

## 2022-23 Southwest Pacific Tropical Cyclone Outlook

The NIWA and MetService assessment of named tropical cyclone (TC) activity indicates 6 to 10 named TCs could occur in the Southwest Pacific basin between November 2022 and April 2023. The seasonal outlook is for near normal activity in terms of overall named TCs in the region.

Tropical cyclones have a significant impact across the Southwest Pacific, with the season officially starting in November and lasting until the end of April. For the coming season, significant differences are expected between the western and eastern halves of the Southwest Pacific basin. Elevated TC activity is expected in and around the Coral Sea and the north/central Tasman Sea during the full season from November - April. The risk of impacts from a TC are expected to be higher across that maritime region and around Vanuatu. Reduced TC activity is expected east of the International Date Line.

Vanuatu and New Caledonia typically experience the greatest TC activity, with an average of about two or three named TCs passing close to those island nations each year. For this season, elevated TC activity is expected for areas around the Coral Sea and Vanuatu. Normal or elevated activity is expected for New Caledonia and Papua New Guinea. The Solomon Islands and Austral Islands are expected to have normal TC activity. Near normal or below normal TC activity is expected for Fiji, Tuvalu, and the southern Cook Islands. Below normal TC activity is forecast for Tuvalu and most other islands near or to the east of the International Date Line including Wallis & Futuna, Samoa, American Samoa, Tokelau, Tonga, Niue, the northern Cook Islands, the Society Islands and the remainder of French Polynesia. Despite the risk reduction in some locations, TCs are still expected for countries that typically experience one or more named storms per year. At least three severe TCs reaching Category 3 or higher might occur anywhere across the region, so all communities should remain prepared.

On average, at least one ex-tropical cyclone passes within 550 km of New Zealand each year. For the coming season, the risk for an ex-tropical cyclone affecting New Zealand is considered near normal to elevated. If an ex-tropical cyclone comes close to the country, there is a near-equal probability of it tracking to either the east or west of the North Island, and landfall of a degrading ex-tropical cyclone is possible. Analogue seasons also show interactions of a decaying storm system can occur with the northern South Island. Significant rainfall, extreme winds, hazardous marine conditions, and coastal damage are all possible leading up to and during these events.

At present, sea surface temperatures across the eastern and central equatorial Pacific Ocean are below average and exceed La Niña thresholds. Atmospheric circulation patterns related to ENSO (El Niño-Southern Oscillation) over French Polynesia and northern Australia indicate at least moderate La Niña conditions at present. Oceanic and atmospheric forecasts for ENSO that cover the 2022/23 TC season suggest that La Niña of at least moderate strength has a 80-85% chance of existing by December 2022 and that La Niña or neutral conditions will exist during the back half of the TC season in February - April.

Tropical cyclones are categorised in strength from 1 to 5, with 5 being the most intense. Past seasons with conditions similar to present suggest several TCs that develop could intensify to at least Category 3 strength. For the coming season, 3-4 TCs are anticipated to reach or exceed Category 3 strength, with mean (ten-minute) wind speeds of at least 119 km/h. Category 5

strength cyclones, where sustained winds exceed 199 km/h, are not associated with the analogue years with similar conditions like what exists ahead of the 2022/23 season. However, we note that there has been a trend toward fewer, but stronger TCs since quality observations began in the early 1970s, and because of those trends one of the expected severe TCs for this season could reach Category 5 strength. Therefore, all communities should remain alert and well-prepared for severe TC events.

New Zealand should also remain vigilant as the season unfolds. About half of the historic seasons used in the preparation of this outlook showed at least one ex-tropical cyclone passing within 550 km of the country; some analogues show multiple systems within the area around New Zealand are possible. Significant wind, waves and rainfall are possible from ex-tropical cyclones that come into the mid-latitudes. The effects of ex-tropical cyclones can also be spread over a large area, particularly if the decaying ex-tropical cyclone interacts with mid-to-high latitude weather systems. Despite the official season running from November through April, TCs can occur outside of this six-month season. All communities, regardless of changes in TC risk, should remain vigilant and be aware if the regional climate situation (including ENSO) changes.

The progress of ENSO and TC activity will continue to be tracked, with an update to this guidance in January 2023 if needed.

It does not take a direct hit or a severe TC to cause considerable damage or life-threatening weather. When dangerous weather is forecast, please heed the advice of your local meteorological service, civil defence, or disaster management offices.

*New Zealand's National Institute of Water & Atmospheric Research (NIWA) led the formulation of this seasonal tropical cyclone outlook, along with contributions from Meteorological Service of New Zealand (MetService), the University of Newcastle and meteorological forecasting organisations from the Southwest Pacific, the Australian Bureau of Meteorology, MétéoFrance and the Pacific Island National Meteorological Services.*

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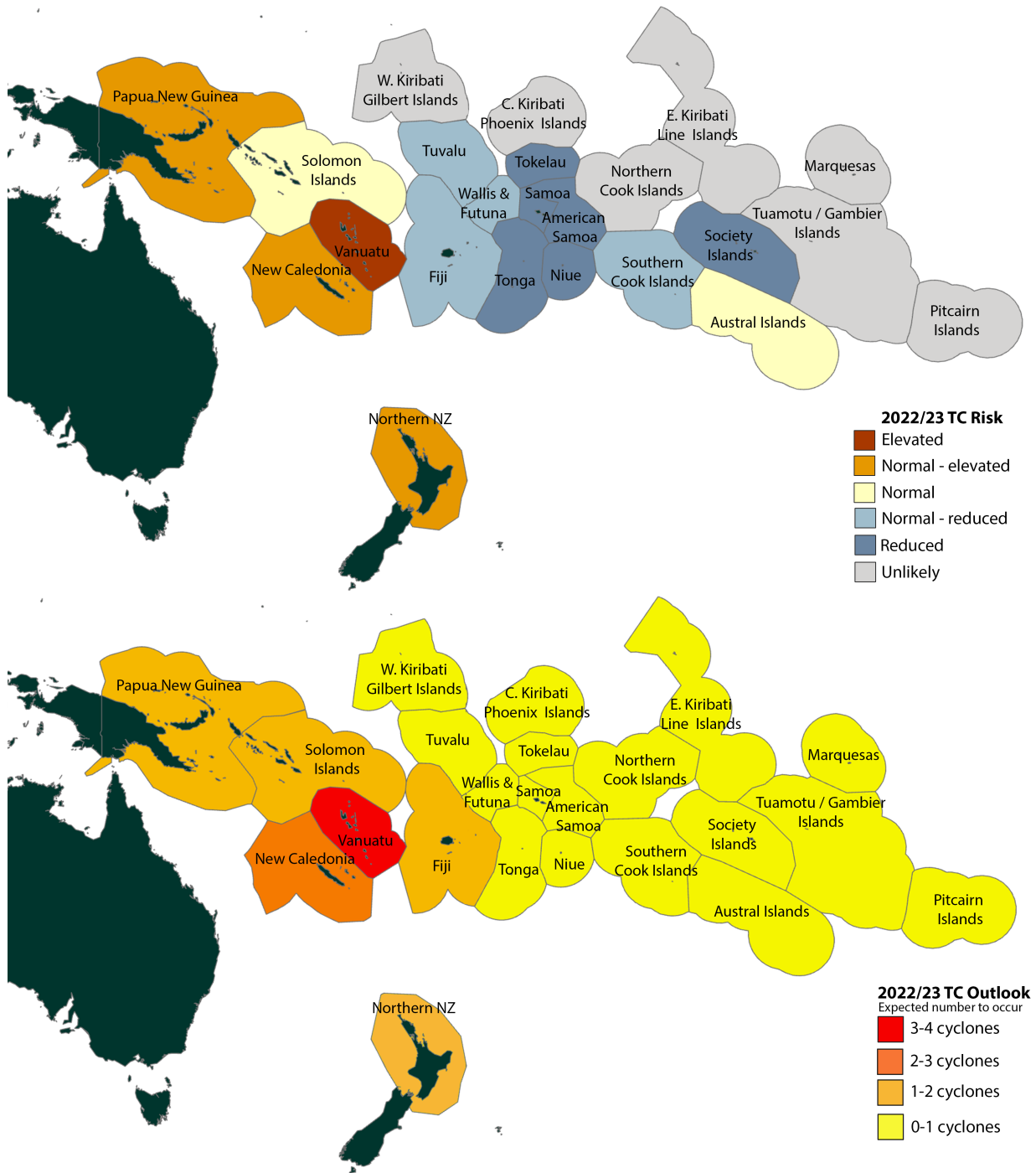
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**In the Pacific Islands**, please contact your local national meteorological service for information about how this guidance should be interpreted.

