

Monthly Climate Bulletin

February 2023



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Photo Credit: Molly Powers (SPC) Samoa Tide Gauge



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- La Niña has weakened in the tropical Pacific Ocean and is likely near its end.
- The Madden-Julian Oscillation (MJO) moved slowly in and around the Western Pacific in the past week, as the result of interaction with an Equatorial Rossby Wave.
- The Intertropical Convergence Zone (ITCZ) was more active in the eastern Pacific around 150° W, while the South Pacific Convergence Zone (SPCZ) displaced southwest over Solomon Islands, Vanuatu, Fiji and Tonga, indicating the La Niña event.
- Sea surface temperatures (SST) in February 2023 were cooler than average across much of the tropical Pacific Ocean, extending from around 165°E in a broadening wedge to the South American coastline.
- The Coral bleaching status for 03 March 2023 shows 'Alert Level 2' extending southeastward from southeast PNG, southern Solomon Islands, western Vanuatu, southeast Fiji and Tonga.
- For March-May 2023, the models unanimously agree on above normal rainfall for Palau, Guam, CNMI, most of FSM, RMI, the southeast of PNG's EEZ, most of Solomon Islands, New Caledonia, Vanuatu, much of Fiji, most of Tonga, Niue, and southern French Polynesia. The models are also unanimous in showing that below normal rainfall is likely or very likely for southern parts of central and eastern Kiribati, most of Tuvalu, Tokelau, Wallis and Futuna, American Samoa, northern Cook Islands and northern French Polynesia.
- The ACCESS-S weekly tropical cyclone forecast model shows a significantly increased risk between 15 and 21 March around the eastern Australia, Coral Sea Region, Vanuatu and New Caledonia. For the northwest Pacific, there is significantly increased risk for the Philippines, Palau and western FSM area between 15 and 28 March.



EL NIÑO–SOUTHERN OSCILLATION

La Niña likely near its end

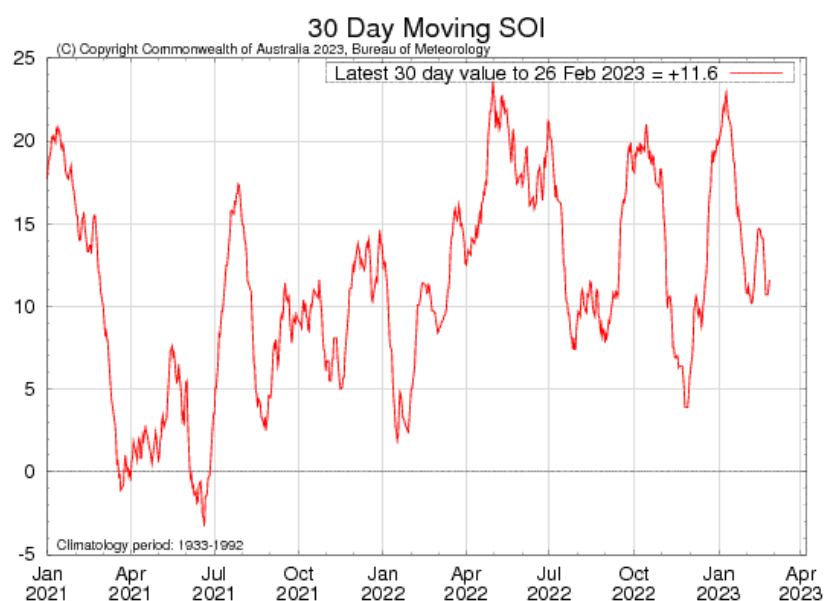
Click link to access [Climate Driver Update issued on 28 February 2023](#)

La Niña has weakened in the tropical Pacific Ocean and is likely near its end. Ocean indicators of La Niña have returned to neutral levels, while atmospheric indicators that remain at La Niña levels have started to weaken.

All but one of the surveyed international climate models suggest sea surface temperatures in the tropical Pacific (including NINO3.4) will remain neutral (neither El Niño nor La Niña) through autumn; one model is neutral in March and April but touches on El Niño thresholds in May. ENSO outlooks extending beyond autumn should be viewed with caution as models typically have lower forecast accuracy at this time of year.

The Southern Annular Mode (SAM) index is currently positive, but is expected to return to neutral values over the coming weeks.

The 30-day Southern Oscillation Index (SOI) for the 30 days ending 26 February 2023 was +11.6 while the 90-day SOI value was +14.6. The 30-day SOI has decreased slightly over the last past week to two weeks.



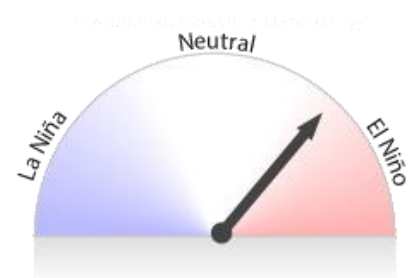
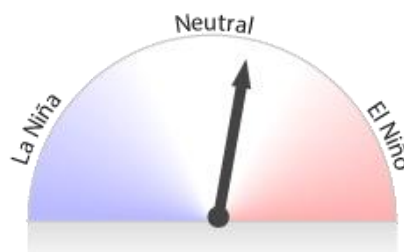
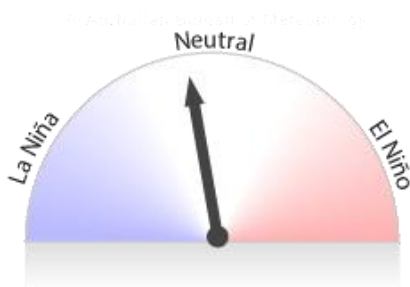


EL NIÑO–SOUTHERN OSCILLATION

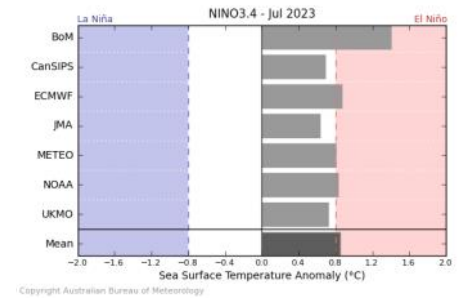
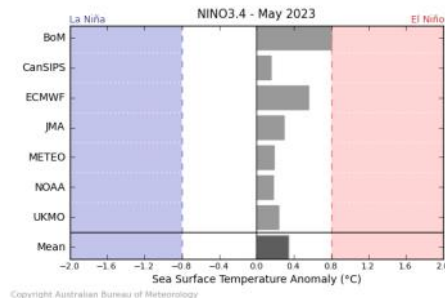
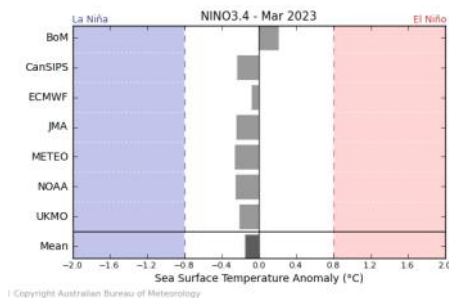
La Niña likely near its end

Click link to access [Climate Driver Update issued on 28 February](#)

Bureau of Meteorology NINO3.4 ENSO Model Outlooks for March, May and July



Bureau of Meteorology NINO3.4 International Model Outlooks



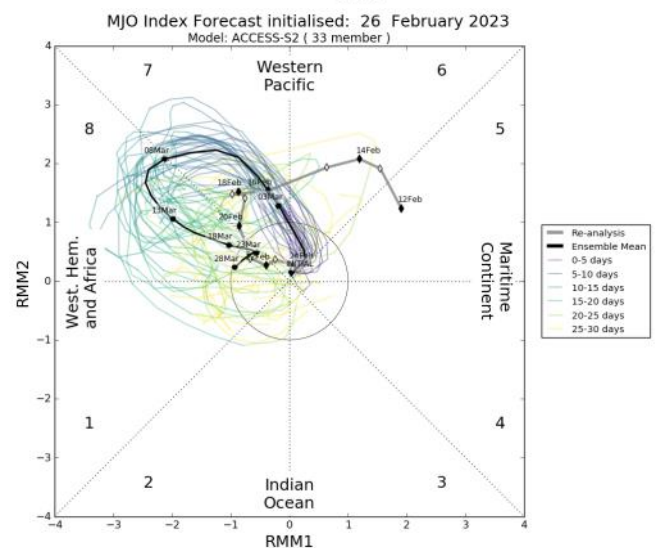
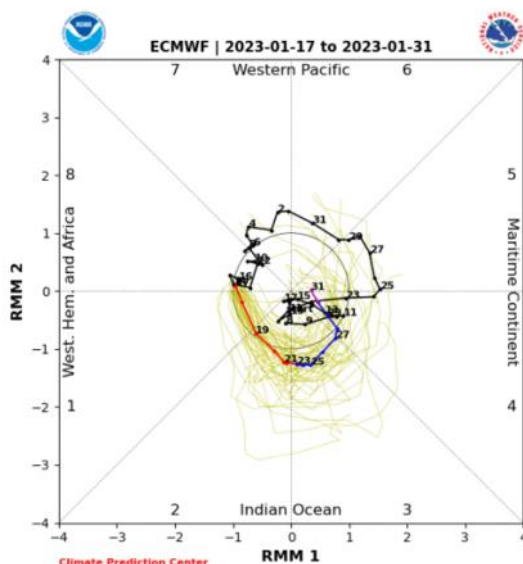
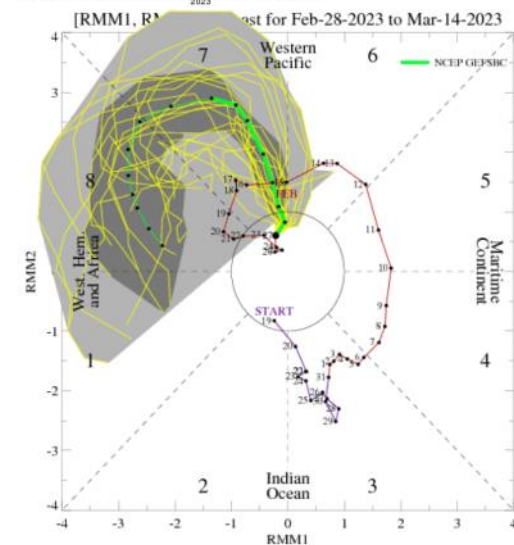
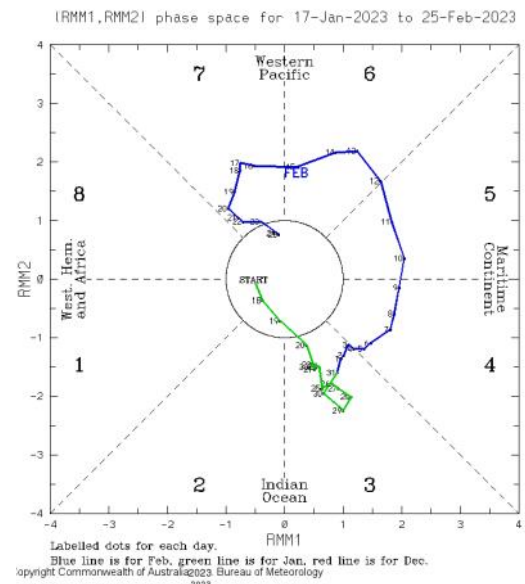
MADDEN–JULIAN OSCILLATION

Click link to access [Tropical Climate Update](#) [Issued on Wednesday 28 February 2023]

A strong pulse of the Madden-Julian Oscillation (MJO) propagated over the Maritime continent and Western Pacific during February. It has shown signs of weakening in recent days in the western Pacific.

