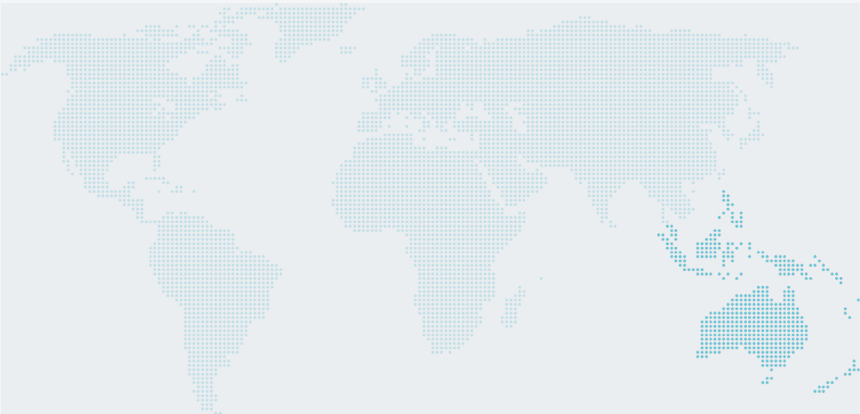
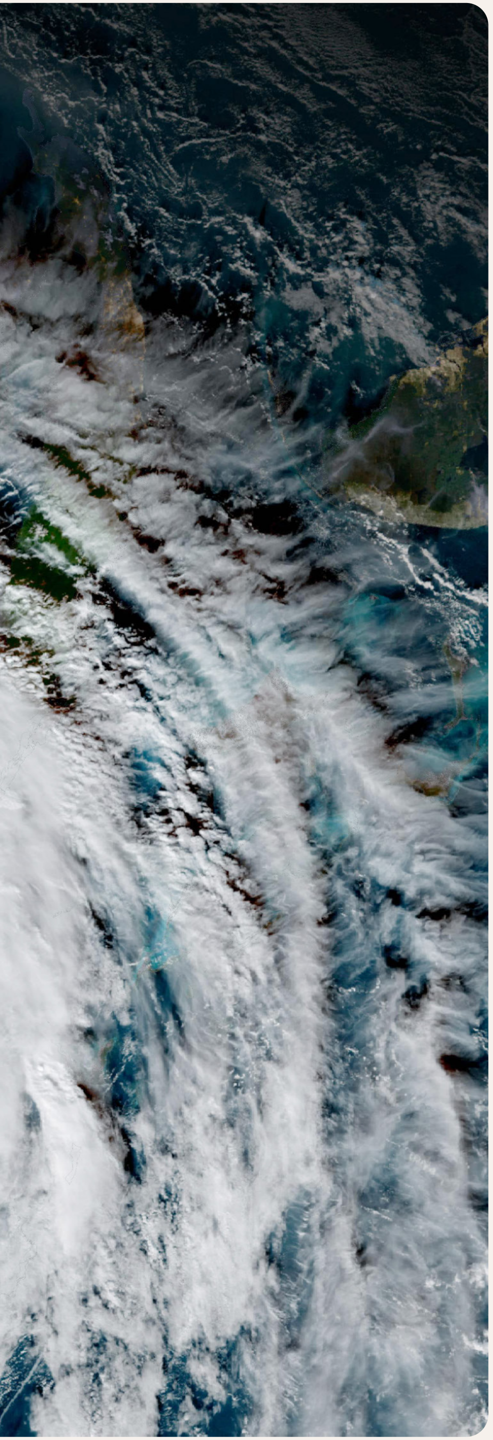
State of the Climate in the South-West Pacific
2025

WEATHER CLIMATE WATER



WORLD METEOROLOGICAL ORGANIZATION

WMO-No. 1400



WMO-No. 1400

Chair, Publications Board
World Meteorological Organization (WMO)
7 bis, avenue de la Paix
P.O. Box 2300
CH-1211 Geneva 2, Switzerland

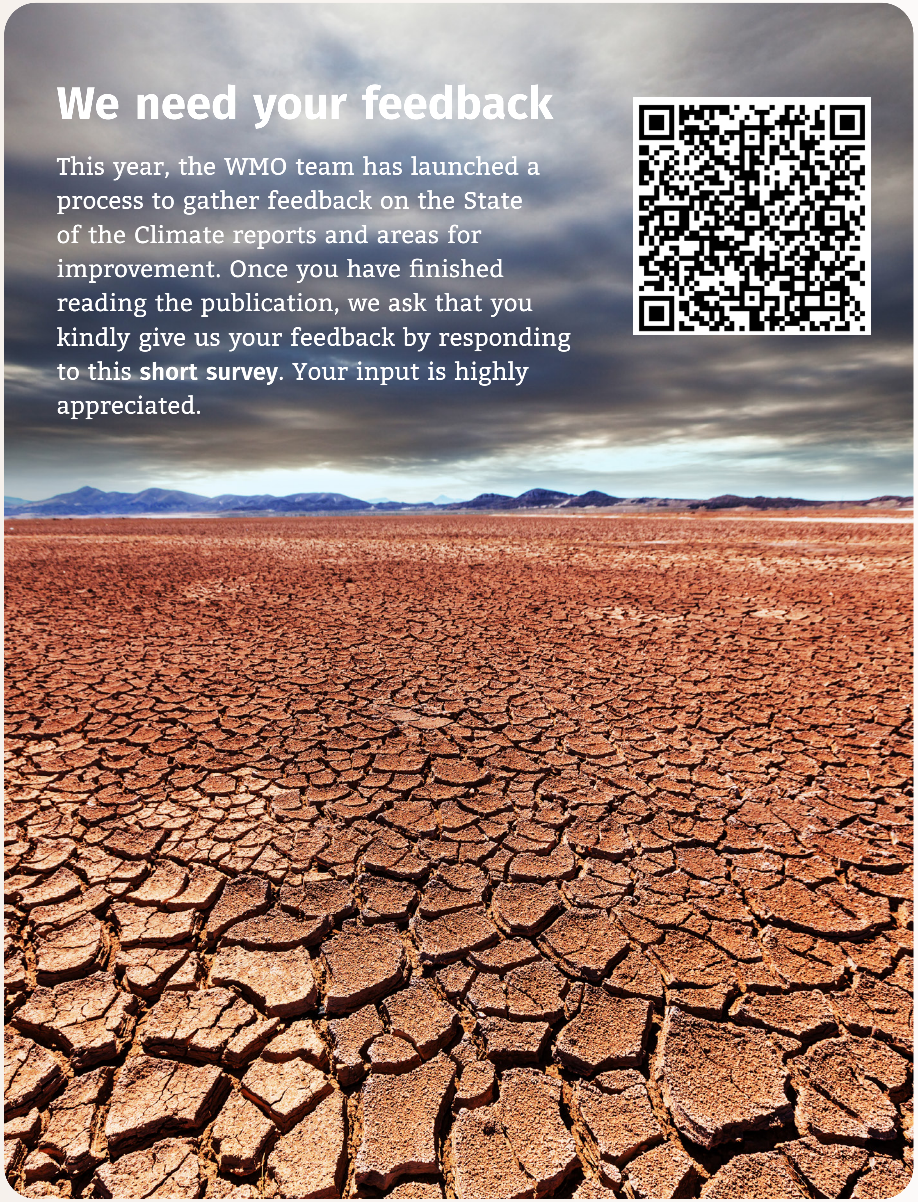
Email: **publications@wmo.int**

Front cover photo: Paddy field in Bireuën, Aceh, Indonesia. *Credit:* Rachmat04

Copyright page photo credit: Magnific

Back cover photo: Jörg Hempel

ISBN 978-92-63-11400-6
https://doi.org/10.59327/WMO/S/CRI/SOC/4/SWP



We need your feedback

This year, the WMO team has launched a process to gather feedback on the State of the Climate reports and areas for improvement. Once you have finished reading the publication, we ask that you kindly give us your feedback by responding to this **short survey**. Your input is highly appreciated.

Credit: Magnific

Contents

Scope of the report 4
Key messages 5
Global climate context 6
Regional climate 8
Temperature 8
Precipitation 9
Cryosphere 10
Snow cover 10
Glaciers 11
Oceans 12
Sea-surface temperature 12
Ocean heat content 12
Sea level 13
Ocean acidification 13
Extreme events 15
Tropical cyclones – Overview 18
Marine heatwaves 19
Major climate drivers 20
El Niño–Southern Oscillation 20
Indian Ocean Dipole 20
Madden–Julian Oscillation 20
Climate-related impacts and risks 21
Operational marine heatwave prediction services supporting preparedness in Australia and the South-West Pacific 21
Tropical Cyclone Senyar in Indonesia and Malaysia – Accelerated and coordinated action pays off 24
Datasets and methods 27
Contributors 28
Endnotes 29

Scope of the report

The WMO *State of the Regional Climate 2025* reports complement the WMO *State of the Global Climate 2025* report by delivering a summarized and consolidated regional assessment of the previous year's climate conditions. These reports provide authoritative information by updating key climate indicators, listing major regional extreme events, and addressing climate impacts and risks. The reports do not provide climate projections or forecasts, nor do they provide in-depth scientific discussion. They address general information needs of the National Meteorological and Hydrological Services (NMHSs), policymakers, scientists and technical experts, media and educators, as well as the public and youth. The reports are produced by WMO in collaboration with NMHSs, international data centres, leading climate research institutions and United Nations partners.

While every attempt is made to ensure consistency, slight deviations in the analyses and assessments may occur between the regional and global State of the Climate reports due to differences in analysis and assessment scales (regional versus global) and slight variations in the methodologies used by different contributing centres.

"For many countries and territories in the South-West Pacific,[a] the ocean is central to livelihoods, economies and resilience. In 2025, the region experienced warming oceans, rising sea levels, marine heatwaves and ocean acidification, alongside tropical cyclones and the continued loss of tropical glacier ice. This report highlights the importance of observations, early warning systems and climate services in helping countries and communities better prepare for climate-related risks."

Professor Celeste Saulo
Secretary-General, WMO

[a] The WMO South-West Pacific region includes part of South-East Asia, Australia, New Zealand and the Pacific (see Annex II to the General Regulations in *Basic Documents No. 1* (WMO-No. 15) for information on the geographical limits of WMO regions).

"Across Asia and the Pacific, heat is intensifying multi-hazard risks, intersecting with food systems, public health, infrastructure and oceans, and placing new pressures on health and livelihoods. Early warning and early action save lives when alerts are timely, messages are trusted and last-mile delivery reaches the vulnerable. Resilience is built over time, through a sustained culture of preparedness."

Armida Salsiah Alisjahbana
Under-Secretary-General of the United Nations and Executive Secretary of the Economic and Social Commission for Asia and the Pacific (ESCAP)

Credit: Adobe Stock

Key messages

The year 2025 was the **second-warmest year** on record in the South-West Pacific region, at 0.37 °C above the 1991–2020 average.

