



ENSO Cycle: Recent Evolution, Current Status and Predictions

**Update prepared by
Climate Prediction Center / NCEP
15 October 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

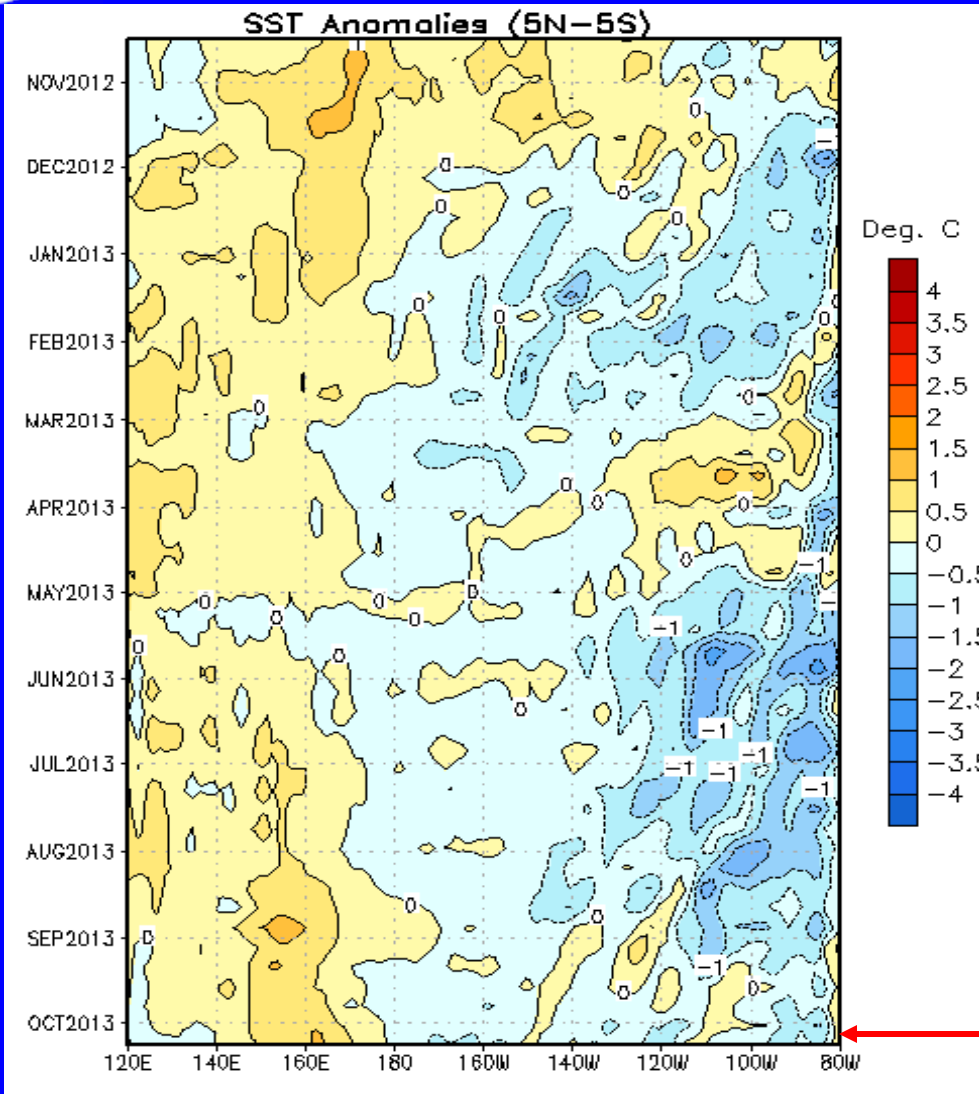
- **ENSO-neutral conditions continue.***
- **Equatorial sea surface temperatures (SST) are near average across much of the equatorial Pacific Ocean.**
- **ENSO-neutral is expected into the Northern Hemisphere spring 2014.***

* 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



Recent Evolution of Equatorial Pacific SST Departures (°C)

Time



Longitude

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

Recently, SSTs have been near-average across much of the equatorial Pacific.



Niño Region SST Departures (°C)

Recent Evolution

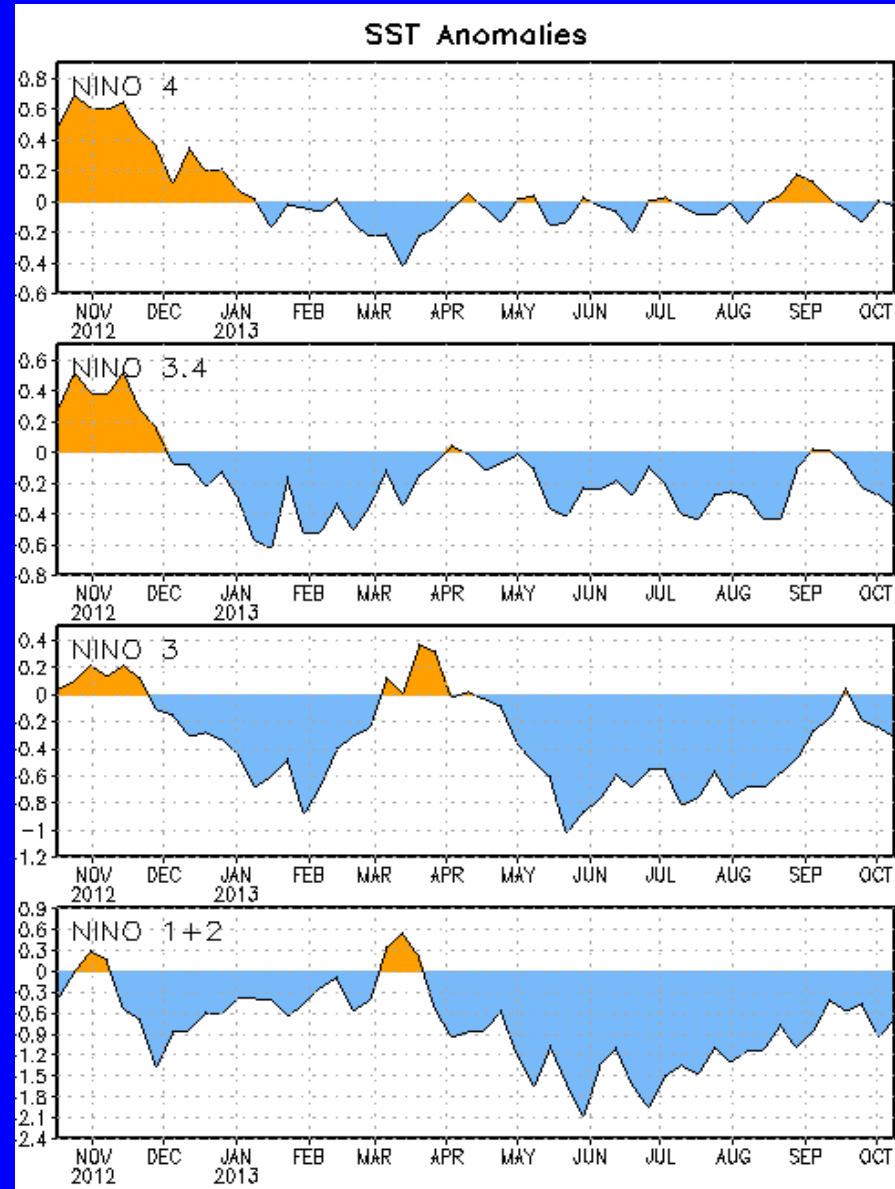
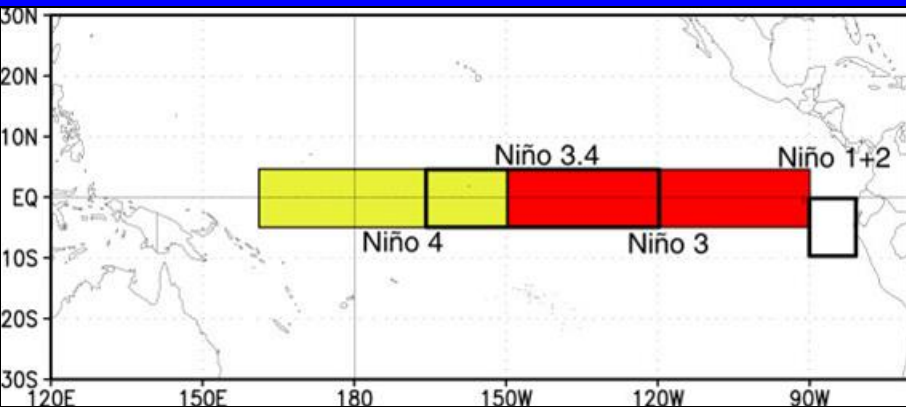
The latest weekly SST departures are:

