ENSO: Recent Evolution, Current Status and Predictions

Update prepared by:
Climate Prediction Center / NCEP
23 December 2024

Outline

Summary

Recent Evolution and Current Conditions

Oceanic Niño Index (ONI)

Pacific SST Outlook

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Summary

Summary

ENSO Alert System Status: La Niña Watch

ENSO-neutral conditions are present.*

Equatorial sea surface temperatures (SSTs) are near-to-below average in the central and eastern Pacific Ocean.

La Niña conditions are most likely to emerge in November 2024 - January 2025 (59% chance), with a transition to ENSO-neutral most likely by March-May 2025.*

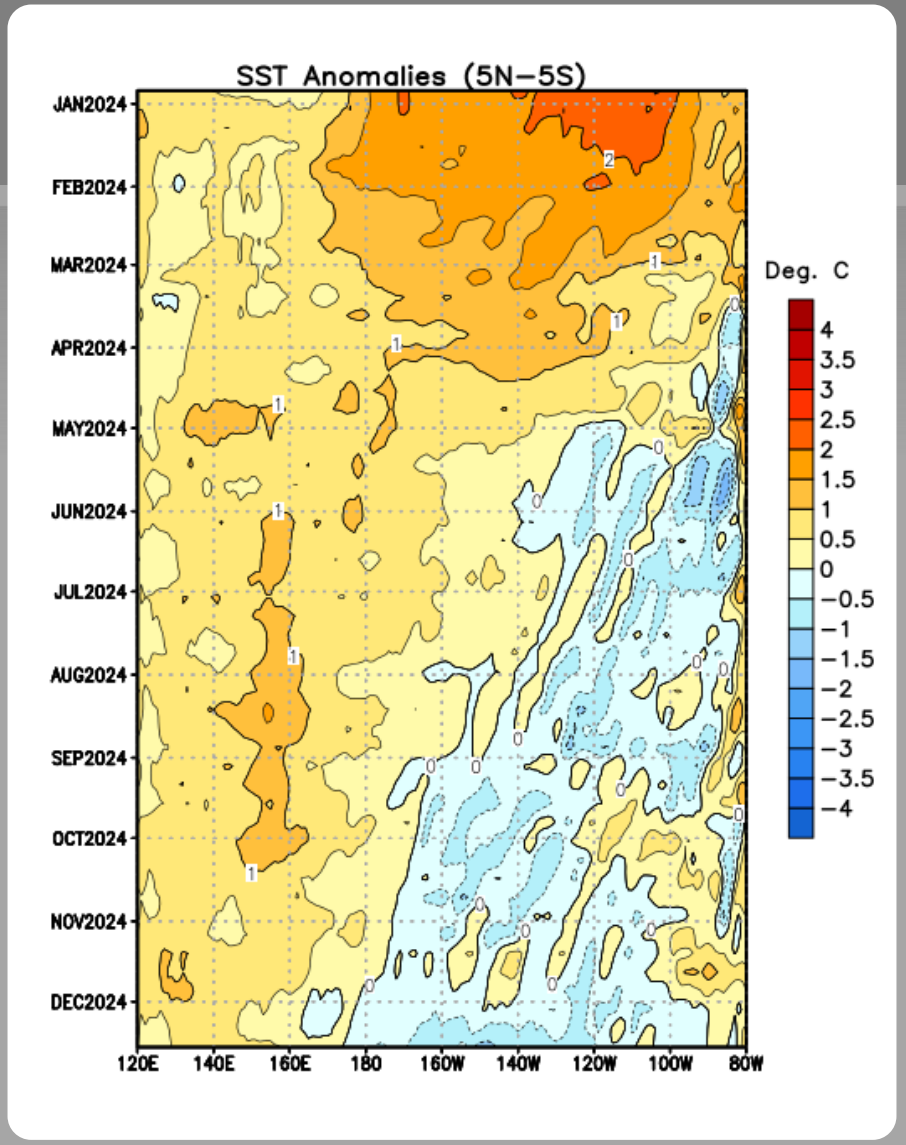
*** Note: These statements are updated once a month (2nd Thursday of each month) in association with the ENSO Diagnostics Discussion, which can be found by clicking here.**

Recent Evolution of Equatorial Pacific SST Departures (ºC)

Positive sea surface temperature (SST) anomalies persisted across most of the eastern and central Pacific Ocean from the beginning of the period until April 2024.

Since mid-March 2024, mostly near-to-below-average SSTs emerged in the eastern Pacific and expanded westward.

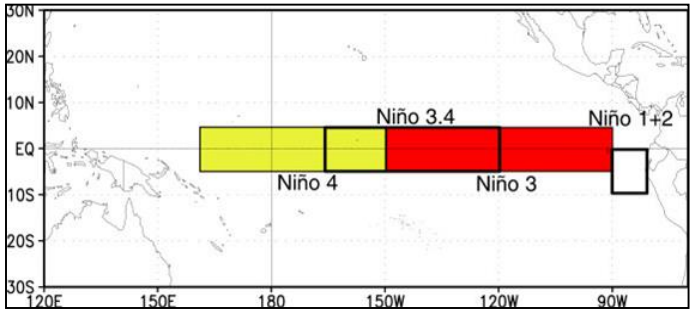
Recently, near-to-below average SSTs were evident across most of the equatorial Pacific.

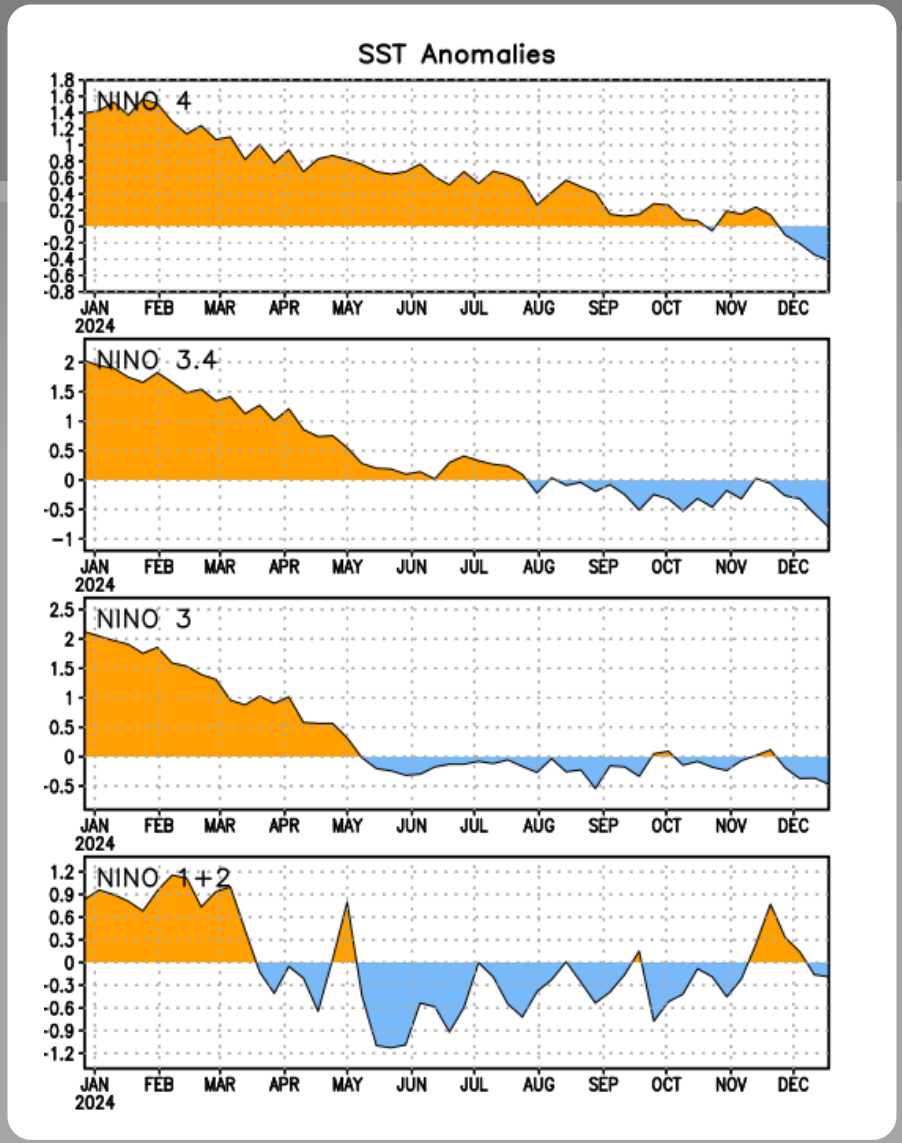


Niño Region SST Departures (ºC) Recent Evolution

The latest weekly SST departures are:

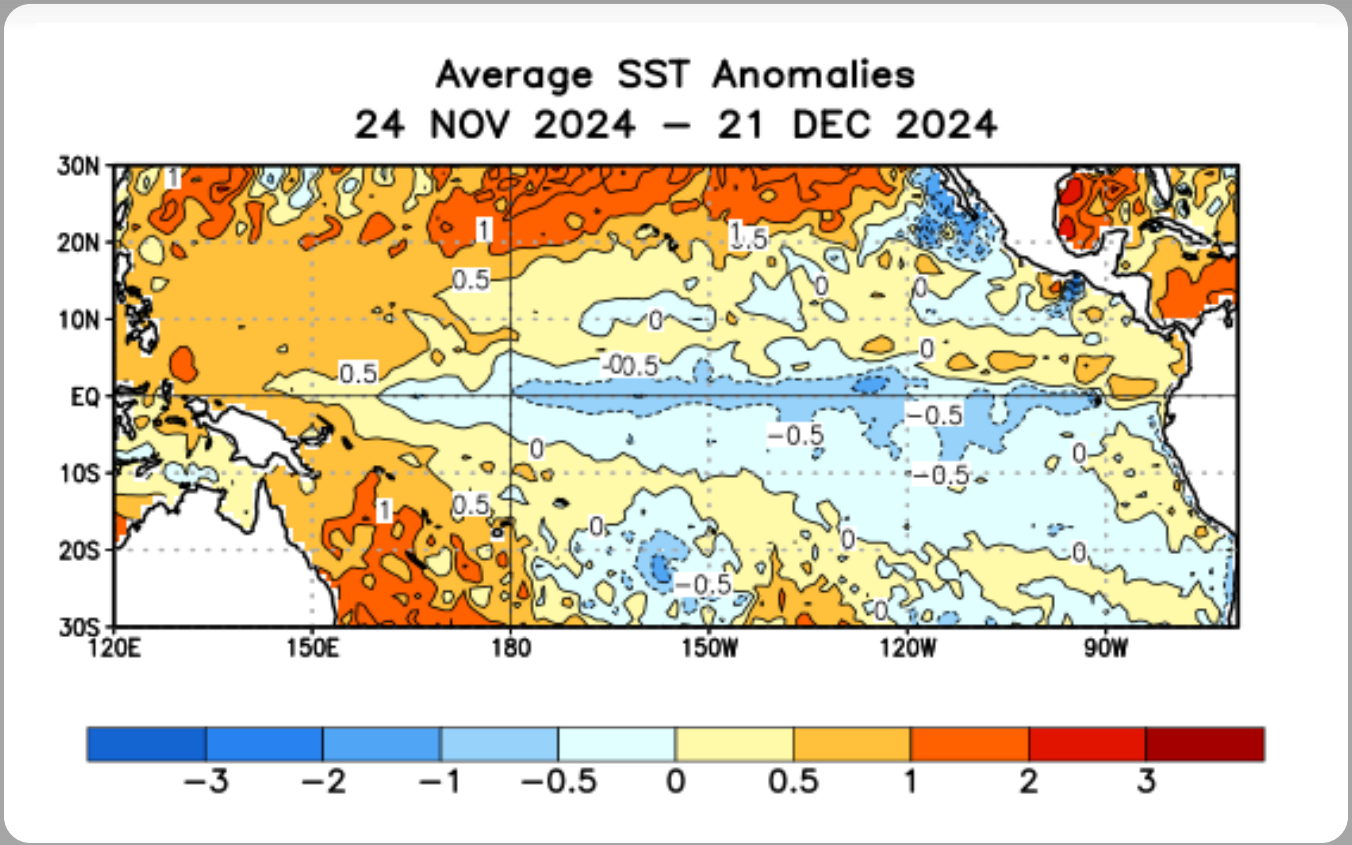
Niño 4	-0.4ºC
Niño 3.4	-0.8ºC
Niño 3	-0.5ºC
Niño 1+2	-0.2ºC