As is typical during La Niña conditions, **rainfall was above average** across much of the Maritime Continent, with many regions recording precipitation within the wettest 10% of years between 1991 and 2020, while much of the western and central equatorial Pacific was drier than average.

Credit: Adobe Stock

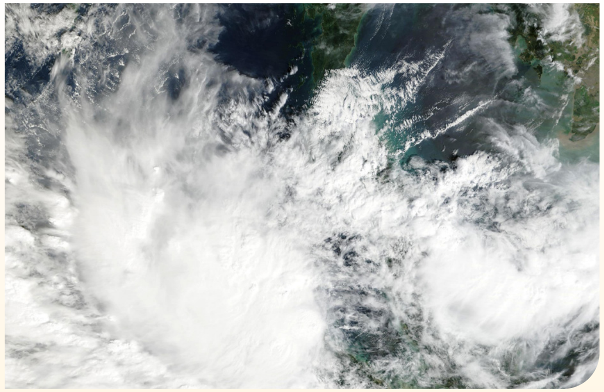
In 2025, the remaining tropical ice cover in Papua, Indonesia was estimated to be only about 2% of the ice area observed in 1988. The last remaining tropical glacier of the region is expected to disappear by the end of 2026 or early 2027.

The average sea-surface temperature for the region was the **second highest on record**, slightly below the record set in 2024.

Credit: Adobe Stock

During the 2024/2025 summer, **prolonged marine heatwaves** contributed to ecosystem disruption, fish kills, and a severe harmful algal bloom in South Australian waters, with major impacts on aquaculture and fisheries. Marine heatwave forecast products are being developed to provide critical early warning and give users weeks to months to prepare for potential impacts.

Ocean acidification continued in 2025, with almost the entire region showing record low surface ocean pH values.



Credit: NASA Terra Satellite

Cyclone *Senyar*, the first known system to reach tropical cyclone intensity in the Strait of Malacca, resulted in **severe flooding** in late November and more than 1 200 deaths reported in Indonesia, demonstrating the importance of early warning, preparedness and coordinated response for rare, high-impact tropical cyclones in near-equatorial areas.

Sea level continued to rise across the South-West Pacific, affecting coastal communities and low-lying island nations.

Global climate context

The global annual mean near-surface temperature in 2025 was 1.43 °C [1.39 °C to 1.47 °C] above the 1850–1900 pre-industrial average and 1.08 °C [1.04 °C to 1.11 °C] above the 1961–1990 baseline. The global mean temperature in 2025 was the second or third highest on record for the period 1850–2025 according to all nine datasets that WMO uses to monitor global mean temperature[1]. The year 2024 remains the warmest year on record at 1.55 °C [1.51 °C to 1.60 °C] above the 1850–1900 pre-industrial average. Each year from 2015 to 2025 was among the eleven warmest on record, and each of the past three years was among the three warmest on record.

Atmospheric concentrations of the three major greenhouse gases reached new record observed highs in 2024, the latest year for which consolidated global figures are available,[2] with levels of carbon dioxide (CO_2) at 423.9 ± 0.2 parts per million (ppm), methane (CH_4) at 1 942 ± 2 parts per billion (ppb) and nitrous oxide (N_2O) at 338.0 ± 0.1 ppb – respectively 152%, 266% and 125% of pre-industrial (the year 1750) levels (Figure 1). The increase in the annual CO_2 concentration in 2024 was the largest increase in the annual CO_2 concentration since modern measurements began in 1957. Real-time data from specific locations, including Mauna Loa[3] (Hawaii, United States of America) and Kennaook/Cape Grim[4] (Tasmania, Australia) indicate that levels of CO_2, CH_4 and N_2O continued to increase in 2025.

The rate of ocean warming over the past two decades (2005–2025) was more than twice that observed over the period 1960–2005, and the ocean heat content in 2025 was the highest on record. Ocean warming and accelerated loss of ice mass from the ice sheets contributed to a rise in global mean sea level of 4.75 ± 0.3 mm per year between 2012 and 2025. In 2025, global mean sea level was comparable to the record high levels observed in 2024 in the satellite altimetry record. The ocean is a sink for CO_2. Over the past decade, it has absorbed more than one quarter of the annual anthropogenic CO_2 emissions into the atmosphere[5]. CO_2 reacts with seawater, altering its carbonate chemistry and decreasing pH, a process known as "ocean acidification".

Credit: Venti Views

Credit: Photo Beto

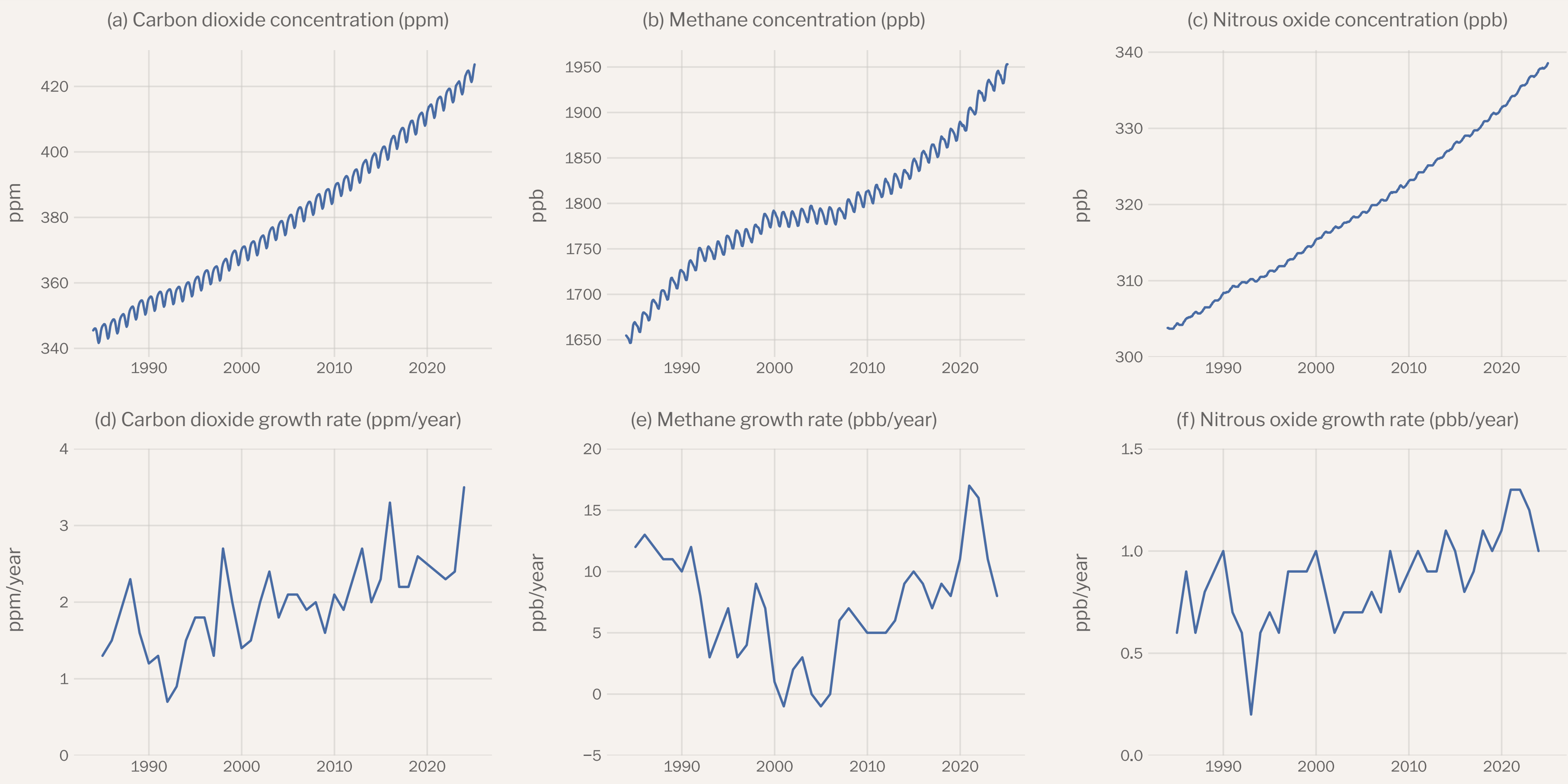


Figure 1. Top row: Monthly globally averaged mole fraction (measure of atmospheric concentration), from 1984 to 2024, of (a) CO_2 in parts per million (ppm), (b) CH_4 in parts per billion (ppb) and (c) N_2O in ppb. Bottom row: Growth rates representing increases in successive annual means of mole fractions for (d) CO_2 in ppm per year, (e) CH_4 in ppb per year and (f) N_2O in ppb per year.

Regional climate

The following sections analyse key indicators of the climate in the South-West Pacific. Some of the indicators are described in terms of anomalies, or departures from a reference period. Where possible, the most recent WMO climatological standard normal, 1991–2020, is used as the reference period, for consistent reporting. Exceptions to the use of this reference period are explicitly noted.

Temperature

Variations in surface temperature have a large impact on natural systems and human beings.

The annual mean surface air temperature averaged over both land and ocean areas in 2025 in the South-West Pacific region ranked as the second highest on record (Figure 2). The mean value for 2025 was 0.37 °C above the 1991–2020 average (0.35 °C–0.41 °C, depending on the dataset used). Relative to the 1961–1990 baseline, the mean value for 2025 was 0.75 °C higher (0.72 °C–0.77 °C, depending on the dataset used).

Temperatures in 2025 were higher than the 1991–2020 average over most of the region, apart from the central tropical Pacific (Figure 3). The most significant warmth was over the western Pacific along with an area extending from central Australia to French Polynesia, with temperatures 0.5 °C to 1.0 °C above the 1991–2020 average. The pattern of warmer-than-average temperatures in the western Pacific and below-average temperatures over the central tropical Pacific is indicative of La Niña conditions.

