ENSO: Recent Evolution, Current Status and Predictions

Update prepared by:
Climate Prediction Center / NCEP
8 July 2024

Outline

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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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Summary

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

ENSO-neutral conditions are present.*

Equatorial sea surface temperatures (SSTs) are above average in the west-central Pacific Ocean, near average in the east-central Pacific Ocean, and below-average in the far eastern Pacific Ocean.

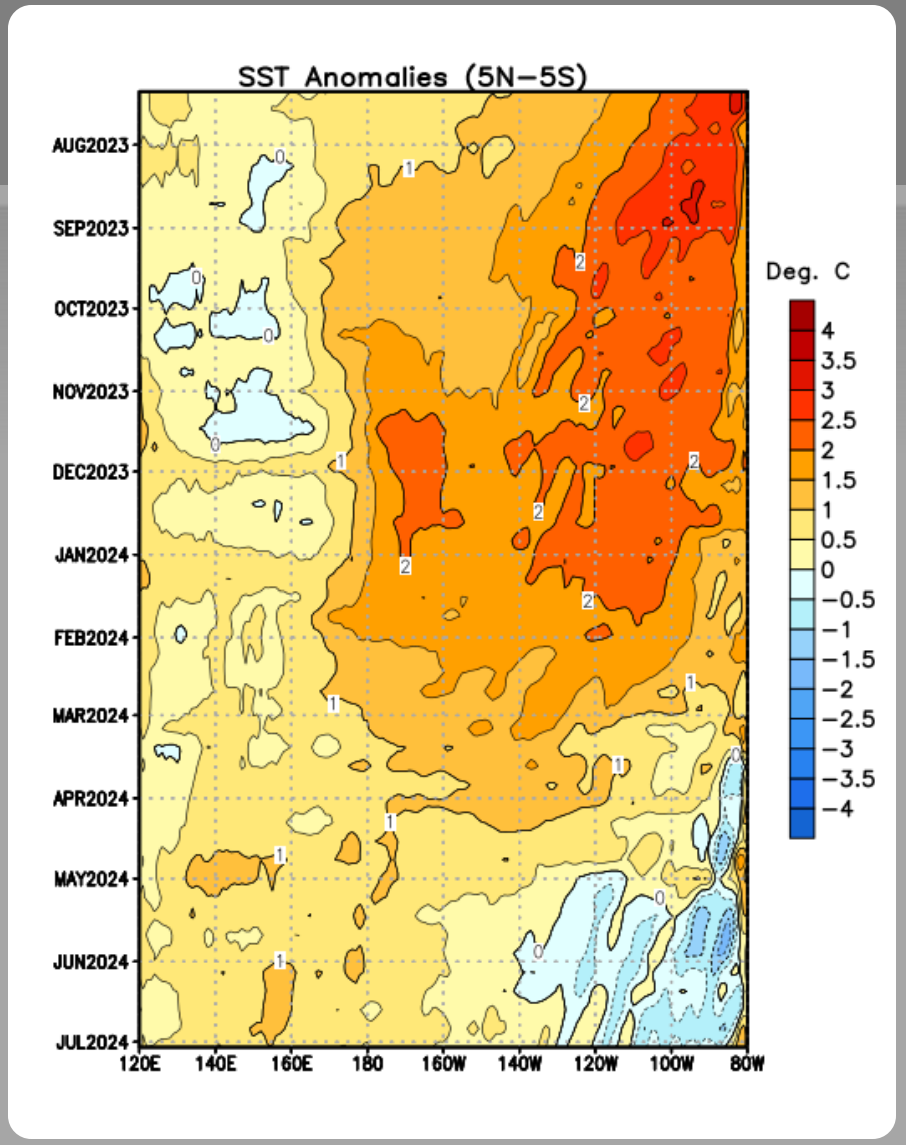
La Niña is favored to develop during July-September (65% chance) and persist into the Northern Hemisphere winter 2024-25 (85% chance during November-January).*

* 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)

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.

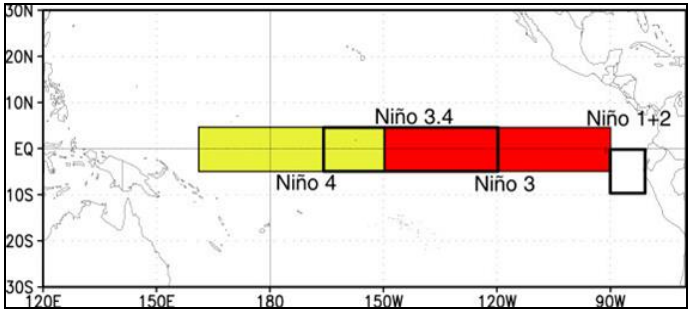
Since mid March 2024, below-average SSTs have emerged in the eastern Pacific and expanded slightly westward. This area weakened and contracted slightly in June 2024.

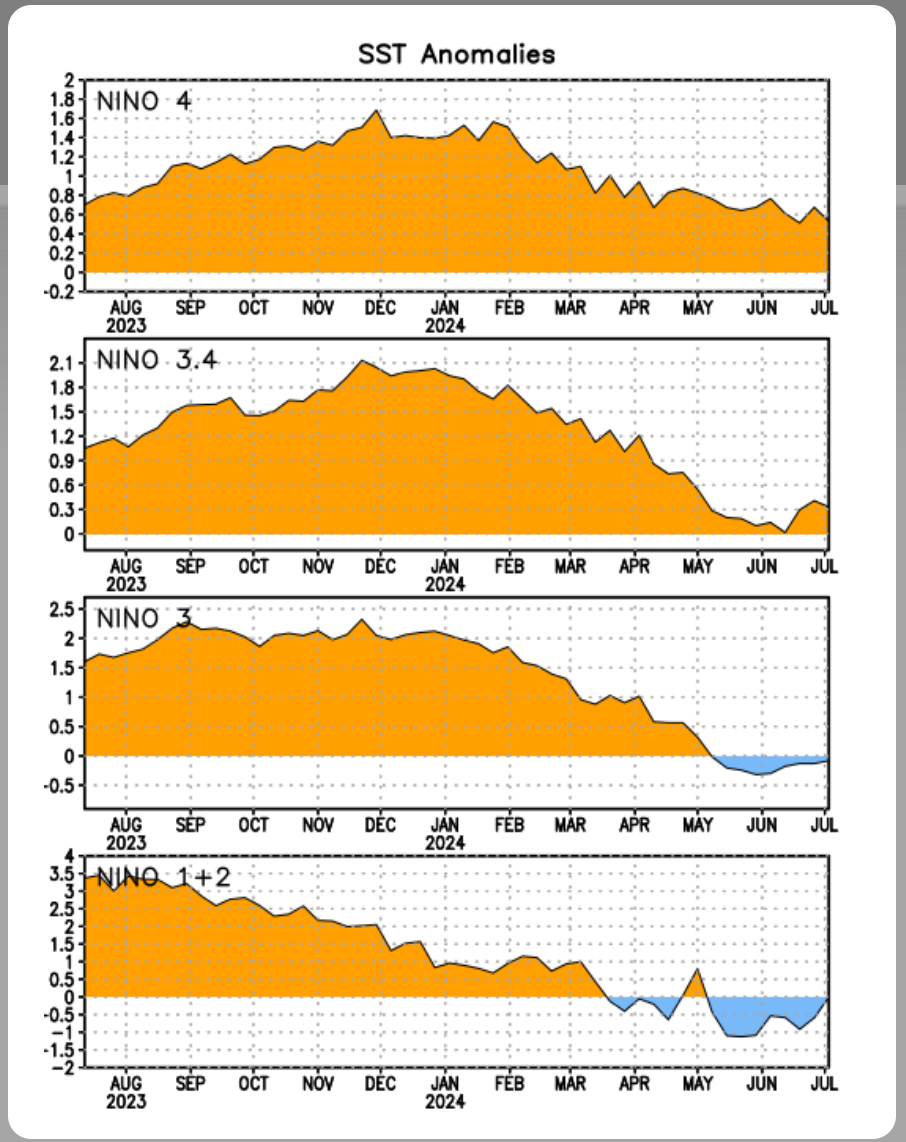


Niño Region SST Departures (ºC) Recent Evolution

The latest weekly SST departures are:

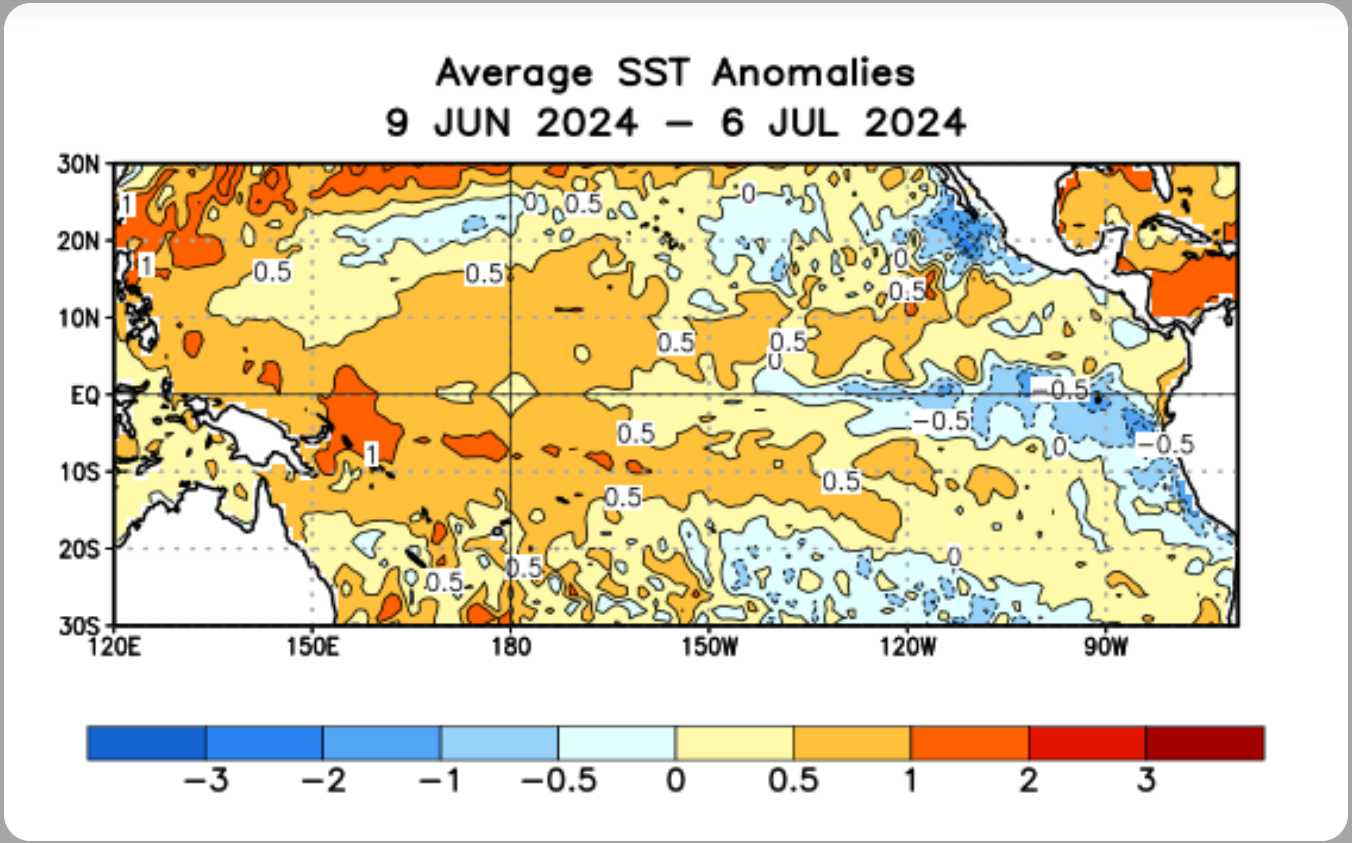
Niño 4	0.5ºC
Niño 3.4	0.3ºC
Niño 3	-0.1ºC
Niño 1+2	0.0ºC





