ENSO: Recent Evolution, Current Status and Predictions

Outline

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.

La Niña is favored to continue through Northern Hemisphere winter 2022-23, with a 91% chance in September-November, decreasing to a 54% chance in January-March 2023.*

* 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.

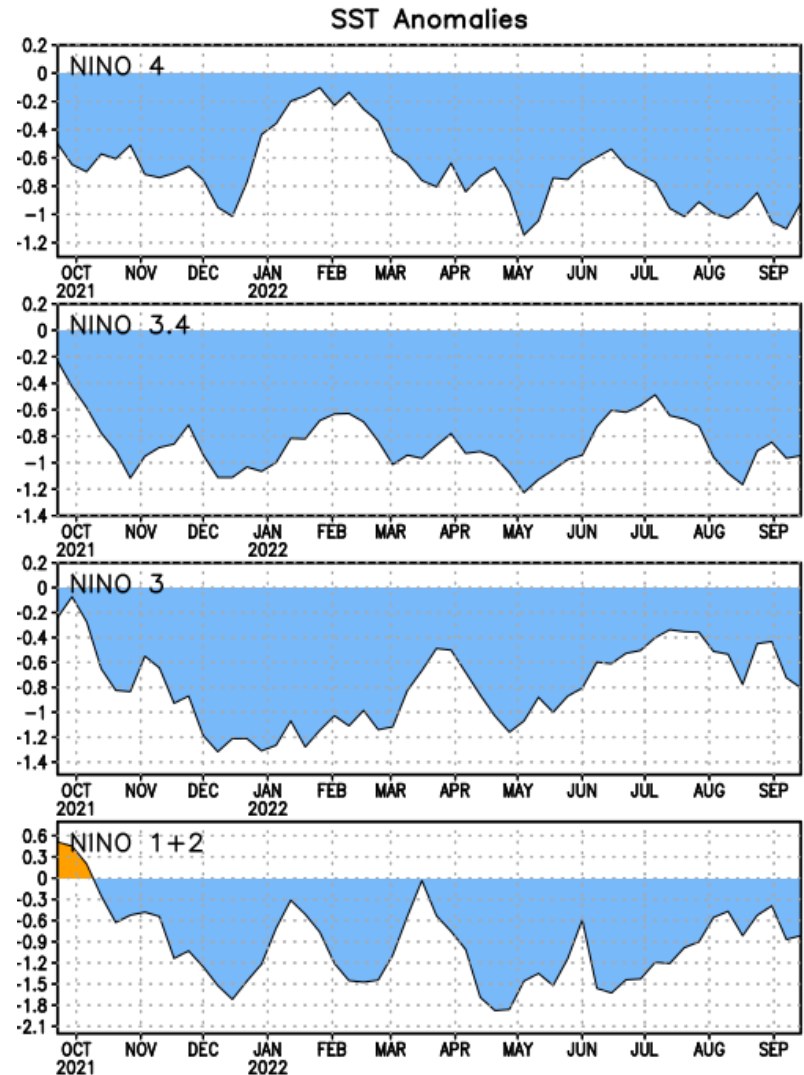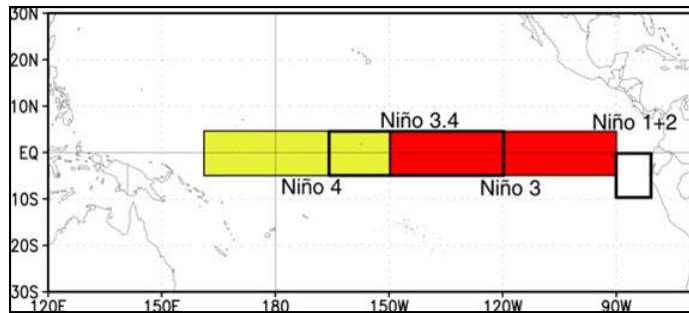# Recent Evolution of Equatorial Pacific SST Departures (ºC)

In the last week, negative equatorial SST anomalies persisted across most of the equatorial Pacific.

SST Anomalies (5N–5S)
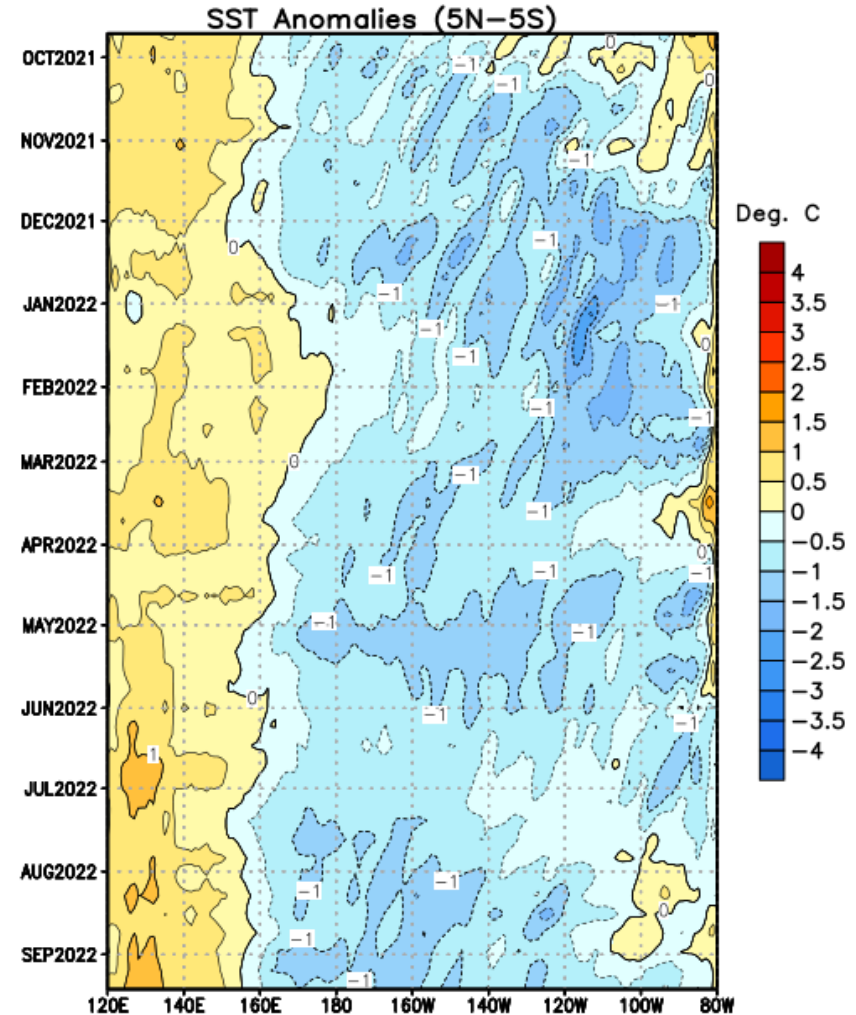
Niño Region SST Departures (ºC) Recent Evolution

The latest weekly SST departures are:

