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

Prepared by

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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

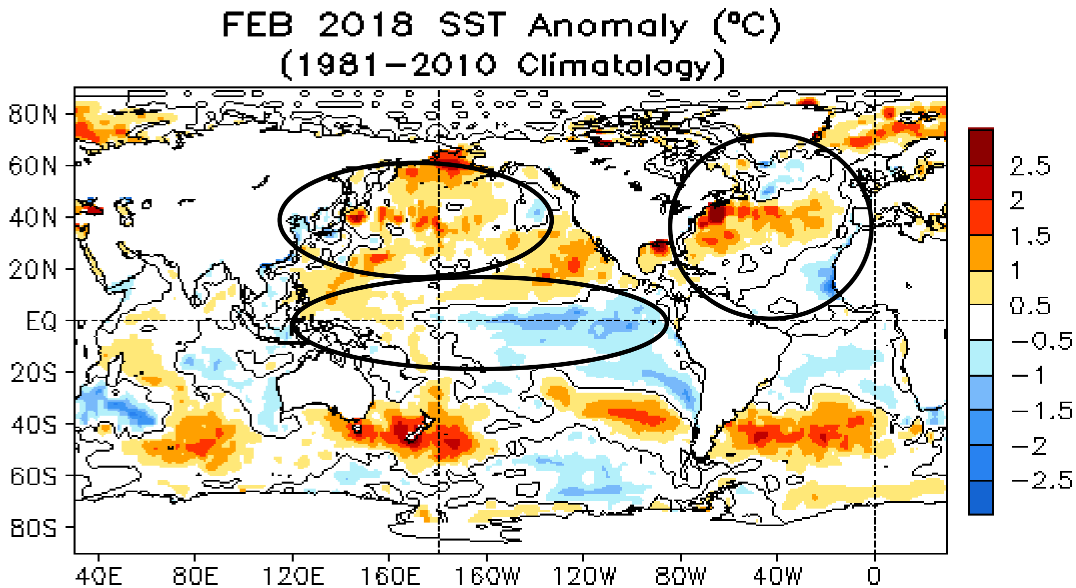
- Overview
- Recent highlights
  - Pacific/Arctic Ocean
  - Indian Ocean
  - Atlantic Ocean
  - Global SST Predictions
  - Some Evidences About Multi-Year La Nina

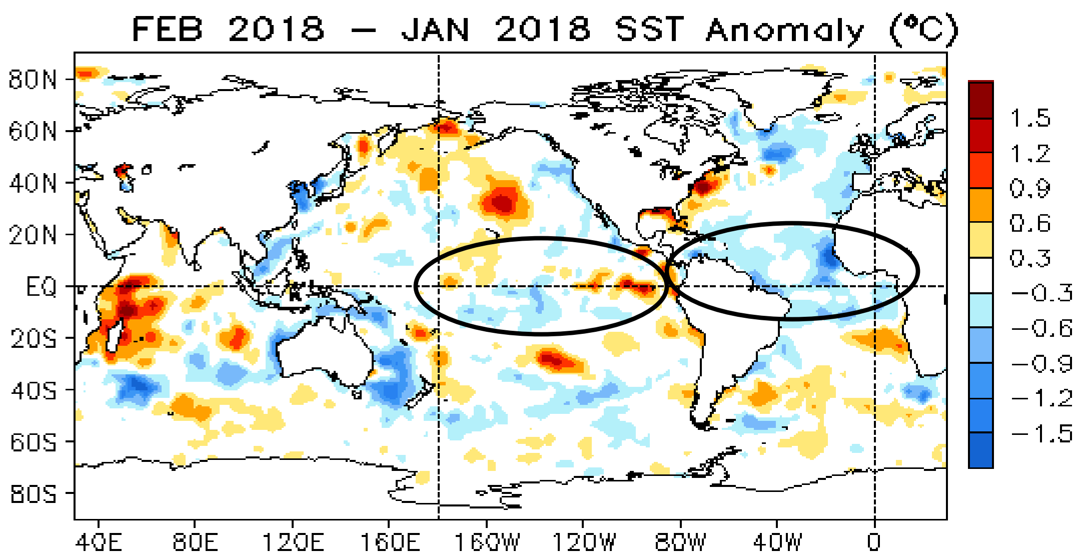
Overview

- **Pacific Ocean**
  - **NOAA "ENSO Diagnostic Discussion" on 8 Mar 2018 indicated "*A transition from La Niña to ENSO-neutral is most likely (~55% chance) during the March-May season, with neutral conditions likely to continue into the second half of the year.*"**
  - **Negative SSTAs persisted in the eastern tropical Pacific with NINO3.4=-0.9°C in Feb 2018.**
  - **Positive subsurface ocean temperature anomalies presented in the western equatorial Pacific and propagated eastward in Feb 2018.**
  - **Positive SST anomalies presented in the N. Pacific with PDOI=0.1 in Feb 2018.**
- **Indian Ocean**
  - **SSTAs were near average in the tropics in Feb 2018.**
- **Atlantic Ocean**
  - **NAO has been in positive phase since Dec 2017 with NAOI=1.3 in Feb 2018, and SSTAs were a tripole/horseshoe pattern with large positive anomalies in the middle latitudes of N. Atlantic.**

Global Oceans

Global SST Anomaly (^0C) and Anomaly Tendency





- SSTAs were positive in the western and negative in the eastern tropical Pacific, consisting with La Nina condition.

- Positive SSTAs were in the North Pacific.

- Horseshoe/tripole-like SSTA pattern presented in the North Atlantic.

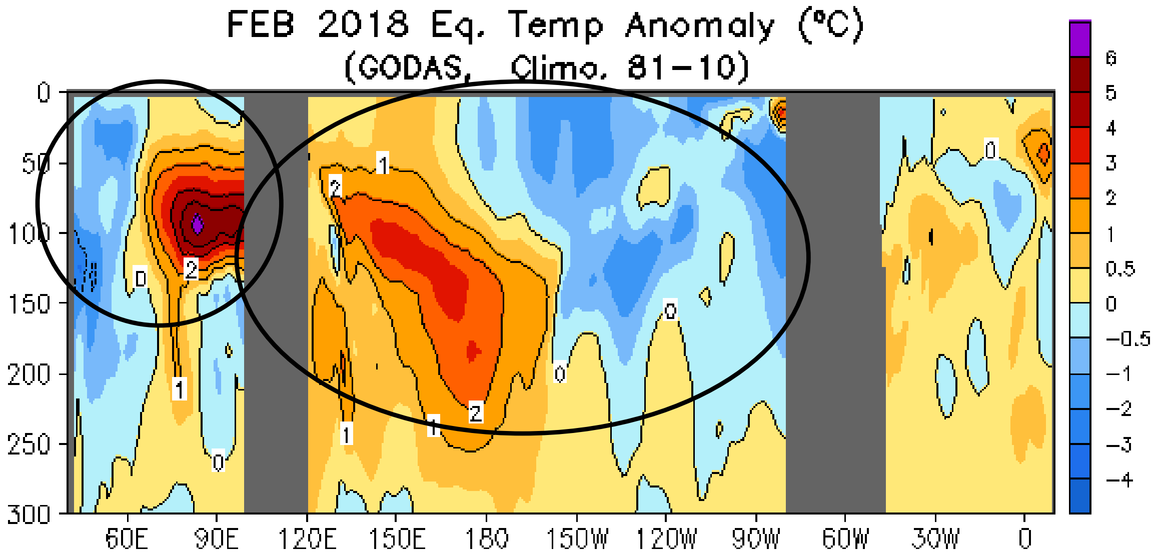
- In Indian Ocean, SSTAs were near average in the tropics.

- Both positive and negative SSTA tendencies were observed in the central and eastern tropical Pacific.

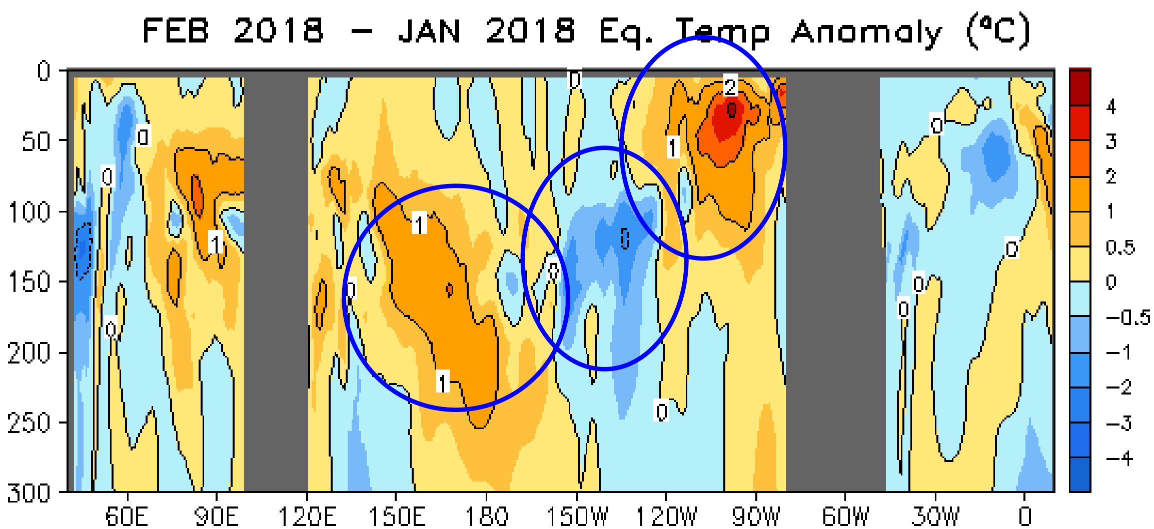
- Negative SSTA tendencies were seen in the tropical Atlantic Ocean.

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



- **Positive (negative) ocean temperature anomalies presented along the thermocline in the western (eastern) Pacific.**
- **Positive ocean temperature anomalies were in eastern and negative in the western Indian Ocean.**

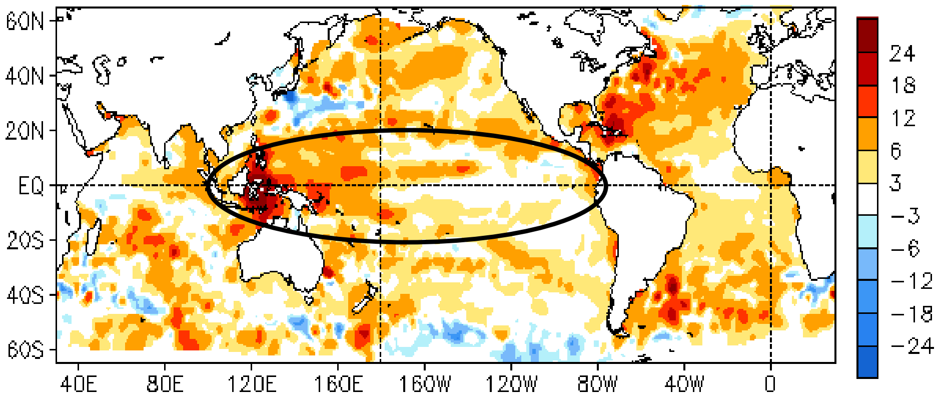


- **It was a tripole pattern in the Pacific: positive in the west and east, and negative in the central.**

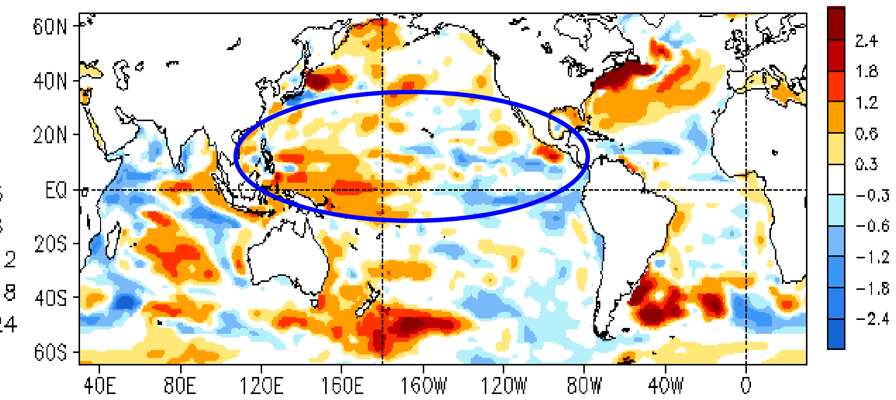
Fig. G3. Equatorial depth-longitude section of ocean temperature anomalies (top) and anomaly tendency (bottom). Data are derived from the NCEP's global ocean data assimilation system which assimilates oceanic observations into an oceanic GCM. Anomalies are departures from the 1981-2010 base period means.

Global SSH and HC300 Anomaly & Anomaly Tendency

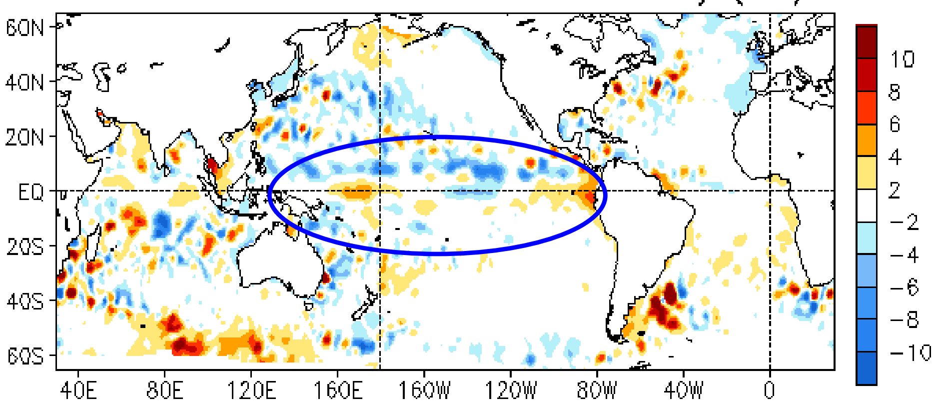
FEB 2018 SSH Anomaly (cm)
(AVISO Altimetry, Climo. 93-13)



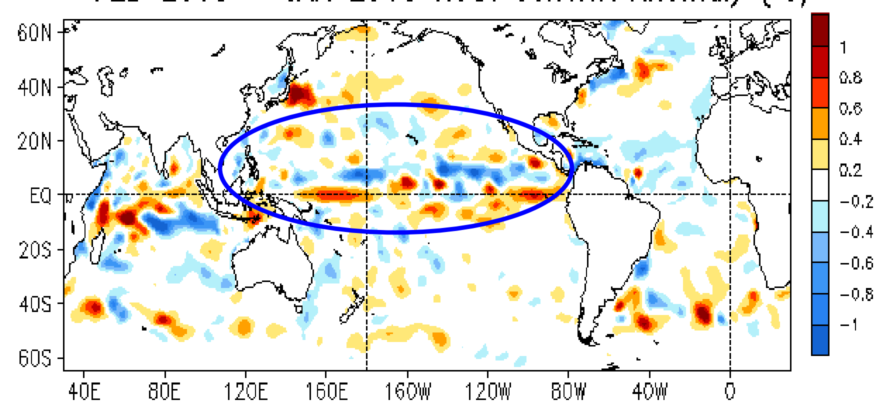
FEB 2018 Heat Content Anomaly (°C)
(GODAS, Climo. 81-10)



FEB 2018 - JAN 2018 SSH Anomaly (cm)



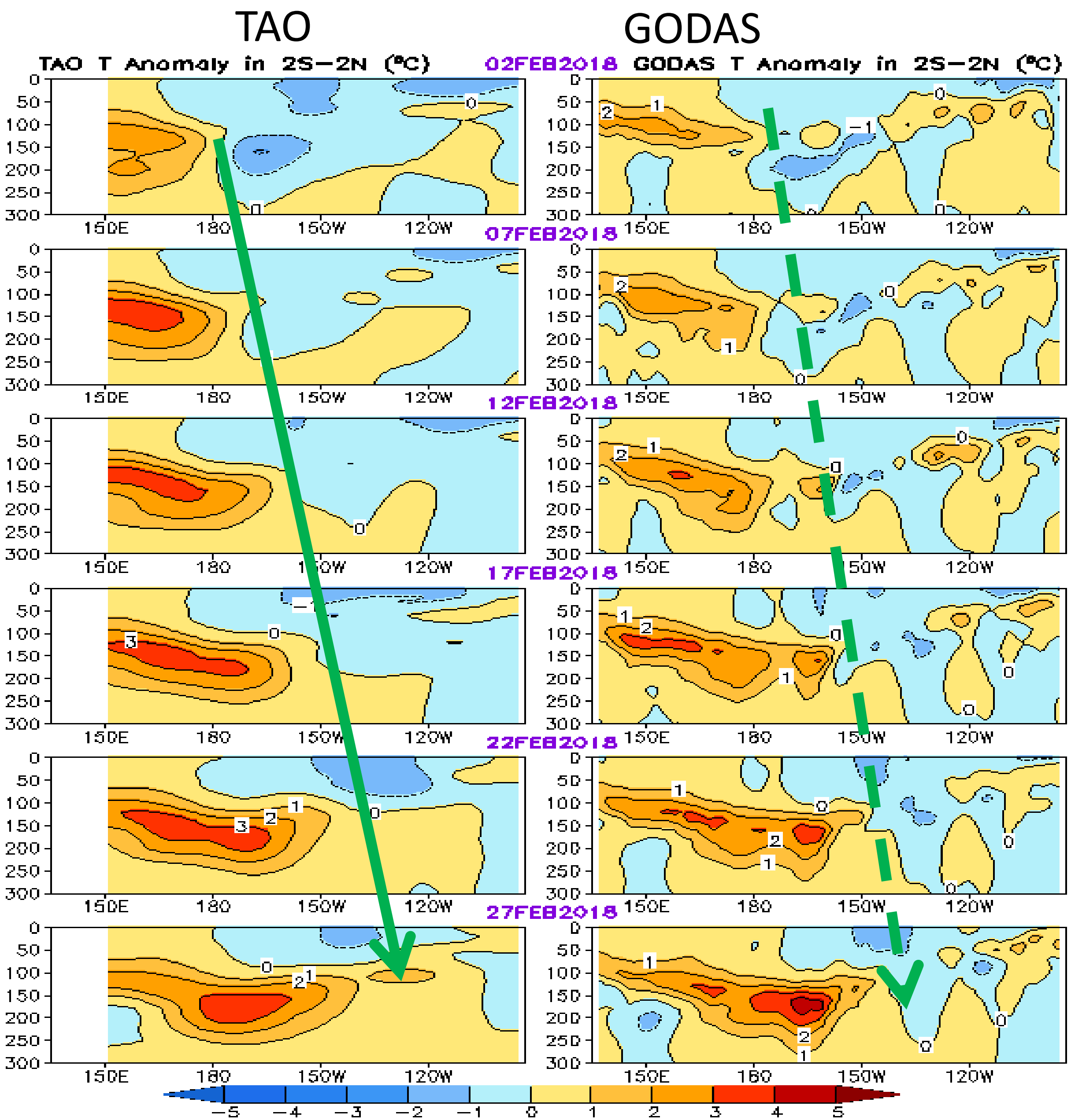
FEB 2018 - JAN 2018 Heat Content Anomaly (°C)



- **The SSHA pattern was overall consistent with HC300A pattern, but there were many detailed differences between HC300A and SSHA.**
- **Both SSHA and HC300A in the tropical Pacific were consisted with the cold phase of ENSO.**
- **Both negative and positive tendencies of SSHA and HC300A presented in the central and eastern tropical Pacific.**

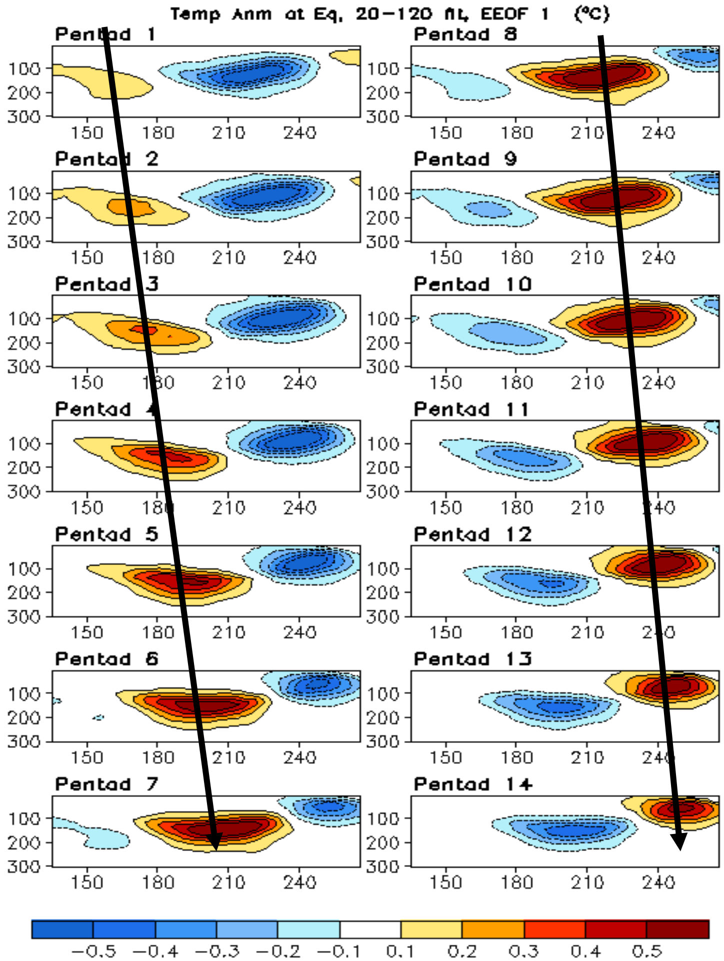
Tropical Pacific Ocean and ENSO Conditions

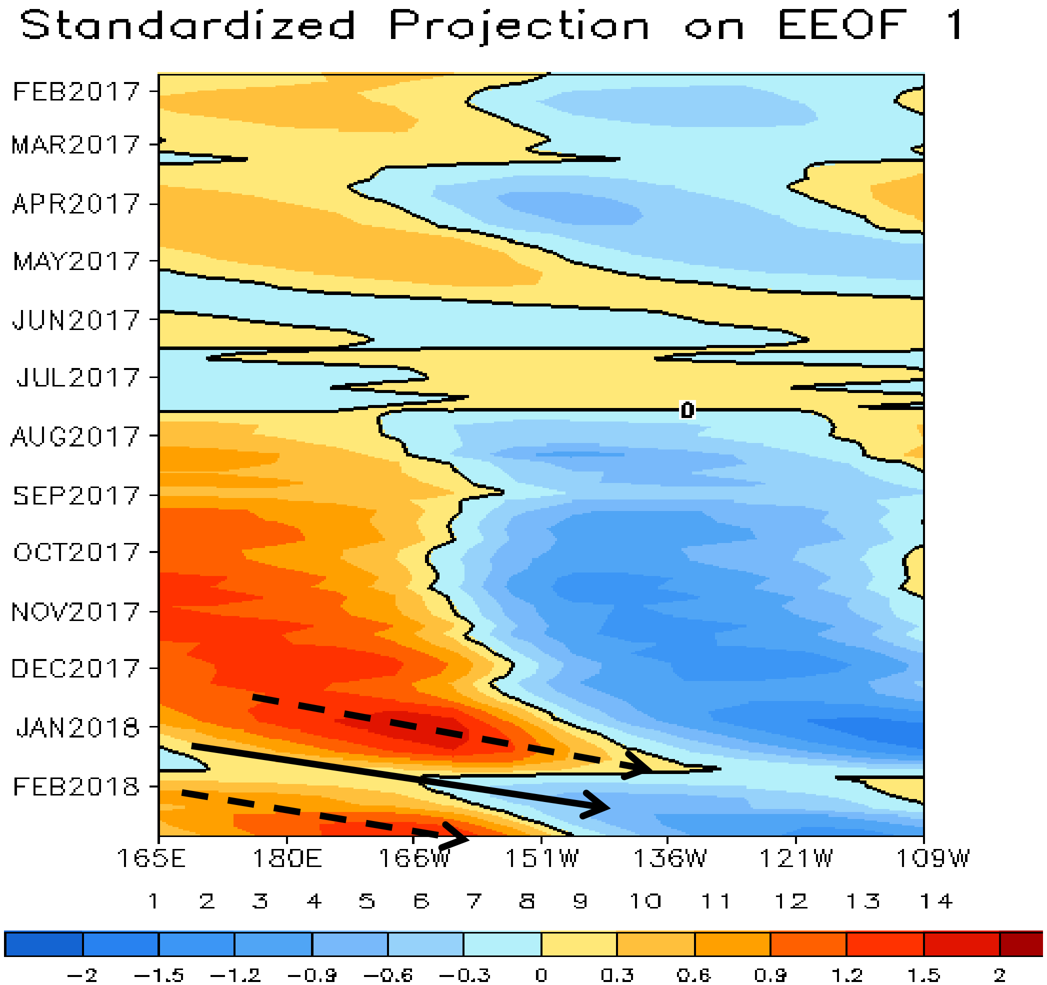
Equatorial Pacific Ocean Temperature Pentad Mean Anomaly



- Positive ocean temperature anomalies in the western Pacific Ocean propagated eastward during last month, associated with eastward propagation of downwelling Kelvin wave.
- Both the anomalous amplitude and propagation speed are comparable between TAO and GODAS.

