



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

**Update prepared by  
Climate Prediction Center / NCEP  
5 November 2012**



# 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: El Niño Watch\*

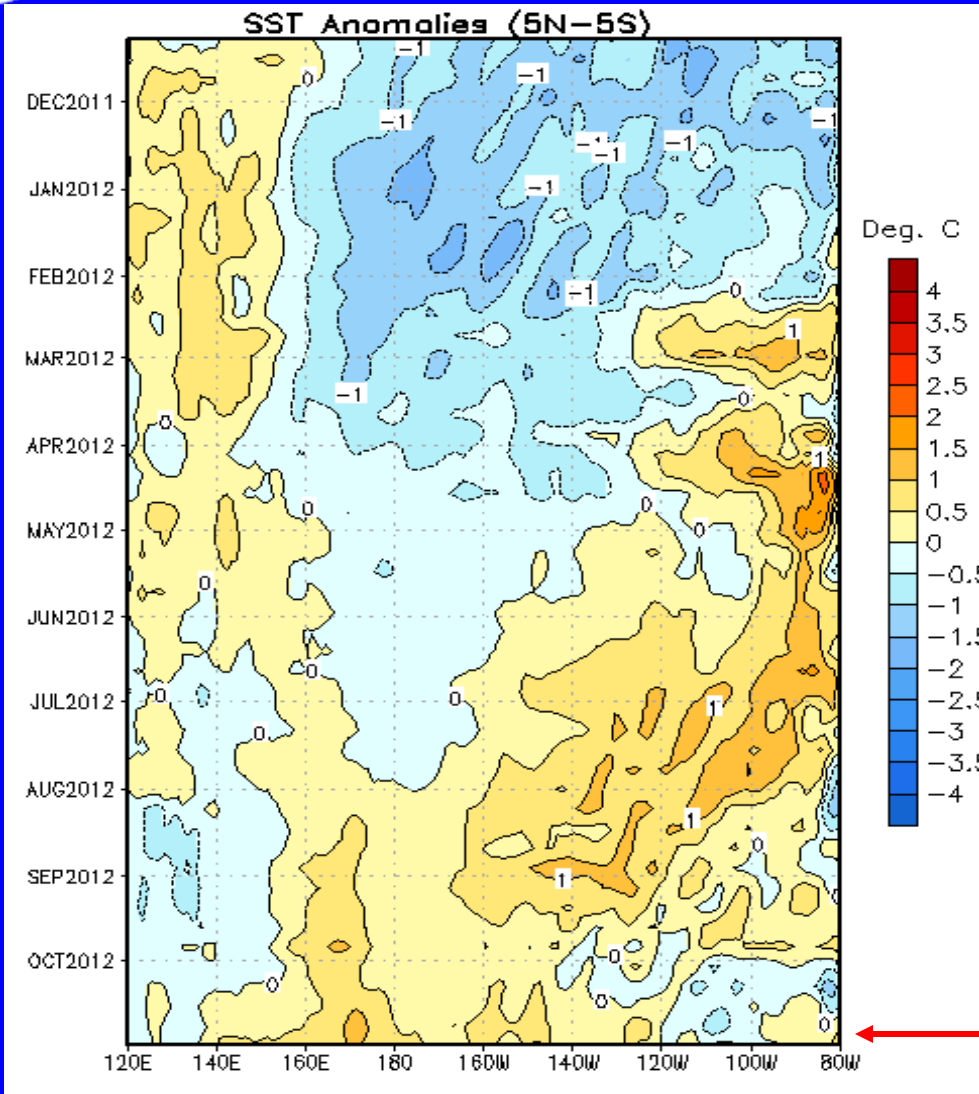
- **ENSO-neutral conditions continue.\***
- **Equatorial sea surface temperatures (SST) remain above average across the western and central Pacific Ocean.**
- **The atmospheric circulation over the tropical Pacific is near average.**
- **Borderline ENSO-neutral/ weak El Niño conditions are expected to continue into Northern Hemisphere winter 2012-13, possibly strengthening during the next few months.\***

\* 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



Longitude

From September 2011- January 2012, below-average SSTs were evident across much of the equatorial Pacific Ocean.

Recently, above-average SSTs have persisted in the central and western tropical Pacific, with relatively weaker SST anomalies in the eastern Pacific.



# Niño Region SST Departures (°C)

## Recent Evolution

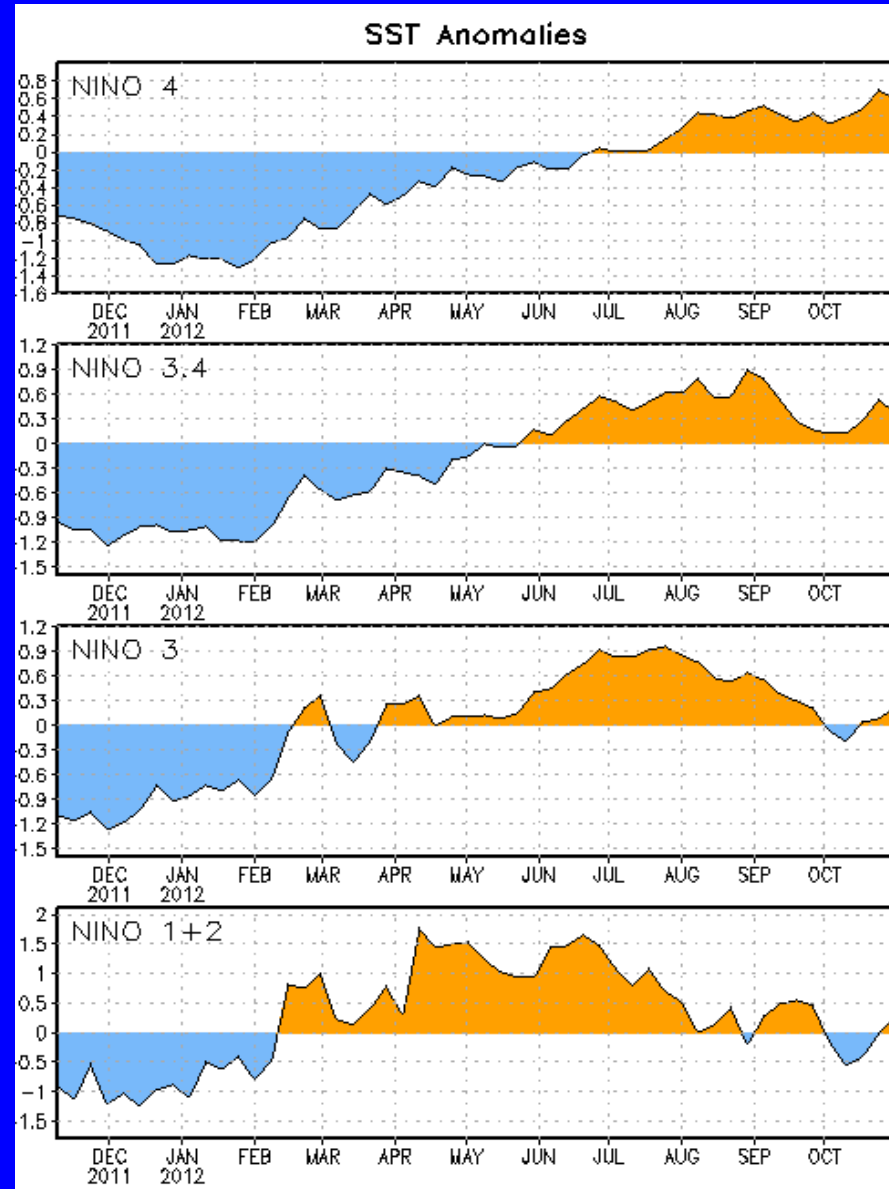
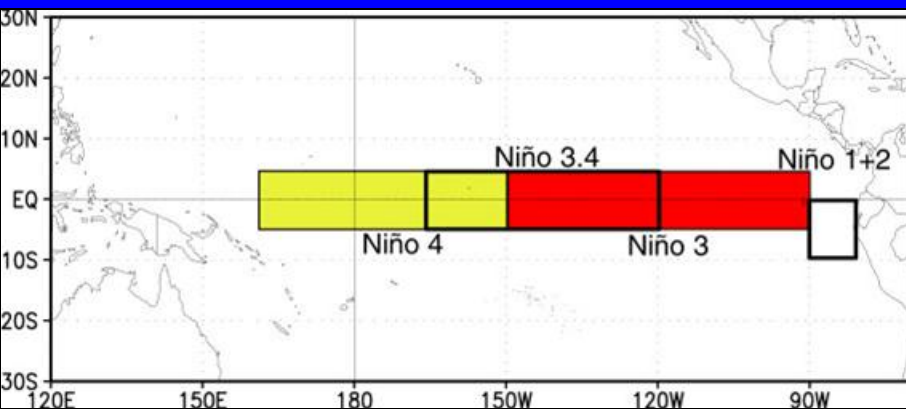
The latest weekly SST departures are:

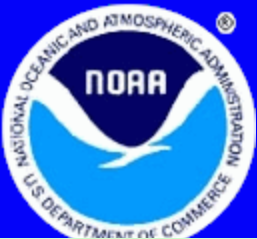
**Niño 4**                    **0.6°C**

**Niño 3.4**                **0.4°C**

**Niño 3**                    **0.2°C**

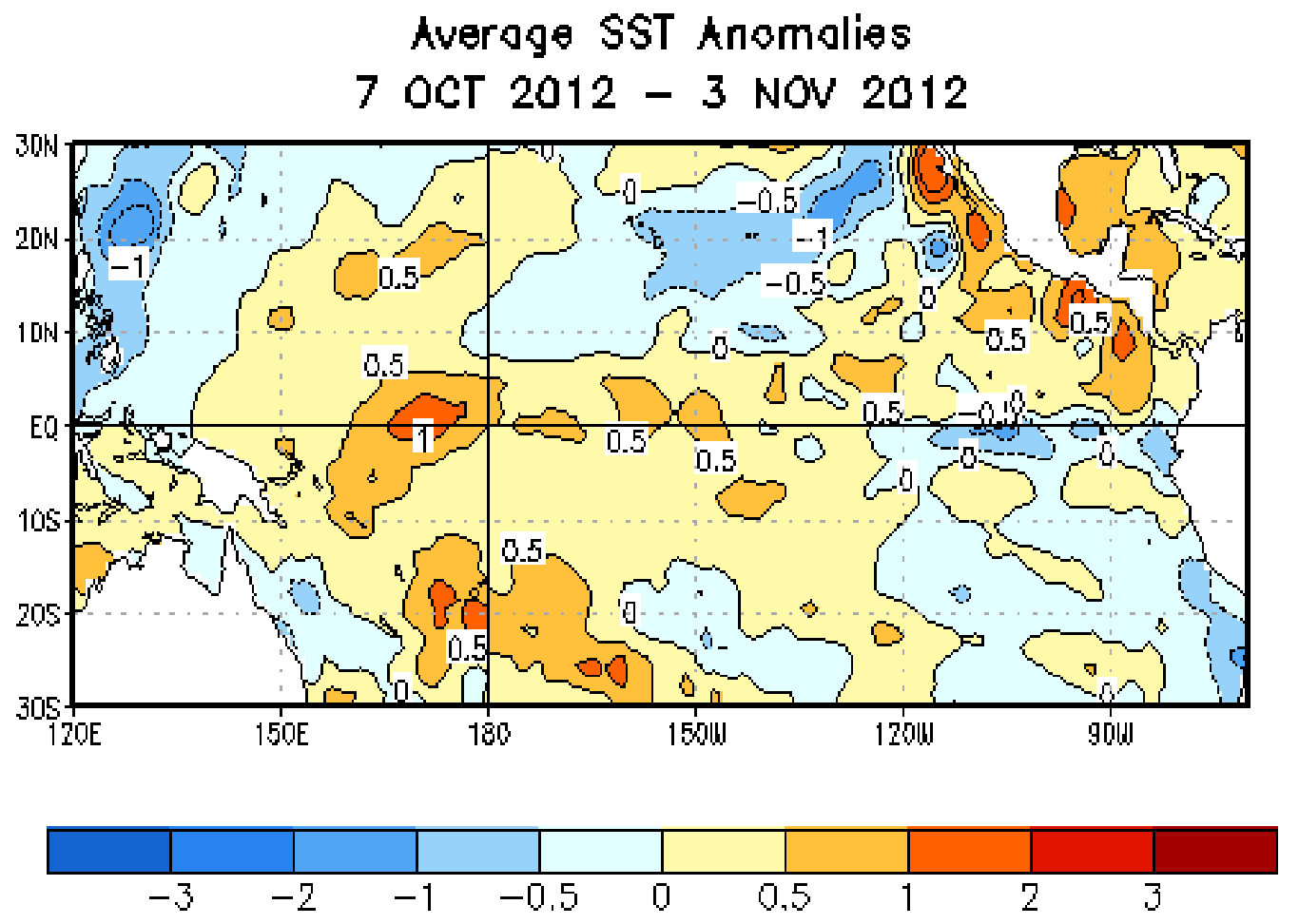
**Niño 1+2**                **0.3°C**





# SST Departures ( $^{\circ}\text{C}$ ) in the Tropical Pacific During the Last 4 Weeks

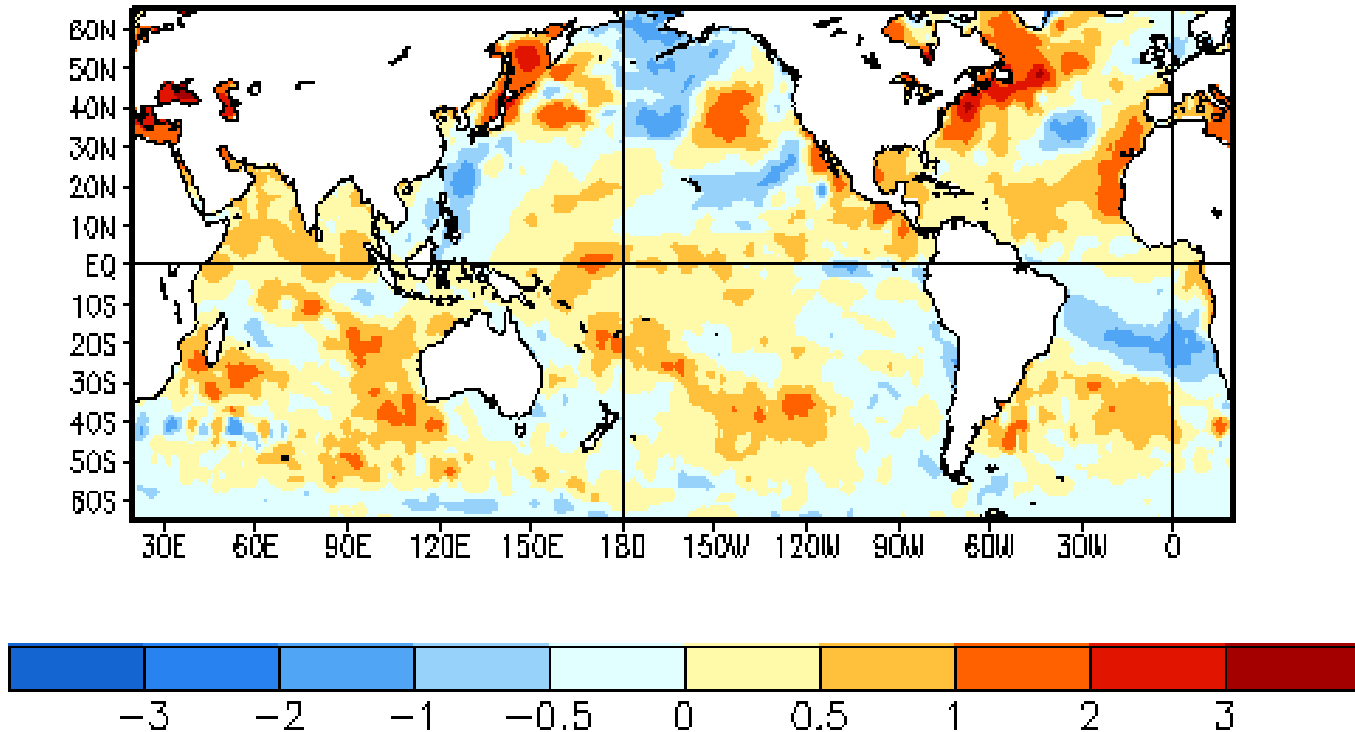
During the last 4-weeks, equatorial SSTs were more than  $0.5^{\circ}\text{C}$  above average west of the Date Line and in scattered regions of the east-central Pacific. In the eastern Pacific, SSTs were  $0.5^{\circ}\text{C}$  below average.





# Global SST Departures (°C)

Average SST Anomalies  
7 OCT 2012 – 3 NOV 2012

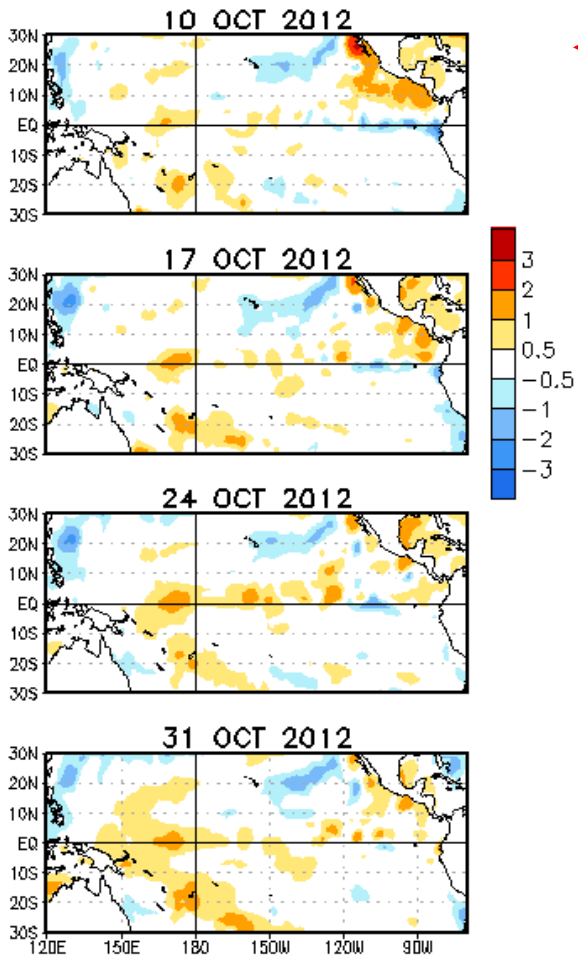


**During the last four weeks, equatorial SSTs were above average across the western and central Pacific Ocean and the Indian Ocean.**



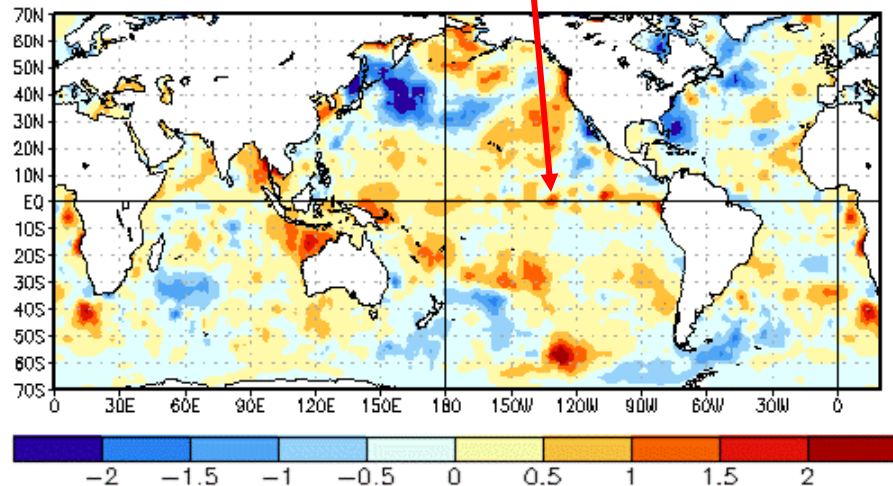
# Weekly SST Departures (°C) for the Last Four Weeks

Weekly SST Anomalies (DEG C)



- During the last 30 days, positive SST anomalies have strengthened in the east-central Pacific.
- The changes in equatorial Pacific SSTs are weakly positive over the last month.

