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

Prepared by

Climate Prediction Center, NCEP/NOAA

January 10, 2023

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

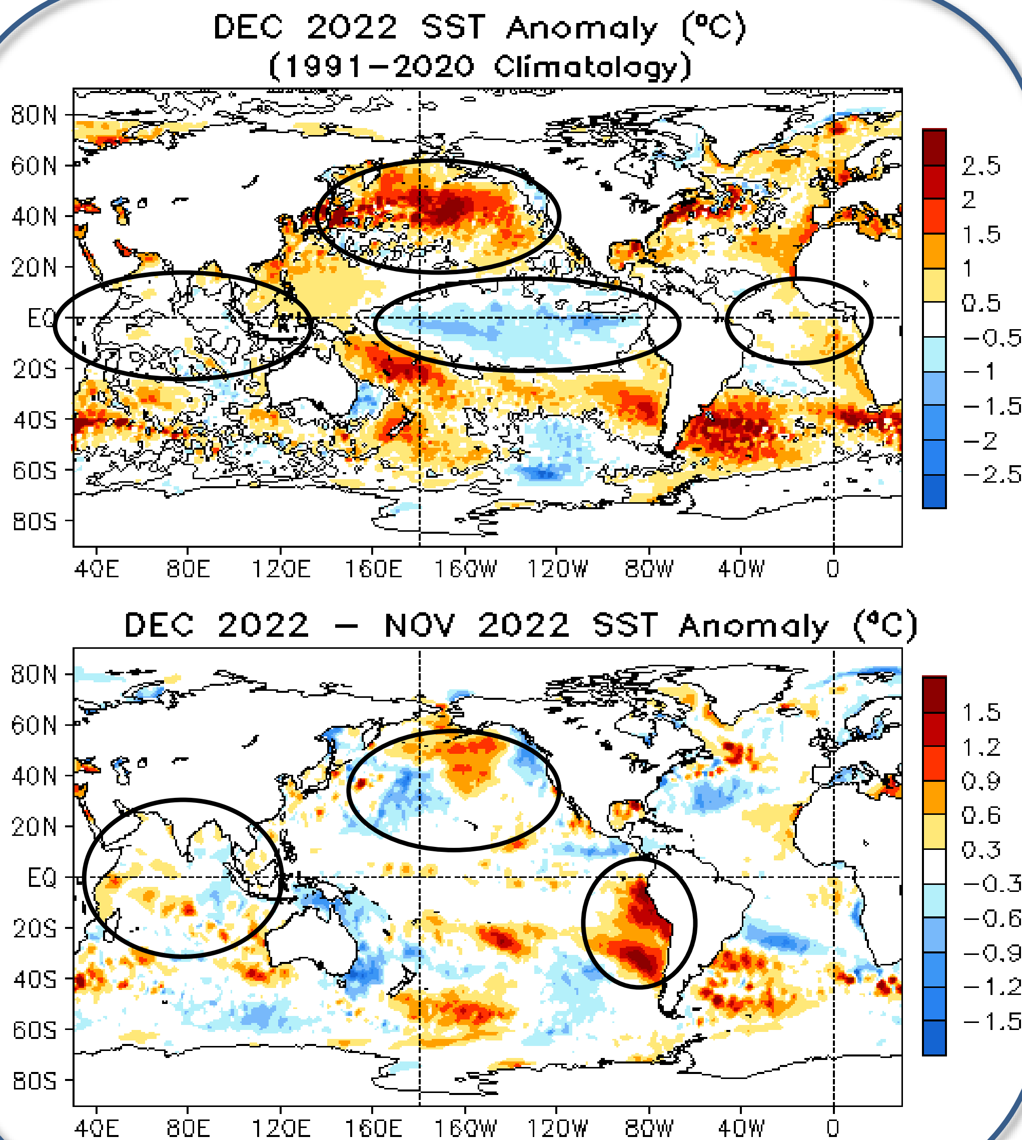
- Overview
- Recent highlights
  - Pacific/Arctic Ocean
  - Indian Ocean
  - Atlantic Ocean
- Global SSTA Predictions
- Possible impacts of the Pandemic on Observing the Global Ocean

Overview

- Pacific Ocean
  - NOAA "ENSO Diagnostic Discussion" on 8 Dec 2022 stated "*La Niña is expected to continue into the winter, with equal chances of La Niña and ENSO-neutral during January-March 2023. In February-April 2023, there is a 71% chance of ENSO-neutral.*"
  - La Niña condition persisted, but weakened with Niño3.4 = -0.9^{o}C in Dec 2022.
  - Positive SSTAs continued in the North Pacific in Dec 2022.
  - The PDO has been in a negative phase since Jan 2020 with PDOI = -2.0 in Dec 2022.
- Arctic Ocean
  - The average Arctic sea ice extent for Dec 2022 was 11.92 million square kilometers. This is the 7th lowest in the satellite record for the month.
- Indian Ocean
  - SSTAs in the tropical Indian Ocean were small in Dec 2022.
- Atlantic Ocean
  - NAO switched to a negative phase in Dec 2022 with NAOI= -0.2.
  - The prolonged tripole pattern with positive SSTAs in the middle latitudes was evident during the last 5-6 years.

Global Oceans

Global SST Anomaly (°C) and Anomaly Tendency

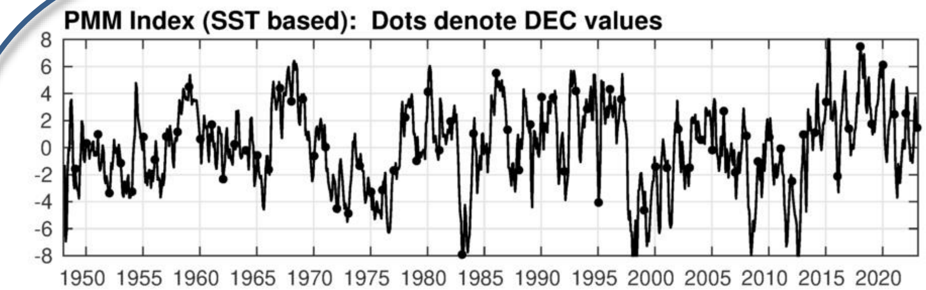


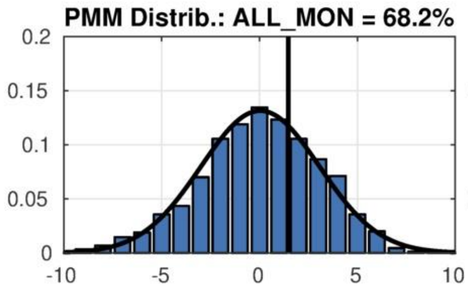
- Negative SSTAs persisted in the central and eastern equatorial Pacific.
- Positive SSTAs persisted in the North Pacific.
- Weak SSTAs were present across the tropical Atlantic.
- SSTs were near average in the tropical Indian Ocean.

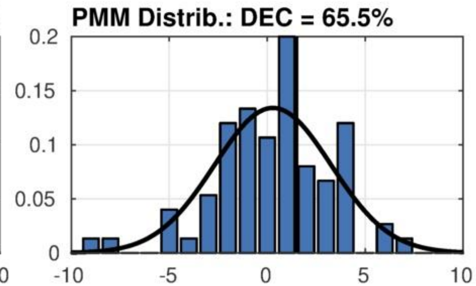
- Positive SSTA tendencies were observed in the southeastern Pacific near the South American coast.
- Positive SSTA tendencies were evident in the central North Pacific.
- Negative (small positive) SSTA tendencies were in the eastern (western) tropical Indian Ocean.

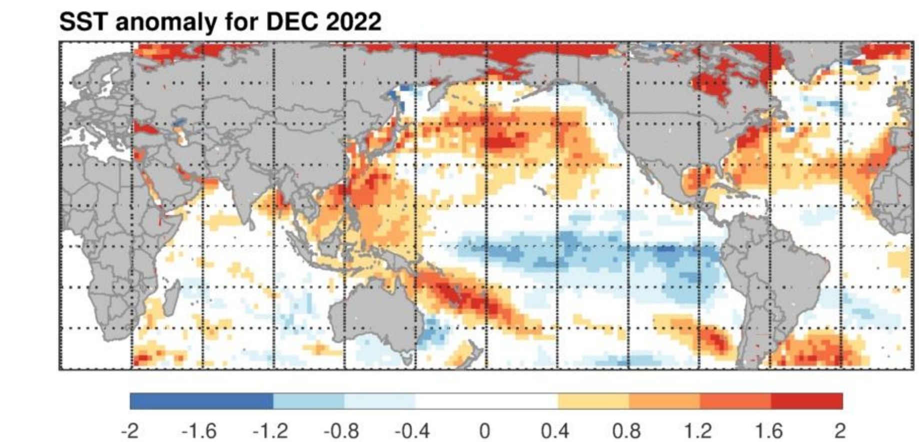
SSTAs (top) and SSTA tendency (bottom). Data are derived from the OIv2.1 SST analysis, and anomalies are departures from the 1991-2020 base period means.

Current Status of the Pacific Meridional Mode (PMM)



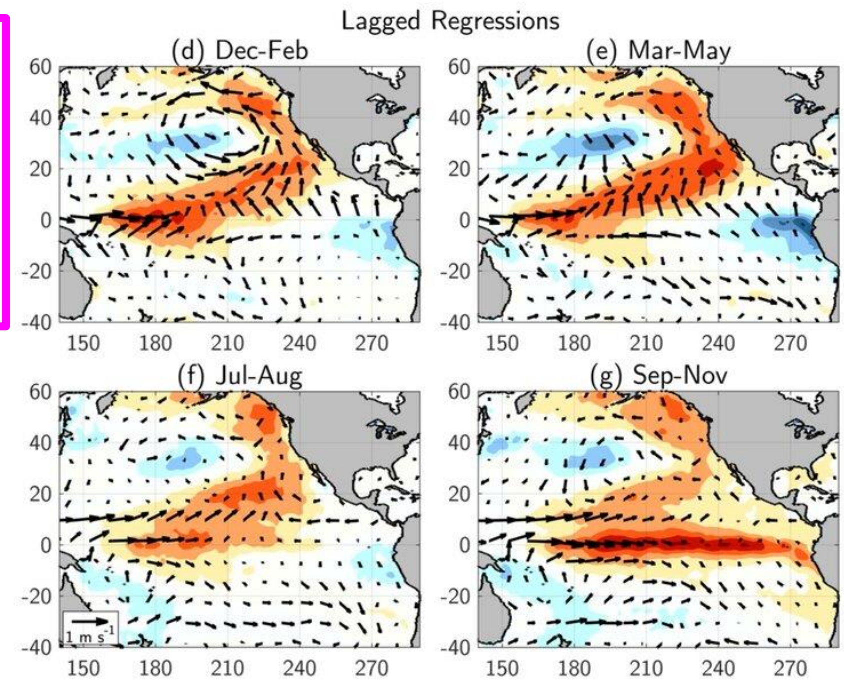






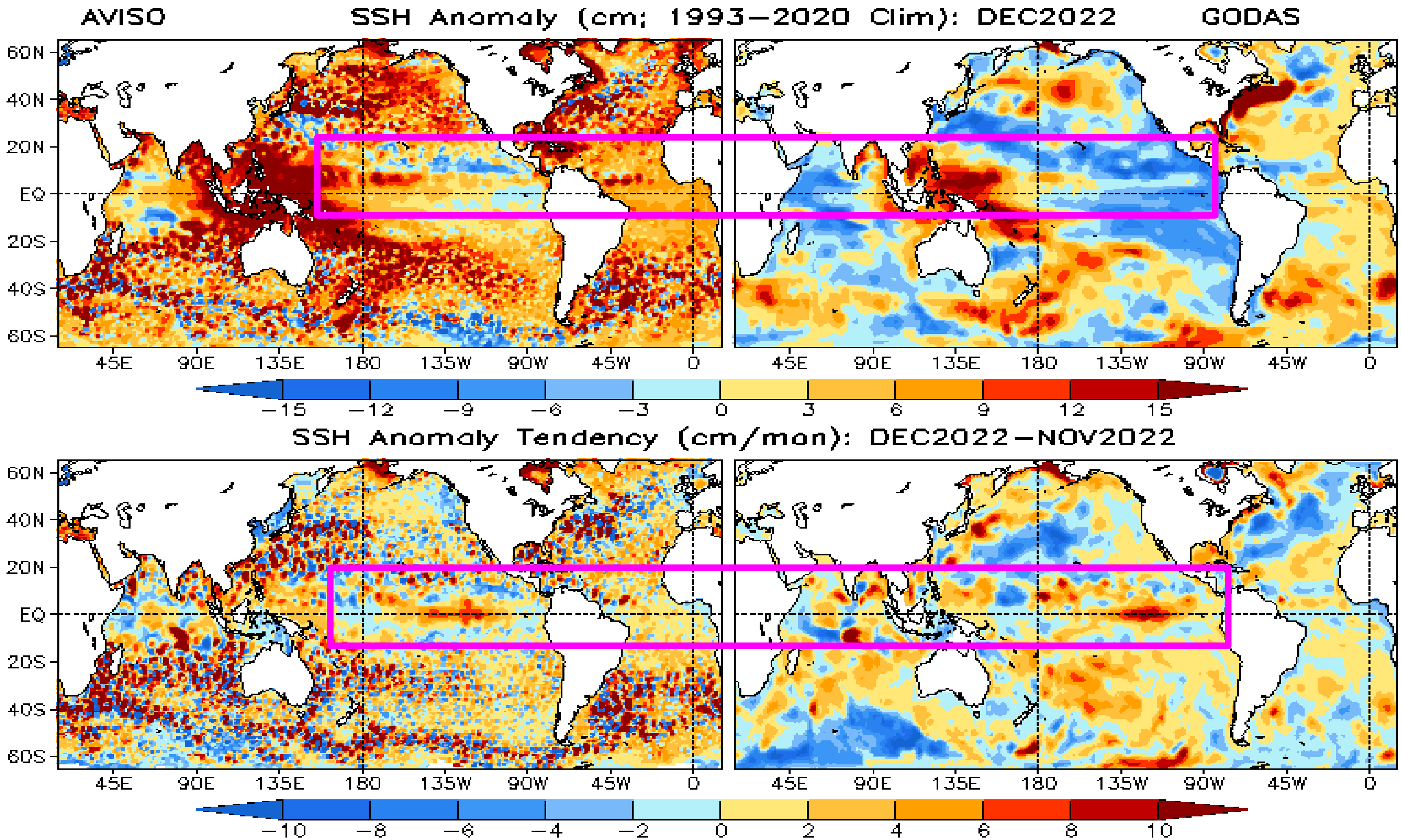
https://www.aos.wisc.edu/~dvimont/MModes/PMM.html

Lagged regressions of seasonally averaged SST and surface wind anomalies on NPMM SST time series calculated from a Maximum Covariance Analysis.



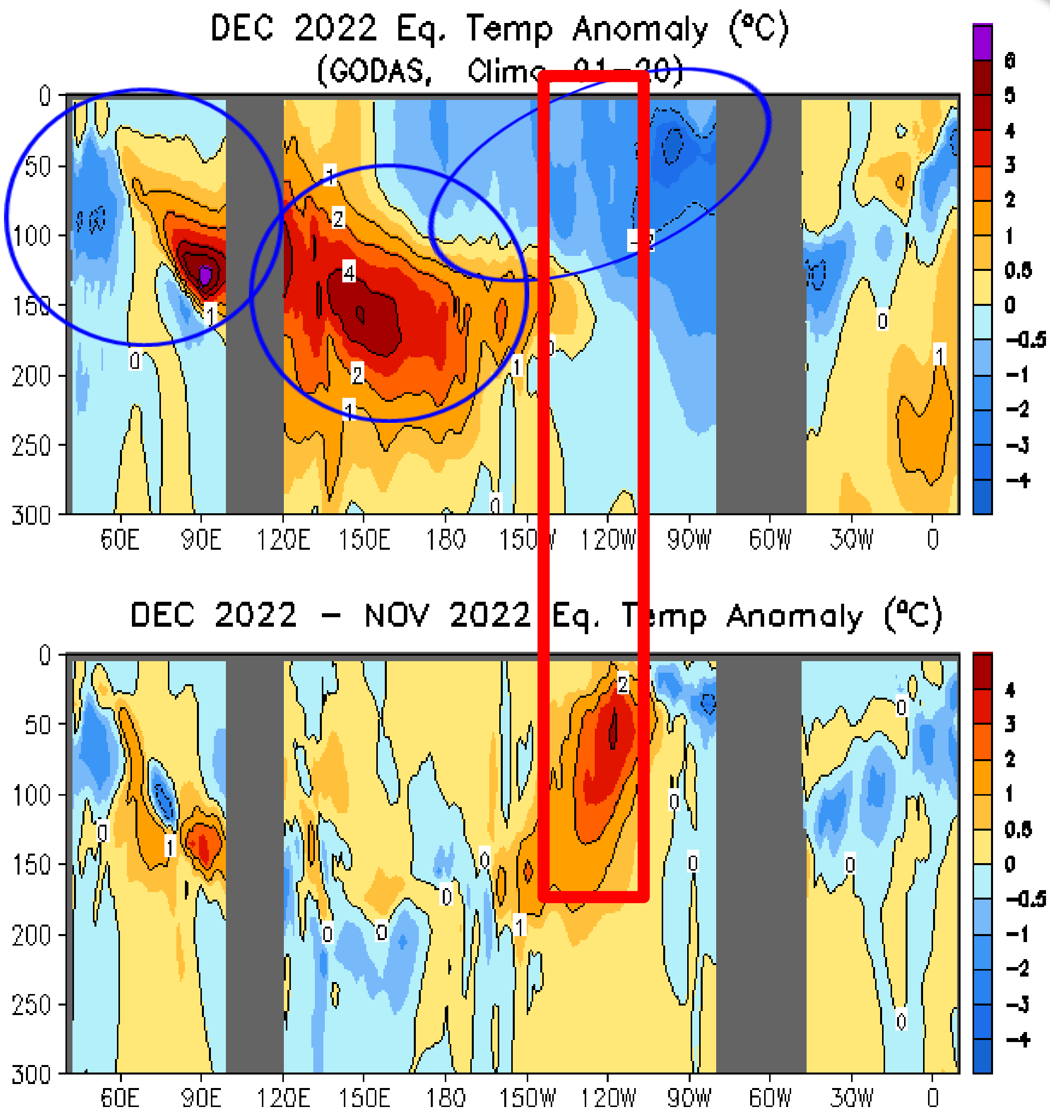
Amaya, D. J., 2019: The Pacific meridional mode and ENSO: A review. Curr. Climate Change Rep., 5, 296–307, 10.1007/s40641-019-00142-x.

AVISO & GODAS SSH Anomaly (cm) and Anomaly Tendency



- SSHAs were still featured with a La Niña Pattern in the tropical Pacific. However, the tendencies indicated a weakening trend of La Niña condition.

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

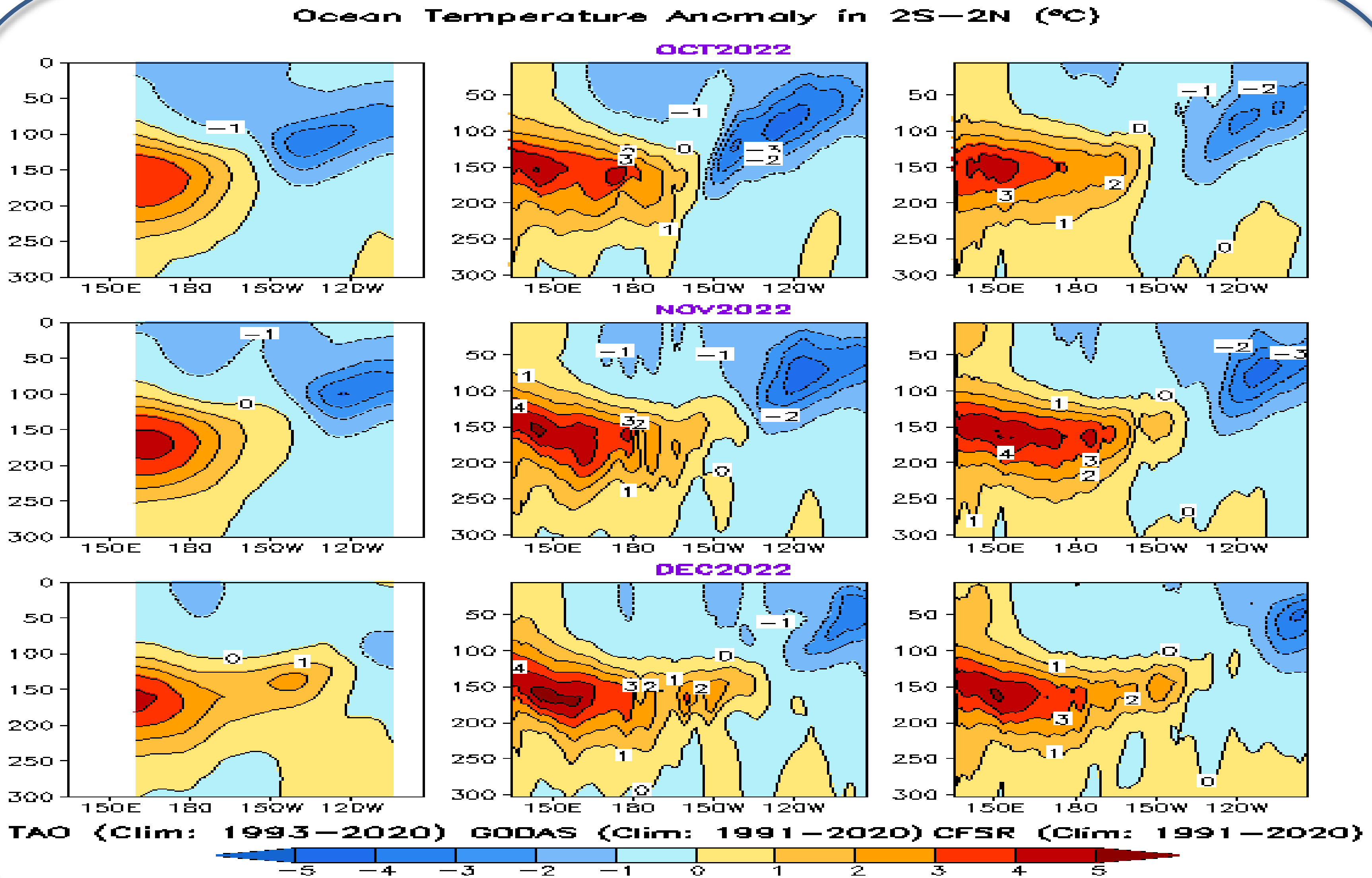


- Negative (positive) temperature anomalies presented along the thermocline in the eastern (western and central) equatorial Pacific.
- Positive (negative) temperature anomalies were observed in the eastern (western) equatorial along the thermocline in the Indian Ocean.

