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

Prepared by

Climate Prediction Center, NCEP/NOAA

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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 Ocean Observing and Monitoring Division (OOMD)

Outline

- **Overview**
- **Recent highlights**
  - **Pacific/Arctic Ocean**
  - **Indian Ocean**
  - **Atlantic Ocean**
- **Global SST Predictions**
  - ***Will the 2018/19 winter be a copycat of 2014 El Niño?***
  - ***North Atlantic Hurricane signatures captured in pentad precipitation and SSS anomalies***

Overview

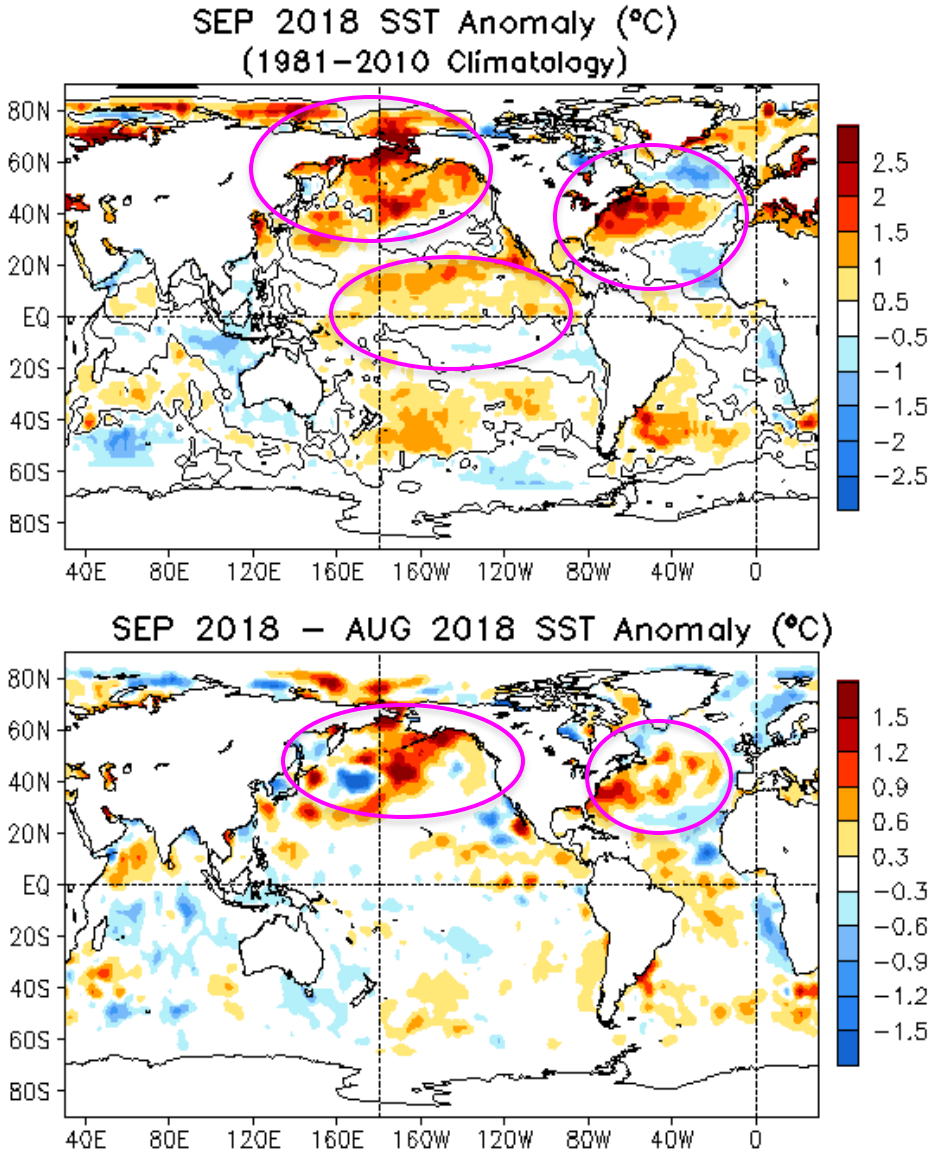
- **Pacific Ocean**
  - **ENSO-neutral conditions continued in Sep 2018.**
  - **Positive subsurface temperature persisted in the western-central Pacific, while negative temperature anomalies in the E. Pac decayed in Sep 2018.**
  - **NOAA Continuously issued El Niño Watch in Oct. 2018 and stated that El Niño is favored to form in the next couple of months and continue through the Northern Hemisphere winter 2018-19 (70-75% chance).**
  - **Arctic sea ice extent in Sep 2018 ties with 2008 for the sixth lowest Sep value since 1979.**

- **Indian Ocean**
  - **Indian Ocean dipole index was well above average in Sep 2018.**

- **Atlantic Ocean**
  - **Atlantic Hurricane season had an active Sep.**
  - **Positive phase of NAO continued in Sep 2018, with NAOI=+1.8.**

Global Oceans

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



- **SSTs were above average across most of the tropical Pacific Ocean.**

-Strong positive SSTAs continued in the mid-high latitudes of N. Pacific.

- **Horseshoe/tripole-like SSTA pattern continued in the N. Atlantic.**

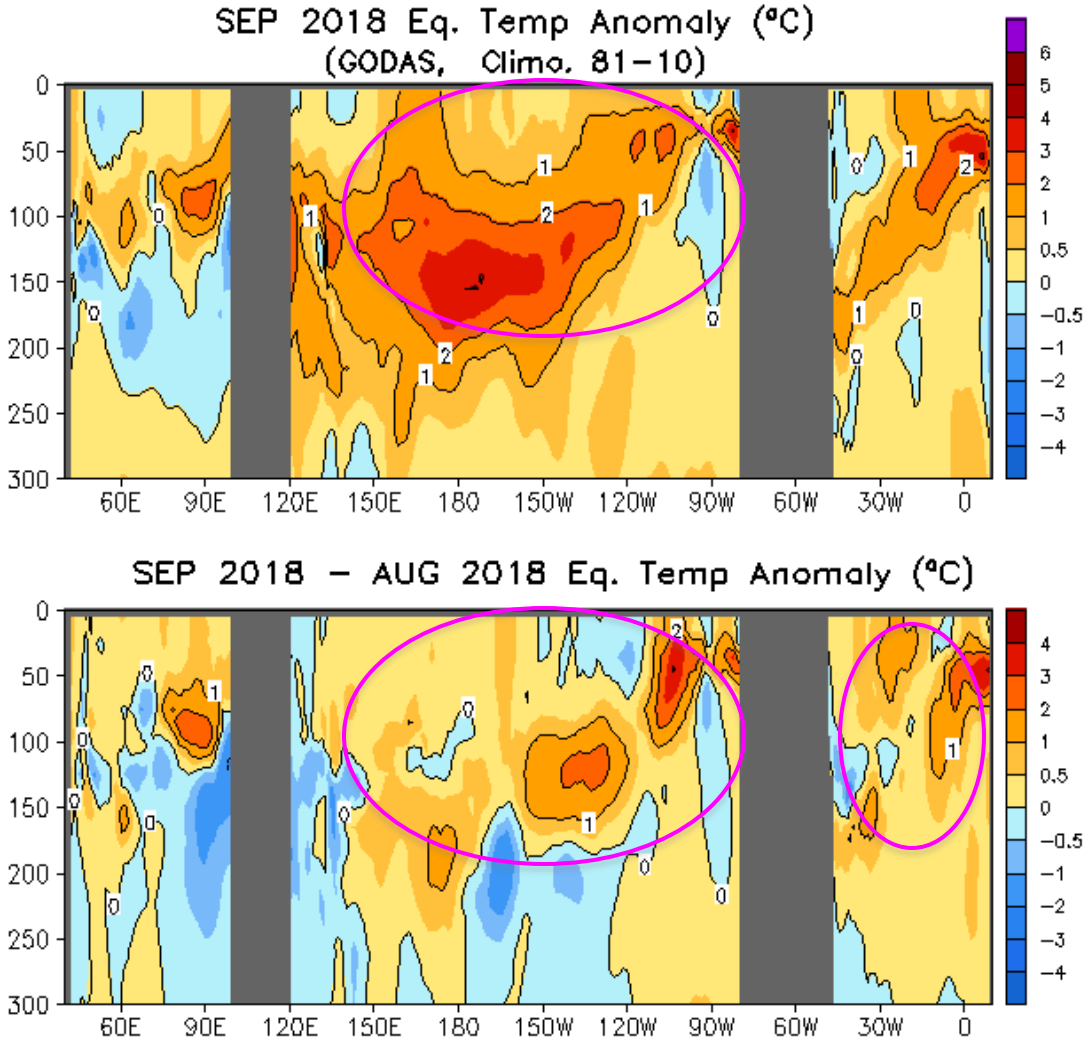
- **Negative SSTAs strengthened in the eastern tropical Indian Ocean.**

- **Positive SSTA tendencies presented in the central-eastern tropical Pacific and western tropical Atlantic.**

- **Large SSTA tendencies were observed in the mid-high latitude of N. Pacific and N. Atlantic.**

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°S-2°N



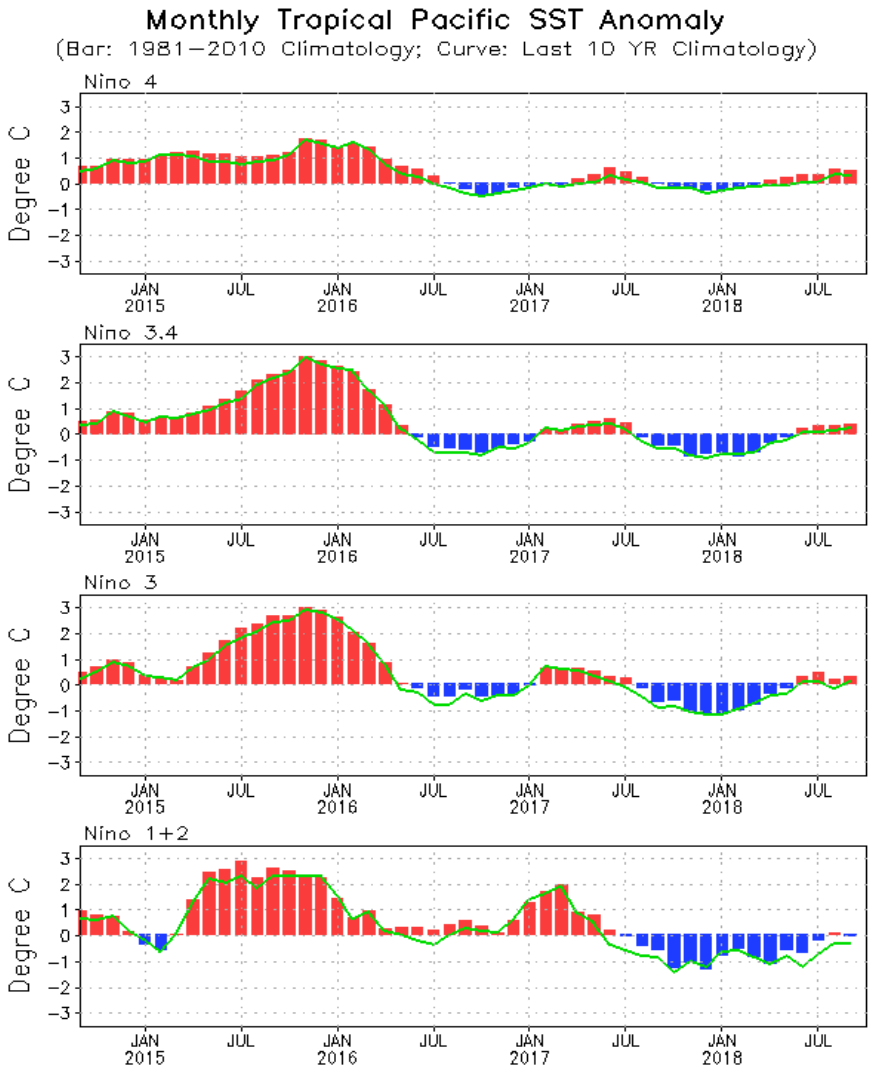
- **Positive temperature anomalies continued along the thermocline in the Western-Central equatorial Pacific and extended to the eastern equatorial Pacific in Sep 2018.**
- **Positive temperature anomaly presented along the thermocline in the Atlantic Ocean.**

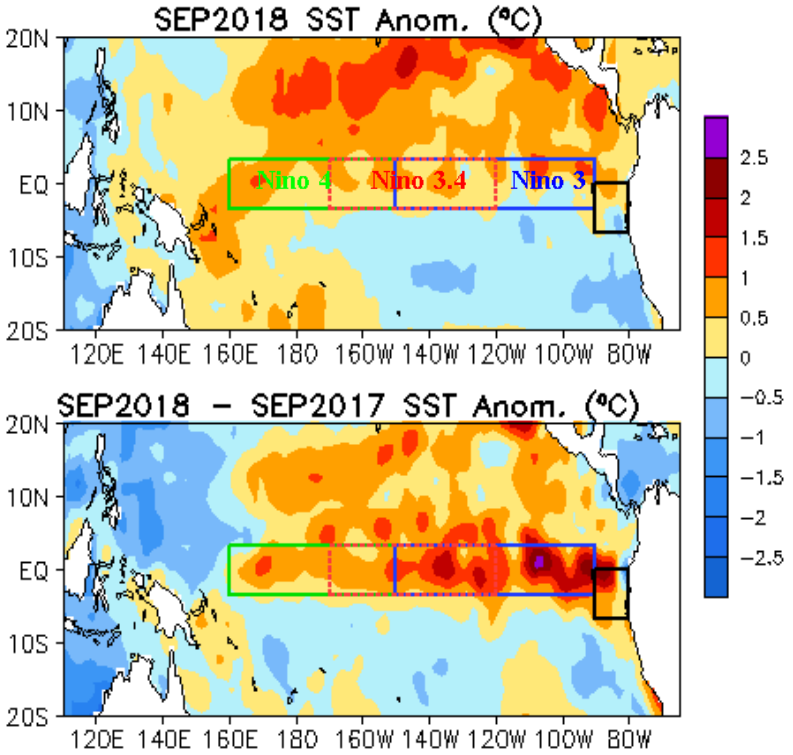
- **Positive temperature tendency dominated across much of the equatorial thermocline in the Pacific and the Atlantic Oceans.**

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



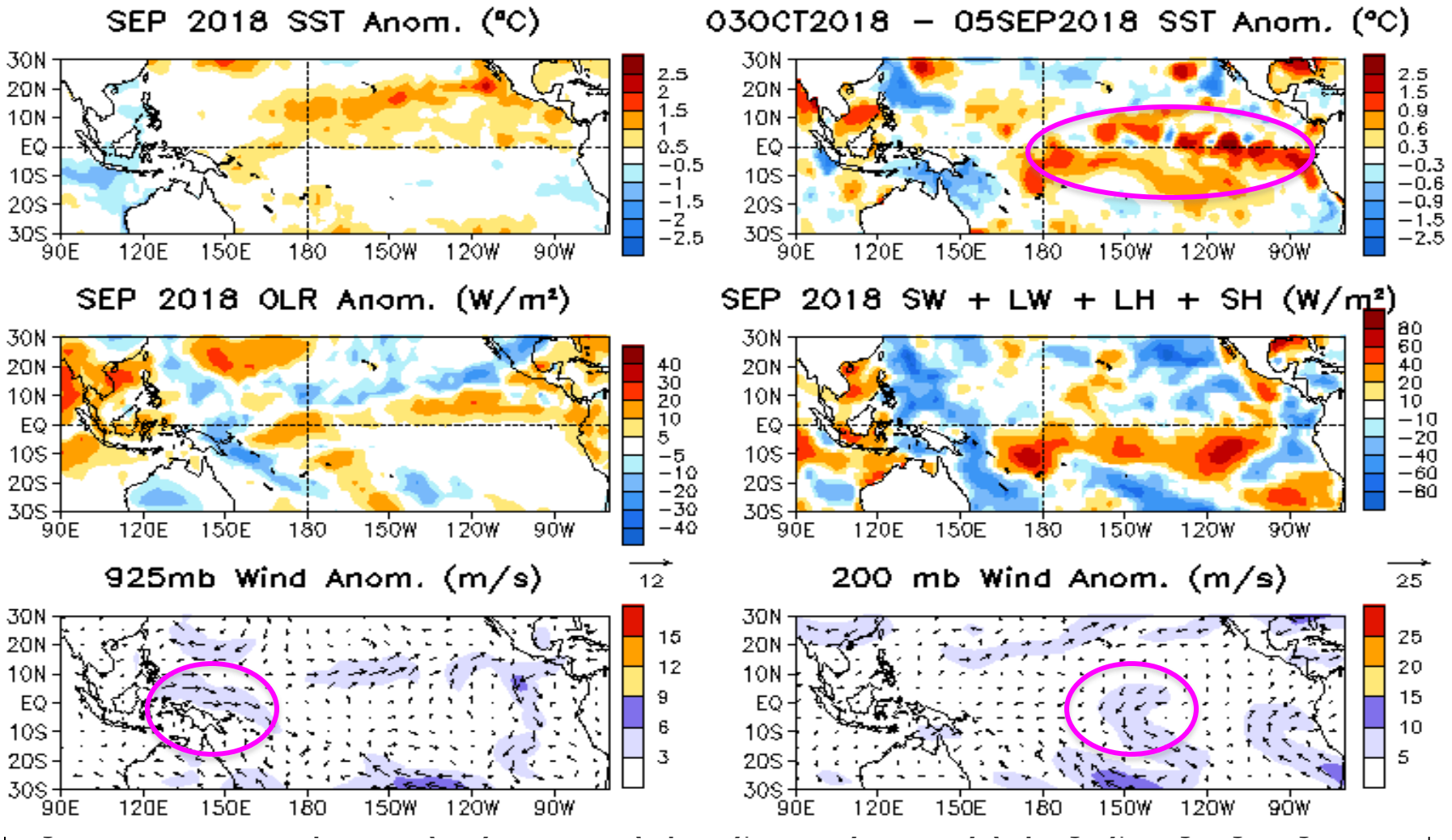


- **Niño 3.4 and Nino3 increased slightly in Sep 2018, with Niño 3.4 = 0.3 C.**

-The indices were calculated based on OISST. They may have some differences compared with those based on ERSST.v5.

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

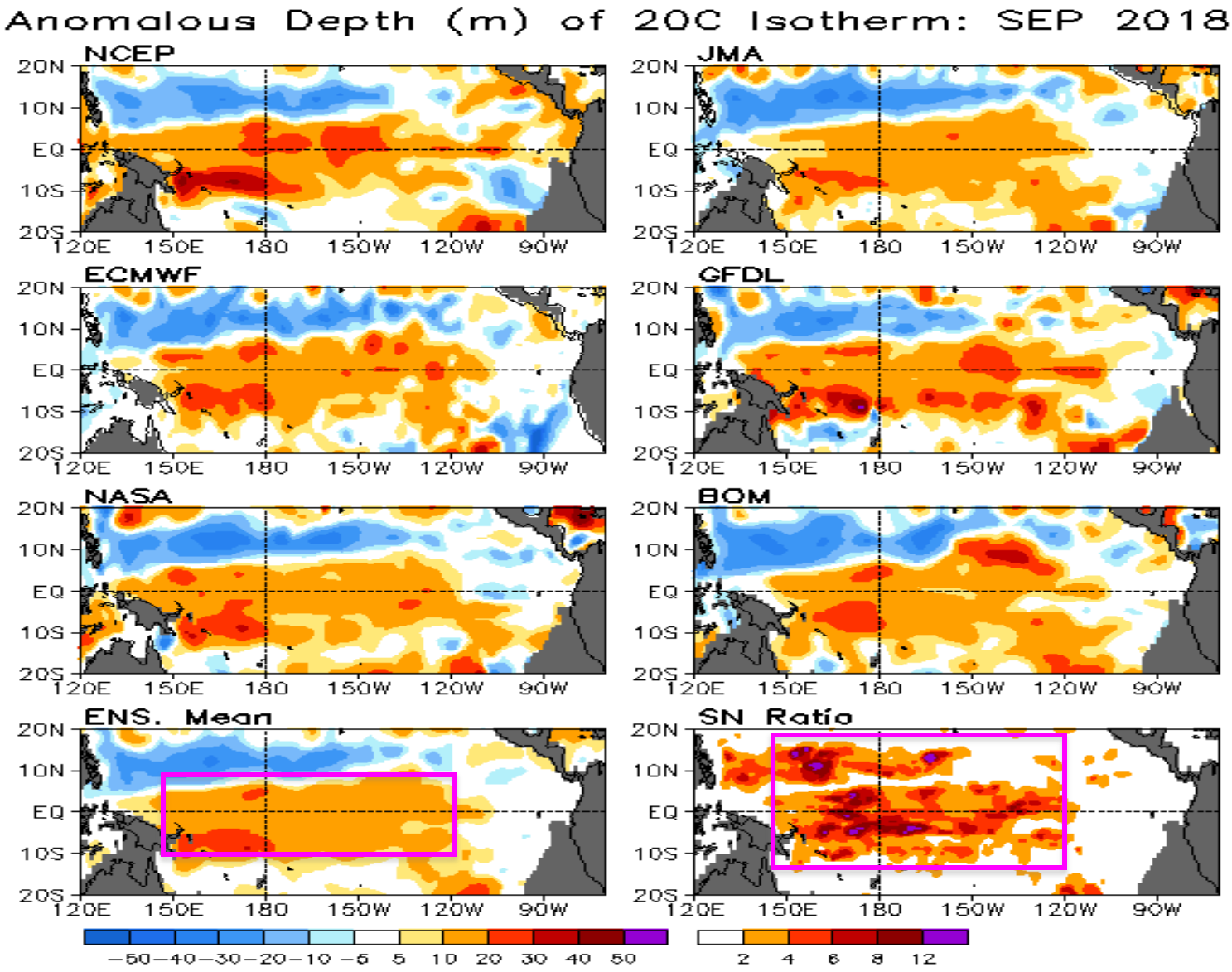


Radiation (OLR) anomalies (middle-left), sum of net surface short- and long-wave radiation, latent and sensible heat flux anomalies (middle-right), 925-mb wind anomaly vector and its amplitude (bottom-left), 200-mb wind anomaly vector and its amplitude (bottom-right). SST are derived from the NCEP OI 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.

