ENSO: Recent Evolution, Current Status and Predictions

Update prepared by:
Climate Prediction Center / NCEP
27 February 2023

Outline

Summary

Recent Evolution and Current Conditions

Oceanic Niño Index (ONI)

Pacific SST Outlook

U.S. Seasonal Precipitation and Temperature Outlooks

Summary

Summary

ENSO Alert System Status: **La Niña Advisory**

La Niña is present.*

Equatorial sea surface temperatures (SSTs) are below average across most of the Pacific Ocean.

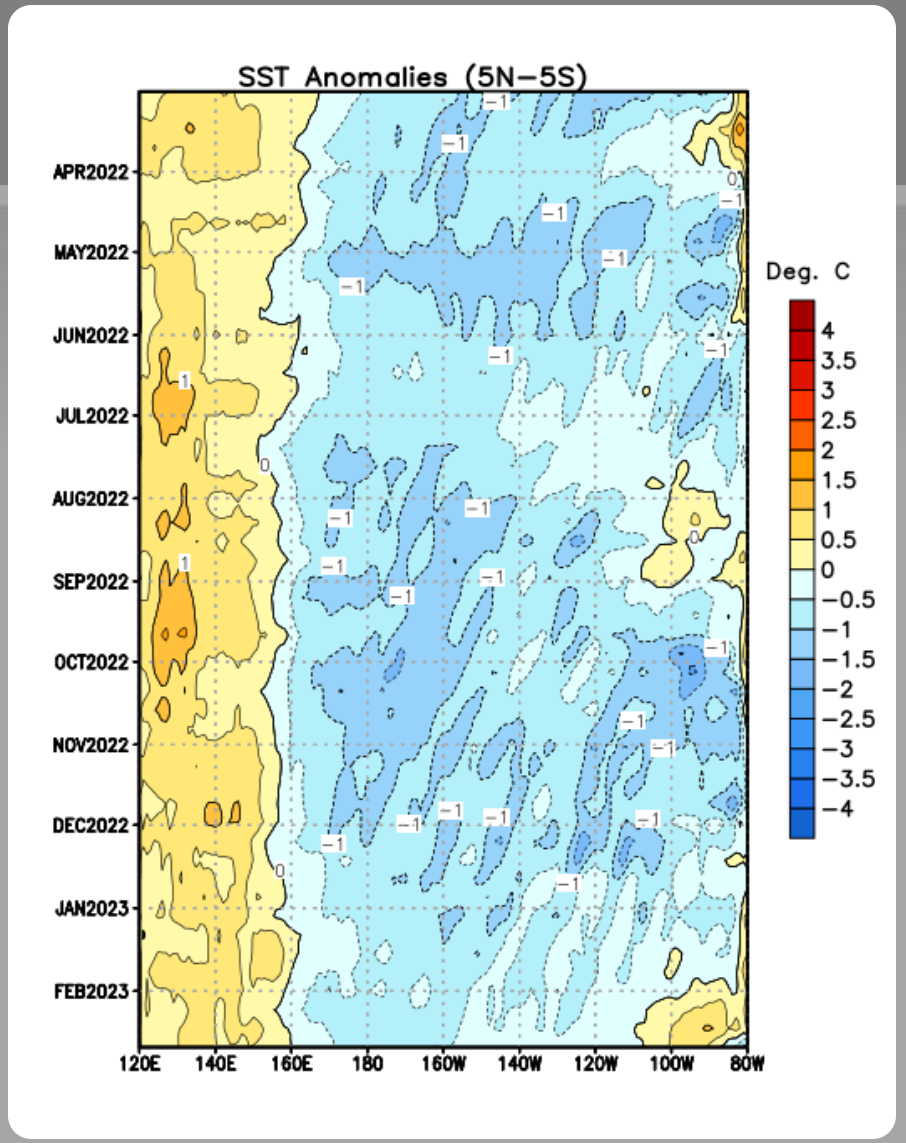
The tropical Pacific atmosphere is consistent with La Niña.

ENSO-neutral conditions are expected to begin within the next couple of months, and persist through the Northern Hemisphere spring and early summer.*

* 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)

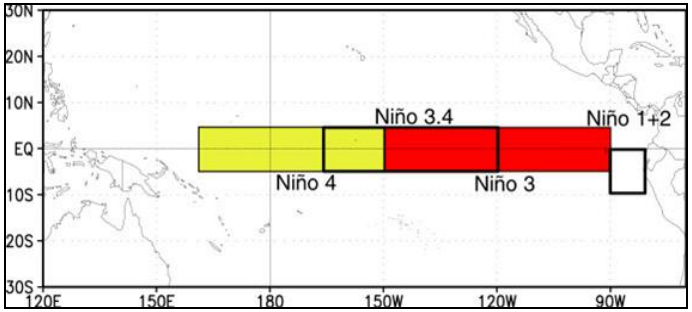
Negative SST anomalies have gradually weakened across most of the equatorial Pacific Ocean since at least December 2022. Positive SST anomalies have emerged in the eastern equatorial Pacific since late January 2023.

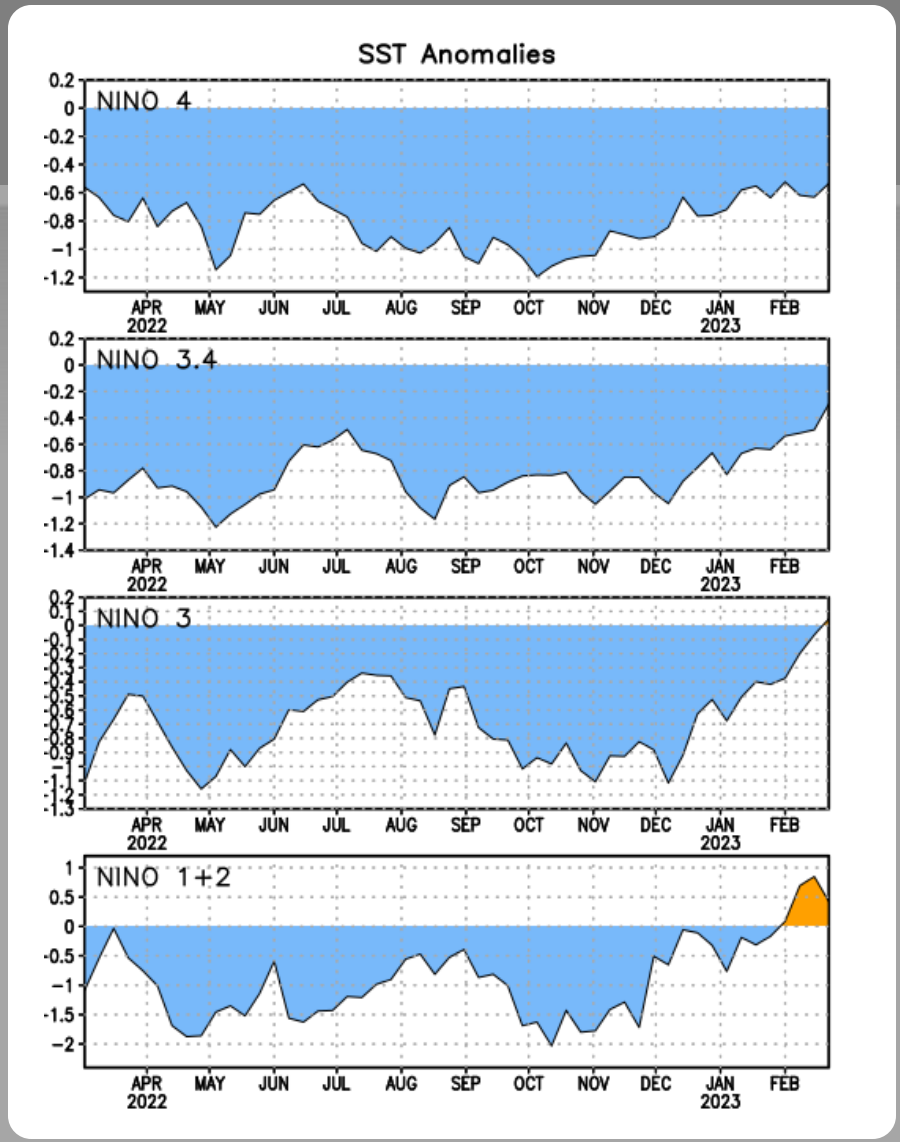


Niño Region SST Departures (ºC) Recent Evolution

The latest weekly SST departures are:

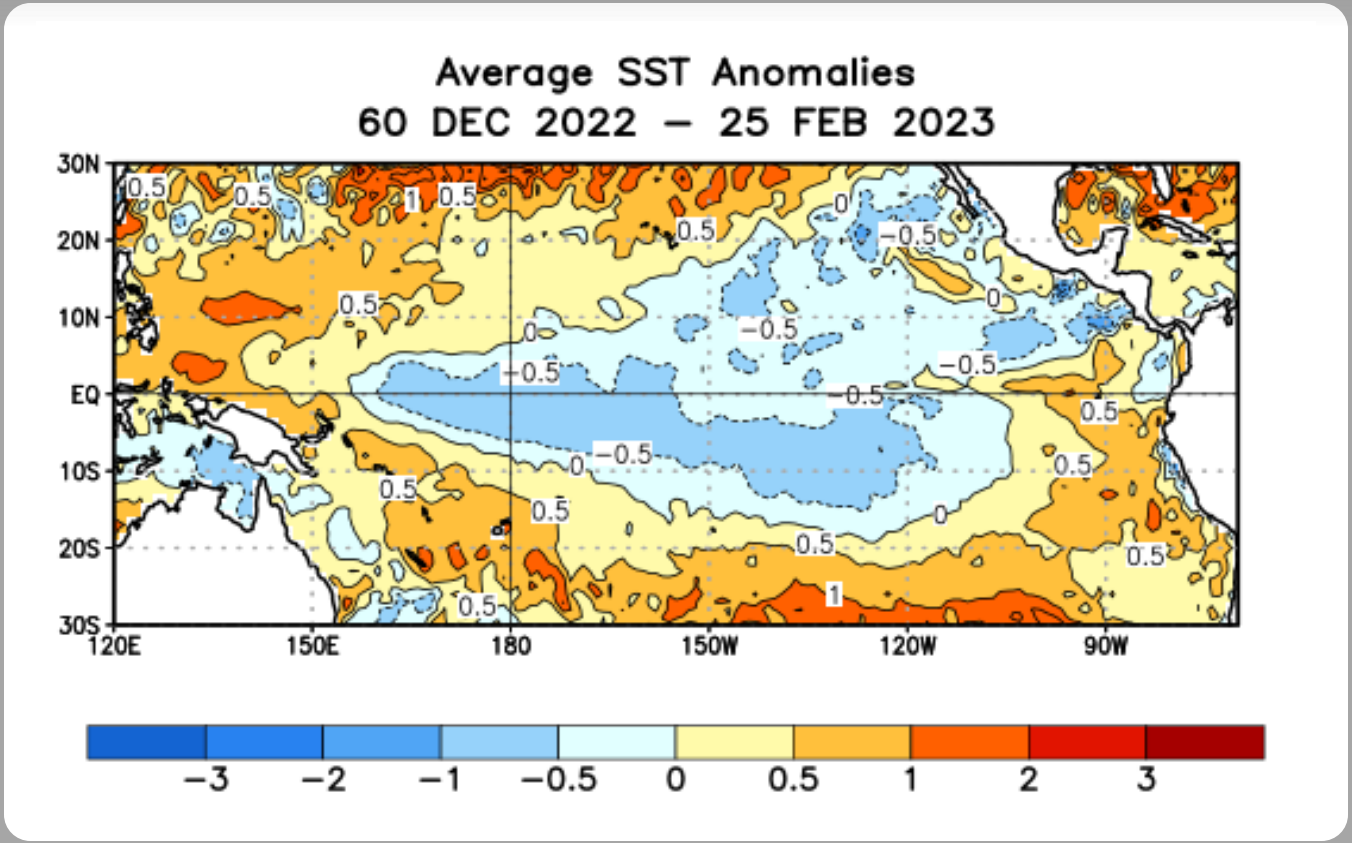
Niño 4	-0.5ºC
Niño 3.4	-0.3ºC
Niño 3	0.0ºC
Niño 1+2	0.4ºC





