

ENSO: Recent Evolution, Current Status and Predictions



Update prepared by:
Climate Prediction Center / NCEP
25 January 2021

Outline

Summary

Recent Evolution and Current Conditions

Oceanic Niño Index (ONI)

Pacific SST Outlook

U.S. Seasonal Precipitation and Temperature Outlooks

Summary

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

La Niña conditions are present.*

Equatorial sea surface temperatures (SSTs) are below average from the west-central to eastern Pacific Ocean.

The tropical atmospheric circulation is consistent with La Niña.

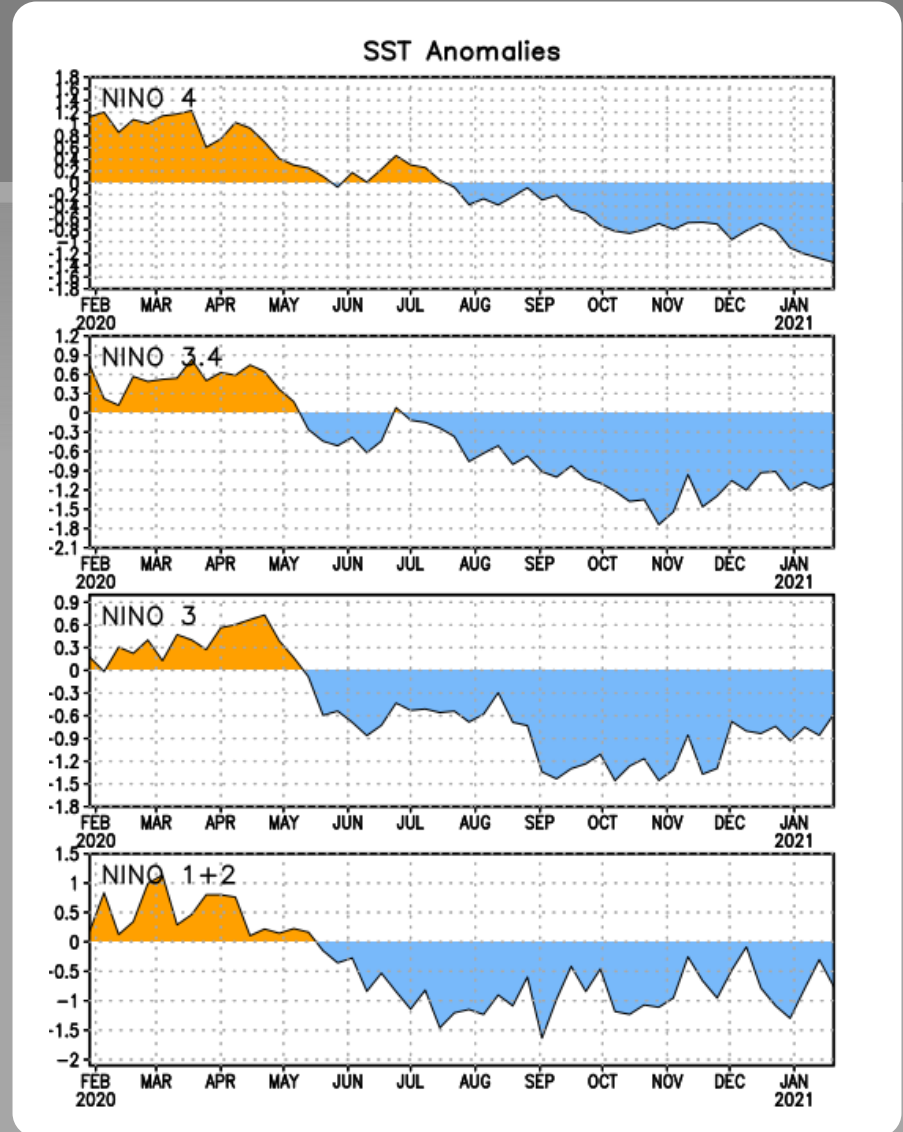
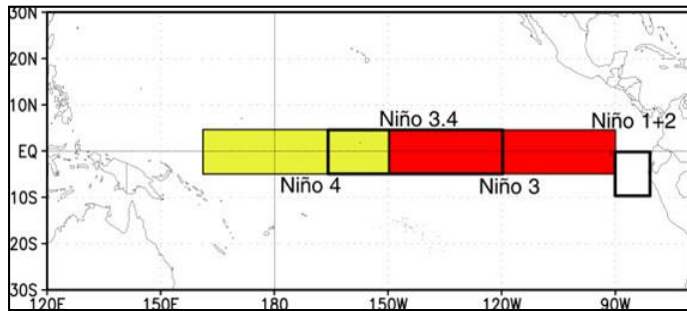
La Niña is expected to continue through the Northern Hemisphere winter 2020-21 (~95% chance during January-March), with a potential transition to ENSO-neutral during the spring 2021 (55% chance during April-June).*

* 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](#).

Niño Region SST Departures (°C) Recent Evolution

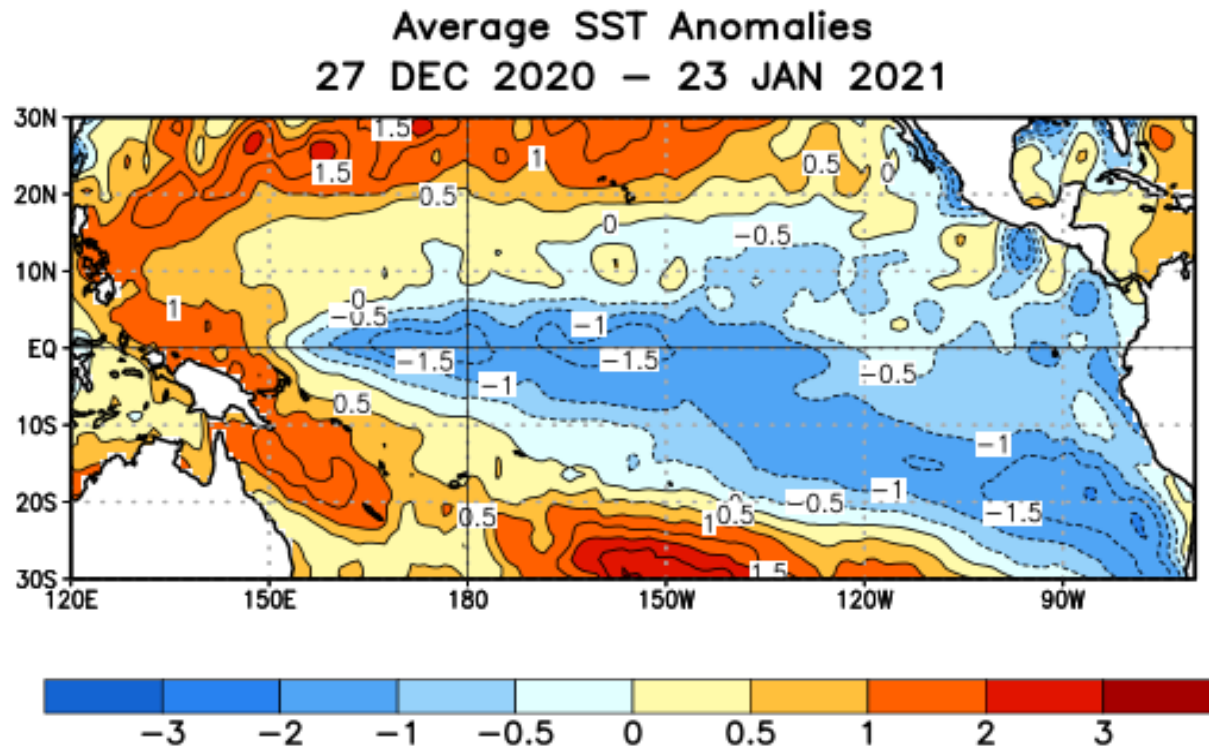
The latest weekly SST departures are:

Niño 4	-1.4°C
Niño 3.4	-1.1°C
Niño 3	-0.6°C
Niño 1+2	-0.8°C



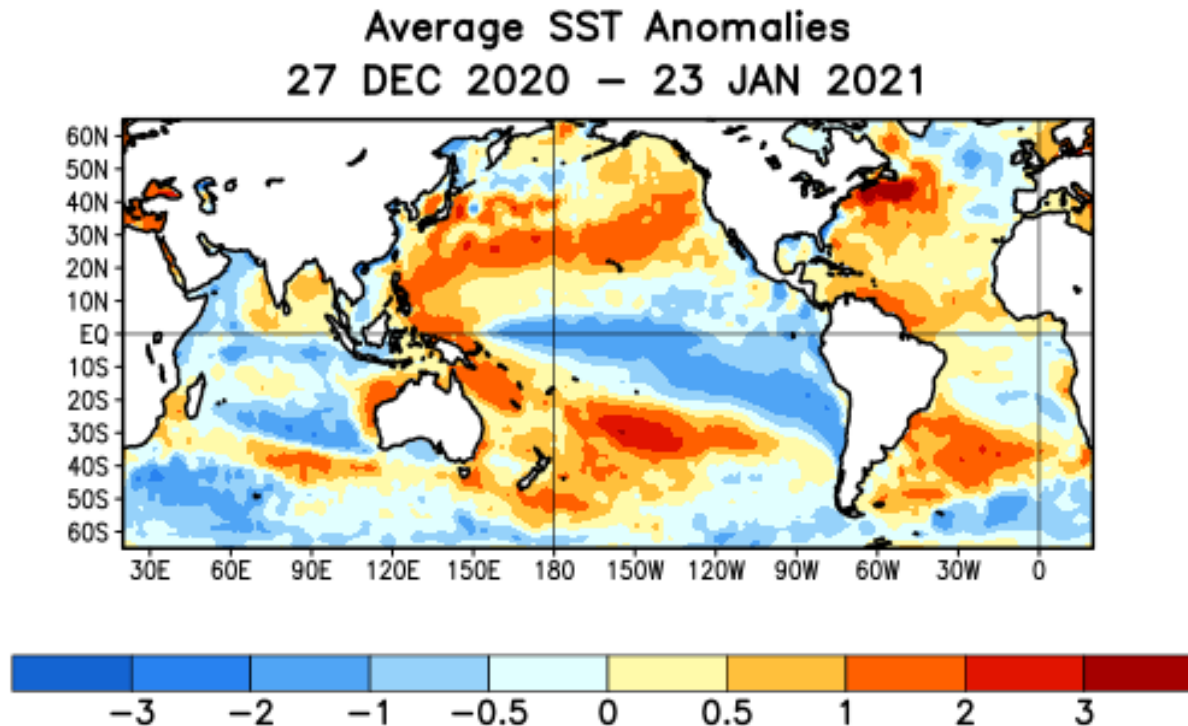
SST Departures ($^{\circ}\text{C}$) in the Tropical Pacific During the Last Four Weeks

During the last four weeks, equatorial SSTs were below average from west of the Date Line to the eastern Pacific Ocean. Below-average SSTs were strongest in the central equatorial Pacific Ocean.



