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

Prepared by

Climate Prediction Center, NCEP/NOAA

November 9, 2015

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 Ocean Climate Observation Program (OCO)

Outline

- **Overview**
- **Recent highlights**
  - **Pacific/Arctic Ocean**

    El Niño, NE Pacific conditions, hurricane activities
  - **Indian Ocean**
  - **Atlantic Ocean**
- **Global SST predictions**

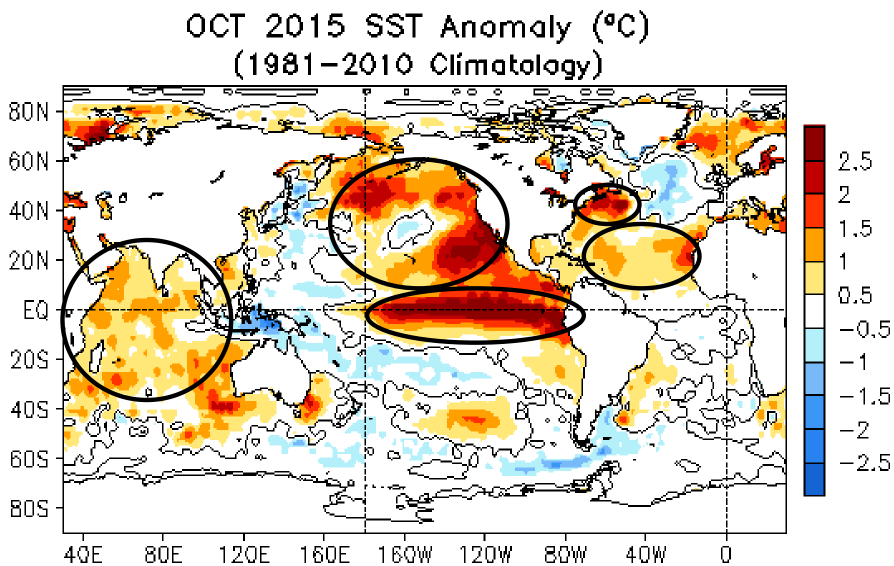
  El Niño, Blob/PDO, tropical North Atlantic

Overview

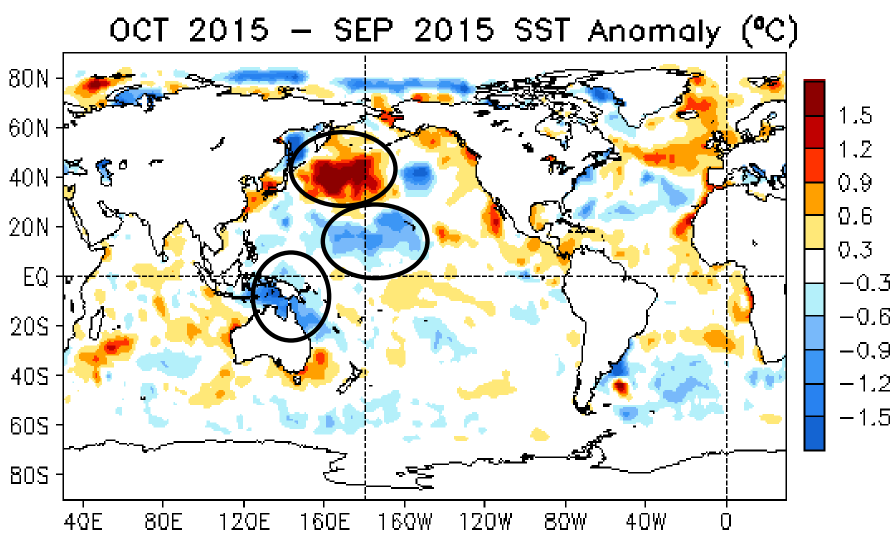
- **Pacific Ocean**
  - **El Niño conditions further strengthened in Oct 2015 and the atmospheric and oceanic anomalies reflect a strong El Niño.**
  - **Most models predicted that Nino 3.4 will peak in Nov-Dec 2015 with an amplitude more than 2^{o}C and decrease gradually through northern hemisphere spring 2016.**
  - **Upper ocean warming associated with the "Blob" has persisted since winter 2013/2014.**
  - **Upper ocean warming in E. Pacific hurricane main development region has enhanced and extended to 100m depth.**
- **Indian Ocean**
  - **Positive SSTAs strengthened across the tropical Indian Ocean.**
  - **Positive India Dipole Mode index persisted.**
- **Atlantic Ocean**
  - **SSTA were well above-average along the eastern coast of North America.**
  - **Positive SSTA extended from mid-latitude to the Atlantic Hurricane Main Development Region.**

Global Oceans

Global SST Anomaly (^0C) and Anomaly Tendency

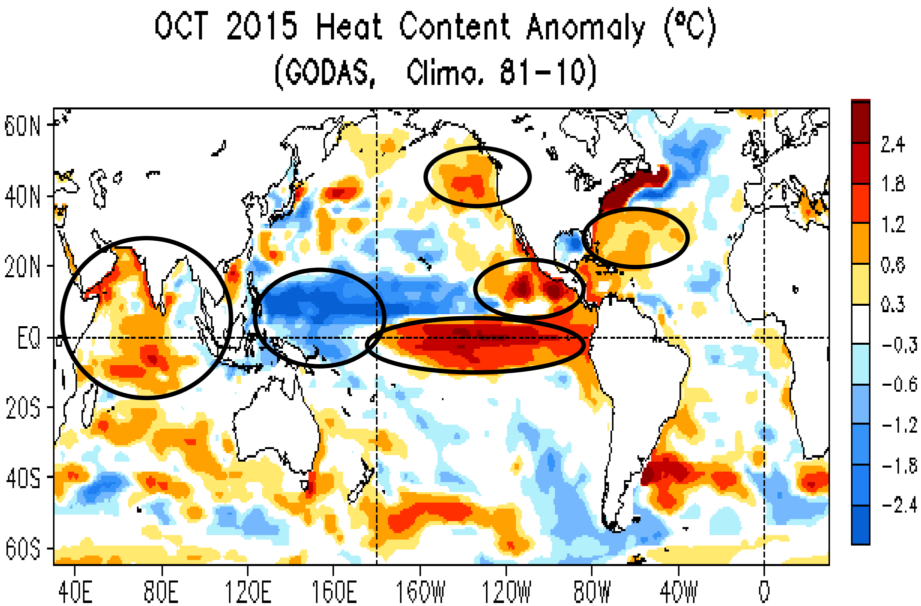


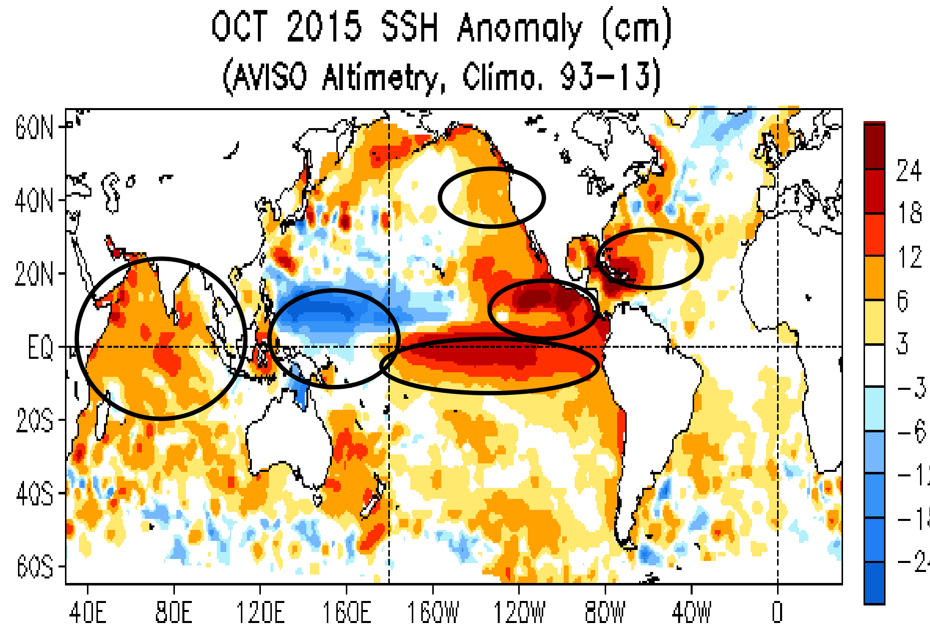
- SSTA exceeded +2°C across the central-eastern equatorial Pacific.
- Strong positive SSTA persisted in the high-latitude and northeastern subtropical North Pacific.
- SSTA were above-average along the eastern coast of North America and in the Atlantic hurricane main development region.
- Positive SSTA continued in the Indian Ocean.

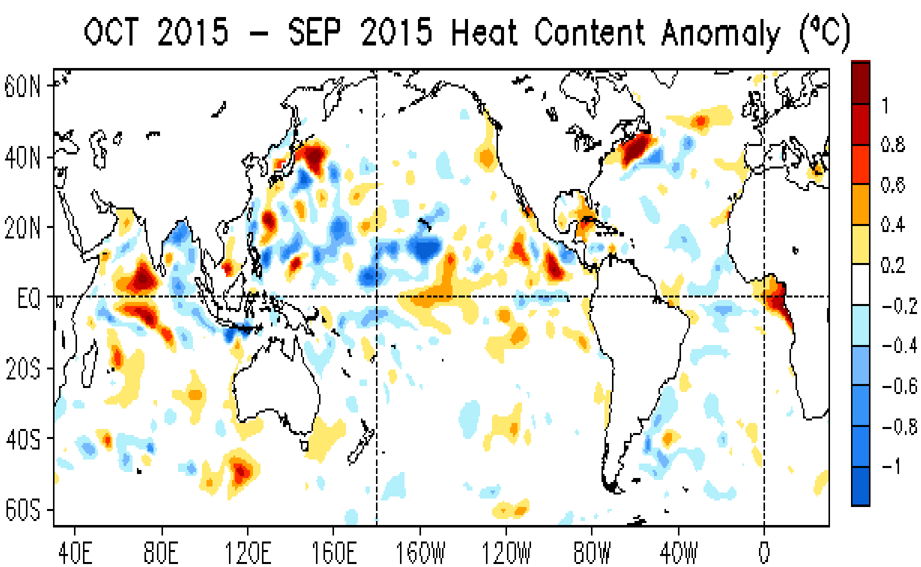


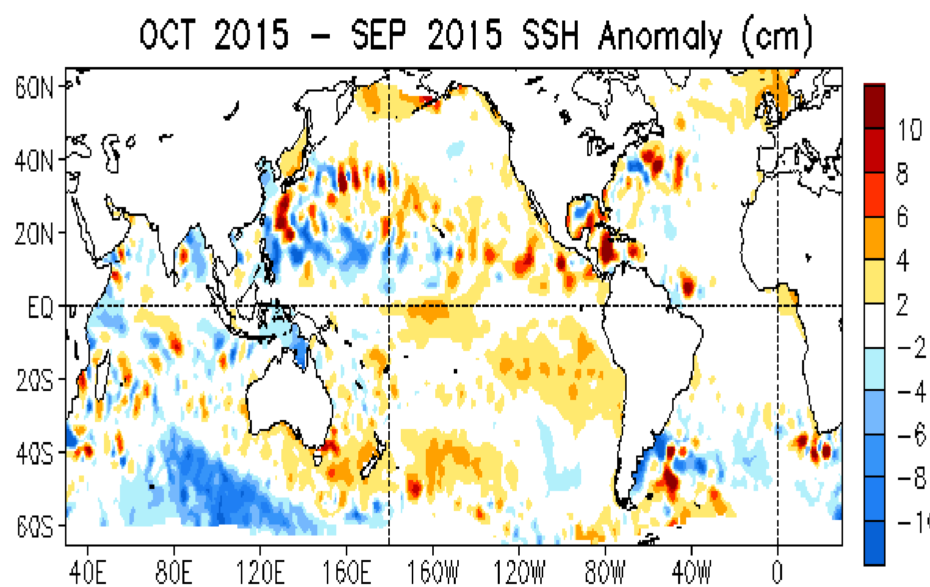
- Strong negative SSTA tendency presented south of New Guinea and west of Hawaii.
- Strong positive SSTA tendency was observed in the west-central North Pacific.

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.



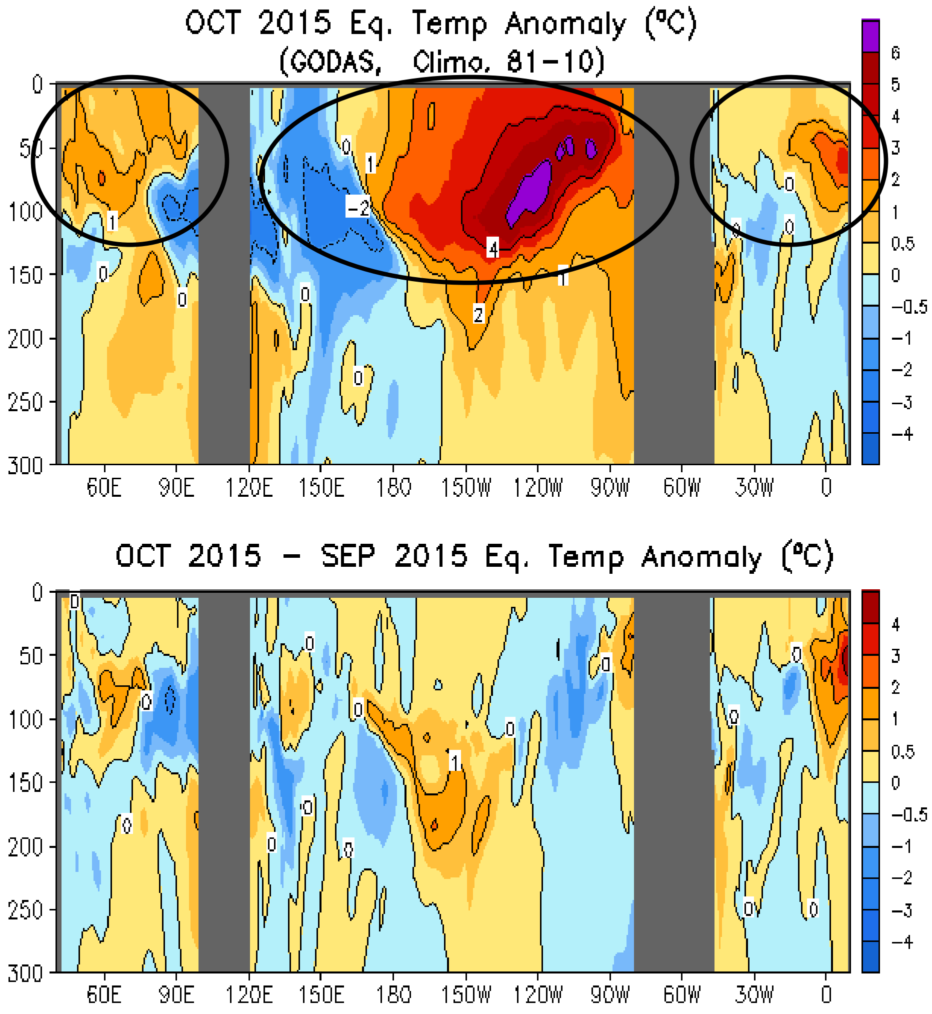






- Patterns of upper 300m ocean heat content and SSH anomaly are largely consistent, and also correspond well with the SSTA pattern.

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



- Positive (negative) temperature anomalies presented in the central-eastern (western) equatorial Pacific.
- Positive temperature anomalies dominated in the upper equatorial Indian Ocean except at 100m depth in the far eastern Indian Ocean.
- Positive temperature anomalies dominated in the upper equatorial Atlantic Ocean.

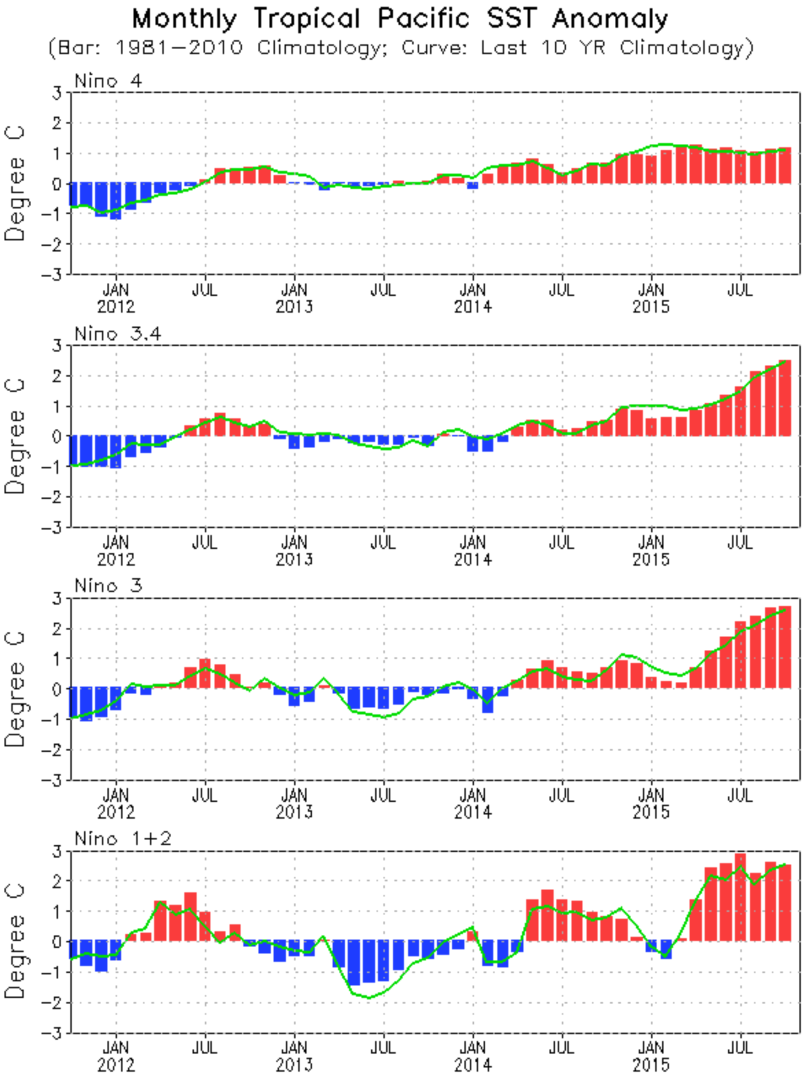
- Anomaly tendency was positive (negative) in the central Pacific (western and eastern) Pacific.

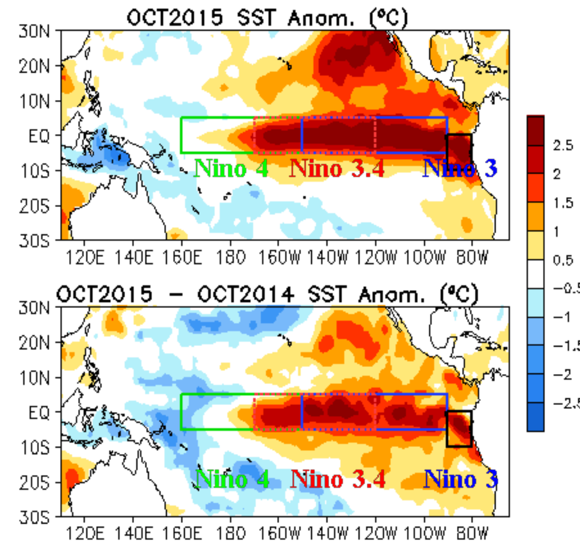
- Anomaly tendency in the Indian and Atlantic Ocean enhanced the anomaly pattern there.

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 Pacific Ocean and ENSO Conditions

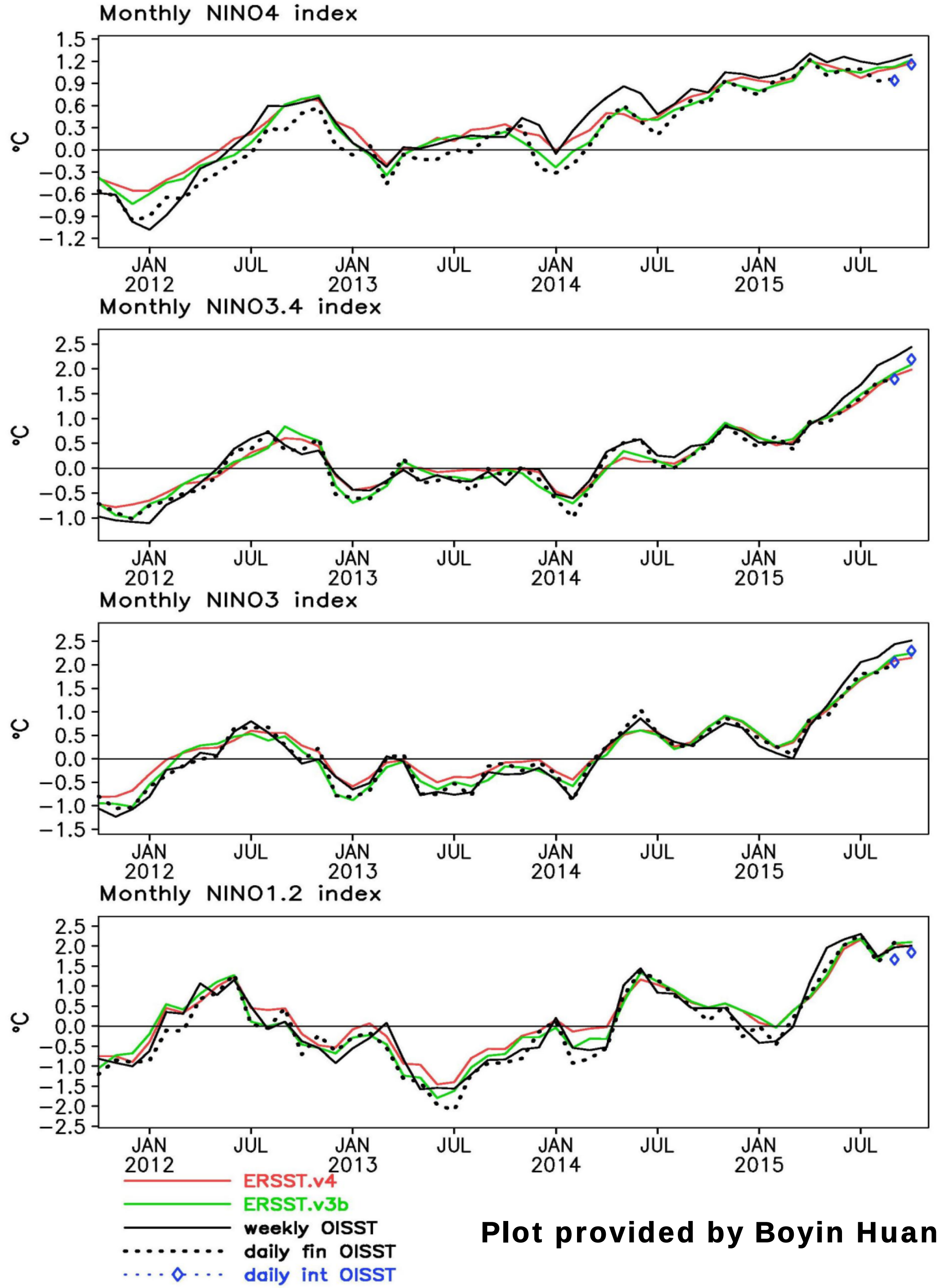
Evolution of Pacific NINO SST Indices





- Nino 3.4 and Nino 3 strengthened in October 2015.
- Nino3.4 = +2.5 °C in October 2015, which is based on weekly OI SST.

