ENSO Cycle: Recent Evolution, Current Status and Predictions

Update prepared by
Climate Prediction Center / NCEP
4 September 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

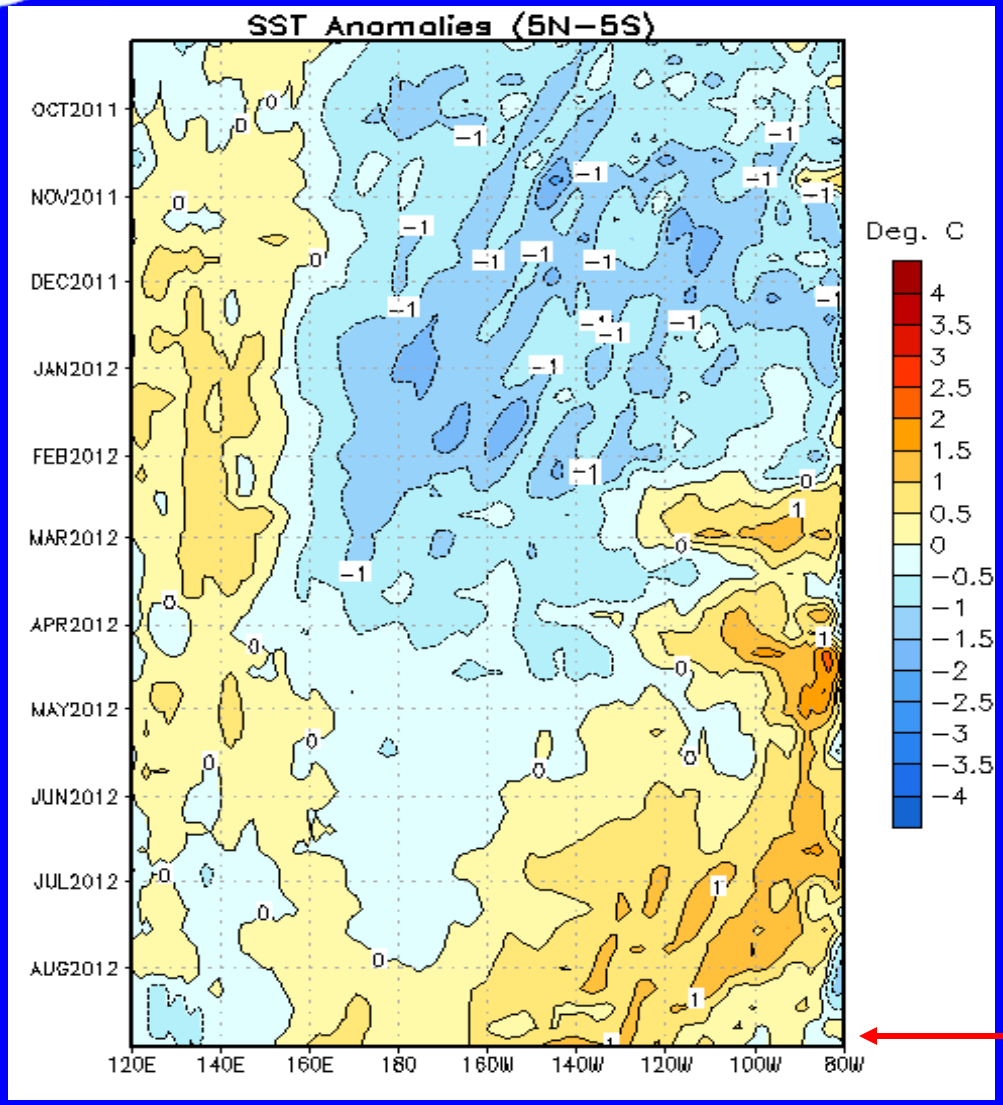
Summary

ENSO Alert System Status: El Niño Watch*

- **ENSO-neutral conditions continue.***
- **Equatorial sea surface temperatures (SST) are greater than 0.5°C above average across the eastern Pacific Ocean.**
- **The atmospheric circulation over the tropical Pacific is near average.**
- **El Niño conditions are likely to develop during August or September 2012.***

* 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

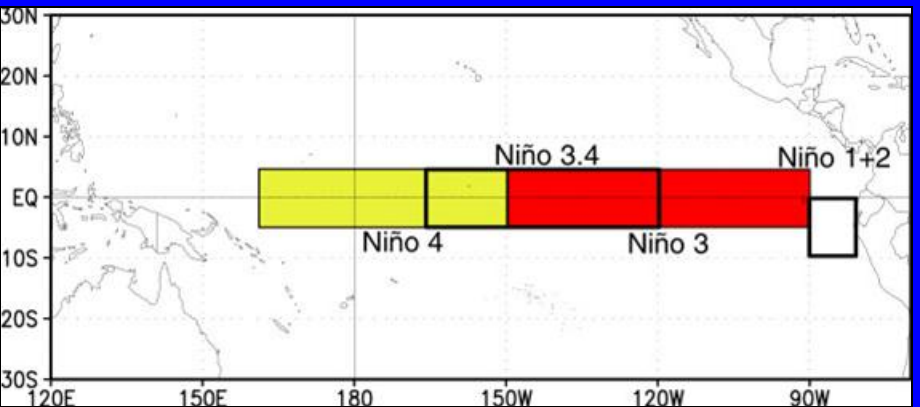
From September 2011- January 2012, below-average SSTs were evident across much of the equatorial Pacific Ocean.

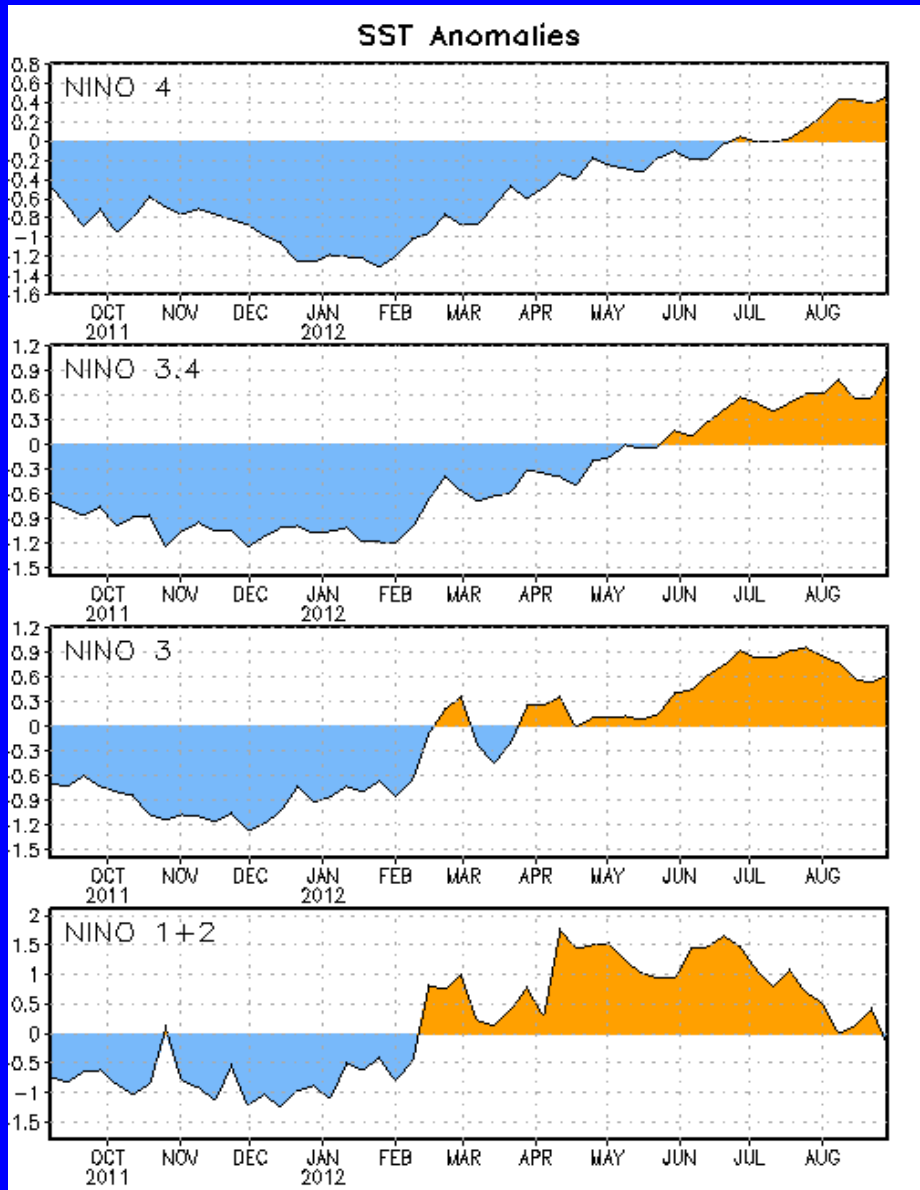
Since June 2012, above-average SSTs have shifted westward across the tropical Pacific.

Niño Region SST Departures (ºC)
Recent Evolution

The latest weekly SST departures are:

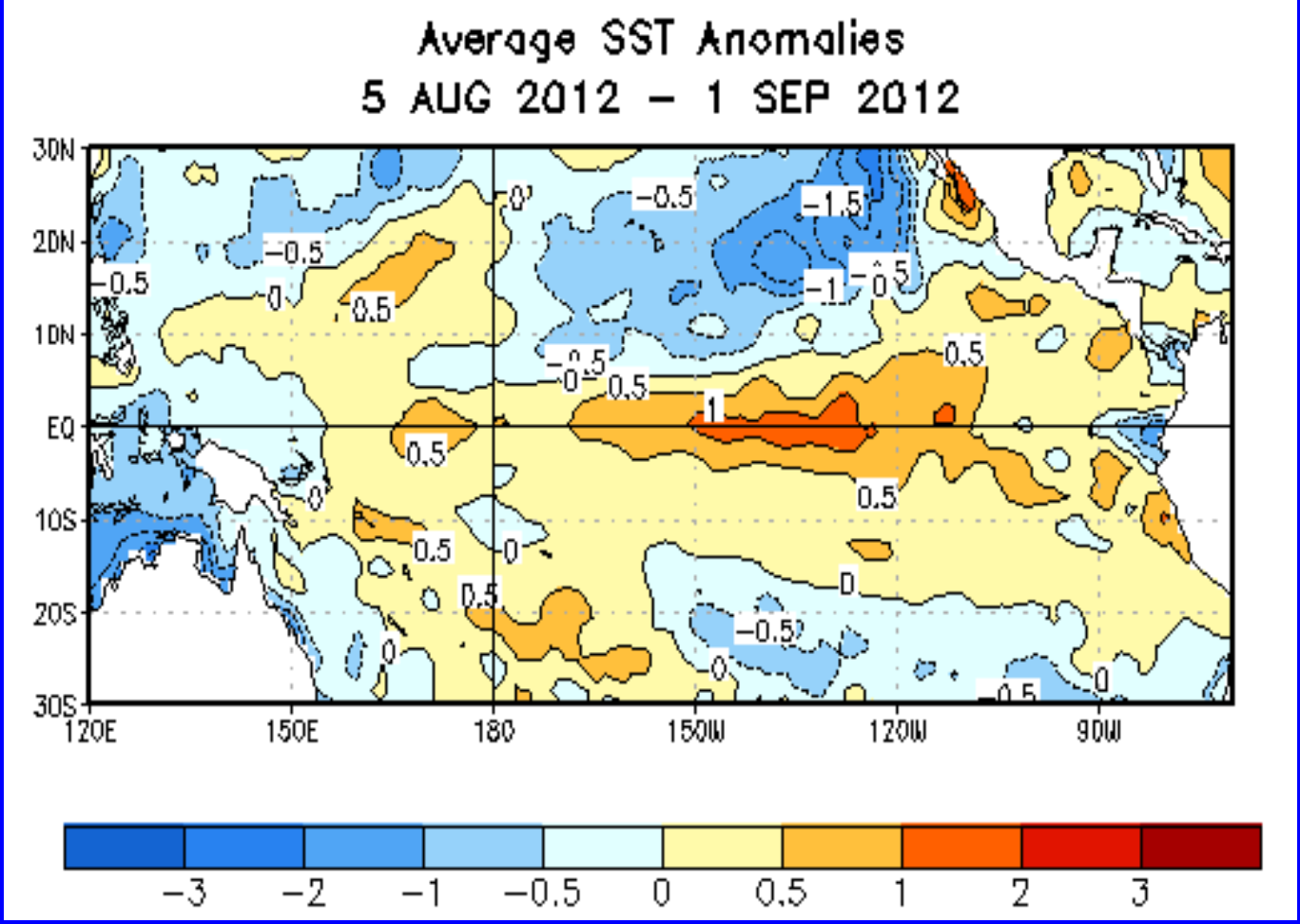
Niño 4	**0.5ºC**
Niño 3.4	**0.9ºC**
Niño 3	**0.7ºC**
Niño 1+2	**-0.2ºC**



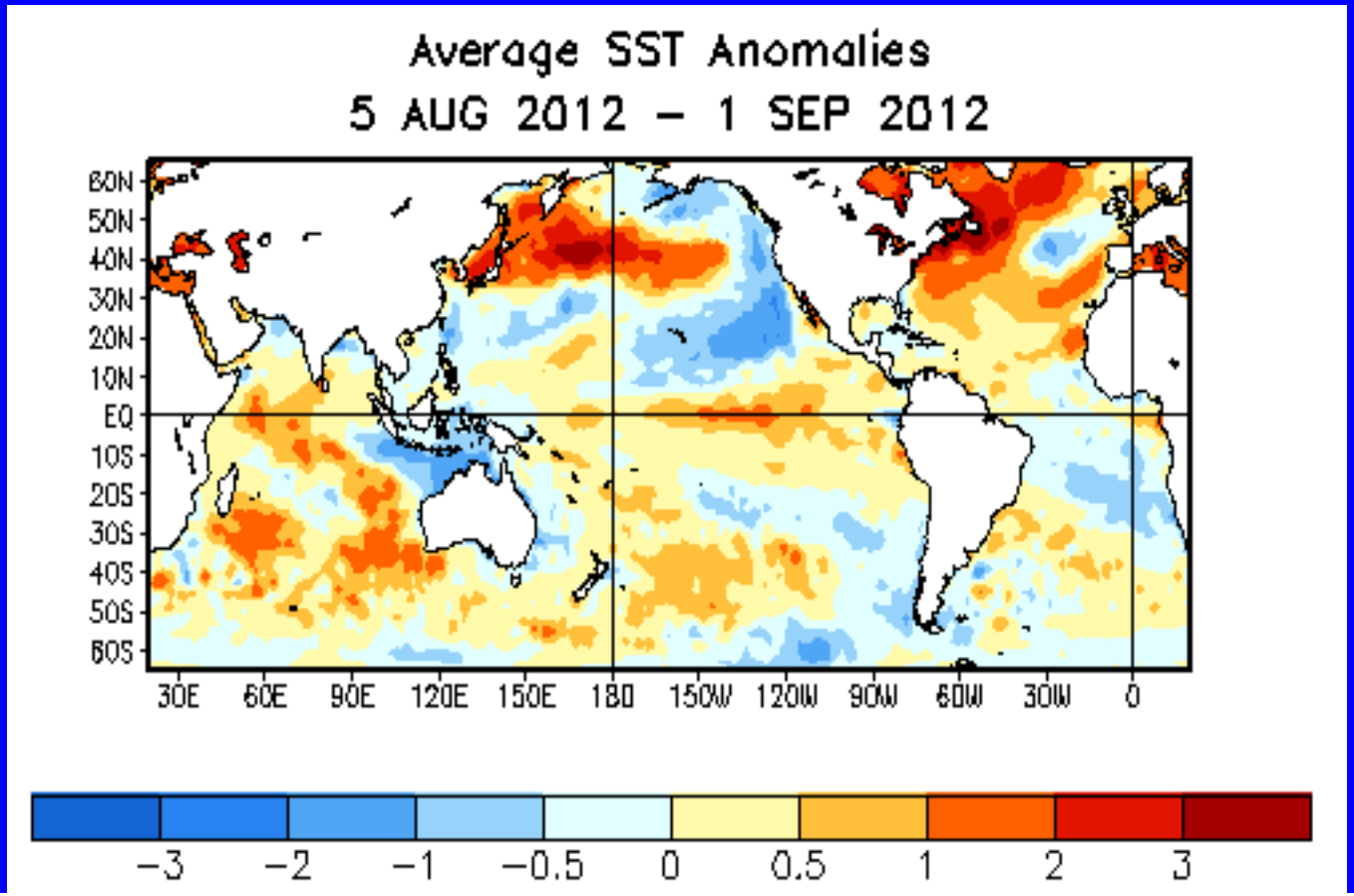


SST Departures (ºC) in the Tropical Pacific During the Last 4 Weeks

During the last 4-weeks, equatorial SSTs were more than 0.5°C above average between 165°W - 110°W and just to the west of the Date Line.

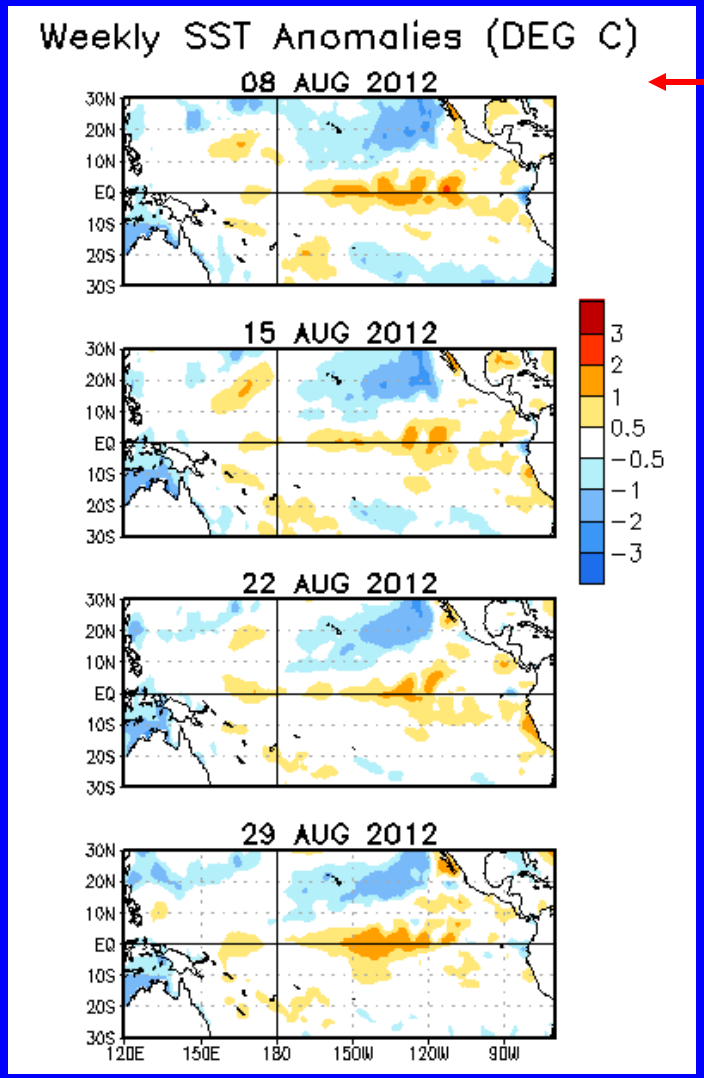


Global SST Departures (°C)



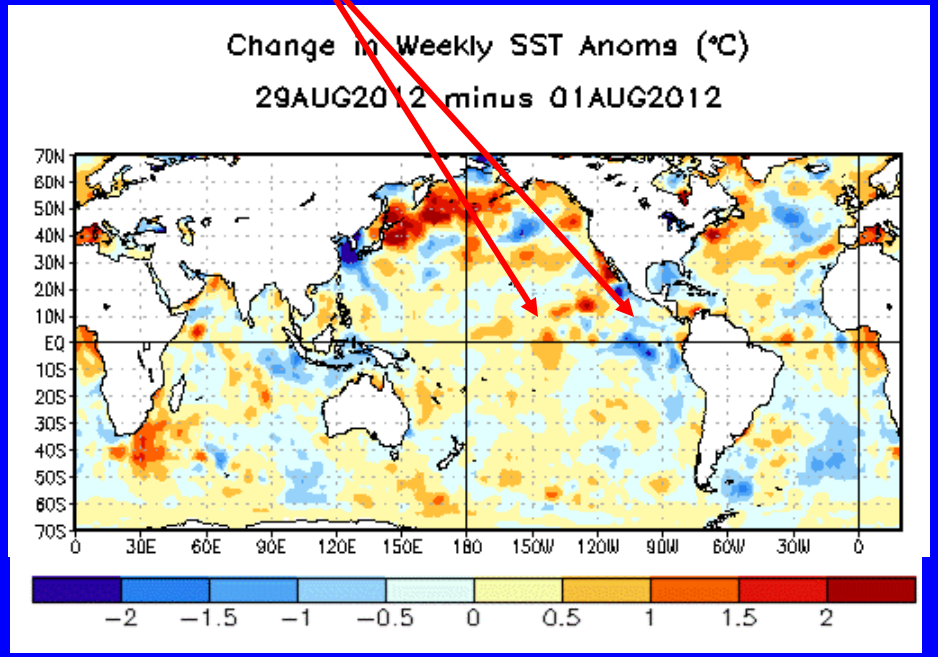
During the last four weeks, equatorial SSTs were above average across much of the Pacific Ocean and the western Indian Ocean, and below average near Indonesia/north of Australia.