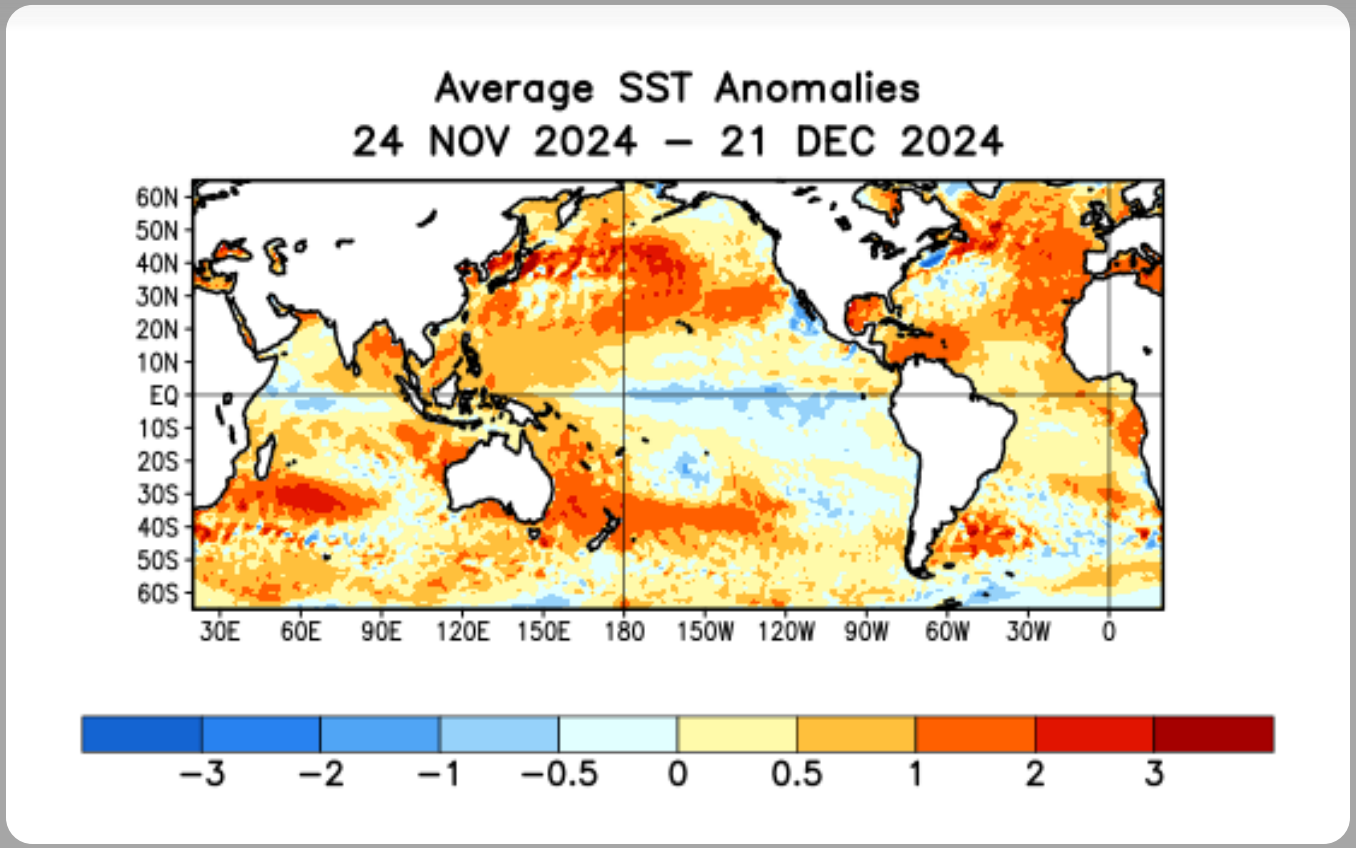
SST Departures (°C) in the Tropical Pacific During the Last Four Weeks

In the last four weeks, equatorial SSTs were above average in the western Pacific Ocean. Near-to-below average SSTs were evident across most of the central and east-central Pacific Ocean.



Global SST Departures (°C) During the Last Four Weeks

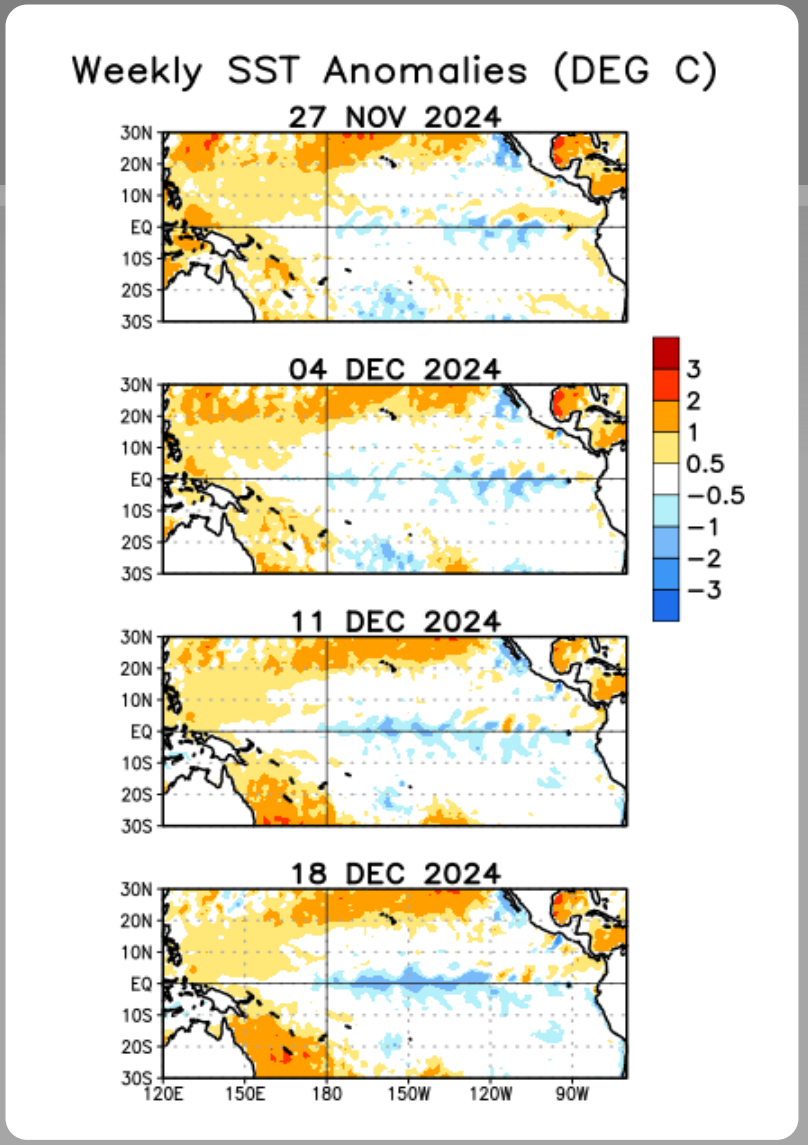
During the last four weeks, equatorial SSTs were above average across the western Pacific Ocean, around the Maritime Continent, and in most of the Atlantic Ocean. Near-to-below-average SSTs were evident in most of the central and east-central Pacific Ocean and in the western Indian Ocean.



Weekly SST Departures during the Last Four Weeks

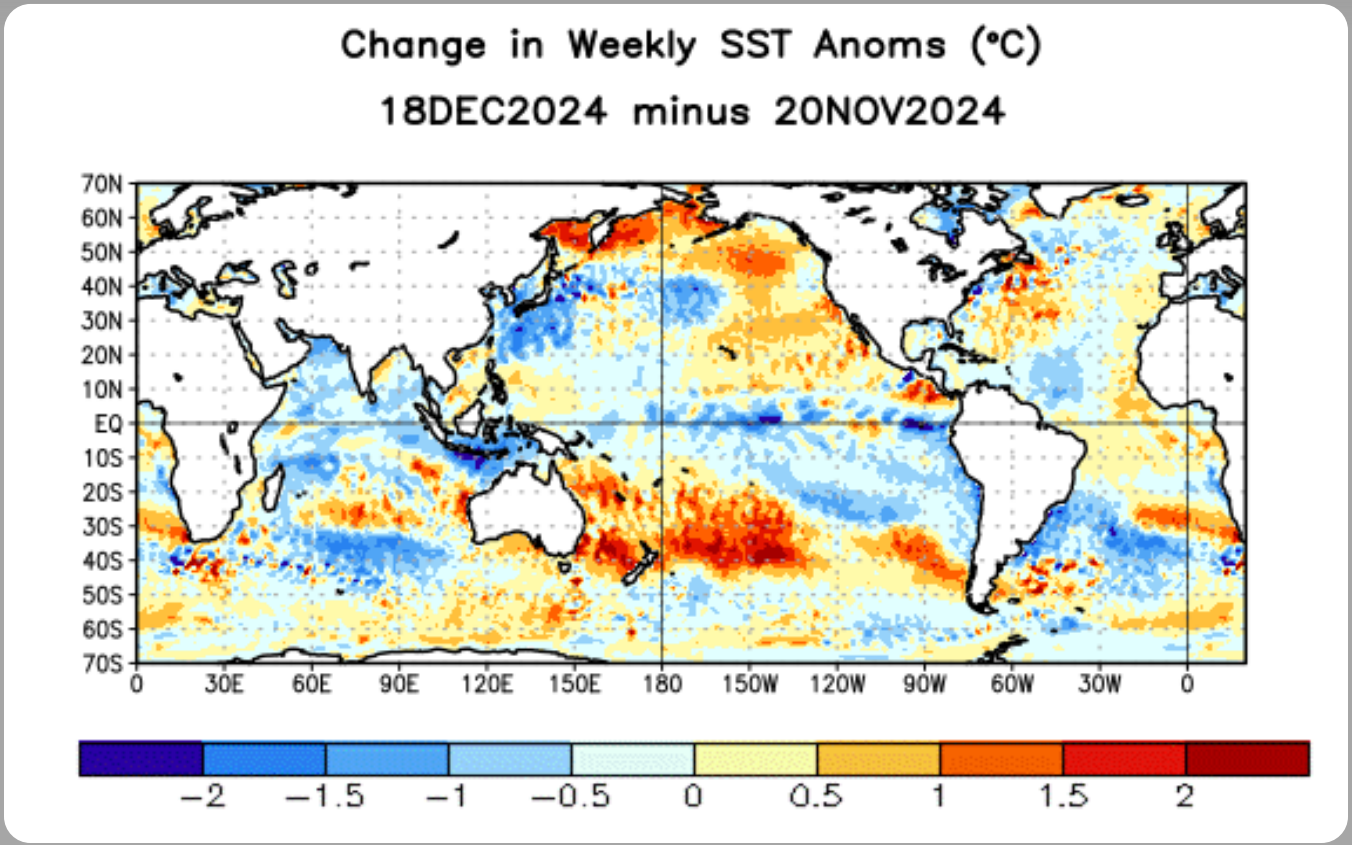
During the last 4 weeks, below-average SSTs strengthened in the central and east-central equatorial Pacific Ocean, while above-average SSTs persisted in the far western Pacific.