Niño 4	-0.9ºC
Niño 3.4	-0.9ºC
Niño 3	-0.8ºC
Niño 1+2	-0.8ºC

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

In the last four weeks, equatorial SSTs were below average across most of the Pacific Ocean.
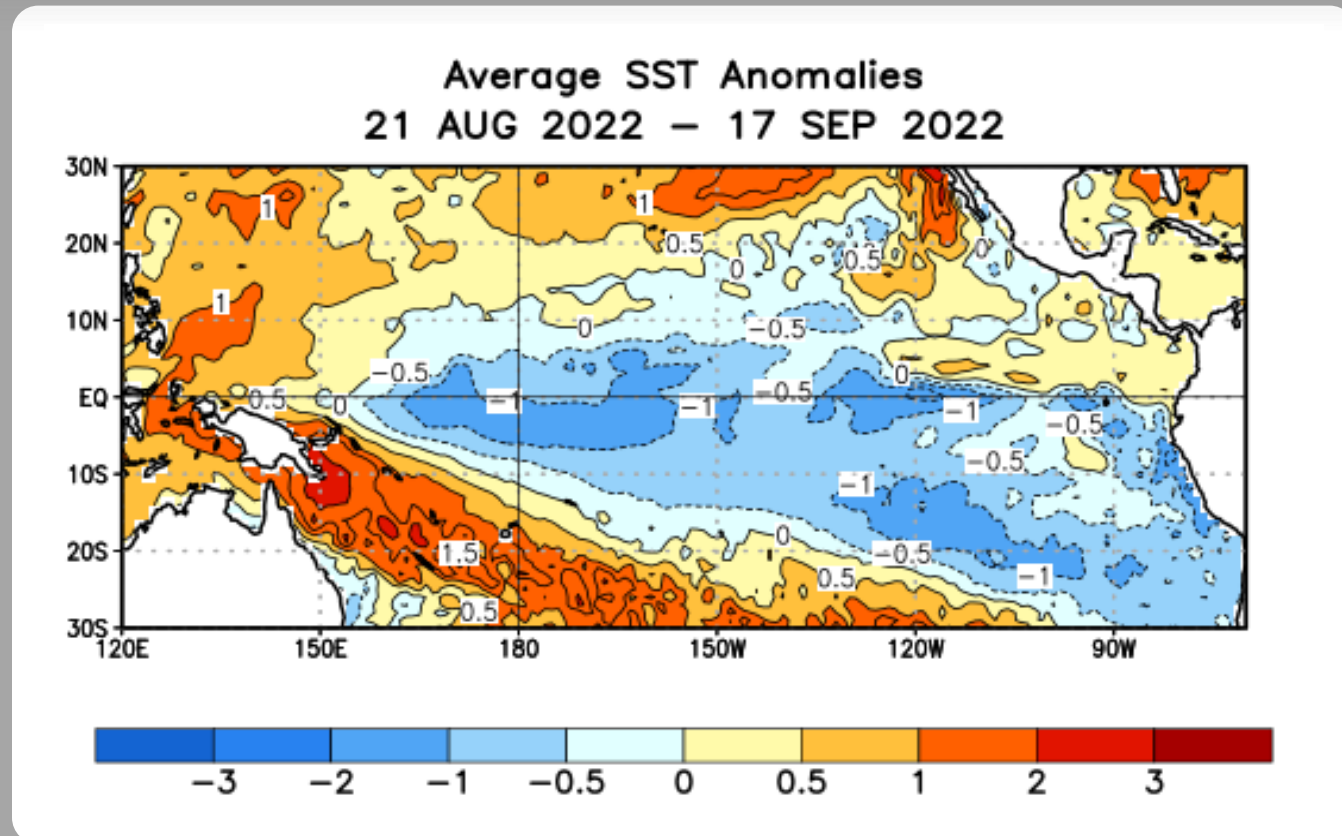
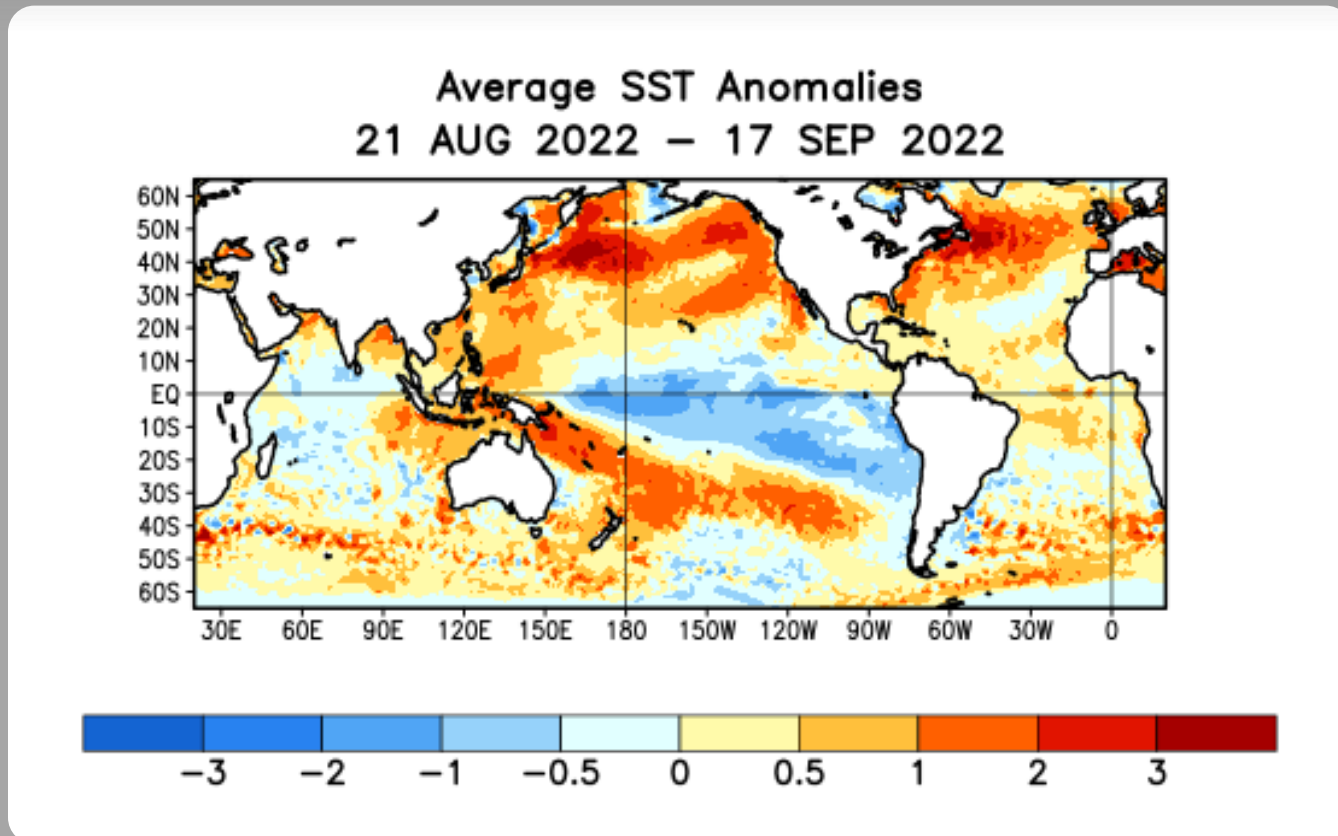# Global SST Departures (°C) During the Last Four Weeks
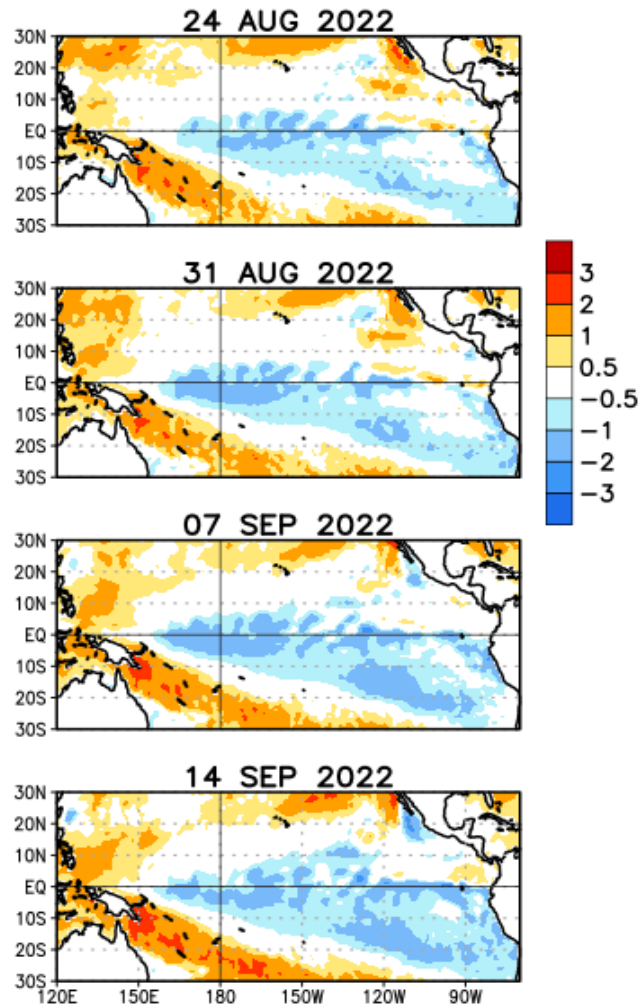
During the last four weeks, equatorial SSTs were below average across most of the Pacific Ocean. Equatorial SSTs were above average around Indonesia and in parts of the Atlantic Ocean.

Average SST Anomalies
21 AUG 2022 − 17 SEP 2022

Weekly SST Departures during the Last Four Weeks

During the last 4 weeks, negative SST anomalies have strengthened in the eastern equatorial Pacific Ocean.

Change in Weekly SST Departures over the Last Four Weeks

During the last four weeks, positive changes in equatorial SST anomalies were observed in the east-central Pacific Ocean. A negative change is evident in the far eastern Pacific Ocean.

Change in Weekly SST Anoms (°C)
14SEP2022 minus 17AUG2022
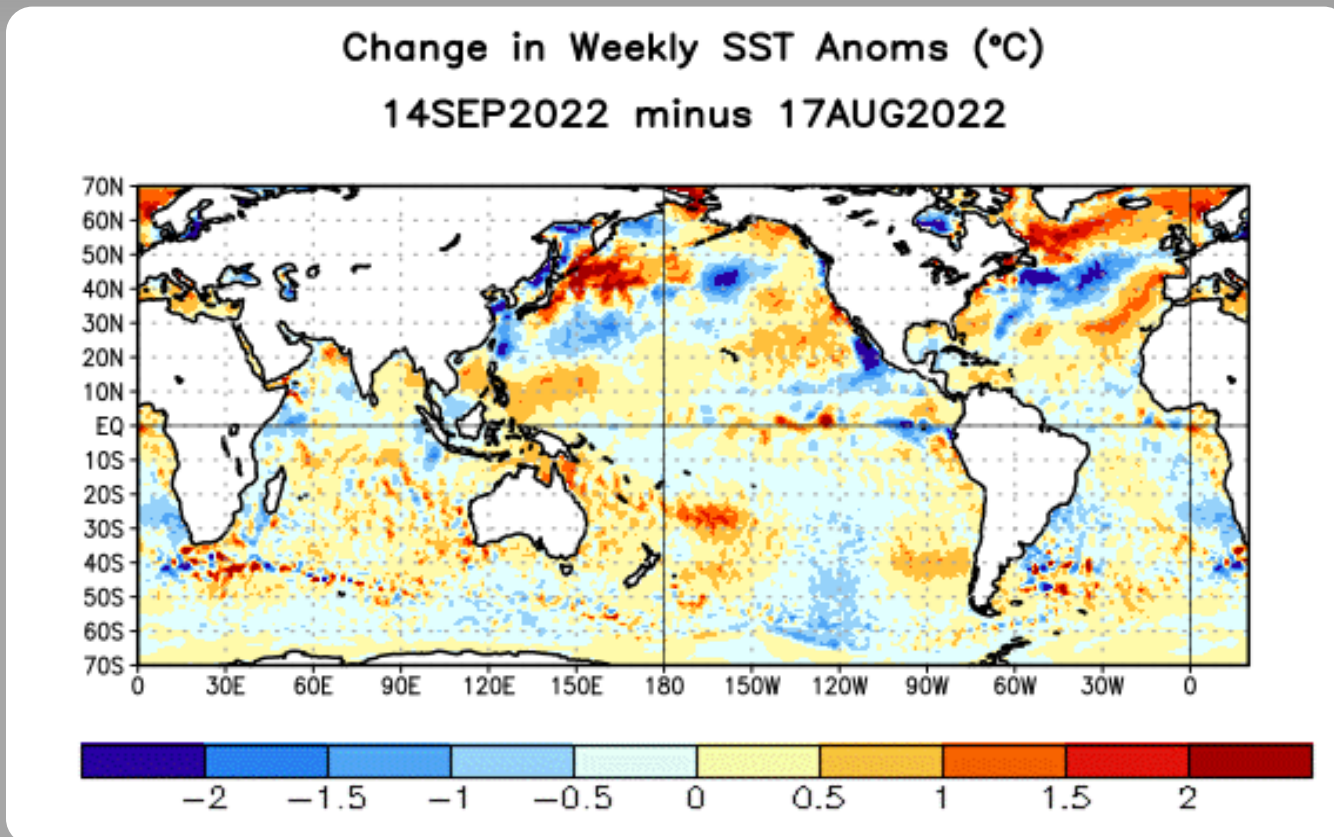
Upper-Ocean Conditions in the Equatorial Pacific

