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

Prepared by

Climate Prediction Center, NCEP/NOAA

September 9, 2022

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**

Overview

- **Pacific Ocean**
  - La Niña condition continued with negative subsurface temperature anomaly enhanced in the central-eastern Pacific Ocean.
  - Strong negative PDO persisted in Aug 2022, with PDOI = -2.
  - Marine Heat Waves (MHWs) developed in the North-east Pacific and near the west coast of USA.

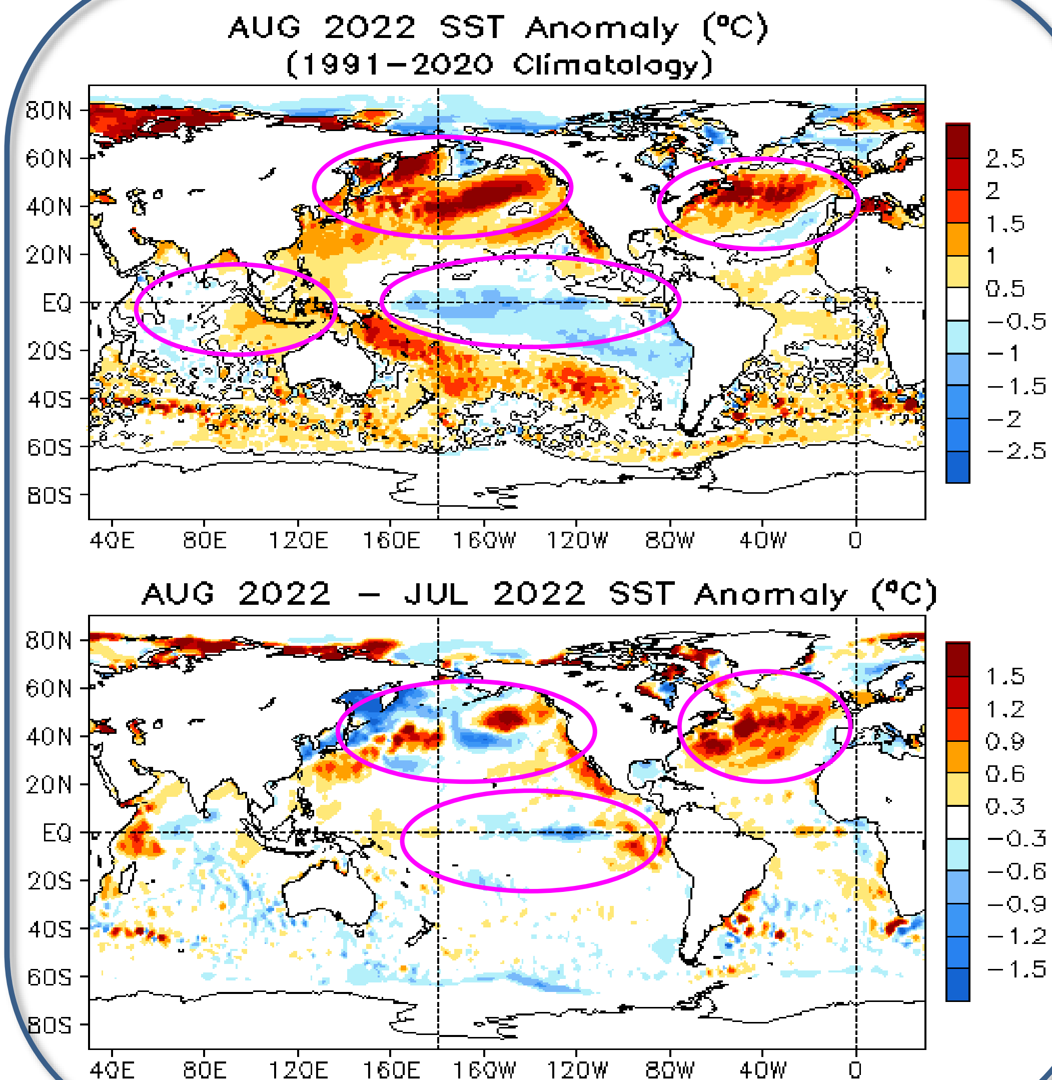
- Arctic Ocean
  - Averaged Arctic sea ice extent for August ranked the thirteenth lowest in the satellite record.

- **Indian Ocean**
  - A negative Indian dipole event is developing in Aug 2022.
  - All NMME models favor a negative IOD event during the northern hemisphere summer-fall 2022.

- **Atlantic Ocean**
  - Atlantic hurricane activity was very quiet in August.
  - A majority of NMME models predicted above or near normal SSTs to persist in the Hurricane main development region through the whole 2022 hurricane season.

Global Oceans

Global SST Anomaly (°C) and Anomaly Tendency

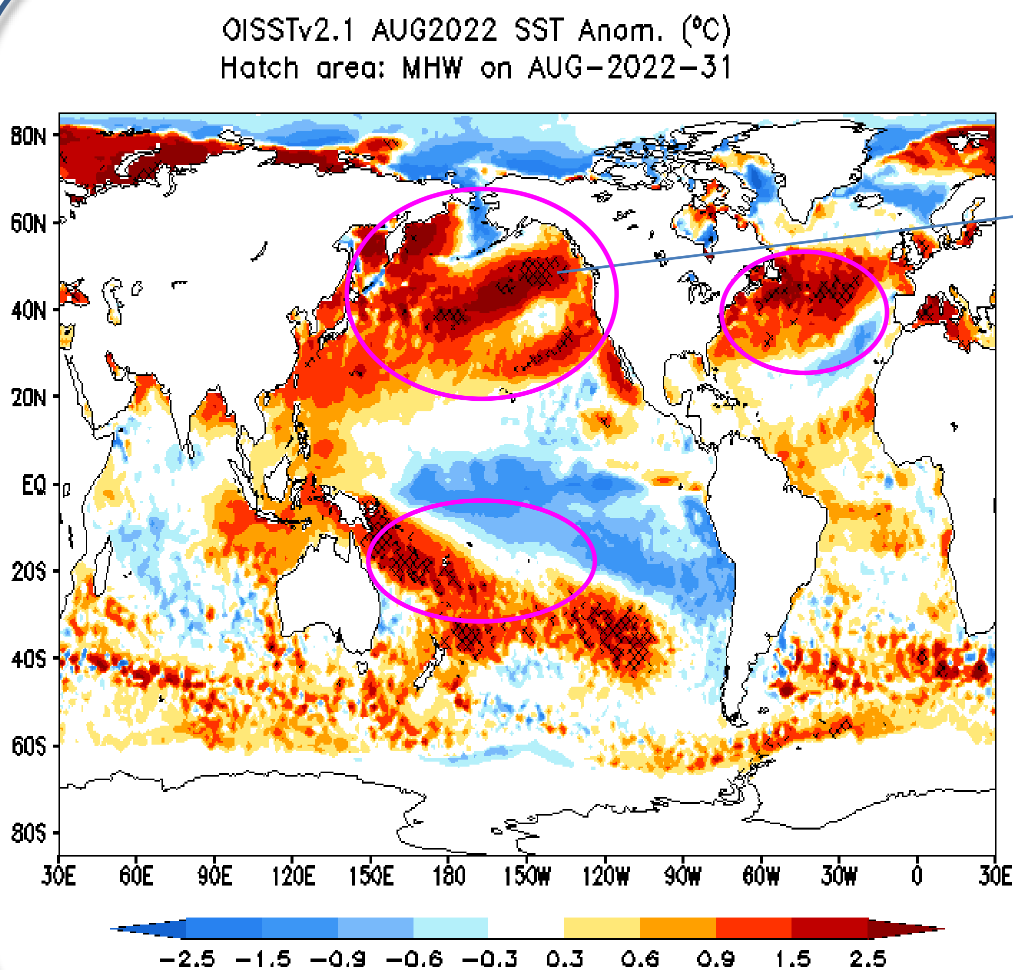


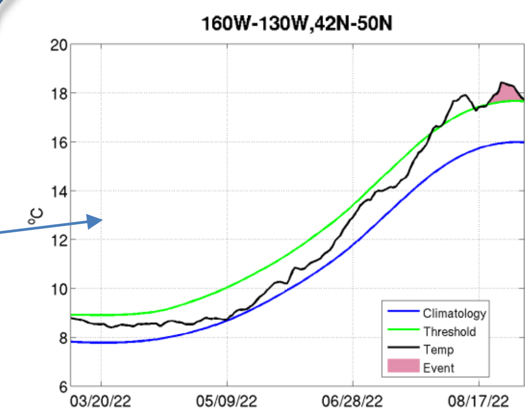
- SSTs were below average across most of the equatorial Pacific Ocean.
- Strong positive SSTAs were presented in the North Pacific and the North Atlantic Oceans.
- Positive SSTA persisted in the eastern Indian Ocean.

- Negative (positive) SSTA tendencies were observed in the central-eastern (far eastern) equatorial Pacific.
- Both positive and negative SSTA tendencies were observed in the North Pacific.
- Large positive SSTA tendencies were observed in the mid-latitudes of North Atlantic Ocean.

SSTAs (top) and SSTA tendency (bottom). Data are derived from the OISSTv2.1 SST analysis, and anomalies are departures from the 1991-2020 base period means.

Global Monthly SST anomaly and Marine Heat Waves

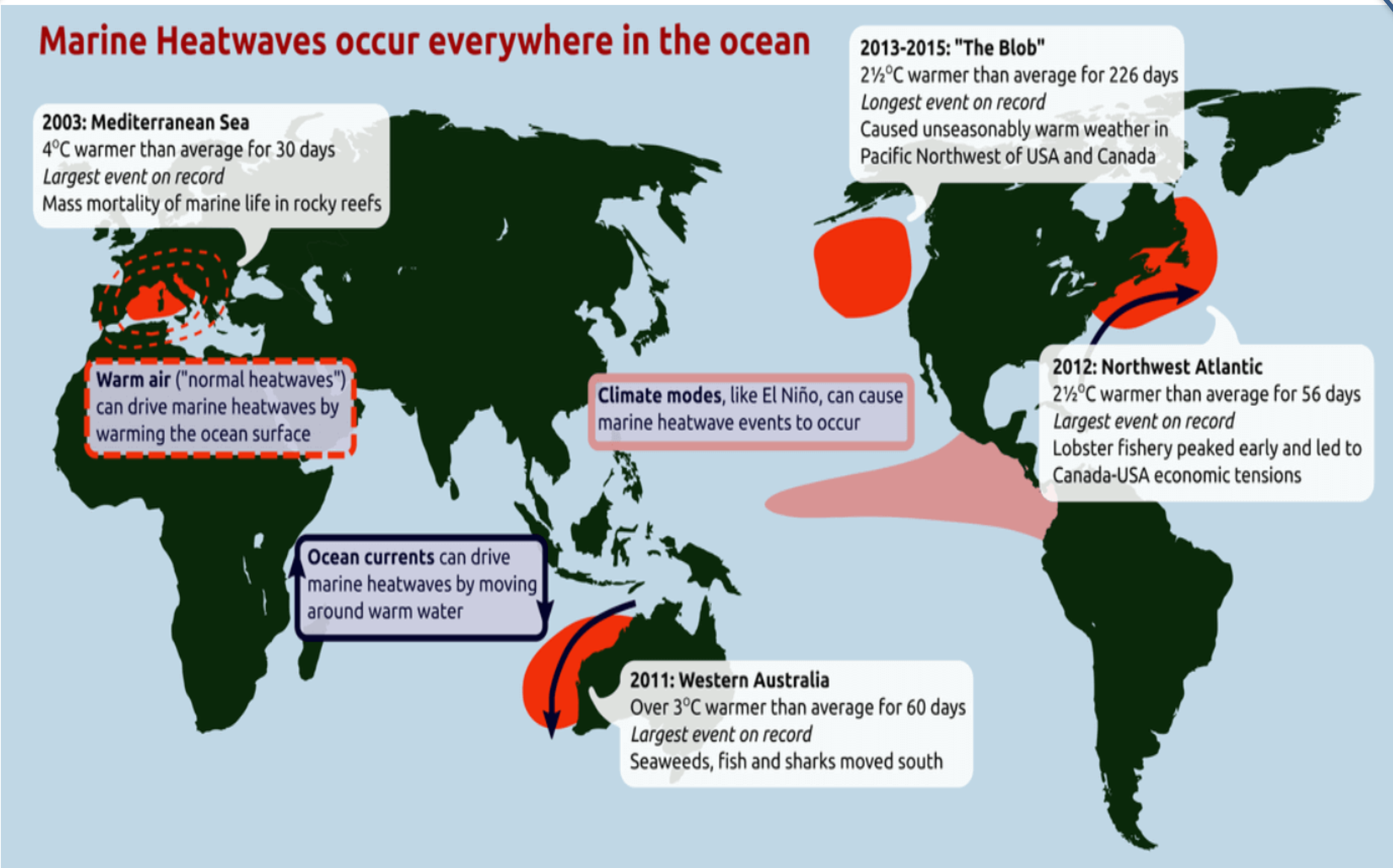




- MHWs were observed in the Northeast Pacific , Northwest Atlantic, and the Coral Sea.

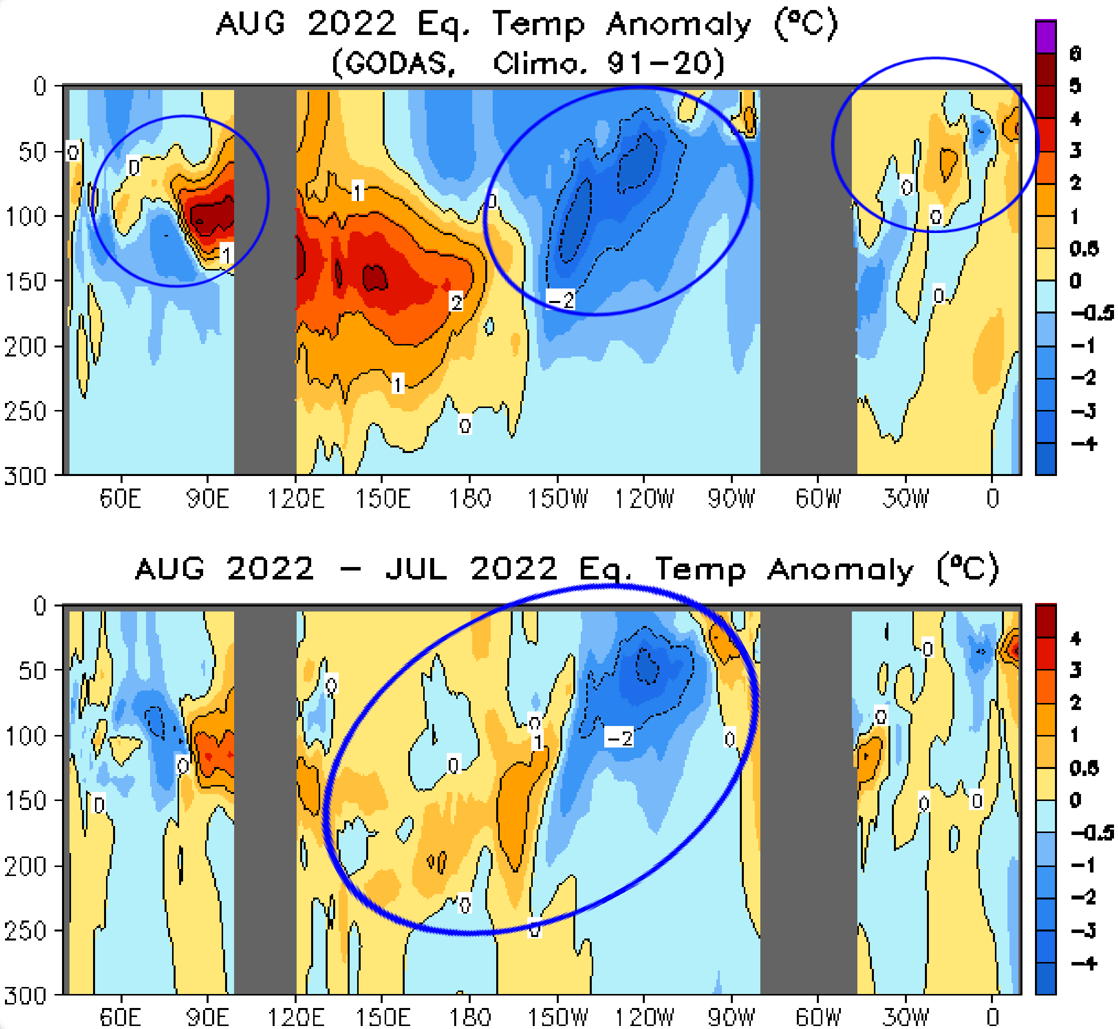
(Left panel) Monthly SST anomaly (shaded) and locations experience Marine heat waves (hatched) by the date labelled in the plot. (right panel) SST evolution at a specific location. Green line and blue line denote the seasonal 90th percentile and daily climatology, respectively. Shaded area denotes the periods experiencing MHW. MHW is defined as a discrete prolonged warmer than 90th percentile of daily SST for at least 14 days. Data is derived from NCEI OISSTv2.1 and the climatology reference period is 1991-2020

Historical Marine Heat Wave events and impacts



https://www.severe-weather.eu/global-weather/north-pacific-ocean-anomaly-2022-usa-seasonal-influence-fa/

Longitude-Depth Temperature Anomaly and Anomaly Tendency in 2°S-2°N



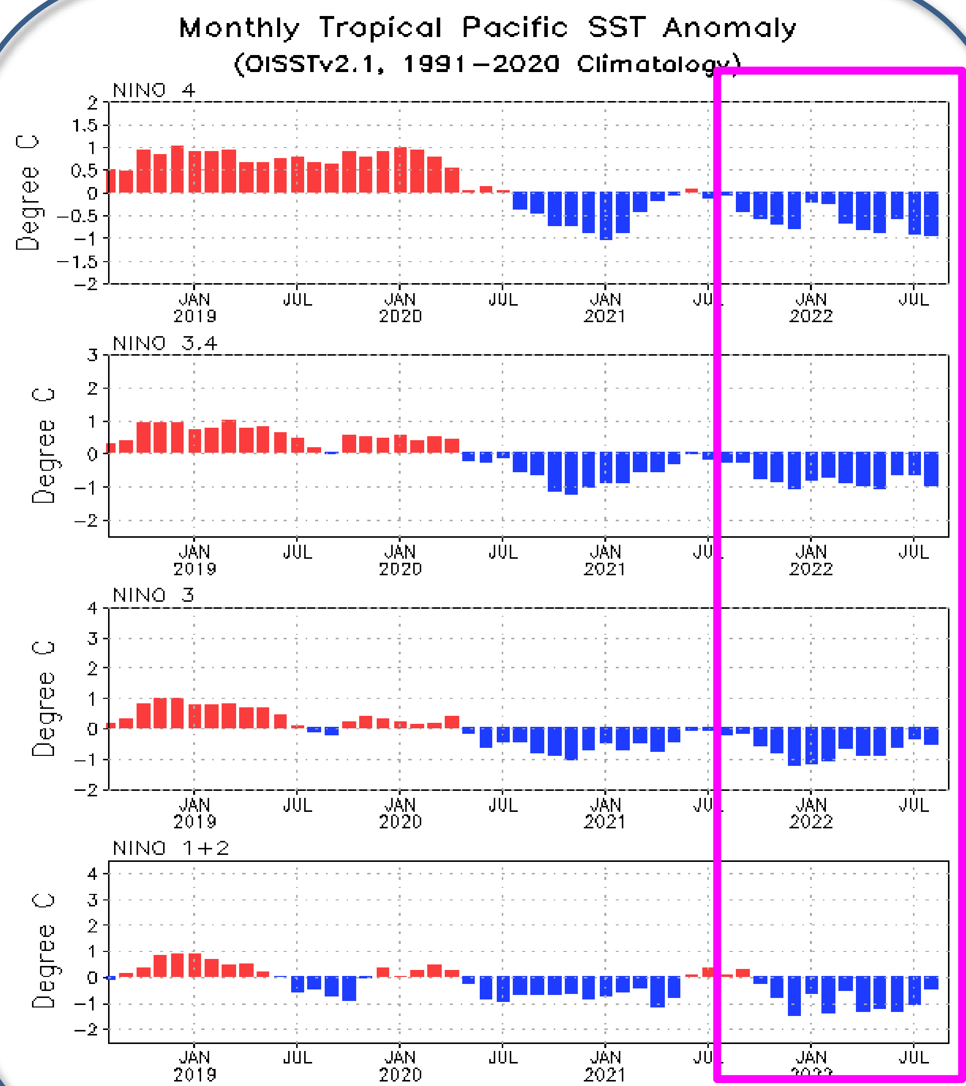
- Negative temperature anomaly strengthened along the thermocline in the central-eastern Pacific Ocean.
- Large positive temperature anomalies persisted in the eastern equatorial Indian Ocean.
- Positive temperature anomalies dominated the upper 100m of equatorial Atlantic Ocean.

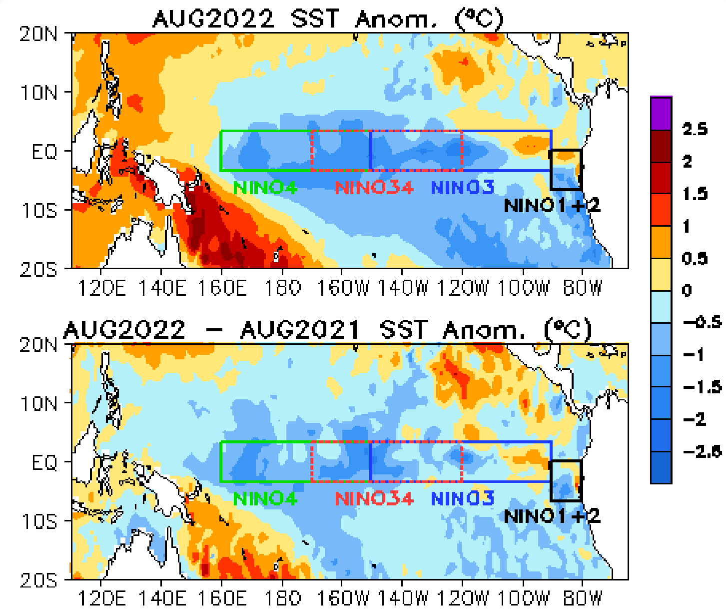
- Negative temperature anomaly tendency was observed along the central-eastern equatorial thermocline in the Pacific Ocean.

Equatorial depth-longitude section of ocean temperature anomalies (top) and anomaly tendency (bottom). Data is from the NCEP's GODAS. Anomalies are departures from the 1991-2020 base period means.

Tropical Pacific Ocean and ENSO Conditions

Evolution of Pacific Niño SST Indices





- Except for Niño 1+2, the other three Niño indices cooled down in Aug2022.

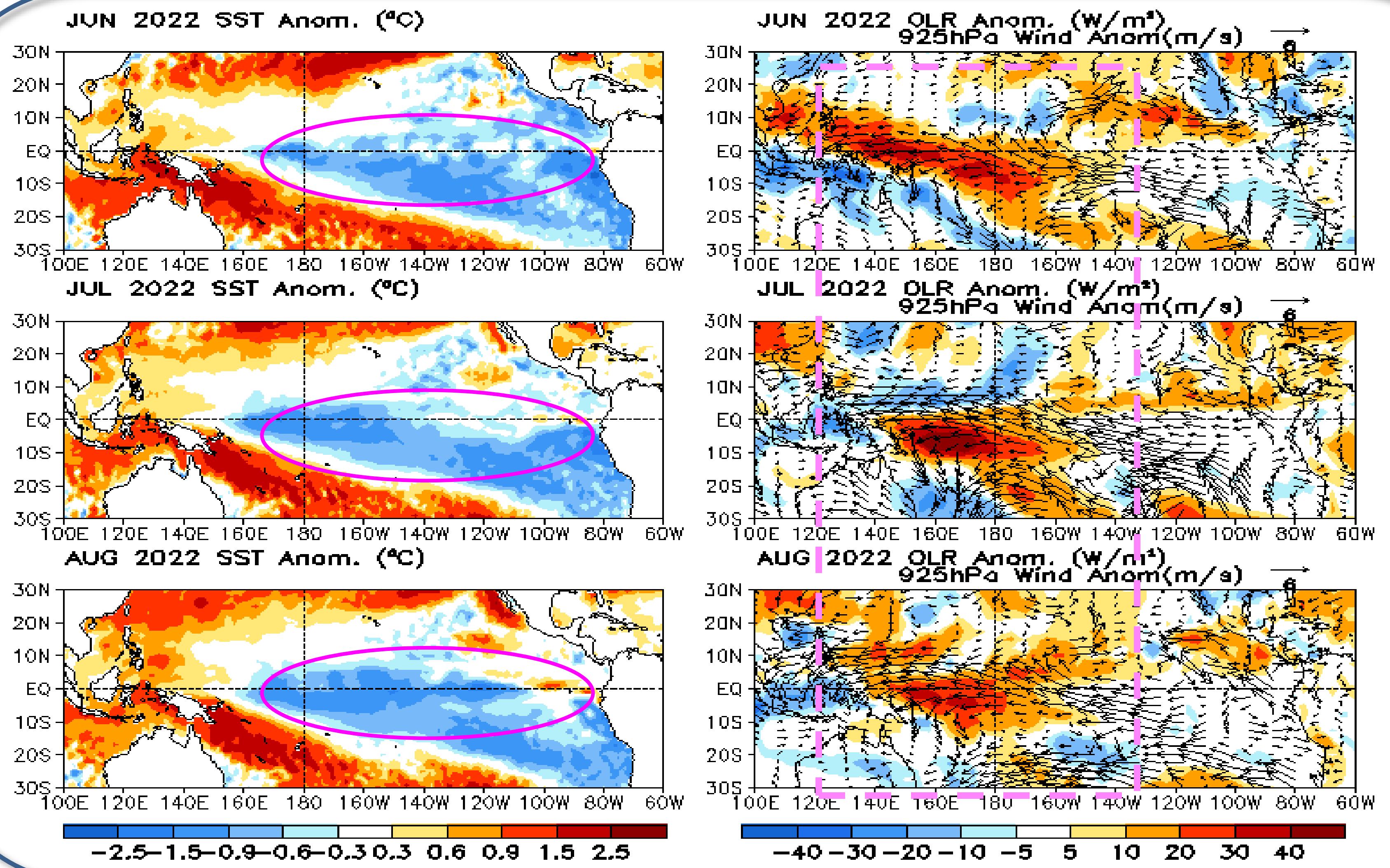
- Negative Niño3.4 enhanced in Aug 2022 , with Niño3.4 = -1C.

- Compared with Aug 2021, the western-central and southeastern tropical Pacific were cooler in Aug 2022.