Niño 4 **0.0°C**

Niño 3.4 **-0.3°C**

Niño 3 **-0.3°C**

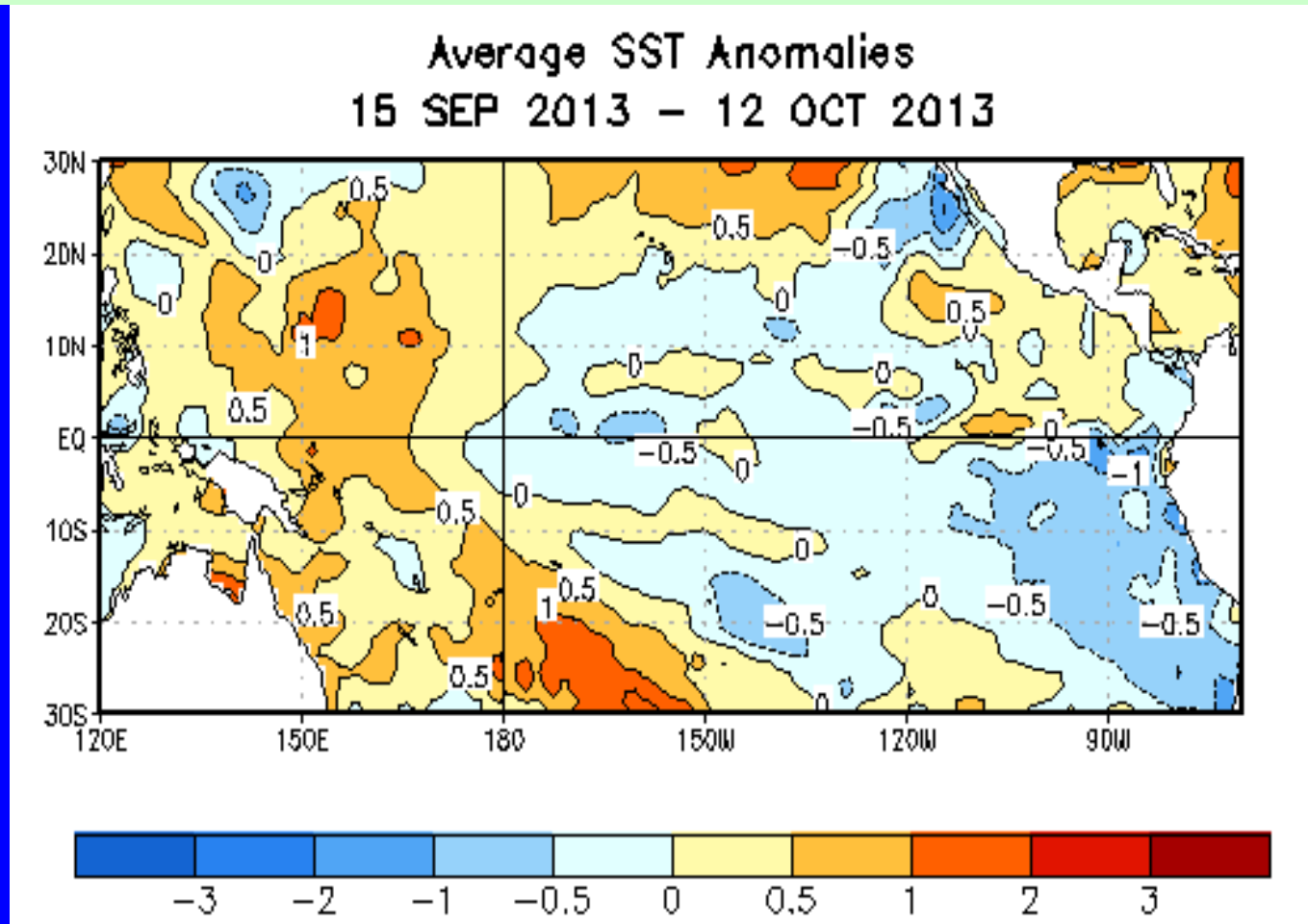
Niño 1+2 **-0.7°C**





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

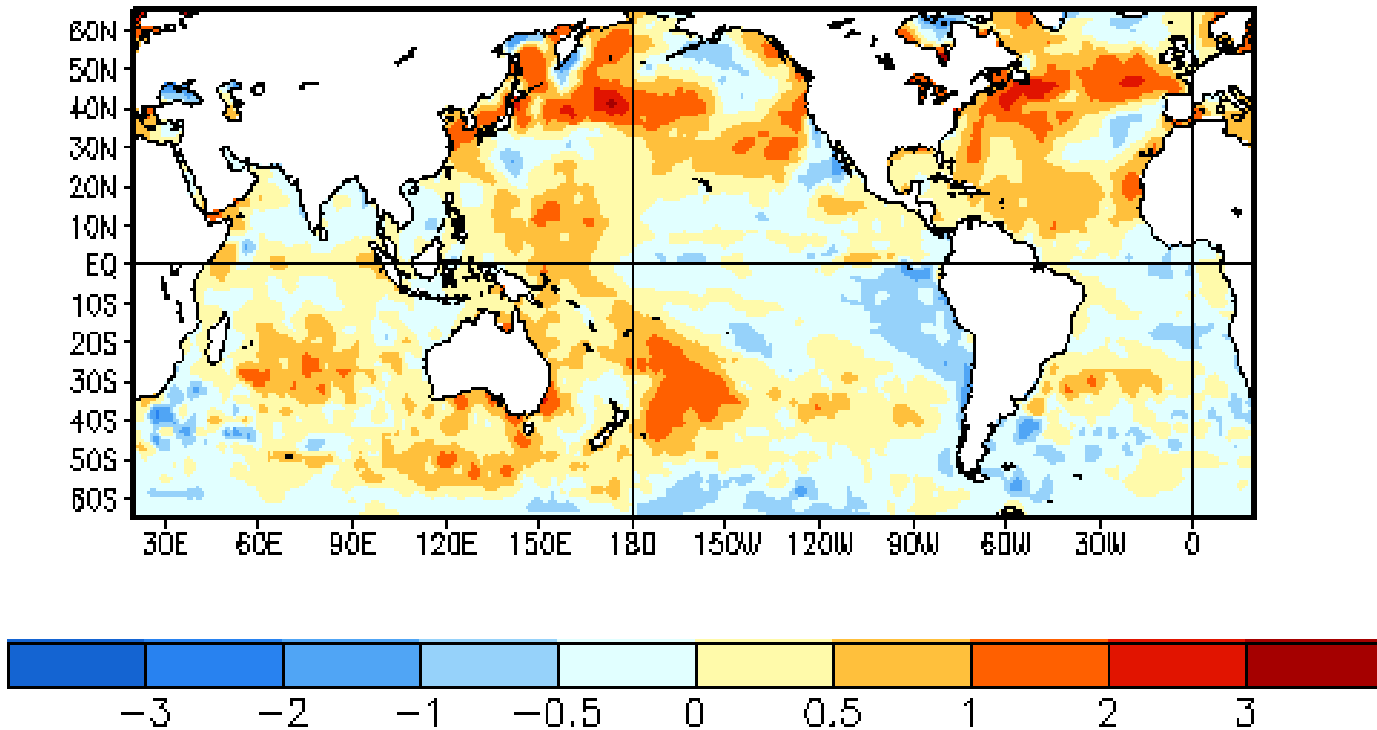
During the last 4-weeks, equatorial SSTs were above average in the western Pacific, below average in the eastern Pacific, and near-average elsewhere.





Global SST Departures (°C)

Average SST Anomalies
15 SEP 2013 – 12 OCT 2013

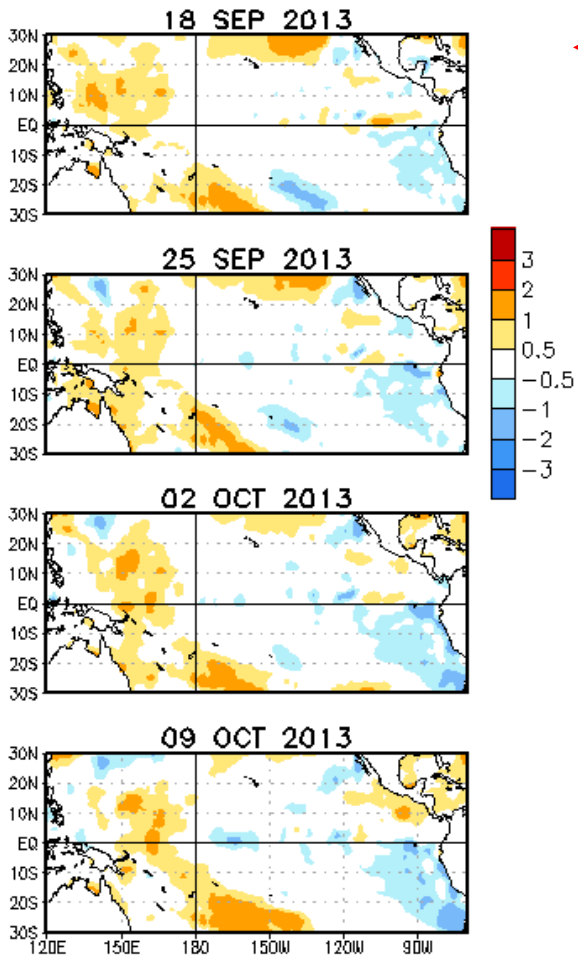


During the last four weeks, equatorial SSTs were below average in the eastern Pacific Ocean and Atlantic Ocean, while above average SSTs were located in the western Pacific.



