ENSO Cycle: Recent Evolution, Current Status and Predictions

Update prepared by
Climate Prediction Center / NCEP
4 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

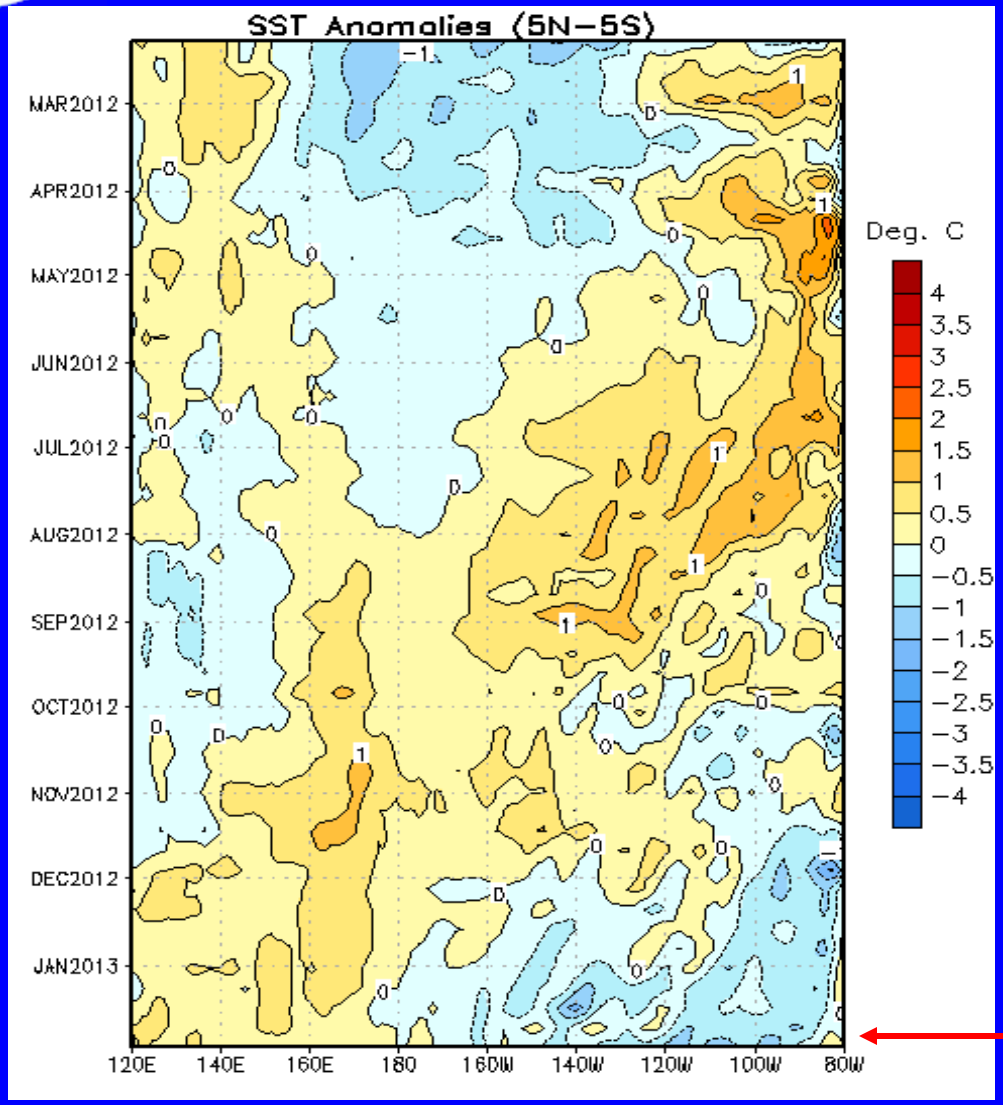
Summary

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.**
- **Some atmospheric circulation features resemble La Niña, but this is at least 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

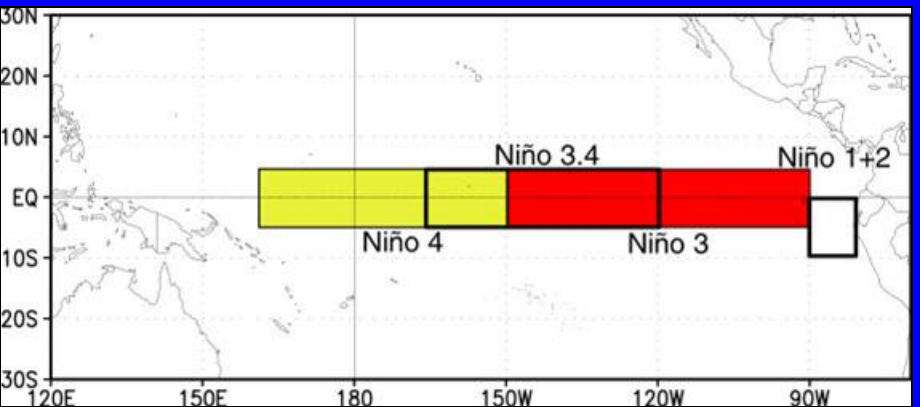
From June - October 2012, above-average SSTs were evident across most of the equatorial Pacific Ocean.

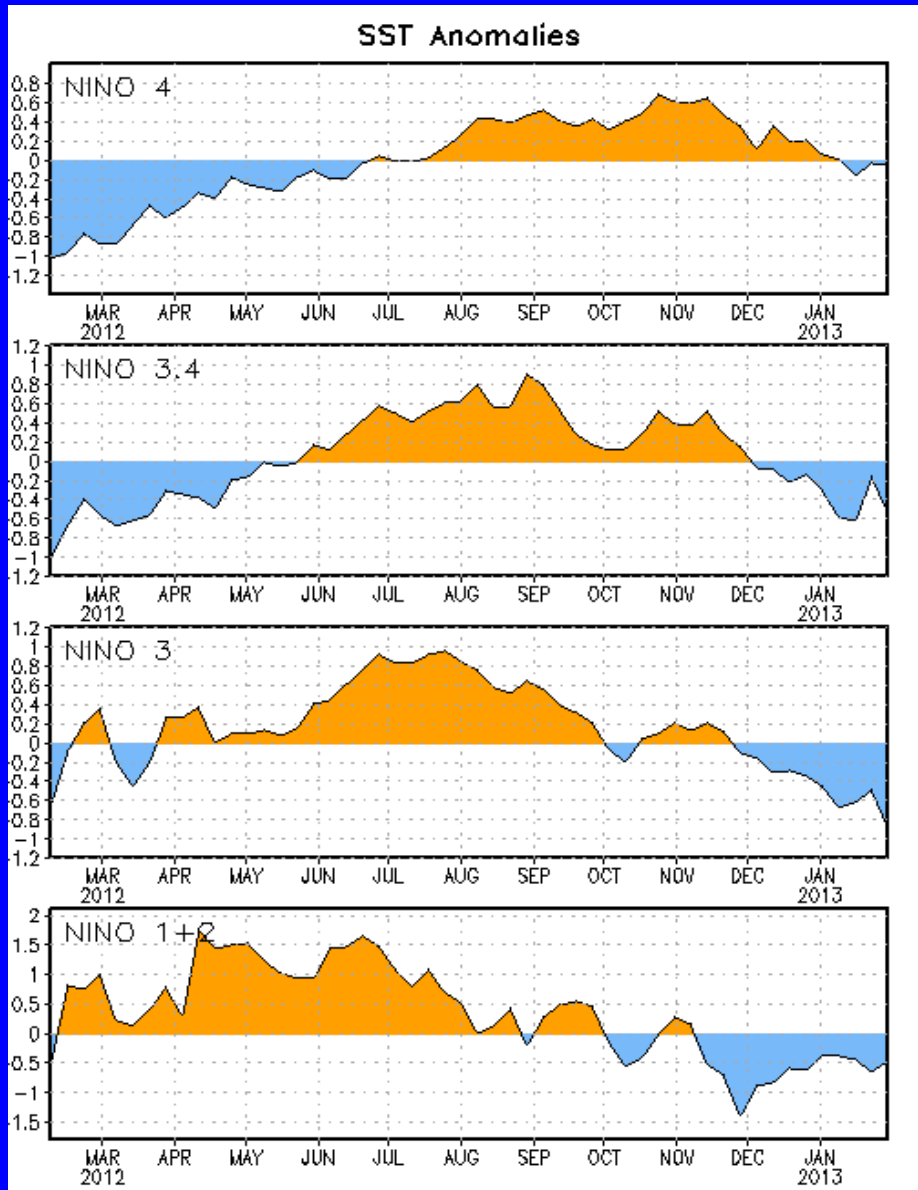
Recently, below-average SSTs in the eastern Pacific have expanded westward.

Niño Region SST Departures (ºC)
Recent Evolution

The latest weekly SST departures are:

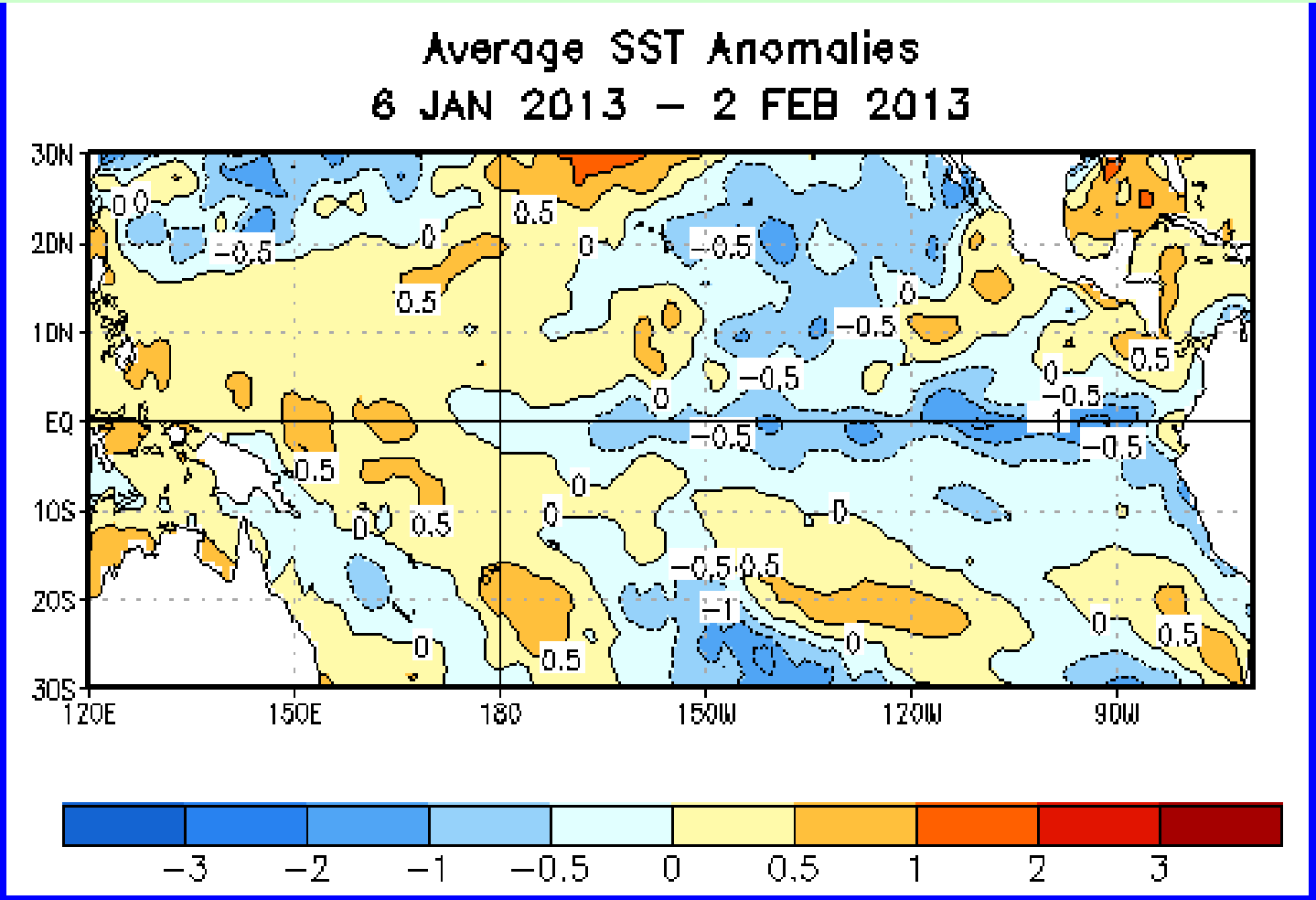
Niño 4	**0.0ºC**
Niño 3.4	**-0.5ºC**
Niño 3	**-0.9ºC**
Niño 1+2	**-0.5ºC**



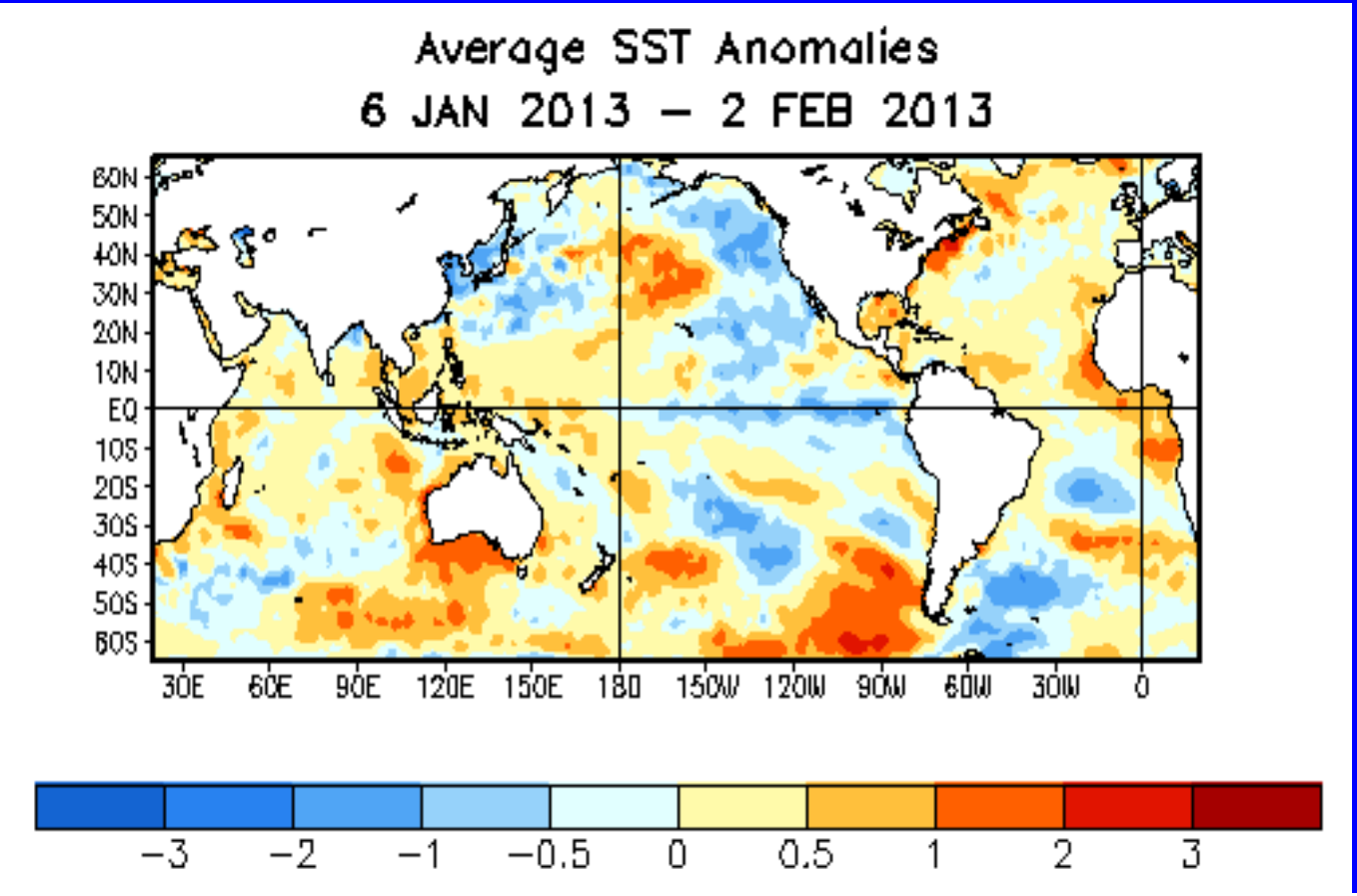


SST Departures (ºC) in the Tropical Pacific During the Last 4 Weeks

During the last 4-weeks, equatorial SST anomalies were more than 0.5ºC below average in the central and eastern Pacific.

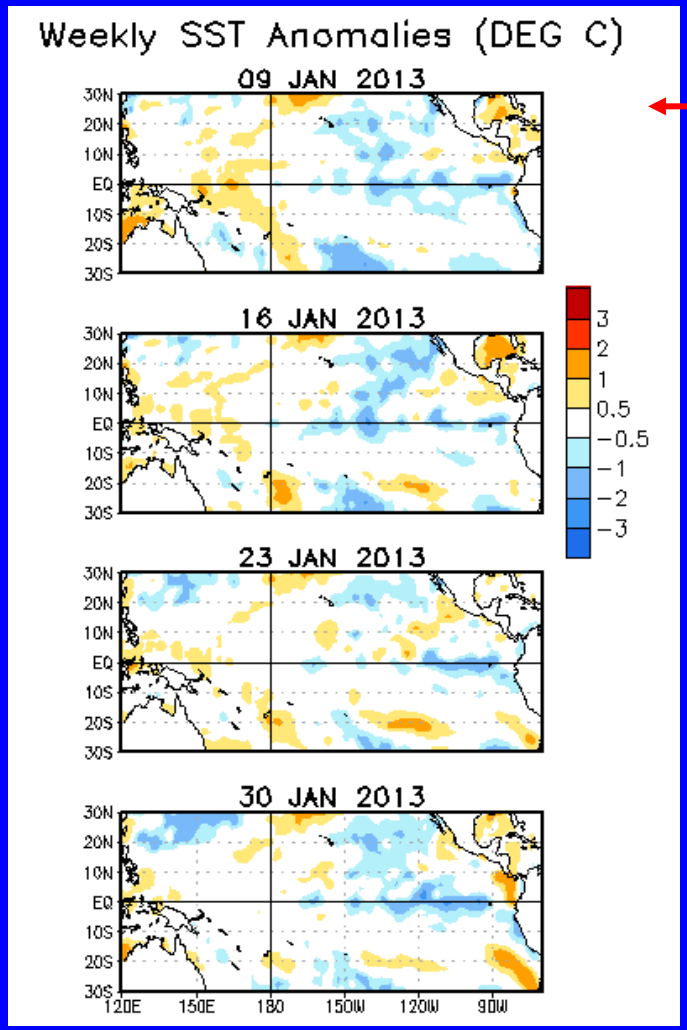


Global SST Departures (°C)

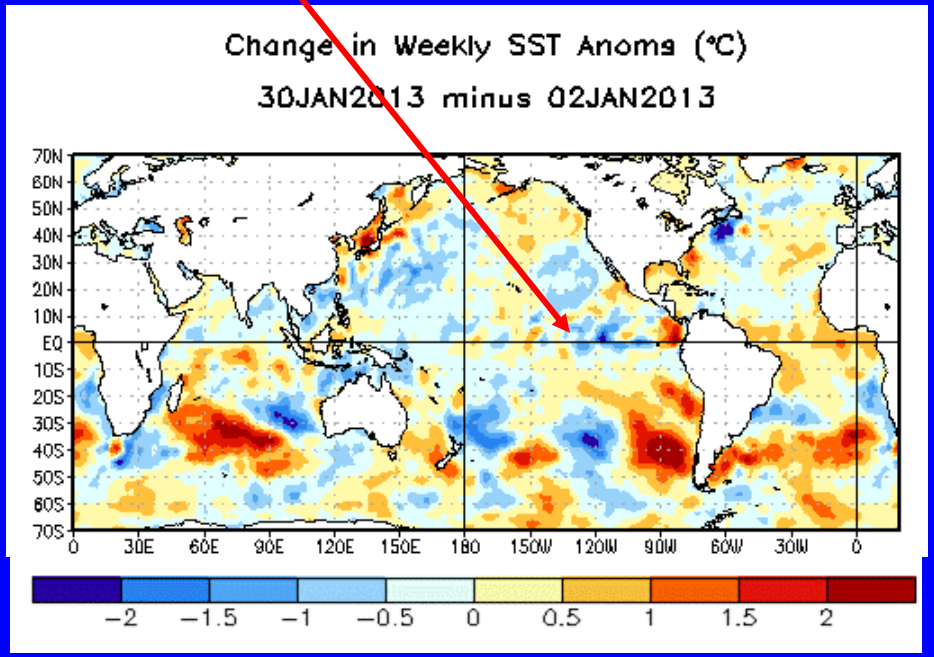


During the last four weeks, equatorial SSTs were above average across the western Pacific Ocean and the eastern Atlantic Ocean. SSTs were below average in the central and eastern Pacific Ocean.

