Global Ocean Monitoring: Recent Evolution, Current Status, and Predictions

Prepared by
Climate Prediction Center, NCEP/NOAA

August 7, 2014

http://www.cpc.ncep.noaa.gov/products/GODAS/

This project to deliver real-time ocean monitoring products is implemented by CPC in cooperation with NOAA's Climate Observation Division (COD)

Outline

- Overview
- Recent highlights
  - Global Oceans
  - Pacific/Arctic Ocean
  - Indian Ocean
  - Atlantic Ocean
- Global SST Predictions

(Possibility of occurrence of an El Nino in 2014/15)

Overview

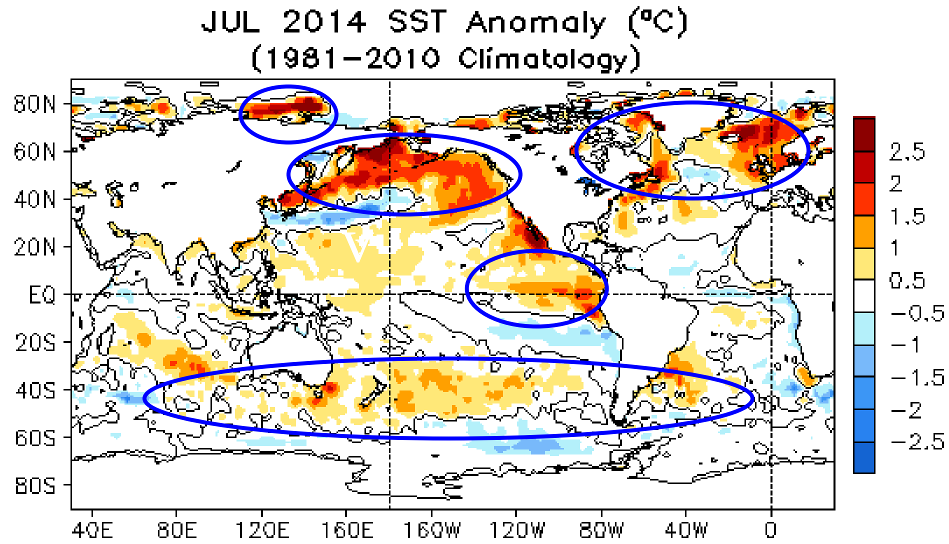
- **Pacific Ocean**
  - ENSO neutral condition continued with OIv2 NINO3.4=0.2^{o}C in July 2014.
  - Subsurface cooling emerged in the central-eastern equatorial Pacific in July.
  - Majority of models still favored El Nino in the next several months.
  - PDO returned to positive phase in July.

- **Indian Ocean**
  - Indian dipole index was -0.4 in July.

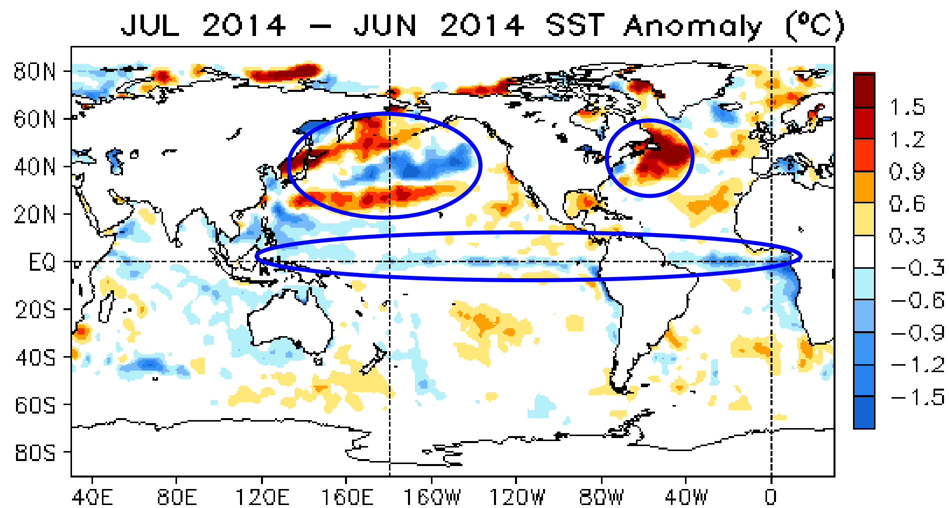
- **Atlantic Ocean**
  - Below-average SSTA continued in the hurricane Main Development Region.
  - NOAA's updated hurricane outlook call for a below-normal Atlantic hurricane season.

Global Oceans

Global SST Anomaly (^{0}C) and Anomaly Tendency



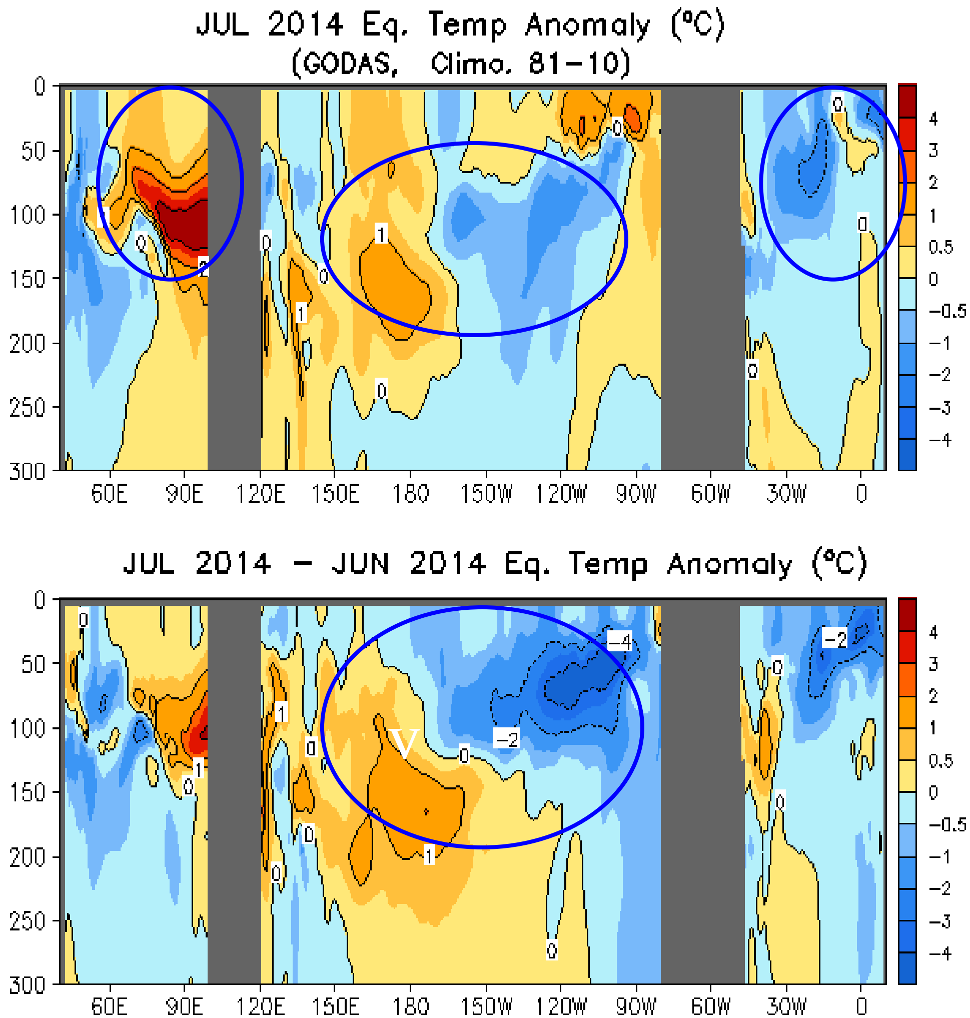
- Large positive SSTA presented in the high-latitude of North Pacific and the Arctic Ocean
- Strong warming continued in the Norwegian Sea.
- SST were above-average in the equatorial eastern Pacific Ocean.
- Positive SSTA dominated in the South Ocean.



- Negative SSTA tendencies were observed across the equatorial Pacific and Atlantic Oceans.
- A strong warming presented in the western North Atlantic.
- A tripolar tendency pattern presented in the North Pacific Ocean.

Fig. G1. Sea surface temperature anomalies (top) and anomaly tendency (bottom). Data are derived from the NCEP OI SST analysis, and anomalies are departures from the 1981-2010 base period means.

Longitude-Depth Temperature Anomaly and Anomaly Tendency in 2^{O}S-2^{O}N



- Negative subsurface anomalies emerged near the thermocline (150-50m) in the central-eastern Pacific, while positive subsurface anomalies presented in the western Pacific.

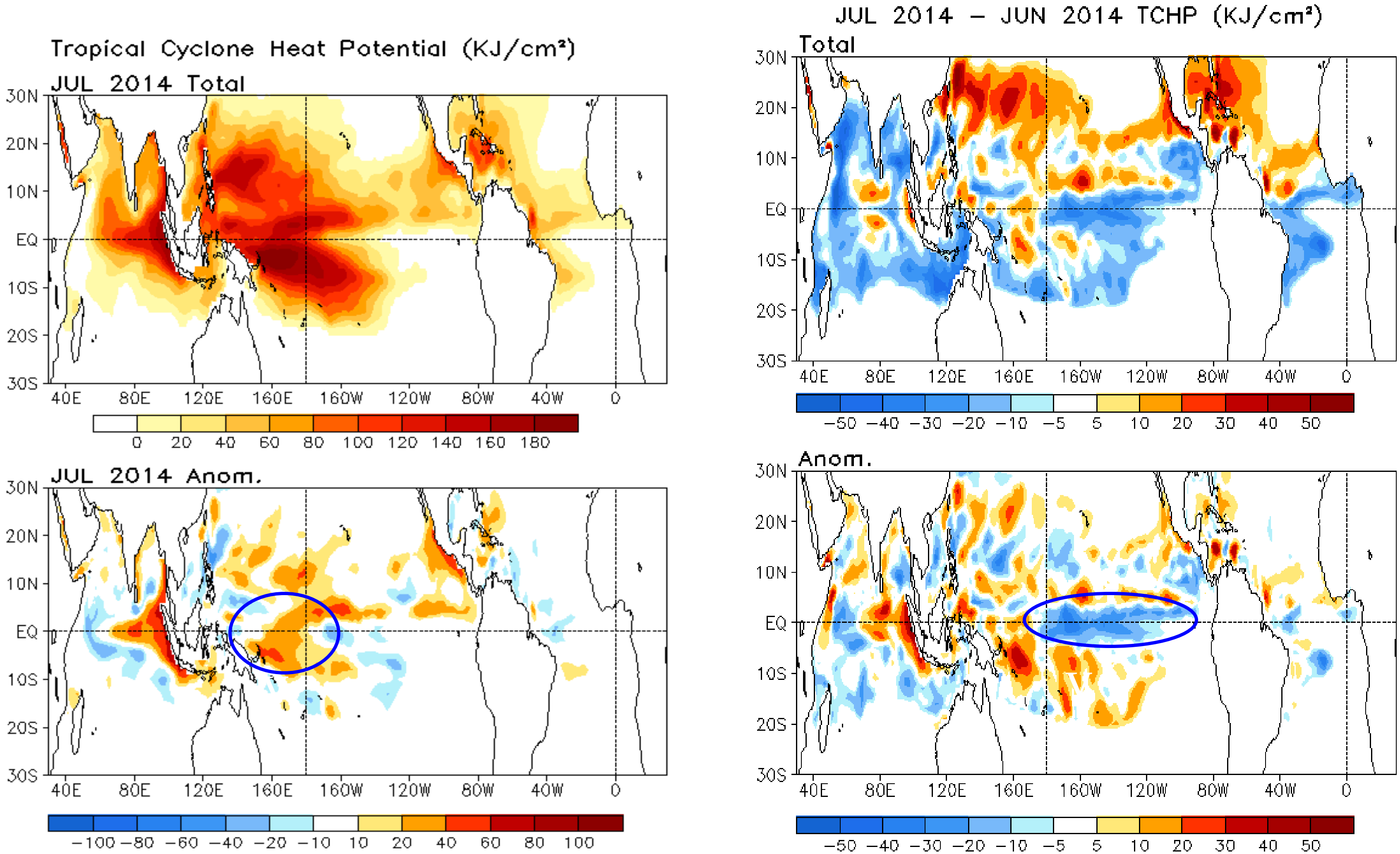
- Lager negative temperature tendency was observed near the thermocline in the central-eastern Pacific.

- Ocean temperature anomalies were mainly positive in Indian Ocean.

- Both negative subsurface anomalies and tendency were observed in the upper Atlantic Ocean.

Fig. G3. Equatorial depth-longitude section of ocean temperature anomalies (top) and anomaly tendency (bottom). Data are derived from the NCEP's global ocean data assimilation system which assimilates oceanic observations into an oceanic GCM. Anomalies are departures from the 1981-2010 base period means.

Tropical Cyclone Heat Potential and Tendency

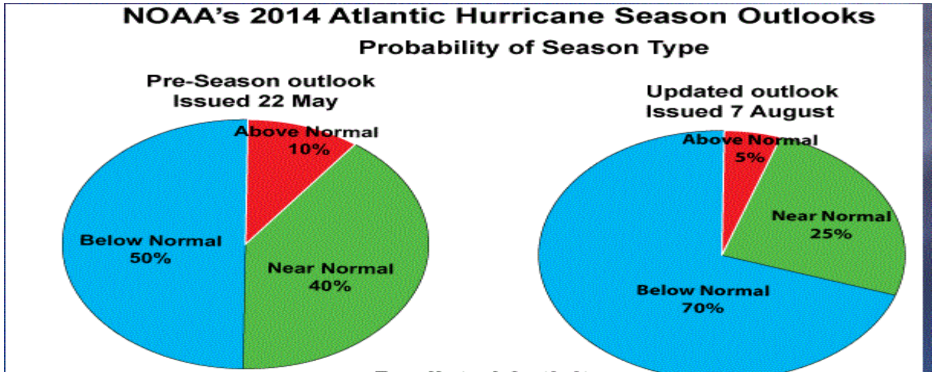


- **TCHP was above-normal west of the date line.**
- **TCHP anomaly tendency was negative in the central-eastern Pacific Ocean.**
- **Near-normal TCHP occupied in the tropical Atlantic Ocean.**

TCHP field is the anomalous heat storage associated with temperatures larger than 26℃.

NOAA’s 2014 Hurricane Outlooks

(http://www.cpc.ncep.noaa.gov/products/outlooks)



Predicted Activity

70% Likelihood For Each Range

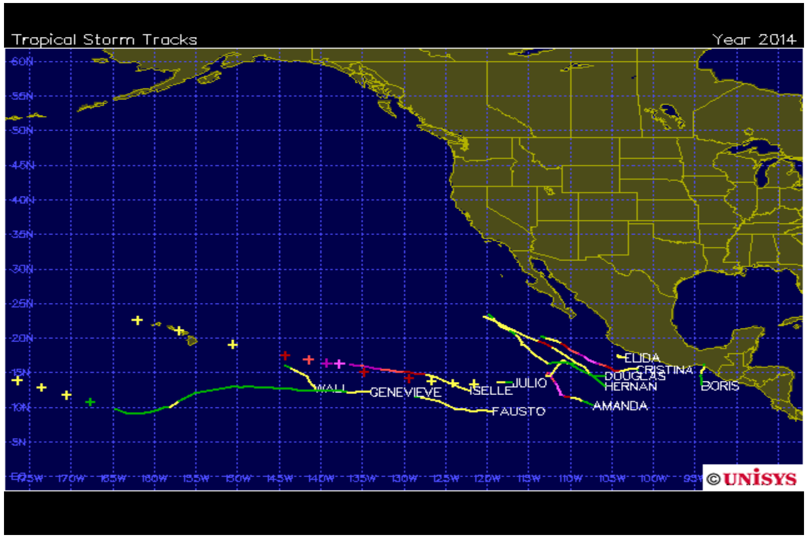
	Pre-Season Outlook issued 22 May	Updated Outlook issued 7 August	Season Averages 1981-2010
Named Storms	8-13	7-12	12
Hurricanes	3-6	3-6	6
Major Hurricanes	1-2	0-2	3

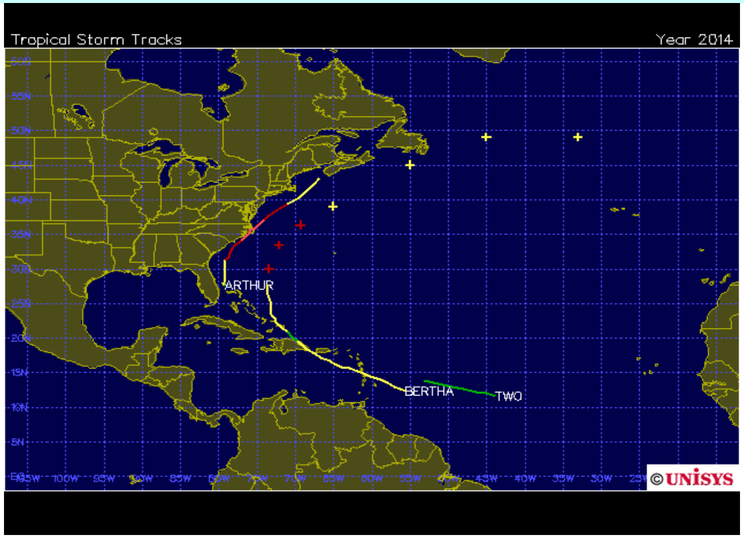
- NOAA’s 2014 Atlantic Hurricane Season outlooks issued in Aug. call for a 70% chance of a below-normal season in Atlantic.

-Outlook issued in May suggested d a 50% chance of a above-normal season in E. Pacific.

- Two hurricanes and one tropical depression were formed in Atlantic by Aug. 6 .

- Four hurricanes and seven tropical storms were formed in E. Pacific by Aug. 6.

