ENSO Cycle: Recent Evolution, Current Status and Predictions

Update prepared by
Climate Prediction Center / NCEP
3 March 2014

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

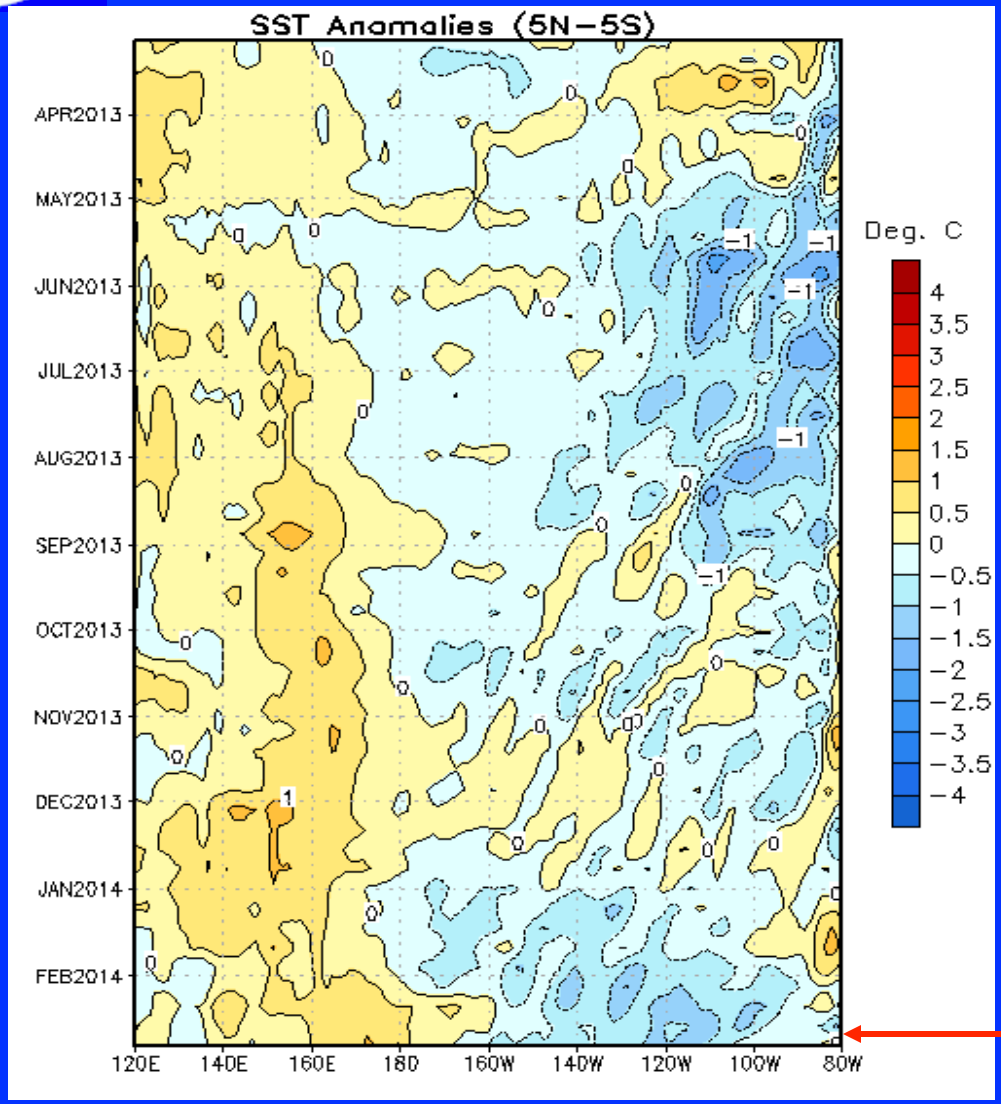
Summary

ENSO Alert System Status: Not Active

- **ENSO-neutral conditions continue.***
- **Equatorial sea surface temperatures (SST) were below-average in the eastern Pacific Ocean, while remaining above average in the western Pacific.**
- **ENSO-neutral is expected to continue through the Northern Hemisphere spring 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

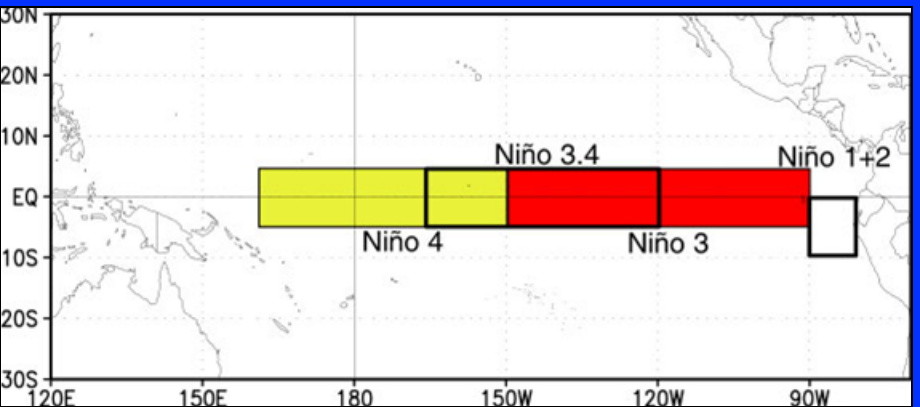
During May-September 2013, well below-average SSTs were observed over the eastern half of the Pacific.

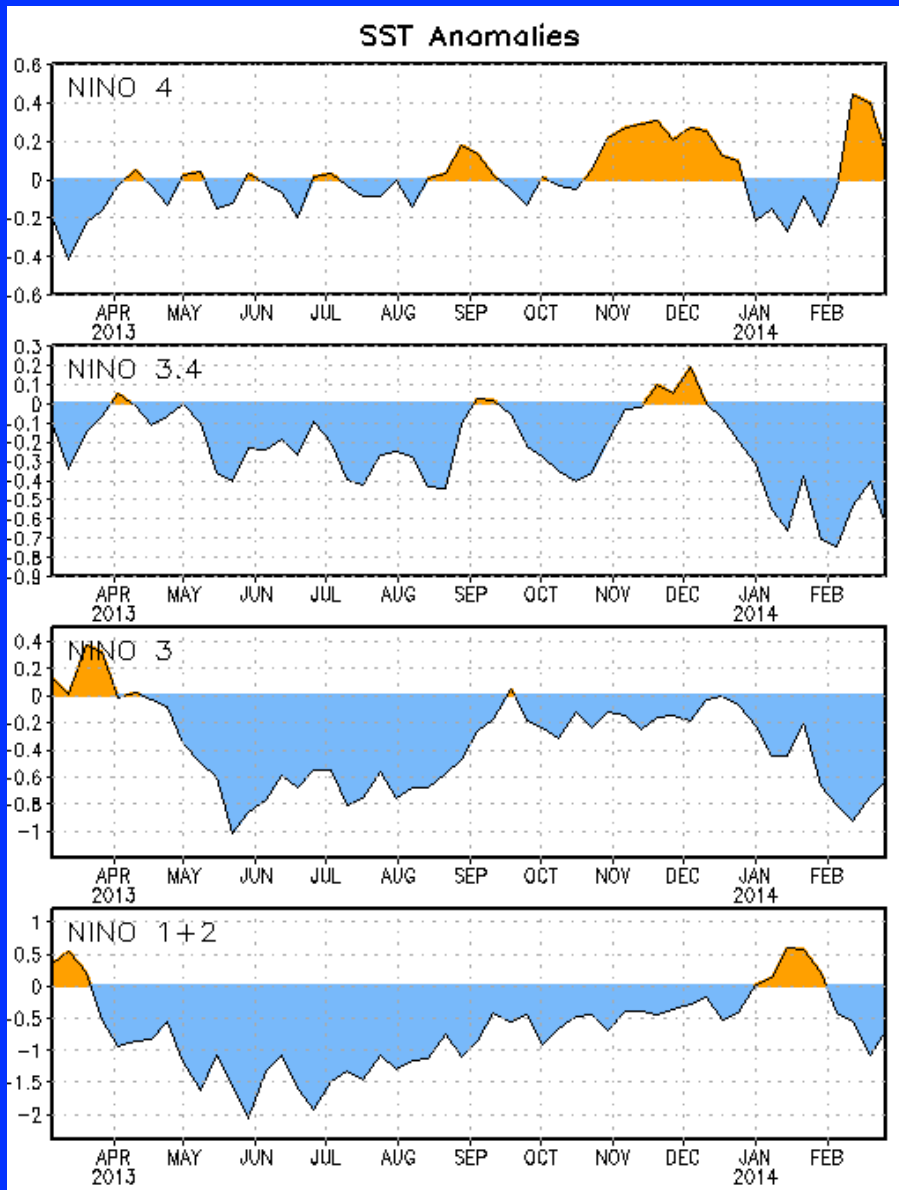
Since January 2014, SSTs have been below average across the eastern equatorial Pacific, while remaining above-average in the western Pacific.

