ENSO: Recent Evolution, Current Status and Predictions

Update prepared by:
Climate Prediction Center / NCEP
6 April 2020
Outline

Summary
Recent Evolution and Current Conditions
Oceanic Niño Index (ONI)
Pacific SST Outlook
U.S. Seasonal Precipitation and Temperature Outlooks
Summary
Summary

ENSO Alert System Status: Not Active

ENSO-neutral conditions are present.*

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

The tropical atmospheric circulation is generally consistent with ENSO-neutral.

ENSO-neutral is favored for the Northern Hemisphere spring 2020 (~65% chance), continuing through summer 2020 (~55% 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.

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

Beginning in mid-September 2019, above-average SSTs expanded from the Date Line into the eastern Pacific Ocean.
Niño Region SST Departures (°C) Recent Evolution

The latest weekly SST departures are:

Niño 4 0.7°C
Niño 3.4 0.6°C
Niño 3 0.6°C
Niño 1+2 0.8°C
During the last four weeks, equatorial SSTs were near-to-above average across the Pacific Ocean.
During the last four weeks, equatorial SSTs were above average across most of the Pacific, the Atlantic Ocean and the Indian Ocean.
During the last four weeks, above-average SSTs weakened near the Date Line, with above-average SSTs strengthening in the eastern Pacific.
Change in Weekly SST Departures over the Last Four Weeks

During the last four weeks, equatorial SST anomalies decreased across the western and central Pacific Ocean and increased in the eastern Pacific Ocean (except near S. America).
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 increased from late September through mid-October 2019. During mid-October through November, positive anomalies decreased. During December 2019 and early January 2020, positive anomalies increased. Since early March, positive anomalies have weakened.
Sub-Surface Temperature Departures in the Equatorial Pacific

In the last two months, positive subsurface temperature anomalies have extended to the east-central Pacific due to a downwelling Kelvin wave.

Since February, negative subsurface temperature anomalies have strengthened at depth between 140°E-140°W and closer to the surface in the eastern Pacific (105°W-80°W).
Positive OLR anomalies (suppressed convection and precipitation) were evident over the Philippines, parts of Malaysia, and south of the equator around the Date Line.

Low-level (850-hPa) wind anomalies were easterly over parts of the east-central and eastern tropical Pacific Ocean.

Upper-level (200-hPa) wind anomalies were westerly over parts of the central and eastern equatorial Pacific and cross-equatorial over the east-central 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.
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.

During December 2019 and January 2020, a downwelling Kelvin wave (dashed line) resulted in above-average subsurface temperatures across the central and east-central equatorial Pacific.

Since mid-December 2019, above-average temperatures have persisted between ~170°E and ~140°W.

Recently, a downwelling Kelvin wave increased temperature anomalies in the east-central Pacific.

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.

From early September to early January, low-level westerly wind anomalies generally persisted east of the Date Line. From mid-December 2019 through February 2020, westerly wind anomalies persisted near the Date Line.

Since mid-March, easterly wind anomalies have dominated the central and eastern equatorial Pacific Ocean.

Westerly Wind Anomalies (orange/red shading)  
Easterly Wind Anomalies (blue shading)
Upper-level (200-hPa) Velocity Potential Anomalies

Eastward propagation of anomalies has, at times, been evident.

Since mid-September 2019, anomalous divergence (green shading) has generally persisted over Africa and the western Indian Ocean.

From early January to early March 2020, anomalous divergence persisted over the Date Line.

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-November through December 2019, positive OLR anomalies were evident near and just east of the Date Line.

From mid-December through February 2019, negative OLR anomalies were observed near and west of the Date Line.

From July 2019 through present, positive OLR anomalies persisted over Indonesia.

Since mid-March, negative OLR anomalies have persisted over the western equatorial Pacific.

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.
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 (January - March 2020) is +0.5 °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 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 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>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>-0.3</td>
<td>-0.3</td>
<td>-0.4</td>
<td>-0.4</td>
<td>-0.3</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>0.5</td>
<td>0.5</td>
</tr>
<tr>
<td>2020</td>
<td>0.5</td>
<td>0.5</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></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 the Northern Hemisphere summer and fall 2020.
The CFS.v2 ensemble mean (black dashed line) predicts ENSO-neutral to continue into summer 2020, with chances favoring La Niña thereafter.
Atmospheric anomalies over the North Pacific and North America During the Last 60 Days

From early February to early April, above-average heights and temperatures were generally evident over the eastern United States.

During mid-March, heights and temperatures switched from mostly above-average to below-average over the western United States.
Atmospheric anomalies over the North Pacific and North America During the Last 60 Days

From early February to early April, above-average heights and temperatures were generally evident over the eastern United States.

During mid-March, heights and temperatures switched from mostly above-average to below-average over the western United States.
Atmospheric anomalies over the North Pacific and North America During the Last 60 Days

From early February to early April, above-average heights and temperatures were generally evident over the eastern United States.

During mid-March, heights and temperatures switched from mostly above-average to below-average over the western United States.
U.S. Temperature and Precipitation Departures During the Last 30 Days

End Date: 4 April 2020
End Date: 4 April 2020
U. S. Seasonal Outlooks
April-June 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 the Pacific Ocean.

The tropical atmospheric circulation is generally consistent with ENSO-neutral.

ENSO-neutral is favored for the Northern Hemisphere spring 2020 (~65% chance), continuing through summer 2020 (~55% 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.