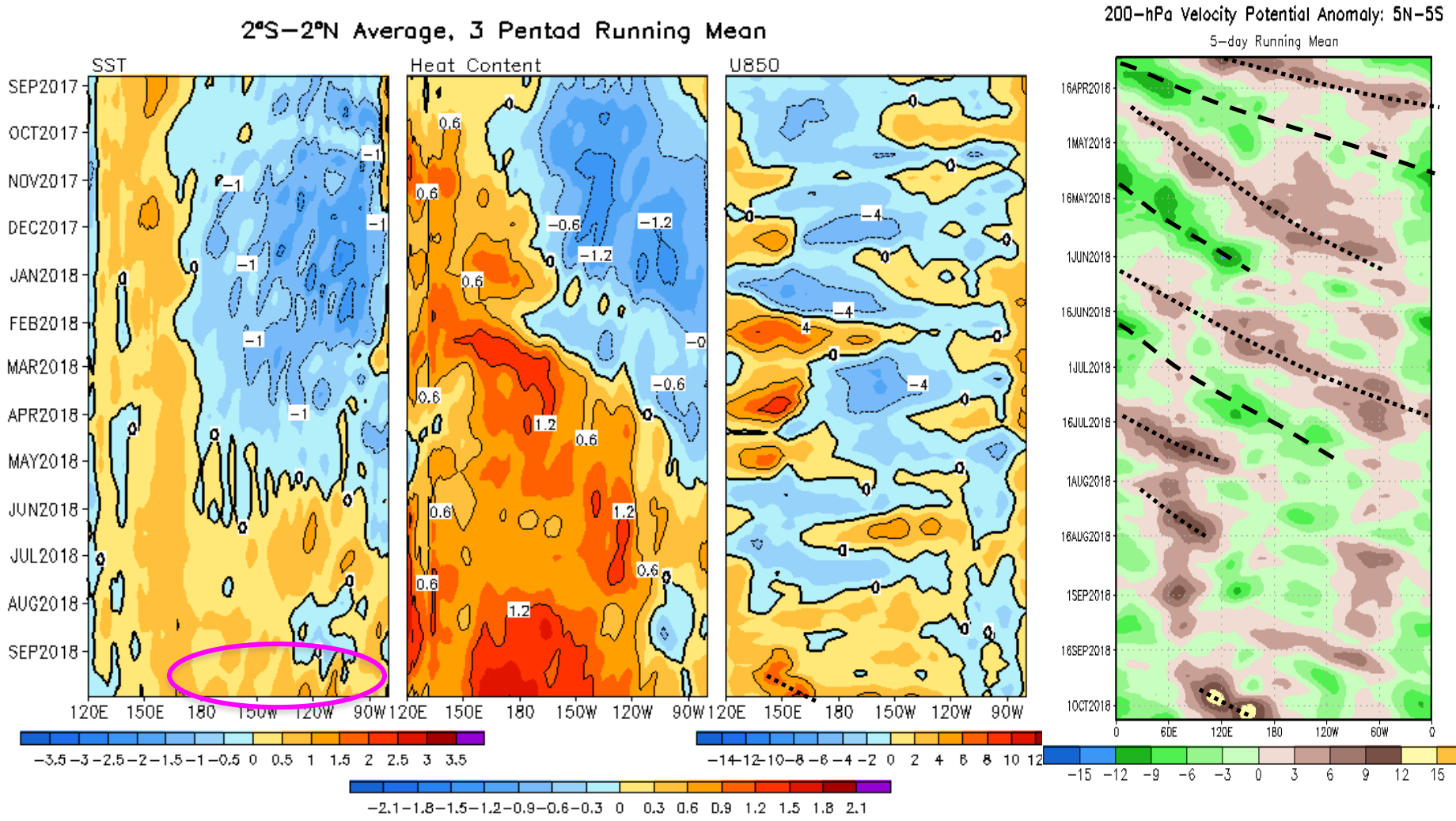
Real-Time Ocean Reanalysis Intercomparison: D20

Climatology : 1981-2010

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



Equatorial (2S-2N) Pacific SST (°C), Surface Zonal Wind (m/s) and HC300 (°C) Anomalies

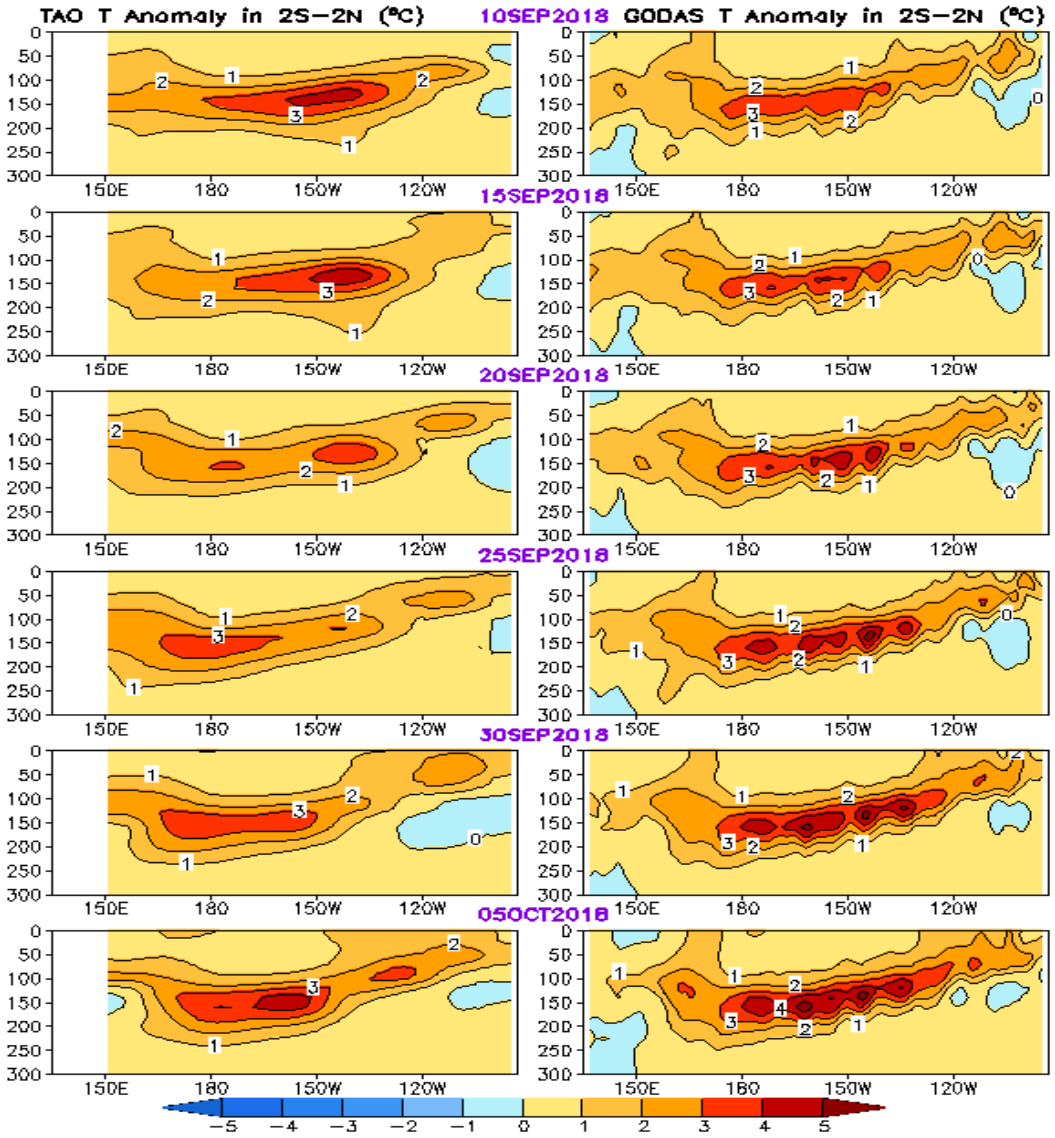


- **Positive SSTA reemerged in the eastern Pacific in Sep 2018, consistent with eastward extension of positive subsurface anomalies.**

- **A westerly wind burst, which was associated with MJO activity in the late Sep, triggered a downwelling Kelvin wave, helping reinforce the subsurface warming.**

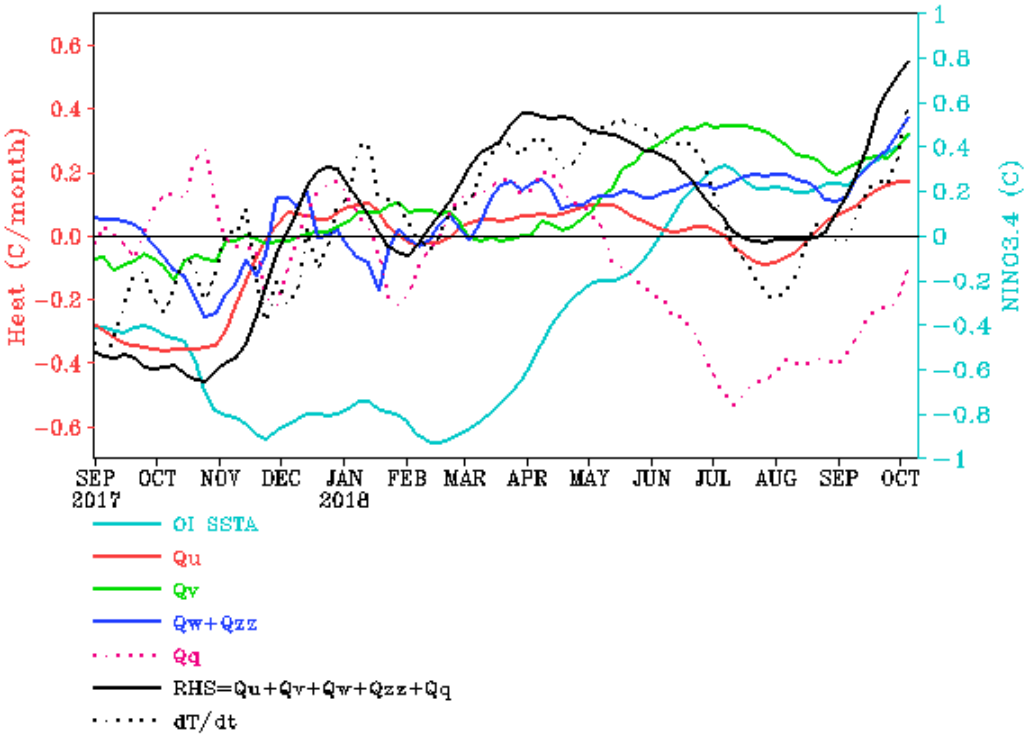
Equatorial Pacific Ocean Temperature Pentad Mean Anomaly

TAO GODAS



- **Positive subsurface temperature anomaly in the central Pacific extended to the eastern Pacific and reached the surface since the end of Sep 2018.**

NINO3.4 Heat Budget



- Positive observed SSTA tendencies (dT/dt; dotted black line) gradually increased in Sep 2018.

- All dynamical terms(Qv, Qu, Qw+Qzz) contributed to the warming tendency.

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.

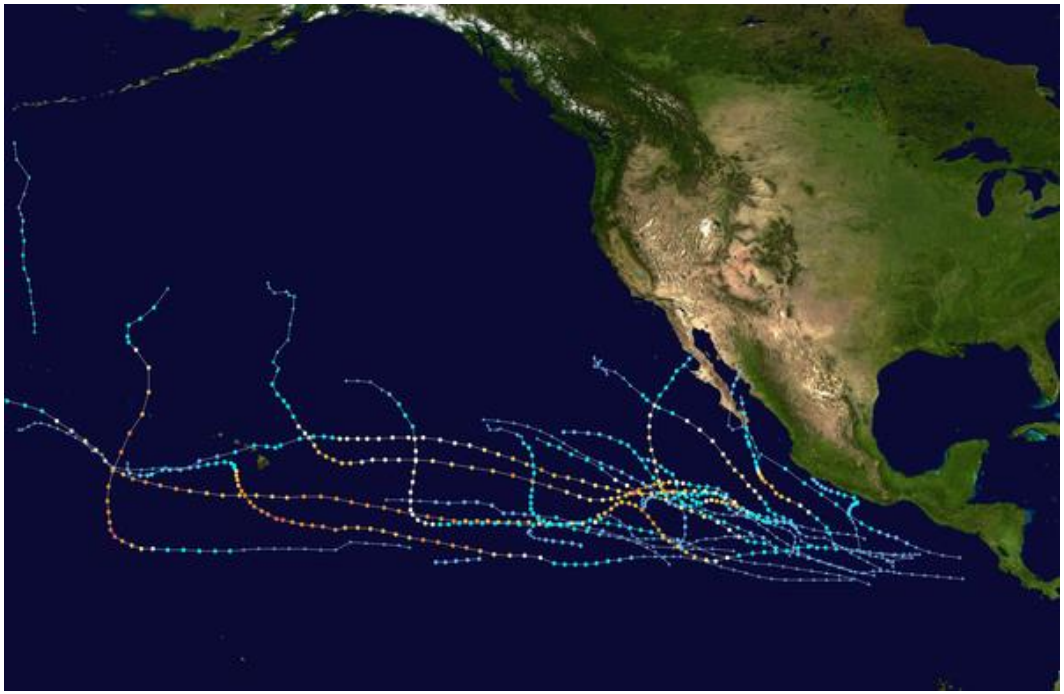
Qu: Zonal advection; Qv: Meridional advection;

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

2018 E. Pacific Hurricane Season



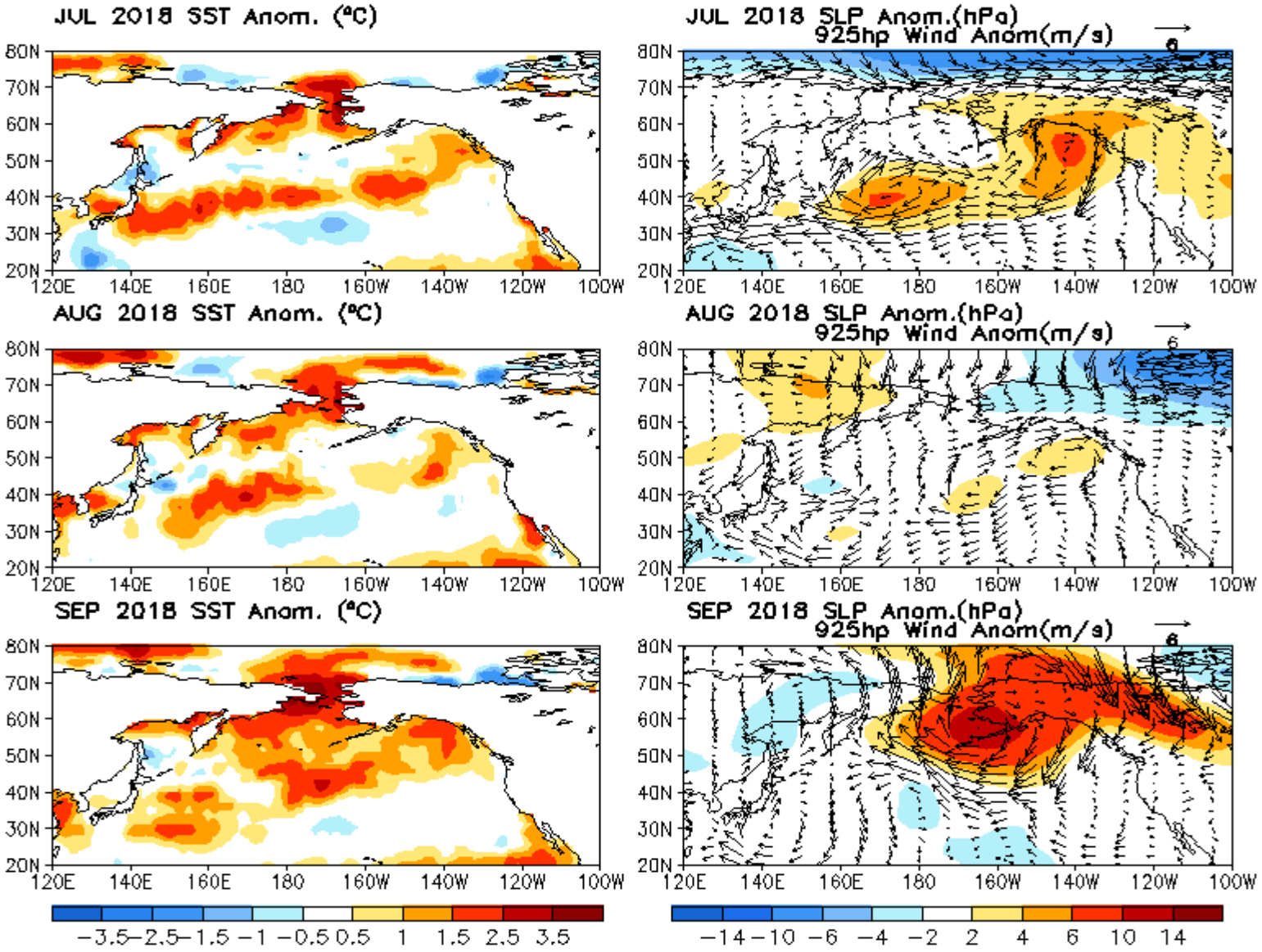
- 19 tropical storms formed by Oct 9, with 12 developing into hurricanes and 9 became major hurricanes.

(https://en.wikipedia.org/wiki/2018_Pacific_hurricane_season)

E.Pac	2018 prediction (issued on May 24) 80% near or above normal	1981-2010	Observations (By Oct 9)
Named storms	14-20	15	19
Hurricanes	7-12	8	12
Major hurricanes	3-7	4	9

North Pacific & Arctic Oceans

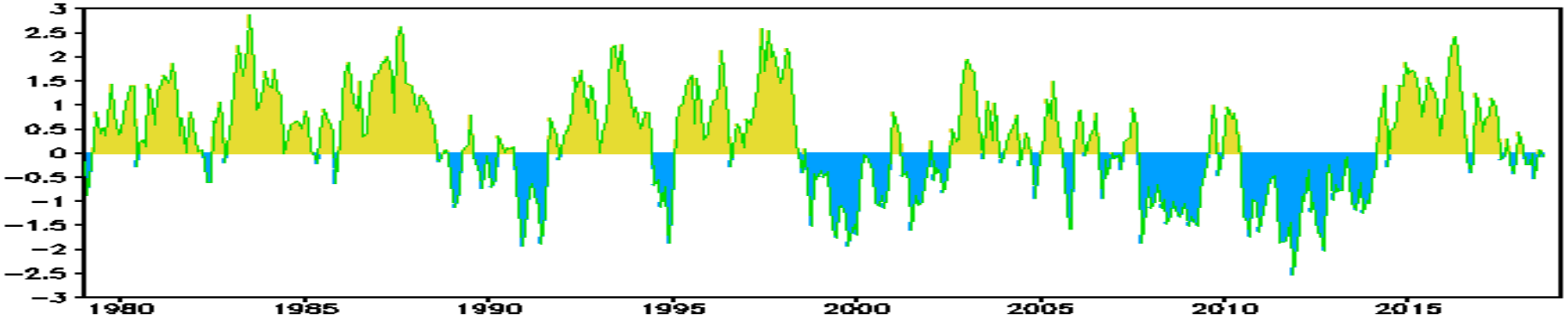
Last Three Month SST, SLP and 925hp Wind Anomalies



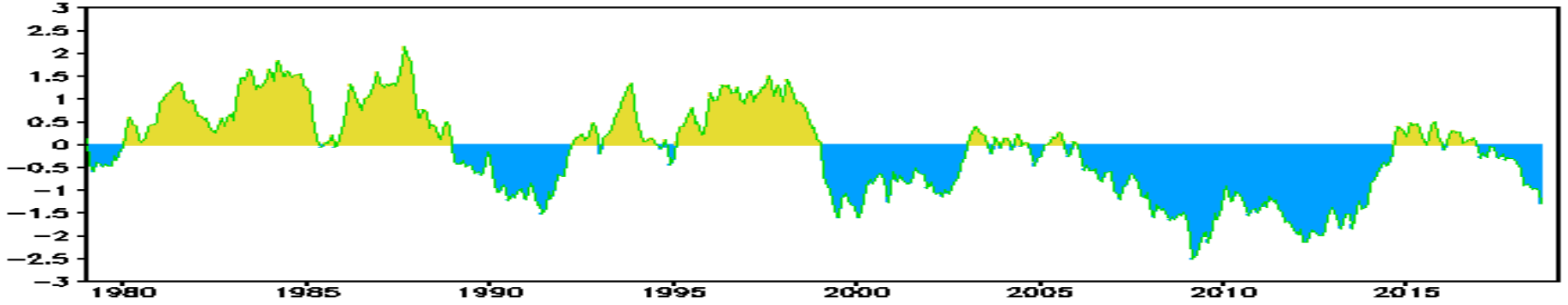
- **Distribution of SST anomalies between 20 - 50N varied month by month, owing to the high frequency changes in the atmospheric circulation.**

Two Oceanic PDO indices

SST-based PDO



H300-based PDO



- **SST-based PDO index switched to negative phase in Sep 2018, with PDO index =-0.1.**
- **Negative H300-based PDO index has persisted 12 months since Nov 2016, with HPDO = -1.3 in Sep 2018.**
- **SST-based PDO index has considerable variability both on seasonal and decadal time scales.**

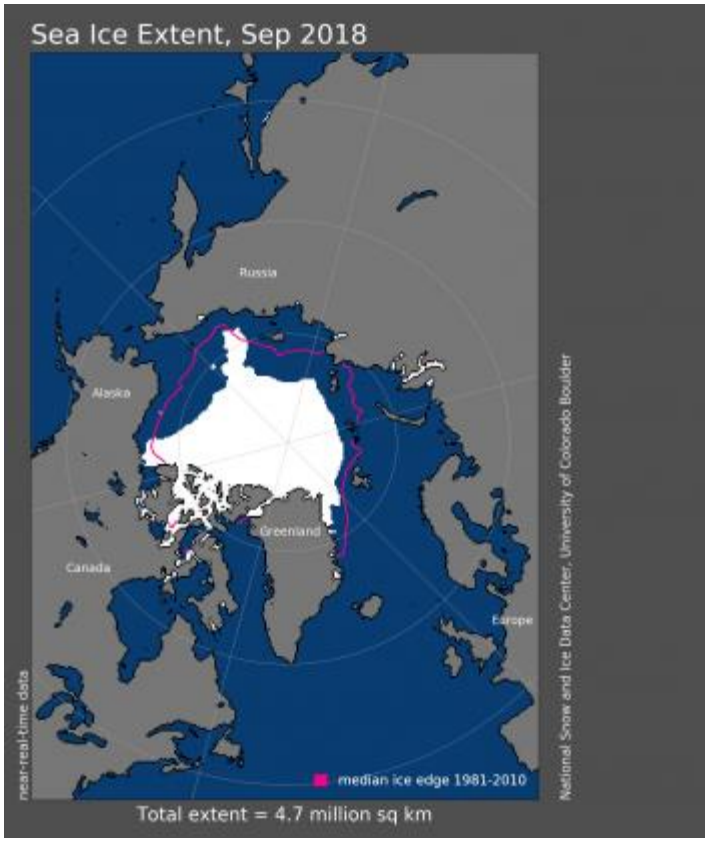
(H300-based PDO index is downloadable from http://www.cpc.ncep.noaa.gov/products/GODAS/PDO_body.html)

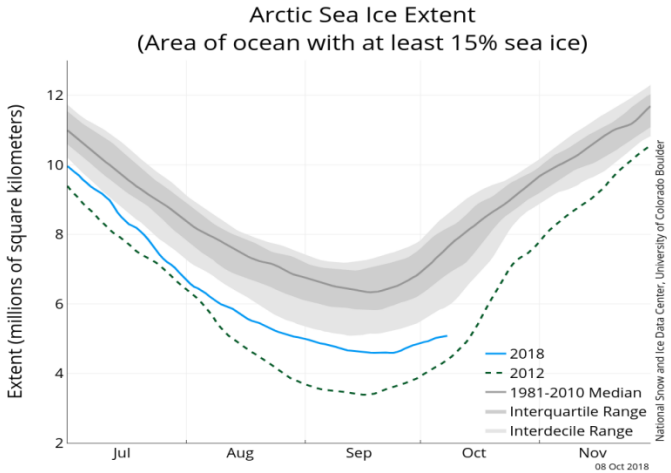
SST-based Pacific Decadal Oscillation is defined as the 1st EOF of monthly ERSST v3b in the North Pacific for the period 1900-1993. PDO index is the standardized projection of the ERSST v4 monthly SST anomalies onto the 1st EOF pattern. H300-based Pacific Decadal Oscillation is defined as the projection of monthly mean H300 anomalies from NCEP GODAS onto their first EOF vector in the North Pacific.