Weekly SST Departures (ºC) for the Last Four Weeks



- **During the last four weeks, above-average SSTs were present in the central and east-central equatorial Pacific.**

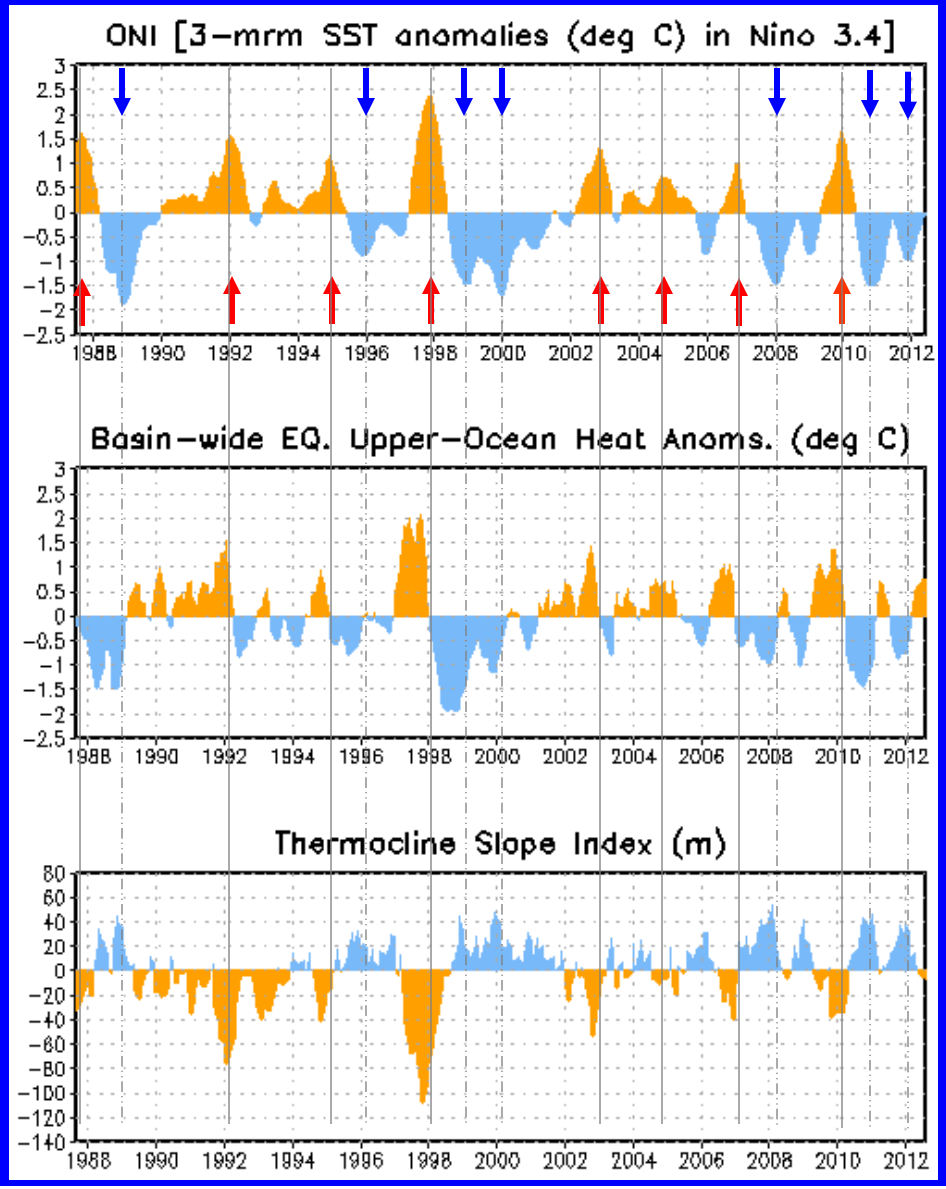
- **During the last 30 days, positive SST anomalies increased in magnitude in the east-central equatorial Pacific and decreased in magnitude in the eastern equatorial Pacific.**



Upper-Ocean Conditions in the Eq. Pacific

Cold Episodes ↓

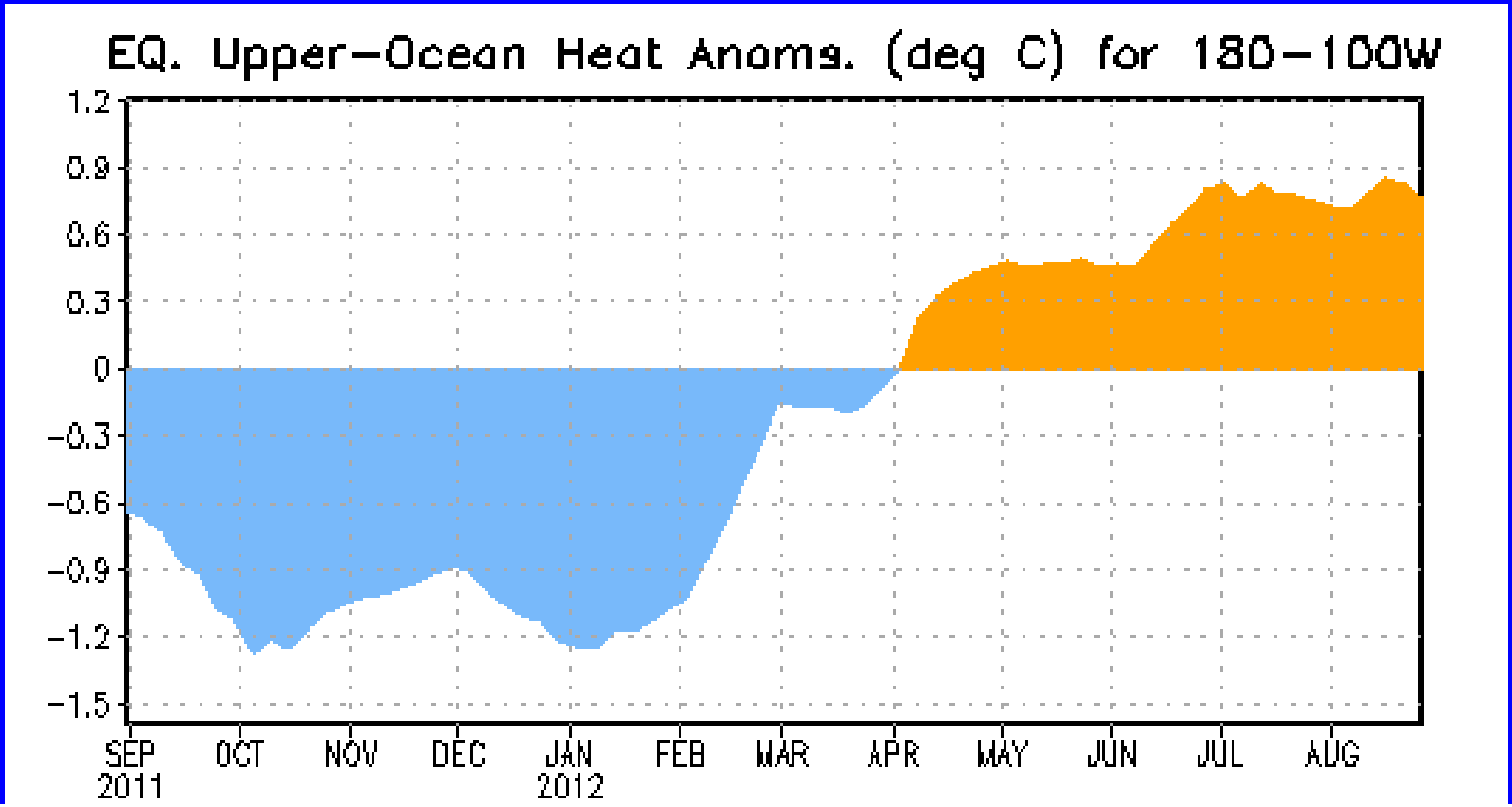
Warm Episodes ↑



- 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 (slightly positive) and a near zero thermocline slope index reflect ENSO neutral conditions.

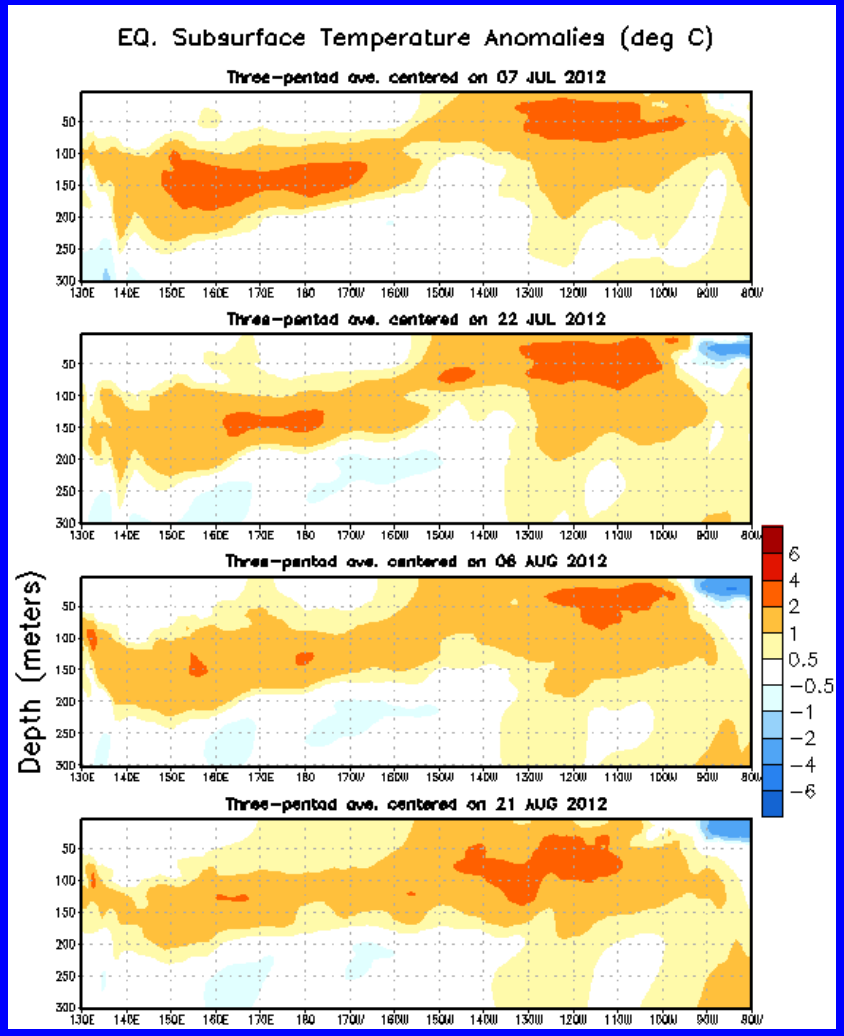
The monthly thermocline slope index represents the difference in anomalous depth of the 20°C isotherm between the western Pacific (160°E-150°W) and the eastern Pacific (90°-140°W).