A small region of above-average SSTs emerged near coastal South America early in the period and mostly dissipated by the end.



Change in Weekly SST Departures over the Last Four Weeks

During the last four weeks, mostly negative SST anomaly changes were evident across the equatorial Pacific Ocean.



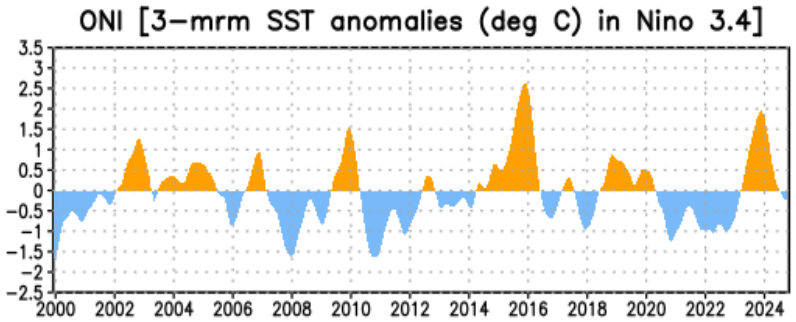
Upper-Ocean Conditions in the Equatorial Pacific

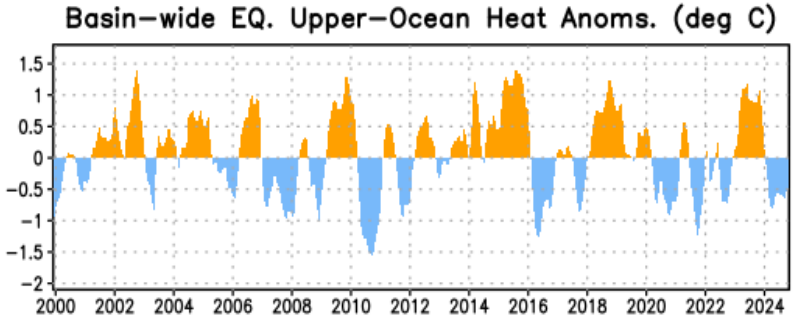
The basin-wide equatorial upper ocean (0-300 m) heat content is greatest prior to and during the early stages of a Pacific warm (El Niño) episode (compare top 2 panels), and least prior to and during the early stages of a cold (La Niña) episode.

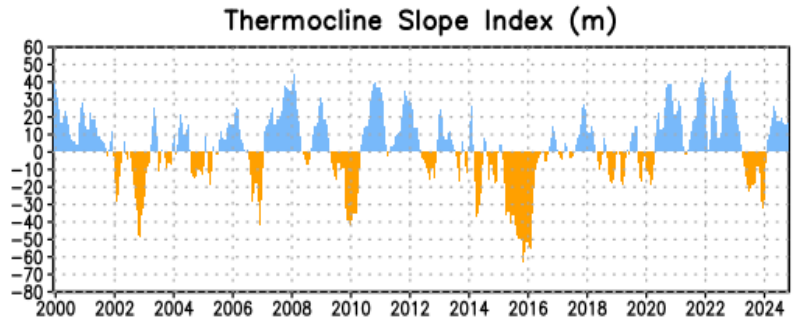
The slope of the oceanic thermocline is least (greatest) during warm (cold) episodes.

Recent values of the upper-ocean heat anomalies (below average) and thermocline slope index (slightly above average) reflect ENSO-neutral.

The monthly thermocline slope index represents the difference in anomalous depth of the 20°C isotherm between the western Pacific (160°E-150°W) and the eastern Pacific (90°-140°W).

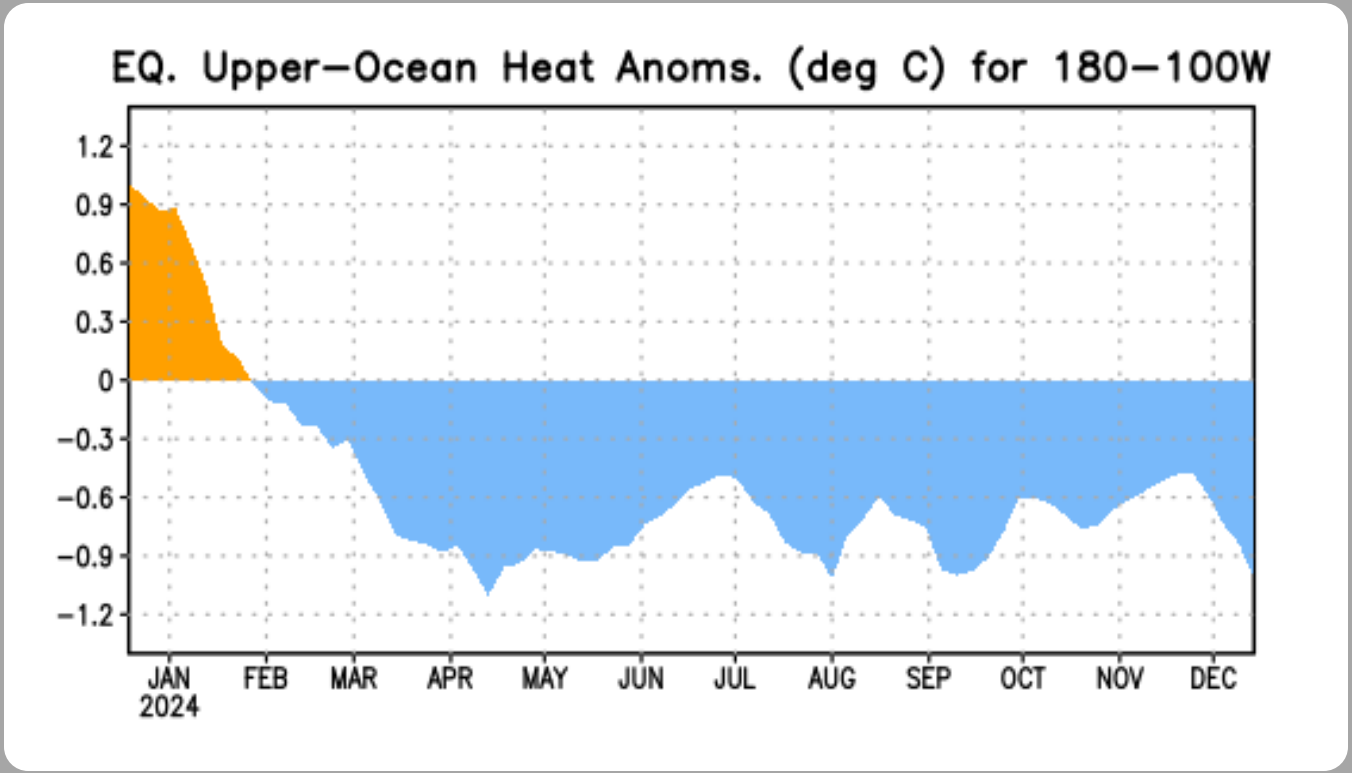






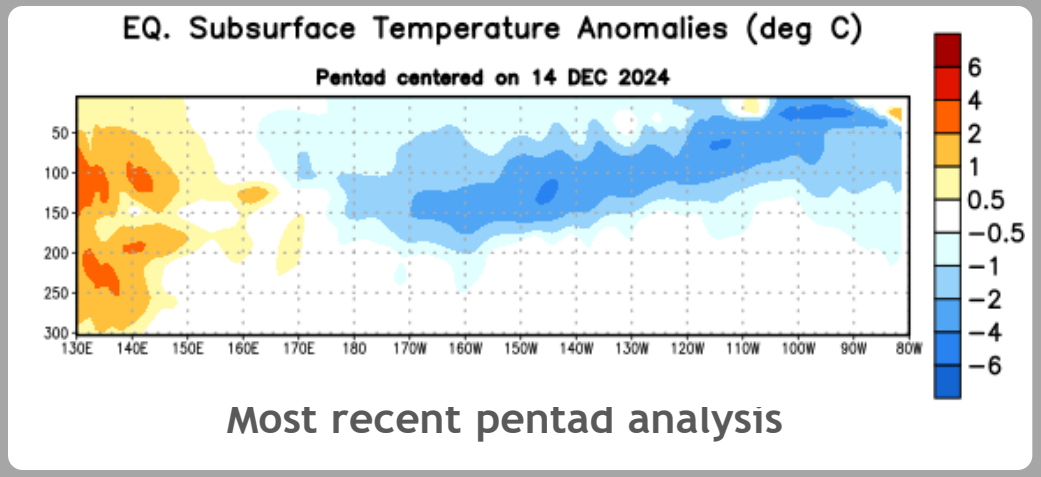
Central and Eastern Pacific Upper-Ocean (0-300 m) Weekly Average Temperature Anomalies

Positive subsurface temperature anomalies persisted through mid-January 2024. Positive subsurface temperature anomalies began weakening in November 2023, became negative in late January, with negative anomalies dominating since February 2024.



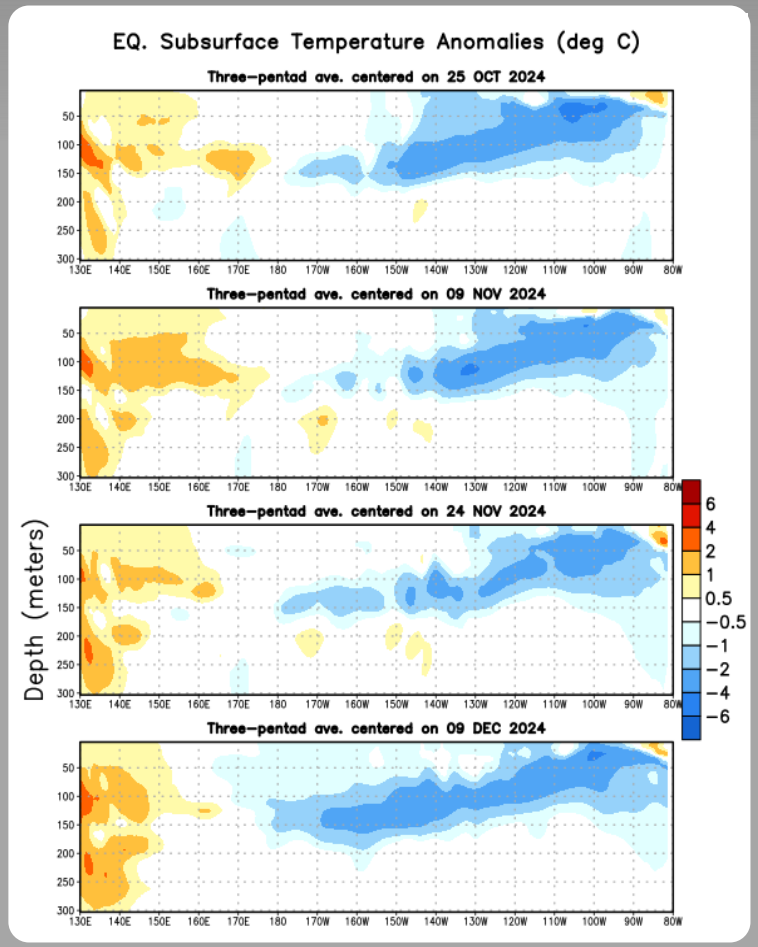
Sub-Surface Temperature Departures in the Equatorial Pacific

Over the last couple of months, negative subsurface temperature anomalies have persisted in the eastern equatorial Pacific Ocean.