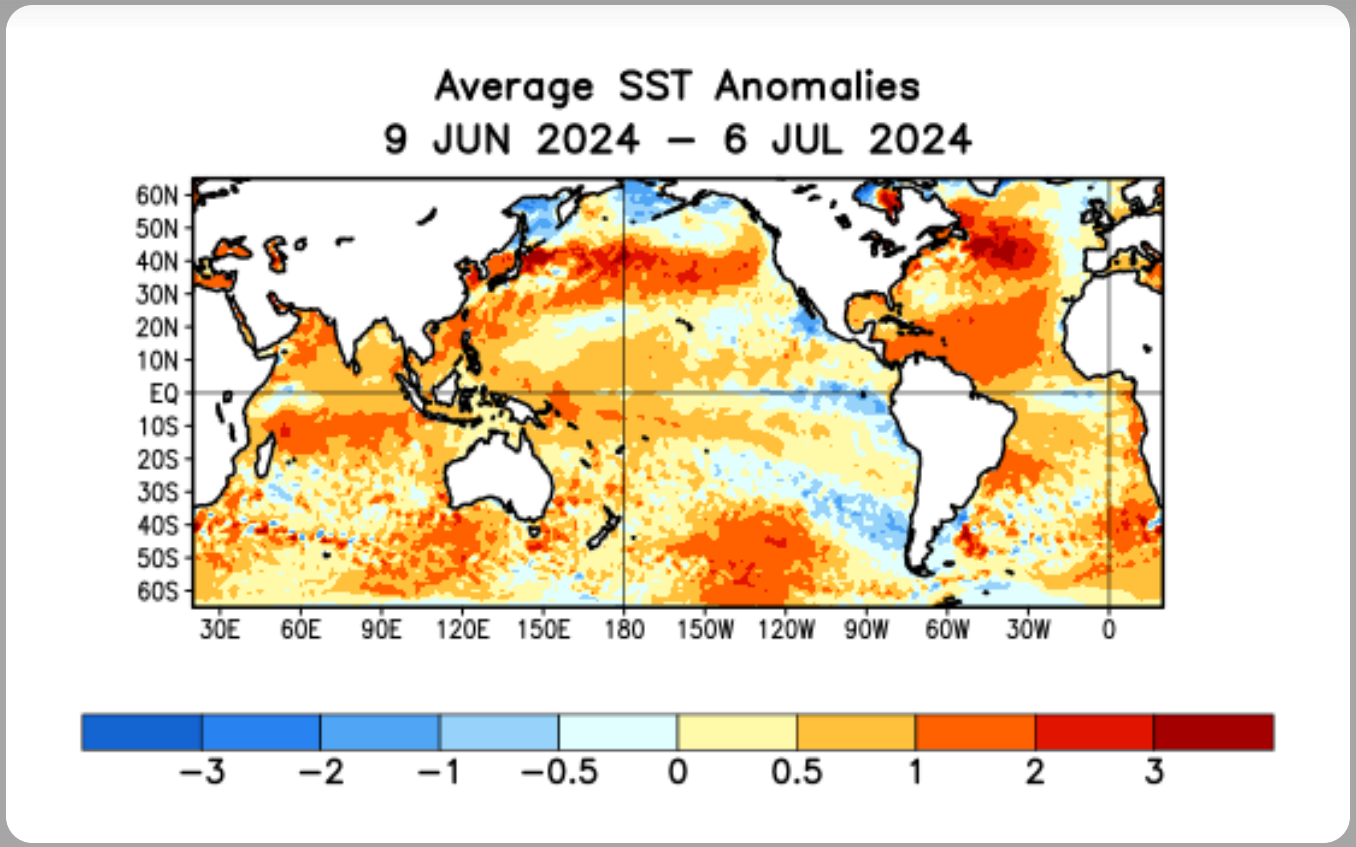
SST Departures (°C) in the Tropical Pacific During the Last Four Weeks

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



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

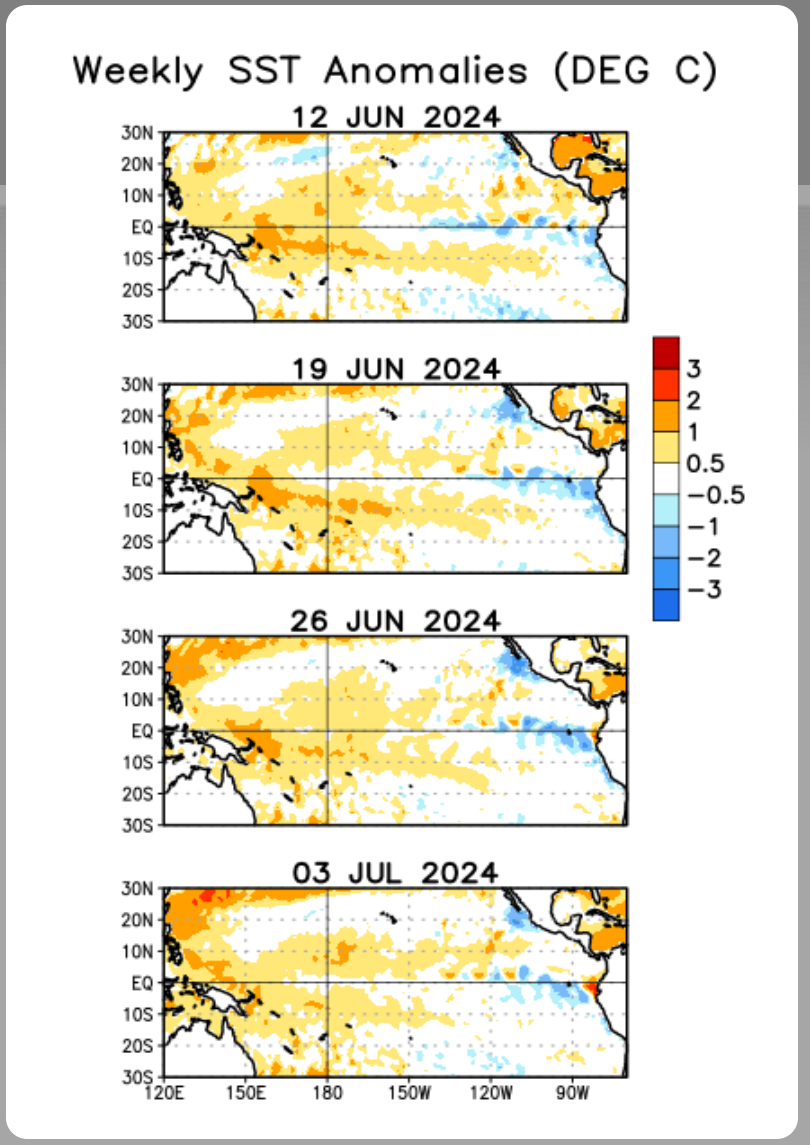
During the last four weeks, equatorial SSTs were above average across the west-central Pacific Ocean and around the Maritime Continent. Near-to-below-average SSTs were evident in the east-central and eastern Pacific Ocean.



