ENSO: Recent Evolution, Current Status and Predictions

Update prepared by:
Climate Prediction Center / NCEP
7 October 2024

Outline

Summary

Recent Evolution and Current Conditions

Oceanic Niño Index (ONI)

Pacific SST Outlook

U.S. Seasonal Precipitation and Temperature Outlooks

Summary

10/7/24: Due to a data outage at NOAA NCEI, the weekly SST data has been temporarily changed from OISSTv2.1 to UK Met OSTIA: https://ghrsst-pp.metoffice.gov.uk/ostia-website/index.html . This impacts slides #4-9. ERSSTv5 has temporarily been replaced with JMA COBE2 SST data. https://ds.data.jma.go.jp/tcc/tcc/products/elnino/cobesst2_doc.html

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.

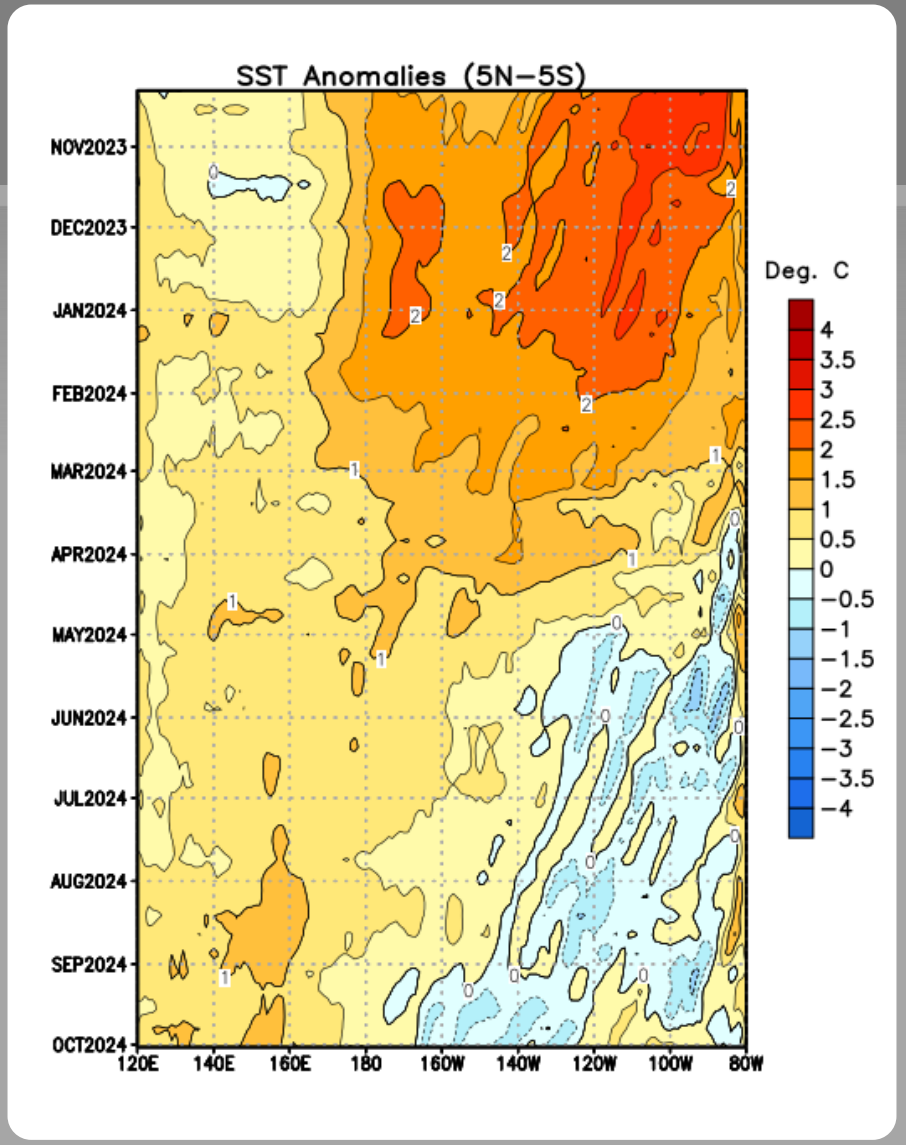
La Niña is favored to emerge in September-November (71% chance) and is expected to persist through January-March 2025.*

*** 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.

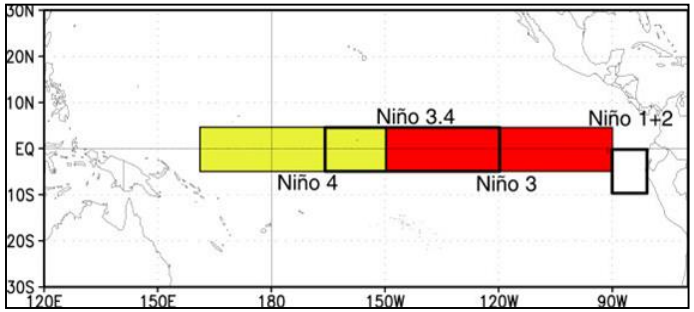
Since mid-March 2024, near-to-below-average SSTs have emerged in the eastern Pacific and expanded westward.

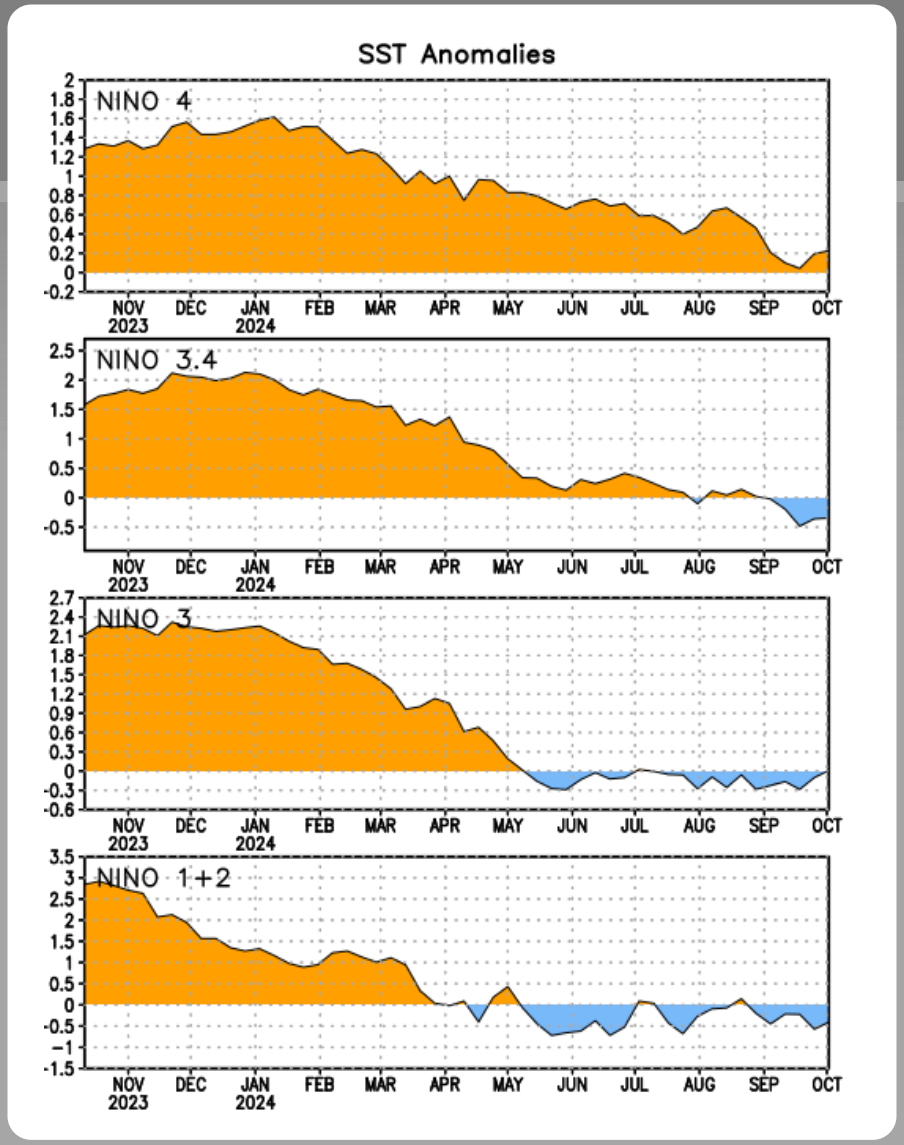


Niño Region SST Departures (ºC) Recent Evolution

The latest weekly SST departures are:

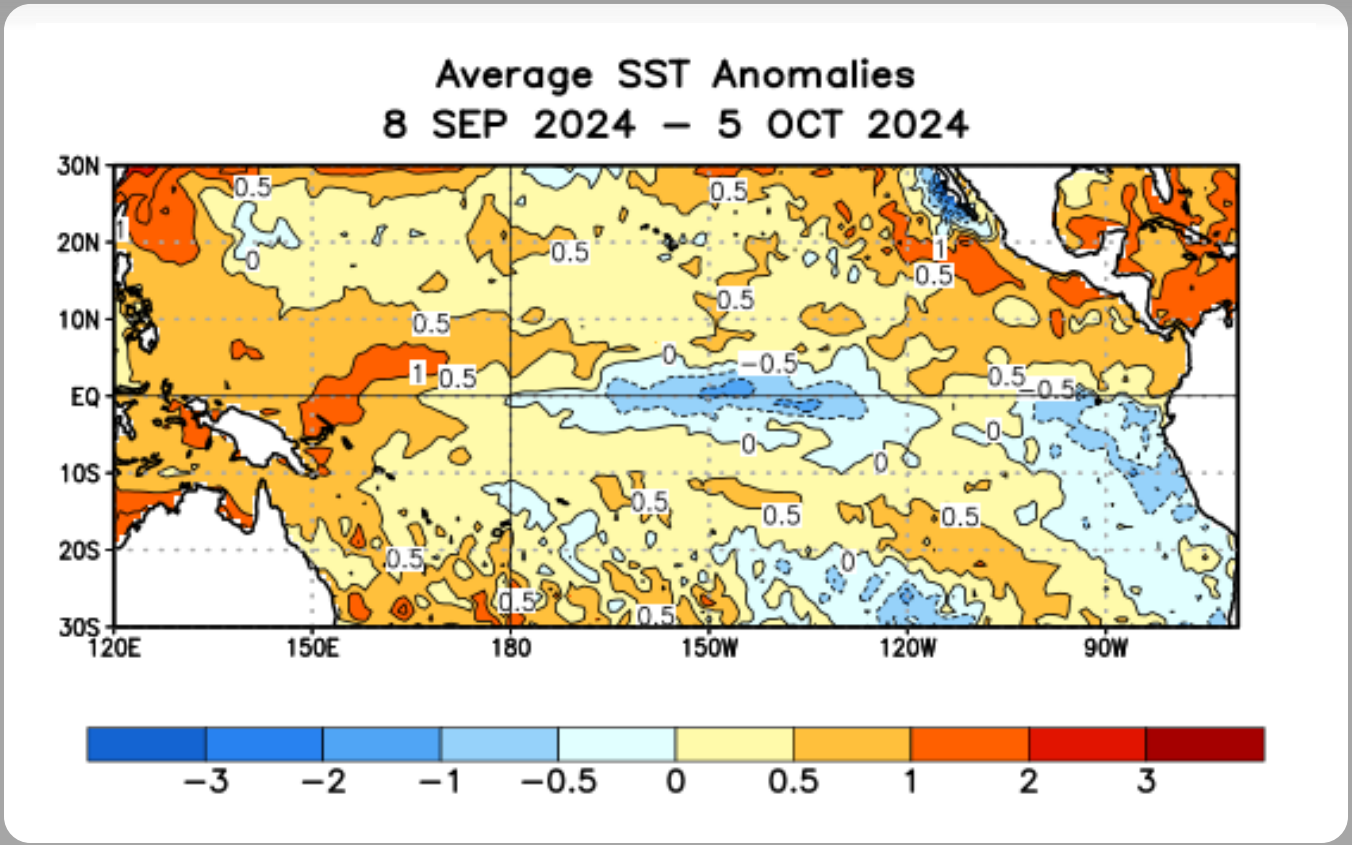
Niño 4	0.2ºC
Niño 3.4	-0.3ºC
Niño 3	0.0ºC
Niño 1+2	-0.4ºC





