

Monthly Climate Bulletin

March 2023



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Photo Credit: Molly Powers (SPC) Samoa Tide Gauge





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Issued 12 April 2023

- El Niño-Southern Oscillation is currently neutral (neither La Niña nor El Niño).
- The Madden-Julian Oscillation (MJO) strengthened recently moved into the western Pacific region.
- The SPCZ displaced to the southwest over the Solomon Islands and Vanuatu, while the ITCZ was weaker than average.
- Sea surface temperatures (SST) in March 2023 were cooler than average across much of the tropical Pacific Ocean, extending from around 165°E in a broadening northeastern wedge to 110°W.
- The Coral bleaching Outlook to 30 April shows area of Warning to 'Alert Level 2' ratings coinciding with the peak positive SST anomalies extending southeast from southeastern PNG, Solomon Islands, northern Vanuatu, northern Fiji, Samoa, and central Cook Islands.
- For April-June 2023, the models unanimously agree on above normal rainfall for most of FSM, central Marshall Islands, the southeast of PNG's EEZ, southern Solomon Islands, and Vanuatu. They are also unanimous in showing that below normal rainfall is likely or very likely for southern parts of central and eastern Kiribati, Tokelau, northern Cook Islands and northern French Polynesia.
- The ACCESS-S weekly tropical cyclone forecast model shows an increased risk between 15 and 21 April around the southeast PNG and western Solomon Islands region in the southwest Pacific, and around the Philippines, Palau and western FSM in the northwest Pacific.

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EL NIÑO–SOUTHERN OSCILLATION

ENSO is neutral. El Niño WATCH continues

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

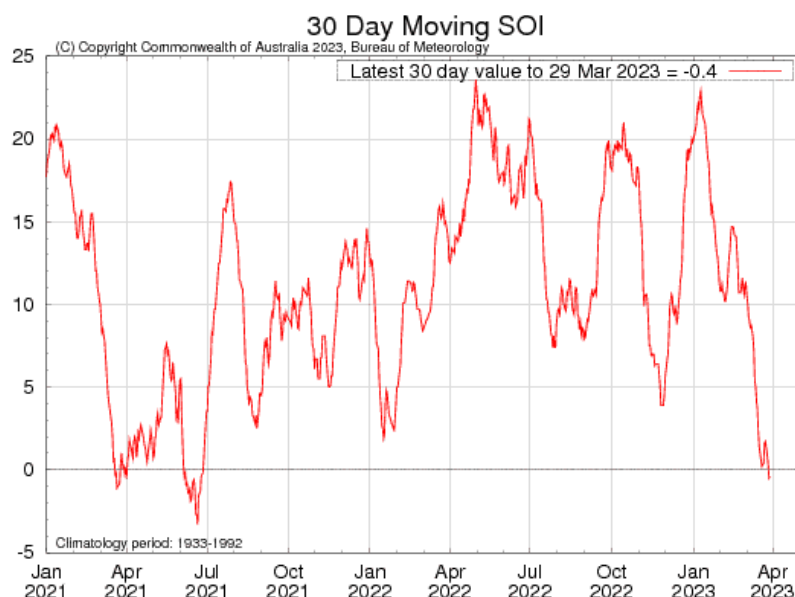
El Niño-Southern Oscillation is currently neutral (neither La Niña nor El Niño). Oceanic and atmospheric indicators for the tropical Pacific Ocean are at neutral ENSO levels.

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. However, there are some signs 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 26 March 2023 was +0.9 while the 90-day SOI value was +9.0. The 30-day SOI has continued to decrease over the past fortnight, and remains within neutral values.



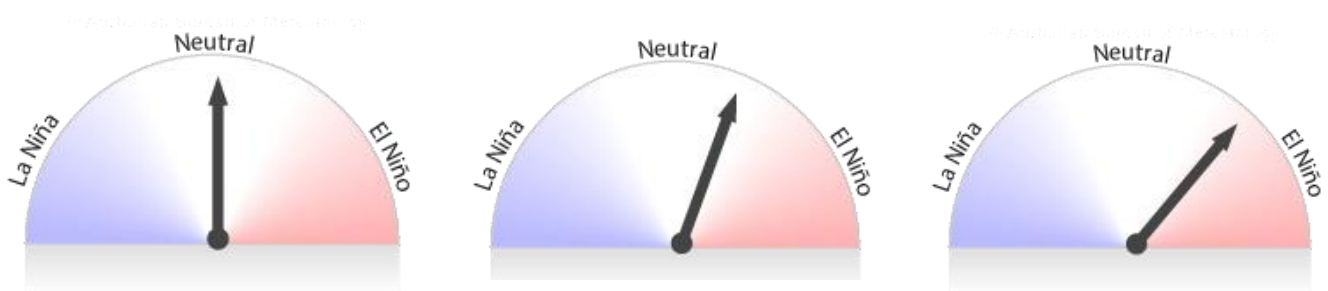


EL NIÑO–SOUTHERN OSCILLATION

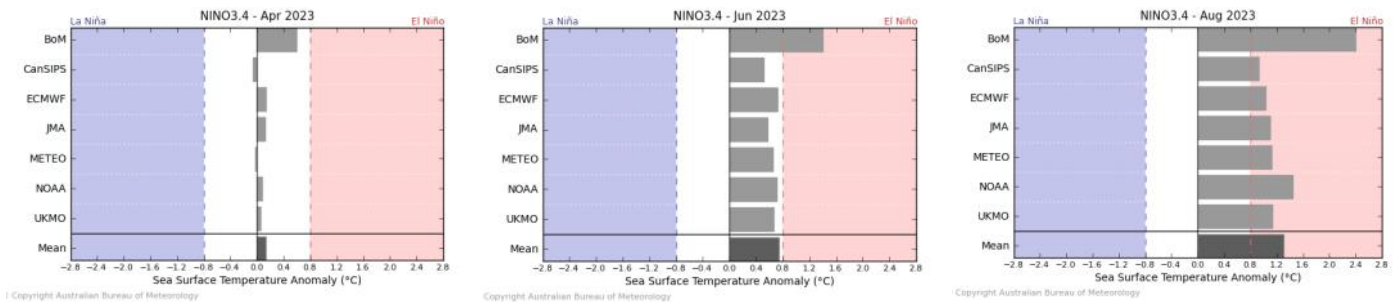
ENSO is neutral. El Niño WATCH continues

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

Bureau of Meteorology NINO3.4 ENSO Model Outlooks for April, June and August



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>

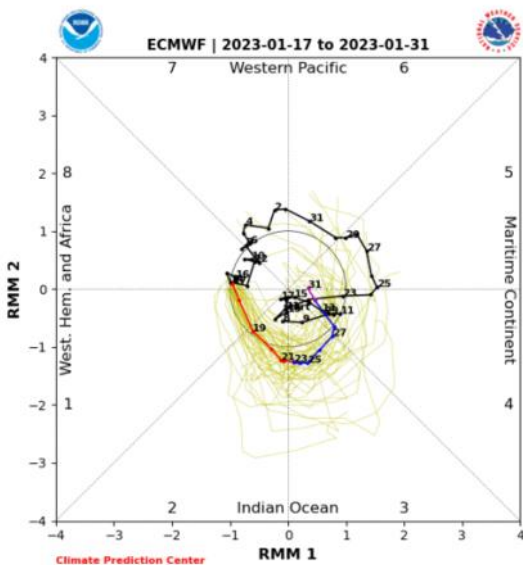
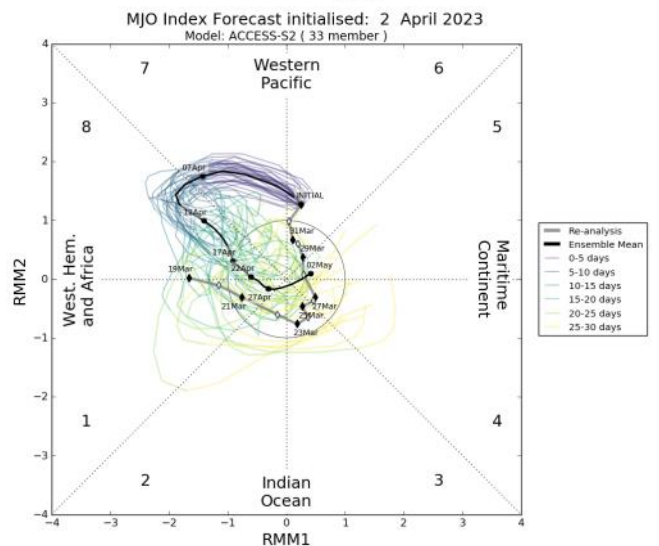
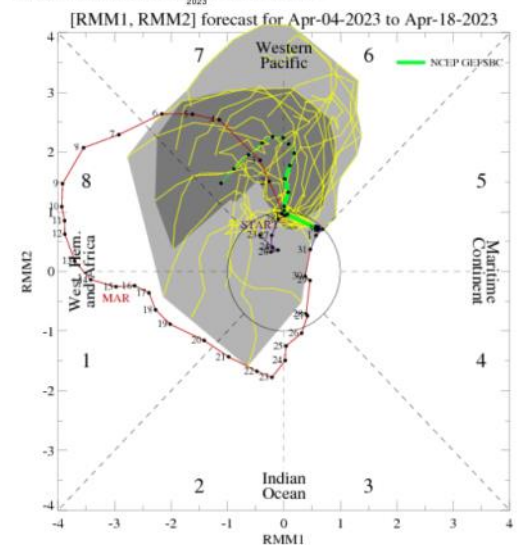
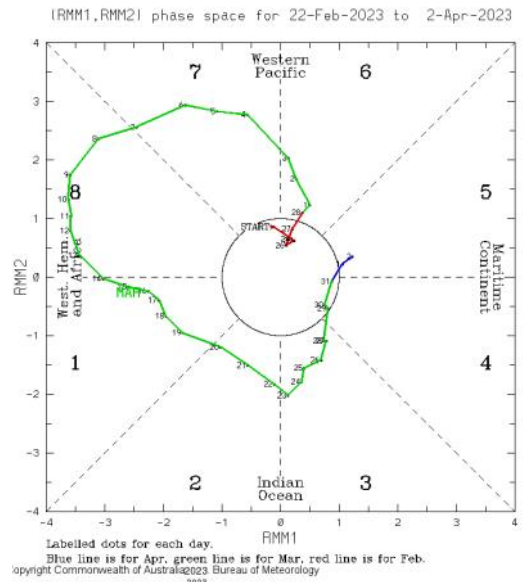
MADDEN–JULIAN OSCILLATION