Weekly SST Departures (ºC) for the Last Four Weeks



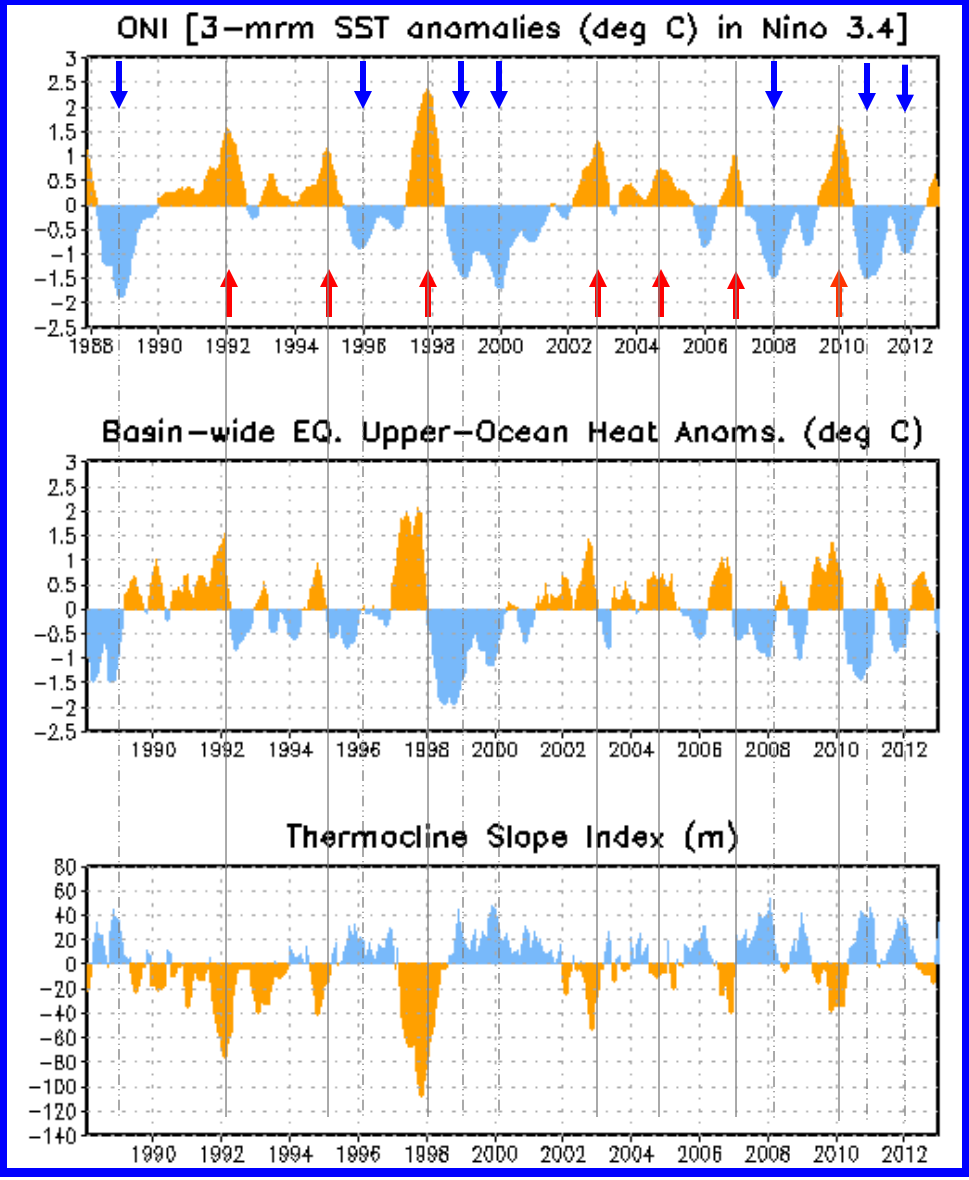
- **Since the beginning of January 2013, below average SST anomalies have persisted in the eastern Pacific.**
- **SST anomalies across the eastern Pacific have become more negative.**



Upper-Ocean Conditions in the Eq. Pacific

Cold Episodes ↓

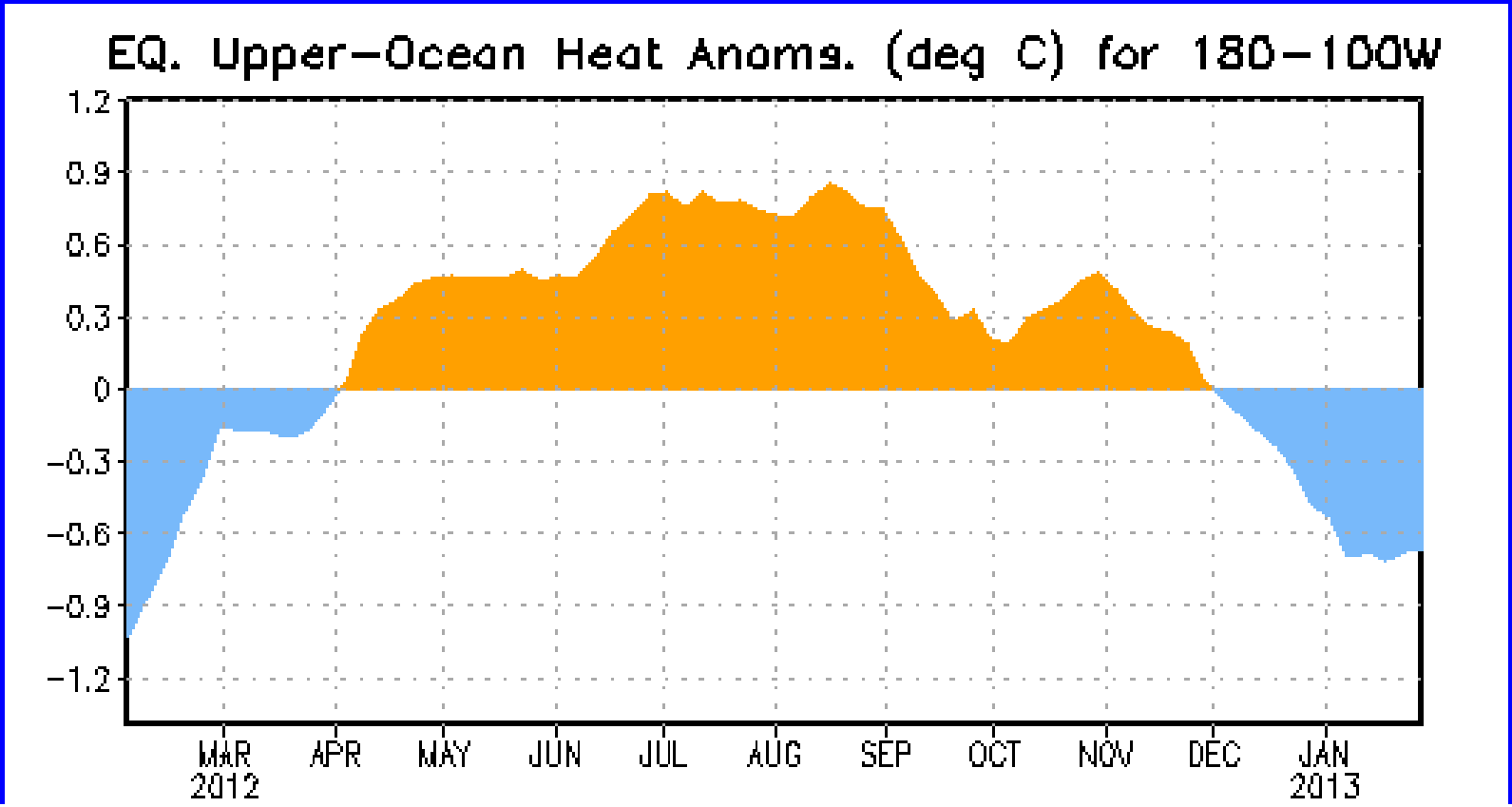
Warm Episodes ↑



- 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.

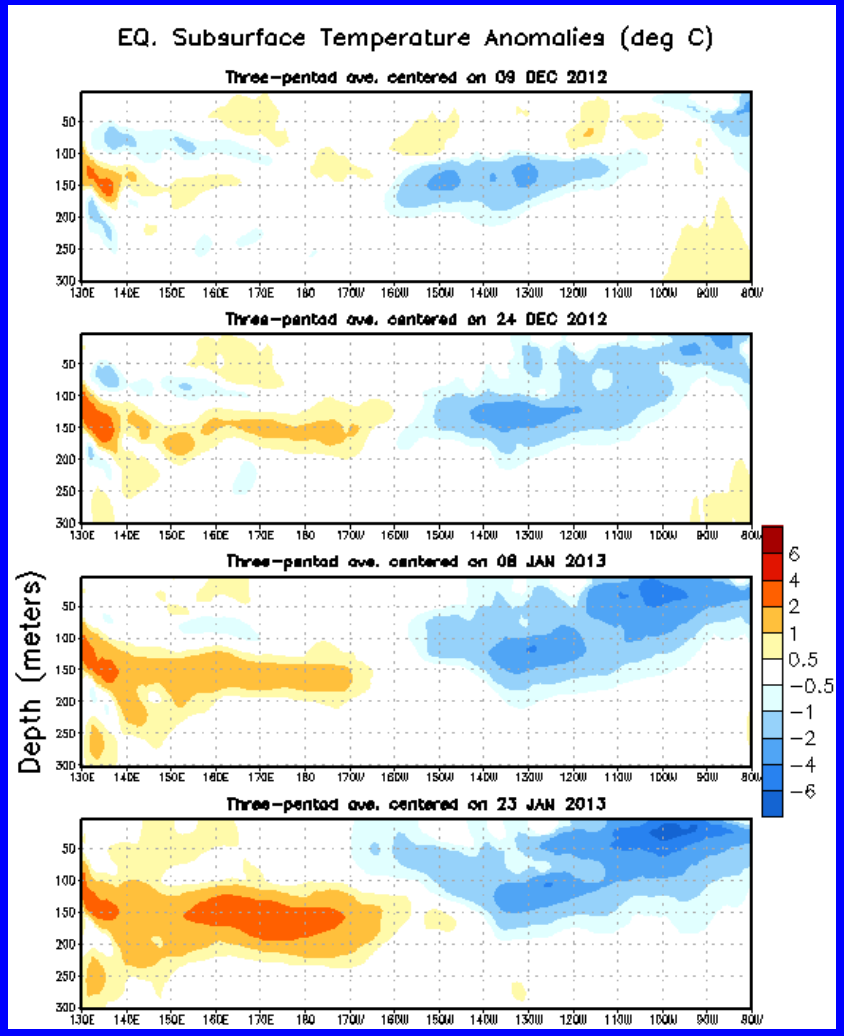
The monthly thermocline slope index represents the difference in anomalous depth of the 20°C isotherm between the western Pacific (160°E-150°W) and the eastern Pacific (90°-140°W).