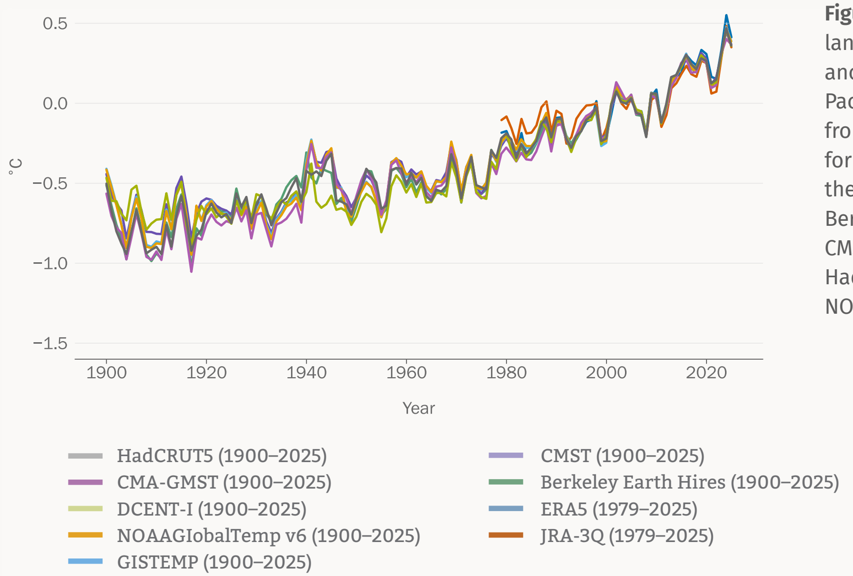


Figure 2. Annual regional mean land and ocean temperature anomaly for the South-West Pacific region (°C, difference from the 1991–2020 average) for 1900–2025. Data are from the following nine data sets: Berkeley Earth, CMA-GMST, CMST, DCENT-I, ERA5, GISTEMP, HadCRUT5, JRA-3Q and NOAAGlobalTemp v6.

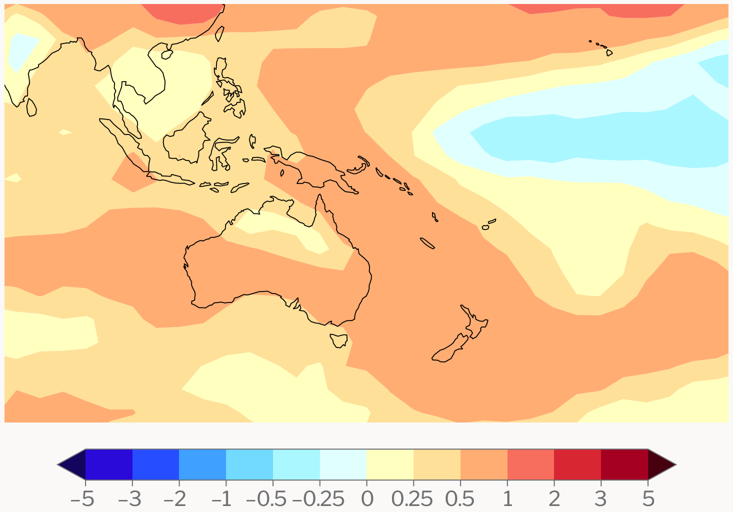


Figure 3. Annual surface air temperature anomalies (°C, difference from the 1991–2020 average) for 2025

Source: Data shown are the median of the following nine datasets: Berkeley Earth, CMA-GMST, CMST, DCENT-I, ERA5, GISTEMP, HadCRUT5, JRA-3Q and NOAAGlobalTemp v6. The boundaries and names shown and the designations used do not imply official endorsement or acceptance by WMO or the United Nations.

Precipitation

Precipitation provides water for drinking, domestic uses, agriculture, industry and hydropower. Precipitation variations also drive droughts and floods.

Precipitation is an essential climate variable, and compared with temperature, it is characterized by high spatiotemporal variability. Its lack causes droughts, while its excess can cause floods and/or high river discharges and soil moistures. Figure 4 illustrates precipitation characteristics for the South-West Pacific region in 2025.

In 2025, rainfall was above the long-term average over most parts of the Maritime Continent, including Indonesia, the Philippines and Malaysia, as is typical during La Niña conditions, with many regions recording precipitation amounts within the wettest 10% of years between 1991 and 2020. This wet area extended east to the Solomon Islands.

Much of the western and central equatorial Pacific was drier than average, which is also typical during La Niña conditions. This included Nauru, Kiribati, Tuvalu and the northern Cook Islands. Dry conditions also prevailed in the northern parts of the Marshall Islands and the Federated States of Micronesia, although rainfall in southern parts of those countries was closer to average.

Elsewhere, for the western and central South Pacific south of 10°S, rainfall was predominately near or above average, with unusually high precipitation in some areas, including Samoa and American Samoa, Tonga, and parts of French Polynesia. Rainfall averages over New Caledonia and parts of Fiji and Vanuatu were close to average.

It was a very dry year in Hawaii, with statewide average rainfall the second lowest in the post-1920 record, more than 30% below the 1991–2020 average. It was the driest year on record for Maui and the second driest for the island of Hawaii.

In Australia, rainfall was significantly above average in large parts of tropical Queensland, as well as on the subtropical east coast between Sydney and Brisbane. Townsville had its wettest year on record (2 950.8 mm, 158% above average).

In contrast, rainfall was below average in many parts of the southern half of Australia away from the east coast, although it was near average in the south-west. Annual rainfall was also well above average in parts of New Zealand, including the central North Island and the northern South Island, although the east coast of the North Island was relatively dry.

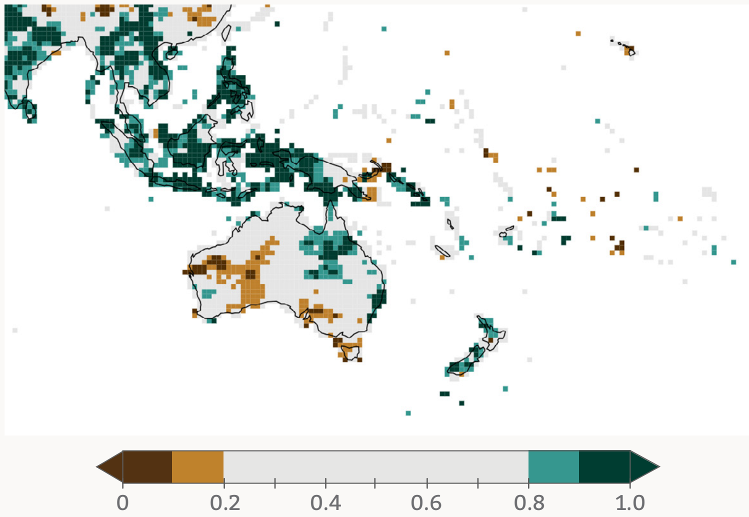


Figure 4. Precipitation quantiles for 2025 relative to the 1991–2020 reference period. Brown areas indicate abnormally low precipitation totals (light brown indicates the lowest 20% of the observed totals, and dark brown indicates the lowest 10%). Green areas indicate unusually high precipitation totals (light green indicates the highest 20% of the observed totals, and dark green indicates the highest 10%).

Source: Third-party map. This map was provided by the Global Precipitation Climatology Centre (GPCC), Deutscher Wetterdienst (DWD), Germany, in March 2026 and may not fully align with United Nations and WMO map guidance.

Cryosphere

Snow cover

Snow cover plays an important role in the feedback mechanisms in the climate system (such as albedo, runoff, soil moisture and vegetation). In the South-West Pacific region, only relatively small areas at higher elevations have regular seasonal snow cover, but these areas are hydrologically important.

In Australia, seasonal snow cover in the south-eastern mountains was above average at higher elevations but below average at lower elevations. The peak seasonal depth at Spencers Creek (at approximately 1 830 m elevation in the New South Wales Snowy Mountains) was 220.4 cm, about 15% above the long-term average and the highest since 2022. Winter precipitation was near average, with higher snow depth at this elevation being associated with temperatures that were slightly lower than in most recent years (although they were still above average) combined with a lack of rain events leading to melting during the season. Outside the alpine areas, an exceptional snow event, associated with an upper-level cold pool on the west side of a low off the east coast, affected areas above 800 m elevation in north-eastern New South Wales on 2–3 August. Falls of 20 to 40 cm were widespread in the Armidale, Walcha and Guyra areas, amongst the heaviest ever recorded there. There were major transport disruptions and significant agricultural losses.

Mountain snowpacks were below long-term average across much of the South Island of New Zealand during winter 2025 with a few notable exceptions. Northern sites were most affected by the lack of snow, with Mahanga electronic weather station (Nelson Lakes) recording only 37% of its long-term mean snowpack and reaching a maximum depth of only 57.8 cm. Snowpack conditions were closer to average at moderate-elevation sites in southern and central areas (Castle Mount/Mt. Larkins/Upper Rakaia), with maximum depths between 66.8 and 145.7 cm. At lower elevations in the south (Murchison Mountains, Albert Burn), mean and maximum snow depths were again below average at around 50% and 70% of long-term average values. At most locations, after generally low snow conditions through most of the winter, maximum snow depths were reached relatively late in September and October.

Credit: Adobe Stock

The deepest snowpack (>344 cm) was recorded at Mueller Hut, a high-elevation site in the Mt. Cook region. This was its second-deepest snowpack on record. Despite this, the site still had a below-average mean snowpack for the year.

Glaciers

Glaciers are limited in the South-West Pacific region, occurring in the mountains of New Zealand and on the highest peaks of the western part of the island of New Guinea.

In Indonesia, Landsat-9 satellite analysis using the Normalized Difference Snow Index (NDSI) method shows that the remaining tropical ice cover in the western part of the island of New Guinea continued to shrink throughout 2025: in July 2025, the estimated ice area was only about 0.10 km^2, a decrease of approximately 34% compared to August 2024 (0.16 km^2); by September 2025, the area had further decreased to only about 0.09 km^2 (9 hectares), representing a total decrease of approximately 44% in a one-year period. This shrinkage is consistent with the long-term trend, with an average ice loss rate of around 0.07 km^2 per year observed between 2016 and 2022, and the ice area remaining in 2025 is estimated to be only about 2% of the ice area observed in 1988, marking the final phase in the existence of tropical glaciers in Indonesia, with the remaining ice expected to disappear by the end of 2026 or early 2027.

New Zealand reported a decrease of 42% in glacier volume for the country between 2005 and 2023, with a 6.5% decrease between April 2022 and March 2023 alone.[6]

Credit: Adobe Stock

Oceans

Sea-surface temperature

Variations in sea-surface temperature (SST) alter the transfer of energy, momentum and gases between the ocean and the atmosphere.

SST is increasing on average in the South-West Pacific region. The average SST for the region was slightly below the record set in 2024 but remains within the range of historically high values observed in recent years (Figure 5). SSTs near or below average occurred in the equatorial central and eastern Pacific, consistent with La Niña conditions, and this contributed to lower average SSTs in 2025. However, regional record SST values in 2025 (Figure 9) were still reported over a broad area of the tropical western North Pacific (extending from east of the Philippines to Hawaii), around Papua New Guinea, in the Indian Ocean area adjacent to the north-western coast of Australia, and in some parts of the Tasman and Coral Seas east of Australia.

Ocean heat content

Ocean warming contributes to sea-level rise and alters ocean currents. It also indirectly alters storm tracks, increases ocean stratification and can lead to changes in marine ecosystems.

