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

Prepared by

Climate Prediction Center, NCEP/NOAA

**July 10, 2020**

**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**

➢ **Sea level predictions**

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

# Overview

- **Pacific Ocean**
  - **ENSO neutral condition persisted, but cooled further in the eastern basin (NINO3.4 = -0.29$^{o}$C).**
  - **Positive SSTAs continued in the NE Pacific in June 2020. The PDO was in a negative phase (PDOI = -0.52).**

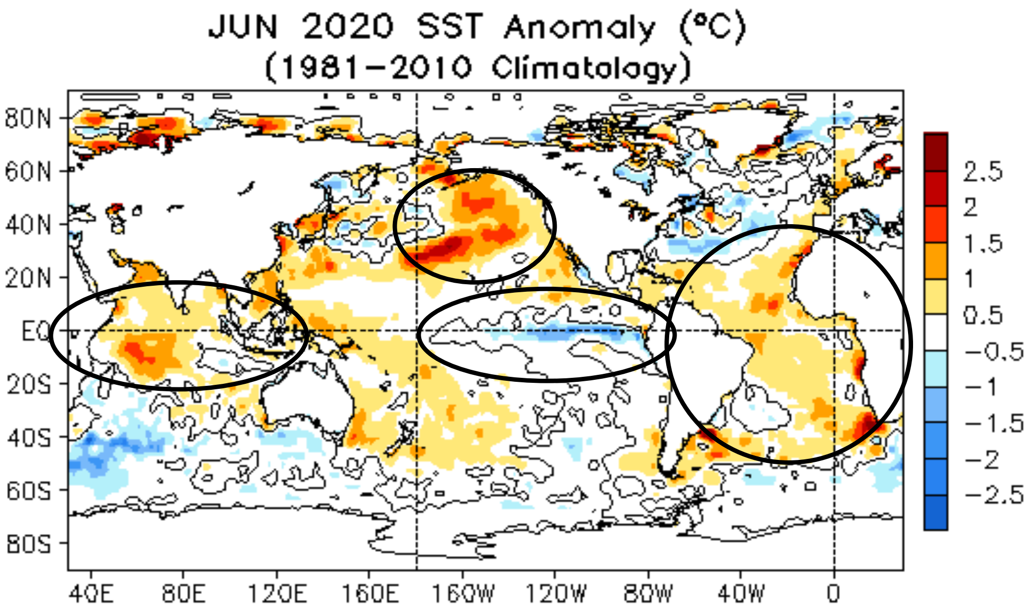
- **Indian Ocean**
  - **Basin-wide SST warming persisted in the tropical Indian Ocean in June 2020.**

- **Atlantic Ocean**
  - **NAO switched to a positive phase in June 2020 with NAOI= 0.16.**
  - **The prolonged tripole SSTA pattern was absent in the north Atlantic in June 2020.**

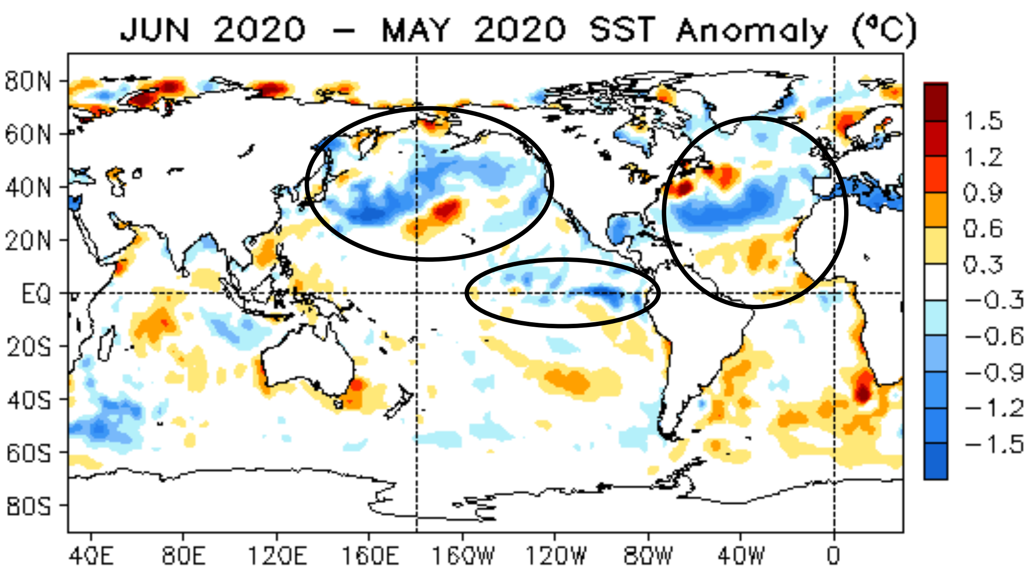
- **Arctic Ocean**
  - **The sea ice extent in June 2020 was ranked as the 3$^{rd}$ lowest since 1979, and its rate of loss was near average.**

# Global Oceans

# Global SST Anomaly ($^0$C) and Anomaly Tendency



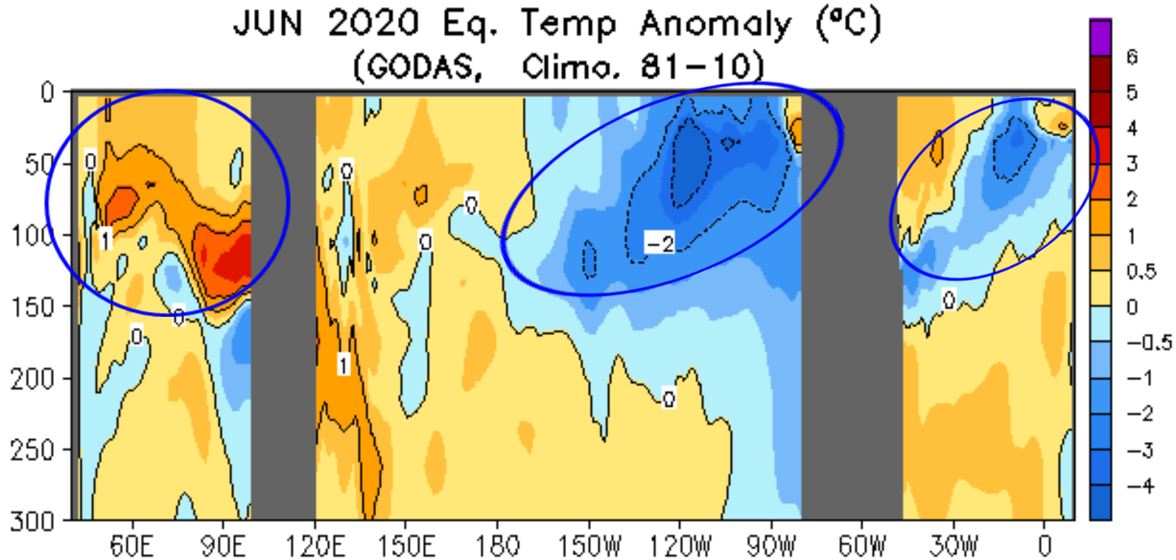

- Negative SSTAs appeared in the eastern equatorial Pacific.
- Positive SSTAs persisted in the NE Pacific.
- Weak positive SSTAs were present across the entire tropical Atlantic basin.
- Positive SSTAs persisted in the tropical Indian Ocean.



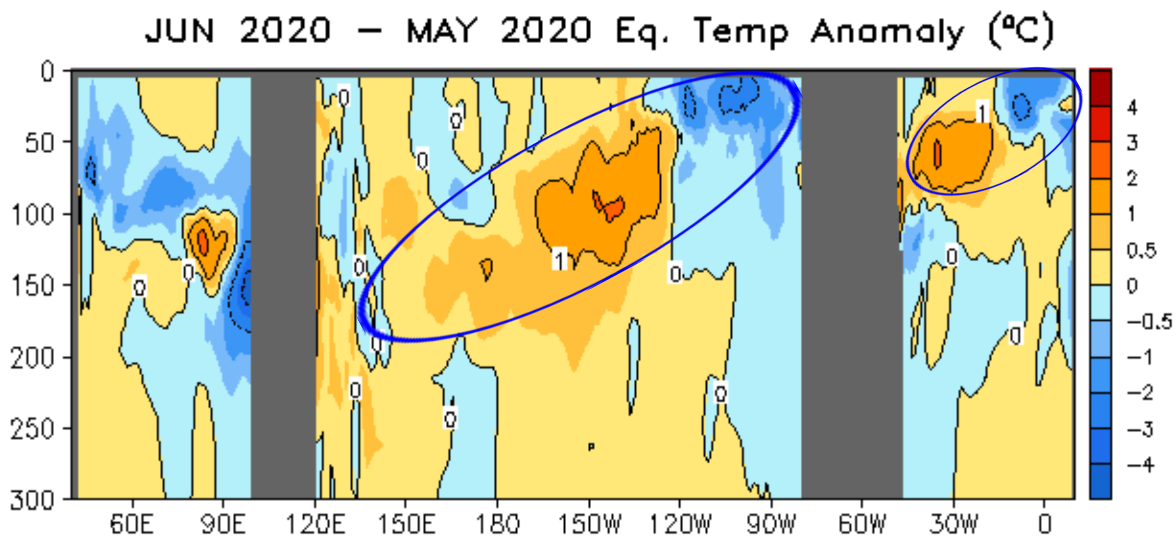

- Negative SSTA tendencies were present in the eastern equatorial Pacific.
- Negative SSTA tendencies presented in the high-latitude North Pacific.
- Negative (positive) SSTA tendencies presented in the mid-latitude (tropical) North Atlantic.

**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 2ºS-2ºN



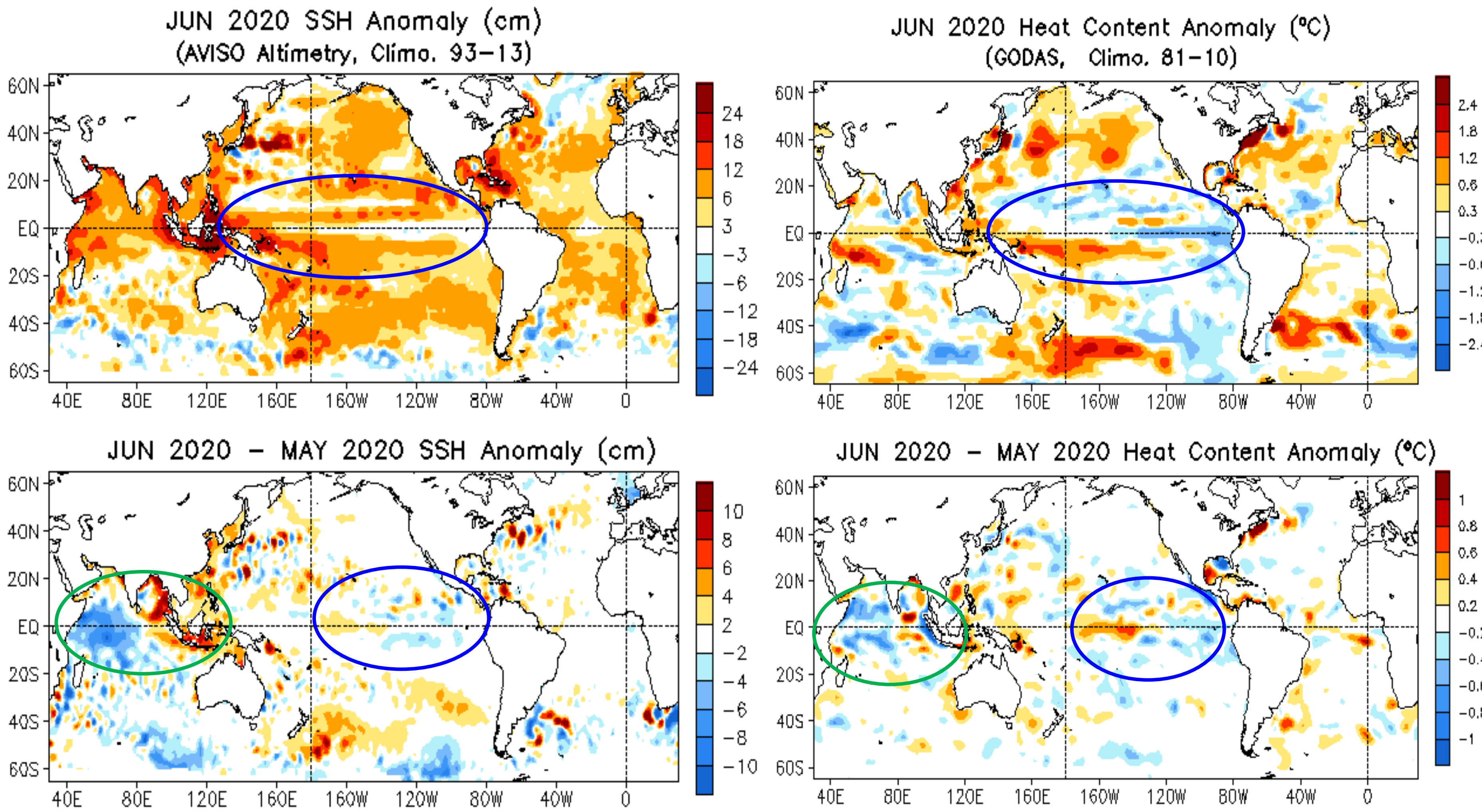

- **Negative temperature anomalies presented along the thermocline in both the eastern equatorial Pacific and Atlantic Oceans.**
- **Positive temperature anomalies were observed in the upper equatorial Indian Ocean.**




**-Temperature anomaly tendency was positive along the thermocline in the western-central Pacific and western Atlantic, and negative in the eastern Pacific and eastern 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.**

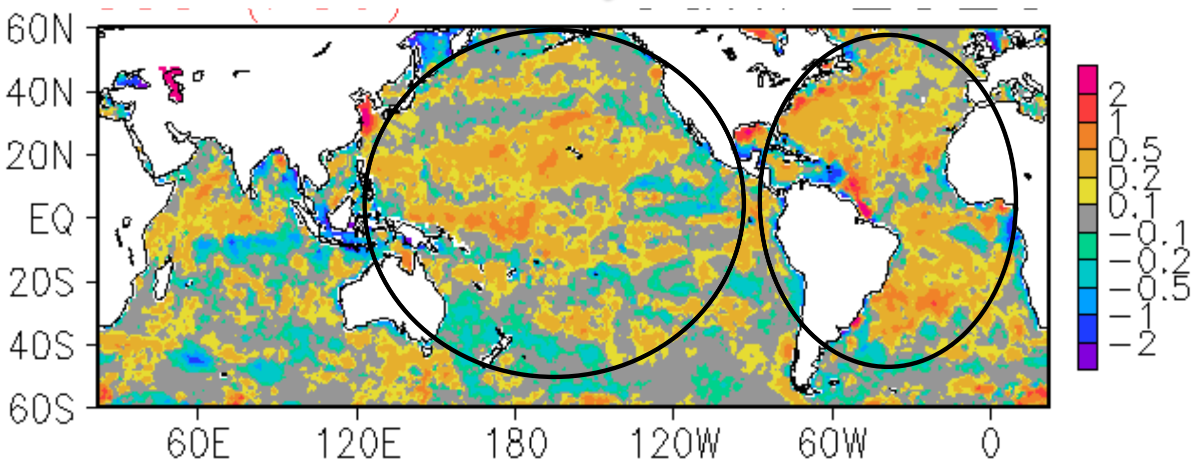
# Global SSH and HC300 Anomaly & Anomaly Tendency



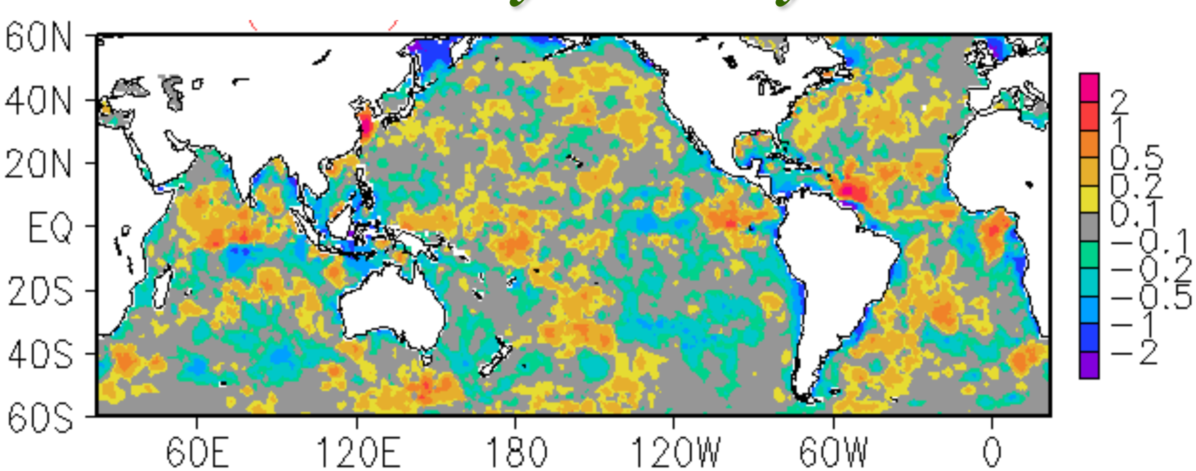

- **The SSHA pattern was overall consistent with the HC300A pattern, but with a significant trend component in SSHA.**
- **Much better consistency for tendencies: negative in the eastern off-equatorial Pacific (western Indian) and positive in the central equatorial Pacific (eastern Indian).**

# Global Sea Surface Salinity (SSS) for June 2020

*Anomaly*




*Anomaly Tendency*



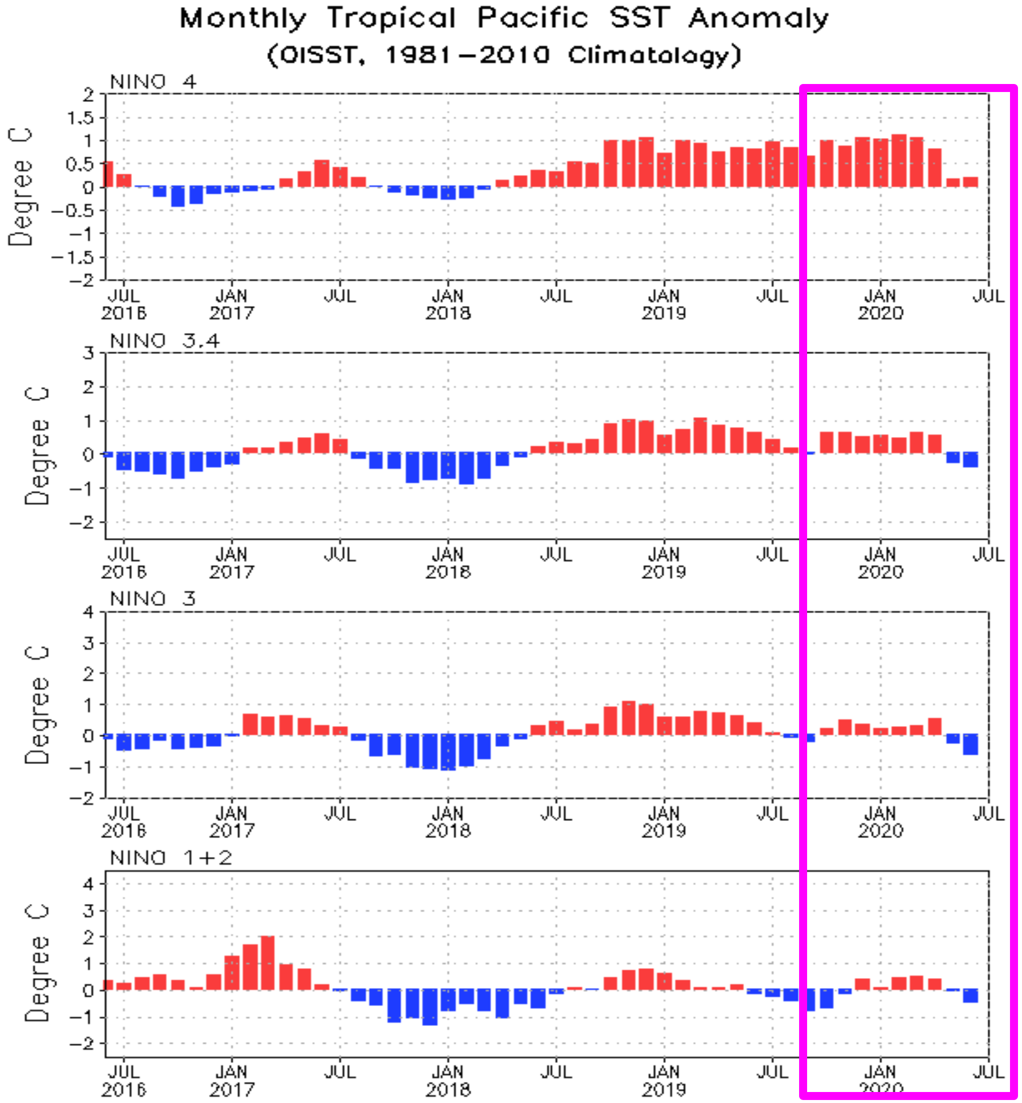

**- Anomaly distribution is similar to that in May 2020, with positive SSS anomalies present across most of the Pacific and Atlantic Oceans.**

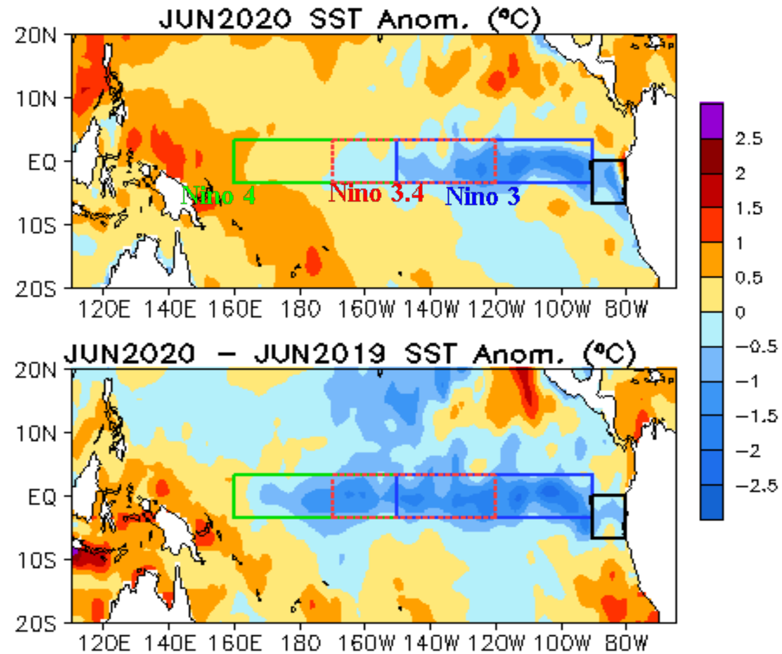
**Blended Analysis of Surface Salinity (BASS) V0.Z (Xie et al. 2014)**

