



ENSO Cycle: Recent Evolution, Current Status and Predictions

**Update prepared by
Climate Prediction Center / NCEP
30 December 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

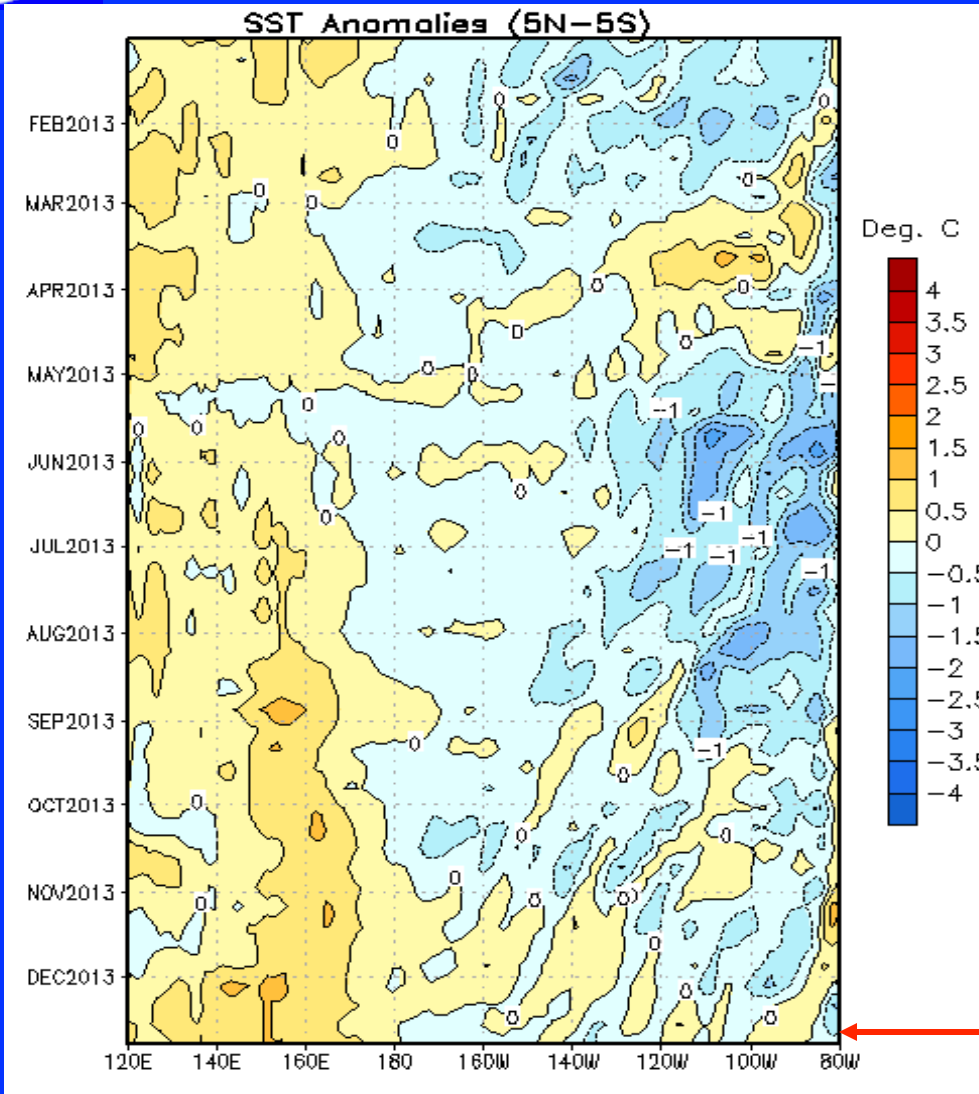
- **ENSO-neutral conditions continue.***
- **Equatorial sea surface temperatures (SST) are near average across much of the Pacific Ocean.**
- **ENSO-neutral is expected to continue into the Northern Hemisphere summer 2014.***

* 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 May-September 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.

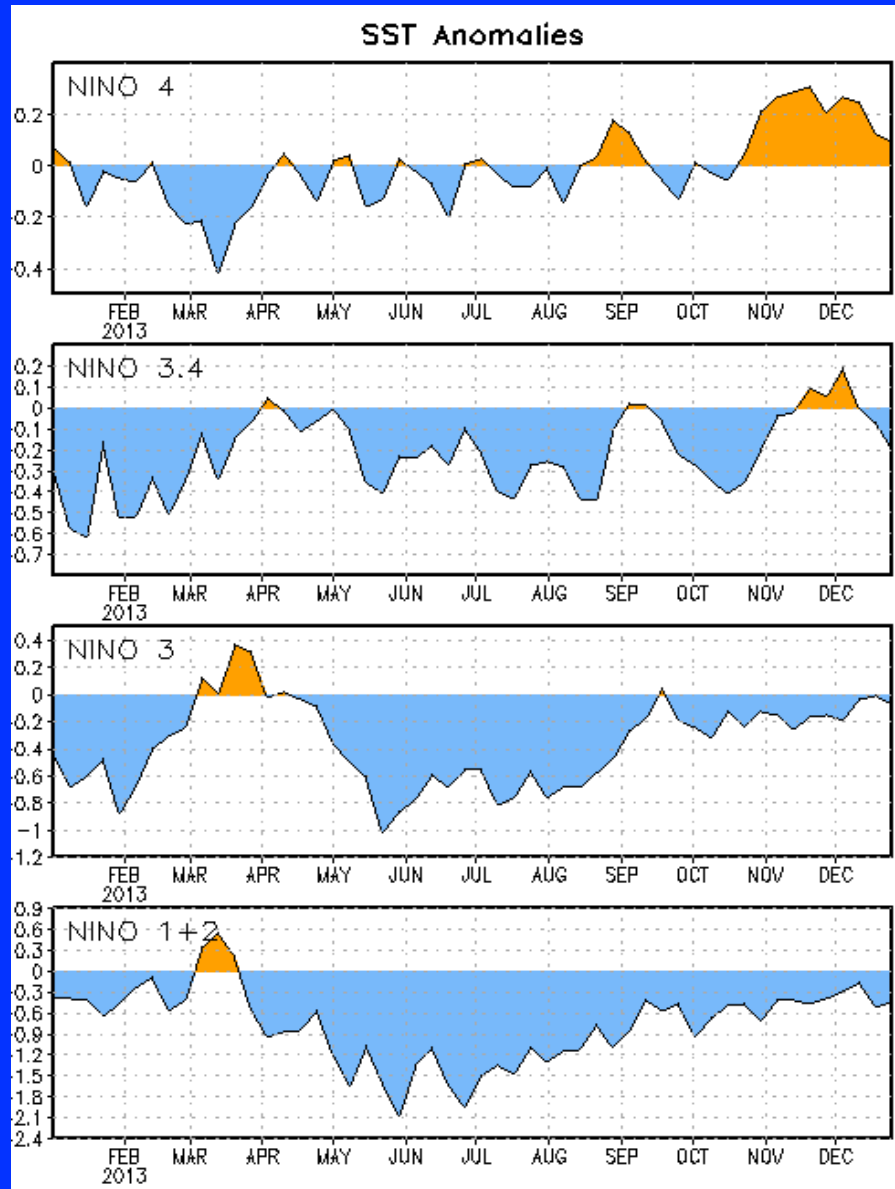
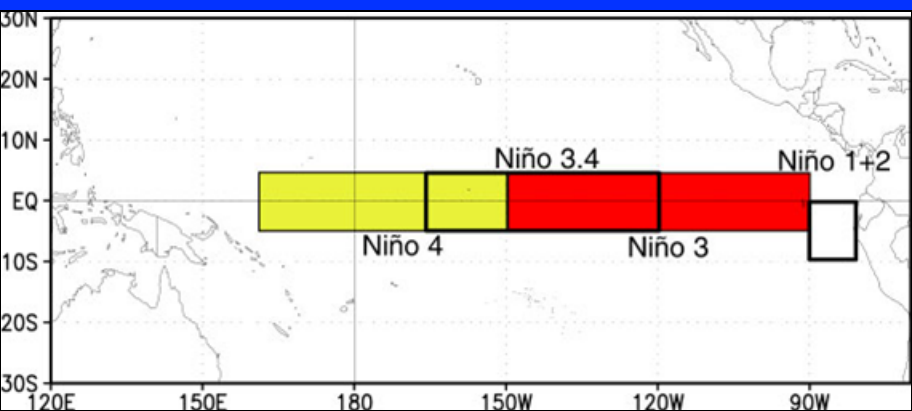


Niño Region SST Departures (°C)

Recent Evolution

The latest weekly SST departures are:

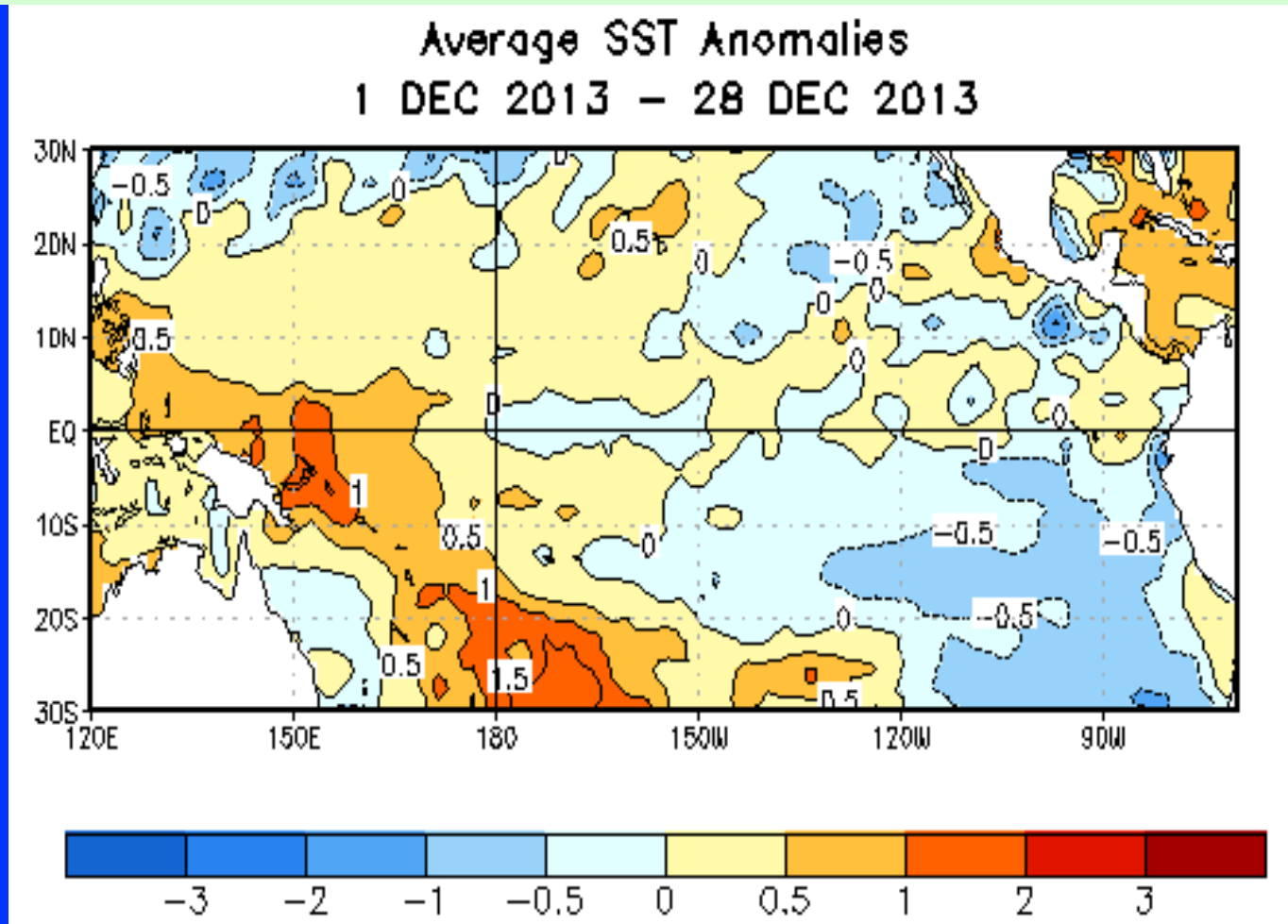
- Niño 4 0.1°C
- Niño 3.4 -0.2°C
- Niño 3 -0.1°C
- Niño 1+2 -0.4°C





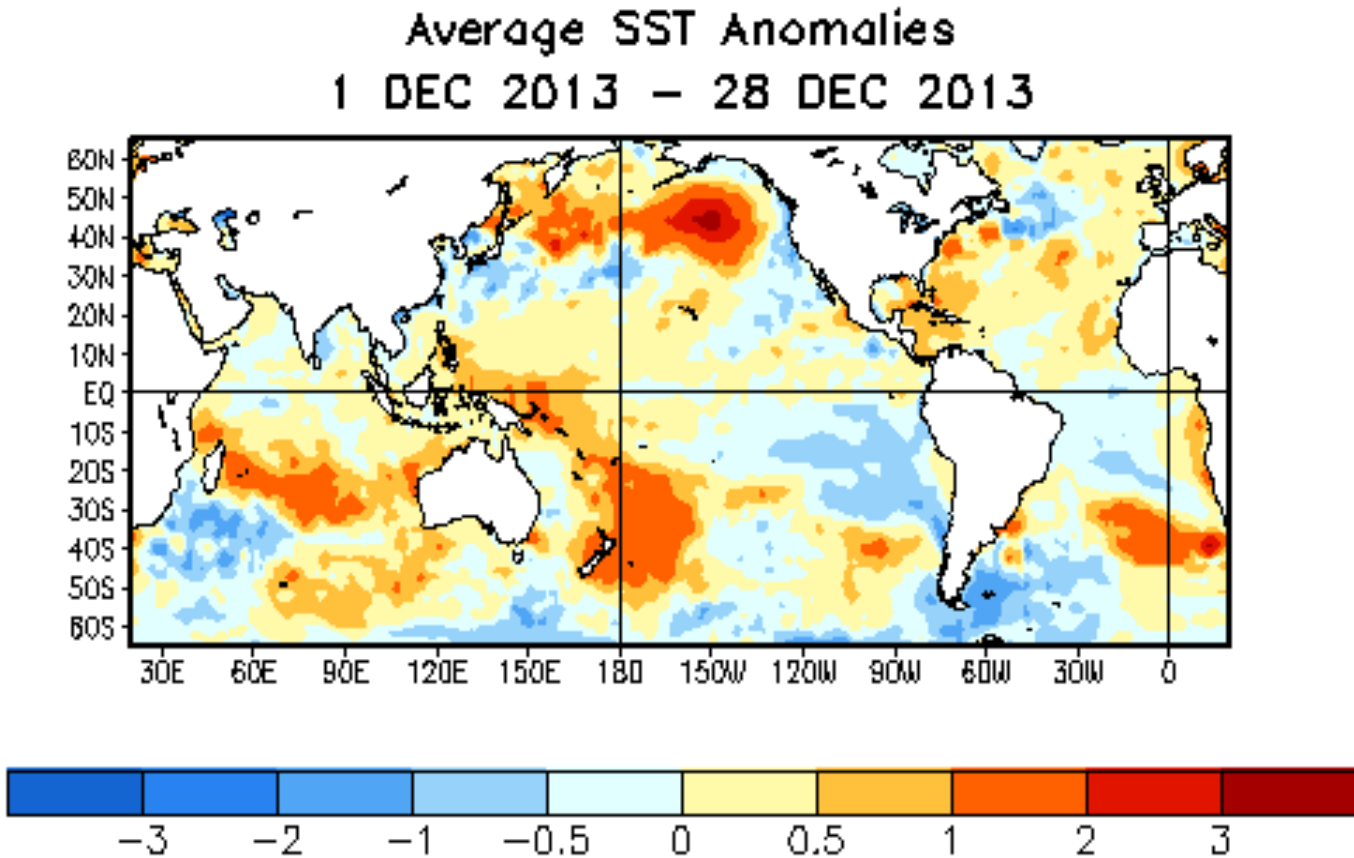
SST Departures (°C) in the Tropical Pacific During the Last 4 Weeks

During the last 4-weeks, equatorial SSTs were above average in the western Pacific and near average across the remainder of the Pacific Ocean.





Global SST Departures (°C)

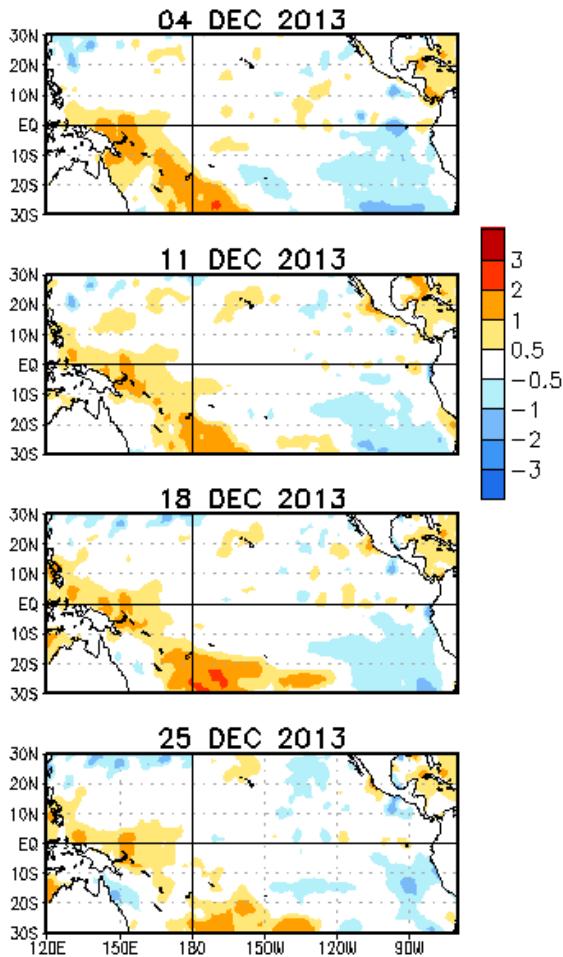


During the last four weeks, equatorial SSTs were above average in the western Pacific Ocean.