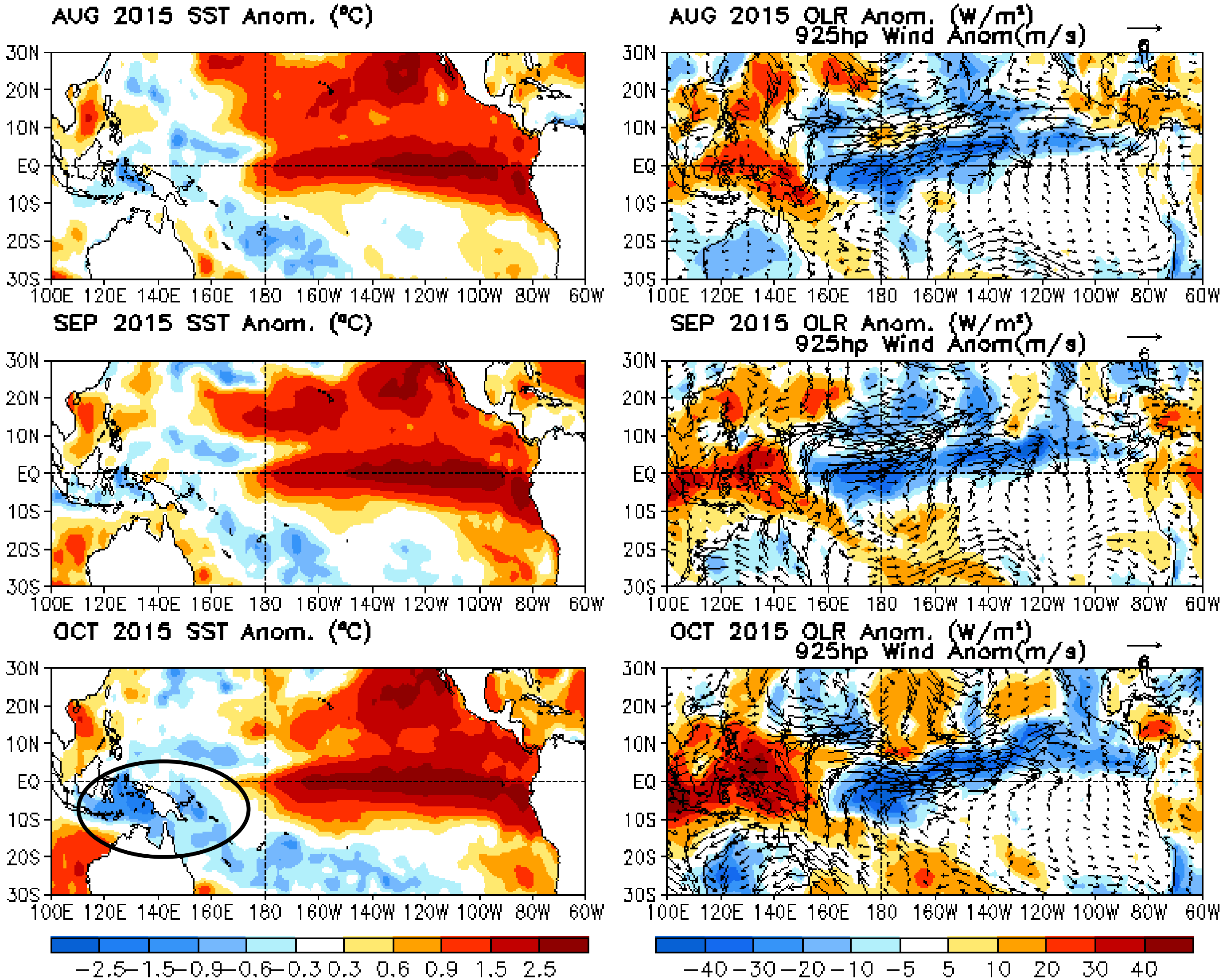
Fig. P1a. Nino region indices, calculated as the area-averaged monthly mean sea surface temperature anomalies (°C) for the specified region. Data are derived from the NCEP OI SST analysis, and anomalies are departures from the 1981-2010 (bar) and last ten year (green line) means.



Plot provided by Boyin Huang

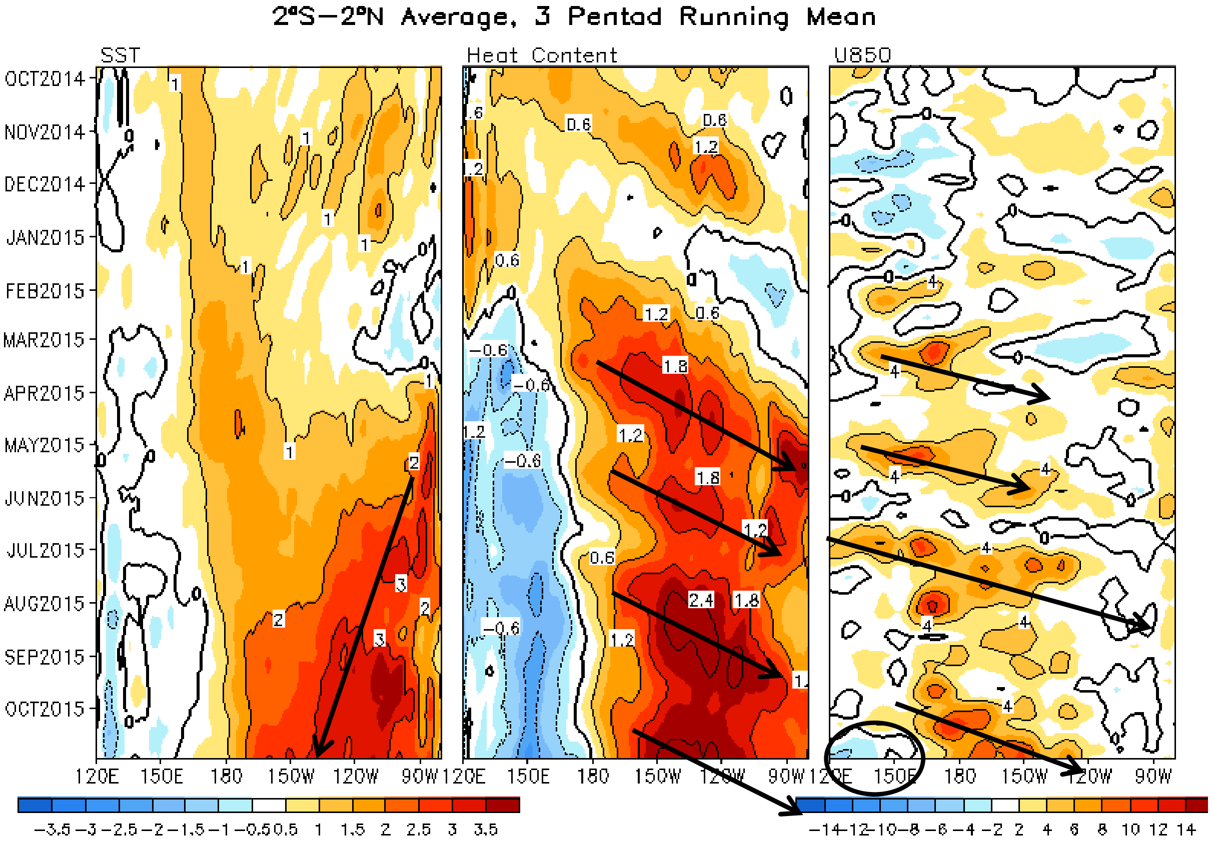
- **NINO3.4 based on weekly OI SST (black line) is a few tenth degree higher than those based on ERSST.v3b, ERSST.v4 and daily OI SST in recent months.**

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

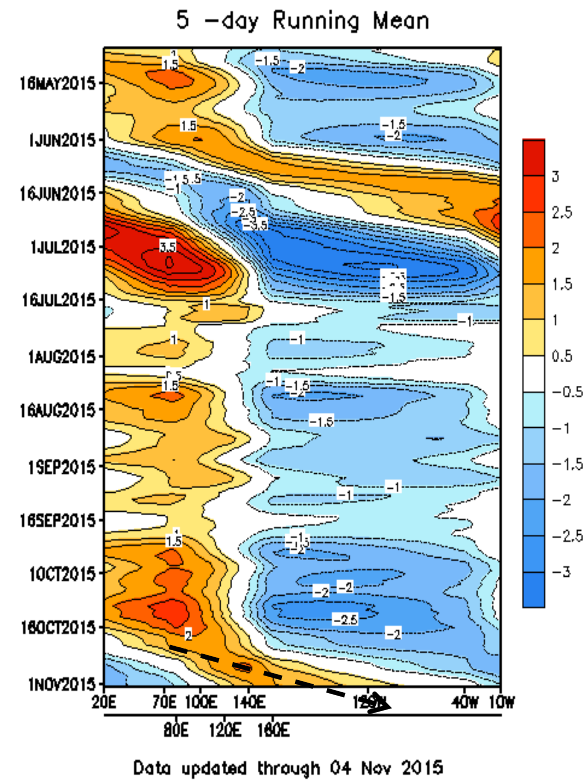


- Negative SSTA strengthened in the far W. Pacific, and positive SSTA persisted and extended further west.
- The atmospheric signature of the El Nino, suppressed (enhanced) convection over the Maritime Continent (near the Dateline), strengthened in October 2015.

Equatorial Pacific SST (°C), HC300 (°C), u850 (m/s) and OLR(W/m²)Anomalies

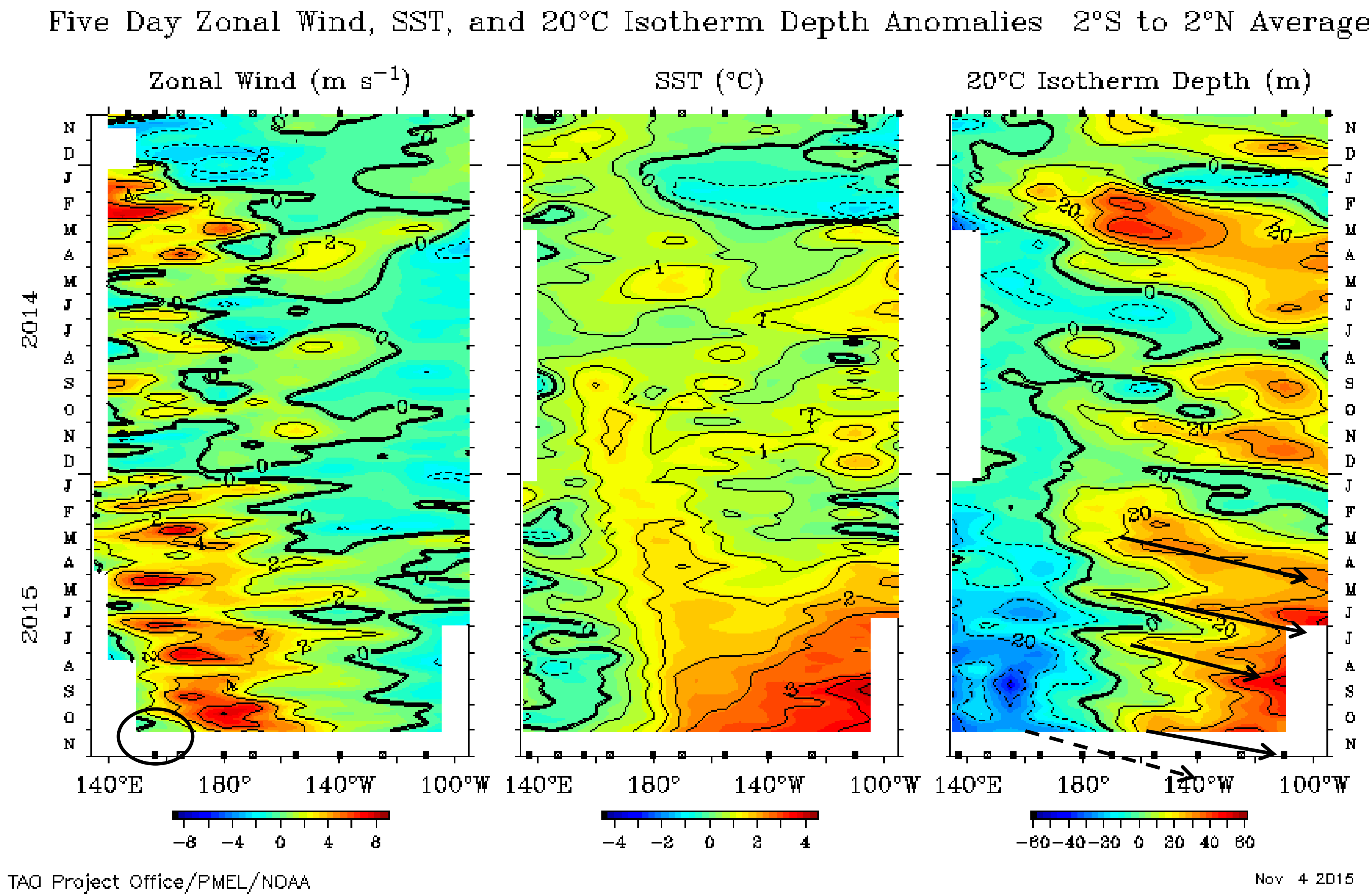


CPC MJO Indices



- Heat content anomaly was dominated by intraseasonal variability associated with four downwelling oceanic Kelvin wave episodes that were forced by four westerly wind burst events in Mar, May, Jul and Oct. The low frequency component of heat content anomaly was largely stationary.
- However, SST variability was dominated by westward propagation since Apr 2015.
- Easterly wind anomalies emerged in the far western equatorial Pacific in late Oct 2015 associated with the negative phase of MJO (orange color in CPC MJO indices).

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 2°S-2°N and Outgoing Long-wave Radiation (OLR, right) averaged in 5°S-5°N. 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.

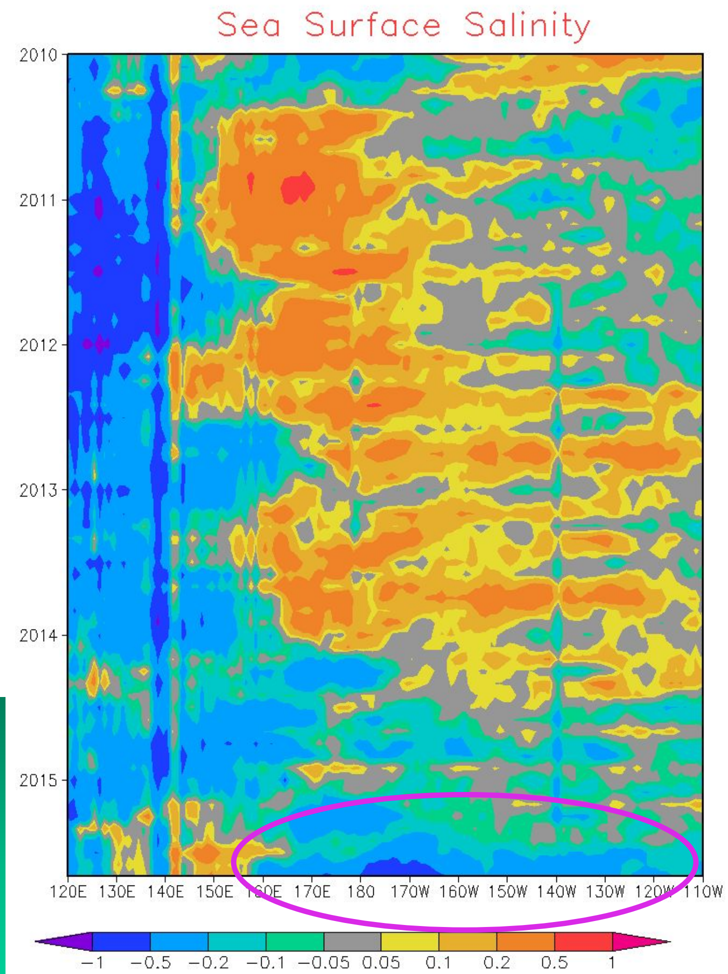


- Upwelling oceanic Kelvin wave emerged in late October, which may cool temperature in the central and eastern Pacific near the thermocline in next 1-2 months.

Sea Surface Salinity (SSS)

Anomaly Evolution over Equatorial Pacific

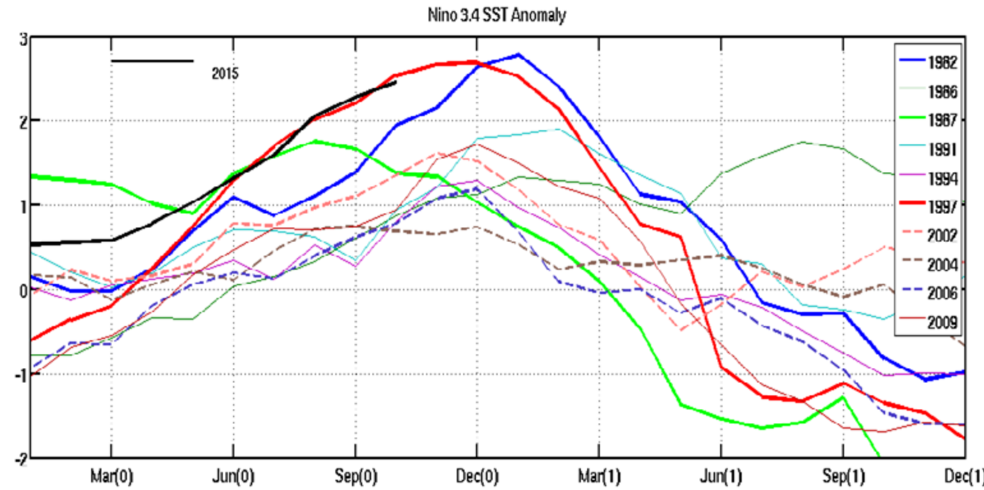
- Hovemoller diagram for equatorial SSS anomaly **(10ºS-10ºN);**
- Negative SSS anomaly continues to strengthen over the central and eastern Pacific, with the maximum SSS anomaly around 170ºW enhanced during this month. At the meantime, a stretch of positive SSS anomaly continues over the western Pacific from 130ºE – 160ºE;



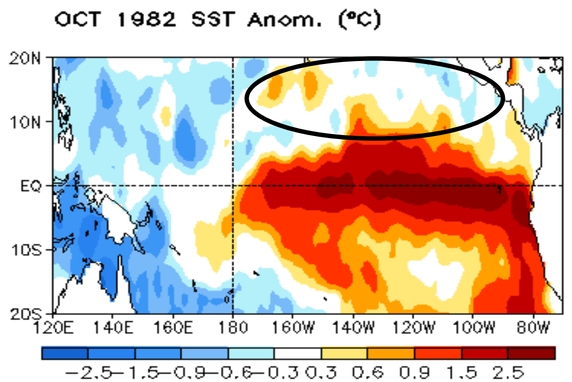
SSS :

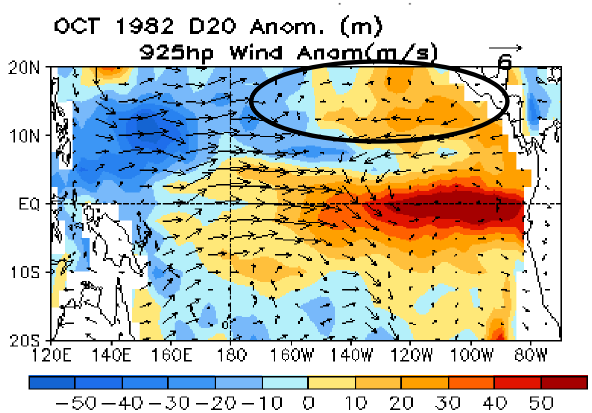
Blended Analysis of Surface Salinity (BASS) V0.Y
(a CPC-NESDIS/NODC-NESDIS/STAR joint effort)
(Xie et al. 2014)
ftp.cpc.ncep.noaa.gov/precip/BASS

