

Monthly Climate Bulletin

April 2023



ISSN: 2617-3557

Photo Credit: Molly Powers (SPC) Samoa Tide Gauge



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- The El Niño-Southern Oscillation status is currently neutral (neither La Niña nor El Niño). Oceanic and atmospheric indicators for the tropical Pacific Ocean are at neutral ENSO levels, but trending towards El Niño.
- The Madden-Julian Oscillation (MJO) recently strengthened and moved into the Maritime Continent region, to the north of Australia.
- The ITCZ and SPCZ were weaker than average in April 2023.
- Sea surface temperatures (SST) in April 2023 were warmer than average over the eastern, southern and far west of the tropical Pacific Ocean.
- The Coral bleaching Outlook to 6 May shows 'Alert Level 2' rating coinciding with a peak positive SST anomalies, extending southeastern PNG, across the southern Solomon Islands, northern Vanuatu, northern Fiji, Samoa, and central Cook Islands.
- For May-July 2023, the models agree on continued warming of the equatorial Pacific, with most reaching El Niño levels by the end of the period. They unanimously agree on above normal rainfall for FSM, southern RMI, PNG's Momase Region, southern Solomon Islands, Nauru, Kiribati, and far southern Tonga.
- The ACCESS-S weekly tropical cyclone outlook shows an increased risk between 24 and 30 May around the Philippines, Palau and far western FSM regions in the northwest Pacific.



EL NIÑO–SOUTHERN OSCILLATION

Tropical Pacific continues to warm

Click link to access [Climate Driver Update issued on 9 May 2023](#)

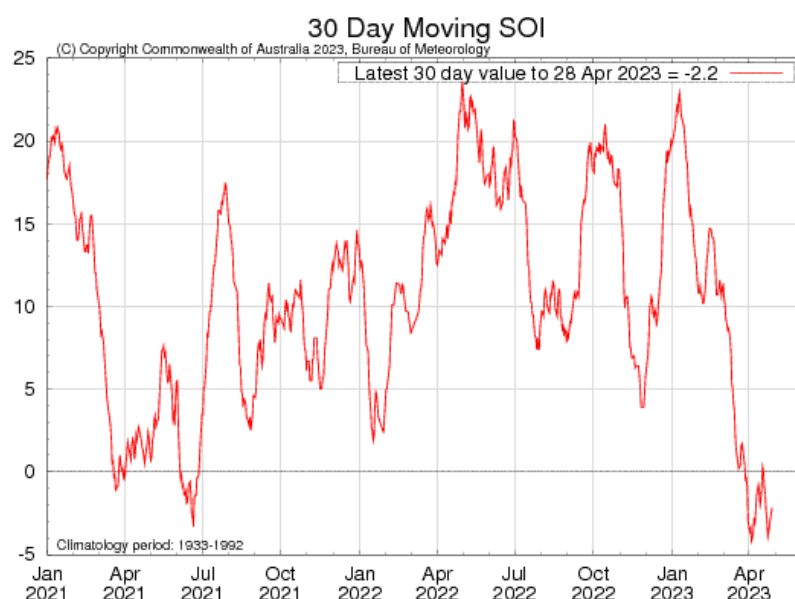
El Niño–Southern Oscillation is currently neutral (neither La Niña nor El Niño). Oceanic and atmospheric indicators for the tropical Pacific Ocean are at neutral ENSO levels.

International climate models suggest a neutral ENSO is likely to persist through the southern hemisphere autumn. Long-range forecasts of ENSO made in early autumn have lower accuracy than those made at other times of the year. There are some signs, however, that El Niño may form later in the year. Hence the Bureau has issued an El Niño WATCH. This means there is a 50% chance of El Niño in 2023.

The Indian Ocean Dipole (IOD) is neutral. A majority of models suggest that a positive event may develop in the coming months. Long-range forecasts of the IOD made in early autumn have lower accuracy than those made at other times of the year.

The Southern Annular Mode (SAM) index is currently neutral, and is expected to remain neutral over the coming weeks.

The 30-day Southern Oscillation Index (SOI) for the 30 days ending 07 May 2023 was -0.7 while the 90-day SOI value was +2.5. The 30-day SOI has returned to values close to zero over the past fortnight while the 90-day SOI has continued to demonstrate a gradual decreasing trend.



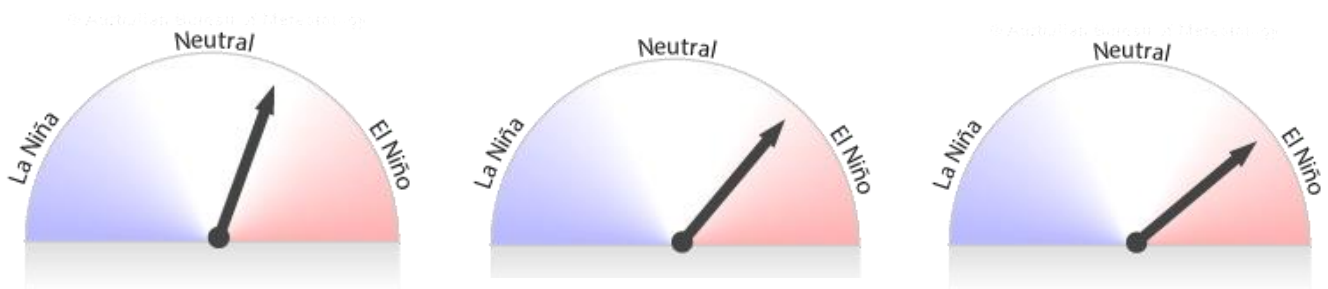


EL NIÑO–SOUTHERN OSCILLATION

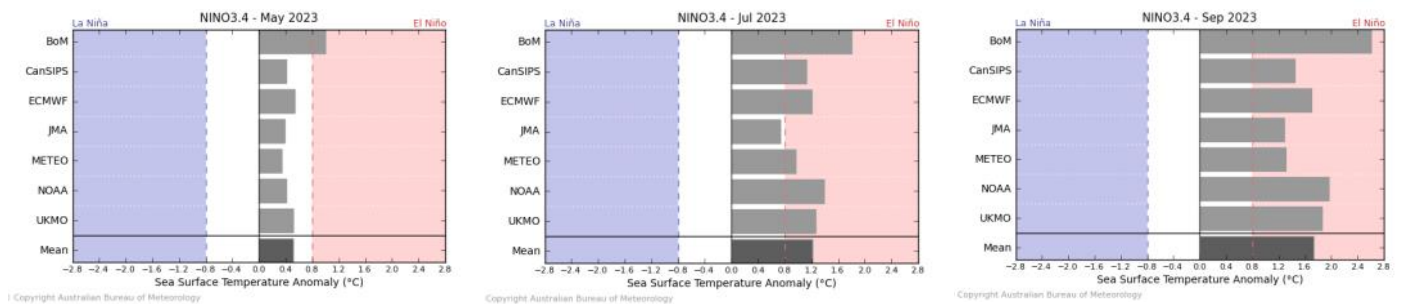
Tropical Pacific continues to warm

Click link to access [Climate Driver Update issued on 9 May 2023](#)

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



Bureau of Meteorology NINO3.4 International Model Outlooks



Bureau of Meteorology summary of international model outlooks for NINO3.4: <http://www.bom.gov.au/climate/model-summary/#tabs=Pacific-Ocean>

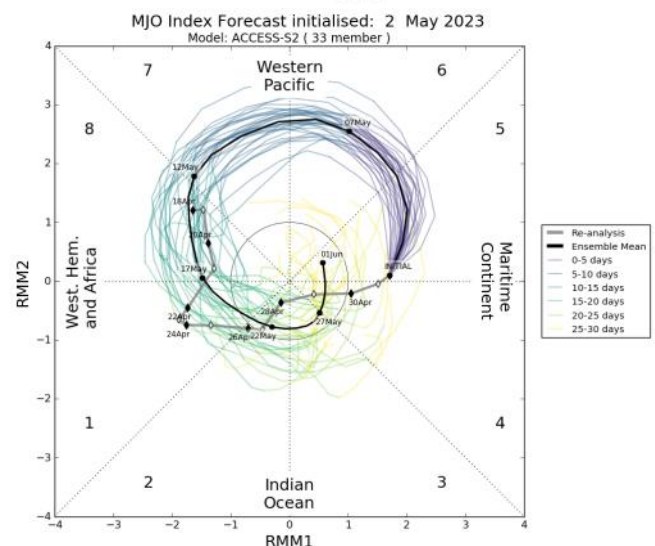
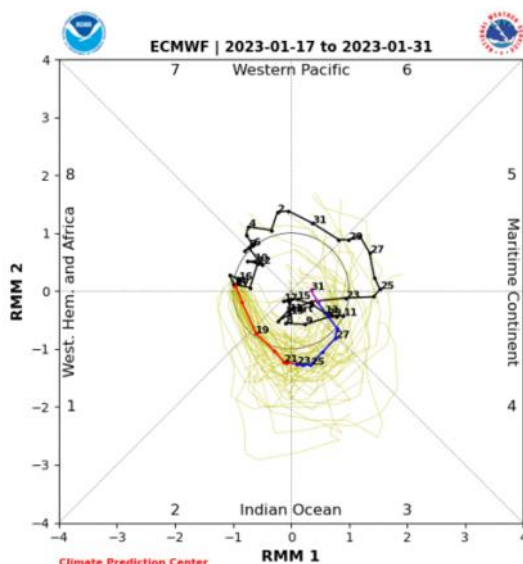
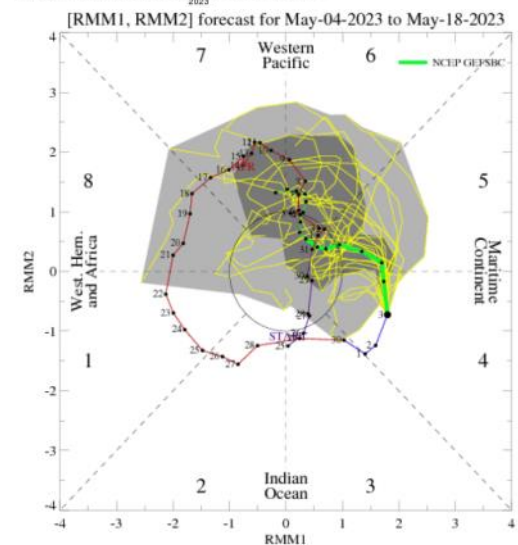
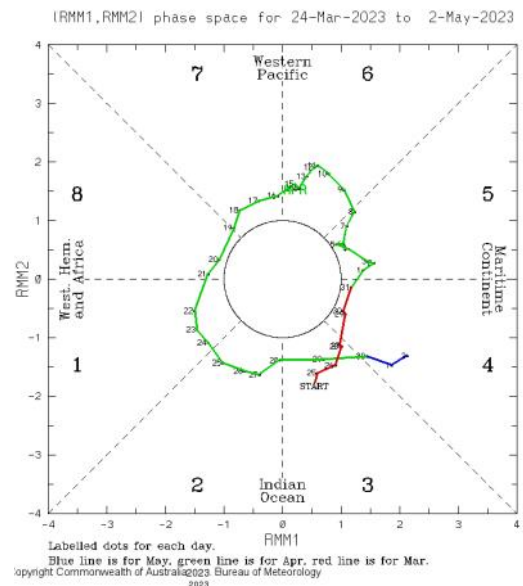
MADDEN–JULIAN OSCILLATION

