

# ENSO: Recent Evolution, Current Status and Predictions



Update prepared by:  
Climate Prediction Center / NCEP  
31 October 2016

# 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: La Niña Watch

ENSO-neutral conditions are present.\*

Equatorial sea surface temperatures (SST) are below average in the central and east-central Pacific Ocean.

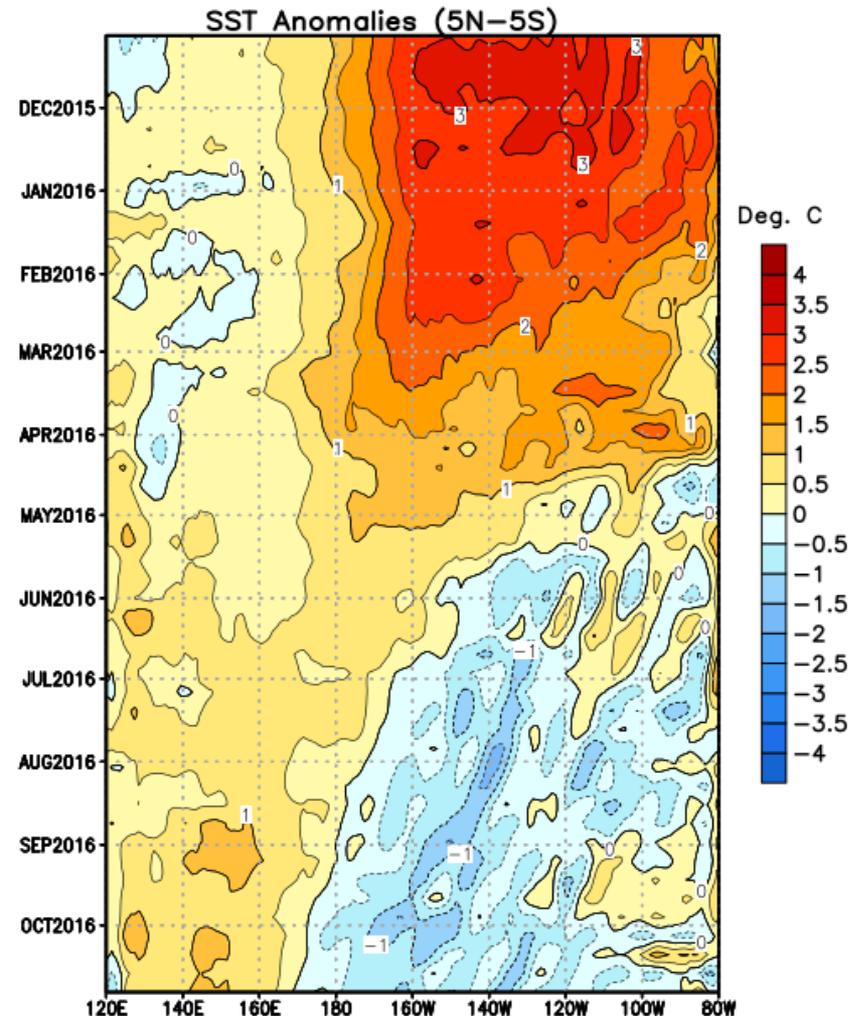
La Niña is favored to develop (~70% chance) during the Northern Hemisphere fall 2016 and slightly favored to persist (~55% chance) during winter 2016-17.\*

\* Note: These statements are updated once a month (2<sup>nd</sup> 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)

Since mid-April 2016, near-to-below average SSTs have expanded westward toward the Date Line.

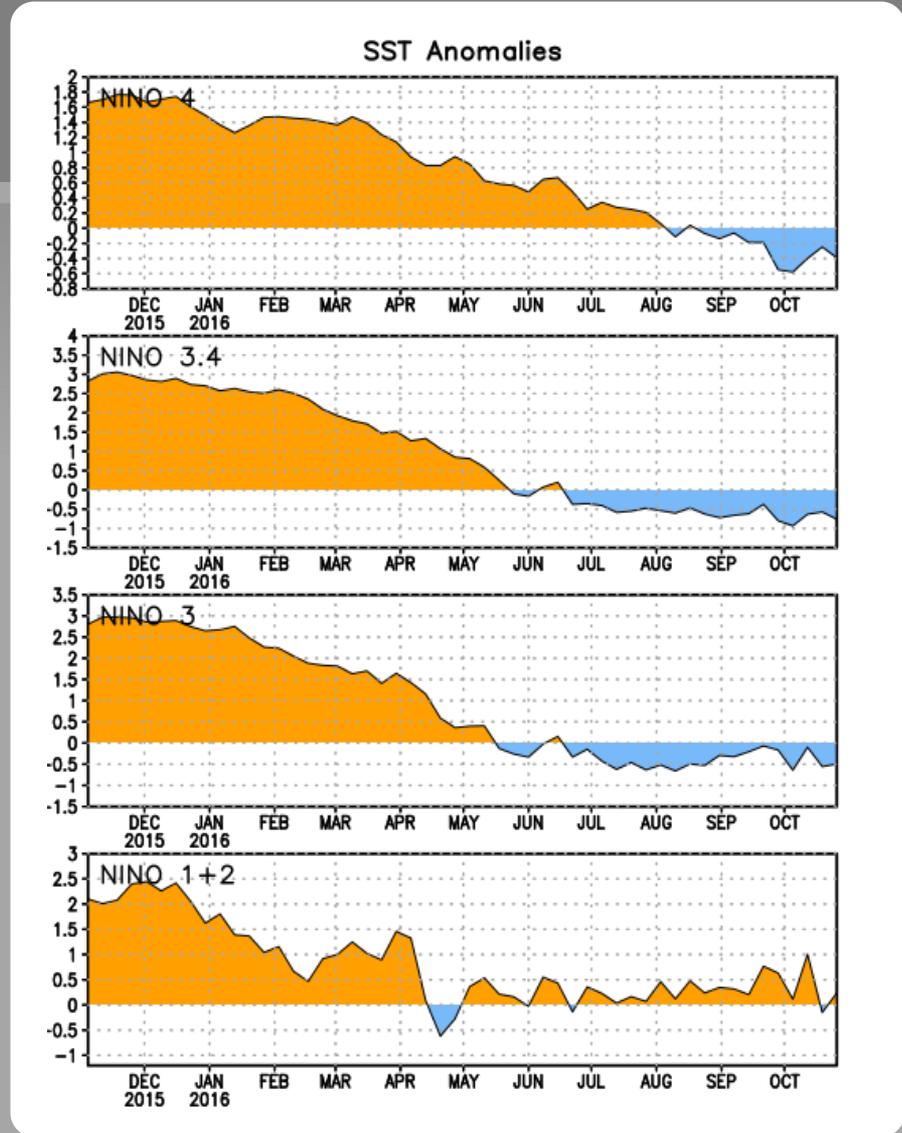
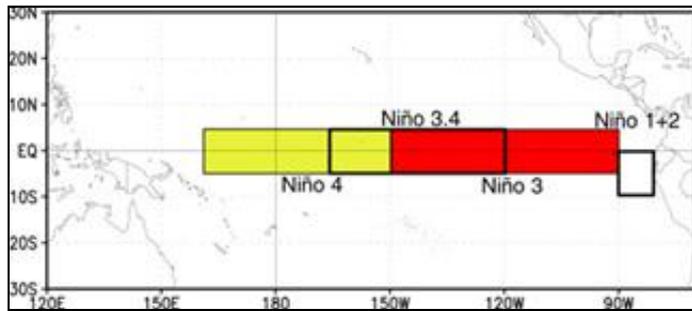
Over the last month, negative SST anomalies have persisted in the central and east-central Pacific, while SST anomalies in the eastern Pacific have been variable.



# Niño Region SST Departures (°C) Recent Evolution

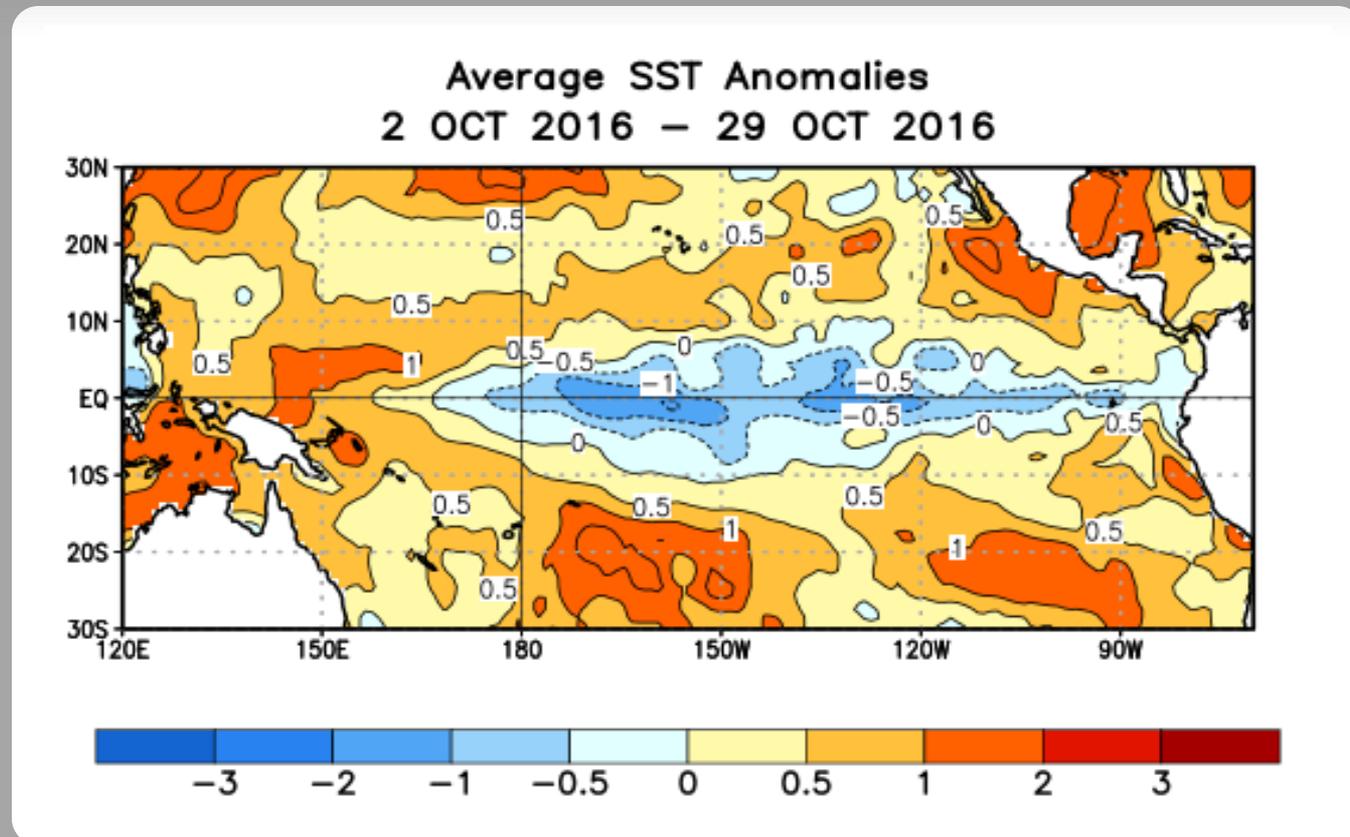
The latest weekly SST departures are:

Niño 4	-0.4°C
Niño 3.4	-0.8°C
Niño 3	-0.5°C
Niño 1+2	0.2°C



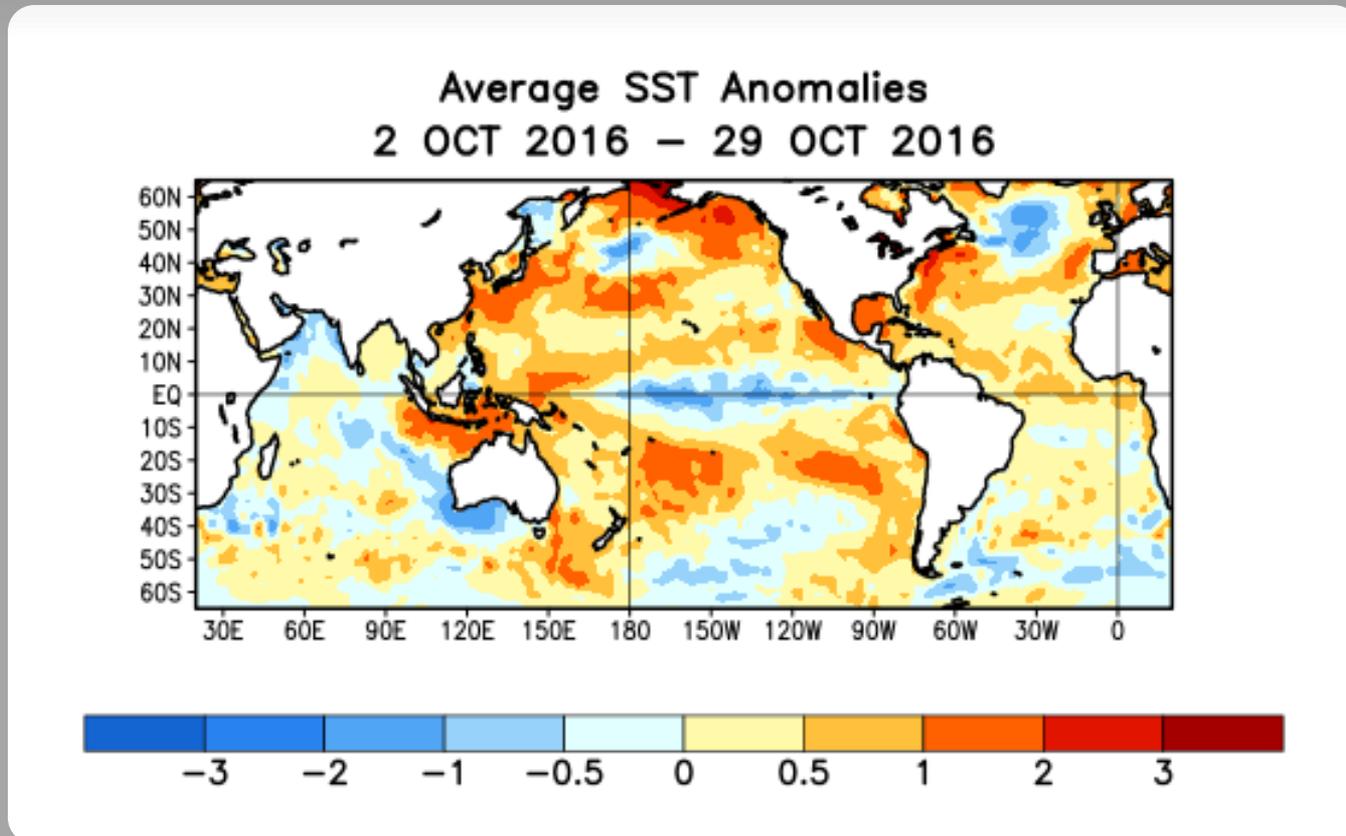
# SST Departures (°C) in the Tropical Pacific During the Last Four Weeks

During the last four weeks, equatorial SSTs were below average across the central and east-central Pacific, and near average in the far eastern Pacific.



# Global SST Departures (°C) During the Last Four Weeks

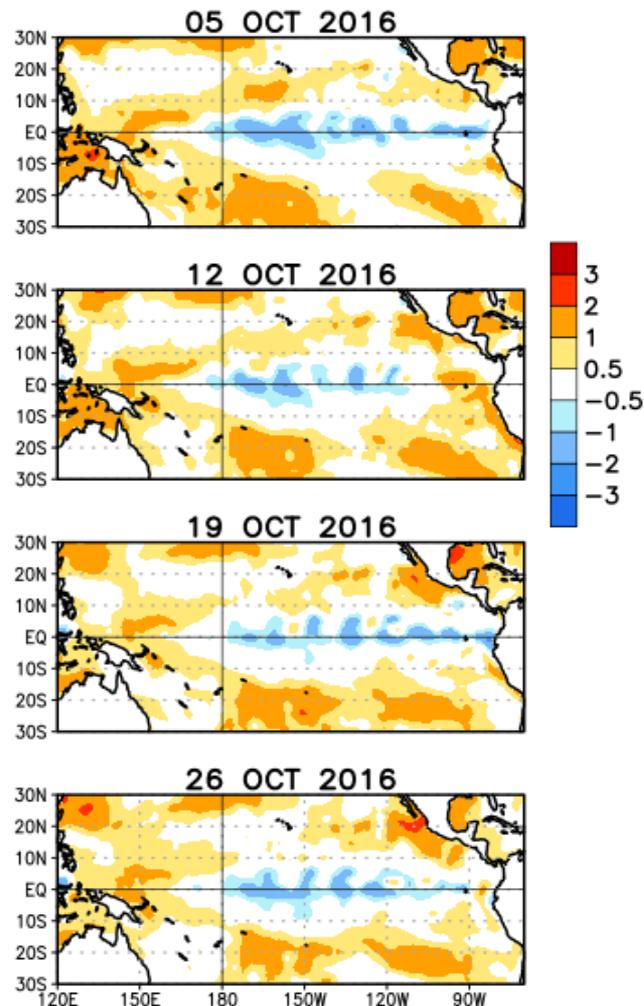
During the last four weeks, equatorial SSTs were above average near the Maritime Continent and in the Atlantic. Equatorial SSTs were below average across the central and east-central Pacific Ocean.



# Weekly SST Departures during the Last Four Weeks

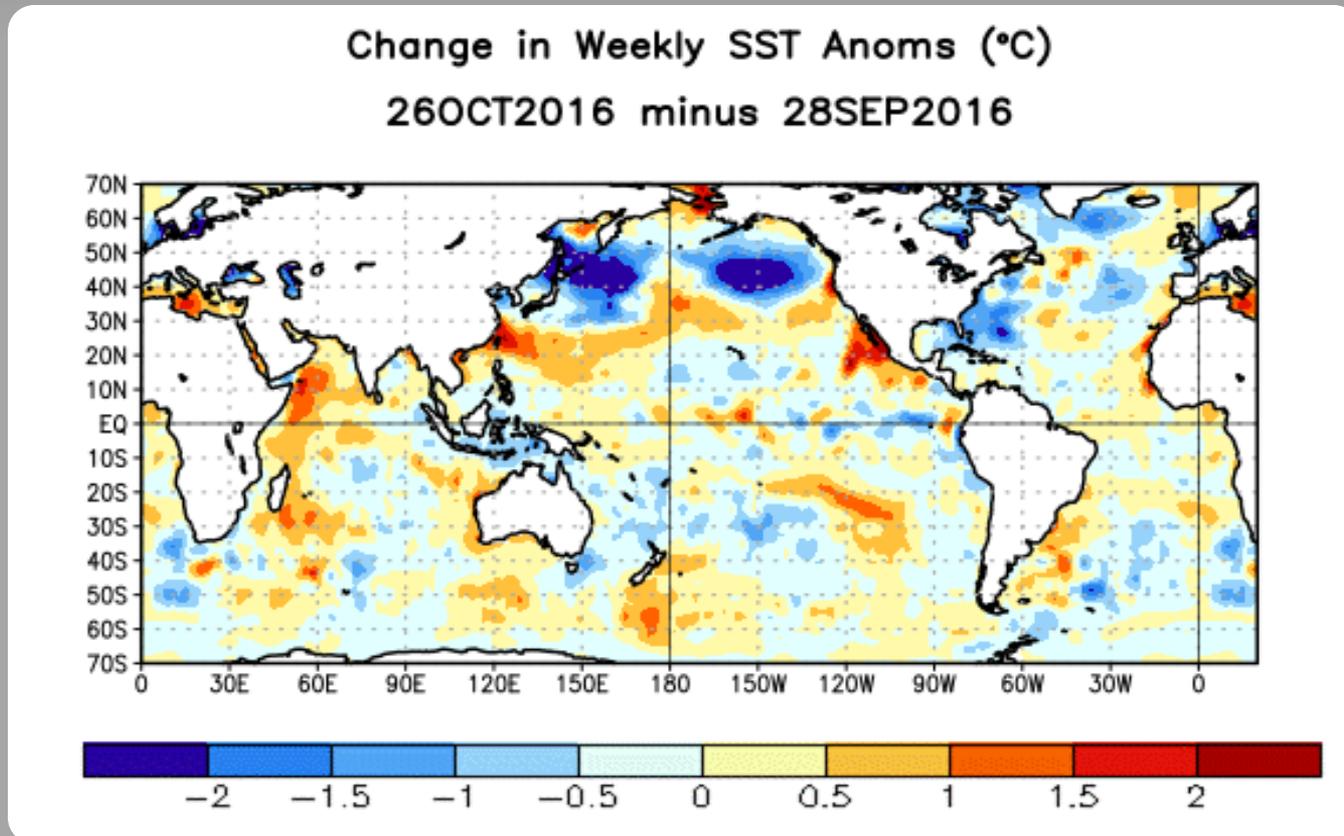
During the last four weeks, negative SST anomalies have persisted in the central and east-central equatorial Pacific. SST anomalies in the eastern Pacific have been variable.