SST,D20 and 925hPa Wind Anomalies in October

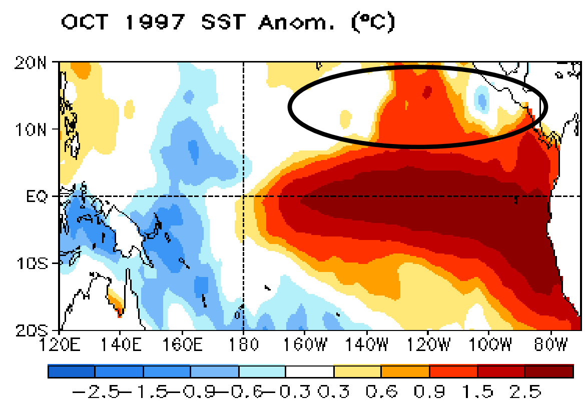


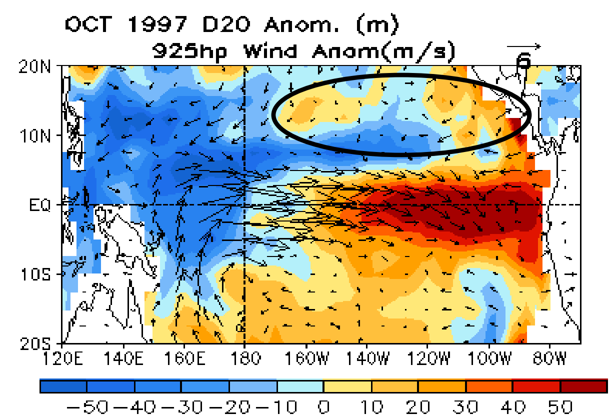
1982



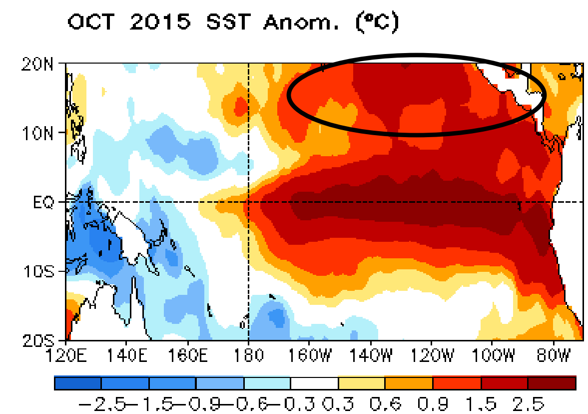


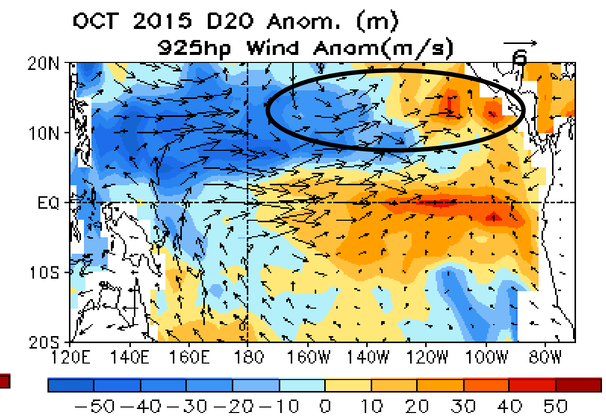
1997



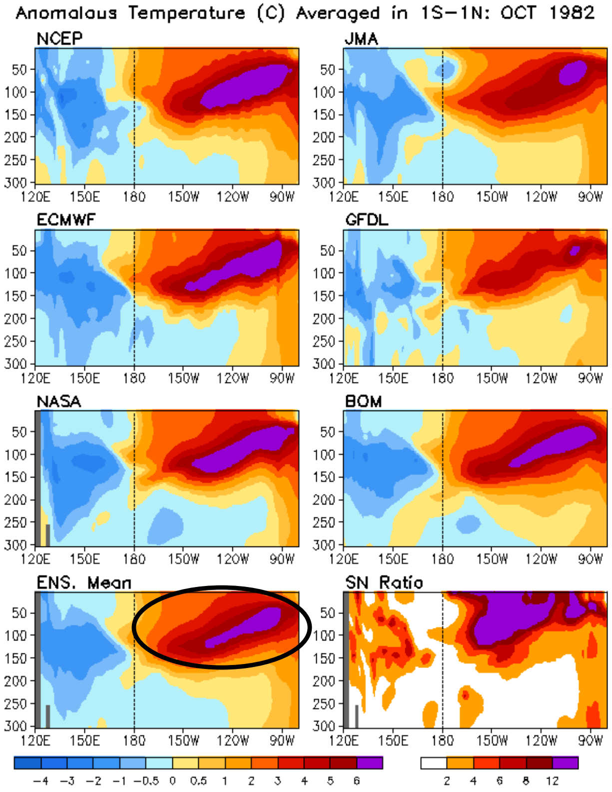


2015

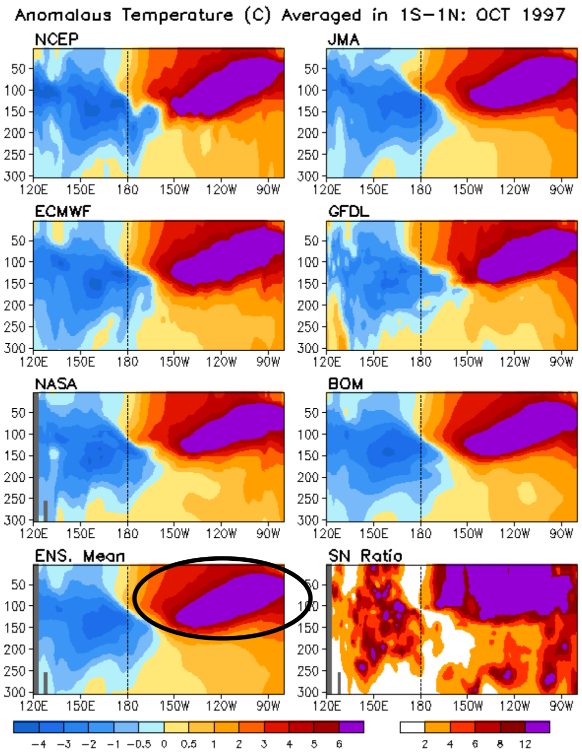




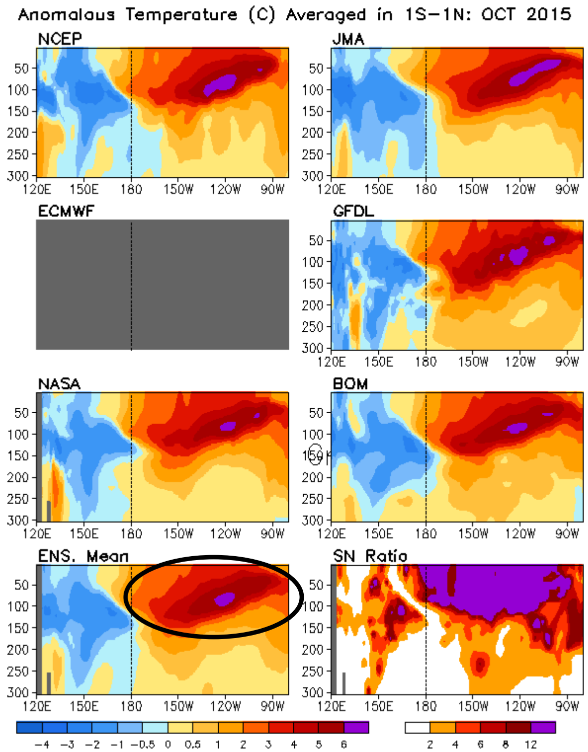
Oct 1982



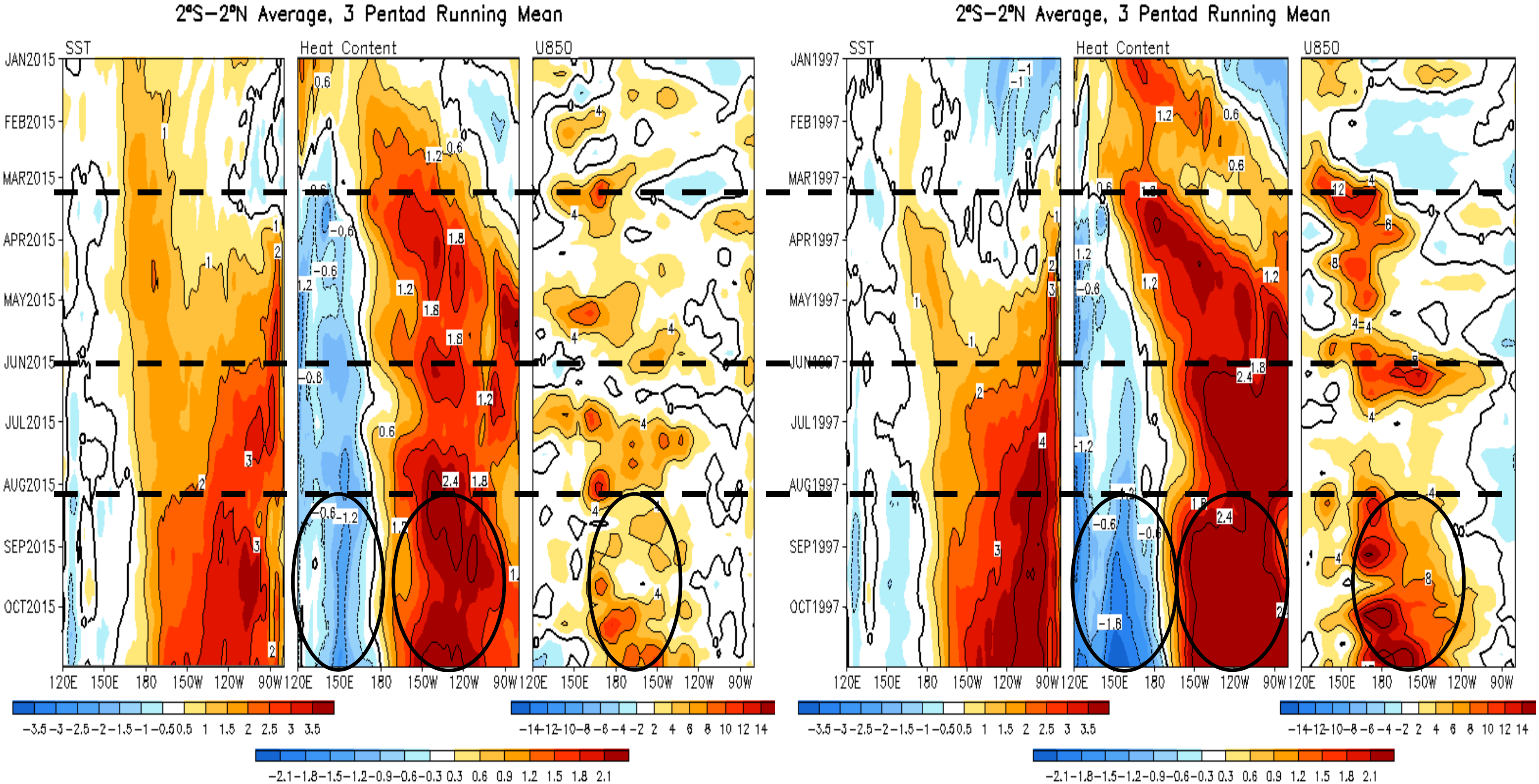
Oct 1997



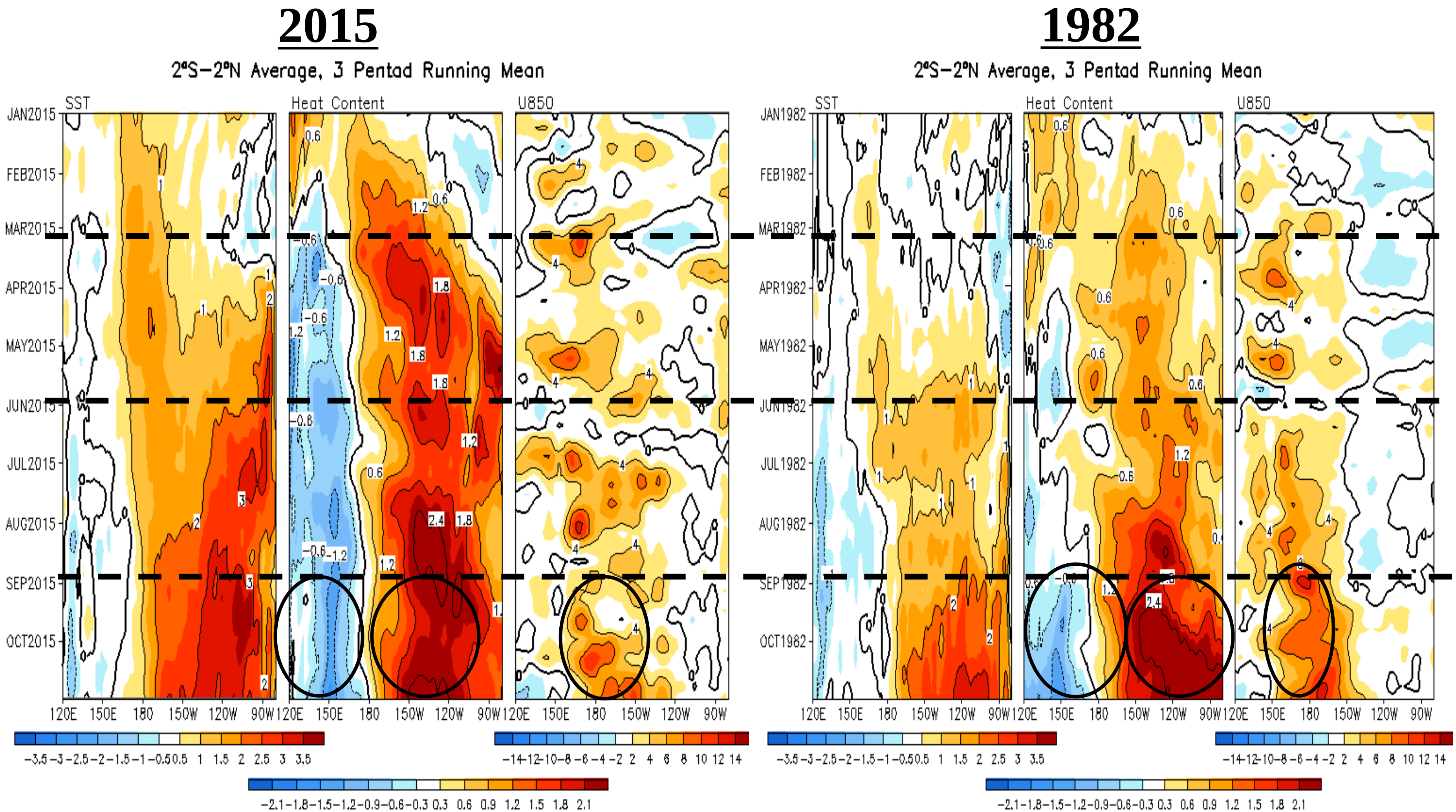
Oct 2015



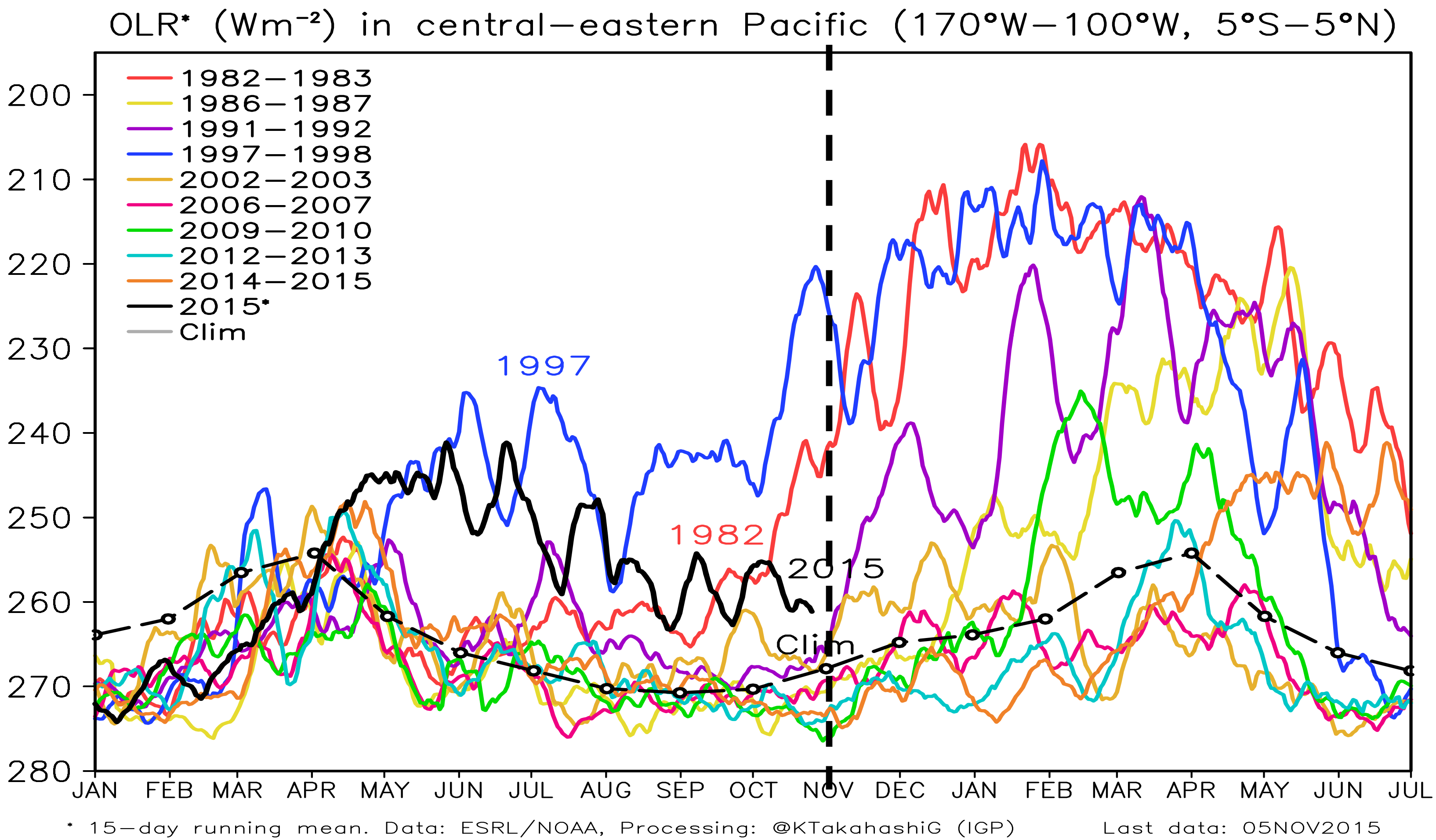
2015 **1997**



- Compared to 1997, westerly wind anomalies in 2015 were much weaker.
- Consistent with weaker westerly wind anomalies, the heat content anomaly dipole, warm in the east and cold in the west, was much weaker.



- The amplitude of SSTA and heat content anomalies were stronger in 2015 than in 1982 before September.
- However, associated with strong westerly wind anomalies since September 1982, the amplitude of SSTA and heat content anomalies grew rapidly and became comparable with those in 2015 by the end of October except the center of positive heat content anomalies was shifted 30-40 degree eastward.

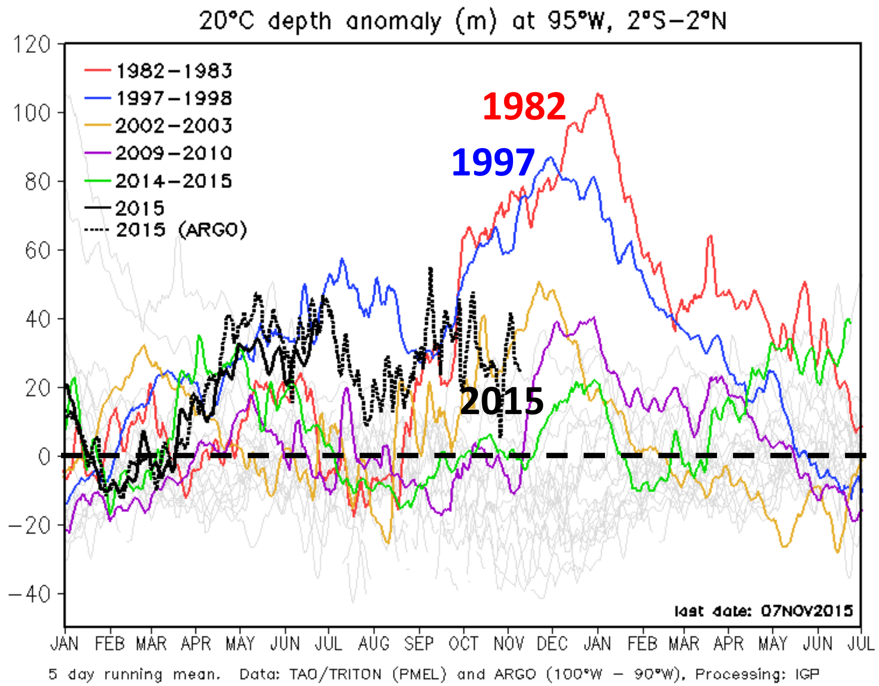


Plot provided by Ken Takahashi

- **Enhanced convection (OLR is below climatology) in the central-eastern Pacific (170W-100W, 5S-5N) in spring/early summer 2015 was comparable to that in 1997, but it has weakened gradually since Jun 2015, and by Oct 2015 it became substantially weaker than that in 1997 and also weaker than that in Oct 1982.**

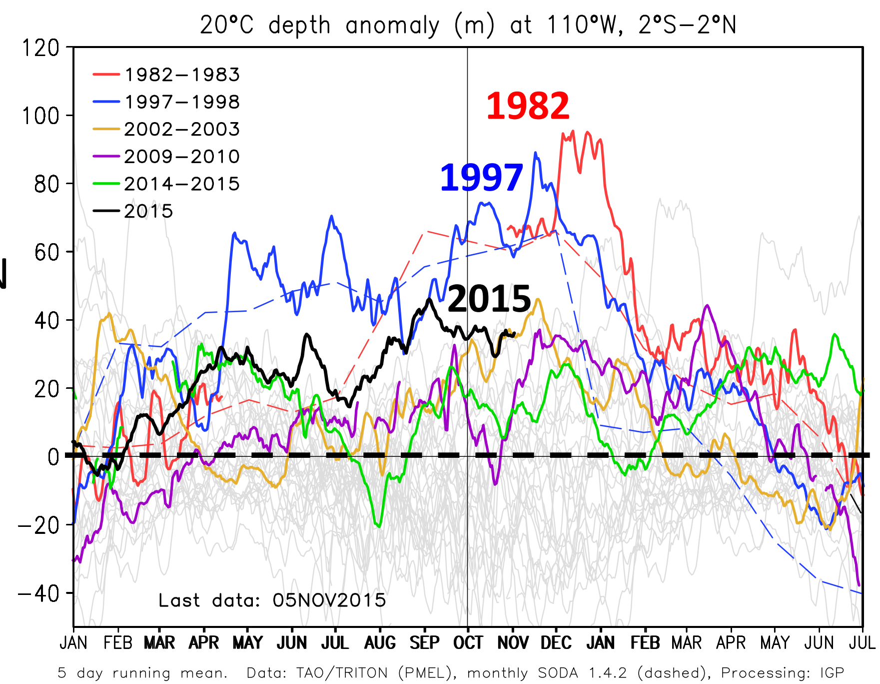
Eastern Pacific 20° C depth anomaly (m)

95° W, 2° S-2° N
(TAO mooring and Argo data)



In the eastern Pacific, the thermocline depth anomaly is between a third to a half of what it was in 1982 and 1997.

