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 Global Ocean Monitoring and Observing Program (GOMO)

Outline

- **Overview**
- **Recent highlights**
  - **Pacific/Arctic Ocean**
  - **Indian Ocean**
  - **Atlantic Ocean**
- **Global SSTA Predictions**

➢ **NOAA 2020 Hurricane Outlooks**

➢ **North Pacific Marine Heatwave status and prediction**

Overview

- **Pacific Ocean**
  - **ENSO neutral conditions persisted, but cooled in the eastern basin (NINO3.4 = -0.17^{o}C).**
  - **Positive SSTAs continued in the NE Pacific in May 2020. The PDO was in a negative phase (PDOI = -0.22).**

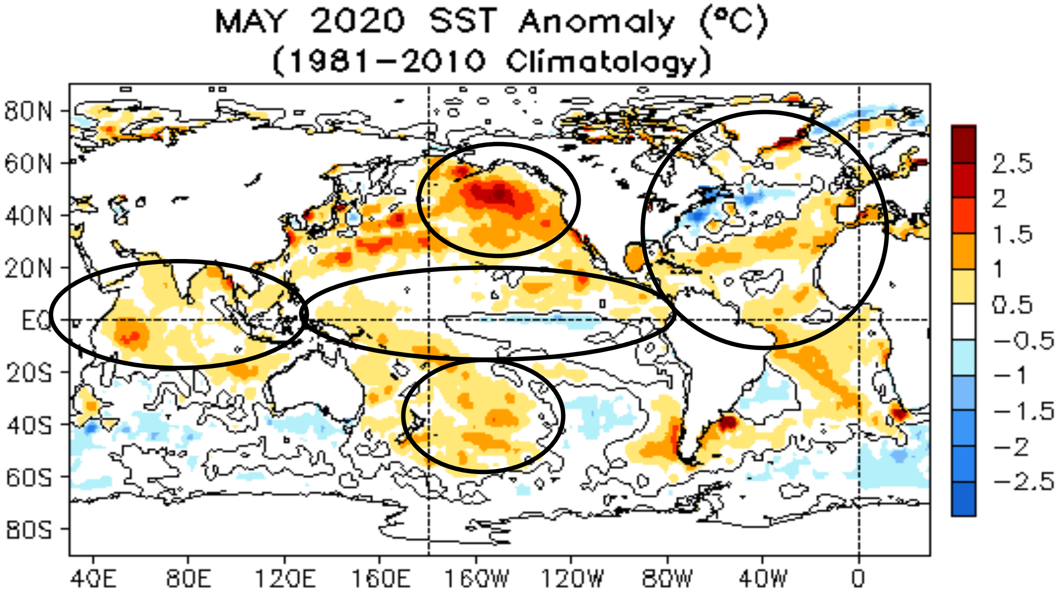
- **Indian Ocean**
  - **Positive SSTAs were present in the tropical Indian Ocean in May 2020.**

- **Atlantic Ocean**
  - **NAO remained in a negative phase in May 2020 with NAOI= -0.33.**
  - **The prolonged tripole SSTA pattern persisted in the north Atlantic in May 2020.**

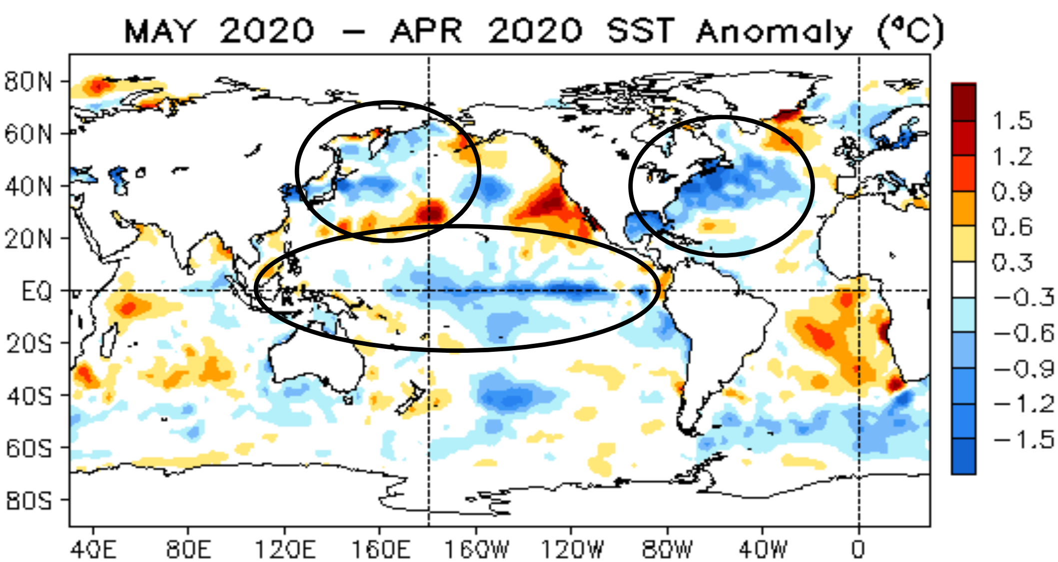
- **Arctic Ocean**
  - **The sea ice extent in May 2020 was ranked as the 4th lowest since 1979, and its pace of loss was near average.**

Global Oceans

Global SST Anomaly (⁰C) and Anomaly Tendency



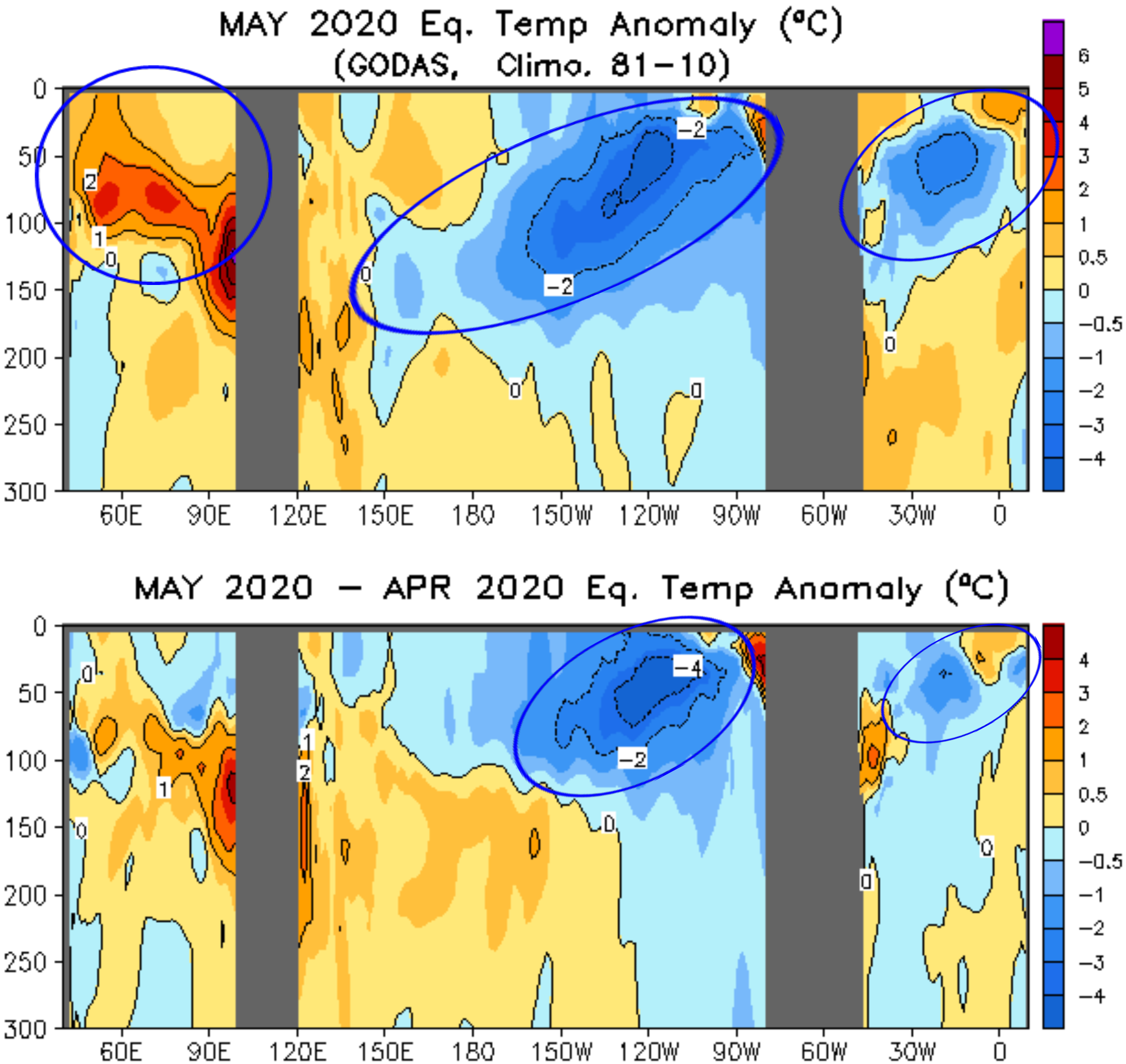
- Negative SSTAs appeared in the eastern equatorial Pacific.
- Positive SSTAs persisted in the NE Pacific.
- Weak tripole SSTA pattern persisted in the North Atlantic.
- Weak positive SSTAs were present across the tropical Indian basin.
- Positive SSTAs were present in the South Pacific.



- Negative SSTA tendencies were present across the tropical Pacific.
- Negative SSTA tendencies presented in the Kuroshio and Gulf Stream regions.

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

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



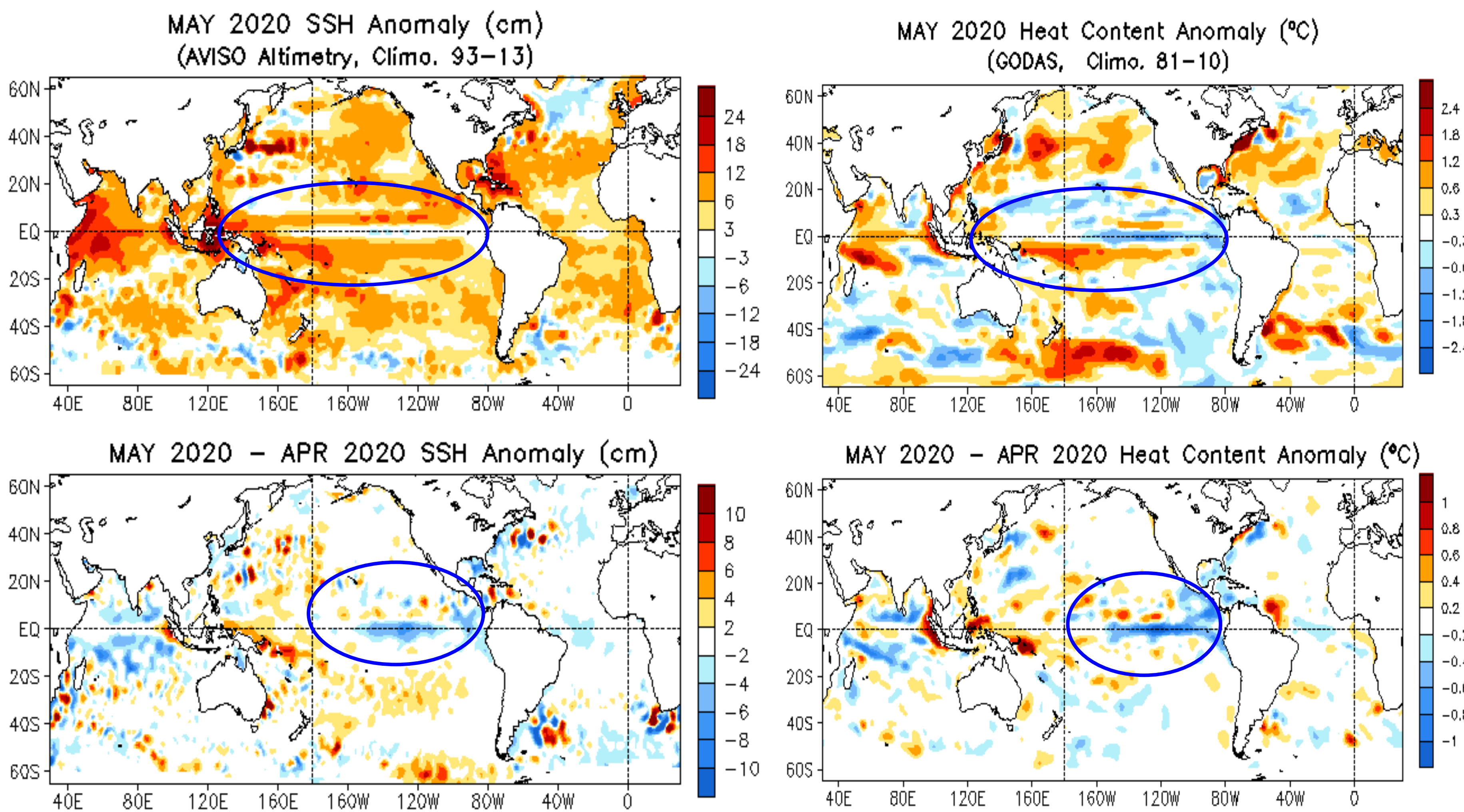
- Negative temperature anomalies presented along the thermocline in both the equatorial Pacific and Atlantic Oceans.

- Positive temperature anomalies were observed in the upper equatorial Indian Ocean.

-Temperature anomaly tendency was negative along the thermocline in the eastern Pacific and Atlantic.

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.

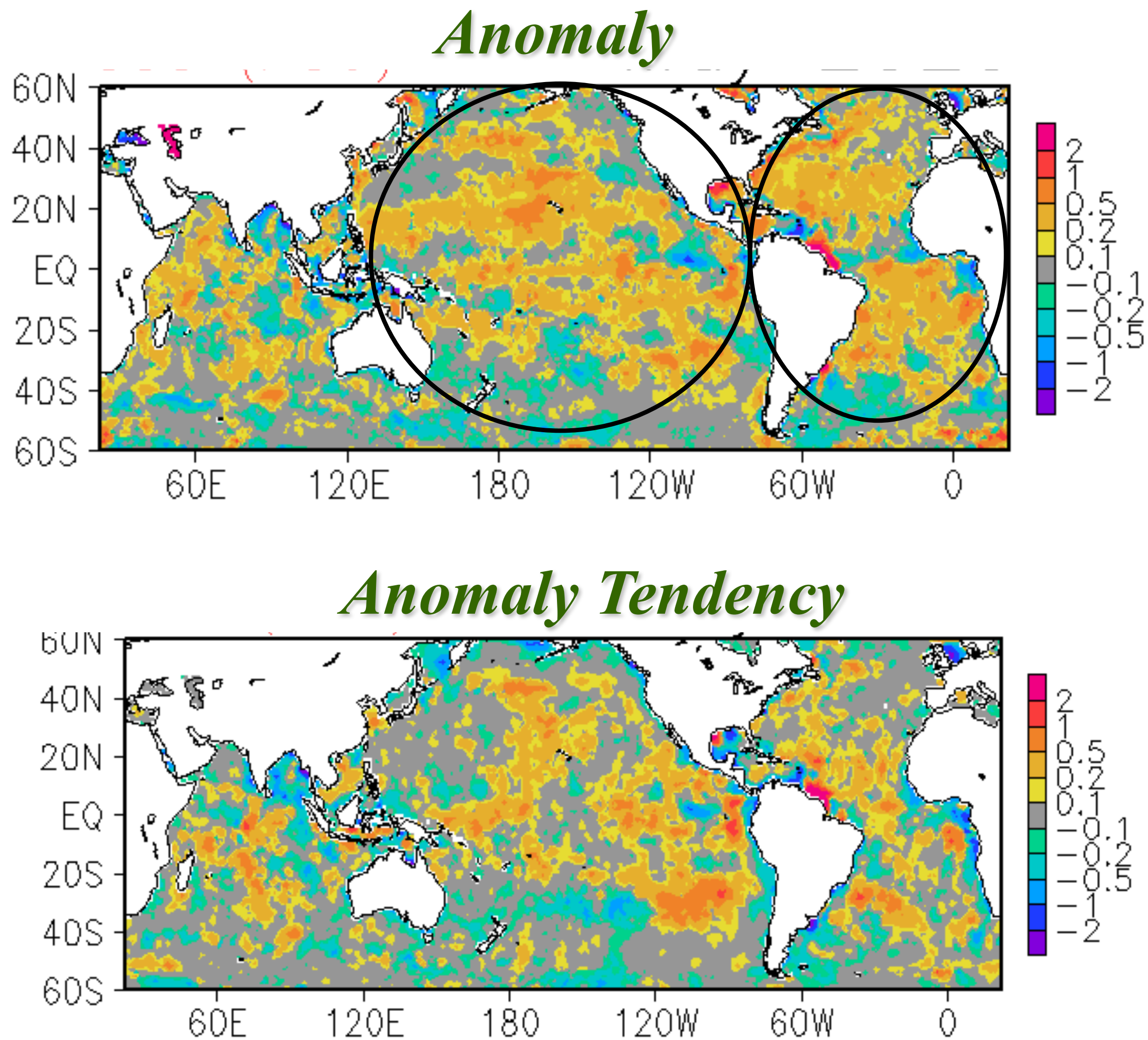
Global SSH and HC300 Anomaly & Anomaly Tendency



- The SSHA pattern was overall consistent with the HC300A pattern, but with a significant trend component in SSHA.

- Much better consistency for tendencies. Both SSHA and HC300A tendencies were negative in the eastern equatorial Pacific.

Global Sea Surface Salinity (SSS) for May2020



- Positive SSS anomalies were present across most of the Pacific and Atlantic Oceans.

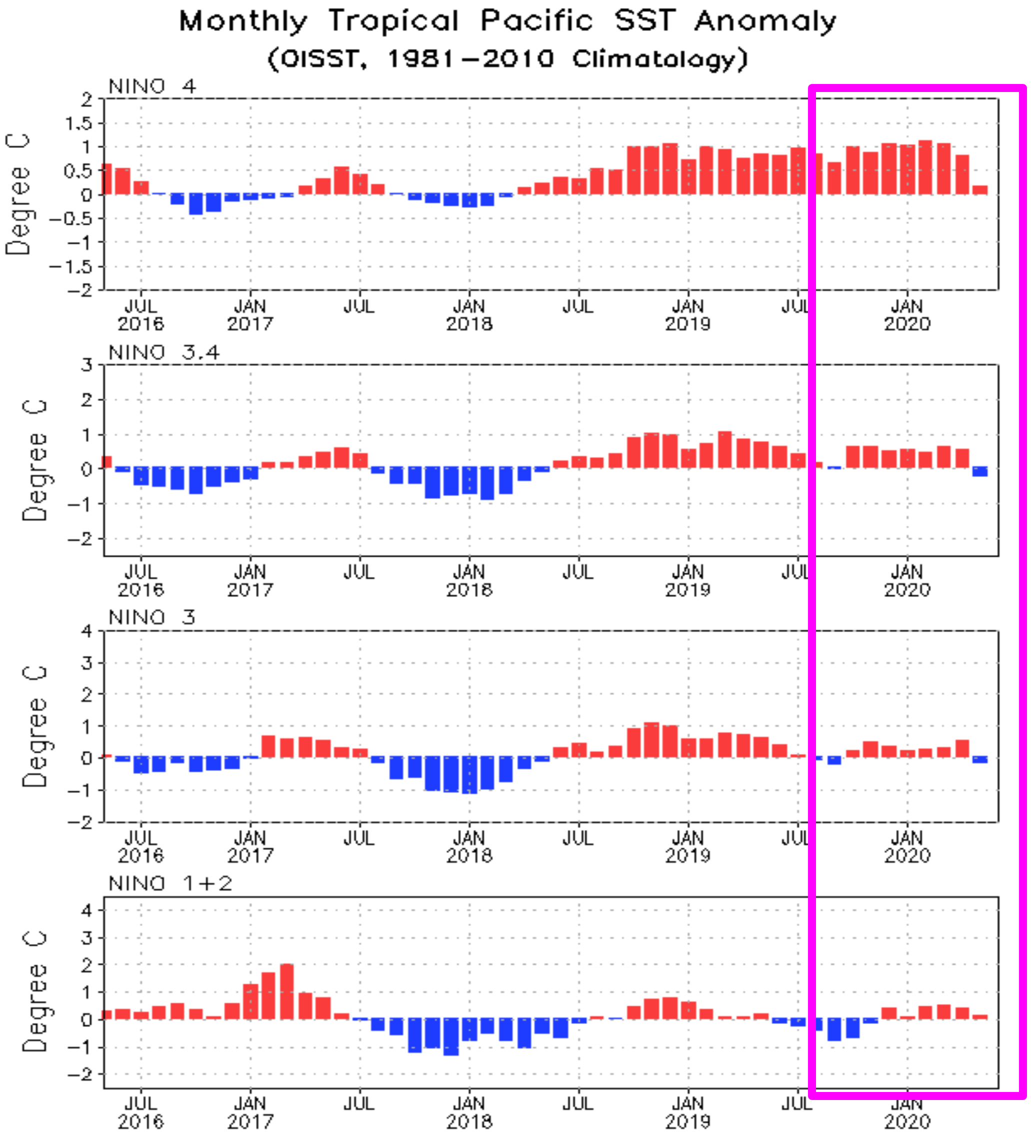
- The tendency distribution similar to the anomaly one, suggesting a persistence and enhancement of the April state.

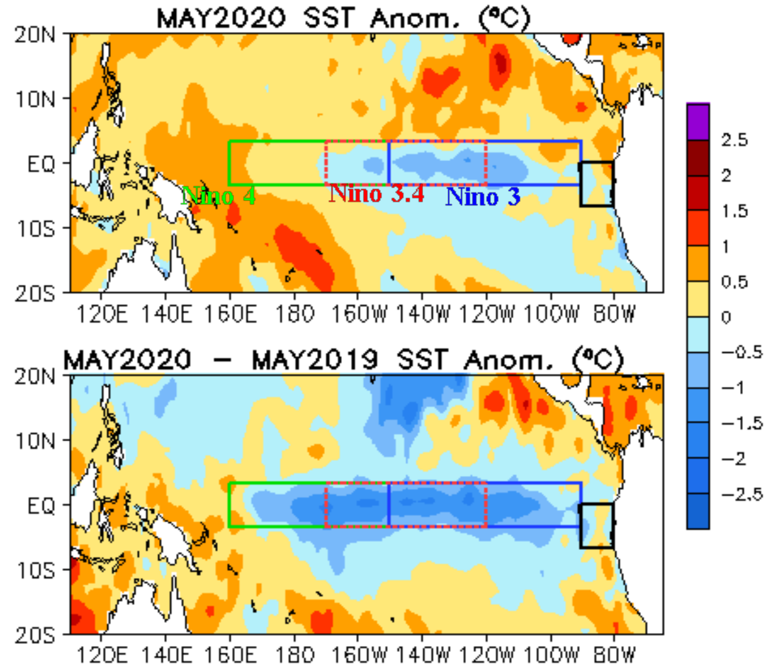
Blended Analysis of Surface Salinity (BASS) V0.Z (Xie et al. 2014)

Courtesy of Dr. Li Ren

Tropical Pacific Ocean and ENSO Conditions

Evolution of Pacific NINO SST Indices



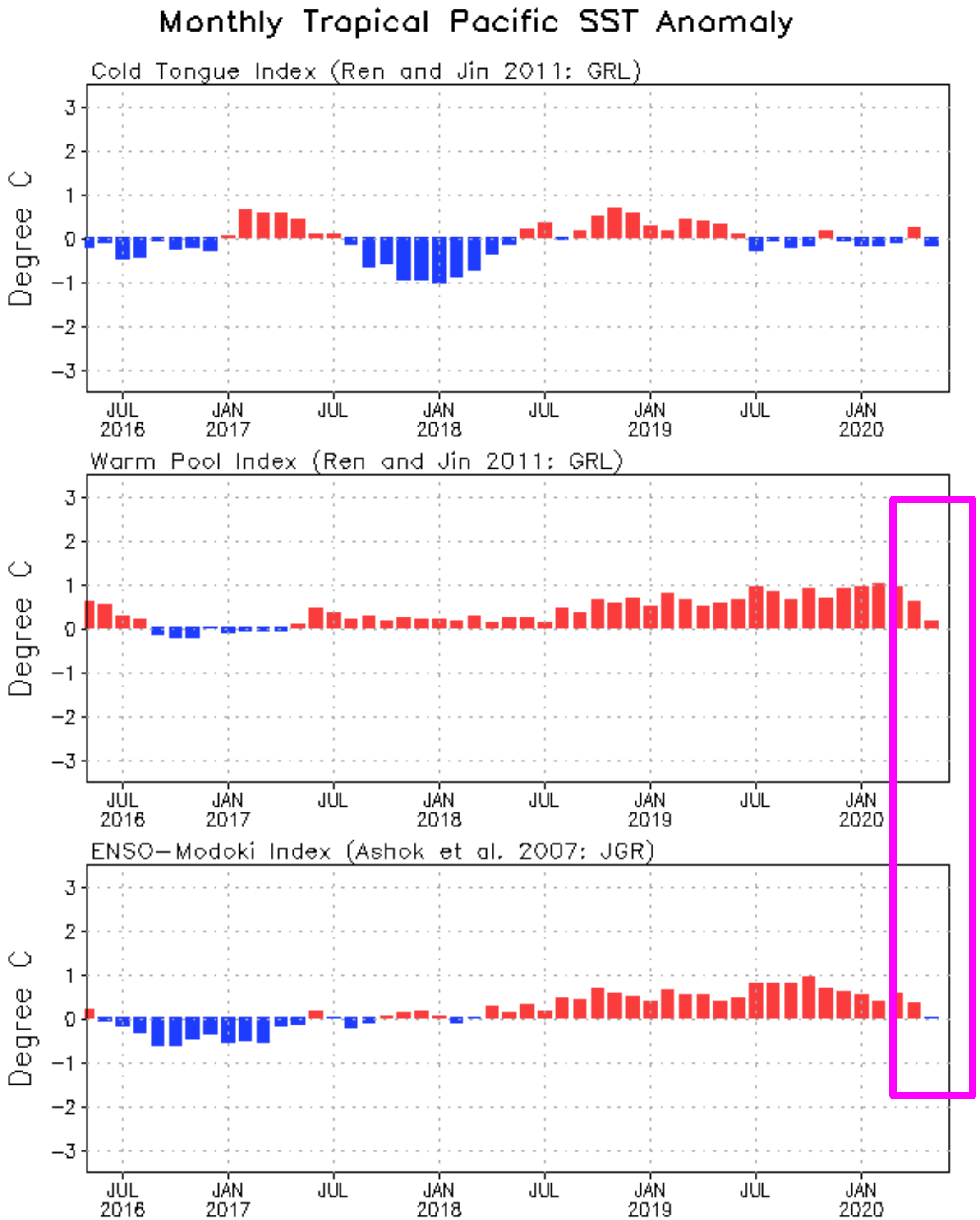


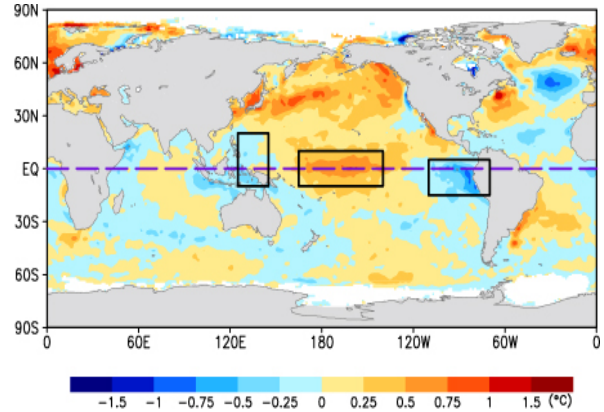
- All Nino indices cooled considerably in May 2020, with Nino3.4 = -0.17C.