Courtesy of Dr. Li Ren

# Tropical Pacific Ocean and ENSO Conditions

# Evolution of Pacific NINO SST Indices



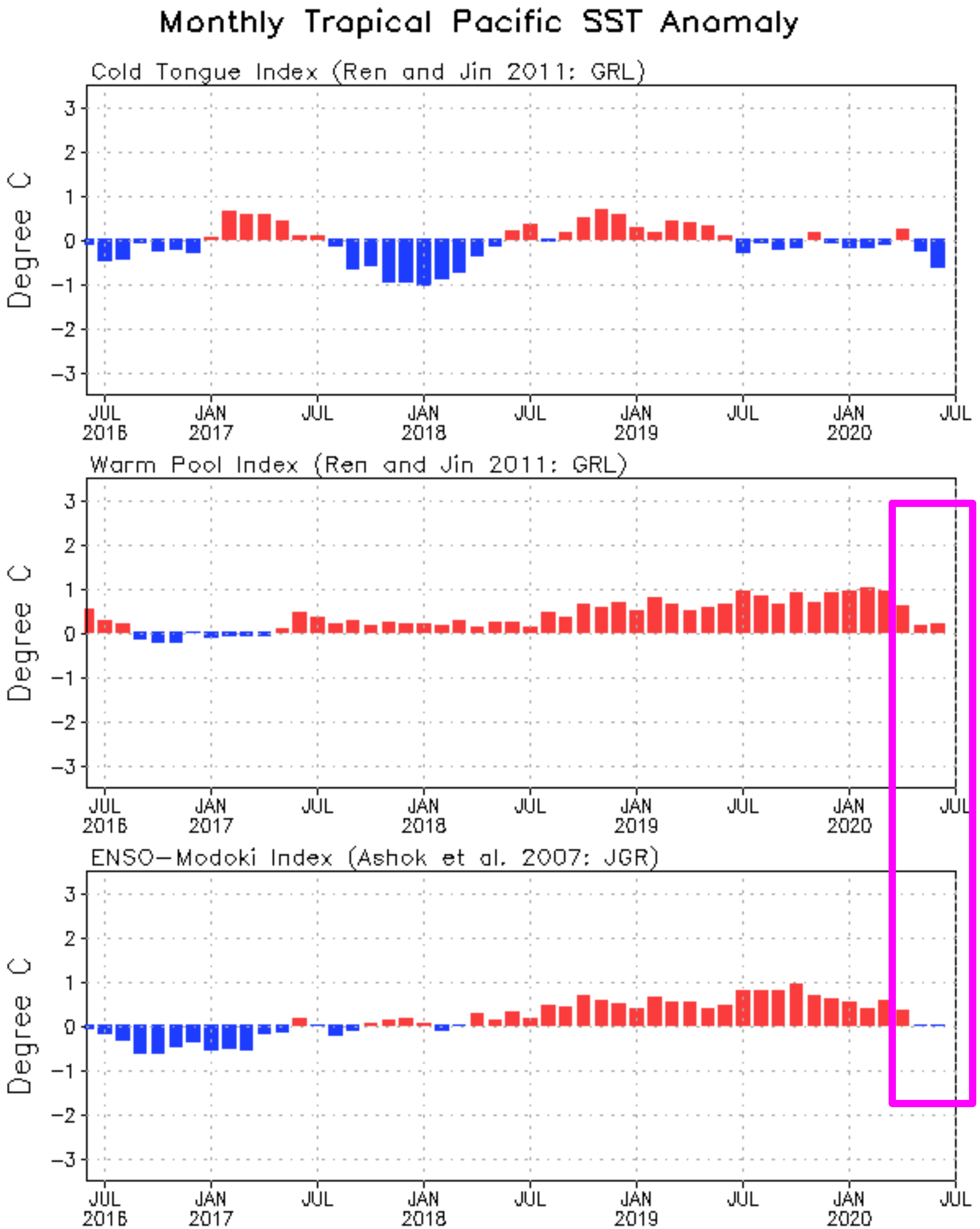



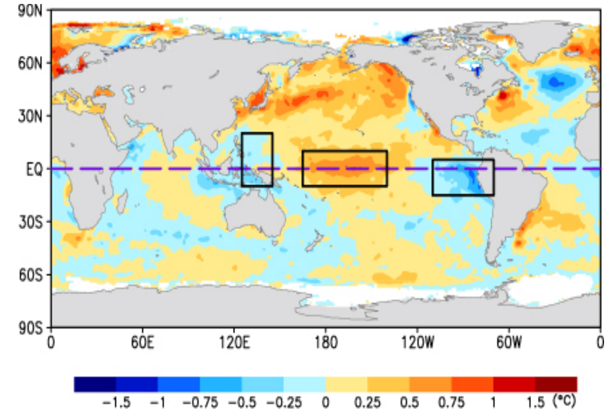

- **All Nino indices cooled considerably since May 2020, with Nino3.4 = -0.29C in June.**

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

- **The indices may have slight differences if 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/ENSO-Modoki indices were positive since 2018, but weakened after May 2020 (Modoki index became slightly negative).**

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

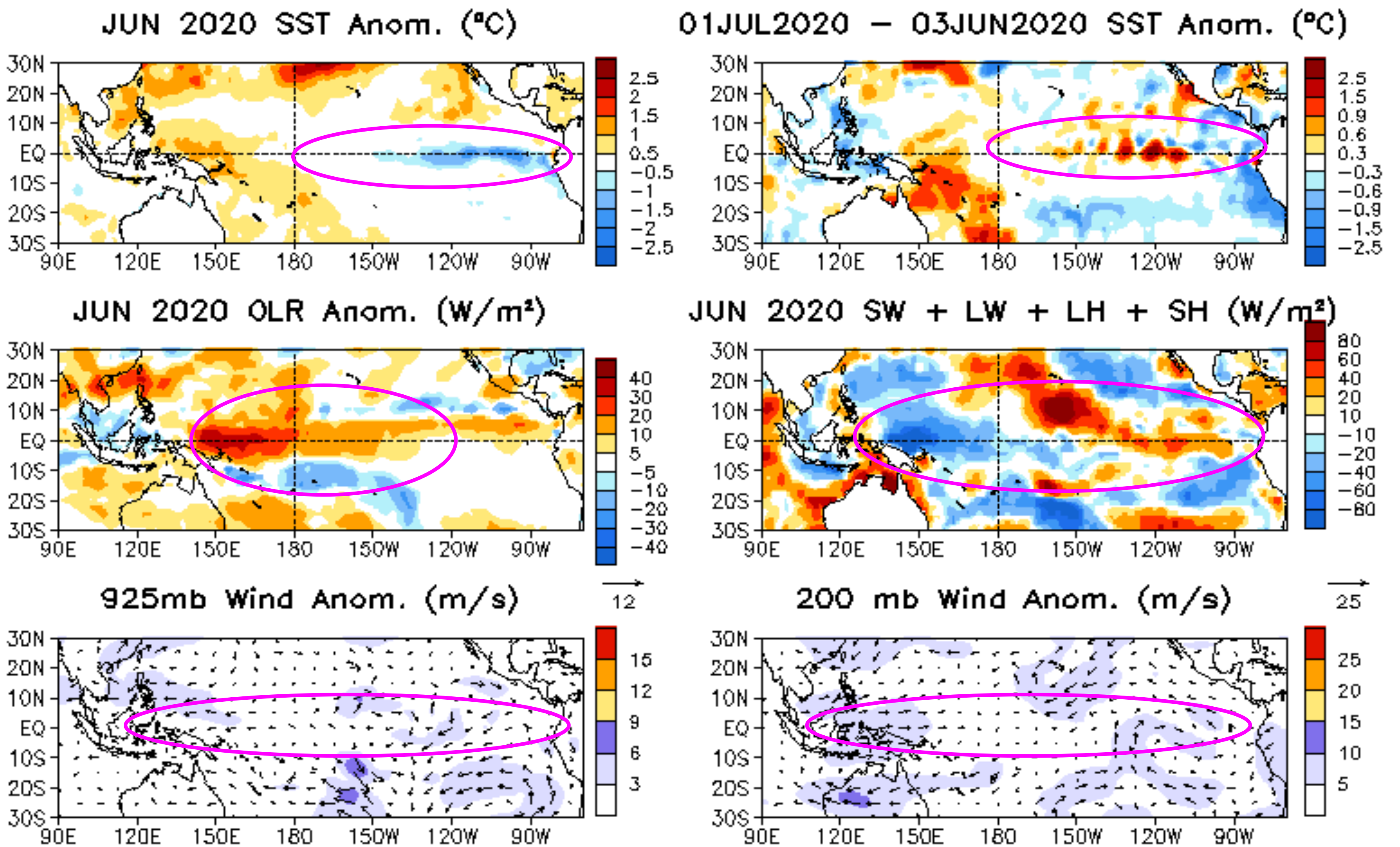
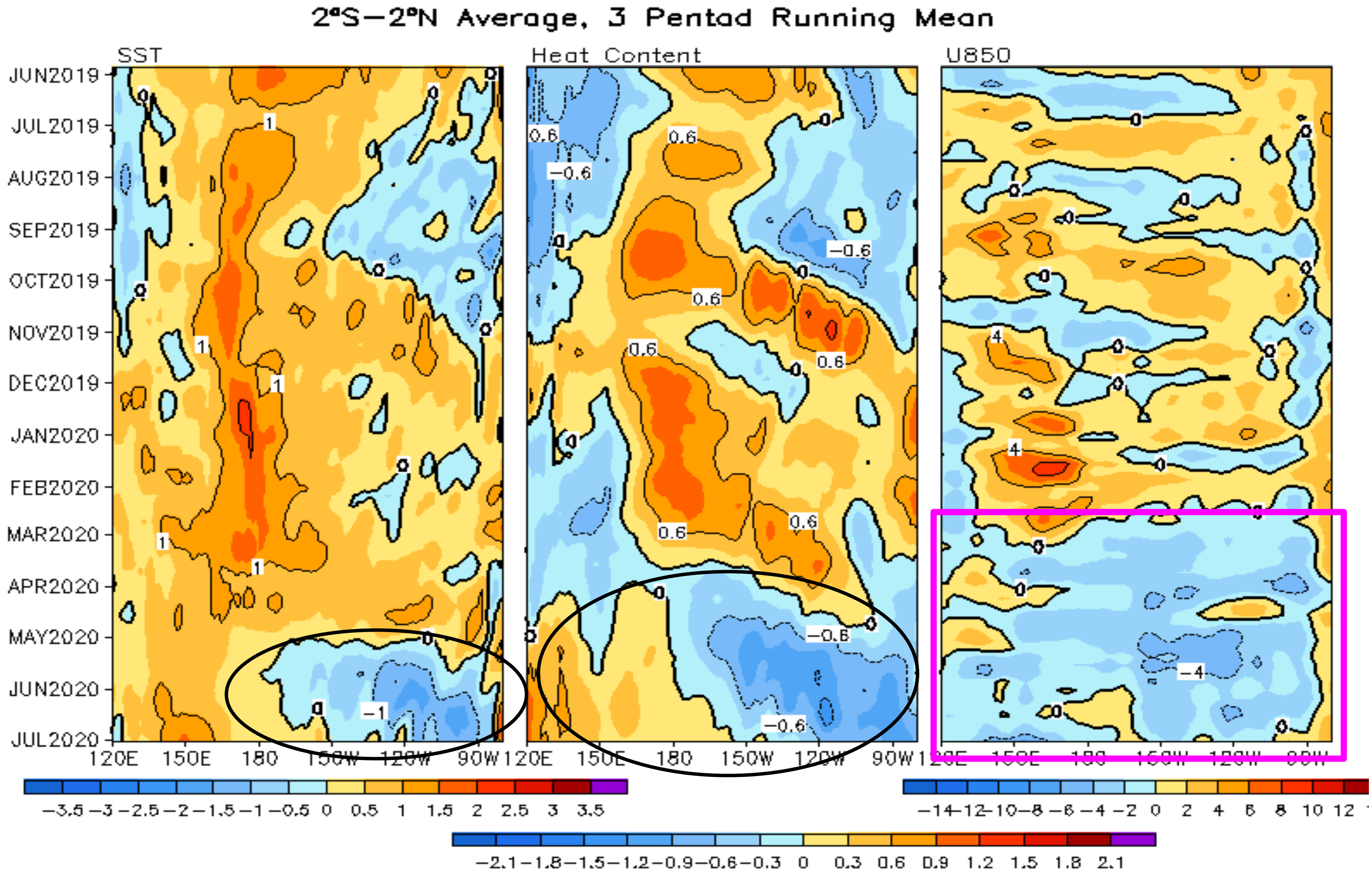



**Fig. P2. Sea surface temperature (SST) anomalies (top-left), anomaly tendency (top-right), Outgoing Long-wave Radiation (OLR) anomalies (middle-left), sum of net surface short- and long-wave radiation, latent and sensible heat flux anomalies (middle-right; positive means heat into the ocean), 925-mb 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.**

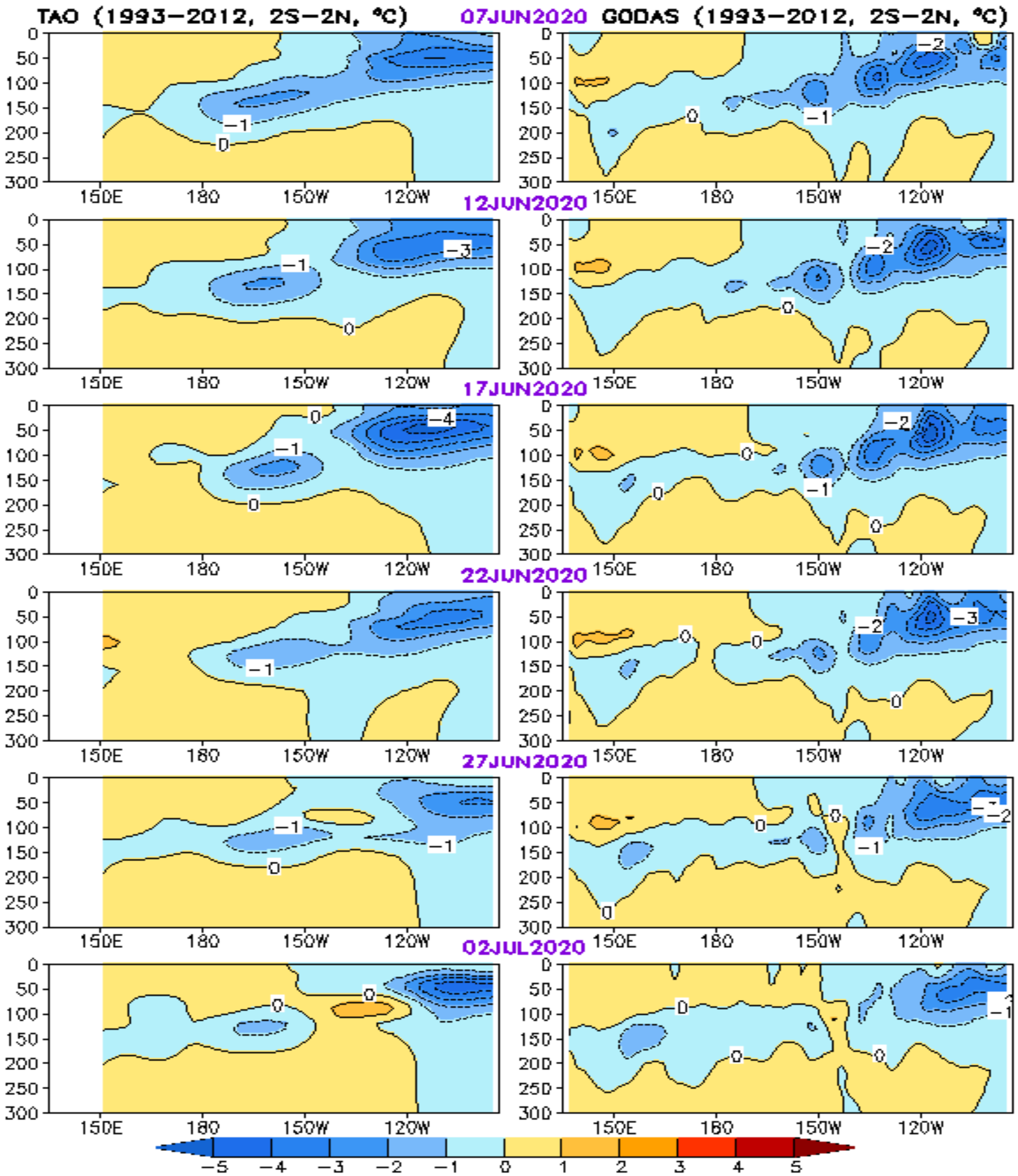
# Equatorial Pacific SST (°C), HC300 (°C), u850 (m/s) Anomalies




- Easterly wind anomaly was present across the equatorial Pacific since March 2020.
- Below- (above-) average HC300 was observed in the eastern (western) Pacific in June 2020.
- Negative SSTA appeared in the eastern equatorial Pacific.

# Equatorial Pacific Ocean Temperature Pentad Mean Anomaly

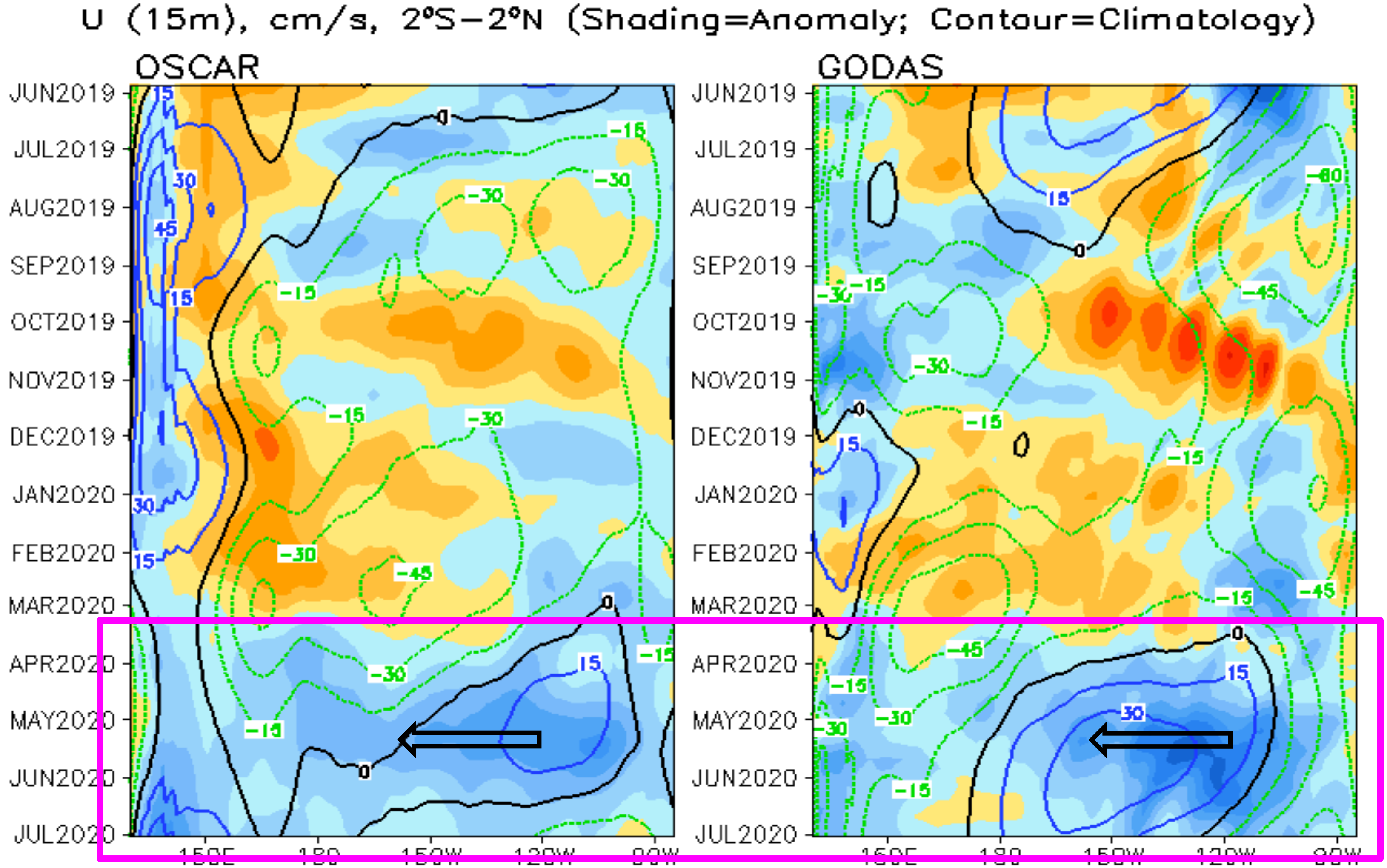
TAO GODAS




- **Ocean temperature anomalies were overall negative along the thermocline;**

- **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 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.**

