ENSO: Recent Evolution, Current Status and Predictions

Update prepared by:
Climate Prediction Center / NCEP
11 March 2024

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Recent Evolution and Current Conditions

Oceanic Niño Index (ONI)

Pacific SST Outlook

U.S. Seasonal Precipitation and Temperature Outlooks

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ENSO Alert System Status: El Niño Advisory / La Niña Watch

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.

A transition from El Niño to ENSO-neutral is likely by April-June 2024 (79% chance), with increasing odds of La Niña developing in June-August 2024 (55% chance).*

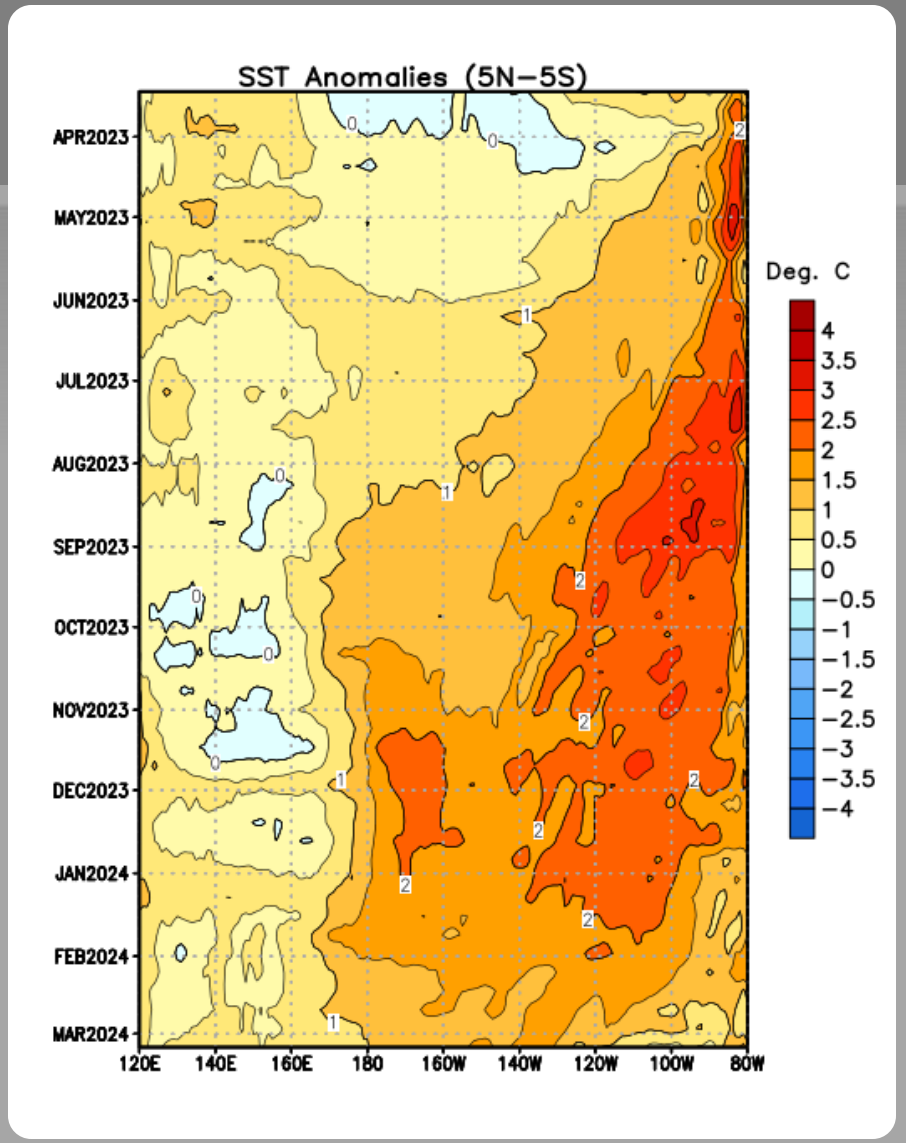
* Note: These statements are updated once a month (2nd Thursday of each month) in association with the ENSO Diagnostics Discussion, which can be found by clicking here.

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.

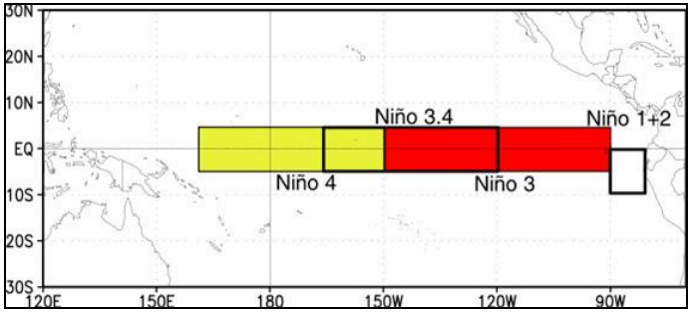
Since late December 2023, positive SST anomalies have weakened across most of the Pacific.

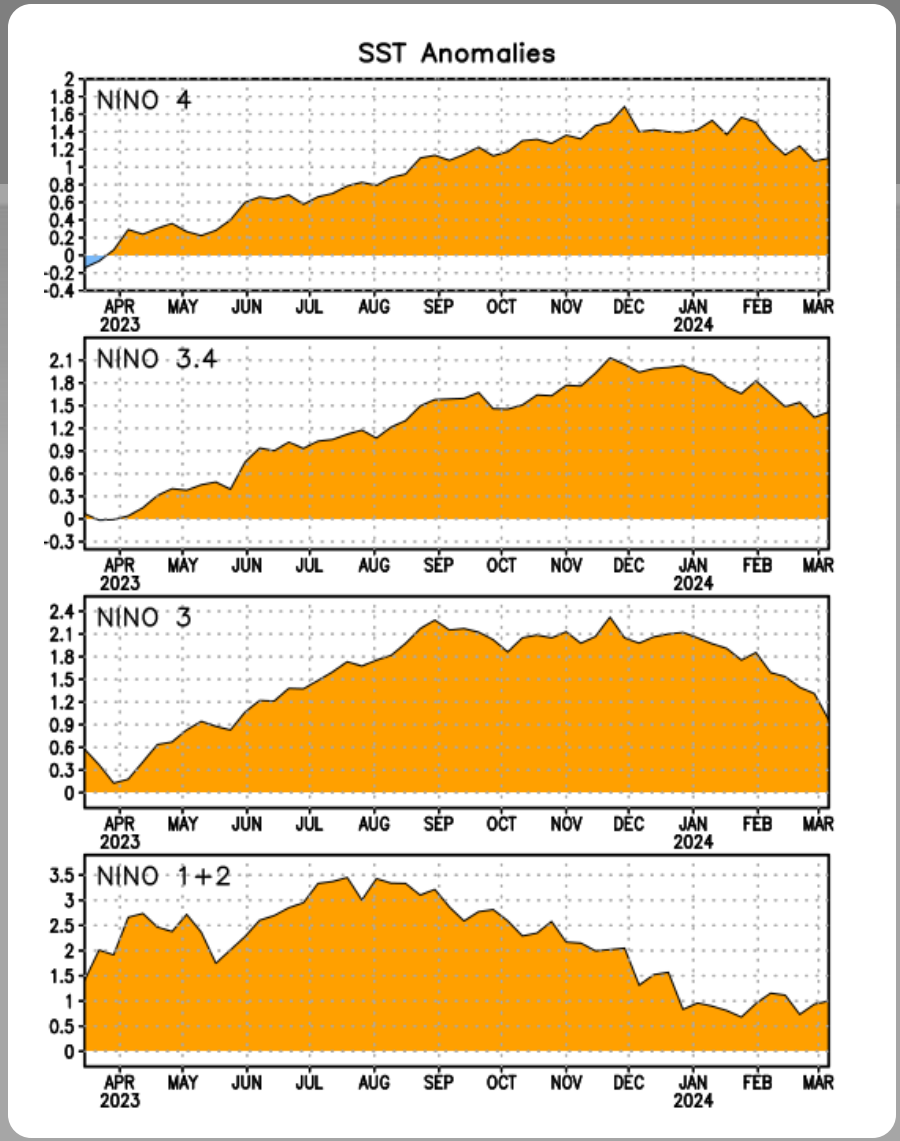


Niño Region SST Departures (ºC) Recent Evolution

The latest weekly SST departures are:

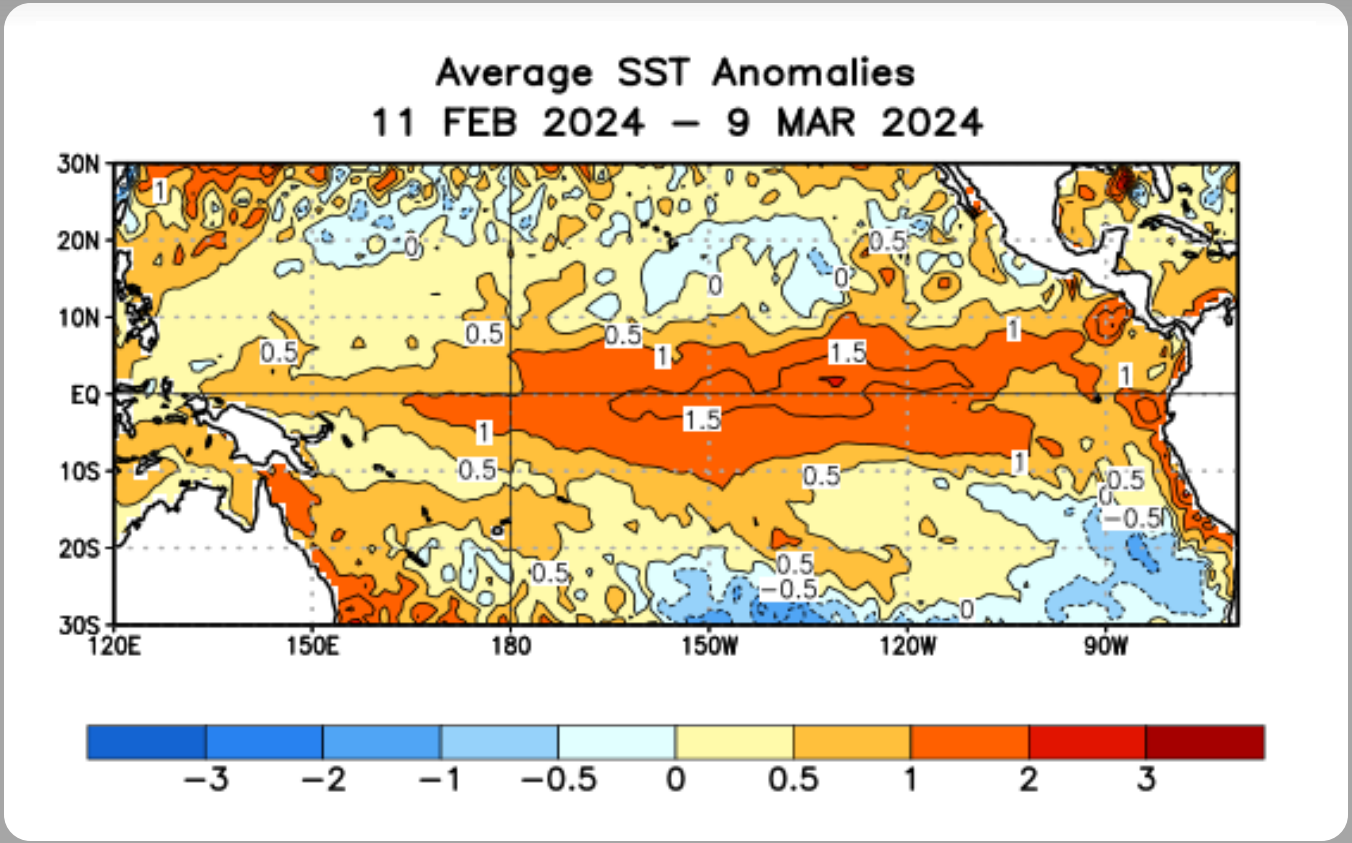
Niño 4	1.1ºC
Niño 3.4	1.4ºC
Niño 3	1.0ºC
Niño 1+2	1.0ºC