Oceanic Kelvin Wave (OKW) Index



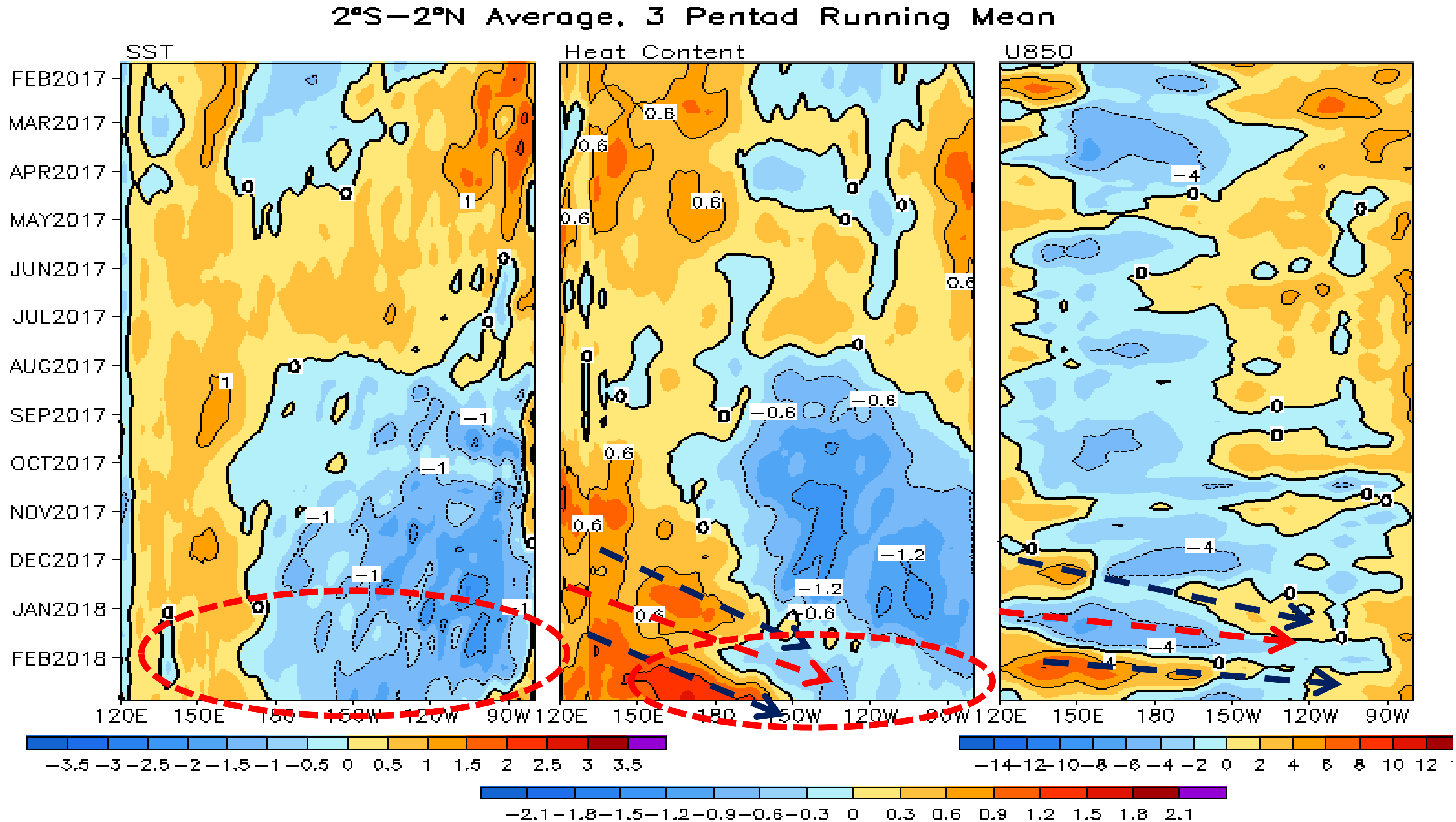


- A downwelling Kelvin wave presented from Dec 2017- Feb 2018, and an upwelling Kelvin wave from mid Jan 2018 to present.

- Since early Feb 2018, another downwelling Kelvin wave has led to positive subsurface anomalies near the Date Line.

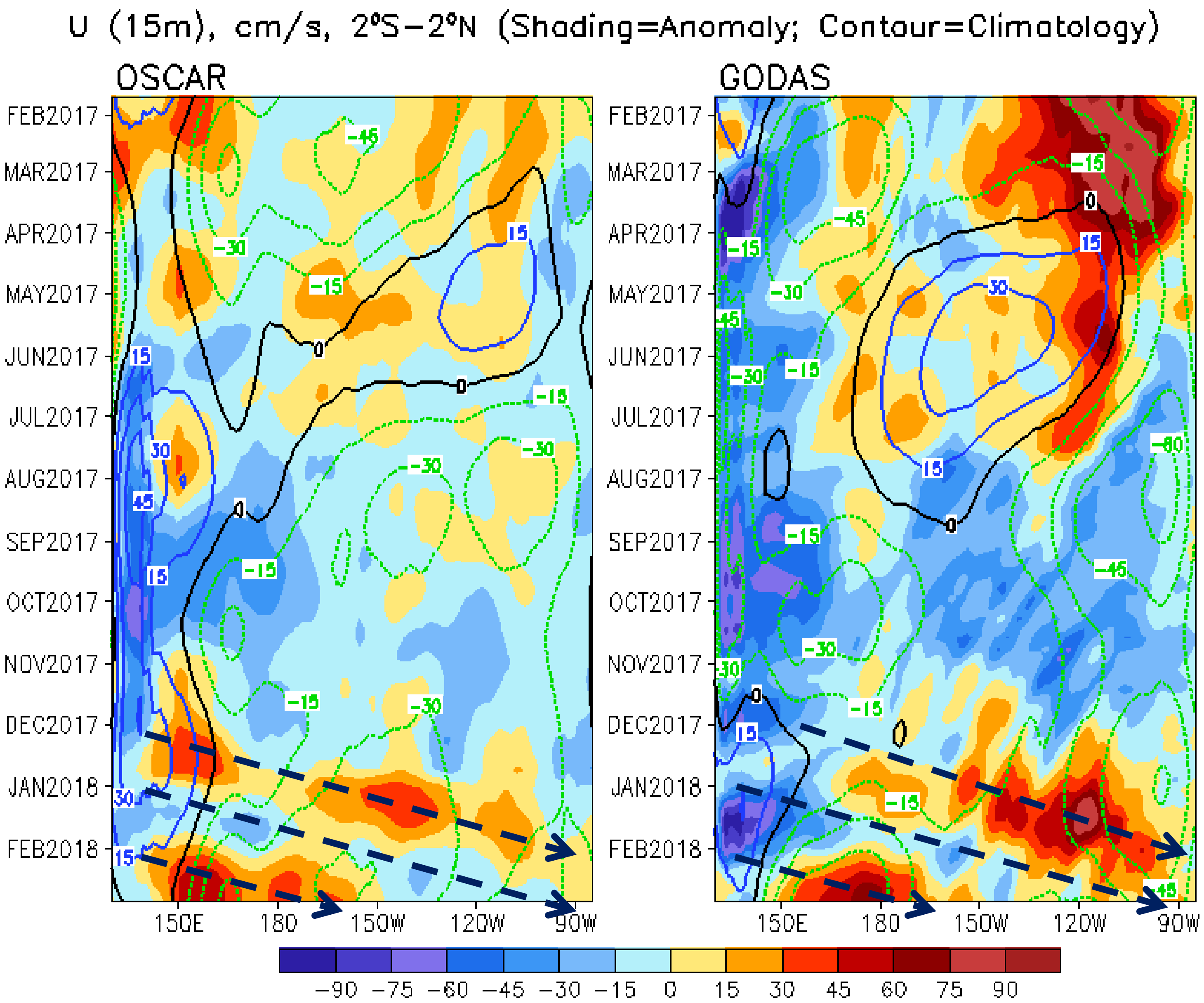
(OKW index is defined as standardized projections of total anomalies onto the 14 patterns of Extended EOF1 of equatorial temperature anomalies (Seo and Xue , GRL, 2005).)

Equatorial Pacific SST (°C), HC300 (°C), u850 (m/s) Anomalies



- **Negative SSTA in the eastern Pacific weakened in last month.**
- **Positive HC300A in the western Pacific propagated eastward in Feb 2018, and low-level westerly wind burst was observed in late Jan and early Feb. 2018, consisting with Kelvin wave activity.**

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



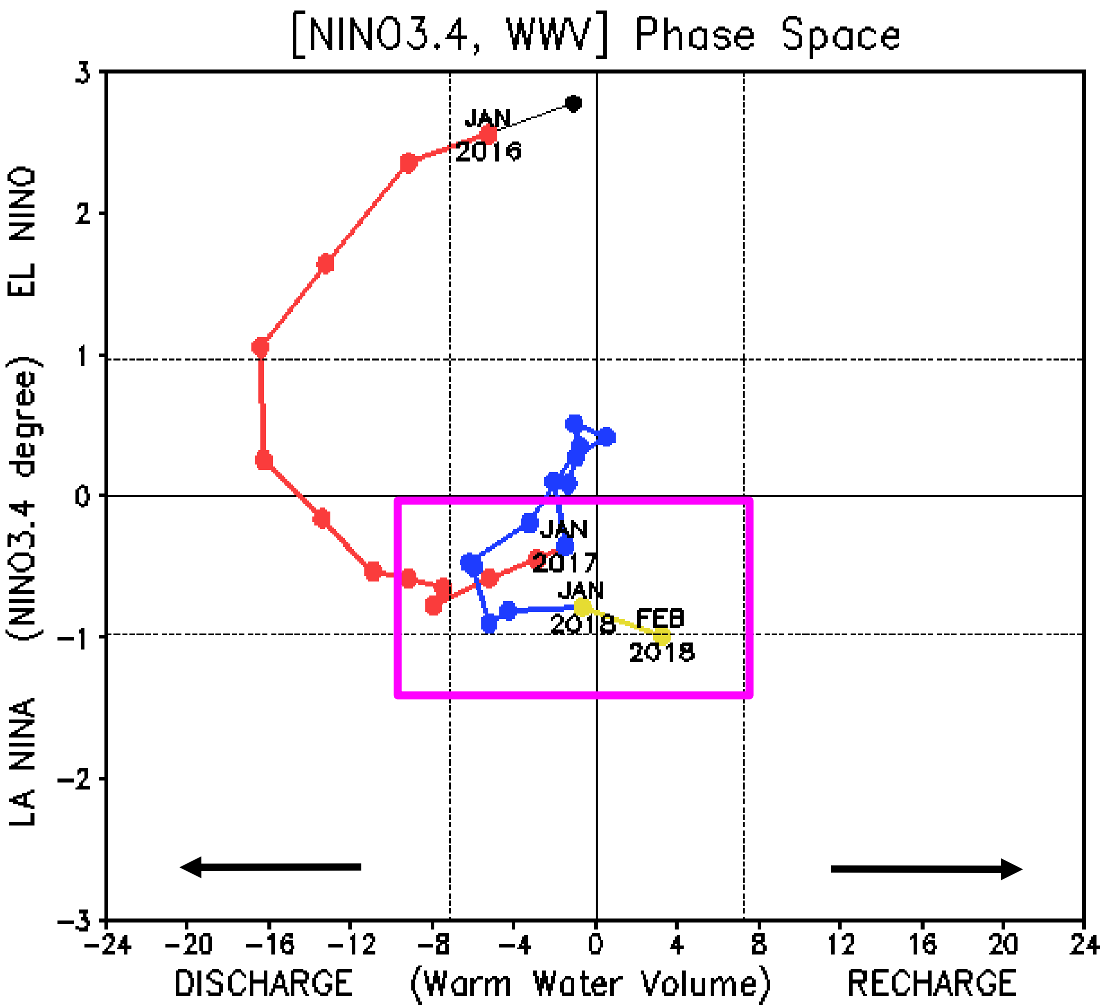
- Anomalous eastward currents were seen in the last month in OSCAR and GODAS. That was favorable for a weakening tendency of La Nina.
- The anomalous currents showed some differences between OSCAR and GODAS.

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).

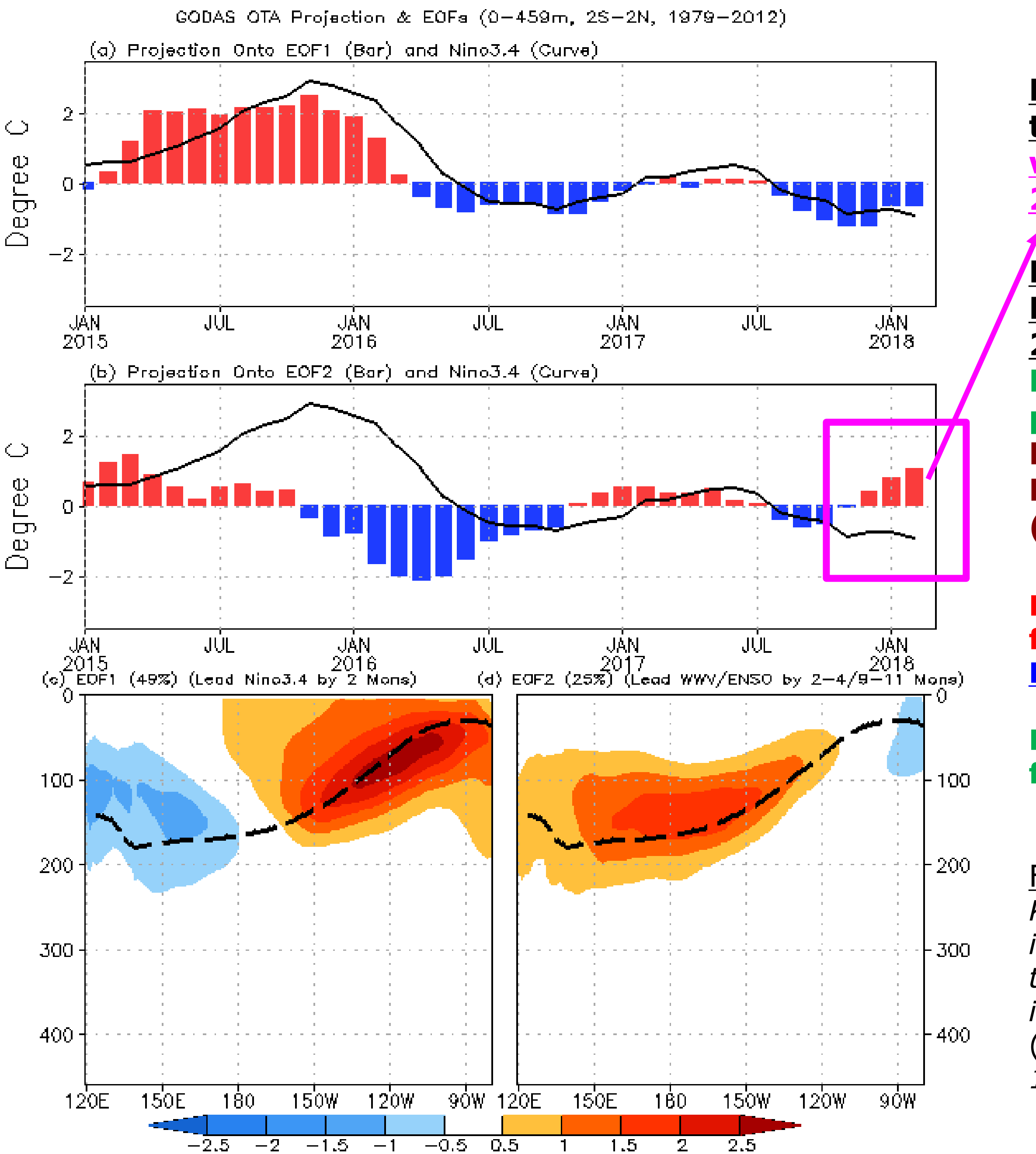
- Since WWV is intimately linked to ENSO variability (Wyrtki 1985; Jin 1997), it is useful to monitor ENSO in a phase space of WWV and NINO3.4 (Kessler 2002).

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



- Equatorial Warm Water Volume (WWV) indicated a weak recharging in Feb 2018.

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



Equatorial subsurface ocean temperature monitoring: ENSO was in recharge phase since Dec 2017.

Projection of OTA onto EOF1 and EOF2 (2S-2N, 0-459m, 1979-2010)

EOF1: Tilt mode (ENSO peak phase);

EOF2: WWV mode, Recharge/discharge oscillation (ENSO transition phase).

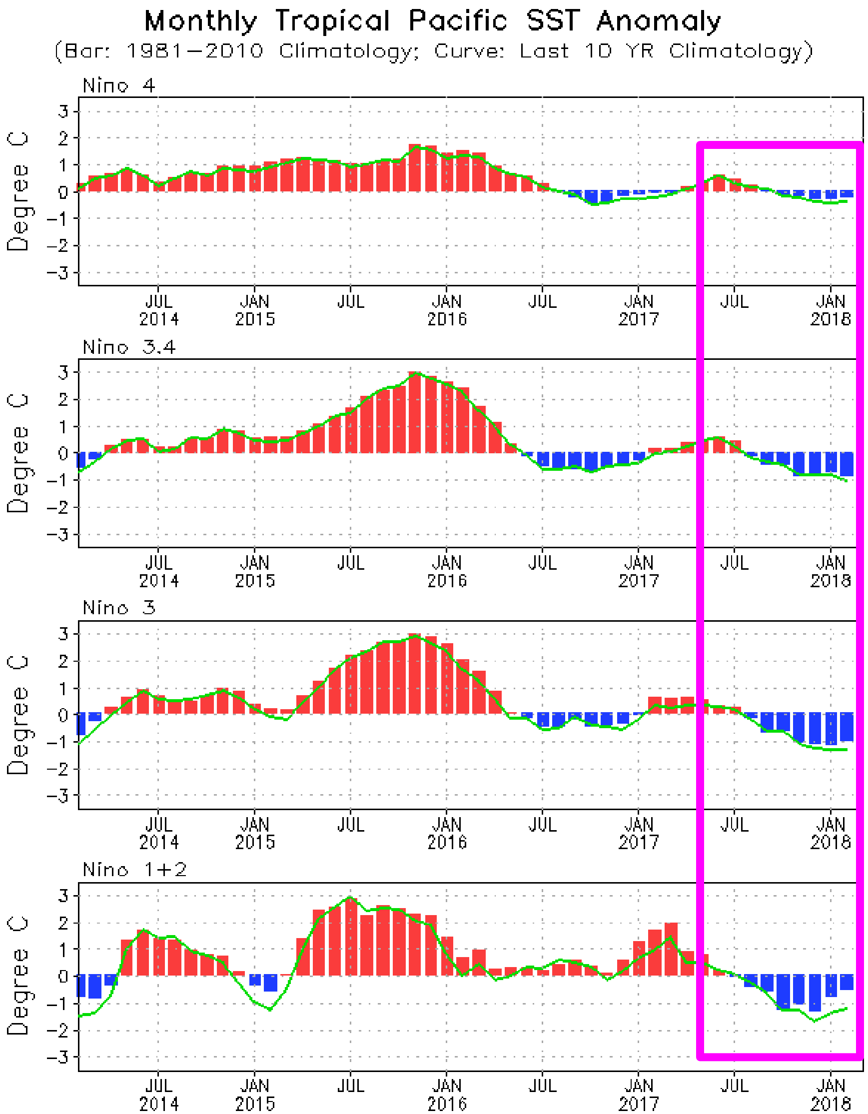
Recharge process: heat transport from outside of equator to equator : Negative -> positive phase of ENSO

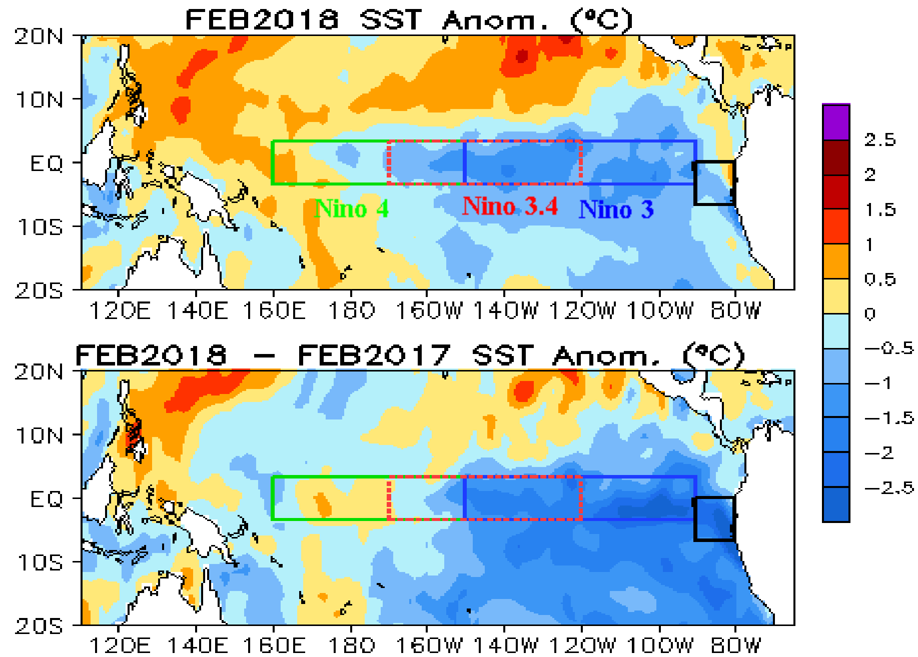
Discharge process: heat transport from equator to outside of equator: Positive -> Negative phase of ENSO

For details, see:

Kumar A, Z-Z Hu (2014) Interannual and interdecadal variability of ocean temperature along the equatorial Pacific in conjunction with ENSO. Clim. Dyn., 42 (5-6)**, 1243-1258.** *DOI: 10.1007/s00382-013-1721-0*.