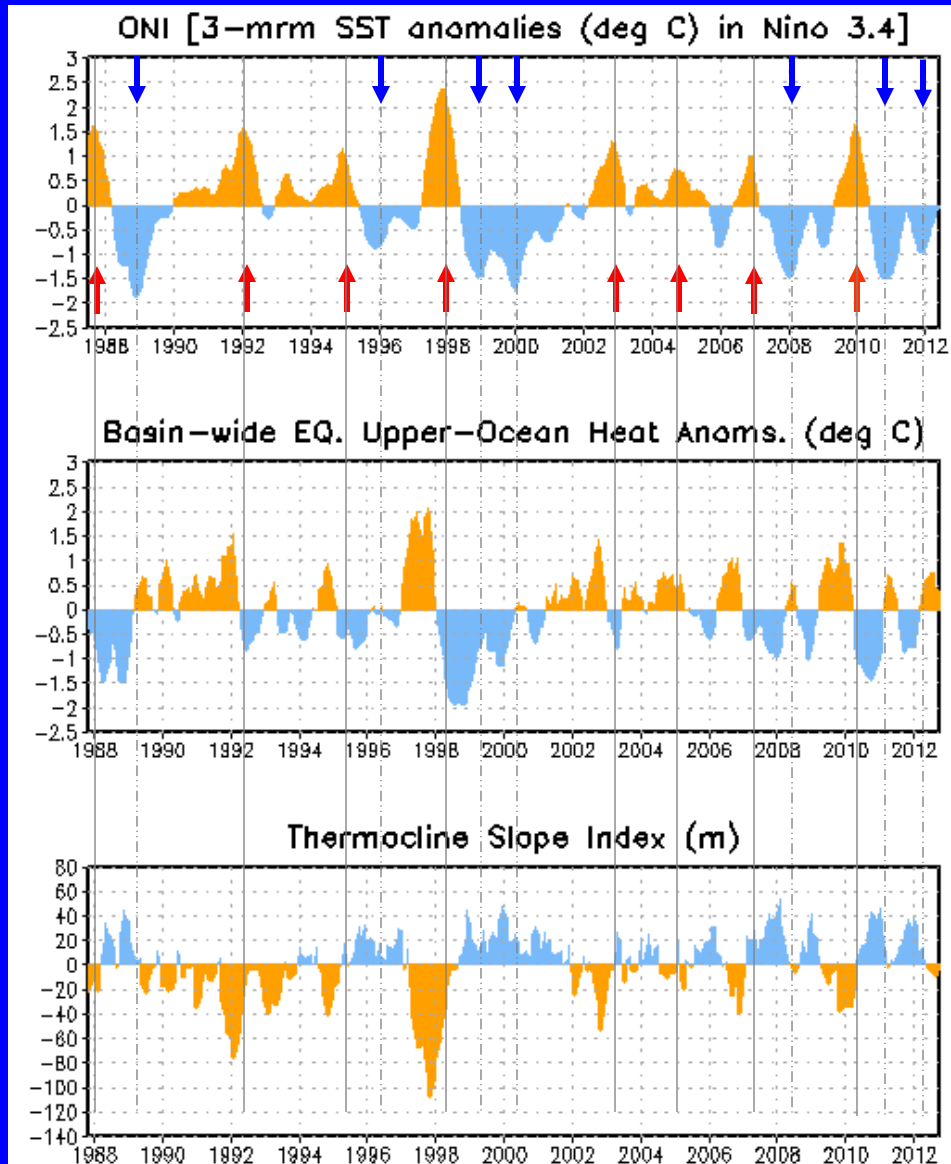
Change in Weekly SST Anoma (°C)  
31OCT2012 minus 03OCT2012







# Upper-Ocean Conditions in the Eq. Pacific



Cold Episodes ↓  
Warm Episodes ↑

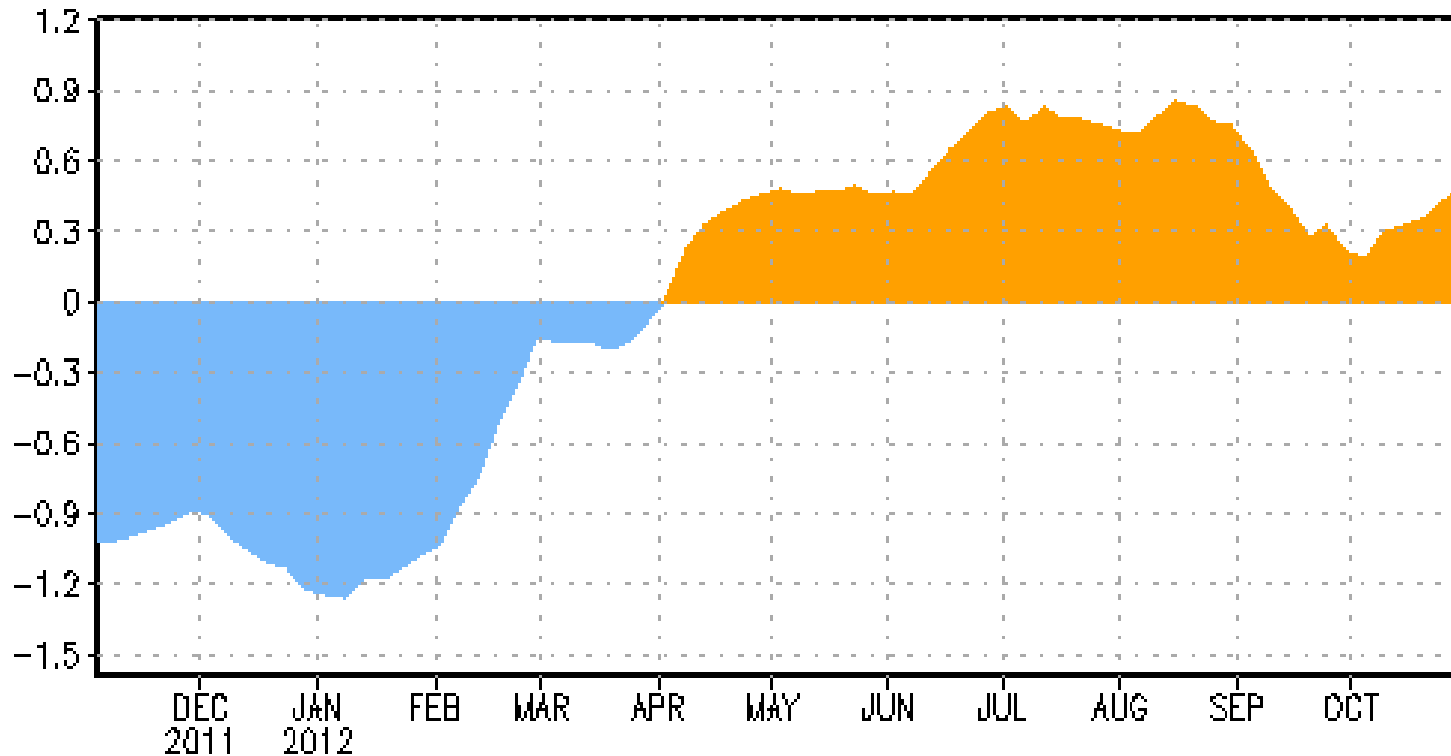
- The basin-wide equatorial upper ocean (0-300 m) heat content is **greatest** prior to and during the early stages of a Pacific **warm** (El Niño) episode (compare top 2 panels) and **least** prior to and during the early stages of a **cold** (La Niña) episode.
- The slope of the oceanic thermocline is least (greatest) during warm (cold) episodes.
- Recent values of the upper-ocean heat anomalies (positive) and a near zero thermocline slope index 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



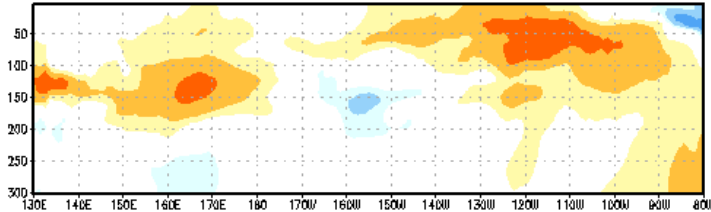
**Negative subsurface temperature anomalies from late July 2011 through March 2012 reflected La Niña. Since April 2012, the anomalies have been positive with increases during April and June. Positive subsurface anomalies weakened during September, but have strengthened slightly during October.**



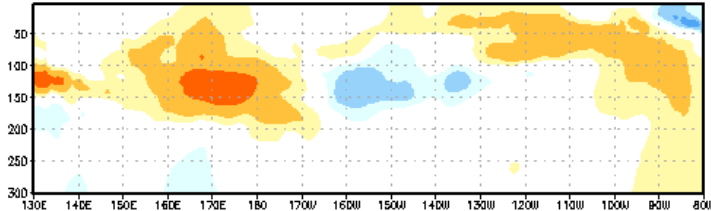
# Sub-Surface Temperature Departures (°C) in the Equatorial Pacific

EQ. Subsurface Temperature Anomalies (deg C)

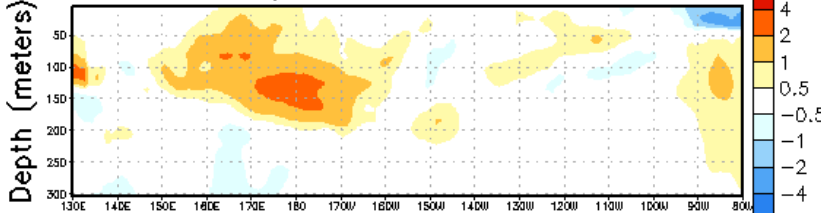
Three-pentad ave. centered on 10 SEP 2012



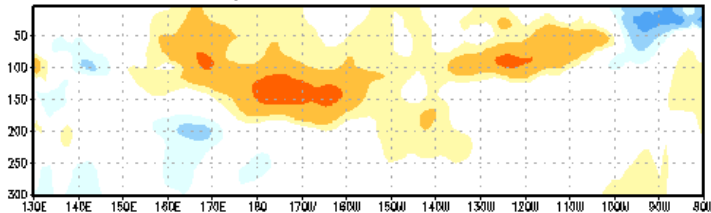
Three-pentad ave. centered on 25 SEP 2012



Three-pentad ave. centered on 10 OCT 2012



Three-pentad ave. centered on 25 OCT 2012



- During September and early October, positive subsurface temperature anomalies weakened across the equatorial Pacific.
- Since late October, positive subsurface temperature anomalies have increased east of the Date Line.