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

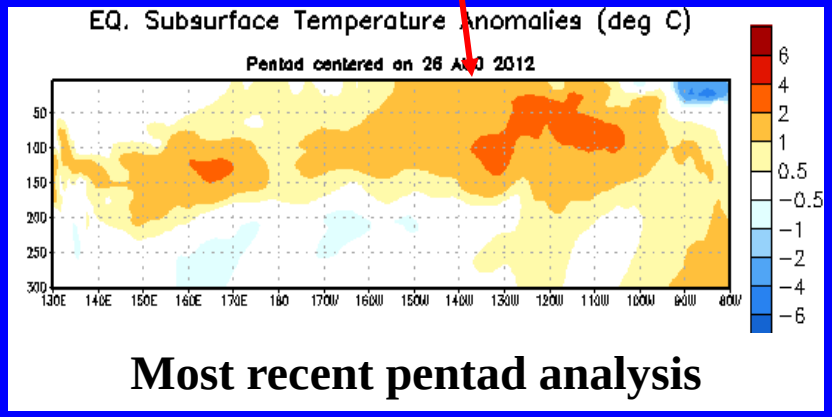


Negative subsurface temperature anomalies from late July 2011 through March 2012 reflected La Niña. Since April 2012, the anomalies have been positive with increases during April and June.

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

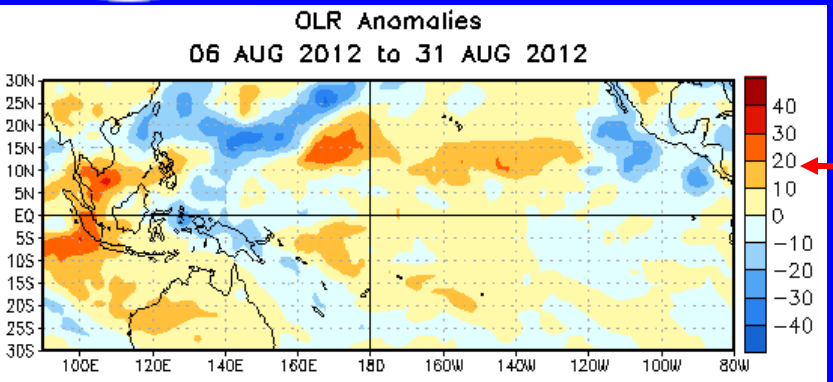


- During the last two months, positive subsurface temperature anomalies have dominated the upper ocean throughout the equatorial Pacific. In mid-July, negative anomalies emerged in the extreme eastern Pacific.
- During the recent period, the pattern of positive subsurface temperature anomalies persisted.

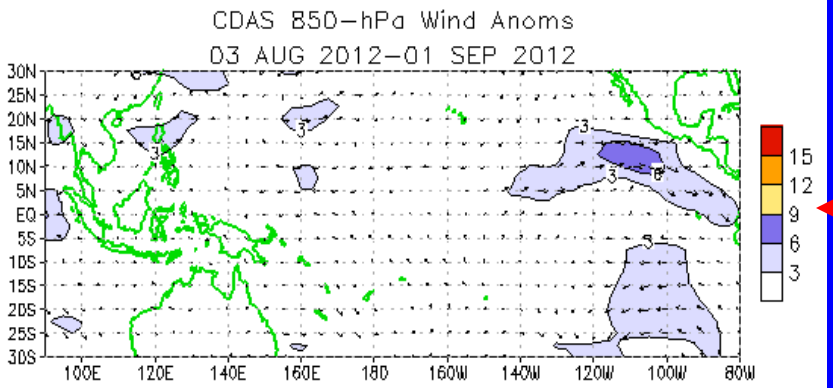


Most recent pentad analysis

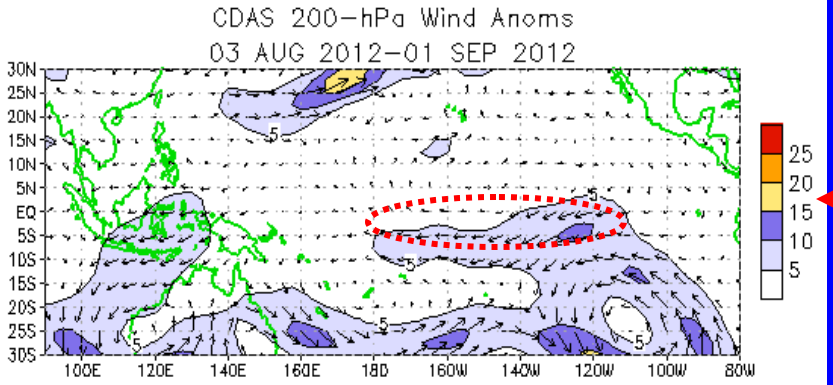
Tropical OLR and Wind Anomalies During the Last 30 Days



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 Malaysia.



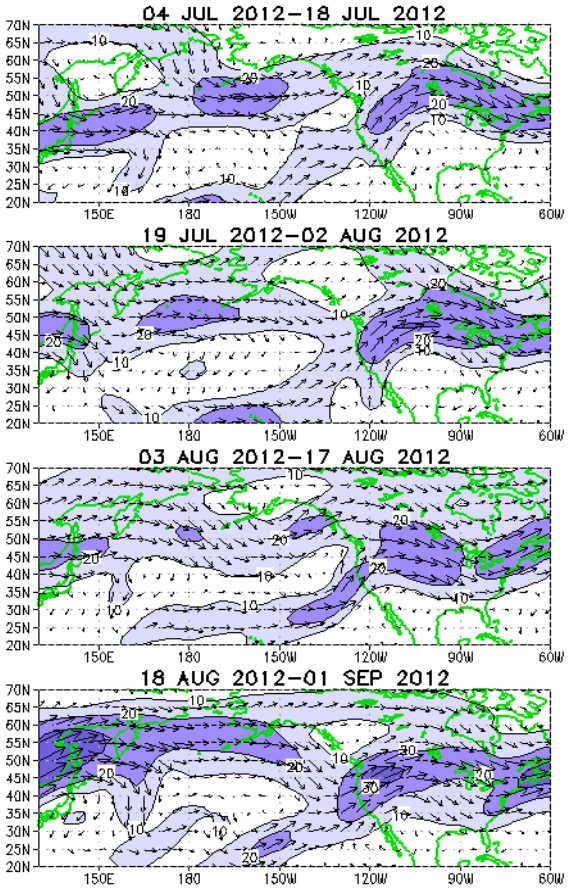
Low-level (850-hPa) winds were near average across the equatorial Pacific.



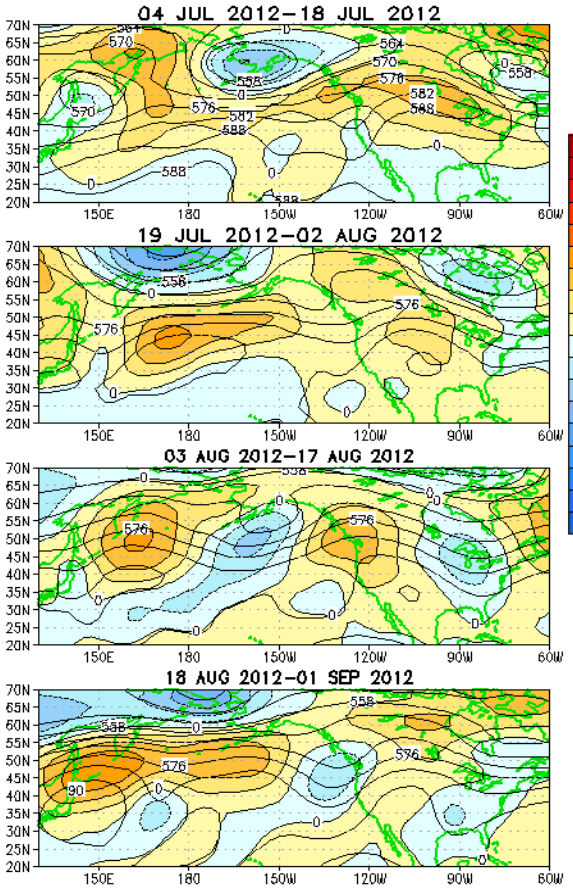
Upper-level (200-hPa) easterly wind anomalies were observed in the east-central equatorial Pacific, just south of the equator.

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

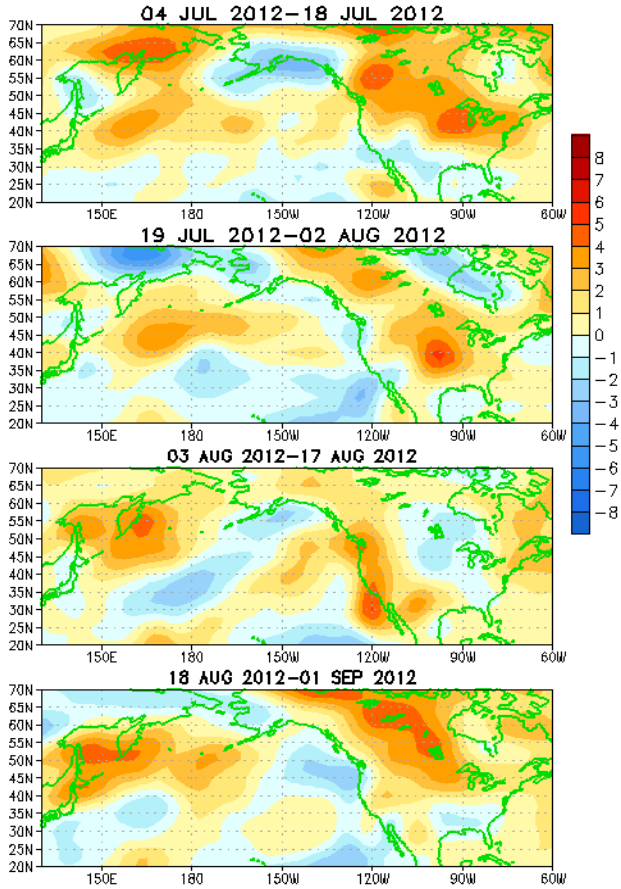
200-hPa Wind



500-hPa Height & Anoms.