-Compared with May 2019, the central and eastern (western) equatorial Pacific was cooler (warmer) in May 2020.

- The indices may have slight differences if calculations are based on different SST products.

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.





- Warm pool and ENSO-Modoki indices were positive since 2018, but weakened in May 2020 (Modoki index became slightly negative).

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

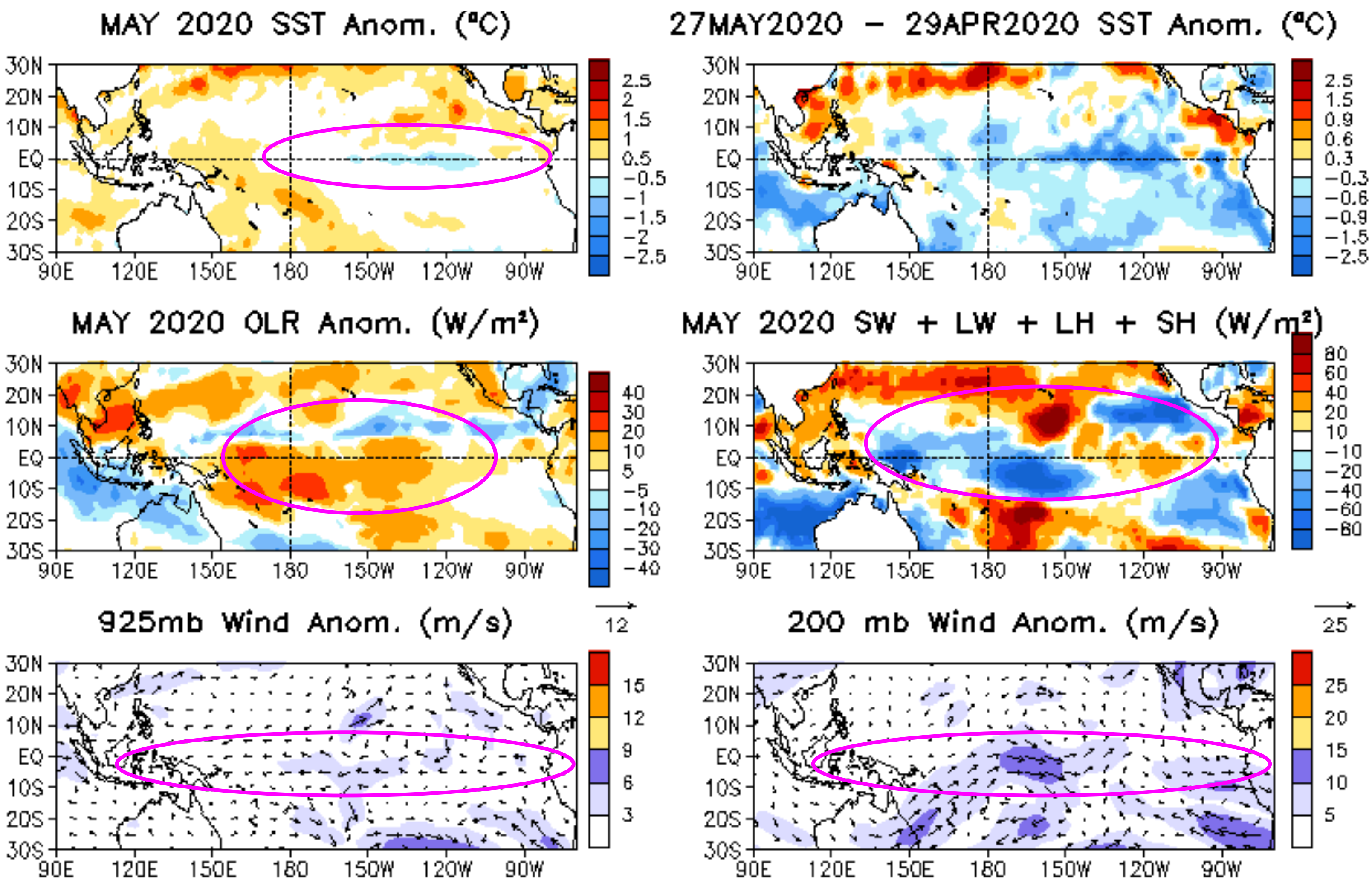
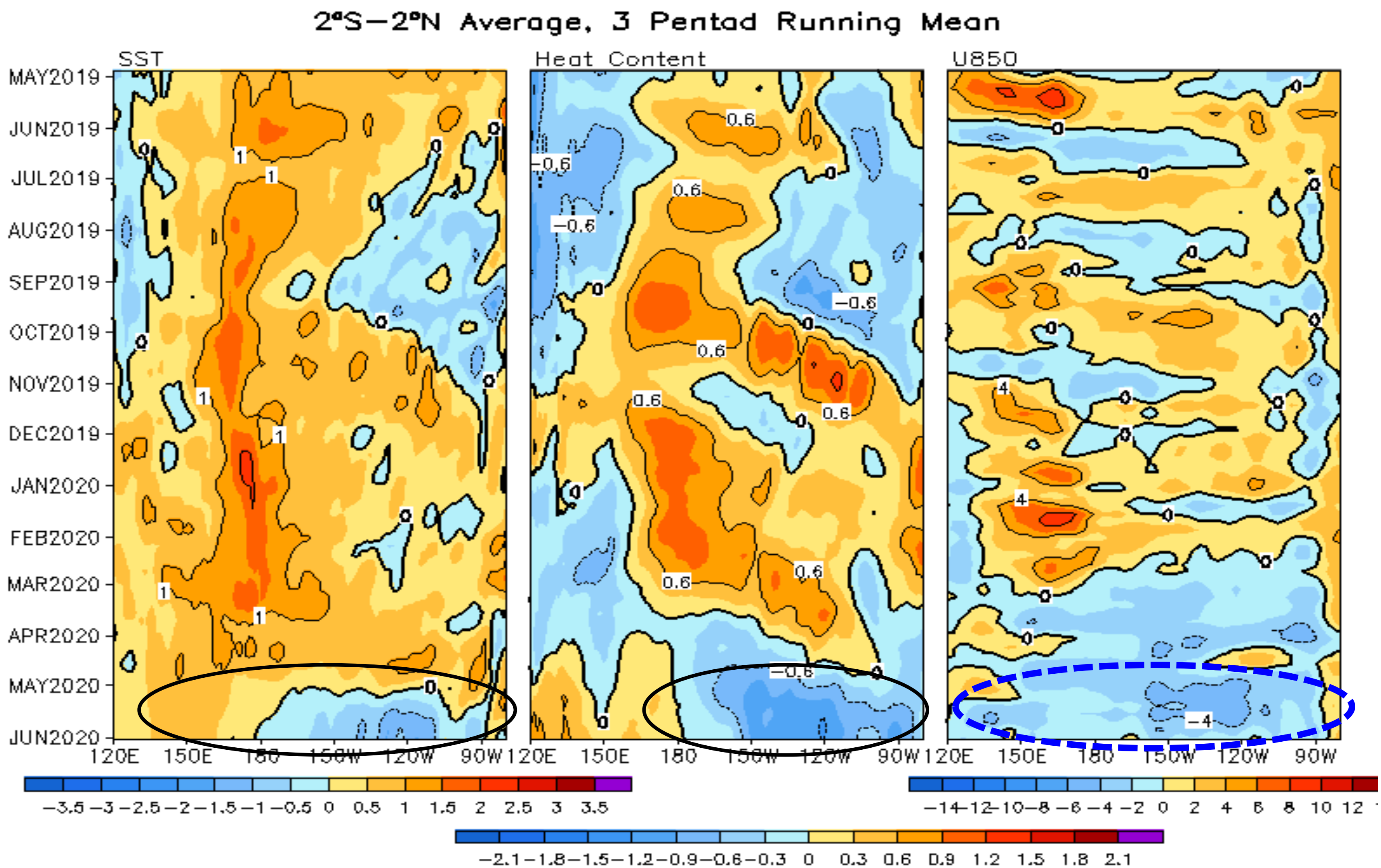


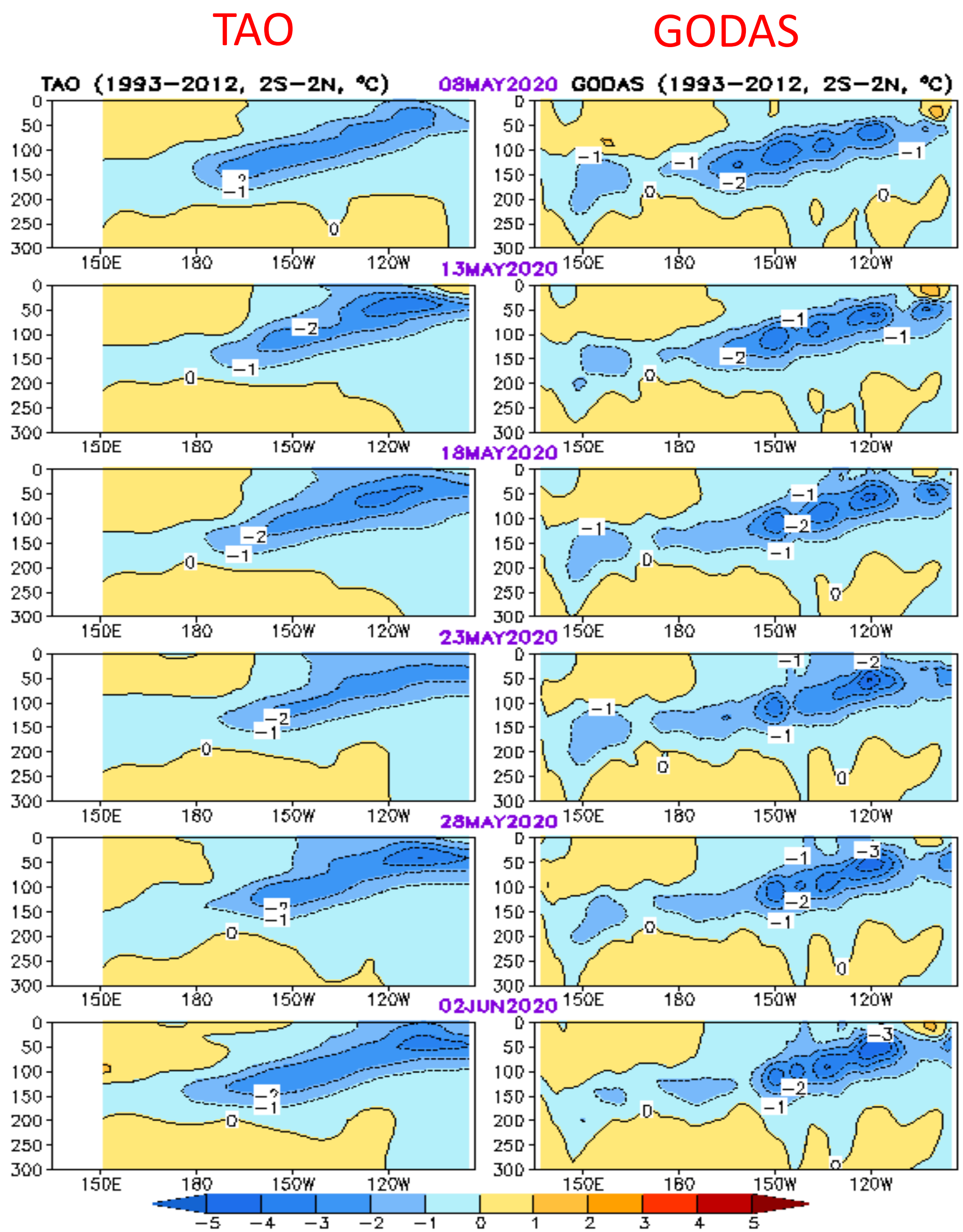
Fig. P2. Sea surface temperature (SST) anomalies (top-left), anomaly tendency (top-right), Outgoing Long-wave Radiation (OLR) anomalies (middle-left), sum of net surface short- and long-wave radiation, latent and sensible heat flux anomalies (middle-right; positive means heat into the ocean), 925-mb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

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



- **Easterly wind anomaly was present across the equatorial central and eastern Pacific, and maximized in the eastern basin in May 2020.**
- **Below-average HC300 was observed in the eastern Pacific in May 2020.**
- **Negative SSTA appeared in the eastern equatorial Pacific.**

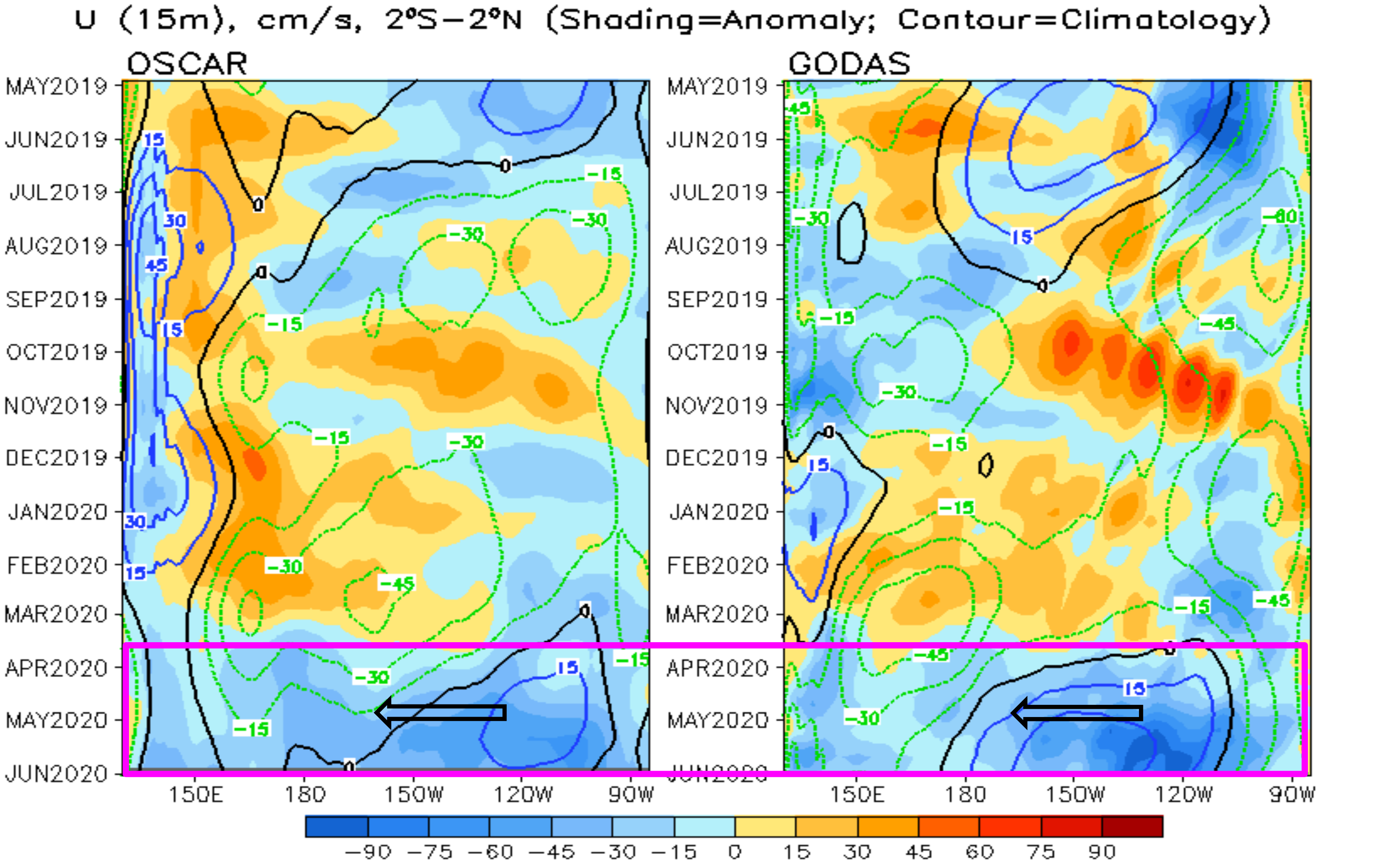
Equatorial Pacific Ocean Temperature Pentad Mean Anomaly



- **Negative ocean temperature anomalies were present along the thermocline (less propagating feature because the maximum zonal wind anomalies were close to the eastern boundary).**

- **The features of the ocean temperature anomalies were similar between GODAS and TAO analysis.**

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



- Anomalous westward currents were observed across much of the equatorial Pacific in both OSCAR and GODAS since late March 2020.

Warm Water Volume (WWV) and NINO3.4 Anomalies

- WWV is defined as average of depth of 20ºC in [120ºE-80ºW, 5ºS-5ºN]. 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) has been in a discharge phase since Mar 2020.**

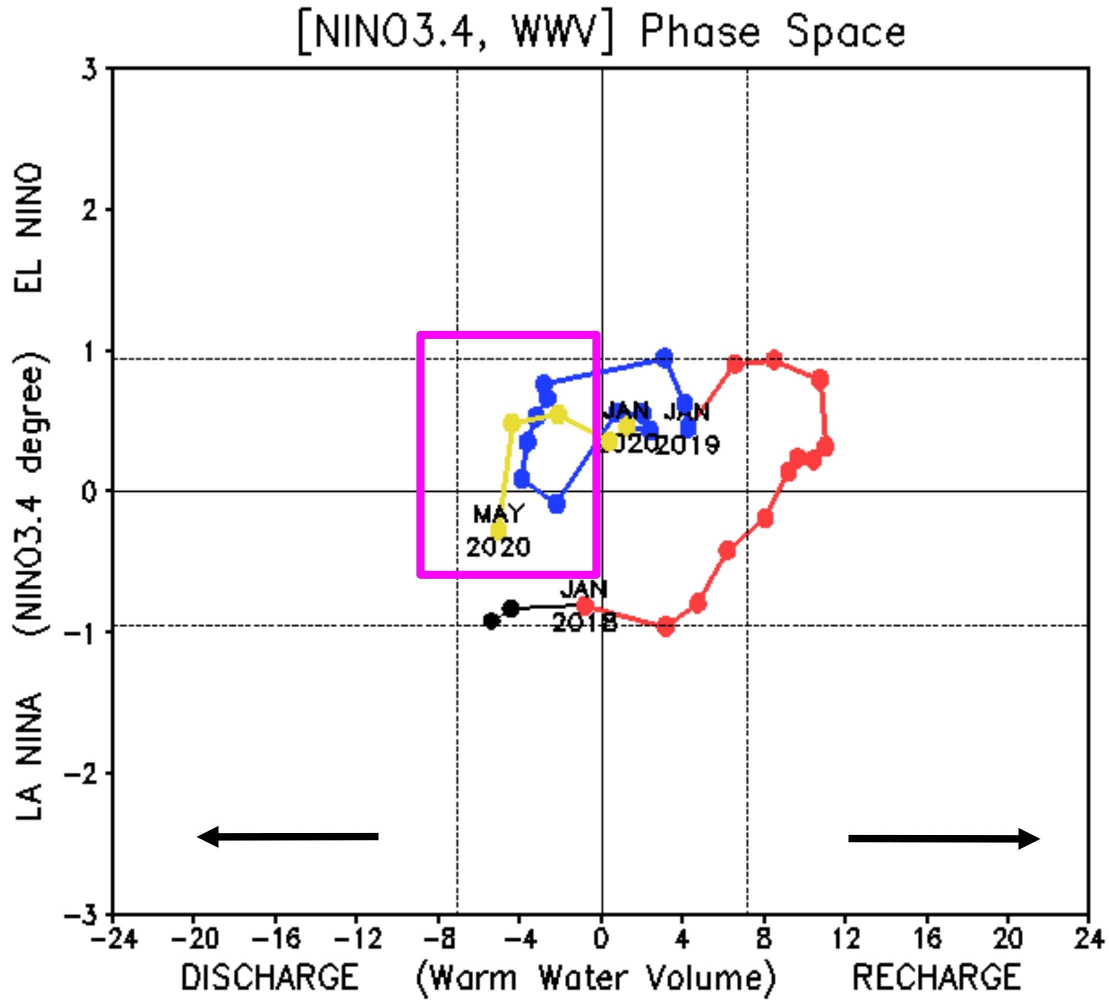
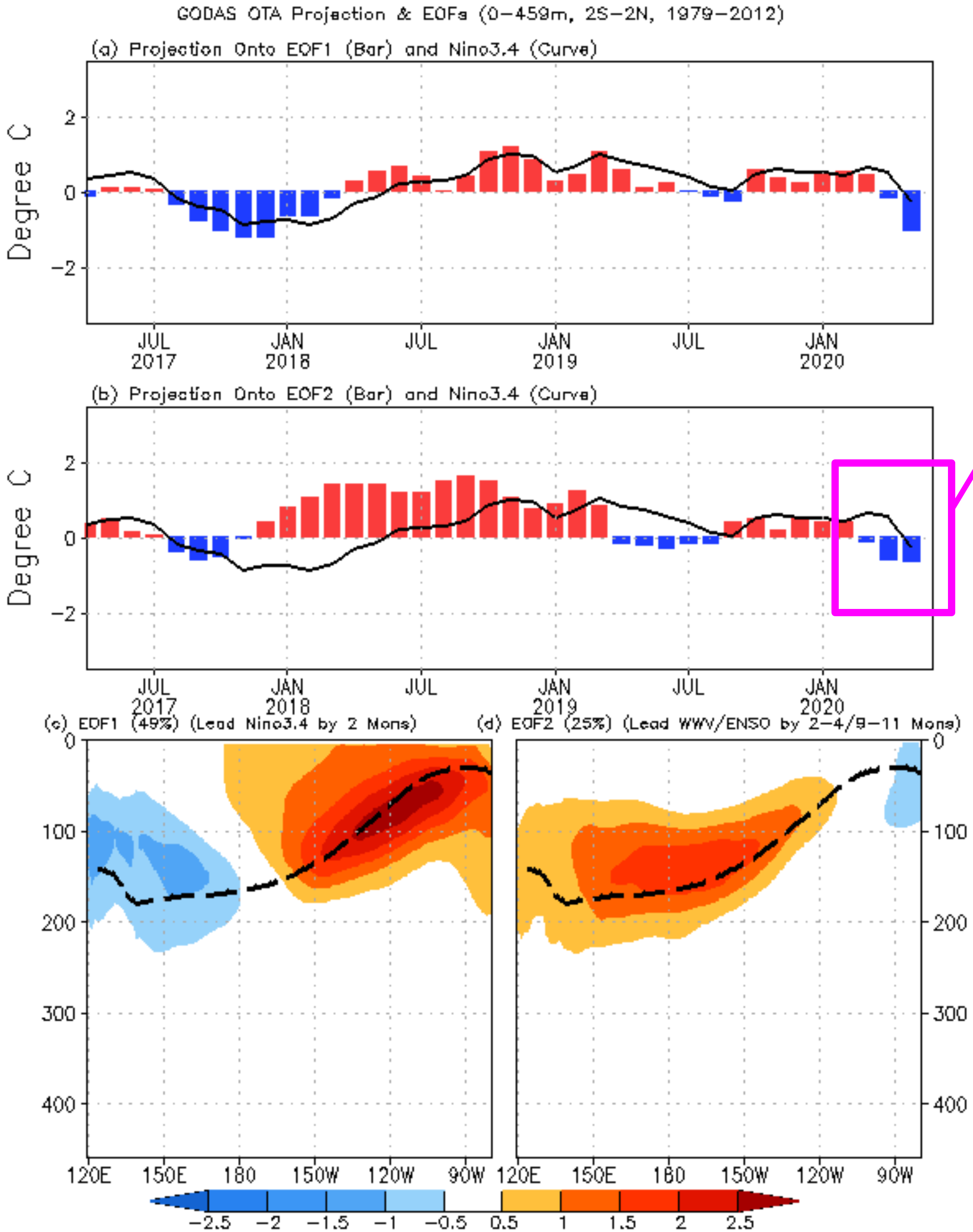


Fig. P3. Phase diagram of Warm Water Volume (WWV) and NINO 3.4 SST anomalies. WWV is the average of depth of 20ºC in [120ºE-80ºW, 5ºS-5ºN] calculated with the NCEP's global ocean data assimilation system. Anomalies are departures from the 1981-2010 base period means.