**For Australia** and associated offshore islands, please contact the Australian Bureau of Meteorology for information about how this guidance should be interpreted.

**For French Polynesia, Wallis, Futuna and New Caledonia**, please contact Météo-France regional offices for information about how this guidance should be interpreted.

**Figure 1. Maps of tropical cyclone risk (top) based on Island Climate Update (ICU) consensus guidance (Table 1) and overall seasonal outlook for the number of named cyclones interacting with an island group (bottom) based on the 2022/23 ICU consensus tropical cyclone guidance (Table 2).**



**Table 1: Island Climate Update (ICU) consensus outlook for November 2022–April 2023 tropical cyclone activity based on combining NIWA analogue model, international dynamical climate model and TCO-SP deterministic statistical model outlook results. Indications for upcoming TC activity based on these joint methods that cover the SW Pacific basin for the 2022/23 season are stated in the “ICU Consensus” column and are also shown in Figure 1. Expected TC numbers are based on the NIWA analogue method (see Table 2) and supported by the TCO-SP deterministic method.**

<i>TC activity 2022/23</i>	<i>NIWA Analogue</i>	<i>International Dynamical</i>		<i>TCO-SP Deterministic</i>	<i>ICU Consensus</i>	<i>Outlook Confidence</i>
<b>SP Basin</b>	Normal-Elevated	Normal	*	Normal	Normal	High
<b>Solomon Is.</b>	Normal	Normal	1	Normal	Normal	High
<b>Papua New Guinea</b>	Normal-Elevated	Normal		Elevated	Normal-Elevated	Moderate
<b>N. New Zealand</b>	Normal-Elevated	Normal		Normal	Normal-Elevated	Moderate-high
<b>Vanuatu</b>	Elevated	Elevated		Normal	Elevated	Moderate-high
<b>New Caledonia</b>	Normal-Elevated	Elevated		Normal	Normal-Elevated	Moderate-high
<b>Tonga</b>	Reduced	Reduced		Reduced	Reduced	High
<b>Fiji</b>	Normal-Reduced	Normal-Reduced		Normal	Normal-Reduced	Moderate-high
<b>Wallis &amp; Futuna</b>	Reduced	Reduced	2	Reduced	Reduced	High
<b>Tokelau</b>	Reduced	Reduced		Reduced	Reduced	High
<b>Tuvalu</b>	Reduced	Normal		Reduced	Normal-Reduced	Moderate-high
<b>Niue</b>	Reduced	Reduced	3	Reduced	Reduced	High
<b>Samoa</b>	Reduced	Reduced		Reduced	Reduced	High
<b>American Samoa</b>	Reduced	Reduced		Reduced	Reduced	High
<b>Austral Is.</b>	Normal	Normal-Elevated	4	Reduced	Normal	Moderate
<b>Society Is.</b>	Reduced	Reduced		Reduced	Reduced	High
<b>S. Cooks</b>	Reduced	Normal		Reduced	Normal-Reduced	Moderate-high
<b>N. Cooks</b>	Unlikely	Unlikely	5	Reduced	Unlikely	Moderate-high
<b>Tuamotu</b>	Unlikely	Unlikely		Reduced	Unlikely	Moderate-high
<b>W. Kiribati</b>	Unlikely	Unlikely		Reduced	Unlikely	Moderate-high
<b>Marquesas</b>	Unlikely	Unlikely		Reduced	Unlikely	Moderate-high
<b>Pitcairn</b>	Unlikely	Unlikely		Reduced	Unlikely	Moderate-high
<b>C. Kiribati</b>	Unlikely	Unlikely		Reduced	Unlikely	Moderate-high
<b>E. Kiribati</b>	Unlikely	Unlikely		Reduced	Unlikely	Moderate-high

1. Island scale model
2. Northern SW Pacific region
3. Central SW Pacific region
4. Southeast SW Pacific region
5. Northeast SW Pacific region

\*TCO-SP model area of focus

## **Additional background information**

### ***Summary of analogue, dynamical and deterministic guidance for the ICU TC outlook***

Analogue, dynamical and deterministic model guidance for the SW Pacific show good agreement for the coming season (Table 1). The ICU consensus column is based on the combined outcomes for the three types of seasonal outlook information. The consensus forms the basis for the full season (November-April) outlook for Southwest Pacific TC activity (and risk) for the 2022/23 season. It should be noted that there are only very minor differences in terms of the TC risk that are ascribed using the consensus method relative to previous years that used the analogue guidance supported by the dynamical guidance. Future work will evaluate (and validate) the outcome of each individual model vs the consensus-based approach.

### ***Modern analogue guidance***

TCs in the Southwest Pacific usually develop between November and April, occasionally develop in October and May, and very rarely develop in June – August. An analysis of past TC tracks in the SW Pacific indicate they are exceptionally unlikely in September, although systems in the past have formed during this time. Peak TC activity in the SW Pacific Basin is usually between January to March; however, severe TCs can occur at any time during the season.

Based on past seasons with similar background climate conditions to the present, TC activity in the coming season is expected to be elevated across the Coral Sea, the Queensland coast and Vanuatu. Near normal or slightly elevated activity is expected for Papua New Guinea, and New Caledonia. In addition, TC activity is expected to be elevated across the northern Tasman Sea region, encompassing the maritime area near Norfolk Island, and near New Zealand. On average, nearly half of the TCs that developed since the 1969/70 season have reached at least Category 3 cyclones with mean wind speeds of at least 64 knots (119 km/h).

To find past analogues that describe the climate state leading into the upcoming TC season, the conditions for May 2022 through to the beginning of October 2022 were examined for the tropical Pacific. Similar situations from 1969 to the present were then identified from the historical record. For most of austral winter (June-August) and early spring 2022 (September), the ENSO system was in a well-coupled La Niña state. There was no evidence of the strength of this current event abating at the onset of austral spring.

NIWA's monitoring of the Niño3.4 region (central-western equatorial Pacific Ocean) shows monthly sea surface temperature anomalies of  $-0.95^{\circ}\text{C}$  as of late September. Significant negative temperatures of  $-3^{\circ}\text{C}$  to  $-5^{\circ}\text{C}$  exist at depth in the same region. This indicates La Niña is more mature relative the same period across the last year two years. In the last four decades, only three years had cooler conditions in the central-western equatorial Pacific Ocean as at the end of September: 2010, 1999, and 1998.

The available information from international forecasting centres that issue global climate outlooks and ENSO diagnostics support this outlook, and they are integrated by NIWA's National Climate Atmosphere and Hazards Centre. The collective guidance summarised by NIWA suggests at least a moderate La Niña at the start of the TC season is likely (80-85% chance). ENSO conditions for late summer to mid-autumn are about equally likely to be La

Niña or neutral (45-50% chance each). El Niño is not expected this season. As such, an additional element used to hone the historic analogues for the upcoming TC season included years when ENSO conditions during November-April were reminiscent of a strong (and at the very least moderate) La Niña in the early season.

