ENSO: Recent Evolution, Current Status and Predictions

Update prepared by:
Climate Prediction Center / NCEP
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Outline

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Recent Evolution and Current Conditions
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Summary

Starting on Oct. 11, 2021, the weekly sea surface temperature data is based on OISSTv2.1 (Huang et al., 2021). This impacts slides #4-9. The source data is available at this link.
Summary

ENSO Alert System Status:  La Niña Advisory

La Niña is present.*

Equatorial sea surface temperatures (SSTs) are below average across the central and east-central Pacific Ocean.

The tropical Pacific atmosphere is consistent with La Niña conditions.

La Niña is likely to continue through the Northern Hemisphere winter 2021-22 (~90% chance) and into spring 2022 (~50% chance during March-May).*

* 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.
During September 2020 to March 2021, the core of the strongest negative SST anomalies shifted from the eastern to the central Pacific Ocean.

From March to July 2021, equatorial SSTs gradually returned to average over most of the Pacific Ocean.

In the last week, below-average SSTs continued across most of the Pacific Ocean.
Niño Region SST Departures (°C) Recent Evolution

The latest weekly SST departures are:

- Niño 4: -0.7°C
- Niño 3.4: -0.9°C
- Niño 3: -1.2°C
- Niño 1+2: -1.1°C
In the last four weeks, equatorial SSTs were below average across most of the Pacific Ocean, and were above average near Indonesia.
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 the Atlantic Ocean.
Weekly SST Departures during the Last Four Weeks

During the last 4 weeks, negative SST anomalies strengthened in the eastern Pacific Ocean.
During the last four weeks, negative changes in equatorial SST anomalies were observed in the eastern Pacific, with mostly positive changes located in the east-central Pacific.
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 (160ºE-150ºW) and the eastern Pacific (90º-140ºW).
Central and Eastern Pacific Upper-Ocean (0-300 m) Weekly Average Temperature Anomalies

Negative subsurface temperature anomalies persisted into March 2021. From mid-March to early July 2021, subsurface temperature was above average. Negative temperature anomalies returned in July and strengthened again in September. Since mid-October, negative anomalies have weakened.
Sub-Surface Temperature Departures in the Equatorial Pacific

During the last two months, negative subsurface temperature anomalies have persisted across the central and eastern Pacific Ocean.

Positive subsurface temperature anomalies remain, at depth, in the western Pacific Ocean.
Positive OLR anomalies (suppressed convection and precipitation) were located over the western and central Pacific Ocean. Negative OLR anomalies (enhanced convection and precipitation) were observed around Indonesia.

Low-level (850-hPa) easterly wind anomalies were evident over most of the 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.

From August 2020 to February 2021, negative subsurface temperature anomalies persisted in the eastern half of the Pacific Ocean.

During March through May 2021, positive anomalies shifted eastward in association with two downwelling Kelvin waves.

In July and in September, negative subsurface temperature anomalies shifted eastward associated with two upwelling Kelvin waves.

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.
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-June, early-to-mid-August, and late October.
Upper-level (200-hPa) Velocity Potential Anomalies

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

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

Note: Eastward propagation is not necessarily indicative of the Madden-Julian Oscillation (MJO).
Since late July 2021, positive OLR anomalies were evident over the western and/or central Pacific Ocean.

Negative OLR anomalies were evident over Indonesia from mid-August to early October 2021, and again beginning in early November 2021.

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).
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 (September - November 2021) is -0.8°C.
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 overlapping 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].
La Niña is expected to continue through Northern Hemisphere winter 2021-22 and into spring 2022.
A majority of models indicate La Niña is expected to continue through winter 2021-22 and into spring 2022.
The CFS.v2 ensemble mean (black dashed line) predicts La Niña to continue through spring 2022.
Atmospheric anomalies over the North Pacific and North America During the Last 60 Days

Through October, above-average heights and temperatures were generally observed over much of the central and/or eastern U.S, while below-average heights were evident over part of the western U.S.

Since early November, anomalous ridging and above-average temperatures have been present over the western U.S., with anomalous troughing and below-average temperatures present over the eastern U.S.
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U.S. Temperature and Precipitation Departures During the Last 30 Days

End Date: 4 December 2021
U.S. Temperature and Precipitation Departures During the Last 90 Days

End Date: 4 December 2021
The seasonal outlooks combine the effects of long-term trends, soil moisture, and, when appropriate, ENSO.
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