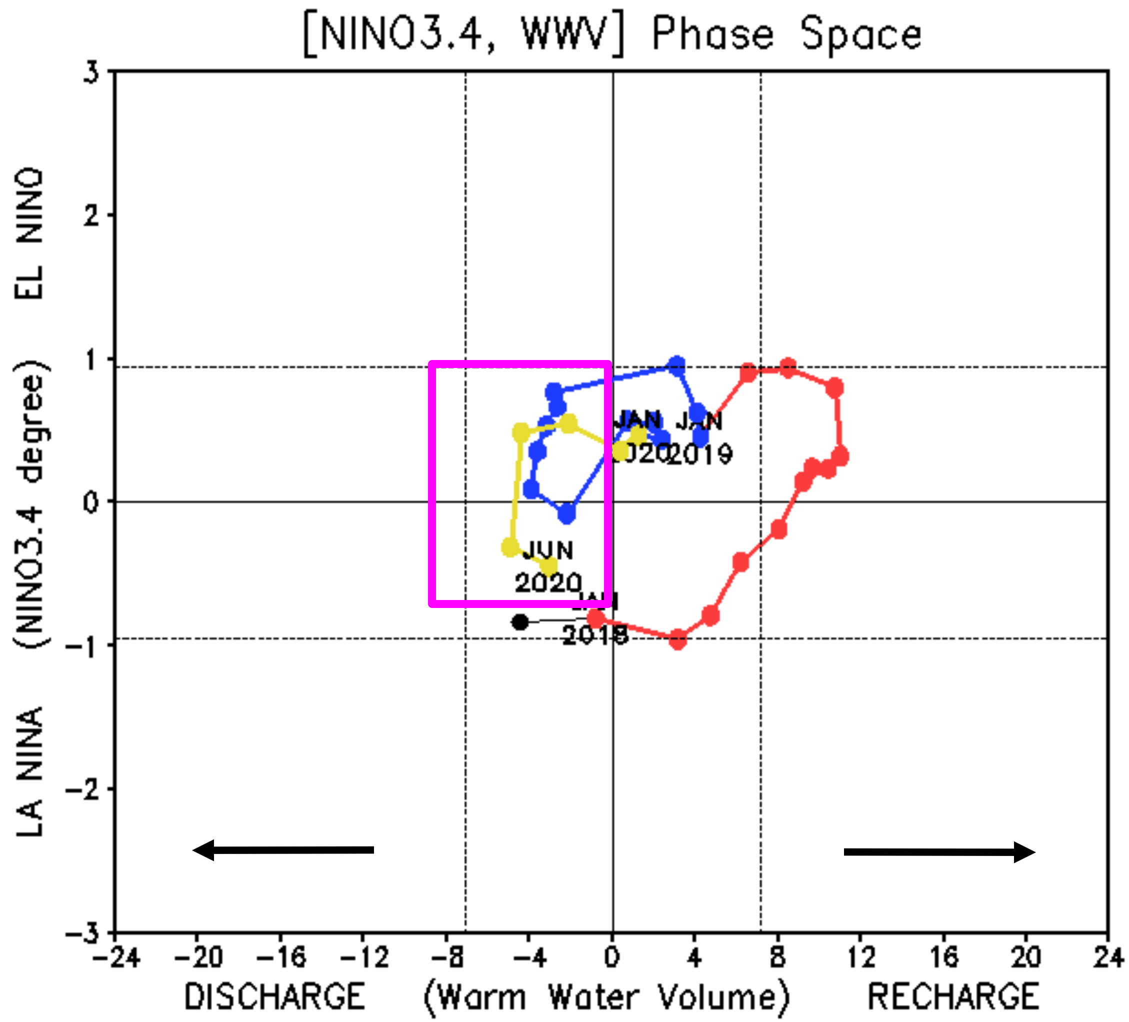
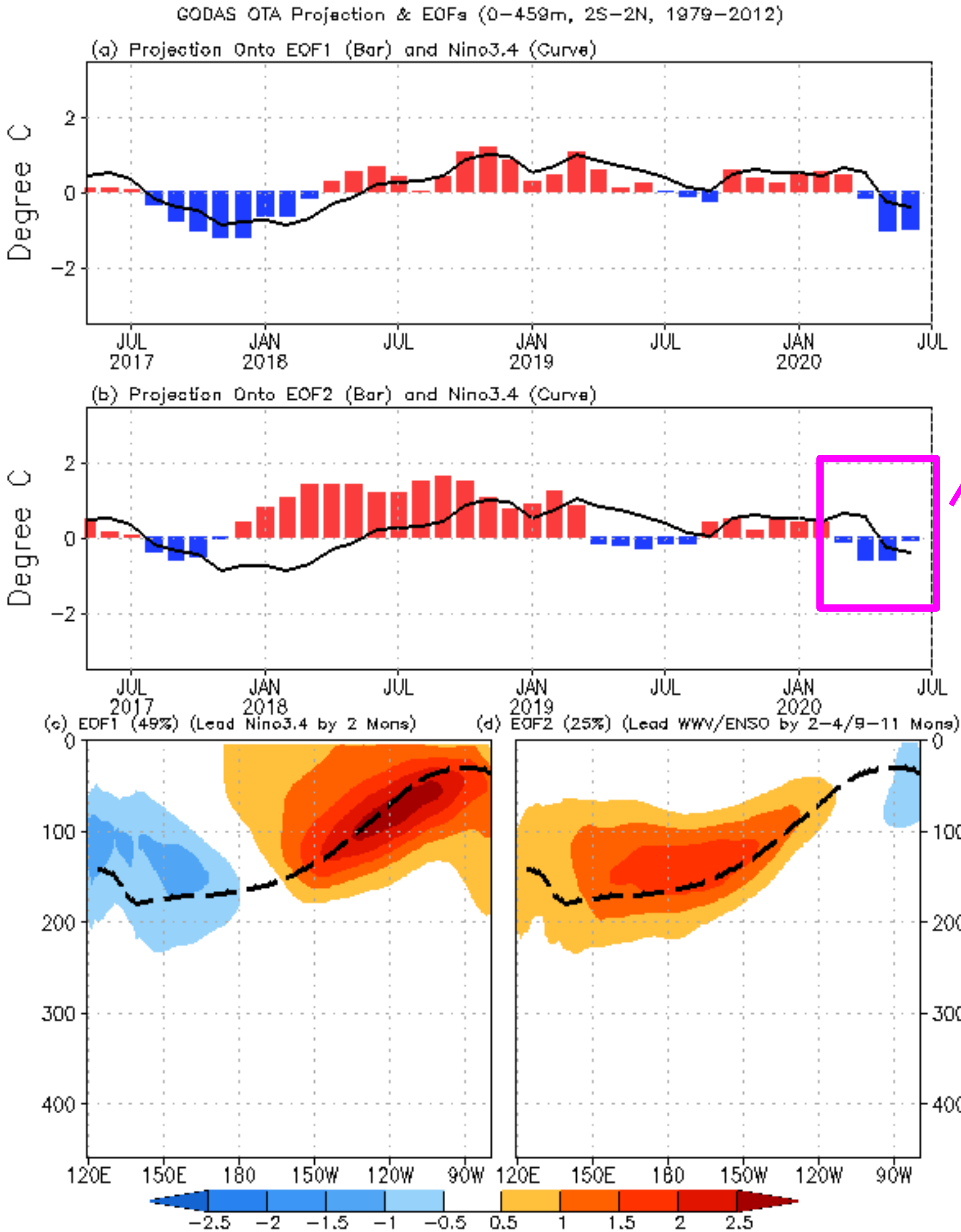



**Fig. P3. Phase diagram of Warm Water Volume (WWV) and NINO 3.4 SST anomalies. WWV is the average of depth of 20ºC in [120ºE-80ºW, 5ºS-5ºN] calculated with the NCEP's global ocean data assimilation system. Anomalies are departures from the 1981-2010 base period means.**




# 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:

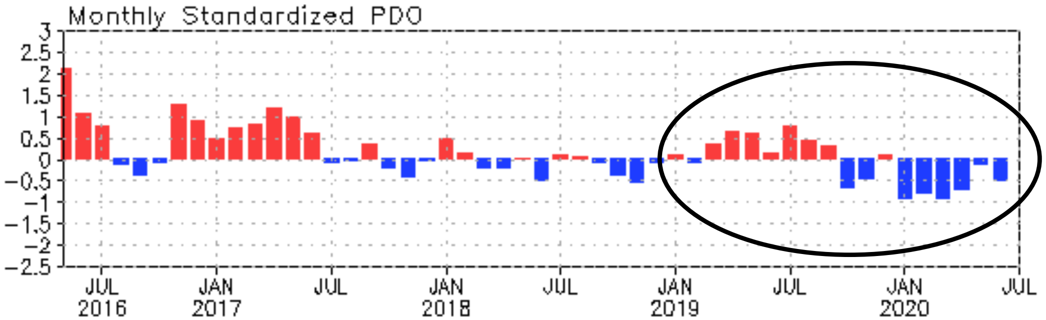
Positive -> Negative phase of ENSO

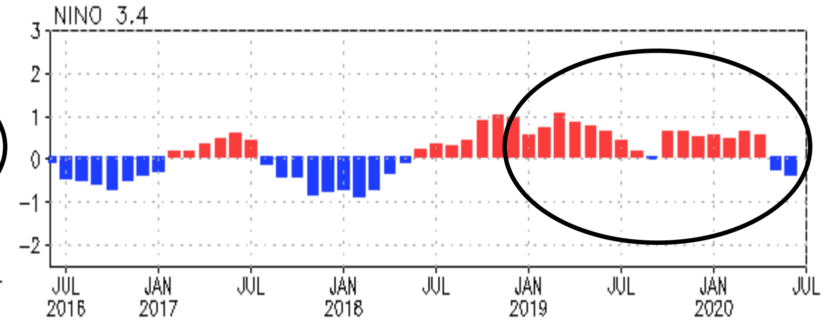
For details, see:

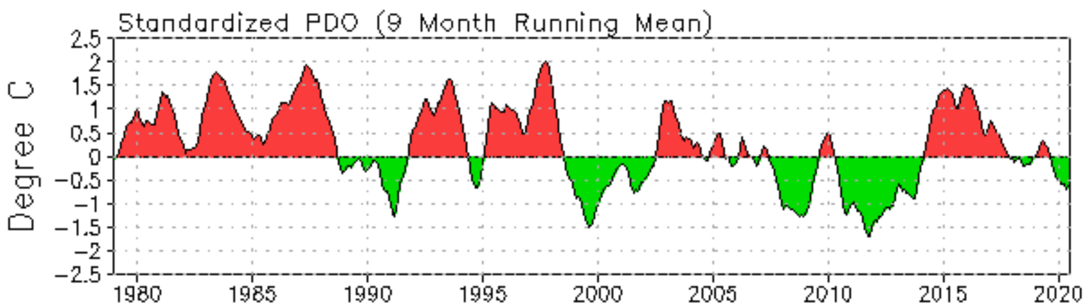
*Kumar A, Z-Z Hu (2014) Interannual and interdecadal variability of ocean temperature along the equatorial Pacific in conjunction with ENSO. Clim. Dyn.,* 42 (5-6), **1243-1258.** *DOI: 10.1007/s00382-013-1721-0.*

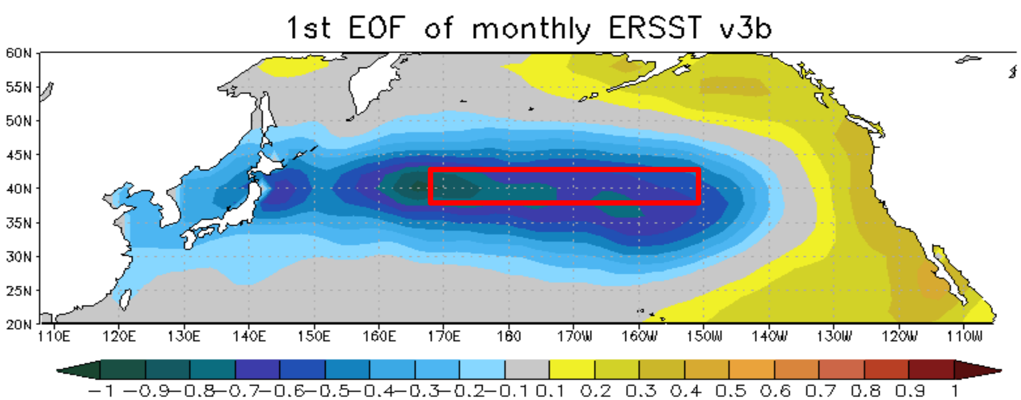
# North Pacific & Arctic Oceans

# PDO index



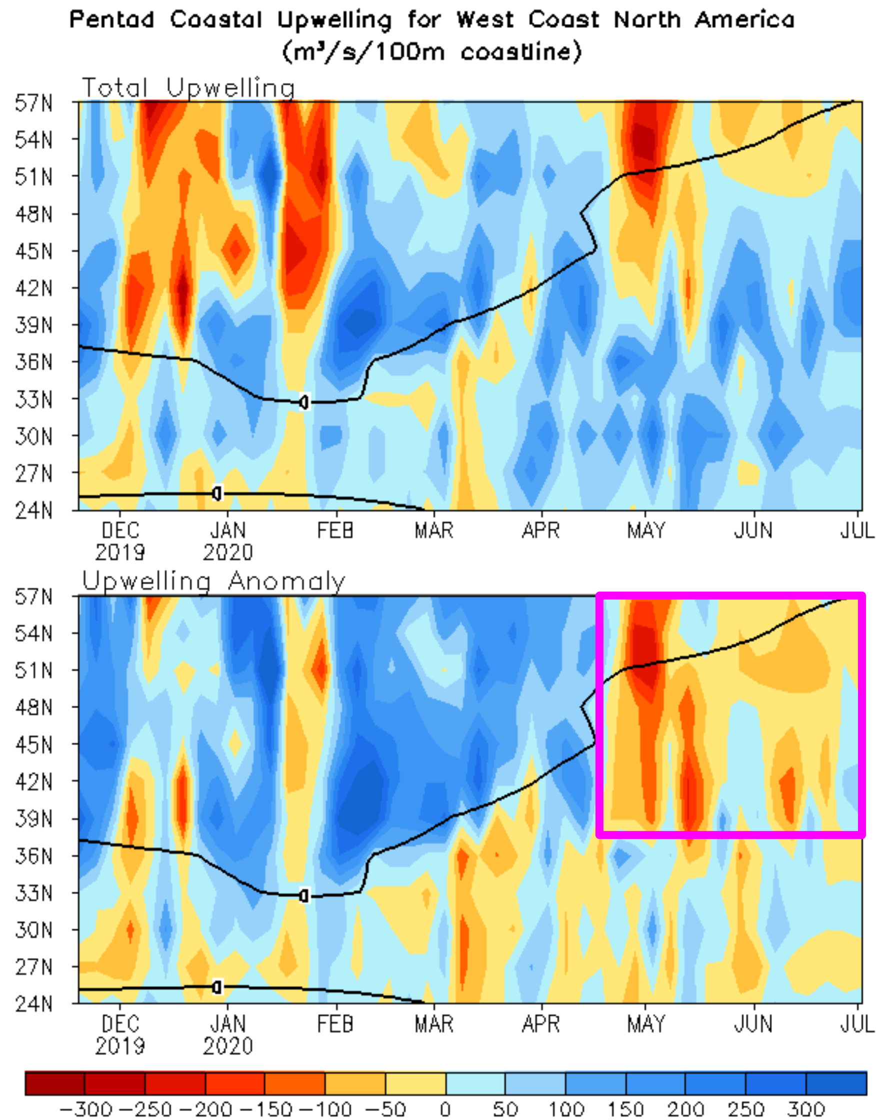

**- The PDO was in a negative phase with PDOI = -0.52 in June2020.**

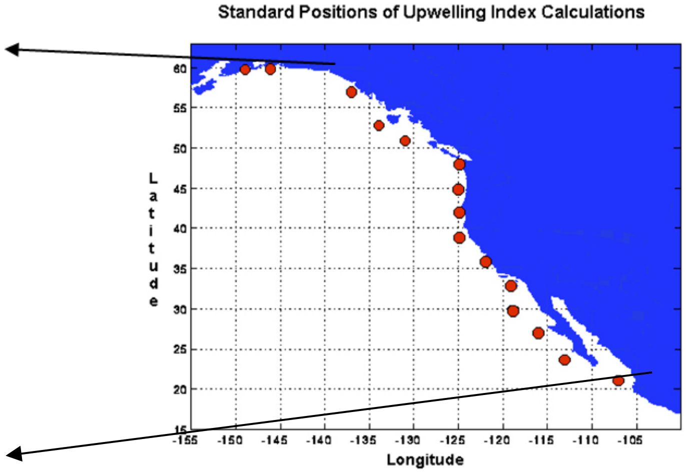
**- Statistically, ENSO leads PDO by 3-4 months, through teleconnection via atmospheric bridge, with El Nino (La Nina) associated with positive (negative) PDO Index.**

**- 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



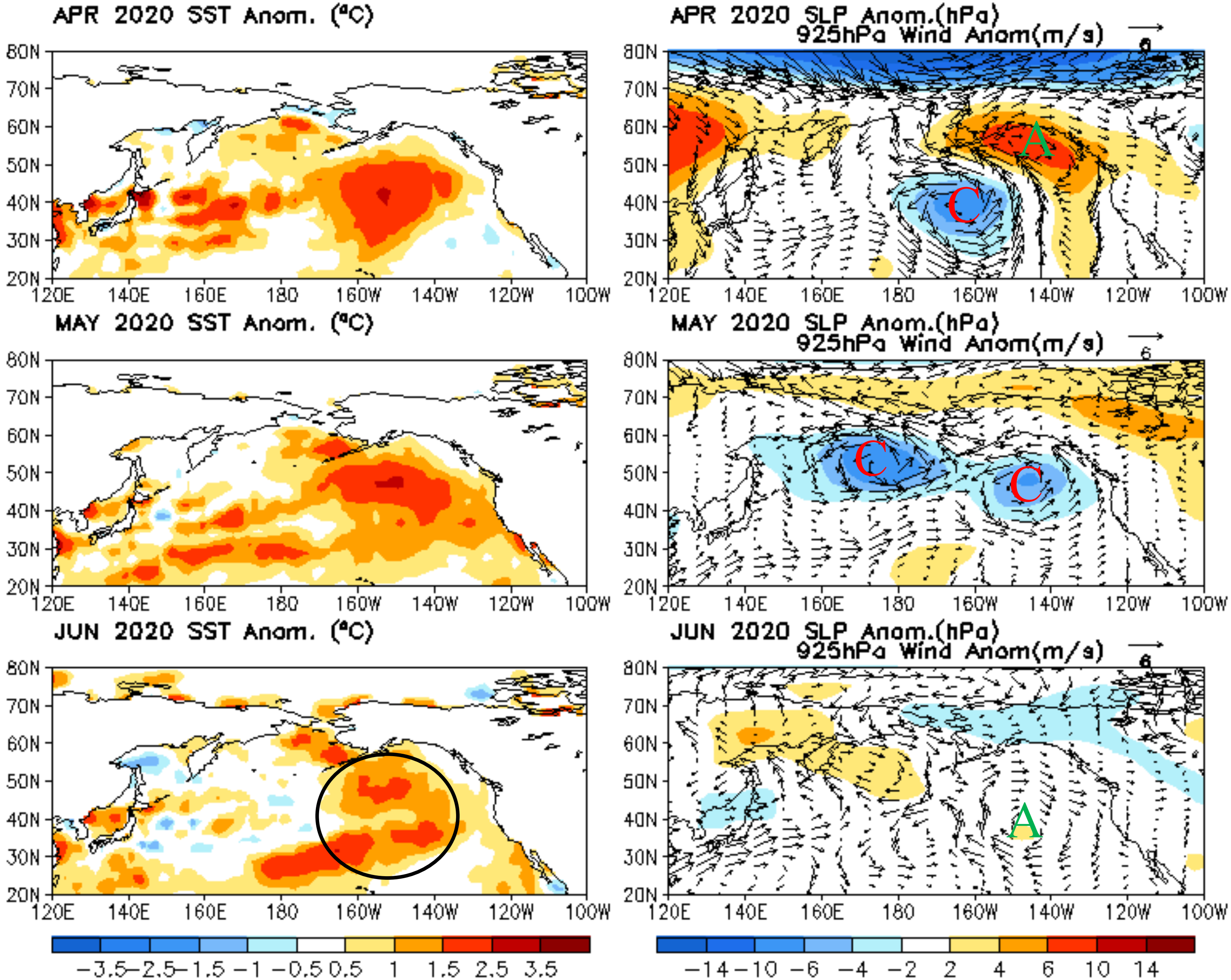




- **Upwelling was weaker than average north of 36N in June 2020, but anomalies were smaller than those in May.**

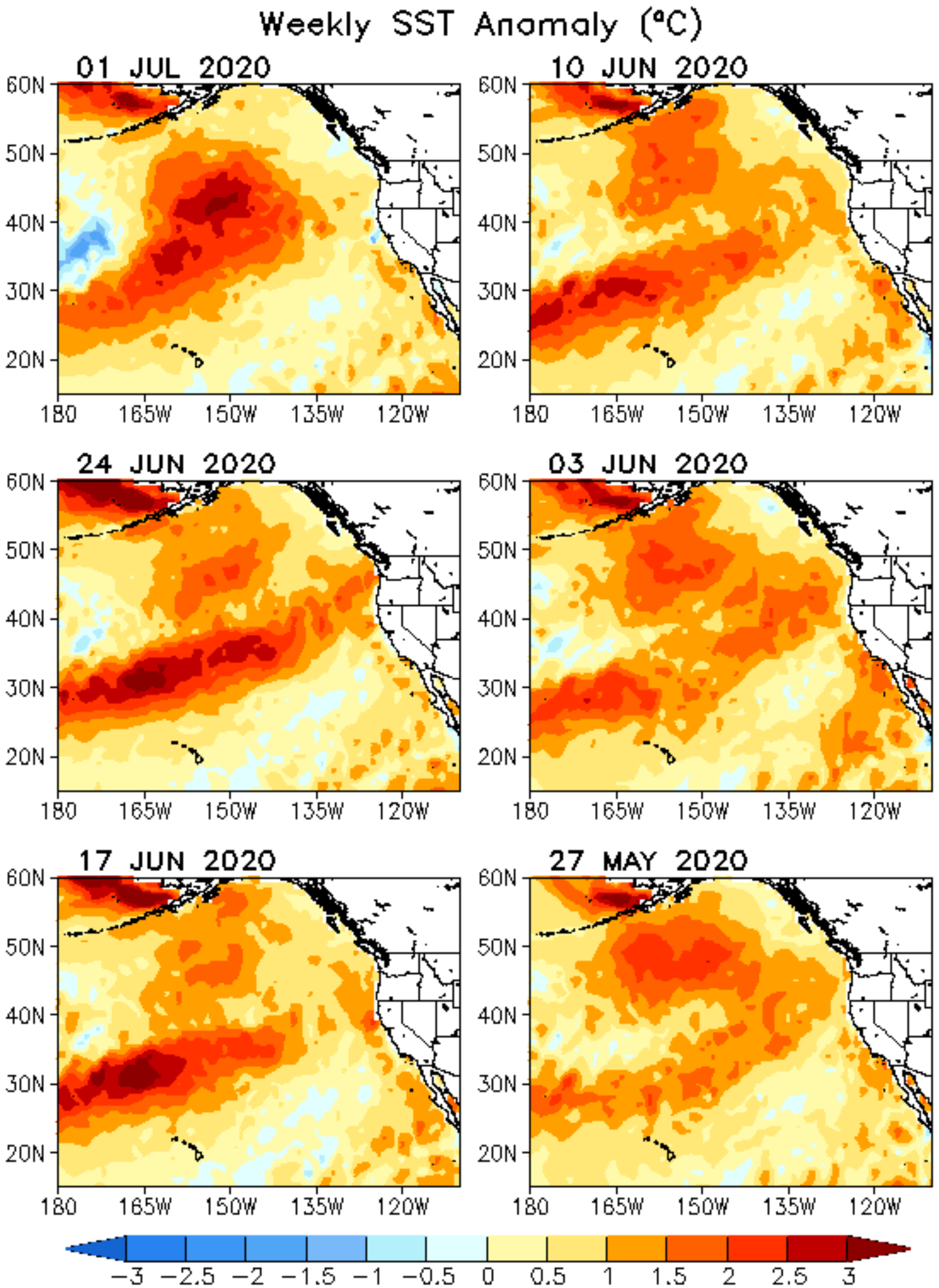
**Fig. NP2. Total (top) and anomalous (bottom) upwelling indices at the 15 standard locations for the western coast of North America. Upwelling indices are derived from the vertical velocity of the NCEP's global ocean data assimilation system, and are calculated as integrated vertical volume transport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



# Weekly SSTA evolutions in the NE Pacific




- **The northern warming core decayed;**
- **The southern warming belt strengthened.**