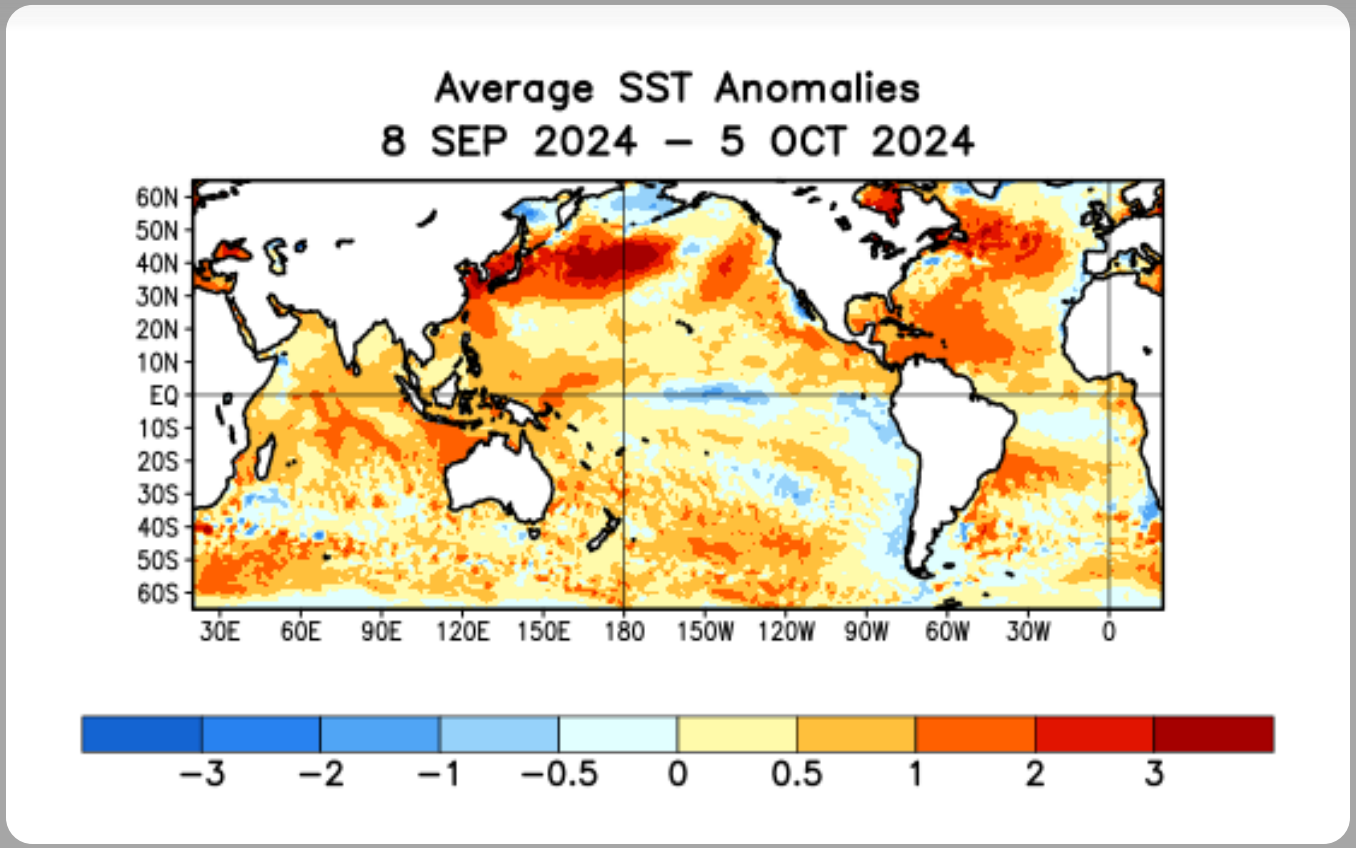
SST Departures (ºC) in the Tropical Pacific During the Last Four Weeks

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



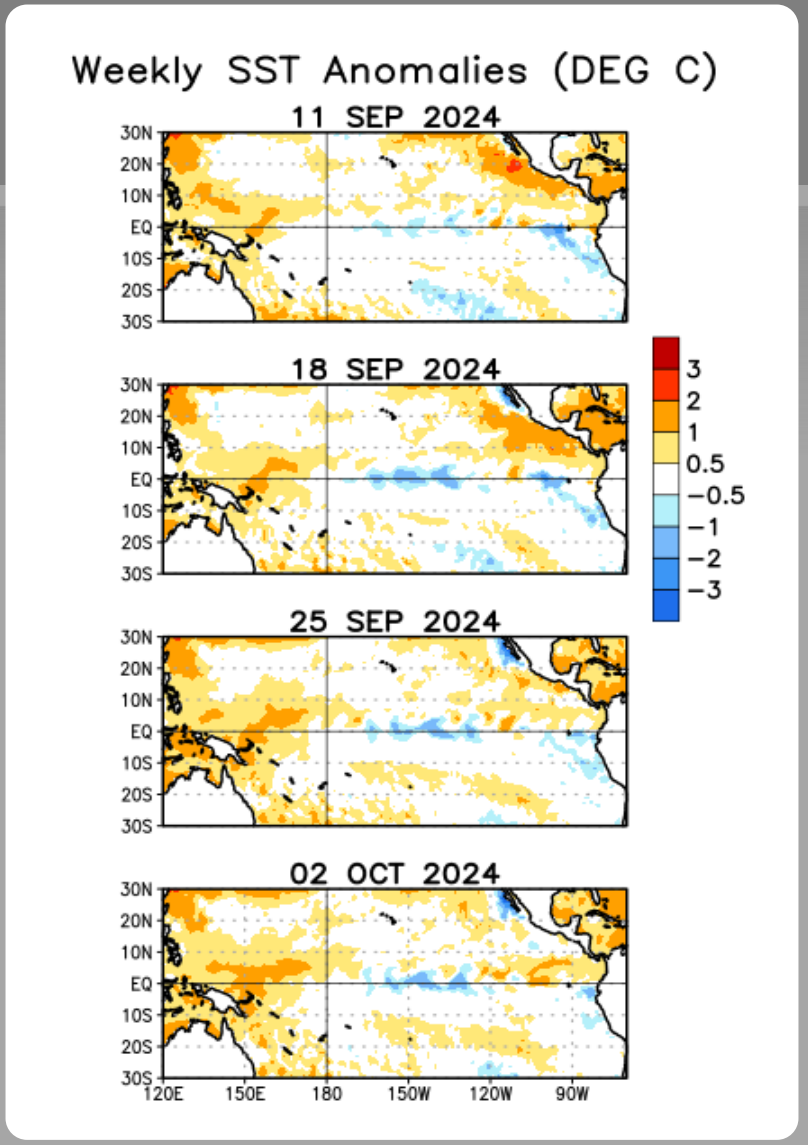
Global SST Departures (°C) During the Last Four Weeks

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



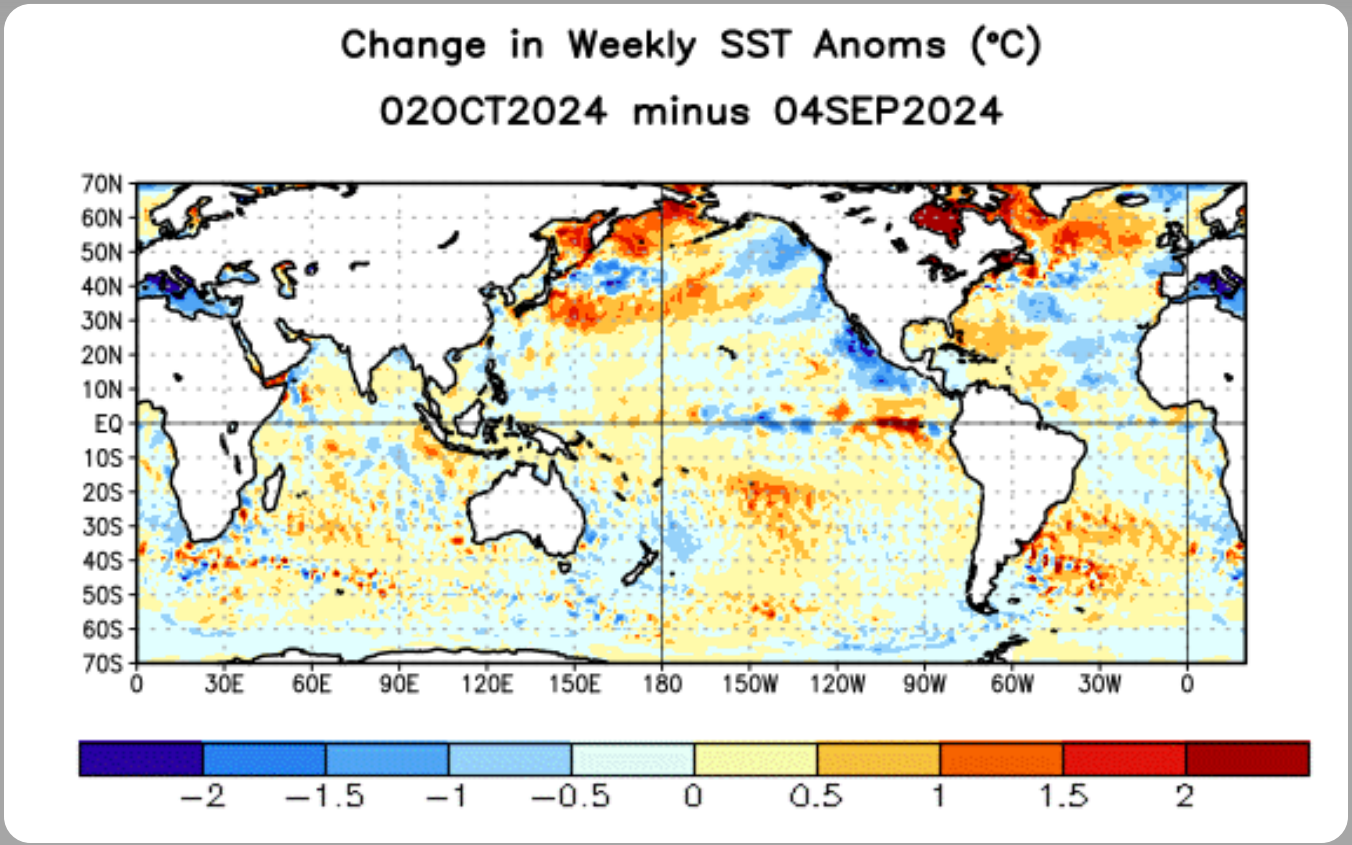
Weekly SST Departures during the Last Four Weeks

During the last 4 weeks, near-to-below-average SSTs persisted in the east-central and eastern Pacific Ocean, while above-average SSTs persisted in the western Pacific.