- Temperature anomaly tendency was positive along the thermocline in the east-central Pacific.

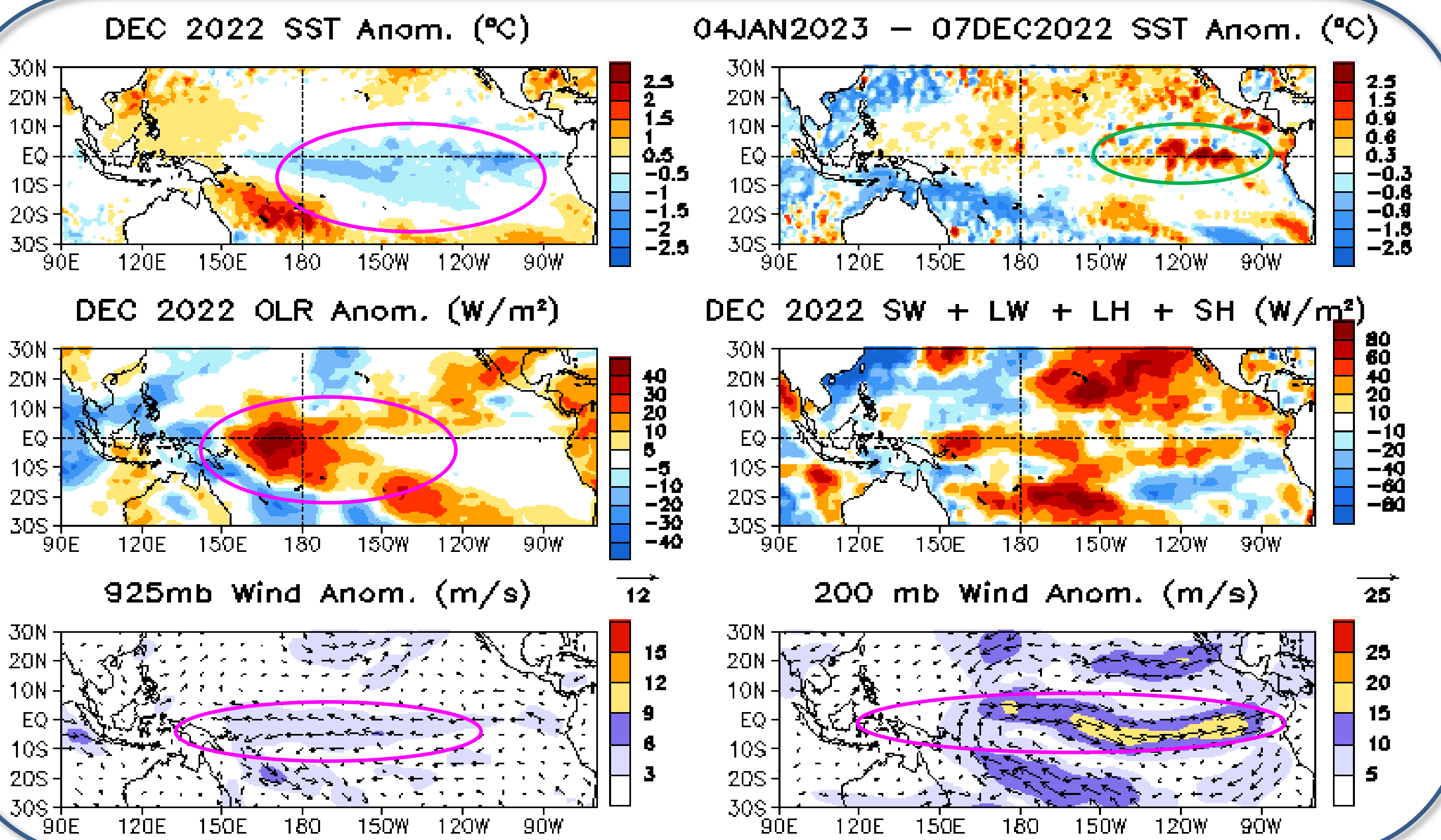
Equatorial depth-longitude section of ocean temperature anomalies (top) and anomaly tendency (bottom). Data is from the NCEP's GODAS. Anomalies are departures from the 1991-2020 base period means.

Monthly mean subsurface temperature anomaly along the Equator: Consistent among 3 products and a weakening tendency of the cooling



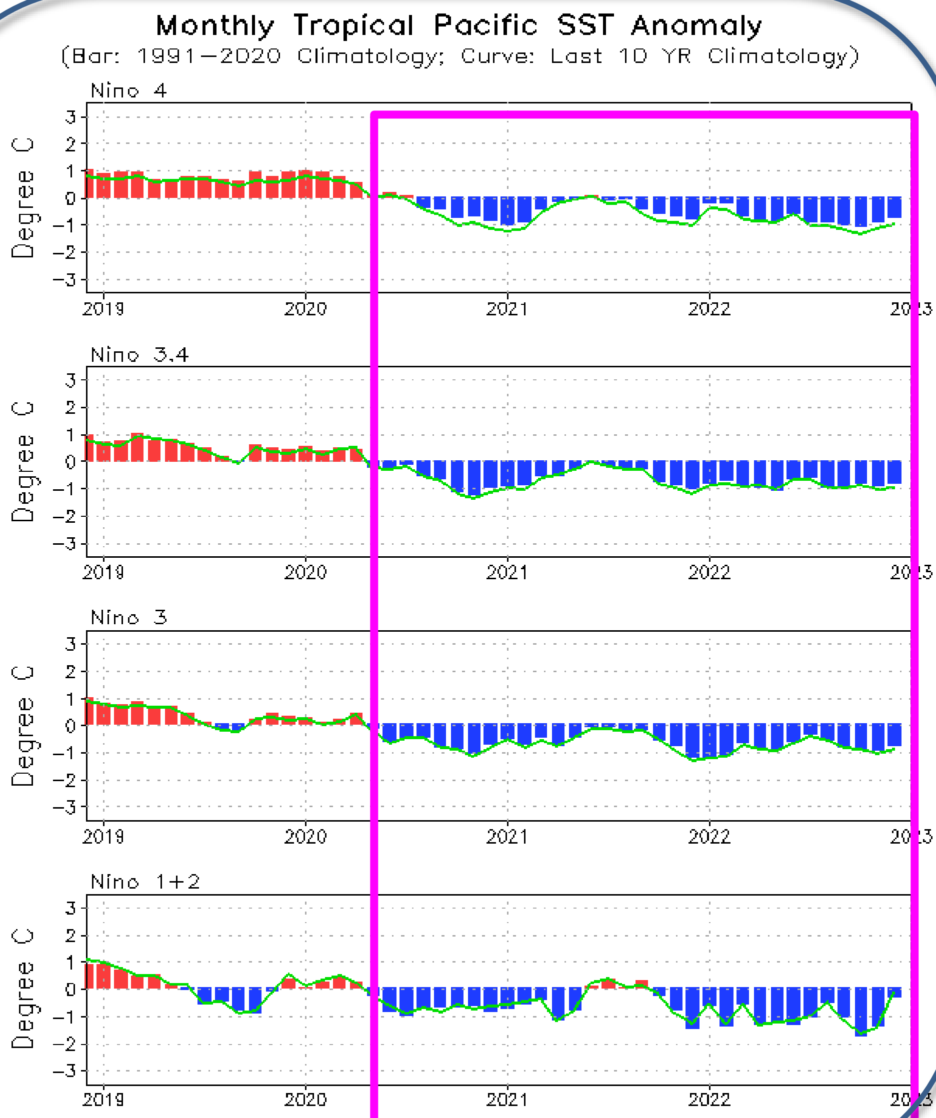
Tropical Pacific Ocean and ENSO Conditions

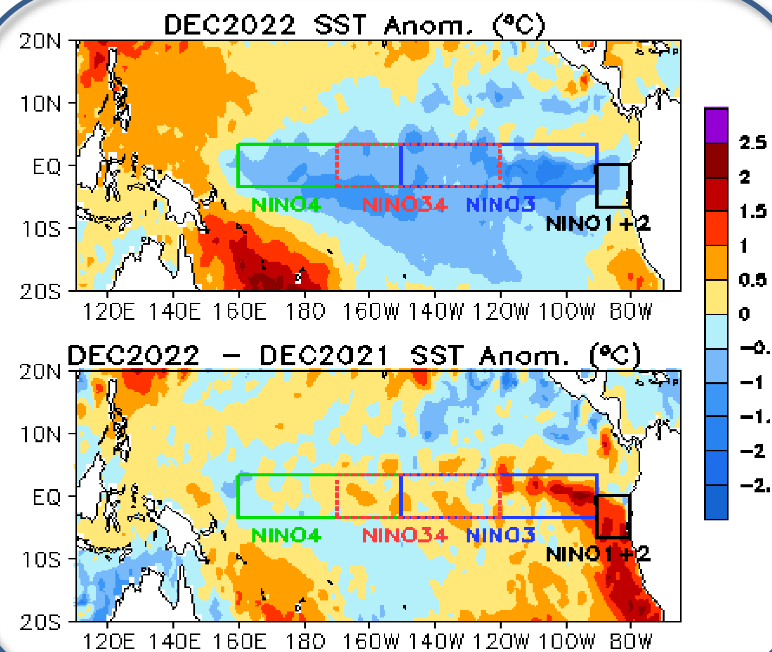
Tropical Pacific: SSTA, SSTA Tend., OLR, Sfc Rad, Sfc Flx, 925-mb & 200-mb Winds



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 OIv2.1 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.

Evolution of Pacific Niño SST Indices





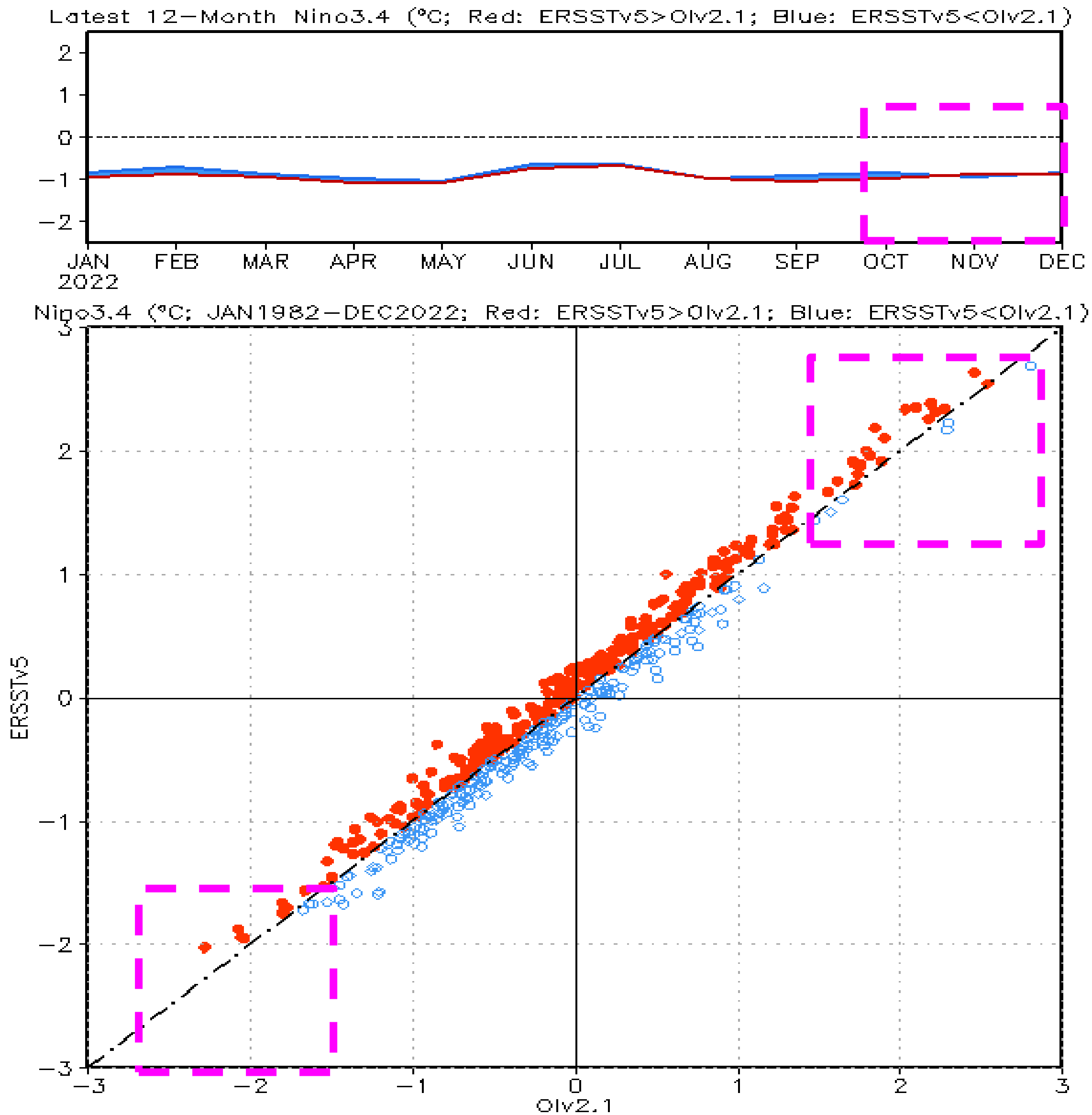
- All Niño indices weakened in Dec 2022, with Niño3.4 = -0.8C (OIv2.1) and -0.9 (ERSSTv5).

- Compared with Dec 2021, the central and eastern equatorial Pacific was warmer in Dec 2022.

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

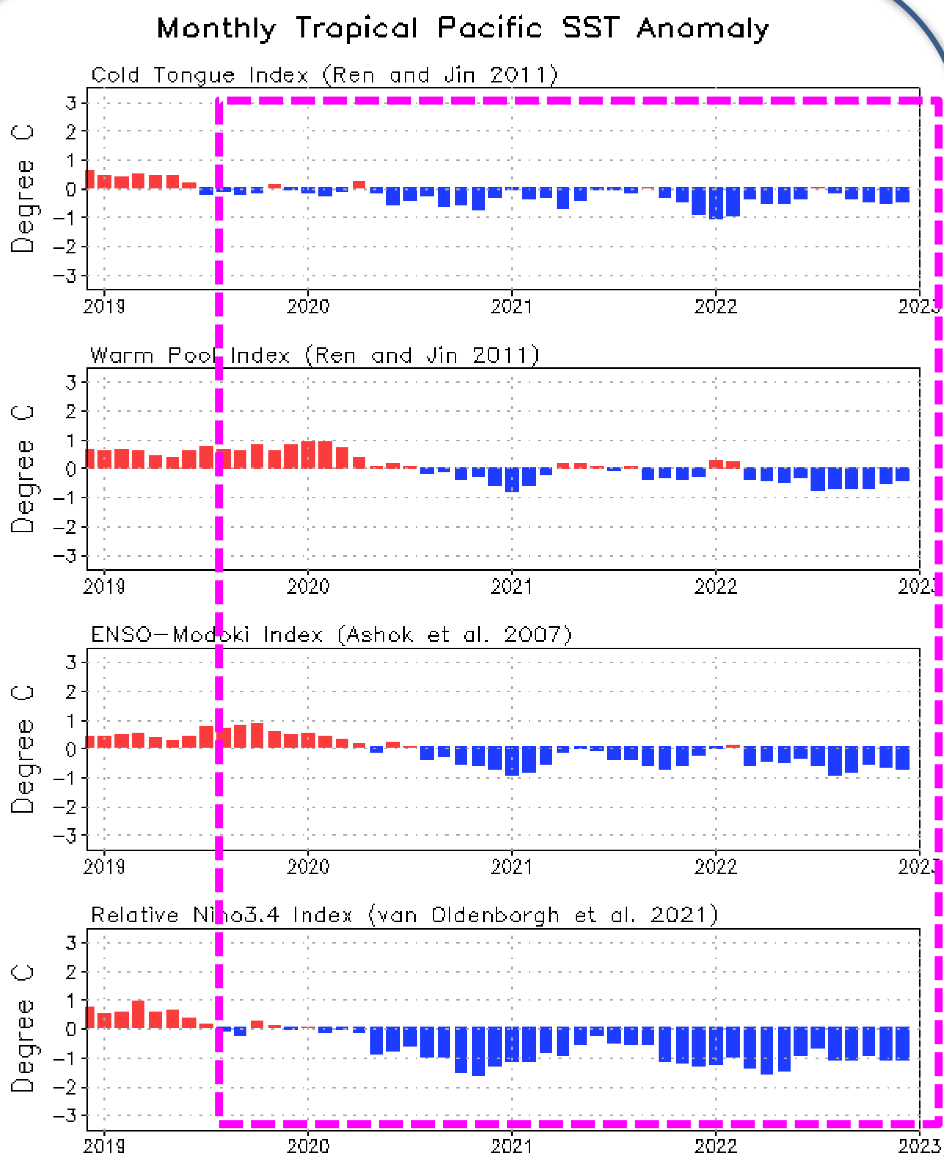
Niño region indices, calculated as the area-averaged monthly mean SSTAs (°C) for the specified region. Data are derived from the OIv2.1 SST analysis, and anomalies are departures from the 1991-2020 base period means.

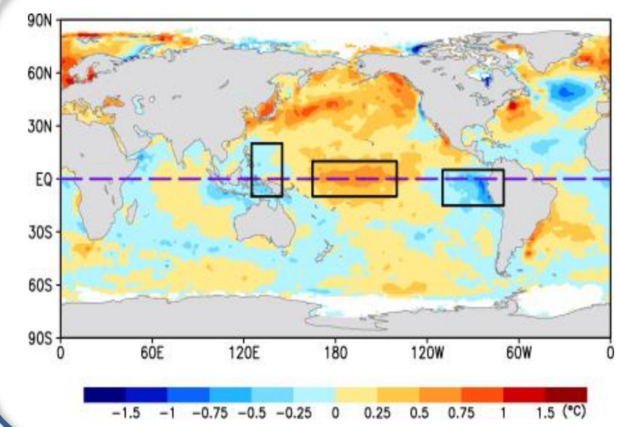
Comparison of ERSSTv5 & OIv2.1 Niño3.4 Index



- Sometimes, ERSSTv5 is either warmer or cooler than OIv2.1.
- For both the extreme positive and negative (>1.5°C or <-1.5°C) Niño3.4, ERSSTv5 is mostly warmer than OIv2.1.
- During last few months, ERSSTv5 was similar to OIv2.1.