## Weekly SST Anomalies (DEG C)



# Change in Weekly SST Departures over the Last Four Weeks

During the last four weeks, small regions of equatorial SST anomalies increased or decreased across the central and eastern Pacific.



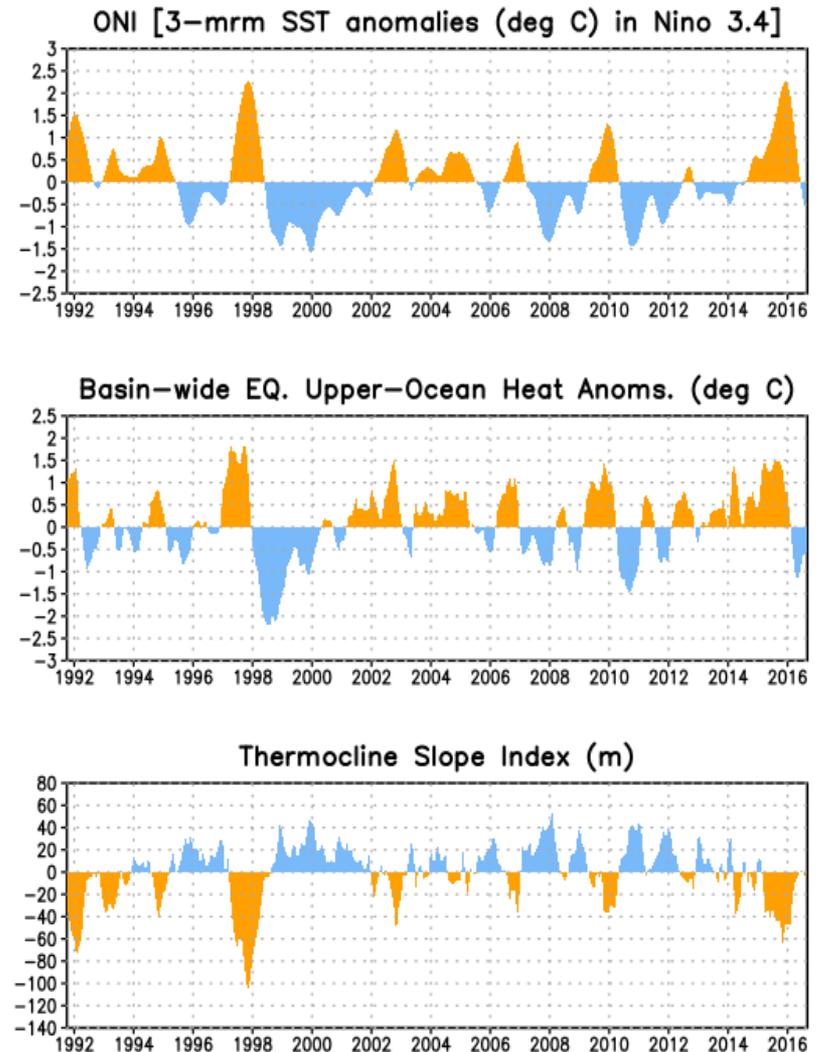
# Upper-Ocean Conditions in the Equatorial Pacific

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.

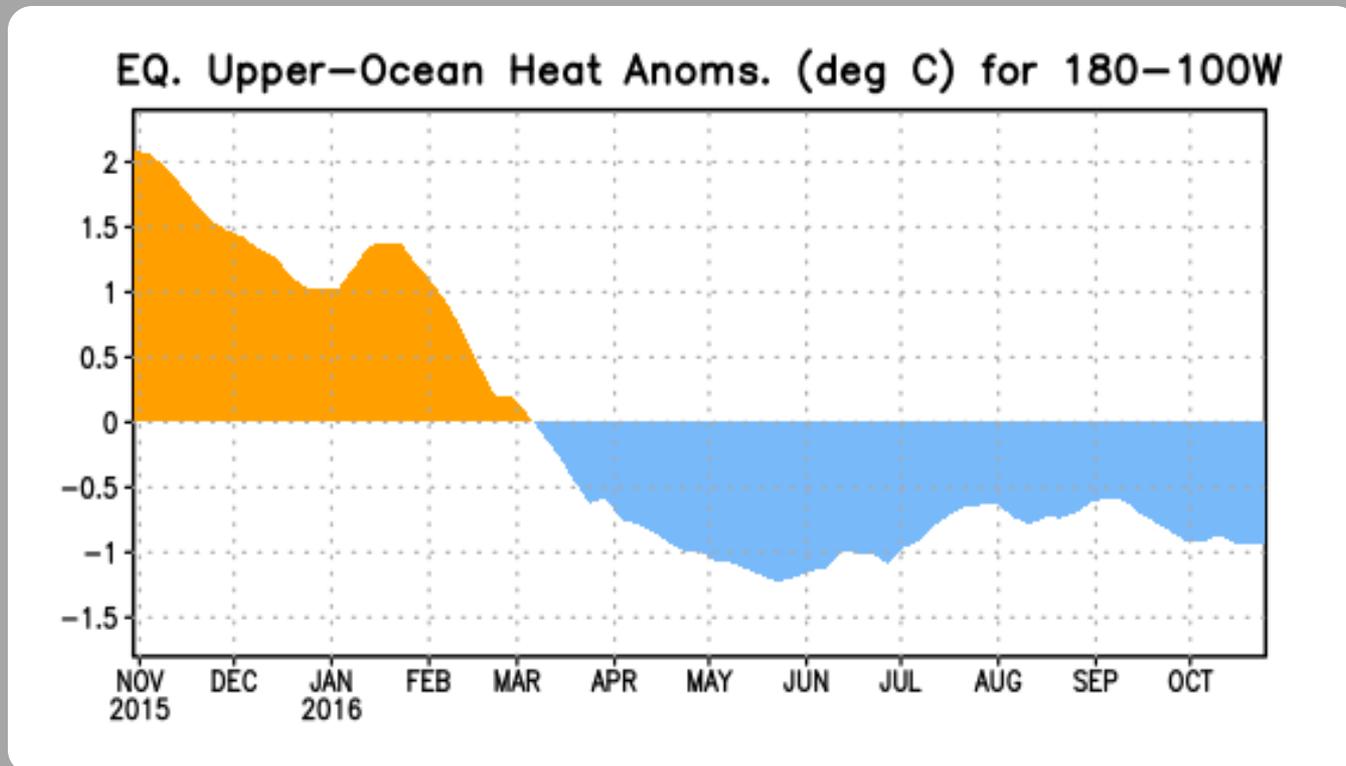
Recent values of the upper-ocean heat anomalies (negative) and thermocline slope index (near zero) reflect ENSO-neutral conditions.

*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).*



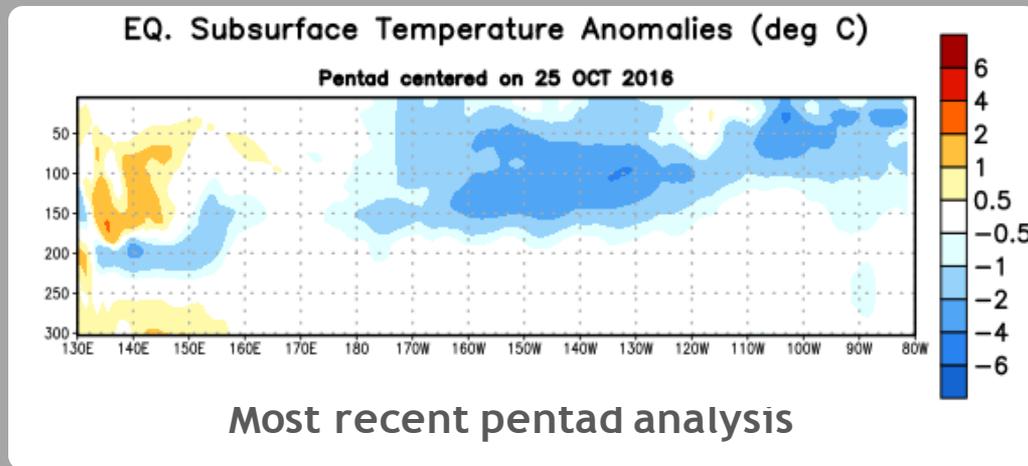
# Central and Eastern Pacific Upper-Ocean (0-300 m) Weekly Average Temperature Anomalies

Overall, positive subsurface temperature anomalies decreased following November 2015, and became negative during March 2016. Negative anomalies strengthened during March - May 2016, followed by weakening in June and July 2016. Since August, weak negative anomalies have persisted.

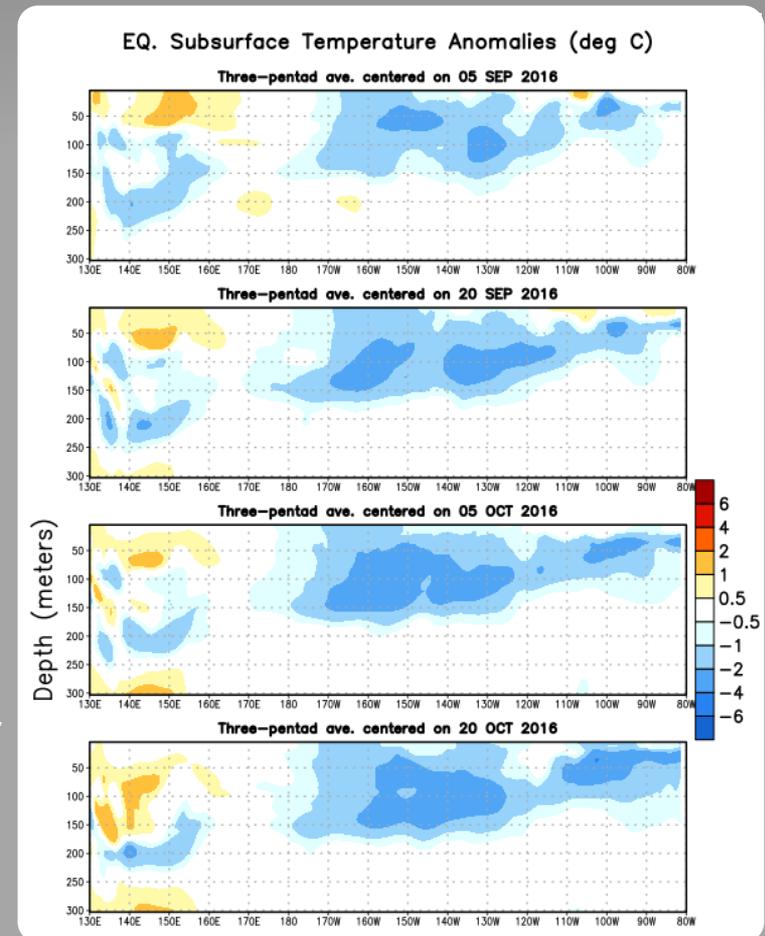


# Sub-Surface Temperature Departures in the Equatorial Pacific

During the last two months, negative subsurface temperature anomalies have extended to the surface in portions of the central and eastern Pacific Ocean.