Change in Weekly SST Departures over the Last Four Weeks

During the last four weeks, negative SST anomaly changes prevailed across the east-central equatorial Pacific, while positive changes were evident in the eastern equatorial Pacific Ocean.



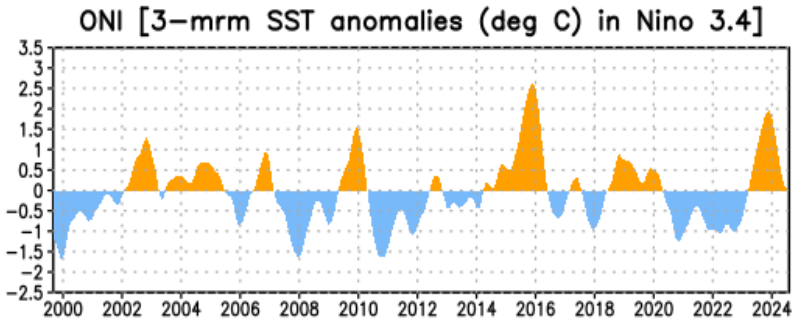
Upper-Ocean Conditions in the Equatorial Pacific

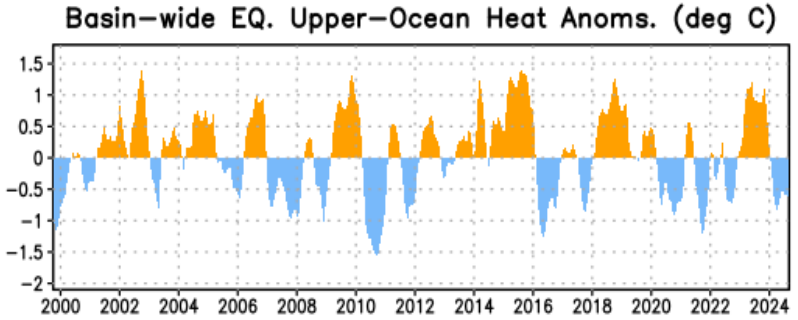
The basin-wide equatorial upper ocean (0-300 m) heat content is greatest prior to and during the early stages of a Pacific warm (El Niño) episode (compare top 2 panels), and least prior to and during the early stages of a cold (La Niña) episode.

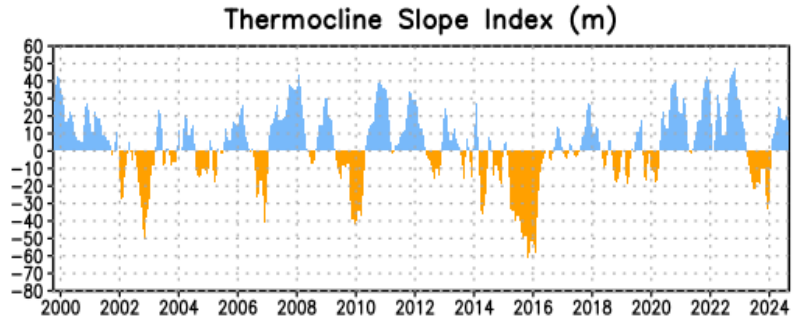
The slope of the oceanic thermocline is least (greatest) during warm (cold) episodes.

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

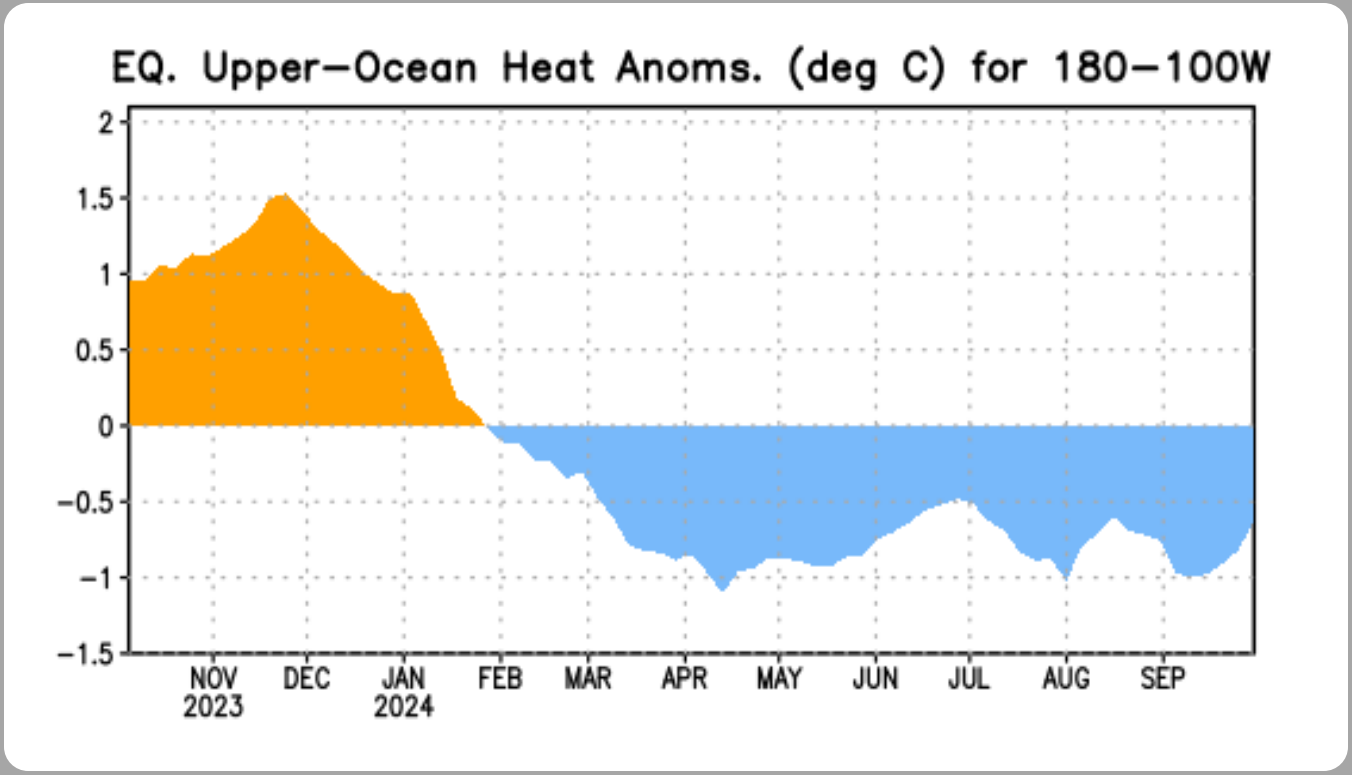






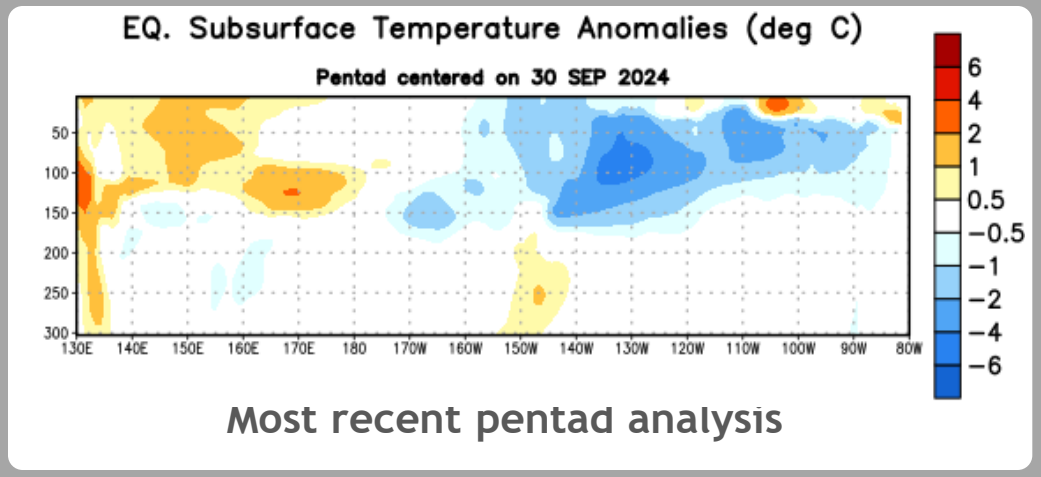
Central and Eastern Pacific Upper-Ocean (0-300 m) Weekly Average Temperature Anomalies

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.