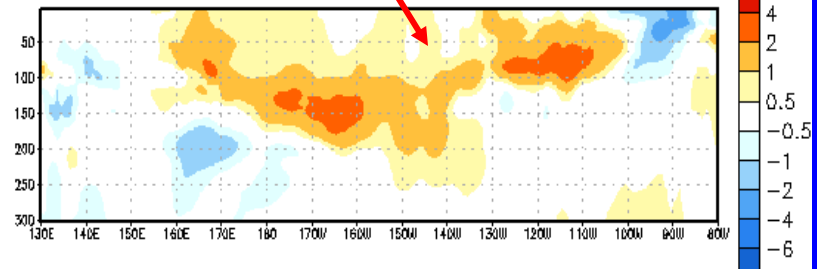
Time



Longitude

EQ. Subsurface Temperature Anomalies (deg C)

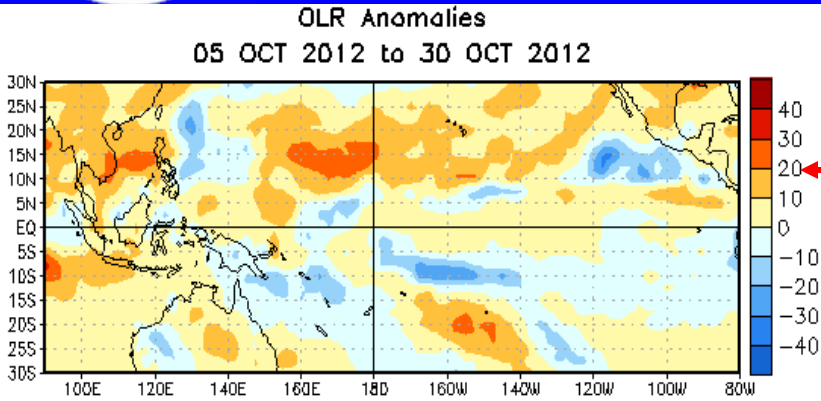
Pentad centered on 30 OCT 2012



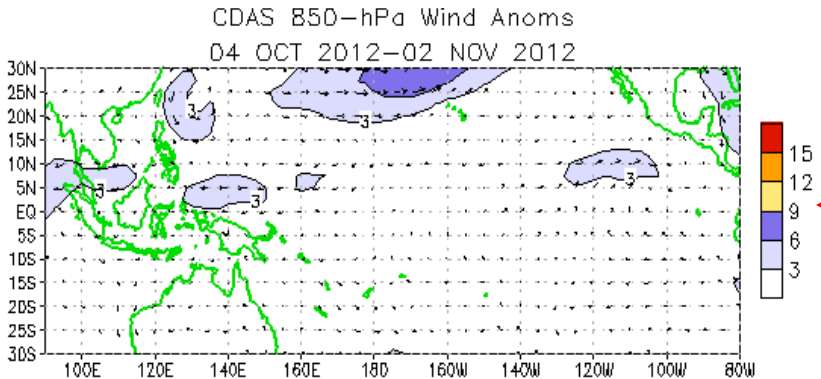
Most recent pentad analysis



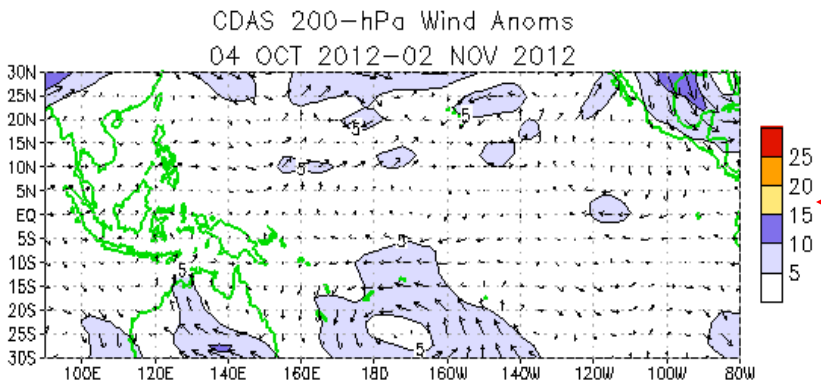
# Tropical OLR and Wind Anomalies During the Last 30 Days



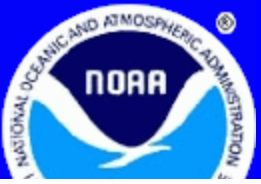
Negative OLR anomalies (enhanced convection and precipitation, blue shading) were observed southeast of Papua New Guinea and near the Date Line. Positive OLR anomalies (suppressed convection and precipitation, red shading) were apparent over Indonesia and Malaysia.



Low-level (850-hPa) winds were near average across the equatorial Pacific.

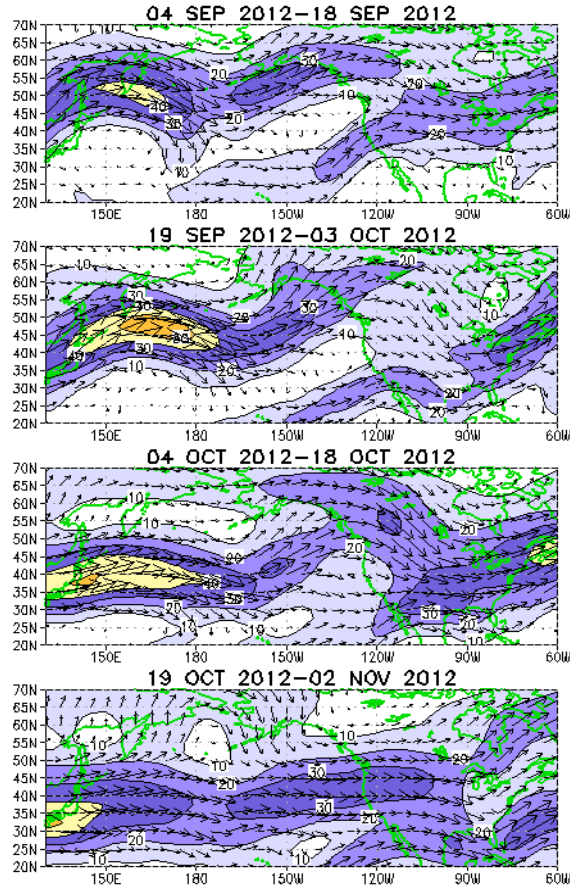


Upper-level (200-hPa) winds were near average across the equatorial Pacific.