To help identify past ENSO conditions for the selection of analogue seasons, we used an ENSO index that combines the Southern Oscillation Index (SOI) with the most widely used oceanic index of sea surface temperature anomalies in the equatorial central-western Pacific (NINO3.4). This joint ENSO index is described in Gergis and Fowler (2005) as the “Coupled ENSO Index” (CEI). Using the CEI, we selected analogue TC seasons for the 2022/23 outlook, highlighting seasons when the equatorial SSTs and the SOI were indicative of a well-coupled La Niña in winter-spring, and continuation of those conditions during summer and into autumn.

NIWA selected four analogue TC seasons (1971/72; 1974/75; 1975/76; 2011/12) that typified the antecedent ENSO conditions during austral winter-early spring. Note that the selection of analogue seasons in this step of the outlook relates to the high-quality TC data period in the satellite era beginning in 1969/70 (53 seasons, for which the availability of TC track data are current only to the end of the 2020/21 season), and the limited number of similar analogues to this season (including rejected analogues). These selected analogues also encapsulate strong-to-moderate La Niña conditions during the full, early and late season that align with the expected ENSO outlook.

NIWA’s SW Pacific TC outlook spans four areas of responsibility overseen by international monitoring and forecast agencies (RMSC Nadi, TCWC Melbourne, TCWC Port Moresby and TCWC Wellington). We used a high-quality set of past TC tracks from the International Best Tracks Archive for Climate Stewardship (IBTrACS) which covers 135°E to 120°W longitude to draw on past TC track patterns for the seasonal outlook. The domain for the seasonal outlook encompasses a basin that is defined by climatological properties of TC occurrences rather than geopolitical or meteorological service administrative boundaries (Diamond et al., 2012). Based on the selection of analogues, elevated TC activity and risk is expected in and around the Coral Sea offshore of Queensland, the area including and between Papua New Guinea and the Solomon Islands, Vanuatu, and New Caledonia. In addition, the north Tasman Sea and Raoul Island are expected to see elevated TC activity. The outlook for the region to the east of the International Date Line shows reduced risk overall (Figure 2).

The analogue guidance also indicates normal risk of TC activity exists for the Solomon Islands and Austral Islands (See Table 1 and Table 4; Figure 1, 2 & 3). Normal to slightly reduced risk exists for Fiji, and risk is reduced for Wallis and Futuna, Tonga, the Society Islands, Niue, Tokelau, the Austral Islands, Samoa, American Samoa, the southern Cook Islands and Tuvalu. The main TC genesis region is expected to lie within a band between 10 – 12°S (northwest of Vanuatu) to the west of the International Date Line but shifted slightly west of normal; very few of the historic tracks associated with the analogue seasons showed storm formation east of the International Date Line. There is a clear signal for elevated risk of cyclones developing and tracking west of the International Date Line during both the early and late season. All analogue seasons had at least one cyclone of Category 3 or greater strength, and most of the analogue seasons (3 of 4) experienced at least one Category 4 cyclone. Based on historic trends, we cannot rule out at least one of the severe storms expected for the season transforming into a Category 5 TC. A total of 8 named cyclones are expected during this coming season (spread of 6-10 based on past analogues), which is near normal to below normal activity relative to an average of 9 named storms that have occurred each season between 1991-2020. One of the

selected analogues (1971/72) had two TCs that formed beyond the end of April; a reminder that all communities should remain vigilant even beyond the traditional end of the season.

A split of the analogue TC seasons into early (November – January) and late (February – April) periods suggests TC activity may be elevated near Vanuatu, New Caledonia, the Coral Sea, and Raoul Island during the early TC season (Figure 4). There is a near-even proportion for the number of named storms that occurred in the early and late season for the selected analogues (~45% and 55%, respectively). However, in general, activity is expected to increase during the late season, especially for areas west of the International Date Line located around the north Tasman Sea, Papua New Guinea, the Solomon Islands and Vanuatu). The spatial anomalies shown for this TC outlook strongly indicate a reduced late season risk of TCs for Tuvalu, Samoa, American Samoa and the southern Cook Islands.

Previous TC research has indicated cyclone track sinuosity reduces during La Niña but increases during neutral seasons (Malsale, 2011). Because there are some indications this La Niña event may fade to neutral by the end of the season, a mixture of TC track trajectories for the coming season are expected. TC intensity is partly related to how long developing cyclonic systems reside in the tropics and gain support for their growth from underlying warm waters. Nevertheless, lower strength TCs that have wandering tracks can still produce significant impacts on island communities and TCs of all strength should be monitored closely. In addition, the subtropical jet and South Pacific Convergence Zone (SPCZ<sup>1</sup>) interact and contribute to shear (which can disorganise cyclone systems) during extra-tropical transition (ETT). Hemispheric winds that help to steering storms exiting the tropical Pacific are expected to be displaced slightly south of normal, which may lead to reduced shear and increased retention of cyclone strength in the subtropics. The outcomes from this type of situation may include stronger ex-TC impacts for northern New Zealand.

The interplay of hemispheric-scale atmospheric circulation with the timing of short-term Madden-Julian Oscillation (MJO) activity on a 30 to 50-day cycle has significant bearing on regional TC activity. Increased frequency and more intense TC activity can be expected during the MJO 6-7 paired phase (Diamond and Renwick, 2015). Weekly statistical forecasts of TC genesis and TC activity for the SW Pacific basin are produced by MétéoFrance based on phasing of the MJO (Leroy and Wheeler, 2008). This guidance is useful for sub-seasonal regional TC guidance (see <https://www.meteo.nc/nouvelle-caledonie/cyclone/coin-des-experts>). Real-time MJO monitoring is also available from the Australian Bureau of Meteorology at <http://www.bom.gov.au/climate/mjo/> and NOAA at [https://www.cpc.ncep.noaa.gov/products/precip/CWlink/MJO/CLIVAR/clivar\\_wh.shtml](https://www.cpc.ncep.noaa.gov/products/precip/CWlink/MJO/CLIVAR/clivar_wh.shtml).

TC tracks that have previously undergone ETT at 25°S latitude (Diamond et al., 2013) cover a wide area spanning east and west of the International Date Line (~165°E – 165°W). For the historical TC tracks in the seasons we have selected as analogues for this outlook, a vast majority underwent ETT to the west of the International Dateline. This presents a view of significantly elevated risk for maritime conditions related to the presence of TCs and ex-TCs in the north Tasman Sea, including the region between New Caledonia, New Zealand and the southern Coral Sea. Extra caution for vessels navigating those areas is warranted.

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<sup>1</sup> The South Pacific convergence zone (SPCZ) is an extensive Southern Hemisphere atmospheric circulation feature that contains one of Earth's most expansive and persistent convective cloud bands.



Previous work indicates New Zealand interacts with at least one ex-tropical cyclone passing within 550 km of the country every year on average (Lorrey et al., 2014). Some years there are none, while in other years there are more than one. For the coming TC season, the risk for New Zealand is normal to slightly above normal. We identified five ex-tropical cyclones using four analogue seasons in this outlook that passed close to New Zealand, which gives a rounded average of one ex-tropical cyclone per year. The historic TC tracks selected for this outlook that passed close to New Zealand indicate a near equal probability of decaying ex-tropical cyclones tracking offshore to either the east or west of the North Island, with one of the tracks interacting with coastal waters to the west of the northern South Island (see Figure 3).

### *Dynamical climate model guidance summary*

A synthesis of atmospheric and sea surface temperature (SST) guidance favours near average tropical cyclone (TC) activity for the 2022/23 SW Pacific TC season. Multi-model ensemble (MME) guidance is in good agreement and reflective of the presence of at least a moderately strong La Niña event in the central and eastern Pacific that is likely to continue for much of the upcoming TC season (Figure 5 and Figure 6). La Niña tends to elevate the risk for TC activity in the western part of the SW Pacific and reduce activity to the east, but every event is unique.