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

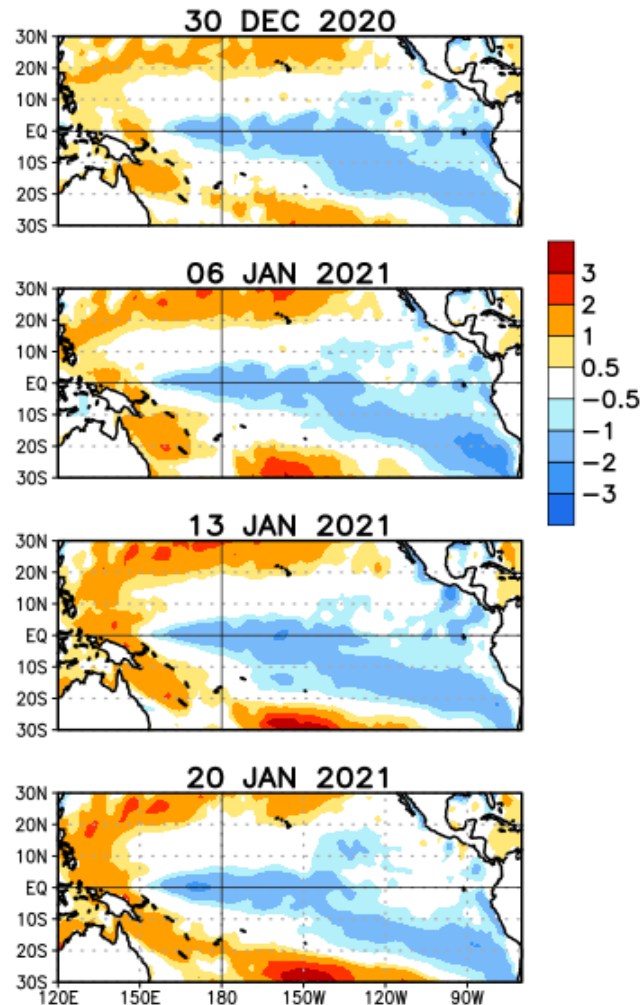
During the last four weeks, equatorial SSTs were above average across the far western Pacific Ocean. SSTs were below average from the west-central to the eastern Pacific Ocean and in the western Indian Ocean.



Weekly SST Departures during the Last Four Weeks

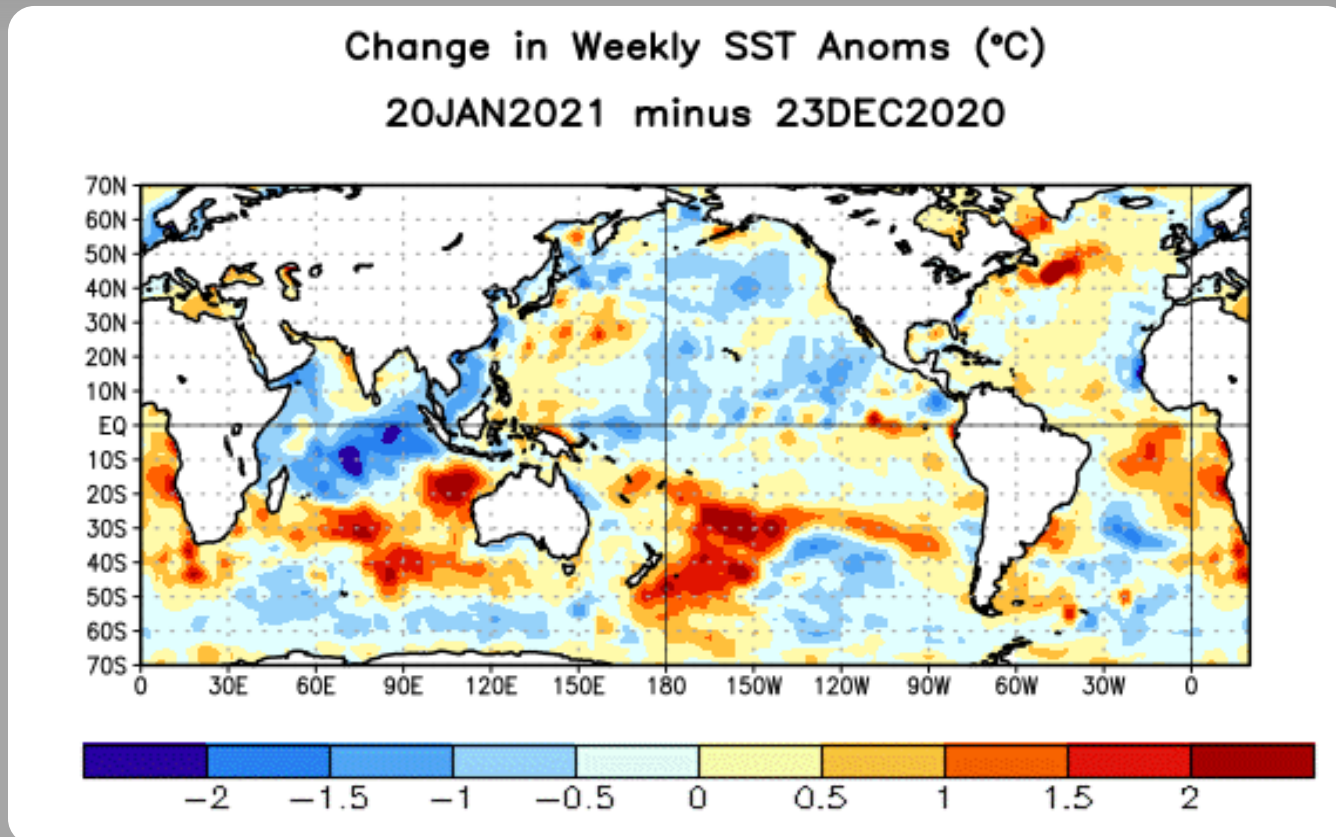
During the last four weeks, below-average SSTs have strengthened in the central equatorial Pacific Ocean, while weakening in the eastern equatorial Pacific Ocean.

Weekly SST Anomalies (DEG C)



Change in Weekly SST Departures over the Last Four Weeks

During the last four weeks, the changes in equatorial SST anomalies were negative around the Date Line and western Pacific Ocean.



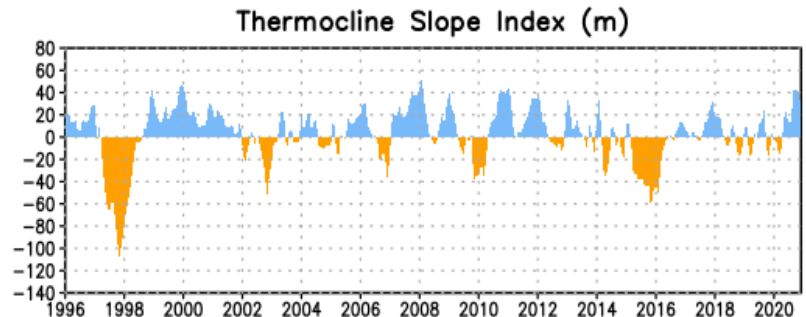
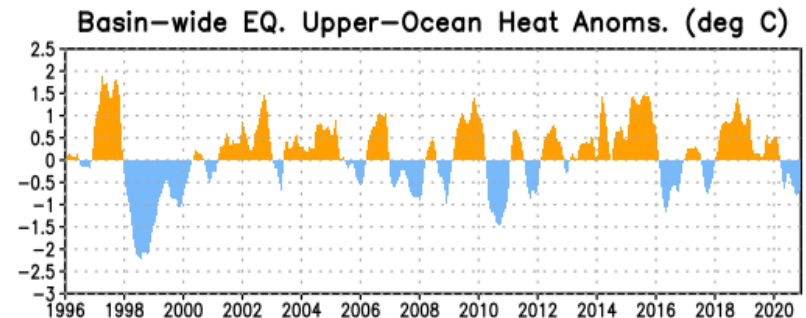
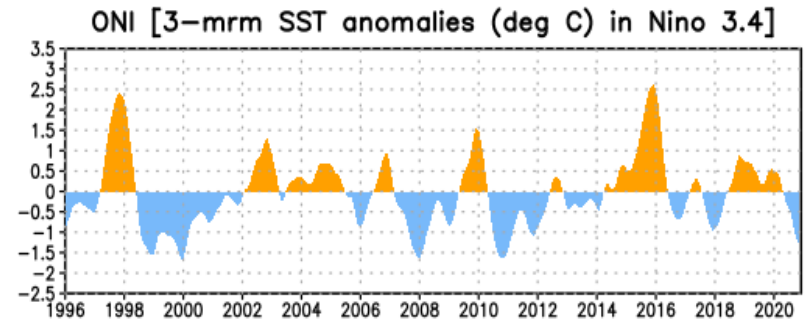
Upper-Ocean Conditions in the Equatorial Pacific

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.