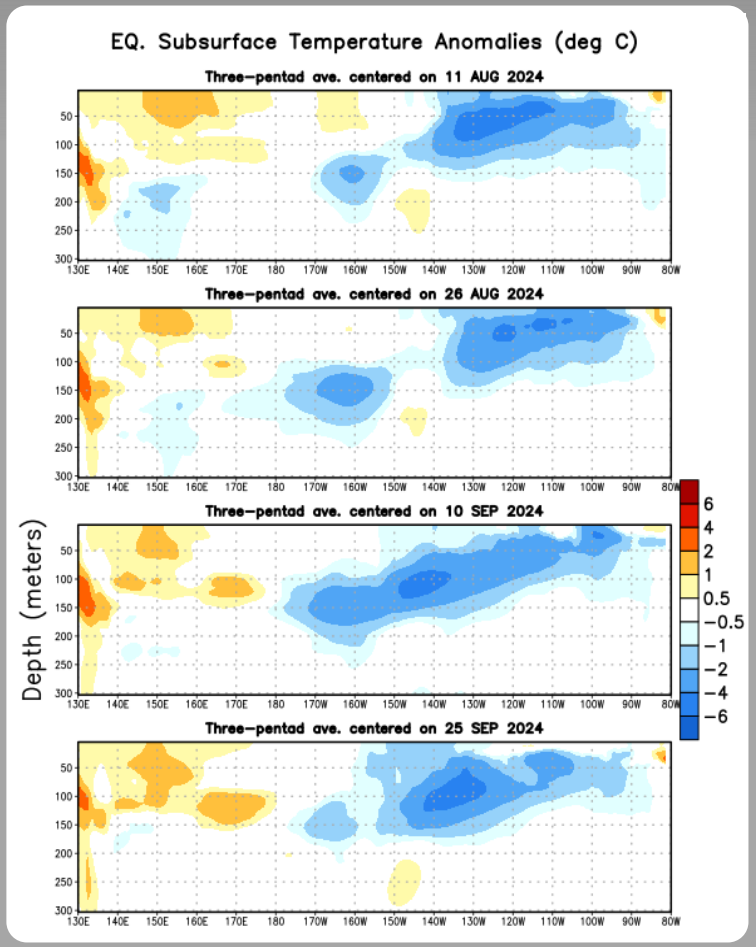
Sub-Surface Temperature Departures in the Equatorial Pacific

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



Most recent pentad analysis

Below-average temperatures remain at depth in the east-central Pacific Ocean, while above-average temperatures prevail at depth and near the surface in the western Pacific.

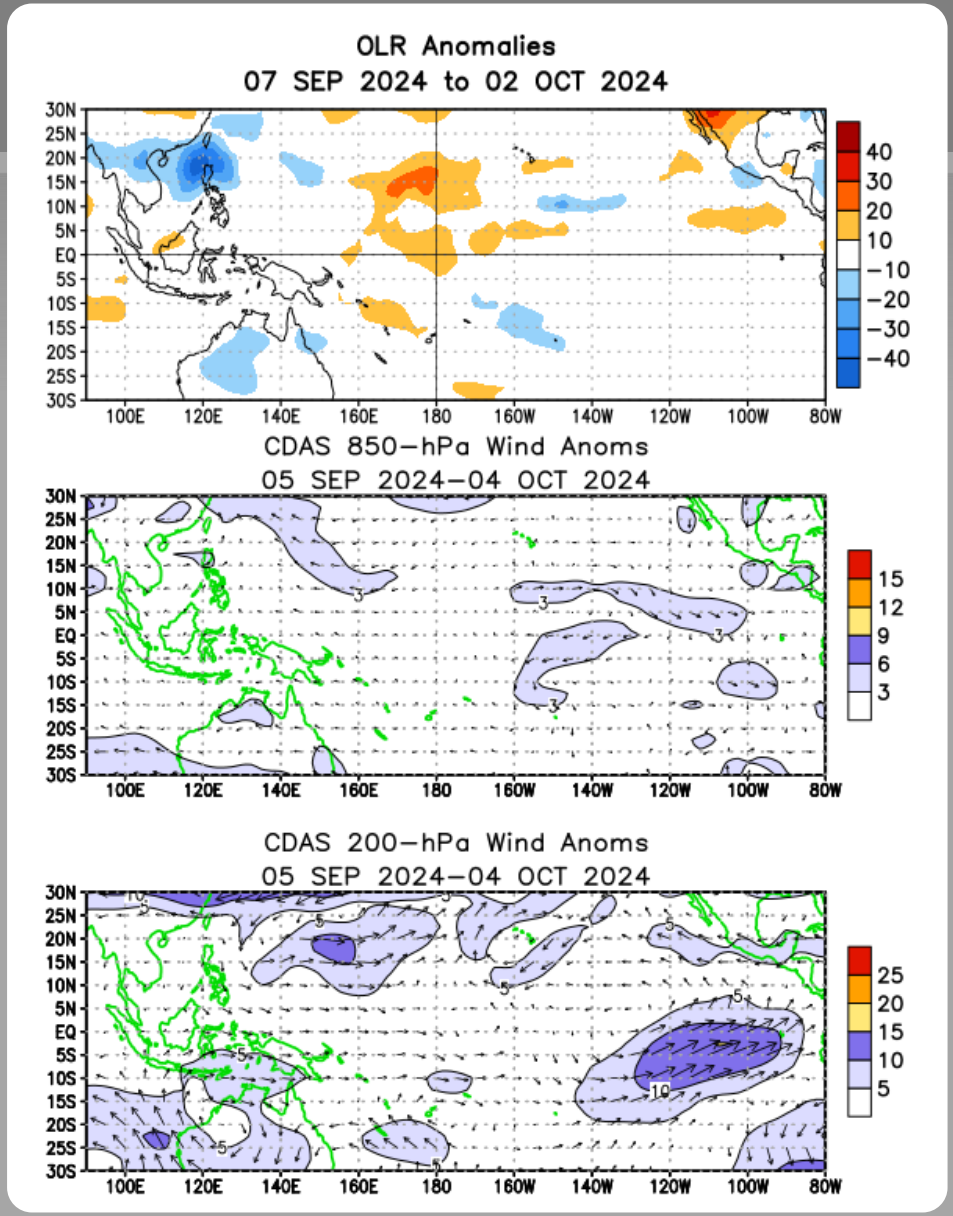


Tropical OLR and Wind Anomalies During the Last 30 Days

Above-average OLR (suppressed convection and precipitation) was observed near the Date Line.

Low-level (850-hPa) easterly wind anomalies were observed in the east-central equatorial Pacific Ocean, with westerly wind anomalies apparent in the eastern Pacific Ocean.

Upper-level (200-hPa) wind anomalies were westerly across 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.

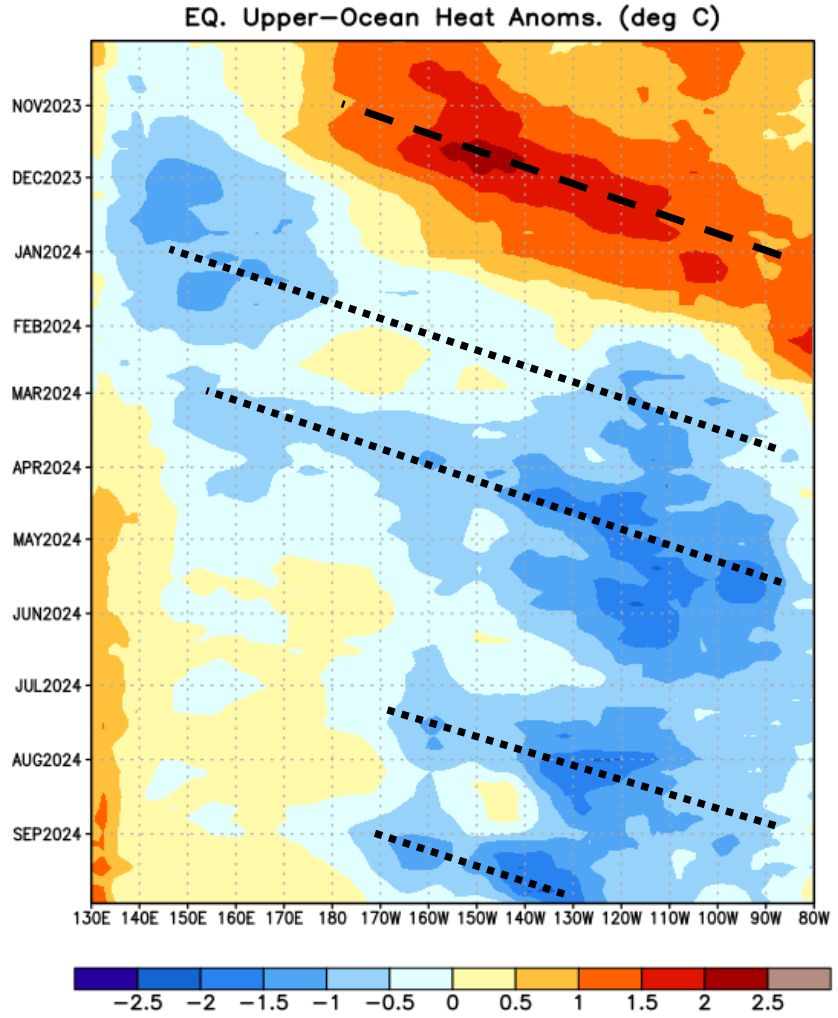
Weekly Heat Content Evolution in the Equatorial Pacific

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.

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

Since late August 2024, below-average subsurface temperatures strengthened in the eastern and central Pacific.

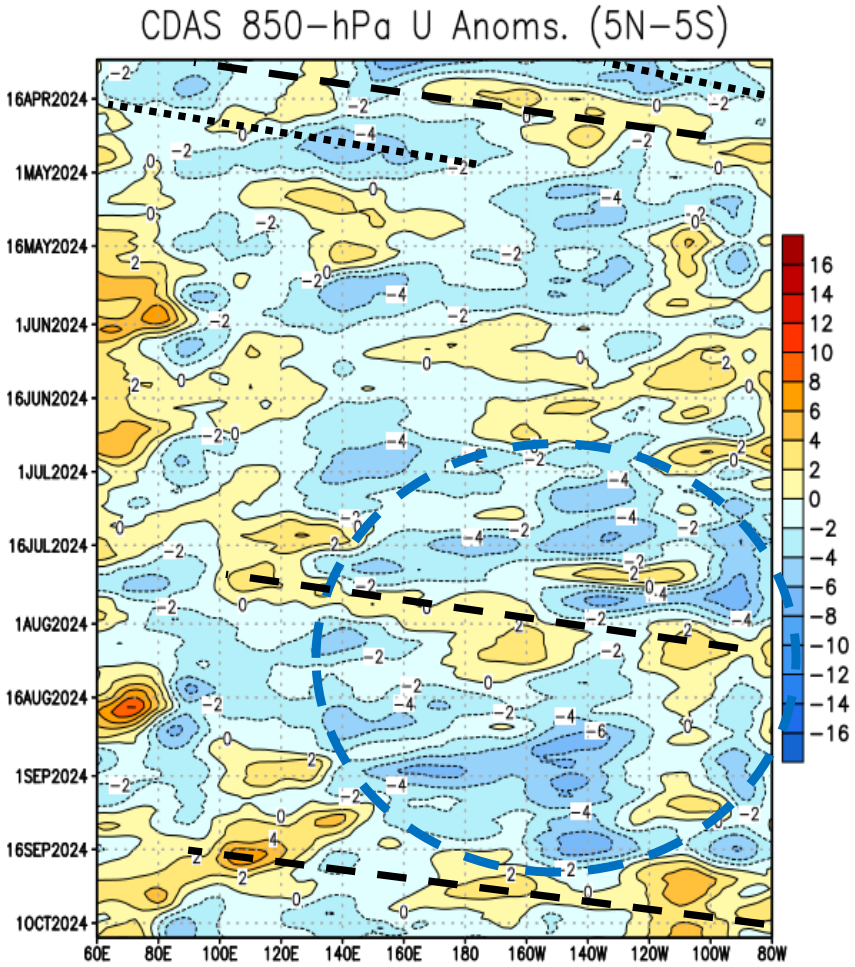


Equatorial oceanic Kelvin waves have alternating warm and cold phases. The warm phase is indicated by dashed lines. Down-welling and warming occur in the leading portion of a Kelvin wave, and up-welling and cooling occur in the trailing portion.