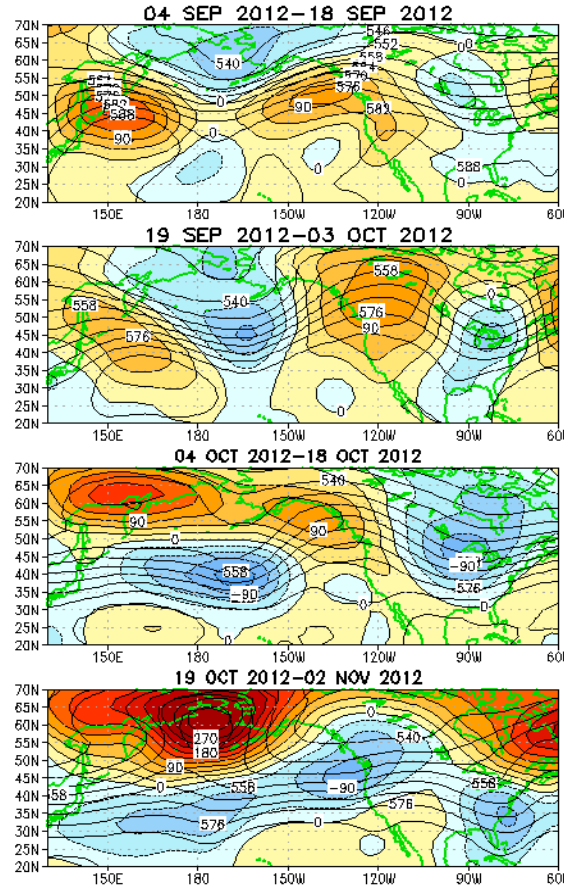


# Atmospheric Circulation over the North Pacific & North America During the Last 60 Days

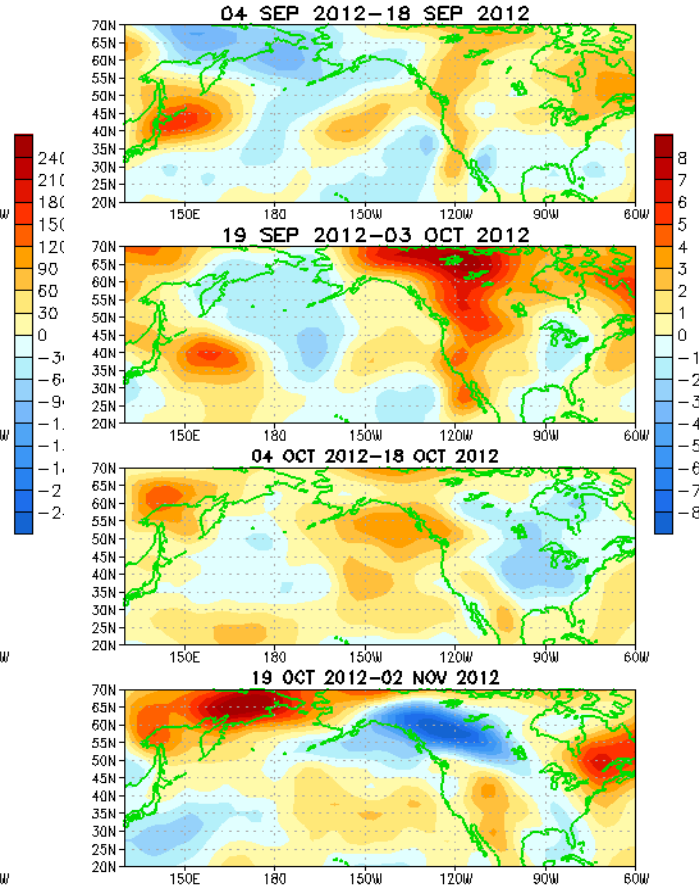
## 200-hPa Wind



## 500-hPa Height & Anoms.



## 925-hPa Temp. Anoms. (°C)



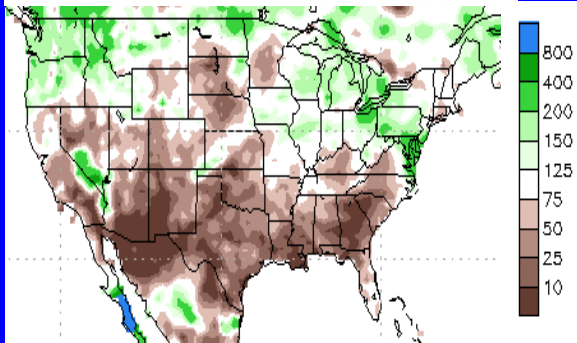
During September through October, below-average 500-hPa heights were evident across the eastern U.S., accompanied by near- or below-average surface temperatures in many areas of the central and eastern U.S. During this same period, above-average heights and temperatures were observed over the western U.S. Recently, below-average temperatures and heights were evident across much of the middle latitudes with above-average temperatures and heights at higher latitudes.



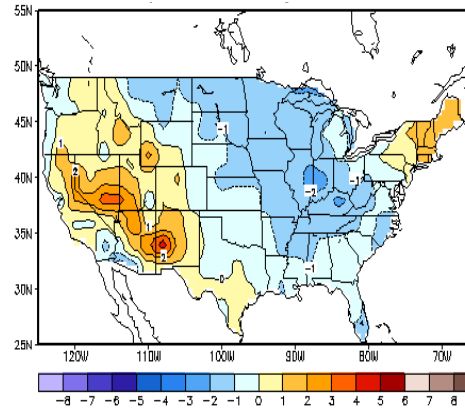
# U.S. Temperature and Precipitation Departures During the Last 30 and 90 Days

## Last 30 Days

30-day (ending 2 Nov 2012) % of average precipitation

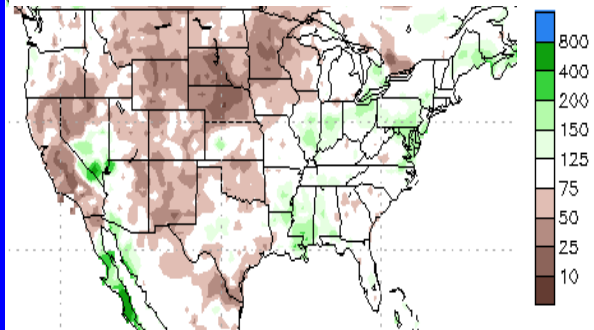


30-day (ending 3 Nov 2012)  
temperature departures (degree C)

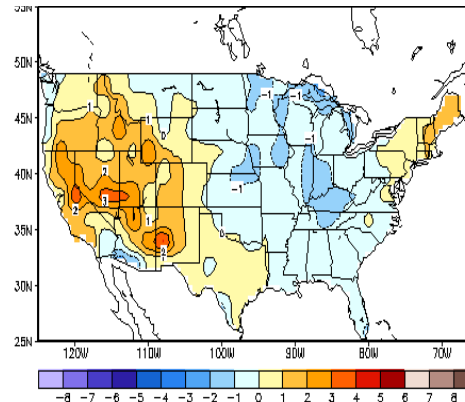


## Last 90 Days

90-day (ending 2 Nov 2012) % of average precipitation



90-day (ending 3 Nov 2012)  
temperature departures (degree C)



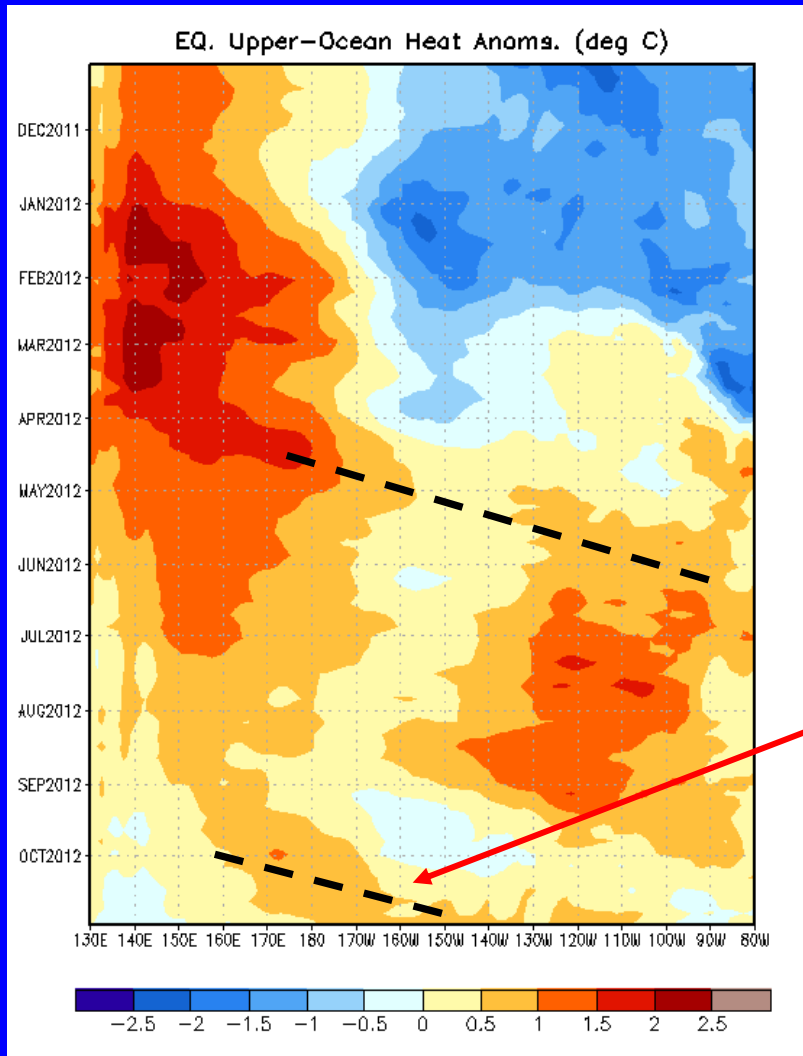


# Intraseasonal Variability

- **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



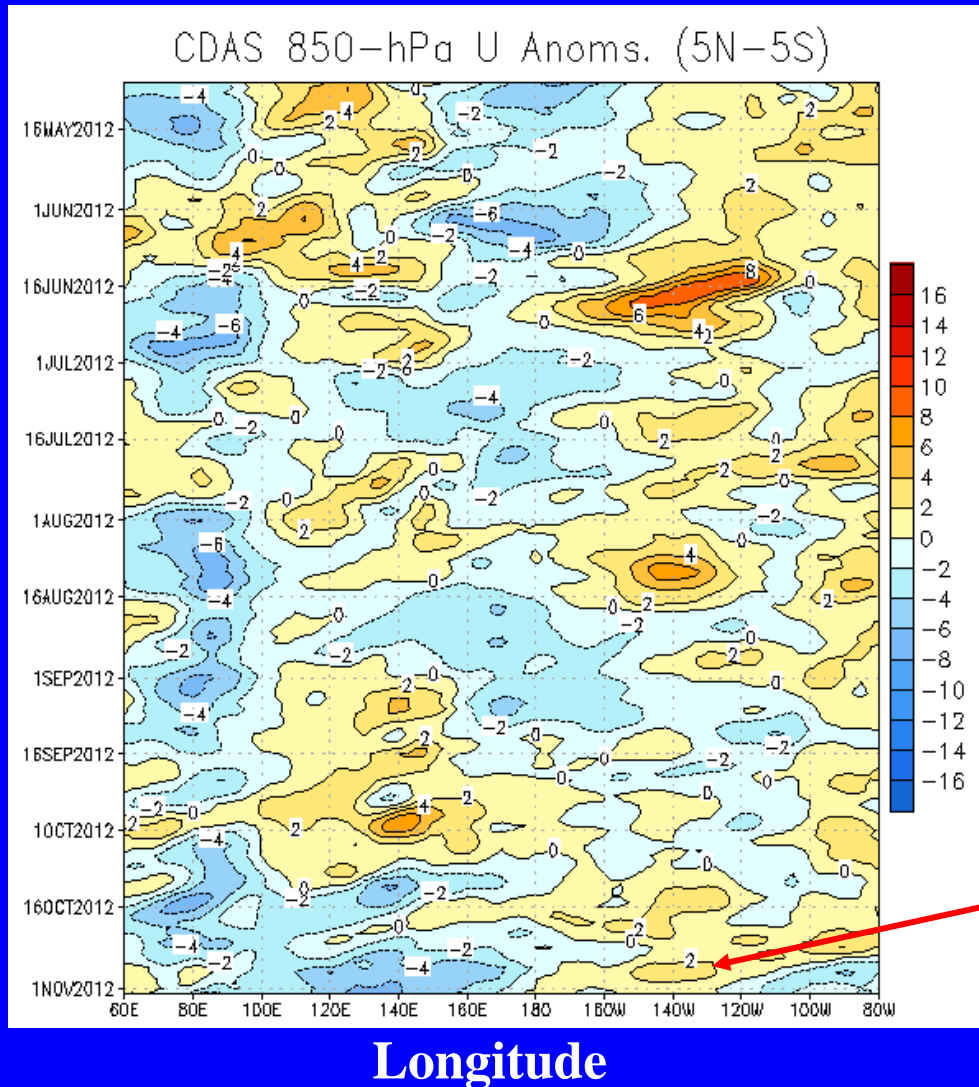
- From September 2011 – February 2012 heat content was below average in the central and eastern equatorial Pacific.
- From March- May 2012, heat content anomalies increased across much of the equatorial Pacific, partly in association with the downwelling phase of a Kelvin wave.
- Recently, heat content anomalies have increased east of the Date Line linked to the downwelling phase of a weak 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 ( $\text{m s}^{-1}$ )