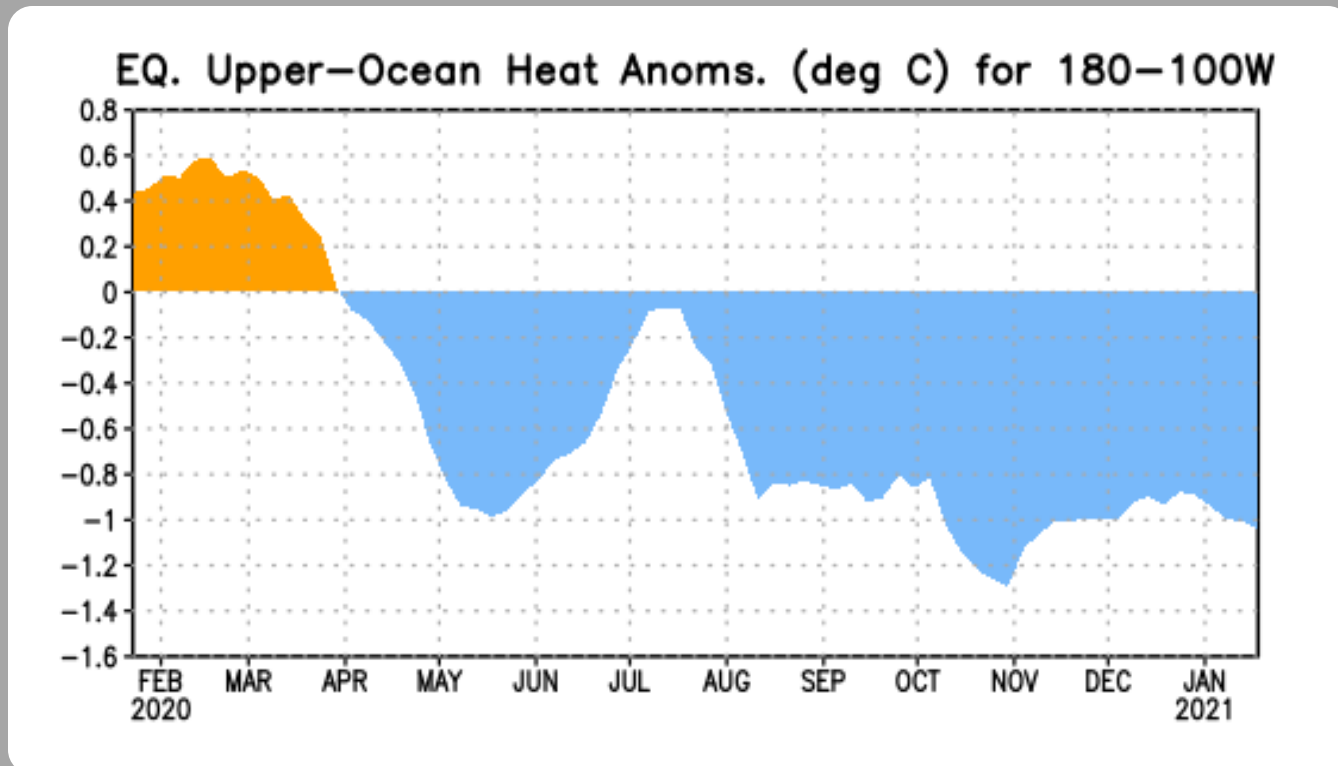
Recent values of the upper-ocean heat anomalies (below average) and thermocline slope index (above average) reflect La Niña.

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).



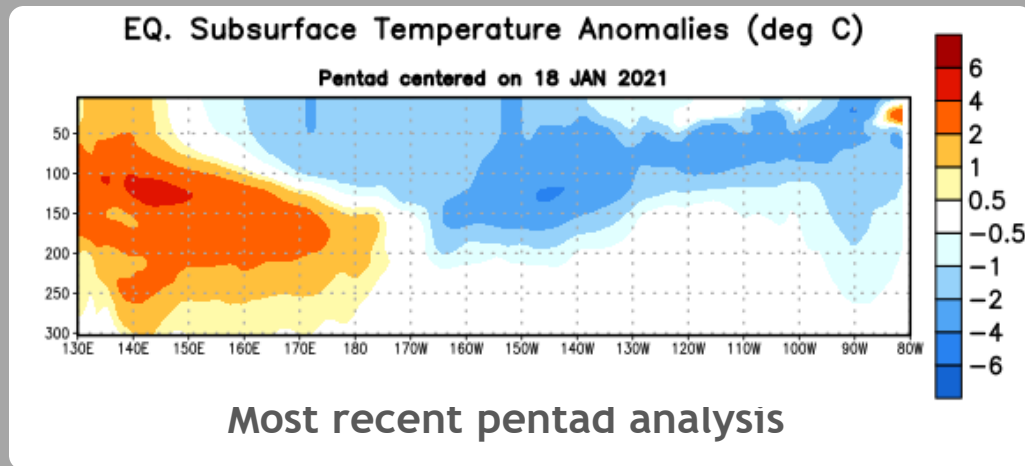
Central and Eastern Pacific Upper-Ocean (0-300 m) Weekly Average Temperature Anomalies

Subsurface temperature anomalies decreased from March-May 2020, before weakening in June. Starting in mid-July, negative anomalies strengthened and then persisted through early October. Negative anomalies strengthened again in October, but then slightly weakened. Since mid-December, negative temperature anomalies have persisted.

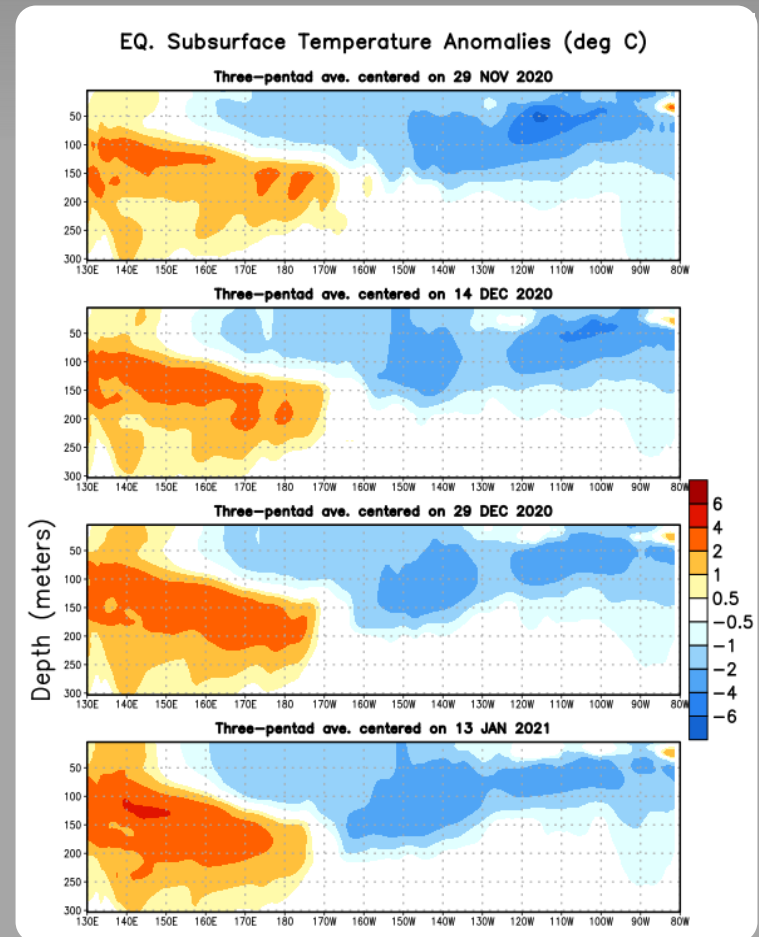


Sub-Surface Temperature Departures in the Equatorial Pacific

In the last two months, negative subsurface temperature anomalies have persisted from the central to the eastern Pacific Ocean.



Meanwhile, positive subsurface temperature anomalies have remained in the western Pacific Ocean and at depth near the Date Line.

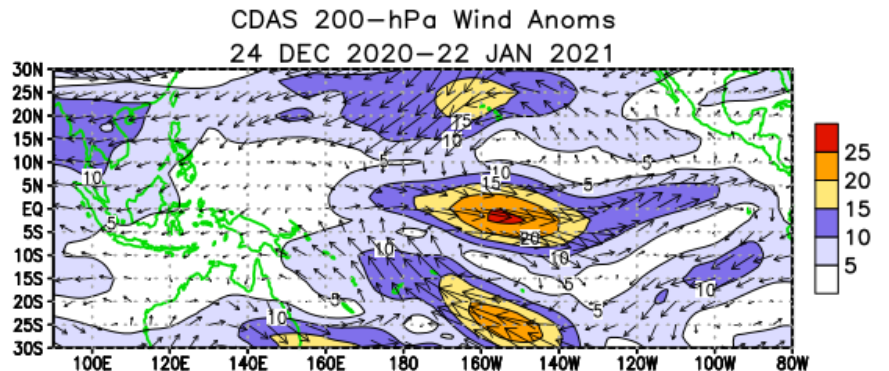
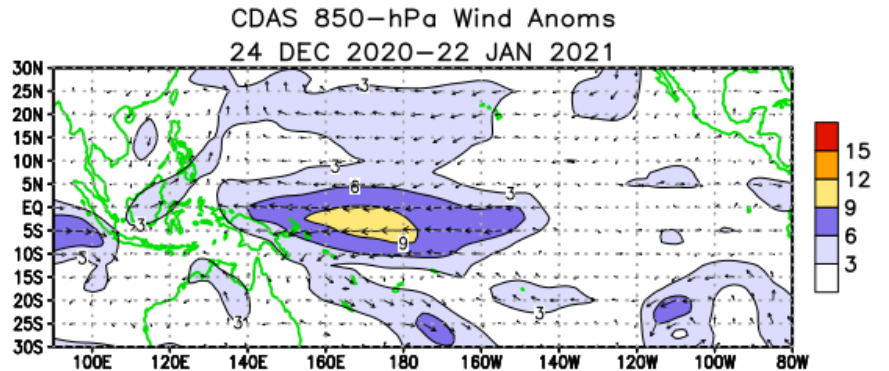
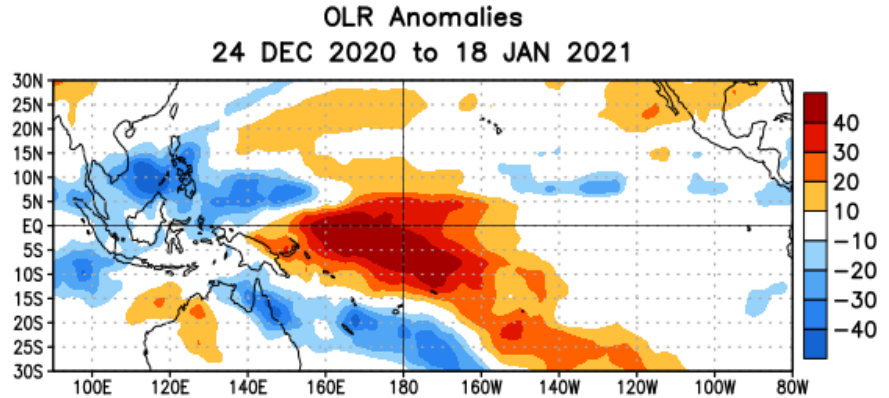