Mean sea level pressure (MSLP) is forecast to be below normal for much of the Southwest Pacific basin along and west of 160°W (Figure 6). This is likely indicative of the South Pacific Convergence Zone being displaced southwest of normal, a typical impact of La Niña, and one that can cause above normal rainfall for many off-equator island groups. For island nations and territories that are located closer to the Equator, particularly north of 10° south latitude, drier than normal conditions are expected to elevate the risk of drought.

MME guidance points to reduced zonal mid-atmospheric wind shear across much of the Southwest Pacific between 10-20° south latitude. Above normal wind shear is forecast for most areas north 10°S and south of 20°S. A reduction in wind shear results in a more favourable environment for TC genesis. If reduced atmospheric wind shear co-exists with other favourable environmental conditions, such as above average SSTs, then areas of increased TC activity are possible.

### *Deterministic statistical model summary*

The Long-Range Tropical Cyclone Outlook for the Southwest Pacific (TCO-SP) product has been incorporated into the ICU outlook since the 2020/21 seasonal outlook to provide support for a consensus-based ensemble of TC risk. TCO-SP is based on a different method than the analogue and dynamical approaches. The TCO-SP method is calibrated using the IBTrACS data set and several key climate indices for the Southern Hemisphere (see Magee et al., 2020 and the supplementary material for more details). For the coming Southwest Pacific TC season, the deterministic TCO-SP outlook suggests 8 named TCs may form (probable range of 7-10), indicating near normal activity for the basin when compared with the 1991-2020 average of 8.7 TCs (Table 1, Table 4 and Figure 7). This TC count range overlaps with the analogue guidance.

References

Gergis, J., and A. M. Fowler, 2005. Classification of synchronous oceanic and atmospheric El Niño–Southern Oscillation (ENSO) events for palaeoclimate reconstruction. *International Journal of Climatology*, **25**: 1541–1565.

Diamond, H.J., and J.A. Renwick, 2015. The climatological relationship between tropical cyclones in the southwest Pacific and the Madden-Julian Oscillation. *International Journal of Climatology*, **35**: 676–686. doi: 10.1002/joc.4012.

Diamond, H.J., A.M. Lorrey, K.R. Knapp, and D.H. Levinson, 2012. Development of an enhanced tropical cyclone tracks database for the southwest Pacific from 1840–2011. *International Journal of Climatology*, **32**: 2240–2250. doi:10.1002/joc.2412.

Diamond, H.J., A.M. Lorrey, and J.A. Renwick, 2013. A Southwest Pacific tropical cyclone climatology and linkages to the El Niño–Southern Oscillation. *Journal of Climate*, **26**(1): 3–25. doi:10.1175/JCLI-D-12-00077.1.

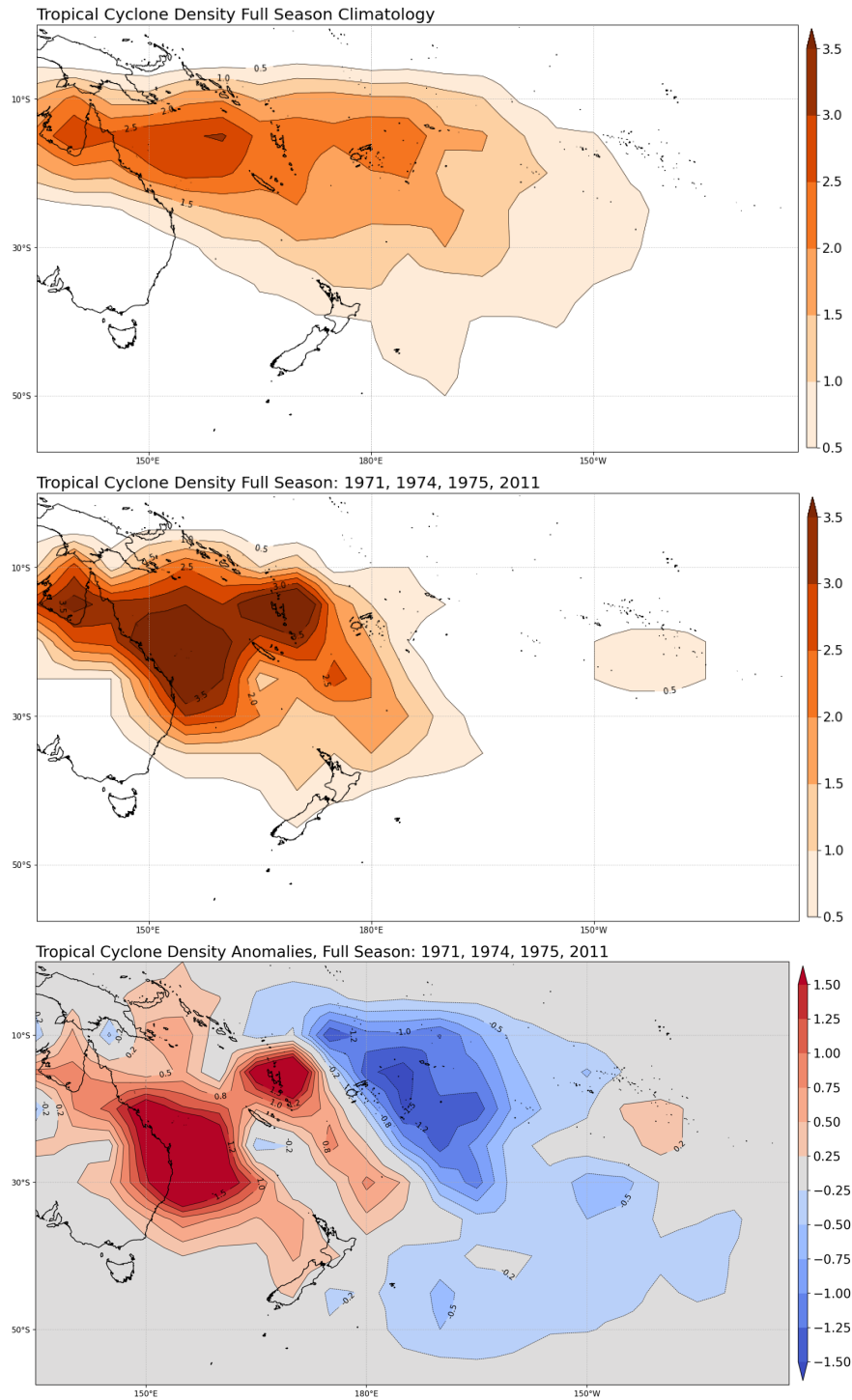
Leroy, A., and M.C. Wheeler, 2008. Statistical prediction of weekly tropical cyclone activity in the Southern Hemisphere. *Monthly Weather Review*, **136**: 3637–3654.

Lorrey, A.M., G. Griffiths, N. Fauchereau, H.J. Diamond, P.R. Chappell, and J. Renwick, 2014. An ex-tropical cyclone climatology for Auckland, New Zealand. *International Journal of Climatology*, **34**: 1157–1168. doi: 10.1002/joc.3753.

Magee, A.D., Lorrey, A.M., Kiem, A.S., Colyvas, K. 2020. A new island-scale tropical cyclone outlook for southwest Pacific nations and territories. *Scientific Reports*, **10**, 11286, <https://doi.org/10.1038/s41598-020-67646-7>

Malsale, P. 2011. Analysis of tropical cyclone track sinuosity in the South Pacific region using ARCGIS. Unpublished MSc Thesis, University of the South Pacific, 155 Pages.