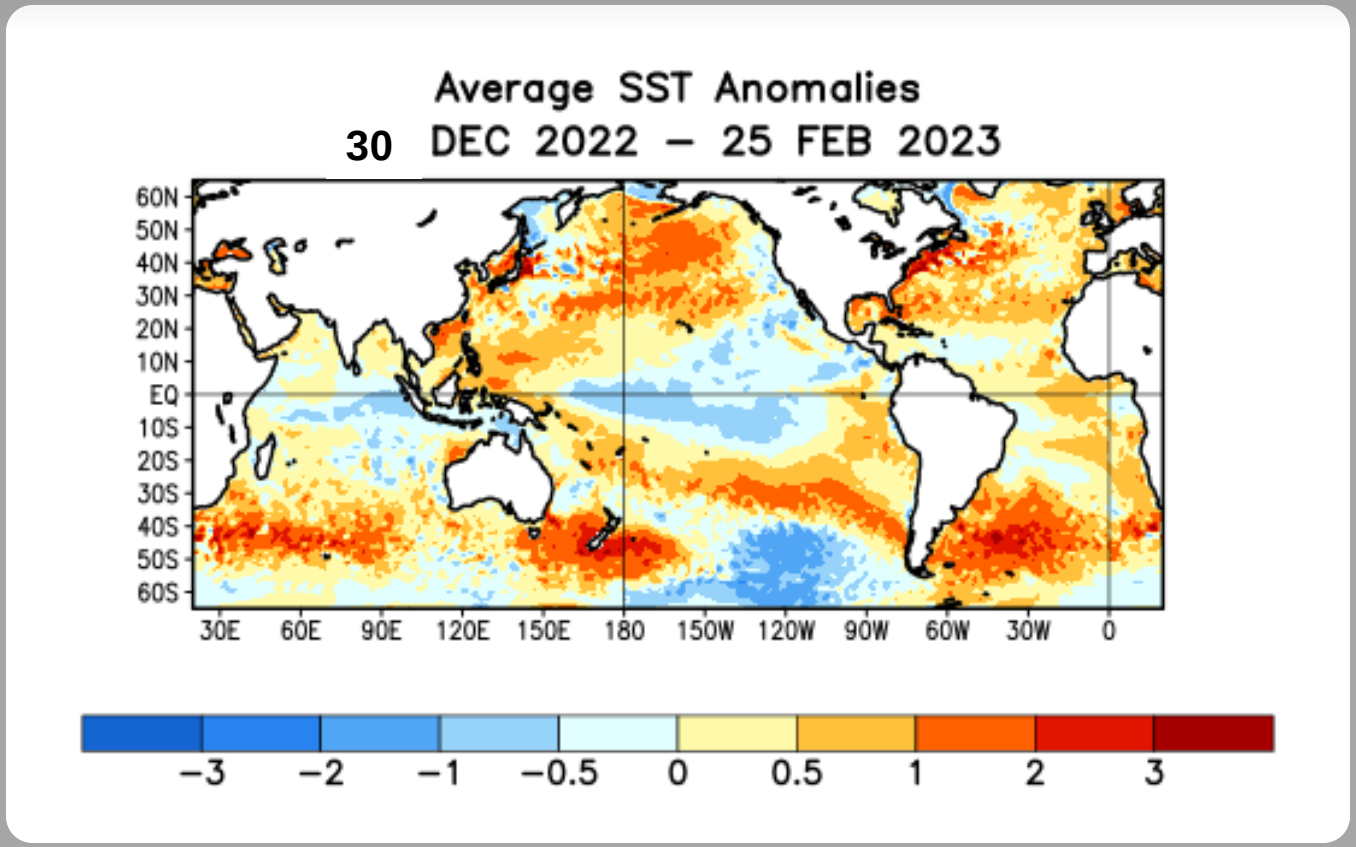
SST Departures (°C) in the Tropical Pacific During the Last Four Weeks

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



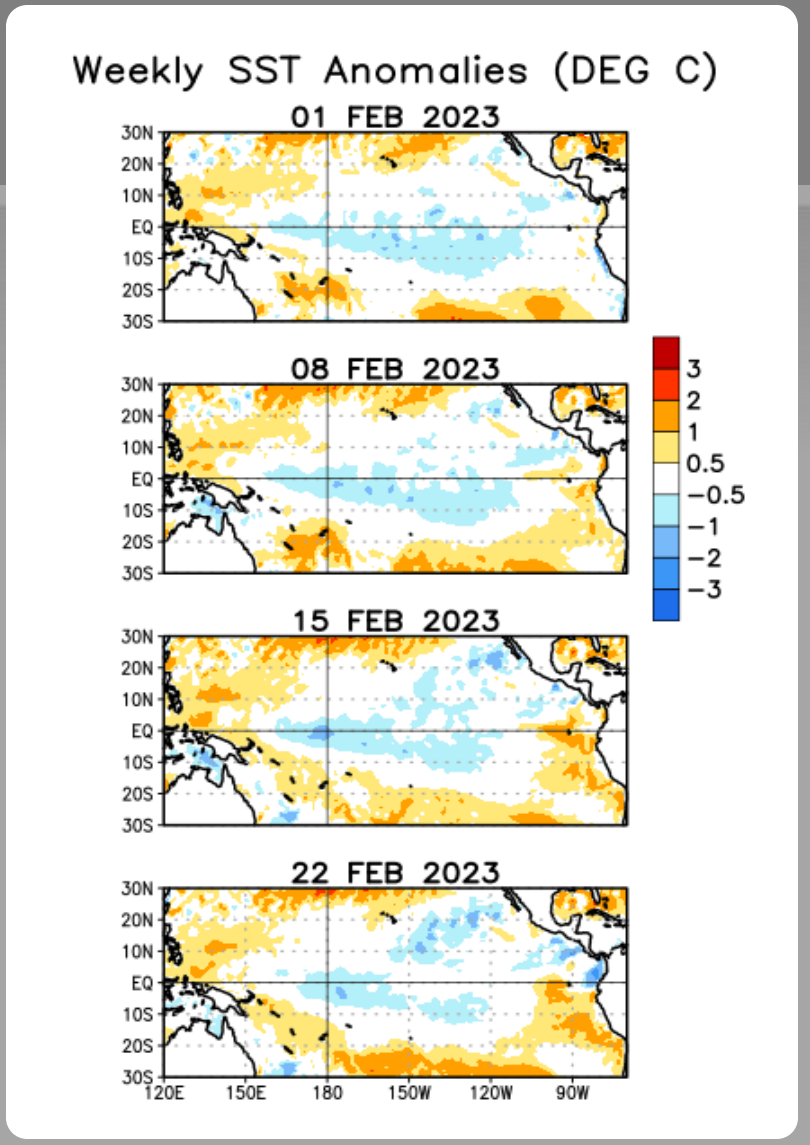
Global SST Departures (°C) During the Last Four Weeks

During the last four weeks, equatorial SSTs were below average across the central and east-central Pacific Ocean and in the eastern Indian Ocean. Equatorial SSTs were above average in the far western and eastern Pacific and in the central Atlantic Ocean.



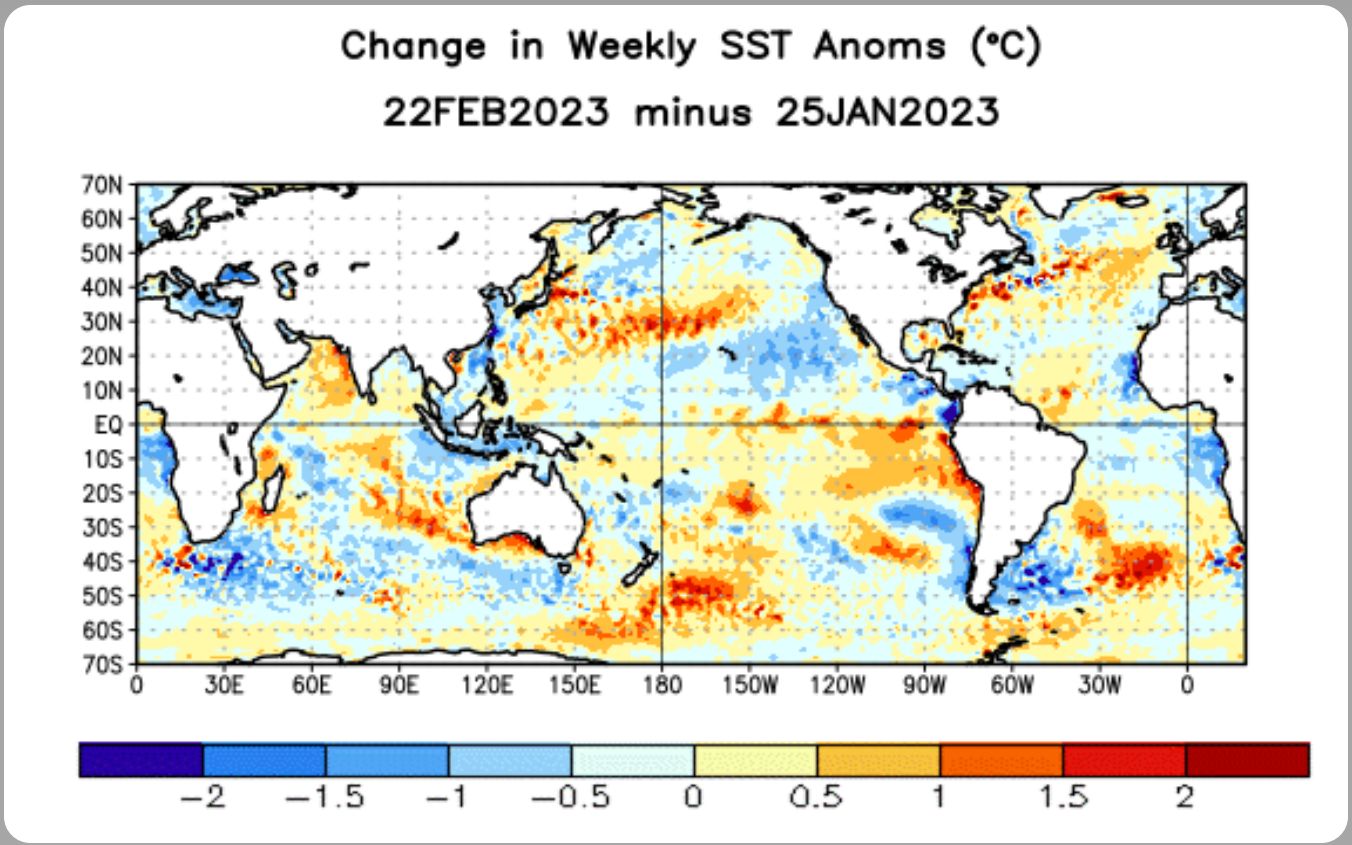
Weekly SST Departures during the Last Four Weeks

During the last 4 weeks, negative SST anomalies weakened across most of the equatorial Pacific Ocean. Positive SST anomalies emerged in the eastern Pacific.