During late September and October, negative temperature anomalies strengthened at depth east of the International Date Line.

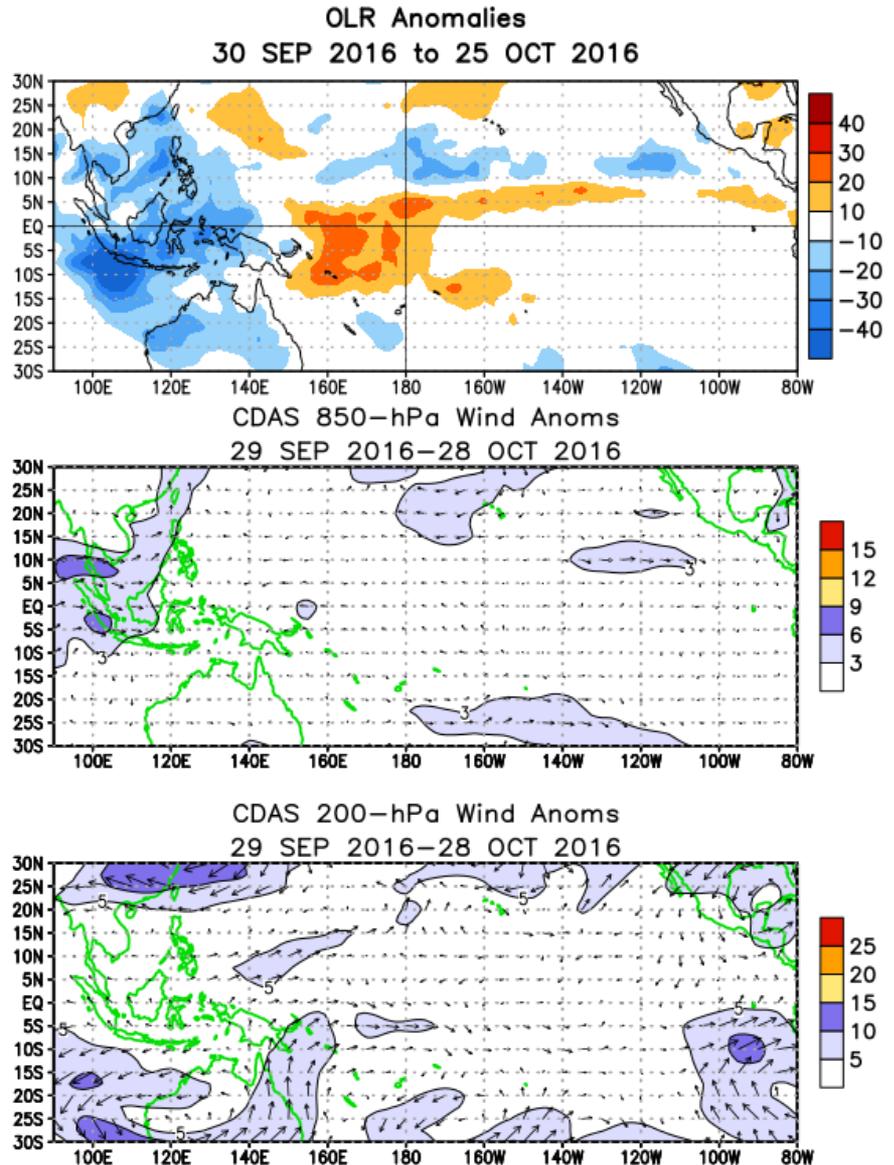


# Tropical OLR and Wind Anomalies During the Last 30 Days

Negative OLR anomalies (enhanced convection and precipitation) were evident over Indonesia, Papua New Guinea, the Philippines, and Australia. Positive OLR anomalies (suppressed convection and precipitation) were observed around the International Date Line and western Pacific.

Low-level (850-hPa) easterly wind anomalies were present across a small region of the western equatorial Pacific.

Upper-level (200-hPa) westerly wind anomalies prevailed across the central and far eastern 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.

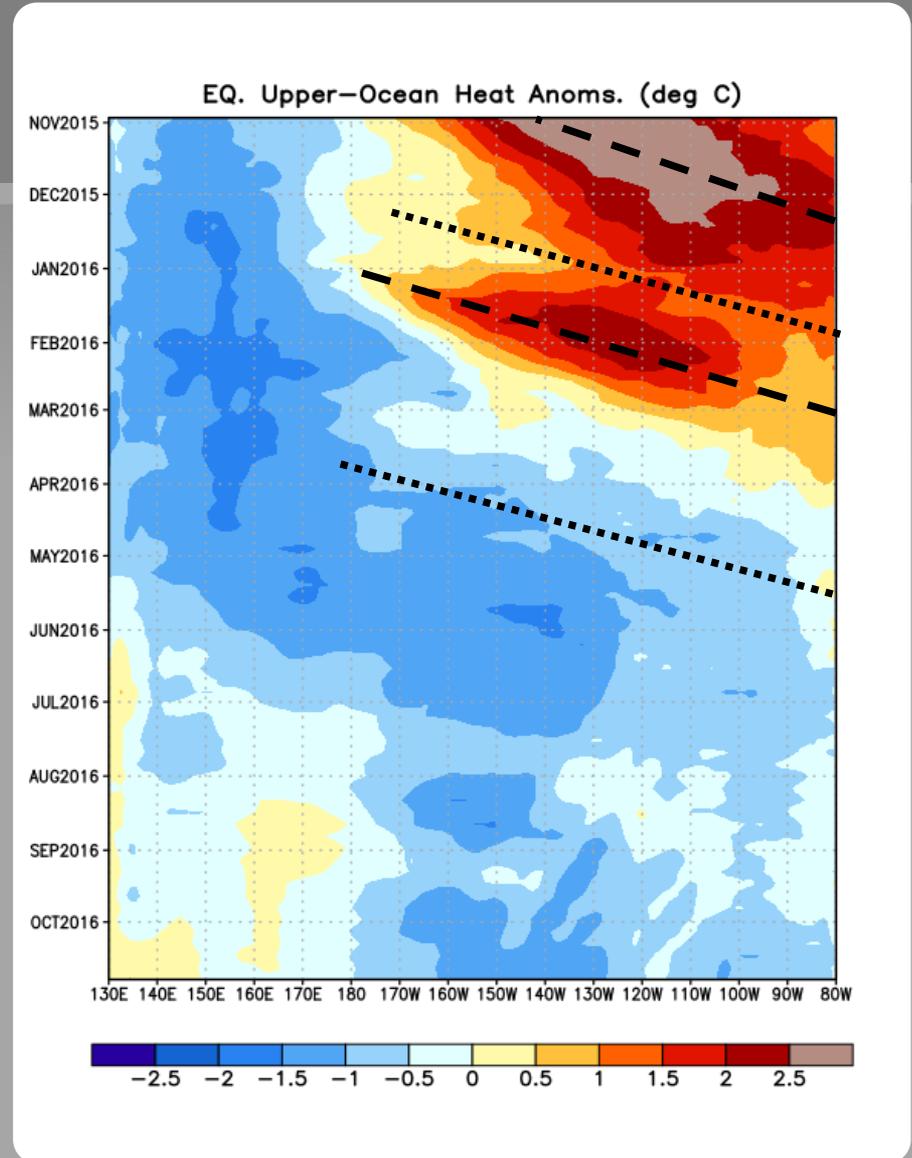
# Weekly Heat Content Evolution in the Equatorial Pacific

Downwelling phases of equatorial oceanic Kelvin waves were observed October-November 2015 and January-February 2016.

Since the passage of an upwelling equatorial oceanic Kelvin wave in March 2016, below-average subsurface temperatures have continued across much of the equatorial Pacific.

Since mid- September 2016, below-average subsurface temperatures have strengthened east of the International 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.



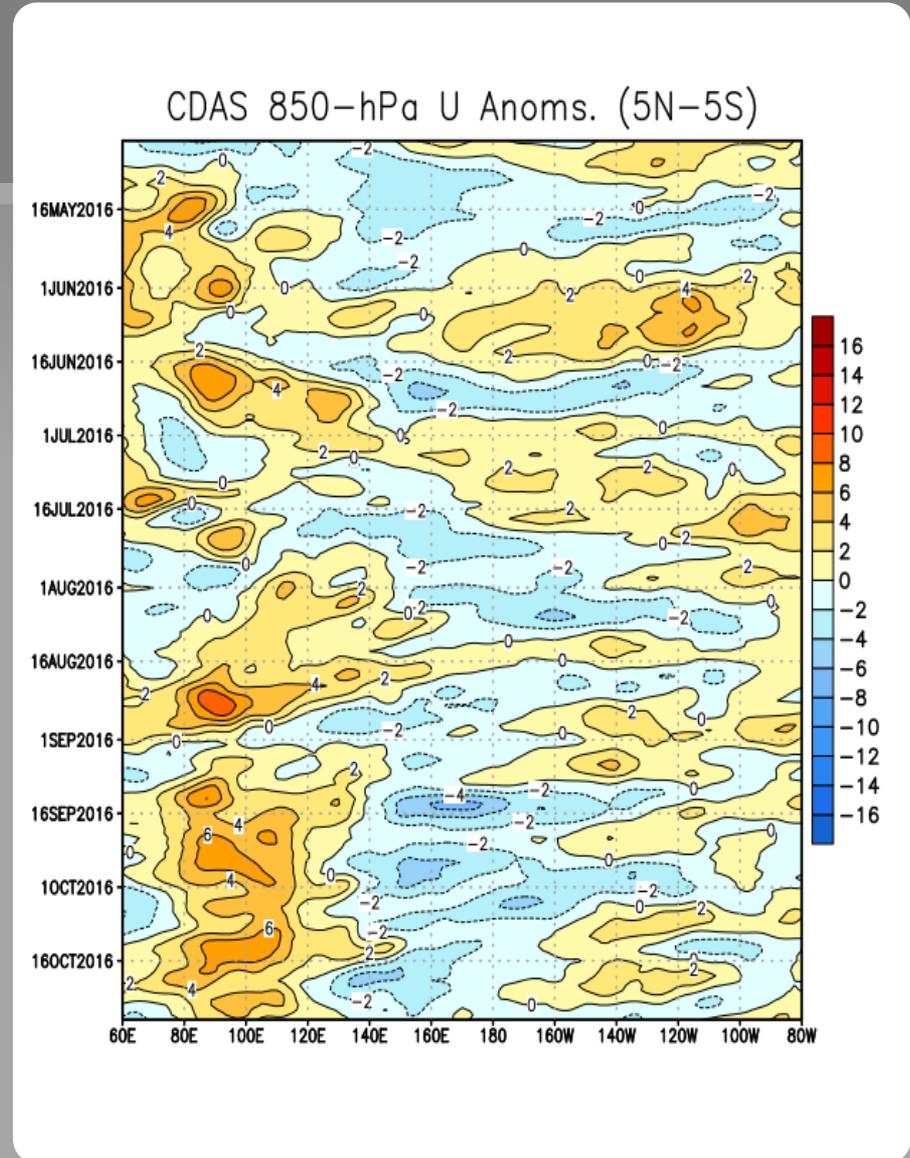
# Low-level (850-hPa) Zonal (east-west) Wind Anomalies ( $\text{m s}^{-1}$ )

Since May, the equatorial Pacific has been characterized by weak anomalous westerlies and easterlies.