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

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 brief periods of westerly wind anomalies.

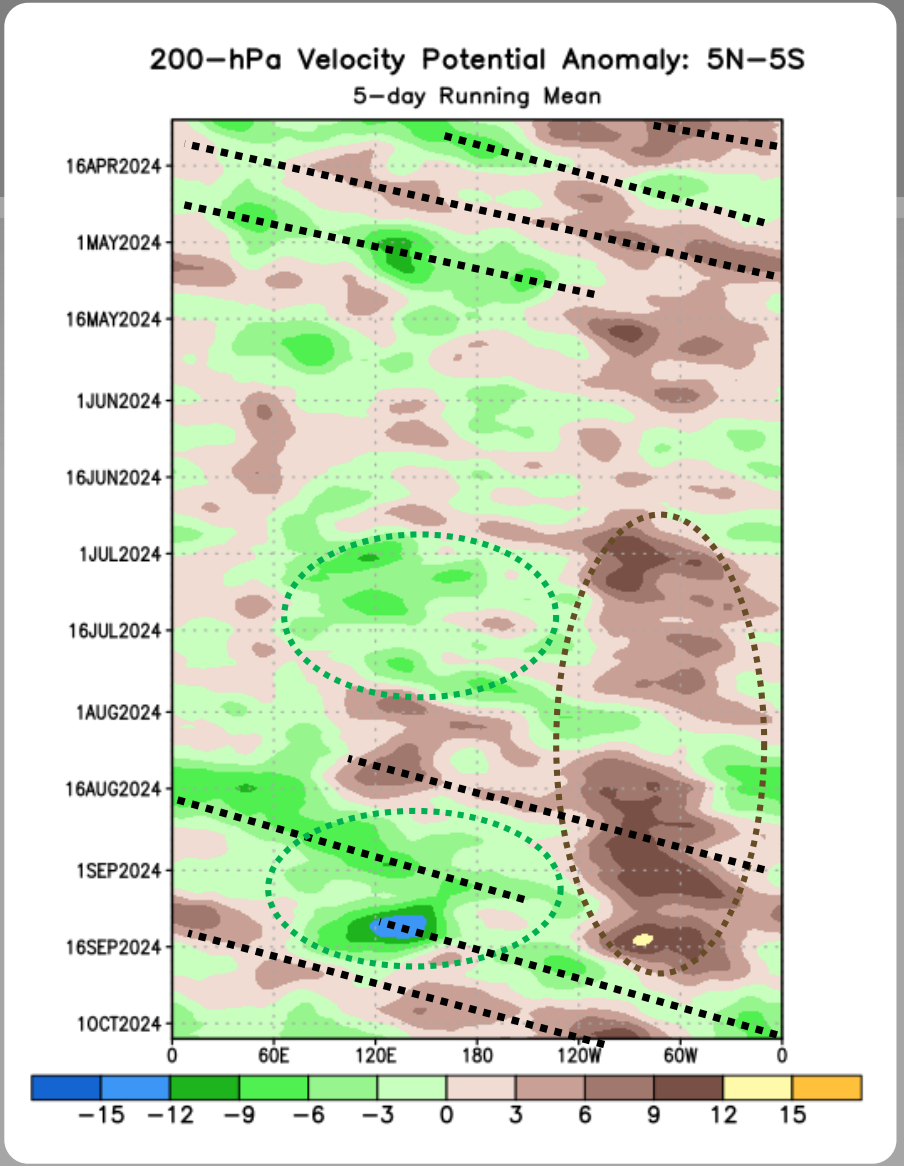


Westerly Wind Anomalies (orange/red shading)
Easterly Wind Anomalies (blue shading)

Upper-level (200-hPa) Velocity Potential Anomalies

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

During most of July and from mid-August to mid-September 2024, anomalous divergence was evident over Indonesia and the western Pacific and anomalous convergence persisted over the eastern Pacific.

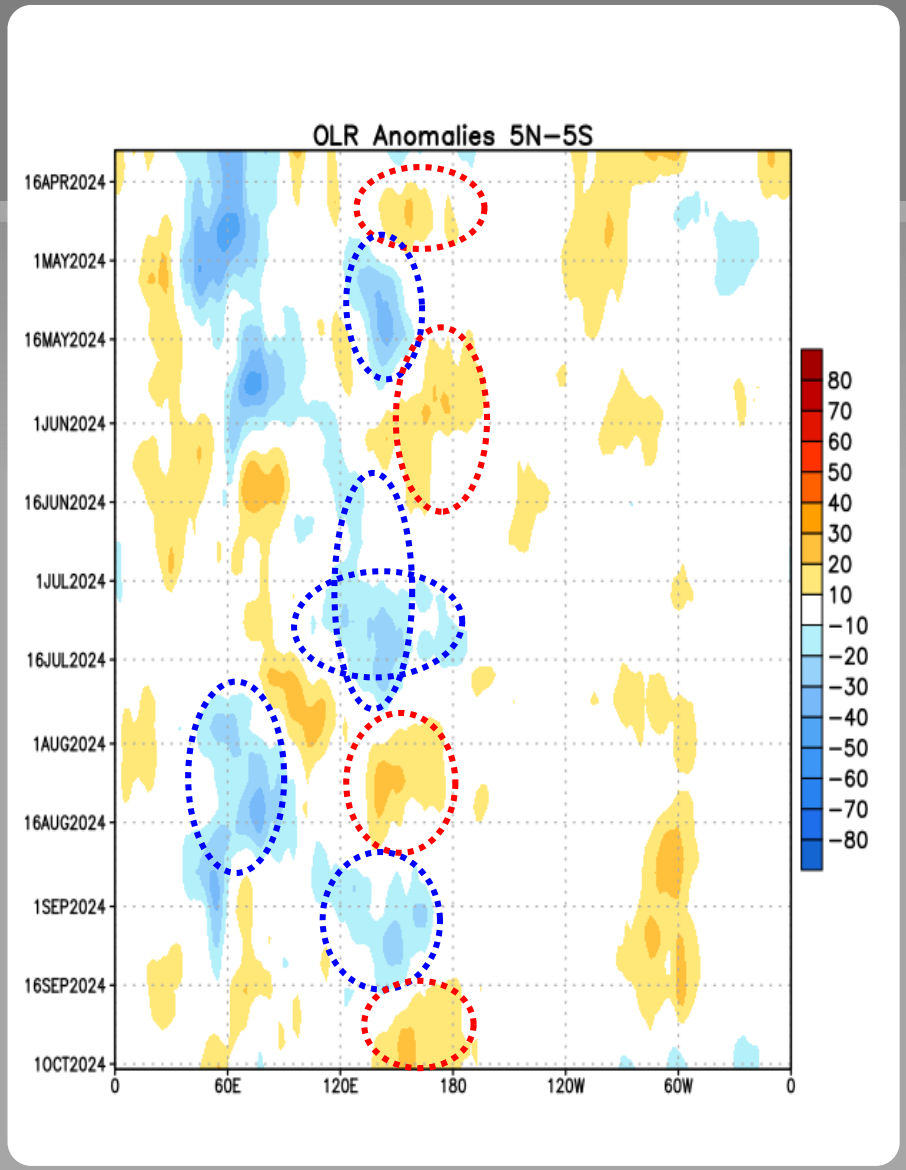


Unfavorable for precipitation (brown shading)
Favorable for precipitation (green shading)
Note: Eastward propagation is not necessarily indicative of the Madden-Julian Oscillation (MJO).

Outgoing Longwave Radiation (OLR) Anomalies

Since mid-March 2024 positive OLR anomalies (suppressed convection/rainfall) have periodically emerged near the Date Line.

Since mid-September 2024, positive OLR anomalies (suppressed convection/rainfall) have persisted near the western Pacific Ocean and 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).

10/7/24: Due to a data outage at NOAA NCEI, the weekly SST data has been temporarily changed from OISSTv2.1 to UK Met OSTIA: https://ghrsst-pp.metoffice.gov.uk/ostia-website/index.html . This impacts slides #4-9. ERSSTv5 has temporarily been replaced with JMA COBE2 SST data. https://ds.data.jma.go.jp/tcc/tcc/products/elnino/cobesst2_doc.html

NOAA Operational Definitions for El Niño and La Niña

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

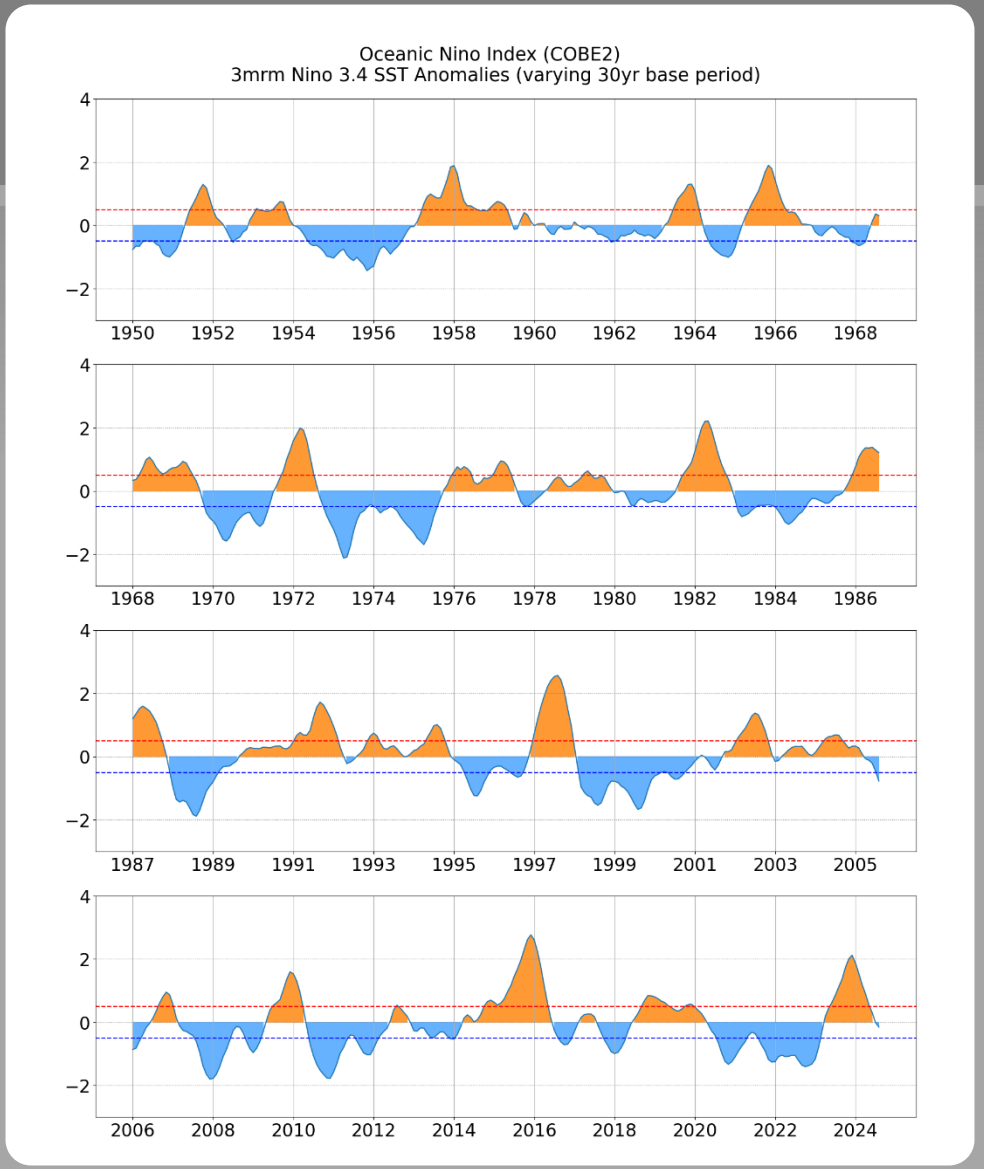
La Niña: characterized by a negative ONI less than or equal to -0.5°C.