Tropical OLR and Wind Anomalies During the Last 30 Days

Positive OLR anomalies (suppressed convection and precipitation) extended from the western to the central Pacific Ocean. Negative OLR anomalies (enhanced convection and precipitation) were evident over Indonesia, the Philippines, and northern Australia.

Low-level (850-hPa) easterly wind anomalies were evident from the western to east-central equatorial Pacific Ocean.

Upper-level (200-hPa) westerly wind anomalies were observed over most of the 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

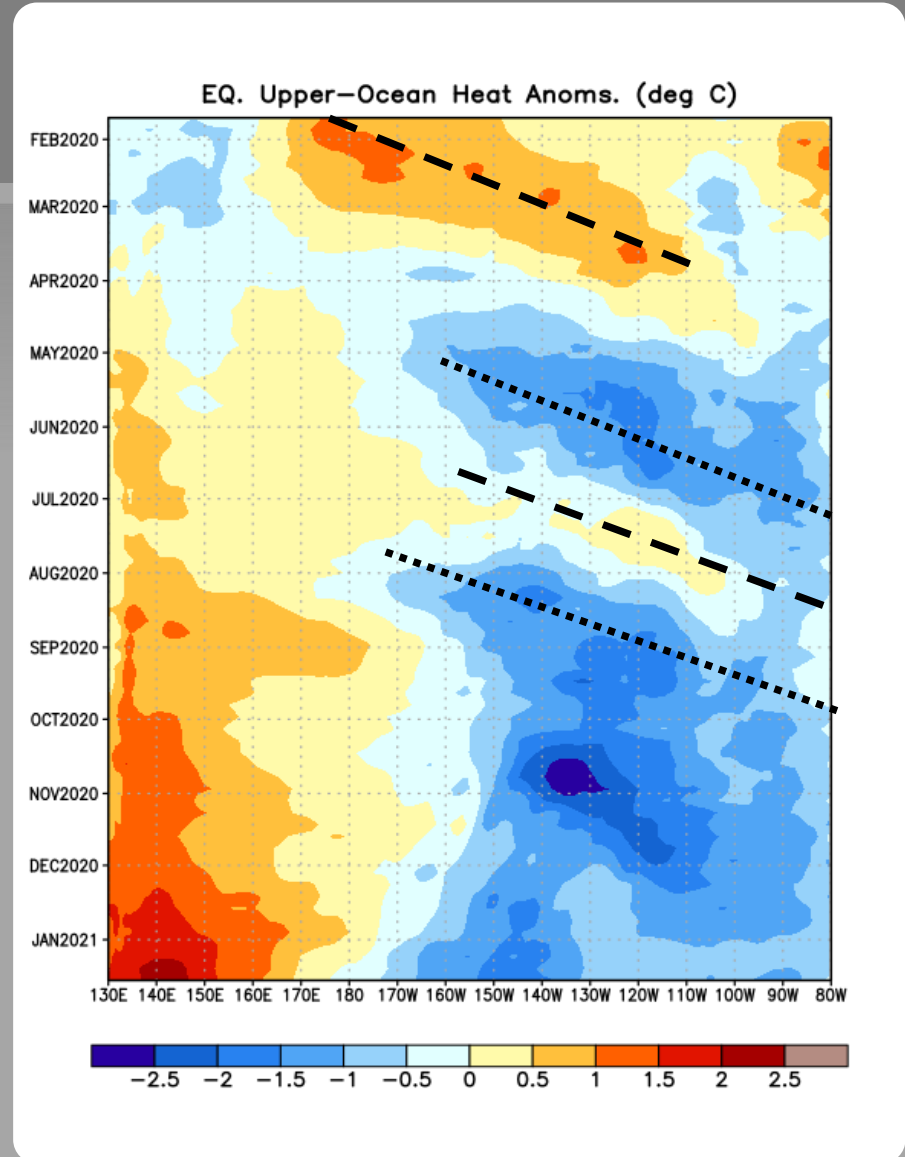
Significant equatorial oceanic Kelvin wave activity (dashed and dotted lines) has been present throughout the period shown.

During April-June and August-September 2020, negative subsurface temperature anomalies were associated with upwelling Kelvin waves.

Since August 2020, negative subsurface temperature anomalies have persisted in the eastern half of the Pacific Ocean.

Since early December 2020, negative anomalies have strengthened between 170°W-130°W.

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



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

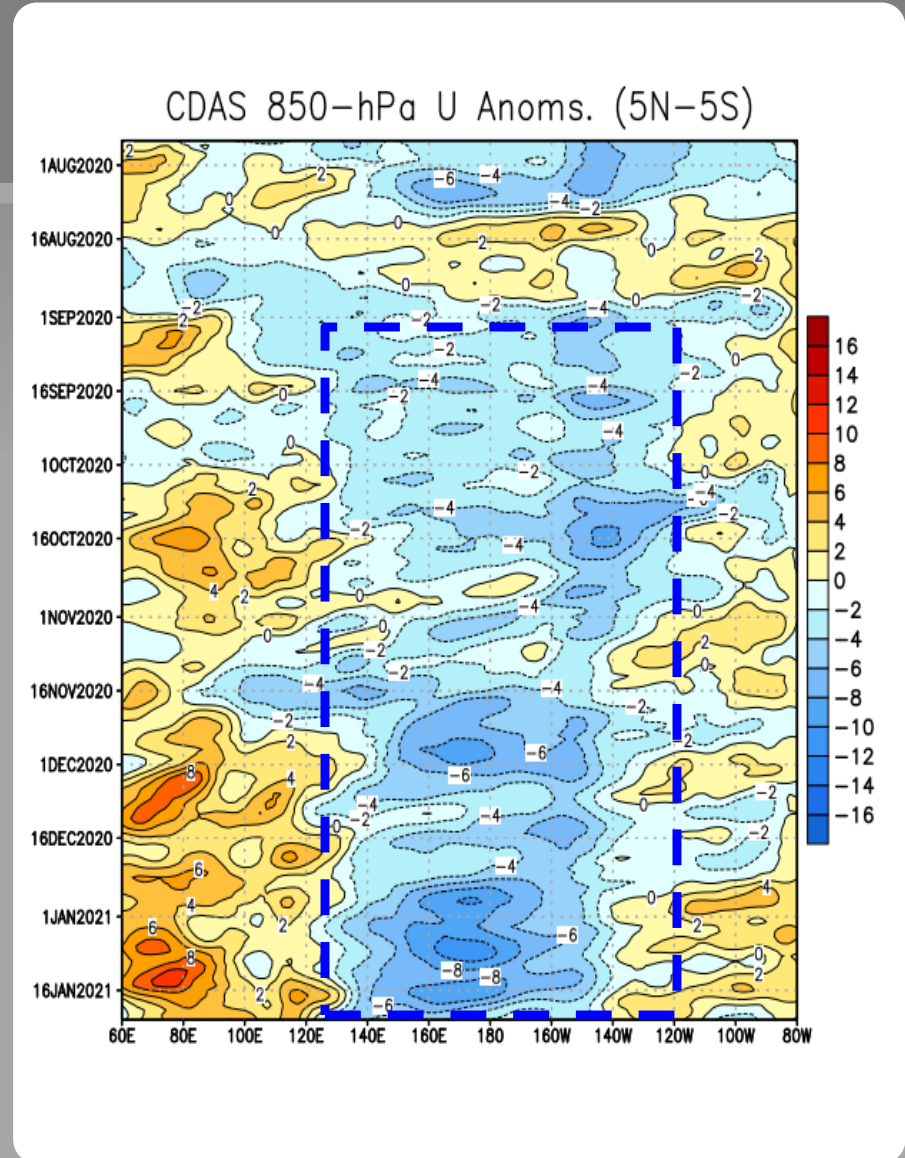
At times, the Madden Julian-Oscillation (MJO) has contributed to the eastward propagation of low-level wind anomalies.

Since late August, easterly wind anomalies have persisted over most of the equatorial Pacific Ocean.

Easterly wind anomalies have strengthened around the Date Line since late December 2020.

Westerly Wind Anomalies (orange/red shading)

Easterly Wind Anomalies (blue shading)



Upper-level (200-hPa) Velocity Potential Anomalies

Since the beginning of the period, anomalous divergence (green shading) has generally persisted over Africa and the western Indian Ocean.

From mid-May through July 2020, anomalous convergence (brown shading) was observed over the Date Line.