Niño Region SST Departures (ºC)
Recent Evolution

The latest weekly SST departures are:

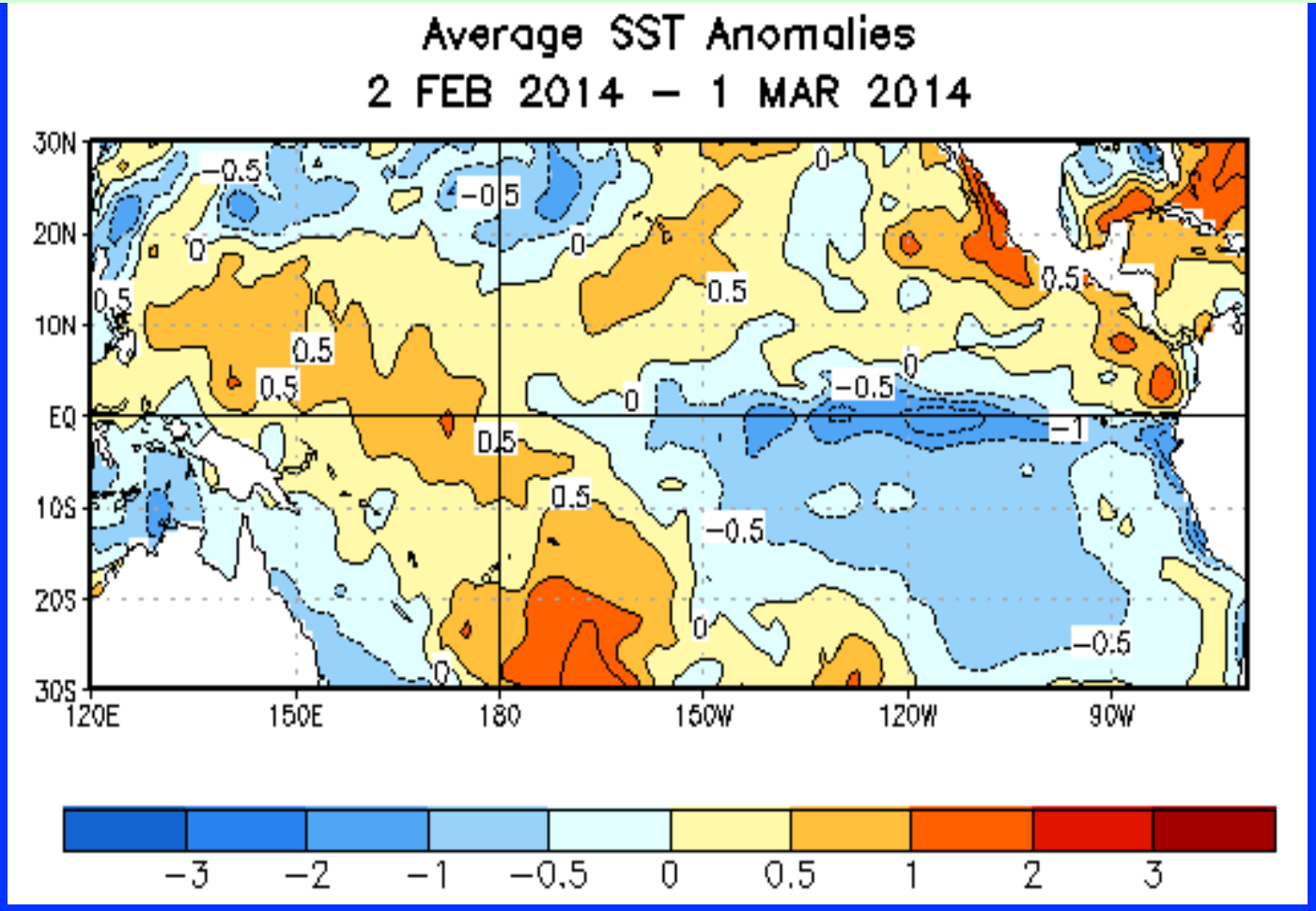
Niño 4	**0.1ºC**
Niño 3.4	**-0.6ºC**
Niño 3	**-0.6ºC**
Niño 1+2	**-0.7ºC**



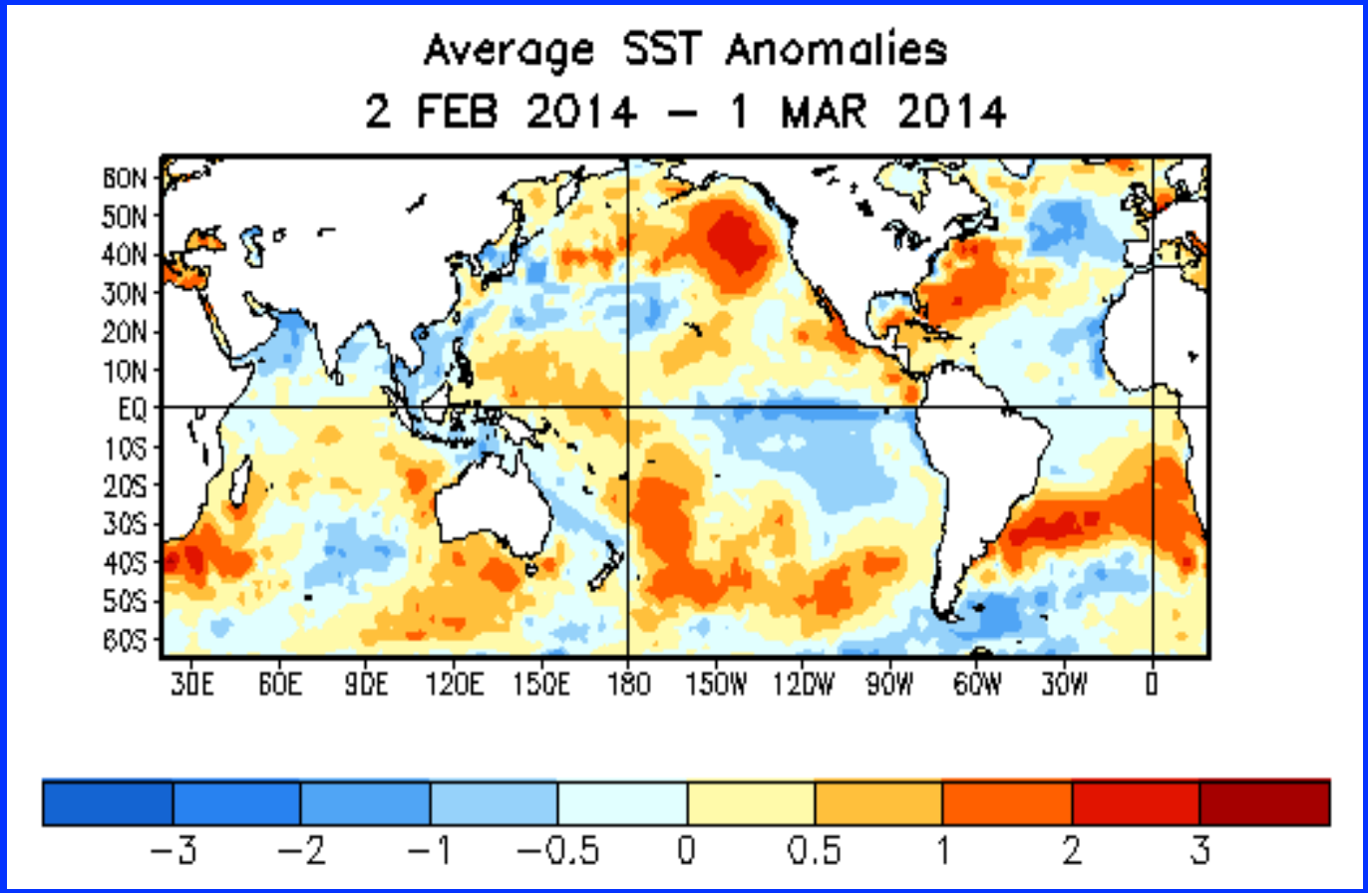


SST Departures (°C) in the Tropical Pacific During the Last 4 Weeks

During the last 4-weeks, equatorial SSTs were above average in the western Pacific and below-average across the eastern half of the Pacific.

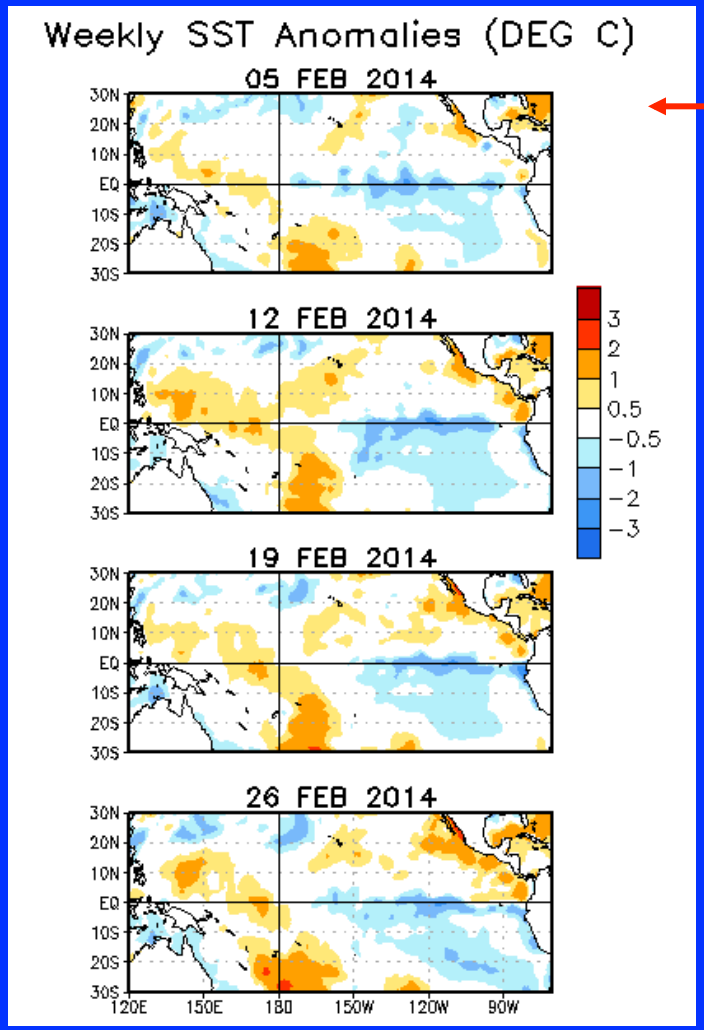


Global SST Departures (°C)



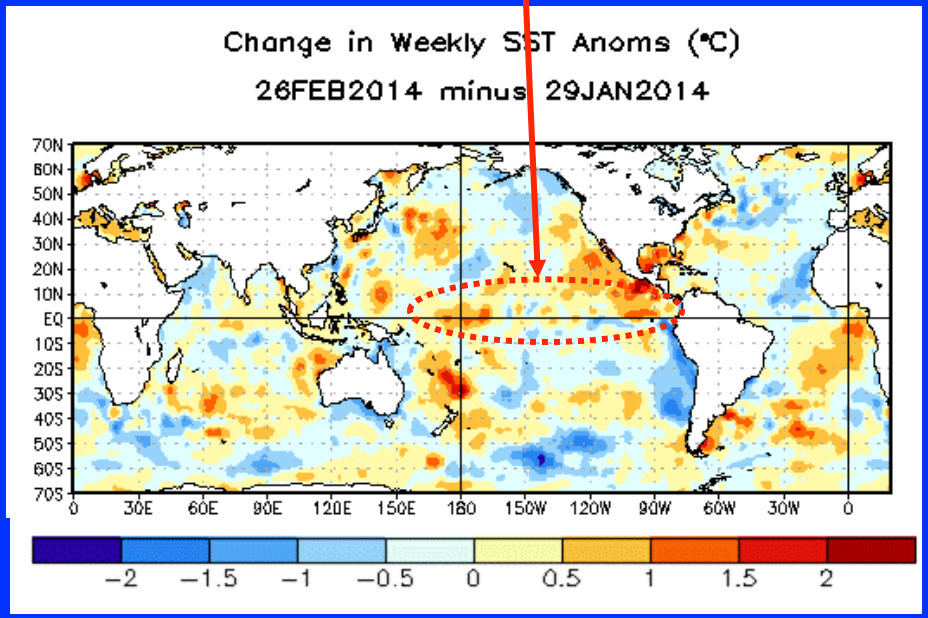
During the last four weeks, equatorial SSTs were above average in the western Pacific Ocean and below average in the eastern half of the Pacific.

