ENSO: Recent Evolution, Current Status and Predictions

Update prepared by:
Climate Prediction Center / NCEP
1 June 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 average across most of the Pacific Ocean.

The tropical atmospheric circulation is consistent with ENSO-neutral.

There is a ~65% chance of ENSO-neutral during Northern Hemisphere summer 2020, with chances decreasing through the autumn (to 45-50%).*

* 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 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.

Beginning in mid-April 2020, above-average SSTs weakened across the equatorial Pacific Ocean.

In the last week, equatorial SSTs were near-to-below average over the central and eastern Pacific Ocean.
Niño Region SST Departures (°C) Recent Evolution

The latest weekly SST departures are:

- Niño 4: -0.1°C
- Niño 3.4: -0.5°C
- Niño 3: -0.5°C
- Niño 1+2: -0.4°C
During the last four weeks, equatorial SSTs were near-to-below average across the central and eastern Pacific Ocean, and above average in the western Pacific.
During the last four weeks, equatorial SSTs were above average across the western Pacific Ocean, the western and eastern Atlantic Ocean, and the Indian Ocean. They were below average in the east-central Pacific Ocean.
During the last four weeks, below-average SSTs emerged in the east-central Pacific.
Change in Weekly SST Departures over the Last Four Weeks

During the last four weeks, the changes in equatorial SST anomalies were negative across most of the 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 (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 peaked during October 2019 and during January-February 2020. In March, positive anomalies weakened and returned to zero. During April and early May, negative anomalies strengthened.
In the last two months, negative subsurface temperature anomalies strengthened and have shifted from the western to eastern Pacific Ocean.

Most recent pentad analysis

Positive subsurface temperature anomalies have mostly dissipated.
Positive OLR anomalies (suppressed convection and precipitation) were evident over the Date Line. Negative OLR anomalies (enhanced convection and precipitation) were observed over parts of Indonesia.

Low-level (850-hPa) wind anomalies were easterly over the east-central equatorial Pacific Ocean.

Upper-level (200-hPa) wind anomalies were westerly over the central and 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 December 2019 to February 2020, downwelling Kelvin waves (dashed line) resulted in above-average subsurface temperatures across the central and east-central equatorial Pacific.

Since late March 2020, negative subsurface temperature anomalies have expanded eastward in association with an upwelling Kelvin wave.

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-April 2020, easterly wind anomalies have persisted over the central and eastern equatorial Pacific.

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 the beginning of the period, 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.

Since mid-April, anomalous convergence (brown shading) has generally persisted over the eastern Pacific 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

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 mid-April 2020, positive OLR anomalies persisted over Indonesia.

Since mid-March, positive OLR anomalies were observed at 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.
ONI (°C): Evolution since 1950

The most recent ONI value (February - April 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>0.6</td>
<td>0.5</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, with increasing chances of La Niña through the rest of the year.
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 through summer 2020, with chances favoring La Niña thereafter.
Atmospheric anomalies over the North Pacific and North America During the Last 60 Days

From April to mid-May, heights and temperatures were mostly below average over the eastern United States and they were mostly above average over the western United States.

During mid-May, heights and temperature transitioned to above average over eastern North America.
Atmospheric anomalies over the North Pacific and North America During the Last 60 Days

From April to mid-May, heights and temperatures were mostly below average over the eastern United States and they were mostly above average over the western United States.

During mid-May, heights and temperature transitioned to above average over eastern North America.
Atmospheric anomalies over the North Pacific and North America During the Last 60 Days

From April to mid-May, heights and temperatures were mostly below average over the eastern United States and they were mostly above average over the western United States.

During mid-May, heights and temperature transitioned to above average over eastern North America.
U.S. Temperature and Precipitation Departures During the Last 30 Days

End Date: 30 May 2020

Percent of Average Precipitation

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

End Date: 30 May 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 average across most of the Pacific Ocean.

The tropical atmospheric circulation is consistent with ENSO-neutral.

There is a ~65% chance of ENSO-neutral during Northern Hemisphere summer 2020, with chances decreasing through the autumn (to 45-50%).*

* 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.