Annual climate statement 2024

Analysis of Australia's oceans, atmosphere, temperature, rainfall, water, and significant weather during 2024

Issued **6 February 2025**

Introduction

The Annual Climate Statement 2024 is the Bureau's official record of Australia's weather and climate for 2024. It includes information on temperature, rainfall, hydrology, water storages, oceans, atmosphere and notable weather events. It describes some of the key climate features and climate indicators for the year.

Australia's climate can vary from year to year. This variation is associated with changes in the global climate system including natural cyclical patterns such as the El Niño–Southern, as well as global warming trends. Sea surface temperature patterns are particularly significant for monthly, seasonal or annual variability in temperature and rainfall in Australia.

This annual snapshot complements the Bureau and CSIRO's State of the Climate report, which is published every 2 years and is a synthesis of the latest science on climate change.

Australia's climate in 2024

Temperature

- Australia's second-warmest year since national records began in 1910, with the national annual average temperature 1.46 °C warmer than the long-term (1961–1990) average.
- The national average maximum temperature was 1.48 °C above the long-term average, the fourth-warmest on record. The national average minimum temperature was 1.43 °C above the long-term average, and the warmest on record.
- Warmth was persistent throughout the year. Nationally, summer 2023–24 was the third-warmest on record, winter was the second-warmest on record and spring was the warmest on record.
- Low-to-severe intensity heatwave conditions affected large parts of Australia during early 2024 and from September to December.

Rainfall

- Nationally-averaged rainfall was 596 mm, 28% above the 1961–1990 average, making it the eighth-wettest year since national records began in 1900.

- Rainfall was above average for the Northern Territory, northern and inland areas of Western Australia, large parts of Queensland, northern and inland areas of New South Wales and western and north-eastern parts of South Australia.
- Rainfall across northern Australia as a whole (north of 26° S) was 42% above average, making it the fifth-wettest year on record, and the wettest since 2011.
- Rainfall was below average to very much below average for small parts of Queensland, south-eastern New South Wales, Victoria, western Tasmania, southern South Australia, and some coastal parts of Western Australia.

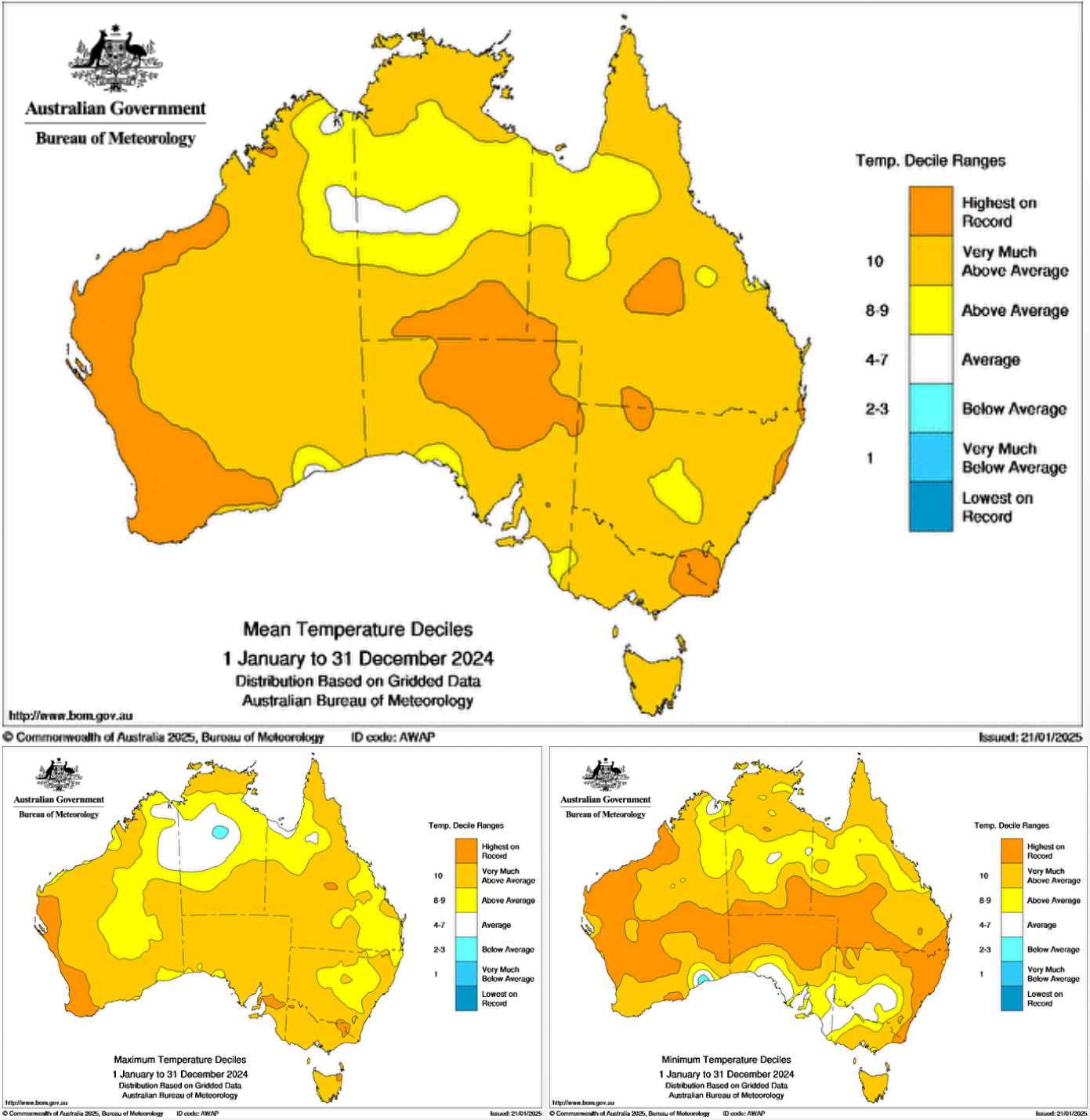
Water resources

- Soil moisture was above the annual average in large parts of northern Australia and central Western Australia, and in parts of eastern and inland New South Wales. However, soil moisture was below the annual average in large parts of the southern coastal mainland and Tasmania.
- Annual streamflow was below average in large areas of southern Australia, while northern and parts of eastern Australia had above average streamflow.
- By the end of 2024, surface water storage levels had decreased across southern parts of the country, including in the Murray–Darling Basin, due to dry conditions and low inflows.
- Australia's total surface water storage was just under 73% at the end of 2024, a slight decrease from the end of 2023.
- By the end of 2024, groundwater levels had increased in the east and north, but decreased in western Victoria, South Australia and south-west Western Australia due to below average rainfall.

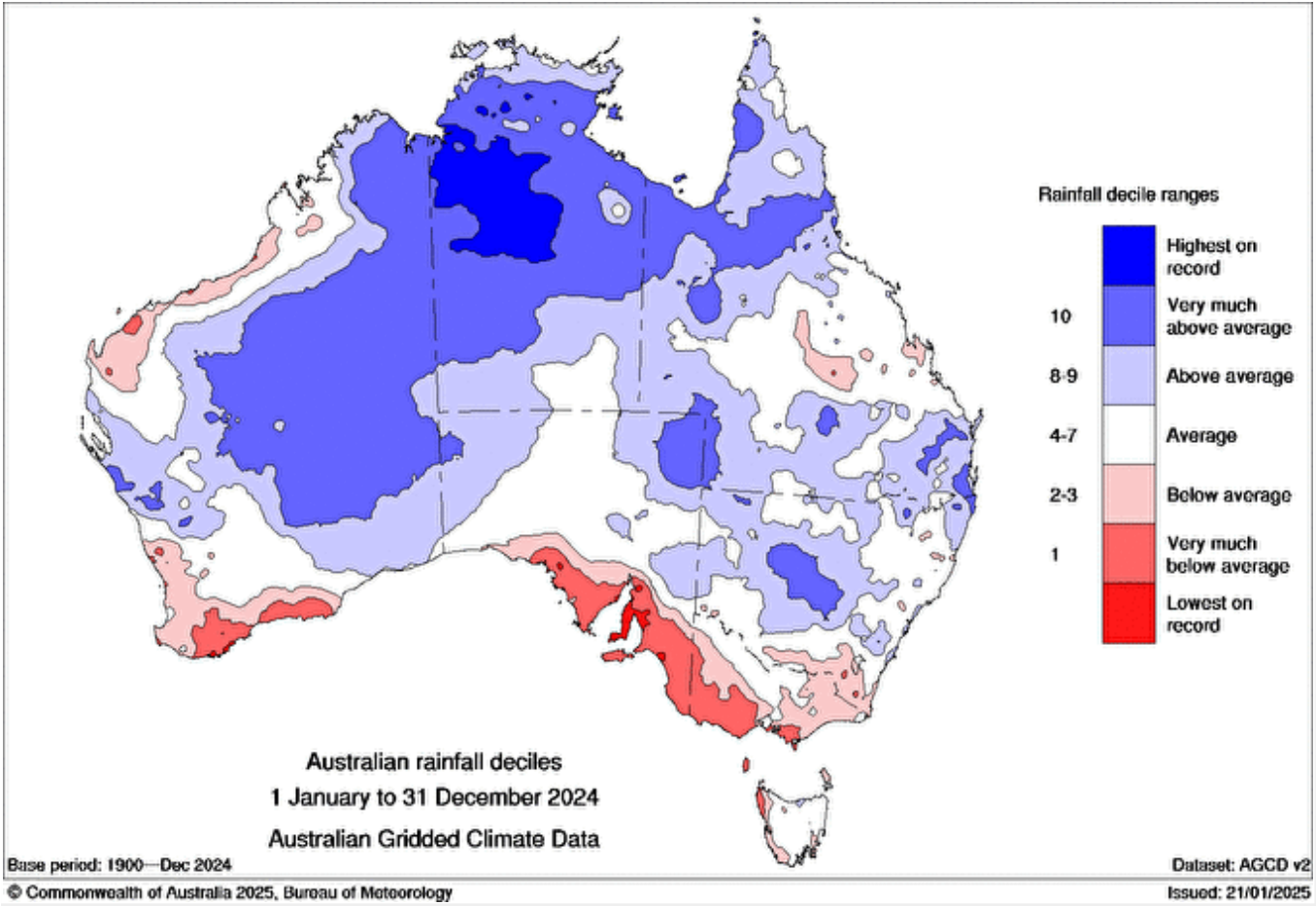
Oceans and atmosphere

- Annual sea surface temperatures for the Australian region for 2024 were the warmest on record, and 0.89 °C above the long-term average.
- Global sea surface temperatures in 2024 were the warmest on record.
- Climate indicators of other major global oceanic and atmospheric systems that affected Australia during 2024.
    - The 2023–24 El Niño eased in early 2024 with a return to neutral El Niño–Southern Oscillation (ENSO) conditions in April. ENSO remained mostly neutral for the remainder of 2024, despite weak La Niña characteristics emerging at times in both oceanic and atmospheric indices.
    - The Indian Ocean Dipole (IOD) was neutral throughout 2024, though it dropped below the negative IOD threshold for a brief period during October and November.
    - A positive phase of the Southern Annular Mode was active at times during the year, particularly in January, April to June, September and November, with a prolonged negative phase during July and August.

Australia's second-warmest year on record and eighth-wettest year on record



Australian average temperature deciles for 2024, relative to all years since 1910 (top), annual maximum temperature (middle) and annual minimum temperature (right).



Australian rainfall deciles for 2024 relative to all years since 1900.

For Australia, 2024 was the second-warmest year since national temperature records began in 1910. For Australia as a whole, the national annual average temperature was 1.46 °C above the 1961–1990 average. The warmest year on record was 2019.

The national maximum temperature was 1.48 °C warmer than average, the fourth-warmest on record, and the national minimum temperature was 1.43 °C warmer than average, the warmest on record.

The area-averaged rainfall total for Australia was 596 mm, which was 28% above the 1961–1990 average of 466 mm. It was the wettest year since 2011 and Australia's eighth-wettest year since national records began in 1900. Rainfall was above average across much of the north and parts of the west and east, but below average across the north-west, southern coastal areas and parts of the south-east.

At the start of 2024, surface water storages across Australia were at 74% of accessible capacity. Despite below average rainfall and dry catchment conditions in southern coastal areas and parts of south-east Australia, which led to low inflows and declining water levels in many storages, including in the Murray–Darling Basin, Australia's total surface water storage volume remained high at the end of the year, just under 73% of accessible capacity.

The surrounding oceans have a large influence on Australia's climate. Record warm sea surface temperatures for the Australian region (4°S to 46°S and 94°E to 174°E) were a key feature of 2024, with the annual sea surface temperature anomaly the warmest on record and 0.89 °C above average.

At the start of the year, the 2023–24 El Niño weakened, and in April the El Niño–Southern Oscillation (ENSO) returned to neutral. ENSO remained neutral for much of the year, with weak La Niña characteristics emerging towards the end of the year.

The positive phase of the Indian Ocean Dipole (IOD) dissipated in February, remained neutral for most of the year and dropped below negative IOD thresholds during October and November.

The Southern Annular Mode was positive in January, April to June and November, with prolonged negative phases in July to August and December.

Frequent slow-moving high pressure systems in the Southern Ocean and Tasman Sea were a major feature of atmospheric circulation during the year, influencing temperature and rainfall patterns across the country.

Similar to 2023, the extent of Antarctic sea-ice in 2024 was very much below average or close to record low levels for much of the year.

Globally, 2024 was the warmest year on record, with the World Meteorological Organization reporting an average global temperature of 1.55 ± 0.13 °C above the pre-industrial (1850–1900) baseline. Global sea surface temperatures were also the warmest on record, and 0.79 °C above the average.

Capital Cities

The 2024 annual maximum temperatures for all capital cities were 0.3 to 1.4 °C above their respective averages, relative to recent decades (see the table caption below for the averaging period for each capital city). All capital cities except for Brisbane and Melbourne were among the top 5 warmest on record, with Perth recording its warmest annual average maximum temperature on record.

Annual minimum temperatures for all capital cities were 0 to 1.2 °C above their respective averages, relative to recent decades (see the table caption below for the averaging period for each capital city). Perth had its warmest annual average minimum temperature on record and Brisbane, Sydney, Hobart and Darwin had their second or equal-second warmest on record.

Rainfall was below average in 2024 compared to recent decades for Canberra, Adelaide and Perth. Adelaide had its seventh-driest year on record and its driest year since 2006, while Canberra had its driest year since 2019. Rainfall was above average for Brisbane, Sydney, Darwin, Melbourne and Hobart. Annual rainfall totals for Brisbane and Sydney were among the top 20 years on record, and Darwin had its wettest year since 2017.

	Opened	Maximum temperature			Minimum temperature			Rainfall		
		2024 average (°C)	Anomaly (°C)	Historical rank	2024 average (°C)	Anomaly (°C)	Historical rank	2024 total (mm)	Anomaly (%)	Historical rank
Canberra	1939	21.7	+0.7	5th-warmest on record	7.1	+0.3		567.8	−12%	Driest since 2019
Brisbane	1840	26.9	+0.3		17.4	+0.9	2nd-warmest on record	1603.8	+52^	
Sydney	1858	23.9	+1.0	2nd-warmest on record	15.2	+0.5	Equal 2nd-warmest on record	1642*	+44^	
Melbourne	1855	20.7	+0.3	Warmest since 2019	11.8	+0.1		591.8	+4^	
Hobart	1882	18.4	+0.8	Equal 3rd-warmest on record	9.6	+0.8	2nd-warmest on record	603.8	+7	
Adelaide	1839	23.5	+0.9	Equal 4th-warmest on record	12.4	0.0		346.6	−36	7th-driest on record, driest since 2006
Perth	1876	26.2	+1.4	Warmest on record	14.1	+1.2	Warmest on record for current site (opened 1994)	613.6	−16	
Darwin	1941	33.0	+0.6	Equal 4th-warmest on record	24.1	+0.8	Equal 2nd-warmest on record	1982.4	+8	Wettest since 2017

Table of annual rainfall and temperature values and anomalies for the capital cities. The year opened is the first year for which rainfall data is available; temperature data at Brisbane starts in 1887, at Sydney in 1859, at Adelaide in 1887 and at Perth in 1897.

Anomalies are relative to recent decades, usually determined by data availability at the current site. For each city these periods are: Canberra 2008–2024 (current Airport site); Brisbane 2000–2024 (current site); Sydney 1991–2020 (former Observatory Hill site); Melbourne 2013–2024 (current site); Hobart 1991–2020; Adelaide 1991–2020 (former Kent Town site); Perth 1994–2024 (current site); Darwin 1991–2020.

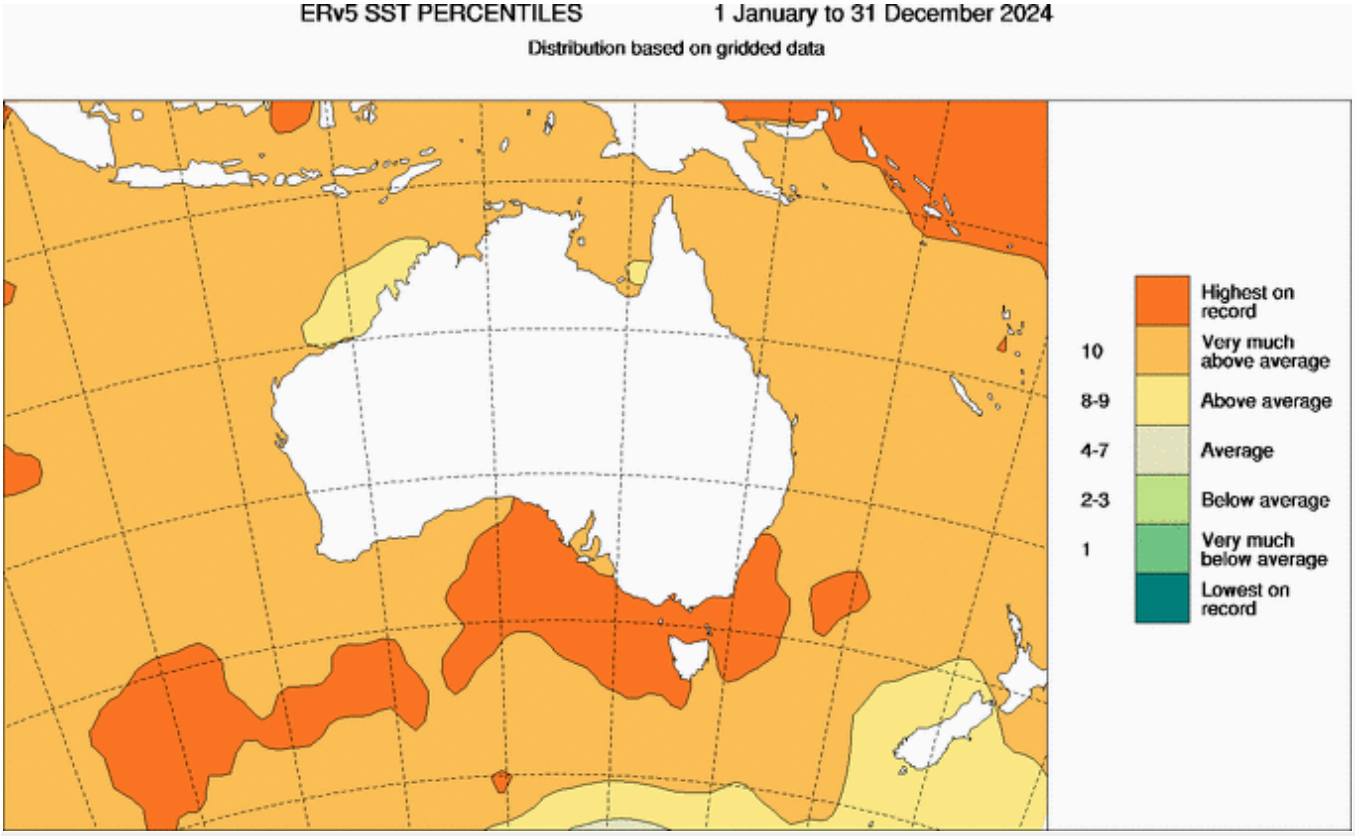
(^) The Brisbane rainfall climatology includes estimated annual totals for 2019, 2021 and 2022. This is due to equipment in those years, requiring an estimate of the rainfall over the period to obtain the annual rainfall total. Due to other equipment faults, the annual rainfall total for Brisbane cannot be reliably estimated for 2003, 2016, 2017 or 2020.

(*) The 2024 Sydney (Observatory Hill) total includes an estimated 195 mm missed during February and April due to equipment faults. The estimated totals during the equipment fault periods are based on rainfall recorded at nearby gauges.

Important climate indicators in 2024

- Annual sea surface temperatures for the Australian region for 2024 were the warmest on record, and 0.89 °C above the 1961–1990 average.
- Sea surface temperatures for the Australian region for each month in 2024 were among their respective top 3 warmest on record, with 5 months being their warmest on record.
- Global sea surface temperatures in 2024 were the warmest on record.
- Similar to 2023, Antarctic sea-ice extent was very much below average or close to record low levels for much of the year but returned to average in December.
- Frequent slow-moving high pressure systems in the Great Australian Bight and Tasman Sea were a major feature of atmospheric circulation in the Australian region in 2024.
- El Niño eased in early 2024 with a return to neutral El Niño–Southern Oscillation conditions in the tropical Pacific in April.
- The Indian Ocean Dipole was positive early in 2024 and returned to neutral conditions for much of the year.
- The Southern Annular Mode was positive at times during the year, with prolonged negative phases from late July to mid-August and for much of December.
- Following large and long-lasting ozone holes from 2020 to 2023, the Antarctic ozone hole in 2024 was the smallest since 2019 and developed later than any year since 2015.
- Concentrations increased in 2024 of all the major long-lived greenhouse gases in the atmosphere, including carbon dioxide and methane.

Sea surface temperatures warmest on record for the Australian region



2024 sea surface temperature deciles compared to historical distribution of all years since 1900.
(NOAA Extended Reconstructed Sea Surface Temperature dataset, ERSST v5)

The 2024 annual sea surface temperature (SST) anomaly for the Australian region (4°S to 46°S and 94°E to 174°E) was the warmest on record and 0.89 °C above the 1961–1990 average.

SSTs were very much above average (in the warmest 10% of all years since 1900) around nearly all of Australia during 2024, and warmest on record for a large area of the Southern Ocean and Tasman Sea.

Monthly SSTs were in the highest 10% of years since 1900 for most of the region during 2024, with the main exception being waters off the north-west coast in January and April, where SSTs were below average.

Monthly SSTs were the highest on record for some areas at times during the year, including:

- across the Coral Sea during January and April
- isolated areas of the Southern Ocean and the Tasman Sea during February and March
- areas off south-eastern Australia during winter
- areas of the Western Australian coastline during September and December
- the Southern Ocean during December.

As a result, area-averaged monthly SSTs for the Australian region were the warmest on record for January, February, October, November and December, and among the top 3 warmest on record for all other months.