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 (July-September 2024) is -0.2°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.

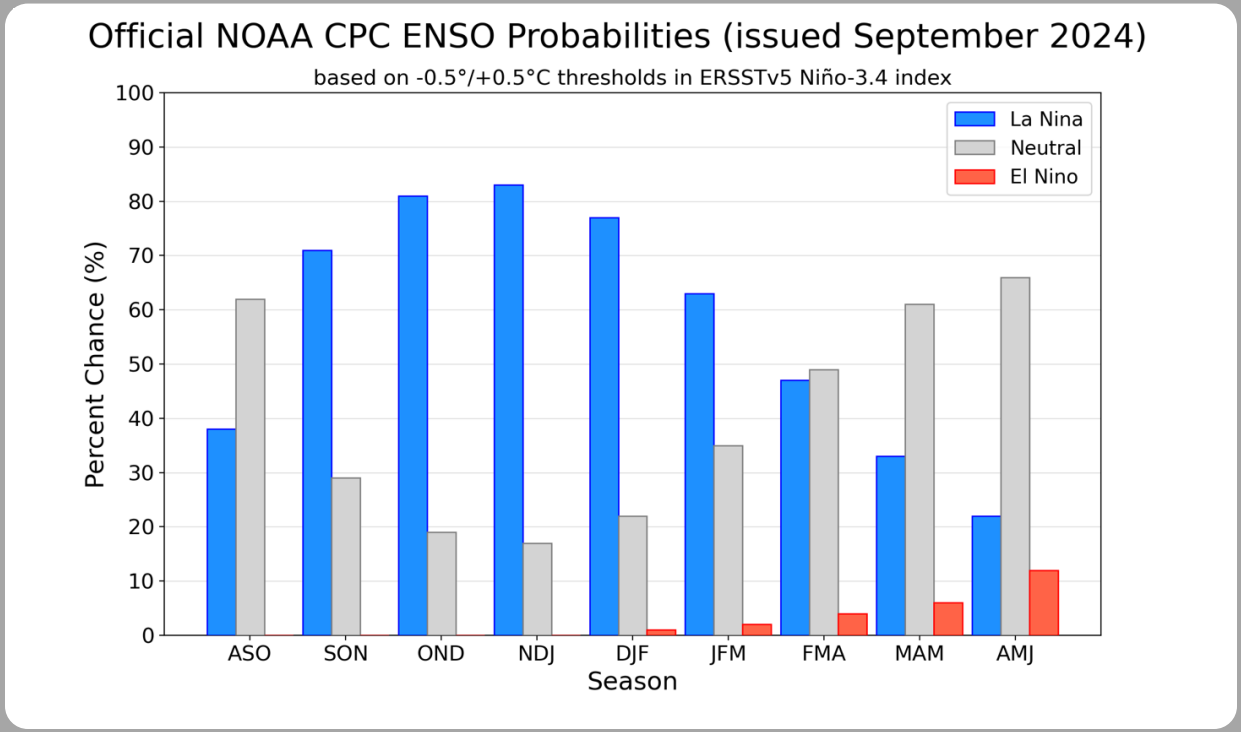
The ONI is one measure of the El Niño-Southern Oscillation, and other indices can confirm whether features consistent with a coupled ocean-atmosphere phenomenon accompanied these periods. The complete table going back to DJF 1950 can be found here.

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	0.2	0.1					

CPC Probabilistic ENSO Outlook

Updated: 12 September 2024

La Niña is favored to emerge during September-November (71% chance) and persist through January-March 2025.



IRI Pacific Niño 3.4 SST Model Outlook

The majority of dynamical models indicate a transition to La Niña in September-November 2024, while the average of the statistical models predicts ENSO-neutral.

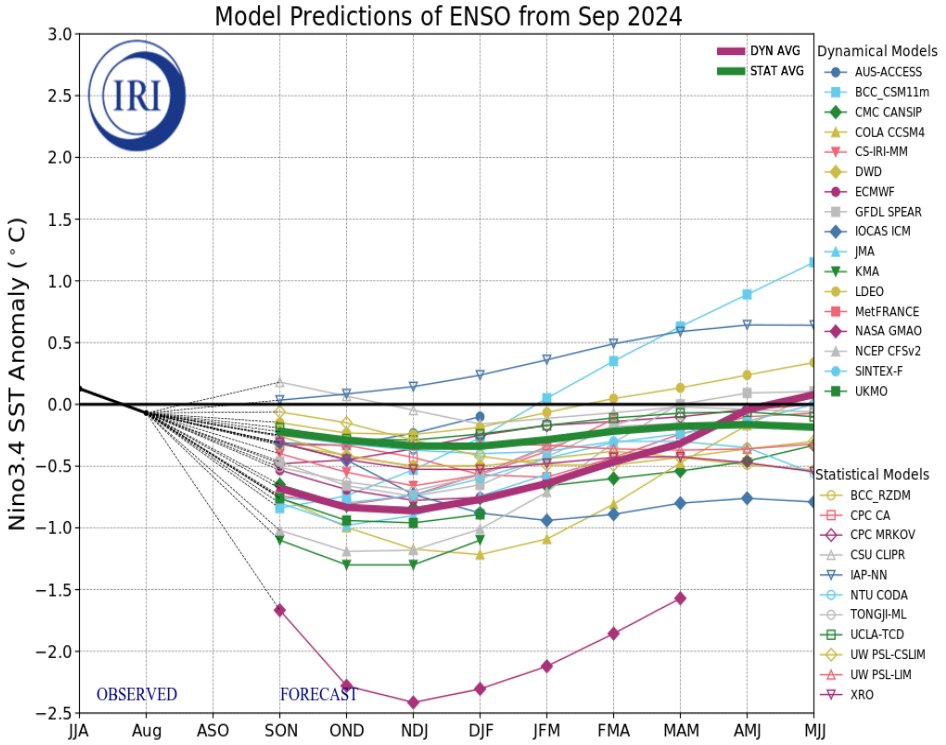
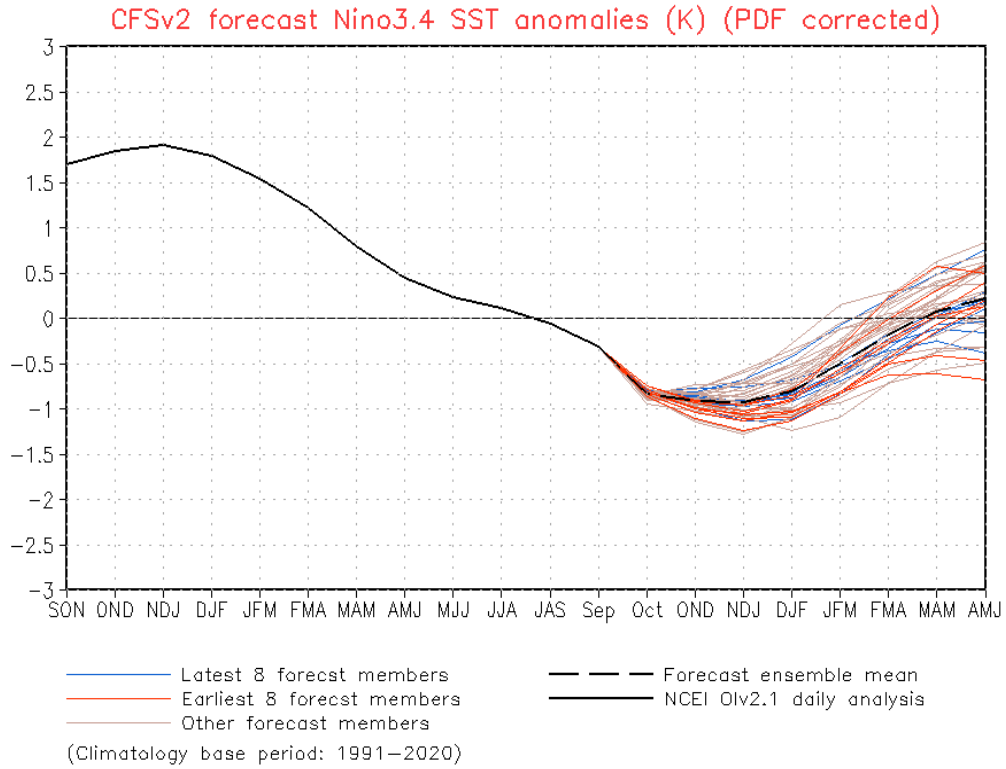


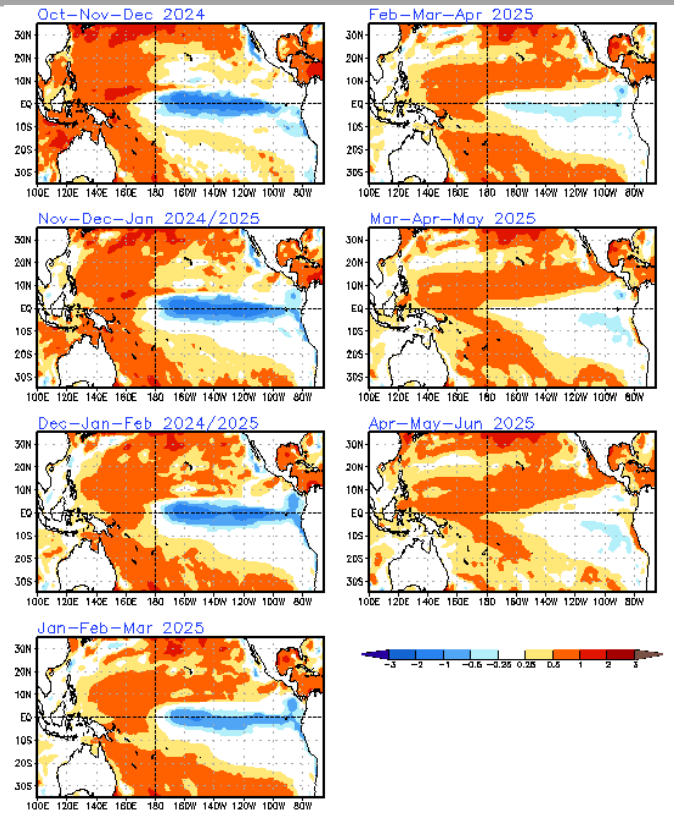
Figure provided by the International Research Institute (IRI) for Climate and Society (updated 19 September 2024).