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

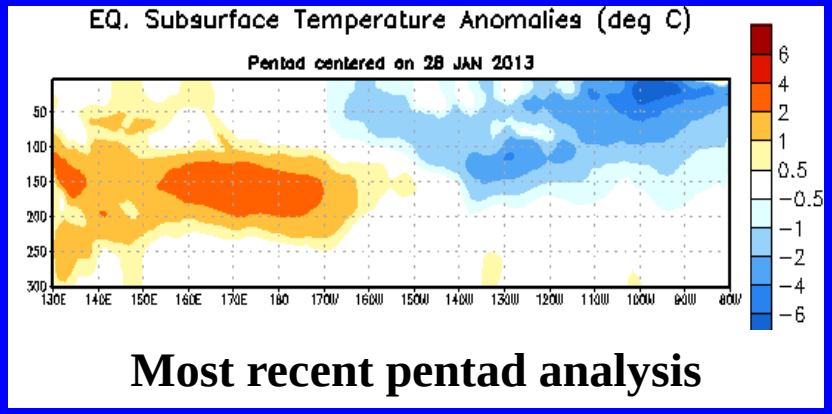


From April - November 2012, the subsurface temperatures were above-average. Since November, anomalies have decreased, becoming negative in December 2012. During January 2013, the negative subsurface temperature anomalies remained nearly unchanged.

Sub-Surface Temperature Departures (ºC) in the Equatorial Pacific

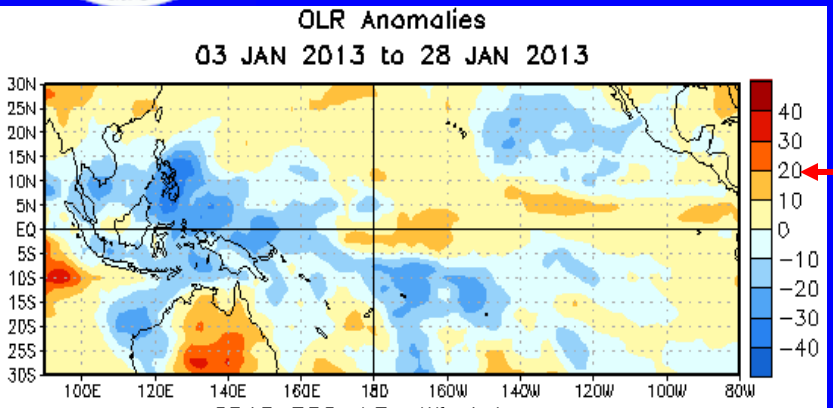


- **In the last two months, negative subsurface temperature anomalies shifted eastward across the equatorial Pacific.**
- **Meanwhile, positive subsurface temperature anomalies have increased at depth in the western Pacific and have expanded eastward to ~150ºW.**
- **Recently, the subsurface temperature anomaly pattern remains unchanged.**

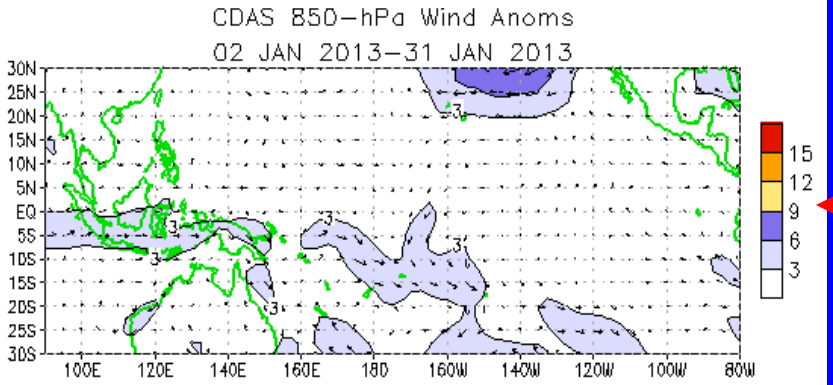


Most recent pentad analysis

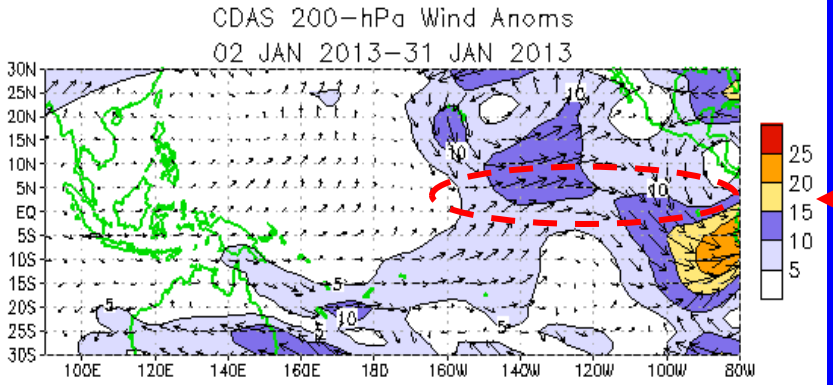
Tropical OLR and Wind Anomalies During the Last 30 Days



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



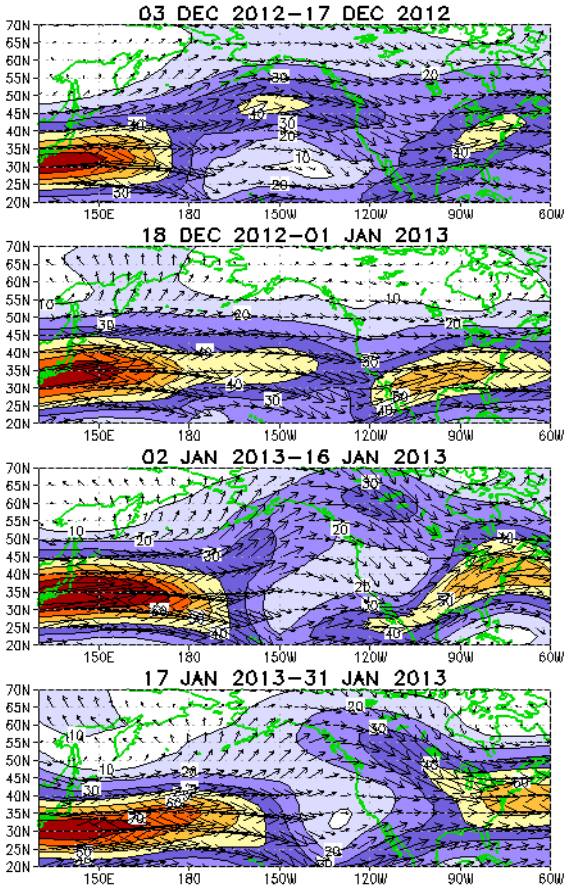
Anomalous low-level (850-hPa) winds were near average across much the equatorial Pacific.



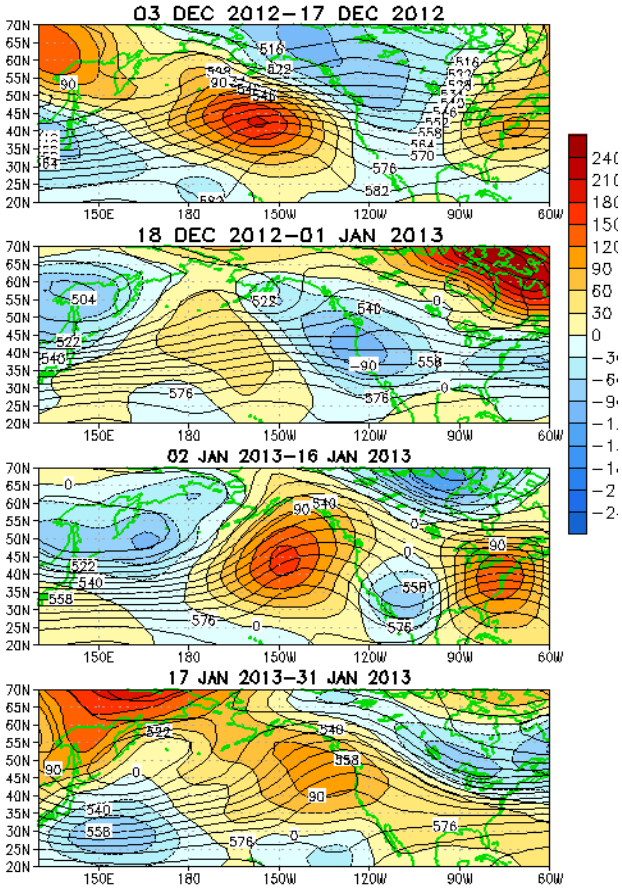
Anomalous upper-level (200-hPa) westerly winds were evident over the eastern equatorial Pacific.

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

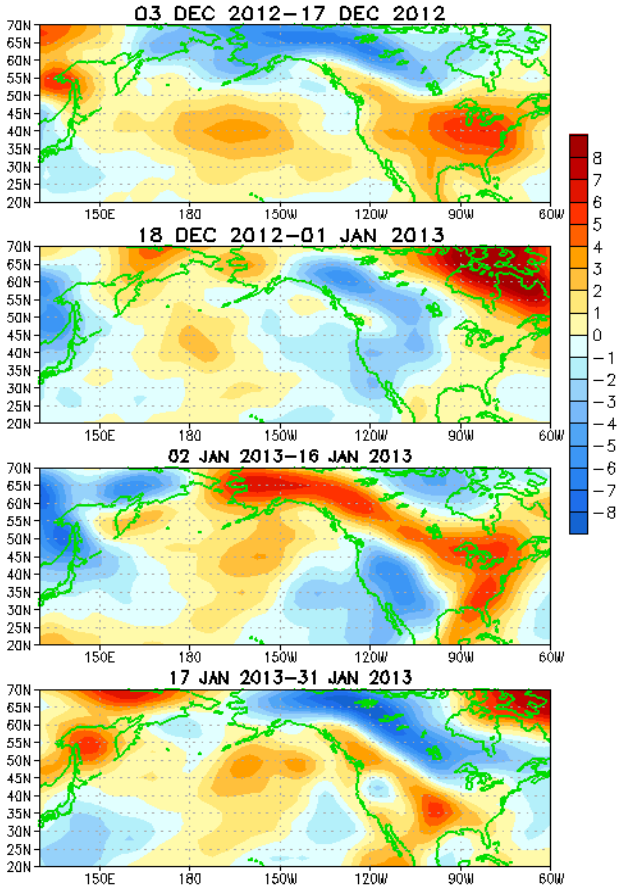
200-hPa Wind



500-hPa Height & Anoms.