Change in Weekly SST Departures over the Last Four Weeks

During the last four weeks, positive SST changes were evident in the east-central and eastern equatorial Pacific Ocean.



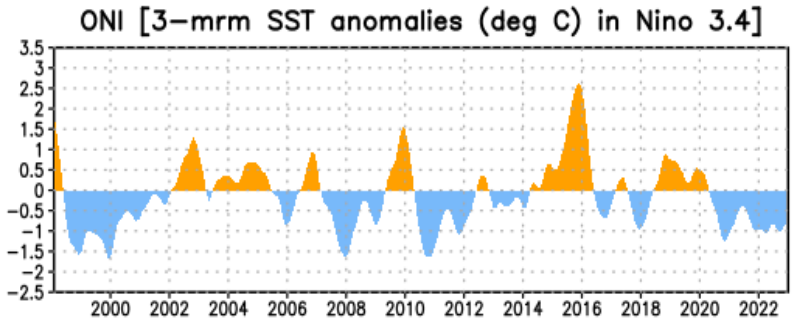
Upper-Ocean Conditions in the Equatorial Pacific

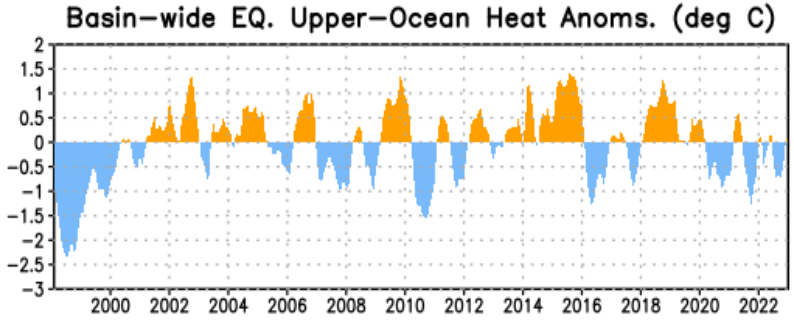
The basin-wide equatorial upper ocean (0-300 m) heat content is greatest prior to and during the early stages of a Pacific warm (El Niño) episode (compare top 2 panels), and least prior to and during the early stages of a cold (La Niña) episode.

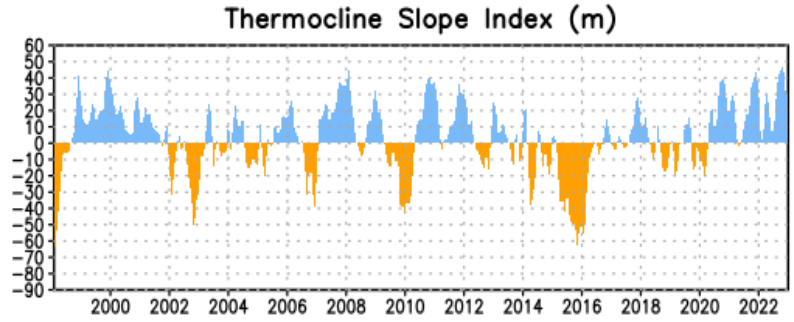
The slope of the oceanic thermocline is least (greatest) during warm (cold) episodes.

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

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).

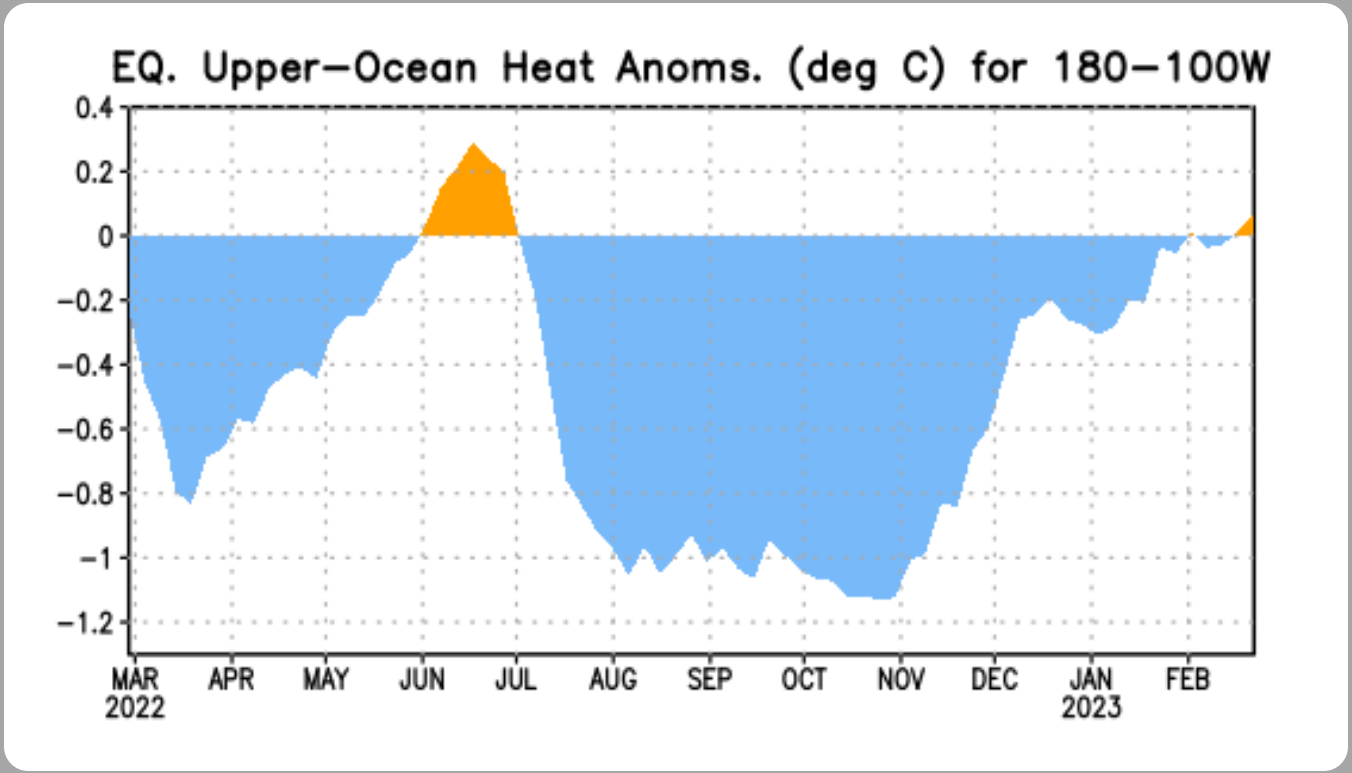






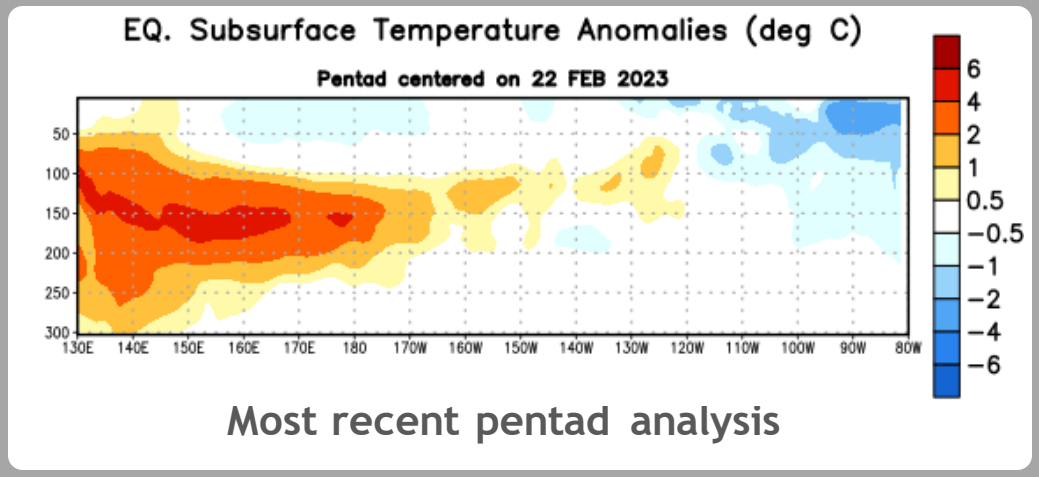
Central and Eastern Pacific Upper-Ocean (0-300 m) Weekly Average Temperature Anomalies

From mid-March to mid-June 2022, subsurface temperature anomalies increased from negative to positive. Anomalies decreased from mid-June through July 2022, and persisted during August-October. Since November 2022, negative anomalies weakened and were near zero in February 2023.