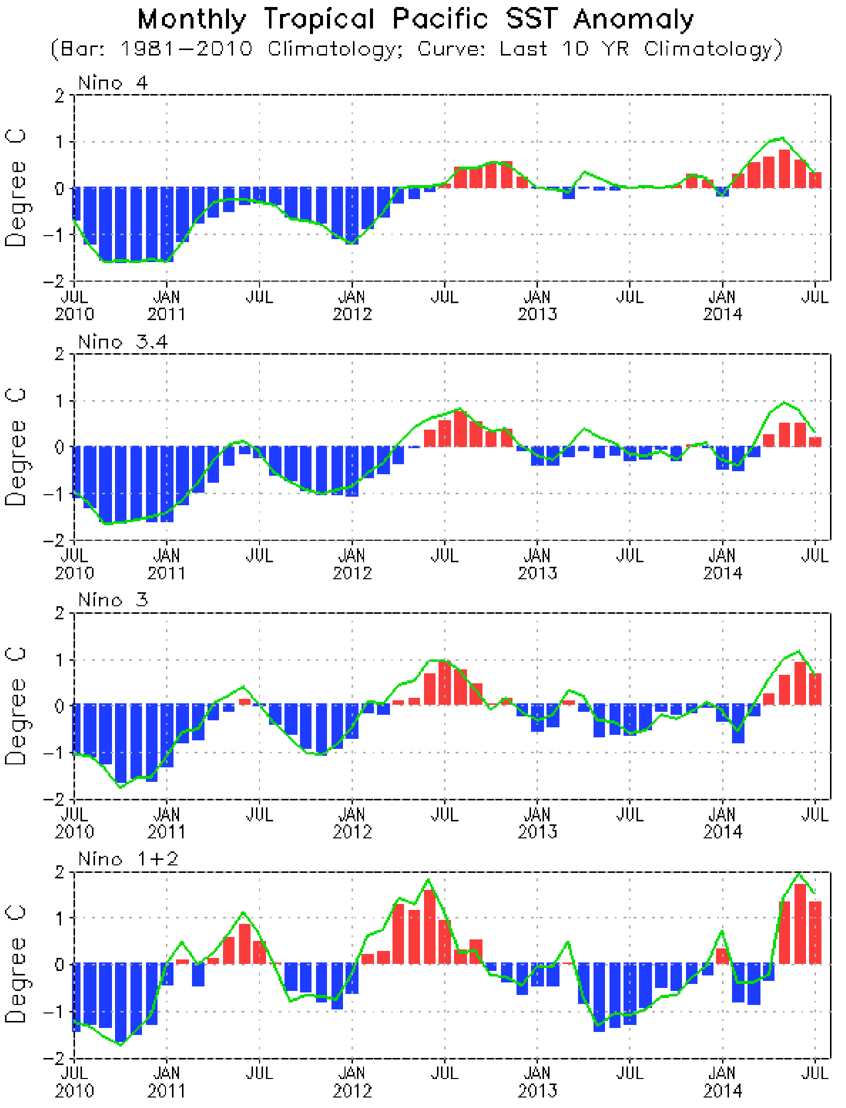


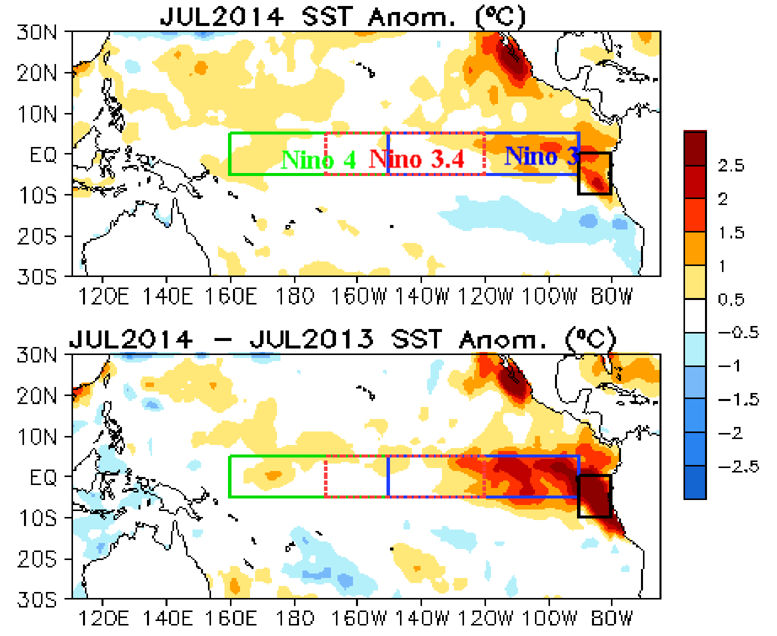


(http://weather.unisys.com/hurricane/)

Tropical Pacific Ocean and ENSO Conditions

Evolution of Pacific NINO SST Indices

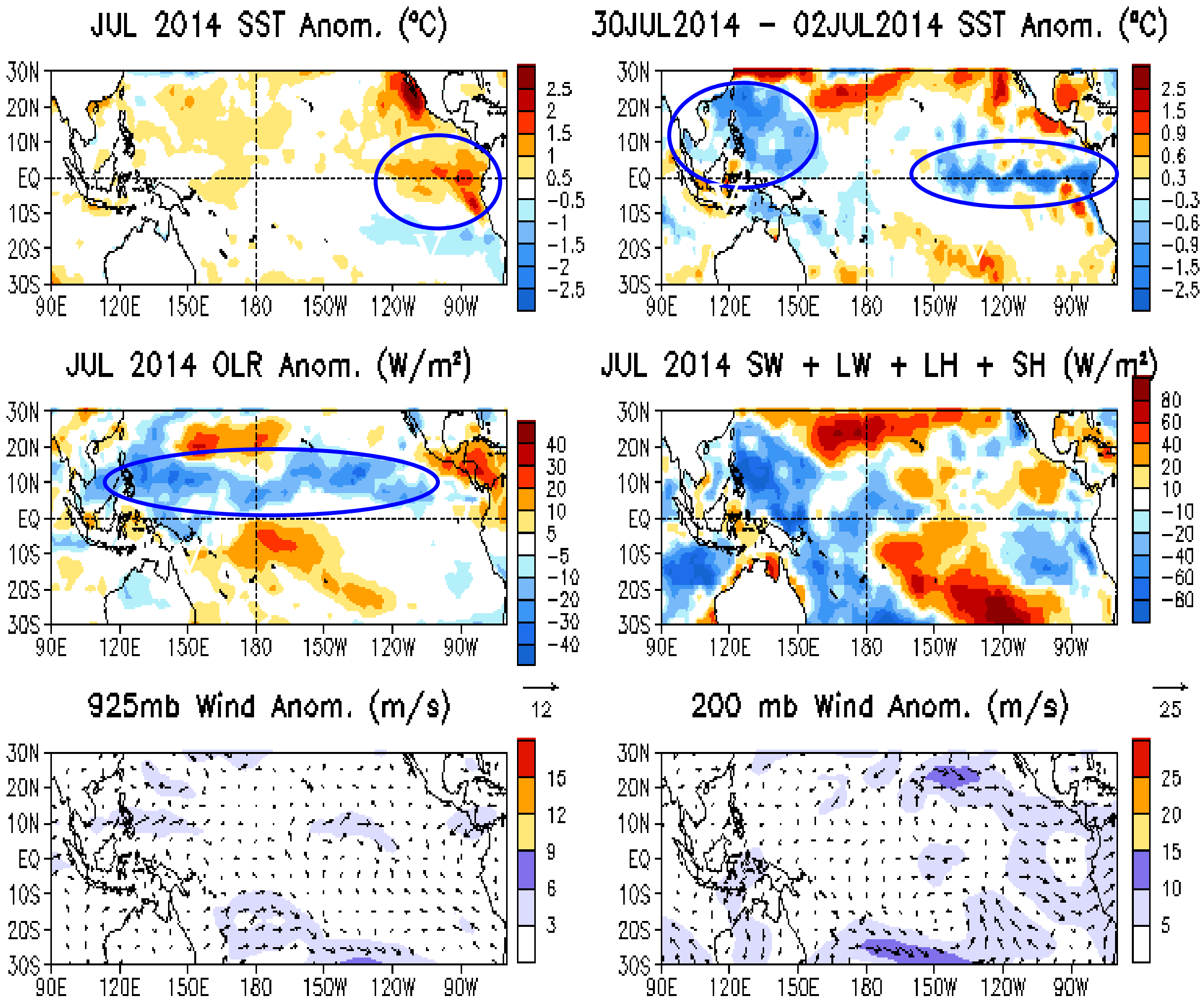




- **All NINO indices decreased in July 2014.**
- **Nino3.4 = +0.2°C in July 2014.**
- **SST in July 2014 was much warmer than that in July 2013 in the eastern Pacific Ocean.**
- **The indices were calculated based on OISST. They may have some differences compared with those based on ERSST.v3b.**

Fig. P1a. Nino region indices, calculated as the area-averaged monthly mean sea surface temperature anomalies (°C) for the specified region. Data are derived from the NCEP OI SST analysis, and anomalies are departures from the 1981-2010 base period means.

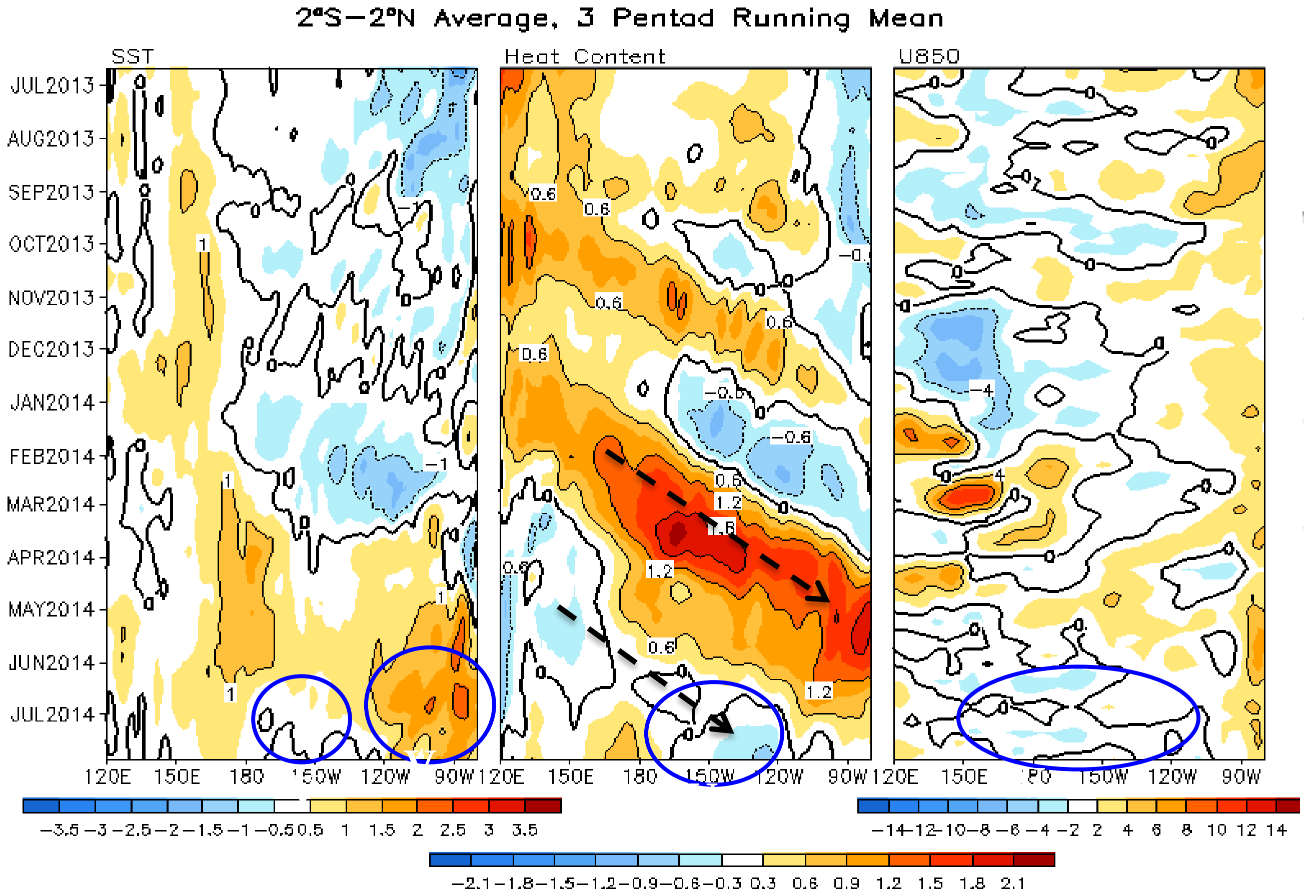
Tropical Pacific: SST Anom., SST Anom. Tend., OLR, Sfc Rad, Sfc Flx, 925-mb & 200-mb Winds



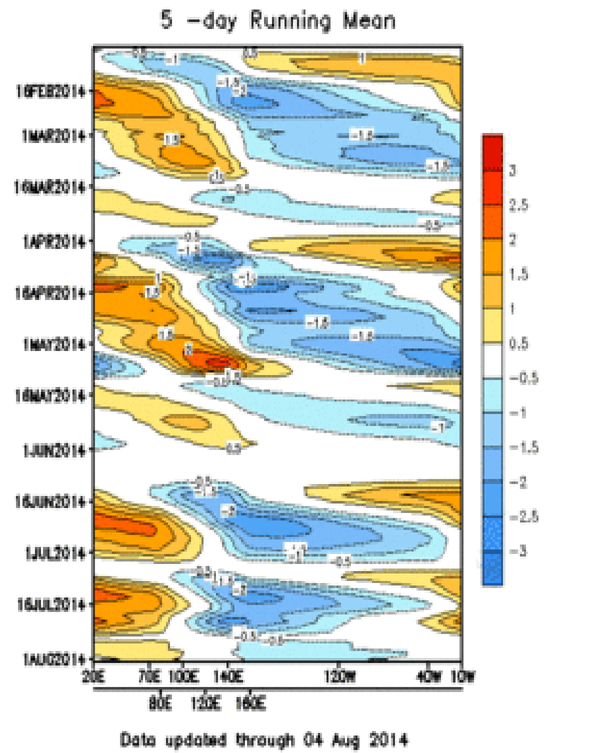
- SST were above-normal in the eastern Pacific and west of date line.
- Negative tendency were observed in the central-eastern equatorial Pacific and north-western Pacific.
- SST tendency was largely consistent with surface heat flux anomalies.
- Basin-wide negative OLR anomalies presented north of the equator, indicating northward shift of ITCZ.
- Atmosphere circulation continued to be near normal in July.

Fig. P2. Sea surface temperature (SST) anomalies (top-left), anomaly tendency (top-right), Outgoing Long-wave Radiation (OLR) anomalies (middle-left), sum of net surface short- and long-wave radiation, latent and sensible heat flux anomalies (middle-right), 925-mb wind anomaly vector and its amplitude (bottom-left), 200-mb wind anomaly vector and its amplitude (bottom-right). SST are derived from the NCEP OI SST analysis, OLR from the NOAA 18 AVHRR IR window channel measurements by NESDIS, winds and surface radiation and heat fluxes from the NCEP CDAS. Anomalies are departures from the 1981-2010 base period means.

Equatorial Pacific SST (ºC), HC300 (ºC), and u850 (m/s) Anomalies



CPC MJO Indices

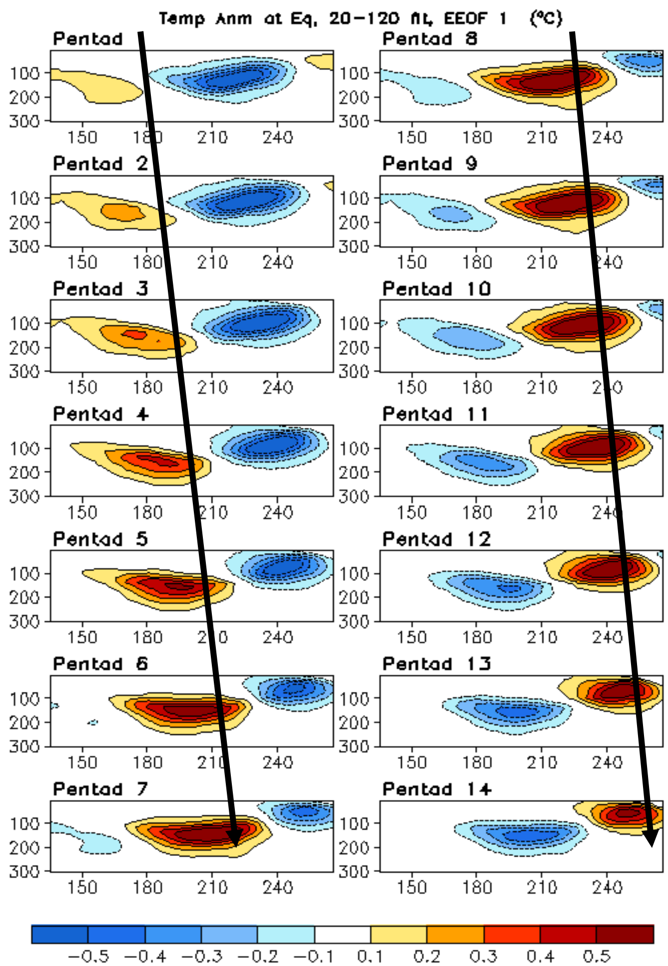


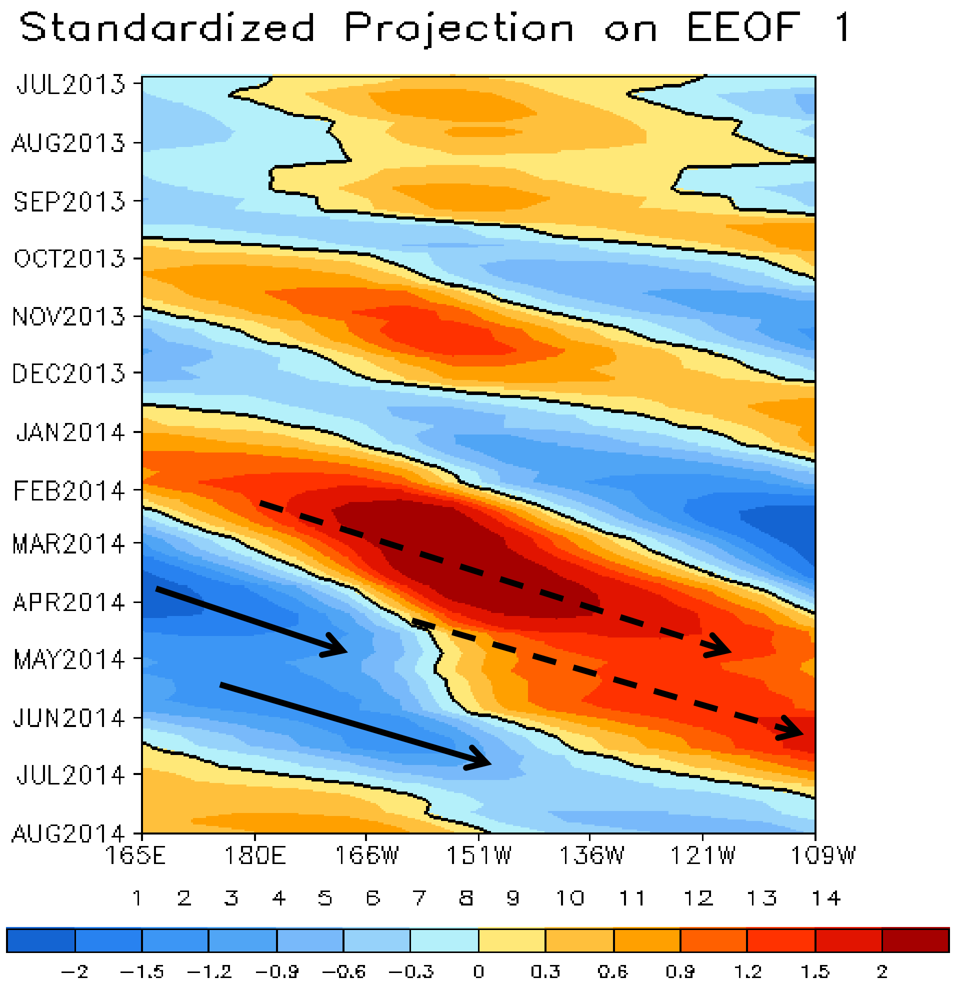
http://www.cpc.ncep.noaa.gov/products/precip/CWlink/daily_mjo_index/mjo_index.shtml

- **Positive SSTA weakened across the whole basin and SST returned to near-normal in the central Pacific in July.**
- **Weak low-level westerly anomaly was evident over central-equatorial Pacific since June.**
- **Positive H300 anomaly progressively weakened across the equatorial Pacific since April.**
- **Weak negative H300 anomaly emerged in the central-eastern Pacific in July, owing to a upwelling Kelvin wave (next slide)**

Fig. P4. Time-longitude section of anomalous pentad sea surface temperature (left), upper 300m temperature average (heat content, middle-left), 850-mb zonal wind (U850, middle-right) averaged in 2ºS-2ºN and Outgoing Long-wave Radiation (OLR, right) averaged in 5ºS-5ºN. SST is derived from the NCEP OI SST, heat content from the NCEP's global ocean data assimilation system, U850 from the NCEP CDAS. Anomalies for SST, heat content and U850/OLR are departures from the 1981-2010 base period pentad means respectively.