Evolution of Pacific Niño SST Indices



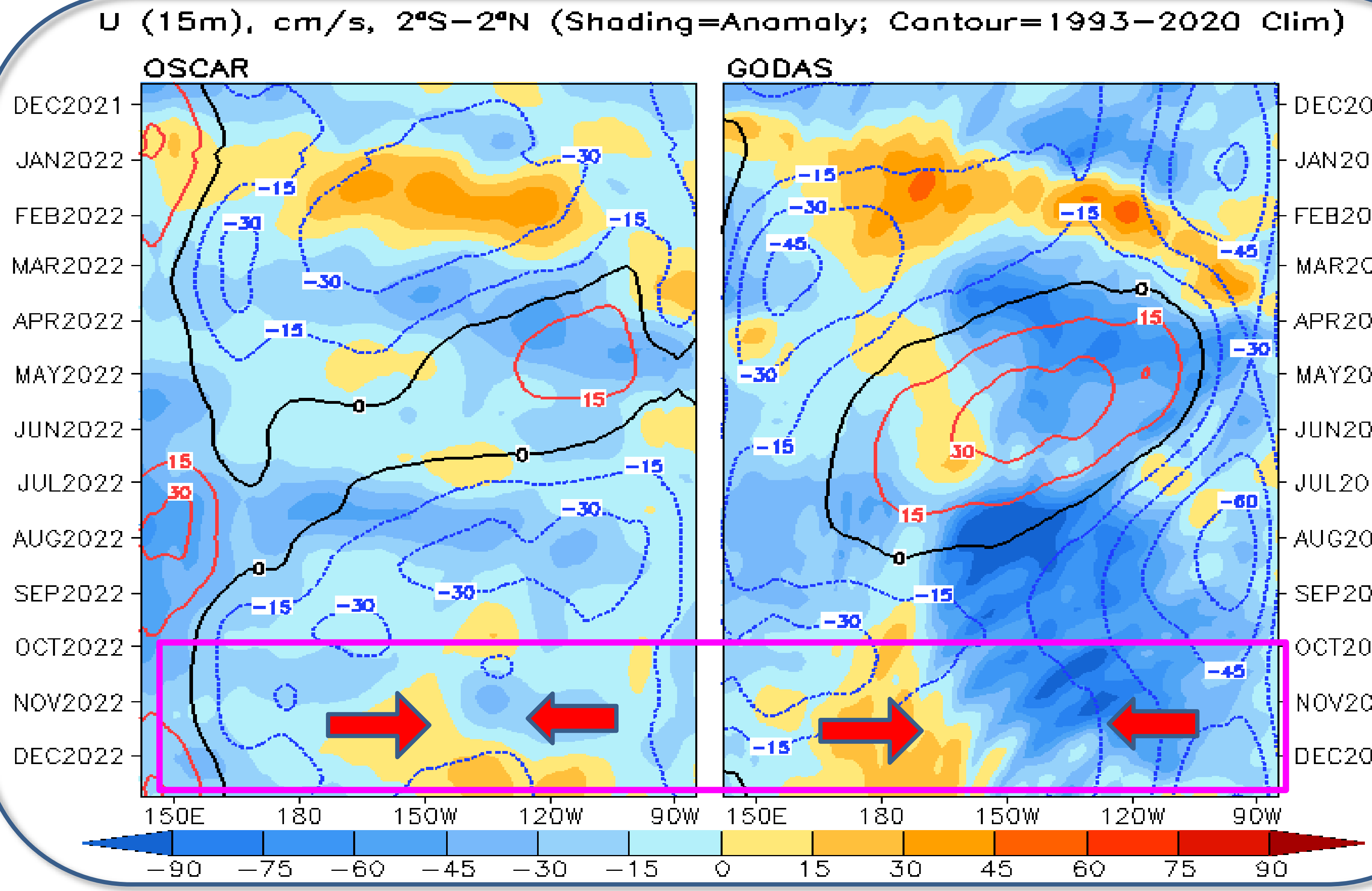


- Relative Niño3.4 index is now included in ENSO monitoring, which is defined as the conventional Niño3.4 index minus the SSTA averaged in the whole tropics (0º-360º, 20ºS-20ºN), in order to remove the global warming signal. Also, to have the same variability as the conventional Niño3.4 index, the relative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

Relative Niño3.4 data updated monthly at:

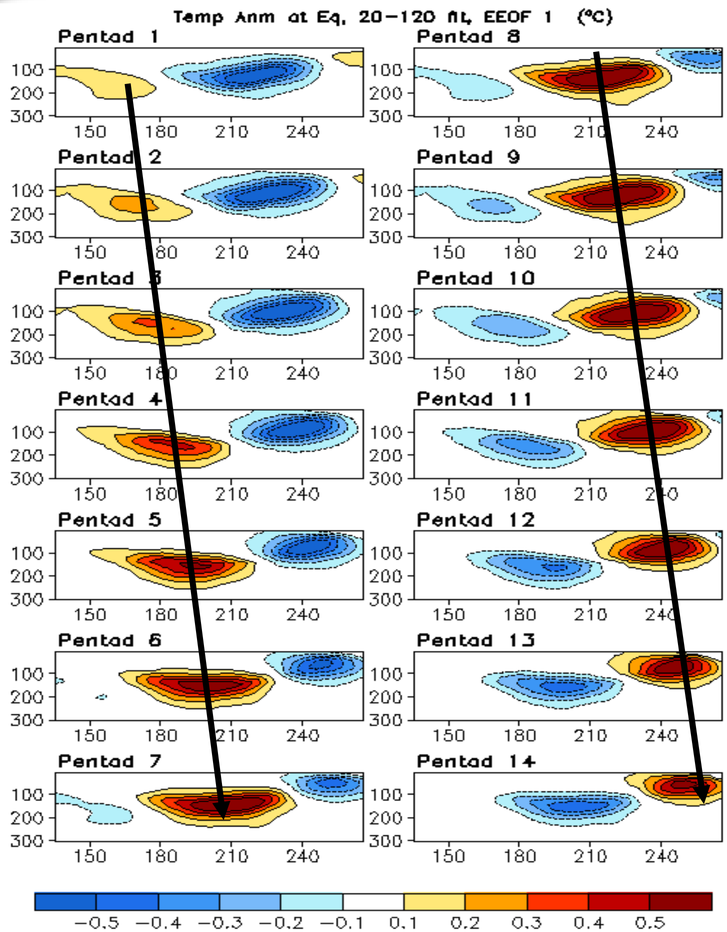
https://www.cpc.ncep.noaa.gov/data/indices/RONI.ascii.txt

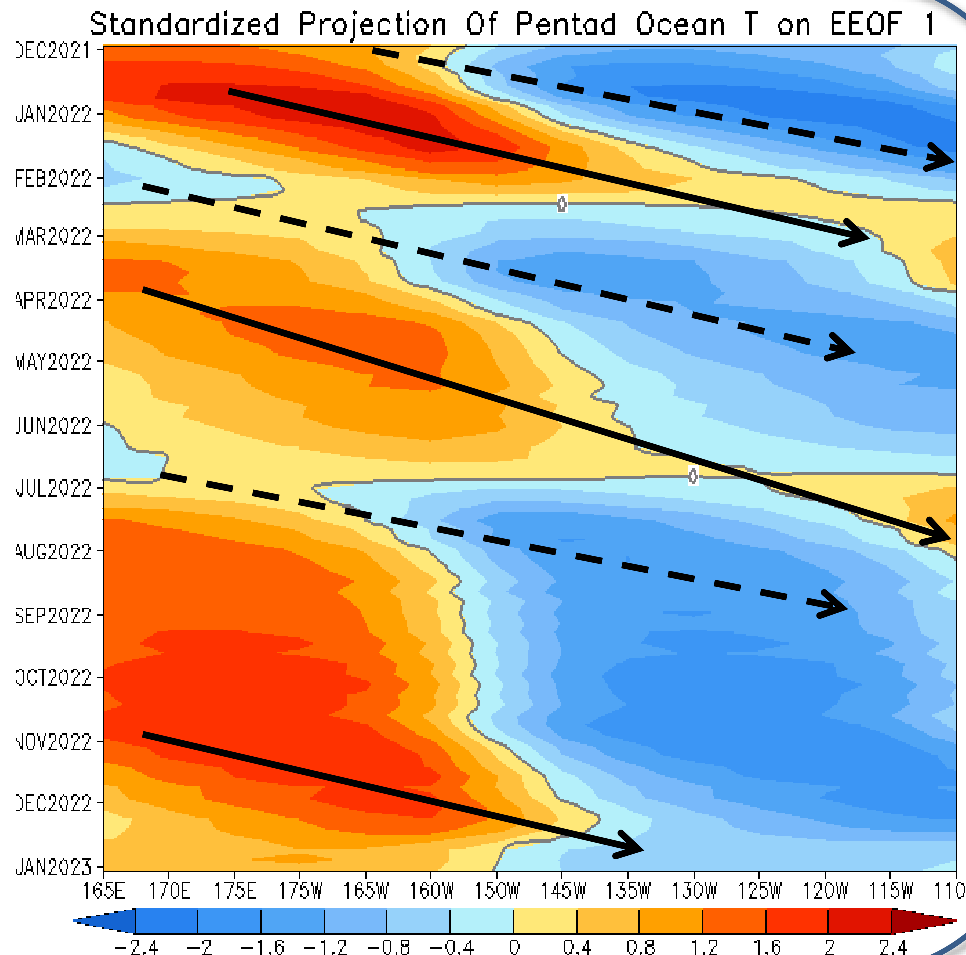
Evolution of Equatorial Pacific Surface Zonal Current Anomaly (cm/s)



- Anomalous westward currents weakened in the eastern equatorial Pacific in both OSCAR and GODAS in Dec 2022, consistent with the weakening equatorial Pacific negative SSTA.

Oceanic Kelvin Wave (OKW) Index

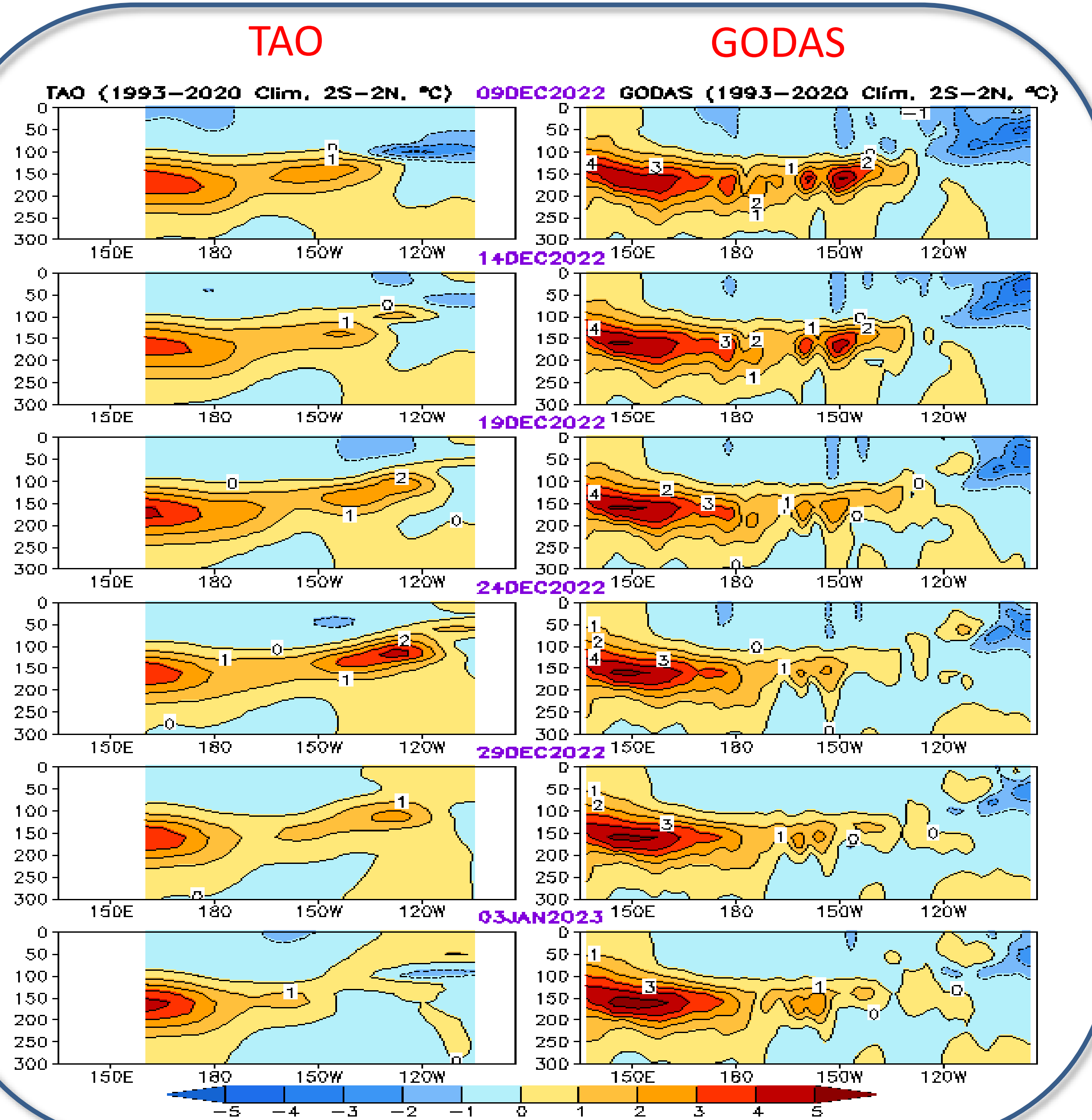




- **Upwelling Kelvin waves were initiated in Jan & Jul 2022, leading to the subsurface cooling in the eastern equatorial Pacific.**
- **During Aug-Oct 2022, stationary component has dominated, and a weak downwelling Kelvin wave propagated eastward since Oct 2022.**

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

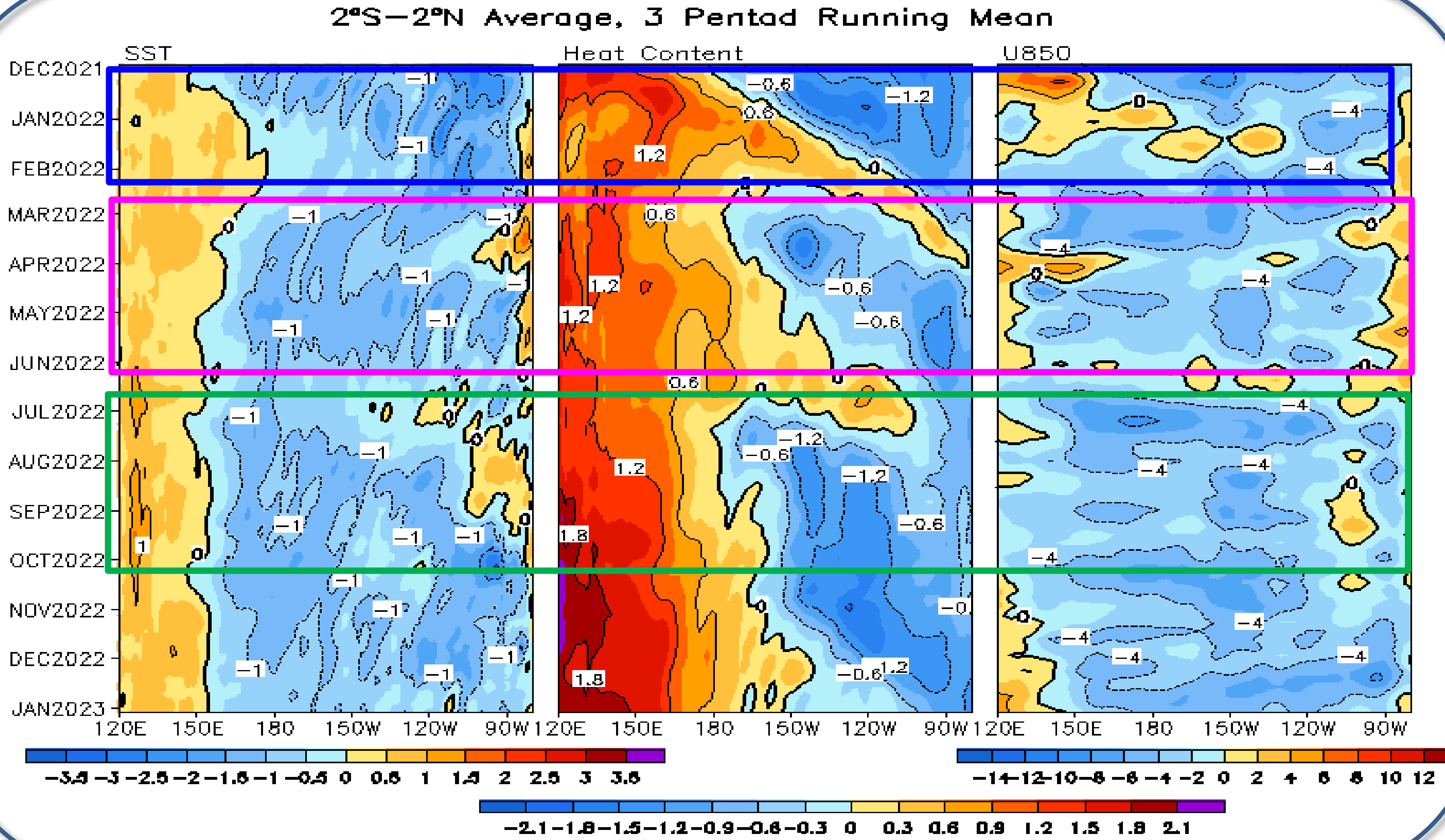
Equatorial Pacific Ocean Temperature Pentad Mean Anomaly



- Negative ocean temperature anomalies along the thermocline in the eastern and near the surface weakened in the last month.

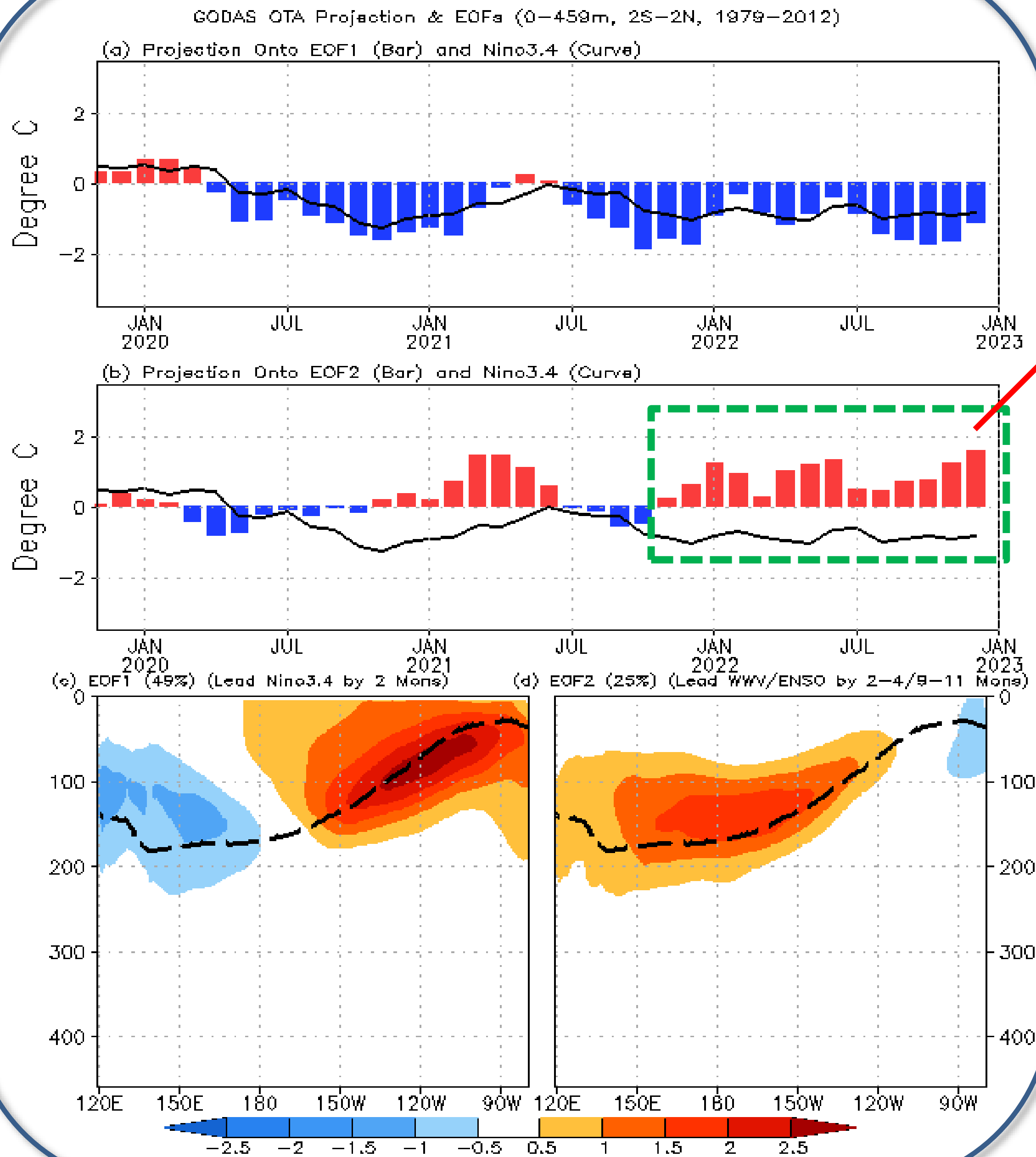
- The features of the ocean temperature anomalies were similar between GODAS and TAO analysis.

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



- The evolution of the triple-dip La Niña SSTA in 2020-22 was linked to low-level zonal wind anomalies and Kelvin wave activities.

Equatorial Sub-surface Ocean Temperature Monitoring



- The equatorial Pacific has been in a recharge phase since Nov 2021.

- Projection of ocean temperature anomalies onto EOF1 and EOF2; EOF1: Tilt/dipole mode (ENSO peak phase); EOF2: WWV mode.