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 20ºC isotherm between the western Pacific (160ºE-150ºW) and the eastern Pacific (90º-140ºW).
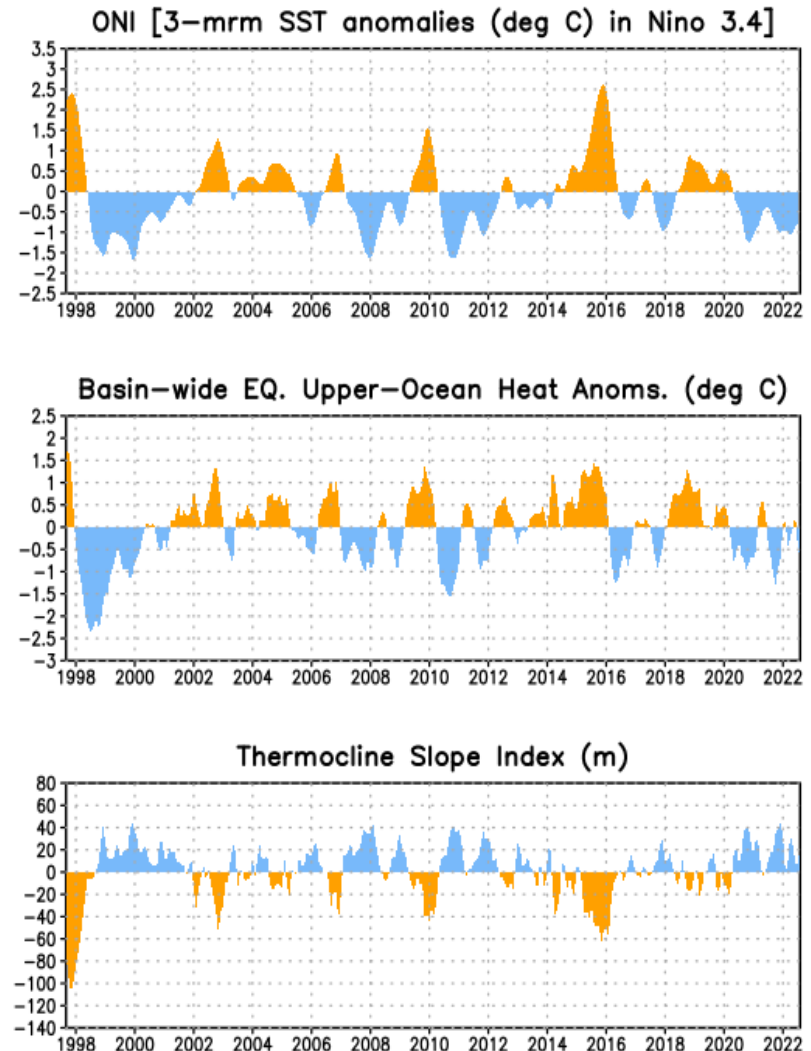
# Central and Eastern Pacific Upper-Ocean (0-300 m) Weekly Average Temperature Anomalies

During February 2022 through mid-March, subsurface temperature anomalies decreased and were negative. From mid-March to mid-June, subsurface temperature anomalies increased from negative to positive. Anomalies decreased from mid-June through July and have remained negative.

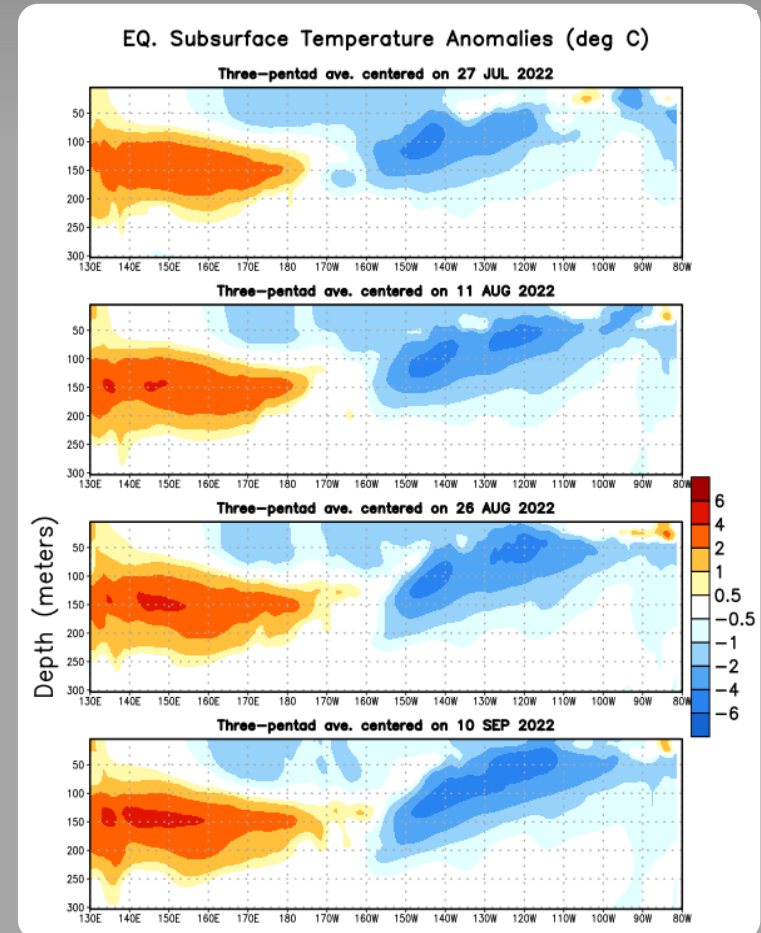EQ. Upper-Ocean Heat Anoms. (deg C) for 180-100W
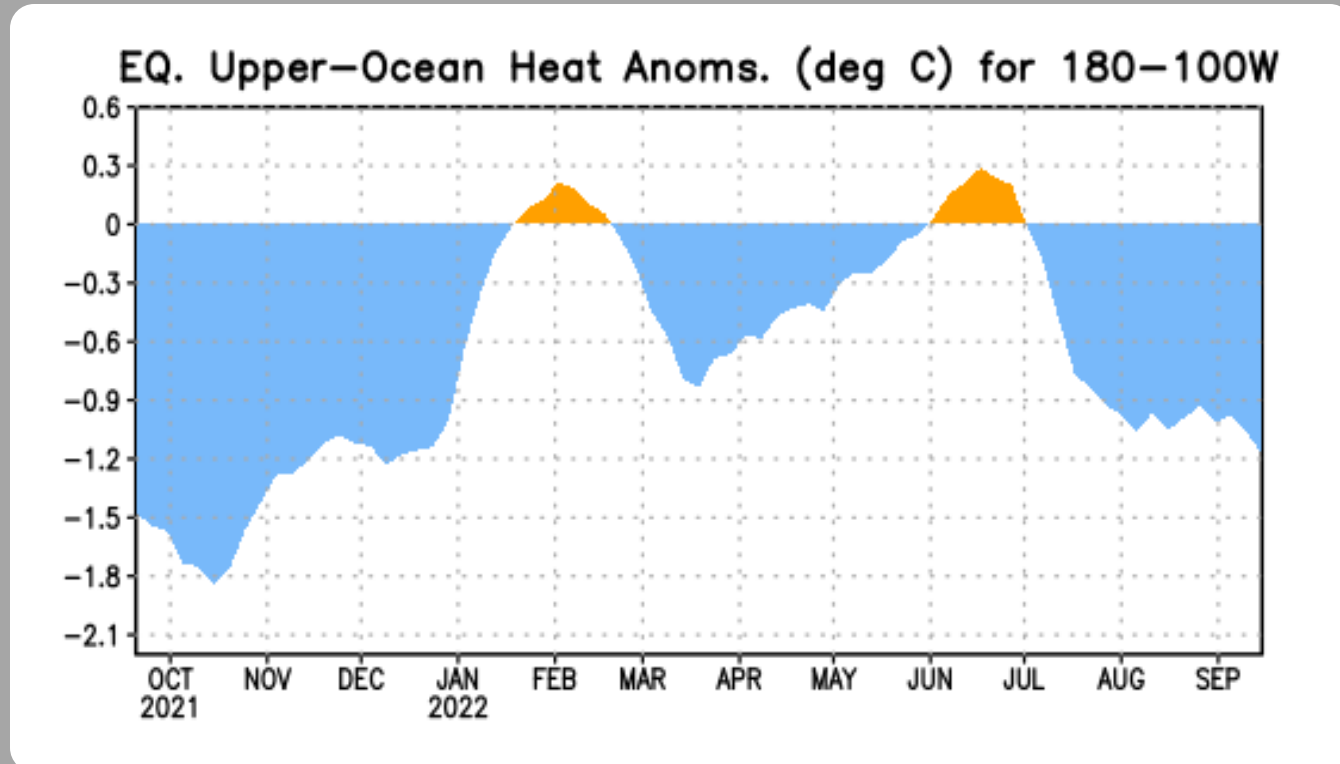
Sub-Surface Temperature Departures in the Equatorial Pacific

During the last two months, negative subsurface temperature anomalies strengthened and persisted near the surface and at depth in the eastern and east-central Pacific.