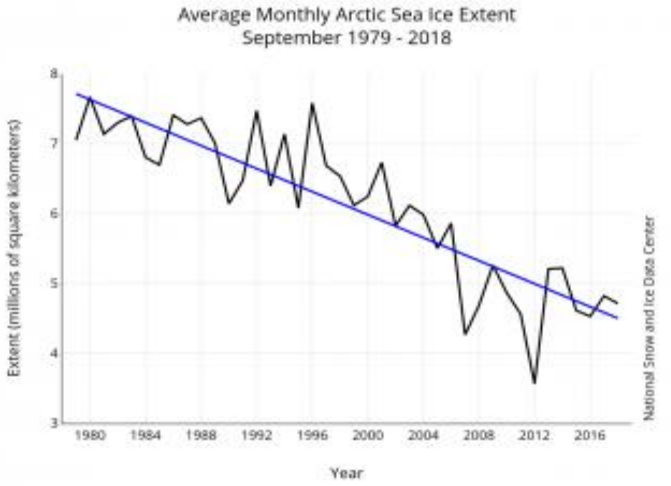
Arctic Sea Ice

National Snow and Ice Data Center

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



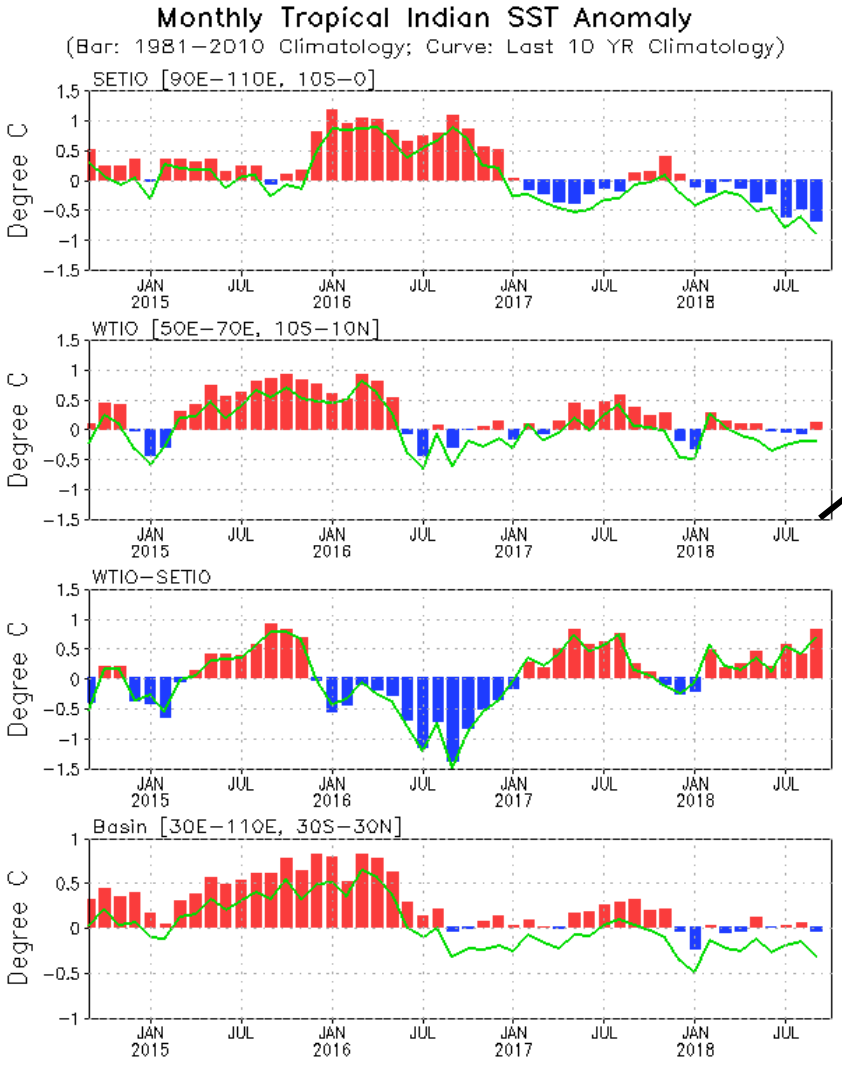


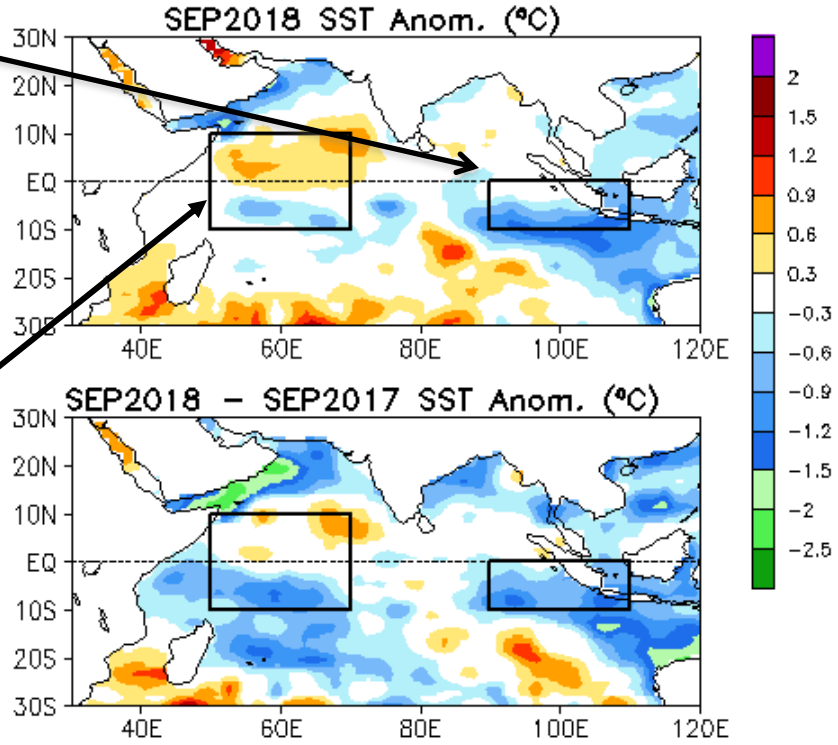


- **Arctic sea ice extent reached its seasonal minimum in Sep.**
- **Arctic sea ice extend in Sep 2018 ties with 2008 for the sixth lowest Sep since 1979.**

Indian Ocean

Evolution of Indian Ocean SST Indices





- **Positive Indian Ocean Dipole strengthen in Sep 2018,with IOD index = 0.8 C.**

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.

- **Negative SSTA strengthened in the eastern Indian Ocean.**

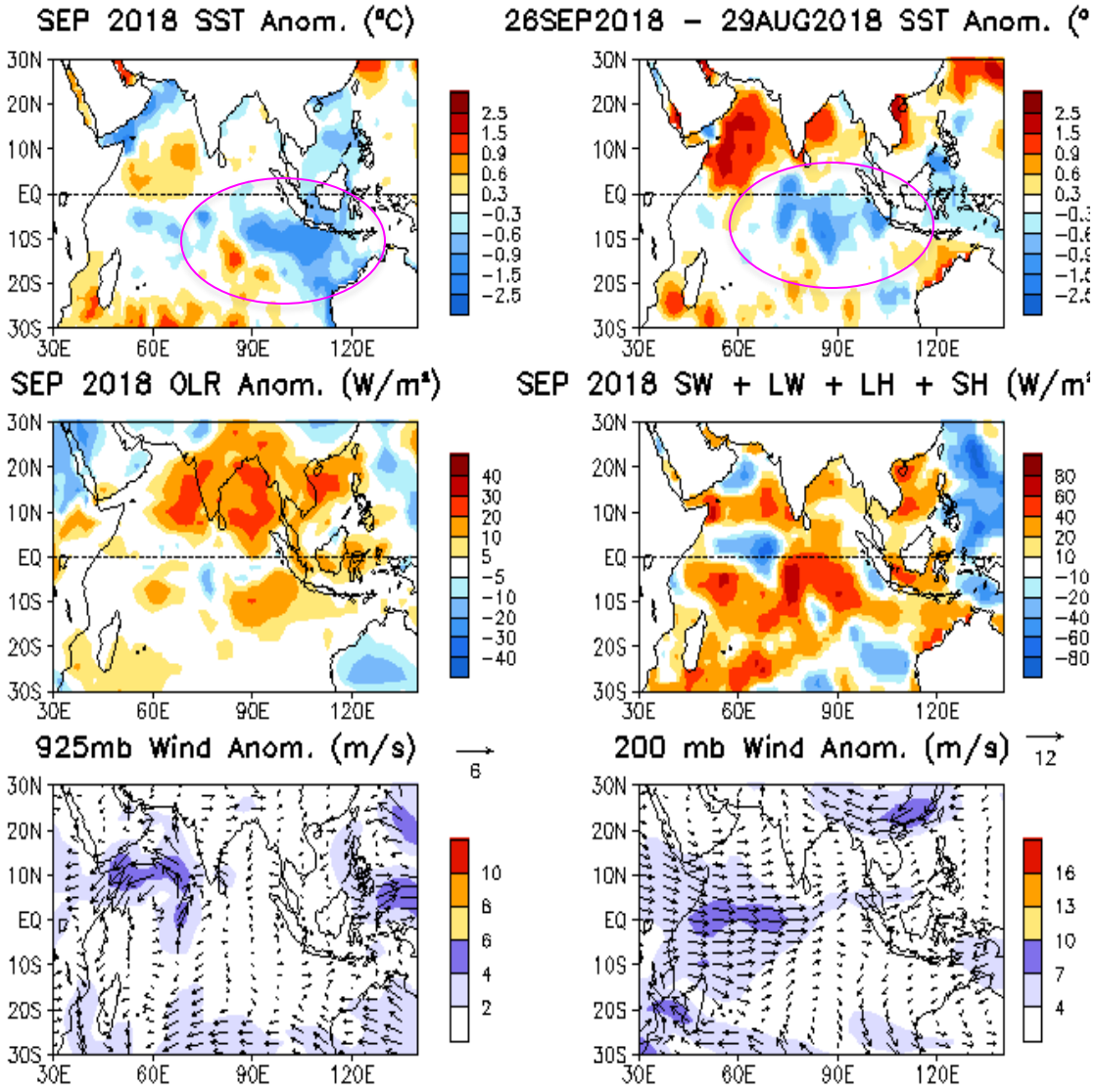


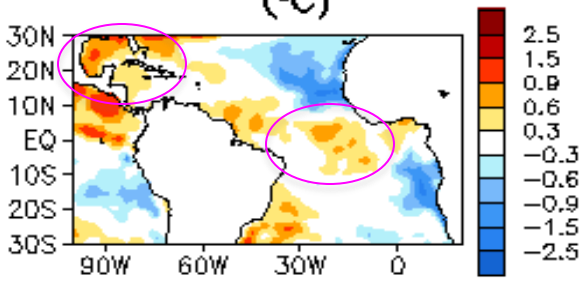
Fig. I2. Sea surface temperature (SST) anomalies (top-left), anomaly tendency (top-right), Outgoing Long-wave Radiation (OLR) anomalies (middle-left), sum of net surface short- and long-wave radiation, latent and sensible heat flux anomalies (middle-right), 925-mb wind anomaly vector and its amplitude (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

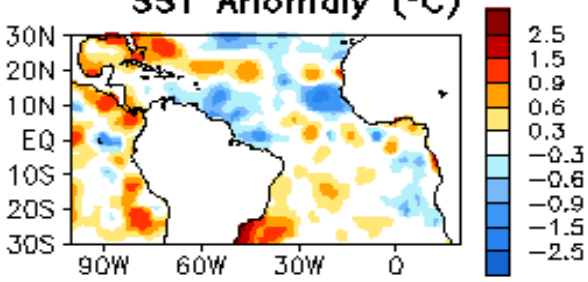
Tropical Atlantic:

SST, SST Anom. Tend., OLR, Sfc Rad, Sfc Flx, TCHP, 925-mb/200-mb Winds anom.

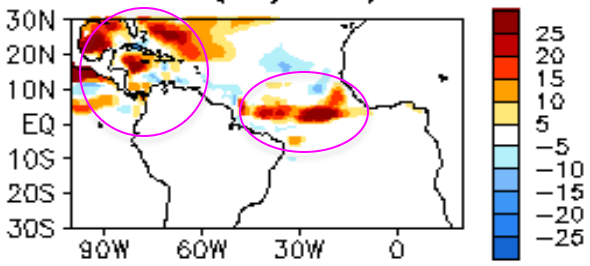
SEP 2018 SST Anom. (°C)



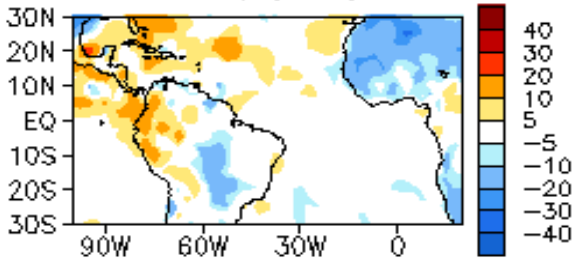
26SEP2018 – 29AUG2018 SST Anomaly (°C)



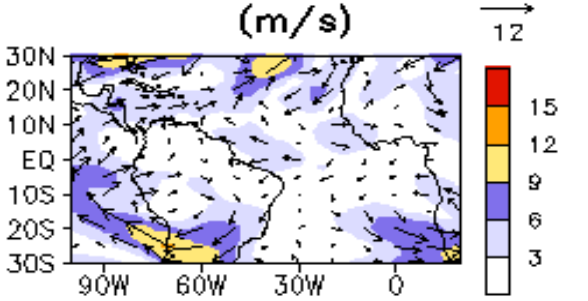
SEP 2018 TCHP Anom. (KJ/cm²)



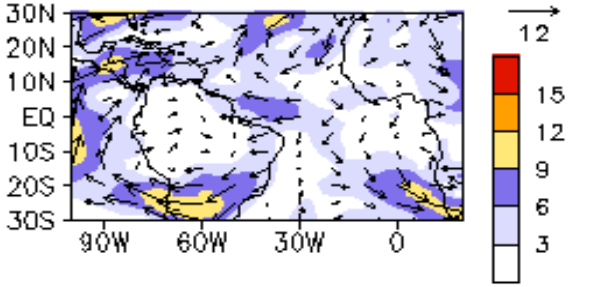
SEP 2018 OLR Anom. (W/m²)



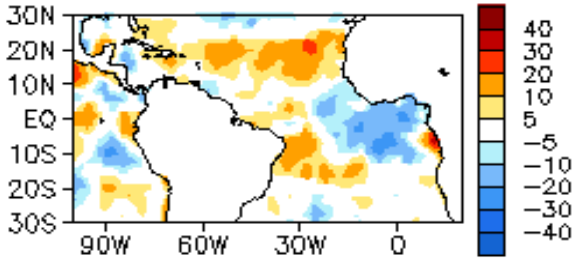
SEP 2018 200mb Wind Anom. (m/s)



SEP 2018 200mb – 850mb Wind Shear Anom. (m/s)

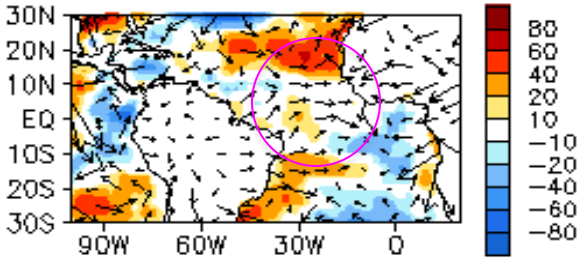


SEP 2018 SW + LW Anom. (W/m²)

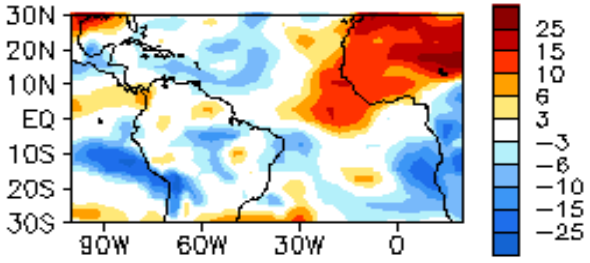


LH + SH Anom. (W/m²)

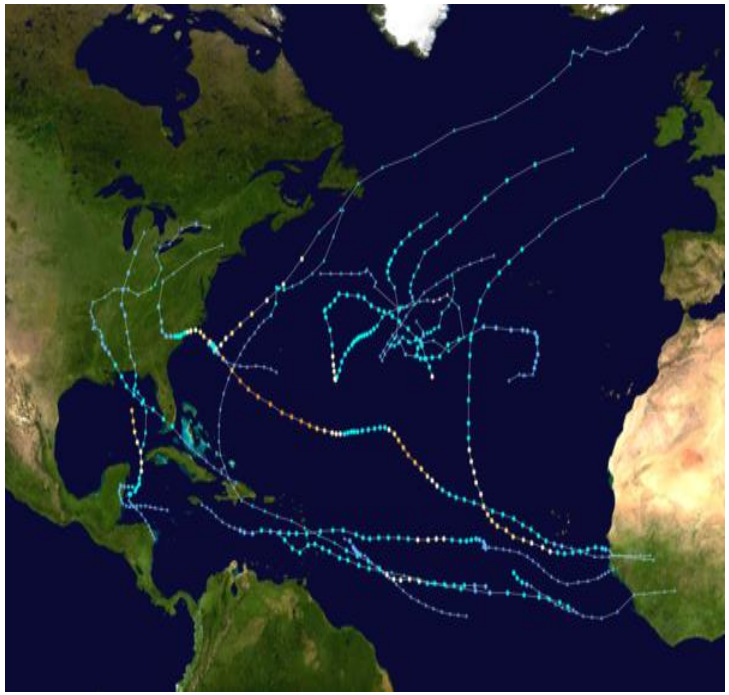
925mb Wind Anom. (m/s)



SEP 2018 700 mb RH Anom. (%)



2018 Atlantic Hurricane Season Activities

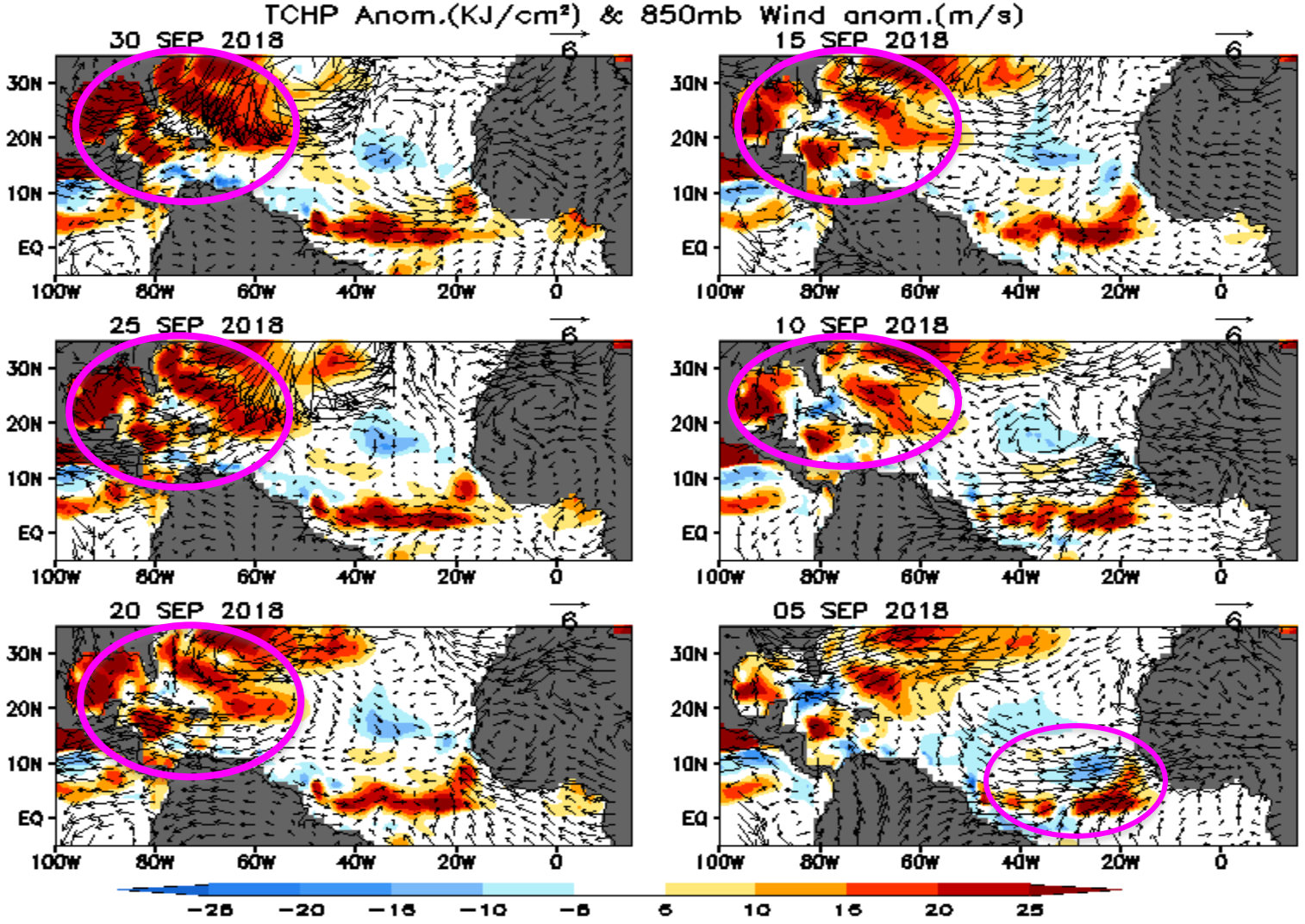


https://en.wikipedia.org/wiki/2018_Atlantic_hurricane_season

- **Eight tropical storms formed during Aug31 – Oct 9, with three developing into hurricanes and two became major hurricanes.**

Atlantic	2018 prediction (issued on May 24) Updated on Aug 9 60% below average	1981-2010	Observations (By Oct 9)
Named storms	(10-16) 9-13	12	14
Hurricanes	(5-9) 4-7	6	7
Major hurricanes	(1-4) 0-2	3	2

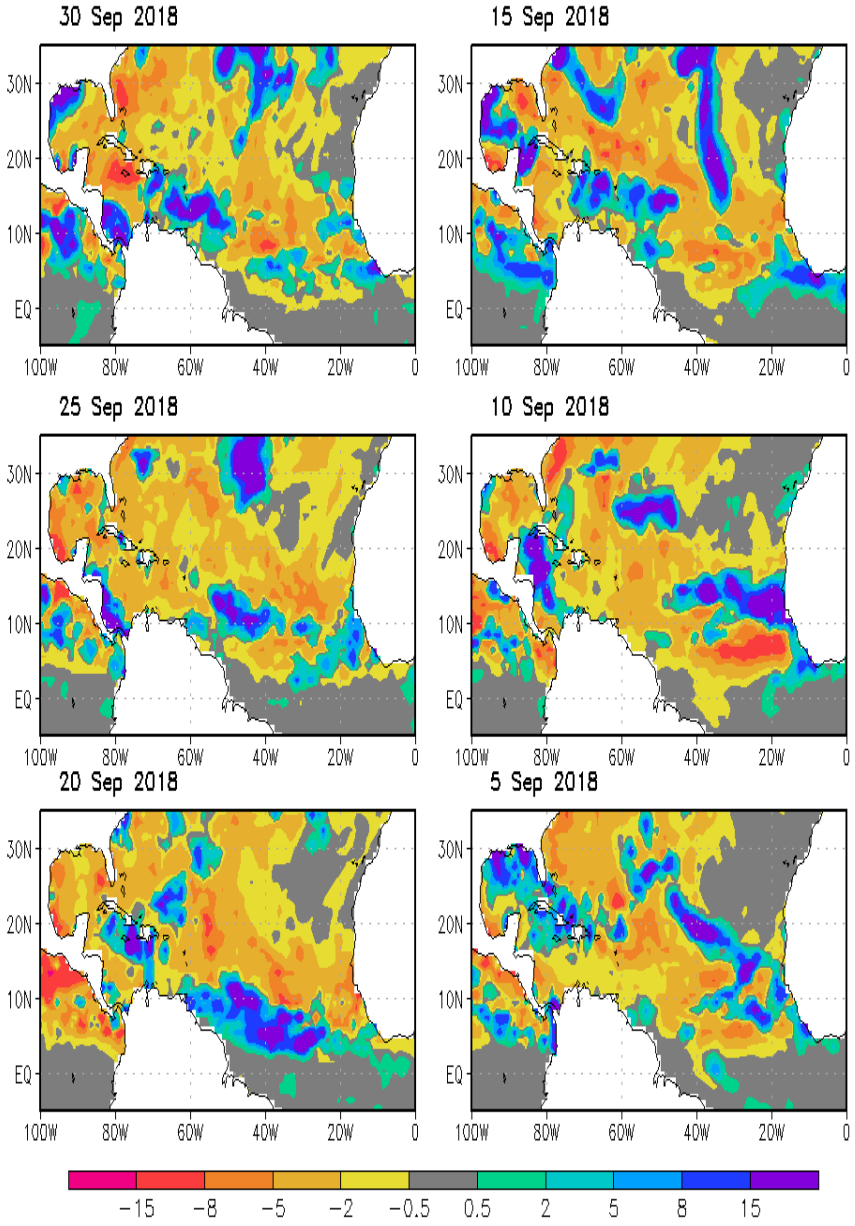
Pendad Tropical Cyclone Heat Potential and 850mb wind Anomaly

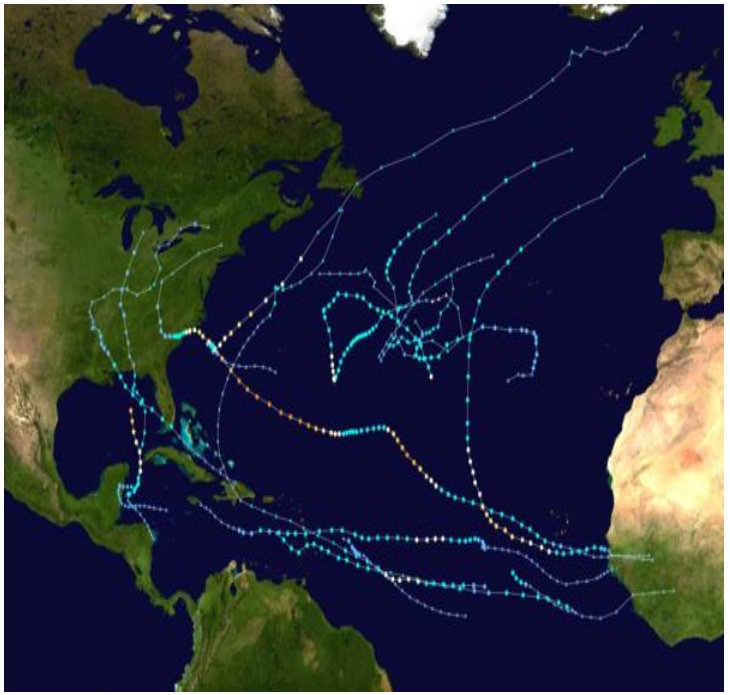


- **Strong positive TCHP anomalies persisted in the Gulf of Mexico and the Gulf stream .**

- **Enhanced African Monsoon in early September might have contributed to the active hurricane activities in September.**

