

ENSO: Recent Evolution, Current Status and Predictions



Update prepared by:
Climate Prediction Center / NCEP
29 January 2024

Outline

Summary

Recent Evolution and Current Conditions

Oceanic Niño Index (ONI)

Pacific SST Outlook

U.S. Seasonal Precipitation and Temperature Outlooks

Summary

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ENSO Alert System Status: **El Niño Advisory**

El Niño conditions are observed.*

Equatorial sea surface temperatures (SSTs) are above average across the central and eastern Pacific Ocean.

The tropical Pacific atmospheric anomalies are consistent with El Niño.

El Niño is expected to continue for the next several seasons, with ENSO-neutral favored during April-June 2024 (73% chance).*

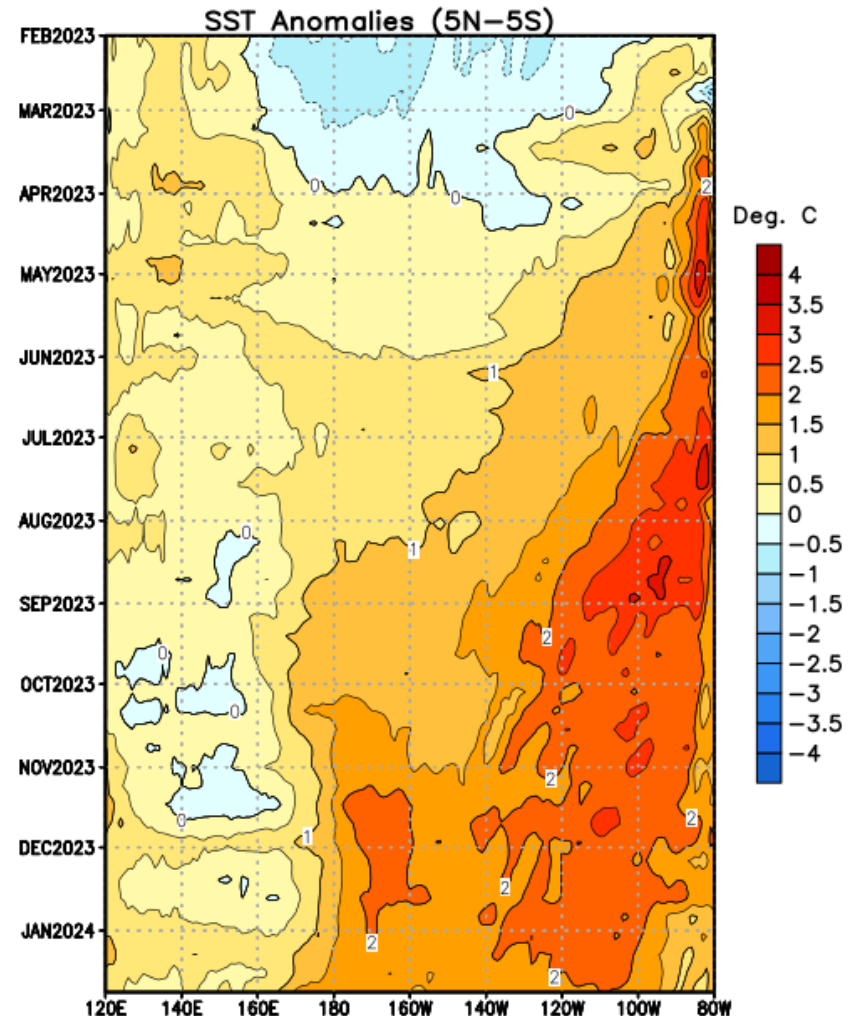
* Note: These statements are updated once a month (2nd Thursday of each month) in association with the ENSO Diagnostics Discussion, which can be found by clicking [here](#).

Recent Evolution of Equatorial Pacific SST Departures (°C)

From March-October 2023, positive sea surface temperature (SST) anomalies in the eastern Pacific Ocean expanded and shifted westward.

In October and November 2023, SST anomalies increased in the central and east-central Pacific. In December, the positive SST anomalies persisted, with the exception of SSTs in the far eastern Pacific which gradually weakened.

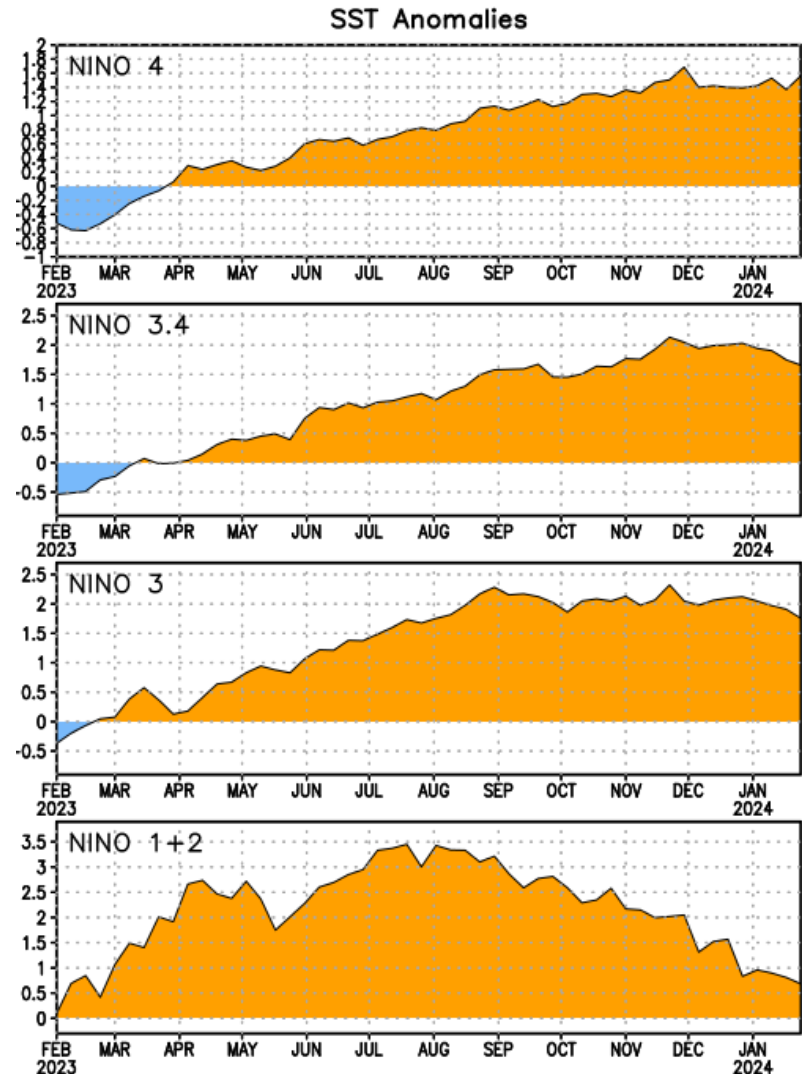
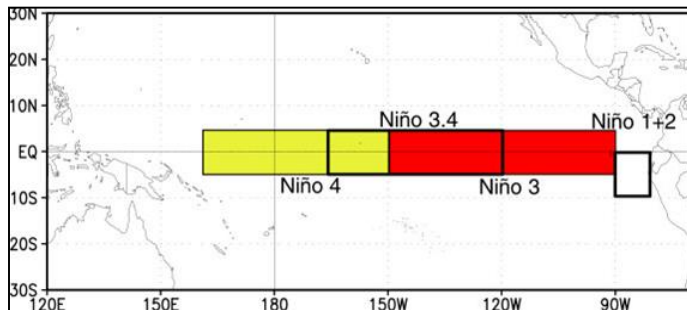
Recently, positive SST anomalies have weakened across the east-central and eastern equatorial Pacific.



Niño Region SST Departures (°C) Recent Evolution

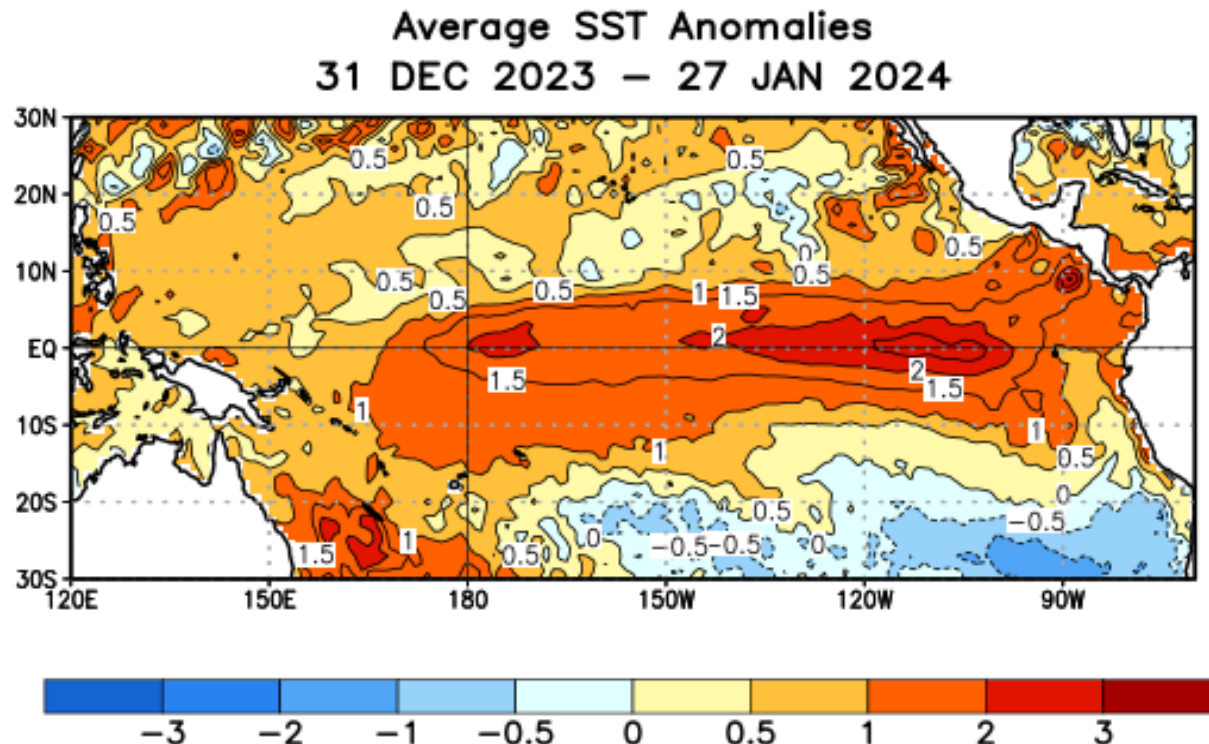
The latest weekly SST departures are:

Niño 4	1.6°C
Niño 3.4	1.7°C
Niño 3	1.8°C
Niño 1+2	0.7°C



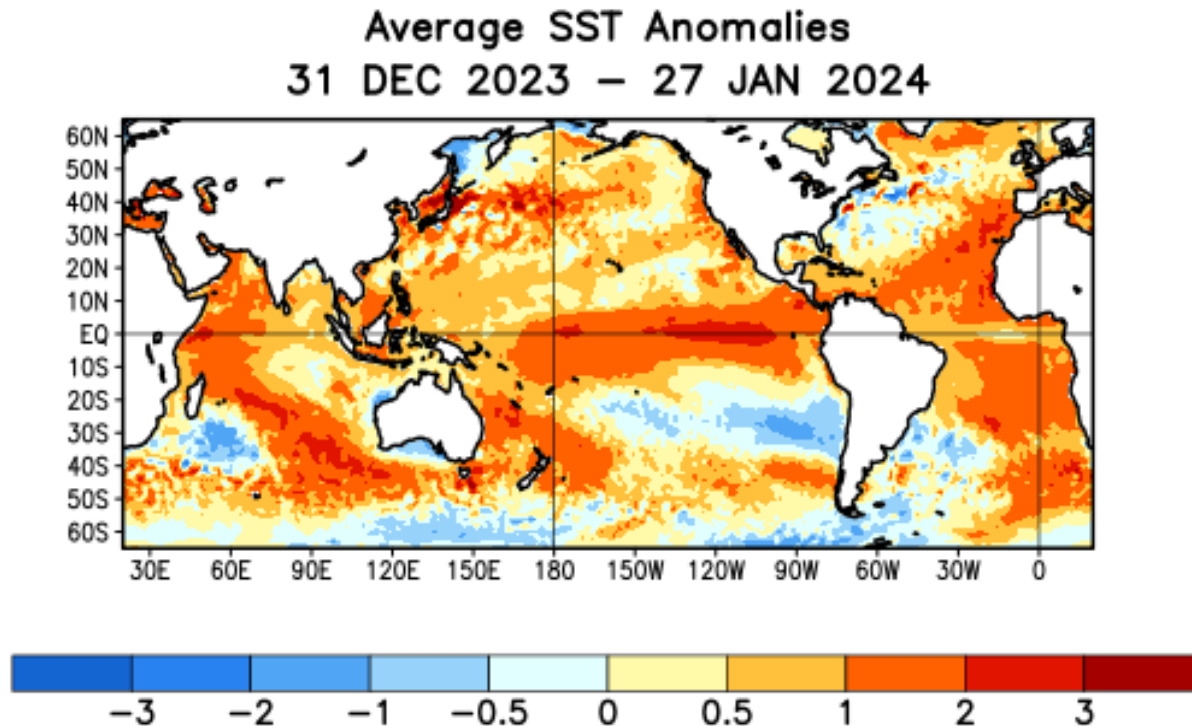
SST Departures ($^{\circ}\text{C}$) in the Tropical Pacific During the Last Four Weeks

In the last four weeks, equatorial SSTs were above average across the Pacific Ocean, with the largest anomalies in the central and east-central Pacific Ocean.



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

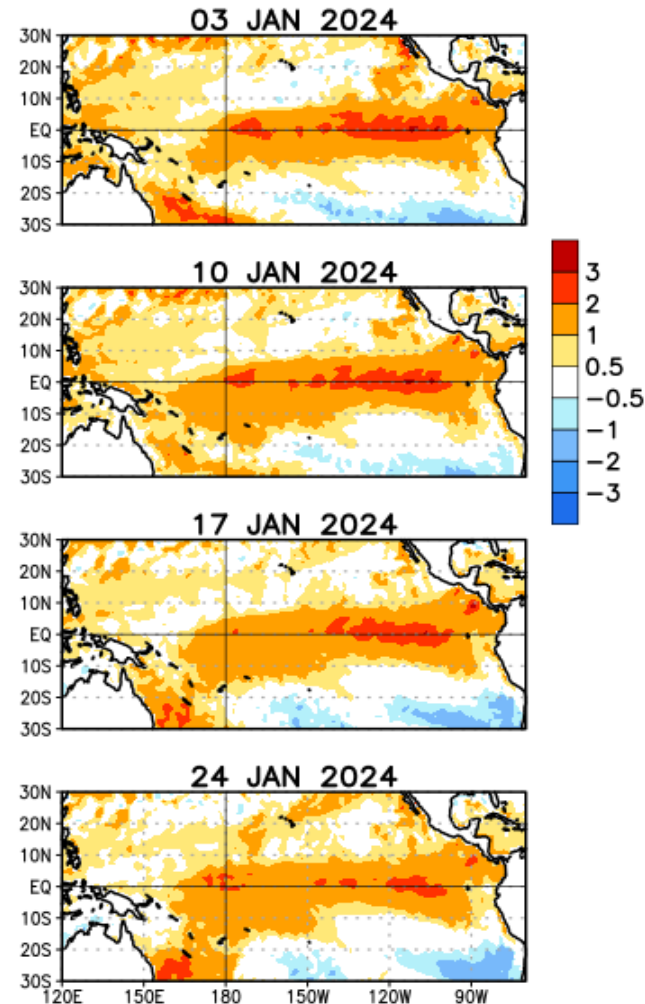
During the last four weeks, equatorial SSTs were above average across the Pacific Ocean, the Indian Ocean, and the Atlantic Ocean.



Weekly SST Departures during the Last Four Weeks

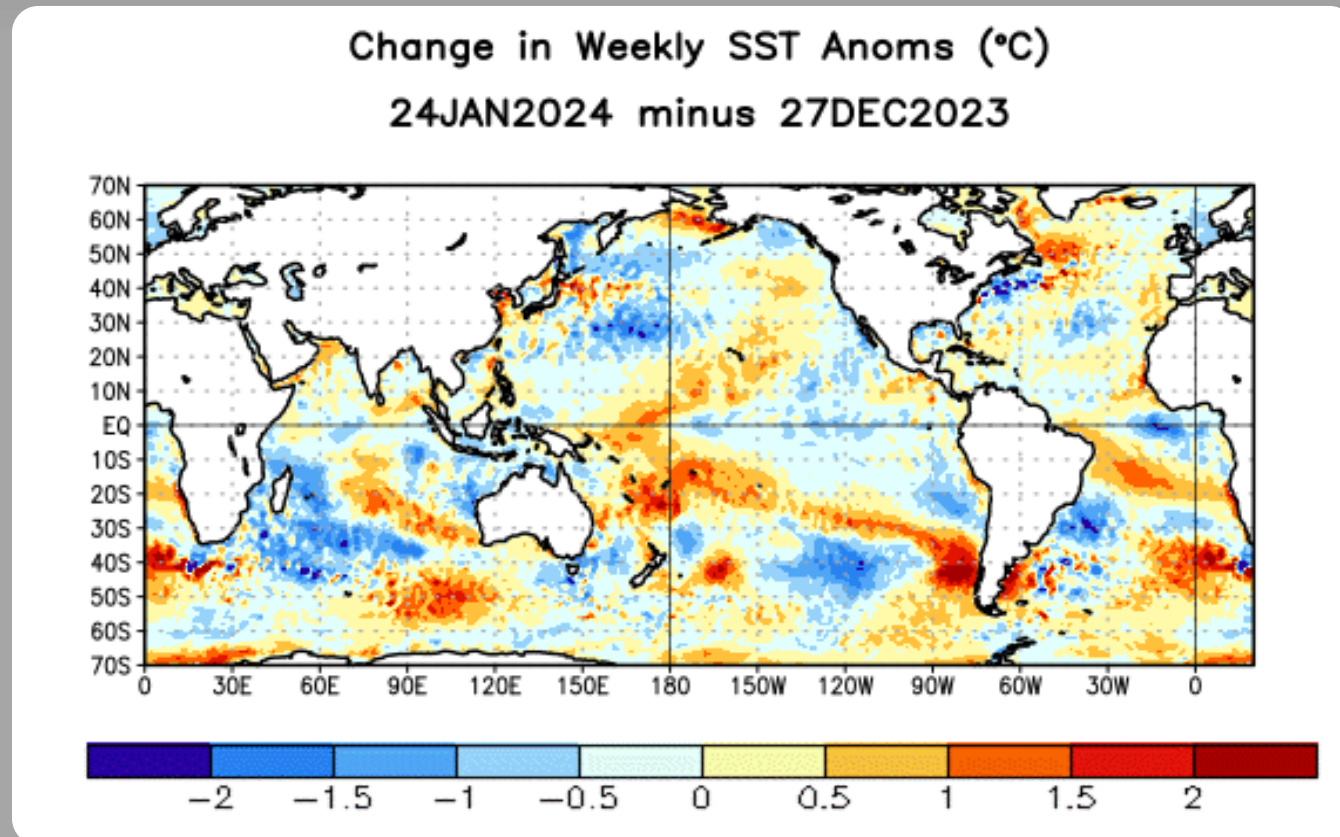
During the last 4 weeks, above-average SSTs weakened in the east-central and eastern equatorial Pacific Ocean.

Weekly SST Anomalies (DEG C)



Change in Weekly SST Departures over the Last Four Weeks

During the last four weeks, negative changes in equatorial SST anomalies were observed in the east-central and eastern Pacific Ocean, while positive changes were evident over west of the Date Line.



