



ENSO Cycle: Recent Evolution, Current Status and Predictions

**Update prepared by
Climate Prediction Center / NCEP
3 December 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: Not Active

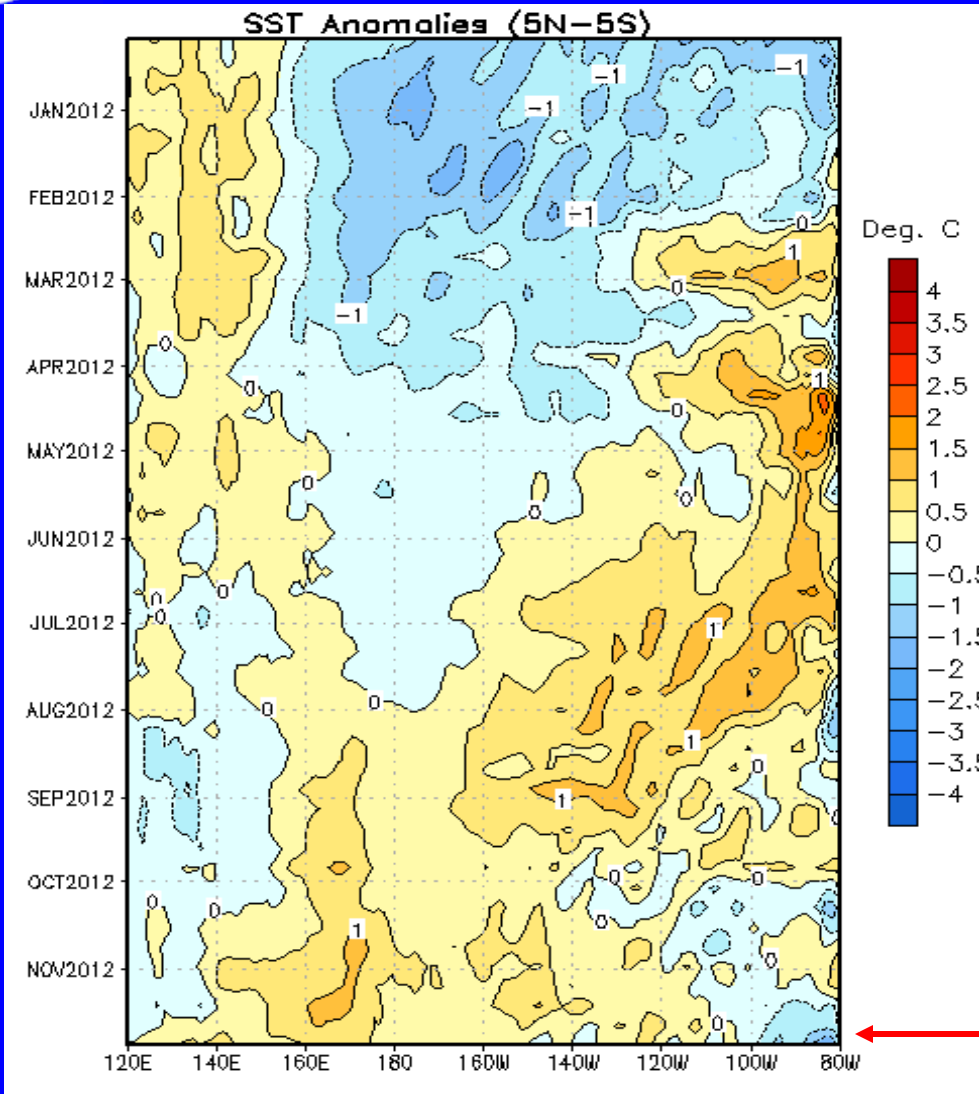
- **ENSO-neutral conditions continue.***
- **Equatorial sea surface temperatures (SST) remain above average across much of the Pacific Ocean.**
- **The atmospheric circulation over the tropical Pacific is near average.**
- **ENSO-neutral is favored through the Northern Hemisphere winter 2012-13.***

* 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

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

Recently, above-average SSTs have persisted across much of the tropical Pacific, with below-average SSTs in the far eastern Pacific.



Niño Region SST Departures (°C) Recent Evolution

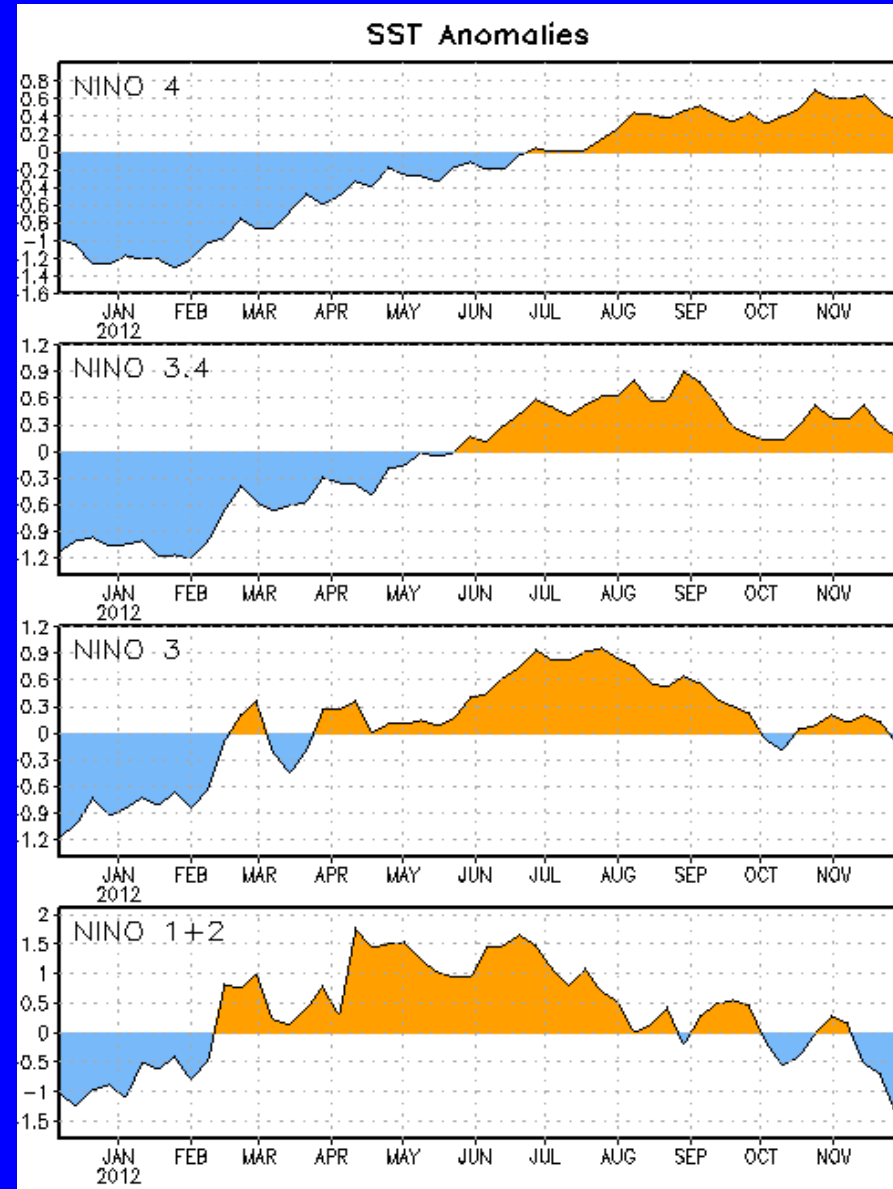
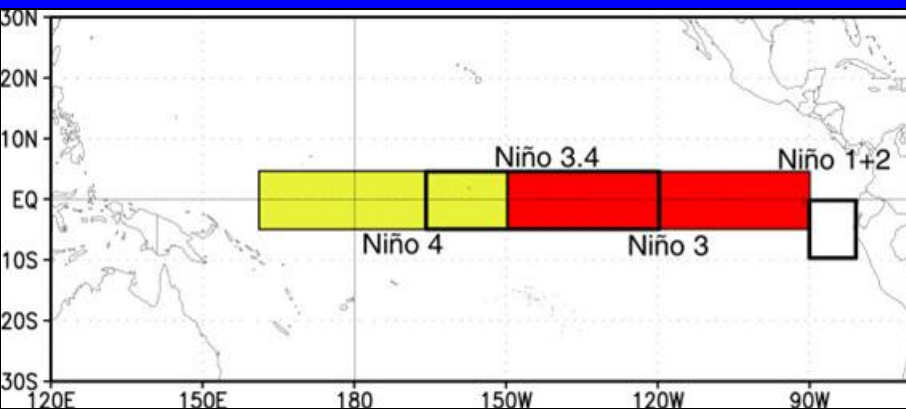
The latest weekly SST departures are:

Niño 4 **0.4°C**

Niño 3.4 **0.2°C**

Niño 3 **-0.1°C**

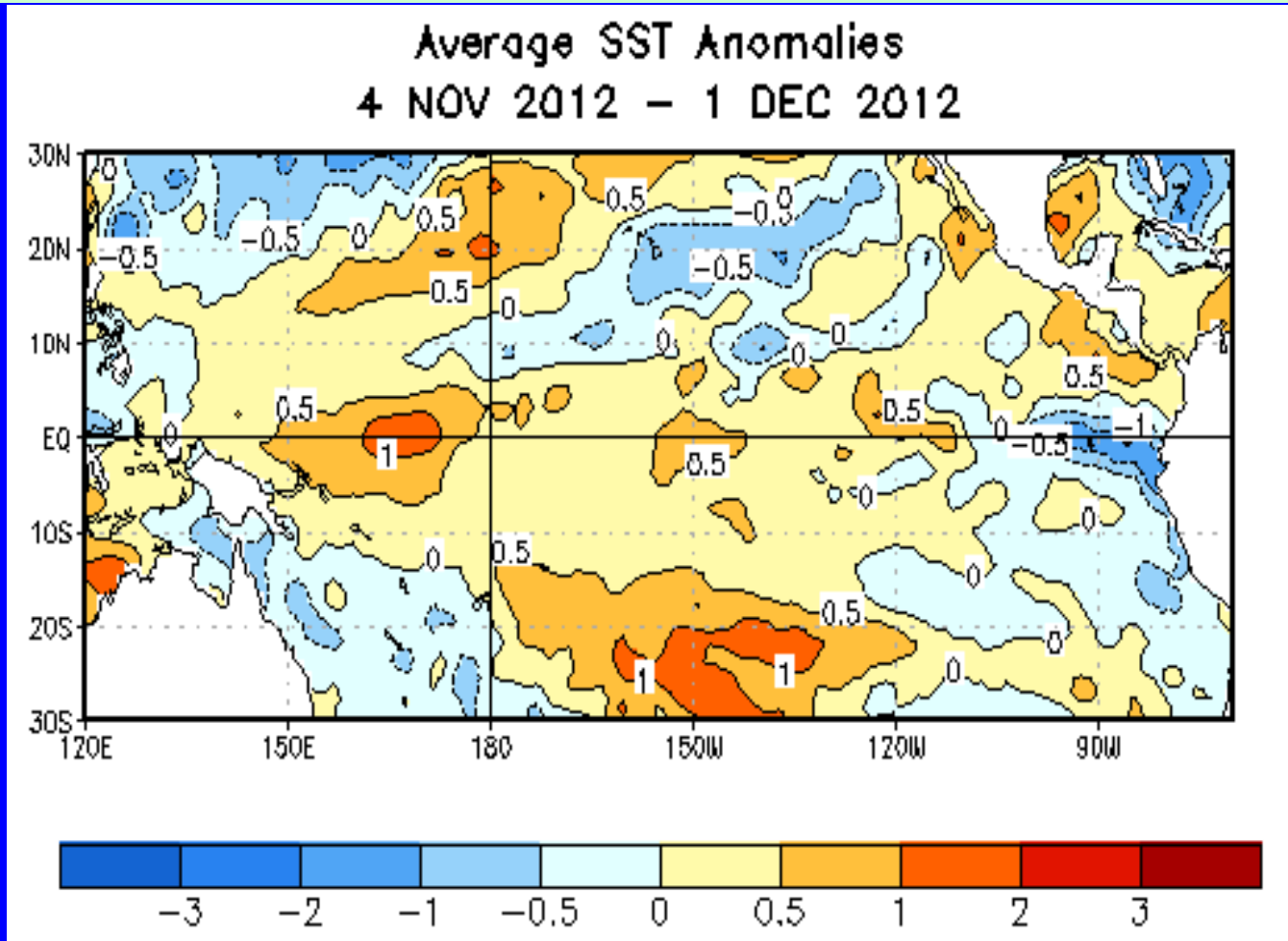
Niño 1+2 **-1.4°C**





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

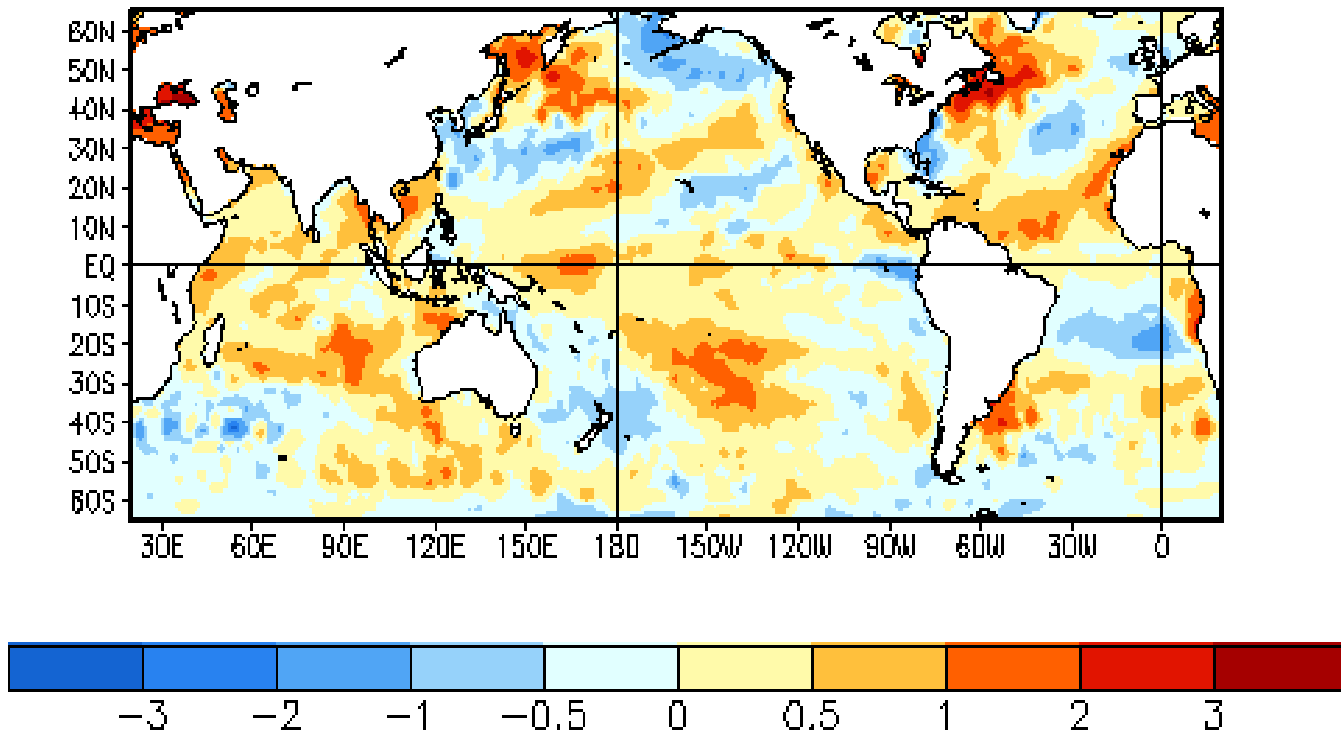
During the last 4-weeks, equatorial SST anomalies were $+0.5^{\circ}\text{C}$ or above between 150°E and 180° . SSTs were more than 0.5°C below average in the eastern Pacific.





Global SST Departures (°C)

Average SST Anomalies
4 NOV 2012 – 1 DEC 2012

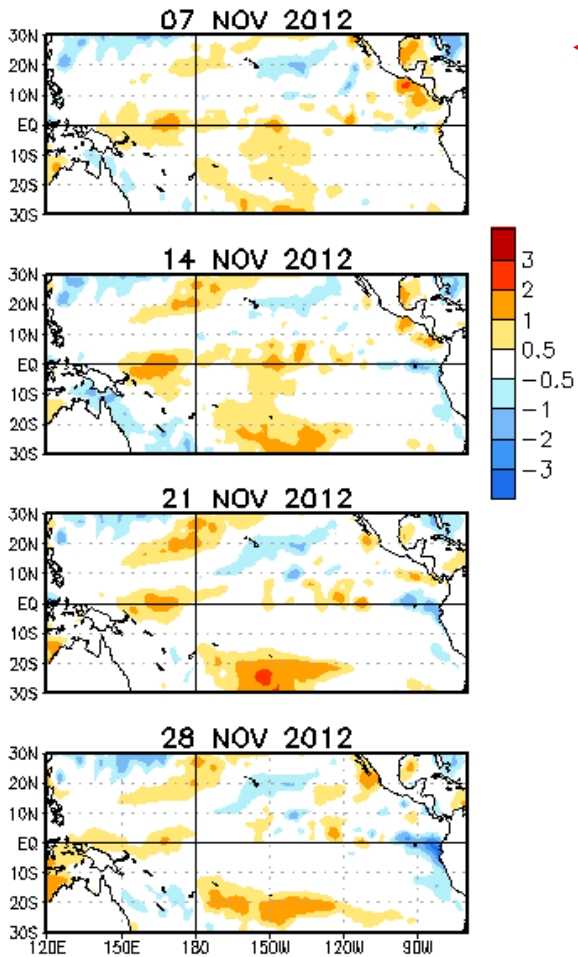


During the last four weeks, equatorial SSTs were above average across most of the Pacific Ocean and the Indian Ocean.



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

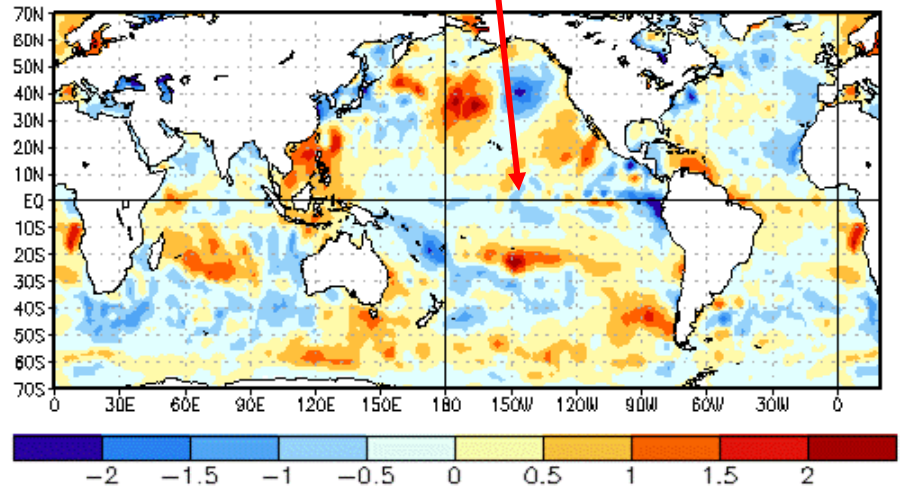
Weekly SST Anomalies (DEG C)



- During the last 30 days, positive SST anomalies have weakened in the east-central Pacific, while negative SST anomalies have strengthened in the eastern Pacific.