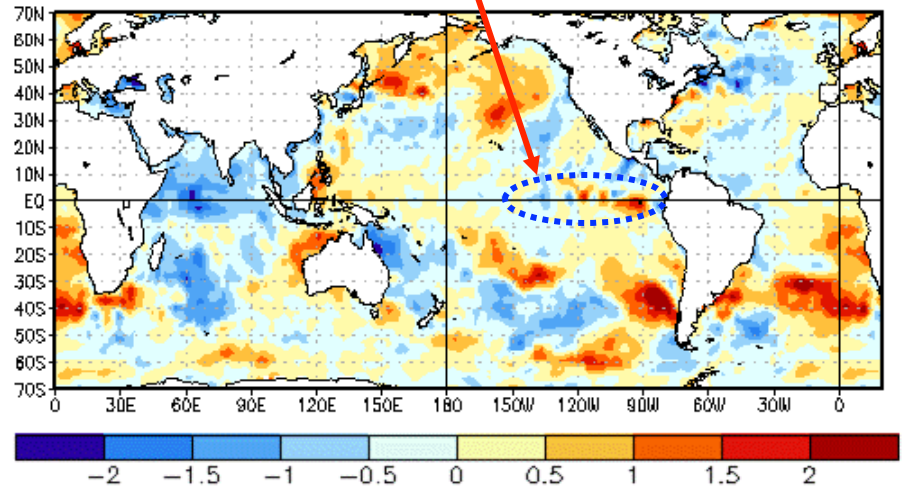
Weekly SST Departures (°C) for the Last Four Weeks

Weekly SST Anomalies (DEG C)



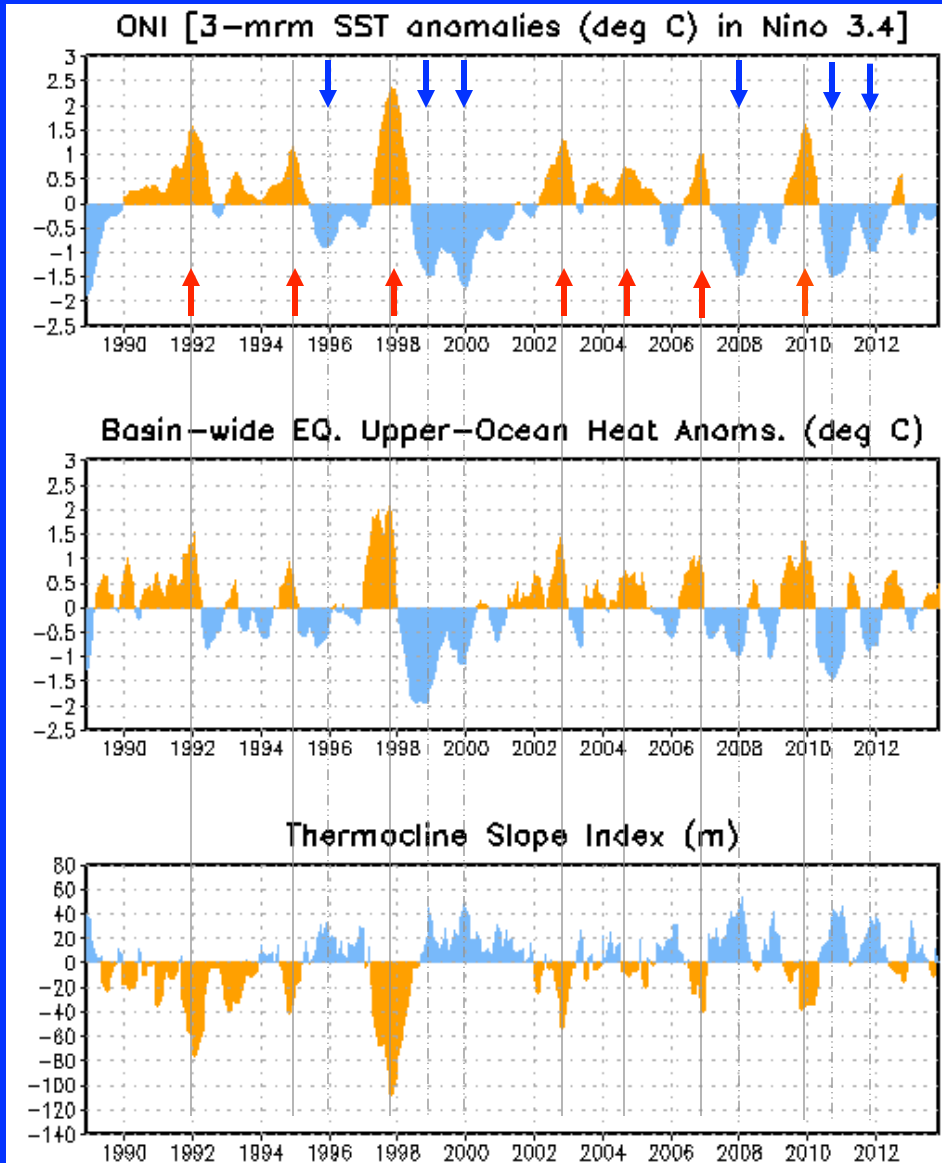
- During the last month, positive SST anomalies continued in the western Pacific.
- Over the last month, more localized changes were evident in the SST anomalies across the eastern half of the equatorial Pacific.

Change in Weekly SST Anoma (°C)
25DEC2013 minus 27NOV2013





Upper-Ocean Conditions in the Eq. Pacific



Cold Episodes ↓
Warm Episodes ↑

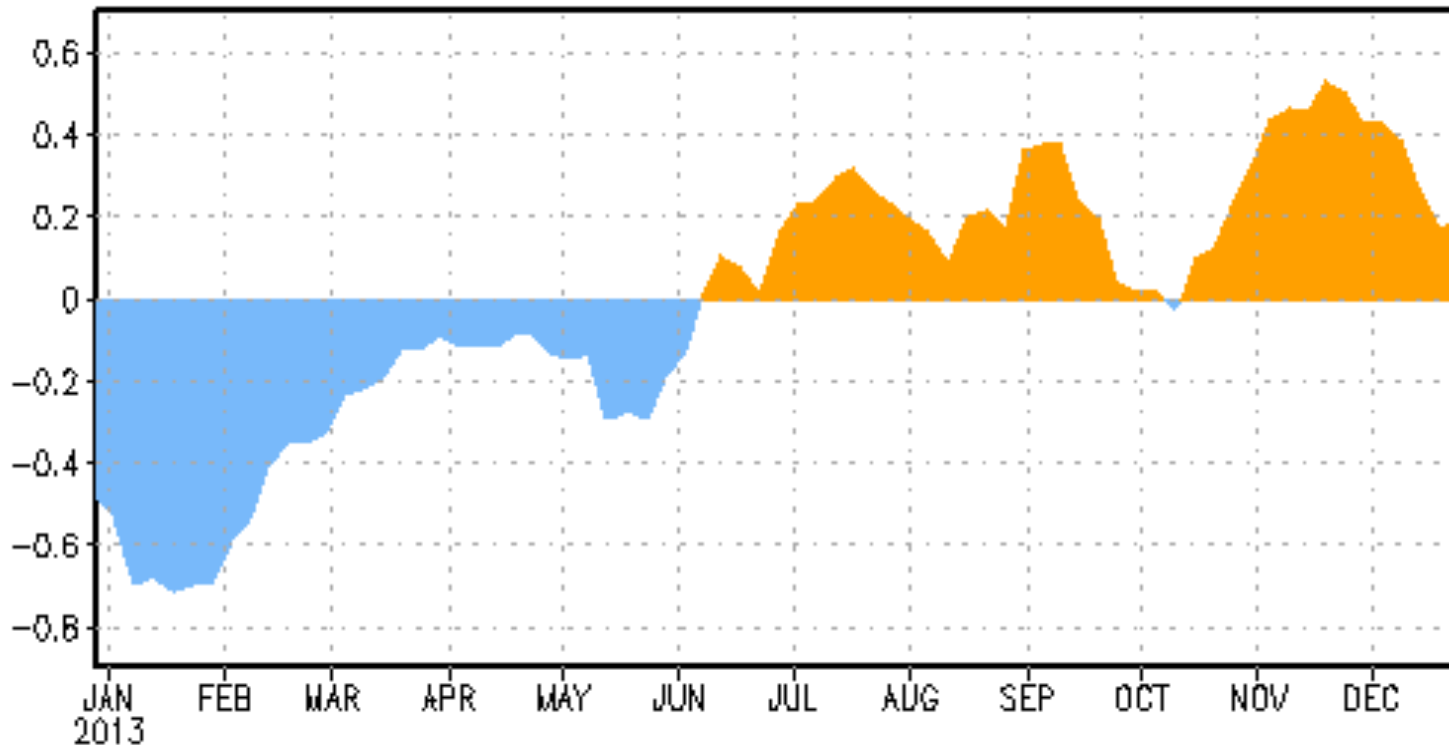
- The basin-wide equatorial upper ocean (0-300 m) heat content is **greatest** prior to and during the early stages of a Pacific **warm** (El Niño) episode (compare top 2 panels) and **least** prior to and during the early stages of a **cold** (La Niña) episode.
- The slope of the oceanic thermocline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



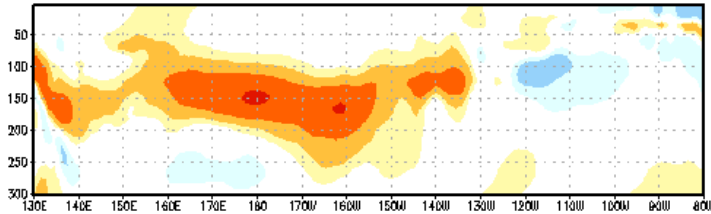
Subsurface temperatures were below average from December 2012 to May 2013, and above average from June 2013 to the present. From mid-October to mid-November, the subsurface temperature anomalies increased and became positive. In the last month, the positive anomalies have weakened.