Ocean warming averaged over the South-West Pacific region shows a continued increasing trend (Figure 6). Record high ocean heat content was observed for the area south of Australia and in the southern Tasman Sea, as well in some parts of the tropical North Pacific between the Philippines and Hawaii, and locally south of Sumatra (Indonesia) (Figure 9).

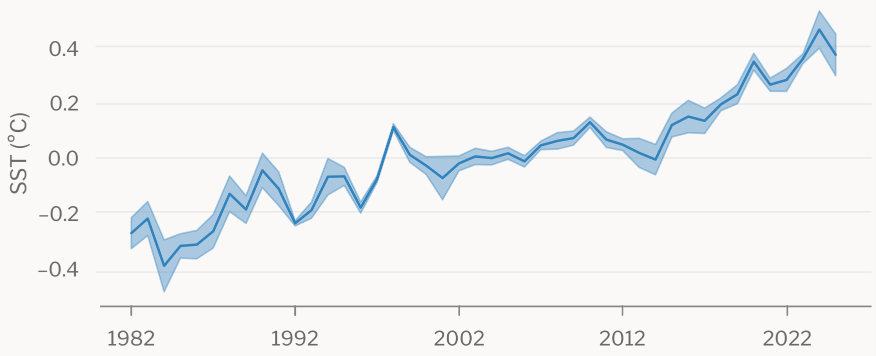


Figure 5. Area-averaged annual mean sea-surface temperature (SST) anomalies (relative to 1991–2020) for the South-West Pacific region from 1982 to 2025, derived from remote sensing observations. Shading indicates uncertainty range.

Source: Copernicus Marine

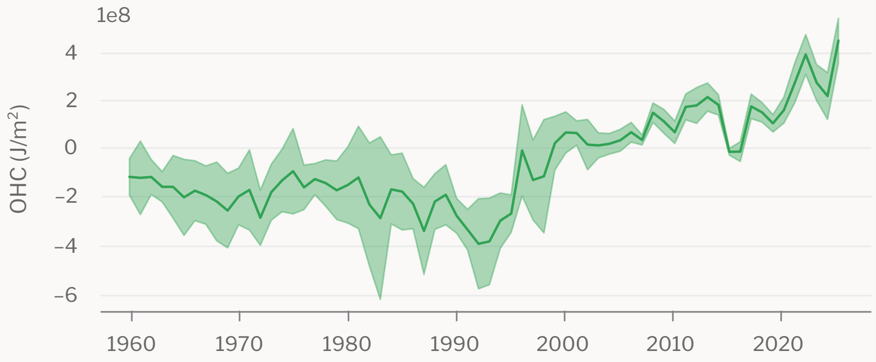


Figure 6. Area-averaged annual mean ocean heat content (OHC) (0–700 m) anomalies (in joules per square metre and relative to 1991–2020) for the South-West Pacific region from 1960 to 2025.

Source: Copernicus Marine

Sea level

Sea level rises in response to ocean warming (via thermal expansion) and the melting of glaciers, ice caps and ice sheets, thereby affecting the lives and livelihoods of coastal communities and low-lying island nations.

Over the period 1999–2025, sea level rose at an average rate of 3.7 ± 0.03 mm per year in the South-West Pacific region (Figure 7). Within the region, an elongated pattern of high rates of sea-level rise has been observed in a region extending from the eastern coast of Australia to about 120°W longitude, encompassing the Coral and Tasman Seas and a large area west of New Zealand. This pattern has remained relatively stable over the entire altimetry era (since the late 1990s). Along the western coast of Australia, the rate of rise (averaged from the coast to 50 km offshore) amounted to 4.0 ± 0.1 mm per year during 1999–2025 (Figure 9).

Ocean acidification

Ocean acidification refers to the shift in the carbonate chemistry towards a less basic state (decrease in pH) and is a consequence of the increasing uptake of CO_2 by the oceans. Ocean acidification, together with ocean warming and deoxygenation, is affecting marine ecosystems, habitats and biodiversity.

Ocean pH averaged over the South-West Pacific region shows a continued decreasing trend at a rate of 0.017 ± 0.005 units per decade (Figure 8). Almost the entire region experienced record low values for ocean pH in 2025 (Figure 9).

Figure 7. Area-averaged annual sea-level anomaly in centimetres relative to a reference ellipsoid (see **www.aviso.altimetry.fr**) for the South-West Pacific region from 1999 to 2025, derived from remote sensing.

Source: Copernicus Marine and the Centre d'études spatiales (CNES)

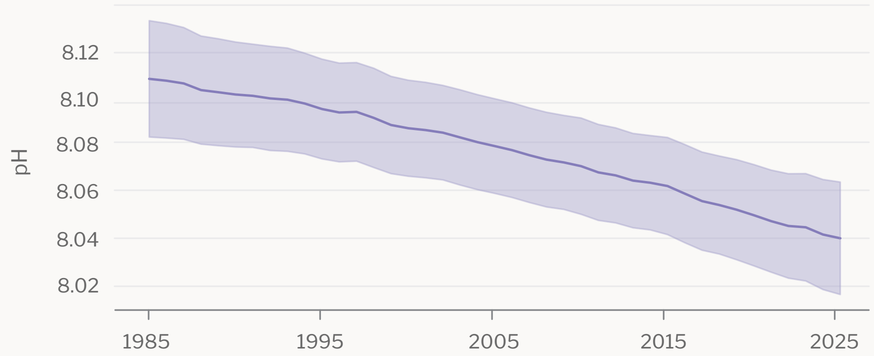


Figure 8. Area-averaged annual mean surface ocean pH for the South-West Pacific region from 1985 to 2025, derived from in situ observations. Shading indicates uncertainty range.