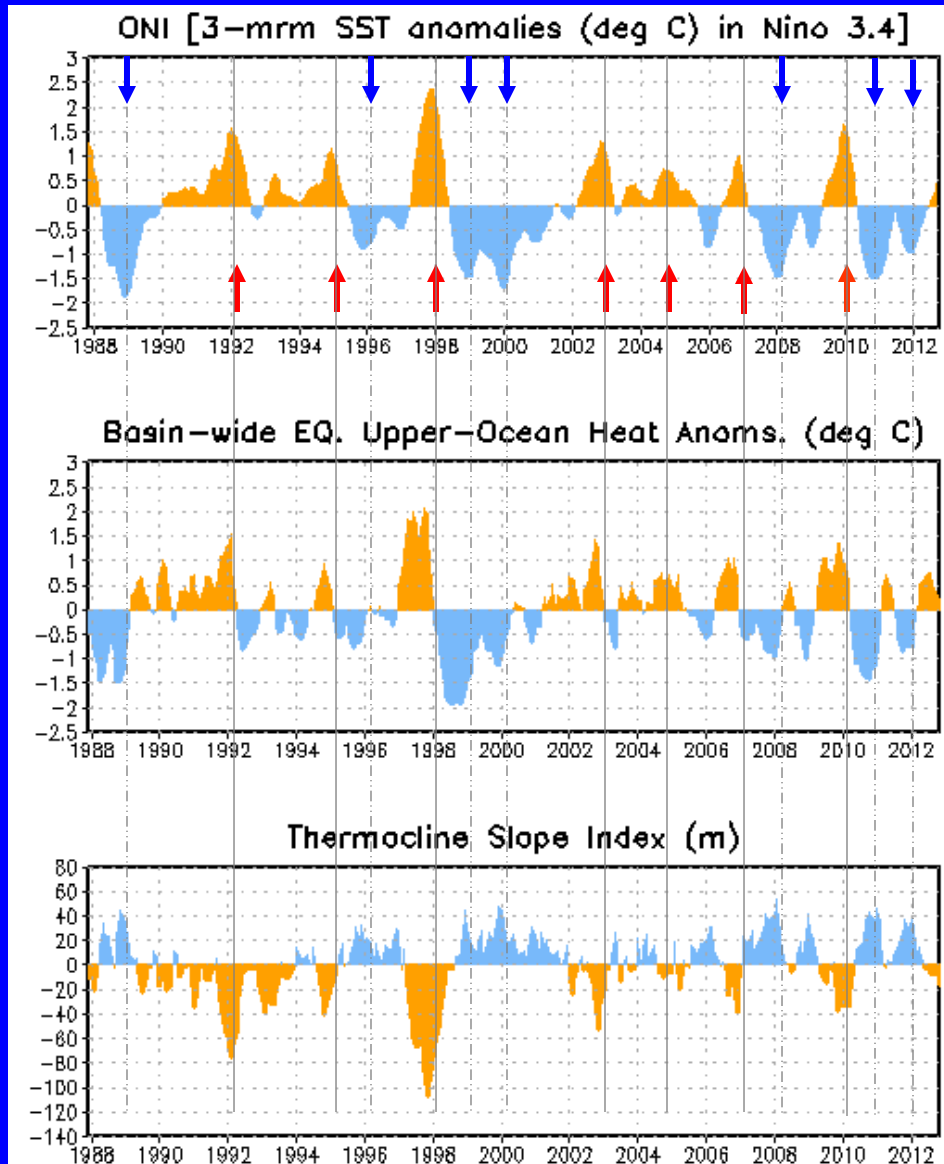
- The change in SSTs is negative over much of the equatorial Pacific

Change in Weekly SST Anoma (°C)
28NOV2012 minus 31OCT2012





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.

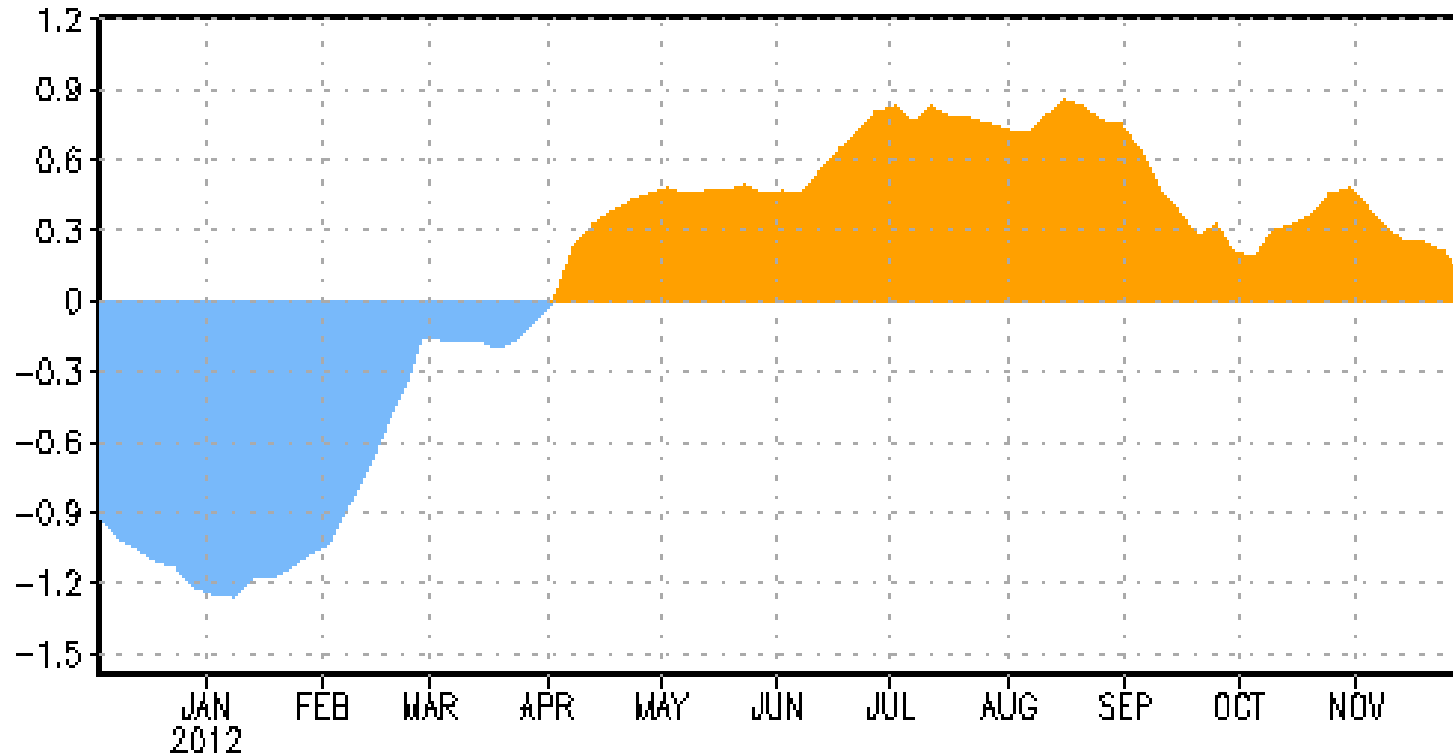
- Recent values of the upper-ocean heat anomalies (positive) and a near zero thermocline slope index reflect ENSO neutral conditions.

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



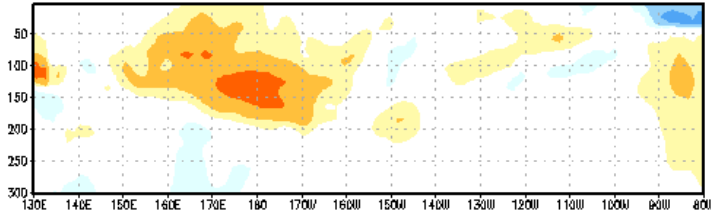
Since April 2012, the anomalies have been positive with increases during April and June. Positive subsurface anomalies weakened during September, strengthened slightly during October, and have gradually weakened during November.