Evolution of Pacific NINO SST Indices

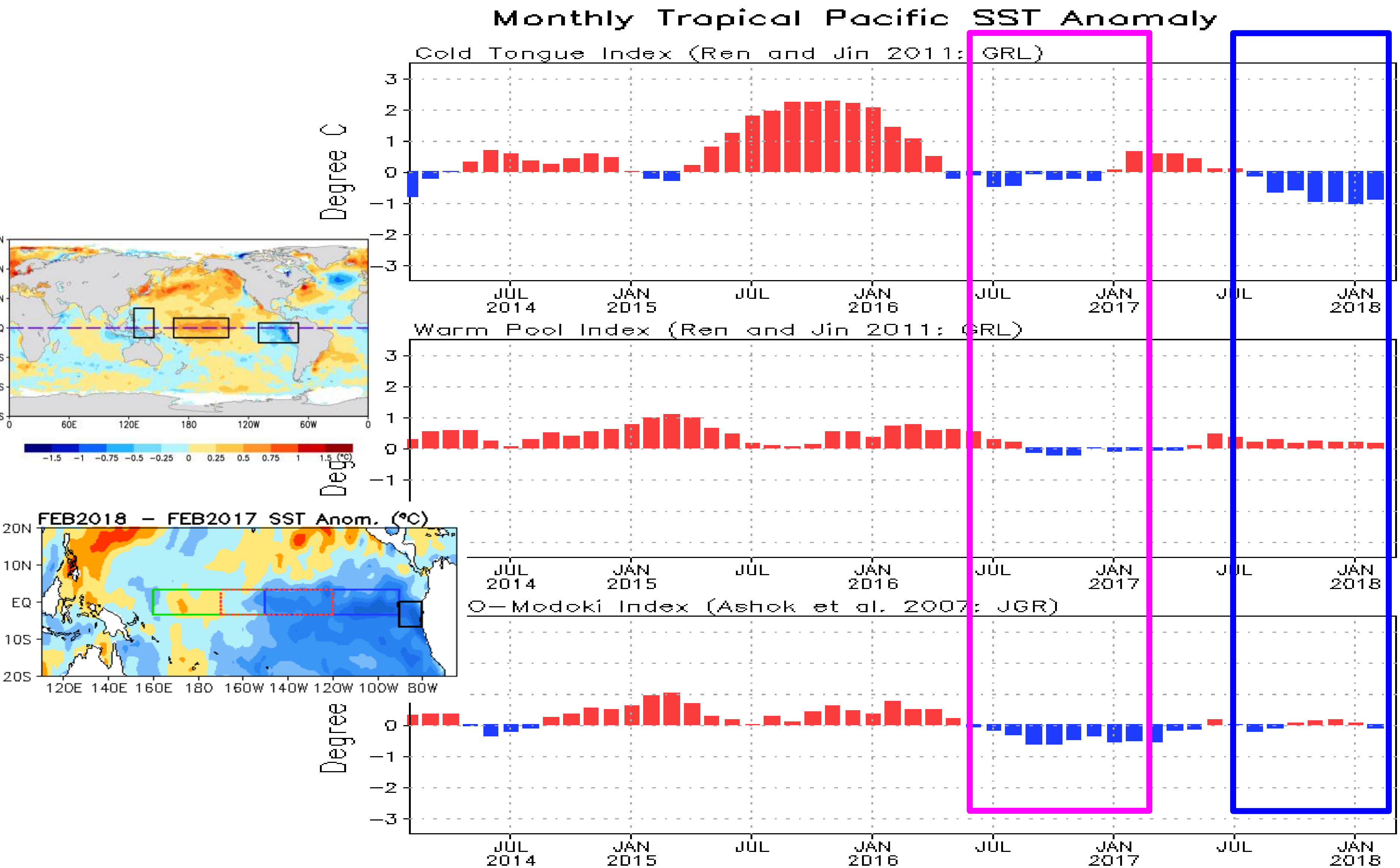




- **All Nino indices were negative in Feb 2018.**
- **Nino3.4 = -0.9C in Feb 2018.**
- **Compared with last Feb, the central and eastern equatorial Pacific was cooler in Feb 2018.**
- **The indices were calculated based on OISST. They may have some differences compared with those based on ERSST.v5.**

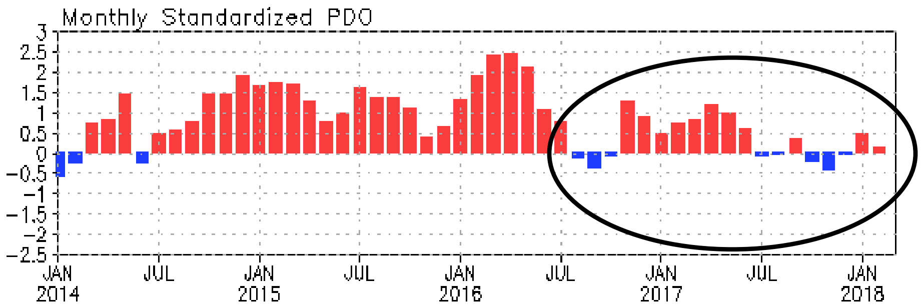
Fig. P1a. Nino region indices, calculated as the area-averaged monthly mean sea surface temperature anomalies (°C) for the specified region. Data are derived from the NCEP OI SST analysis, and anomalies are departures from the 1981-2010 base period means.

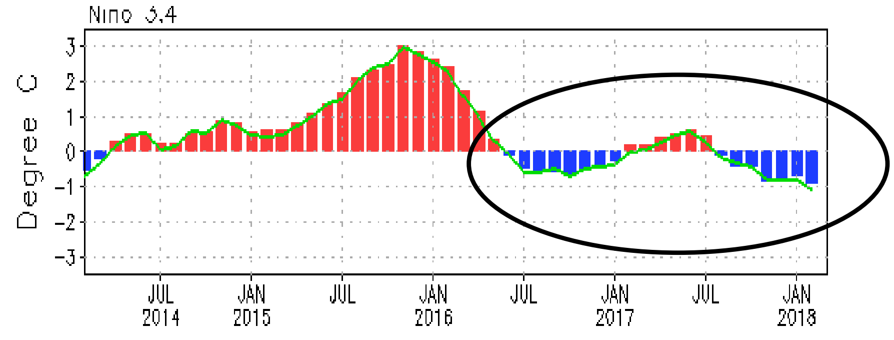
SSTA projections were larger in the cold tongue in 2017/18 La Nina than in 2016/17 La Nina

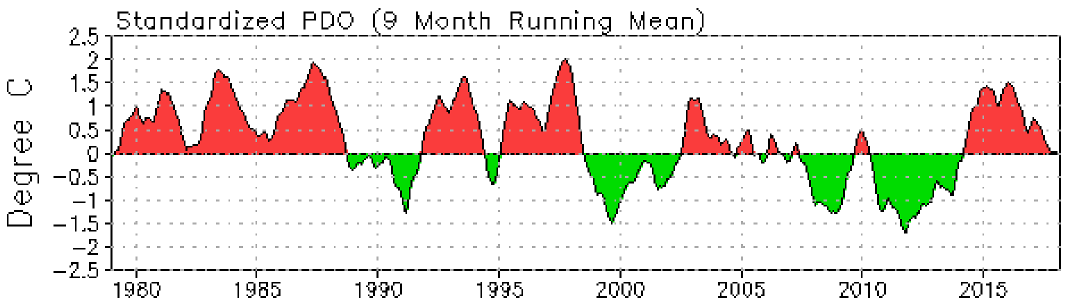


North Pacific & Arctic Oceans

PDO index

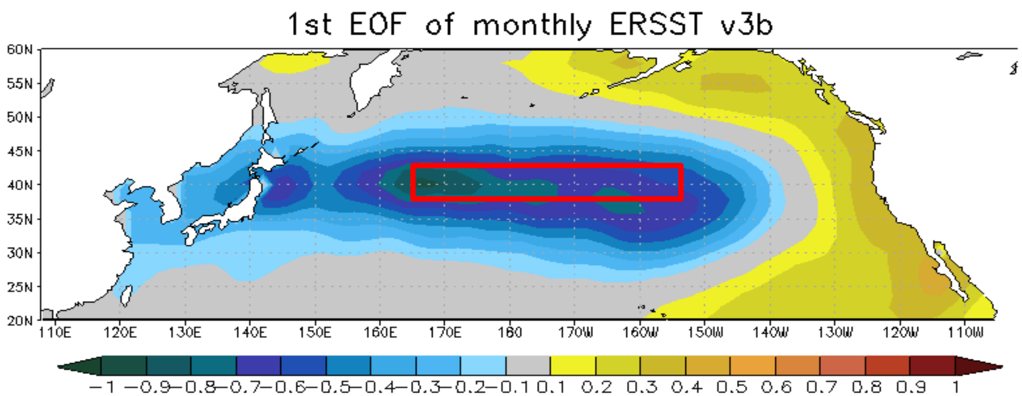






- **The positive SSTAs presented with PDO index =0.1 in Feb 2018.**

- **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.

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

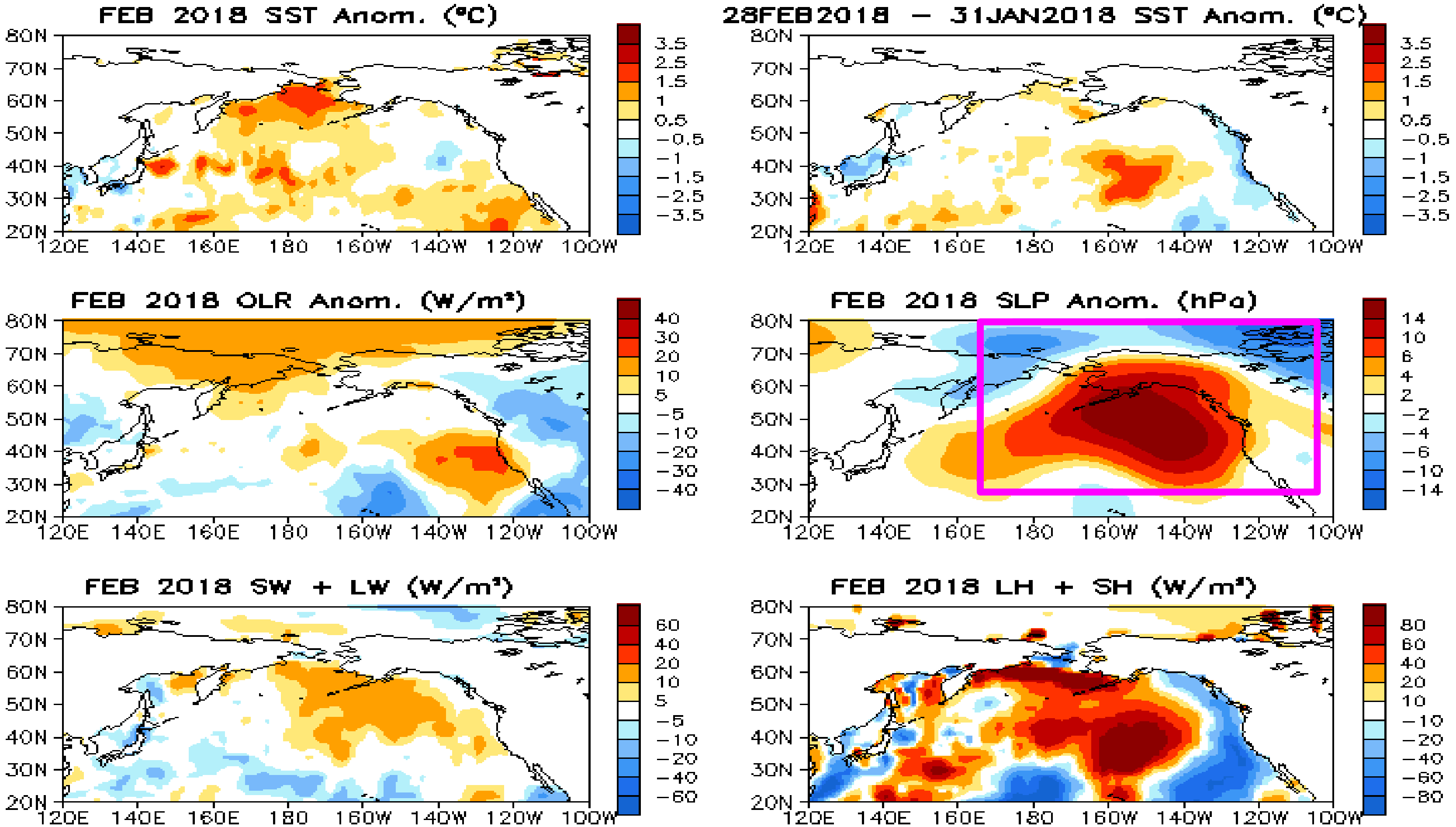
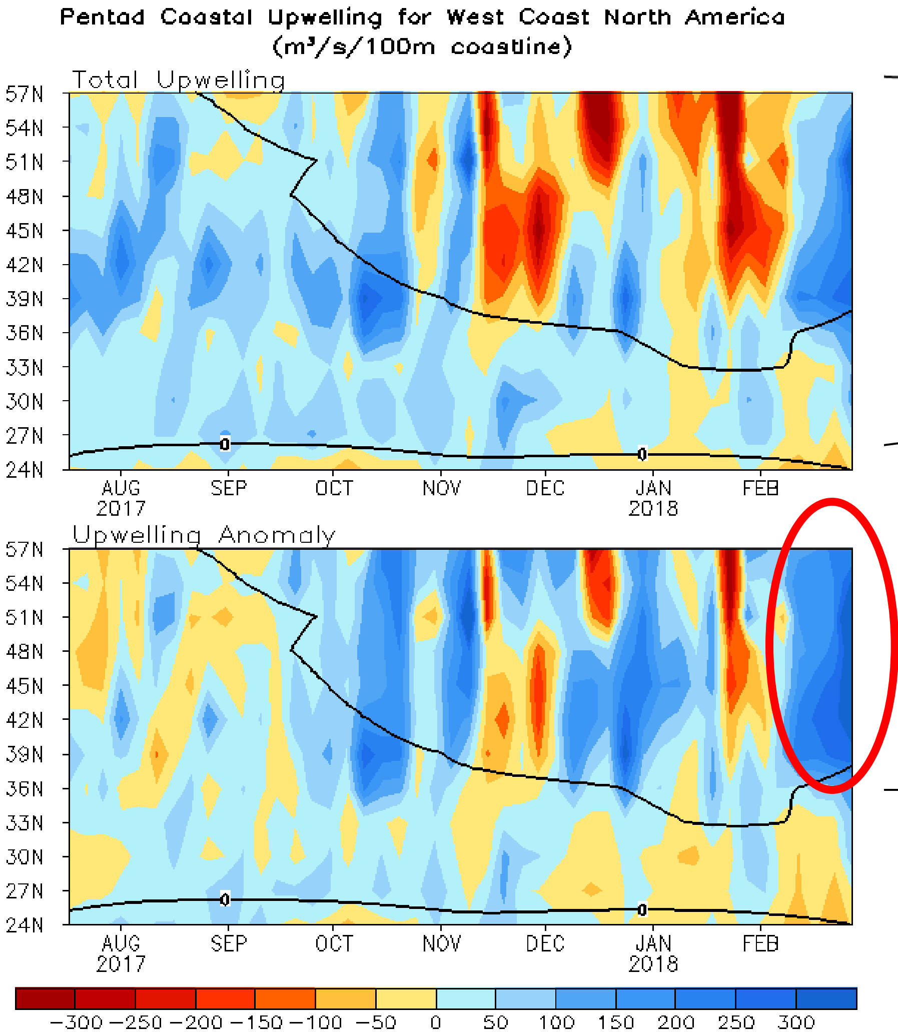
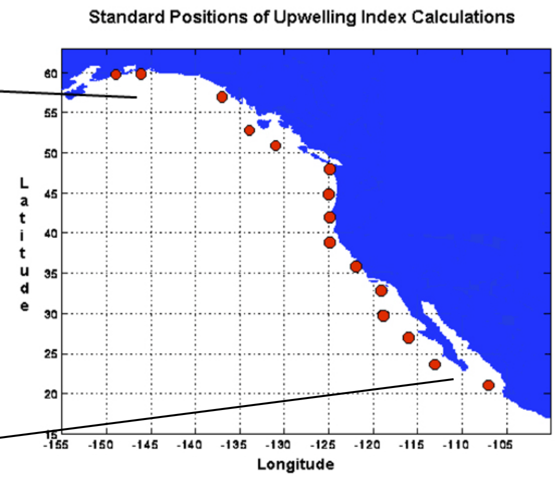


Fig. NP1. Sea surface temperature (SST) anomalies (top-left), anomaly tendency (top-right), Outgoing Long-wave Radiation (OLR) anomalies (middle-left), sea surface pressure anomalies (middle-right), sum of net surface short- and long-wave radiation anomalies (bottom-left), sum of latent and sensible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

North America Western Coastal Upwelling





- **Recently, strong anomalous upwelling presented in Feb 2018, may be associated with positive SLP anomalies along the coast.**

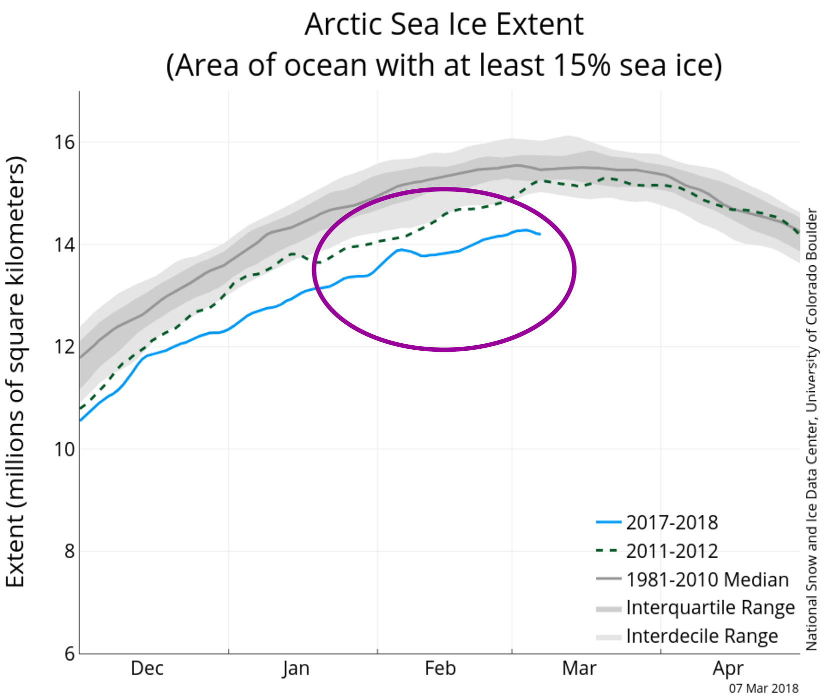
Fig. NP2. Total (top) and anomalous (bottom) upwelling indices at the 15 standard locations for the western coast of North America. Upwelling indices are derived from the vertical velocity of the NCEP's global ocean data assimilation system, and are calculated as integrated vertical volume transport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

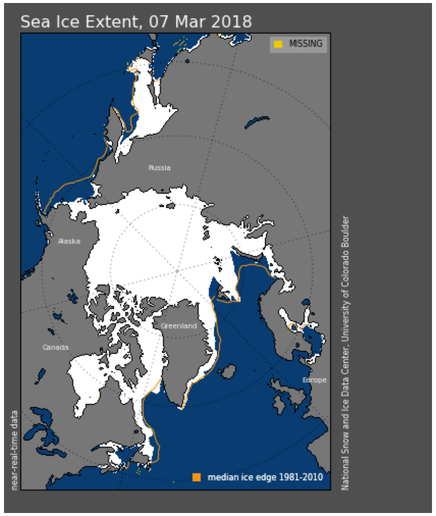
- **Area below (above) black line indicates climatological upwelling (downwelling) season.**
- **Climatologically upwelling season progresses from March to July along the west coast of North America from 36ºN to 57ºN.**

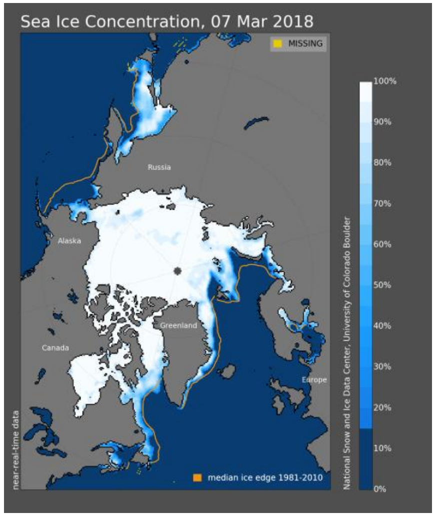
Arctic Sea Ice

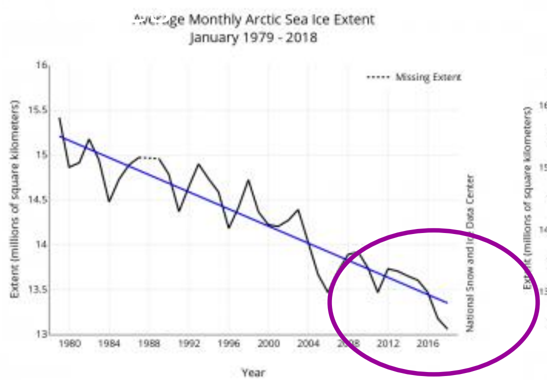
National Snow and Ice Data Center

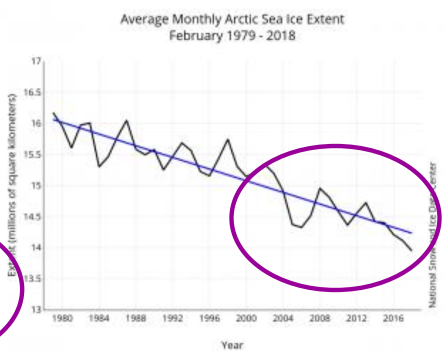
http://nsidc.org/arcticseaicenews/index.html









