ENSO: Recent Evolution, Current Status and Predictions
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:  **Final La Niña Advisory**

ENSO-neutral conditions are present.*

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

ENSO-neutral likely to continue through the Northern Hemisphere summer (67% chance in June-August 2021).*

* 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](#).
During September 2020 to March 2021, the core of the strongest negative SSTs shifted from the eastern to the central Pacific Ocean.

Since early March 2021, negative anomalies have weakened in the central and east-central equatorial Pacific Ocean.
Niño Region SST Departures (°C) Recent Evolution

The latest weekly SST departures are:

- Niño 4: -0.1°C
- Niño 3.4: -0.3°C
- Niño 3: -0.4°C
- Niño 1+2: -0.6°C
SST Departures (°C) in the Tropical Pacific During the Last Four Weeks

In the last four weeks, equatorial SSTs were below average in the eastern Pacific Ocean and near average across the rest of the Pacific Ocean.
Global SST Departures (°C) During the Last Four Weeks

During the last four weeks, equatorial SSTs were below average in the eastern Pacific Ocean. SSTs were above average in the Indian Ocean and parts of the Atlantic Ocean.
During the last 4 weeks, SSTs returned to near average across most of the equatorial Pacific Ocean, while negative SSTs persisted in the eastern Pacific Ocean.
During the last four weeks, the changes in equatorial SST anomalies were positive in the eastern 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 (above average) and thermocline slope index (above average) reflect the return of 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 weakened in June 2020. Starting in mid-July, negative temperature anomalies strengthened and persisted through early February 2021, when the negative anomalies weakened. Beginning in mid-March 2021, subsurface temperature was above average and increasing.
In the last two months, positive subsurface temperature anomalies have shifted eastward and closer to the surface in the eastern Pacific Ocean.

Negative subsurface temperature anomalies remain in a small region of the eastern Pacific Ocean down to ~150m depth.
Tropical OLR and Wind Anomalies During the Last 30 Days

Positive OLR anomalies (suppressed convection and precipitation) were located over Indonesia.

Low-level (850-hPa) easterly wind anomalies were evident over a small area of the east-central equatorial Pacific Ocean.

Upper-level (200-hPa) westerly wind anomalies were observed over the east-central equatorial Pacific Ocean.
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 August 2020 to February 2021, negative subsurface temperature anomalies persisted in the eastern half of the Pacific Ocean.

During March and April 2021, positive temperature anomalies shifted eastward in association with a downwelling Kelvin wave.

Recently, a second downwelling Kelvin wave has been propagating into 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 late August 2020 onwards, easterly wind anomalies mostly persisted over the central and east-central equatorial Pacific Ocean.
Upper-level (200-hPa) Velocity Potential Anomalies

From the beginning of the period through mid-April 2021, anomalous divergence (green shading) remained over Indonesia, while anomalous convergence (brown shading) persisted over the eastern Pacific Ocean.

In the last week, anomalous convergence shifted into the eastern Pacific Ocean, while anomalous divergence shifted to Indonesia and the central 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 late April 2020 through March 2021, positive OLR anomalies persisted around the Date Line.

From mid-December 2020 through February 2021, negative OLR anomalies were evident over Indonesia.

Since early May, negative OLR anomalies have emerged over the western Indian Ocean.

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 (February - April 2021) is -0.8°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 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](#).