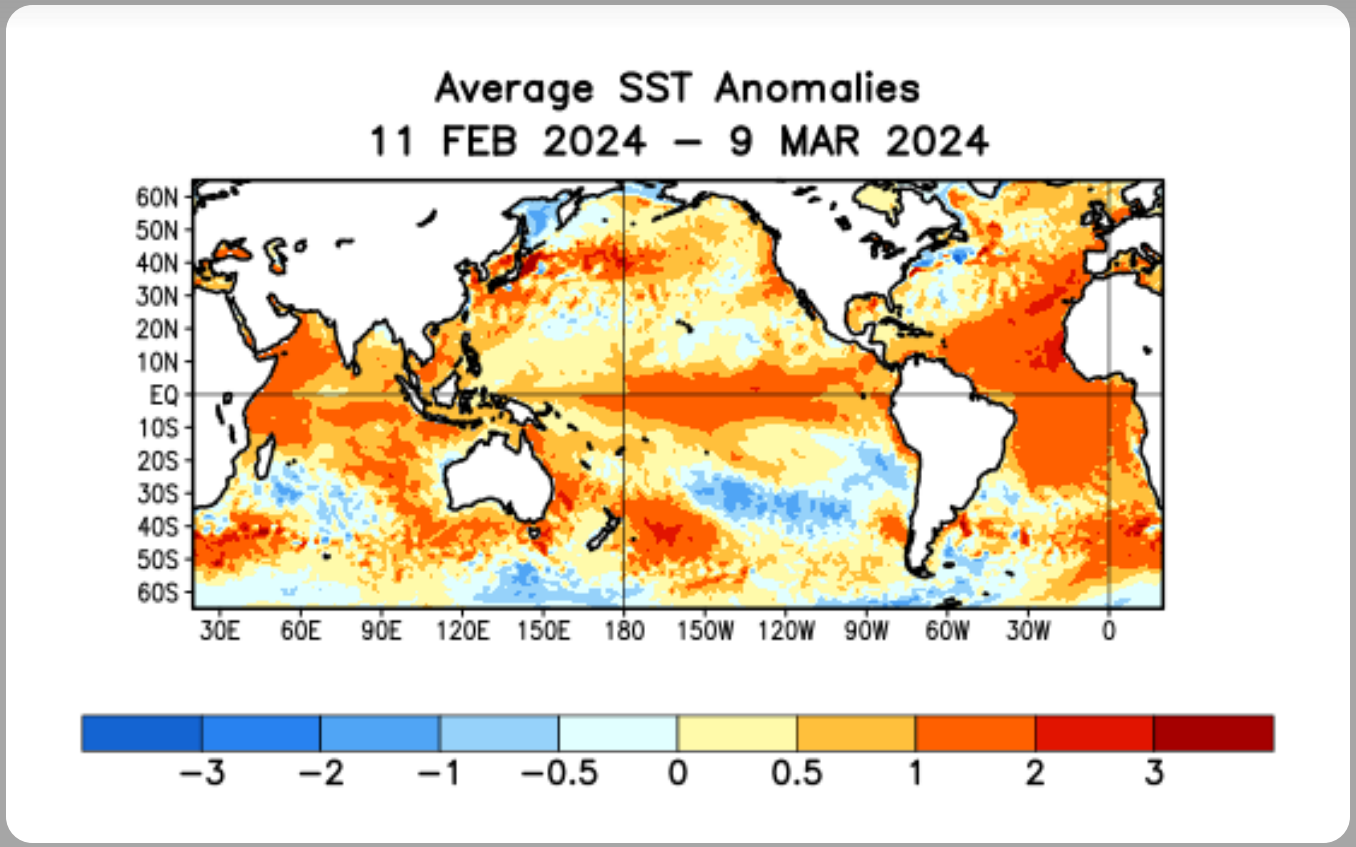
SST Departures (°C) in the Tropical Pacific During the Last Four Weeks

In the last four weeks, equatorial SSTs were above average across most of the Pacific Ocean.



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

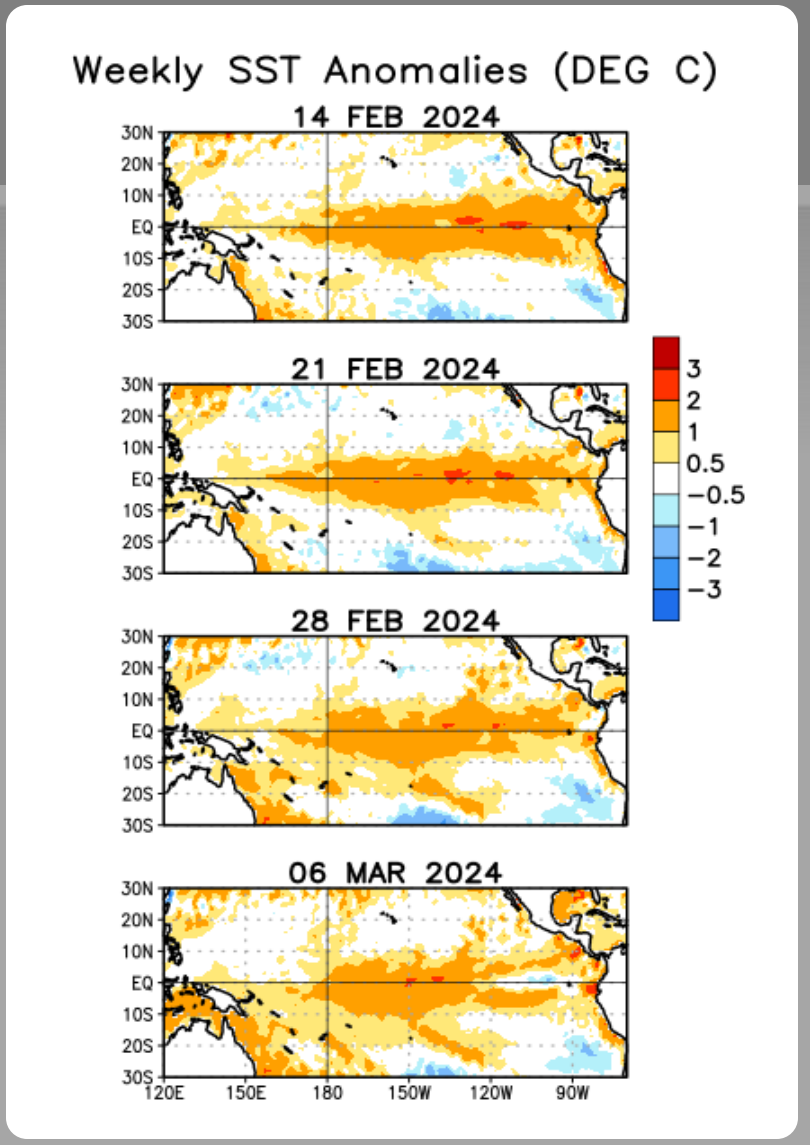
During the last four weeks, equatorial SSTs were above average across most of the Pacific Ocean, the Indian Ocean, and the Atlantic Ocean.



Weekly SST Departures during the Last Four Weeks

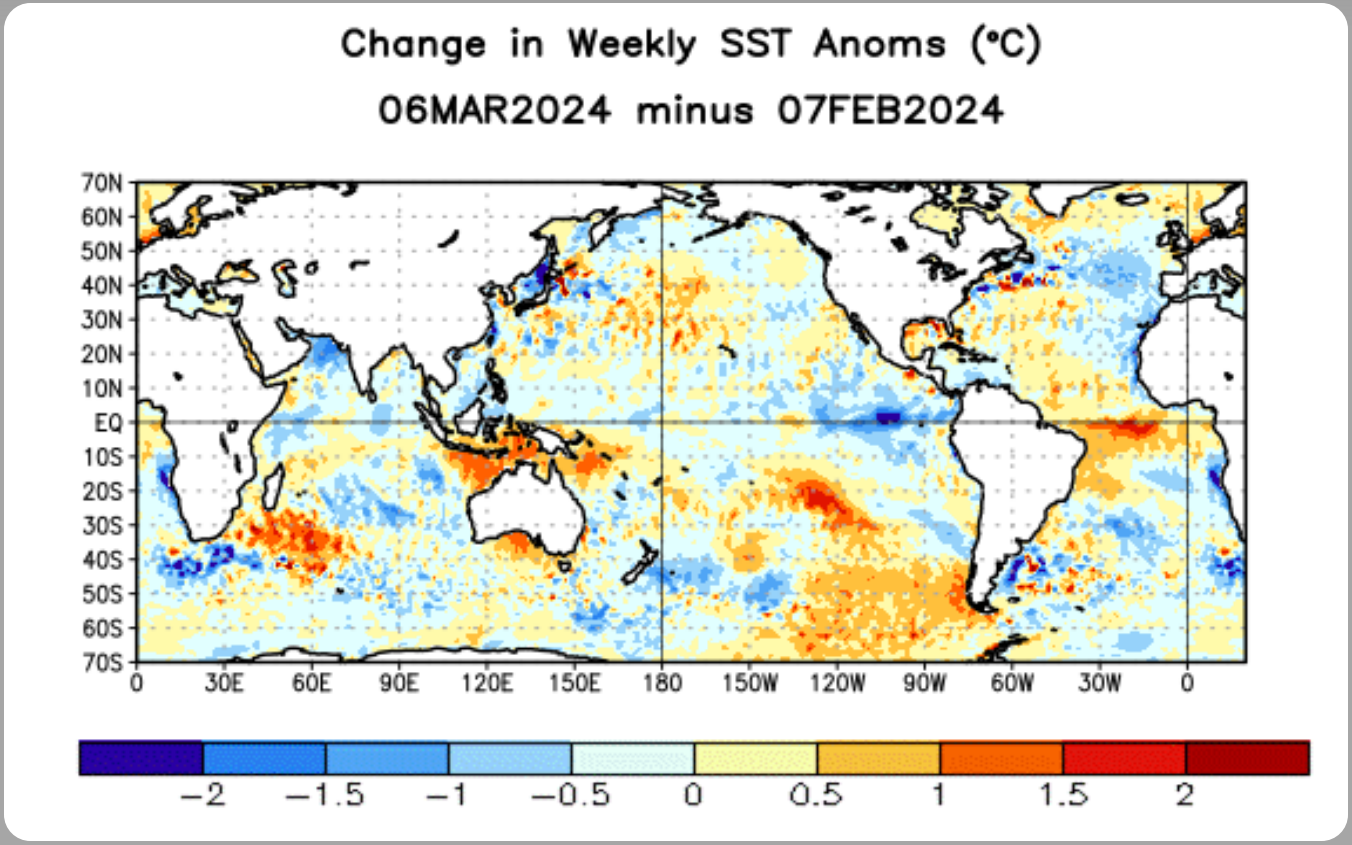
During the last 4 weeks, above-average SSTs weakened across most of the equatorial Pacific Ocean.