925-hPa Temp. Anoms. (ºC)

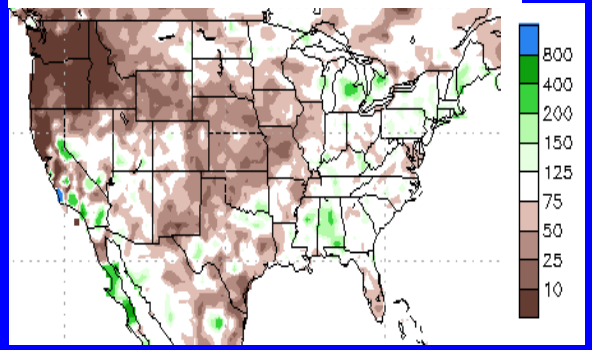


During July, above-average 500-hPa heights and above-average temperatures occurred over most of the conterminous U.S. Since early August, below-average heights have become more evident across the eastern U.S., accompanied by near- or below-average temperatures in many areas of the central and eastern U.S.

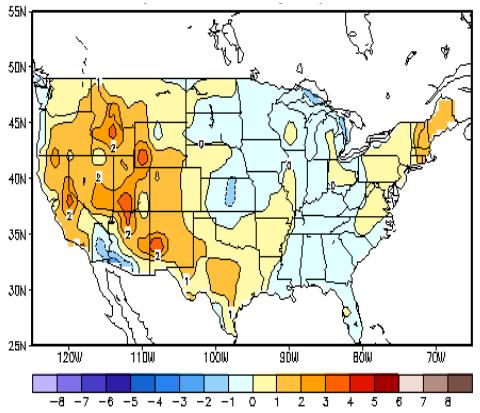
U.S. Temperature and Precipitation Departures During the Last 30 and 90 Days

Last 30 Days

30-day (ending 22 Aug 2012) % of average precipitation

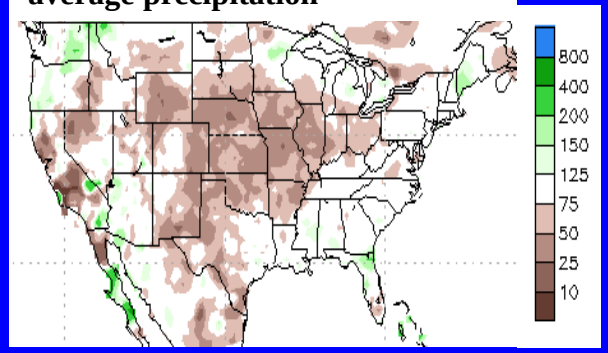


30-day (ending 2 Sept 2012) temperature departures (degree C)

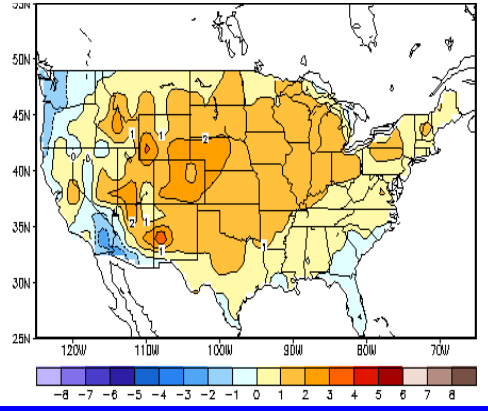


Last 90 Days

90-day (ending 22 Aug 2012) % of average precipitation



90-day (ending 2 Sept 2012) temperature departures (degree C)

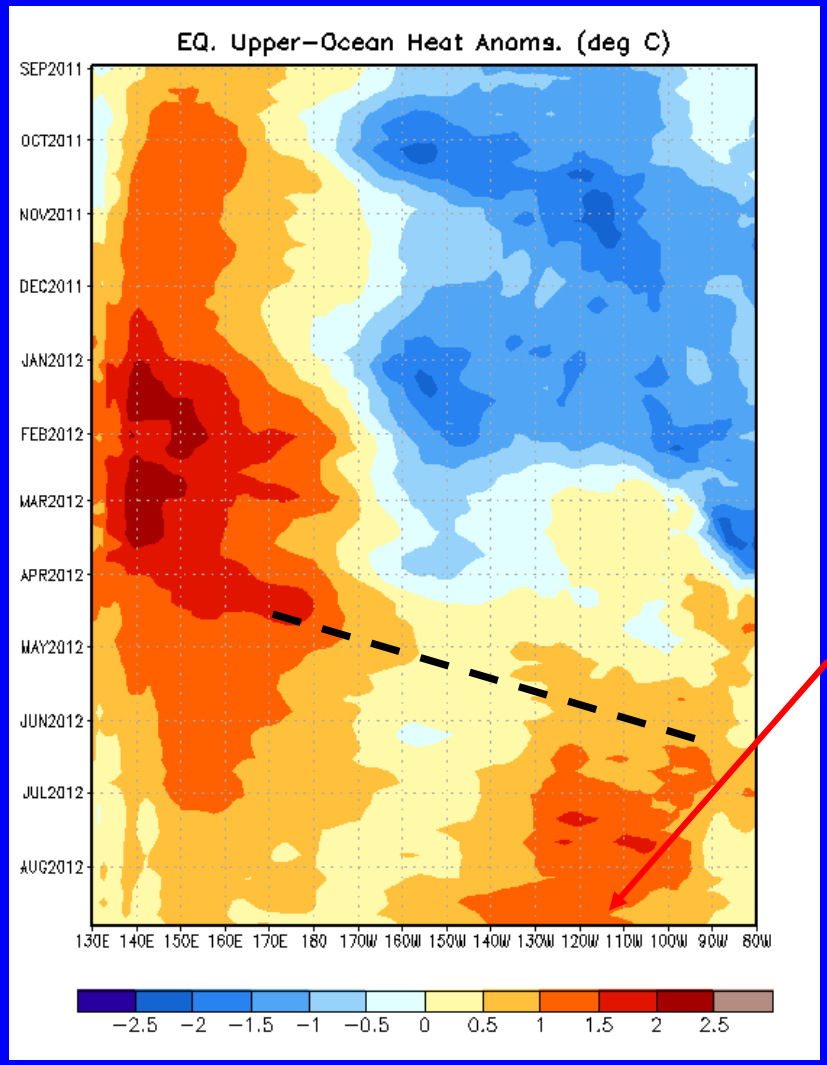


Intraseasonal Variability

- **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



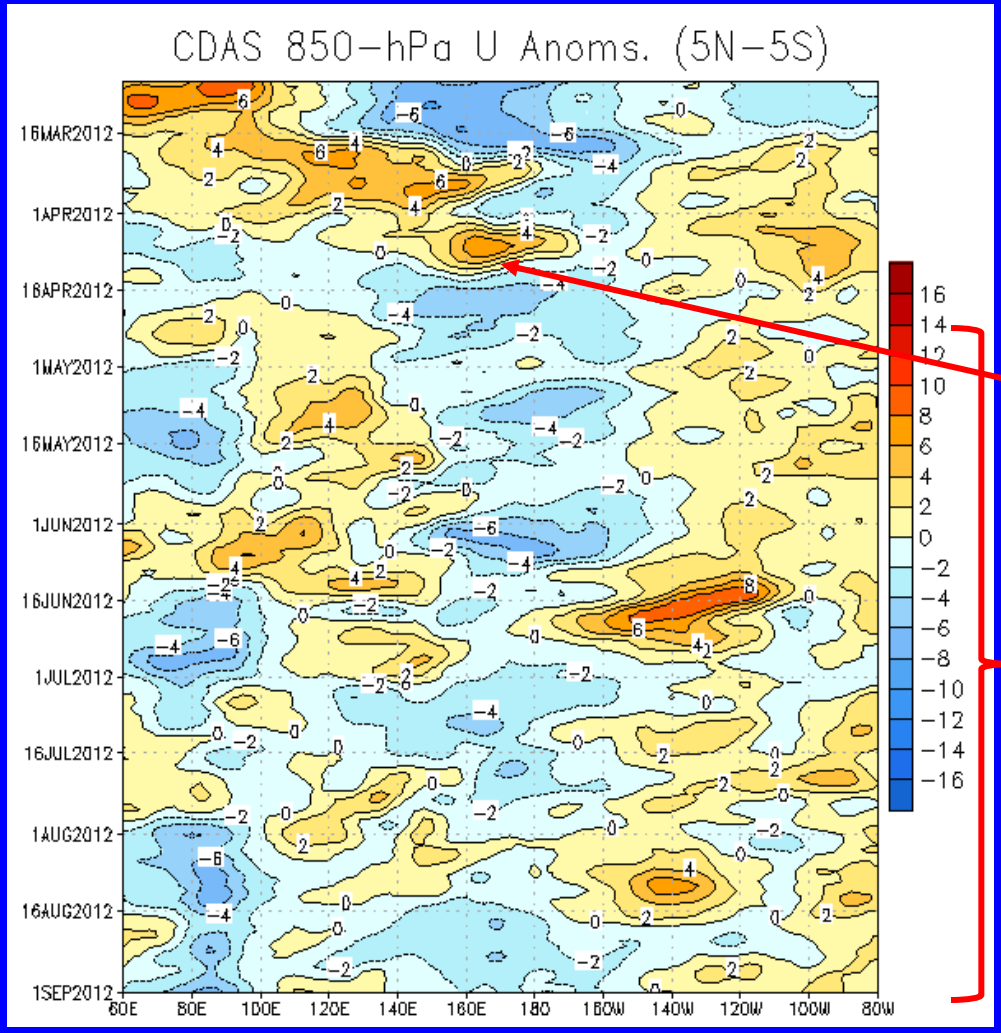
Time

Longitude

- **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 a downwelling Kelvin wave.**
- **Since June, positive heat content anomalies have prevailed across the east-central and eastern equatorial 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