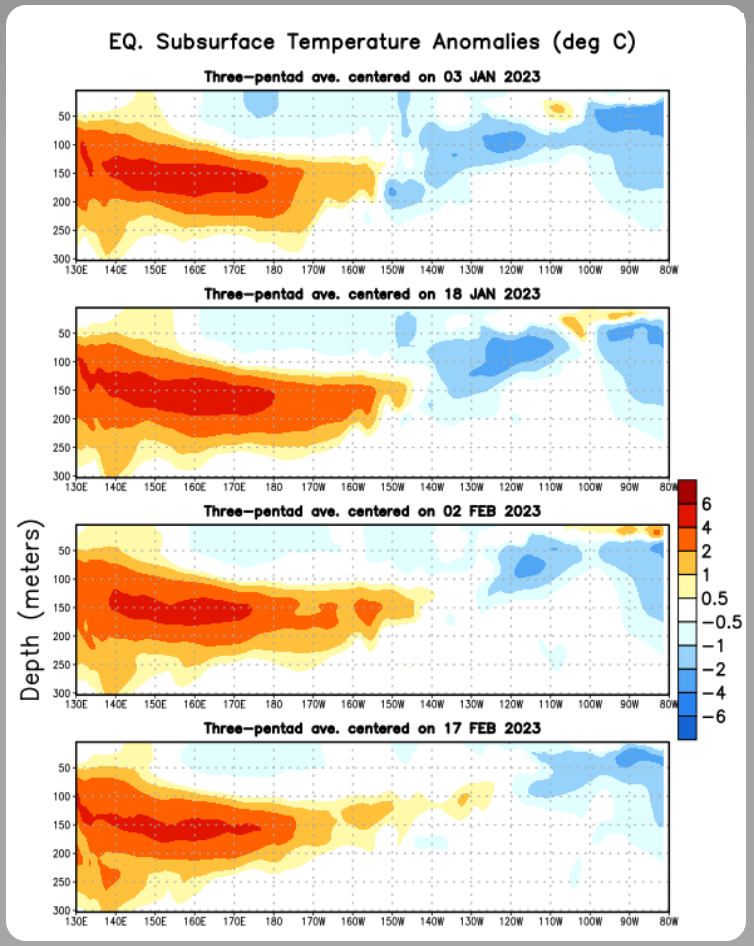
Sub-Surface Temperature Departures in the Equatorial Pacific

Positive subsurface temperature anomalies have expanded eastward, remaining mostly at depth, except near the surface in the eastern Pacific Ocean.



Most recent pentad analysis

Negative subsurface temperature anomalies weakened across the equatorial Pacific Ocean, but weak anomalies continue to reside near the surface.

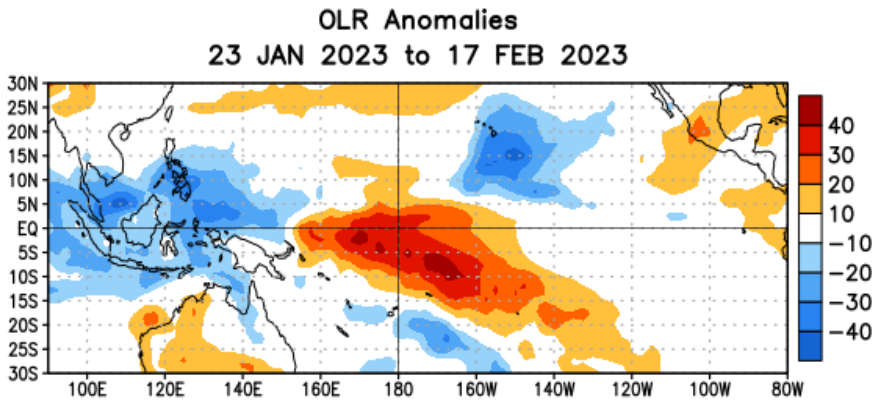


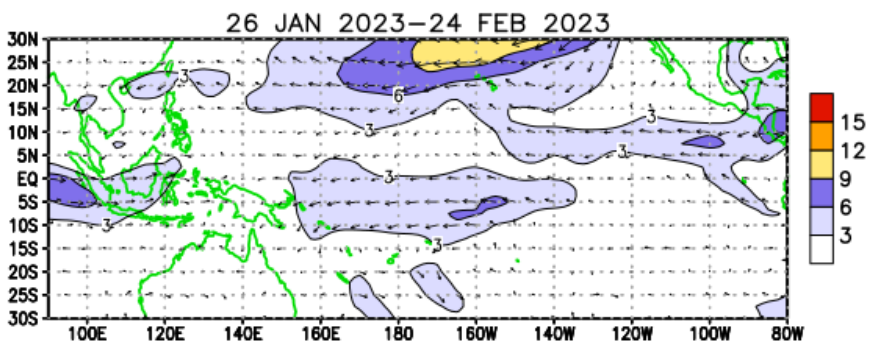
Tropical OLR and Wind Anomalies During the Last 30 Days

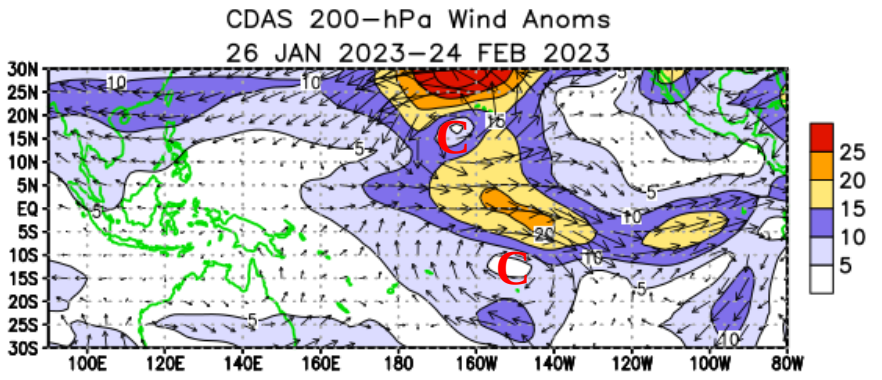
Positive OLR anomalies (suppressed convection and precipitation) were located over the central tropical Pacific Ocean. Negative OLR anomalies (enhanced convection and precipitation) were observed near the Philippines and over Indonesia.

Low-level (850-hPa) easterly wind anomalies were evident across the western and central equatorial Pacific Ocean.

Upper-level (200-hPa) westerly wind anomalies were observed across the central and east-central equatorial Pacific, with anomalous cyclones on either side of the equator.







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

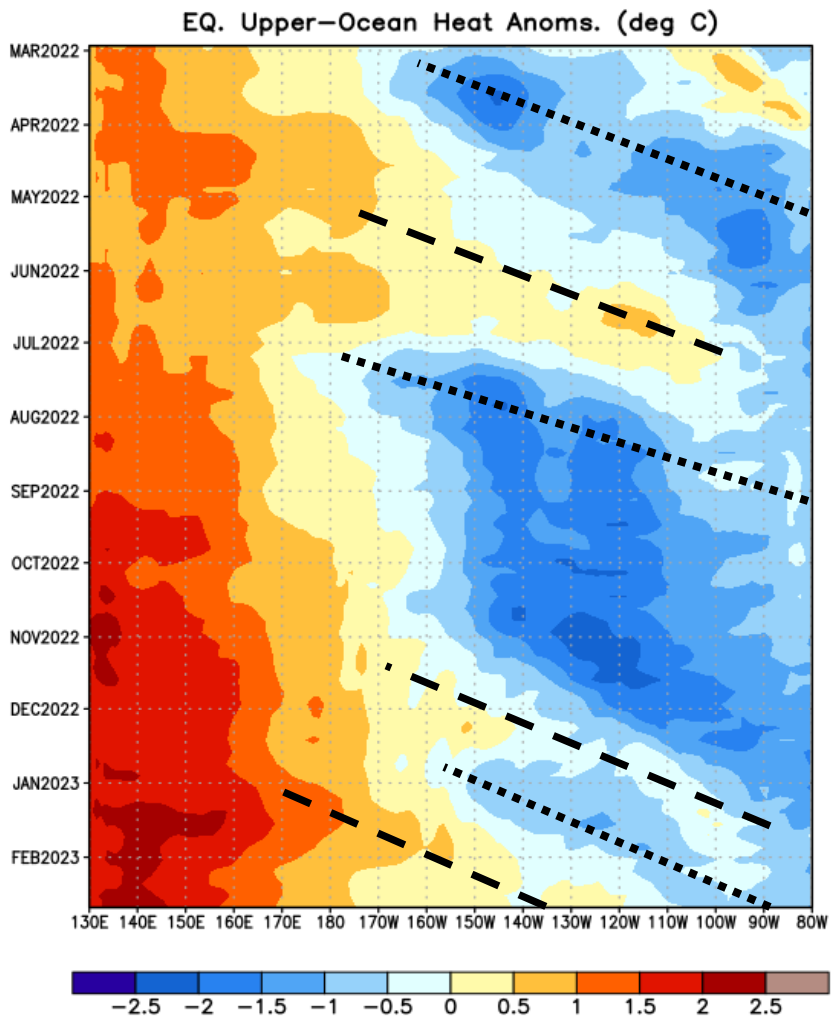
Significant equatorial oceanic Kelvin wave activity (dashed and dotted lines) has been present throughout the period shown.

From August through October, following an upwelling Kelvin wave, negative subsurface temperature anomalies were stationary in the eastern Pacific Ocean.

During late December 2022 and January 2023, negative anomalies strengthened in the east-central Pacific Ocean.

Downwelling Kelvin waves were evident during late November/December 2022 and then again in January-February 2023.

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.

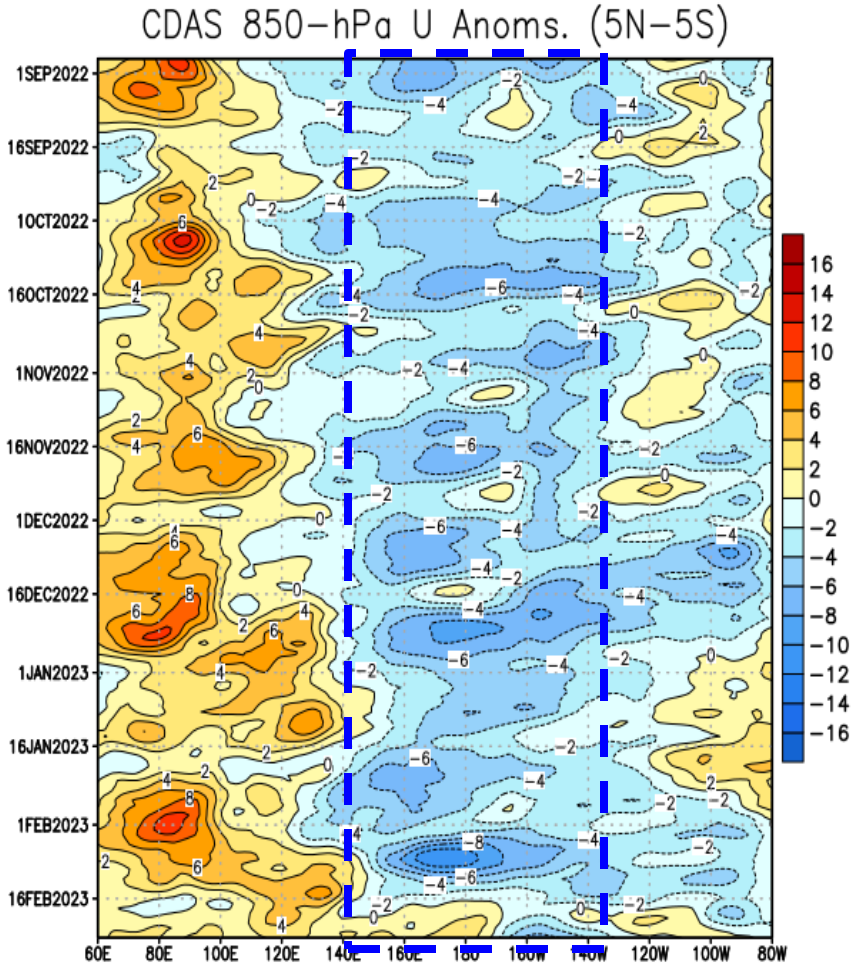


Low-level (850-hPa) Zonal (east-west) Wind Anomalies (m s^{-1})

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

Since the beginning of the period, easterly wind anomalies have generally dominated over the central and east-central Pacific, except for breaks during early September 2022, early and late November 2022, and mid-December 2022.