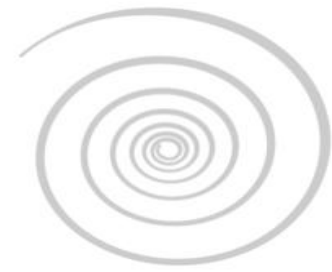
Click link to access [Tropical Climate Update](#) [Issued on Wednesday 04 April 2023]

During March, the Madden Julian Oscillation (MJO) was very active associated with a lot of rainfall and twin tropical cyclones (Judy and Kevin) in the south Pacific.

A strengthening pulse of the Madden Julian Oscillation (MJO) recently moved into the western Pacific region. Climate models generally agree that this pulse of the MJO will continue to strengthen as it tracks towards the central Pacific region later this week. It is then likely to weaken and may become indiscernible by the middle of April.

This is an abbreviated version of the Tropical Climate Update. Click on the [Weekly Tropical Update](#) for more information .



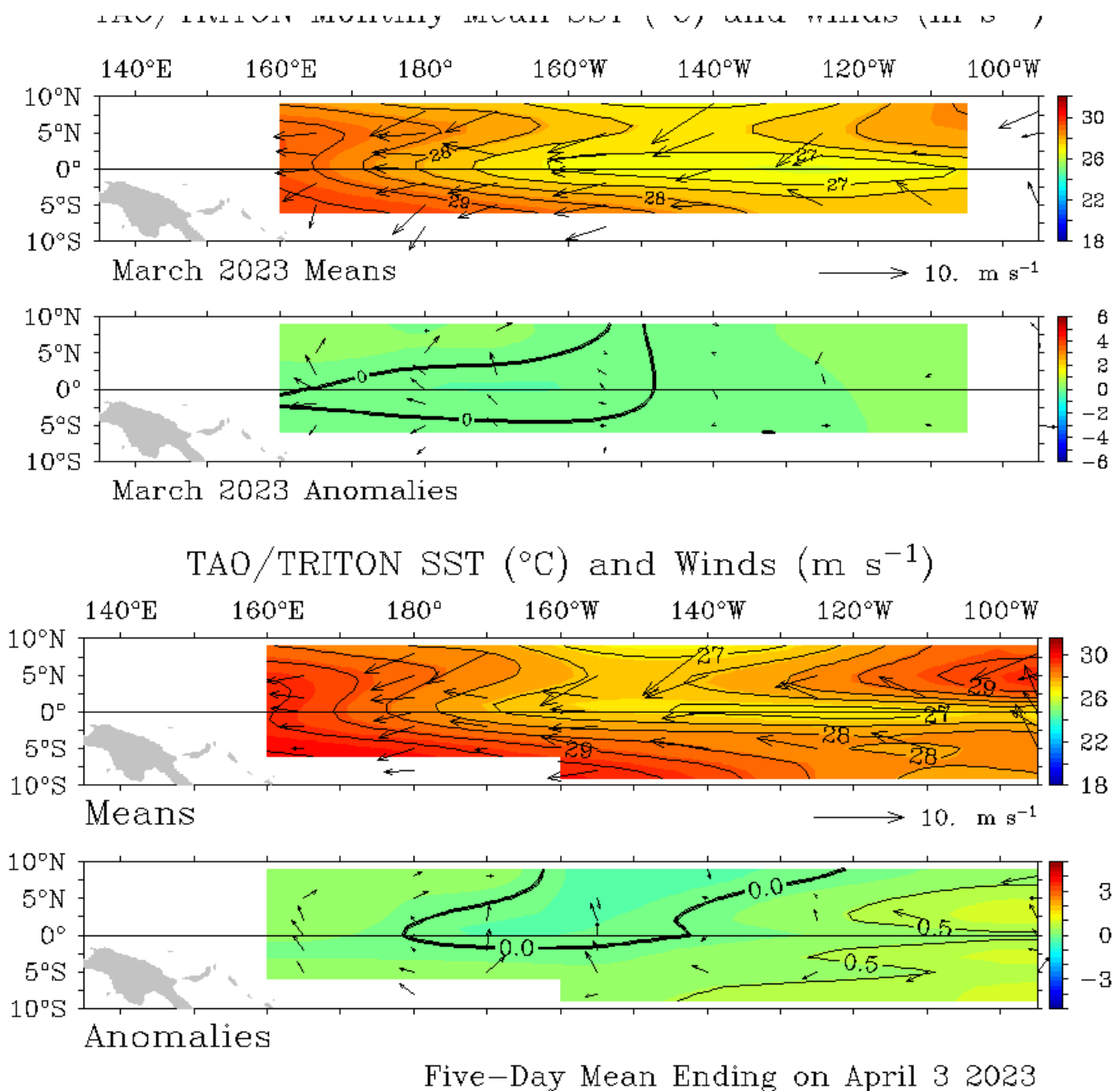


WIND

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

For the five days ending 03 April 2023, the trade winds were near normal over most of the near-equatorial Pacific. During March, the trade winds were close to average east of 170°W, but somewhat stronger than average to the west.

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

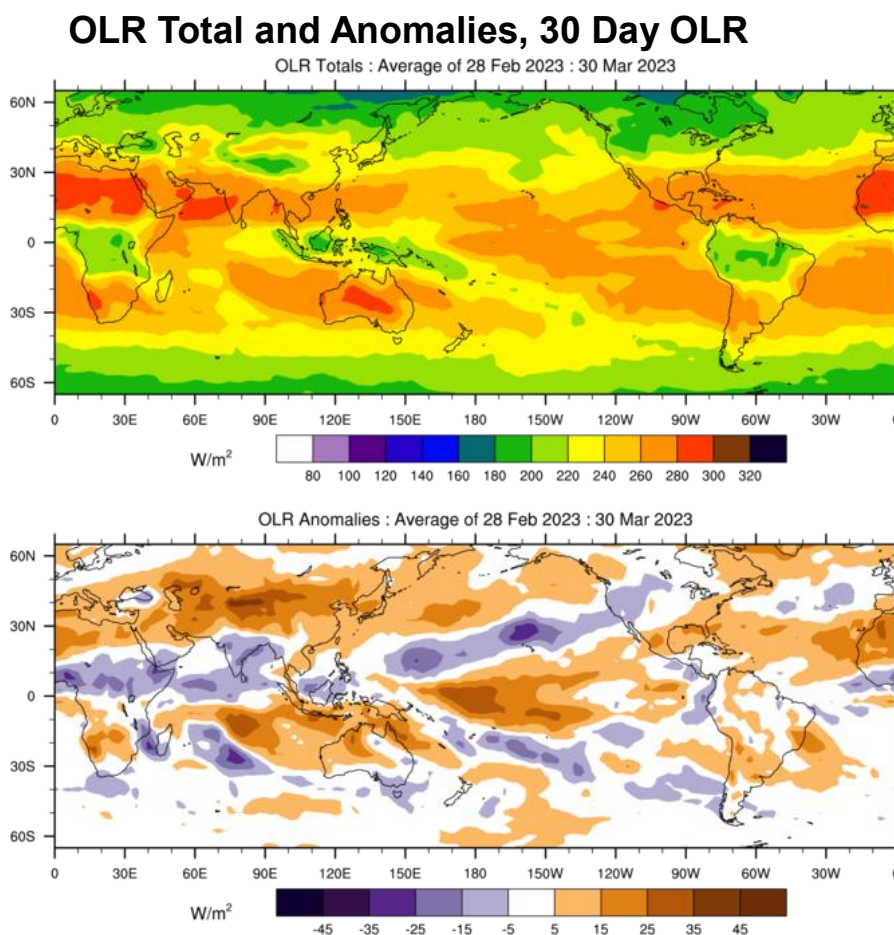
Click link to access [OLR](#)