Equatorial subsurface ocean temperature monitoring:

The equatorial Pacific switched to a discharge phase after Mar 2020.

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:

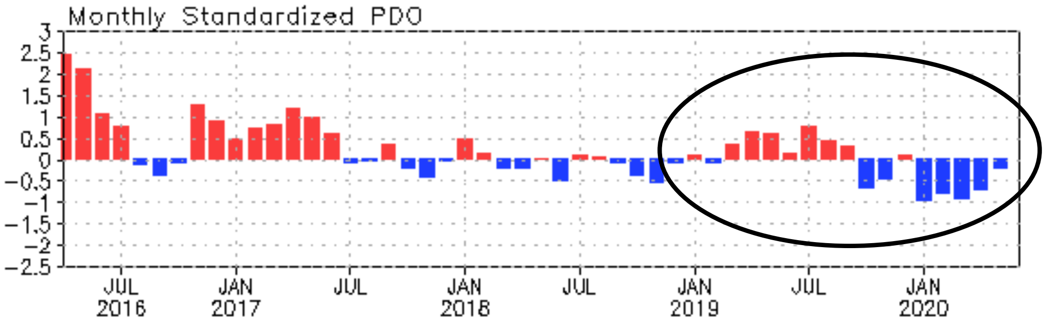
Positive -> Negative phase of ENSO

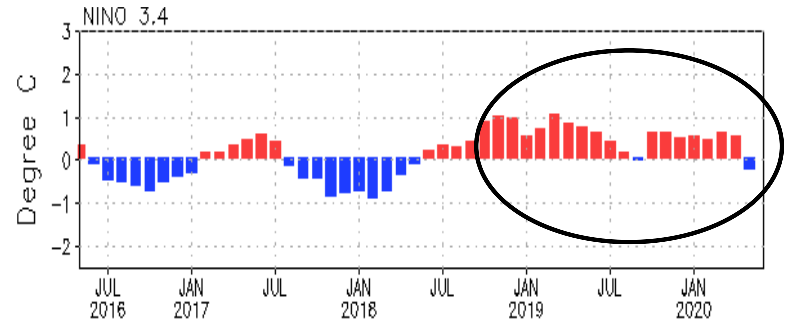
For details, see:

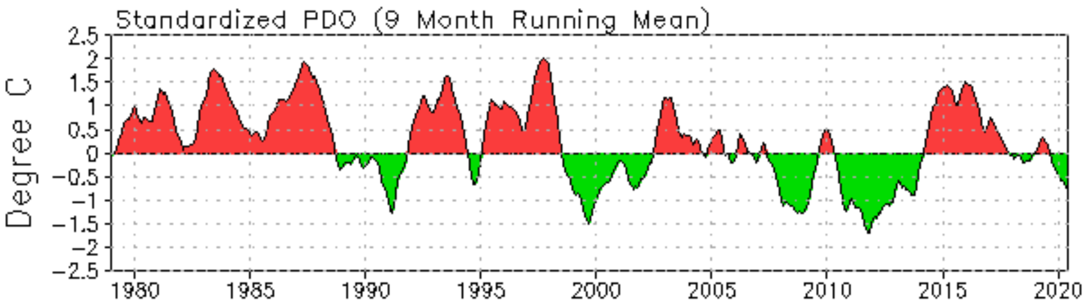
Kumar A, Z-Z Hu (2014) Interannual and interdecadal variability of ocean temperature along the equatorial Pacific in conjunction with ENSO. Clim. Dyn., 42 (5-6), **1243-1258.** *DOI: 10.1007/s00382-013-1721-0.*

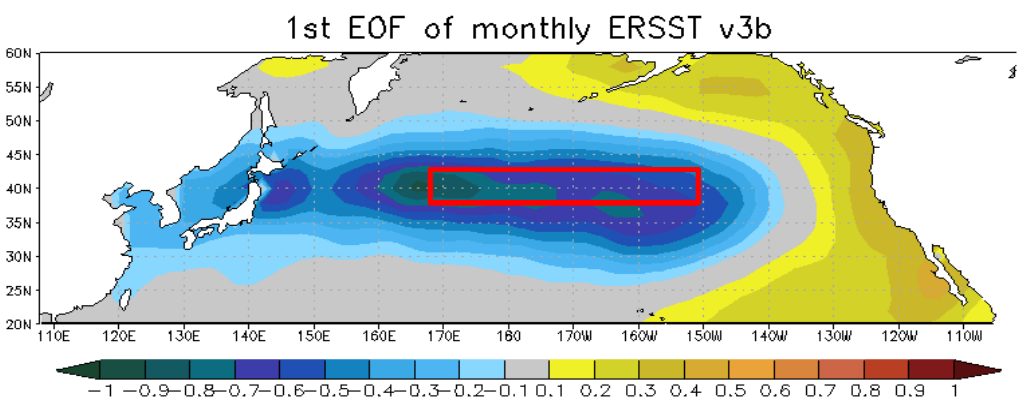
North Pacific & Arctic Oceans

PDO index







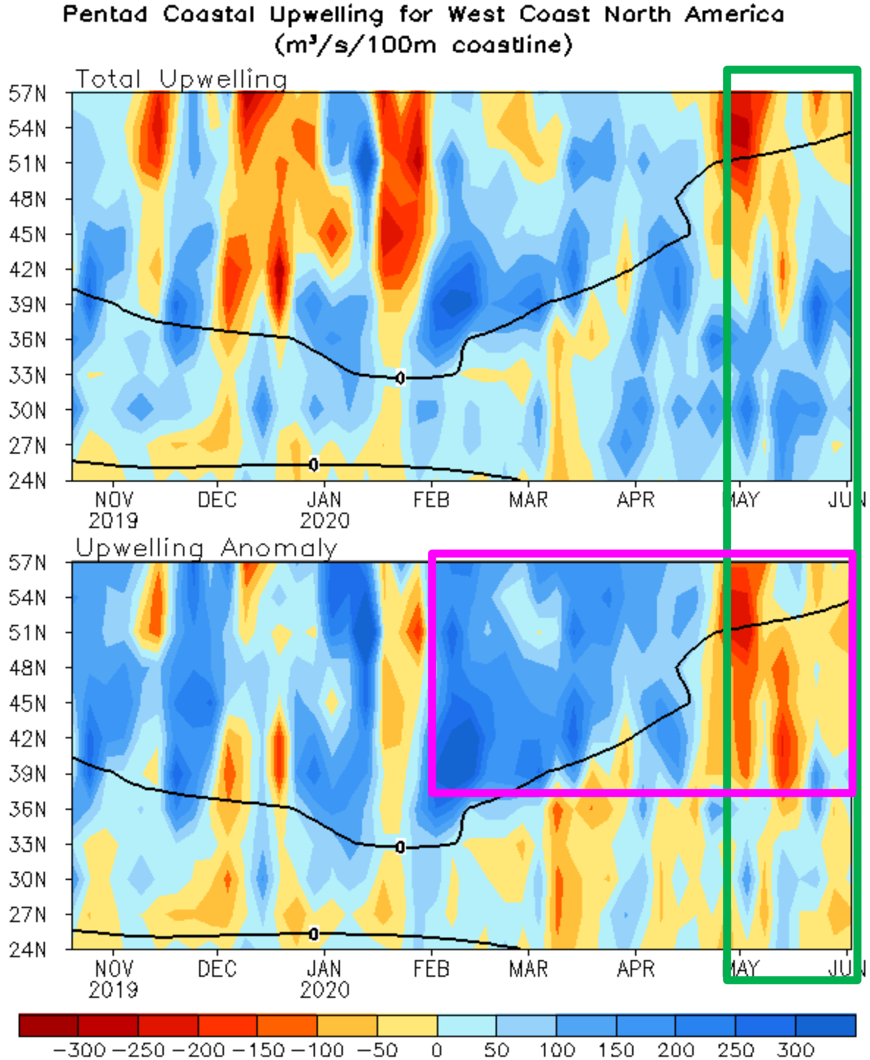


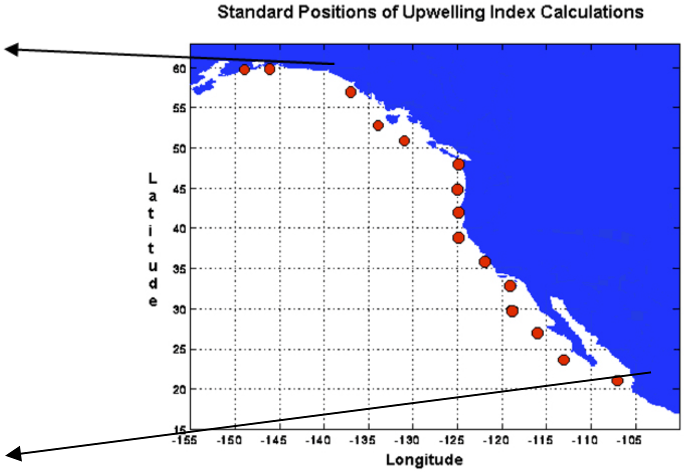
- **The PDO was in a negative phase with PDOI = -0.22 in May 2020.**

- **Statistically, ENSO leads PDO by 3-4 months, through teleconnection via atmospheric bridge, with El Nino (La Nina) associated with positive (negative) PDO Index.**

- **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 America Western Coastal Upwelling



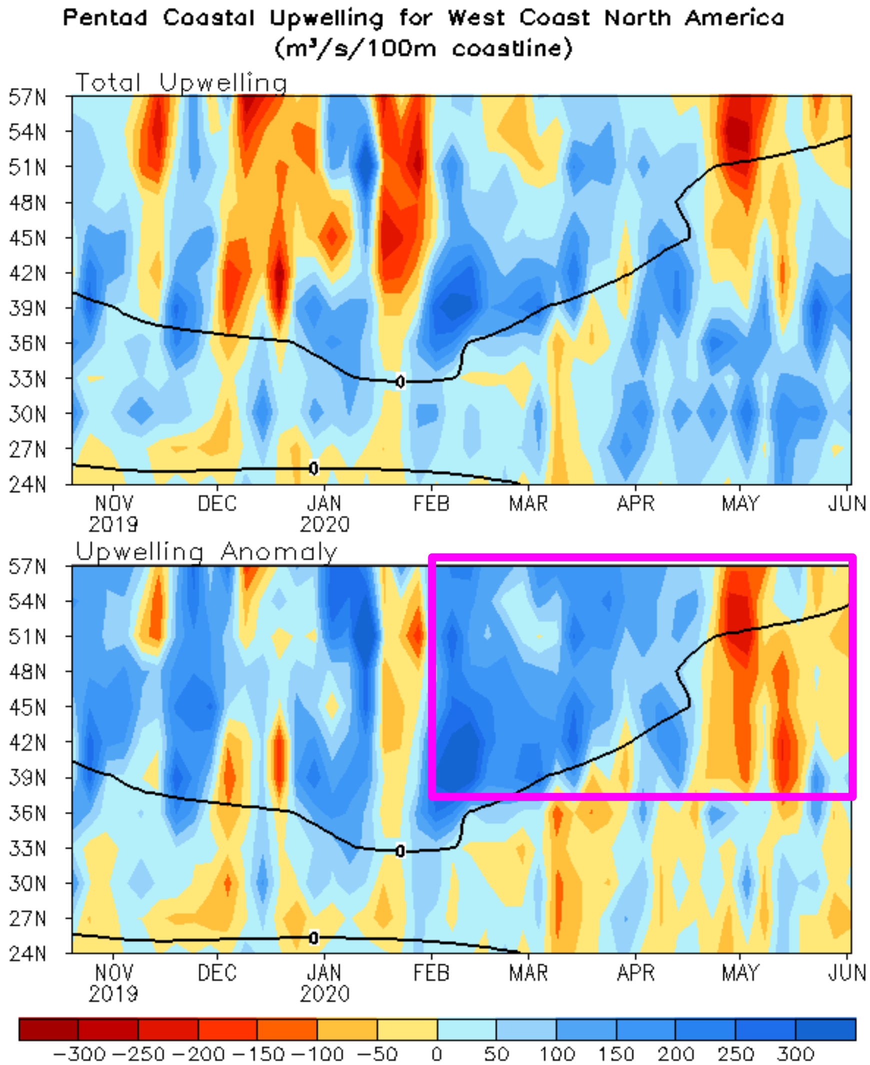


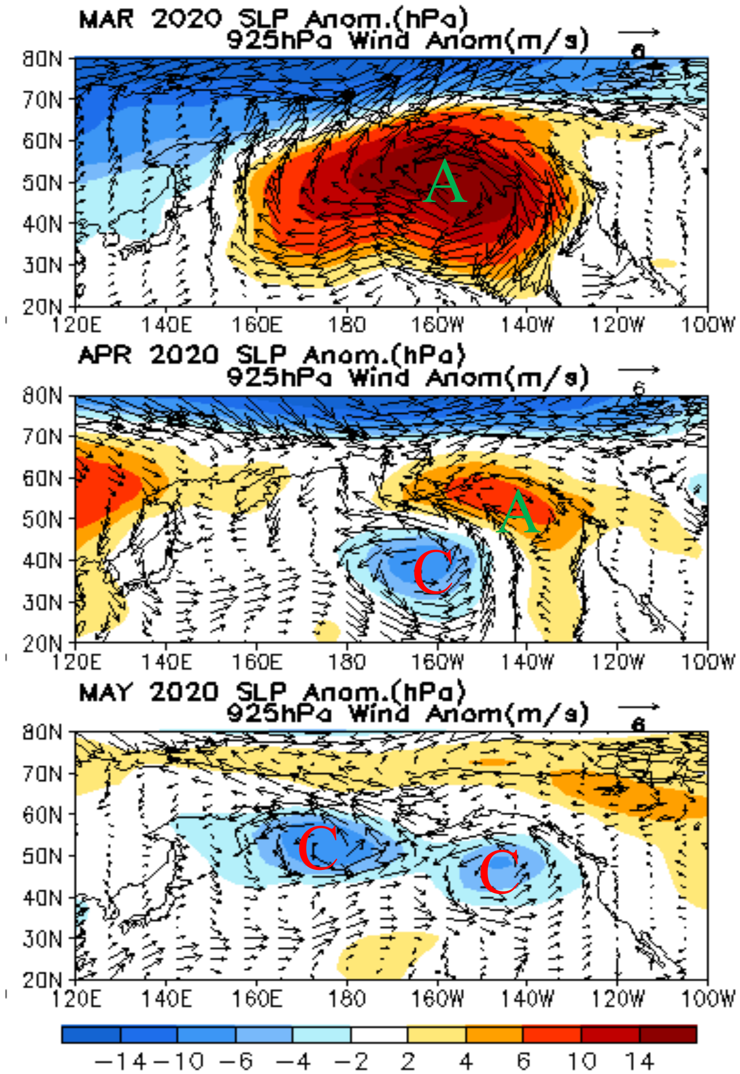
- Upwelling was weaker than average north of 36N in May 2020.

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.**

North America Western Coastal Upwelling





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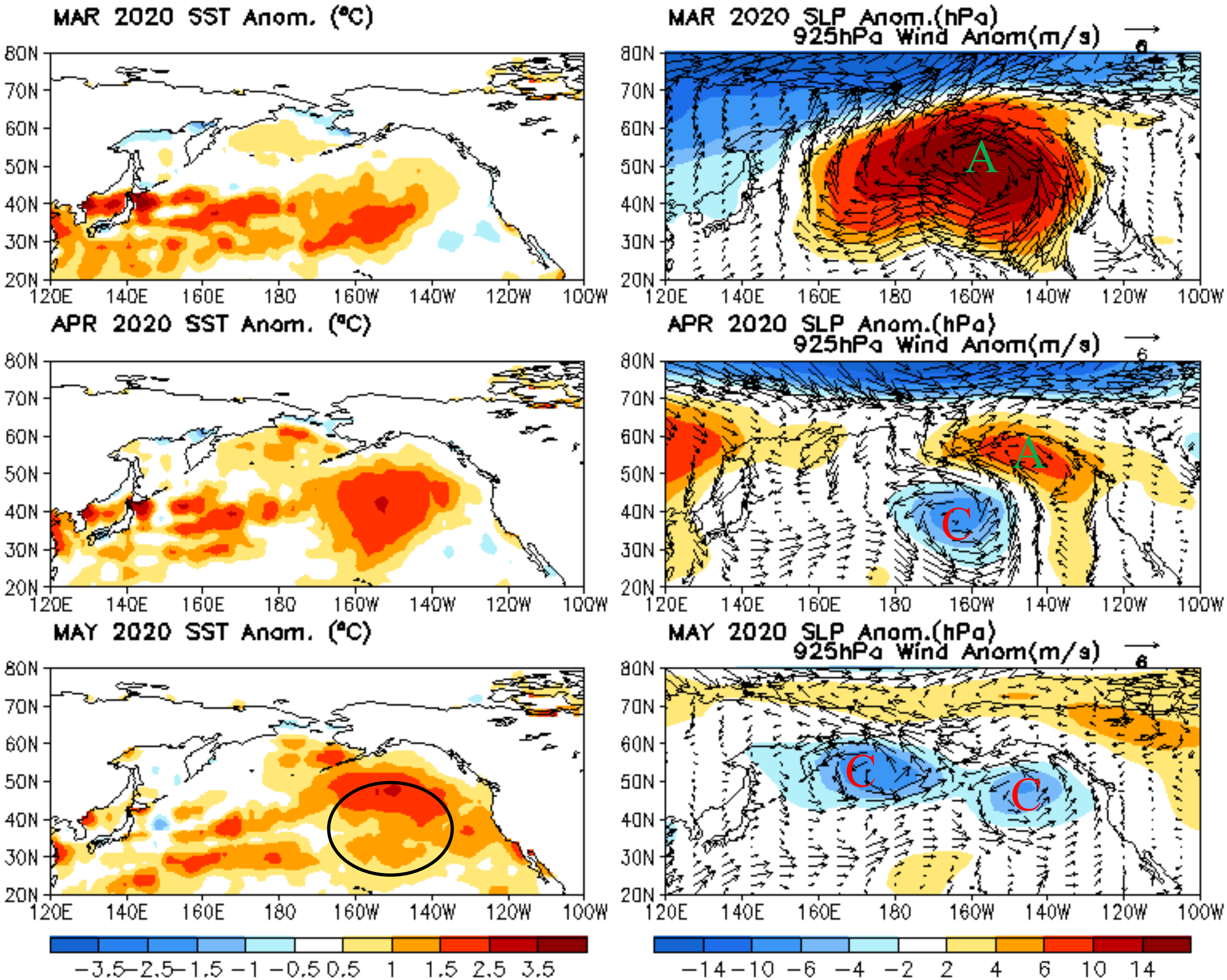

MAR 2020 SST Anom. (°C)
MAR 2020 SLP Anom.(hPa)
925hPa Wind Anom(m/s)
6
A
APR 2020 SST Anom. (°C)
APR 2020 SLP Anom.(hPa)
925hPa Wind Anom(m/s)
6
A
C
MAY 2020 SST Anom. (°C)
MAY 2020 SLP Anom.(hPa)
925hPa Wind Anom(m/s)
6
C
C
80N
70N
60N
50N
40N
30N
20N
120E 140E 160E 180 160W 140W 120W 100W
−3.5 −2.5 −1.5 −1 −0.5 0.5 1 1.5 2.5 3.5
−14 −10 −6 −4 −2 2 4 6 10 14