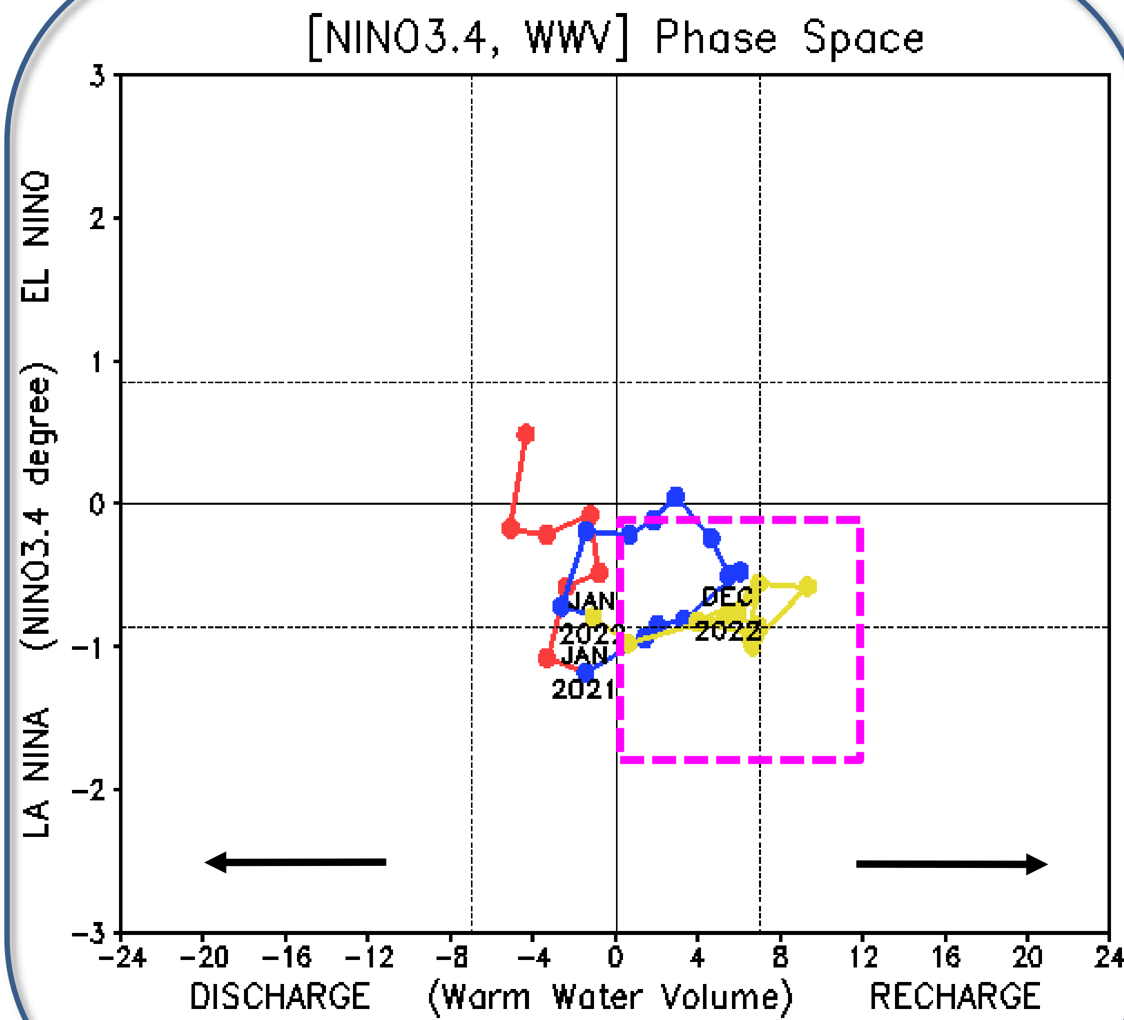
- Recharge/discharge oscillation (ENSO transition phase); Recharge process: heat transport from outside of equator to equator; Negative -> positive phase of ENSO

- For details, see: Kumar and Hu (2014) DOI: 10.1007/s00382-013-1721-0.

Warm Water Volume (WWV) and Niño3.4 Anomalies

- Equatorial Warm Water Volume (WWV) was in a recharge phase in Dec 2022.

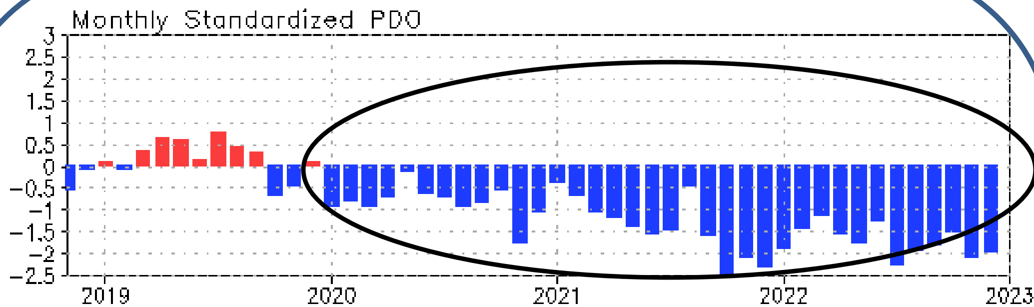
-As WWV is intimately linked to ENSO variability (Wyrtki 1985; Jin 1997), it is useful to monitor ENSO in a phase space of WWV and Niño3.4 (Kessler 2002).
- Increase (decrease) of WWV indicates recharge (discharge) of the equatorial oceanic heat content.

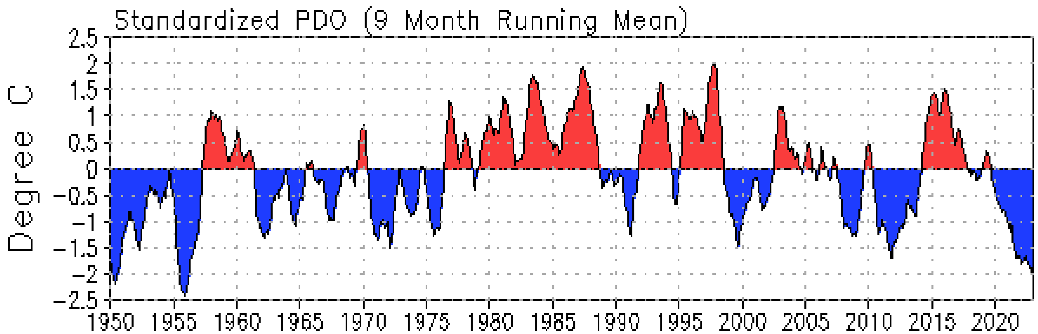


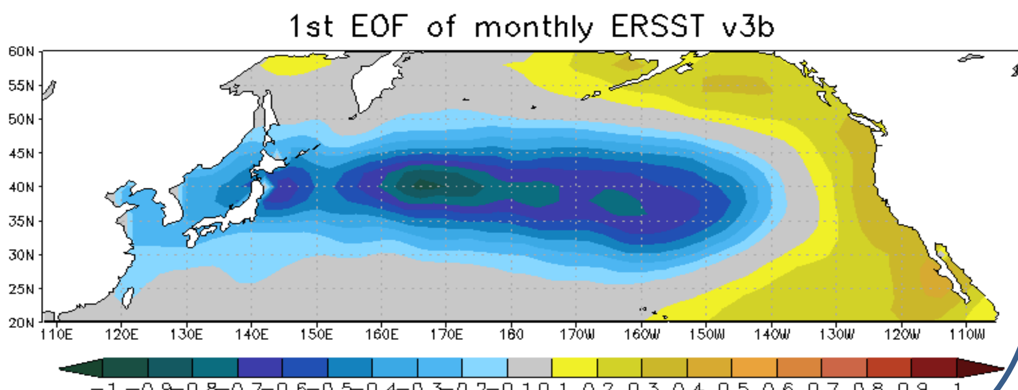
Phase diagram of Warm Water Volume (WWV) and Niño3.4 indices. WWV is the average of depth of 20ºC in [120ºE-80ºW, 5ºS-5ºN] calculated with the NCEP's GODAS. Anomalies are departures from the 1991-2020 base period means.

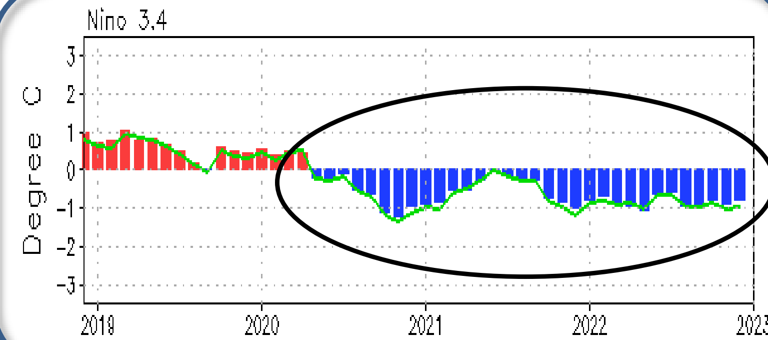
North Pacific & Arctic Oceans

Pacific Decadal Oscillation (PDO) Index







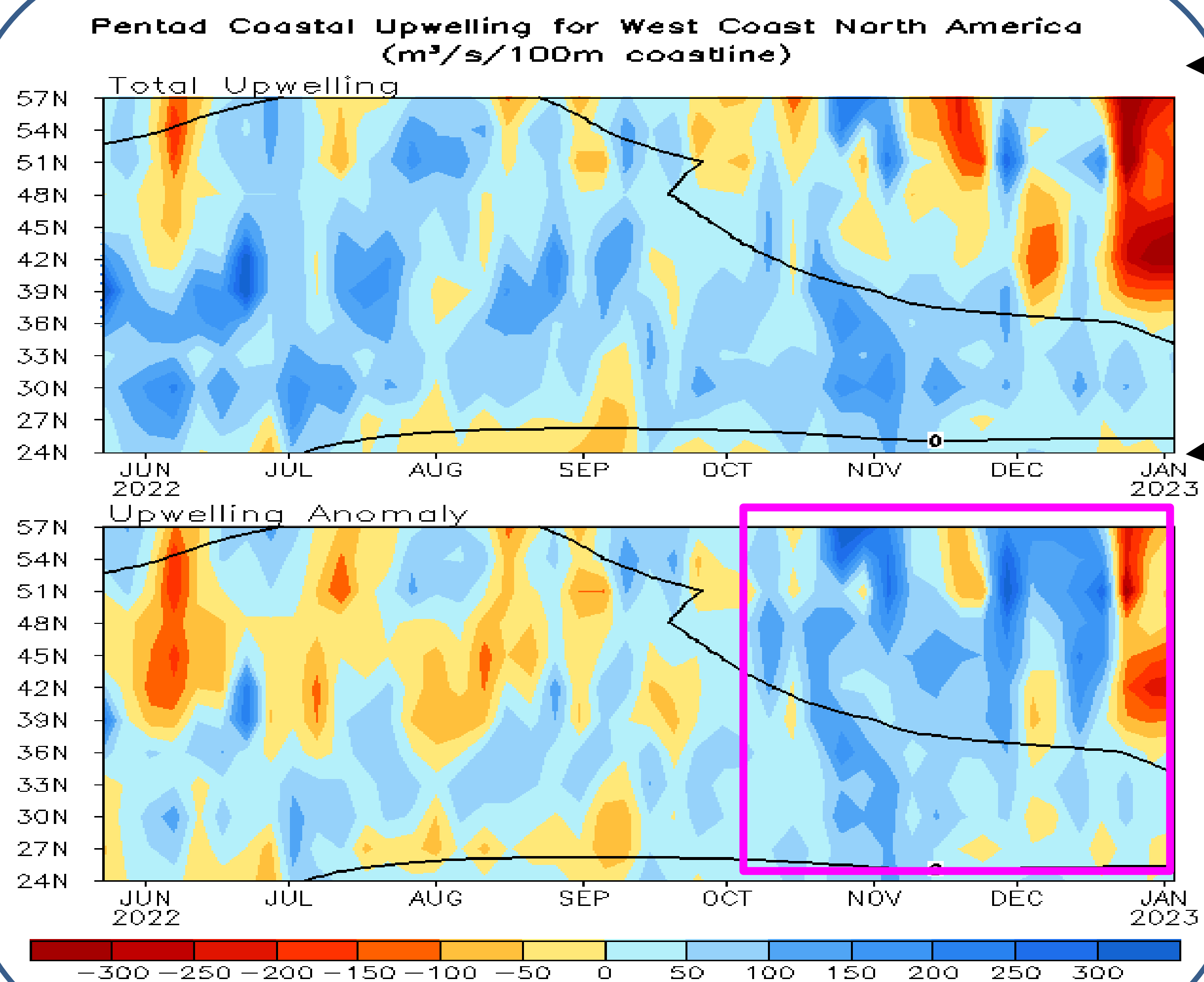


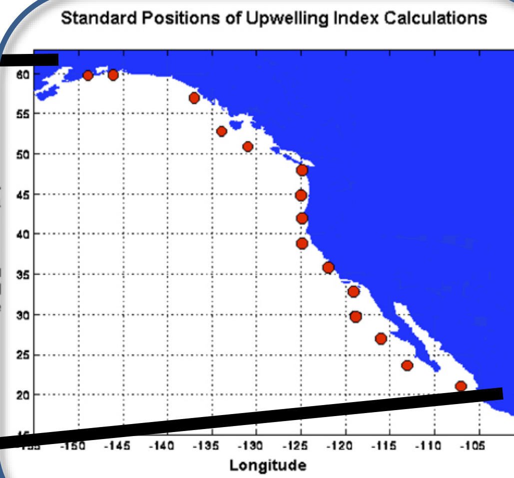
- The PDO has been in a negative phase since Jan 2020 with PDOI = -2.0 in Dec 2022.

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

• 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 SST anomalies onto the 1st EOF pattern.

North America Western Coastal Upwelling



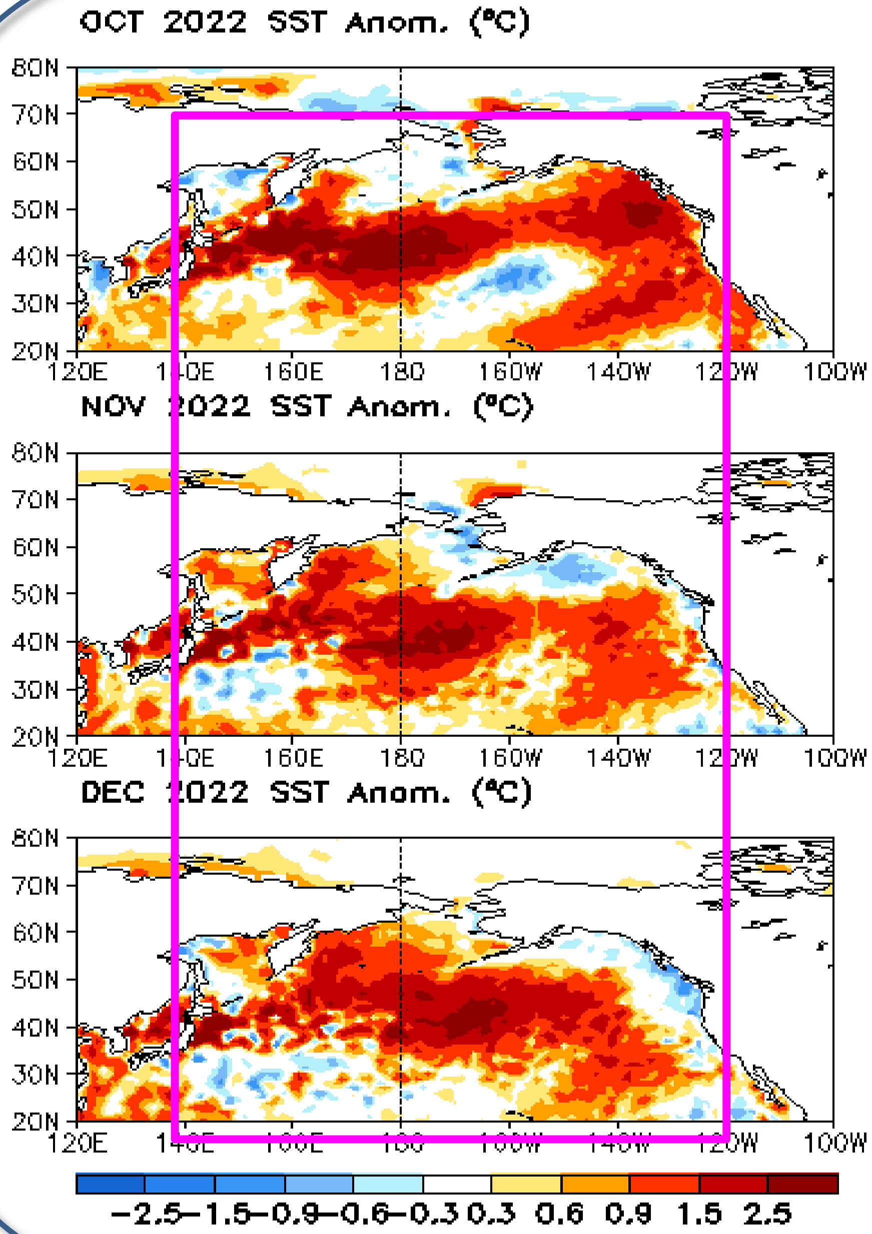


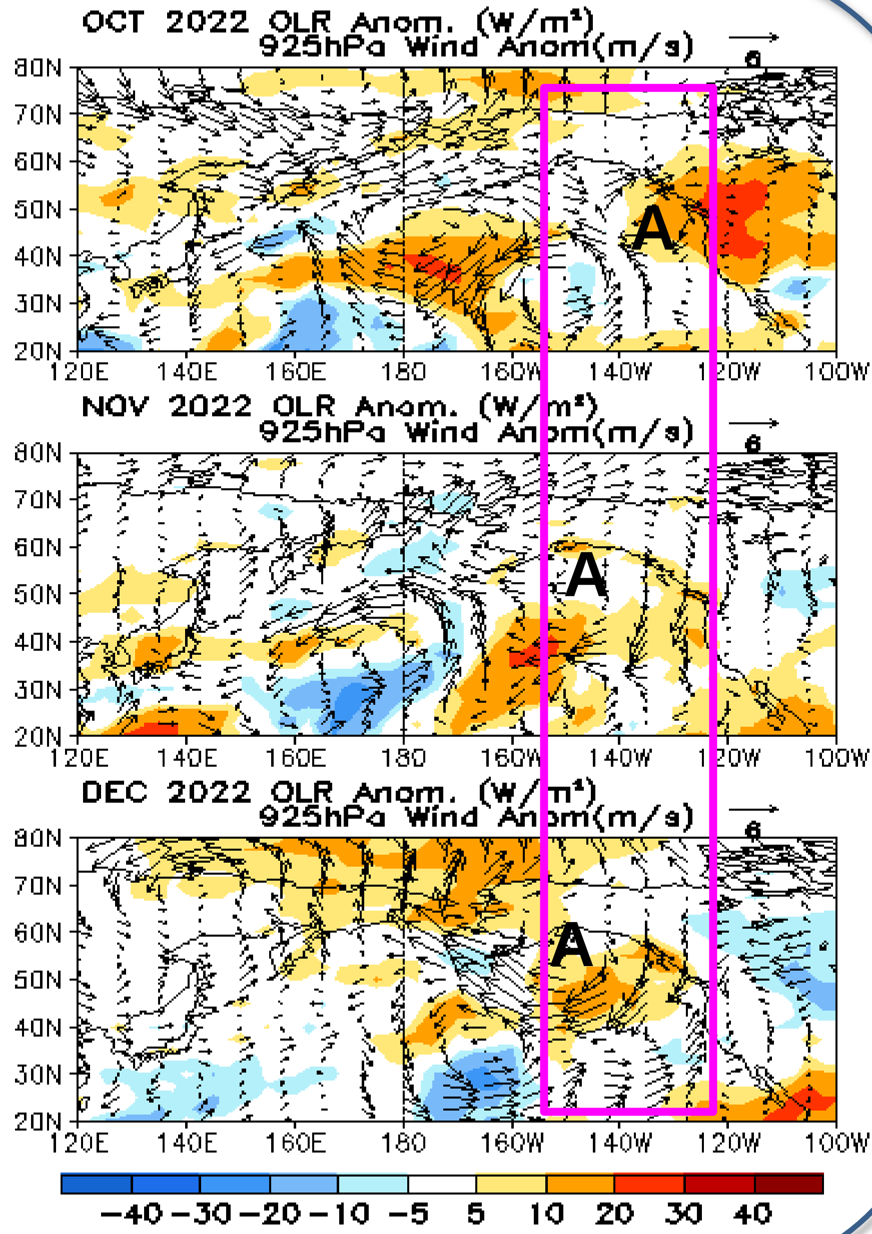
- Coastal anomalous upwelling has turned to anomalous downwelling since late Dec 2023.

(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.

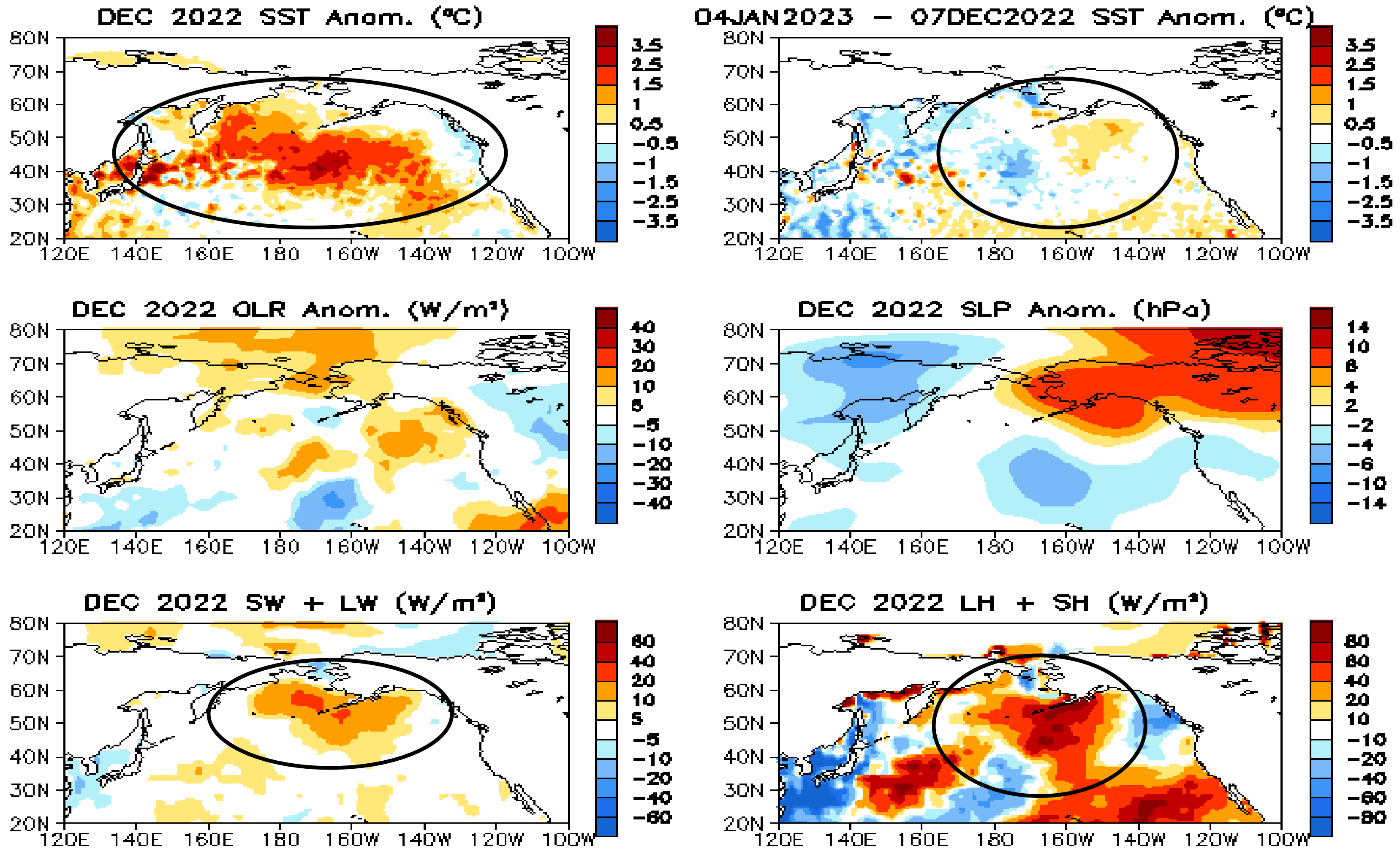
- Area below (above) black line indicates climatological upwelling (downwelling) season.
- Climatologically upwelling season progresses from March to July along the west coast of North America from 36ºN to 57ºN.