During the last month, easterly wind anomalies have persisted near and west of the International Date Line, while fluctuating over the eastern Pacific.

Westerly Wind Anomalies (orange/red shading)

Easterly Wind Anomalies (blue shading)



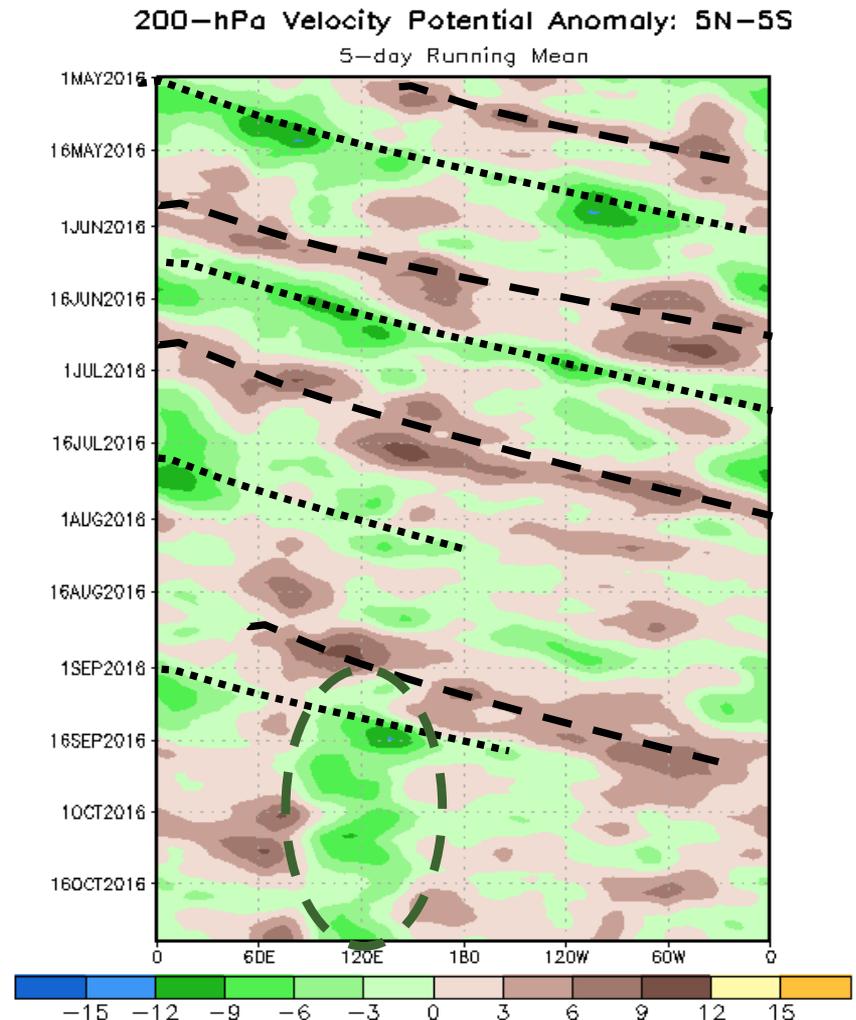
# Upper-level (200-hPa) Velocity Potential Anomalies

Eastward propagation of regions of upper-level divergence (green shading) and convergence (brown shading) are particularly evident from mid April through early August 2016 and also during September 2016.

Since early September, anomalous upper-level divergence has persisted near Indonesia.

Unfavorable for precipitation (brown shading)  
Favorable for precipitation (green shading)

Note: Eastward propagation is not necessarily indicative of the Madden-Julian Oscillation (MJO).

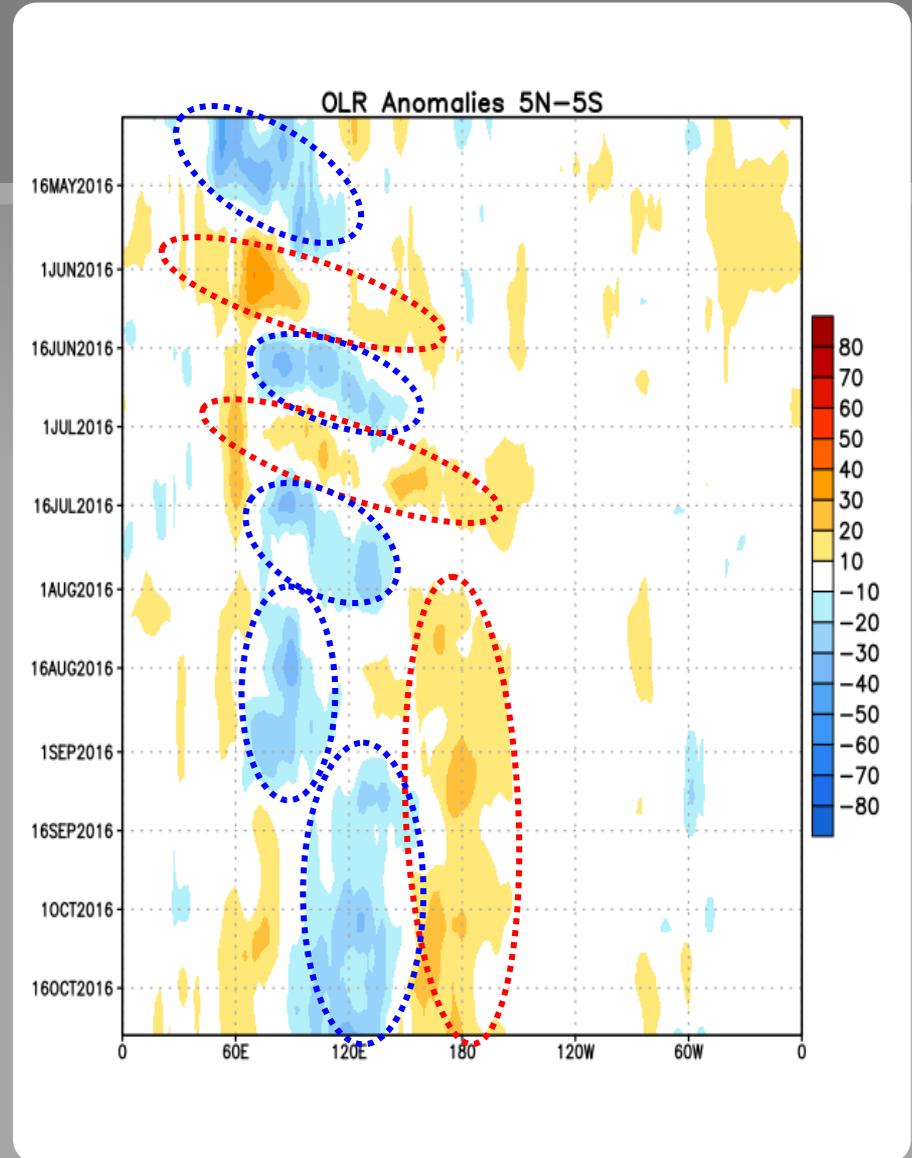


# Outgoing Longwave Radiation (OLR) Anomalies

During May through July 2016, eastward shifting OLR anomalies prevailed over the Indian Ocean and extended into the central Pacific Ocean.

Since early August 2016, positive OLR anomalies have persisted near the International Date Line. Since early September 2016, negative OLR anomalies have persisted near the Maritime Continent.

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.v4). The SST reconstruction methodology is described in Huang et al., 2015, J. Climate, vol. 28, 911-930.)

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  $+0.5^{\circ}\text{C}$ .

La Niña: characterized by a negative ONI less than or equal to  $-0.5^{\circ}\text{C}$ .