Source: Copernicus Marine

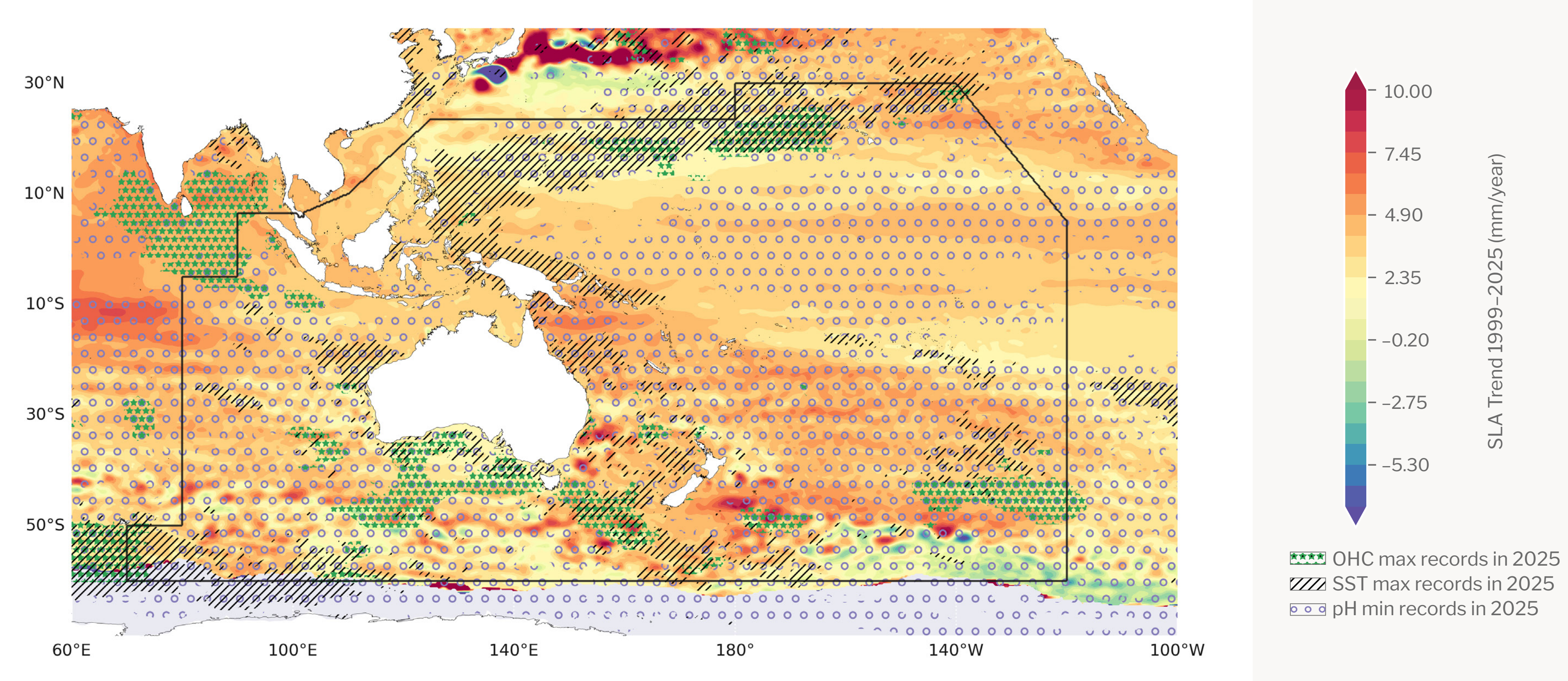


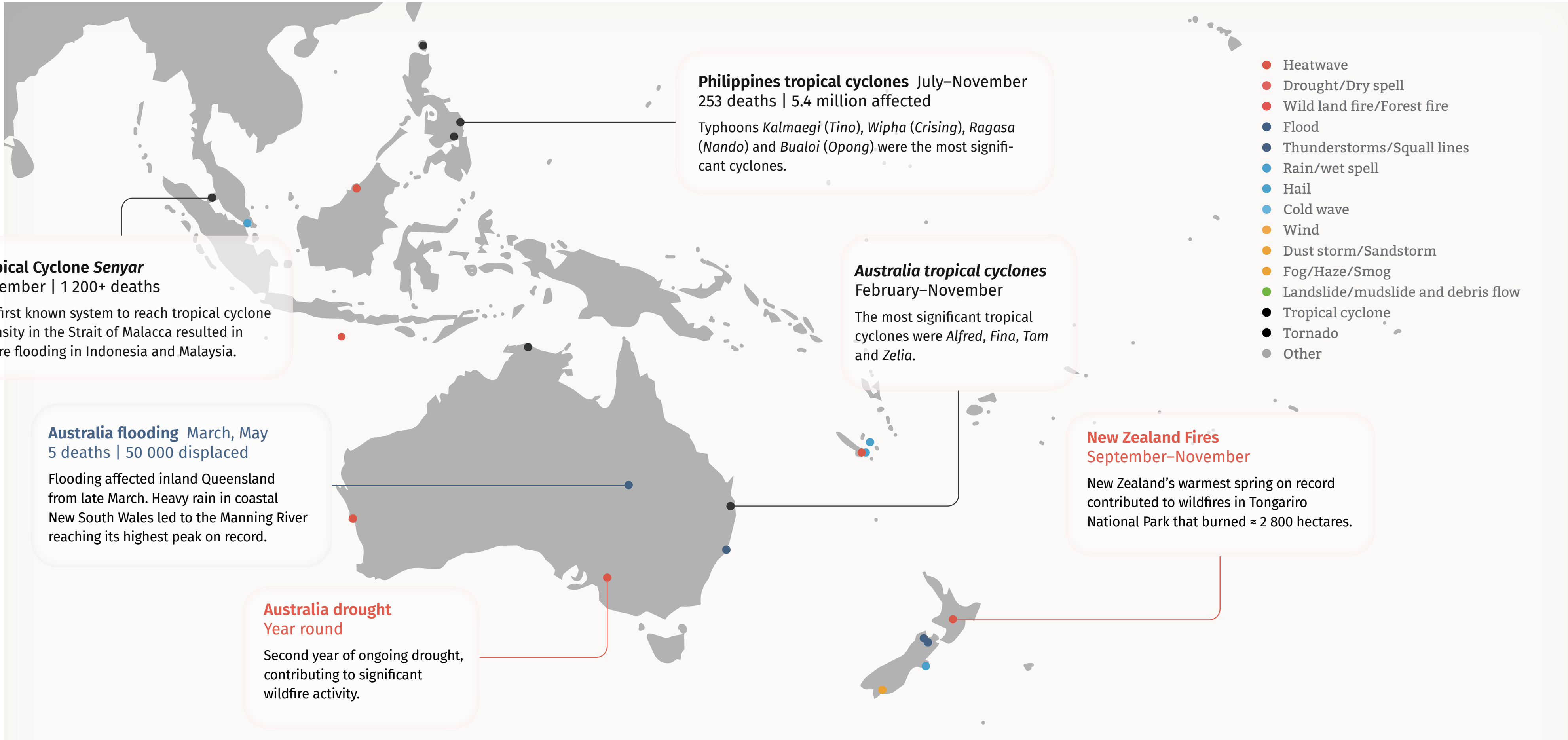
Figure 9. Regional sea level trends over the period 1999–2025 (corrected for glacial isostatic adjustment,[7] units: mm per year), and significant annual maximum values over the observation record for ocean heat content (OHC) (green), sea-surface temperature (SST) (black) and annual minimum ocean pH (purple), indicating where ocean surface and subsurface warming were at record levels in 2025. The light grey shaded areas indicate product limitations and/or limitations from seasonal sea-ice coverage.

Source: Third-party map. This map was provided by Copernicus Marine and CNES in March 2026 and may not fully align with United Nations and WMO map guidance.

Extreme events

Several countries in the South-West Pacific region experienced extreme weather and climate events with fatalities and significant economic losses. Figure 10 highlights selected extreme events reported across the region in 2025. The events shown in the map are illustrative, and additional details are provided in the table.

Figure 10. Examples of extreme weather and climate events reported in the WMO South-West Pacific region in 2025



Note: More details on Member-reported events can be found online on the **interactive dashboard** and in a **PDF supplement**.

Source: Data are from NMHSs. The boundaries and names shown and the designations used do not imply official endorsement or acceptance by WMO or the United Nations.

Table. Selected extreme weather and climate events in the South-West Pacific in 2025

Month	Area	Event
February, April, November	Australia, New Zealand	**Major cyclones** in the Australian region in 2025 included *Zelia*, which made landfall on 14 February as a Category 4[8] system east of Port Hedland and brought significant flooding, and *Fina*, a notable early-season system which made landfall as a Category 3 system on the Cobourg Peninsula, east of Darwin, on 21 November (the earliest landfall on record in Australia), with impacts on the Tiwi Islands and in the Darwin area. In April, following extratropical transition, *Tam* brought heavy rain and flooding to Norfolk Island and parts of northern New Zealand, and damaging surf on the New South Wales coast, contributing to a number of drownings.
March	Australia	The most significant **tropical cyclone** in the Australian region during the year was *Alfred*, which was the first cyclone to make landfall so far south in Queensland since 1974. After peaking in the Coral Sea as a Category 4 system, it moved west towards the southern Queensland coast in early March. It made landfall as a Category 1 system on Moreton Island, just offshore from Brisbane, overnight on 7–8 March and then stalled before moving onto the mainland as a subtropical low on 8 March. Heavy rain fell in many parts of southern Queensland and northern New South Wales. Upper Springbrook had a weekly total of 1 146 mm, while Brisbane had its wettest day since 1974 on 10 March with 275.2 mm. There was widespread main river and flash flooding and extensive coastal erosion, and more than 500 000 properties lost power. Insurance claims exceeded 1.5 billion Australian dollars (AU$) (US$1 billion).[9]
March, May	Australia	**Major flooding** affected areas of inland Queensland from late March as a result of extremely heavy rainfall in normally dry areas of the interior. Sunbury, south of Longreach, received 347 mm on 27 March, close to its annual average, and a weekly total of 602 mm for the week ending 31 March. Record flood levels were observed on the Cooper Creek at Jundah, and the Bulloo River at Thargomindah, and several communities were significantly inundated. The floodwaters made their way slowly downstream over the following months, leading to one of the most significant fillings of Kati Thanda-Lake Eyre in the last 40 years from July onwards, and closing the Birdsville Track for several months, significantly disrupting regional transport. Another significant Australian flood occurred in May, with heavy rain in coastal New South Wales north of Sydney on 19–22 May. The Manning River at Taree reached its highest peak on record. Wingham had 278.8 mm of rain on 20 May, its wettest day on record, and a total of 592.6 mm for the three days 20–22 May. Five deaths were reported and over 50 000 people were displaced.[10]
September–November	New Zealand	New Zealand had its **warmest spring on record**, with temperatures 1.3 °C above the 1991–2020 average. Dry conditions in the central North Island contributed to major wildfires in Tongariro National Park that burned about 2 800 hectares. There were also significant wildfires in the Kaikoura region of the eastern South Island on 21–23 October, associated with severe windstorms which also led to wind damage and extensive power outages in the southern South Island and the Wellington region. A wind gust of 194 km per hour was reported at South West Cape.

November	Indonesia, Malaysia and other South-East Asian countries	**Cyclone** *Senyar*, the first known system to reach tropical cyclone intensity in the Strait of Malacca, resulted in severe flooding in late November. Senyar first made landfall in northern Sumatra on 26 November before recrossing the Strait and making a second landfall over Peninsular Malaysia. The most extreme rainfall was observed in far northern Indonesia, southern Thailand and northern Peninsular Malaysia. In Indonesia the highest daily total was 411 mm on 26 November in the Bireuen Regency. Over 1 200 deaths were reported in Indonesia.[11]
July–November	Philippines	The Philippines, one of the countries most prone to **tropical cyclones**, was severely impacted by several cyclones during the year. The most significant of these was Typhoon *Kalmaegi* (*Tino*), which traversed numerous islands in the central Philippines after making its initial landfall on 4 November. In total 253 deaths were reported in the Philippines, mostly from flooding, and 5.4 million people were affected.[12] Other cyclones to have significant impacts in the Philippines included *Wipha* (*Crising*) in July, and *Ragasa* (*Nando*) and *Bualoi* (*Opong*) in September. *Ragasa* was the season's strongest cyclone to make landfall in the north-west Pacific, reaching a minimum central pressure of 905 hPa and making landfall at near peak intensity on 24 September in the Babuyan Islands in the far north.
All year	Australia	A second year of **drought conditions** affected parts of southern Australia, especially South Australia and southern and western Victoria. While 2025 was generally slightly less dry than 2024 in this region, rainfall was still widely below average, and some areas around Adelaide and south-east of Melbourne had their driest two-year period on record. Tasmania had its second-driest January–August on record before wetter conditions returned from September onwards. The dry conditions contributed to significant wildfire activity[13] during the 2025/2026 summer.

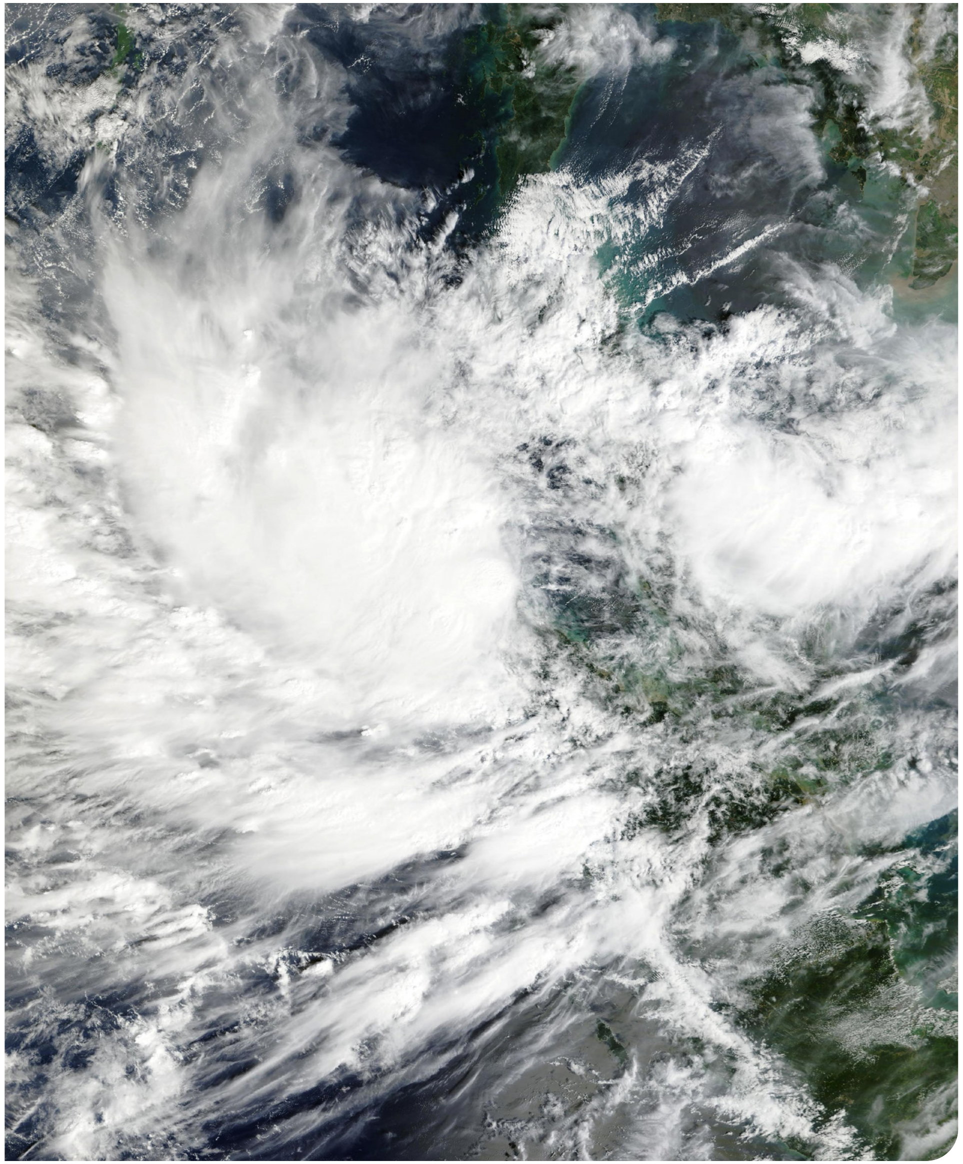
Credit: Pramod Kanakath

Tropical cyclones – Overview

With 12 cyclones in the 2024/2025 season, the full Australian region had its most active season since 2005/2006. Eleven of the 12 cyclones were on the Indian Ocean side of the Australian continent. Two cyclones made landfall on the Australian continent, and a third on near-coastal islands, at cyclone intensity. In contrast, activity in 2024/2025 in the South Pacific was well below average, and it was the first season since 2008/2009 with no severe[14] cyclones east of 160°E.