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

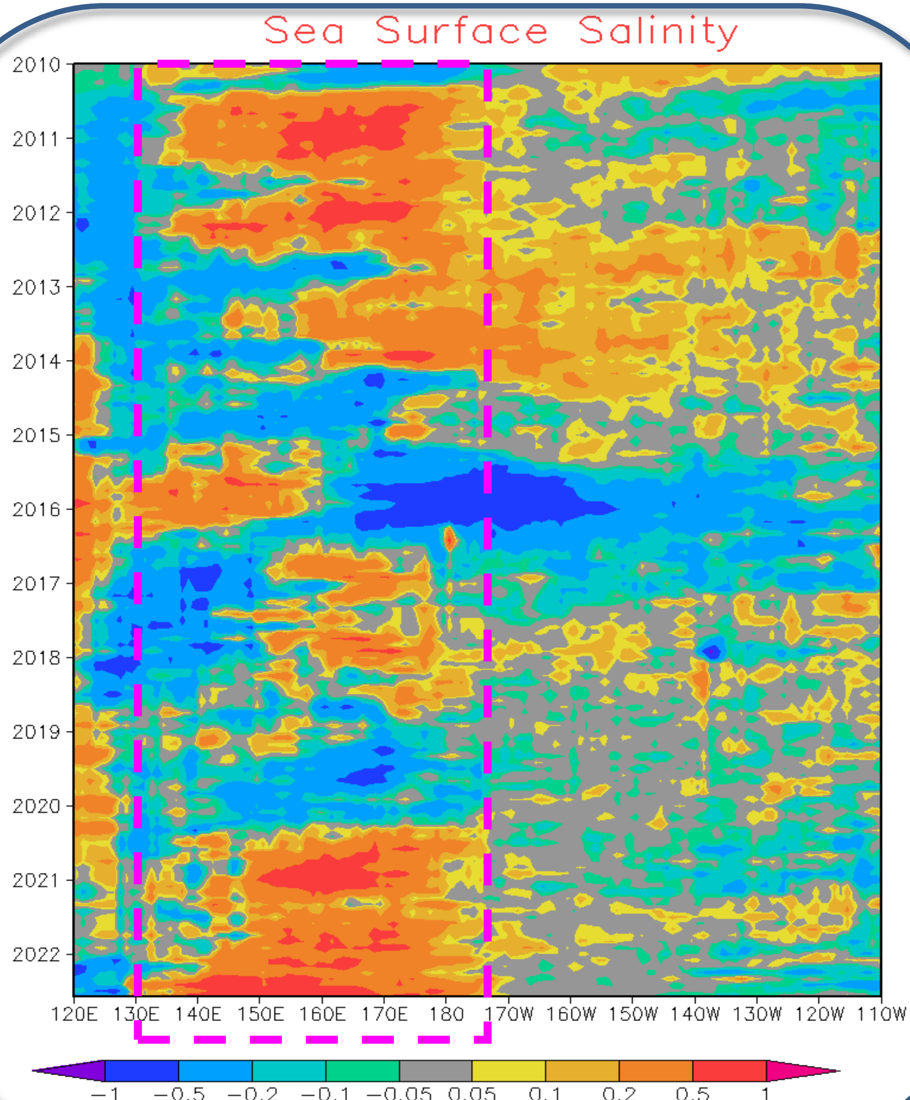
Niño region indices, calculated as the area-averaged monthly mean SSTAs (°C) for the specified region. Data are derived from the OISSTv2.1 SST analysis, and anomalies are departures from the 1991-2020 base period means.

Last three months SST, OLR and uv925 anomalies



SSTAs (top-left), SSTA 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 OISSTv2.1 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 1991-2020 base period means.

Equatorial Pacific Sea Surface Salinity(SSS) Anomaly

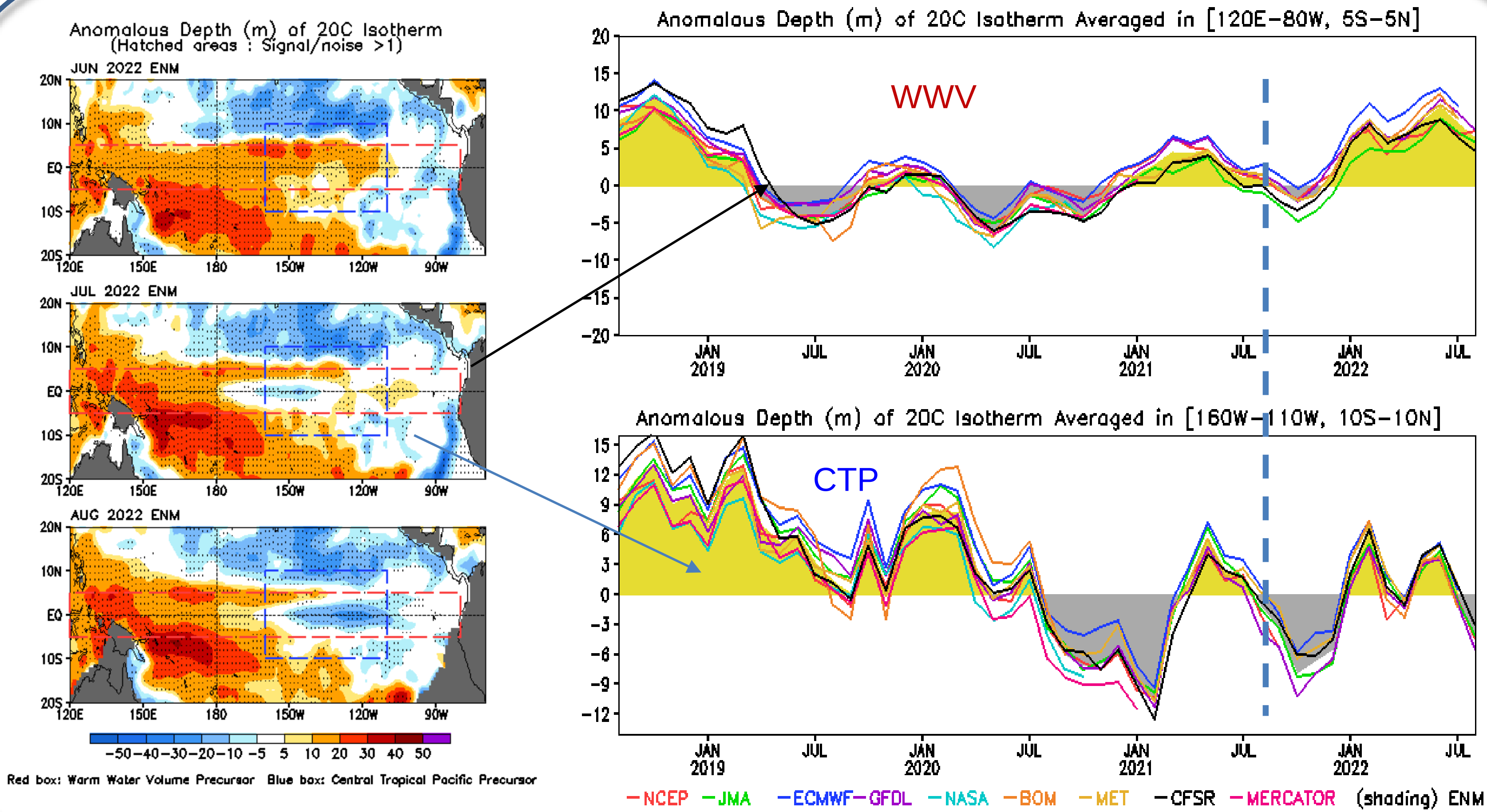


- Positive (negative) SSS anomaly presented east (west) of 140E during 2010, 2011, 2016,2017, 2020, 2021 La Nina events.

- Positive SSS anomaly continued and enhanced in the western-central equatorial Pacific

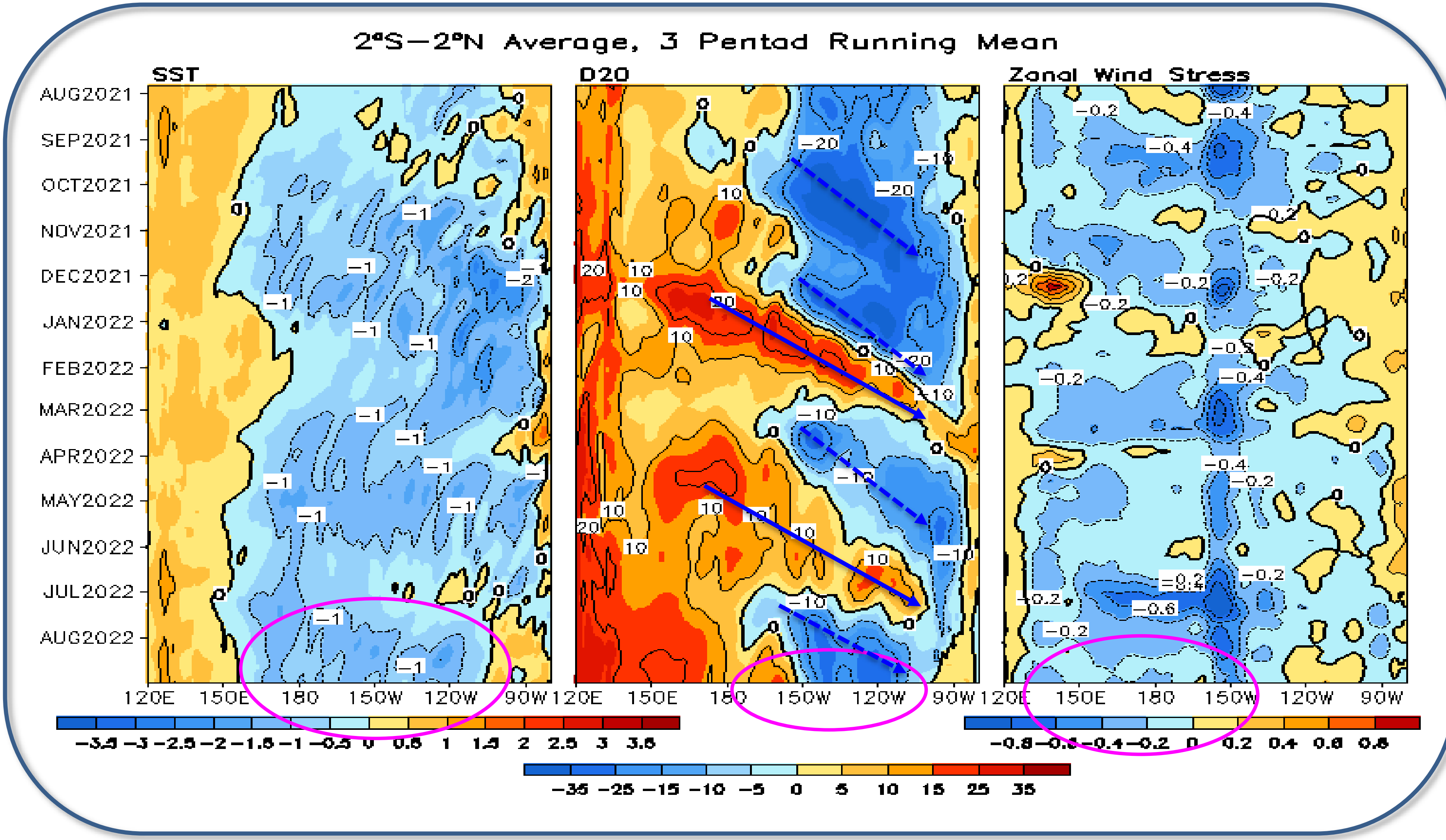
Sea surface salinity (SSS) anomalies are derived from Blended Analysis of Surface Salinity (BASS) V0.Z (Xie et al. 2014). Since June 2015, the BASS SSS is from in situ, SMOS and SMAP; before June 2015,The BASS SSS is from in situ, SMOS and Aquarius. Data is available at ftp.cpc.ncep.noaa.gov/precip/BAS.

Oceanic ENSO Precursors: WWV & CTP



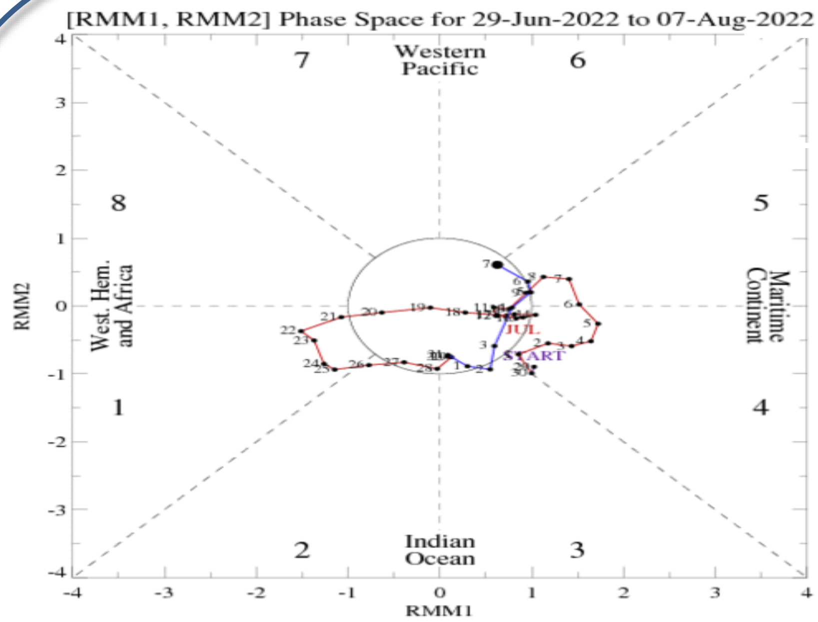
Warm water volume (WWV) is defined as an average of D20 anomaly across the equatorial Pacific (120° E – 80° W, 5° S-5° N) (Meinen and McPhaden 2000). Central tropical Pacific (CTP) index is calculated as the averaged D20 anomaly in the central tropical Pacific (160° W-110° W, 10° S-10° N) (Wen et al. 2014). The monthly D20 data is obtained from the Real-time Ocean Reanalysis Intercomparison Project(https://www.cpc.ncep.noaa.gov/products/GODAS/multiora93_body.html).

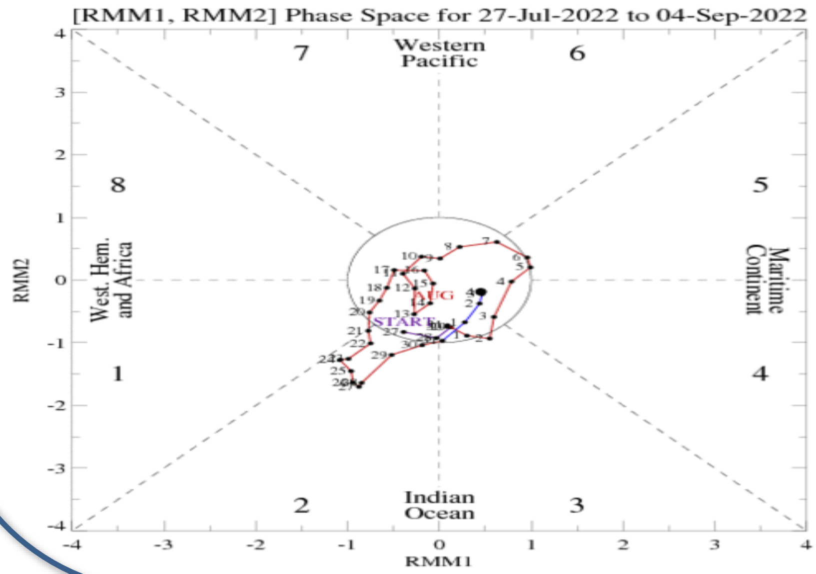
Equatorial Pacific TAUX (dyne/cm ^{2}) , SST (°C) and D20 (m) Anomalies



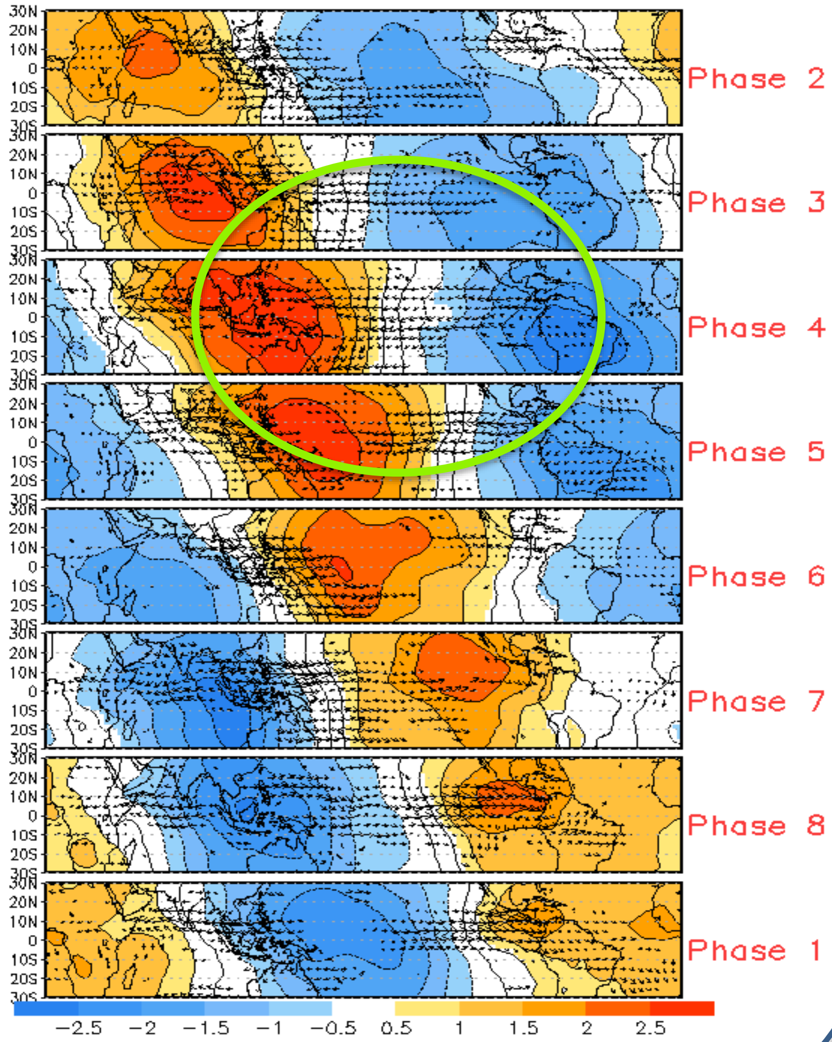
- Negative SSTA enhanced in the central-eastern Pacific in Aug 2022.
- In respond to the strong easterly wind surges during early July, an upwelling ocean Kevin wave was initiated in the central Pacific and propagated to the central-eastern Pacific by the end of Aug 2022.

MJO Activities

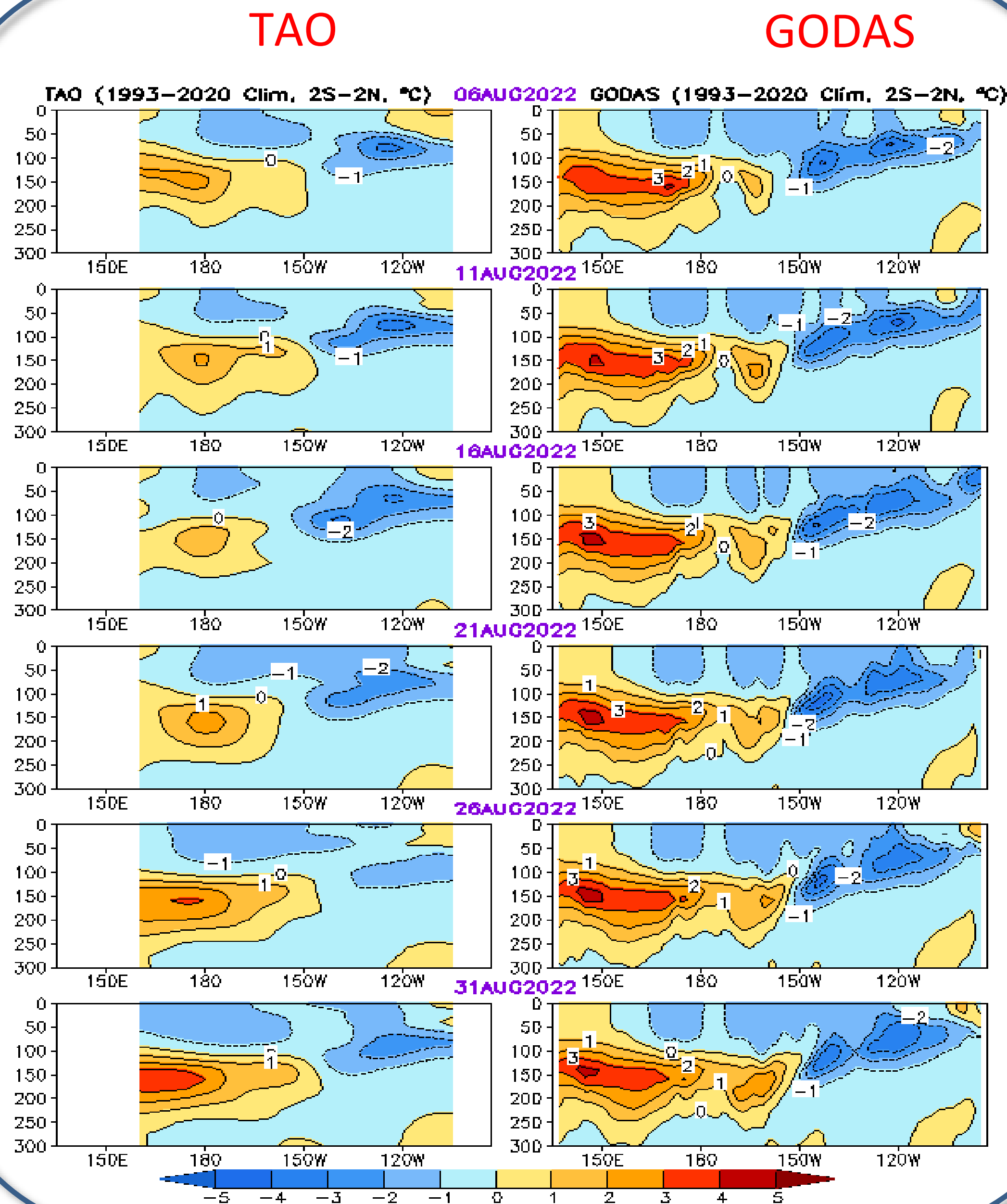




850-hPa Velocity Potential and Wind Anomalies

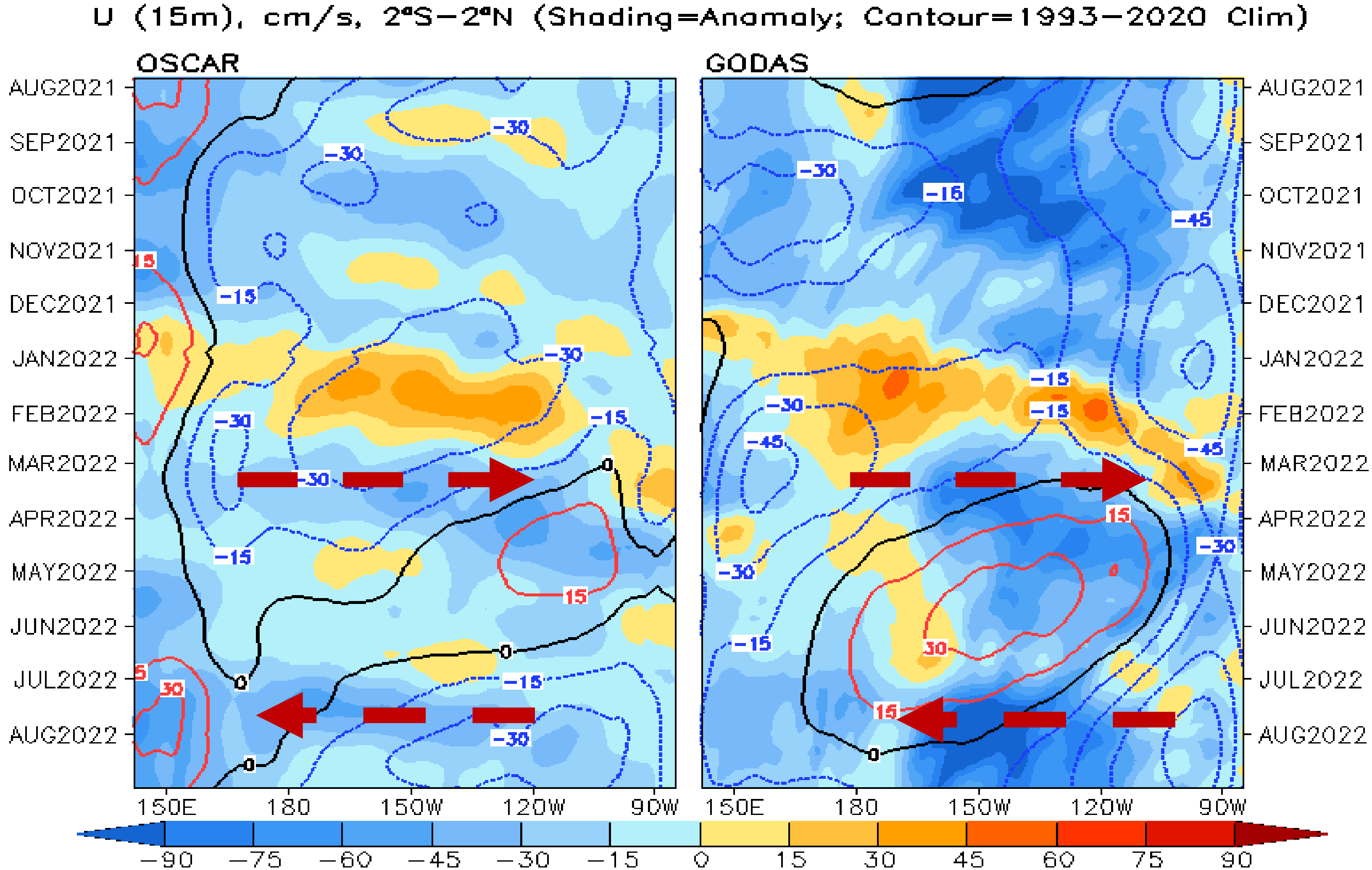


Equatorial Pacific Ocean Temperature Pentad Mean Anomaly



- Negative temperature anomaly in the eastern Pacific entered the mixed layer by the mid-August, favoring of further SST cooling in the eastern Pacific.
- West-east dipole pattern was relatively stationary in the last six pentads.