Click link to access [Tropical Climate Update](#) [Issued on Wednesday 02 May 2023]

During April, the Madden Julian Oscillation (MJO) was active in the eight regions including the Western Pacific.

A pulse of the Madden Julian Oscillation (MJO) recently strengthened and moved into the Maritime Continent region, to the north of Australia. While this location typically favours above average cloudiness and rainfall for the Australian tropics and western Pacific during the wet season, the MJO's influence on northern Australia and western Pacific reduces markedly at this time of the year. While parts of north-eastern Australia have a marginally increased likelihood of above average rainfall, the MJO is expected to have little to no influence on most of northern Australia and west Pacific countries. However, the likelihood of above average rainfall is increased for near-equatorial regions to the north of Australia in the coming fortnight, along with an increased tropical cyclone risk for the Bay of Bengal and the western North Pacific Ocean.

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



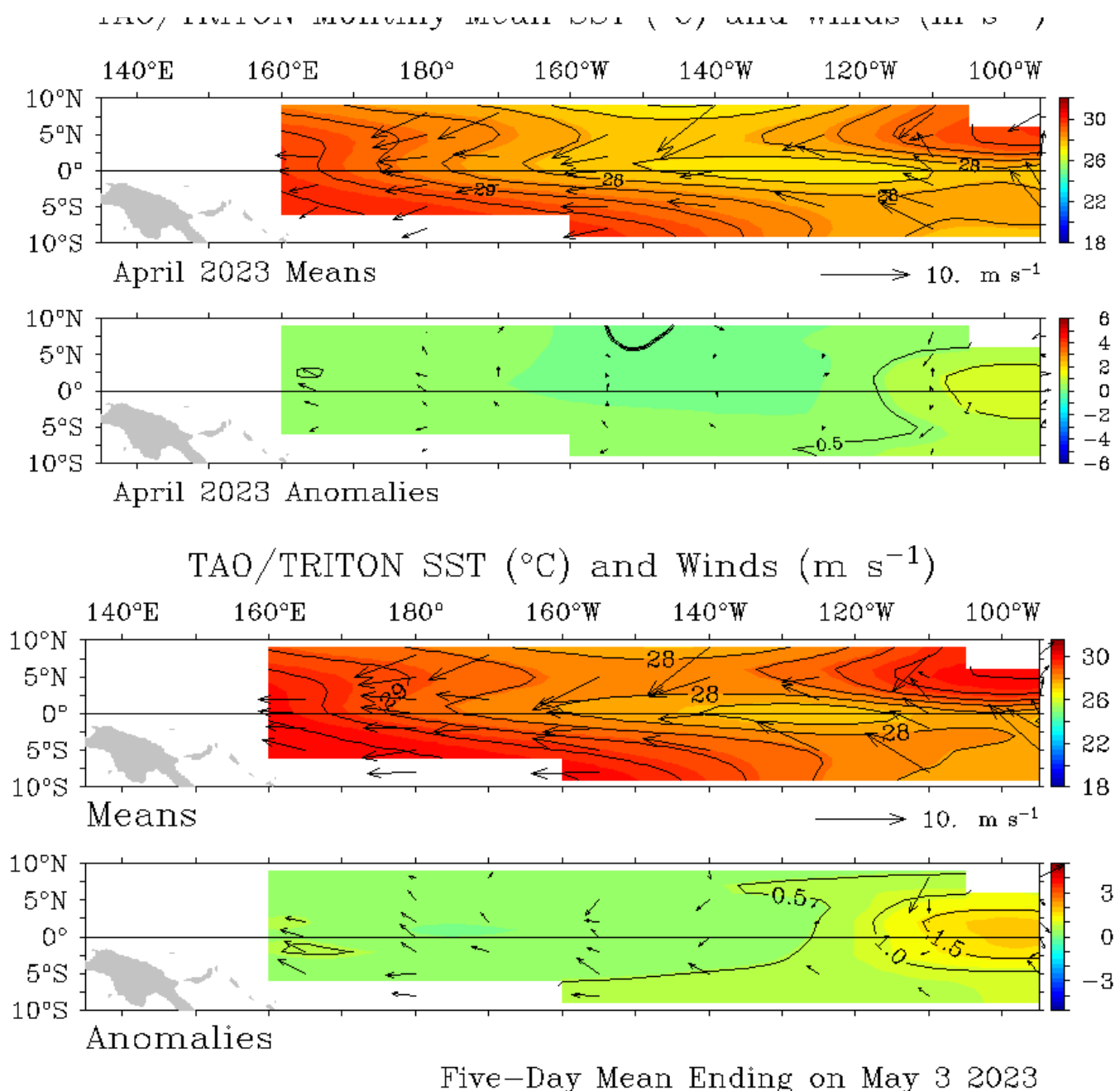
WIND



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

For the five days ending 03 May 2023, the trade winds were a little stronger than normal over most of the near-equatorial Pacific. During April, the trade winds were close to normal across the equatorial Pacific, but somewhat stronger than average to the west of the Date Line.

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](#)



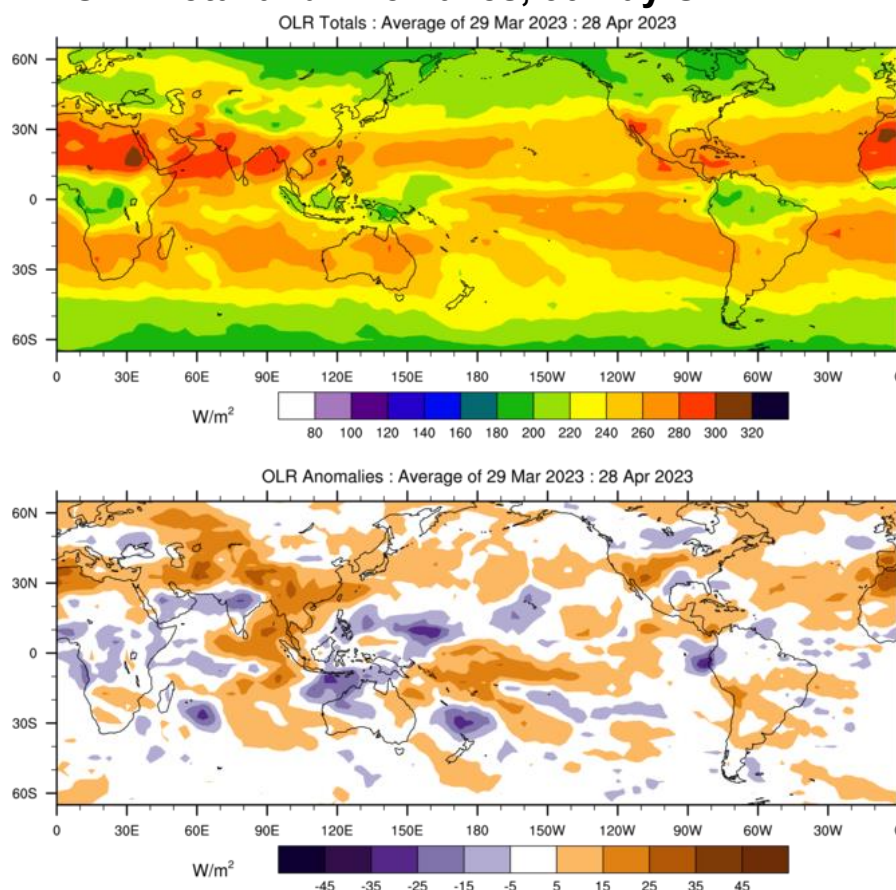
The main feature of the April 30-day OLR total and anomaly maps were the anomalously high OLR centre (reduced convection) centred near the equatorial Date Line. The main centre of low OLR (convection) was situated over PNG and the Federated States of Micronesia.

From the centre of anomalously high OLR was one main extension reaching east-southeast across the Pacific Basin, indicating reduced cloudiness in the normal location of the SPCZ.