In the part of the region located in the northern hemisphere, there were 27 tropical cyclones in the western Pacific, slightly above the long-term average of 25.1. Of these, nine made landfall in the Philippines, with several having significant impacts (see the table). Cyclone *Senyar* in the North Indian Ocean also had major impacts in the region. East of the dateline (180° meridian), there were four tropical cyclones, three of which reached hurricane intensity, in the central North Pacific region, although Hurricane *Kiko* was the only one which had any significant impact in Hawaii.

Notable individual tropical cyclones in 2025 are discussed in the table.



Credit: NASA Terra Satellite

Marine heatwaves

Marine heatwaves (MHW) are prolonged periods of extreme heat that affect the ocean and have a range of consequences for marine life and dependent communities.

Parts of the ocean area of the South-West Pacific region were affected by MHWs of strong, severe or extreme intensity during the year 2025. The most significant areas with severe and extreme heatwaves in 2025 were in the Maritime Continent near the coasts of Australia, and in the western South Pacific in the area between New Zealand, New Caledonia and Vanuatu (Figure 11). Overall, MHW coverage in the South-West Pacific region in 2025 was smaller than in previous years, although it was still the most extensive ever recorded in a year without an El Niño event.

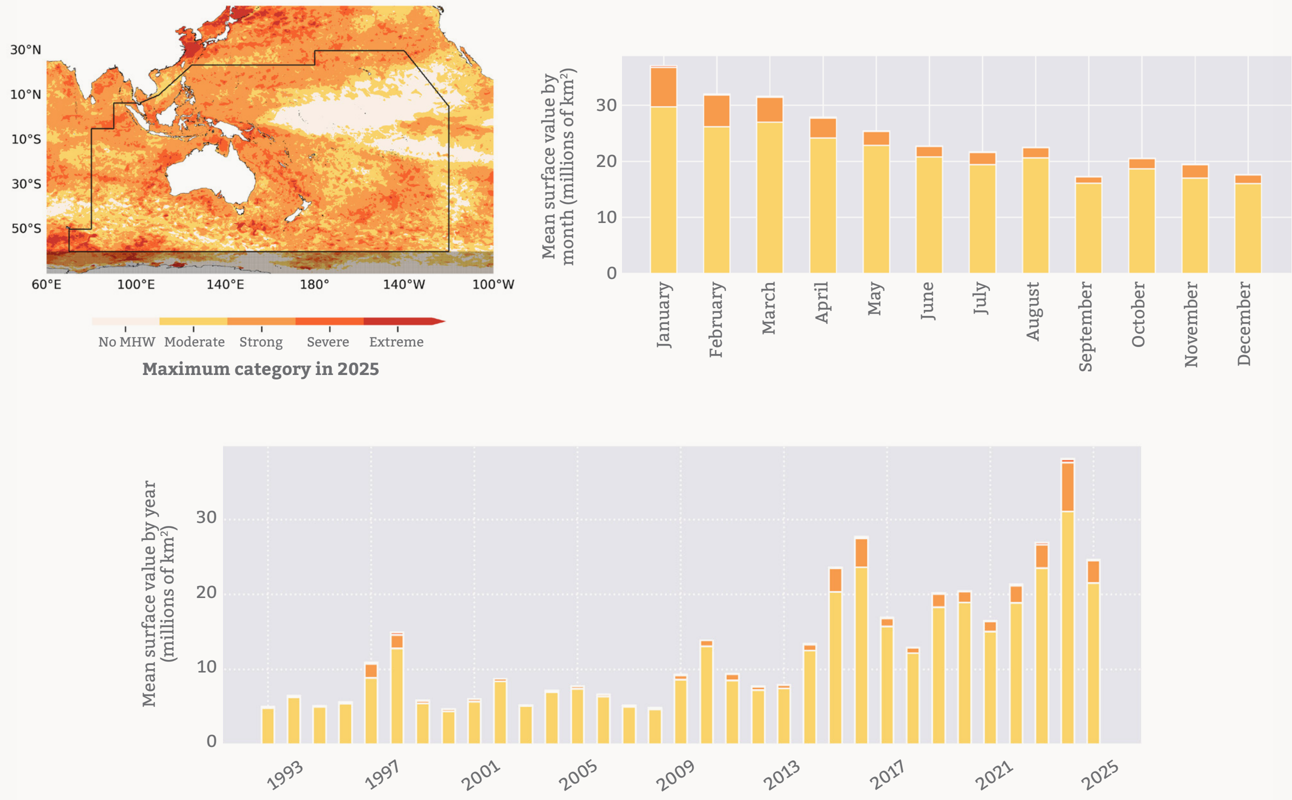


Figure 11. Upper left: Map of annual maximum MHW category in 2025 for the South-West Pacific region (enclosed by the black line on the map), using a Copernicus Marine product. The light shaded areas in the Southern Ocean indicate product limitations and/or limitations related to seasonal sea-ice coverage. Upper right: Monthly mean surface area affected by MHWs during 2025 (upper chart), and annual mean over the entire period from 1993 to 2025 (lower chart). The colours correspond to the categories on the map (left).

Source: Third-party map. This map was provided by Copernicus Marine in March 2026 and may not fully align with United Nations and WMO map guidance.

Major climate drivers

There are many modes of natural variability in the climate system, often referred to as climate patterns or climate modes, which affect weather and climate at timescales ranging from days to months, or even decades.

El Niño–Southern Oscillation

In terms of El Niño–Southern Oscillation (ENSO), back-to-back La Niña events occurred in 2025, both of which were relatively weak compared with the three events in the 2020–2023 period. The tropical Pacific Ocean experienced La Niña conditions at the start of the year, before transitioning to ENSO-neutral conditions in March–May 2025. La Niña conditions began to develop in the second half of the year and became established in September–November 2025. The La Niña conditions contributed to the above-average rainfall over the Maritime Continent and dry conditions over much of the western and central equatorial Pacific, although their impact in other areas with typically strong La Niña-rainfall relationships, such as eastern Australia, was more muted. Despite the La Niña conditions, which normally lead to cooler temperatures in the region, 2025 was still the second-warmest year on record for the South-West Pacific, and the warmest without El Niño conditions present.

Indian Ocean Dipole

The Indian Ocean Dipole (IOD) was generally neutral for the first half of 2025. A negative IOD developed in the second half of the year, peaking in October and November, and returning towards neutral conditions late in 2025. The negative IOD likely contributed to above-average rainfall in the southern Maritime Continent, although in Australia its impact on rainfall was limited compared with recent strong negative IOD events, such as 2016 and 2022.

Madden–Julian Oscillation

The Madden–Julian Oscillation (MJO) has a strong influence on tropical climate within the region. Early in the year, it was generally strong in January and February, but relatively weak for most of the period from March to September except in July. It was then active through much of October and November.

The MJO was centred in the Maritime Continent region in late January and early February. During this period three severe tropical cyclones (*Taliah*, *Vince* and *Zelia*) developed in the Australian region in the space of eight days. Later in the year, the active July phase in the Maritime Continent and Western Pacific sectors coincided with an active period of tropical cyclone formation in the western North Pacific, with seven cyclones forming during July. In late October, an active phase in the Maritime Continent coincided with the formation of Typhoon *Kalmaegi* (*Tino*), which had major impacts in the Philippines (see the table).

Credit: Adobe Stock

Climate-related impacts and risks

Two case studies are presented below, showcasing the impacts and risks associated with selected weather and climate-related events in the South-West Pacific region. Following an introductory overview, the examples highlight impacts on communities, summarize societal response, and conclude with a brief discussion of lessons learned and outlook.

Operational marine heatwave prediction services supporting preparedness in Australia and the South-West Pacific

1. Overview

Sea-surface temperatures (SSTs) averaged over the Australian region in 2025 were the warmest on record, and the summer of 2024/2025 was the warmest in the region since observations began in 1900. During this period, extensive marine heatwave (MHW) conditions affected northern Australia, the west coast, the Great Australian Bight and southern waters. These extreme temperatures contributed to coral bleaching in both the eastern and western reef systems, the first time this has happened in both systems in the same season, highlighting the escalating nature of MHW risk and the need for effective early warning services (Figure 12).

2. Associated impacts

MHWs, defined as periods of sustained extreme ocean temperatures, are an increasing climate hazard in the South-West Pacific. Long-term ocean warming has led to more frequent, longer lasting and more intense events, with serious consequences for marine ecosystems and the communities and industries that depend on them. MHWs have caused widespread coral bleaching, fish kills, major disruptions to aquaculture operations, kelp forest mortality, shifts in species distributions and harmful algal blooms.