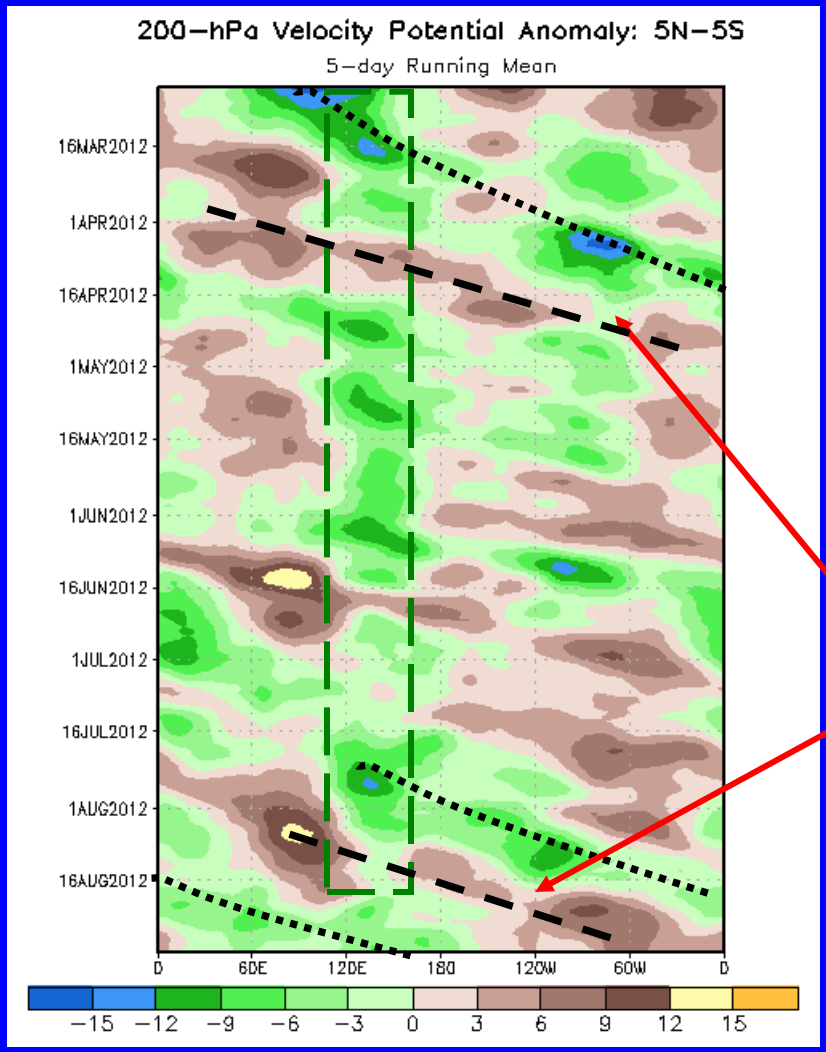
Westerly wind anomalies (orange/red shading).

Easterly wind anomalies (blue shading).

During late March and early April, westerly anomalies were evident across the western equatorial Pacific, in part due to the MJO.

Relative to the last two years, westerly wind anomalies are more prevalent across the equatorial Pacific.

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



Time

Longitude

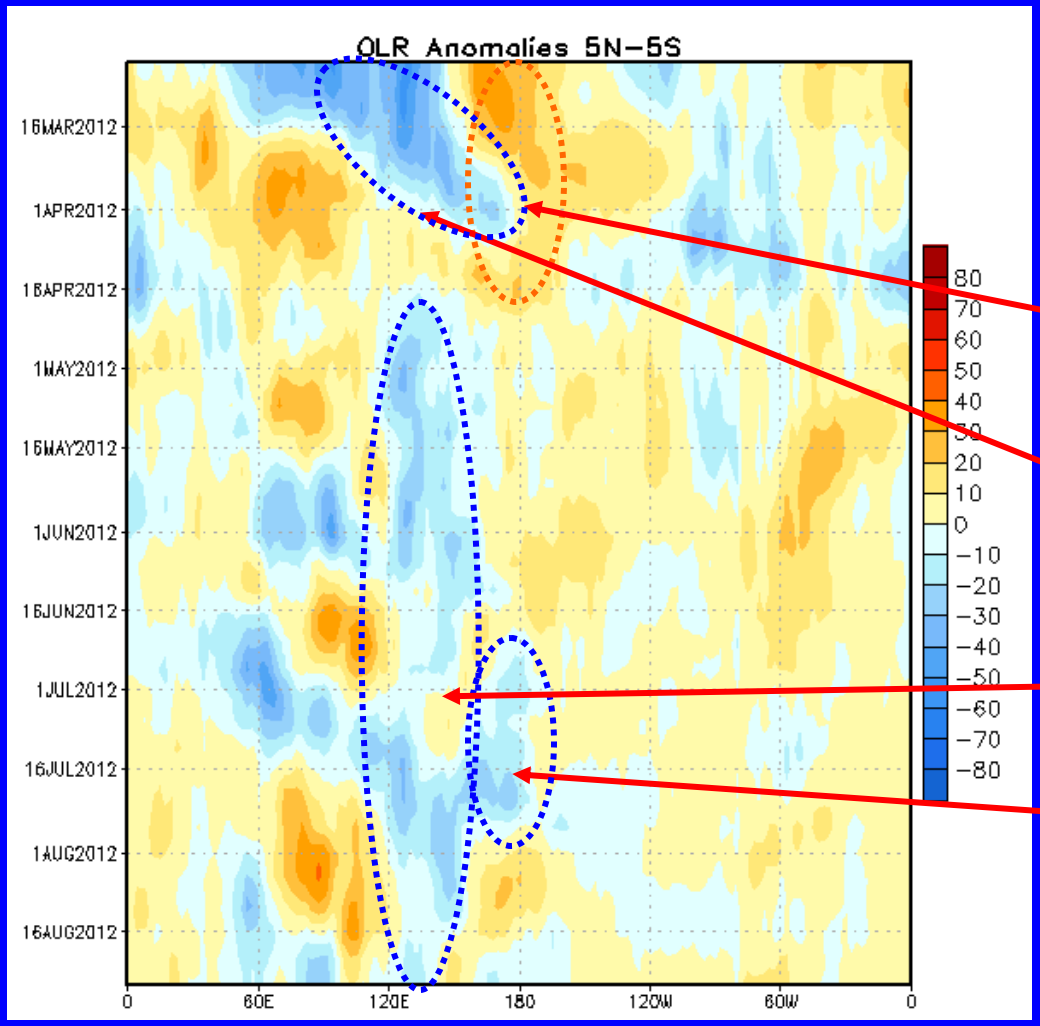
Positive anomalies (brown shading) indicate unfavorable conditions for precipitation.

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

Through the period, a quasi- persistent pattern of upper-level divergence (green) generally prevailed over the Maritime Continent.

The MJO was active during February through mid April 2012. In late July. the MJO strengthened, but recently shows signs of weakening.

Outgoing Longwave Radiation (OLR) Anomalies



Time

Longitude

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

Wetter-than-average conditions (blue shading)

From April 2010 – April 2012, negative OLR anomalies were observed near the Maritime Continent and positive OLR anomalies prevailed over the western and central Pacific.

During February through March 2012, eastward propagation of negative OLR anomalies is evident.

Since mid-April 2012, negative OLR anomalies have been observed near the eastern Maritime Continent.

During July, negative OLR anomalies were observed 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.

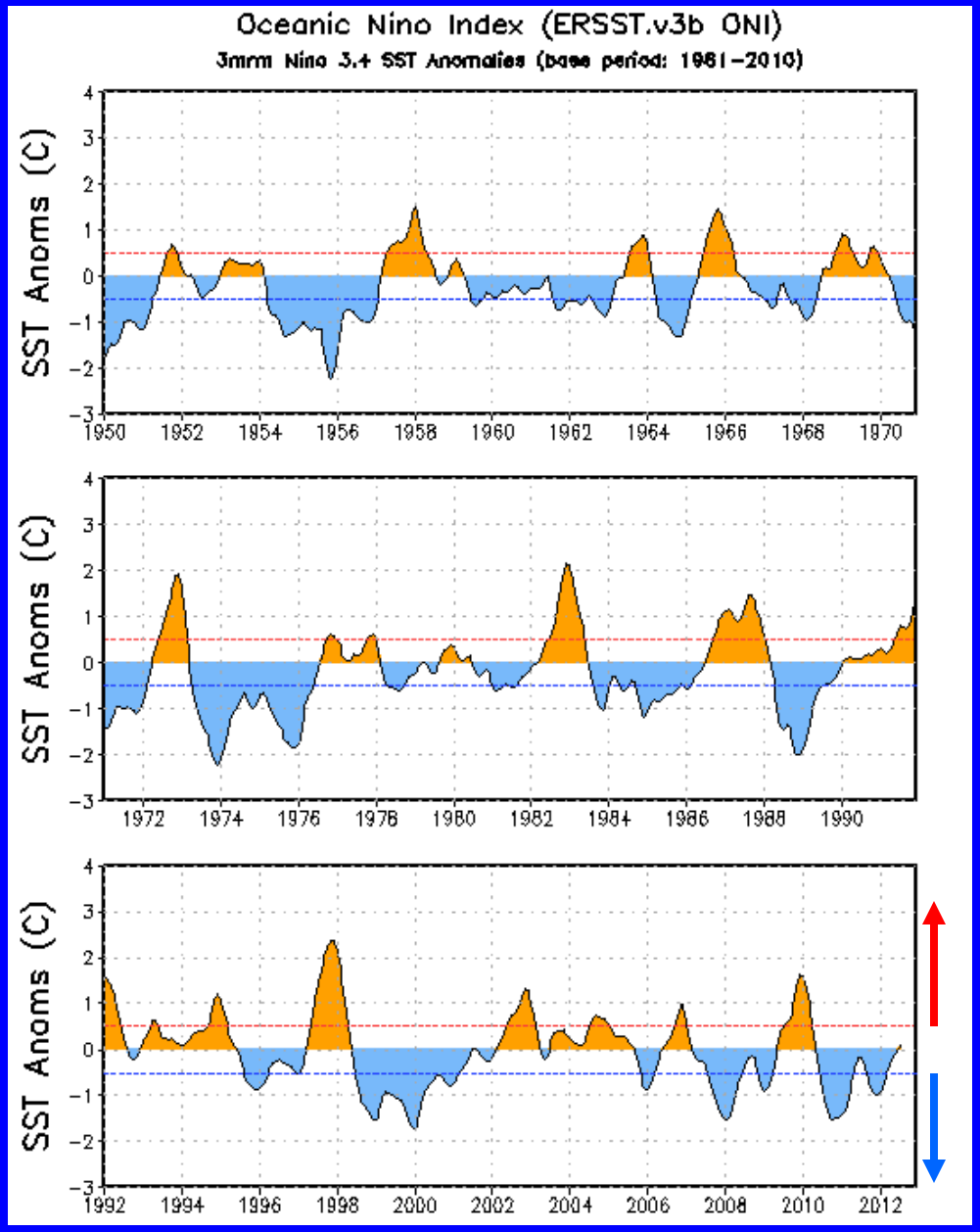
La Niña: characterized by a *negative* ONI less than or equal to −0.5°C.

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 (June – August 2012) is 0.1ºC.