EQ. Subsurface Temperature Anomalies (deg C)
Pentad centered on 15 SEP 2022

Most recent pentad analysis
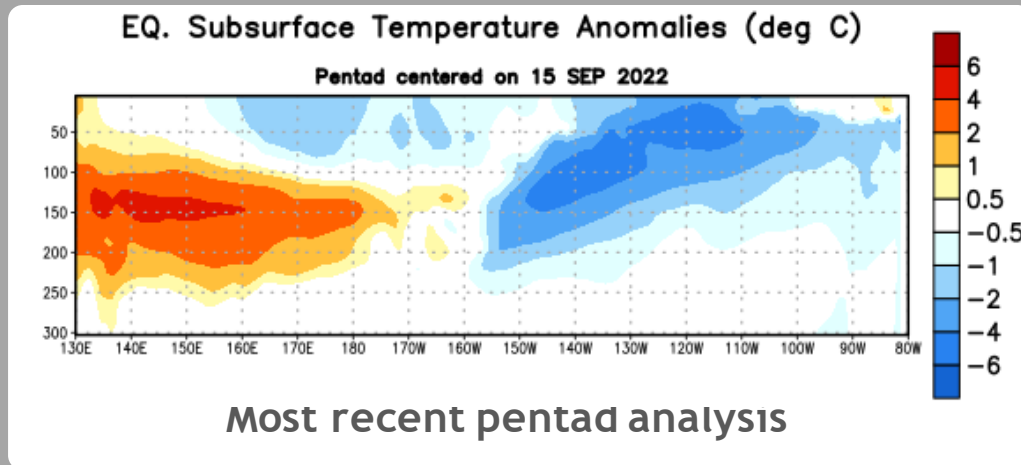
Positive subsurface temperature anomalies have persisted, at depth, in the western and central Pacific Ocean.

EQ. Subsurface Temperature Anomalies (deg C)
Three-pentad ave. centered on 27 JUL 2022
Three-pentad ave. centered on 11 AUG 2022
Three-pentad ave. centered on 26 AUG 2022
Three-pentad ave. centered on 10 SEP 2022

Tropical OLR and Wind Anomalies During the Last 30 Days

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

Low-level (850-hPa) easterly wind anomalies were evident across most of the equatorial Pacific Ocean.

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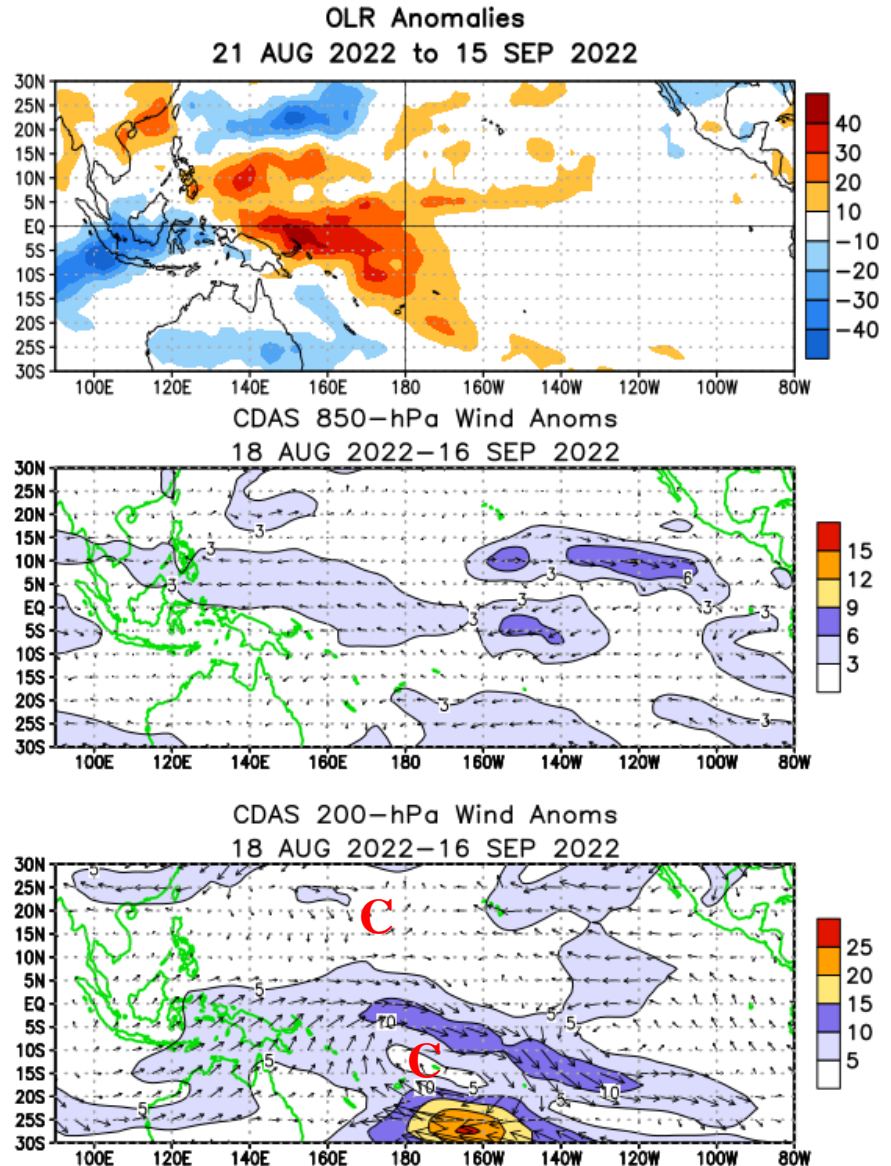
Intraseasonal Variability

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.

During March- May 2022, an upwelling Kelvin wave shifted eastward into the eastern Pacific Ocean, which was followed by a downwelling Kelvin wave.

During July and August 2022, an upwelling Kelvin wave expanded eastward. Subsurface temperature anomalies have become stationary and remain negative in the east-central and eastern Pacific Ocean.

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.


EQ. Upper—Ocean Heat Anoms. (deg C)
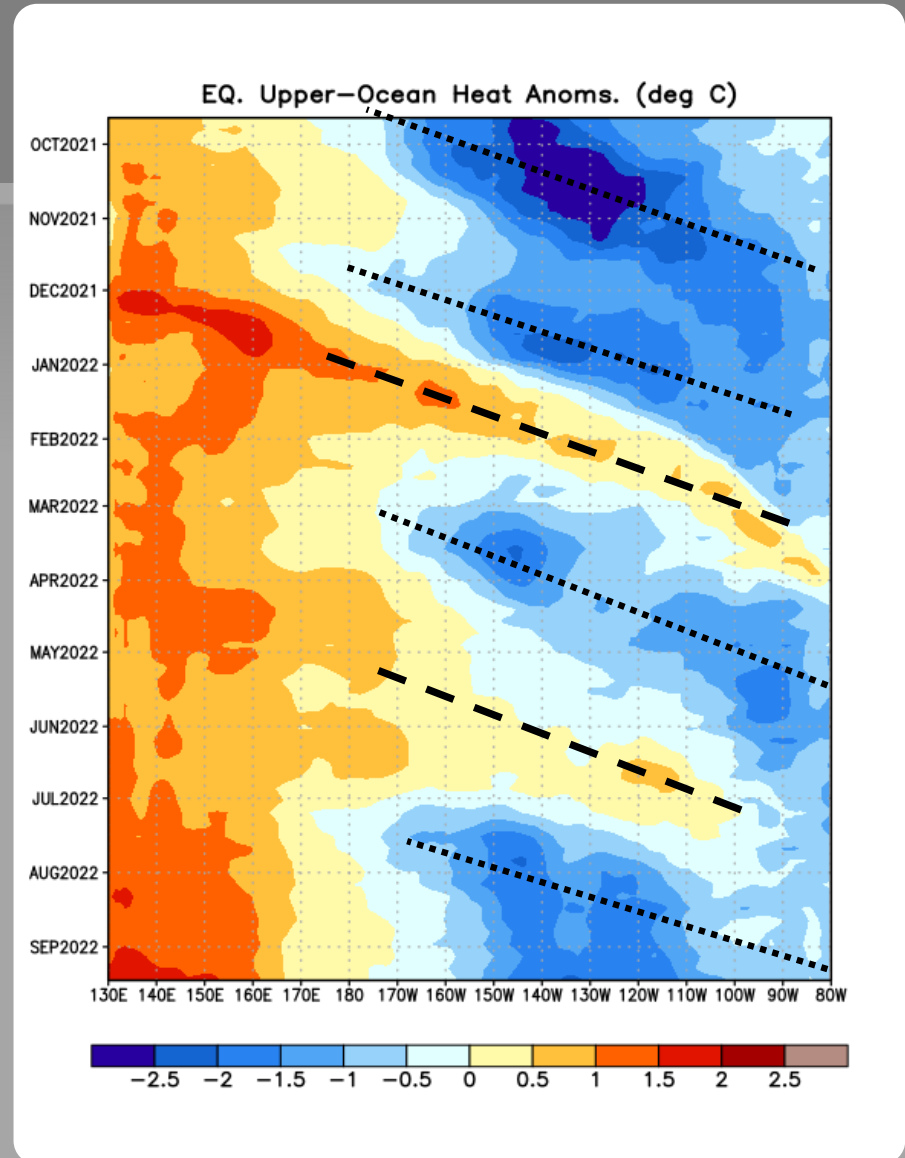
Low-level (850-hPa) Zonal (east-west) Wind Anomalies (m s^{-1})

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 mid-May 2022, early-to-mid June 2022, and early September 2022.