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



- During the last month, SST anomalies were positive in the western Pacific Ocean and near the International Date Line. Below-average SSTs persisted in the eastern Pacific.

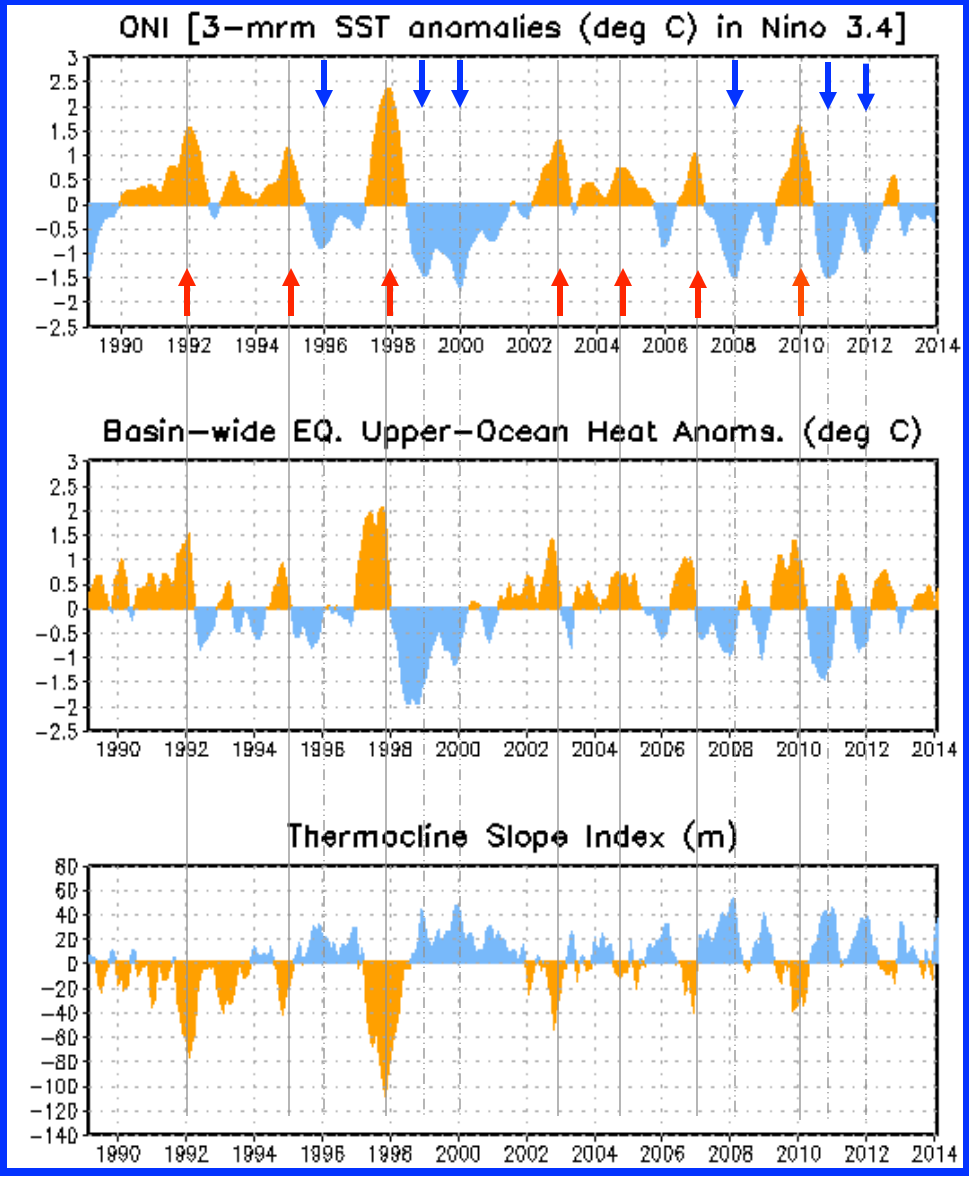
- Over the last month, changes in equatorial SST anomalies were mostly positive across the Pacific.



Upper-Ocean Conditions in the Eq. Pacific

Cold Episodes ↓

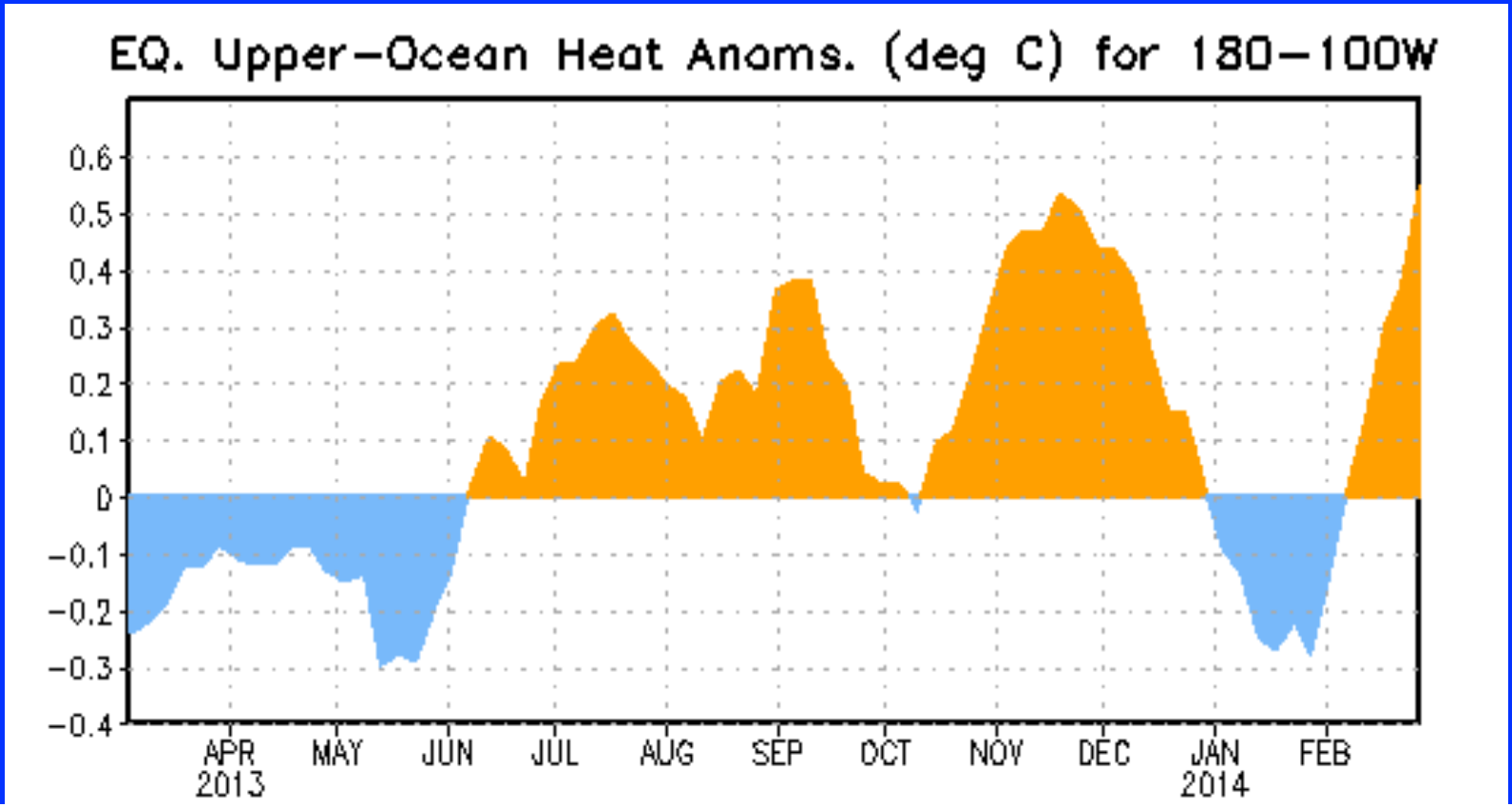
Warm Episodes ↑



- 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.