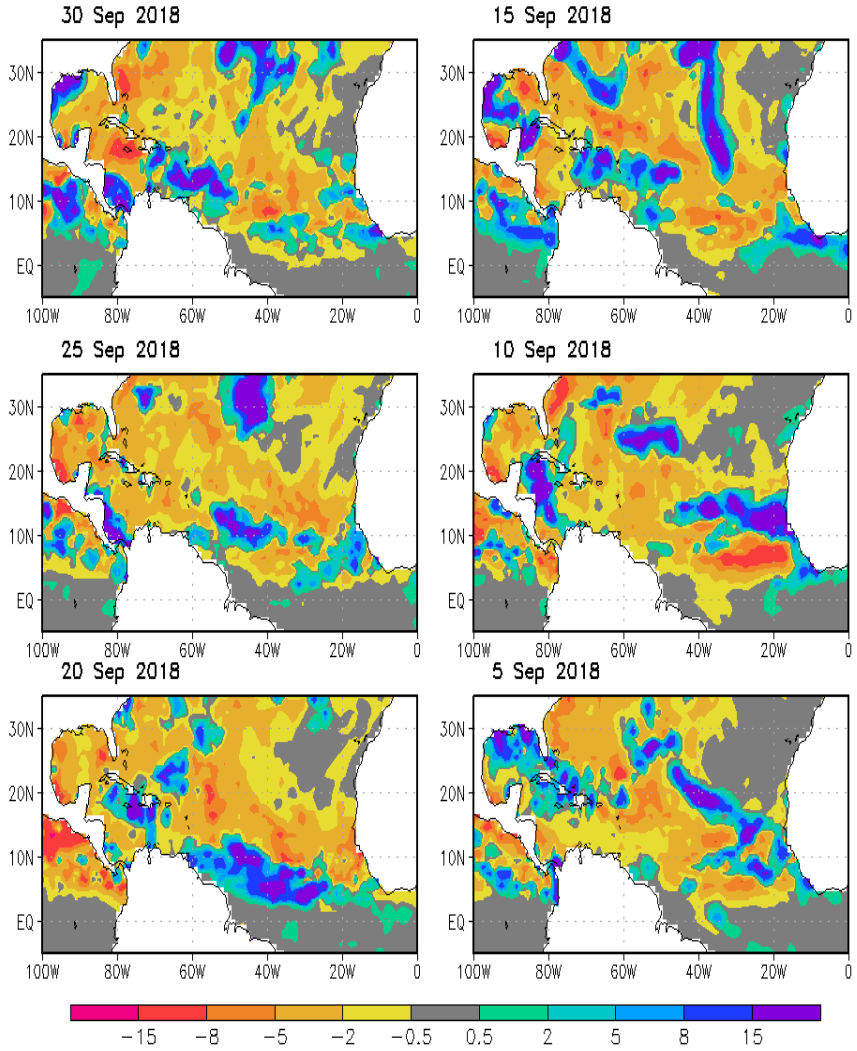
Pendad Precipitation Anomaly



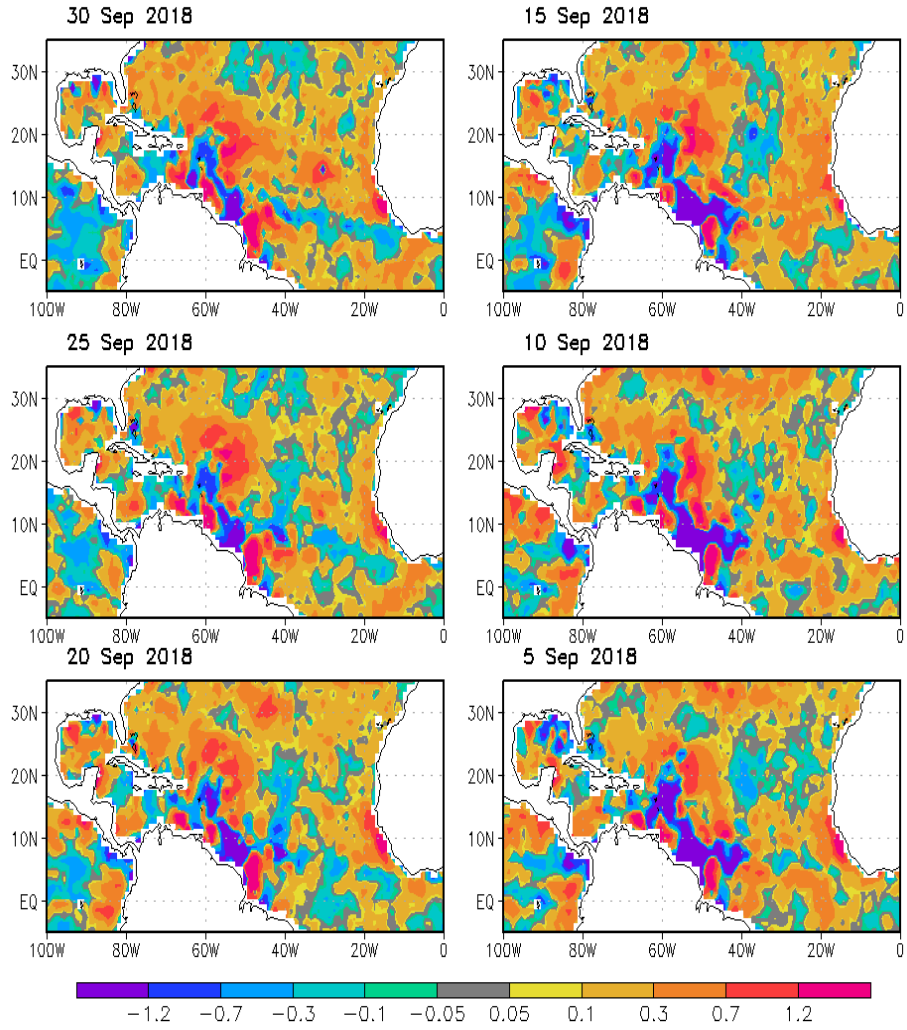


Precipitation: CMORPH adjusted satellite precipitation estimates

Pendad Precipitation Anomaly



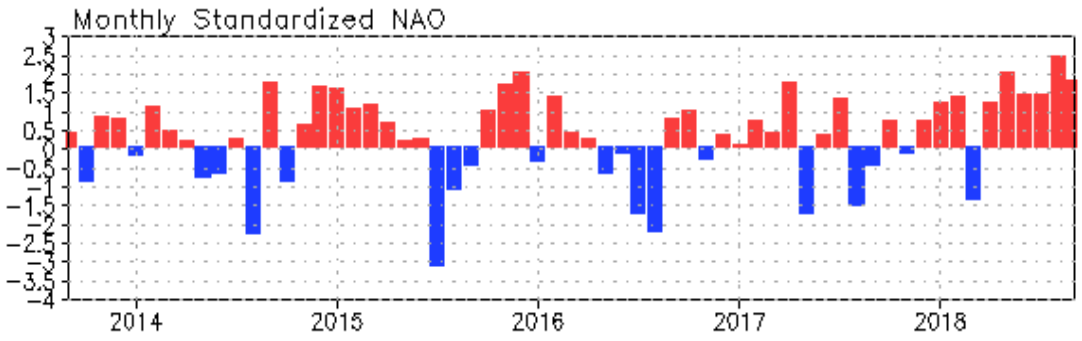
Pendad SSS Anomaly

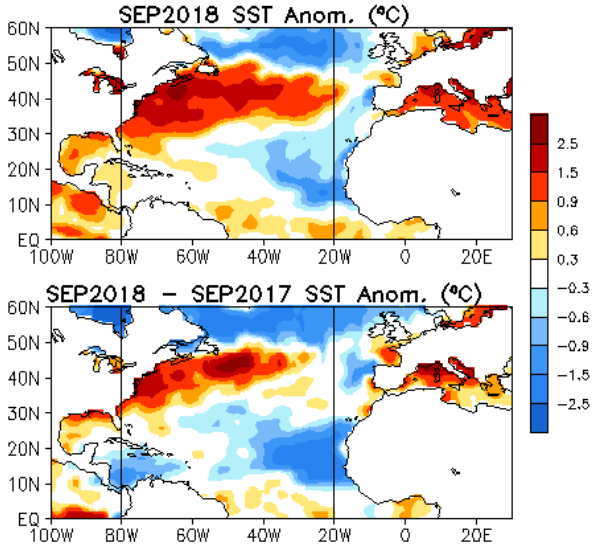


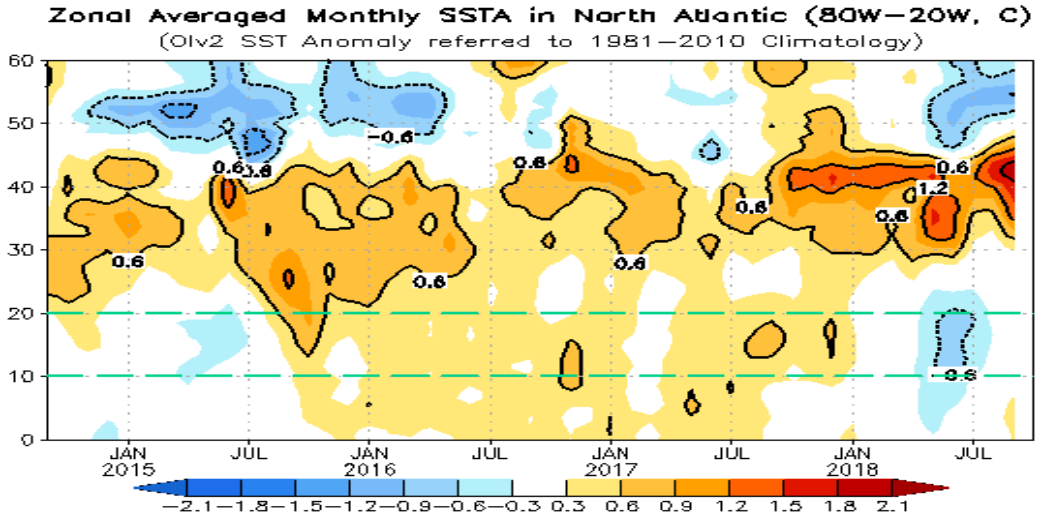
- **Footprints of the Atlantic hurricanes were clearly observed in the precipitation and SSS anomalies.**

SSS : Blended Analysis of Surface Salinity (BASS) V0.Z (a CPC-NESDIS/NODC-NESDIS/STAR joint effort)
(Xie et al. 2014) ftp.cpc.ncep.noaa.gov/precip/BASS
Precipitation: CMORPH adjusted satellite precipitation estimates

NAO and SST Anomaly in North Atlantic





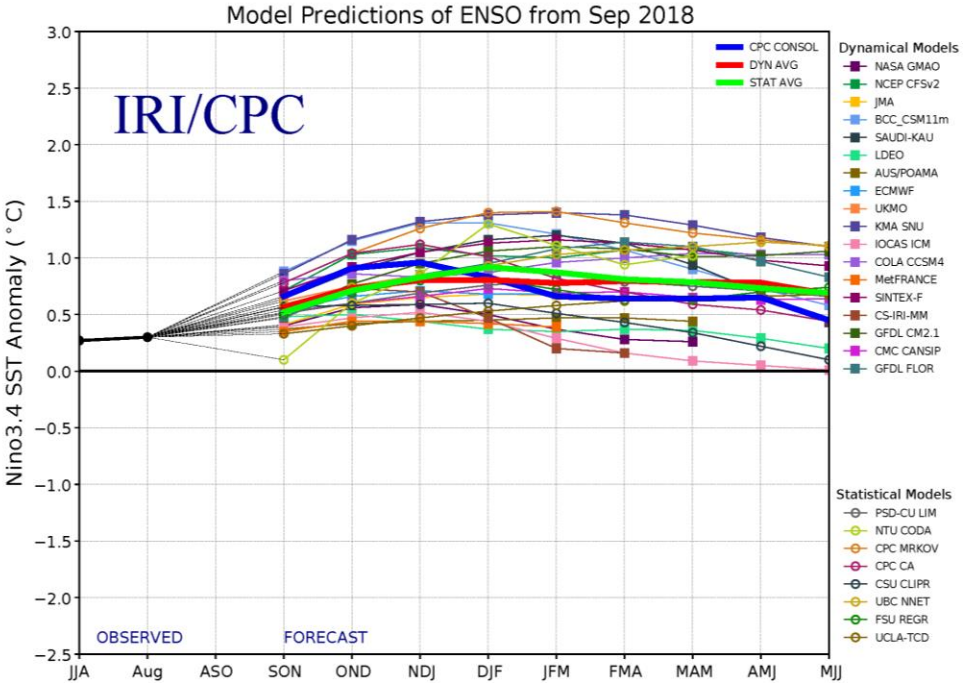


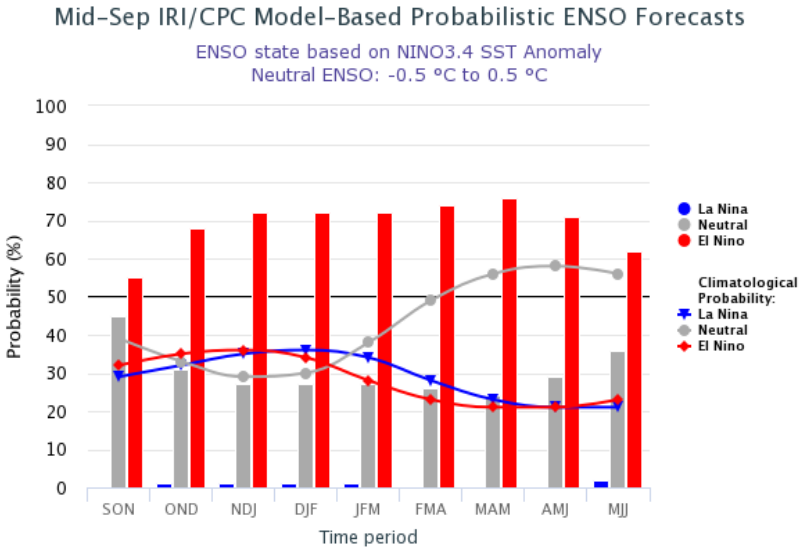
- **Positive NAO index continued to be well above average, with NAOI= +1.8 in Sep 2018.**

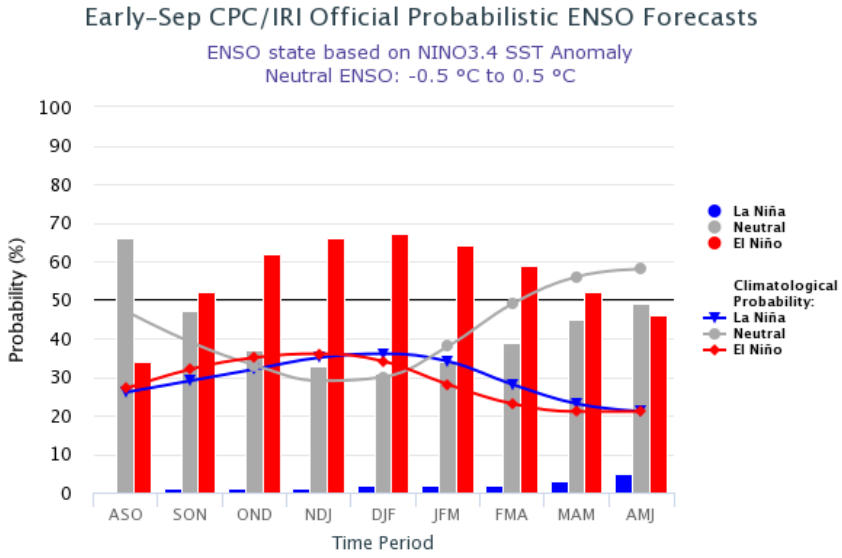
- **SSTA has a tripole/horseshoe pattern with positive in the mid- latitudes and negative in lower and higher latitudes, which resembled the late 2014 and 2015 period.**

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.

ENSO and Global SST Predictions



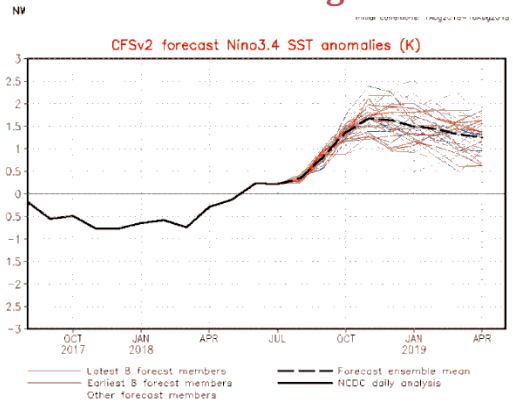




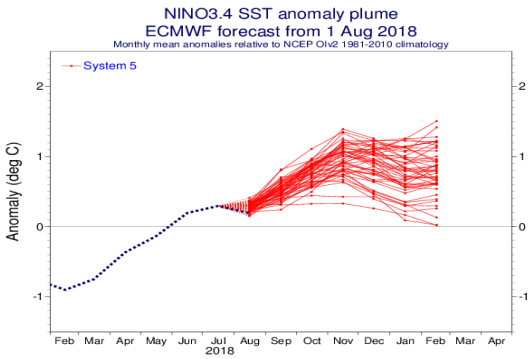
- **NOAA Continuously issued El Niño Watch in Oct.11 2018 and stated that El Niño is favored to form in the next couple of months and continue through the Northern Hemisphere winter 2018-19 (70-75% chance)**

Changes in NINO3.4 predictions

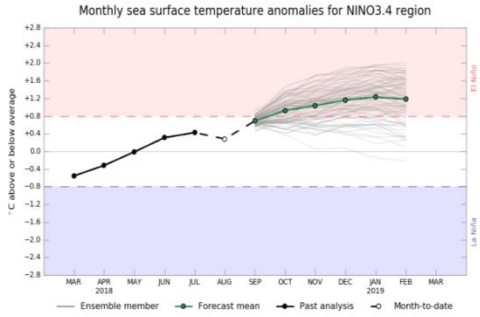
CFSv2 IC= 10 Aug 2018



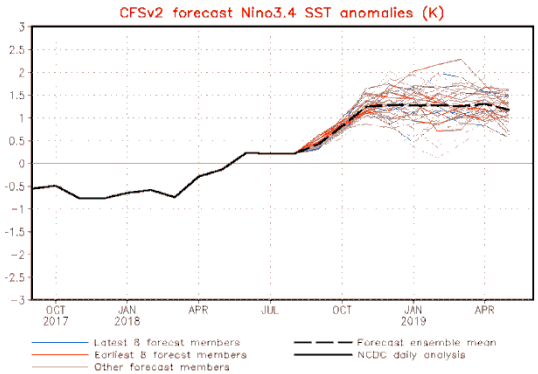
ECMWF IC= 1 Aug 2018



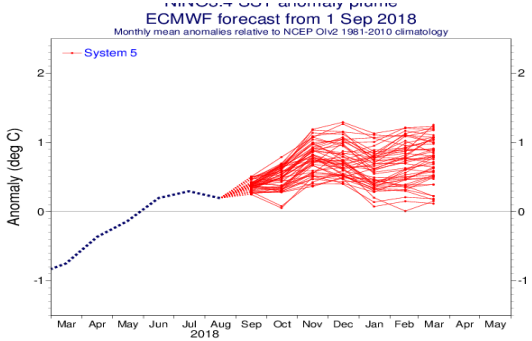
BOM, IC= 25 Aug 2018



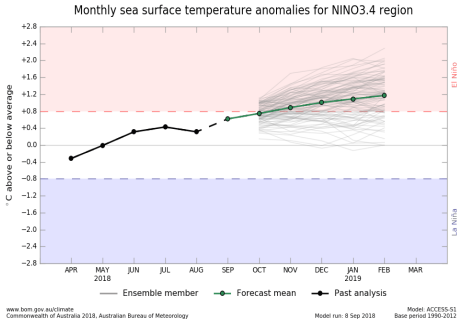
CFSv2 IC= 10 Sep 2018



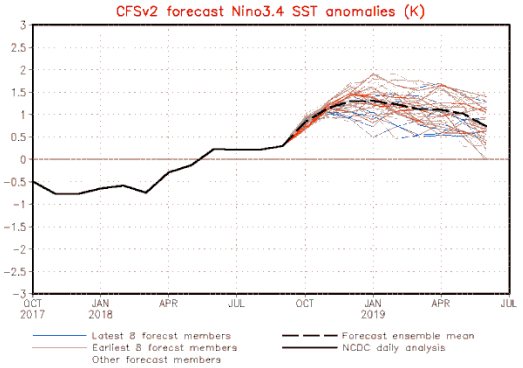
ECMWF IC= 1 Sep 2018

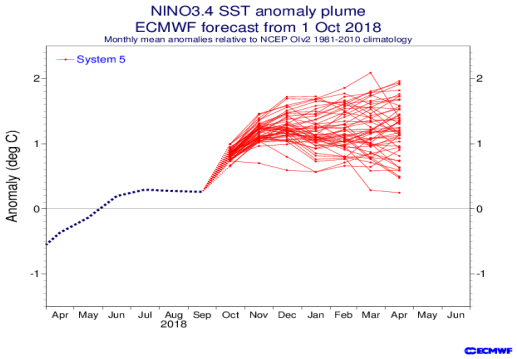


BOM IC= 8 Sep 2018

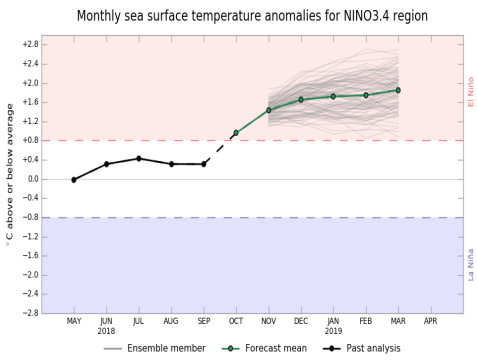


CFSv2 IC= 9 Oct 2018

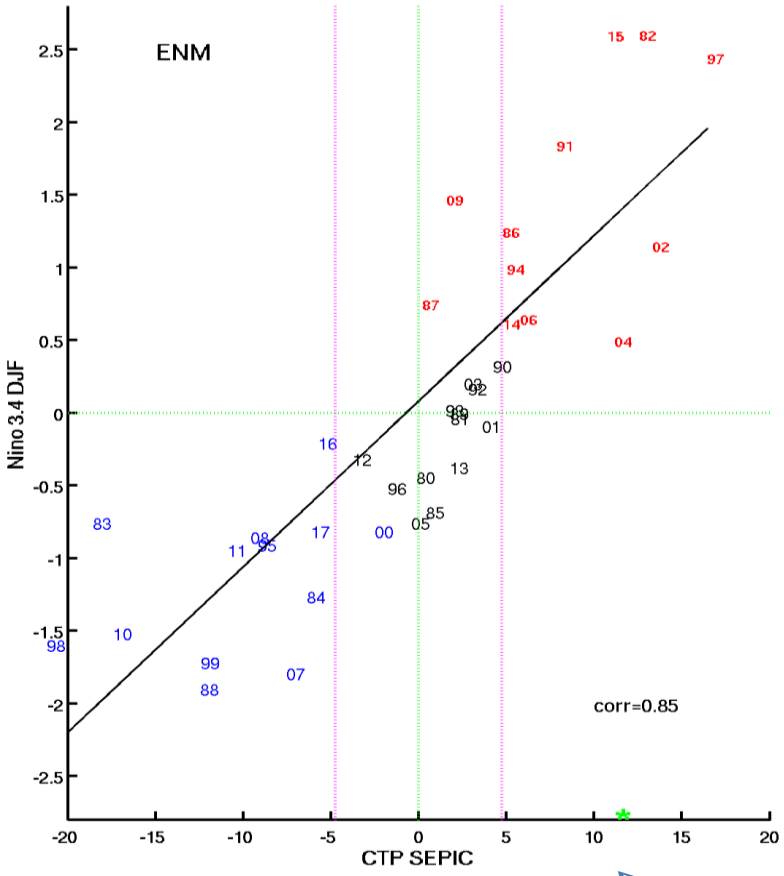




BOM IC= 6 Oct 2018



ENSO Precursor: Central Tropical Pacific D20 (CTP) vs. NINO3.4 in DJF



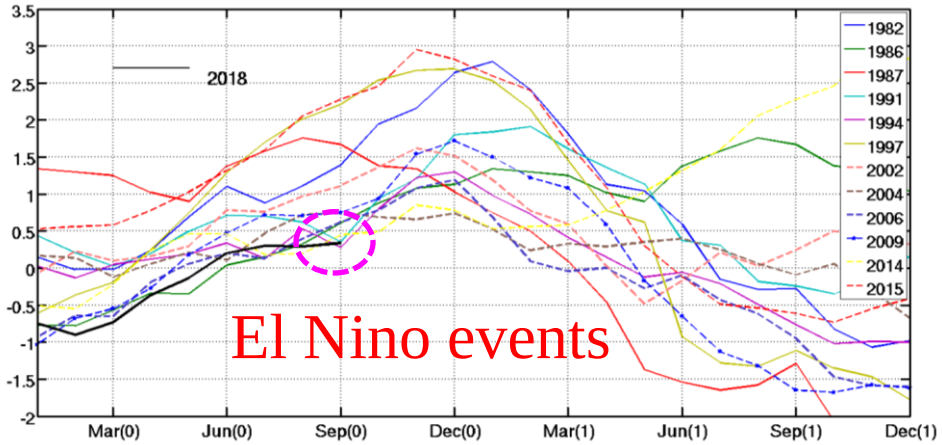
2x2 contingency table El Niño Case (1980-2017)	Sep Criterion: 4.74 = 0.5 STD
Percent correct rate	0.95 (36/38)
Hit rate	0.83 (10/12)
False alarm rate	0 (0/10)

