



ENSO Cycle: Recent Evolution, Current Status and Predictions

**Update prepared by
Climate Prediction Center / NCEP
11 February 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

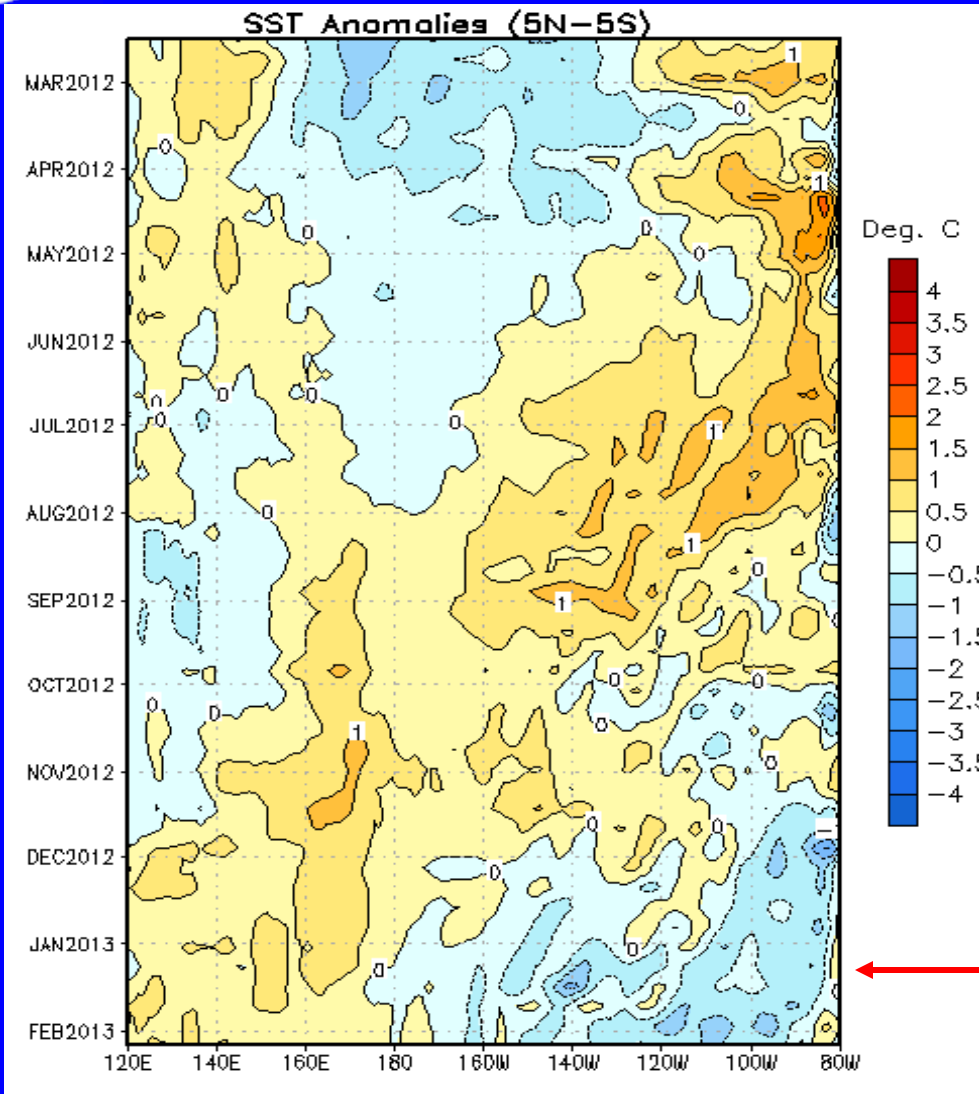
- **ENSO-neutral conditions continue.***
- **Equatorial sea surface temperatures (SST) are near average to below average across the Pacific Ocean.**
- **Over the last month, the atmospheric circulation has been variable partially due to an active Madden-Julian Oscillation (MJO).**
- **ENSO-neutral is favored through Northern Hemisphere spring 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



Recent Evolution of Equatorial Pacific SST Departures (°C)

Time



Longitude

From June - October 2012, above-average SSTs were evident across most of the equatorial Pacific Ocean.

During December 2012- January 2013, below-average SSTs in the eastern Pacific expanded westward.



Niño Region SST Departures (°C) Recent Evolution

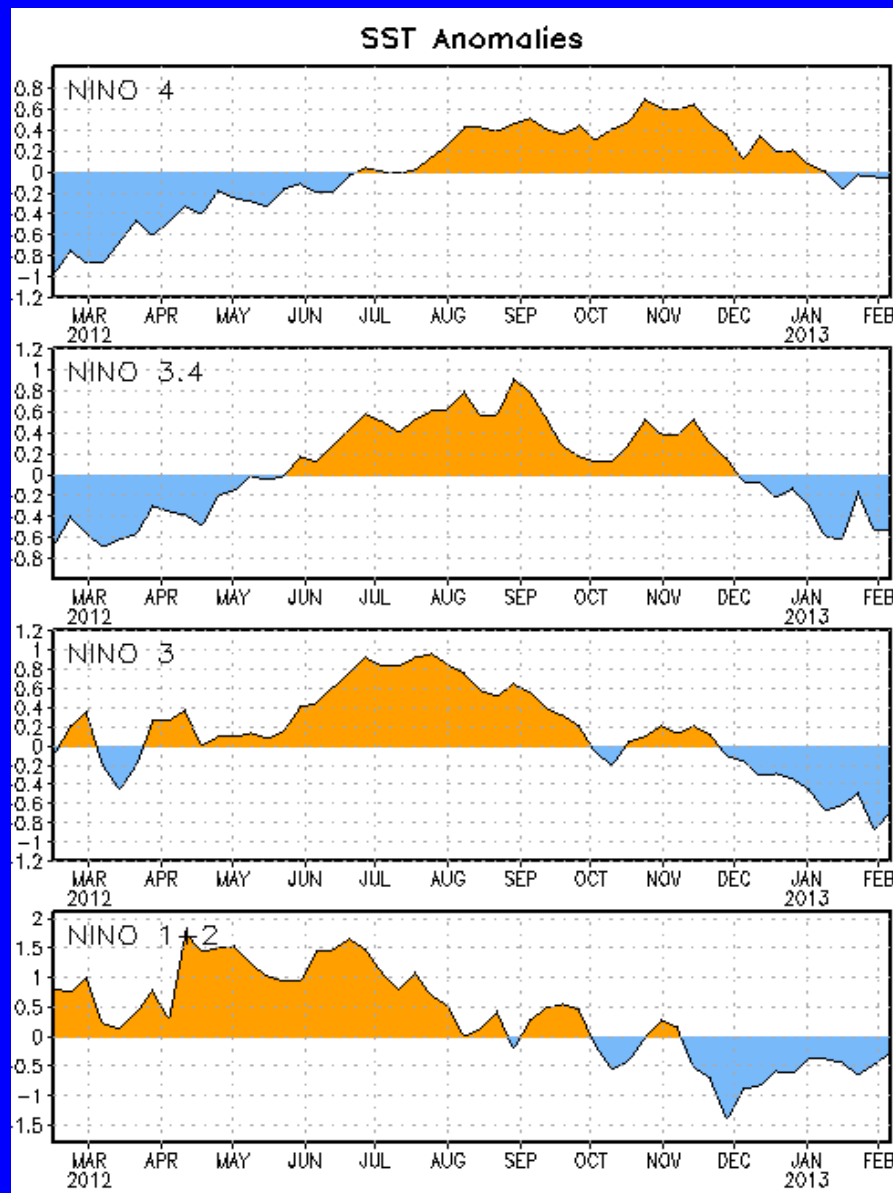
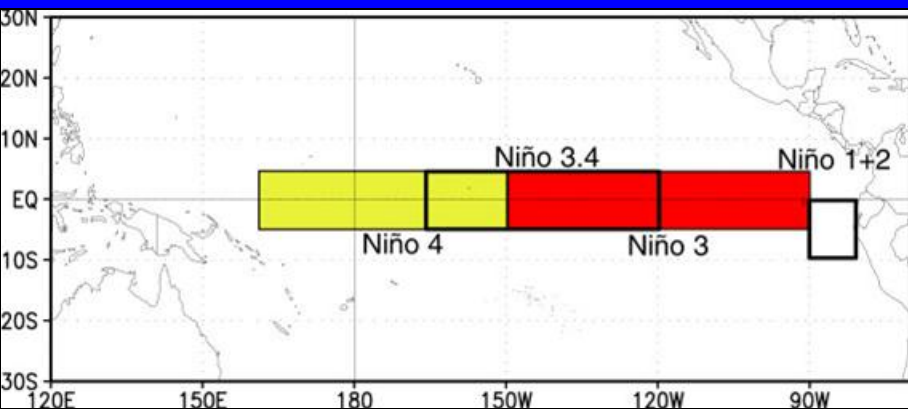
The latest weekly SST departures are:

Niño 4 **-0.1°C**

Niño 3.4 **-0.5°C**

Niño 3 **-0.7°C**

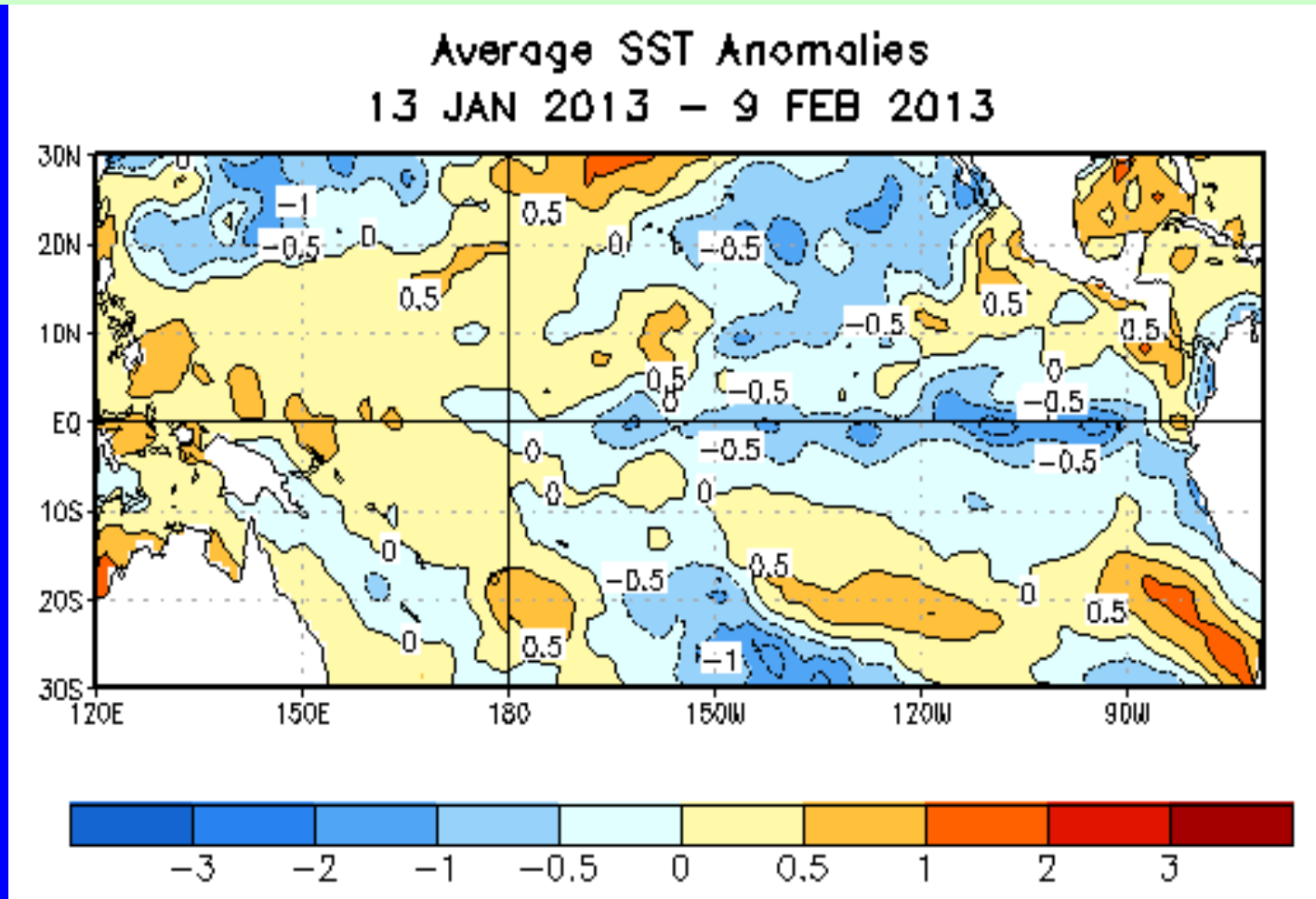
Niño 1+2 **-0.2°C**





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

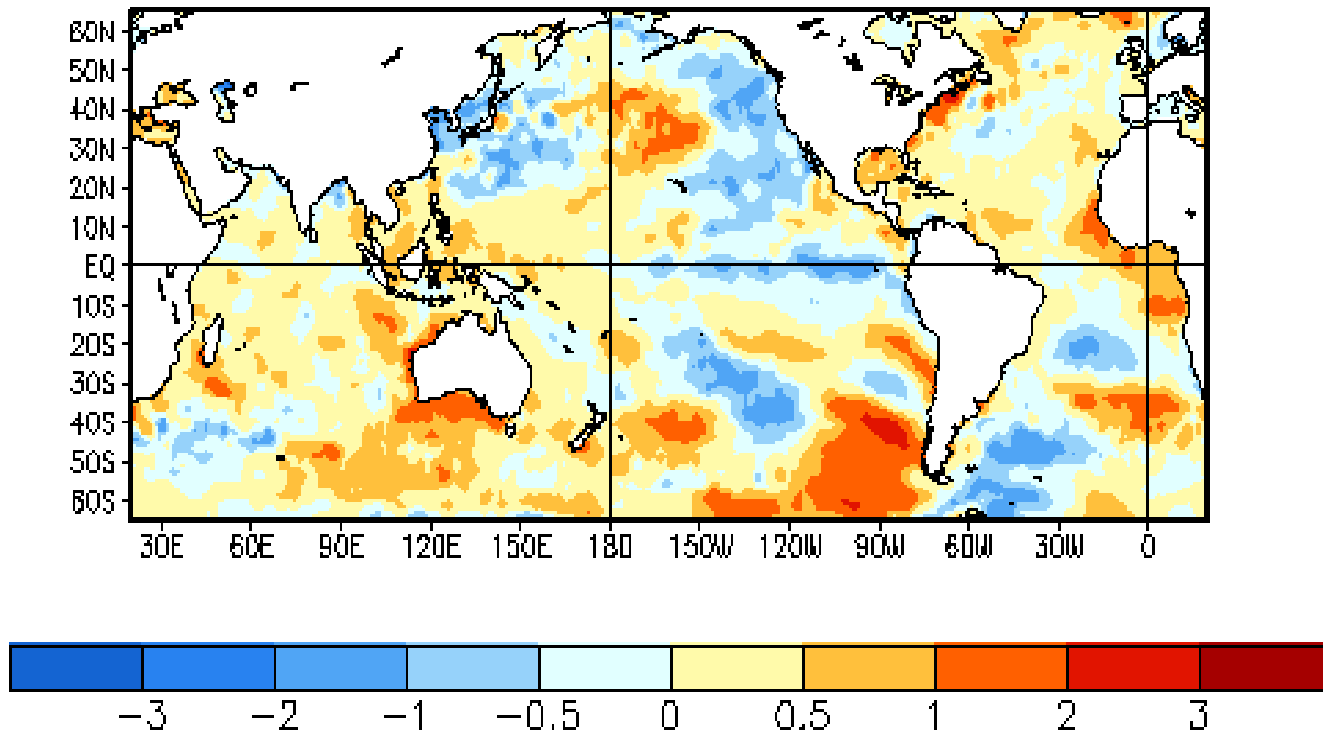
During the last 4-weeks, equatorial SSTs were more than 0.5°C below average across the eastern half of the Pacific Ocean.





Global SST Departures (°C)

Average SST Anomalies
13 JAN 2013 – 9 FEB 2013

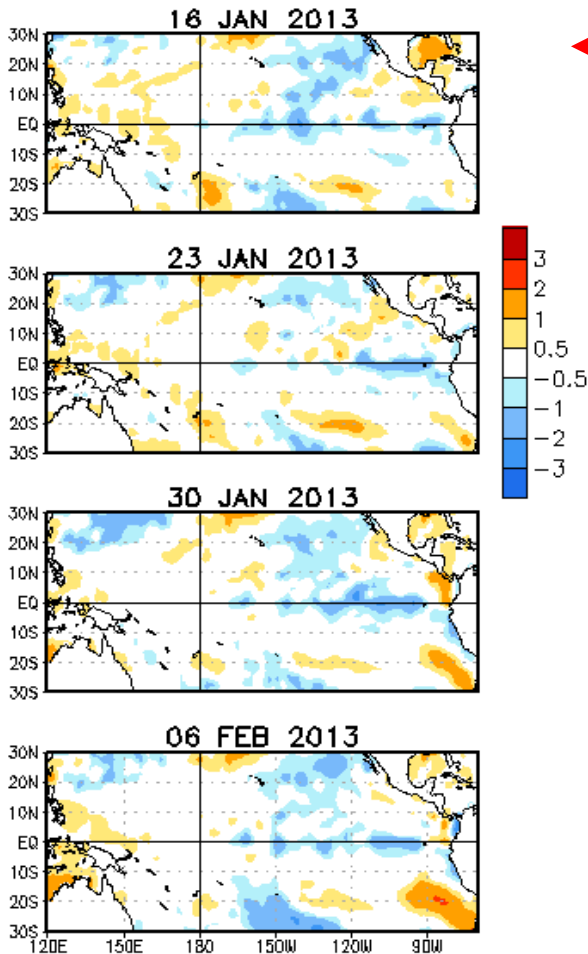


During the last four weeks, equatorial SSTs were above average across the western Pacific Ocean and the eastern Atlantic Ocean. SSTs were below average in the central and eastern Pacific Ocean.



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

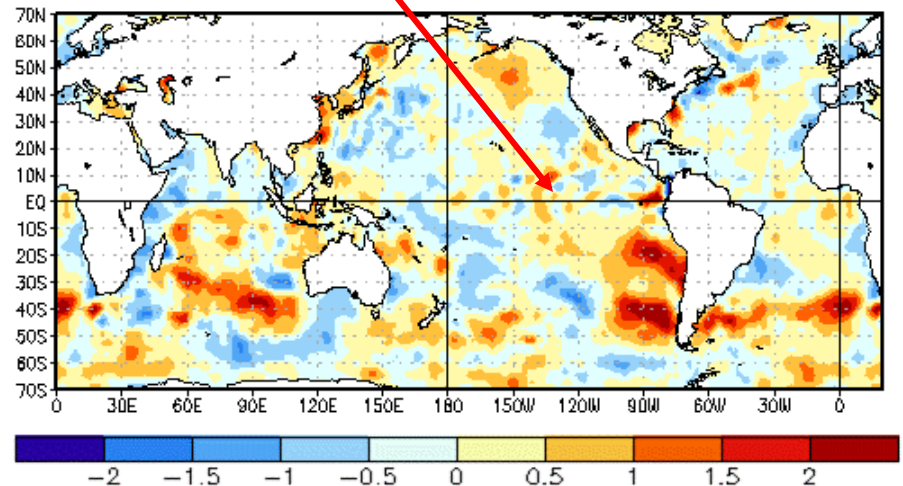
Weekly SST Anomalies (DEG C)



• Since the middle of January 2013, below average SSTs have persisted in the eastern Pacific.