Oceanic Kelvin Wave (OKW) Index





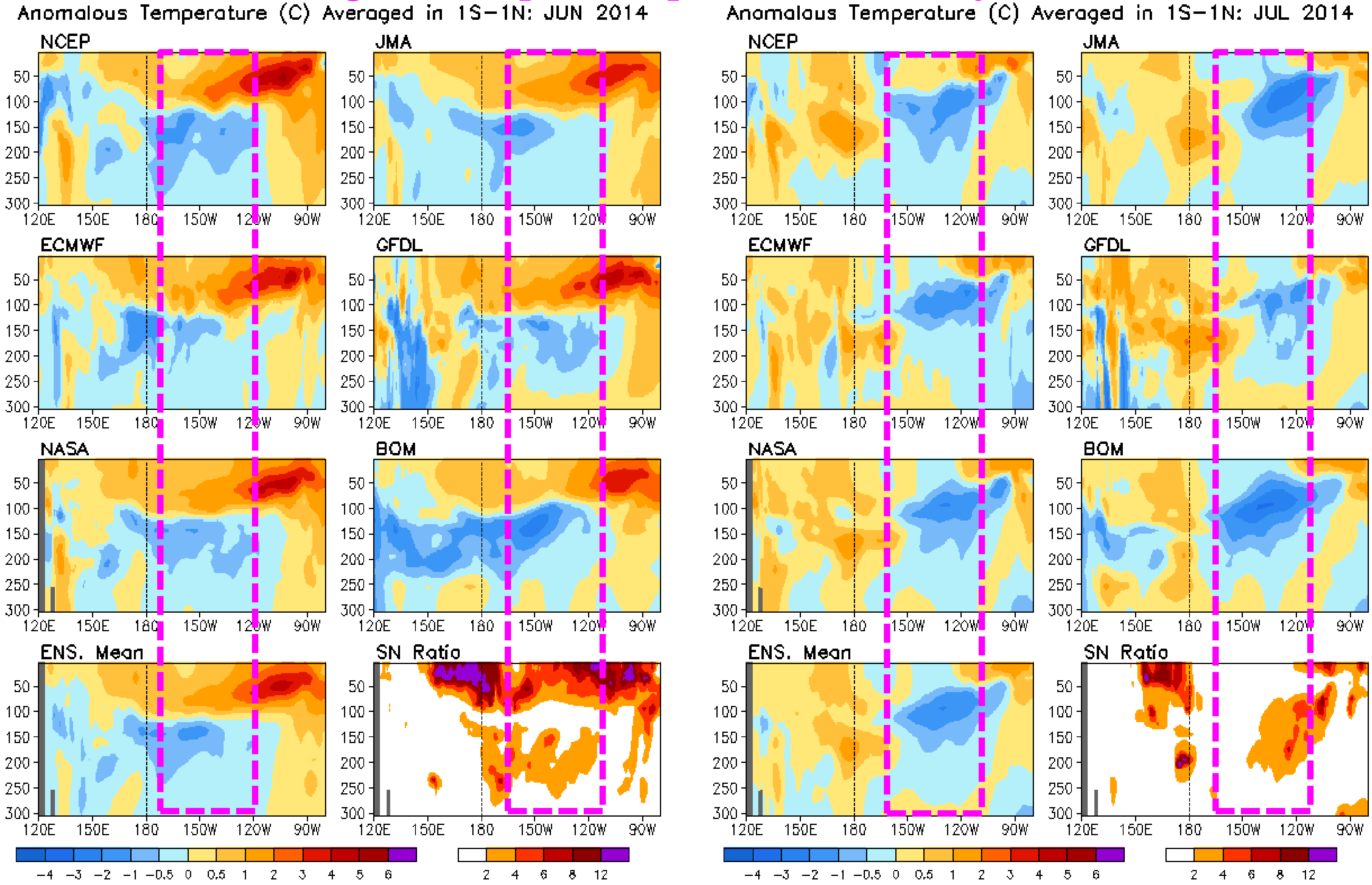
- A upwelling OKW (solid line) initiated in the western Pacific around May, and reached the eastern Pacific in July.

-OKW index is defined as standardized projections of total anomalies onto the 14 patterns of Extended EOF1 of equatorial temperature anomalies (Seo and Xue , GRL, 2005).

Real-Time Multiple Ocean Reanalysis Intercomparison

(http://www.cpc.ncep.noaa.gov/products/GODAS/multiora_body.html)

Longitude-Depth Temperature Anomaly in 1S-1N



Last Five Month W at 55m and Surface Windstress Anom.

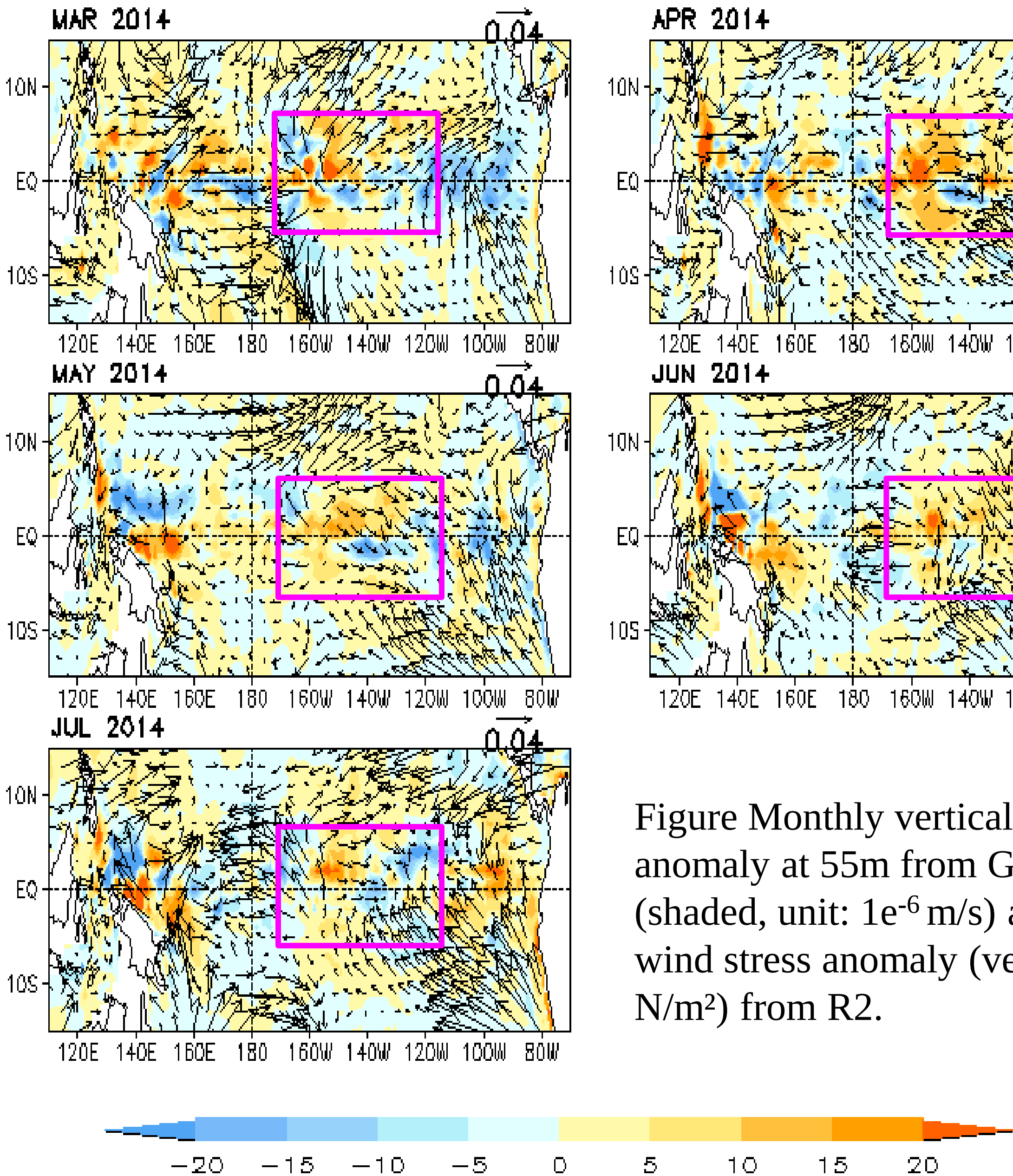
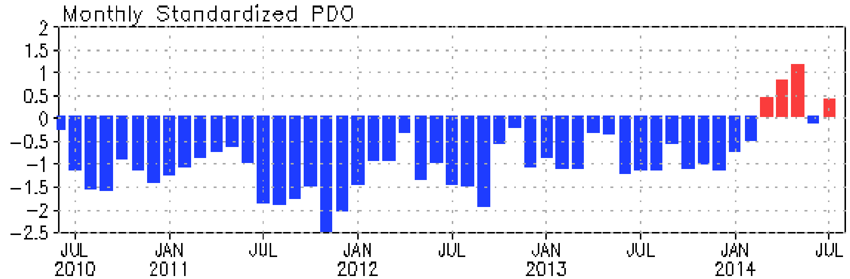


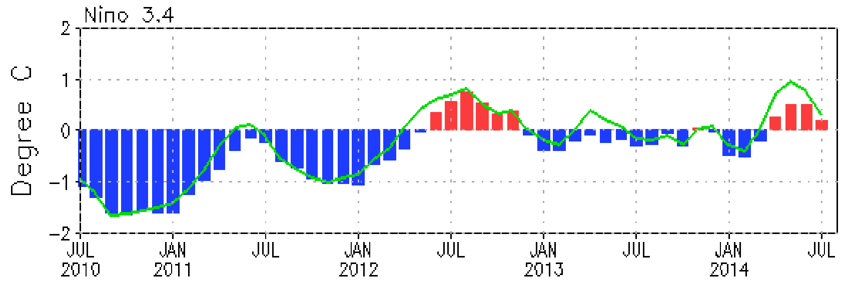
Figure Monthly vertical velocity anomaly at 55m from GODAS (shaded, unit: 1e^{-6} m/s) and surface wind stress anomaly (vector, unit: N/m²) from R2.

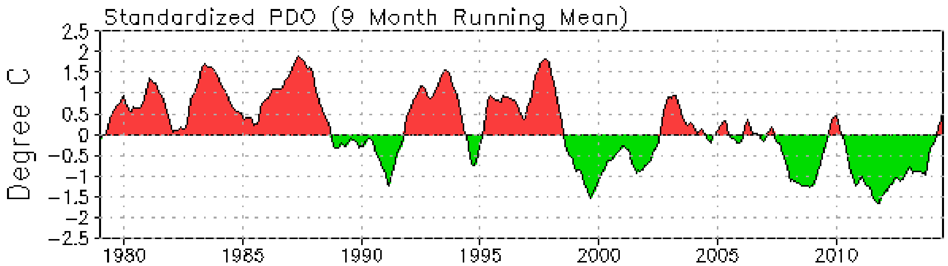
- **Positive vertical velocity (W) anomaly (enhanced upwelling) dominated the central Pacific (purple box) since March.**
- **Anomalous upwelling (w′∂T/∂t) tended to cool the mixed layer.**
- **Easterly wind anomalies persisted east of the date line in the last five months.**

North Pacific & Arctic Oceans

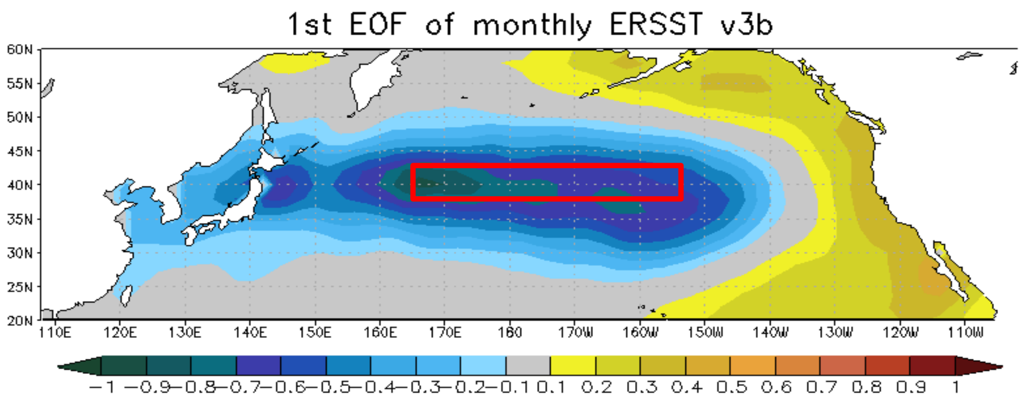
PDO index





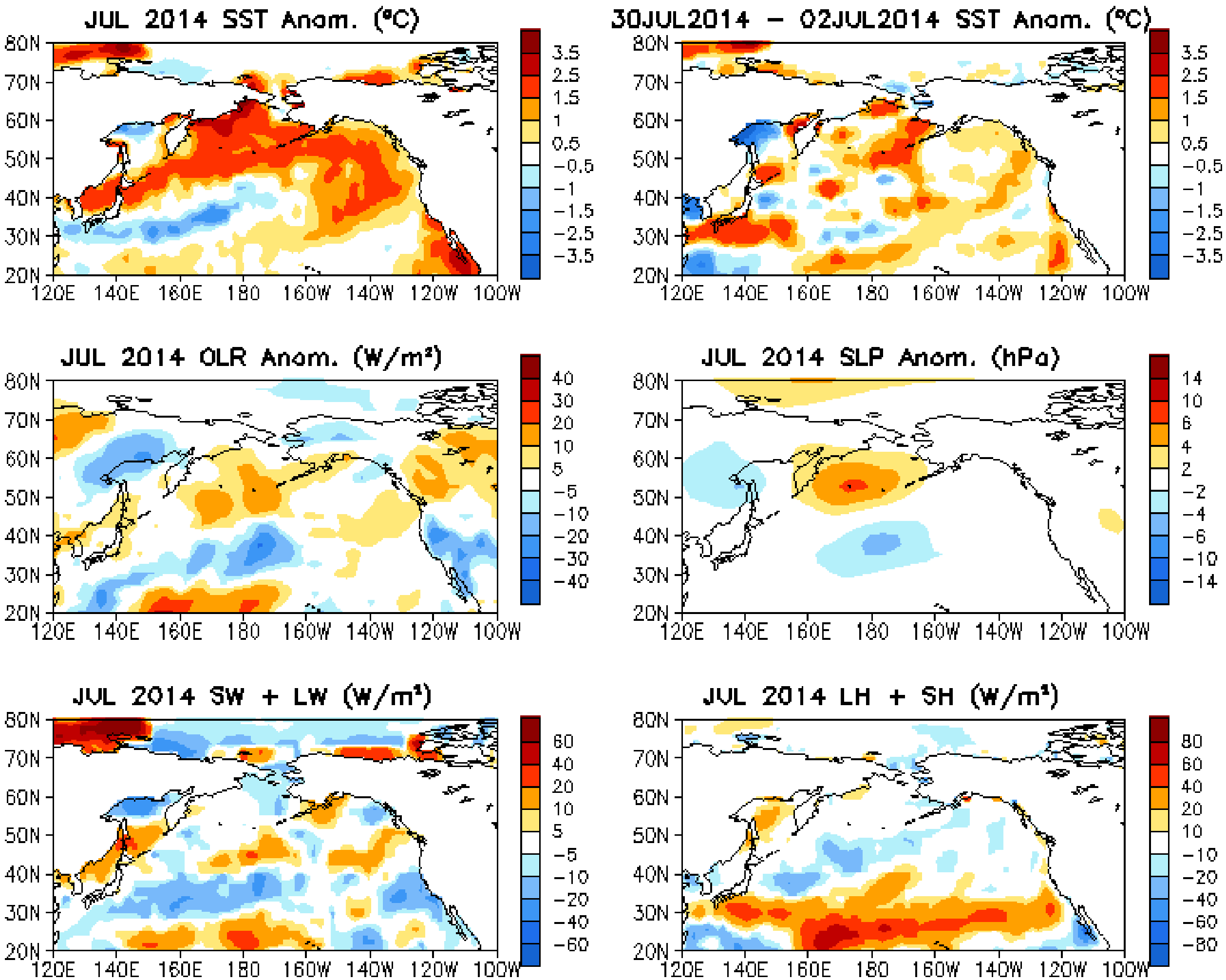


- **PDO returned to positive phase in July with PDO index = 0.4.**



- **Pacific Decadal Oscillation is defined as the 1st EOF of monthly ERSST v3b in the North Pacific for the period 1900-1993. PDO index is the standardized projection of the monthly SST anomalies onto the 1st EOF pattern.**
- **The PDO index differs slightly from that of JISAO, which uses a blend of UKMET and OIv1 and OIv2 SST.**

North Pacific & Arctic Ocean: SST Anom., SST Anom. Tend., OLR, SLP, Sfc Rad, Sfc Flx

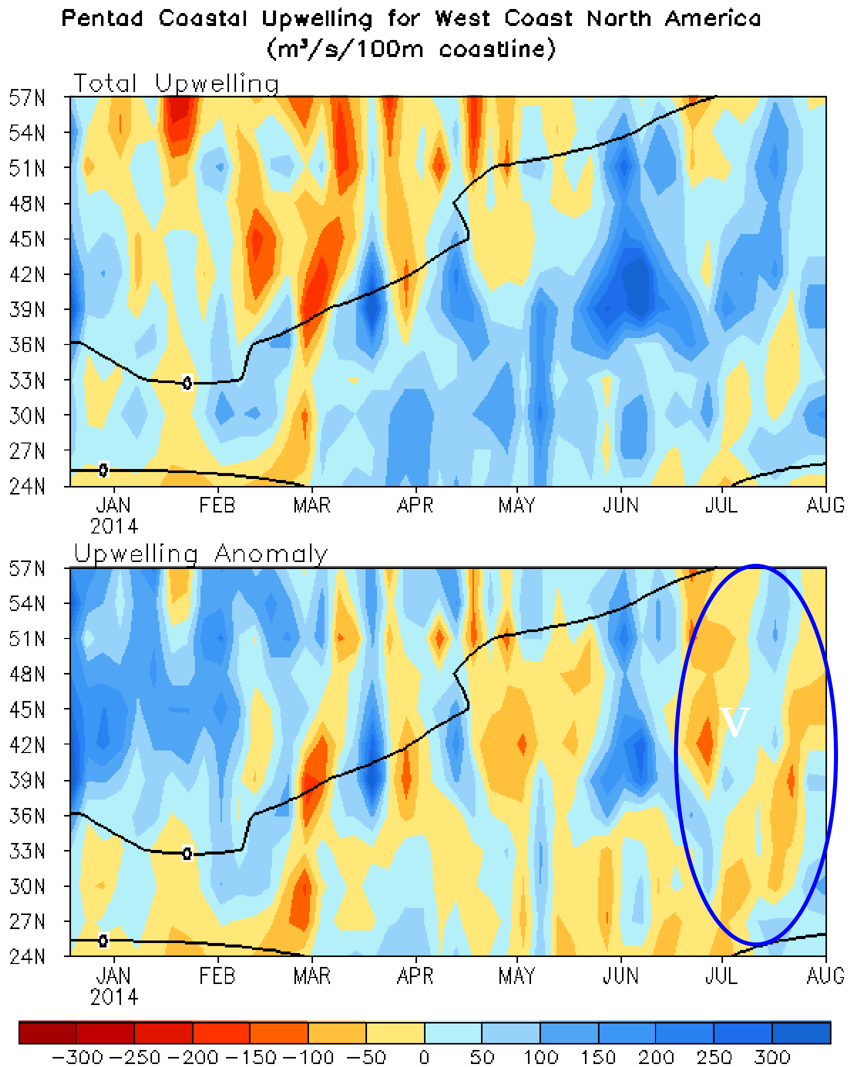


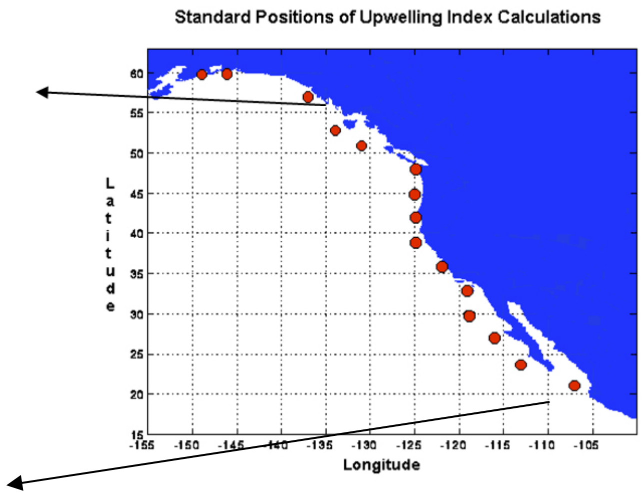
- Positive SST tendency dominated the North Pacific.

- Phase shift of PDO might be associated with positive SST tendency along the west coast of N. America.

Fig. NP1. Sea surface temperature (SST) anomalies (top-left), anomaly tendency (top-right), Outgoing Long-wave Radiation (OLR) anomalies (middle-left), sea surface pressure anomalies (middle-right), sum of net surface short- and long-wave radiation anomalies (bottom-left), sum of latent and sensible heat flux anomalies (bottom-right). SST are derived from the NCEP OI SST analysis, OLR from the NOAA 18 AVHRR IR window channel measurements by NESDIS, sea surface pressure and surface radiation and heat fluxes from the NCEP CDAS. Anomalies are departures from the 1981-2010 base period means.