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

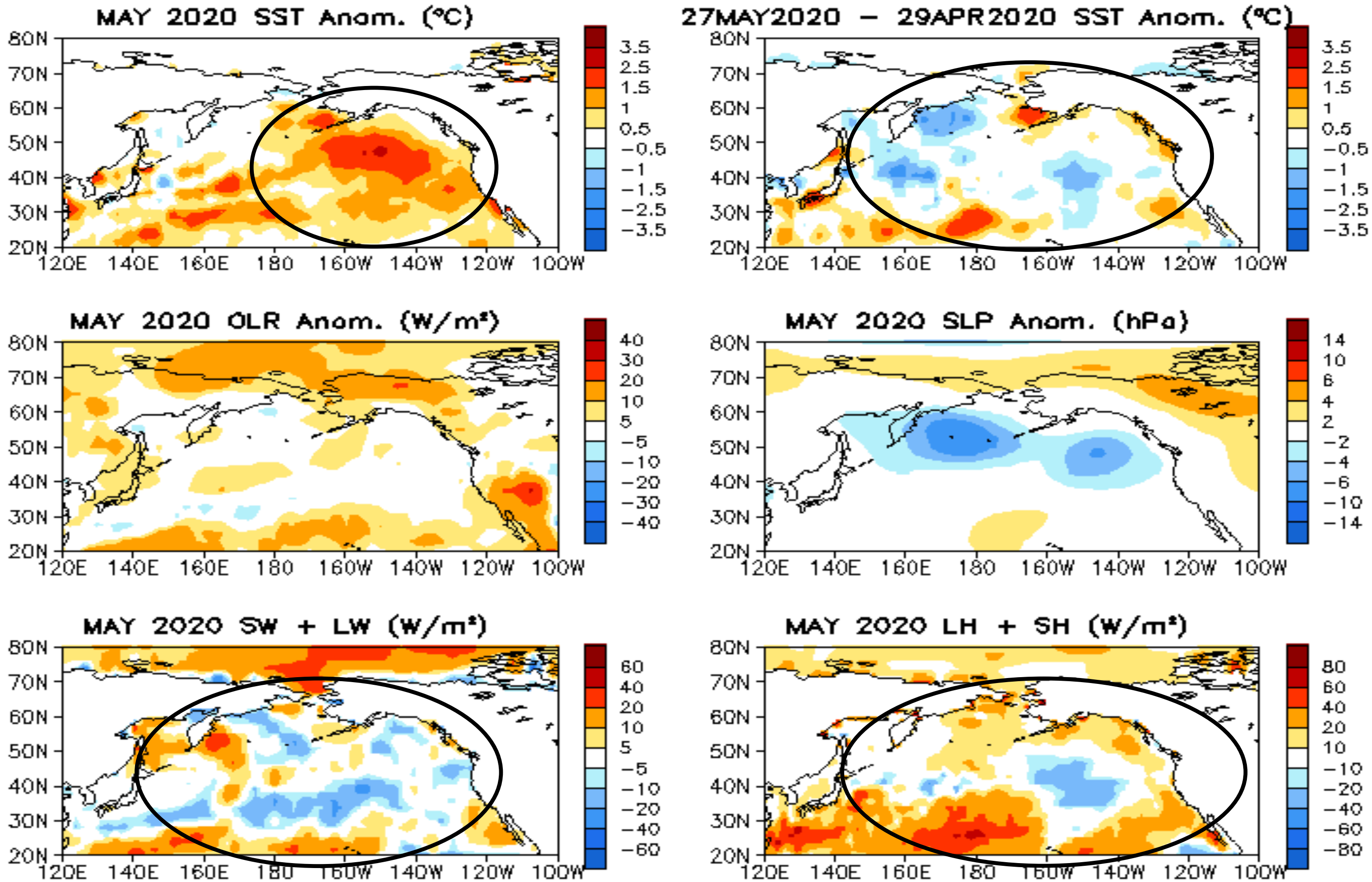
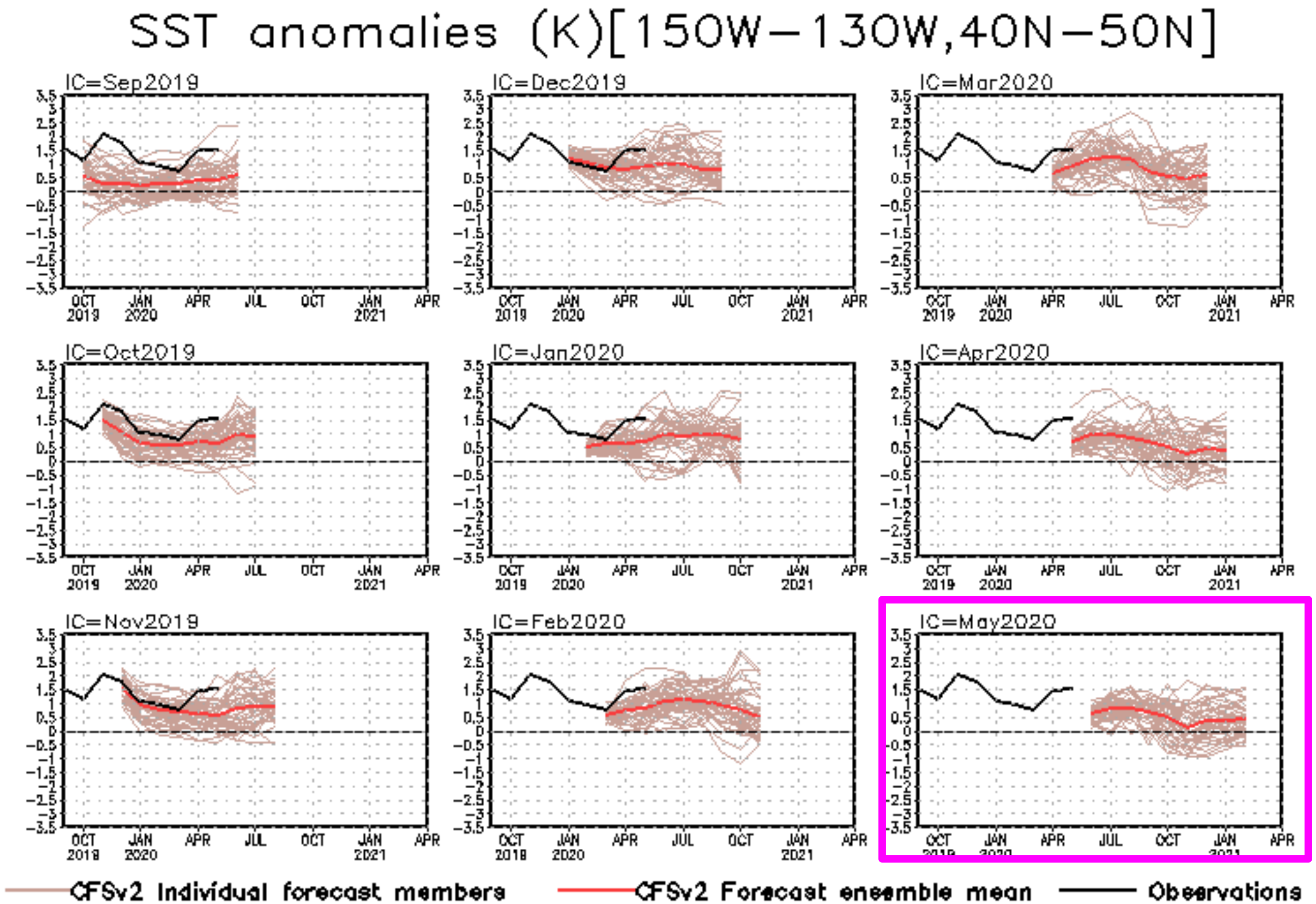


Fig. NP1. Sea surface temperature (SST) anomalies (top-left), anomaly tendency (top-right), Outgoing Long-wave Radiation (OLR) anomalies (middle-left), sea surface pressure anomalies (middle-right), sum of net surface short- and long-wave radiation anomalies (bottom-left; positive means heat into the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

CFS NE Pacific Marine Heatwave Index Predictions from Different Initial Months

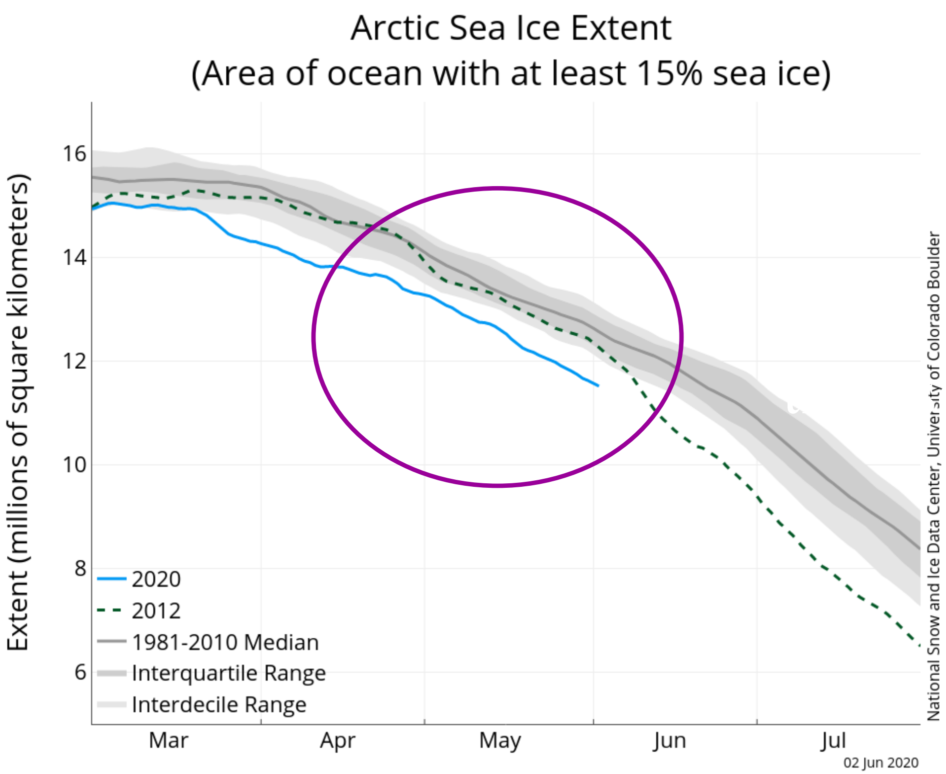


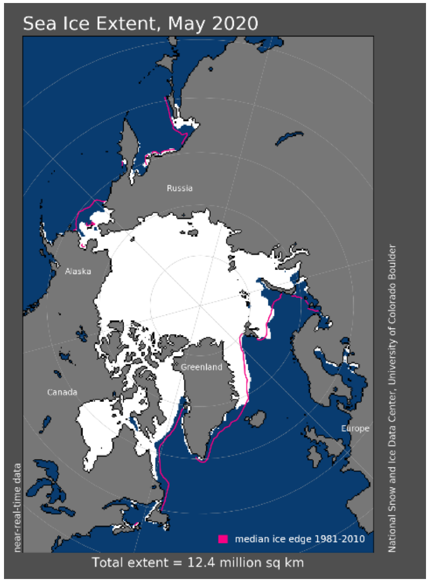
- Earlier CFSv2 predictions underestimated the strength of NP Marine Heatwave;
- Latest CFSv2 predictions suggest that the current warm state will continue in 2020.

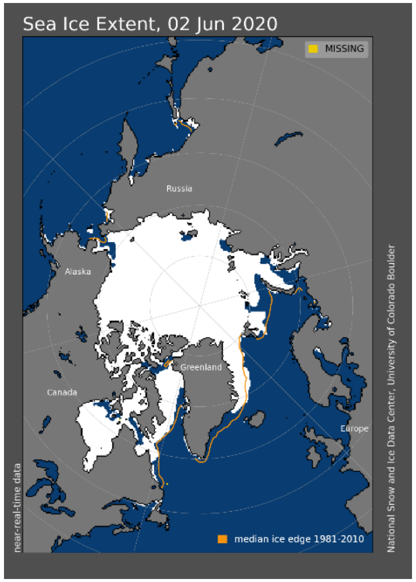
Fig. M3. CFS NE Pacific SST predictions from the latest 9 initial months. Displayed are 40 forecast members (brown) made four times per day initialized from the last 10 days of the initial month (labelled as IC=MonthYear) as well as ensemble mean (blue) and observations (black). Anomalies were computed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

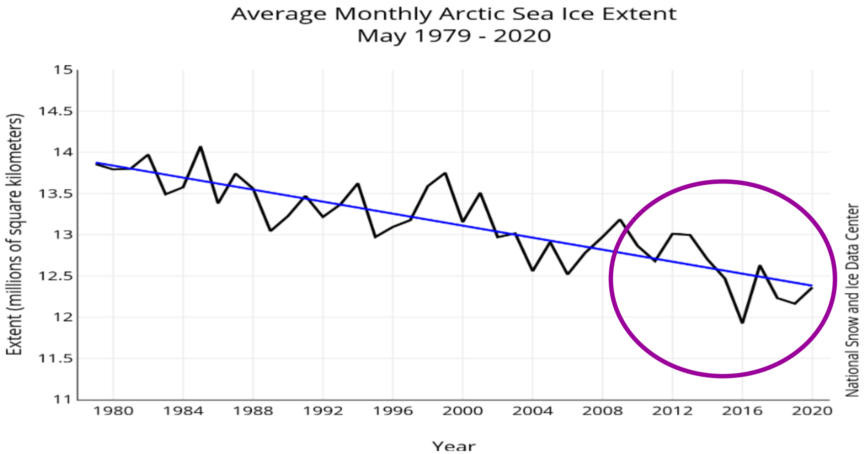
Arctic Sea Ice

National Snow and Ice Data Center
http://nsidc.org/arcticseaicenews/index.html





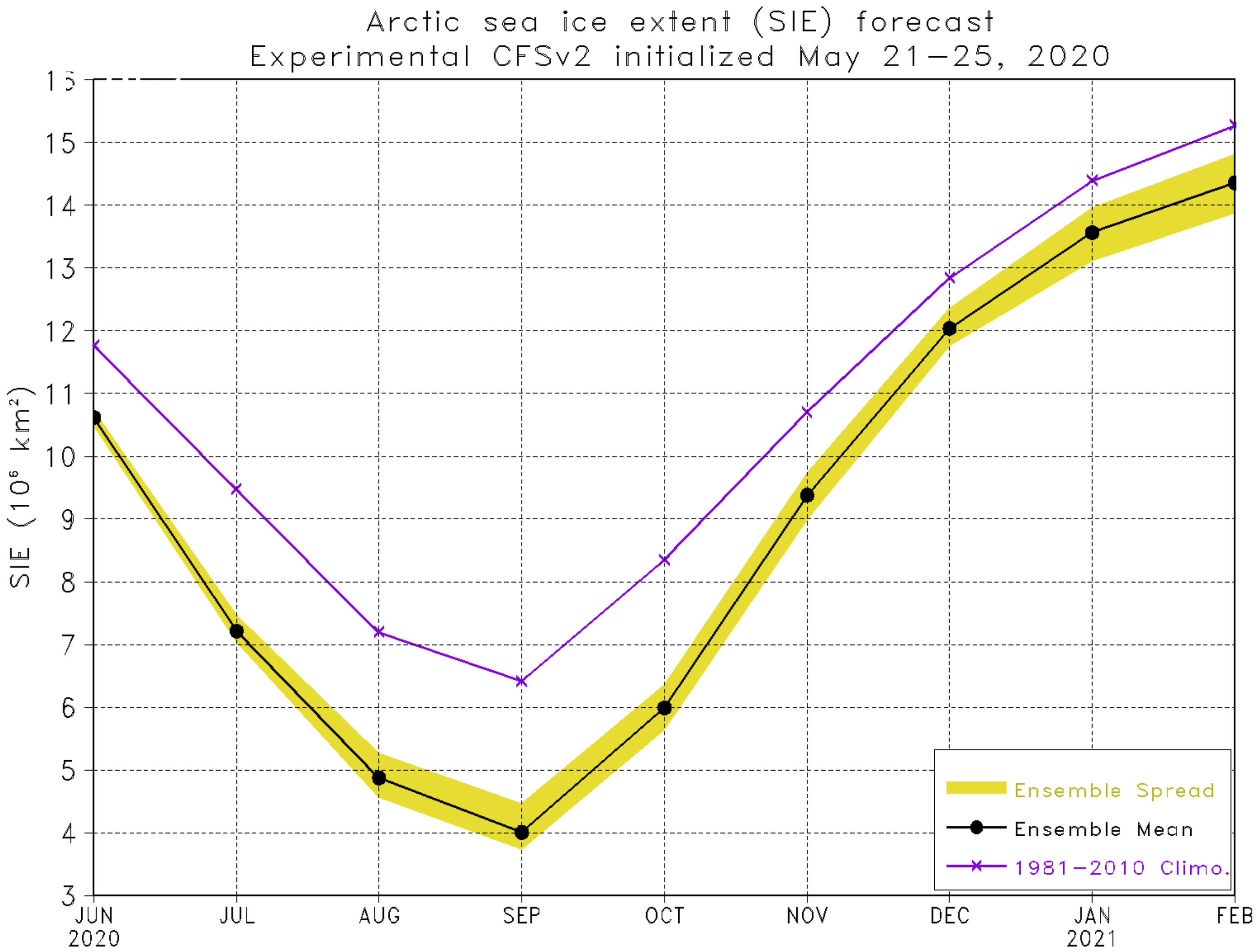




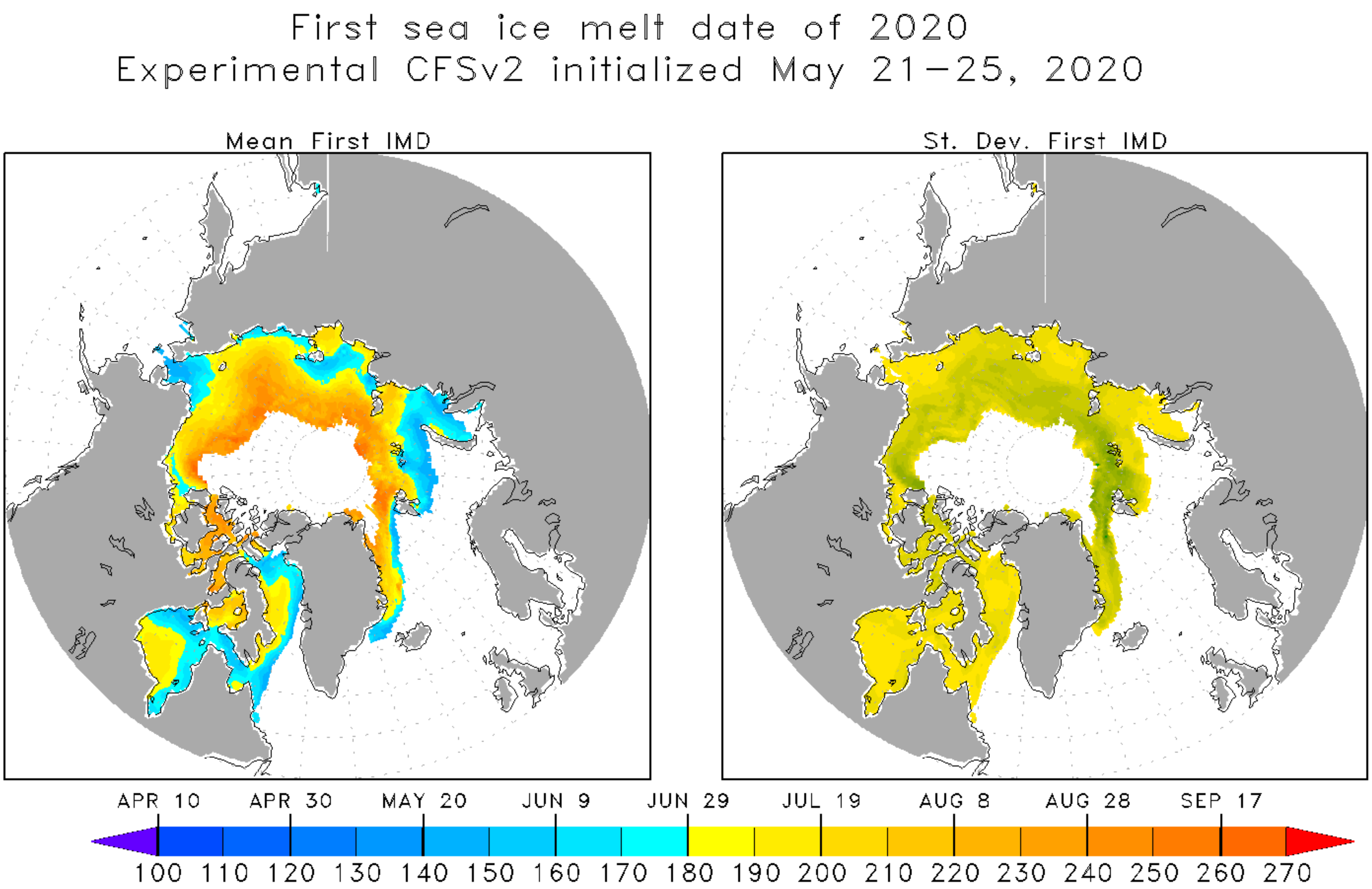
- **Arctic sea ice extent was well below normal in May 2020.**

- **The monthly average extent for May 2020 of 12.36 million square kilometers ended up as the fourth lowest since satellite observations in 1979.**

- **The pace of sea ice decline in May was near average.**



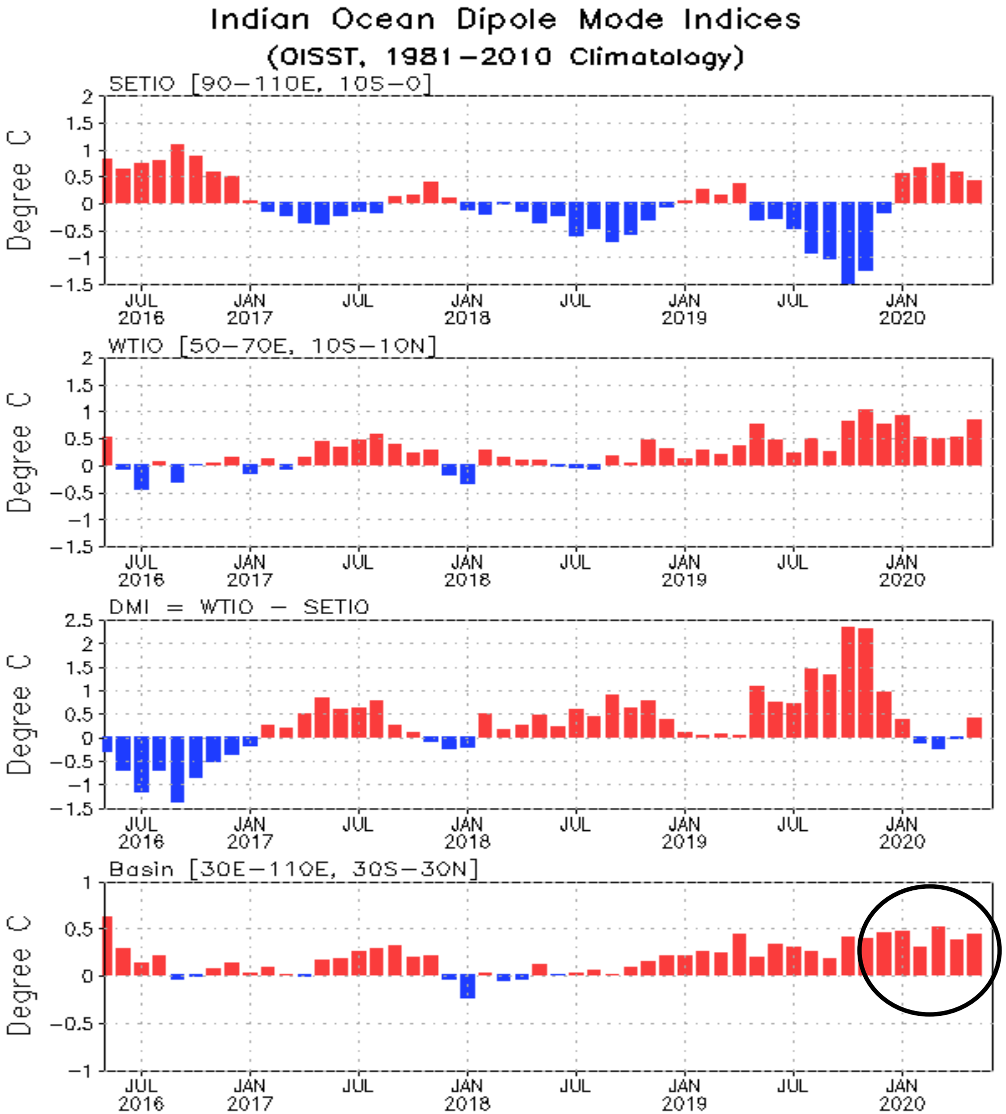
https://www.cpc.ncep.noaa.gov/products/people/wwang/seaice_seasonal/index.html

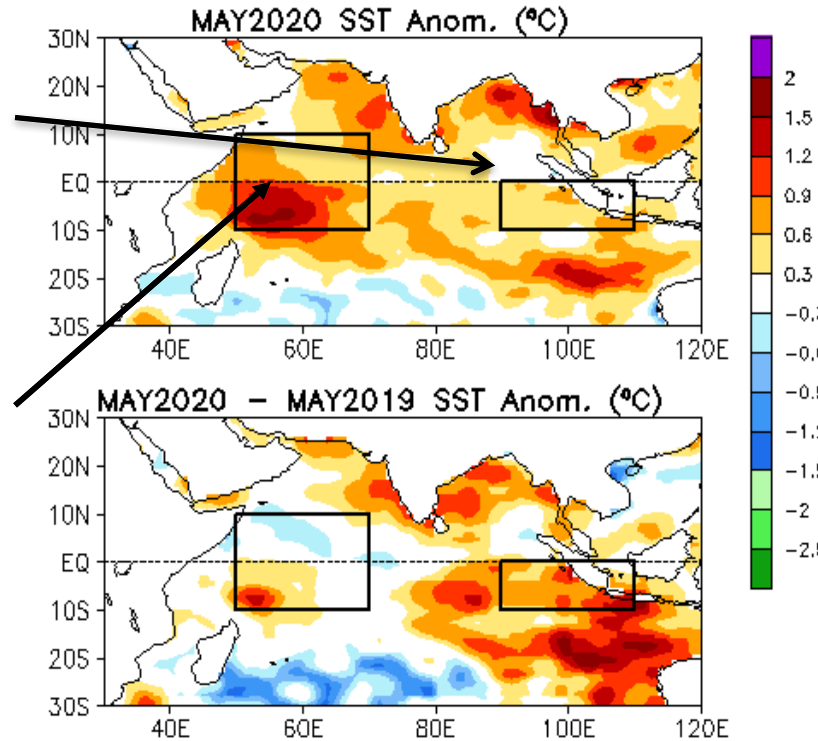


https://www.cpc.ncep.noaa.gov/products/people/wwang/seaice_seasonal/index.html

Indian Ocean

Evolution of Indian Ocean SST Indices





- **Positive SSTAs were present in the tropical Indian Ocean in May 2020.**

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.

- SSTAs were overall positive in the entire tropical Indian Ocean.

- Convection was enhanced over the central and eastern Indian Ocean.

- Westerly wind anomalies were present at low/high levels.