In late February 2023, westerly wind anomalies extended eastward from the western Pacific to the central Pacific Ocean.

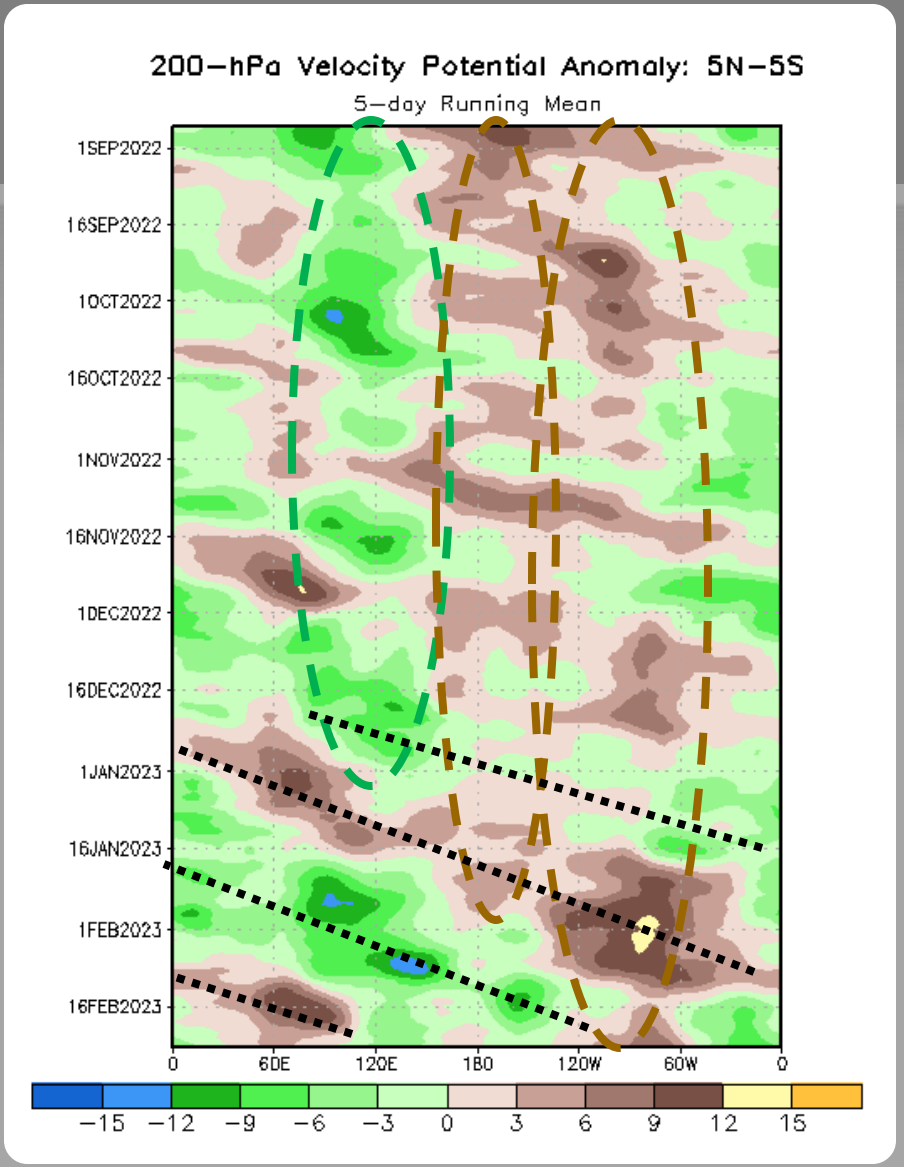


Westerly Wind Anomalies (orange/red shading)
Easterly Wind Anomalies (blue shading)

Upper-level (200-hPa) Velocity Potential Anomalies

During most of the period, anomalous divergence (green shading) generally remained near Indonesia, while anomalous convergence (brown shading) persisted over the central and/or eastern Pacific Ocean.

Since mid-December 2022, eastward propagation of anomalies has been evident.



Unfavorable for precipitation (brown shading)
Favorable for precipitation (green shading)

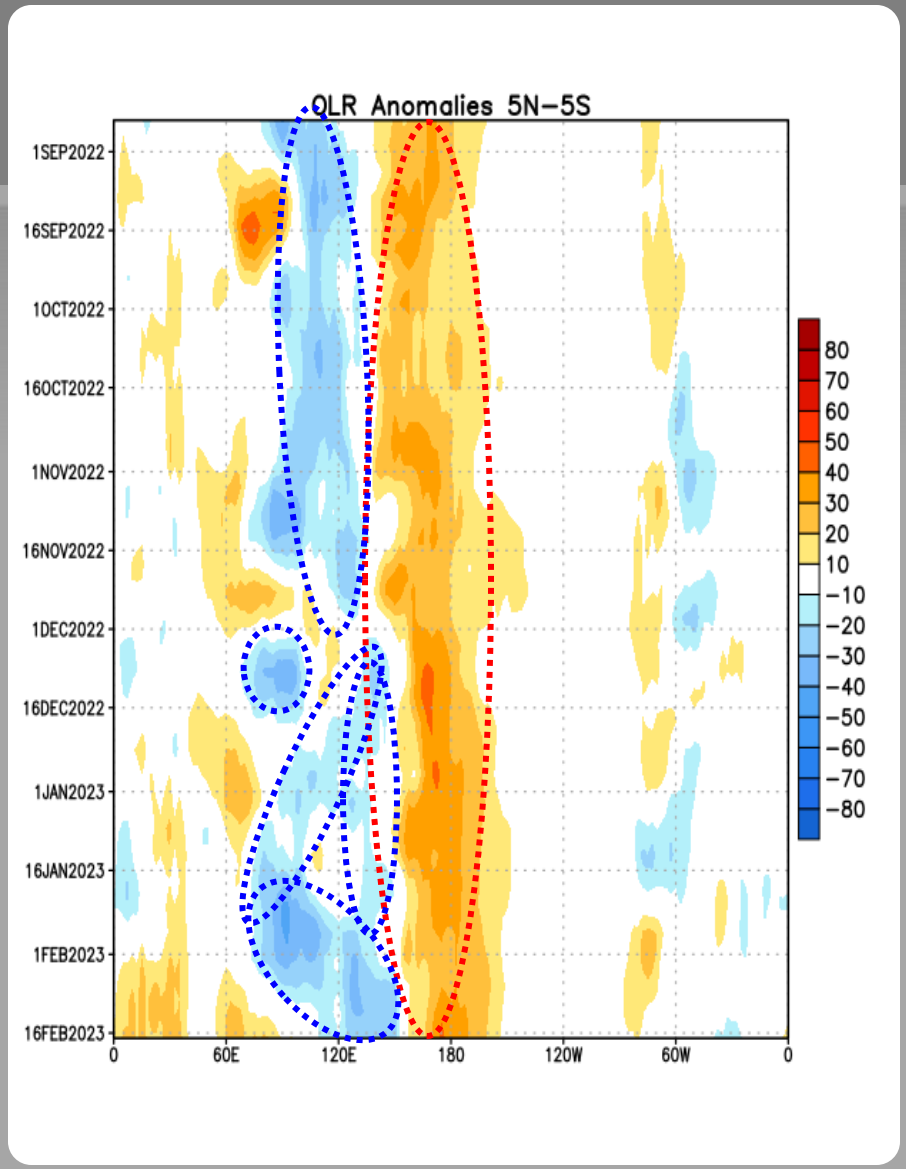
Note: Eastward propagation is not necessarily indicative of the Madden-Julian Oscillation (MJO).

Outgoing Longwave Radiation (OLR) Anomalies

Since the beginning of the period, positive OLR anomalies were evident over the western and/or central Pacific Ocean.

Negative OLR anomalies persisted over Indonesia from late August 2022 through November 2022.

Weak, negative OLR anomalies resumed in early December 2022 and have persisted near Indonesia and/or the far western 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 +0.5ºC.

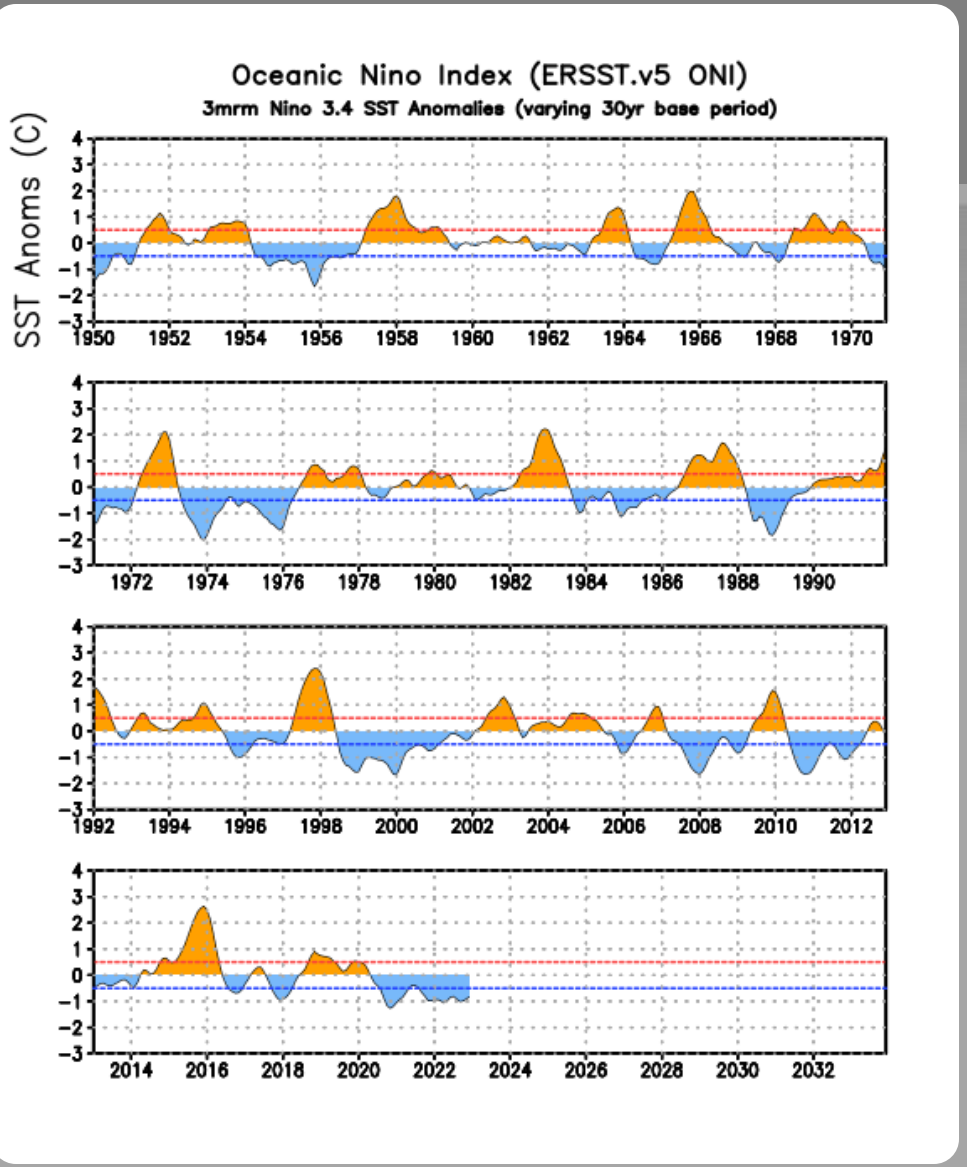
La Niña: characterized by a negative ONI less than or equal to -0.5ºC.