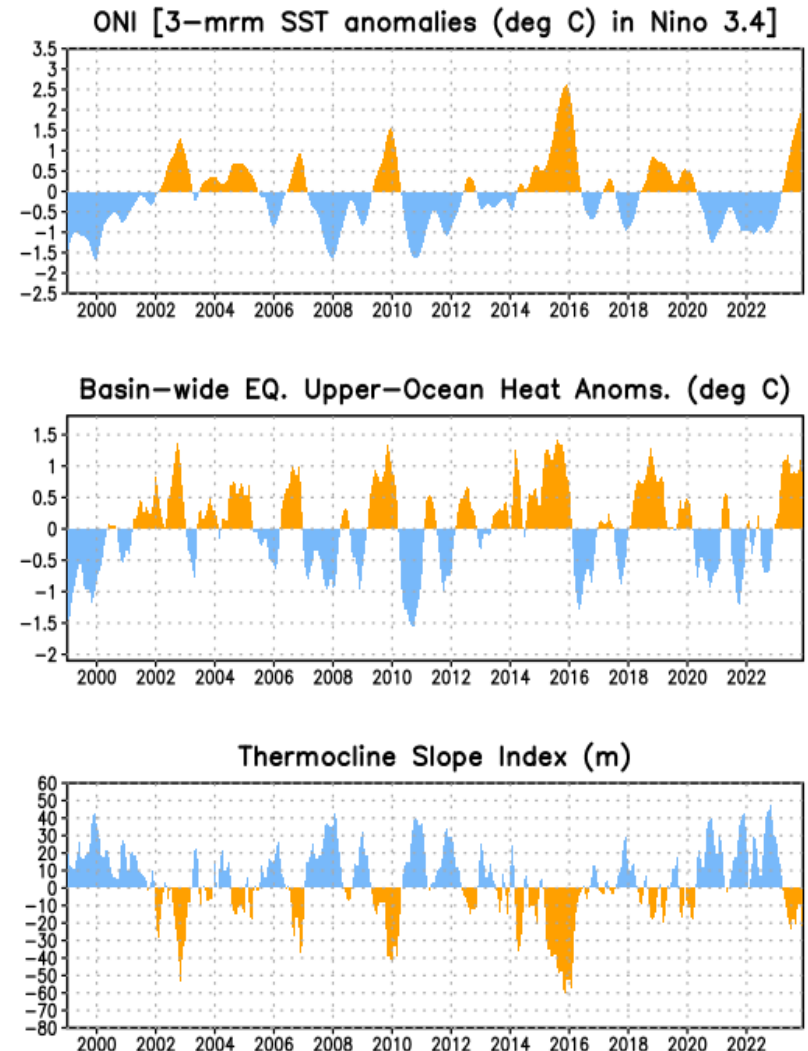
Upper-Ocean Conditions in the Equatorial Pacific

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.

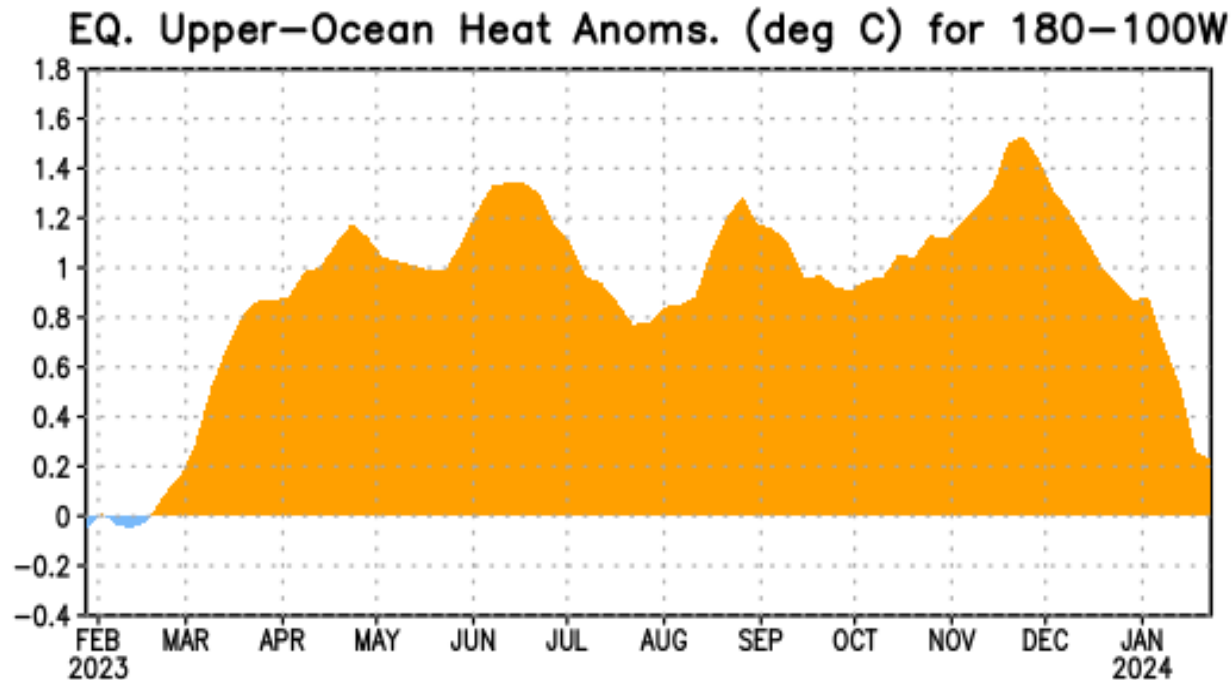
Recent values of the upper-ocean heat anomalies (above average) and thermocline slope index (below average) reflect El Niño.

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).



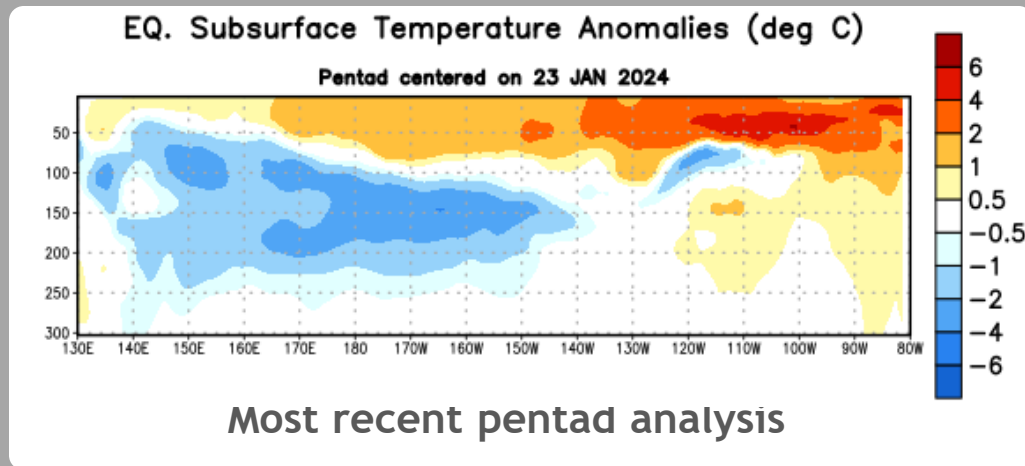
Central and Eastern Pacific Upper-Ocean (0-300 m) Weekly Average Temperature Anomalies

Subsurface temperature anomalies became positive in February 2023 and have persisted through the present. Variability in the anomalies was associated with several oceanic Kelvin waves. Since late November 2023, positive anomalies have weakened.

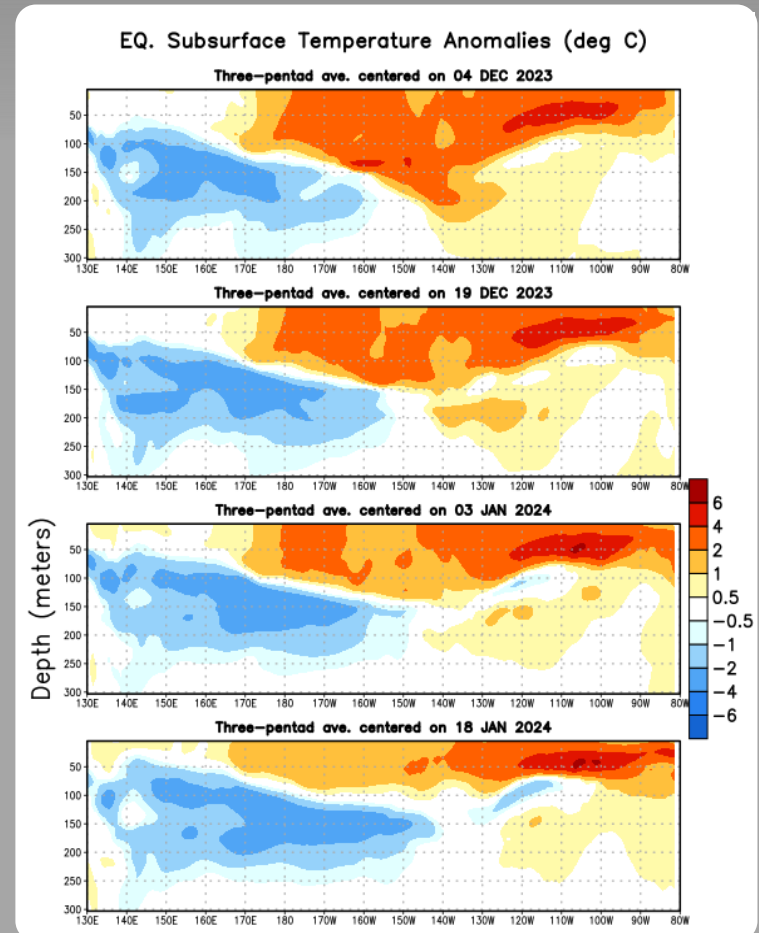


Sub-Surface Temperature Departures in the Equatorial Pacific

Positive subsurface temperature anomalies persist near the surface across most of the equatorial Pacific Ocean, but have been gradually weakening at depth.



Negative subsurface temperature anomalies have strengthened in the western Pacific Ocean and expanded to the eastern Pacific, while remaining at depth.