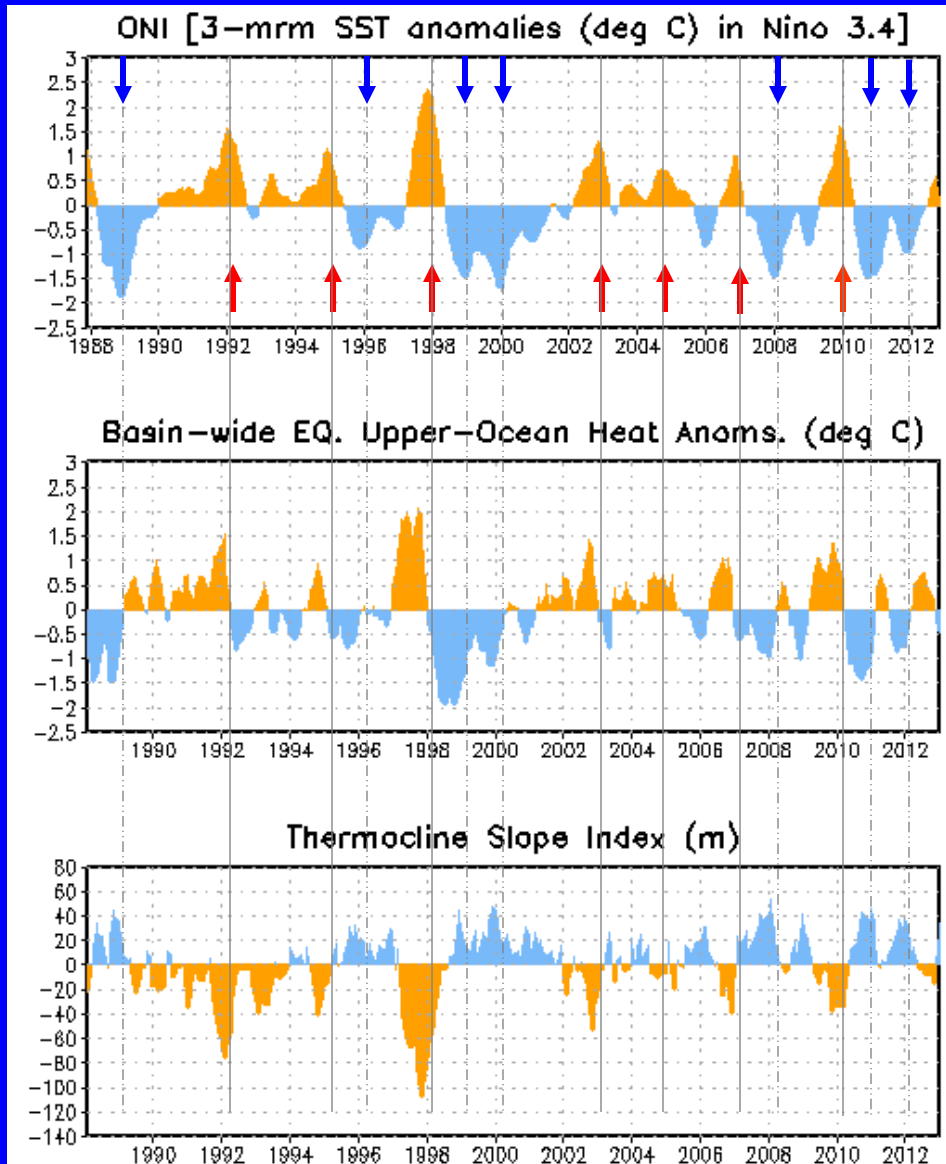
• Small changes in SSTs are evident across the equatorial Pacific over the last month.

Change in Weekly SST Anoma (°C)
06FEB2013 minus 09JAN2013





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.

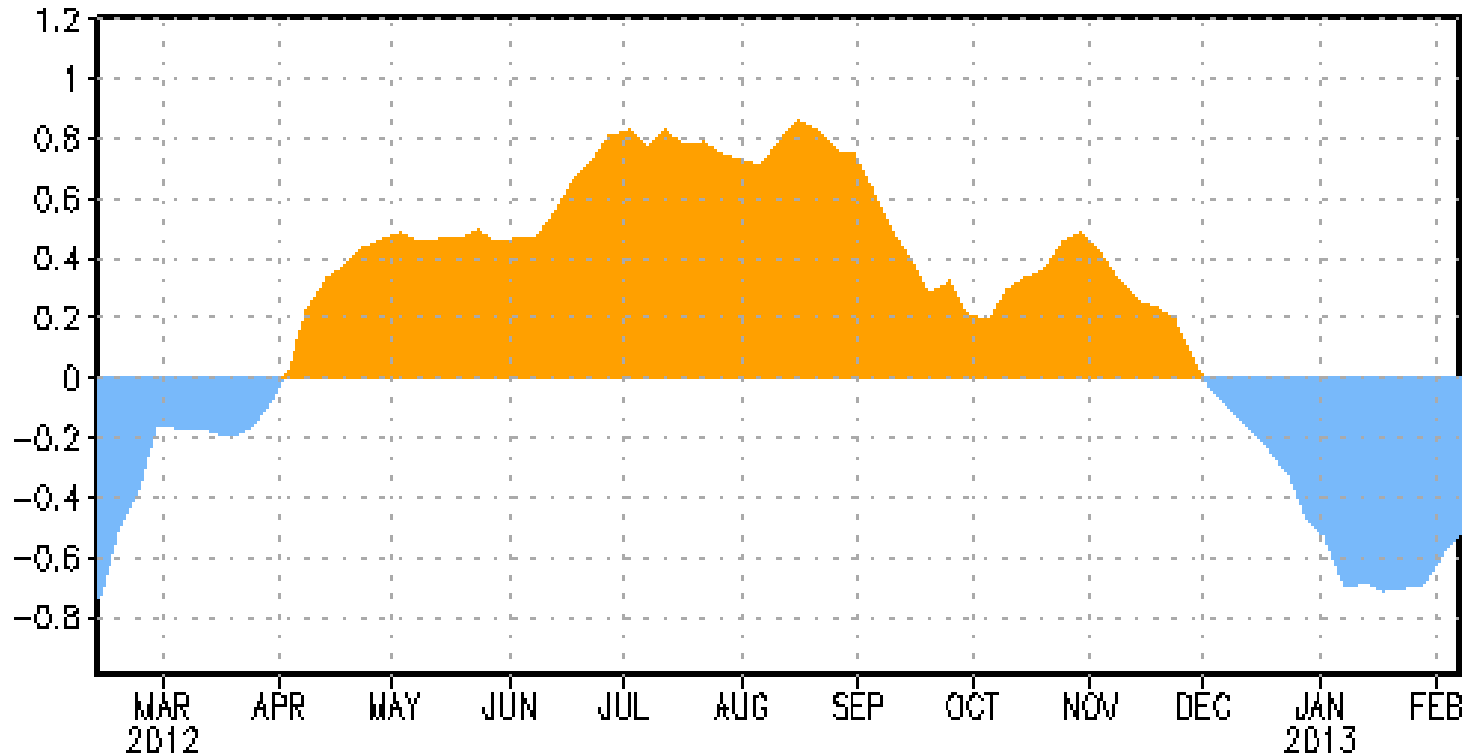
- Recent values of the upper-ocean heat anomalies (slightly negative) and a near zero thermocline slope index reflect ENSO neutral conditions.

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



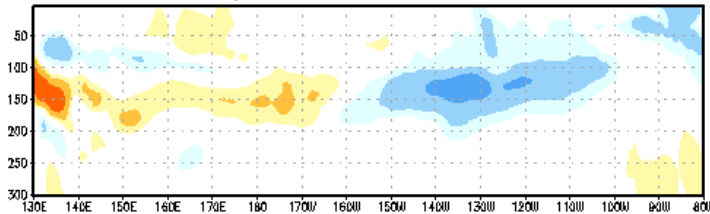
From April - November 2012, the subsurface temperatures were above-average. Since November, anomalies have decreased, becoming negative in December 2012. During January 2013, the negative subsurface temperature anomalies remained nearly unchanged. Recently, subsurface temperature anomalies have increased.