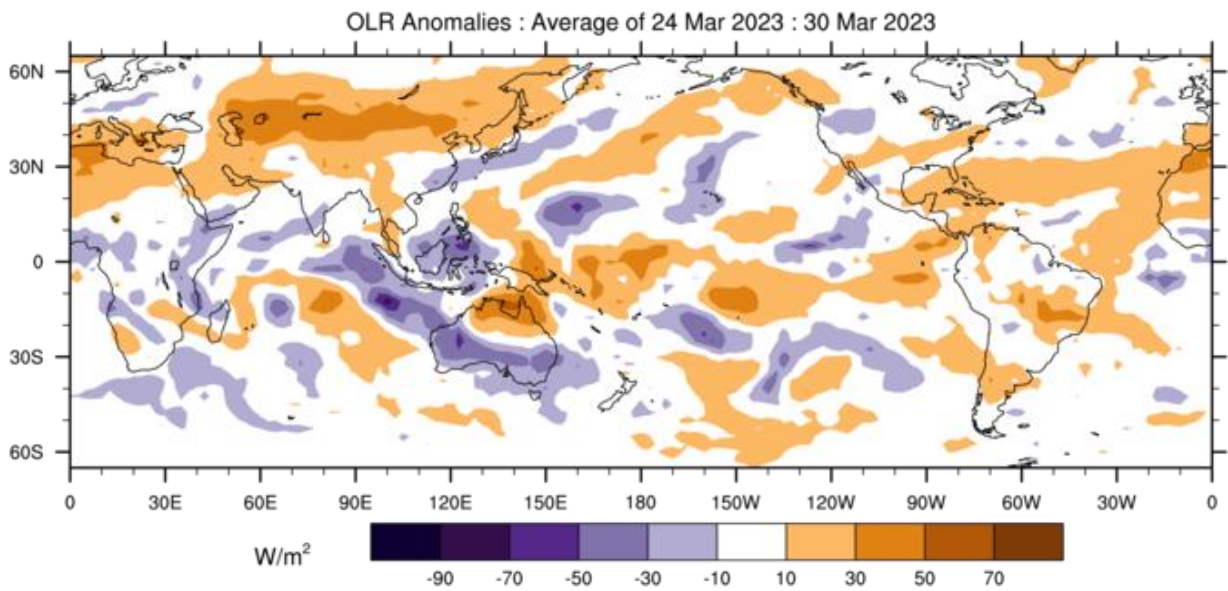
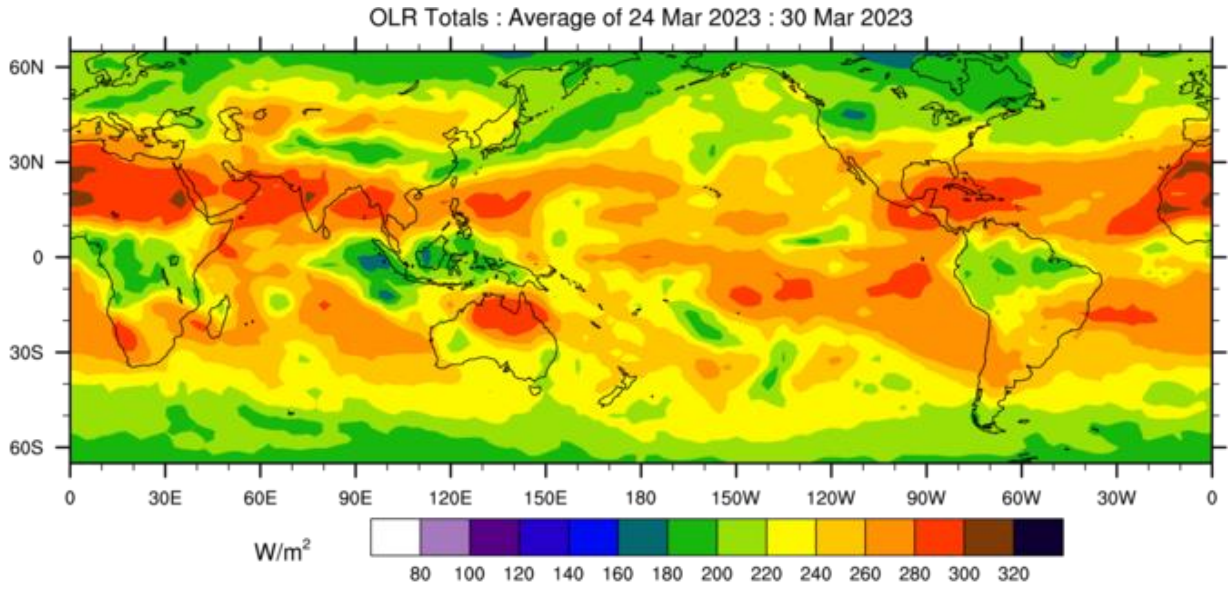
The main features of the March 30-day OLR total and anomaly maps were the anomalously high OLR centre (reduced convection) centred near the equatorial Date Line and the SPCZ (evident on both totals and anomalies) which was displaced to the southwest over the Solomon Islands and Vanuatu. The main centre of low OLR (increased convection) was situated over PNG and the Maritime continent.

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 30 March showed active convection over the Maritime Continent.

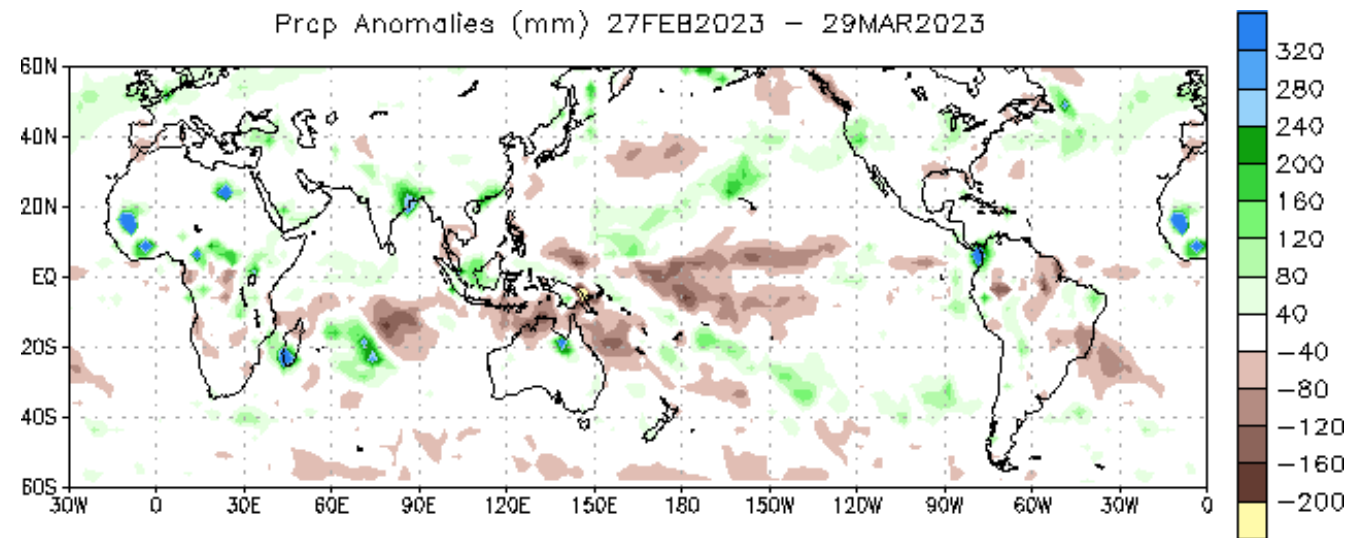
Note: Global maps of OLR below highlight regions experiencing increased or decreased cloudiness. The top panel is the total OLR in Watts per square metre (W/m^2) and the bottom panel is the anomaly (current minus the 1979-1998 climate average), in W/m^2 . In the bottom panel, negative values (blue shading)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