North Pacific SST, OLR, and uv925 anomalies



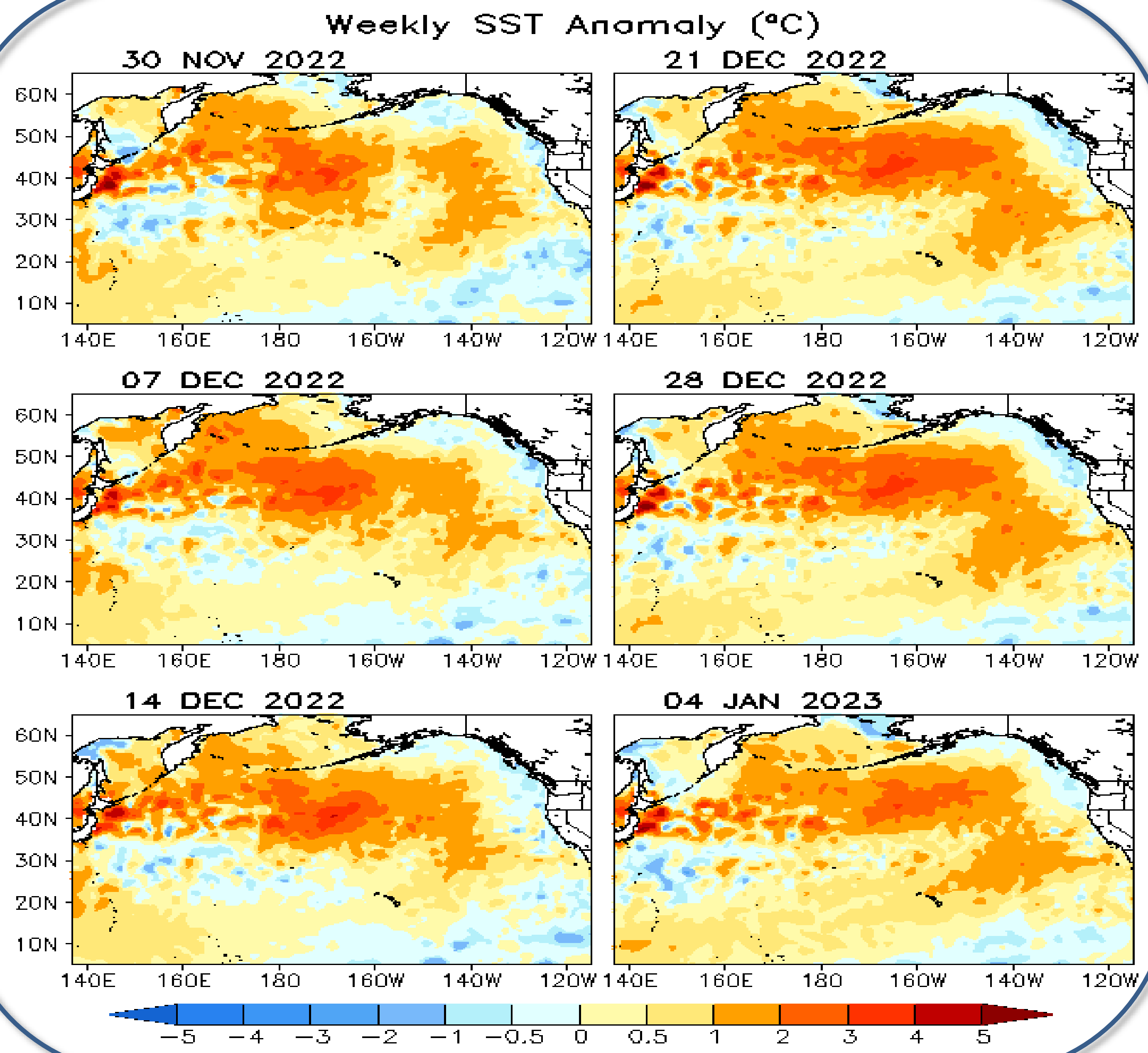


North Pacific & Arctic Ocean: SSTA, SSTA Tend., OLR, SLP, Sfc Rad, Sfc Flx Anomalies



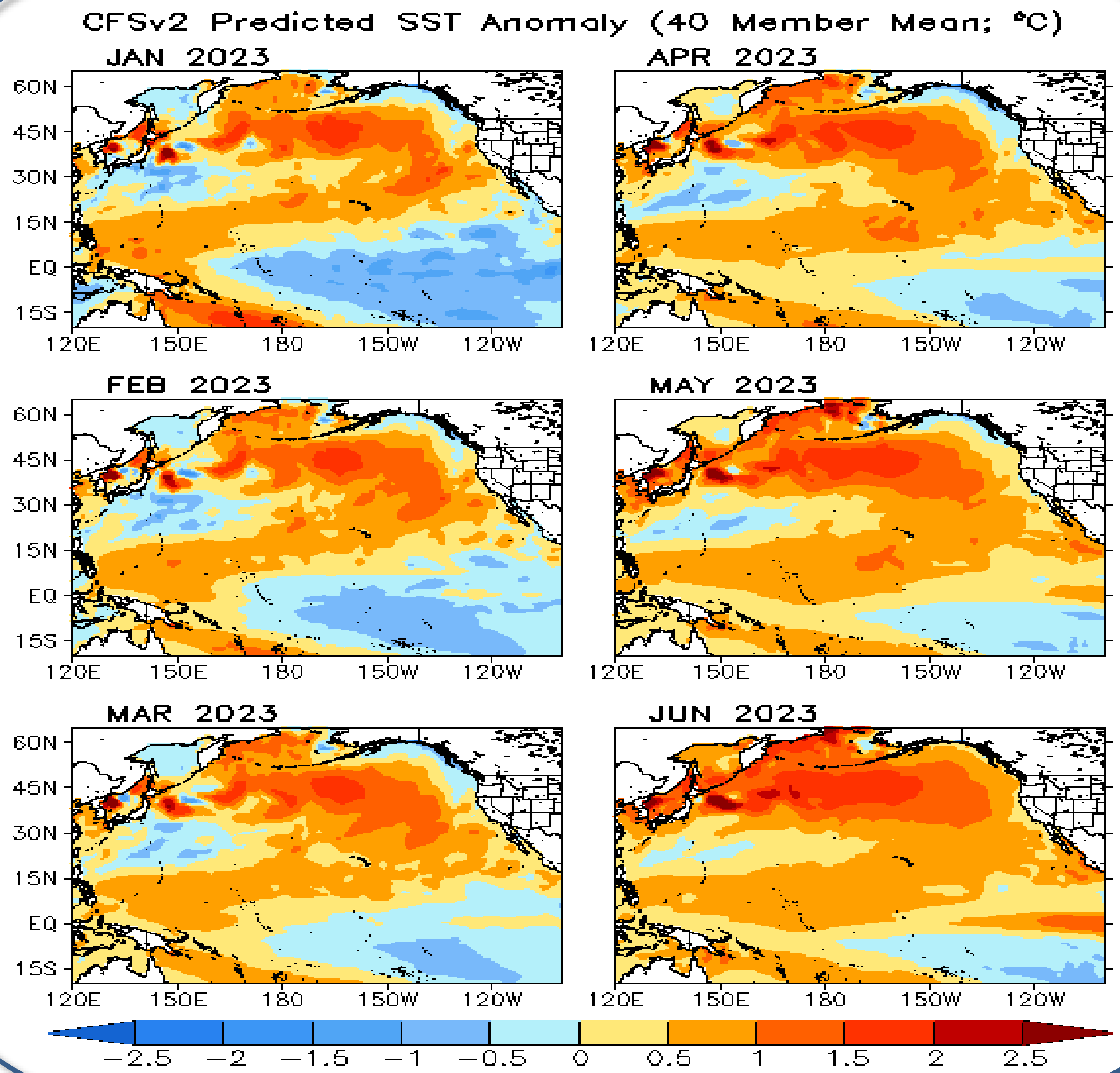
SSTA (top-left; OIv2.1 SST Analysis), SSTA tendency (top-right), Outgoing Long-wave Radiation (OLR) (middle-left; NOAA 18 AVHRR IR), sea surface pressure (middle-right; NCEP CDAS), sum of net surface short- and long-wave radiation (bottom-left; positive means heat into the ocean; NCEP CDAS), sum of latent and sensible heat flux (bottom-right; positive means heat into the ocean; NCEP CDAS). Anomalies are departures from the 1991-2020 base period means.

Weekly SSTA evolutions in the NE Pacific



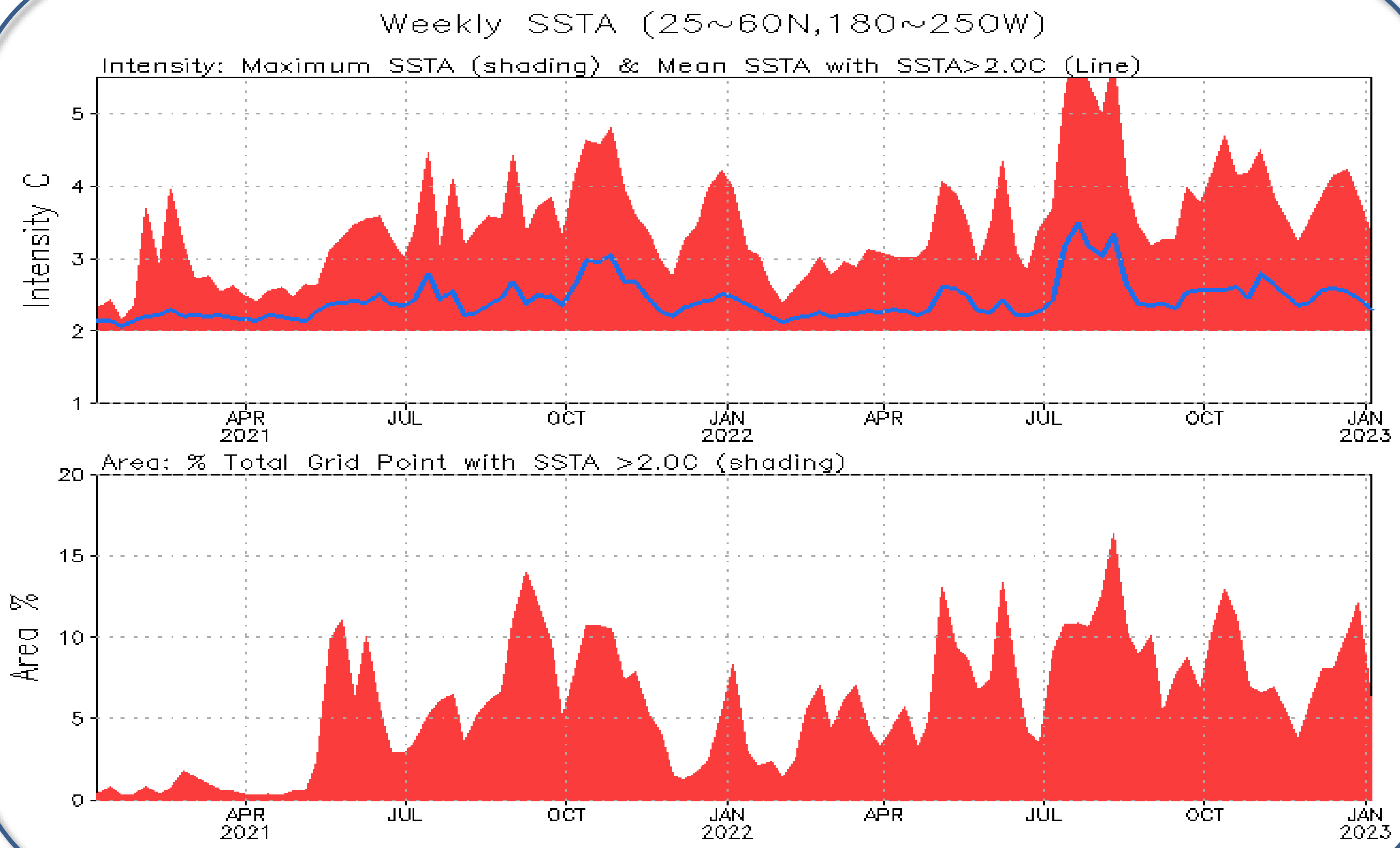
- The northern Pacific SST warming persisted and moved eastward during the last six weeks.

CFSv2 NE Pacific SSTA Predictions



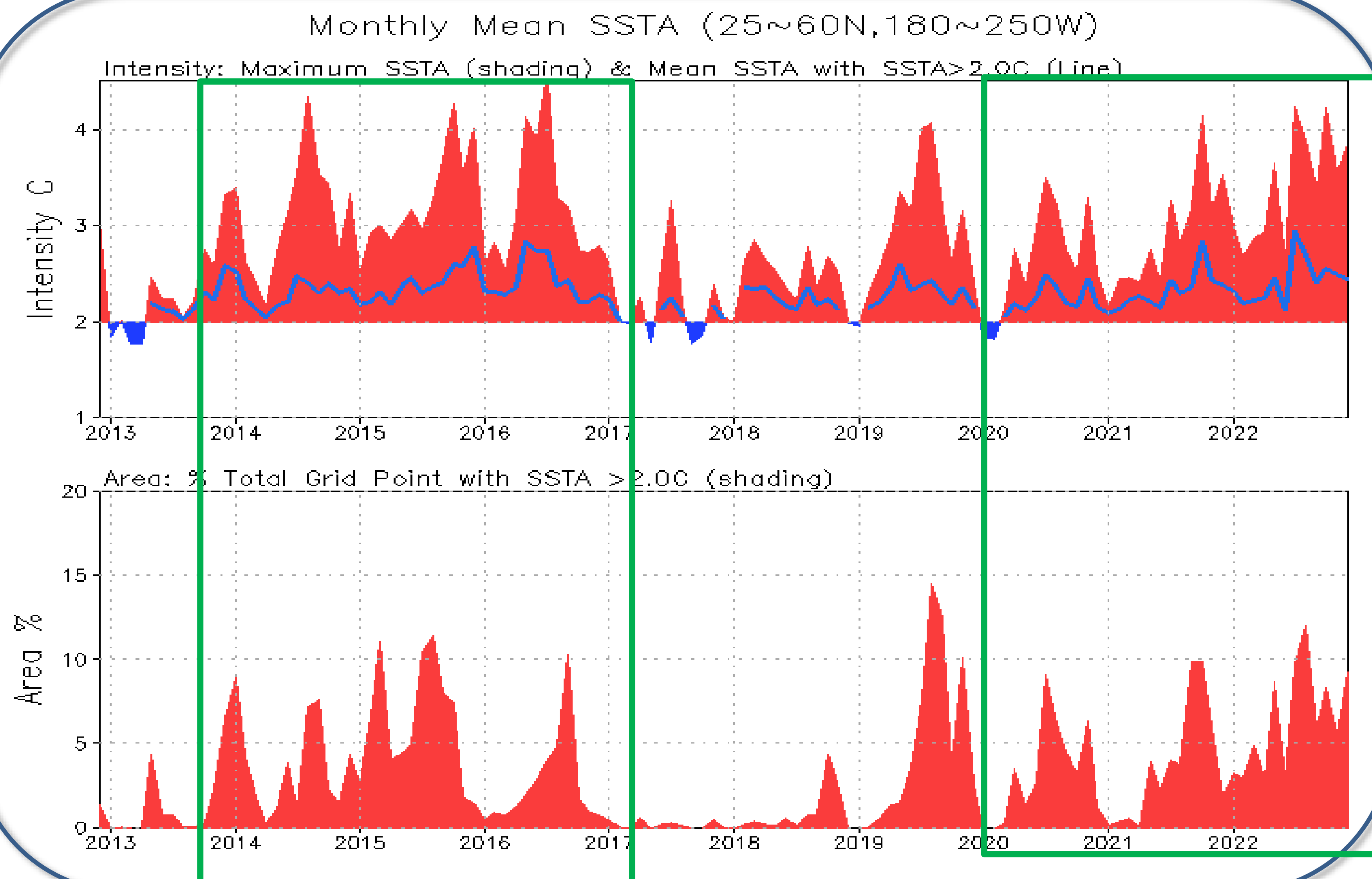
- The CFSv2 predicts the current SST warm state in the N Pacific will continue into the summer 2023.

N. Pacific Marine Heat Wave



https://origin.cpc.ncep.noaa.gov/products/GODAS/MarineHeatWave.html

N. Pacific Marine Heat Wave



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NOAA/NWS/NCEP CPC Marine Heat Wave Webpage

https://www.cpc.ncep.noaa.gov/products/GODAS/MarineHeatWave.html

NOAA/NCEP Climate Prediction Center

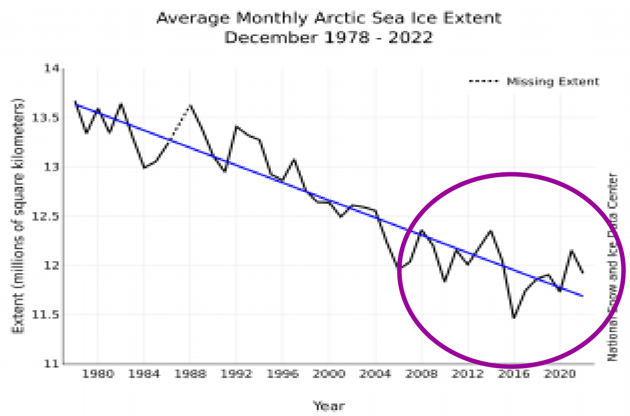
Marine Heatwave Monitoring and Forecast

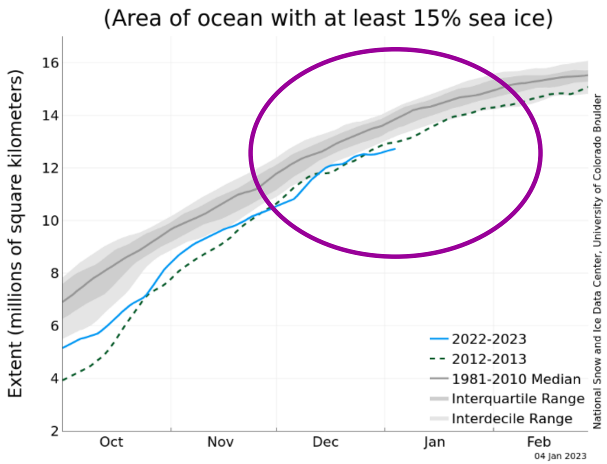
- **Indices & Time Series**
  - N. Pacific MHW Intensity & Area Indices: Weekly Monthly
  - Regional Mean SST: Global Monthly & Nino3.4 Since 1854 N. Pacific Weekly Gulf of Alaska & Subtropical Coast Weekly