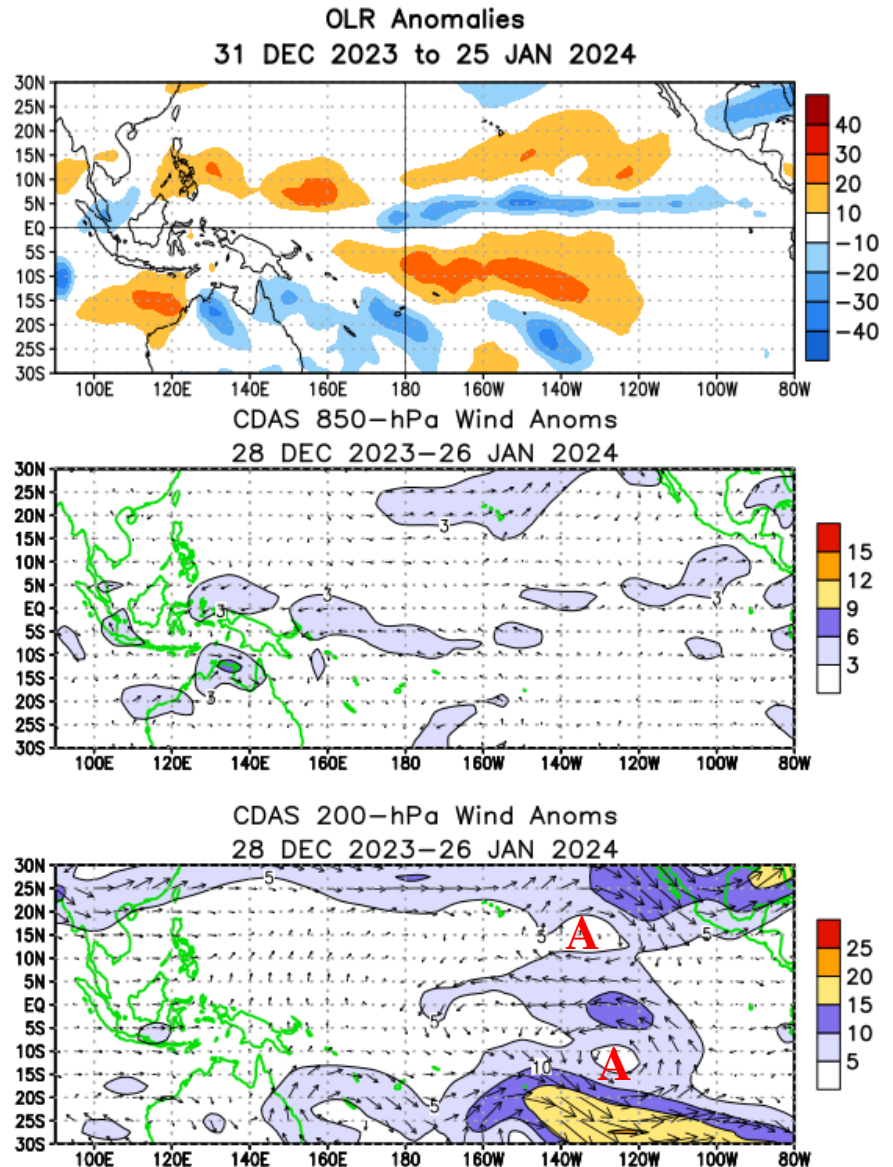


Tropical OLR and Wind Anomalies During the Last 30 Days

Positive OLR anomalies (suppressed convection and precipitation) were evident around the Philippines. Negative OLR anomalies (enhanced convection and precipitation) were observed around the Date Line, and extend into the eastern tropical Pacific, north of the equator.

Low-level (850-hPa) wind anomalies were westerly over the western equatorial Pacific.

Upper-level (200-hPa) wind anomalies were easterly along the east-central and eastern equatorial Pacific. An anomalous anticyclonic couplet straddles the equator in the east-central Pacific.



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.

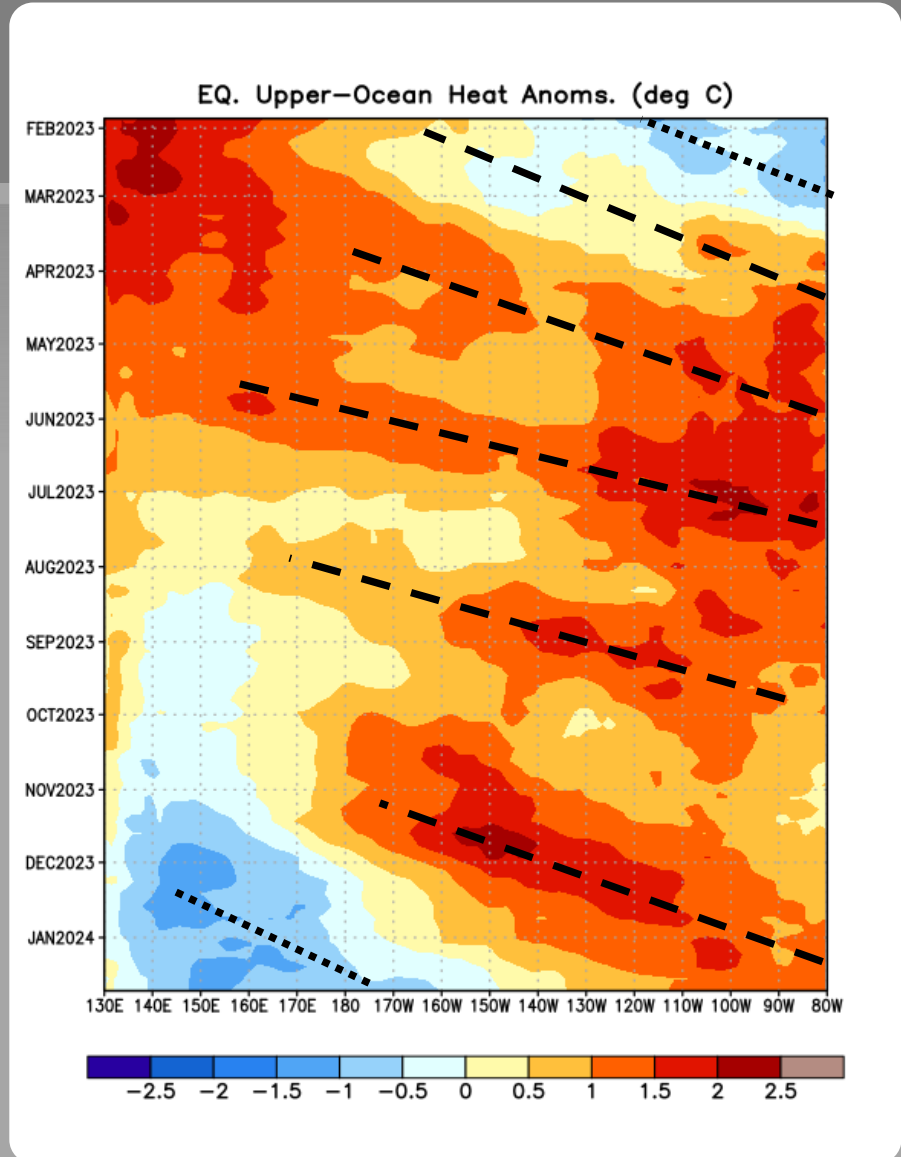
Weekly Heat Content Evolution in the Equatorial Pacific

Significant equatorial oceanic Kelvin wave activity (dashed and dotted lines) has been present throughout the period shown. Six downwelling waves have occurred since late November 2022.

Since March 2023, above-average subsurface temperature anomalies have persisted across most of the Pacific Ocean.

Since early November 2023, below-average temperature anomalies have strengthened in the western Pacific Ocean and have gradually expanded to the central 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})

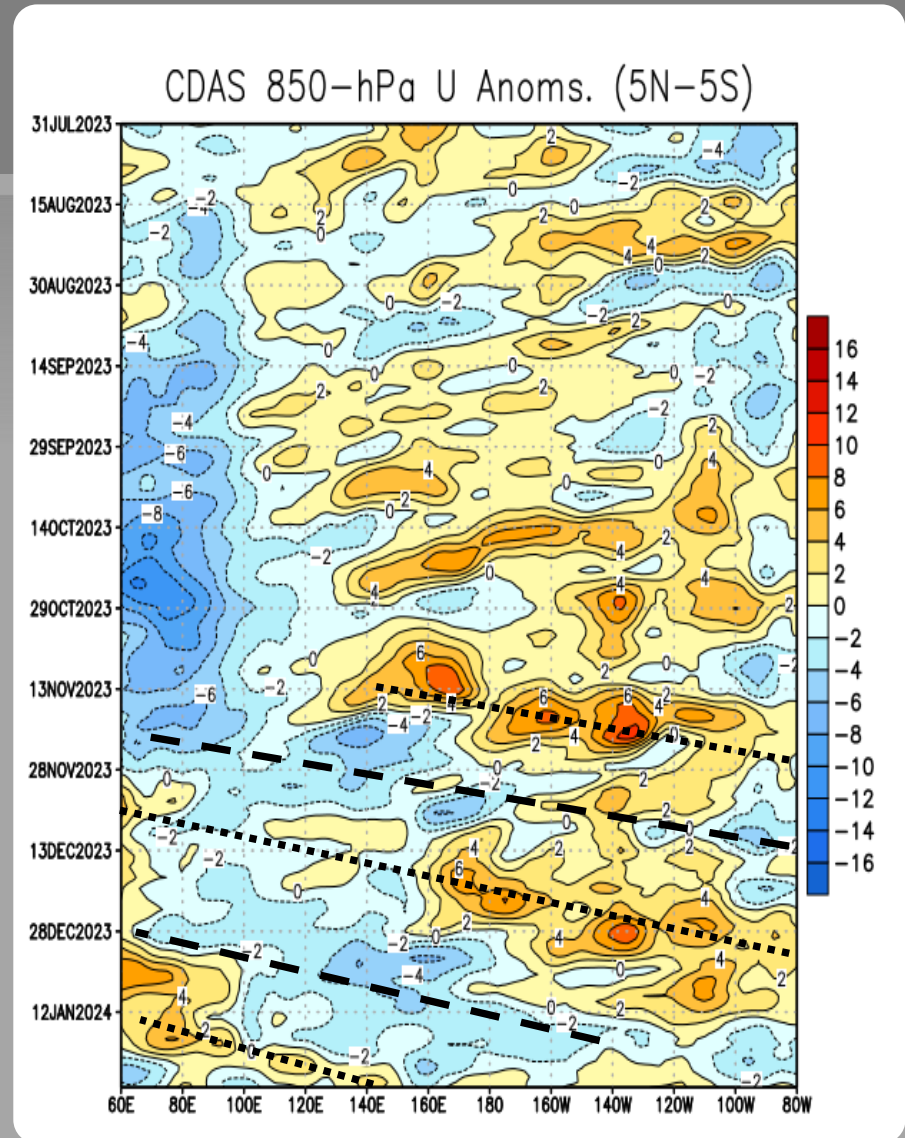
Starting in mid-July 2023, westerly wind anomalies became more predominant over the equatorial Pacific Ocean.