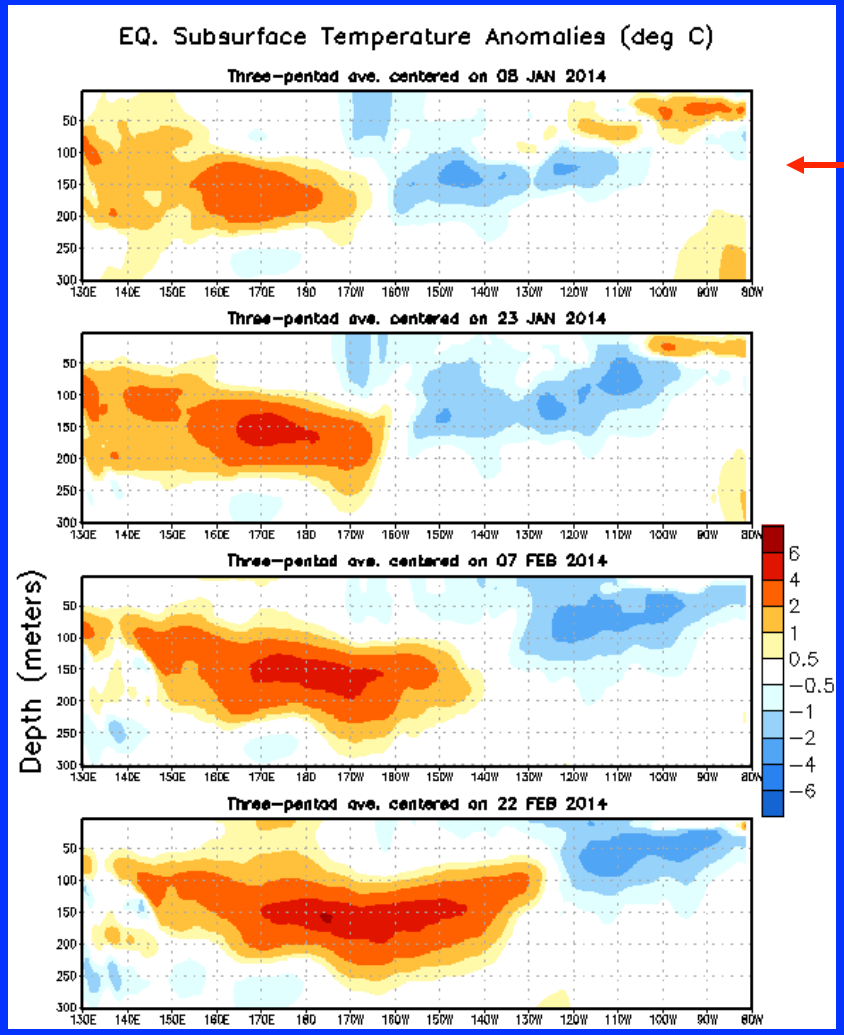
The monthly thermocline slope index represents the difference in anomalous depth of the 20°C isotherm between the western Pacific (160°E-150°W) and the eastern Pacific (90°-140°W).

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

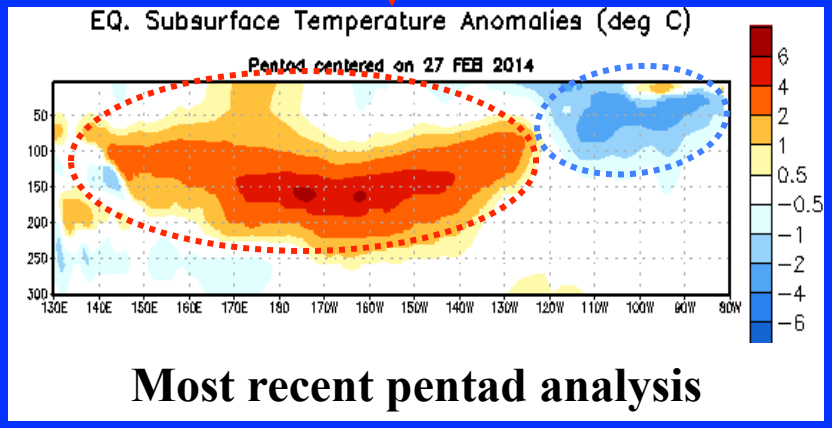


A strong increase in positive temperature anomalies occurred during mid-October 2013. A significant decrease in the temperature anomalies, beginning in mid-November 2013, resulted in slightly below-average conditions during January 2014. Since the end of January, temperature anomalies have been increasing and now are above average.

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

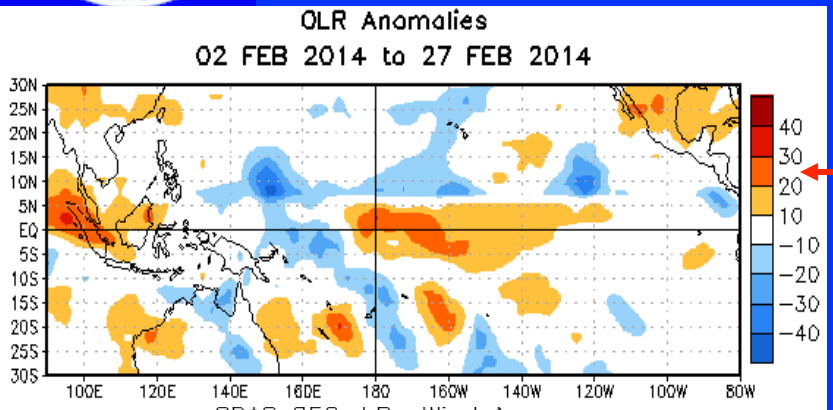


- During the last 2 months, below-average temperatures developed in the eastern Pacific, associated with the upwelling phase of a Kelvin wave. A new oceanic Kelvin wave (downwelling phase) is associated with the eastward shift of above-average temperatures.
- Recently, positive subsurface anomalies have shifted farther eastward, while negative anomalies have retracted into the eastern Pacific.

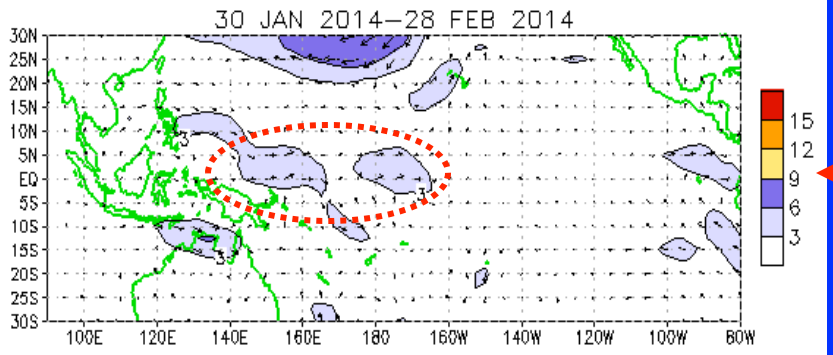


Most recent pentad analysis

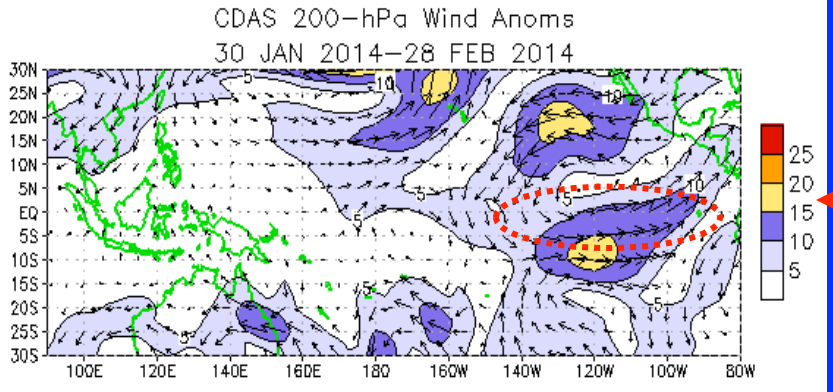
Tropical OLR and Wind Anomalies During the Last 30 Days



Positive OLR anomalies (suppressed convection and precipitation, red shading) were evident over and east of the International Date Line and over western Indonesia.



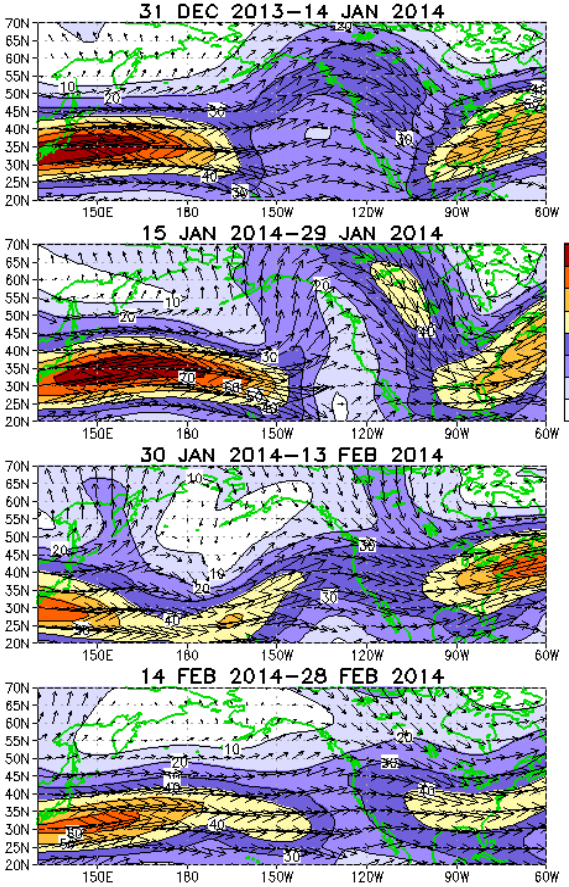
Anomalous low-level (850-hPa) westerly winds were evident in the western equatorial Pacific and near the International Date Line.



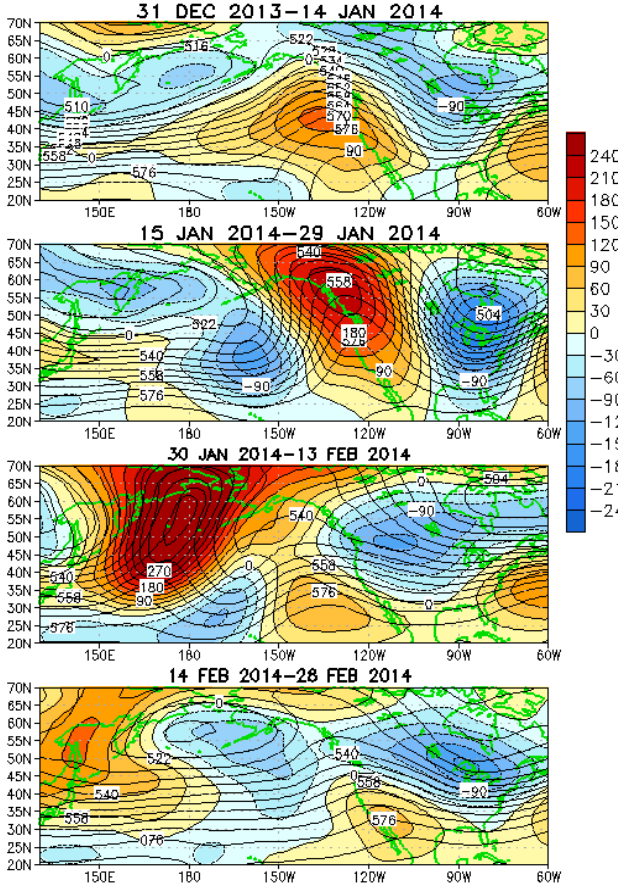
Upper-level (200-hPa) westerly wind anomalies were evident over the eastern equatorial Pacific Ocean.