In the last week, below-average SSTs emerged in a small region of the eastern Pacific Ocean.



Change in Weekly SST Departures over the Last Four Weeks

During the last four weeks, negative SST anomaly changes were observed over most of the equatorial Pacific, but were strongest in the eastern Pacific.



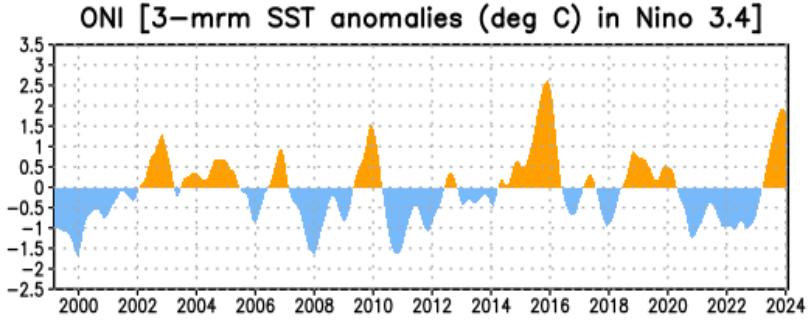
Upper-Ocean Conditions in the Equatorial Pacific

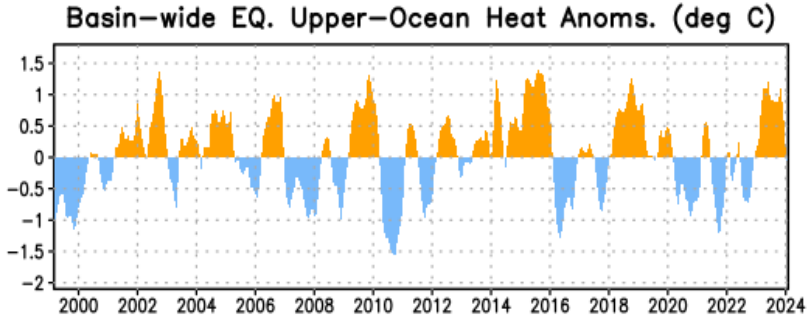
The basin-wide equatorial upper ocean (0-300 m) heat content is greatest prior to and during the early stages of a Pacific warm (El Niño) episode (compare top 2 panels), and least prior to and during the early stages of a cold (La Niña) episode.

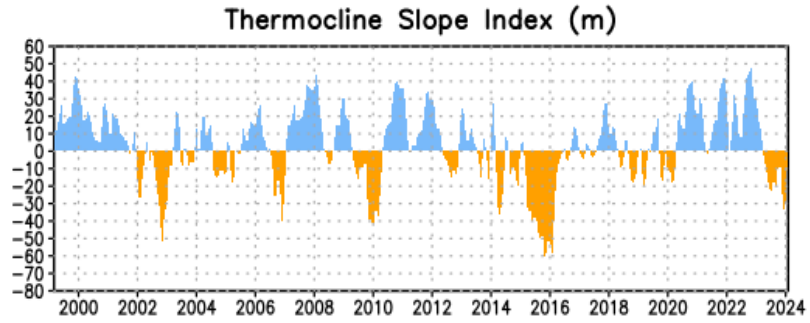
The slope of the oceanic thermocline is least (greatest) during warm (cold) episodes.

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).

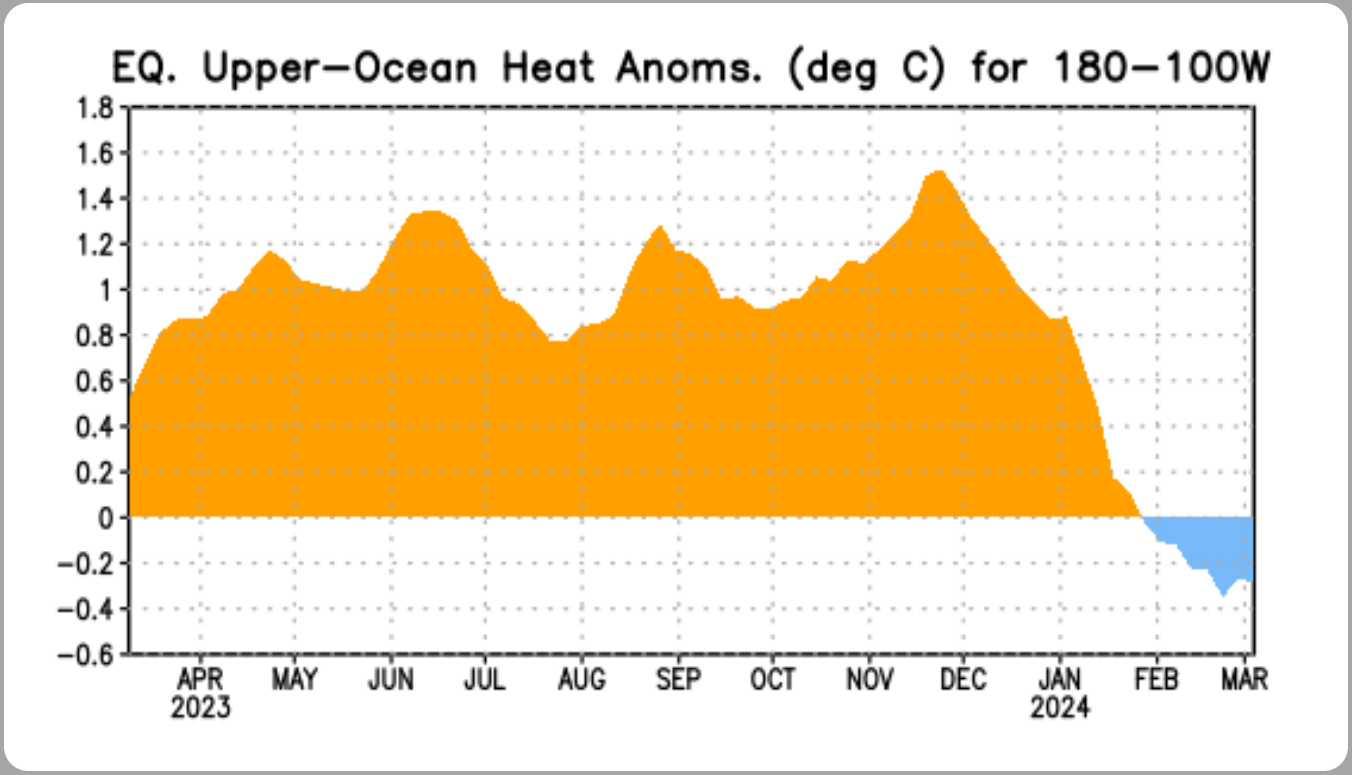






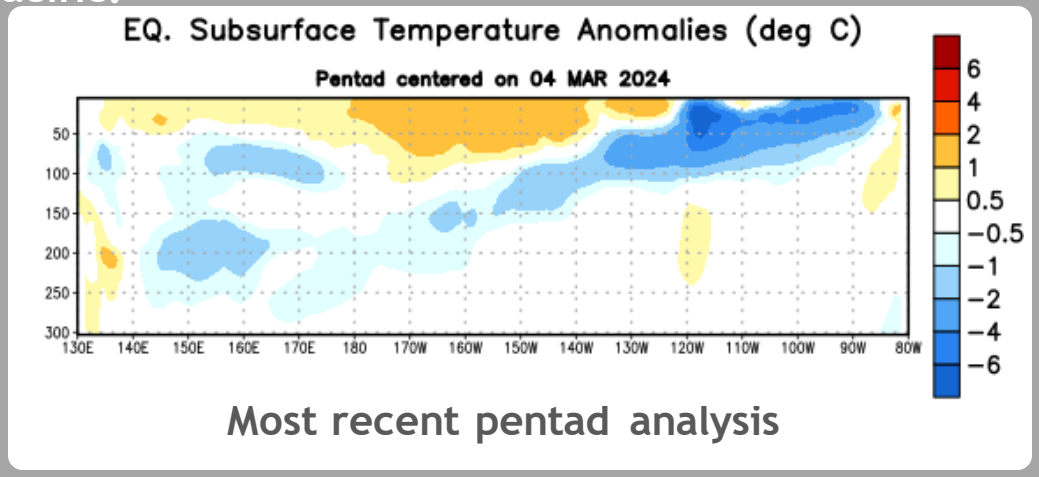
Central and Eastern Pacific Upper-Ocean (0-300 m) Weekly Average Temperature Anomalies

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 and are now slightly below average.