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

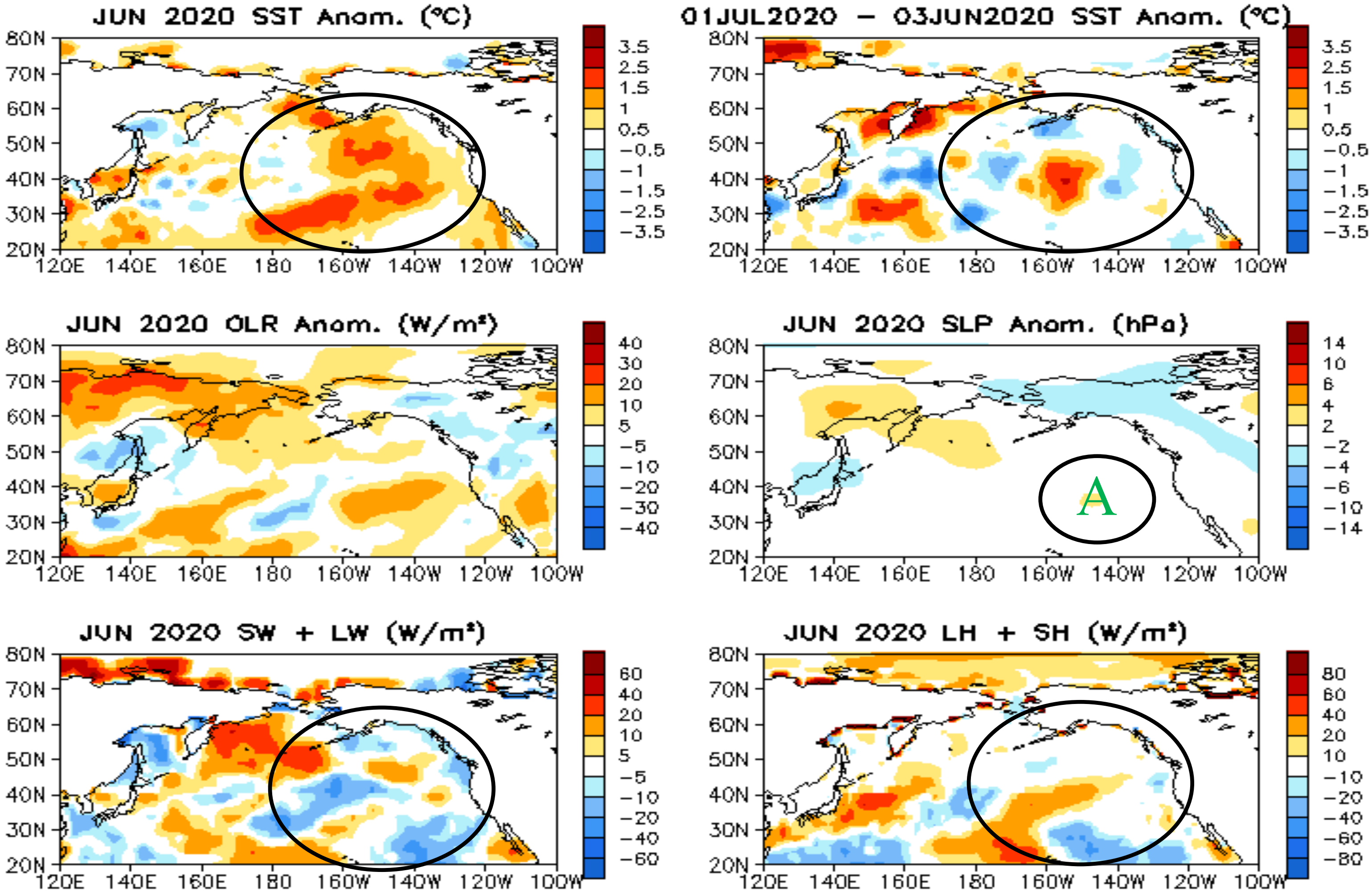
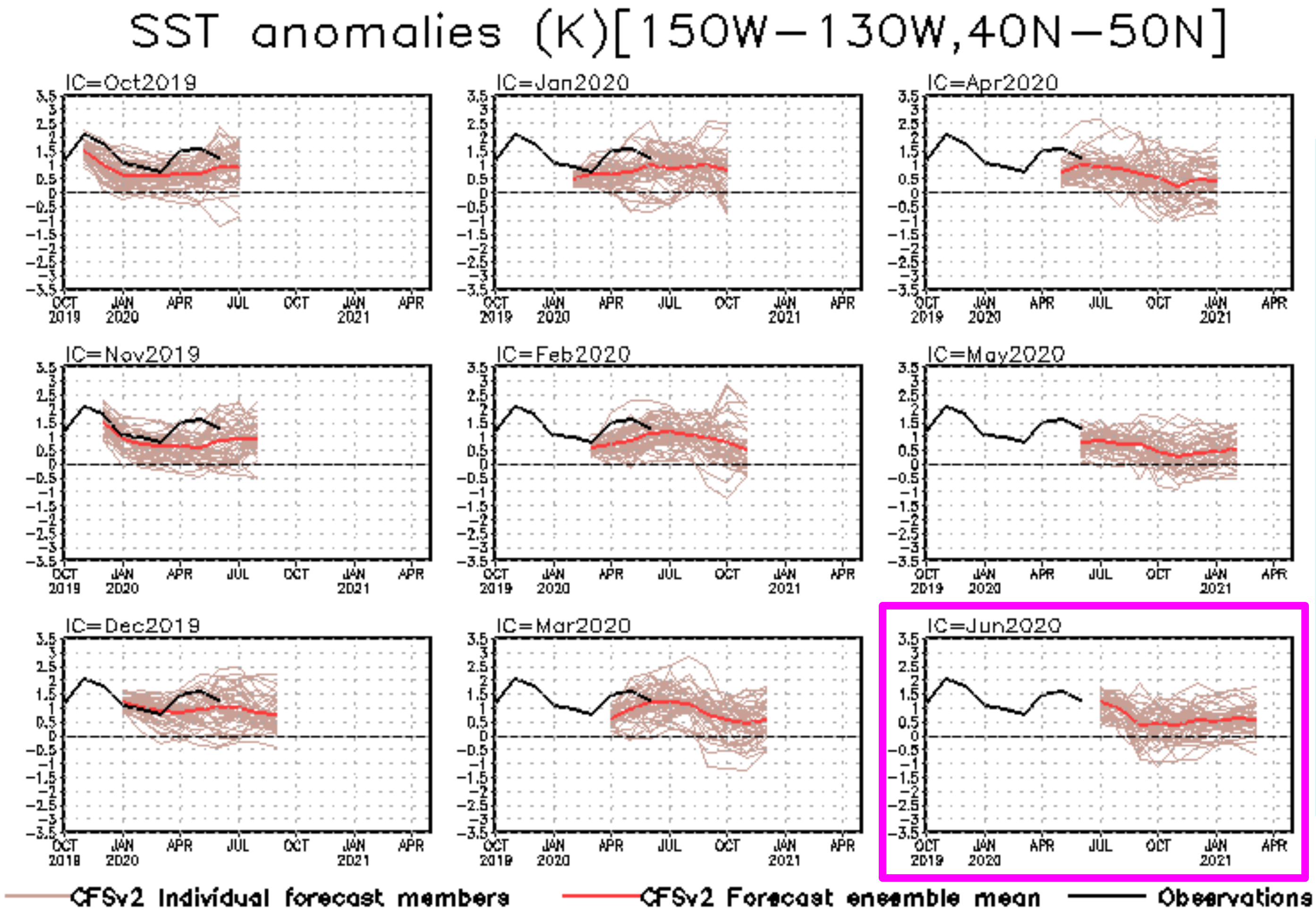



**Fig. NP1. Sea surface temperature (SST) anomalies (top-left), anomaly tendency (top-right), Outgoing Long-wave Radiation (OLR) anomalies (middle-left), sea surface pressure anomalies (middle-right), sum of net surface short- and long-wave radiation anomalies (bottom-left; positive means heat into the 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.**

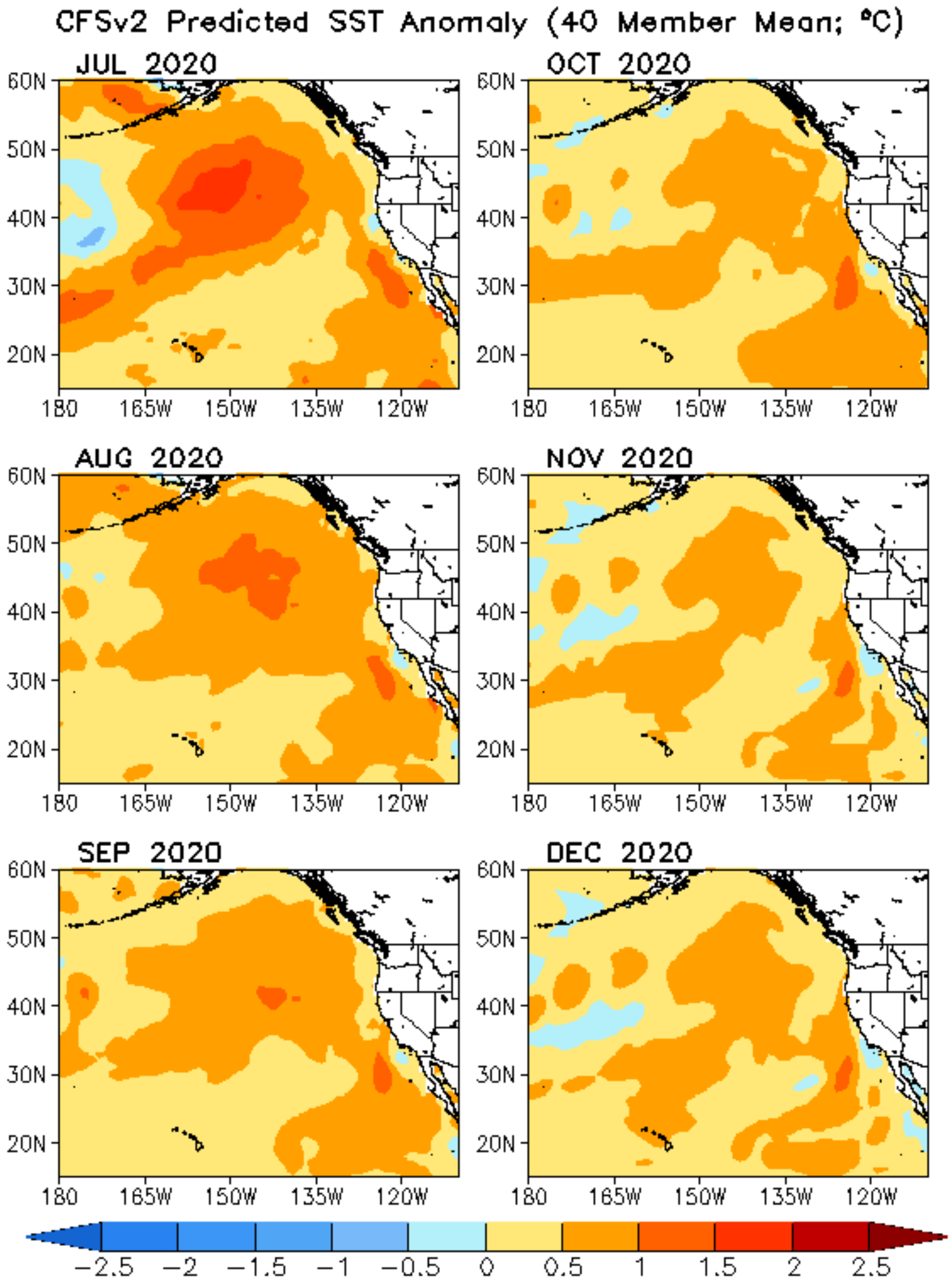
# CFS NE Pacific Marine Heatwave Index Predictions from Different Initial Months




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

**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.**

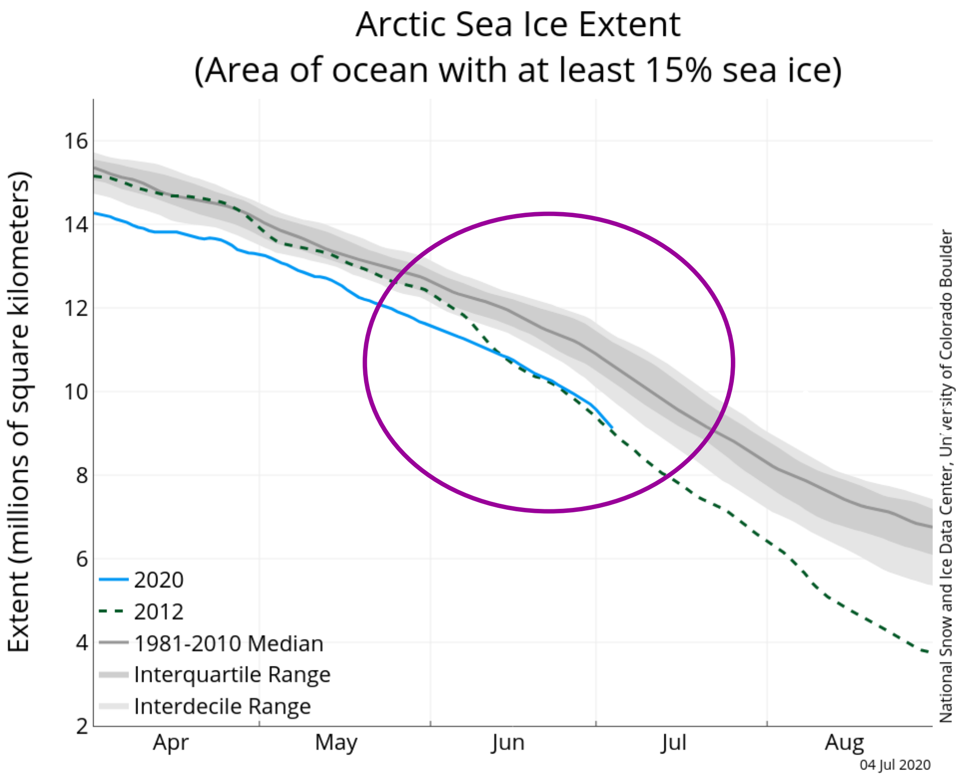
# CFSv2 NE Pacific Marine Heatwave Predictions

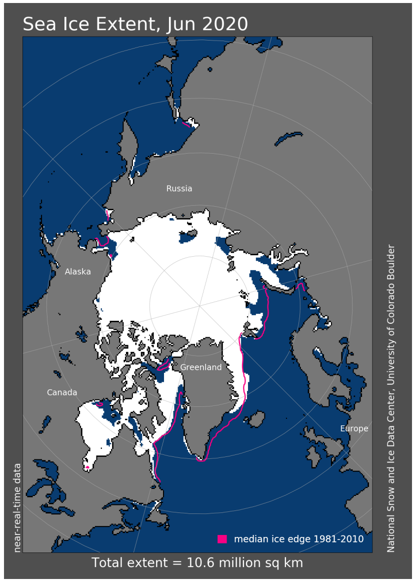


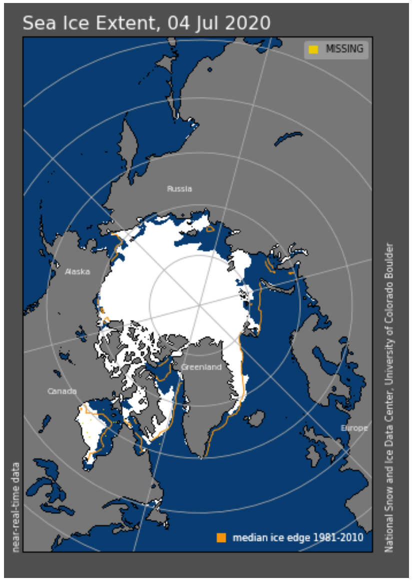

- **Latest CFSv2 predictions suggest that the current warm state will continue, but decay in 2020.**

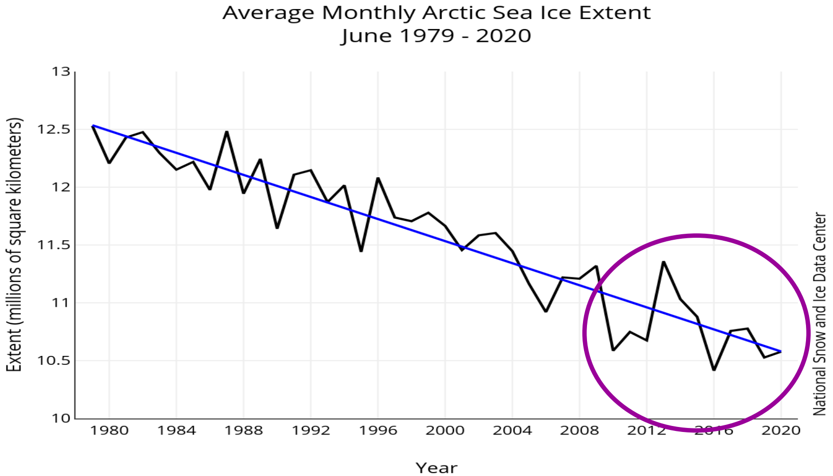
# Arctic Sea Ice

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



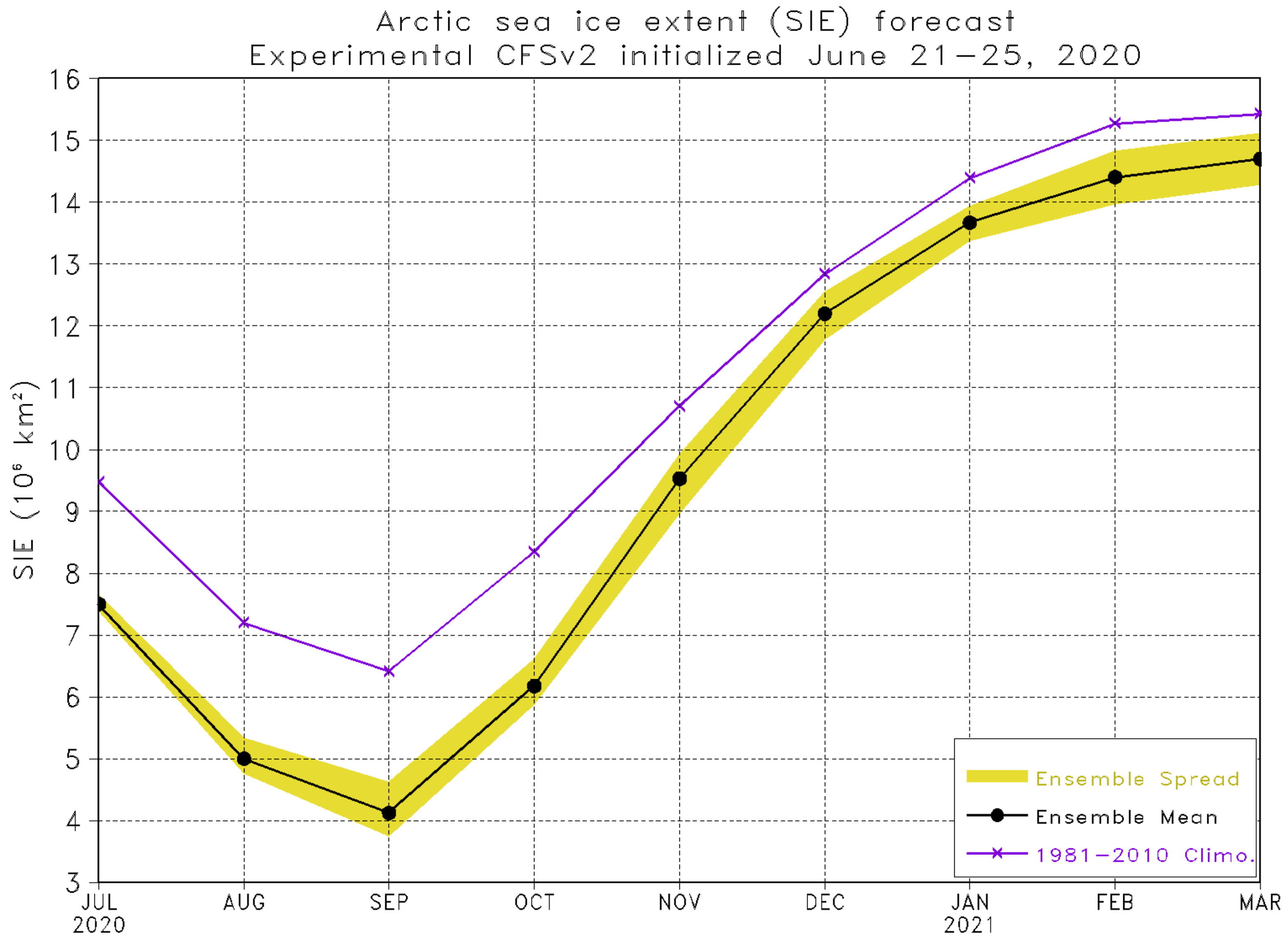



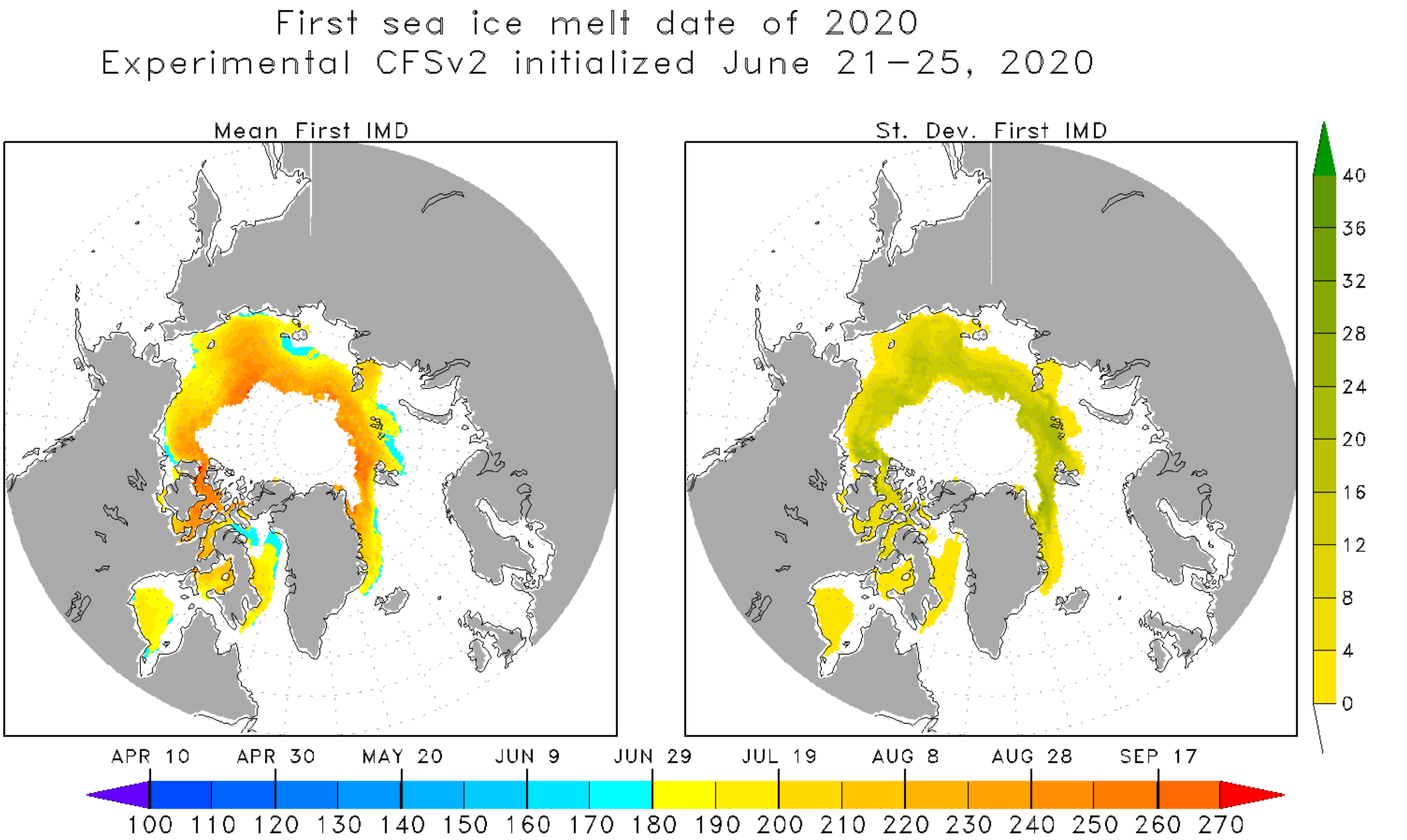

- **Arctic sea ice extent was well below normal in June 2020.**

- **The monthly average extent for June 2020 of 10.58 million square kilometers ended up as the third lowest since satellite observations in 1979.**