Weekly SST Departures during the Last Four Weeks

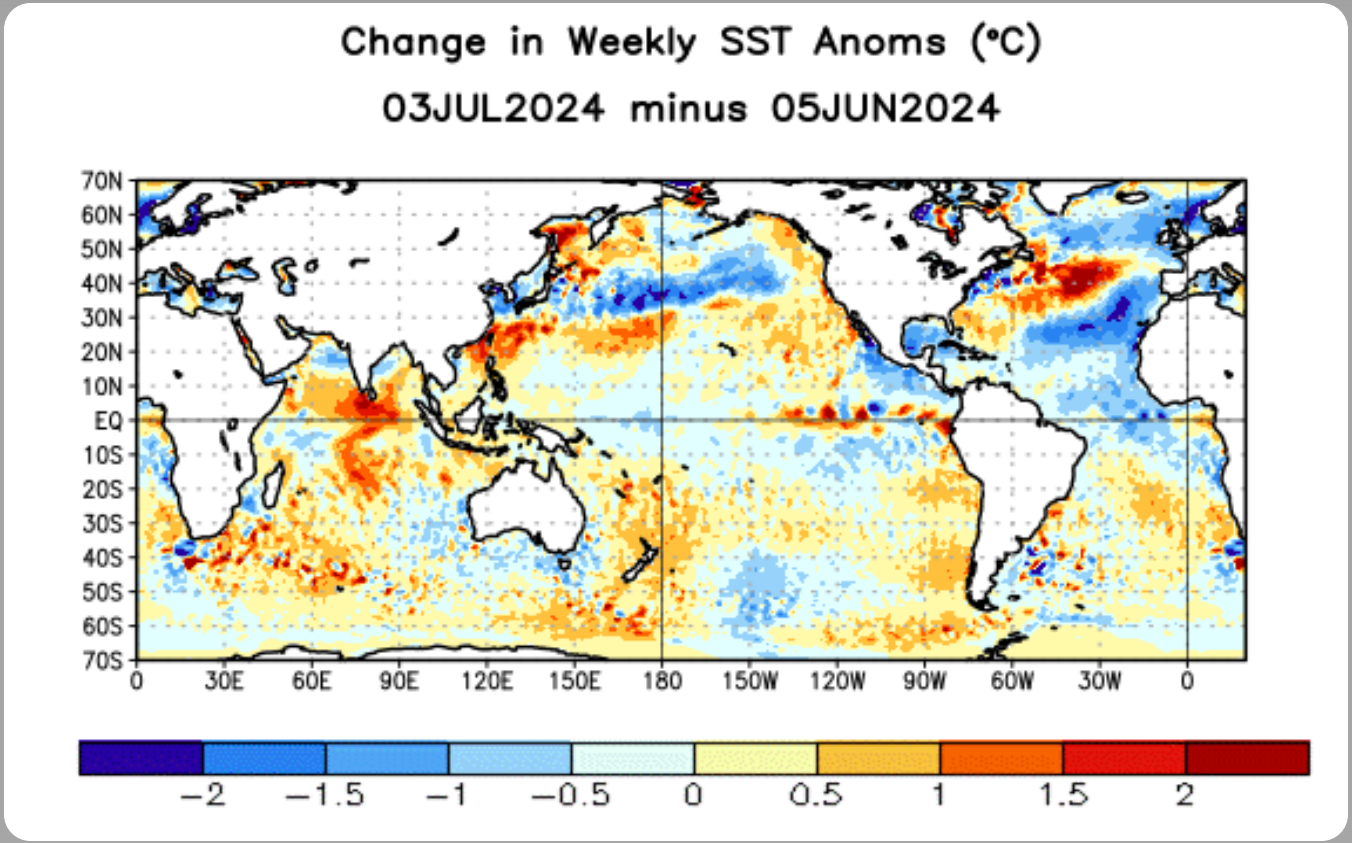
During the last 4 weeks, below-average SSTs persisted in the eastern Pacific Ocean, while above-average SSTs persisted in the western Pacific.

SSTs have varied from below-average to near average in the east-central Pacific Ocean.



Change in Weekly SST Departures over the Last Four Weeks

During the last four weeks, mostly positive SST anomaly changes were observed in the east-central and eastern equatorial Pacific Ocean. Negative changes were evident near the Date Line.



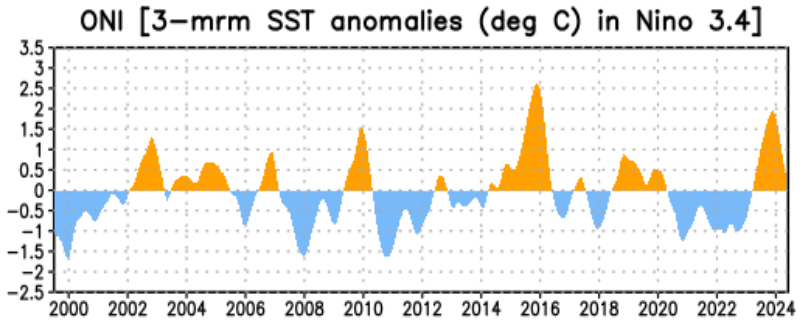
Upper-Ocean Conditions in the Equatorial Pacific

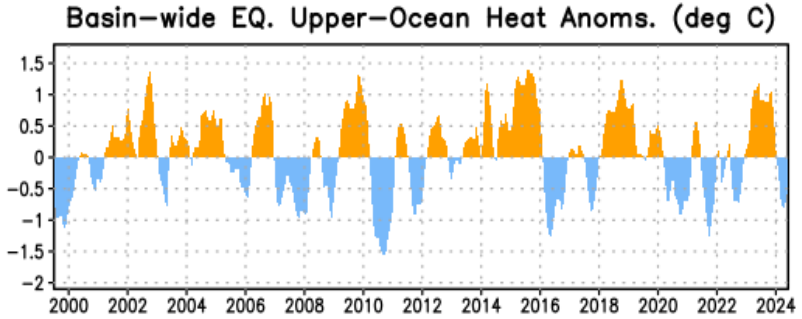
The basin-wide equatorial upper ocean (0-300 m) heat content is greatest prior to and during the early stages of a Pacific warm (El Niño) episode (compare top 2 panels), and least prior to and during the early stages of a cold (La Niña) episode.

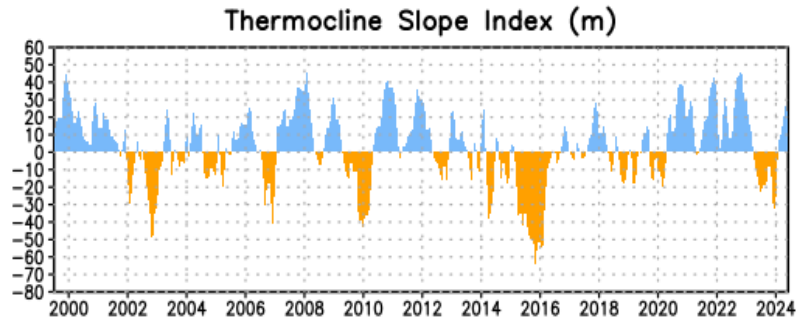
The slope of the oceanic thermocline is least (greatest) during warm (cold) episodes.

Recent values of the upper-ocean heat anomalies (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).

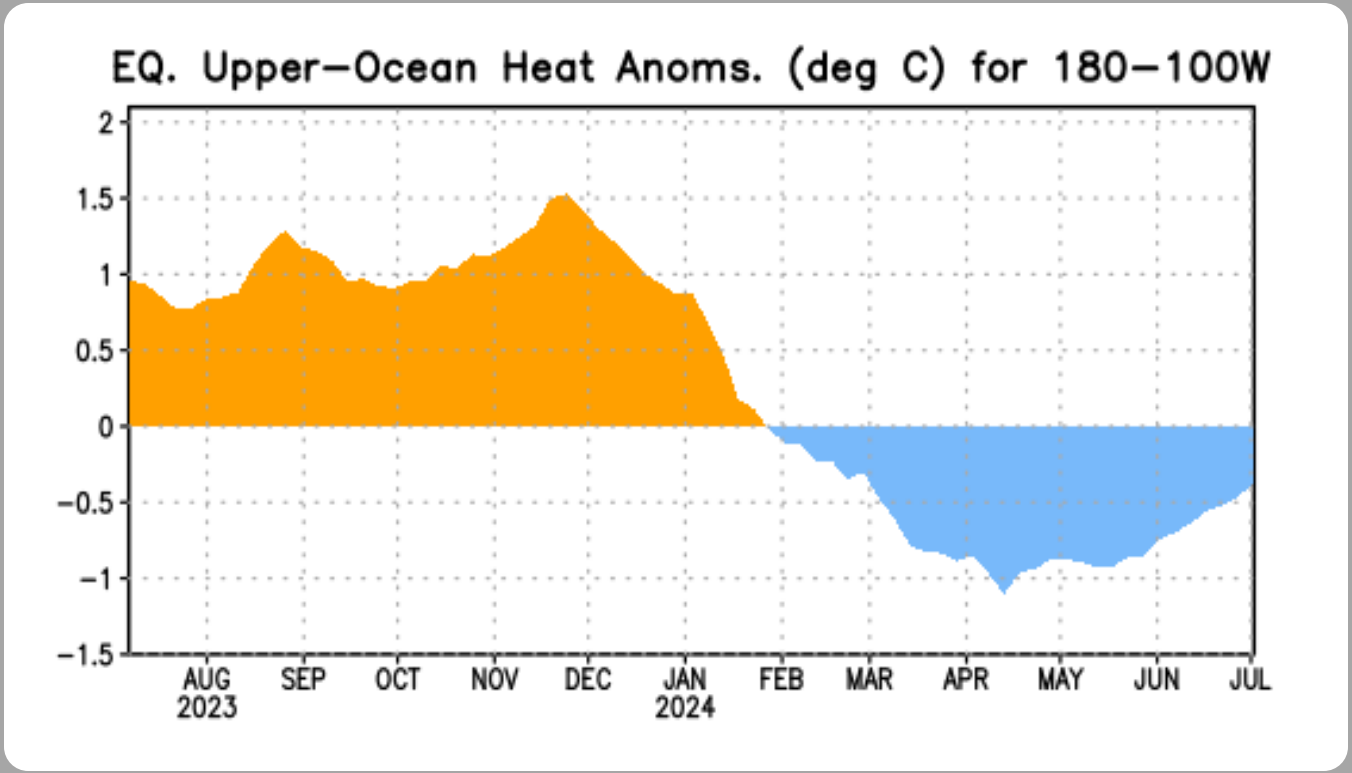






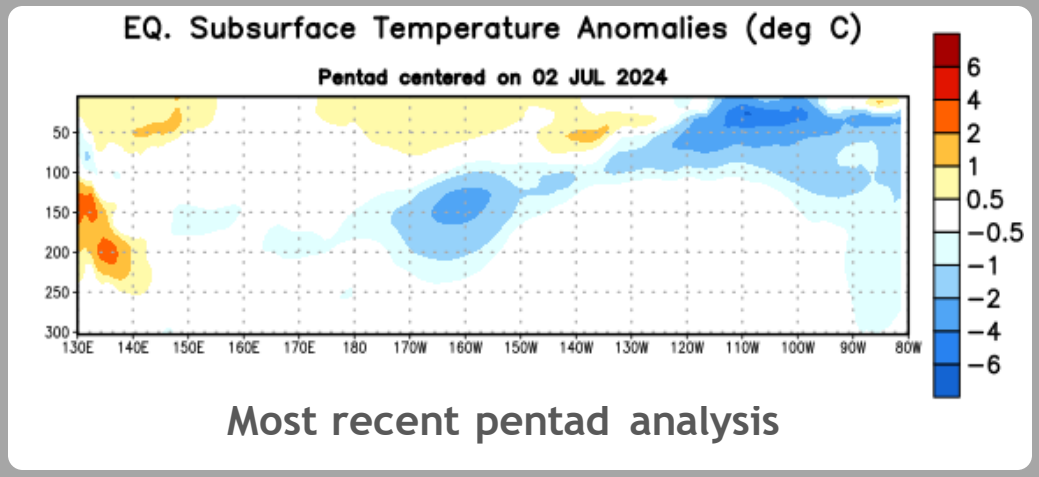
Central and Eastern Pacific Upper-Ocean (0-300 m) Weekly Average Temperature Anomalies

Positive subsurface temperature anomalies persisted through mid-January 2024. Variability in the positive anomalies was associated with several oceanic Kelvin waves. Starting in November 2023, positive subsurface temperature anomalies weakened to near zero. From late January to mid-April 2024, negative temperature anomalies emerged and strengthened. Over the last month, negative anomalies have weakened.