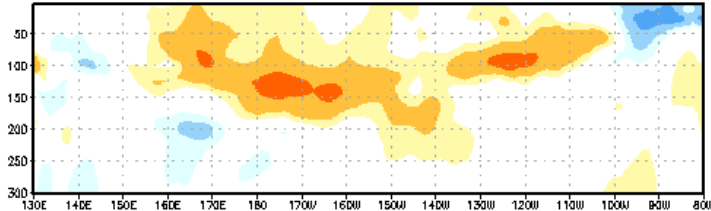
Sub-Surface Temperature Departures (°C) in the Equatorial Pacific

EQ. Subsurface Temperature Anomalies (deg C)

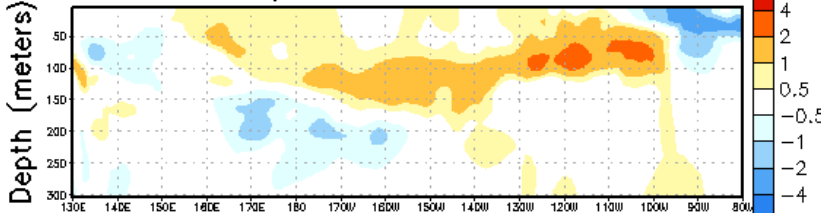
Three-pentad ave. centered on 10 OCT 2012



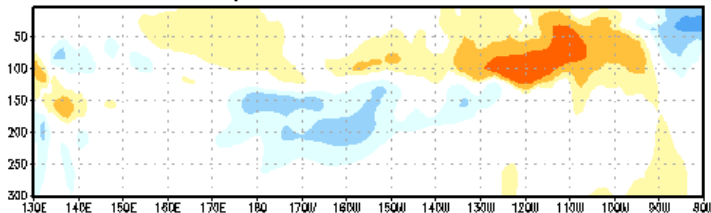
Three-pentad ave. centered on 25 OCT 2012



Three-pentad ave. centered on 09 NOV 2012



Three-pentad ave. centered on 24 NOV 2012



- In the last two months, positive subsurface temperature anomalies shifted eastward across the equatorial Pacific.
- Recently, negative subsurface temperature anomalies have expanded eastward, but remain at depth.

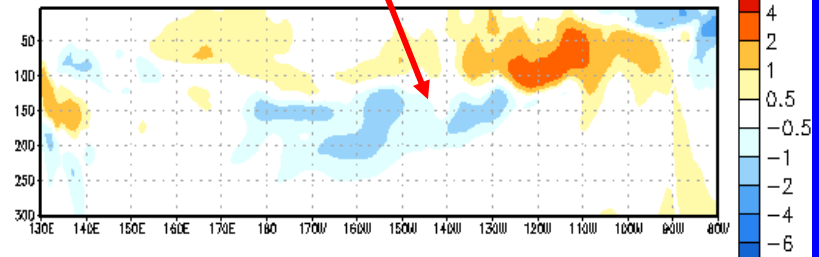
Time



Longitude

EQ. Subsurface Temperature Anomalies (deg C)

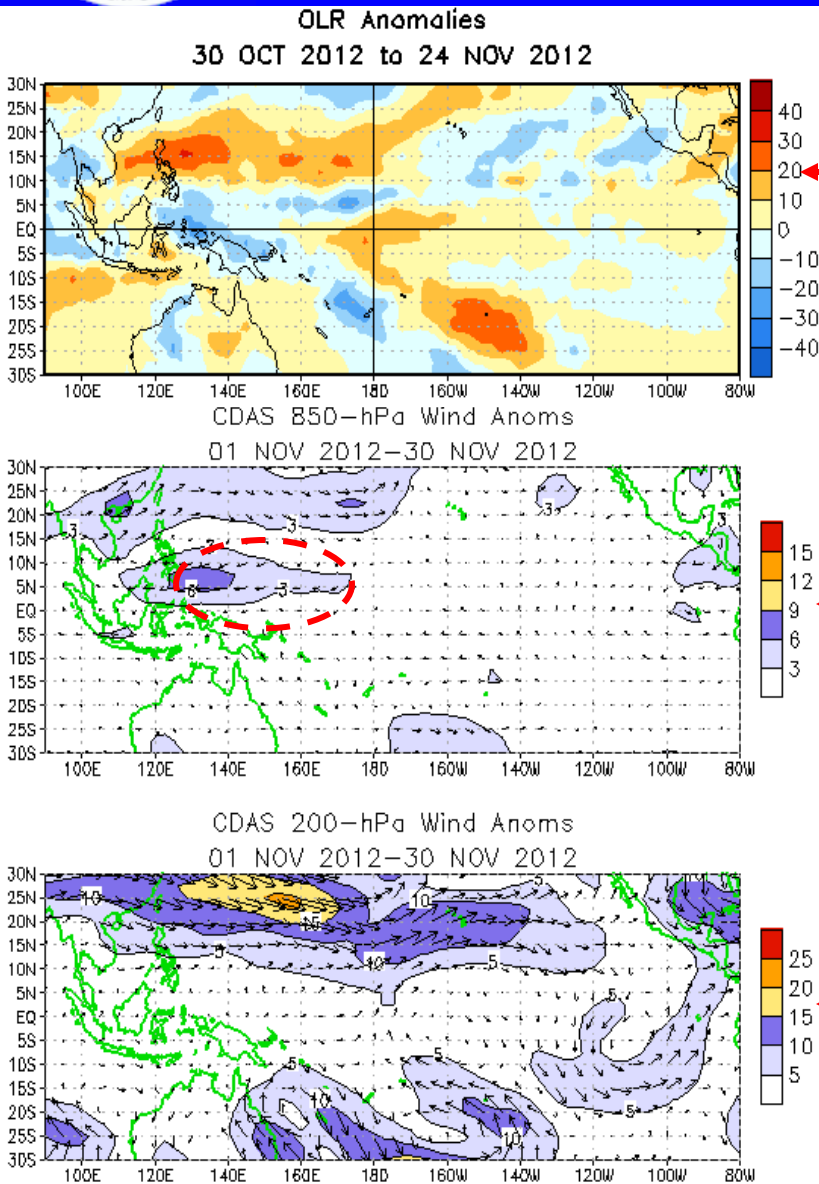
Pentad centered on 29 NOV 2012



Most recent pentad analysis



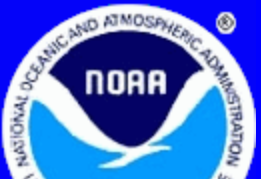
Tropical OLR and Wind Anomalies During the Last 30 Days



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

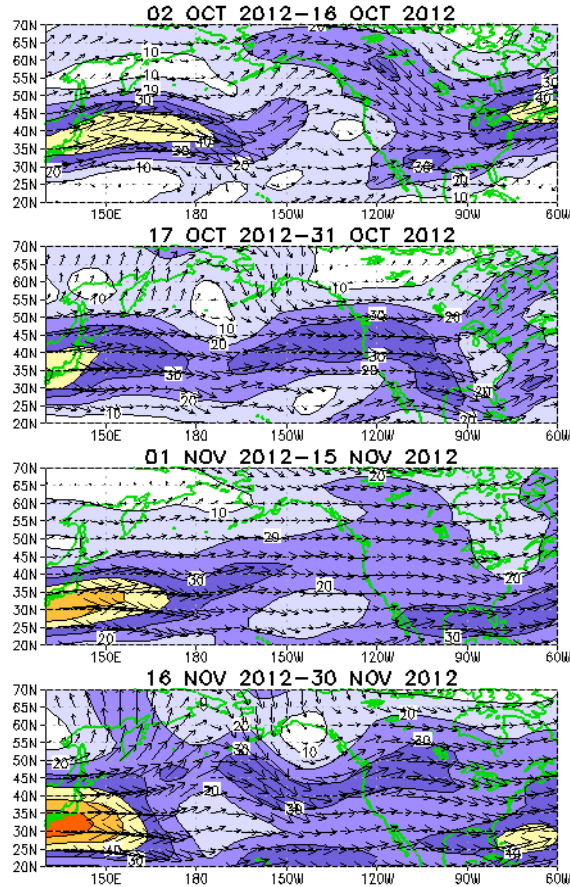
Anomalous low-level (850-hPa) easterly winds were evident across the western Pacific Ocean, but are focused north of the equator. Over the rest of the Pacific, winds are near average.

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

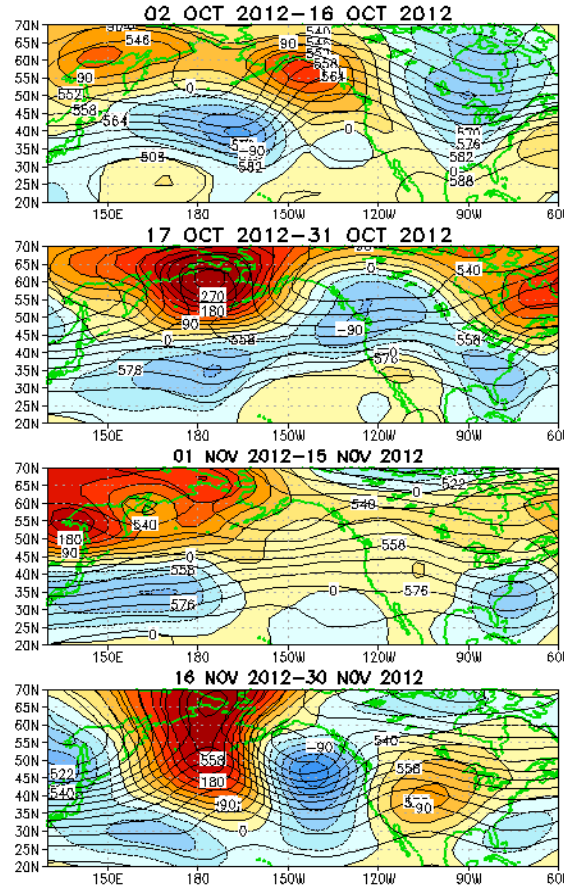


Atmospheric Circulation over the North Pacific & North America During the Last 60 Days