- **The rate of sea ice decline in June was near average.**



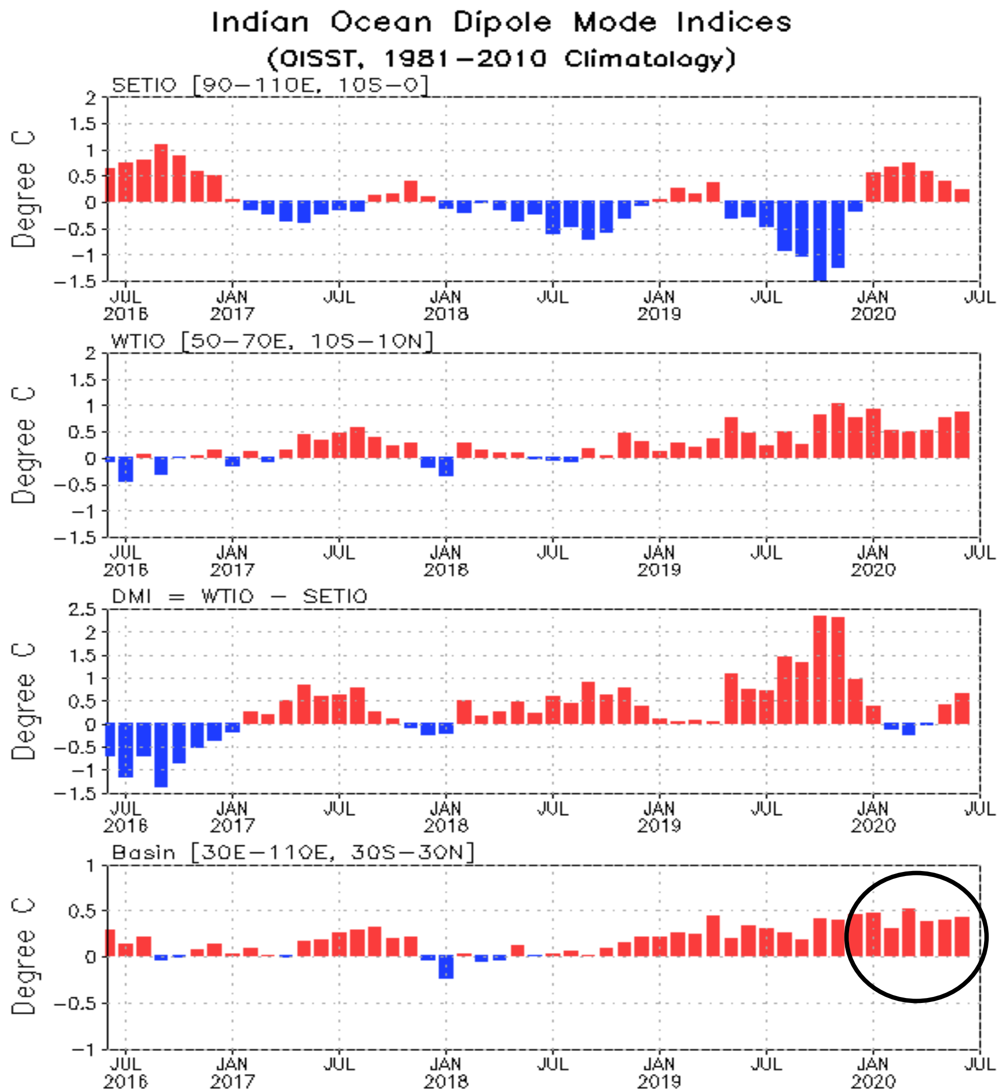

https://www.cpc.ncep.noaa.gov/products/people/wwang/seaice_seasonal/index.html

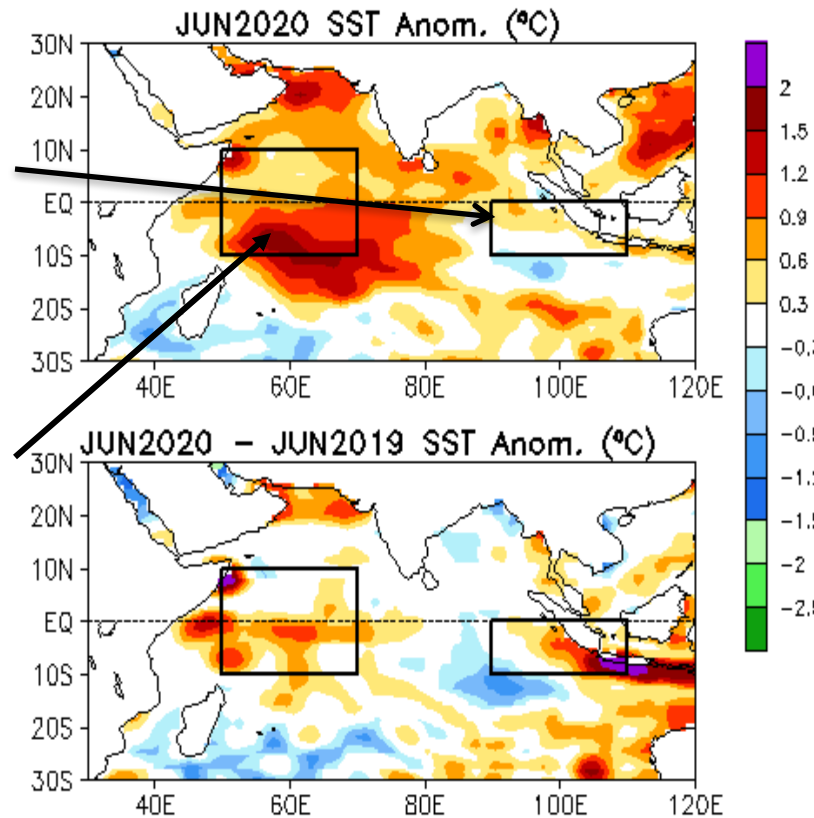



https://www.cpc.ncep.noaa.gov/products/people/wwang/seaice_seasonal/index.html

# Indian Ocean

# Evolution of Indian Ocean SST Indices




- **Positive SSTAs were present in the tropical Indian Ocean in June 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 across the tropical Indian Ocean.

- Convection was enhanced over India, southwest tropical Indian Ocean, and the Maritime Continent.

- A cyclonic system was present at low levels over the southwest tropical Indian Ocean.

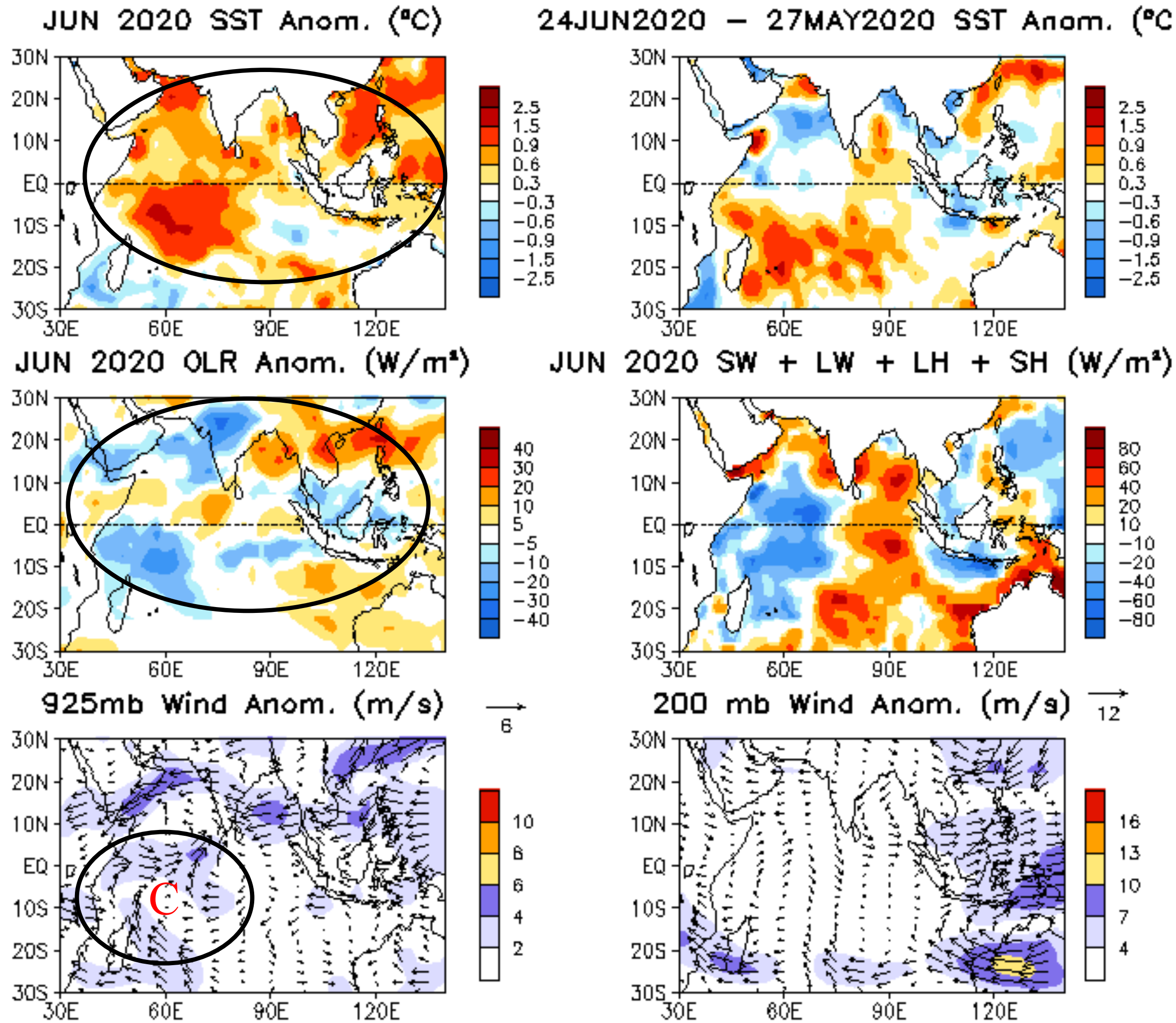
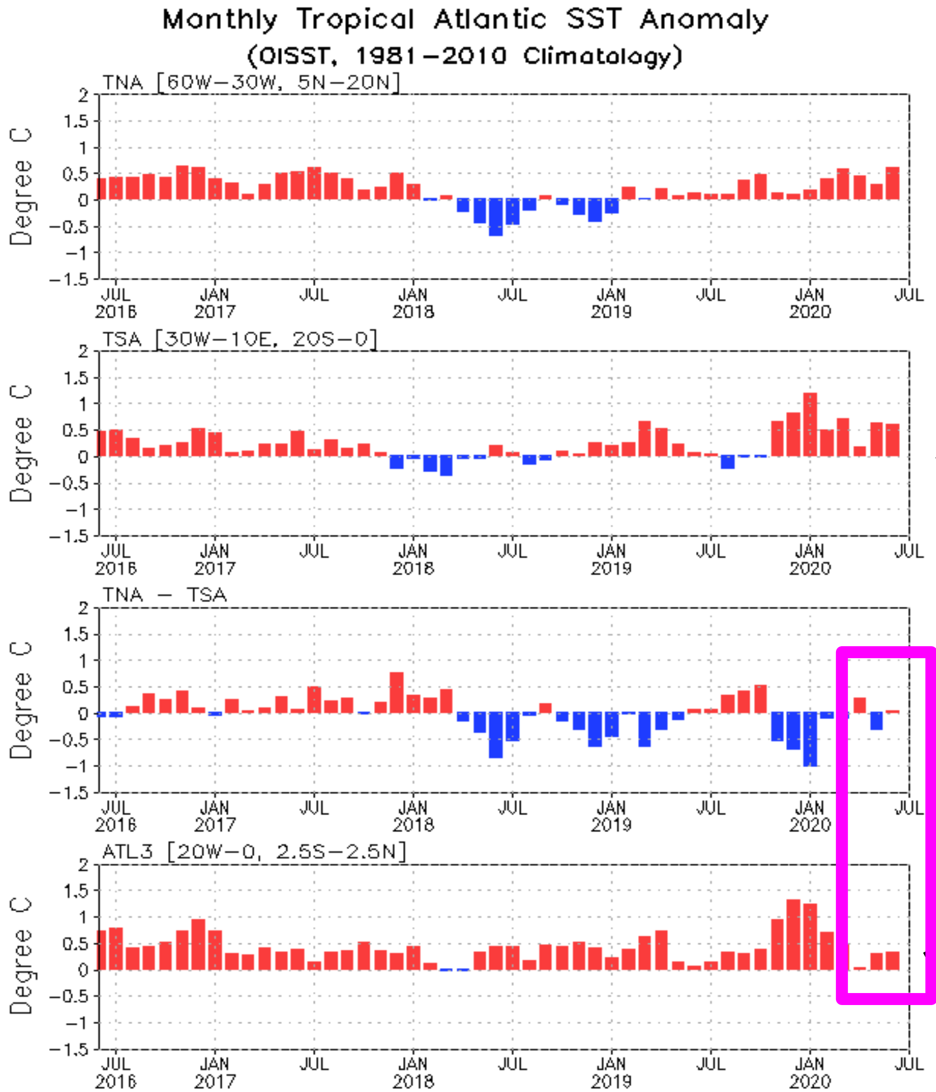
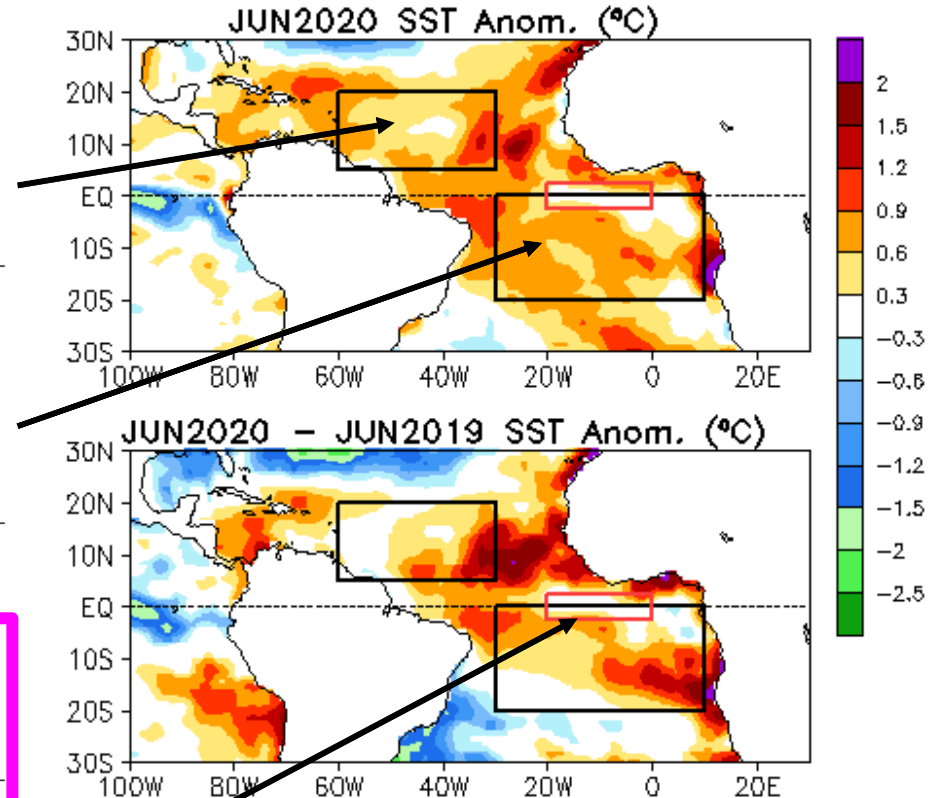



Fig. I2. Sea surface temperature (SST) anomalies (top-left), anomaly tendency (top-right), Outgoing Long-wave Radiation (OLR) anomalies (middle-left), sum of net surface short- and long-wave radiation, latent and sensible heat flux anomalies (middle-right), 925-mb wind anomaly vector and its amplitude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

# Evolution of Tropical Atlantic SST Indices

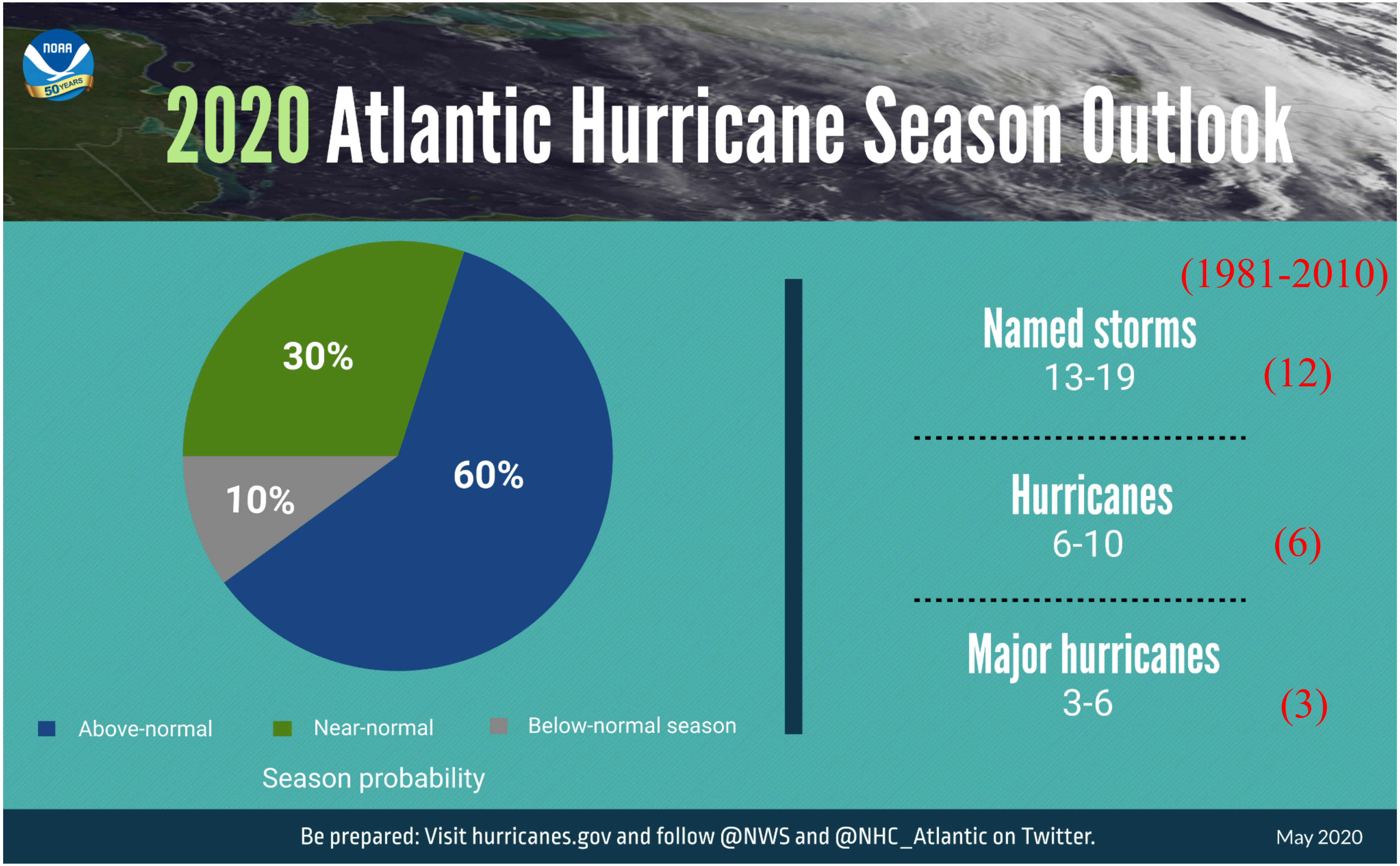



- **Positive SSTAs were present across the tropical Atlantic basin in June 2020.**

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

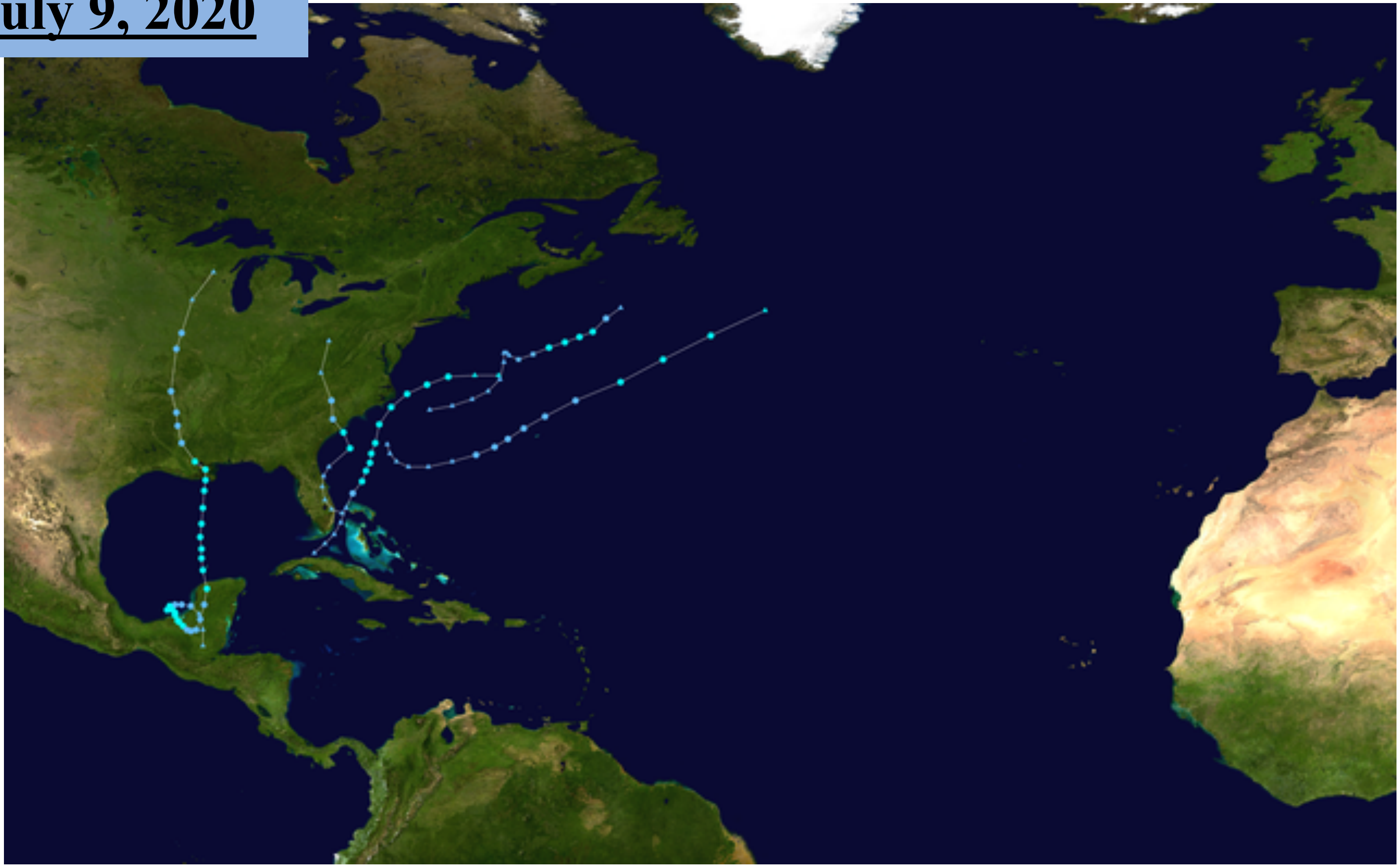
**Fig. A1a. Tropical Atlantic Variability region indices, calculated as the area-averaged monthly mean sea surface temperature anomalies (°C) for the TNA [60°W-30°W, 5°N-20°N], TSA [30°W-10°E, 20°S-0] and ATL3 [20°W-0, 2.5°S-2.5°N] regions, and Meridional Gradient Index, defined as differences between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




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.