The Madden-Julian Oscillation (MJO) moved slowly in and around the western Pacific in the past week, as the result of interaction with an Equatorial Rossby Wave. Models indicate the weak MJO pulse is expected to re-intensify in the western Pacific as a moderately strong MJO at the start of March, then move across the western Pacific to the central and eastern Pacific over the next fortnight.

This is an abbreviated version of the Tropical Climate Update. Click on the *Weekly Tropical Update* for more information .



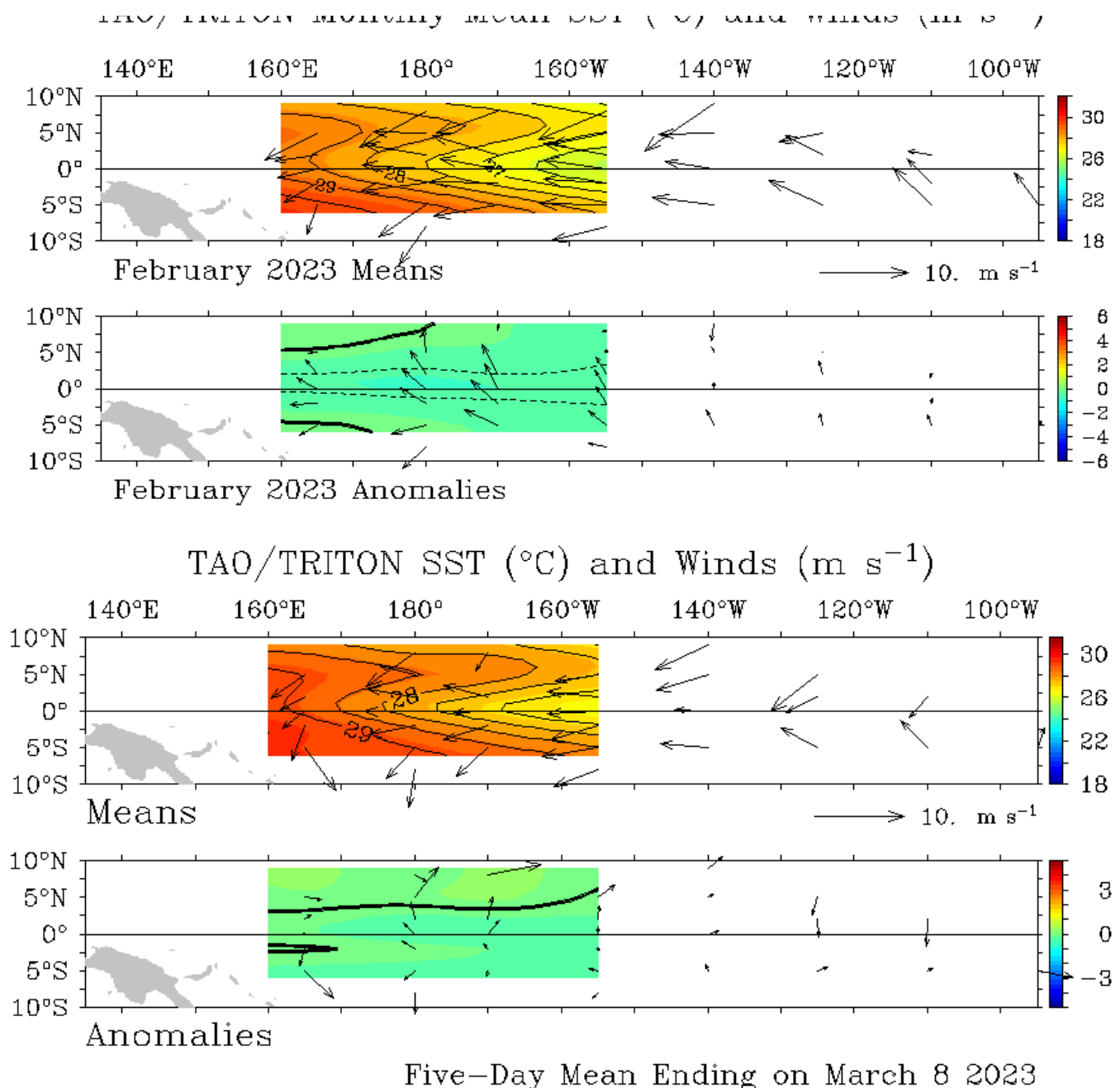
WIND



Click link to access [Wind plots link](#)

For the five days ending 08 March 2023, there were westerlies winds in the central and eastern equatorial Pacific. The trade winds were weaker than normal in western and central longitudes of the near-equatorial Pacific. The trade winds were stronger than normal in the western and central equatorial Pacific in February, but weak in the eastern Pacific showing signs of weakening La Niña.

During La Niña events, there is a sustained strengthening of the trade winds across much of the tropical Pacific, while during El Niño events there is a sustained weakening, or even reversal, of the trade winds.



CLOUD AND RAINFALL

Click link to access [OLR](#)



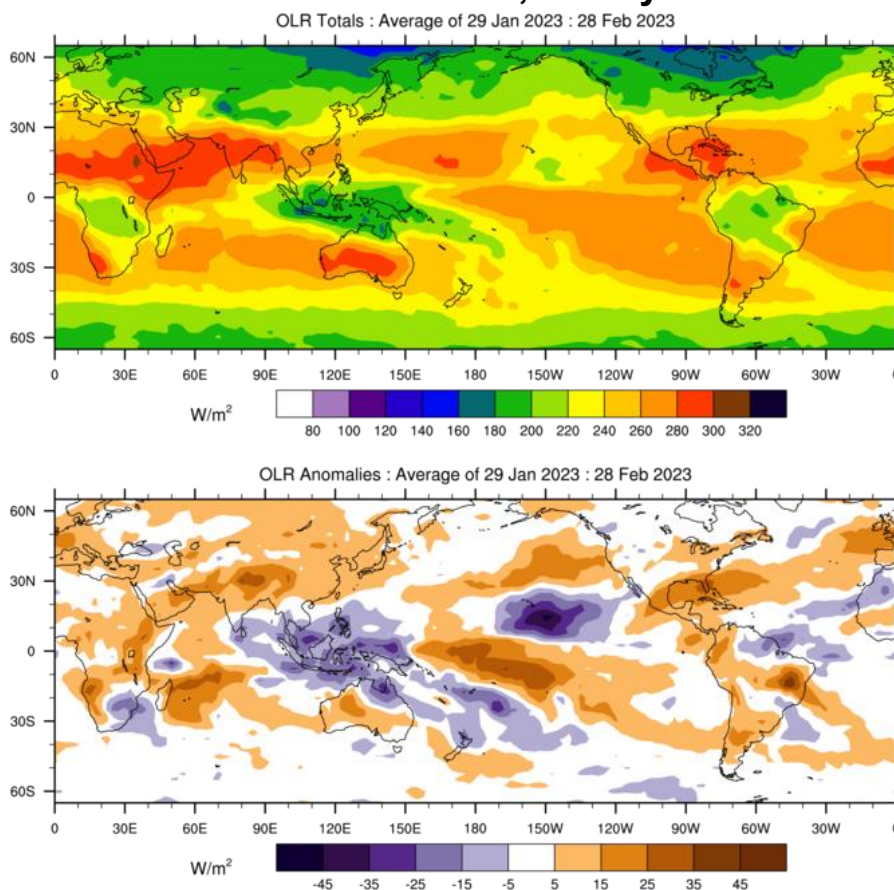
The main feature of the February 31-day (including 3 days of January) OLR total and anomaly maps was the prominent feature of the SPCZ displaced to the southwest over the Solomon Islands, Vanuatu, Fiji and Tonga, as is common La Niña events. The centre of low OLR (increased convection) was situated over Indonesia. The ITCZ was more active in the eastern Pacific around 150°W

In contrast, the centre of high OLR (reduced convection) was centred on the equator near and west of the Date Line, with one main extension reaching east-southeast across the Pacific Basin, indicated reduced cloudiness in the normal location of the SPCZ.