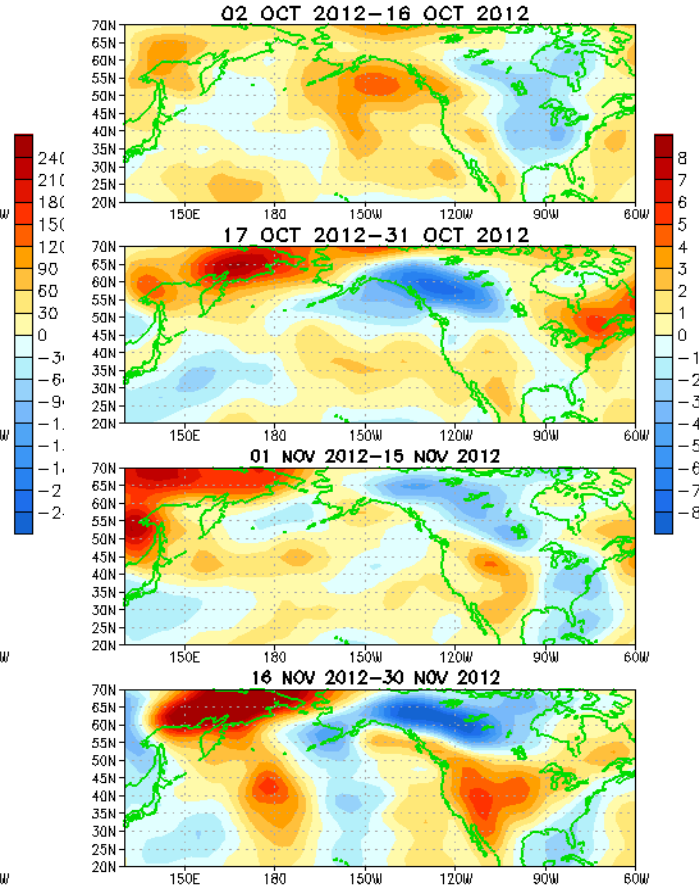
200-hPa Wind



500-hPa Height & Anoms.



925-hPa Temp. Anoms. (°C)



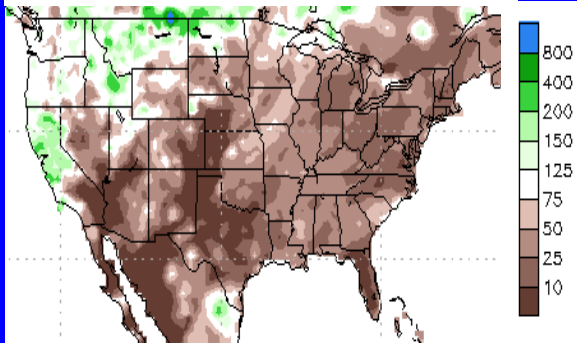
During October through mid November, below-average 500-hPa heights were evident across the eastern U.S., accompanied by near- or below-average surface temperatures in many areas of the central and eastern U.S. During this same period, above-average heights and temperatures were observed over the western U.S. After mid-November, above-average heights and temperatures expanded eastward over the U.S., except for the far southeastern states.



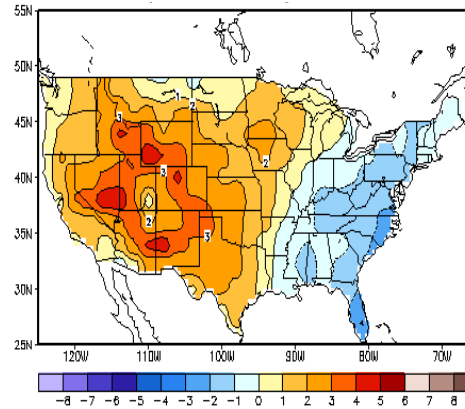
U.S. Temperature and Precipitation Departures During the Last 30 and 90 Days

Last 30 Days

30-day (ending 1 Dec 2012) % of average precipitation

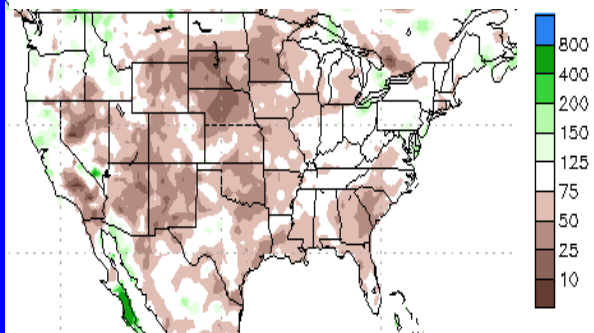


30-day (ending 1 Dec 2012)
temperature departures (degree C)

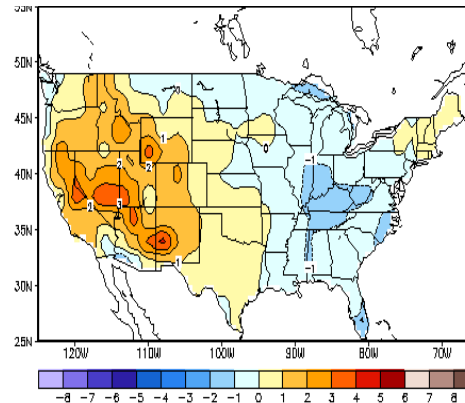


Last 90 Days

90-day (ending 1 Dec 2012) % of average precipitation



90-day (ending 1 Dec 2012)
temperature departures (degree C)