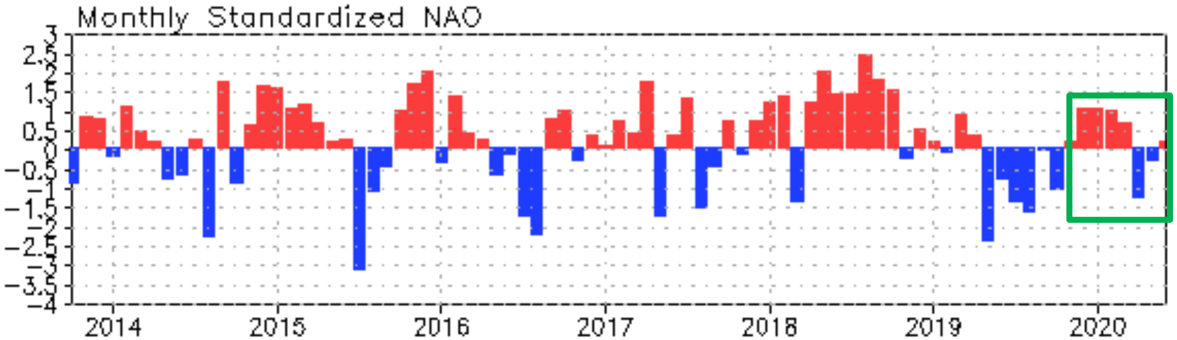
https://www.noaa.gov/media-release/busy-atlantic-hurricane-season-predicted-for-2020

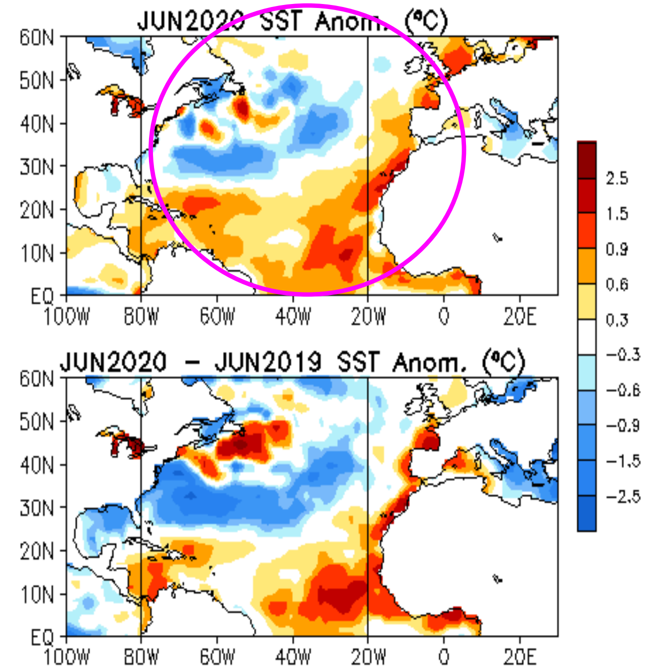
# By July 9, 2020

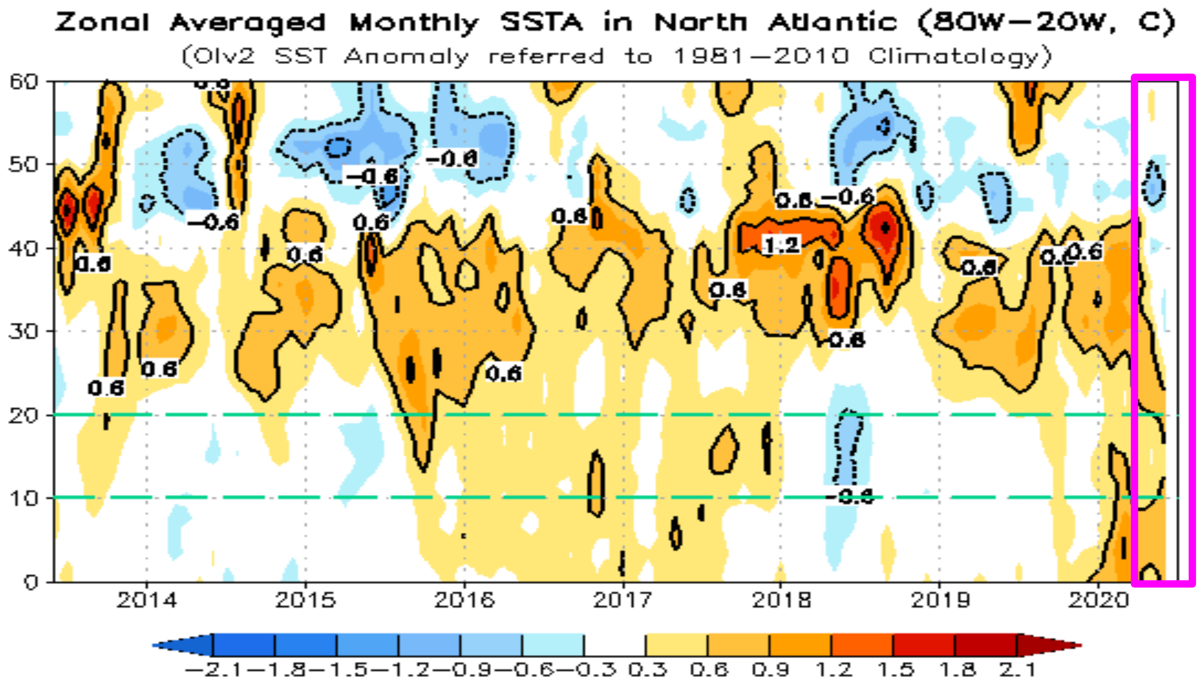


| 2020 | | Outlook (May 21) | (1981-2010) |
|---|---|---|---|
| Total storms | **5** | 13-19 | 12 |
| Hurricanes | **0** | 6-10 | 6 |
| Major hurricanes (Cat. 3+) | **0** | 3-6 | 3 |

# NAO and SST Anomaly in North Atlantic



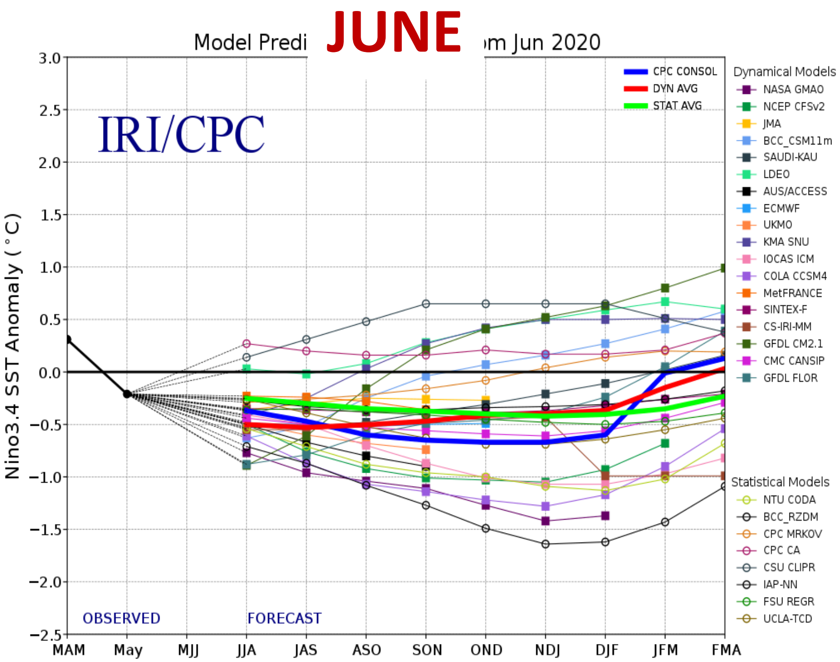



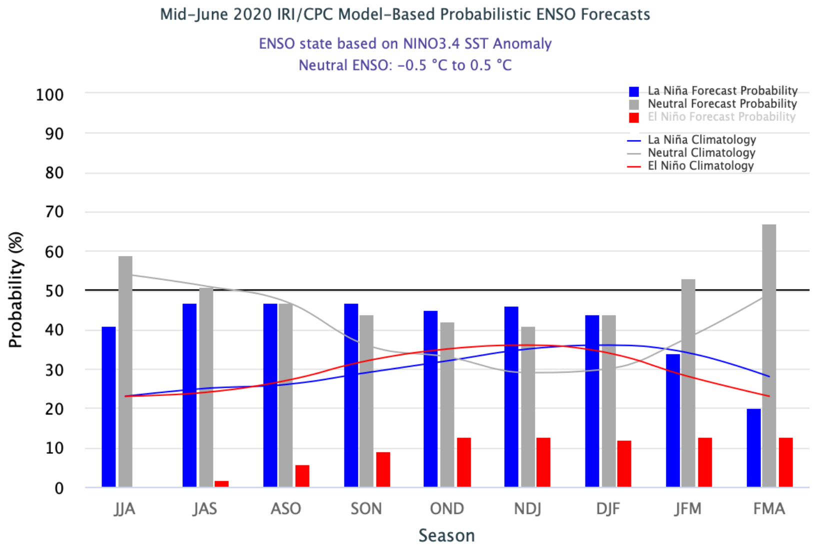

- NAO switched to a positive phase in June 2020 with NAOI= 0.16.
- The prolonged tripole SSTA pattern was absent in June 2020, probably due to negative NAO phases in Apr.-May 2020.

**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/CPC NINO3.4 Forecast Plum



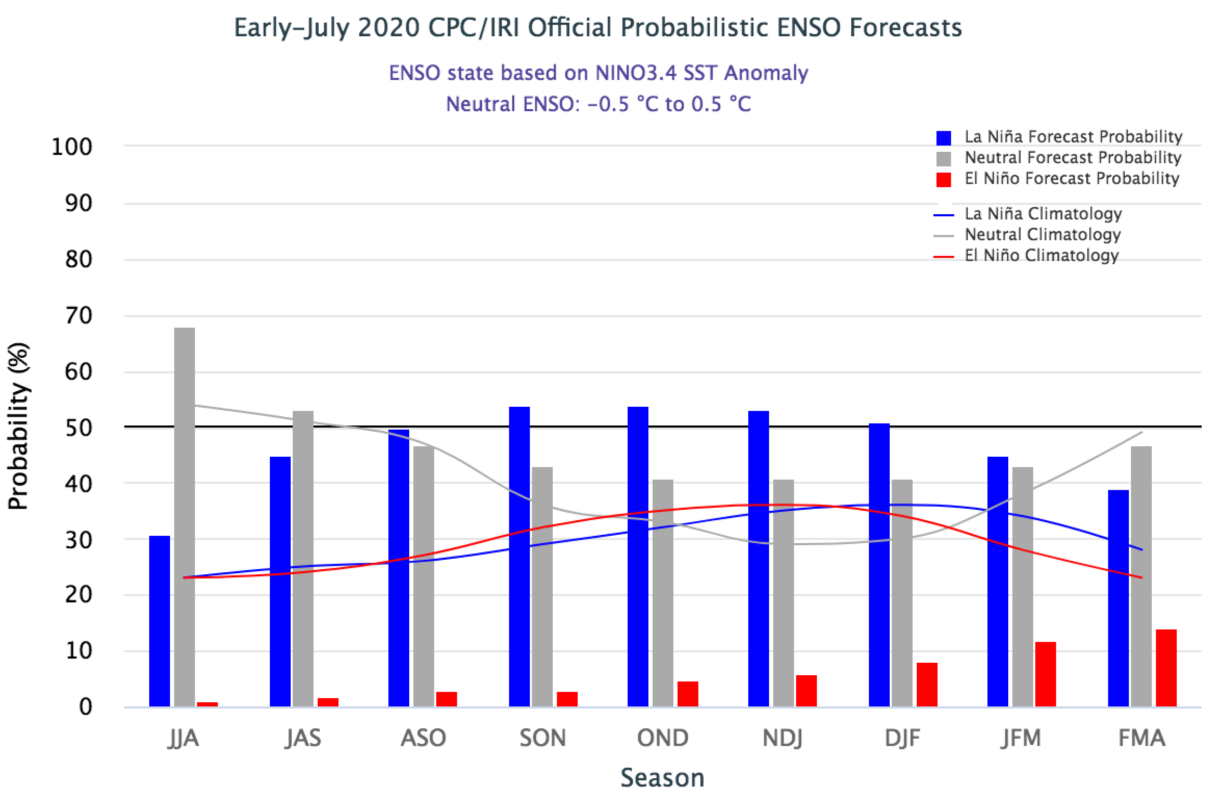



# NOAA "ENSO Diagnostic Discussion"

*(9 July 2020)*

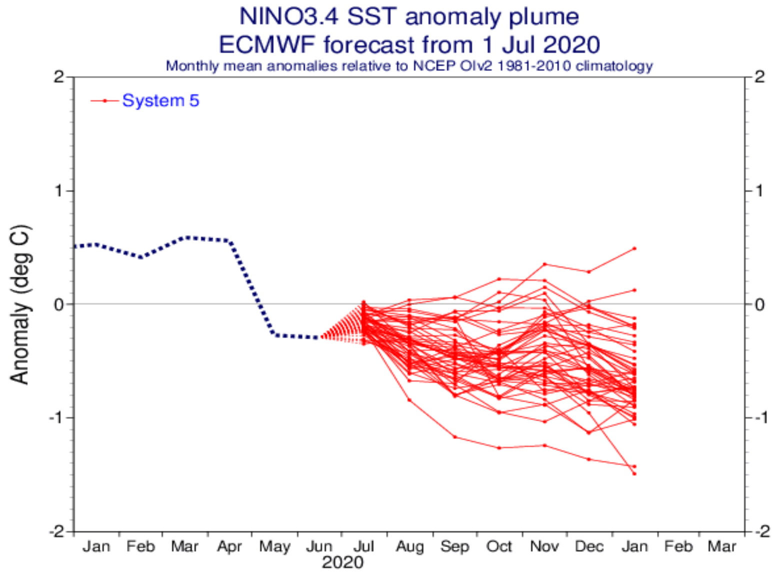
**ENSO Alert System Status: La Niña Watch**

**Synopsis: ENSO-neutral is favored to continue through the summer, with a 50-55% chance of La Niña development during Northern Hemisphere fall 2020 and continuing through winter 2020-21 (~50% chance).**

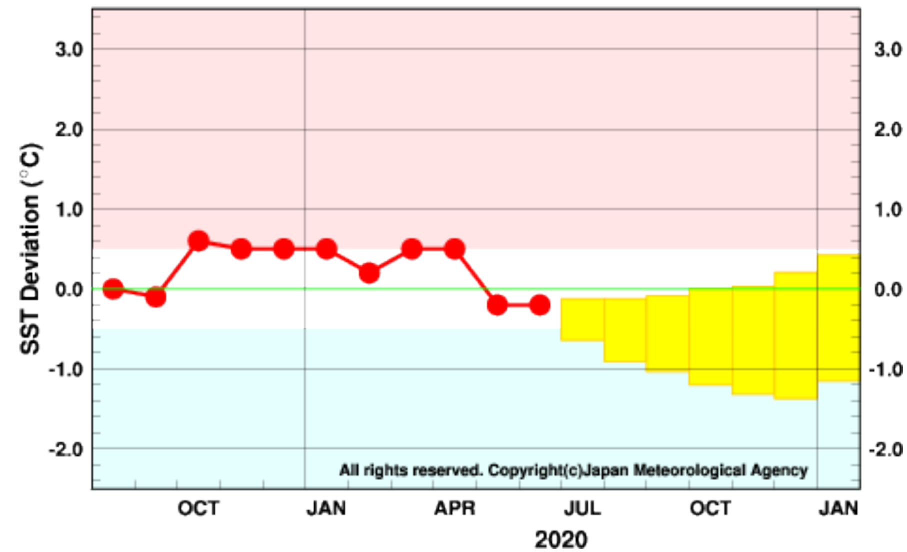


# Individual Model Forecasts: ENSO-Neutral or La Nina

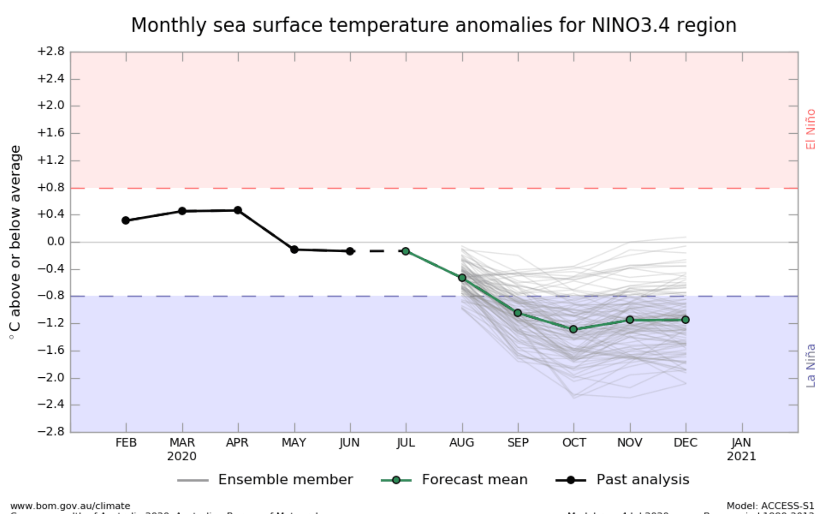
## EC: Nino3.4, IC=01July 2020



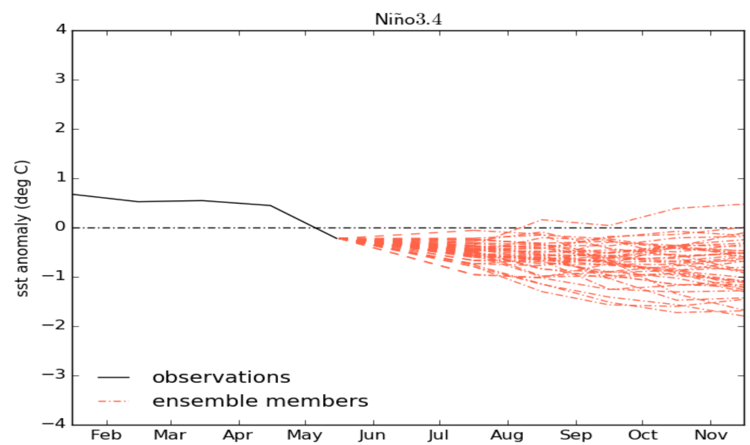

## JMA: Nino3.4, Updated 10 July 2019

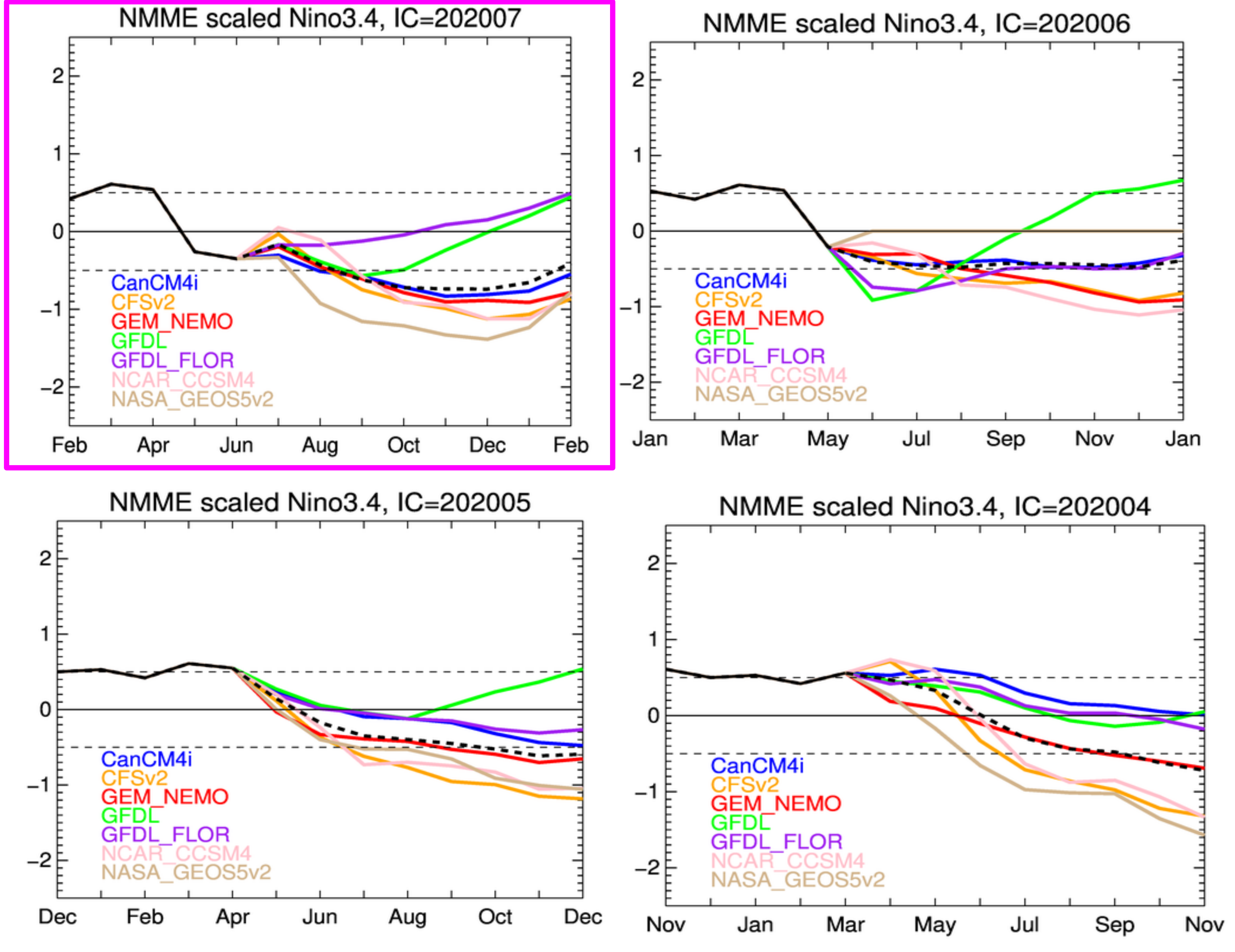



## Australian BOM: Nino3.4, Updated 4 July 2020



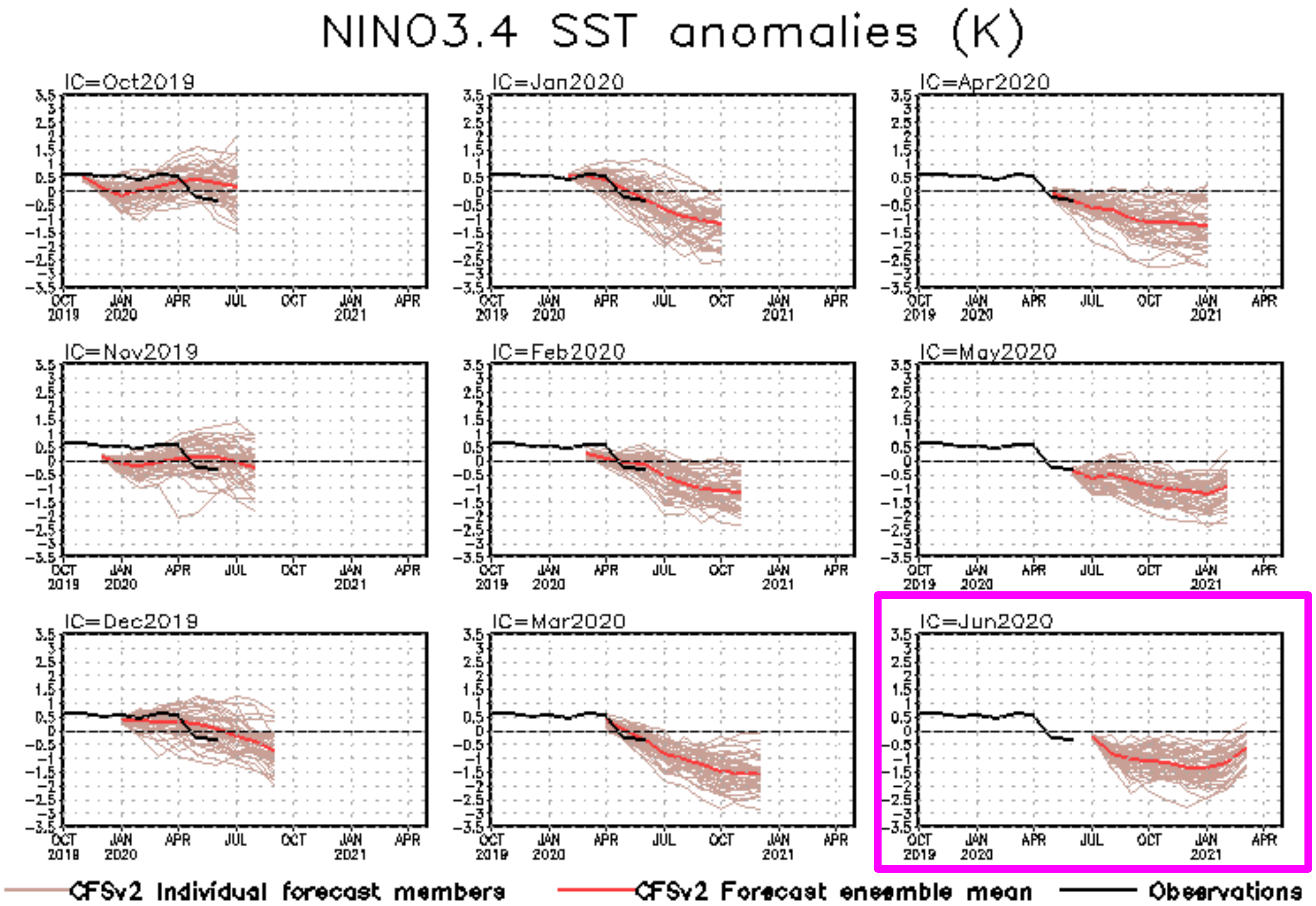

## UKMO: Nino3.4, Updated 11June 2019





NMME scaled Nino3.4, IC=202007
NMME scaled Nino3.4, IC=202006
NMME scaled Nino3.4, IC=202005
NMME scaled Nino3.4, IC=202004
CanCM4i
CFSv2
GEM_NEMO
GFDL
GFDL_FLOR
NCAR_CCSM4
NASA_GEOS5v2
2
1
0
−1
−2
Feb
Apr
Jun
Aug
Oct
Dec
Jan
Mar
May
Jul
Sep
Nov