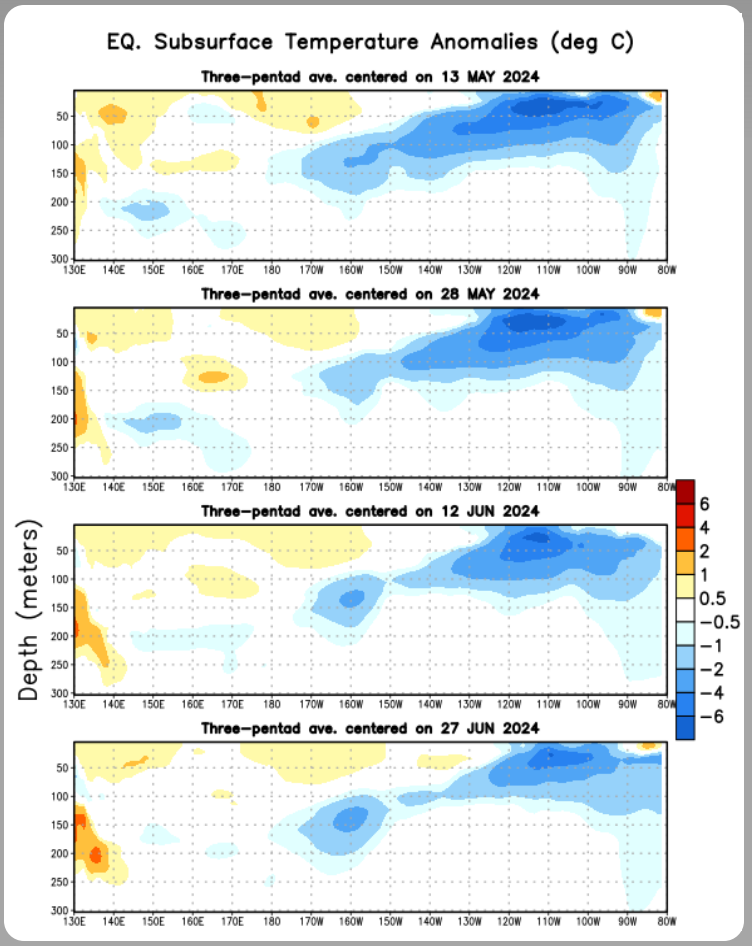
Sub-Surface Temperature Departures in the Equatorial Pacific

Over the last couple months, negative subsurface temperature anomalies have persisted in the eastern equatorial Pacific Ocean and extend to the surface.



Most recent pentad analysis

Below-average temperatures remain at depth in the central Pacific Ocean, with slightly above-average temperatures near the surface.

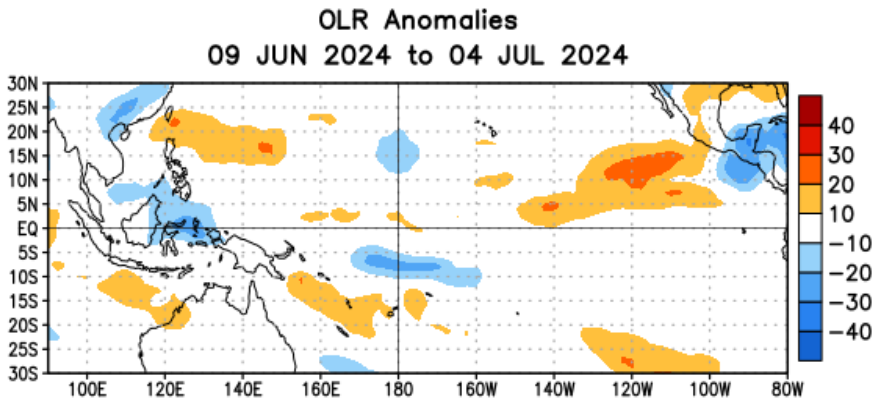


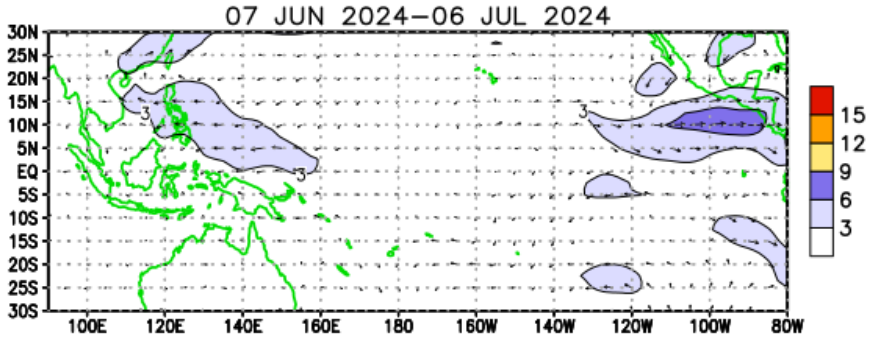
Tropical OLR and Wind Anomalies During the Last 30 Days

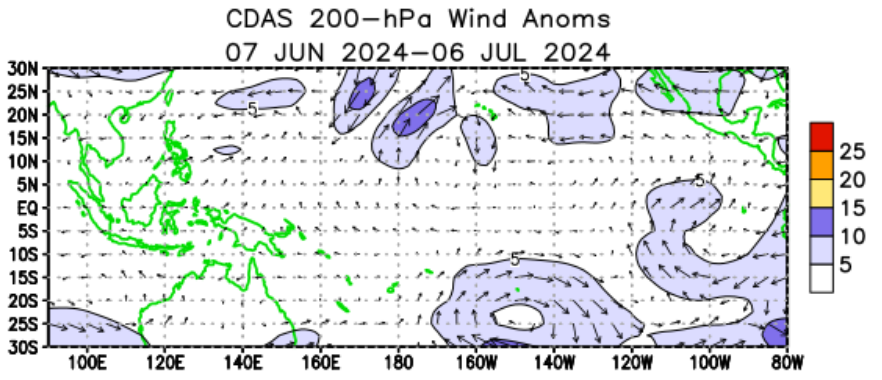
OLR is near-average across the western and central equatorial Pacific, while weak, below-average OLR (enhanced convection and precipitation) was observed around Borneo and parts of Indonesia.

Weak, low-level (850-hPa) wind anomalies were easterly across the western equatorial Pacific Ocean.

Upper-level (200-hPa) wind anomalies were westerly over the eastern 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

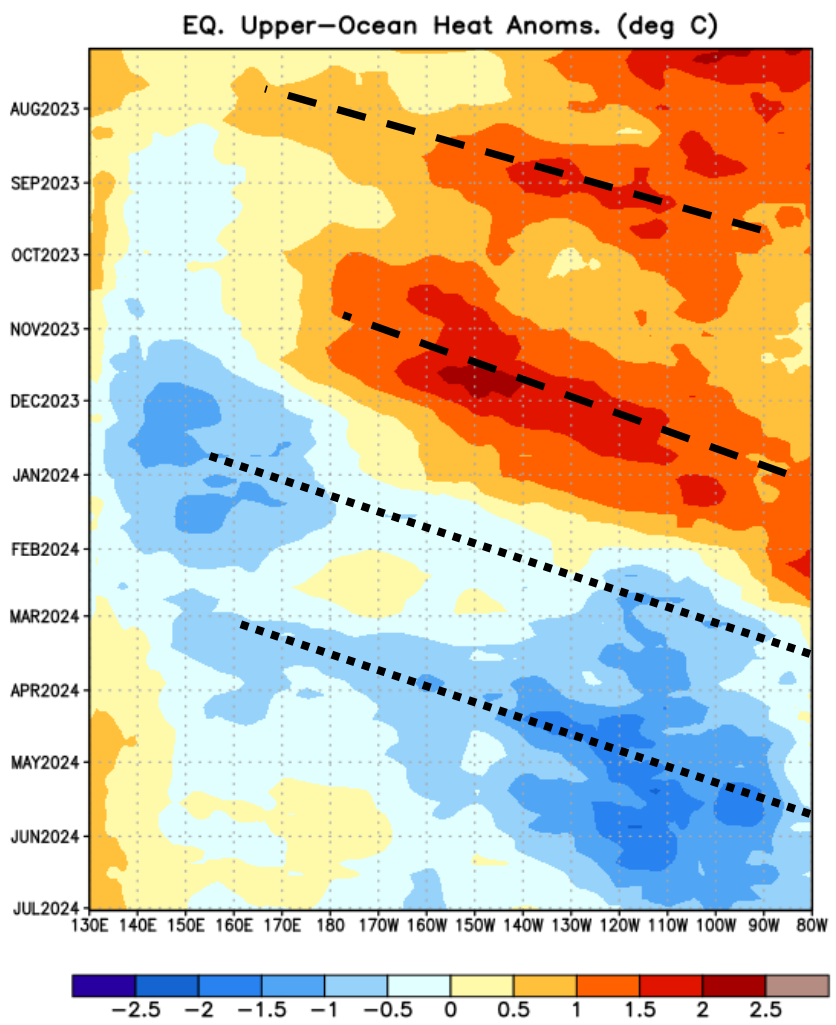
Significant equatorial oceanic Kelvin wave activity (dashed and dotted lines) has been present throughout the period shown.

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

Since December 2023, two upwelling Kelvin waves have shifted eastward.