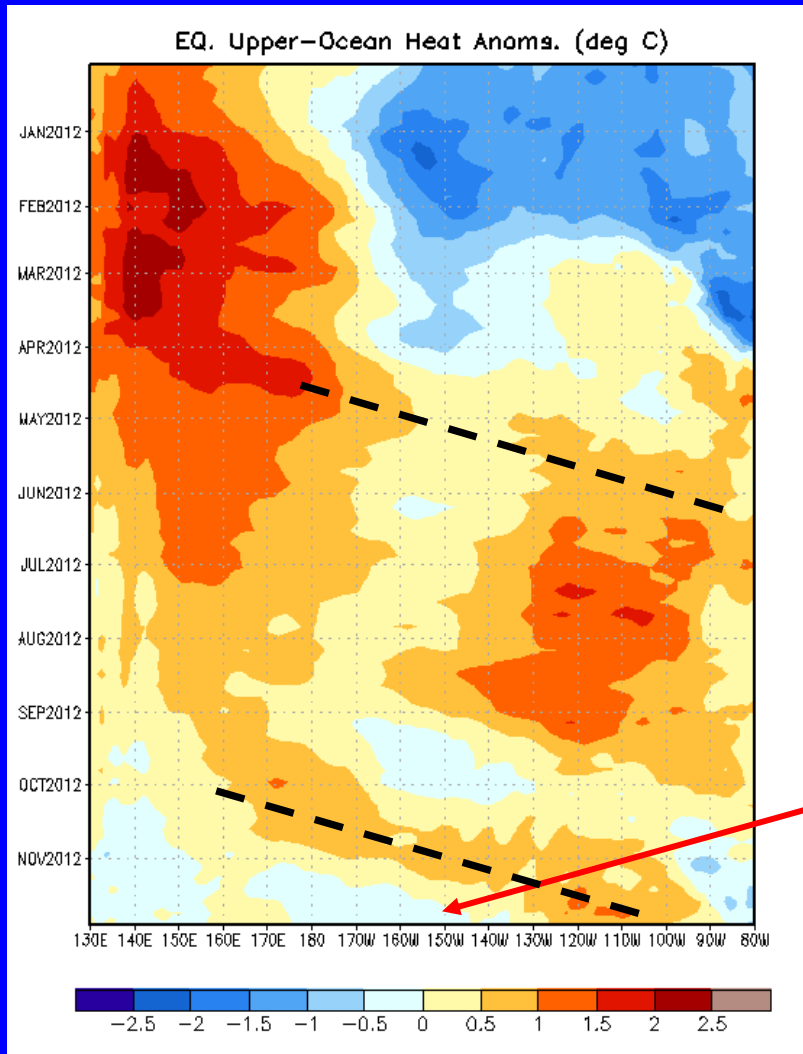


Intraseasonal Variability

- **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

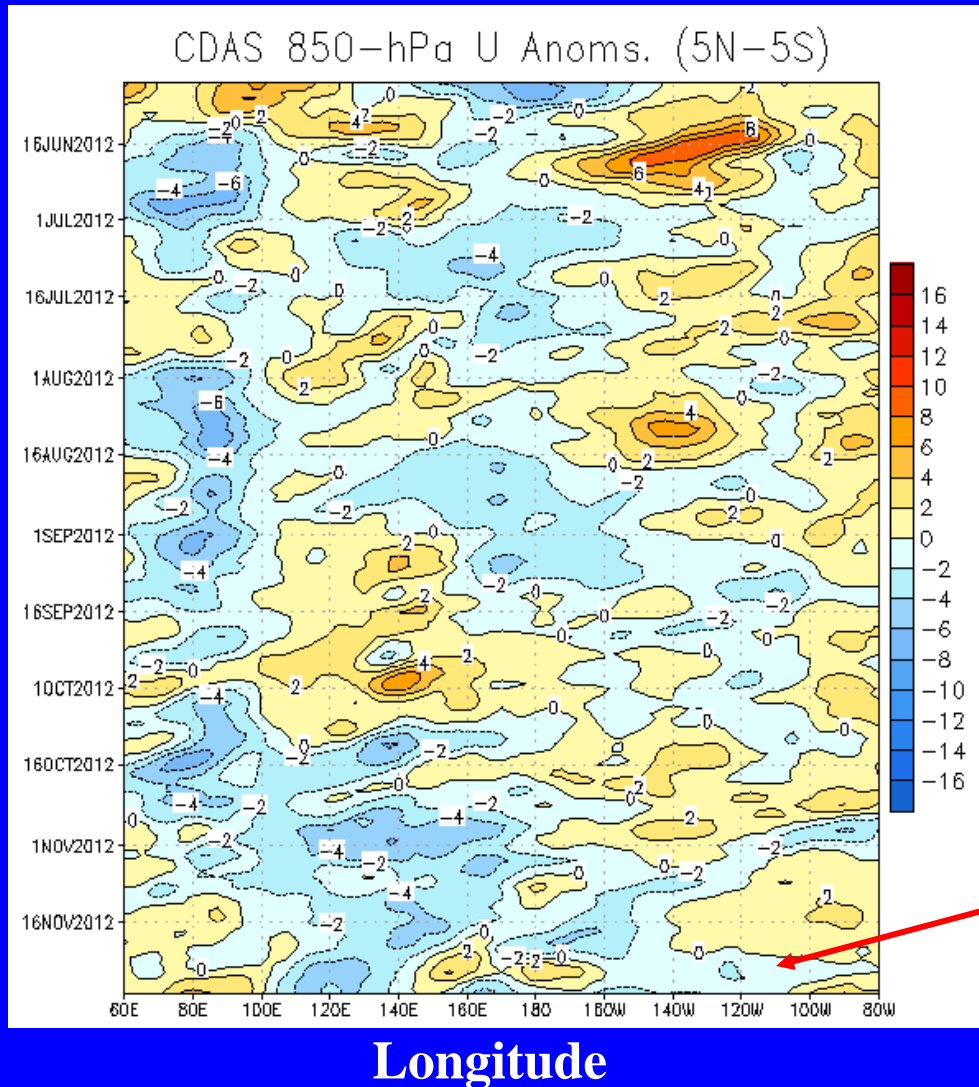


- From September 2011 – February 2012 heat content was below average in the central and eastern equatorial Pacific.
- From March- May 2012, heat content anomalies increased across much of the equatorial Pacific, partly in association with the downwelling phase of a Kelvin wave.
- During October-November 2012, heat content anomalies increased associated with the downwelling phase of a weak Kelvin wave.
- Recently, there is evidence of an upwelling phase of a Kelvin wave, which has weakened the subsurface temperature anomalies west of 130°W.

• 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})



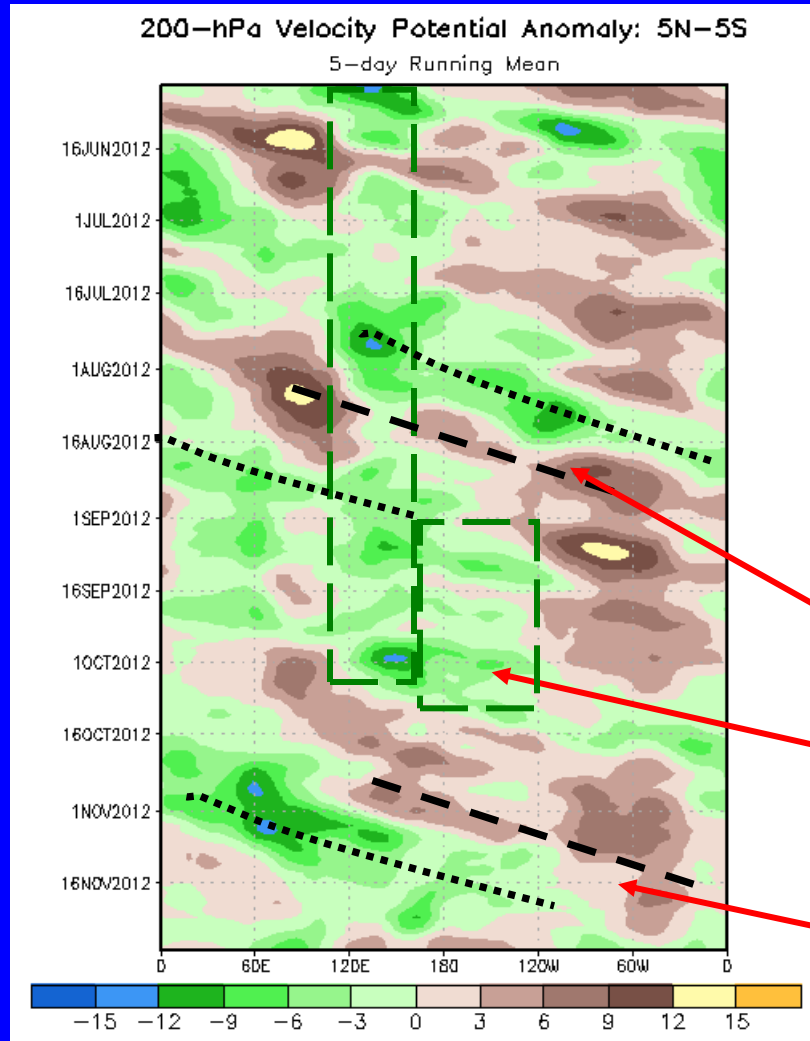
**Westerly wind anomalies
(orange/red shading).**

**Easterly wind anomalies (blue
shading).**

**Recently, weak wind anomalies were
evident across the equatorial Pacific
Ocean.**



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.

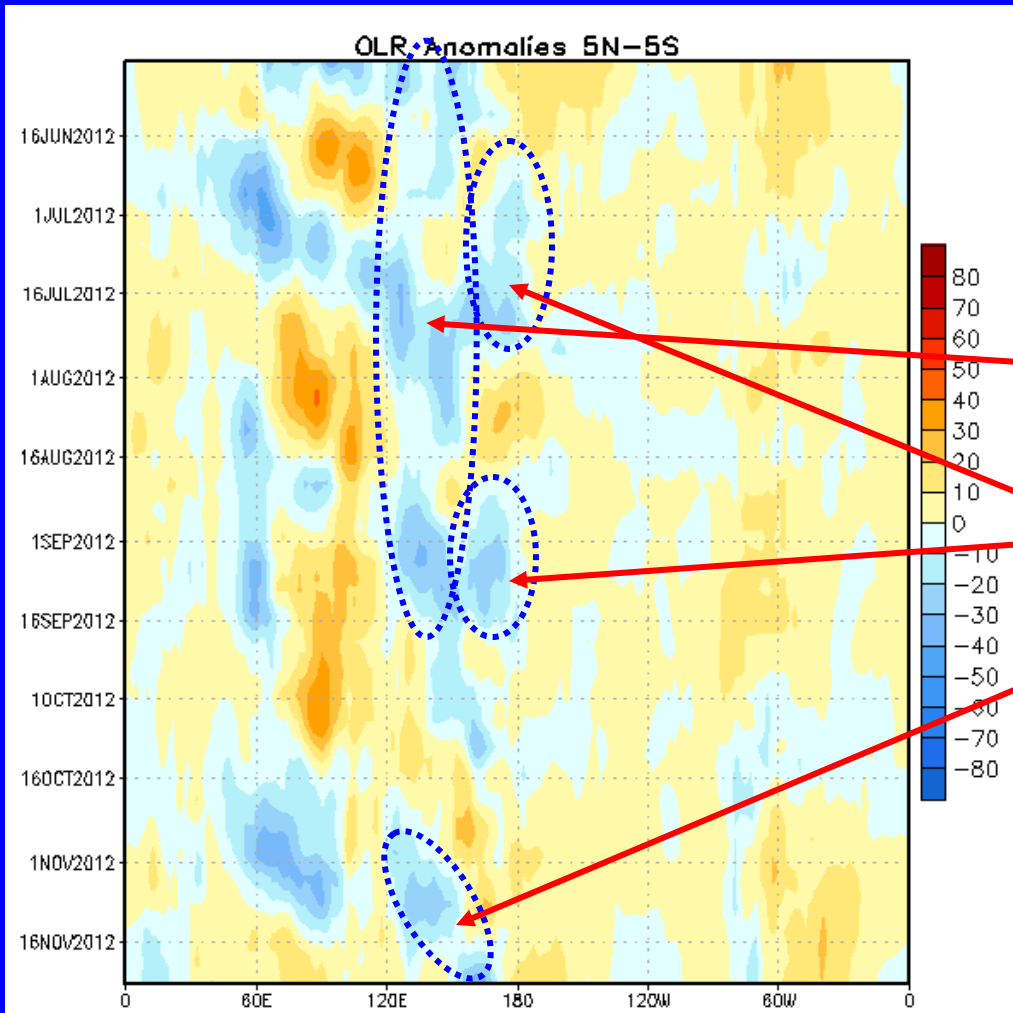
During September and early October, upper-level divergence (green) expanded eastward to near the Date Line.

During mid October through mid November, a weak MJO was evident.



Outgoing Longwave Radiation (OLR) Anomalies

Time



Longitude

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

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

**From mid-May to mid-October 2012,
negative OLR anomalies were observed
near the eastern Maritime Continent.**

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

**Recently, negative OLR anomalies were
evident near the Maritime Continent
and 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° C.