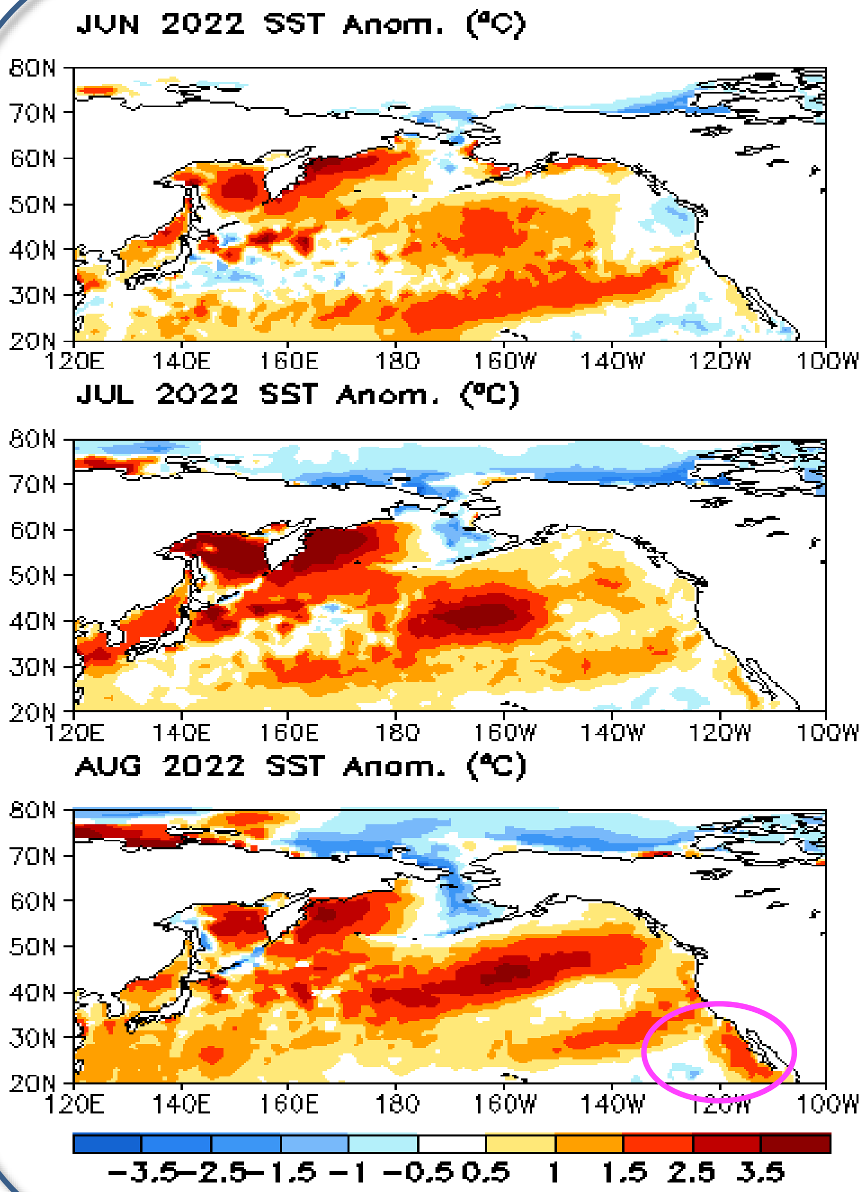
Evolution of Equatorial Pacific Surface Zonal Current Anomaly (cm/s)

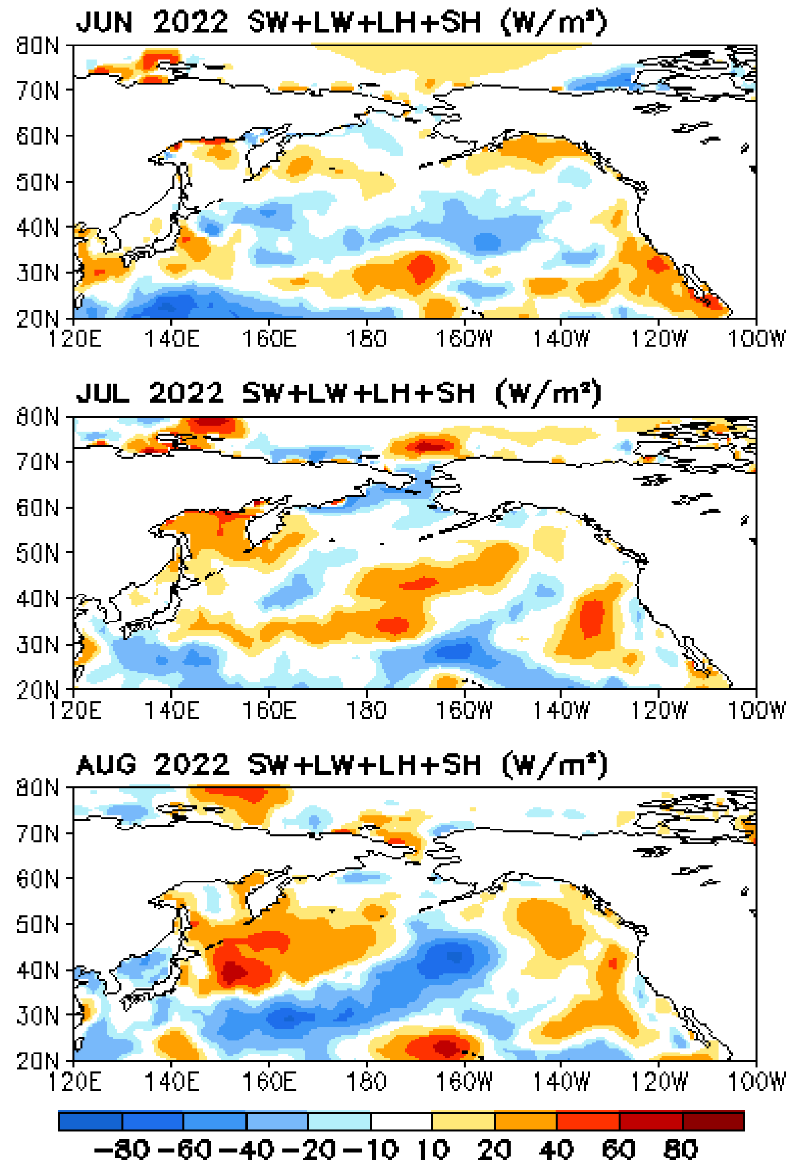


- Anomalous westward currents were present in the equatorial Pacific both in OSCAR and GODAS since Feb 2022.

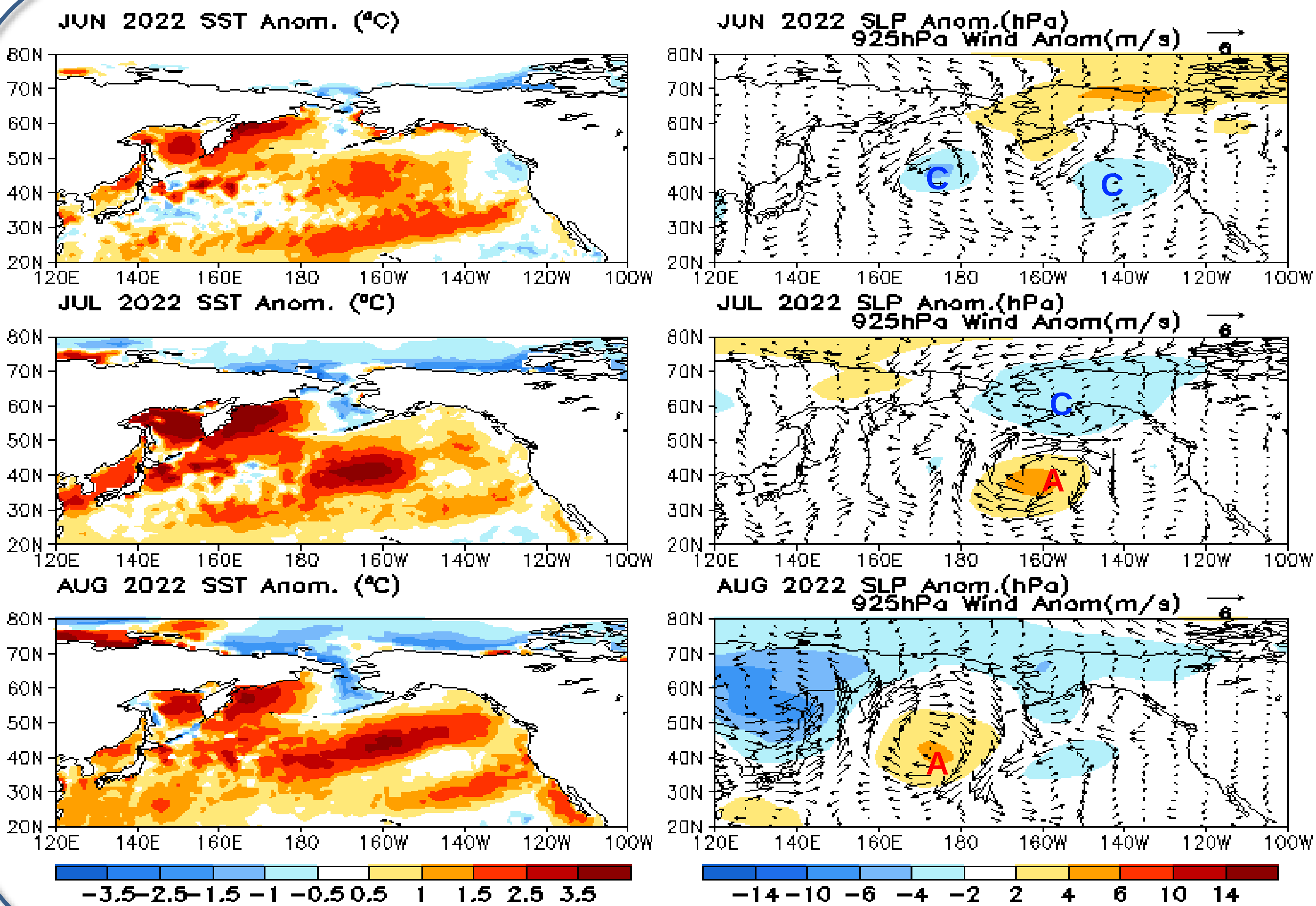
North Pacific & Arctic Oceans

Last 3- month North Pacific SST and Surface Heat Flux anomalies

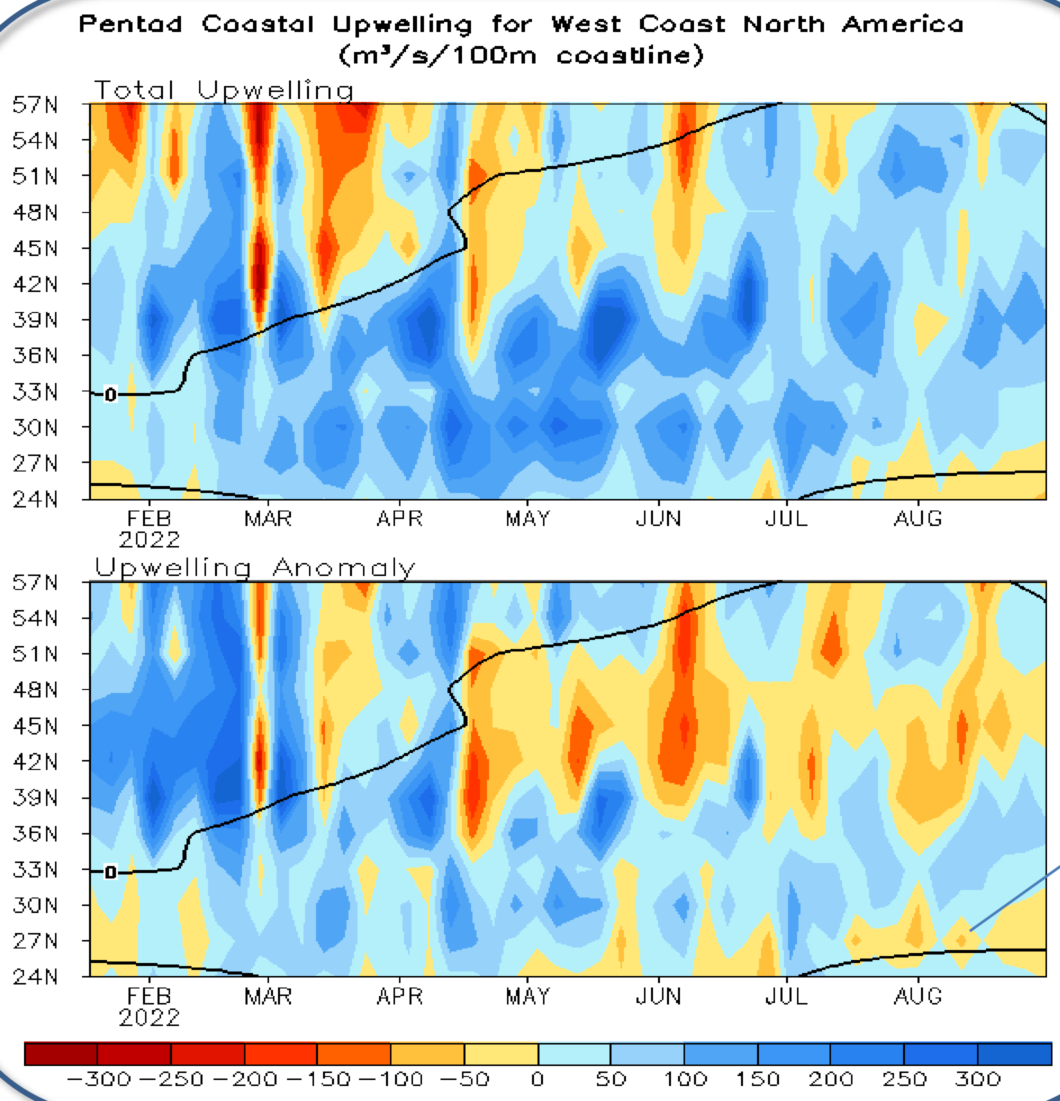


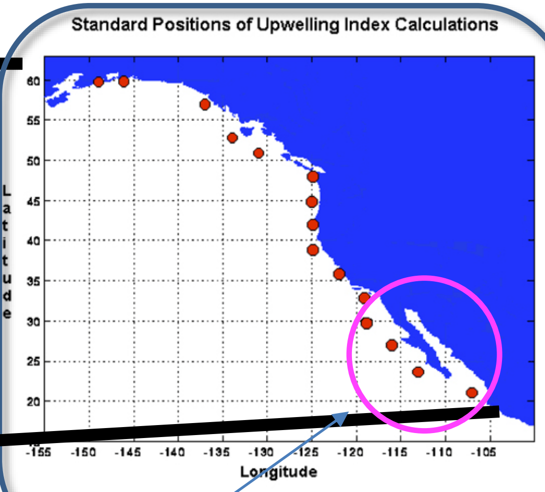


Last 3- month North Pacific SST, SLP, and uv925 anomalies



North America Western Coastal Upwelling

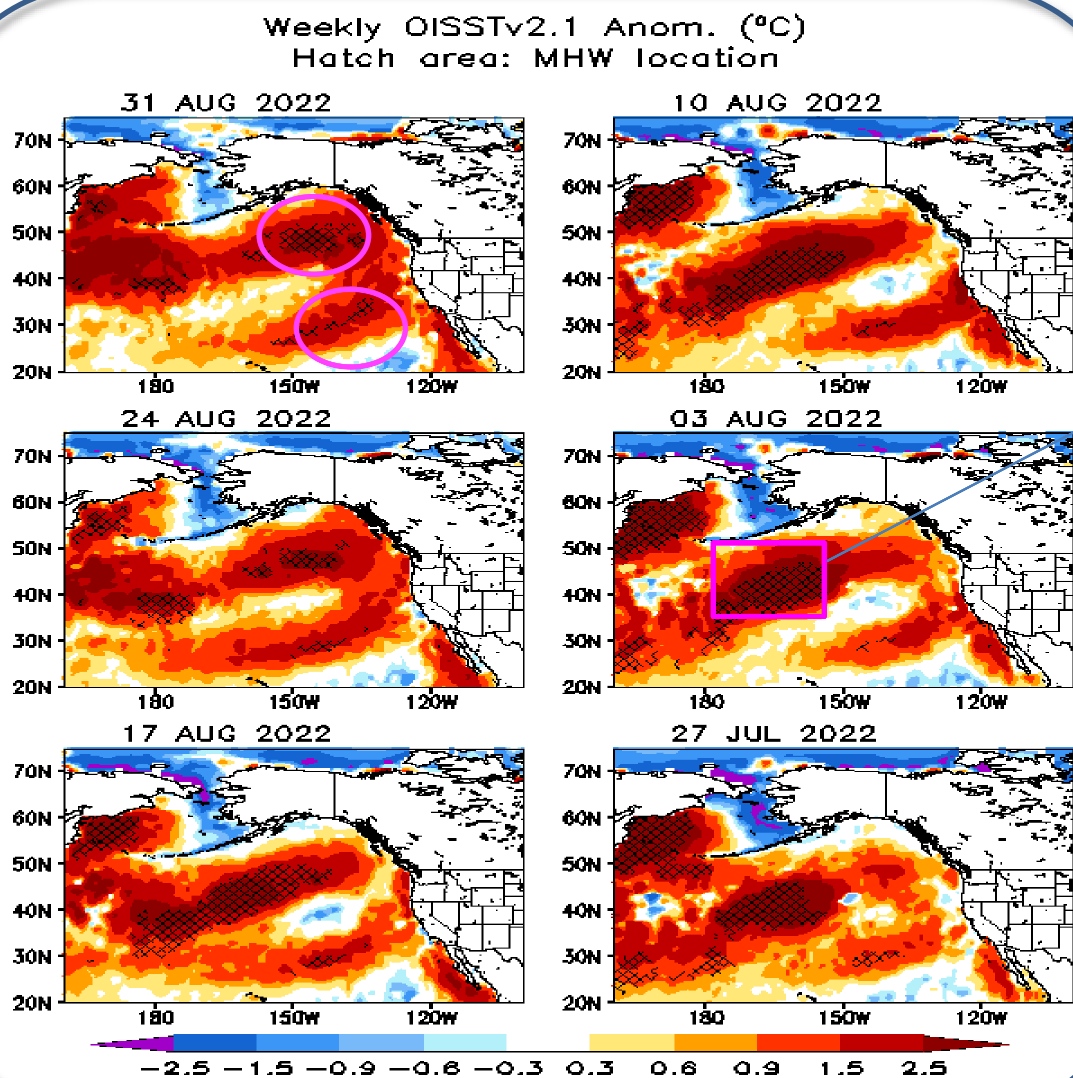


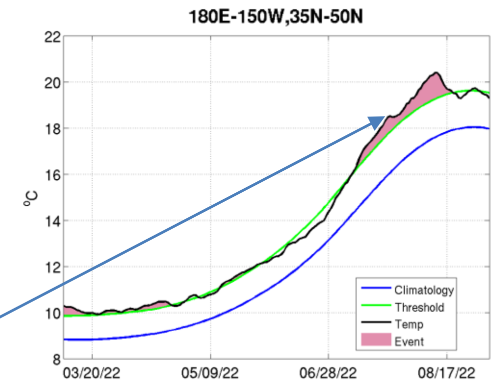


- Anomalous downwelling was observed south of 30ºN.
- Both anomalous coastal downwelling and upwelling were observed since mid-Apr 2022.

(top) Total and (bottom) anomalous upwelling indices at the 15 standard locations for the western coast of North America. Derived from the vertical velocity of the NCEP's GODAS 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 1991-2020 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.

Weekly SST anomaly and MHWs in the North Pacific

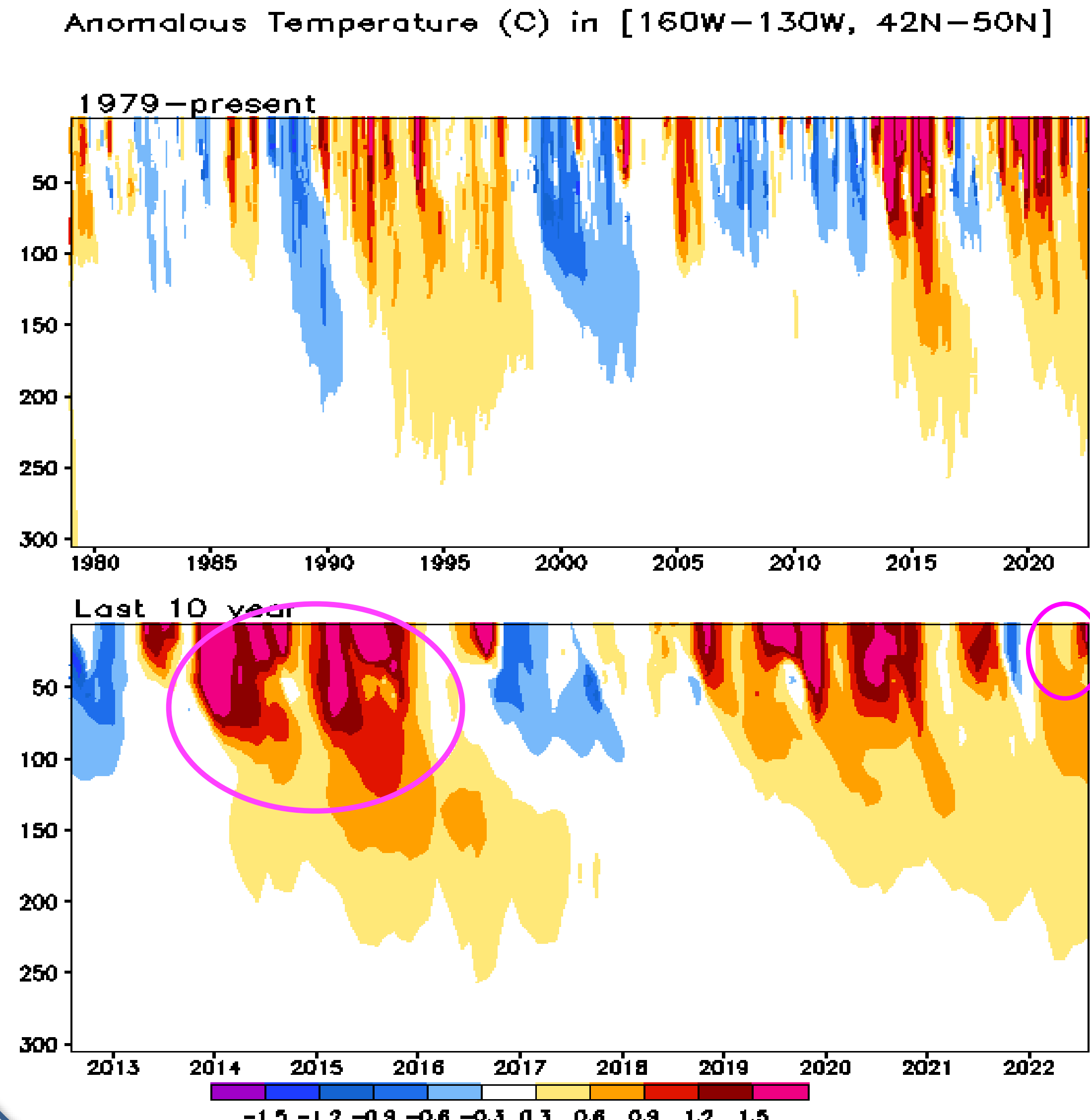


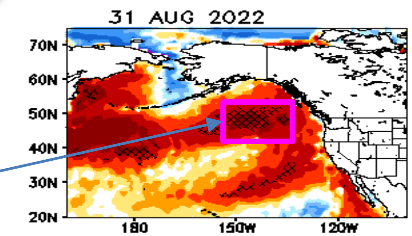


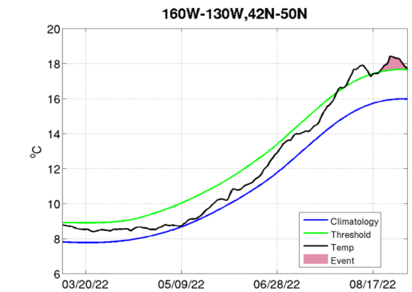
- MHWs in the north central Pacific decayed in the last couple of weeks, but SSTs were still close to 90th percentile.
- MHWs developed in the northeast Pacific (Pacific Blob) and near the west coast of USA.

(Left panel) Weekly SST anomaly (shaded) and locations experience Marine heat waves (hatched) by the date labelled in the plot. (right panel) SST evolution at a specific location. Green line and blue line denote the seasonal 90th percentile and daily climatology, respectively. Shaded area denotes the periods experiencing MHW. MHW is defined as a discrete prolonged warmer than 90th percentile of daily SST for at least 14 days. Data is derived from NCEI OISSTv2.1 and the climatology reference period is 1991-2020

Subsurface Temperature Anomaly in the Northeast Pacific (Pacific Blob)

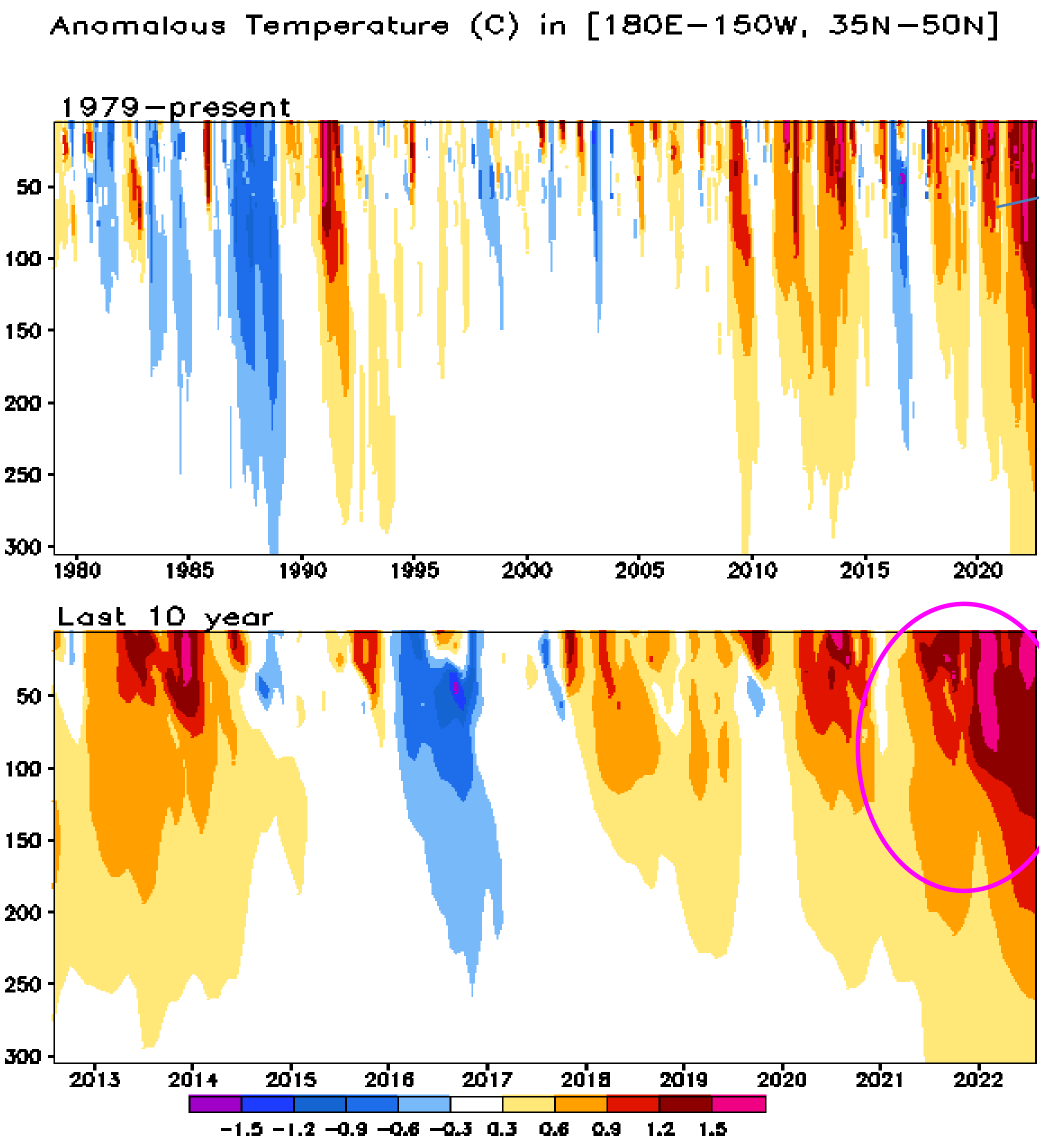


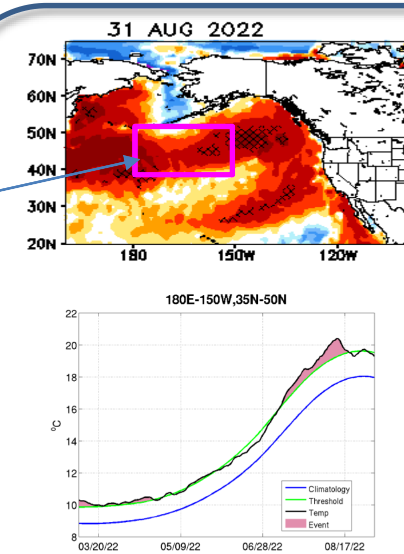




- Positive subsurface temperature anomaly (>0.9ºC) was confined in the upper 50m in Aug 2022.
- Subsurface warming was strongest during 2014-2016 (Pacific Blob).