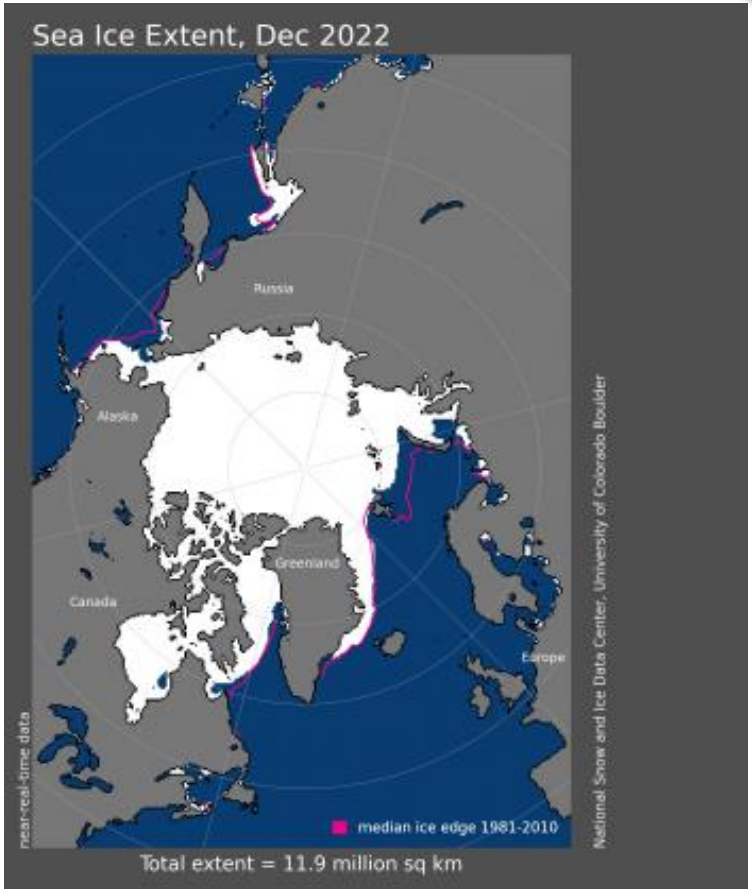
- **Spatial Distribution**
  - Global Monthly Anomaly
  - SST
  - N. Pacific Anomaly
  - Pentad Subsurface Ocean Temperature: 5m 55m 105m 155m
  - Weekly SST Weekly SST2
  - Pentad 300m Ocean Heat Content Pentad Ocean Surface Heigh Pentad Surface Heat Flux
  - 3-month SST, SLP, & UV925 SST Tendency & 3-Month Heat Flux
  - Ocean Temperature Profile GODAS Ocean Temperature Profile
  - N. Atlantic Anomaly
  - Weekly SSTA Monthly MDR SSTA
  - 3-month SST, SLP, & UV925 SST Tendency & 3-Month Heat Flux

- **NMME & CFSv2 Forecasts**
  - Tropical N. Atlantic SSTA: NMME CFSv2
  - N. Pacific SSTA: NMME CFSv2
  - CFSv2: N. Pacific Sea Surface Height Anomaly
  - CFSv2 SSTA Index: Last month Last 9 months

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

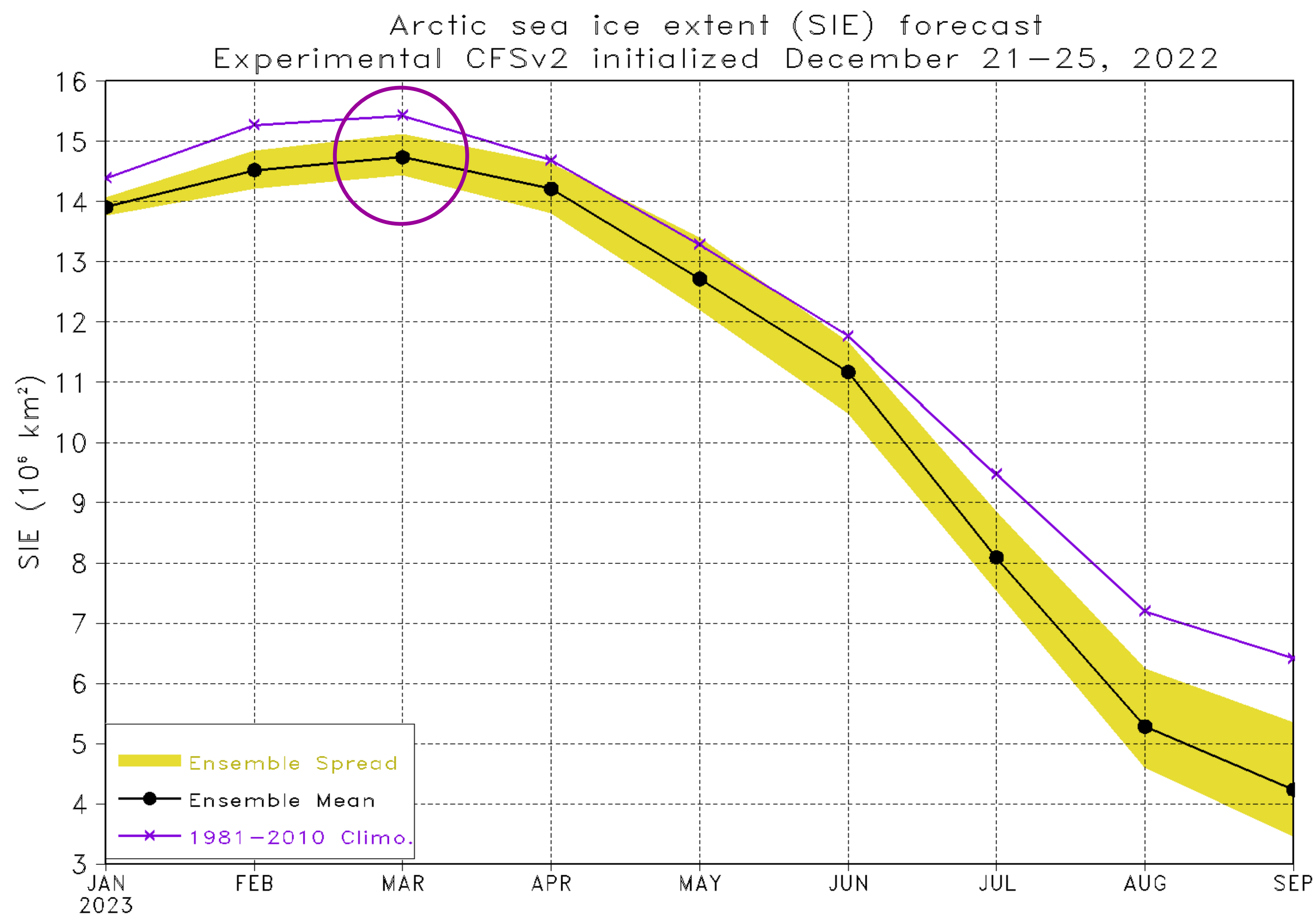






- The average Arctic sea ice extent for Dec 2022 was 11.92 million square kilometers. This is the 7th lowest in the satellite record for the month.
- The downward linear trend in Dec sea ice extent over the 45-year satellite record is 3.5% per decade relative to the 1981 to 2010 average. .

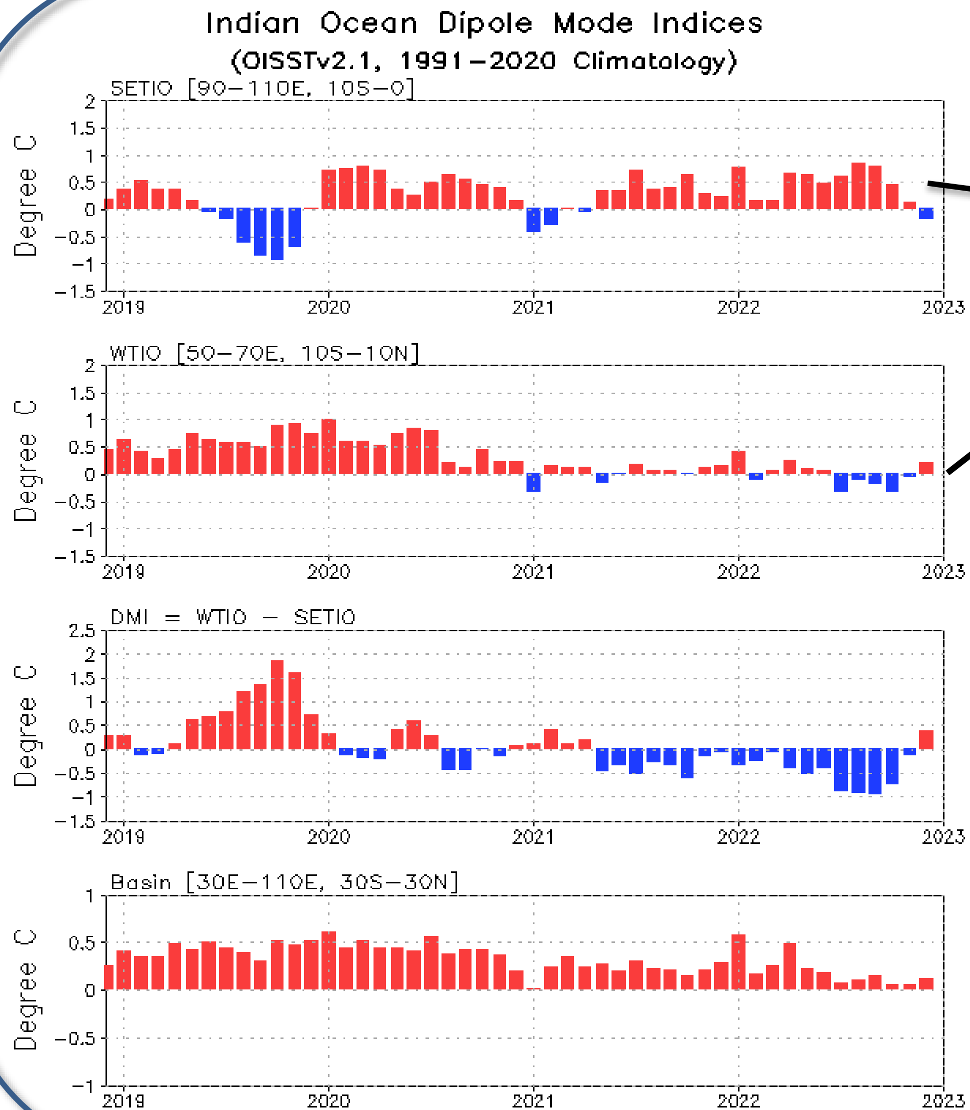
NCEP/CPC Arctic Sea Ice Extent Forecast

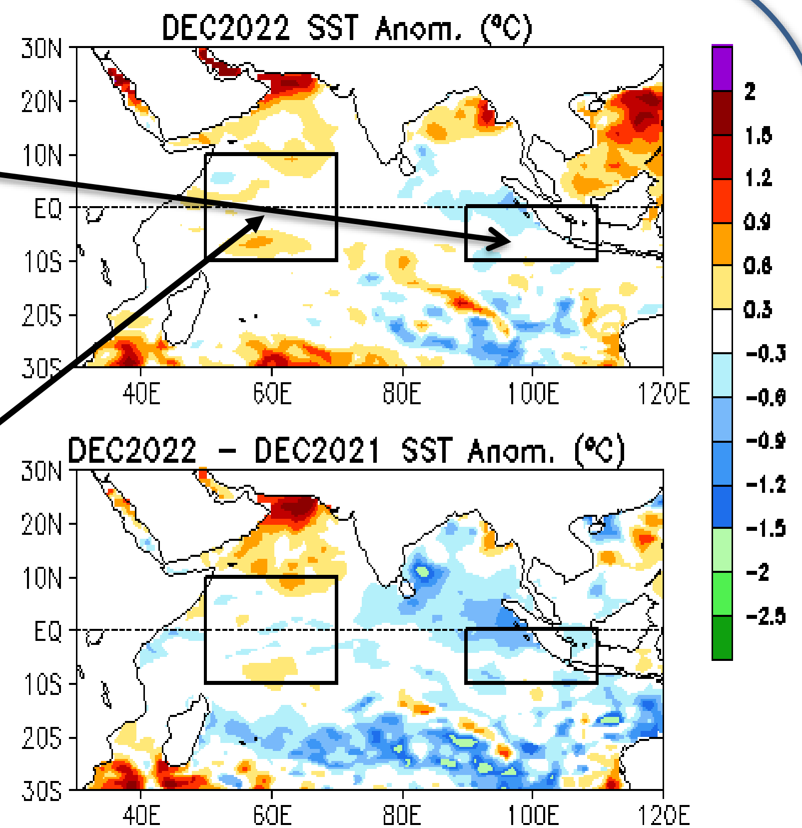


https://www.cpc.ncep.noaa.gov/products/people/wwang/seaice_seasonal/index.html

Indian Ocean

Evolution of Indian Ocean SST Indices

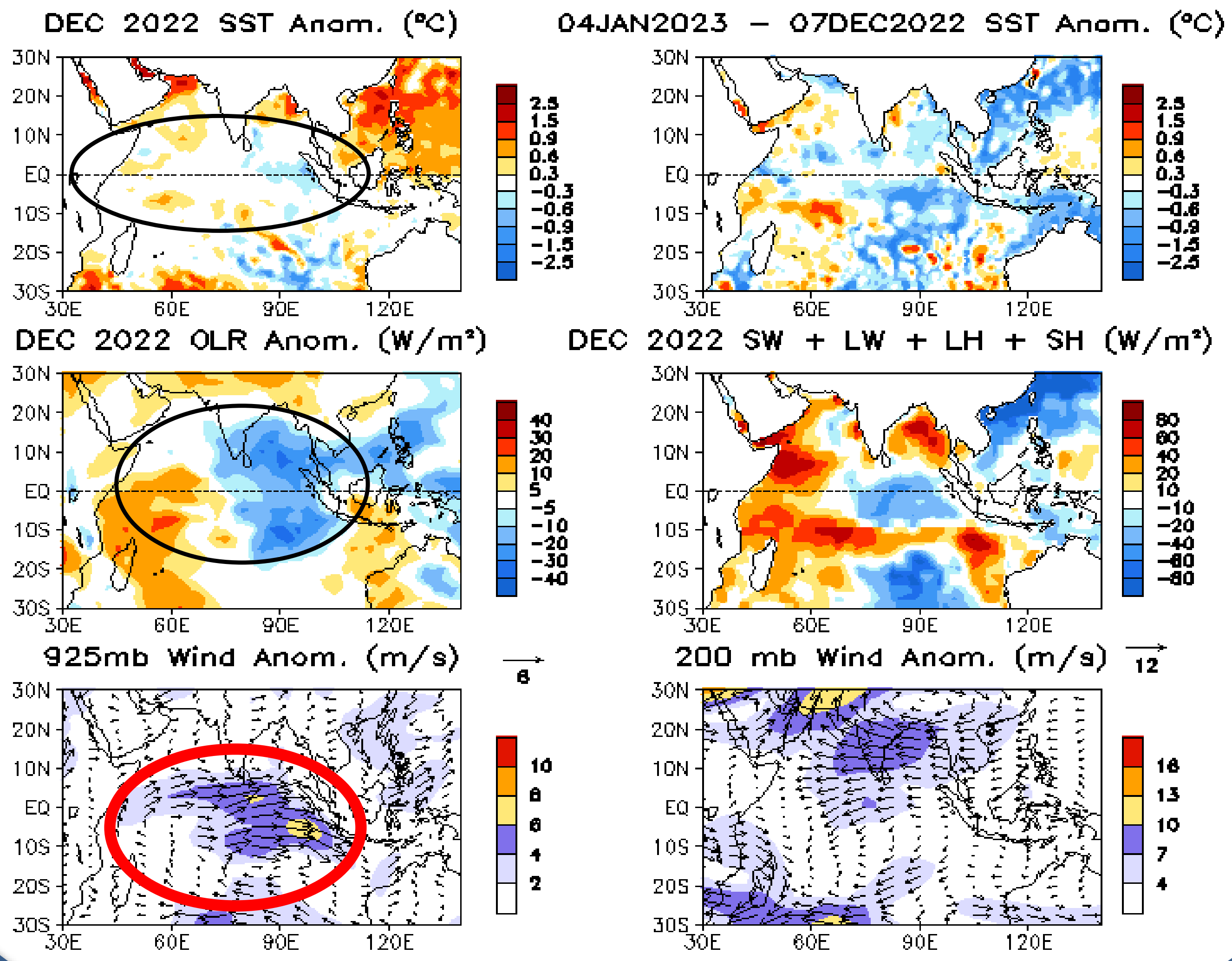




- Overall, SSTAs were small in the tropical Indian Ocean in Dec 2022.

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.

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



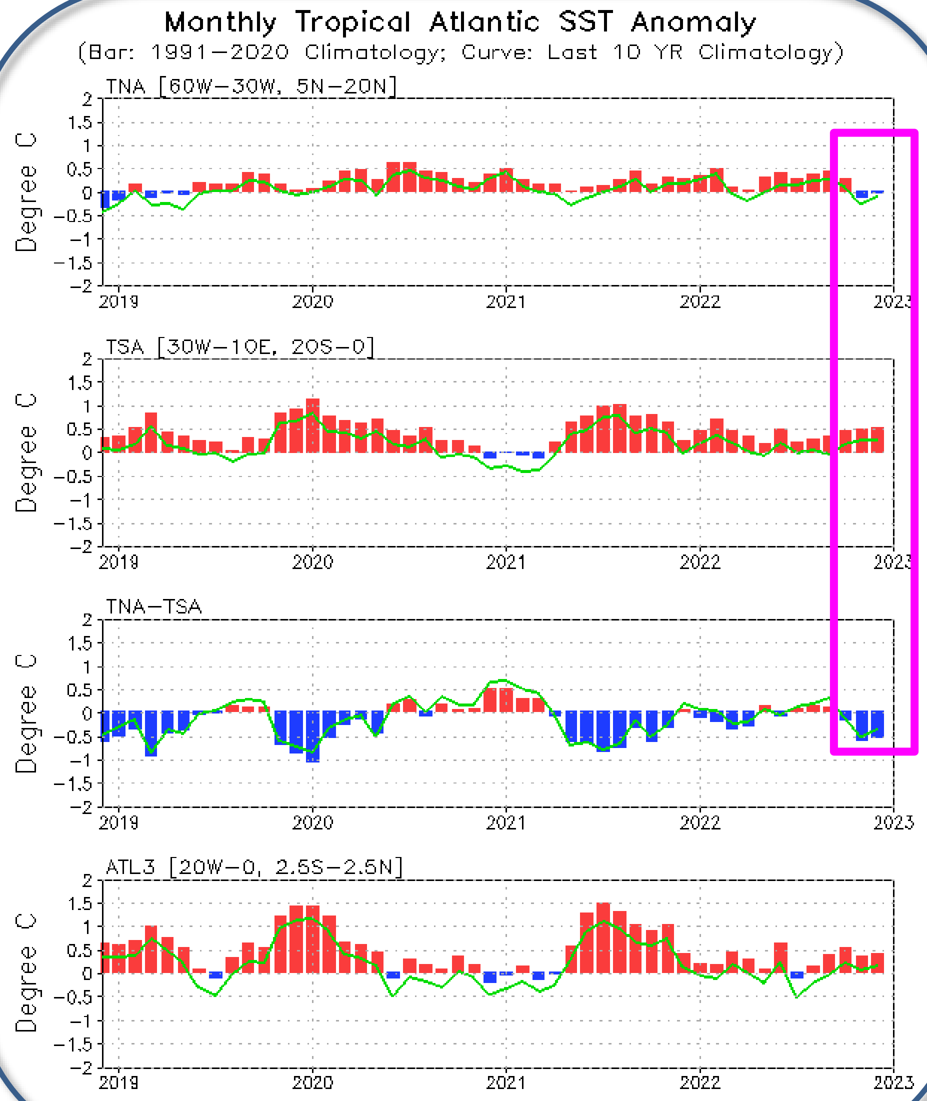
- SSTAs were overall small in the tropical Indian Ocean.

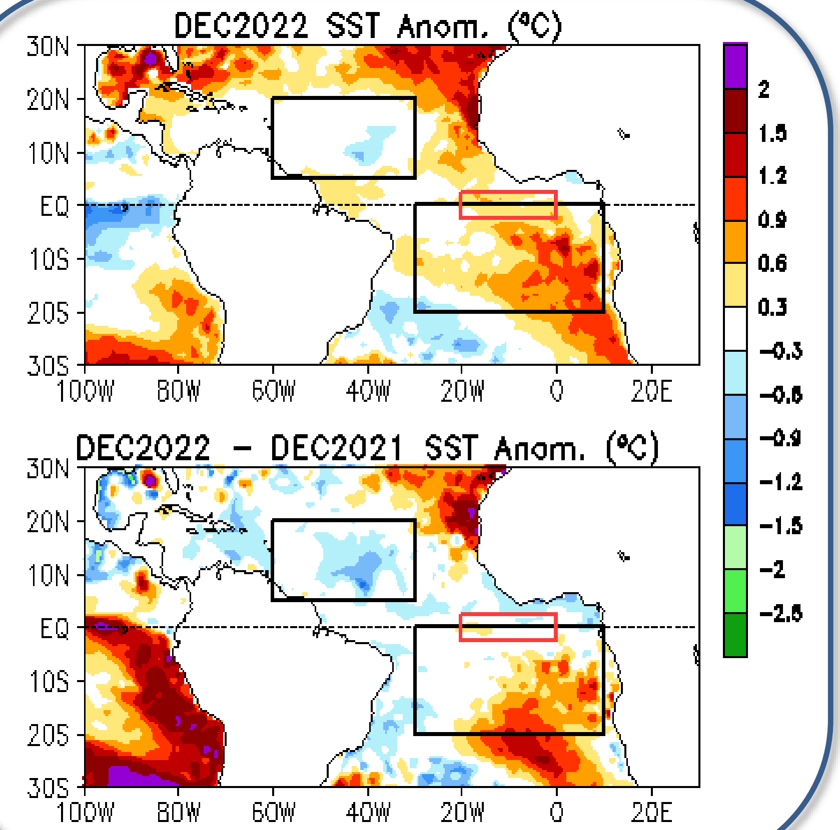
- Convection was enhanced (suppressed) over the eastern (western) Indian Ocean.

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 OIv2.1 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.