925-hPa Temp. Anoms. (ºC)

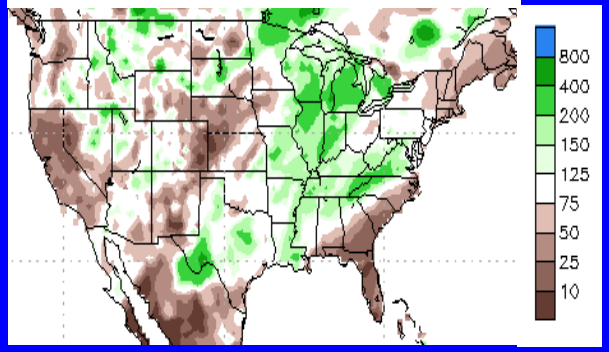


In December 2012, an anomalous ridge developed in the central N. Pacific, with a downstream trough amplifying over the eastern Pacific/ western U.S., accompanied by ridging over the eastern U.S. During January 2013, the ridge shifted to the eastern Pacific/west coast of the U.S., which shifted the height pattern over the U.S. eastward. During the last half of January, below average heights over Canada and the northeastern U.S. contributed to near- to-below average temperatures in that region.

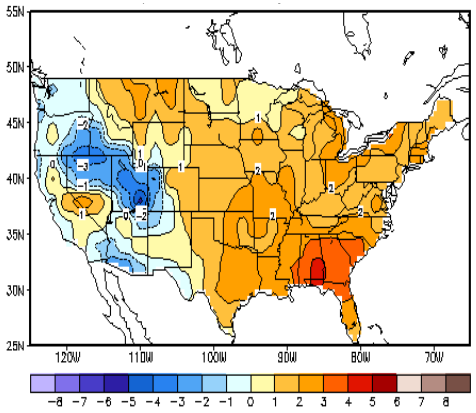
U.S. Temperature and Precipitation Departures During the Last 30 and 90 Days

Last 30 Days

30-day (ending 2 Feb 2013) % of average precipitation

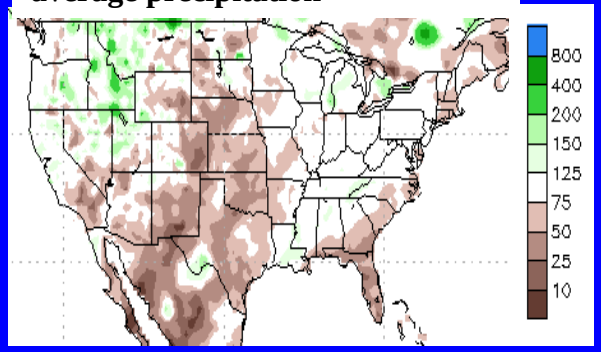


30-day (ending 2 Feb 2013) temperature departures (degree C)

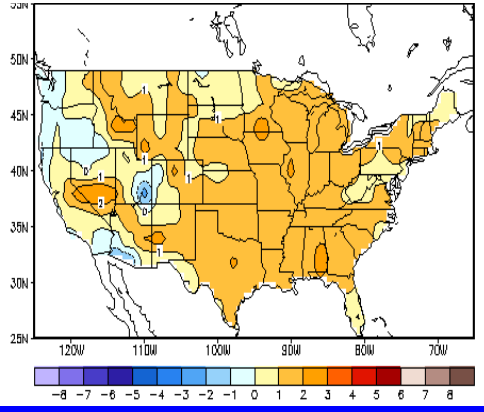


Last 90 Days

90-day (ending 2 Feb 2013) % of average precipitation



90-day (ending 2 Feb 2013) temperature departures (degree C)

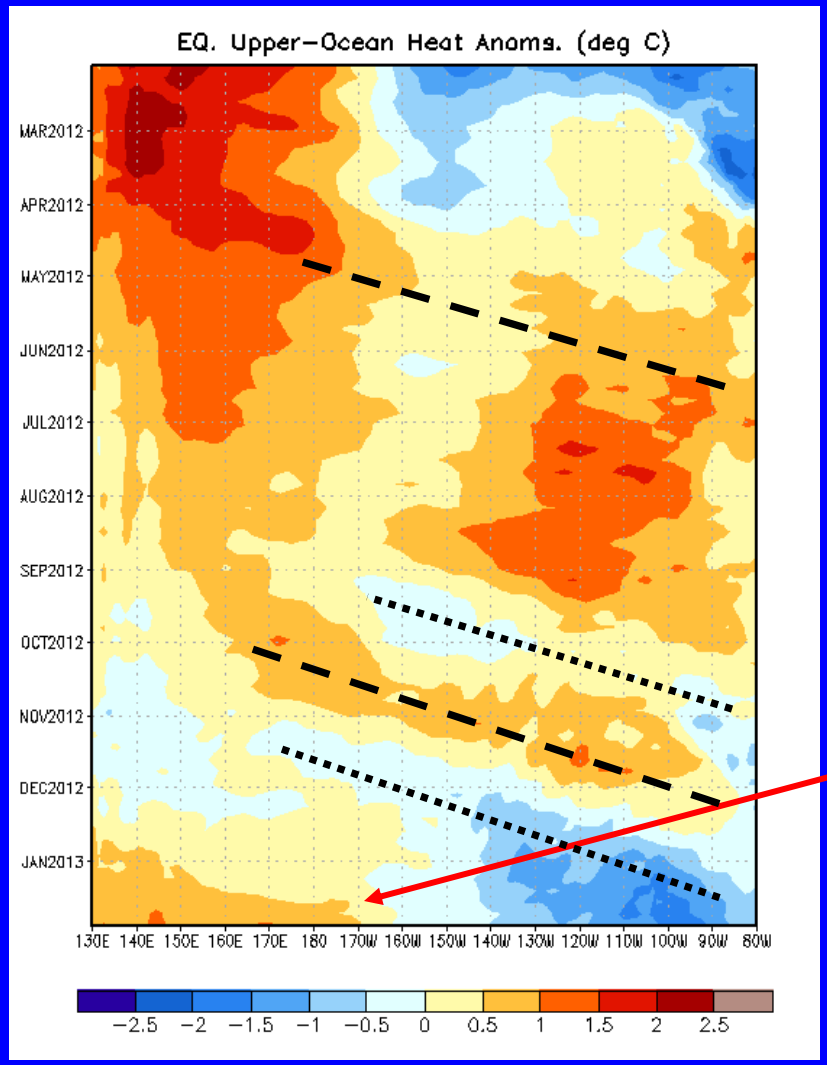


Intraseasonal Variability

- **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



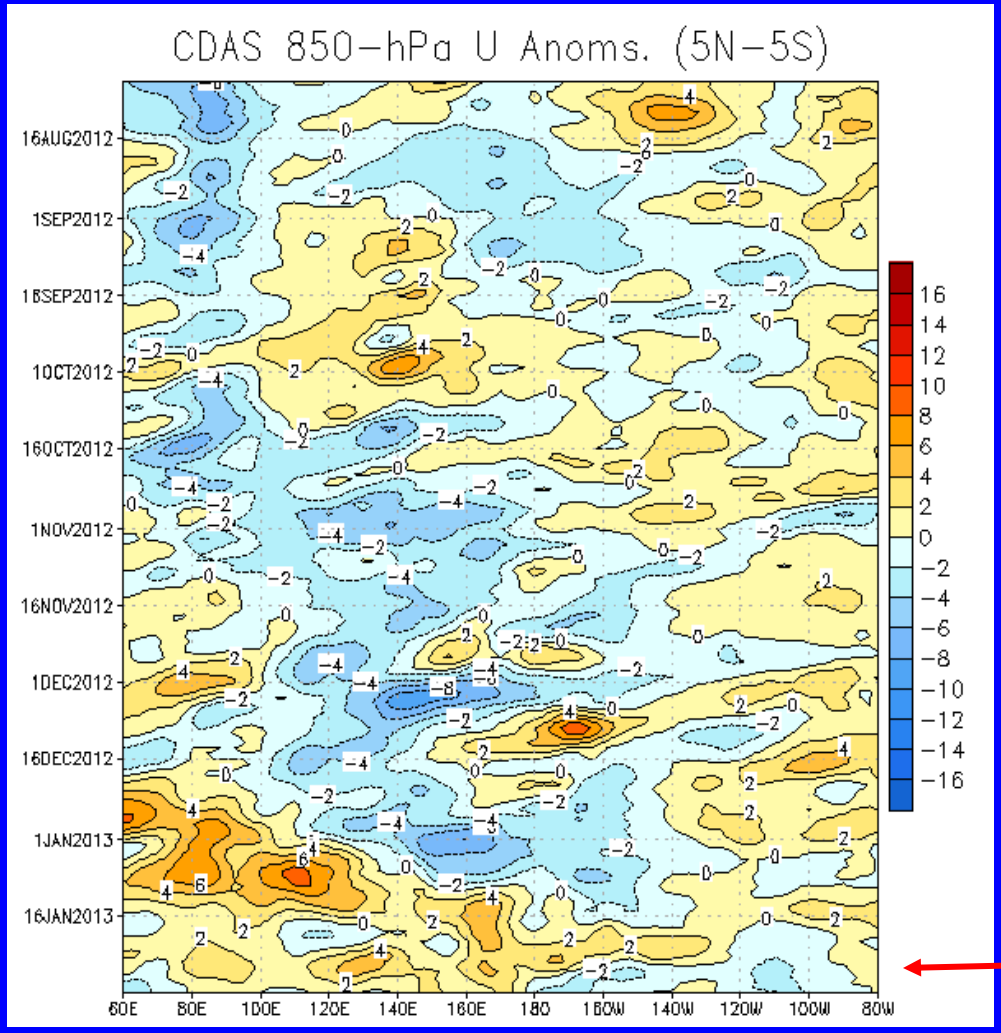
Time

Longitude

- 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})