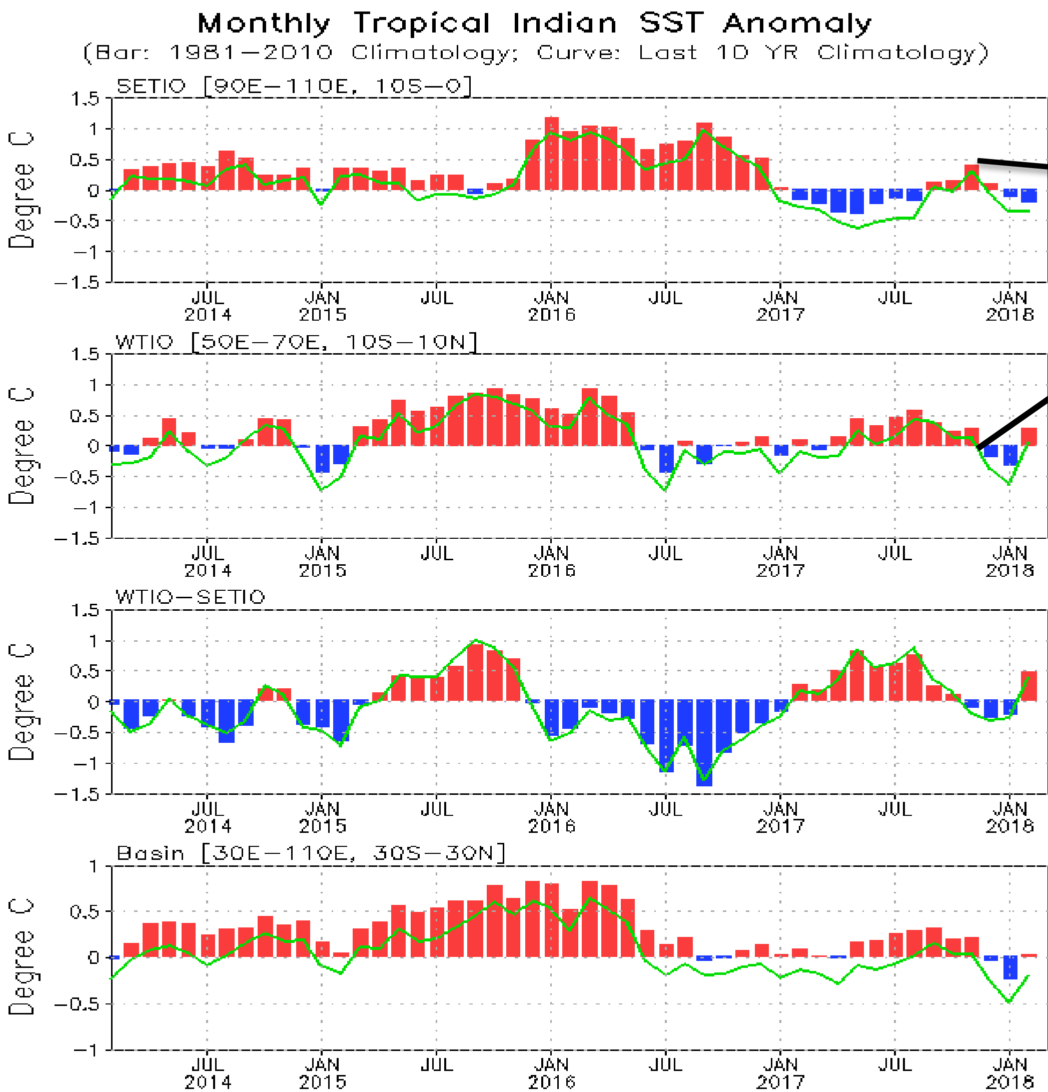


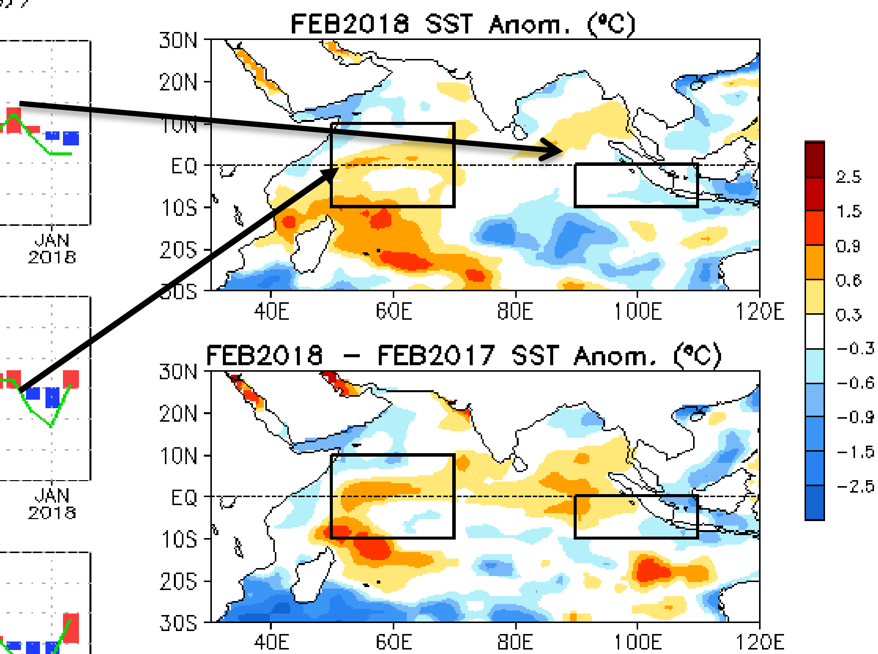
- In both Jan and Feb 2018, Arctic sea ice extent was in historical low and smaller than -2 standard deviations.

- As temperatures at the North Pole approached the melting point at the end of February, Arctic sea ice extent tracked at record low levels for this time of year. Extent was low on both the Atlantic and Pacific sides of the Arctic, with open water areas expanding rapidly in the Bering Sea during the latter half of the month.

Indian Ocean

Evolution of Indian Ocean SST Indices





- Overall, tropical SSTAs were small.

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.

- Overall SSTAs were small in the tropics.
- SSTA tendency was partially determined by heat flux.
- Convections were enhanced over the northern basin.

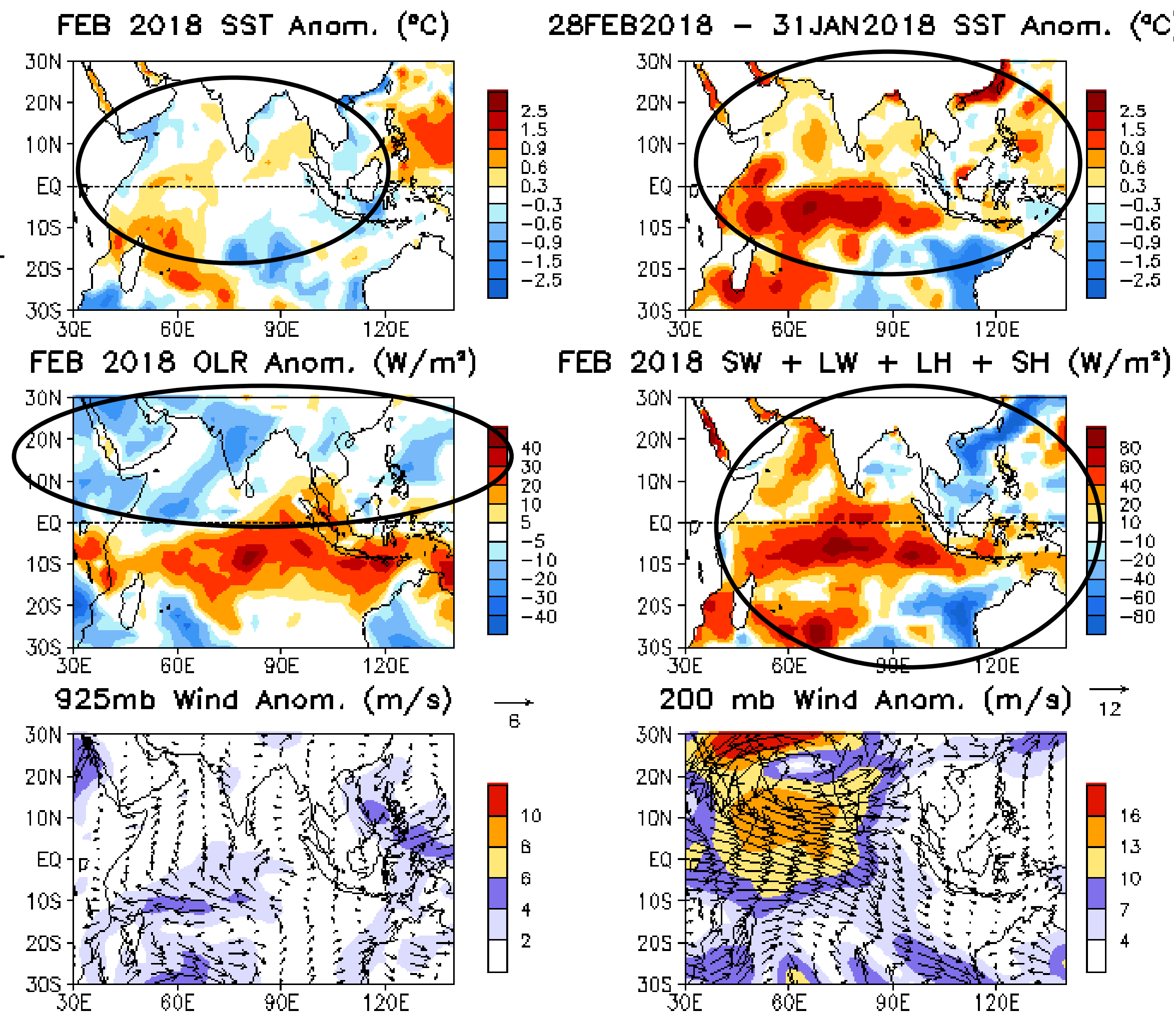
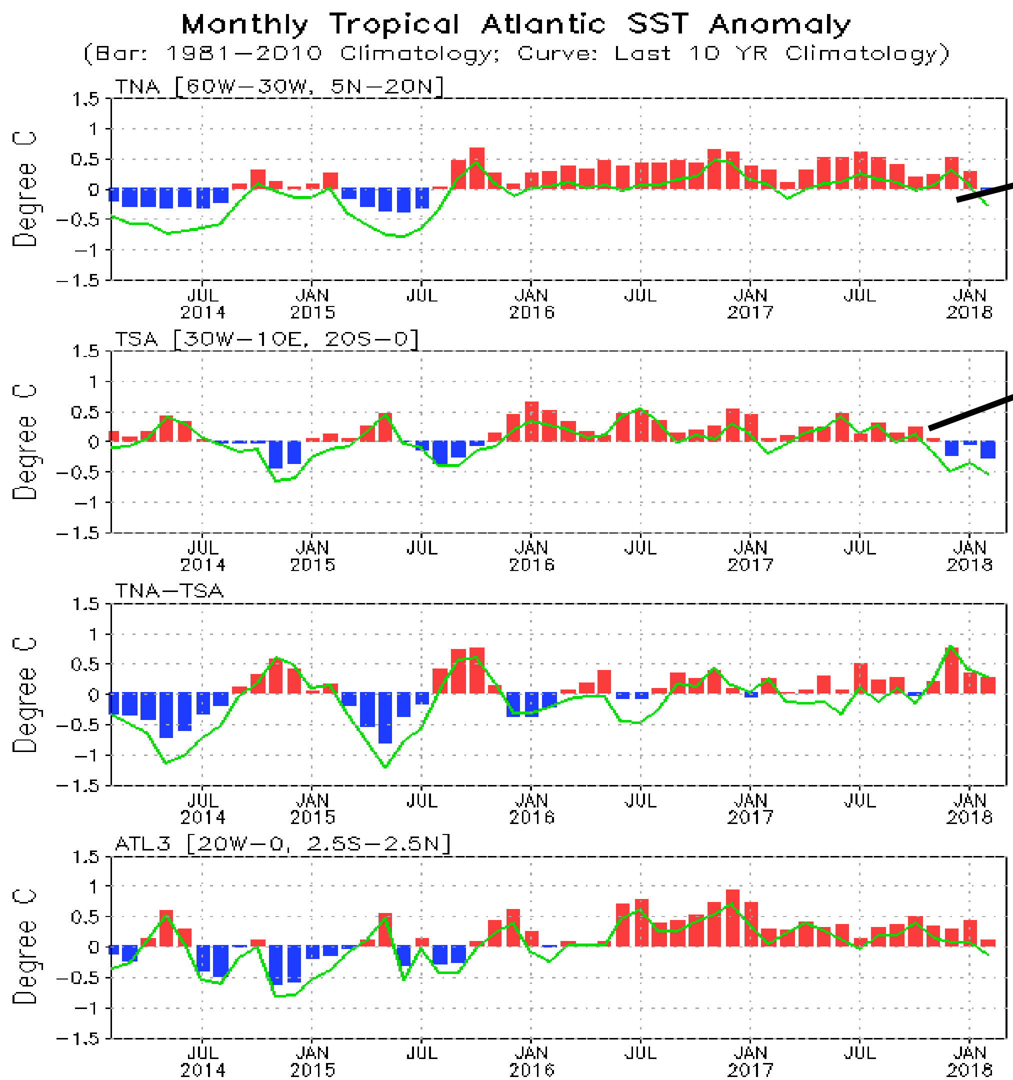
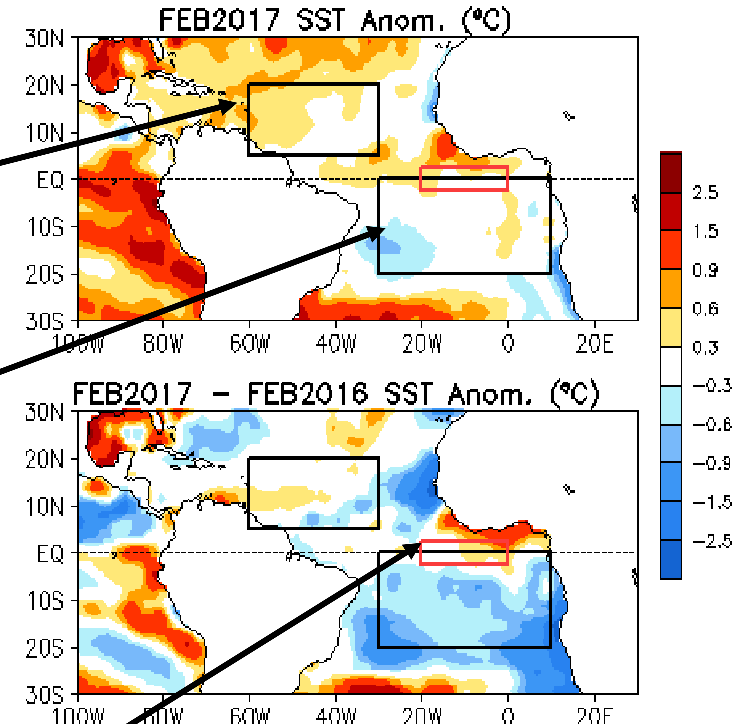


Fig. I2. Sea surface temperature (SST) anomalies (top-left), anomaly tendency (top-right), Outgoing Long-wave Radiation (OLR) anomalies (middle-left), sum of net surface short- and long-wave radiation, latent and sensible heat flux anomalies (middle-right), 925-mb wind anomaly vector and its amplitude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

Evolution of Tropical Atlantic SST Indices

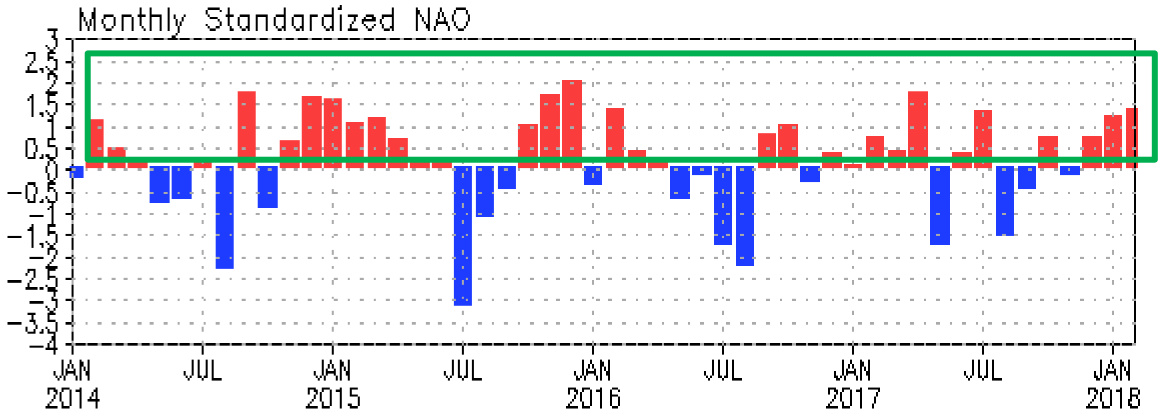


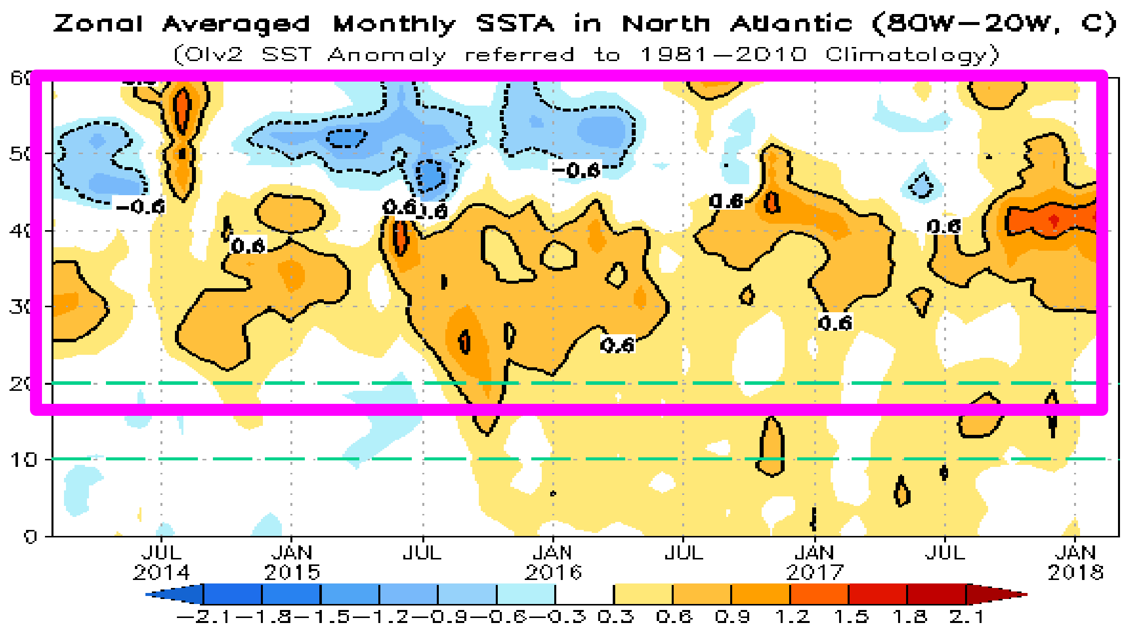


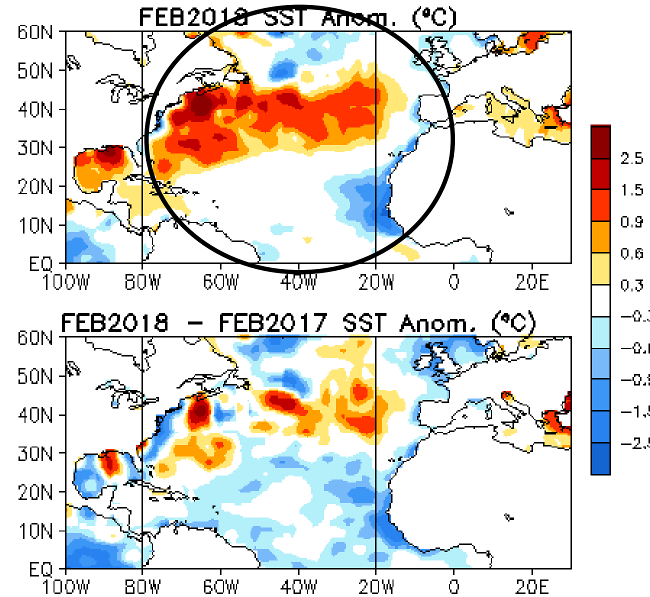
- **All indices, except TSA, were positive in Feb 2018.**

Fig. A1a. Tropical Atlantic Variability region indices, calculated as the area-averaged monthly mean sea surface temperature anomalies (ºC) for the TNA [60ºW-30ºW, 5ºN-20ºN], TSA [30ºW-10ºE, 20ºS-0] and ATL3 [20ºW-0, 2.5ºS-2.5ºN] 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.

NAO and SST Anomaly in North Atlantic







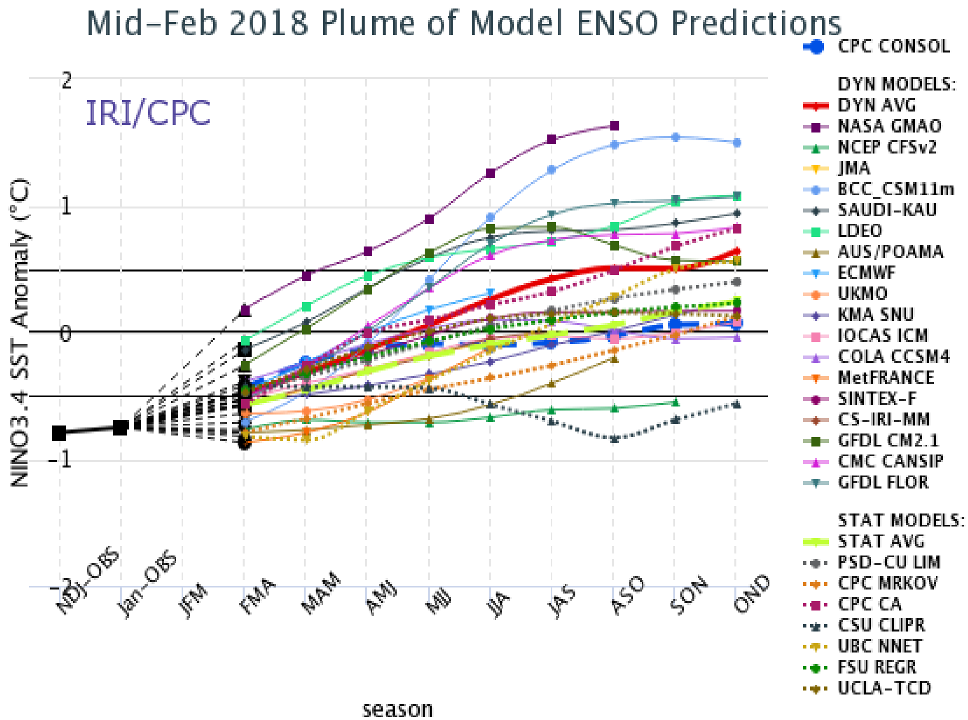
- NAO has been in positive phase since Dec 2017 with NAOI=1.3 in Feb 2018.

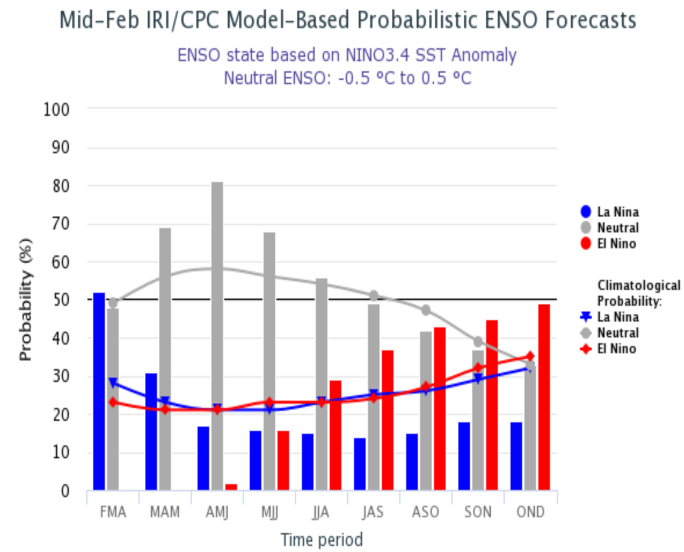
- SSTA was a tripole/horseshoe –like pattern with positive in the mid-latitudes and negative in lower and higher latitudes.