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

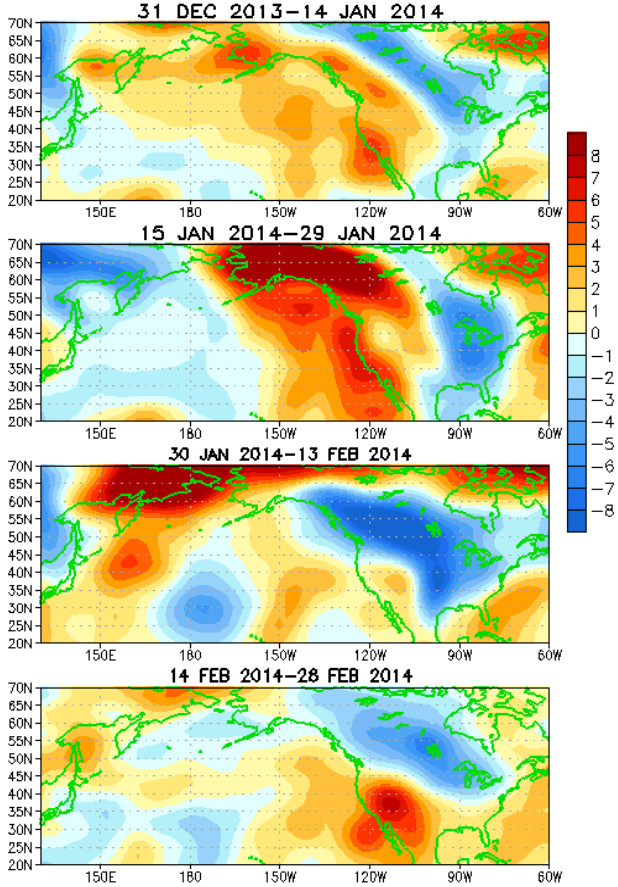
200-hPa Wind



500-hPa Height & Anoms.



925-hPa Temp. Anoms. (ºC)

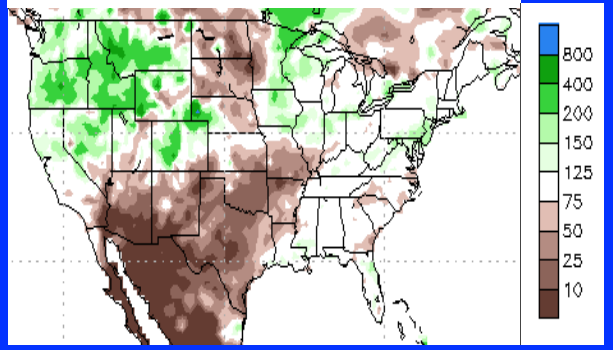


During January through February, an anomalous trough and below-average temperatures affected portions of central and eastern North America. Upstream, strong ridging over the North Pacific Ocean and/or western N. America led to above-average temperatures over those regions.

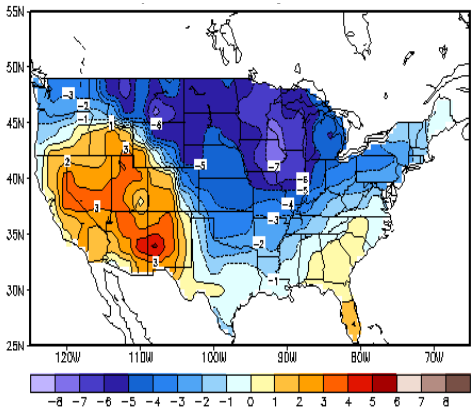
U.S. Temperature and Precipitation Departures During the Last 30 and 90 Days

Last 30 Days

30-day (ending 1 Mar 2014) % of average precipitation

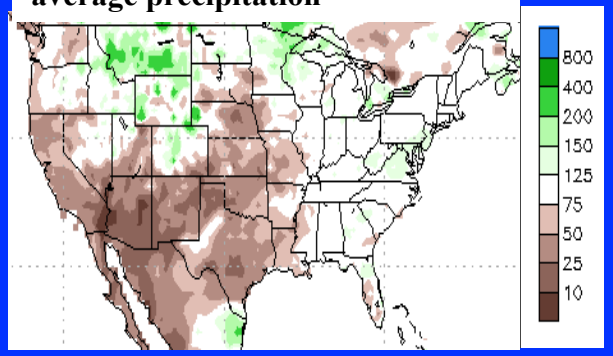


30-day (ending 1 Mar 2014) temperature departures (degree C)

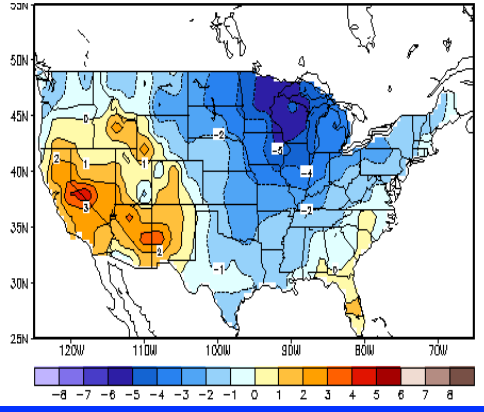


Last 90 Days

90-day (ending 1 Mar 2014) % of average precipitation



90-day (ending 1 Mar 2014) temperature departures (degree C)