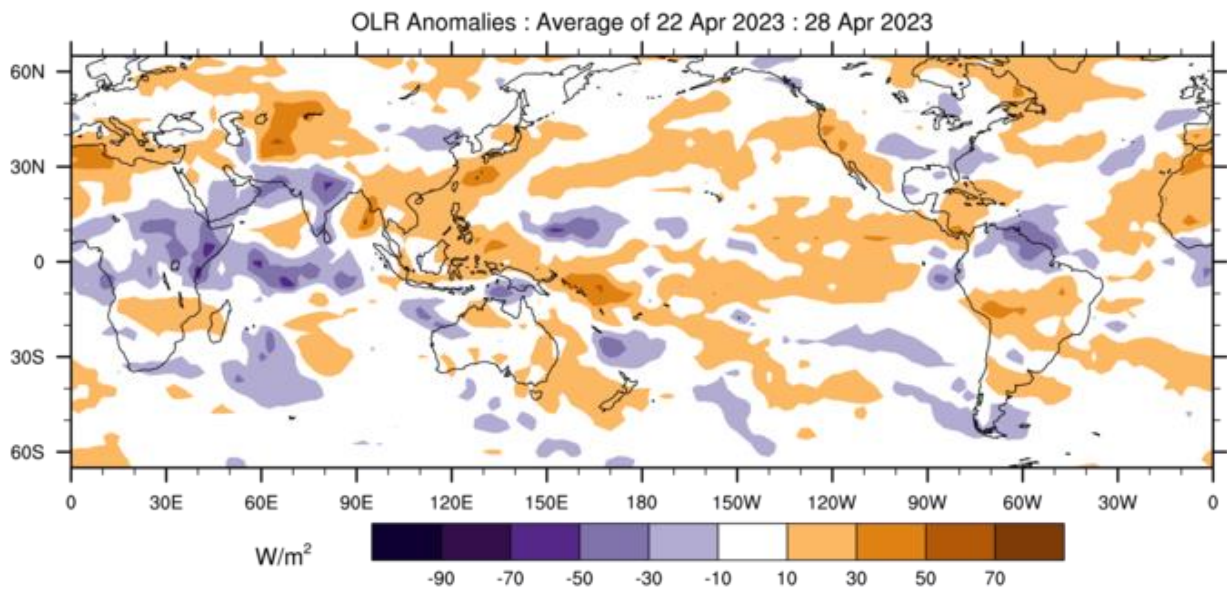
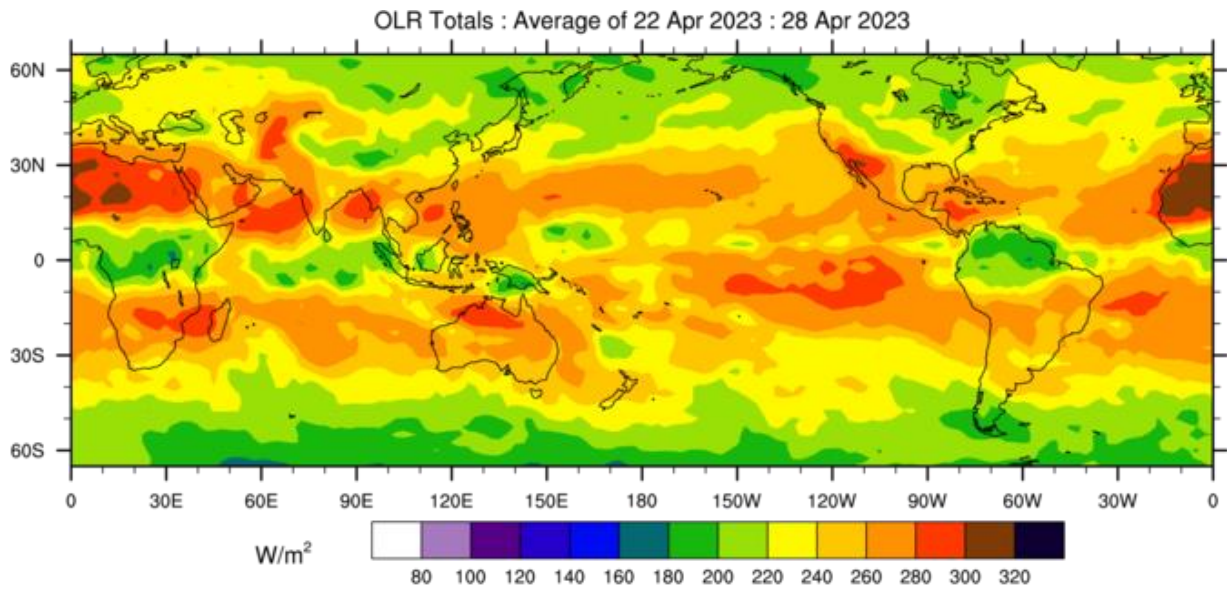
The weekly OLR to 28 April showed reduced convection in a line from Palau to Niue, while increased convection was evident over parts of FSM and RMI.

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.