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

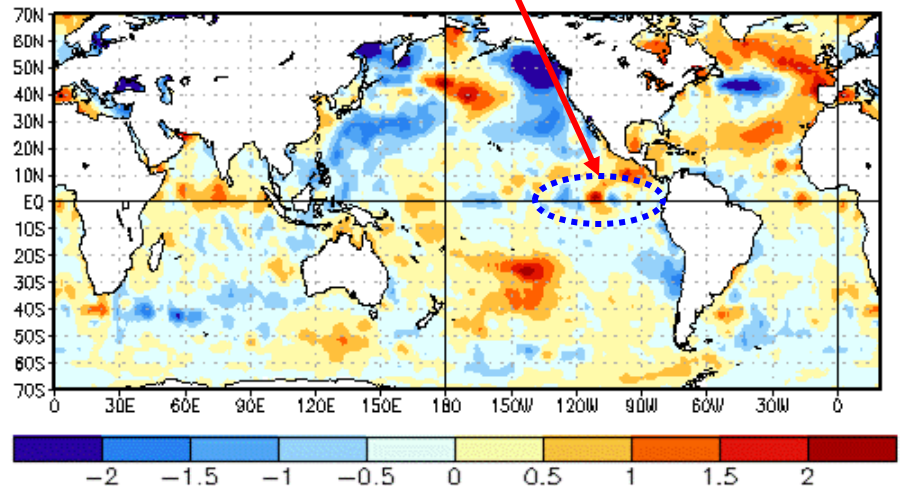
Weekly SST Anomalies (DEG C)



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

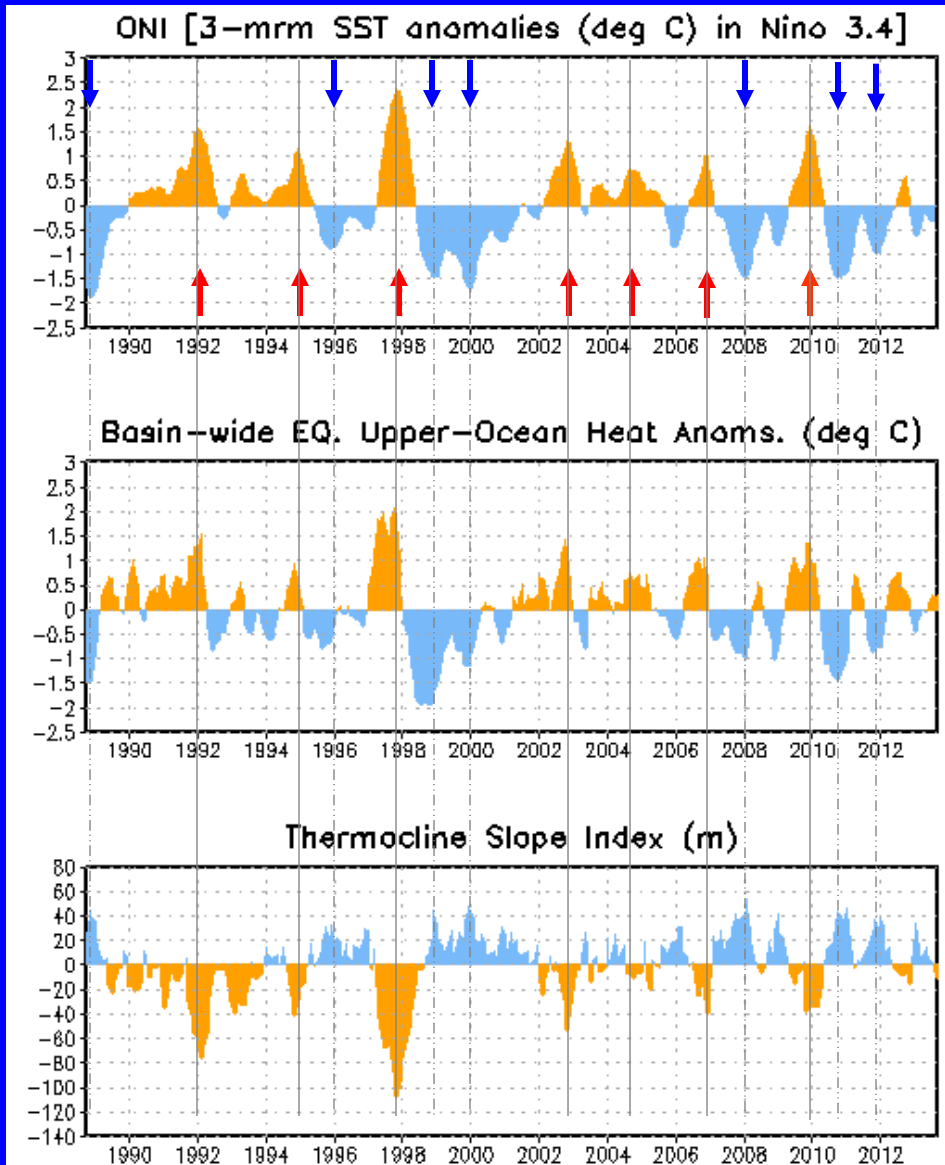
• Over the last month, a mix of positive and negative changes in SST anomalies were observed in the eastern equatorial Pacific.

Change in Weekly SST Anoma (°C)
09OCT2013 minus 11SEP2013





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.

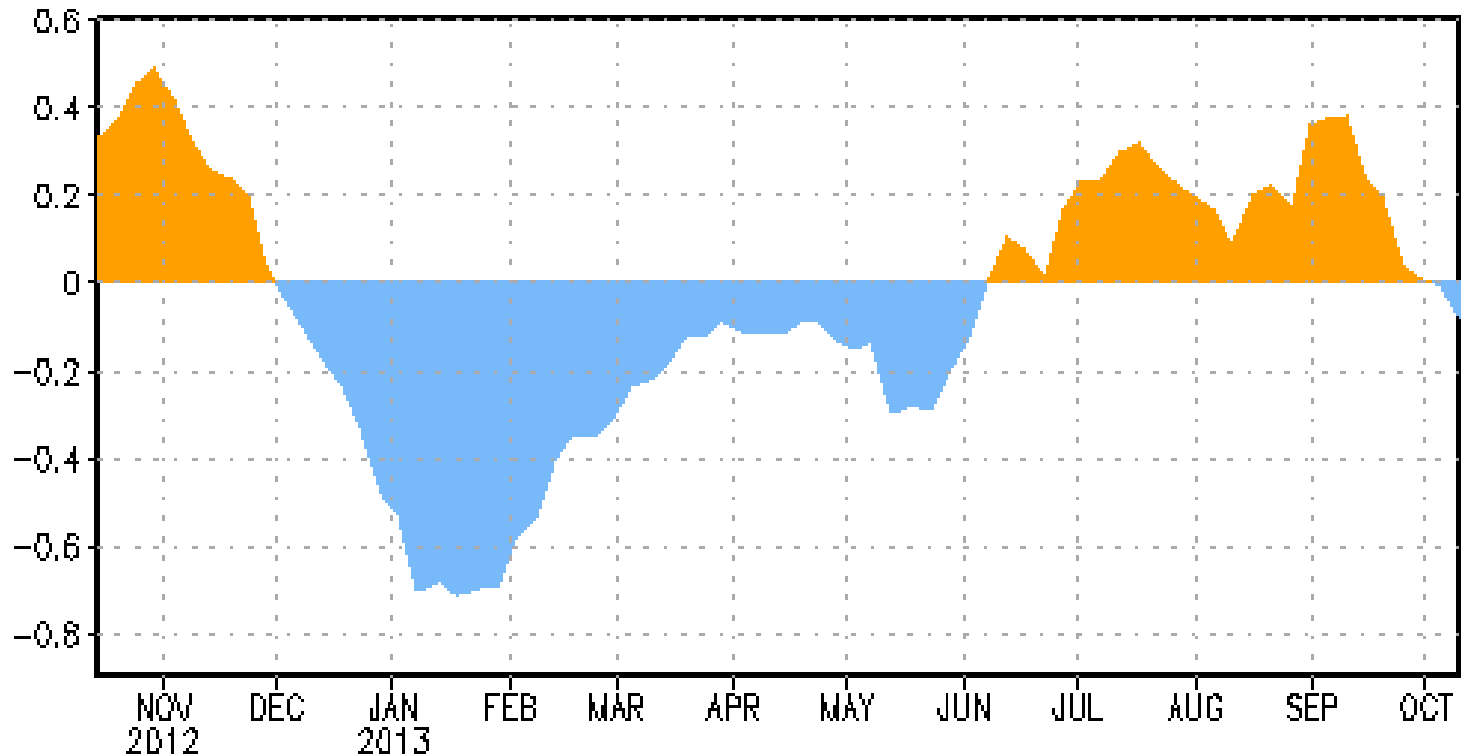
- Recent values of the upper-ocean heat anomalies (near zero) and thermocline slope index (near zero) reflect ENSO-neutral conditions.

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).



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

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



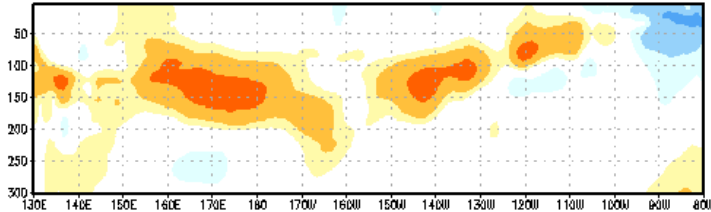
Subsurface temperatures were above-average from April – November 2012, and below average during December 2012 – May 2013. From June – September 2013, subsurface temperature anomalies were positive. Currently, subsurface temperatures are near average.