OLR Total and Anomalies, 7 Day OLR

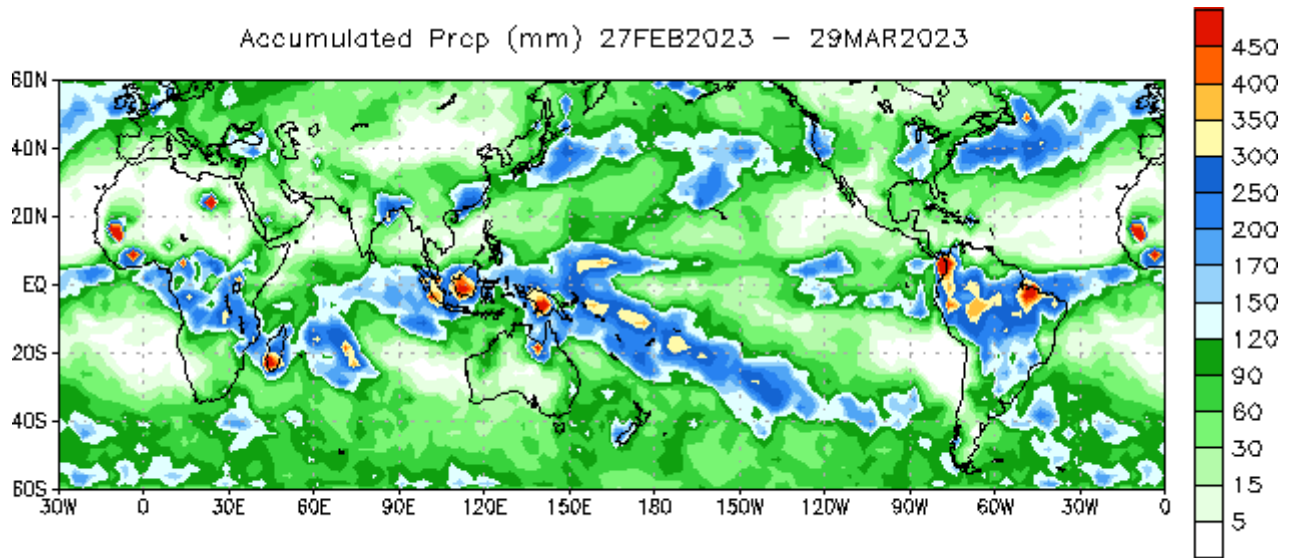


(C) Copyright Commonwealth of Australia 2023. Bureau of Meteorology

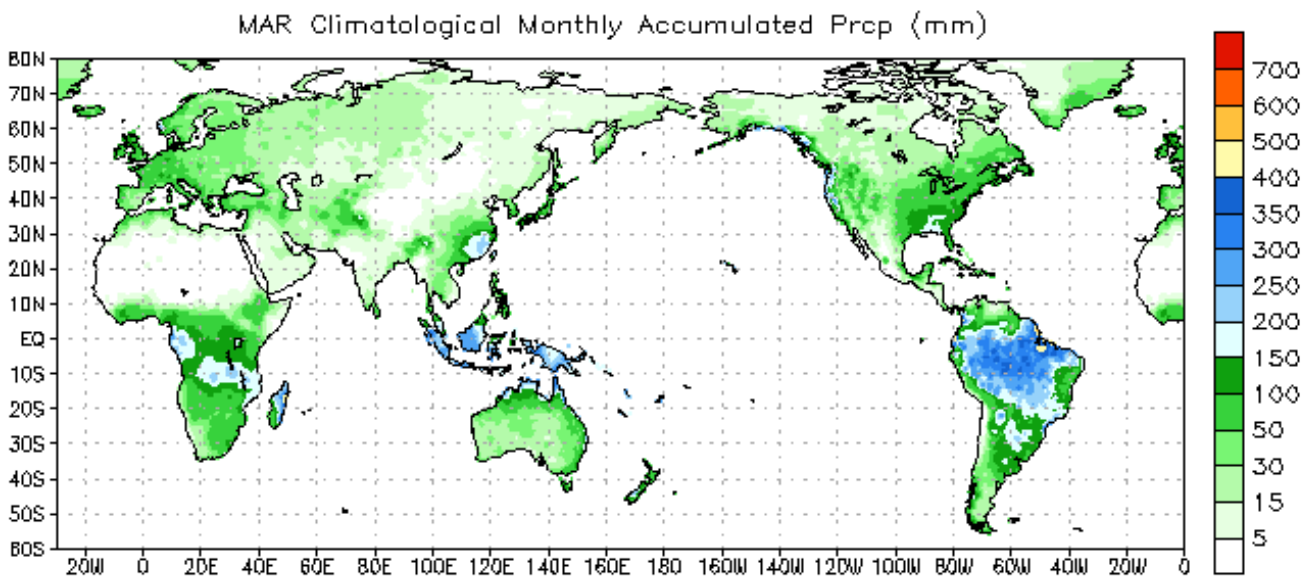


Data Source: NCEP CMAP Precipitation
Climatology (1991-2020)

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

OCEAN CONDITIONS

SEA SURFACE TEMPERATURE

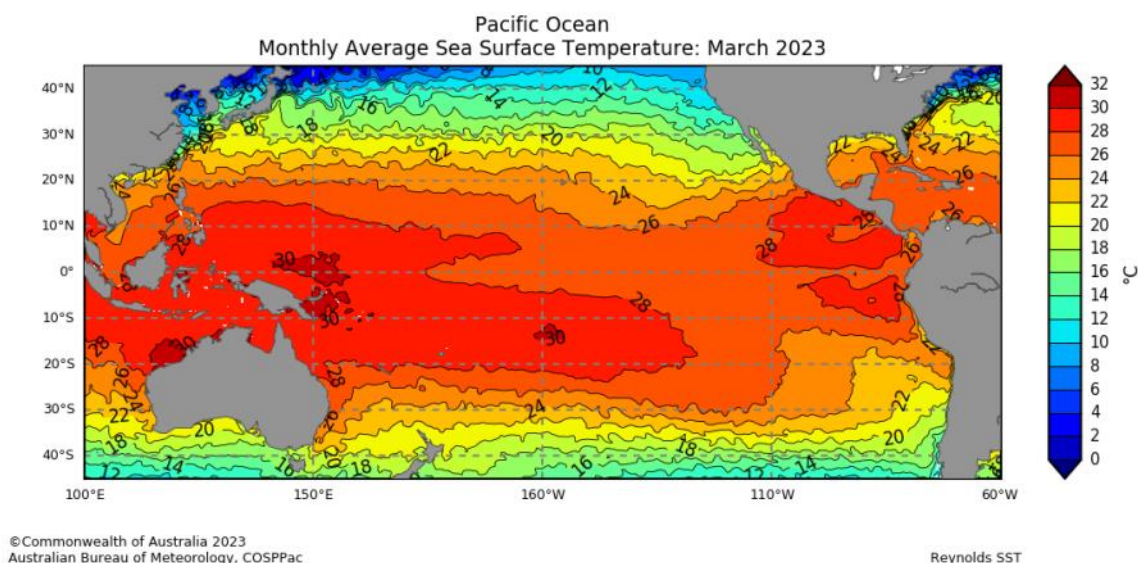


Click link to access [Pacific Community COSPPac Ocean Portal](#)

Sea surface temperatures (SST) in March 2023 were cooler than average across much of the tropical Pacific Ocean, extending from around 165°E in a broadening northeastern wedge to 110°W. Negative anomalies ranging from -0.5°C to -1.0°C were observed in Nauru and Kiribati. A boomerang-shape of warm anomalies, ranging 0.5°C to 1.0°C, surrounded the cool anomalies in both hemispheres and more along the north American coast.

Record-high March SSTs occurred in northern FSM and patches in central Cook Islands. 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 March were observed in southern Kiribati, and the far southern Fiji.

Mean Sea Surface Temperature

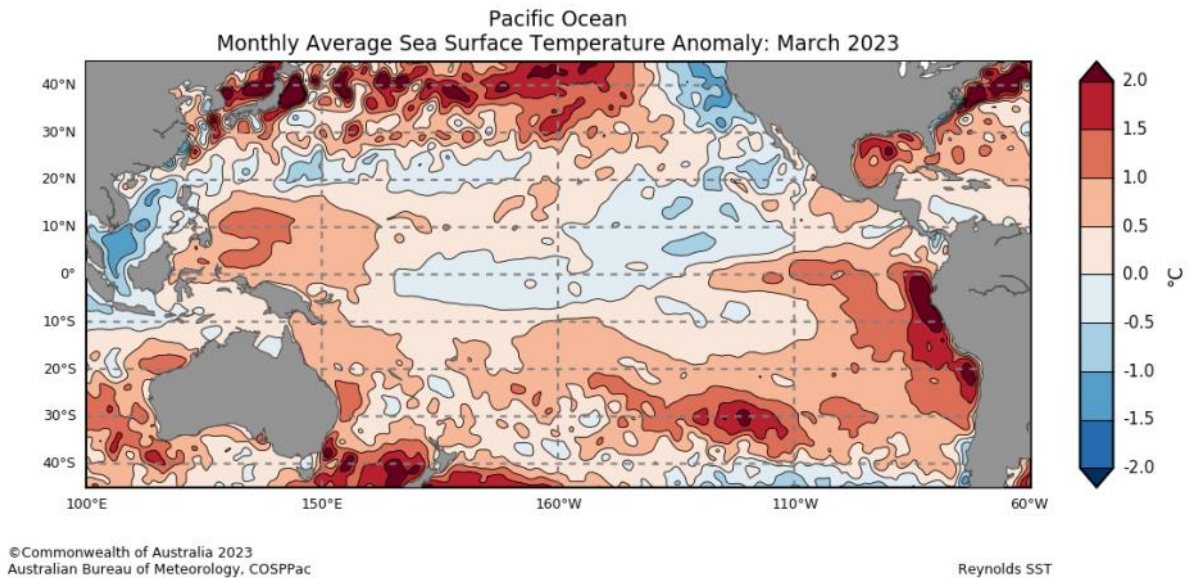


OCEAN CONDITIONS

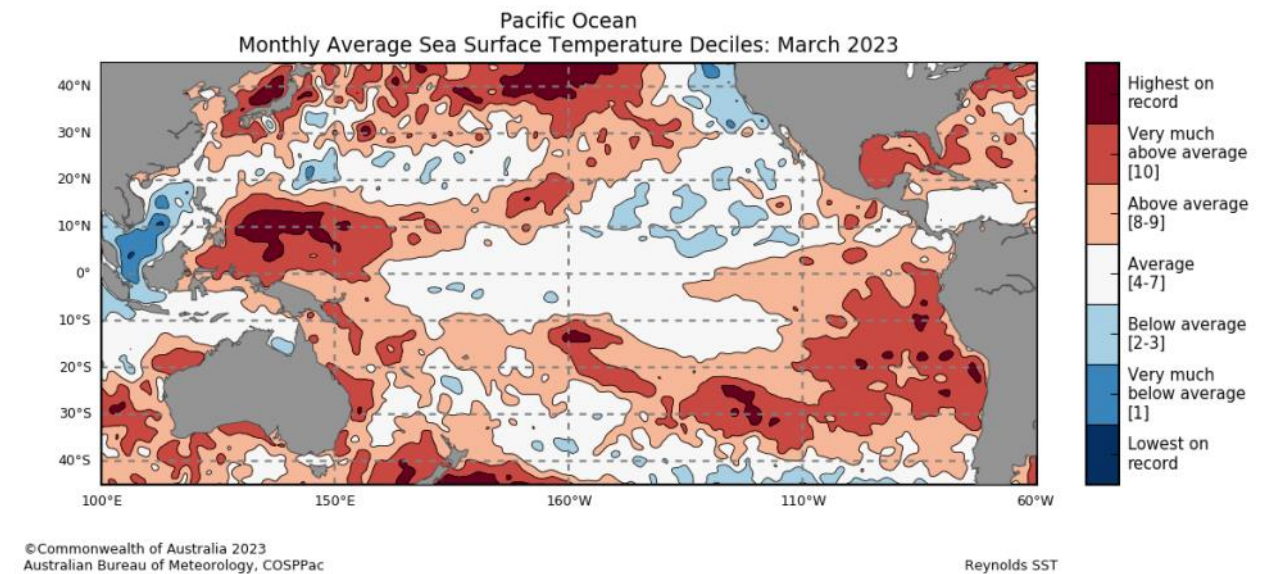
Click link to access [SEA SURFACE TEMPERATURE](#)