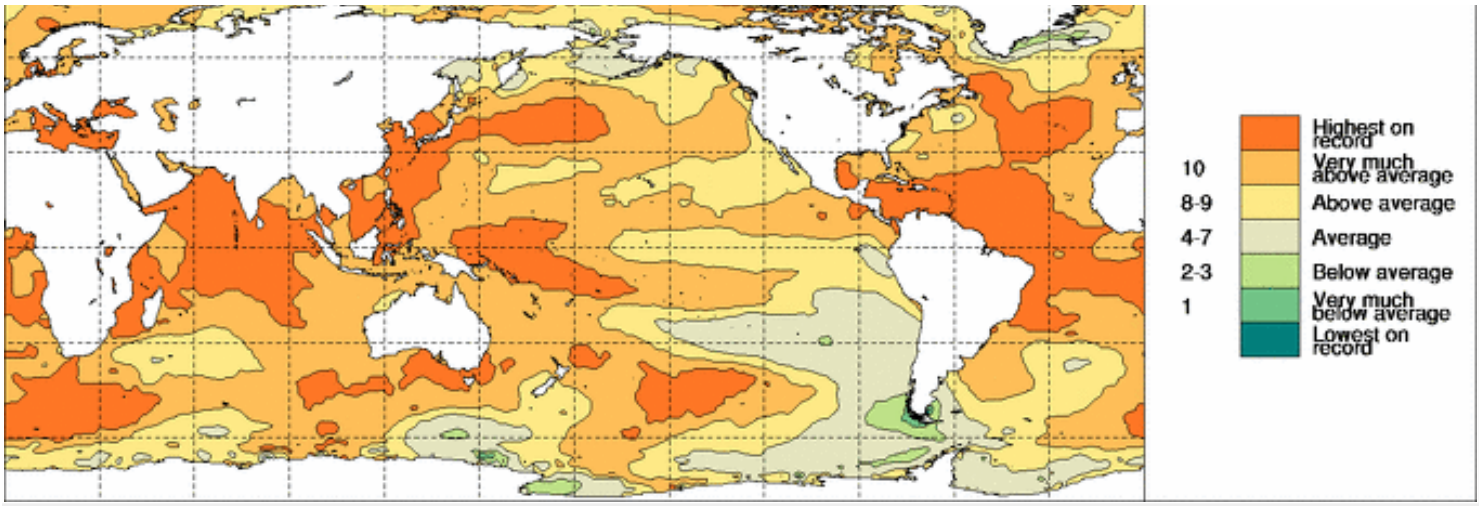
Annual average SSTs in the Australian region have warmed by 1.13 ± 0.11 °C between 1900 and 2024, a rate close to that of the global average SST. Average annual SSTs have been above the 1961–1990 average for the Australian region every year since 1995, and 9 of the top 10 warmest years on record have occurred since 2010.

Global oceans

In 2024, global SSTs (from 60°S to 60°N) were the warmest on record. The annual global SST was 0.79 °C above the 1961–1990 average in the ERSST v5 dataset. The second and third-warmest years on record in ERSSTv5 were 2023 (+0.74 °C) and 2022 (+0.61 °C). Global SSTs for the past 10 years have been the 10 warmest on record.

From January to June 2024, monthly SSTs were the warmest on record for their respective months. Since July, monthly SSTs have been slightly cooler than the record levels observed in 2023, although well above all other years except in December.

Annual SSTs were above to very much above average across the globe, but below average for areas of the Southern Ocean between 120°E and 160°W and around South America's Cape Horn.



2024 global sea surface temperature deciles compared to historical records.
(NOAA Extended Reconstructed Sea Surface Temperature dataset, ERSST v5)

Indian Ocean

The Indian Ocean was substantially warmer than average during 2024, particularly in the tropical and sub-tropical regions, where a large area observed their highest annual SSTs on record.

The year began with substantially warmer than average temperatures in the western part of the basin, and cooler in the east – reflecting a prolonged positive phase of the Indian Ocean Dipole (IOD) that began in September 2023 and ended in late January 2024.

For the majority of 2024, the Indian Ocean remained warmer than average but in a neutral IOD state, with no anomalous temperature gradient forming across the basin. In September, cooler than average temperatures emerged off the Horn of Africa, and warm anomalies off the Indonesian islands of Java and Sumatra. These strengthened in October, resulting in a reduction in the weekly IOD index below the negative IOD threshold (–0.4 °C). The IOD index remained below this threshold for 7 consecutive weeks during October and early November, although this was not long enough to be considered a negative IOD event. IOD index values returned to neutral in early December as SST anomalies in both the western and eastern Indian Ocean weakened.

November also saw a rapid warming of ocean temperatures off the north-west Australian coast. November monthly average SSTs for the north-west Australian region overall were the second-warmest on record, 0.84 °C above the 1991–2020 average. Waters were exceptionally warm close to the coast, with weekly SST anomalies of up to 4 °C above the 1991–2020 average. The unusually warm waters in the region contributed to increased tropical activity in the region, including the formation of Tropical Cyclone Robyn on 29 November, the first in the Australian region in the 2024–25 season.

Pacific Ocean

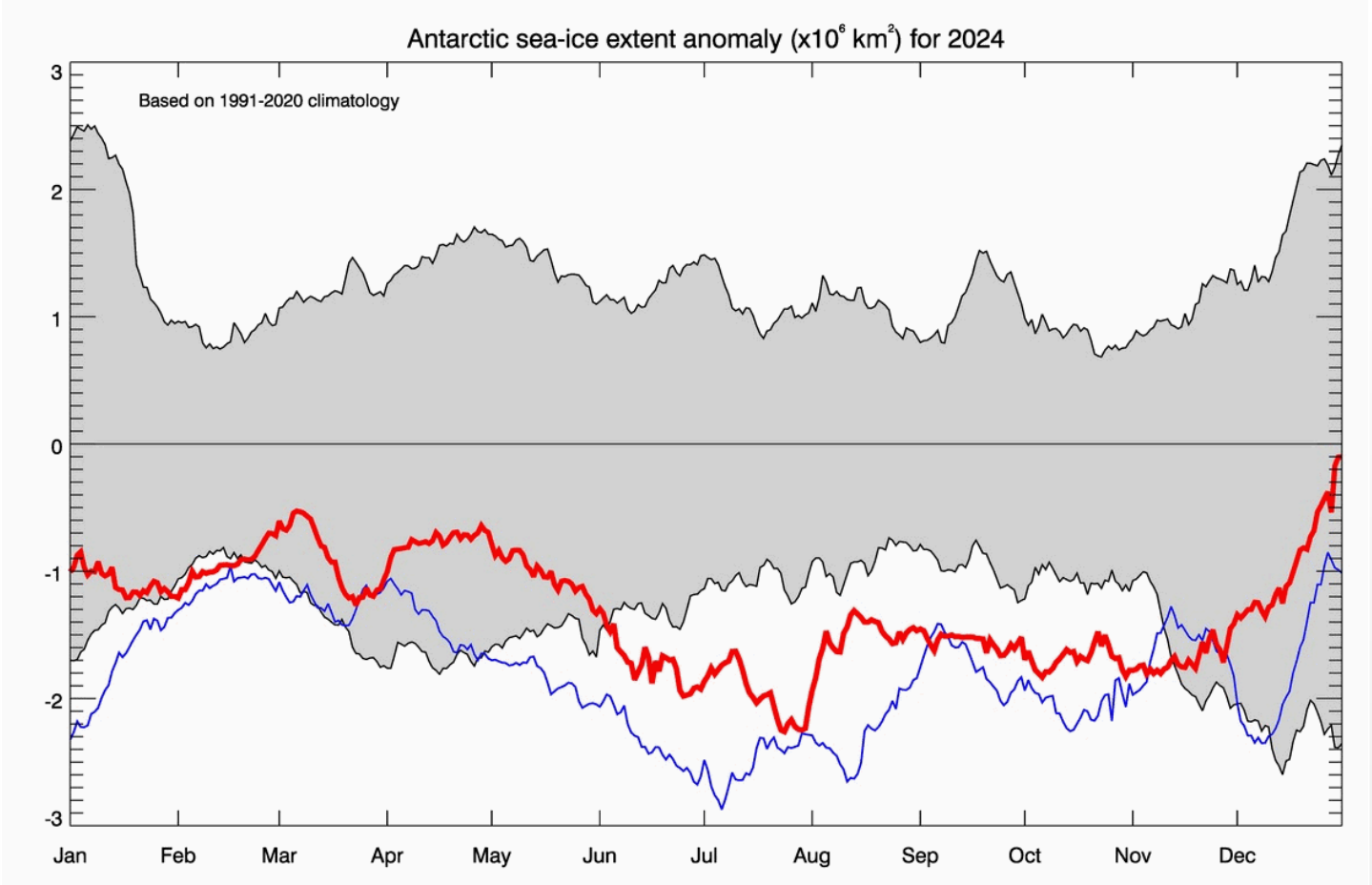
In January 2024, a broad area across the tropical Pacific was 1 to 3 °C above the 1991–2020 average with a El Niño active at the time. The El Niño-Southern Oscillation (ENSO) returned to neutral by April as the tropical central and eastern Pacific cooled, with parts of the eastern equatorial Pacific being up to 1.2 °C cooler than average by May. Further cooling in the tropical central Pacific occurred during the southern hemisphere winter, at the surface and sub-surface. This cooling continued with some pauses through to December.

Warmer than average waters remained in the western Pacific for most of the year, reaching up to 2 °C above average near the equator in August and September.

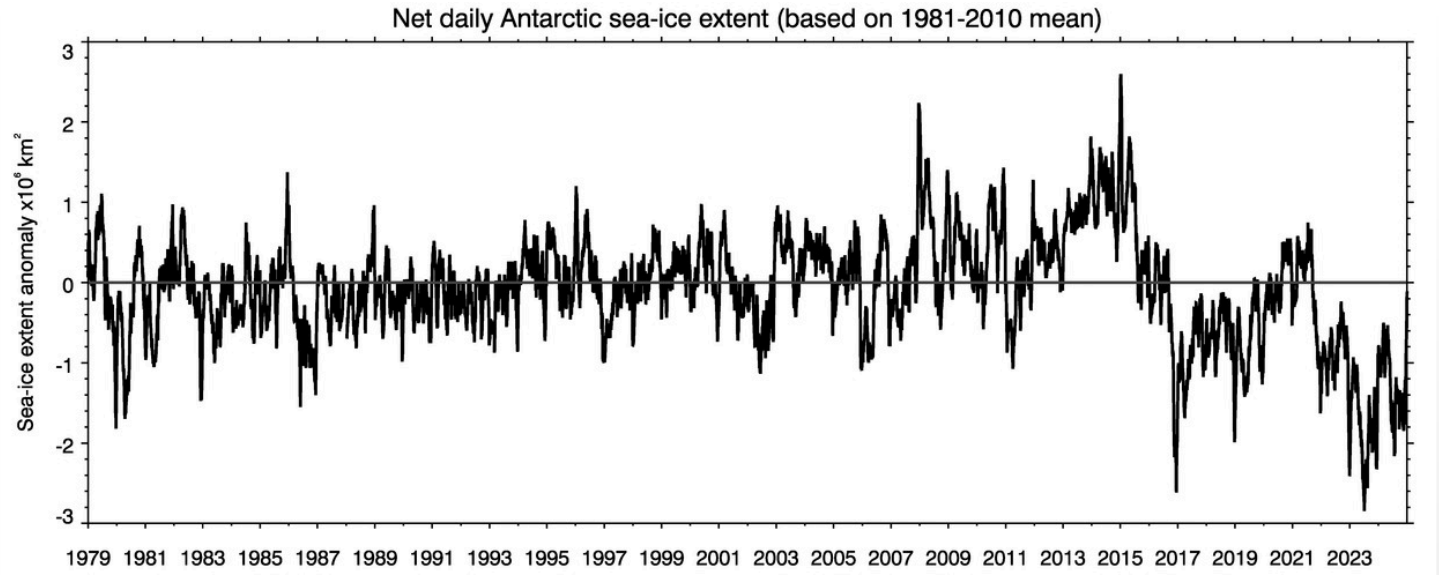
Late in the year, conditions across the tropical Pacific became more La Niña like, with both oceanic and atmospheric indicators beginning to align. However, the Bureau considered that ENSO remained neutral throughout this period. Atmospheric indicators were not sustained at the levels or duration necessary for a La Niña event. Equatorial trade winds in the western and central Pacific were stronger than average for much of the second half of the year. However, surface pressure and cloudiness patterns were not consistent with the atmosphere-ocean coupling required for a La Niña event that could affect Australia's climate.

In December, a strengthening of the Southern Oscillation Index (SOI) and other atmospheric indices towards La Niña thresholds was observed following a period of strengthened trade winds. This was followed by a renewed period of ocean cooling across the central and eastern tropical Pacific.

Winter net Antarctic sea-ice extent second lowest on record



Daily values of net (total) of Antarctic sea-ice extent. Grey area = historical maximum and minimum extents (1979–2024), blue line = net sea-ice extent from 2023, red line = net sea-ice extent from 2024



Changes in net daily Antarctic sea-ice extent since 1979 to 2024 (based on 1981–2010 mean).

Antarctic sea ice (ice that is formed from the freezing of the ocean surface) is an important component of the Earth's climate and ecology, reflecting incoming solar radiation, influencing interactions between the ocean and atmosphere, contributing to the global ocean circulation, protecting ice-shelves from ocean processes, and providing a habitat for polar species.

The extent of Antarctic sea-ice (defined as the area of the Southern Ocean where at least 15% of the surface is frozen) experiences large seasonal changes, with net summertime sea-ice extent being ~2–4 million km^2 expanding to a

wintertime extent of ~18–20 million km^2. The last decade has seen quite a distinct rise in variability in sea-ice extent, with record high wintertime extents being observed in 2012–2014 followed swiftly by record low values observed since 2016.

Following record low Antarctic sea ice-extent in 2023, the sea-ice extent in 2024 has remained either close to record lows or well below the 1991–2020 average for much the year. On 18 February 2024, the daily sea-ice extent was observed at 1.97×10^6 km^2, the third-lowest on record behind only 2023 and 2022. Similar to 2023, net sea-ice extent was also low during the growth season (autumn and winter), achieving an annual daily maximum of 17.18×10^6 km^2 on 29 September, the second-lowest maximum on record behind 2023. Towards the end of 2024 sea ice retreated somewhat slower than usual, with net sea-ice extent being close to average by the end of the year. The recent record low values seen over the last few years are largely attributed to warmer than average subsurface Southern Ocean temperatures.

Frequent slow-moving high pressure systems in the Southern Ocean and Tasman Sea

Australian region

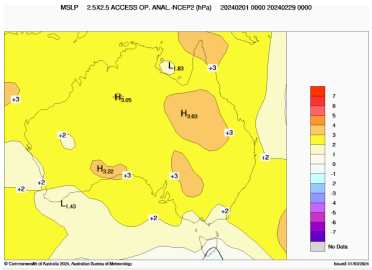
The location, strength and movement of high pressure systems affected weather patterns across Australia throughout the year.

In February, a high pressure system located in the Great Australian Bight directed warm north-easterly winds from the interior of the continent towards the west coast of Western Australia, supported by a surface trough off the west coast. Most of the state experienced several low to severe intensity heatwaves during the month with many sites observing their highest February or annual maximum temperature on record. Overall, it was Western Australia's second warmest February.

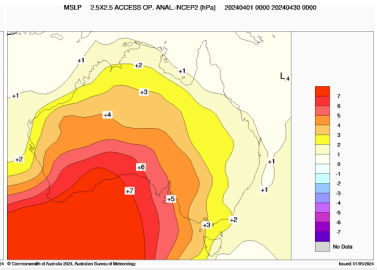
In April and May, rainfall was above average for coastal and inland areas of New South Wales, as slow-moving high pressure systems located to the south of the country directed moist onshore airflow from the Tasman Sea inland. When combined with low pressure troughs extending from the west this brought persistent rainfall, frequently heavy, particularly in coastal regions. In April, the high pressure systems directed cold southerly airflow across much of the continent. As a result, it was Australia's coolest April since 2015 and the only month in 2024 cooler than its 1961–1990 average. Clear nights and light winds resulted in stations across the south-eastern inland observing their coldest April minimum temperatures on record.

In August, a slow-moving high pressure system located over central and eastern Australia allowed heat to build up during the day over the interior of the continent for several weeks. Many sites in Western Australia, Northern Territory, South Australia and Queensland set records for their warmest winter and August temperatures. Overall, it was Australia's warmest August on record.

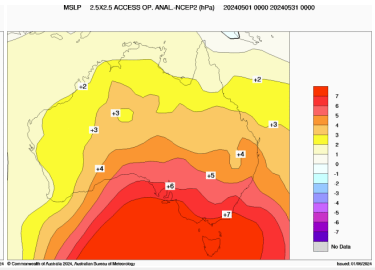
For more details of the weather patterns related to significant weather, see the Events section.



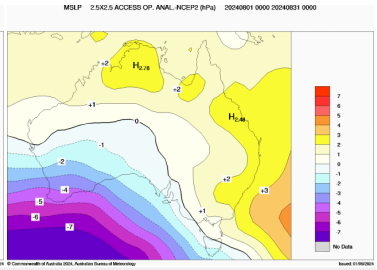
February Mean Sea Level Pressure (MSLP)



April Mean Sea Level Pressure (MSLP)



May Mean Sea Level Pressure (MSLP)



August Mean Sea Level Pressure (MSLP)

Southern Annular Mode

In 2024, the Southern Annular Mode (SAM) was in a positive phase (+1) during most of January and February, the first half of April and September, and most of November. Shorter significant positive SAM index values (> +2) were observed during late June and mid-July.

SAM was in a negative phase (index values less than –1) from late July to mid-August and for much of December. During August, the SAM index was strongly negative and on 3 August dropped to its lowest daily value since October 2019 at –4.25, with daily SAM index values remaining strongly negative for most of August.

Shorter periods of significant negative SAM index values (< –2) were observed during mid-March, late September and early December.

The impact on Australian climate from positive and negative phases of SAM depends on the time of year and what weather patterns or other climate factors are active at the time.

Madden–Julian Oscillation

In January, an active phase of the Madden–Julian Oscillation (MJO) was in the Australian tropical region. This coincided with the monsoon onset at Darwin on 10 January 2024; roughly 2 weeks later than average. March and April saw further MJO activity in the Australian tropical region, triggering periods of monsoonal activity and tropical cyclone development.

From late November to mid-December, there was a particularly active pulse over the Australian longitudes, which likely contributed to increased tropical activity and above average rainfall over large parts of northern Australia, although not sufficient to trigger the onset of the Australian monsoon. This active MJO pulse also likely contributed to an increase in La Niña-like activity in the tropical Pacific in December, although this activity was not sustained beyond early January 2025.

Antarctic ozone hole was the smallest since 2019

Stratospheric ozone over the southern high latitudes influences the general circulation of the Southern Hemisphere, particularly during spring, when the combination of cold temperatures, returning sunlight and ozone-depleting hydrocarbons cause a seasonal ozone-depleted 'hole' over the Antarctic, which influences the Southern Annular Mode.

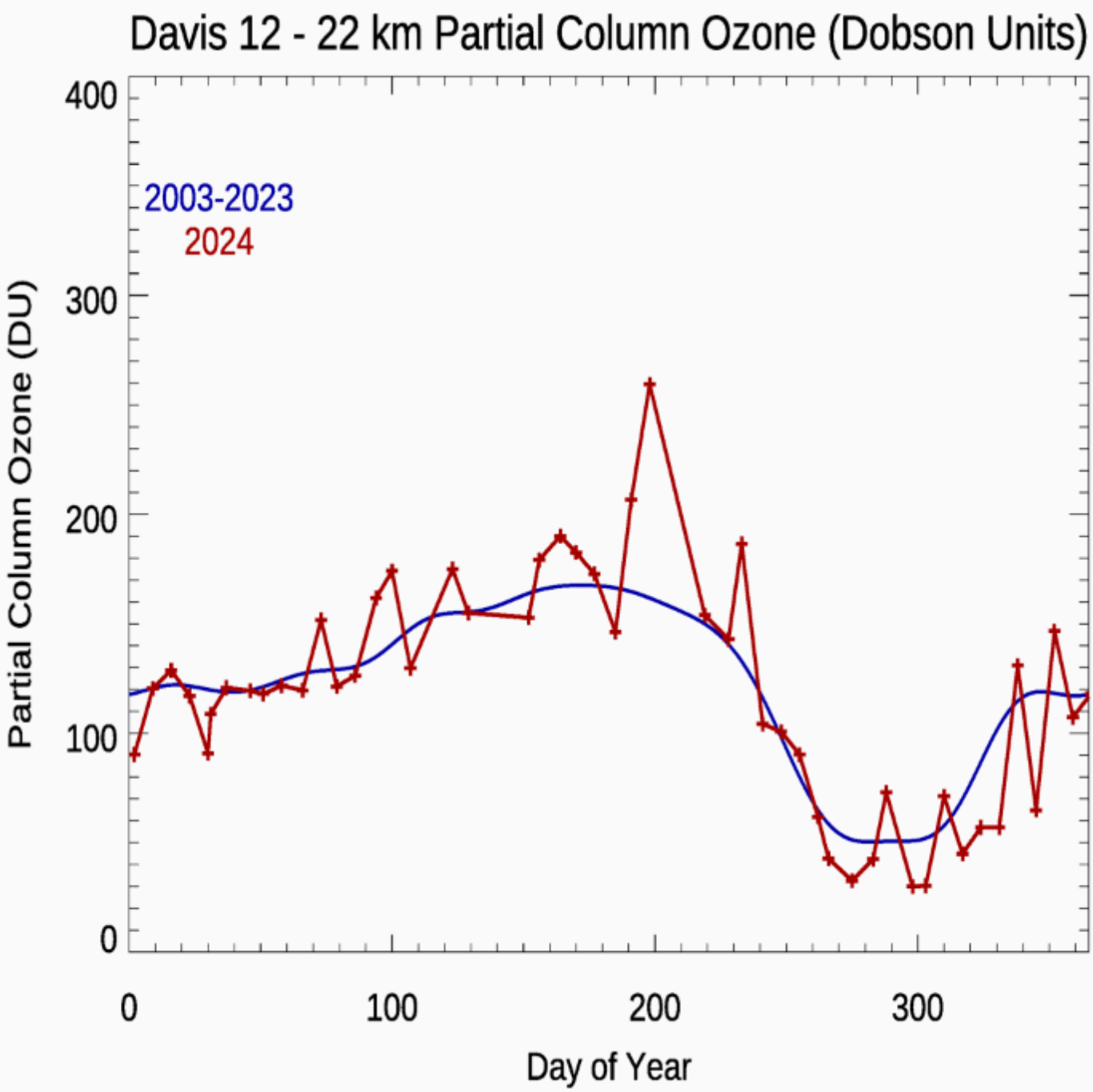
The 2024 Antarctic ozone hole was the smallest since 2019, following 4 consecutive years of relatively large and long-lasting ozone holes from 2020 to 2023. According to NASA satellite measurements, the 2024 ozone hole began to develop in mid-August and grew to a significant size. This occurred later than in any year since 2015. It reached a maximum area of 22.4 million km^2 on 28 September. This was smaller than each of the previous 4 years which ranged from 24.8 to 26.0 million km^2. The minimum value of total ozone measured in 2024 was 107 Dobson Units (DU) on 5 October. This was the first year since 2019 that satellite observations showed no total ozone values less than 100 DU over Antarctica. The 2024 ozone hole persisted into early December but had reduced in area to less than 3 million km^2 by 6 December, 1 to 3 weeks earlier than in 2020 to 2023.