Since March 2024, below-average subsurface temperatures have persisted in the eastern Pacific, but are gradually weakening in 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})

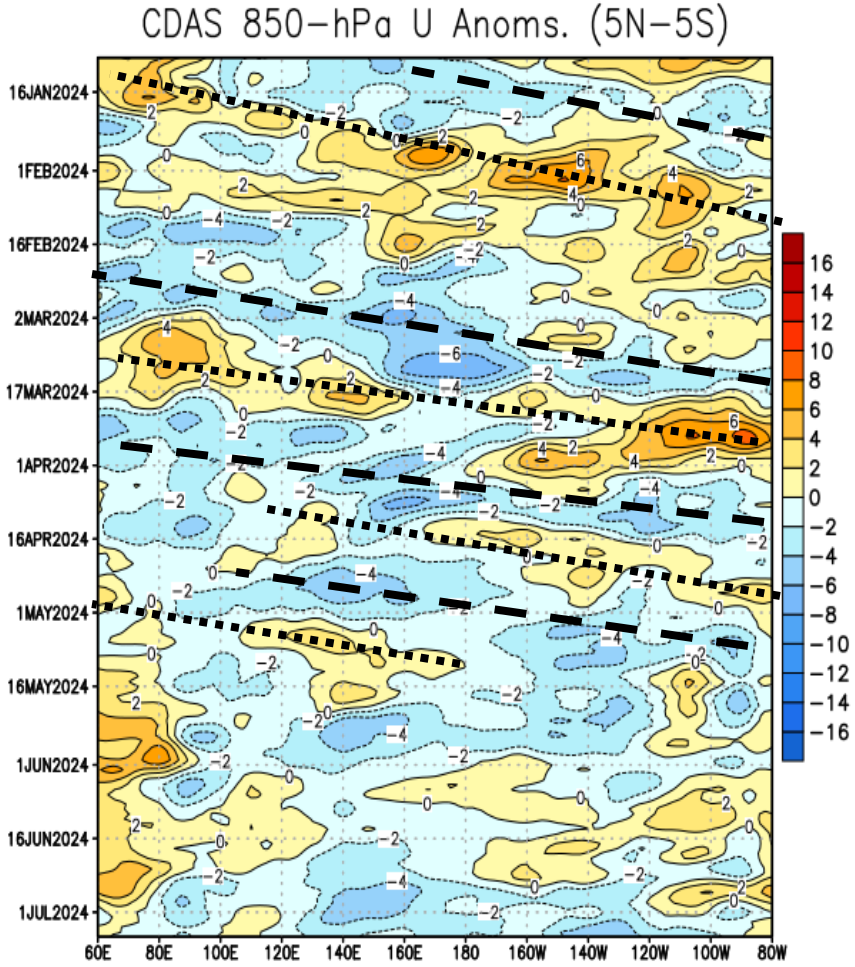
At times, the Madden Julian-Oscillation (MJO) has contributed to the eastward propagation of low-level wind anomalies.

An eastward propagating pattern of westerly and easterly wind anomalies was evident starting in November 2023. Since early May 2024, this pattern has weakened.

During June 2024, westerly wind anomalies persisted over the east-central Pacific.

Recently, easterly wind anomalies have strengthened across most of the Pacific.

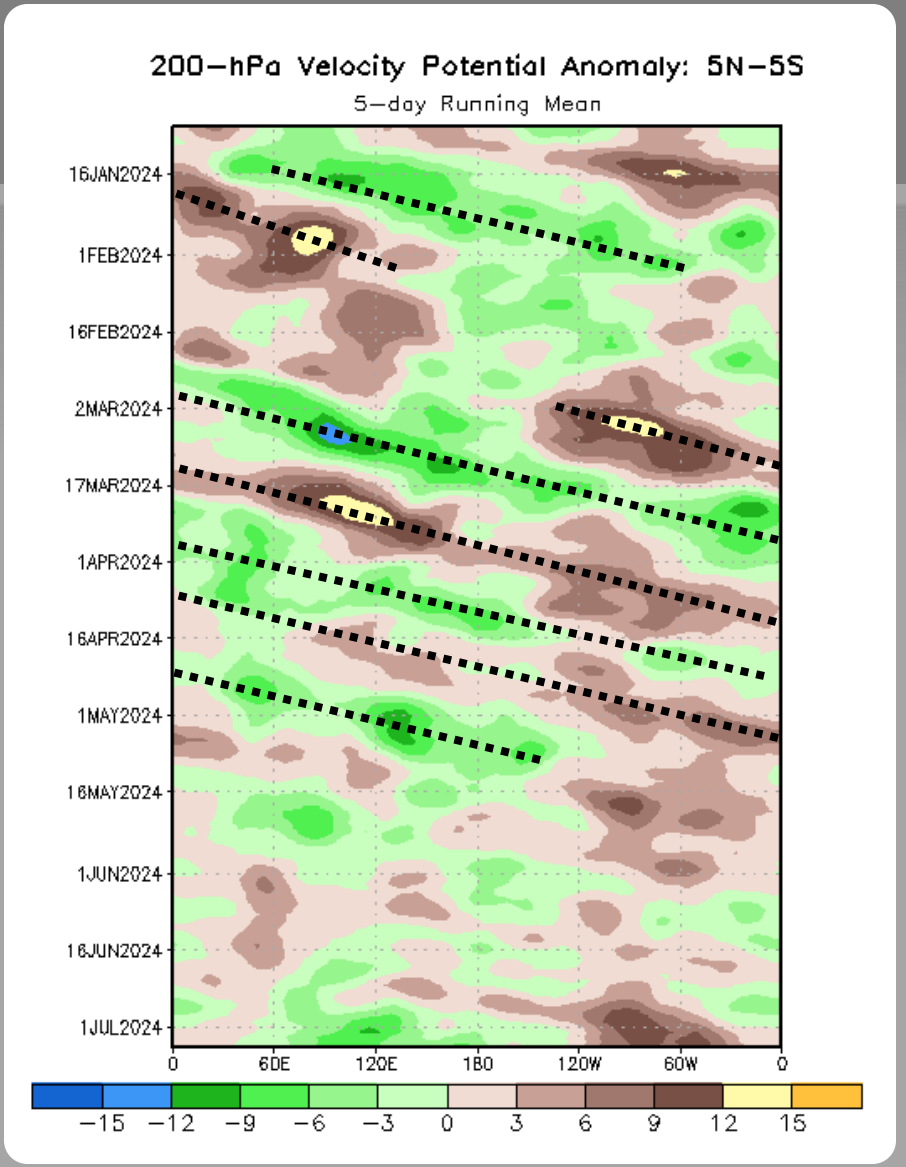
Westerly Wind Anomalies (orange/red shading)
Easterly Wind Anomalies (blue shading)



Upper-level (200-hPa) Velocity Potential Anomalies

From the beginning of the period, regions of anomalous divergence (green shading) and convergence (brown shading) were shifting eastward. Since early May 2024, this pattern has weakened.

From early December 2023 to mid-March 2024, anomalous divergence persisted over the 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

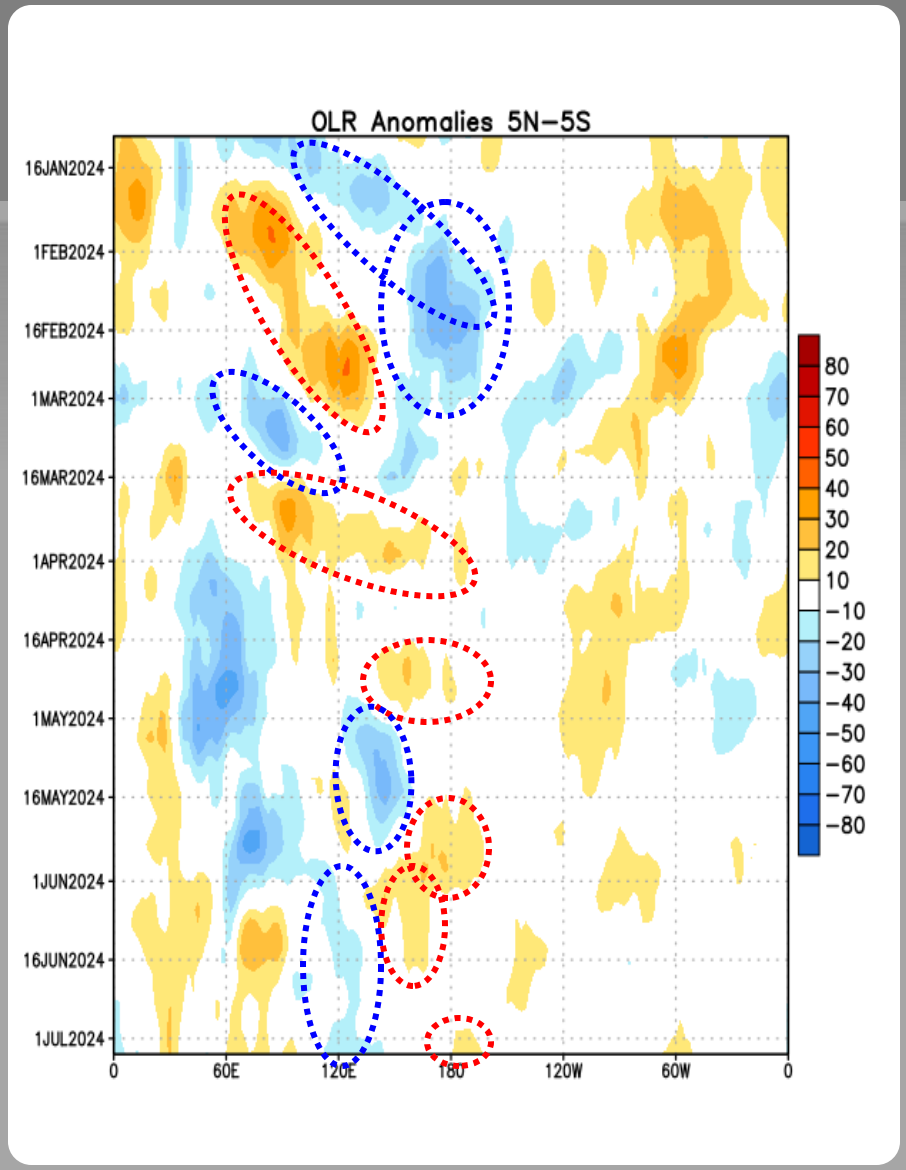
Through early March 2024, negative OLR anomalies (more convection) persisted over the central equatorial Pacific Ocean

From mid-December 2023 through March 2024, OLR anomalies shifted eastward from the Indian Ocean/Indonesia to the western Pacific/Date Line.

Since mid-May 2024, OLR has been either near-average or above-average (less convection) near the western Pacific or Date Line.

Since early June 2024, weak, negative anomalies were evident near 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 +0.5ºC.