CDAS 850−hPa U Anoms. (5N−5S)

Westerly Wind Anomalies (orange/red shading)
Easterly Wind Anomalies (blue shading)
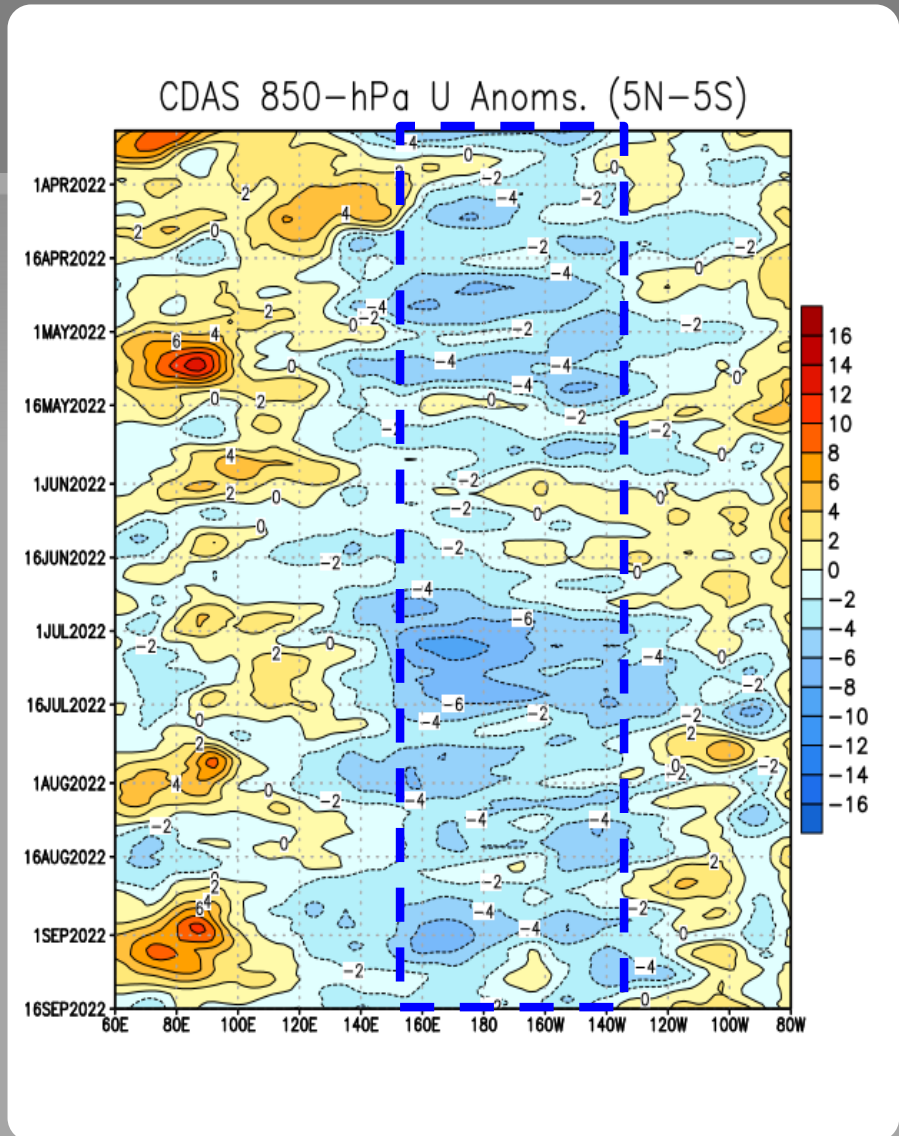
Upper-level (200-hPa) Velocity Potential Anomalies

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

200-hPa Velocity Potential Anomaly: 5N-5S
5-day Running Mean

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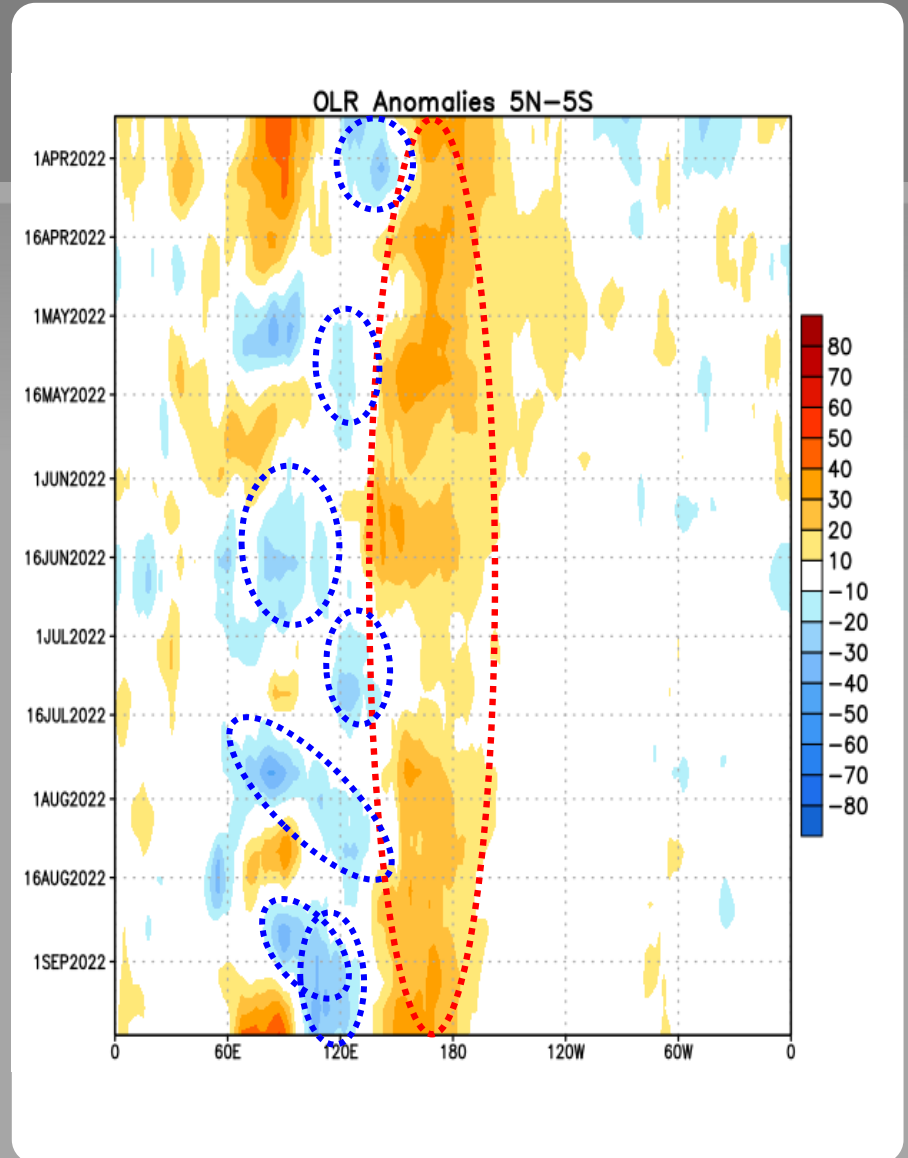Favorable for precipitation (green shading)

Note: Eastward propagation is not necessarily indicative of the Madden-Julian Oscillation (MJO).
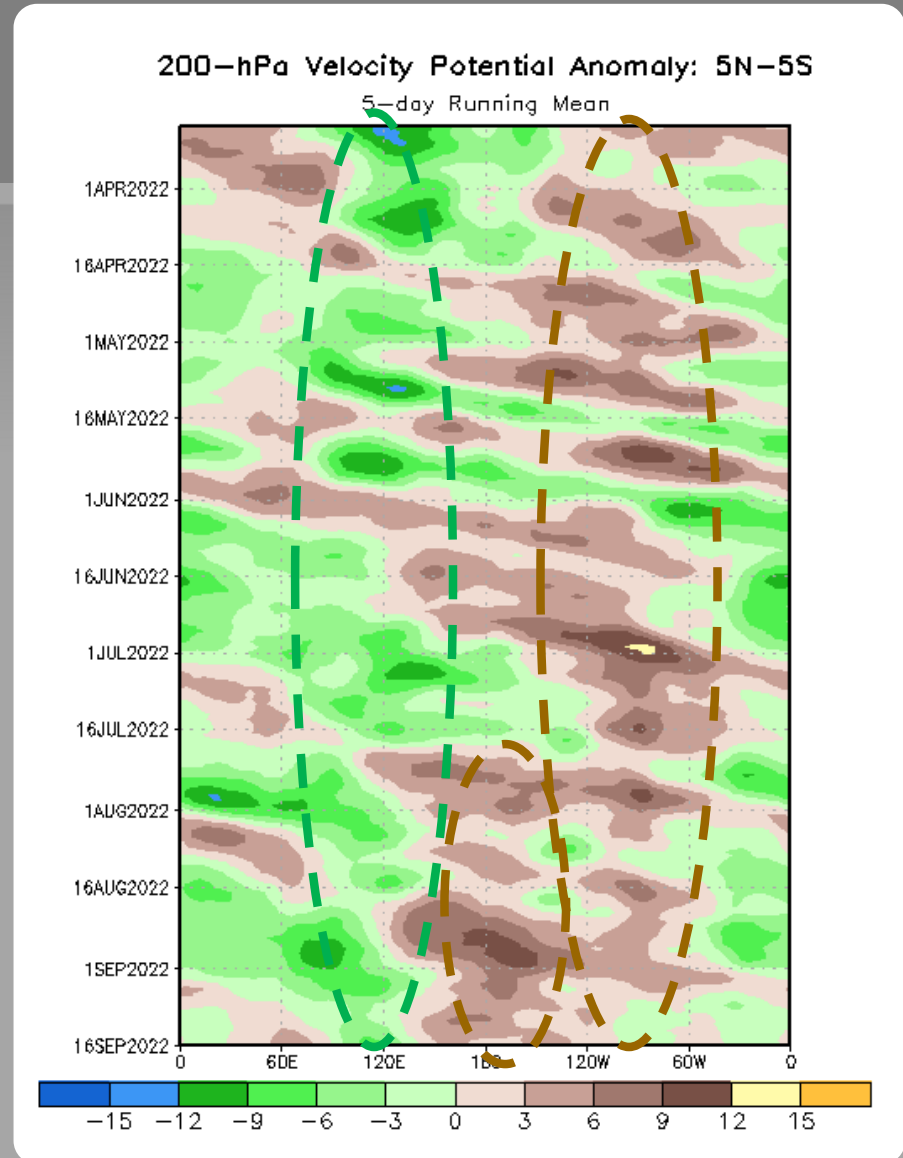
Outgoing Longwave Radiation (OLR) Anomalies

Since late July 2021, positive OLR anomalies were evident over the western and/or central Pacific Ocean.