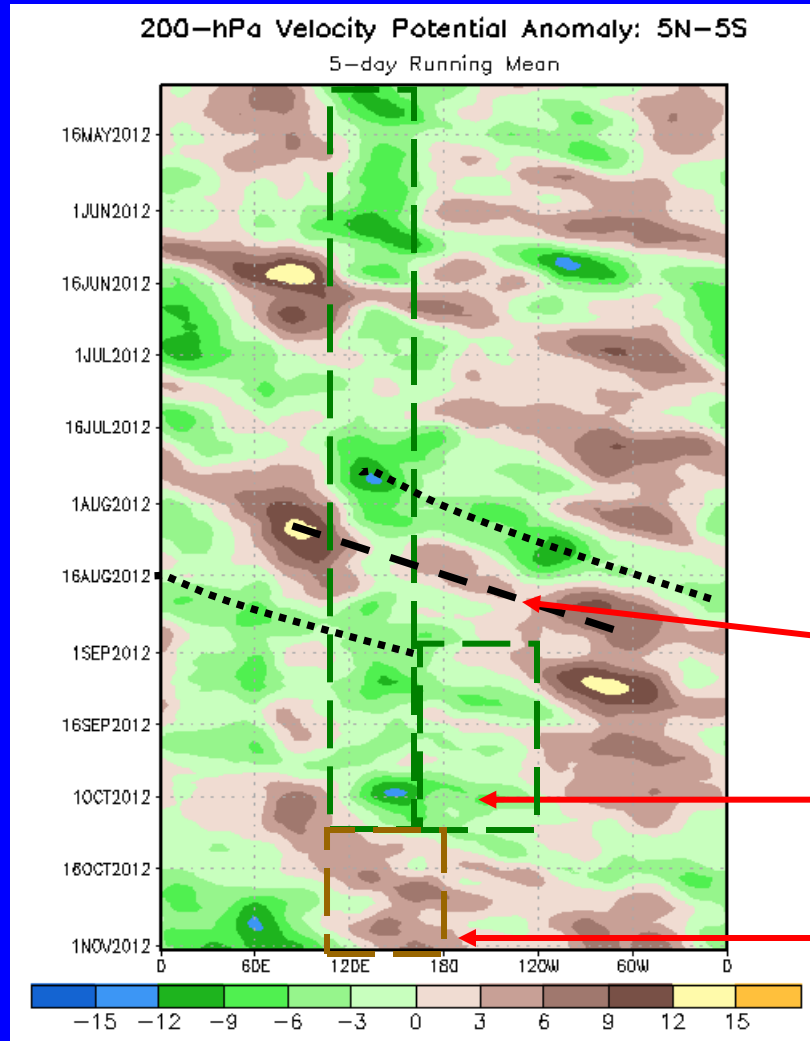
Westerly wind anomalies  
(orange/red shading).

Easterly wind anomalies (blue  
shading).

Recently, westerly wind anomalies  
have persisted in the east-central  
Pacific, while easterly anomalies are  
evident across the rest of the 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.

Through the period, a quasi-persistent pattern of upper-level divergence (green) generally prevailed over the Maritime Continent.

The MJO was active during late July through August 2012.

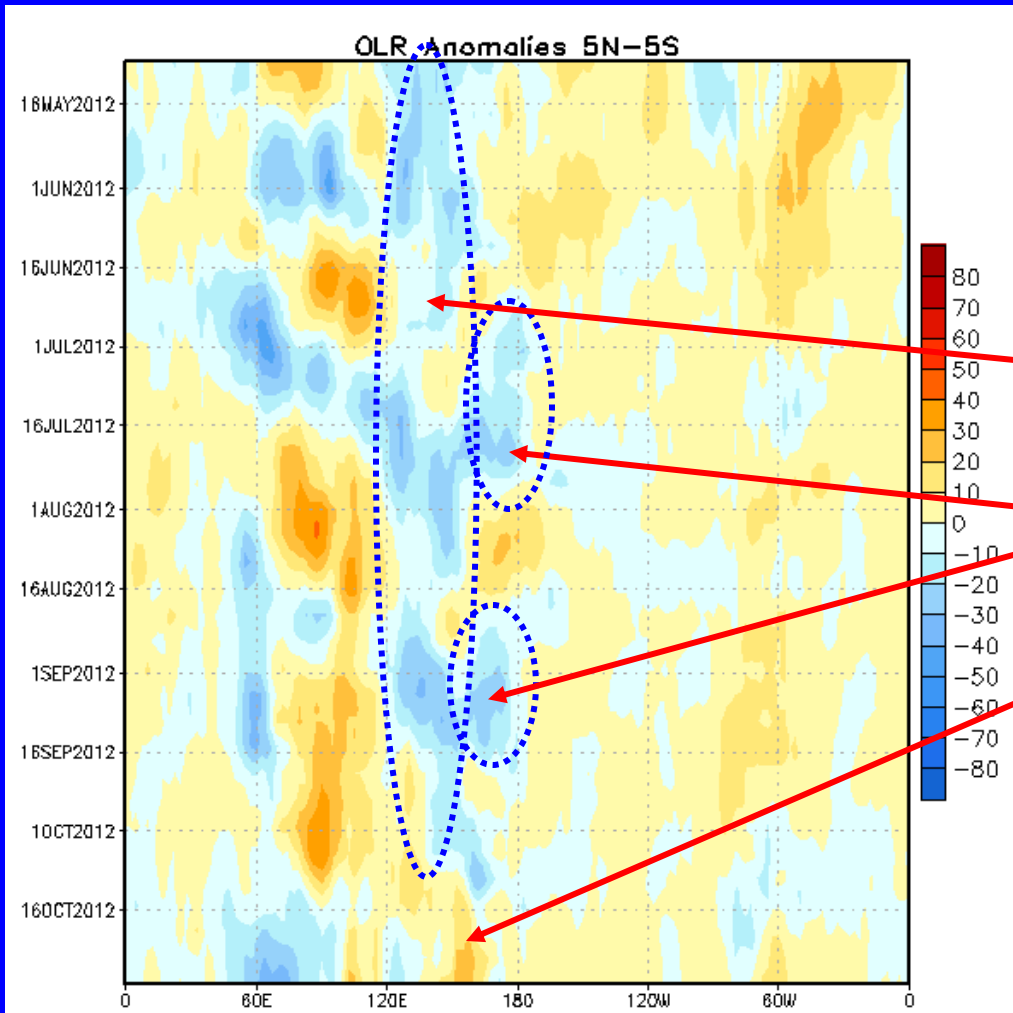
During September and early October, upper-level divergence (green) expanded eastward to near the Date Line.

During mid October, upper-level convergence (brown) persisted west of the Date Line.



# Outgoing Longwave Radiation (OLR) Anomalies

Time



Longitude

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

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

**From mid-April to mid-October 2012,  
negative OLR anomalies have been  
observed near the eastern Maritime  
Continent.**

**During July and late August/mid  
September, negative OLR anomalies  
were observed near the Date Line.**

**Recently, positive OLR anomalies are  
evident west of 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  $+0.5^{\circ}$  C.