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

An eastward propagating pattern of westerly and easterly wind anomalies was evident starting in November 2023.

Westerly Wind Anomalies (orange/red shading)

Easterly Wind Anomalies (blue shading)



Upper-level (200-hPa) Velocity Potential Anomalies

Since the beginning of the period, anomalous divergence (green shading) has generally persisted near the Date Line, while anomalous convergence (brown shading) was mostly observed over South America.

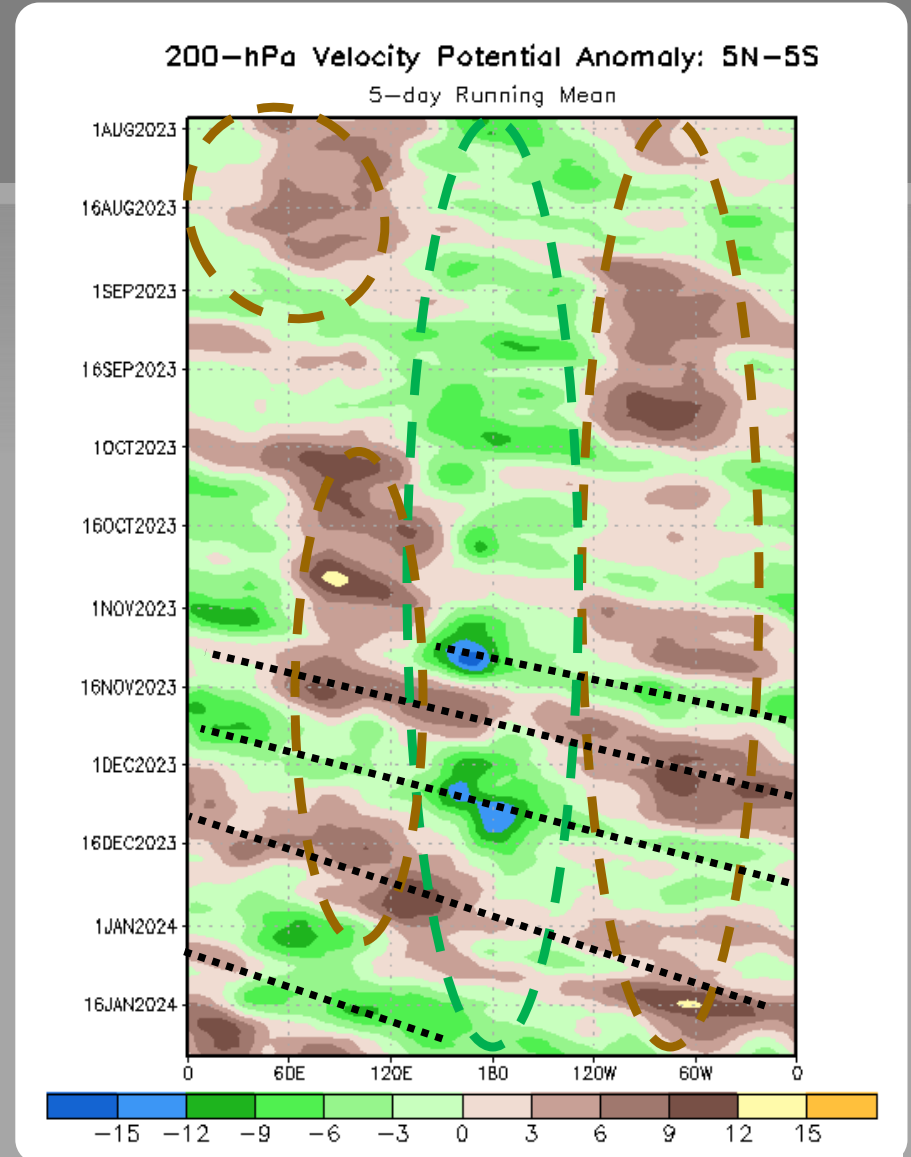
From late September to mid-November 2023, anomalous convergence strengthened near Indonesia.

Since November 2023, eastward propagation in the velocity potential anomalies have been evident.

Unfavorable for precipitation (brown shading)

Favorable for precipitation (green shading)

Note: Eastward propagation is not necessarily indicative of the Madden-Julian Oscillation (MJO).



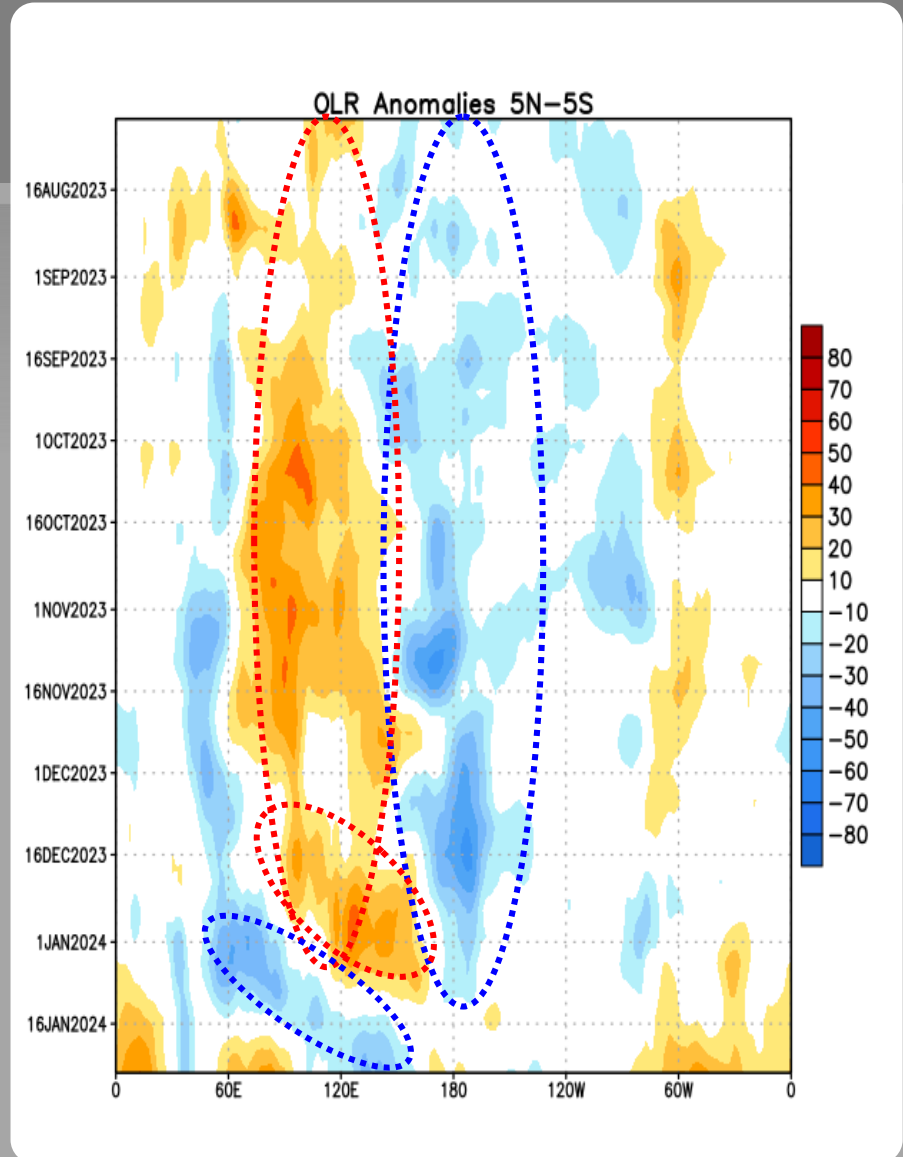
Outgoing Longwave Radiation (OLR) Anomalies

During most of the period, negative OLR anomalies (more convection) persisted over the central equatorial Pacific Ocean, and periodically emerged in the eastern Pacific.

From mid-July through December 2023, positive OLR anomalies persisted around Indonesia.

In the last couple of weeks, negative OLR anomalies have shifted from the Indian Ocean to the western equatorial Pacific Ocean.

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 $+0.5^{\circ}\text{C}$.