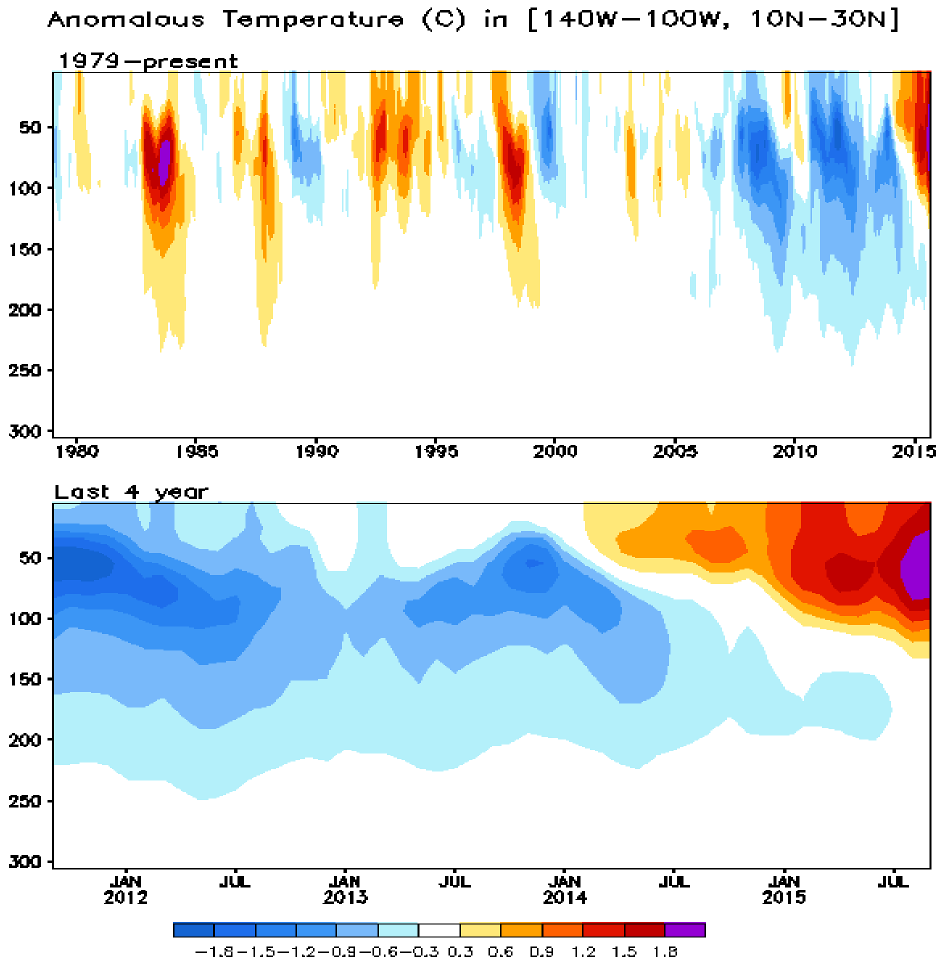
110° W, 2° S-2° N
(TAO mooring and SODA 1.4.2 data)

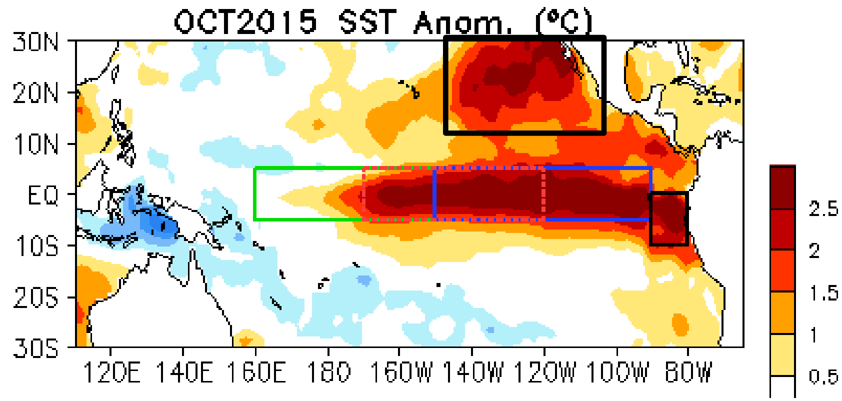


(SODA is dashed)

Slide provided by Ken Takahashi

Strong Warming in NE Pacific

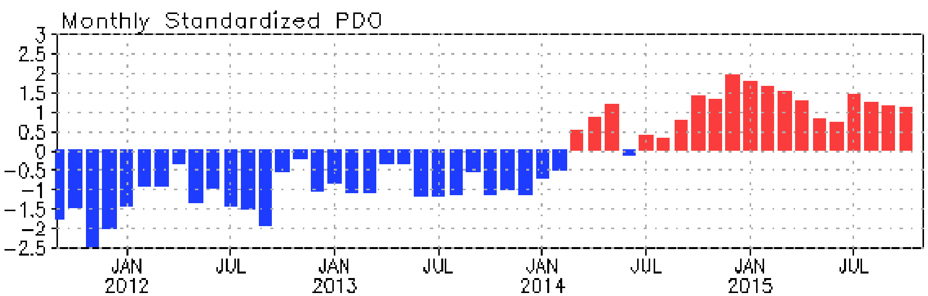




- The strong positive SSTA in the NE Pacific [140°W-100°W, 10°N-30°N] emerged in early 2014, and the warming enhanced and migrated to the depth since then.

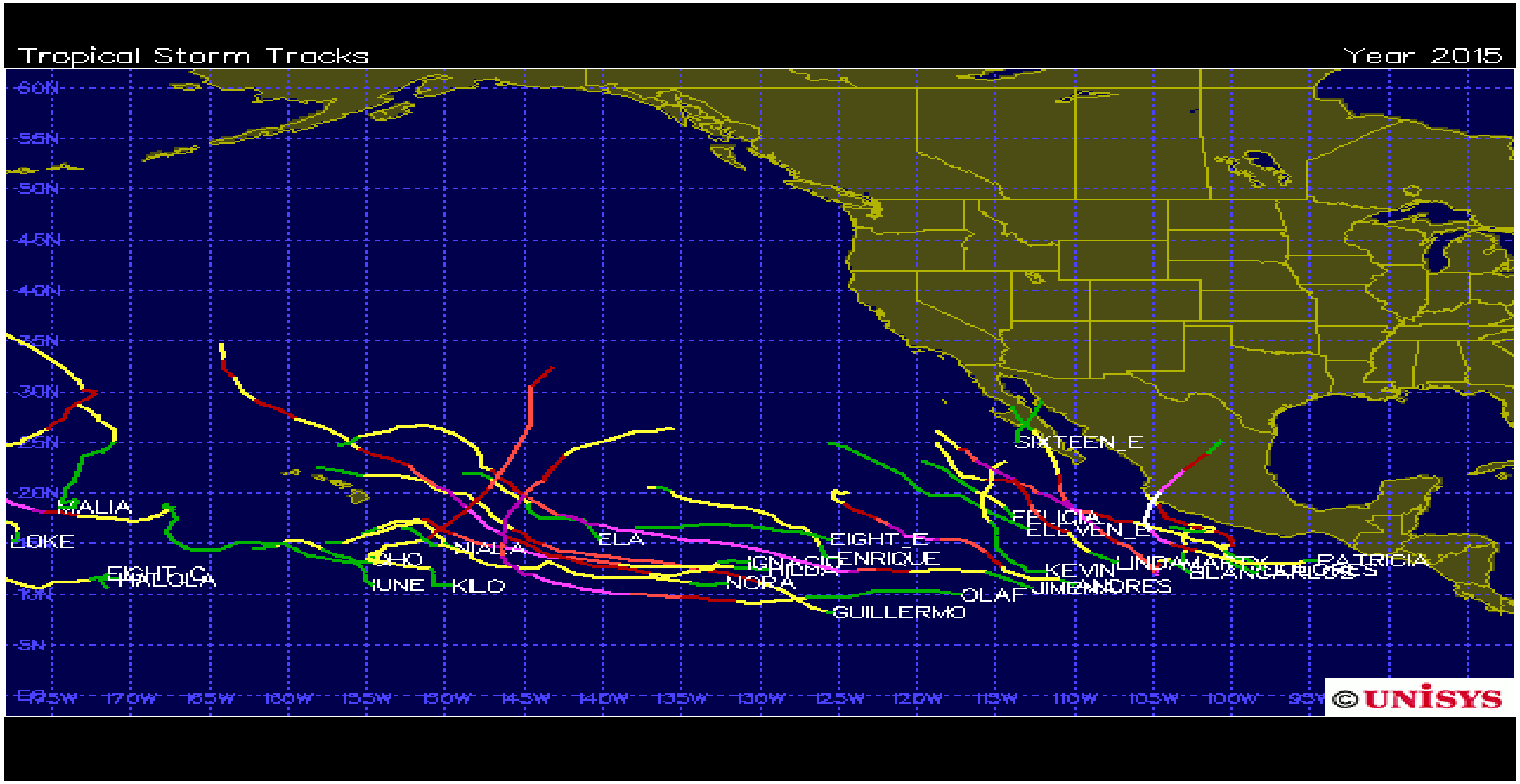
- The development of positive SSTA in the region was associated with the switch to positive PDO phase.

- The near surface warming was the strongest since 1980.



2015 E. Pacific Hurricane Counts

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



- **E. Pacific Outlook (70% above-normal)**:

15-22 Named Storms (15 average)

7-12 Hurricanes (8 average)

5-8 Major Hurricanes (4 average)

110%-190% ACE

- **E. Pacific Counts by Nov 5**:

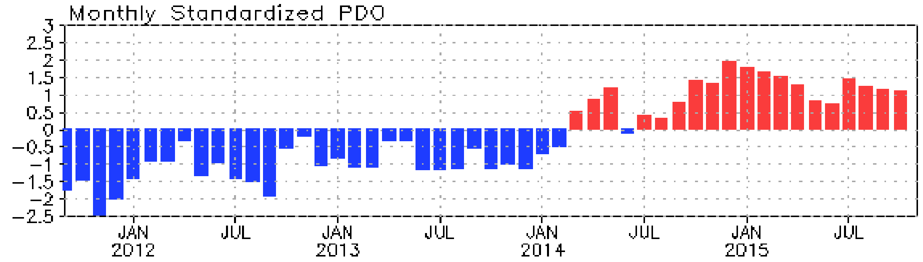
24 Named Storms > outlook

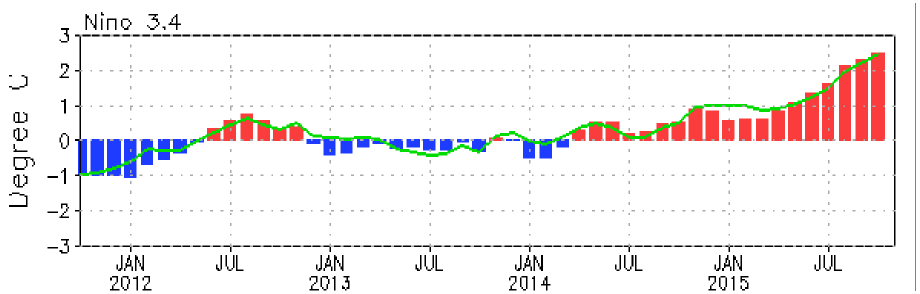
15 Hurricanes > outlook

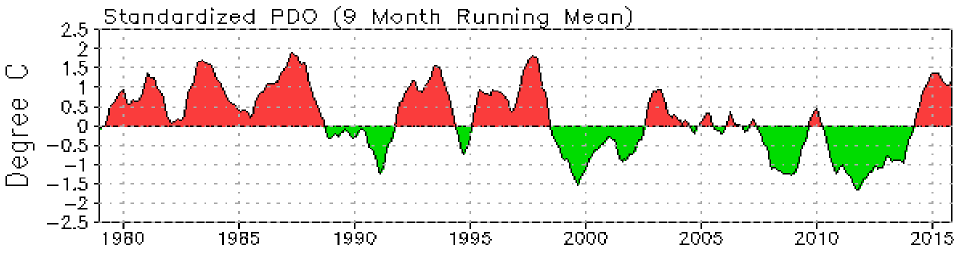
10 Major Hurricanes > outlook

North Pacific & Arctic Oceans

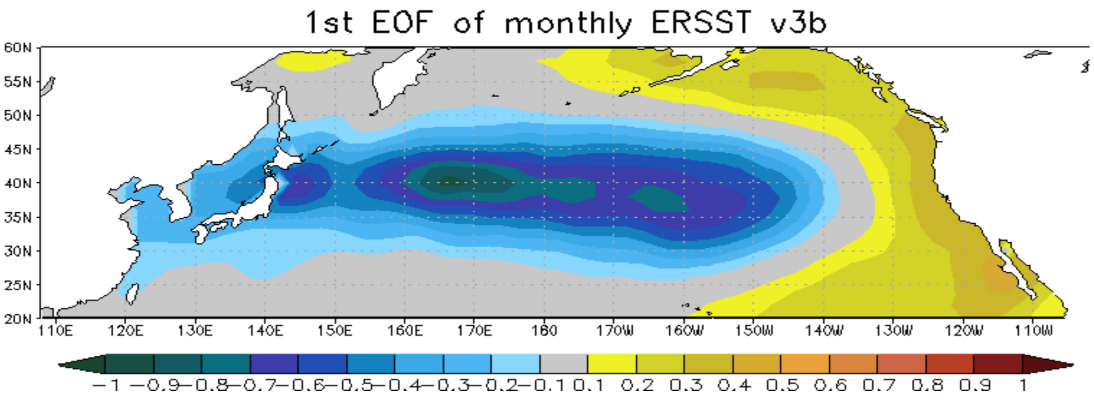
Pacific Decadal Oscillation Index





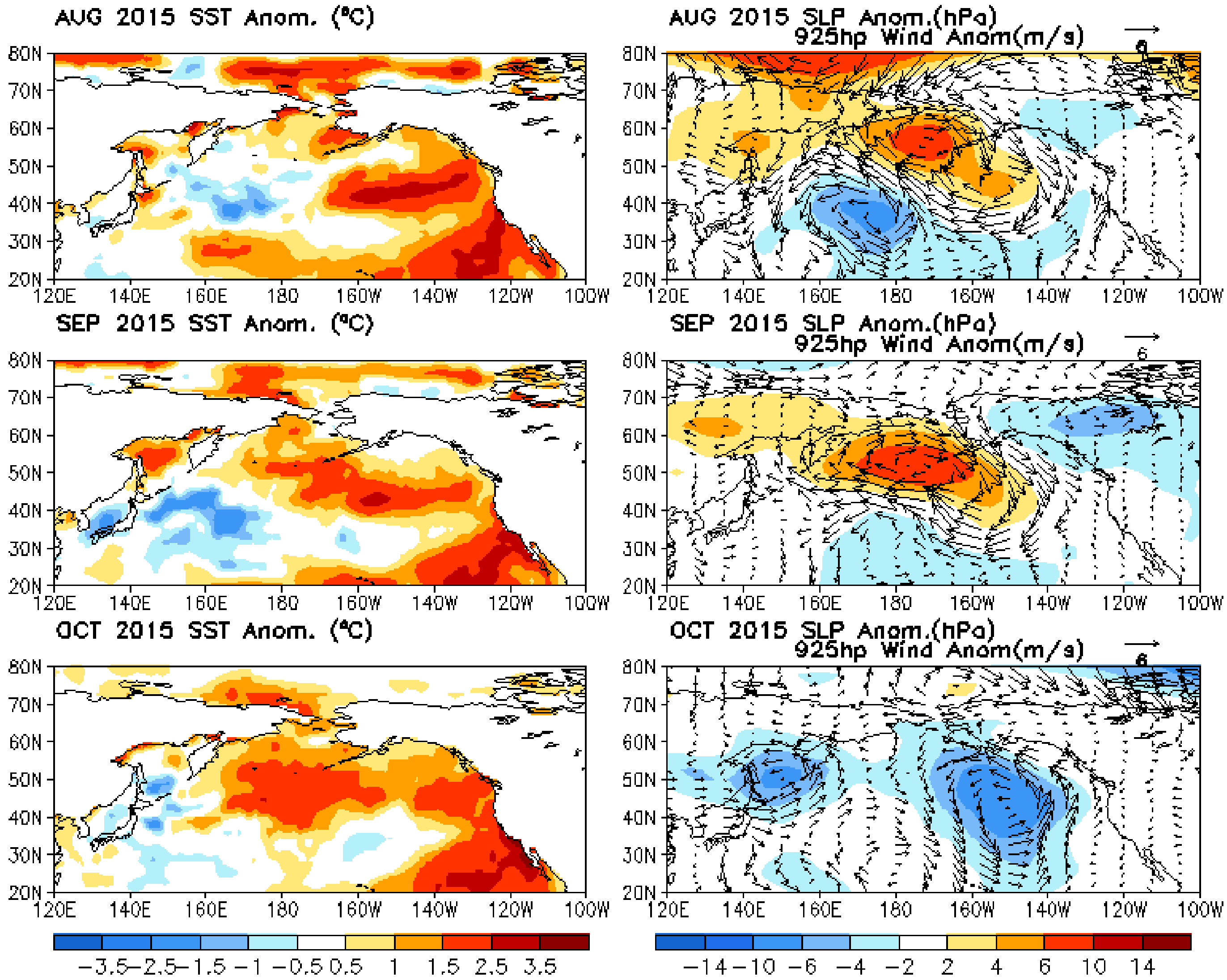


- **Positive PDO has persisted 16 months since July 2014 and PDO index =+1.1 in Oct 2015.**

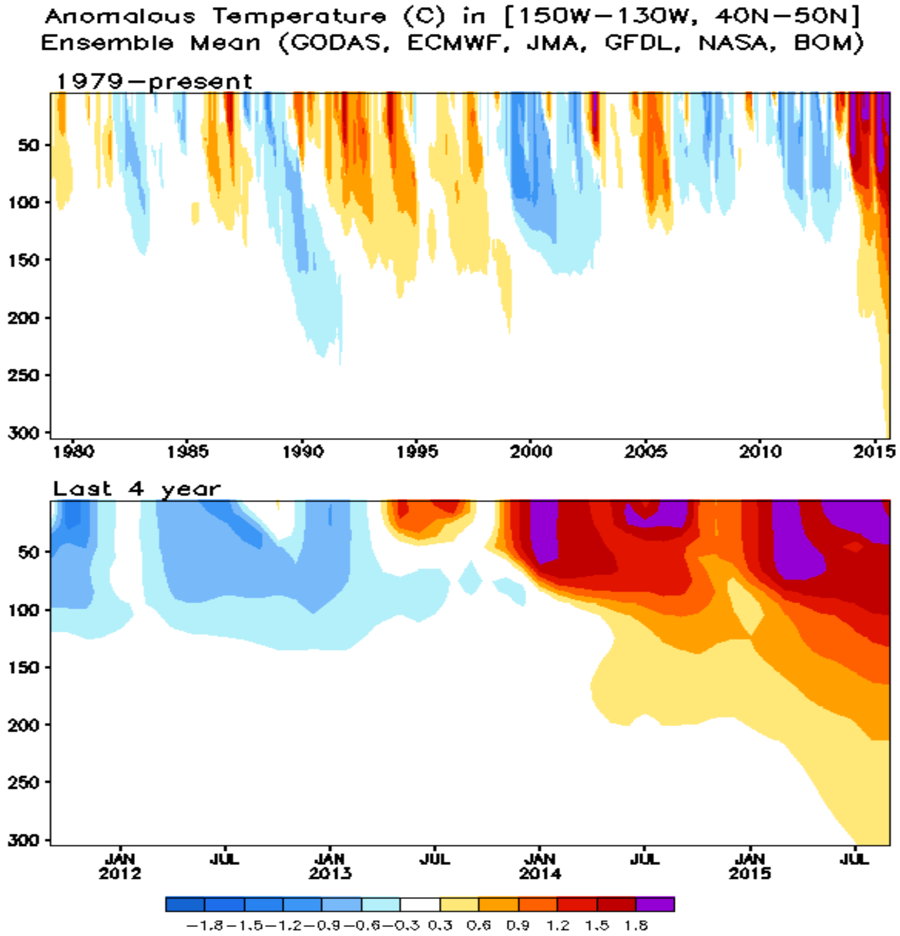


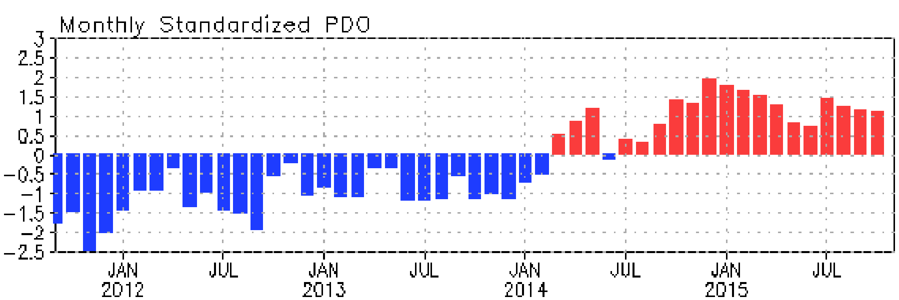
- **Pacific Decadal Oscillation is defined as the 1st EOF of monthly ERSST v3b in the North Pacific for the period 1900-1993. PDO index is the standardized projection of the monthly SST anomalies onto the 1st EOF pattern.**
- **The PDO index differs slightly from that of JISAO, which uses a blend of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

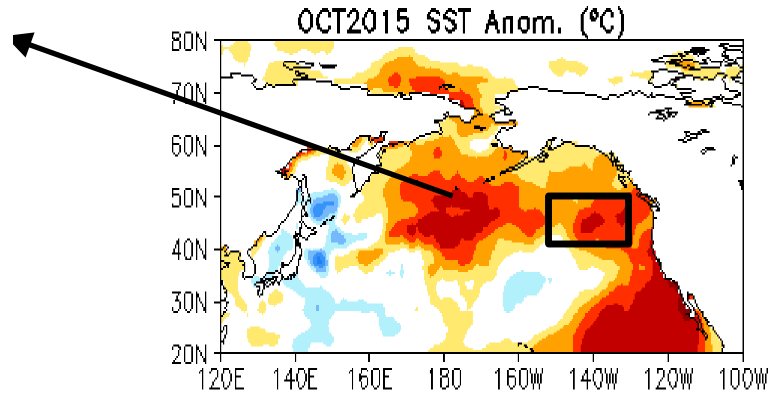
Last Three Month SST, SLP and 925hp Wind Anom.



“Blob” in North Pacific







- Record SST warming appeared near the coast of North America in late 2013, referred to as “Blob” by Bond et al. (2015).

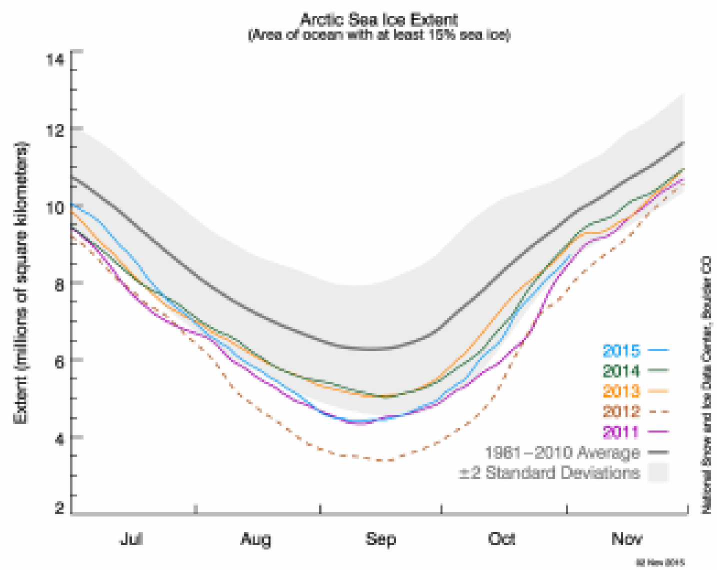
- The warming in the NE Pacific box [150°W-130°W, 40°N-50°N] started near the surface in late 2013 and has persisted and extended to depth since then.