Negative OLR anomalies were periodically observed over 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 +0.5°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 (June – August 2022) is -0.8°C.

El Niño
Neutral
La Niña

Oceanic Nino Index (ERSST.v5 ONI)
3mrm Nino 3.4 SST Anomalies (varying 30yr base period)
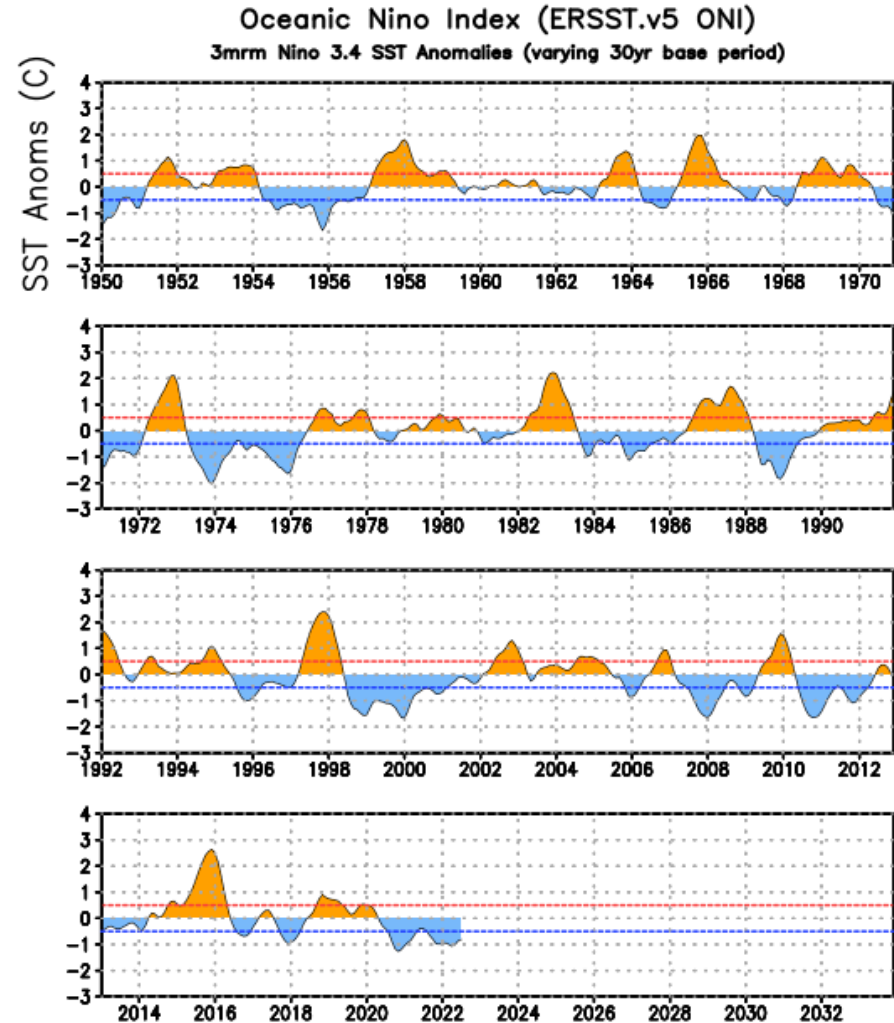
Historical El Niño and La Niña Episodes Based on the ONI computed using ERSST.v5

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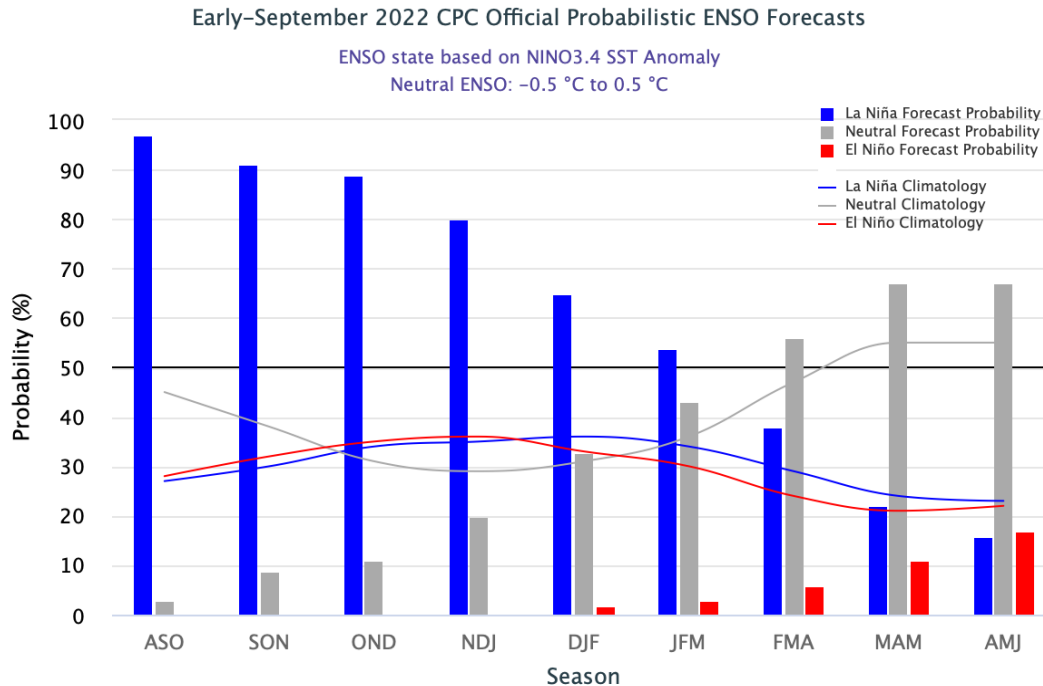
The ONI is one measure of the El Niño-Southern Oscillation, and other indices can confirm whether features consistent with a coupled ocean-atmosphere phenomenon accompanied these periods. The complete table going back to DJF 1950 can be found here.

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					

CPC Probabilistic ENSO Outlook

Updated: 8 September 2022

Chances of La Niña gradually decrease through the Northern Hemisphere fall and winter, with ENSO-neutral favored beginning in February-April 2023.