The delayed development of the ozone hole, with unusually high polar cap ozone in 2024, was related to an unusually early and strong winter stratospheric warming event accompanied by a significant shrinkage and distortion of the polar vortex. This vortex event increased poleward ozone transport. For example, the Bureau's balloon ozonesonde flight on 16 July measured ozone in the 12–22 km altitude range at Davis station in Antarctica as 259 DU, which was more than 100 DU above the 2003–2023 mean for this time of year. The significant vortex contraction and warming and associated high ozone in July led to an unusually persistent equatorward shift of the tropospheric westerly jet. As a result, the daily Southern Annular Mode (SAM) had greater than 4 standard deviation negative departures from the climatological mean of 1979–2000 during the first week of August 2024.

Despite the fact that the Antarctic ozone concentration was higher in 2024 than the previous 4 years, it was still below its long-term average with a significant ozone depletion. Weekly measurements made by the Bureau's balloon ozonesonde program at Davis station show ozone in the 12–22 km altitude range, decreased by almost 80% from the middle of August to the end of October. The lowest observed value during 2024 was 30.04 DU, recorded on 24 October. Since the commencement of ozone observations at Davis in 2003 (22 years of data), the 2024 minimum was the eighth-lowest annual minimum in the Davis record. The lowest annual minimum recorded at Davis was 17.6 DU in 2006.

Although actions taken under the Montreal Protocol to end the use of ozone-depleting substances have led to a slow underlying recovery in Antarctic ozone since the year 2000, the year-to-year variability in the severity of the Antarctic ozone hole is determined primarily by meteorological conditions in the Antarctic stratosphere, with other factors also playing a role. The 2023 ozone hole was influenced by the eruption of the Hunga-Tonga-Hunga Ha'apai volcano in January 2022 which injected an unprecedented amount of water vapour directly into the stratosphere. By winter 2023, water vapour concentration in the polar vortex was strongly elevated, which led to an earlier and more extensive formation of polar stratospheric clouds than usual. This in turn led to chlorine activation occurring earlier in the year. Any effects of Hunga Tonga on the 2024 ozone hole are unclear at this time.

See also: A review of Antarctic stratospheric ozone trends and variability and their impacts on surface climate



12–22 km partial column ozone measured by ozonesondes at Davis in Antarctica; sonde launches are weekly, listed by day of year. The red line connects the 2024 values and the blue line shows the 2003 to 2022 mean. The program is operated in collaboration with the Australian Antarctic Division.

An increase in greenhouse gas concentrations

Greenhouse

Concentrations of all the major long-lived greenhouse gases in the atmosphere rose again in 2024. Increasing greenhouse gases are the principal driving force of observed global temperature increases. Carbon dioxide is the single most important anthropogenic greenhouse gas, accounting for approximately 66% of the radiative forcing by the long-lived greenhouse gases.

Greenhouse gas concentrations are based on air sampled at the Kennaook / Cape Grim Baseline Air Pollution Station (KCG BAPS) in north-west Tasmania. Air masses sampled at Kennaook / Cape Grim travel thousands of kilometres across the Southern Ocean, free of pollutants due to human and terrestrial influence, before arriving at the station. The air is well-mixed, making it representative of the background or 'baseline' composition of the atmosphere in the southern hemisphere. These baseline air samples have been measured at Kennaook / Cape Grim since 1976.

By December 2024, the baseline concentration of carbon dioxide (CO_2) was 421.4 parts per million in dry air (ppm), an increase from 417.8 ppm in December 2023. A decade earlier, in December 2014, the concentration was 395.9 ppm. The December 2024 value marks a 52% increase from the pre-industrial concentration of 278 ppm in 1750. Pre-industrial concentrations are based on measurements of air trapped in ice and compacted snow collected at Law Dome, Antarctica.

The baseline methane (CH_4) concentration in December 2024 was 1881 parts per billion in dry air (ppb). This represents an increase of 7 ppb over 12 months and is 158% higher than the pre-industrial level of 729 ppb. Methane accounts for about 16% of the radiative forcing by long-lived greenhouse gases.

The baseline nitrous oxide (N_2O) concentration in November 2024 was 337.5 ppb, 0.9 ppb higher than the same time in 2023, and 25% higher than the pre-industrial concentration of 270 ppb. Nitrous oxide accounts for about 6% of the radiative forcing by long-lived greenhouse gases.

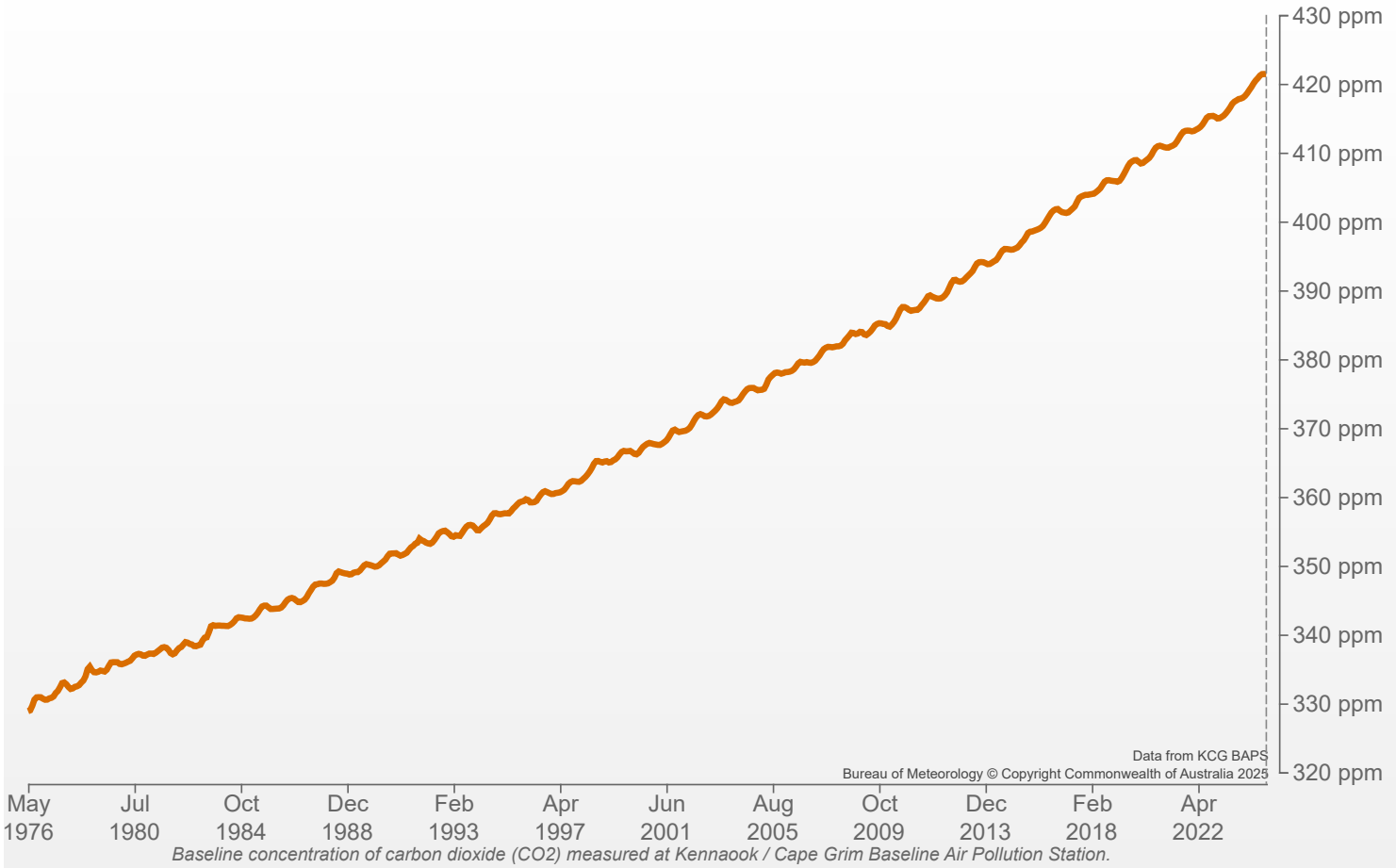
The remaining 12% of the radiative forcing is due to synthetic greenhouse gases, many of which are also ozone depleting substances. These synthetic greenhouse gases are many and include the chlorofluorocarbons (CFCs), hydrochlorofluorocarbons (HCFCs) and hydrofluorocarbons (HFCs) as well as other halogenated gases.

The relative radiative forcings and pre-industrial concentrations of carbon dioxide, methane and nitrous oxide are consistent with (and referenced in) the WMO Greenhouse Gas Bulletin No. 20 of 28 October 2024.

See State of the Climate 2024 for further information about greenhouse gases

Baseline gas carbon dioxide (CO2)

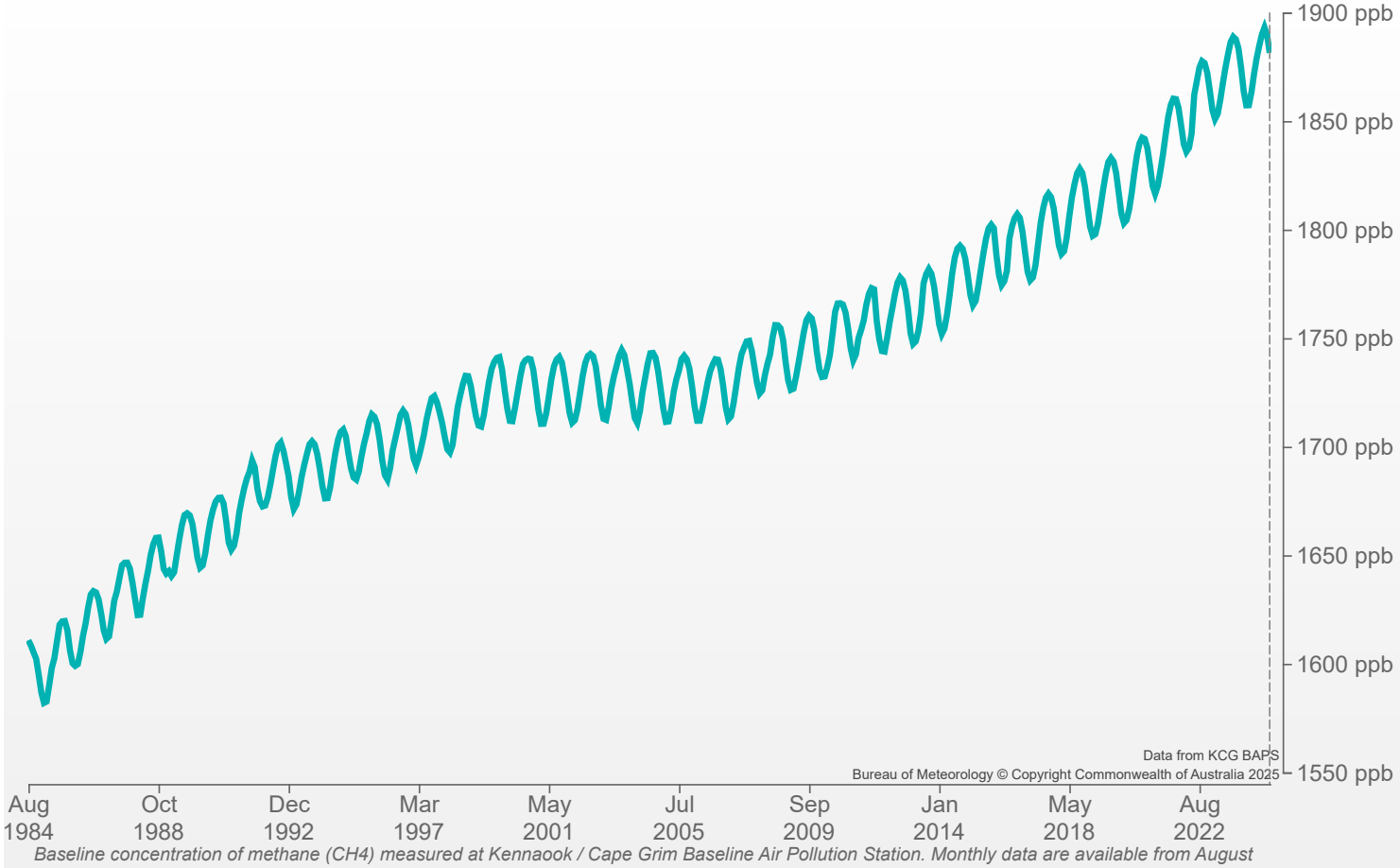
Dec 2024 **421.377 ppm**



Baseline concentration of carbon dioxide (CO2) measured at Kennaook / Cape Grim Baseline Air Pollution Station.

Baseline gas methane (CH4)

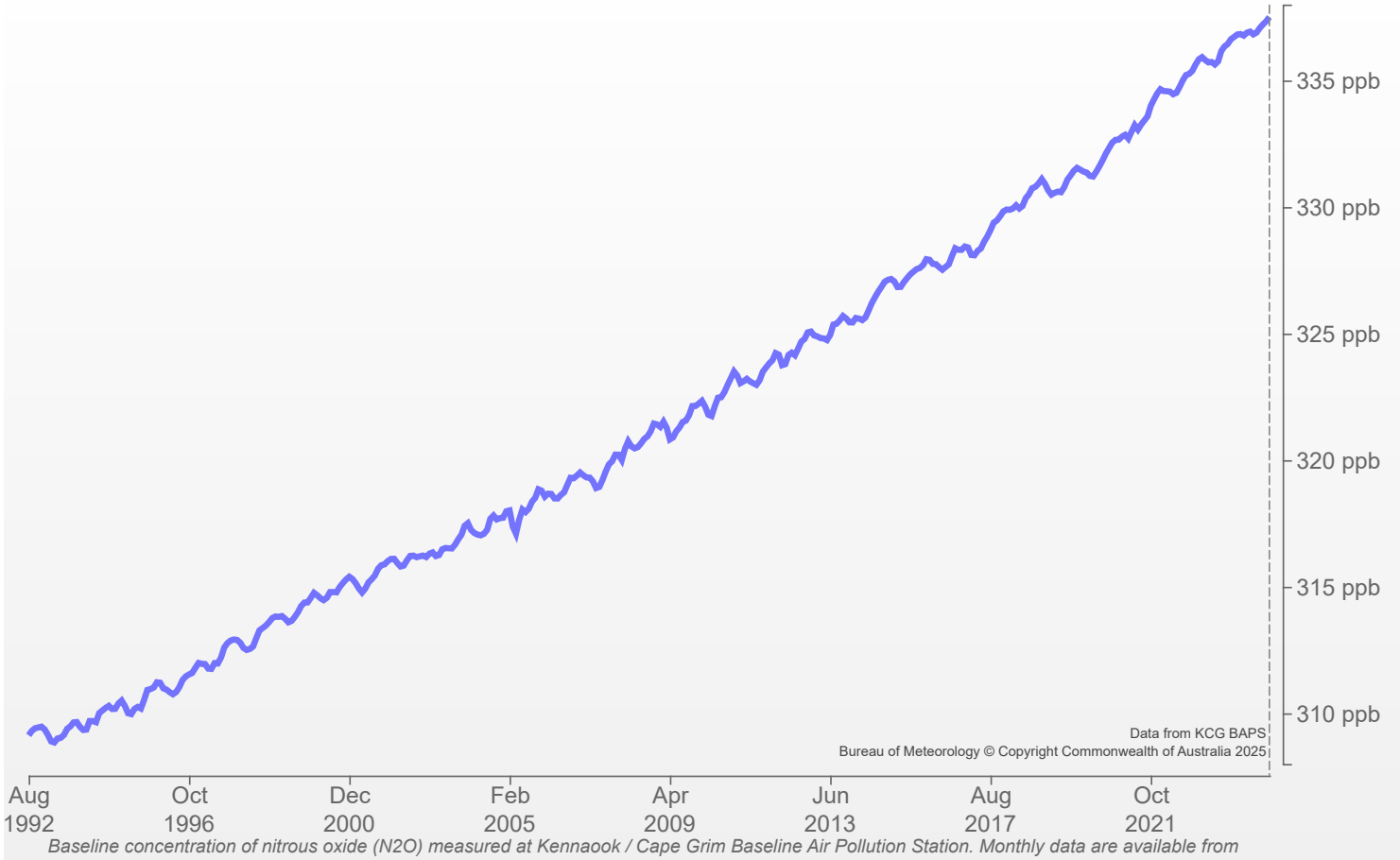
Dec 2024 **1881 ppb**



Baseline concentration of methane (CH4) measured at Kennaook / Cape Grim Baseline Air Pollution Station. Monthly data are available from August 1984. Select each year to view the value.

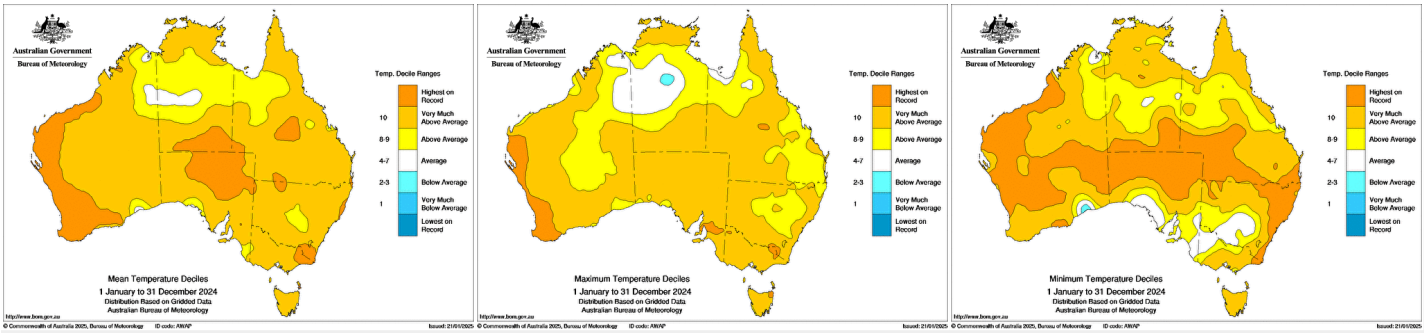
Baseline gas nitrous oxide (N2O)

Nov 2024 **338 ppb**



Baseline concentration of nitrous oxide (N2O) measured at Kennaook / Cape Grim Baseline Air Pollution Station. Monthly data are available from August 1992.

2024 was Australia's second warmest year on record



2024 annual average temperature deciles relative to all years since 1910 (leftt), annual maximum temperature (middle), and annual minimum temperature (right).

Australia

For Australia, 2024 was the second-warmest year since national temperature records began in 1910. For Australia as a whole, the national annual average temperature was 1.46 °C above the 1961–1990 average. The warmest year on record was 2019.

The national maximum temperature in 2024 was 1.48 °C warmer than average, the fourth-warmest on record. The national minimum temperature was 1.43 °C warmer than average, the warmest on record.

Australia's climate has warmed on average by 1.55 ± 0.23 °C between 1910 when national records began, and 2024, with most of the warming having occurred since 1950. Every decade since 1950 has been warmer than preceding decades, and Australia's 10 warmest years on record have all occurred since 2005.

The warming in Australia is consistent with global trends, with the amount of warming similar to the overall average across the Earth's land areas.

Average temperature

Annual average (daily) temperatures were very much above average (in the warmest 10% of years since 1910) across Australia and were highest on record for:

- isolated pockets of eastern Victoria, south-eastern and central coastal New South Wales, and southern and central, interior Queensland
- Western Australia's south-west and coastal areas
- an area of central and northern South Australia, and adjacent southern parts of the Northern Territory.

Maximum temperature

Maximum temperatures were very much above average for most of Australia and were the highest on record for:

- isolated pockets of south-eastern South Australia, north-eastern Victoria and adjacent south-eastern New South Wales; north-western Tasmania; and central, interior Queensland
- Western Australia's southern and central coasts.

An isolated area of the central Northern Territory had average to below average maximum temperatures.

Minimum temperature

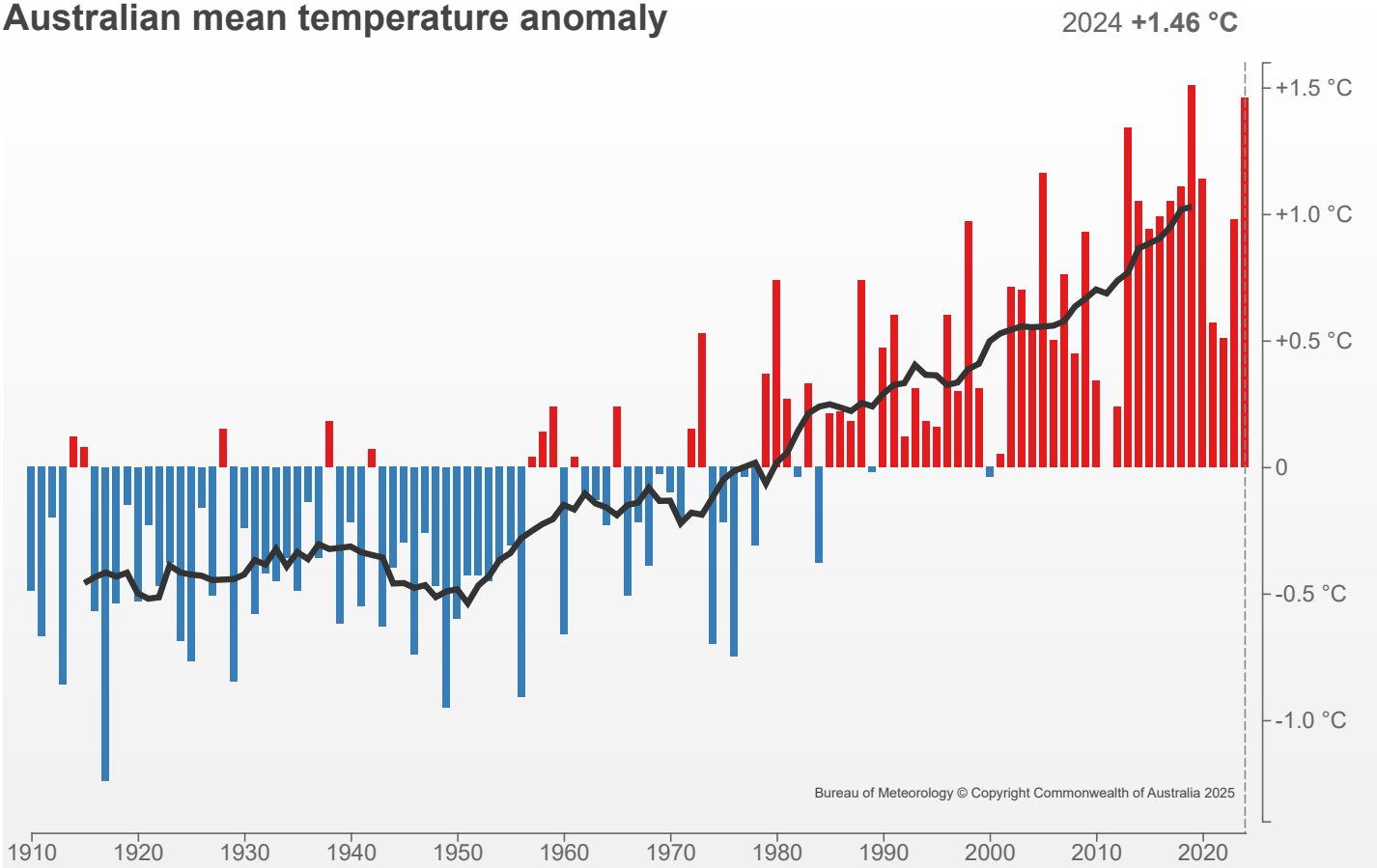
Minimum temperatures were very much above average for most of Australia and were the highest on record for:

- coastal and northern parts of New South Wales
- an area of eastern Victoria
- southern and western Queensland
- coastal and inland areas of Western Australia

- northern and inland regions of South Australia
- southern parts of the Northern Territory.