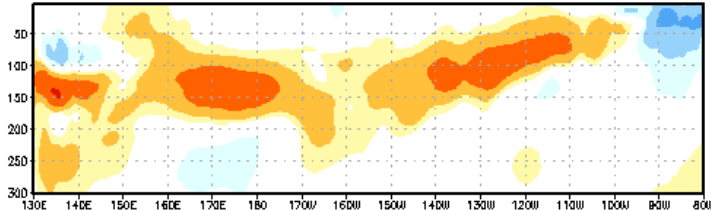
Sub-Surface Temperature Departures (°C) in the Equatorial Pacific

EQ. Subsurface Temperature Anomalies (deg C)

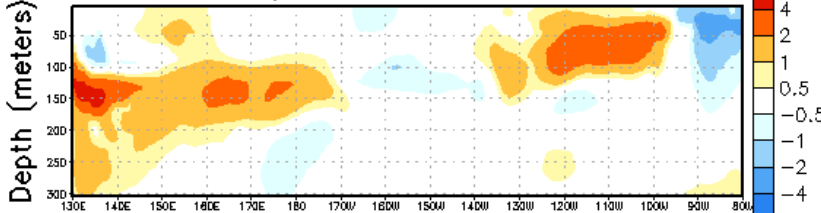
Three-pentad ave. centered on 21 AUG 2013



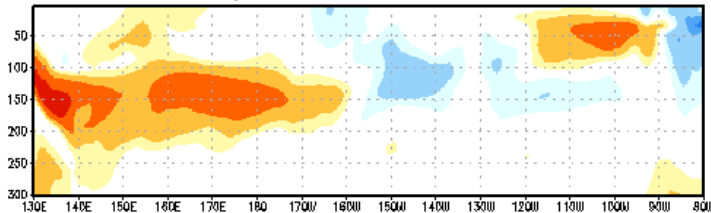
Three-pentad ave. centered on 05 SEP 2013



Three-pentad ave. centered on 20 SEP 2013



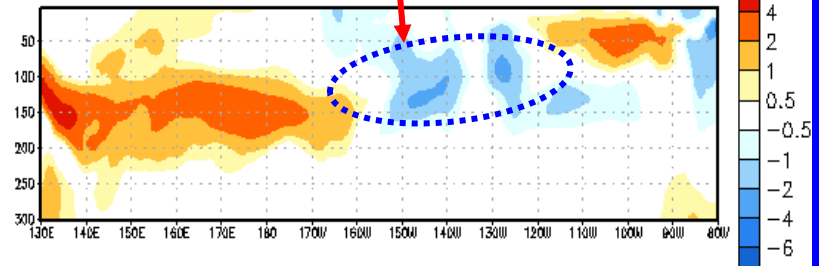
Three-pentad ave. centered on 05 OCT 2013



- During the last two months, above-average subsurface temperatures were evident across much of the equatorial Pacific Ocean. However, below average temperatures persisted in the far eastern Pacific and emerged in the east-central Pacific.
- Recently, negative subsurface anomalies strengthened in the east-central Pacific Ocean.

EQ. Subsurface Temperature Anomalies (deg C)

Pentad centered on 10 OCT 2013



Most recent pentad analysis

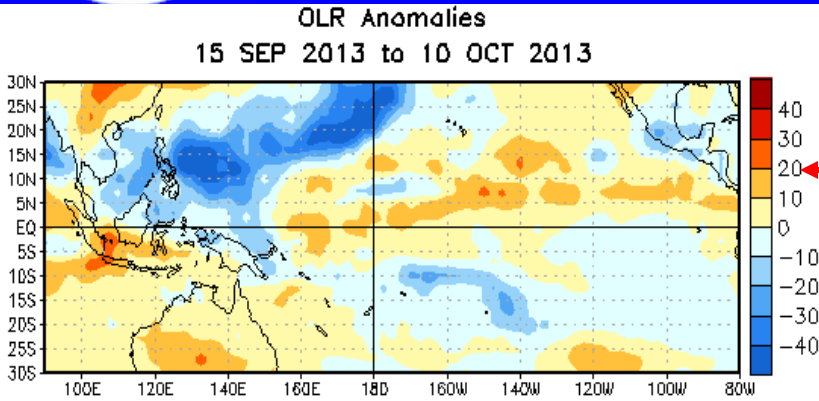
Time



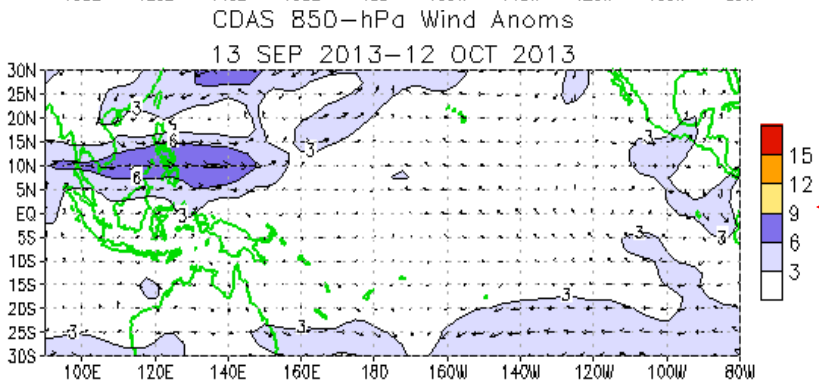
Longitude



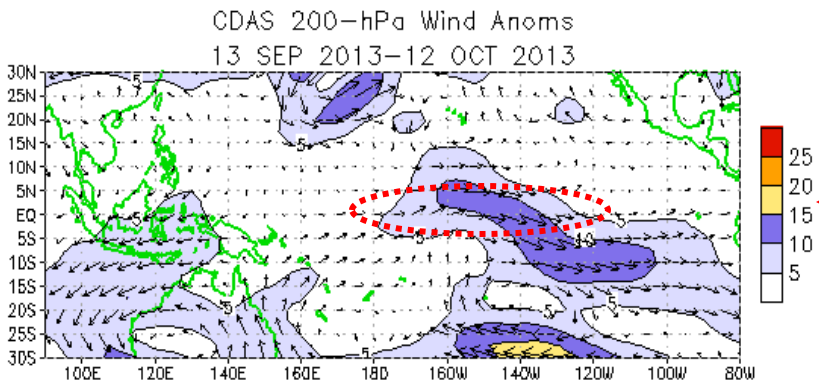
Tropical OLR and Wind Anomalies During the Last 30 Days



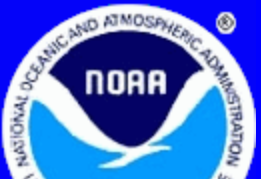
Negative OLR anomalies (enhanced convection and precipitation, blue shading) were observed near the Philippines. Weak positive OLR anomalies (suppressed convection and precipitation, red shading) were evident over western Indonesia and near the International Date Line.



Low-level (850-hPa) winds were near normal across most of the equatorial Pacific.

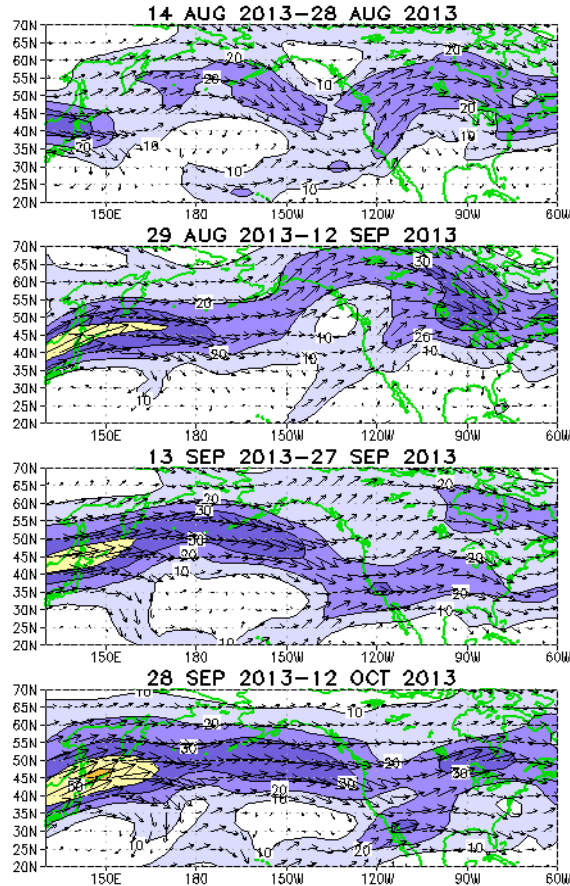


Upper-level (200-hPa) westerly wind anomalies were evident over the east-central equatorial Pacific.

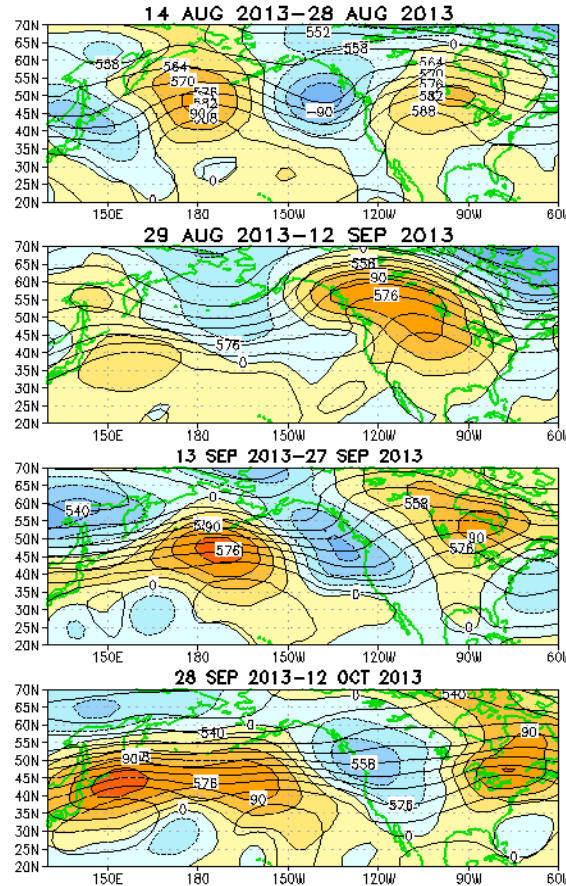


Atmospheric Circulation over the North Pacific & North America During the Last 60 Days