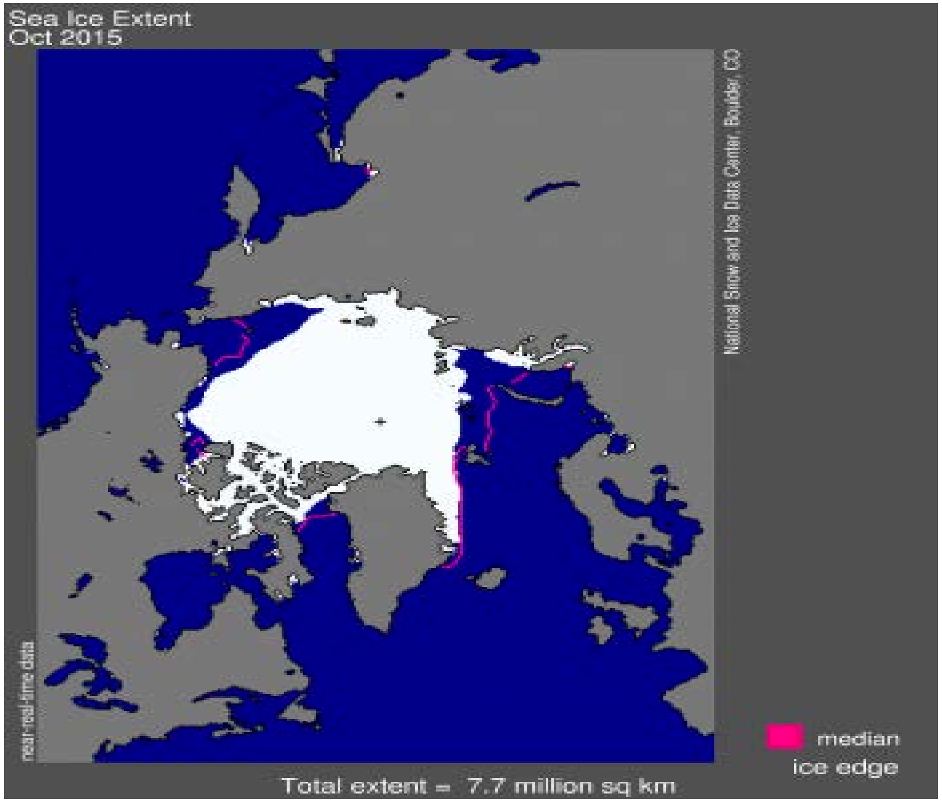
- The development of the enhanced warming in late 2013 was associated with the switch to positive PDO phase.

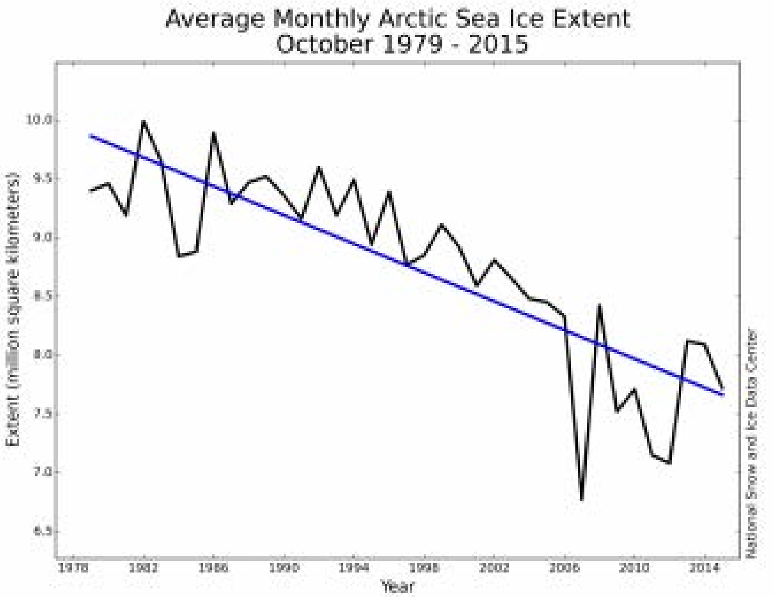
Arctic Sea Ice

National Snow and Ice Data Center

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



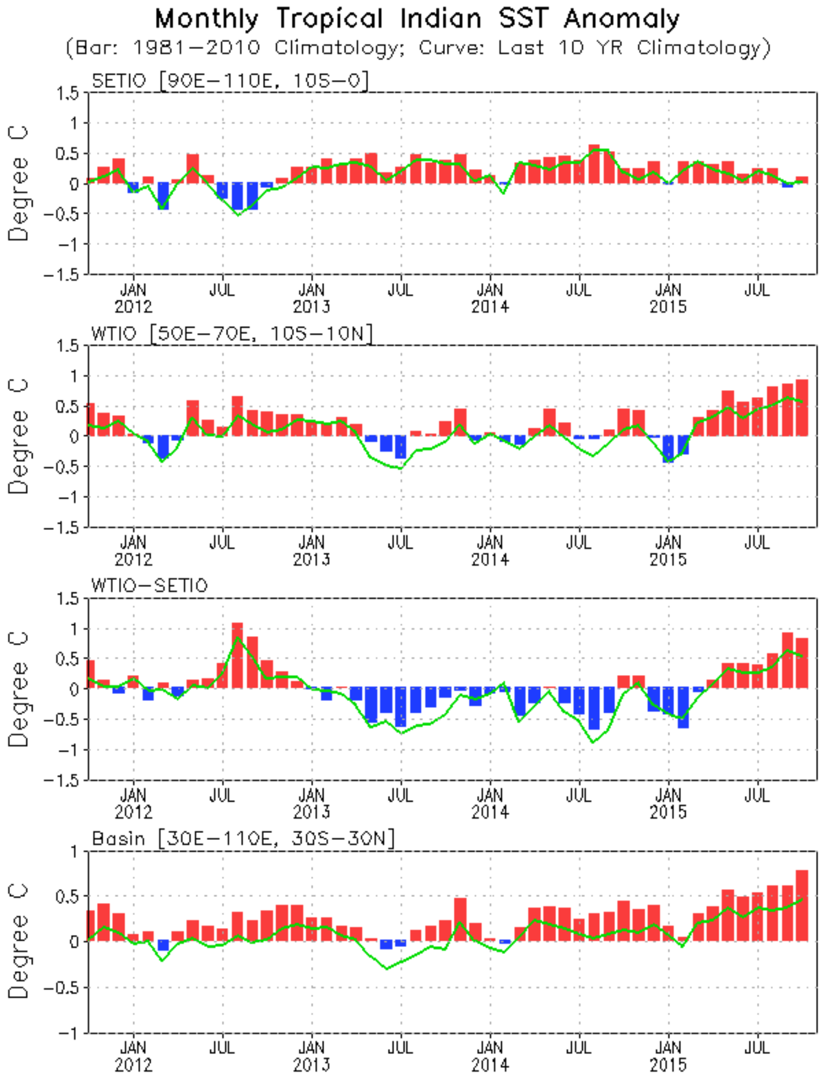


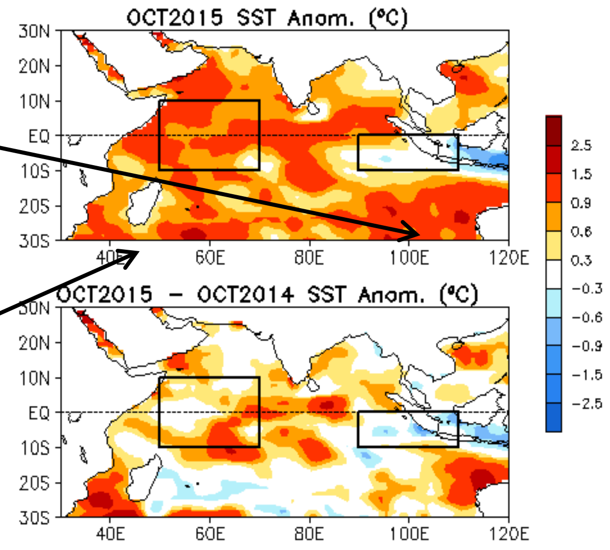


- Arctic sea ice extent reached the sixth lowest minimum in the satellite record.

Indian Ocean

Evolution of Indian Ocean SST Indices



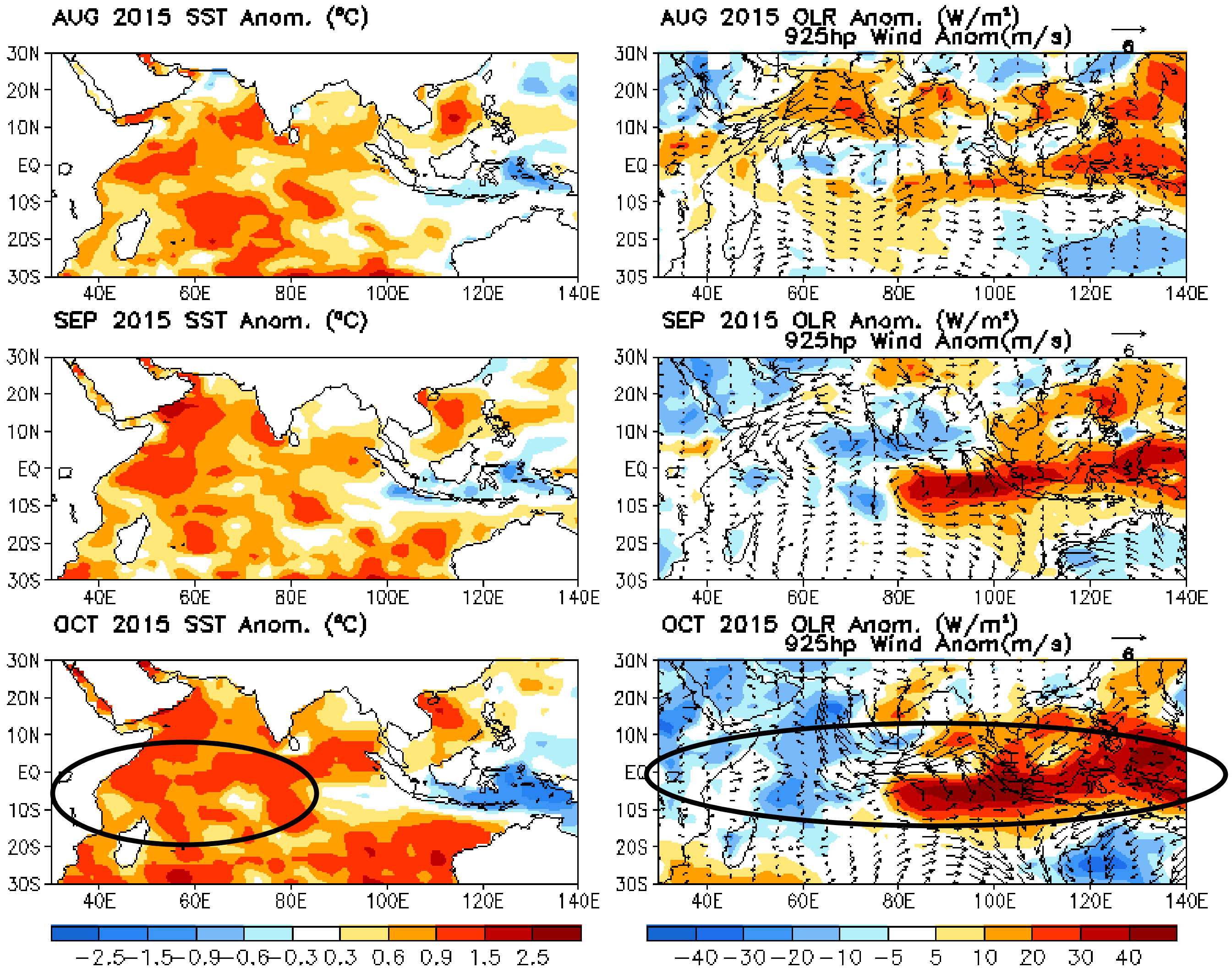


- The western tropical Indian Ocean (WTIO) warmed up, and the Dipole Mode Index (WTIO-SETIO) has been above 0.5 in the past three months.

- The warming trend in the basin average SSTA since early 2015 continued.

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 departures from the 1981-2010 base period means and the recent 10 year means are shown in bars and green lines.

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

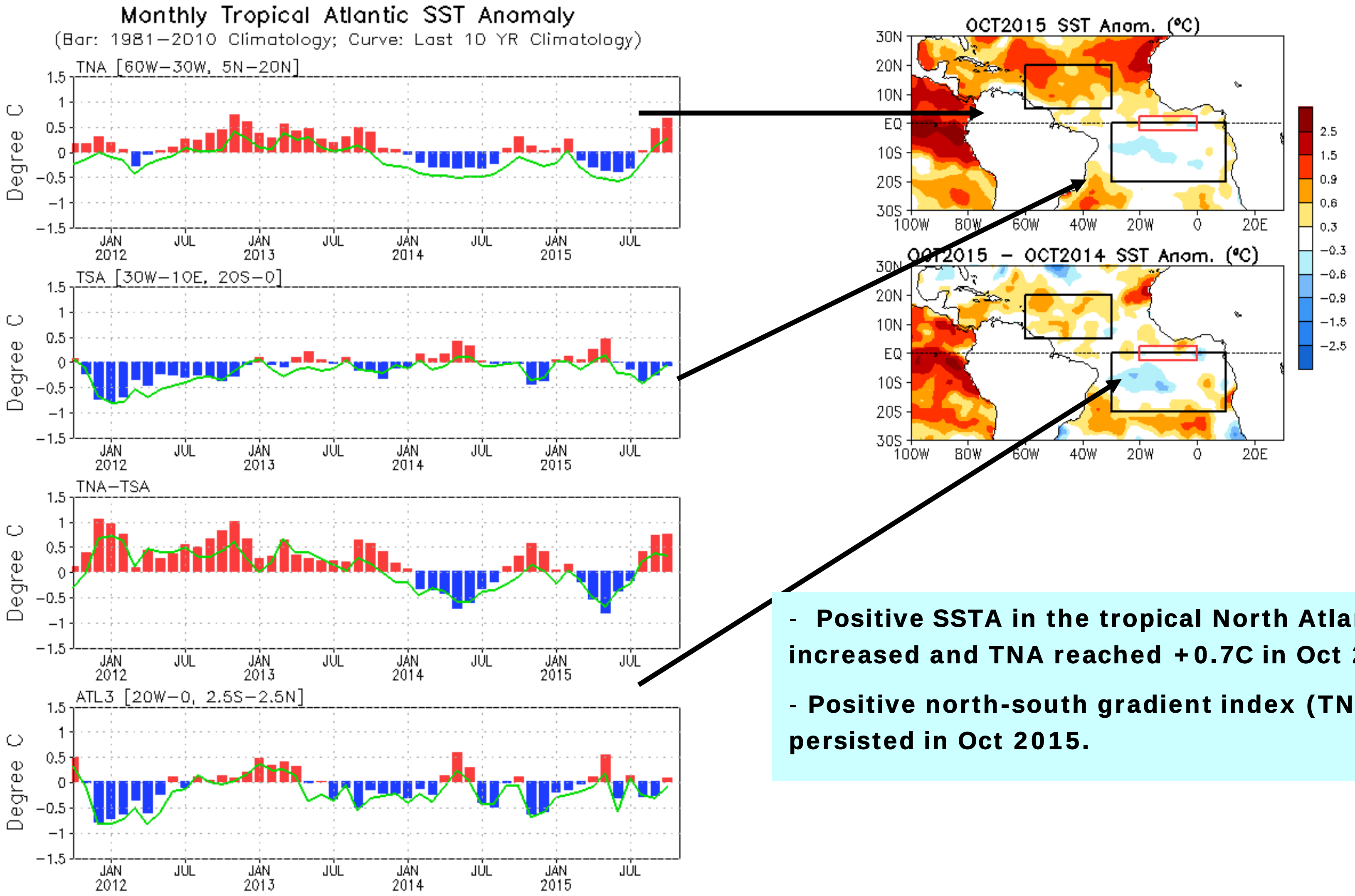


- Positive SSTA exceeded +0.9C over most of the tropical Indian Ocean.

- Convection was enhanced (suppressed) in the central tropical Indian Ocean (in the eastern tropical Indian Ocean and over Indonesia).

Tropical and North Atlantic Ocean

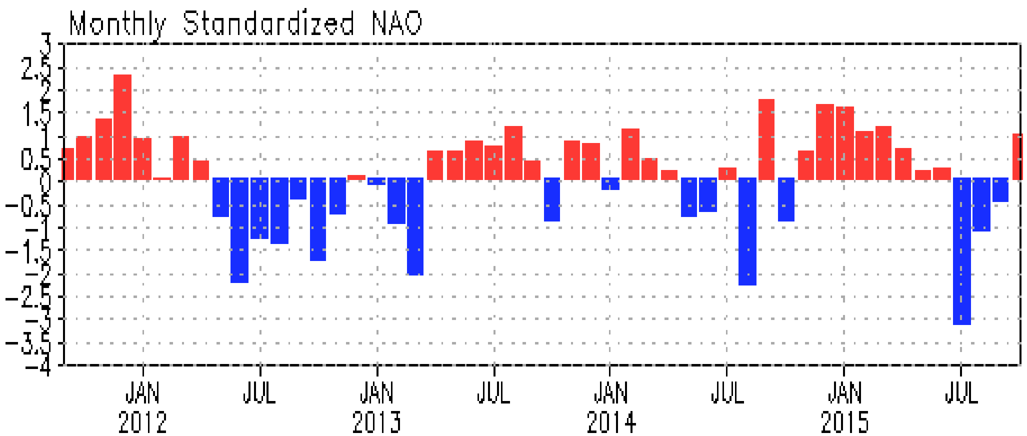
Evolution of Tropical Atlantic SST Indices

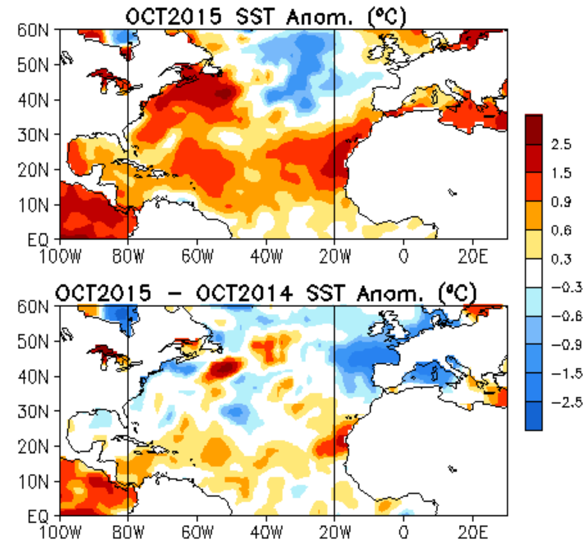


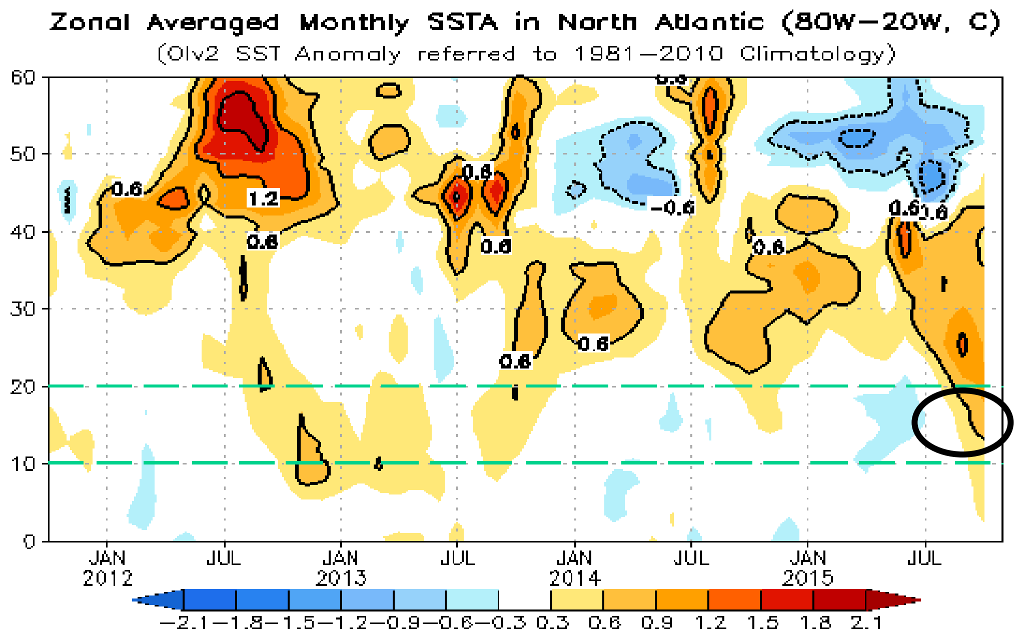
- Positive SSTA in the tropical North Atlantic increased and TNA reached +0.7C in Oct 2015.
- Positive north-south gradient index (TNA-TSA) persisted in Oct 2015.

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 departures from the 1981-2010 base period means and the recent 10 year means are shown in bars and green lines.

NAO and SST Anomaly in North Atlantic







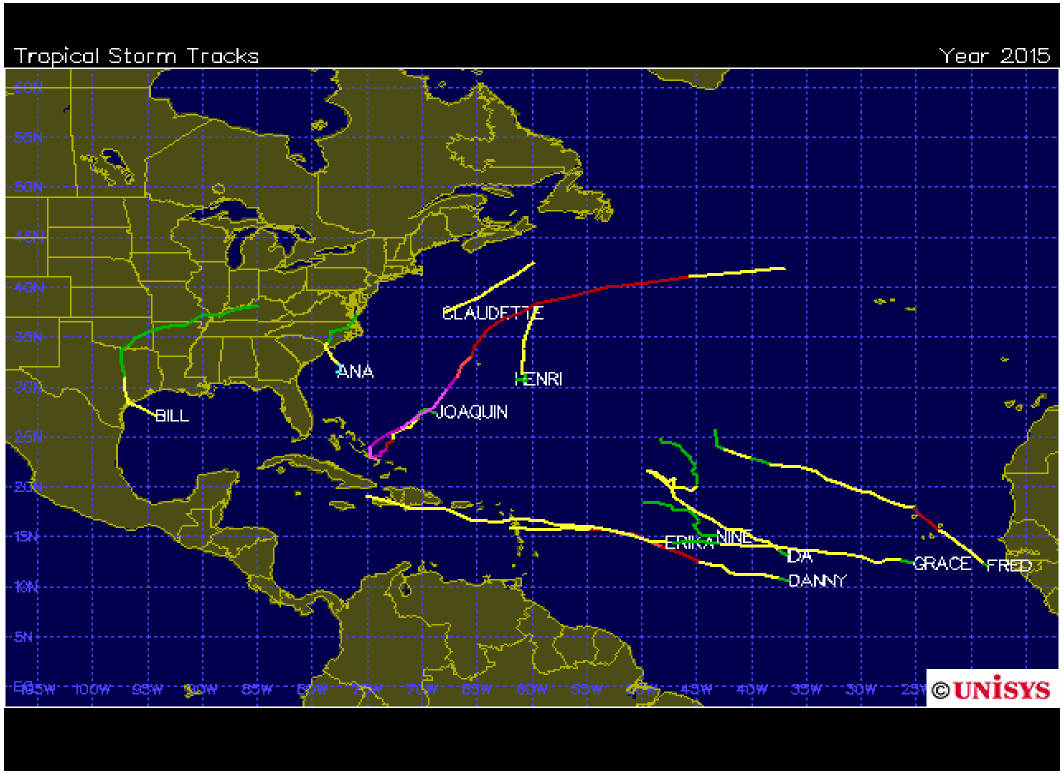
- NAO switched to positive, and NAO=+1 in Oct 2015.