An isolated area of Western Australian had average to below average minimum temperatures.

Australian mean temperature anomaly



Mean temperature anomalies averaged over Australia (as calculated from the 1961–1990 average). The black line shows the 11-year moving average.

Summer 2023–24

Summer 2023–24 was the third-warmest on record for Australia, with the national temperature 1.63 °C above average. Western Australia recorded its warmest summer on record and every state and territory, excluding Victoria and Tasmania, had among the top 10 warmest summers on record.

Frequent low to severe intensity heatwave conditions affected large parts of Australia throughout summer, with areas of locally extreme heatwave conditions across northern, western and central Australia.

Autumn

The national temperature in autumn was 0.54 °C above average.

Weather conditions in April and May were dominated by slow-moving high pressure systems to the south of the continent that promoted clear skies and light winds.

The national monthly temperature in April was 0.51 °C below average and the coldest since 2015. In April, mean temperatures were below average for most of the country and in the lowest 10% of Aprils since 1910 for inland and southern coastal areas of the mainland. Areas of southern South Australia had their lowest April minimum temperatures on record, as a high pressure system in the Great Australia Bight directed cool southerly airflow inland.

Winter

The national temperature in winter was 1.49 °C above average, the second-warmest on record, with all states and

territories excluding Tasmania among their top 10 warmest on record.

As in autumn, frequent slow-moving high pressure systems to the south of the continent dominated weather conditions in winter, bringing clear skies and light winds.

It was Australia's warmest August on record, with the monthly national temperature 3.03 °C above average. It was also the warmest August on record for every state and territory excluding Western Australia and the Northern Territory. A slow-moving high pressure system over central and eastern Australia allowed the build-up of heat and the creation of an unseasonably hot airmass over the country.

Spring and early summer

Warm conditions continued into spring, with the area-averaged spring temperature 2.06 °C above average, the warmest on record.

Heat build-up in northern parts of the country in late September led to low–intensity to severe heatwave conditions across parts of northern Australia, which persisted until December. Heatwaves were experienced across large parts of the country throughout October to December.

The year ended with the third-warmest December on record, 1.88 °C above average, and large parts of Australia recording very much above average maximum and minimum temperatures (in the warmest 10% of all Decembers since 1910).

For more information on individual heat events, see the Events section.

Area-average temperatures

	Maximum Temperature			Minimum Temperature			Mean Temperature		
	Rank (of 114)	Anomaly (°C)	Comment	Rank (of 114)	Anomaly (°C)	Comment	Rank (of 115)	Anomaly (°C)	Comment
Australia	112	+1.48	4th highest	115	+1.43	highest	114	+1.46	2nd highest
Queensland	109	+1.40	7th highest	114	+1.85	2nd highest	115	+1.63	highest
New South Wales	109	+1.72	7th highest	114	+1.38	2nd highest	113	+1.55	3rd highest
Victoria	113	+1.43	3rd highest	105	+0.74		= 110	+1.08	equal 5th highest
Tasmania	108	+0.78	8th highest	114	+0.76	2nd highest	= 110	+0.77	equal 5th highest
South Australia	113	+1.97	3rd highest	114	+1.24	2nd highest	114	+1.61	2nd highest
Western Australia	114	+1.69	2nd highest	115	+1.44	highest	114	+1.57	2nd highest
Northern Territory	99	+0.73		109	+1.16		= 104	+0.95	

*Rank ranges from 1 (lowest value on record) to 115 (highest value on record). The national temperature dataset commences in 1910. A rank marked with '=' indicates that a value is shared by two or more years, resulting in a tie for that rank.
^Anomaly is the departure from the long-term (1961–1990) average.
In climatology a baseline, or long-term average, is required against which to compare changes over time. The Bureau uses the 1961–1990 period as the climate reference period for the Annual Climate Statement and other climate monitoring products. It has no bearing on the calculation of trends over time, or the ranking of one year compared to all other years in a dataset.

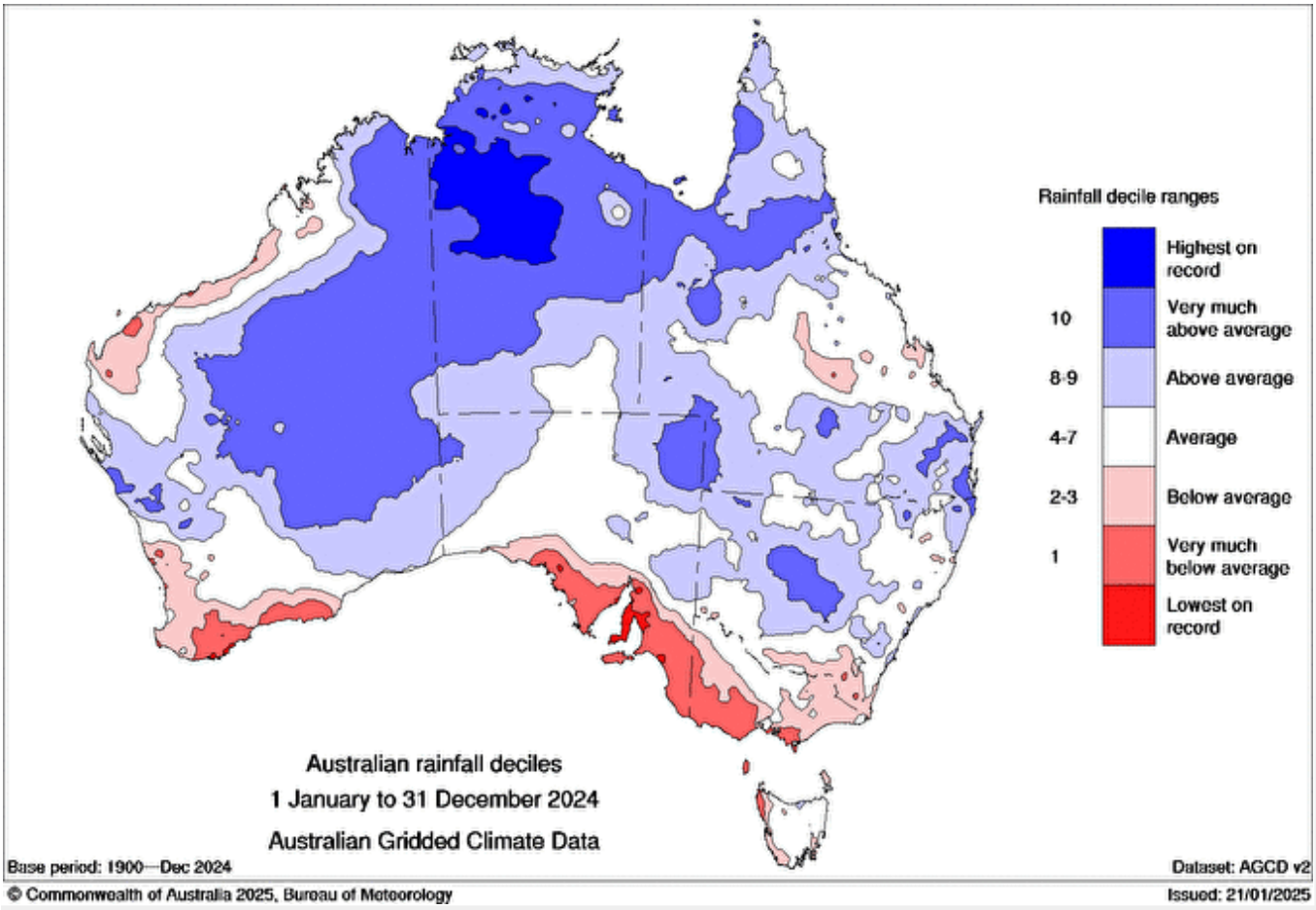
Global temperatures

On 10 January, the World Meteorological Organization (WMO) declared that 2024 was the warmest year on record, based on data from six leading international datasets. The average global temperature was 1.55 ± 0.13 °C above the

pre-industrial (1850–1900) baseline. The previous warmest years on record were 2023 and 2019, with 1.45 ± 0.12 °C and 1.29 ± 0.12 °C above the 1850–1900 average, respectively. The past 10 consecutive years (2015–2024) were the 10 warmest years on record for the globe as a whole.

Global monthly temperatures between January and August set new monthly records, with July 2024 the hottest of all months on record.

2024 was the eighth-wettest year on record



2024 annual rainfall deciles, relative to all years since 1900.

In 2024, Australia's national, area-averaged rainfall total was 596 mm, 28% above the 1961–1990 average of 466 mm. It was the wettest year since 2011 and Australia's eighth-wettest recorded year.

Total rainfall for the year was above to very much above average (in the highest 10% of all years since 1900) for:

- inland areas of New South Wales
- large parts of Queensland
- western and north-eastern South Australia
- most of Western Australia and the Northern Territory.

Rainfall was the highest on record for parts of central and north-western Northern Territory.

The Northern Territory had its fourth-wettest year on record and its wettest since 2011. For Western Australia, 2024 was the wettest year since 2017.

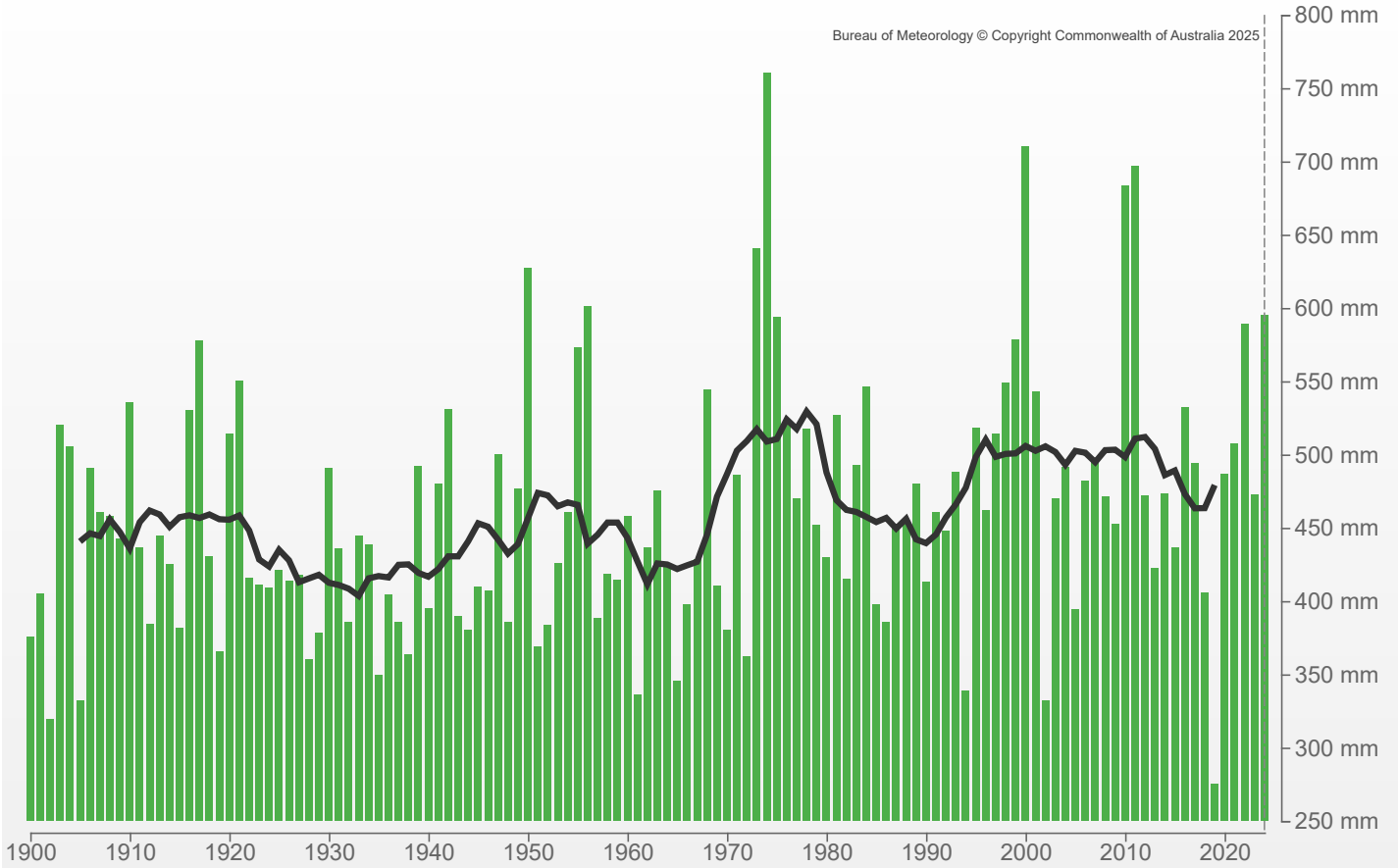
Total rainfall for the year was below to very much below average (in the lowest 10% of historical observations) for:

- south-eastern New South Wales
- most of Victoria
- parts of Queensland's central interior and central coast
- coastal parts of south-west and north-west Western Australia
- southern and south-eastern South Australia
- western and southern coastal areas of Tasmania.

Rainfall was the lowest on record for parts of South Australia's Yorke Peninsula and Mid-North districts. Overall, it was Victoria's driest year since 2019.

Australian annual mean rainfall

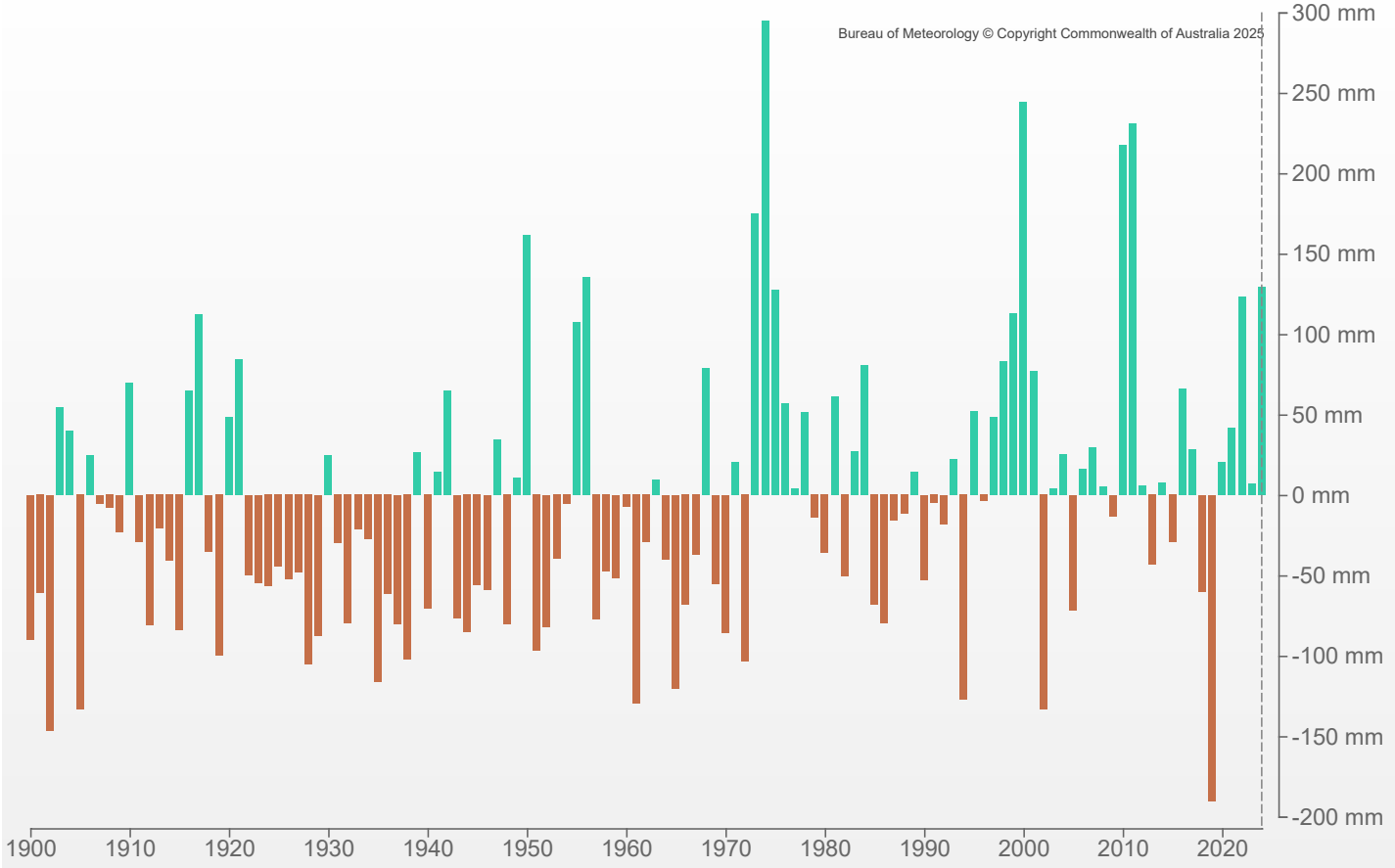
2024 **595.60 mm**



Annual mean rainfall totals for Australia. The black line shows the 11-year moving average.

Australian annual mean rainfall anomaly

2024 **129.57 mm**



Annual mean rainfall anomalies for Australia (as calculated from the 1961–1990 average).

Monthly rainfall

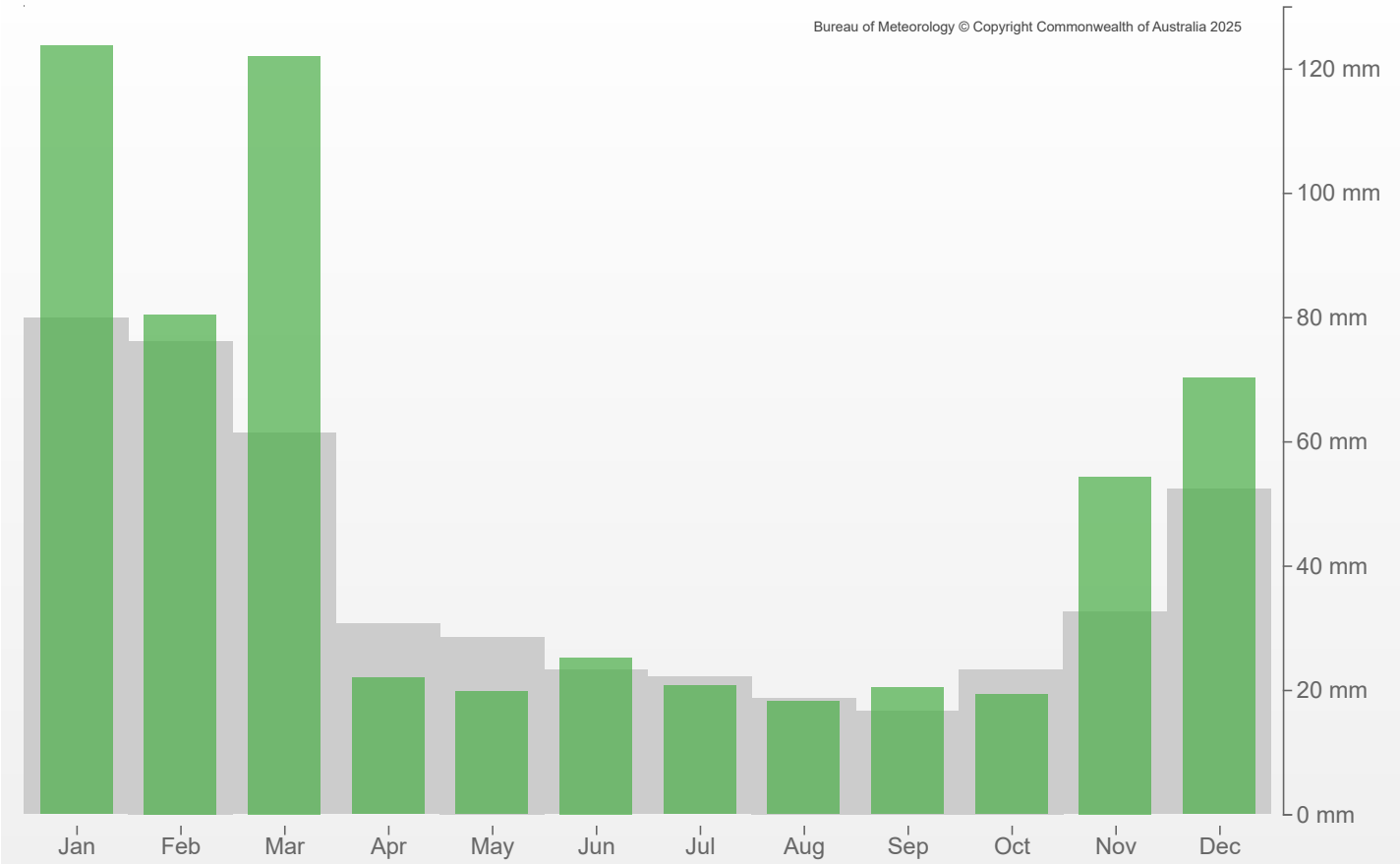
January 2024 was Australia's ninth-wettest January on record. This was followed by a slightly wetter than average February and the third-wettest March on record.

April and May were drier than average for large parts of Australia and nationally drier than average overall, while rainfall in the winter months (June, July and August) was close to average.

September was wetter than average for large parts of the country, and for Western Australia, Tasmania and the Northern Territory, it was among the top 10 wettest Septembers on record.

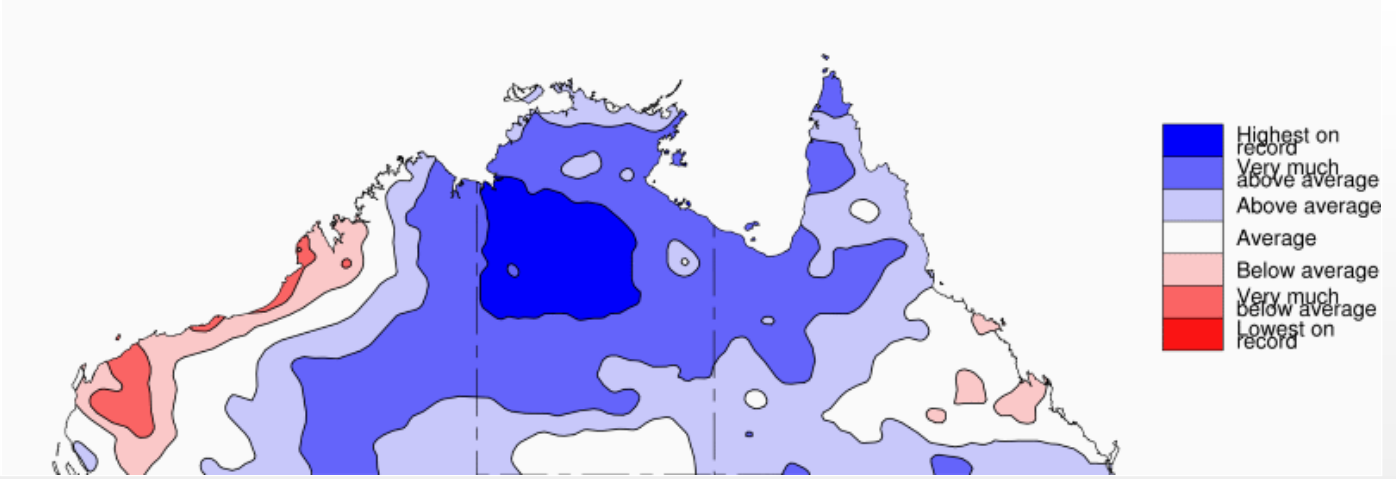
November and December were wetter than average for large parts of Australia, due to widespread and locally heavy rainfall and thunderstorms.