North America Western Coastal Upwelling





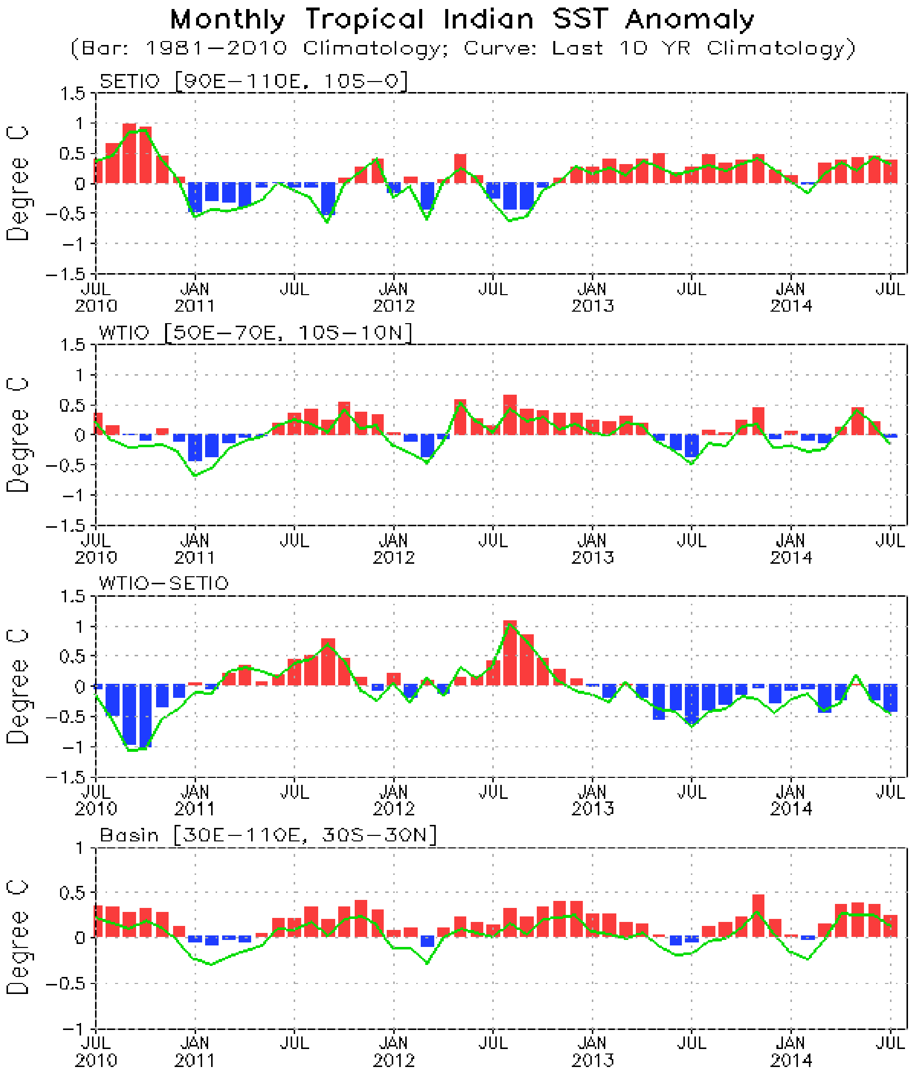
- **Upwelling was depressed along the west coast of N. American.**

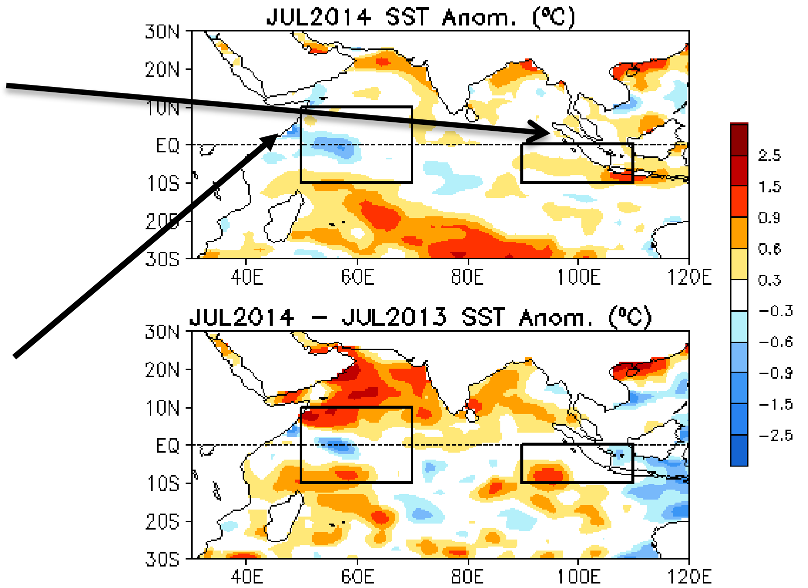
Fig. NP2. Total (top) and anomalous (bottom) upwelling indices at the 15 standard locations for the western coast of North America. Upwelling indices are derived from the vertical velocity of the NCEP's global ocean data assimilation system, and are calculated as integrated vertical volume transport at 50 meter depth from each location to its nearest coast point ($m^3/s/100m$ coastline). Anomalies are departures from the 1981-2010 base period pentad means.

- **Area below (above) black line indicates climatological upwelling (downwelling) season.**
- **Climatologically upwelling season progresses from March to July along the west coast of North America from 36°N to 57°N.**

Indian Ocean

Evolution of Indian Ocean SST Indices





- **Positive SSTA mainly presented in the tropical southern Indian Ocean.**
- **DMI =-0.4 in July.**

Fig. I1a. Indian Ocean Dipole region indices, calculated as the area-averaged monthly mean sea surface temperature anomalies (°C) for the SETIO [90°E-110°E, 10°S-0] and WTIO [50°E-70°E, 10°S-10°N] regions, and Dipole Mode Index, defined as differences between WTIO and SETIO. Data are derived from the NCEP OI SST analysis, and anomalies are departures from the 1981-2010 base period means.

Tropical Indian: SST Anom., SST Anom. Tend., OLR, Sfc Rad, Sfc Flx, 925-mb & 200-mb Wind Anom.

- Positive SSTA dominated across the whole Indian Ocean.

- During the last four weeks, changes in SSTA were mostly negative in India Ocean.

-Convection was suppressed over the central Indian Ocean.

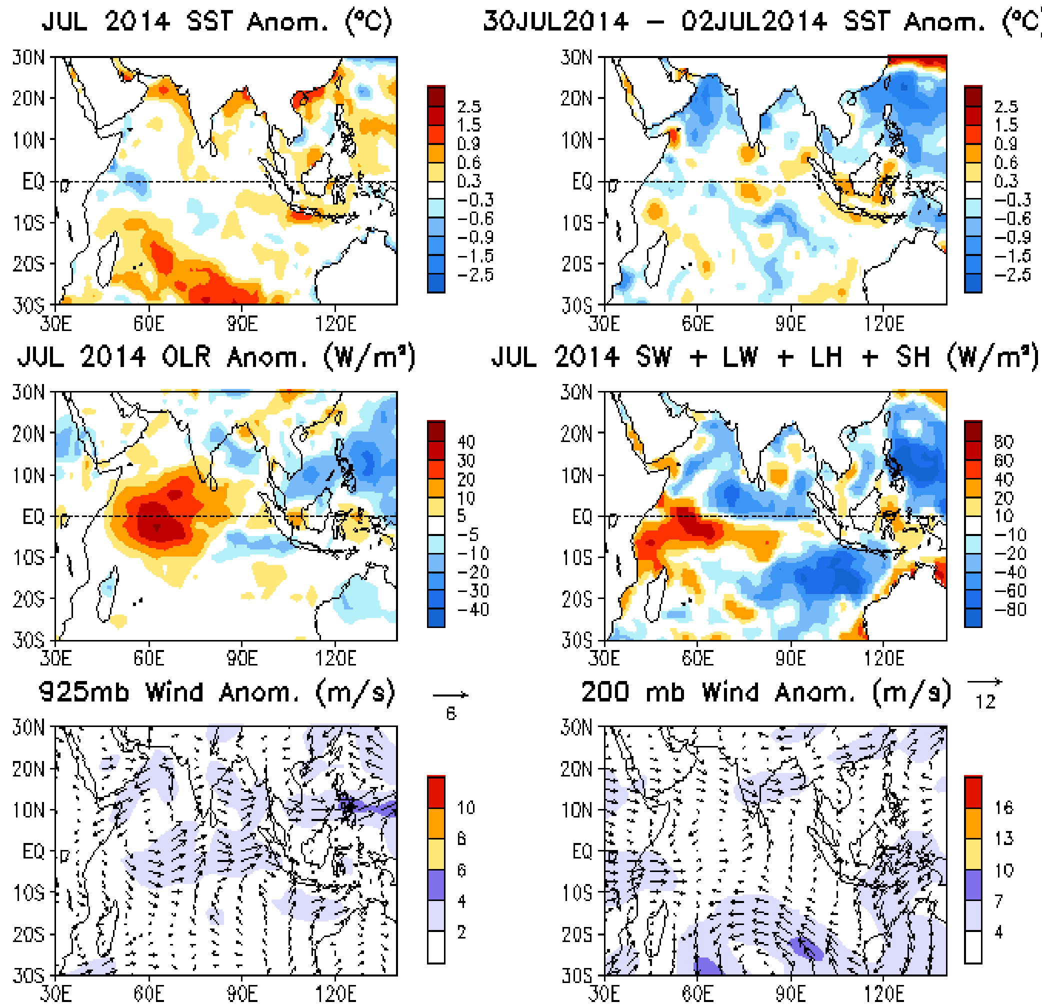
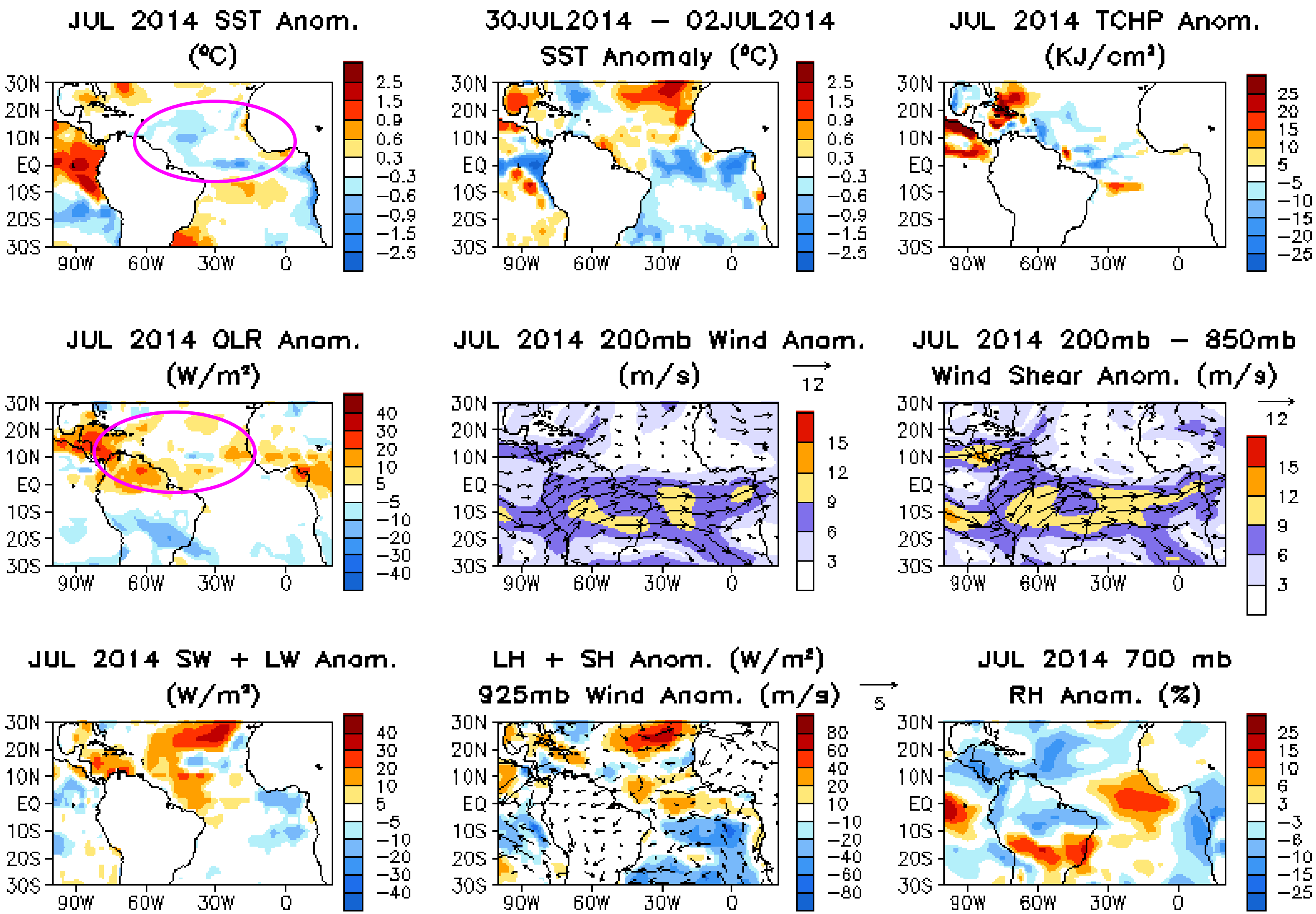


Fig. I2. Sea surface temperature (SST) anomalies (top-left), anomaly tendency (top-right), Outgoing Long-wave Radiation (OLR) anomalies (middle-left), sum of net surface short- and long-wave radiation, latent and sensible heat flux anomalies (middle-right), 925-mb wind anomaly vector and its amplitude (bottom-left), 200-mb wind anomaly vector and its amplitude (bottom-right). SST are derived from the NCEP OI SST analysis, OLR from the NOAA 18 AVHRR IR window channel measurements by NESDIS, winds and surface radiation and heat fluxes from the NCEP CDAS. Anomalies are departures from the 1981-2010 base period means.

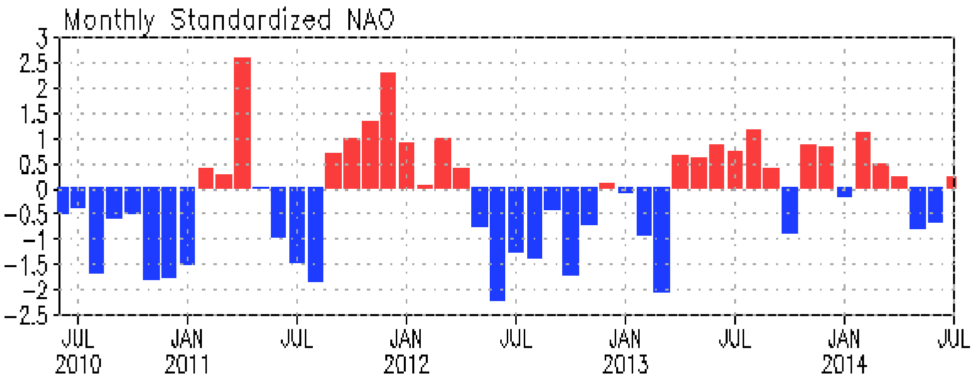
Tropical and North Atlantic Ocean

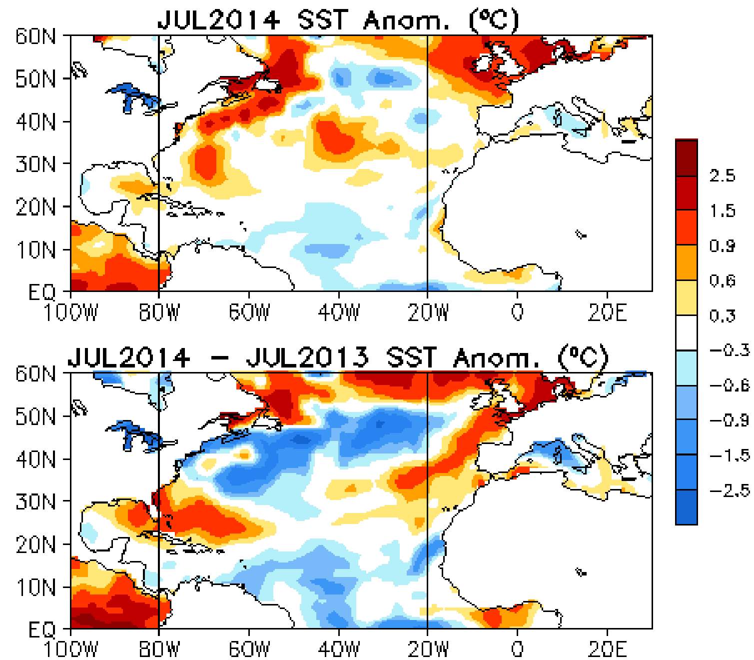
Tropical Atlantic:

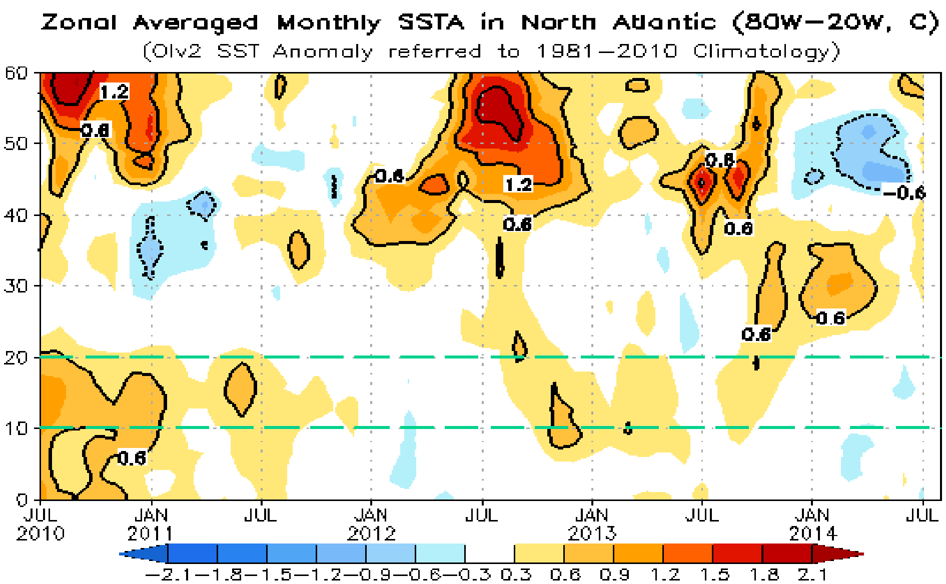


- **Below-normal SSTA dominated the North tropical Atlantic.**
- **Convection was suppressed in the hurricane main development region.**

NAO and SST Anomaly in North Atlantic





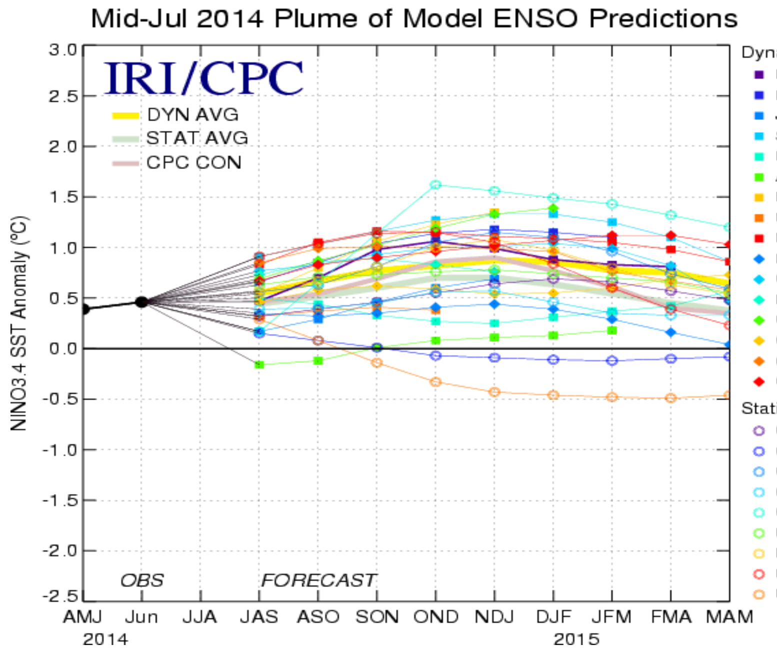


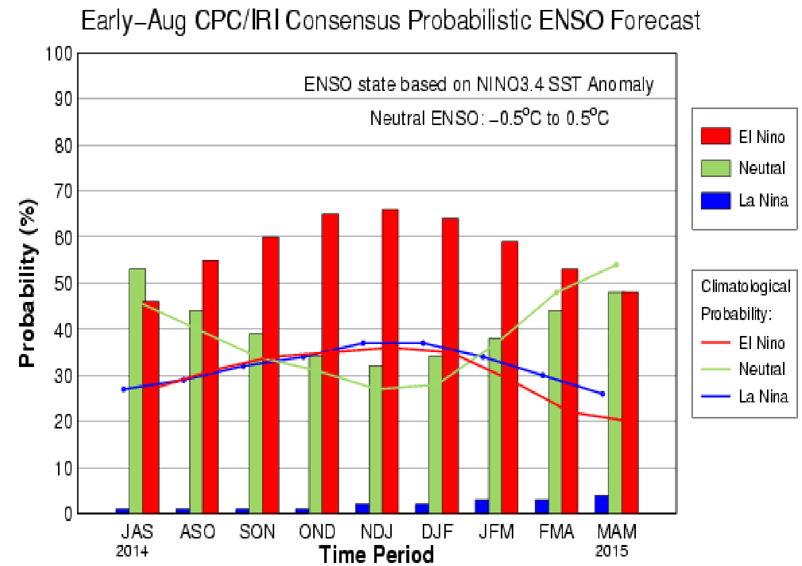
- Large positive SST anomaly was observed near the east coast of Canada and Norwegian Sea.
- NAO was near normal in July.