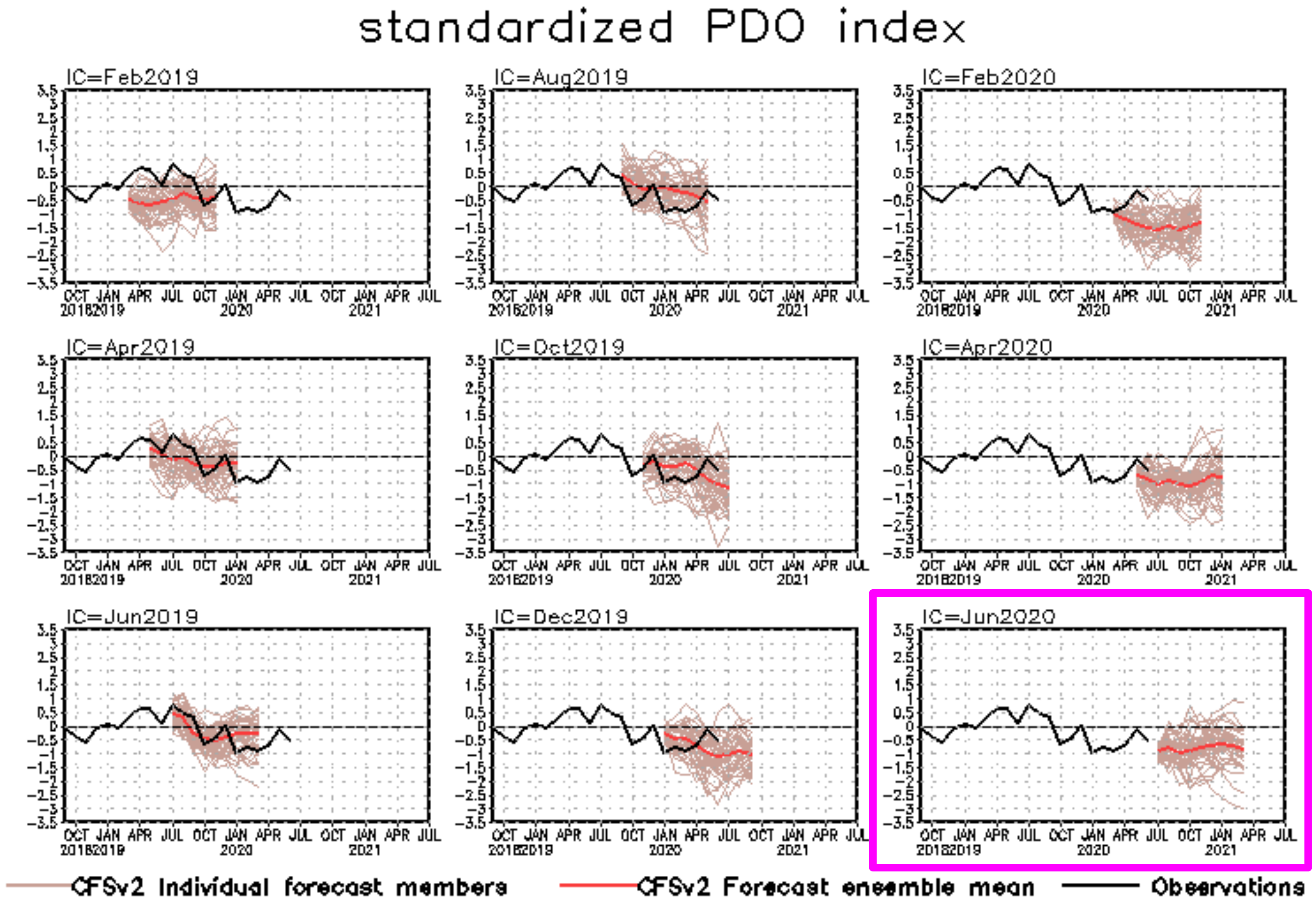
# CFS Niño3.4 SST Predictions from Different Initial Months




**- 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



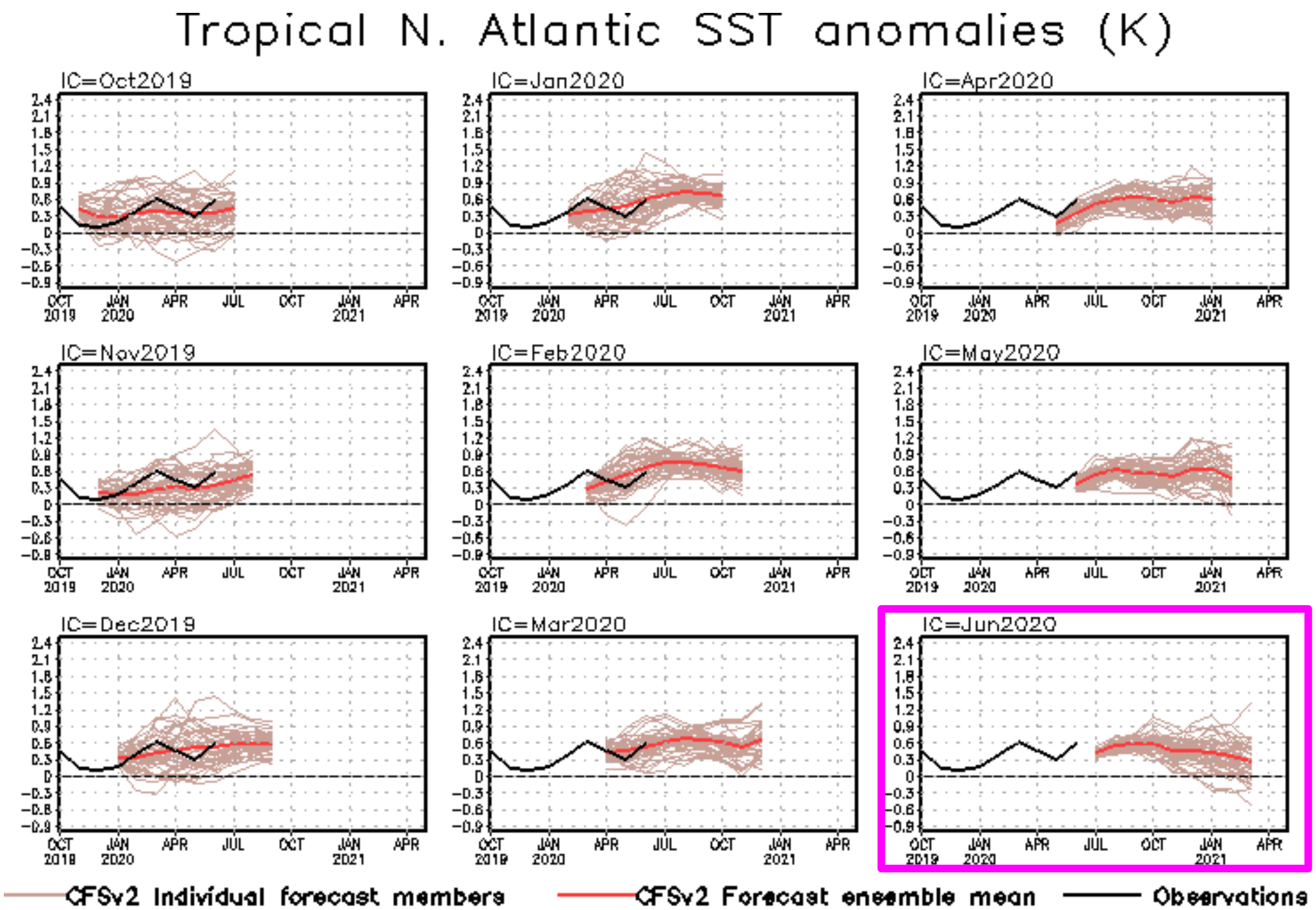

PDO is the first EOF of monthly ERSSTv3b anomaly in the region of [110°E-100°W, 20°N-60°N].

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.

# Sea Level Predictions

UNIVERSITY OF HAWAII
SEA LEVEL CENTER

*https://uhslc.soest.hawaii.edu/sea-level-forecasts/*

**Multimodel Ensemble Sea Level Forecasts for Tropical Pacific Islands** (*JAMC*, 2017)

Matthew J. Widlansky[a,b], John J. Marra[c], Md. Rashed Chowdhury[d], Scott A. Stephens[e], Elaine R. Miles[f], Nicolas Fauchereau[e], Claire M. Spillman[f], Grant Smith[f], Grant Beard[f], and Judith Wells[a]

[a] *Joint Institute for Marine and Atmospheric Research, School of Ocean and Earth Science and Technology, University of Hawai'i at Mānoa, Honolulu, Hawaii*

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[d] *Pacific ENSO Applications Climate Center, Joint Institute for Marine and Atmospheric Research, University of Hawai'i at Mānoa, Honolulu, Hawaii*

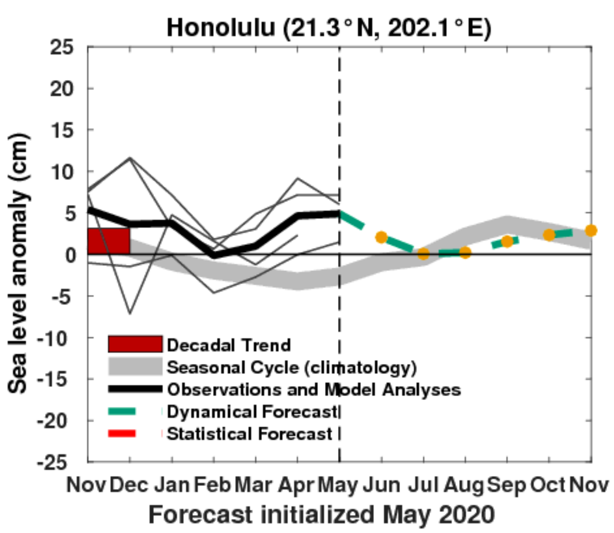
[e] *National Institute of Water and Atmospheric Research, Hamilton, New Zealand*

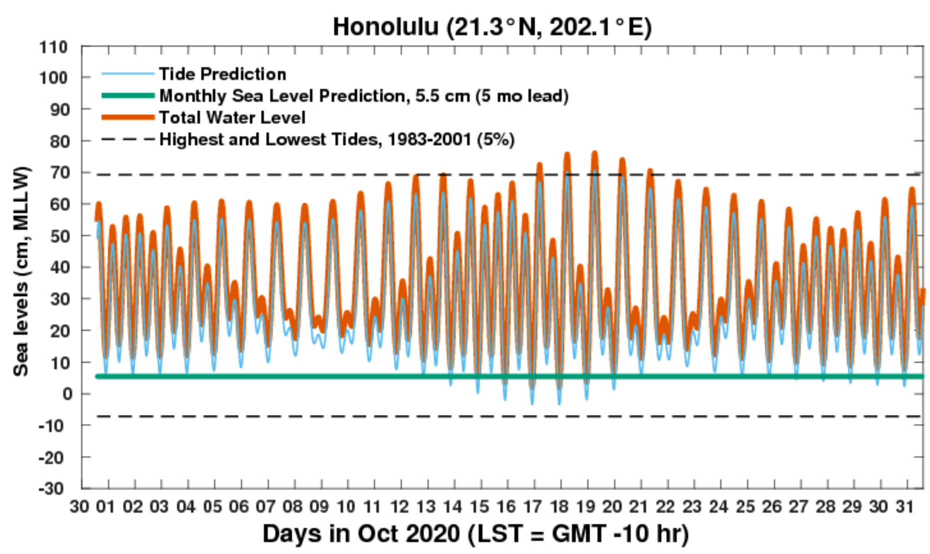
[f] *Bureau of Meteorology, Melbourne, Victoria, Australia*

# Observing and forecasting seasonal sea level anomalies in the tropical Pacific

**Multi-model sea level forecasts are combined with astronomical tide predictions to provide better predictions of coastal water levels in an *experimental* monthly forecast product.**

**Sample forecast for the Honolulu:**
Above-normal sea levels are expected to **elevate high tides** during mid-October.

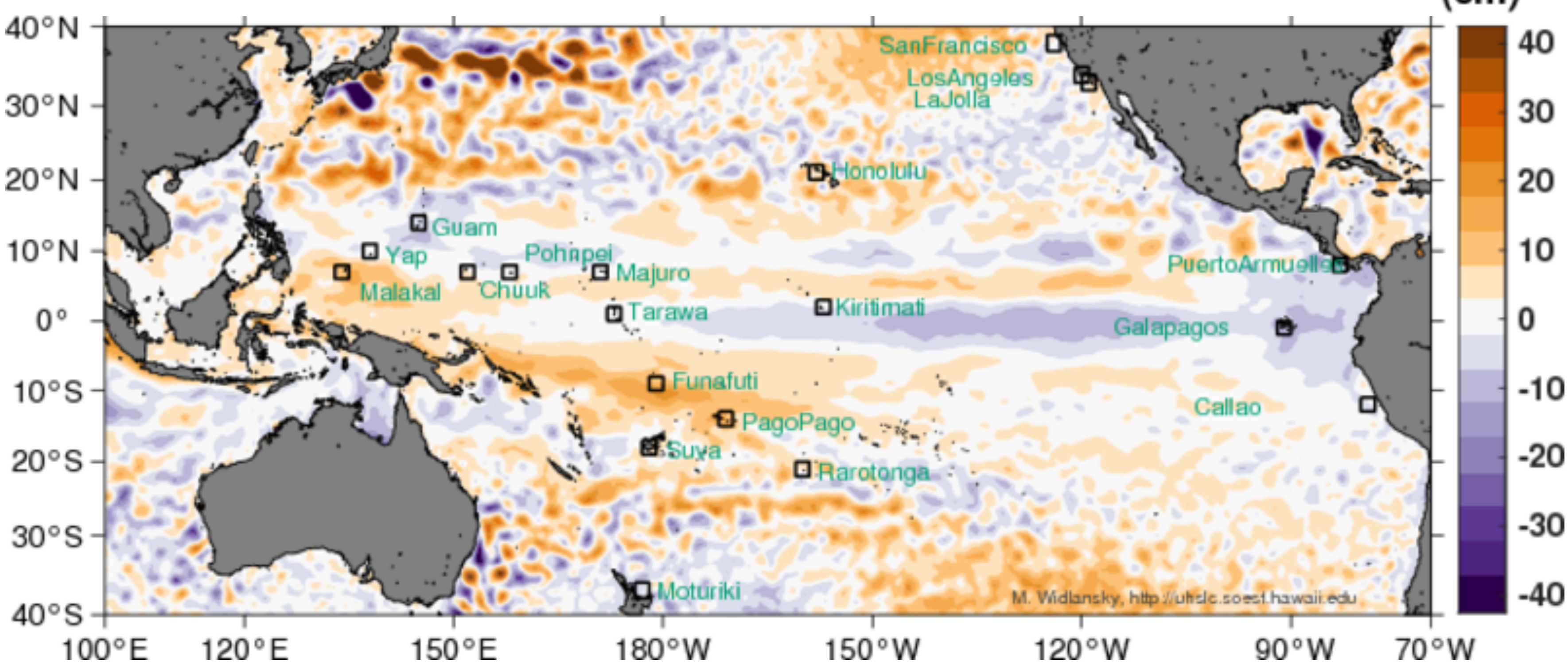


# Sea Surface Height (SSH) anomalies

**During the June, sea levels were below average in the equatorial Pacific and above average in the off-equatorial Pacific.**

**Average SSH anomalies (cm) from CMEMS satellite altimetry**
**June 2020**

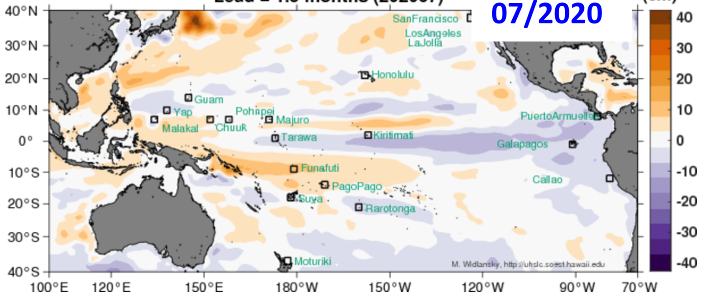



Seasonal cycle (1999–2010) and trend (1999–2017) removed

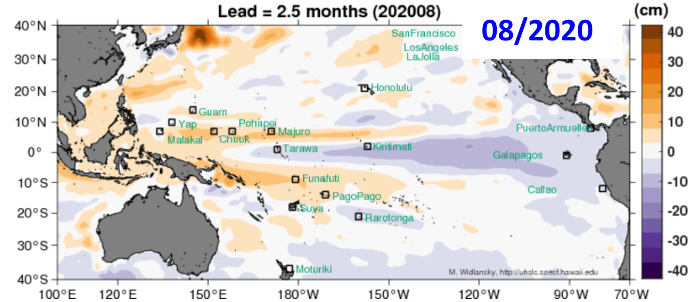
# Sea Surface Height (SSH) outlook: NCEP CFSv2 Forecast

## Updated: 2 July 2020

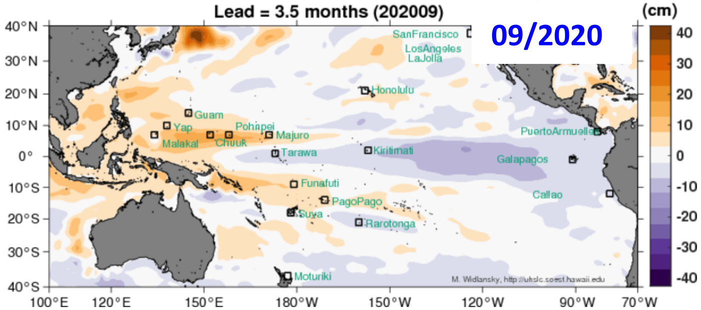
Model forecast (CFSv2: initialized 20200601-20200630)
Lead = 1.5 months (202007)



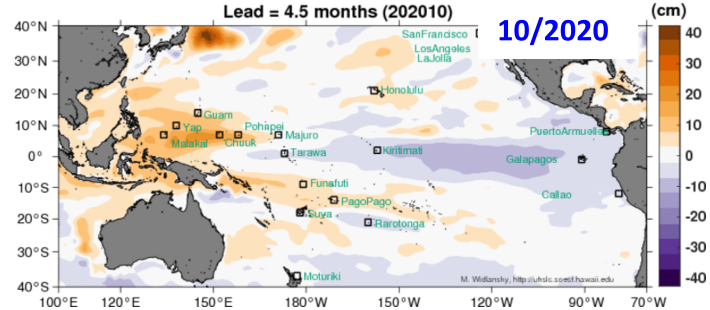

Model forecast (CFSv2: initialized 20200601-20200630)
Lead = 2.5 months (202008)



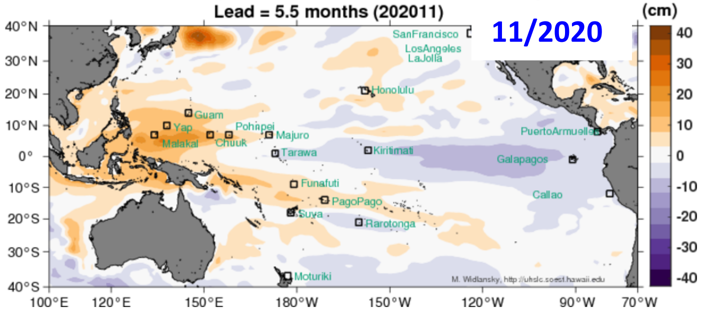

Model forecast (CFSv2: initialized 20200601-20200630)
Lead = 3.5 months (202009)



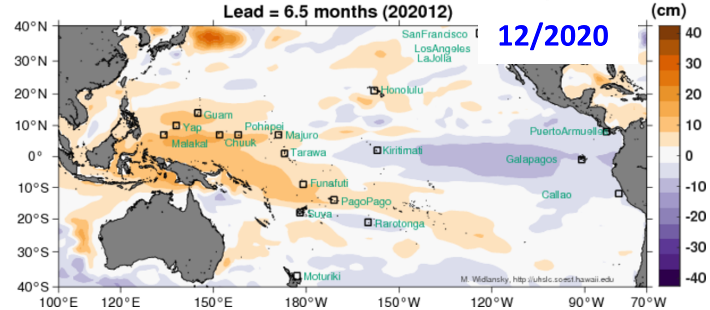

Model forecast (CFSv2: initialized 20200601-20200630)
Lead = 4.5 months (202010)




Model forecast (CFSv2: initialized 20200601-20200630)
Lead = 5.5 months (202011)



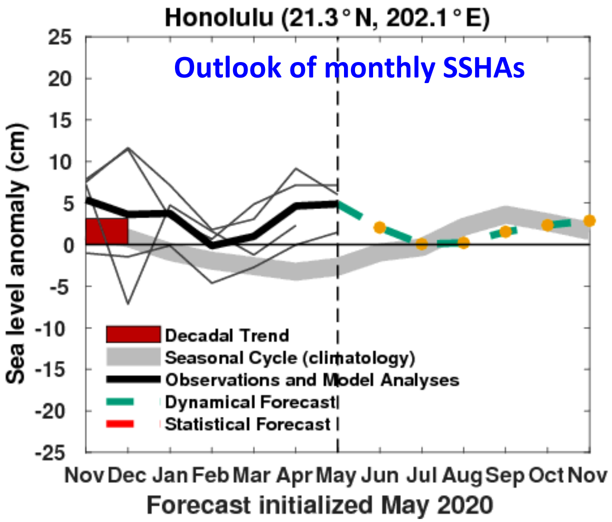

Model forecast (CFSv2: initialized 20200601-20200630)
Lead = 6.5 months (202012)