Tropical and North Atlantic Ocean

Evolution of Tropical Atlantic SST Indices

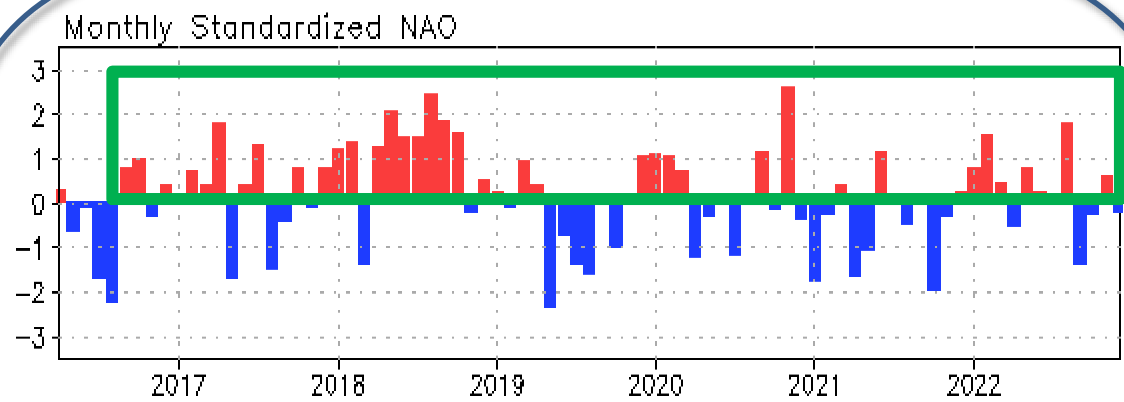


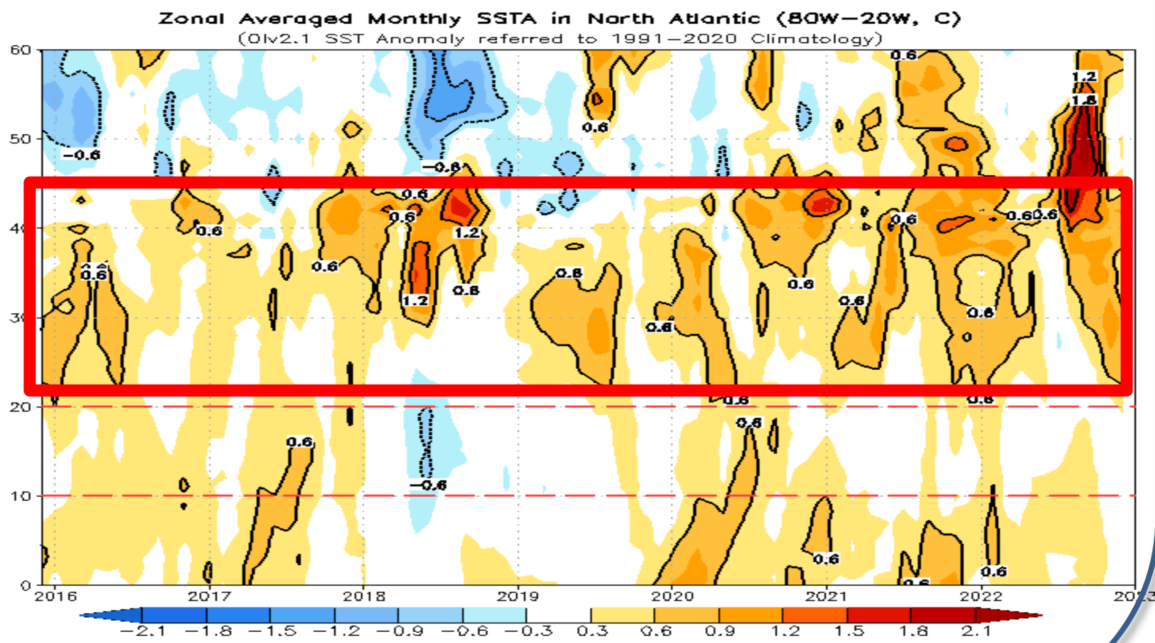


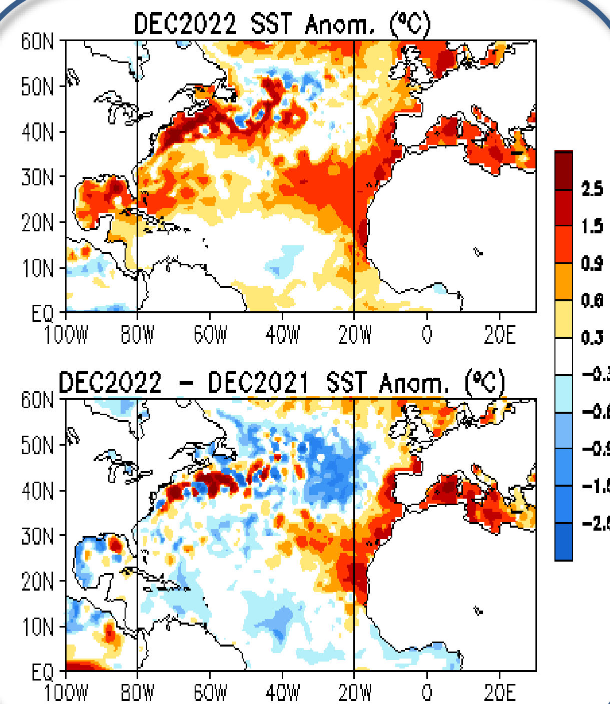
- Positive (negative) SSTAs in the tropical South (North) Atlantic feature a negative phase of the Atlantic meridional dipole mode.

Tropical Atlantic Variability region indices, calculated as the area-averaged monthly mean SSTAs (^{O}C) for the TNA [60^{O}W-30^{O}W, 5ºN-20^{O}N], TSA [30^{O}W-10^{O}E, 20^{O}S-0] and ATL3 [20^{O}W-0, 2.5^{O}S-2.5^{O}N] regions, and Meridional Gradient Index, defined as differences between TNA and TSA. Data are derived from the OIv2.1 SST analysis, and anomalies are departures from the 1991-2020 base period means.

NAO and SST Anomaly in North Atlantic





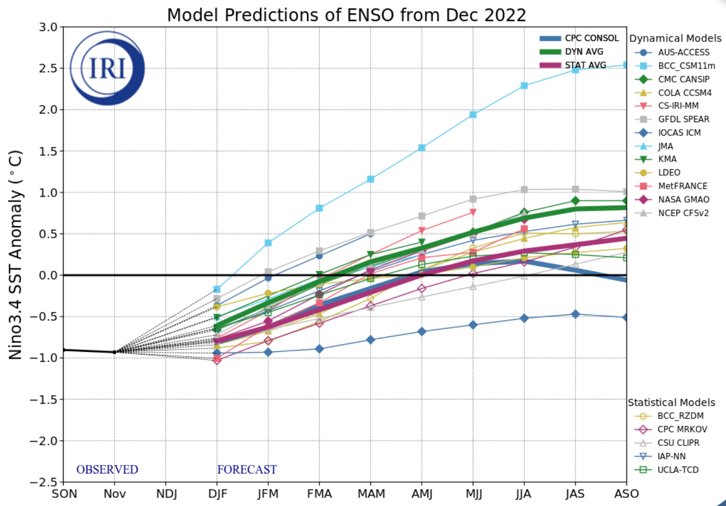


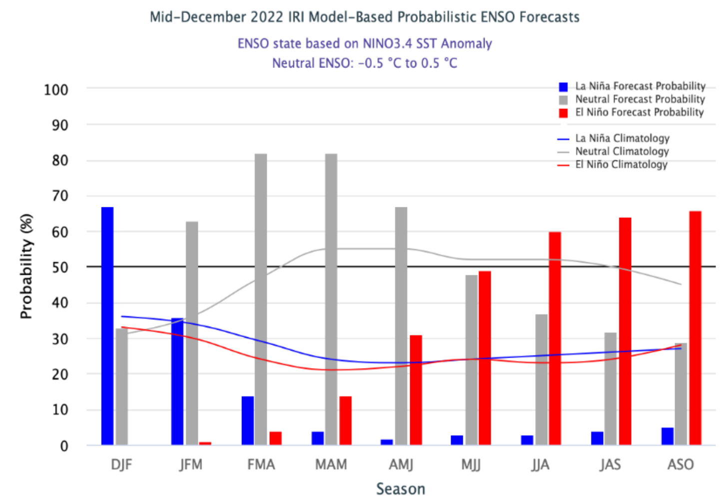
- NAO switched to a negative phase in Dec 2022 with NAOI= -0.2.
- The prolonged positive SSTAs in the middle latitudes were evident, due to the domination of the positive phase of NAO during the last 5-6 years.

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.

ENSO and Global SST Predictions

IRI/CPC Niño3.4 Forecast: Dec 2022





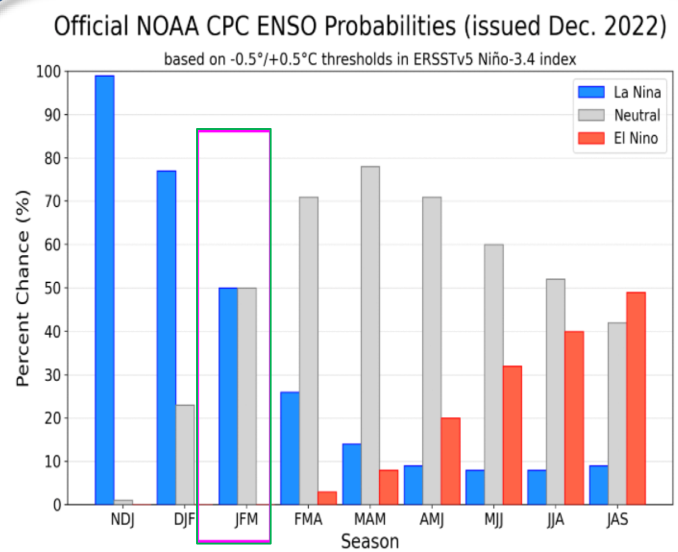
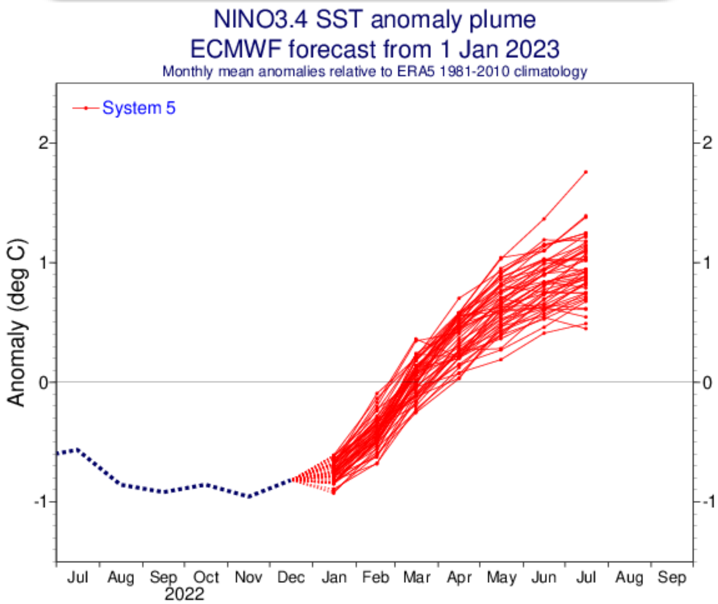


Figure 7. Official ENSO probabilities for the Niño 3.4 sea surface temperature index (5°N-5°S, 120°W-170°W). Figure updated 8 December 2022.

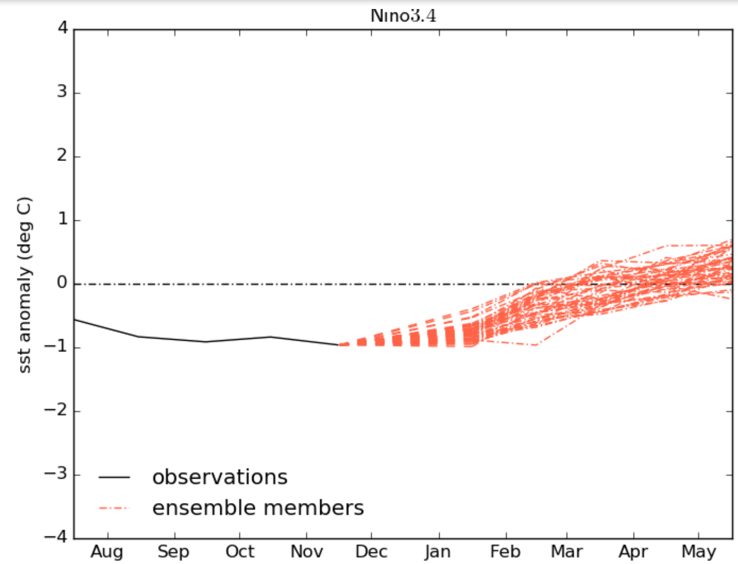
- **ENSO Alert System Status: La Niña Advisory**
- Synopsis: *"La Niña is expected to continue into the winter, with equal chances of La Niña and ENSO-neutral during January-March 2023. In February-April 2023, there is a 71% chance of ENSO-neutral."*

Individual Model Forecasts: Moderate La Niña will return to neutral in spring

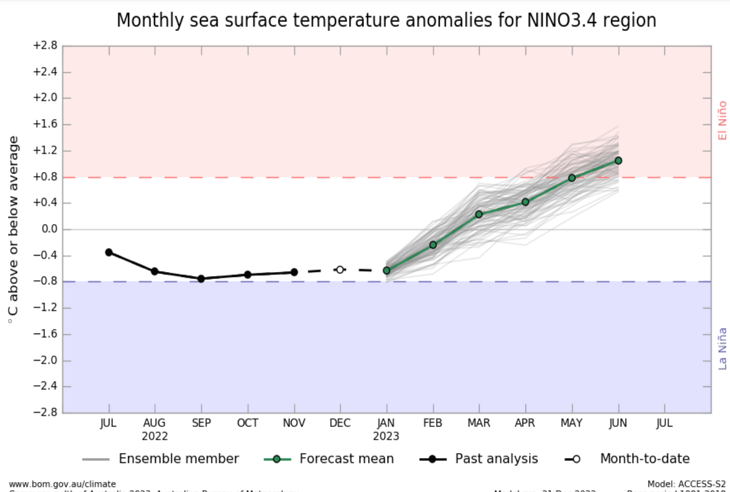
EC: Niño3.4, IC= 01Jan 2023



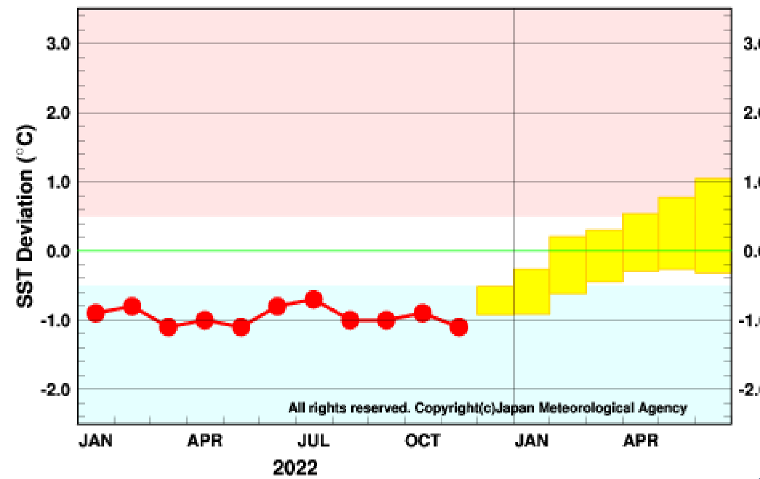
UKMO: Niño3.4, Updated 11 Dec 2022



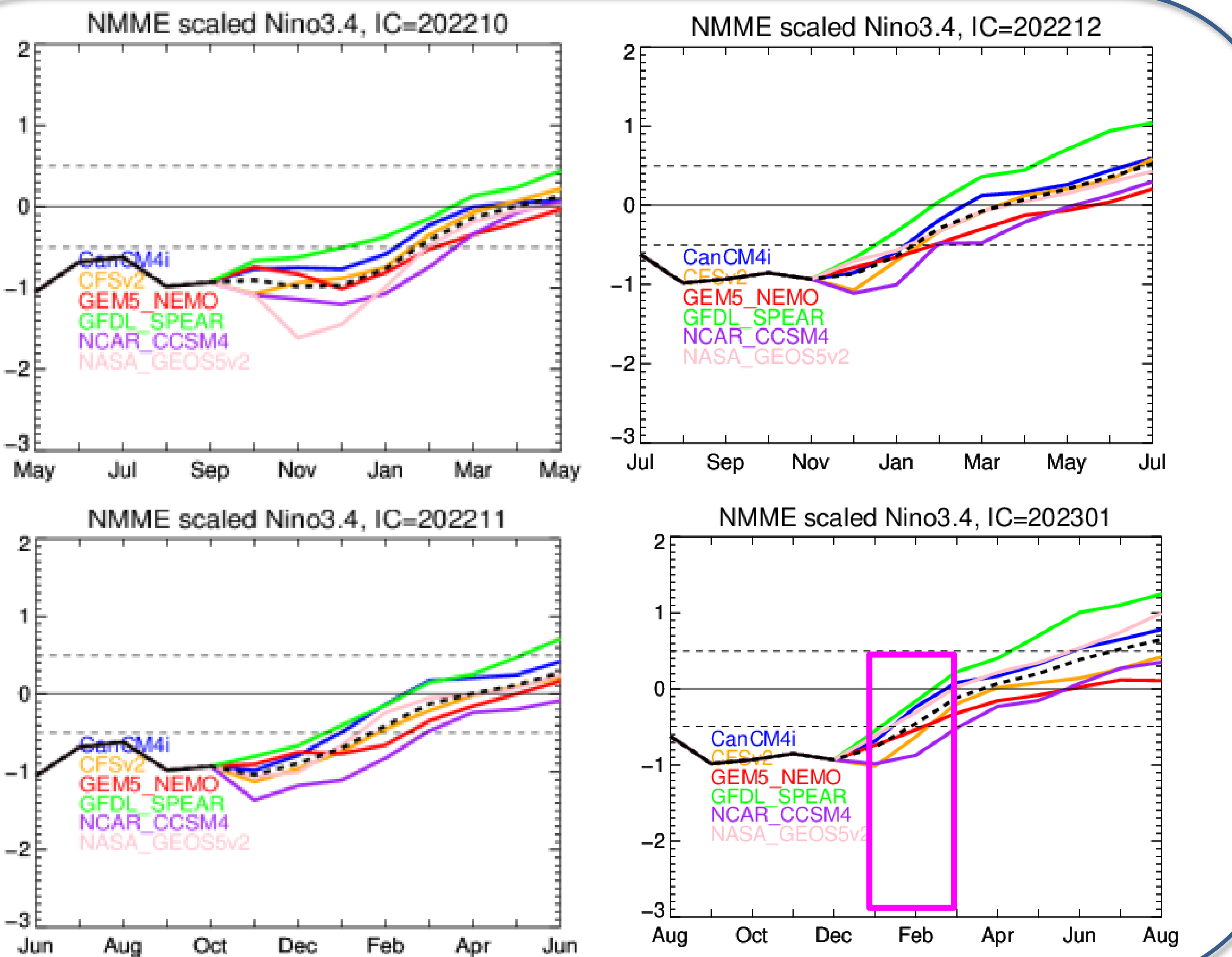
Australian BOM: Niño3.4, Updated 31 Dec 2022