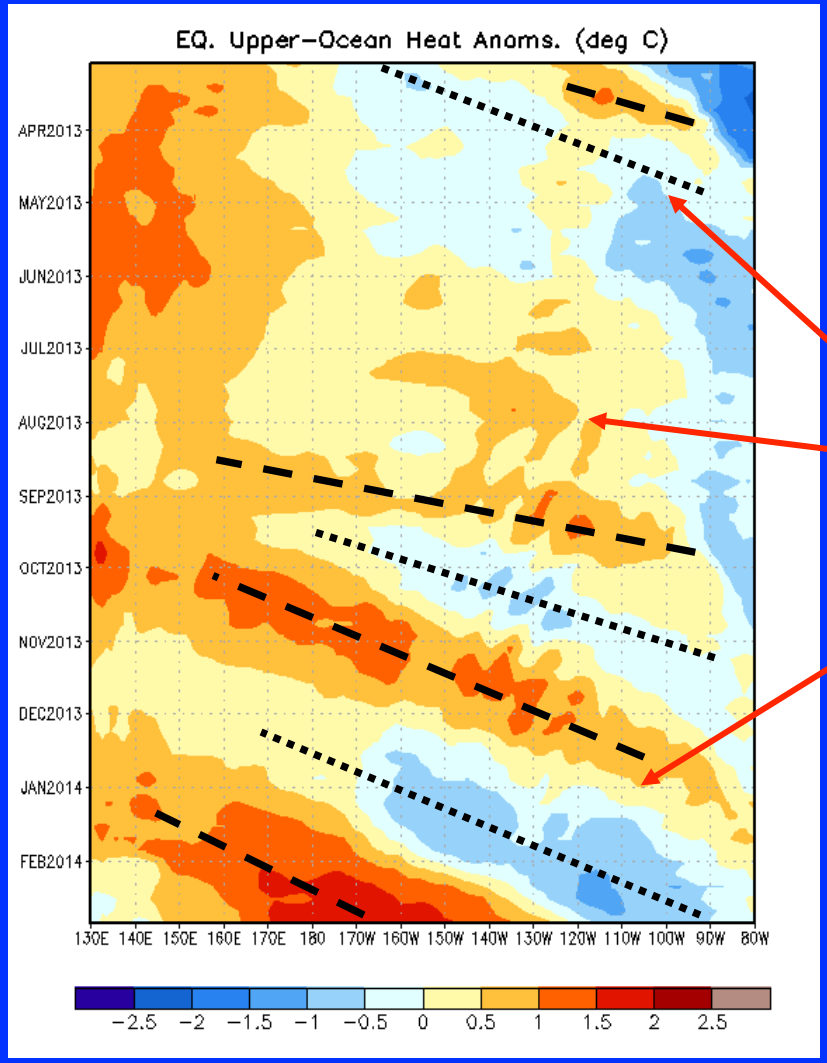


Intraseasonal Variability

- 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



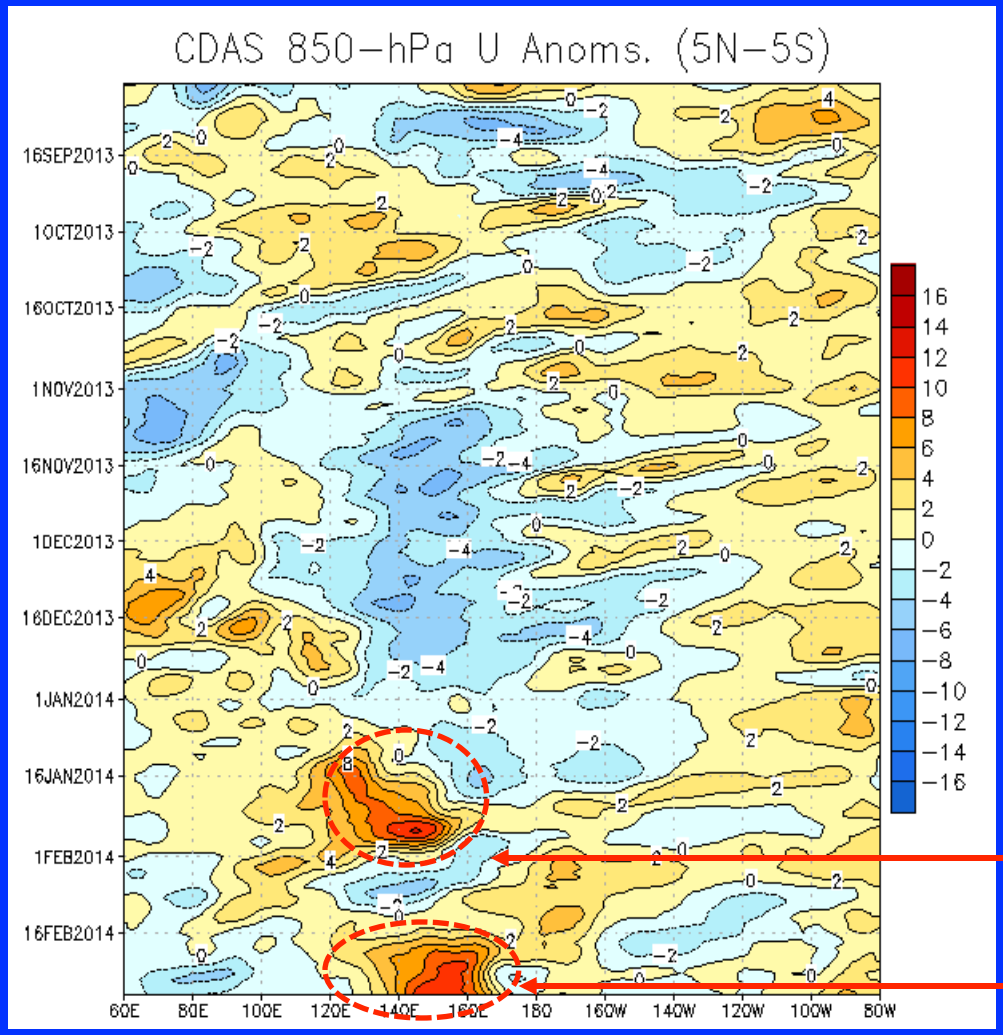
Time

Longitude

- During 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})



Time

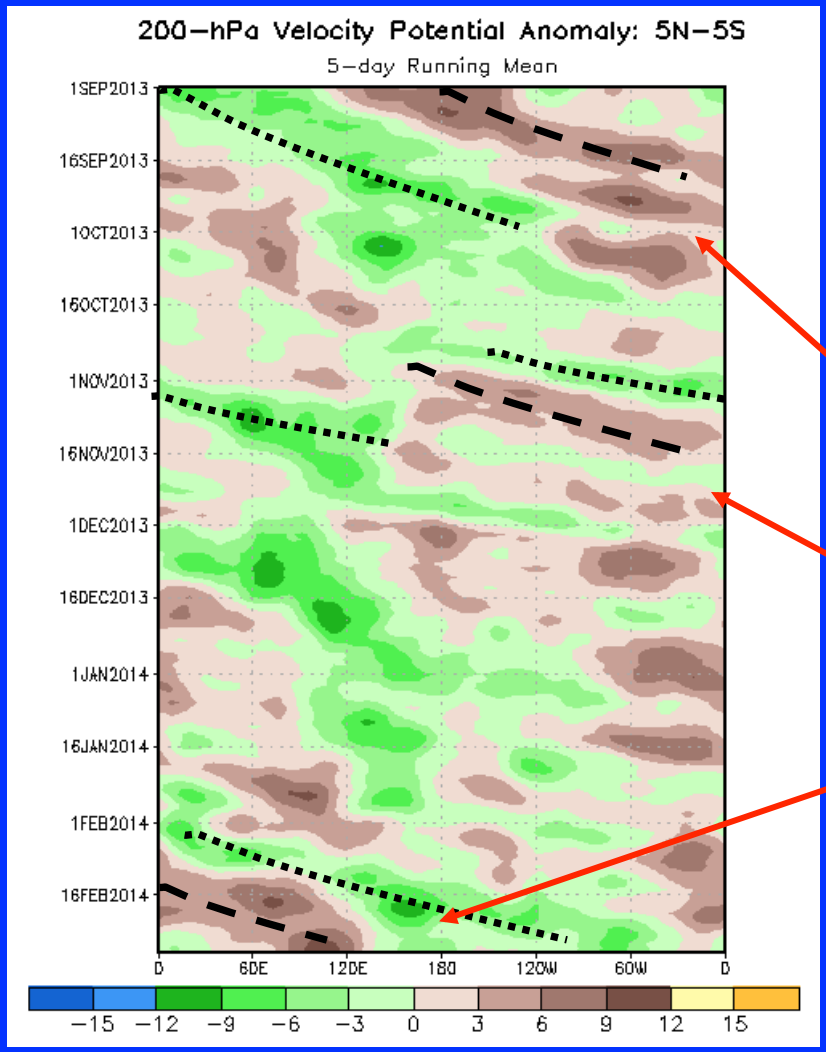
Longitude

Westerly wind anomalies (orange/ red shading).

Easterly wind anomalies (blue shading).

During the last half of January 2014, a strong westerly wind burst occurred over the western equatorial Pacific. Over the last couple weeks, another strong burst has emerged.

200-hPa Velocity Potential Anomalies (5°N-5°S)



Time

Longitude

Positive anomalies (brown shading) indicate unfavorable conditions for precipitation.

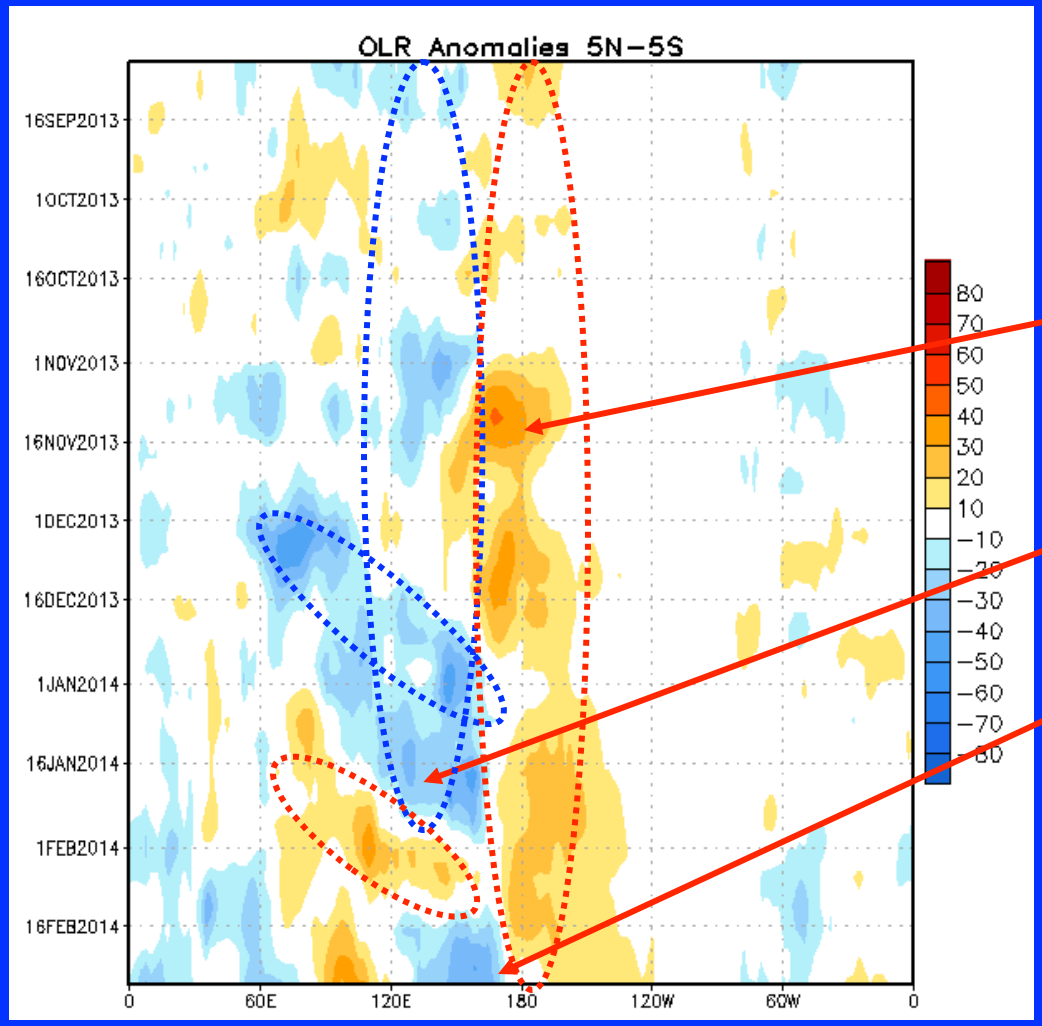
Negative anomalies (green shading) indicate favorable conditions for precipitation.

From mid-August through late September, the Madden Julian Oscillation (MJO) was active.

During early November, weak MJO activity was evident.

Recently, eastward propagation in the velocity potential 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, above-average OLR has persisted near the Date Line.

Until January 2014, below-average OLR was generally evident over the western Pacific.

Recently, near to below-average OLR has returned to the western Pacific.

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 +0.5ºC.