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 (November 2022 - January 2023) is -0.8°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.

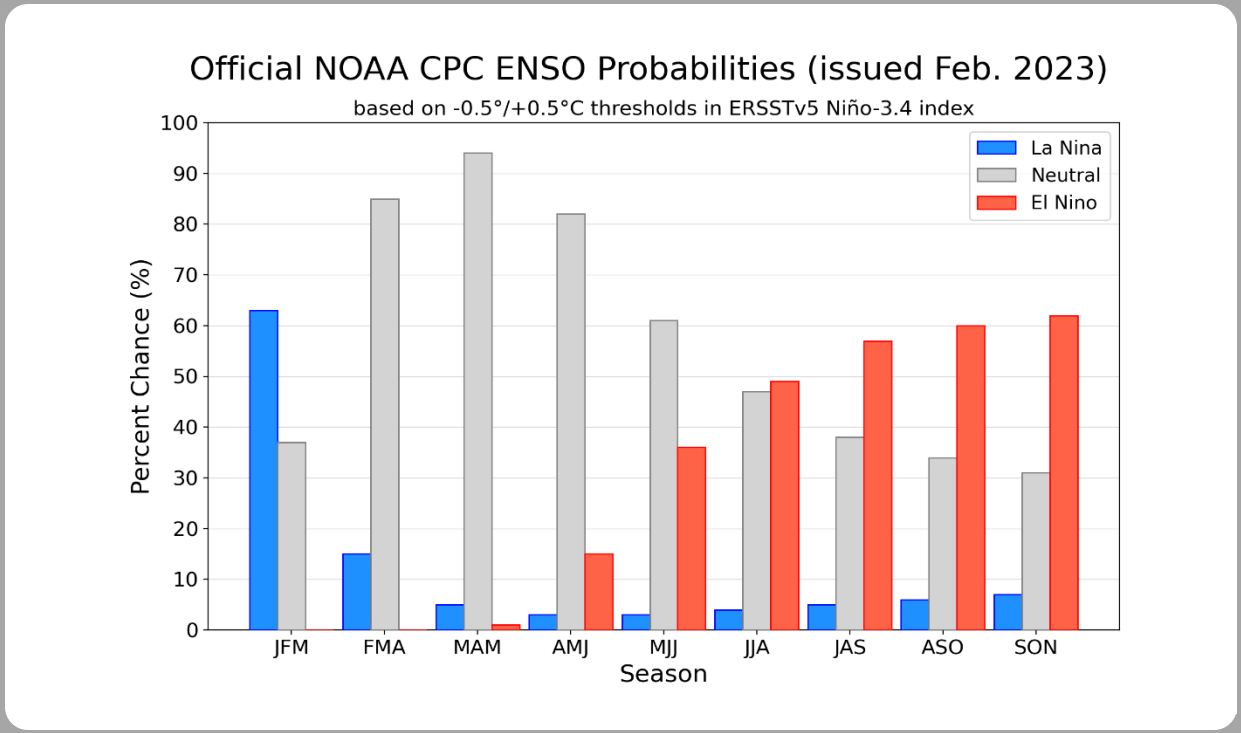
The ONI is one measure of the El Niño-Southern Oscillation, and other indices can confirm whether features consistent with a coupled ocean-atmosphere phenomenon accompanied these periods. The complete table going back to DJF 1950 can be found here.

Year	DJF	JFM	FMA	MAM	AMJ	MJJ	JJA	JAS	ASO	SON	OND	NDJ
2010	1.5	1.2	0.8	0.4	-0.2	-0.7	-1.0	-1.3	-1.6	-1.6	-1.6	-1.6
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

CPC Probabilistic ENSO Outlook

Updated: 9 February 2023

A transition from La Niña to ENSO-neutral is very likely during the February-April 2023 season, with ENSO-neutral persisting through the Northern Hemisphere early summer 2023. During the summer, there is a chance of a transition to El Niño.



IRI Pacific Niño 3.4 SST Model Outlook

By February-April 2023, most models indicate the return of ENSO-neutral. By May-July, the dynamical models suggest a potential return to El Niño, while the statistical models indicate the continuation of ENSO-neutral through the Northern Hemisphere summer.

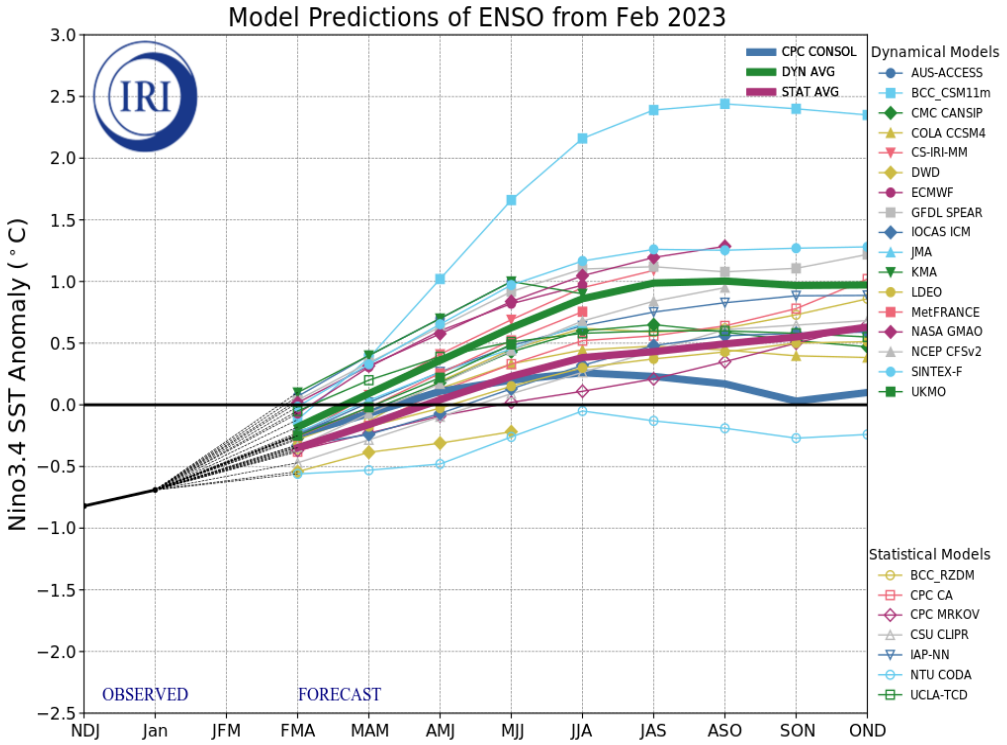
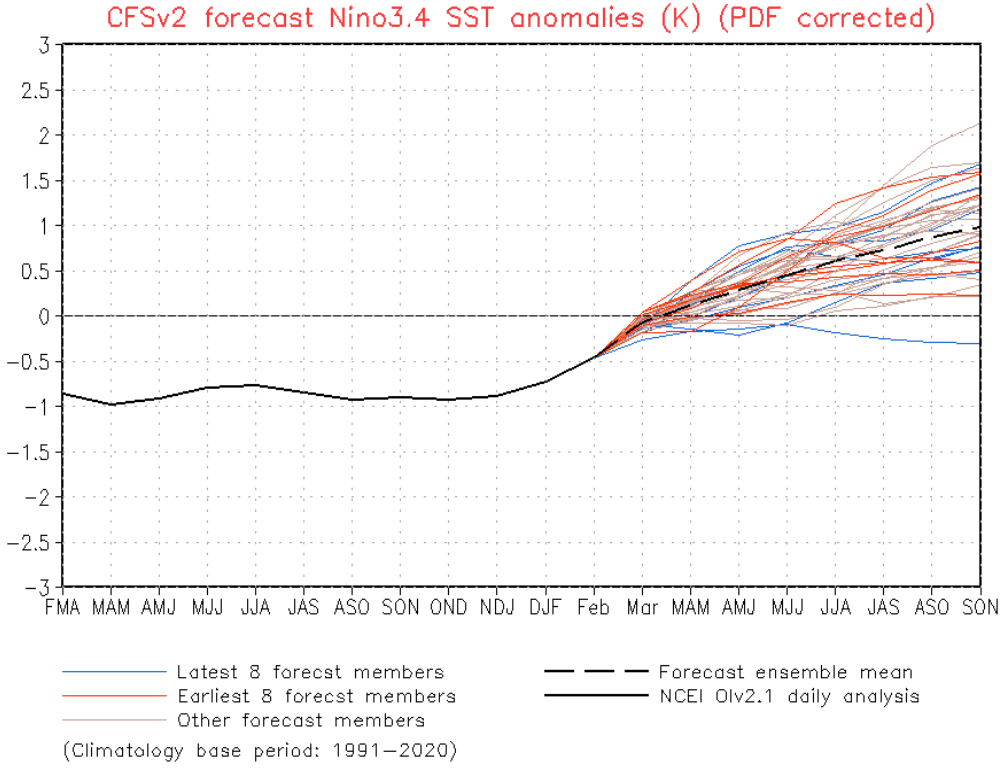


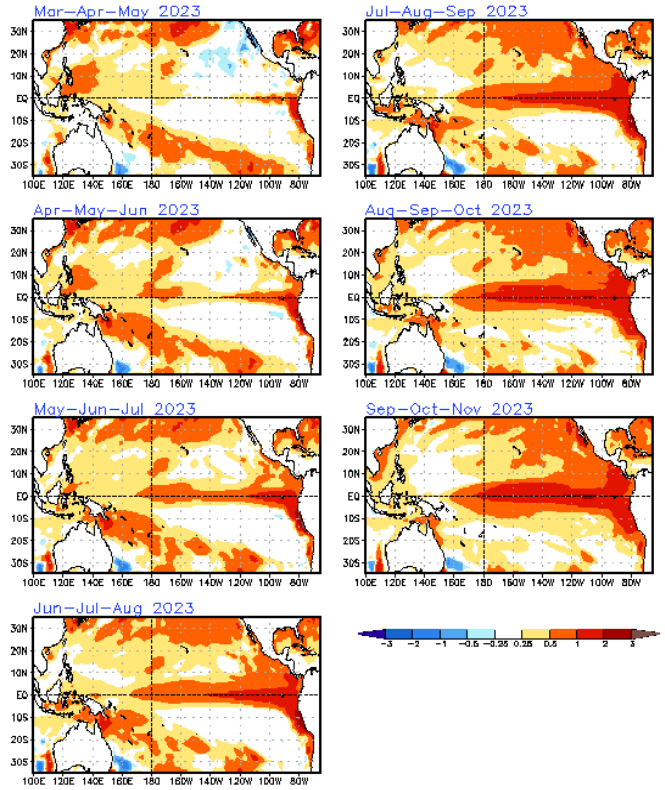
Figure provided by the International Research Institute (IRI) for Climate and Society (updated 19 February 2023).