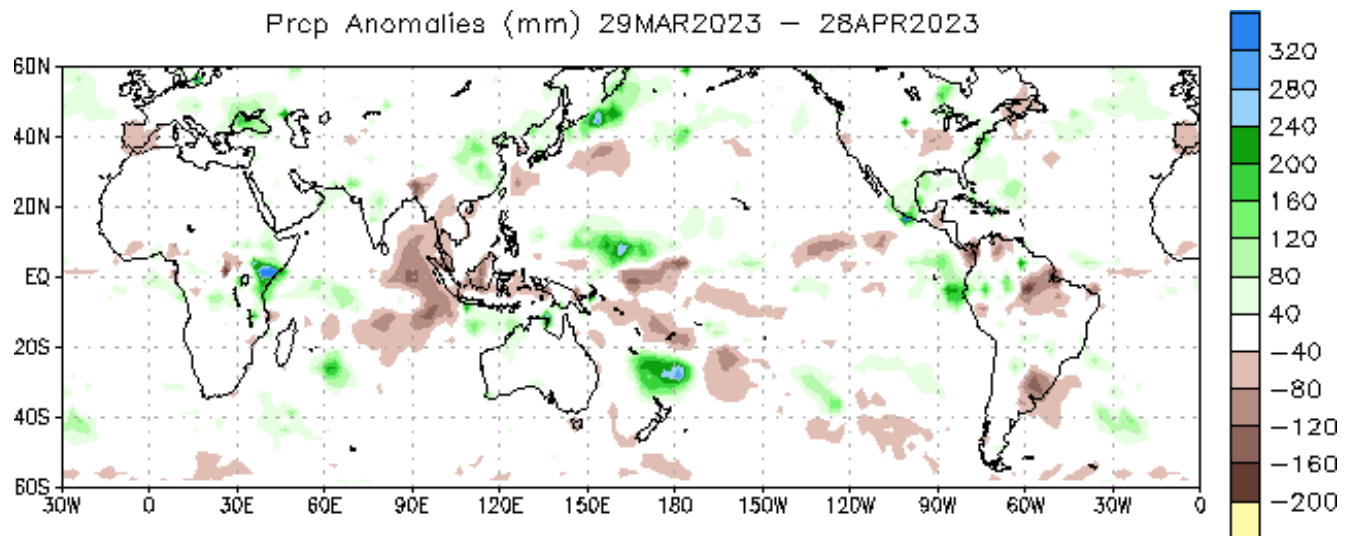
OLR Total and Anomalies, 30 Day OLR



OLR Total and Anomalies, 7 Day OLR

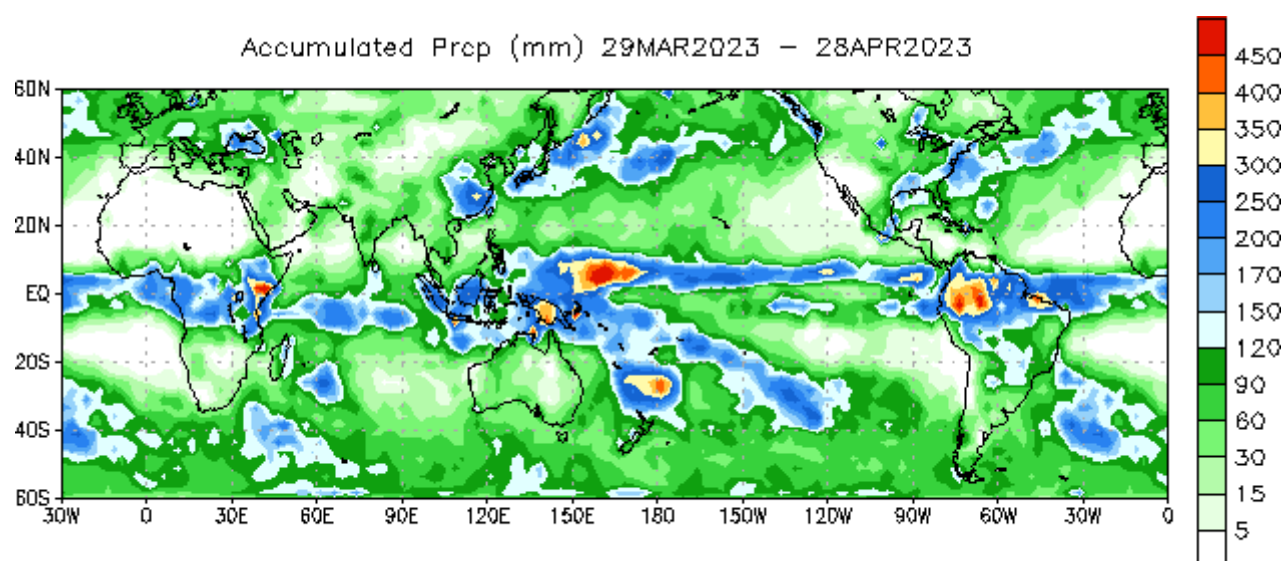


(C) Copyright Commonwealth of Australia 2023. Bureau of Meteorology

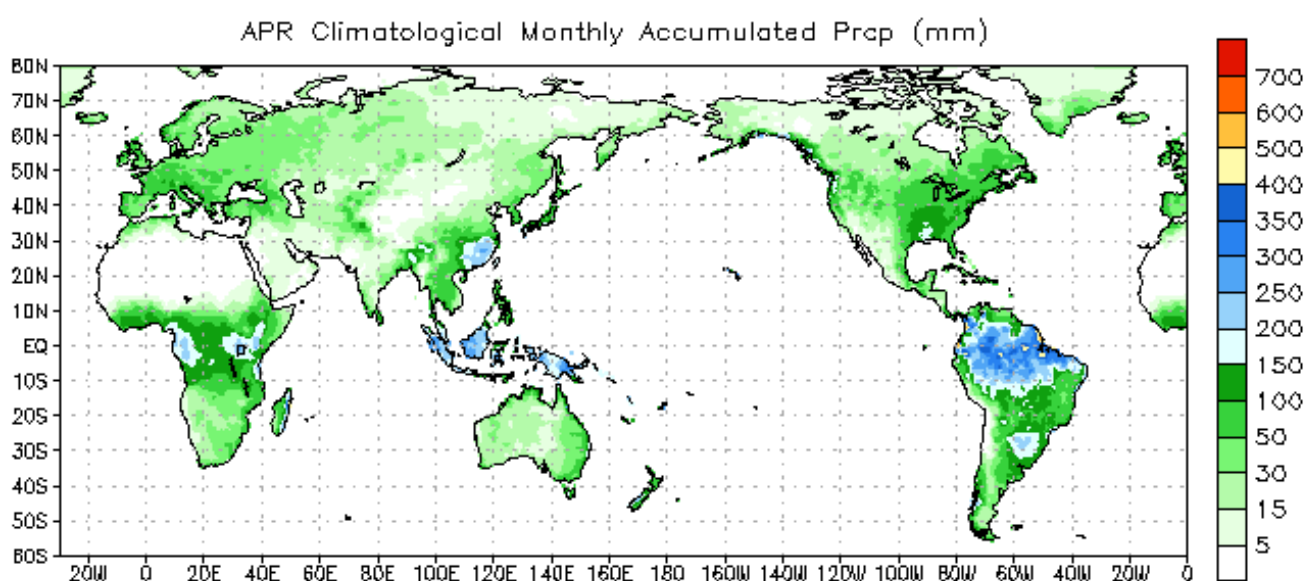


Data Source: NCEP CMAP Precipitation
Climatology (1991–2020)

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

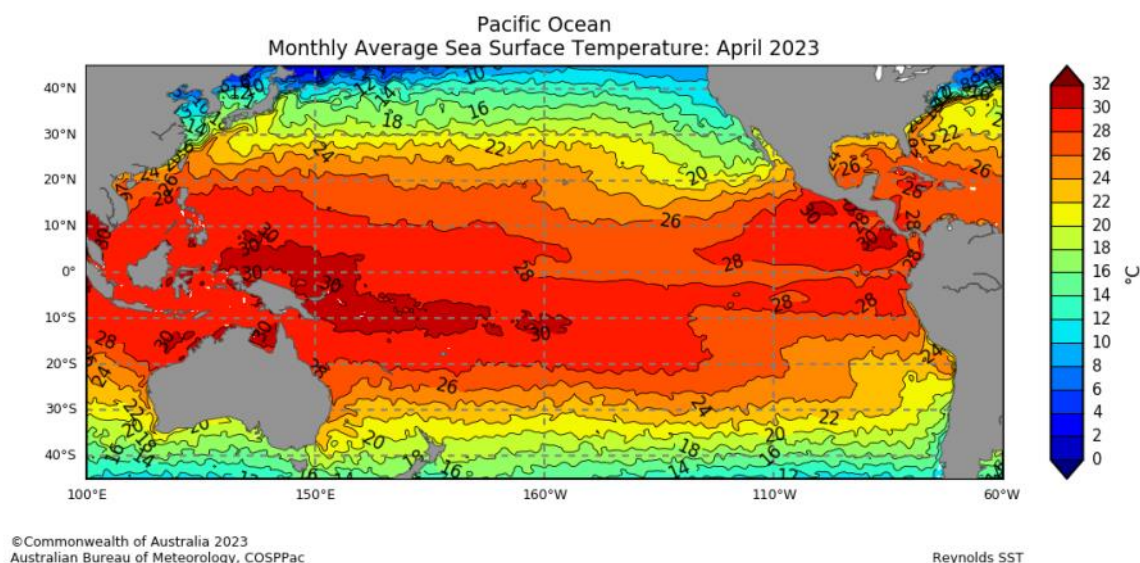


Click link to access [Pacific Community COSPPac Ocean Portal](#)

Sea surface temperatures (SST) in April 2023 were warmer than average over the eastern, southern and far west of the tropical Pacific Ocean. Warm anomalies up to 2 °C warmer than average were present over these regions, increasing to more than 4 °C warmer than average off parts of the South American coast. Compared to March, large parts of the basin have warmed, especially in the east and south-west of the tropical Pacific. Warm SST anomalies also continued in the southern Tasman Sea, between south-east Australia and New Zealand, as well as to the south-west of Western Australia. Warm anomalies off the west coast of Western Australia have eased to near-average values. Globally, the April 2023 SSTs were the warmest on record. In the ERSSTv5 dataset, the global area-average SST was 0.71 °C above the 1961-1990 average, exceeding the previous April record of 0.67 °C in 2019.

Record-high April SSTs occurred in Palau, western FSM, southeast PNG, Coral Sea region, patches in central Solomon Islands, New Caledonia, Vanuatu, Fiji and southern French Polynesia. The SSTs in decile 10 (very much above average) and above average (8-9) span a region from FSM to Pitcairn Islands. Average SSTs (4-7) for April were observed in parts of Nauru, Kiribati and southern Cook Islands.

Mean Sea Surface Temperature

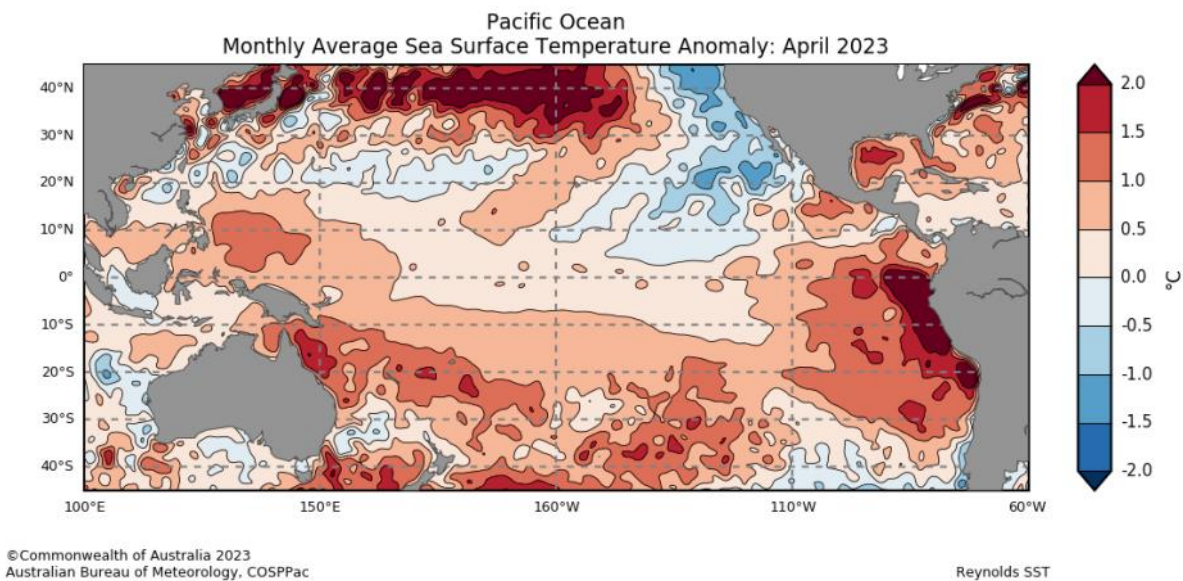


OCEAN CONDITIONS

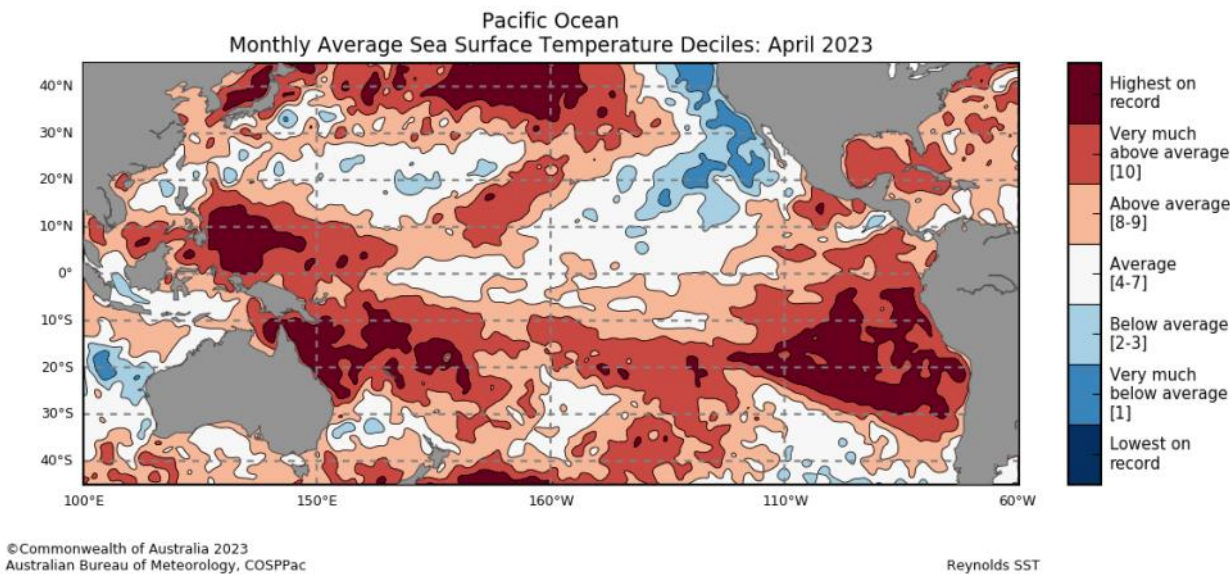
Click link to access [SEA SURFACE TEMPERATURE](#)



