



# **ENSO Cycle: Recent Evolution, Current Status and Predictions**

**Update prepared by  
Climate Prediction Center / NCEP  
3 September 2013**



# Outline

- Overview
- Recent Evolution and Current Conditions
- Oceanic Niño Index (ONI) – **Revised March 2012**
- Pacific SST Outlook
- U.S. Seasonal Precipitation and Temperature Outlooks
- Summary



# Summary

## ENSO Alert System Status: Not Active

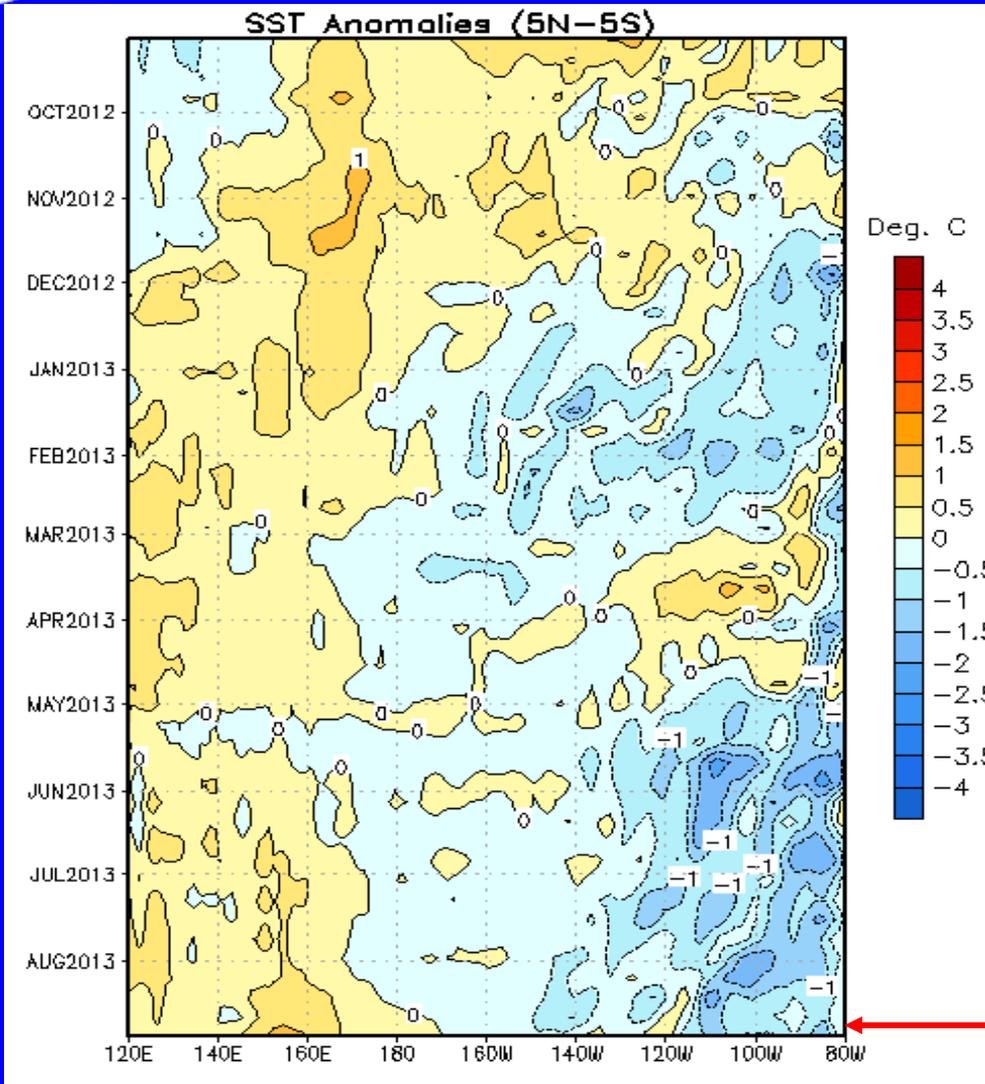
- **ENSO-neutral conditions continue.\***
- **Equatorial sea surface temperatures (SST) are above average across the western Pacific, near average in the central Pacific, and below average in the eastern Pacific.**
- **ENSO-neutral is favored into the Northern Hemisphere fall 2013.\***

\* Note: These statements are updated once a month in association with the ENSO Diagnostics Discussion:  
[http://www.cpc.ncep.noaa.gov/products/analysis\\_monitoring/enso\\_advisory](http://www.cpc.ncep.noaa.gov/products/analysis_monitoring/enso_advisory)



# Recent Evolution of Equatorial Pacific SST Departures (°C)

Time



During January-February 2013, below-average SSTs were observed over the eastern half of the Pacific.

Recently, equatorial SSTs have been near-average across the central Pacific and below average in the eastern Pacific.



# Niño Region SST Departures (°C)

## Recent Evolution

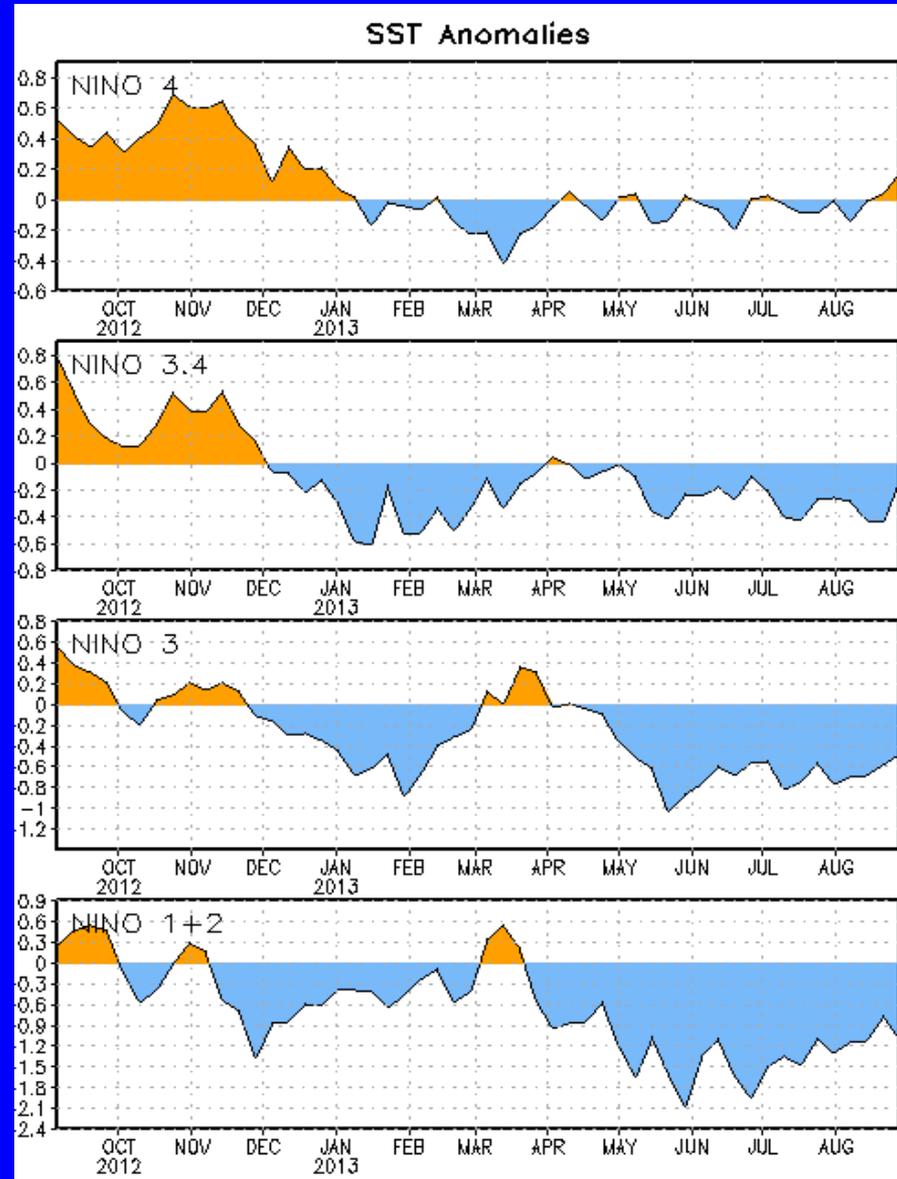
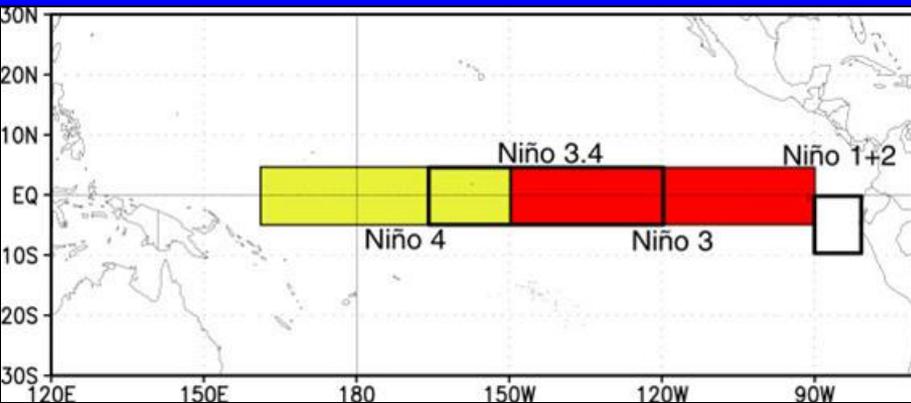
The latest weekly SST departures are:

**Niño 4**                    **0.2°C**

**Niño 3.4**                **-0.1°C**

**Niño 3**                    **-0.5°C**

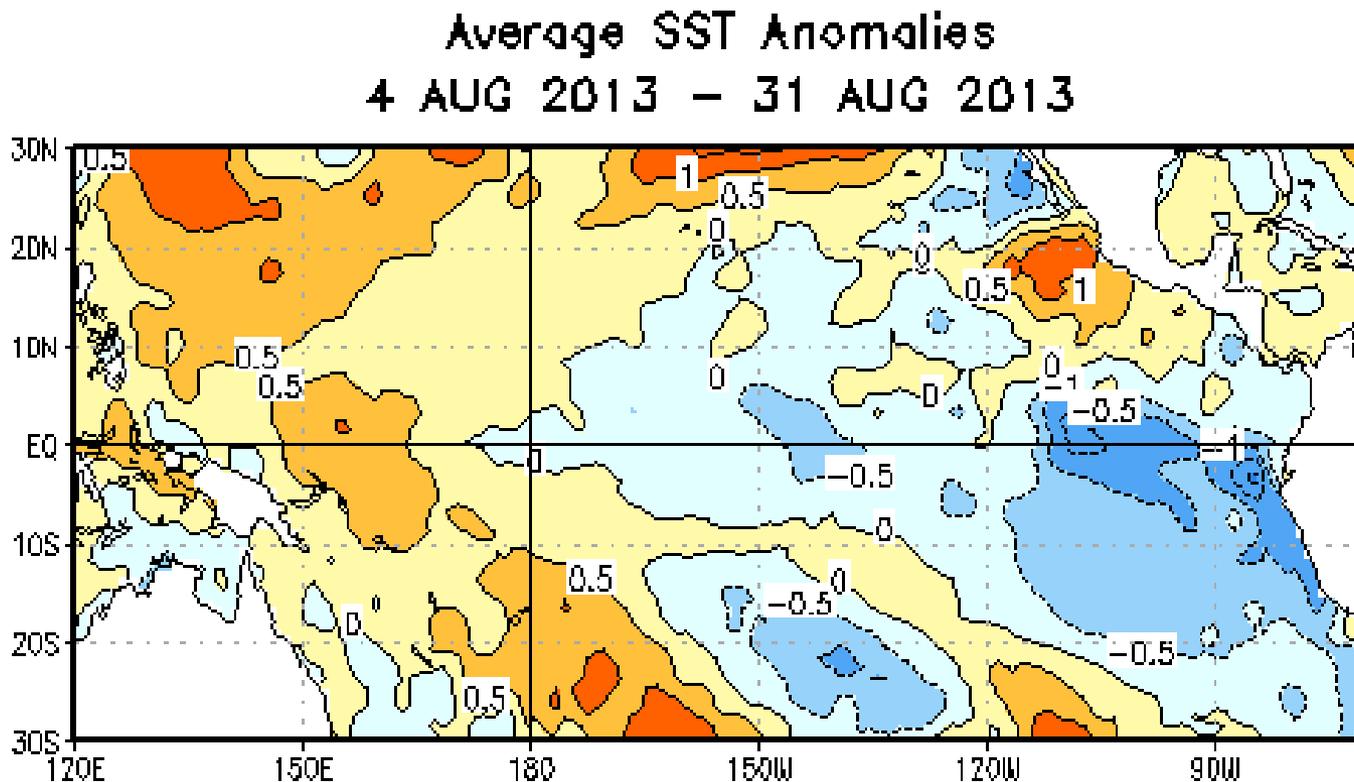
**Niño 1+2**                **-1.1°C**





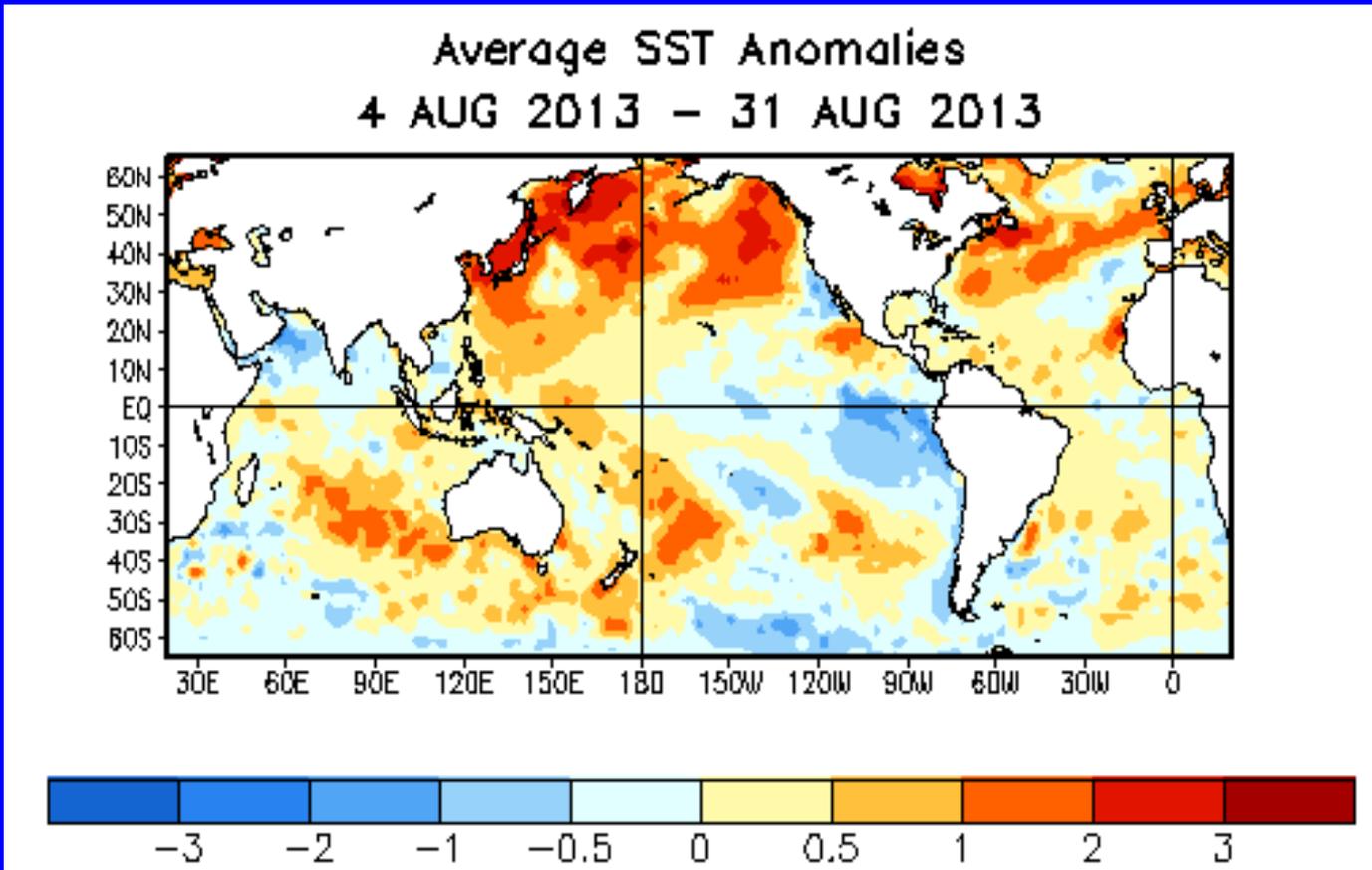
# SST Departures (°C) in the Tropical Pacific During the Last 4 Weeks

During the last 4-weeks, equatorial SSTs were above average in the western Pacific, near average in the central Pacific, and below average in the eastern Pacific.





# Global SST Departures (°C)

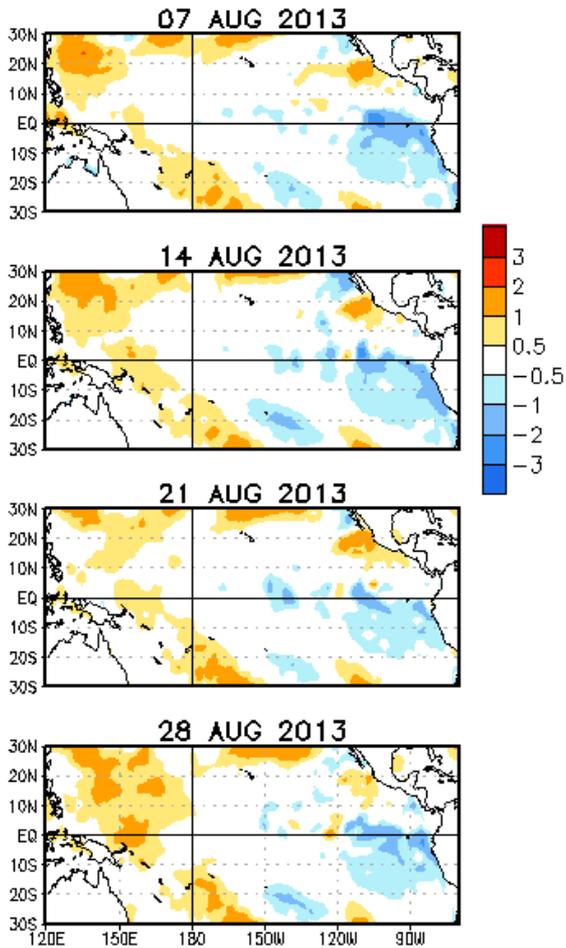


**During the last four weeks, equatorial SSTs were below average in the eastern Pacific Ocean and above average in the western Pacific Ocean.**



# Weekly SST Departures (°C) for the Last Four Weeks

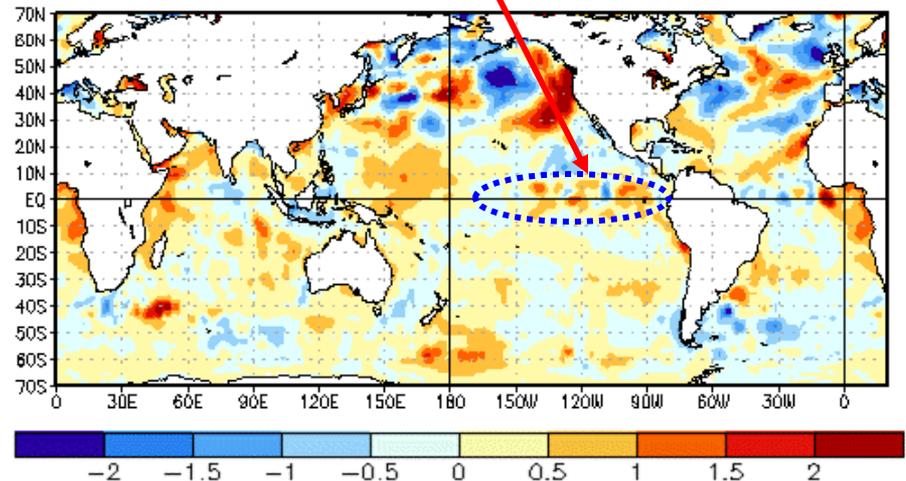
Weekly SST Anomalies (DEG C)



- During the last month, negative SST anomalies persisted in the eastern Pacific Ocean, while positive SST anomalies strengthened in the western Pacific Ocean.