Early–September 2022 CPC Official Probabilistic ENSO Forecasts

ENSO state based on NINO3.4 SST Anomaly
Neutral ENSO: −0.5 °C to 0.5 °C

IRI Pacific Niño 3.4 SST Model Outlook

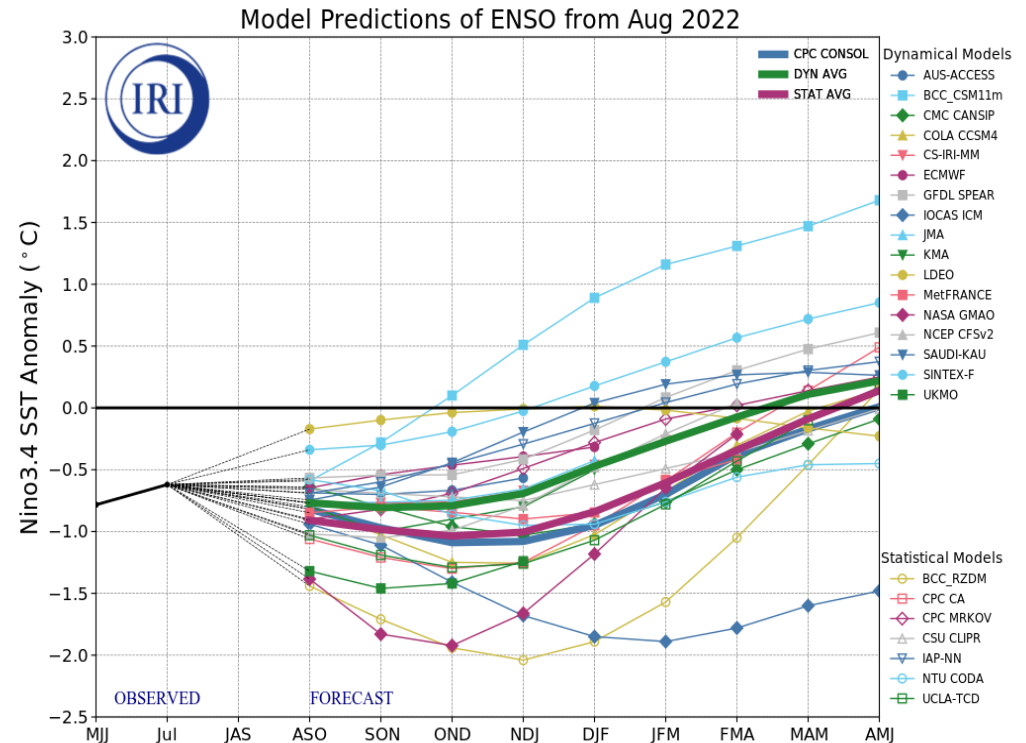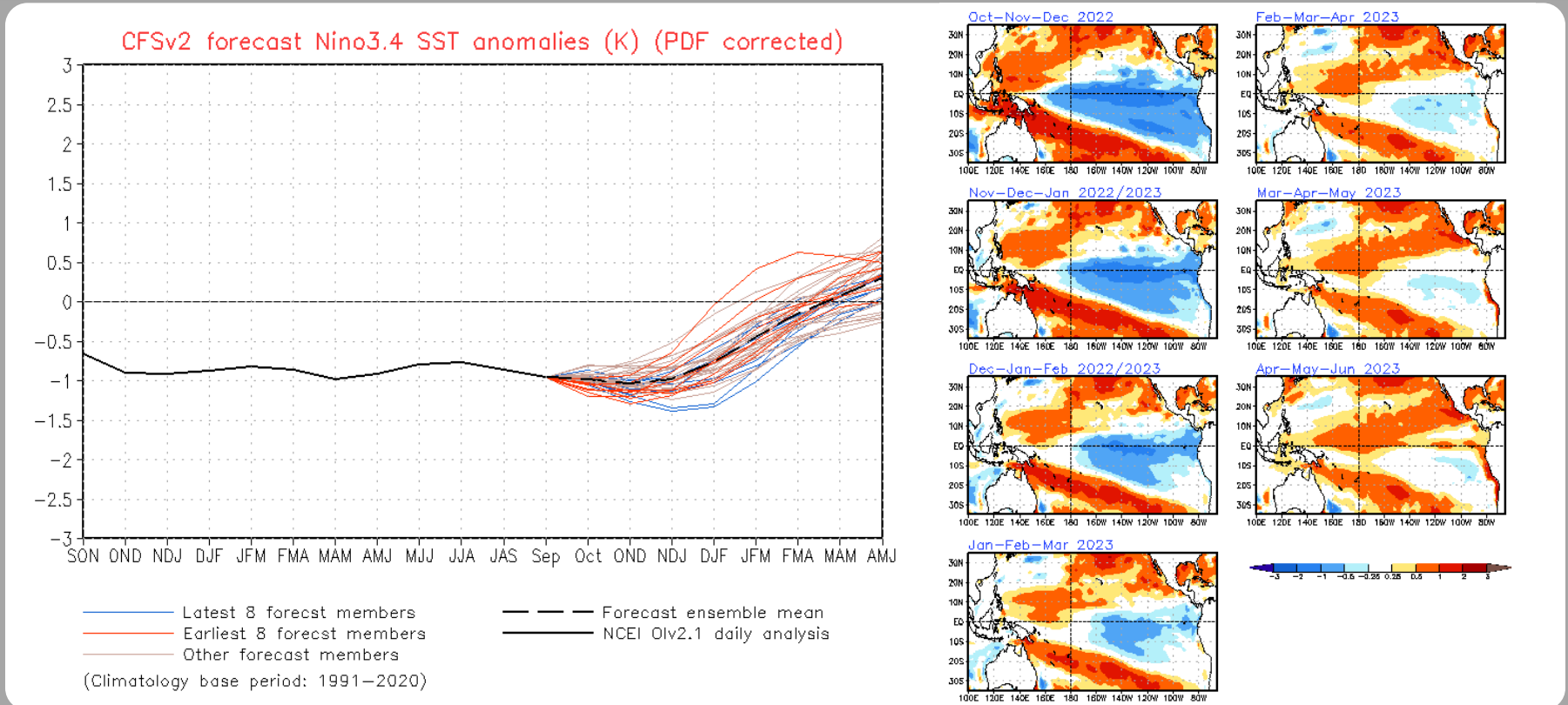La Nina is expected to persist through the Northern Hemisphere winter 2022-23.

Figure provided by the International Research Institute (IRI) for Climate and Society (updated 19 August 2022).

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

Issued: 19 September 2022

The CFS.v2 ensemble mean (black dashed line) indicates La Niña persisting into the Northern Hemisphere winter 2022-23, and then transitioning to ENSO-neutral around January-March 2023.

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

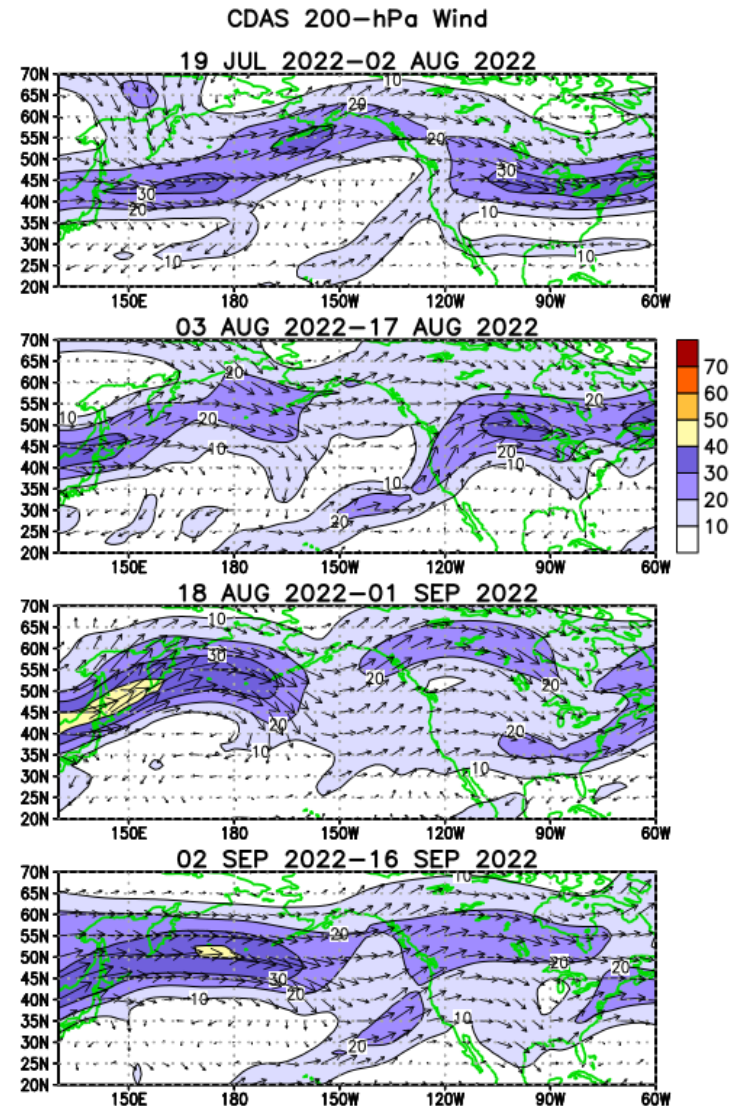Since late July, above-average heights and temperatures persisted over the northwestern U.S.
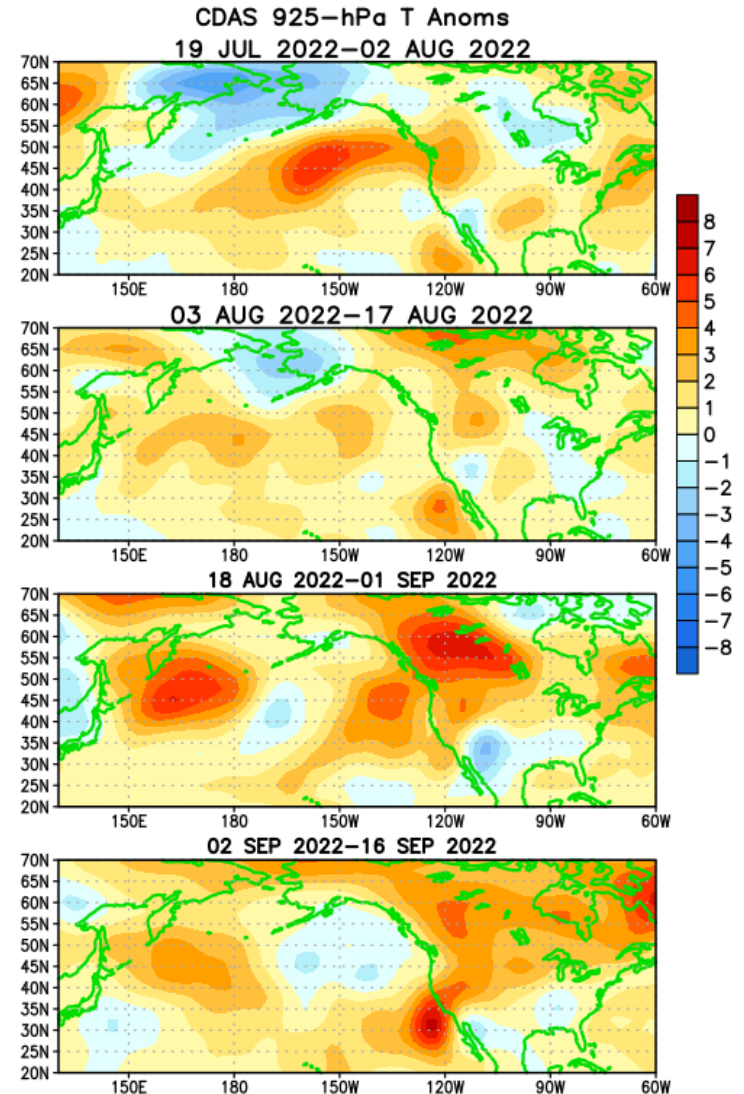
Since early August, below-average heights and temperatures have dominated the southeastern U.S.