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

Issued: 27 February 2023

The CFS.v2 ensemble mean (black dashed line) indicates ENSO-neutral is expected by March 2023 and then may continue into the Northern Hemisphere early summer, before potentially transitioning to El Niño.

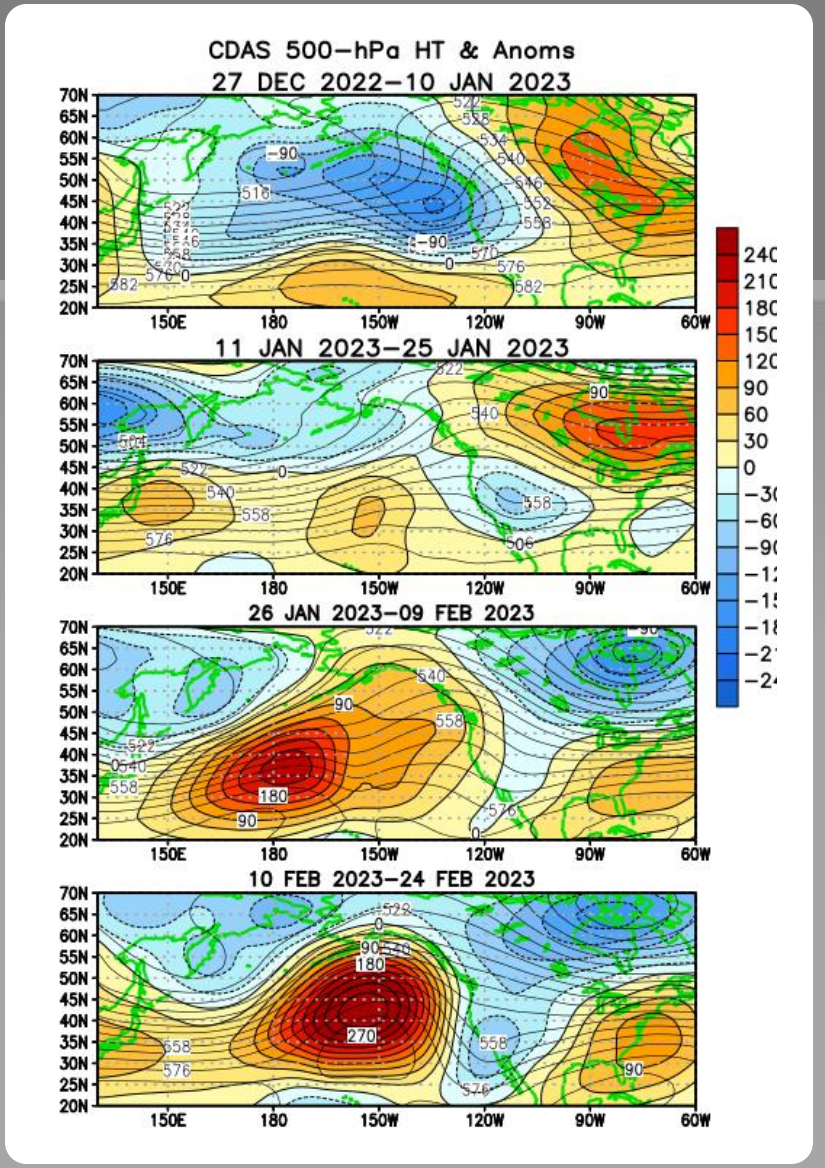




Atmospheric anomalies over the North Pacific and North America During the Last 60 Days

During late December through mid-January, an anomalous trough dominated the North Pacific Ocean, along with an extended jet stream. Downstream of the trough, above-average heights and temperatures were evident.

Since mid-January, an anomalous ridge and retracted jet stream were evident over the North Pacific Ocean. A downstream anomalous trough was associated with below-average temperatures over the western U.S., while above-average heights/temperatures persisted over the eastern U.S.



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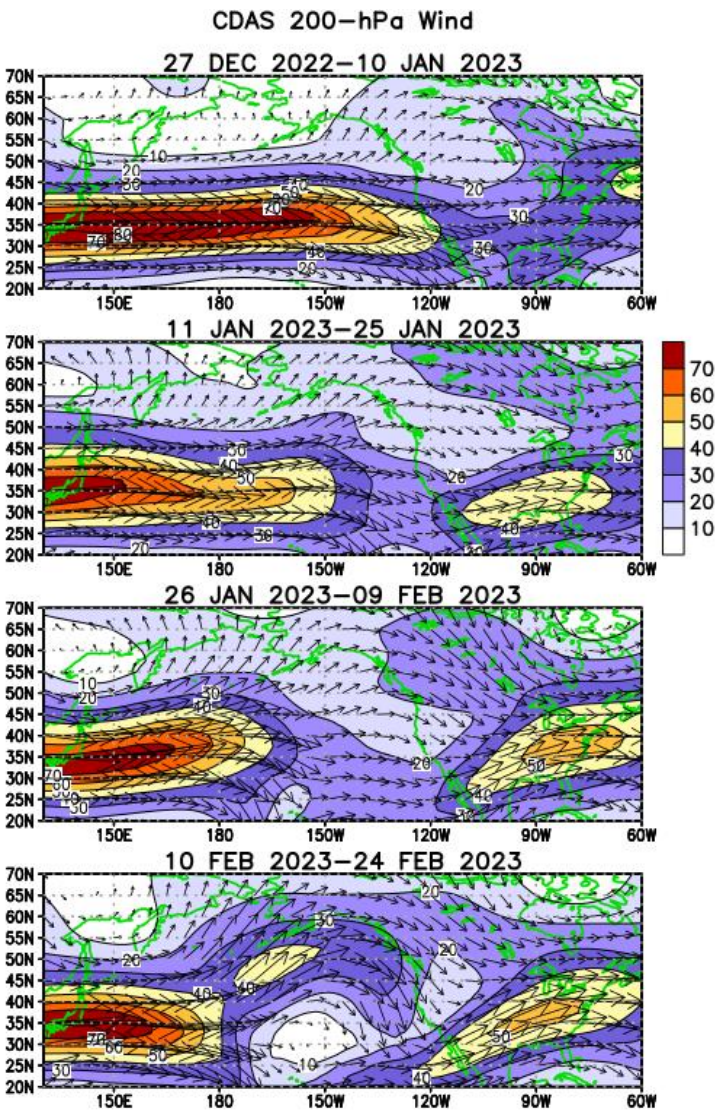

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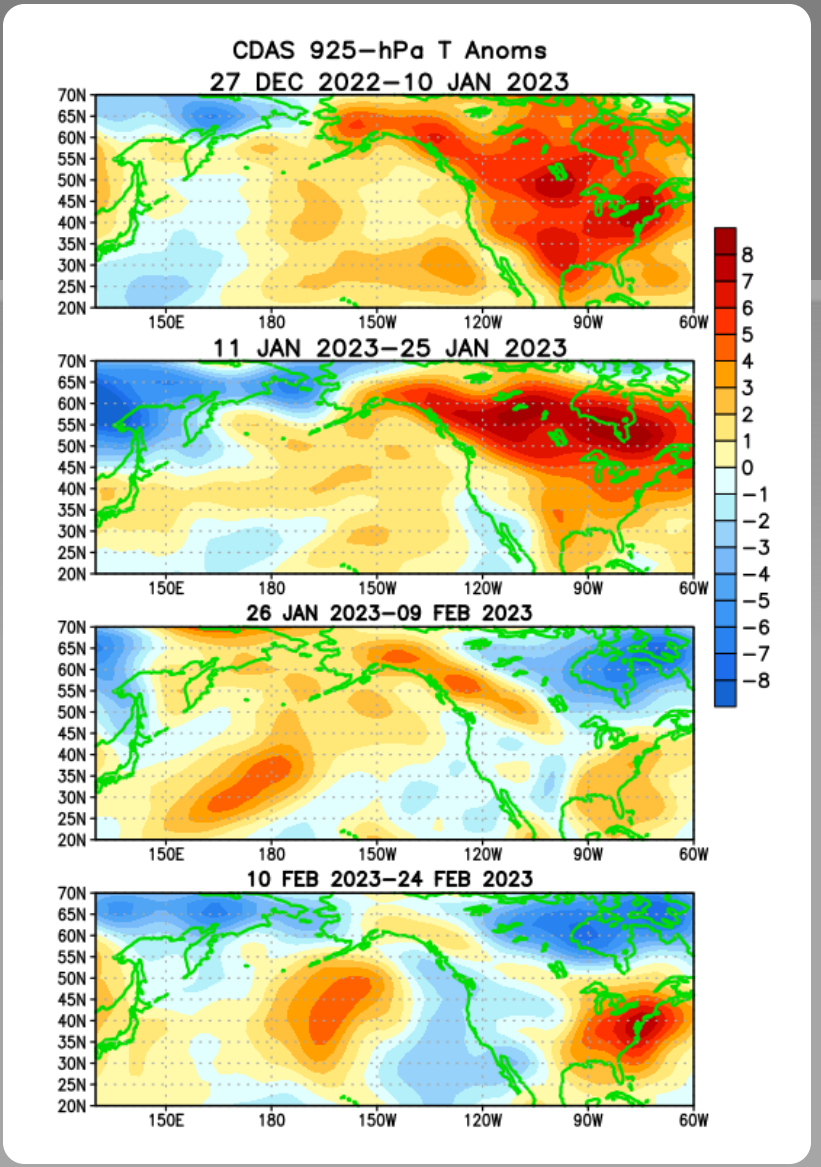
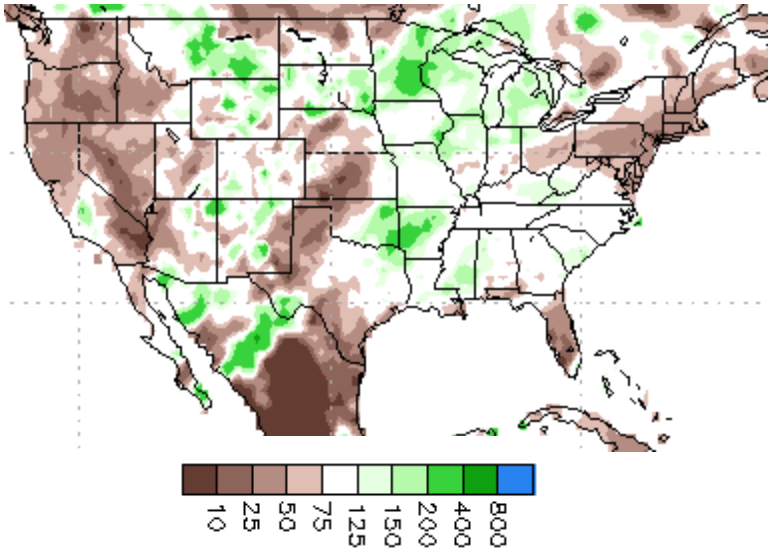