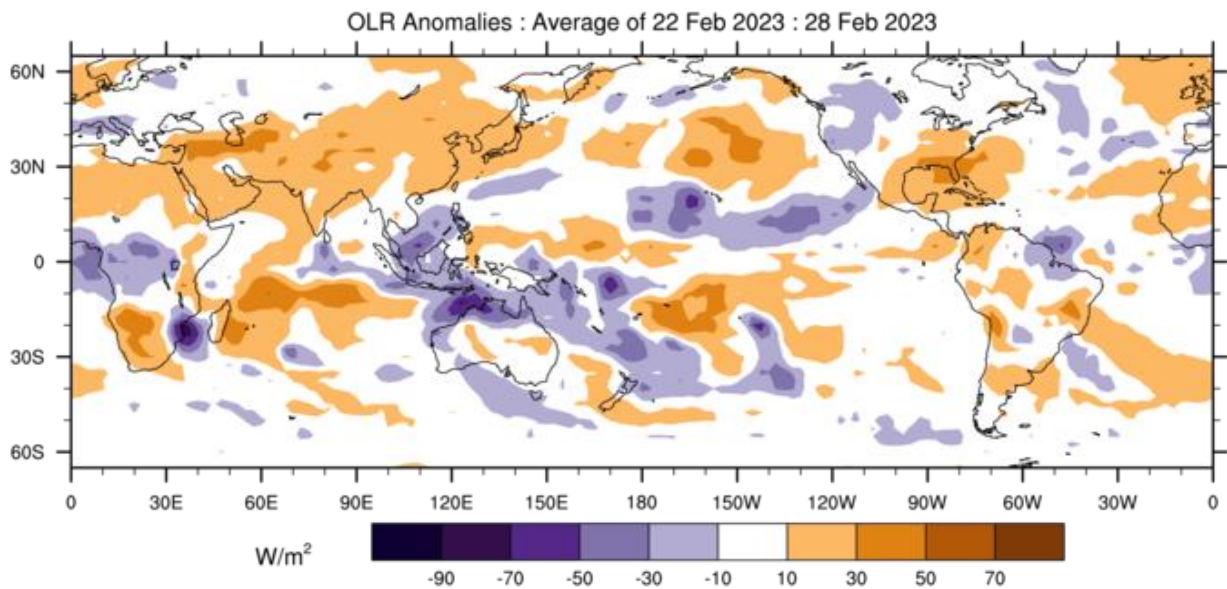
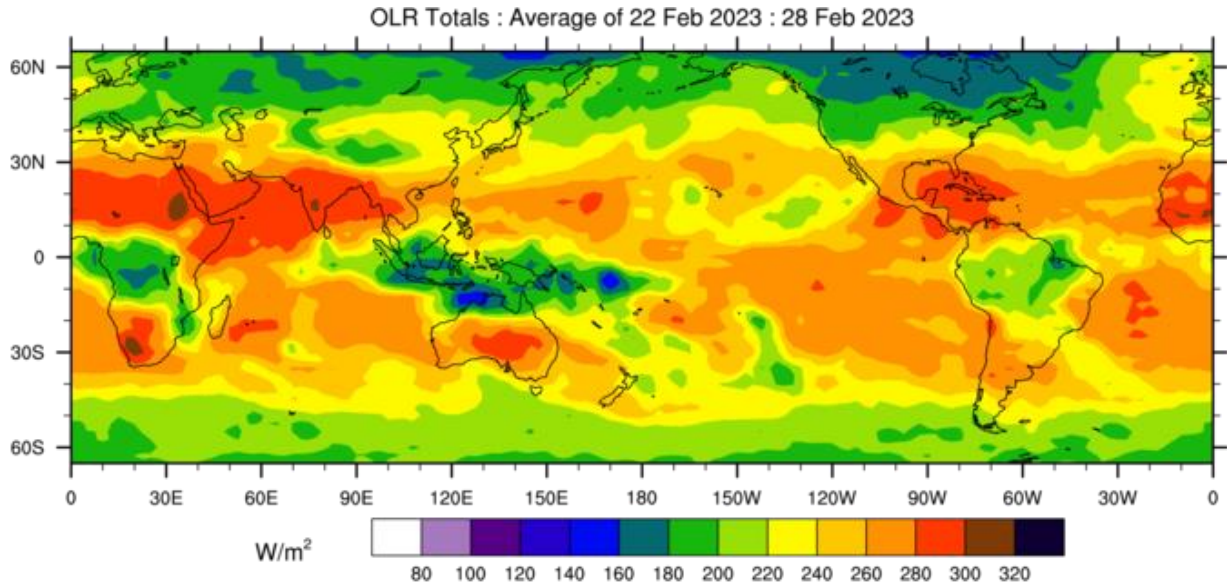
The weekly OLR to 28 February showed active convection over the Maritime Continent, with an extension to the east of the Solomon Islands.

Note: Global maps of OLR below highlight regions experiencing increased or decreased cloudiness. The top panel is the total OLR in Watts per square metre (W/m^2) and the bottom panel is the anomaly (current minus the 1979-1998 climate average), in W/m^2 . In the bottom panel, negative values (blue shading) represent above normal cloudiness while positive values (brown shading) represent below normal cloudiness.

OLR Total and Anomalies, 30 Day OLR

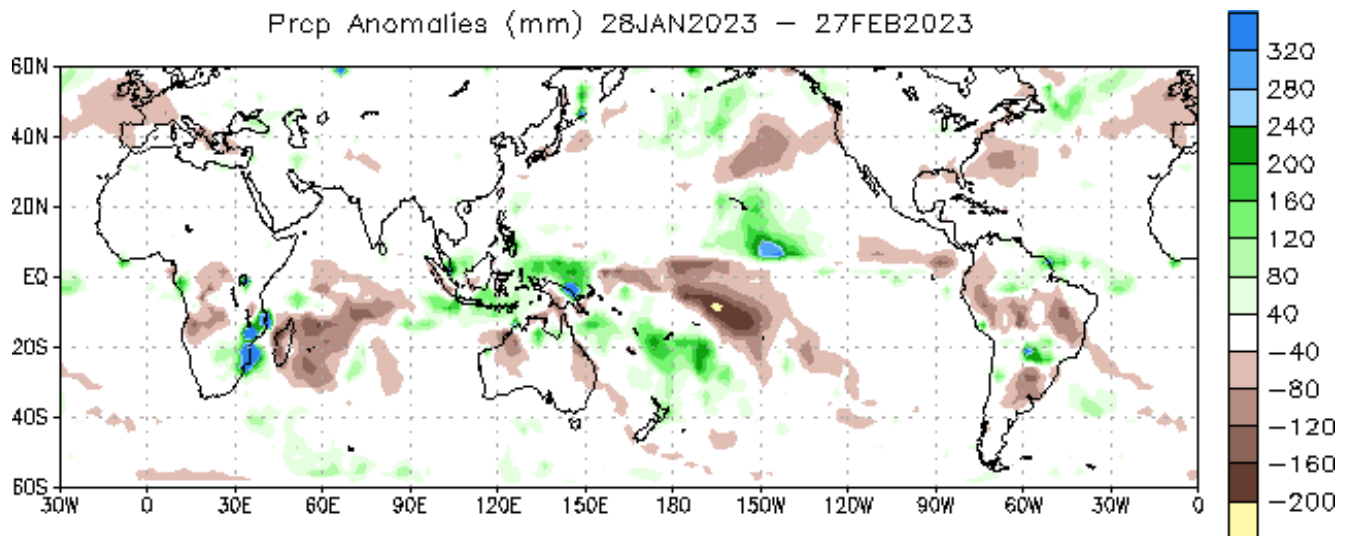


OLR Total and Anomalies, 7 Day OLR



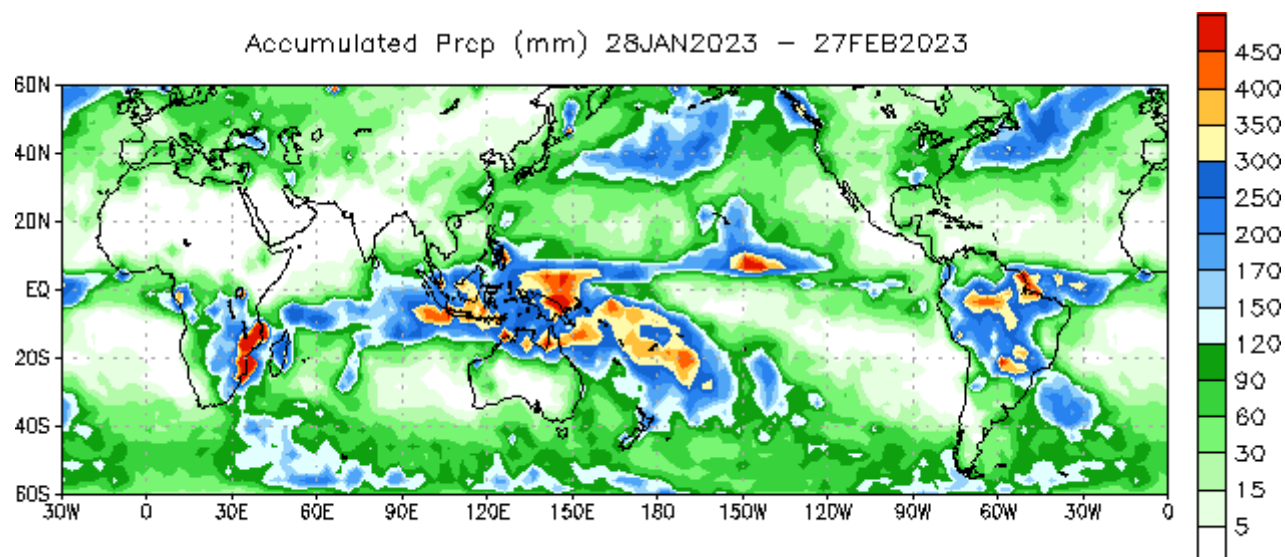
(C) Copyright Commonwealth of Australia 2023. Bureau of Meteorology

Prcp Anomalies (mm) 28JAN2023 – 27FEB2023

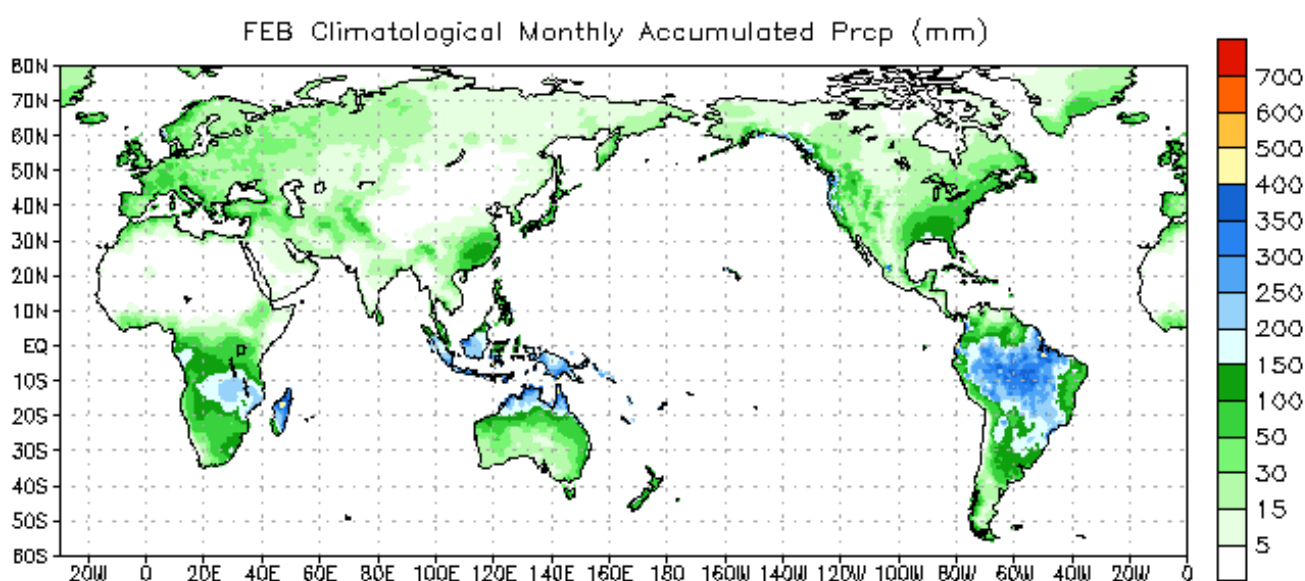


Data Source: NCEP CMAP Precipitation
Climatology (1991–2020)