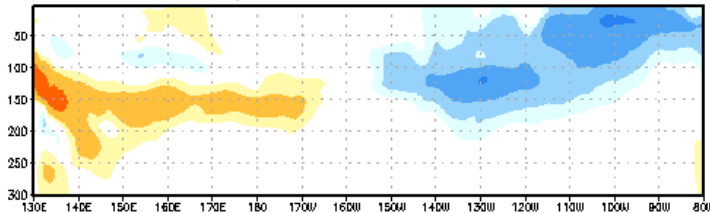
Sub-Surface Temperature Departures (°C) in the Equatorial Pacific

EQ. Subsurface Temperature Anomalies (deg C)

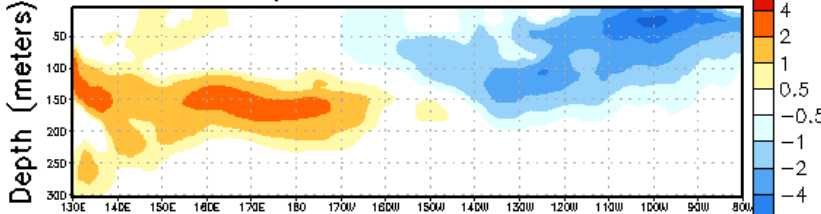
Three-pentad ave. centered on 19 DEC 2012



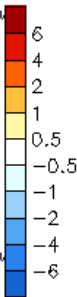
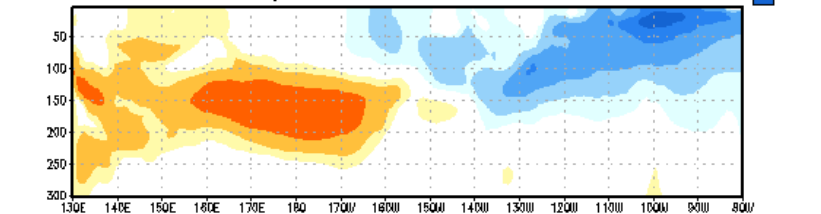
Three-pentad ave. centered on 03 JAN 2013



Three-pentad ave. centered on 18 JAN 2013



Three-pentad ave. centered on 02 FEB 2013



Time

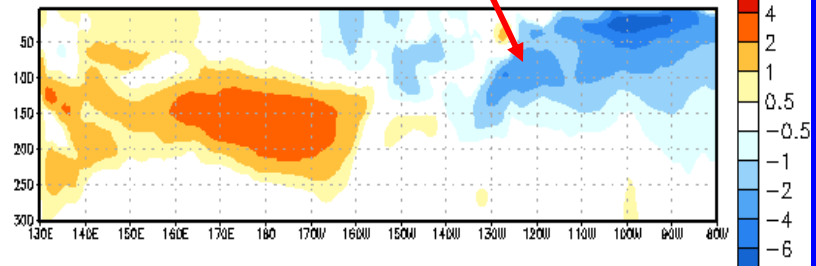


Longitude

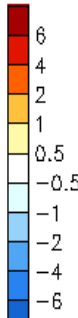
- In the last two months, negative subsurface temperature anomalies shifted eastward across the equatorial Pacific.
- Meanwhile, positive subsurface temperature anomalies have increased at depth in the western Pacific and have expanded eastward to ~150°W.
- Recently, the negative subsurface temperature anomalies have weakened slightly in the east-central Pacific.

EQ. Subsurface Temperature Anomalies (deg C)

Pentad centered on 07 FEB 2013

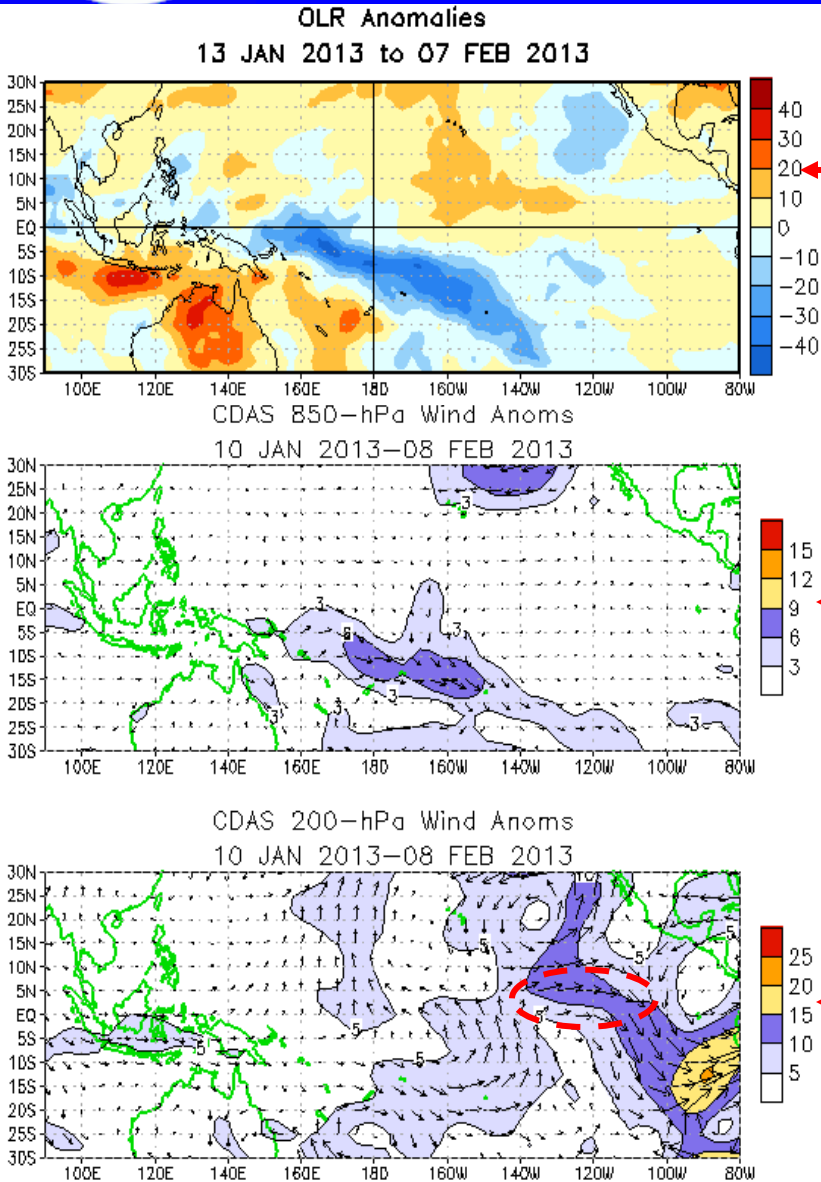


Most recent pentad analysis





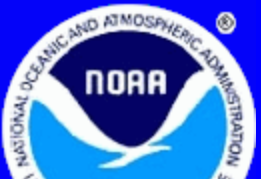
Tropical OLR and Wind Anomalies During the Last 30 Days



Negative OLR anomalies (enhanced convection and precipitation, blue shading) were observed just to the west of the Date Line and in a band extending southeastward over the S. Pacific. Positive OLR anomalies (suppressed convection and precipitation, red shading) were evident near Indonesia and northern Australia.

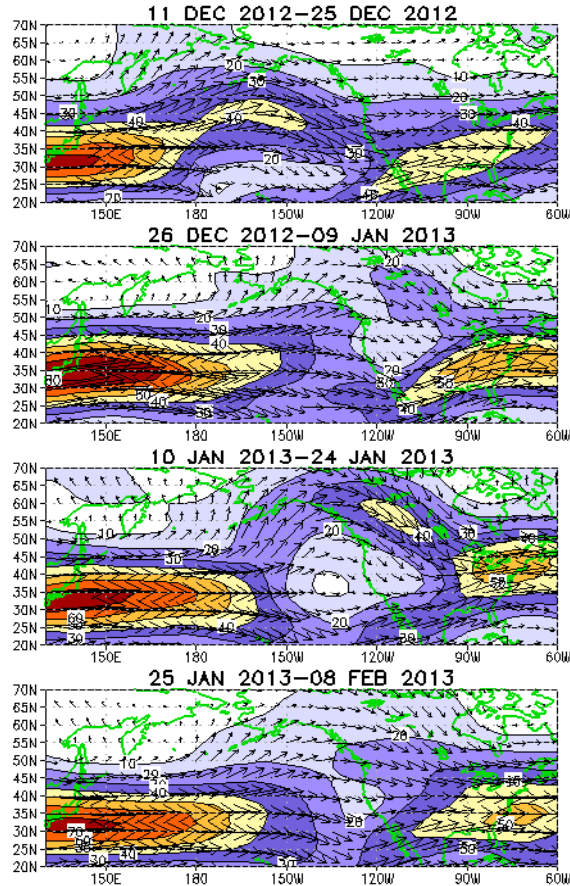
Anomalous low-level (850-hPa) winds were near average across much of the equatorial Pacific.

Anomalous upper-level (200-hPa) westerly winds were evident over the eastern equatorial Pacific.

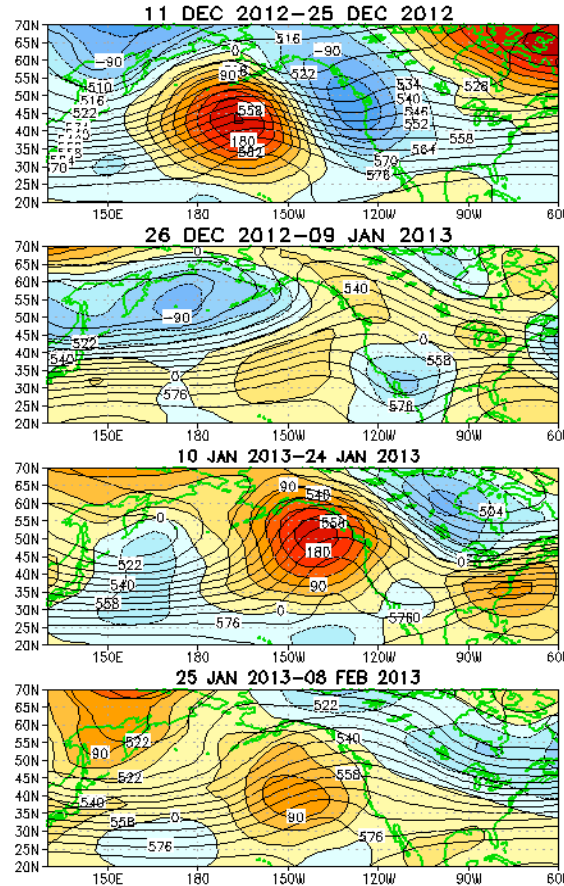


Atmospheric Circulation over the North Pacific & North America During the Last 60 Days