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

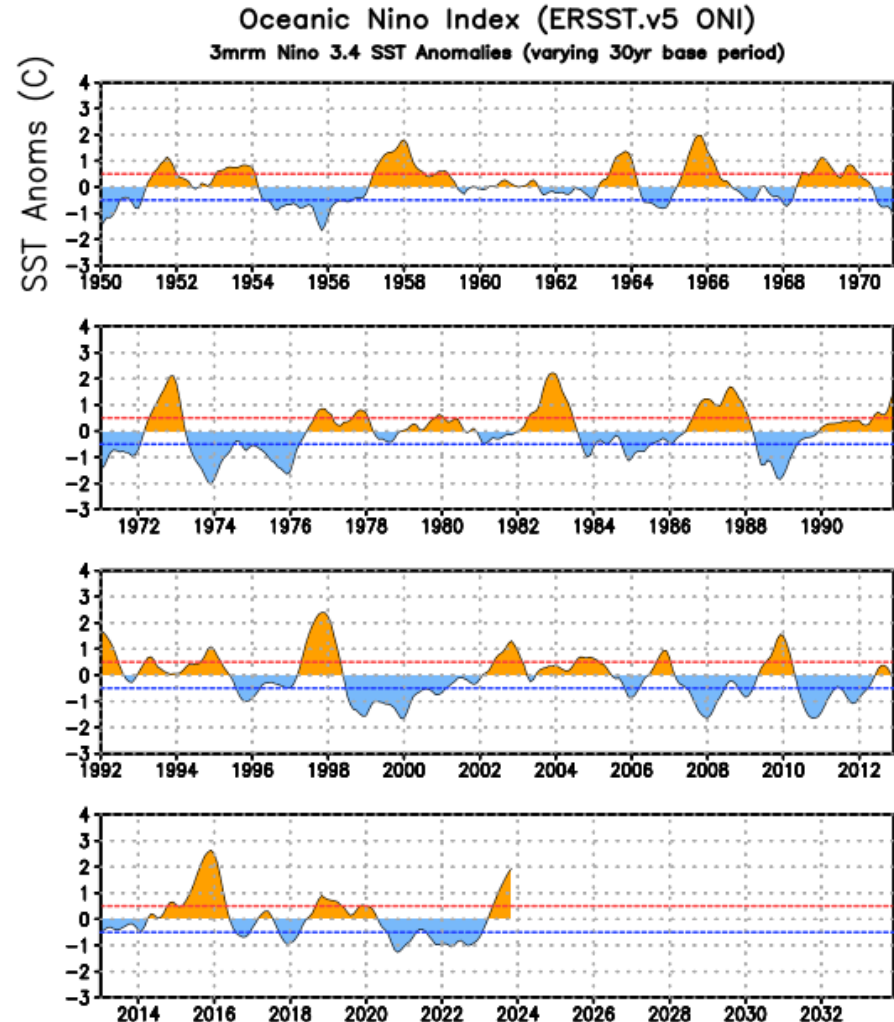
By historical standards, to be classified as a full-fledged El Niño or La Niña episode, these thresholds must be exceeded for a period of at least 5 consecutive overlapping 3-month seasons.

CPC considers El Niño or La Niña conditions to occur when the monthly Niño3.4 OISST departures meet or exceed $\pm 0.5^{\circ}\text{C}$ 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 (October - December 2023) is 1.9°C.

El Niño ↑
Neutral
La Niña ↓



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.

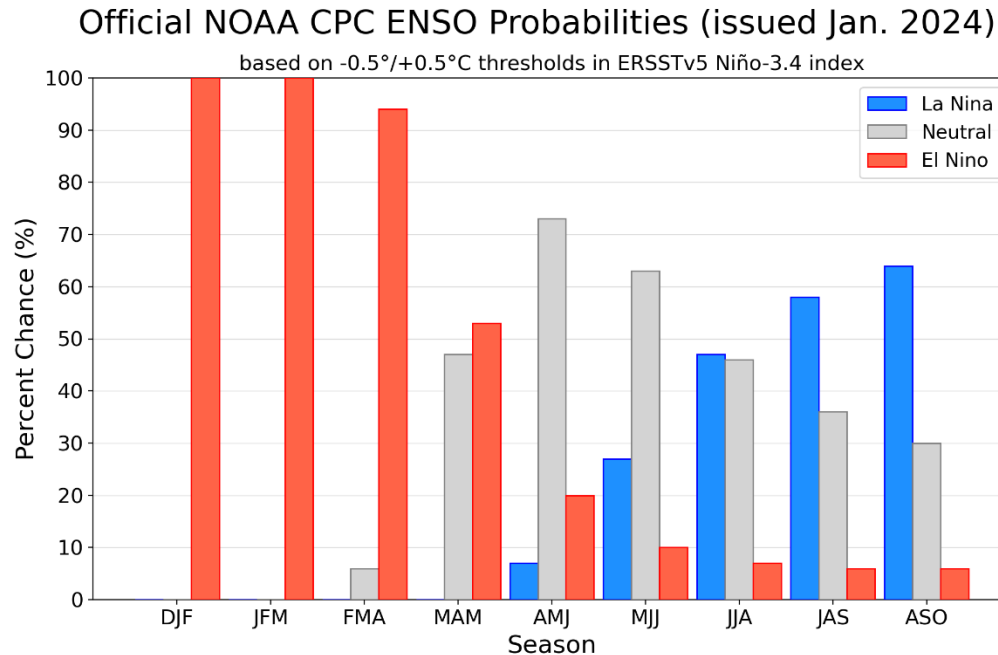
The ONI is one measure of the El Niño-Southern Oscillation, and other indices can confirm whether features consistent with a coupled ocean-atmosphere phenomenon accompanied these periods. The complete table going back to DJF 1950 can be found [here](#).

Year	DJF	JFM	FMA	MAM	AMJ	MJJ	JJA	JAS	ASO	SON	OND	NDJ
2011	-1.4	-1.2	-0.9	-0.7	-0.6	-0.4	-0.5	-0.6	-0.8	-1.0	-1.1	-1.0
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	

CPC Probabilistic ENSO Outlook

Updated: 11 January 2024

El Niño is expected to continue for the next several seasons, with chances gradually decreasing from the winter through the spring. A transition to ENSO-neutral is anticipated by April-June 2024 (73% chance).



IRI Pacific Niño 3.4 SST Model Outlook

The majority of models indicate El Niño will persist through March-May 2024 and then transition to ENSO-neutral during April-June 2024.

After a brief period of ENSO-neutral conditions, most models indicate a transition to La Niña around July-September 2024.

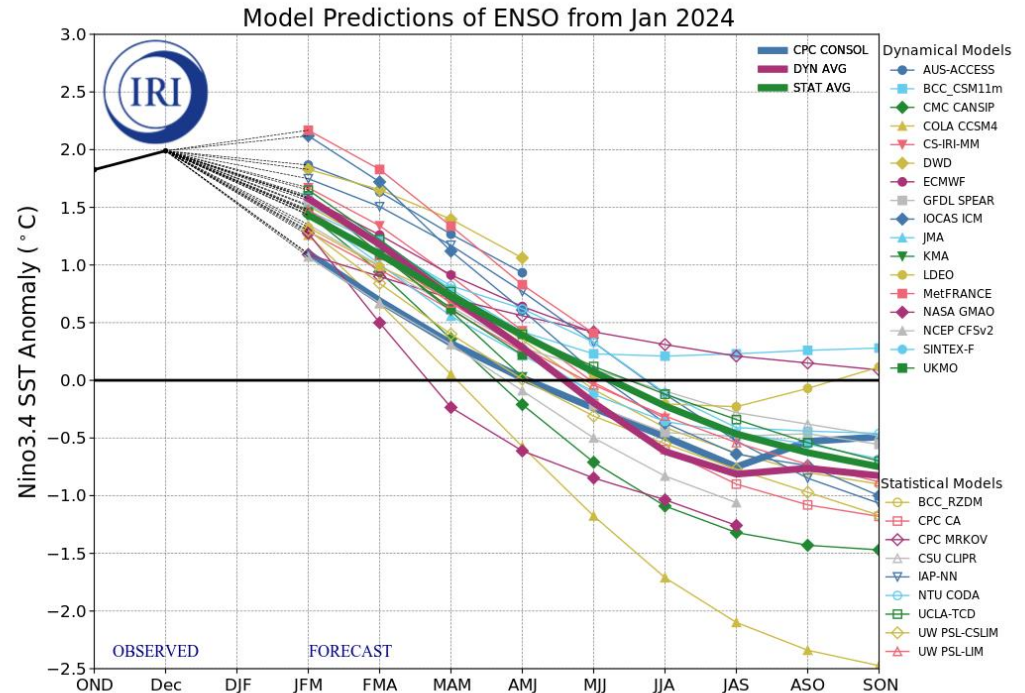


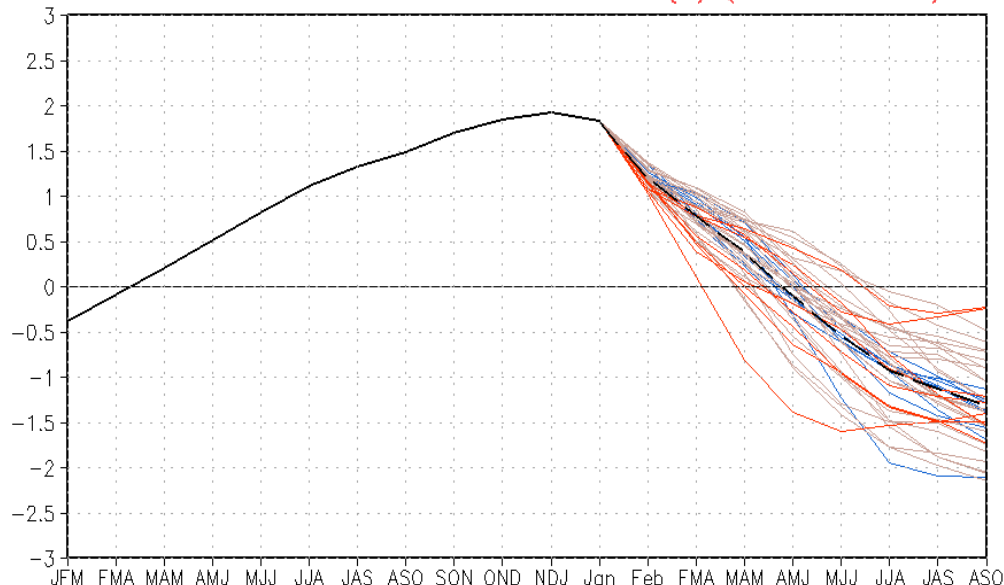
Figure provided by the International Research Institute (IRI) for Climate and Society (updated 19 January 2024).