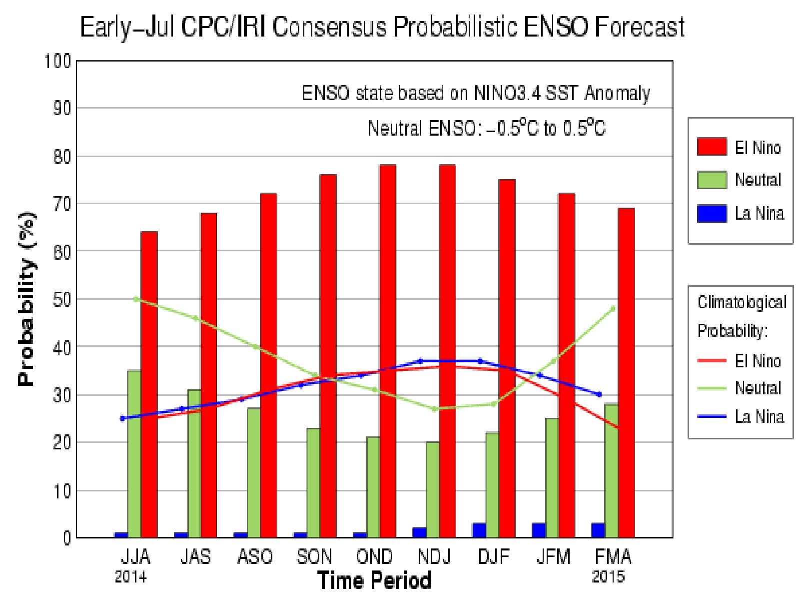
Fig. NA2. Monthly standardized NAO index (top) derived from monthly standardized 500-mb height anomalies obtained from the NCEP CDAS in 20ºN-90ºN (http://www.cpc.ncep.noaa.gov). Time-Latitude section of SST anomalies averaged between 80ºW and 20ºW (bottom). SST are derived from the NCEP OI SST analysis, and anomalies are departures from the 1981-2010 base period means.

ENSO and Global SST Predictions

IRI/CPC NINO3.4 Forecast Plum

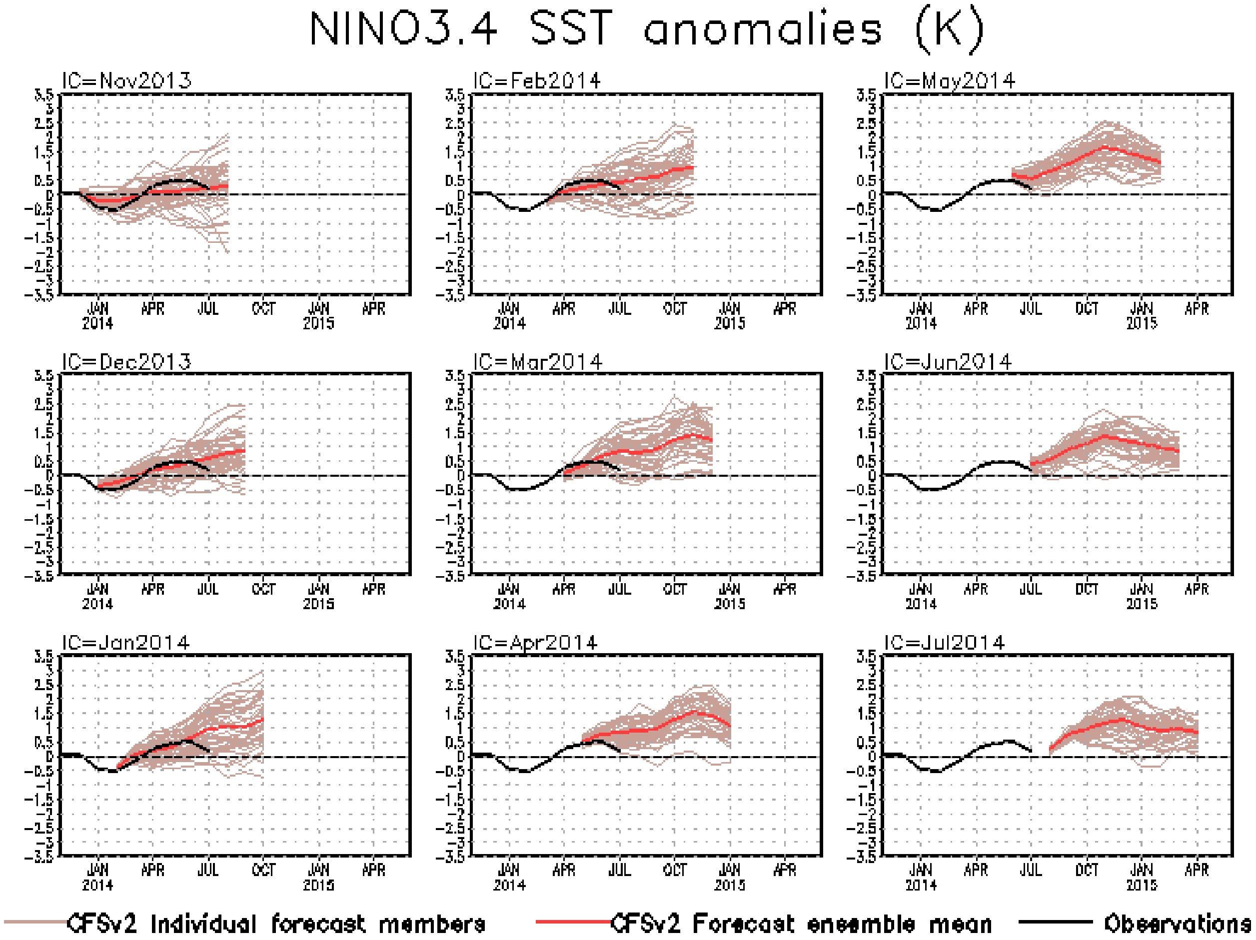






- **Most of models predicted that an weak-moderate El Niño will develop in the next several months and persist through Northern Hemisphere winter 2014-15.**
- **The consensus forecast suggested that chance of El Niño is less 50% in JAS and is above 60% during the fall and winter.**

CFSv2 Niño3.4 SST Predictions from Different Initial Months



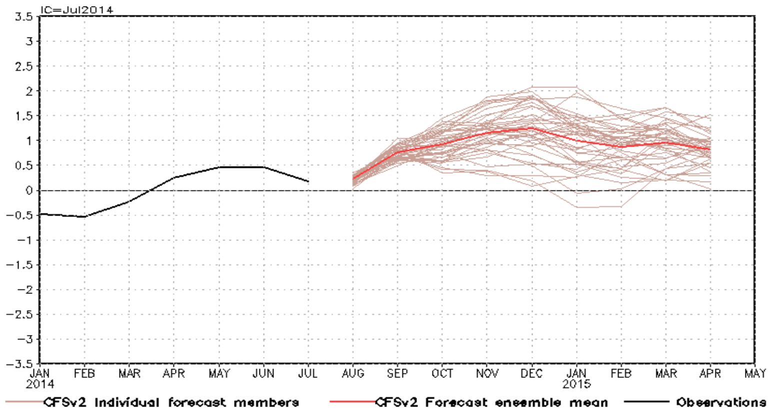
- Latest CFSv2 prediction suggested an El Niño will start in Sep. and last through early 2015.

- CFSv2 made good predictions of the onset of warming during Nov.2013-Feb.2014.

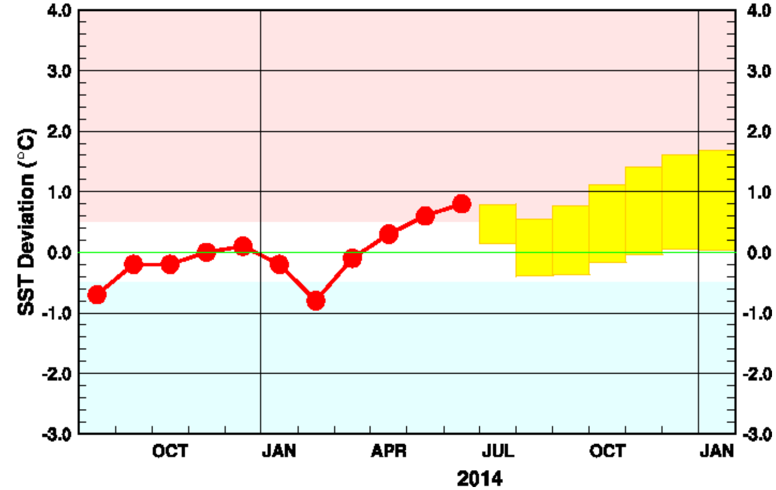
Fig. M1. CFS Nino3.4 SST prediction from the latest 9 initial months. Displayed are 40 forecast members (brown) made four times per day initialized from the last 10 days of the initial month (labelled as IC=MonthYear) as well as ensemble mean (blue) and observations (black). Anomalies were computed with respect to the 1981-2010 base period means.

Individual Model Forecasts: Predict an El Nino/neutral in 2014

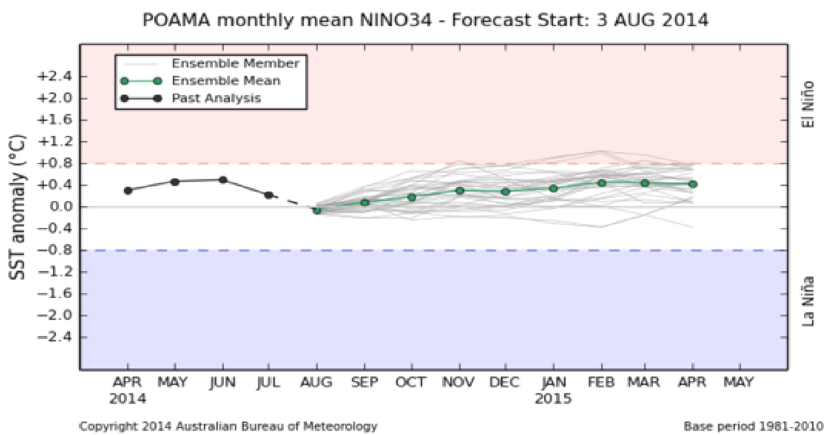
NCEP: NINO34 IC=Aug 3 2014

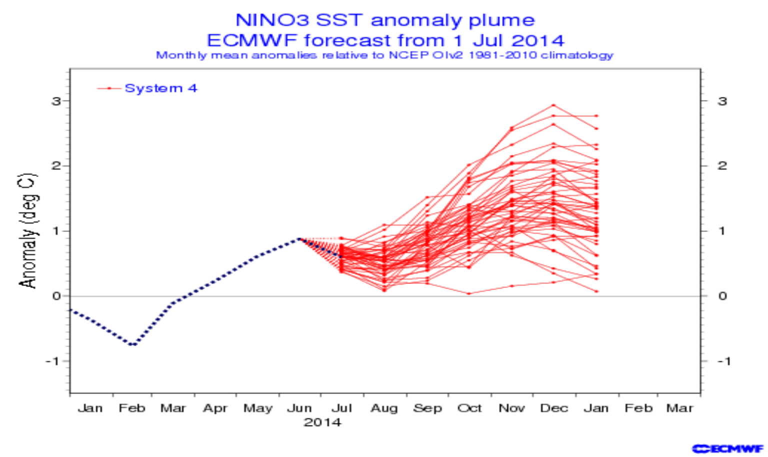


JMA: Nino3, IC=June2014



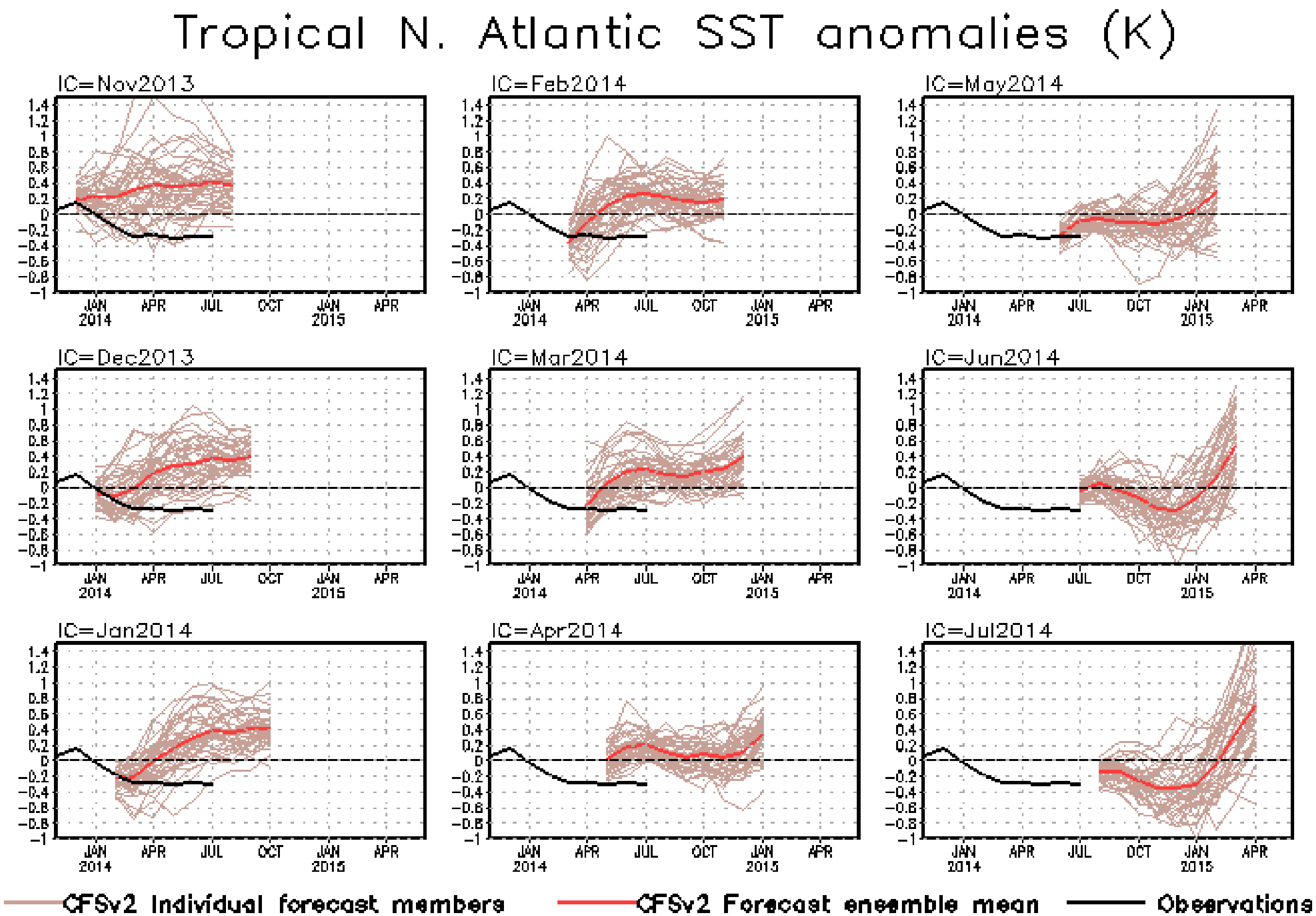
Australia: Nino3.4, IC= 3 Aug 2014





- Differences in model forecasts might be partially related with differences in ocean initializations provided by ocean reanalyses.

CFSv2 Tropical North Atlantic (TNA) SST Predictions from Different Initial Months



- Forecast from July 2014 IC suggests below-normal SST in the tropical North Atlantic will persist through the second half of 2014.

TNA is the SST anomaly averaged in the region of [60°W-30°W, 5°N-20°N].

Fig. M3. CFS Tropical North Atlantic (TNA) SST predictions from the latest 9 initial months. Displayed are 40 forecast members (brown) made four times per day initialized from the last 10 days of the initial month (labelled as IC=MonthYear) as well as ensemble mean (blue) and observations (black). Anomalies were computed with respect to the 1981-2010 base period means.

Overview

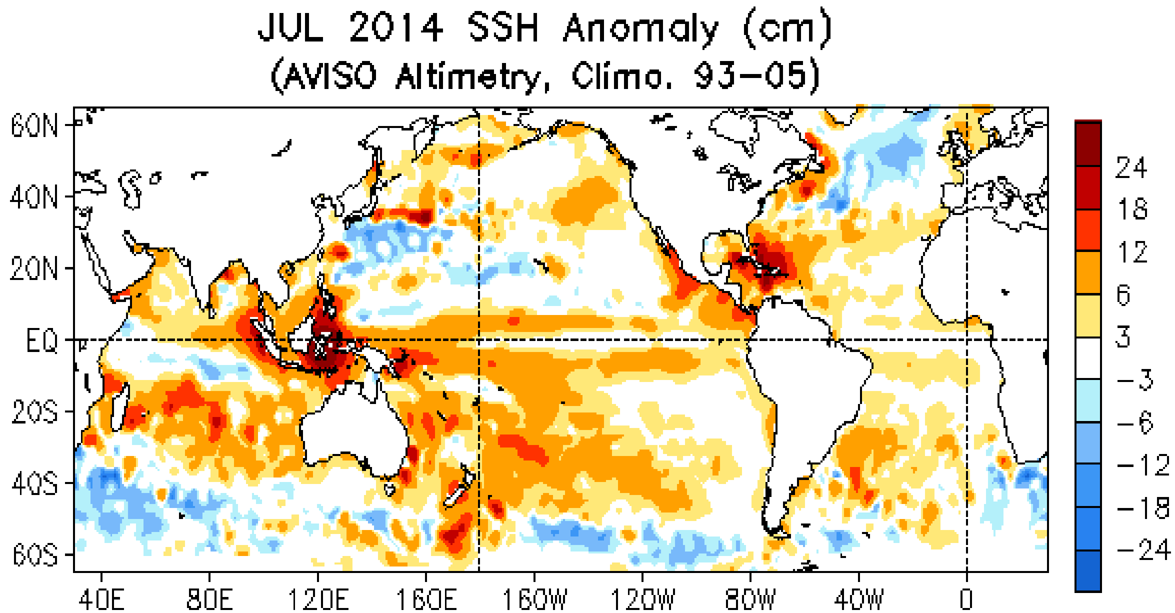
- **Pacific Ocean**
  - **ENSO neutral condition continued with OIv2 NINO3.4=0.2^{o}C in July 2014.**
  - **Subsurface cooling emerged in the central-eastern equatorial Pacific in July.**
  - **Majority of models still favored El Nino in the next several months.**
  - **PDO returned to positive phase in July.**

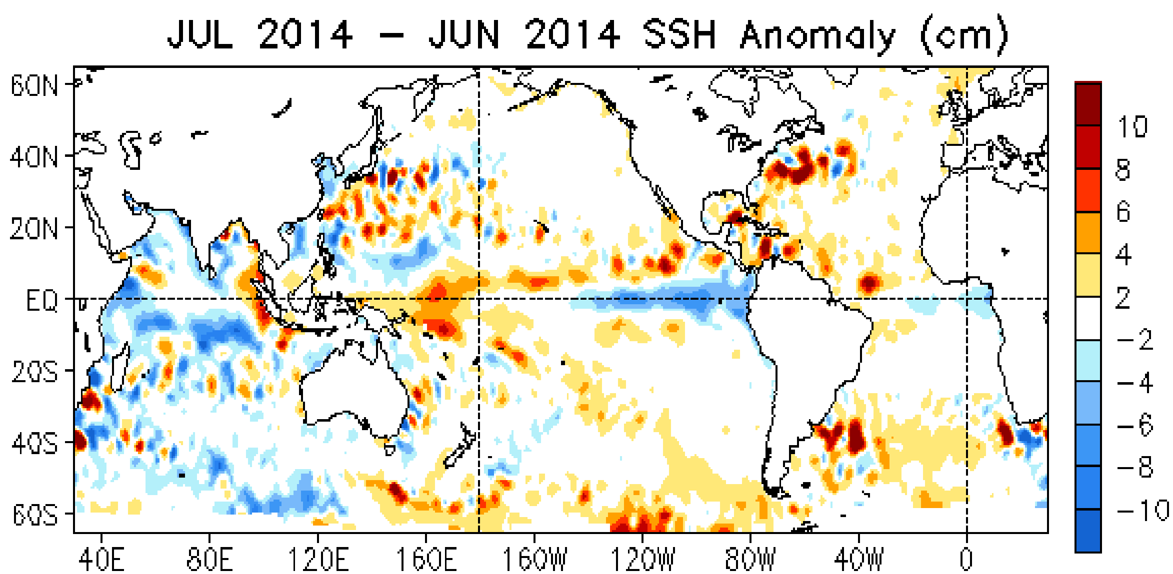
- **Indian Ocean**
  - **Indian dipole index was -0.4 in July.**

