ENSO: Recent Evolution, Current Status and Predictions

Update prepared by:
Climate Prediction Center / NCEP
2 January 2024
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Recent Evolution and Current Conditions
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ENSO Alert System Status: **El Niño Advisory**

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.

El Niño is expected to continue through the Northern Hemisphere winter, with a transition to ENSO-neutral favored during April-June 2024 (60% 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](#).
Since March 2023, positive sea surface temperature (SST) anomalies in the eastern Pacific Ocean gradually expanded and shifted westward.

In October and November 2023, SST anomalies increased in the central and east-central Pacific. Since early December, the positive SST anomalies have persisted.

In the far eastern Pacific, positive SST anomalies have been gradually weakening.

Recent Evolution of Equatorial Pacific SST Departures (°C)
Niño Region SST Departures (°C) Recent Evolution

The latest weekly SST departures are:

- Niño 4: 1.4°C
- Niño 3.4: 2.0°C
- Niño 3: 2.1°C
- Niño 1+2: 0.8°C
In the last four weeks, equatorial SSTs were above average across most of the Pacific Ocean, with near-average SSTs in the western Pacific Ocean.
During the last four weeks, equatorial SSTs were above average across most of the Pacific Ocean, the Indian Ocean, and the Atlantic Ocean. Equatorial SSTs were near-to-below average south and east of Papua New Guinea.
During the last 4 weeks, above-average SSTs persisted across much of the central and east-central equatorial Pacific Ocean, while weakening in the far eastern Pacific.
During the last four weeks, negative changes in equatorial SST anomalies were observed across the Pacific Ocean, with the exception of 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 (above average) and thermocline slope index (below average) reflect 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).
Subsurface temperature anomalies were negative until mid-February 2023. Subsurface anomalies became positive in February and increased through mid-April 2023 before leveling off. From late May to mid-June 2023, anomalies increased. Anomalies decreased from mid-June to mid-July, increased from late July through August, decreased in September, and increased from early October through late November. During December, anomalies have decreased.
Positive subsurface temperature anomalies dominate most of the equatorial Pacific Ocean.

Negative subsurface temperature anomalies have strengthened in the western Pacific Ocean and expanded to 150°W, while remaining at depth.
Positive OLR anomalies (suppressed convection and precipitation) were evident around Indonesia. Negative OLR anomalies (enhanced convection and precipitation) were observed around the Date Line, and extend into the eastern Pacific, remaining just north of the equator.

Low-level (850-hPa) wind anomalies were westerly over the east-central equatorial Pacific.

Upper-level (200-hPa) wind anomalies were easterly along the east-central equatorial Pacific. An anomalous anticyclonic couplet straddles the equator in the east-central Pacific.
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. Six downwelling waves have occurred since late November 2022.

Since March 2023, above-average subsurface temperature anomalies have persisted across most of the Pacific Ocean.

Since early November 2023, below-average subsurface anomalies have strengthened in the western 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.
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 during November and December 2023.

Starting in mid-July 2023, westerly wind anomalies became more predominant over the equatorial Pacific Ocean.
Upper-level (200-hPa) Velocity Potential Anomalies

Since the beginning of the period, anomalous divergence (green shading) has generally persisted near the Date Line, while anomalous convergence (brown shading) was mostly observed over South America.

From late September to mid-November 2023, anomalous convergence strengthened near Indonesia.

In November and December, eastward propagation in the velocity potential anomalies was observed.

Unfavorable for precipitation (brown shading)
Favorable for precipitation (green shading)
Note: Eastward propagation is not necessarily indicative of the Madden-Julian Oscillation (MJO).
During the period, negative OLR anomalies (more convection) persisted over the central equatorial Pacific Ocean, and periodically emerged in the eastern Pacific. Since mid-July 2023, positive OLR anomalies persisted around 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 (September - November 2023) is 1.8°C.
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 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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El Niño is expected through Northern Hemisphere winter 2023-24, with chances gradually decreasing from the winter through the spring. A transition to ENSO-neutral is anticipated in April-June 2024 (60% chance).
The majority of models indicate El Niño will persist through March-May 2024 and then transition to ENSO-neutral.

Figure provided by the International Research Institute (IRI) for Climate and Society (updated 19 December 2023).
The CFS.v2 ensemble mean (black dashed line) indicates El Niño will continue through the Northern Hemisphere winter 2023-24 and then transition to ENSO-neutral by March-May 2024.
Atmospheric anomalies over the North Pacific and North America During the Last 60 Days

For most of the period, below-average heights persisted in the eastern North Pacific Ocean, with above-average heights and temperatures evident over the northern tier of the U.S. and western Canada.
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End Date: 31 December 2023

U.S. Temperature and Precipitation Departures During the Last 30 Days
U.S. Temperature and Precipitation Departures During the Last 90 Days

End Date: 31 December 2023
U. S. Seasonal Outlooks
January - March 2024

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

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