Australian mean monthly rainfall

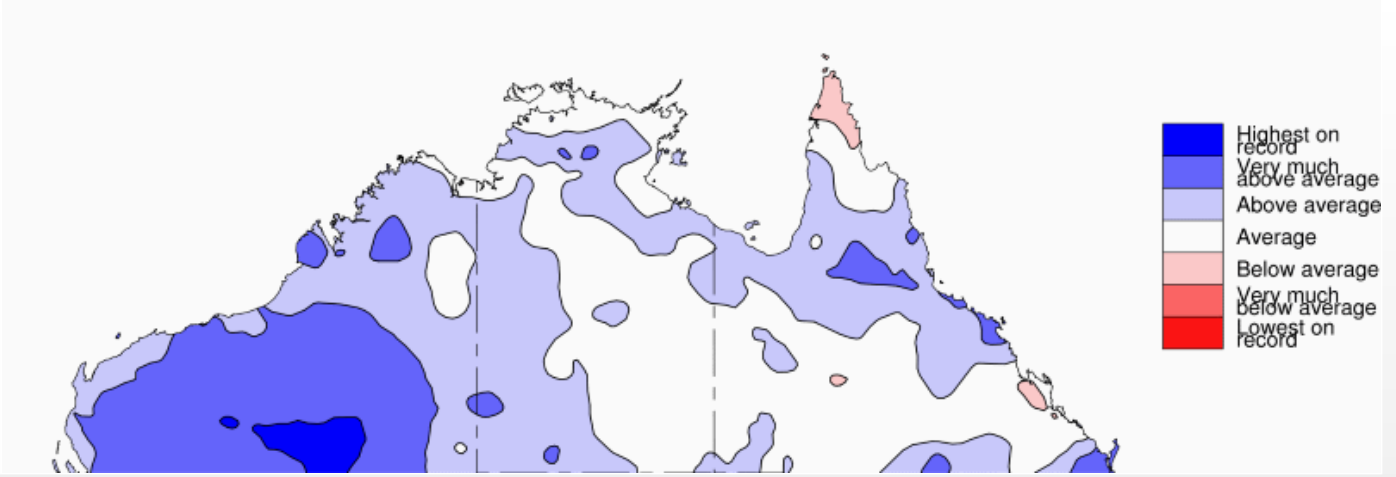


Monthly mean rainfall totals for Australia. The grey bars show the monthly mean for 1961–1990.

Northern Australia



1 January to 30 April 2024 rainfall compared to the distribution of all years since 1900



1 October to 31 December 2024 rainfall compared to the distribution of all years since 1900

Rainfall across northern Australia as a whole (north of 26° S, the South Australia and Northern Territory border) was 42% above average. It was the wettest year since 2011 and the fifth-wettest on record.

Over January to April, the latter part of the 2023–24 northern wet season, northern Australia rainfall totals were generally above average, including the tenth-wettest January and the second-wettest March on record. January to April rainfall was in the highest 10% of all years since 1900 for large parts of Queensland's north and north-west, Western Australia's north-east, and most of the Northern Territory. Rainfall was the highest on record for January to April for northern parts of the Northern Territory.

The above average rainfall across northern Australia during the latter part of the 2023–24 northern wet season was related to a monsoon trough, tropical lows and tropical cyclones Kirrily, Lincoln and Megan that brought heavy rainfall across the region in January, February and March.

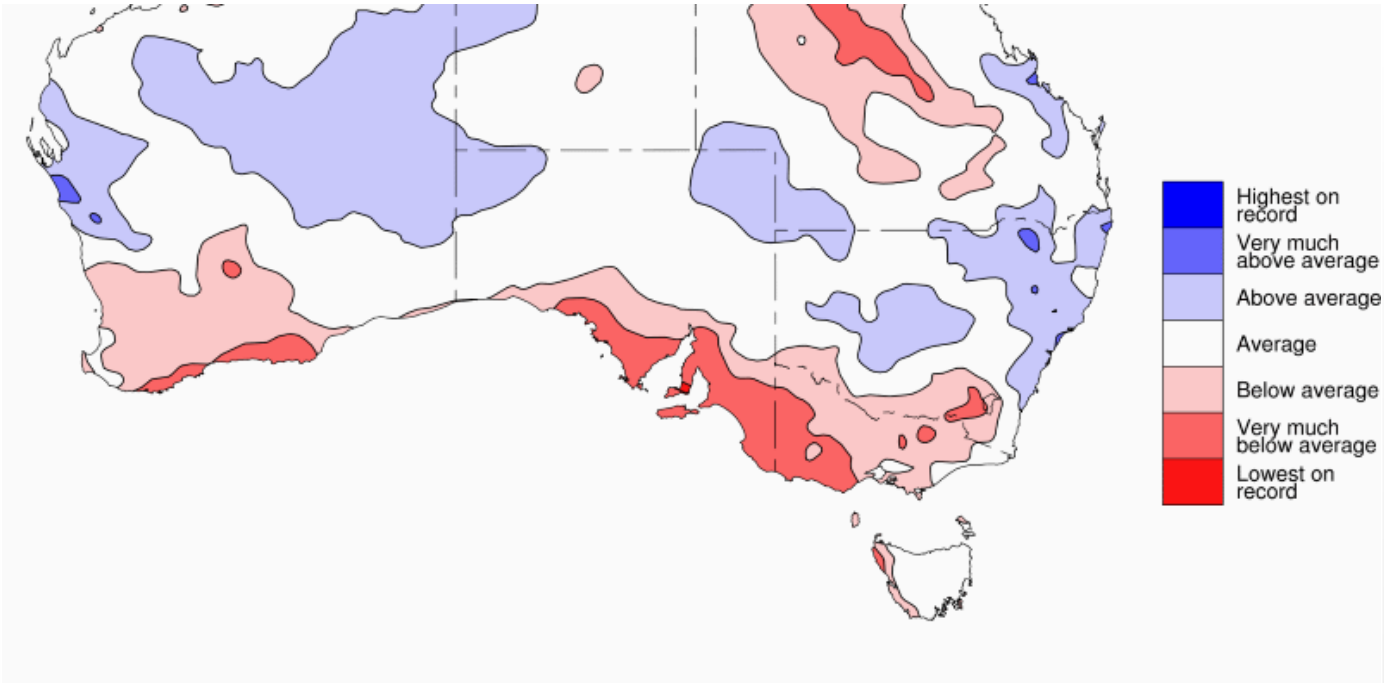
During the start to the 2024–25 northern wet season (October to December), rainfall was close to average or above average for most of Queensland and the Northern Territory. Rainfall was above to very much above average for most of Western Australia and the highest on record for inland areas of Western Australia. Significant rainfall across north-west Western Australia during October to December is unusual, as generally the northern wet season commences much later in January and February for north-west Western Australia.

For more information on northern wet season rainfall, see the Northern Rainfall Onset.

State of the Climate 2024 reported that northern Australia has been wetter than average over the last 30 years across all seasons, especially in the north-west during the northern wet season. Since 1994, wet season rainfall in northern Australia has been 20% above the 1900–1993 average.

In addition, State of the Climate 2024 reported that the intensity of heavy rainfall events in Australia is increasing as the climate warms. Warmer air can hold more water vapour than cooler air, and moisture in the atmosphere can increase by 7% per degree of warming, all other things being equal. This can cause an increased likelihood of heavy rainfall events across Australia.

Southern Australia



1 April to 31 October 2024 rainfall compared to the distribution of all years since 1900

The cool season period (April to October) is an important monitoring period for rainfall in southern Australia (south of 26° S, the South Australia and Northern Territory border). As detailed in State of the Climate 2024 there has been a decline in southern Australian April to October rainfall over the south-west and south-east of Australia in recent decades, with more frequent periods of below-average rainfall in these areas in these months. Cool season rainfall across southern Australia since 1994 has been 9% below the 1900–1993 average.

In 2024, cool season (April to October) rainfall for southern Australia was drier than average, with the area-averaged rainfall total 11% below average.

Rainfall was below to very much below average (in the lowest 10% of all years since 1900) for most of Victoria extending into southern inland New South Wales, south-western and southern coastal areas of Western Australia, large parts of southern and south-eastern South Australia, and coastal areas of western Tasmania.

For each month from April to October, rainfall was below average for large areas of southern Australia, resulting in the development of serious to severe rainfall deficiencies (totals in the lowest 10% or 5% of historical observations since 1900) along southern coastal areas of Western Australia, south-eastern South Australia and western and far north-eastern Victoria. Persistent high pressure systems over the April to October period brought settled weather conditions, clear skies, and fewer cold fronts that typically bring rainfall to the south.

Further rainfall information

For more information on significant rain events, see the Events section. For more information on rainfall deficiencies, see the monthly Drought Statements.

Area-average rainfall

Area-average rainfall

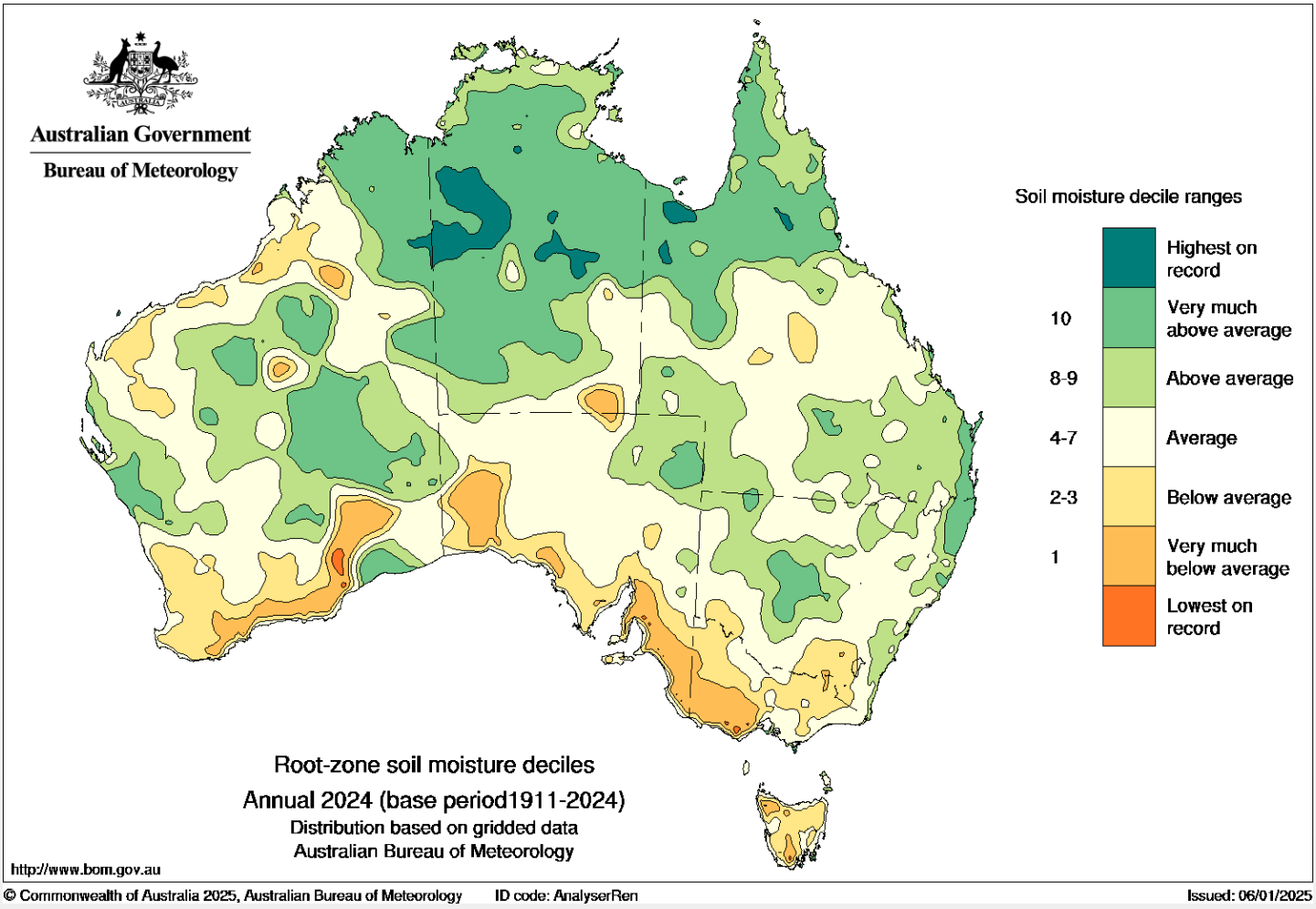
	Rank (of 125)	Average (mm)	Departure from mean	Comment
Australia	118	596	+28%	8th highest
Queensland	104	768	+22%	
New South Wales	87	581	+4%	
Victoria	19	529	−20%	
Tasmania	41	1269	−8%	

Area-average rainfall				
	Rank (of 125)	Average (mm)	Departure from mean	Comment
South Australia	73	218	−3%	
Western Australia	114	461	+35%	
Northern Territory	122	898	+65%	4th highest
Murray-Darling Basin	81	519	+5%	

*Rank ranges from 1 (lowest value on record) to 124 (highest value on record). The national rainfall dataset commences in 1900. A rank marked with '=' indicates that a value is shared by two or more years, resulting in a tie for that rank.
^Departure from mean is relative to the long-term (1961–1990) average.

In climatology a baseline, or long-term average, is required against which to compare changes over time. The Bureau uses the 1961–1990 period as the climate reference period for the Annual Climate Statement and other climate monitoring products. It has no bearing on the calculation of trends over time, or the ranking of one year compared to all other years in a dataset.

Above average soil moisture in Australia's north and below average in the south



2024 root-zone soil moisture deciles map from the Australian Water Resources Assessment Landscape model (AWRA-L) 7.0. Based on all years since 1911.

In 2024, annually-averaged soil moisture in the root zone (in the top 100 cm) was above to very much above average (in the highest 10% of all years since 1911) for:

- parts of eastern and inland areas of New South Wales
- large parts of Queensland and Western Australia
- most of the Northern Territory
- north-eastern South Australia

Annually-averaged soil moisture was the highest on record for parts of the central Northern Territory and north-western Queensland. These wetter than average soil conditions were largely due to above average rainfall from January to April in northern Australia, which had its 10th-wettest January and second-wettest March on record, and above average rainfall for most of Western Australia during November and December.

Annually-averaged soil moisture was below to very much below average (in the lowest 10% of all years since 1911) for:

- parts of south-west and south-eastern New South Wales
- most of Victoria
- large parts of southern and north-west Western Australia
- pockets of south-east Northern Territory
- a large area of southern South Australia
- most of Tasmania.

The drier than average soil conditions were due to below to very much below average rainfall during the southern Australia cool season (April to October).

Northern Australia

At the start of the year, soil moisture was above to very much above average for most of northern Australia, except in the north-west and small pockets of the central north.

Heavy rainfall from January to March across the Top End and central Western Australia, associated with monsoonal activity, helped recover the below average soil moisture conditions in the Pilbara and Kimberley districts of Western Australia, and central northern Australia. In March, soil moisture was highest on record for central parts of the Northern Territory, and wet soil conditions extended into the northern Queensland in April.

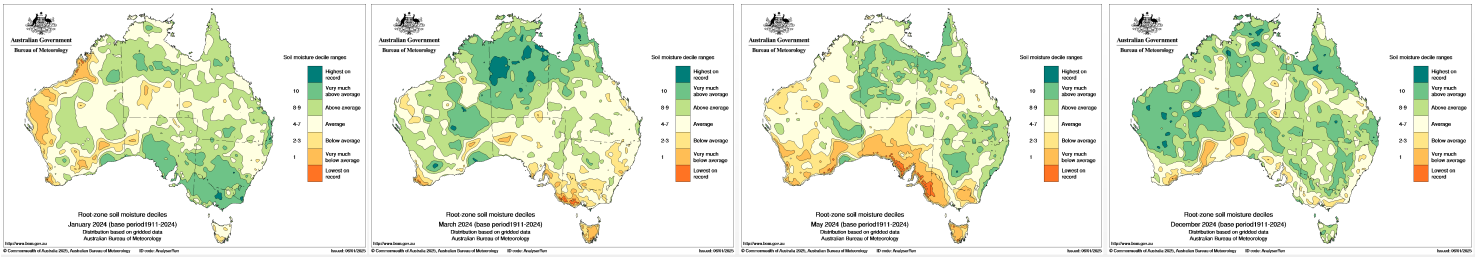
The overall soil moisture conditions remained stable with average to above average soil moisture from May through August, except for some below average conditions in the Pilbara region in May. Most of northern Australia ended the year with above to very much above average soil moisture. This was due to average to above average rainfall during the early northern wet season (October to December), combined with heavy rainfall and thunderstorms in large parts of Western Australia in November and December.

Southern Australia

With southern Australia's eighth-wettest January on record, the month began with above average soil moisture across large areas of Southern Australia, except in west and south of Western Australia and Tasmania. As the below average rainfall conditions persisted in those regions, soil moisture declined in the following months. The situation worsened in May, with soil moisture levels reaching record lows across southern parts of South Australia and Victoria.

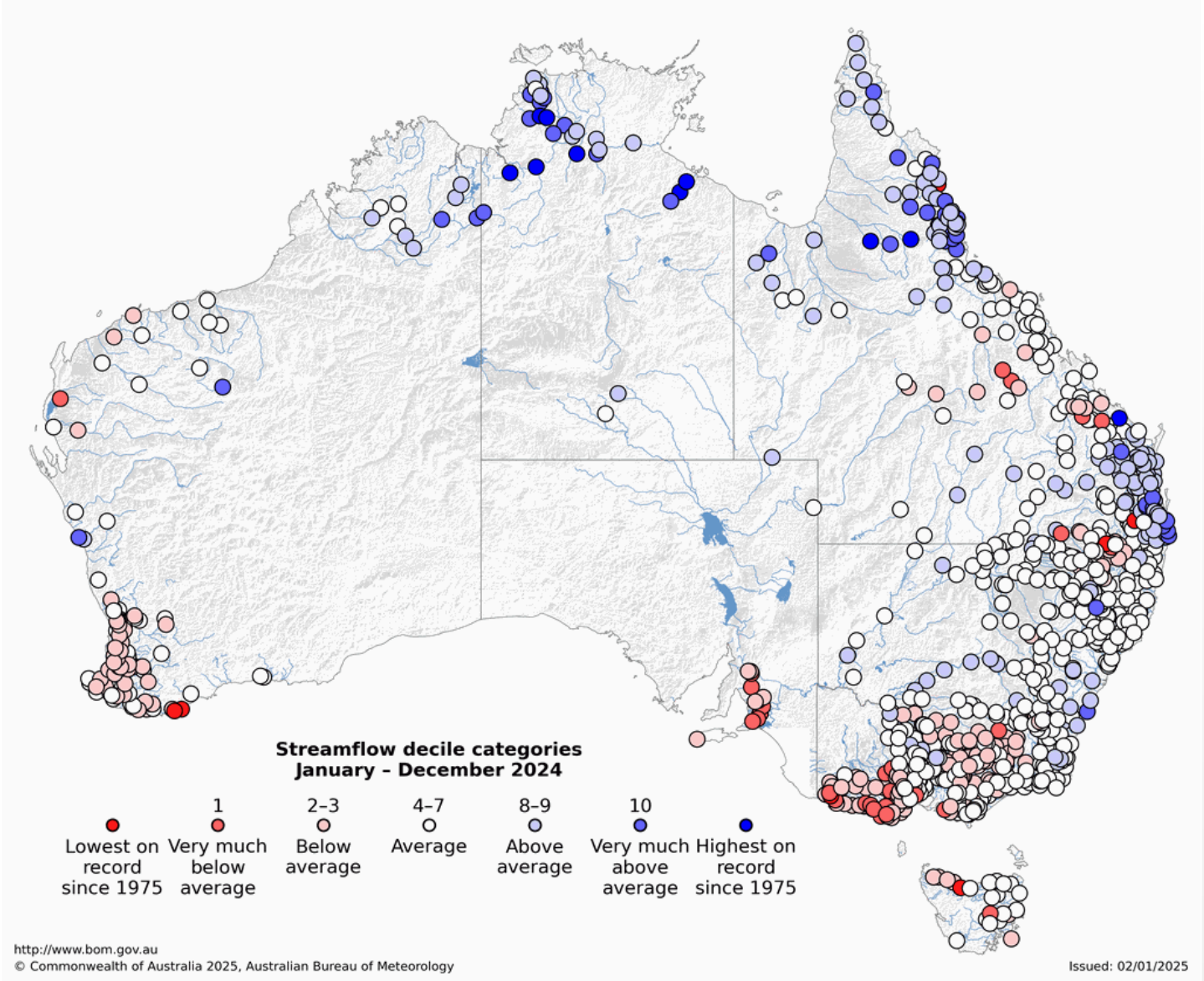
While June and July saw slight improvements in soil moisture across the southern Australia, deficiencies persisted until October due to below average cool season (April to October) rainfall across much of the region. For western Tasmania, dry conditions subsided following weeks of rainfall in late August and early September, and September soil moisture was above-average.

Soil moisture significantly increased during November and December due to above average rainfall. By the end of 2024, soil moisture was above to very much above average for most of southern Australia, except the southern coastal mainland.



Root-zone soil moisture deciles maps from the Australian Water Resources Assessment Landscape model (AWRA-L) 7.0 for January, March, May and December 2024. Based on all years since 1911.

Below average streamflow in Australia's south and above average in the north and parts of east



Streamflow deciles for 2024, relative to all years since 1975. The analysis includes, in total, 929 sites which had at least 80% of daily observations available during 2024.

Streamflow conditions in 2024 mostly followed rainfall patterns. Overall, average streamflow was analysed at 484 of the 929 sites where streamflow is measured. The analysis included stations with more than 80% of daily records available for 2024.

Annual streamflow was below to very much below average at 25% of sites, including:

- most of Victoria
- parts of Queensland's central interior
- parts of Pilbara and south-west Western Australia
- south-east South Australia
- north-west and south-east Tasmania.

Annual streamflow was the lowest on record (at 1% of sites) in some areas of south-west Victoria, south-east South Australia, and south-west Western Australia.

In contrast, due to above average rainfall and wet catchment conditions, above to very much above average annual streamflow was observed at 20% of sites, including:

- inland areas of New South Wales
- parts of northern and south-east Queensland
- the Kimberley region of Western Australia
- the Top End.

Annual streamflow was the highest on record (at 1% of sites) in some areas of Top End and northern Queensland.

Streamflow decile category	Number of sites	Percentage of sites (%)
Highest on record	12	1
Very much above average	42	5
Above average	142	15
Average	484	52
Below average	208	22
Very much below average	32	3
Lowest on record	9	1

Number of streamflow sites in each decile category for 2024. Observations from 929 sites where streamflow is measured and which had at least 80% of daily observations available during 2024.

Major flooding across northern Australia early in the year and in Tasmania later

Australia experienced multiple major flood events in the first quarter of 2024, mostly in the northern regions, during which some rivers recorded their highest flows on record. Overall however, Australia had average to below average streamflow conditions in 2024.