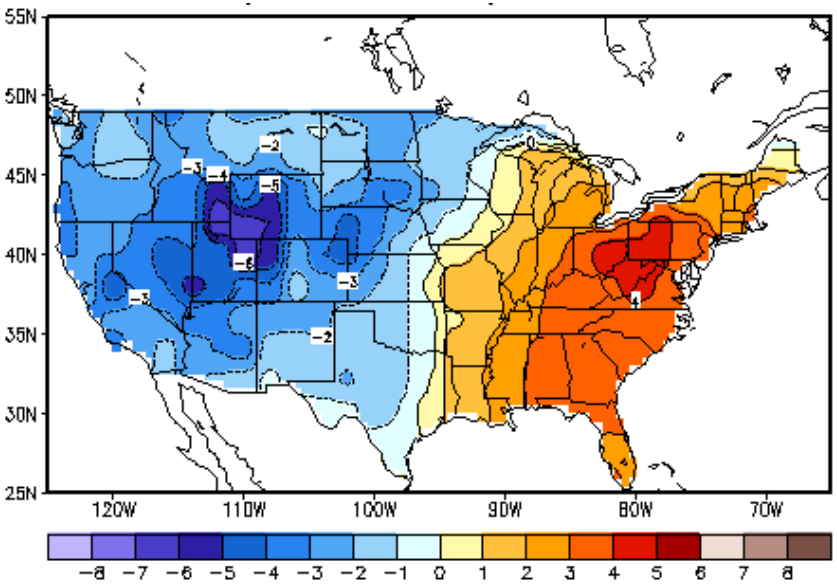
U.S. Temperature and Precipitation Departures During the Last 30 Days

End Date: 25 February 2023

Percent of Average Precipitation



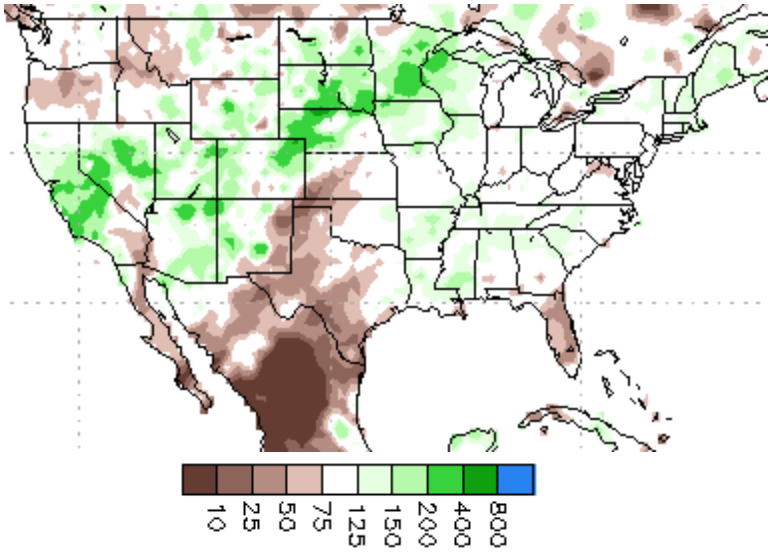
Temperature Departures (degree C)



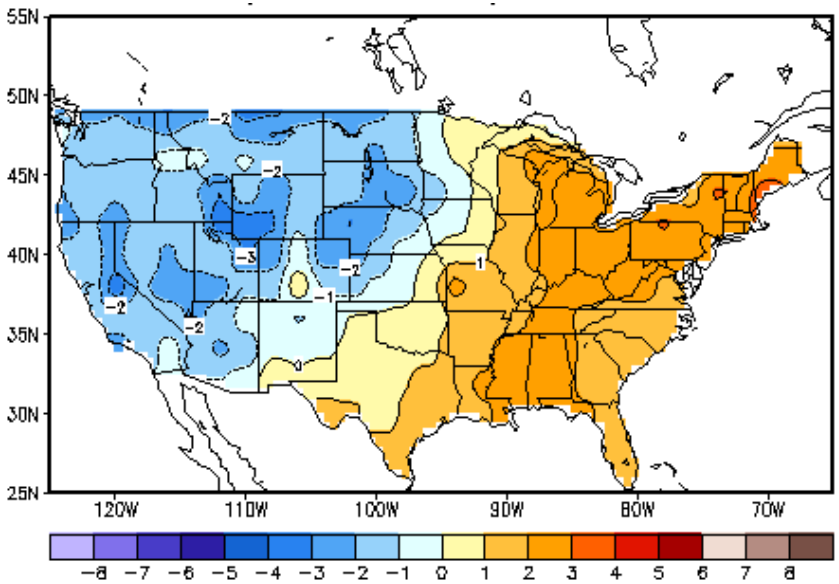
U.S. Temperature and Precipitation Departures During the Last 90 Days

End Date: 25 February 2023

Percent of Average Precipitation



Temperature Departures (degree C)

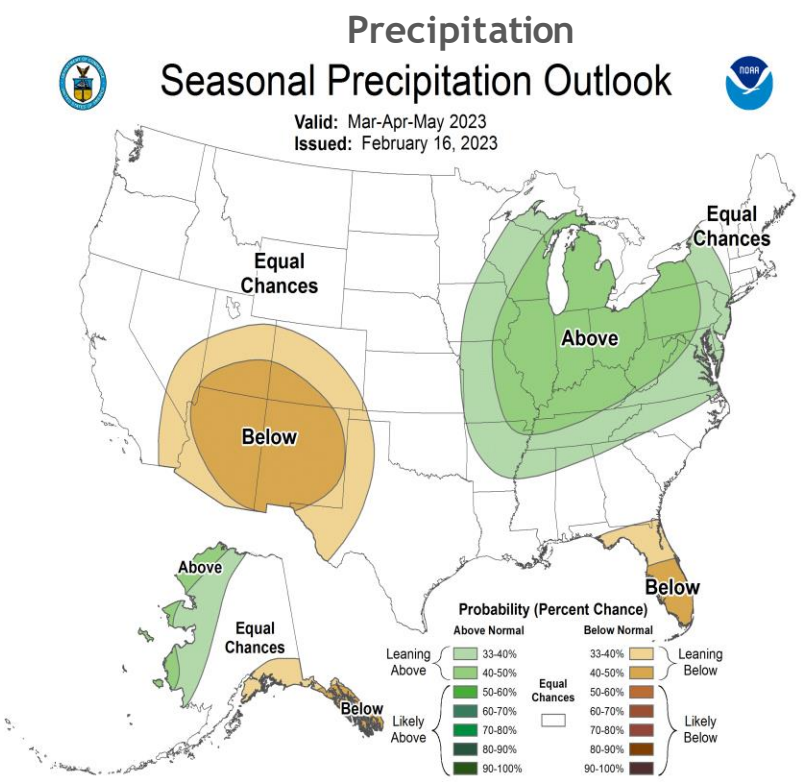


U. S. Seasonal Outlooks

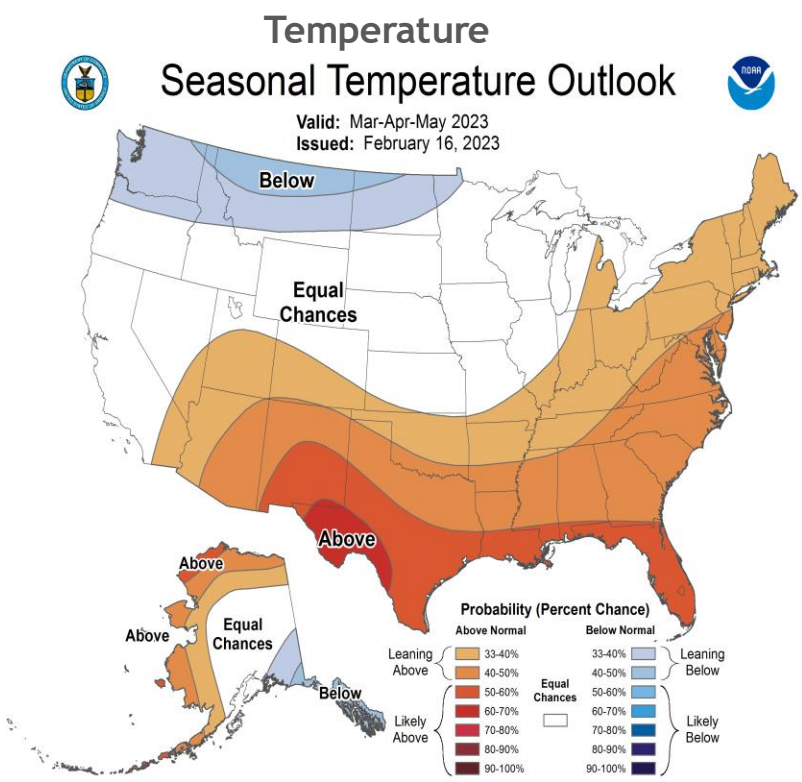
March - May 2023

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

Precipitation



Temperature



Summary

ENSO Alert System Status: **La Niña Advisory**

La Niña is present.*

Equatorial sea surface temperatures (SSTs) are below average across most of the Pacific Ocean.

The tropical Pacific atmosphere is consistent with La Niña.

ENSO-neutral conditions are expected to begin within the next couple of months, and persist through the Northern Hemisphere spring and early summer.*

* 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.