Subsurface Temperature Anomaly in the North-Central Pacific

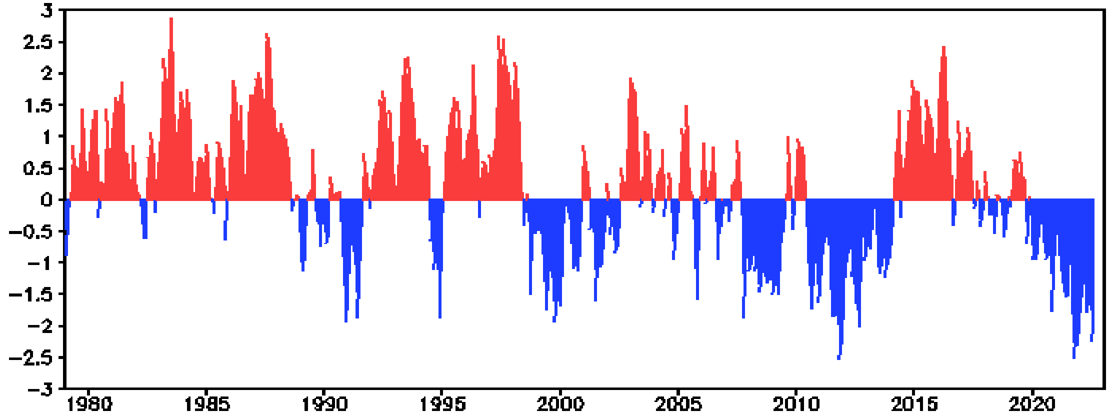




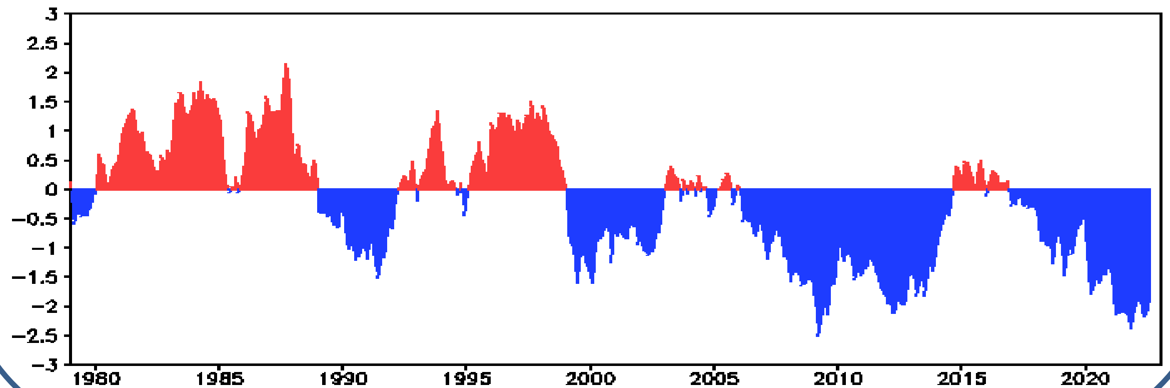
- Positive subsurface temperature anomaly in the North central Pacific has persisted since 2018.
- Subsurface warming in recent months is the strongest event since 1979.
- Positive temperature anomaly (>0.9ºC) penetrates to 200m in recent months.

Two Oceanic PDO indices

SST-based PDO (Wen et al. 2014: GRL)



H300-based PDO (Arun and Wen 2016:Mon.Wea.Rev.)



- The negative phase of PDO has persisted since Jan 2020 with PDOI = -2. in Aug 2022.

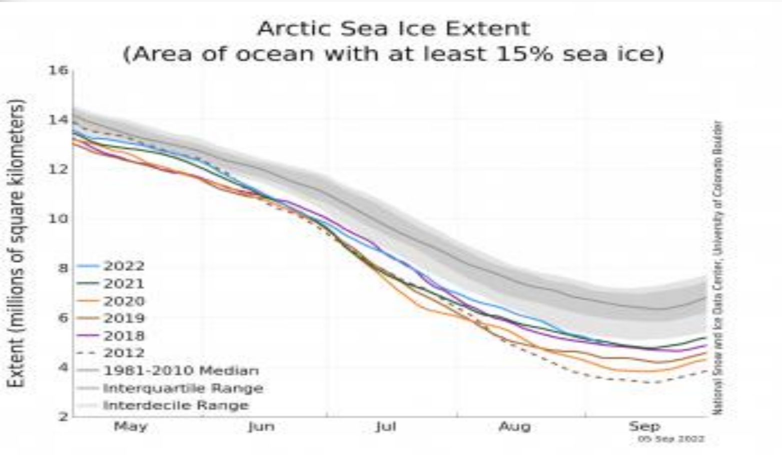
- Negative H300-based PDO index has persisted 70 months since Nov 2016, with HPDO = - 1.9 in Aug 2022.

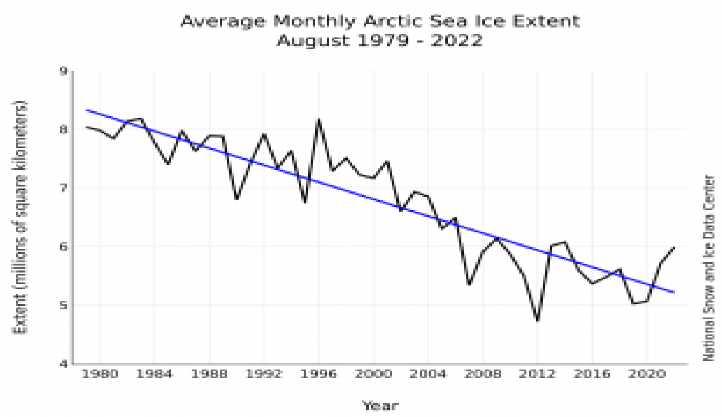
- SST-based PDO index has considerable variability both on seasonal and decadal time scales.

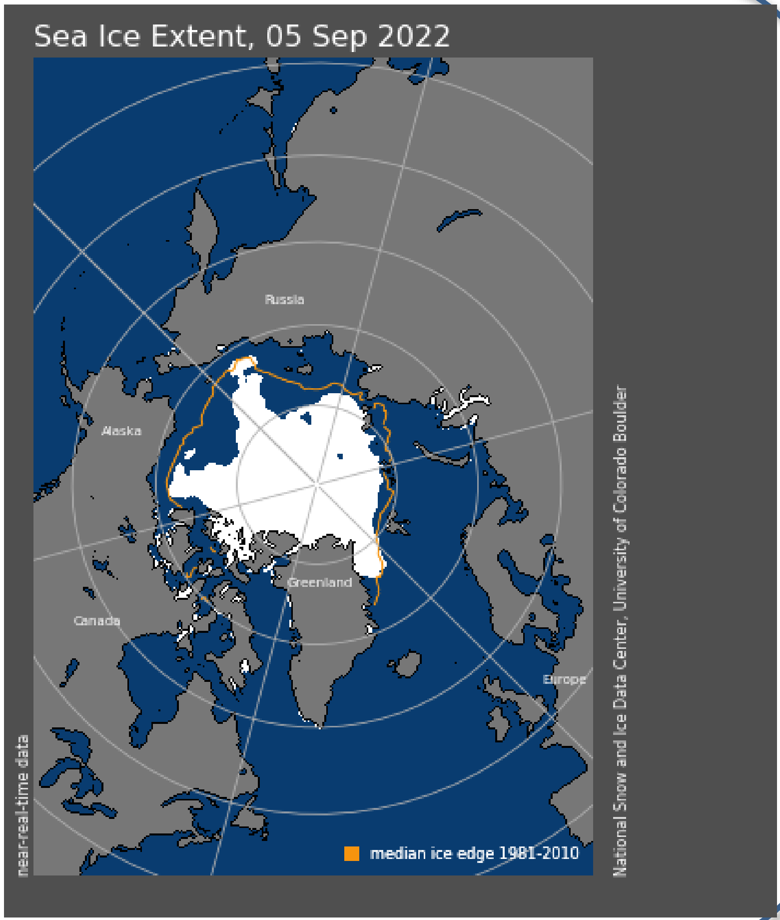
- H300-based PDO index highlights the slower variability and encapsulates an integrated view of temperature variability in the upper ocean.

SST-based PDO 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 ERSSTv5 SST anomalies onto the 1st EOF pattern. H300-based Pacific Decadal Oscillation is defined as the projection of monthly mean H300 anomalies from NCEP GODAS onto their first EOF vector in the North Pacific. PDO indices are downloadable from https://www.cpc.ncep.noaa.gov/products/GODAS/ocean_briefing.shtml.

Arctic Sea Ice; NSIDC (http://nsidc.org/arcticseaicenews/)

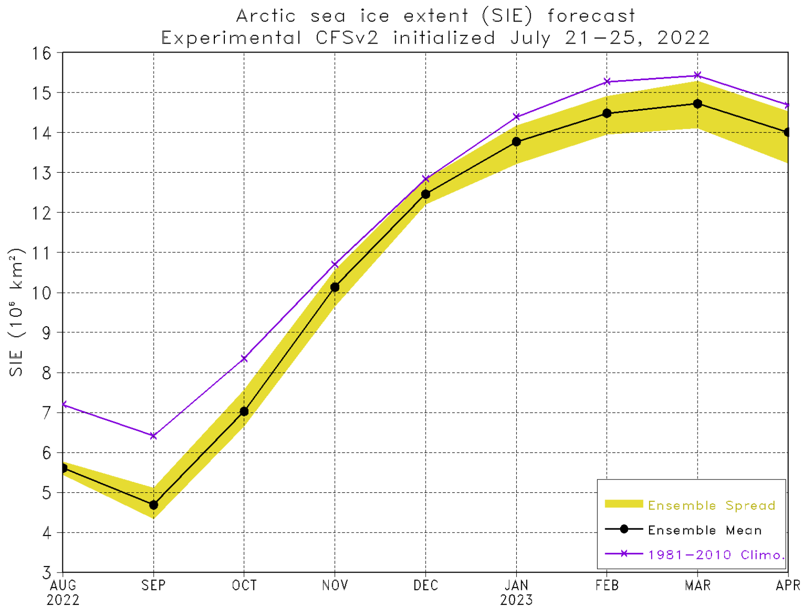


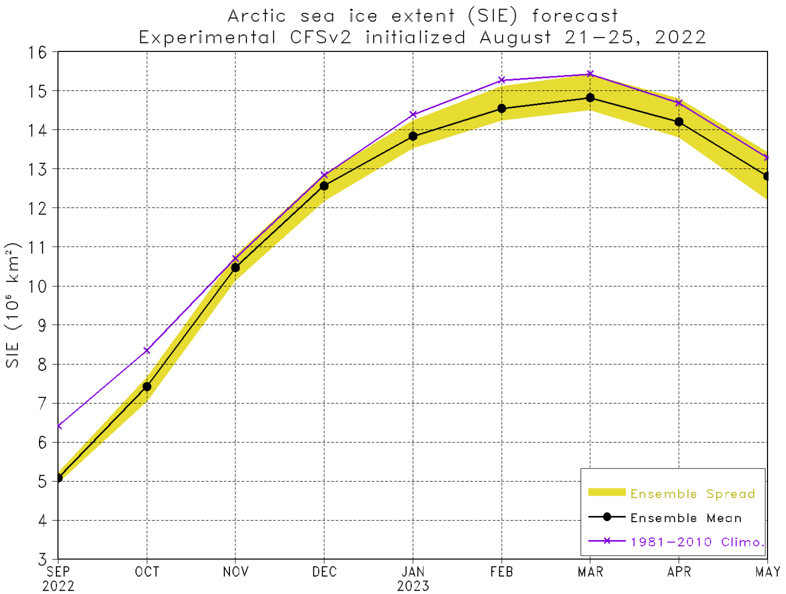




- Average Arctic sea ice extent for August 2022 was 5.99million square kilometers, ranking thirteenth lowest in the satellite record.

NCEP/CPC Arctic Sea Ice Extent Forecast

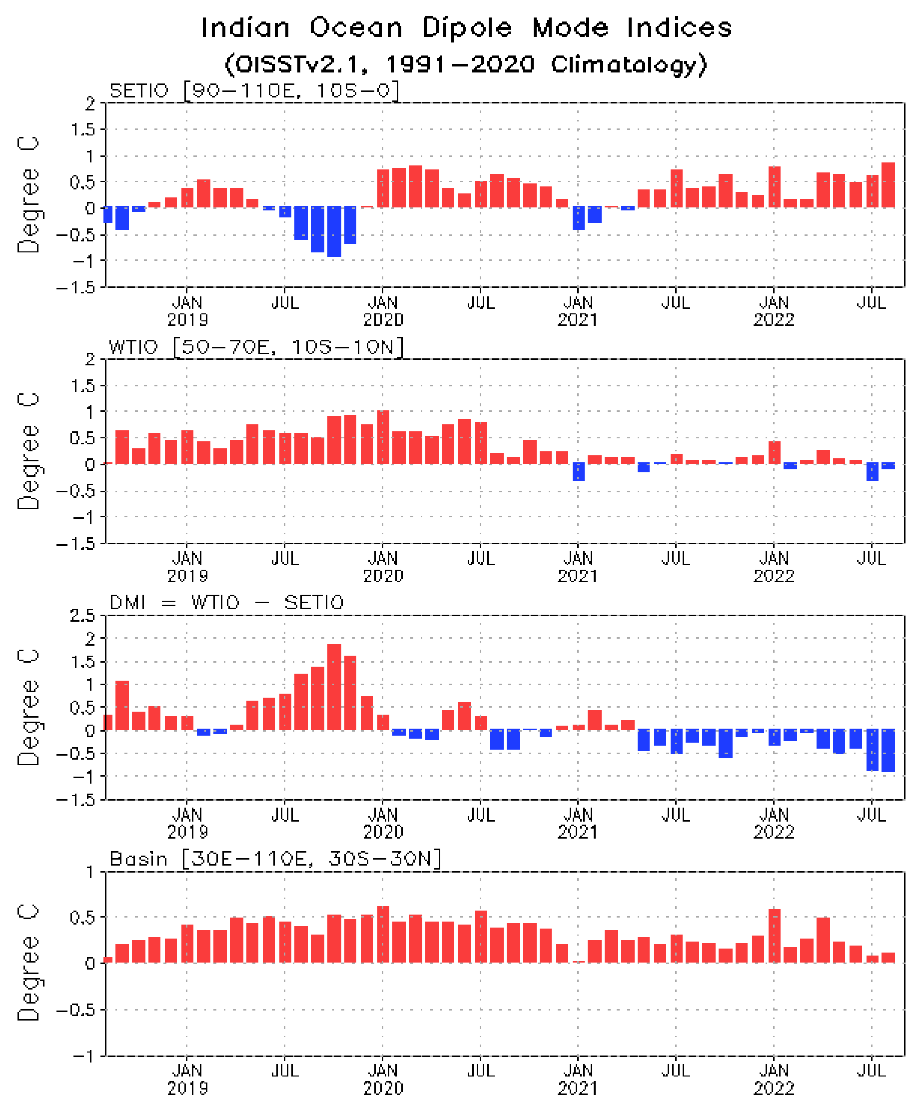


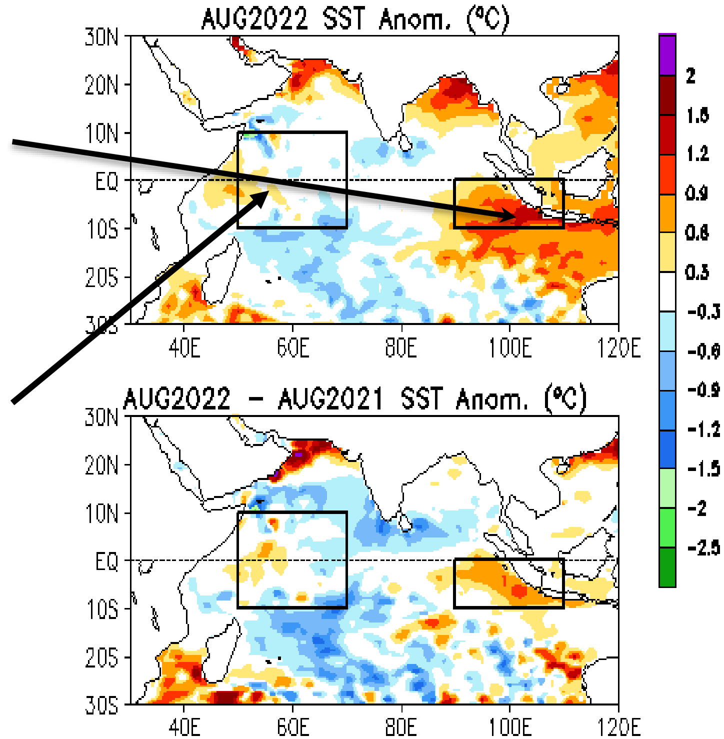


https://www.cpc.ncep.noaa.gov/products/people/wwang/seaice_seasonal/index.html

Indian Ocean

Evolution of Indian Ocean SST Indices

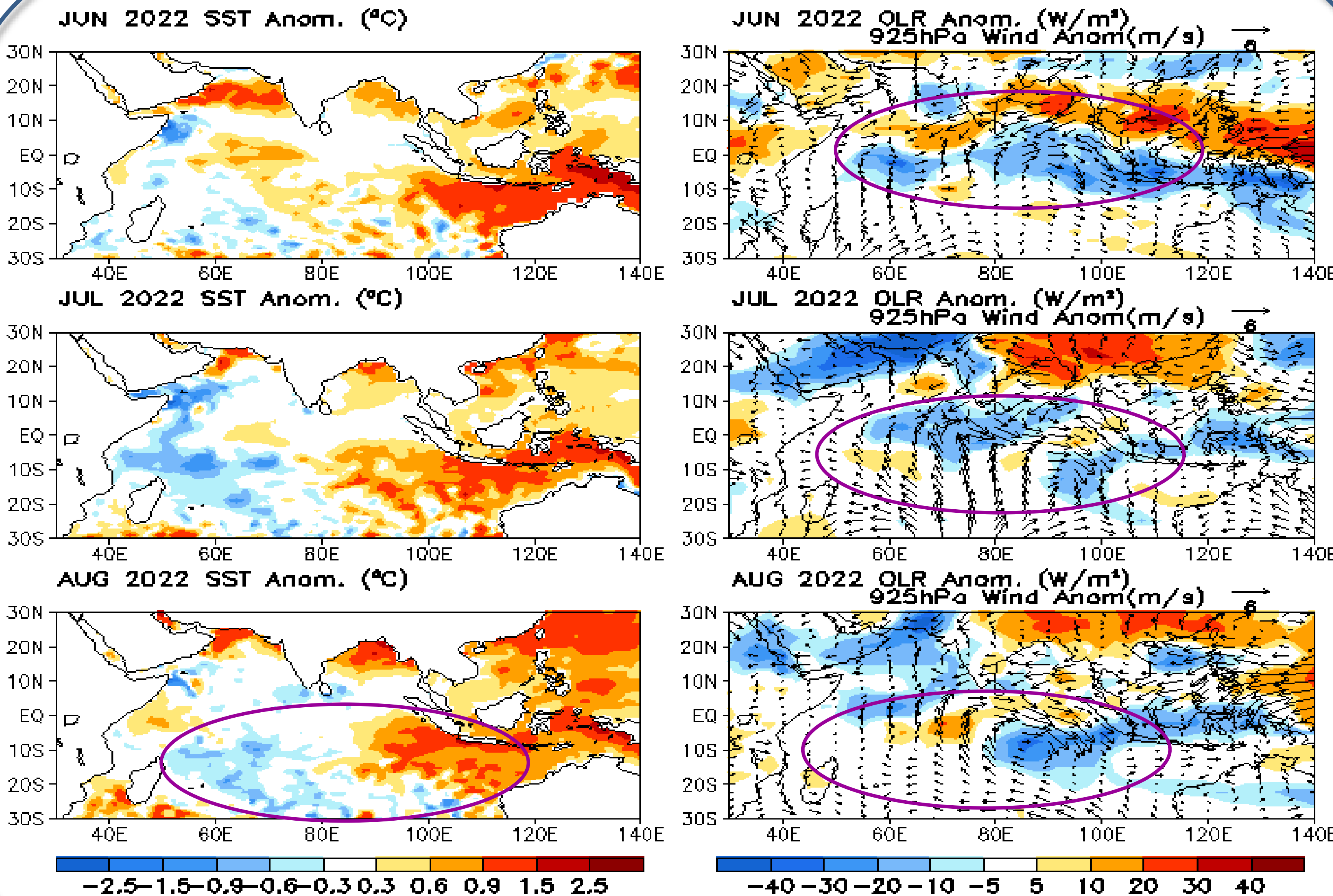




- Negative Indian Ocean Dipole Mode index (DMI) continued to be well below the -0.4℃ threshold in Aug 2022, indicating the development of a negative Indian Ocean Dipole event.

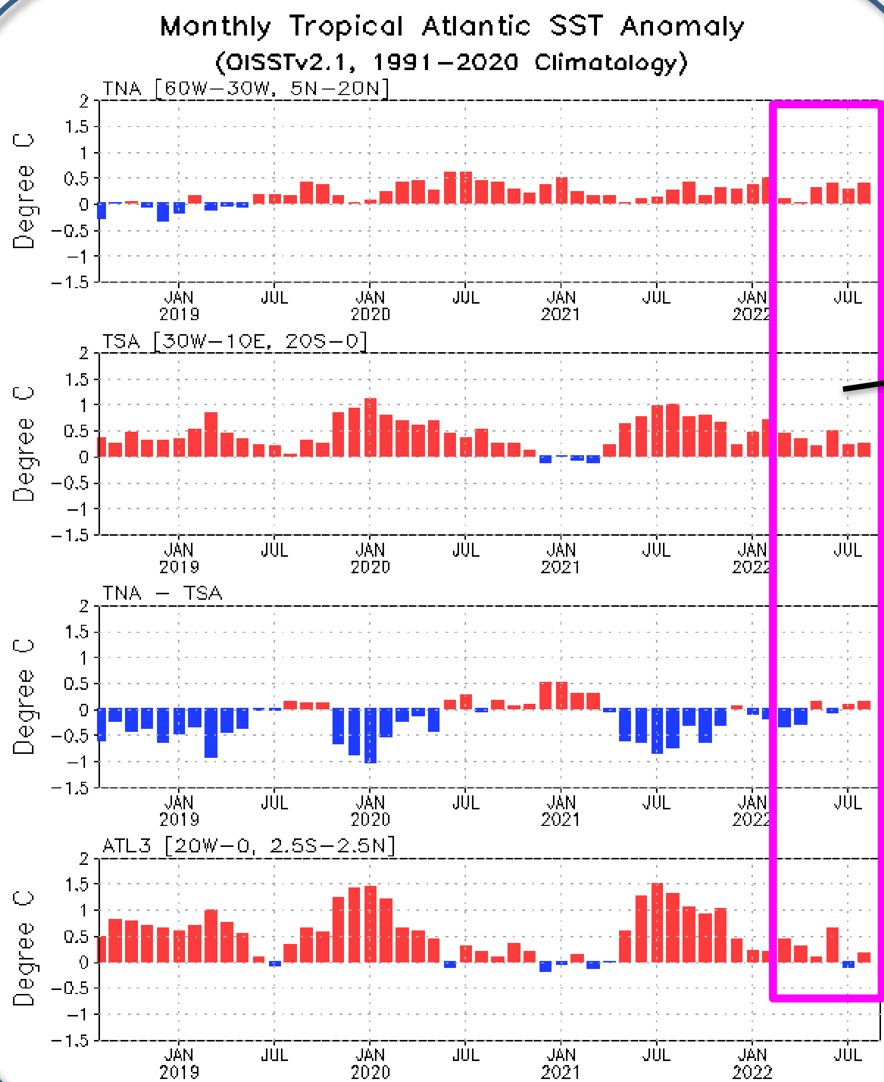
Indian Ocean region indices, calculated as the area-averaged monthly mean SSTA (OC) for the SETIO [90ºE-110ºE, 10ºS-0] and WTIO [50ºE-70ºE, 10ºS-10ºN] regions, and Dipole Mode Index, defined as differences between WTIO and SETIO. Data are derived from the OIv2.1 SST analysis, and anomalies are departures from the 1991-2020 base period means.