In January, with the onset of the monsoon, widespread heavy rain resulted in moderate to major flood in the Katherine, Daly and Victoria rivers in the Northern Territory. Heavy rainfall due to ex-Tropical Cyclone Kirrily also brought major flooding to the Nicholson, Gregory, and Flinders rivers in north-west Queensland.

The wet conditions in western Queensland and central parts of the Northern Territory continued into February and March, with heavy rainfall from ex-Tropical cyclones Lincoln and Megan. Major Flood Warnings were current in February for the Flinders River and Eyre Creek and numerous catchments were at flood watch across Queensland.

At the beginning of April, a series of low-pressure troughs drew tropical moisture south across Queensland, resulting in heavy rain and widespread flooding of western and southern Queensland that lasted for weeks as the water made its way south.

In early June, a low-pressure system and associated trough brought several days of heavy rain to the New South Wales coast. There was minor to moderate flooding at various sections of the Nepean River in New South Wales, while the Warragamba Dam reached capacity several times between April and June, and subsequently spilling multiple times.

In late August and early September, several weeks of rainfall across large parts of Tasmania led to high river levels and major flooding in the Derwent and Meaner rivers, and moderate flooding in the South Esk River.

In mid-December, a coastal trough and low interacted with deep tropical moisture in eastern and south-eastern Queensland, bringing heavy rainfall to the Wide Bay, Burnett and Southeast Coast districts. This heavy rainfall, combined with already saturated catchments from several weeks of earlier rainfall, caused river and creek levels to rise again, leading to riverine flooding across south-eastern Queensland and parts of the eastern inland. Minor to moderate flooding occurred along the Mary, Burnett and Logan rivers.

Surface water volume declined in the south, increased in northern Australia

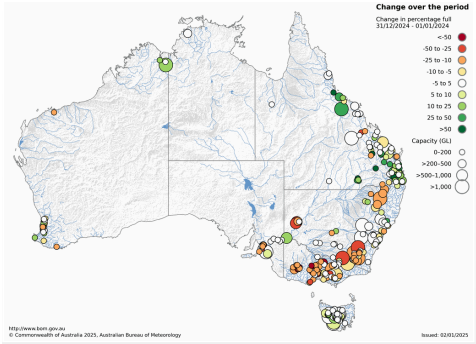
In 2024, total rainfall was below to very much below average across southern coastal areas and parts of the south-east Australia, where many water storages are located. As a result, catchments were dry and inflows to the water storages were low, causing water levels in these storages to decline. However, Australia's total surface water storage volume remained high, at 73% of accessible capacity, at the end of 2024, a slight decrease from 74% at the start of the year.

Urban

At the end of 2024, the surface water storages supplying most capital cities were high (over 80% of their accessible capacity), with the exception of storages supplying Adelaide (46%) and Perth (46%), where rainfall was below average

throughout the year. By the end of 2024, levels in storages that supply Adelaide and Melbourne declined significantly since the start of the year, by 23% and 9%, respectively. For Brisbane, however, high inflows and wet conditions significantly increased the city's storage levels, by 22%.

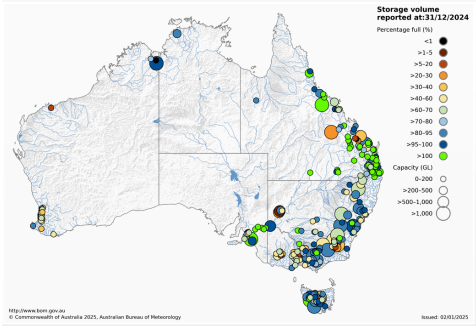
Warragamba Dam, the largest urban water supply storage in Australia, supplies approximately 80% of the Sydney region's water. At the start of 2024, the Warragamba Dam was at 95% of its accessible capacity. In the first half of the year, it spilled multiple times due to high inflows generated from above average rainfall across its catchments. The water level remained high for the rest of the year, reaching 98% of accessible capacity by the end of 2024.



Map showing percentage change in storage system volume during 2024

Murray–Darling Basin

Levels in major storages in the Murray–Darling Basin have been in decline since late 2022. With dry catchment conditions and increased demand during the irrigation season (October to March), total storage volume in the Murray–Darling Basin decreased from 86% at the start of 2024 to 72% at the end of 2024. The storage volume decreased across both northern and southern basins. In 2024, the storages in southern basin decreased from 88% to 73%, and those in the northern basin decreased from 76% to 69%.



Map showing percentage full of storage system at the end of 2024

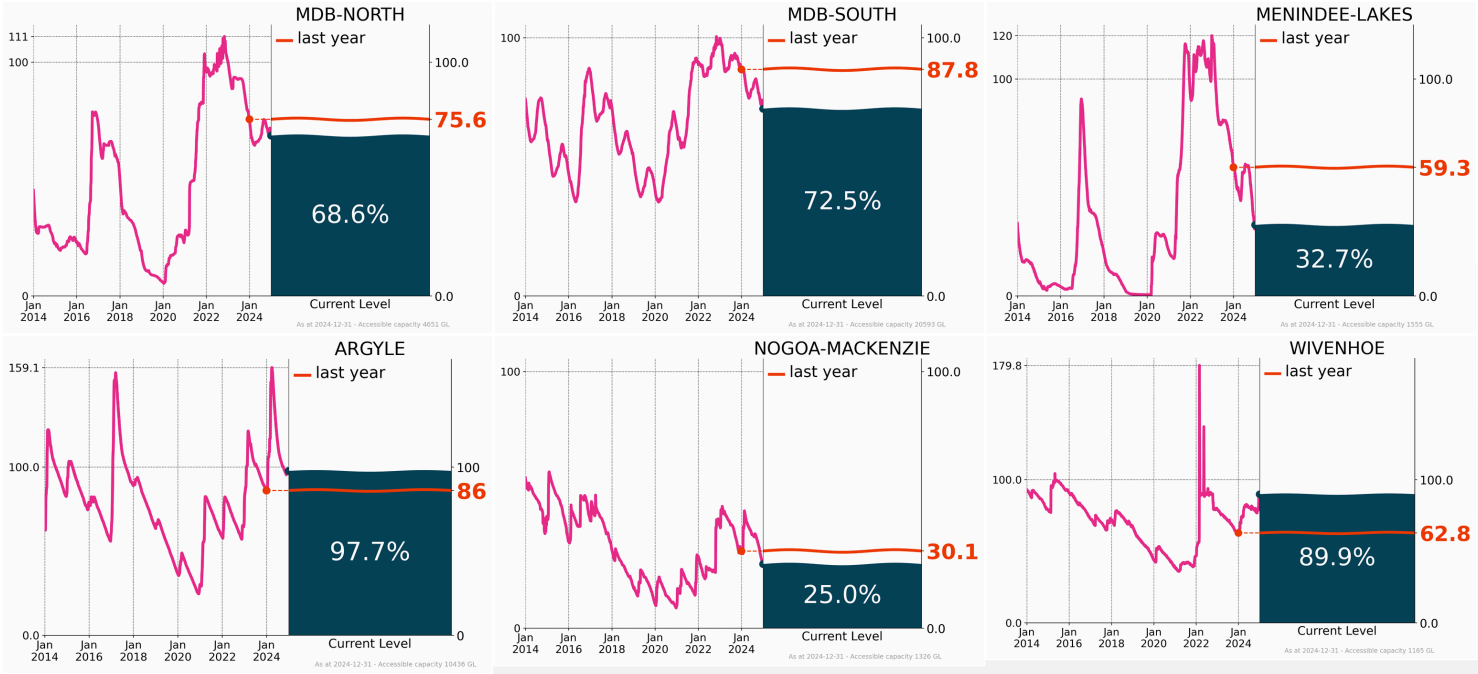
Since 2023, storage levels in both the Menindee Lakes and the Wimmera Mallee systems have sharply declined due to below average rainfall. The Menindee Lakes saw water levels decline from 59% at the start of the year to 33% by the year's end, primarily due to low inflows from the Darling River. Similarly, the Wimmera Mallee system, a critical rural water supply to western Victoria for both domestic and agricultural purposes, experienced a 20% decline in volume over the year.

Northern Australia

In northern Australia, very much above average rainfall resulted in high soil moisture and increased inflows to Lake Argyle. Lake Argyle started the year at 86% capacity. In early April, it reached 159% of its accessible capacity, its highest since 2011. In the months that followed, Lake Argyle's volume steadily declined and was 98% by the end of the year.

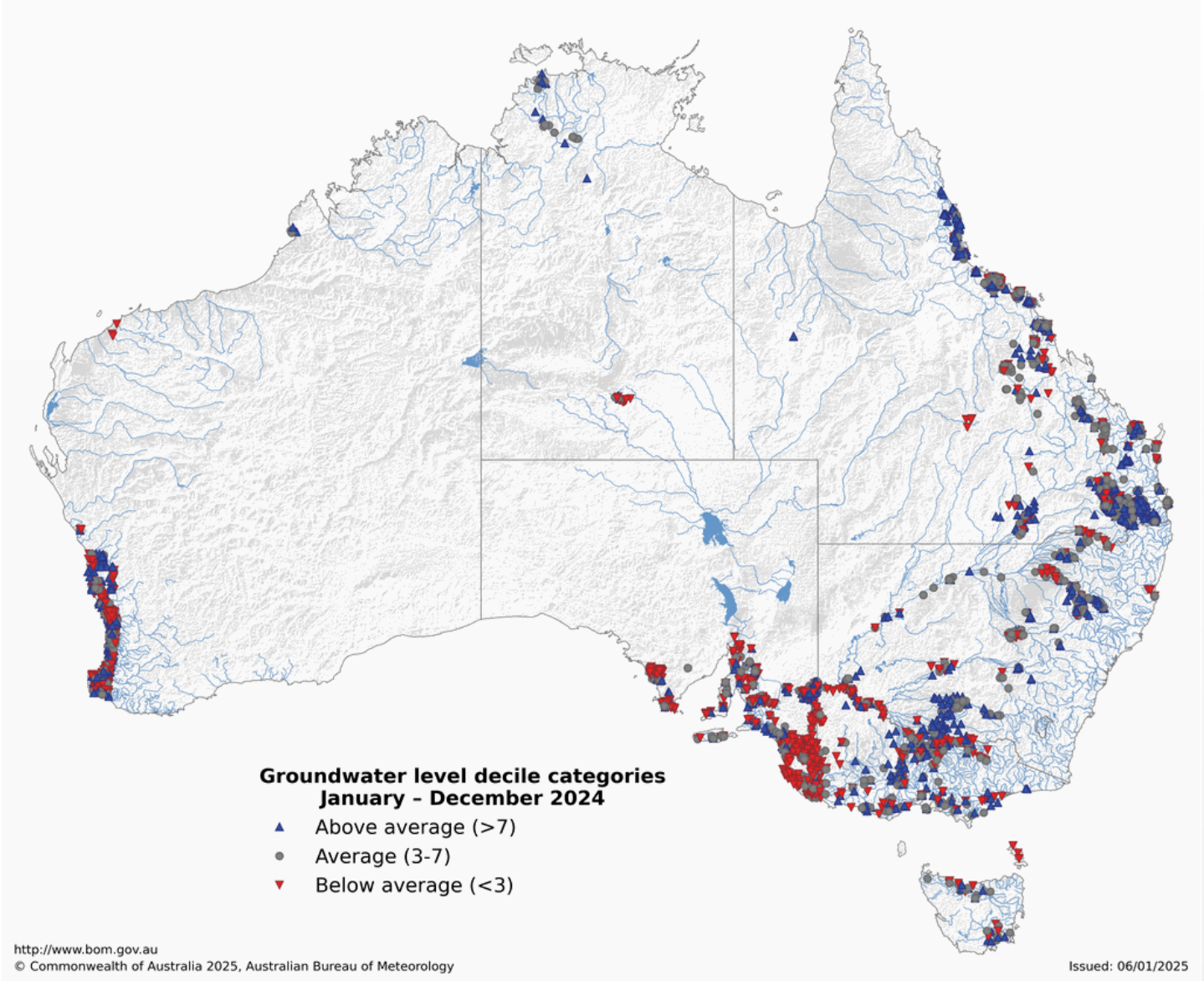
South East Queensland

Spatial variability in rainfall across Queensland led to varied inflows into the region's water storages. The storage volume in the Nogoa-Mackenzie system, an important rural water supply for central Queensland communities, declined steeply from mid-March and ended the year very low, at 25% of its accessible capacity. In contrast, Wivenhoe Dam, the largest storage in south-eastern Queensland, started the year at 63% of its accessible capacity and increased to 90% by the end of 2024, due to high inflows resulting from above average rainfall and wet soil conditions during January to March and December 2024



Storage levels, as percentage of accessible capacity at the end of 2024 compared to 2023 (and back to 2014), for Murray–Darling North and South, Menindee Lakes, Lake Argyle, Nogoa Mackenzie and Wivenhoe.

Groundwater levels recovering in the east and north, declining in western Victoria, South Australia and south-west Western Australia



Groundwater level status map for Australia in 2024 (based on data records from 1997, except for Tasmania where records commence in 2008).

Overall, groundwater levels declined across Australia in 2024, compared to 2023. However, there was considerable variation in groundwater levels across the country, with 35% of bores being below average, 34% average, and 31% above average. Compared to 2023, there was a significant decrease (about 12%) in bores classified as 'above average' and a notable increase (about 9%) in those classified as 'below average'.

Groundwater level trends over the recent 5-year period (2020–2024) show that levels are rising in 39% of bores (a 10% drop from 2023), 47% are stable (a 6% rise), and 13% are declining (a 3% rise).

Murray–Darling Basin and south-eastern Queensland

Following a period of heavy rainfall and flooding during 2021-23, groundwater levels returned to pre-millenium-drought conditions in many areas of the northern Murray–Darling Basin and south-eastern Queensland, including the aquifers in the areas of Namoi and Condamine basins. With above average rainfall in 2024, groundwater levels remained high or continued to recover in those areas. Decreased reliance on groundwater for water supply may have also contributed to this recovery, as higher rainfall in the recent years has increased surface water availability.

Victoria–South Australia border

Groundwater levels in most bores in the Victoria–South Australia border region were average to below average in 2024. In South Australia, water levels in around 84% of bores were average to below average. This reflects both low rainfalls in recent years and long-term consequences of groundwater extraction.

South-west Western Australia

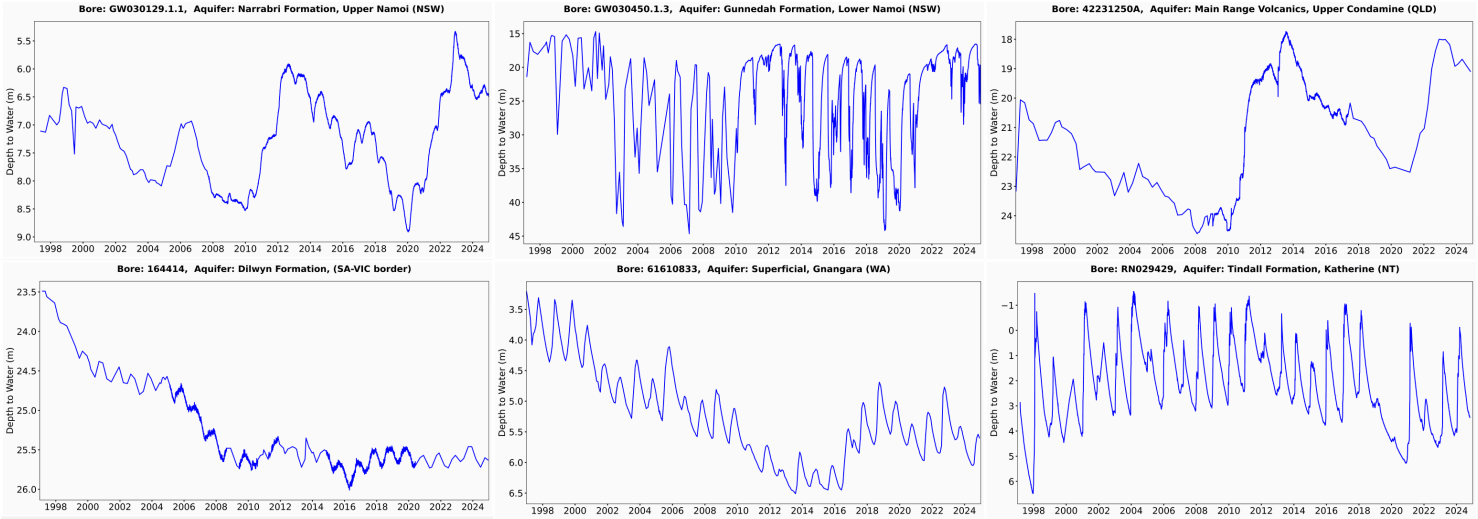
In south-west Western Australia, groundwater levels have generally been in decline over the past 40 years due to the decreasing rainfall, which decreases surface water stores and increases demand on groundwater. Below average winter rainfall in 2024 resulted in less recharge to surficial aquifers of the Gnangara Mound, continuing the trend of declining groundwater levels.

Top End

In the top end of the Northern Territory, where groundwater recharge relies on wet season rainfall and streamflow, groundwater levels have shown some improvement since 2021. However, groundwater levels in around 73% of bores in the Northern Territory, groundwater levels were below average to average in 2024. Heavy rainfall and flooding along the north tropical coast and Gulf of Carpentaria have helped in increase groundwater levels in north-eastern Queensland and Katherine, in the Northern Territory.

Tasmania

In Tasmania, as a result of below average rainfall in 2024, only 25% of bores had above average levels.



Groundwater levels in monitoring bores in the Narrabri and Gunnedah Formations in the Namoi catchment in the northern Murray–Darling Basin, Main Range Volcanics in Upper Condamine in Queensland, Dilwyn Formation in the Victoria–South Australia border, Gnangara Mound in Western Australia, and Tindall aquifer in the Katherine region, Northern Territory.

Percentage of bores in each trend category over 5-, 10- and 20-year periods ending in 2024. Data are from 6599 bores where groundwater level is measured.

Trend category	5-year trend	10-year trend	20-year trend
Rising	39%	21%	16%
Stable	47%	64%	73%
Declining	13%	15%	11%

Notable events

Regions

All None NSW & ACT VIC QLD WA SA TAS NT

Event types

All None Heat Cold Snow Rainfall Hail Flood Storms Wind

Tropical cyclones East Coast Lows Bushfire Coast Sea surface temperature

January

During the first week of January humid and unstable weather in eastern Australia triggered thunderstorms and heavy rainfall across eastern Queensland and north-eastern New South Wales. The highest daily rainfall totals recorded to 9 am on 1 and 2 January were 351.0 mm at Springbrook Road and 252.0 mm at Mt Tamborine (both in Queensland) respectively. On the 4th, thunderstorms affected New South Wales and central parts of the mainland. Severe thunderstorms in north-eastern South Australia generated a wind gust of 137 km/h at Moomba Airport, a record highest daily wind gust for this station for any month (29 years of data).

January

On 7 and 8 January, a broad band of rain with embedded thunderstorms, associated with a slow-moving low pressure trough, moved across south-eastern Australia. Heavy rainfall impacted central Victoria and many stations had their highest daily rainfall on record for January in the 24 hours to 9 am on 8 January, with the highest daily rainfall total of 154.4 mm recorded at Heathcote, the wettest January day on record there (148 years of data). Flood warnings were issued for a number of catchments across Victoria, including Major Flood Warnings for the Campaspe, Goulburn and Yea rivers.

January

A tropical low and a monsoon trough, stretching across the Top End of the Northern Territory to Cape York Peninsula in Queensland, brought many days of widespread rainfall and thunderstorms with areas of heavy to locally intense rainfall in mid-January. This led to flooding of large parts of the Northern Territory and Queensland including Major flooding of the Herbert River at Gleneagle (Queensland) and Magnificent Creek at Kowanyama Airport (Queensland).

January

A widespread low to severe intensity heatwave, with locally extreme conditions in parts of Western Australia's Pilbara, affected large parts of the country between 20 and 26 January. Large areas of New South Wales, north-eastern South Australia and south-western Queensland had maximum temperatures above 40 °C, including 40.6 °C at Sydney Airport on the 26th. A Fire Weather Warning for Extreme Fire Danger was issued for the Greater Huner district (New South Wales), as high temperatures combined with strong and dry northerly winds ahead of a cold front.

January

Tropical Cyclone (TC) Kirrily formed on 24 January from a tropical low in the Coral Sea. It intensified and reached Severe Tropical Cyclone strength (Category 3) on the 25th and crossed the north Queensland coast as a Category 1 system around 11 pm AEDT on the 25th just north of Townsville. After landfall, it continued moving south-west towards Queensland's interior and stalled over western Queensland bringing heavy rain and flooding, before moving north to near the Gulf of Carpentaria coast on 1 and 2 February. Westmoreland Station, near the Queensland-Northern Territory border west of Burketown, received 332.0 mm on 2 February, a February record for that location (58 years of data).

January

In late January, moisture from the ex-Tropical Cyclone Kirrily was advected over much of Queensland, resulting in high dew point temperatures. In conjunction with existing heatwave conditions, the cloudy conditions contributed to high daily minimum temperatures. Many stations in

south-eastern Queensland reported night-time temperatures in excess of 30 °C. Birdsville Airport recorded a maximum of 49.4 °C on the 25th, the second-highest temperature ever recorded in Queensland. This was followed by a minimum of 36.4 °C to 9 am on the 26th, the annual daily minimum temperature record for Queensland and the second-highest daily minimum temperature for Australia (0.2 °C behind 36.6 °C observed at Borrona Downs in New South Wales on 26 January 2019).

January

On 29 January, thunderstorms developed over south-eastern Queensland, with the heaviest rainfall to the north and west of Brisbane. Heavy rainfall led to some rivers and streams in the area reaching major flood levels, with major flooding at Laidley Creek in Lockyer Valley and Major Flood Warnings issued for Condamine and Moonie rivers. On the following day, the thunderstorms and heavy rain gradually moved northwards through the Sunshine Coast, Wide Bay and Burnett, Capricornia, Central Coast and Central Highlands district. The highest daily rainfall totals of 169.4 mm and 107.4 mm in the 24 hours to 9 am on 31 January were recorded at Caloundra Airport and Sunshine Coast Airport respectively.

February

A tropical low (07U) that was embedded into the monsoon trough started to develop and move eastward over the Top End of the Northern Territory on 13 February, and later developed into Tropical Cyclone (TC) Lincoln on the morning of the 16th. It crossed the southern Gulf of Carpentaria coast as a Category 1 system in the evening on the 16th, west of the border between Northern Territory and Queensland. After landfall, it rapidly weakened below tropical cyclone intensity while moving west through central Northern Territory and northern Western Australia, bringing gale force winds and heavy rainfall to areas near these regions. Heavy rainfall resulted in renewed flooding across parts of north-western Queensland and north-eastern Northern Territory and numerous Flood Warnings were issued with Major Flood Warnings for the Nicholson, Gregory and Flinders rivers (Queensland). The tropical low went on to move off the coast of northern Western Australia and track parallel to the coast before making a further landfall north of Carnarvon on the 24th, bringing substantial rain to the area.