- Positive SSTA extended from middle latitude to the Atlantic Hurricane Main Development Region.

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

2015 Atlantic Hurricane Counts

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



- Only four seasons since 1995 were below-normal (1997, 2009, 2013 and 2014).

- If the current outlook verifies, 2015 will become the fifth below-normal season since 1995.

- It would mark the first time since 1995 that three consecutive seasons were below-normal.

- **Atlantic Outlook (May update, 70% below-normal):**

6-11 Named Storms (12 average)

3-6 Hurricanes (6 average)

0-2 Major Hurricanes (3 average)

40%-85% ACE

- **Atlantic Counts by Nov 5:**

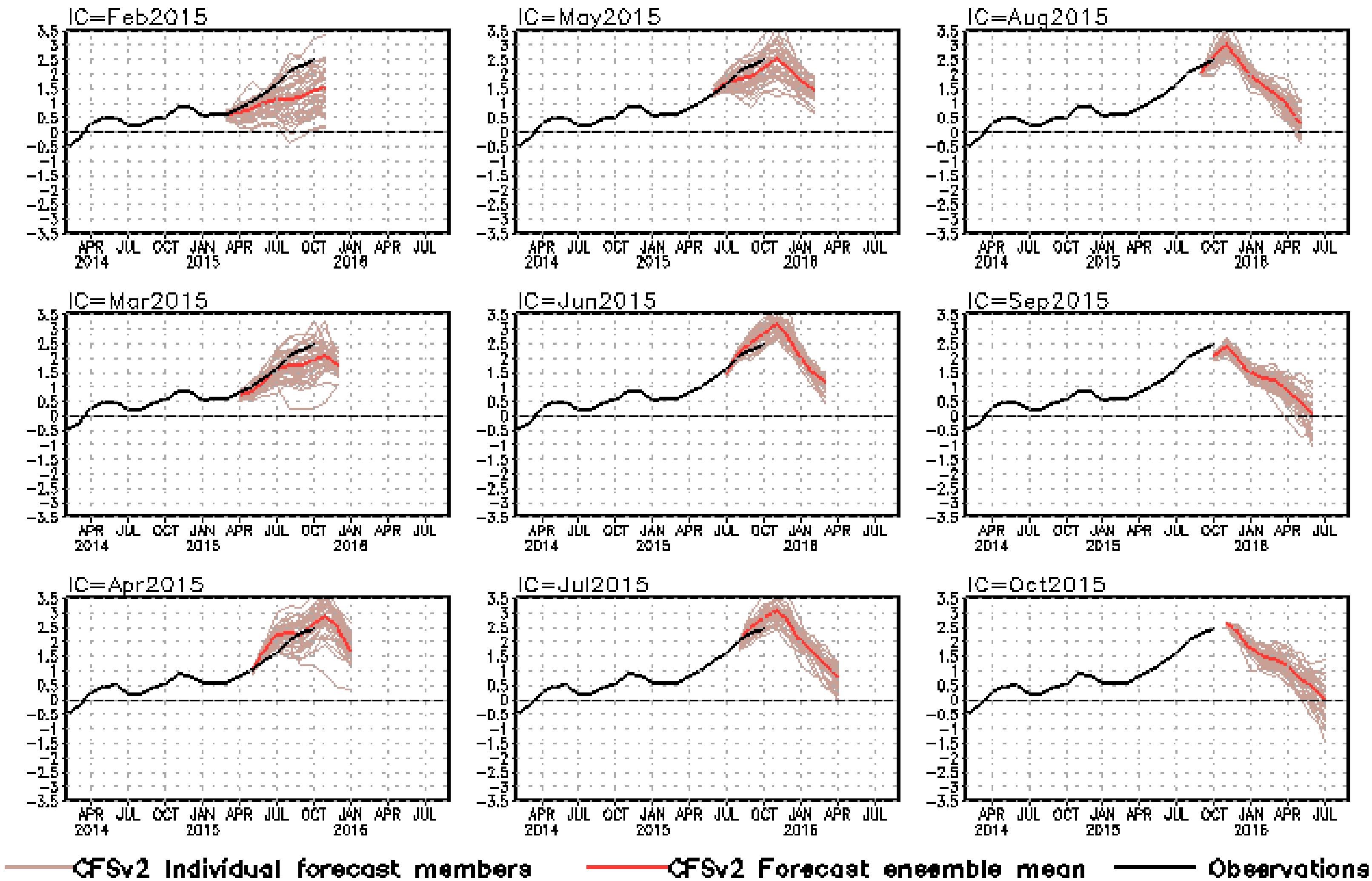
10 Named Storms

3 Hurricanes

2 Major Hurricanes

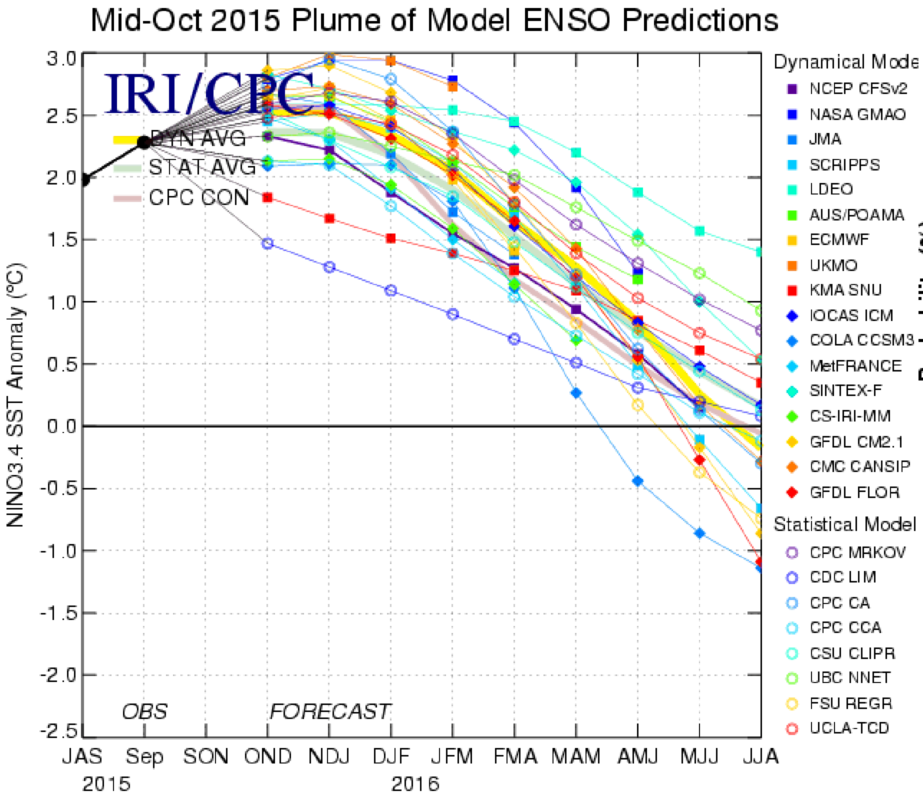
Global SST Predictions

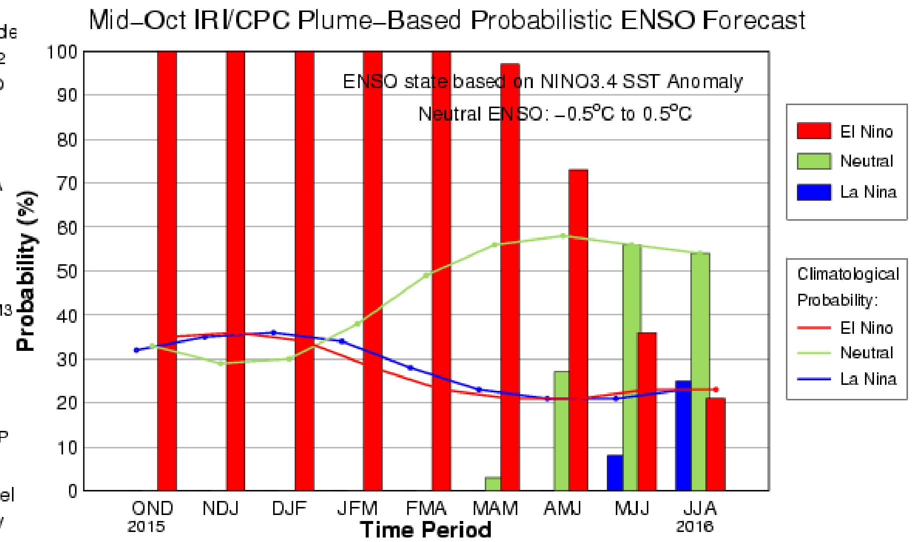
NCEP CFSv2 NINO3.4 Forecast



- CFSv2 predicted Nino 3.4 will peak in Nov 2015 (2.5°C) and decrease gradually through northern hemisphere spring 2016.
- The ensemble spread in the CFSv2 forecasts is noticeably small since Jun 2015 I.C., indicating a high confidence in the forecast.

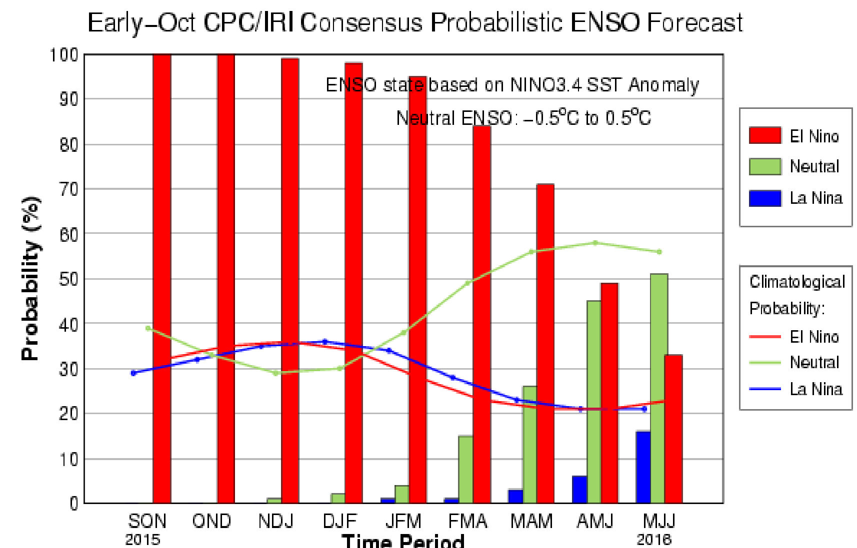
IRI NINO3.4 Forecast Plum



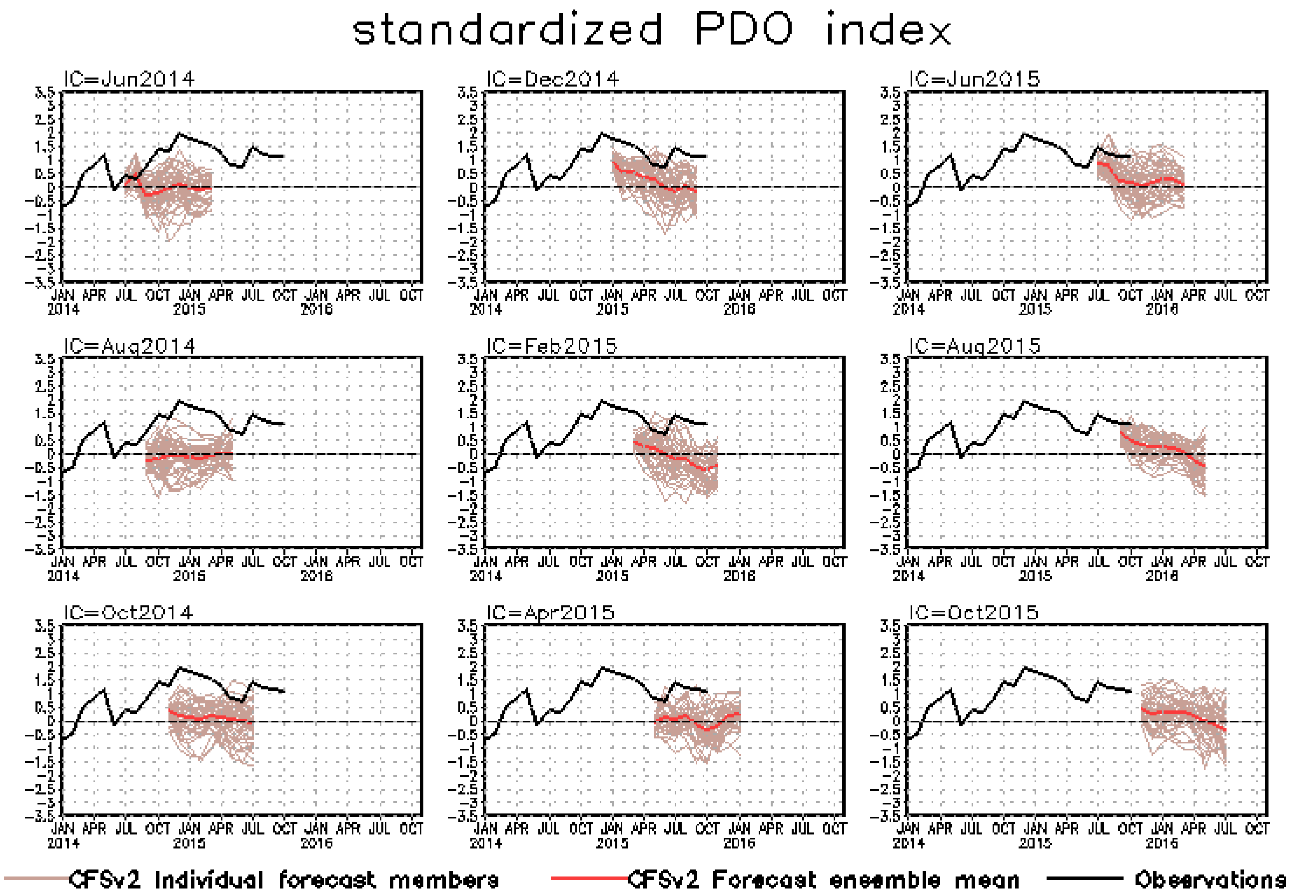


- **<u>NOAA "ENSO Diagnostic Discussion" on 8 Oct. 2015</u> suggested that "There is 95% chance that El Niño will continue through Northern Hemisphere winter 2015-16.**

- **Most of dynamical and statistical models predicted a peak amplitude of NINO3.4>=2°C in Nov-Dec 2015.**



NCEP CFSv2 Pacific Decadal Oscillation (PDO) Forecast



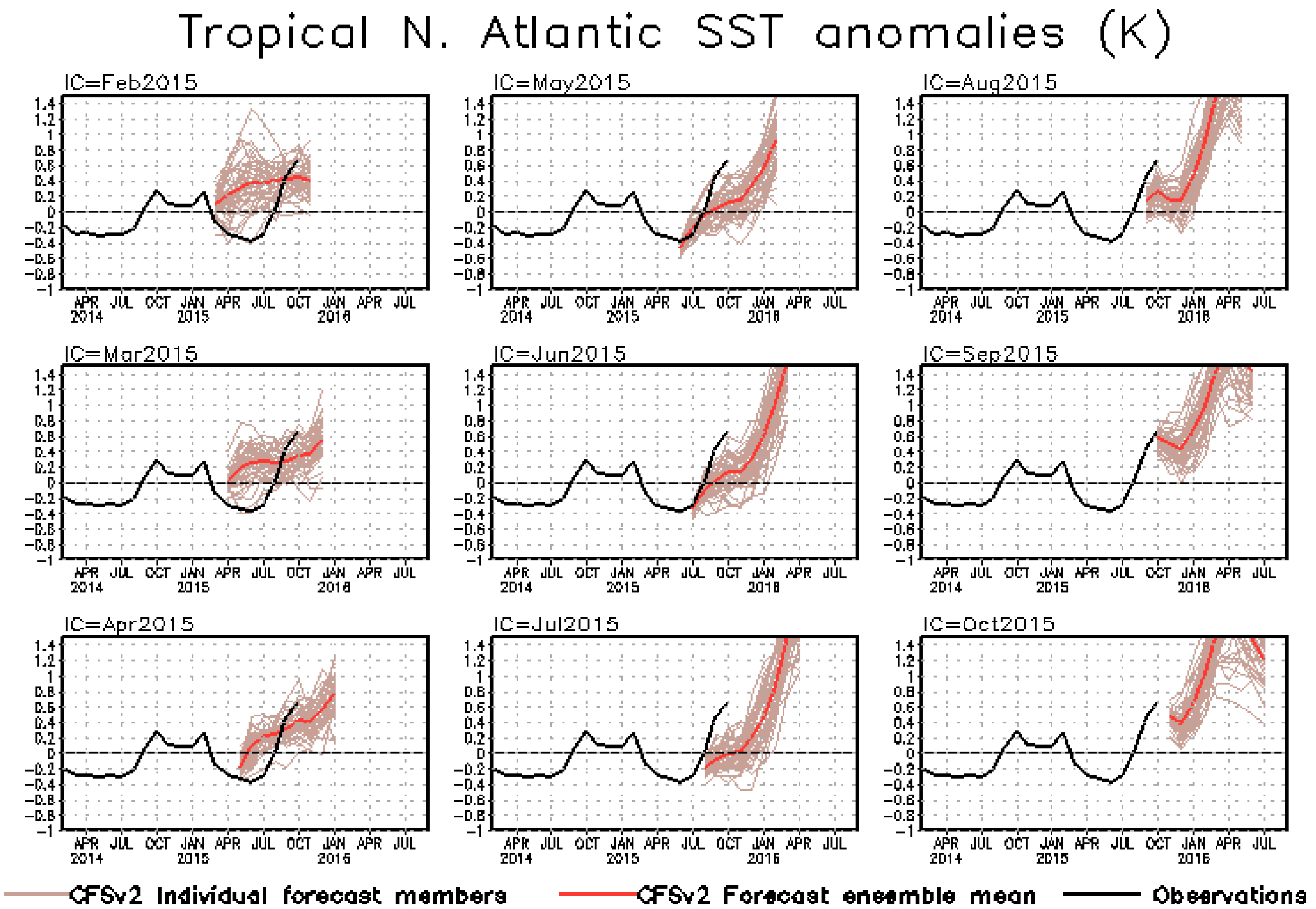
PDO is the first EOF of monthly ERSSTv3b anomaly in the region of [110°E-100°W, 20°N-60°N].

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

- Latest CFSv2 prediction suggests positive PDO phase will dissipate and neutral PDO phase will dominate in the coming winter and next spring/summer.

NCEP CFSv2 Tropical North Atlantic SST Forecast

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

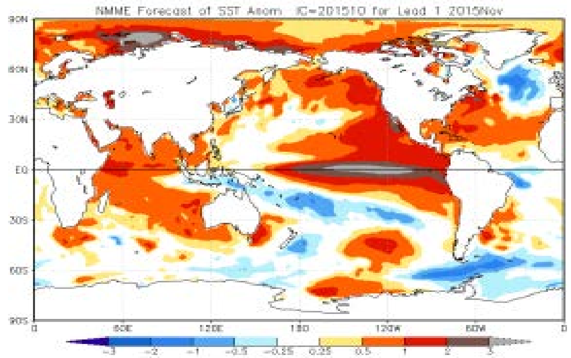


- CFSv2 predicted tropical North Atlantic SSTA will grow rapidly in early 2016.