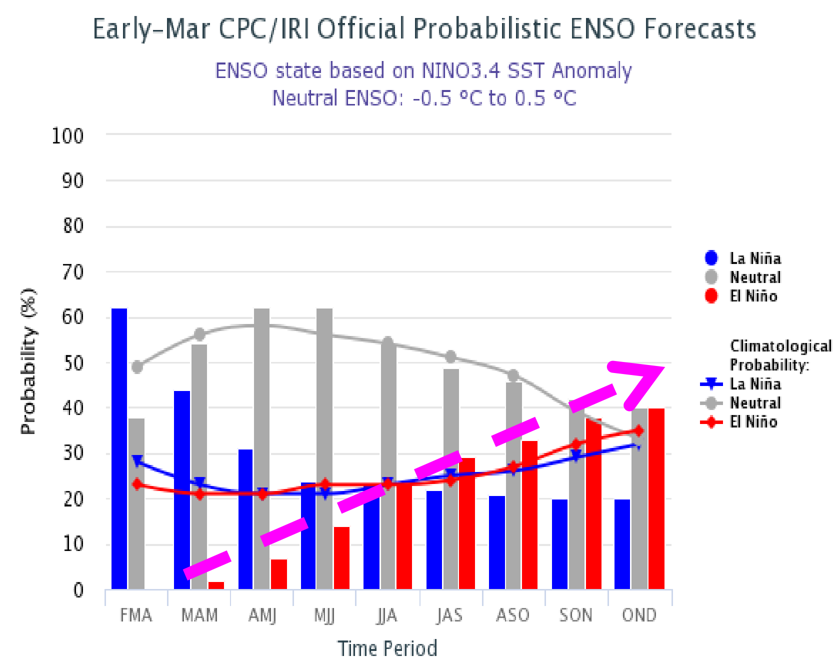
Fig. NA2. Monthly standardized NAO index (top) derived from monthly standardized 500-mb height anomalies obtained from the NCEP CDAS in 20ºN-90ºN (http://www.cpc.ncep.noaa.gov). Time-Latitude section of SST anomalies averaged between 80ºW and 20ºW (bottom). SST are derived from the NCEP OI SST analysis,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

ENSO and Global SST Predictions

IRI NINO3.4 Forecast Plum

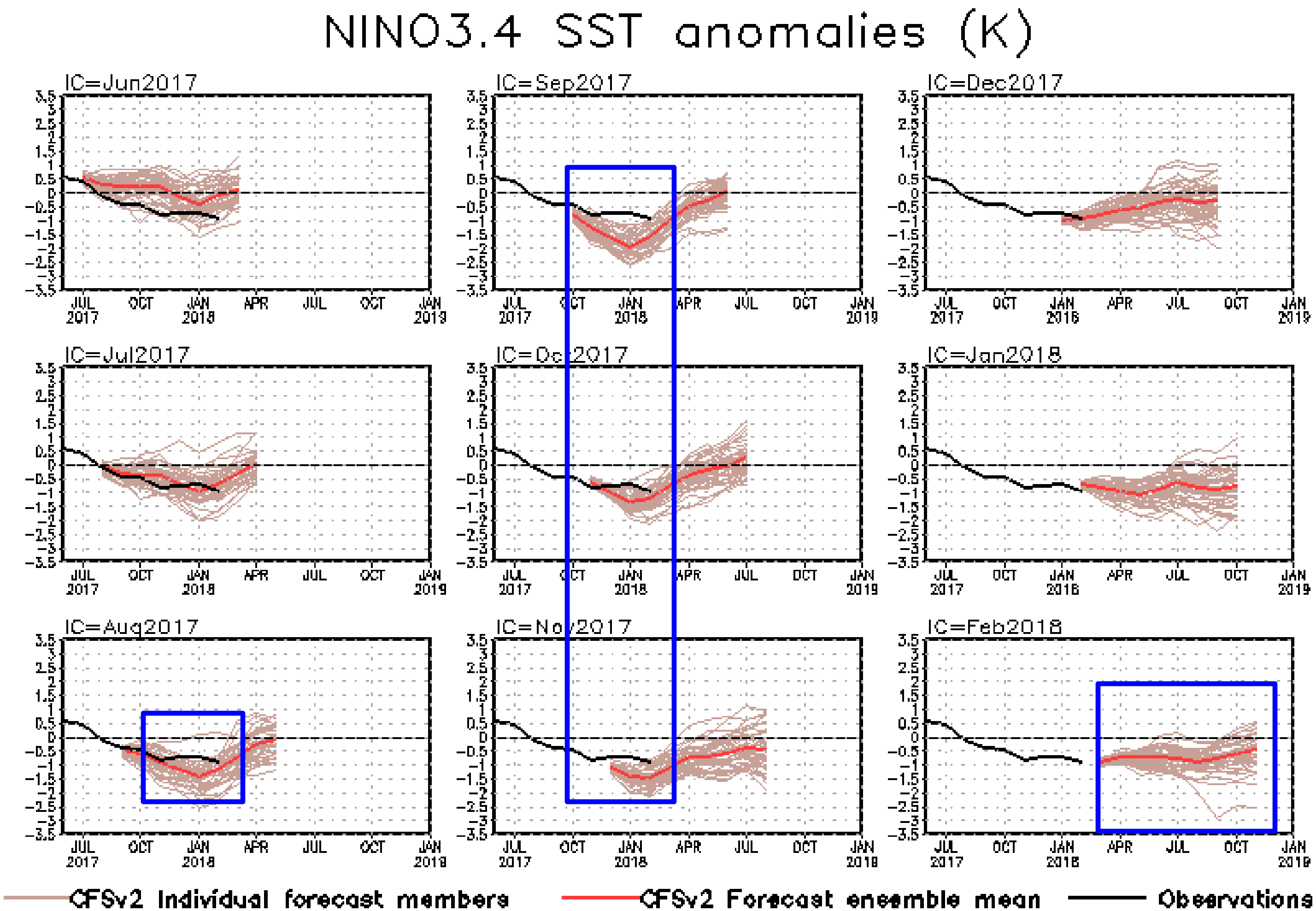






- **Majority of models predict ENSO-neutral in 2018 with a warming tendency.**
- **NOAA "ENSO Diagnostic Discussion" on 08 Mar 2018 suggested that *"A transition from La Niña to ENSO-neutral is most likely (~55% chance) during the March-May season, with neutral conditions likely to continue into the second half of the year."***

CFS Niño3.4 SST Predictions from Different Initial Months

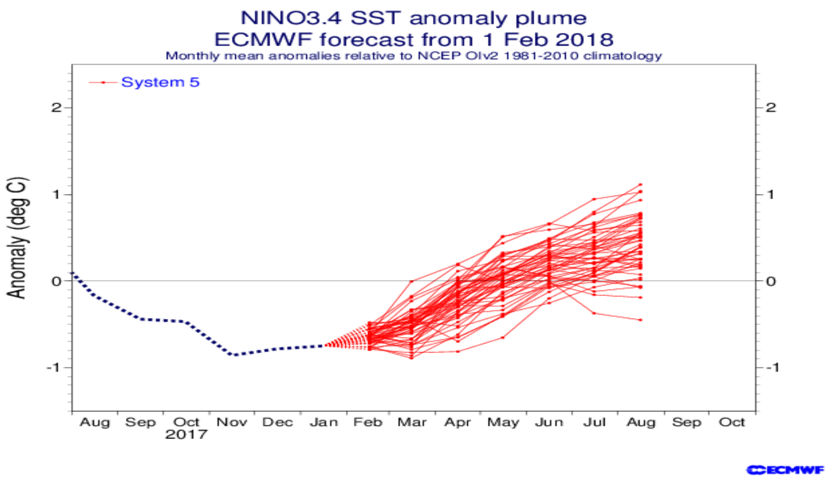


- Latest CFSv2 forecasts call for a boardline ENSO-neutral or La Nina during summer-autumn 2018.
- CFSv2 predictions had cold biases with ICs in Aug-Nov 2017.

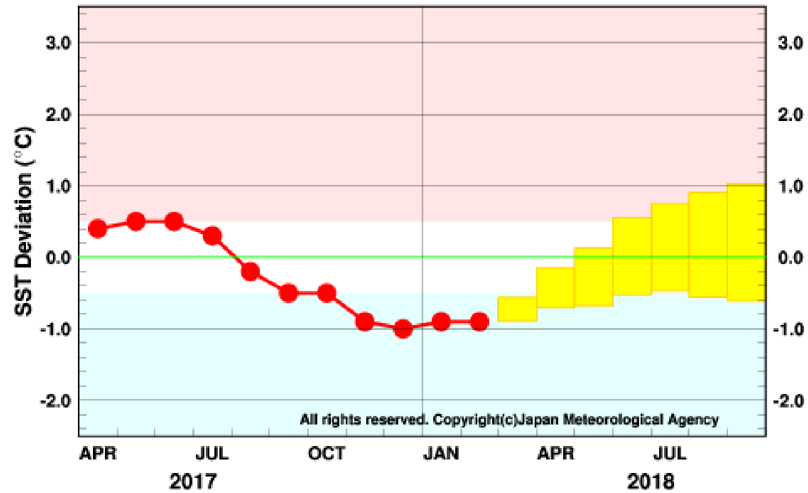
Fig. M1. CFS Nino3.4 SST prediction from the latest 9 initial months. Displayed are 40 forecast members (brown) made four times per day initialized from the last 10 days of the initial month (labelled as IC=MonthYear) as well as ensemble mean (blue) and observations (black). Anomalies were computed with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