Most recent pentad analysis

Below-average temperatures have expanded to the central Pacific Ocean, while above-average temperatures prevail in the far western Pacific.

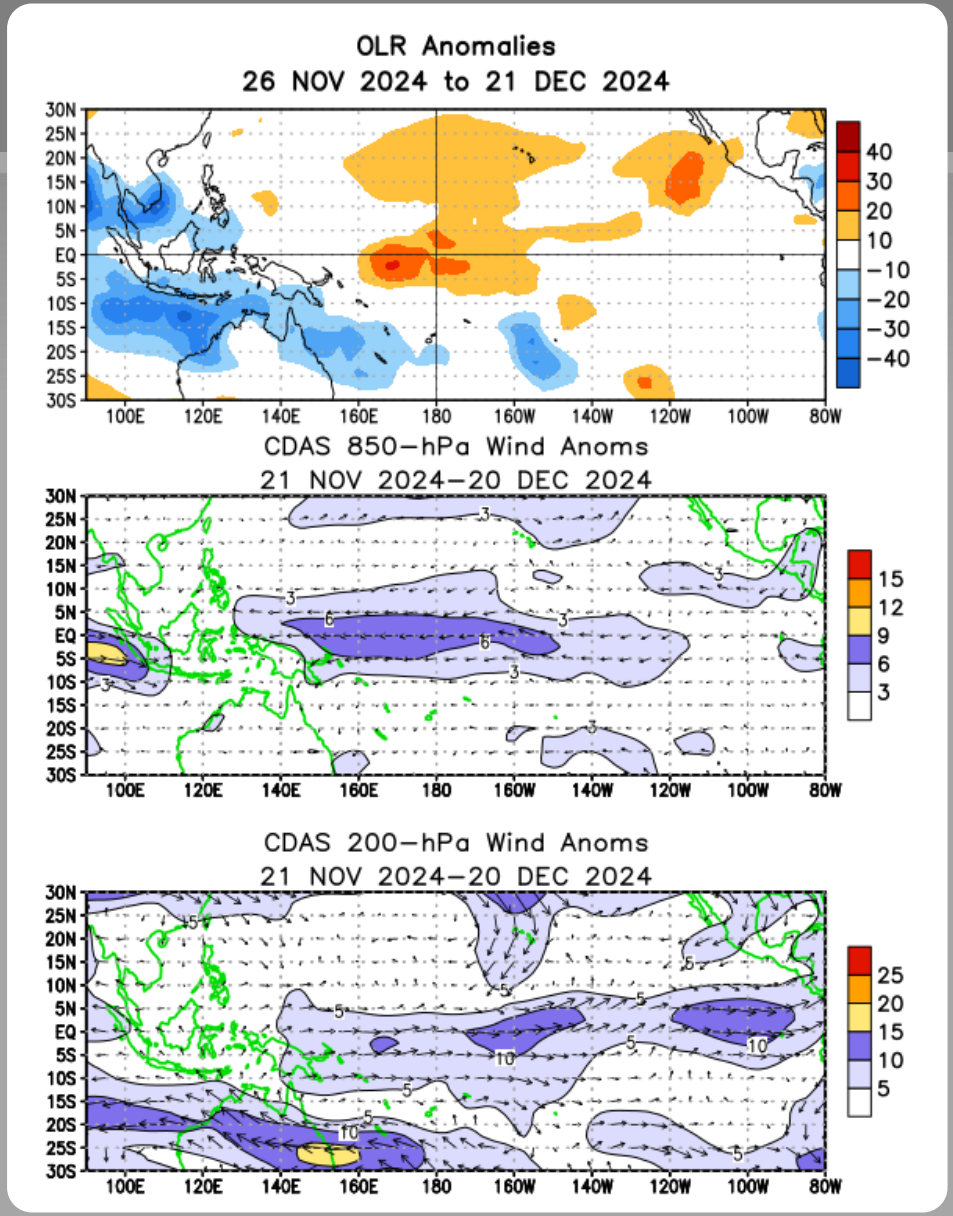


Tropical OLR and Wind Anomalies During the Last 30 Days

Above-average OLR (suppressed convection and precipitation) was observed around the Date Line. Below-average OLR (enhanced convection and precipitation) was evident over parts of Indonesia, Southeast Asia, and northern Australia.

Low-level (850-hPa) wind anomalies were easterly from the western to east-central equatorial Pacific Ocean.

Upper-level (200-hPa) wind anomalies were westerly across the equatorial Pacific Ocean.



Intraseasonal Variability

Intraseasonal variability in the atmosphere (wind and pressure), which is often related to the Madden-Julian Oscillation (MJO), can significantly impact surface and subsurface conditions across the Pacific Ocean.

Related to this activity:

Significant weakening of the low-level easterly winds usually initiates an eastward-propagating oceanic Kelvin wave.

Weekly Heat Content Evolution in the Equatorial Pacific

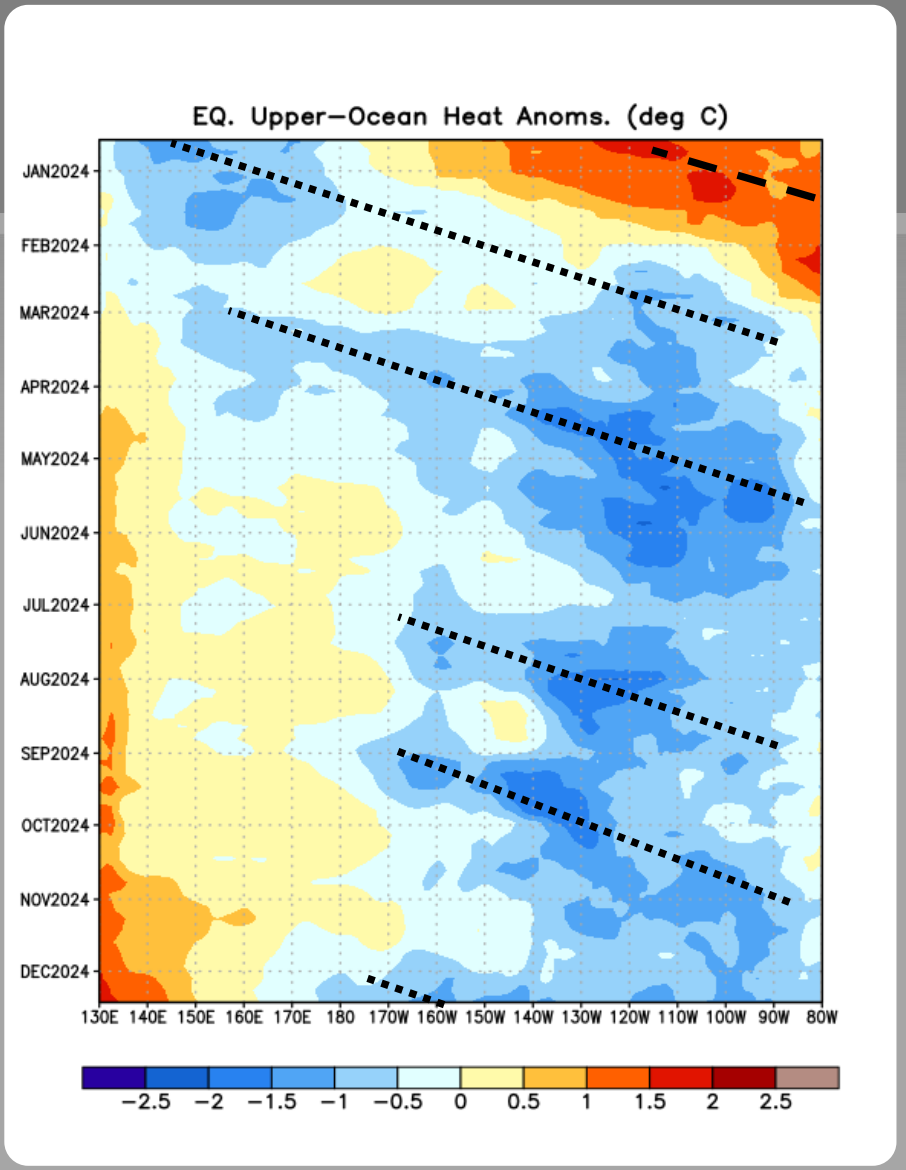
Significant equatorial oceanic Kelvin wave activity (dashed and dotted lines) has been present throughout the period shown.

Through January 2024, above-average subsurface temperatures persisted across most of the Pacific Ocean.

Upwelling Kelvin waves were initiated during January, March, July, September, and December 2024.

Below-average subsurface temperatures persisted in the east-central and eastern Pacific.

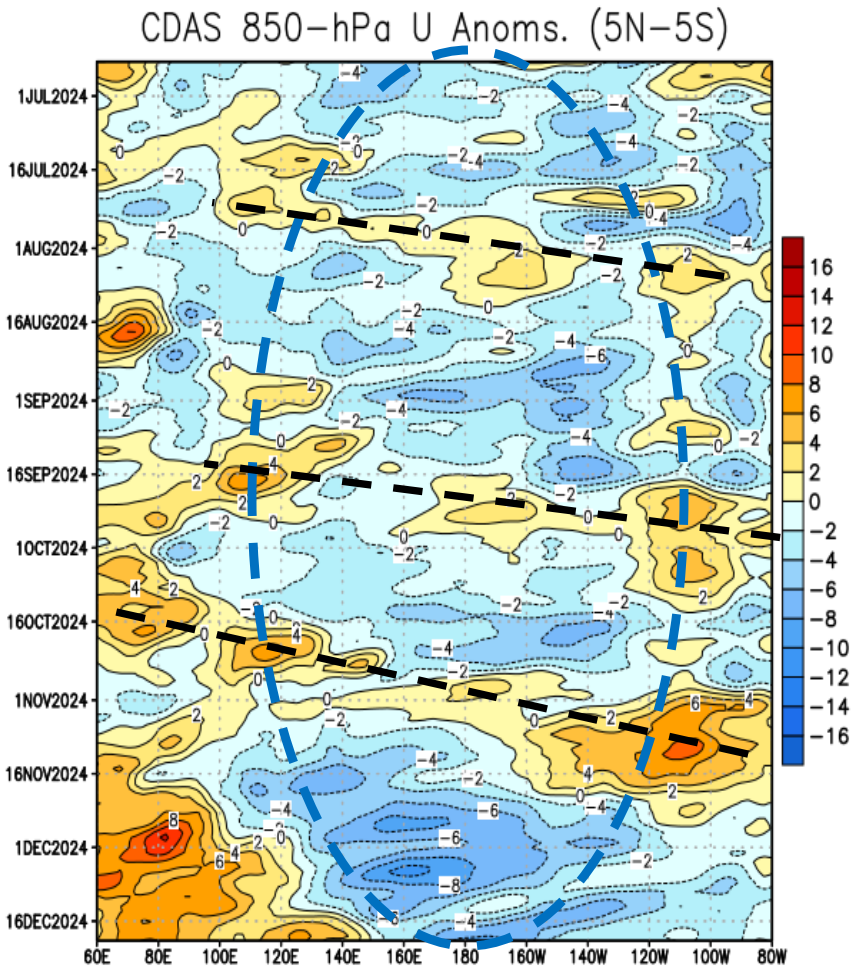
Equatorial oceanic Kelvin waves have alternating warm and cold phases. The warm phase is indicated by dashed lines. Down-welling and warming occur in the leading portion of a Kelvin wave, and up-welling and cooling occur in the trailing portion.