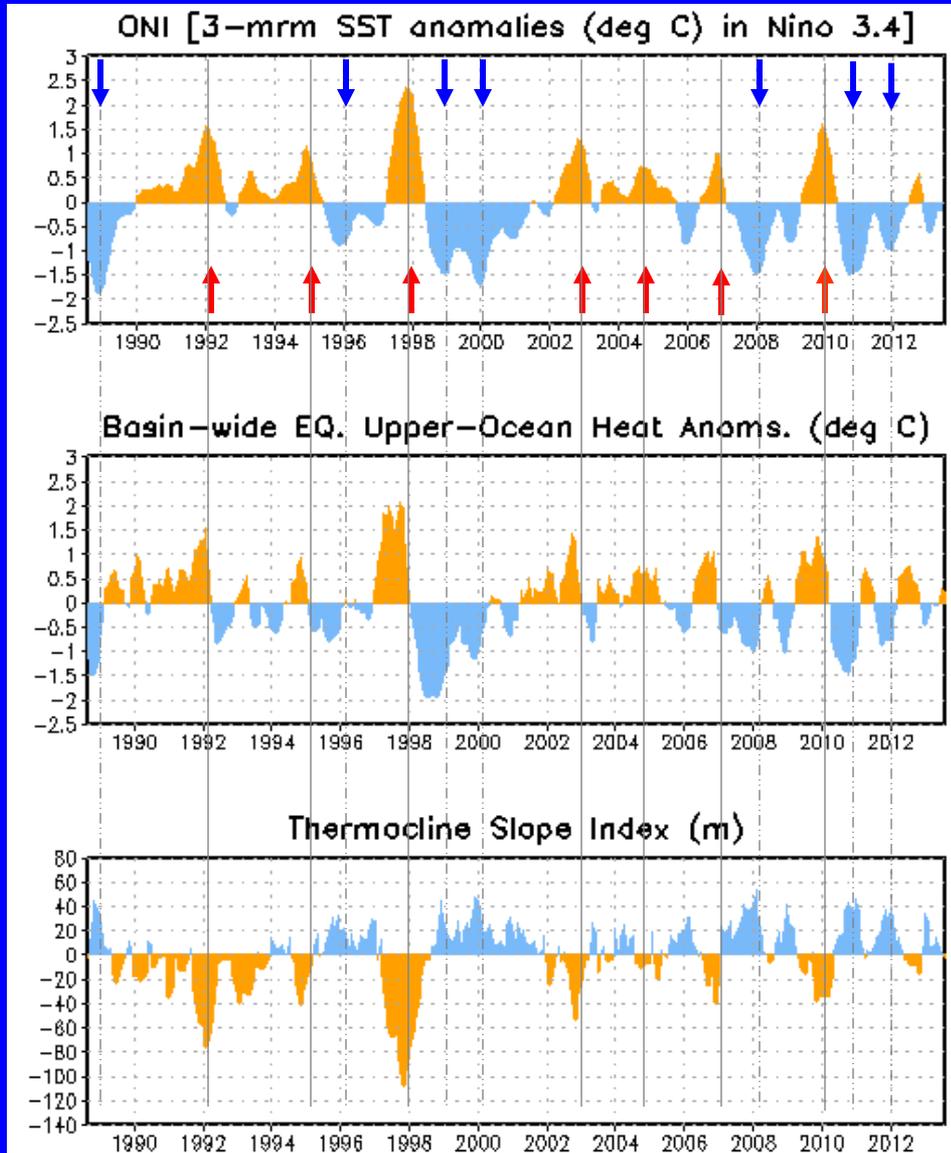
- Over the last month, mostly positive changes in SST anomalies were observed in the eastern Pacific.

Change in Weekly SST Anoma (°C)  
28AUG2013 minus 31JUL2013





# Upper-Ocean Conditions in the Eq. Pacific



Cold Episodes ↓  
Warm Episodes ↑

- 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.

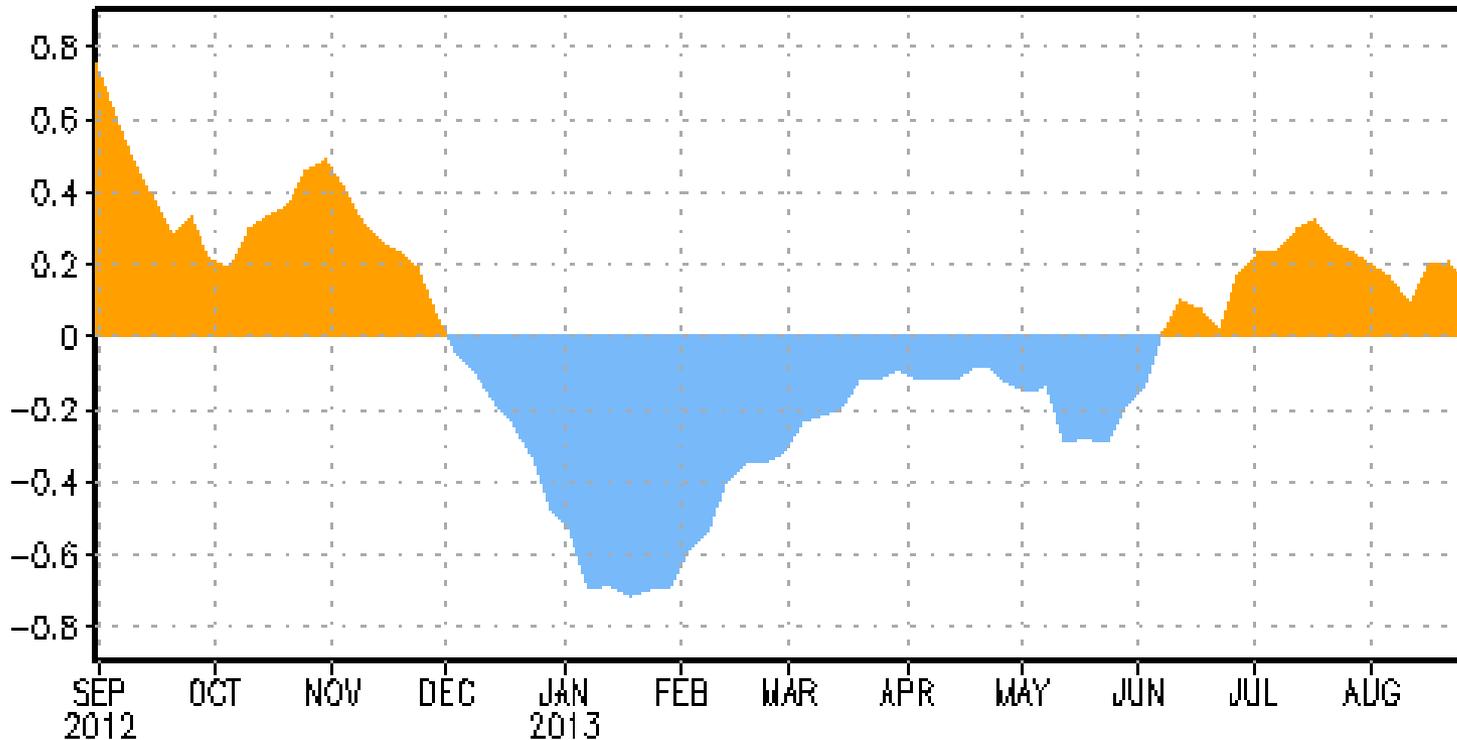
- Recent values of the upper-ocean heat anomalies (near average) and thermocline slope index (near average) reflect ENSO-neutral conditions.

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).



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

EQ. Upper-Ocean Heat Anoms. (deg C) for 180-100W



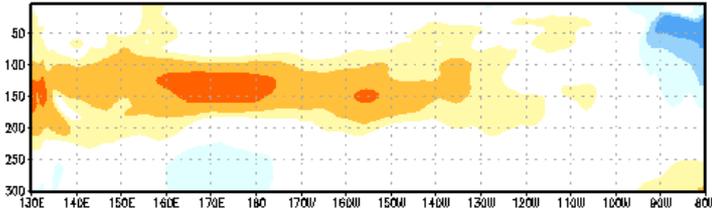
**Subsurface temperatures were above-average from April – November 2012, and below average during December 2012 – May 2013. Then, beginning in mid-May, subsurface temperature anomalies increased with positive anomalies developing during June 2013.**



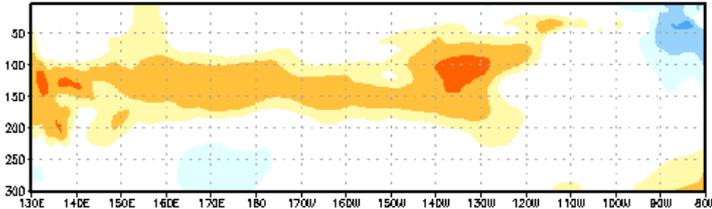
# Sub-Surface Temperature Departures (°C) in the Equatorial Pacific

EQ. Subsurface Temperature Anomalies (deg C)

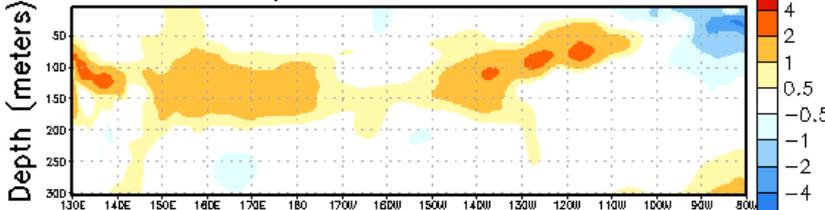
Three-pentad ave. centered on 07 JUL 2013