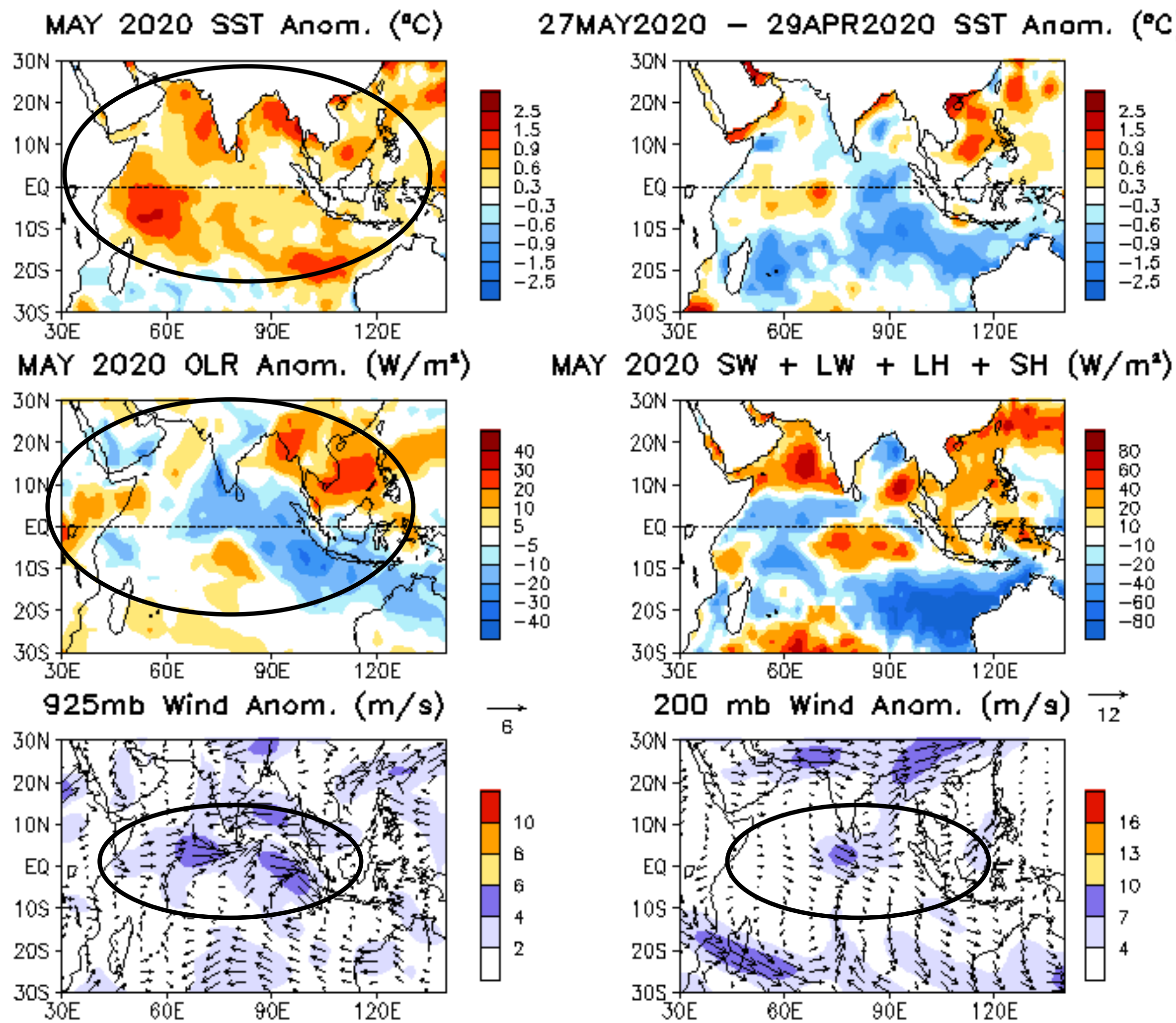
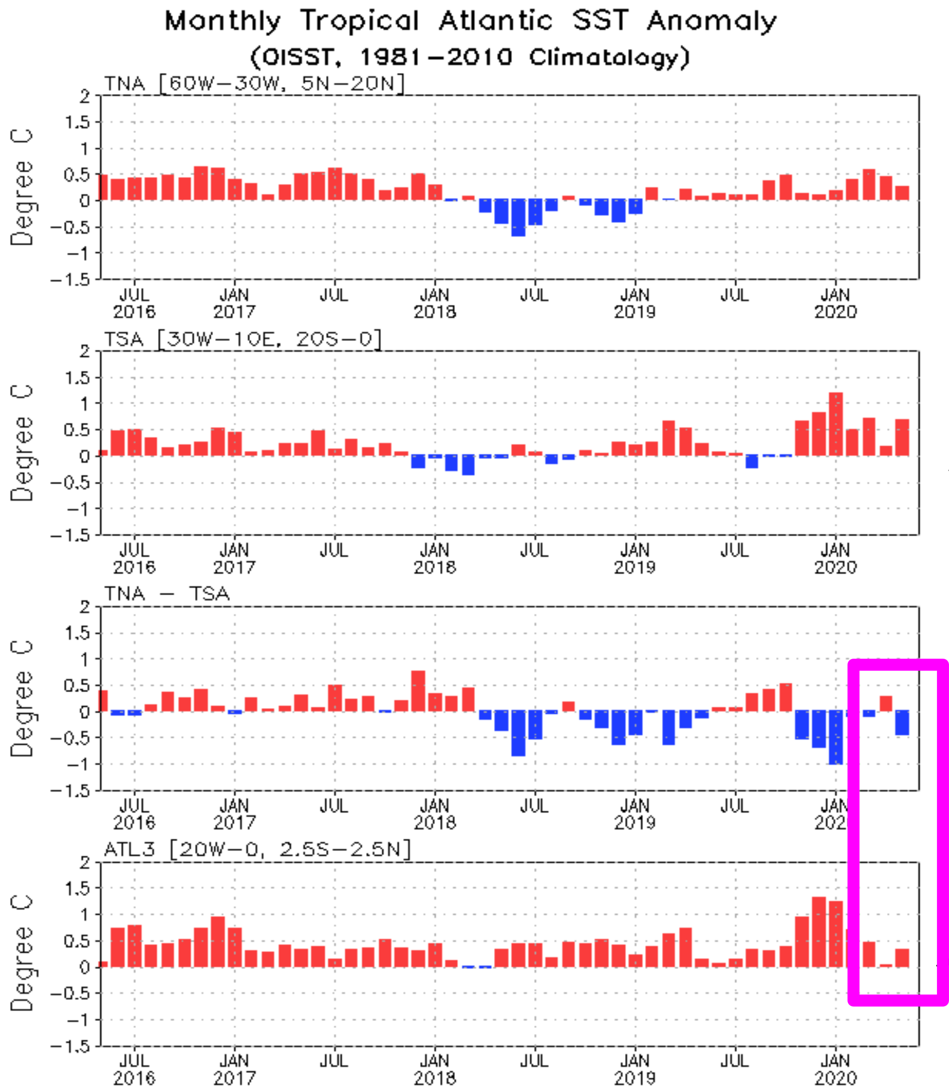
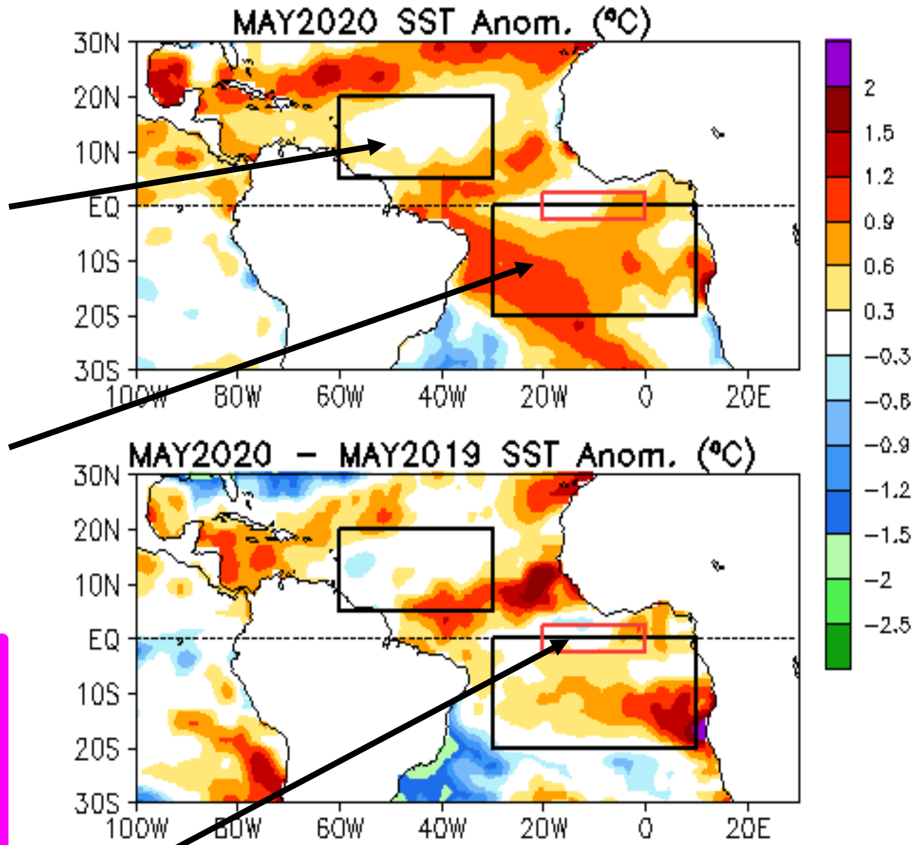


Fig. I2. Sea surface temperature (SST) anomalies (top-left), anomaly tendency (top-right), Outgoing Long-wave Radiation (OLR) anomalies (middle-left), sum of net surface short- and long-wave radiation, latent and sensible heat flux anomalies (middle-right), 925-mb wind anomaly vector and its amplitude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

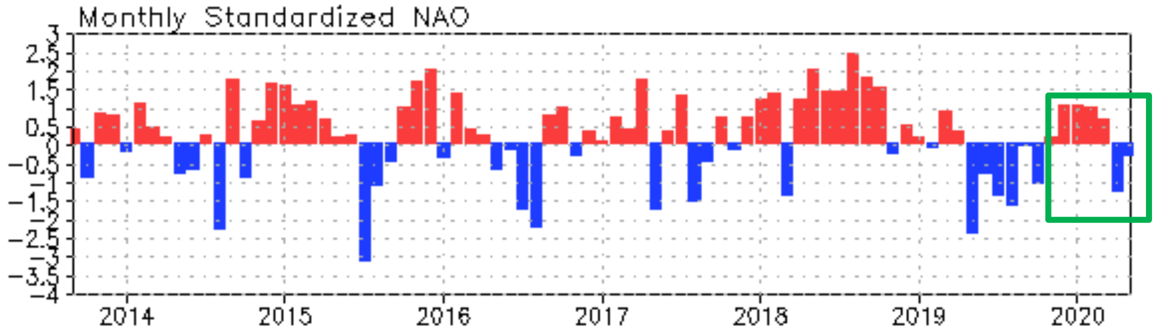


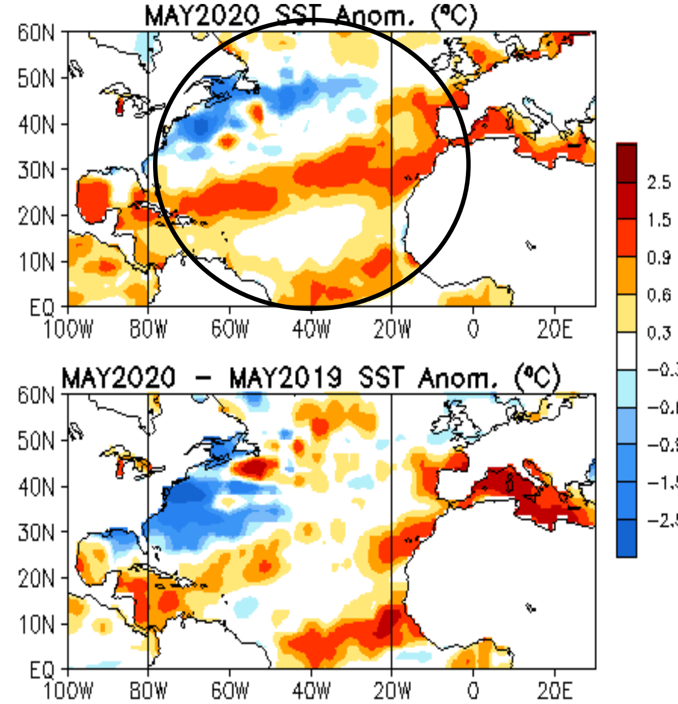


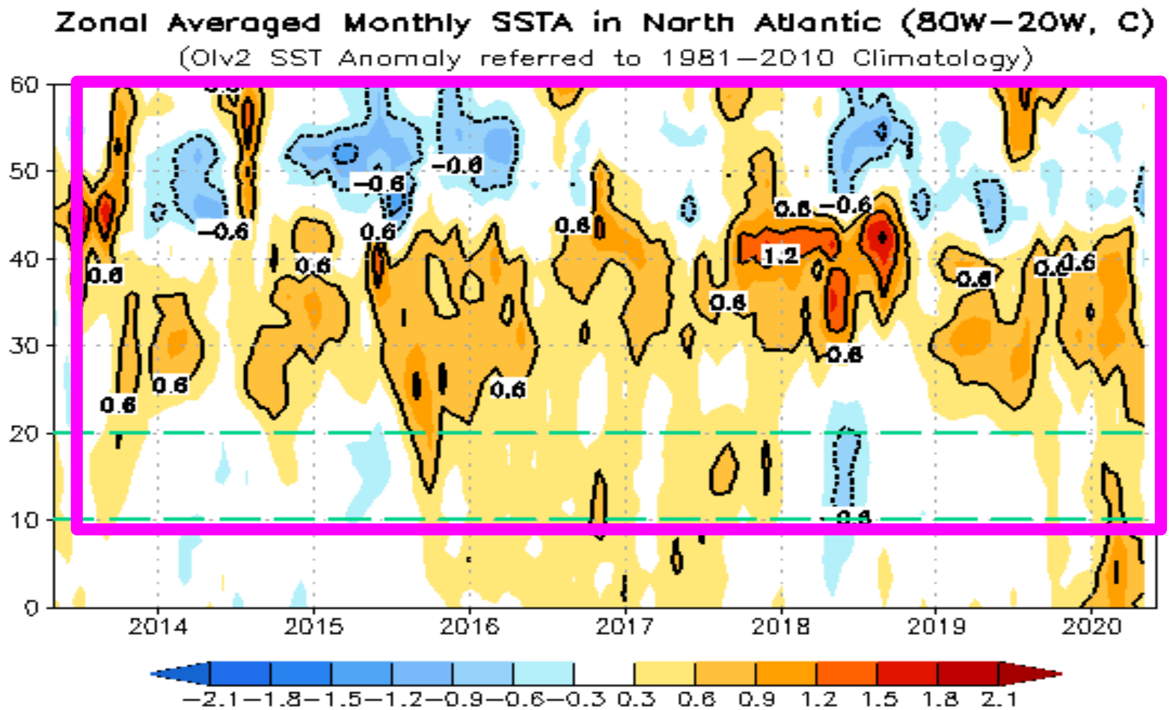
- Indices representing the Atlantic Meridional and Nino modes were small (<0.5 C) in May 2020.

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.

NAO and SST Anomaly in North Atlantic







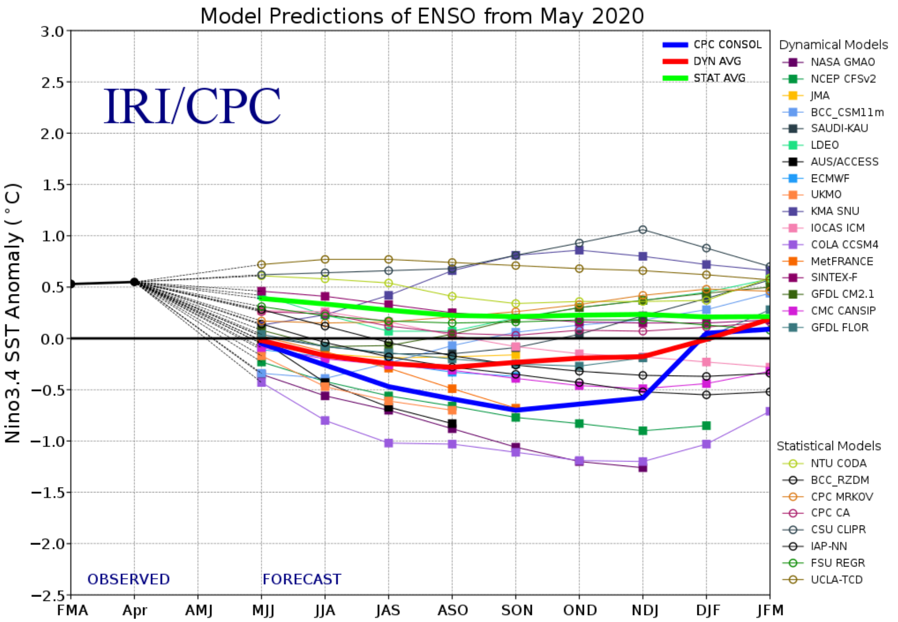
- NAO switched to a negative phase in Apr 2020 with NAOI= -0.33 in May 2020.

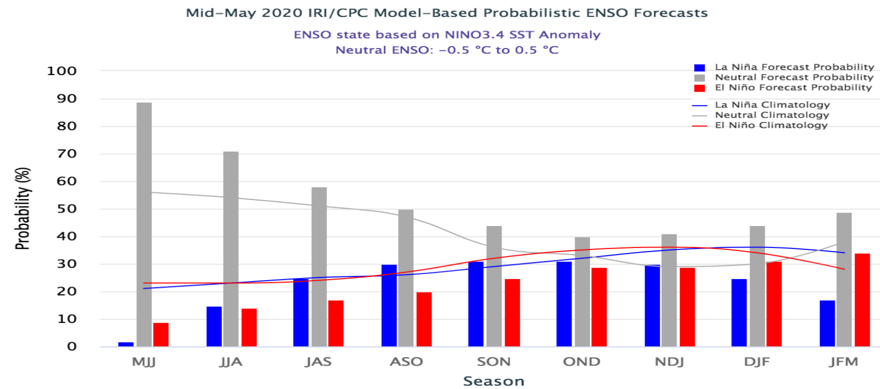
- The prolonged tripole SSTA pattern persisted in May 2020.

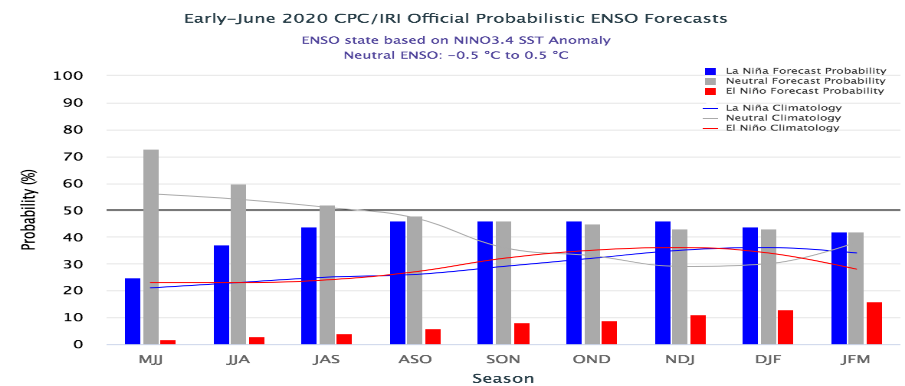
Fig. NA2. Monthly standardized NAO index (top) derived from monthly standardized 500-mb height anomalies obtained from the NCEP CDAS in 20ºN-90ºN (http://www.cpc.ncep.noaa.gov). Time-Latitude section of SST anomalies averaged between 80ºW and 20ºW (bottom). SST are derived from the NCEP OI SST analysis,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

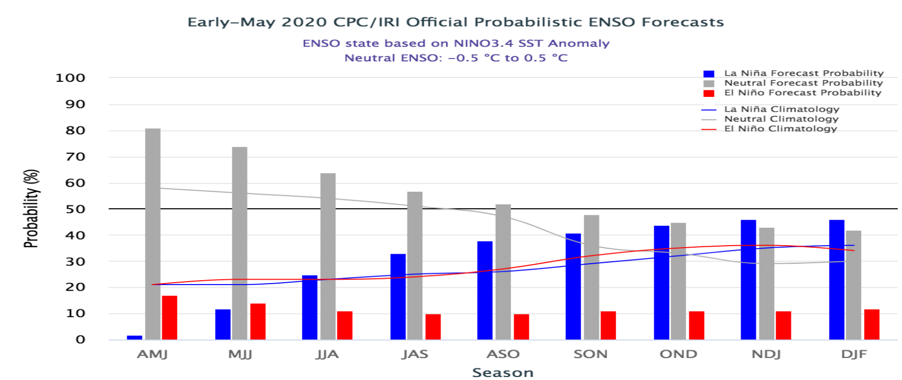
ENSO and Global SST Predictions

IRI NINO3.4 Forecast Plum





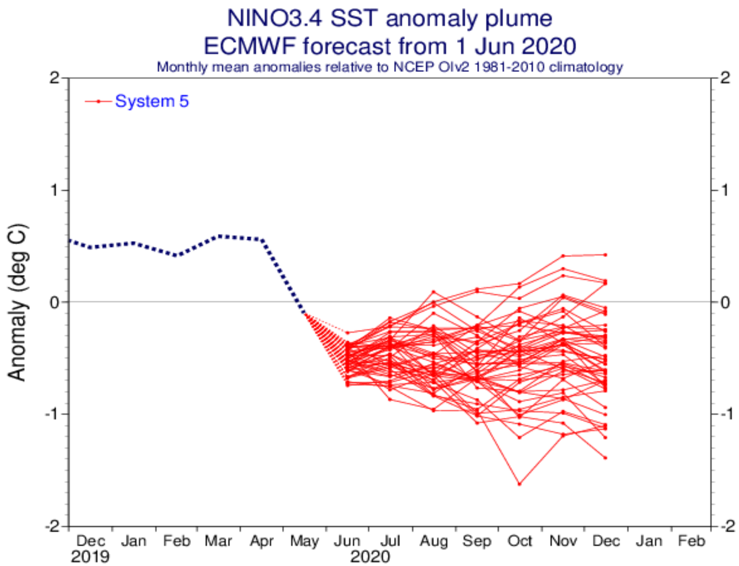




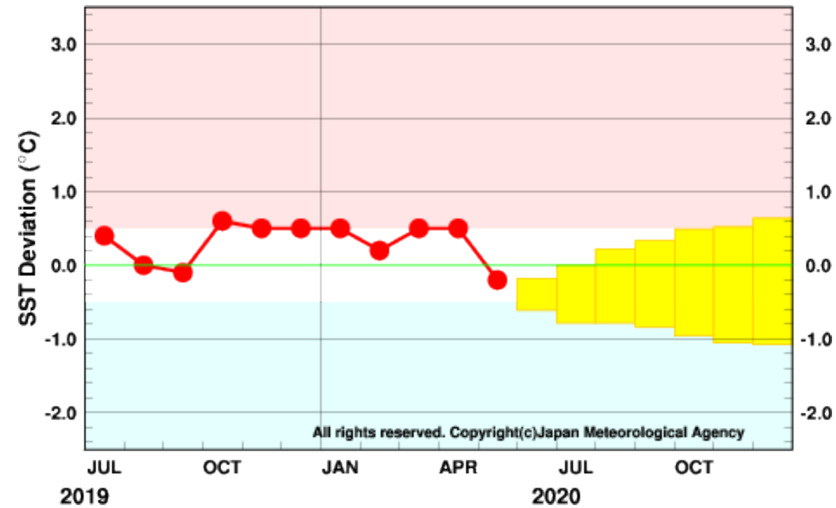
- **Predictions with ICs in May 2020 diverged with most models predicting a ENSO-neutral state through boreal summer/fall 2020; Dyn. AVG. versus Stat. AVG.**
- **NOAA "ENSO Diagnostic Discussion" on 11 June 2020 stated that "There is a ~60% chance of ENSO-neutral during Northern Hemisphere summer 2020, with roughly equal chances (~40-50%) of La Niña or ENSO-neutral during the autumn and winter 2020-21."**