Anomalous Sea Surface Temperature



Sea Surface Temperatures Deciles



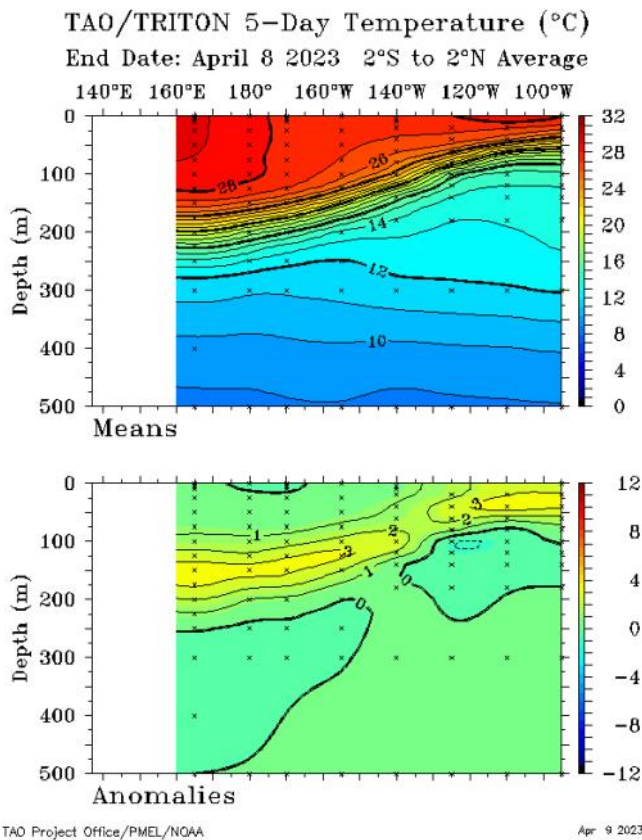
OCEAN CONDITIONS

SUB SURFACE

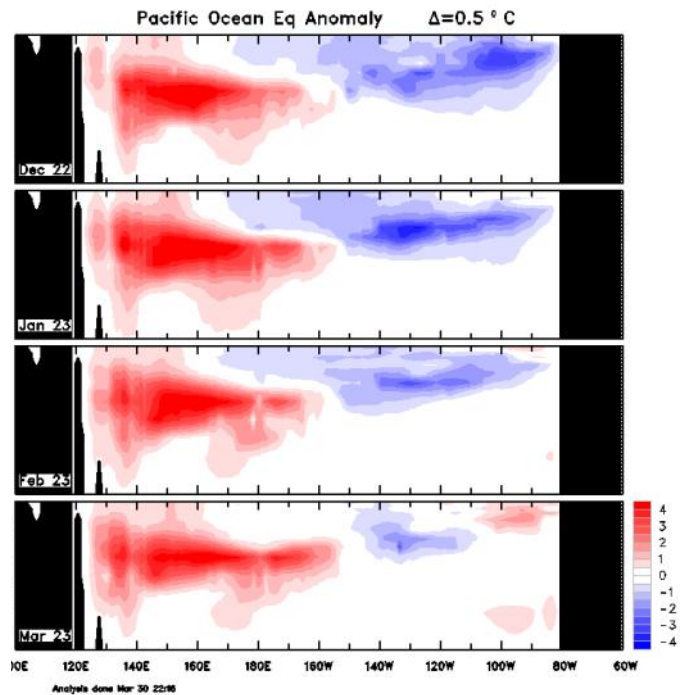


The four-month sequence of equatorial Pacific sub-surface temperature anomalies (to 23 March 2023) shows warm anomalies present in the western to central equatorial Pacific (west of 160° W), mostly between 100 m and 200 m depth in the central Pacific and across much of the column depth in the west. Anomalies reached more than 3 °C warmer than average across much of this region. Weak cool anomalies persist in a small area of the top 150 m of the eastern equatorial Pacific sub-surface, between around 155°W and 100°W. Compared to previous months, cool anomalies have steadily decreased in strength and extent, while warm anomalies have expanded eastward during March compared to February.

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

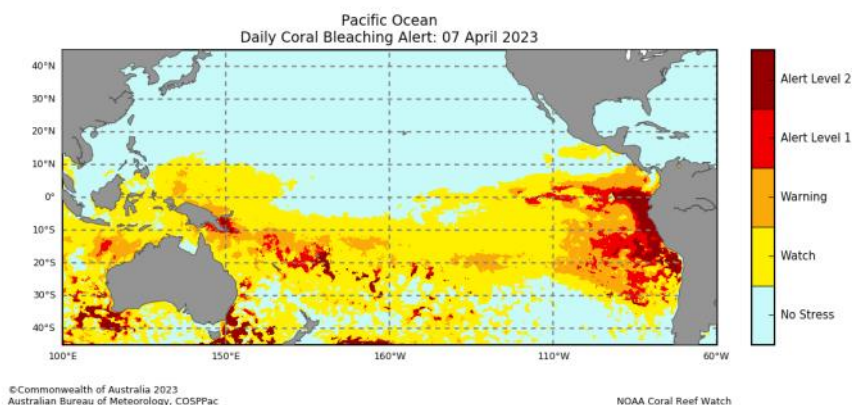
CORAL BLEACHING



The daily Coral Bleaching Alert status for 07 April 2023 shows 'Alert Level 2' southeast of PNG, and southeast of Fiji. 'Alert Level 1' were observed around southeast Solomon Islands, Vanuatu, western Fiji and patches of south French Polynesia. Patches of 'Warning' are shown for eastern Palau, far western FSM, PNG, southern Solomon Islands, northern Fiji and Samoa. The four-week Coral Bleaching Outlook to 30 April shows area of Warning to 'Alert Level 2' ratings coinciding with the peak positive SST anomalies extending southeast from southeastern PNG, Solomon Islands, northern Vanuatu, northern Fiji, Samoa, and central Cook Islands.

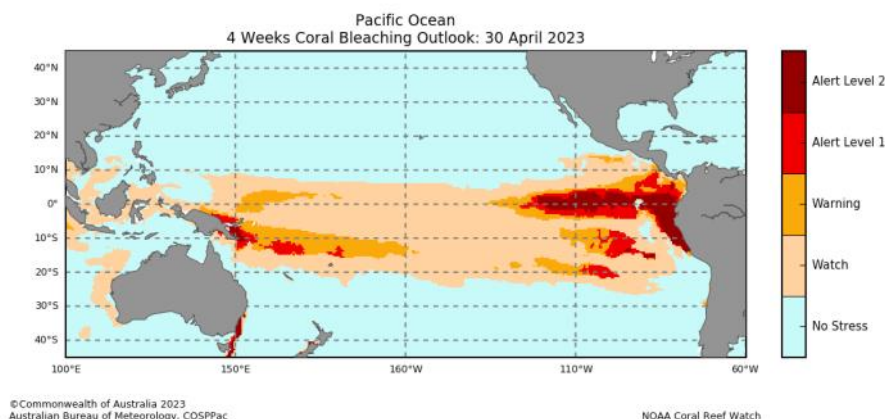
Daily Coral Bleaching Alert

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



4 Weeks Coral Bleaching Outlook

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



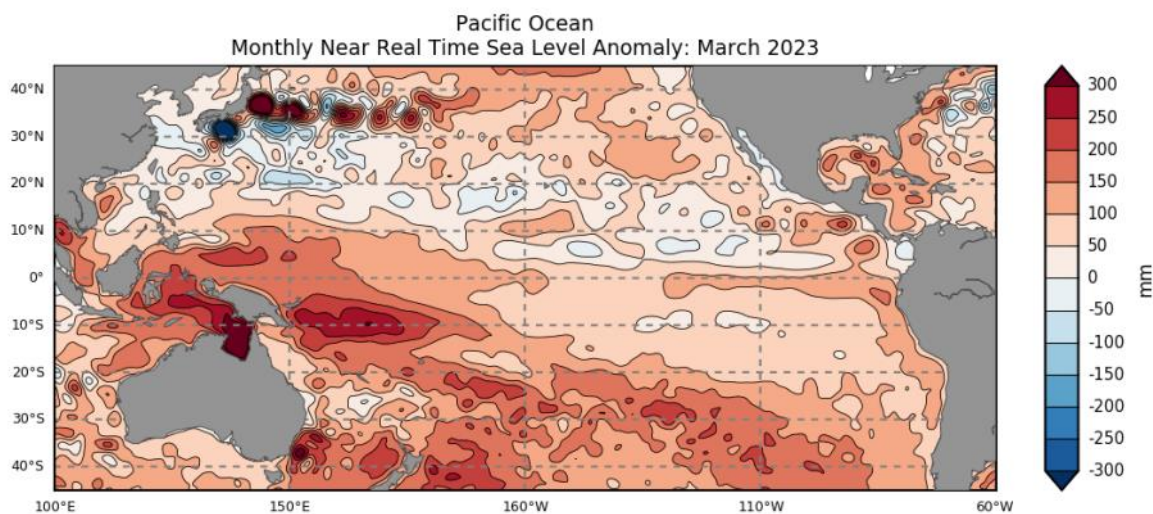
OCEAN CONDITIONS

OCEAN SURFACE CURRENTS AND SEA LEVEL

Sea level in March was above normal over COSPPac countries. Anomalies above +250 mm were observed in eastern PNG and eastern Solomon Islands. Anomalies of +200 mm were observed in most of southeast PNG and Solomon Islands. Patches of sea level between +100 mm +200 mm were observed in most of the COSPPac countries.