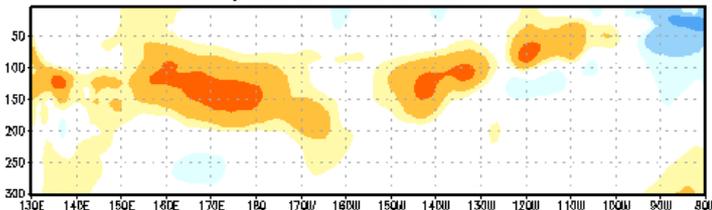
Three-pentad ave. centered on 22 JUL 2013



Three-pentad ave. centered on 06 AUG 2013



Three-pentad ave. centered on 21 AUG 2013



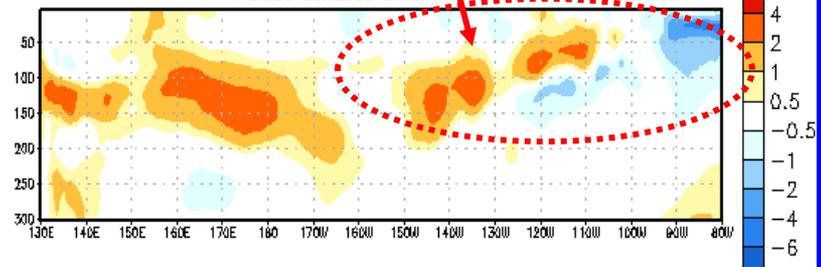
• During the last two months, above-average subsurface temperatures persisted across most of the equatorial Pacific Ocean, except for below average temperatures in the eastern Pacific.

• Recently, negative subsurface temperature anomalies persisted in the far eastern Pacific, while positive anomalies persisted in the east-central Pacific.



EQ. Subsurface Temperature Anomalies (deg C)

Pentad centered on 28 AUG 2013



Most recent pentad analysis

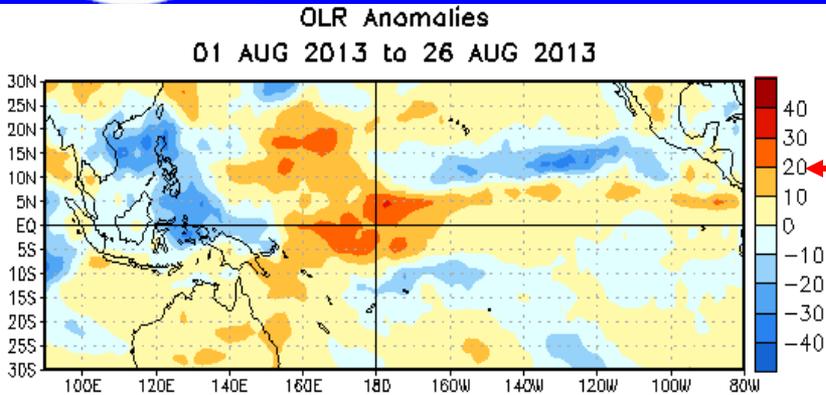
Time



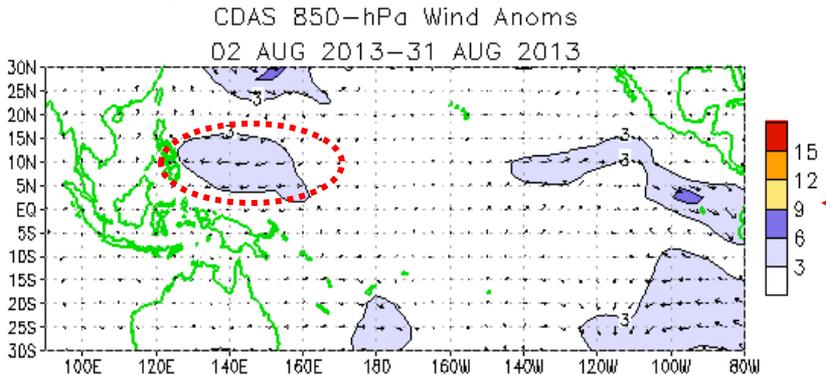
Longitude



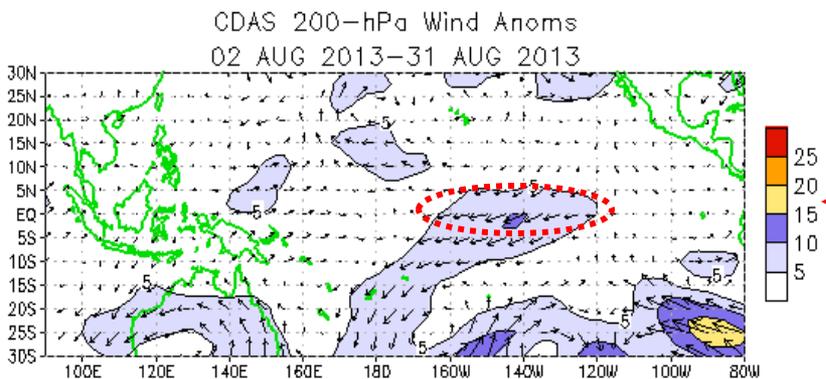
# Tropical OLR and Wind Anomalies During the Last 30 Days



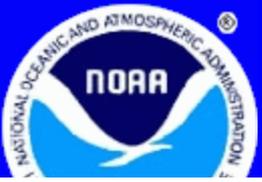
Negative OLR anomalies (enhanced convection and precipitation, blue shading) were observed over the Philippines. Positive OLR anomalies (suppressed convection and precipitation, red shading) were evident near the International Date Line and along 5°N in the eastern half of the Pacific.



Low-level (850-hPa) winds were near normal across the equatorial Pacific. Anomalous easterly winds were observed just north of the equator in the far western Pacific.

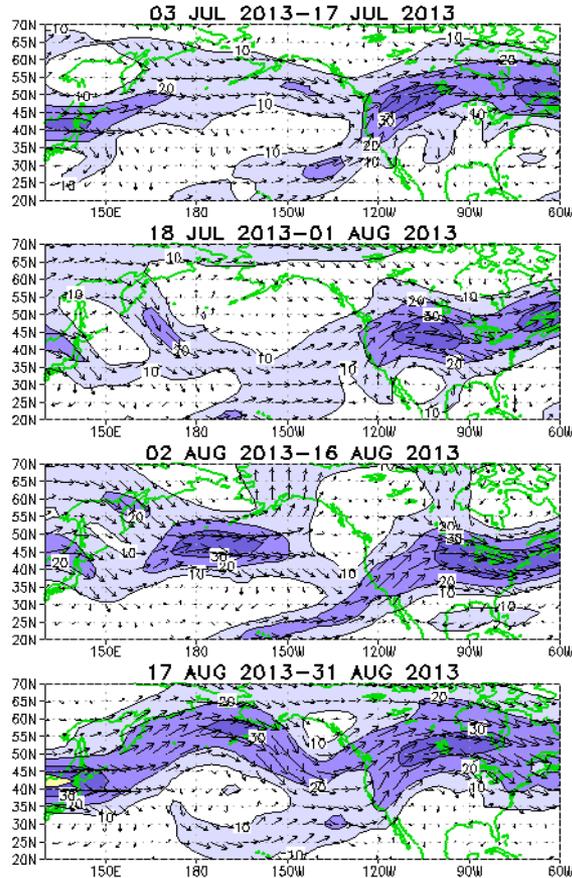


Upper-level (200-hPa) easterly wind anomalies were evident over the east-central equatorial Pacific.

