ENSO: Recent Evolution, Current Status and Predictions

Update prepared by:
Climate Prediction Center / NCEP
16 December 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 near-to-above average across most of the Pacific Ocean.

The pattern of anomalous convection is generally consistent with ENSO-neutral.

ENSO-neutral is favored during the Northern Hemisphere winter 2019-20 (70% chance), continuing through spring 2020 (~65% 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 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.

Since mid-September, above-average SSTs expanded from the Date Line into the eastern Pacific Ocean.
The latest weekly SST departures are:

- Niño 4: 1.0°C
- Niño 3.4: 0.5°C
- Niño 3: 0.4°C
- Niño 1+2: 0.5°C
During the last four weeks, equatorial SSTs were above average across most of the Pacific. Near-to-below average SSTs were evident in a small region of the eastern Pacific and in the far western Pacific.
During the last four weeks, equatorial SSTs were above average across most of the Pacific, the Atlantic Ocean, and the western Indian Ocean. SSTs were below average near Indonesia and in a small region of the eastern Pacific.
Weekly SST Departures during the Last Four Weeks

During the last four weeks, above-average SSTs persisted across the central equatorial Pacific.
Change in Weekly SST Departures over the Last Four Weeks

During the last four weeks, equatorial SST anomalies increased in the far eastern Pacific Ocean, while decreasing in the western and 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 (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. Weak anomalies were then present through mid-September. Since mid-September, anomalies have been positive with weakening evident beginning in mid-October.
In the last two months, positive subsurface temperature anomalies have shifted eastward to the eastern Pacific.

At depth, negative subsurface temperature anomalies have shifted from the central to the eastern Pacific Ocean.
Positive OLR anomalies (suppressed convection and precipitation) were evident over Indonesia and near and east of the Date Line on the equator. Negative OLR anomalies (enhanced convection and precipitation) were observed over the western Pacific Ocean.

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

Upper-level (200-hPa) winds were near average across the equatorial Pacific Ocean.
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.

In the past month, a downwelling Kelvin wave and anomalous warming (dashed line) reached the west coast of South America, while an upwelling Kelvin wave and anomalous cooling (dotted line) moved into the east-central equatorial Pacific.

Above-average subsurface temperature anomalies are also evident near the Date Line.

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.

Since early September, low-level westerly wind anomalies have mostly persisted over the eastern Pacific.

In the last week, westerly wind anomalies continued over the eastern Pacific, while easterly wind anomalies were evident over the western Pacific.
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.

Since mid-September 2019, anomalous divergence has persisted over Africa and western Indian Ocean.

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

Since July 2019, positive OLR anomalies have been present over Indonesia.

From late October through November, negative OLR anomalies were present just west of the Date Line.

Since mid-November, positive OLR anomalies have persisted near and just east of 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
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.
The most recent ONI value (September-November 2019) is +0.3°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](#).