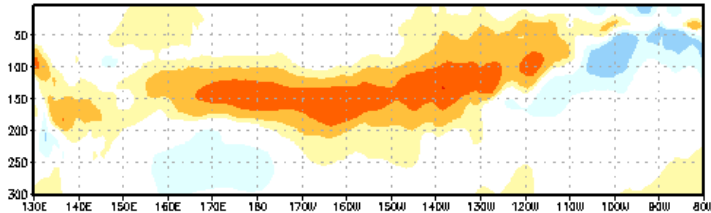
Sub-Surface Temperature Departures (°C) in the Equatorial Pacific

EQ. Subsurface Temperature Anomalies (deg C)

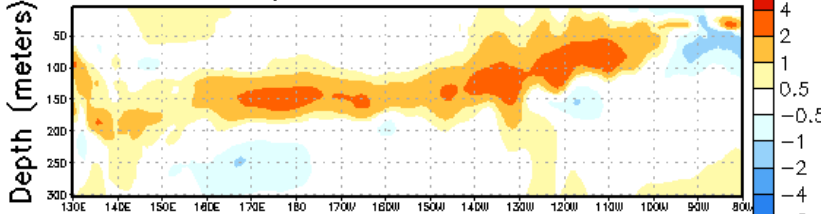
Three-pentad ave. centered on 04 NOV 2013



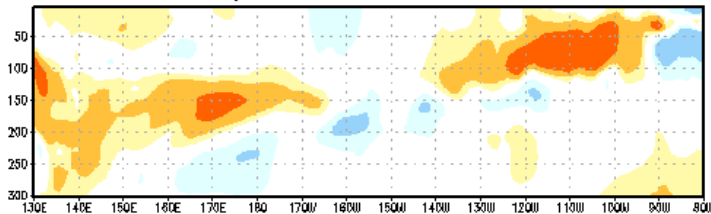
Three-pentad ave. centered on 19 NOV 2013



Three-pentad ave. centered on 04 DEC 2013



Three-pentad ave. centered on 19 DEC 2013



• During the last two months, above-average temperatures in the western Pacific shifted eastward in association with a downwelling oceanic Kelvin wave.

• Recently, positive subsurface temperature anomalies were observed in most of the equatorial Pacific, except for a region of negative anomalies in the east-central Pacific.

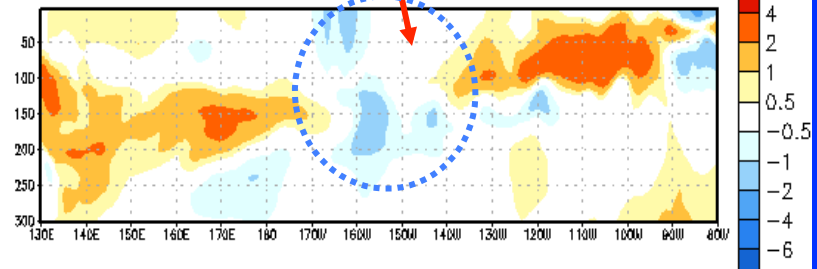
Time



Longitude

EQ. Subsurface Temperature Anomalies (deg C)

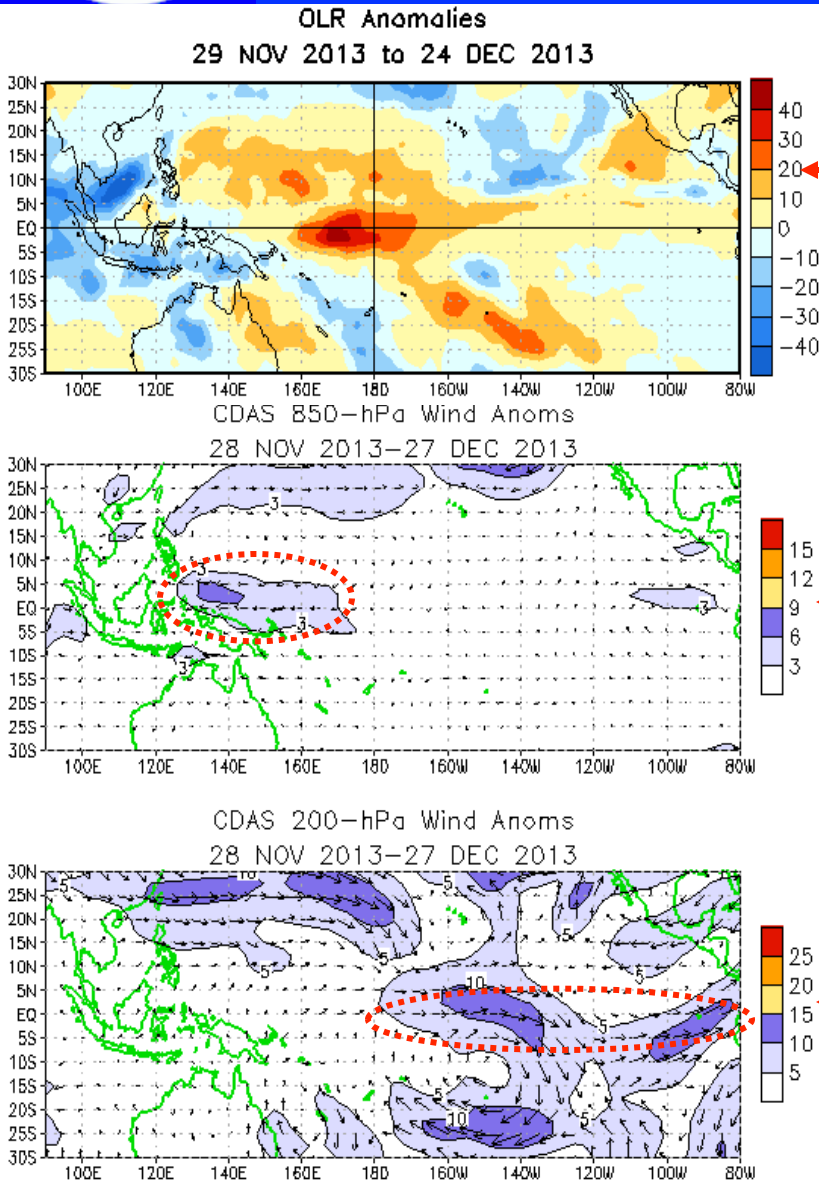
Pentad centered on 24 DEC 2013



Most recent pentad analysis



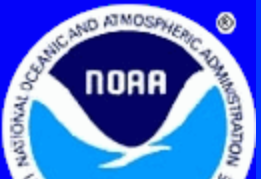
Tropical OLR and Wind Anomalies During the Last 30 Days



Negative OLR anomalies (enhanced convection and precipitation, blue shading) were observed over Malaysia, Indonesia, Papua New Guinea, and northwestern Australia. Positive OLR anomalies (suppressed convection and precipitation, red shading) were evident over the western and central equatorial Pacific Ocean.

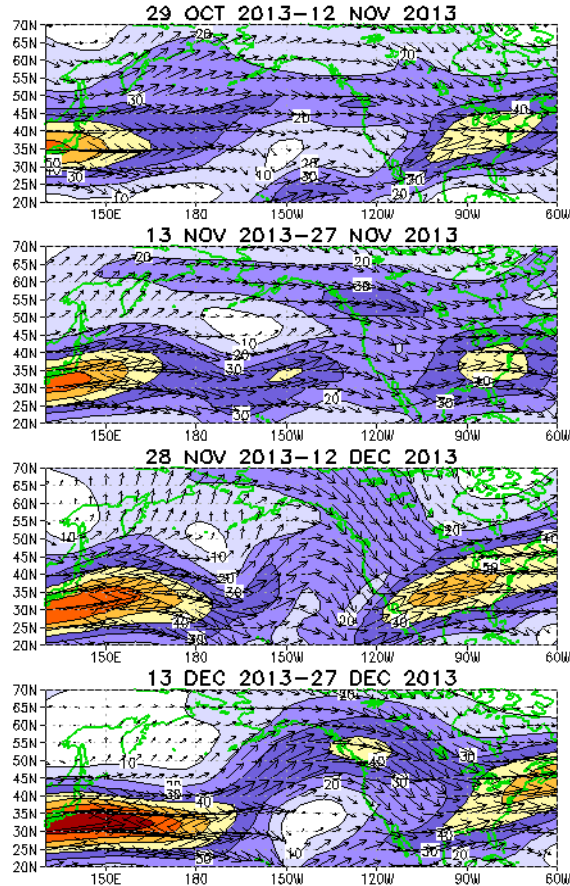
Low-level (850-hPa) easterly wind anomalies continued over the western equatorial Pacific.

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

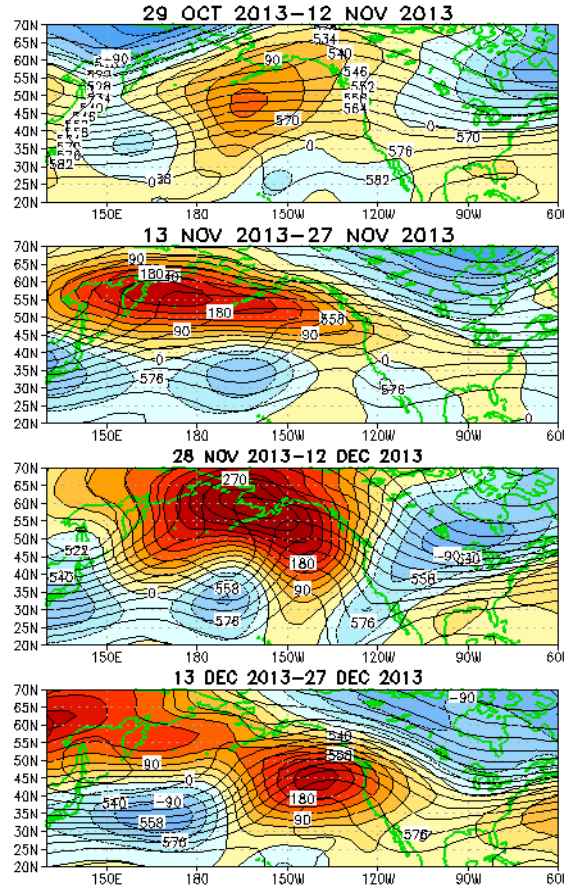


Atmospheric Circulation over the North Pacific & North America During the Last 60 Days