30-Day Rainfall Accumulated



Data Source: NCEP CMAP Precipitation



Data Source: CPC Unified (gauge-based) Precipitation
Climatology (1979–1995)

NOAA Climate Prediction Centre - NCEP CMAP precipitation:

https://www.cpc.ncep.noaa.gov/products/Global_Monsoons/Global-Monsoon.shtml

OCEAN CONDITIONS

SEA SURFACE TEMPERATURE

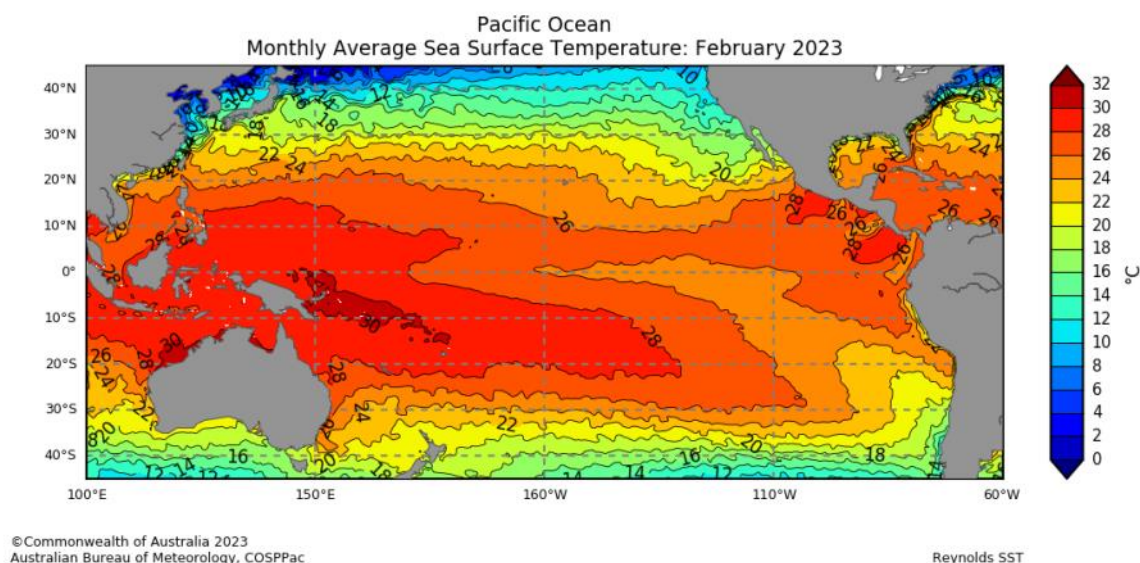


Click link to access [Pacific Community COSPPac Ocean Portal](#)

Sea surface temperatures (SST) in February 2023 were cooler than average across much of the tropical Pacific Ocean, extending from around 165°E in a broadening wedge to the South American coastline. Negative anomalies ranging from -0.5°C to -1.0°C were observed in Kiribati. A boomerang-shape of warm anomalies surrounded the cool anomalies in both hemispheres and more along the north American coast. Peak positive anomalies upmost +1.5°C in a region extending from New Caledonia to southern Tonga. Cool anomalies in the eastern Pacific were a little weaker than those in January. The overall pattern was typical of a weakening La Niña.

Record-high February SSTs occurred in northern FSM, patches in eastern Marshall Islands, patches in PNG, Solomon Islands, southern Vanuatu, patches in eastern Fiji and Tonga. The record-high SSTs were surrounded by large areas with SSTs in decile 10 (very much above average) and above average (8-9). In contrast, SSTs below average (2-3) and very much below average (decile 1) for January were observed in Nauru, northern Tuvalu, Kiribati, and the far northern Tokelau and northern Cook Islands.

Mean Sea Surface Temperature

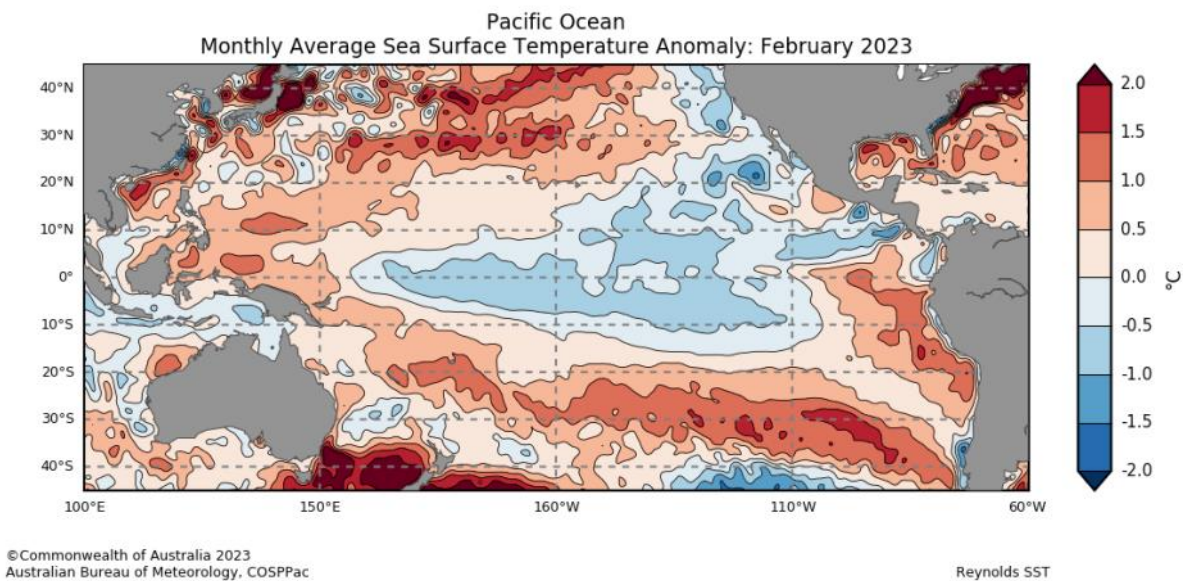


OCEAN CONDITIONS

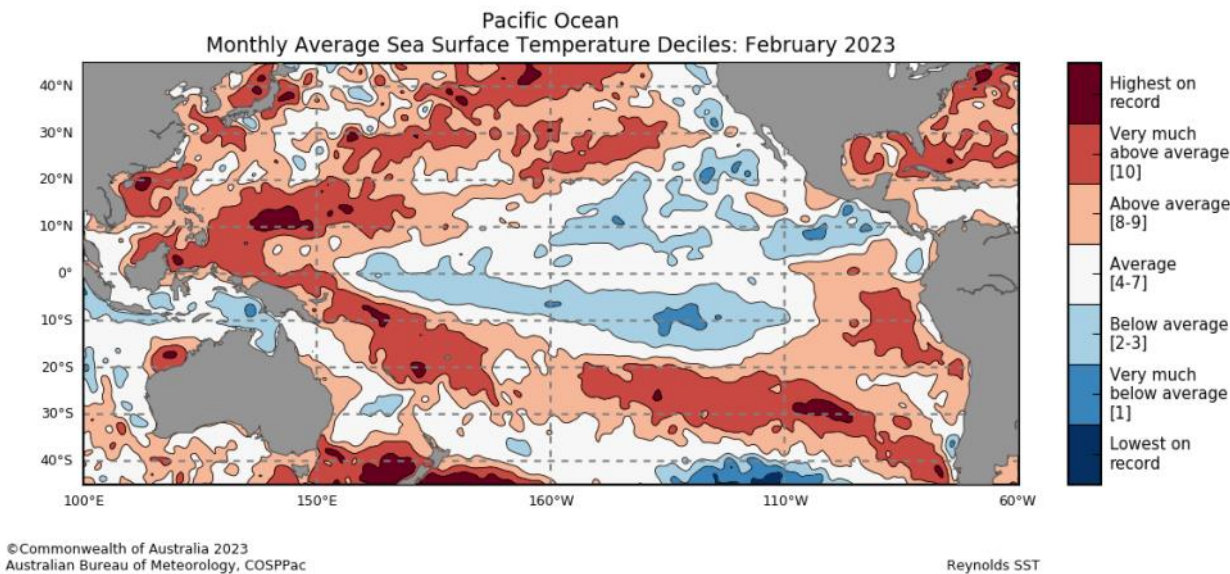
Click link to access [→ SEA SURFACE TEMPERATURE](#)