Anomalous Sea Surface Temperature



Sea Surface Temperatures Deciles



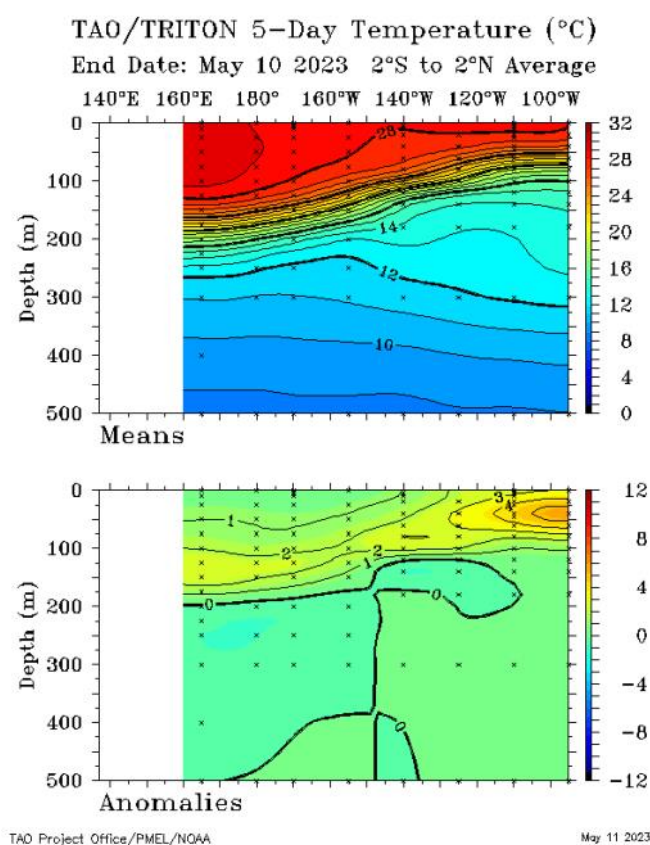
OCEAN CONDITIONS

SUB SURFACE

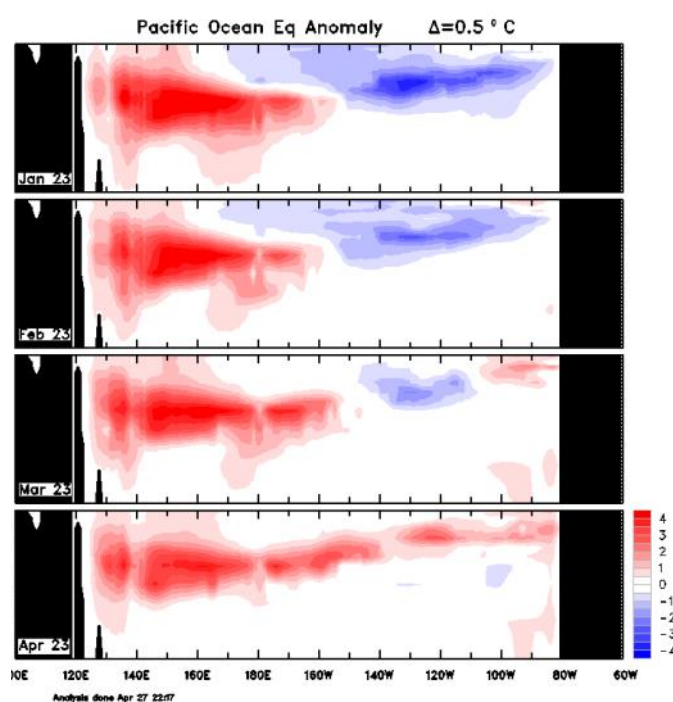


The four-month sequence of equatorial Pacific sub-surface temperature anomalies (to 30 April 2023) shows warm anomalies across the basin, between 50 m and 250 m in the western Pacific, between 75 m and 175 m depth in the central Pacific and above 100 m depth in the eastern Pacific. Anomalies reached more than 2 °C warmer than average across much of this region. Compared to previous months, cool anomalies have steadily decreased in extent, and are now absent in April. In March, warm anomalies developed in the far east. During April, warm anomalies have expanded in extent to cover the whole basin.

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

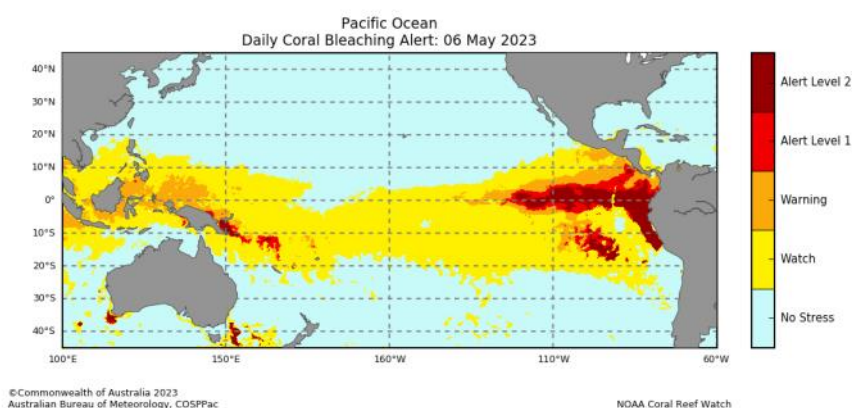
CORAL BLEACHING



The daily Coral Bleaching Alert status for 06 May 2023 shows 'Alert Level 2' for southeast of PNG and southern Solomon Islands. 'Alert Level 1', southeast of PNG, southern Solomon Islands, northern Vanuatu and patches in northern Fiji. Patches of 'Warning' are shown for southern Palau, patches in FSM, western Solomon Islands, western Vanuatu and northern Fiji. The four-week Coral Bleaching Outlook to 28 May shows area of Warning to 'Alert Level 1' ratings extending east from Palau, northern PNG, southern Marshall Islands, Nauru, and Kiribati.

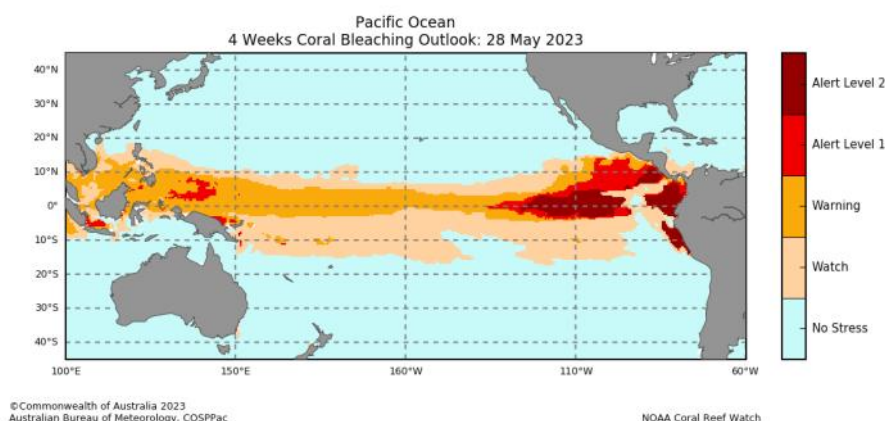
Daily Coral Bleaching Alert

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



4 Weeks Coral Bleaching Outlook

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



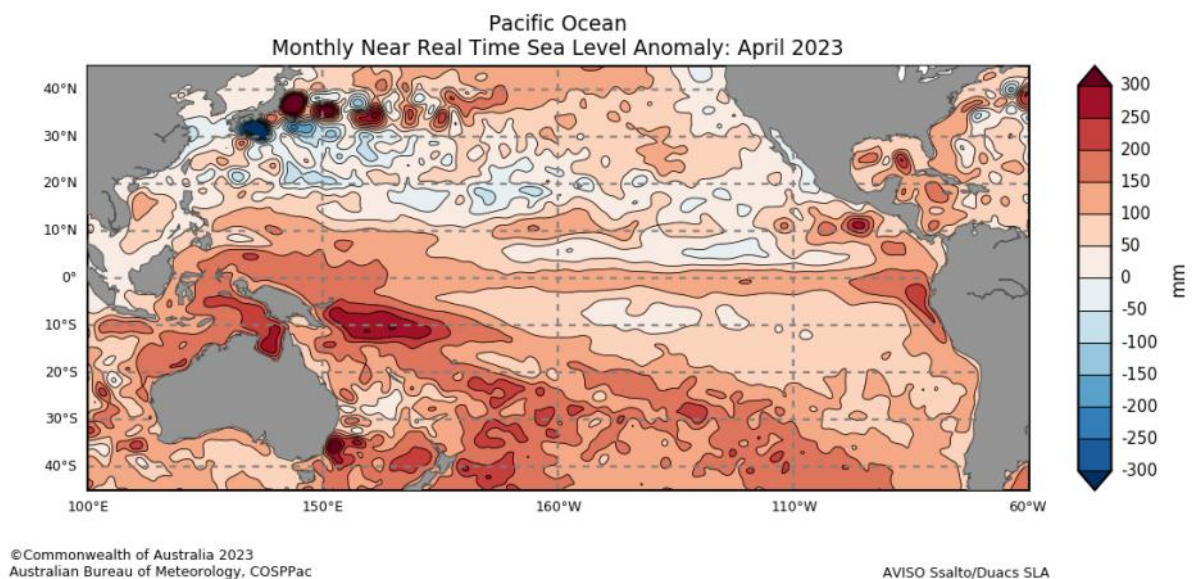
OCEAN CONDITIONS

OCEAN SURFACE CURRENTS AND SEA LEVEL

Sea level in April was above normal over COSPPac countries. Anomalies above +300 mm were observed in eastern PNG and central Solomon Islands. Anomalies of +200-250 mm were observed in most of Solomon Islands. Patches of sea level between +50 mm +150 mm were observed in most of the COSPPac countries.