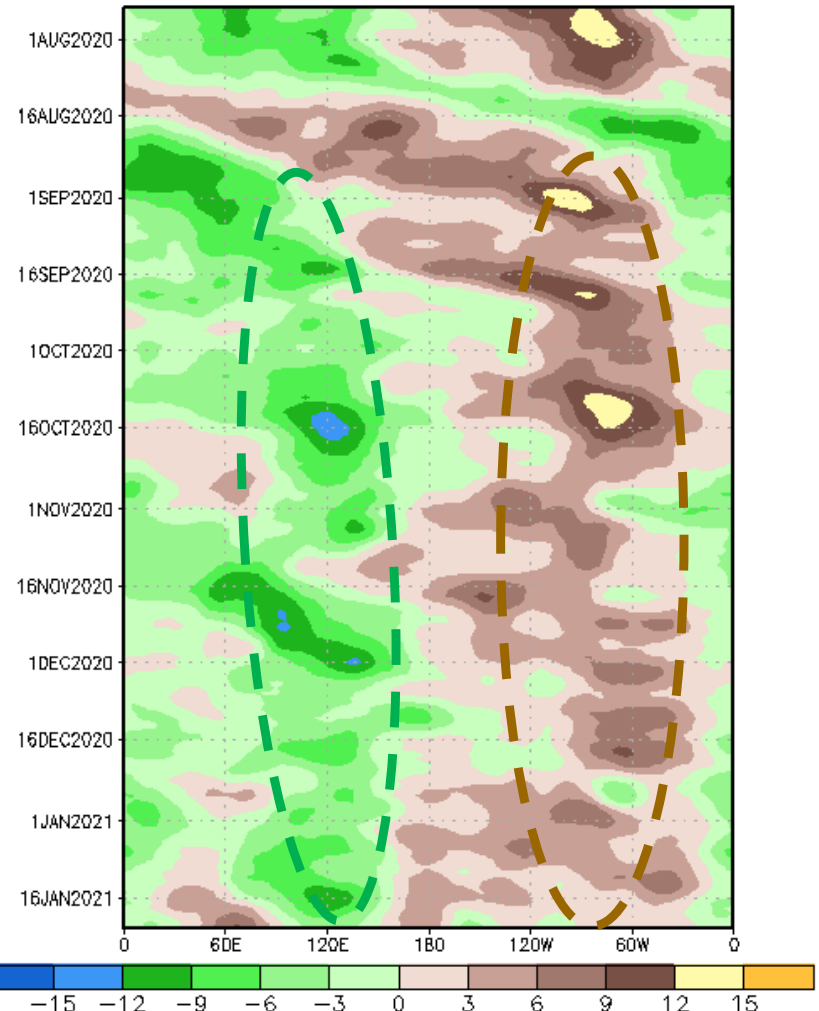
Since mid-August 2020, anomalous convergence has persisted over the eastern Pacific Ocean, while anomalous divergence has generally remained near Indonesia and the Indian Ocean.

Unfavorable for precipitation (brown shading)

Favorable for precipitation (green shading)

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

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

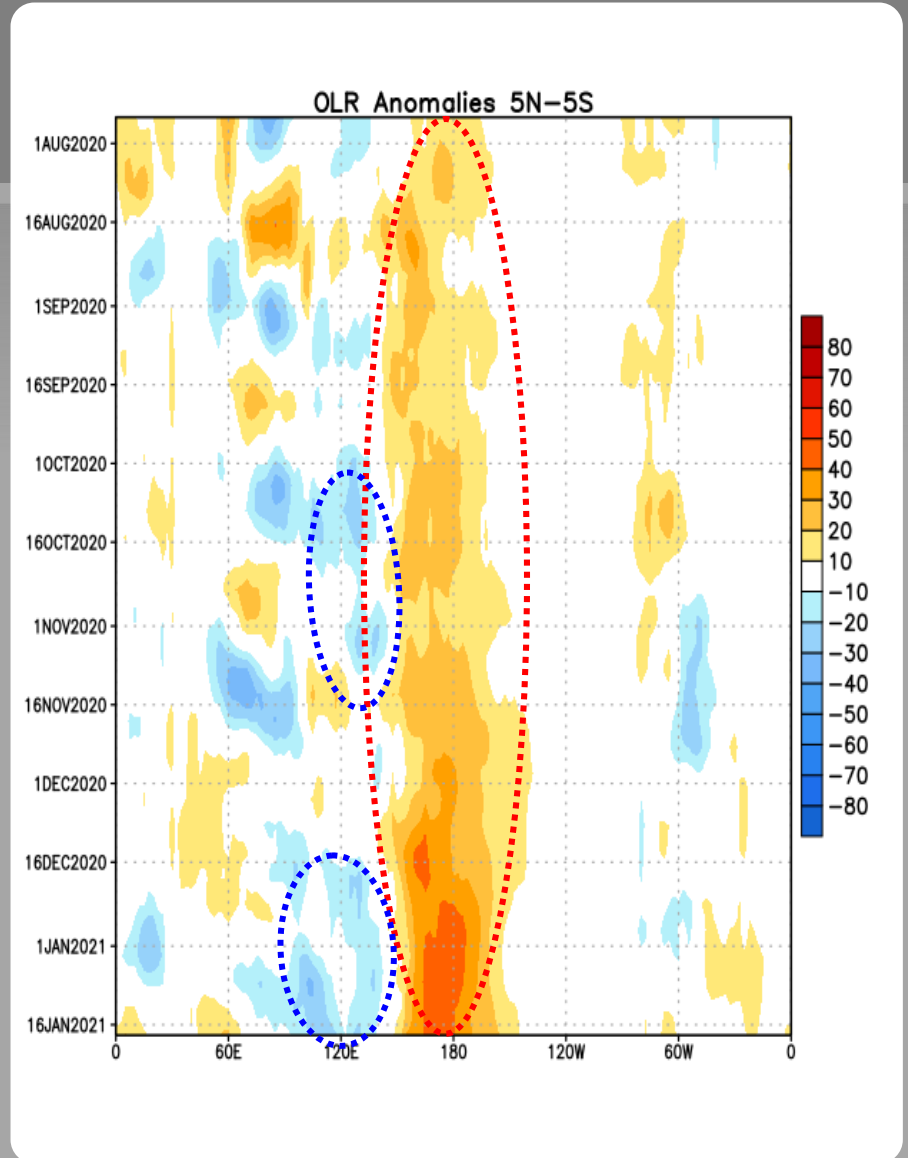


Outgoing Longwave Radiation (OLR) Anomalies

Since late April 2020, positive OLR anomalies have been observed at the Date Line. OLR anomalies have strengthened since late November 2020.

Since mid-December 2020, negative OLR anomalies have been evident 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

NOAA Operational Definitions for El Niño and La Niña

El Niño: characterized by a positive ONI greater than or equal to $+0.5^{\circ}\text{C}$.

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

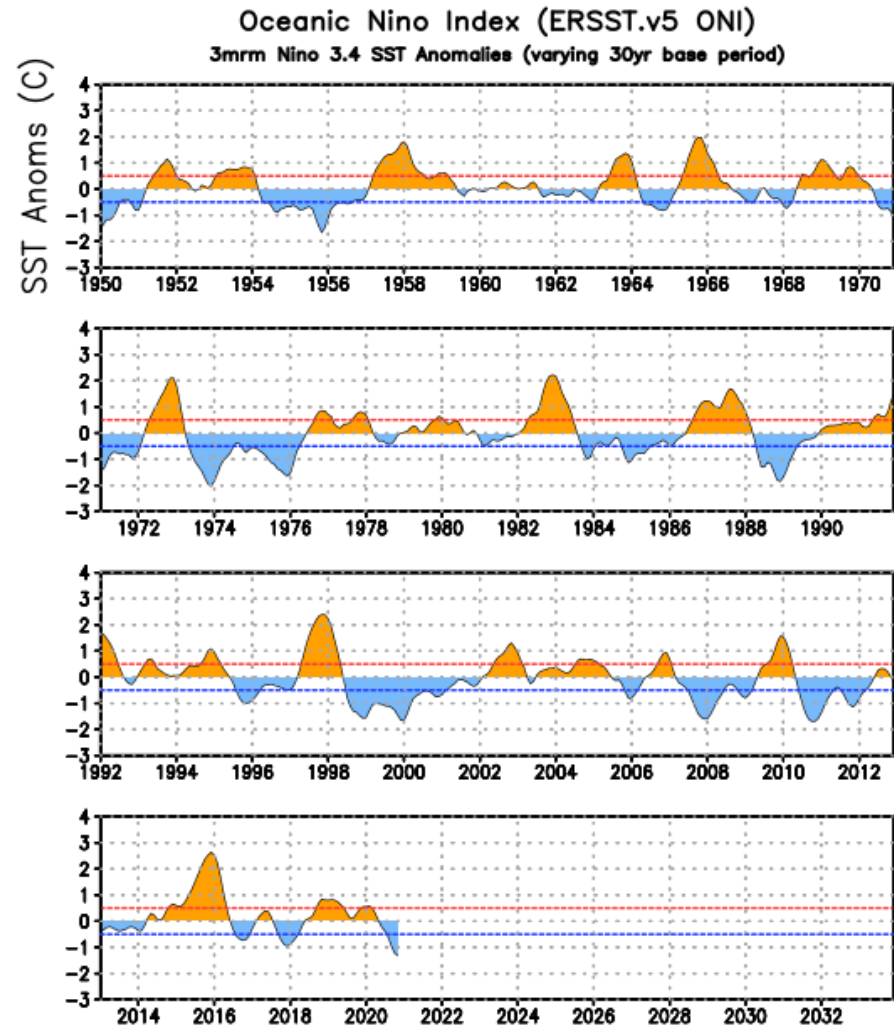
By historical standards, to be classified as a full-fledged El Niño or La Niña episode, these thresholds must be exceeded for a period of at least 5 consecutive overlapping 3-month seasons.

CPC considers El Niño or La Niña conditions to occur when the monthly Niño3.4 OISST departures meet or exceed $\pm 0.5^{\circ}\text{C}$ 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 (October- December 2020) is -1.3°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 Niño Index (ONI) [3 month running mean of ERSST.v5 SST anomalies in the Niño 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.