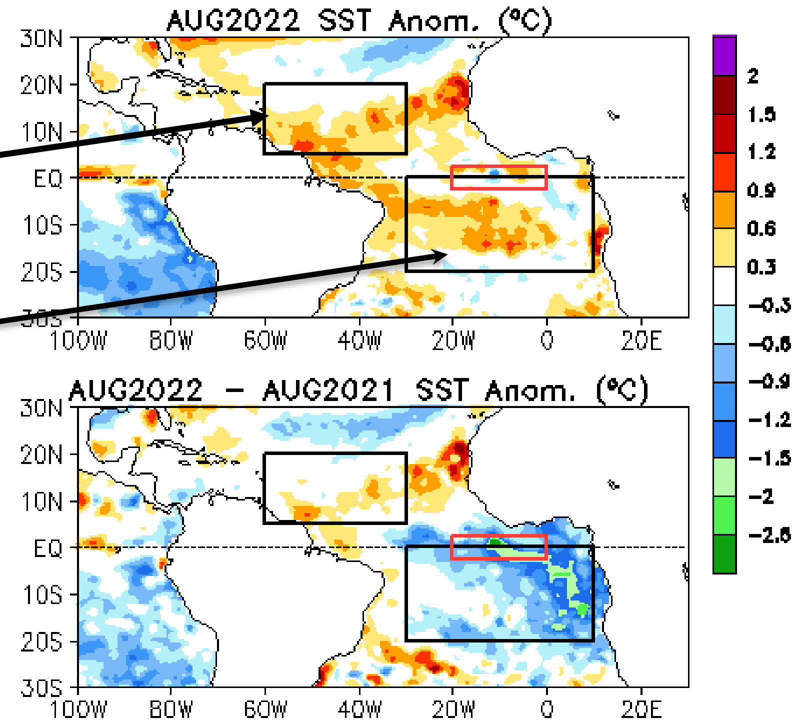
Last 3-month Tropical Indian SST , OLR & uv925 anomalies



Tropical and North Atlantic Ocean

Evolution of Tropical Atlantic SST Indices



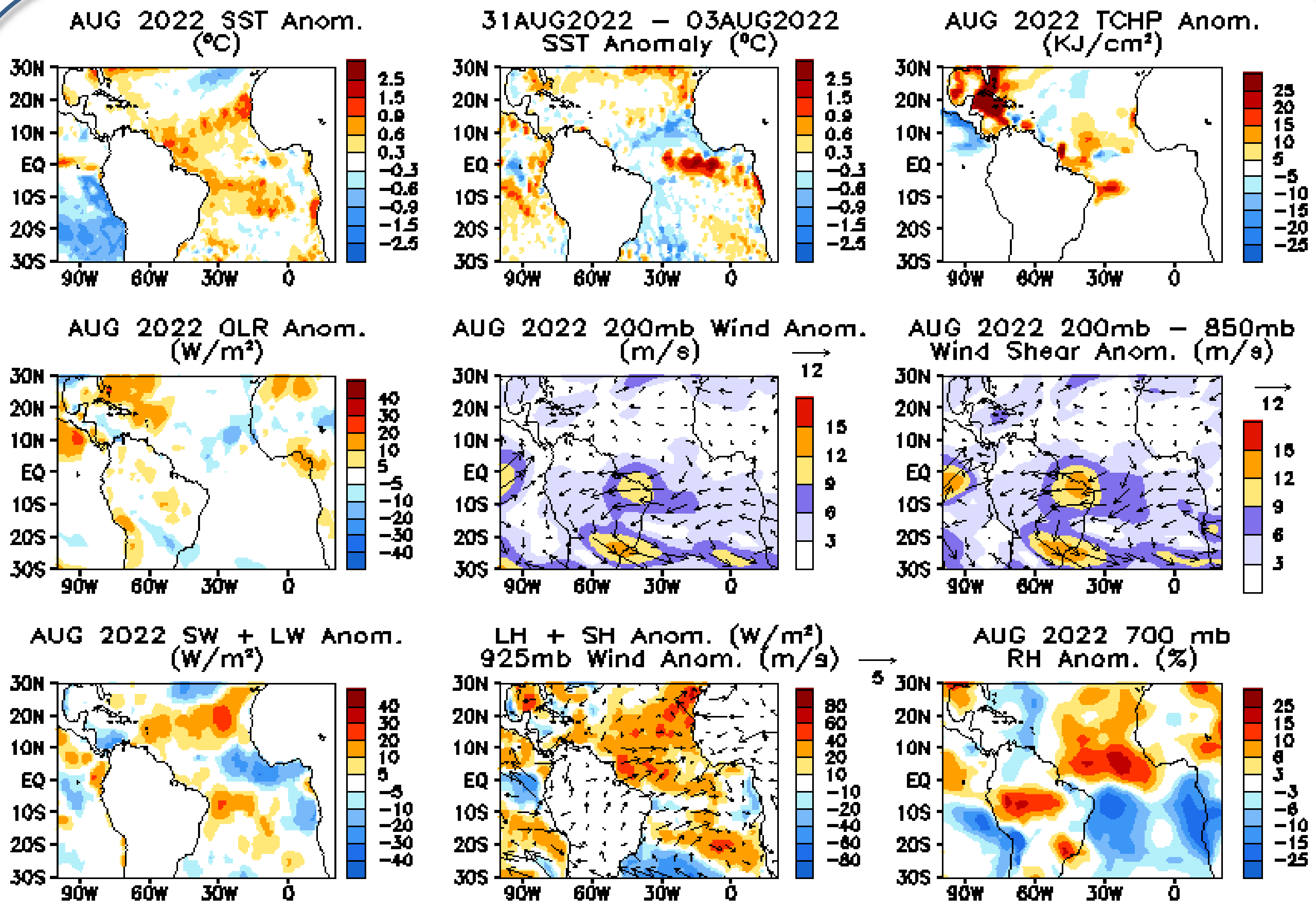


-TNA index warmed up slightly in Aug 2022.

- ATL3 index was near normal in Aug 2022.

Tropical Atlantic Variability region indices, calculated as the area-averaged monthly mean SSTAs (°C) for the TNA [60°W-30°W, 5ºN-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 OISSTv2.1 SST analysis, and anomalies are departures from the 1991-2020 base period means.

Tropical Atlantic Ocean: SSTA, SSTA Trend, TCHP,OLR,UV200,UV200-UV850, Heat Flux and RH Anomalies



2022 Atlantic Hurricane Season Activities

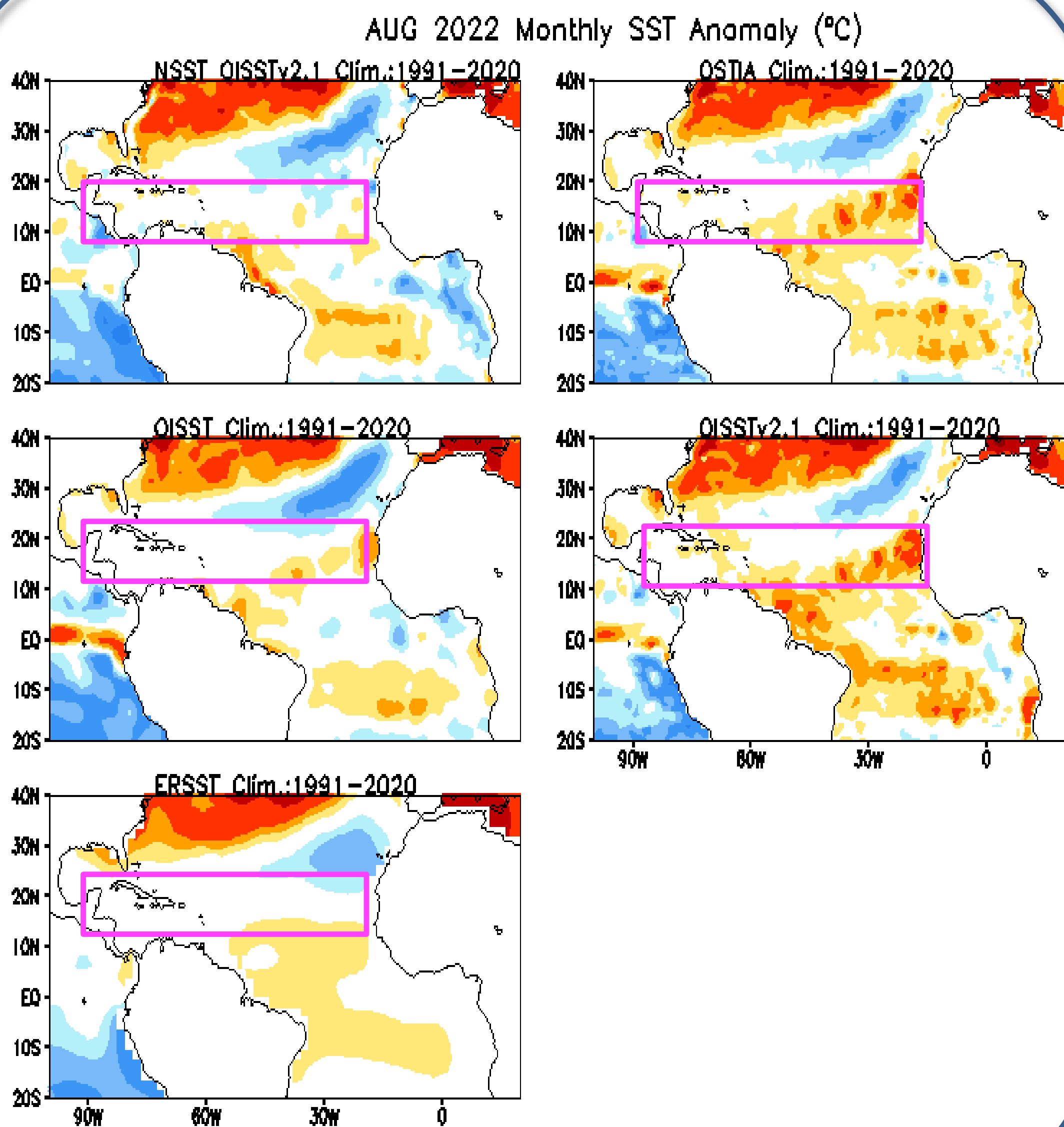
https://en.wikipedia.org/wiki/2022_Atlantic _hurricane_season

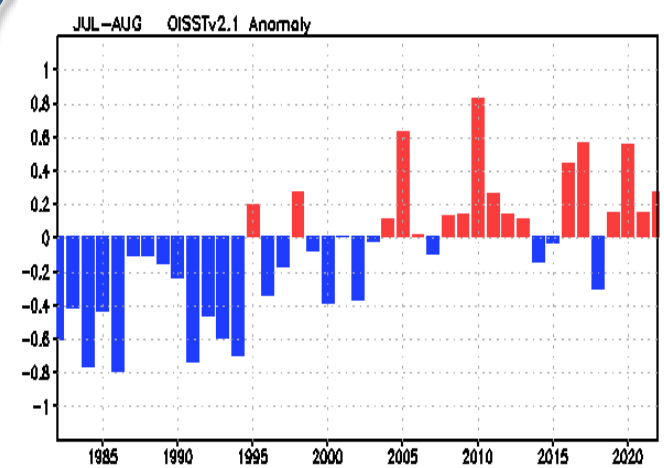
- No tropical storms developed during 3 Jul -31 Aug.

-By 7 Sep 2022, five tropical storms formed, with two developed into hurricanes.

Atlantic	Observations (By Sep7)	Updated Outlook (Aug) 60% above-normal	Outlook (May) 65% above-normal	(1991-2020)
Total storms	5	14-20	14-21	14
Hurricanes	2	6-10	6-10	7
Major hurricanes	0	3-5	3-6	3

Monthly SST Anomaly in the Atlantic Ocean

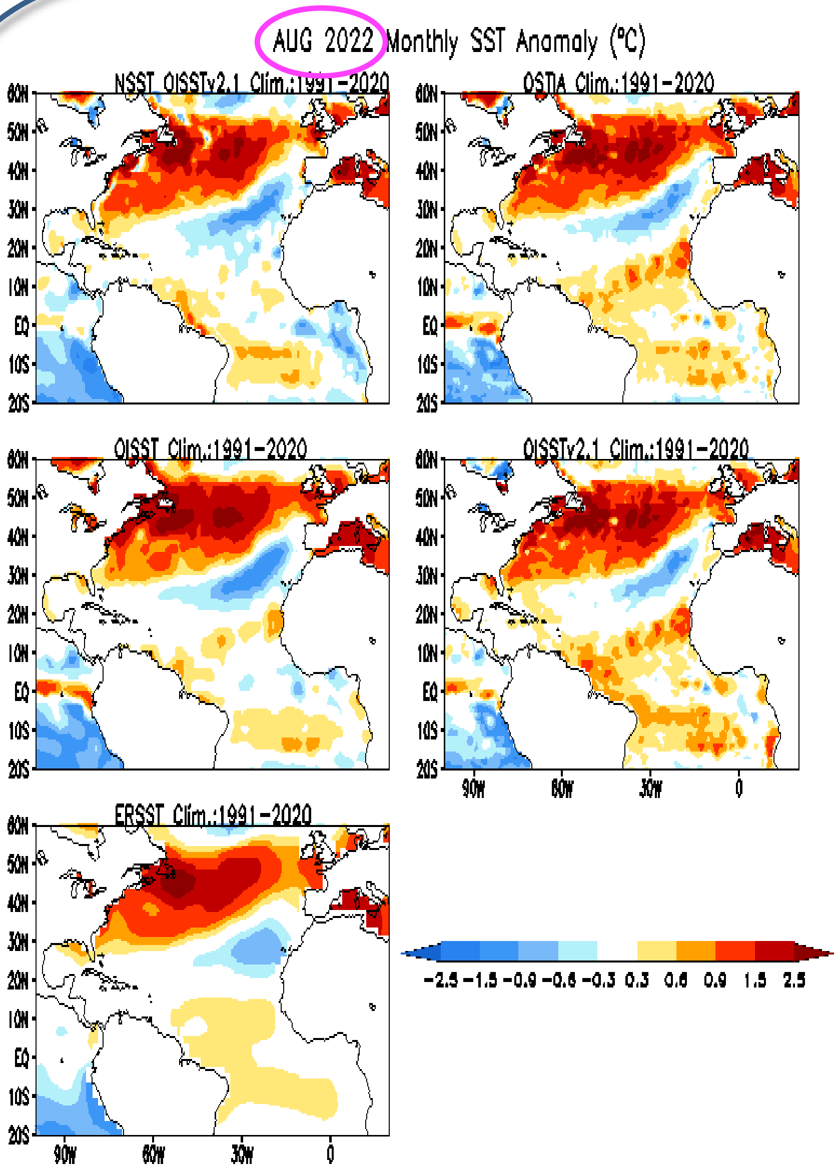


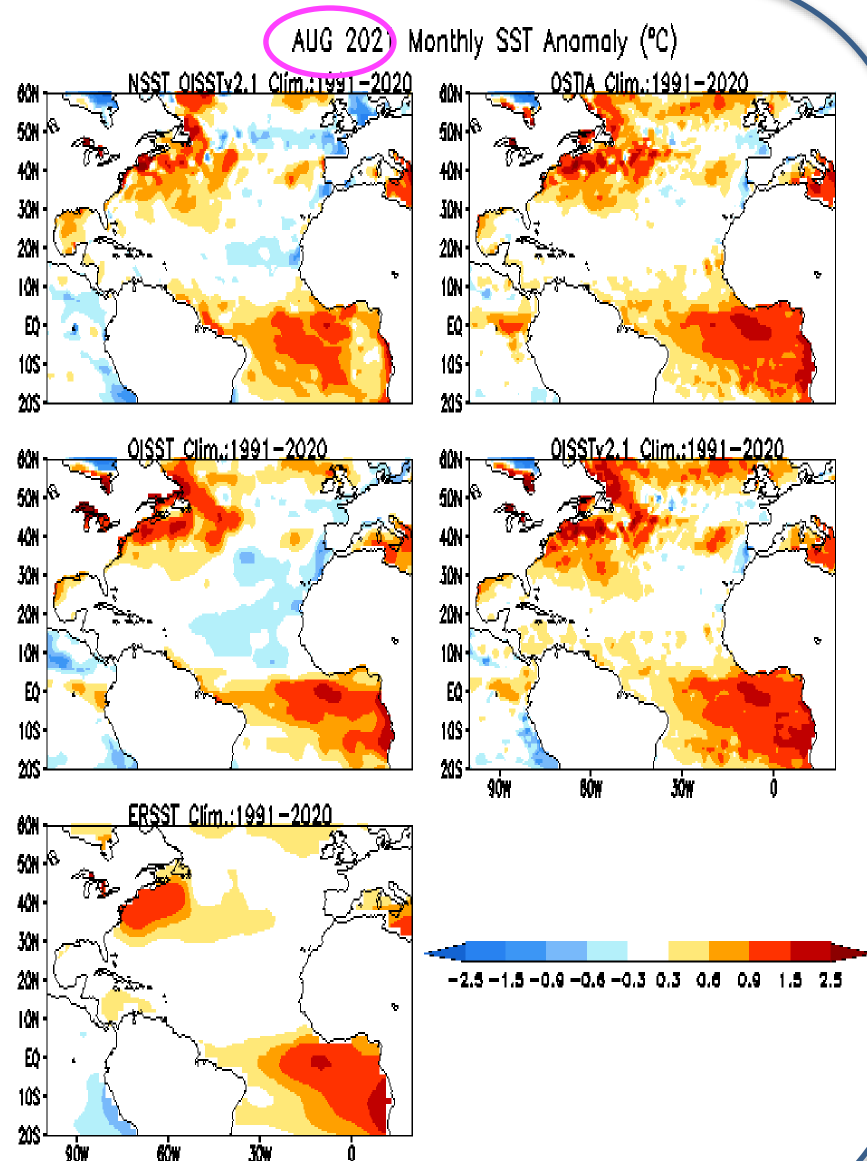


- Different SST datasets display anomalies of different sign in the hurricane main development region (MDR).

-NSST was cooler than OISST v2.1 in the northern tropical Atlantic Ocean.

Monthly SST Anomaly in the Atlantic Ocean

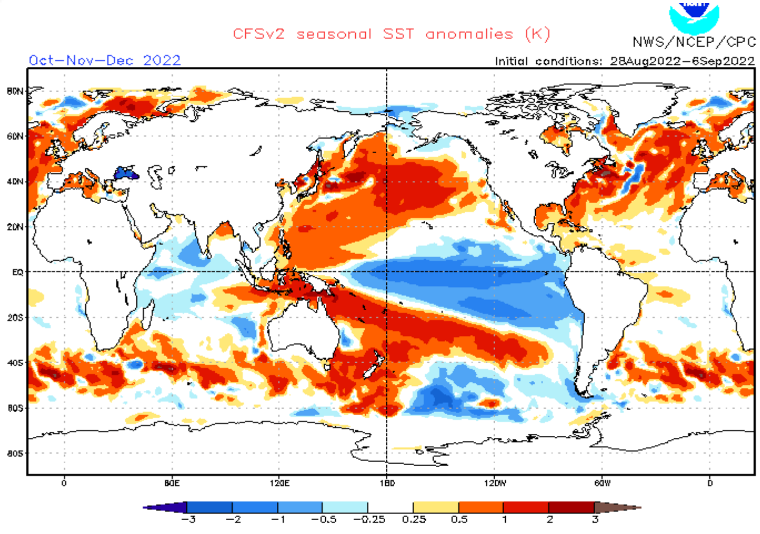




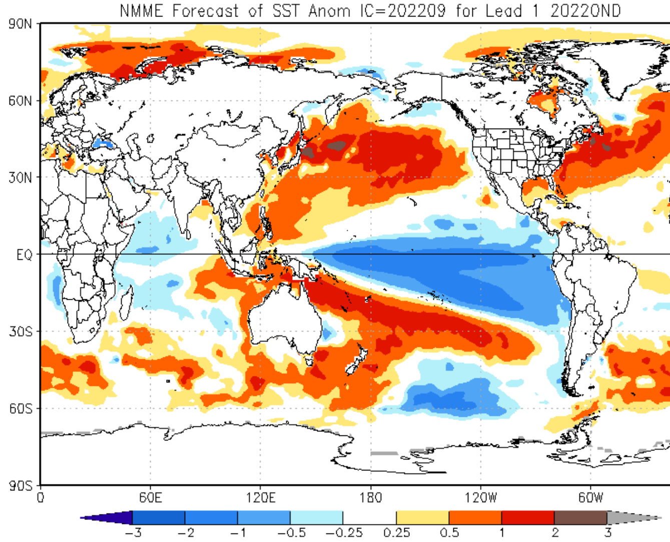
ENSO and Global SST Predictions

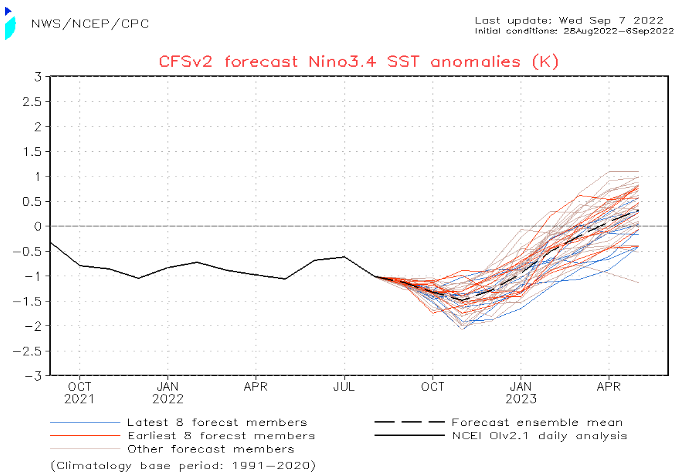
CFSv2 and NMME SST predictions

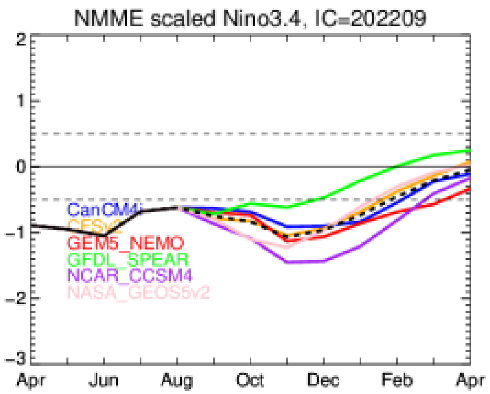
CFSv2 IC:Sep for 2022 OND



NMME IC:Sep for 2022 OND



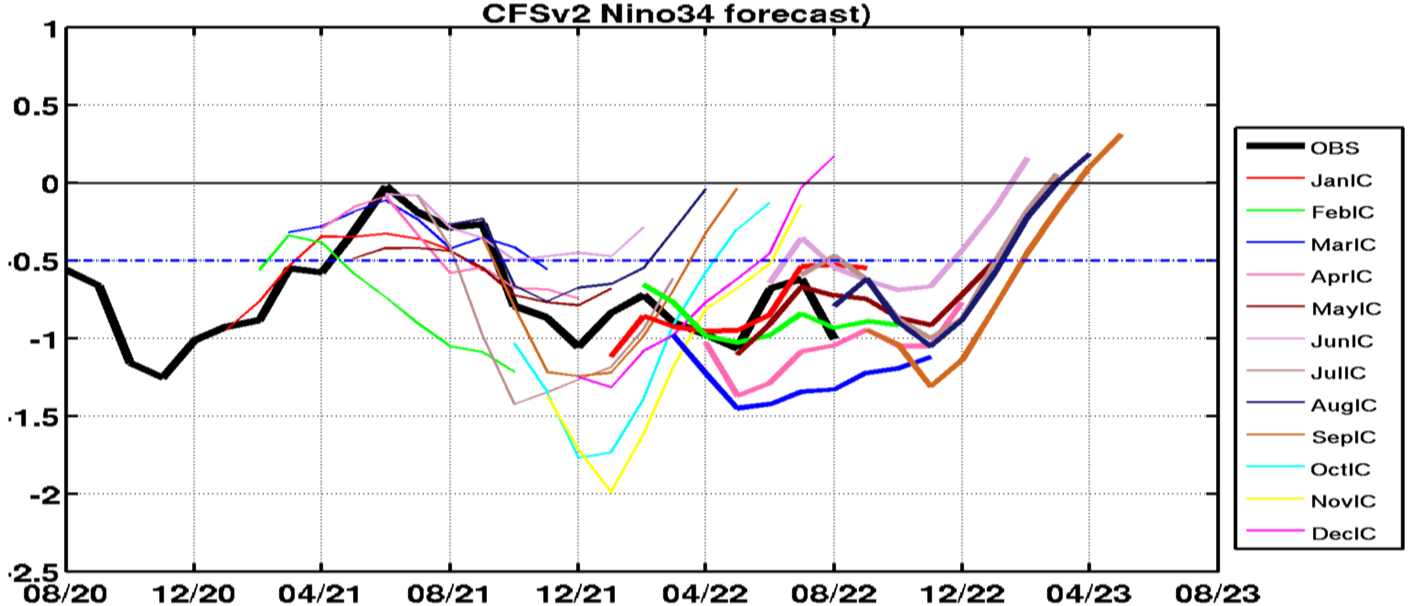


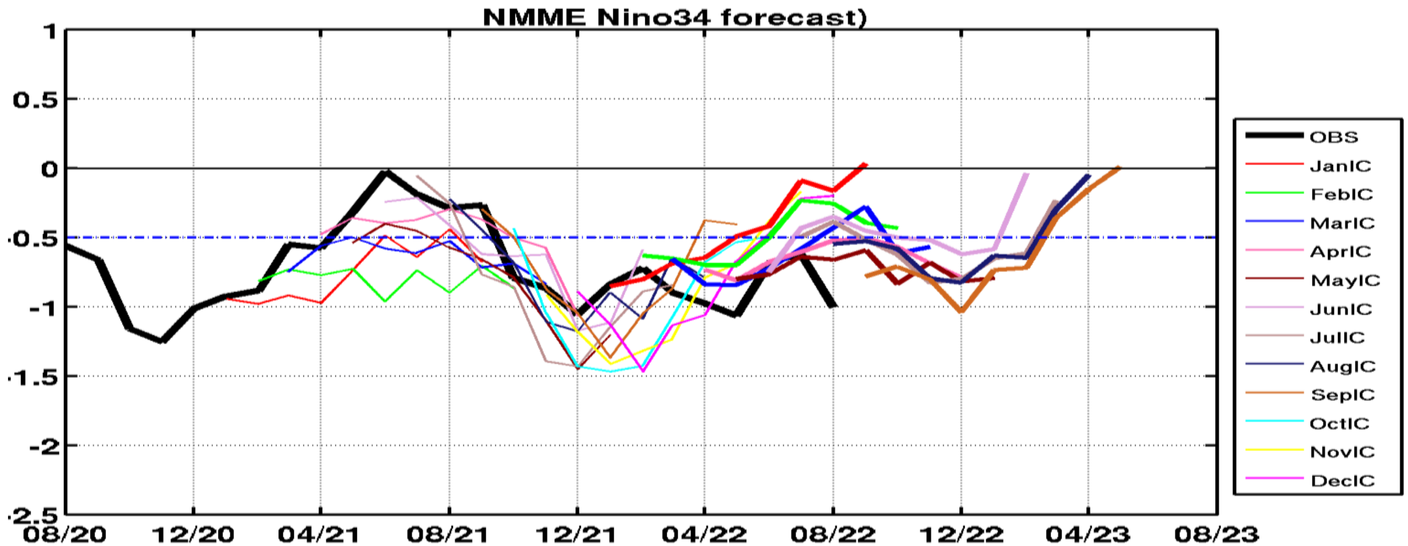


https://www.cpc.ncep.noaa.gov/products/CFSv2/CFSv2seasonal.shtml

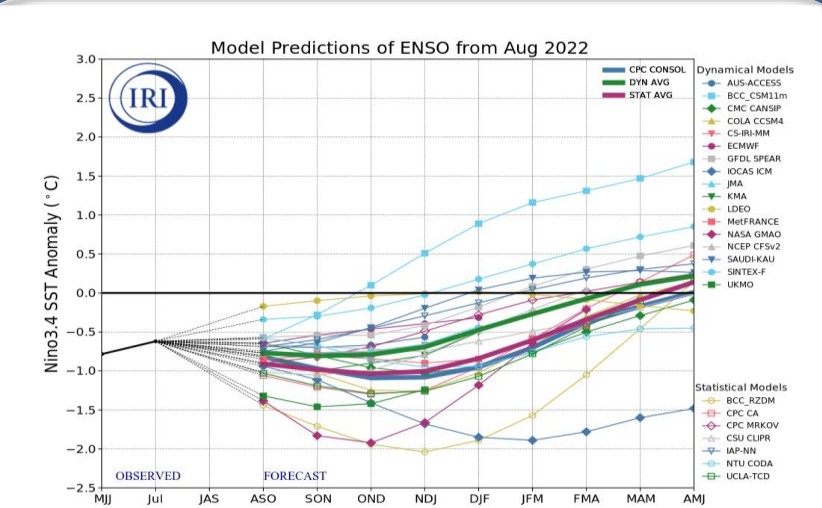
https://www.cpc.ncep.noaa.gov/products/NMME/