Low-level (850-hPa) Zonal (east-west) Wind Anomalies (m s^{-1})

At times, the Madden Julian-Oscillation (MJO) has contributed to the eastward propagation of low-level wind anomalies.

Since July 2024, easterly wind anomalies have mostly dominated over the central and east-central Pacific Ocean, with some shorter-lived periods of westerly wind anomalies.

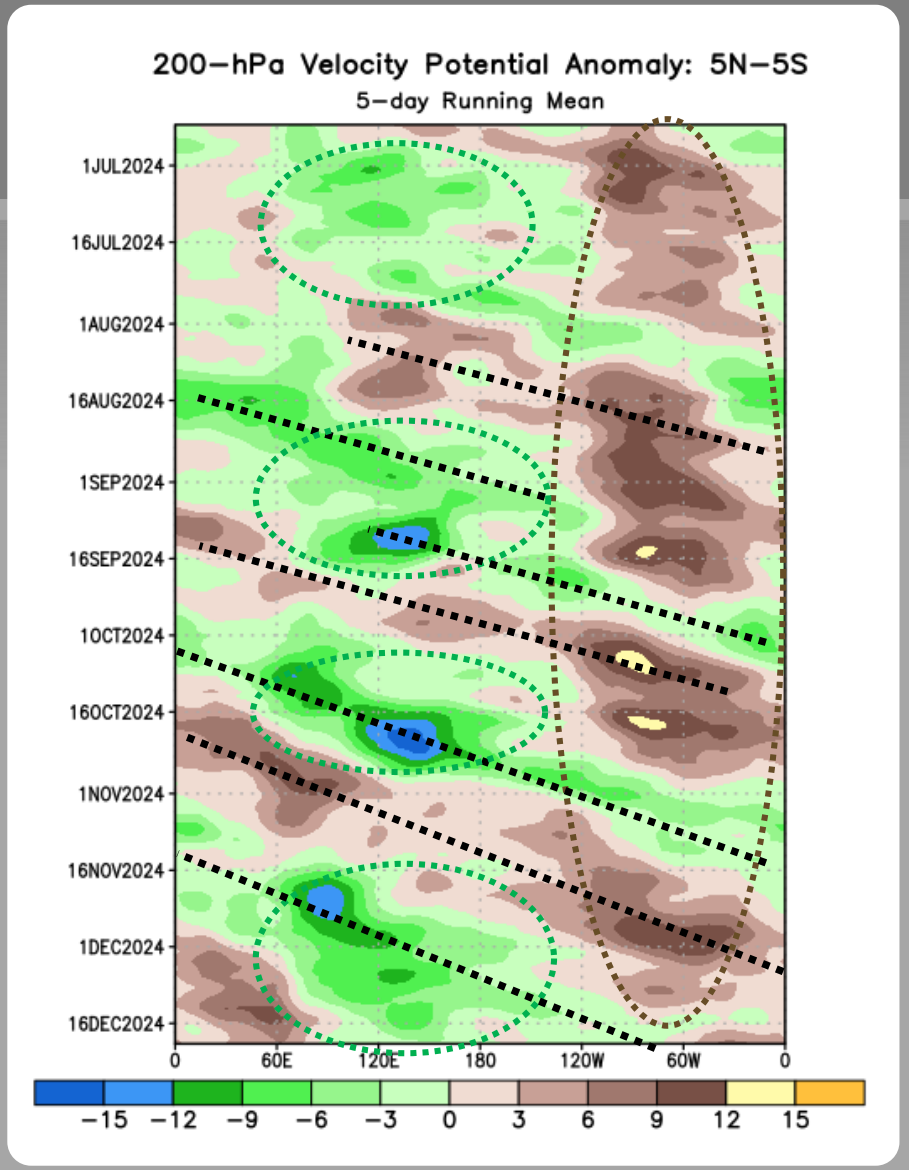


Westerly Wind Anomalies (orange/red shading)
Easterly Wind Anomalies (blue shading)

Upper-level (200-hPa) Velocity Potential Anomalies

At times, regions of anomalous divergence (green shading) and convergence (brown shading) shifted eastward.

Since July 2024, anomalous divergence has been periodically evident over Indonesia and the western Pacific. Over the eastern Pacific, anomalous convergence has mostly persisted.

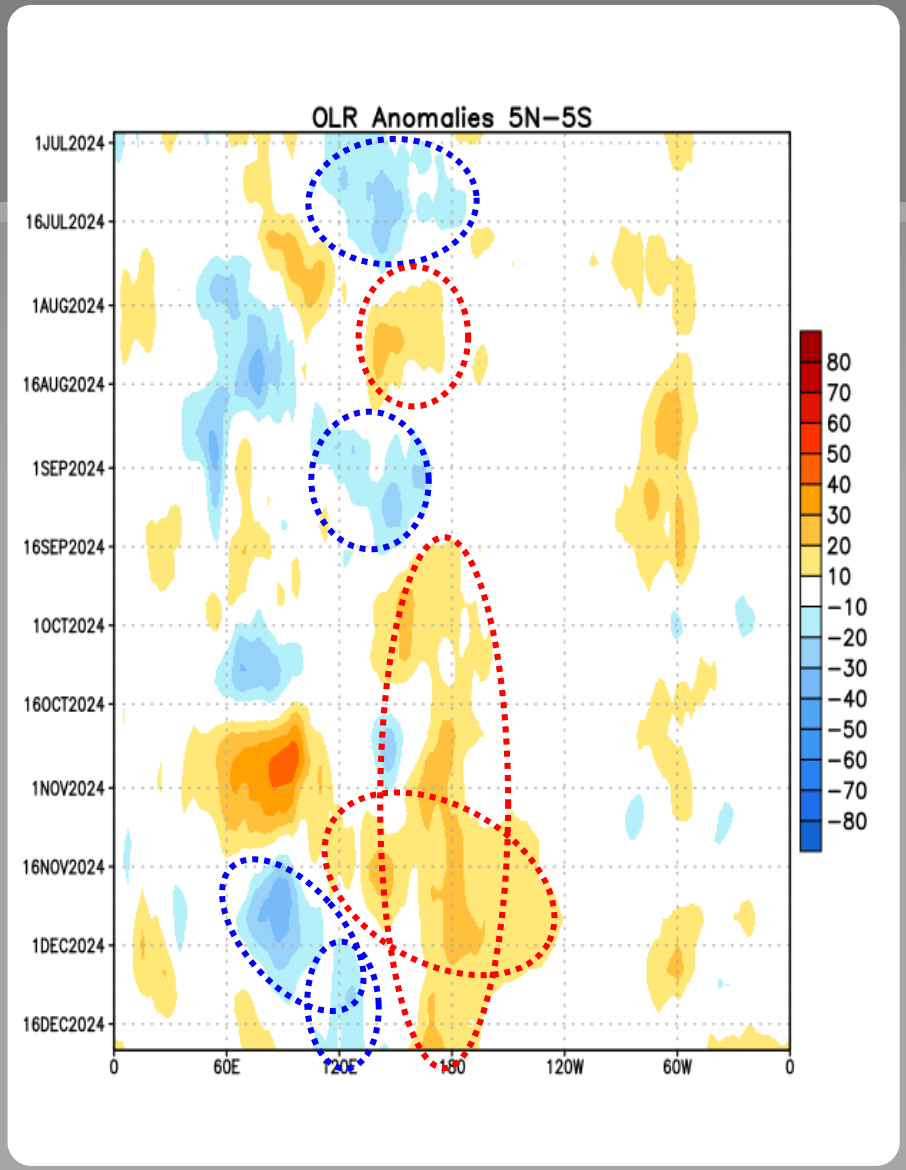


Unfavorable for precipitation (brown shading)
Favorable for precipitation (green shading)
Note: Eastward propagation is not necessarily indicative of the Madden-Julian Oscillation (MJO).

Outgoing Longwave Radiation (OLR) Anomalies

Since mid-September 2024, positive OLR anomalies (suppressed convection/rainfall) have persisted near the Date Line.

Since early December 2024, negative OLR anomalies (enhanced convection/rainfall) have emerged over Indonesia.



Drier-than-average Conditions (orange/red shading)
Wetter-than-average Conditions (blue shading)

Oceanic Niño Index (ONI)

The ONI is based on SST departures from average in the Niño 3.4 region, and is a principal measure for monitoring, assessing, and predicting ENSO.

Defined as the three-month running-mean SST departures in the Niño 3.4 region. Departures are based on a set of improved homogeneous historical SST analyses (Extended Reconstructed SST – ERSST.v5). The SST reconstruction methodology is described in Huang et al., 2017, J. Climate, vol. 30, 8179-8205.)

It is one index that helps to place current events into a historical perspective.

Note: a different SST dataset is used for weekly SST monitoring (slides #4-9) and is using OISSTv2.1 (Huang et al., 2021).

NOAA Operational Definitions for El Niño and La Niña

El Niño: characterized by a positive ONI greater than or equal to +0.5°C.

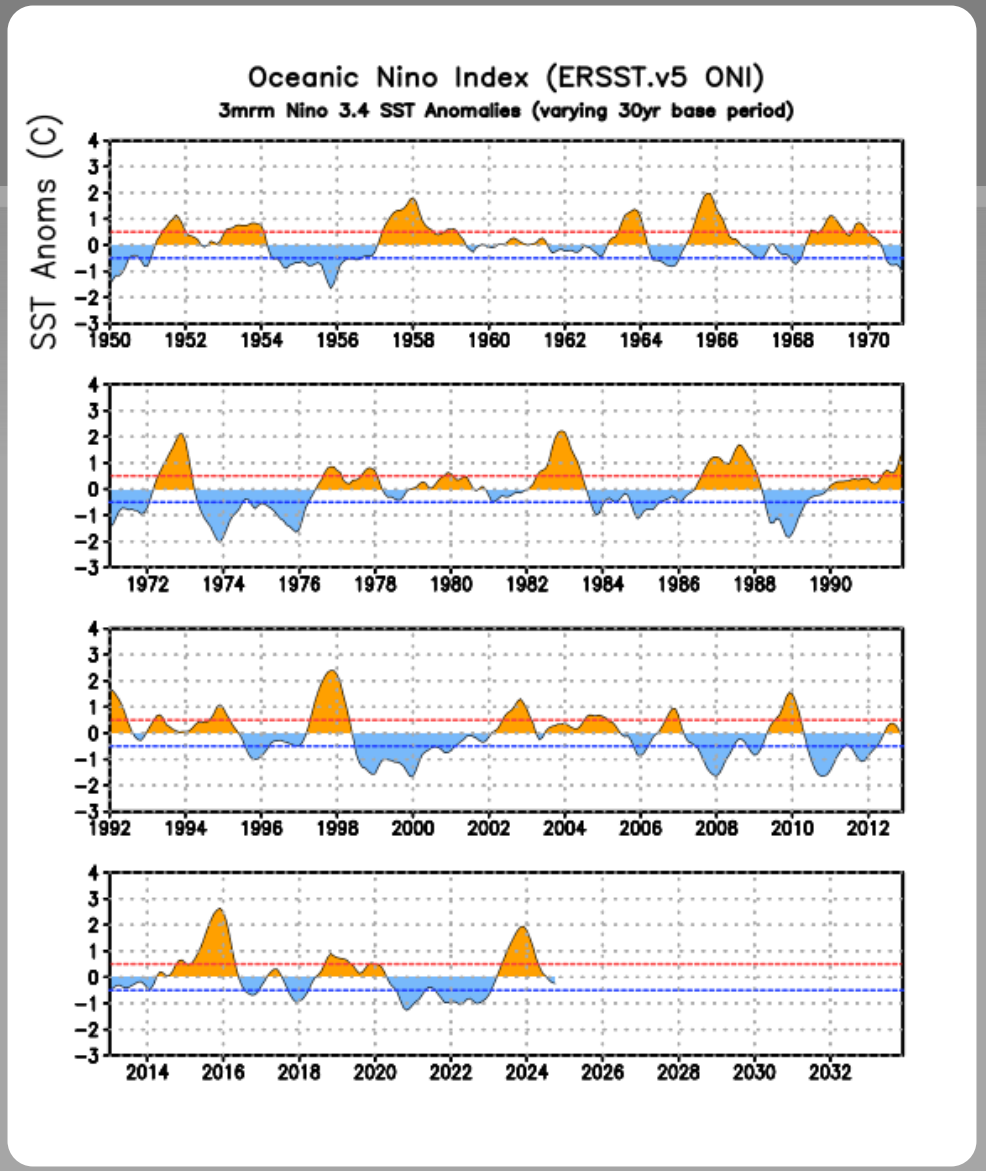
La Niña: characterized by a negative ONI less than or equal to -0.5°C.