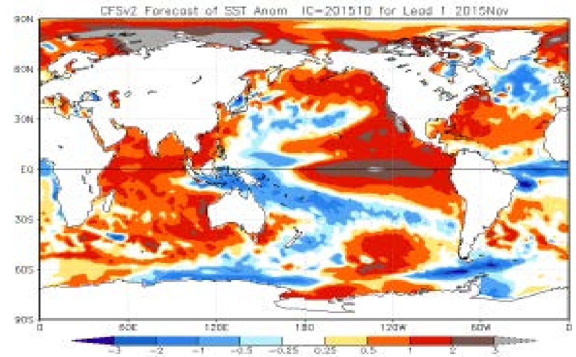
Comparison of NCEP CFSv2 and NMME SST Prediction

IC= 201509

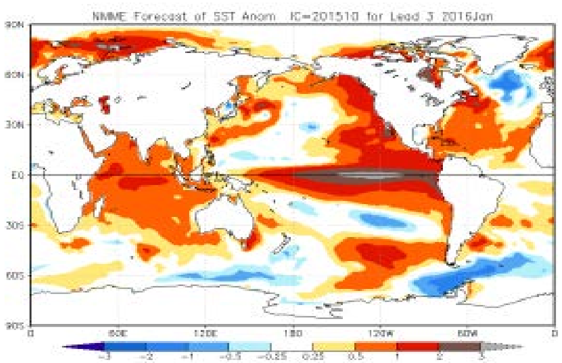
NMME 2015Nov



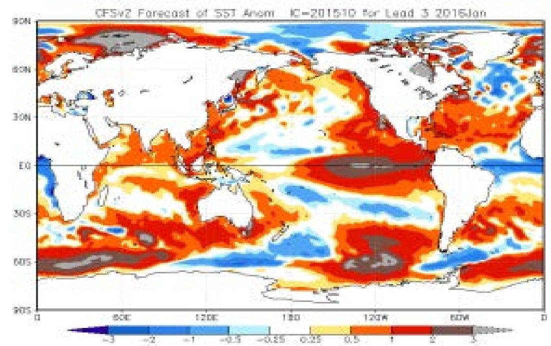
CFSv2 2015Oct



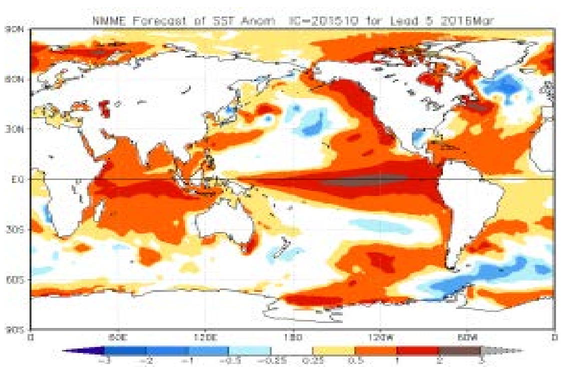
NMME 2016Jan



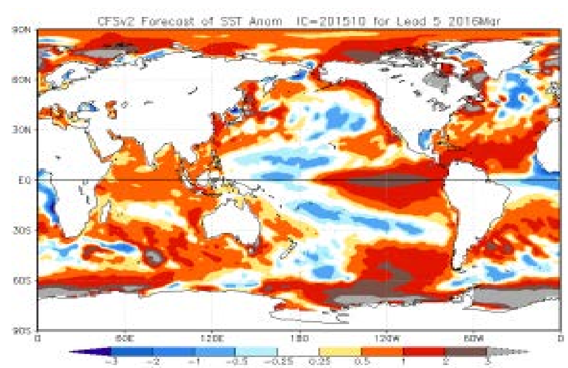
CFSv2 2016Jan



NMME 2016Mar

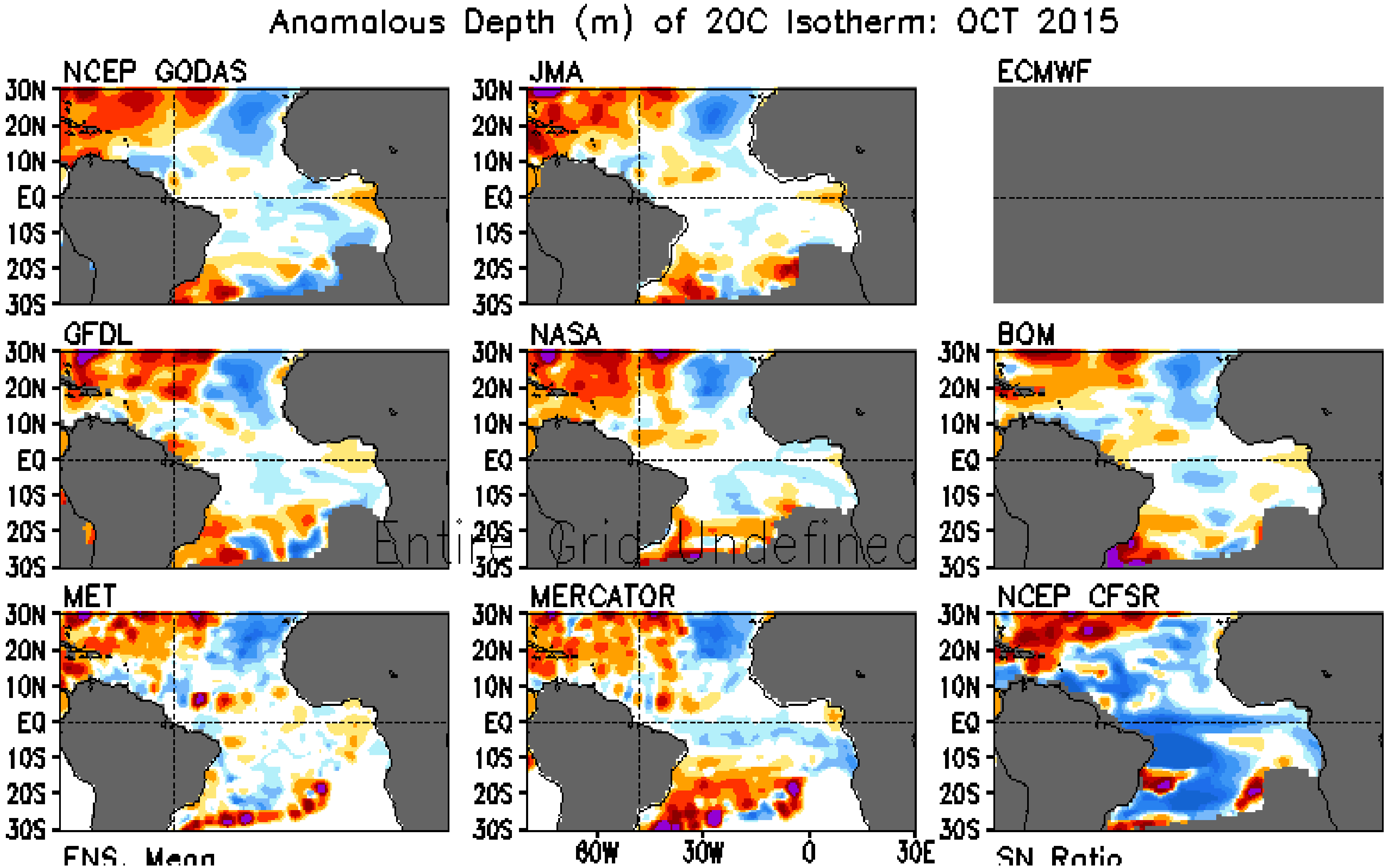


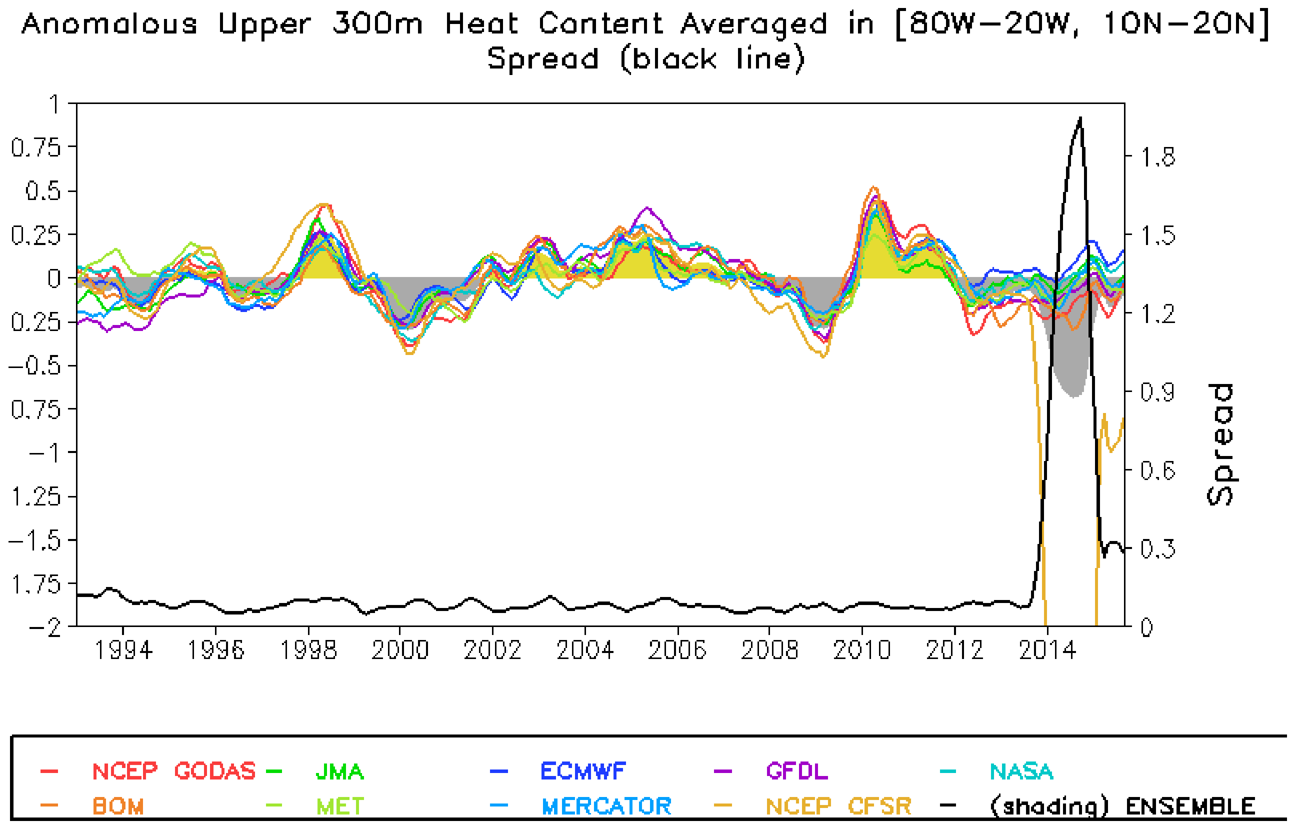
CFSv2 2016Mar



- CFSv2 predicted comparable warming in the central-eastern Pacific, but stronger cooling in the western Pacific than NMME did.
- CFSv2 predicted the “Blob” SSTA will dissipate rapidly, while NMME suggested it will persist.
- CFSv2 predicted much stronger warming in the tropical North Atlantic in spring 2016 than NMME did.

Real-Time Multiple Ocean Reanalyses Intercomparison
(1993-2013 Climatology)



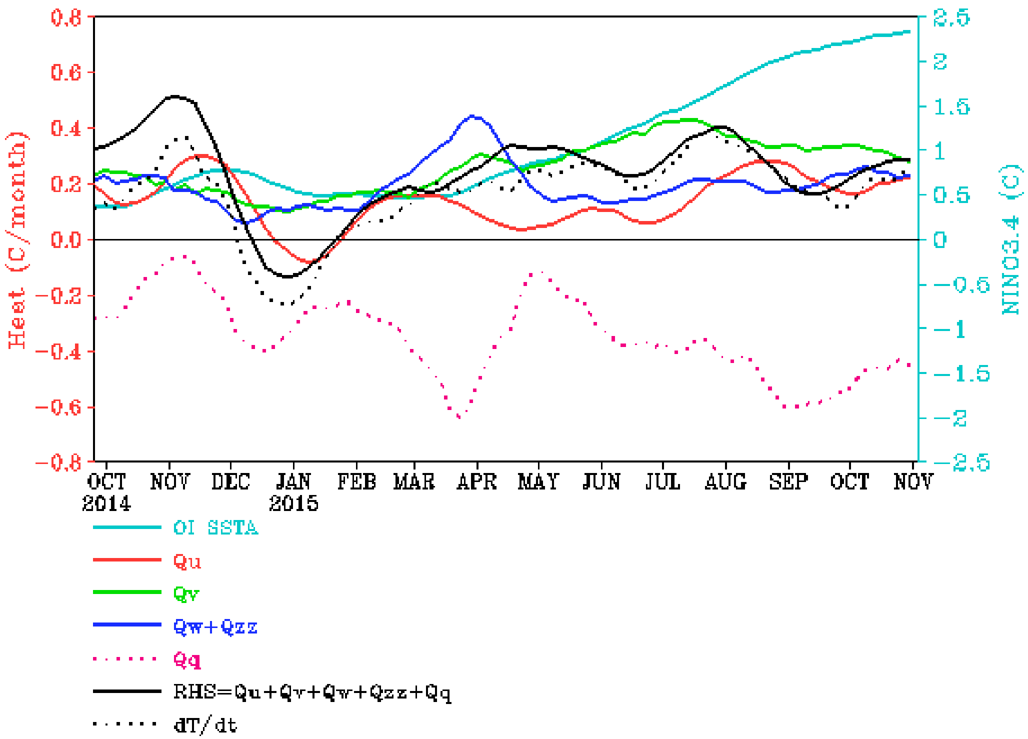

Anomalous Upper 300m Heat Content Averaged in [80W−20W, 10N−20N]
Spread (black line)
1
0.75
0.5
0.25
0
0.25
−0.5
0.75
−1
1.25
−1.5
1.75
−2
1994
1996
1998
2000
2002
2004
2006
2008
2010
2012
2014
1.8
1.5
1.2
0.9
0.6
0.3
0
Spread
NCEP GODAS
JMA
ECMWF
GFDL
NASA
BOM
MET
MERCATOR
NCEP CFSR
(shading) ENSEMBLE

Overview

- **Pacific Ocean**
  - **El Niño conditions further strengthened in Oct 2015 and the atmospheric and oceanic anomalies reflect a strong El Niño.**
  - **Most models predicted that Nino 3.4 will peak in Nov-Dec 2015 with an amplitude more than 2^{o}C and decrease gradually through northern hemisphere spring 2016.**
  - **Upper ocean warming associated with the "Blob" has persisted since winter 2013/2014.**
  - **Upper ocean warming in E. Pacific hurricane main development region has enhanced and extended to 100m depth.**
- **Indian Ocean**
  - **Positive SSTAs strengthened across the tropical Indian Ocean.**
  - **Positive India Dipole Mode index persisted.**
- **Atlantic Ocean**
  - **SSTA were well above-average along the eastern coast of North America.**
  - **Positive SSTA extended from mid-latitude to the Atlantic Hurricane Main Development Region.**

Backup Slides

NINO3.4 Heat Budget



- SSTA tendency (dT/dt) in NINO3.4 region (dotted black line) was near zero in Nov 2012, indicating a persistence in NINO3.4.

- All the advection terms were positive, the sum of which was largely in balance with the negative thermodynamical term (**Qq**).

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.

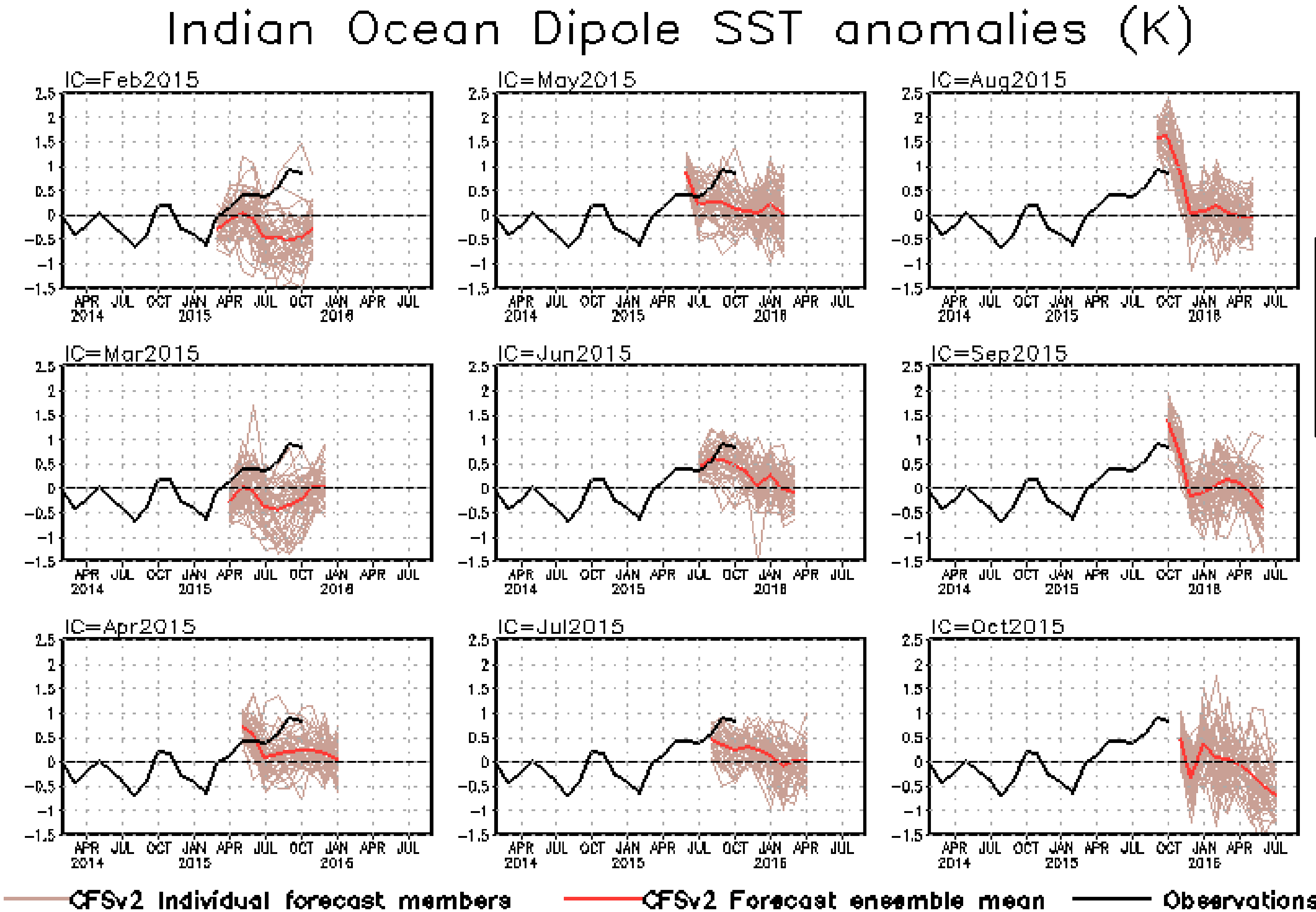
Qu: Zonal advection; Qv: Meridional advection;

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

NCEP CFS DMI SST Predictions from Different Initial Months



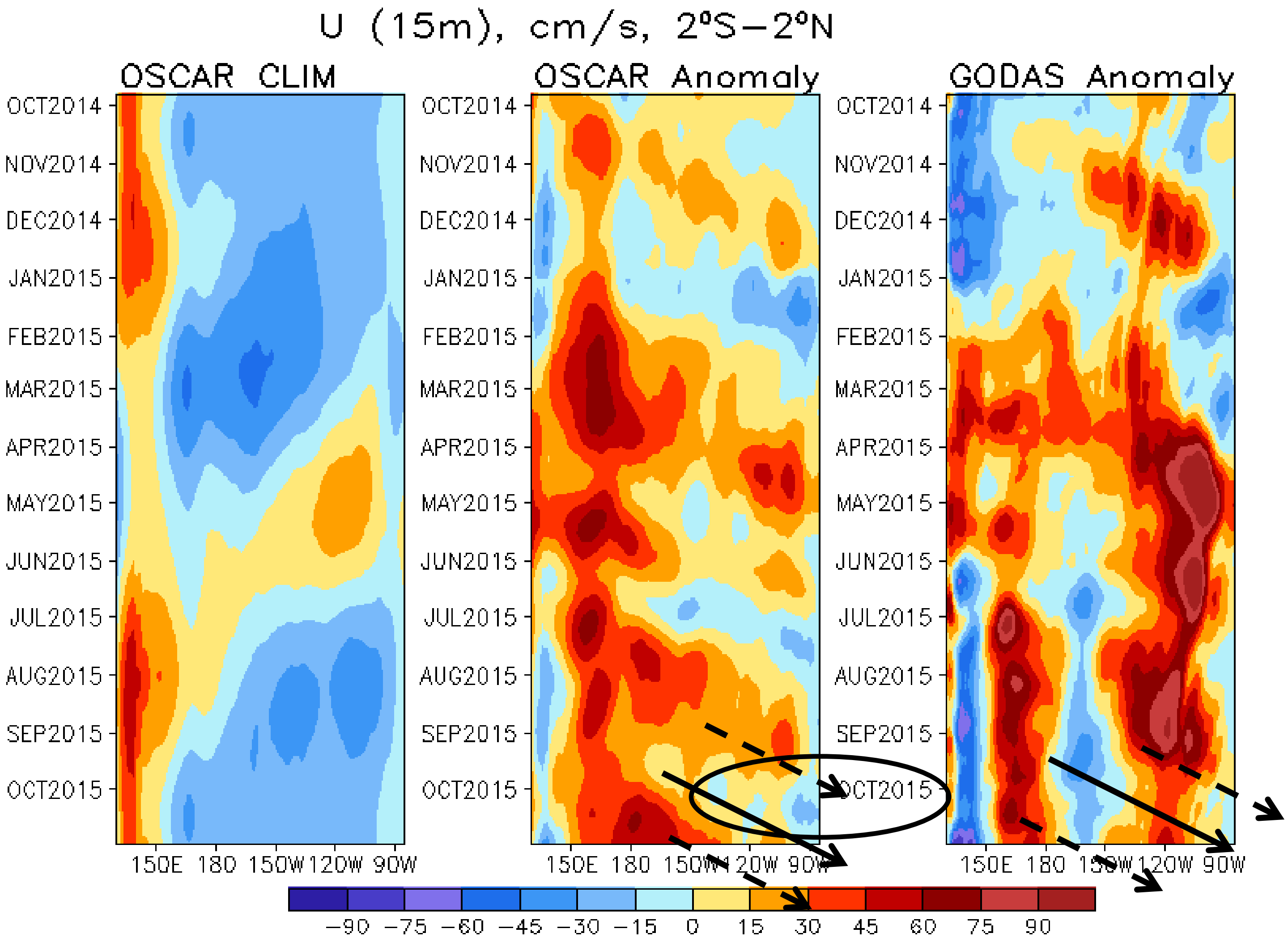
DMI = WTIO- SETIO

SETIO = SST anomaly in [90ºE-110ºE, 10ºS-0]

WTIO = SST anomaly in [50ºE-70ºE, 10ºS-10ºN]

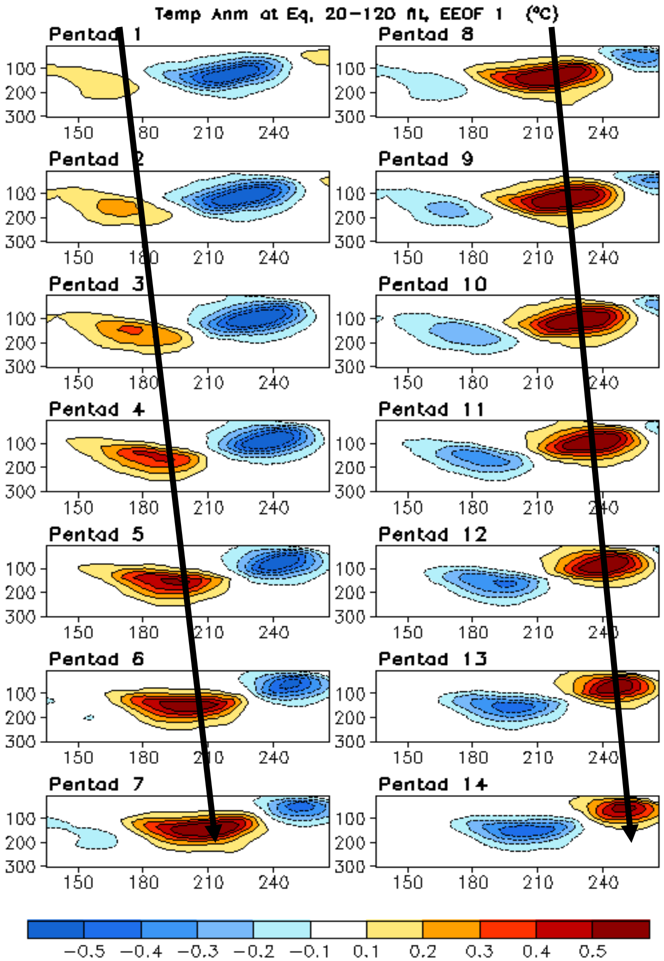
Fig. M2. CFS Dipole Model Index (DMI) SST predictions from the latest 9 initial months. Displayed are 40 forecast members (brown) made four times per day initialized from the last 10 days of the initial month (labelled as IC=MonthYear) as well as ensemble mean (blue) and observations (black). The hindcast climatology for 1981-2006 was removed, and replaced by corresponding observation climatology for the same period. Anomalies were computed with respect to the 1981-2010 base period means.