- **Atlantic Ocean**
  - **Below-average SSTA continued in the hurricane Main Development Region.**
  - **NOAA's updated hurricane outlook call for a below-normal Atlantic hurricane season.**

Backup Slides

Global SSH Anomaly & Anomaly Tendency

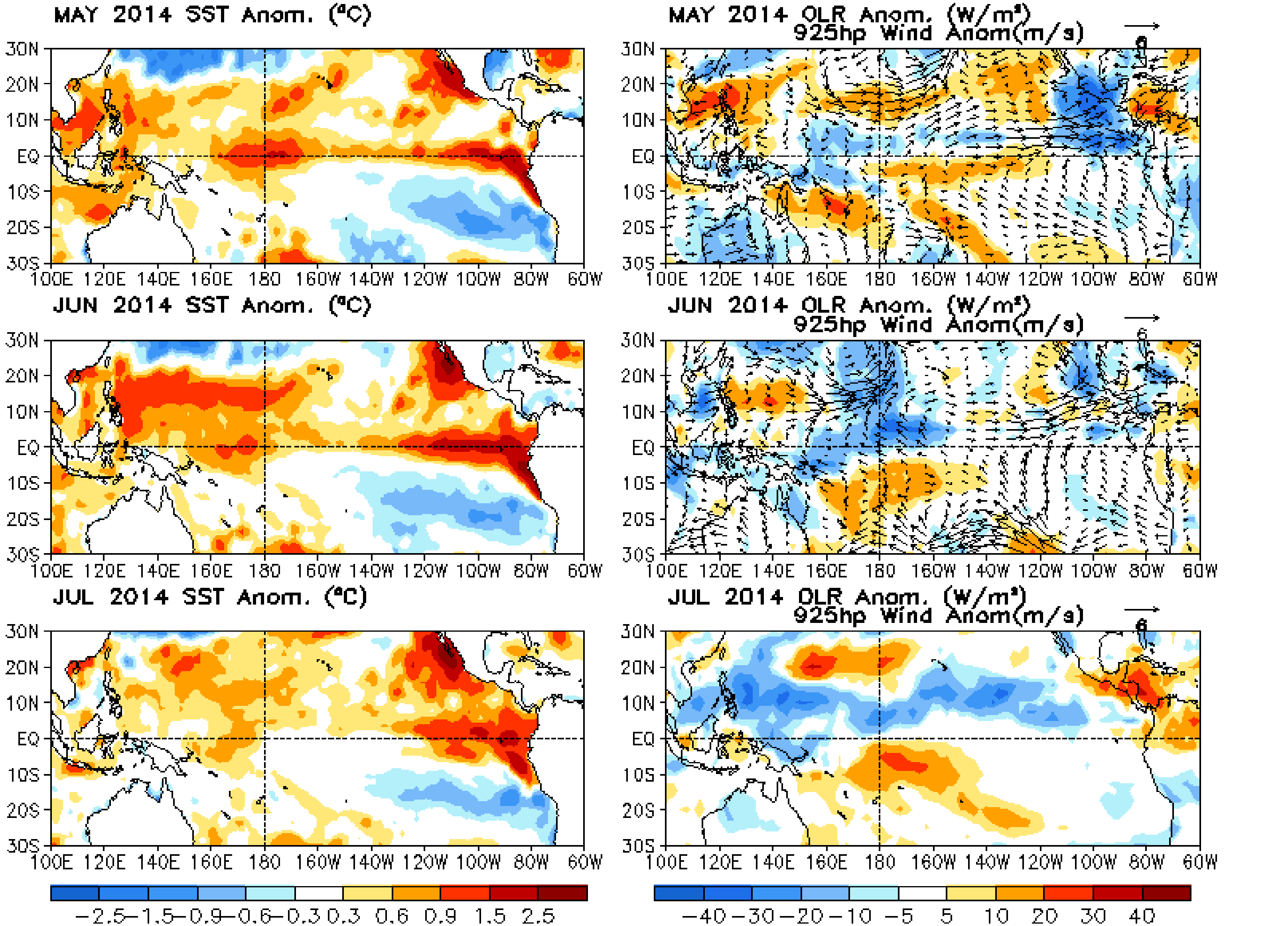




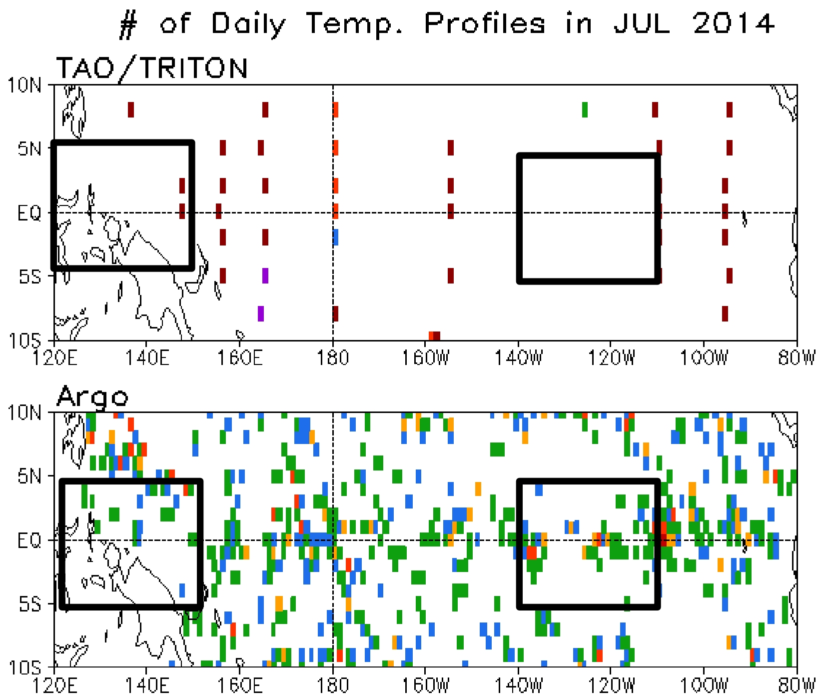
- **Strong positive SSHA were observed near the Indonesia and in the Caribbean sea.**

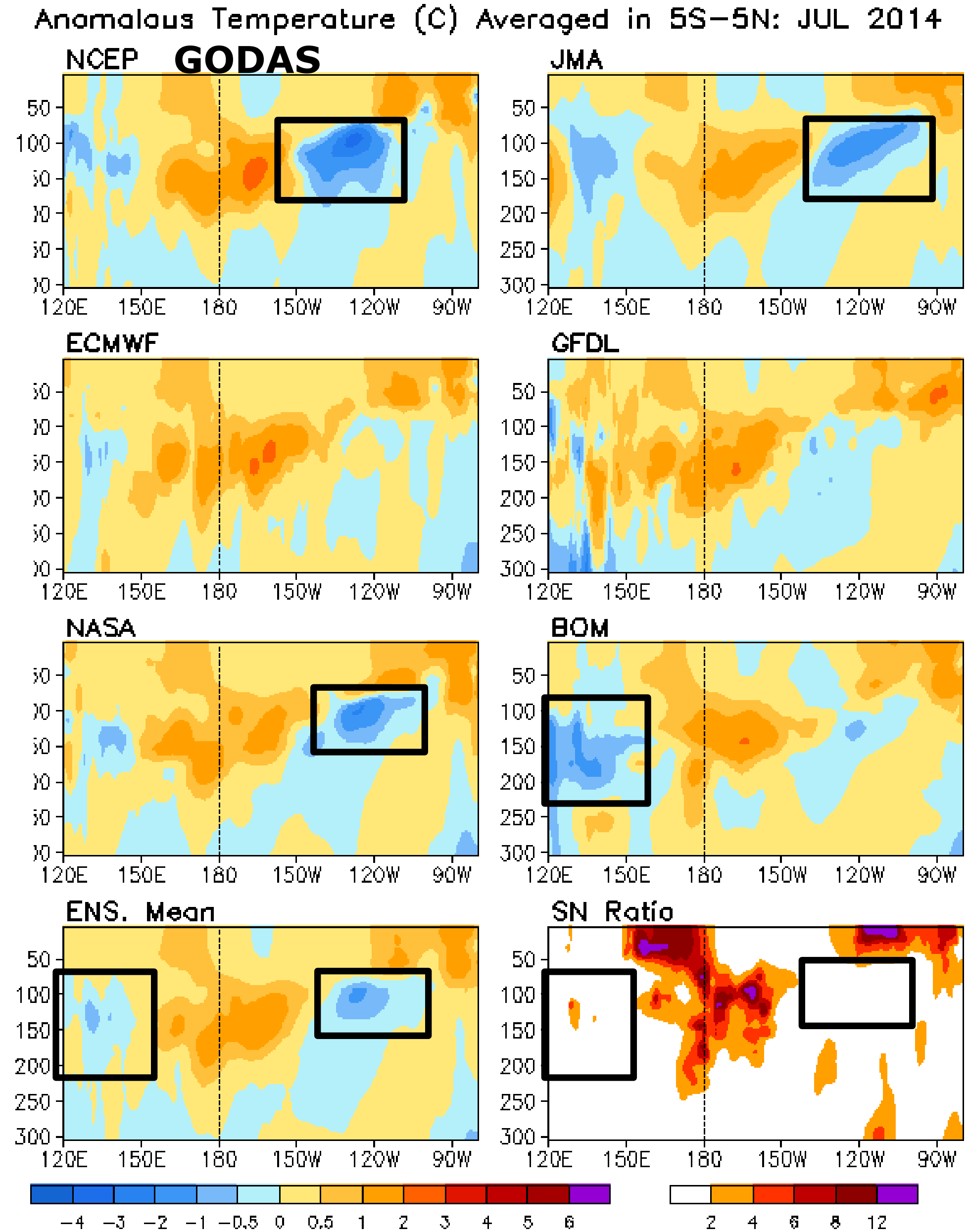
- **In the deep tropical regions, SSH tendency was roughly positive related with SST tendency.**

Last Three Month SST, OLR and 925hp Wind Anom.



Real-Time Multiple Ocean Reanalysis Intercomparison

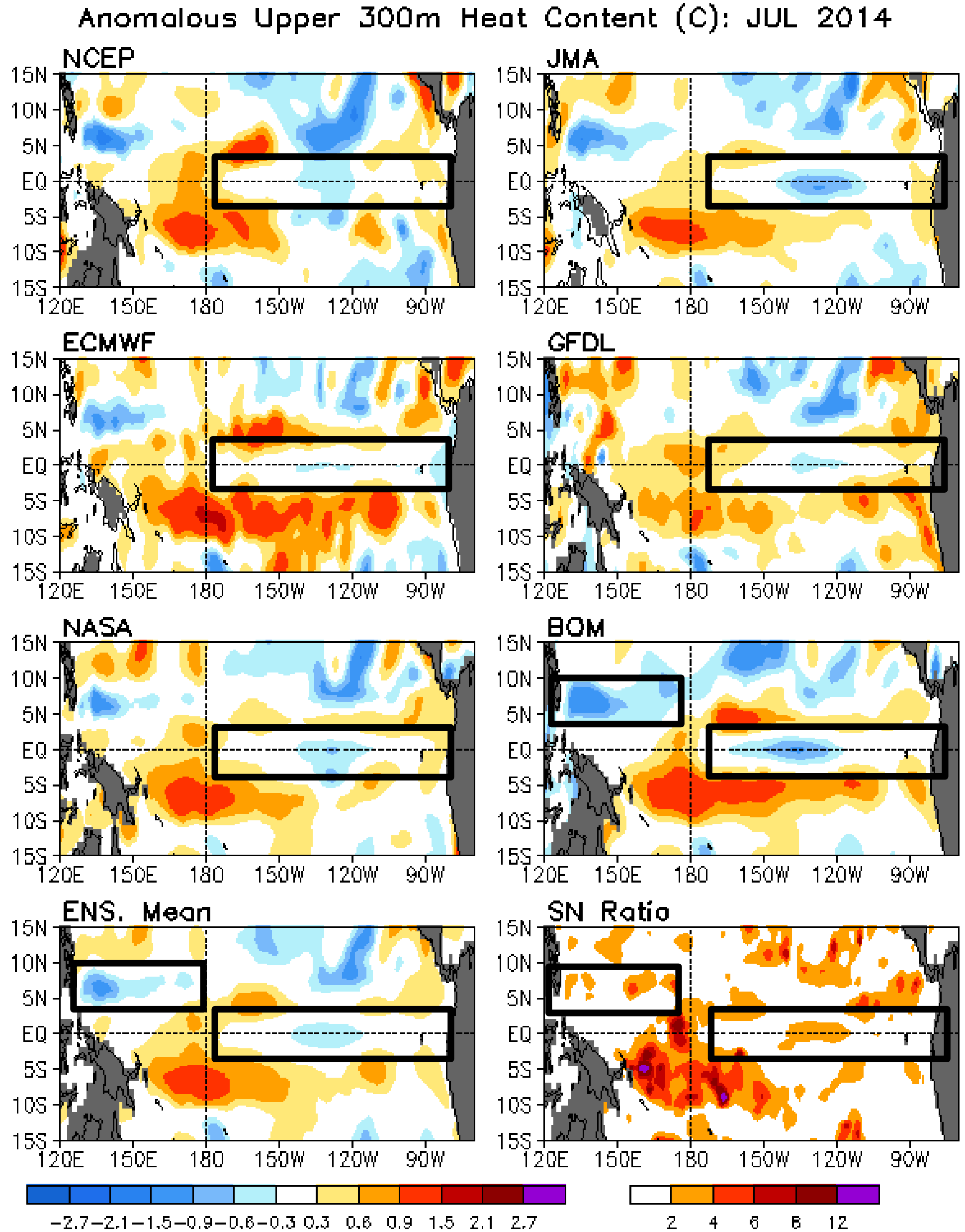




-The signal (ensemble mean) to noise (ensemble spread) ratio is relatively small in the western Pacific where negative anomalies dominated near the thermocline and in the eastern Pacific where negative anomalies dominated at depths of 75-150m. The small signal-to-noise ratio is partially related to sparse observations.

1981-2010 Clim

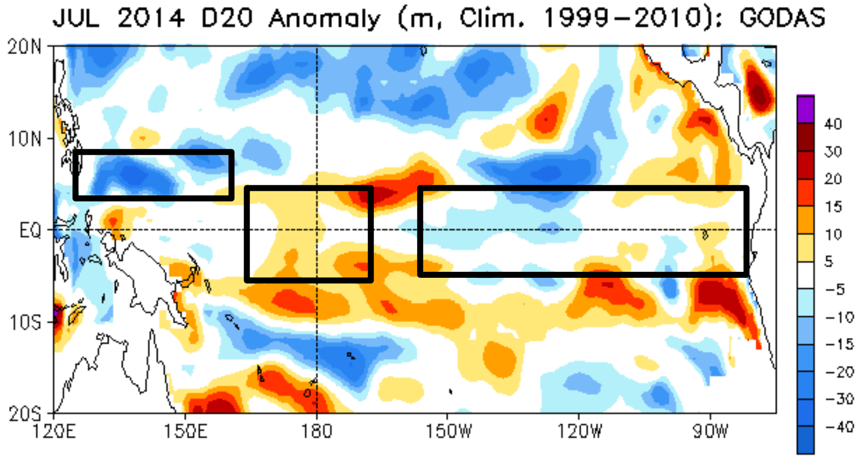
Upper 300m Heat Content Anomaly (1981-2010 Clim.)

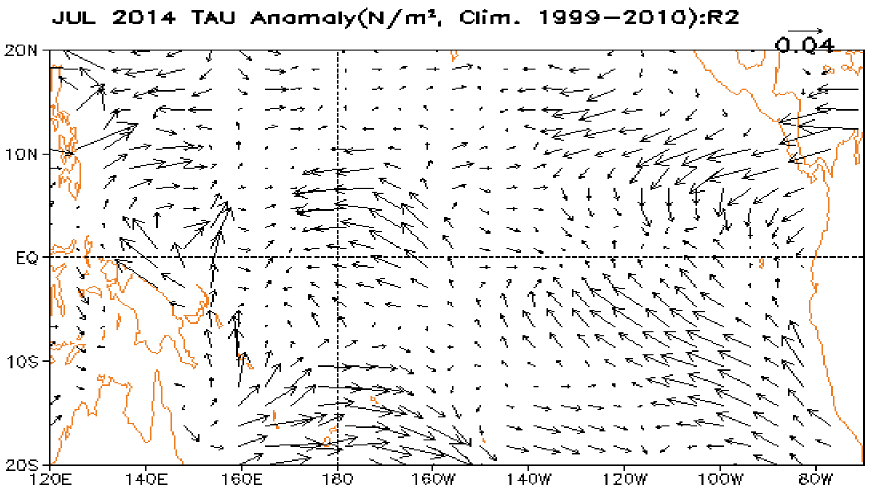


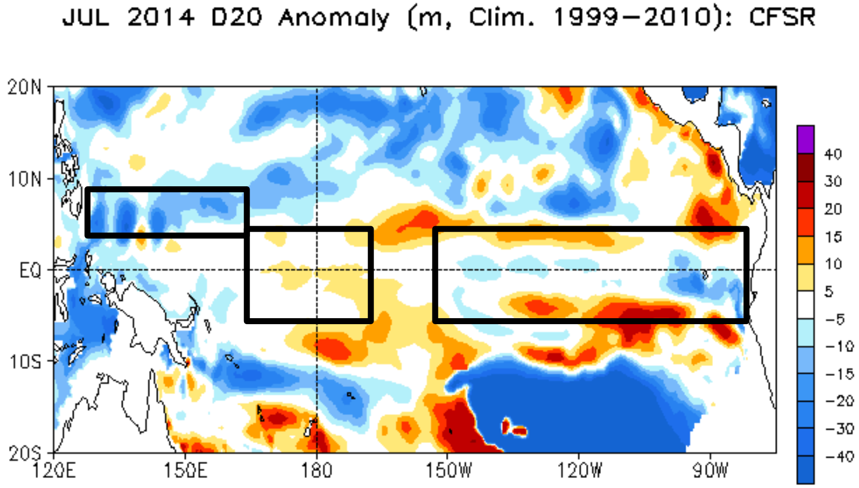
- **Positive heat content anomaly presented on equator near Dateline and off-equator along 7S and 5N.**

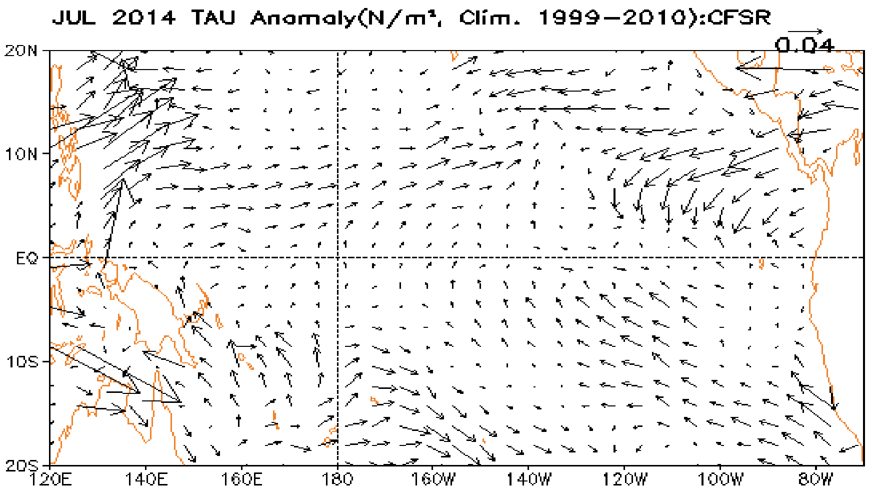
- **Negative heat content anomaly was observed along the equator between 150W-120W, and in the northwest Pacific along 5N, which are unfavorable for El Nino development.**