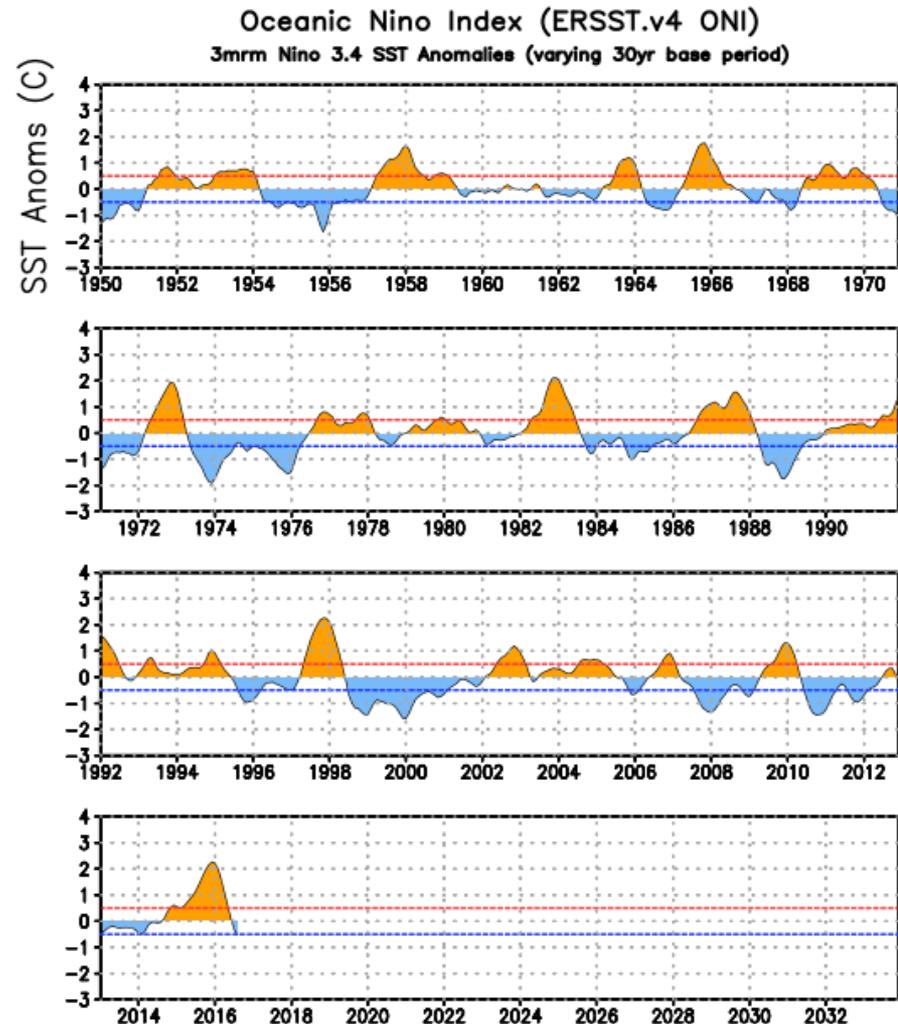
By historical standards, to be classified as a full-fledged El Niño or La Niña episode, these thresholds must be exceeded for a period of at least 5 consecutive overlapping 3-month seasons.

CPC considers El Niño or La Niña conditions to occur when the monthly Niño3.4 OISST departures meet or exceed  $\pm 0.5^{\circ}\text{C}$  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 (July-September 2016) is  $-0.5^{\circ}\text{C}$ .

El Niño ↑  
Neutral  
La Niña ↓



# Historical El Niño and La Niña Episodes Based on the ONI computed using ERSST.v4

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.v4 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.

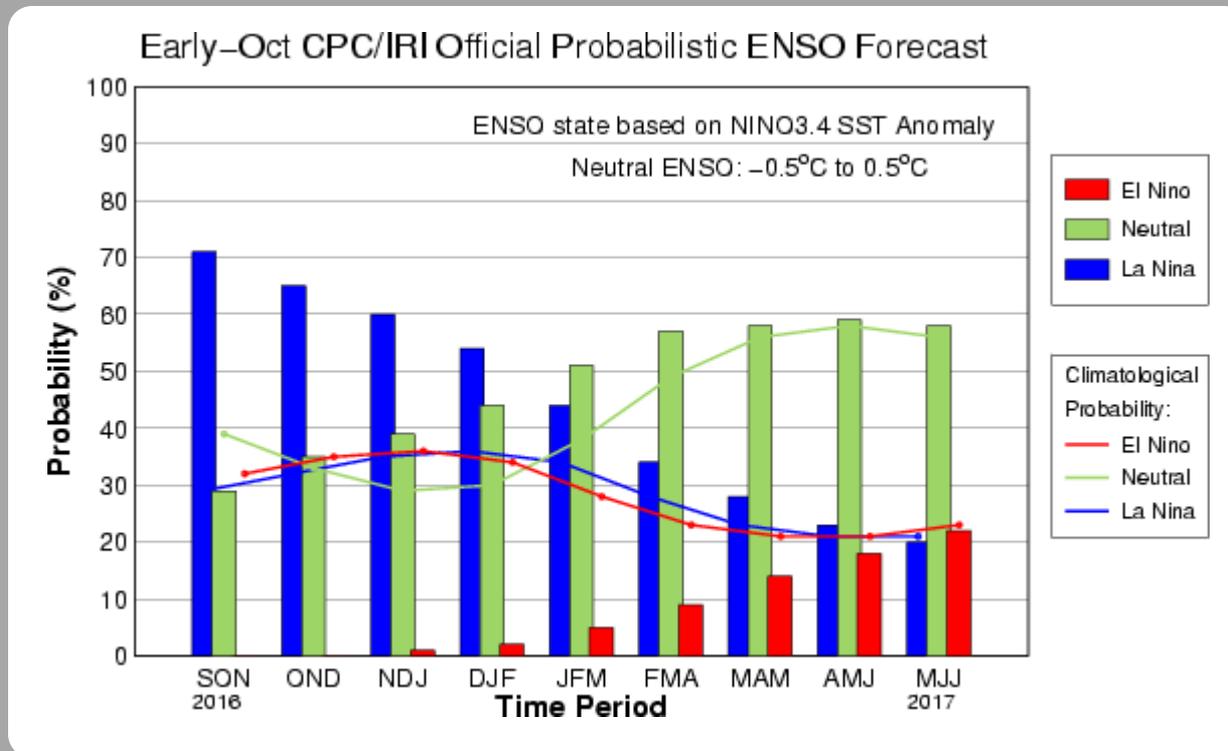
The ONI is one measure of the El Niño-Southern Oscillation, and other indices can confirm whether features consistent with a coupled ocean-atmosphere phenomenon accompanied these periods. The complete table going back to DJF 1950 can be found [here](#).

Year	DJF	JFM	FMA	MAM	AMJ	MJJ	JJA	JAS	ASO	SON	OND	NDJ
2004	0.3	0.3	0.2	0.1	0.2	0.3	0.5	0.6	0.7	0.7	0.6	0.7
2005	0.7	0.6	0.5	0.5	0.3	0.2	0.0	-0.1	0.0	-0.2	-0.5	-0.7
2006	-0.7	-0.6	-0.4	-0.2	0.0	0.0	0.1	0.3	0.5	0.7	0.9	0.9
2007	0.7	0.4	0.1	-0.1	-0.2	-0.3	-0.4	-0.6	-0.9	-1.1	-1.3	-1.3
2008	-1.4	-1.3	-1.1	-0.9	-0.7	-0.5	-0.4	-0.3	-0.3	-0.4	-0.6	-0.7
2009	-0.7	-0.6	-0.4	-0.1	0.2	0.4	0.5	0.5	0.6	0.9	1.1	1.3
2010	1.3	1.2	0.9	0.5	0.0	-0.4	-0.9	-1.2	-1.4	-1.5	-1.4	-1.4
2011	-1.3	-1.0	-0.7	-0.5	-0.4	-0.3	-0.3	-0.6	-0.8	-0.9	-1.0	-0.9
2012	-0.7	-0.5	-0.4	-0.4	-0.3	-0.1	0.1	0.3	0.3	0.3	0.1	-0.2
2013	-0.4	-0.4	-0.3	-0.2	-0.2	-0.2	-0.3	-0.3	-0.2	-0.3	-0.3	-0.3
2014	-0.5	-0.5	-0.4	-0.2	-0.1	0.0	-0.1	0.0	0.1	0.4	0.5	0.6
2015	0.6	0.5	0.6	0.7	0.8	1.0	1.2	1.4	1.7	2.0	2.2	2.3
2016	2.2	2.0	1.6	1.1	0.6	0.1	-0.3	-0.5				

# CPC/IRI Probabilistic ENSO Outlook

Updated: 13 October 2016

La Niña is favored to develop (~70% chance) during the Northern Hemisphere fall 2016 and slightly favored to persist (~55% chance) during winter 2016-17.



# IRI/CPC Pacific Niño

## 3.4 SST Model Outlook

Most multi-model averages indicate weak La Niña conditions during the Northern Hemisphere fall and early winter 2016-17.