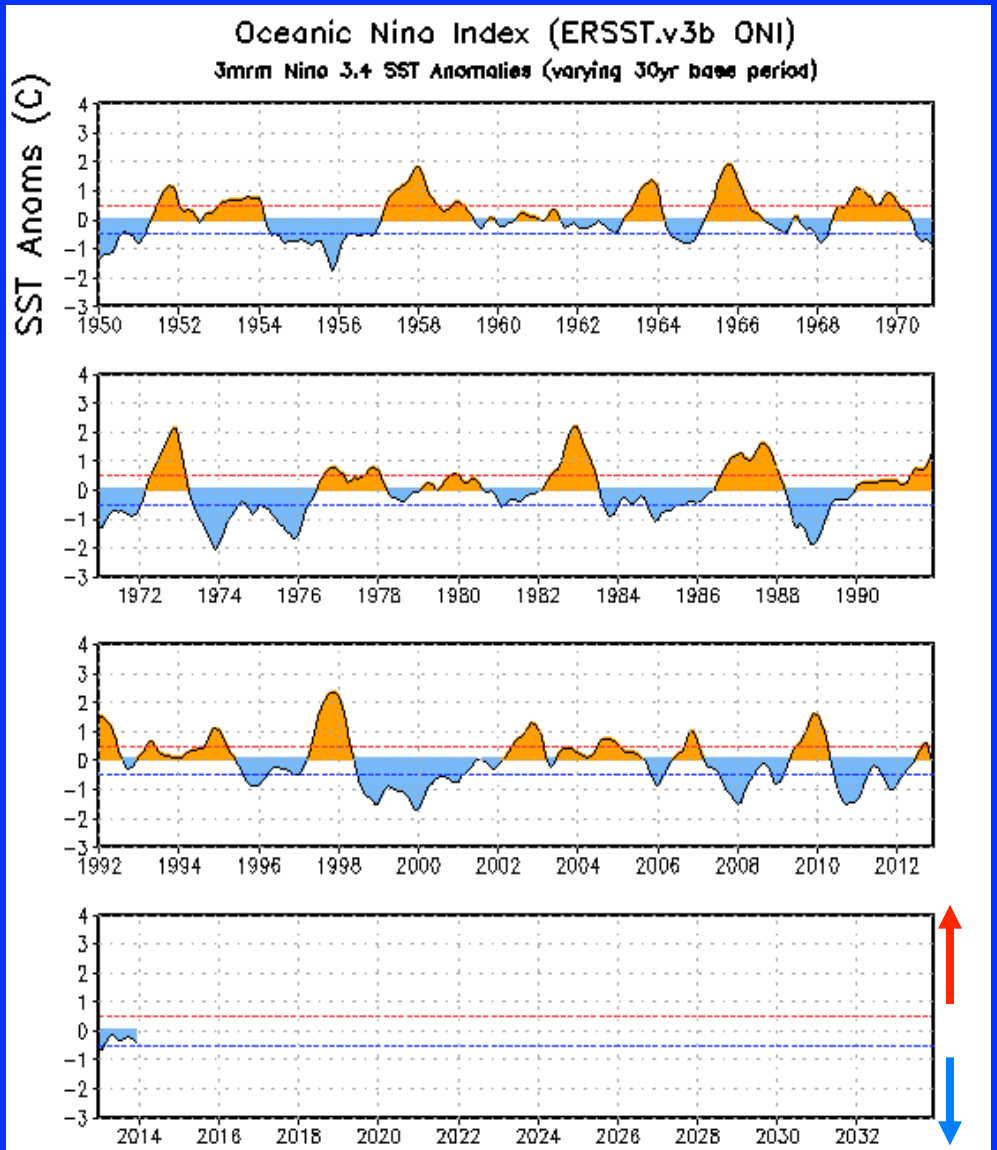
La Niña: characterized by a *negative* ONI less than or equal to –0.5ºC.

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 (°C): Evolution since 1950

The most recent ONI value (November 2013 – January 2014) is -0.4°C.



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
OND 2008 – FMA 2009	-0.8
JJA 2010 – MAM 2011	-1.5
ASO 2011 – FMA 2012	-1.0

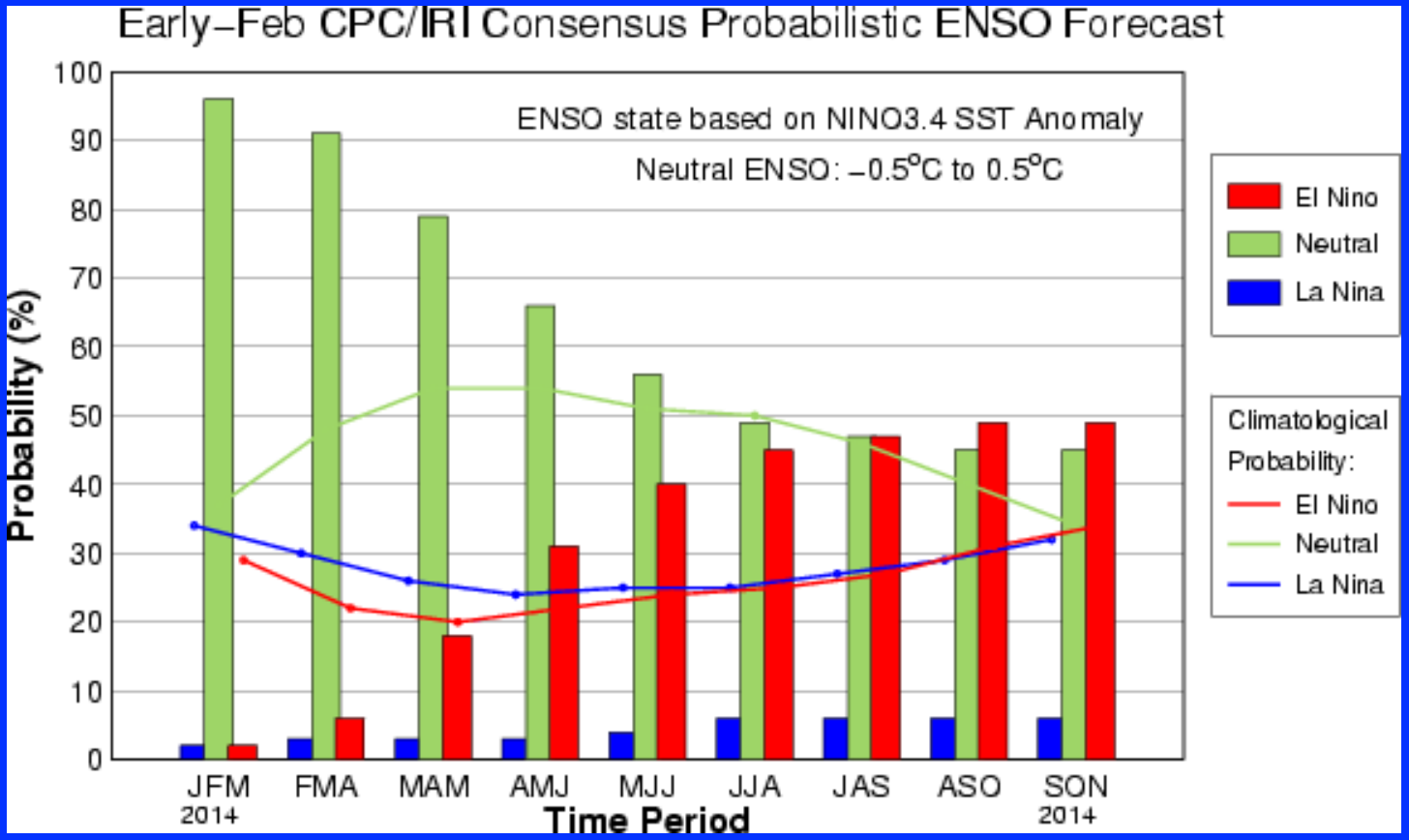
Recent Pacific warm (red) and cold (blue) episodes based on a threshold of +/- 0.5 °C for the Oceanic Nino Index (ONI) [3 month running mean of ERSST.v3b SST anomalies in the Nino 3.4 region (5N-5S, 120-170W)]. For historical purposes El Niño and La Niña episodes are defined when the threshold is met 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	0.3
2004	0.3	0.2	0.1	0.1	0.2	0.3	**0.5**	**0.7**	**0.8**	**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	-0.4	**-0.6**	**-0.8**	**-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	**-0.5**	**-0.7**
2009	**-0.8**	**-0.7**	**-0.5**	-0.2	0.2	0.4	**0.5**	**0.6**	**0.8**	**1.1**	**1.4**	**1.6**
2010	**1.6**	**1.3**	**1.0**	**0.6**	0.1	-0.4	**-0.9**	**-1.2**	**-1.4**	**-1.5**	**-1.5**	**-1.5**
2011	**-1.4**	**-1.2**	**-0.9**	**-0.6**	-0.3	-0.2	-0.2	-0.4	**-0.6**	**-0.8**	**-1.0**	**-1.0**
2012	**-0.9**	**-0.6**	**-0.5**	-0.3	-0.2	0.0	0.1	0.4	0.5	0.6	0.2	-0.3
2013	-0.6	-0.6	-0.4	-0.2	-0.2	-0.3	-0.3	-0.3	-0.3	-0.2	-0.3	-0.4
2014												
2015												
2016												
2017												
2018												
2019												
2020												
2021												
2022												
2023												
2024												
2025												
2026												
2027												

CPC/IRI Probabilistic ENSO Outlook

(updated 6 February 2014)

ENSO-neutral is favored through the Northern Hemisphere spring 2014, with a possible onset of El Niño sometime after the spring.



Pacific Niño 3.4 SST Outlook

• Most models predict ENSO-neutral (-0.5ºC to +0.5ºC) to continue through the Northern Hemisphere spring. After that, models predict either ENSO-neutral or El Niño (greater or equal to +0.5ºC) during the Northern Hemisphere summer 2014.