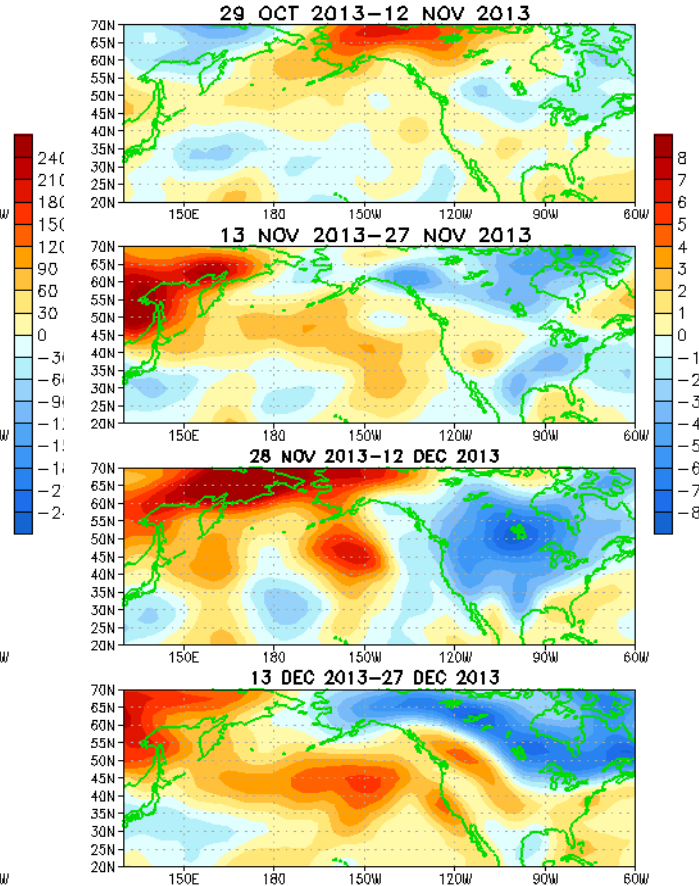
200-hPa Wind



500-hPa Height & Anoms.



925-hPa Temp. Anoms. (°C)



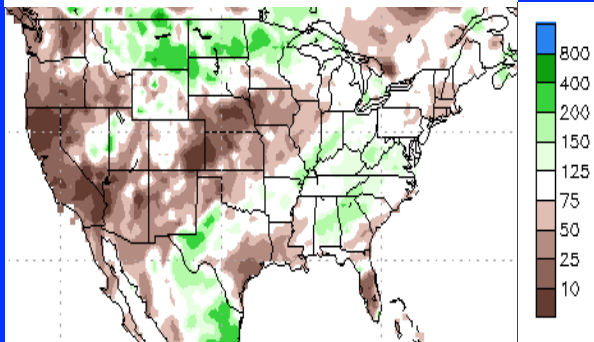
During late October through late December, an anomalous trough and below-average temperatures affected portions of central and eastern North America. Strong ridging over the North Pacific and/or Alaska led to above-average temperatures in the region.



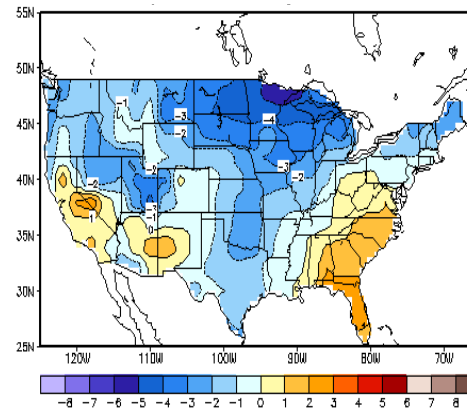
U.S. Temperature and Precipitation Departures During the Last 30 and 90 Days

Last 30 Days

30-day (ending 28 Dec 2013) % of average precipitation

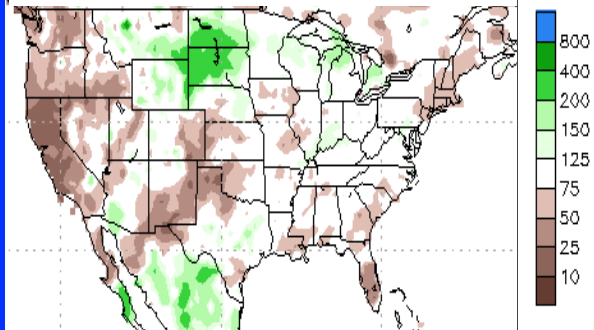


30-day (ending 28 Dec 2013) temperature departures (degree C)

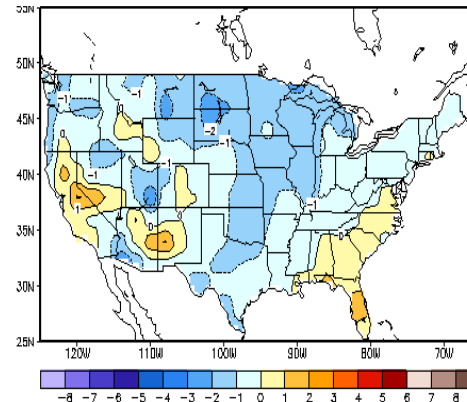


Last 90 Days

90-day (ending 28 Dec 2013) % of average precipitation



90-day (ending 28 Dec 2013) temperature departures (degree C)