Individual Model Forecasts: ENSO-Neutral or Boardline La Nina

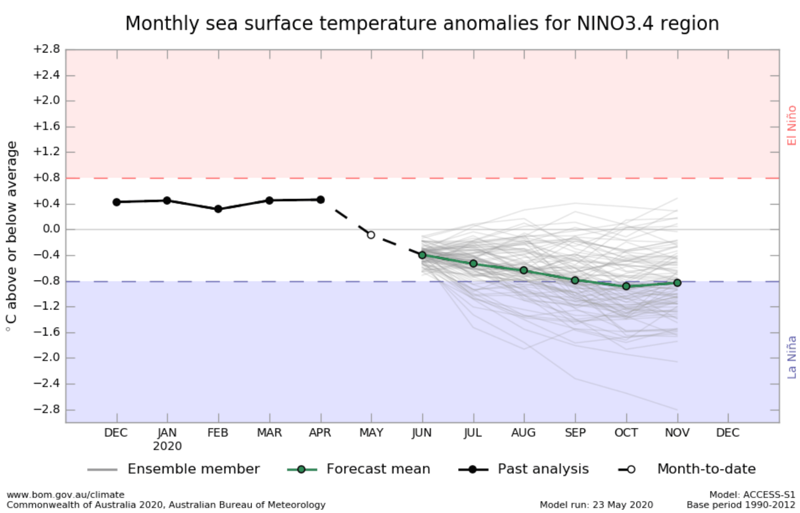
EC: Nino3.4, IC=01June 2020



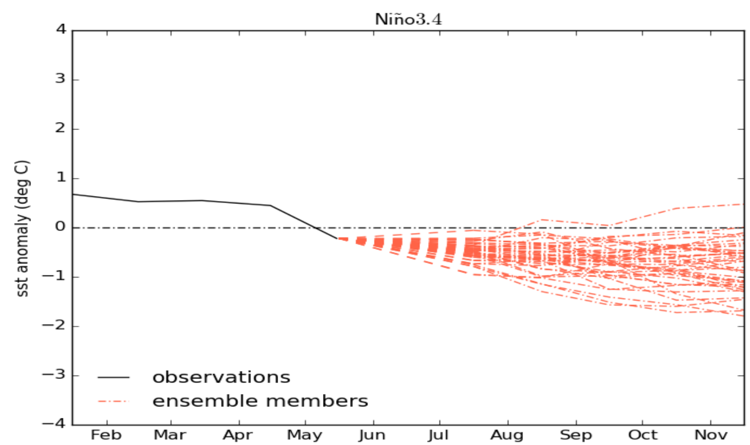
JMA: Nino3.4, Updated 10 June 2019



Australian BOM: Nino3.4, Updated 23 May 2020

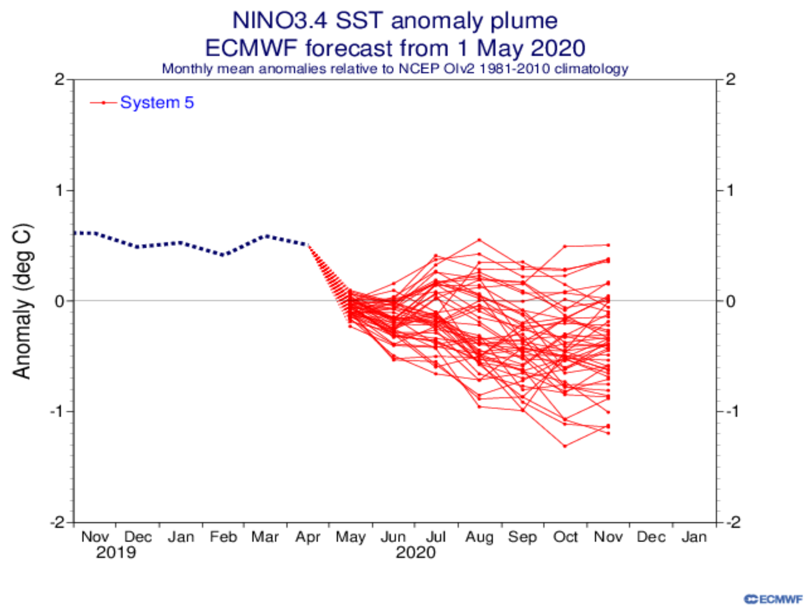


UKMO: Nino3.4, Updated 11June 2019

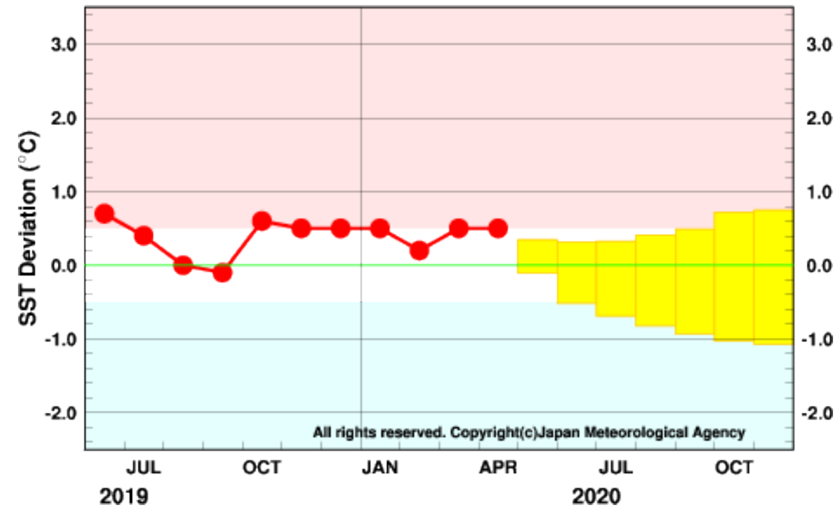


Individual Model Forecasts: ENSO-Neutral or Boardline La Nina

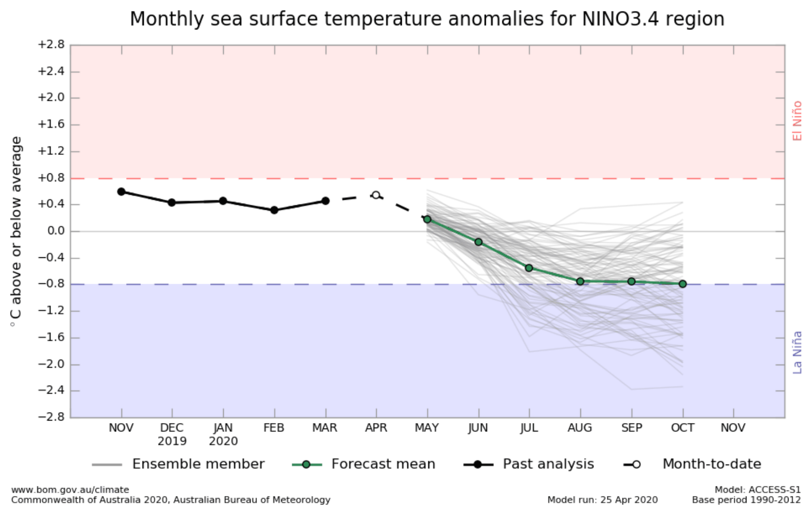
EC: Nino3.4, IC=01May 2020



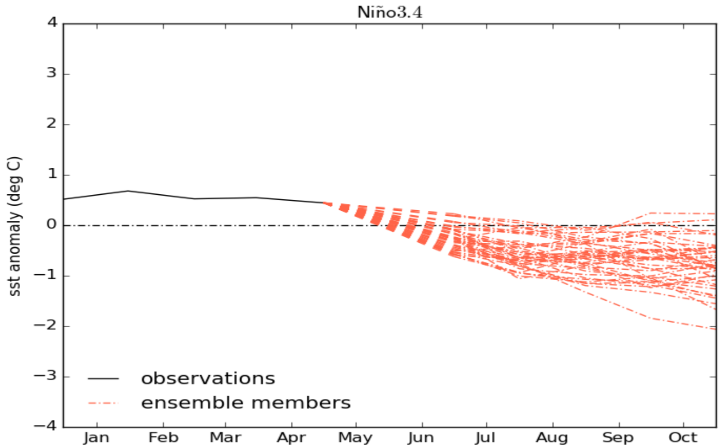
JMA: Nino3.4, Updated 12May 2019

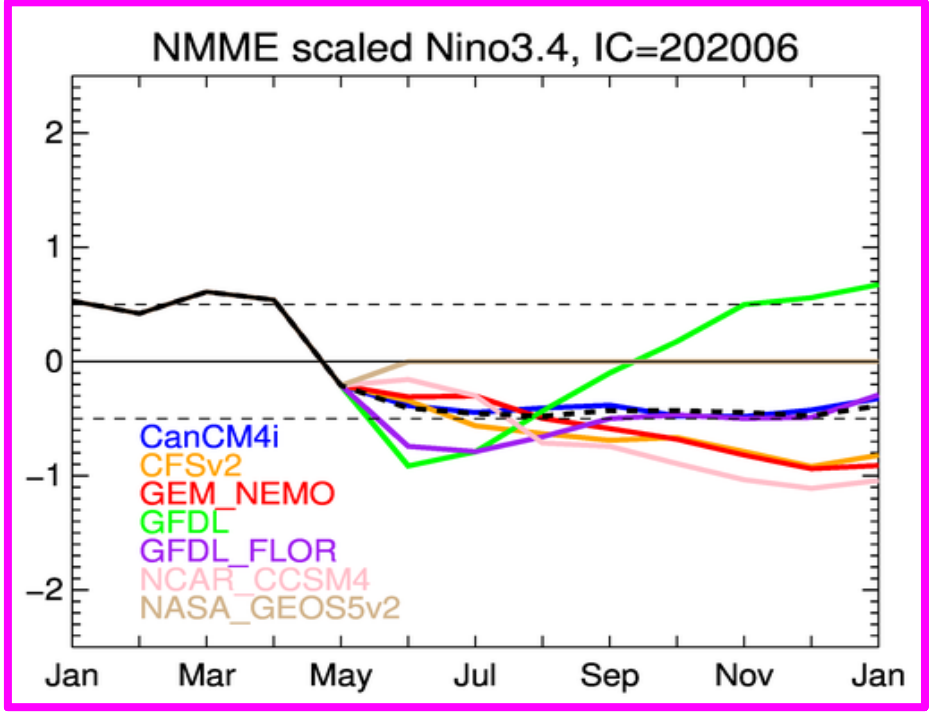


Australian BOM: Nino3.4, Updated 25 Apr 2020



UKMO: Nino3.4, Updated 11May 2019

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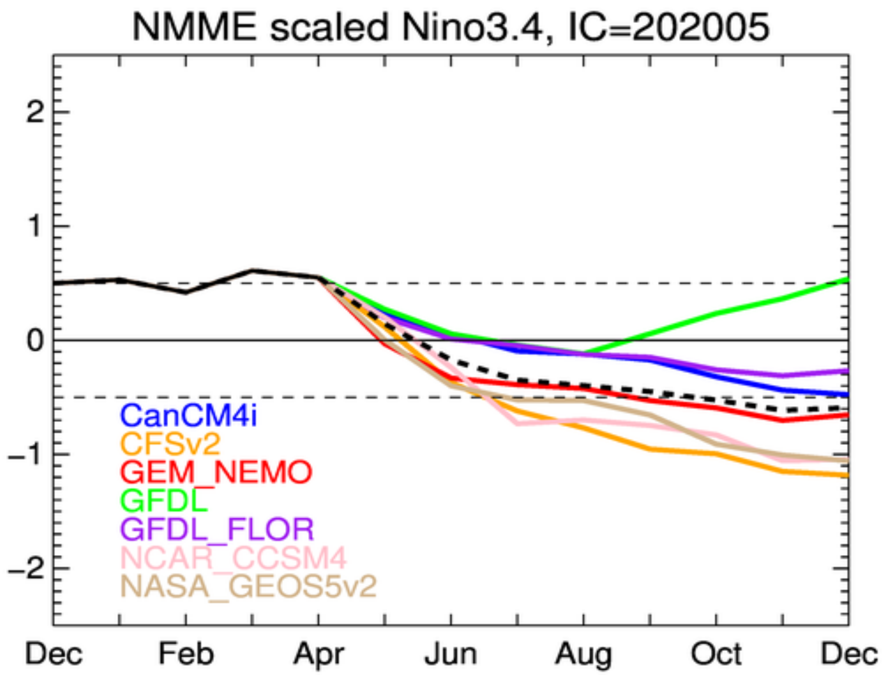
CanCM4i
CFSv2
GEM_NEMO
GFDL
GFDL_FLOR
NCAR_CCSM4
NASA_GEOS5v2
2
1
0
−1
−2
Jan
Mar
May
Jul
Sep
Nov
Jan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CFSv2
GEM_NEMO
GFDL
GFDL_FLOR
NCAR_CCSM4
NASA_GEOS5v2
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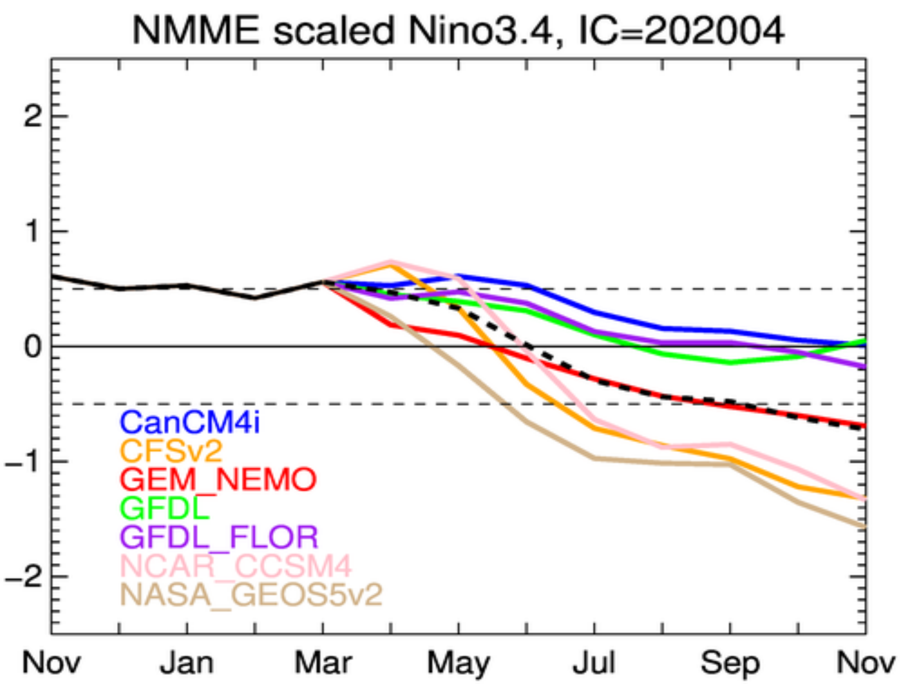
Dec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CanCM4i
CFSv2
GEM_NEMO
GFDL
GFDL_FLOR
NCAR_CCSM4
NASA_GEOS5v2
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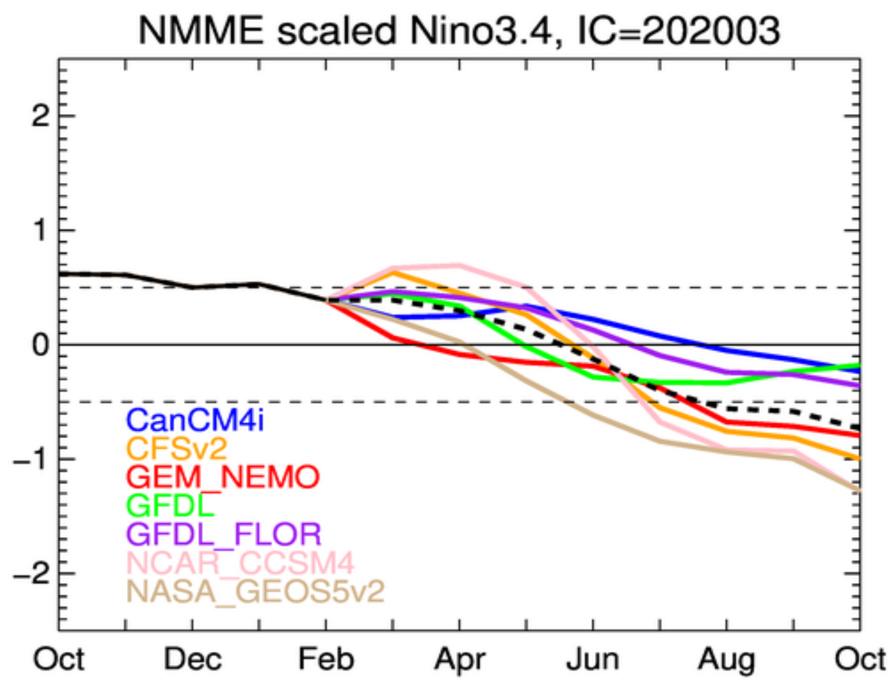
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CanCM4i
CFSv2
GEM_NEMO
GFDL
GFDL_FLOR
NCAR_CCSM4
NASA_GEOS5v2
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0
−1
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Oct
Dec
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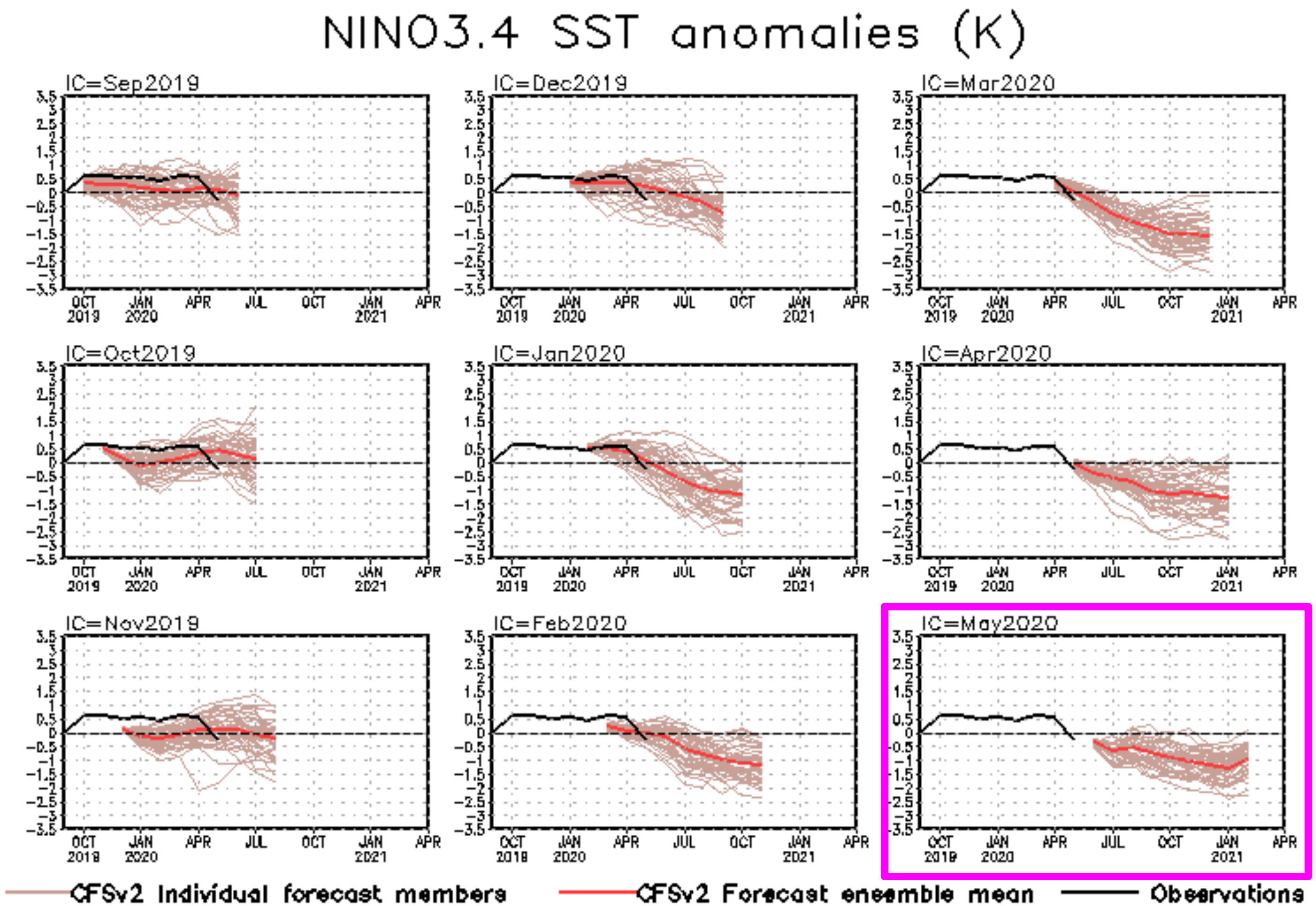
Aug
Oct

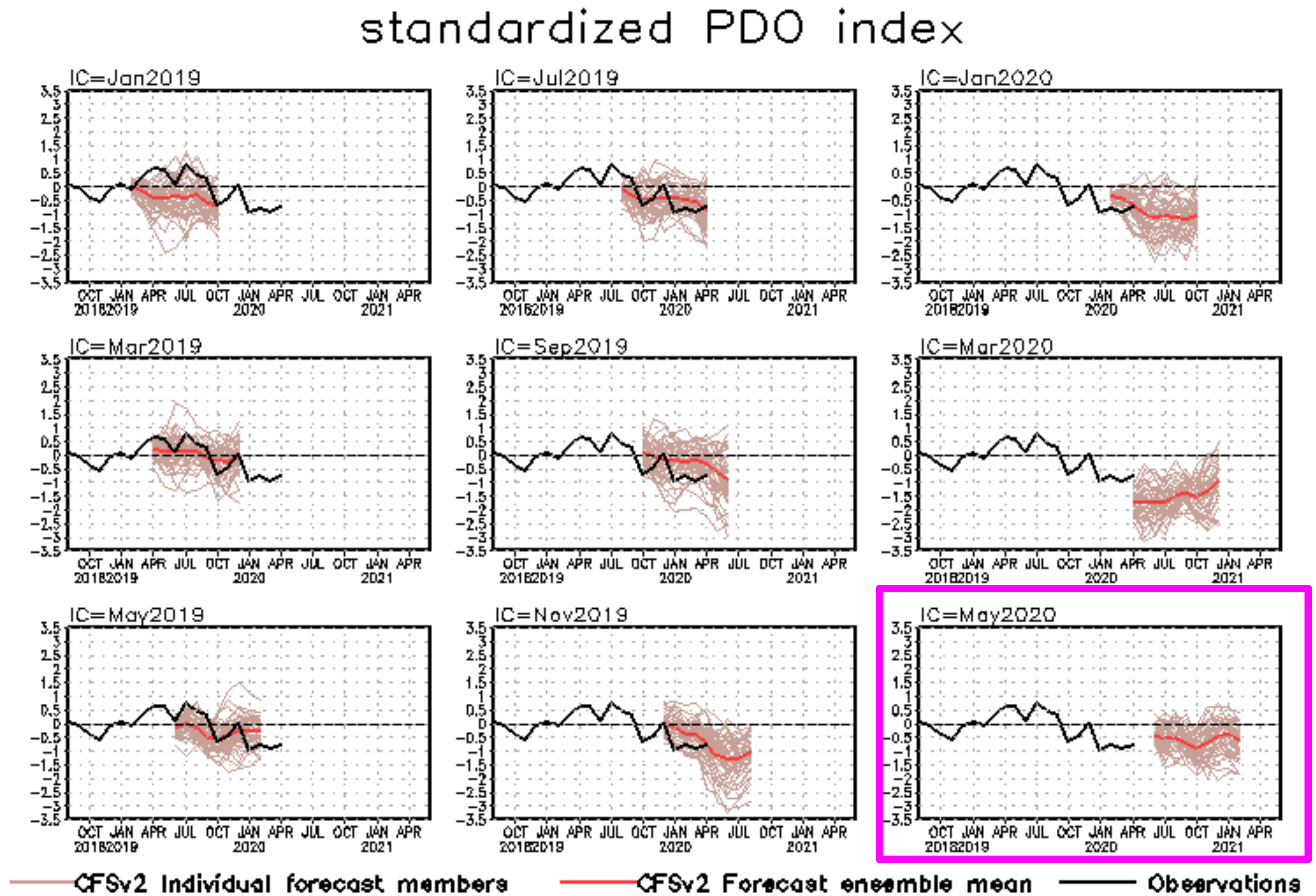
CFS Niño3.4 SST Predictions from Different Initial Months



- The latest CFSv2 forecasts call for a La Nina state through this summer/fall peaking in winter.

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.