Difference between GODAS and CFSR

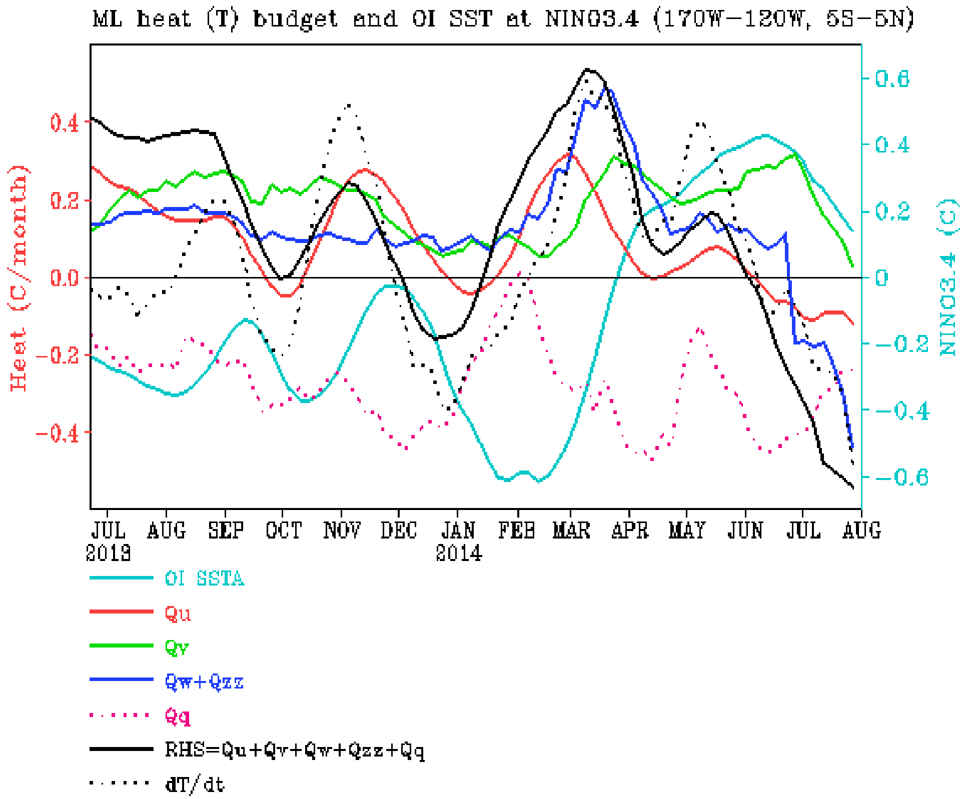








NINO3.4 Heat Budget



- **SSTA tendency (dT/dt) in NINO3.4 (dotted line) was negative in July 2014**

- **Qu , Qw+Qzz and Qq were negative in july**

Huang, B., Y. Xue, X. Zhang, A. Kumar, and M. J. McPhaden, 2010 : The NCEP GODAS ocean analysis of the tropical Pacific mixed layer heat budget on seasonal to interannual time scales, J. Climate., 23, 4901-4925.

Qu: Zonal advection; Qv: Meridional advection;

Qw: Vertical entrainment; Qzz: Vertical diffusion

Qq: (Qnet - Qpen + Qcorr)/ρcph; Qnet = SW + LW + LH +SH;

Qpen: SW penetration; Qcorr: Flux correction due to relaxation to OI SST

Warm Water Volume (WWV) and NINO3.4 Anomalies

- **WWV is defined as average of depth of 20°C in [120°E-80°W, 5°S-5°N]. Statistically, peak correlation of Nino3 with WWV occurs at 7 month lag (Meinen and McPhaden, 2000).**

- **Since WWV is intimately linked to ENSO variability (Wyrtki 1985; Jin 1997), it is useful to monitor ENSO in a phase space of WWV and NINO3.4 (Kessler 2002).**

- **Increase (decrease) of WWV indicates recharge (discharge) of the equatorial oceanic heat content.**

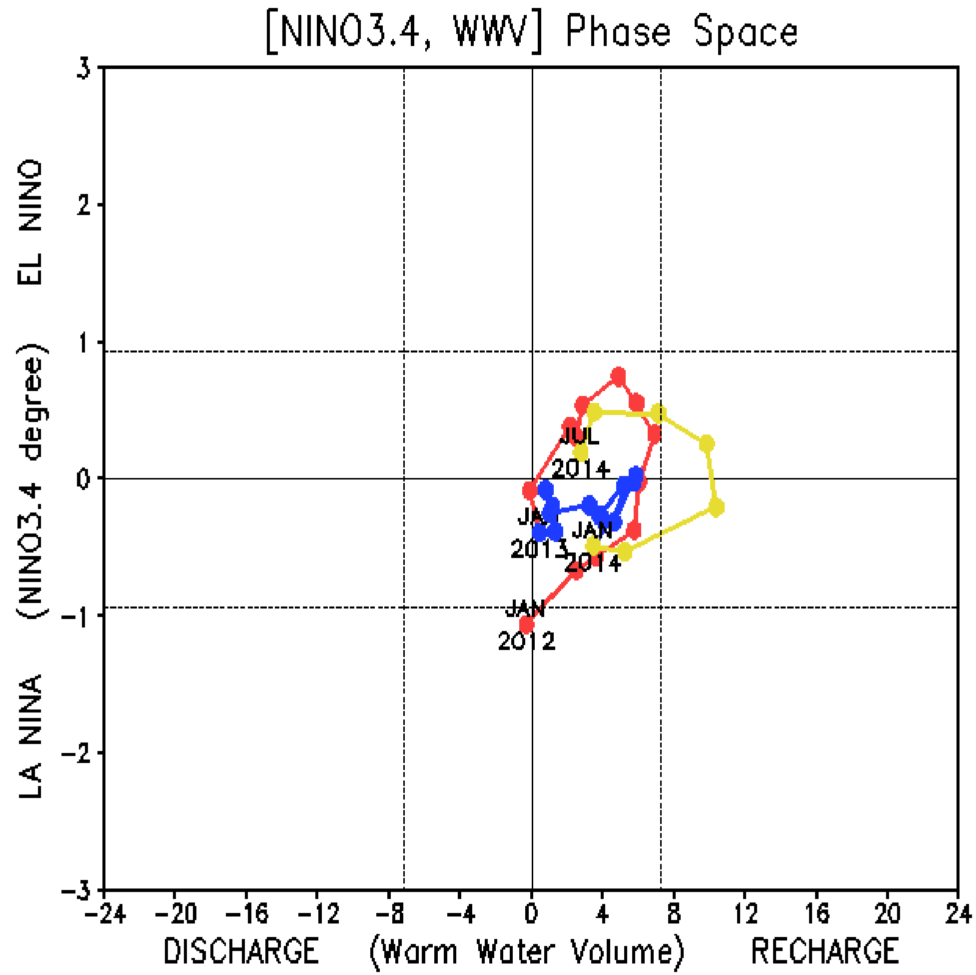
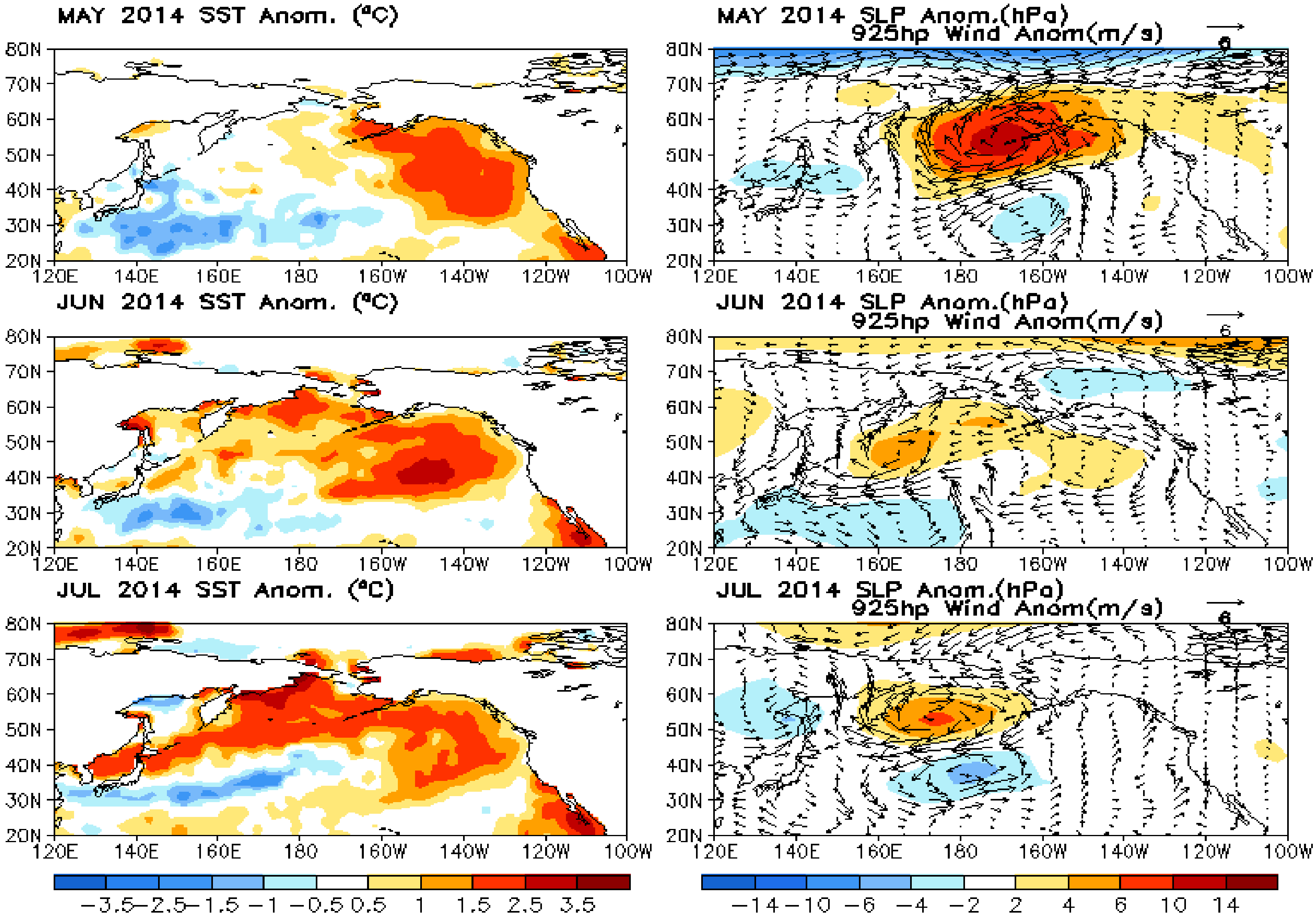


Fig. P3. Phase diagram of Warm Water Volume (WWV) and NINO 3.4 SST anomalies. WWV is the average of depth of 20°C in [120°E-80°W, 5°S-5°N] calculated with the NCEP's global ocean data assimilation system. Anomalies are departures from the 1981-2010 base period means.

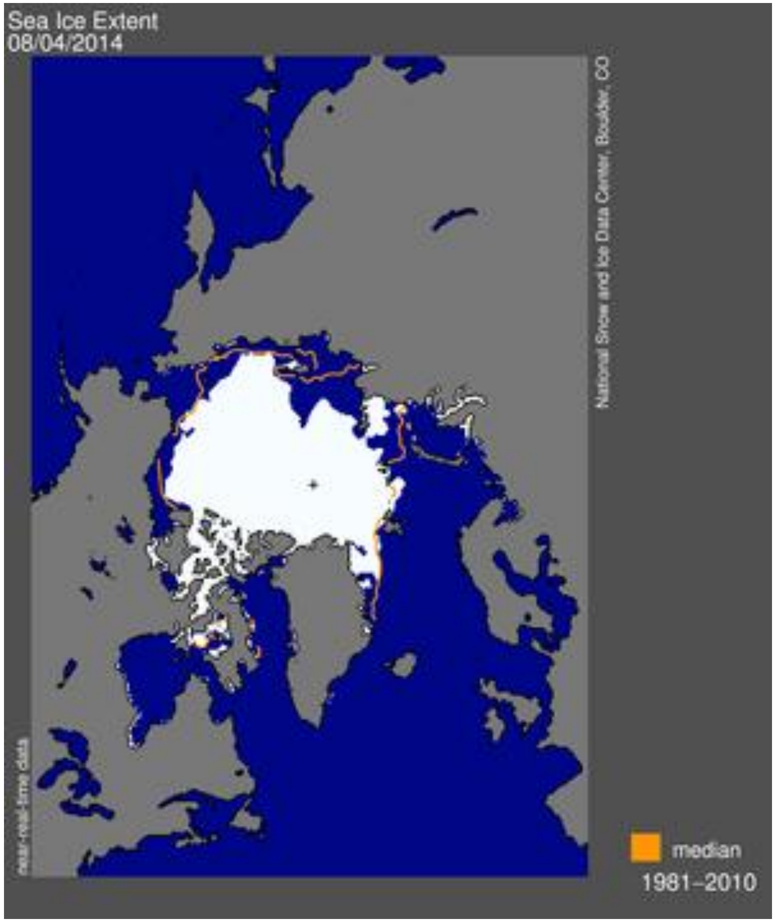
Last Three Month SST, OLR and 925hp Wind Anom.

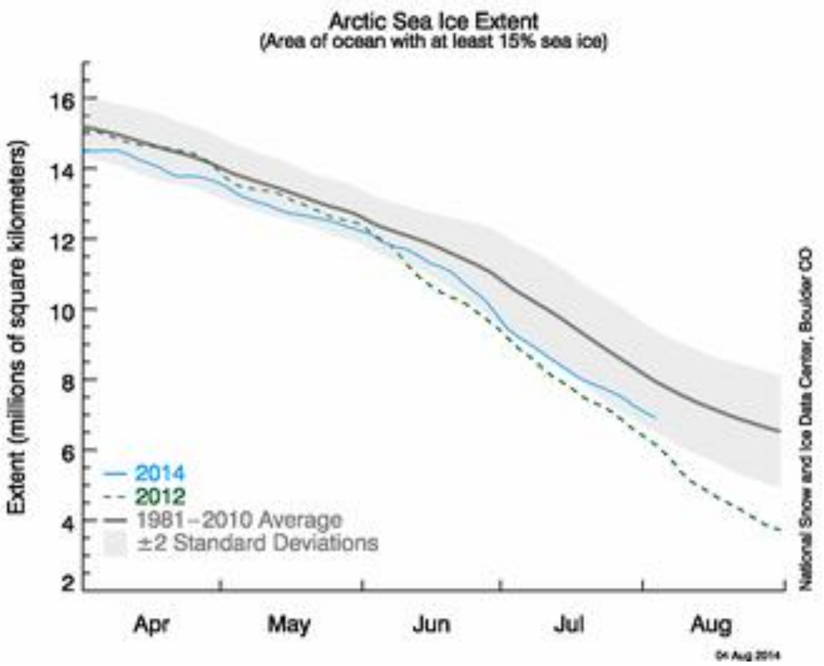


Arctic Sea Ice

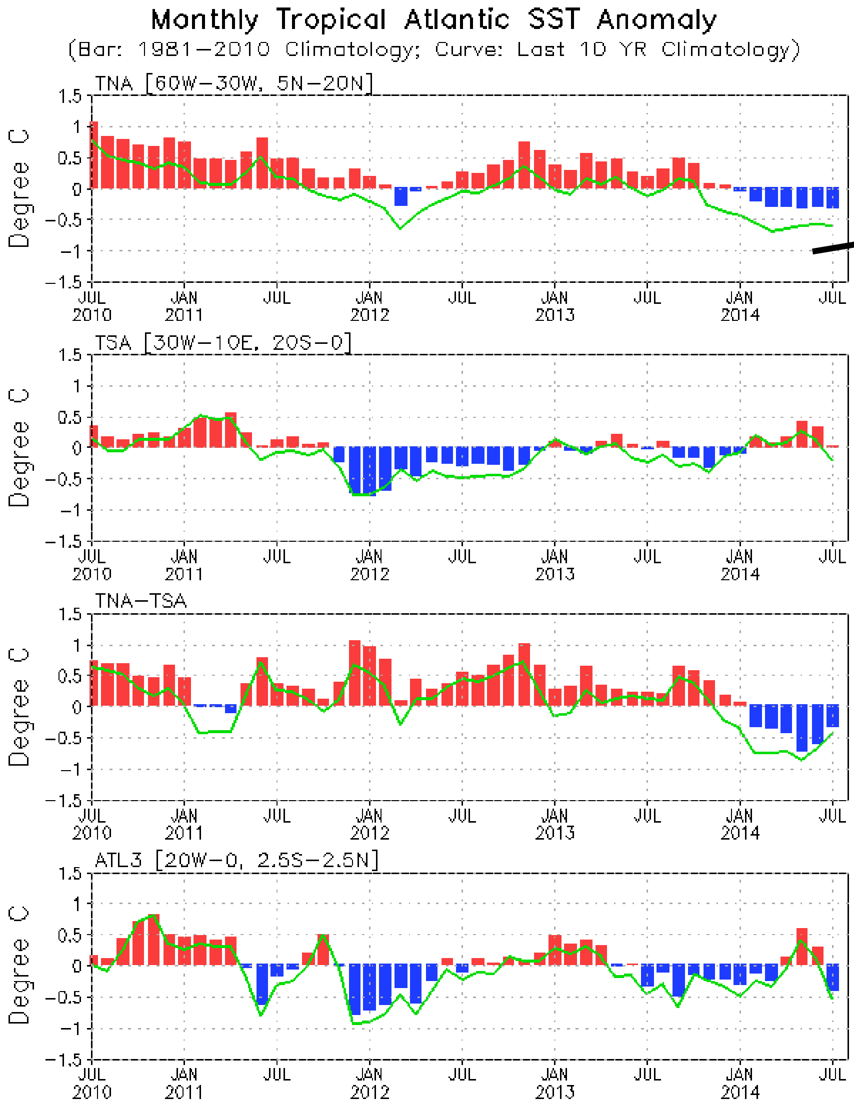
National Snow and Ice Data Center

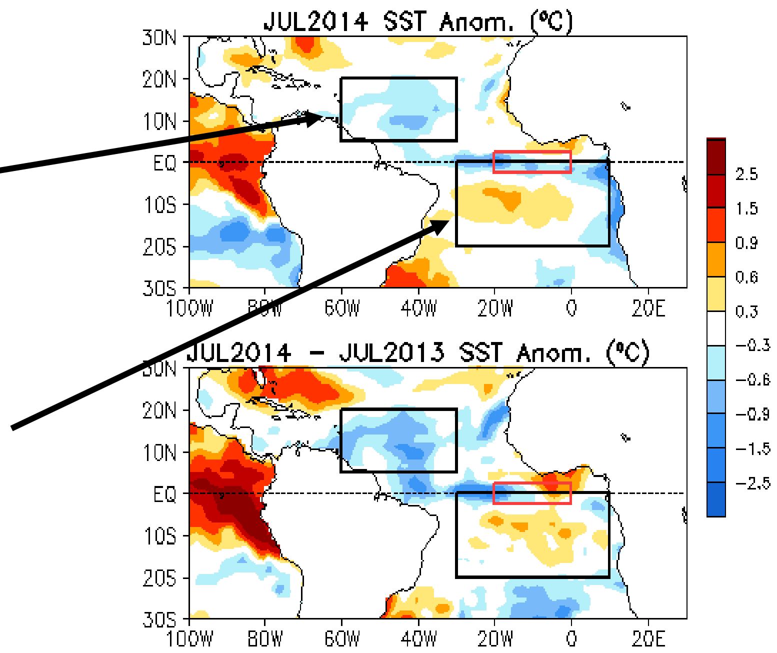
http://nsidc.org/arcticseaicenews/index.html





Evolution of Tropical Atlantic SST Indices





- **Tropical North Atlantic (TNA) index was negative since Jan 2014 and gradually strengthened.**
- **Tropical South Atlantic (TSA) index was near-normal in July.**
- **Meridional Gradient Mode (TNA-TSA) has switched to negative phase in Feb 2014**
- **ATL3 SSTA switched to negative in July 2014.**

Fig. A1a. Tropical Atlantic Variability region indices, calculated as the area-averaged monthly mean sea surface temperature anomalies (°C) for the TNA [60°W-30°W, 5°N-20°N], TSA [30°W-10°E, 20°S-0] and ATL3 [20°W-0, 2.5°S-2.5°N] regions, and Meridional Gradient Index, defined as differences between TNA and TSA. Data are derived from the NCEP OI SST analysis, and anomalies are departures from the 1981-2010 base period means.