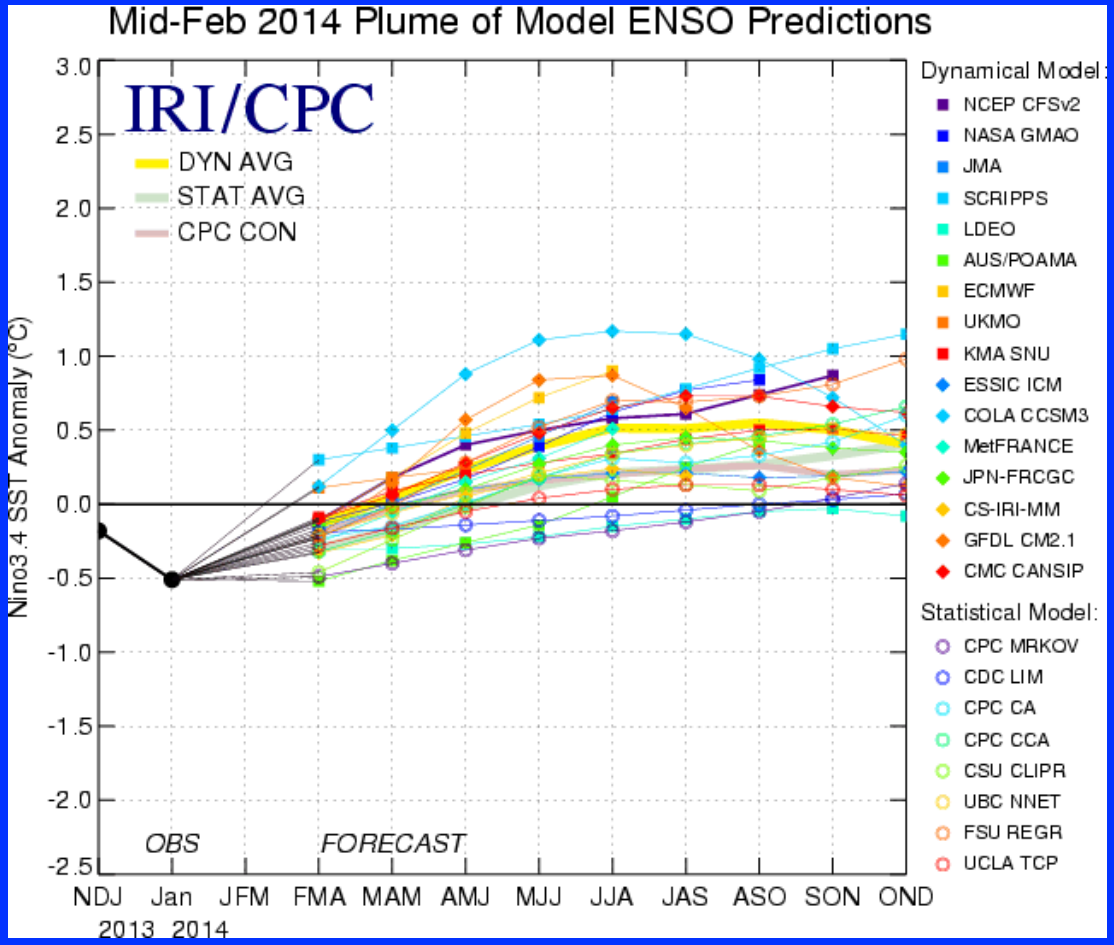
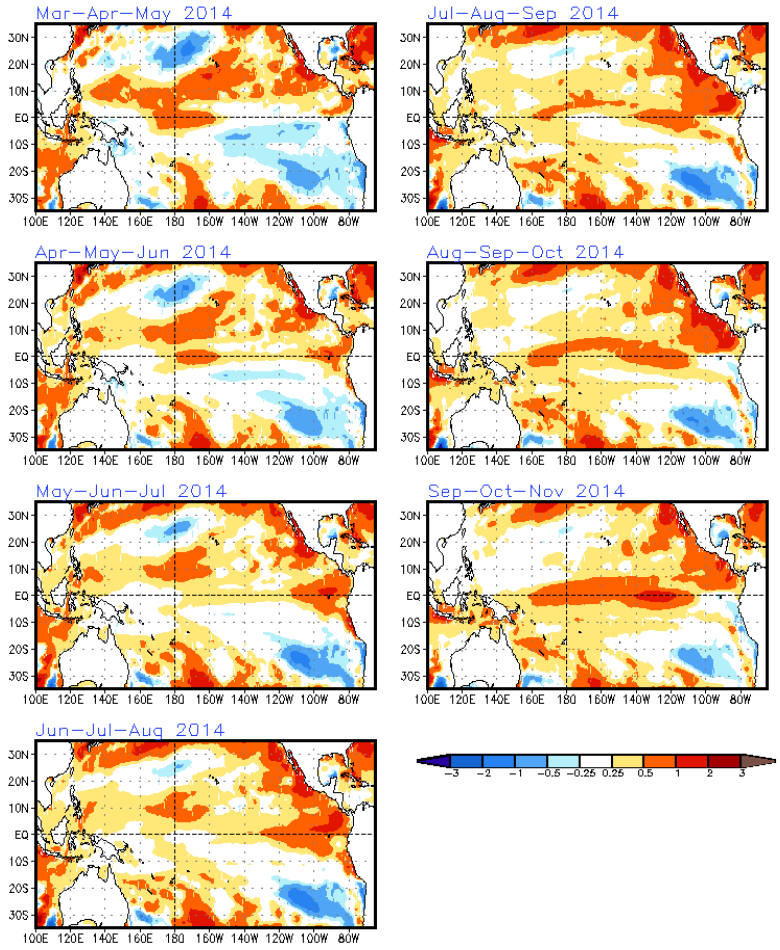


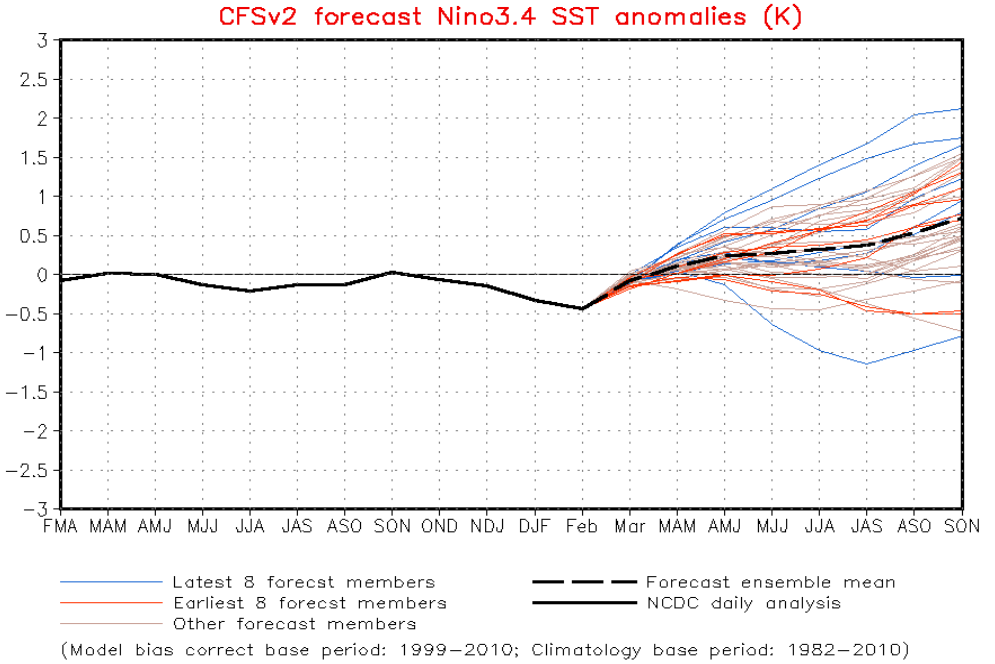
Figure provided by the International Research Institute (IRI) for Climate and Society (updated 18 February 2014).

SST Outlook: NCEP CFS.v2 Forecast Issued 3 March 2014



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

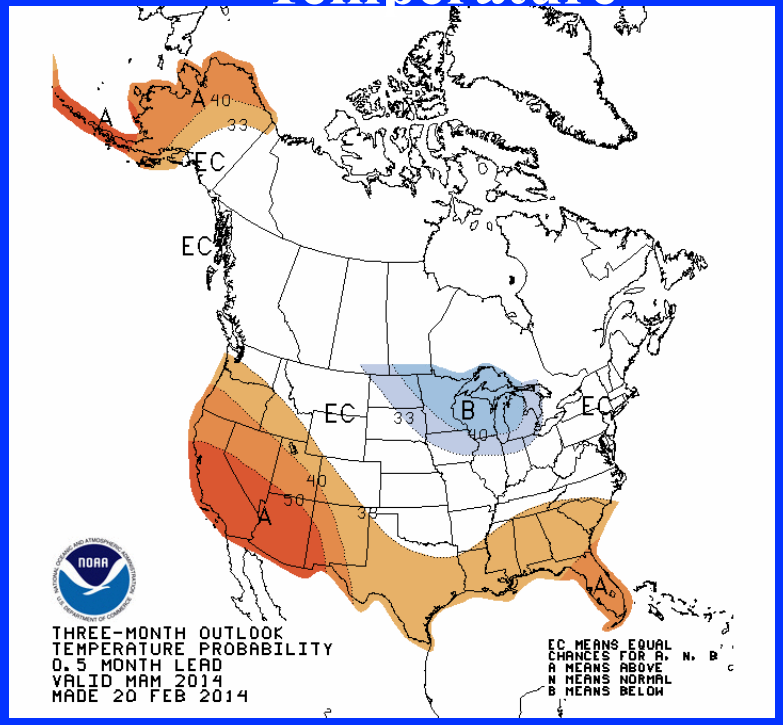
The CFS.v2 ensemble mean (black dashed line) predicts ENSO-neutral through the N.H. spring 2014 followed by El Niño starting in August-October (ASO) 2014



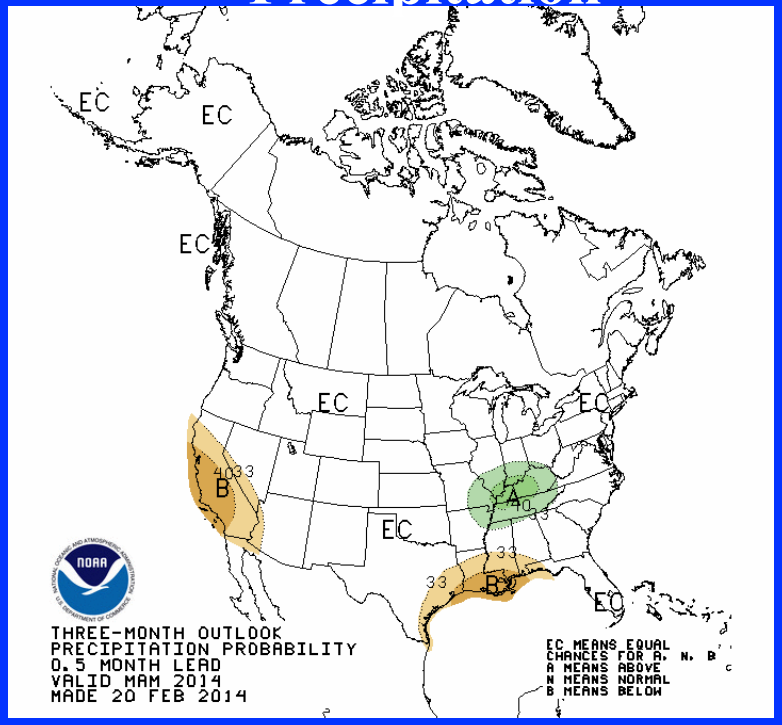
(Model bias correct base period: 1999–2010; Climatology base period: 1982–2010)

U. S. Seasonal Outlooks
March – May 2014

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) were below-average in the eastern Pacific Ocean, while remaining above average in the western Pacific.**
- **ENSO-neutral is expected to continue through the Northern Hemisphere spring 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