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

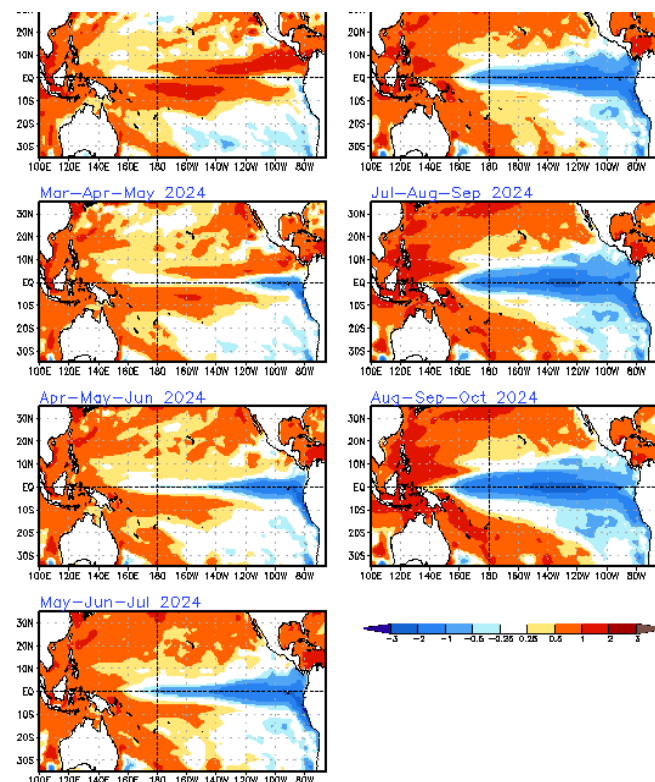
Issued: 26 January 2024

The CFS.v2 ensemble mean (black dashed line) indicates El Niño may transition to ENSO-neutral by March-May 2024.

CFSv2 forecast Nino3.4 SST anomalies (K) (PDF corrected)



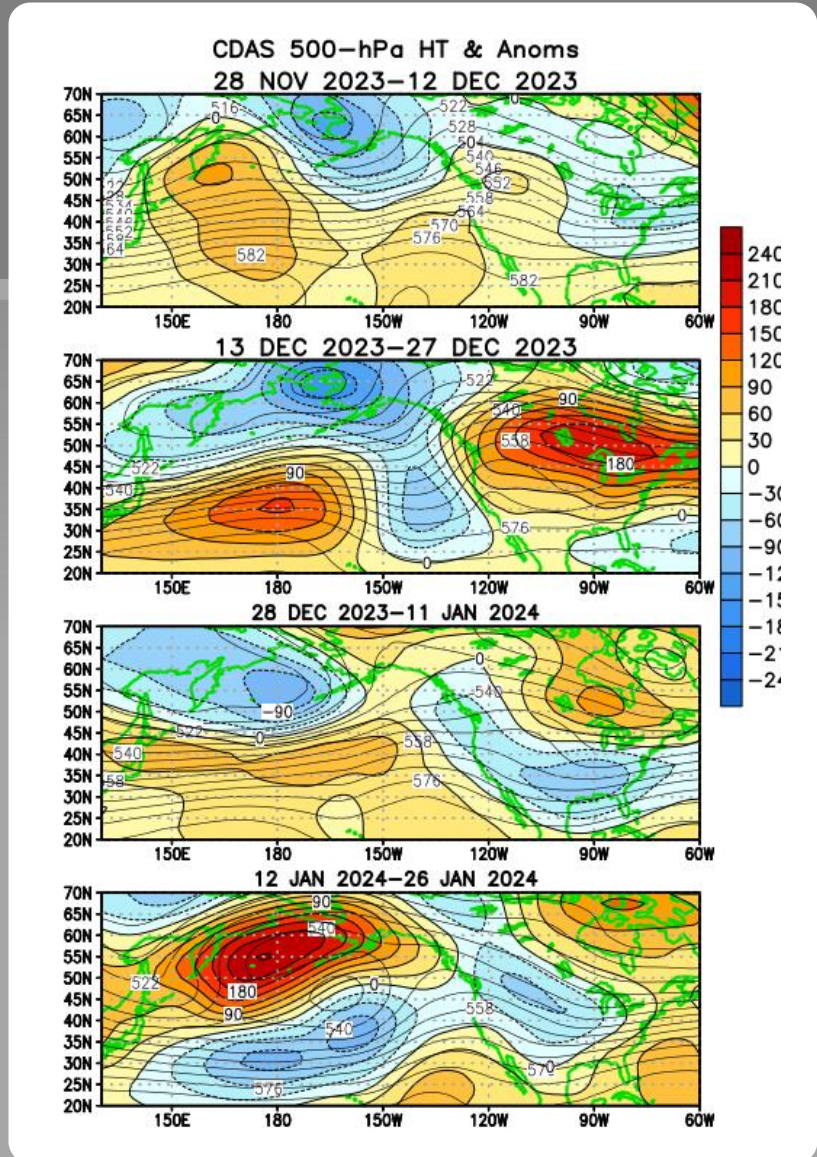
— Latest 8 forecast members
— Earliest 8 forecast members
— Other forecast members
— Forecast ensemble mean
— NCEP Olv2.1 daily analysis
(Climatology base period: 1991–2020)



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

During the second half of December 2023, below-average heights persisted in the eastern North Pacific Ocean, with above-average heights and temperatures evident over most of North America.

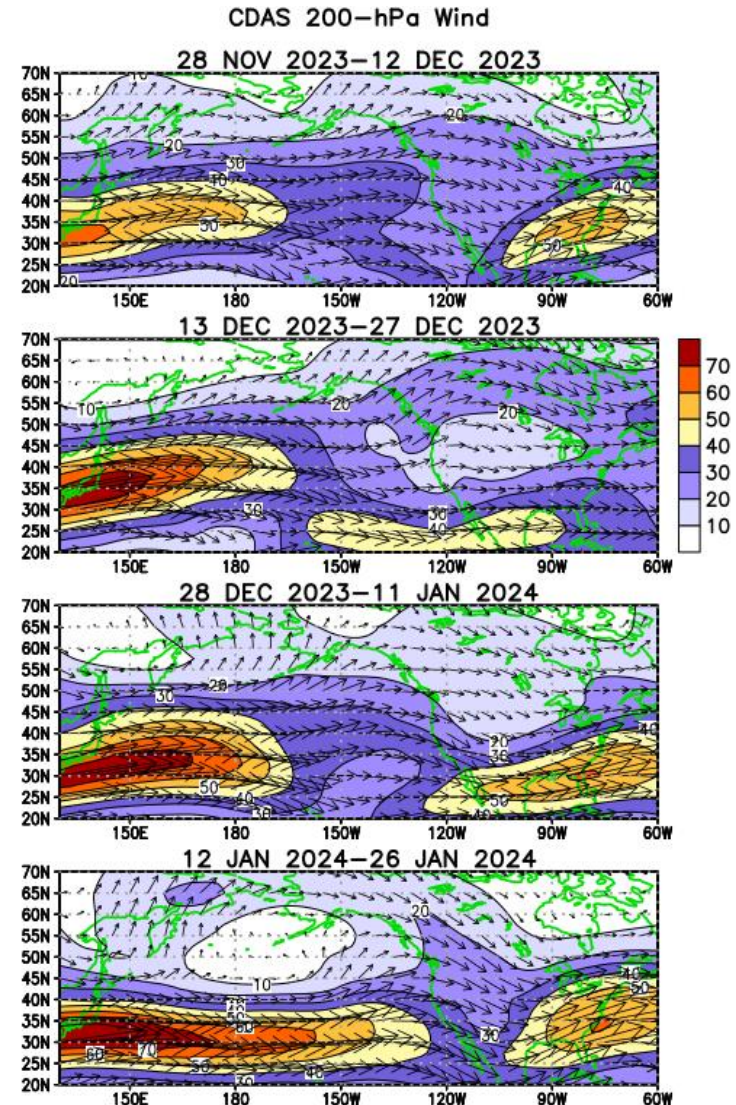
During January 2024, below-average heights and temperatures were evident over large regions of North America.