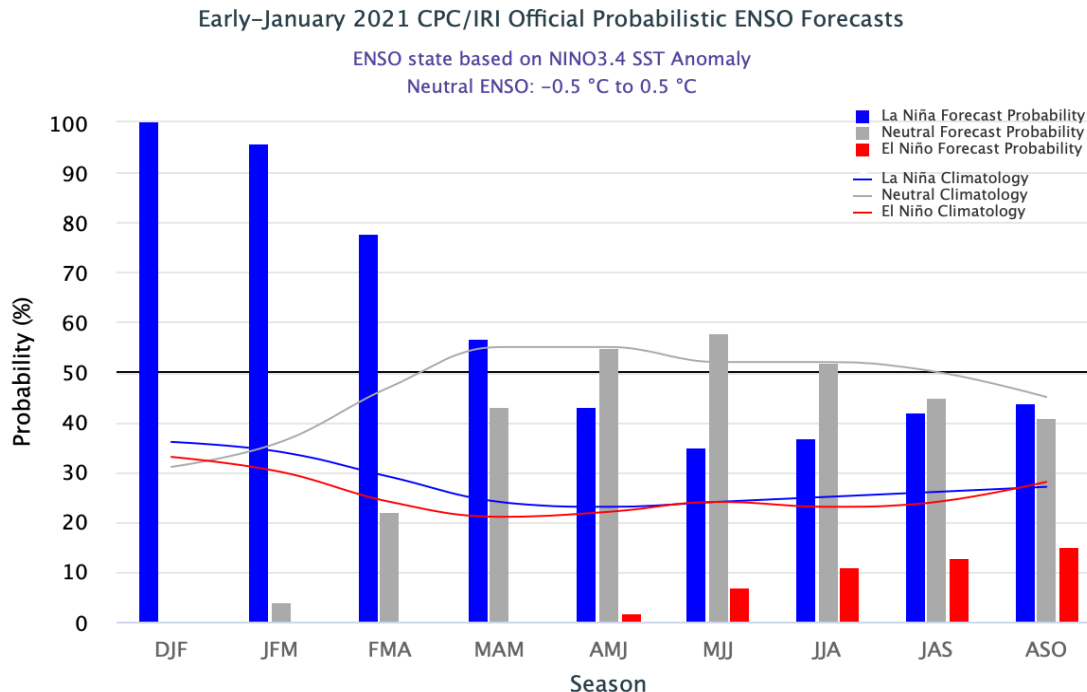
The ONI is one measure of the El Niño-Southern Oscillation, and other indices can confirm whether features consistent with a coupled ocean-atmosphere phenomenon accompanied these periods. The complete table going back to DJF 1950 can be found [here](#).

Year	DJF	JFM	FMA	MAM	AMJ	MJJ	JJA	JAS	ASO	SON	OND	NDJ
2008	-1.6	-1.4	-1.2	-0.9	-0.8	-0.5	-0.4	-0.3	-0.3	-0.4	-0.6	-0.7
2009	-0.8	-0.7	-0.5	-0.2	0.1	0.4	0.5	0.5	0.7	1.0	1.3	1.6
2010	1.5	1.3	0.9	0.4	-0.1	-0.6	-1.0	-1.4	-1.6	-1.7	-1.7	-1.6
2011	-1.4	-1.1	-0.8	-0.6	-0.5	-0.4	-0.5	-0.7	-0.9	-1.1	-1.1	-1.0
2012	-0.8	-0.6	-0.5	-0.4	-0.2	0.1	0.3	0.3	0.3	0.2	0.0	-0.2
2013	-0.4	-0.3	-0.2	-0.2	-0.3	-0.3	-0.4	-0.4	-0.3	-0.2	-0.2	-0.3
2014	-0.4	-0.4	-0.2	0.1	0.3	0.2	0.1	0.0	0.2	0.4	0.6	0.7
2015	0.6	0.6	0.6	0.8	1.0	1.2	1.5	1.8	2.1	2.4	2.5	2.6
2016	2.5	2.2	1.7	1.0	0.5	0.0	-0.3	-0.6	-0.7	-0.7	-0.7	-0.6
2017	-0.3	-0.1	0.1	0.3	0.4	0.4	0.2	-0.1	-0.4	-0.7	-0.9	-1.0
2018	-0.9	-0.8	-0.6	-0.4	-0.1	0.1	0.1	0.2	0.4	0.7	0.9	0.8
2019	0.8	0.8	0.8	0.8	0.6	0.5	0.3	0.1	0.1	0.3	0.5	0.5
2020	0.5	0.6	0.5	0.3	0.0	-0.2	-0.4	-0.6	-1.0	-1.2	-1.3	

CPC/IRI Probabilistic ENSO Outlook

Updated: 14 January 2021

The chances of La Niña are greater than 95% through January-March 2021, with a 55% chance of a transition to ENSO-neutral in April-June 2021.



IRI/CPC Pacific Niño

3.4 SST Model Outlook

The model averages predict La Niña to continue into the Northern Hemisphere spring 2021.

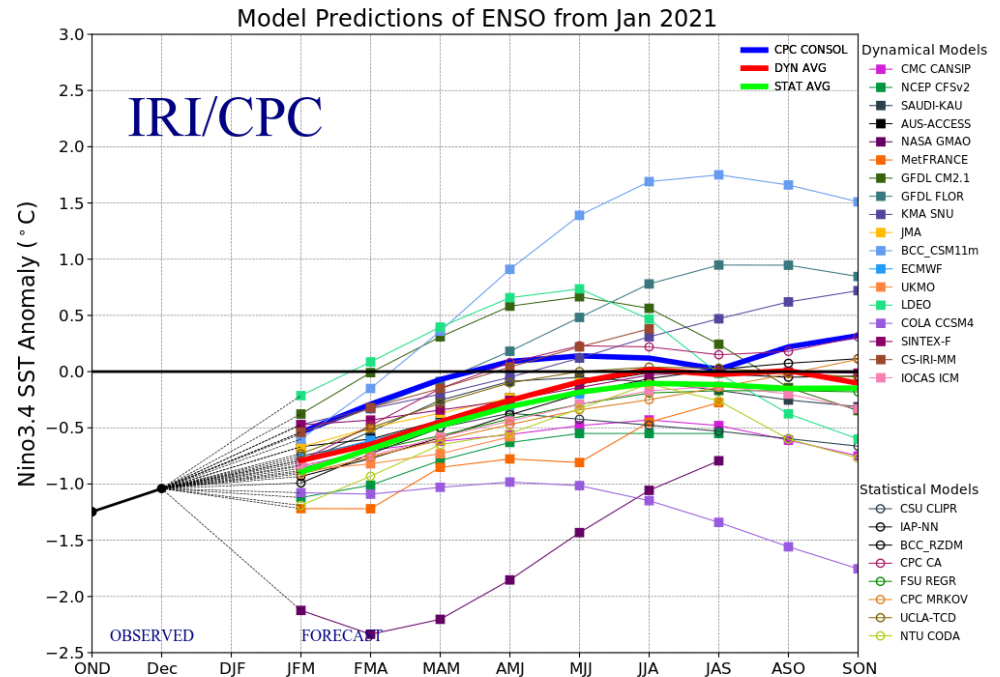


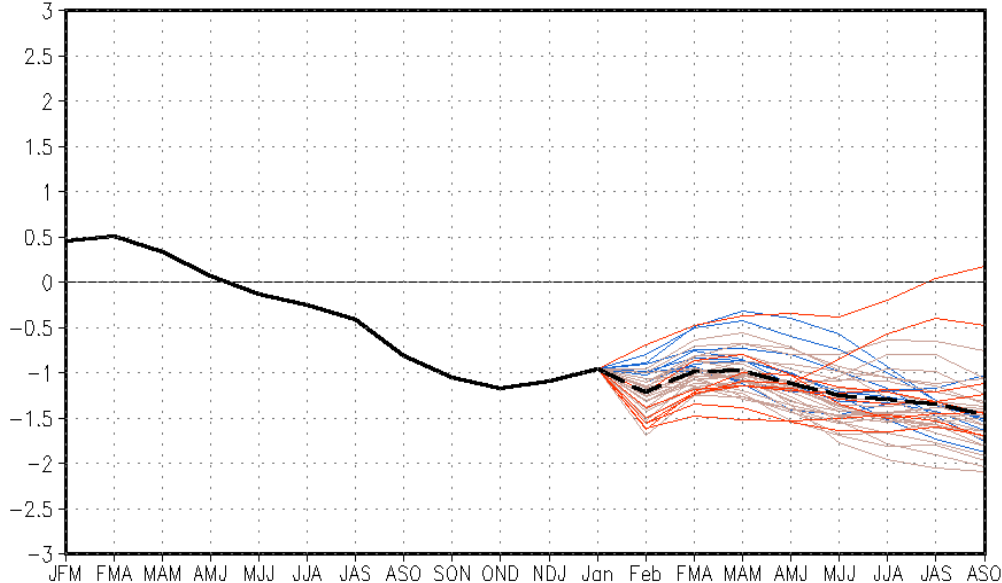
Figure provided by the International Research Institute (IRI) for Climate and Society (updated 19 January 2021).

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

Issued: 25 January 2021

The CFS.v2 ensemble mean (black dashed line) predicts La Niña will continue into Fall 2021.