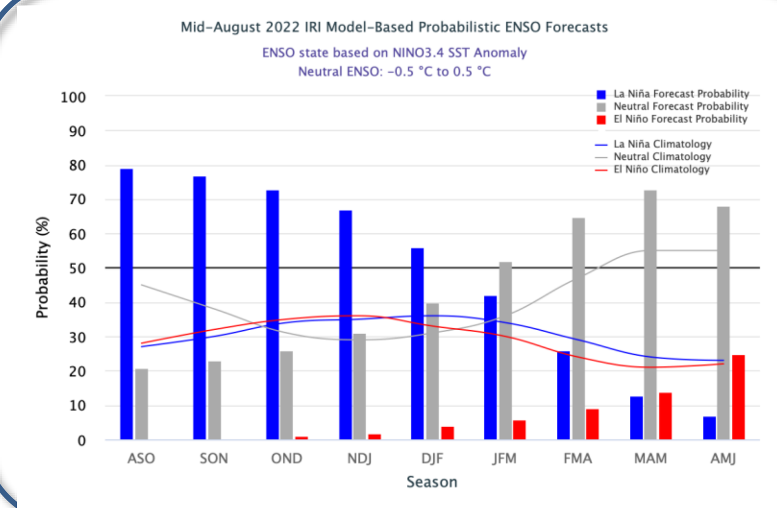
CFSv2 and NMME Nino34 predictions





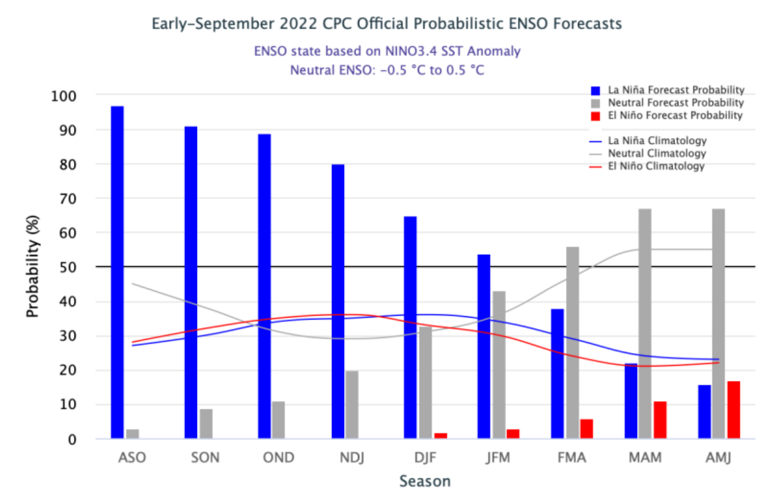
IRI/CPC Niño3.4 Forecast : July 2022



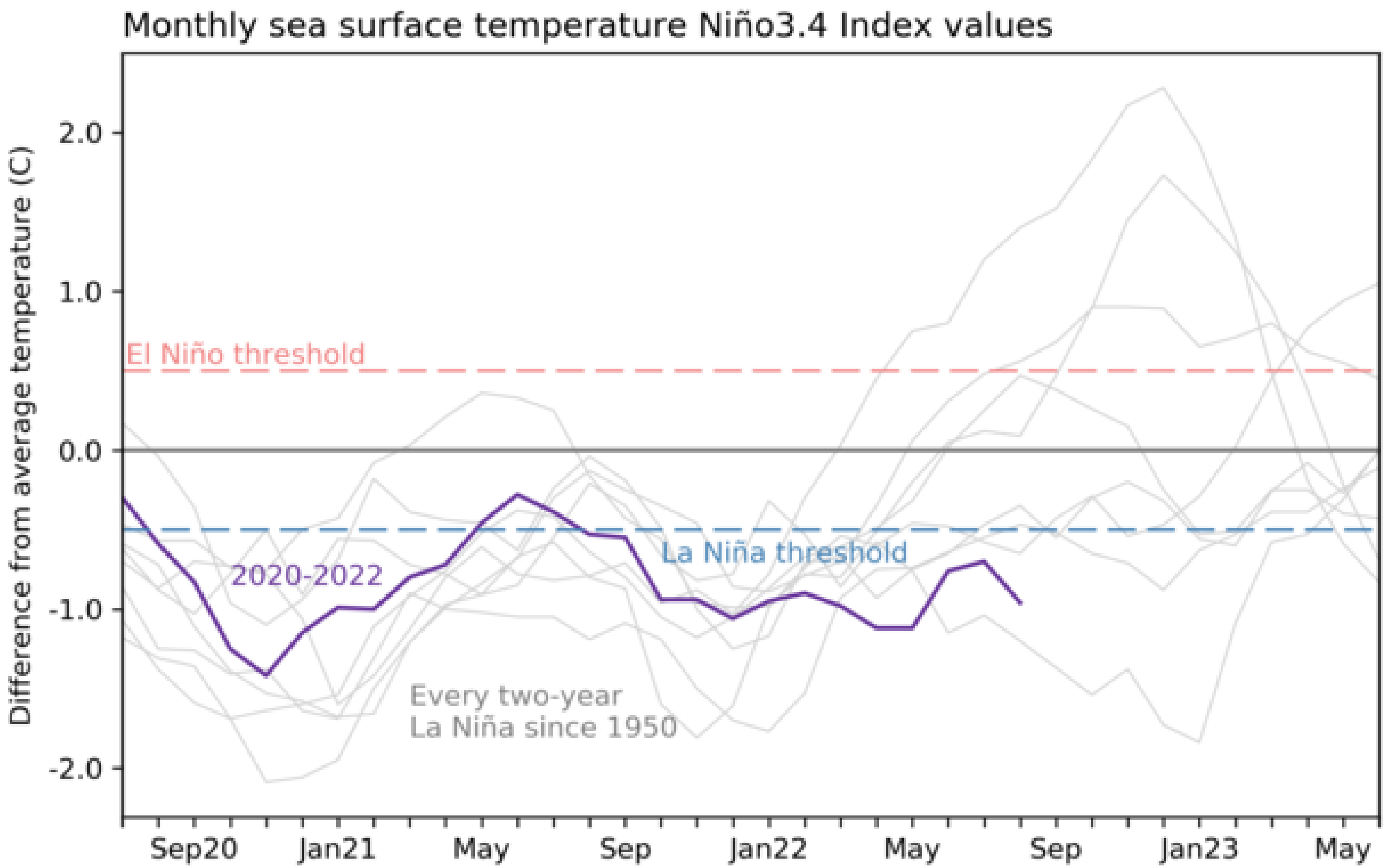


- A majority of models predict SSTs to remain below-normal at the level of a La Niña until at least Dec-Feb 2023.

- NOAA "ENSO Diagnostics Discussion" on 8 September stated that "La Niña is favored to continue through Northern Hemisphere winter 2022-23, with a 91% chance in Sep-Nov and decreasing to a 54% chance in Jan-Mar 2023.

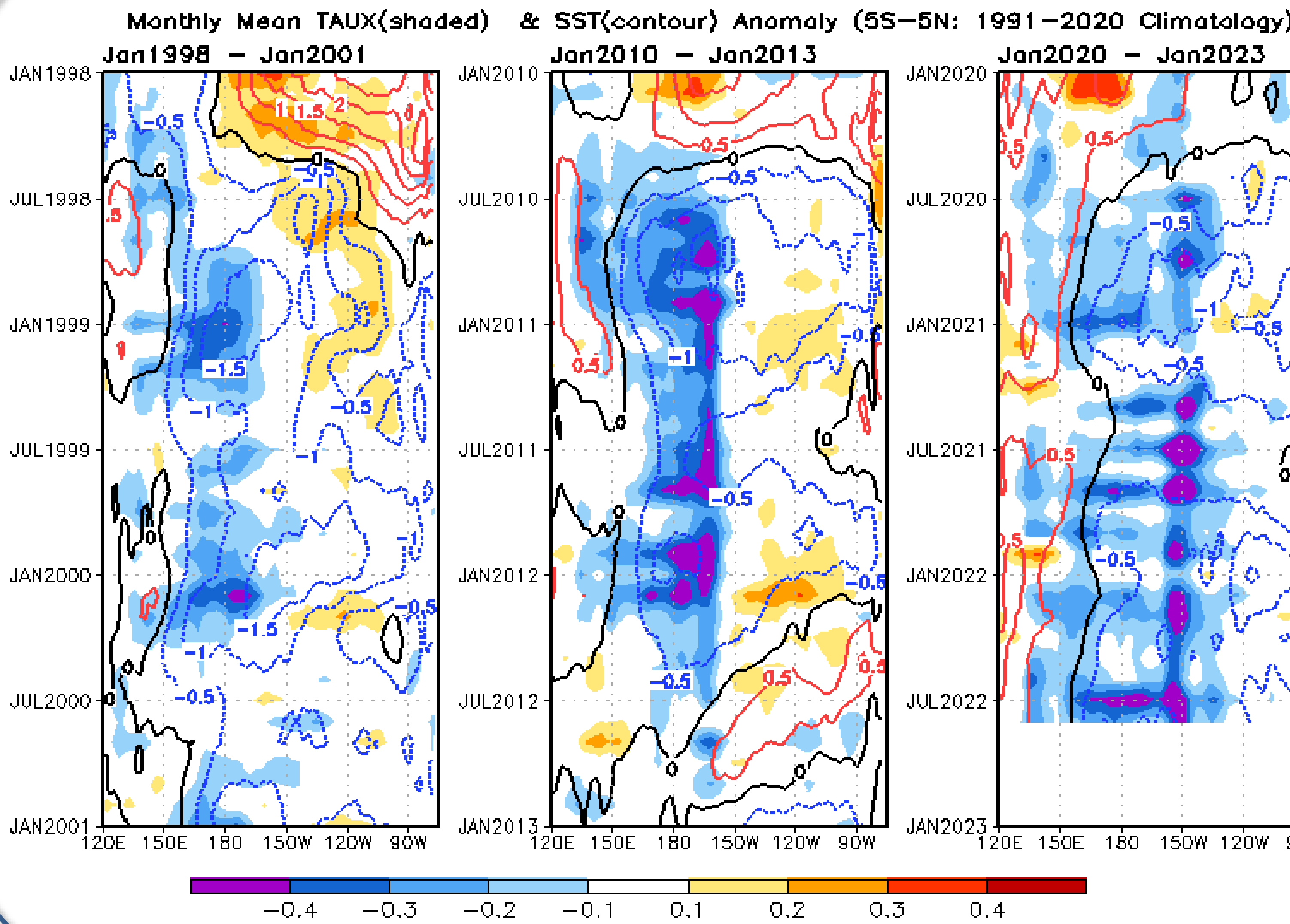


Nino3.4 Index Evolution in two-year La Ninas since 1950 (MICHELLE L'HEUREUX)



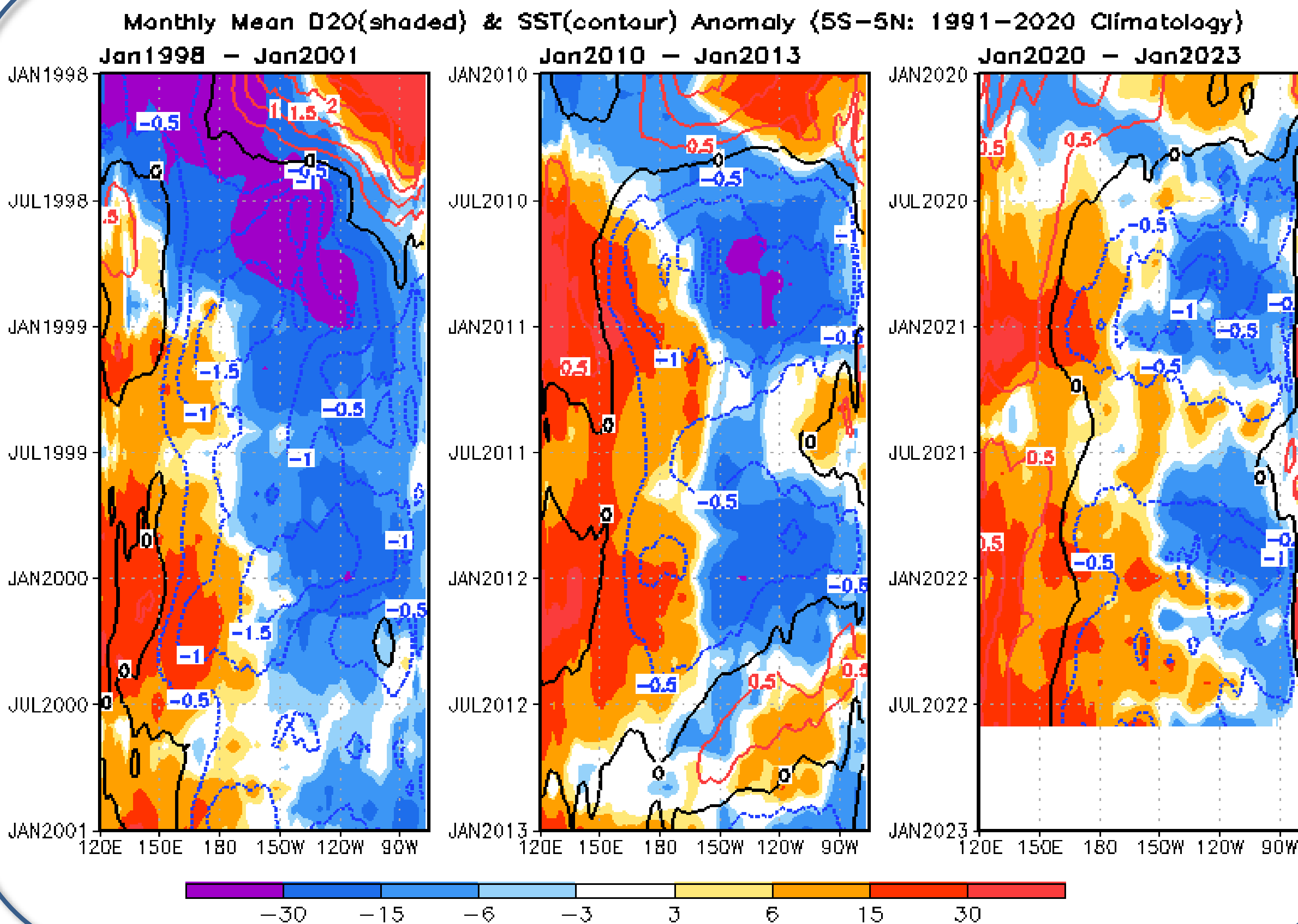
https://www.climate.gov/news-features/blogs/september-2022-la-ni%C3%B1a-update-it%E2%80%99s-q-time

Evolution of Monthly Mean TAUX & SST Anomaly across [5S-5N]



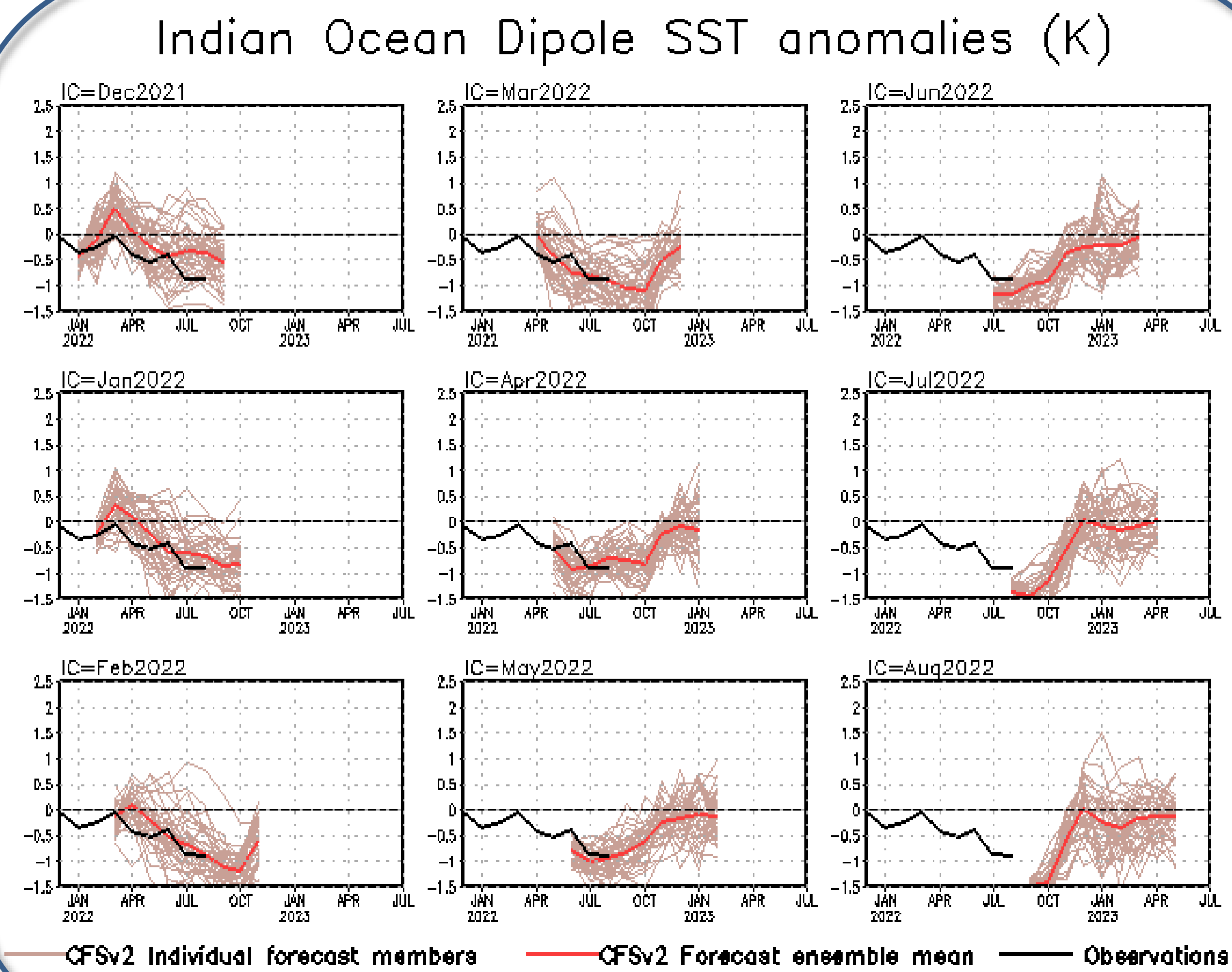
Data source: NCEP R2 reanalysis

Evolution of Monthly Mean D20 & SST Anomaly across [5S-5N]



Data source: NCEP R2 reanalysis

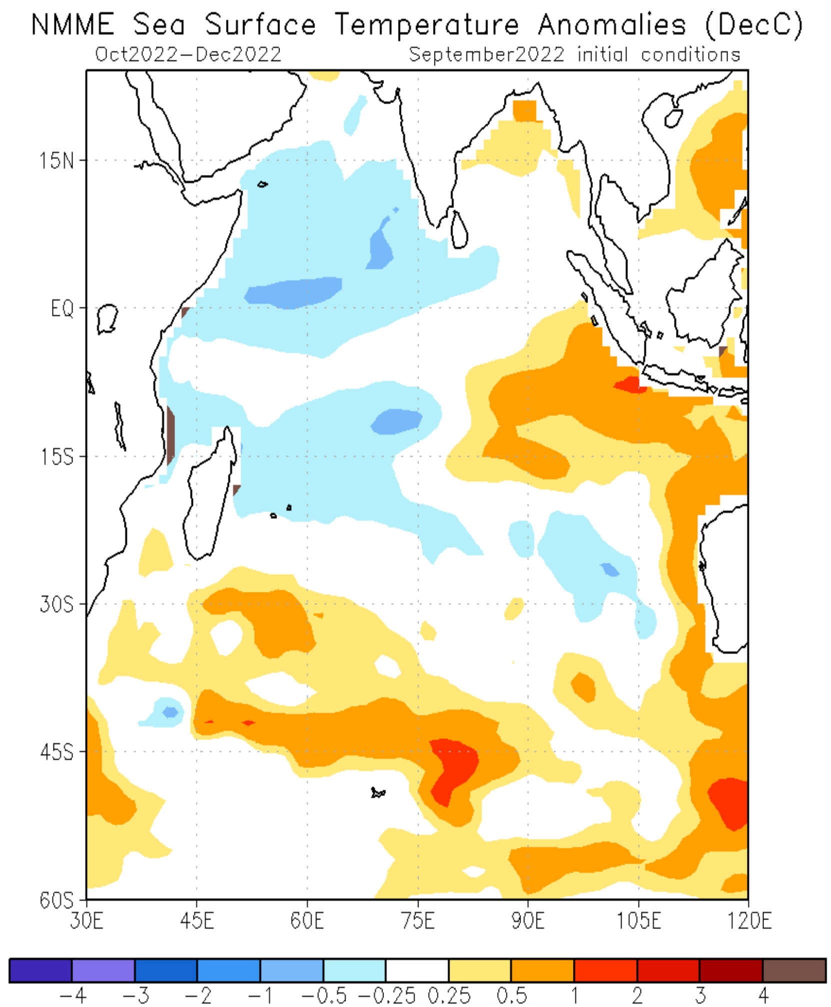
CFSv2 DMI SST Predictions

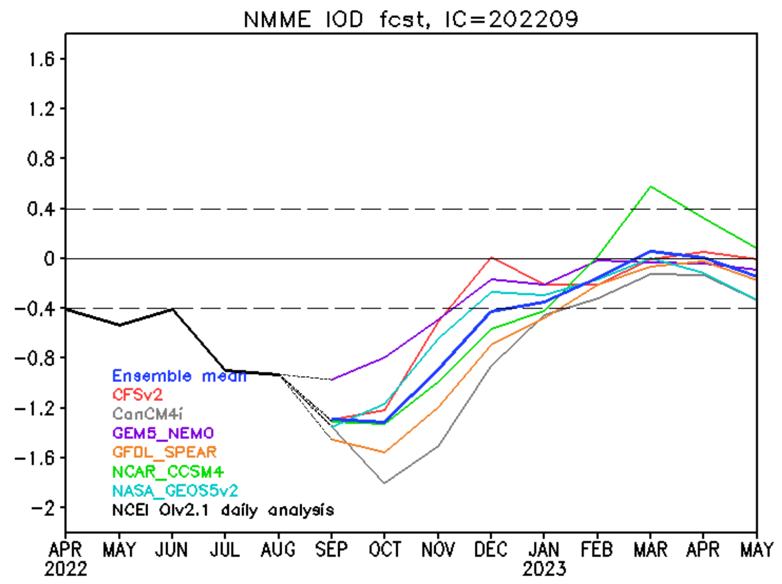


- CFSv2 did a good job in prediction the IOD evolution with IC Jan-May 2022.
- Latest CFSv2 forecasts favored a negative IOD conditions through fall 2022.

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 1991-2020 base period means.

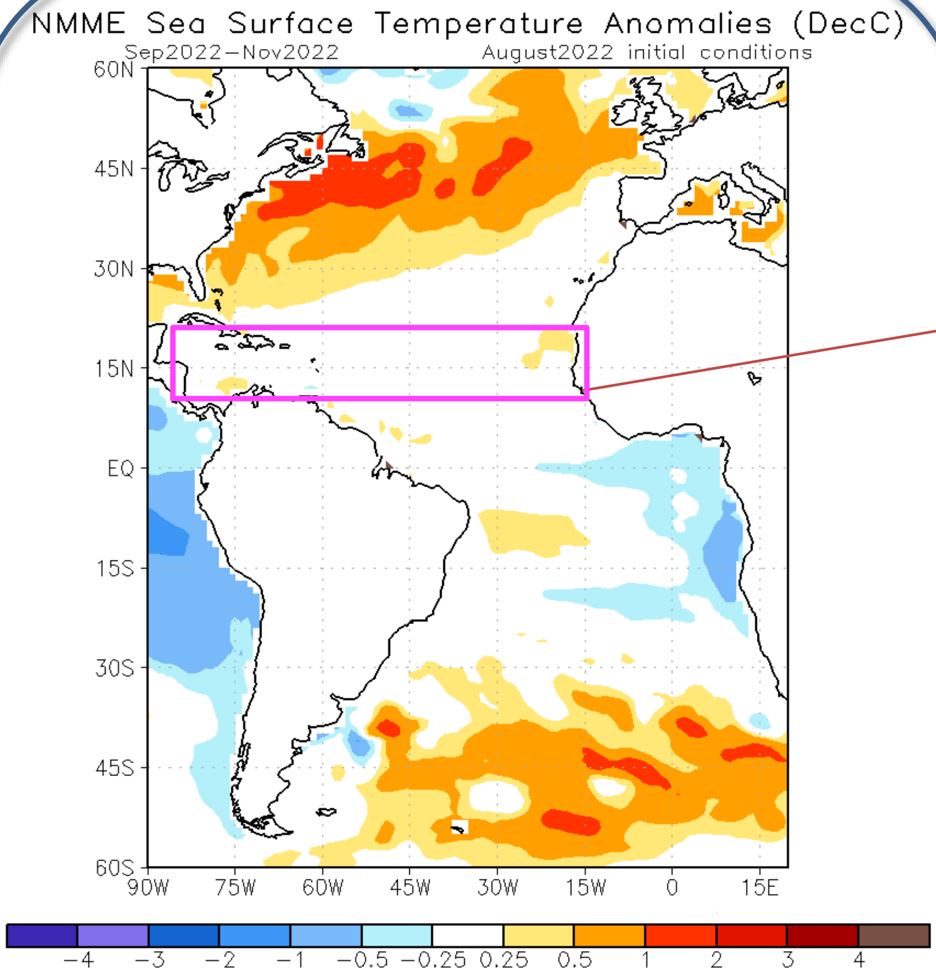
NMME Forecasts in the Indian Ocean





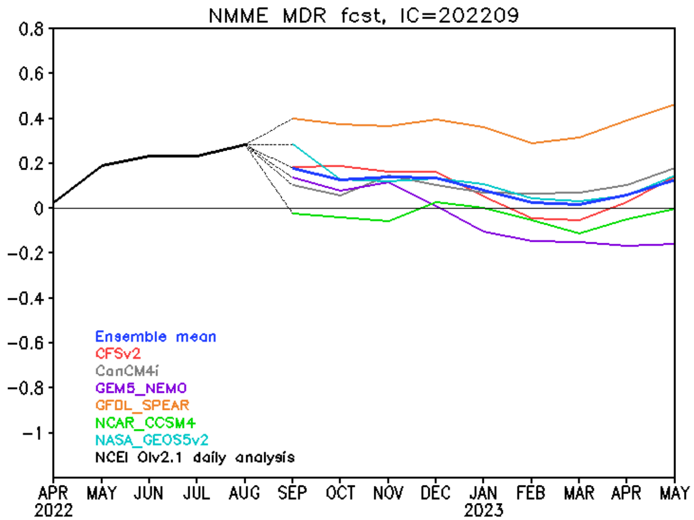
- All NMME models predict the negative IOD condition will last through Nov 2022.