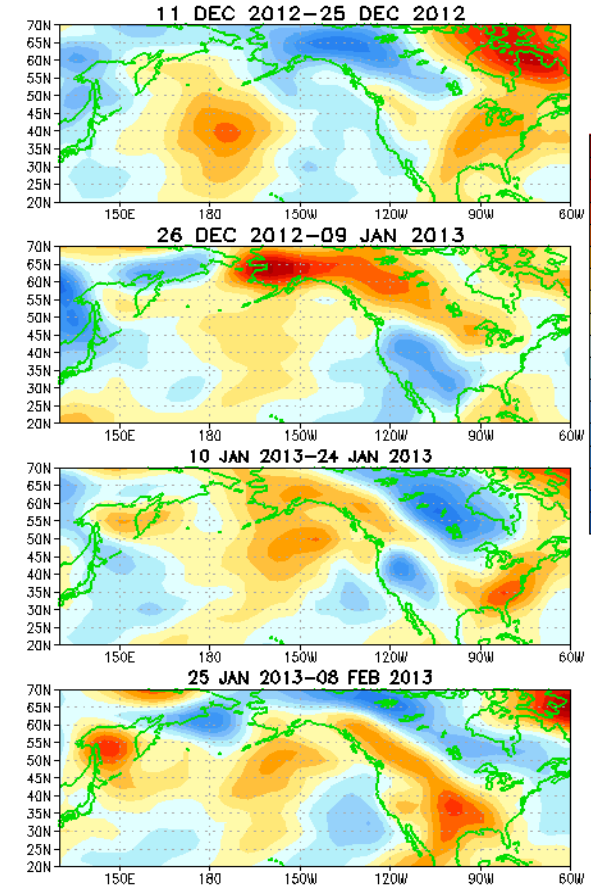
200-hPa Wind



500-hPa Height & Anoms.



925-hPa Temp. Anoms. (°C)



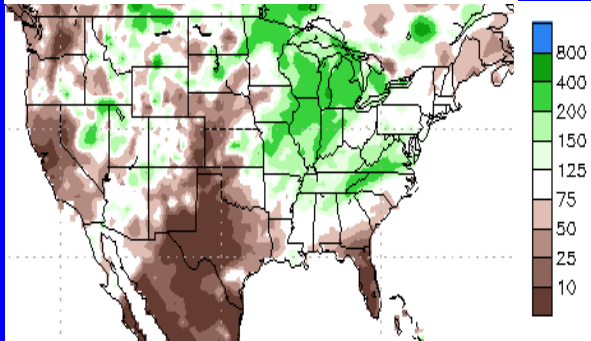
During the period, an anomalous ridge has been evident in the N. Pacific, with a downstream trough in proximity to the western U.S. and an anomalous ridge over the eastern U.S. Associated with these height anomalies, mostly below-average temperatures have been observed in the western U.S. with above-average temperatures often occurring over the eastern U.S.



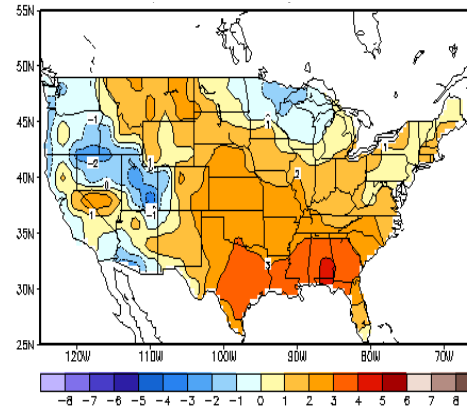
U.S. Temperature and Precipitation Departures During the Last 30 and 90 Days

Last 30 Days

30-day (ending 9 Feb 2013) % of average precipitation

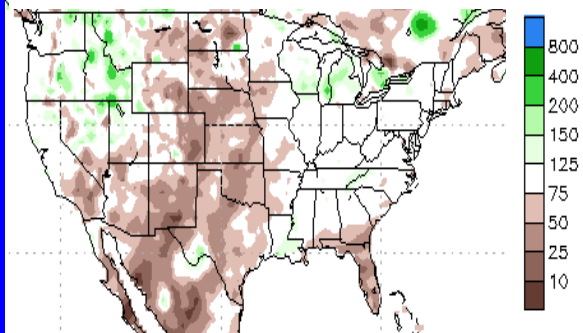


30-day (ending 9 Feb 2013)
temperature departures (degree C)

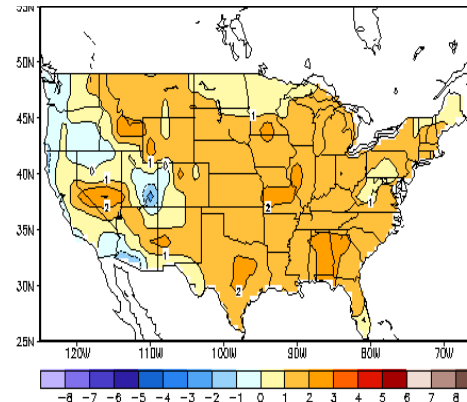


Last 90 Days

90-day (ending 9 Feb 2013) % of average precipitation



90-day (ending 9 Feb 2013)
temperature departures (degree C)