Individual Model Forecasts: neutral or El Nino

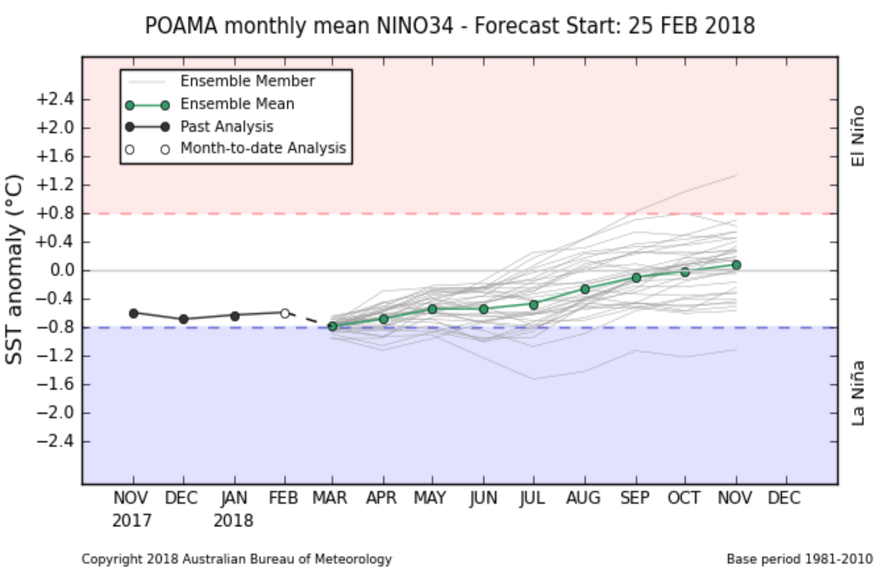
EC: Nino3.4, IC=01Feb 2018



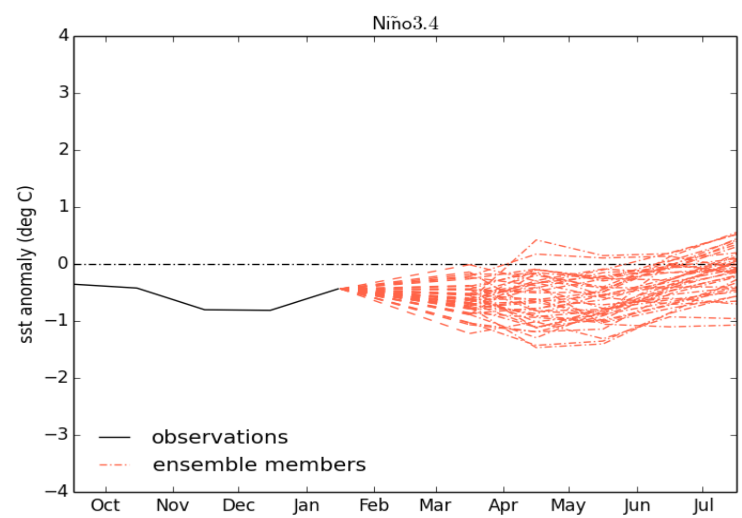
JMA: Nino3, IC= 09 Mar2018

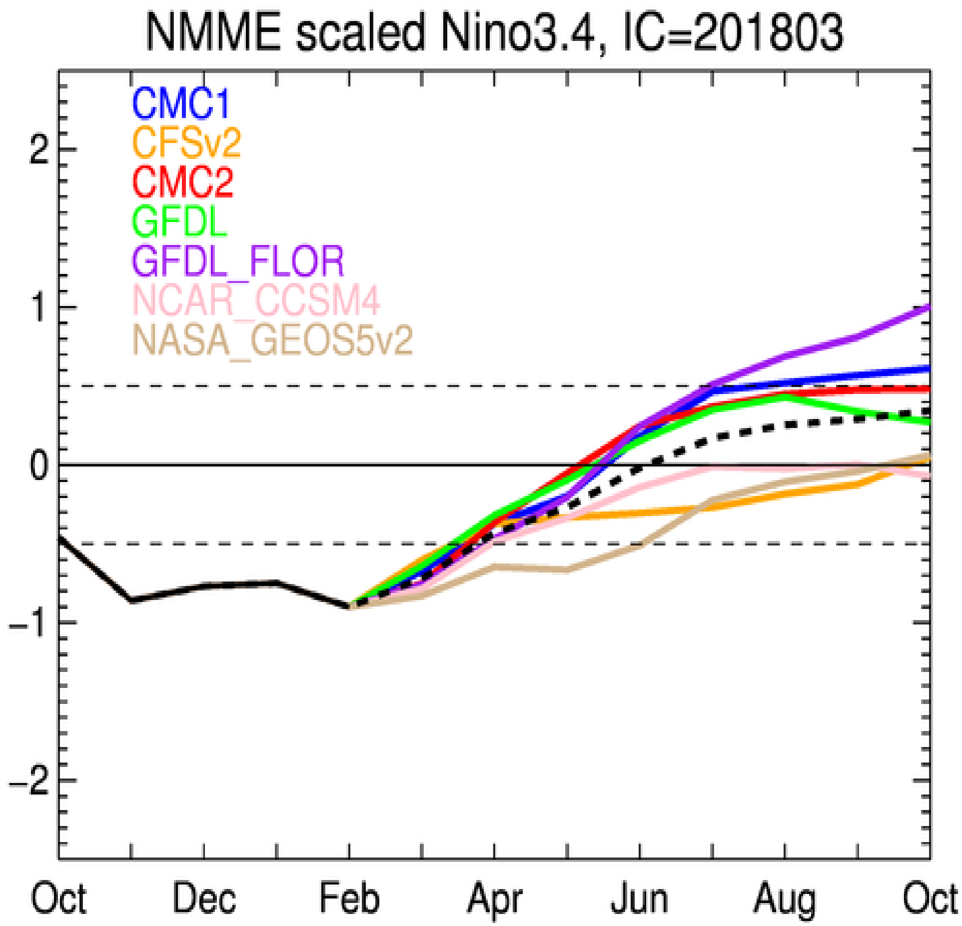


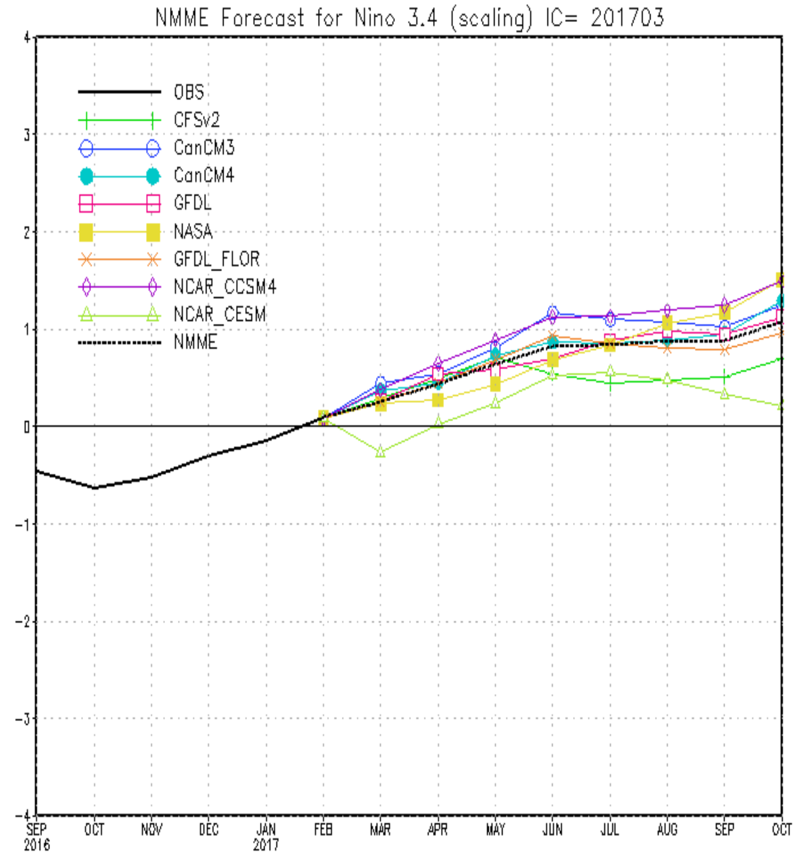
Australia: Nino3.4, IC=25Feb 2018



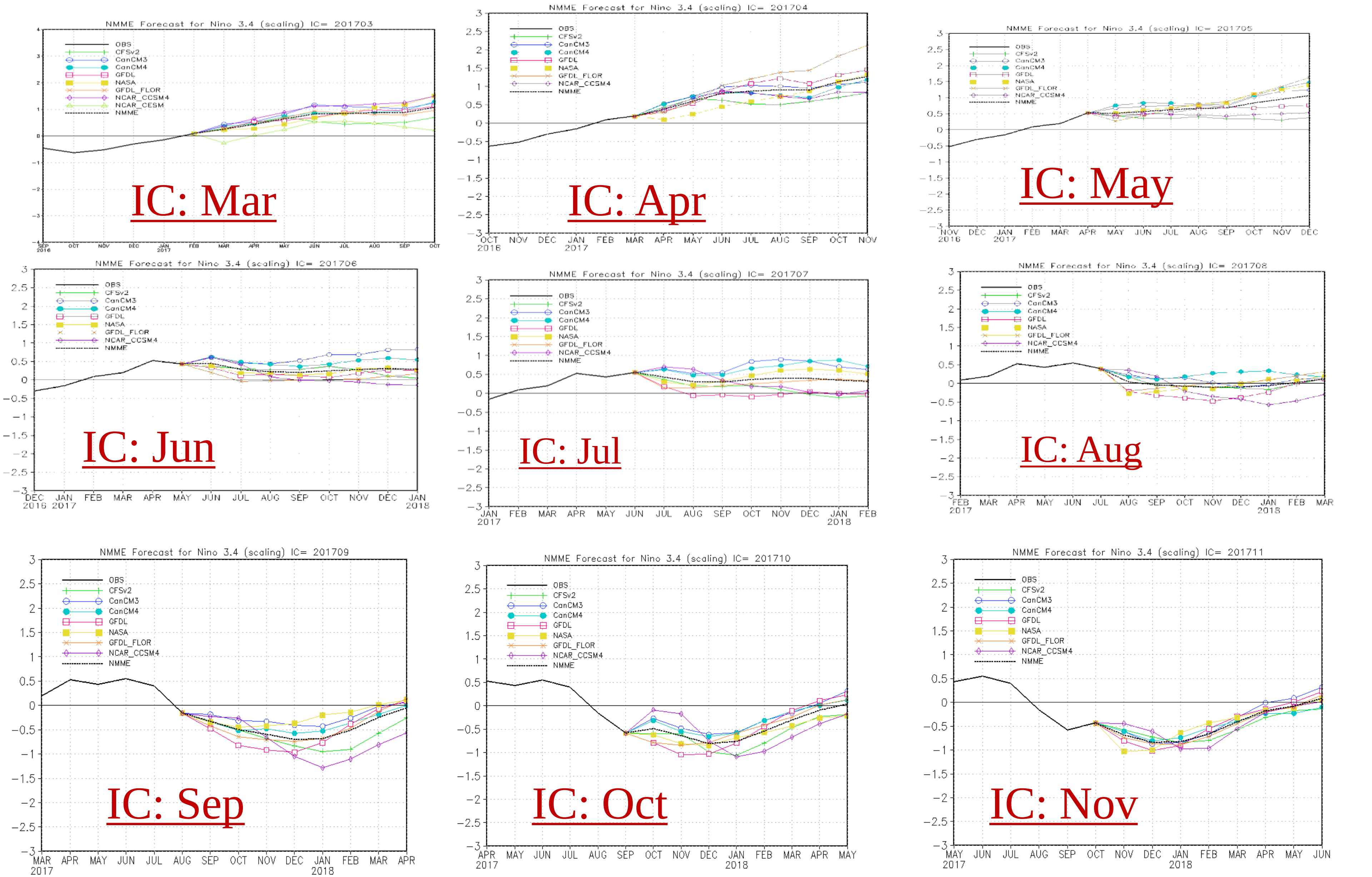
UKMO: Nino3.4, IC=11Feb 2018

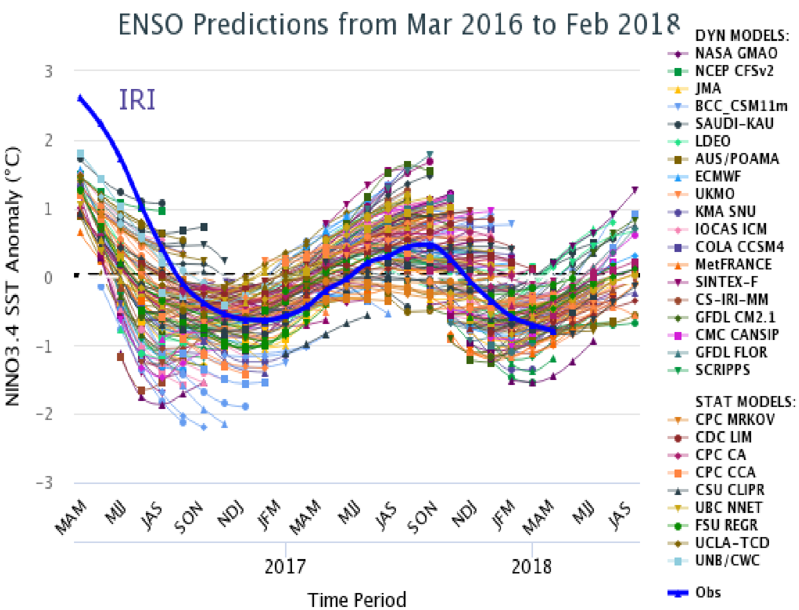


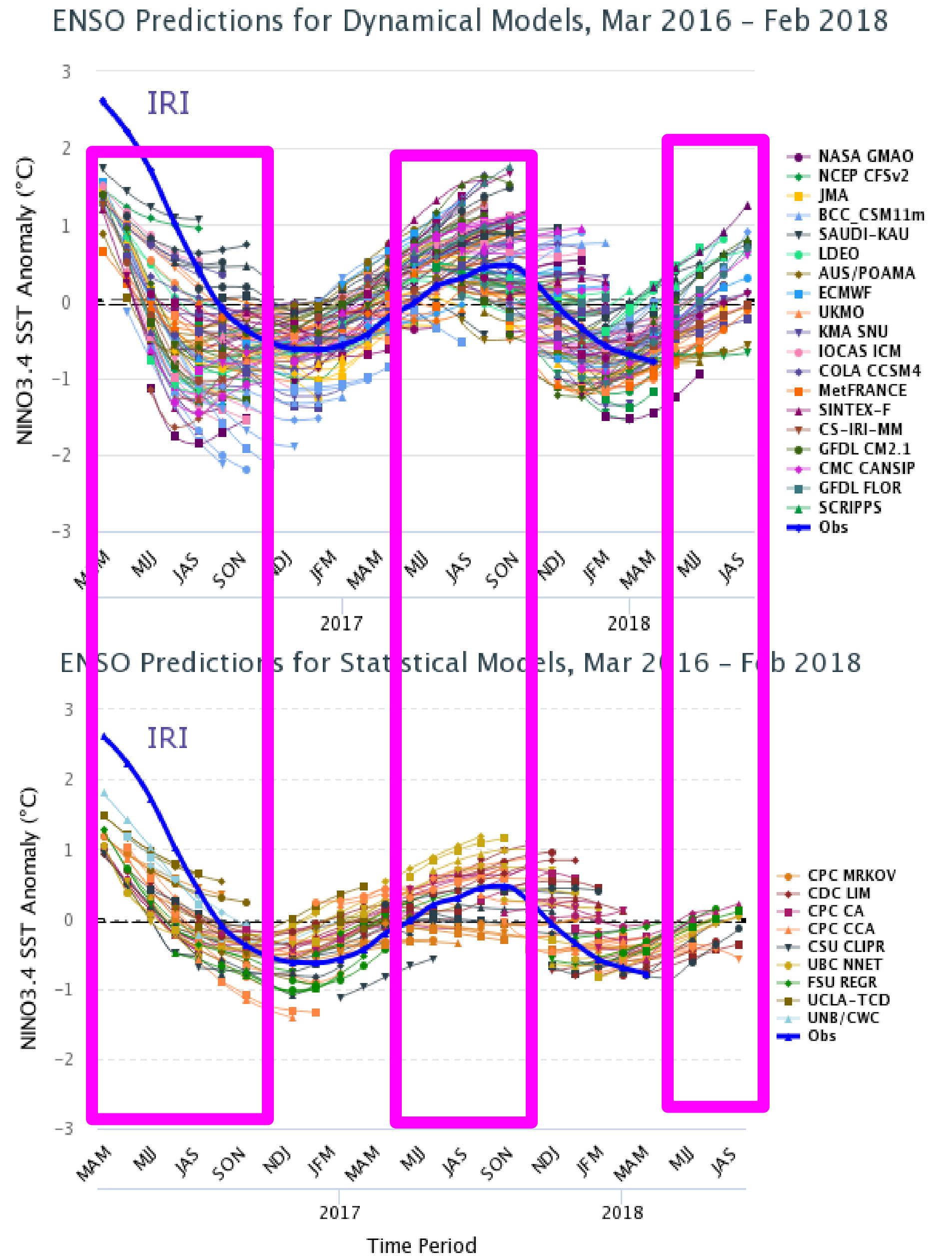

NMME scaled Nino3.4, IC=201803
CMC1
CFSv2
CMC2
GFDL
GFDL_FLOR
NCAR_CCSM4
NASA_GEOS5v2
2
1
0
−1
−2
Oct
Dec
Feb
Apr
Jun
Aug
Oct

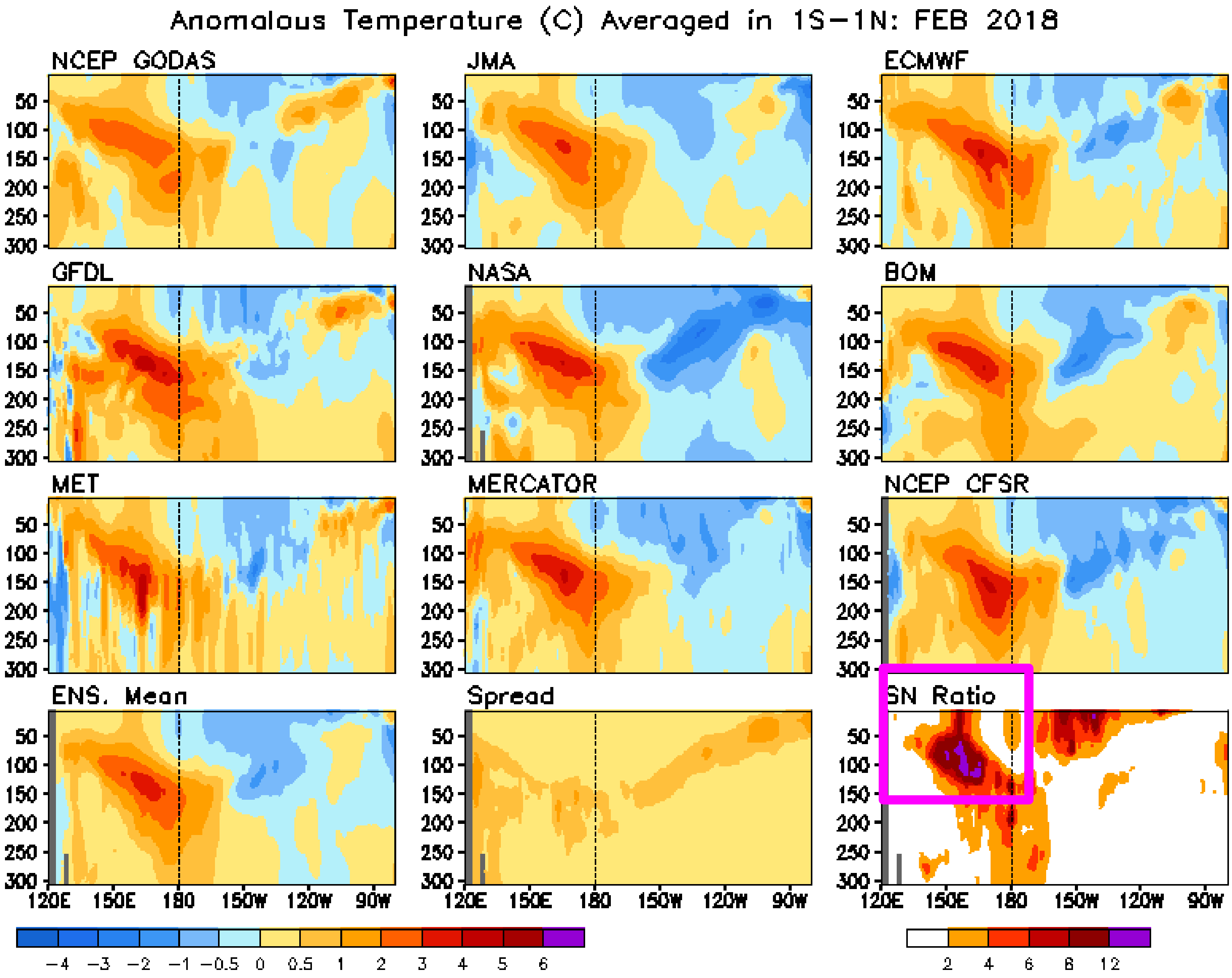

NMME Forecast for Nino 3.4 (scaling) IC= 201703
OBS
CFSv2
CanCM3
CanCM4
GFDL
NASA
GFDL_FLOR
NCAR_CCSM4
NCAR_CESM
NMME
SEP 2016
OCT
NOV
DEC
JAN 2017
FEB
MAR
APR
MAY
JUN
JUL
AUG
SEP
OCT

Large Uncertainty: 7 NMME Models with ICs in Mar-Nov 2017

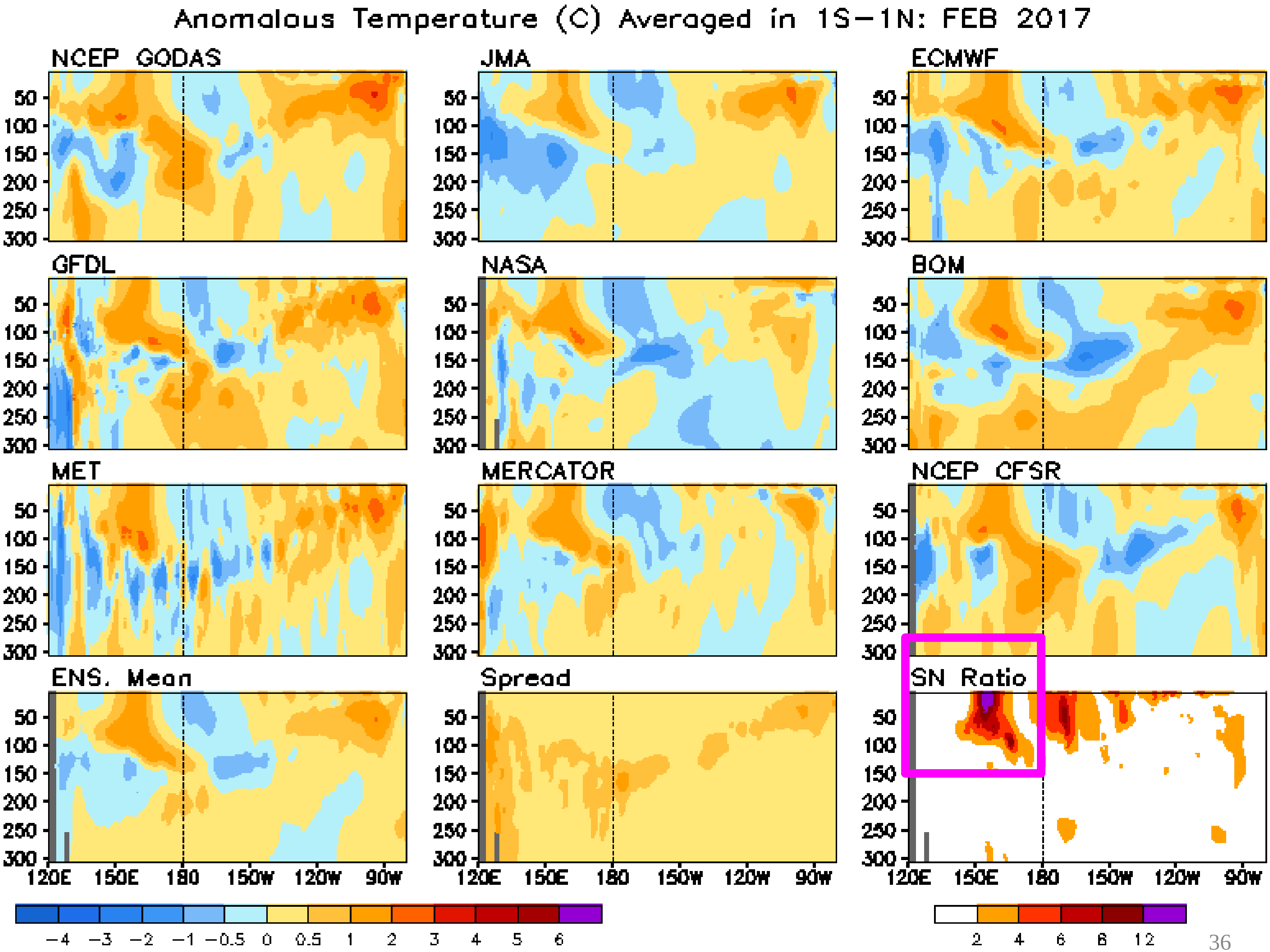



ENSO Predictions from Mar 2016 to Feb 2018
IRI
NINO3.4 SST Anomaly (°C)
Time Period
MAM MJJ JAS SON NDJ JFM MAM MJJ JAS SON NDJ JFM MAM MJJ JAS
2017
2018
DYN MODELS:
NASA GMAO
NCEP CFSv2
JMA
BCC_CSM11m
SAUDI-KAU
LDEO
AUS/POAMA
ECMWF
UKMO
KMA SNU
IOCAS ICM
COLA CCSM4
MetFRANCE
SINTEX-F
CS-IRI-MM
GFDL CM2.1
CMC CANSIP
GFDL FLOR
SCRIPPS
STAT MODELS:
CPC MRKOV
CDC LIM
CPC CA
CPC CCA
CSU CLIPR
UBC NNET
FSU REGR
UCLA-TCD
UNB/CWC
Obs


ENSO Predictions for Dynamical Models, Mar 2016 – Feb 2018
IRI
NINO3.4 SST Anomaly (°C)
MAM MJJ JAS SON NDJ JFM MAM MJJ JAS SON NDJ JFM MAM MJJ JAS
2017
2018
NASA GMAO
NCEP CFSv2
JMA
BCC_CSM11m
SAUDI-KAU
LDEO
AUS/POAMA
ECMWF
UKMO
KMA SNU
IOCAS ICM
COLA CCSM4
MetFRANCE
SINTEX-F
CS-IRI-MM
GFDL CM2.1
CMC CANSIP
GFDL FLOR
SCRIPPS
Obs
ENSO Predictions for Statistical Models, Mar 2016 – Feb 2018
IRI
NINO3.4 SST Anomaly (°C)
Time Period
2017
2018
CPC MRKOV
CDC LIM
CPC CA
CPC CCA
CSU CLIPR
UBC NNET
FSU REGR
UCLA-TCD
UNB/CWC
Obs



Anomalous Temperature (C) Averaged in 1S–1N: FEB 2018
NCEP GODAS
JMA
ECMWF
GFDL
NASA
BOM
MET
MERCATOR
NCEP CFSR
ENS. Mean
Spread
SN Ratio
50 100 150 200 250 300
120E 150E 180 150W 120W 90W
−4 −3 −2 −1 −0.5 0 0.5 1 2 3 4 5 6
2 4 6 8 12


Anomalous Temperature (C) Averaged in 1S-1N: FEB 2017
NCEP GODAS
JMA
ECMWF
GFDL
NASA
BOM
MET
MERCATOR
NCEP CFSR
ENS. Mean
Spread
SN Ratio
50 100 150 200 250 300
120E 150E 180 150W 120W 90W
-4 -3 -2 -1 -0.5 0 0.5 1 2 3 4 5 6
2 4 6 8 12

According to ENSO definition of CPC/NCEP/NOAA

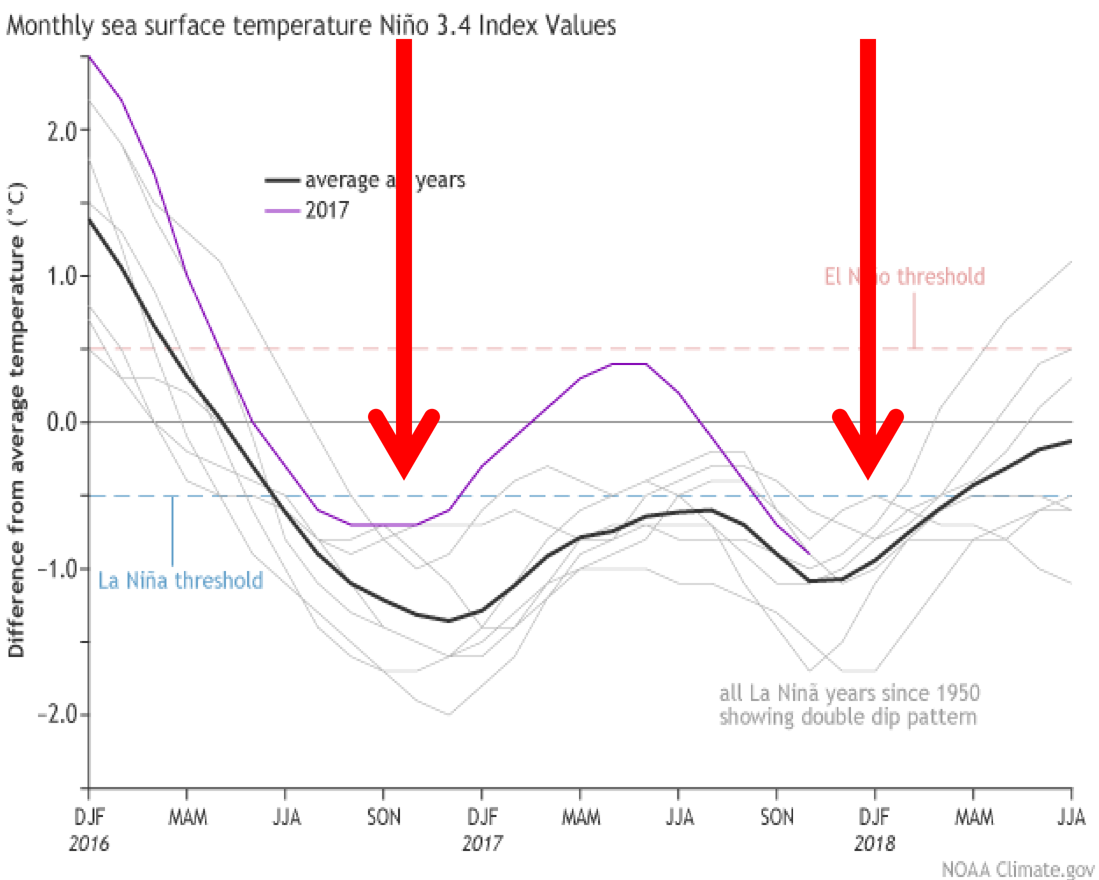
(http://origin.cpc.ncep.noaa.gov/products/analysis_monitoring/ensostuff/ONI_v5.php)

Since 1951, there are total 12 La Ninas

1. 2 three-year Ninas (17%): 1973/76, 1998/2001
2. 6 two-year La Ninas (50%): 1954/56; 1970/72; 1983/85; 2007/09; 2010/12; *2016/18?*
3. 4 one-year La Ninas (33%): 1964/65; 1988/89; 1995/96; 2005/06

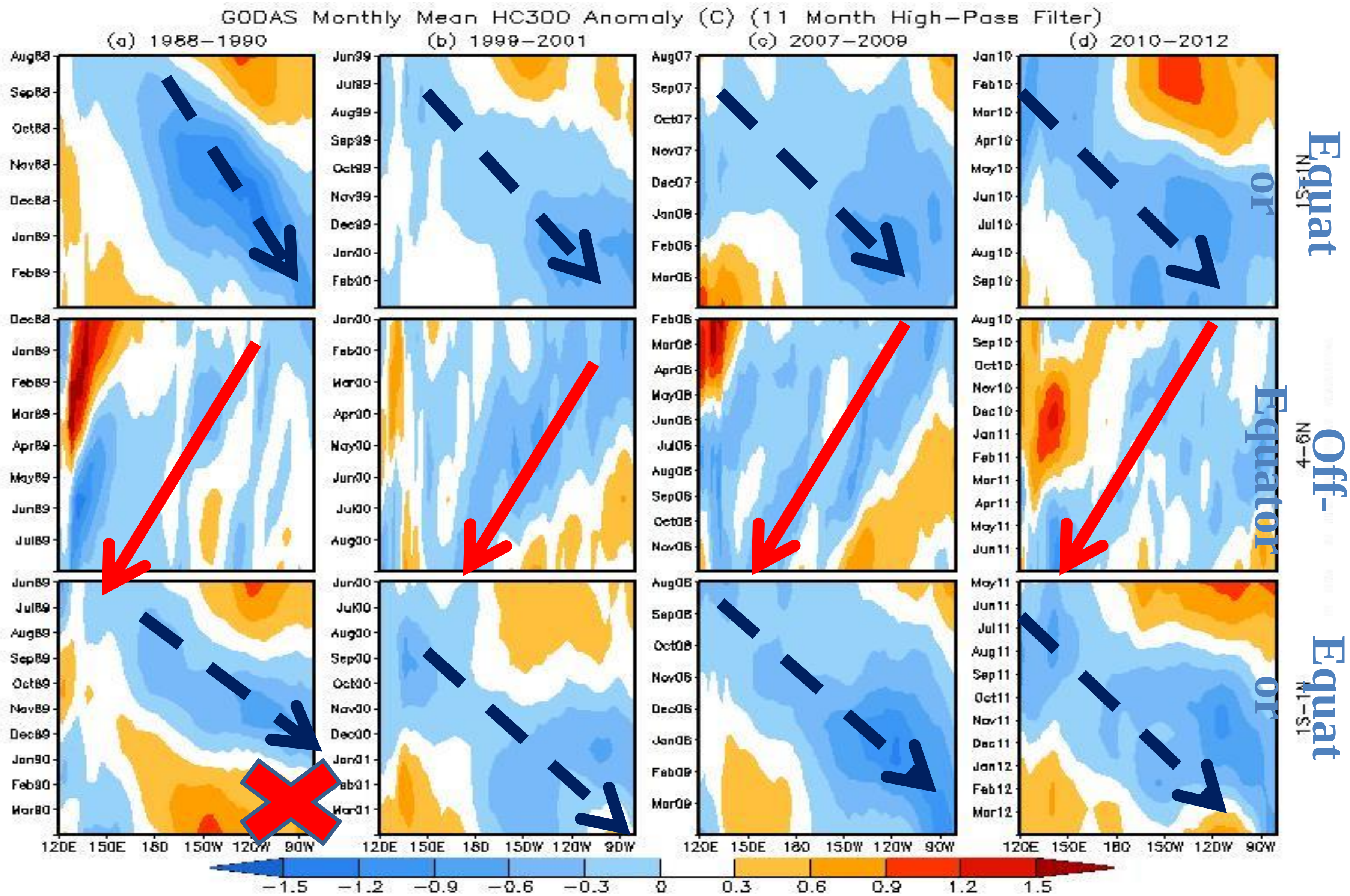
More U.S. drought in a second-year La Niña? (by Nat Johnson)

(https://www.climate.gov/news-features/blogs/enso/more-us-drought-second-year-la-ni%C3%B1a)

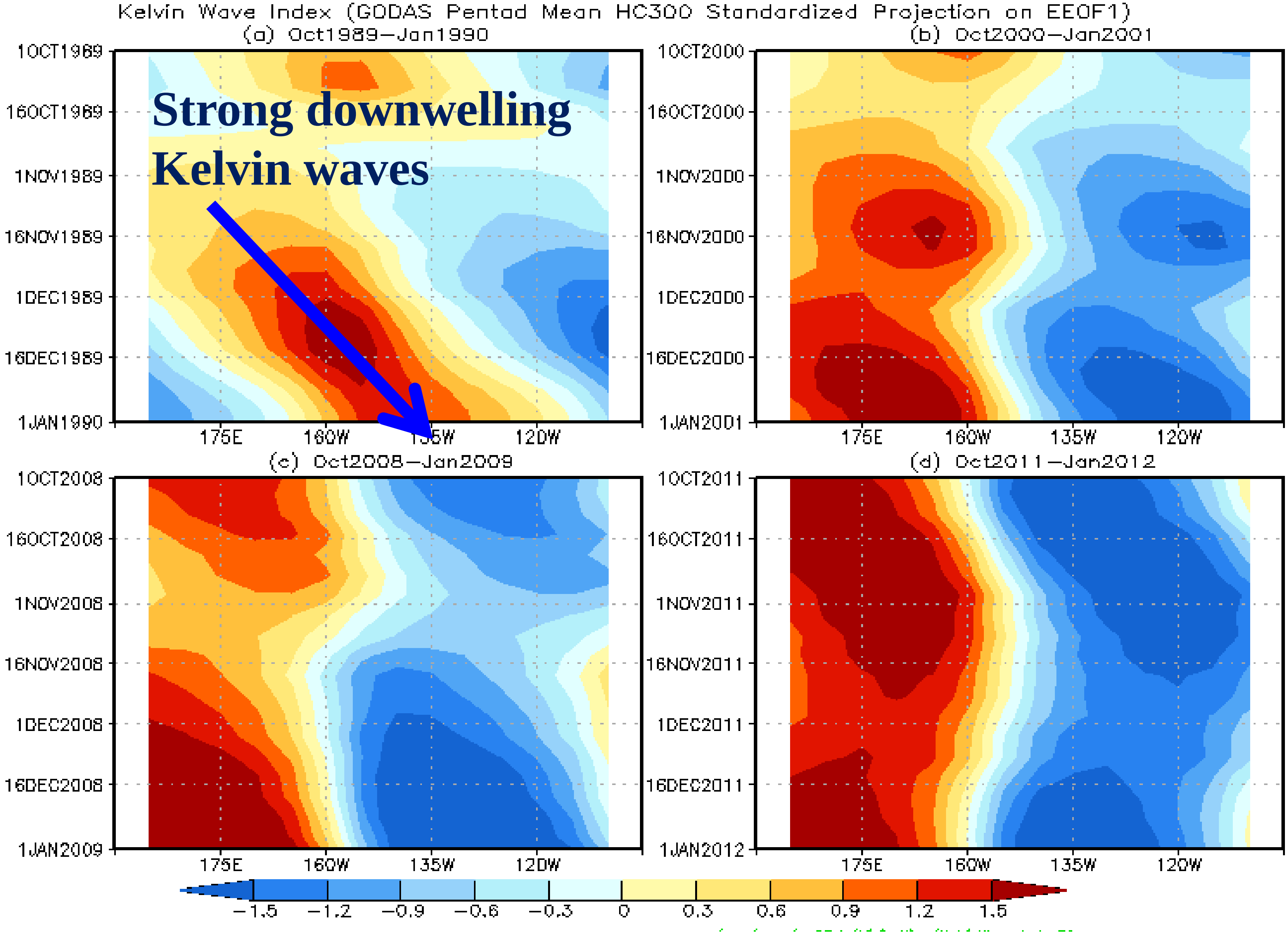


Three-month seasonal sea surface temperature in the Niño 3.4 region of the tropical Pacific compared to the long-term average for all multi-year La Niñas since 1950, showing how the average Niño 3.4 amplitude (black line) evolves in time. The purple line shows the evolution since December-March of 2015, and the light grey lines show the other seven events. Multi-year La Niña events are defined as at least 2 years in a row where the La Niña criteria are met. Both continuous events, when the Oceanic Niño Index remained below -0.5°C, and years when the ONI warmed mid-year before again cooling, are included here. Climate.gov graph based on ERSSTv5 temperature data..