**Figure 2: Number of TCs occurring for the main development season (November – April) in the Southwest Pacific (135°E to 120°W): (top panel) average number during 1991 to 2020 (normal); (centre panel) average number over selected four analogue seasons (Table 3); (bottom panel) departure from normal for the analogue seasons (difference between count in centre and top panels). For each year noted, that represents the start of the main development season (i.e. 1970 = November 1970–April 1971)**



**Table 2: The average number of TCs passing close to the main South Pacific Island groups between November and April based on analogue guidance but contains subjective assessments in some cases to be consistent with the wishes of the national meteorological services involved in generating this regional outlook. In addition, subjective qualification of activity (and associated risk) also recognises the small differences between the actual TC counts for the analogue composites and climatological values. The table is therefore only generally indicative of how many cyclones might be expected for any given island group for the coming season. This information feeds into the final outlook for the season seen in Table 1.**

Country/Territory	Climatology	Analogue seasons	Anomaly	% normal	Risk
Vanuatu	2.3	3.9	1.6	170	Elevated
Papua New Guinea	0.8	1.0	0.2	125	Normal-Elevated
New Caledonia	2.3	2.8	0.5	120	Normal-Elevated
N. New Zealand	0.8	0.9	0.1	115	Normal-Elevated
Solomon Is.	1.7	1.8	0.1	105	Normal
Austral Is.	0.7	0.7	0.0	100	Normal
Fiji	2.2	1.6	-0.6	75	Reduced
S. Cooks	1.2	0.8	-0.4	65	Reduced
Society Is.	0.7	0.4	-0.3	60	Reduced
Tuvalu	1.4	0.6	-0.8	45	Reduced
Tonga	2.0	0.7	-1.3	35	Reduced
Wallis & Futuna	2.1	0.7	-1.4	35	Reduced
Samoa	1.7	0.5	-1.2	30	Reduced
American Samoa	1.6	0.5	-1.1	30	Reduced
Tokelau	1.3	0.3	-1.0	25	Reduced
Niue	1.4	0.1	-1.3	10	Reduced
N. Cooks	0.4	0.1	-0.3	N/A	Unlikely
Tuamotu	0.1	0.1	0.0	N/A	Unlikely
W. Kiribati	0.1	0.1	0.0	N/A	Unlikely
Marquesas	0.1	0.1	0.0	N/A	Unlikely
Pitcairn	0	0.0	0.0	N/A	Unlikely
C. Kiribati	0	0.0	0.0	N/A	Unlikely
E. Kiribati	0	0.0	0.0	N/A	Unlikely

**Table 3: Previous analogue seasons and intensity of TCs that occurred in the Southwest Pacific during the November-April TC season. Categorisation of TCs aligns to the Australian Bureau of Meteorology (BoM) scale. Italicised figures for category totals are the mean of the count for that category instead of the rounded mean total.**

Season	Number of storms Cat 1 or higher	Right: TC category (BoM scale)	Cat 1	Cat 2	Cat 3	Cat 4	Cat 5
1971/72	12		3	0	6	3	0
1974/75	6		1	2	3	0	0
1975/76	11		3	3	4	1	0
2011/12	4		1	2	0	1	0
Cat total	8.3		2.0	1.8	3.3	1.3	0.0
Rounded totals	8		2	2	3	1	0

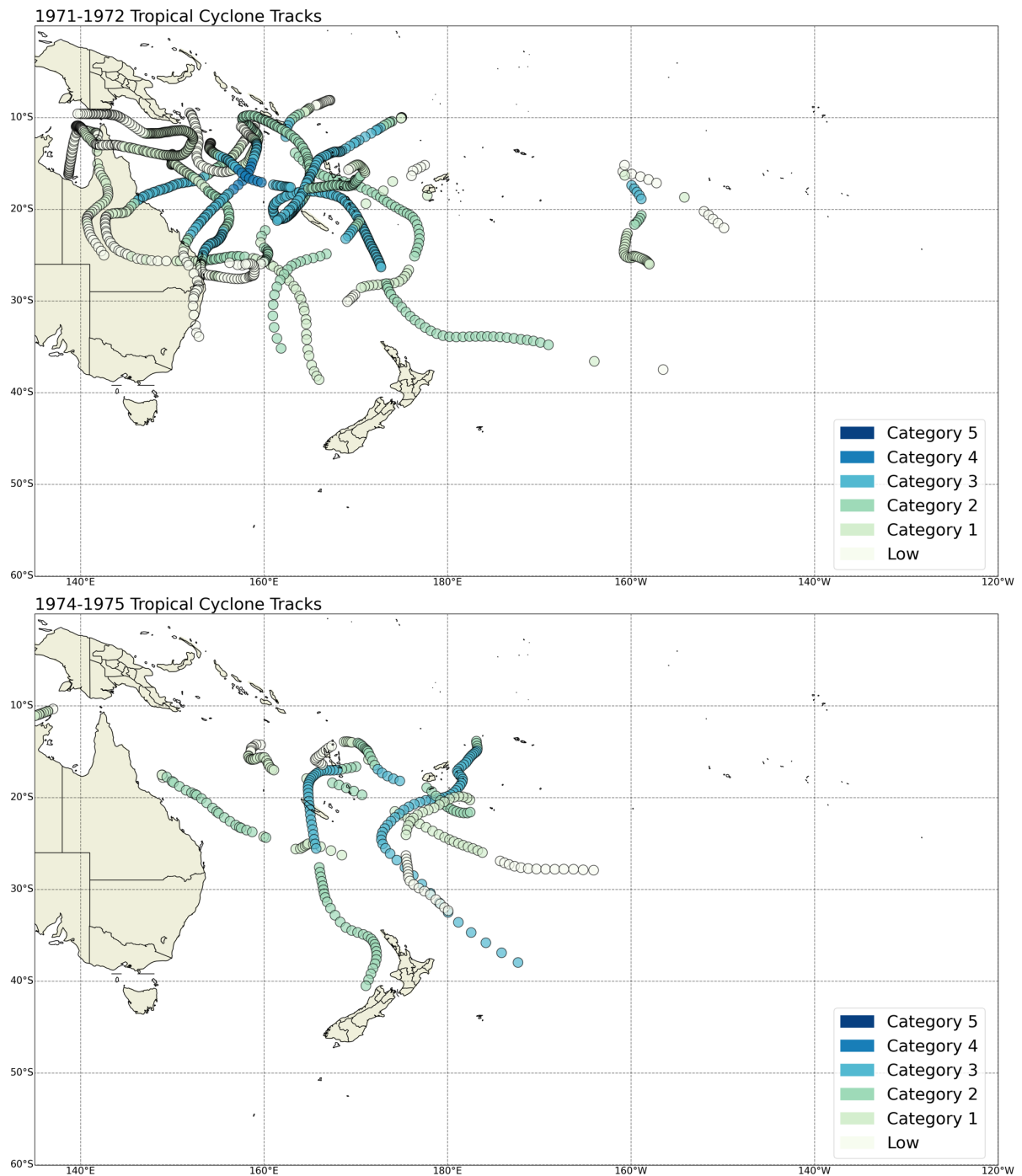
#### Analogue guidance summary

Based on the guidance from the NIWA analogue method, a conservative range of 6-10 named TCs could be expected during the 2022/23 season for the Southwest Pacific basin (135° E – 120° W). The spread for the estimated cyclone activity comes from the variation between four selected analogue seasons. The historic long-term seasonal average is just under 9 named TCs for the SW Pacific basin. There is a split between the analogues for the total number of cyclones for this season, with half indicating below normal and half indicating above normal activity. The long-term regional trend for TC occurrence in the SW Pacific has seen decreasing numbers of named storms.