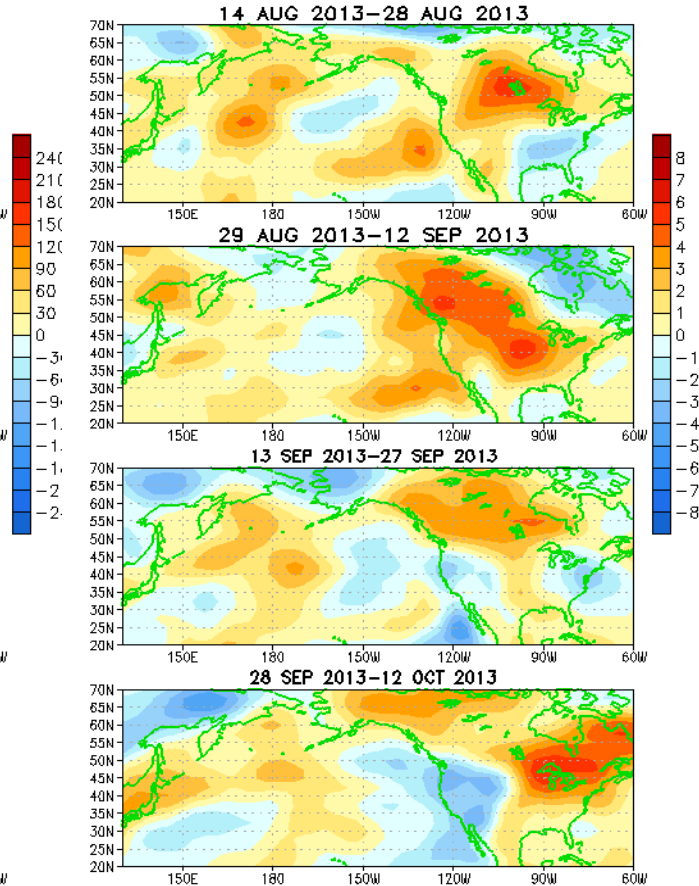
200-hPa Wind



500-hPa Height & Anoms.



925-hPa Temp. Anoms. (°C)



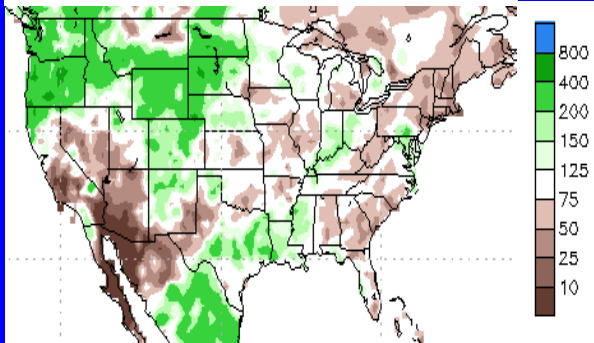
During mid August through September , below-average heights and below-average temperatures were observed across portions of eastern N. America or over the western Atlantic Ocean. During that same period, anomalous ridging over Canada and the northern U.S. contributed to above-average temperatures across much of the continent. Since early October, an anomalous trough-ridge pattern over the contiguous U.S. has led to below-average temperatures over the western U.S. and above-average temperatures over the eastern U.S.



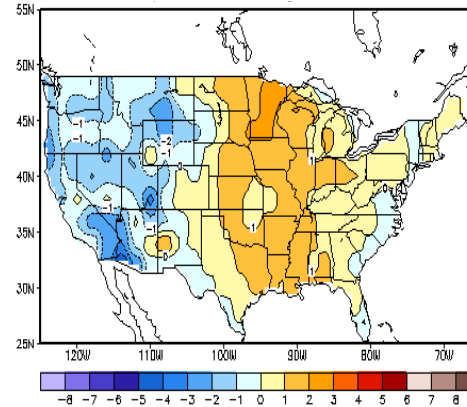
U.S. Temperature and Precipitation Departures During the Last 30 and 90 Days

Last 30 Days

30-day (ending 13 Oct 2013) % of average precipitation

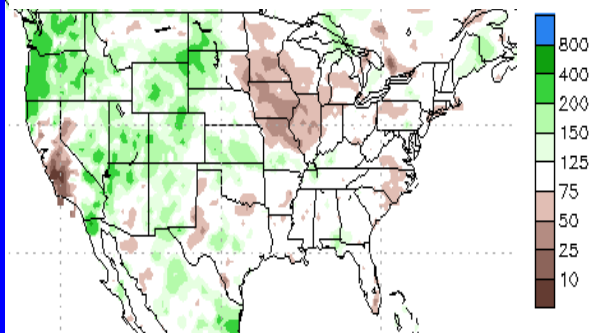


30-day (ending 13 Oct 2013) temperature departures (degree C)

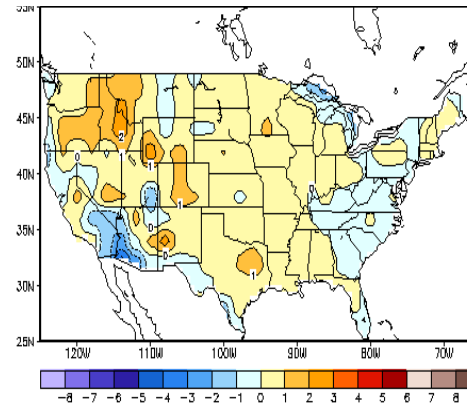


Last 90 Days

90-day (ending 13 Oct 2013) % of average precipitation



90-day (ending 13 Oct 2013) temperature departures (degree C)



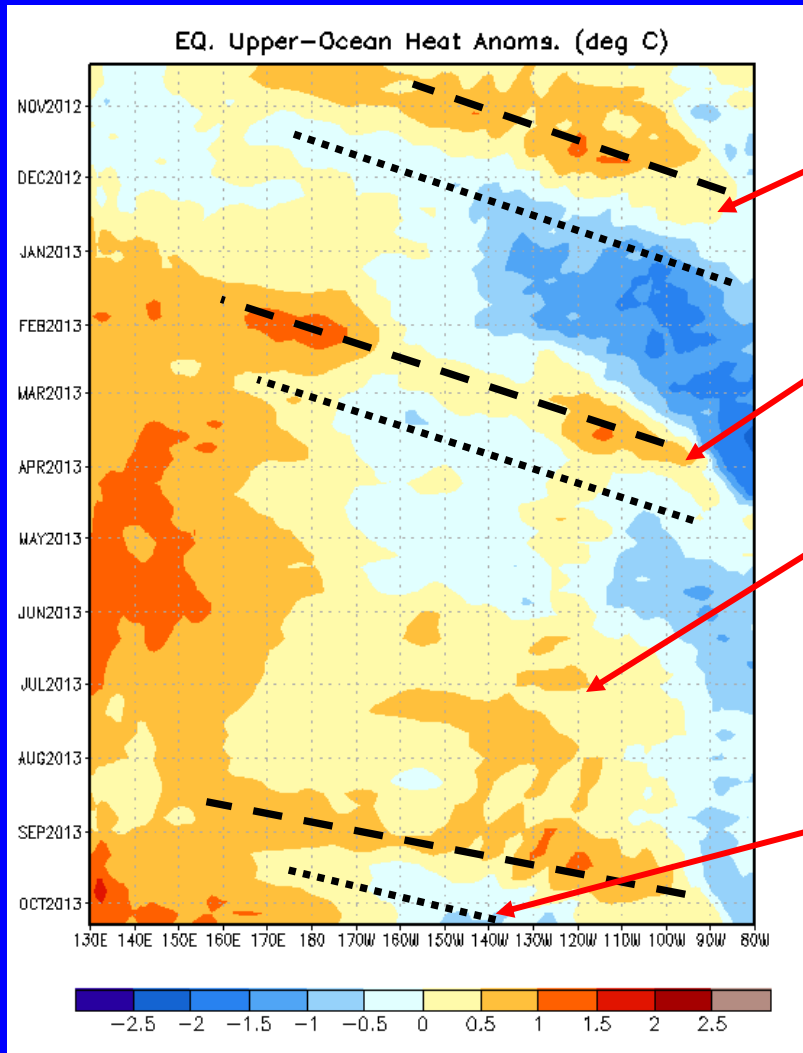


Intraseasonal Variability

- **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 since early June 2013 across the equatorial Pacific (except in the far eastern basin).