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

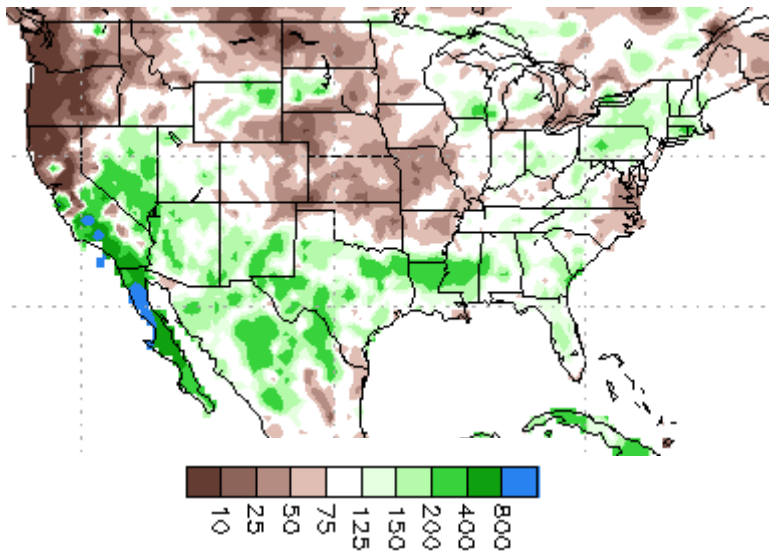Since late July, above-average heights and temperatures persisted over the northwestern U.S.

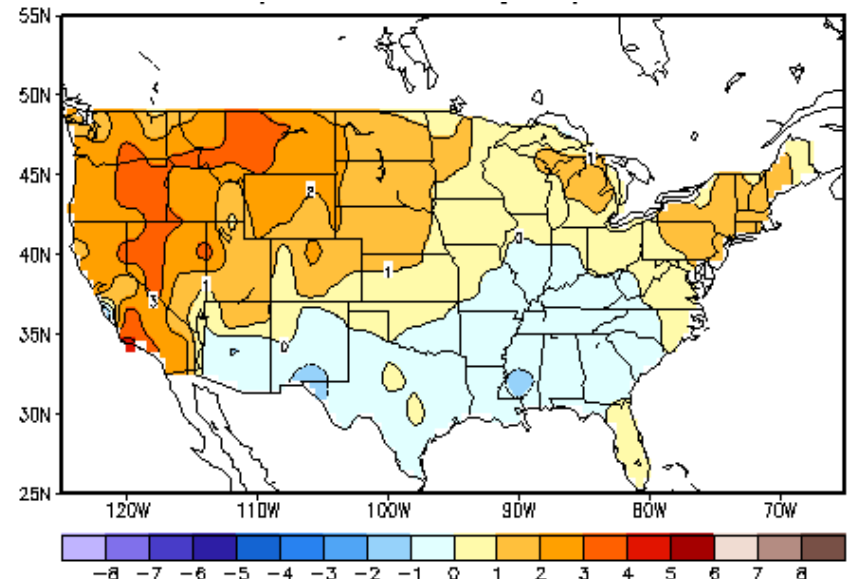Since early August, below-average heights and temperatures have dominated the southeastern U.S.

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

Since late July, above-average heights and temperatures persisted over the northwestern U.S.

Since early August, below-average heights and temperatures have dominated the southeastern U.S.

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

End Date: 17 September 2022
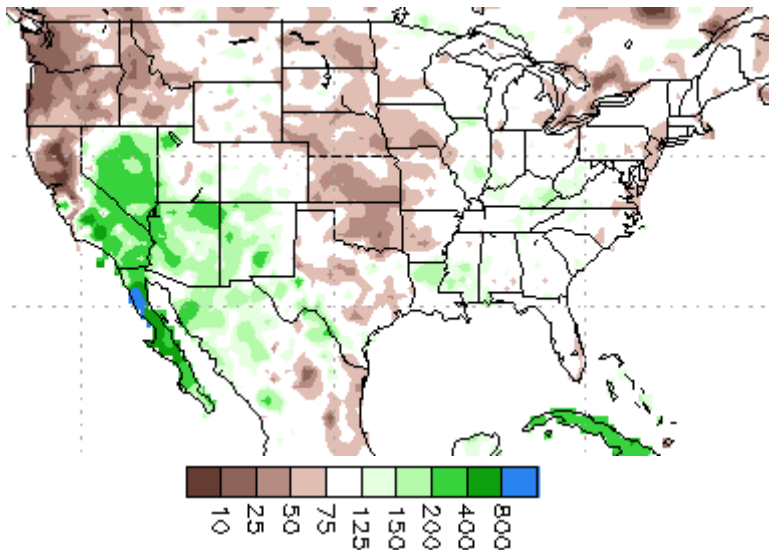

Percent of Average Precipitation
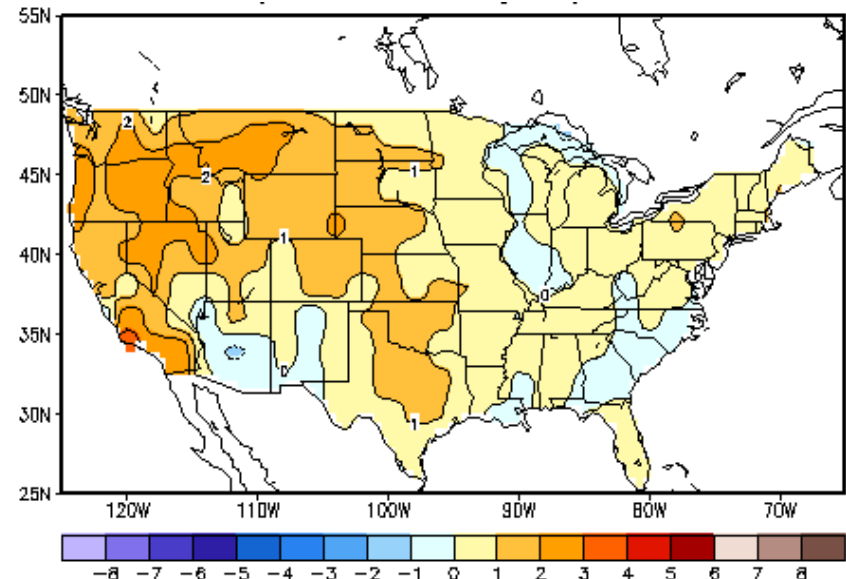
Temperature Departures (degree C)

End Date: 17 September 2022

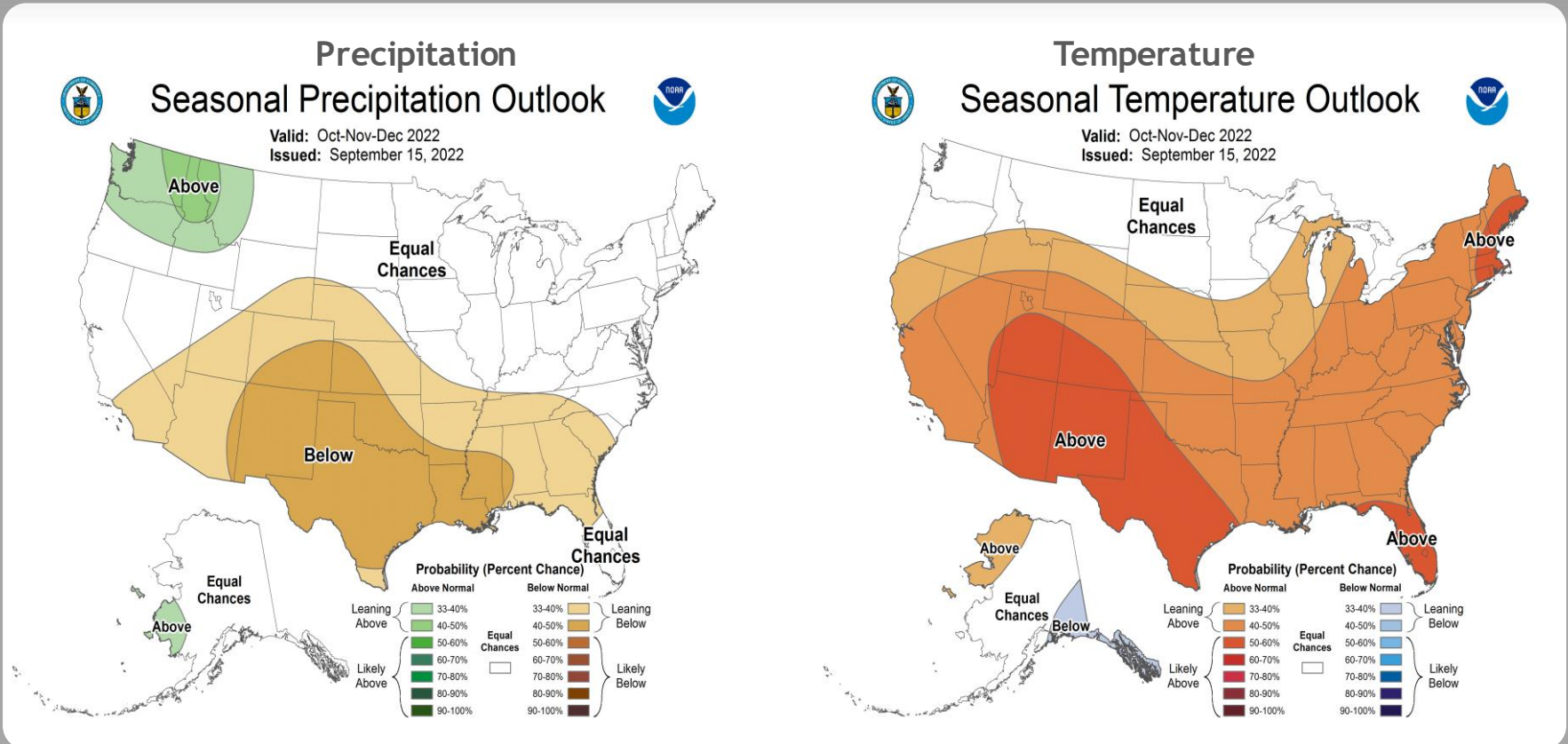Percent of Average Precipitation

Temperature Departures (degree C)

U. S. Seasonal Outlooks

October – December 2022

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

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.

La Niña is favored to continue through Northern Hemisphere winter 2022-23, with a 91% chance in September-November, decreasing to a 54% chance in January-March 2023.*

* 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.