February

On 13 February, a cold front moved across Victoria bringing thunderstorms, some severe, locally heavy rainfall and hail, as well as damaging wind gusts. Wind gusts in excess of 90 km/h were recorded at many stations. A number of stations set records for February wind gust speed and some approached or exceeded their annual record, including 122 km/h at Avalon Airport (21 years of data). Hot daytime temperatures combined with strong gusty winds led to Victoria's worst fire weather conditions since the 2019–20 fire season. A Catastrophic Fire Danger Warning was issued for Wimmera and Extreme Fire Danger Warnings were issued for the Mallee, Northern Country and Central districts and with a Total fire ban across all western and central districts. Dry lightning ignited fires in western Victoria with the most significant in the Grampians region.

February

Moist onshore airflow brought daily showers and thunderstorms to parts of eastern Queensland and New South Wales on many days during February and combined with low pressure troughs resulting in heavy rainfall. In the 24 hours to 9 am on the 16th, Brisbane recorded 183.6 mm and flash flooding was reported in some parts of Greater Brisbane. On the 19th, slow-moving thunderstorms developed around eastern New South Wales and south-eastern Queensland, bringing heavy rain that resulted in flash flooding at a number of locations and about 75,000 lightning strikes were recorded across Greater Sydney. Thunderstorms also brought heavy rain to parts of the north-eastern coast between Cairns and Townsville. In the 24 hours to 9 am on the 24th, daily rainfall totals of more than 300 mm were recorded at multiple locations, resulting in flash and riverine flooding.

February

On 21 and 22 February, heat that built up over southern Western Australia extended eastwards across South Australia to Victoria, Tasmania and New South Wales. The heat further intensified due to hot northerly airflow ahead of a cold front that crossed south-eastern Australia on the 22nd and 23rd. Daytime temperatures were more than 10 °C above average in some areas;

nights were also warm with minimum temperatures 6 to 10 °C above average. Hot and dry weather with strong, gusty winds ahead of the cold front resulted in extreme fire danger conditions for some districts in south-eastern South Australia, western and central Victoria and eastern Tasmania. Two significant fires were ignited – north of Beaufort in western Victoria and near Dee in central Tasmania.

February

Western Australia experienced several low to severe intensity heatwaves during February. These conditions were associated with a deep stationary trough off the west coast which directed hot easterly winds from Australia's interior towards the coast. Extreme heatwave conditions impacted the western Kimberley on 18 and 19 February and several stations had their highest daytime temperature for February, some exceeding their annual records, including 49.9 °C at Carnarvon Airport on the 18th, the equal eighth-highest ever recorded in Australia, 49.8 °C at Shark Bay Airport and 49.3 °C at Geraldton Airport. Perth Metro had 7 days in February with daily maximum temperature above 40.0 °C, exceeding its previous February record of 4 such days. The hot, dry and windy conditions caused elevated fire danger across much of southern and central Western Australia, with Extreme Fire Danger in parts of the south-west and south and a significant fire burned near Balladonia.

March

During the first week of March, a series of troughs moved across most of the mainland, generating widespread showers and some isolated thunderstorms. Severe thunderstorms were observed through parts of Western Australia's Kimberley and interior, the Top End in the Northern Territory, central Queensland and along the North Tropical Coast. On 5 March, severe thunderstorms developed over parts of Western Australia and in the 24 hours to 9 am on the 6th, some sites in the Gascoyne and Southern Interior districts had rainfall totals generally between 30 and 50 mm, with isolated higher totals. The average March rainfall for these areas is between 25 and 50 mm.

March

From 8 March, a slow-moving high pressure system centred over the Tasman Sea directed hot air from central parts of the mainland towards south-eastern Australia. Daytime temperatures peaked on the 9th, with temperatures 10 to 16 °C above average through south-eastern South Australia, western and southern Victoria and southern Tasmania. Night-time temperatures peaked on the 10th, at 10 to 12 °C above average. Some stations set March or late season maximum and minimum temperature records. The highest daily maximum temperature during this event was 42.8 °C at North Shields (Port Lincoln AWS) on the 9th and the highest daily minimum temperature was 29.3 °C at Cleve Aerodrome also on the 9th. Low to severe intensity heatwave conditions persisted between the 8th and 11th over most of south-east Australia. Heatwave warnings were issued for large parts of South Australia, Victoria and Tasmania.

March

In early March, a near-stationary low pressure trough across central and eastern Western Australia interacted with tropical moisture that was advected from the Timor Sea, resulting in frequent showers, heavy rain and thunderstorms mainly over south-eastern Western Australia. Four-day rainfall totals ending at 9 am on 12 March were two to five times the March average (of 20 to 30 mm) across a large area in Western Australia's interior. Eyre, on the Nullarbor coast, received 325.4 mm of rainfall in the 4 days to 9 am on the 12th, exceeding its annual average rainfall of 314.9 mm. This triggered significant flooding through parts of southern and south-eastern Western Australia.

March

A monsoon trough that redeveloped across the Top End of the Northern Territory and far north Queensland on 11 March persisted until the 20th resulting in rain, widespread showers and thunderstorms over parts of northern Australia. Heavy rainfall impacted Queensland's North Tropical Coast where many stations recorded daily rainfall totals above 100.0 mm on multiple days. Daily rainfall totals of 100 to 150 mm were reported near the Top End coast during the passage of tropical low 09U before it developed into Tropical Cyclone Megan. Heavy rainfall resulted in flash and riverine flooding across parts of northern Queensland, the Northern Territory and northern Western Australia.

March

Tropical low 09U developed into Tropical Cyclone (TC) Megan on the afternoon of 16 March and brought heavy rainfall to eastern parts of the Arnhem district in the Northern Territory, where Groote Eylandt Airport received 431.0 mm in the 24 hours to 9 am on the 17th (the annual highest daily rainfall record for this station) and 680.4 mm for the two days 16 and 17 March. TC Megan made landfall on the 18th around 4 pm AEST on the south-western Gulf of Carpentaria coast, south-east of Port McArthur, before weakening over land. Severe TC Megan brought heavy rainfall and strong winds to coastal regions of the Northern Territory and Queensland and to several nearby islands. To 9 am on the 19th, Borroloola Airport and McArthur River Mine Airport (both in the Northern Territory) had daily rainfall totals of 256.6 mm and 274.4 mm respectively, their highest daily rainfall for any month. This caused major flooding along the McArthur River at Borroloola, which exceeded the record flood level of 15.0 m from 2001. Ex-TC Megan continued to move westwards across the Northern Territory towards the Kimberley in Western Australia, bringing gale force winds and heavy rainfall to these regions and exacerbating existing flooding.

March

A strong cold front crossed south-eastern Australia on 19 and 20 March, bringing gusty winds and daily maximum and minimum temperatures up to 10.0 °C below average. Associated clouds and embedded thunderstorms resulted in rain and showers for much of eastern Victoria, Tasmania, eastern New South Wales and south-eastern Queensland. On the 19th, many stations in Victoria and Tasmania recorded wind gusts of more than 80 km/h in a northerly airflow preceding the approaching cold front. The passage of the front was followed by gusty south-westerly winds with Wilsons Promontory Lighthouse and Hogan Island (both in Victoria) recording on the 20th, wind gusts of 120 km/h and 122 km/h respectively. Many stations across south-eastern South Australia, Victoria, southern New South Wales and Tasmania observed low minimum temperatures on the 21st. Cleve (South Australia) recorded the lowest daily minimum temperature for March at 6.8 °C and Thredbo AWS (New South Wales) recorded −4.4 °C, its lowest minimum temperature in March since 2001. A dusting of snow was observed over some elevated areas of Tasmania on the 20th.

March

From 23 to 26 March, showers and thunderstorms impacted parts of central and southern Northern Territory, western and southern Queensland and north-western New South Wales as a low pressure trough advected moisture that was left by the ex-Tropical Cyclone Megan. Alice Springs Airport had a three-day rainfall total (ending the 25 March) of 153.8 mm, nearly five times its March average of 30.9 mm. Cloud cover and rainfall led to low daily maximum temperatures especially in southern parts of the Northern Territory and much of Queensland. On the 24th, several stations had their lowest daily maximum temperature on record for March, including Brisbane Aero which recorded 21.1 °C. Alice Springs had maximum temperatures below 18 °C on two consecutive days (the 22nd and 23rd), which has not occurred in March since 2001.

April

A trough and associated cold front moved across Victoria and northern Tasmania at the start of April, bringing widespread showers, localised thunderstorms with heavy falls and strong damaging winds. In the 24 hours to 9 am on the 2nd, 25 to 100 mm of rainfall was recorded across central and southern parts of Victoria and northern, western and central parts of Tasmania. Many sites across central and south-eastern Victoria and northern Tasmania set records for their highest daily April rainfall, while heavy rainfall caused flash flooding across the Melbourne metropolitan area.

April

On 8 April, the New South Wales coast experienced several days of widespread and heavy rainfall, as a deep coastal trough with an embedded low pressure system and a strong easterly flow moved southward along the coast. In the 24 hours to 9 am on the 5th, widespread daily rainfall totals of 25 to 50 mm were recorded along the New South Wales coast, with the Mid North Coast and Sydney Metropolitan area receiving 50 to 100 mm of rainfall with the majority of the rain falling overnight. In the 24 hours to 9 am on the 6th, the Mid North Coast, Hunter, Illawarra and Sydney Metropolitan area received more than 100 mm of rainfall with some isolated falls over 200 mm. Many daily April rainfall records were set, and Flood Warnings were issued across coastal and inland areas of New South Wales. The widespread heavy rainfall had significant impacts for the Sydney Metropolitan, Illawarra and Hunter districts.

April

On 8 April, a cold front moved across southern South Australia, Victoria and Tasmania. This front was associated with a cold southerly airstream that brought cooler conditions to south-east Australia with mean maximum temperatures 2 to 4 °C below average on the 9th. The cold front moved up the New South Wales coast on the 9th and generated damaging, gale force winds with wind gusts in excess of 100 km/h. Snow was reported across New South Wales and Victoria, with 10 cm of snow around Perisher in New South Wales and several centimetres of snow across alpine areas of Victoria.

April

Parts of Queensland's tropical north received several days of heavy rainfall and isolated thunderstorms between 15 and 19 April, as an easterly surge and trough with an embedded tropical low (15U) extended across the northern Peninsula district and Gulf of Carpentaria. The highest daily rainfall totals were recorded along the North Tropical Coast and Tablelands district in the 24 hours to 9 am on the 16th. This resulted in flash and riverine flooding with flood warnings issued including a moderate Flood Warning for the Daintree and Mossman Rivers.

May

On 2 May, an upper low pressure system developed over western New South Wales, moving eastwards towards the coast and generating up to 50 mm of rainfall in central areas in the 24 hours to 9 am on the 4th. The low pressure system combined with onshore flow producing daily rainfall totals of 50 to 100 mm in the 24 hours to 9 am on the 5th across the Illawarra, Sydney Metropolitan and Hunter districts, with the highest rainfall totals of over 100 mm in the Illawarra district. Several sites had their highest daily May rainfall on record. On the 6th the system moved north, and the Central Coast recorded daily rainfall totals of 50 to 100 mm.

May

In early May a cold front and low pressure trough triggered thunderstorms and heavy rainfall as it moved across south-west Western Australia, with isolated daily rainfall totals of 25 to 50 mm in the South West and Lower West districts on the 2nd and 3rd. The South West Land Division experienced strong winds, showers and severe thunderstorms, as a trough ahead of a cold front crossed south-west Western Australia on the 10th. A cool season tornado impacted Bunbury and surrounding suburbs that afternoon.

May

In mid-May an upper trough moved eastwards across western New South Wales, combined with onshore flow and generating widespread rainfall along the coast. Over 3 days, from the 11th to 13th, the South Coast and Illawarra districts received 100 to 150 mm of rainfall, with isolated totals greater than 200 mm in the South Coast district, leading to minor flood warnings issued for the Deau River, Hawkesbury River and St Georges Basin.

May

South Australia, Victoria, New South Wales, the Australian Capital Territory and Queensland experienced cooler than average May minimum temperatures for several days mid-month, in the wake of a cold front that moved across south-east and eastern Australia and combined with a slow moving high pressure system. This produced persistent cooler southerly airflow that reached inland areas. Minimum temperatures were 6 °C below average across large areas of south-eastern and eastern Australia from the 18 to 23 May and several sites in southern South Australia recorded their lowest May minimum temperature on record on the 22nd.

May

In late May, a cold front moved across south-west Western Australia, accompanied by isolated thunderstorms with small hail, strong wind gusts and widespread rainfall. Wind gusts across Perth Metropolitan region on the morning of the 29th exceeded 100 km/h in some locations and Perth Metro had its highest wind gust on record for May at 80 km/h. A waterspout also formed off the coast in Dunsborough in south-west Western Australia.

May

A cold front moved across south-eastern Australia on 30 May, with warm northerly winds strengthening ahead of the front bringing damaging wind gusts over elevated areas of

southern New South Wales, Victoria and Tasmania. Several sites across south-eastern Tasmania, and elevated areas across north-eastern Victoria and south-eastern New South Wales recorded wind gusts exceeding 100 km/h, including Thredbo (New South Wales) with its equal highest wind gust on record for May at 146 km/h. Widespread light to moderate rainfall was associated with the passing of the cold front and associated trough with a large band of rainfall extending from the Kimberley in Western Australia to south-eastern states. Many sites across north-eastern Victoria had their highest daily rainfall for May, including Mount Hotham with 115.8 mm, Falls Creek with 84.6 mm and Mansfield with 61.4 mm.

June

A coastal low developed and deepened off the New South Wales coast on 1 June generating widespread rainfall across coastal and adjacent inland areas. In the 24 hours to 9 am on the 2nd, large areas of coastal New South Wales recorded widespread falls of 15 to 50 mm, with the falls greater than 50 mm concentrated across the Sydney Metropolitan district. Several sites had their highest daily rainfall on record for June, including Sydney (Observatory Hill) with 164.6 mm, with the previous record 150.6 mm on 11 June 1991 at the previous site. The heavy rainfall led to localised flash flooding in areas of Sydney. Flood watches and warnings were issued for the coast from the Hunter to the South Coast districts including a moderate Flood Warning for the Hawkesbury and Nepean Rivers. Significant wave heights exceeded 5 m off the Sydney coast, the largest in the region for more than a year.

June

Strong to damaging wind gusts impacted Victoria, Tasmania and New South Wales as a strong cold front moved across south-east Australia on 11 June. This front was also associated with widespread showers, cooler than average temperatures and several centimetres of snow on alpine areas. Wind gusts exceeded 80 km/h across many coastal and alpine areas of Victoria, Tasmania and New South Wales.

June

Clear skies and light winds from a high pressure system in the Great Australian Bight combined with a cooler southerly airflow from a stationary low pressure system in the Tasman Sea, resulting in cooler than average minimum temperatures across eastern Australia for several days between the 18 and 20 June. Minimum temperatures on the 18th and 19th were 2 to 6 °C below average for much of Victoria, New South Wales, Australian Capital Territory, Tasmania and Queensland, with areas in central Queensland 6 to 10 °C below average on the 18th. Several sites recorded their lowest minimum temperature for June on the 18th, including Tambo Post Office (Queensland) at −5.6 °C. On the 19th, several sites across Victoria and northern Tasmania reported their lowest June minimum temperature on record, with Westmere (Victoria) reaching −5.7 °C, its lowest for any month.

June

At the end of June a low pressure trough extending over central and southern Queensland, drew in moisture from the Coral Sea generating widespread and locally heavy rainfall across coastal and central areas. During this time of the year central parts of Queensland are generally dry with average June rainfall of 10 to 25 mm. However, in the 3 days to 9 am on the 28th rainfall totals across the area were 25 to 100 mm. Most of the rain fell on the 27th when many sites received more than their average June rainfall. Several records were set including 68.0 mm at Woodbine Station (118 years of record); the average June rainfall for this station is 20.4 mm.

July

From 2 to 6 July, a large stationary high pressure system located in the Great Australian Bight directed a cooler southerly airmass across much of the country, with minimum temperatures generally up to 6.0 °C below average. On the 4th, 5th and 6th, several sites across Tasmania recorded their lowest daily minimum temperature on record for July. The lowest temperature recorded was −13.5 °C at Liawanee in the Central Highlands on the 4th, the second-coldest temperature ever recorded in Tasmania. Liawenee had four consecutive nights below −10 °C from 2 to 5 July. Many sites across Tasmania and Victoria, had their highest mean sea level pressure (MSLP) on record on the 4th, with these stations observing MSLPs between 1040 hPa and 1043 hPa. The highest observed MSLP was 1043.9 hPa at Ouse (southern Tasmania), just below the highest MSLP reliably observed in Australia, of 1044.3 hPa at Launceston Airport on 7 June 1967.

July

A low pressure system developed off the New South Wales coast on 12 July and travelled south towards the east coast of Tasmania bringing several days of strong to damaging wind gusts, heavy rainfall and below average temperatures across Victoria and Tasmania. Three day rainfall totals of 50 to 100 mm were recorded across Victoria's Central and East Gippsland districts and southern and eastern parts of Tasmania, with higher falls of 100 to 150 mm in southern areas of Tasmania between 15 and 17 July). Heavy rainfall led to minor and moderate flood warnings across rivers in the Central and West and South Gippsland districts in Victoria, and minor flooding warnings for parts of the St Pauls and Huon Rivers in Tasmania.

July

From 18 to 20 July, a deep low pressure system in the Tasman Sea and a high pressure system over southern and central Australia directed a cooler southerly airflow well into northern Australia. During this period, minimum temperature anomalies were generally 2 to 6 °C below average across large parts of northern Australia with some areas 10 to 12 °C below average. Many sites across northern Queensland and several sites across the Top End of the Northern Territory observed their lowest July or daily annual minimum temperature on record. On the 18th, Palmerville (Queensland) reached 0.5 °C, the lowest temperature there since 1913 and the first time it has fallen below 5 °C there since 1984. On the same day Winton (Queensland) had its lowest July and annual minimum temperature on record at −0.6 °C (22 years of data) and on the 20th, Daly Waters (Northern Territory) had its lowest July and annual daily minimum temperature on record at 0.8 °C (55 years of data).

July

At the end of July, a low pressure system in the Tasman Sea directed strong south to south-westerly winds along coastal areas of New South Wales generating large and powerful waves. Wave heights along the central New South Wales coastline exceeded 5 m, including a significant wave height of 5.70 m recorded at the Crowdy Head wave buoy on the 30th.

August

At the start of August, a cloudband associated with a surface trough brought unseasonal rainfall to north-west and inland areas of Western Australia. The average August rainfall for this region is 10 mm or less, however daily rainfall totals of 5 to 25 mm were recorded in the 24 hours to 9 am on the 3rd. Several sites across northern and inland parts of Western Australia had their highest August daily rainfall on record on the 3rd including Carnegie, which recorded 35.0 mm (69 years of data).

August

In mid-August, an upper level low pressure system combined with moist onshore flow generated widespread rainfall across large parts of Queensland and northern New South Wales. Widespread rainfall over a 4-day period (12th to the 15th) ranged from 50 to 100 mm across coastal and adjacent inland areas of central and southern Queensland and north-eastern New South Wales, with higher falls of 100 to 150 mm in isolated areas. Many sites had their highest August daily rainfall total on record, including 157.4 mm at Evans Head Bombing Range AWS (New South Wales) in the 24 hours to 9 am on the 12th and 176.6 mm at Samuel Hill Aero (Queensland) in the 24 hours to 9 am on the 14th. Heavy rainfall led to minor flood warnings being issued through the Capricornia and Wide Bay and Burnett districts of Queensland and the Northern Rivers district of New South Wales.

August

On 15 and 16 August, a cold front and associated low pressure system crossed South Australia, generating widespread showers across south-eastern parts of the state along with isolated thunderstorms and strong winds. Severe thunderstorms impacted the Eyre Peninsula with reports of large hail of 2 to 4 cm in diameter at Arno Bay.

August

A warm air mass brought unseasonal warmth to large parts of the country between 22 and 31 August, with daytime temperatures more than 4 °C above average. A slow-moving high pressure system over central and eastern Australia allowed for the build-up of heat across the country. Many sites across South Australia, Western Australia, Northern Territory, New South Wales and Queensland recorded their warmest August and winter maximum temperature on record. On the 26th, Yampi Sound in Western Australia observed 41.6 °C, the highest August and winter maximum

temperature recorded in Australia, exceeding the previous record of 41.2 °C at West Roebuck (Western Australia) on 23 August 2020. Bidyadanga in Western Australia recorded a minimum temperature of 28.5 °C on the 27th, the highest August and winter minimum temperature recorded in Australia, exceeding the previous record of 27.5 °C at Cadjebut (Western Australia) on 26 August 1998. August State/Territory records were also set for the Northern Territory (40.0 °C at Bradshaw (Angallari Valley) on the 26th), South Australia (39.4 °C at Oodnadatta on the 24th, 2.9 °C above the previous record) and Queensland (39.7 °C at Birdsville Airport on the 30th and Boulia Airport on the 31st).

August

A succession of cold fronts between 21 August and 10 September resulted in several weeks of rainfall across large parts of Tasmania, with the heaviest rainfall occurring in early September. A number of sites across western and northern Tasmania had their highest September monthly total rainfall on record, including 670.0 mm at Mount Read, or their highest since at least 2003. The steady rain resulted in high river levels in many catchments. Major flooding occurred along the Derwent River at Meadowbank Dam and the Meander River at Strathbridge and moderate flooding occurred along the South Esk River at Llewellyn.

August

Multiple consecutive cold fronts associated with a slow moving deep low pressure system moved across south-eastern Australia between 24 August and 2 September. Damaging to locally destructive wind gusts impacted South Australia, Victoria, Tasmania and elevated areas of New South Wales over several days.

- On the 25 August, Melbourne Airport recorded a maximum wind gust of 100 km/h and Mount Buller had its highest August daily wind gust on record of 150 km/h.
- On the 28 August, Hogan Island in Bass Strait had a maximum wind gust of 161 km/h, its highest daily wind gust on record for August, and Mount Read in Tasmania recorded 156 km/h, its highest annual daily wind gust on record.
- On the 31 August, many sites across Tasmania recorded maximum daily wind gusts over 100 km/h, with the strongest wind gust of 187 km/h at Maatsuyker Island Lighthouse, the highest August daily wind gust on record for the station.
- On the 2 September, many sites across the Melbourne metropolitan area recorded locally destructive wind gusts, with the strongest wind gust of 141 km/h at Fawkner Beacon (Port Philip Bay).

The strong winds also generated high seas during this period. Maximum wave heights of over 15 m were record off Cape Sorrell in western Tasmania, and 8.4 m at Cape Bridgewater near Portland in south-western Victoria. There were reports that strong to locally destructive winds caused damage to properties, vegetation and power outages.

September

A cold front that crossed Tasmania, Victoria and New South Wales on 14 September brought cooler than average temperatures, as a cold airmass behind the front combined with clear and settled conditions from a high pressure system located in the Great Australian Bight. Minimum temperatures were 2 to 8 °C below average across south-eastern Australia from the 15th to the 17th and many sites recorded their coldest September night on record. On the 15th, Keith (Munkora) in South Australia observed −4.6 °C (23 years of data), South Australia's lowest minimum temperature ever recorded in September. On the 16th Canberra Airport recorded −6.9 °C (102 years of composite data) and on the 17th, Adelaide (West Terrace / ngayidapira) recorded 1.3 °C (100 years of data), the lowest minimum temperature on record for September for both sites. There were reports that several nights of temperatures below 0 °C across parts of South Australia, Victoria and New South Wales caused widespread frost damage to crops.

