ENSO: Recent Evolution, Current Status and Predictions

Update prepared by:
Climate Prediction Center / NCEP
11 September 2023
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Recent Evolution and Current Conditions
Oceanic Niño Index (ONI)
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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 anticipated to continue through the Northern Hemisphere winter (with greater than a 95% chance through December 2023-February 2024).*

* 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.
Below-average SSTs persisted in the central and eastern Pacific during most of 2022.

Beginning in January 2023, SSTs transitioned from below-average to above-average.

Since March 2023, positive SST anomalies in the eastern Pacific Ocean have gradually expanded westward.
Niño Region SST Departures (°C) Recent Evolution

The latest weekly SST departures are:

- Niño 4: 1.1°C
- Niño 3.4: 1.6°C
- Niño 3: 2.2°C
- Niño 1+2: 2.9°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 near average SSTs present in the western Pacific Ocean.
During the last four weeks, equatorial SSTs were above average across most of the Pacific Ocean, in the western Indian Ocean, and across much of the Atlantic Ocean.
During the last 4 weeks, above-average equatorial SSTs increased across the central and east-central Pacific Ocean. SSTs near Ecuador and Peru remain strongly above average.
During the last four weeks, positive SST anomaly changes were evident across most of the Pacific Ocean, with the exception of 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 (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 2023, but then increased during late July through August 2023.
Positive subsurface temperature anomalies dominate most of the equatorial Pacific Ocean.

Most recent pentad analysis

Positive subsurface temperature anomalies weakened in the western equatorial Pacific, with negative anomalies emerging at depth (150-300m).
Tropical OLR and Wind Anomalies During the Last 30 Days

Positive OLR anomalies (suppressed convection and precipitation) were evident around Southeast Asia, northern Philippines, and Indonesia. Negative OLR anomalies (enhanced convection and precipitation) were observed from the western Pacific and mostly extend, just north of the equator, into the eastern Pacific Ocean.

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

Upper-level (200-hPa) wind anomalies were cross equatorial over the eastern tropical Pacific. Easterly anomalies were present over the east-central Pacific, with an anomalous anticyclone in the S. Hemisphere, off the equator.
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.
Significant equatorial oceanic Kelvin wave activity (dashed and dotted lines) has been present throughout the period shown.

Since late November 2022, four downwelling Kelvin waves have occurred.

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

From late July 2023 through present, a fifth downwelling Kelvin shifted eastward.

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. An eastward propagating pattern of westerly and easterly wind anomalies was clearly evident from late February through mid-June 2023. Since mid-July 2023, westerly wind anomalies have become more predominant over the equatorial Pacific Ocean.
Upper-level (200-hPa) Velocity Potential Anomalies

From the beginning of the period to mid-June 2023, eastward propagation of anomalies were clearly evident.

Since mid-March 2023, anomalous divergence (green shading) has generally persisted near the Date Line.

While not as persistent, anomalous convergence (brown shading) has mostly remained over the far eastern Pacific Ocean and South America.

During July and August, anomalous convergence (brown shading) persisted over the Indian Ocean and/or Indonesia.

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

From the beginning of the period through April 2023, positive OLR anomalies were evident over the western and/or central Pacific Ocean.

Since early May 2023, negative anomalies have mostly persisted over the western and central equatorial Pacific Ocean.

Since mid-July 2023, positive OLR anomalies have mostly persisted over Indonesia.

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 (°C): Evolution since 1950

The most recent ONI value (June - August 2023) is 1.1°C.
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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El Niño is favored through Northern Hemisphere winter 2023-24, with chances exceeding 95% through December-February 2023-24.
Nearly all models indicate El Niño will persist through the Northern Hemisphere winter 2023-24.

At its peak (November-January), a strong El Niño (ONI values at or greater than 1.5°C) is indicated by the dynamical model average.
The CFS.v2 ensemble mean (black dashed line) indicates El Niño will continue through the Northern Hemisphere winter 2023-24. A moderate El Niño is favored (ONI between 1.0°C and 1.5°C).
Atmospheric anomalies over the North Pacific and North America During the Last 60 Days

From mid-July to mid-August, an anomalous ridge (and above-average temperatures) has persisted in the south-central and/or southwestern U.S. Near the Great Lakes and/or northeastern U.S., anomalous troughs (and below-average temperatures) were prevalent.
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U.S. Temperature and Precipitation Departures During the Last 30 Days

End Date: 9 September 2023
U.S. Temperature and Precipitation Departures During the Last 90 Days

End Date: 9 September 2023
The seasonal outlooks combine the effects of long-term trends, soil moisture, and, when appropriate, ENSO.
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