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

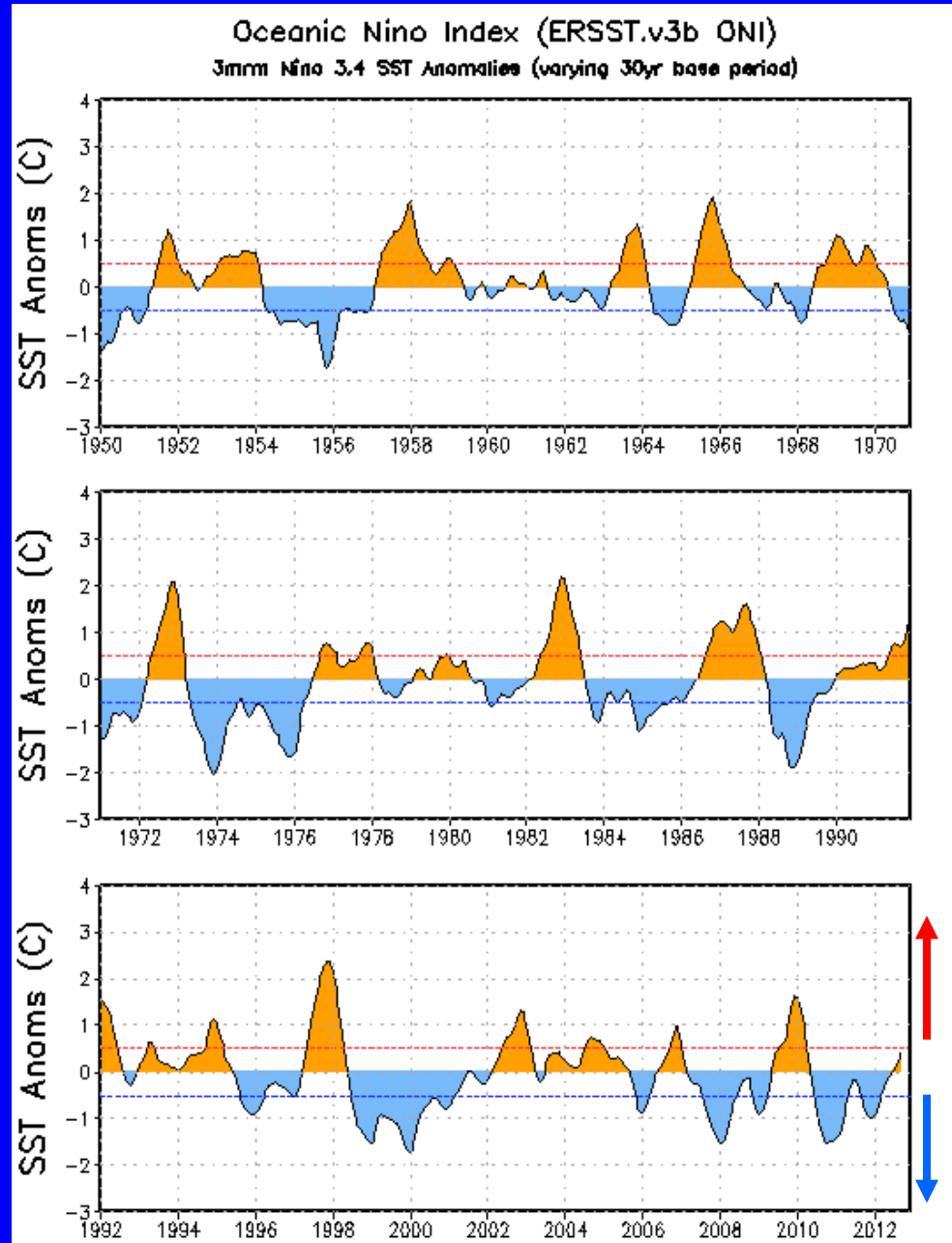
By historical standards, to be classified as a full-fledged El Niño or La Niña episode, these thresholds must be exceeded for a period of at least 5 consecutive overlapping 3-month seasons.

*CPC considers El Niño or La Niña conditions to occur when the monthly Niño3.4 OISST departures meet or exceed  $\pm 0.5^{\circ}$  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 (August – October 2012) is 0.4°C.



El Niño  
neutral  
La Niña



# 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	JJA 2010 – MAM 2011	-1.5
AMJ 2002 – JFM 2003	1.3	ASO 2011 – FMA 2012	-1.0
JJA 2004 – DJF 2004/05	0.7		
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](#)



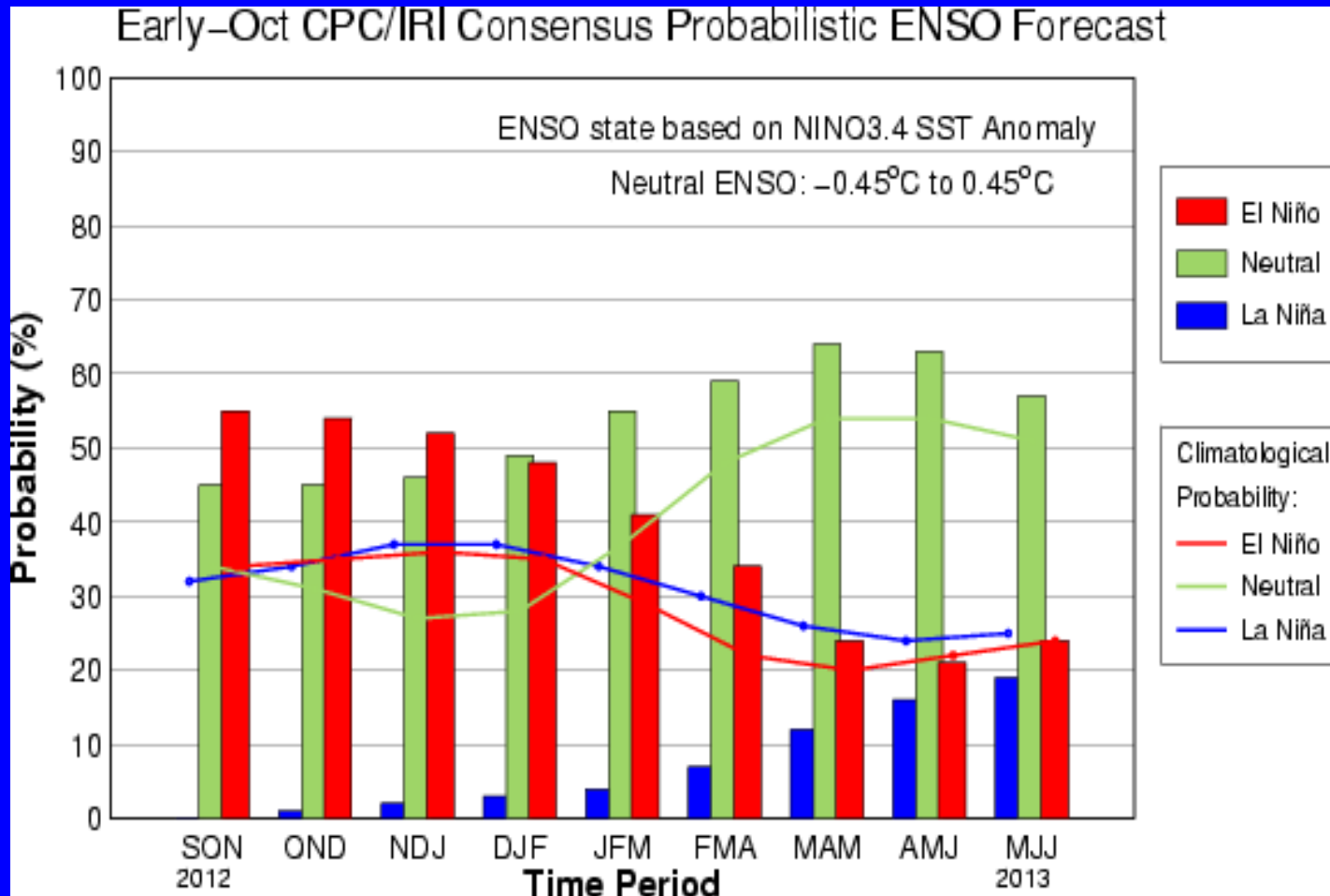




# CPC/IRI Probabilistic ENSO Outlook

(updated 4 Oct 2012)

**El Niño is favored beginning in September-November (SON) 2012 and persisting through November-January (NDJ) 2012-13.**





# Pacific Niño 3.4 SST Outlook

- Most models predict either persistence or a gradual weakening of current Niño-3.4 values, with most models predicting ENSO-neutral continuing into the N. Hemisphere summer 2013.
- The average dynamical model forecast is warmer than the statistical model mean.