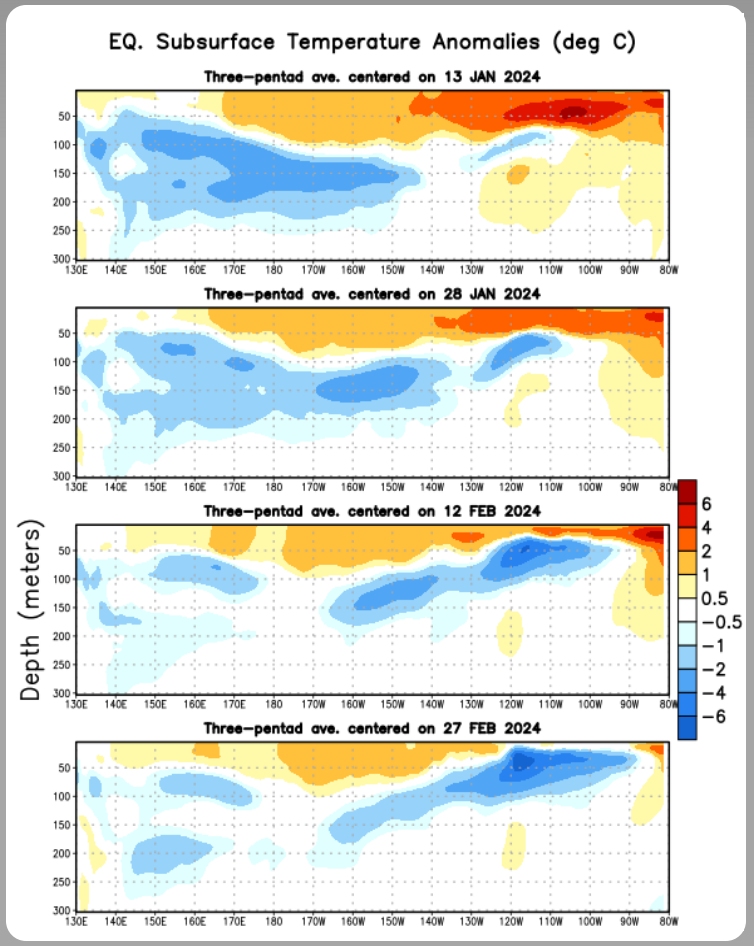
Sub-Surface Temperature Departures in the Equatorial Pacific

Positive subsurface temperature anomalies have weakened across the equatorial Pacific, remaining close to the surface in the western and central Pacific.



Most recent pentad analysis

Negative subsurface temperature anomalies expanded across the equatorial Pacific. Recently, below-average temperatures have reached the surface in the eastern Pacific Ocean (near 120°-90°W).

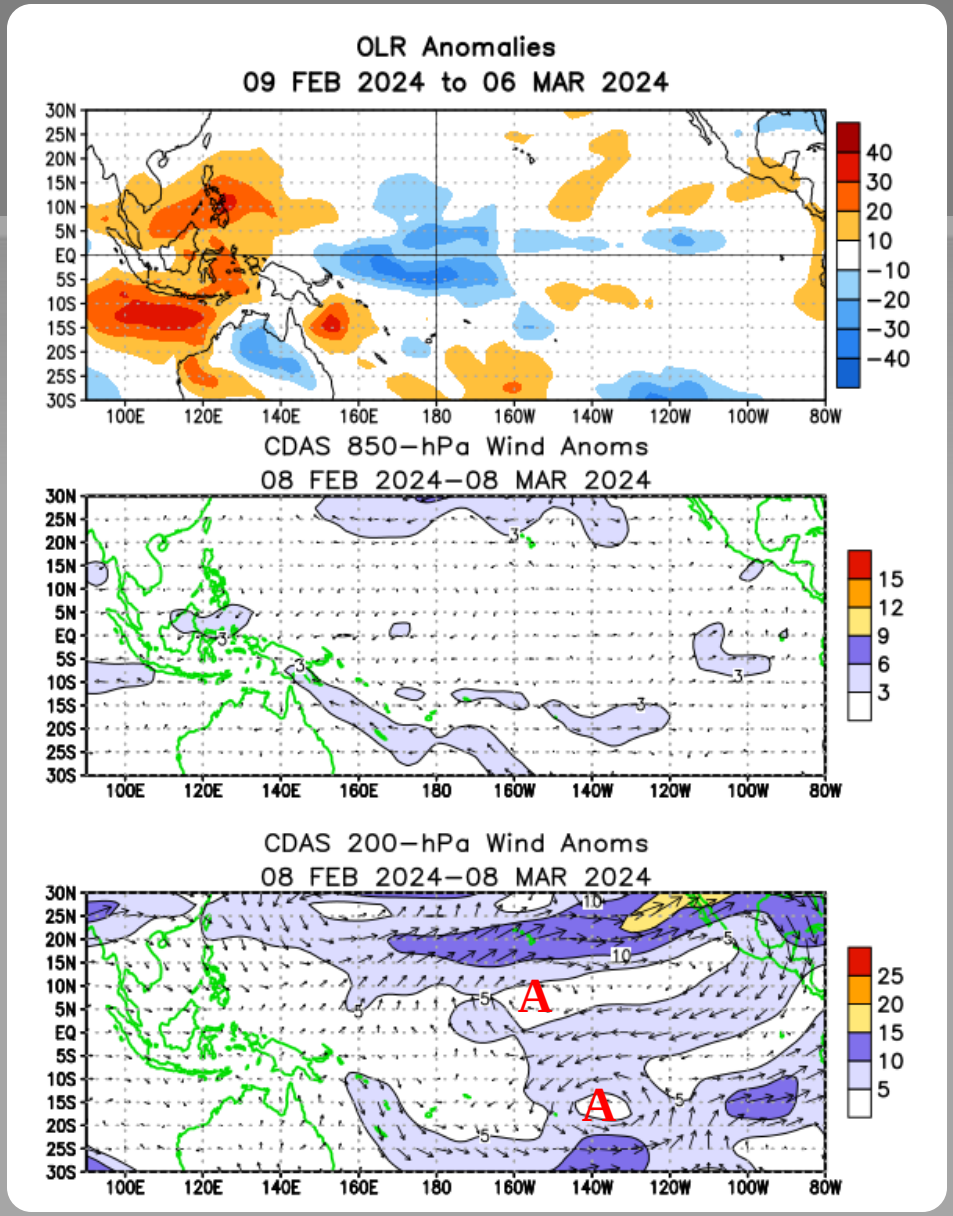


Tropical OLR and Wind Anomalies During the Last 30 Days

Negative OLR anomalies (enhanced convection and precipitation) were observed near the Date Line, while positive OLR anomalies (suppressed convection and precipitation) were evident around Indonesia.

Low-level (850-hPa) winds were near average over most of the tropical Pacific Ocean.

Upper-level (200-hPa) wind anomalies were easterly over the east-central equatorial Pacific. An anomalous anticylonic 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:

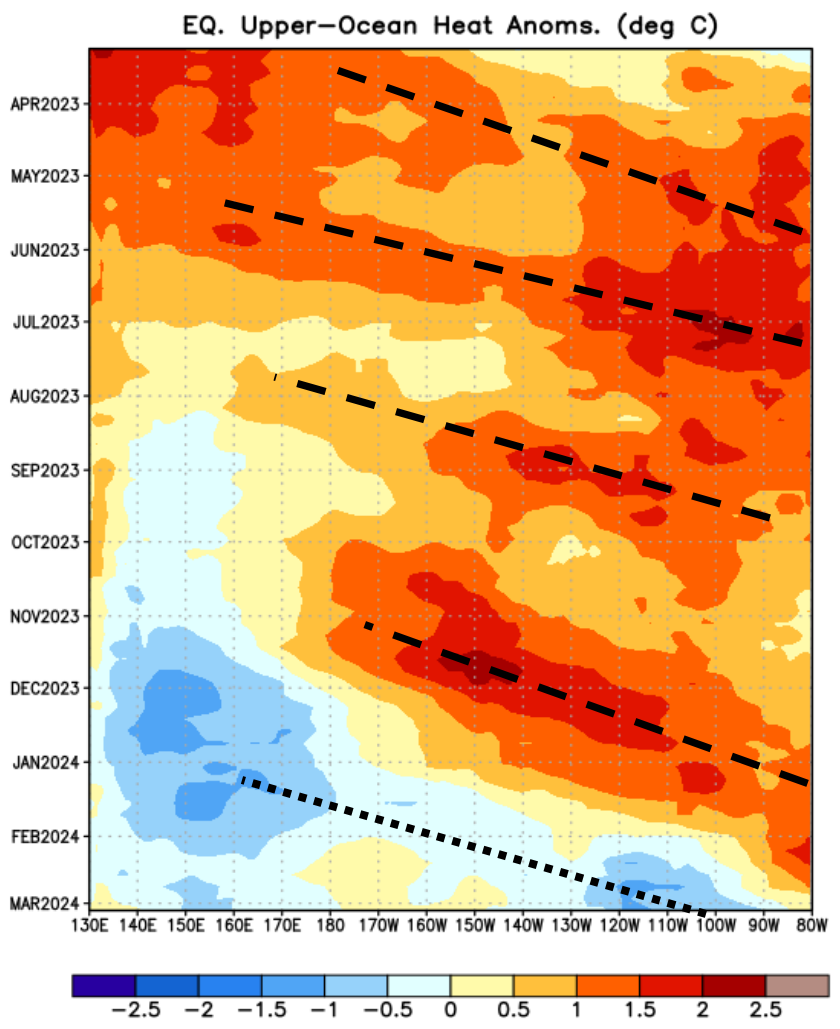
Significant weakening of the low-level easterly winds usually initiates an eastward-propagating oceanic Kelvin wave.

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.

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

Since early November 2023, below-average temperatures strengthened in the western Pacific Ocean and have gradually shifted into the eastern Pacific.

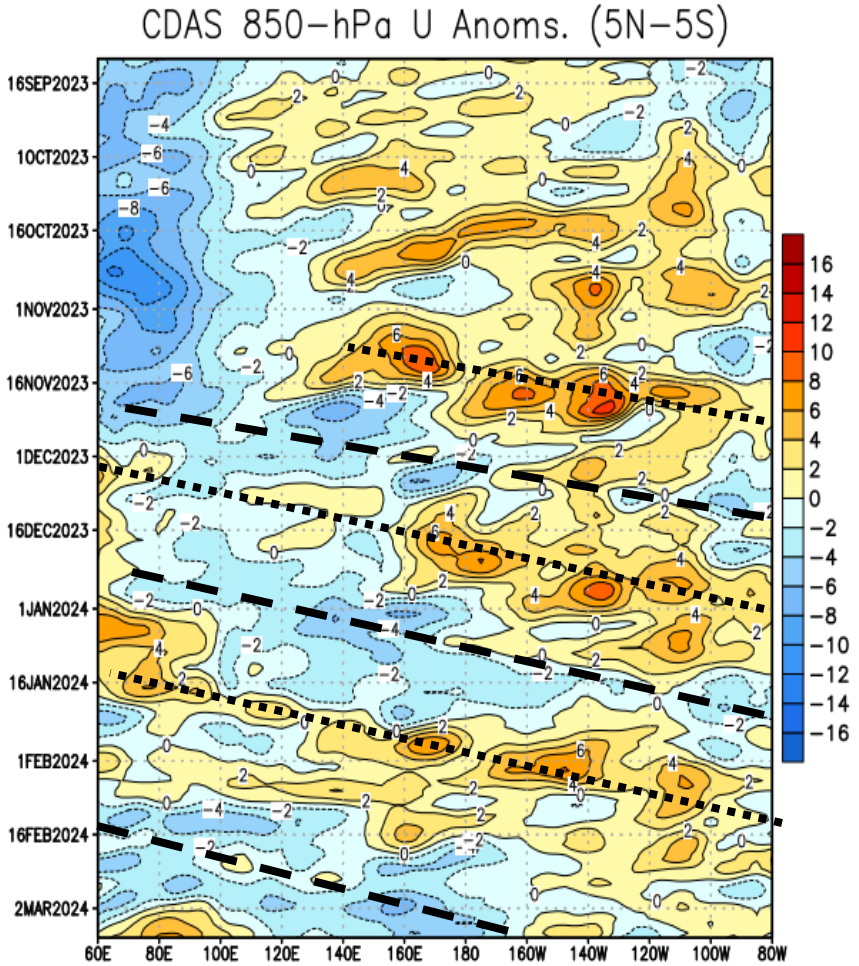


Equatorial oceanic Kelvin waves have alternating warm and cold phases. The warm phase is indicated by dashed lines. Down-welling and warming occur in the leading portion of a Kelvin wave, and up-welling and cooling occur in the trailing portion.