HC300 propagation along equator and off-equator:4 Strong La Ninas

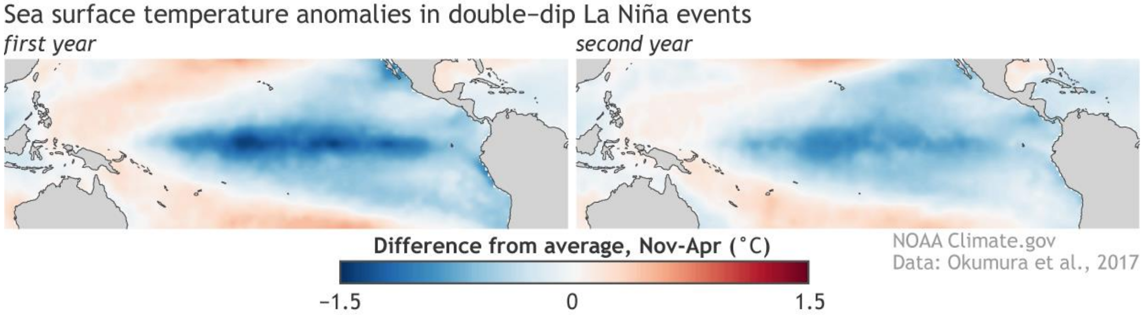


Kelvin wave activity differences

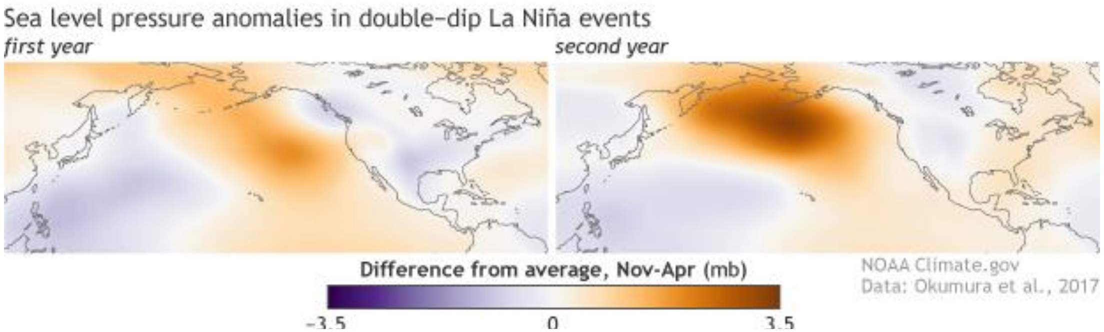


More U.S. drought in a second-year La Niña? (by Nat Johnson)

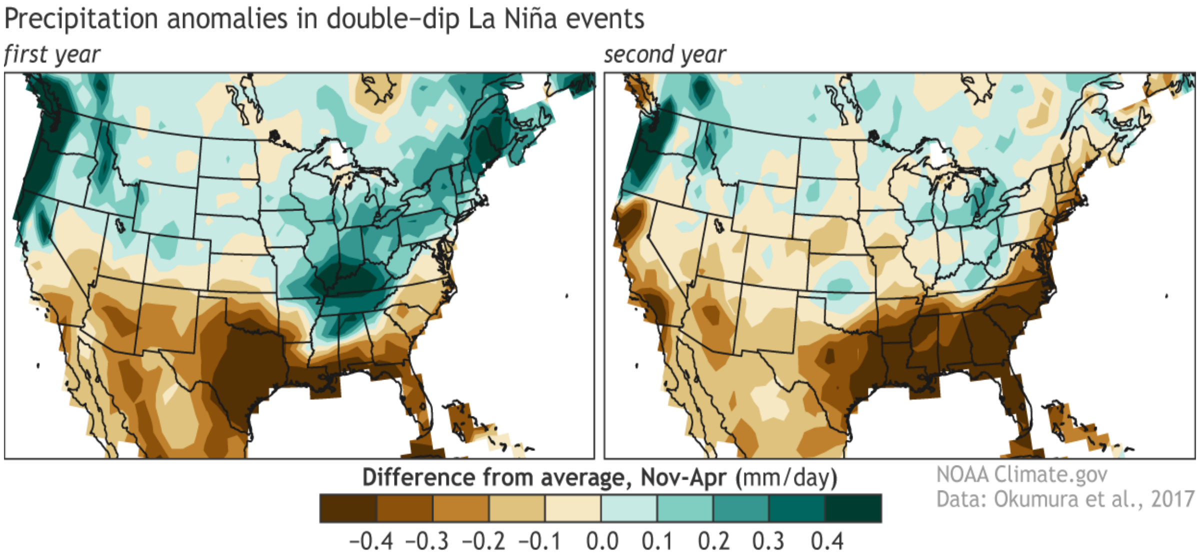
(https://www.climate.gov/news-features/blogs/enso/more-us-drought-second-year-la-ni%C3%B1a)



Average SSTAs in Nov–Apr for the first (left) and second (right) extended winters of all multi-year La Niñas since 1900. Anomalies are compared to the 1900-2012 average, with the linear trend removed. Adapted from Okumura et al. (2017).



Average SLPa during Nov–Apr for the first (left) and second (right) extended winters of all multi-year La Niñas since 1900. Anomalies are compared to the 1900-2012 average, with the linear trend removed. Adapted from Okumura et al. (2017).



Average precipitation anomalies (mm/day) for Nov–Apr for the first (left) and second (right) extended winters of all multi-year La Niñas since 1900. Anomalies are compared to the 1900-2012 average, with the linear trend removed. Adapted from Okumura et al. (2017).

Some Evidences About La Nina

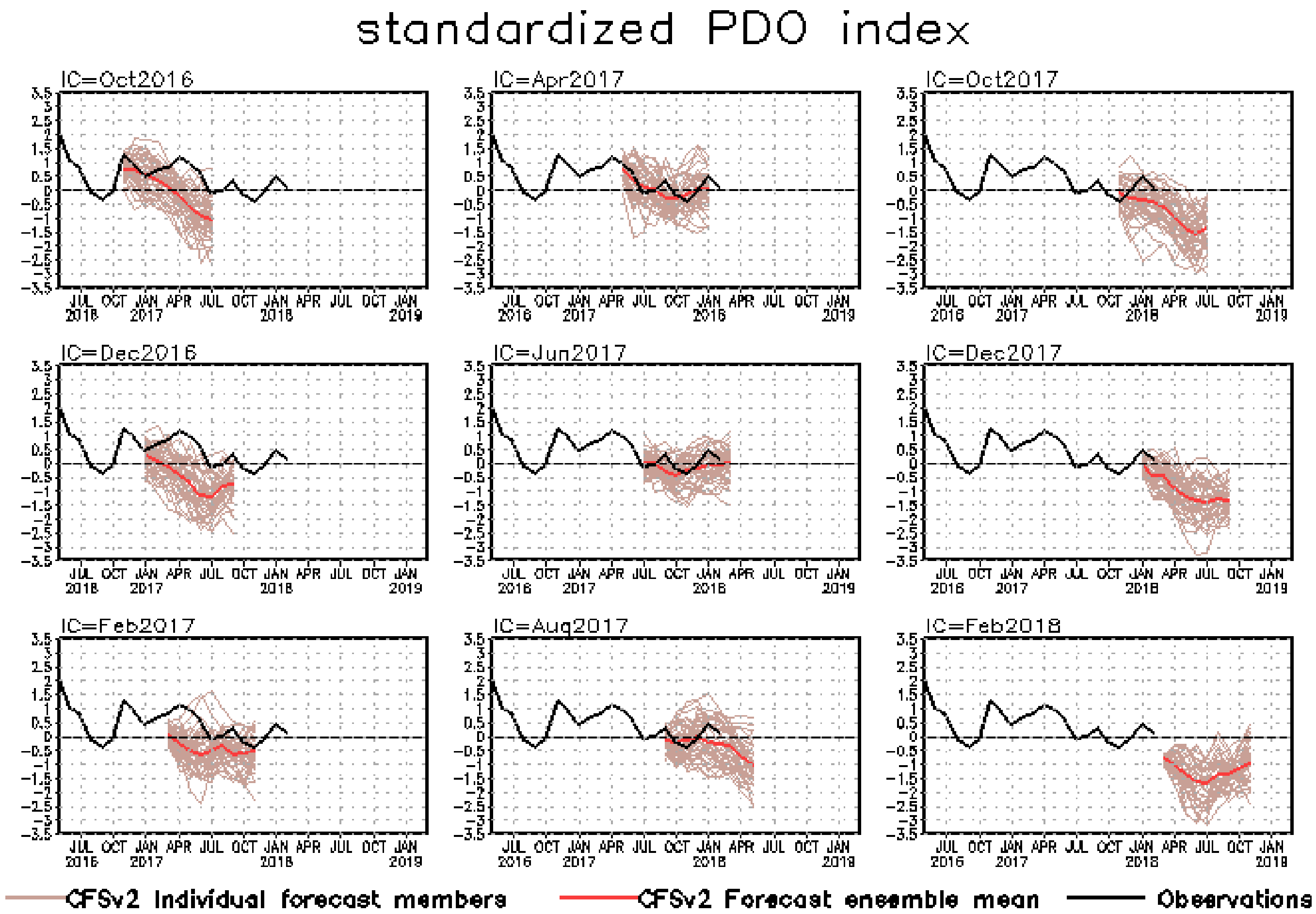
- Statistically, since 1951, chance of 2-3 years La Nina is 2/3, chance of 1 year La Nina is 1/3.
- On average, the intensity of 2^{nd} year is weaker than 1^{st} year, and they have similar impact on N. American winter climate.
- Large negative HC anomalies associated with (strong) La Nina propagate eastward as Equatorial cold Kelvin wave, then are reflected in the east boundary as cold Rossby waves in the tropical N/S Pacific. The westward propagating negative HC anomaly interrupts the recharge process after the peak of (major) La Nina, and prevents the formation of El Nino, sometime may generate a follow-up La Nina.
- However, if there is strong (weak) eastward propagating warm Kelvin waves, that may make the following-up La Nina died young (formed).
- The warm Kelvin wave may be triggered by strong westerly wind anomaly (WWB/weather noise) and its associated divergence along the equatorial western Pacific (120-130E). That may be a reason causing large uncertainty of model prediction for follow-up La Nina.

(1) Hu, Z.-Z., A. Kumar, Y. Xue, and B. Jha, 2014: Why were some La Niñas followed by another La Niña? Clim. Dyn., 42 (3-4), 1029-1042. DOI: 10.1007/s00382-013-1917-3.

(2) NOAA ENSO Blog Post: More U.S. drought in a second-year La Niña? (by Nat Johnson)

(https://www.climate.gov/news-features/blogs/enso/more-us-drought-second-year-la-ni%C3%B1a)

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



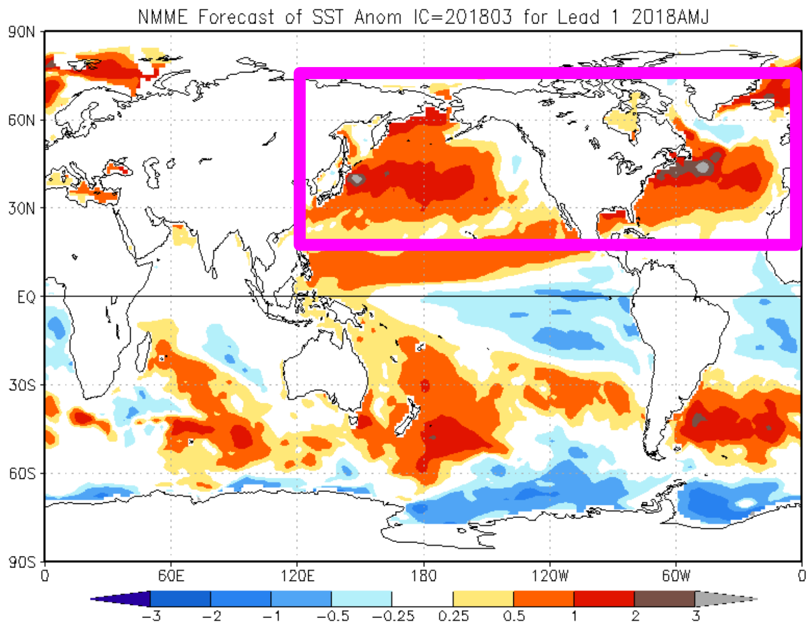
PDO is the first EOF of monthly ERSSTv3b anomaly in the region of [110°E-100°W, 20°N-60°N].

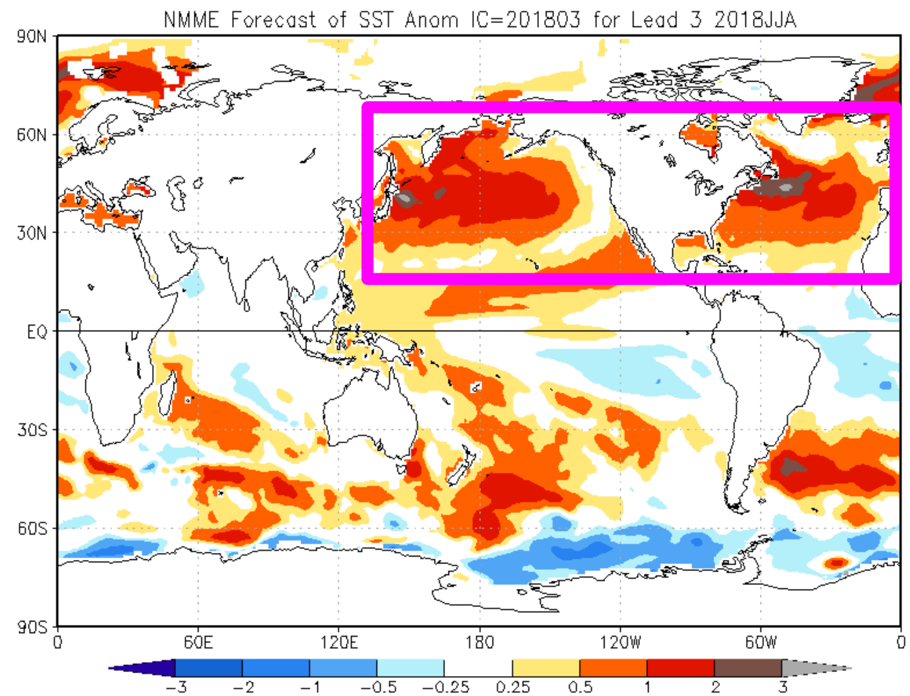
CFS PDO index is the standardized projection of CFS SST forecast anomalies onto the PDO EOF pattern.

- CFSv2 predicts a negative phase of PDO in 2018.

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.

NMME predicted strong warming in N. Pacific & N. Atlantic





Acknowledgements

- Drs. Caihong Wen, Arun Kumar, and Yan Xue: reviewed PPT, and provide insight and constructive suggestions and comments

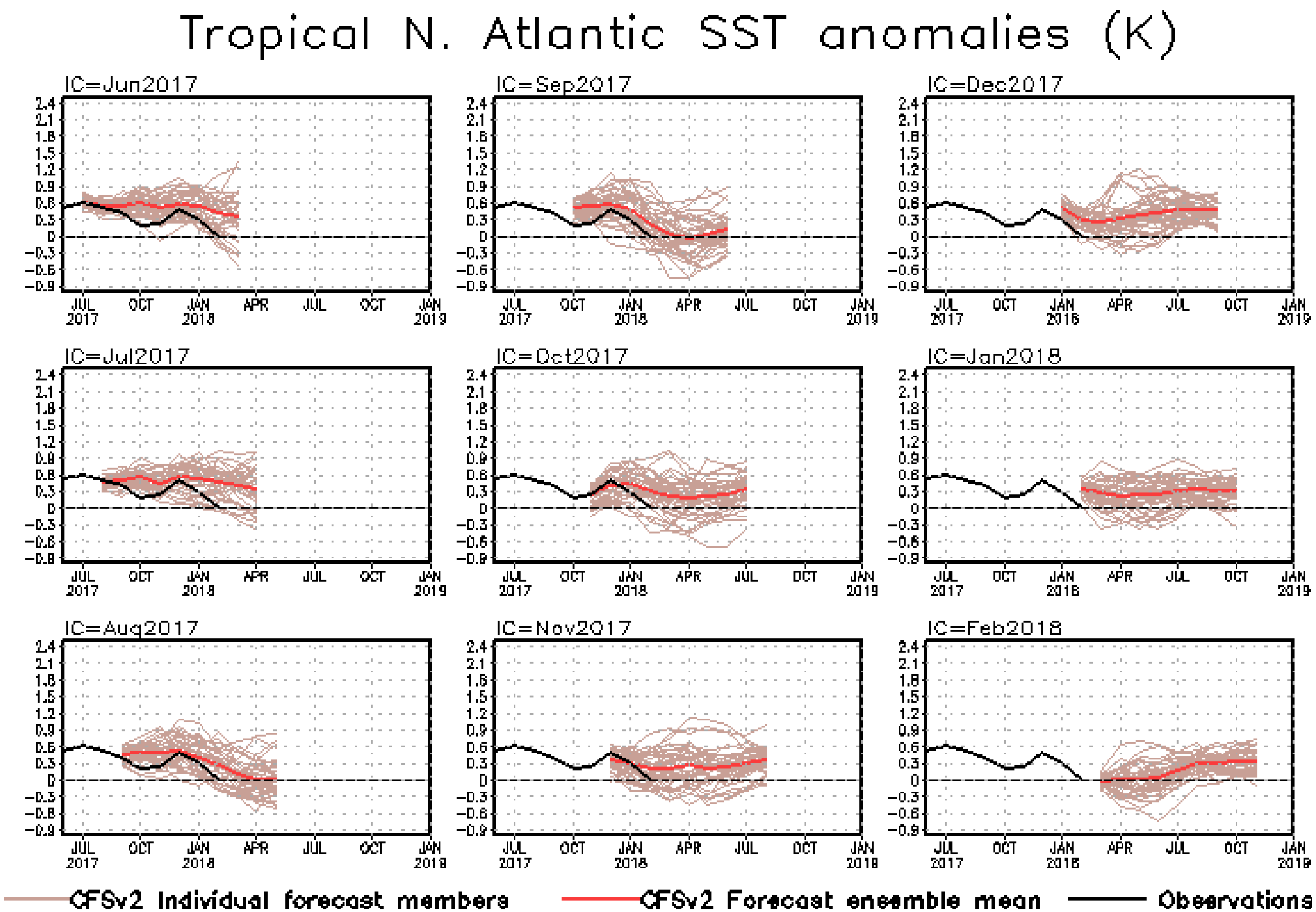
- Drs. Li Ren and Pingping Xie: Provided SSS slides

- Dr. Emily Becker: timely provided NMME plot

Backup Slides

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

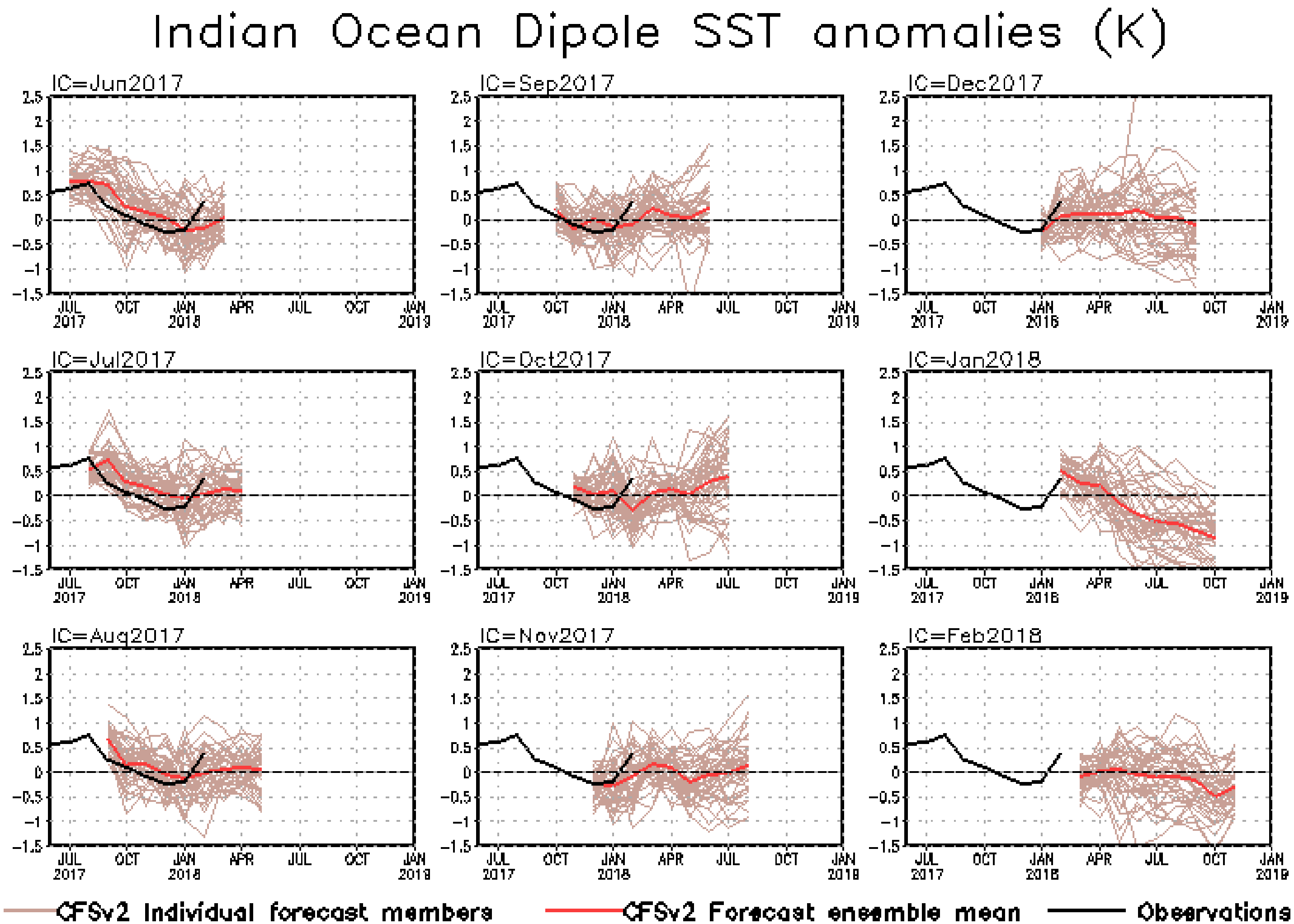
TNA is the SST anomaly averaged in the region of [60°W-30°W, 5°N-20°N].