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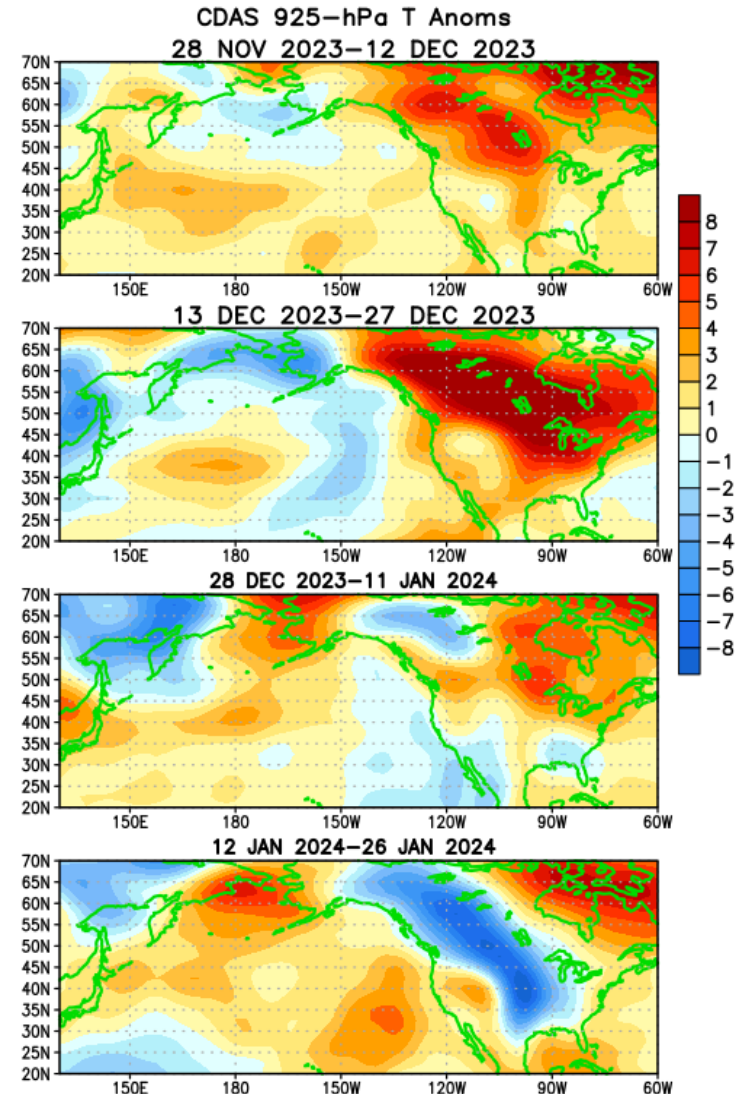
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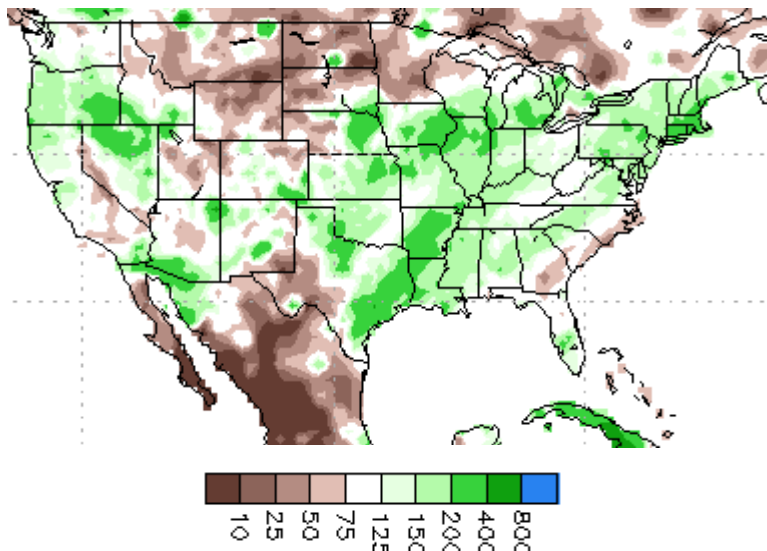
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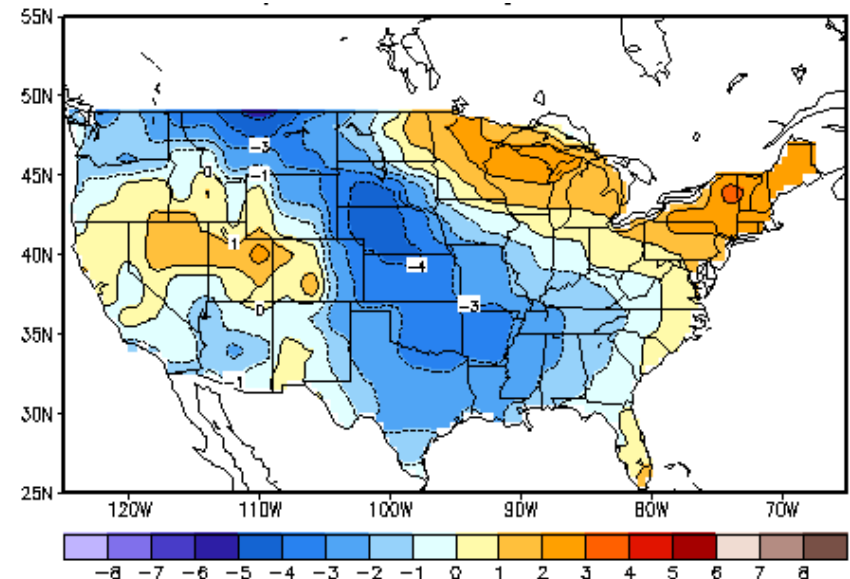
U.S. Temperature and Precipitation Departures During the Last 30 Days

End Date: 27 January 2024

Percent of Average Precipitation



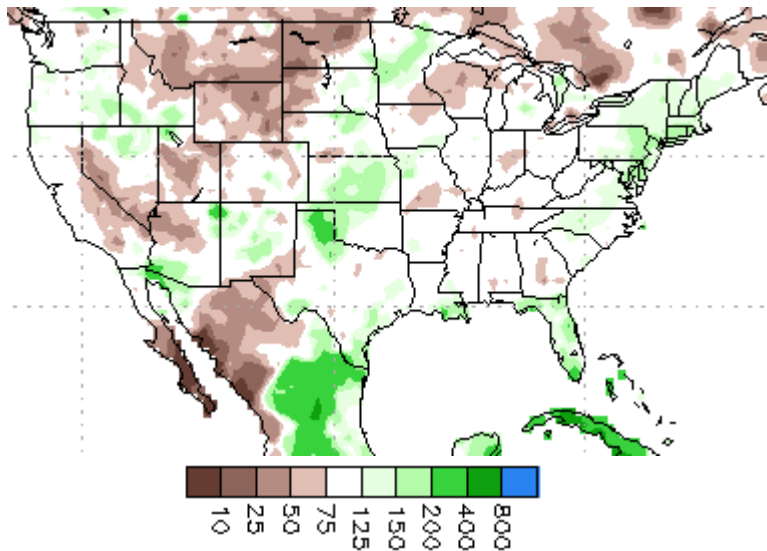
Temperature Departures (degree C)



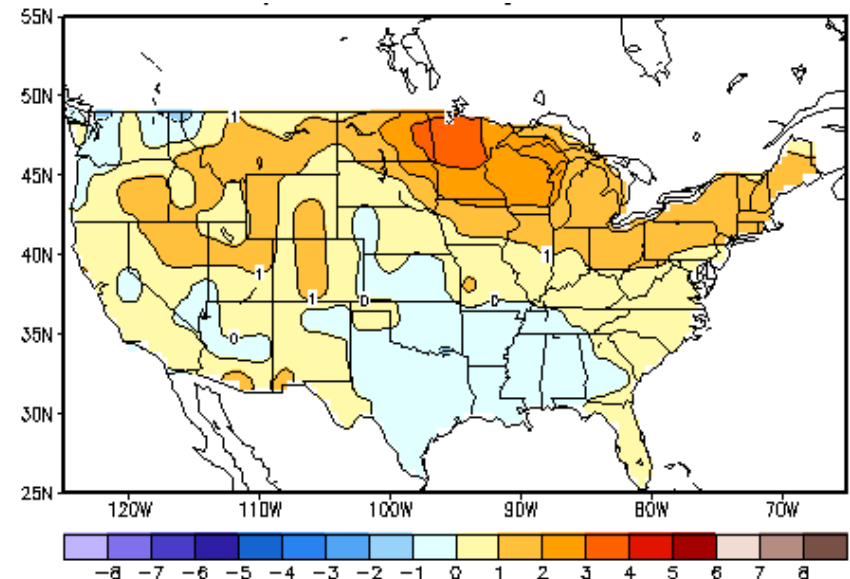
U.S. Temperature and Precipitation Departures During the Last 90 Days

End Date: 27 January 2024

Percent of Average Precipitation



Temperature Departures (degree C)



U. S. Seasonal Outlooks

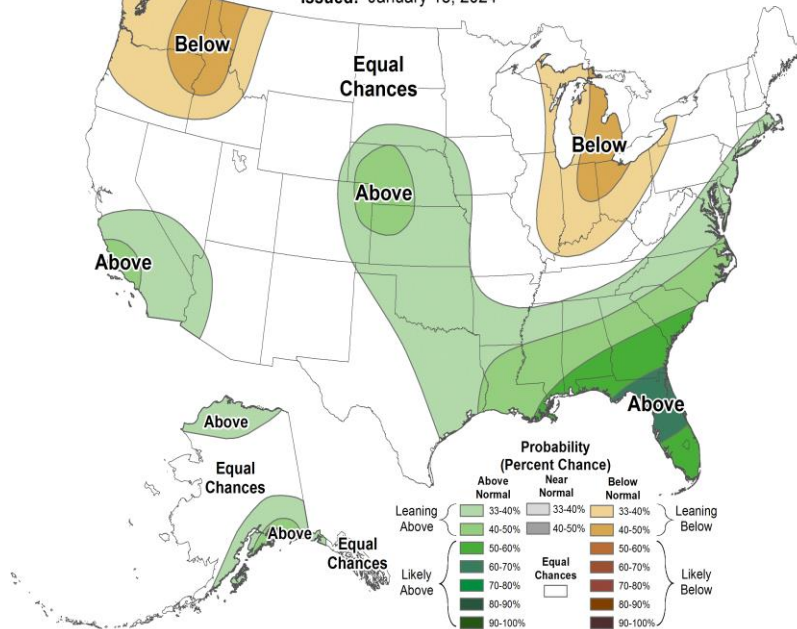
February - April 2024

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

Precipitation

Seasonal Precipitation Outlook

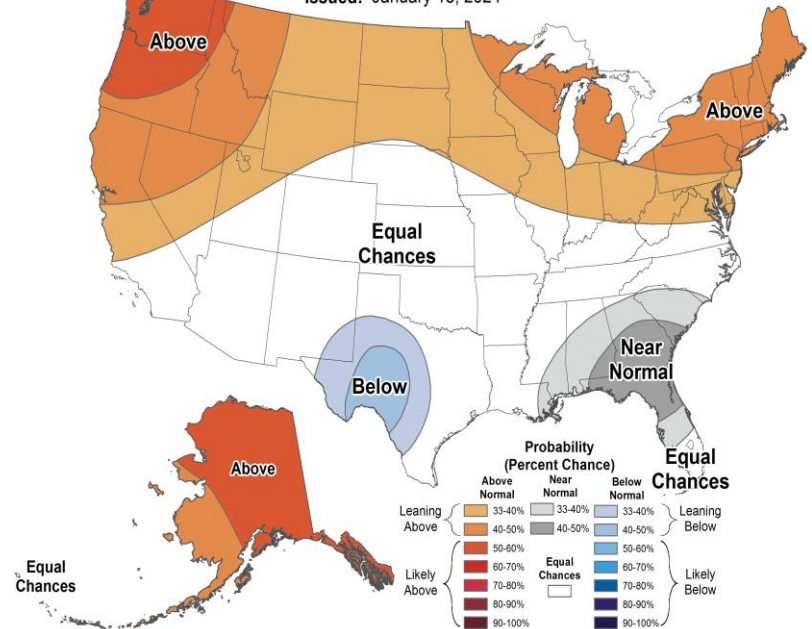
Valid: Feb-Mar-Apr 2024
Issued: January 18, 2024



Temperature

Seasonal Temperature Outlook

Valid: Feb-Mar-Apr 2024
Issued: January 18, 2024



Summary

ENSO Alert System Status: **El Niño Advisory**

El Niño conditions are observed.*

Equatorial sea surface temperatures (SSTs) are above average across the central and eastern Pacific Ocean.

The tropical Pacific atmospheric anomalies are consistent with El Niño.

El Niño is expected to continue for the next several seasons, with ENSO-neutral favored during April-June 2024 (73% chance).*

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