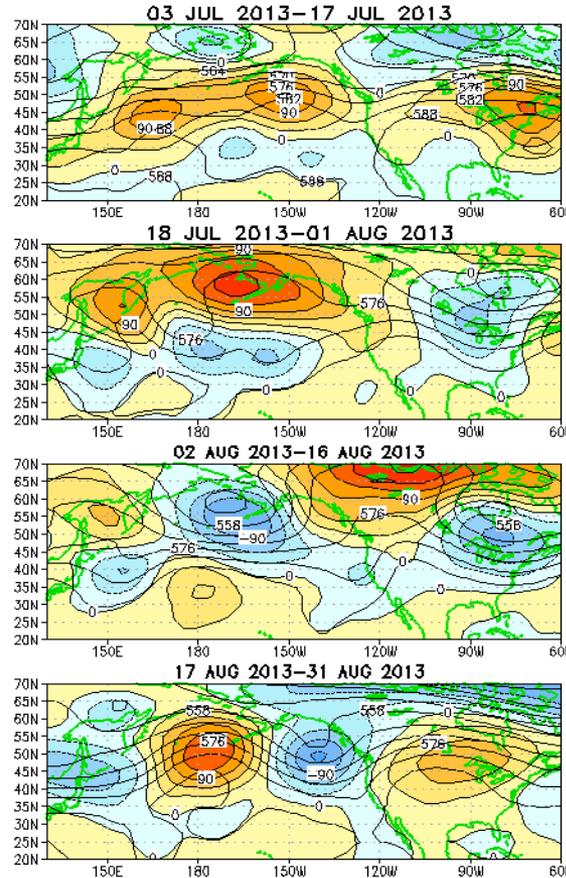


# Atmospheric Circulation over the North Pacific & North America During the Last 60 Days

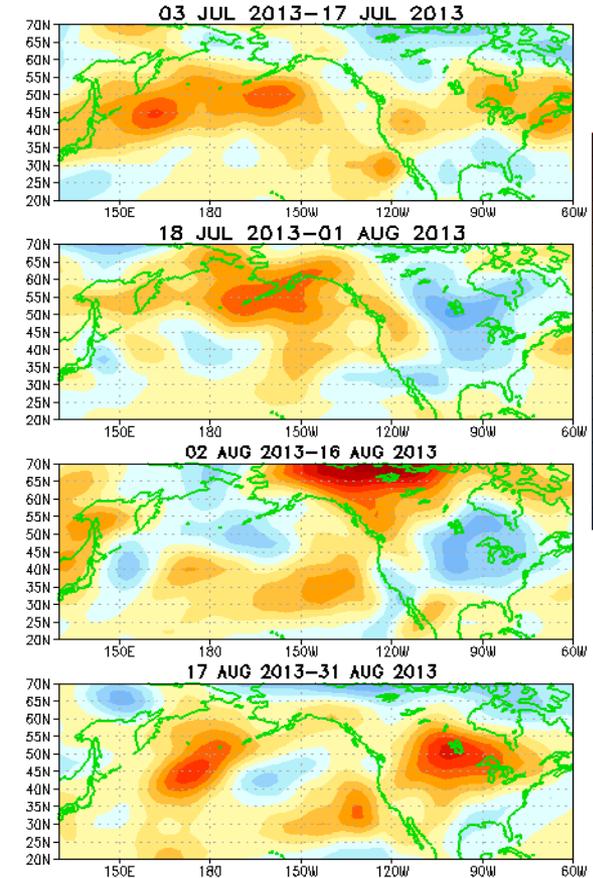
## 200-hPa Wind



## 500-hPa Height & Anoms.



## 925-hPa Temp. Anoms. (°C)



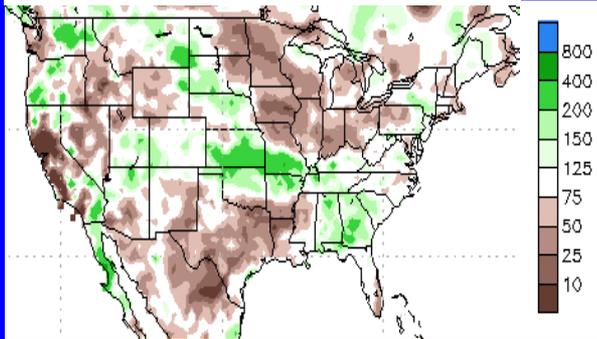
During late July into mid August, below-average heights and below average temperatures were observed across the central and eastern U.S. Recently, anomalous ridging has emerged over central Canada and the northern U.S. contributing to above-average temperatures across much of the continent.



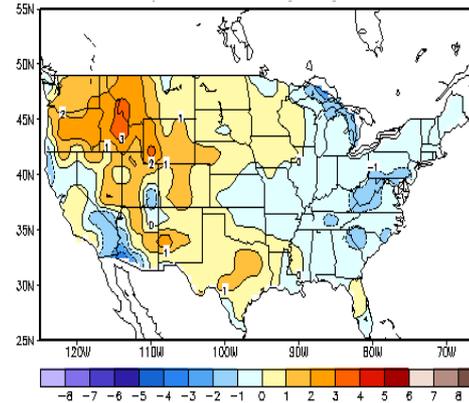
# U.S. Temperature and Precipitation Departures During the Last 30 and 90 Days

## Last 30 Days

30-day (ending 27 Aug 2013) % of average precipitation

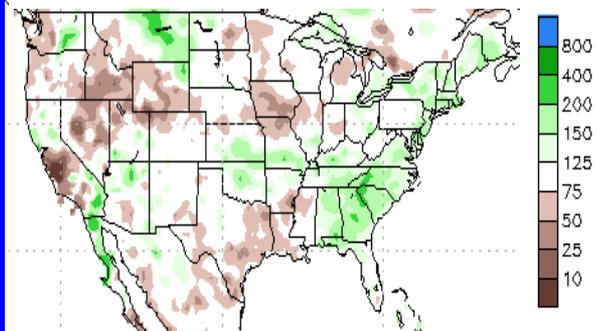


30-day (ending 31 Aug 2013) temperature departures (degree C)

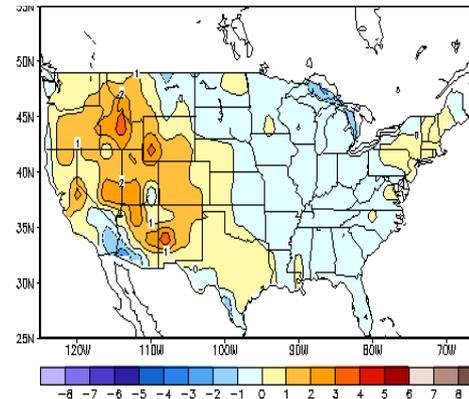


## Last 90 Days

90-day (ending 27 Aug 2013) % of average precipitation



90-day (ending 31 Aug 2013) temperature departures (degree C)



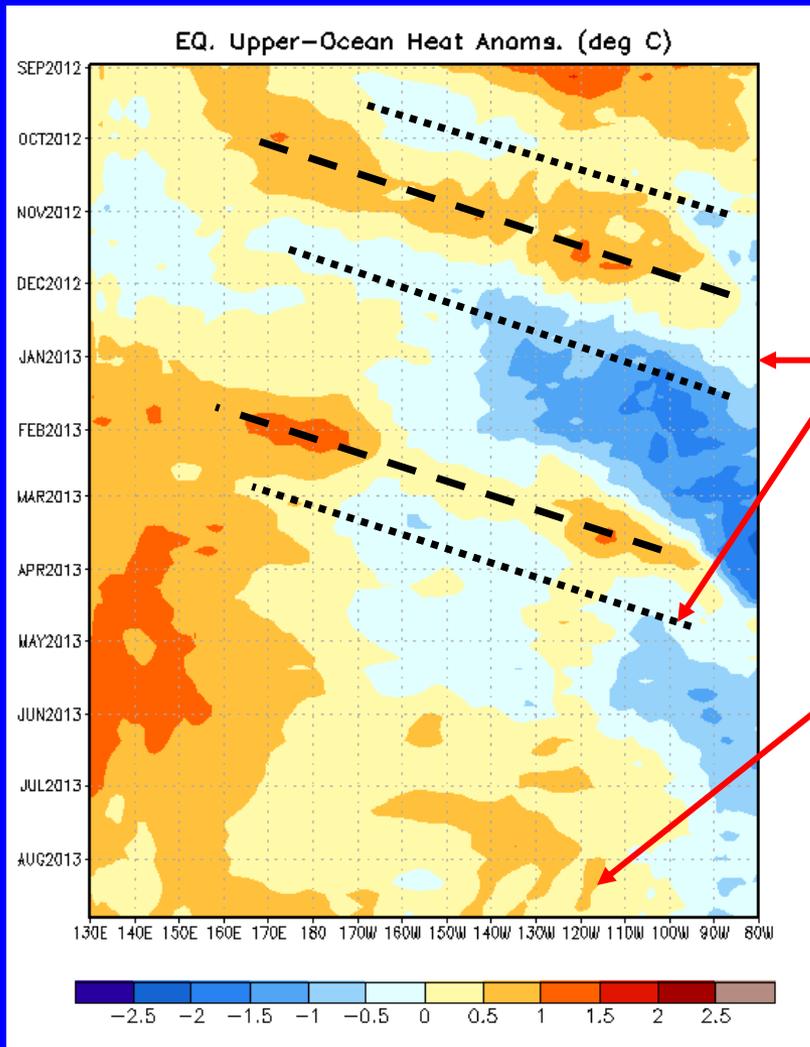


# Intraseasonal Variability

- **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



- Strong oceanic Kelvin wave activity was evident during September – December 2012 and February-March 2013.

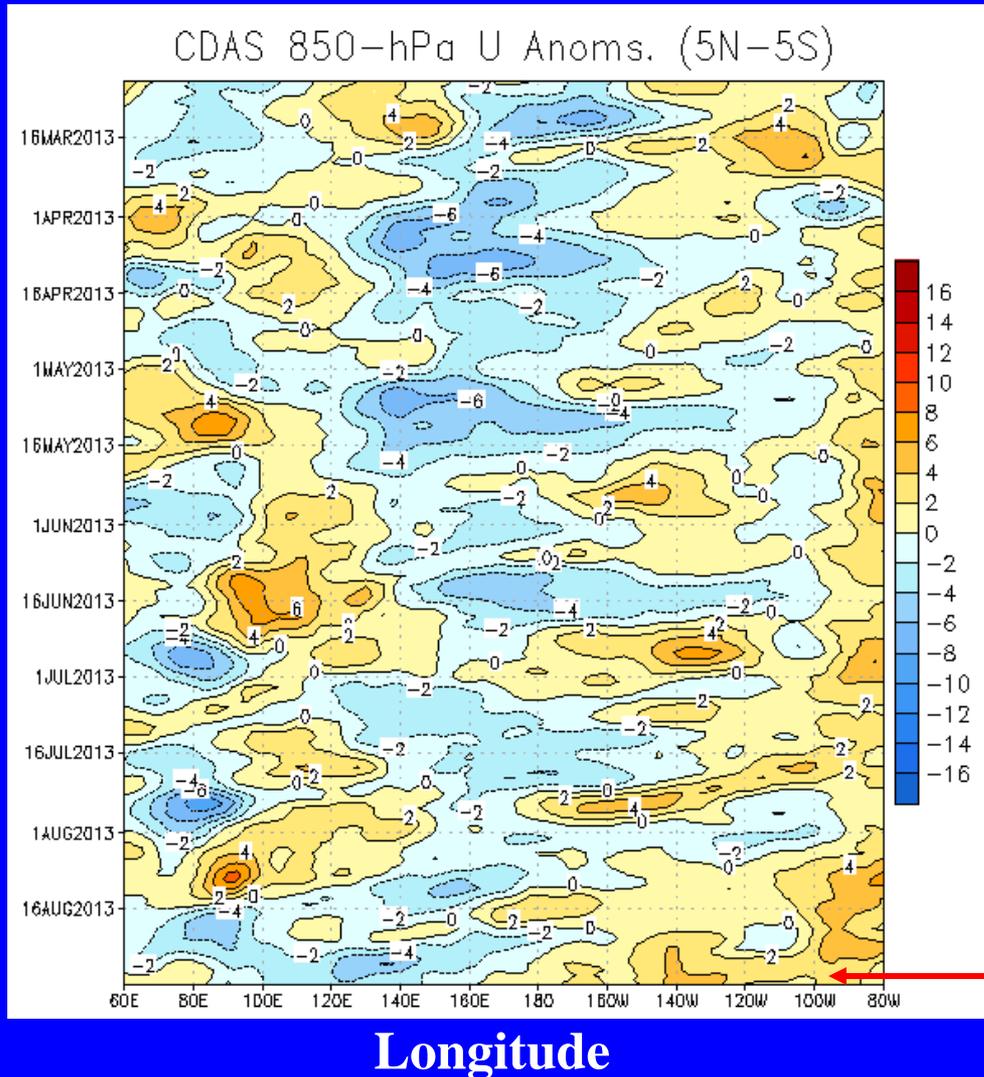
- In March and early April 2013, above-average heat content weakened in the eastern Pacific in association with the upwelling phase of a Kelvin wave.