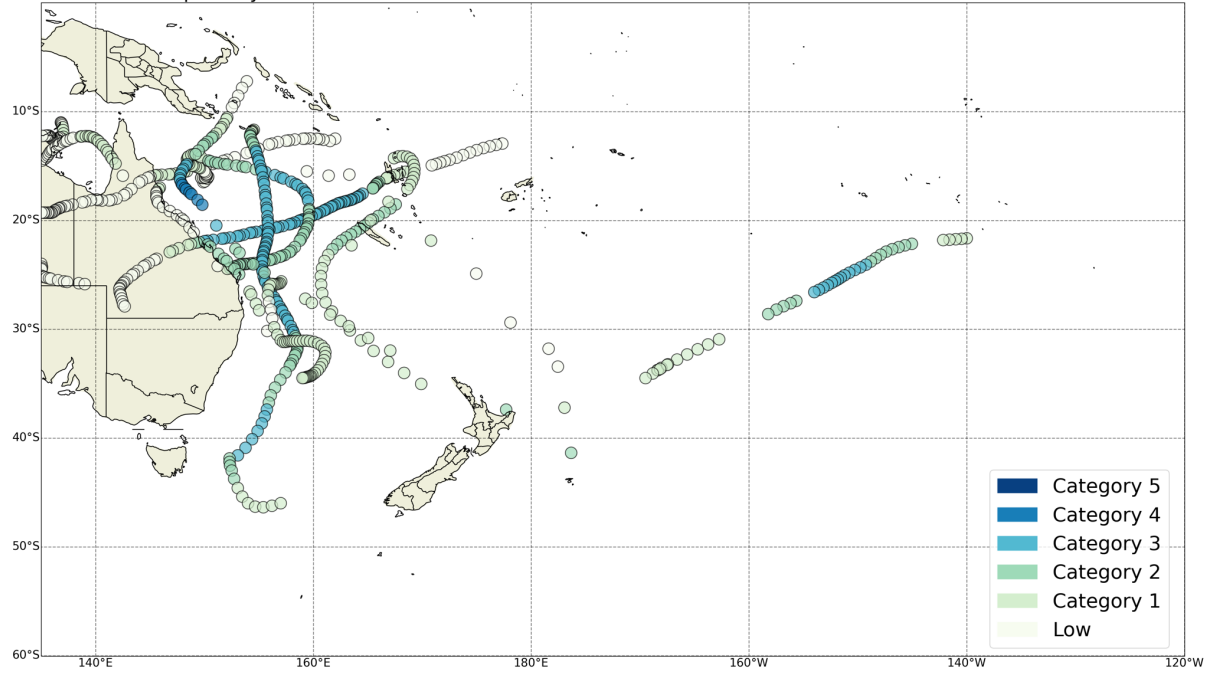
A potential combination of 3-4 cyclones may reach severe Category 3 or higher status. All the historic analogues selected for the 2022/23 outlook indicate a severe TCs could occur in the SW Pacific. Three out of four of the historic analogue seasons indicate at least one cyclone of Category 4 strength or higher could occur, and that there could also be multiple named storm systems that reach Category 3 strength or greater. This provides confidence in the statistical outlook for expected cyclone strengths and supports a conservative range of 3-4 severe tropical cyclones for the coming season. The analogues for NIWA's analogue outlook do not contain a Category 5 cyclone (see Table 3). However, there has been a notable trend toward fewer named storms and stronger TCs in the SW Pacific. This long-term perspective raises the possibility that one or more of the severe storms expected for this season could transform into a Category 5 system.

For the selected analogues, most show at least one ex-tropical cyclone came within 550 km of New Zealand. Some of the seasons had no ex-tropical cyclone interactions (2011/12) while others had multiple systems interact with both the North and South Island (1975/76). The rounded average interaction for New Zealand with an ex-tropical cyclone this coming season is one named system. Some of the decaying ex-tropical cyclone systems were also associated with high rainfall, damaging winds and amplified coastal wave conditions. The risk of an interaction for New Zealand (with at least one cyclone coming within 550 km of the country) for the 2022/23 season is normal. There is a near-equal probability of a decaying ex-tropical cyclone tracking to the east or west of the North Island based on historic track data (Figure 3).

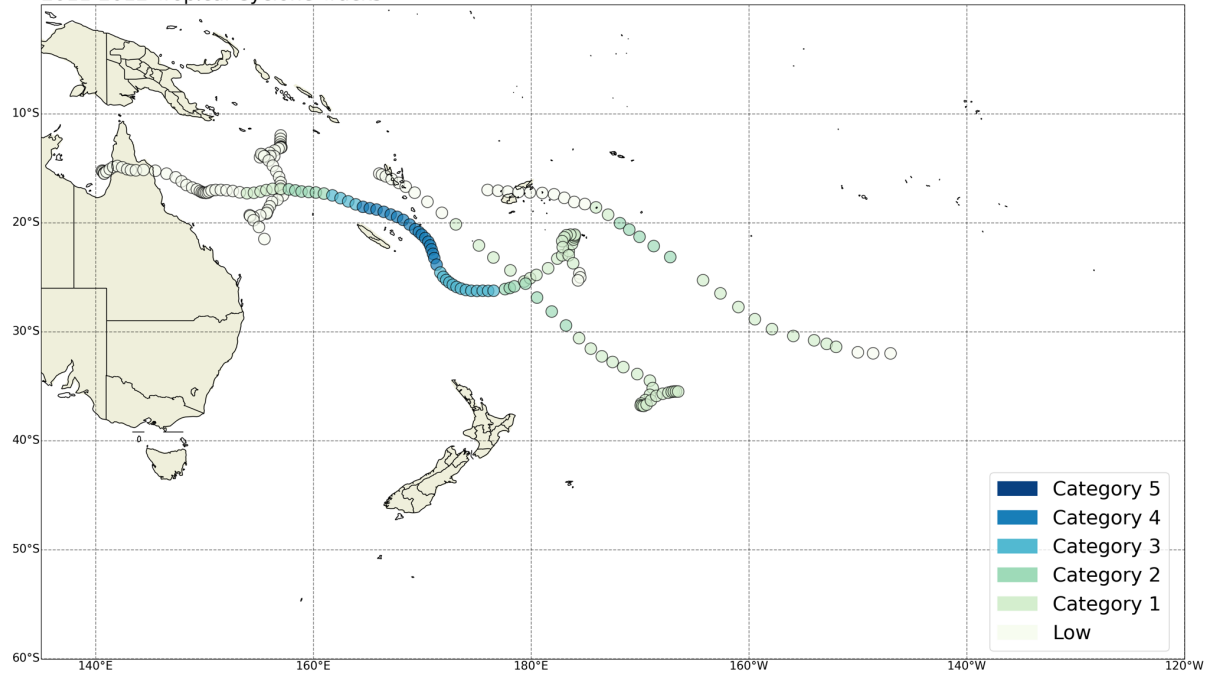
**Figure 3: Plots of TC tracks and major tropical lows that were monitored for analogue seasons used in the 2022/23 seasonal forecast for the full season (November - April). Track data are courtesy of International Best Tracks Archive for Climate Stewardship (IBTRaCS).**