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

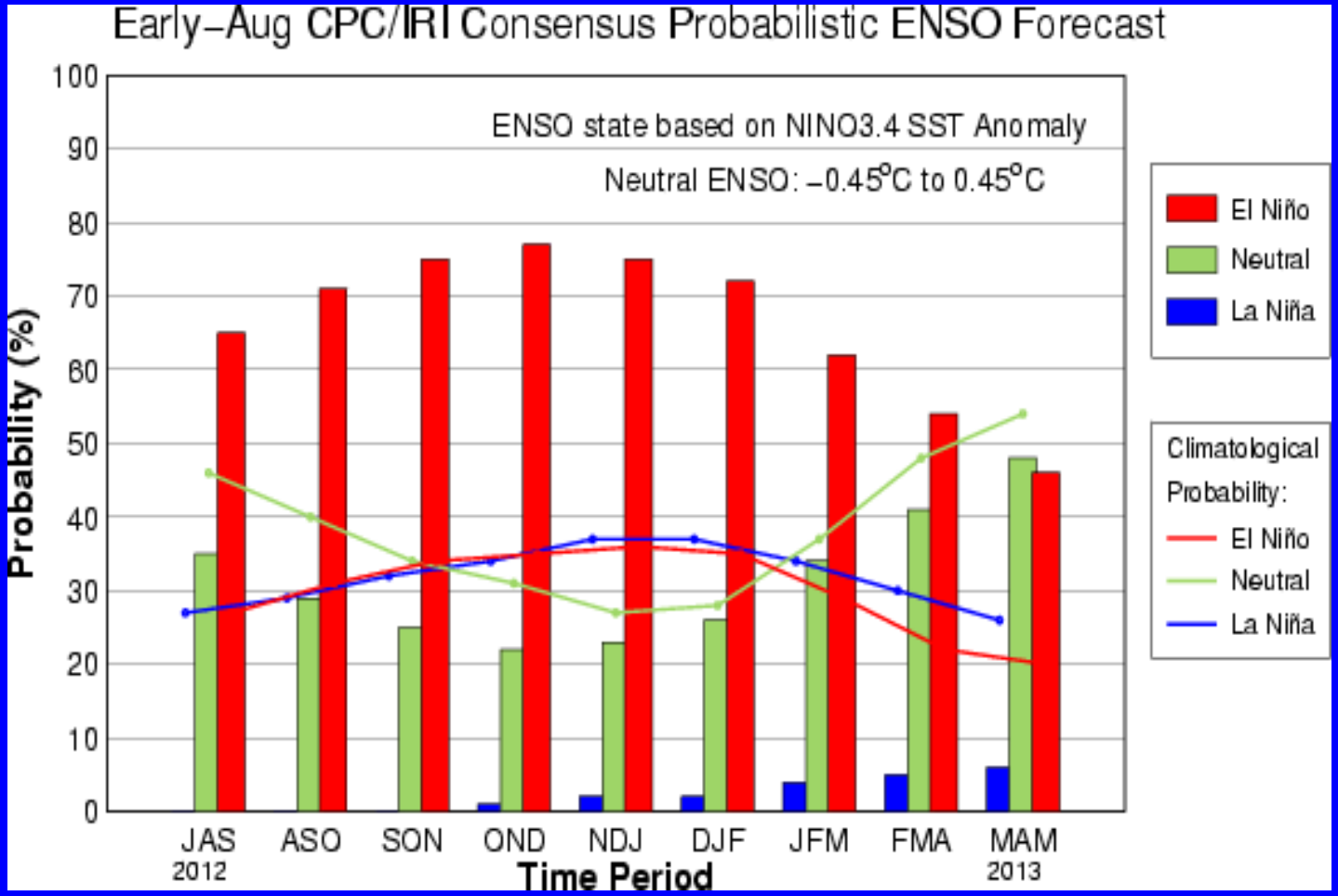
Recent Pacific warm (red) and cold (blue) episodes based on a threshold of +/- 0.5 ºC for the Oceanic Nino Index (ONI) [3 month running mean of ERSST.v3b SST anomalies in the Nino 3.4 region (5N-5S, 120-170W)]. For historical purposes El Niño and La Niña episodes are defined when the threshold is met 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					
2013												
2014												
2015												
2016												
2017												
2018												
2019												
2020												
2021												
2022												
2023												
2024												
2025												
2026												
2027												

CPC/IRI Probabilistic ENSO Outlook

(updated 9 Aug 2012)

El Niño is favored beginning in July-September 2012 and continuing through Northern Hemisphere winter 2012-13.



Pacific Niño 3.4 SST Outlook

• Nearly all of the dynamical models predict a transition from ENSO-neutral conditions (Niño-3.4 SST anomalies between -0.5°C and +0.5°C) to El Niño during the Northern Hemisphere summer/fall, with El Niño continuing into winter 2012-13.

• The average dynamical model forecast is warmer than the statistical models.

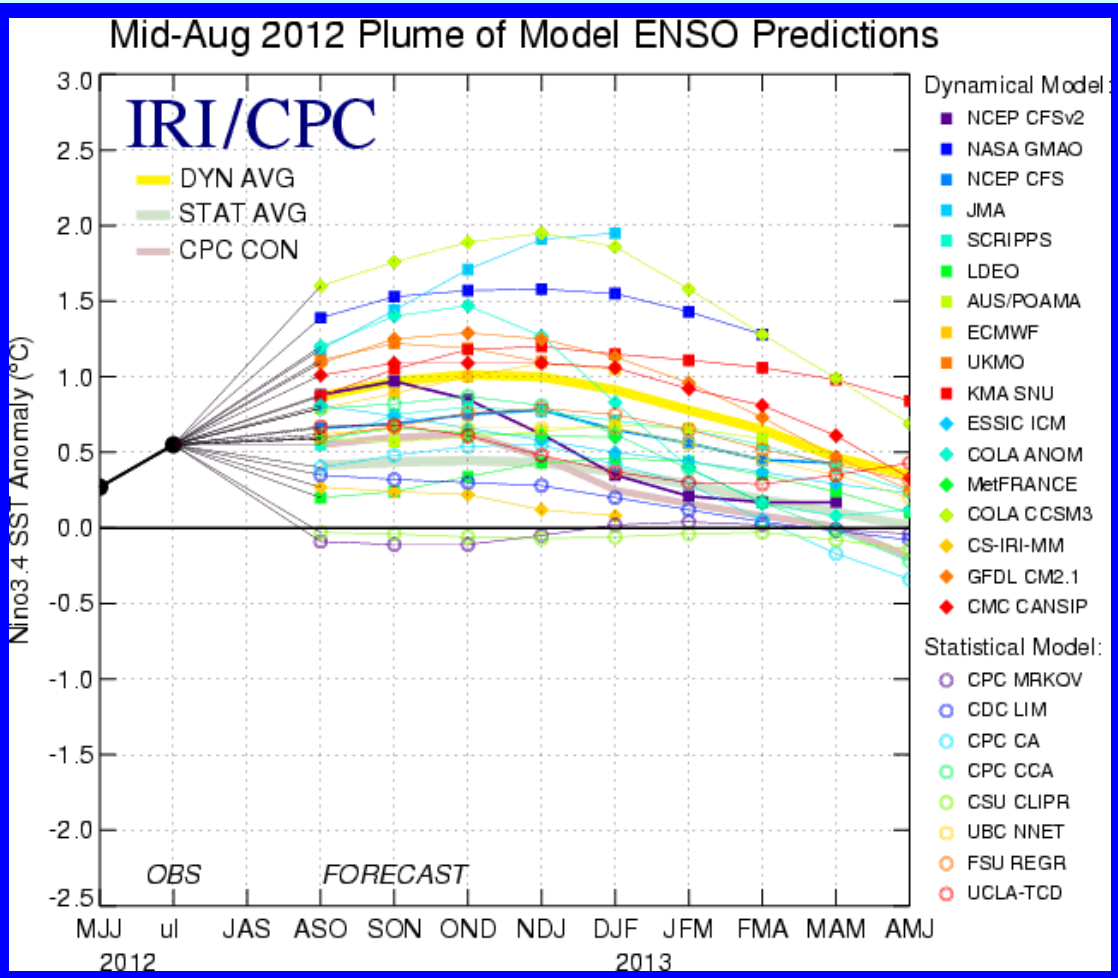
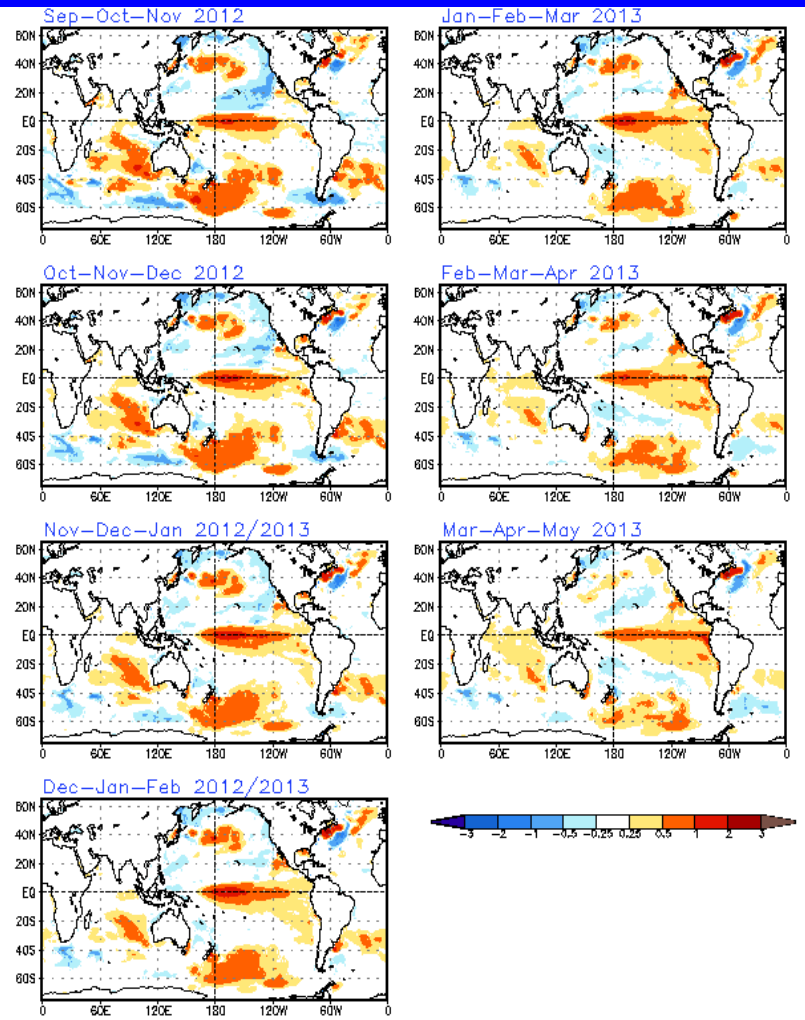
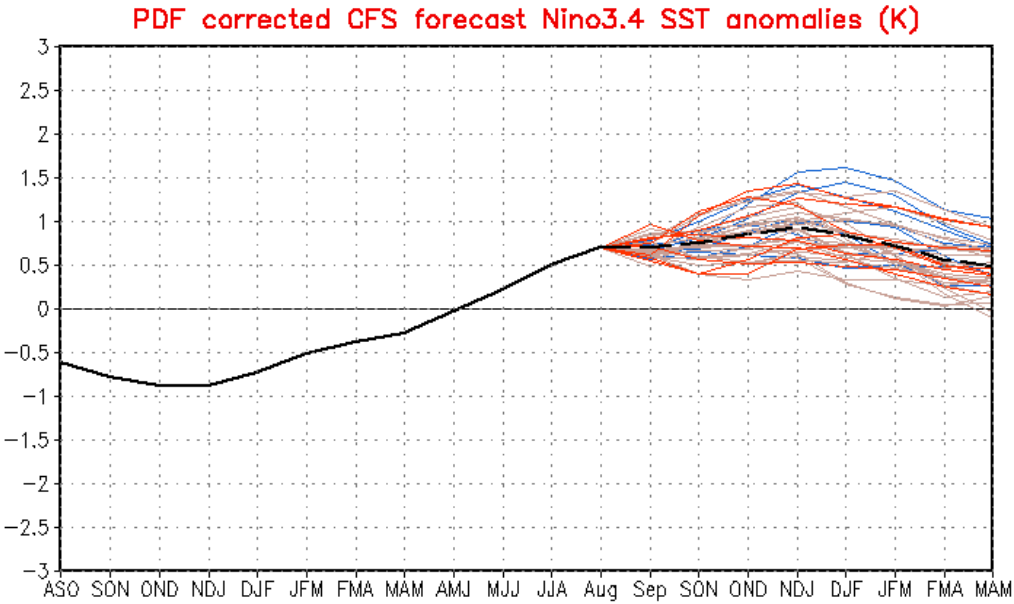