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

Issued: 7 October 2024

The CFS.v2 ensemble mean (black dashed line) indicates a transition to La Niña in October 2024 and persisting through January-March 2025.

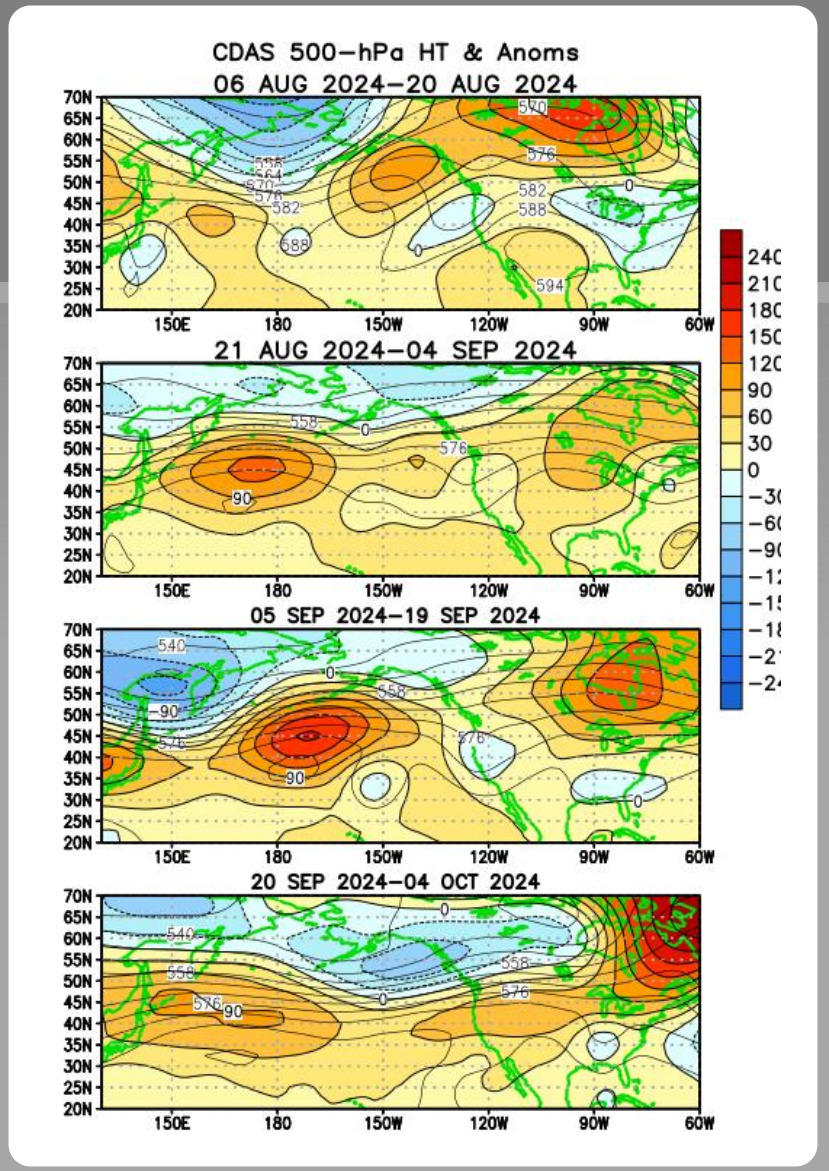




Atmospheric anomalies over the North Pacific and North America During the Last 60 Days

Over the North Pacific Ocean, positive height anomalies have dominated since late August.

Above-average heights and temperatures also persisted over the Hudson Bay and eastern Canada. Over the contiguous U.S., positive height anomalies have been weaker with small regions of below-average heights.



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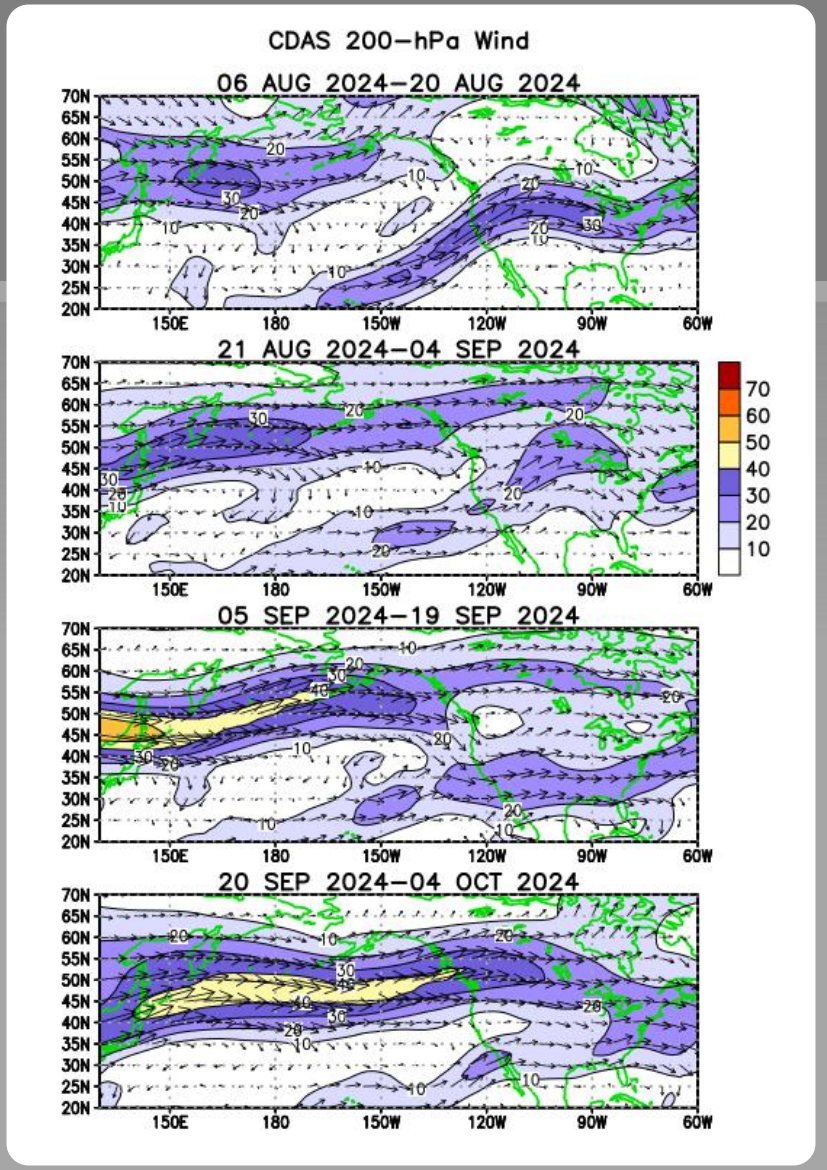

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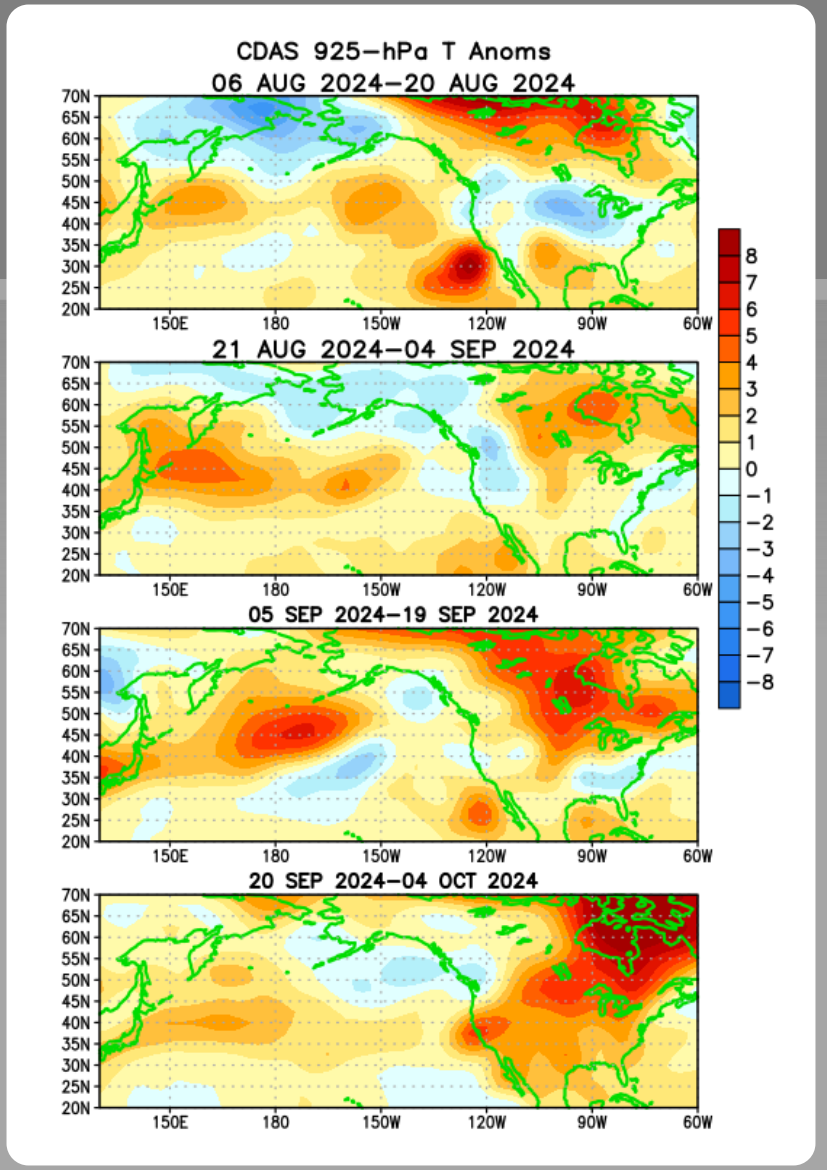
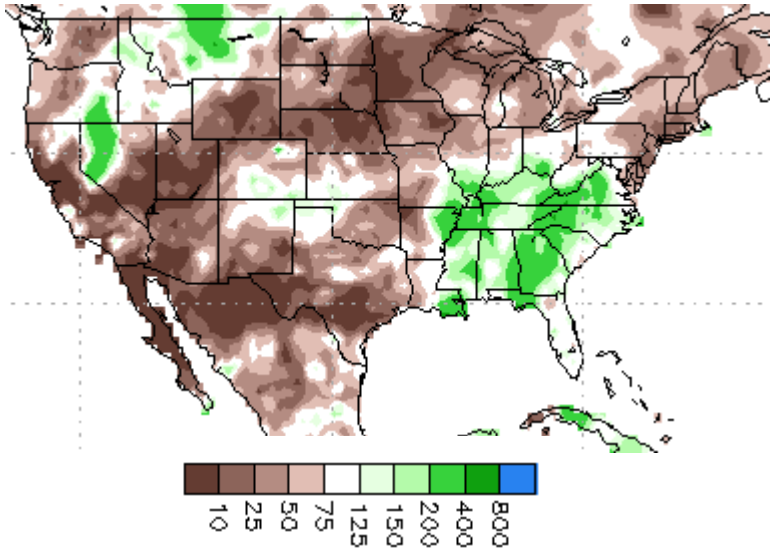