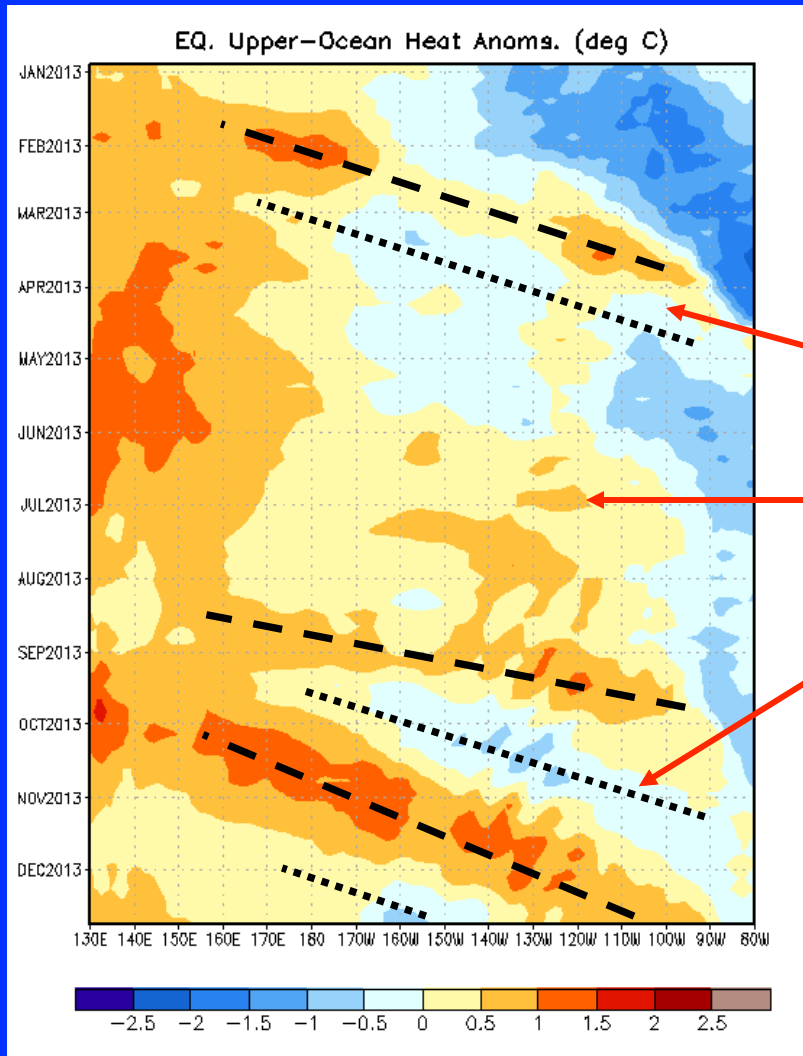


Intraseasonal Variability

- **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



Time



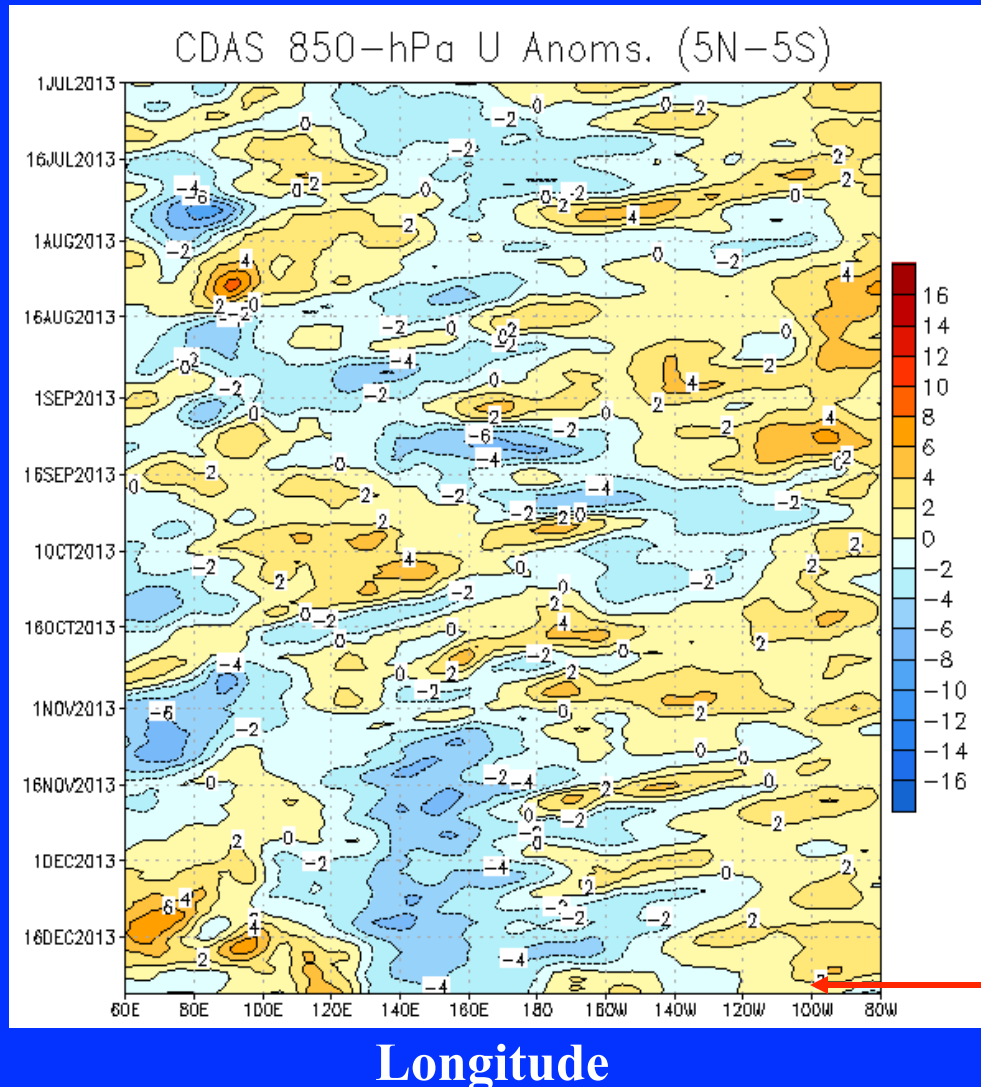
Longitude

- In February through April 2013, oceanic Kelvin wave activity was evident.
- Above-average heat content persisted from June-September 2013 across the equatorial Pacific (except in the far eastern basin).
- Oceanic Kelvin wave activity has been observed since early August 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 up-welling and cooling occur in the trailing portion.



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



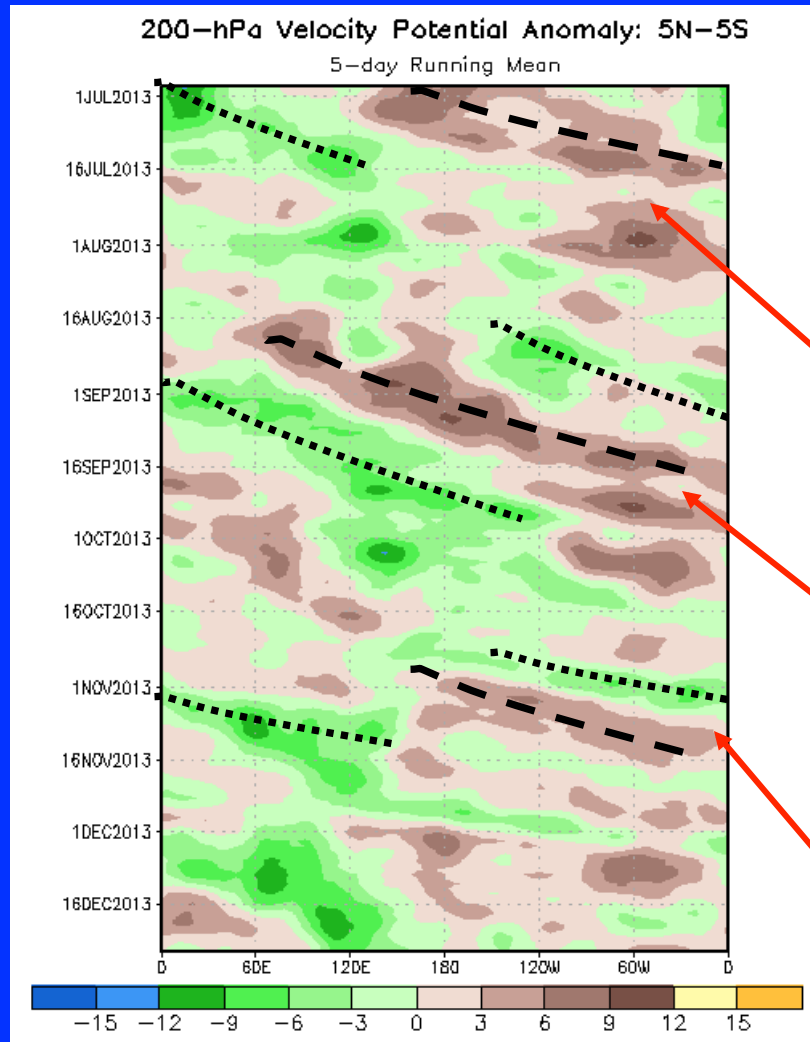
Westerly wind anomalies (orange/red shading).

Easterly wind anomalies (blue shading).

Over the last week, easterly anomalies persisted over the western equatorial 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.

During June and early July, the Madden Julian Oscillation (MJO) was active.

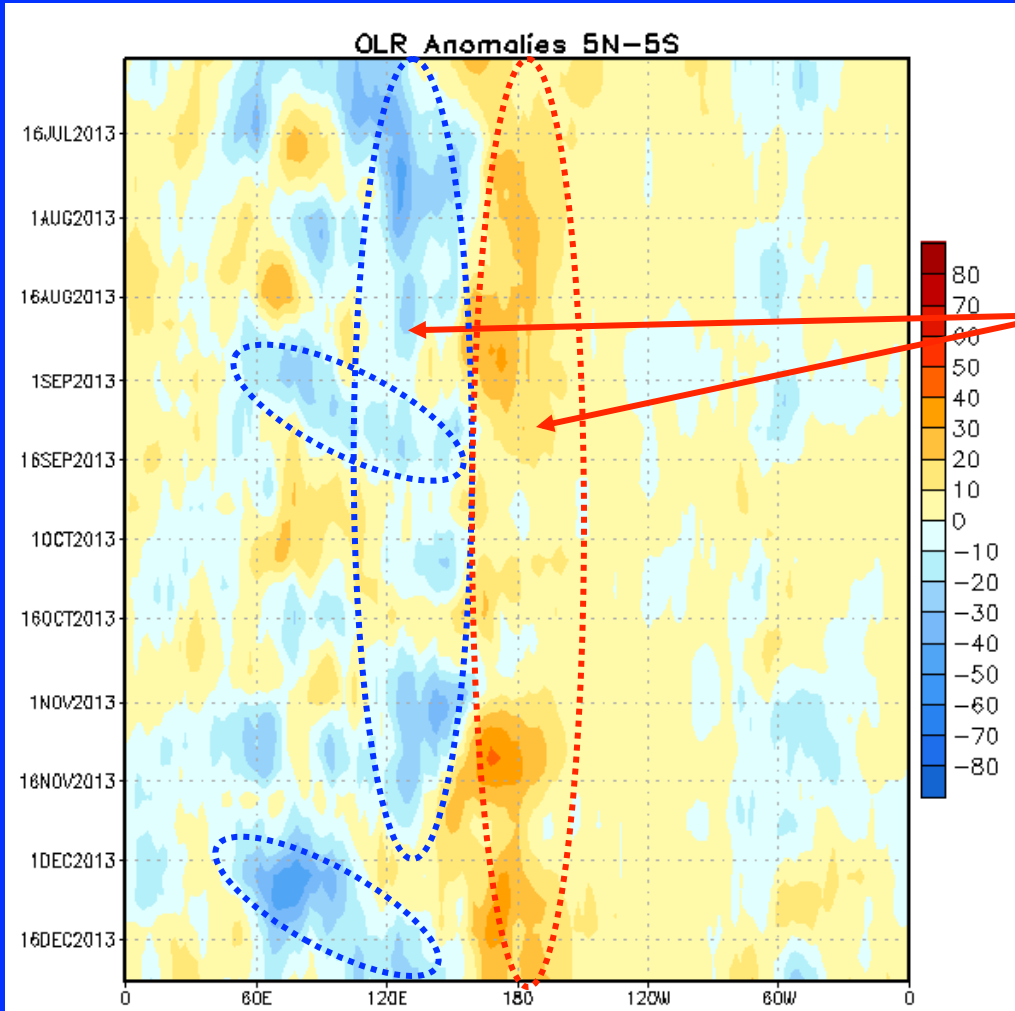
From mid-August through late September, the MJO was active.

During early November, weak MJO activity was evident.



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 .