Monthly Sea Level Anomalies

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



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Australian Bureau of Meteorology, COSPPac

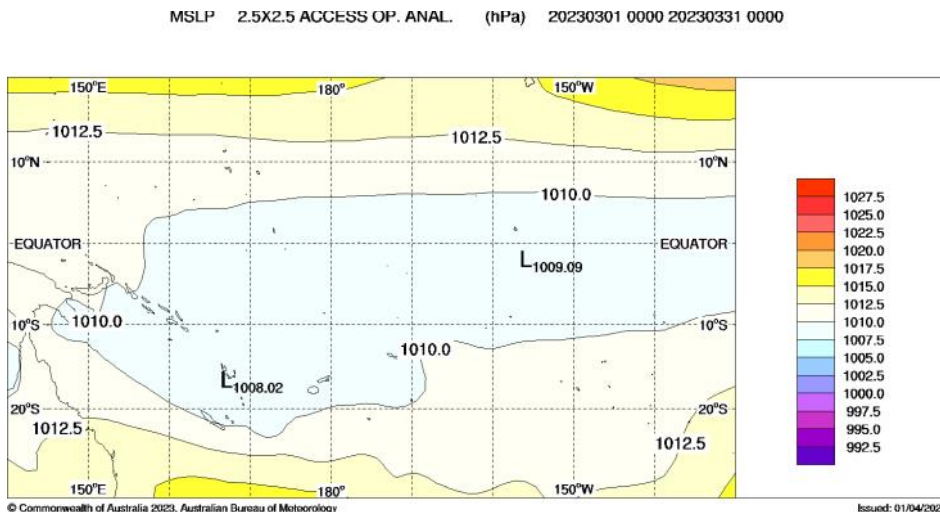
AVISO Ssalto/Duacs SLA

MEAN SEA LEVEL PRESSURE

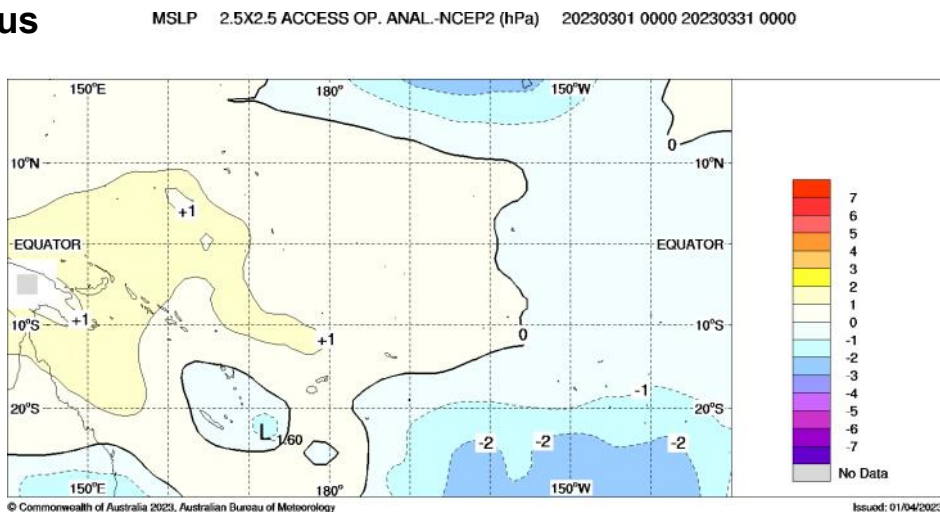
The March mean sea level pressure (MSLP) anomaly map shows mostly negative anomalies of 1hPa or greater over southern Vanuatu, as well as east of the Date Line south of Niue, Cook Islands and French Polynesia. Positive anomalies of 1hPa or greater were analysed over PNG and western Solomon Islands.

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

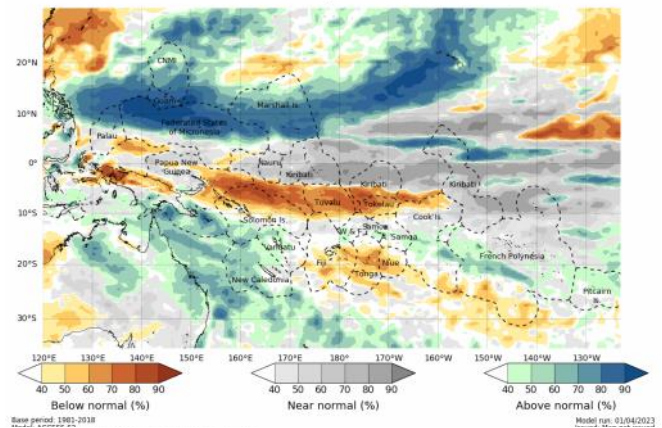
April—June 2023



The ACCESS-S model forecast for April 2023, favours below normal rainfall for northeast PNG, much of Solomon Islands, southern Fiji, Tuvalu, Tonga, Niue, southern Phoenix Islands (Kiribati), and the far northern Cook Islands. Above normal rainfall is likely or very likely for northern Palau, CNMI, Guam, most of FSM, most of RMI, the southeast of PNG's EEZ, the far southwest Solomon Islands, New Caledonia, northern Vanuatu, Samoa, southern Cook Islands, and central French Polynesia.

The three-month rainfall outlook (April-June 2023) is very similar to the April outlook as it favours below normal rainfall for Tuvalu, Tokelau, eastern Fiji, Tonga, Niue, northern Cook Islands, the far southern Line Islands (Kiribati), and northern French Polynesia. Above normal rainfall is likely or very likely for Palau, Guam, northern CNMI, FSM, central and southern RMI, the southeast and northwest of PNG's EEZ, southern Solomon Islands, New Caledonia, Vanuatu, northern Fiji, southern French Polynesia and Pitcairn Islands.

Monthly [ACCESS-S](#) Maps



The APEC Climate Centre multi-model for April-June 2023 is also very similar to the ACCESS-S model. The main differences is a decreased wet signal for Palau, FSM and Guam in APEC.