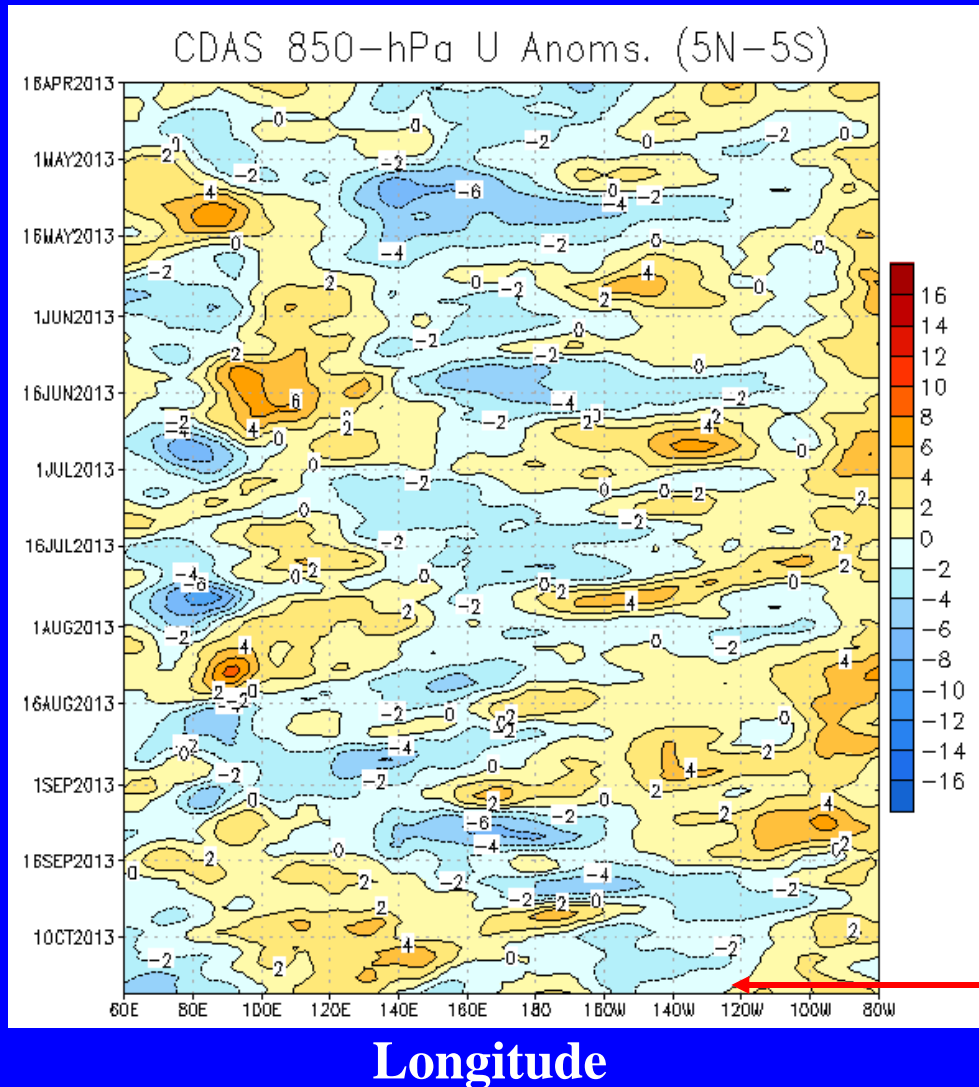
- From early August through September 2013, the downwelling phase of an oceanic Kelvin wave propagated eastward.

- The recent emergence of below-average temperatures indicates an upwelling Kelvin wave

- 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 up-welling and cooling occur in the trailing portion.



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



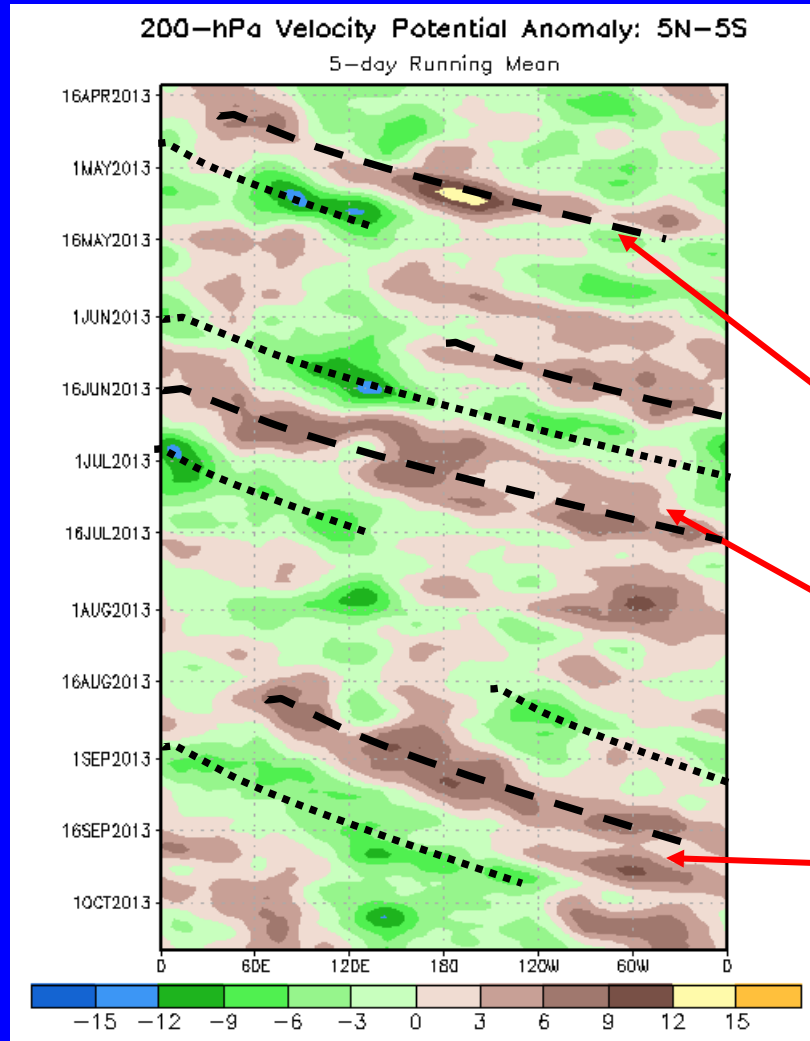
Westerly wind anomalies (orange/red shading).

Easterly wind anomalies (blue shading).

In the last week, westerly wind anomalies strengthened over the western Pacific, while easterly anomalies persisted in the east-central 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 during the first half of May 2013.

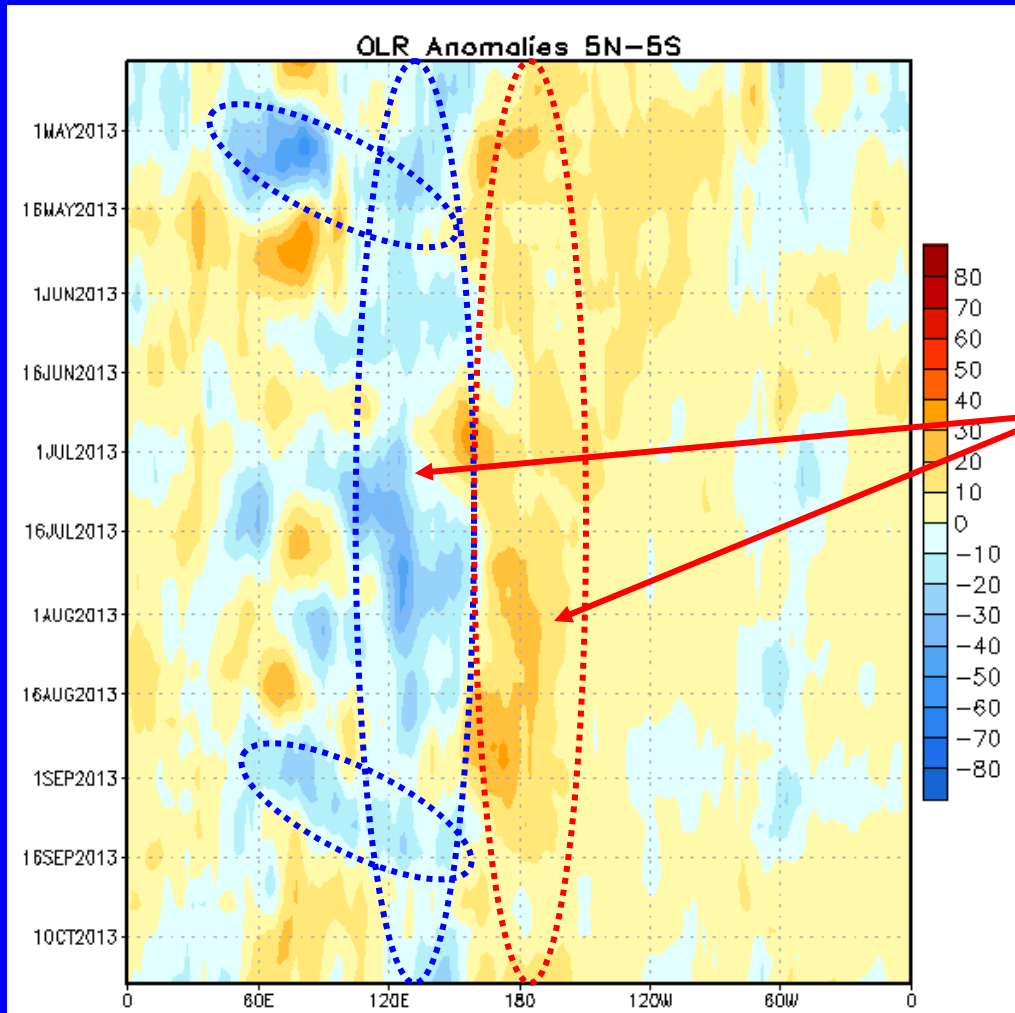
During June and early July, the MJO was active.

From mid-August through late September, 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 April 2013, below-average OLR
has been evident over the western
Pacific, while 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°C .