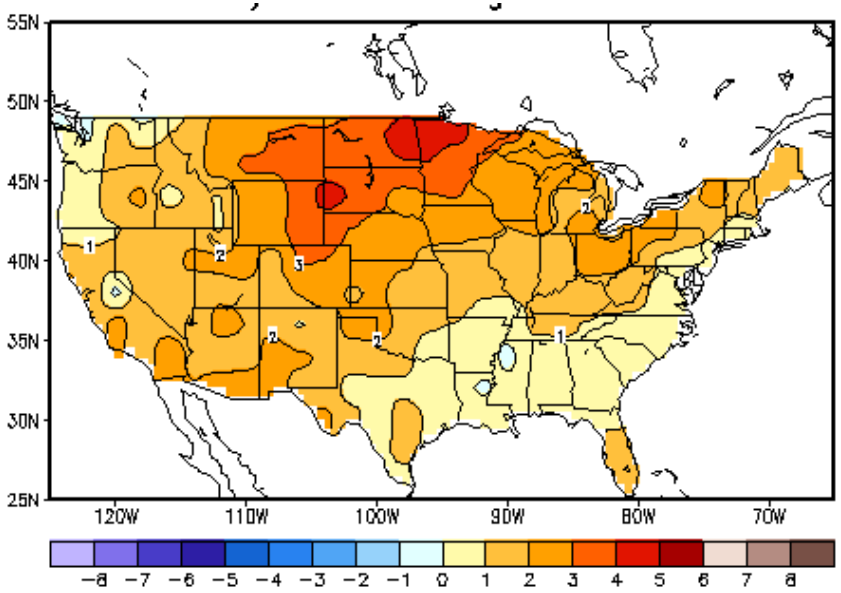
U.S. Temperature and Precipitation Departures During the Last 30 Days

End Date: 5 October 2024

Percent of Average Precipitation



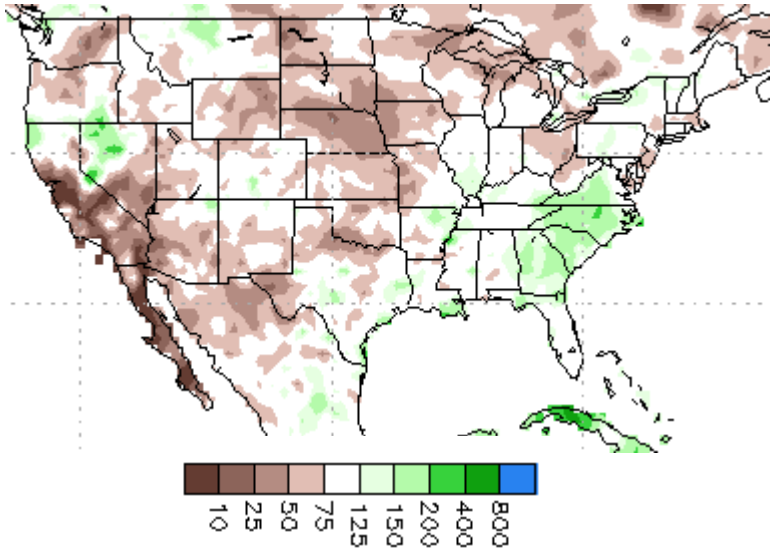
Temperature Departures (degree C)



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

End Date: 5 October 2024

Percent of Average Precipitation



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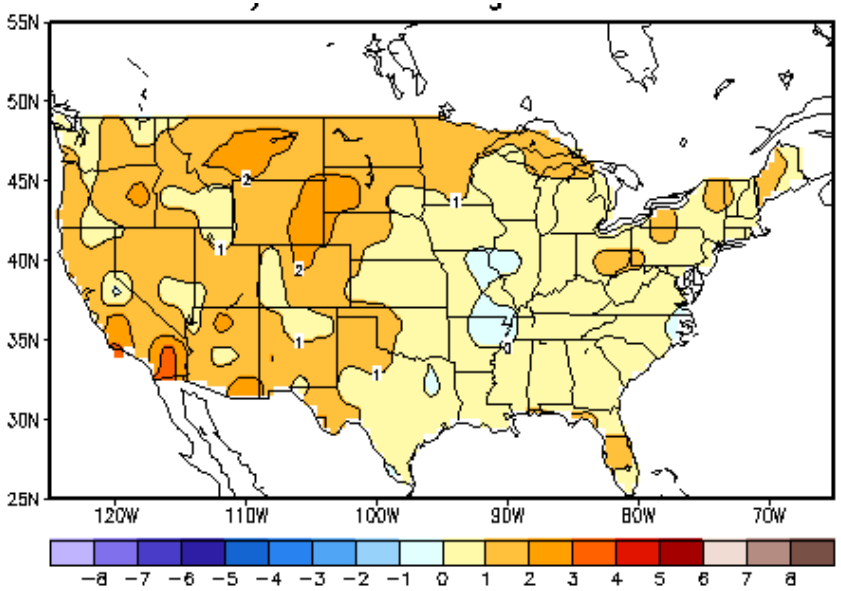
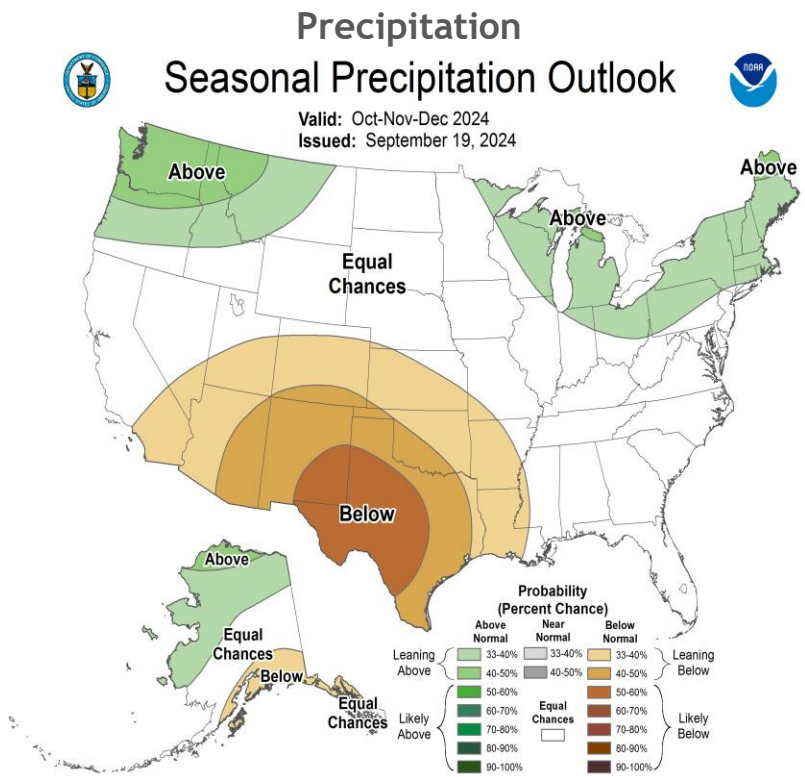


U. S. Seasonal Outlooks

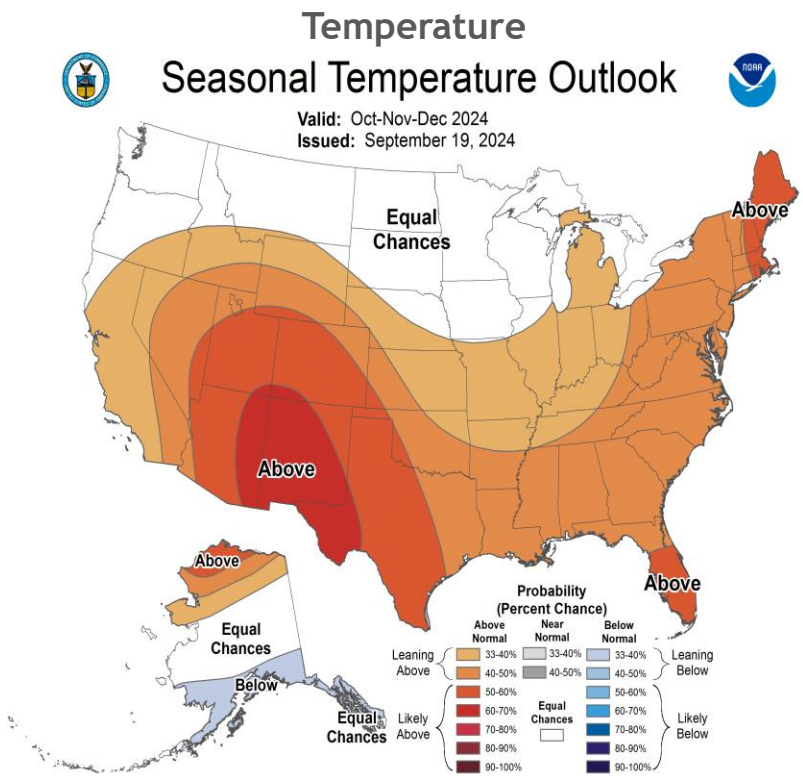
October-December 2024

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

Precipitation



Temperature



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