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



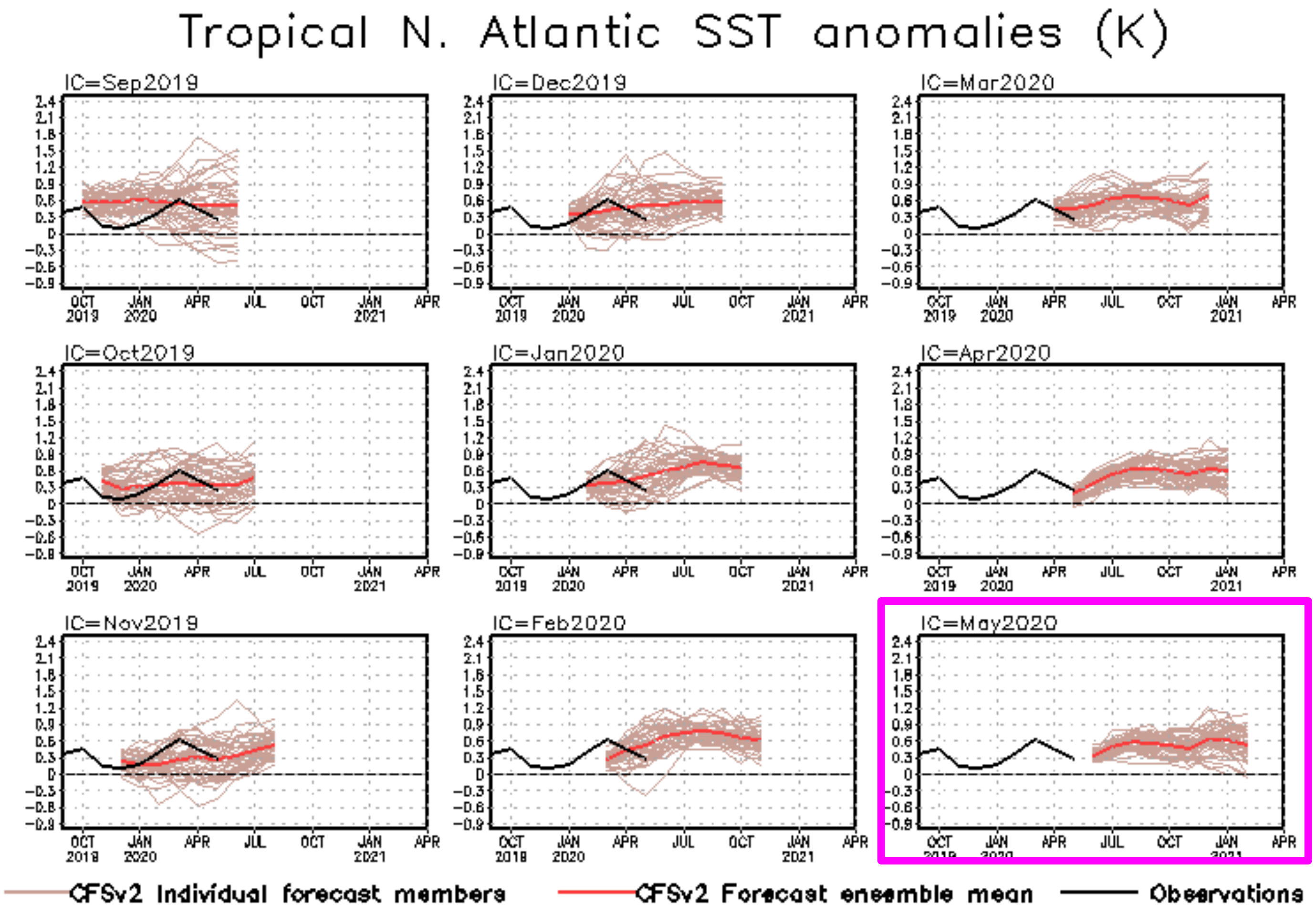
PDO is the first EOF of monthly ERSSTv3b anomaly in the region of [110°E-100°W, 20°N-60°N].

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 coming seasons.**

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.

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

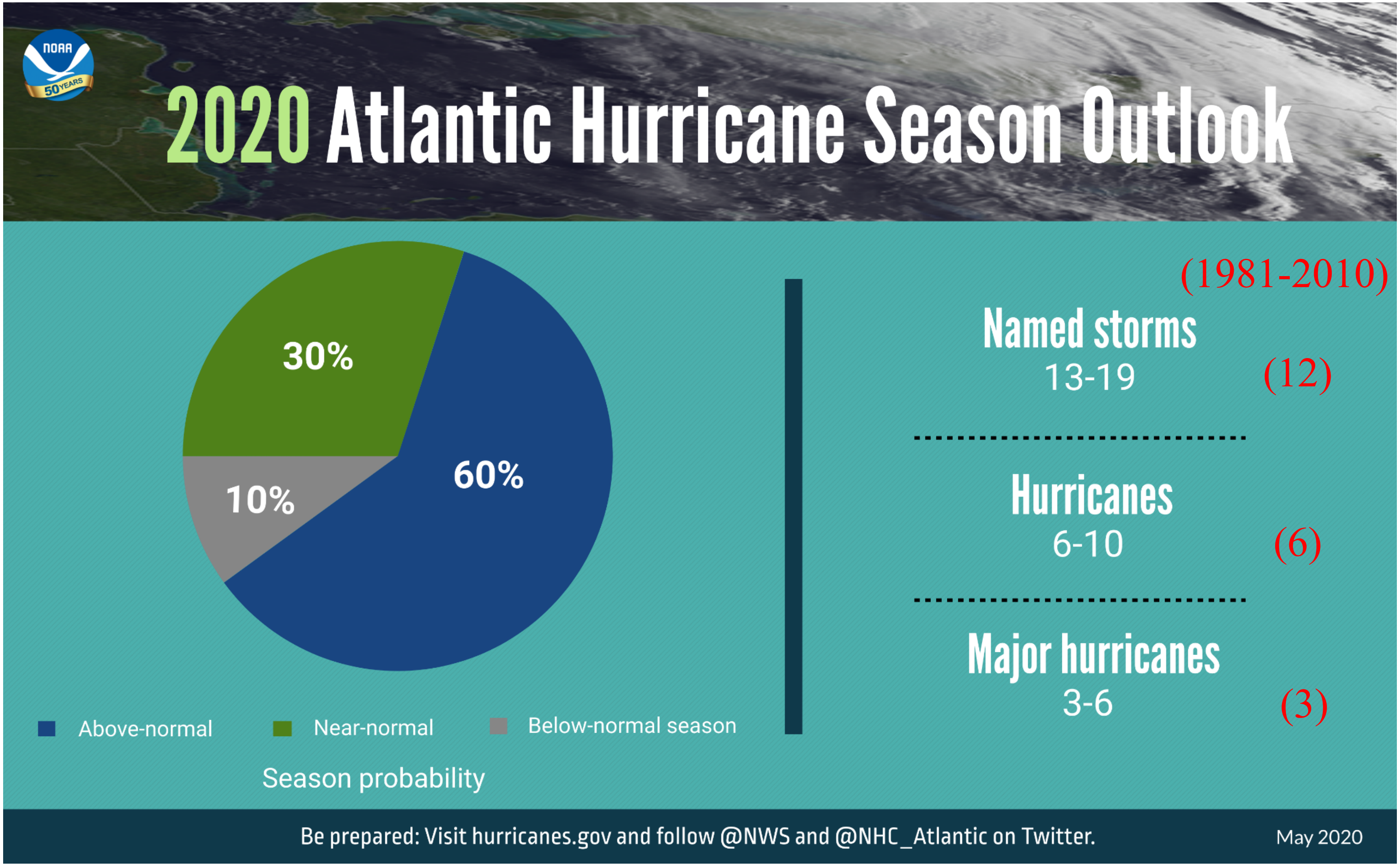


TNA is the SST anomaly averaged in the region of [60°W-30°W, 5°N-20°N].

- **Latest CFSv2 predictions call for above normal SSTA in the tropical N. Atlantic in 2020.**

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.

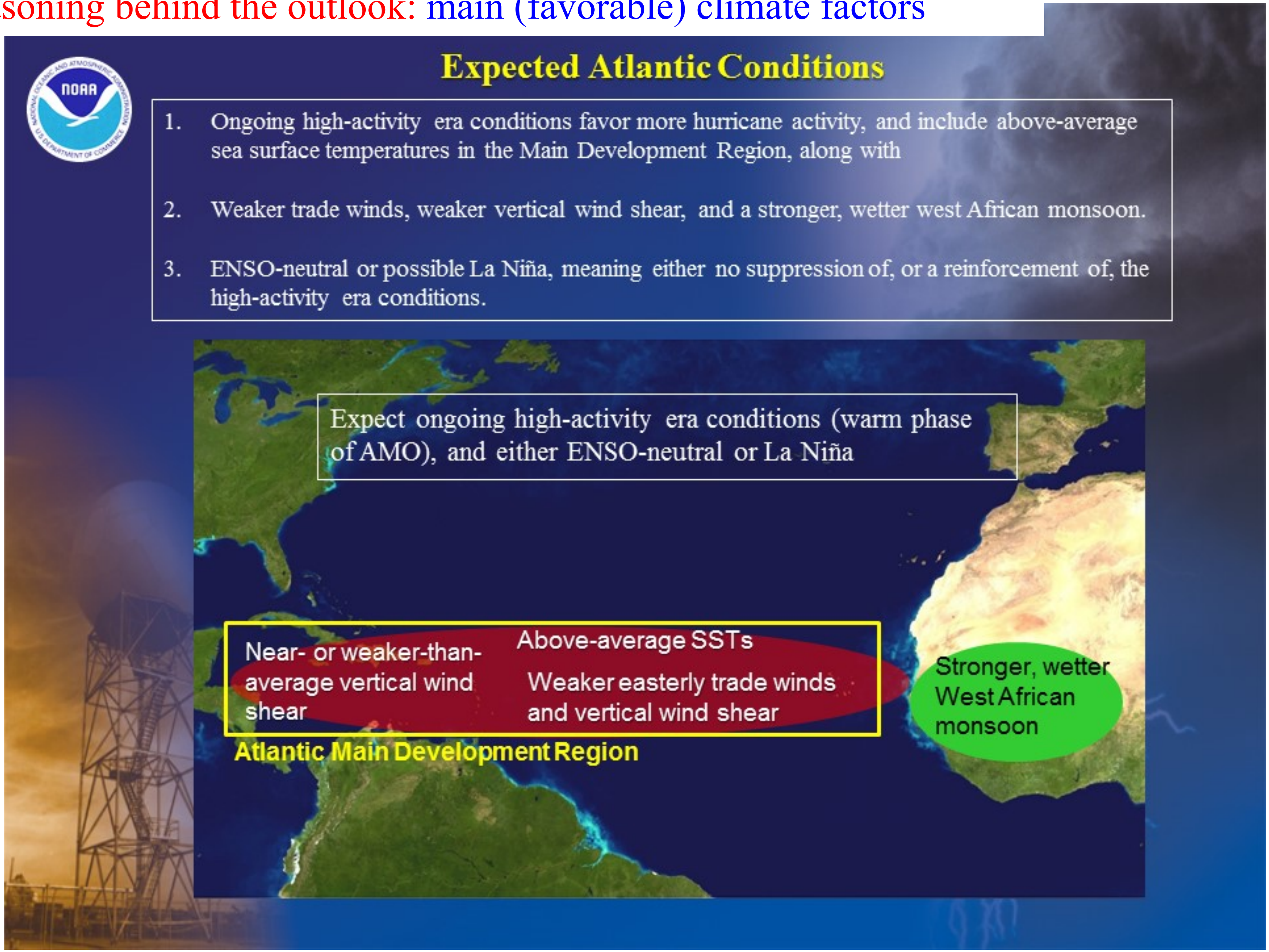
NOAA 2020 Hurricane Outlooks (21 May 2020)



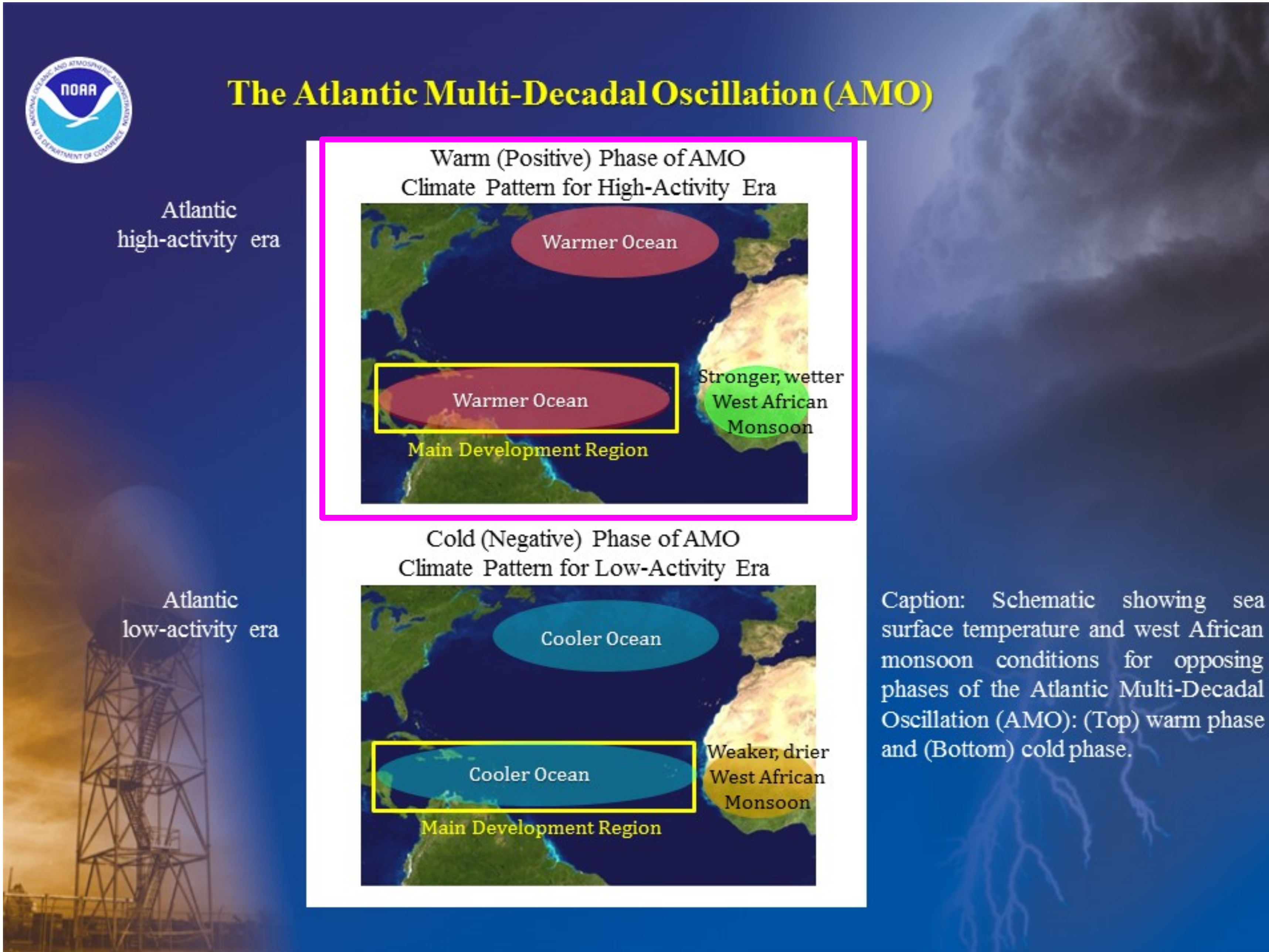
NOAA 2020 Atlantic Hurricane Season Outlook: a 60% chance of an above-normal season, a 30% chance of a near-normal season and a 10% chance of a below-normal season.

https://www.noaa.gov/media-release/busy-atlantic-hurricane-season-predicted-for-2020

Reasoning behind the outlook: main (favorable) climate factors

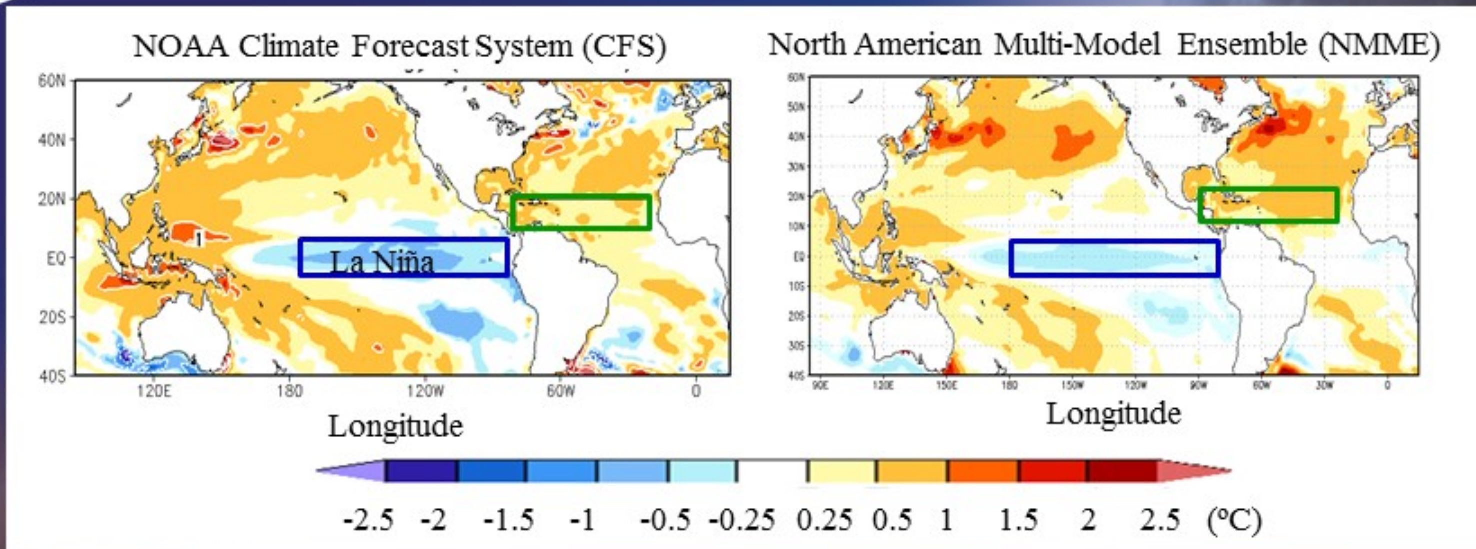


https://www.cpc.ncep.noaa.gov/products/outlooks/Slide2.JPG



https://www.cpc.ncep.noaa.gov/products/outlooks/Slide6.JPG

Predicted Sea Surface Temperature (SST) Anomalies



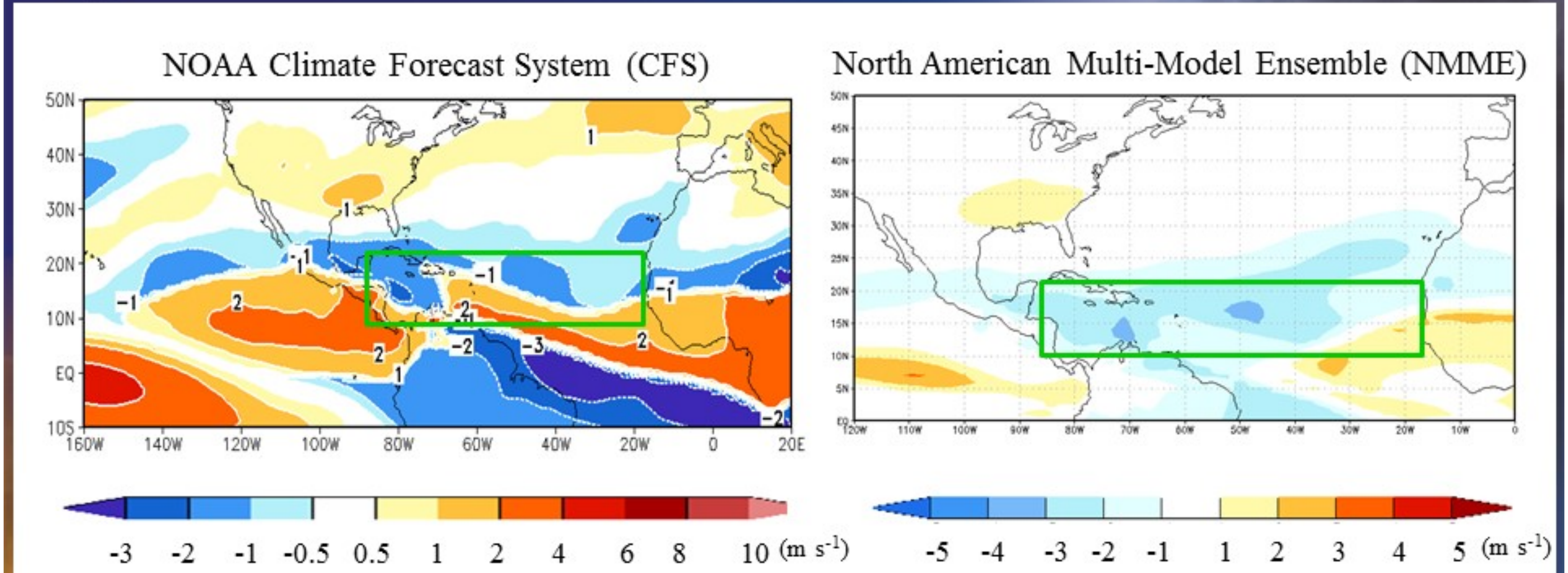
Caption: Predicted SST anomalies (°C) for August-October (ASO) 2020, from (Left) NOAA's Climate Forecast System (CFS) and (Right) the North American Multi-Model Ensemble (NMME). Green box denotes the Main Development Region (MDR) and Blue box highlights the El Niño/ La Niña region. Anomalies are departures from the 1981-2010 means.

Both the CFS and NMME models are predicting above-average SSTs in the MDR (green box) during the peak months (ASO) of the Atlantic hurricane season.

These models are predicting either La Niña or somewhat below-average SSTs in the central and east-central equatorial Pacific (Blue box).

https://www.cpc.ncep.noaa.gov/products/outlooks/Slide10.JPG

Model Forecasts for the Anomalous Magnitude of Vertical Wind Shear during August-October 2020

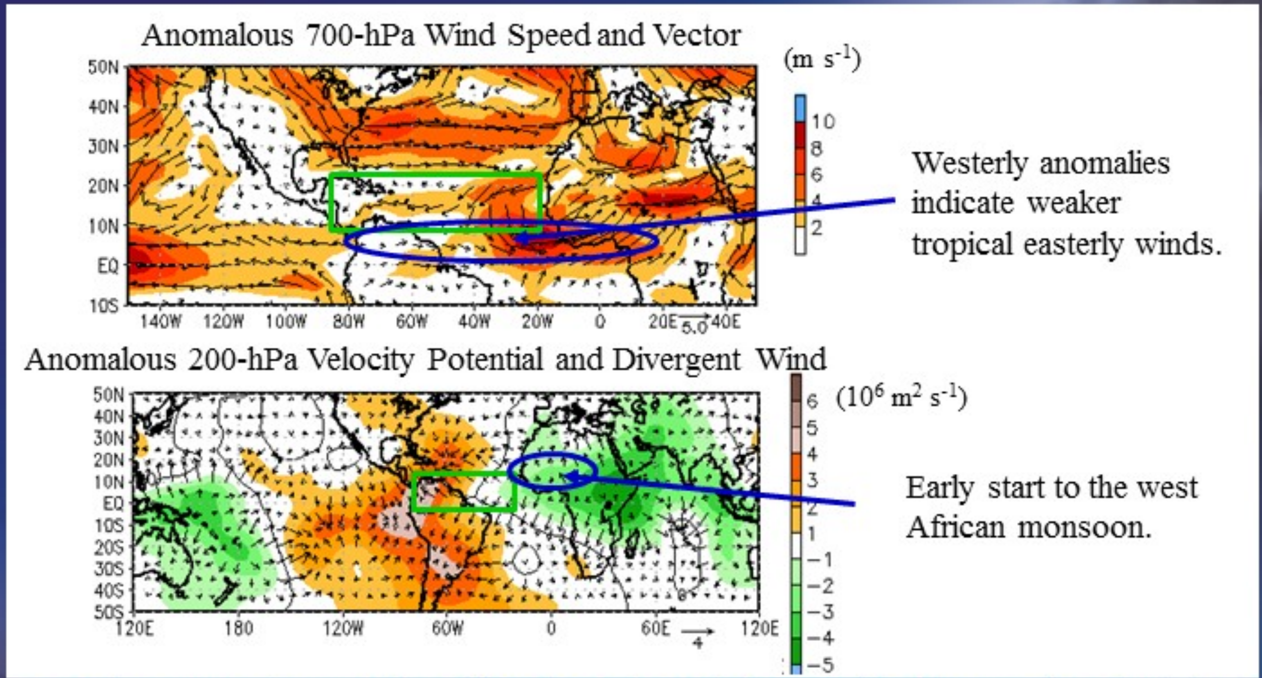


Caption: Predicted anomalous magnitude of the vertical wind shear (m s^{-1}) for August-October 2020, from (Left) NOAA's Climate Forecast System (CFS) and (Right) the North American Multi-Model Ensemble (NMME). Green box denotes the Atlantic Main Development Region (MDR). Blue (Red) shading indicates anomalously weak (strong) shear. Anomalies are departures from the 1981-2010 means.