By historical standards, to be classified as a full-fledged El Niño or La Niña episode, these thresholds must be exceeded for a period of at least 5 consecutive overlapping 3-month seasons.

CPC considers El Niño or La Niña conditions to occur when the monthly Niño3.4 OISST departures meet or exceed +/- 0.5°C along with consistent atmospheric features. These anomalies must also be forecasted to persist for 3 consecutive months.

ONI (°C): Evolution since 1950

The most recent ONI value (September-November 2024) is -0.2°C.



Historical El Niño and La Niña Episodes Based on the ONI computed using ERSST.v5

Recent Pacific warm (red) and cold (blue) periods based on a threshold of +/- 0.5 °C for the Oceanic Nino Index (ONI) [3 month running mean of ERSST.v5 SST anomalies in the Nino 3.4 region (5N-5S, 120-170W)]. For historical purposes, periods of below and above normal SSTs are colored in blue and red when the threshold is met for a minimum of 5 consecutive over-lapping seasons.

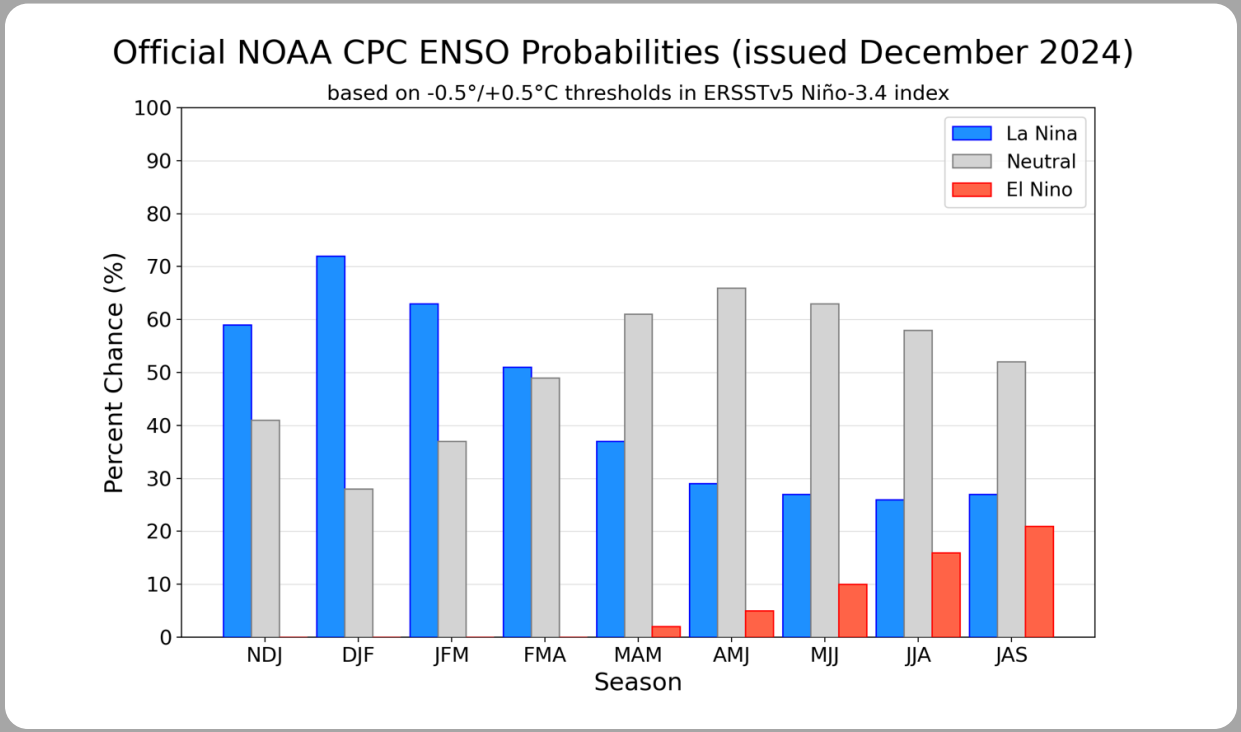
The ONI is one measure of the El Niño-Southern Oscillation, and other indices can confirm whether features consistent with a coupled ocean-atmosphere phenomenon accompanied these periods. The complete table going back to DJF 1950 can be found here.

Year	DJF	JFM	FMA	MAM	AMJ	MJJ	JJA	JAS	ASO	SON	OND	NDJ
2012	-0.9	-0.7	-0.6	-0.5	-0.3	0.0	0.2	0.4	0.4	0.3	0.1	-0.2
2013	-0.4	-0.4	-0.3	-0.3	-0.4	-0.4	-0.4	-0.3	-0.3	-0.2	-0.2	-0.3
2014	-0.4	-0.5	-0.3	0.0	0.2	0.2	0.0	0.1	0.2	0.5	0.6	0.7
2015	0.5	0.5	0.5	0.7	0.9	1.2	1.5	1.9	2.2	2.4	2.6	2.6
2016	2.5	2.1	1.6	0.9	0.4	-0.1	-0.4	-0.5	-0.6	-0.7	-0.7	-0.6
2017	-0.3	-0.2	0.1	0.2	0.3	0.3	0.1	-0.1	-0.4	-0.7	-0.8	-1.0
2018	-0.9	-0.9	-0.7	-0.5	-0.2	0.0	0.1	0.2	0.5	0.8	0.9	0.8
2019	0.7	0.7	0.7	0.7	0.5	0.5	0.3	0.1	0.2	0.3	0.5	0.5
2020	0.5	0.5	0.4	0.2	-0.1	-0.3	-0.4	-0.6	-0.9	-1.2	-1.3	-1.2
2021	-1.0	-0.9	-0.8	-0.7	-0.5	-0.4	-0.4	-0.5	-0.7	-0.8	-1.0	-1.0
2022	-1.0	-0.9	-1.0	-1.1	-1.0	-0.9	-0.8	-0.9	-1.0	-1.0	-0.9	-0.8
2023	-0.7	-0.4	-0.1	0.2	0.5	0.8	1.1	1.3	1.6	1.8	1.9	2.0
2024	1.8	1.5	1.1	0.7	0.4	0.2	0.0	-0.1	-0.2	-0.2		

CPC Probabilistic ENSO Outlook

Updated: 12 December 2024

La Niña conditions are favored to emerge during November 2024 - January 2025 (59% chance), with a transition to ENSO-neutral most likely by March-May 2025.



IRI Pacific Niño 3.4 SST Model Outlook

The majority of dynamical models indicate an imminent transition to La Niña, lasting through January-March 2025, while the average of statistical models predicts ENSO-neutral through winter 2024-2025.

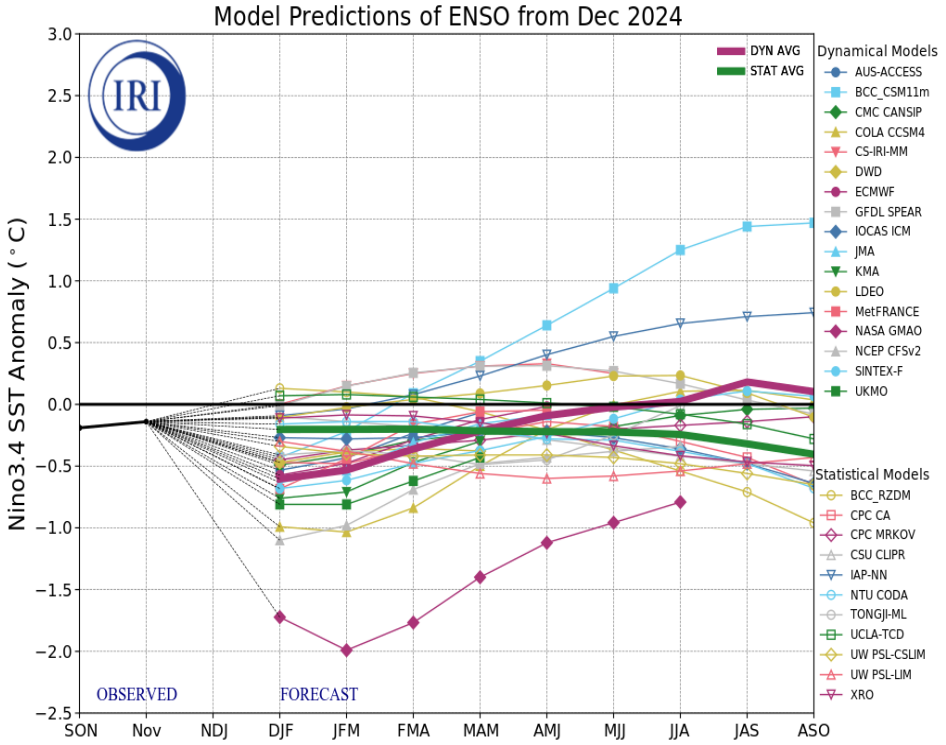
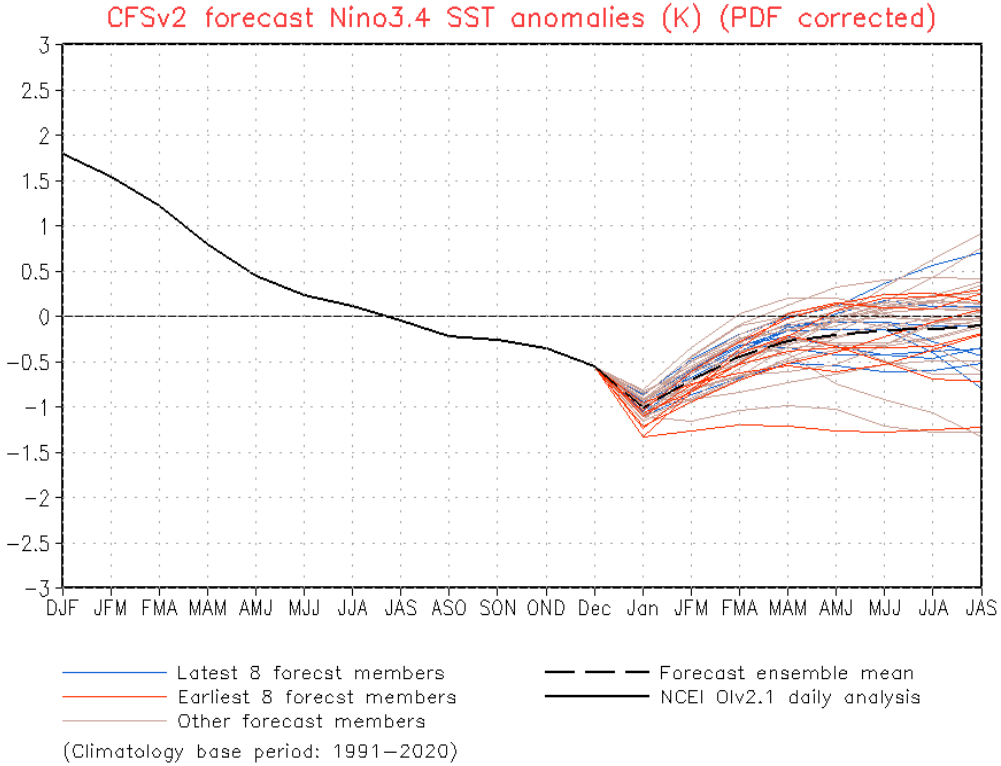