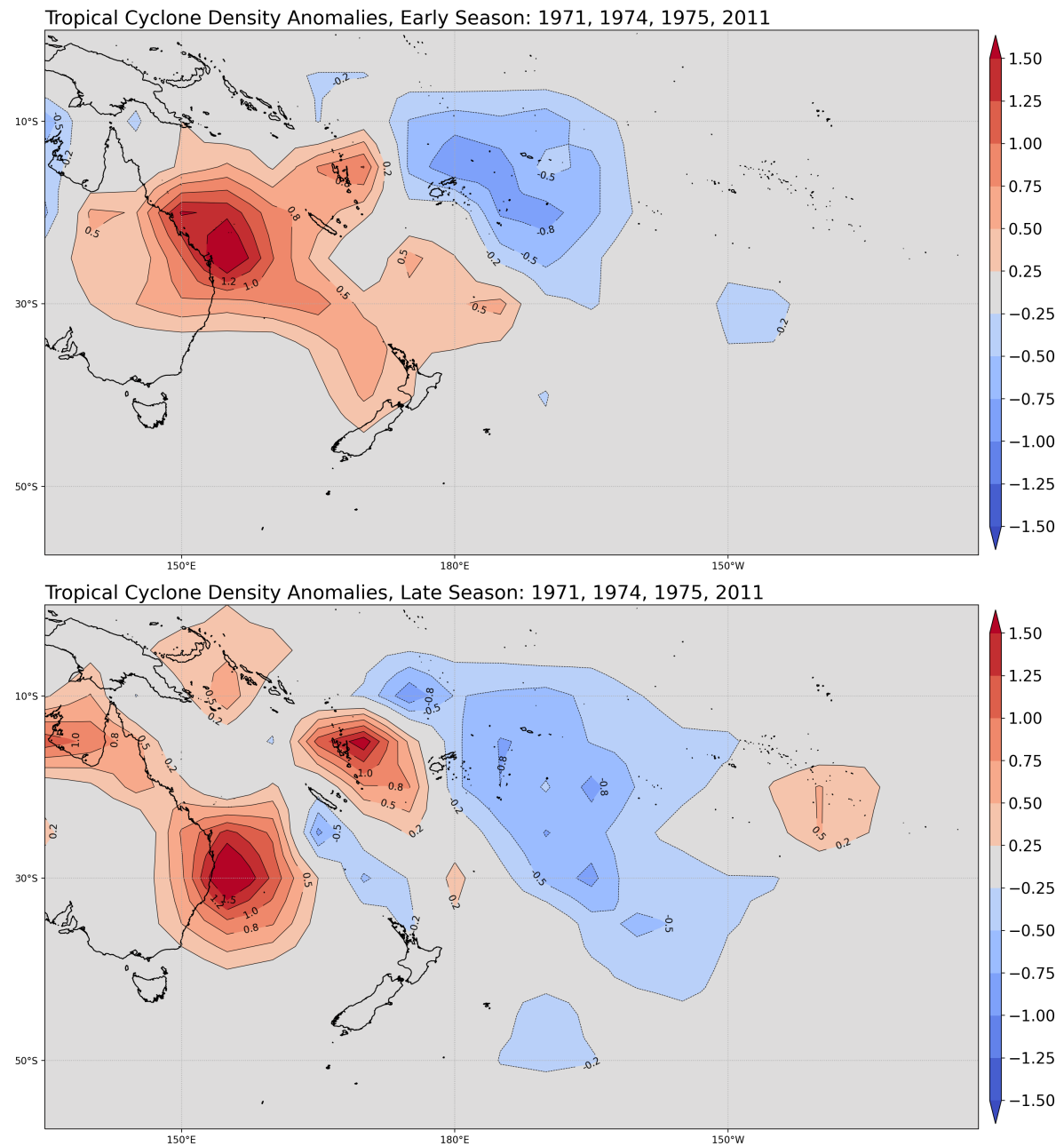
1975-1976 Tropical Cyclone Tracks



2011-2012 Tropical Cyclone Tracks



**Figure 4: Early season (November to January; top panel) and late season (February to April; bottom panel) anomaly plots for selected TC analogue seasons (data courtesy of International Best Tracks Archive for Climate Stewardship (IBTrACS)). The year label notes the first month in the analogue year selection (i.e. for the early TC season “1971” = November 1971, December 1971, January 1972; and for the late TC season “1971” = February – April 1972).**





### Dynamical Guidance Summary

A synthesis of model atmospheric and SST guidance favour near average TC activity for the 2022/23 Southwest Pacific TC season. However, there is the potential for above normal storm occurrences near northern New Zealand and around the Coral Sea region. Normal or below normal activity is expected to occur to the east of the International Date Line.

### ECMWF seasonal guidance, November 2022-April 2023

The Accumulated Cyclone Energy, or ACE forecast: October 2022 ECMWF seasonal guidance indicates that near normal (80% of normal) seasonal accumulated cyclone energy (ACE) is most likely for the Southwest Pacific region (160°E-120°W) and that near normal (110% of normal) ACE is most likely for the Australian region (90°E-160°E). ACE is a metric derived from tropical cyclone intensity and duration, averaged across the basin.

Tropical storm (cyclone) density anomaly is forecast to be near normal for the basin. However, the pattern across the region is quite polar, and shows elevated activity, or positive density anomalies, from the Coral Sea, east to Vanuatu, south to near Norfolk Island, and continuing eastward to south of the Cook Islands. Areas of reduced activity, or negative density anomalies, are signalled for areas due east of Fiji, including around Niue, Samoa, American Samoa, and northern parts of French Polynesia.

Tropical storm (cyclone) and hurricane frequency (Category 3 or higher):

For the Southwest Pacific region, ECMWF seasonal guidance indicates that the number of tropical cyclones is most likely to be near normal amount (around 85% of normal). Guidance suggests that the frequency of severe TCs will be around 80% of normal.

For the Australian region, ECMWF seasonal guidance indicates that the number of tropical cyclones is most likely to be around 105% of normal and severe TCs around 110% of normal.

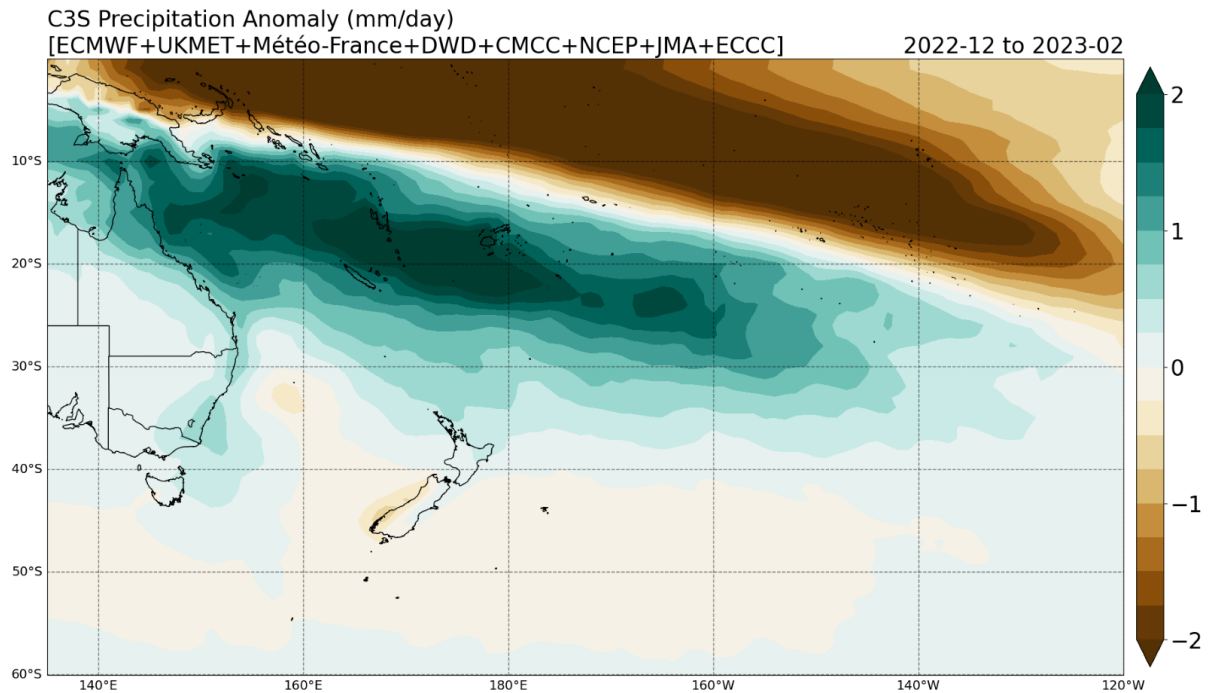
For the region, this guidance supports a near normal number of TCs (Category 1 or higher) and at least a near normal amount of severe TCs (Category 3 or higher) for the 2022/23 tropical cyclone season. However, the dynamical guidance indicates regional variability; western and southern areas of the basin are likely to be more active than eastern parts.