Anomalous Sea Surface Temperature



Sea Surface Temperatures Deciles



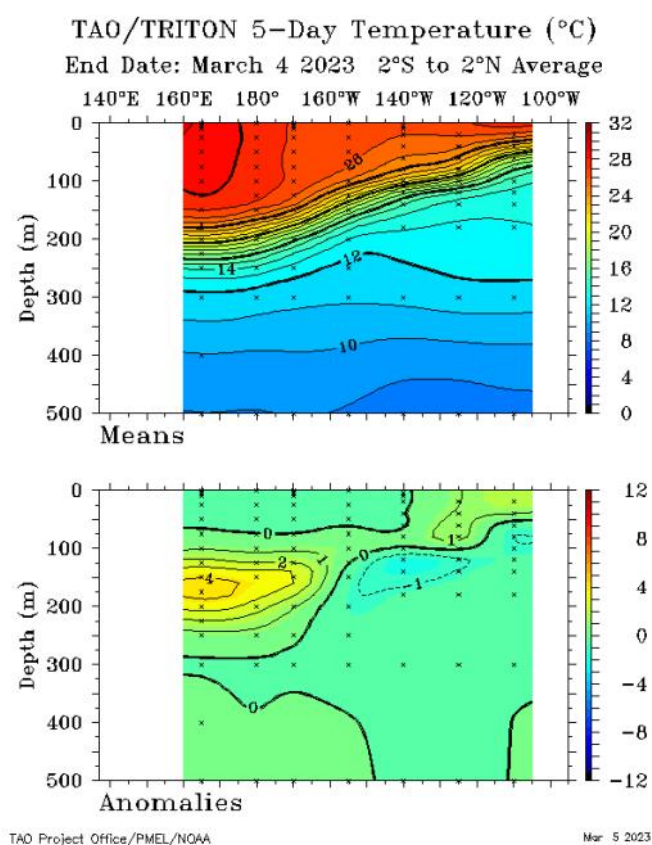
OCEAN CONDITIONS

SUB SURFACE

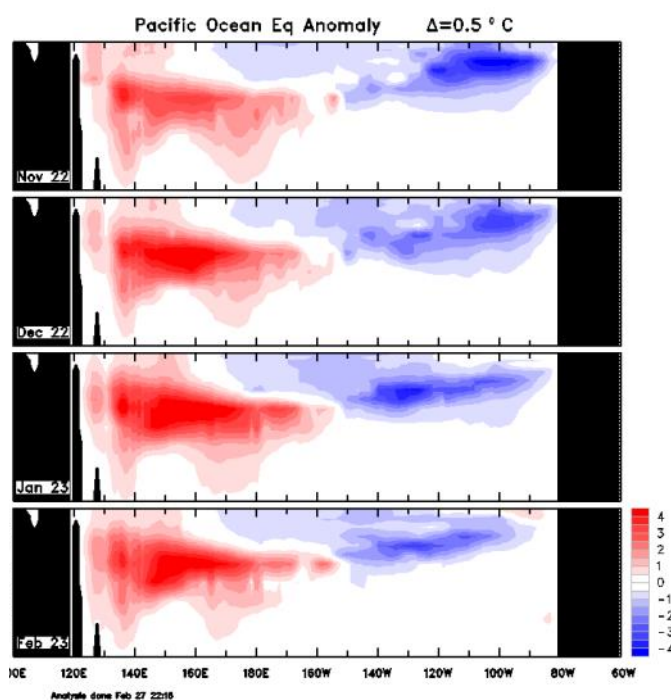


The four-month sequence of equatorial Pacific sub-surface temperature anomalies (to 23 February 2023) shows weak cool anomalies across the top 150 m of the central to eastern equatorial Pacific. Warm anomalies are in place between around 50 and 300 m depth in the western to central equatorial Pacific (west of 160°W). Anomalies reached more than 3°C warmer than average across much of this region. Compared to previous months, cool anomalies have decreased month-on-month during summer, while warm anomalies have remained fairly consistent during February when compared to those for January.

Weekly Temperatures Mean and Anomalies



Monthly Temperatures Anomalies



Bureau of Meteorology Sea Temperature Analysis: <http://www.bom.gov.au/marine/sst.shtml>

TAO/TRITON Data Display: <http://www.pmel.noaa.gov/tao/jsdisplay/>

OCEAN CONDITIONS

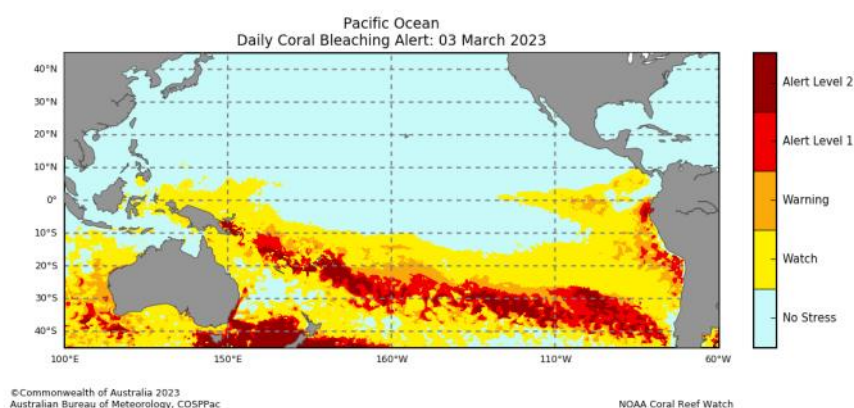
CORAL BLEACHING



The daily Coral Bleaching Alert status for 03 March 2023 shows 'Alert Level 2' extending southeastward from southeast PNG, southern Solomon Islands, western Vanuatu, southeast Fiji and Tonga. 'Alert Level 1' were observed around central Solomon Islands, eastern New Caledonia, Vanuatu, most of Fiji and far southern Niue and southern Cook Islands. Patches of 'Warning' are shown in northern Solomon Islands and southeastwards to southern French Polynesia. The four-week Coral Bleaching outlook to 26 March shows a broad area of Warning to 'Alert Level 2' ratings coinciding with the peak positive SST anomalies extending southeast from southeastern PNG, southern Solomon Islands, Vanuatu, Fiji, Tonga, southern Niue, southern Cook Islands and southern French Polynesia.

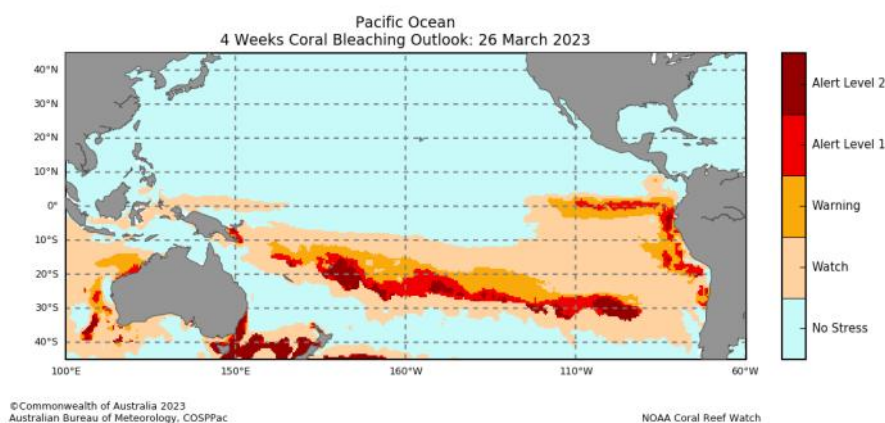
Daily Coral Bleaching Alert

(Source: [Pacific Community COSPPac Ocean Portal Coral Bleaching](#))



4 Weeks Coral Bleaching Outlook

(Source: [Pacific Community COSPPac Ocean Portal](#))



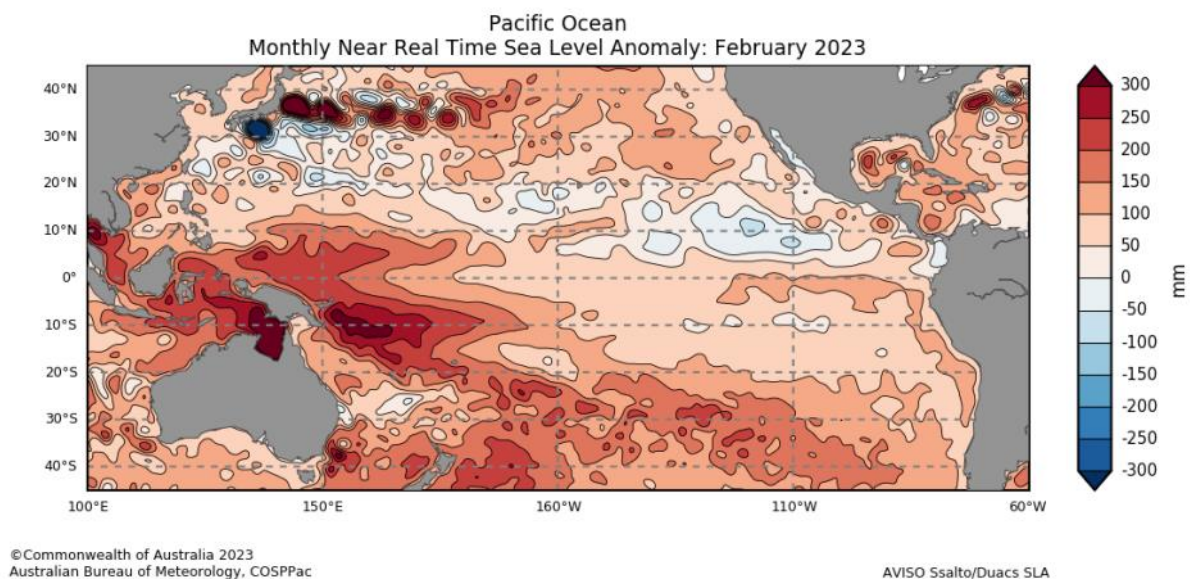
OCEAN CONDITIONS

OCEAN SURFACE CURRENTS AND SEA LEVEL

Apart from northern RMI, patches in Palau, far northern Line Islands of Kiribati, and the central Cook Islands where sea level was close to normal, February sea level was above normal over COSPPac countries. Anomalies above +300 mm were observed in eastern PNG and southern Solomon Islands. Anomalies of +200 mm were observed in FSM, southern Palau, PNG, Solomon Islands, Vanuatu, eastern New Caledonia, and in patches of Fiji, Tonga, Niue, Tuvalu, southern Cook Islands and southern French Polynesia. Sea level was generally 100 mm to 250 mm above average elsewhere.