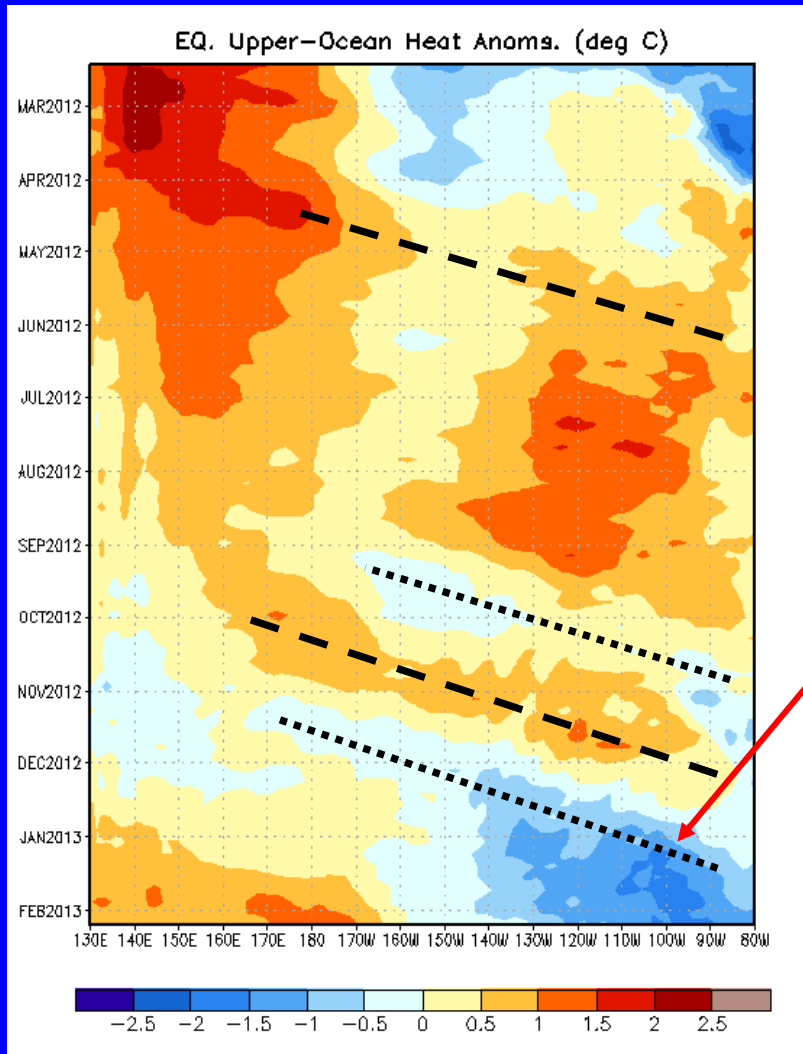


Intraseasonal Variability

- **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



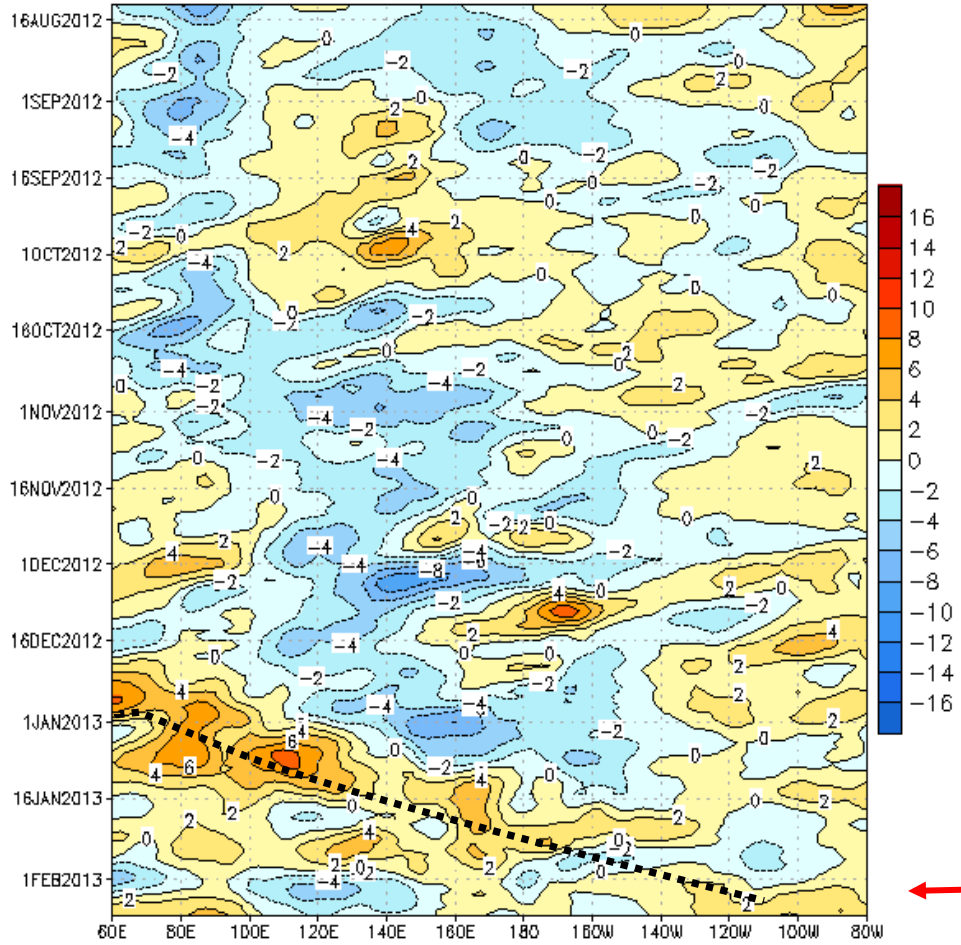
- From March- May 2012, heat content anomalies increased across much of the equatorial Pacific, partly in association with the downwelling phase of a Kelvin wave.
- During October-November 2012, heat content anomalies increased associated with the downwelling phase of a weak Kelvin wave.
- In December 2012- January 2013, an upwelling phase of a Kelvin wave contributed to negative heat content anomalies in the eastern half of the equatorial Pacific.
- Recently, heat content anomalies have increased near the Date Line, while below average heat content has persisted in the eastern half of the Pacific.

• 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})

CDAS 850-hPa U Anoms. (5N-5S)



Time



Longitude

Westerly wind anomalies
(orange/red shading).

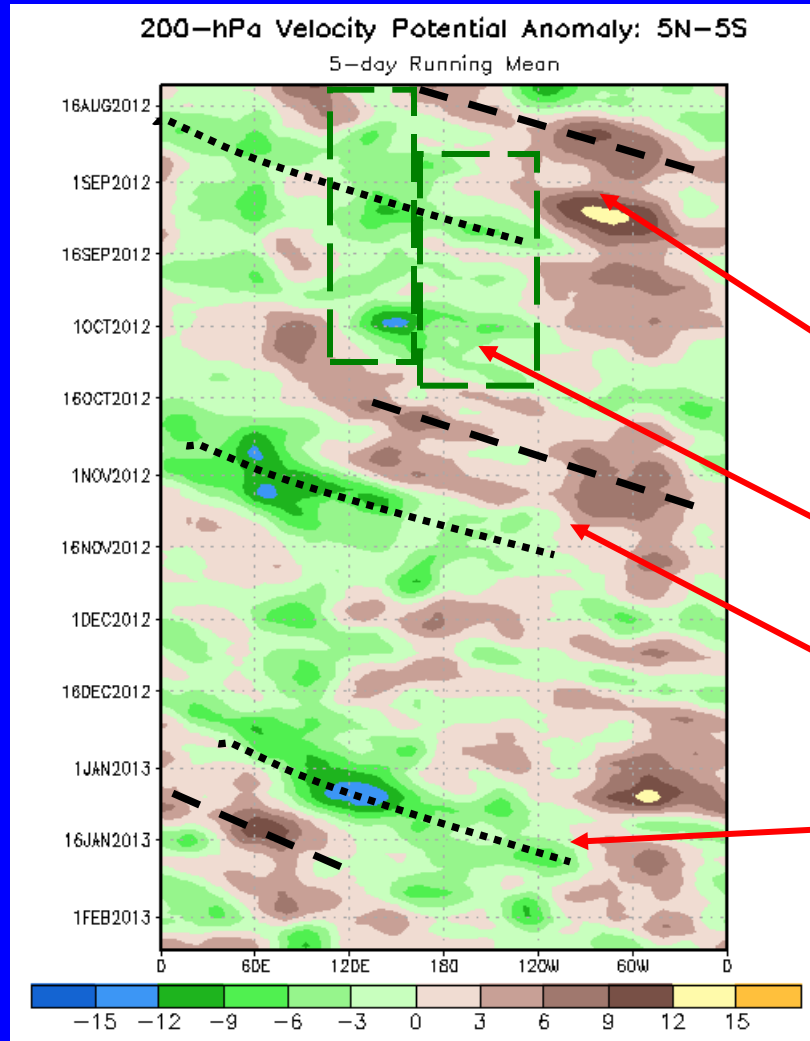
Easterly wind anomalies (blue
shading).

During January 2013, the Madden
Julian Oscillation (MJO) was evident
in the eastward shift of easterly and
westerly wind anomalies.

Currently, equatorial westerly wind
anomalies are located over the eastern
Pacific, while easterly wind anomalies
are evident over the western 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 MJO was active during late July through September 2012.

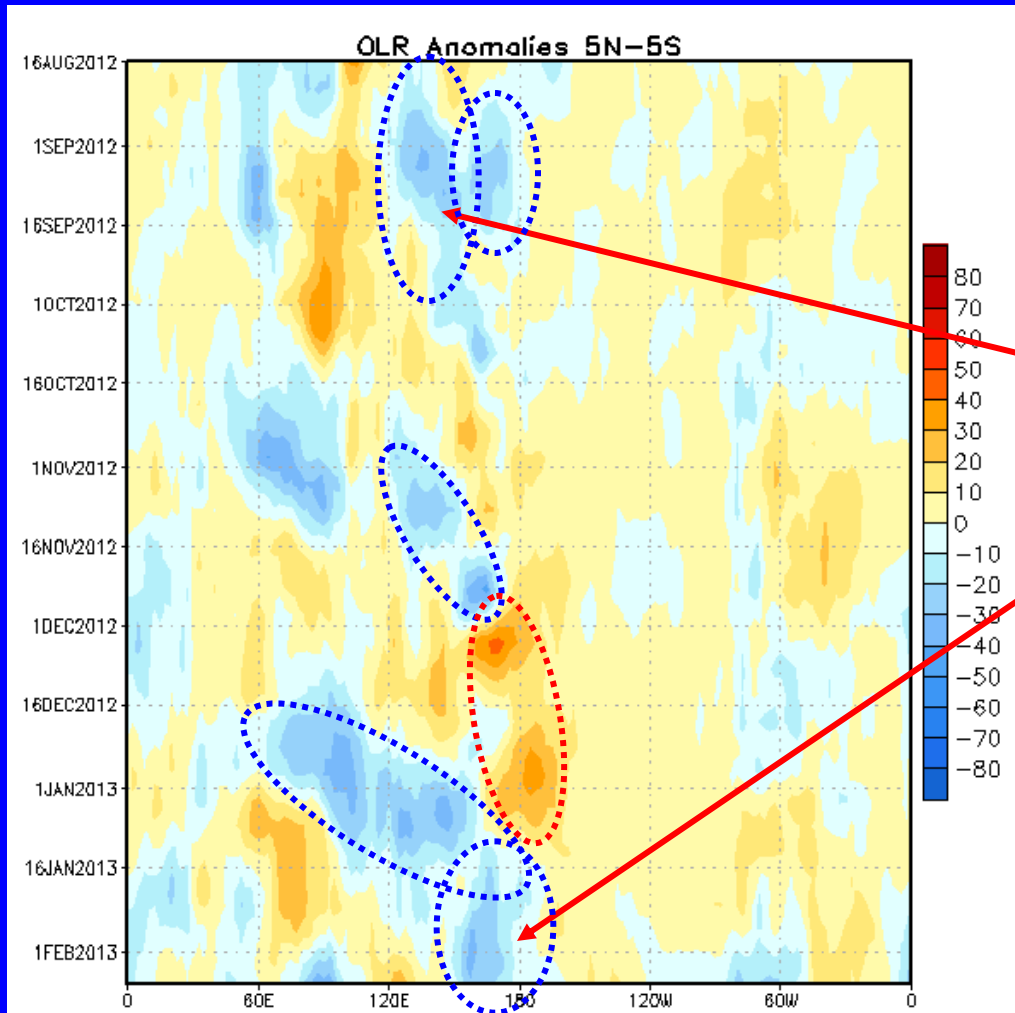
During September and early October, upper-level divergence (green) expanded eastward to near the Date Line.

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

The Madden Julian Oscillation (MJO) emerged in early January, but recently eastward propagation has paused.



Outgoing Longwave Radiation (OLR) Anomalies



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

Wetter-than-average conditions (blue shading)

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

Recently, negative OLR anomalies persisted just to the west of the Date Line.

Longitude



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.