CTP in September * **CTP in September 2018**

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

SST,D20 and 925hPa Wind anomalies in September

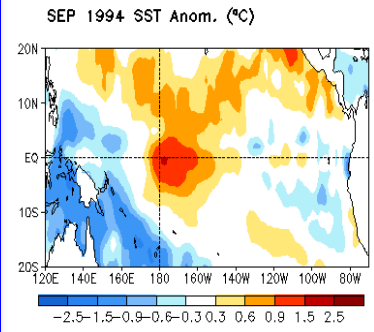
NINO3.4 Anomaly

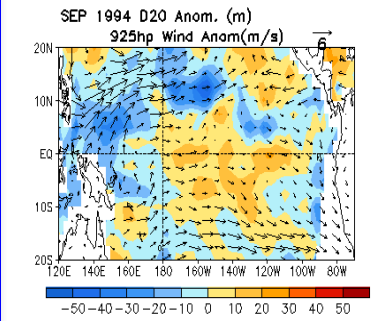


Weak El Niños

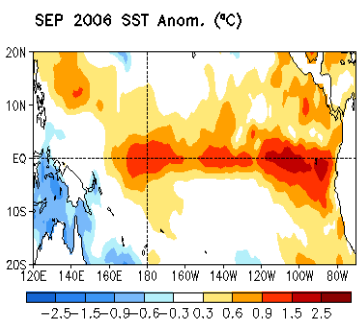
Strong El Niños

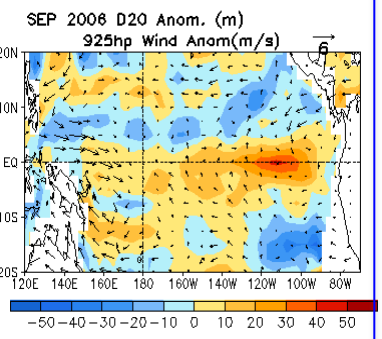
1994



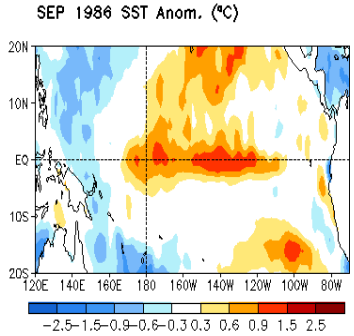


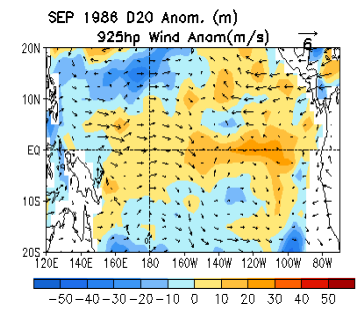
2006



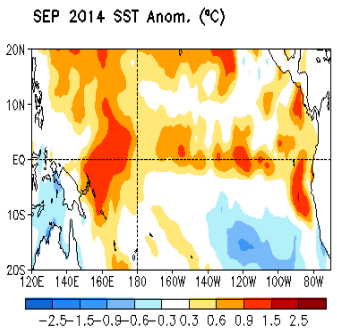


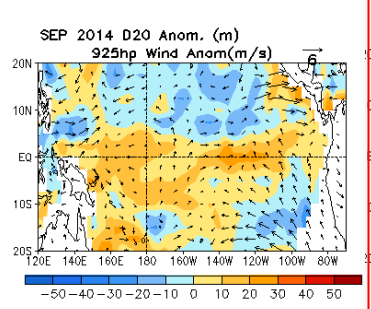
1986



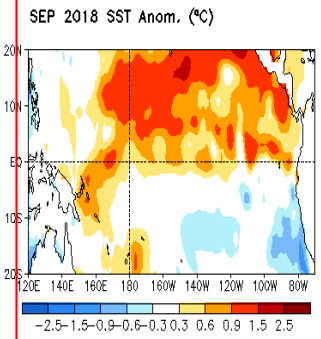


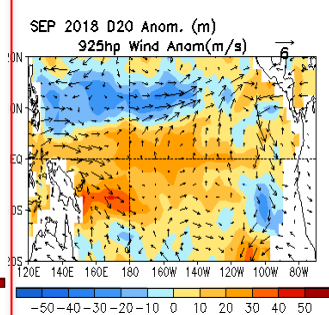
2014





2018

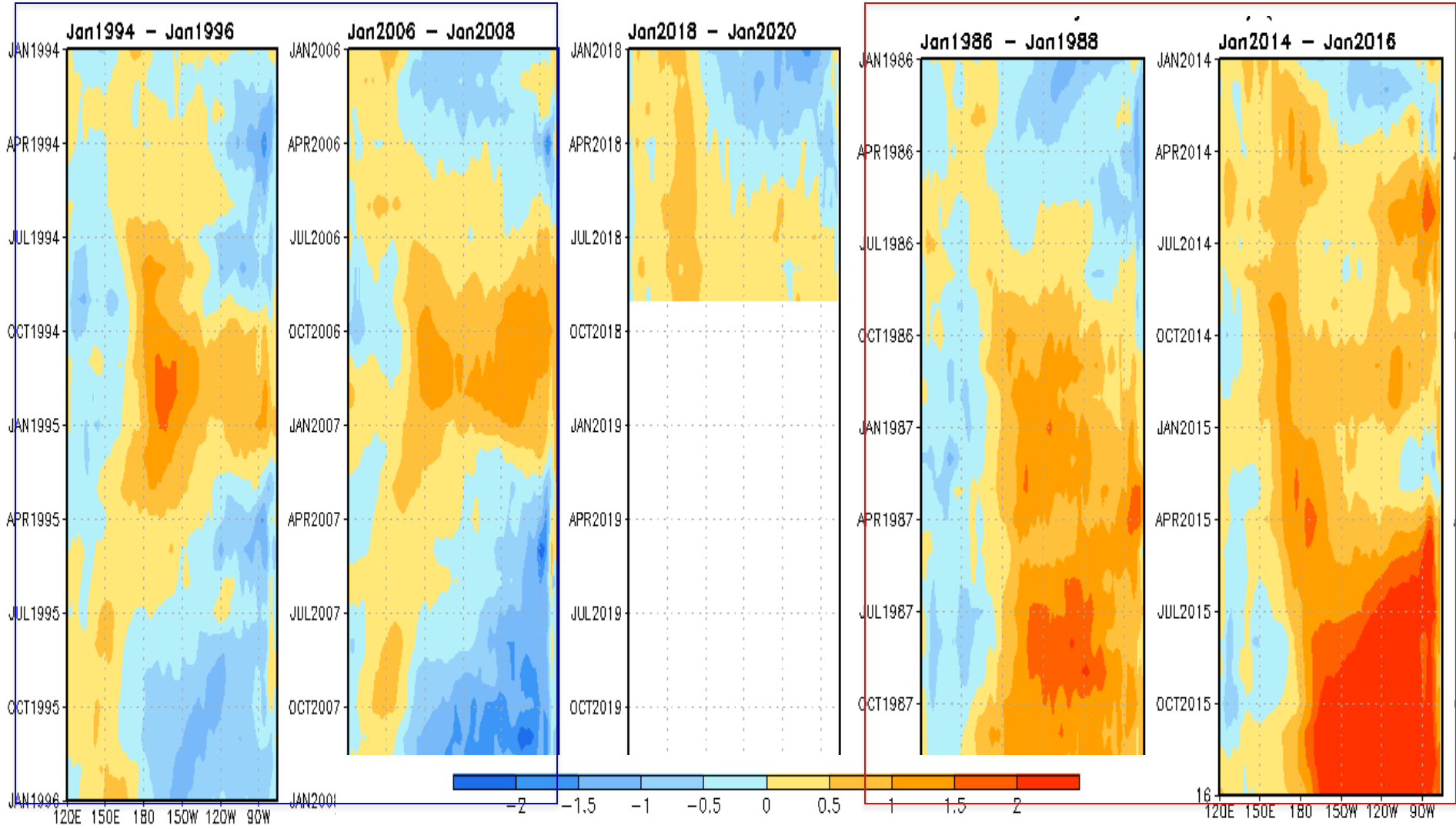




Monthly Mean SST Anomaly across [5S-5N]

Weak El Niños

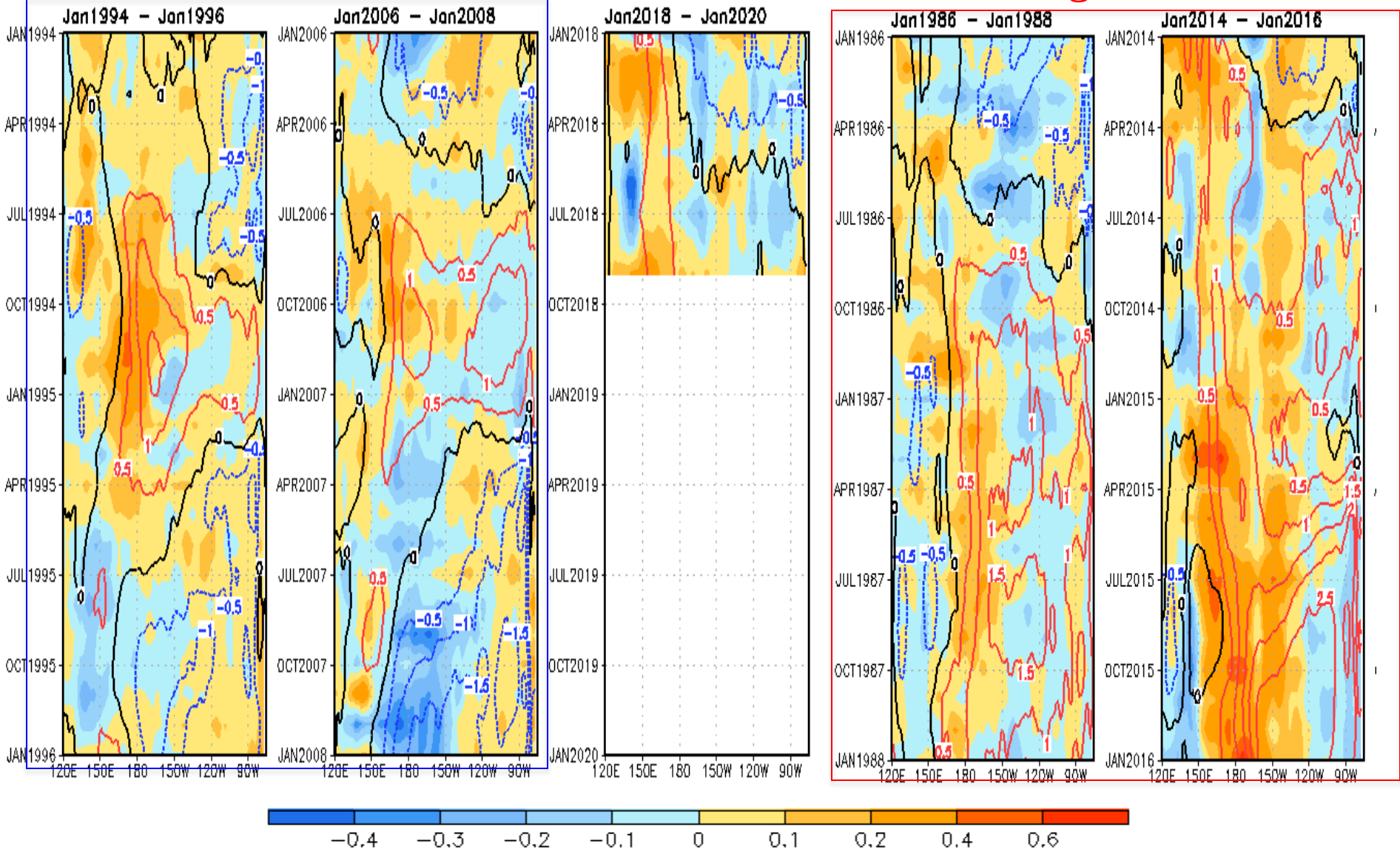
Strong El Niños



Monthly Mean Zonal Wind Stress Anomaly across [5S-5N]

Weak El Niños

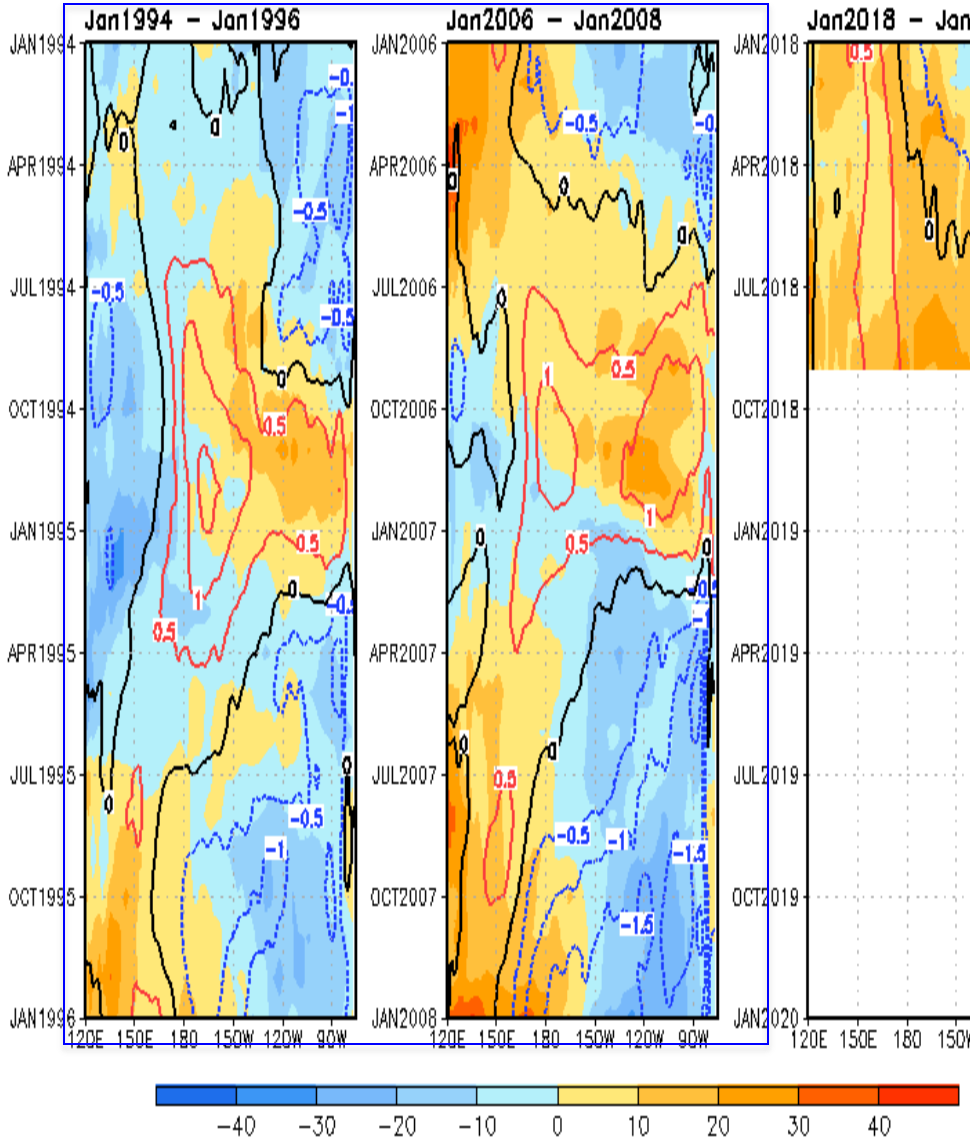
Strong El Niños

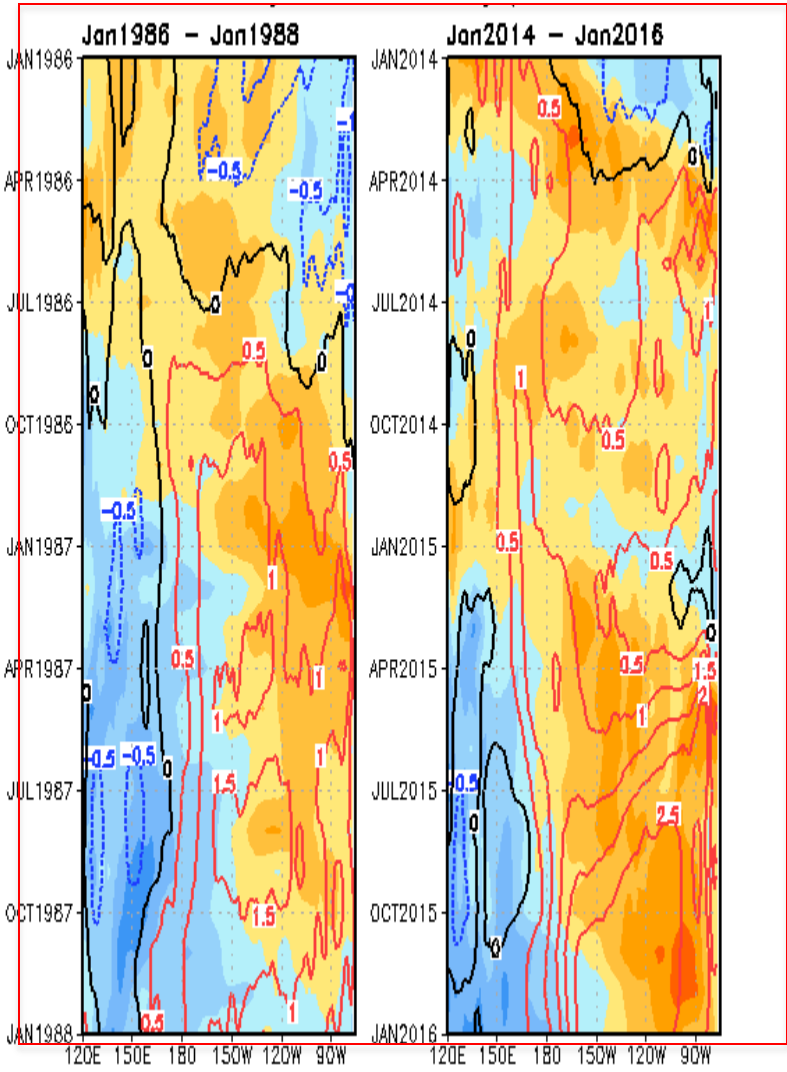


Monthly Mean D20 Anomaly across [5S-5N]

Weak El Niños

Strong El Niños





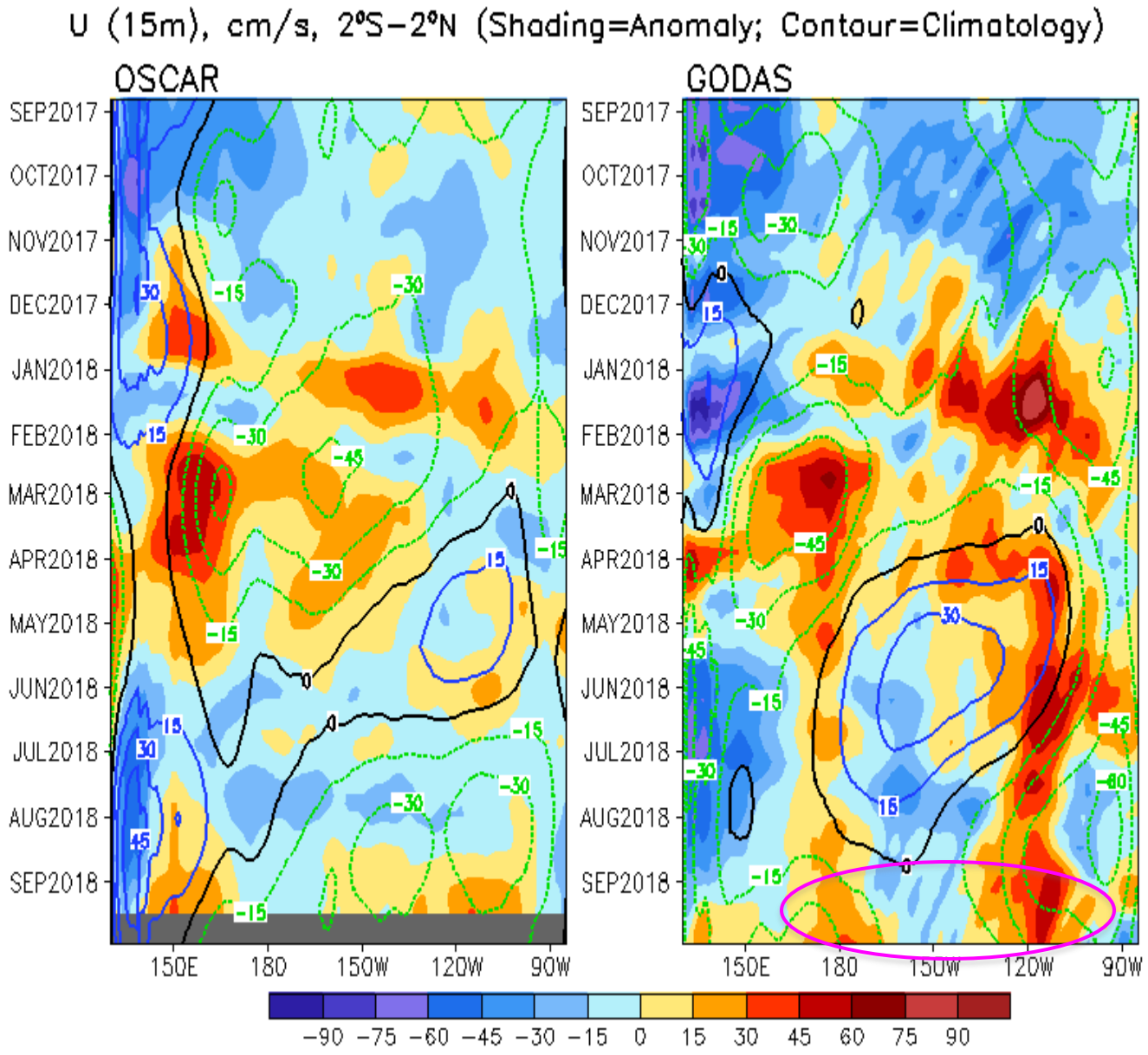
Acknowledgements

- Dr. Zeng-Zhen Hu , Yan Xue and Arun Kumar: reviewed PPT, and provided insight and constructive suggestions and comments

- Drs. Li Ren and Pingping Xie: Provided SSS slides

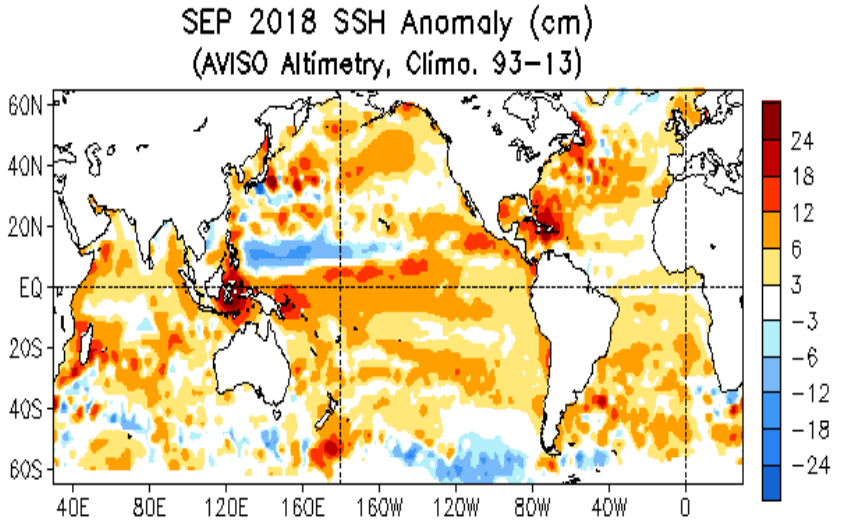
Back up

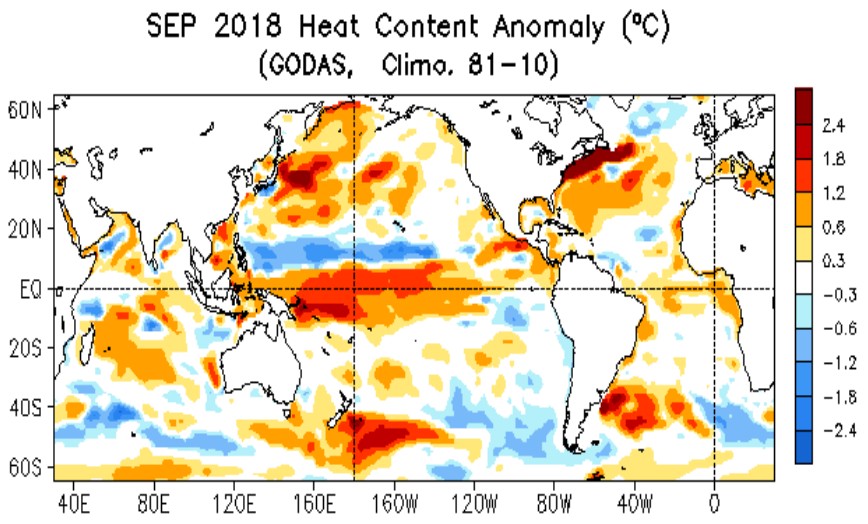
Evolution of Equatorial Pacific Surface Zonal Current Anomaly (cm/s)

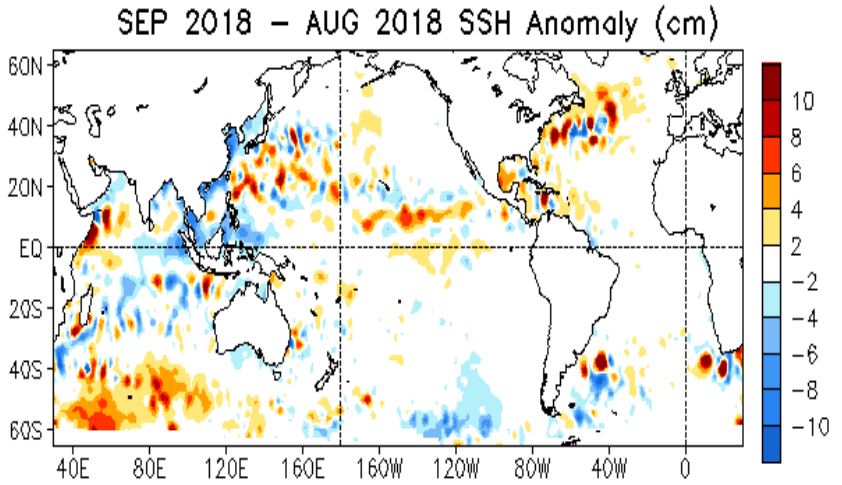


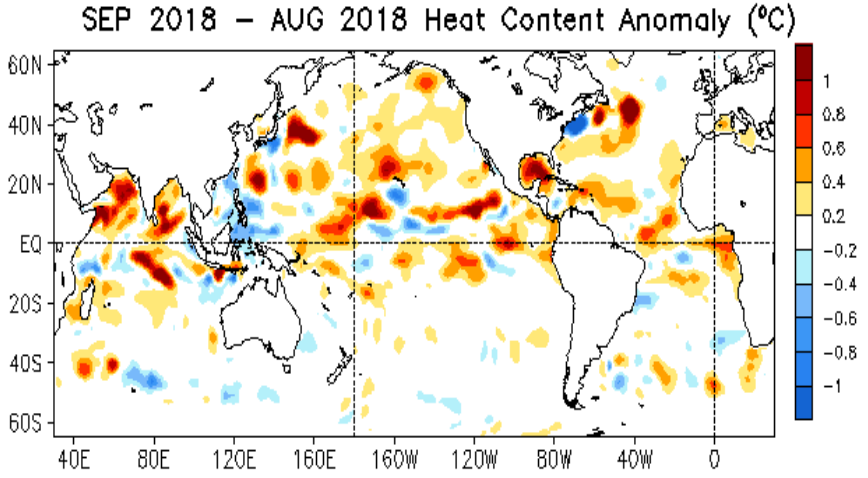
-Positive zonal current anomalies dominated cross much of the equatorial Pacific in Sep 2018.