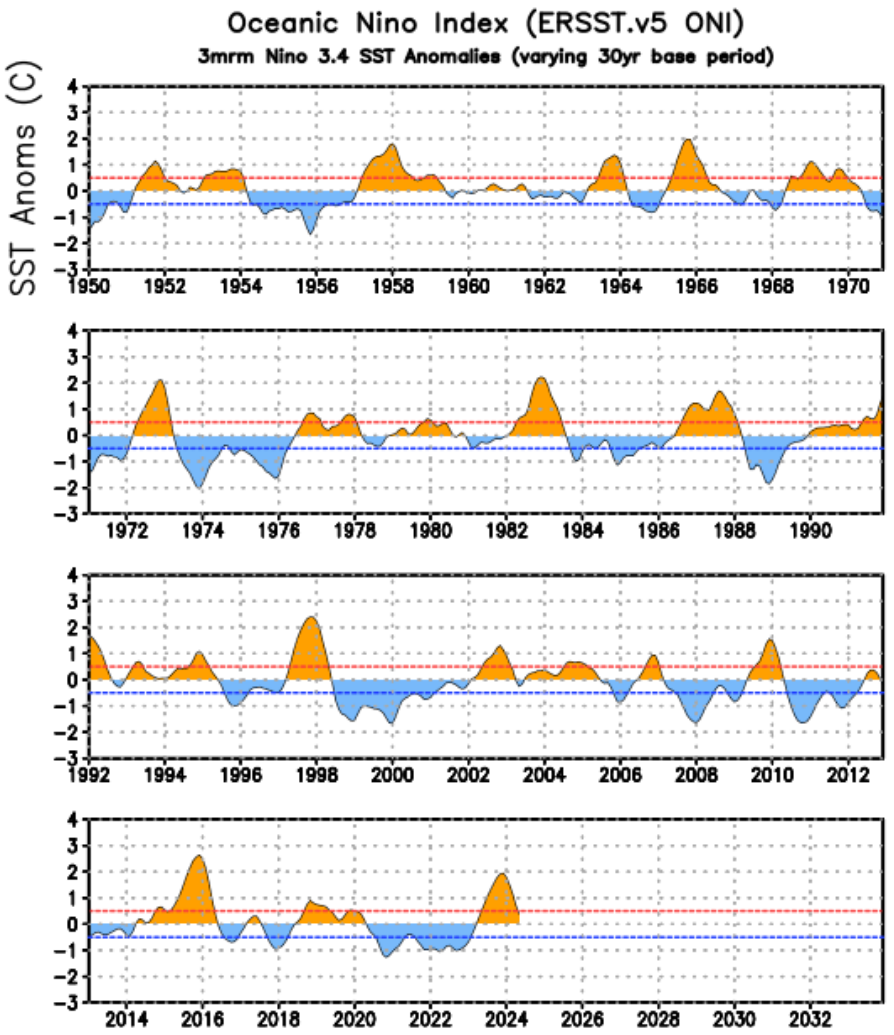
La Niña: characterized by a negative ONI less than or equal to -0.5ºC.

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 (April - June 2024) is 0.4°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.

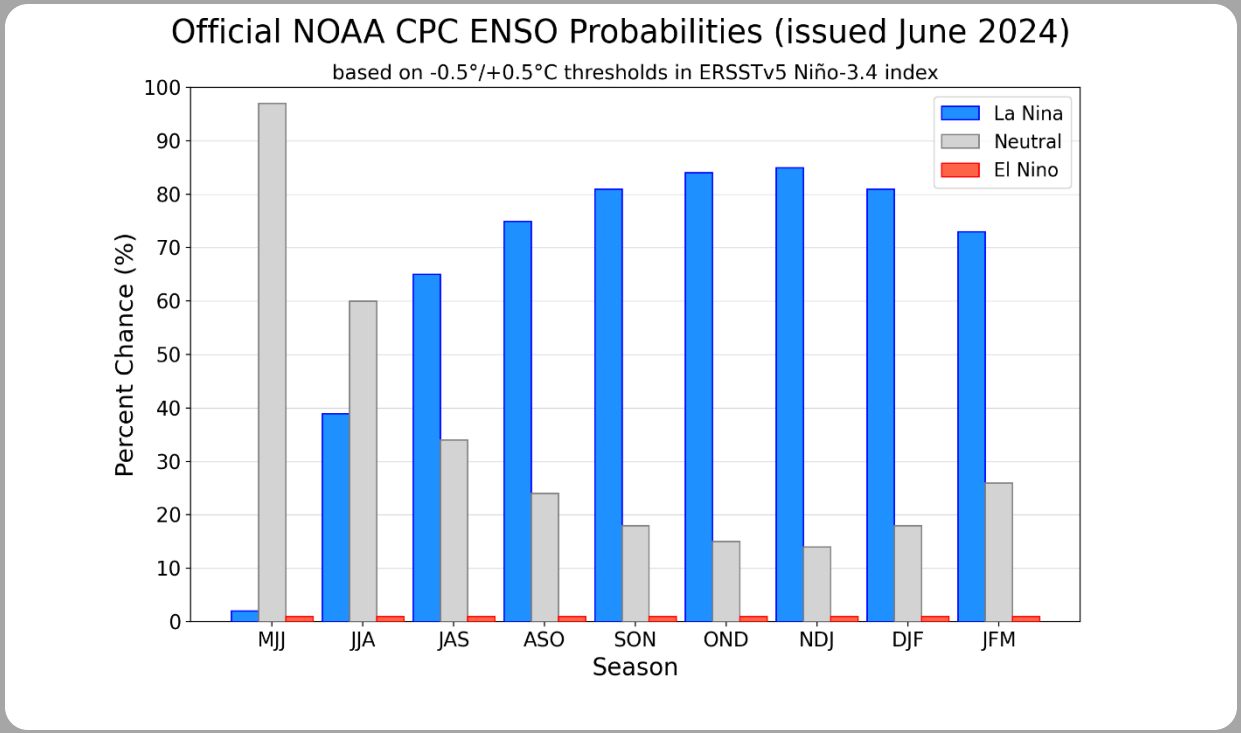
The ONI is one measure of the El Niño-Southern Oscillation, and other indices can confirm whether features consistent with a coupled ocean-atmosphere phenomenon accompanied these periods. The complete table going back to DJF 1950 can be found here.

Year	DJF	JFM	FMA	MAM	AMJ	MJJ	JJA	JAS	ASO	SON	OND	NDJ
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							

CPC Probabilistic ENSO Outlook

Updated: 13 June 2024

ENSO-neutral is favored in May-July and June-August 2024. La Niña may develop in July-September (65% chance) and persist through Northern Hemisphere winter 2024-25.



IRI Pacific Niño 3.4 SST Model Outlook

The majority of models indicate ENSO-neutral will persist through August-October 2024. Thereafter, most models indicate a transition to La Niña around September-November 2024.

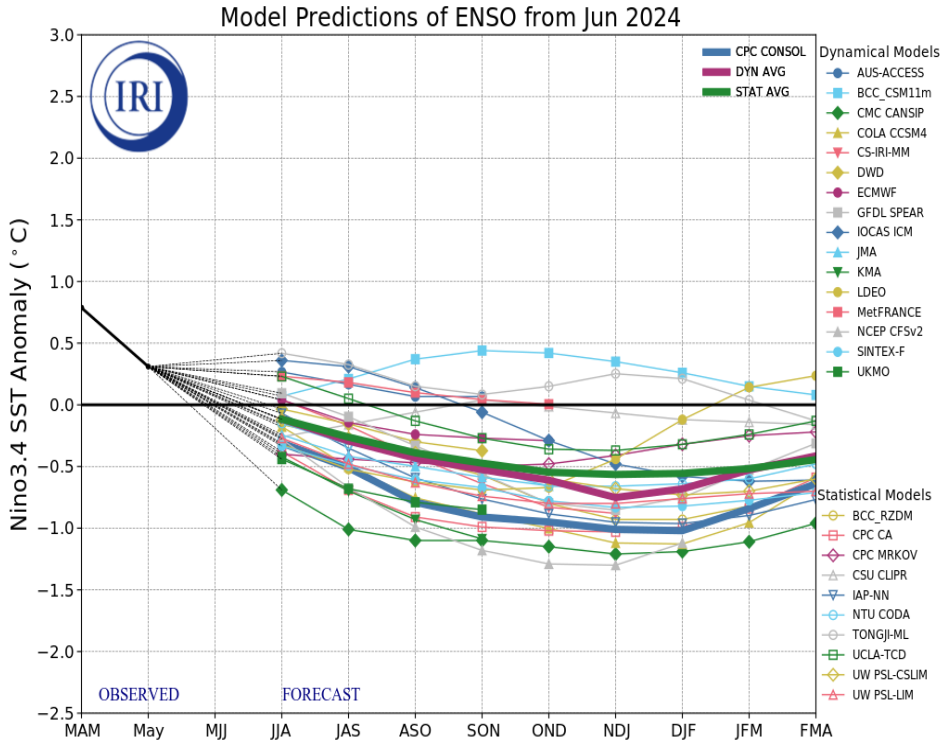
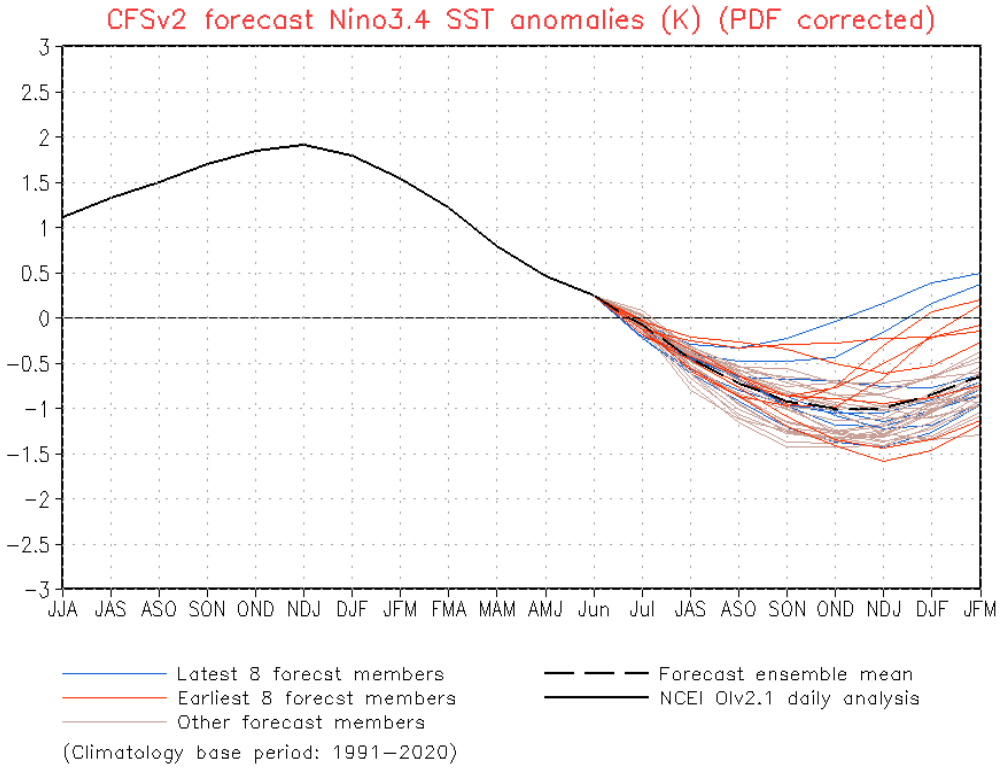