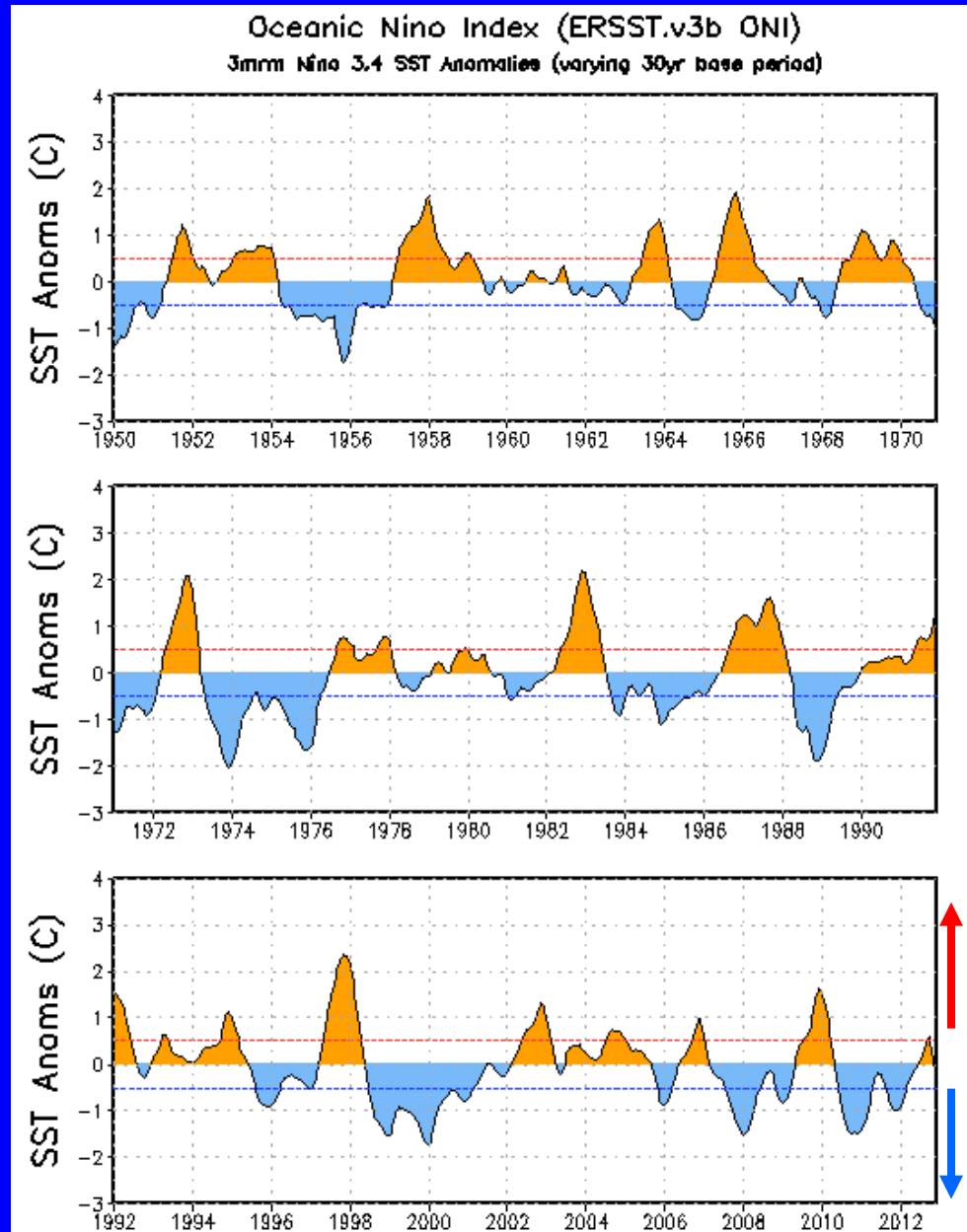
By historical standards, to be classified as a full-fledged El Niño or La Niña episode, these thresholds must be exceeded for a period of at least 5 consecutive overlapping 3-month seasons.

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 (November 2012 – January 2013) is **-0.3°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	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:

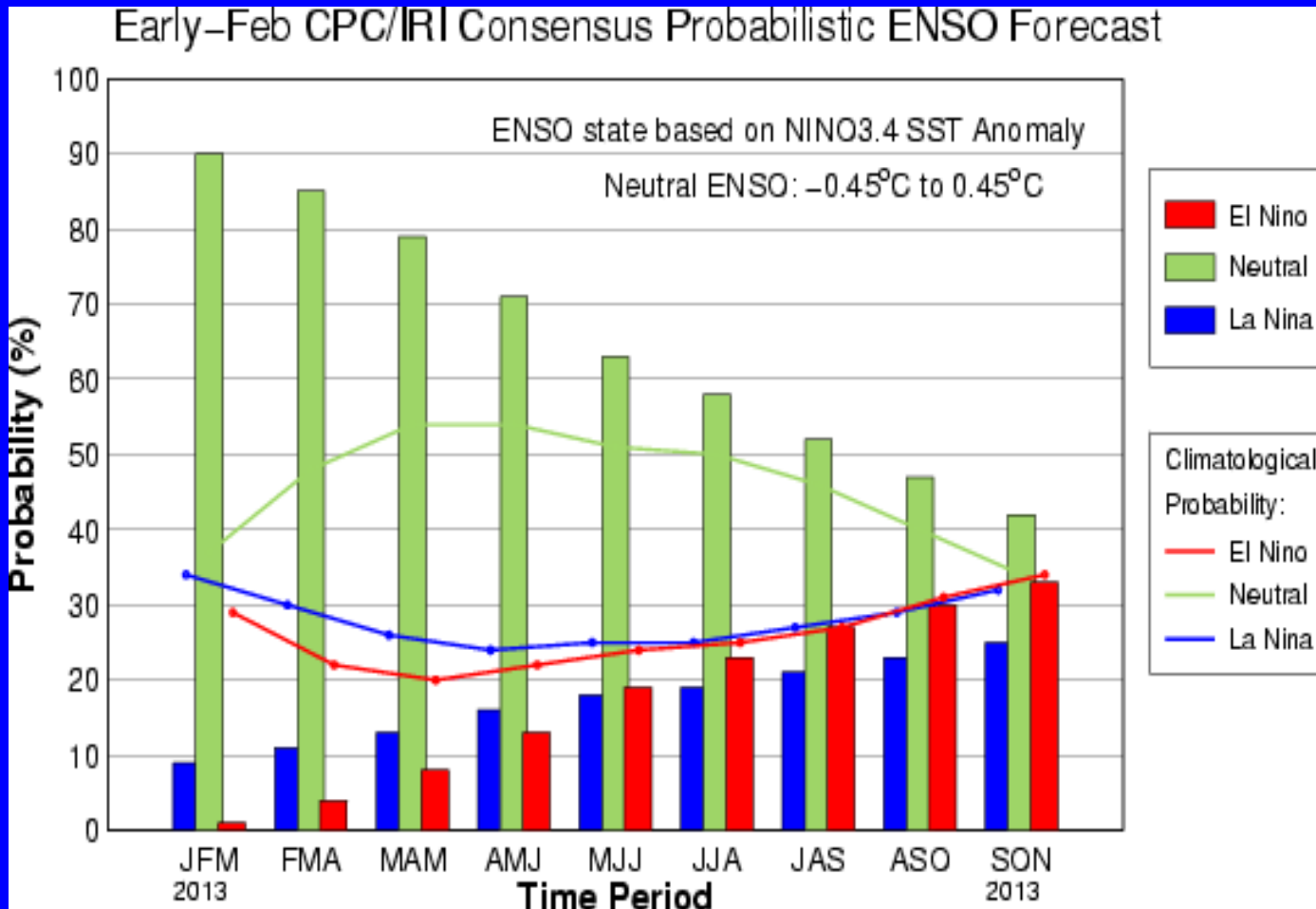
[Historical ONI Values](#)



CPC/IRI Probabilistic ENSO Outlook

(updated 7 Feb 2013)

ENSO-neutral is favored into Northern Hemisphere fall 2013.





Pacific Niño 3.4 SST Outlook

- Most models predict the persistence of current Niño-3.4 values, with ENSO-neutral (-0.5°C to $+0.5^{\circ}\text{C}$) continuing through the Northern Hemisphere summer 2013.