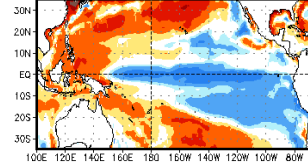
CFSv2 forecast Nino3.4 SST anomalies (K) (PDF corrected)



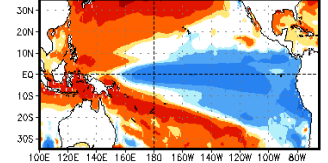
— Latest 8 forecast members
— Earliest 8 forecast members
— Other forecast members
- - - Forecast ensemble mean
— NCEP NSST daily analysis

(Model bias correct base period: 1999–2010; Climatology base period: 1982–2010)

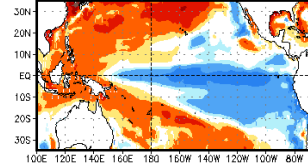
Feb–Mar–Apr 2021



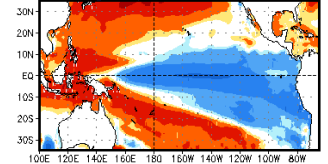
Jun–Jul–Aug 2021



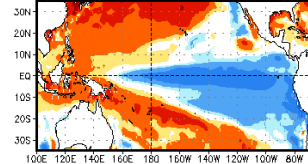
Mar–Apr–May 2021



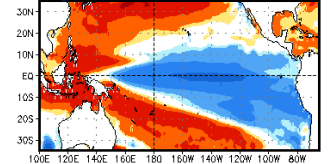
Jul–Aug–Sep 2021



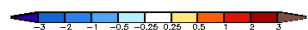
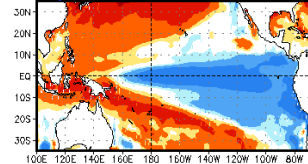
Apr–May–Jun 2021



Aug–Sep–Oct 2021

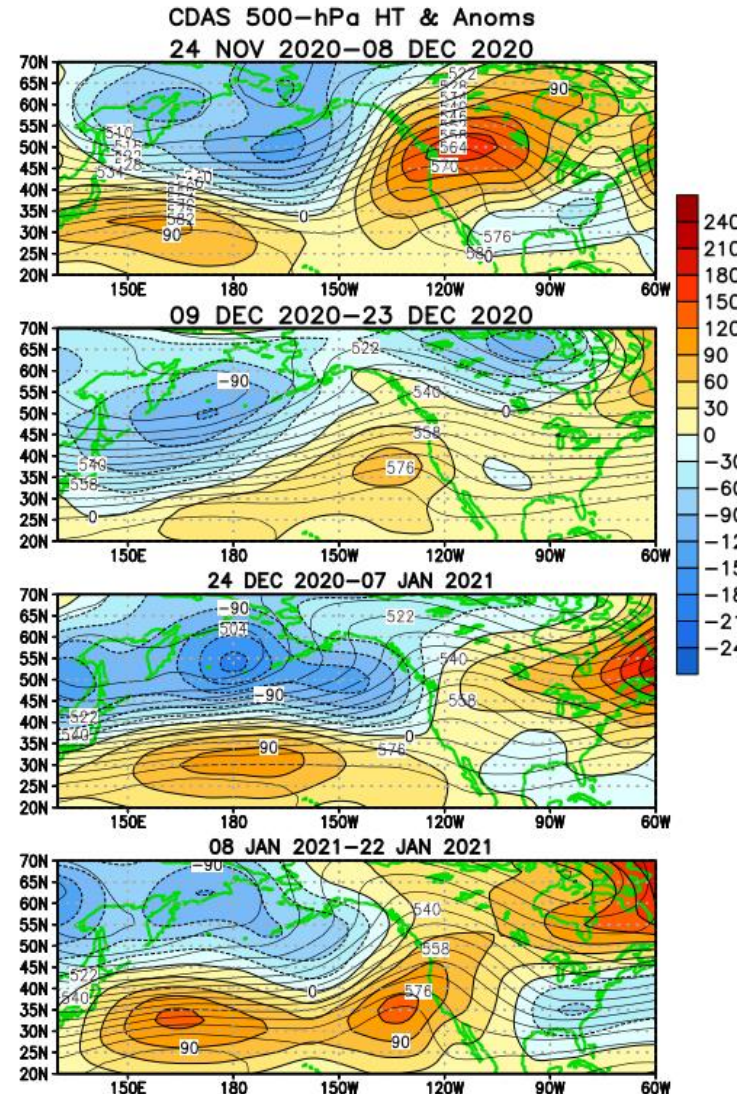


May–Jun–Jul 2021



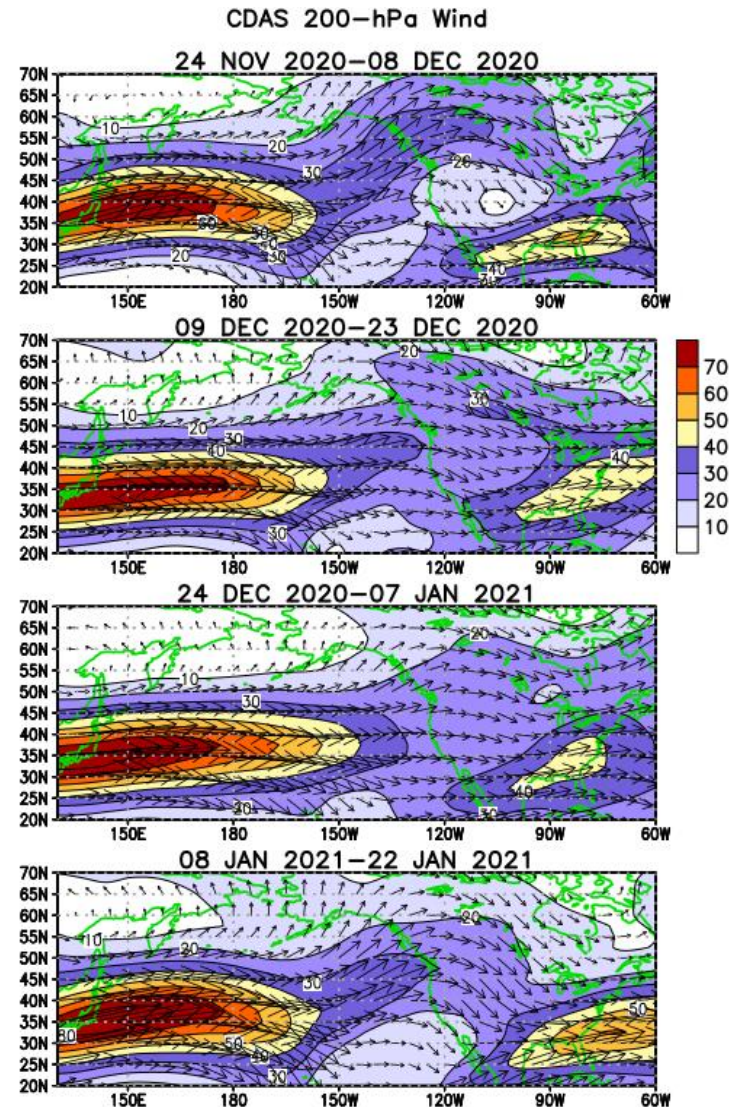
Atmospheric anomalies over the North Pacific and North America During the Last 60 Days

From late November to late January, anomalous ridging and generally above-average temperatures were observed over the northern U.S. and Canada.



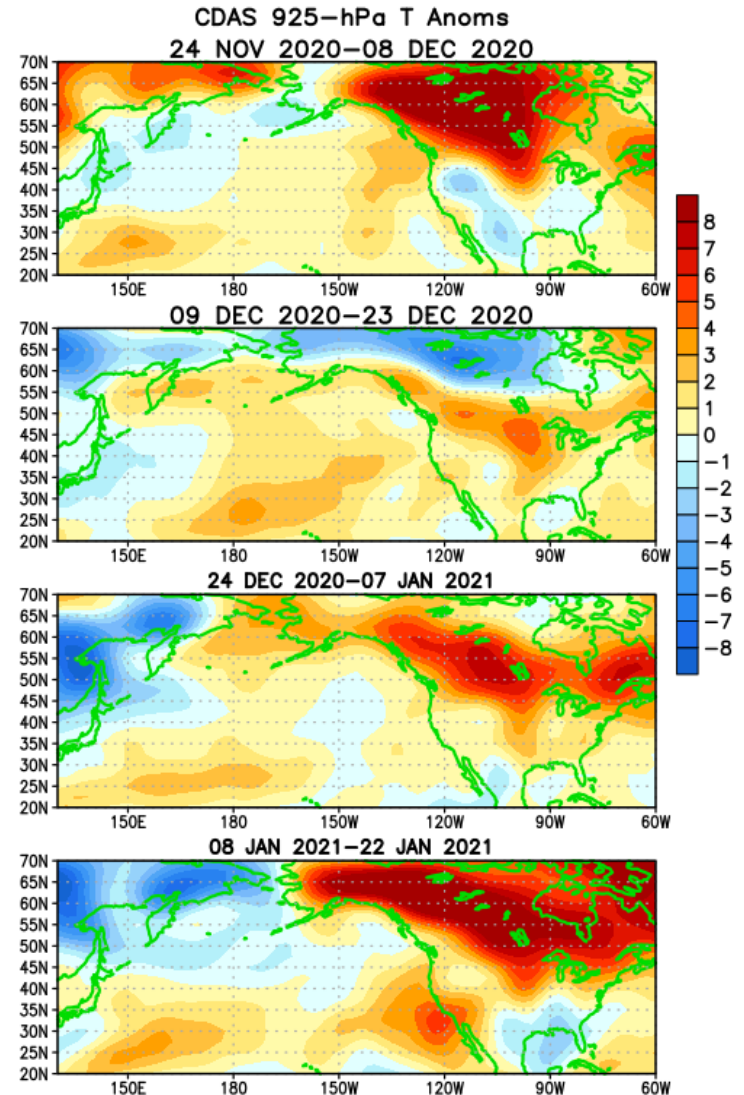
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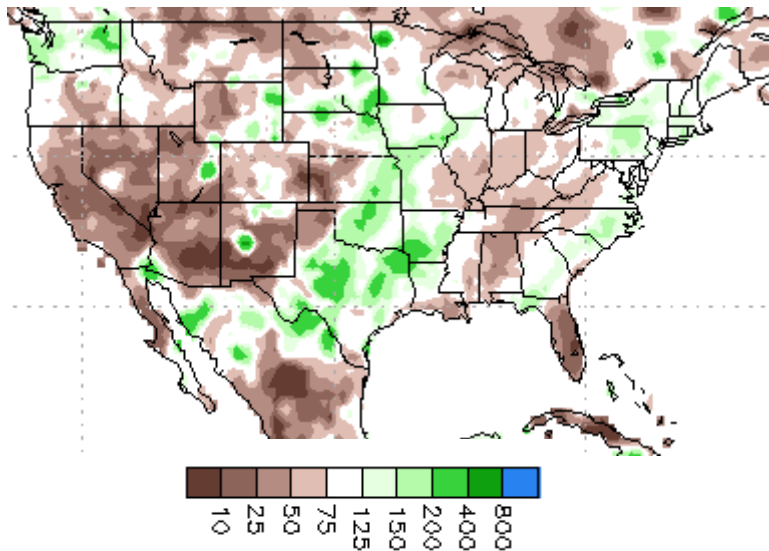
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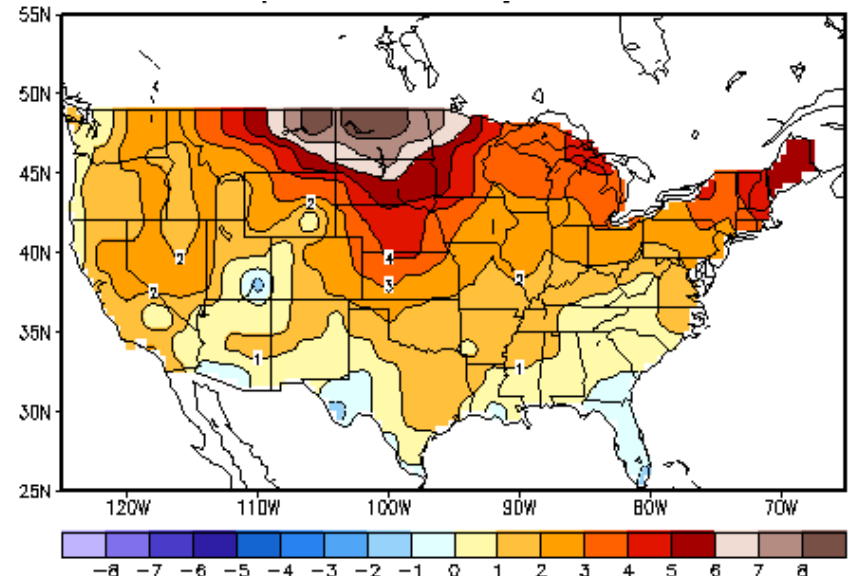
U.S. Temperature and Precipitation Departures During the Last 30 Days