Time

Longitude

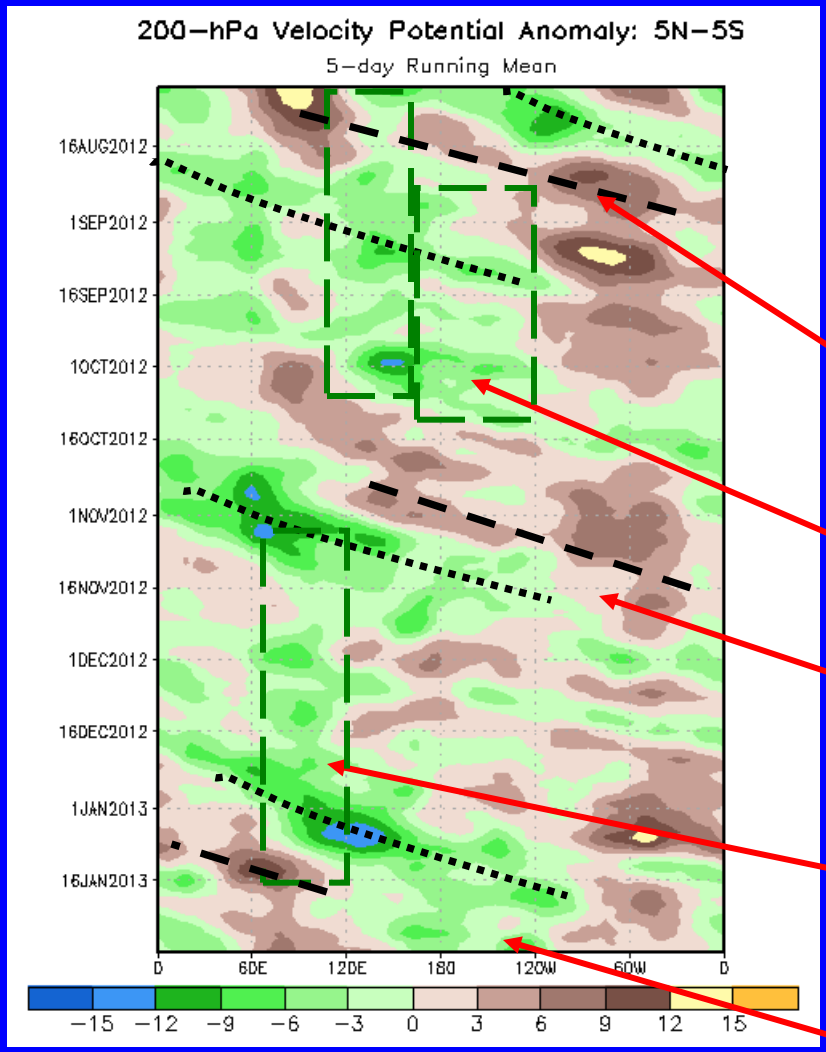
Westerly wind anomalies (orange/red shading).

Easterly wind anomalies (blue shading).

Since the beginning of January 2013, the Madden Julian Oscillation (MJO) has been evident in the eastward shift of easterly and westerly wind anomalies.

Currently, equatorial westerly wind anomalies are located over the western Pacific, while easterly wind anomalies are evident over the eastern Pacific.

200-hPa Velocity Potential Anomalies (5ºN-5ºS)



Time

Longitude

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 August 2012.

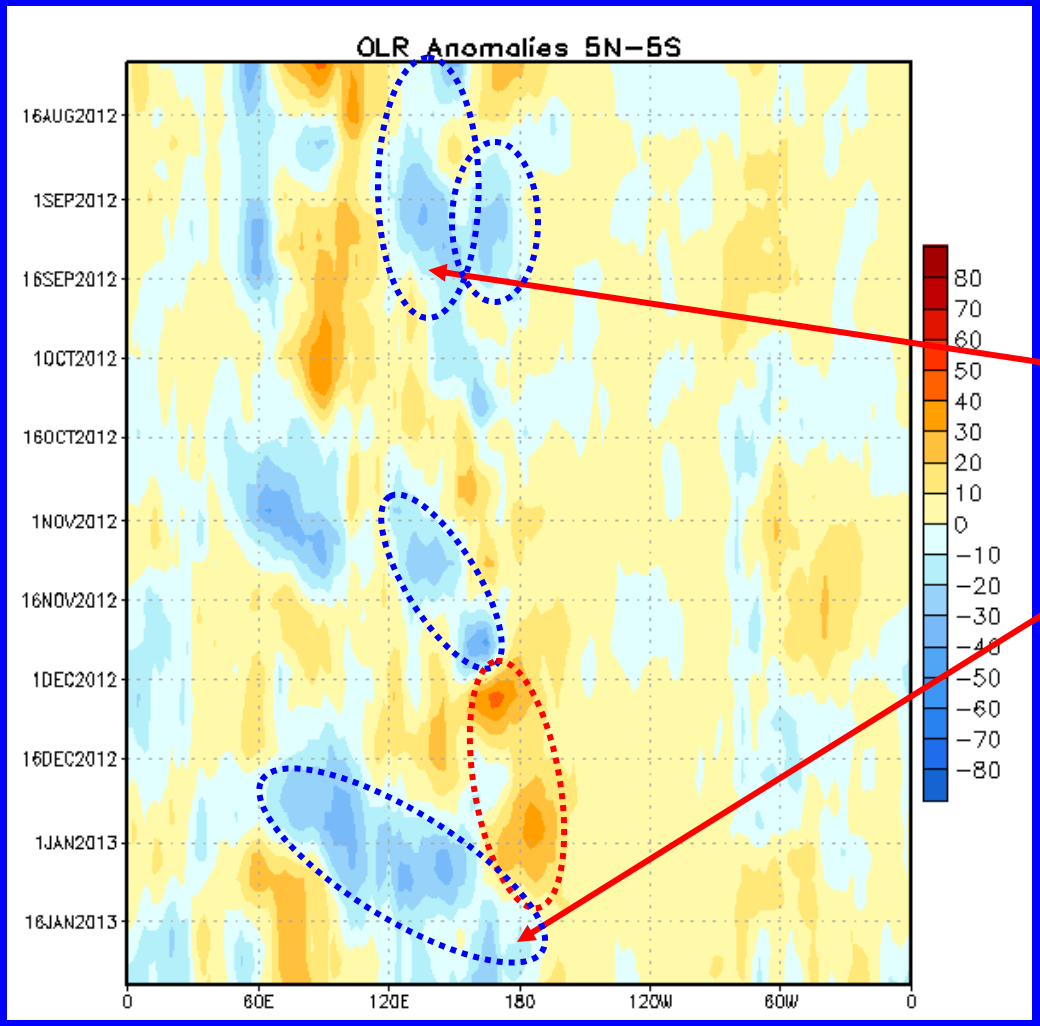
During September and early October, upper-level divergence (green) expanded eastward to near the Date Line.

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

During November 2012 – early January 2013, a pattern of upper-level divergence (green) prevailed over the western Maritime Continent and eastern Indian Ocean.

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

Outgoing Longwave Radiation (OLR) Anomalies



Time

Longitude

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 over Indonesia have shifted eastward to 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° C.

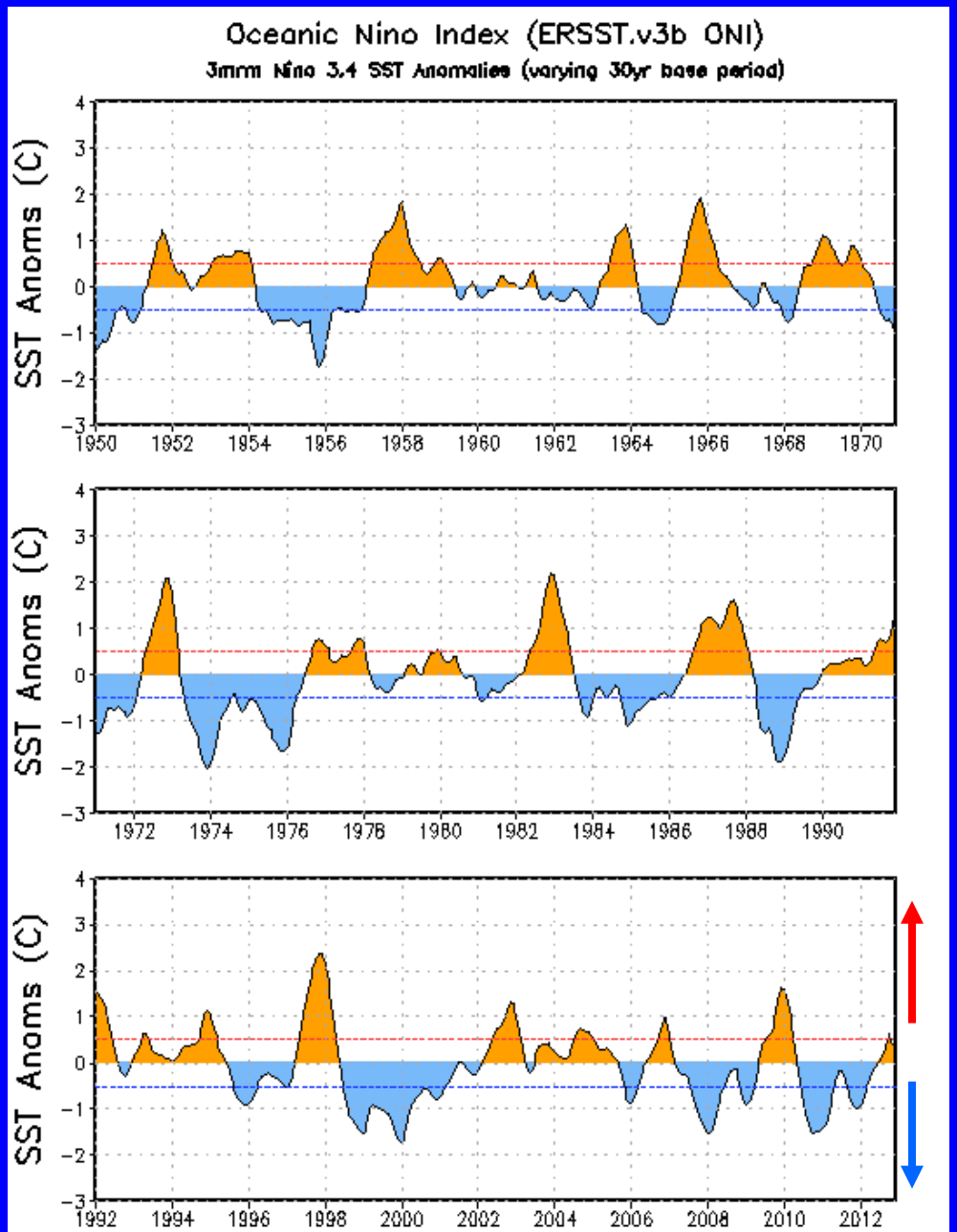
La Niña: characterized by a *negative* ONI less than or equal to −0.5° C.