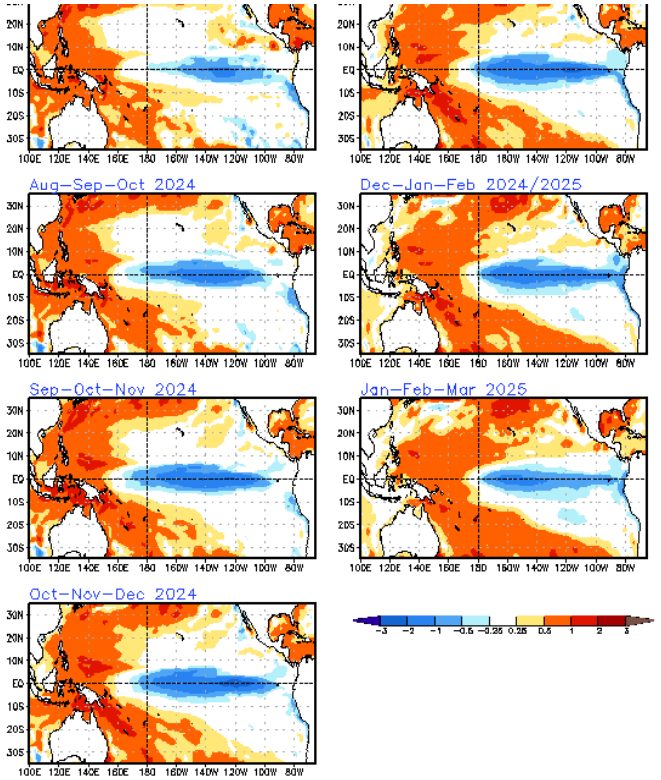
Figure provided by the International Research Institute (IRI) for Climate and Society (updated 20 June 2024).

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

Issued: 8 July 2024

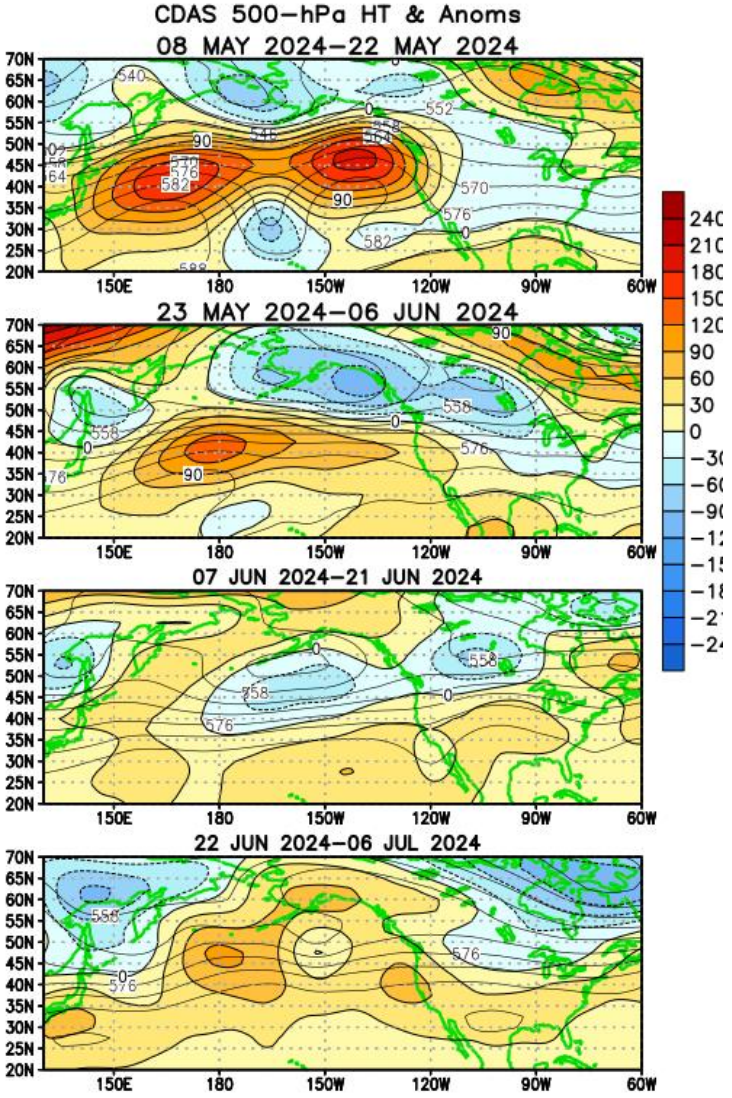
The CFS.v2 ensemble mean (black dashed line) indicates a transition to La Niña around July-September 2024.





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

During June, above-average heights and temperatures dominated the contiguous United States, with below-average heights and temperatures prevailing over the north-central U.S.



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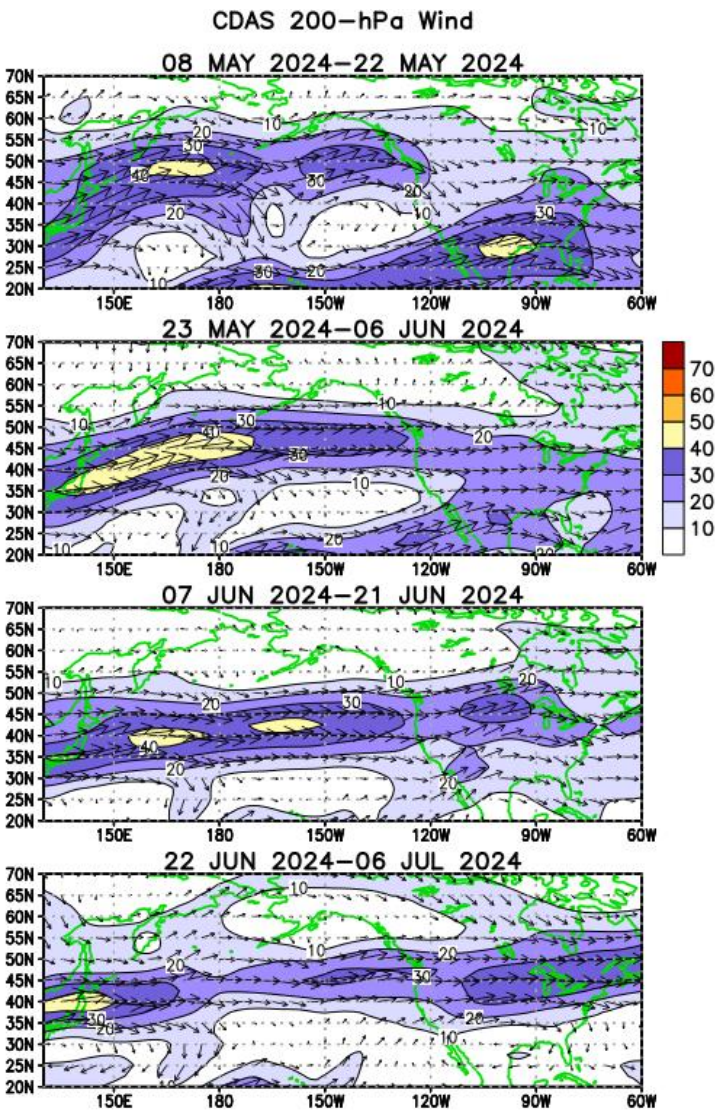

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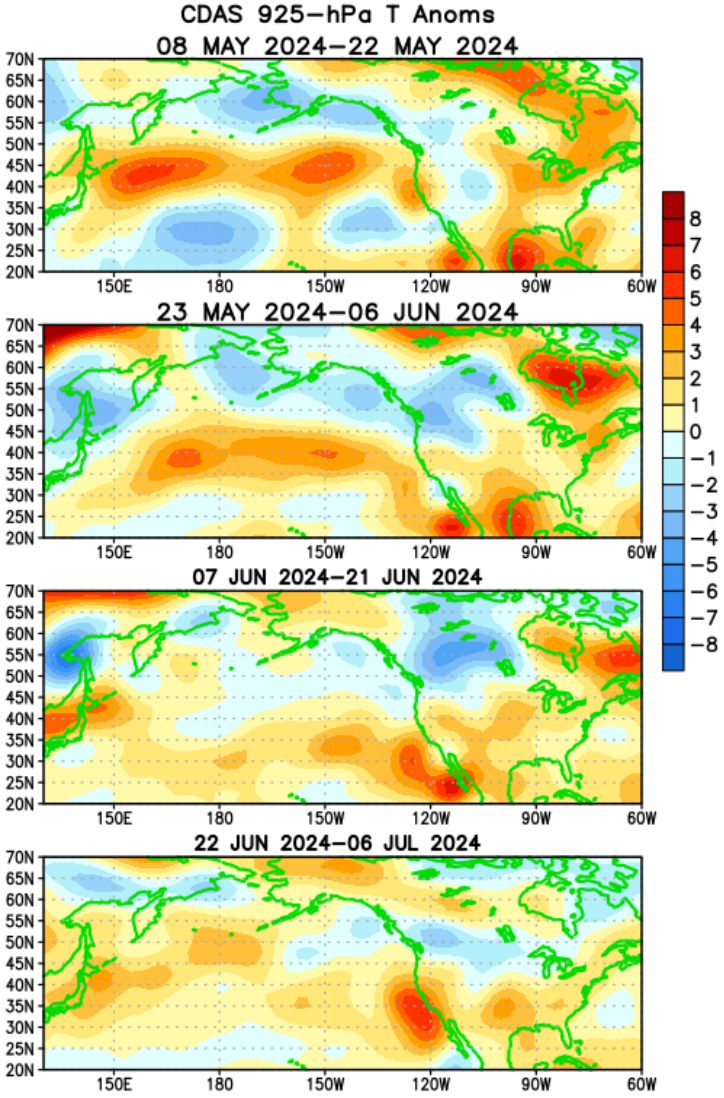
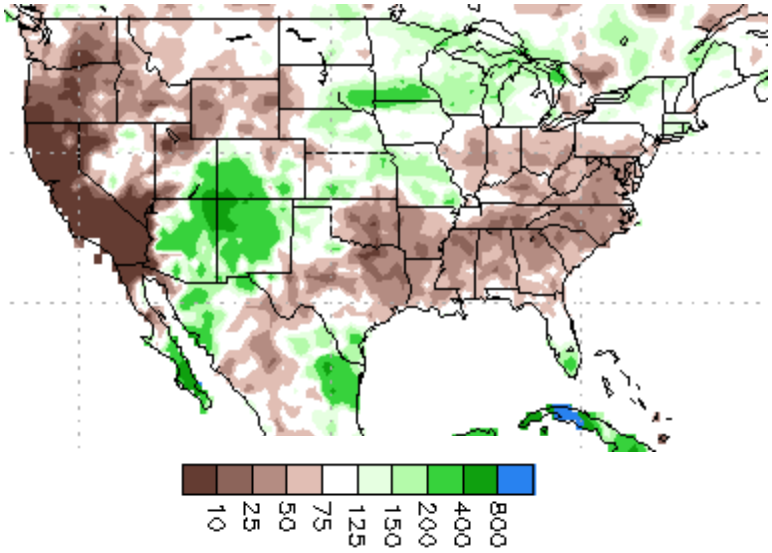