<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>2009</td>
<td>-0.8</td>
<td>-0.8</td>
<td>-0.6</td>
<td>-0.3</td>
<td>0.0</td>
<td>0.3</td>
<td>0.5</td>
<td>0.6</td>
<td>0.7</td>
<td>1.0</td>
<td>1.4</td>
<td>1.6</td>
</tr>
<tr>
<td>2010</td>
<td>1.5</td>
<td>1.2</td>
<td>0.8</td>
<td>0.4</td>
<td>-0.2</td>
<td>-0.7</td>
<td>-1.0</td>
<td>-1.3</td>
<td>-1.6</td>
<td>-1.6</td>
<td>-1.6</td>
<td>-1.6</td>
</tr>
<tr>
<td>2011</td>
<td>-1.4</td>
<td>-1.2</td>
<td>-0.9</td>
<td>-0.7</td>
<td>-0.6</td>
<td>-0.4</td>
<td>-0.5</td>
<td>-0.6</td>
<td>-0.8</td>
<td>-1.0</td>
<td>-1.1</td>
<td>-1.0</td>
</tr>
<tr>
<td>2012</td>
<td>-0.9</td>
<td>-0.7</td>
<td>-0.6</td>
<td>-0.5</td>
<td>-0.3</td>
<td>0.0</td>
<td>0.2</td>
<td>0.4</td>
<td>0.4</td>
<td>0.3</td>
<td>0.1</td>
<td>-0.2</td>
</tr>
<tr>
<td>2013</td>
<td>-0.4</td>
<td>-0.4</td>
<td>-0.3</td>
<td>-0.3</td>
<td>-0.4</td>
<td>-0.4</td>
<td>-0.4</td>
<td>-0.3</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>-0.5</td>
<td>-0.3</td>
<td>0.0</td>
<td>0.2</td>
<td>0.2</td>
<td>0.0</td>
<td>0.1</td>
<td>0.2</td>
<td>0.5</td>
<td>0.6</td>
<td>0.7</td>
</tr>
<tr>
<td>2015</td>
<td>0.5</td>
<td>0.5</td>
<td>0.5</td>
<td>0.7</td>
<td>0.9</td>
<td>1.2</td>
<td>1.5</td>
<td>1.9</td>
<td>2.2</td>
<td>2.4</td>
<td>2.6</td>
<td>2.6</td>
</tr>
<tr>
<td>2016</td>
<td>2.5</td>
<td>2.1</td>
<td>1.6</td>
<td>0.9</td>
<td>0.4</td>
<td>-0.1</td>
<td>-0.4</td>
<td>-0.5</td>
<td>-0.6</td>
<td>-0.7</td>
<td>-0.7</td>
<td>-0.6</td>
</tr>
<tr>
<td>2017</td>
<td>-0.3</td>
<td>-0.2</td>
<td>0.1</td>
<td>0.2</td>
<td>0.3</td>
<td>0.3</td>
<td>0.1</td>
<td>-0.1</td>
<td>-0.4</td>
<td>-0.7</td>
<td>-0.8</td>
<td>-1.0</td>
</tr>
<tr>
<td>2018</td>
<td>-0.9</td>
<td>-0.9</td>
<td>-0.7</td>
<td>-0.5</td>
<td>-0.2</td>
<td>0.0</td>
<td>0.1</td>
<td>0.2</td>
<td>0.5</td>
<td>0.8</td>
<td>0.9</td>
<td>0.8</td>
</tr>
<tr>
<td>2019</td>
<td>0.7</td>
<td>0.7</td>
<td>0.7</td>
<td>0.5</td>
<td>0.5</td>
<td>0.3</td>
<td>0.1</td>
<td>0.2</td>
<td>0.3</td>
<td>0.5</td>
<td>0.5</td>
<td>0.5</td>
</tr>
<tr>
<td>2020</td>
<td>0.5</td>
<td>0.5</td>
<td>0.4</td>
<td>0.2</td>
<td>-0.1</td>
<td>-0.3</td>
<td>-0.4</td>
<td>-0.6</td>
<td>-0.9</td>
<td>-1.2</td>
<td>-1.3</td>
<td>-1.2</td>
</tr>
<tr>
<td>2021</td>
<td>-1.0</td>
<td>-0.9</td>
<td>-0.8</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 favored through the Northern Hemisphere summer, with chances of La Niña increasing into the fall and winter 2020-21.
The model averages predict ENSO-neutral to continue into winter 2021-22.
The CFS.v2 ensemble mean (black dashed line) predicts ENSO-neutral to continue into winter 2021-22.
Atmospheric anomalies over the North Pacific and North America During the Last 60 Days

During mid-March to mid-April, above-average heights and temperatures were observed over the central and/or eastern U.S.

During mid-April to mid-May, below-average heights and temperatures dominated the central and eastern U.S.

Since late April, above-average heights and temperatures are most prominent over the western U.S.
Atmospheric anomalies over the North Pacific and North America During the Last 60 Days

During mid-March to mid-April, above-average heights and temperatures were observed over the central and/or eastern U.S.

During mid-April to mid-May, below-average heights and temperatures dominated the central and eastern U.S.

Since late April, above-average heights and temperatures are most prominent over the western U.S.
Atmospheric anomalies over the North Pacific and North America During the Last 60 Days

During mid-March to mid-April, above-average heights and temperatures were observed over the central and/or eastern U.S.

During mid-April to mid-May, below-average heights and temperatures dominated the central and eastern U.S.

Since late April, above-average heights and temperatures are most prominent over the western U.S.
U.S. Temperature and Precipitation Departures During the Last 30 Days

End Date: 15 May 2021
U.S. Temperature and Precipitation Departures During the Last 90 Days

End Date: 15 May 2021
The seasonal outlooks combine the effects of long-term trends, soil moisture, and, when appropriate, ENSO.
Summary

ENSO Alert System Status: **Final La Niña Advisory**

ENSO-neutral conditions are present.*

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

ENSO-neutral likely to continue through the Northern Hemisphere summer (67% chance in June-August 2021).*

* 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](#).