Monthly Sea Level Anomalies

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

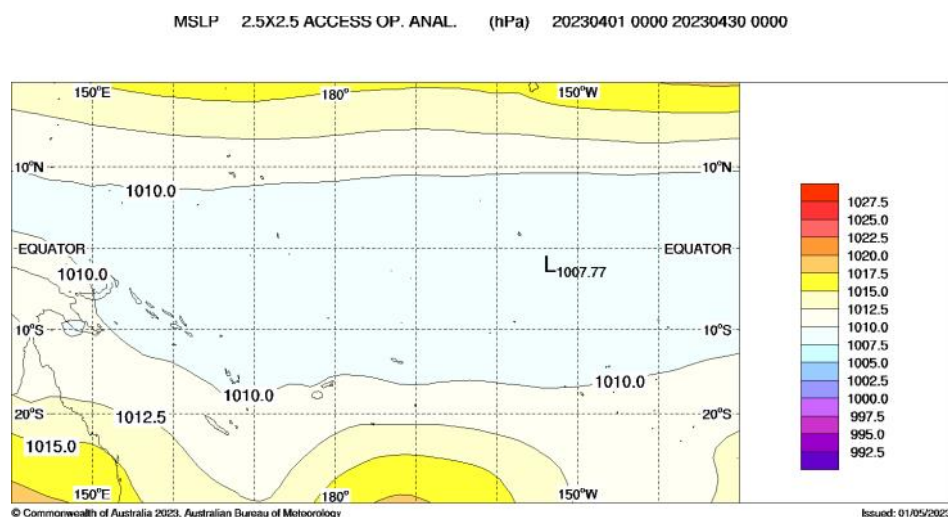


MEAN SEA LEVEL PRESSURE

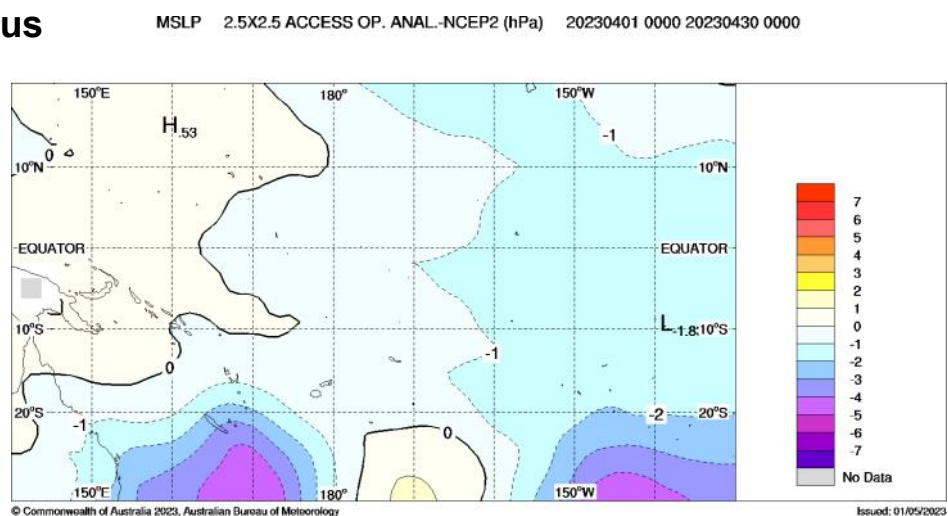
The April mean sea level pressure (MSLP) anomaly map shows mostly negative anomalies of 1hPa or greater over southern Vanuatu, as well as across a large region east of the Date Line, especially south of the Cook Islands and French Polynesia.

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

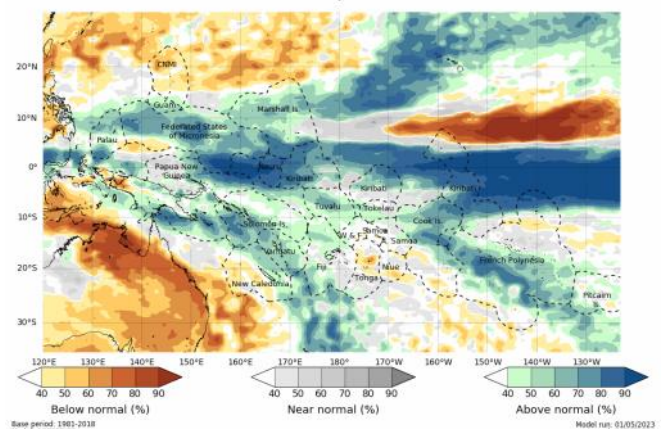
May—July 2023



The ACCESS-S model forecast for May 2023, favours below normal rainfall for CNMI, for southwest FSM, central Tonga, southern Niue, along with patches in Wallis and Futuna, Samoa, southern Cook Islands and northern French Polynesia. Above normal rainfall is likely or very likely for Palau, Guam, FSM, RMI, most of PNG, Solomon Islands, eastern New Caledonia, Nauru, Vanuatu, Kiribati, Fiji, Tuvalu, most of Tokelau, northern Cook Islands and French Polynesia.

The three-month rainfall outlook (May-July 2023) is very similar to the May outlook as it favours below normal rainfall for CNMI, northern RMI, the Highlands and Islands of PNG, southwest New Caledonia, central Tonga, eastern Wallis and Futuna, Samoa, American Samoa, northern French Polynesia, plus patches in Niue and, the central Cook Islands. Above normal rainfall is likely or very likely for northern Palau, Guam, FSM, central and southern RMI, the northern mainland of PNG and southeast of its EEZ, most of Solomon Islands, Nauru, Kiribati, northern Tuvalu, northeast New Caledonia, Vanuatu, patches in Fiji, southern Tonga, central Cook Islands, southern to central French Polynesia and Pitcairn Islands.

Monthly [ACCESS-S](#) Maps



The Copernicus multi-model outlook for May-July 2023 favours above normal rainfall for Palau, FSM, central to southern RMI, PNG, Solomon Islands, southern Vanuatu, Nauru, Kiribati, southern and eastern Fiji, southern Tonga, Niue and southern Cook Islands. Below normal rainfall is likely or very likely for central and southern Tuvalu, Tokelau, northern and central Cook Islands and northern French Polynesia.

The APEC Climate Centre multi-model for May-July 2023 is also very similar to the ACCESS-S and Copernicus models. The main differences are a decreased wet signal for Palau, FSM, Solomon Islands, Vanuatu and Fiji, and an increased dry signal for Tuvalu to French Polynesia in APEC.