End Date: 23 January 2021

Percent of Average Precipitation



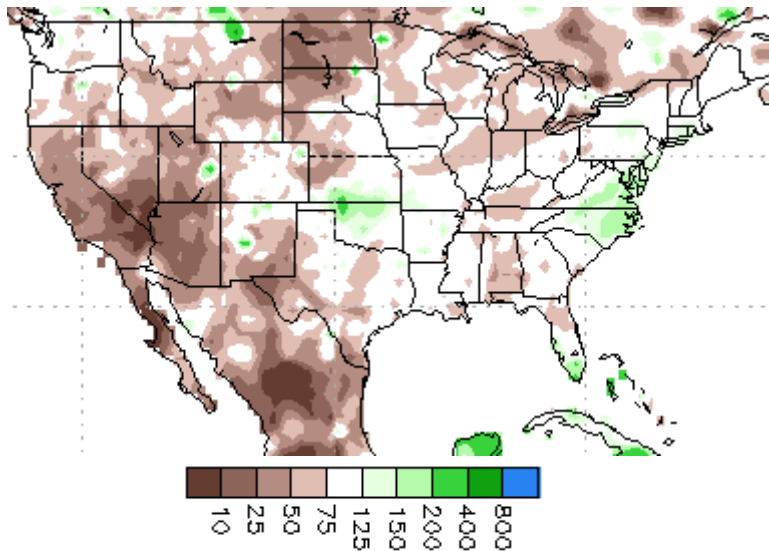
Temperature Departures (degree C)



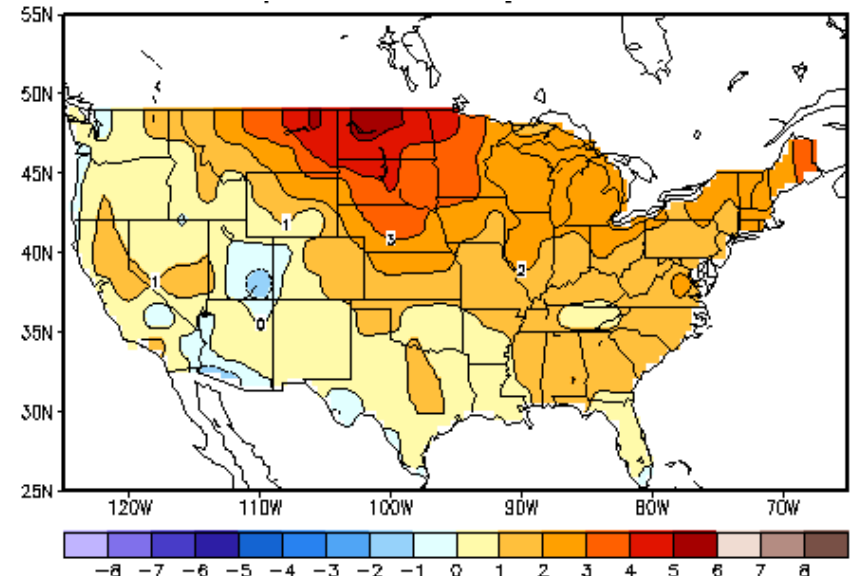
U.S. Temperature and Precipitation Departures During the Last 90 Days

End Date: 23 January 2021

Percent of Average Precipitation



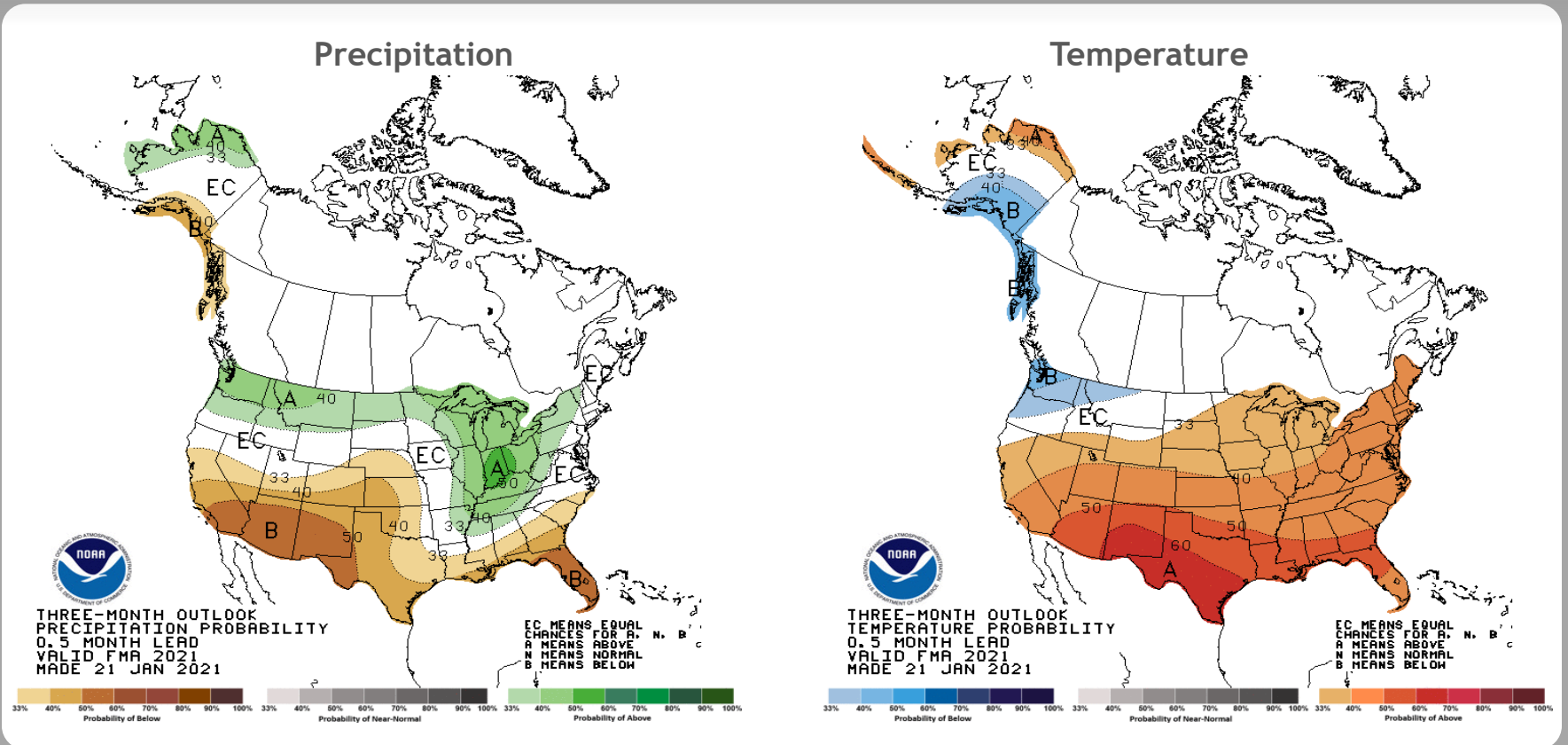
Temperature Departures (degree C)



U. S. Seasonal Outlooks

February - April 2021

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 conditions are present.*

Equatorial sea surface temperatures (SSTs) are below average from the west-central to eastern Pacific Ocean.

The tropical atmospheric circulation is consistent with La Niña.

La Niña is expected to continue through the Northern Hemisphere winter 2020-21 (~95% chance during January-March), with a potential transition to ENSO-neutral during the spring 2021 (55% chance during April-June).*

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