The dynamical guidance agrees with the analogue guidance for TC count and shows similar patterns for areas of enhanced and reduced TC activity. The dynamical guidance has clusters of enhanced activity north of New Zealand, in the Coral Sea and along coastal Queensland, and in the subtropics south of the Cook Islands and near the Austral Islands. Reduced activity is forecast for areas due east of Fiji, including around Niue, Samoa, American Samoa, and northern parts of French Polynesia.

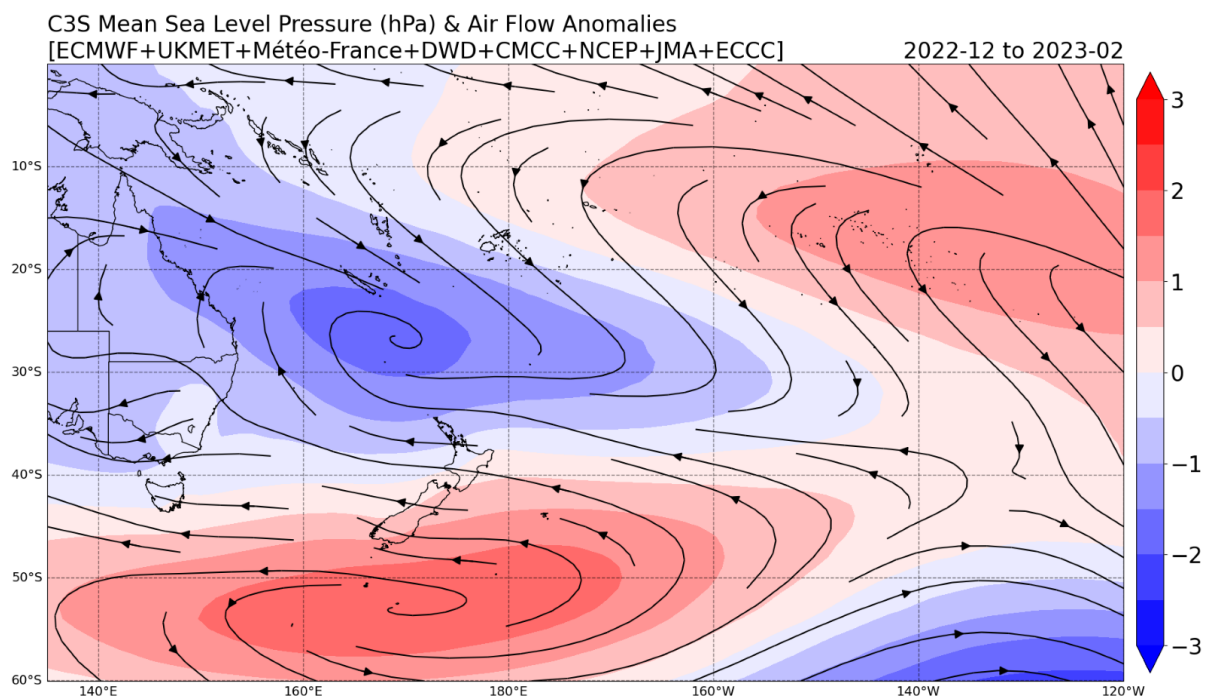
NB: The ECMWF Southwest Pacific forecast domain for ACE is from 160°E to 120°W. NIWA's outlook covers 135°E to 120°W, therefore the forecast generated by NIWA extends 25° westward relative to the ECMWF forecast domain.

**Information about the dynamical models used:** information on ECMWF model skill can be found here for: [tropical cyclones](#), [severe tropical cyclones](#), and [ACE](#). An overview of the multi-model ensemble used to create the rainfall and air pressure plots can be found [here](#).

**Figure 5. Multi-model ensemble forecast rainfall anomaly (mm/day), December 2022-February 2023; green (brown) shades indicate above (below) normal forecast rainfall**



**Figure 6. Multi-model ensemble forecast air pressure anomaly (hPa), December 2022-February 2023; red (blue) shades indicate above (below) normal air pressure; areas of below normal pressure in the tropics can indicate an increased potential for tropical cyclone genesis**



*TCO-SP (University of Newcastle) deterministic model summary*

TCO-SP is a long-range tropical cyclone outlook based on a multivariate statistical method generated using Poisson Regression (Magee et al., 2020) published in *Scientific Reports*. This is the third year the product is available and we have continued to incorporate it into the ICU outlook because it provides a different view from analogue and dynamical approaches. For the coming 2022/23 season, the deterministic TCO-SP outlook for Southwest Pacific TC season suggests 8 named TCs may form (probable range of 7-10), indicating normal activity for the basin when compared with the 1991-2020 average of 8.7 TCs (Table 4 and Figure 7). See <https://tcoutlook.com/swpacific/> for more details related to this part of the outlook.

**Table 4: Expected TC counts including expected range (95% confidence intervals (CI)) for the 2022/23 Southwest Pacific tropical cyclone season (September 2022 update), difference from long term average TC count (1991-2020).**

		Long-term average TC count (1991-2020 <sup>b</sup> )	Expected TC Count (Probable TC count range: 95% CI)	Difference between expected and long-term average (TC)
	Southwest Pacific	8.7	8.2 (6.5 – 10.3)	▼ -0.5
Island Scale Models	Fiji	2.5	2.3 (1.5 – 3.4)	▼ -0.2
	Solomon Islands	2.5	2.5 (1.9 – 3.2)	0.0
	New Caledonia	2.3	2.5 (1.2 – 3.4)	▲ +0.2
	Vanuatu	2.0	1.7 (1.1 – 2.6)	▼ -0.3
	Tonga	2.0	1.6 (0.9 – 2.9)	▼ -0.4
	Papua New Guinea	1.6	2.2 (1.3 – 4.0)	▲ +0.6
	Northern New Zealand	0.7	0.8 (0.2 – 2.8)	▲ +0.1
Subregional models <sup>a</sup>	<b>N SWP</b> (Tuvalu, Wallis & Futuna, Tokelau)	1.8	1.0 (0.4 – 2.7)	▼ -0.8
	<b>C SWP</b> (Samoa, American Samoa, Niue)	1.5	0.6 (0.2 – 1.4)	▼ -0.9
	<b>SE SWP</b> (Southern Cook Islands, Society Islands, Austral Islands)	1.6	0.7 (0.3 – 1.9)	▼ -0.9
	<b>NE SWP</b> (Northern Cook Islands, E Kiribati: Line Islands, Marquesas, Tuamotu Archipelago, Gambier Islands, Pitcairn Islands)	1.1	0.1 (0.0 – 0.2)	▼ -1.0

<sup>a</sup> Sub-regional models – where individual island TC climatology shows less than 1.5 TCs per season, geographically neighbouring EEZs have been merged to increase sample size ([Click here](#) for more information).

<sup>b</sup> Average TC counts calculated for November-April TC season.

For the SW Pacific basin, the multi-model average based on the 10 models used in TCO-SP indicates ~8 TCs are expected (see Figure 7). The majority of the models indicate normal or below normal activity for the basin. The skill score of the model for the basin-wide outlook (which has been selected using an objective convention) is the highest of the group of 10 models employed in the TCO-SP guidance. The expected TC count (8.2 TCs) for the SWP domain is similar to the average TC count (8.7 TCs). The near-normal risk profile for this region considers the percentage difference between the normal and forecast TC numbers (8.2 vs 8.7 = 6% decrease). Overall, the spatial pattern for the TCO-SP outlook for most islands is similar to analogue and dynamical guidance.

**Figure 7. Expected TC count including probable range (95% confidence intervals) for the 2022/23 Southwest Pacific Tropical Cyclone Season based on TCO-SP (Magee et al., 2020). Expected TC counts are summarised for the Southwest Pacific (panel a) and island-scale and sub-regional locations (panel b).**