Figure provided by the International Research Institute (IRI) for Climate and Society (updated 16 Aug 2012).

SST Outlook: NCEP CFS.v1 Forecast Issued 22 August 2012

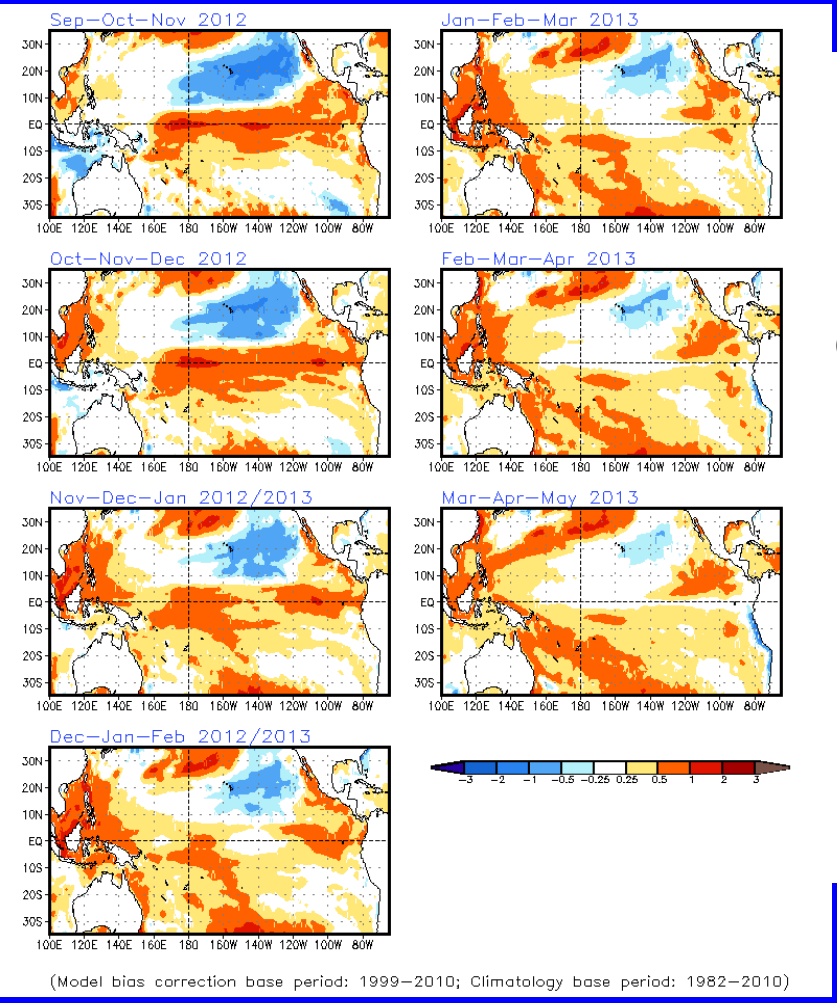


The CFS.v1 ensemble mean (black dashed line) predicts El Niño will develop and continue into Northern Hemisphere winter 2012-13.



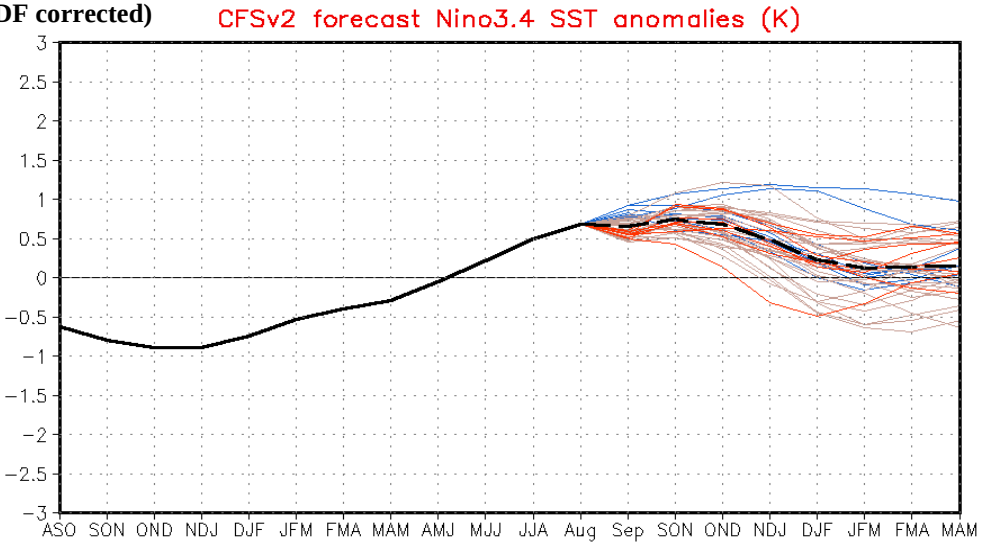
Please note that CFS.v1 will be discontinued in October 2012.

SST Outlook: NCEP CFS.v2 Forecast Issued 4 September 2012



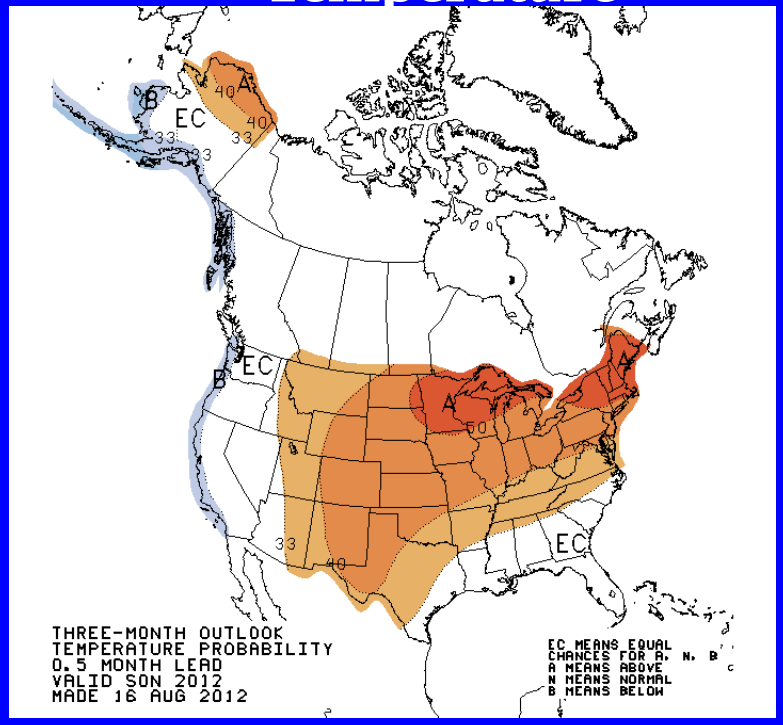
The CFS.v2 ensemble mean (black dashed line) predicts El Niño will develop and persist through early Northern Hemisphere winter 2012-13.

(not PDF corrected)

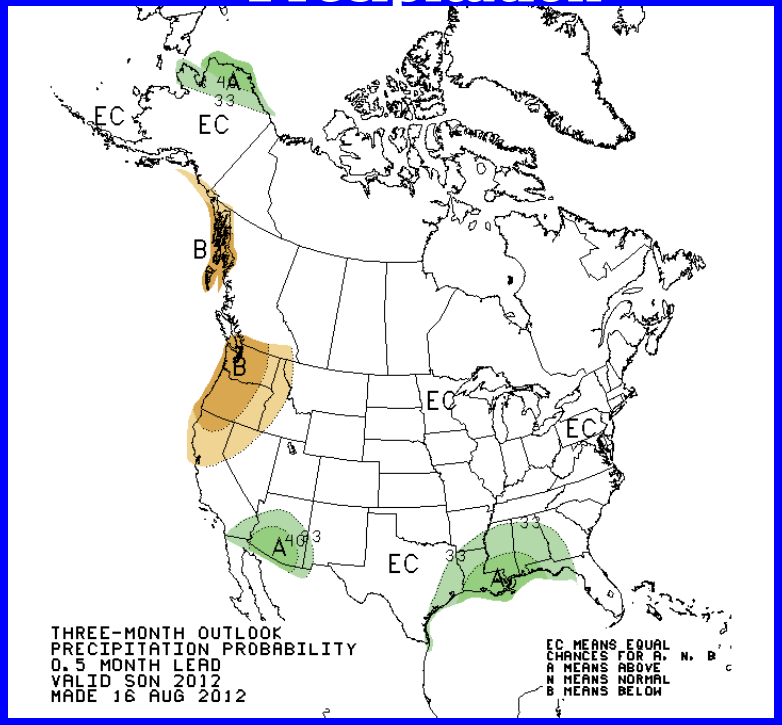


U. S. Seasonal Outlooks
September – November 2012

Temperature



Precipitation



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

Summary

ENSO Alert System Status: El Niño Watch*

- **ENSO-neutral conditions continue.***
- **Equatorial sea surface temperatures (SST) are greater than 0.5°C above average across the eastern Pacific Ocean.**
- **The atmospheric circulation over the tropical Pacific is near average.**
- **El Niño conditions are likely to develop during August or September 2012.***

* 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