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.

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



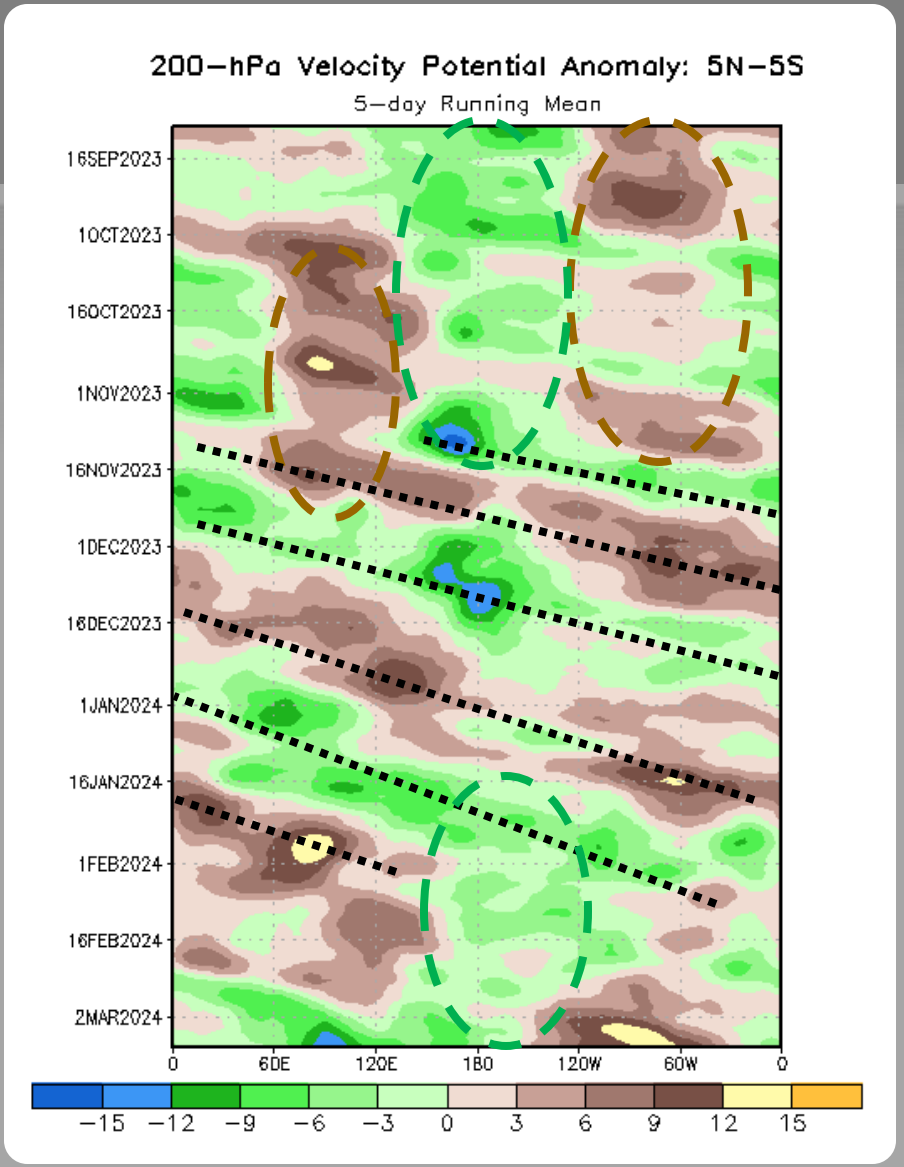
Westerly Wind Anomalies (orange/red shading)
Easterly Wind Anomalies (blue shading)

Upper-level (200-hPa) Velocity Potential Anomalies

Since the beginning of the period through mid-November 2023, anomalous divergence (green shading) persisted near the Date Line, while anomalous convergence (brown shading) was mostly observed over South America.

From November 2023-January 2024, eastward propagation in the velocity potential anomalies was evident.

Since mid-January 2024, anomalous divergence has persisted over the Date Line and east-central Pacific.



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

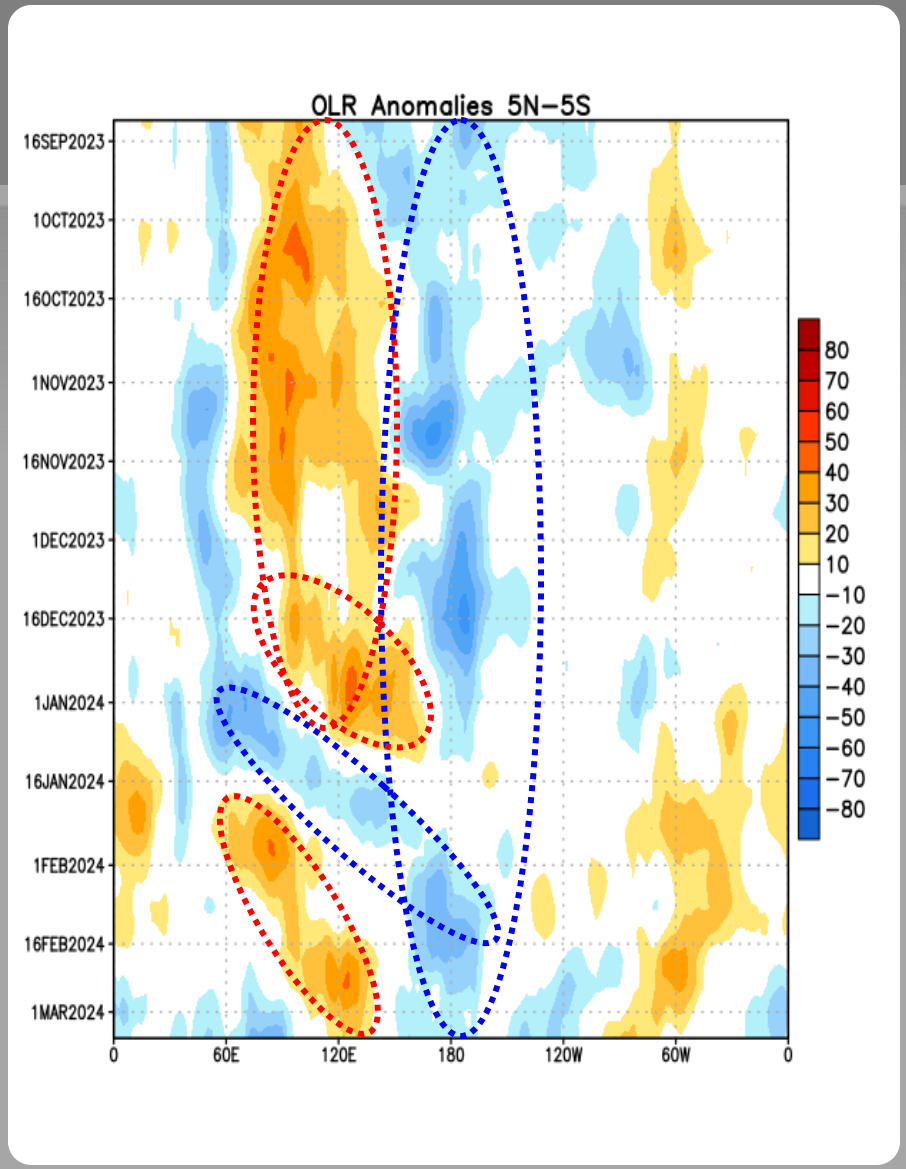
Outgoing Longwave Radiation (OLR) Anomalies

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.

Since mid-December 2023, an alternating pattern of OLR anomalies has shifted eastward from the Indian Ocean/Indonesia to the western Pacific/Date Line.

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 +0.5ºC.