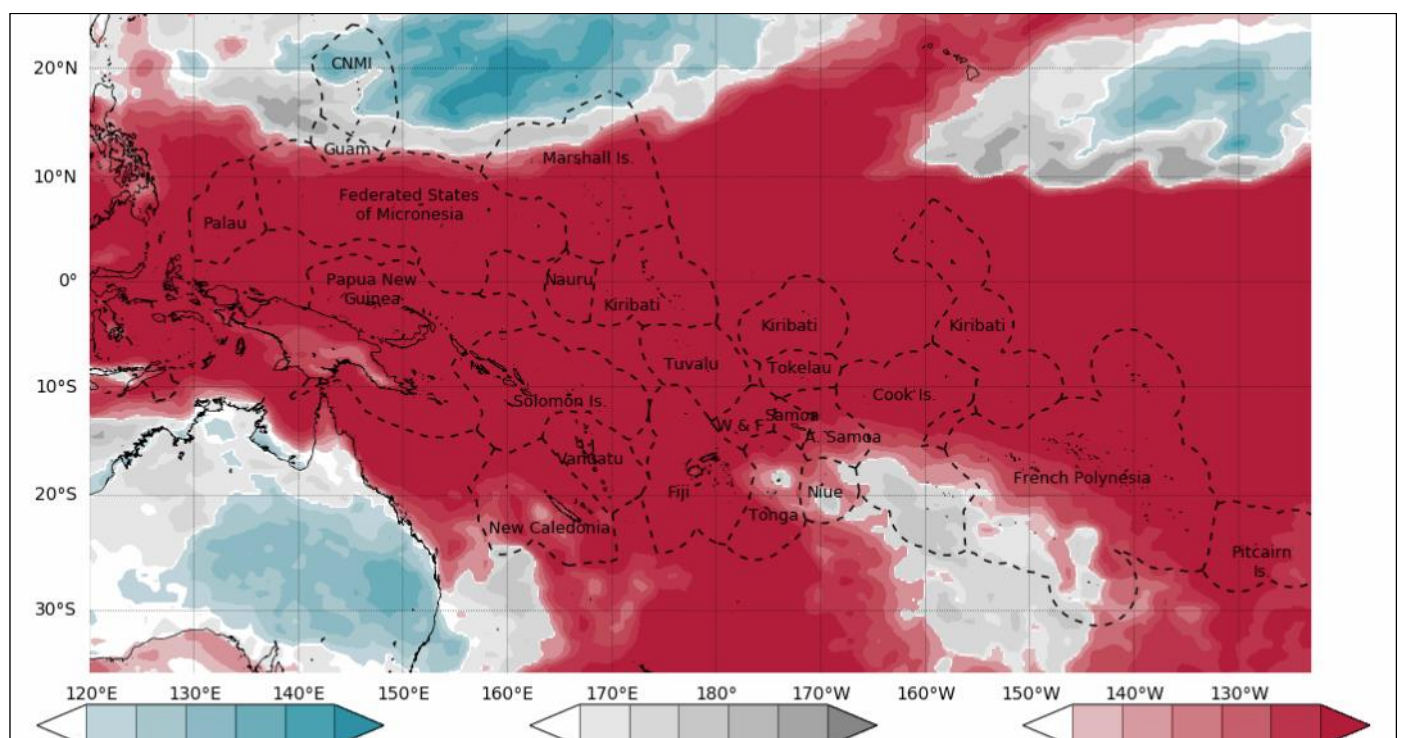
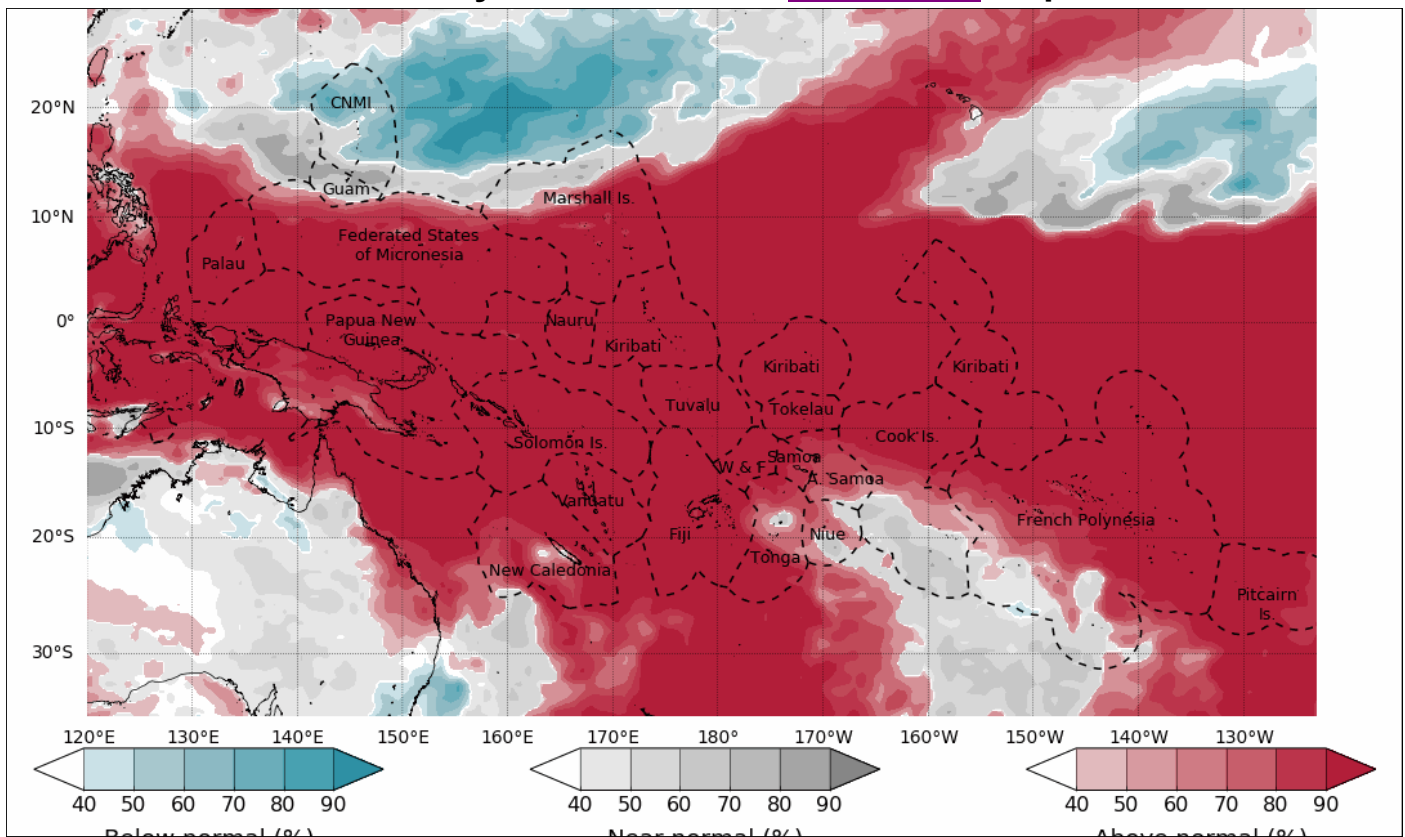
For May-July 2023, the models agree on continued warming of the equatorial Pacific, with most reaching El Niño levels by end of the period. They unanimously agree on above normal rainfall for FSM, southern RMI, PNG's Momase Region, southern Solomon Islands, Nauru, Kiribati, and far southern Tonga. There are no regions where the models are unanimous in showing that below normal rainfall is likely or very likely..

SEASONAL TEMPERATURE OUTLOOK

May—July 2023



Monthly Tmax and Tmin **ACCESS-S** Maps



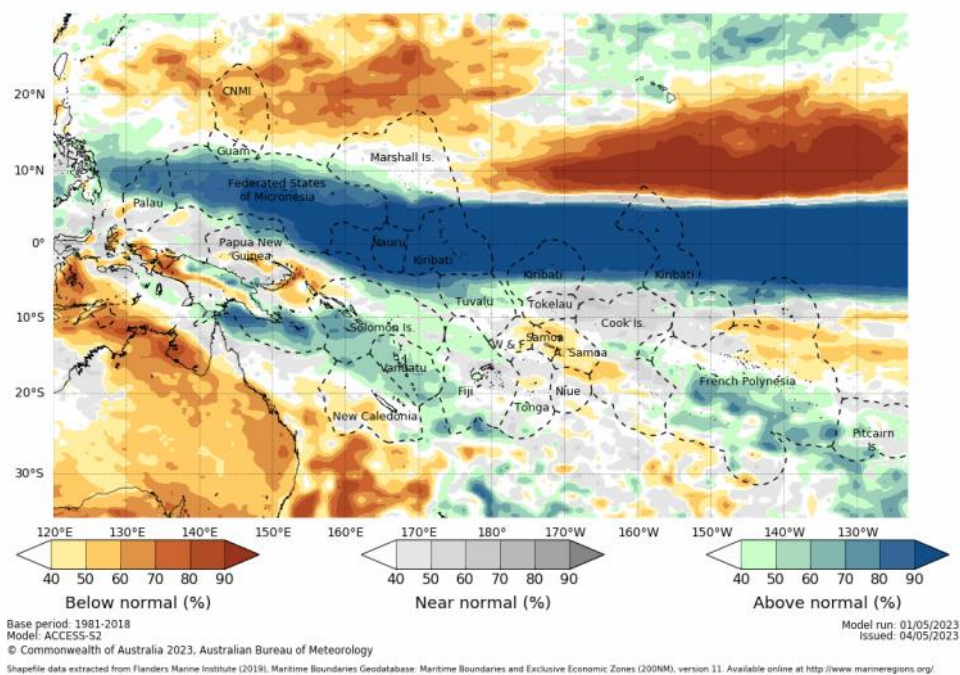
SEASONAL RAINFALL OUTLOOK

May—July 2023

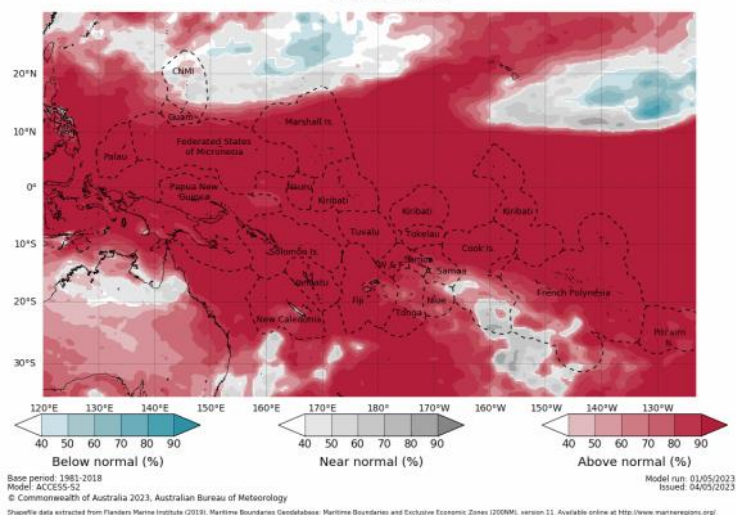


Seasonal ACCESS-S maps

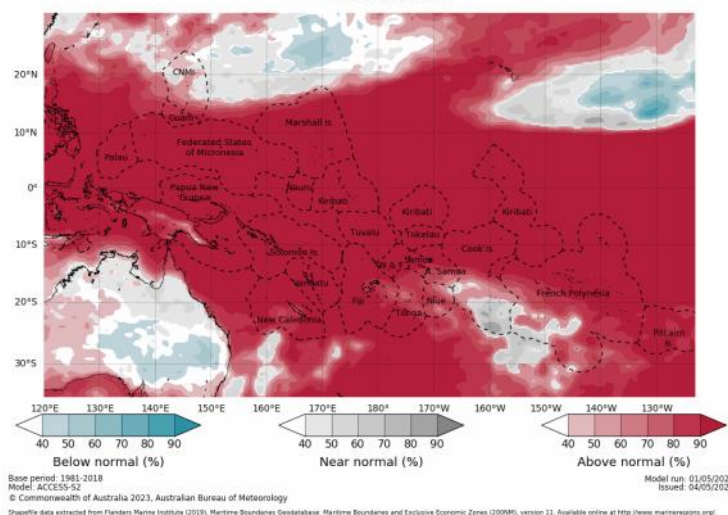
Tercile rainfall probabilities for
May to July 2023