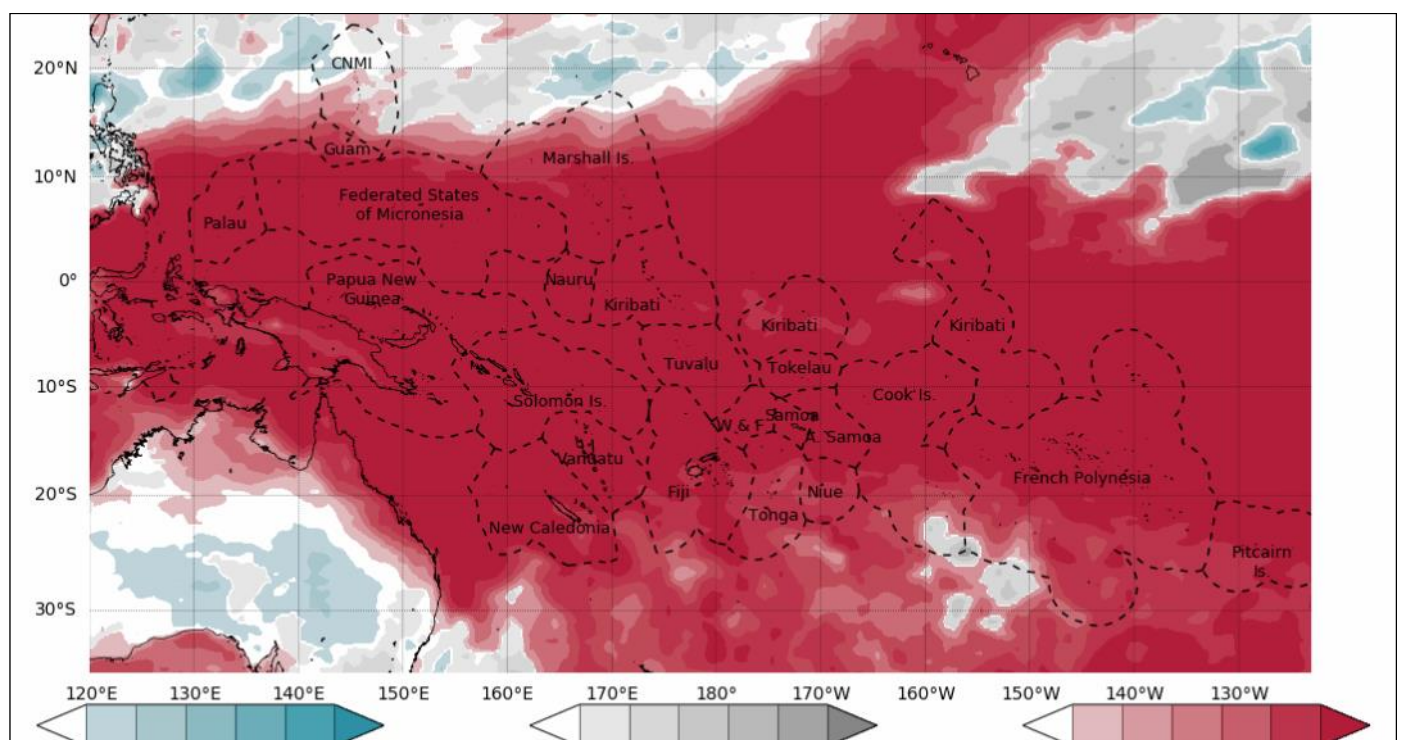
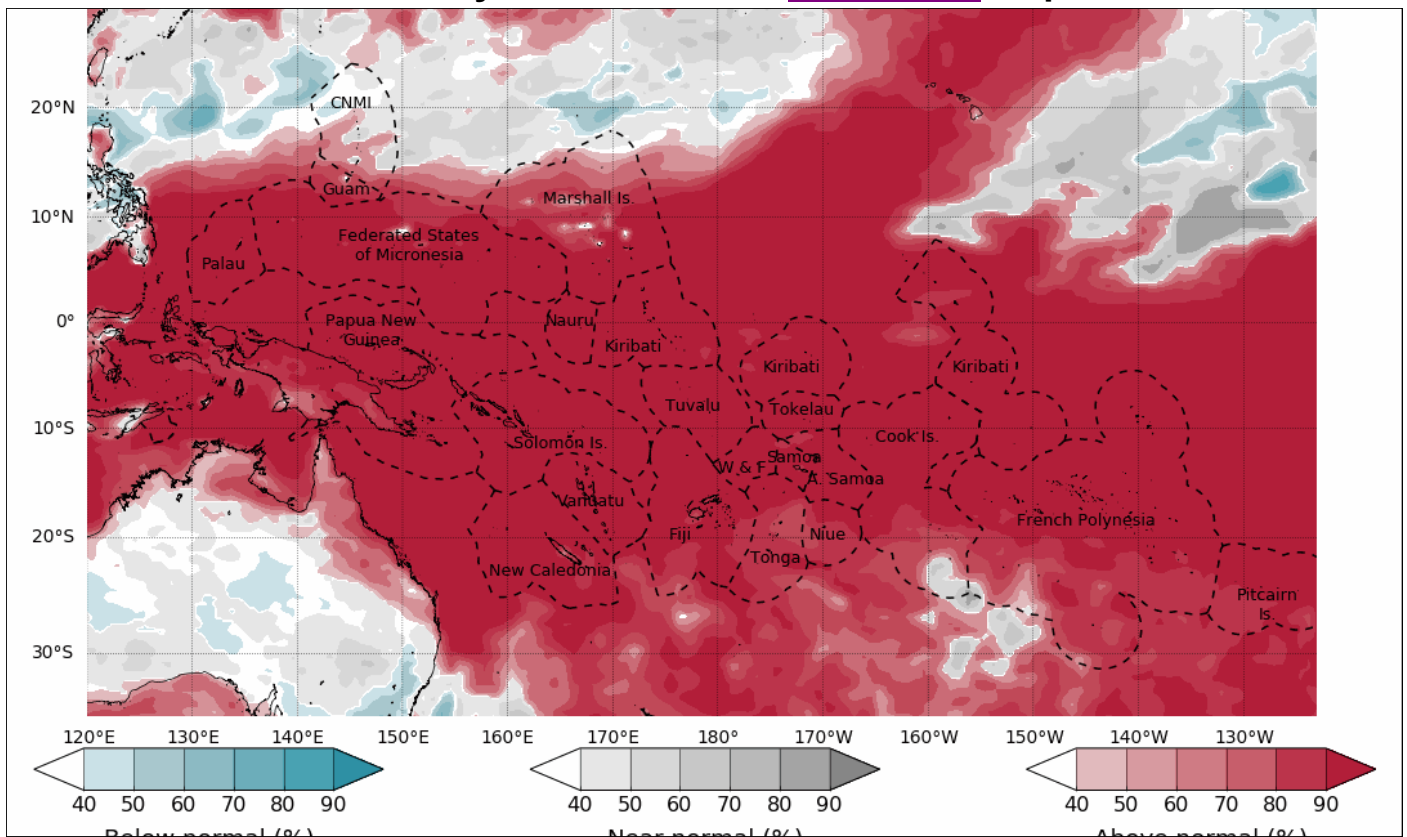
For April-June 2023, there is much less agreement among the models compared with the situation during the recent La Niña. They unanimously agree on above normal rainfall for most of FSM, central Marshall Islands, the southeast of PNG's EEZ, southern Solomon Islands, Vanuatu. The models are also unanimous in showing that below normal rainfall is likely or very likely for central and eastern Kiribati, Tokelau, northern Cook Islands and northern French Polynesia.

SEASONAL TEMPERATURE OUTLOOK

April—June 2023



Monthly Tmax and Tmin ACCESS-S Maps



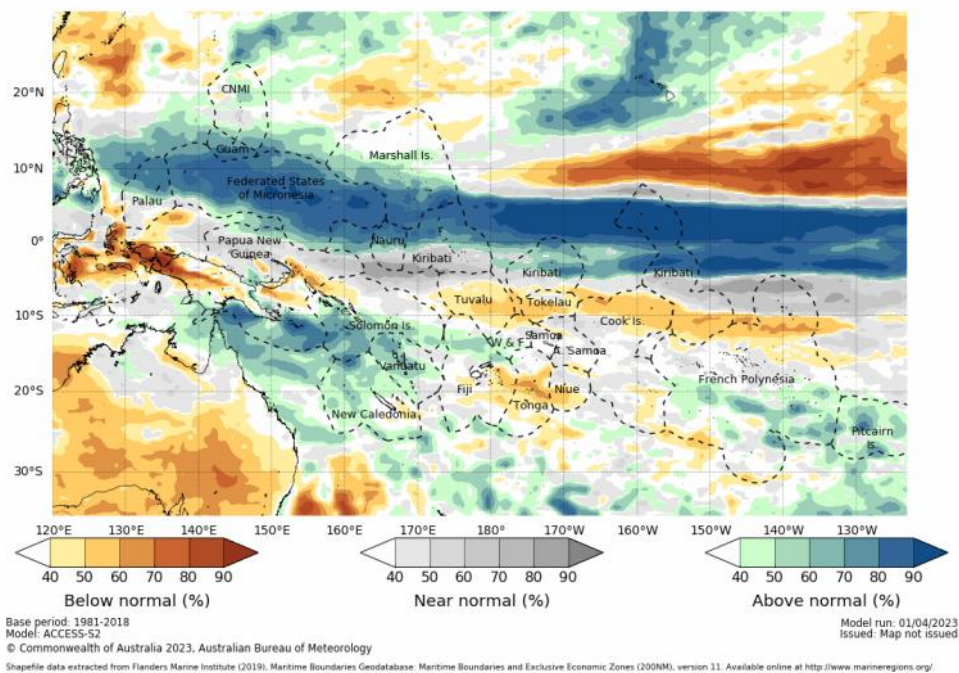
SEASONAL RAINFALL OUTLOOK

April—June 2023

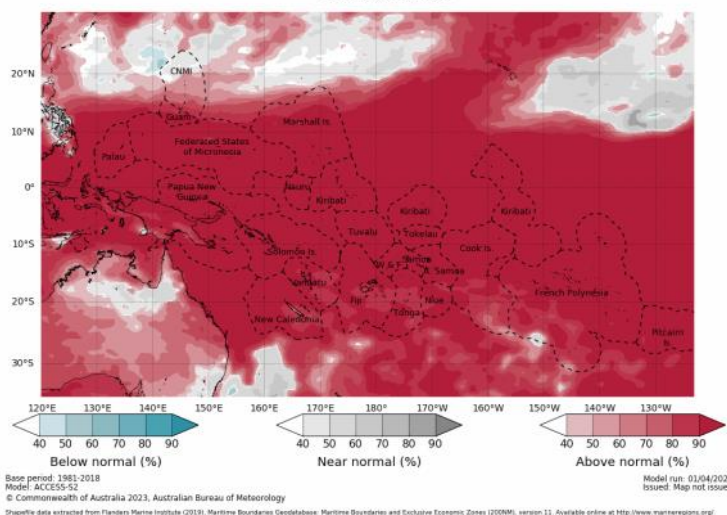


Seasonal ACCESS-S maps

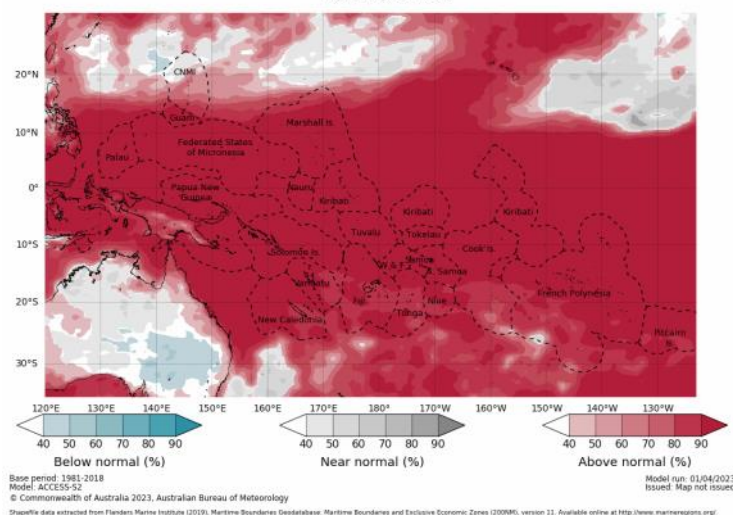
Tercile rainfall probabilities for April to June 2023