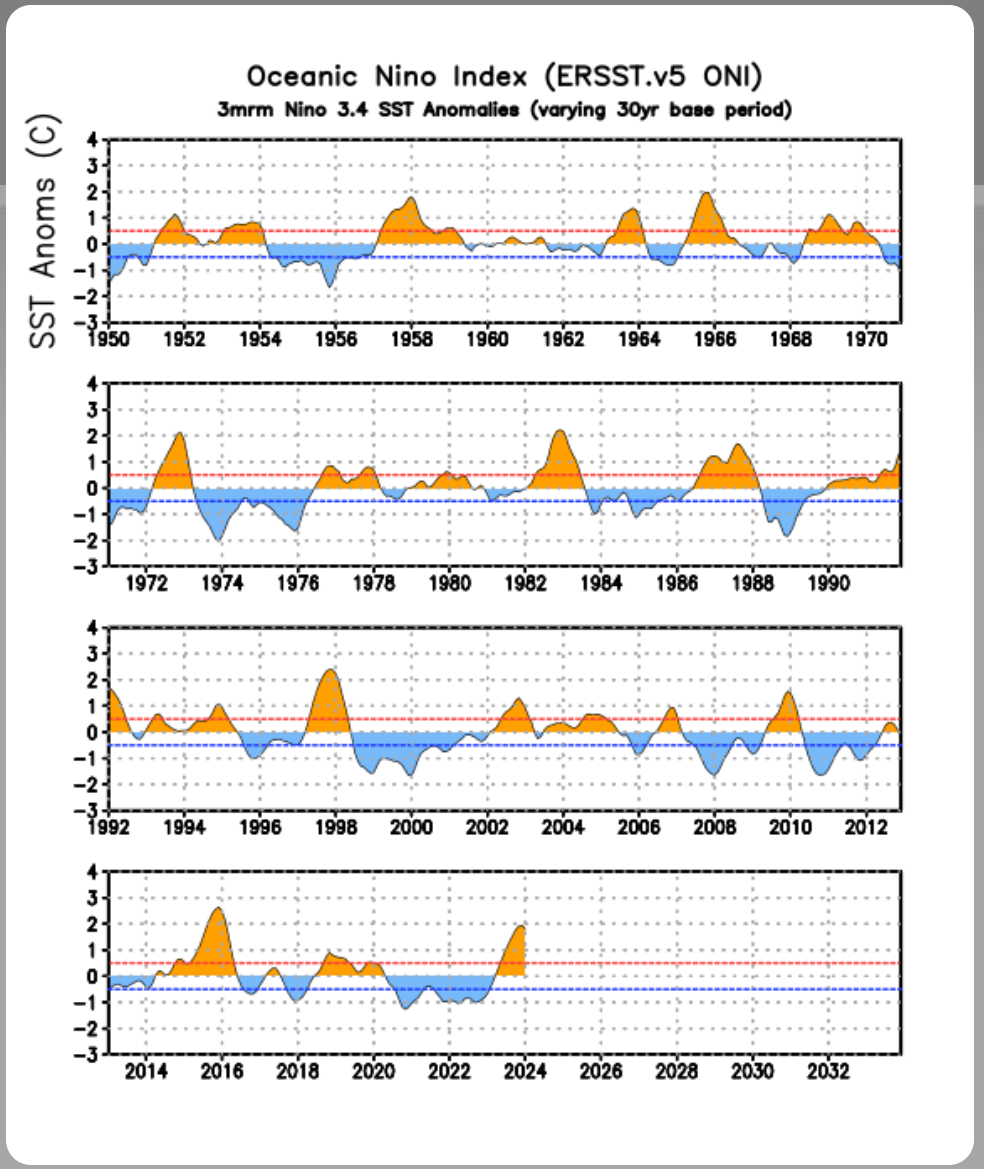
La Niña: characterized by a negative ONI less than or equal to -0.5ºC.

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 +/- 0.5ºC 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 (December 2023 - February 2024) is 1.8°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.

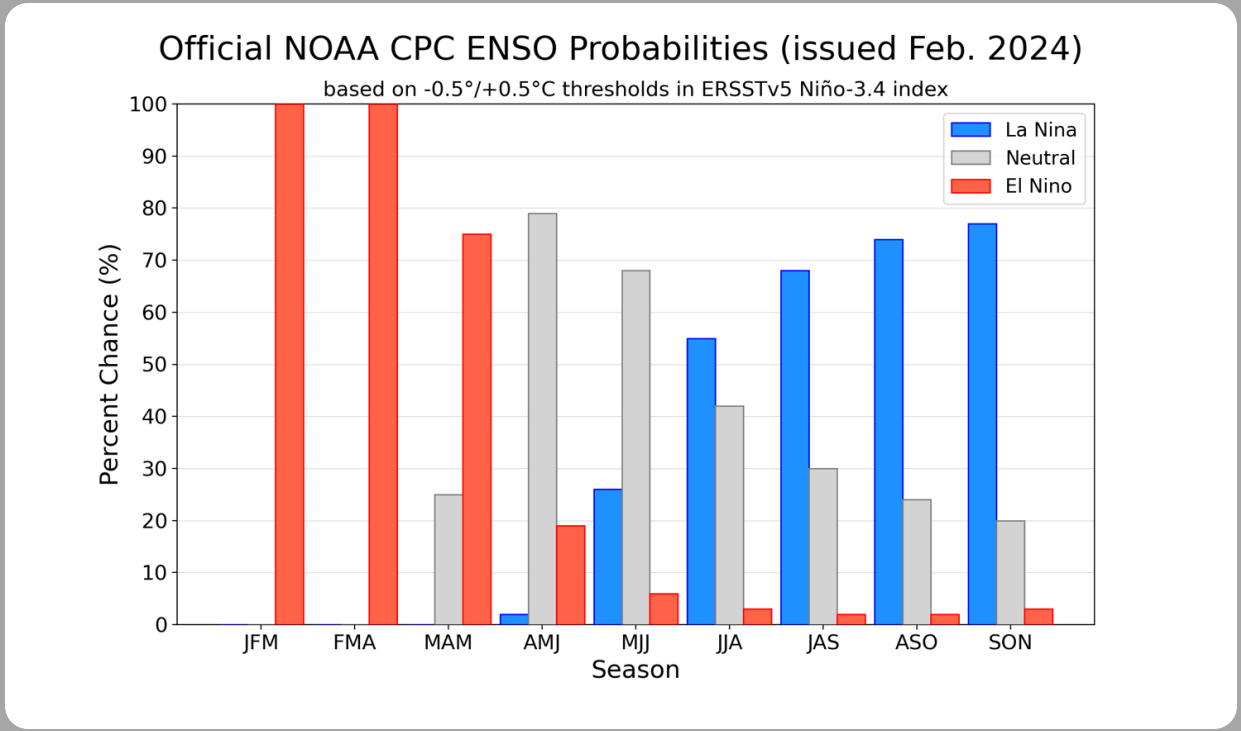
The ONI is one measure of the El Niño-Southern Oscillation, and other indices can confirm whether features consistent with a coupled ocean-atmosphere phenomenon accompanied these periods. The complete table going back to DJF 1950 can be found here.

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											

CPC Probabilistic ENSO Outlook

Updated: 8 February 2024

A transition from El Niño to ENSO-neutral is expected by April-June season 2024, with ENSO-neutral persisting through May-July 2024. Thereafter, La Niña is favored in June-August, and chances increase through the September-November season.



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 June-August 2024.

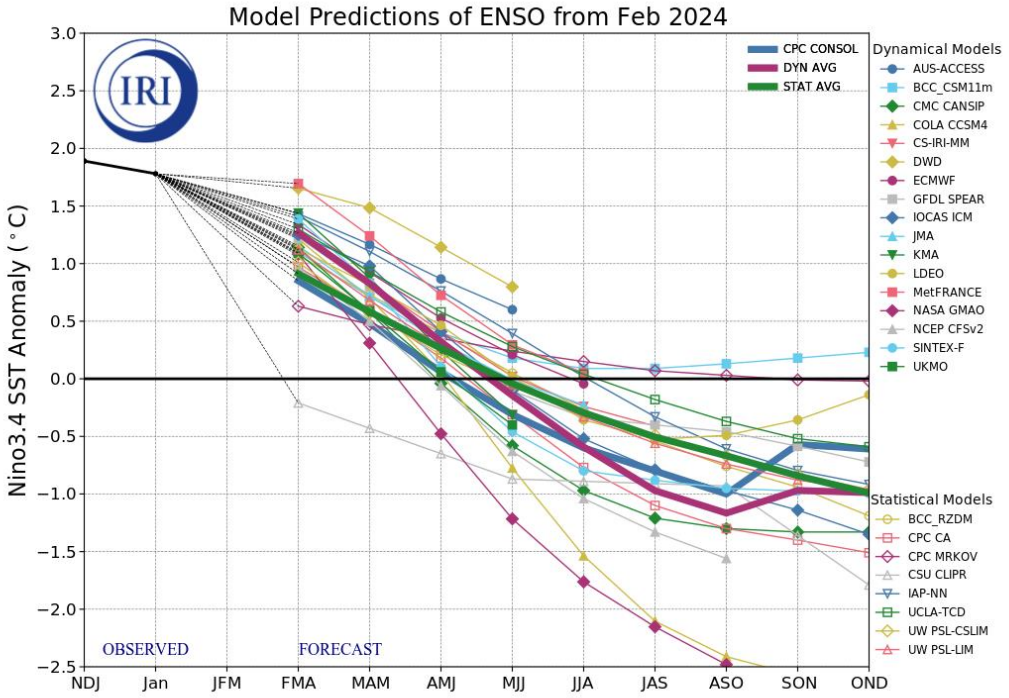
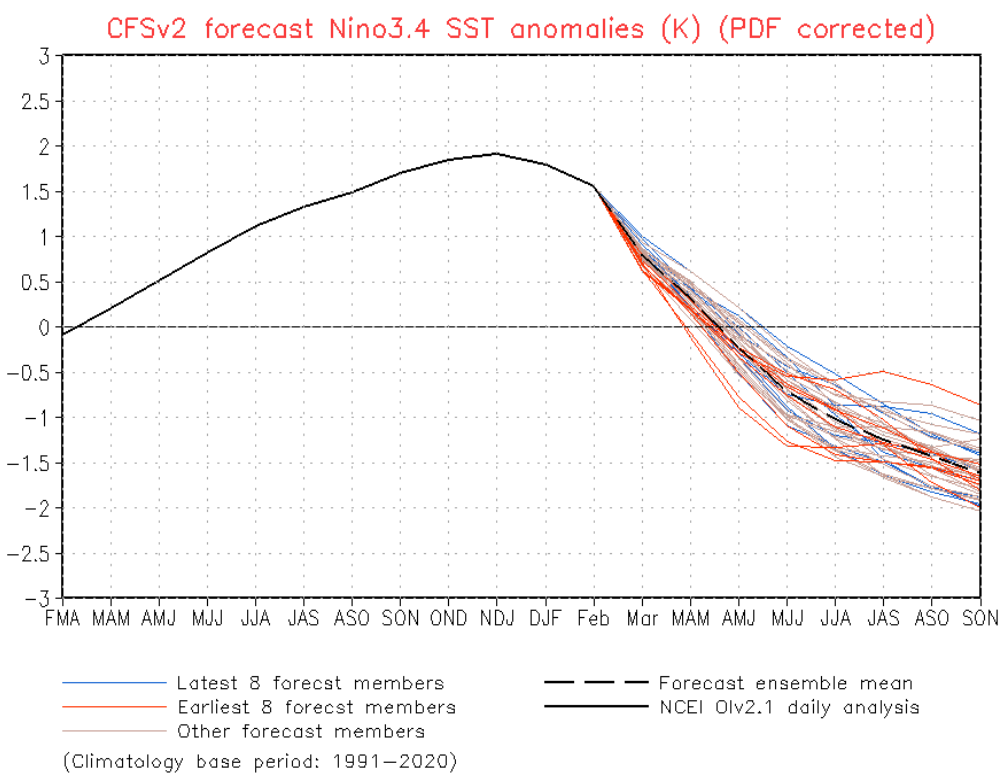


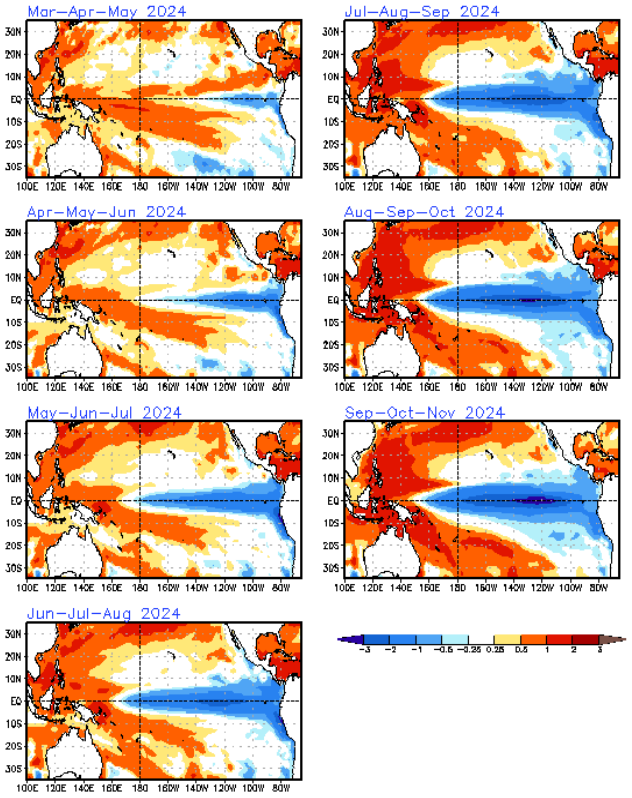
Figure provided by the International Research Institute (IRI) for Climate and Society (updated 19 February 2024).