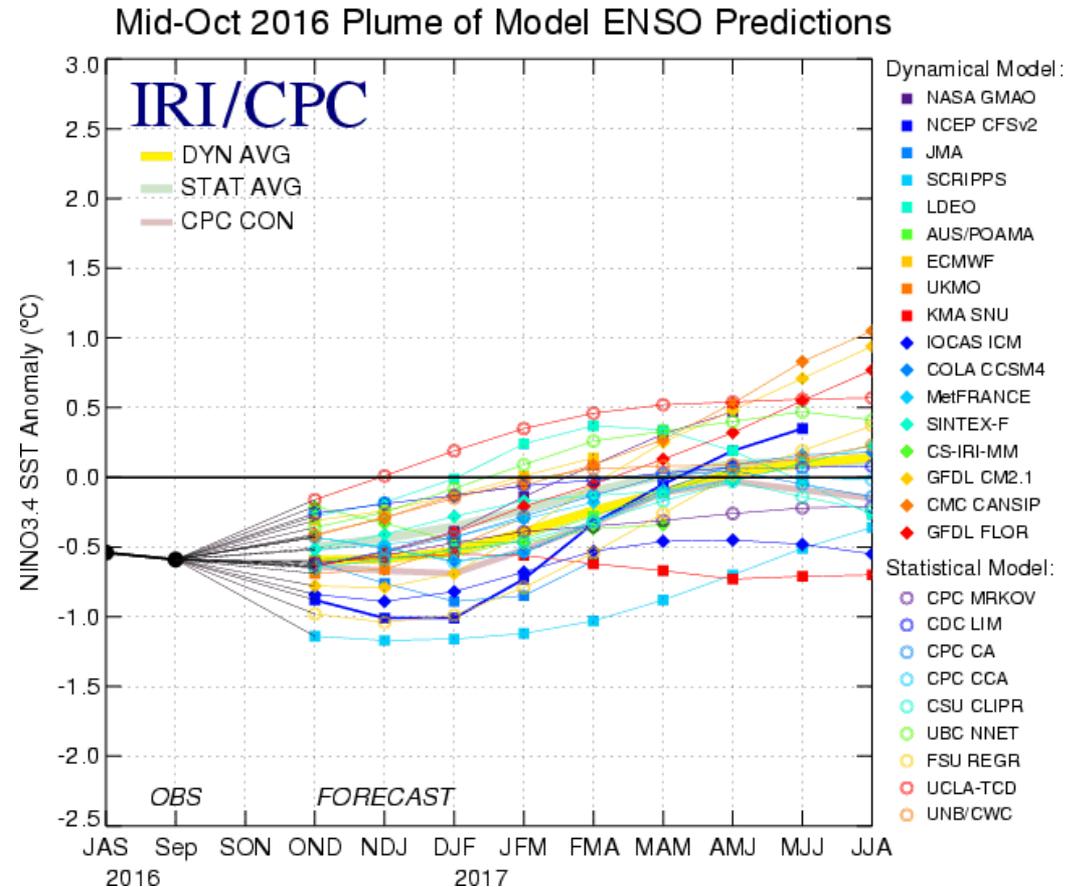
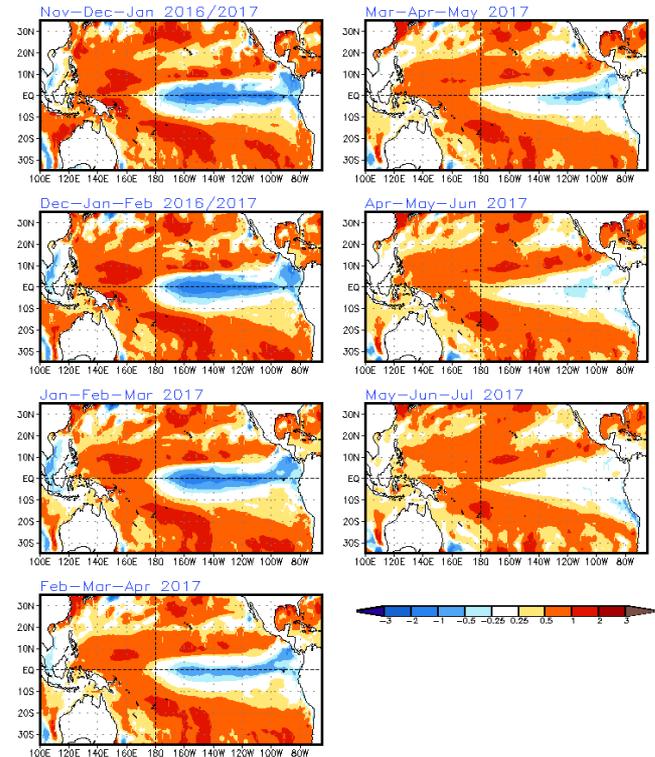
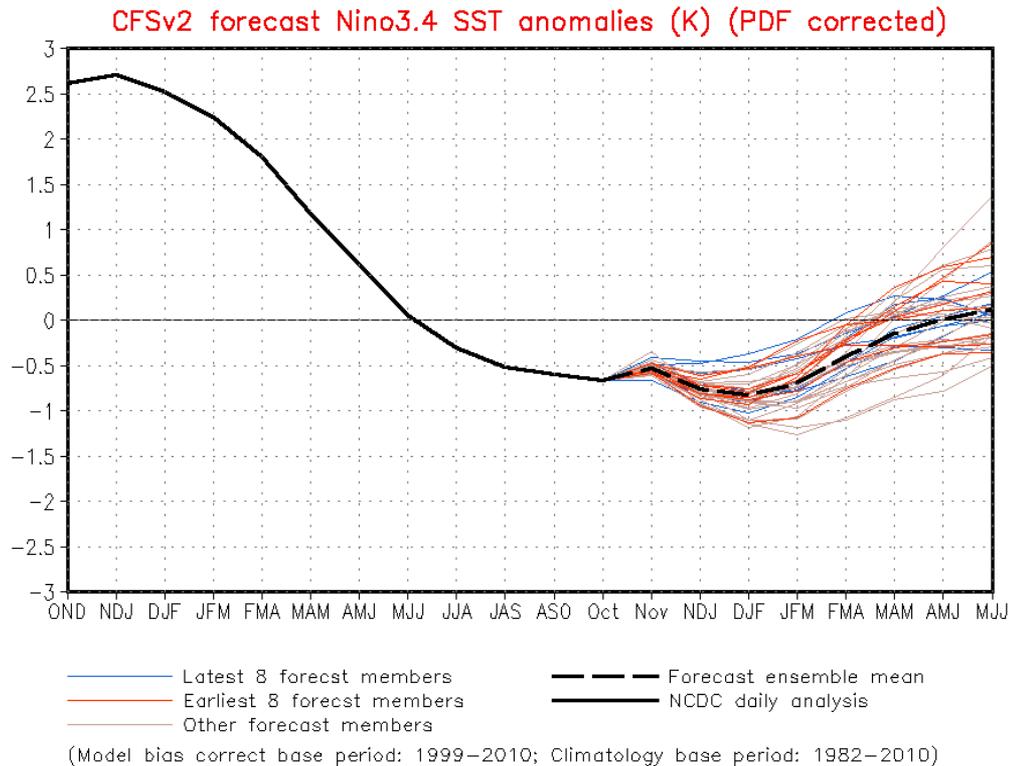


Figure provided by the International Research Institute (IRI) for Climate and Society (updated 18 October 2016).

# SST Outlook: NCEP CFS.v2 Forecast (PDF corrected)

Issued: 31 October 2016

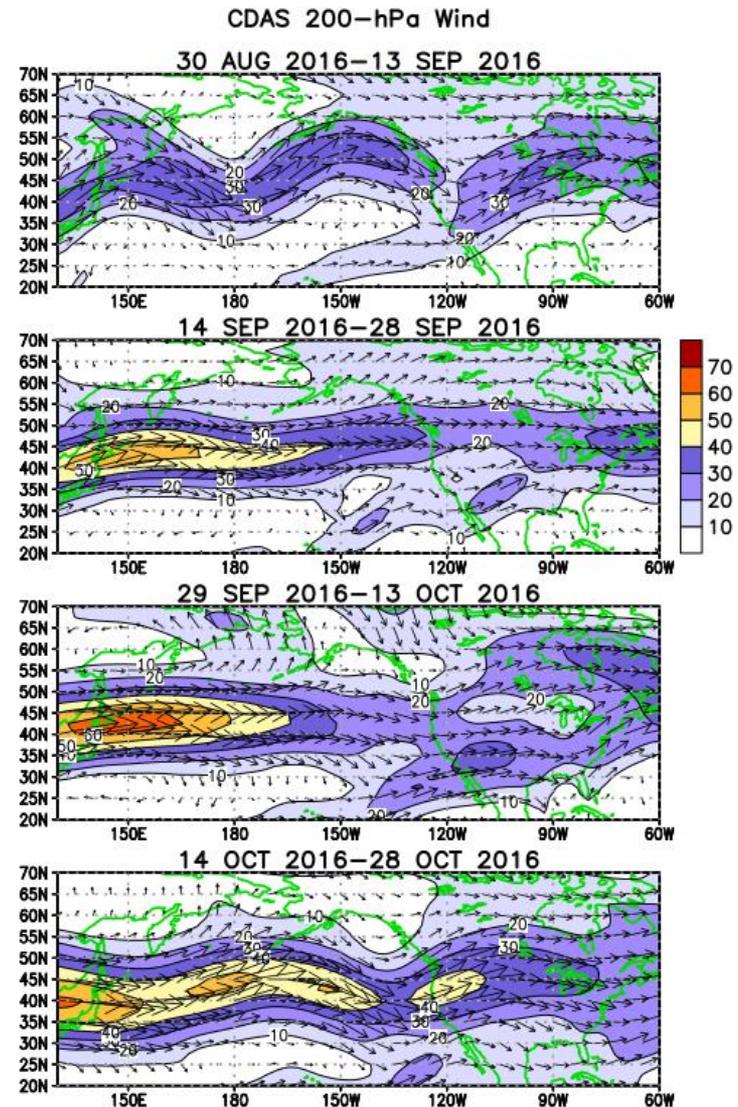
The CFS.v2 ensemble mean (black dashed line) favors La Niña during the Northern Hemisphere fall and winter 2016-17.





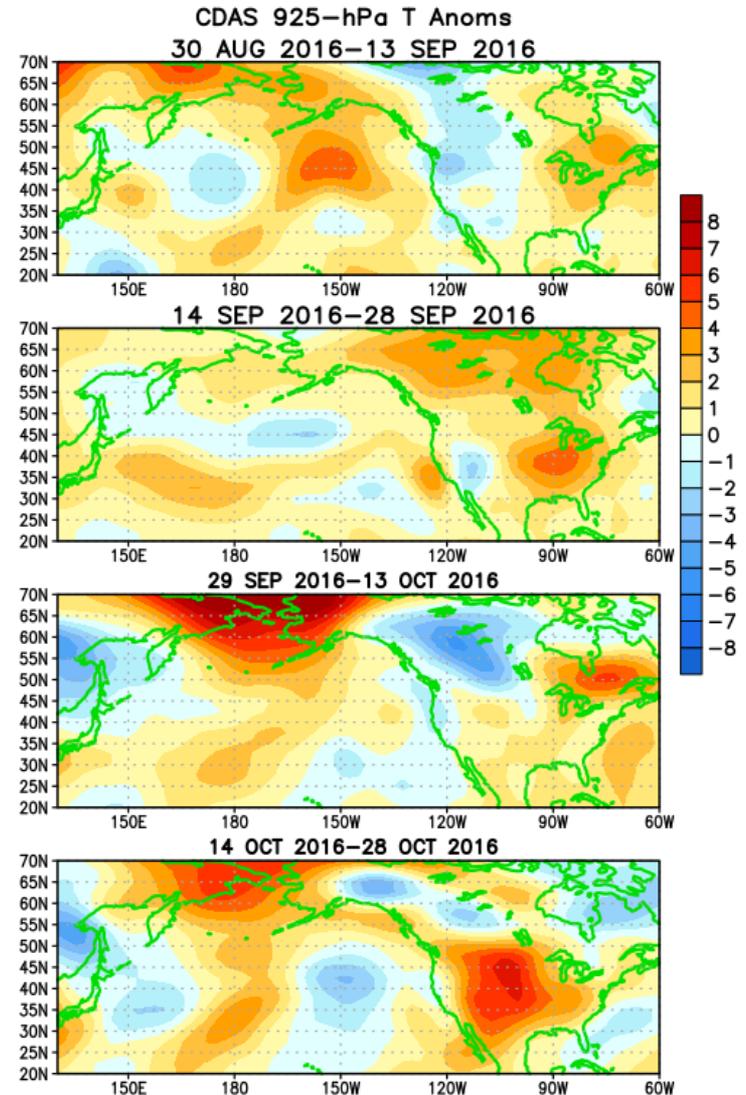
# Atmospheric anomalies over the North Pacific and North America During the Last 60 Days

Since September, above-average heights and temperatures have prevailed over eastern N. America. Over the western contiguous U.S., an anomalous trough and below-average temperatures have generally persisted.