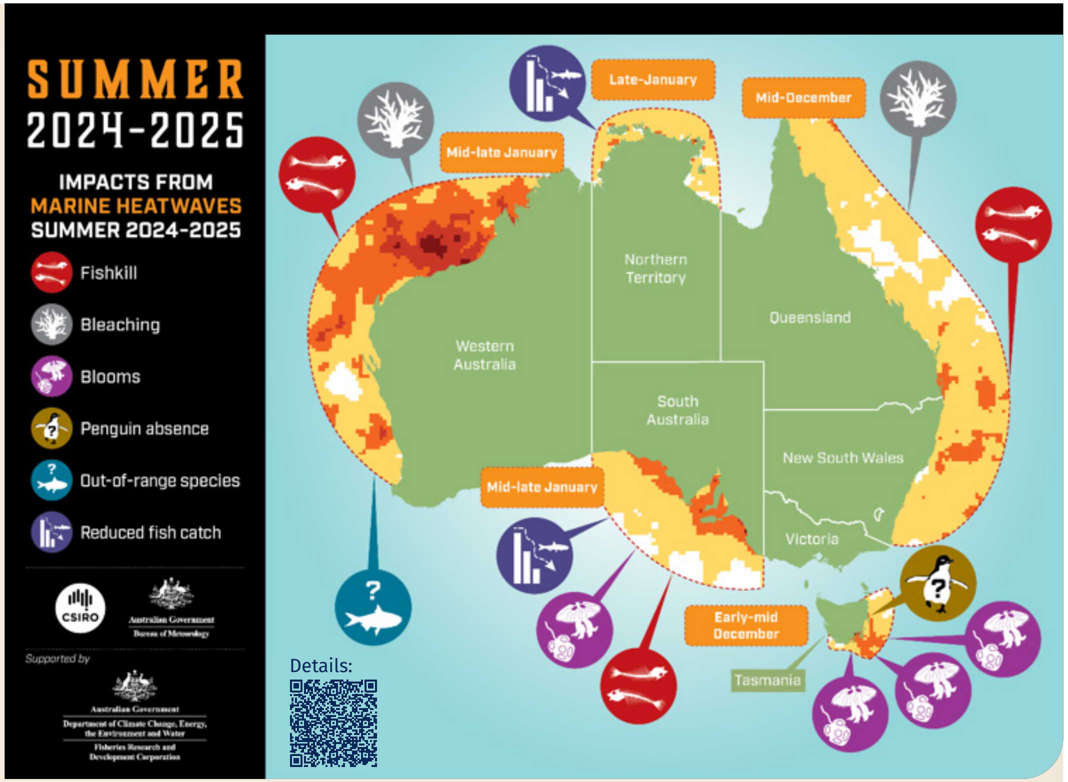


Figure 12. Reported biological impacts around the Australian coast for autumn and summer 2024/2025. The orange boxes indicate the approximate dates during which marine heatwave conditions intensified in each region and impacts were first reported.

Source: Third-party map. This map was taken from Hobday et al. (2026)[15] in March 2026 and may not fully align with United Nations and WMO map guidance.

3. Intervention

Collaborative response: Marine heatwave prediction service

In response to increasing impacts, the Australian Bureau of Meteorology, in partnership with the Commonwealth Scientific and Industrial Research Organisation (CSIRO), developed an operational MHW prediction service (**https://www.bom.gov.au/climate/ocean/long-range-forecasts/**). The service was designed to transition MHW research into an operational climate service to support preparedness and risk-based decision-making for marine sectors.

The prediction system uses SST output from the Bureau's operational seasonal forecast system, ACCESS-S2. MHW conditions are identified using an internationally recognized definition: areas where ocean temperatures exceed the warmest 10% of historical observations for that location and time of year. This approach ensures consistency with global good practice and allows comparison across regions and seasons. The products are publicly accessible and designed to complement existing national climate and ocean services.

Forecast products provide probabilistic information on the likelihood, location and potential severity of MHW conditions up to three to four months ahead, depending on location and season (Figure 13). This represents a significant advance beyond monitoring and short-range outlooks, enabling marine managers to move from reactive responses to proactive risk management.

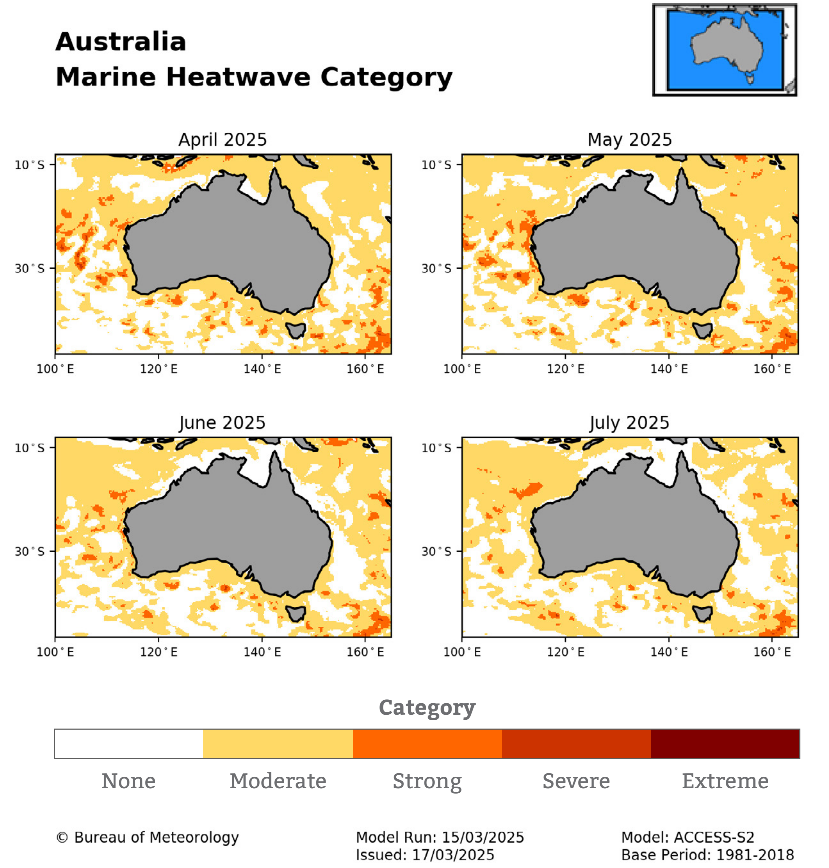


Figure 13. An example of a marine heatwave forecast, issued 15 March 2025 for April–July 2025

Source: Third-party maps. These maps were provided by the Australian Bureau of Meteorology[16] in March 2026 and may not fully align with United Nations and WMO map guidance.

Strengthening cooperation with stakeholders

Stakeholder engagement has been central to development of the service. Forecasts have been trialled and refined through briefings and consultations with users, including fisheries agencies, aquaculture operators, marine scientists and environmental managers. National Marine Climate Briefings hosted by the Fisheries Research and Development Corporation have provided an important platform for gathering feedback and building capability in interpreting MHW forecasts and uncertainty (**https://www.frdc.com.au/climate-change**). This co-development approach has improved the relevance, clarity and usability of forecast products, helping to build user confidence and uptake for operational decision-making.

4. Value and application

MHW forecasts provide critical early warning, giving users weeks to months to prepare for potential impacts. This preparation window supports actions such as adjusting aquaculture operations, advancing or delaying harvests, increasing ecological monitoring, planning aerial or in-water surveys, and briefing decision-makers and stakeholders.

Recent events have demonstrated both the risks associated with MHWs and the importance of timely forecasting information. During the 2024/2025 summer, prolonged extreme ocean temperatures contributed to ecosystem disruption, fish kills and a severe harmful algal bloom in South Australian waters, with major impacts on aquaculture and fisheries. These events highlighted the need for earlier warnings to support preparedness actions such as adjusting harvest schedules, relocating stock and increasing monitoring efforts. Earlier MHWs in 2023/2024 in New South Wales and Tasmania similarly underscored the importance of operational forecasting for protecting vulnerable marine ecosystems and industries.

In response to recent impacts, several Australian states have developed MHW response frameworks, with early warning identified as a critical enabling component. The operational MHW prediction service directly supports these emerging preparedness and response approaches.

5. Lessons learned and future directions

Experience to date highlights the importance of sustained investment in ocean observing systems, robust seasonal prediction capability and clear communication of probabilistic information. Ongoing engagement with users has been essential for building trust, improving ocean literacy related to MHWs, and integrating MHW forecasts into operational decision processes.

Future development will focus on refining impact-relevant indicators and strengthening links with ecological and fisheries information. MHW forecast products will be extended to cover the South-West Pacific and will be provided by the Climate and Oceans Support Program in the Pacific (COSPPac)[17] during 2026. As MHWs continue to intensify under climate change, operational prediction services such as this will play an increasingly important role in supporting marine preparedness and resilience across Australia and the wider South-West Pacific region.

Tropical Cyclone *Senyar* in Indonesia and Malaysia – Accelerated and coordinated action pays off

1. Overview

Tropical Cyclone *Senyar* was an exceptionally rare tropical cyclone that developed in the Strait of Malacca in late November 2025, marking the first recorded cyclone in the area since 1886.

In Indonesia, persistent heavy rains between 22 and 25 November triggered severe floods and landslides in Aceh, West Sumatra and North Sumatra, displacing thousands of people. The most pronounced rainfall totals were documented at Kuala Subdistrict, Bireuen Regency (411 mm); Karang Baru, Aceh Tamiang Regency (397.4 mm); Langsa Baro, Langsa City (382 mm); Pasie Raja, South Aceh Regency (376.6 mm); and Meureudu, Pidie Jaya Regency (376.6 mm).

On 25–26 November, the cyclone made a sharp U-turn and moved eastward towards Peninsular Malaysia, where it made its second landfall before crossing the central part of the peninsula and entering the South China Sea. This brought heavy and persistent rainfall to the region between 26 and 28 November. Prior to landfall, during the early phase of the system between 23 and 25 November, the associated circulation had already affected northern Peninsular Malaysia and parts of the west coast. In Malaysia, the National Disaster Management Agency (NADMA) reported flooding across eight states, namely Kelantan, Perlis, Perak, Selangor, Kedah, Pulau Pinang, Terengganu and Pahang. Daily rainfall records for November were broken at several meteorological stations, including Sitiawan (234.8 mm on 23 November), Subang (124.2 mm on 23 November and 127.6 mm on 27 November), KLIA Sepang (126.6 mm on 27 November) and Kerteh (245.6 mm on 27 November).

Credit: Rahmatdenas

According to the National Oceanic and Atmospheric Administration (NOAA) and the European Centre for Medium-Range Weather Forecasts (ECMWF), as reported by the Global Disaster Alert and Coordination System (GDACS), the cyclone was expected to produce maximum wind speeds of 133 km per hour, a storm surge estimated at 1.5 m in height, and widespread rainfall across Indonesia and Malaysia. Damage in Indonesia was worsened by an earthquake that struck on 27 November.

Cyclone *Senyar* did not intensify into a severe cyclonic storm; its rare nature was associated primarily with its formation in the Strait of Malacca rather than its strength. The event highlights the potential risk of low-frequency, near-equatorial tropical cyclones and underscores the need to strengthen disaster preparedness and the protection of critical infrastructure.

2. Immediate impacts

Note: The numbers below are illustrative and have been provided in order to indicate the severity of impacts. Some of the numbers refer to one country (Indonesia). The latest official numbers can be obtained from the governments of the countries affected.

- **Affected:** More than 10 million people in the region were affected.
- **Casualties:** Over 1 200 deaths were recorded.
- **Infrastructure:** Over 100 000 houses were destroyed, and more than 2 000 roads and over 850 bridges were damaged. Over 4 900 education facilities were affected.
- **Displacement:** Over 1.2 million people in the region were displaced.
- **Public health:** More than 200 health facilities were damaged.
- **Cultural heritage:** Over 800 houses of worship were damaged.

