ENSO: Recent Evolution, Current Status and Predictions

Update prepared by:
Climate Prediction Center / NCEP
10 July 2023
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Recent Evolution and Current Conditions
Oceanic Niño Index (ONI)
Pacific SST Outlook
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Summary
ENSO Alert System Status: El Niño Advisory

El Niño conditions are observed.*

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

The tropical Pacific atmospheric anomalies are consistent with weak El Niño conditions.

El Niño conditions are expected to gradually strengthen into the Northern Hemisphere winter 2023-24.*

* 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 during most of 2022.

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

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

The latest weekly SST departures are:

- Niño 4: 0.7°C
- Niño 3.4: 1.0°C
- Niño 3: 1.5°C
- Niño 1+2: 3.3°C
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.
Global SST Departures (°C) During the Last Four Weeks

During the last four weeks, equatorial SSTs were above average across most of the Pacific Ocean and over small regions of the Indian and Atlantic Oceans.
During the last 4 weeks, above-average equatorial SSTs persisted across the eastern and east-central Pacific Ocean. SSTs near Ecuador and Peru remain strongly above average.
Change in Weekly SST Departures over the Last Four Weeks

During the last four weeks, positive SST anomaly changes were evident in the eastern equatorial Pacific Ocean, while small, negative SST anomaly changes were observed in the 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 (above average) and thermocline slope index (slightly below average) reflect El Niño conditions.

*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 June 2022, before becoming briefly positive. From early July 2022 to mid-February 2023, anomalies were mostly negative. Subsurface anomalies became positive in February and increased through mid-April 2023 before leveling off. From late May to mid-June 2023, anomalies increased.
Sub-Surface Temperature Departures in the Equatorial Pacific

Positive subsurface temperature anomalies dominate the equatorial Pacific Ocean.

Most recent pentad analysis
Weak, positive OLR anomalies (suppressed convection and precipitation) were evident around Southeast Asia and Indonesia, while negative OLR anomalies (enhanced convection and precipitation) were observed on the equator near the Date Line and west-central Pacific.

Low-level (850-hPa) winds were near average across most of the tropical Pacific Ocean.

Upper-level (200-hPa) wind anomalies were easterly over the western tropical Pacific and westerly over the eastern tropical 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.

From August through November 2022, negative subsurface temperature anomalies persisted in the east-central and eastern Pacific Ocean.

Since late November 2022, three downwelling Kelvin waves have occurred. Since March 2023, above-average subsurface temperature anomalies have persisted across the Pacific Ocean.

From late May 2023 through present, a fourth downwelling Kelvin has 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.
At times, the Madden Julian-Oscillation (MJO) has contributed to the eastward propagation of low-level wind anomalies.

From the beginning of the period to mid-February 2023, easterly wind anomalies dominated the equatorial Pacific Ocean.

Since late February 2023, four episodes of westerly wind anomalies have been observed across the Pacific Ocean.

An eastward propagating pattern of westerly and easterly wind anomalies has been evident since late February 2023.
Upper-level (200-hPa) Velocity Potential Anomalies

Through February 2023, anomalous divergence (green shading) generally remained near Indonesia, while anomalous convergence (brown shading) persisted over the eastern Pacific Ocean.

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

Since the beginning of the period, eastward propagation of anomalies has been evident.

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.

Negative OLR anomalies generally persisted over Indonesia through February 2023.

Since early May 2023, positive anomalies were evident over the eastern Indian Ocean and Indonesia.

Negative anomalies have periodically emerged over the western and central equatorial Pacific Ocean.

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 (ºC): Evolution since 1950

The most recent ONI value (April - June 2023) is 0.5ºC.
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 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 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](#).

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El Niño is favored through Northern Hemisphere winter 2023-24, with chances exceeding 90% for most of the period.
Nearly all models indicate El Niño will persist into the Northern Hemisphere winter 2023-24. A strong El Niño (ONI values at or greater than 1.5°C) is indicated by the dynamical model average through December 2023-February 2024.

Figure provided by the International Research Institute (IRI) for Climate and Society (updated 16 June 2023).
The CFS.v2 ensemble mean (black dashed line) indicates El Niño will continue through the Northern Hemisphere winter 2023-24. A moderate-strength El Niño is favored (ONI between 1.0ºC and 1.5ºC).
During the entire period, above-average heights (and above-average temperatures) were evident Canada and the north-central U.S. South of the anomalous ridge (across parts of the contiguous U.S.), below-average heights and temperatures were generally observed (with the exception of the south-central U.S. in June).
Atmospheric anomalies over the North Pacific and North America During the Last 60 Days

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

End Date: 8 July 2023
U.S. Temperature and Precipitation Departures During the Last 90 Days

End Date: 8 July 2023
The seasonal outlooks combine the effects of long-term trends, soil moisture, and, when appropriate, ENSO.
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