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 +/- 0.5° C along with consistent atmospheric features. These anomalies must also be forecasted to persist for 3 consecutive months.

ONI (ºC): Evolution since 1950

The most recent ONI value (October – December 2012) is 0.4ºC.



Historical El Niño and La Niña Episodes

Based on the ONI computed using ERSST.v3b

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

El Niño	Highest ONI Value
JJA 1951 – DJF 1951/52	1.2
DJF 1952/53 – JFM 1954	0.8
MAM 1957 – JJA 1958	1.8
OND 1958 – FMA 1959	0.6
MJJ 1963 – JFM 1964	1.4
AMJ 1965 – MAM 1966	1.9
JAS 1968 – DJF 1969/70	1.1
AMJ 1972 – FMA 1973	2.1
ASO 1976 - JFM 1977	0.8
ASO 1977 – JFM 1978	0.8
AMJ 1982 – MJJ 1983	2.2
JAS 1986 – JFM 1988	1.6
AMJ 1991 – MJJ 1992	1.6
ASO 1994 – FMA 1995	1.2
AMJ 1997 – MAM 1998	2.4
AMJ 2002 – JFM 2003	1.3
JJA 2004 – DJF 2004/05	0.7
ASO 2006 – DJF 2006/07	1.0
JJA 2009 – MAM 2010	1.6

La Niña	Lowest ONI Value
ASO 1949 – JAS 1950	-1.4
SON 1950 – JFM 1951	-0.8
AMJ 1954 – NDJ 1956/57	-1.7
AMJ 1964 – DJF 1964/65	-0.8
JJA 1970 – DJF 1971/72	-1.3
AMJ 1973 – JJA 1974	-2.0
SON 1974 – MAM 1976	-1.7
ASO 1983 – DJF 1983/84	-0.9
SON 1984 – ASO 1985	-1.1
AMJ 1988 – AMJ 1989	-1.9
ASO 1995 – FMA 1996	-0.9
JJA 1998 – FMA 2001	-1.7
OND 2005 – FMA 2006	-0.9
JAS 2007 – MJJ 2008	-1.5
JJA 2010 – MAM 2011	-1.5
ASO 2011 – FMA 2012	-1.0

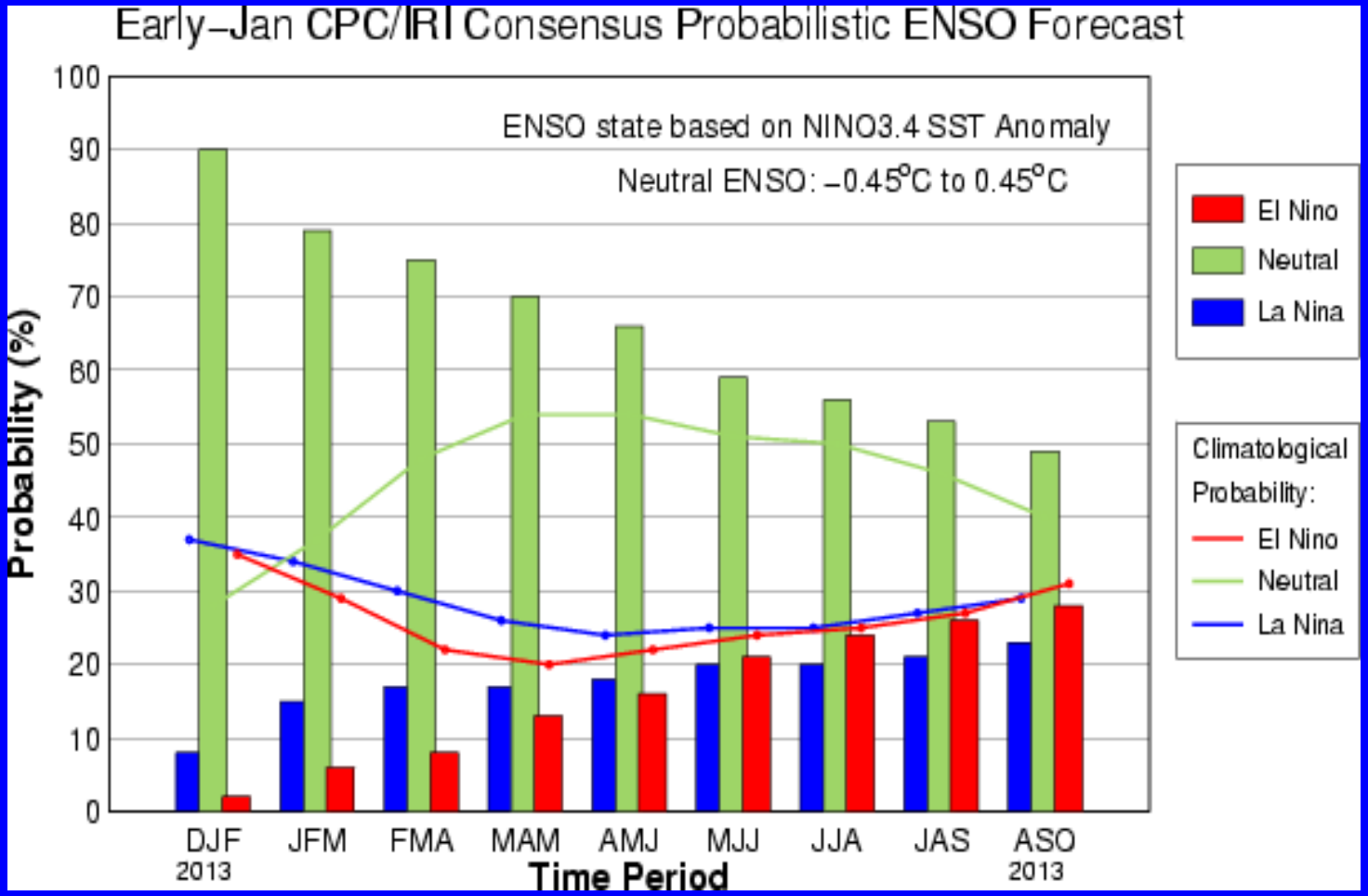
Recent Pacific warm (red) and cold (blue) episodes based on a threshold of +/- 0.5 ºC for the Oceanic Nino Index (ONI) [3 month running mean of ERSST.v3b SST anomalies in the Nino 3.4 region (5N-5S, 120-170W)]. For historical purposes El Niño and La Niña episodes are defined when the threshold is met for a minimum of 5 consecutive over-lapping seasons. The complete table going back to DJF 1950 can be found by clicking: Historical ONI Values

Year	DJF	JFM	FMA	MAM	AMJ	MJJ	JJA	JAS	ASO	SON	OND	NDJ
2002	-0.2	0.0	0.1	0.3	**0.5**	**0.7**	**0.8**	**0.8**	**0.9**	**1.2**	**1.3**	**1.3**
2003	**1.1**	**0.8**	0.4	0.0	-0.2	-0.1	0.2	0.4	0.4	0.4	0.4	0.4
2004	0.3	0.2	0.1	0.1	0.1	0.3	**0.5**	**0.7**	**0.7**	**0.7**	**0.7**	**0.7**
2005	**0.6**	0.4	0.3	0.3	0.3	0.3	0.2	0.1	0.0	-0.2	**-0.5**	**-0.8**
2006	**-0.9**	**-0.7**	**-0.5**	-0.3	0.0	0.1	0.2	0.3	**0.5**	**0.8**	**1.0**	**1.0**
2007	**0.7**	0.3	-0.1	-0.2	-0.3	-0.3	-0.3	**-0.6**	**-0.9**	**-1.1**	**-1.2**	**-1.4**
2008	**-1.5**	**-1.5**	**-1.2**	**-0.9**	**-0.7**	**-0.5**	-0.3	-0.2	-0.1	-0.2	-0.4	-0.7
2009	-0.9	-0.8	-0.6	-0.2	0.1	0.4	**0.5**	**0.6**	**0.7**	**1.0**	**1.4**	**1.6**
2010	**1.6**	**1.4**	**1.1**	**0.7**	0.2	-0.3	**-0.8**	**-1.2**	**-1.4**	**-1.5**	**-1.5**	**-1.5**
2011	**-1.4**	**-1.3**	**-1.0**	**-0.7**	-0.4	-0.2	-0.2	-0.3	**-0.6**	**-0.8**	**-1.0**	**-1.0**
2012	**-0.9**	**-0.7**	**-0.5**	-0.3	-0.1	0.0	0.1	0.3	0.4	0.6	0.4	
2013												
2014												
2015												
2016												
2017												
2018												
2019												
2020												
2021												
2022												
2023												
2024												
2025												
2026												
2027												

CPC/IRI Probabilistic ENSO Outlook

(updated 10 Jan 2012)

ENSO-neutral is favored through mid-2013.



Pacific Niño 3.4 SST Outlook

• Most models predict the persistence of current Niño-3.4 values, with ENSO-neutral (-0.5ºC to +0.5ºC) continuing through the Northern Hemisphere summer 2013.