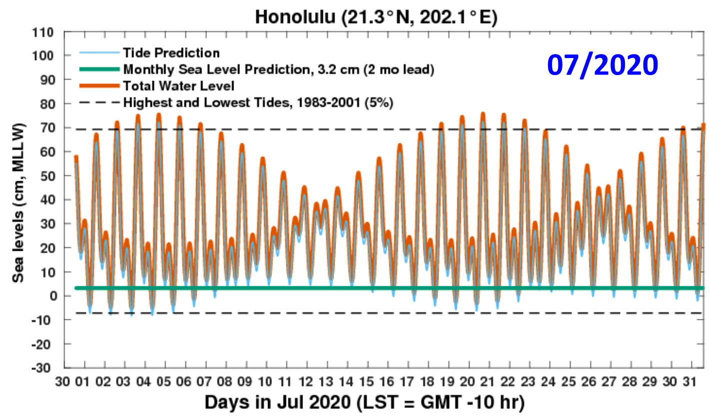



**Over the coming seasons, sea levels are forecasted to be below-normal along the equator in the EP (the Galapagos Islands), and above-normal in parts of the off-equator regions (e.g., Hawaii).**

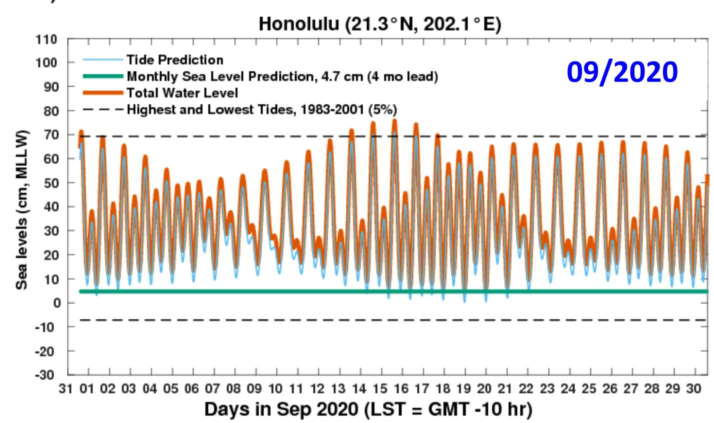
Seasonal cycle and trend removed

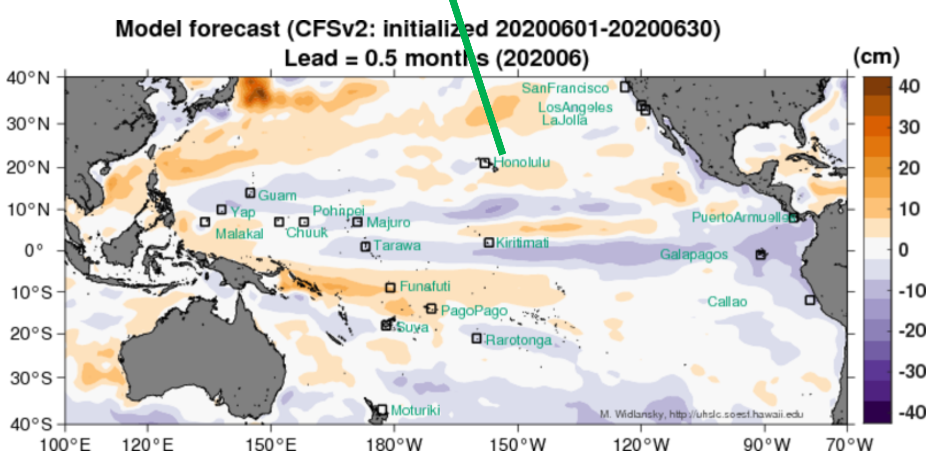
# Sea Surface Height (SSH) anomalies

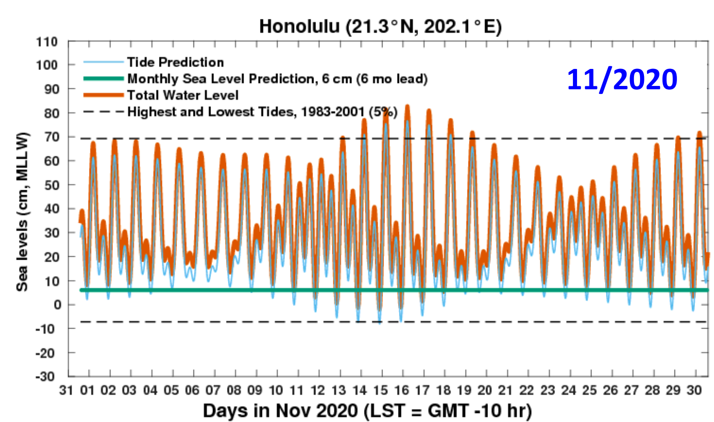



https://uhslc.soest.hawaii.edu/sea-level-forecasts/



# 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 archive

- Dr. Matthew Widlansky (U. Hawaii) provided sea level predictions



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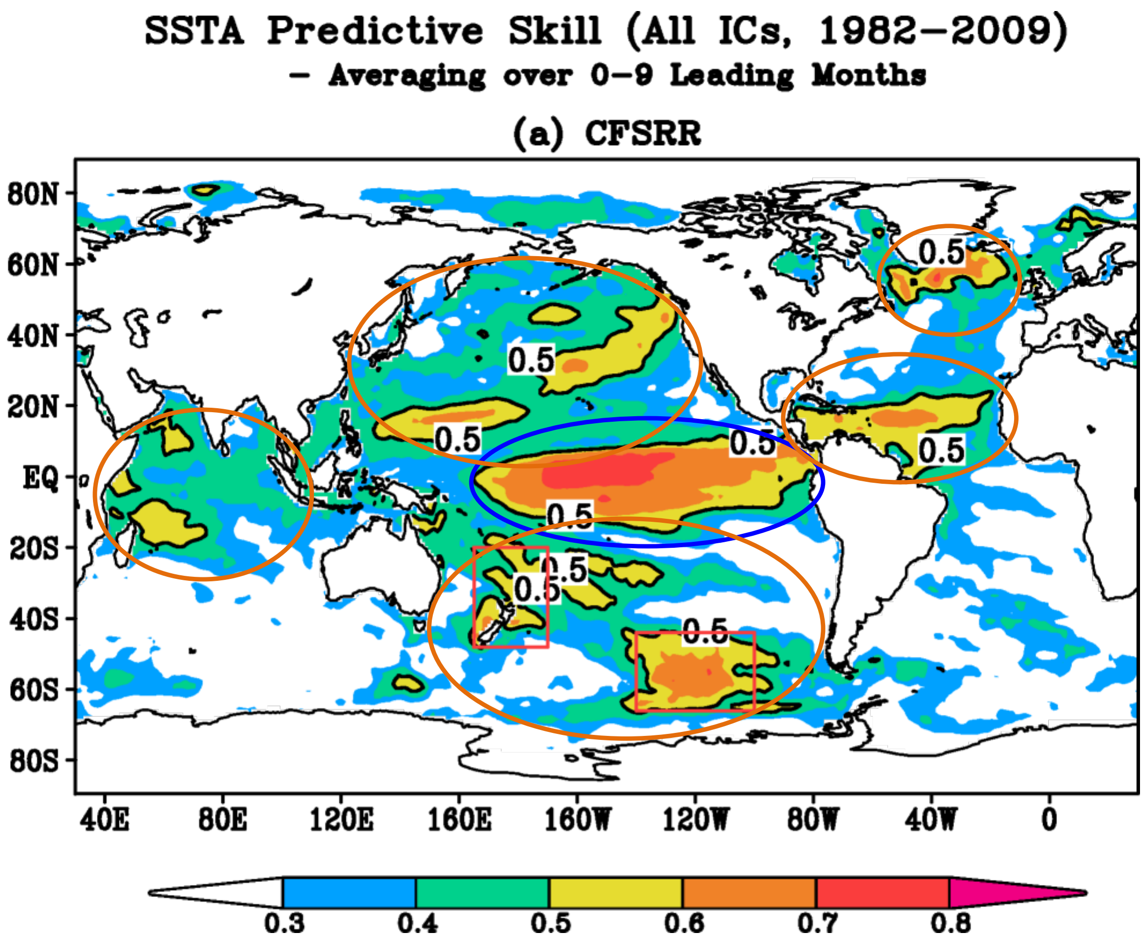
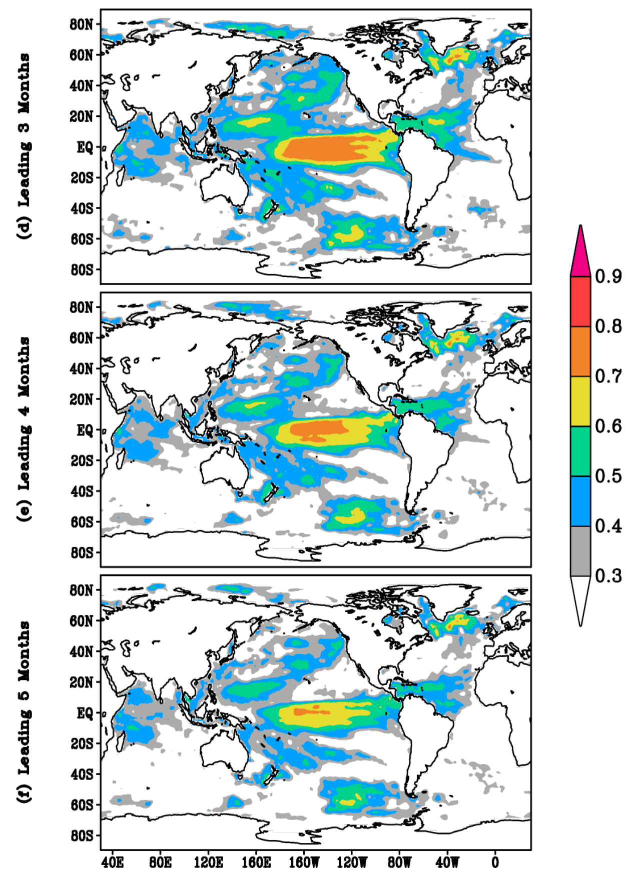
**Caihong.Wen@noaa.gov**

**Jieshun.Zhu@noaa.gov**

# Backup Slides

# Spatial Distribution of SSTA prediction skill with CFSv2



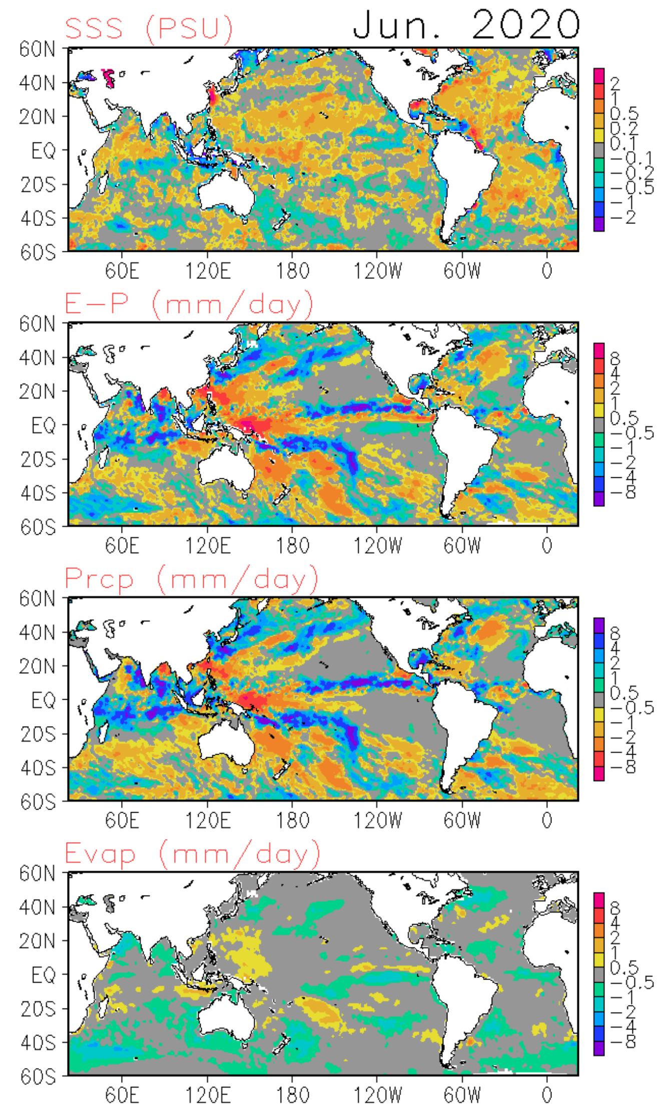

(Guan et al. 2014)

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

# Global Sea Surface Salinity (SSS)

## Anomaly for June 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 in the subtropical N. Pacific Ocean. In the west equatorial Pacific ocean, the SSS became positive with reduced precipitation. While, in the east equatorial Pacific Ocean, the SSS became negative with increased precipitation. Positive SSS anomalies continue in the latitudes from nearby 0° to 40°N/°S in the Atlantic Ocean. Negative SSS appears in the central Indo-Pacific and extends west to the Indian ocean, which is likely caused by the increased precipitation in these regions.




- **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**

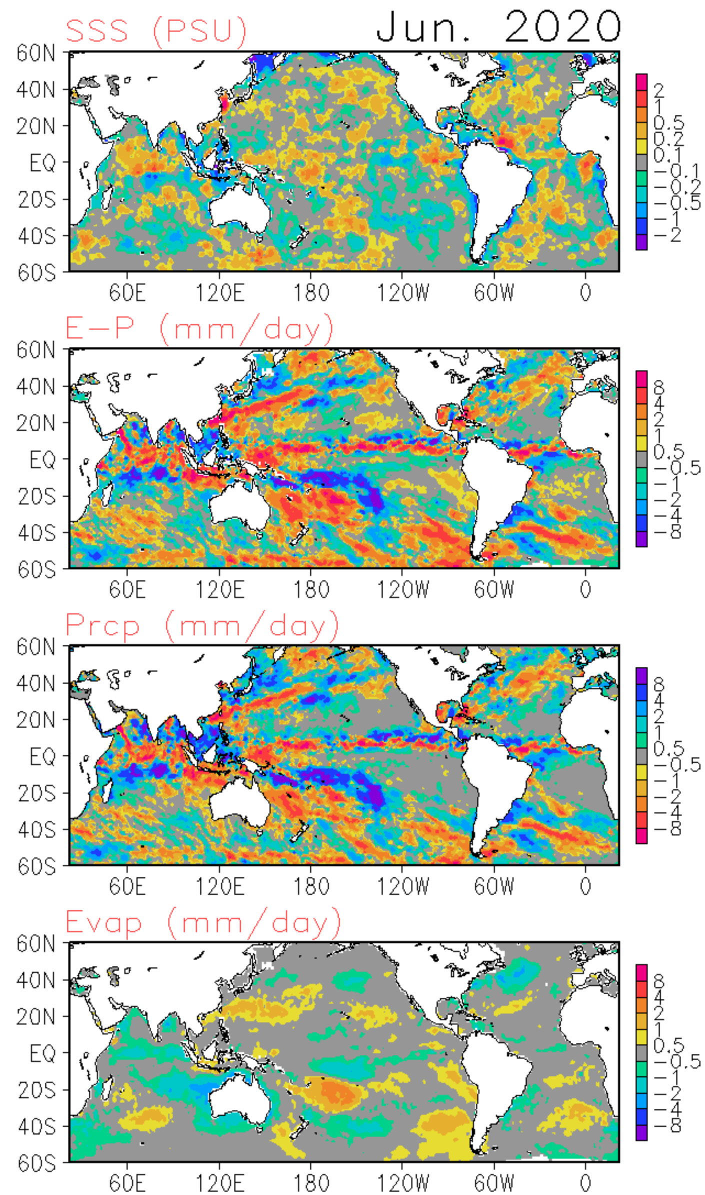
  **Precipitation: CMORPH adjusted satellite precipitation estimates**

  **Evaporation: Adjusted CFS Reanalysis**

# Global Sea Surface Salinity (SSS)

## Tendency for June 2020

Compared with last month, the SSS continued increasing in the west equatorial Pacific Ocean; while, the SSS decreased in the east equatorial Pacific ocean. In the central Indo-Pacific region, the SSS decreased with increased precipitation. The SSS increased in the northeast Pacific ocean, which is likely caused by the oceanic advection/entrainments. The SSS continued decreasing in the Bay of Bengal except in the northern area.

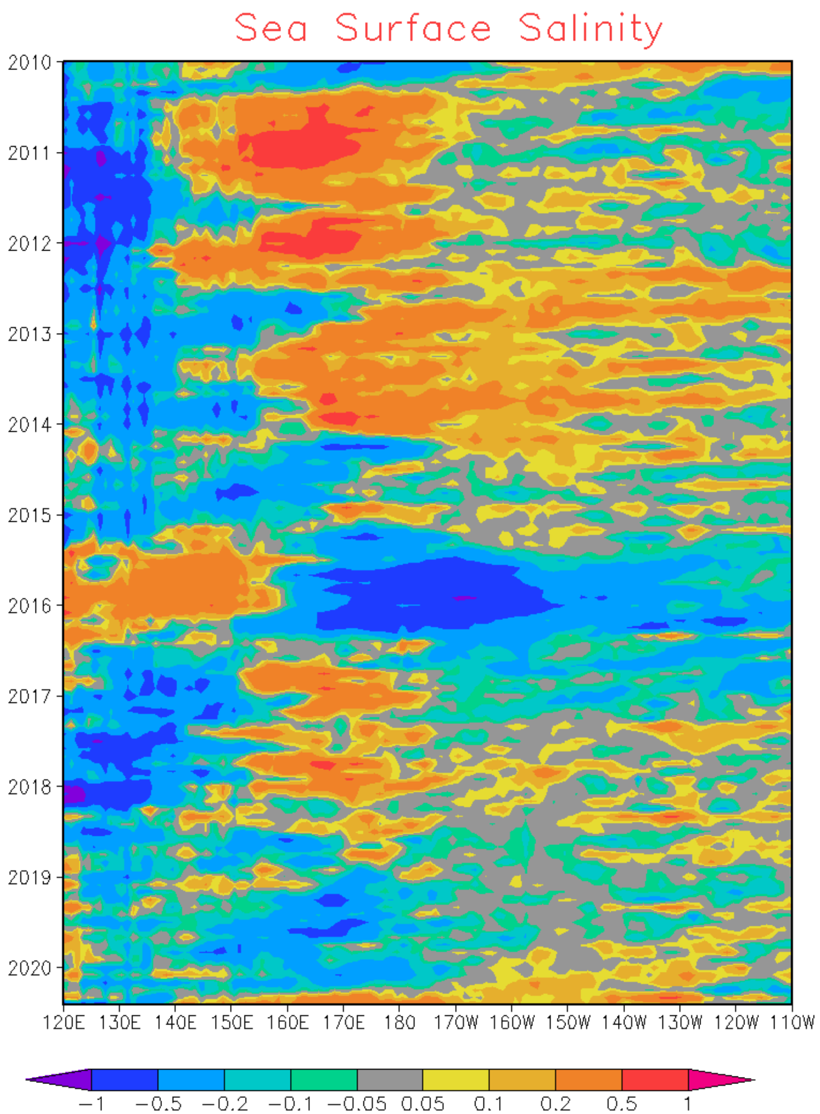


# Global Sea Surface Salinity (SSS)

## *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.**

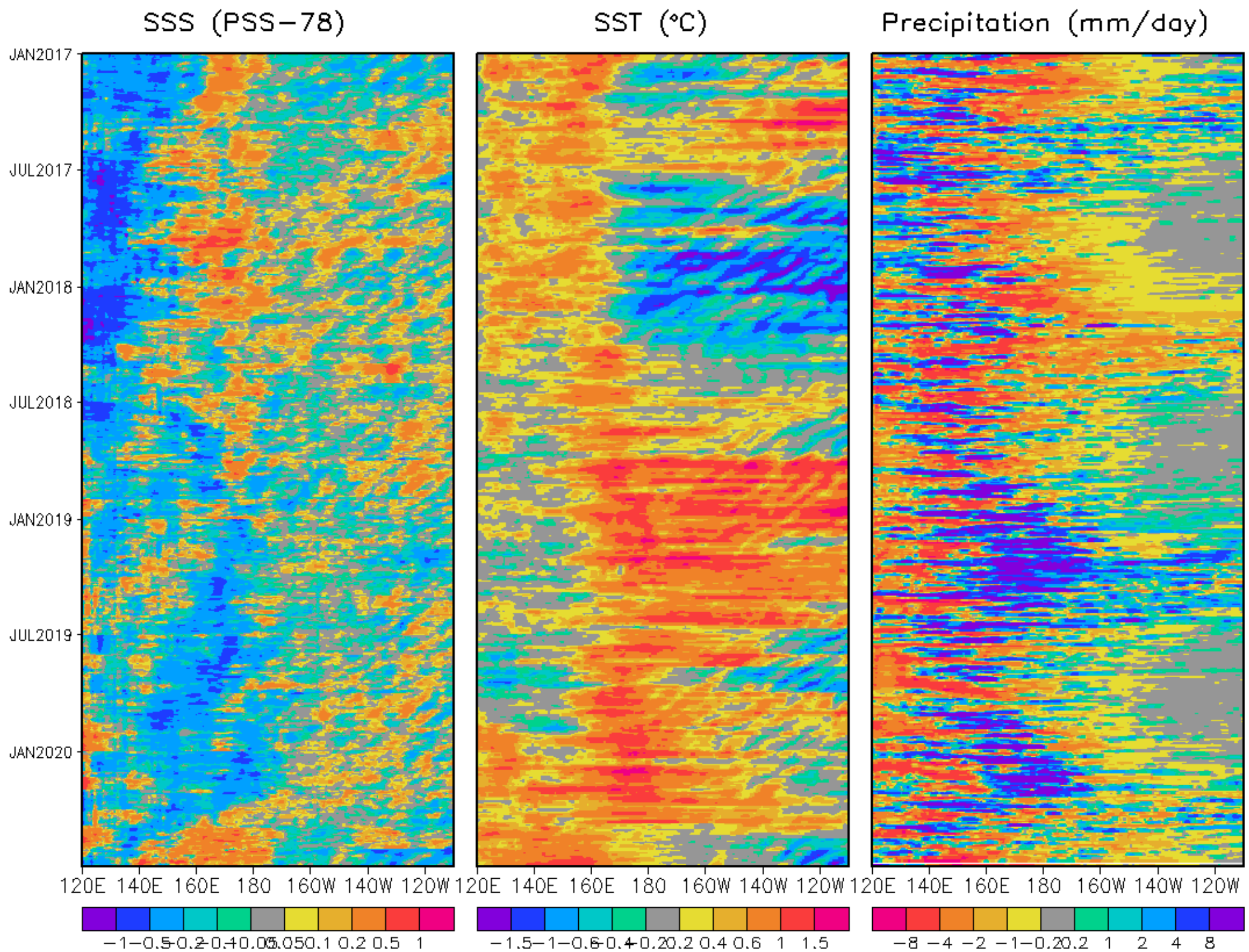
- Hovemoller diagram for equatorial SSS anomaly **(5˚S-5˚N);**
- In the equatorial Pacific Ocean, the SSS signal is negative west of 140°E; the positive SSS signals appears from 140°E to 130°W; while some negative and/or neutral SSS signals exist east of 125°W.



# 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