North Atlantic: SST Anom., SST Anom. Tend., OLR, SLP, Sfc Rad, Sfc Flx

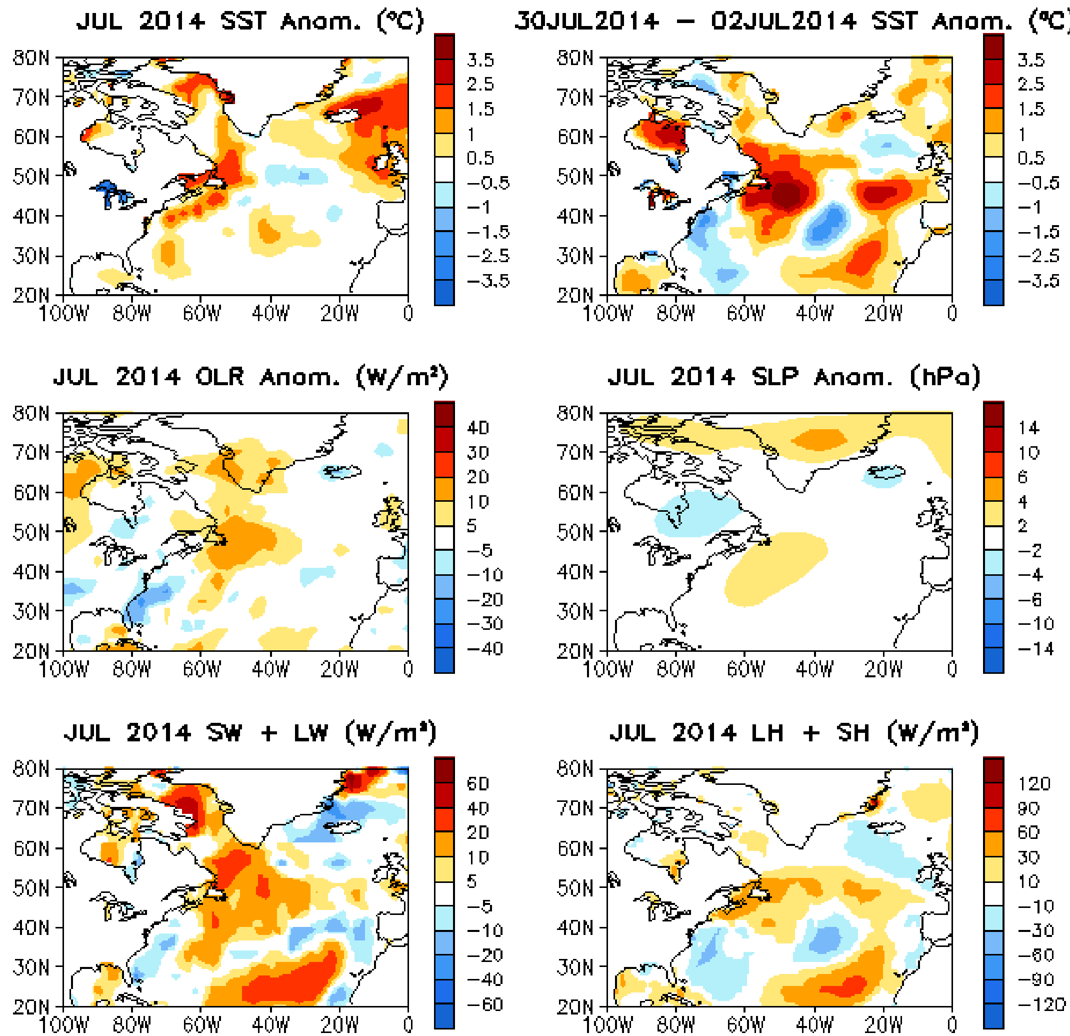
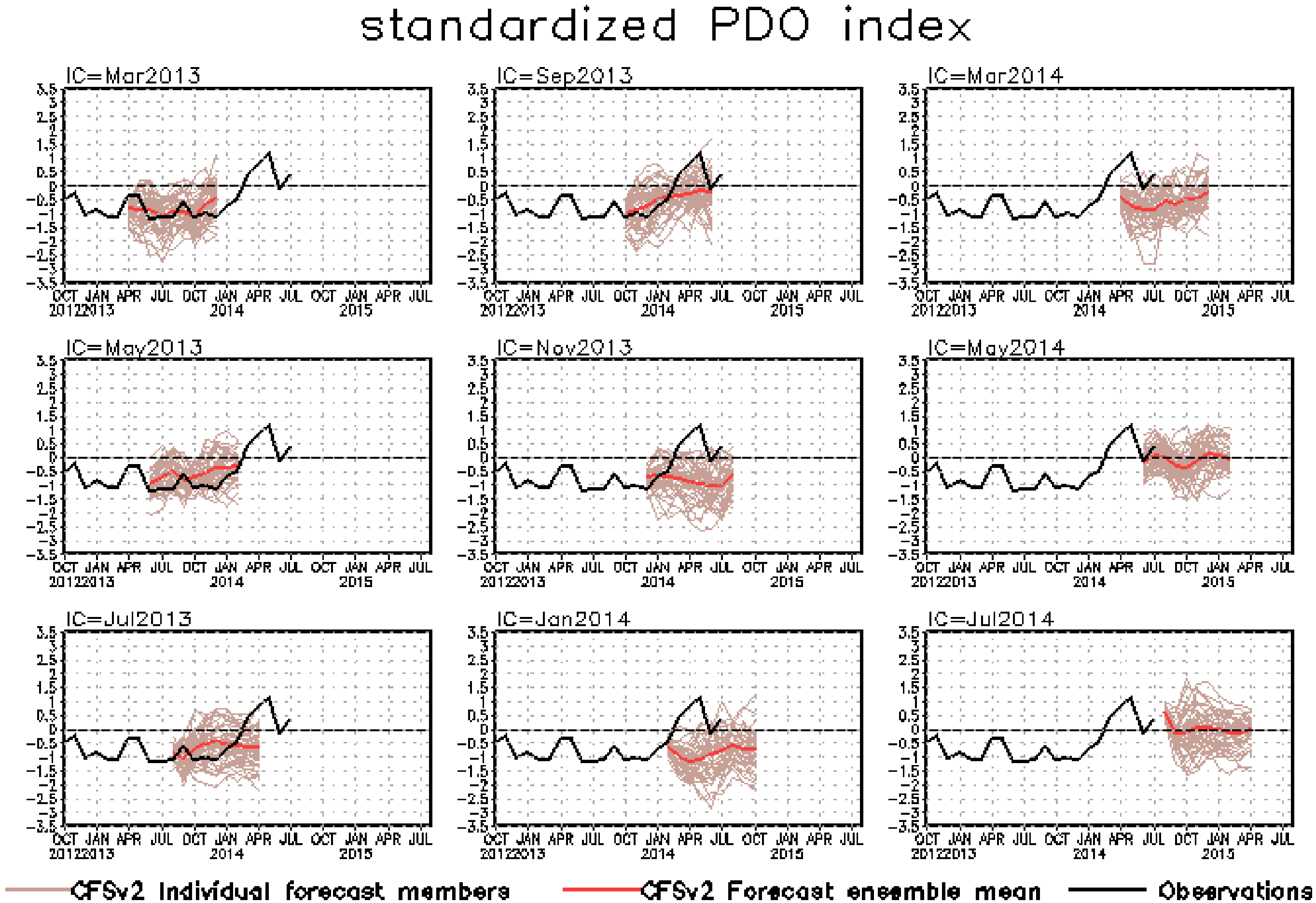


Fig. NA1. Sea surface temperature (SST) anomalies (top-left), anomaly tendency (top-right), Outgoing Long-wave Radiation (OLR) anomalies (middle-left), sea surface pressure anomalies (middle-right), sum of net surface short- and long-wave radiation anomalies (bottom-left), sum of latent and sensible heat flux anomalies (bottom-right). SST are derived from the NCEP OI SST analysis, OLR from the NOAA 18 AVHRR IR window channel measurements by NESDIS, sea surface pressure and surface radiation and heat fluxes from the NCEP CDAS. Anomalies are departures from the 1981-2010 base period means.

CFS Pacific Decadal Oscillation (PDO) Index Predictions from Different Initial Months

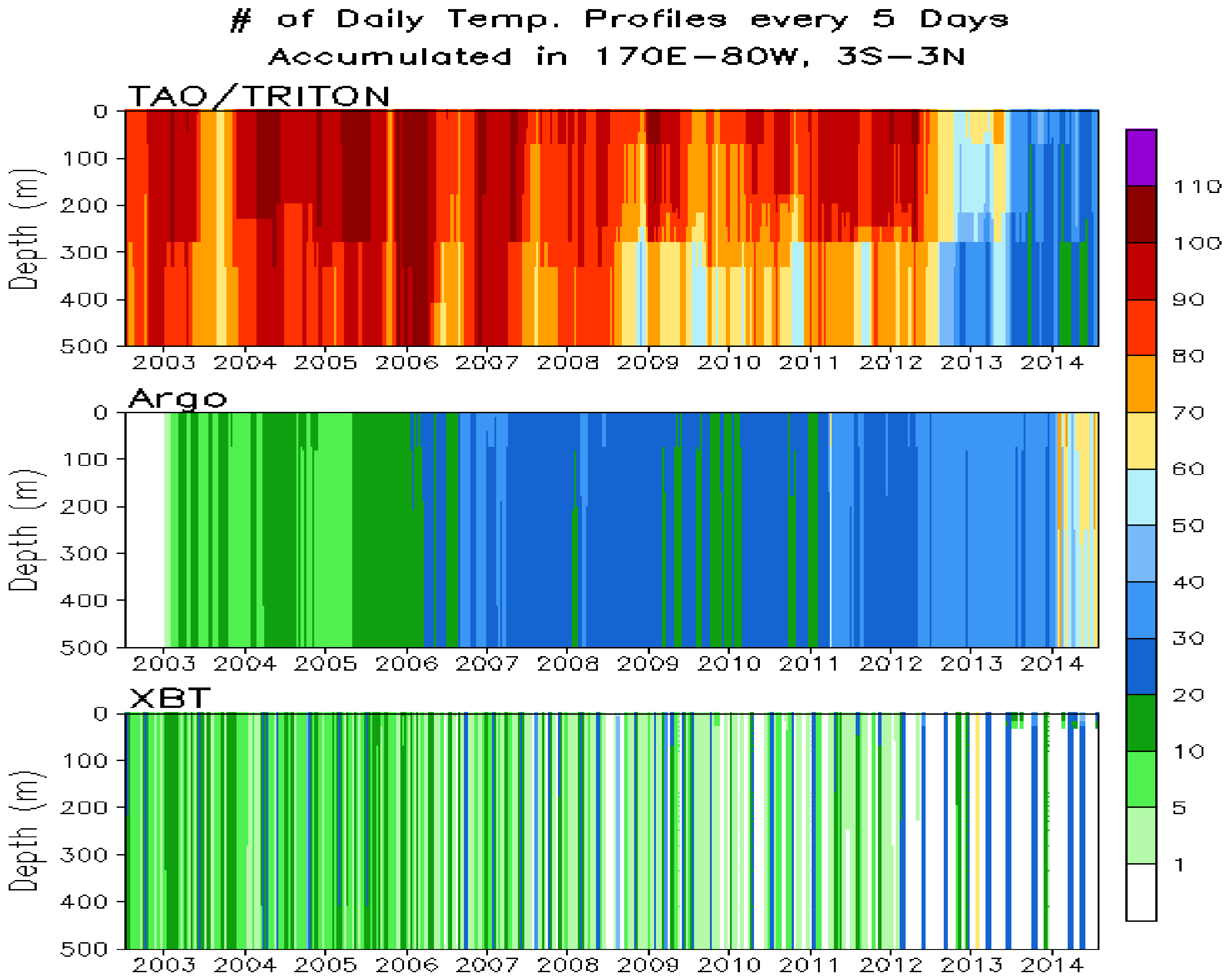


- Forecast in July 2014 IC calls for near-normal PDO in next 9 months.

PDO is the first EOF of monthly ERSSTv3b anomaly in the region of [110°E-100°W, 20°N-60°N].

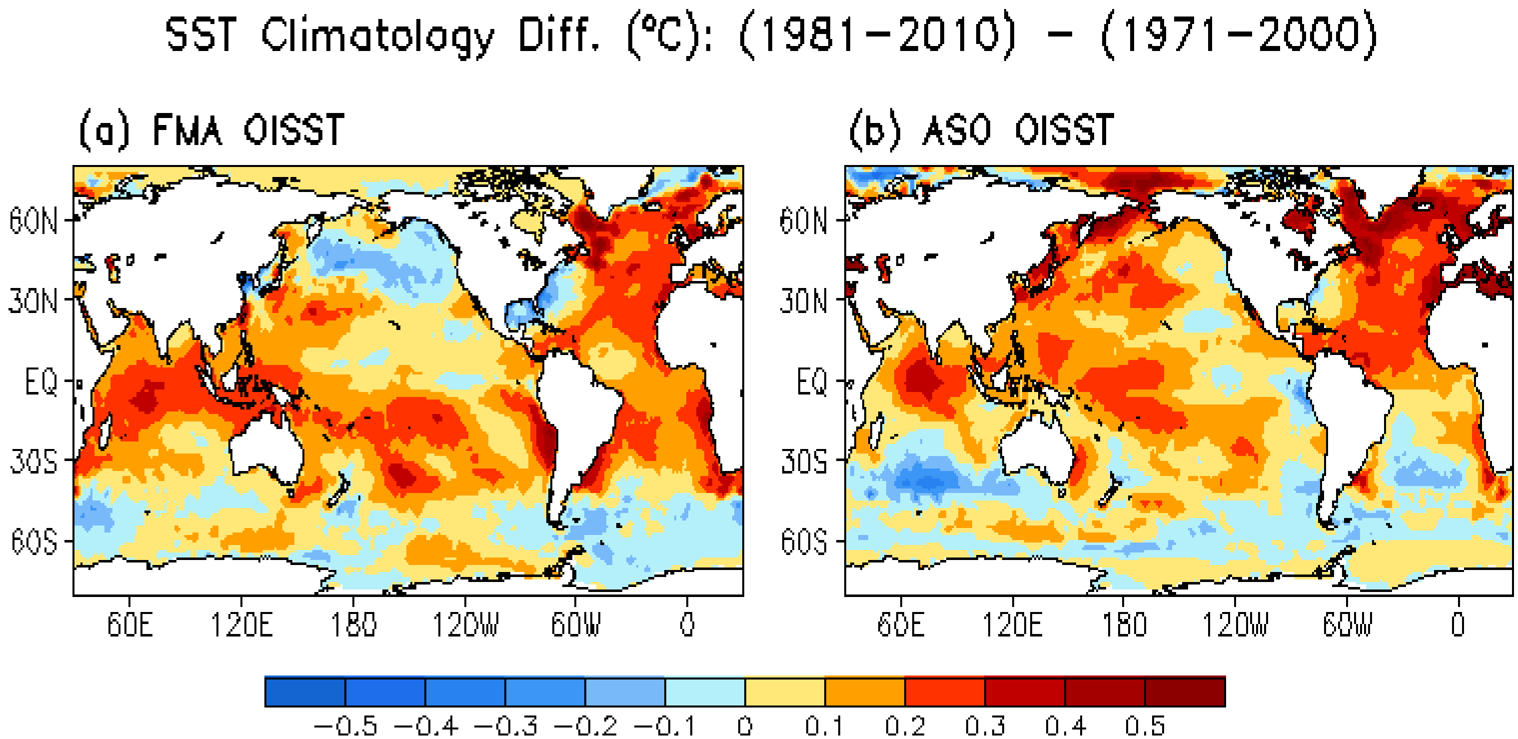
CFS PDO index is the standardized projection of CFS SST forecast anomalies onto the PDO EOF pattern.

Fig. M4. CFS Pacific Decadal Oscillation (PDO) index predictions from the latest 9 initial months. Displayed are 40 forecast members (brown) made four times per day initialized from the last 10 days of the initial month (labelled as IC=MonthYear) as well as ensemble mean (blue) and observations (black). Anomalies were computed with respect to the 1981-2010 base period means.



# of Daily Temp. Profiles every 5 Days
Accumulated in 170E-80W, 3S-3N
TAO/TRITON
Argo
XBT
Depth (m)
0
100
200
300
400
500
2003 2004 2005 2006 2007 2008 2009 2010 2011 2012 2013 2014
110
100
90
80
70
60
50
40
30
20
10
5
1

Be aware that new climatology (1981-2010) was applied since Jan 2011



1971-2000 SST Climatology (Xue et al. 2003):
http://www.cpc.ncep.noaa.gov/products/predictions/30day/SSTs/sst_clim.htm

1981-2010 SST Climatology: http://origin.cpc.ncep.noaa.gov/products/people/yxue/sstclim/

- The seasonal mean SST in February-April (FMA) increased by more than 0.2°C over much of the Tropical Oceans and N. Atlantic, but decreased by more than 0.2°C in high-latitude N. Pacific, Gulf of Mexico and along the east coast of U.S.

- Compared to FMA, the seasonal mean SST in August-October (ASO) has a stronger warming in the tropical N. Atlantic, N. Pacific and Arctic Ocean, and a weaker cooling in Gulf of Mexico and along the east coast of U.S.

Switch to 1981-2010 Climatology

- **SST from 1971-2000 to 1981-2010**
  - ➢ **Weekly OISST.v2, monthly ERSST.3b**
- **Atmospheric fields from 1979-1995 to 1981-2010**
  - ➢ **NCEP CDAS winds, sea level pressure, 200mb velocity potential, surface shortwave and longwave radiation, surface latent and sensible fluxes, relative humidity**
  - ➢ **Outgoing Long-wave Radiation**
- **Oceanic fields from 1982-2004 to 1981-2010**
  - ➢ **GODAS temperature, heat content, depth of 20^{o}C, sea surface height, mixed layer depth, tropical cyclone heat potential, surface currents, upwelling**
- **Satellite data climatology 1993-2005 unchanged**
  - ➢ **Aviso Altimetry Sea Surface Height**
  - ➢ **Ocean Surface Current Analyses – Realtime (OSCAR)**

Data Sources and References

- **Optimal Interpolation SST (OI SST) version 2 (Reynolds et al. 2002)**
- **NCEP CDAS winds, surface radiation and heat fluxes**
- **NESDIS Outgoing Long-wave Radiation**
- **NDBC TAO data (http://tao.noaa.gov)**
- **PMEL TAO equatorial temperature analysis**
- **NCEP's Global Ocean Data Assimilation System temperature, heat content, currents (Behringer and Xue 2004)**
- **Aviso Altimetry Sea Surface Height**
- **Ocean Surface Current Analyses – Realtime (OSCAR)**

Please send your comments and suggestions to Yan.Xue@noaa.gov. Thanks!

Real Time Multiple Ocean Reanalysis Intercomparison

(with contributions from NCEP, ECMWF , JMA , GFDL , NASA , BOM based on 1981-2010 Climatology)

(Background Information)

Tropical Pacific Ocean

- **Climate Indices**
  - Depth of 20C isotherm anomaly in NINO3: last 4 years last 15 years 1979-present
  - Depth of 20C isotherm anomaly in NINO4: last 4 years last 15 years 1979-present
  - Upper 300m heat content anomaly in NINO3: last 4 years last 15 years 1979-present
  - Upper 300m heat content anomaly in NINO4: last 4 years last 15 years 1979-present
  - Warm Water Volume: last 4 years last 15 years 1979-present
  - Warm Water Volume average in last two months ending in:
    Jan Feb Mar Apr May Jun Jul Aug Sep Oct Nov Dec
- **Spatial Maps**
  - Equatorial temperature anomaly: last month month before last month 1979-present
  - Depth of 20C isotherm anomaly: last month month before last month 1979-present
  - Upper 300m heat content anomaly: last month month before last month 1979-present

Global Ocean

- **Spatial Maps**
  - Equatorial temperature anomaly: last month month before last month 1979-present
  - Depth of 20C isotherm anomaly: last month month before last month 1979-present
  - Upper 300m heat content anomaly: last month month before last month 1979-present

http://www.cpc.ncep.noaa.gov/products/GODAS/multiora_body.html