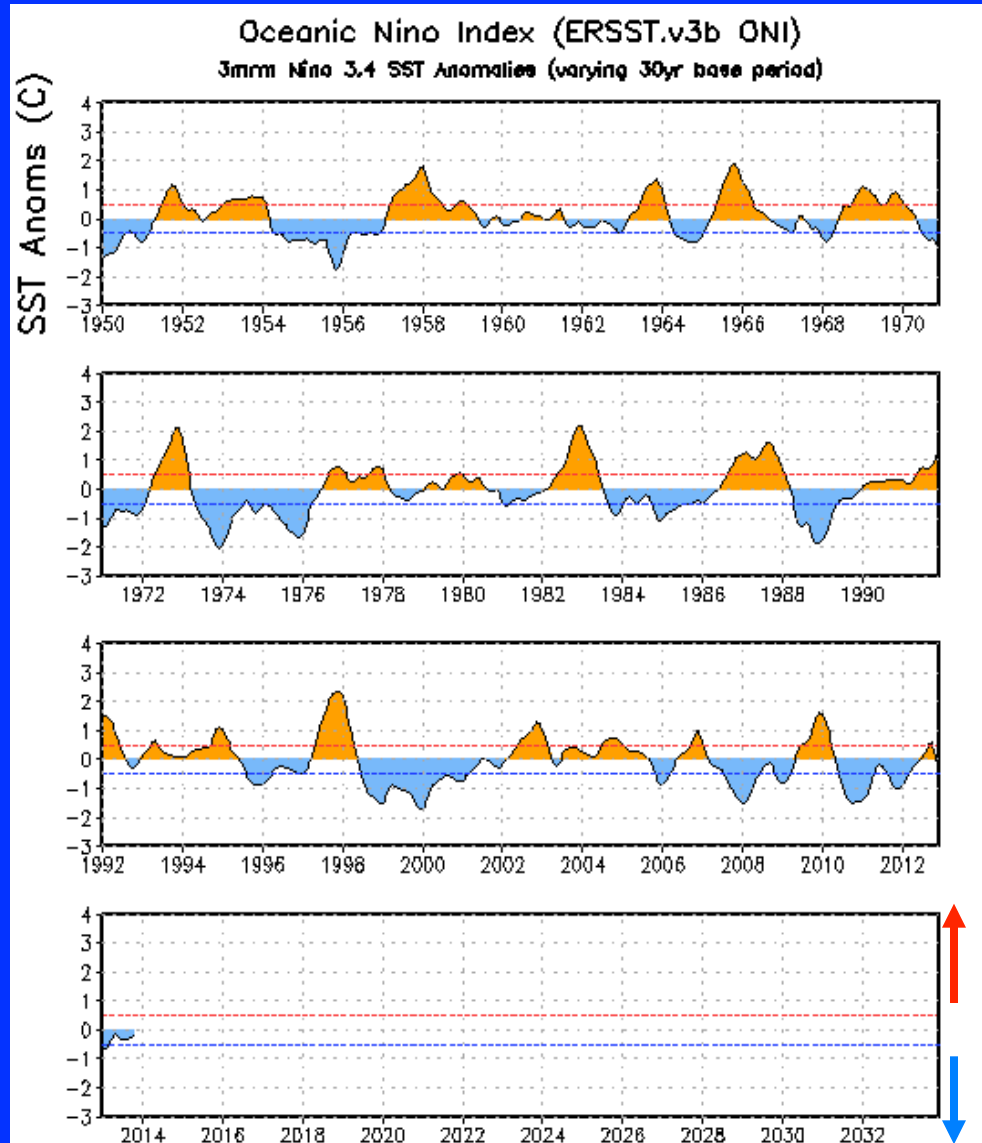
By historical standards, to be classified as a full-fledged El Niño or La Niña episode, these thresholds must be exceeded for a period of at least 5 consecutive overlapping 3-month seasons.

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 (September – November 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:

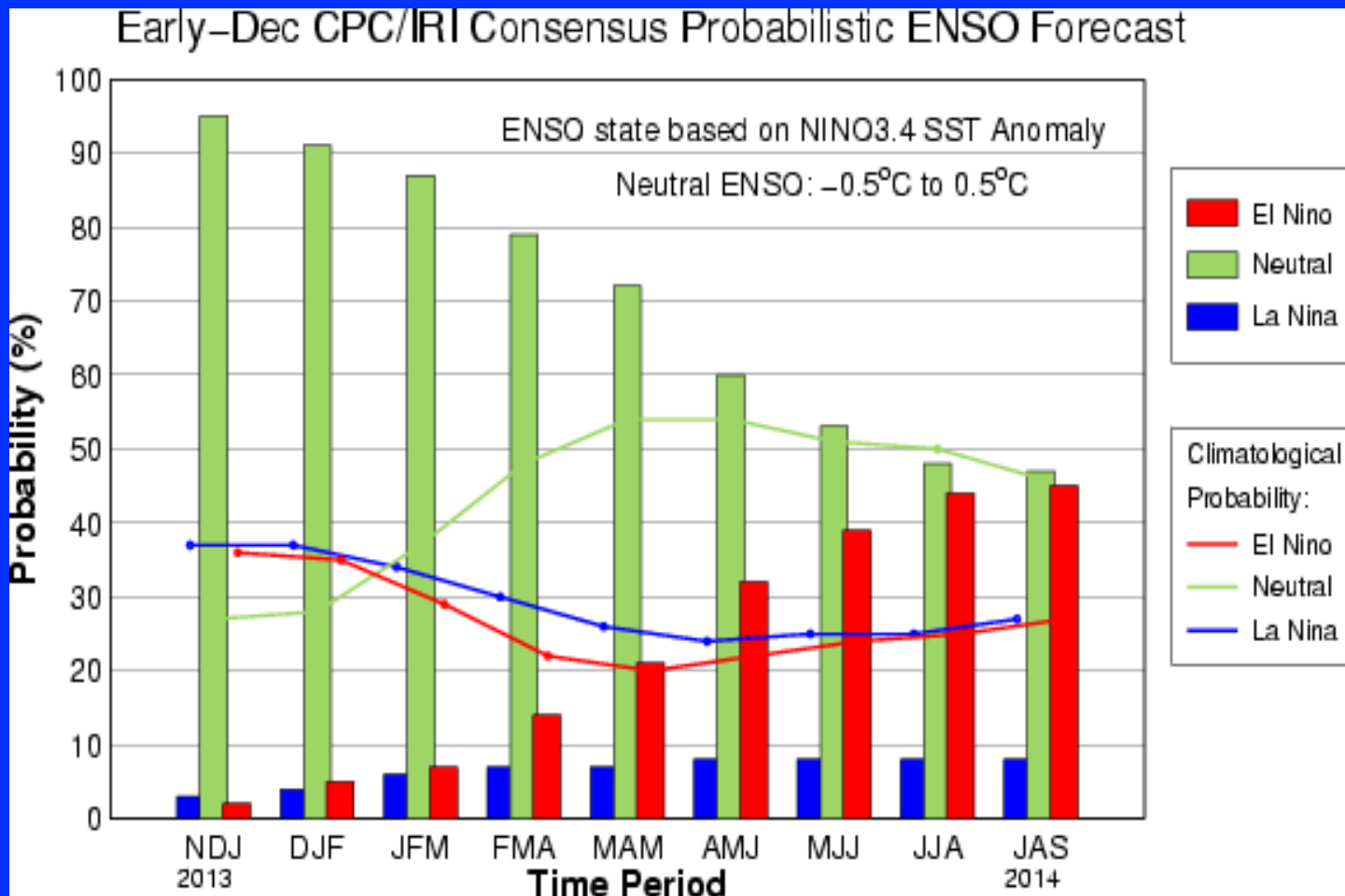
[Historical ONI Values](#)



CPC/IRI Probabilistic ENSO Outlook

(updated 5 December 2013)

ENSO-neutral is favored into the Northern Hemisphere summer 2014, with an increasing chance for the development of El Niño.





Pacific Niño 3.4 SST Outlook

- Most models predict ENSO-neutral (-0.5°C to $+0.5^{\circ}\text{C}$) to continue through the Northern Hemisphere spring. After that, models predict either ENSO-neutral or El Niño (greater or equal to $+0.5^{\circ}\text{C}$) during the Northern Hemisphere summer 2014.