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

Issued: 11 March 2024

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



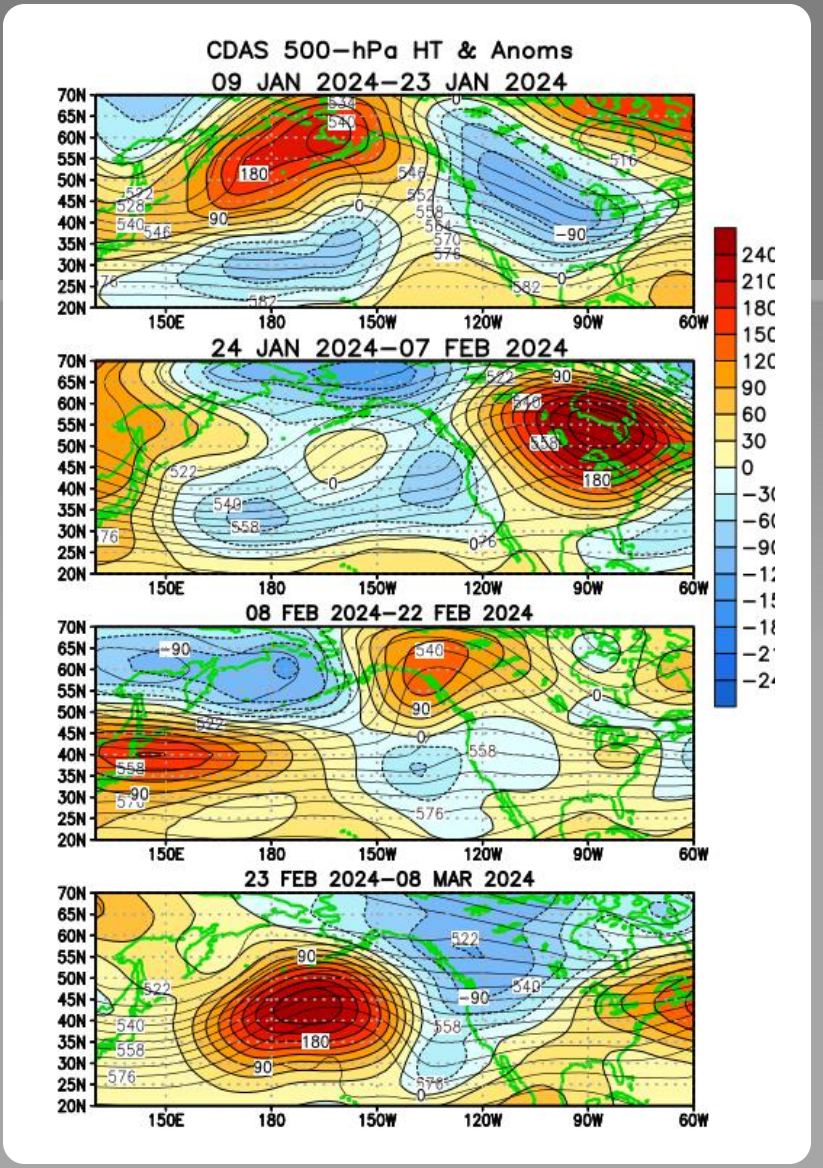


Atmospheric anomalies over the North Pacific and North America During the Last 60 Days

Since mid-January 2024, below-average heights persisted in the eastern North Pacific Ocean.

Over Canada and the northern tier of the U.S., above-average heights and temperatures were prevalent from mid-January through mid-February.

Since late February, above-average heights and temperatures have strengthened in the central Pacific Ocean and over the eastern U.S., with below-average heights and temperatures over western North America.



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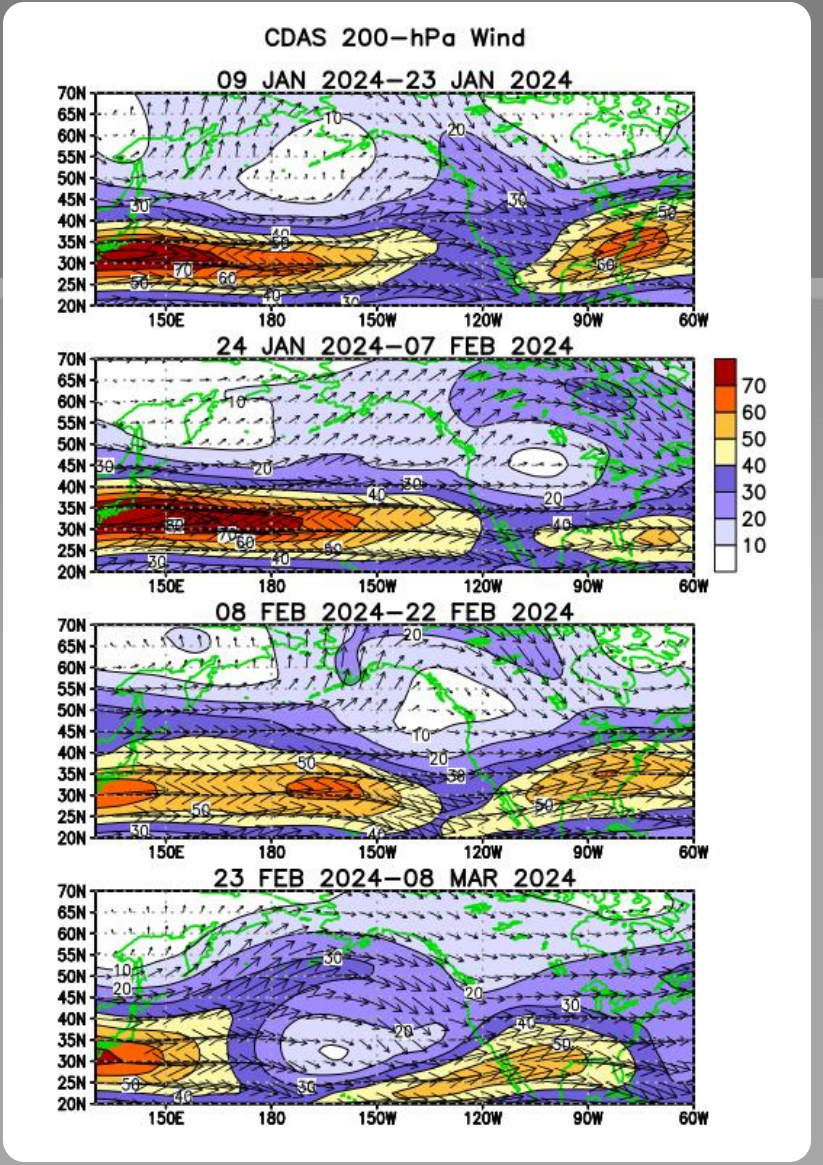

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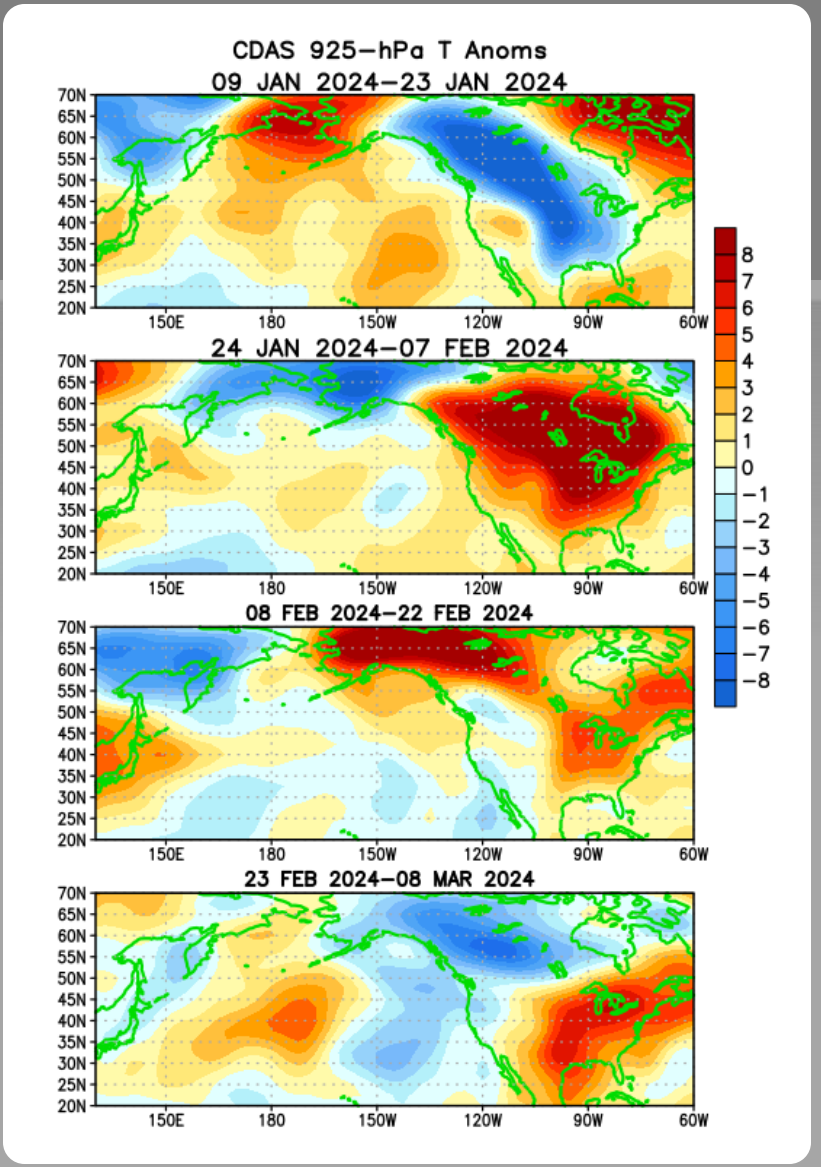
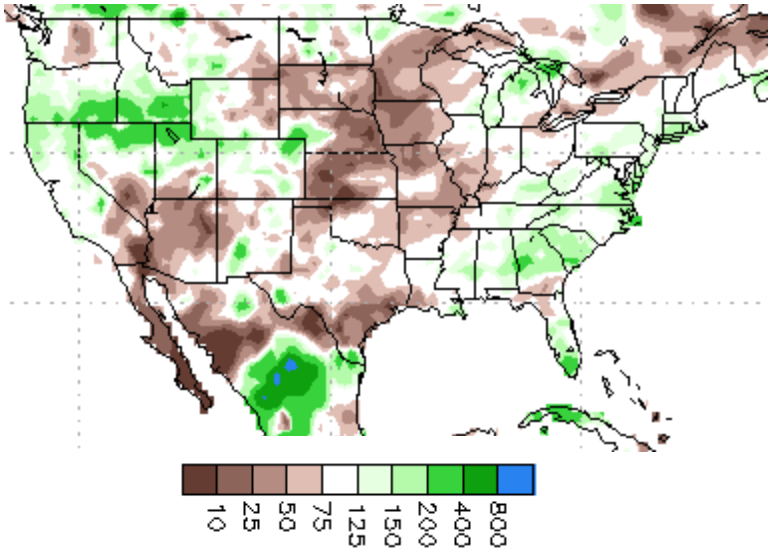