<table>
<thead>
<tr>
<th>Year</th>
<th>DJF</th>
<th>JFM</th>
<th>FMA</th>
<th>MAM</th>
<th>AMJ</th>
<th>MJJ</th>
<th>JJA</th>
<th>JAS</th>
<th>ASO</th>
<th>SON</th>
<th>OND</th>
<th>NDJ</th>
</tr>
</thead>
<tbody>
<tr>
<td>2007</td>
<td>0.7</td>
<td>0.3</td>
<td>0.0</td>
<td>-0.2</td>
<td>-0.3</td>
<td>-0.4</td>
<td>-0.5</td>
<td>-0.8</td>
<td>-1.1</td>
<td>-1.4</td>
<td>-1.5</td>
<td>-1.6</td>
</tr>
<tr>
<td>2008</td>
<td>-1.6</td>
<td>-1.4</td>
<td>-1.2</td>
<td>-0.9</td>
<td>-0.8</td>
<td>-0.5</td>
<td>-0.4</td>
<td>-0.3</td>
<td>-0.3</td>
<td>-0.4</td>
<td>-0.6</td>
<td>-0.7</td>
</tr>
<tr>
<td>2009</td>
<td>-0.8</td>
<td>-0.7</td>
<td>-0.5</td>
<td>-0.2</td>
<td>0.1</td>
<td>0.4</td>
<td>0.5</td>
<td>0.5</td>
<td>0.7</td>
<td>1.0</td>
<td>1.3</td>
<td>1.6</td>
</tr>
<tr>
<td>2010</td>
<td>1.5</td>
<td>1.3</td>
<td>0.9</td>
<td>0.4</td>
<td>-0.1</td>
<td>-0.6</td>
<td>-1.0</td>
<td>-1.4</td>
<td>-1.6</td>
<td>-1.7</td>
<td>-1.7</td>
<td>-1.6</td>
</tr>
<tr>
<td>2011</td>
<td>-1.4</td>
<td>-1.1</td>
<td>-0.8</td>
<td>-0.6</td>
<td>-0.5</td>
<td>-0.4</td>
<td>-0.5</td>
<td>-0.7</td>
<td>-0.9</td>
<td>-1.1</td>
<td>-1.1</td>
<td>-1.0</td>
</tr>
<tr>
<td>2012</td>
<td>-0.8</td>
<td>-0.6</td>
<td>-0.5</td>
<td>-0.4</td>
<td>-0.2</td>
<td>0.1</td>
<td>0.3</td>
<td>0.3</td>
<td>0.3</td>
<td>0.2</td>
<td>0.0</td>
<td>-0.2</td>
</tr>
<tr>
<td>2013</td>
<td>-0.4</td>
<td>-0.3</td>
<td>-0.2</td>
<td>-0.2</td>
<td>-0.2</td>
<td>0.3</td>
<td>0.3</td>
<td>0.3</td>
<td>0.2</td>
<td>0.2</td>
<td>-0.2</td>
<td>-0.3</td>
</tr>
<tr>
<td>2014</td>
<td>-0.4</td>
<td>-0.4</td>
<td>-0.2</td>
<td>0.1</td>
<td>0.3</td>
<td>0.2</td>
<td>0.1</td>
<td>0.0</td>
<td>0.2</td>
<td>0.4</td>
<td>0.6</td>
<td>0.7</td>
</tr>
<tr>
<td>2015</td>
<td>0.6</td>
<td>0.6</td>
<td>0.6</td>
<td>0.8</td>
<td>1.0</td>
<td>1.2</td>
<td>1.5</td>
<td>1.8</td>
<td>2.1</td>
<td>2.4</td>
<td>2.5</td>
<td>2.6</td>
</tr>
<tr>
<td>2016</td>
<td>2.5</td>
<td>2.2</td>
<td>1.7</td>
<td>1.0</td>
<td>0.5</td>
<td>0.0</td>
<td>-0.3</td>
<td>-0.6</td>
<td>-0.7</td>
<td>-0.7</td>
<td>-0.7</td>
<td>-0.6</td>
</tr>
<tr>
<td>2017</td>
<td>-0.3</td>
<td>-0.1</td>
<td>0.1</td>
<td>0.3</td>
<td>0.4</td>
<td>0.4</td>
<td>0.2</td>
<td>-0.1</td>
<td>-0.4</td>
<td>-0.7</td>
<td>-0.9</td>
<td>-1.0</td>
</tr>
<tr>
<td>2018</td>
<td>-0.9</td>
<td>-0.8</td>
<td>-0.6</td>
<td>-0.4</td>
<td>-0.1</td>
<td>0.1</td>
<td>0.1</td>
<td>0.2</td>
<td>0.4</td>
<td>0.7</td>
<td>0.9</td>
<td>0.8</td>
</tr>
<tr>
<td>2019</td>
<td>0.8</td>
<td>0.8</td>
<td>0.8</td>
<td>0.8</td>
<td>0.6</td>
<td>0.5</td>
<td>0.3</td>
<td>0.1</td>
<td>0.1</td>
<td>0.3</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
ENSO-neutral is most likely to continue through the Northern Hemisphere summer 2020.
A majority of models favor ENSO-neutral through Northern Hemisphere summer 2020.
The CFS.v2 ensemble mean (black dashed line) predicts ENSO-neutral to continue into summer 2020.
Atmospheric anomalies over the North Pacific and North America During the Last 60 Days

During late October and the first half of November, an amplified ridge-trough pattern covered the U.S., along with above-average temperatures in the far western U.S. and below-average temperatures in the central and eastern U.S.

In the last half of November and first half of December, mostly above-average temperatures and heights prevailed over the western or central U.S., while below-average heights and temperatures remained over the eastern U.S.
Atmospheric anomalies over the North Pacific and North America During the Last 60 Days

During late October and the first half of November, an amplified ridge-trough pattern covered the U.S., along with above-average temperatures in the far western U.S. and below-average temperatures in the central and eastern U.S.

In the last half of November and first half of December, mostly above-average temperatures and heights prevailed over the western or central U.S., while below-average heights and temperatures remained over the eastern U.S.
Atmospheric anomalies over the North Pacific and North America During the Last 60 Days

During late October and the first half of November, an amplified ridge-trough pattern covered the U.S., along with above-average temperatures in the far western U.S. and below-average temperatures in the central and eastern U.S.

In the last half of November and first half of December, mostly above-average temperatures and heights prevailed over the western or central U.S., while below-average heights and temperatures remained over the eastern U.S.
U.S. Temperature and Precipitation Departures During the Last 30 Days

End Date: 14 December 2019

Percent of Average Precipitation

Temperature Departures (degree C)
U.S. Temperature and Precipitation Departures During the Last 90 Days

End Date: 14 December 2019
U. S. Seasonal Outlooks
December 2019 - February 2020

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

ENSO Alert System Status: Not Active

ENSO-neutral conditions are present.*

Equatorial sea surface temperatures (SSTs) are near-to-above average across most of the Pacific Ocean.

The pattern of anomalous convection is generally consistent with ENSO-neutral.

ENSO-neutral is favored during the Northern Hemisphere winter 2019-20 (70% chance), continuing through spring 2020 (~65% 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.