Monthly Sea Level Anomalies

Source: [Pacific Community COSPPac Ocean Portal](#)

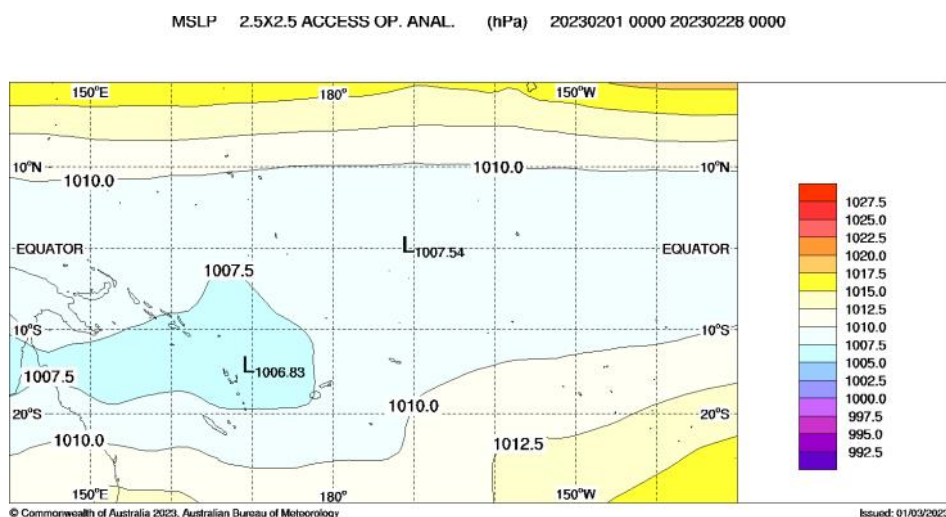


MEAN SEA LEVEL PRESSURE

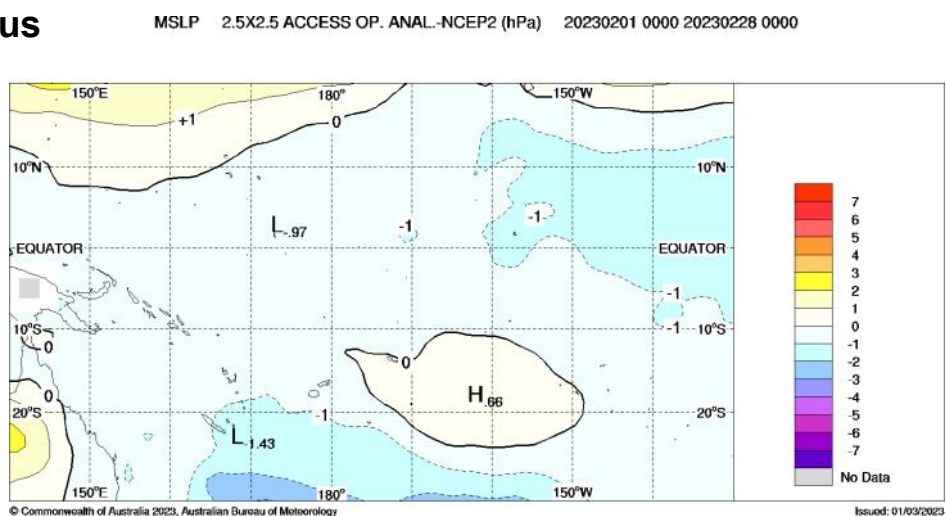
The February mean sea level pressure (MSLP) anomaly map shows mostly negative anomalies of 1hPa or greater over southern Vanuatu, New Caledonia and towards New Zealand, as well as east of the Date Line. Positive anomalies of 1hPa or greater were analysed over Australia and the CNMI and Guam.

Areas of above (below) average MSLP usually coincide with areas of suppressed (enhanced) convection and rain throughout the month.

Mean



Anomalous



Bureau of Meteorology South Pacific Circulation Patterns: <http://www.bom.gov.au/cgi-bin/climate/cmb.cgi?variable=mslp&area=spac&map=anomaly&time=latest>

SEASONAL RAINFALL OUTLOOK

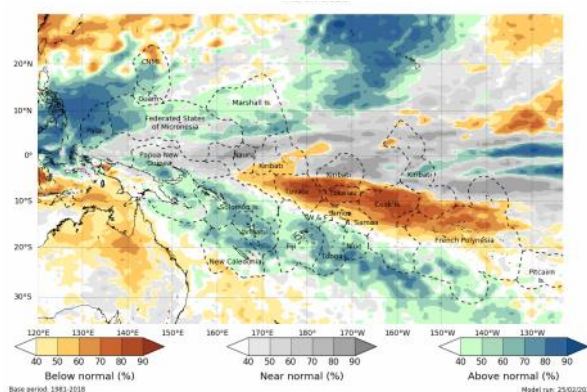
March—May 2023



The ACCESS-S model forecast for March 2023, favours below normal rainfall for the far northern CNMI, the southern halves of western, central and eastern Kiribati, Tuvalu, Tokelau, northern Wallis and Futuna, Samoa, American Samoa, northern and central Cook Islands, and northern and central French Polynesia. Above normal rainfall is likely or very likely for Palau, most of CNMI, Guam, most of FSM, most of RMI, the southeast of PNG's EEZ and PNG islands, Solomon Islands, New Caledonia, Vanuatu, Fiji, Tonga, Niue, southern Cook Islands and southern French Polynesia.

The three-month rainfall outlook (March-May 2023) is very similar to the March outlook as it favours below normal rainfall for northern CNMI, southern parts of central and eastern Kiribati, Tuvalu, Tokelau, Wallis and Futuna, American Samoa, northern Cook Islands, central and northern French Polynesia, and northern Pitcairn Island. Above normal rainfall is likely or very likely for Palau, Guam, western CNMI, much of FSM, southern RMI, the southeast and northwest of PNG's EEZ, most of Solomon Islands, New Caledonia, Vanuatu, Fiji, Tonga, Niue, southern Cook Islands, and southern French Polynesia.

Monthly [ACCESS-S](#) Maps



The Copernicus multi-model outlook for March-May 2023 is similar to the ACCESS-S model, with below normal rainfall for northern Solomon Islands, southern parts of central and eastern Kiribati, central and southern Tuvalu, Tokelau, Wallis and Futuna, Samoa, American Samoa, northern Cook Islands, central and northern French Polynesia. Above normal rainfall is likely or very likely for Palau, most of FSM, central RMI, the southeast PNG's mainland and EEZ, central and eastern Solomon Islands, New Caledonia, Vanuatu, most of Fiji, Tonga, Niue, and southern French Polynesia.

The APEC Climate Centre multi-model for March-May 2023 is also very similar to the ACCESS-S model. The main differences are an increased wet signal for CNMI, Guam, PNG mainland and drier signal for western Kiribati.

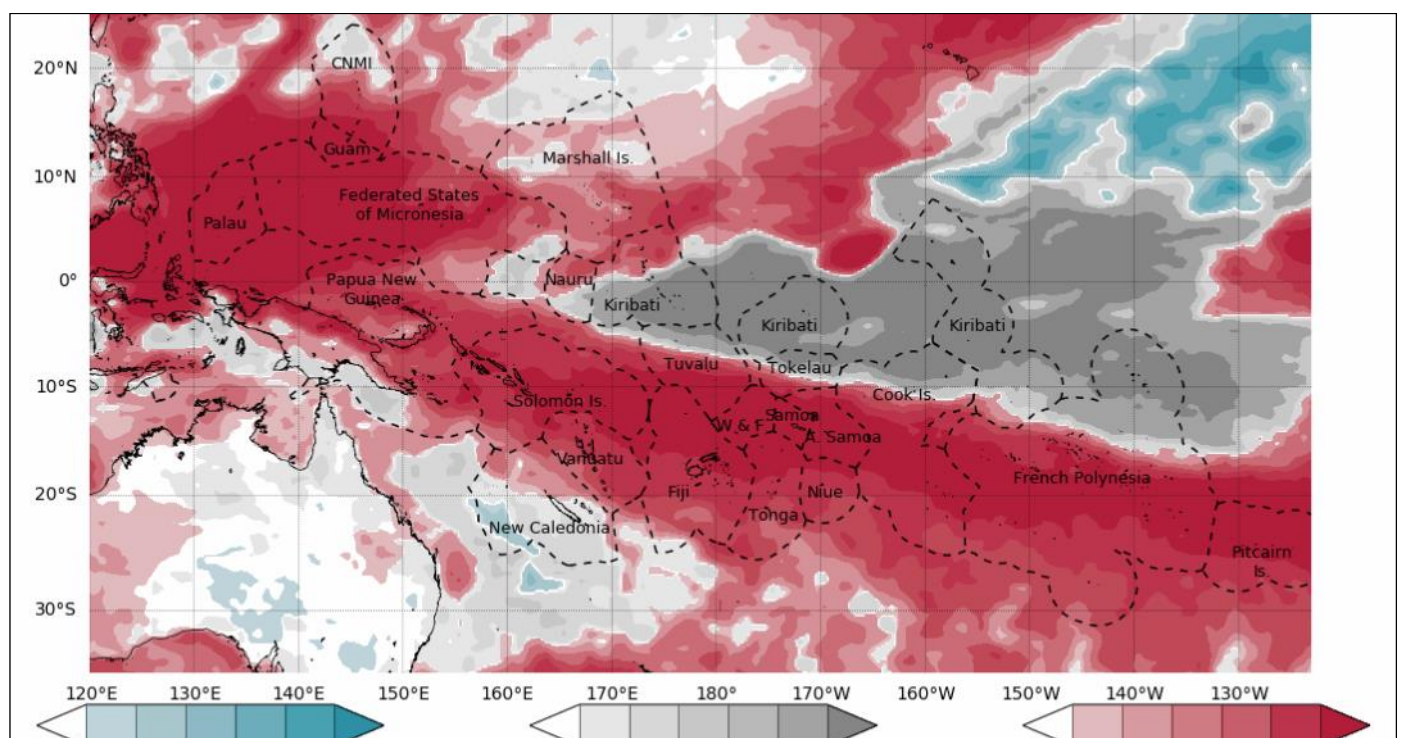
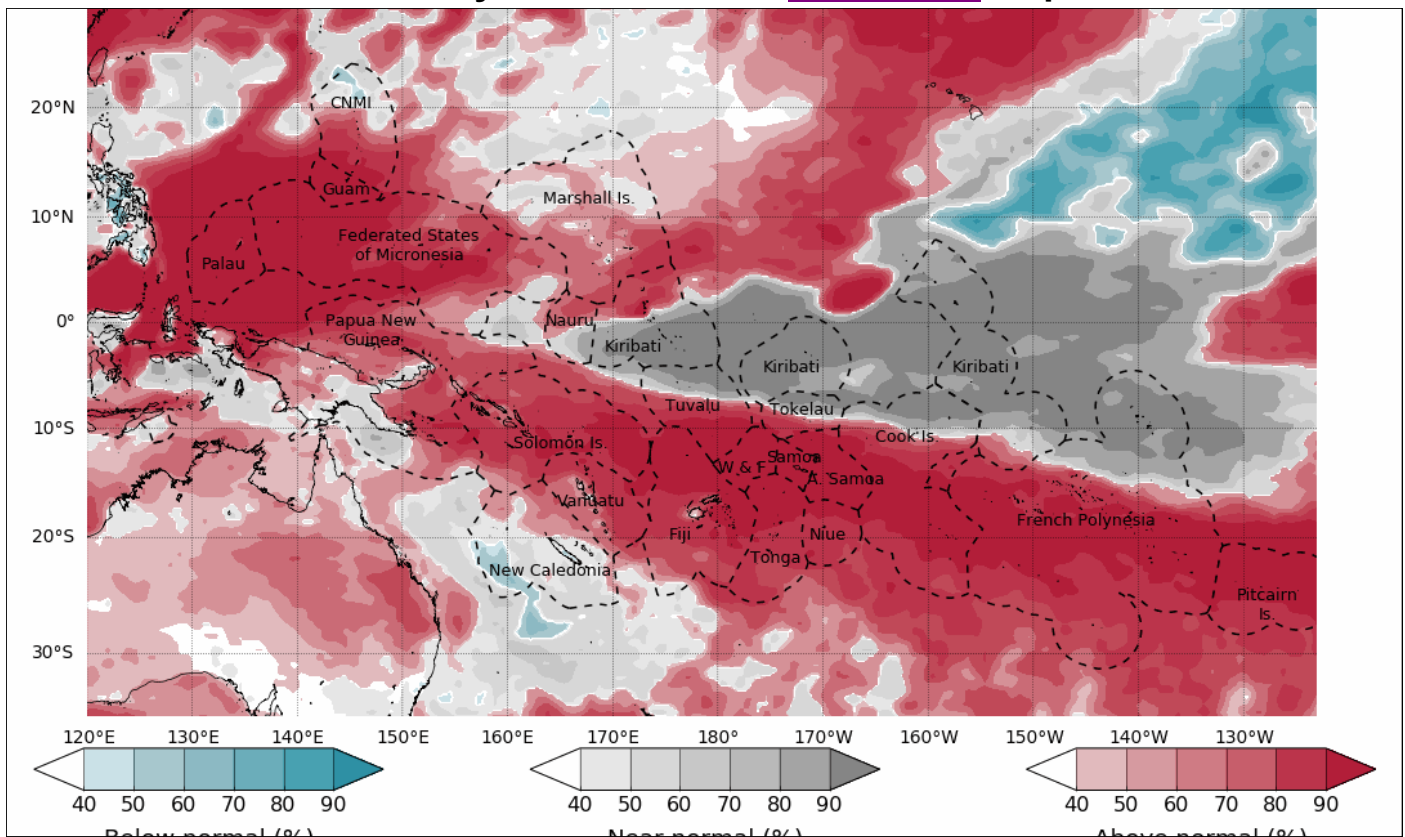
For March-May 2023, the models unanimously agree on above normal rainfall for Palau, Guam, CNMI, most of FSM, the southeast of PNG's EEZ, most of Solomon Islands, New Caledonia, Vanuatu, much of Fiji, most of Tonga, Niue, and southern French Polynesia. The models are also unanimous in showing that below normal rainfall is likely or very likely for southern parts of central and eastern Kiribati, most of Tuvalu, Tokelau, Wallis and Futuna, American Samoa, northern Cook Islands and northern French Polynesia.