NMME Forecasts in the Atlantic Ocean



https://www.cpc.ncep.noaa.gov/products/international/index.shtml

Hurricane Main Development Region (90ºW-12ºW, 9ºN-21.5ºN)



- A majority of NMME models predicted above or near normal SSTs to persist in the Hurricane main development region through the whole 2022 hurricane season.

Data Sources (climatology is for 1991-2020)

- **NCEP Weekly Optimal Interpolation SST (OI SST) version 2 (Reynolds et al. 2002, historical Monthly Ocean Briefing achieves ,Ocean briefing and GODAS web pages prior July 2022)**
- **Staring July 2022, NCEI Daily OISSTv2.1(Huang et al. 2021) replaced NCEP Weekly OISST data in the Monthly Ocean Briefing PPT , Ocean Briefing and GODAS web pages)**
- **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)**
- **NCDP/DOE Reanalysis II (R2) winds and heat fluxes (Kanamitsu et al. 2002)**
- **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

Acknowledgement

- Drs. Arun Kumar, Zeng-Zhen Hu and Jieshun Zhu : reviewed PPT, and provide insightful suggestions and comments
- Dr. Pingping Xie provided the BASS/CMORPH/CFSR EVAP package
- Dr. Wanqiu Wang provides the sea ice forecasts and maintains the CFSv2 forecast archive

Please send your comments and suggestions to:
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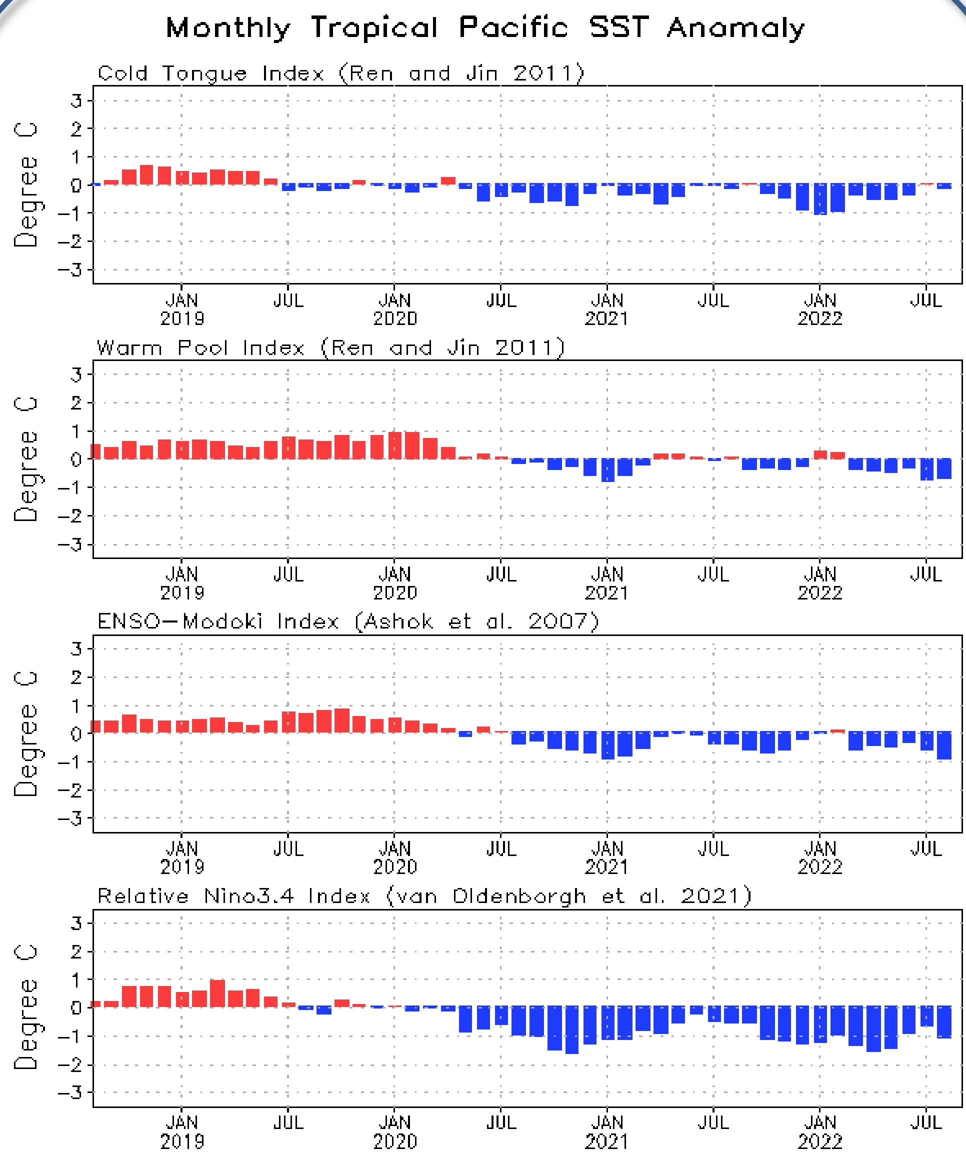
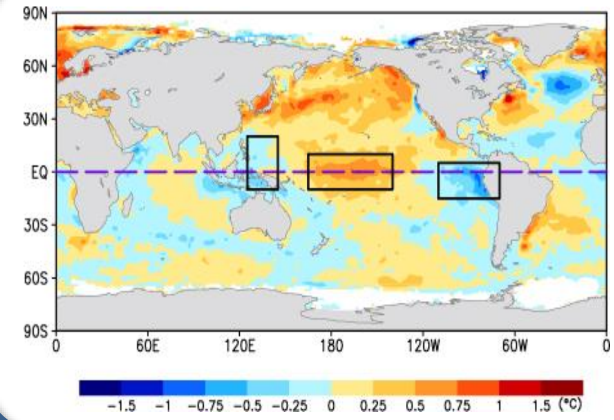
Jieshun.Zhu@noaa.gov
Caihong.Wen@noaa.gov
Zeng-Zhen.Hu@noaa.gov

Backup Slides

Evolution of Pacific Niño SST Indices



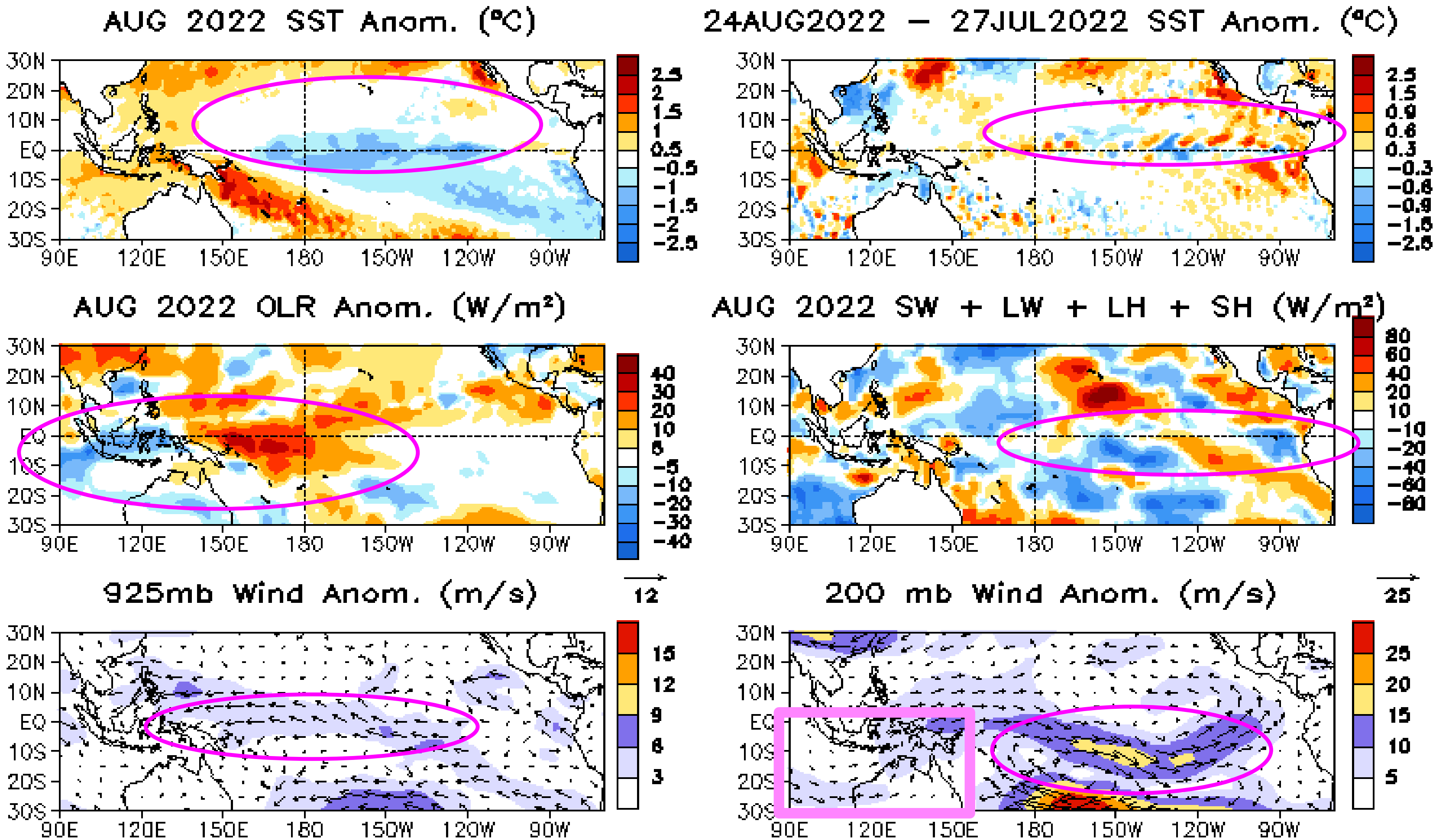


- Relative Niño3.4 index is defined as the conventional Niño3.4 index minus the SSTA averaged in the whole tropics (0º-360º, 20ºS-20ºN), in order to remove the global warming signal. Also, to have the same variability as the conventional Niño3.4 index, the relative Niño3.4 index is renormalized (van Oldenborgh et al. 2021: ERL, 10.1088/1748-9326/abe9ed).

Relative Niño3.4 data updated monthly at:

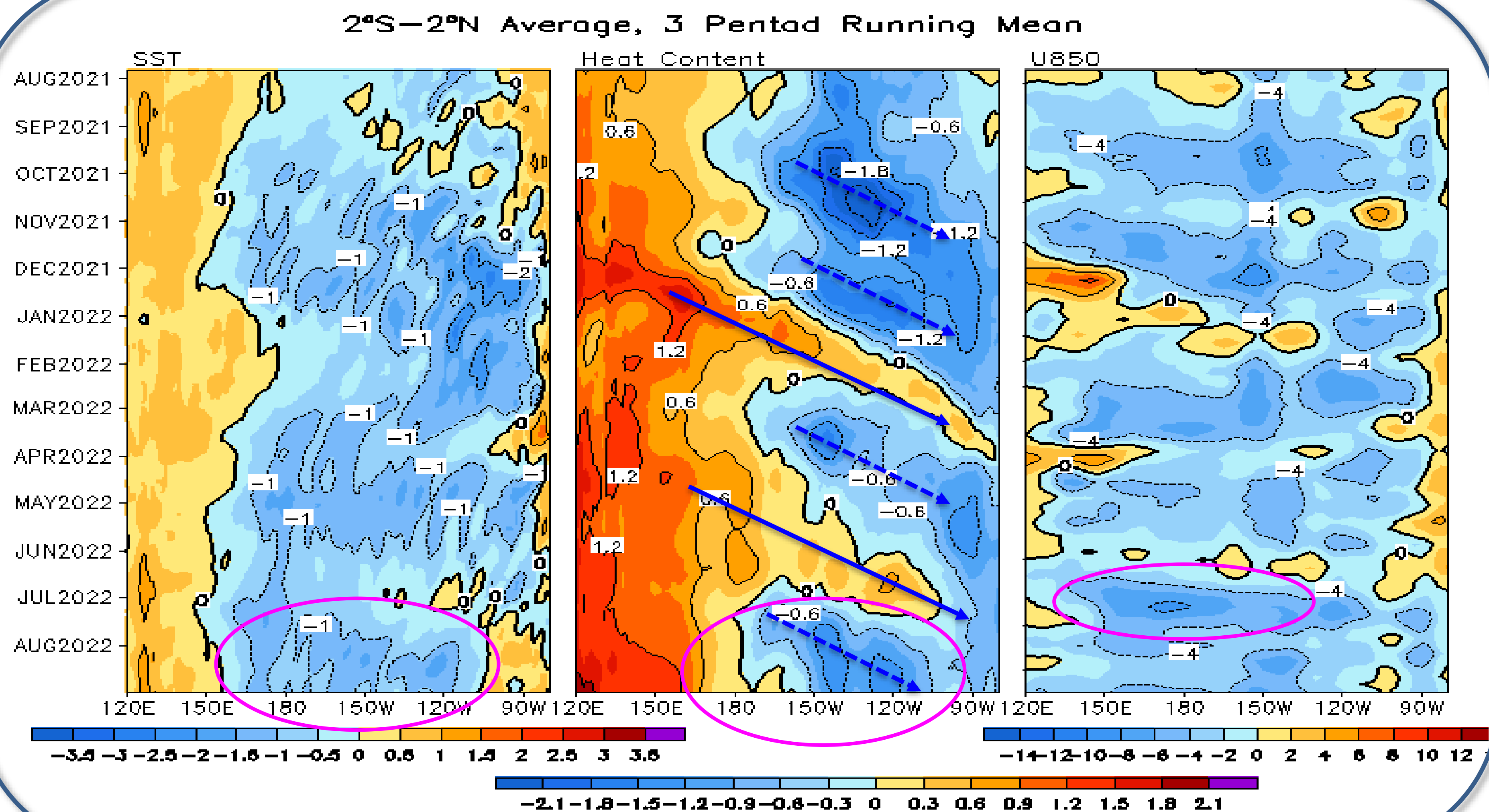
https://www.cpc.ncep.noaa.gov/data/indices/RONI.ascii.txt

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



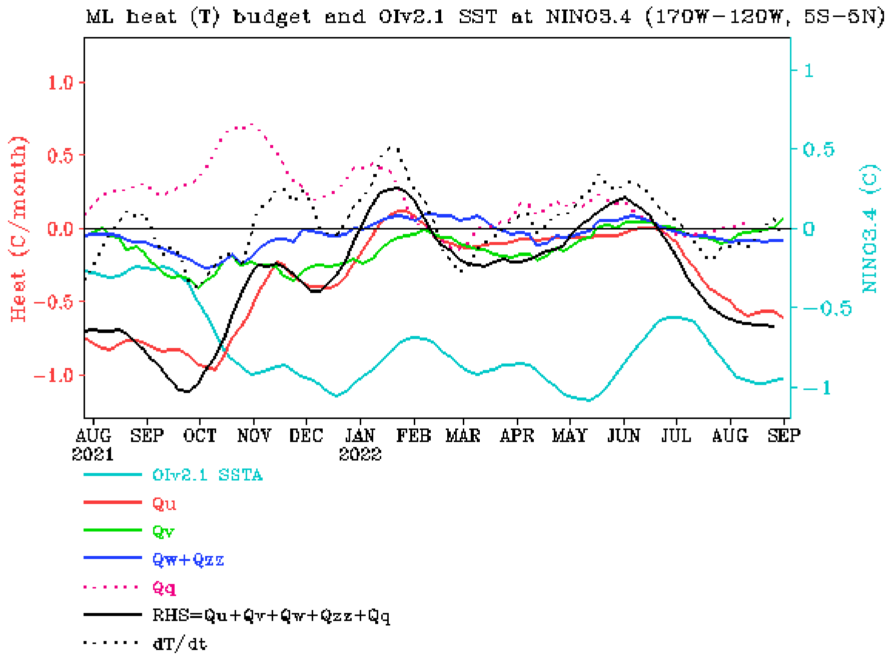
SSTAs (top-left), SSTA tendency (top-right), Outgoing Long-wave Radiation (OLR) anomalies (middle-left), sum of net surface short- and long-wave radiation, latent and sensible heat flux anomalies (middle-right; positive means heat into the ocean), 925-mb wind anomaly vector and its amplitude (bottom-left), 200-mb wind anomaly vector and its amplitude (bottom-right). SST are derived from the OISSTv2.1 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 1991-2020 base period means.

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



- Negative SSTA enhanced in the western-central Pacific in Aug 2022.
- In respond to the strong easterly wind surges in early July, an upwelling ocean Kevin wave was initiated in the central Pacific and propagated to the eastern Pacific by the end of Aug 2022.

NINO3.4 Heat Budget



Qu: Zonal advection; Qv: Meridional advection;

Qw: Vertical entrainment; Qzz: Vertical diffusion

Qq: (Qnet - Qpen + Qcorr)/ρcph;

Qnet = SW + LW + LH +SH;

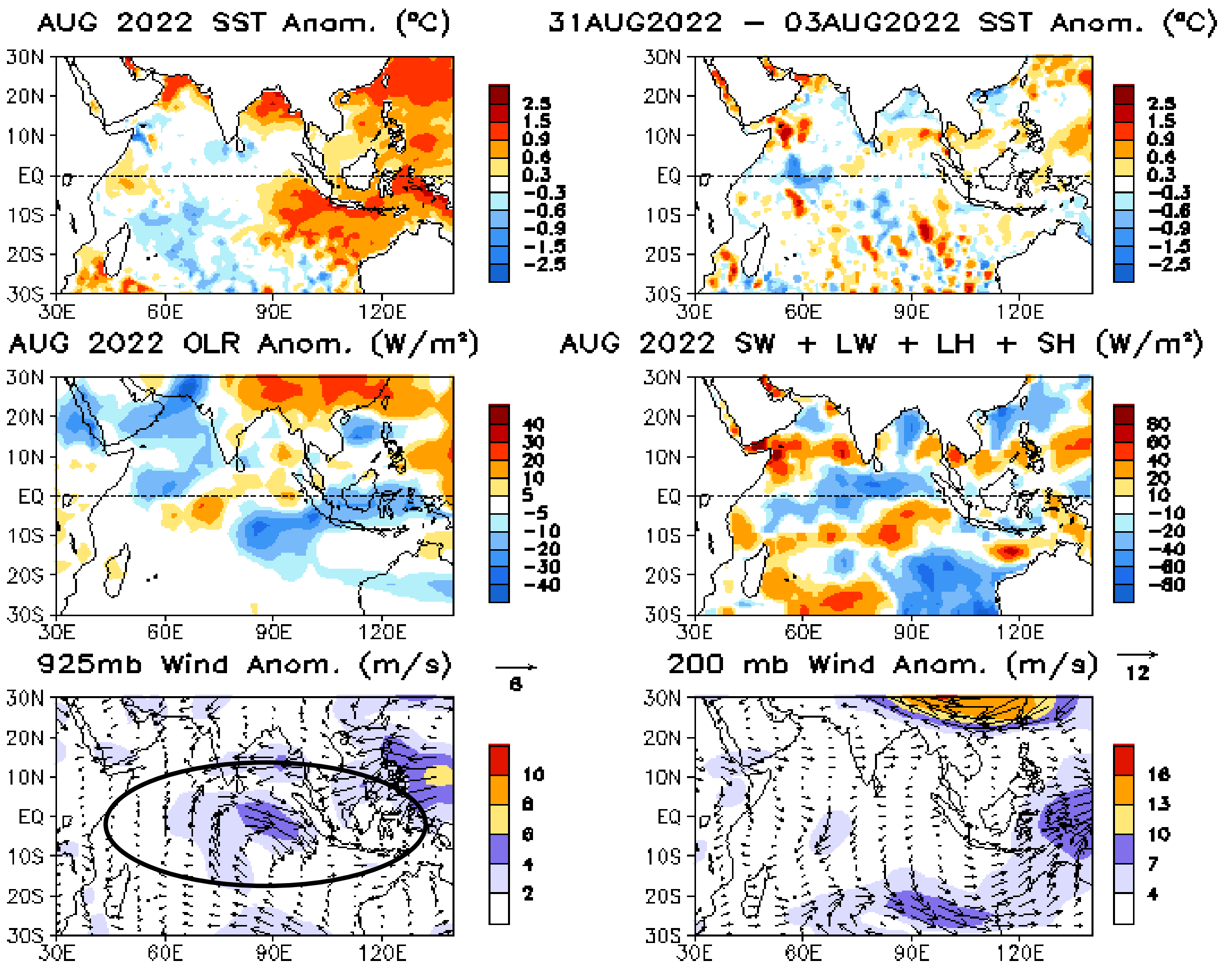
Qpen: SW penetration;

Qcorr: Flux correction due to relaxation to OI SST

- Observed SSTA tendency (dT/dt) in Nino3.4 region (dotted black line) was nearly zero in Aug 2022.
- Zonal advection (Qu, reg line) term is the primary dynamical processes contributing to RHE.

Huang, B., Y. Xue, X. Zhang, A. Kumar, and M. J. McPhaden, 2010 : The NCEP GODAS ocean analysis of the tropical Pacific mixed layer heat budget on seasonal to interannual time scales, J. Climate., 23, 4901-4925.

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

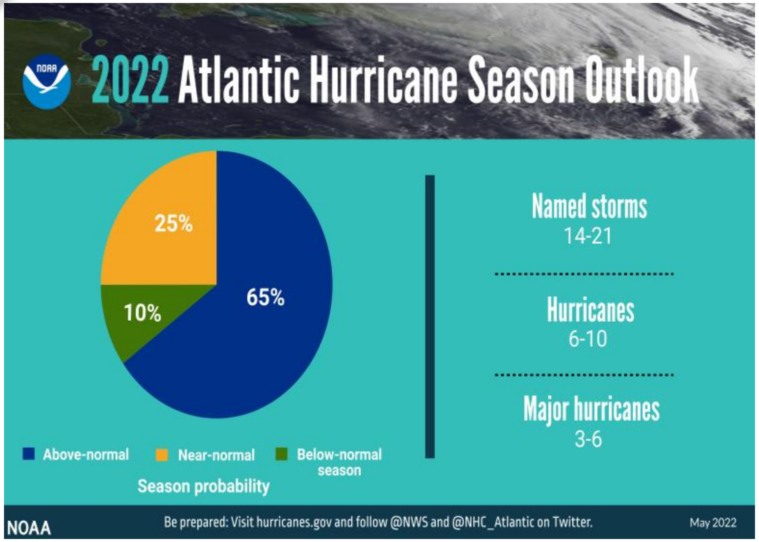


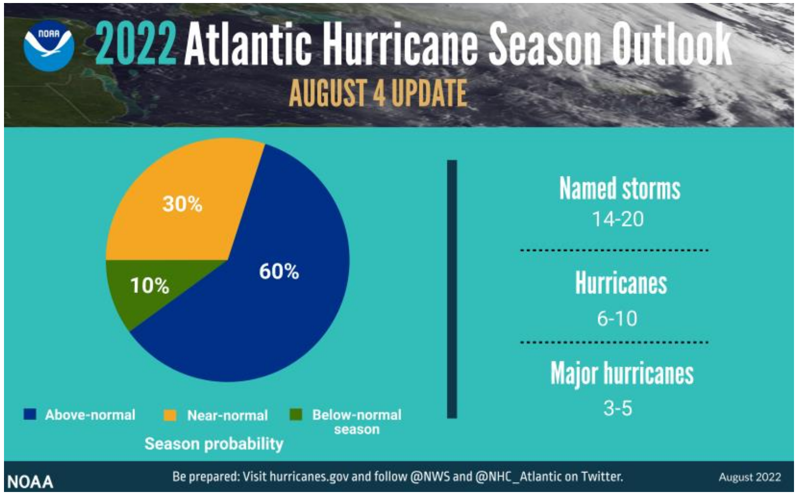
- Westerly wind anomaly prevailed over the eastern Indian Ocean, favoring further warming in the southeastern Indian Ocean.

- SSTA tendencies were generally consistent with the net heat flux anomalies.

SSTAs (top-left), SSTA tendency (top-right), 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 OISSTv2.1 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 1991-2020 base period means.

Updated 2022 Atlantic Hurricane Season Outlook (4 Aug 2022)

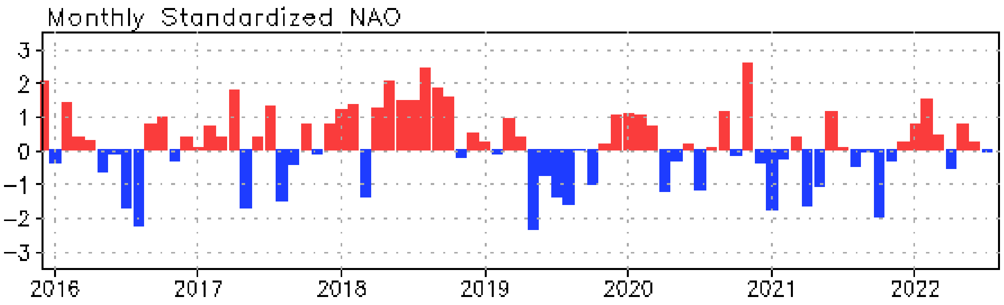


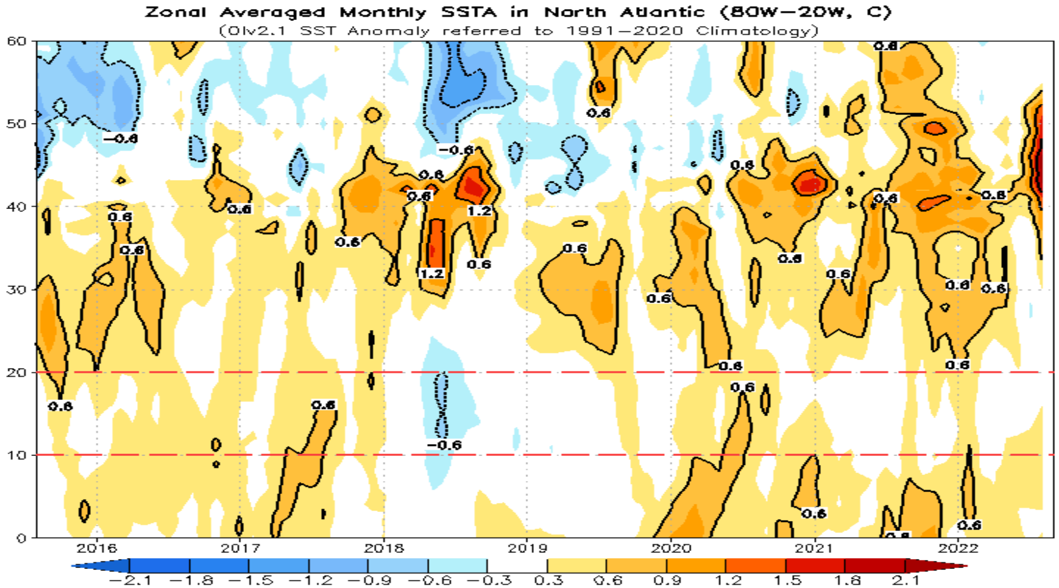


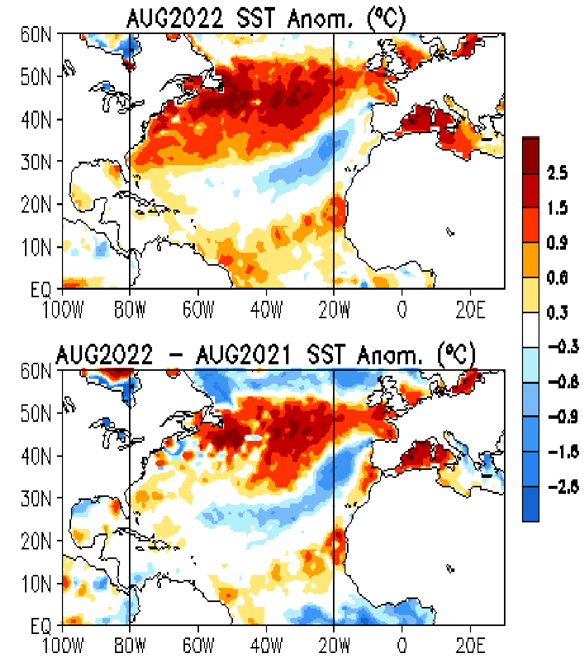
https://www.noaa.gov/news-release/noaa-still-expects-above-normal-atlantic-hurricane-season

- NOAA updated Atlantic hurricane season outlook slightly decreased the likelihood of an above-normal Atlantic hurricane season to 60%.
- Several atmospheric and oceanic conditions still favor an active hurricane season, including La Nina conditions, weaker tropical Atlantic trade winds, an active west African Monsoon, and likely above-normal SSTs.
- Uncertainty factor: SSTs have been varying on both sides of normal in hurricane main development region during the past 2 months.