Global SSH and HC300 Anomaly and Anomaly Tendency



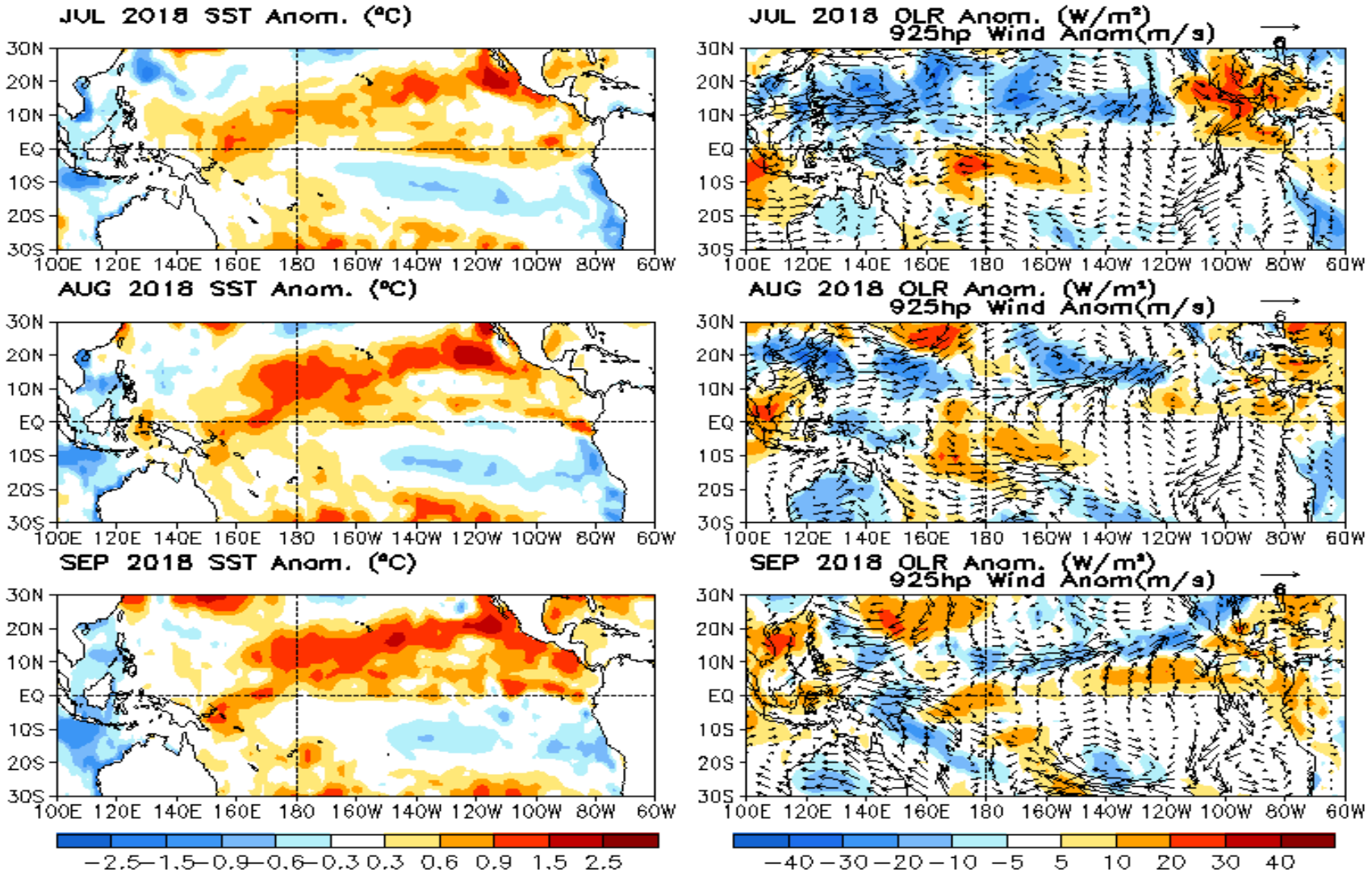






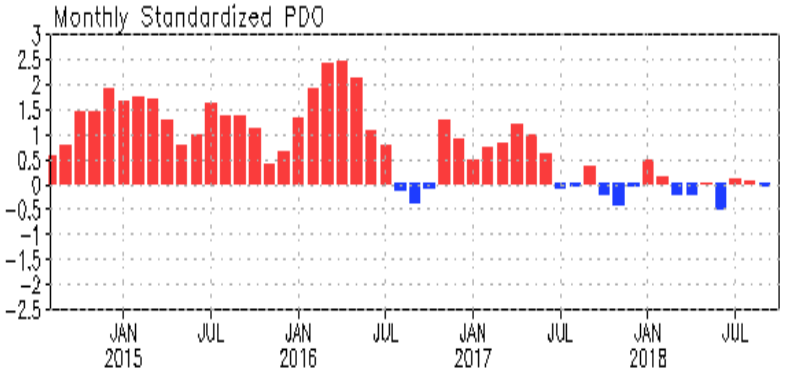
- **SSHA pattern was overall consistent with H300A pattern in the Pacific Ocean.**

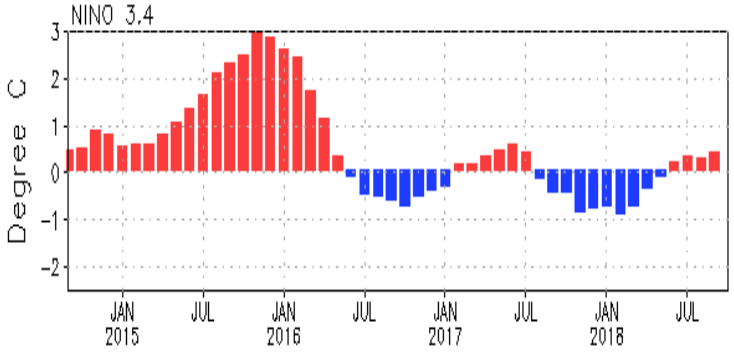
Last Three Month SST, OLR and 925hPa Wind Anomalies

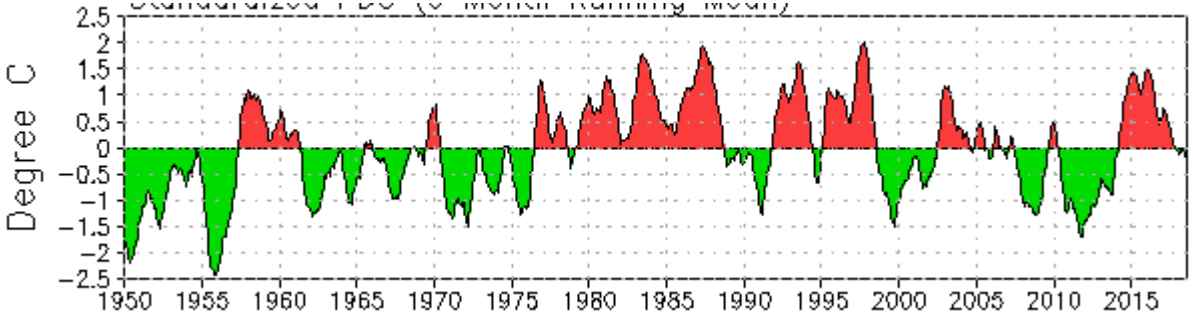


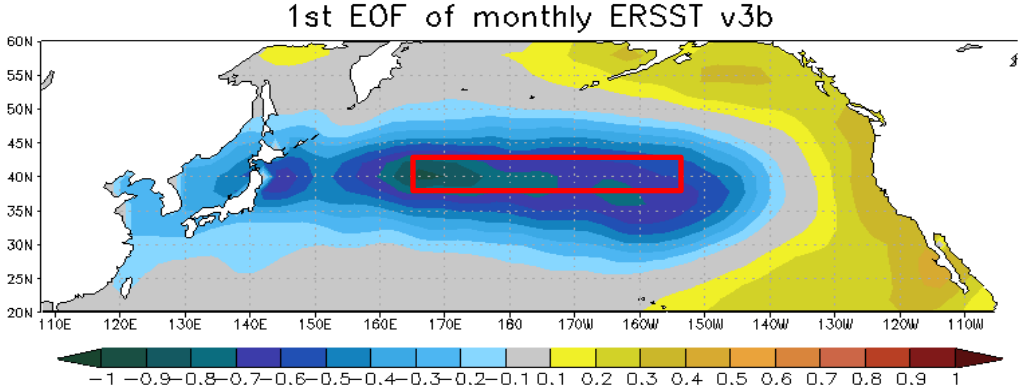
- **Most of positive SSTA were confined in the north of the equator.**

PDO index









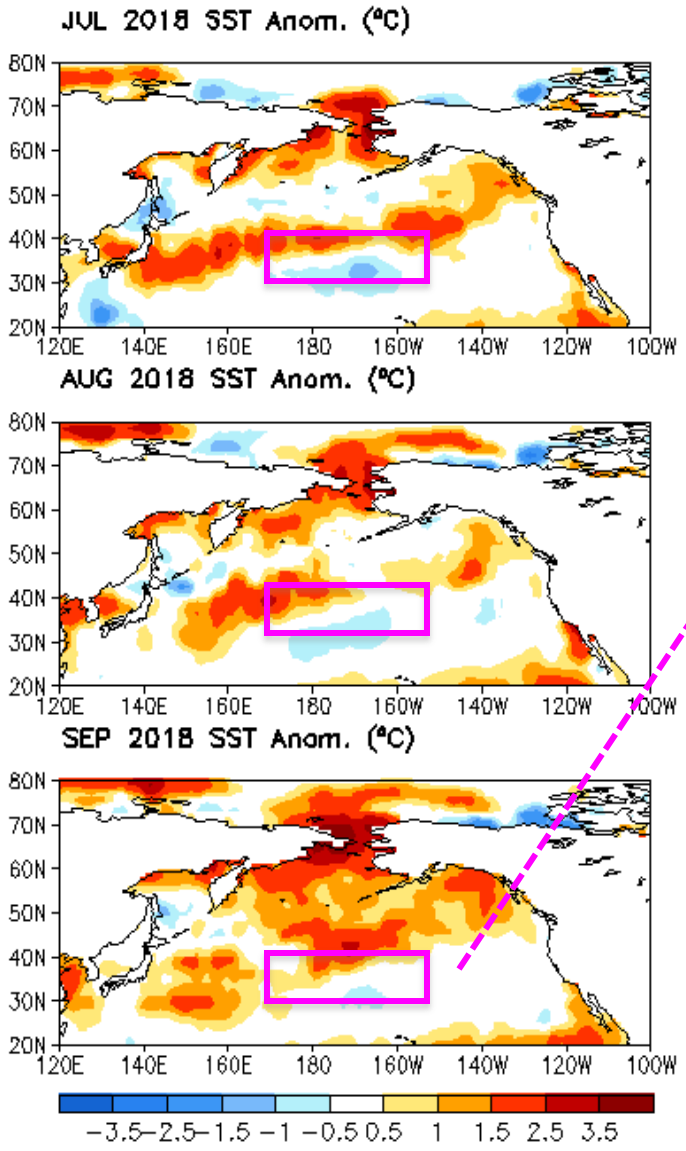
-PDO index = -0.1 in Sep 2018.

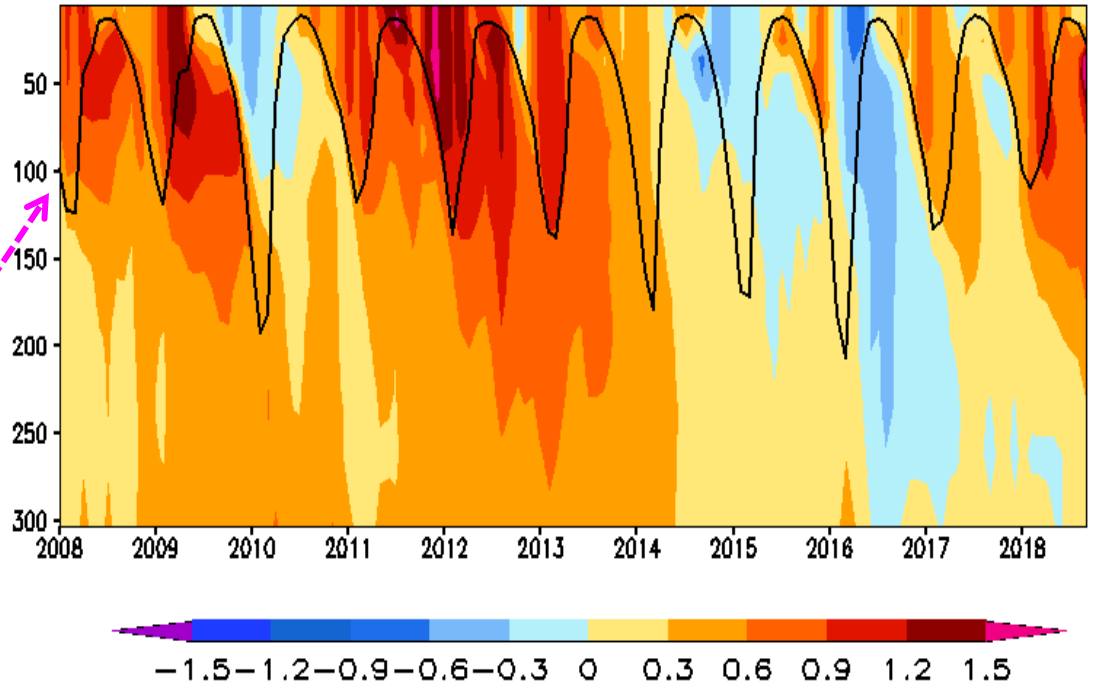
- Statistically, ENSO leads PDO by 3-4 months, may through atmospheric bridge.

- 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.

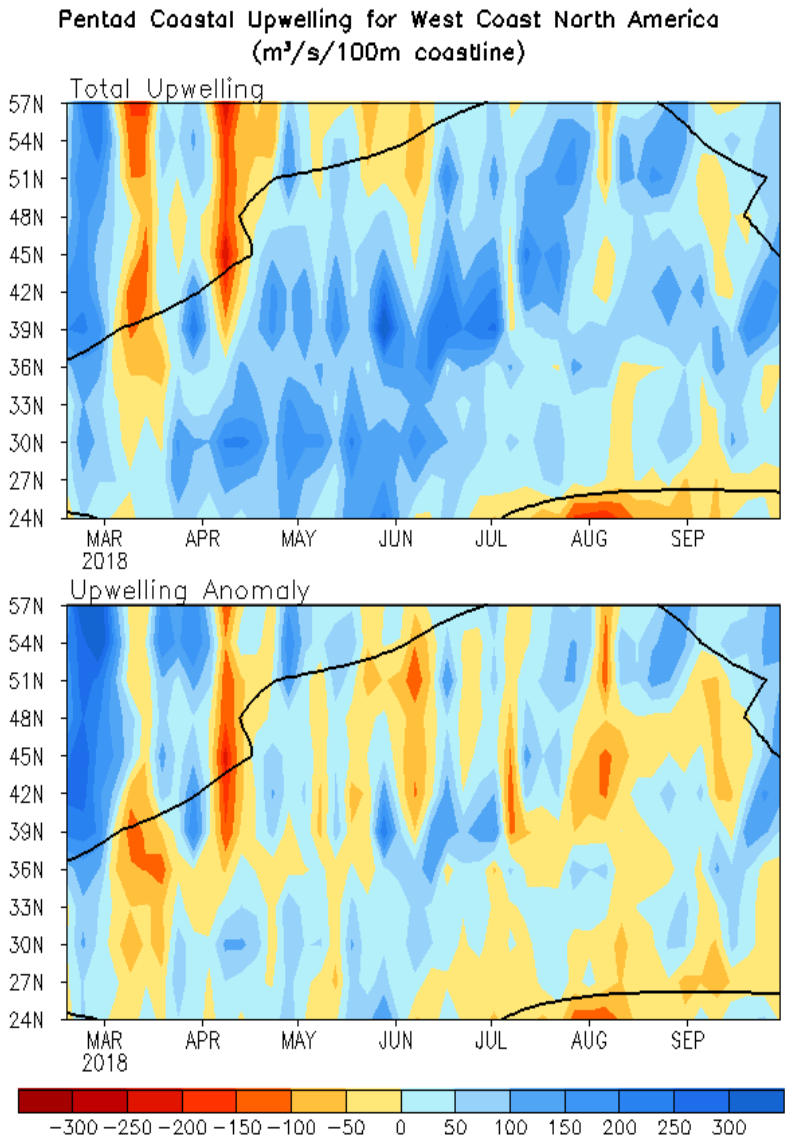
Subsurface Temperature Anomaly in the C. N Pacific

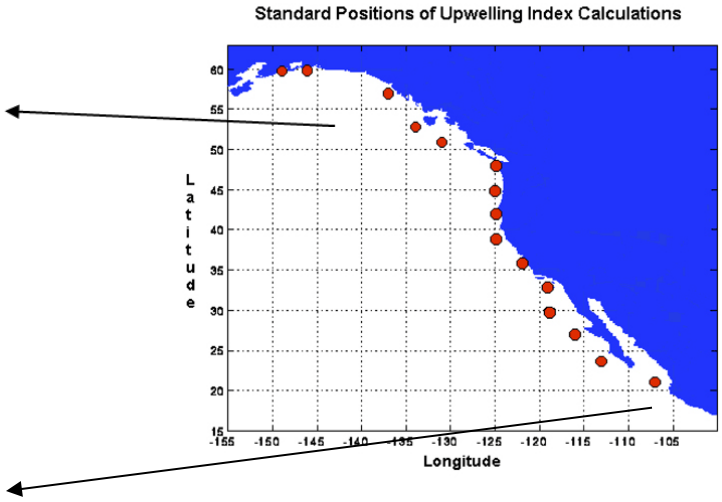




- **Positive subsurface temperature anomaly in the central North Pacific has persisted since 2016.**

North America Western Coastal Upwelling





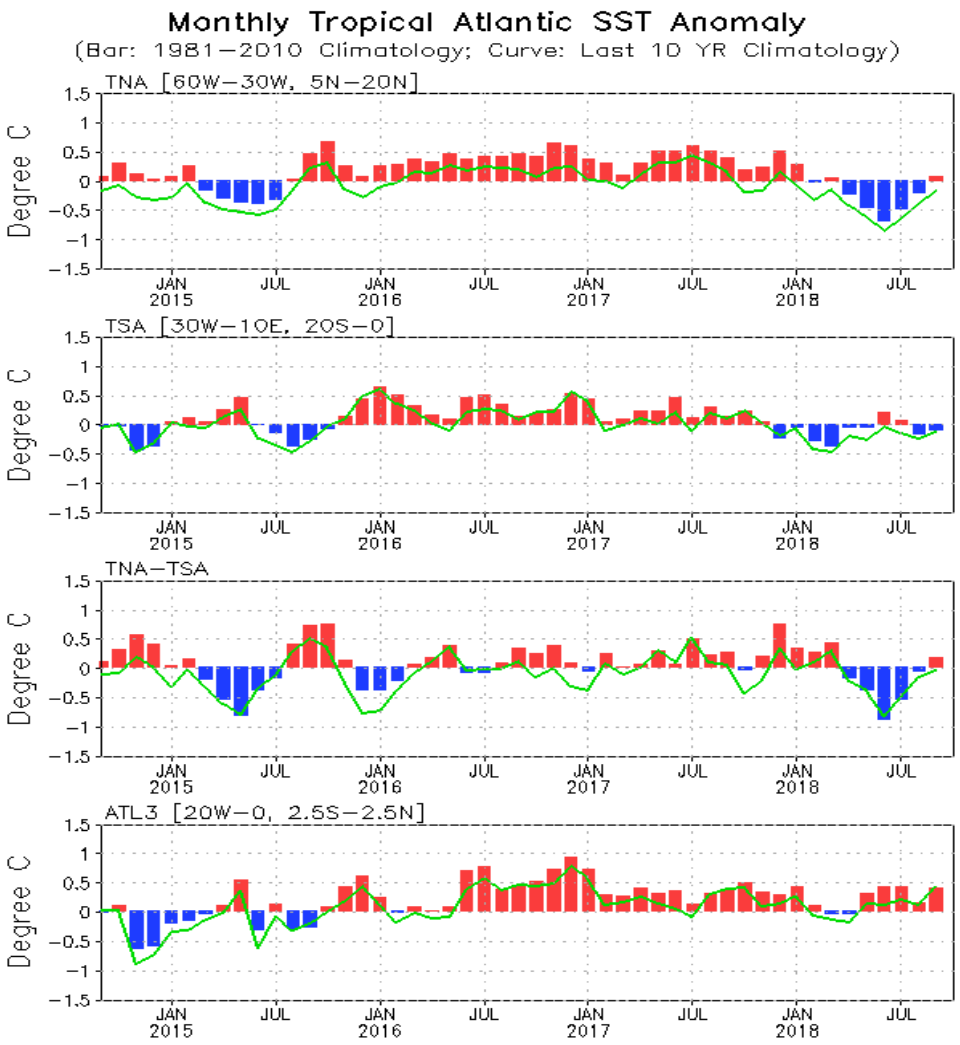
- **Both anomalous upwelling and downwelling were small.**

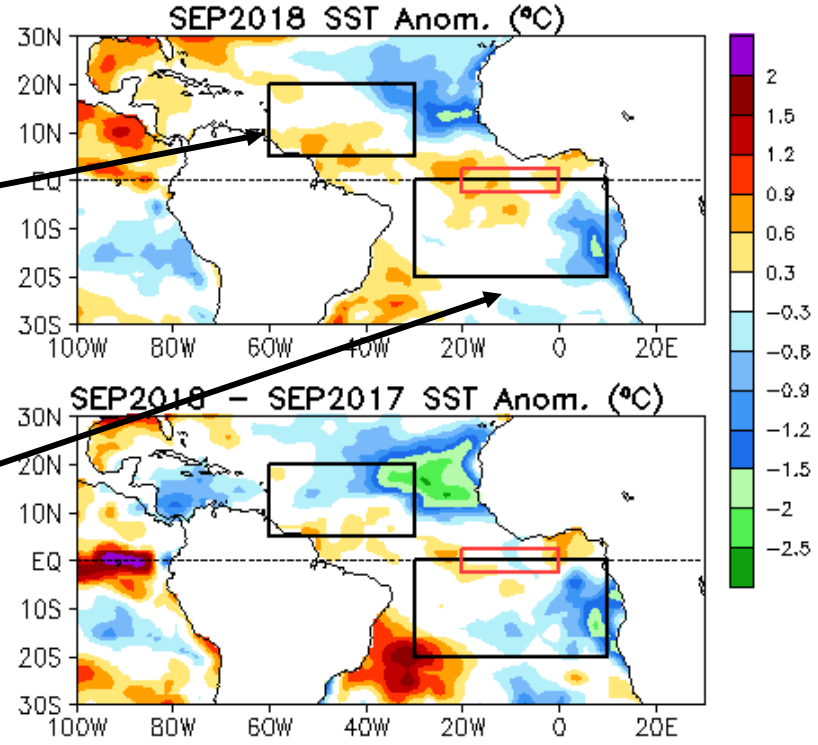
Fig. NP2. Total (top) and anomalous (bottom) upwelling indices at the 15 standard locations for the western coast of North America. Upwelling indices are derived from the vertical velocity of the NCEP's global ocean data assimilation system, and are calculated as integrated vertical volume transport 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.

gical upwelling (downwelling) season.