# Atmospheric anomalies over the North Pacific and North America During the Last 60 Days

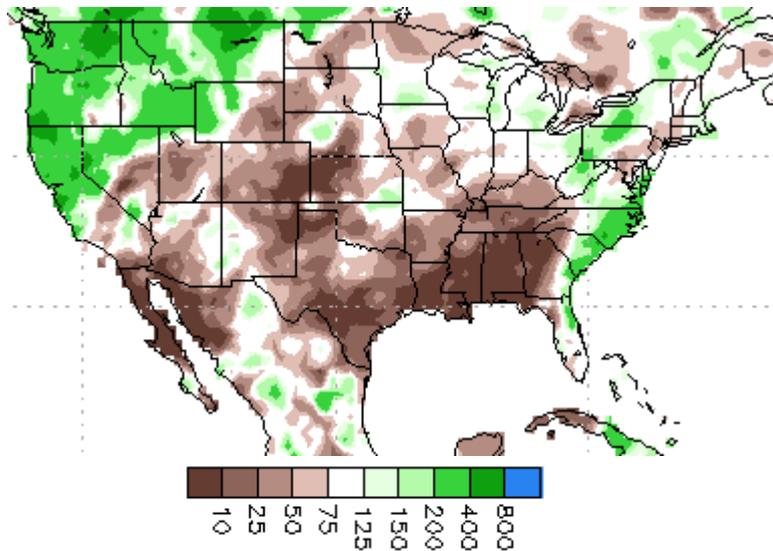
Since September, above-average heights and temperatures have prevailed over eastern N. America. Over the western contiguous U.S., an anomalous trough and below-average temperatures have generally persisted.



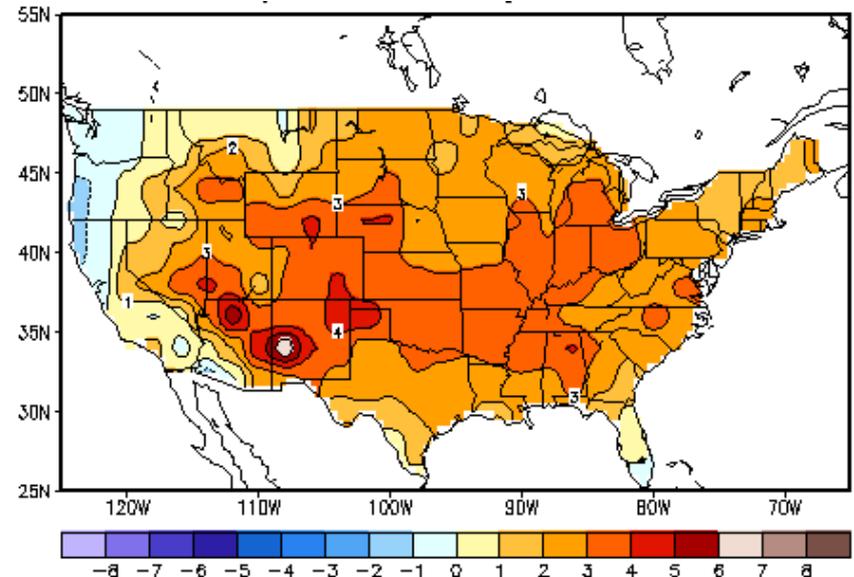
# U.S. Temperature and Precipitation Departures During the Last 30 Days

End Date: 29 October 2016

### Percent of Average Precipitation



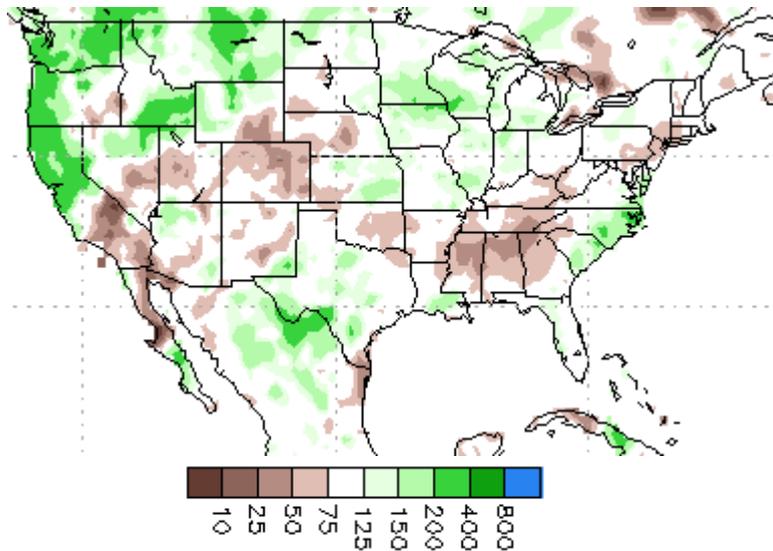
### Temperature Departures (degree C)



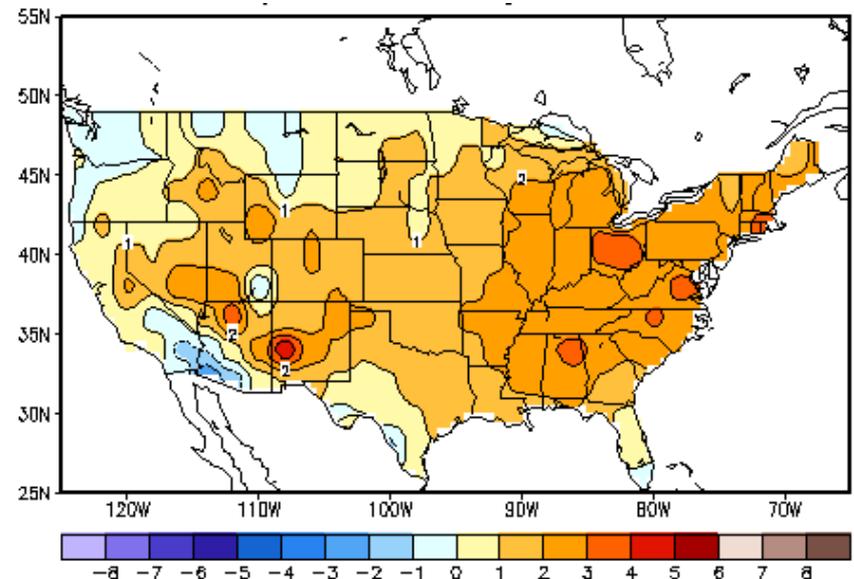
# U.S. Temperature and Precipitation Departures During the Last 90 Days

End Date: 29 October 2016

### Percent of Average Precipitation



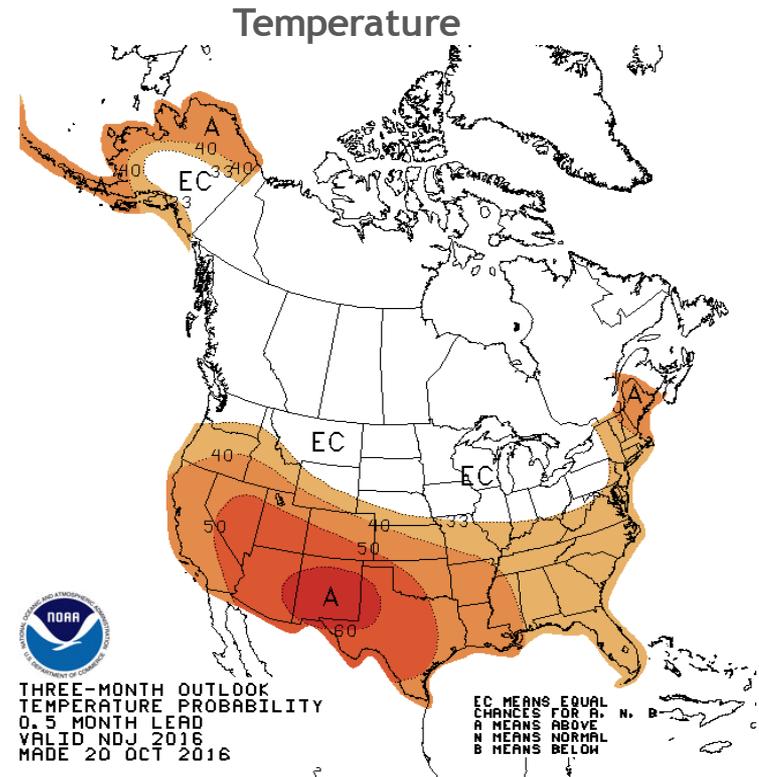
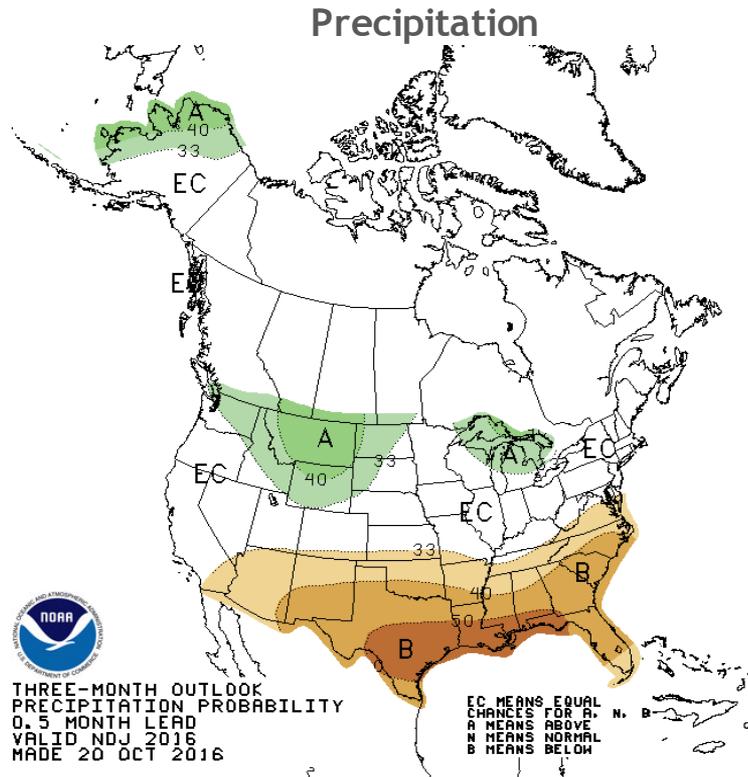
### Temperature Departures (degree C)



# U. S. Seasonal Outlooks

November 2016 - January 2017

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



# Summary

## ENSO Alert System Status: La Niña Watch

ENSO-neutral conditions are present.\*

Equatorial sea surface temperatures (SST) are below average in the central and east-central Pacific Ocean.

La Niña is favored to develop (~70% chance) during the Northern Hemisphere fall 2016 and slightly favored to persist (~55% chance) during winter 2016-17.\*

\* Note: These statements are updated once a month (2<sup>nd</sup> Thursday of each month) in association with the ENSO Diagnostics Discussion, which can be found by clicking [here](#).