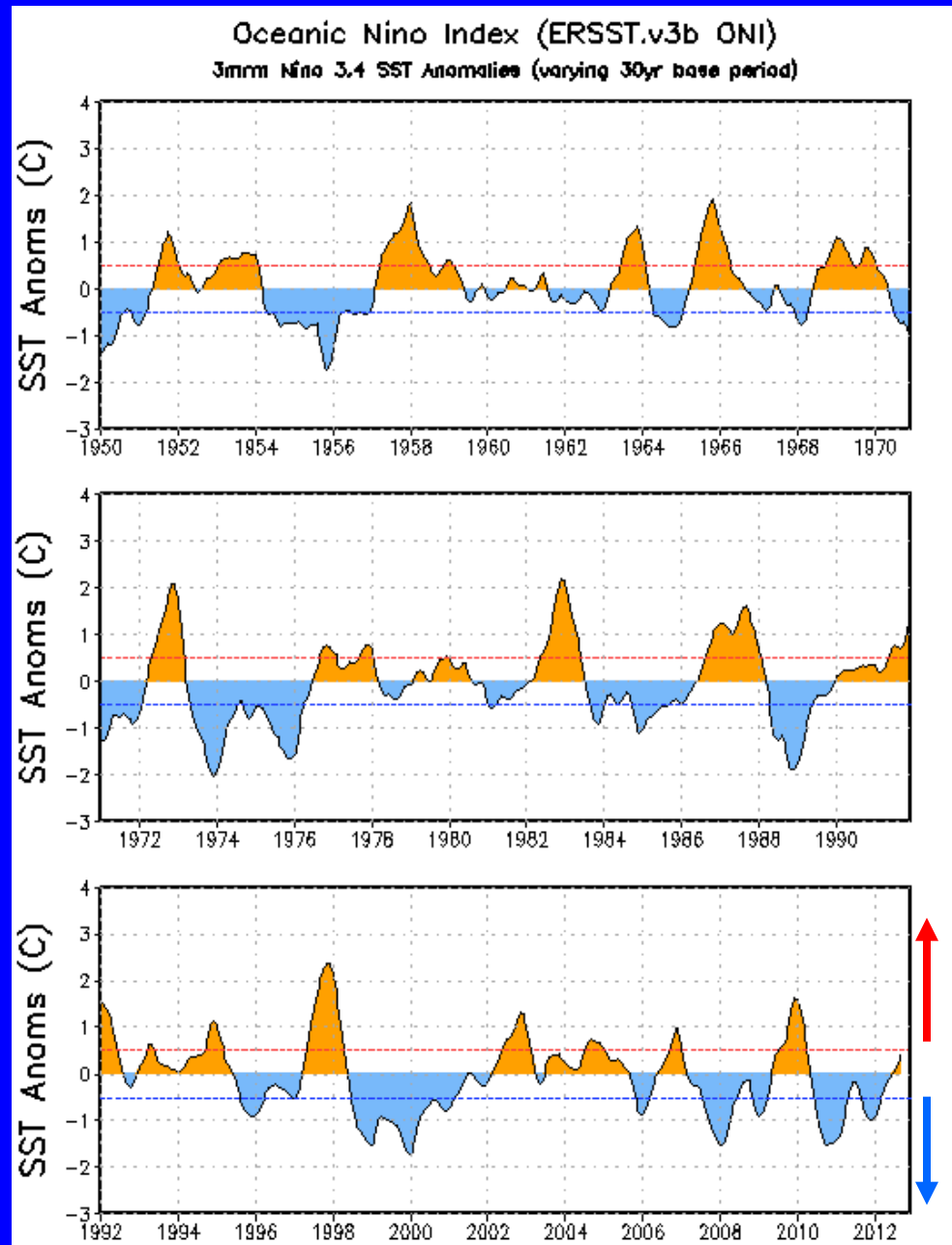
By historical standards, to be classified as a full-fledged El Niño or La Niña episode, these thresholds must be exceeded for a period of at least 5 consecutive overlapping 3-month seasons.

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:

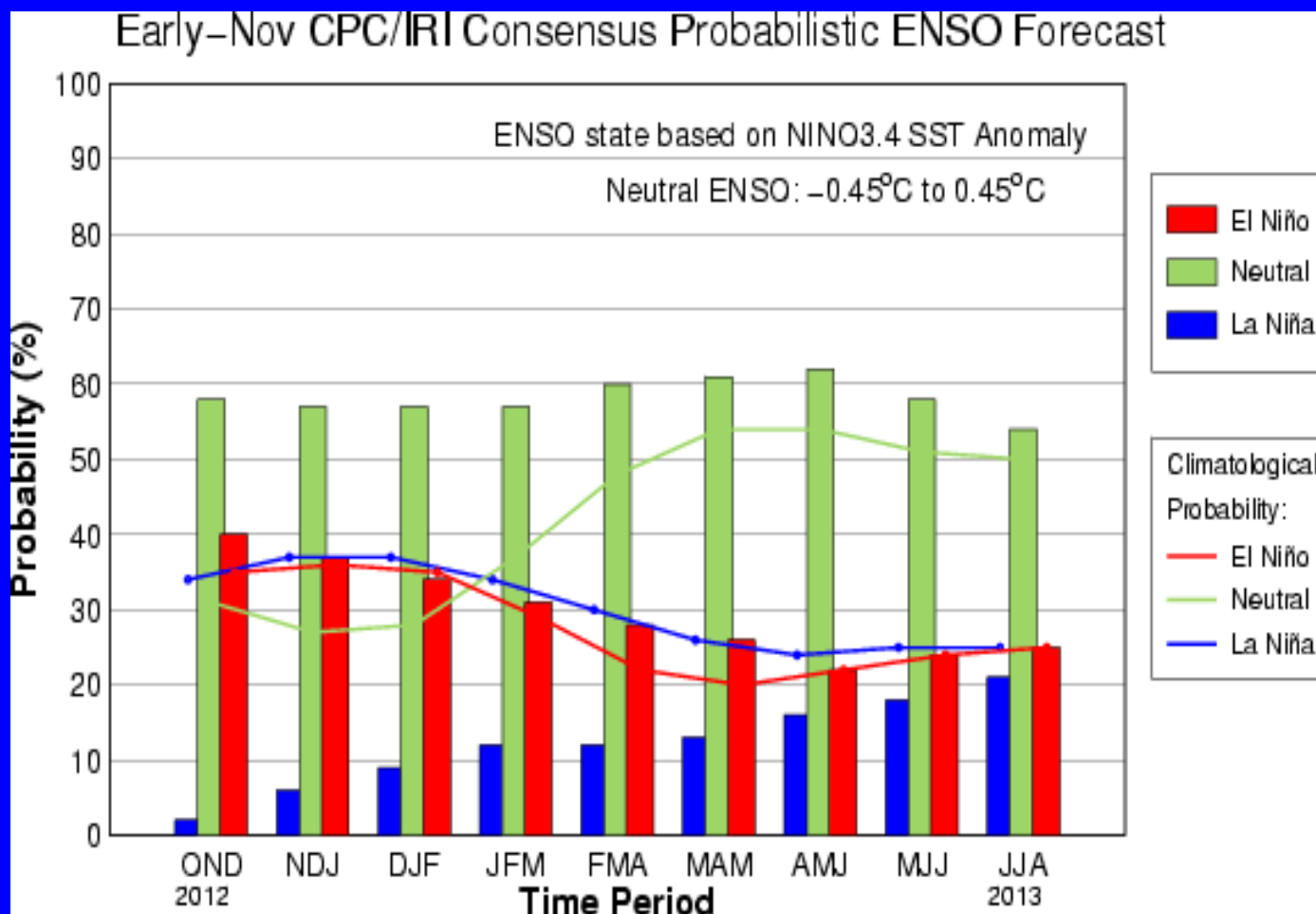
[Historical ONI Values](#)



CPC/IRI Probabilistic ENSO Outlook

(updated 8 Nov 2012)

ENSO-neutral is favored through mid-2013.