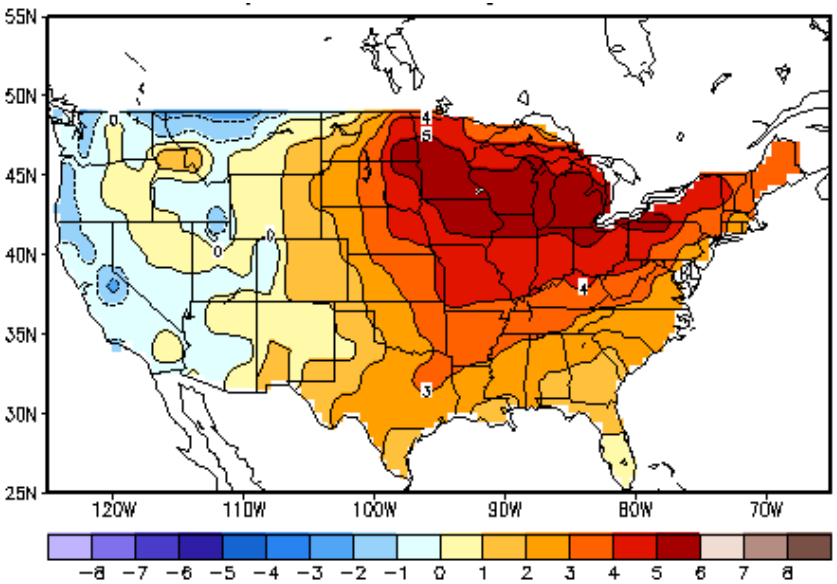
U.S. Temperature and Precipitation Departures During the Last 30 Days

End Date: 9 March 2024

Percent of Average Precipitation



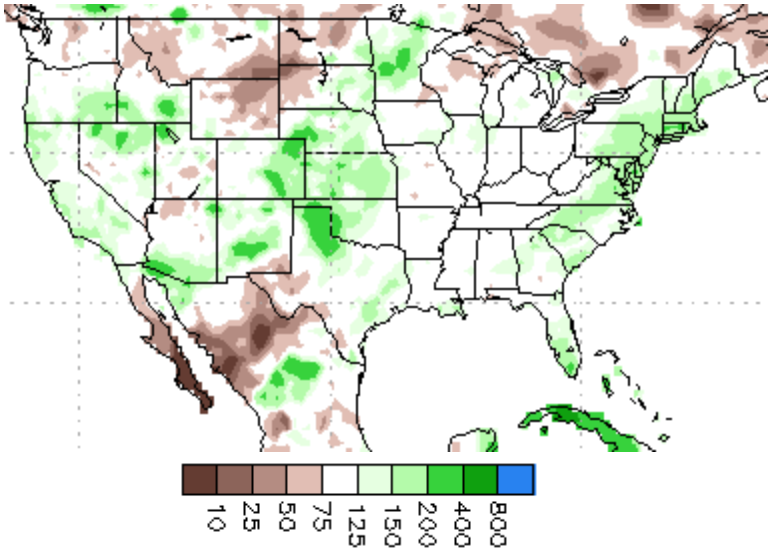
Temperature Departures (degree C)



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

End Date: 9 March 2024

Percent of Average Precipitation



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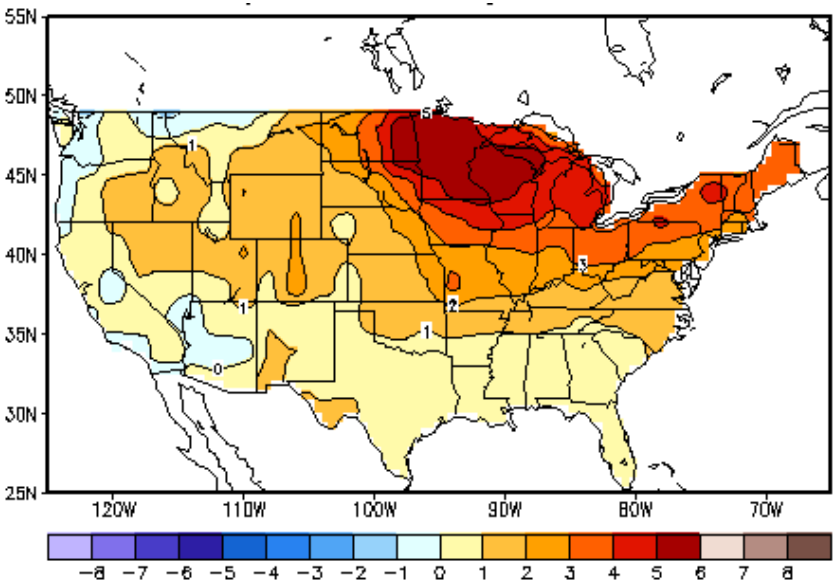
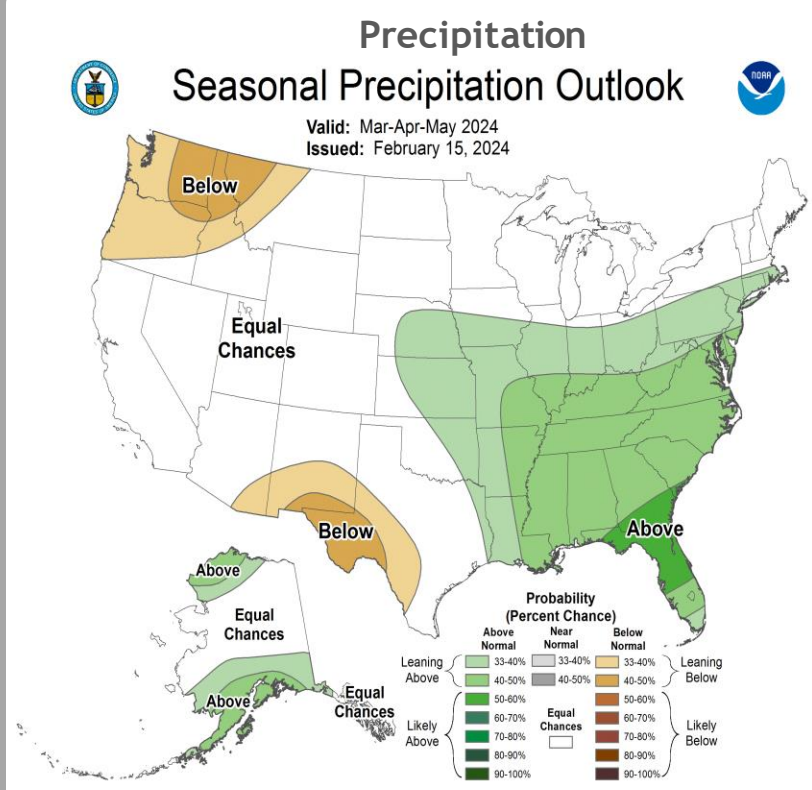


U. S. Seasonal Outlooks

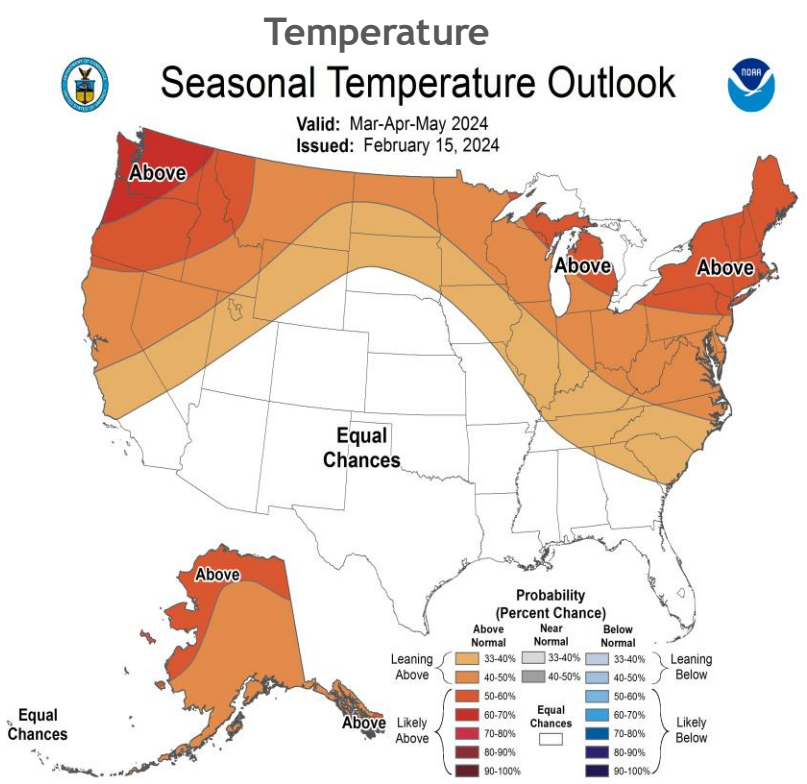
March - May 2024

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

Precipitation



Temperature



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