ENSO: Recent Evolution, Current Status and Predictions

Update prepared by:
Climate Prediction Center / NCEP
25 March 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
Summary
ENSO Alert System Status:  **El Niño Advisory / La Niña Watch**

El Niño conditions are observed.*

Equatorial sea surface temperatures (SSTs) are above average across the central and eastern Pacific Ocean.

The tropical Pacific atmospheric anomalies are consistent with El Niño.

A transition from El Niño to ENSO-neutral is likely by April-June 2024 (83% chance), with increasing odds of La Niña developing in June-August 2024 (62% chance).*

* 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](#).
From March-October 2023, positive sea surface temperature (SST) anomalies in the eastern Pacific Ocean expanded and shifted westward.

In October and November 2023, SST anomalies increased in the central and east-central Pacific.

Since late December 2023, positive SST anomalies have weakened across most of the Pacific.

Recently, below-average SSTs emerged in the far eastern Pacific.
Niño Region SST Departures (°C) Recent Evolution

The latest weekly SST departures are:

- Niño 4: 1.0°C
- Niño 3.4: 1.3°C
- Niño 3: 1.0°C
- Niño 1+2: -0.1°C
SST Departures (°C) in the Tropical Pacific During the Last Four Weeks

In the last four weeks, equatorial SSTs were above average across most of the Pacific Ocean, with the largest anomalies in the central and east-central Pacific.
During the last four weeks, equatorial SSTs were above average across most of the Pacific Ocean, the Indian Ocean, and the Atlantic Ocean.
During the last 4 weeks, above-average SSTs weakened across most of the equatorial Pacific Ocean.

In the last couple of weeks, below-average SSTs emerged in small regions of the eastern Pacific Ocean.
Change in Weekly SST Departures over the Last Four Weeks

During the last four weeks, negative SST anomaly changes were observed over most of the equatorial Pacific, but were strongest in the far eastern 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 (near average) and thermocline slope index (slightly below average) reflect a weakening El Niño.

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 anomalies was associated with several oceanic Kelvin waves. Subsurface temperature anomalies have weakened since late November 2023. Since late January 2024, negative temperature anomalies have gradually strengthened.
Positive subsurface temperature anomalies have weakened across the equatorial Pacific, remaining close to the surface in the central Pacific.

Negative subsurface temperature anomalies expanded across the equatorial Pacific. Recently, below-average temperatures have reached the surface in the eastern Pacific Ocean (near 120°-90°W).
Tropical OLR and Wind Anomalies During the Last 30 Days

Weak, negative OLR anomalies (enhanced convection and precipitation) were observed in the western Pacific, while positive OLR anomalies (suppressed convection and precipitation) were evident around the Philippines.

Low-level (850-hPa) wind anomalies were easterly over the west-central tropical Pacific Ocean and Date Line.

Upper-level (200-hPa) wind anomalies were westerly over a small region of the central equatorial Pacific.
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.

From November 2023 through March 2024, below-average temperatures strengthened in the western Pacific Ocean and shifted into the eastern Pacific.

Recently, below-average temperatures have strengthened west of the Date Line and have been expanding eastward.

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.
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.
Upper-level (200-hPa) Velocity Potential Anomalies

Since the beginning of the period through mid-November 2023, anomalous divergence (green shading) persisted near the Date Line, while anomalous convergence (brown shading) was mostly observed over South America.

From November 2023-January 2024, eastward propagation in the velocity potential anomalies was evident.

Since mid-January 2024, anomalous divergence has persisted over the central and east-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

During most of the period, negative OLR anomalies (more convection) persisted over the central equatorial Pacific Ocean, and periodically emerged in the eastern Pacific.

Through December 2023, positive OLR anomalies persisted around Indonesia.

Since mid-December 2023, an alternating pattern of OLR anomalies has shifted eastward from the Indian Ocean/Indonesia to the western Pacific/Date Line.

Drier-than-average Conditions (orange/red shading)  
Wetter-than-average Conditions (blue shading)
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 (ºC): Evolution since 1950

The most recent ONI value (December 2023 - February 2024) is 1.8ºC.
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 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](#).

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A transition from El Niño to ENSO-neutral is expected by April-June season 2024, with ENSO-neutral persisting through May-July 2024. Thereafter, La Niña is favored in June-August, and chances increase through the October-December season.
The majority of models indicate El Niño will persist through March-May 2024 and then transition to ENSO-neutral during April-June 2024.

After a brief period of ENSO-neutral conditions, most models indicate a transition to La Niña around July-September 2024.
The CFS.v2 ensemble mean (black dashed line) indicates El Niño may transition to ENSO-neutral around April, followed by a transition to La Niña around May-July 2024.
Atmospheric anomalies over the North Pacific and North America During the Last 60 Days

From mid-January to early March 2024, below-average heights persisted in the eastern North Pacific Ocean.

Over Canada and the northern tier of the U.S., above-average heights and temperatures were prevalent from mid-January through late February.

Since early March, above-average heights and temperatures have prevailed over the western contiguous U.S. and Canada, with below-average heights over the eastern U.S.
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U.S. Temperature and Precipitation Departures During the Last 30 Days

End Date: 23 March 2024

Percent of Average Precipitation

Temperature Departures (degree C)
End Date: 23 March 2024
The seasonal outlooks combine the effects of long-term trends, soil moisture, and, when appropriate, ENSO.

**U. S. Seasonal Outlooks**

**April - June 2024**

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