SEASONAL TEMPERATURE OUTLOOK

March—May 2023



Monthly Tmax and Tmin [ACCESS-S](#) Maps



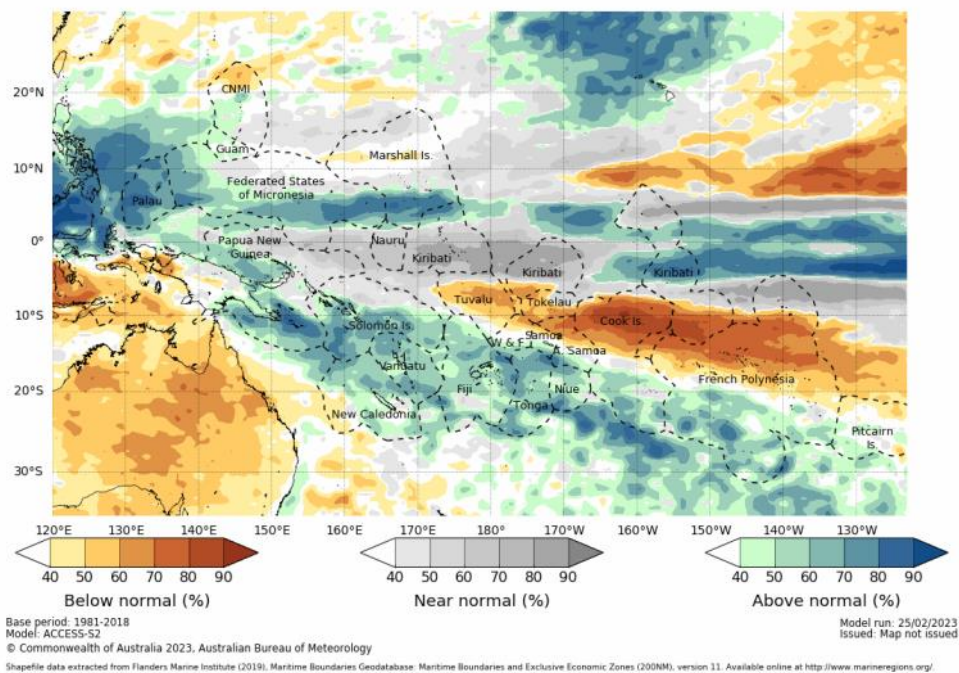
SEASONAL RAINFALL OUTLOOK

March—May 2023

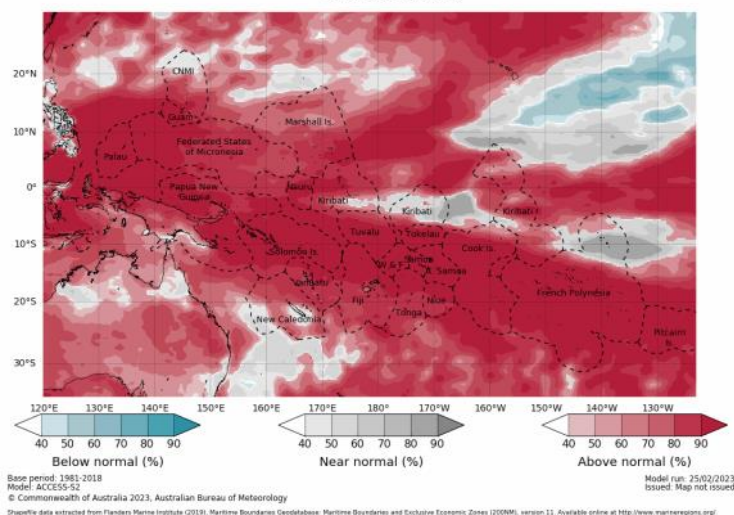


Seasonal ACCESS-S maps

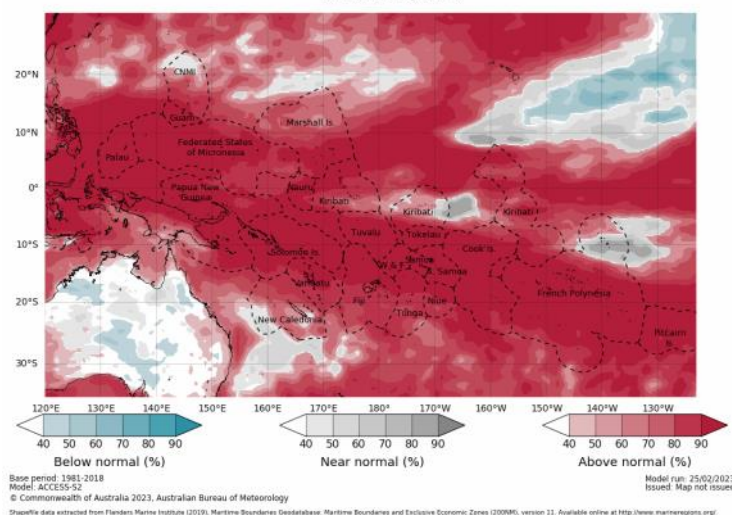
Tercile rainfall probabilities for
March to May 2023



Tercile maximum temperature probabilities for
March to May 2023



Tercile minimum temperature probabilities for
March to May 2023



'About ACCESS-S <http://access-s.climatecloud/>

SEASONAL RAINFALL OUTLOOK

March—May 2023



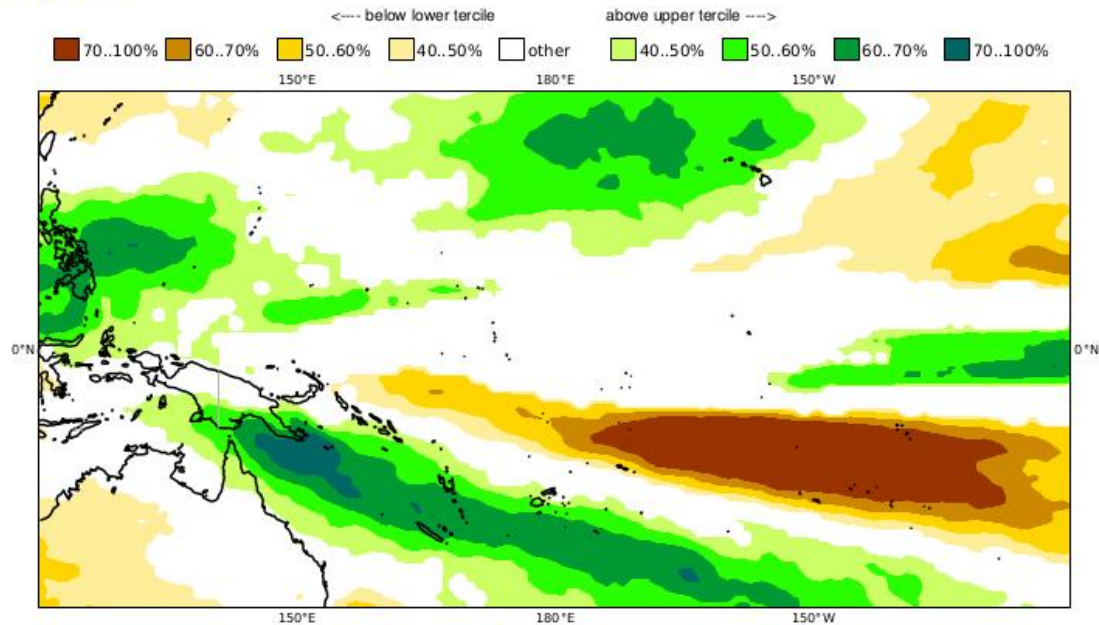
Copernicus (C3S multi-system)-Rainfall

Prob(most likely category of precipitation)