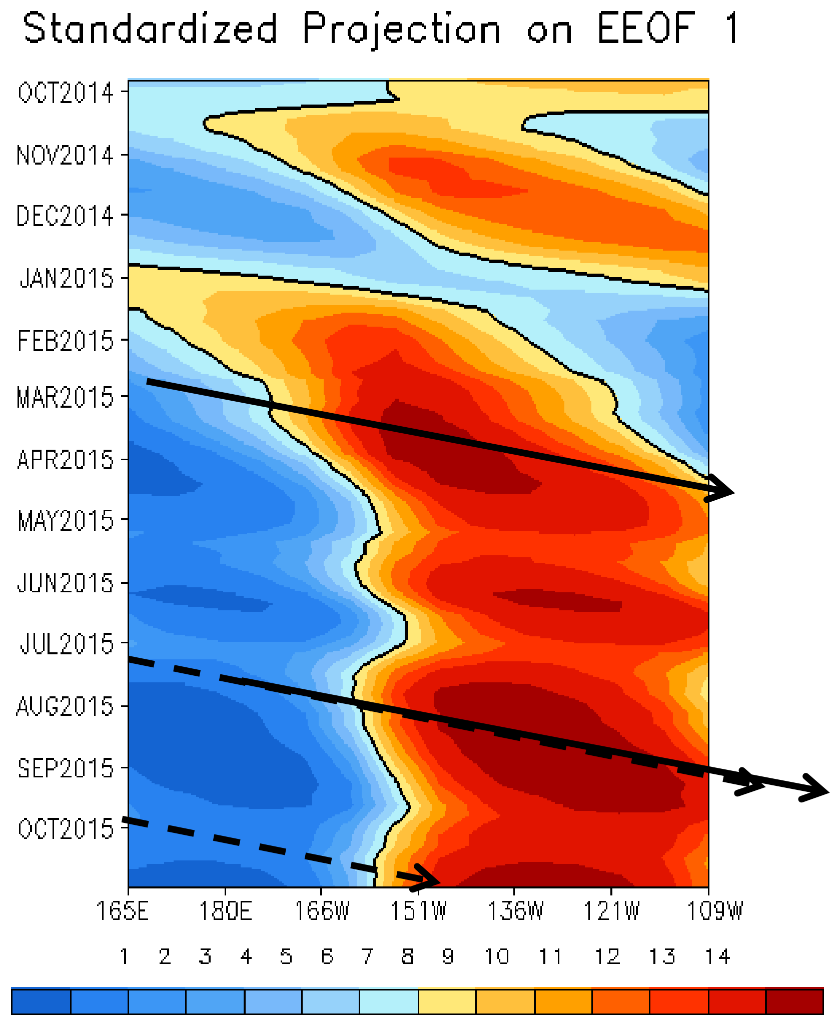
Evolution of Equatorial Pacific Surface Zonal Current Anomaly (cm/s)



- Positive (negative) zonal current anomalies were associated with downwelling (upwelling) oceanic Kelvin waves.

Oceanic Kelvin Wave Indices





- Upwelling oceanic Kelvin wave (OKW, dash line) emerged in mid-Aug in the W. Pacific and propagated eastward associated with the negative phase of MJO.

- Downwelling OKW (solid line) emerged in mid-Sep in the W. Pacific was associated with the positive phase of MJO, while upwelling OKW initiated in early-Nov in the W. Pacific was associated with the negative phase of MJO.

- Oceanic Kelvin wave indices are defined as standardized projections of total anomalies onto the 14 patterns of Extended EOF 1 of equatorial temperature anomalies (Seo and Xue , GRL, 2005).

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

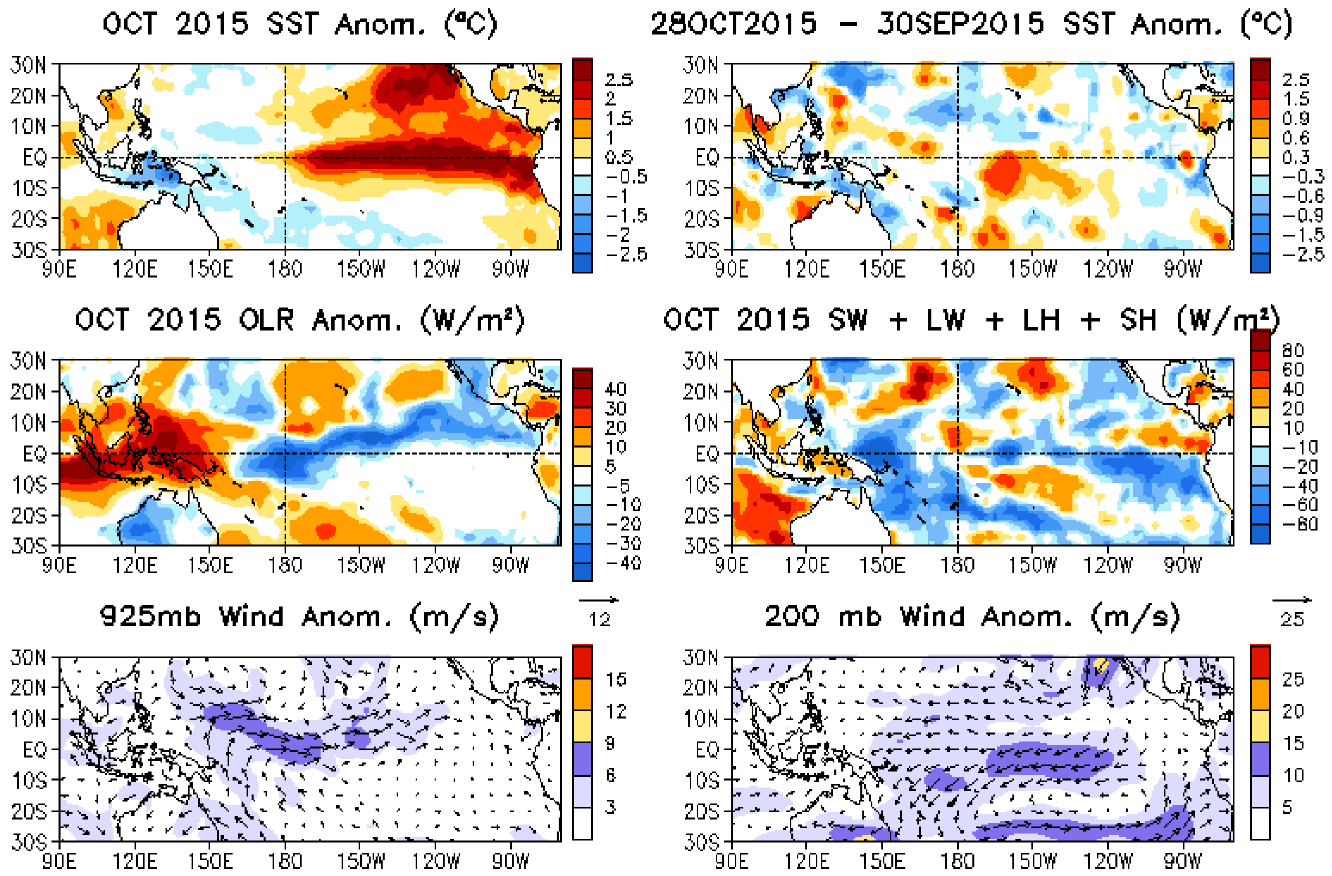


Fig. P2. Sea surface temperature (SST) anomalies (top-left), anomaly tendency (top-right), Outgoing Long-wave Radiation (OLR) anomalies (middle-left), sum of net surface short- and long-wave radiation, latent and sensible heat flux anomalies (middle-right), 925-mb wind anomaly vector and its amplitude (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.

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

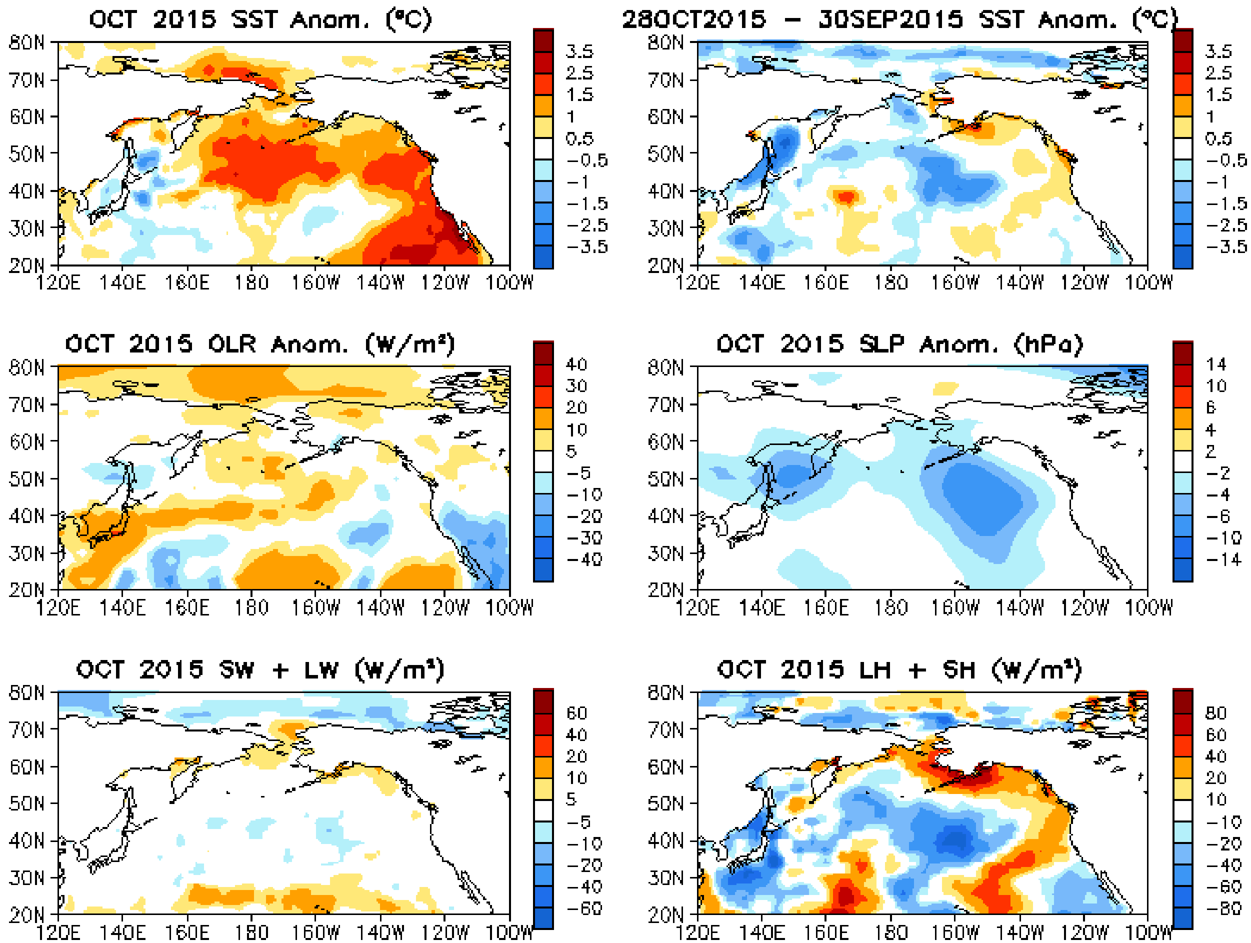


Fig. NP1. Sea surface temperature (SST) anomalies (top-left), anomaly tendency (top-right), Outgoing Long-wave Radiation (OLR) anomalies (middle-left), sea surface pressure anomalies (middle-right), sum of net surface short- and long-wave radiation anomalies (bottom-left), sum of latent and sensible 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.

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

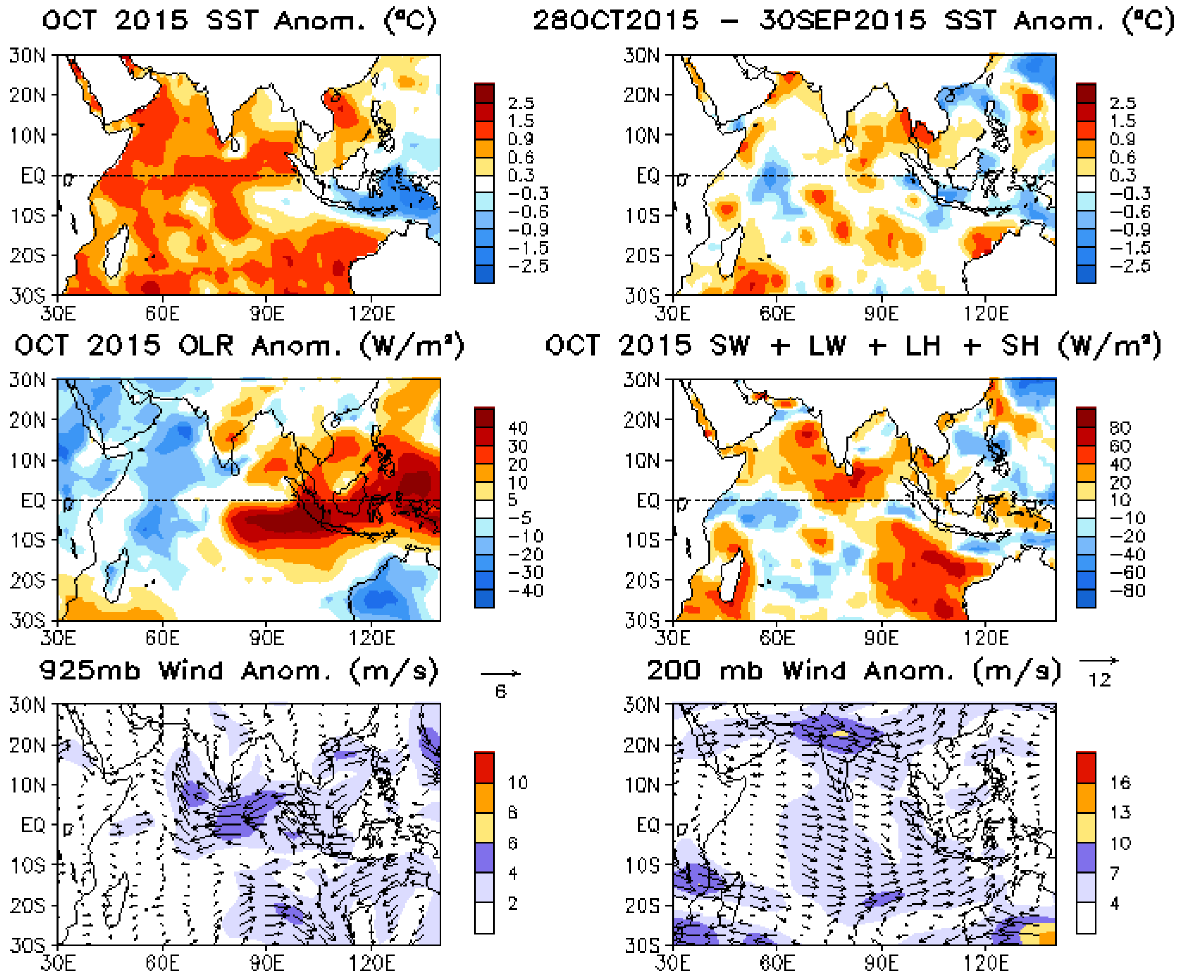


Fig. 12. Sea surface temperature (SST) anomalies (top-left), anomaly tendency (top-right), Outgoing Long-wave Radiation (OLR) anomalies (middle-left), sum of net surface short- and long-wave radiation, latent and sensible heat flux anomalies (middle-right), 925-mb wind anomaly vector and its amplitude (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.

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

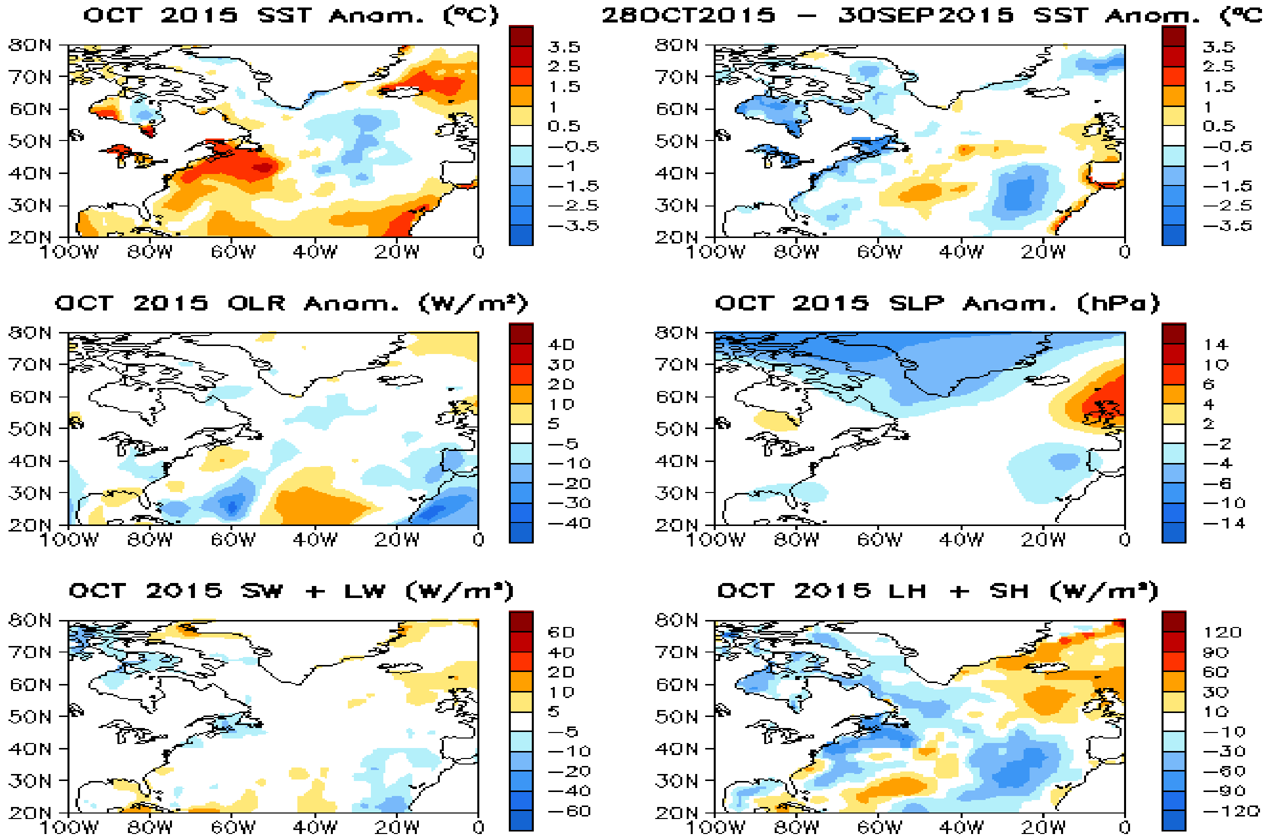
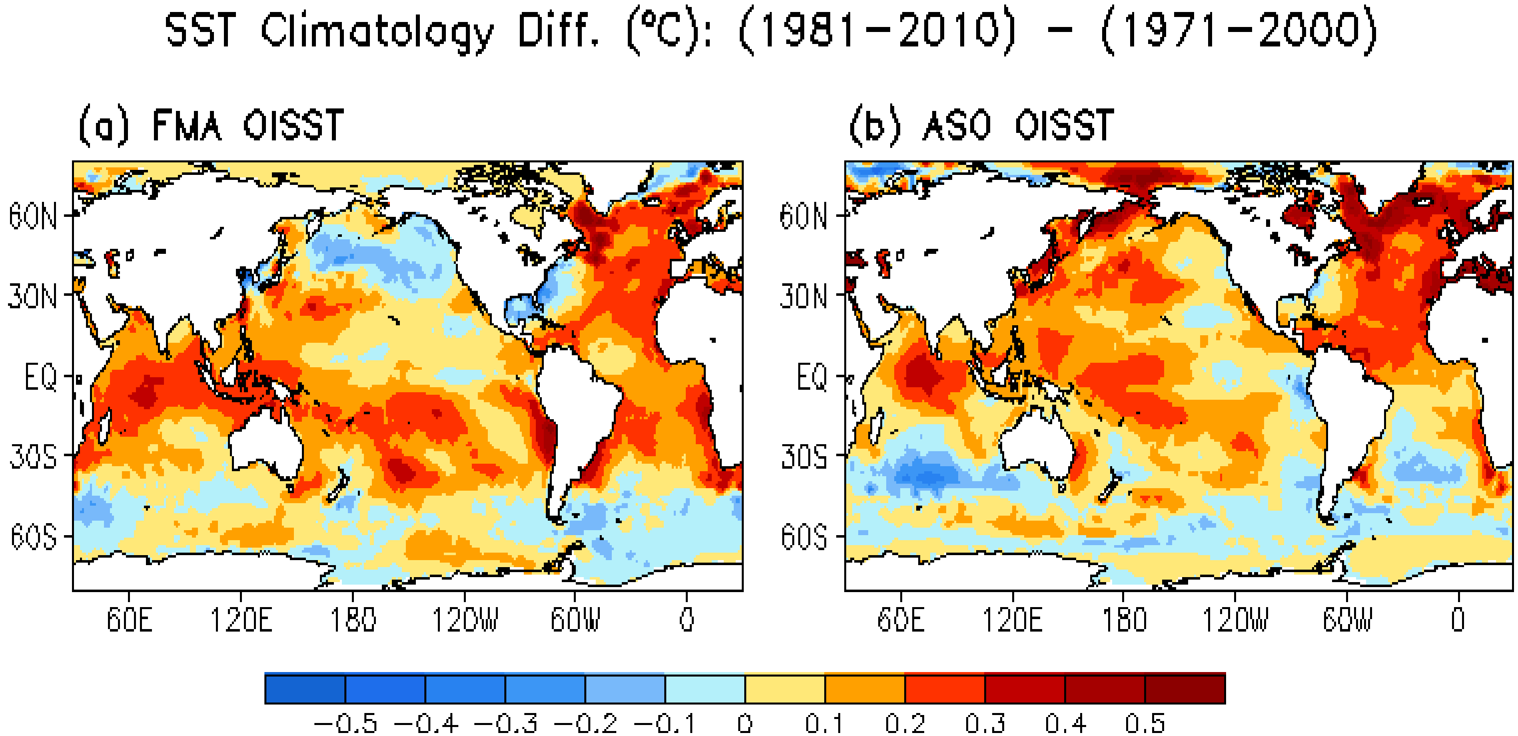


Fig. NA1. Sea surface temperature (SST) anomalies (top-left), anomaly tendency (top-right), Outgoing Long-wave Radiation (OLR) anomalies (middle-left), sea surface pressure anomalies (middle-right), sum of net surface short- and long-wave radiation anomalies (bottom-left), sum of latent and sensible 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 1979-1995 base period means except SST anomalies are computed with respect to the 1971-2000 base period means.

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°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)**

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.

Data Sources and References

- Optimal Interpolation SST (weekly 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!