Tercile maximum temperature probabilities for
May to July 2023



Tercile minimum temperature probabilities for
May to July 2023



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

SEASONAL RAINFALL OUTLOOK

May—July 2023



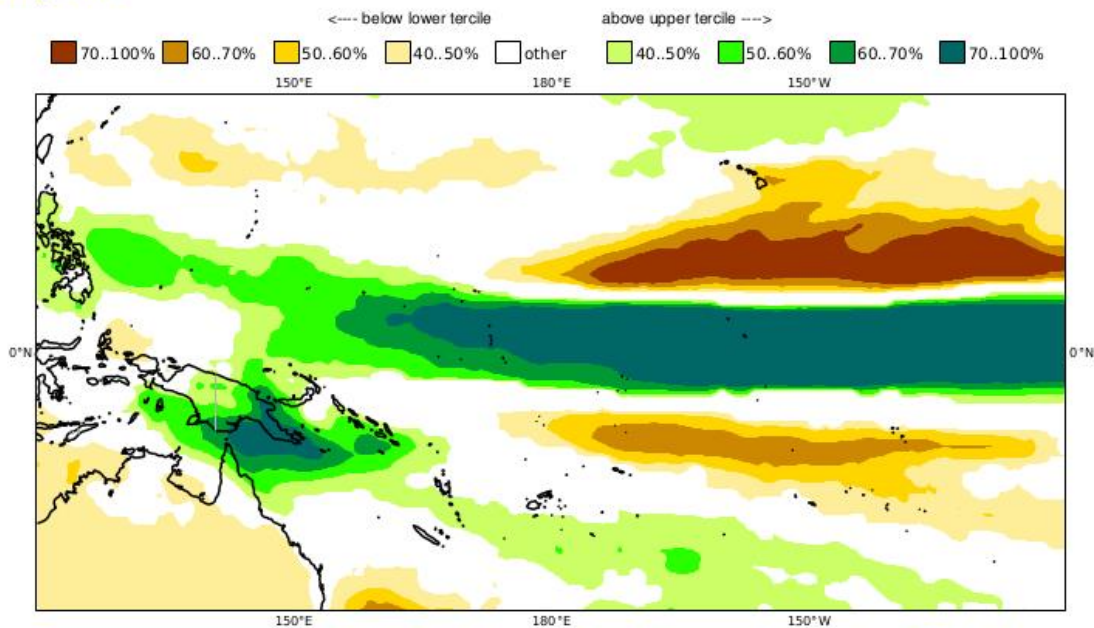
Copernicus (C3S multi-system)-Rainfall

Prob(most likely category of precipitation)

MJJ 2023

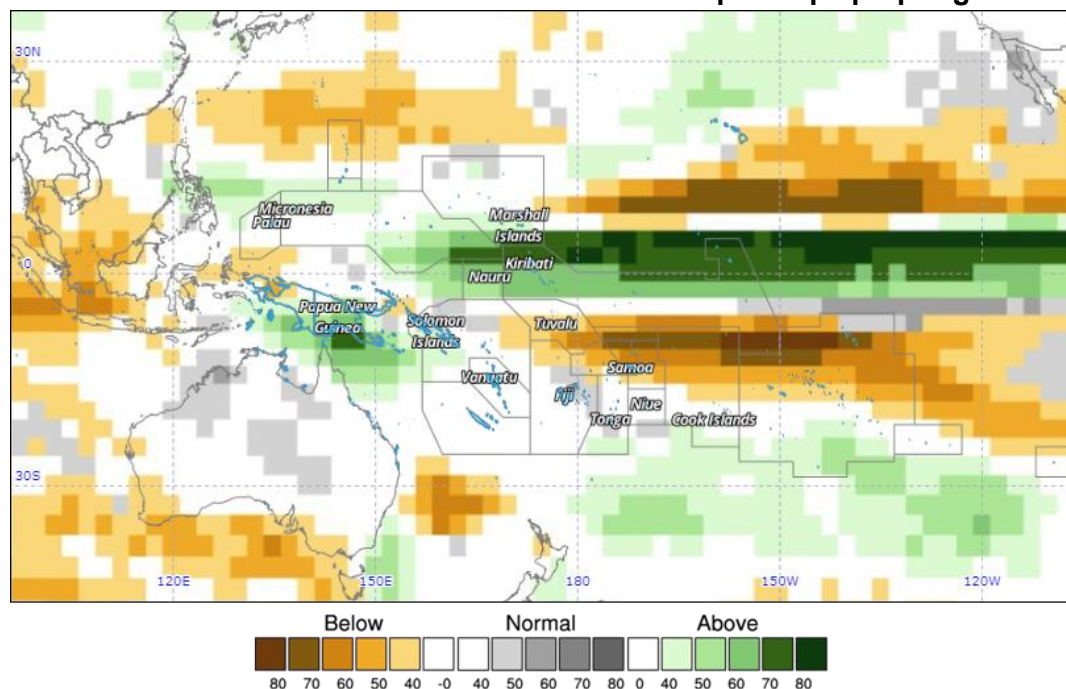
Nominal forecast start: 01/04/23

Unweighted mean



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

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



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

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

Generated using CLIK® (2023-5-9)

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TROPICAL CYCLONE

2022/2023 Season



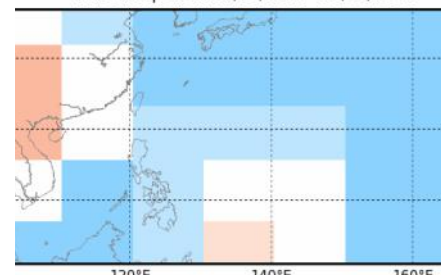
In the southwest Pacific, the 2022-23 tropical cyclone ended on 30th April 2023. The outlook for the season favoured enhanced risk for tropical cyclone activity in the western part of the basin. In the central part of the region, cyclone risks were considered to be generally near-normal to below normal. 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. TC activity in the Western North Pacific occurs year around and with the possible development of El Niña, an increase in TC activity is supported, as stated in the PI-COF 12 regional statement.

It's important to remember that history showed that TC can happen outside the normal cyclone season and 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, especially if the system is slow-moving. 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 an increased risk between 24 and 30 May around the Philippines, Palau and far western FSM regions in the northwest Pacific.

ACCESS-S Weekly Forecasts –Northwest Pacific

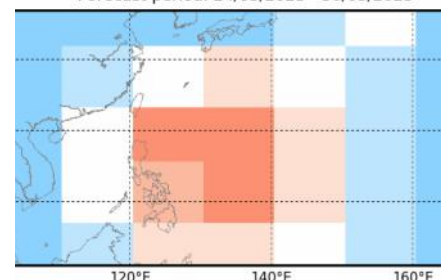
a from normal chance of Tropical Cyclone's in the Nor
Forecast period: 17/05/2023 - 23/05/2023



d Risk Significantly Increased Risk
Percentage (%)

robability in overlapping 15 x 20 degree boxes
123. Australian Bureau of Meteorology Model: ACCESS_S2 Model Run: 1

a from normal chance of Tropical Cyclone's in the Nor
Forecast period: 24/05/2023 - 30/05/2023

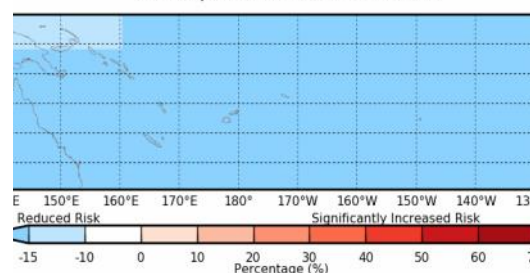


d Risk Significantly Increased Risk
Percentage (%)

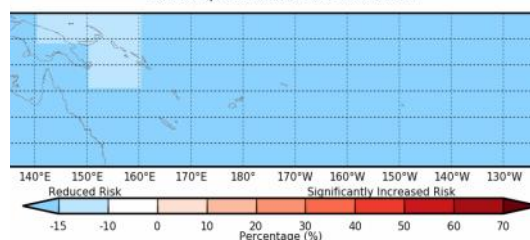
robability in overlapping 15 x 20 degree boxes
123. Australian Bureau of Meteorology Model: ACCESS_S2 Model Run: 1

ACCESS-S Weekly Forecasts –Southwest Pacific

Difference from normal chance of Tropical Cyclone's in the South Pacific
Forecast period: 17/05/2023 - 23/05/2023



robability in overlapping 15 x 20 degree boxes
123. Australian Bureau of Meteorology Model: ACCESS_S2 Model Run: 09/05/2023



Model anomaly probability in overlapping 15 x 20 degree boxes
south of Australia 2023, Australian Bureau of Meteorology Model: ACCESS_S2 Model Run: 09/05/2023 Issued

Individual Model Links

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

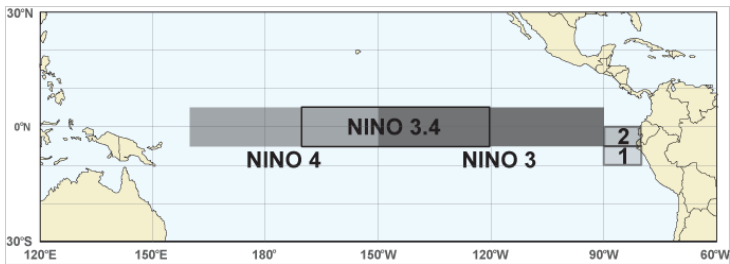
20 degrees Celsius Isotherm Depth

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