MAM 2023

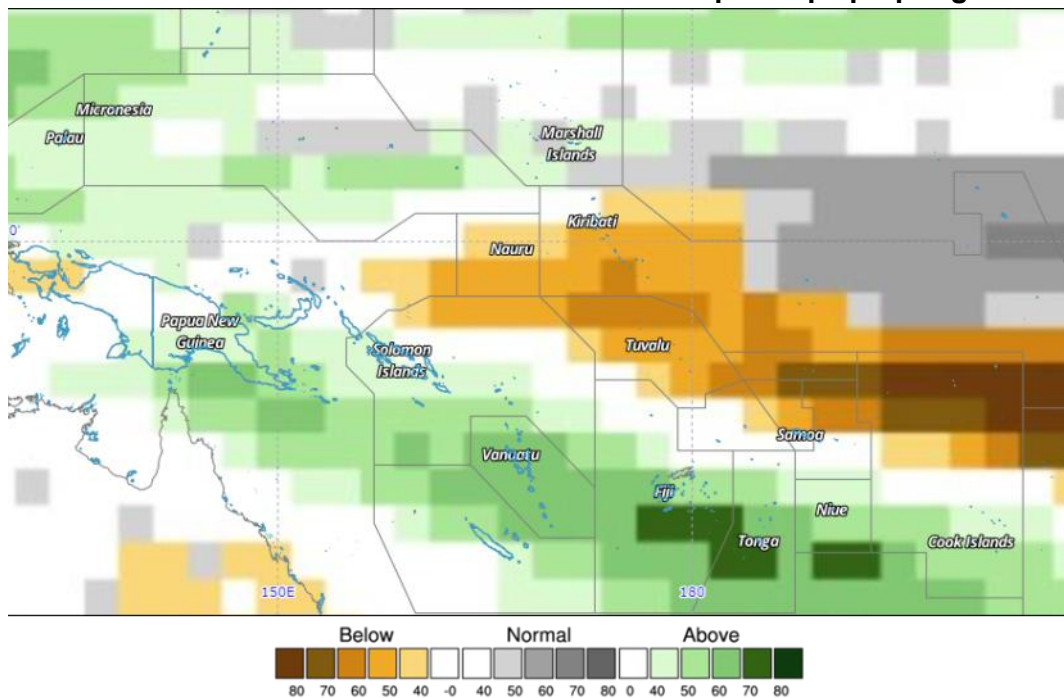
Nominal forecast start: 01/02/23

Unweighted mean



Copernicus Rainfall: <https://climate.copernicus.eu/charts/>

APEC Climate Information Toolkit for the Pacific: <http://clikp.sprep.org/>



Year: 2023, Season: MAM, Lead Month: 3, Method: GAUS

Model: APCC, BOM, CWB, MSC, NASA, NCEP, PNU

Generated using CLIK® (2023-3-7)

© APEC Climate Center

TROPICAL CYCLONE

2022/2023 Season



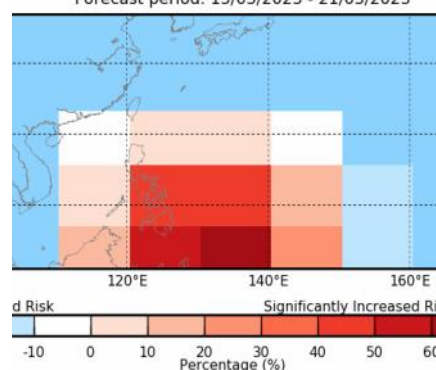
The northwest Pacific, tropical cyclone season is year around, with most cyclones occurring between May and October. Most TCs in the southwest Pacific occur between November and April. Associated with the existing La Niña, models favoured slightly enhanced TC risk in the western Pacific. In the central part of south Pacific, TC risks are generally near normal to below normal. These forecasts are part of the PI-COF-11 Regional Statement. There were five cyclones (Hale, Irene, Gabrielle, Judy, Kevin) over the southwest Pacific with three (Gabrielle, Judy and Kevin) reaching severe status, affecting Australia, New Caledonia, Vanuatu, Fiji and New Zealand.

It's important to remember that it does not take a severe cyclone to produce severe impacts. Coastal and river flooding rainfall can occur with a distant, weak or former cyclone. Communities should remain vigilant, and follow forecast information provided by their National Meteorological and Hydrological Service (NMHS).

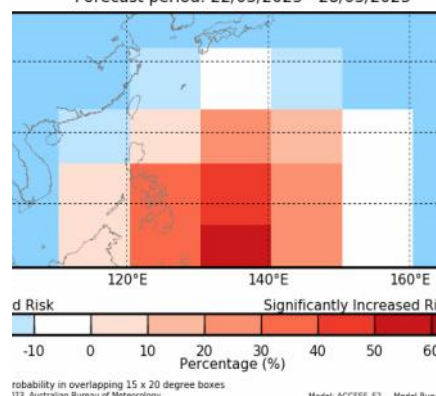
The weekly tropical cyclone forecast from the ACCESS-S model shows a significantly increased risk between 15 and 21 March around the eastern Australia, Coral Sea Region, Vanuatu and New Caledonia. There is still increased cyclone risk for the same areas for 22 to 28 March, but not as significant as the first week. For the northwest Pacific, there is significant increased risk for the Philippines, Palau and western FSM areas between 15 to 28 March.

ACCESS-S Weekly Forecasts –Northwest Pacific

Difference from normal chance of Tropical Cyclone's in the Northwest Pacific
Forecast period: 15/03/2023 - 21/03/2023

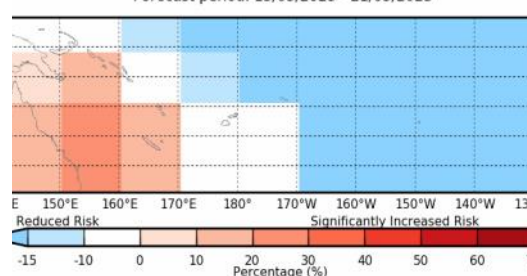


Difference from normal chance of Tropical Cyclone's in the Northwest Pacific
Forecast period: 22/03/2023 - 28/03/2023

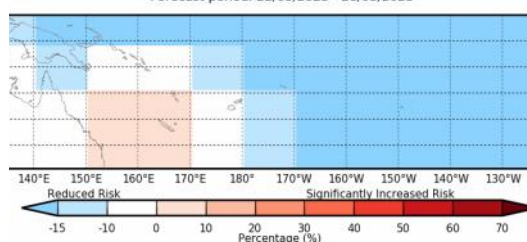


ACCESS-S Weekly Forecasts –Southwest Pacific

Difference from normal chance of Tropical Cyclone's in the Southwest Pacific
Forecast period: 15/03/2023 - 21/03/2023



Difference from normal chance of Tropical Cyclone's in the Southwest Pacific
Forecast period: 22/03/2023 - 28/03/2023



Model anomaly probability in overlapping 15 x 20 degree boxes
Model: ACCESS-S2 Model Run: 07/03/2023 Issued: 07/03/2023

Individual Model Links

UKMO Global long-range model probability maps: <http://www.metoffice.gov.uk/research/climate/seasonal-to-decadal/gpc-outlooks/global-seas-prob>

ECMWF Rain (Public charts) - Long range forecast: <http://www.ecmwf.int/en/forecasts/charts/seasonal/rain-public-charts-long-range-forecast>

POAMA Pacific Seasonal Prediction Portal: <http://poama.bom.gov.au/experimental/pasap/index.shtml>

APEC Climate Center (APCC): <http://www.apcc21.org/eng/service/6mon/ps/japcc030703.jsp>

NASA GMAO GEOS-5: <http://gmao.gsfc.nasa.gov/research/ocean/>

NOAA CFSv2: <http://www.cpc.ncep.noaa.gov/products/CFSv2/CFSv2seasonal.shtml>

IRI for Climate and Society: <http://iri.columbia.edu/our-expertise/climate/forecasts/seasonal-climate-forecasts/>

OTHER INFORMATION

Southern Oscillation Index

The Southern Oscillation Index, or SOI, gives an indication of the development and intensity of El Niño and La Niña events across the Pacific Basin. The SOI is calculated using the difference in air pressure between Tahiti and Darwin. Sustained negative values of the SOI below -7 often indicate El Niño episodes. These negative values are usually accompanied by sustained warming of the central and/or eastern tropical Pacific Ocean, and a decrease in the strength of the Pacific Trade Winds. Sustained positive values of the SOI greater than $+7$ are typical of La Niña episodes. They are associated with stronger Pacific Trade Winds and sustained cooling of the central and eastern tropical Pacific Ocean. In contrast, ocean temperatures to the north of Australia usually become warmer than normal.

Multivariate ENSO Index (MEI)

The Climate Diagnostics Center Multivariate ENSO Index (MEI) is derived from a number of parameters typically associated with El Niño and La Niña. Sustained negative values indicate La Niña, and sustained positive values indicate El Niño.

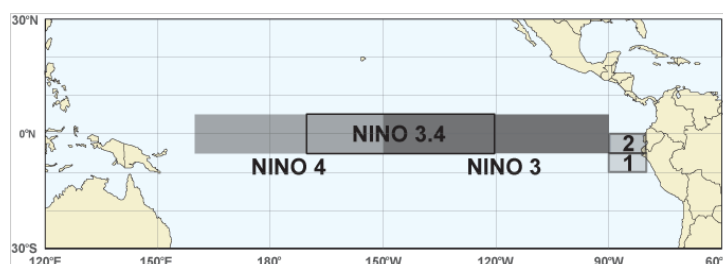
20 degrees Celsius Isotherm Depth

The 20°C Isotherm Depth is the depth at which the water temperature is 20°C. This measurement is important, as the 20°C isotherm usually occurs close to the thermocline, the region of most rapid change of temperature with depth, or the division between the mixed surface layer and deep ocean. A 20°C isotherm that is deeper than normal (positive anomaly) implies a greater heat content in the upper ocean, while a shallower 20°C isotherm (negative anomaly) implies a lower-than-normal heat content in the upper ocean.

Regions

SST measurements may refer to the NINO1, 2, 1+2, 3, 3.4 or 4 regions. These descriptions simply refer to the spatially averaged SST for the region described. The NINO regions (shown in the figure below) cover the following areas:

Region	Latitude	Longitude
NINO1	5-10°S	80-90°W
NINO2	0-5°S	80-90°W
NINO3	5°N to 5°S	150-90°W
NINO3.4	5°N to 5°S	120-170°W
NINO4	5°N to 5°S	160°E to 150°W



NOTE: NINO1+2 is the combined areas 1 and 2