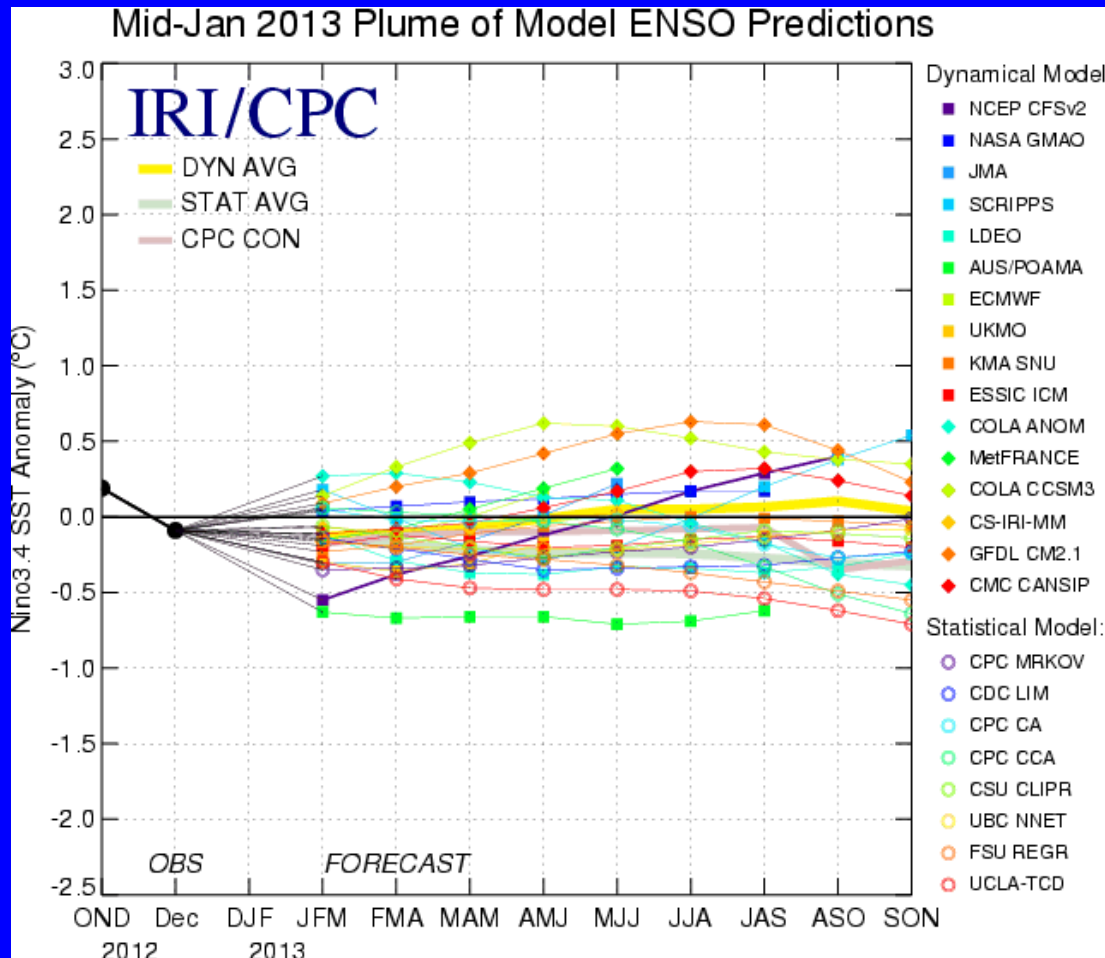


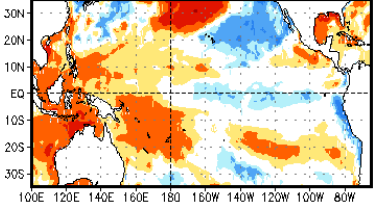
Figure provided by the International Research Institute (IRI) for Climate and Society (updated 15 Jan 2012).



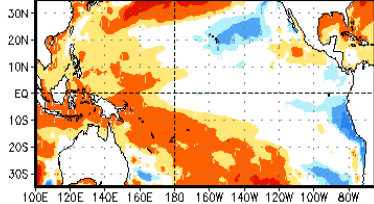
SST Outlook: NCEP CFS.v2 Forecast

Issued 10 February 2013

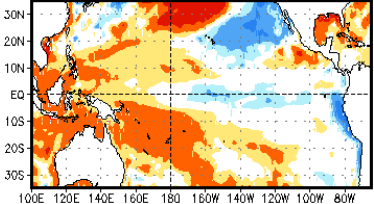
Feb-Mar-Apr 2013



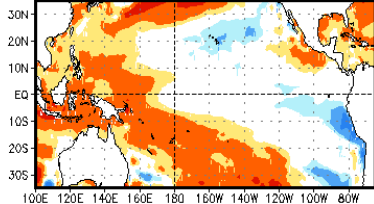
Jun-Jul-Aug 2013



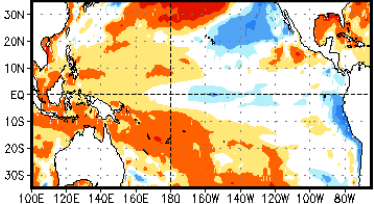
Mar-Apr-May 2013



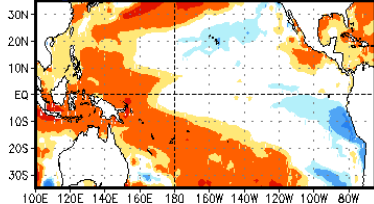
Jul-Aug-Sep 2013



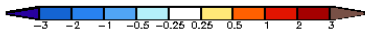
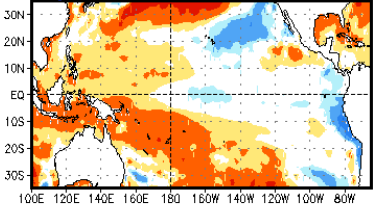
Apr-May-Jun 2013



Aug-Sep-Oct 2013



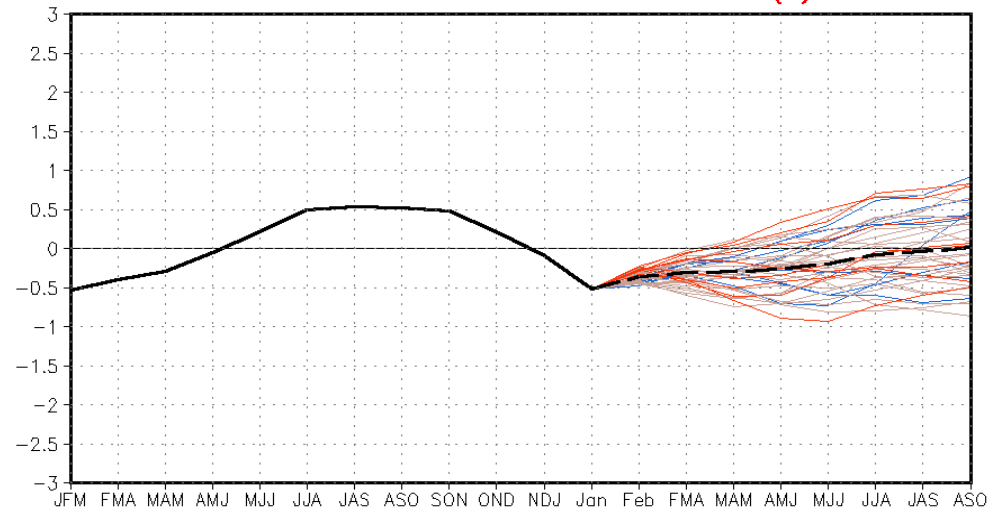
May-Jun-Jul 2013



(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, and a gradual increase in SST anomalies into summer 2013.

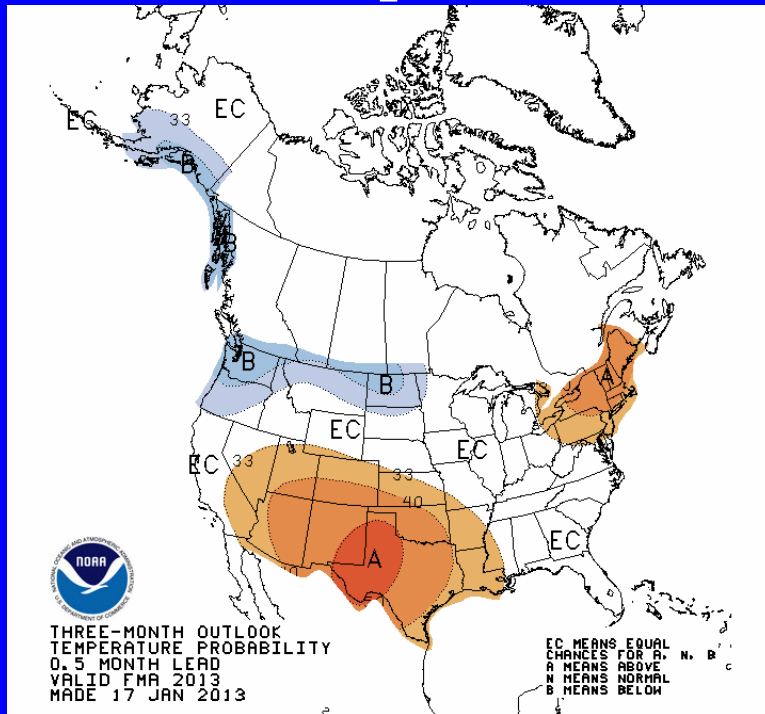
CFSv2 forecast Nino3.4 SST anomalies (K)



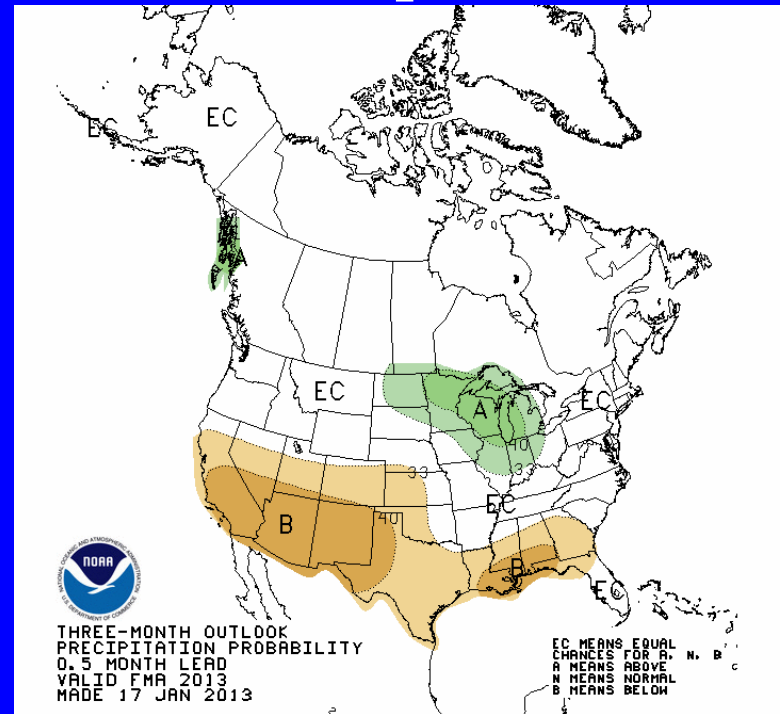


U. S. Seasonal Outlooks February – April 2013

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 to below average across the Pacific Ocean.**
- **Over the last month, the atmospheric circulation has been variable partially due to an active Madden-Julian Oscillation (MJO).**
- **ENSO-neutral is favored through Northern Hemisphere spring 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