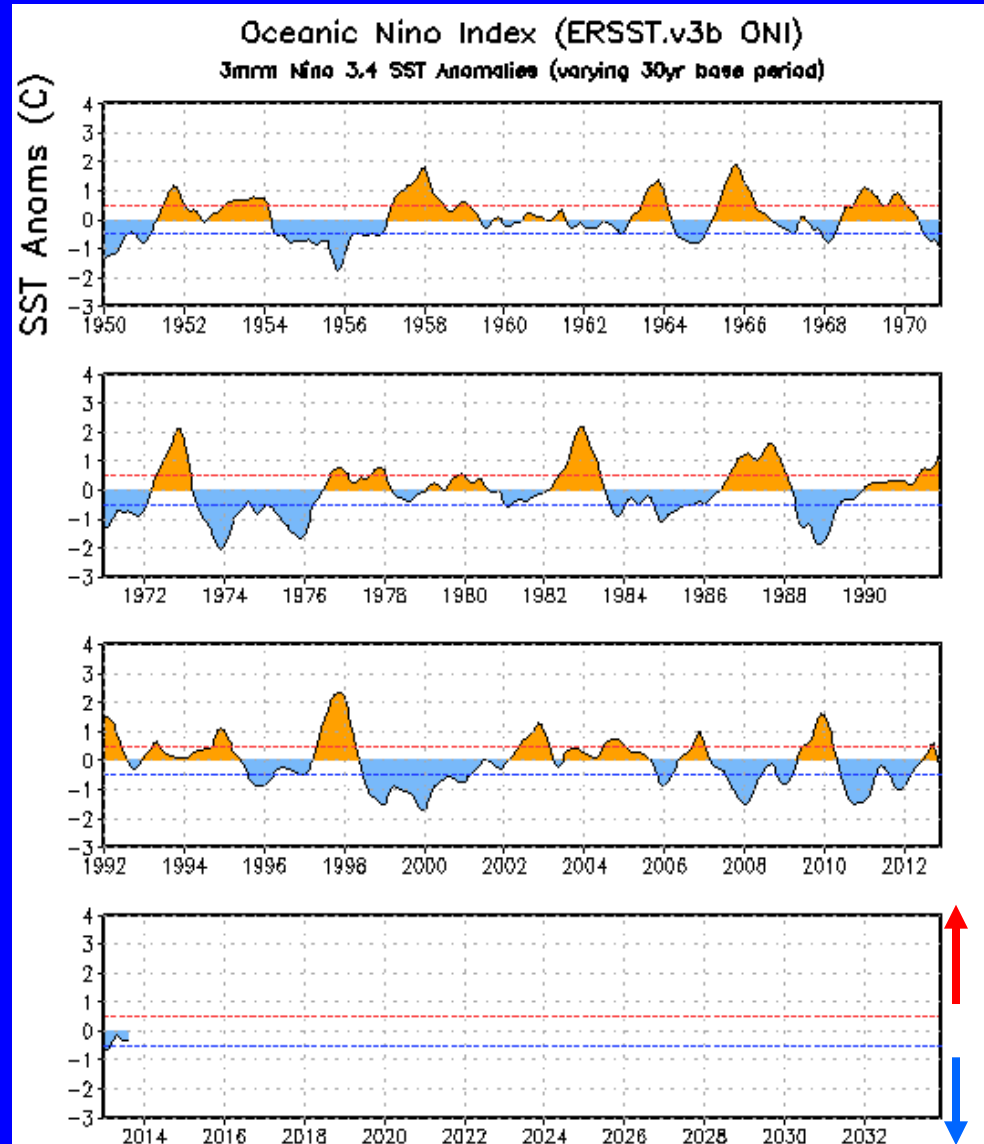
By historical standards, to be classified as a full-fledged El Niño or La Niña episode, these thresholds must be exceeded for a period of at least 5 consecutive overlapping 3-month seasons.

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 2013) is **-0.3°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:

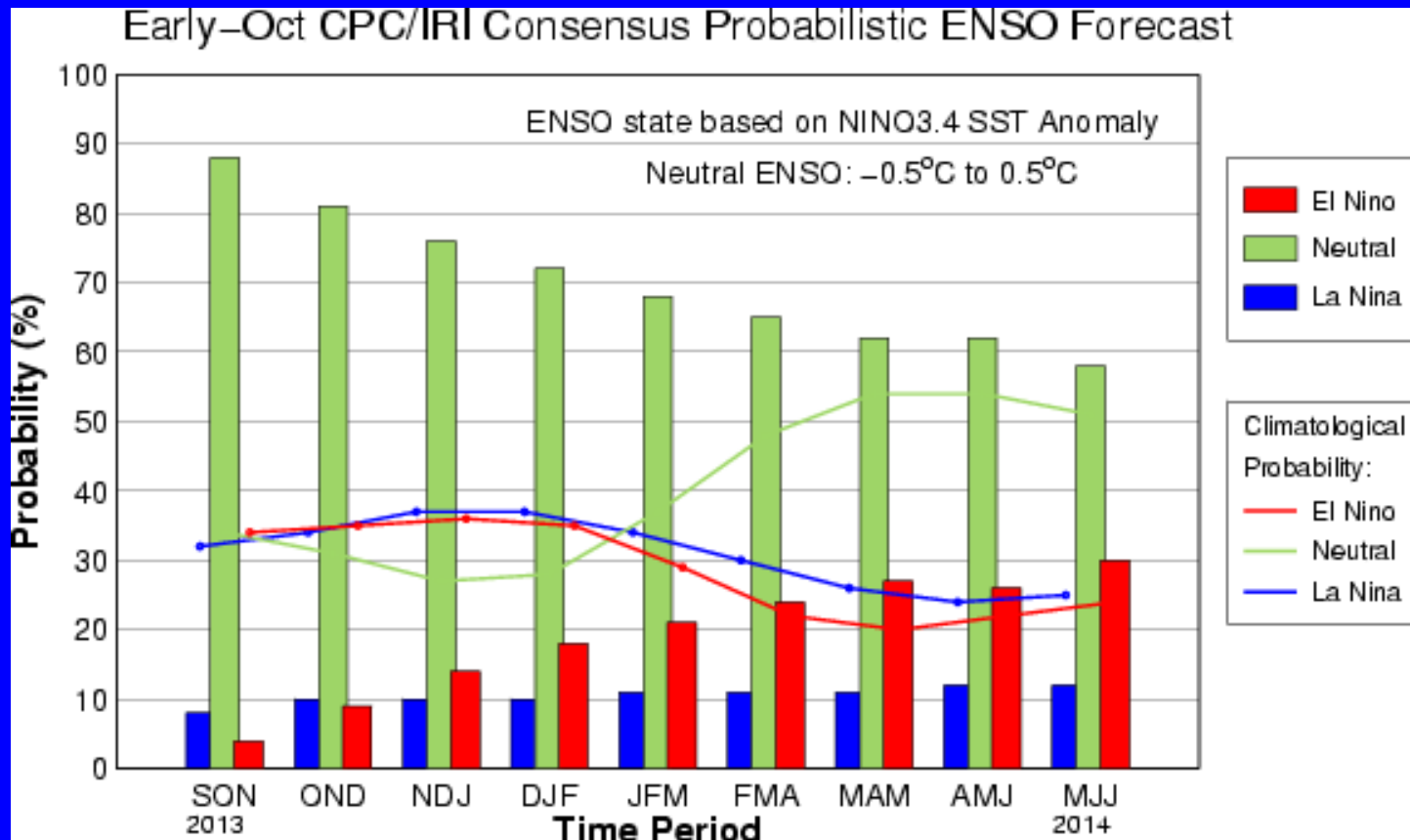
[Historical ONI Values](#)



CPC/IRI Probabilistic ENSO Outlook

(updated 10 October 2013)

ENSO-neutral is expected through the Northern Hemisphere spring 2014.