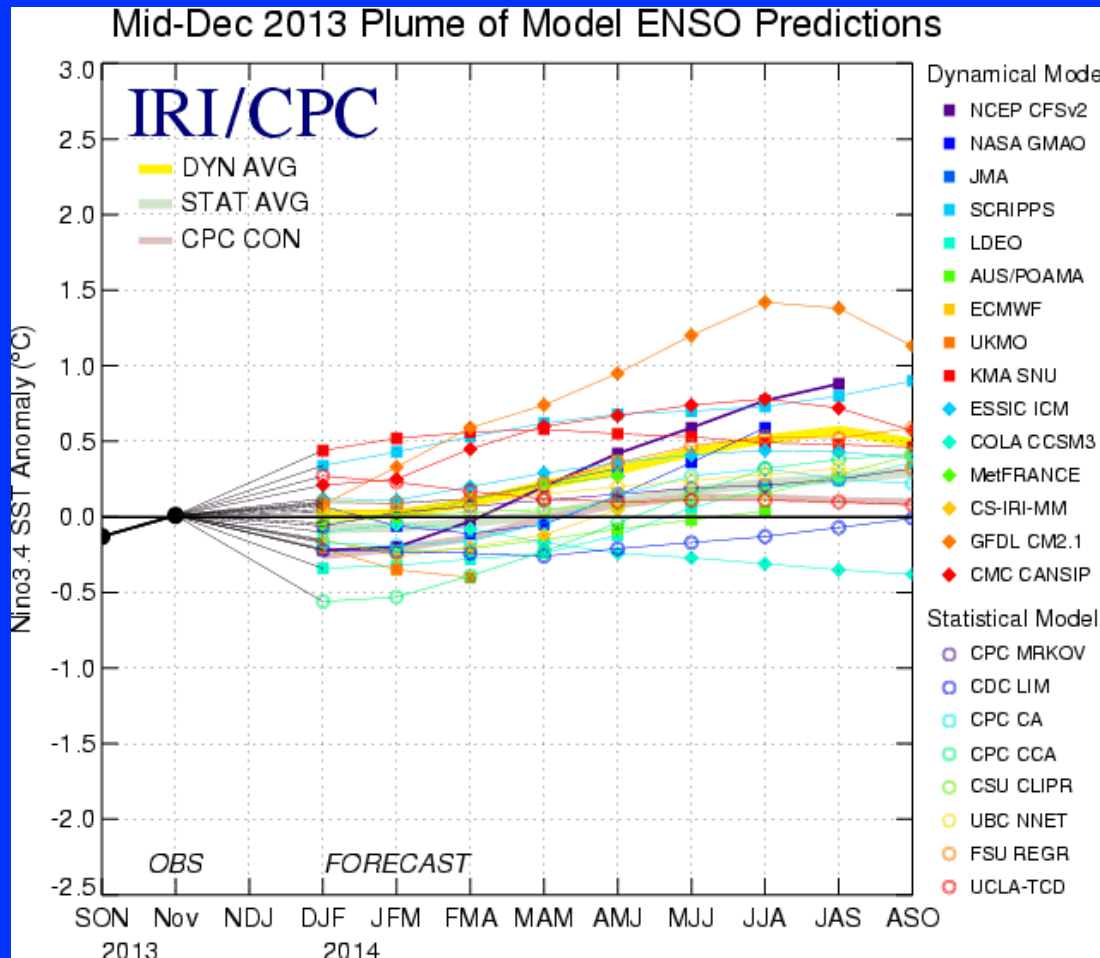
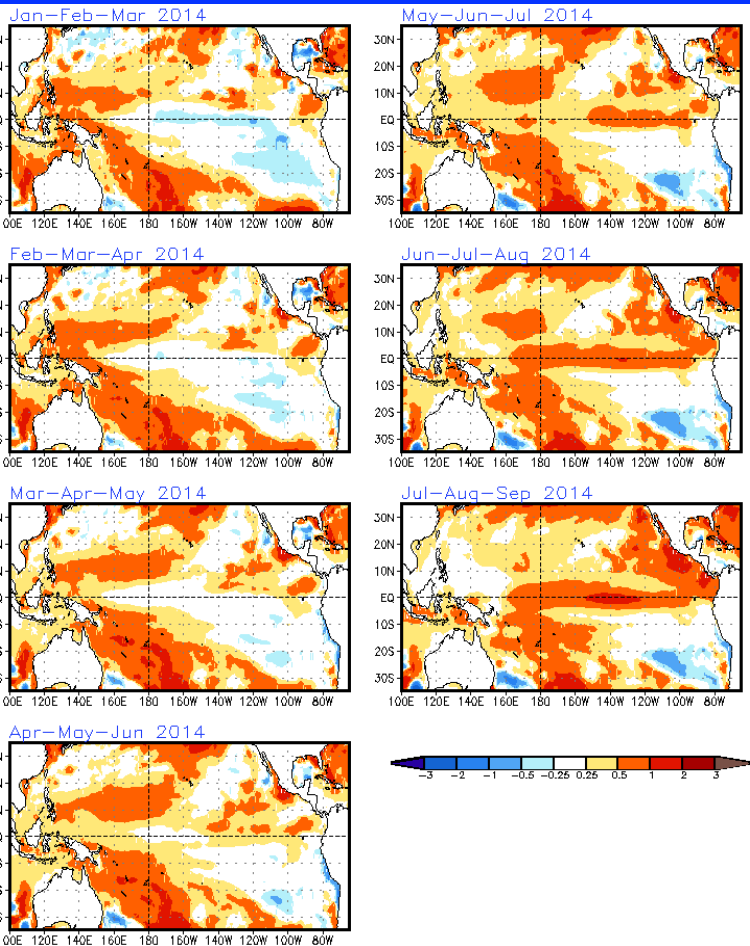


Figure provided by the International Research Institute (IRI) for Climate and Society (updated 17 December 2013).



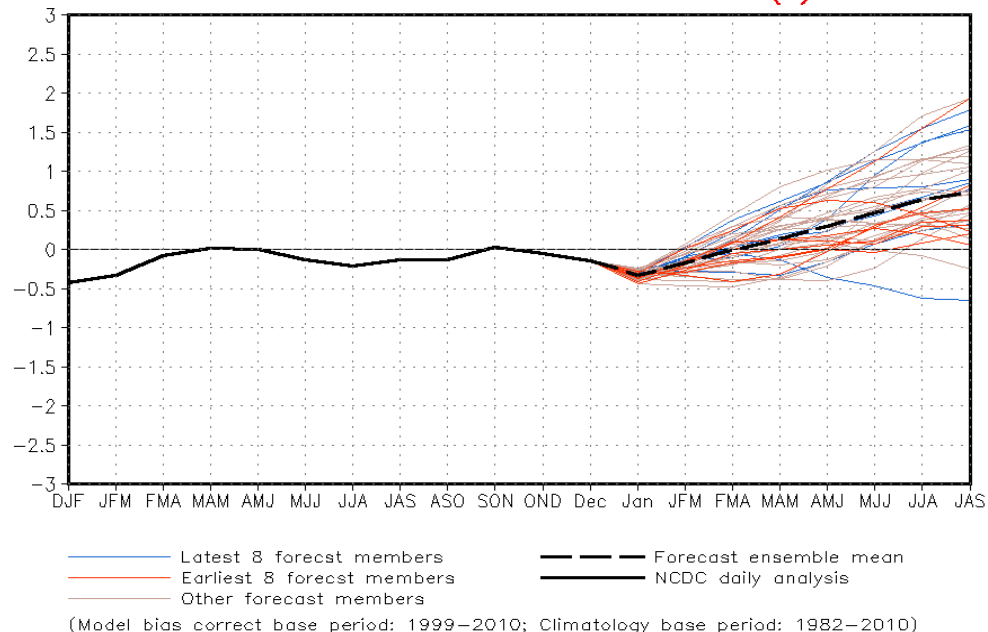
SST Outlook: NCEP CFS.v2 Forecast Issued 30 December 2013

The CFS.v2 ensemble mean (black dashed line) predicts ENSO-neutral through the N.H. spring 2014 followed by El Niño during summer 2014.



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

CFSv2 forecast Nino3.4 SST anomalies (K)

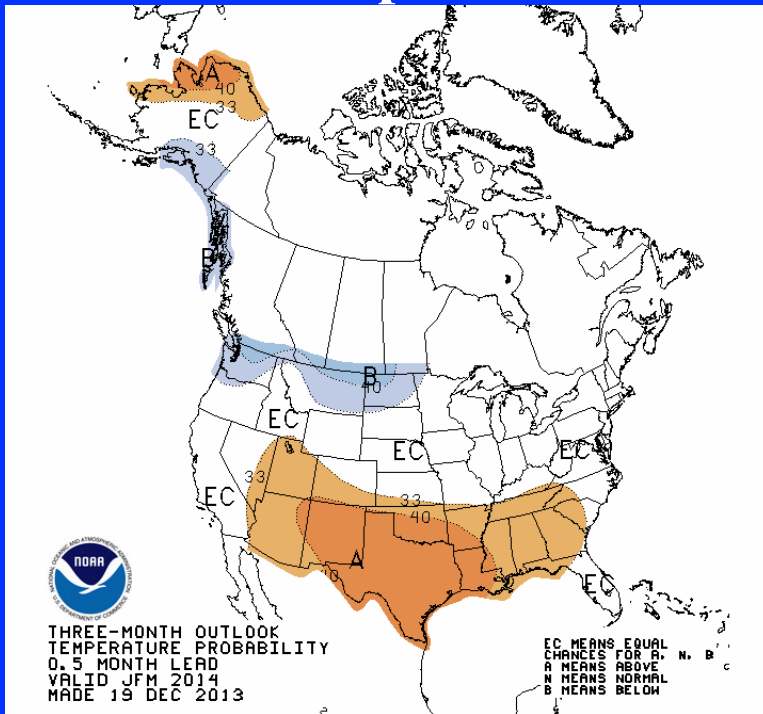


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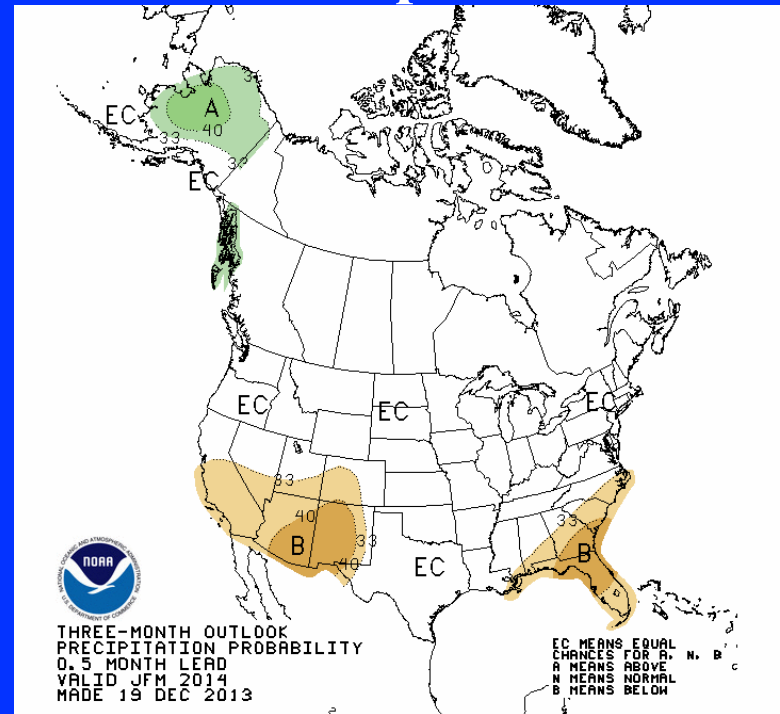


U. S. Seasonal Outlooks January – March 2014

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) are near average across much of the Pacific Ocean.**
- **ENSO-neutral is expected to continue into the Northern Hemisphere summer 2014.***

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