- **Climatologically upwelling season progresses from Mayil to July along the west coast of North America from 36ºN to 57ºN.**

Evolution of Tropical Atlantic SST Indices

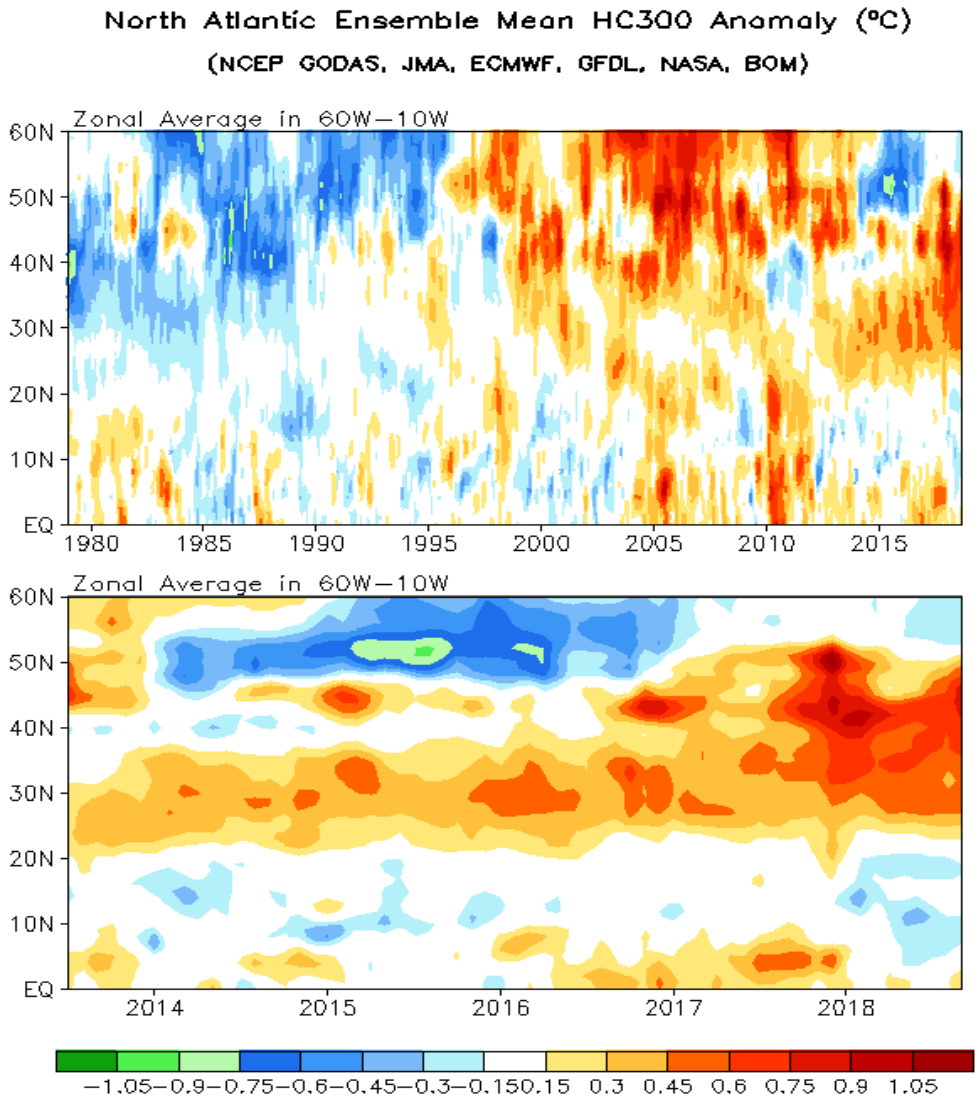


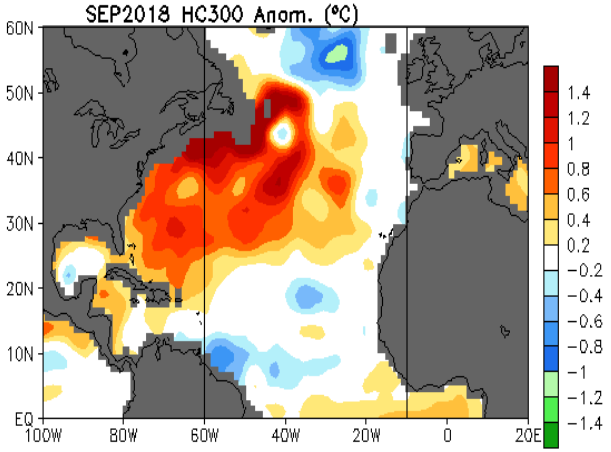


- **Positive Atl 3 increased in Sep 2018.**

- **The SST in the eastern tropical N Atlantic in Sep 2018 was about 2 degree colder than that in Sep 2017 .**

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.





- HC300 anomaly has a tripole/horseshoe pattern with positive in the mid- latitudes and negative in lower and higher latitudes.

-The "cold blob" in the subpolar gyre in 2014-2016 was comparable to that before 1996.

- The "cold blob" weakened substantially during 2017-2018.

CPC's Markov Model NINO3.4 Forecast

(http://www.cpc.ncep.noaa.gov/products/people/yxue/ENSO_forecast_clim81-10_godas.html)

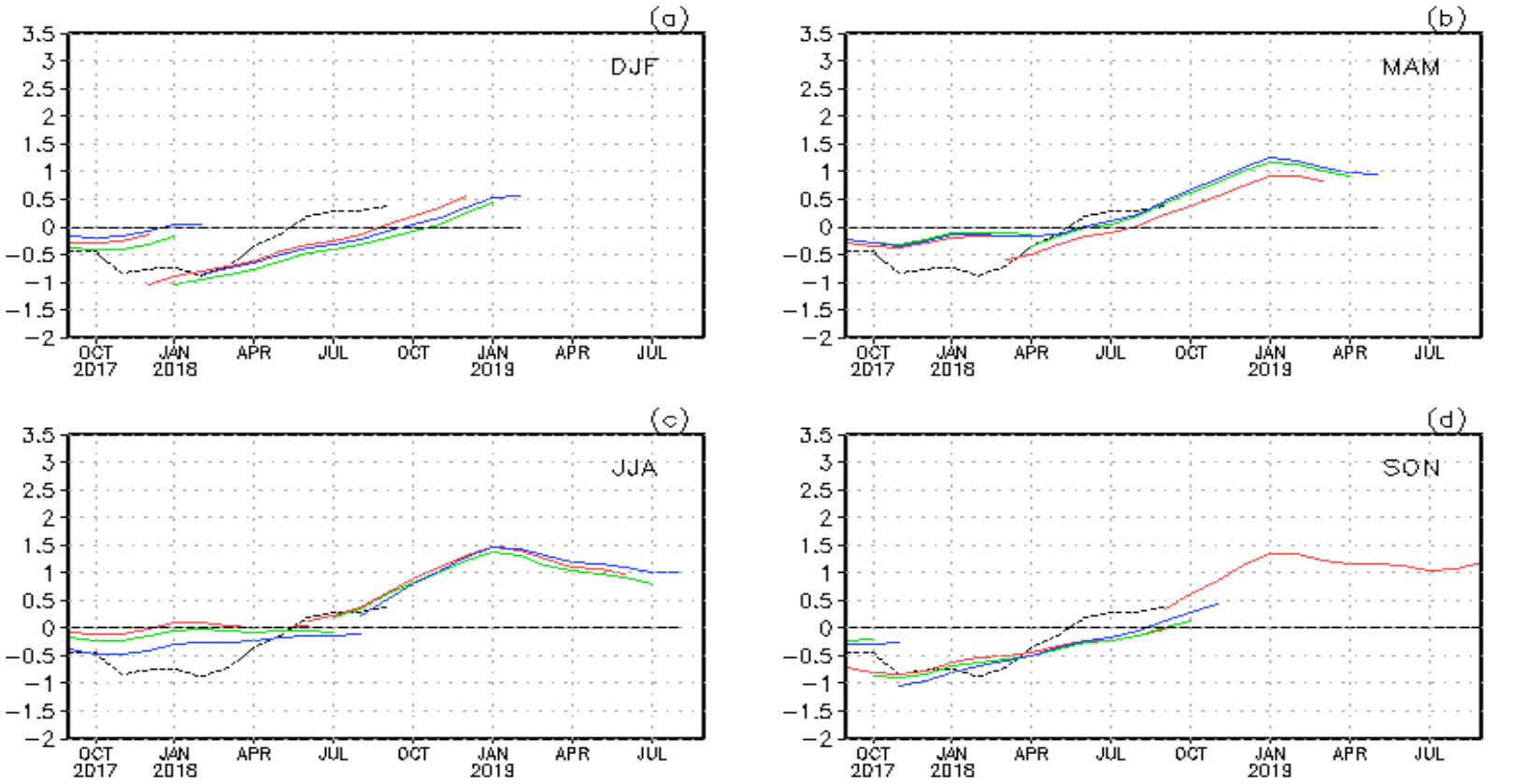
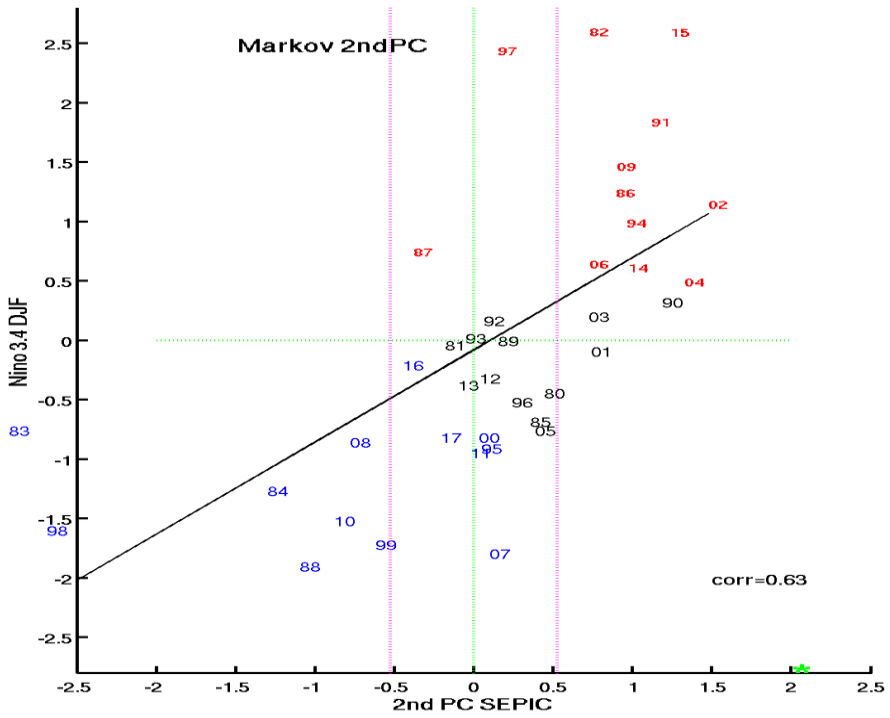


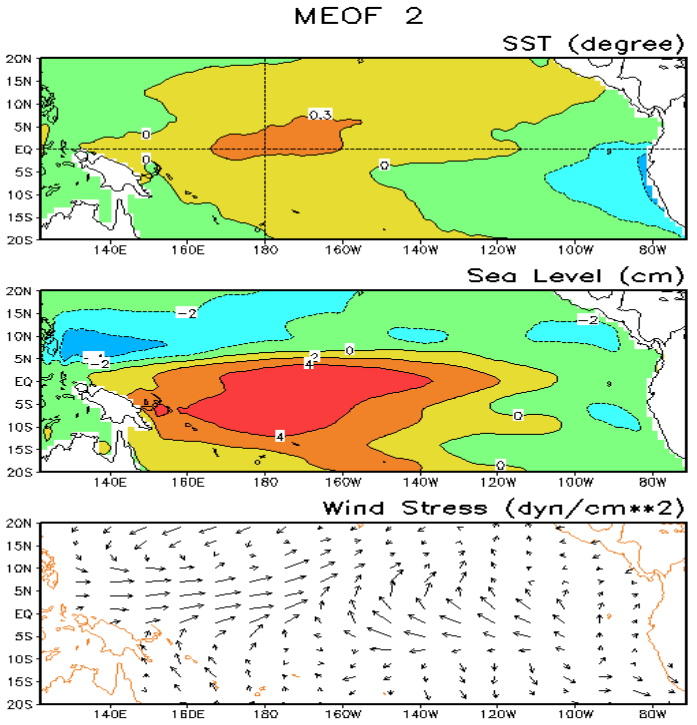
Fig. 4. Time evolution of NINO3.4 forecasts up to 12 lead months by the Markov model initiated monthly up to September 2018. Shown in each panel are the forecasts grouped by three consecutive starting months: (a) is for December, January and February, (b) is for March, April and May, (c) is for June, July and August and (d) is for September, October and November. The observed NINO3.4 SST anomalies are shown in the heavy-dashed lines.

ENSO Precursor: Markov PC2 vs. NINO3.4 in DJF

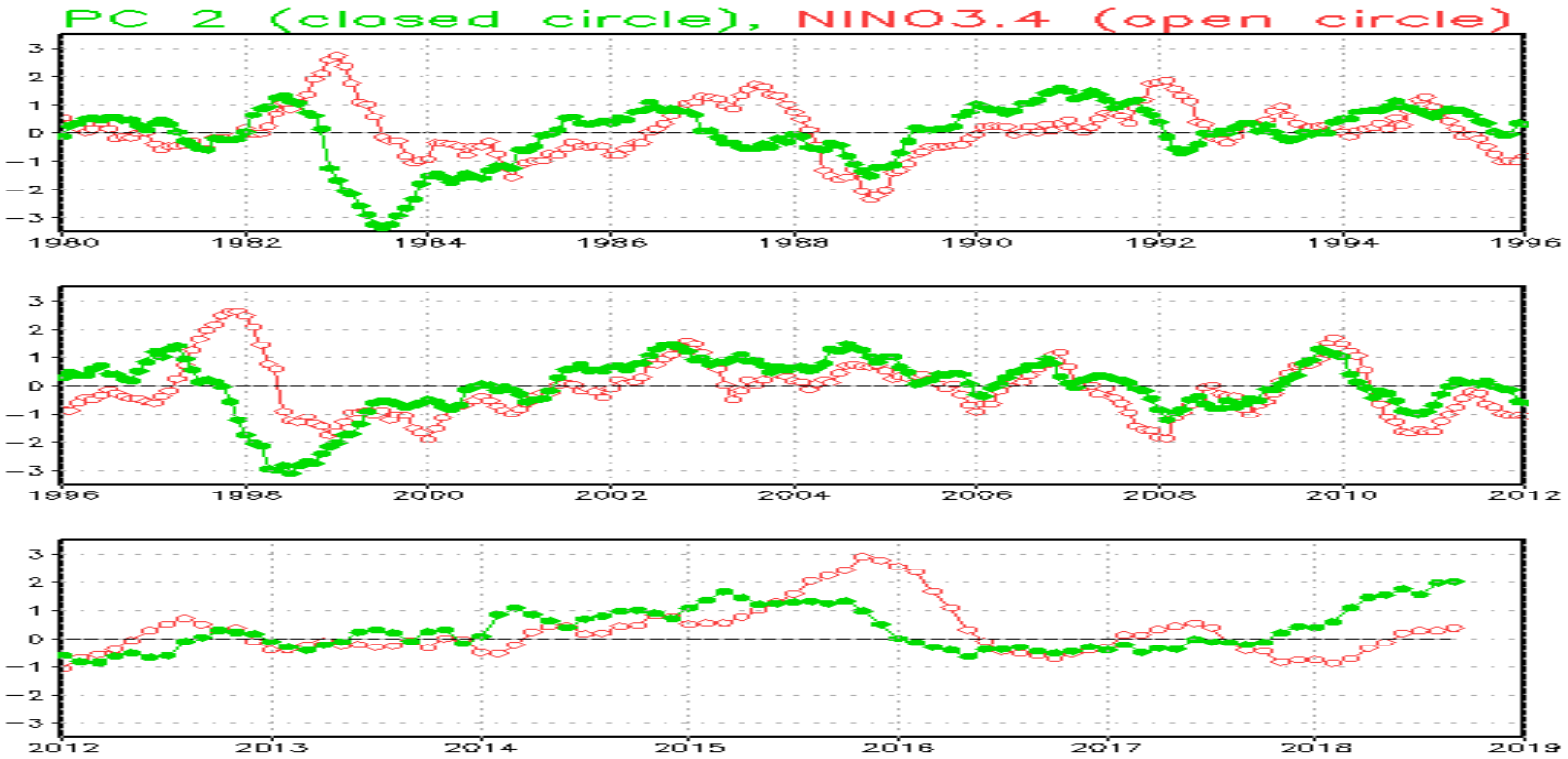


* Markov 2nd PC in Sep 2018

2x2 contingency table El Nino Case (1980-2017)	Sep Criterion: 0.56=0.5 STD
Percent correct rate	0.9 (33/38)
Hit rate	0.83(10/12)
False alarm rate	0.23 (3/13)

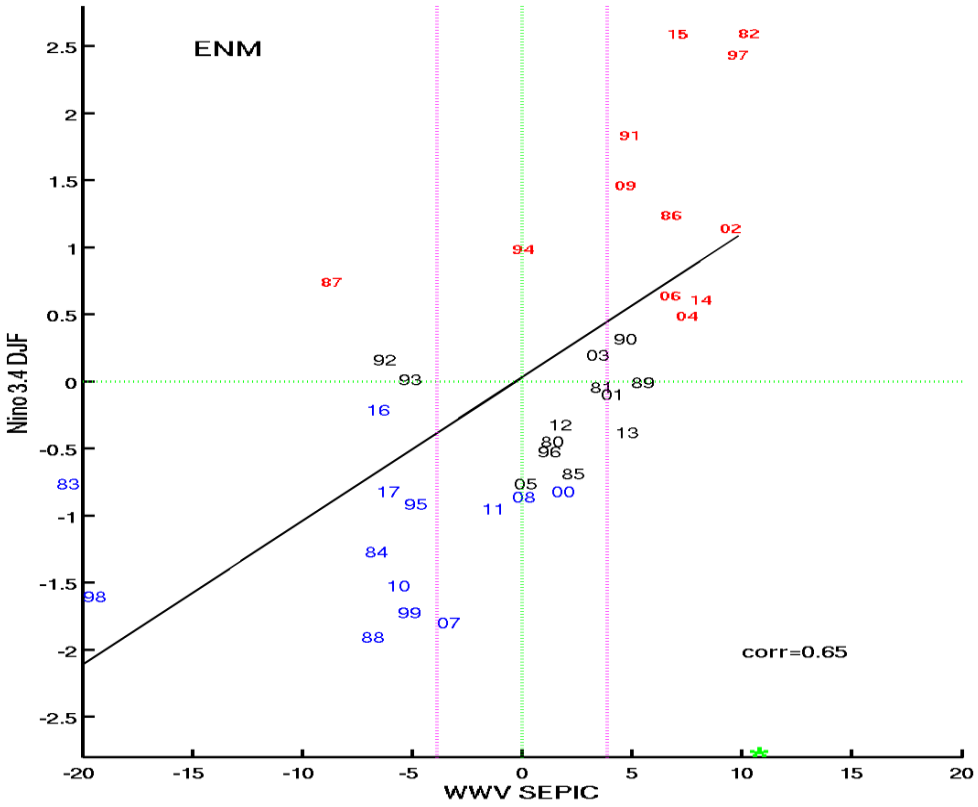


http://www.cpc.ncep.noaa.gov/products/people/yxue/ENSO_forecast_clim81-10_godas.html



PC2	82	86	91	94	97	02	04	06	09	14	15	18
Jun	1.3	1.1	1.2	0.8	0.6	1.1	1.3	0.5	0.3	0.4	1.2	1.7
Jul	1.1	0.9	0.9	0.9	0.1	1.3	1.2	0.6	0.4	0.7	1.3	1.6
Aug	1.1	0.8	1.1	1.2	0.2	1.4	1.5	0.7	0.8	0.8	1.3	1.9
Sep	0.7	0.9	1.1	1.0	0.2	1.5	1.3	0.5	0.9	1	1.2	2.0

ENSO Precursor: Warm Water Volume (WWV) vs. NINO3.4 in DJF



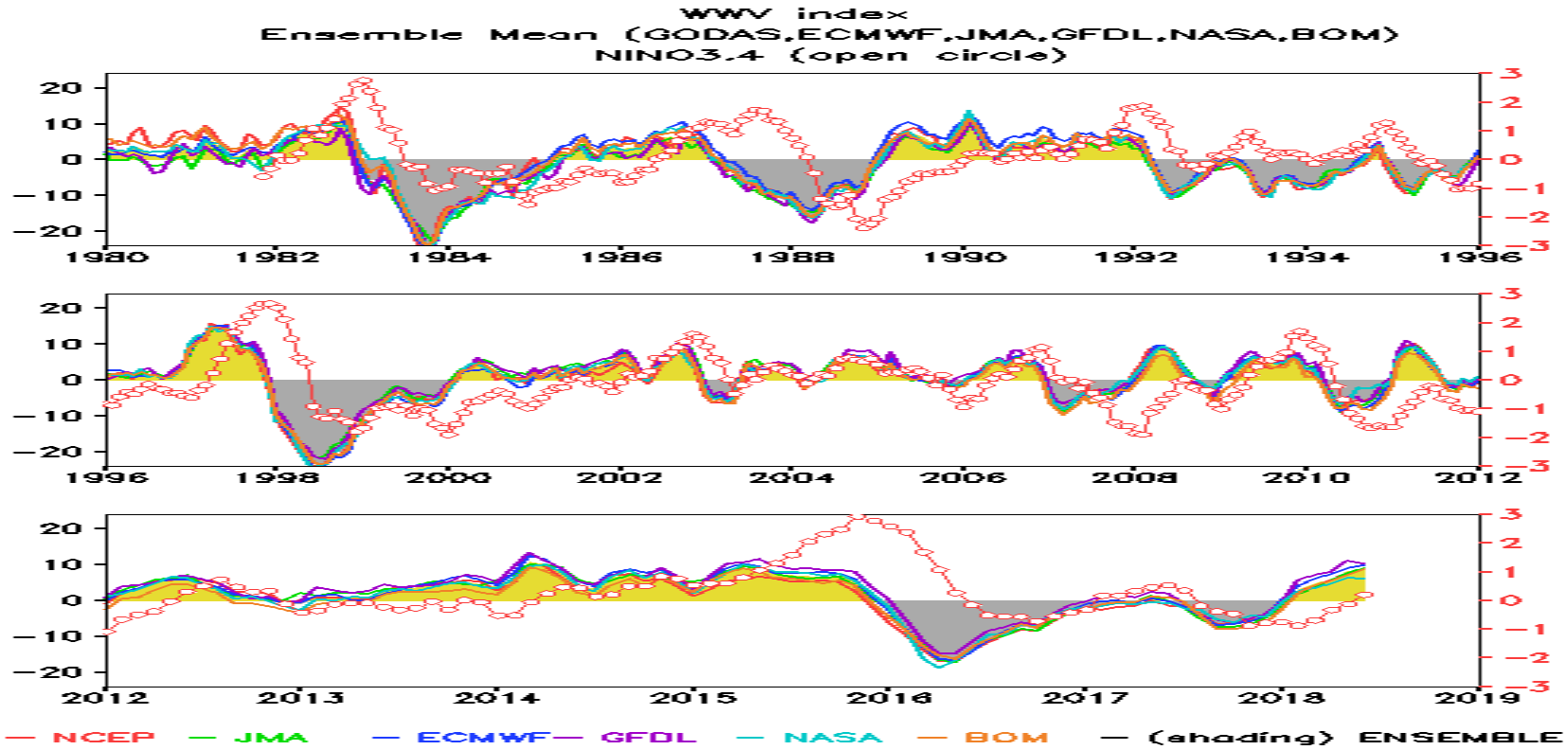
2x2 contingency table El Nino Case (1980-2017)	September Criterion: 3.9= 0.5 STD
Percent correct rate	0.9 (33/38)
Hit rate	0.83 (10/12)
False alarm rate	0.23(3/13)

