ENSO: Recent Evolution, Current Status and Predictions

Update prepared by:
Climate Prediction Center / NCEP
10 August 2020
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:  **La Niña Watch**

ENSO-neutral conditions are present.*

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

The tropical atmospheric circulation is consistent with ENSO-neutral.

ENSO-neutral is favored to continue through the summer, with a 50-55% chance of La Niña development during Northern Hemisphere fall 2020 and continuing through winter 2020-21 (~50% 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](#).
Recent Evolution of Equatorial Pacific SST Departures (°C)

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.

Since early May 2020, equatorial SSTs were near-to-below average in the east-central and eastern Pacific Ocean.

In the past couple of weeks, negative SST anomalies strengthened across most of the equatorial Pacific, east of the Date Line.
The latest weekly SST departures are:

- Niño 4: -0.3°C
- Niño 3.4: -0.6°C
- Niño 3: -0.6°C
- Niño 1+2: -1.2°C
During the last four weeks, equatorial SSTs were below average from the Date Line to the eastern Pacific, and were above average in the western Pacific.
During the last four weeks, equatorial SSTs were above average across the western Pacific Ocean and most of the Indian Ocean. SSTs were below average from the central to the eastern Pacific Ocean.
Weekly SST Departures during the Last Four Weeks

During the last four weeks, below-average SSTs strengthened in the central and east-central equatorial 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, with positive changes around 100-110ºW.
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. From mid-May to early July, anomalies weakened to near zero. Since mid-July, negative anomalies have strengthened.
Sub-Surface Temperature Departures in the Equatorial Pacific

In the last two months, negative subsurface temperature anomalies have strengthened in the east-central Pacific Ocean.

Also, negative subsurface temperature anomalies have persisted, but have gradually weakened, in the eastern Pacific Ocean.
Positive OLR anomalies (suppressed convection and precipitation) extended from the western Pacific to ~160°W.

Low-level (850-hPa) wind anomalies were easterly over most of the equatorial Pacific Ocean and were cross-equatorial over the eastern tropical Pacific.

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

From April-June 2020, negative subsurface temperature anomalies expanded eastward in association with an upwelling Kelvin wave.

In July 2020, negative anomalies strengthened in the east-central Pacific Ocean.

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 mid-December 2019 through February 2020, westerly wind anomalies persisted near the Date Line.

From mid-April to mid-June 2020, easterly wind anomalies persisted over the eastern equatorial Pacific.

Since mid-July, the easterly wind anomalies have persisted over most of the Pacific Ocean.
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 central and/or 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-December 2019 through February 2020, 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 and/or over the western 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.
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 (ºC): Evolution since 1950

The most recent ONI value (April - June 2020) is -0.2ºC.
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.

<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>0.3</td>
<td>0.0</td>
<td>-0.2</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 La Niña favored (50-55% chance) beginning in August-October 2020 and continuing through Northern Hemisphere winter 2020-21.
The averages of the models predict a borderline or weak La Niña into the Northern Hemisphere winter 2020-21.
The CFS.v2 ensemble mean (black dashed line) predicts ENSO-neutral to transition to La Niña beginning in the August-October 2020 season.
Atmospheric anomalies over the North Pacific and North America During the Last 60 Days

From early June to early August, above-average heights and temperatures have generally persisted over eastern Canada and the northeastern U.S.
Atmospheric anomalies over the North Pacific and North America During the Last 60 Days

From early June to early August, above-average heights and temperatures have generally persisted over eastern Canada and the northeastern U.S.
Atmospheric anomalies over the North Pacific and North America During the Last 60 Days

From early June to early August, above-average heights and temperatures have generally persisted over eastern Canada and the northeastern U.S.
U.S. Temperature and Precipitation Departures During the Last 30 Days

End Date: 8 August 2020
U.S. Temperature and Precipitation Departures During the Last 90 Days

End Date: 8 August 2020
The seasonal outlooks combine the effects of long-term trends, soil moisture, and, when appropriate, ENSO.
ENSO Alert System Status:  **La Niña Watch**

ENSO-neutral conditions are present.*

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

The tropical atmospheric circulation is consistent with ENSO-neutral.

ENSO-neutral is favored to continue through the summer, with a 50-55% chance of La Niña development during Northern Hemisphere fall 2020 and continuing through winter 2020-21 (~50% 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 \textit{here}.\ 