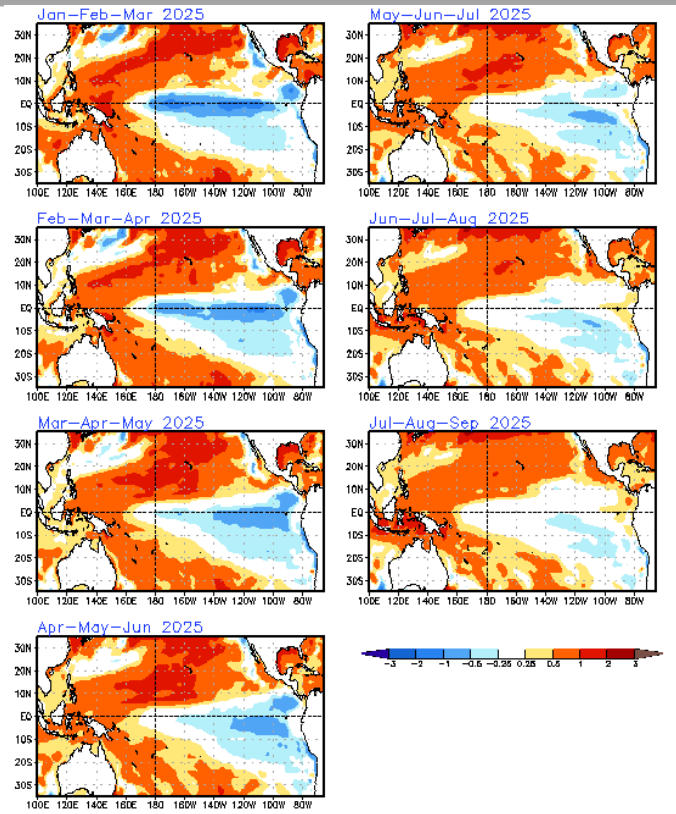
Figure provided by the International Research Institute (IRI) for Climate and Society (updated 19 December 2024).

SST Outlook: NCEP CFS.v2 Forecast (PDF corrected)

Issued: 22 December 2024

The CFS.v2 ensemble mean (black dashed line) indicates La Niña conditions will develop shortly and persist through February-April 2025.

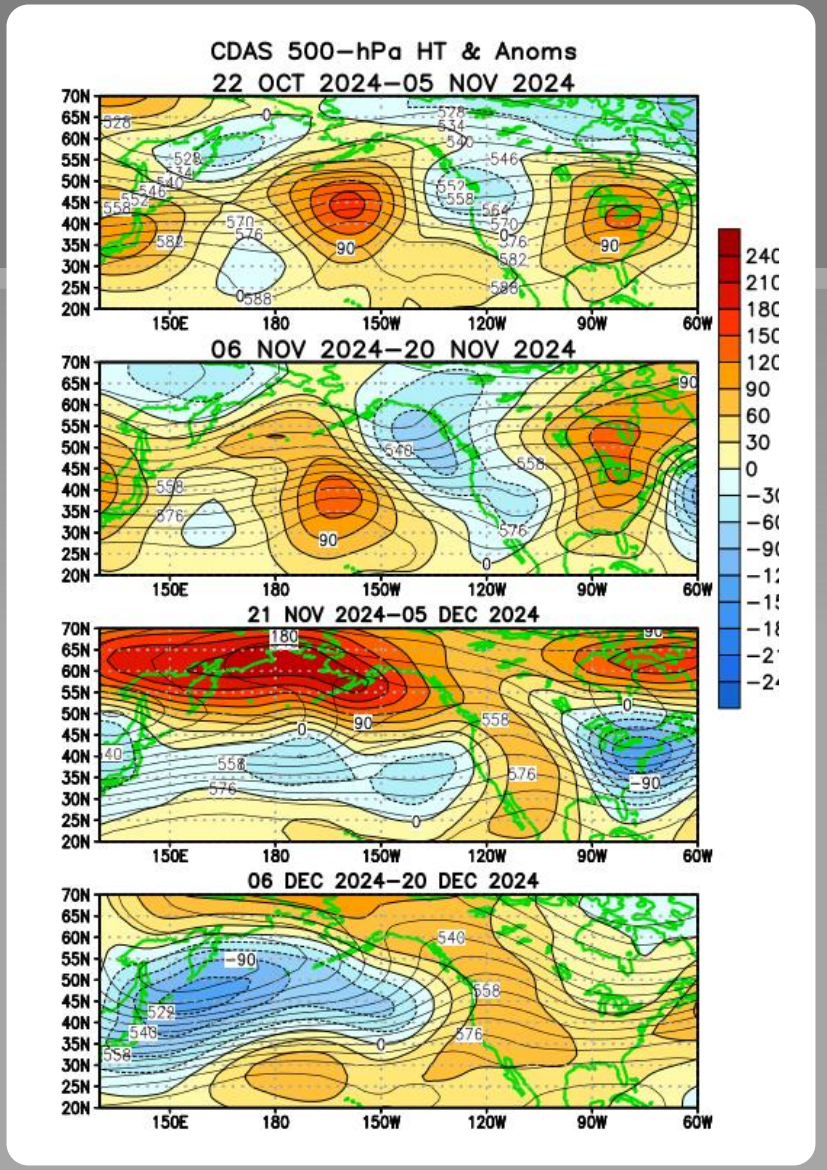




Atmospheric anomalies over the North Pacific and North America During the Last 60 Days

From mid-October to mid-November, above-average heights and temperatures dominated the eastern U.S., with below-average heights and temperature across the western U.S.

From mid-November to mid-December, the pattern flipped with above-average heights and temperatures prevailing over the western U.S.



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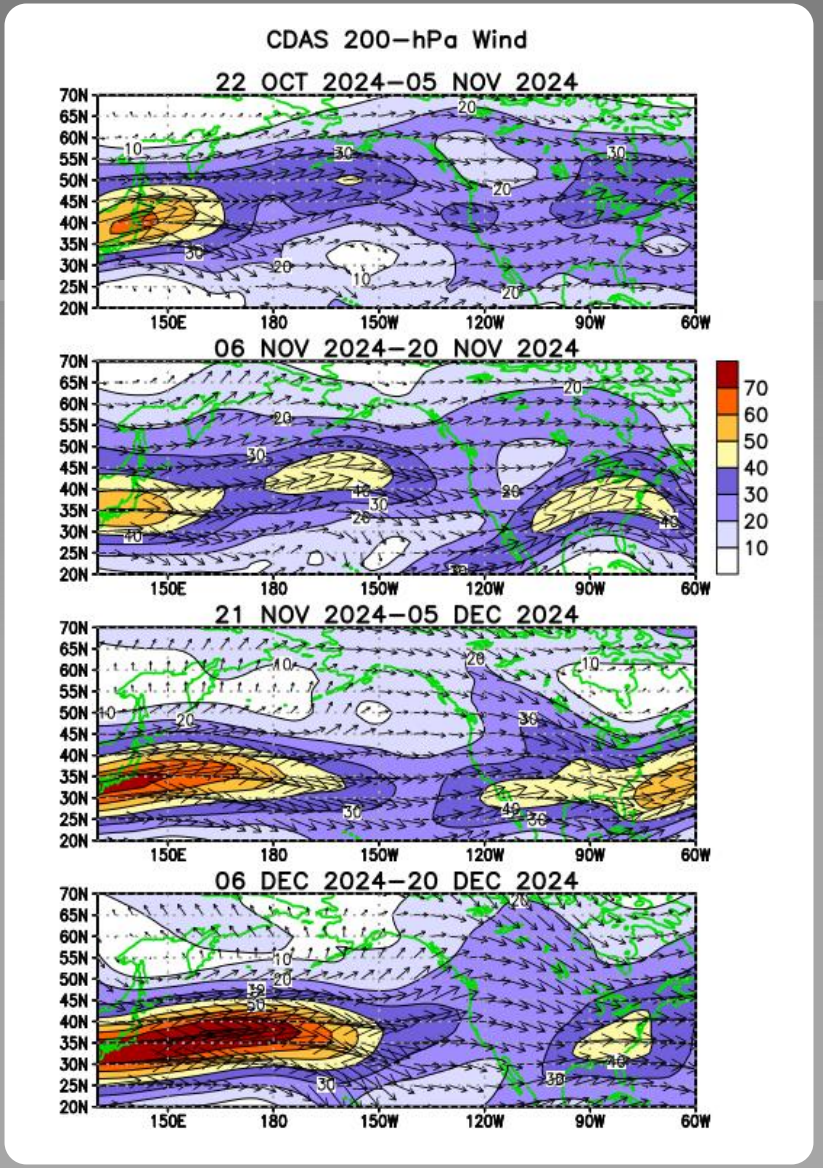