Tercile maximum temperature probabilities for April to June 2023



Tercile minimum temperature probabilities for April to June 2023



About ACCESS-S <http://access-s.clide.cloud/>

SEASONAL RAINFALL OUTLOOK

April—June 2023



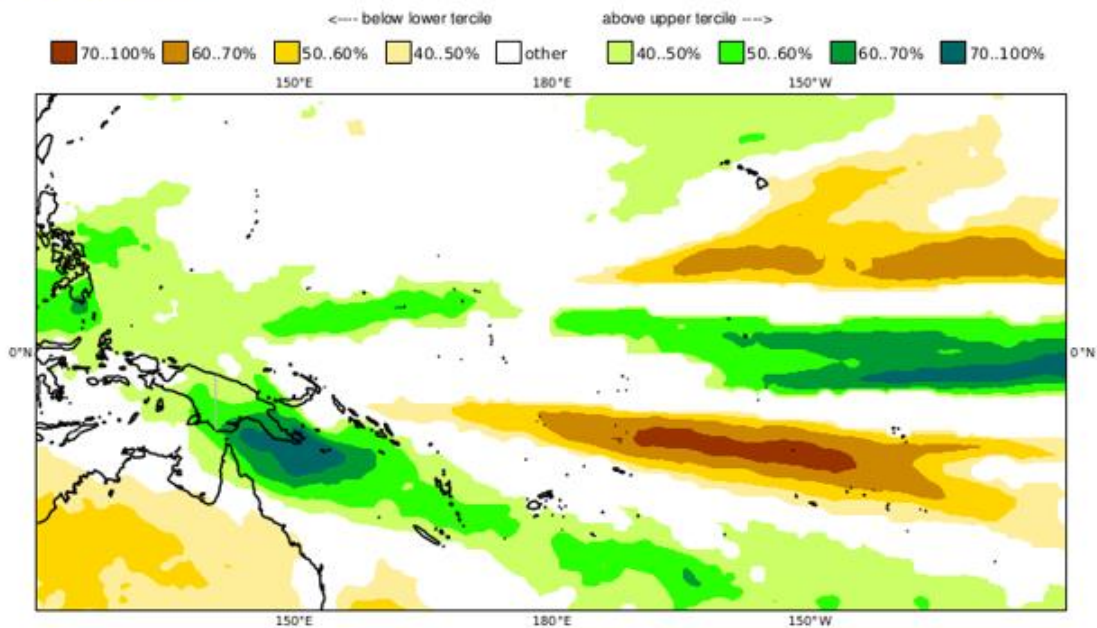
Copernicus (C3S multi-system)-Rainfall

Prob(most likely category of precipitation)

AMJ 2023

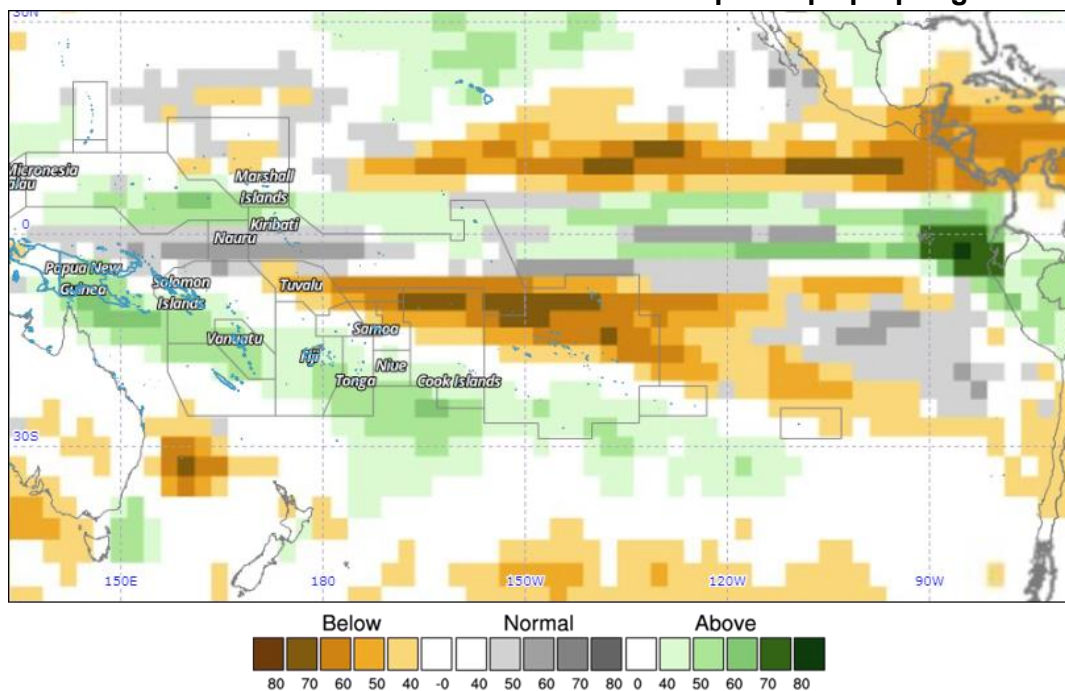
Nominal forecast start: 01/03/23

Unweighted mean



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

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



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

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

Generated using CLIK® (2023-4-10)

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TROPICAL CYCLONE

2022/2023 Season

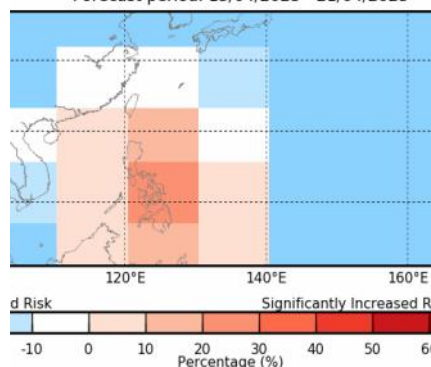


The northwest Pacific, tropical cyclone season is year round, with most cyclones occurring between May and October. Most TCs in the southwest Pacific occur between November and April. Associated with the decaying La Niña, models favoured slightly enhanced TC risk in the western Pacific. In the central part of south Pacific, TC risks are generally near-normal to below normal. These forecasts are part of the Pacific Islands Climate Outlook Forum-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).'

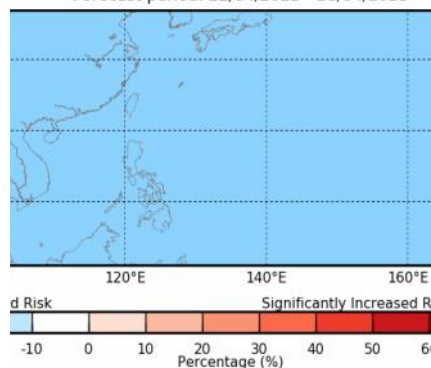
The weekly tropical cyclone forecast from the ACCESS-S model shows an increased risk between 15 and 21 April around the south-east PNG and western Solomon Islands region in the southwest Pacific, and around the Philippines, Palau and western FSM in the northwest Pacific.

ACCESS-S Weekly Forecasts –Northwest Pacific
 Difference from normal chance of Tropical Cyclone's in the North Pacific
 Forecast period: 15/04/2023 - 21/04/2023



Probability in overlapping 15 x 20 degree boxes
 123, Australian Bureau of Meteorology Model: ACCESS_S2 Model Run: 07/04/2023

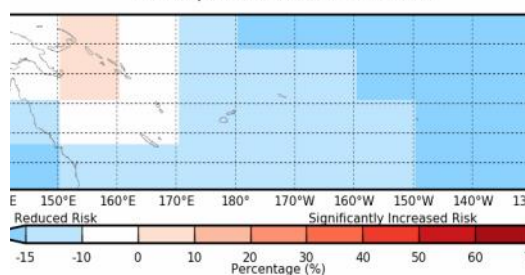
ACCESS-S Weekly Forecasts –Southwest Pacific
 Difference from normal chance of Tropical Cyclone's in the South Pacific
 Forecast period: 22/04/2023 - 28/04/2023



Probability in overlapping 15 x 20 degree boxes
 123, Australian Bureau of Meteorology Model: ACCESS_S2 Model Run: 07/04/2023

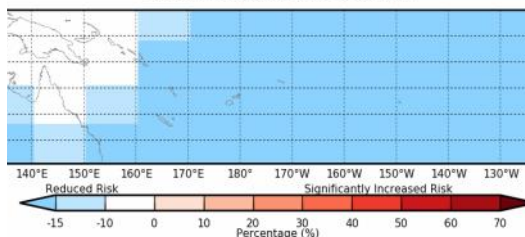
ACCESS-S Weekly Forecasts –Southwest Pacific

Difference from normal chance of Tropical Cyclone's in the South Pacific
 Forecast period: 15/04/2023 - 21/04/2023



Probability in overlapping 15 x 20 degree boxes
 123, Australian Bureau of Meteorology Model: ACCESS_S2 Model Run: 07/04/2023

Difference from normal chance of Tropical Cyclone's in the South Pacific
 Forecast period: 22/04/2023 - 28/04/2023



Model anomaly probability in overlapping 15 x 20 degree boxes
 south of Australia 2023, Australian Bureau of Meteorology Model: ACCESS_S2 Model Run: 07/04/2023 Issue:

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.

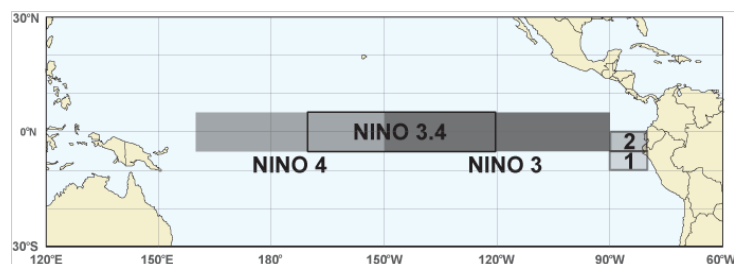
20 degrees Celsius Isotherm Depth

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