Pacific Niño 3.4 SST Outlook

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

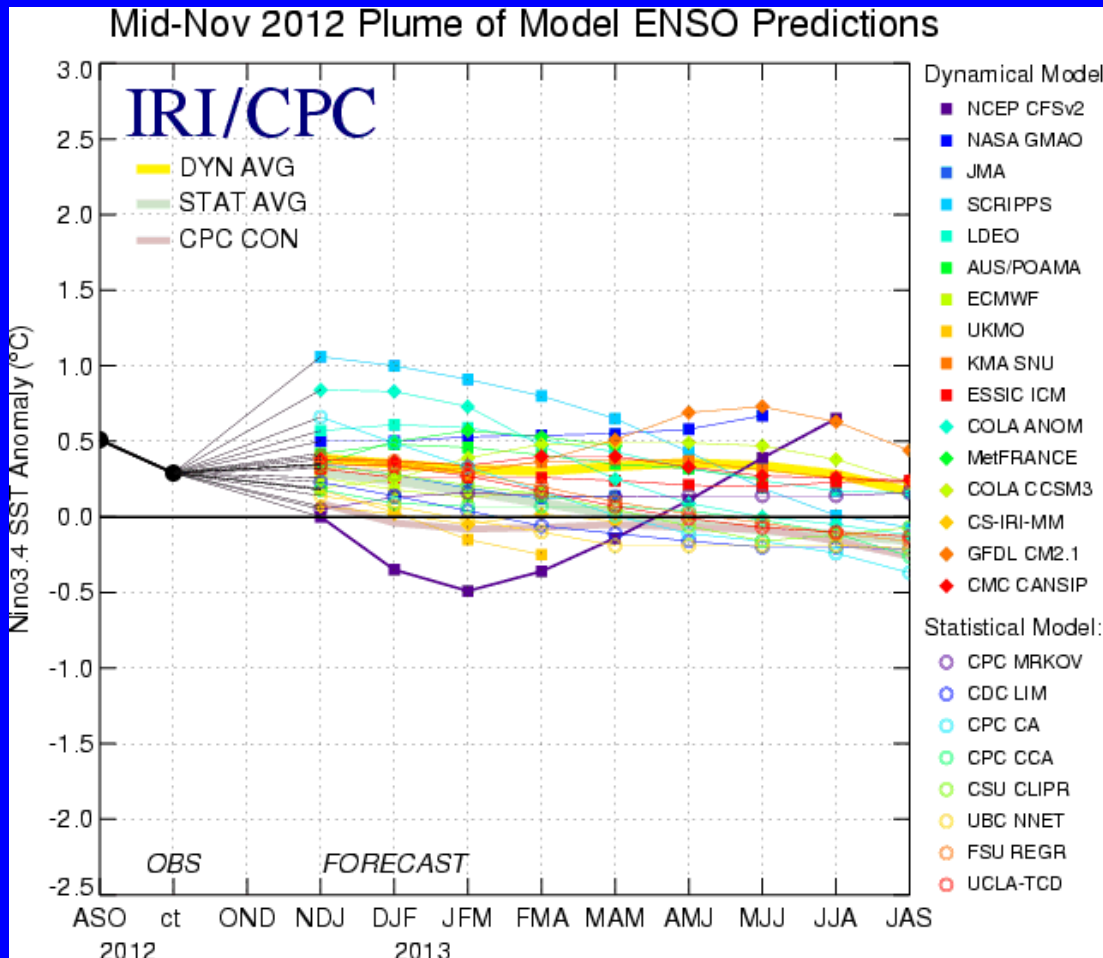
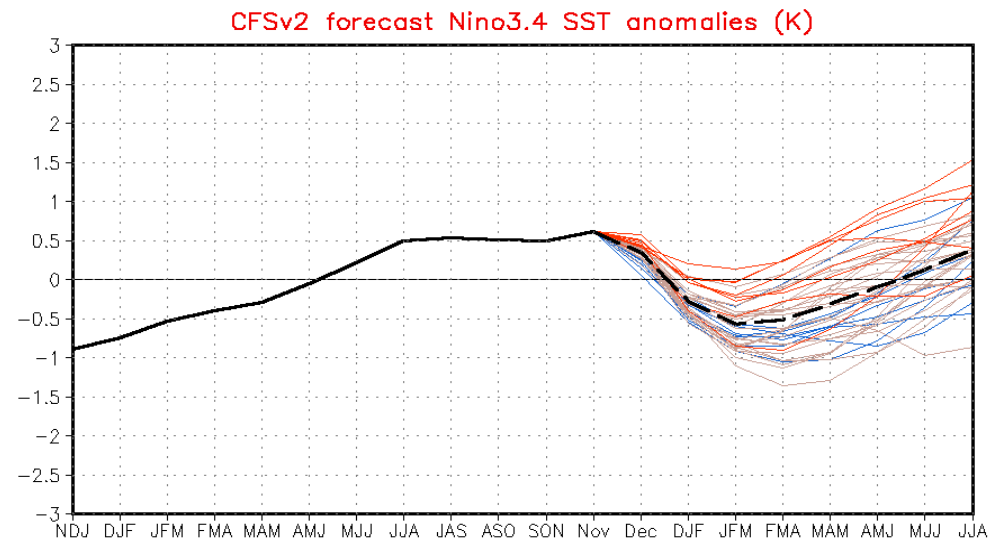
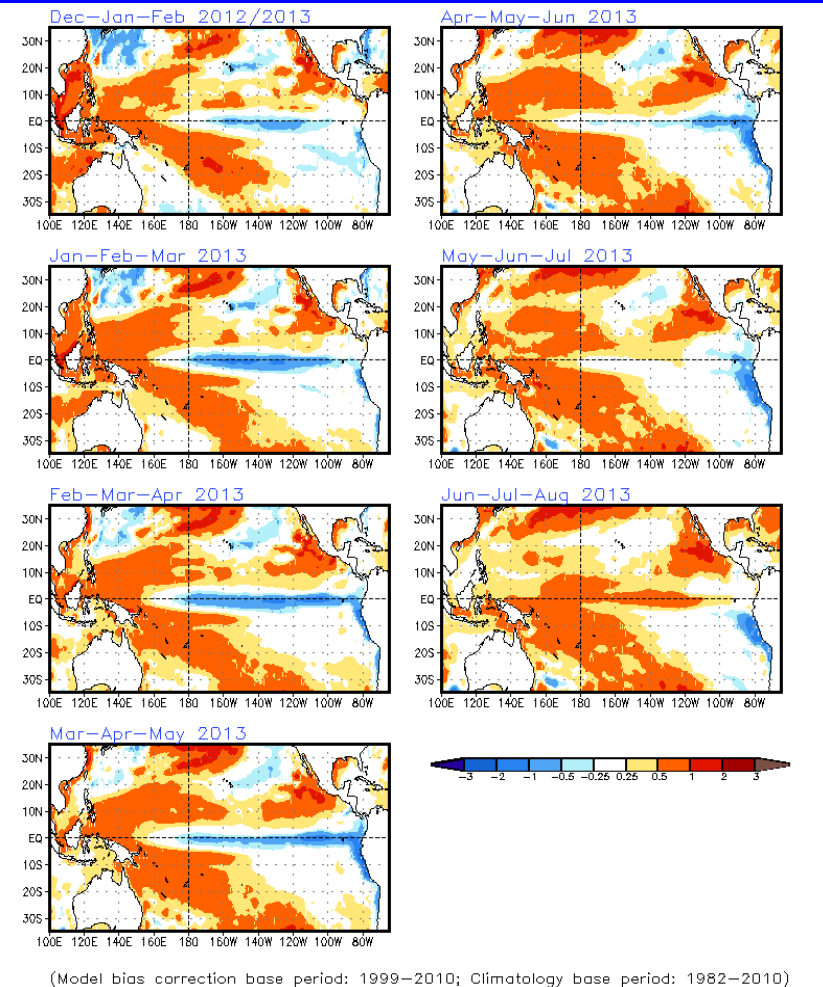


Figure provided by the International Research Institute (IRI) for Climate and Society (updated 13 Nov 2012).



SST Outlook: NCEP CFS.v2 Forecast Issued 1 December 2012

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

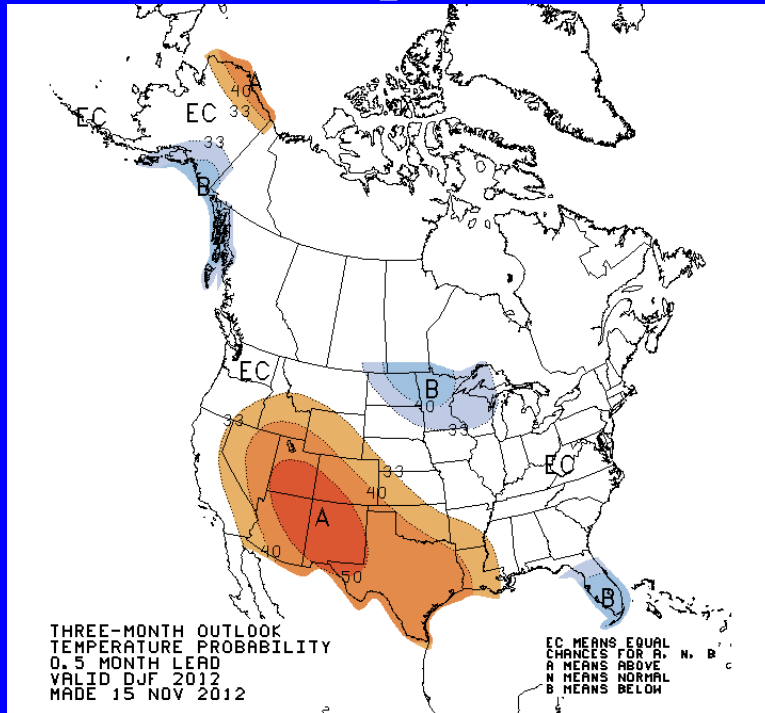


CFS.v1 has been discontinued.

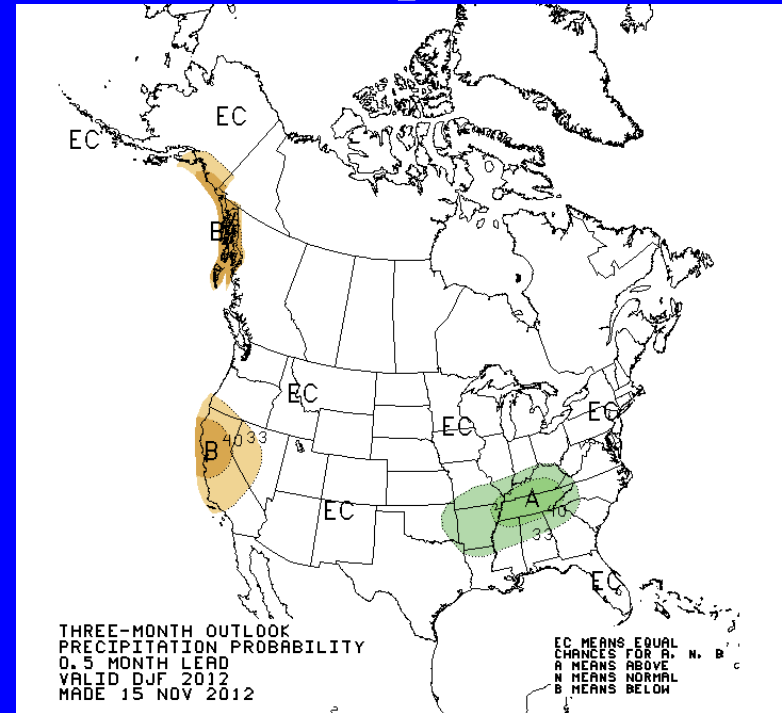


U. S. Seasonal Outlooks December 2012 – February 2013

Temperature



Precipitation



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



Summary

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- **ENSO-neutral conditions continue.***
- **Equatorial sea surface temperatures (SST) remain above average across much of the Pacific Ocean.**
- **The atmospheric circulation over the tropical Pacific is near average.**
- **ENSO-neutral is favored through the Northern Hemisphere winter 2012-13.***

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