NOAA's CFS and the NMME are predicting below-average vertical wind shear (Blue shading) during ASO 2020 across much of the MDR. These forecasts are consistent with the combination of La Niña and a stronger West African monsoon system.

https://www.cpc.ncep.noaa.gov/products/outlooks/Slide11.JPG

Last 45 days: Mid-Level and Upper-Level Atmospheric Anomalies Related to the West African Monsoon

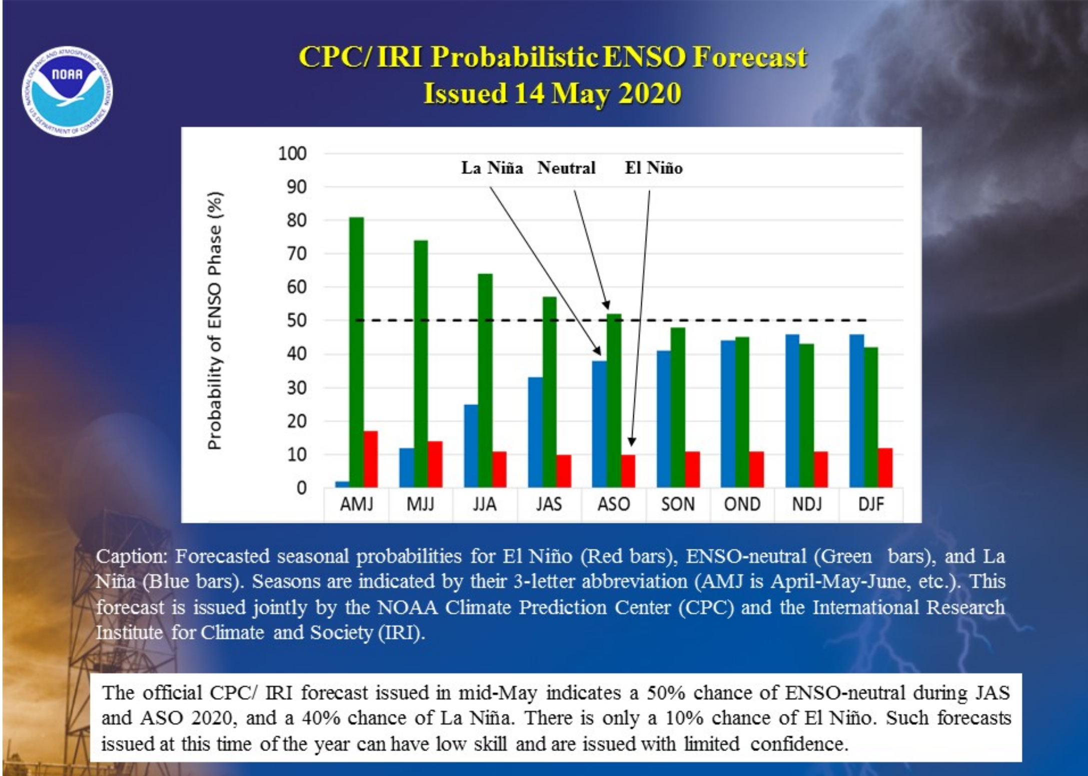


Caption. Last 45-day averaged anomalies of: (Top) 700-hPa wind speed (shading, m s^{-1}) and wind vectors, and (Bottom) 200-hPa velocity potential (shading, x 10^6 m^2 s^{-1}) and divergent wind vectors (m s^{-1}). Vector scale is below each plot at right. Green box denotes the Atlantic Main Development Region (MDR). At Bottom, green (orange) shading is associated with anomalous upper-level divergence (convergence). Anomalies are departures from the CDAS 1981-2010 period means.

(Top) Strong westerly wind anomalies (i.e., weaker easterly winds) across the tropical Atlantic are consistent with the warm phase of the AMO, and also with the expected enhanced west African monsoon system.

(Bottom) The upper-level circulation shows anomalous divergence (green) over Africa, suggesting an early start to the west African monsoon.

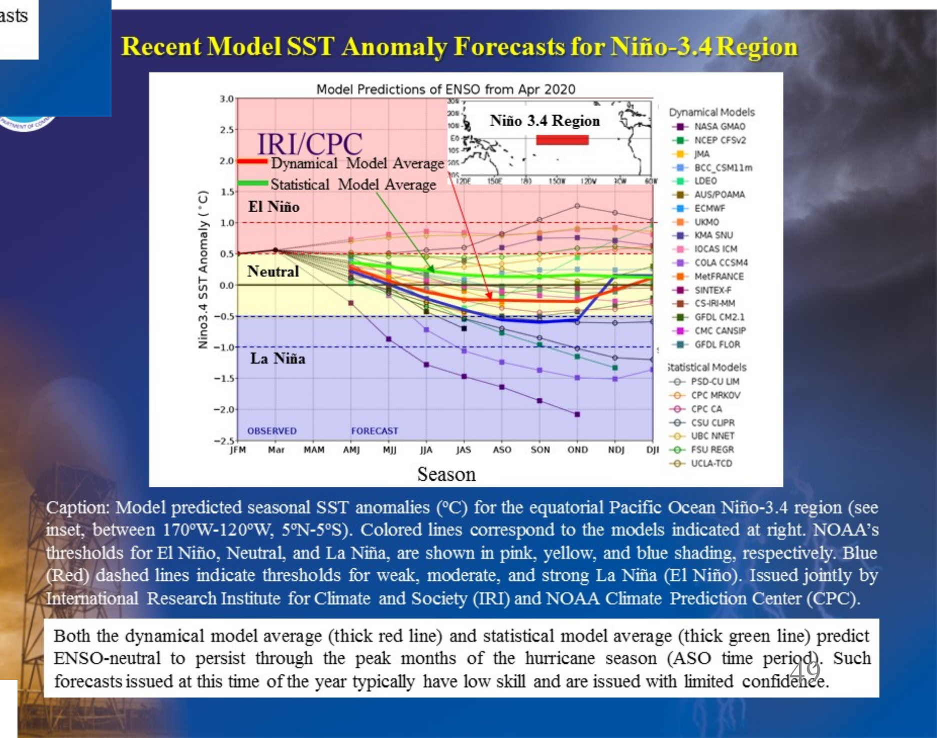
https://www.cpc.ncep.noaa.gov/products/outlooks/Slide12.JPG



https://www.cpc.ncep.noaa.gov/products/outlooks/Slide4.JPG

ENSO-neutral or La Niña most likely throughout the hurricane season

(based on the May ENSO outlook)



https://www.cpc.ncep.noaa.gov/products/outlooks/Slide5.JPG

NOAA's 2020 Hurricane Season Outlooks

For 2020 the probabilities of each season type are:

	Atlantic	Eastern Pacific	Central Pacific
Above Normal	60%	25%	25%
Near Normal	30%	40%	40%
Below Normal	10%	35%	35%

- Accumulated Cyclone Energy (ACE) measures the overall strength of the hurricane season.
- For the Central Pacific, Tropical Cyclones (TCs) include tropical depressions, tropical storms and hurricanes.

For the Atlantic hurricane season, climate signals and model forecasts indicate that an above-normal season is most likely (60% chance), followed by a 30% chance of a near-normal season and a 10% chance of a below-normal season.

For the eastern and central Pacific hurricane regions, the outlooks indicate that a near-or below-normal season is most likely (75% combined chance).

https://www.cpc.ncep.noaa.gov/products/outlooks/Slide1.JPG

Acknowledgements

- Drs. Zeng-Zhen Hu, Caihong Wen, and Arun Kumar: reviewed PPT, and provide insightful suggestions and comments

- Drs. Li Ren and Pingping Xie provided the BASS/CMORPH/CFSR EVAP package

- Dr. Wanqiu Wang provided the sea ice forecasts and maintained the CFSv2 forecast achieve

- NOAA Hurricane Outlook Team provided the slides about hurricane seasonal outlook

Please send your comments and suggestions to:

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Caihong.Wen@noaa.gov

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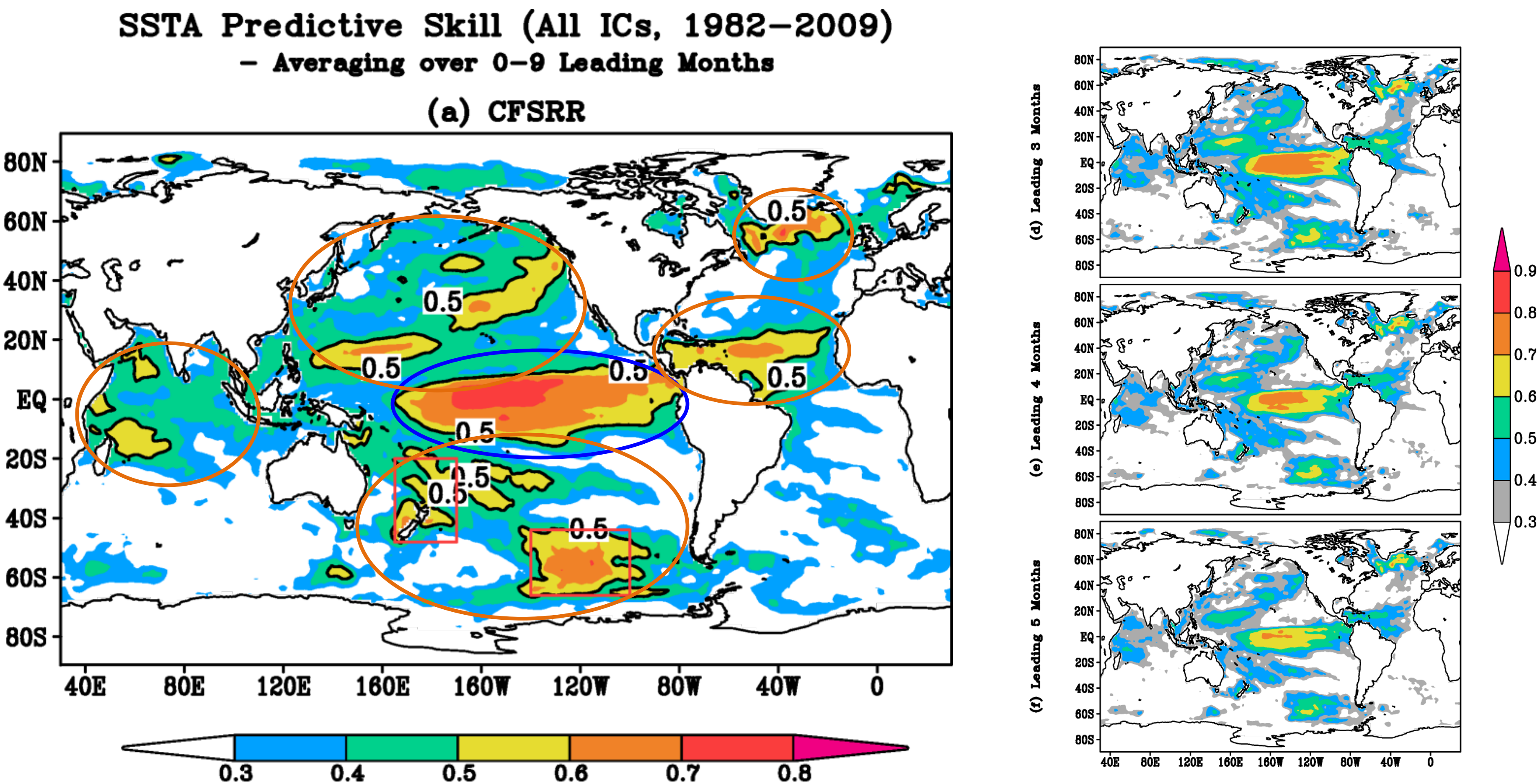
Backup Slides

Spatial Distribution of SSTA prediction skill with CFSv2



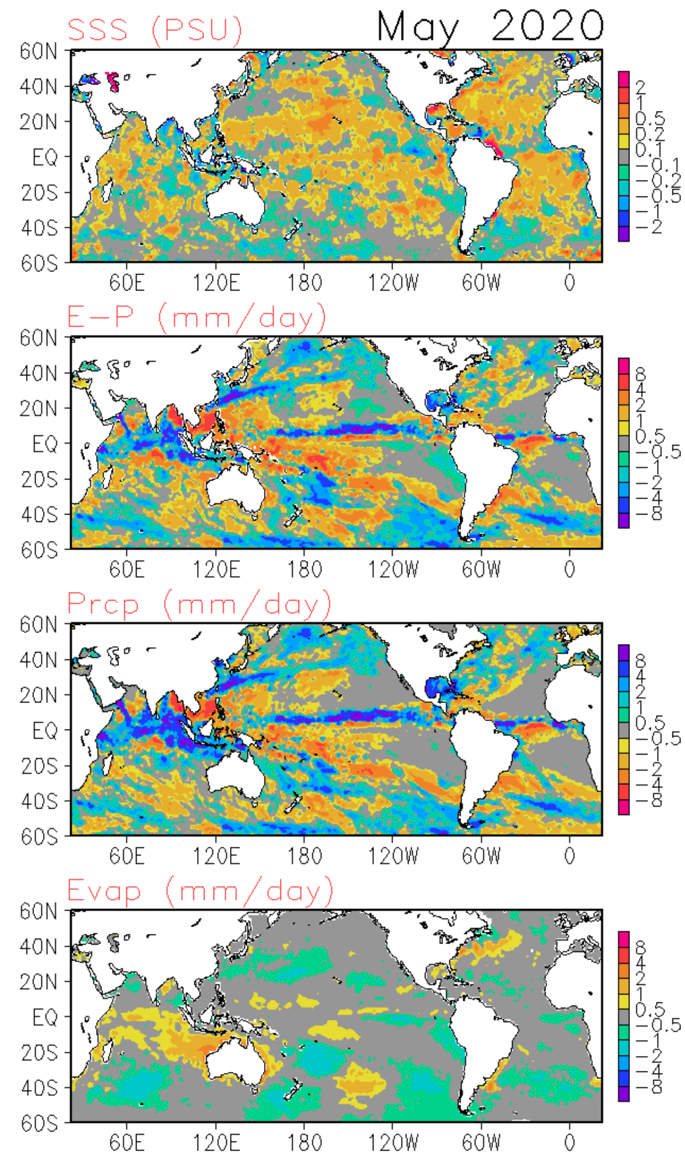
(Guan et al. 2014)

- ENSO-related SST presents the highest prediction skill;
- Other skillful regions include: tropical North Atlantic, South Pacific, tropical Indian Ocean, part of extratropical North Pacific,…

Global Sea Surface Salinity (SSS)

Anomaly for May 2020

- New Update: The NCEI SST data used in the quality control procedure has been updated to version 2.1 since May 2020
- Positive SSS anomalies continue and/or strengthen in most areas within the latitudes between 0° and 40°N in the N. Pacific Ocean and N. Atlantic Ocean. Meanwhile, positive SSS anomalies appear in the latitudes between 0° and 40°S in the S. Pacific Ocean and S. Atlantic Ocean. While, negative SSS signal is persistent in the equatorial Atlantic Ocean with increased precipitation. Negative SSS anomalies continue and expand in the northern region of Bay of Bengal and is likely caused by oceanic advection/entrainment.



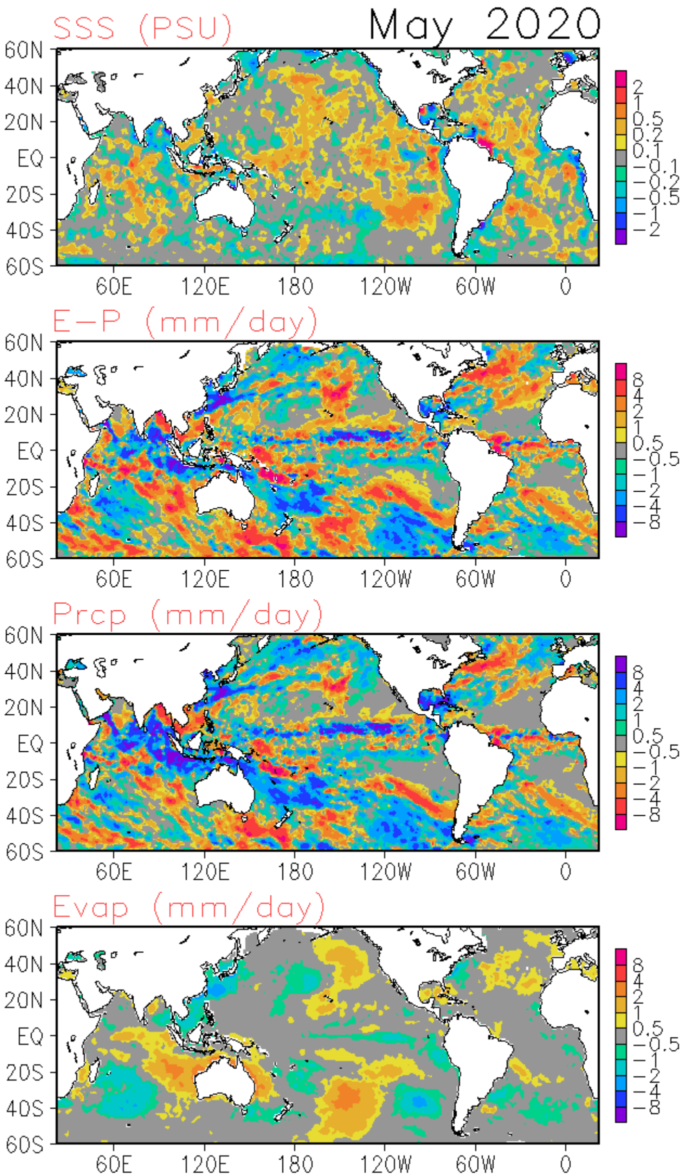
- **Data used**

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 May 2020

Compared with last month, the SSS continued increasing in most areas of N. Pacific ocean and N. Atlantic between equator and 40°N. The SSS signal also became positive in most areas of S. Pacific Ocean and S. Atlantic Ocean between equator and 40°S. The SSS continued decreasing in the Bay of Bengal, and such signal is likely caused by oceanic advection/entrainment.

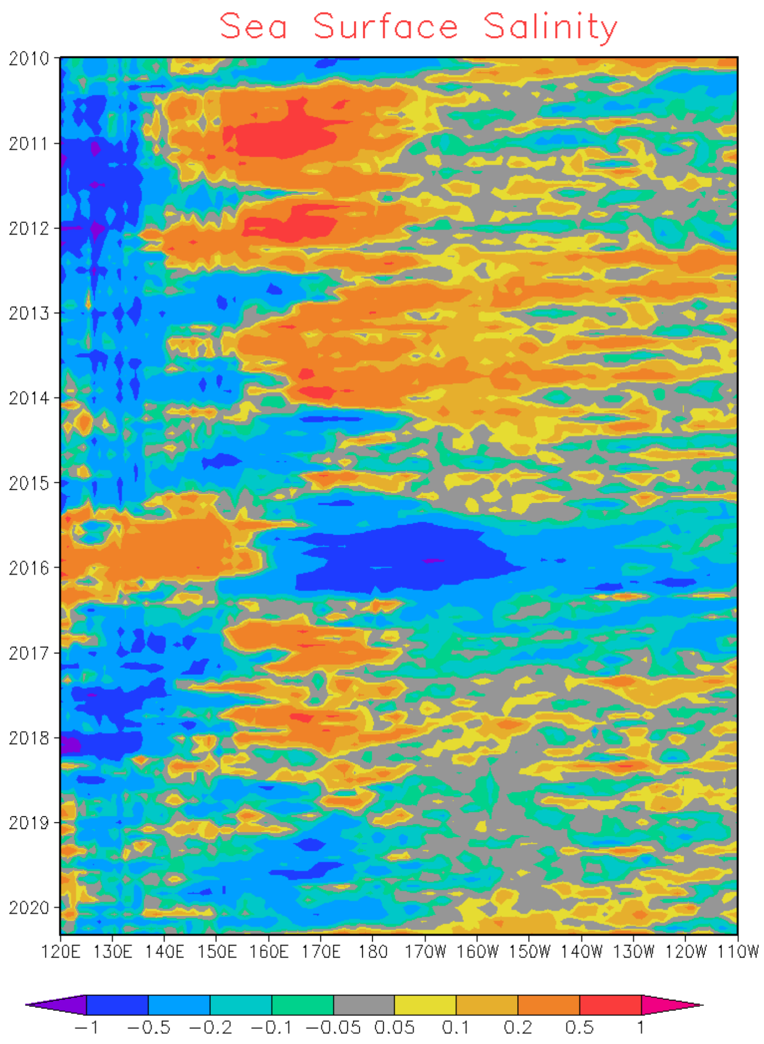


Global Sea Surface Salinity (SSS)

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.

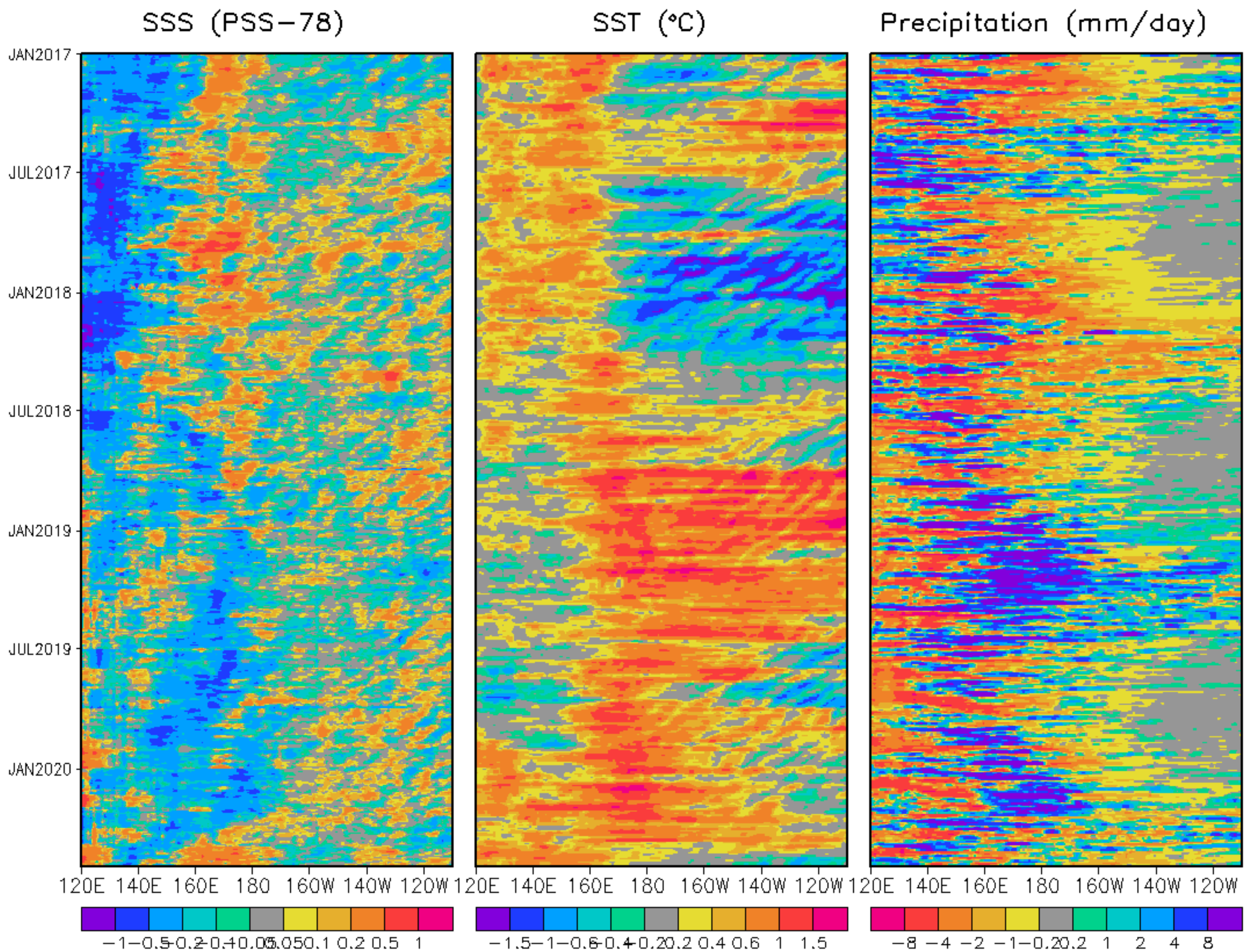
- Hovemoller diagram for equatorial SSS anomaly **(5˚S-5˚N);**
- In the equatorial Pacific Ocean, the SSS signal is negative and tend to became neutral west of 160°E; the positive SSS signals expanded and such positive anomalies show east of 160°E, while some negative SSS signals are in the east of 125°W.



Global Sea Surface Salinity (SSS)

Anomaly Evolution along the 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.



Data Sources (climatology is for 1981-2010)

- Weekly Optimal Interpolation SST (OI SST) version 2 (Reynolds et al. 2002)
- Extended Reconstructed SST (ERSST) v5 (Huang et al. 2017)
- Blended Analysis of Surface Salinity (BASS) (Xie et al. 2014)
- CMORPH precipitation (Xie et al. 2017)
- CFSR evaporation adjusted to OAFlux (Xie and Ren 2018)
- NCEP CDAS winds, surface radiation and heat fluxes (Kalnay et al. 1996)
- NESDIS Outgoing Long-wave Radiation (Liebmann and Smith 1996)
- NCEP's GODAS temperature, heat content, currents (Behringer and Xue 2004)
- Aviso altimetry sea surface height from CMEMS
- Ocean Surface Current Analyses – Realtime (OSCAR)
- In situ data objective analyses (IPRC, Scripps, EN4.2.1, PMEL TAO)
- Operational Ocean Reanalysis Intercomparison Project

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

  http://www.cpc.ncep.noaa.gov/products/GODAS/multiora93_body.html