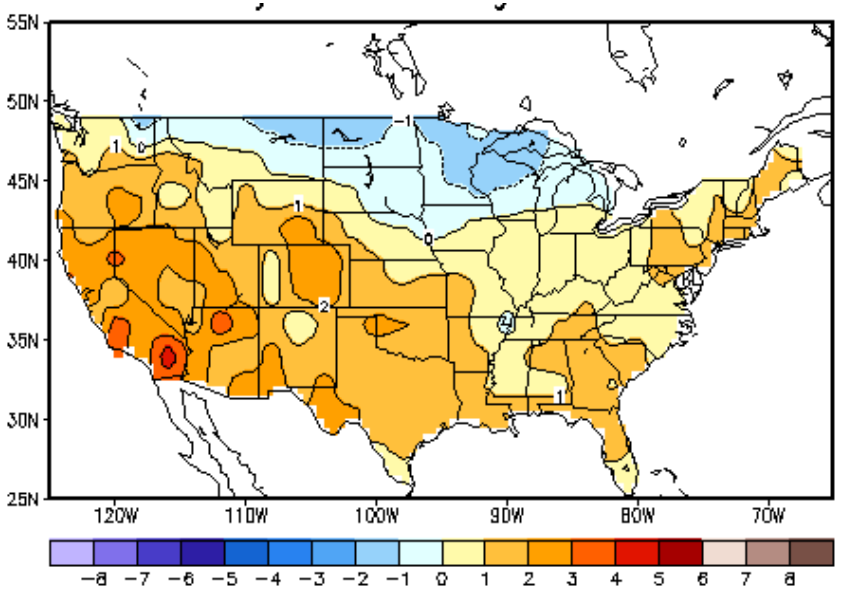
U.S. Temperature and Precipitation Departures During the Last 30 Days

End Date: 6 July 2024

Percent of Average Precipitation



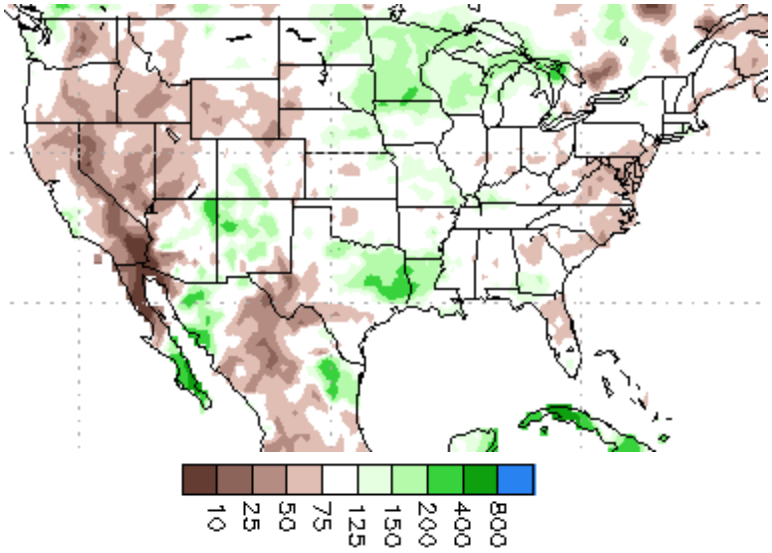
Temperature Departures (degree C)



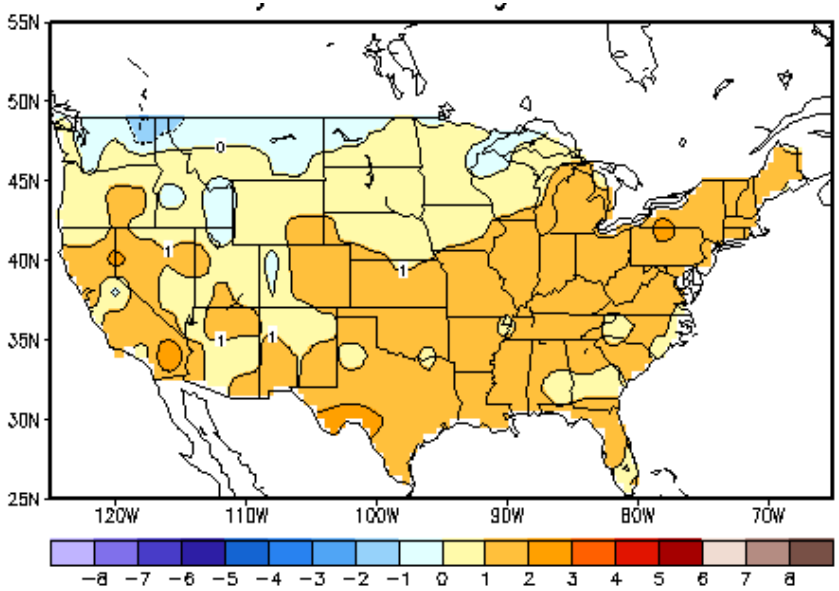
U.S. Temperature and Precipitation Departures During the Last 90 Days

End Date: 6 July 2024

Percent of Average Precipitation



Temperature Departures (degree C)

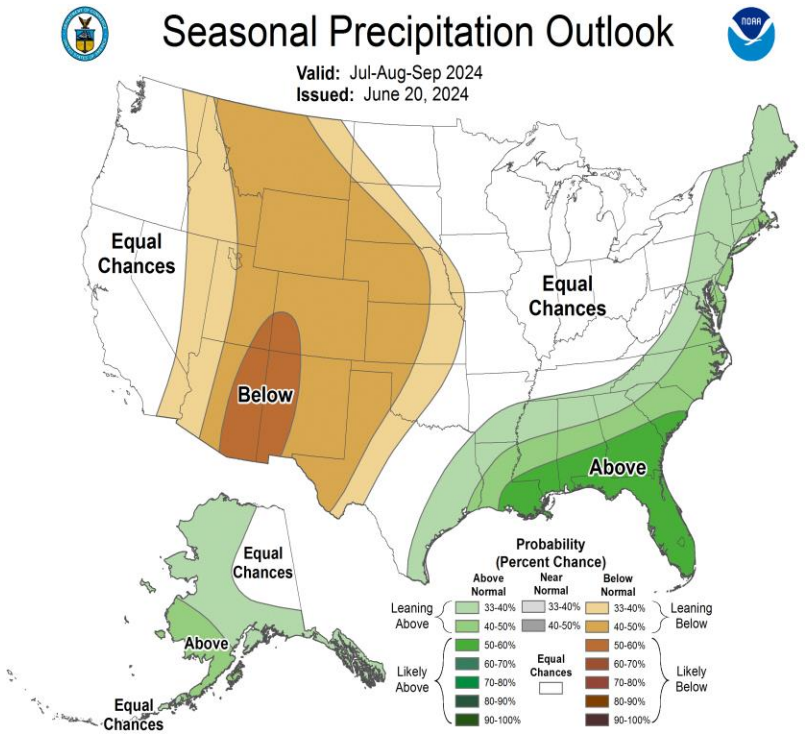


U. S. Seasonal Outlooks

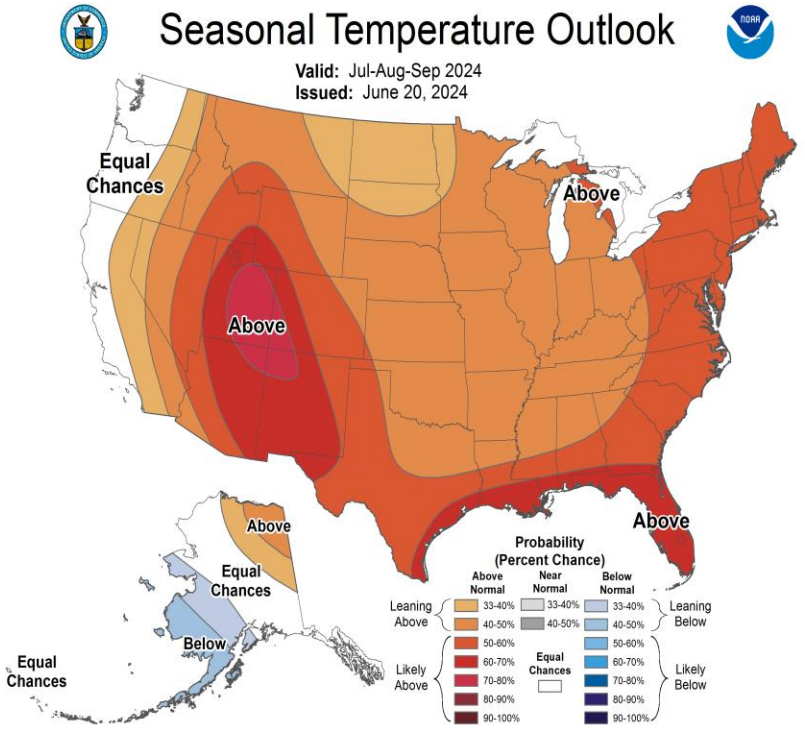
July - September 2024

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

Precipitation



Temperature



Summary

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

ENSO-neutral conditions are present.*

Equatorial sea surface temperatures (SSTs) are above average in the west-central Pacific Ocean, near average in the east-central Pacific Ocean, and below-average in the far eastern Pacific Ocean.

La Niña is favored to develop during July-September (65% chance) and persist into the Northern Hemisphere winter 2024-25 (85% chance during November-January).*

* 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.