- Above-average heat content has persisted in the central and east-central Pacific since early June 2013.

- Oceanic Kelvin waves have alternating warm and cold phases. The warm phase is indicated by dashed lines. Down-welling 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 ( $\text{m s}^{-1}$ )



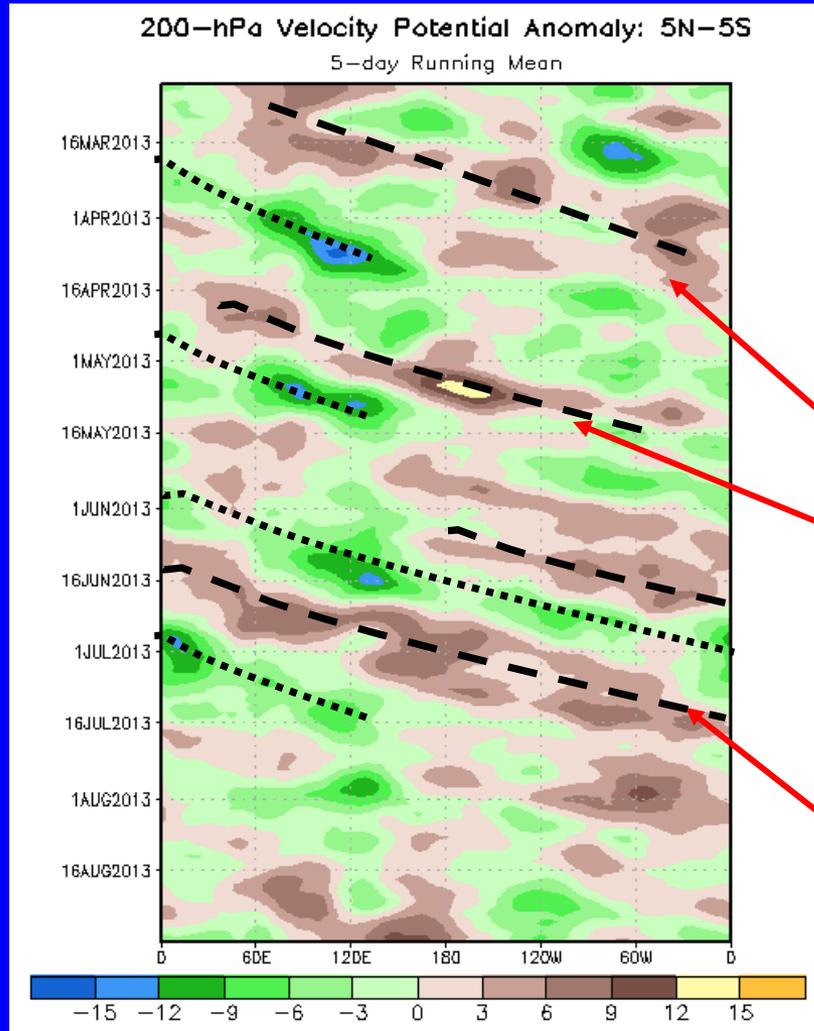
Westerly wind anomalies  
(orange/red shading).

Easterly wind anomalies (blue  
shading).

Currently, westerly wind anomalies  
are prevalent over the central and  
eastern Pacific.



# 200-hPa Velocity Potential Anomalies (5°N-5°S)



Positive anomalies (brown shading) indicate unfavorable conditions for precipitation.

Negative anomalies (green shading) indicate favorable conditions for precipitation.

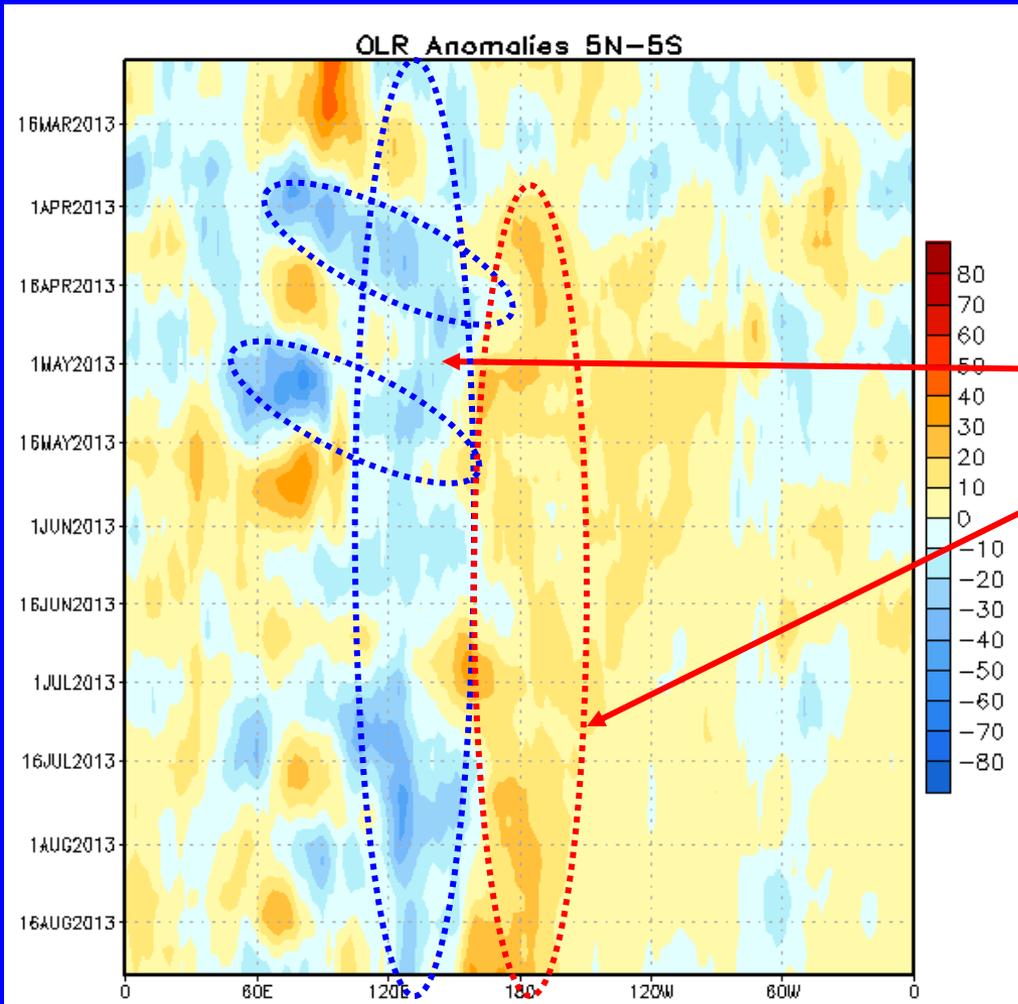
The Madden Julian Oscillation (MJO) was active from early January through mid April 2013, and also during the first half of May 2013.

During June and early July, the MJO was active.



# Outgoing Longwave Radiation (OLR) Anomalies

Time



Longitude

**Drier-than-average conditions  
(orange/red shading)**

**Wetter-than-average conditions  
(blue shading)**

**Since mid-February 2013, below-average OLR has been evident over the western Pacific.**

**Since early April 2013, above-average OLR has persisted near the Date Line.**



# 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.v3b**). The SST reconstruction methodology is described in Smith et al., 2008, *J. Climate*, vol. 21, 2283-2296.)
- Used to place current events into a historical perspective
- NOAA's operational definitions of El Niño and La Niña are keyed to the ONI index.



# 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  $-0.5^{\circ}\text{C}$ .

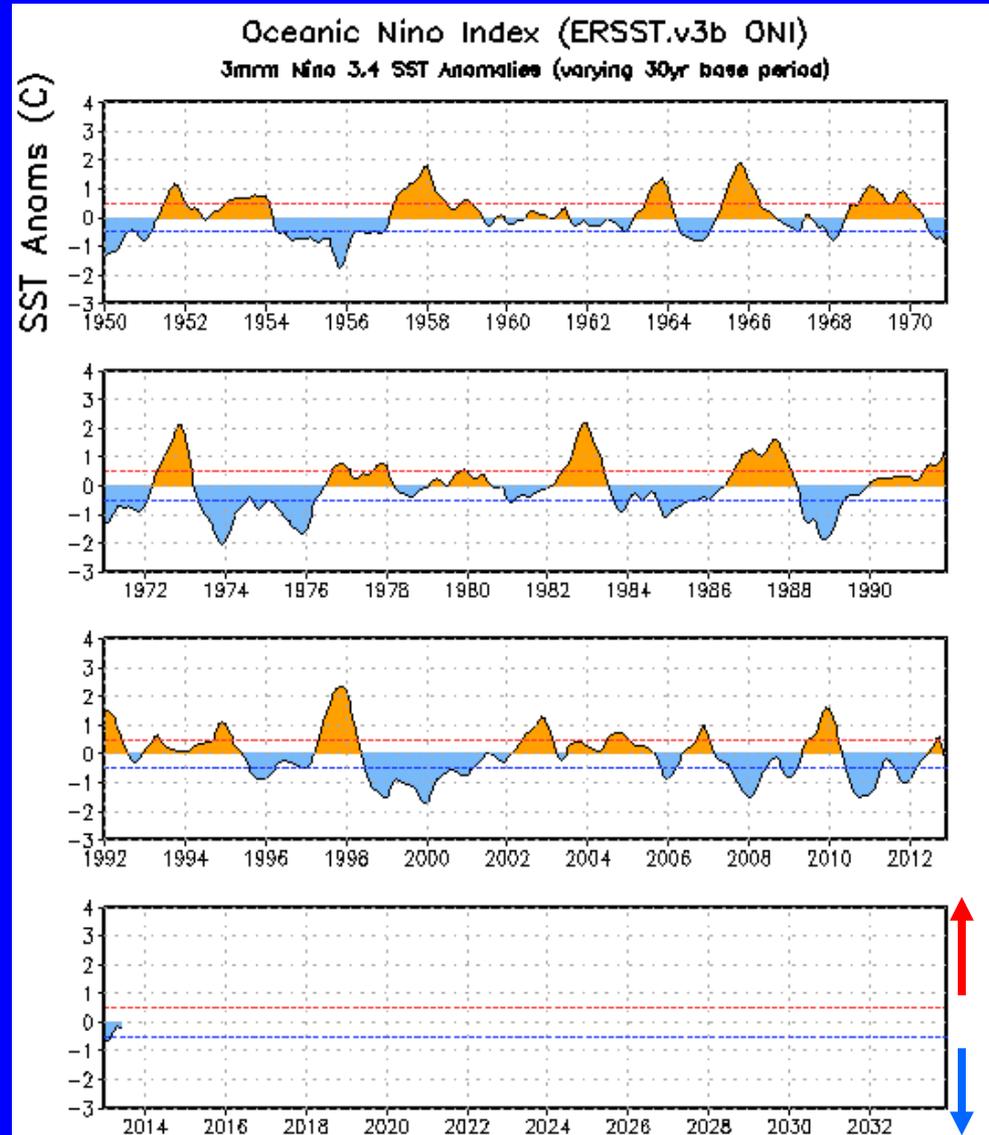
By historical standards, to be classified as a full-fledged El Niño or La Niña episode, these thresholds must be exceeded for a period of at least 5 consecutive overlapping 3-month seasons.