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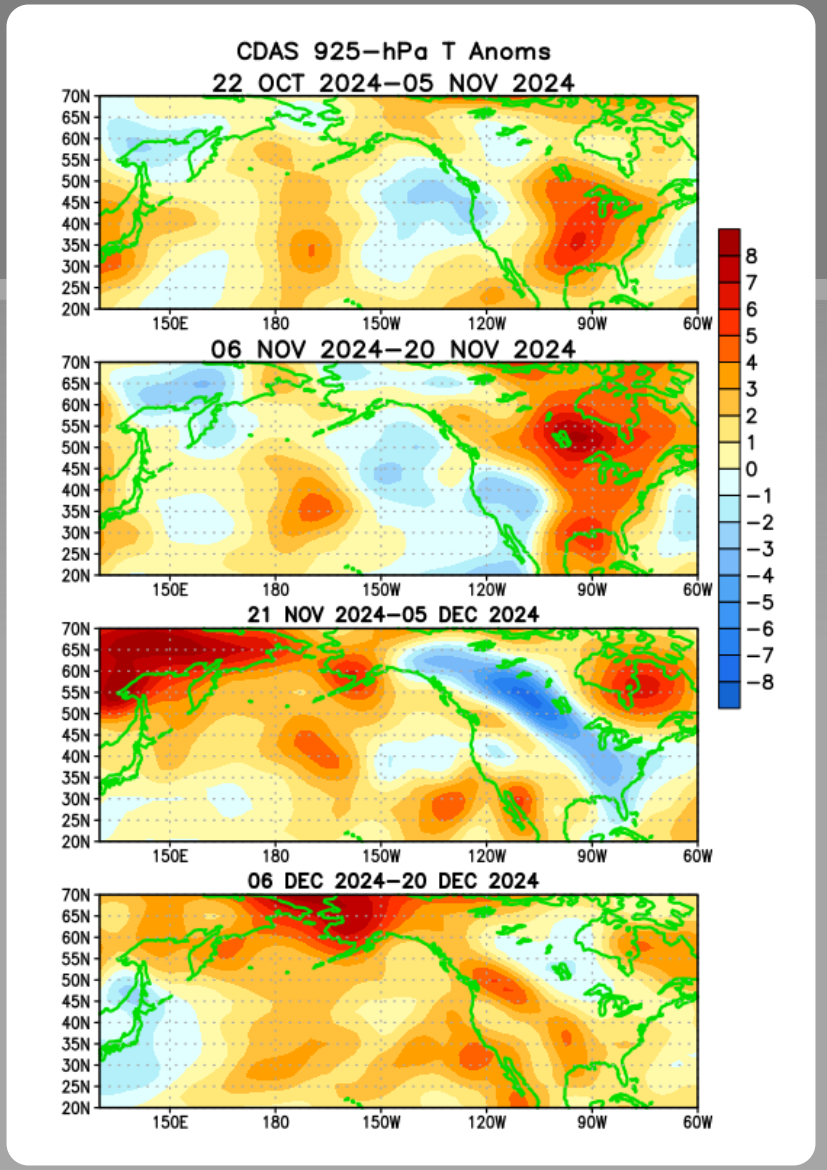
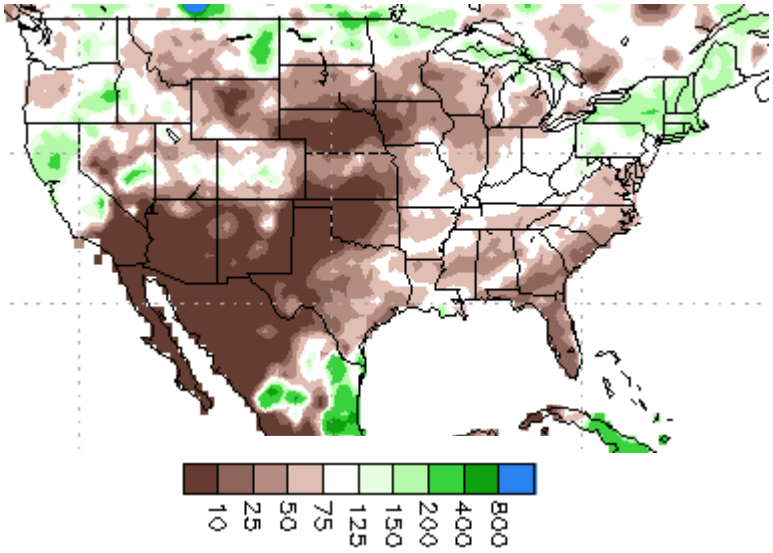


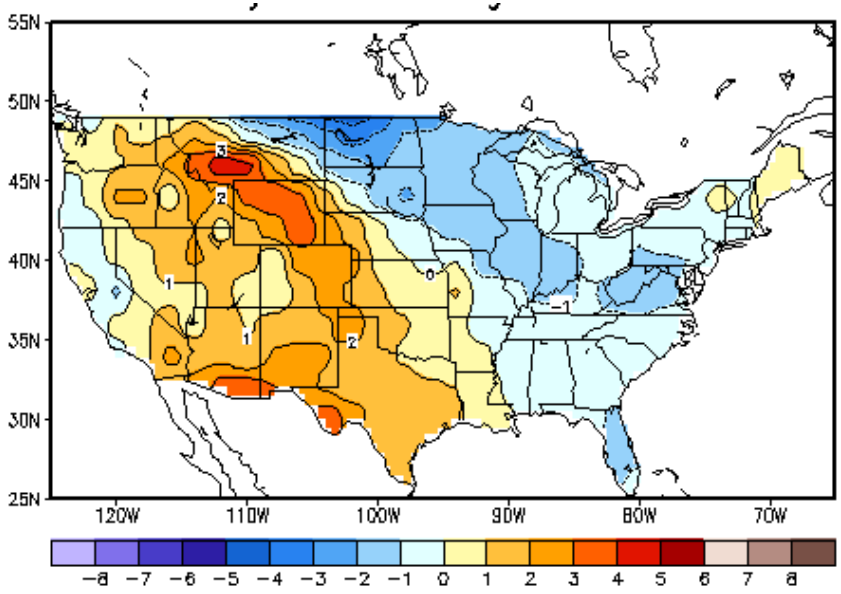
U.S. Temperature and Precipitation Departures During the Last 30 Days

End Date: 21 December 2024

Percent of Average Precipitation



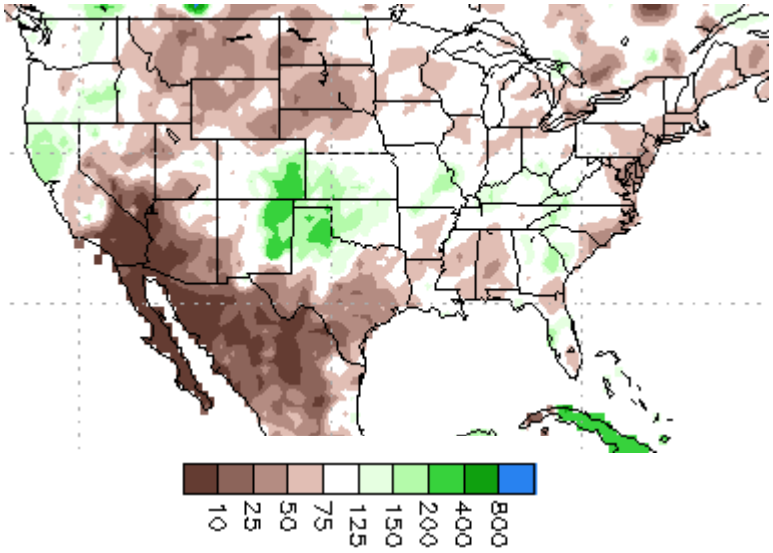
Temperature Departures (degree C)



U.S. Temperature and Precipitation Departures During the Last 90 Days

End Date: 21 December 2024

Percent of Average Precipitation



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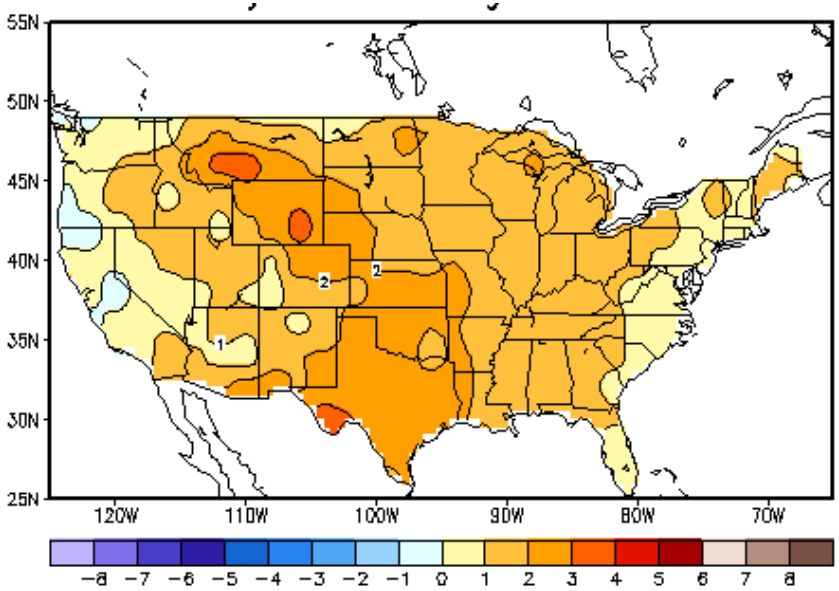
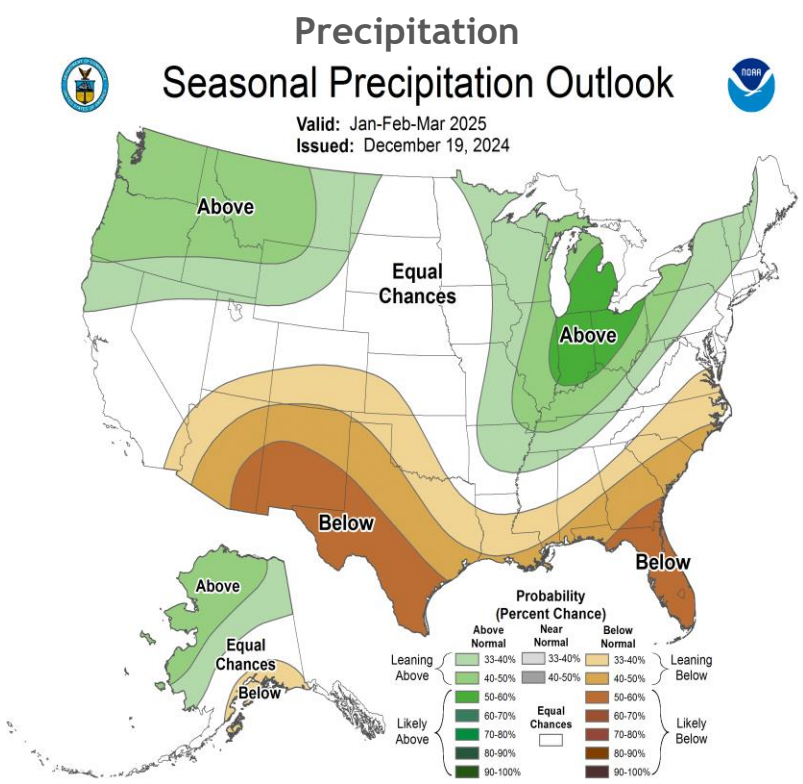


U. S. Seasonal Outlooks

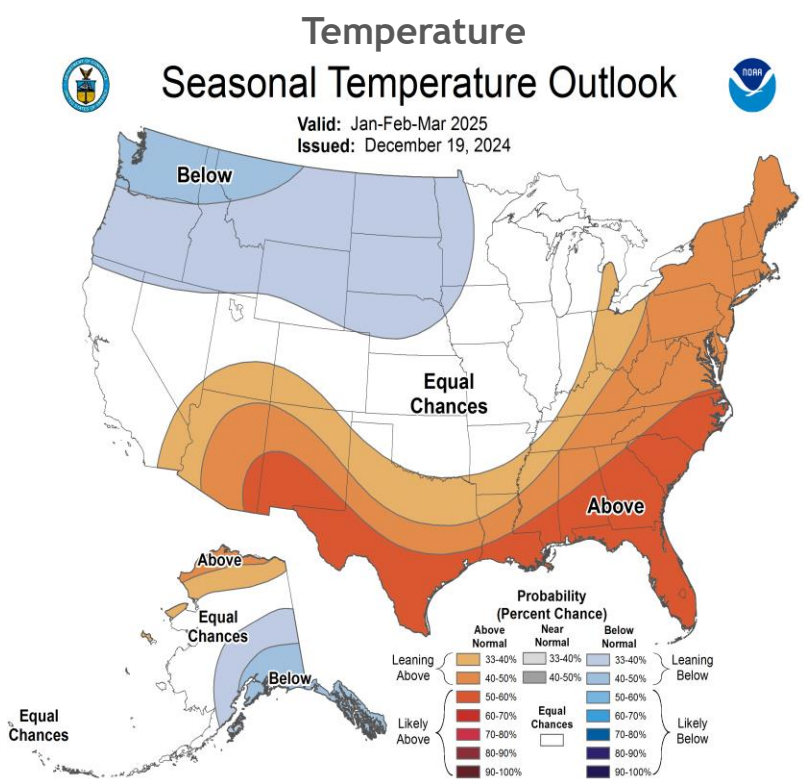
January - March 2025

The seasonal outlooks combine the effects of long-term trends, soil moisture, and, when appropriate, ENSO.

Precipitation



Temperature



Summary

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La Niña conditions are most likely to emerge in November 2024 - January 2025 (59% chance), with a transition to ENSO-neutral most likely by March-May 2025.*

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