NAO and SST Anomaly in North Atlantic



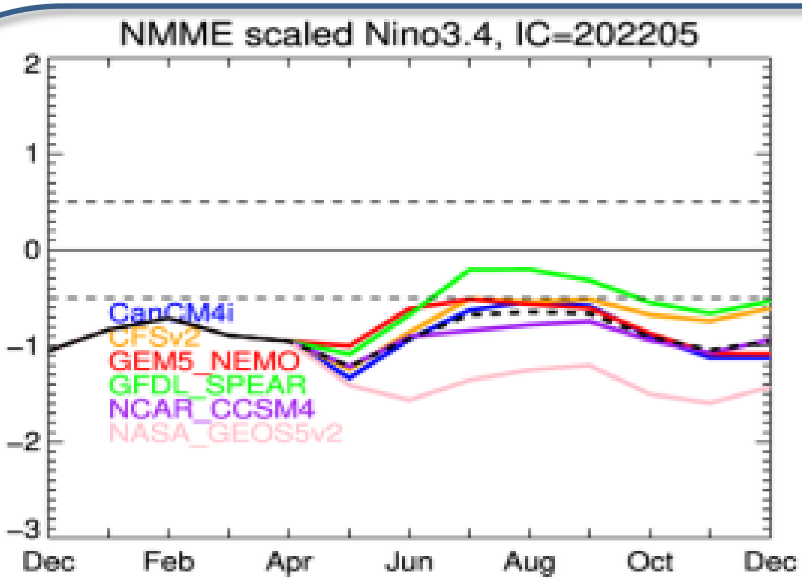


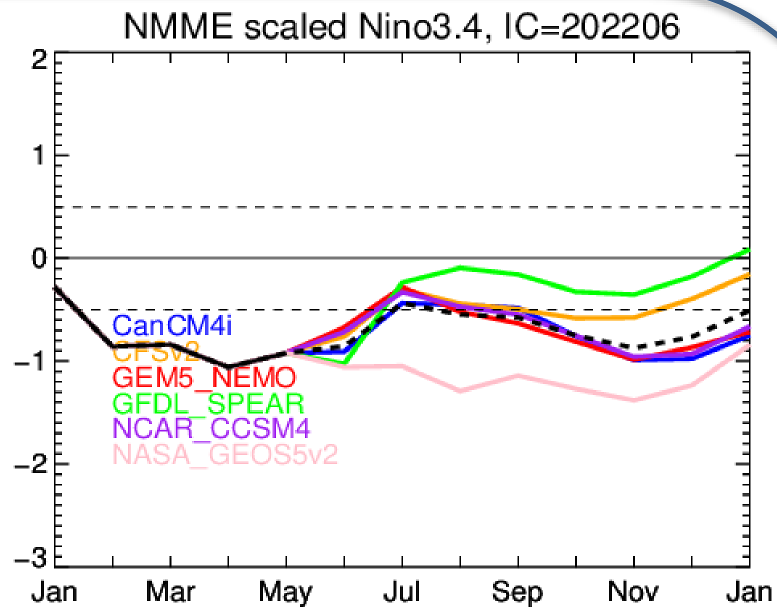


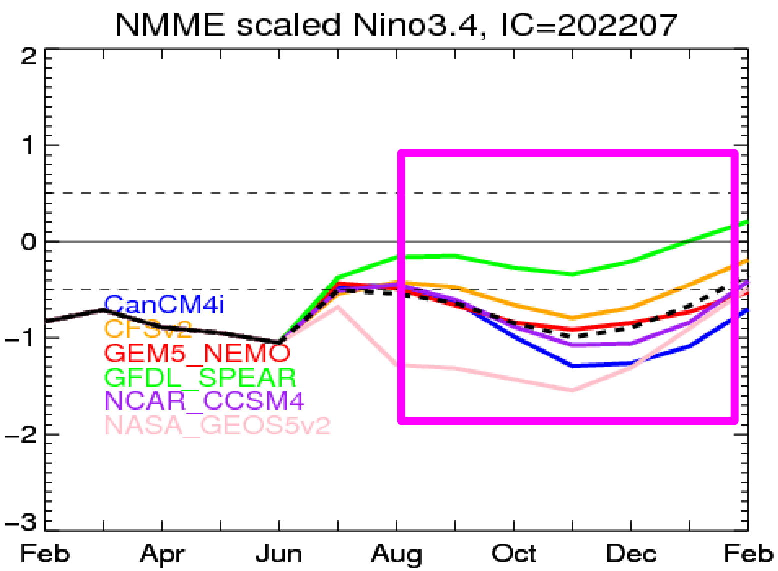
- NAO was near-normal in Jul 2022.
- The positive SSTAs in the mid-high latitudes of the North Atlantic Ocean were evident since 2021.

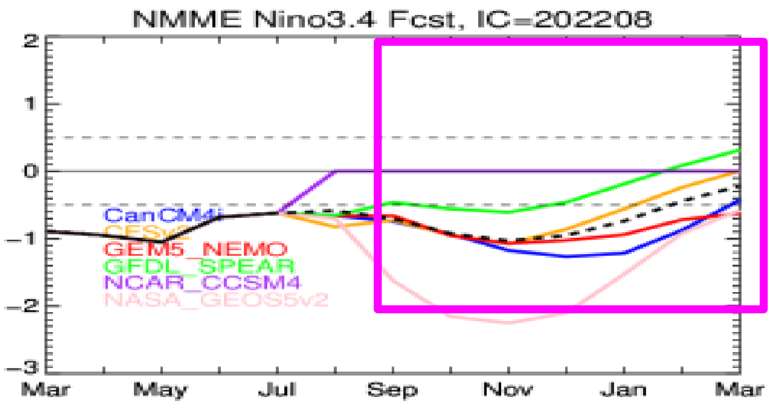
Monthly standardized NAO index (top) derived from monthly standardized 500-mb height anomalies obtained from the NCEP CDAS in 20^{O}N-90^{O}N. Time-latitude section of SSTAs averaged between 80ºW and 20ºW (bottom). SST are derived from the OIv2.1 SST analysis, and anomalies are departures from the 1991-2020 base period means.

NMME forecasts from different initial conditions



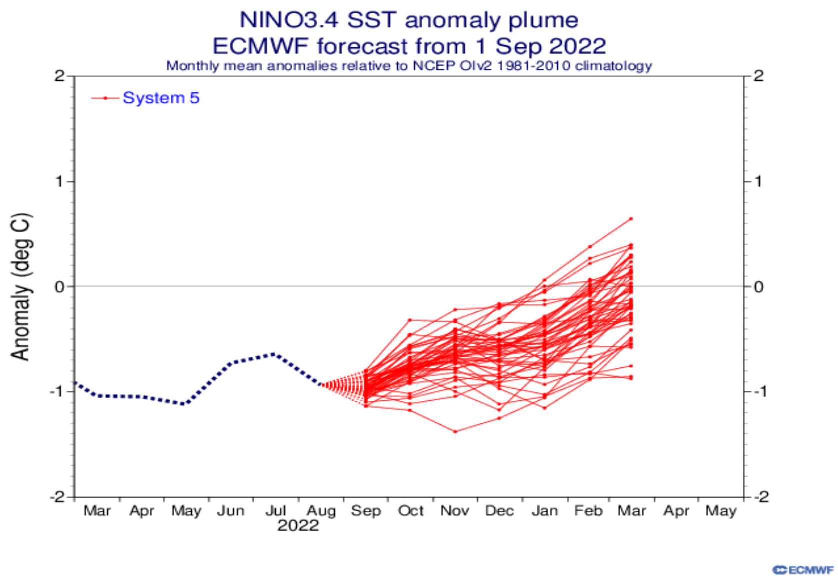




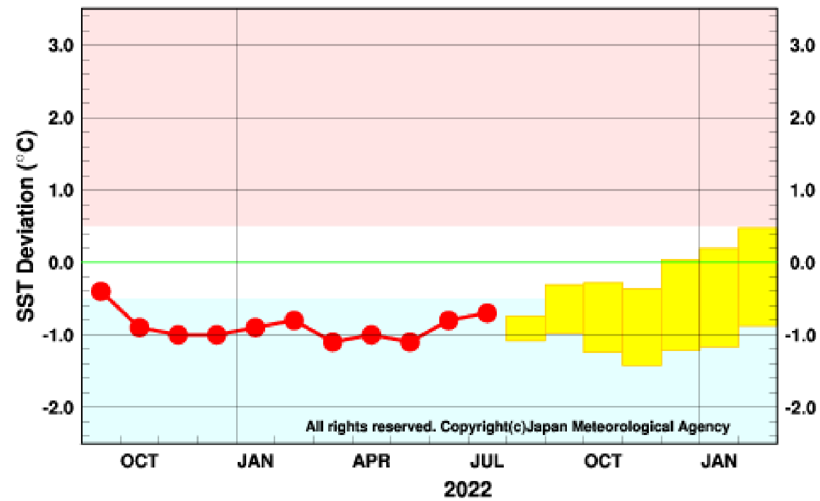


Individual Model Forecasts: ENSO neutral or borderline La Nina

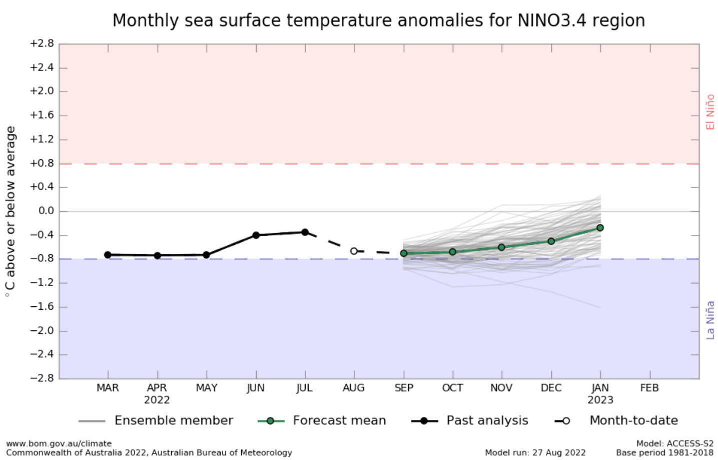
EC: IC= 1 Sep 2022



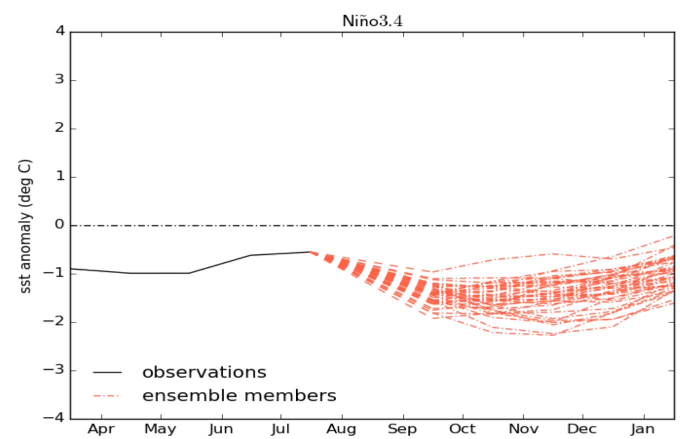
JMA: Updated 10 Aug 2022



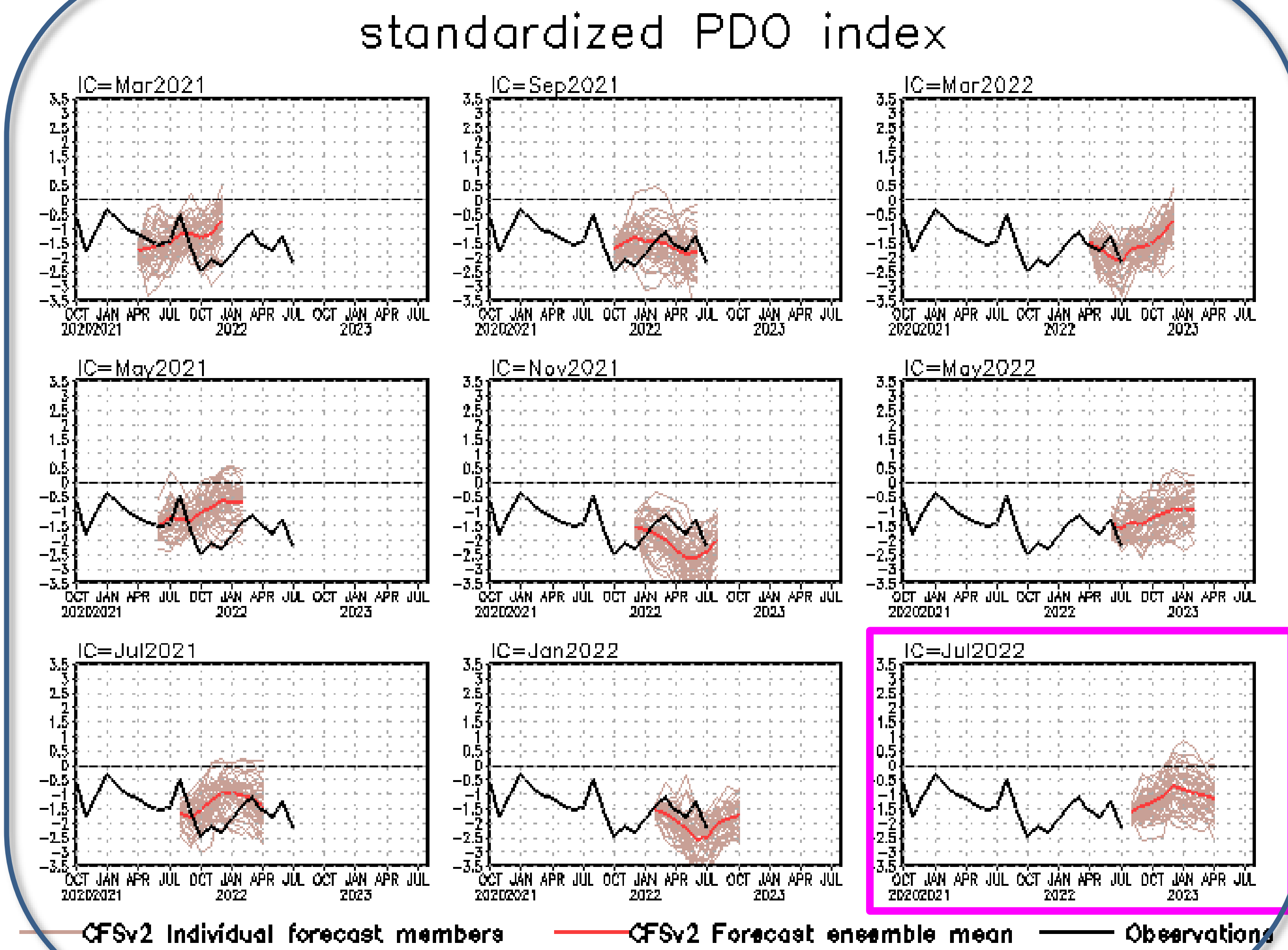
Australian BOM: Updated 27 Aug 2022



UKMO: Updated 11 Aug 2022



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



- Latest CFSv2 predicts the negative phase of PDO will continue through northern hemisphere Spring 2023.

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 1991-2020 base period means. PDO is the first EOF of monthly ERSSTv3b anomaly in the region of [110ºE-100ºW, 20ºN-60ºN]. CFS PDO index is the standardized projection of CFS SST forecast anomalies onto the PDO EOF pattern.

Global Sea Surface Salinity (SSS): Anomaly for August 2022

New Update: The NCEI SST data used in the quality control procedure has been updated to version 2.1 since May 2020;

While large-scale SSS anomaly patterns over the equatorial and southern Pacific remain largely unchanged, intensities of the positive / negative anomalies over the western side of the ocean is weakened largely attributable to the smaller magnitude of precipitation anomaly there. A belt of freshened SSS anomaly is observed along the east coast of China except a small portion off the Yangtze river mouth. Small areas of soldier anomalies are also visible off the river mouths of the Amazon and the Ganges.

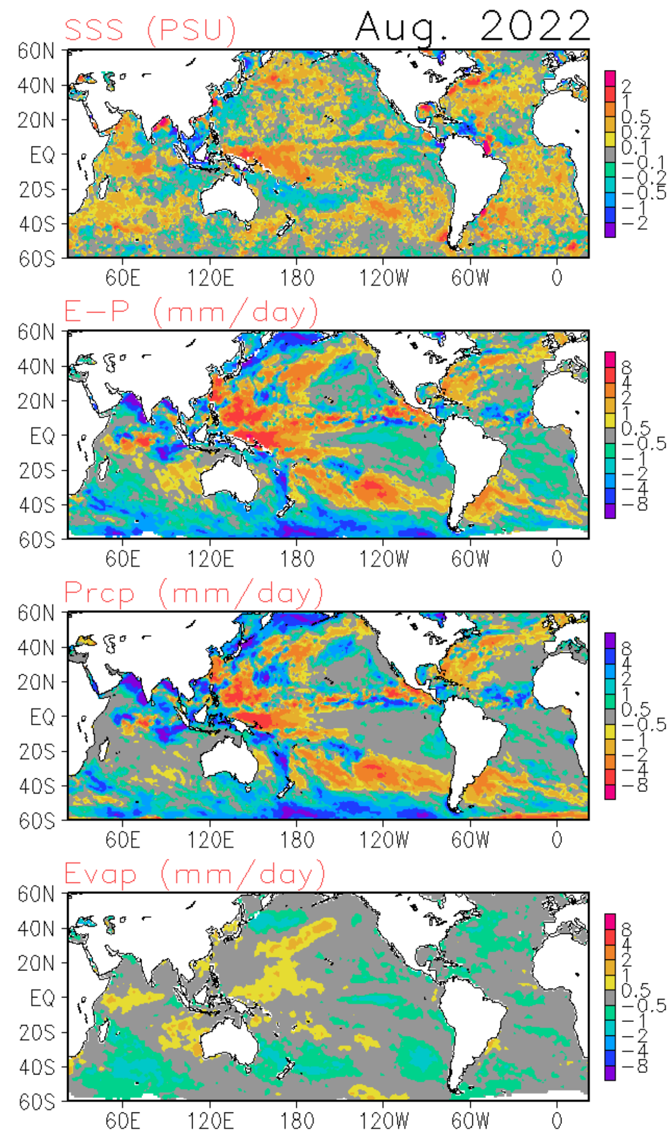
SSS : Blended Analysis of Surface Salinity (BASS) V0.Z

(a CPC-NESDIS/NODC-NESDIS/STAR joint effort)

ftp.cpc.ncep.noaa.gov/precip/BASS

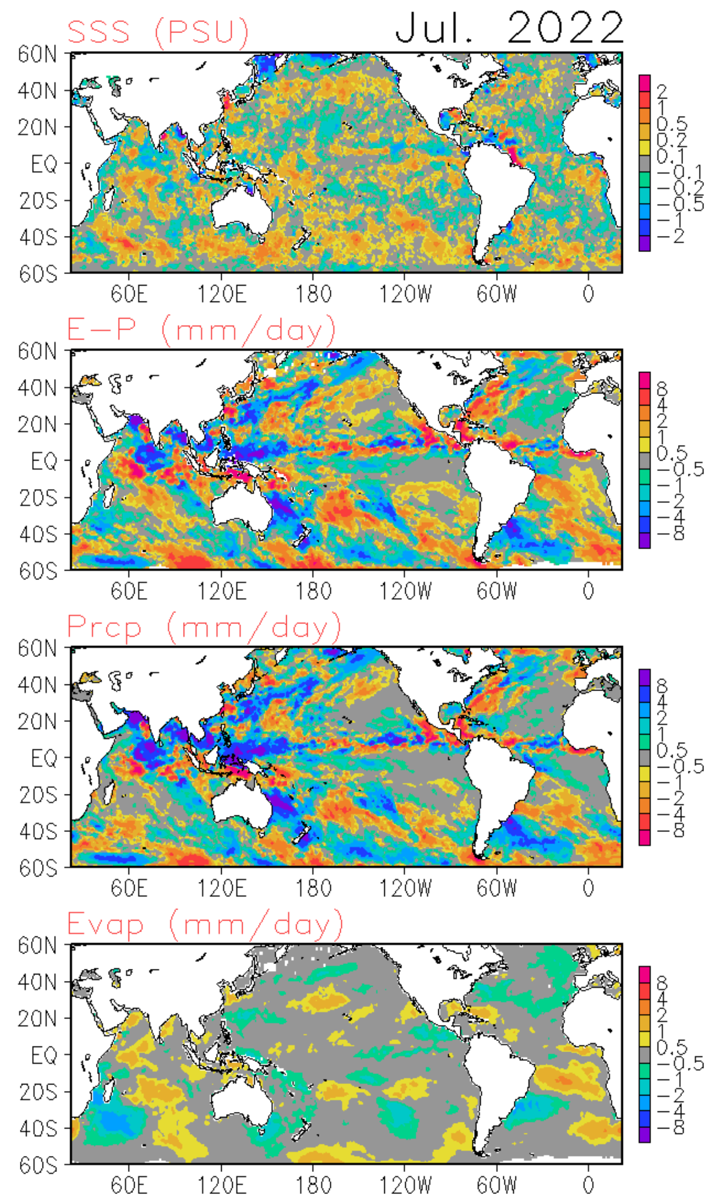
Precipitation: CMORPH adjusted satellite precipitation estimates

Evaporation: Adjusted CFS Reanalysis



Global Sea Surface Salinity (SSS): Tendency for August 2022

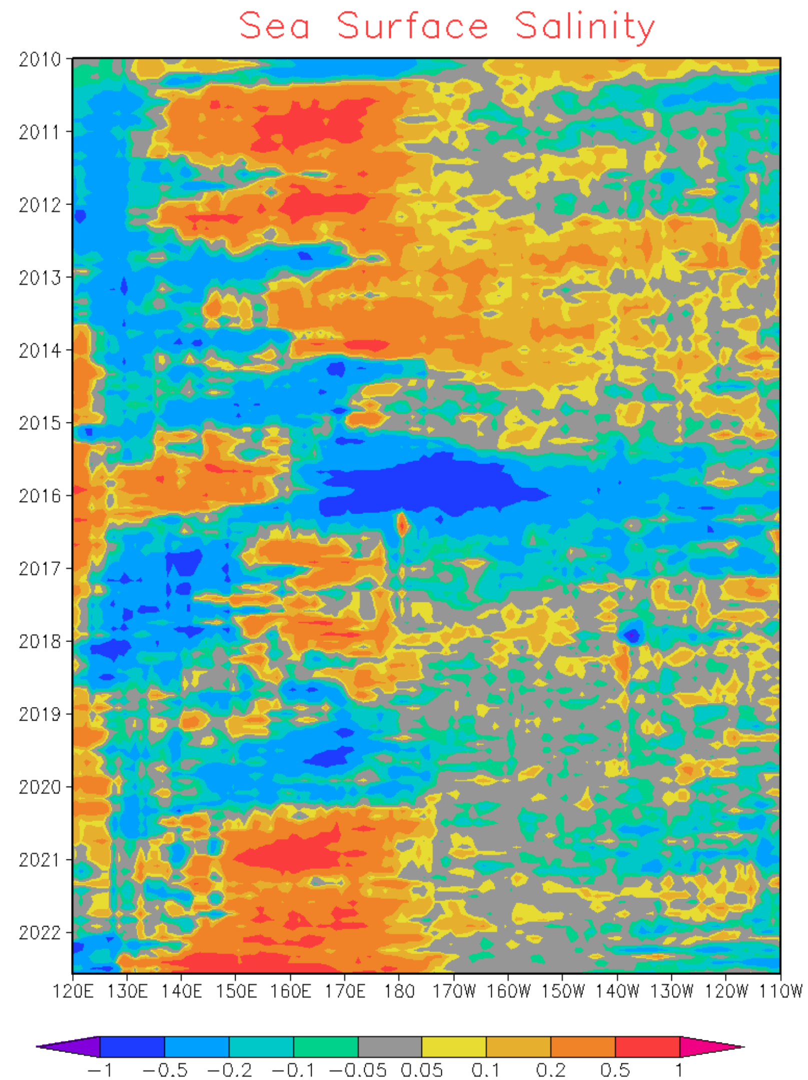
Soldier tendency of substantial magnitude is observed over the coastal regions off three major rivers, i.e. the Amazon, the Yangtze, and the Ganges. Although no real-time observation data are available for examination, these positive SSS anomalies are caused at least partially by the suppressed river runoffs. Large portion of the eastern Indian ocean is covered by weak positive SSS anomalies, while eastern equatorial Pacific lies a pair of zonally oriented positive / negative SSS tendency in association with the merional shift of the ITCZ there.



Monthly 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);**
- Positive SSS anomaly continues over the central / western equatorial Pacific between 140°E and 170°W. Weak negative SSS anomalies over the eastern Pacific continues.



Pentad SSS Anomaly Evolution over Equatorial Pacific

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.