*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 (May – July 2013) is **-0.2°C**.





# Historical El Niño and La Niña Episodes

## Based on the ONI computed using ERSST.v3b

<u>El Niño</u>	<u>Highest ONI Value</u>	<u>La Niña</u>	<u>Lowest ONI Value</u>
JJA 1951 – DJF 1951/52	1.2	ASO 1949 – JAS 1950	-1.4
DJF 1952/53 – JFM 1954	0.8	SON 1950 – JFM 1951	-0.8
MAM 1957 – JJA 1958	1.8	AMJ 1954 – NDJ 1956/57	-1.7
OND 1958 – FMA 1959	0.6	AMJ 1964 – DJF 1964/65	-0.8
MJJ 1963 – JFM 1964	1.4	JJA 1970 – DJF 1971/72	-1.3
AMJ 1965 – MAM 1966	1.9	AMJ 1973 – JJA 1974	-2.0
JAS 1968 – DJF 1969/70	1.1	SON 1974 – MAM 1976	-1.7
AMJ 1972 – FMA 1973	2.1	ASO 1983 – DJF 1983/84	-0.9
ASO 1976 - JFM 1977	0.8	SON 1984 – ASO 1985	-1.1
ASO 1977 – JFM 1978	0.8	AMJ 1988 – AMJ 1989	-1.9
AMJ 1982 – MJJ 1983	2.2	ASO 1995 – FMA 1996	-0.9
JAS 1986 – JFM 1988	1.6	JJA 1998 – FMA 2001	-1.7
AMJ 1991 – MJJ 1992	1.6	OND 2005 – FMA 2006	-0.9
ASO 1994 – FMA 1995	1.2	JAS 2007 – MJJ 2008	-1.5
AMJ 1997 – MAM 1998	2.4	OND 2008 – FMA 2009	-0.8
AMJ 2002 – JFM 2003	1.3	JJA 2010 – MAM 2011	-1.5
JJA 2004 – DJF 2004/05	0.7	ASO 2011 – FMA 2012	-1.0
ASO 2006 – DJF 2006/07	1.0		
JJA 2009 – MAM 2010	1.6		

**NOTE (Mar. 2012):**

**The historical values of the ONI have slightly changed due to an update in the climatology. Please click here for more details on the methodology:**

[Historical ONI Values](#)

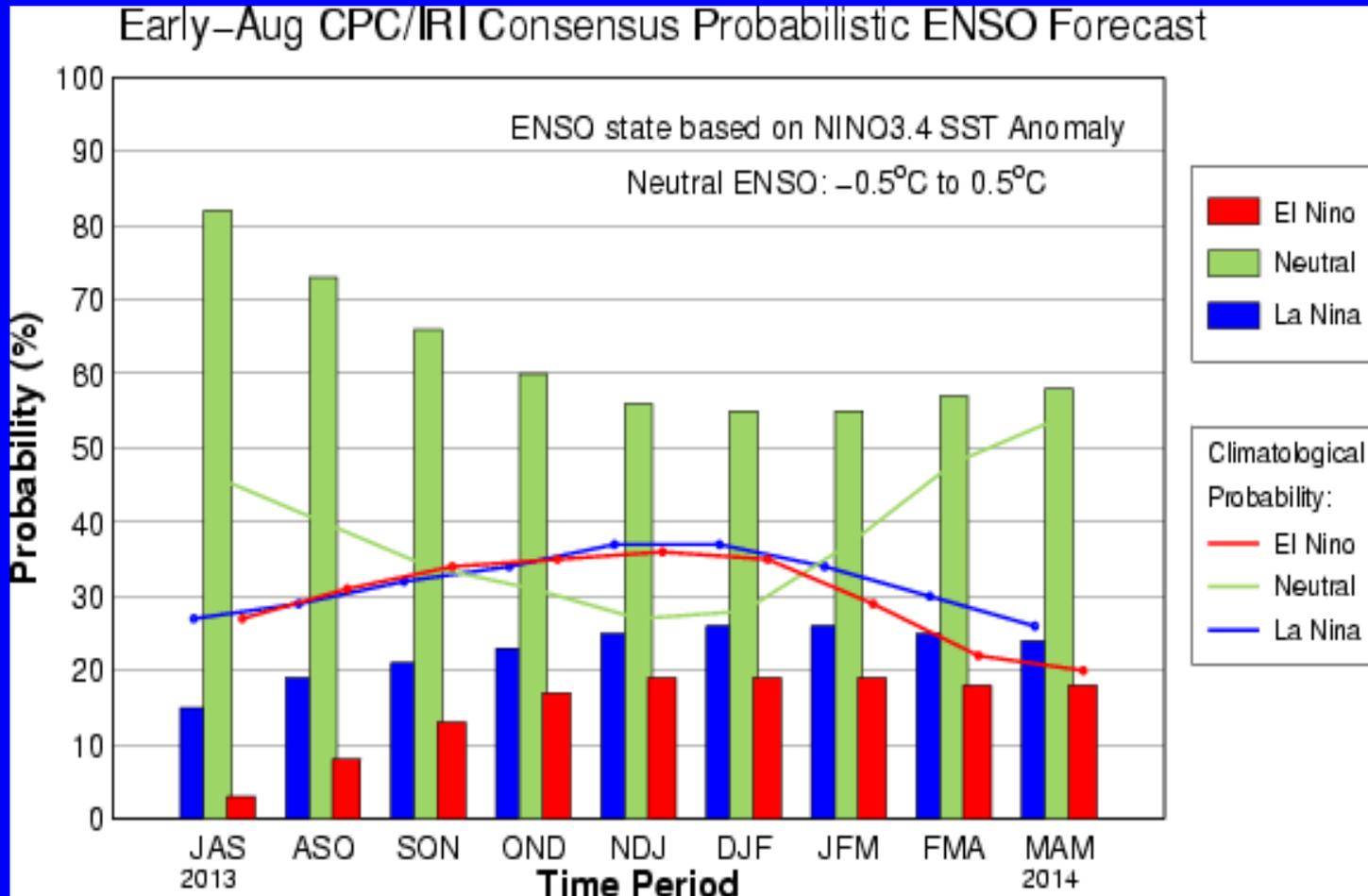




# CPC/IRI Probabilistic ENSO Outlook

(updated 8 August 2013)

ENSO-neutral is favored through the Northern Hemisphere winter 2013-14.





# Pacific Niño 3.4 SST Outlook

- Most models predict ENSO-neutral ( $-0.5^{\circ}\text{C}$  to  $+0.5^{\circ}\text{C}$ ) continuing into Northern Hemisphere spring 2014.

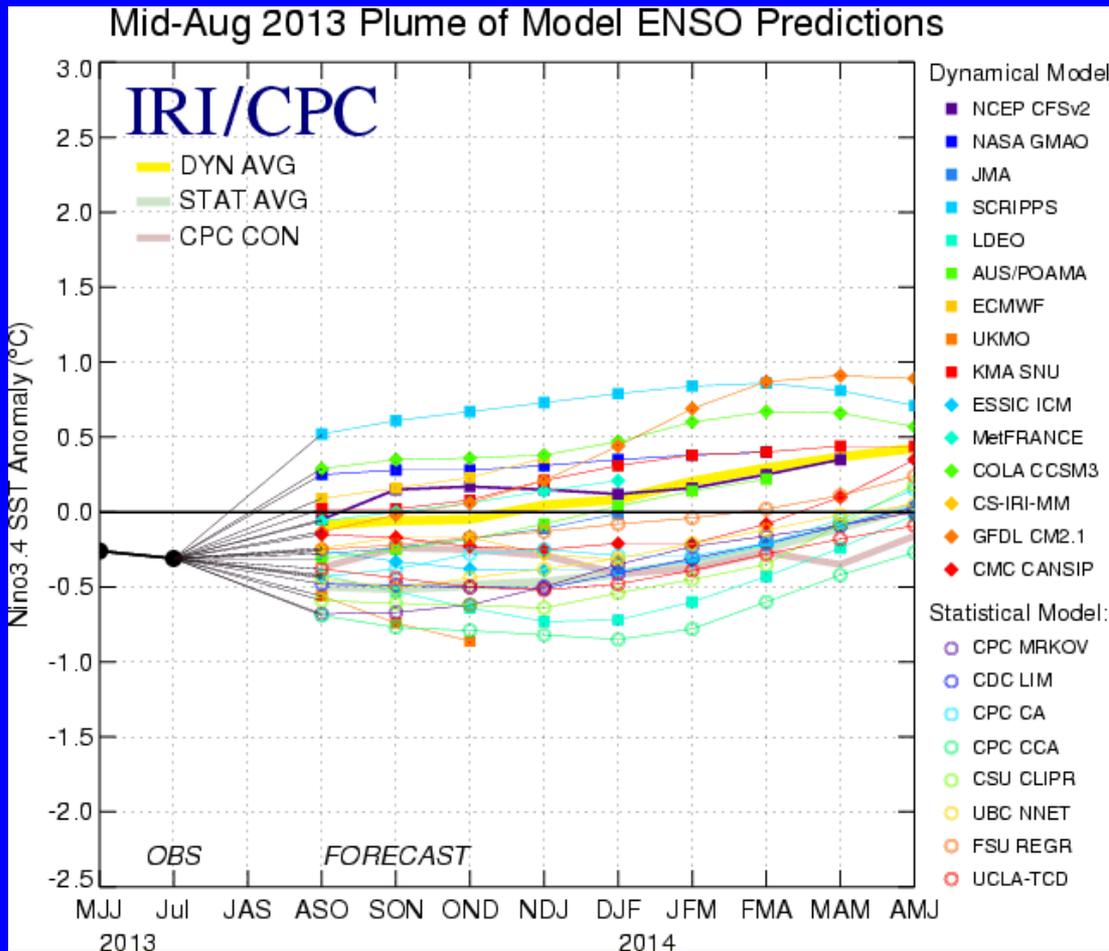


Figure provided by the International Research Institute (IRI) for Climate and Society (updated 16 August 2013).