Pacific Niño 3.4 SST Outlook

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

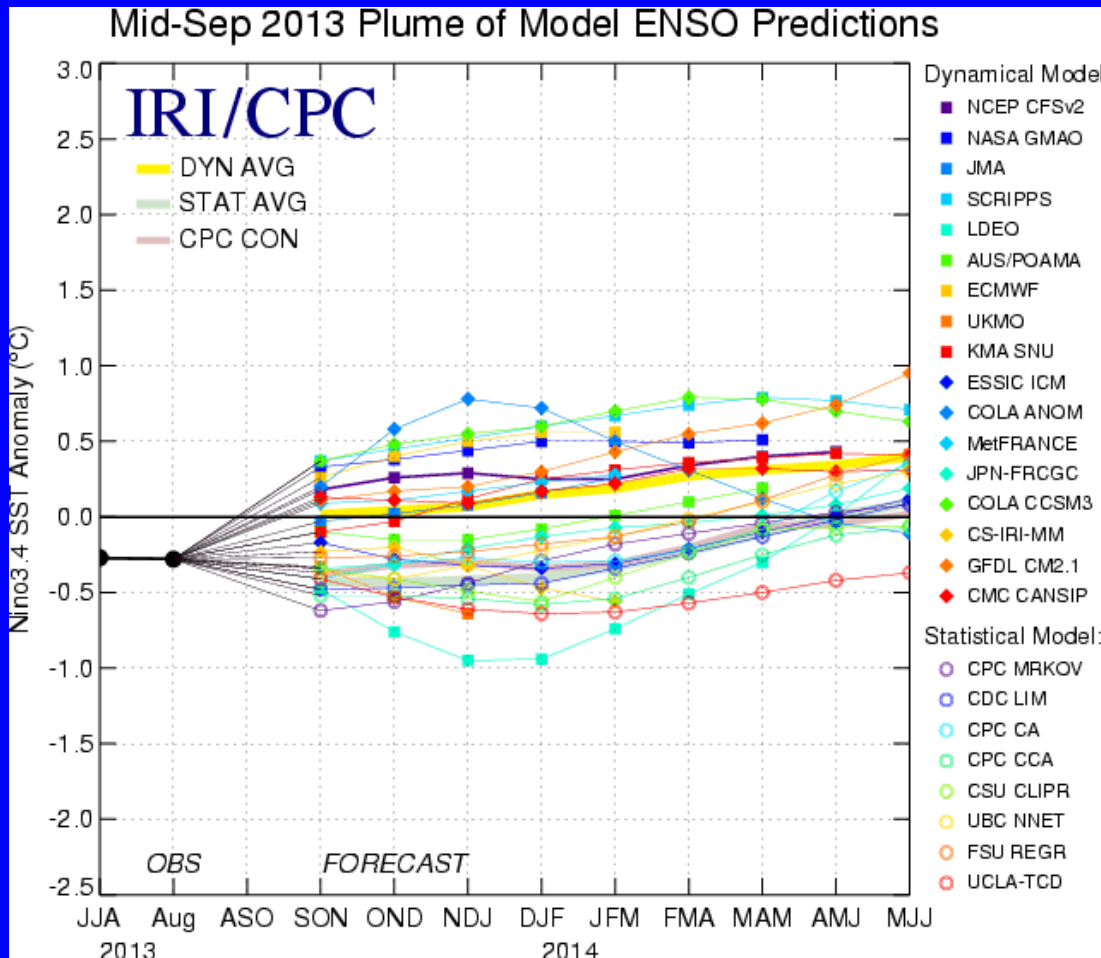


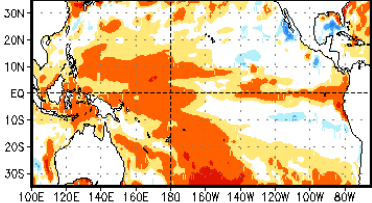
Figure provided by the International Research Institute (IRI) for Climate and Society (updated 18 September 2013).



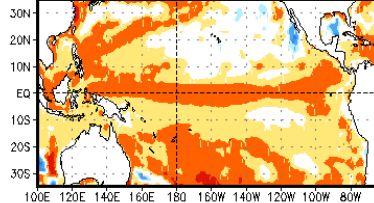
SST Outlook: NCEP CFS.v2 Forecast

Issued 15 October 2013

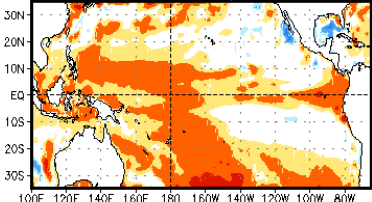
Nov-Dec-Jan 2013/2014



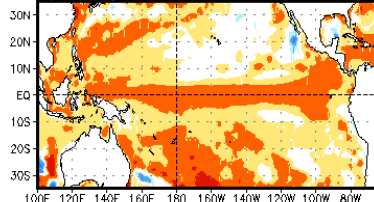
Mar-Apr-May 2014



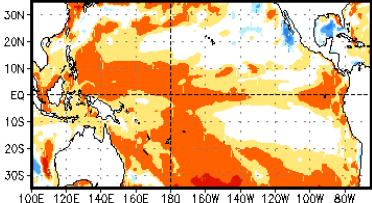
Dec-Jan-Feb 2013/2014



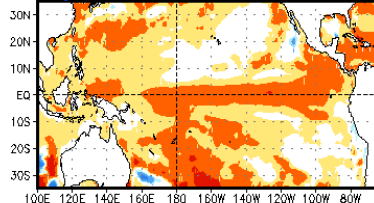
Apr-May-Jun 2014



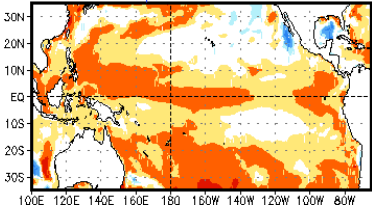
Jan-Feb-Mar 2014



May-Jun-Jul 2014



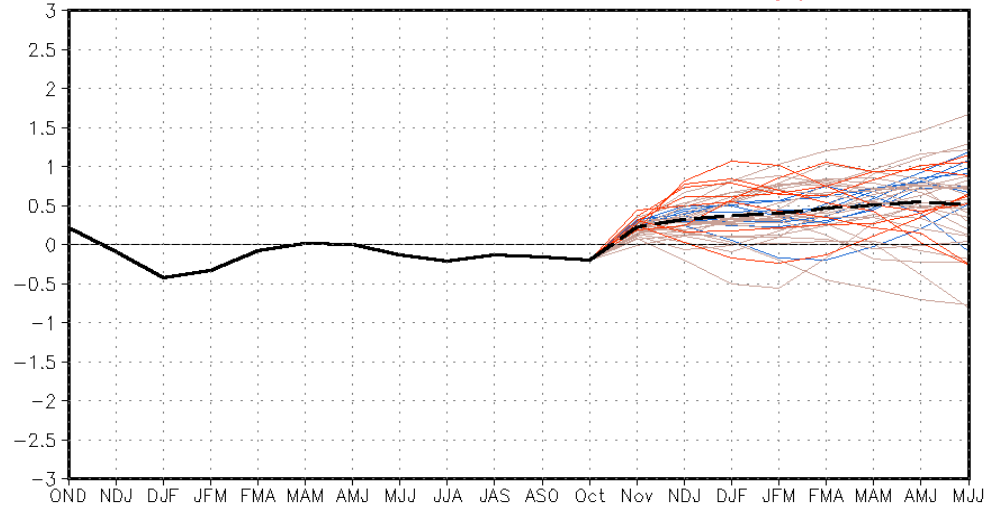
Feb-Mar-Apr 2014



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

The CFS.v2 ensemble mean (black dashed line) predicts ENSO-neutral conditions (warm side of neutral) through spring 2014.

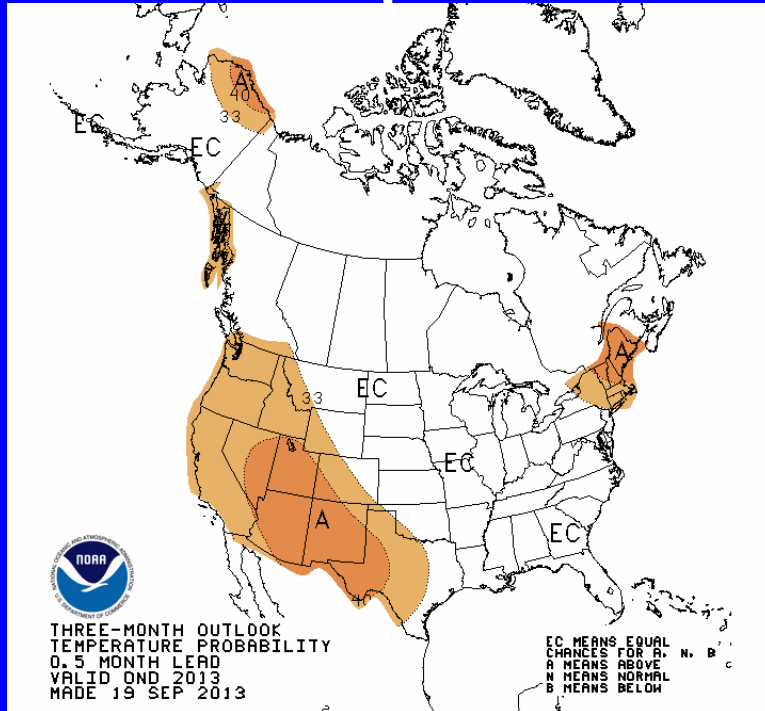
CFSv2 forecast Nino3.4 SST anomalies (K)



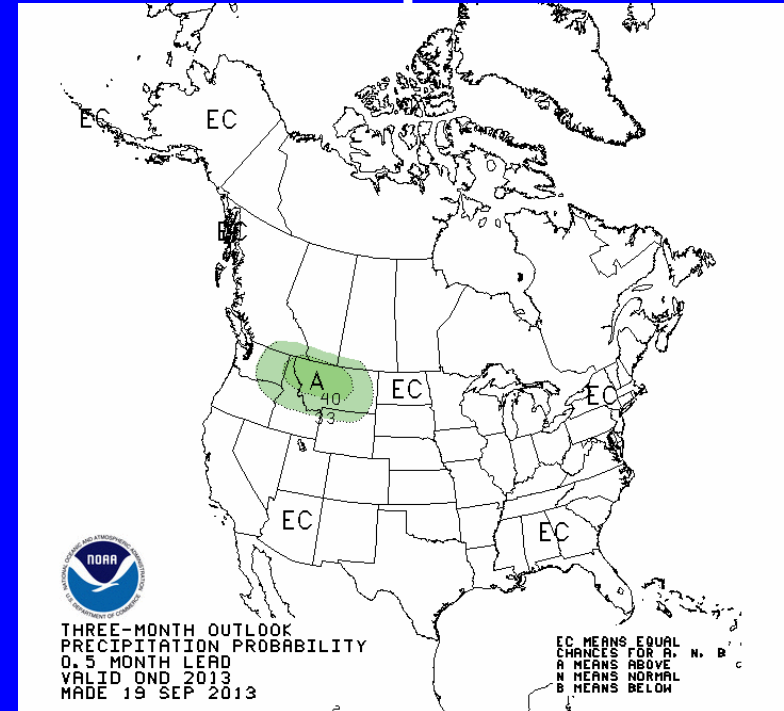


U. S. Seasonal Outlooks October – December 2013

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 near average across much of the equatorial Pacific Ocean.**
- **ENSO-neutral is expected into the Northern Hemisphere spring 2014.***

* 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