3. Intervention

- **Days before landfall,** Indonesia's Meteorology, Climatology and Geophysics Agency (BMKG) issued warnings regarding the tropical disturbance potentially affecting Aceh, North Sumatra, West Sumatra and Riau.
- **The Malaysian Meteorological Department (MET Malaysia)** issued a series of tropical storm warnings, continuous heavy rain warnings, and strong wind and rough seas warnings before and during the active phase of Tropical Storm *Senyar* and held a media conference on 27 November 2025 to provide official updates to the public and relevant agencies.
- **The WMO RMSC – Tropical Cyclones New Delhi,** hosted by IMD, and the Joint Typhoon Warning Center flagged the system as it developed over the Strait of Malacca.
- **As of 29 November,** three Sumatran provinces in Indonesia had declared their own states of emergency, enabling mobilization of relief assistance.
- **Assistance from Malaysia** was sent in the form of medical supplies to Aceh Province in Indonesia.
- **Free Starlink services** were provided to help restore communications during the emergency.
- **Indonesia's National Disaster Management Agency (BNPB)** received 40 tons of relief supplies, with the process coordinated by the Ministry for Economic Affairs. The aid included food, drinking water and medical equipment to be distributed to affected areas.
- **Government officers and police personnel** were deployed urgently to help affected communities and restore order in the impacted areas.
- **The role of the United Nations was characterized by a "support and coordinate" strategy** because of the robustness of the national disaster management agencies of Indonesia and Malaysia (BNPB and NADMA). Related examples include the mobilization of United Nations Country Teams to provide supplementary food, health supplies, and water, sanitation and hygiene (WASH) infrastructure to reinforce overstretched government stockpiles, and targeted technical support on logistics coordination and information management by the World Food Programme (WFP).

4. Positive outcomes

- **Early warnings were issued well ahead** of the event and contributed to timely evacuations in several areas, reducing potential loss of life.
- **Preparedness actions** such as pre-positioning of relief supplies improved response efficiency.

- **Strong coordination** between national and local agencies and international partners facilitated rapid assistance.
- **Deployment of emergency communication solutions** (such as satellite internet) supported uninterrupted coordination.

5. Lessons learned

— What worked:

- Early warnings, collaboration, and local grants **reduced casualties** and aided rapid relief.

— Challenges:

- **The effectiveness of early warning communication varied across communities,** with gaps in last-mile dissemination affecting some coastal populations and fishers. While warnings contributed to reducing impacts where they were received in time, uneven reach limited their overall effectiveness in certain areas and highlights the need to strengthen the early warning systems.

— Next steps:

- **Further strengthen impact-based forecasting** and improve cross-sector coordination.
- **Further enhance multi-hazard early warning systems** and proactive early action (such as pre-emptive evacuations from known landslide zones, rapid opening of shelters, protection of hospitals and schools, and temporary closure of key roads and ports), all of which can significantly reduce fatalities.
- **Further strengthen anticipatory action and other disaster risk financing mechanisms** that depend on accurate, timely and authoritative forecasts and warnings.

6. Legacy and outlook

Cyclone *Senyar* demonstrated the urgent need to prepare for complex scenarios where cyclonic storms combined with monsoon surges trigger simultaneous floods, landslides and debris flows and may even coincide with geophysical hazards such as earthquakes or tsunamis.

Early warning systems need to ensure that warnings are effectively received, understood and translated into action by communities at risk.

7. References and further reading

- Tsunami and Disaster Mitigation Research Center (TDMRC). *Extreme Rainfall from Tropical Cyclone Senyar Triggers Widespread Flooding and Infrastructure Damage Across Aceh*; TDMRC, 29 November 2025. https://tdmrc.usk.ac.id/2025/11/29/extreme-rainfall-from-tropical-cyclone-senyar-triggers-widespread-flooding-and-infrastructure-damage-across-aceh/.
- Jong, H. N. *After Cyclone* Senyar*, Indonesia Probes Whether Development Amplified Scale of Disaster*; MONGABAY, 6 January 2026. https://news.mongabay.com/2026/01/after-cyclone-senyar-indonesia-probes-whether-development-amplified-scale-of-disaster/.
- National Aeronautics and Space Administration (NASA). Senyar *Swamps Sumatra*; NASA, 5 December 2025. https://science.nasa.gov/earth/earth-observatory/senyar-swamps-sumatra/.
- The Malaysian Reserve. *Death Toll from Floods, Landslides in Indonesia Rises to 811*; 3 December 2025. https://themalaysianreserve.com/2025/12/03/death-toll-from-floods-landslides-in-indonesia-rises-to-811/.
- Sharma, M. What Made Cyclone Senyar a Once-in-a-Century Weather Anomaly in Malacca Strait. *India Today*, https://www.indiatoday.in/science/story/cyclone-senyar-malacca-strait-rare-135-years-november-2025-imd-india-weather-2829342-2025-12-02.
- Reliefweb. *Asia and the Pacific: Southeast and South Asia Cyclones and Floods Humanitarian Snapshot (Covering 17 November to 3 December 2025)*; Reliefweb, 2025. https://reliefweb.int/report/sri-lanka/asia-and-pacific-southeast-and-south-asia-cyclones-and-floods-humanitarian-snapshot-covering-17-november-3-december-2025.
- ASEAN Food Security Information System (AFSIS). *A Rare Tropical Cyclone* Senyar; AFSIS, 2025. https://aptfsis.org/uploads/normal/Disaster%20news%202025/17%20TC%20senyar/Tropical%20cyclone%20Senyar.pdf.
- Buakamsri, T. *Cyclone* Senyar *Shows the Equator Is No Longer a Safe Zone – Southeast Asia's Risk Maps Are Already Out of Date*; Climate Connectors, 1 December 2025. https://climate-connectors.org/cyclone-senyar-shows-the-equator-is-no-longer-a-safe-zone-southeast-asias-risk-maps-are-already-out-of-date/.

Datasets and methods

A description of the data and methods used for this report can be accessed here:
https://wmo.int/files/regional-state-of-climate-2025-datasets-and-methods.

Credit: Adobe Stock

Contributors

Contributing experts

Thea Turkington (co-lead author, Meteorological Service Singapore (MSS), Singapore), Blair Trewin (co-lead author, Bureau of Meteorology (BOM), Australia), Nurizana Amir Aziz (Malaysian Meteorological Department (METMalaysia)), Anny Cazenave (Laboratoire d'Etudes en Géophysique et Océanographie Spatiales (LEGOS), Leila Salarpour Goodarzi (United Nations Economic and Social Commission for Asia and the Pacific (ESCAP)), Flora Gues (Mercator Ocean International (Mercator Ocean)), Peer Hechler (WMO), Sarah Holmes (WMO), Ahmad Fairudz Jamaluddin (METMalaysia), Catherine Jones (Food and Agriculture Organization of the United Nations (FAO)), John Kennedy (WMO), Byungjun Kim (WMO), Lancelot Leclercq (LEGOS), Jochen Luther (WMO), Sharifah Faridah Syed Mahbar (METMalaysia), Clare Nullis (WMO), Claire Ransom (WMO), Damien Riquet (FAO), Karina von Schuckmann (Mercator Ocean), Claire Spillman (BOM, Australia), Parvathy Subha (ESCAP), Jothi Ganesh Shanmuga Sundaram (World Food Programme (WFP)), Markus Ziese (Deutscher Wetterdienst (DWD), Germany)

Expert Team on Monitoring and Communication of Climate Variability and Change (reviewers)

Jessica Blunden (United States of America), Renata Libonati (Brazil), Awatif Ebrahim Mostafa (Egypt), Serhat Sensoy (Türkiye), Blair Trewin (Australia), Freja Vamborg (European Centre for Medium-Range Weather Forecasts (ECMWF)), Ken Yamada (Japan), Markus Ziese (Germany)

Note: This Expert Team falls under the Commission for Weather, Climate, Hydrological, Marine, and Related Environmental Services and Applications (SERCOM) Standing Committee on Climate Services.

Contributing organizations

DWD, ESCAP, FAO, LEGOS, Mercator Ocean, WFP, WMO

Contributing WMO Members

Australia, Brunei Darussalam, Indonesia, Malaysia, New Caledonia, New Zealand, Philippines, Singapore

Endnotes

1. Data are from the following datasets: Berkeley Earth, CMA-GMST, CMST v3, DCENT-I, ERA5, GISTEMP v4, HadCRUT.5.1.0.0, JRA-3Q and NOAAGlobalTemp v6.
2. *WMO Greenhouse Gas Bulletin: The State of Greenhouse Gases in the Atmosphere Based on Global Observations through 2024, No. 21*; 16 October 2025.
3. http://www.esrl.noaa.gov/gmd/ccgg/trends/mlo.html
4. https://www.csiro.au/greenhouse-gases/
5. Friedlingstein, P.; O'Sullivan, M.; Jones, M. W. et al. Global Carbon Budget 2025. *Earth System Science Data* **2025** [preprint]. https://doi.org/10.5194/essd-2025-659.
6. https://www.stats.govt.nz/news/new-zealands-glacier-volume-down-42-percent-since-2005/
7. Richard Peltier, W.; Argus, D. F.; Drummond, R. Comment on "An Assessment of the ICE-6G_C (VM5a) Glacial Isostatic Adjustment Model" by Purcell et Al. *Journal of Geophysical Research (Solid Earth)* **2018**, *123*, 2019–2028. https://doi.org/10.1002/2016JB013844.
8. Australian tropical cyclone categories.
9. Insurance Council of Australia.
10. Natural Hazards Research Australia, https://www.naturalhazards.com.au/sites/default/files/2025-08/NSW%20Mid%20North%20Coast%20flood%20impact%20and%20resilience%20research_RiskFrontiers_FINAL.pdf
11. BNPB flood and landslide emergency dashboard, https://gis.bnpb.go.id/BANSORSUMATERA2025/
12. National Disaster Risk Reduction and Management Council, https://ndrrmc.gov.ph/wp-content/uploads/2025/11/Situational_Report_No._30_for_the_Effects_of_Tropical_Cyclone_TINO_2025.pdf.
13. To be covered in more detail in the *State of the Climate in the South-West Pacific 2026* report.
14. Category 3 or higher on the Australian scale.
15. https://www.bom.gov.au/government-and-industry/government-sectors/indo-pacific-development/climate-and-oceans-support-program-in-the-pacific
16. https://www.bom.gov.au/climate/ocean/long-range-forecasts/
17. https://doi.org/10.5670/oceanog.2026.e105

For more information please visit:
wmo.int/resources/publications

WORLD
METEOROLOGICAL
ORGANIZATION

JN26312