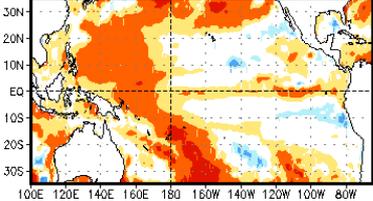


# SST Outlook: NCEP CFS.v2 Forecast

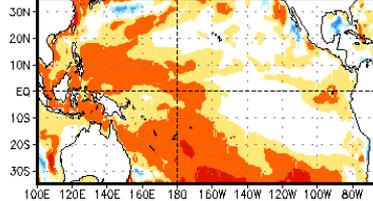
## Issued 2 September 2013

CFSv2 seasonal SST (K)

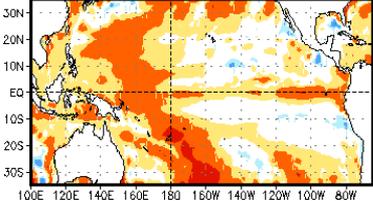
Sep-Oct-Nov 2013



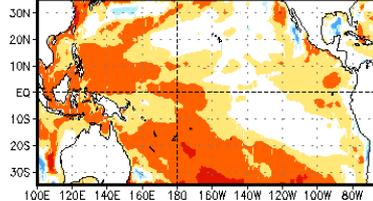
Jan-Feb-Mar 2014



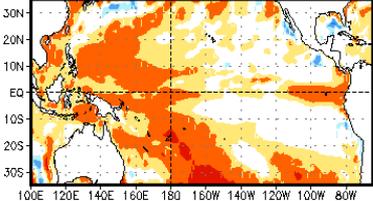
Oct-Nov-Dec 2013



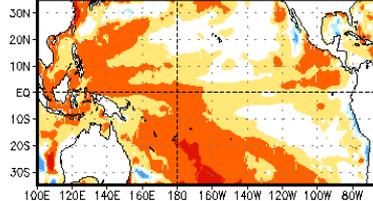
Feb-Mar-Apr 2014



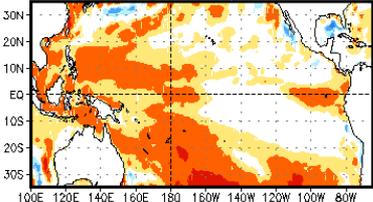
Nov-Dec-Jan 2013/2014



Mar-Apr-May 2014



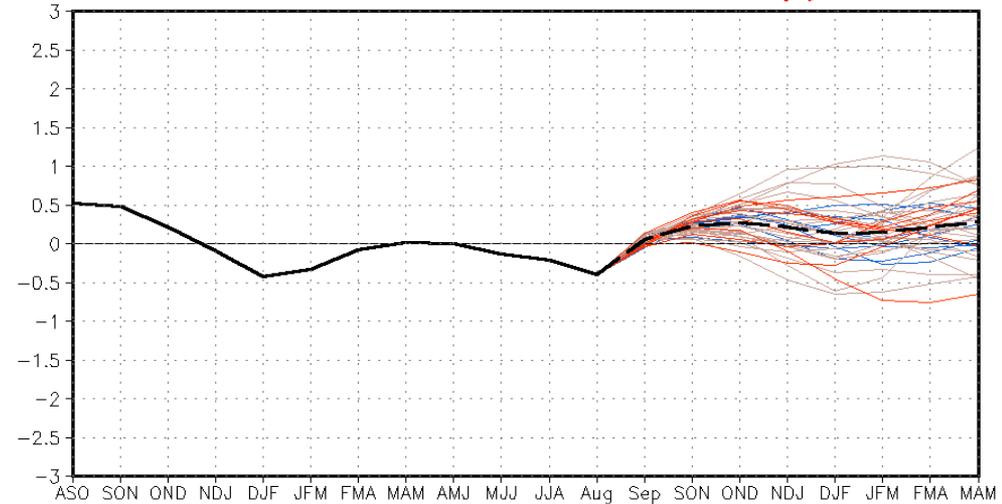
Dec-Jan-Feb 2013/2014



(Model bias correction base period: 1999-2010; Climatology base period: 1982-2010)

The CFS.v2 ensemble mean (black dashed line) predicts ENSO-neutral conditions into early 2014.

CFSv2 forecast Nino3.4 SST anomalies (K)

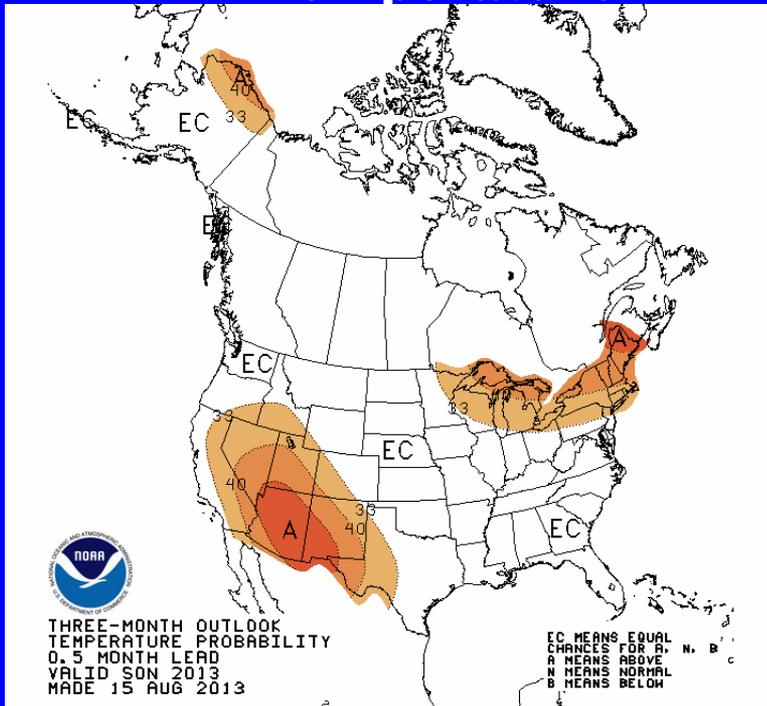


— Latest 8 forecast members  
 — Earliest 8 forecast members  
 — Other forecast members  
 - - - Forecast ensemble mean  
 — NCDC daily analysis  
 (Model bias correct base period: 1999-2010; Climatology base period: 1982-2010)

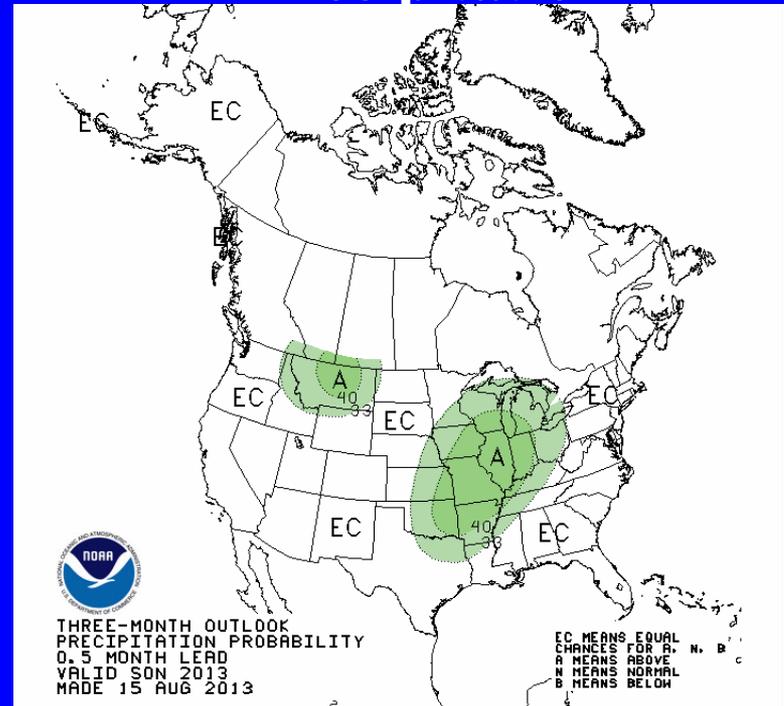


# U. S. Seasonal Outlooks September – November 2013

## Temperature



## Precipitation



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 continue.\***
- **Equatorial sea surface temperatures (SST) are above average across the western Pacific, near average in the central Pacific, and below average in the eastern Pacific.**
- **ENSO-neutral is favored into the Northern Hemisphere fall 2013.\***

\* Note: These statements are updated once a month in association with the ENSO Diagnostics Discussion:  
[http://www.cpc.ncep.noaa.gov/products/analysis\\_monitoring/enso\\_advisory](http://www.cpc.ncep.noaa.gov/products/analysis_monitoring/enso_advisory)