September

Extensive cloud cover across northern Western Australia and areas of western Northern Territory on 17 and 18 September led to daytime temperatures 2 to 10 °C below average. Many sites had their lowest September maximum temperature on record on the 17th including 26.8 °C at Darwin

Airport in the Northern Territory (84 years of data) and 25.8 °C at Kununurra Aero in Western Australia (39 years of data).

September

A low pressure system that developed off the east coast in late September generated widespread rainfall along the north-eastern New South Wales and south-eastern Queensland coast. This system generated strong to damaging winds and hazardous surf conditions with reported wave heights of 4 m along the northern coast of New South Wales. In the 48 hours to 9 am on 29 September, widespread falls of 25 to 50 mm were recorded along the northern New South Wales and south-east Queensland coasts and surrounding inland areas with higher falls of 50 to 100 mm in the Mid North and Northern Rivers districts. Several days of persistent rain along the New South Wales coast caused minor flooding in several catchments in north-eastern New South Wales.

September

Low to severe intensity heatwave conditions persisted from late September to mid-October across parts of the Top End of the Northern Territory, northern Western Australia and areas of the Cape York Peninsula in Queensland, including pockets of extreme heatwave conditions. Several sites had their highest daily maximum temperature for September including 40.4 °C at Jabiru Airport (Northern Territory) on the 29th (47 years of data).

October

A strong cold front moved across southern Western Australia early in October, bringing damaging winds, widespread rainfall and isolated thunderstorms. Wind gusts on the 2nd were greater than 60 km/h across a broad area of southern Western Australia. The south-west coast recorded 10 to 25 mm of rainfall, and a large area of inland Western Australia recorded 25 to 50 mm in the 24 hours to 9 am on the 3rd. Prenti Downs in inland Western Australia recorded 34.0 mm, the stations highest daily rainfall for October on record (50 years of data).

October

Throughout October, a series of low pressure troughs combined with a humid airmass triggered thunderstorm activity across Queensland and north-eastern New South Wales with the following reported impacts.

- On 9 October, large (over 2 cm in diameter) to giant (over 5 cm) hail fell across some locations in south-eastern Queensland, including reports of 7 cm hailstones north of Injune and 6 cm hailstones around Kogan.
- On 28 October, thunderstorms moved across central and south-eastern Queensland and north-eastern New South Wales with reports of giant hail (5 cm), in Yamba (Queensland), large hail (3 to 5 cm) at Clontarf (Redcliffe area) (Queensland) and giant hail (5 cm) around Maclean in New South Wales.
- On 31 October, thunderstorms moved across southern and central Queensland and north-eastern New South Wales, with reports of more than 600,000 lightning strikes, giant hail (5 to 8 cm) in diameter at Uki in New South Wales and high rainfall rates across some areas of the Sunshine Coast in Queensland including 60 to 80 mm within 1 hour.

October

On 16 October, a supercell thunderstorm impacted the town of Casterton in western Victoria, with 21.0 mm of rain within 30 minutes. A maximum daily wind gust of 87 km/h was recorded at Casterton, the second-highest on record for the station in October (19 years of data), and there were reports of large hail (4 cm in diameter) and large accumulations of small hail across the town.

October

A low pressure system and cold front moved across South Australia on 17 October. There were strong northerly winds ahead of this front with several sites across central and eastern South Australia recording wind gusts over 100 km/h, including 113 km/h at Tarcoola Aero, this was the stations highest daily maximum wind gust on record for October (26 years of data). Mean maximum

temperatures were 10 to 12 °C above average across much of the state and Roxby Downs (Olympic Dam Aerodrome) had its highest daily maximum temperature on record for October at 42.9 °C (27 years of data).

October

On 18 October, a low pressure system and cold front moved across Victoria producing widespread rainfall over the state. Severe thunderstorms developed across the Melbourne metropolitan region and surrounding areas including Geelong. There were reports of flash flooding in Geelong, as a thunderstorm bought 50 mm of rainfall within 45 minutes. In the 24 hours to 9 am on the 19th, southern, central and eastern parts of the state recorded 25 to 50 mm of rainfall, with areas with higher totals.

November

On 1 November severe thunderstorms impacted south-eastern Queensland. A severe thunderstorm generated giant hail 6 to 7 cm in diameter near Boonah (south-west of Brisbane) and large hail 3 to 4 cm in diameter around the Brisbane CBD. A confirmed gustnado, a non-supercell tornado formed on the Brisbane River with reports of trees brought down near the river.

November

A surface trough and a cold front moved across south-eastern Australia on 16 November. Strong northerly winds and high temperatures ahead of this system, increased fire dangers across South Australia and Victoria, including Extreme Fire Dangers for north-western Victoria and southern South Australia and Catastrophic Fire Dangers for the eastern Eyre Peninsula in South Australia. Several bushfires started across Victoria's west including one south of Ballarat.

November

A slow-moving low pressure trough and associated cloudband extended from northern Australia towards south-eastern Australia. The moist tropical air from northern Australia resulted in unusually high humid conditions across Victoria, New South Wales and northern Tasmania for several days. On the 26 and 27 November many stations in the region recorded 9 am and 3 pm dewpoint temperatures over 20 °C, among their highest dewpoint temperatures on record for November. The high humidity levels generated widespread morning fog across parts of Victoria and Tasmania.

November

A surface trough and low pressure system along the west coast of Western Australia generated unseasonable rainfall and isolated thunderstorms across most of the state between 18 and 22 November. The highest daily rainfall totals occurred on the 20th and 21st, with 2-day rainfall totals to 9 am on the 21st between 10 to 50 mm across southern, western and inland areas of Western Australia, and with an area of the Goldfields district and south-western parts of the state recording 50 to 100 mm. Many sites across western and southern parts of the state had their highest November daily rainfall on record in the 24 hrs to 9 am on the 20th, some with over 100 years of data including 72.4 mm at Perenjori and 56.8 mm at Brunswick Junction.

November

There was widespread rainfall across most of eastern Australia between 30 November and 1 December, as a slow-moving high pressure trough combined with a low pressure system. In the 48 hours to 9 am on 1 December, most of eastern Australia received more than 10 mm of rainfall, while inland areas and northern New South Wales, southern and central Queensland and scattered areas of northern Tasmania recorded 50 to 100 mm. Isolated areas of southern Queensland and north-eastern Tasmania received more than 200 mm. The highest daily rainfall total was 207.4 mm at Gray (Dalmayne Rd) in north-eastern Tasmania in the 24 hours to 9 am on the 1st, the seventh-highest daily rainfall ever recorded in Tasmania in December. Several days of heavy rainfall led to minor and moderate flood warnings issued for catchments in southern and western Queensland, northern New South Wales, north-eastern Victoria and central and north-eastern Tasmania.

December

Widespread showers and isolated thunderstorms, some severe, impacted large areas of the Northern Territory and northern Queensland on 2 and 3 December. More than 25 mm of rainfall

was recorded in the 24 hours to 9 am on the 3rd across northern and central parts of the Northern Territory and north-eastern Queensland, with falls of 50 to 100 mm in a large area of western Northern Territory and Queensland's North Tropical Coast and Tablelands, and Peninsula districts. The highest daily rainfall totals were observed at West Waterhouse in the Northern Territory, which recorded 105.0 mm, the third-highest for the station (23 years of data) and 110.0 mm at Mount Sofia in Queensland (57 years of data).

December

Hot conditions developed across south-eastern Australia between 15 and 17 December, as strong northerly winds ahead of a cold front dragged hot and humid air from northern Australia to the south-east. On the 16th, maximum temperatures were more than 12 °C above average for most of the country's south-east, and minimum temperatures on the 16th and 17th were 6 to 12 °C above average across the south-east. The highest temperature recorded during this low-intensity heat event was 47.1 °C at Walpeup, Victoria. Several sites across south-eastern South Australia had their warmest December minimum temperature on record. Keith (Munkora), reported 28.3 °C on the 16th, its warmest minimum temperature on record for any month (23 years of data). Hot and dry temperatures combined with strong northerly winds also resulted in elevated fire dangers across South Australia, Victoria and New South Wales.

December

On 16 December, a major bushfire started by dry lightning impacted the Grampians National Park in western Victoria. The bushfire persisted for several weeks due to frequent hot temperatures and strong northerly winds ahead of cold fronts that crossed the state during December and January. On the 26th, Extreme Fire Danger warnings were issued for most of Victoria with strong northerly winds ahead of a cold front, including a maximum daily wind gust of 81 km/h at the Grampians (Mount William) weather station. Emergency Warnings and Immediate evacuation Warnings were issued for Halls Gap and towns north of the park (Pomonal to Ledcourt) and east (Moyston, Strathmore, Willaura), as well as south of Ararat (Maroona to Westmere). Conditions worsened on 4 and 5 January 2025, as heatwave conditions and elevated fire dangers ahead of a cold front and associated low pressure system impacted much of Victoria. Cooler, wetter, conditions on the 6th allowed fire crews to contain the bushfire which had reportedly burnt through 76,000 hectares.

December

Throughout the month, a series of troughs, generated widespread rainfall and severe thunderstorms with isolated heavy rainfall across south-eastern and central parts of Queensland, with the following reported impacts.

- On 14 December, heavy rainfall impacted Brisbane and surrounding areas, causing widespread flash flooding across Greater Brisbane. The Brisbane weather station recorded 70 mm of rainfall in the 24 hours to 9 am on the 15th, the seventh-highest December daily rainfall on record for the station (26 years of data).
- On 16 December, widespread rainfall and thunderstorms impacted south-eastern and central areas of Queensland. In the 24 hours to 9 am on the 17th, areas of the Wide Bay and Burnett, and Southeast Coast districts had daily totals of over 100 mm. Harvey Bay Airport recorded 121.0 mm, the second-highest December daily rainfall for the station (26 years of data).
- On 30 December, a severe thunderstorm bought 120 mm of rainfall within 2 hours at Kingaroy Airport and led to flash flooding around the town. In the 24 hours to 9 am on the 31st, the station received 149.4 mm, the highest daily rainfall for December on record (24 years of data).

Persistent and widespread rainfall on already saturated soils led to higher river and creek levels with riverine flooding across some catchments in southern and central Queensland, including minor to moderate flooding along the Mary River, the Burnett River, and the Logan River.

December

In late December, low to severe intensity heatwaves impacted much of Western Australia with severe conditions along parts of the west coast and adjacent inland areas. From the 21st to 23rd, daytime temperatures were 4 to 12 °C above average and fire dangers were high to extreme for large parts of Western Australia. Several sites had their highest daily maximum temperature on record for

December, including Murchison, which recorded 46.0 °C on the 22nd (35 years of data) and Pearce RAAF, which recorded 44.7 °C on the 23rd (65 years of data). Several sites also had 2 to 3 consecutive days of maximum temperatures above 45 °C between 21st to 23rd, including Morawa (2 days) and Mullewa and Murchison (3 days).

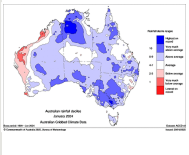
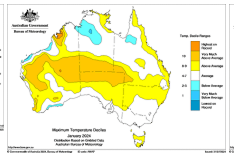
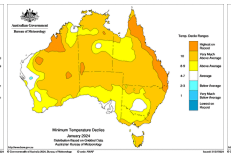
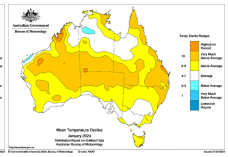
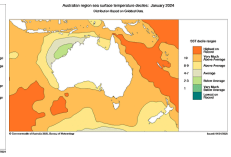
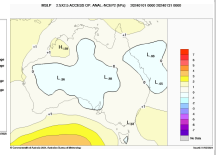
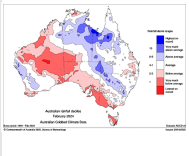
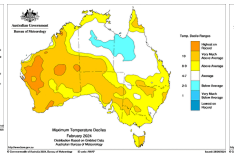
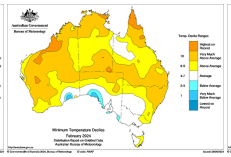
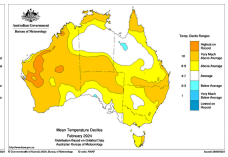
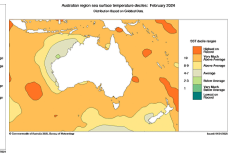
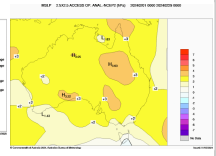
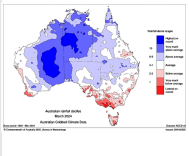
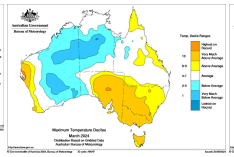
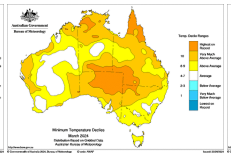
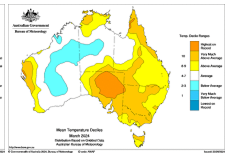
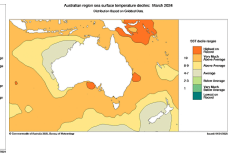
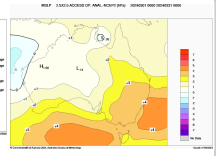
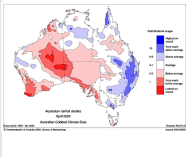
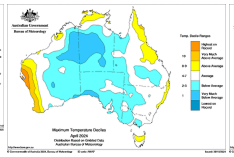
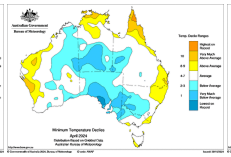
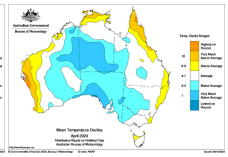
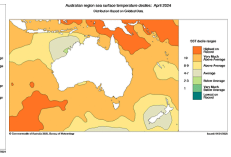
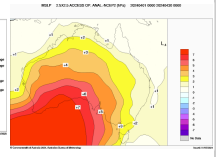
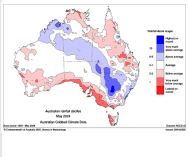
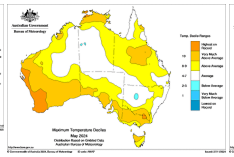
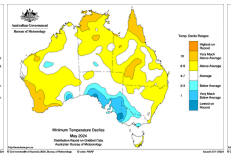
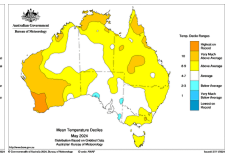
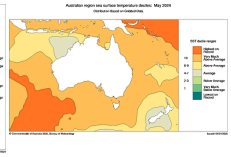
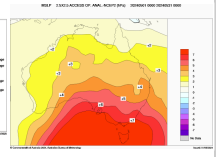
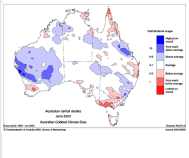
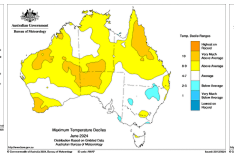
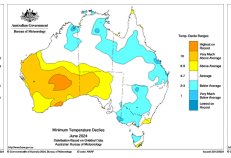
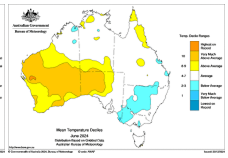
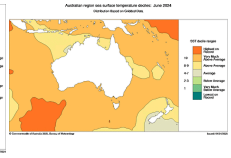
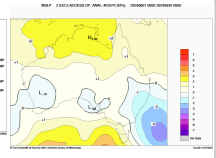
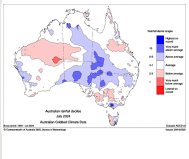
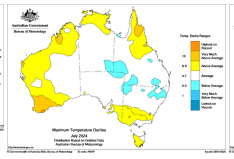
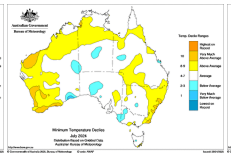
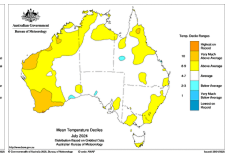
December

A tropical low pressure system (06U) developed on 20 December along a low pressure trough that stretched across the Cape York Peninsula in Queensland. The system produced several days of persistent heavy rainfall across northern Queensland, with daily rainfall totals in the 72 hours to 9 am on the 22nd greater than 50 mm for large parts of northern Queensland, and isolated falls greater than 200 mm in the North Tropical Coast and Tablelands, and Capricornia districts. Some stations exceeded daily rainfall totals of 200 mm, including 204.4 mm at Prosperine Airport in the 24 hours to 9 am on the 20th, the third-highest daily total for December at this station (44 years of data). The tropical low crossed the northern Cape York Peninsula and on the 22nd moved into the Coral Sea, away from Australia.

December

A weak tropical low (07U) developed on 22 December in the Indian Ocean, and passed close the Cocos (Keeling) Islands. The low brought several days of heavy rainfall to the Islands. In the 48 hours to 9 am on the 27th, the Cocos Island Airport weather station recorded 337.8 mm, nearly three times the average December rainfall for the station of 117.8 mm (122 years of data).

2024 monthly and annual rainfall, temperature and sea surface temperature deciles maps

	Rainfall deciles	Maximum temperature deciles	Minimum temperature deciles	Mean temperature deciles	Sea surface temperature deciles	Mean sea level pressure anomalies
January						
February						
March						
April						
May						
June						
July						
August						

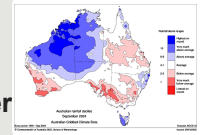
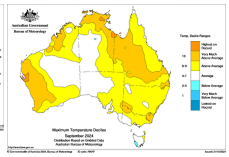
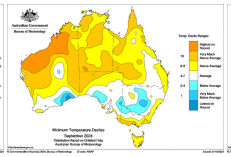
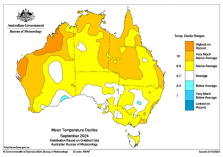
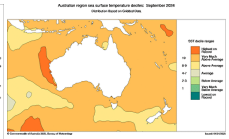
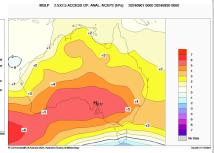
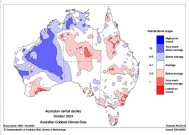
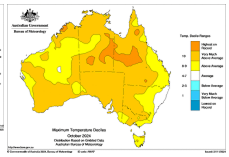
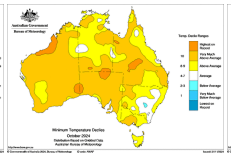
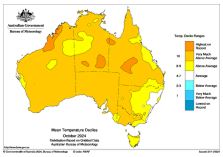
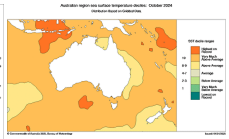
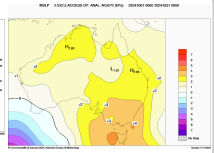
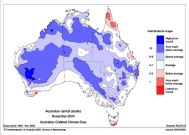
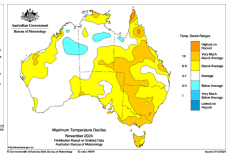
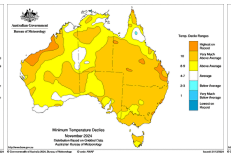
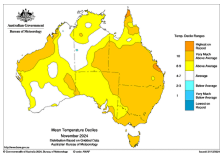
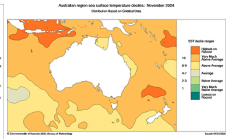
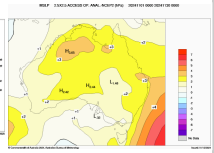
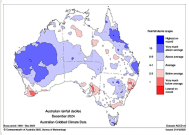
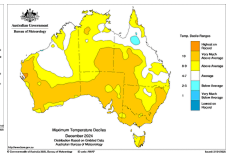
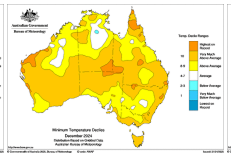
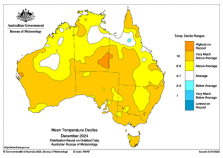
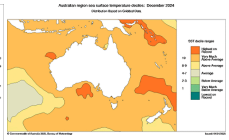
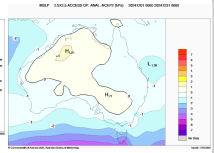
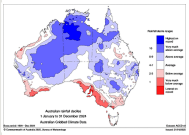
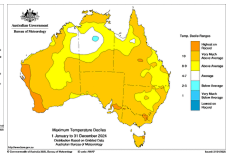
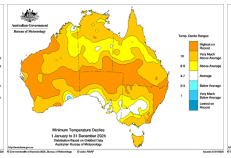
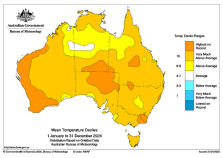
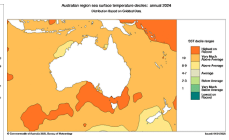
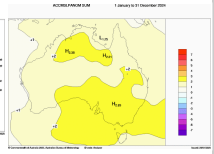
	Rainfall deciles	Maximum temperature deciles	Minimum temperature deciles	Mean temperature deciles	Sea surface temperature deciles	Mean sea level pressure anomalies
September						
October						
November						
December						
Year						

Table of rainfall, temperature and sea surface temperature maps for each month and the year

Data currency

All values in this statement were compiled from data available on the issue date. Subsequent quality control and the availability of additional data may later result in minor changes to values published elsewhere in the underlying datasets as compared to the values published in this statement.

Accessing datasets

The Bureau collects, manages and safeguards Australia's climate data archive. Several datasets have been developed from this archive to identify, monitor, and attribute changes in the Australian climate. You can access these datasets on our website. The datasets used in the preparation of this statement are outlined below.

Area-averaged temperature values are from the national homogenised Australian temperature dataset (ACORN-SAT), which starts in 1910.

Mapped temperature analyses use AWAP temperature data, which starts in 1910.

Area-averaged rainfall values and mapped monthly analyses use the national AGCD dataset which starts in 1900.

Sea surface temperature data are from the NOAA Extended Reconstructed Sea Surface Temperature dataset, ERSST. Comparisons are made in the Australian region for all years since 1900.

Soil moisture analysis uses Australian Water Resources Assessment Landscape model (AWRA-L) data, which starts in 1911.

Atmospheric gas charts use data from CSIRO Kennaook / Cape Grim Baseline Air Pollution Station (KCG BAPS)

Sea-ice extent values use data from the National Snow and Ice Data Center, University of Colorado, Boulder – Nimbus-7 SMMR and DMSP SSM/I-SSMIS Passive Microwave Data for 1979 to the year before last, and Near-Real-Time DMSP SSM/I-SSMIS Daily Polar Gridded Sea Ice Concentrations for observations during the most recent year.

A note on climatology periods

In climatology a baseline, or long-term average, is required against which to compare changes in climate over time. Except where noted in the text, the Bureau uses the 1961–1990 period as the climate reference period for the Annual Climate Statement and other climate monitoring products.

A minimum 30 years of data is required to form a robust climatological average, accounting for decadal variability. In general, baseline climatological periods try to make use of the period with the best data coverage, and can best represent the average climate conditions for the region of interest. The 1961–1990 period is used as a benchmark for reporting climate change.

Alternate averaging periods are used for other purposes, such as facilitating comparison to a more recent period for climate outlooks, or where climate change has shifted the average climate conditions. For example, the sea surface temperature and sea ice extent datasets presented here use the 1991–2020 period.

The choice of base period is a convention. It has no bearing on the calculation of trends over time, or the ranking of one year compared to all other years in a dataset.

More information:

- Annual summaries for states, territories, and capital cities

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