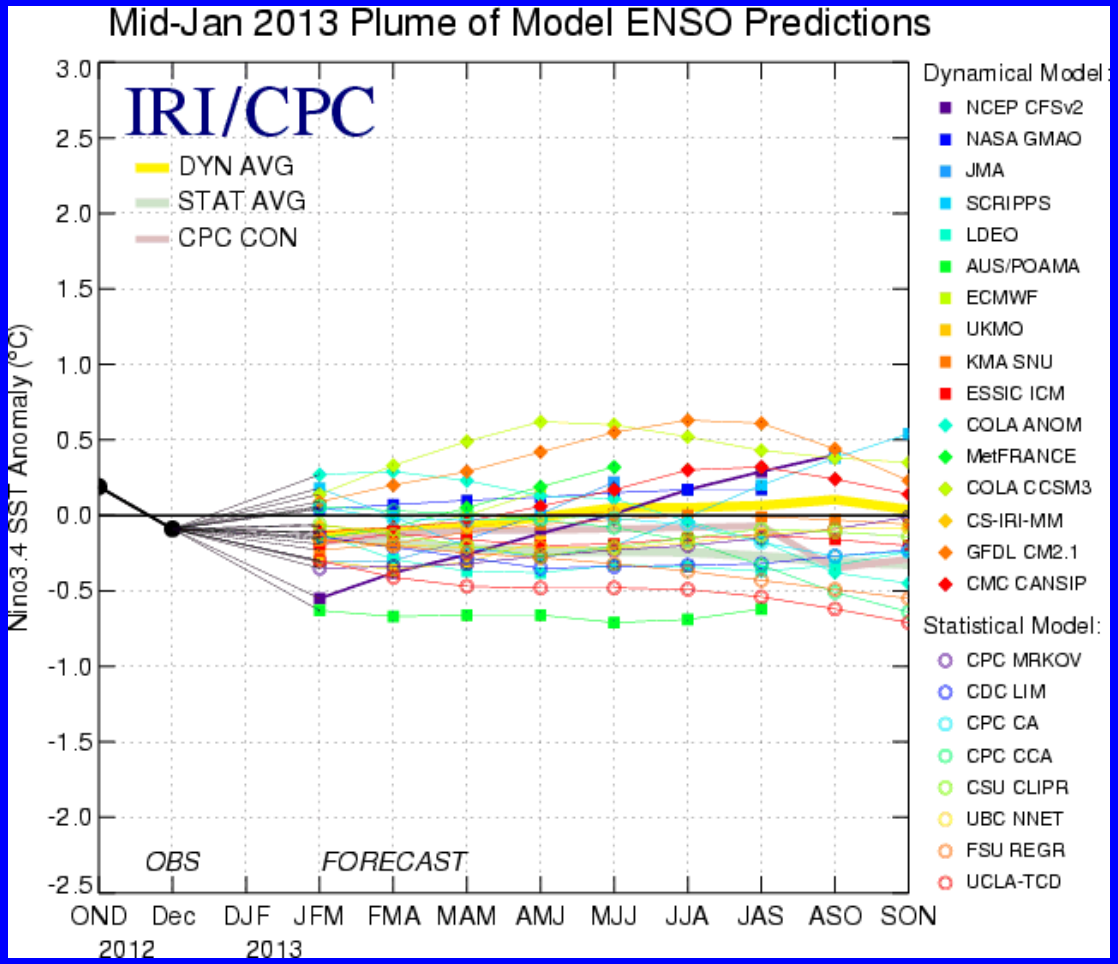
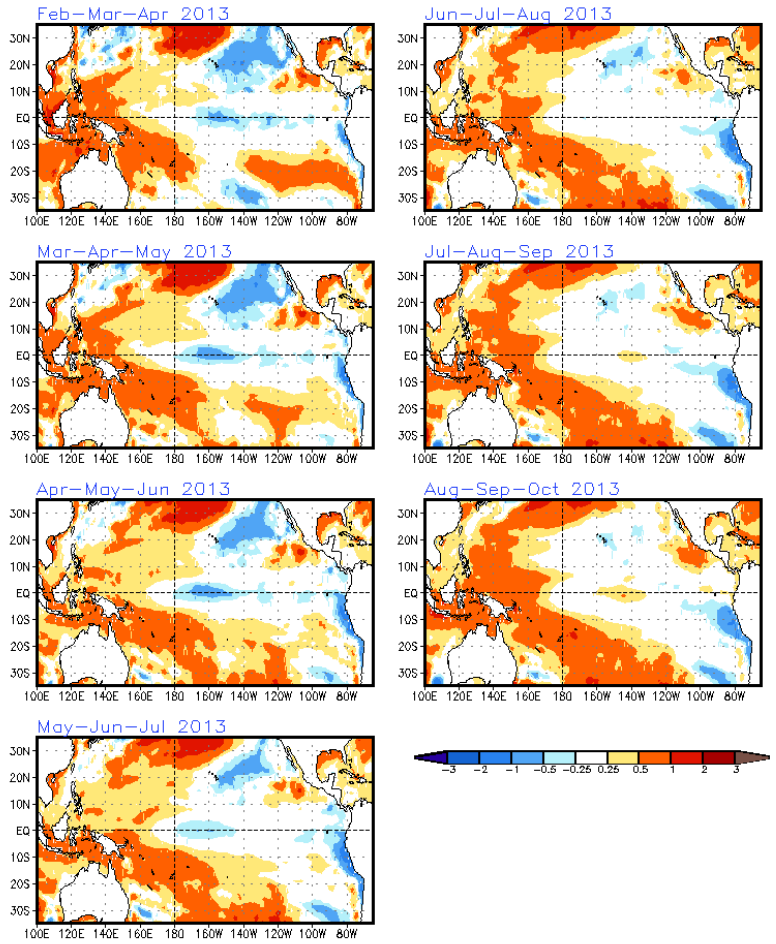


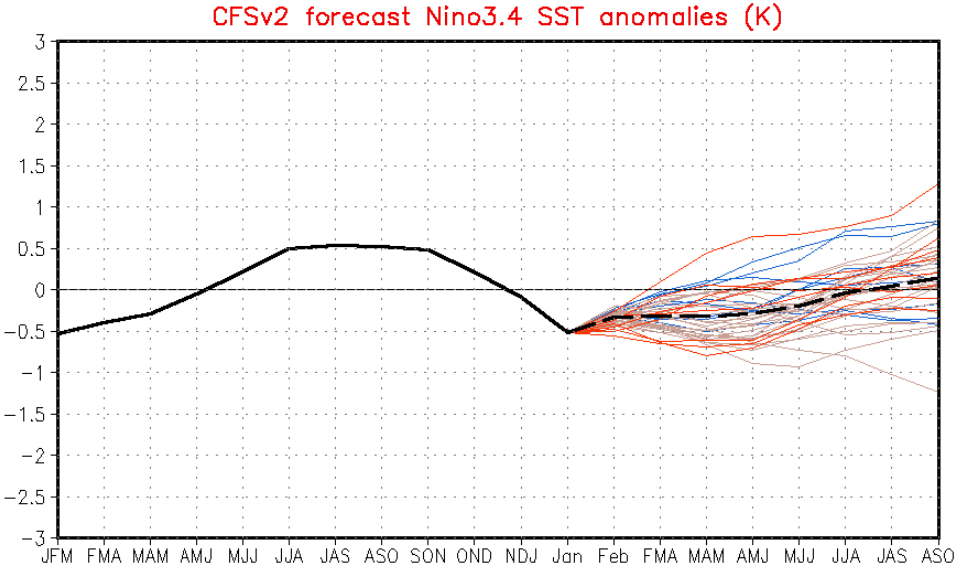
Figure provided by the International Research Institute (IRI) for Climate and Society (updated 15 Jan 2012).

SST Outlook: NCEP CFS.v2 Forecast Issued 3 February 2013



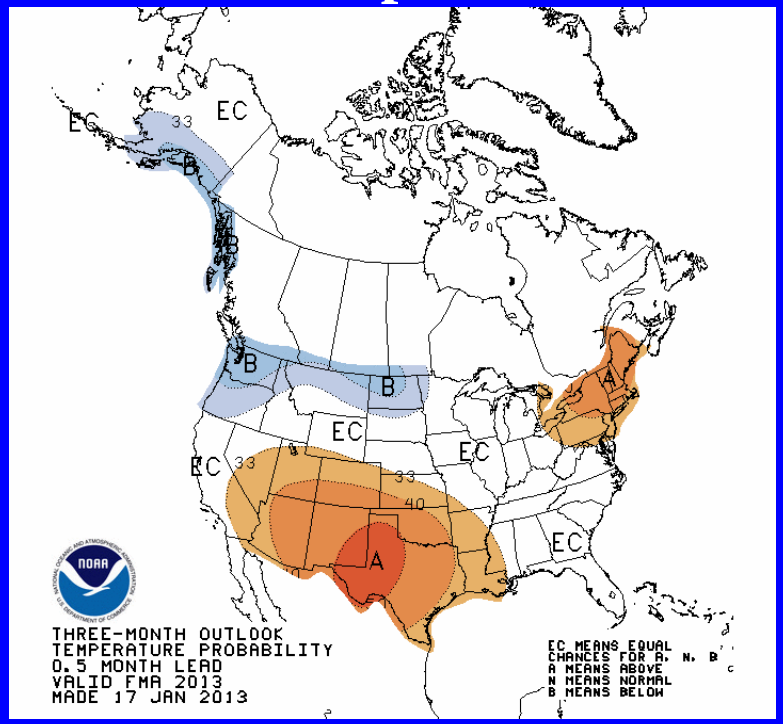
(Model bias correction base period: 1999–2010; Climatology base period: 1982–2010)

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.

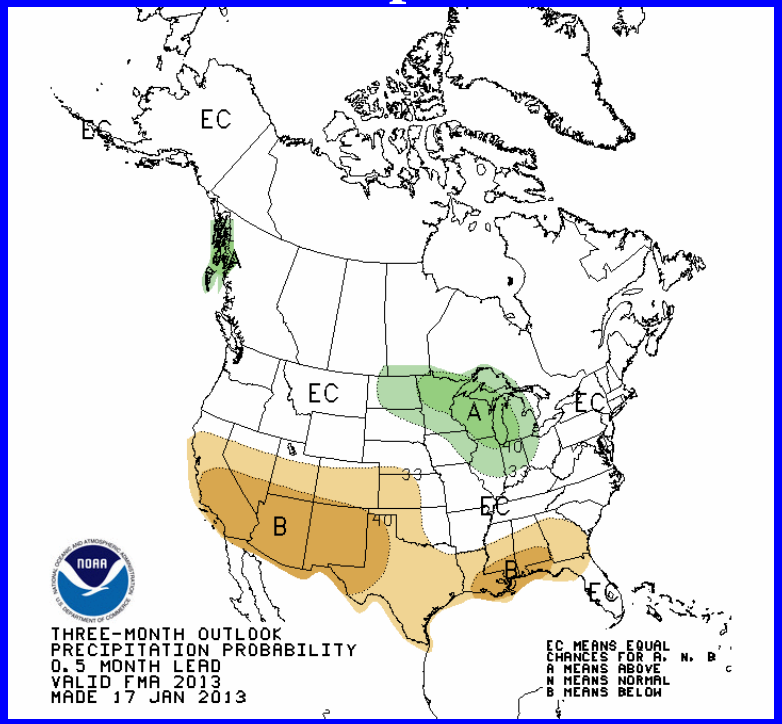


U. S. Seasonal Outlooks
February – April 2013

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.**
- **Some atmospheric circulation features resemble La Niña, but this is at least 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