WWV in Sep

* **WWV in Sep 2018**

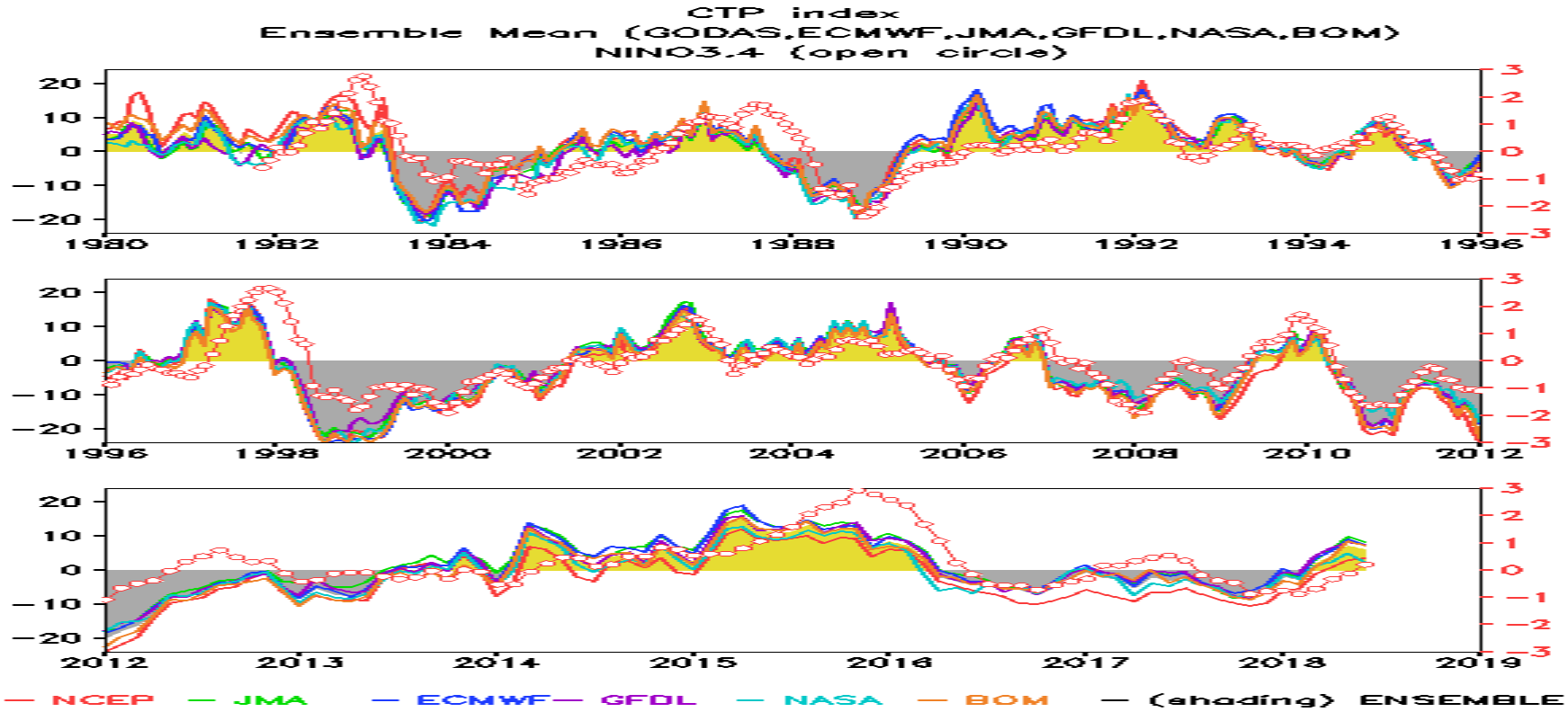
Data downloadable from http://www.cpc.ncep.noaa.gov/products/GODAS/multiora_body.html

Warm Water Volume (WWV) & NINO3.4 (open circles)



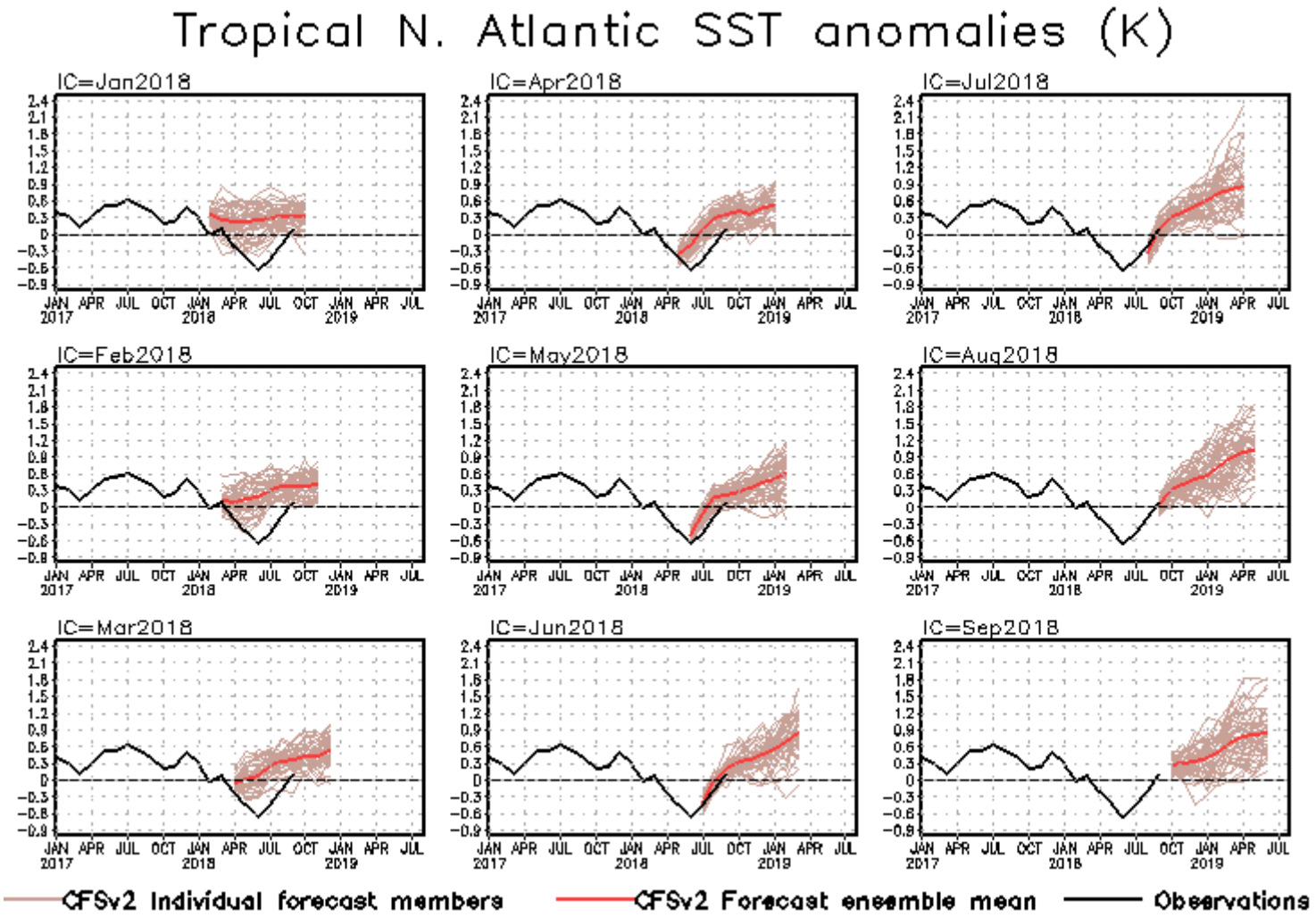
ENM WWV	82	86	87	91	94	97	02	04	06	09	14	15	18
Jun	7.2	6.6	-5.7	5.5	-3.3	14.8	3.5	1.6	5.5	6.5	4.2	7.4	8.8
Jul	7.4	6.2	-7.2	5.9	-3.1	12.1	4.7	5.5	4.4	5.2	3.1	7.0	8.2
Aug	8.4	6.3	-6.6	4.8	-0.4	8.9	6.6	5.2	6.3	4.4	6.2	6.8	8.5
Sep	9.8	6.3	-9.2	4.4	-0.4	9.3	9.0	7.0	6.3	4.4	7.6	6.6	10.3

Central Tropical Pacific (CTP) Index & NINO3.4 (open circles)



ENM CTP	82	86	91	94	97	02	04	06	09	14	15	18
Jun	8.6	5.0	7.6	-0.6	14.2	5.5	4.6	0.4	0.9	2.9	11.0	6.0
Jul	8.3	2.4	7.6	-0.8	10.3	6.8	10.4	2.1	1.8	1.4	11.2	6.8
Aug	11.1	3.3	7.0	5.0	11.1	10.8	8.2	5.6	1.5	4.0	13.3	7.5
Sep	12.6	4.8	7.9	5.0	16.4	13.3	11.1	5.8	1.6	4.8	10.7	11.1

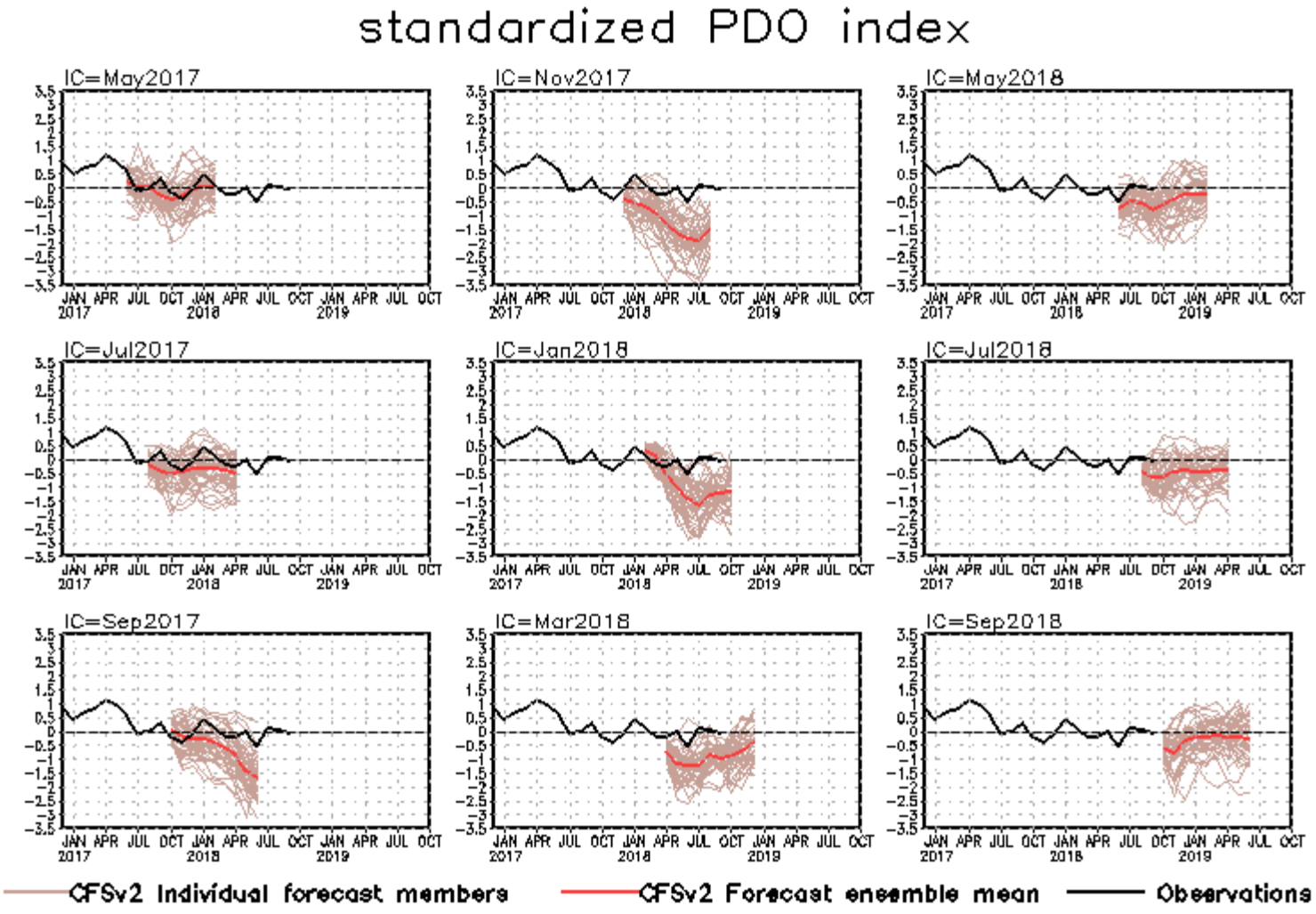
CFS Tropical North Atlantic (TNA) SST Predictions from Different Initial Months



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.

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

CPC's Sea Surface Salinity (SSS) Monitoring Products

- **Monthly SSS**
  - *BASS (Blended Analysis of Surface Salinity, Xie et al. 2014)*
  - *Combining information from in situ measurements and satellite retrievals*
  - *1.0^{o} over the global ocean, monthly from January 2010*
  - *Supporting CPC's Monthly Ocean Briefing in real-time*
- **Pentad SSS**
  - *Resolving SSS variations associated with MJO and oceanic mesoscale processes and interactions with ENSO*
  - *In situ pentad mean salinity data from NCEI*
  - *Satellite retrievals from multiple satellites (*NASA/SMAP, ESA/SMOS, NASA/Aquarius)
  - *OI-based blending technique developed for monthly analysis revised for pentad applications*

Primary Features of the Pentad Global SSS Monitoring Package

- Refined Resolution
  - *daily updated pentad*
  - *Spatial resolution kept at 1.0^{o}lat/lon due to restriction in inputs*
- Reduced Production Latency
  - *2 days after the ending date for each pentad*
- Composed of SSS , E, P, and E-P
  - *SSS: BASS/Pentad (in situ – Satellite Blended Analysis)*
  - *E: CFSR Evaporation adjusted against OAFlux*
  - *P: Bias Corrected CMORPH satellite precipitation estimates*

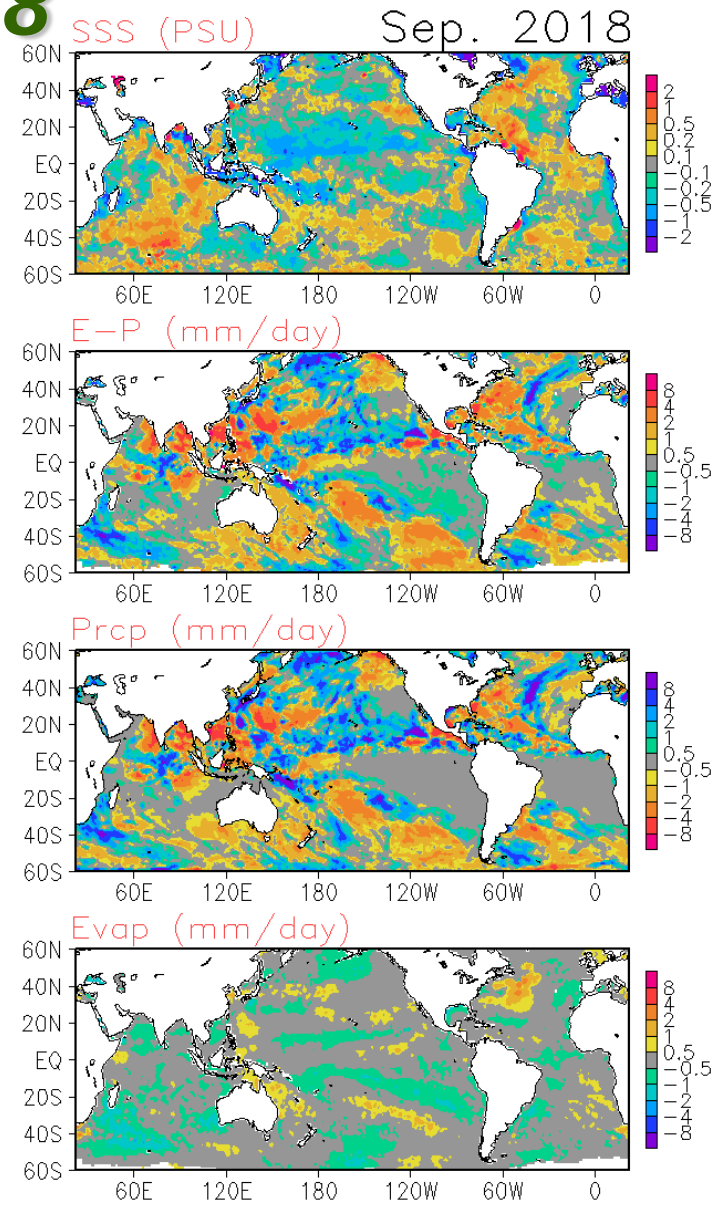
Global Sea Surface Salinity (SSS)

Anomaly for September 2018

- **New Update: The input satellite sea surface salinity of SMAP from NSAS/JPL was changed from Version 4.0 to Near Real Time product in August 2018.**
- **Attention: There is no SMAP SSS available in July 2018**
- A large scale of negative SSS signal between equator and 20˚ N in the N. Pacific Ocean continues this month. This negative SSS signal is likely caused by the increased precipitation in this area. Also, a large scale of freshening appeared in the subarctic region of N. Pacific between 35˚ N and 50˚ N, which is possibly caused by heavier precipitation. West basin of the equatorial Indian ocean became freshening this month. The positive SSS along the Gulf Stream continues. Meanwhile, the negative SSS in the central N. Atlantic ocean is co-incident with a strong positive precipitation signal.

- **Data used**

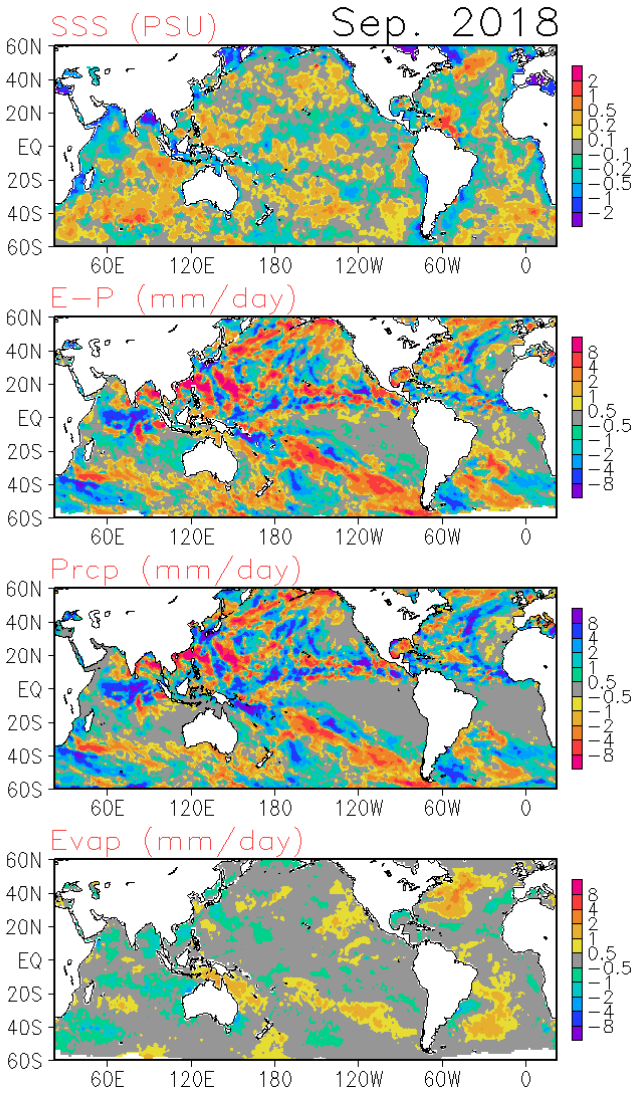
  SSS : Blended Analysis of Surface Salinity (BASS) V0.Z
  (a CPC-NESDIS/NODC-NESDIS/STAR joint effort)
  (Xie et al. 2014)
  ftp.cpc.ncep.noaa.gov/precip/BASS
  Precipitation: CMORPH adjusted satellite precipitation estimates
  Evaporation: Adjusted CFS Reanalysis



Global Sea Surface Salinity (SSS)

Tendency for September 2018

Compared with last month, the SSS in the ITCZ and SPCZ region decreases with the increase of the precipitation. The SSS in the west basin of the equatorial Indian Ocean decreases as the precipitation increases as well. The SSS in the central North Atlantic ocean and equatorial Atlantic Ocean decreases which is accompanied with increased precipitation.

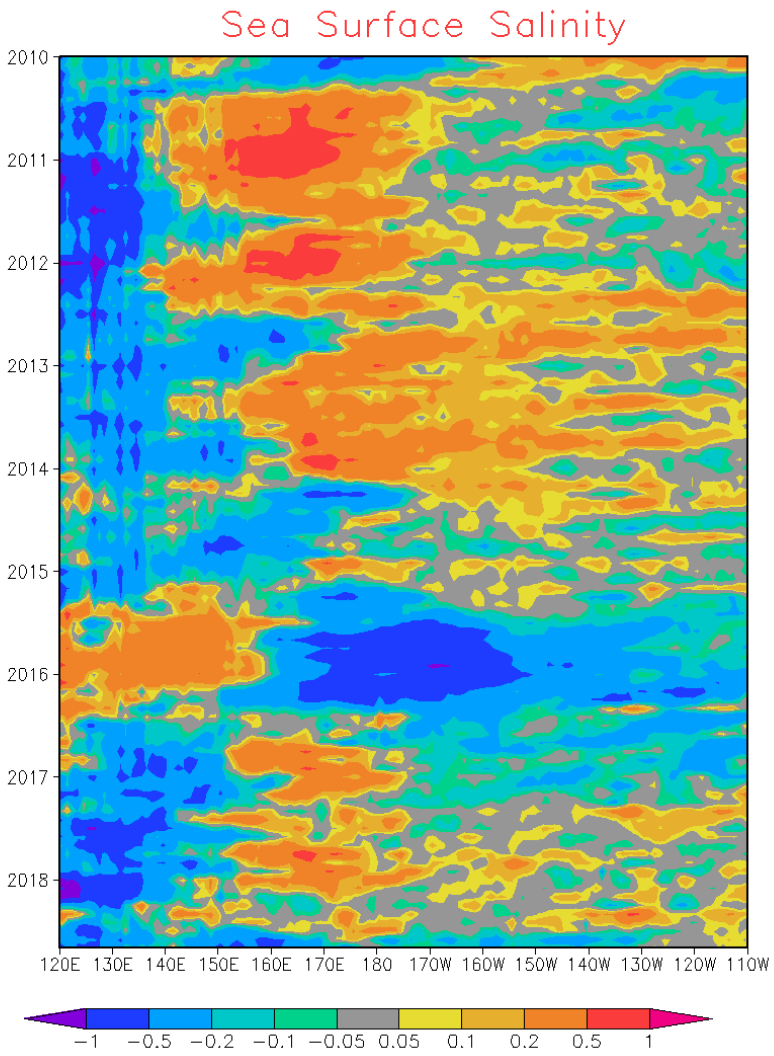


Global Sea Surface Salinity (SSS)

Anomaly Evolution over Equatorial Pacific from Monthly SSS

NOTE: Since June 2015, the BASS SSS is from in situ, SMOS and SMAP; before June 2015,The BASS SSS is from in situ, SMOS and Aquarius.

- Hovemoller diagram for equatorial SSS anomaly **(5˚ S-5˚ N);**
- In the equatorial Pacific Ocean, from 120˚ E to 150˚ E, the negative SSS signal continues in this month. East of 150˚ E, the SSS anomalies became negative this month.



Global Sea Surface Salinity (SSS)

Anomaly Evolution over N. of Equatorial Pacific from Pentad SSS

Figure caption: Hovemoller diagram for equatorial (5° S-5° N) 5-day mean SSS, SST and precipitation anomalies. The climatology for SSS is Levitus 1994 climatology. The SST data used here is the OISST V2 AVHRR only daily dataset with its climatology being calculated from 1985 to 2010. The precipitation data used here is the adjusted CMORPH dataset with its climatology being calculated from 1999 to 2013.