ENSO: Recent Evolution, Current Status and Predictions

Update prepared by:
Climate Prediction Center / NCEP
7 October 2019
Outline

Summary
Recent Evolution and Current Conditions
Oceanic Niño Index (ONI)
Pacific SST Outlook
U.S. Seasonal Precipitation and Temperature Outlooks
Summary
ENSO Alert System Status:  Not Active

ENSO-neutral conditions are present.*

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

The pattern of anomalous convection and winds are generally consistent with ENSO-neutral.

ENSO-neutral is favored during the Northern Hemisphere fall 2019 (~75% chance), continuing through spring 2020 (55-60% chance).*

* Note: These statements are updated once a month (2\textsuperscript{nd} Thursday of each month) in association with the ENSO Diagnostics Discussion, which can be found by clicking here.
From early June 2018 through May 2019, near-to-above average SSTs were present across most of the Pacific Ocean.

During February 2019, positive SST anomalies strengthened across most of the equatorial Pacific.

From July-September 2019, below-average SSTs expanded westward into the east-central Pacific.

In the last week, above-average SSTs expanded from the Date Line into the eastern Pacific, while remaining below-average 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: 0.5°C
- Niño 3: 0.3°C
- Niño 1+2: -0.6°C
During the last four weeks, equatorial SSTs were above average in the western and central Pacific Ocean. Below-average SSTs were evident in parts of the eastern Pacific.
Global SST Departures (°C) During the Last Four Weeks

During the last four weeks, equatorial SSTs were above average across the western and central Pacific Ocean, eastern Atlantic, and the central Indian Ocean. SSTs were below average near Indonesia and in the eastern Pacific.
During the last four weeks, above-average SSTs expanded eastward into the east-central Pacific, while below-average SSTs became confined to the far eastern Pacific.
Change in Weekly SST Departures over the Last Four Weeks

During the last four weeks, equatorial SST anomalies increased over most of the Pacific Ocean and decreased in parts of the 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 (near average) reflect ENSO-neutral.

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 decreased to near zero in late April before returning to positive in late May. During June and July, anomalies were slightly positive at times. During August and most of September, subsurface temperatures were below average. Since mid-September, anomalies have become positive.
In the last two months, positive subsurface temperature anomalies have strengthened in the central Pacific and have expanded to ~130°W.

Negative subsurface temperature anomalies have strengthened in the eastern Pacific and shifted eastward.
Positive OLR anomalies (suppressed convection and precipitation) were evident over Southeast Asia, Indonesia, Malaysia, most of the Philippines, and the Date Line. Negative OLR anomalies (enhanced convection/precipitation) were located just to the east of Papua New Guinea.

Low-level (850-hPa) westerly wind anomalies persisted over the western and central equatorial Pacific, while cross-equatorial wind anomalies were evident in the eastern tropical Pacific Ocean.

Upper-level (200-hPa) wind anomalies were easterly from west of the Date Line to 110°W.
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.
In October, November 2018, and in January-March 2019, positive subsurface temperature anomalies increased, partly due to downwelling Kelvin waves. During May 2019, an upwelling Kelvin wave contributed to a reduction of positive subsurface temperature anomalies and the emergence of negative anomalies around 110°-90°W.

Since mid-September, a downwelling Kelvin wave has increased subsurface temperature anomalies in the east-central Pacific, while the eastern Pacific remains below-average.

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.

During the period, westerly wind anomalies have periodically emerged over the western or central equatorial Pacific Ocean.

During September, low-level westerly wind anomalies shifted from the western to the eastern Pacific Ocean.
Upper-level (200-hPa) Velocity Potential Anomalies

Eastward propagation of anomalies has, at times, been evident throughout the period.

From June to mid-September 2019, anomalous upper-level convergence (brown shading) persisted in the far eastern Pacific and over S. America, while anomalous divergence (green shading) persisted over the east-central Pacific.

Recently, anomalous upper-level convergence has persisted over 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 mid-December 2018 to mid-June 2019, negative OLR anomalies largely persisted near the Date Line.

Since early February 2019, positive OLR anomalies have, at times, been evident over Indonesia.

Since late June 2019, convection has been suppressed over western Indonesia.

Since mid-September, suppressed convection has expanded from Indonesia to the 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.
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 (July - September 2019) is +0.1°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 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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ENSO-neutral is most likely to continue through the Northern Hemisphere spring 2020.
A majority of models favor ENSO-neutral through Northern Hemisphere spring 2020, with multi-model averages of Niño-3.4 values remaining close to El Niño thresholds (+0.5°C).
The CFS.v2 ensemble mean (black dashed line) predicts ENSO-neutral to continue through spring 2020.
Atmospheric anomalies over the North Pacific and North America During the Last 60 Days

During August, below-average heights and temperatures were evident over the north-central or northeastern U.S., while above-average heights and temperatures were present across the southern tier of the U.S.

Since early September, above-average heights and temperatures were observed over most of the central and eastern U.S., while below-average heights and temperatures were located over the western U.S.
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U.S. Temperature and Precipitation Departures During the Last 30 Days

End Date: 5 October 2019
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The seasonal outlooks combine the effects of long-term trends, soil moisture, and, when appropriate, ENSO.
Summary

ENSO Alert System Status: Not Active

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