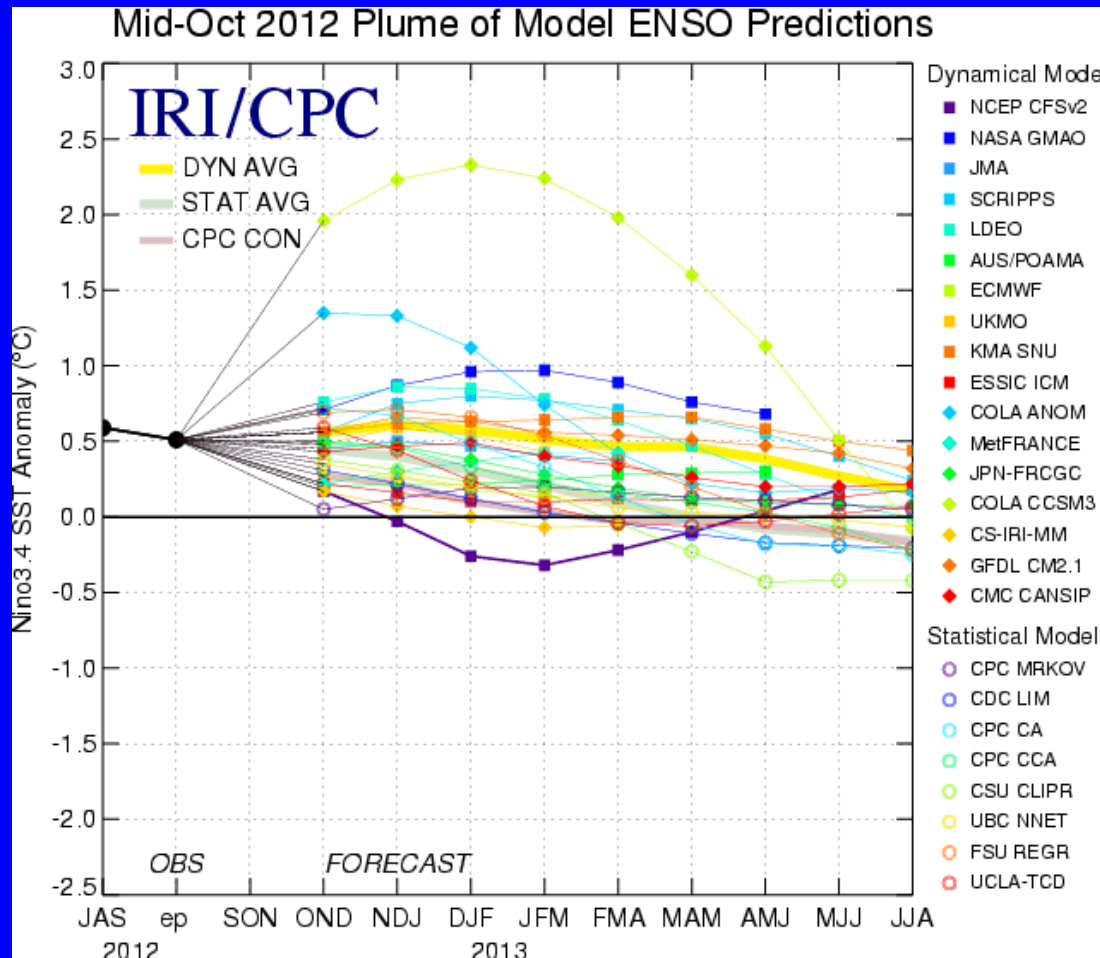


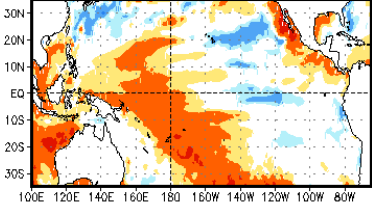
Figure provided by the International Research Institute (IRI) for Climate and Society (updated 15 Oct 2012).



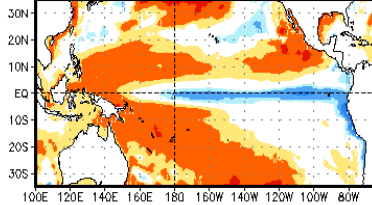
# SST Outlook: NCEP CFS.v2 Forecast

## Issued 4 November 2012

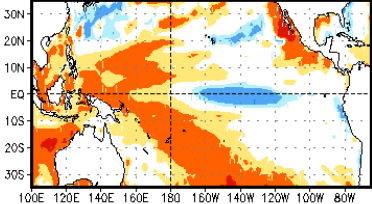
Nov-Dec-Jan 2012/2013



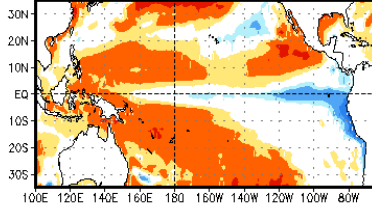
Mar-Apr-May 2013



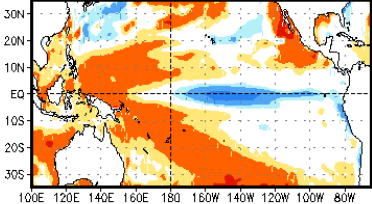
Dec-Jan-Feb 2012/2013



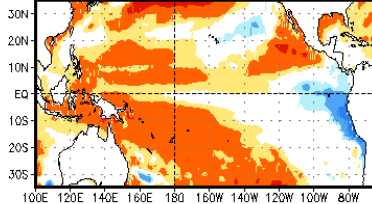
Apr-May-Jun 2013



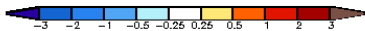
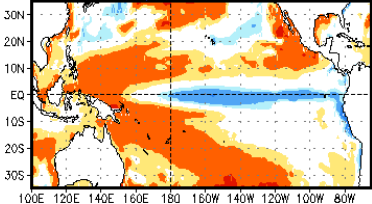
Jan-Feb-Mar 2013



May-Jun-Jul 2013



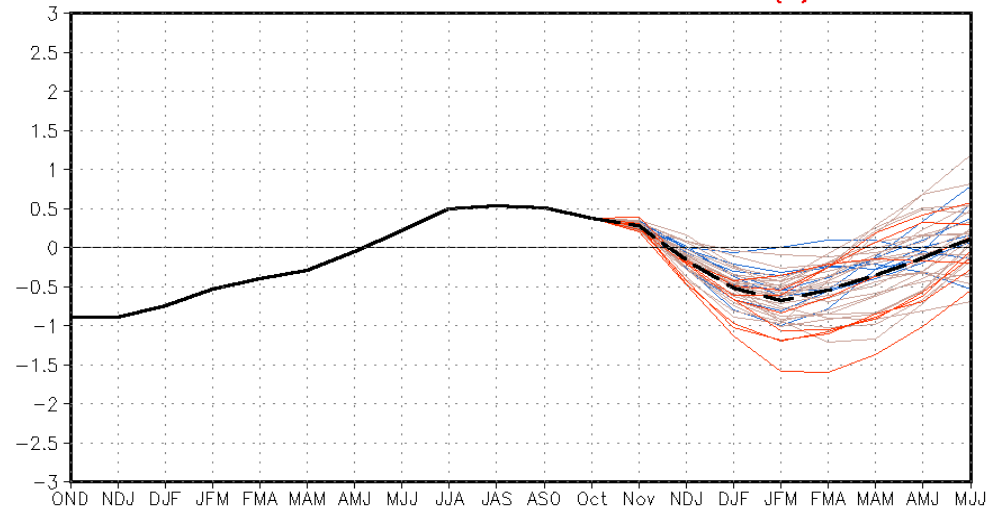
Feb-Mar-Apr 2013



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

The CFS.v2 ensemble mean (black dashed line) predicts below-average SSTs during N. Hemisphere winter 2012-13.

CFSv2 forecast Nino3.4 SST anomalies (K)



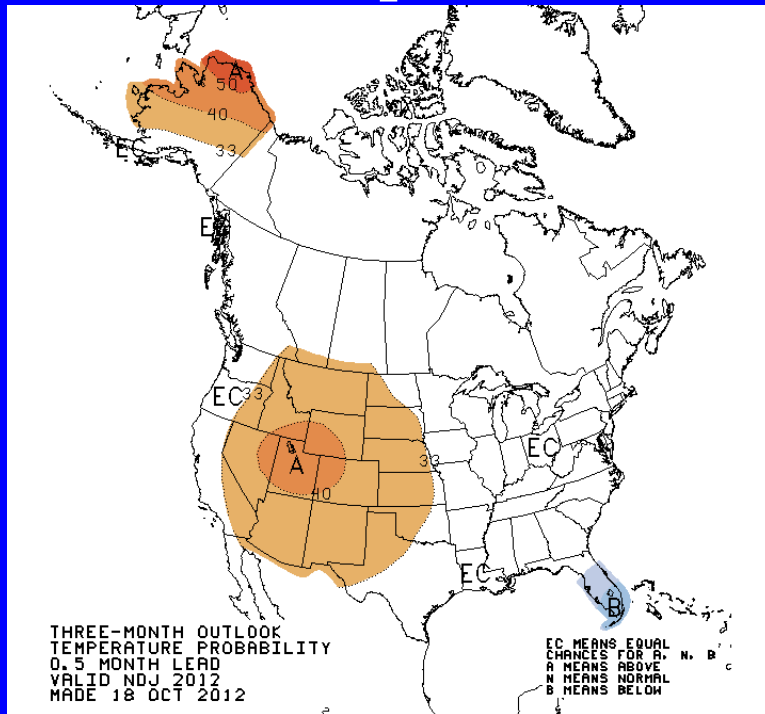
CFS.v1 has been discontinued.



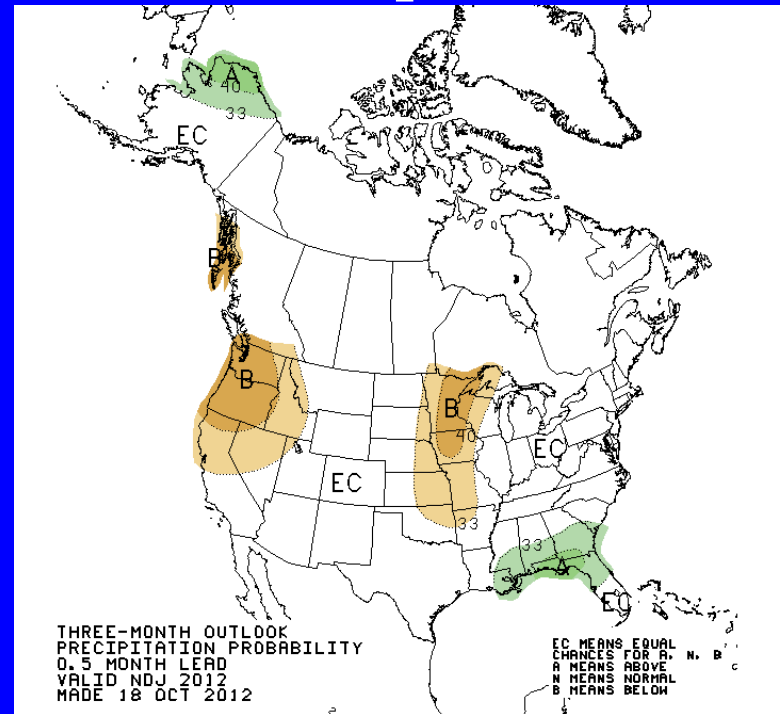
# U. S. Seasonal Outlooks

## November 2012– January 2013

### Temperature



### Precipitation



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



# Summary

## ENSO Alert System Status: El Niño Watch\*

- **ENSO-neutral conditions continue.\***
- **Equatorial sea surface temperatures (SST) remain above average across the western and central Pacific Ocean.**
- **The atmospheric circulation over the tropical Pacific is near average.**
- **Borderline ENSO-neutral/ weak El Niño conditions are expected to continue into Northern Hemisphere winter 2012-13, possibly strengthening during the next few months.\***

\* 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)