- **Latest CFSv2 predictions call above normal SSTA in tropical N. Atlantic in summer-autumn 2018.**

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.

NCEP CFS DMI SST Predictions from Different Initial Months



DMI = WTIO- SETIO

SETIO = SST anomaly in [90°E-110°E, 10°S-0]

WTIO = SST anomaly in [50°E-70°E, 10°S-10°N]

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.

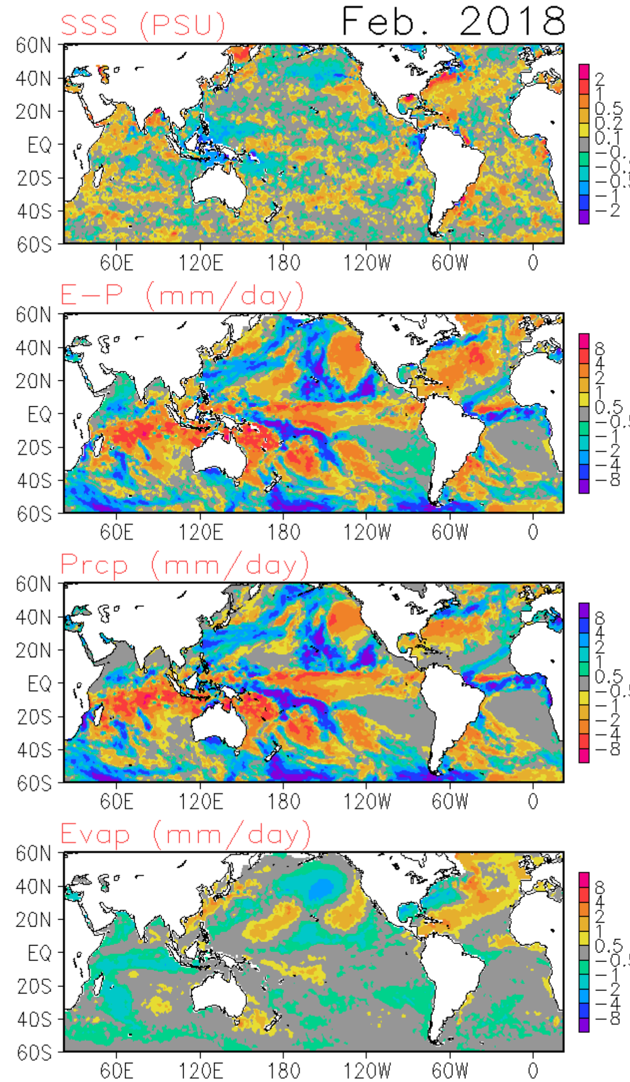
Global Sea Surface Salinity (SSS)

Anomaly for February 2018

- **New Update: The input satellite sea surface salinity of SMAP from NSAS/JPL was changed from Version 3.0 to Version 4.0 in January 2018.**
- The negative SSS signal continued in the Indonesia equatorial Pacific. However, the precipitation was reduced in this area. The SSS in the west Equatorial Pacific ocean (150ºE to 180) increased and it is accompanied by reduced precipitation. In the North Pacific subarctic region, the negative SSS anomaly continued along the storm track region with increased precipitation. Meanwhile, the positive SSS anomaly in the Gulf Stream of the North Atlantic Ocean became stronger. In the Bay of Bengal, the SSS increased. The SSS in the sea of Okhotsk also increased with no significant precipitation change.

- **Data used**

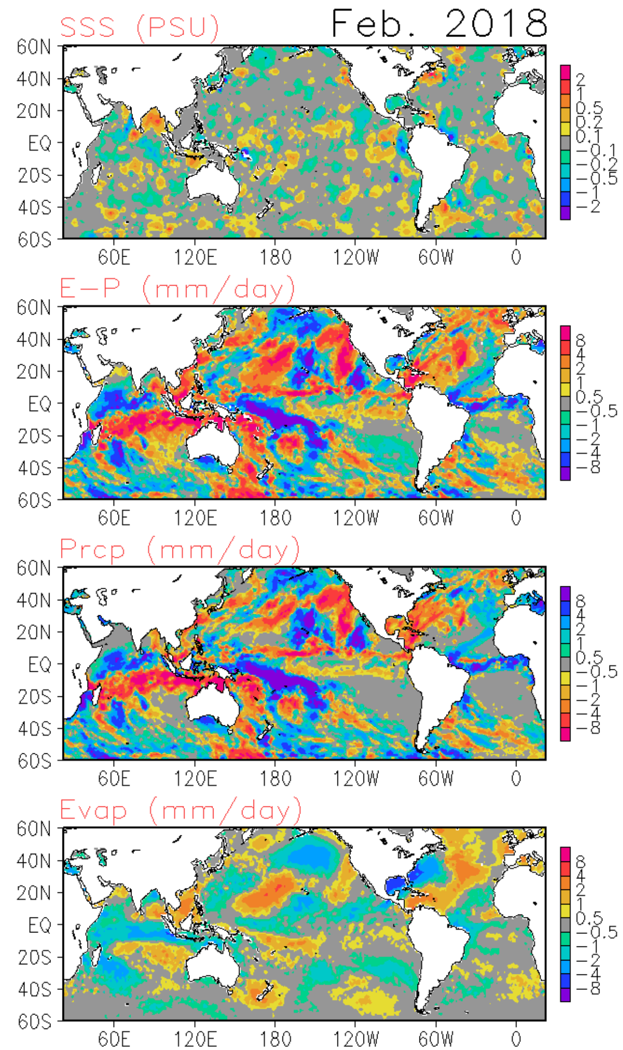
SSS : Blended Analysis of Surface Salinity (BASS) V0.Z
(a CPC-NESDIS/NODC-NESDIS/STAR joint effort)
(Xie et al. 2014)
ftp.cpc.ncep.noaa.gov/precip/BASS
Precipitation: CMORPH adjusted satellite precipitation estimates
Evaporation: Adjusted CFS Reanalysis



Global Sea Surface Salinity (SSS)

Tendency for February 2018

Compared with last month, the SSS in the Bay of Bengal significantly increased. The SSS in the west Equatorial Pacific Ocean increased with increasing precipitation. The SSS in the Gulf Stream region increased and it is likely caused by the ocean current advection. The SSS in the Equatorial Atlantic Ocean also increased being accompanied with the freshwater input increasing, which suggests that such change is likely due to the ocean current advection/entrainment.

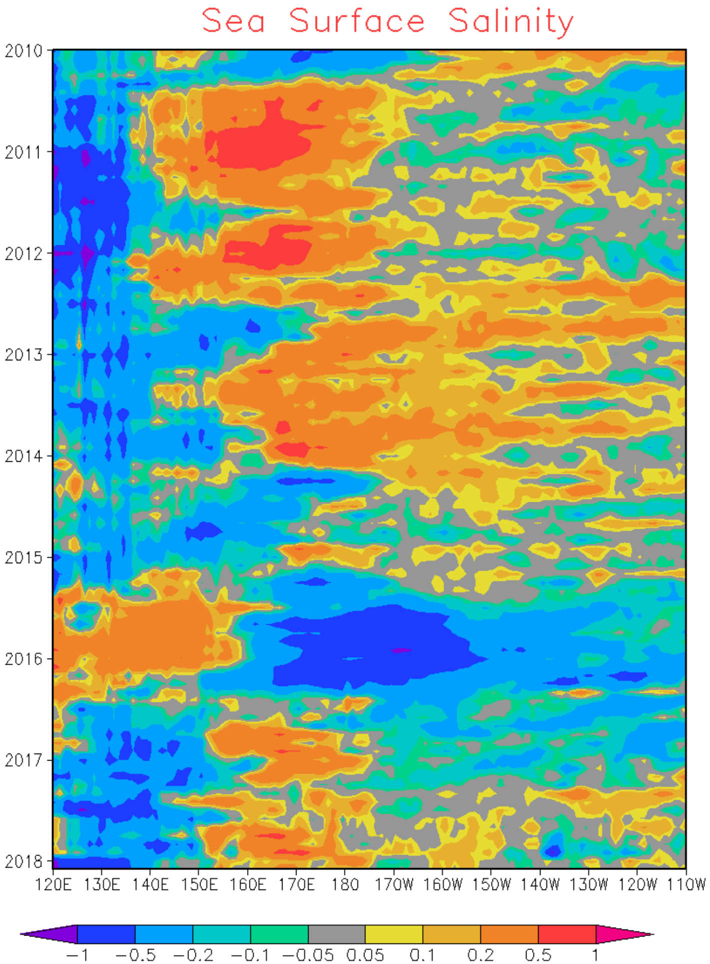


Global Sea Surface Salinity (SSS)

Anomaly Evolution over Equatorial Pacific

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. The positive SSS anomaly signal in the central equatorial Pacific Ocean continues from 150°E to 150°W. The SSS became slightly negative west of 150°W.



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

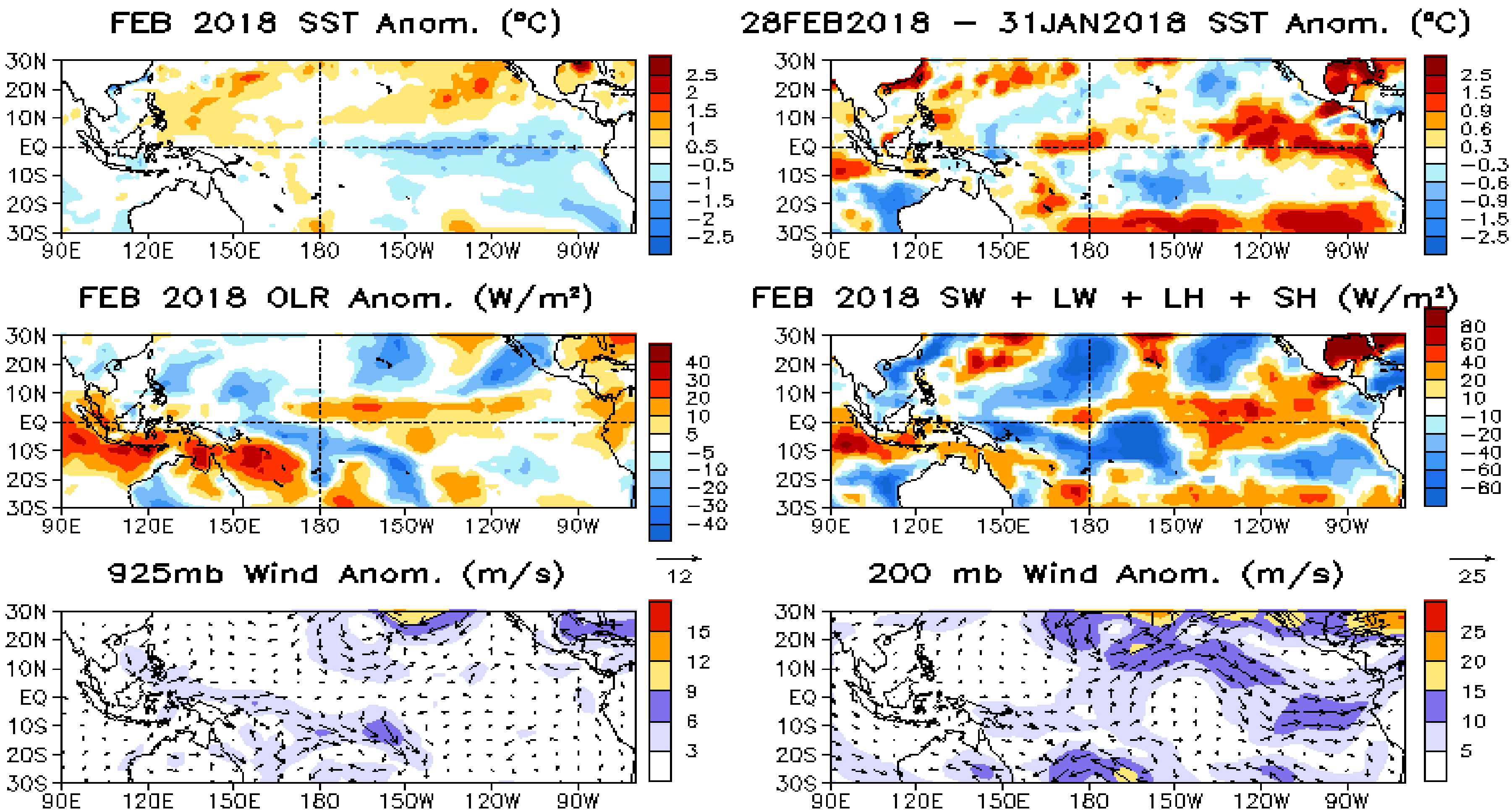
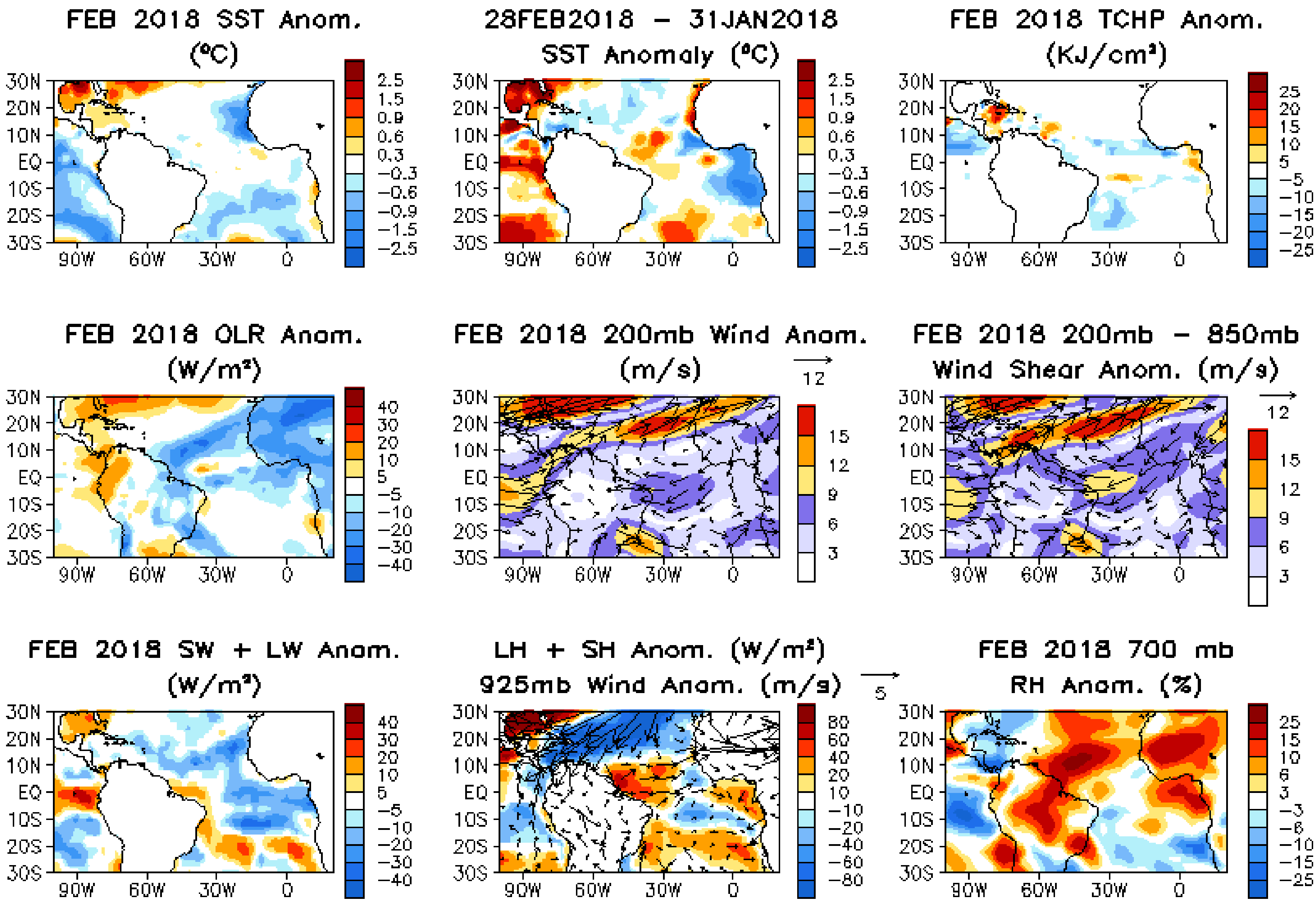


Fig. P2. Sea surface temperature (SST) anomalies (top-left), anomaly tendency (top-right), Outgoing Long-wave Radiation (OLR) anomalies (middle-left), sum of net surface short- and long-wave radiation, latent and sensible heat flux anomalies (middle-right), 925-mb wind anomaly vector and its amplitude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

Tropical Atlantic:



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

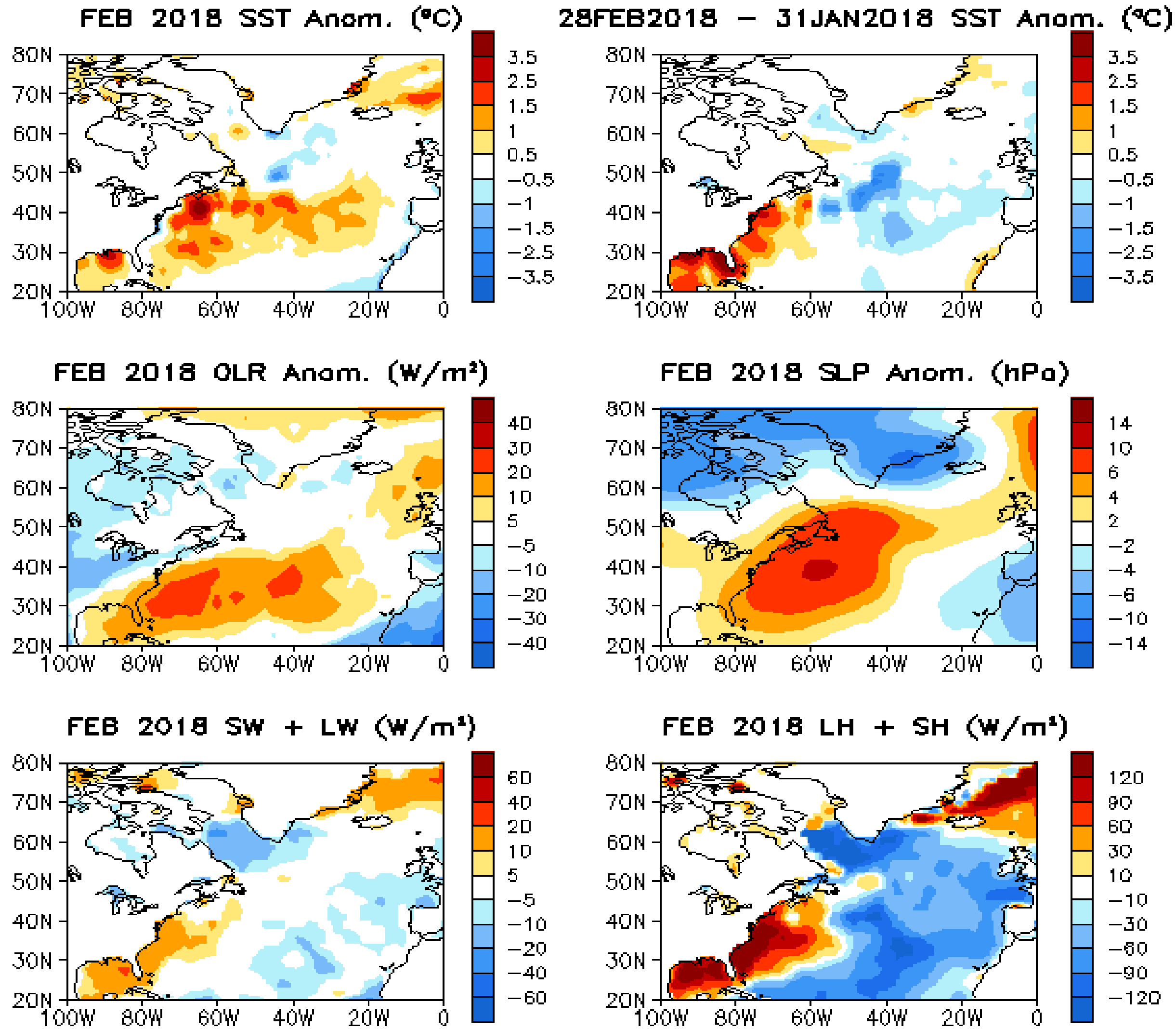


Fig. NA1. Sea surface temperature (SST) anomalies (top-left), anomaly tendency (top-right), Outgoing Long-wave Radiation (OLR) anomalies (middle-left), sea surface pressure anomalies (middle-right), sum of net surface short- and long-wave radiation anomalies (bottom-left), sum of latent and sensible 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.

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.ndbc.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!