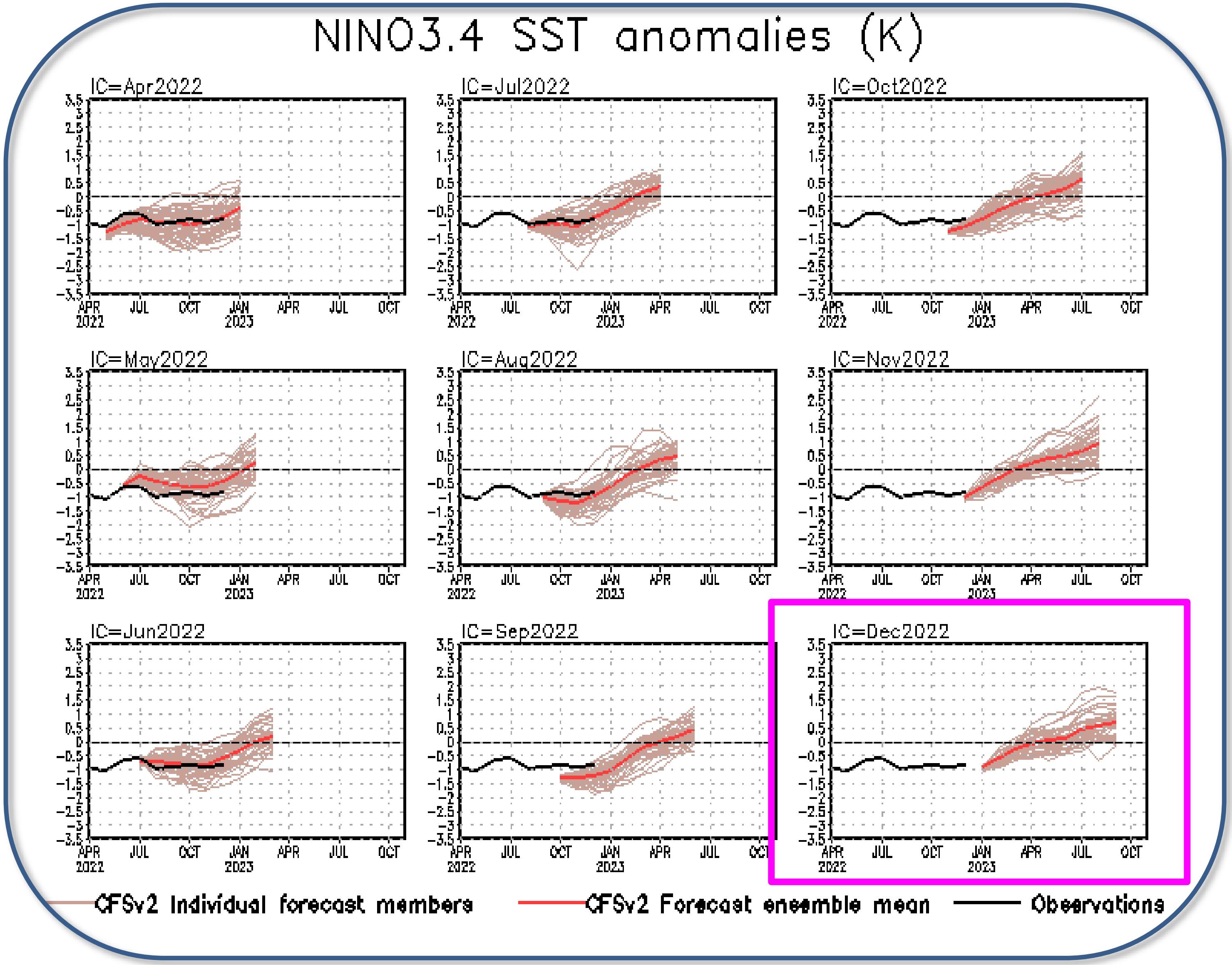
JMA: Niño3.4, Updated 9 Dec 2022



NMME forecasts from different initial conditions



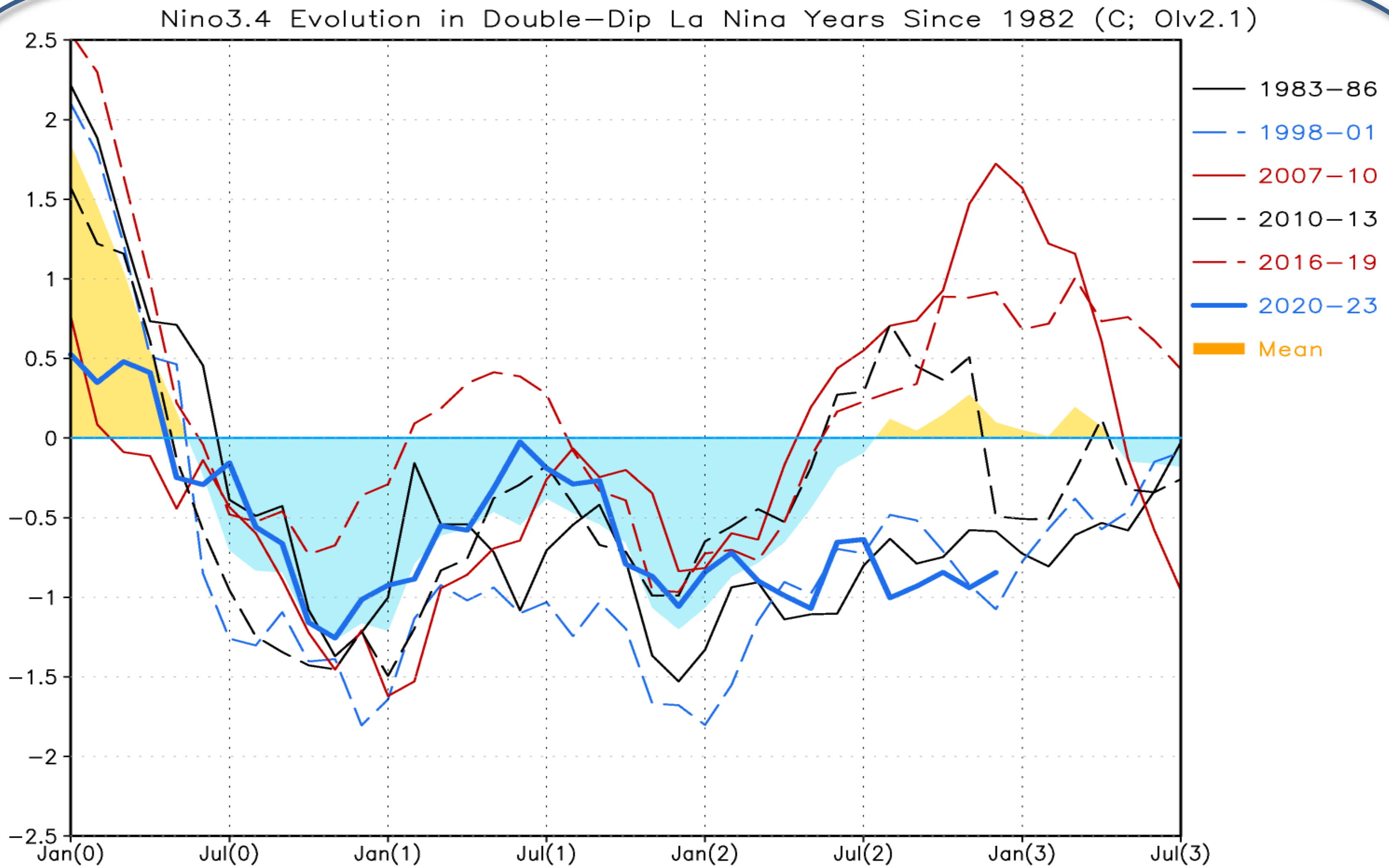
CFS Niño3.4 SST Predictions from Different Initial Months



- The latest CFSv2 forecasts the La Niña will return to a neutral condition in spring 2023.

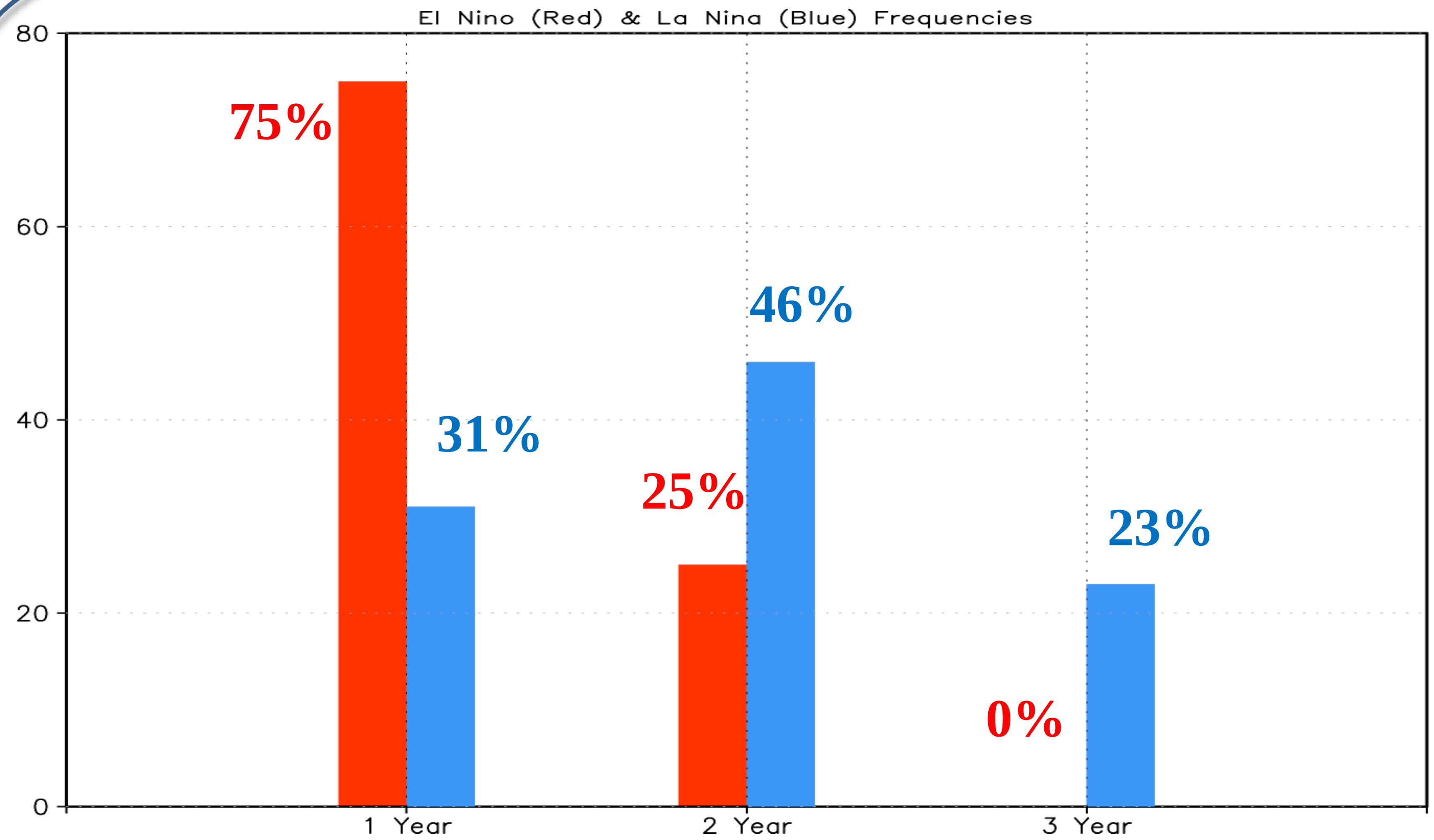
CFS Niño3.4 SST prediction from the latest 9 initial months. Displayed are 40 forecast members (brown) made four times per day initialized from the last 10 days of the initial month (labelled as IC=MonthYear) as well as ensemble mean (blue) and observations (black). Anomalies were computed with respect to the 1991-2020 base period means.

Niño3.4 Evolution in Double & Triple dip La Niña Years Since 1982 (OIv2.1; C)



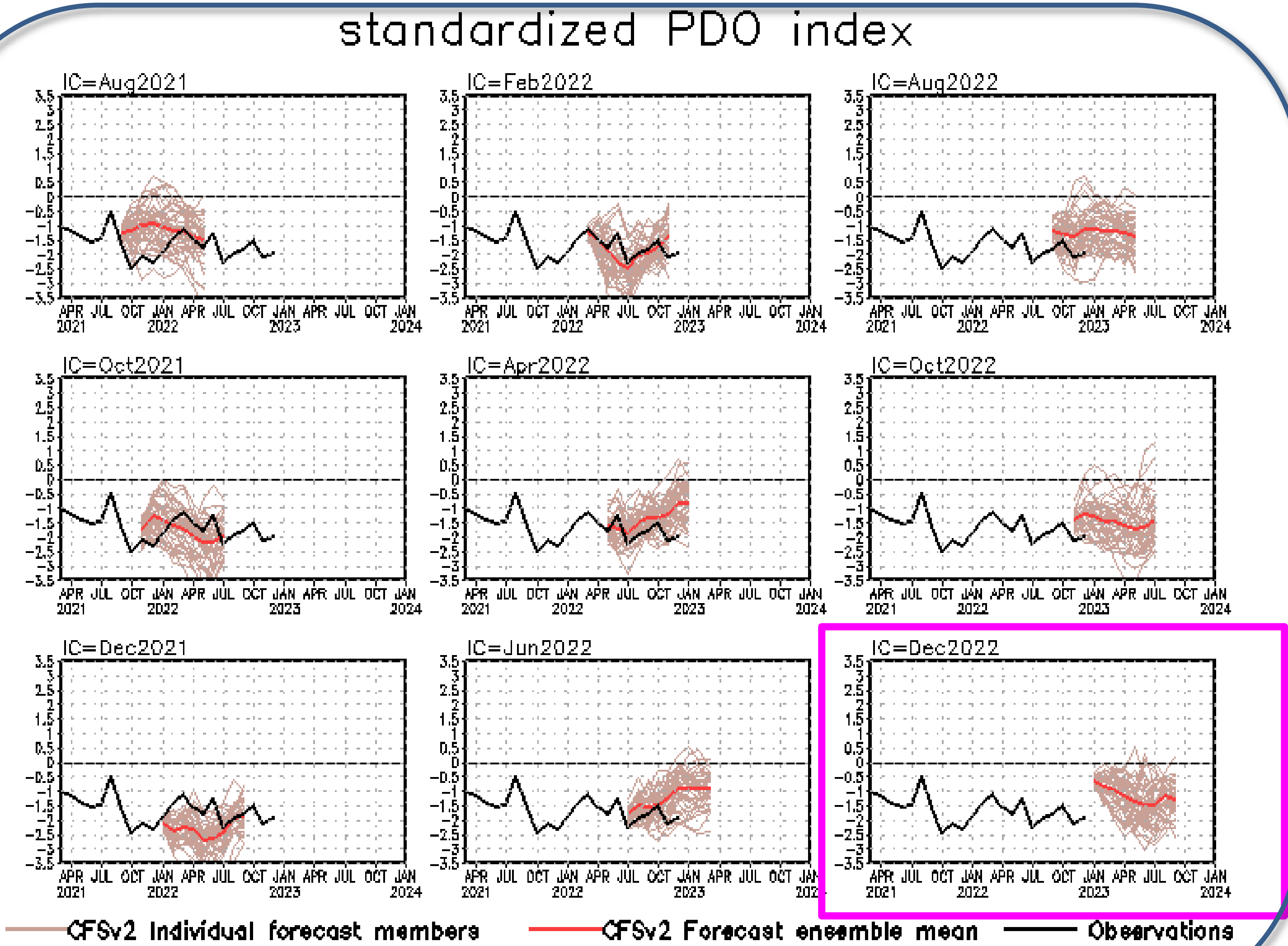
During 1982-2022, among 6 double-dip La Niñas, 2 (2007-09 & 2016-18) were followed by El Niño; 2 (1998-00; 2020-22) by a 3rd-year La Niña, & 2 (1983-85 & 2010-12) by neutral.

Percentages (%) of single-, double-, and triple-year El Niños (red bars) and La Niñas (blue bars) during 1951-2022



Gao, Z., et al., 2023: Single-Year and Double-Year El Niños. Climate Dyn. DOI: 10.1007/s00382-022-06425-8.

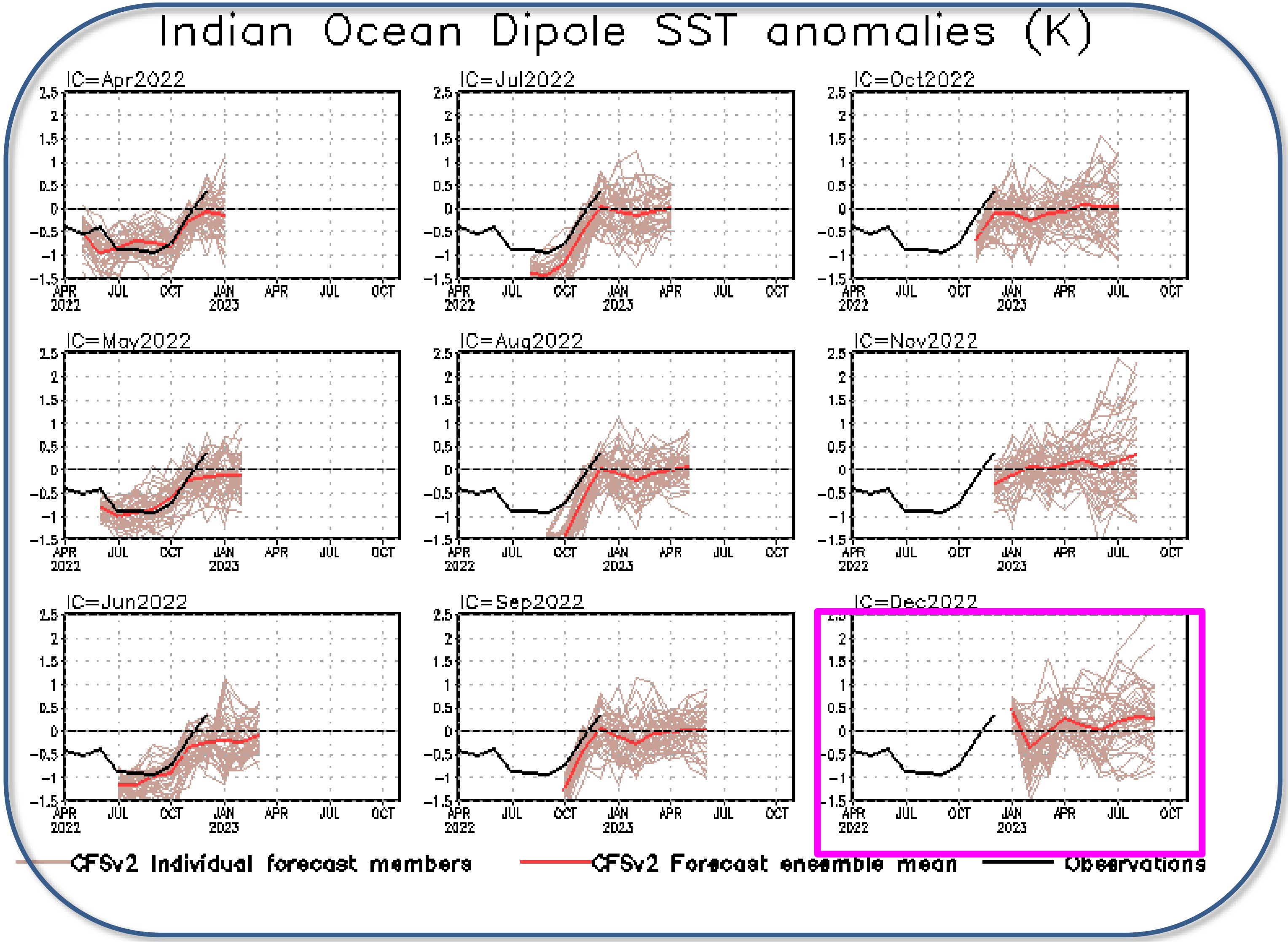
CFS Pacific Decadal Oscillation (PDO) Index Predictions from Different Initial Months



- CFSv2 predicts a persistent negative phase of PDO through summer 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 [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.

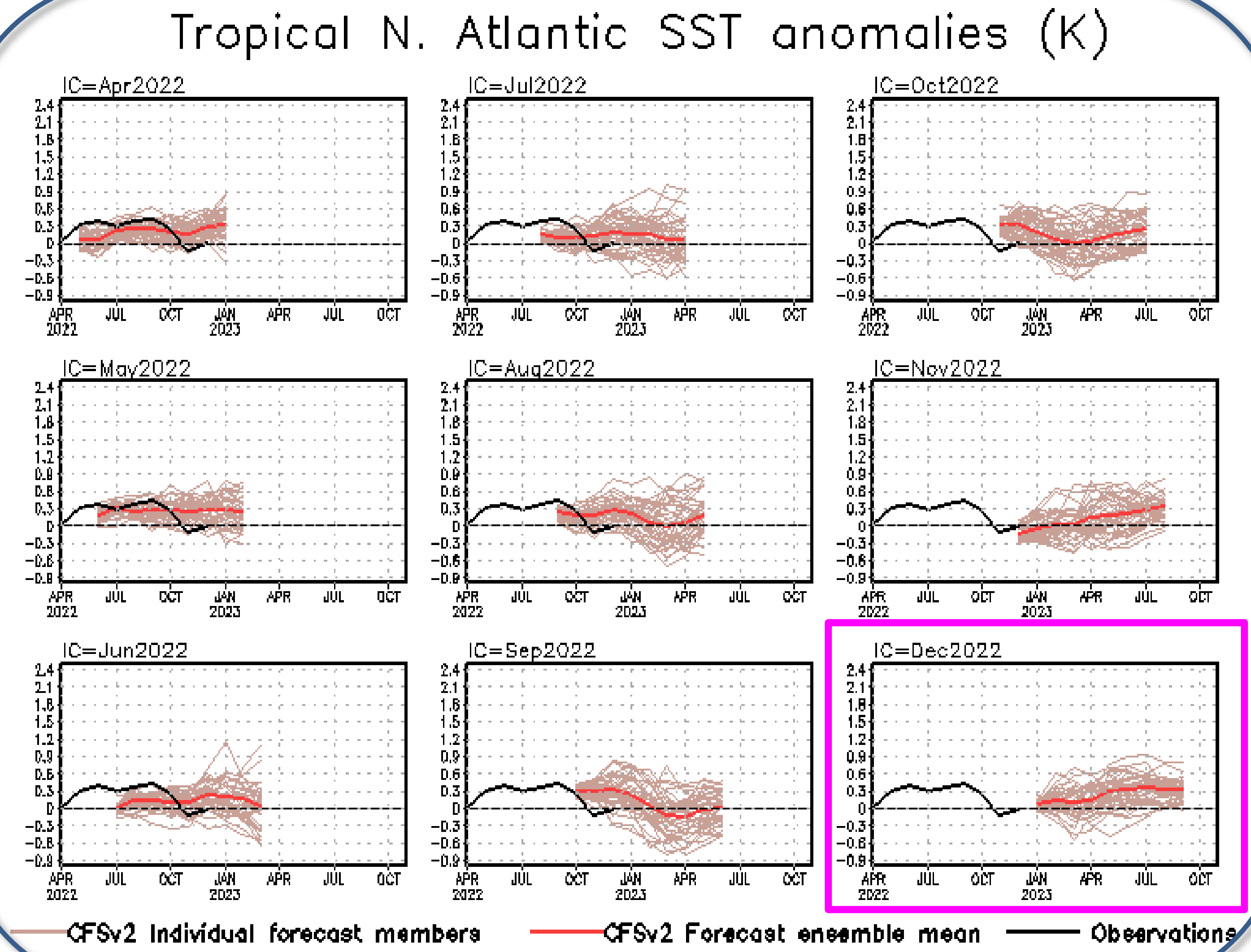
NCEP CFS DMI SST Predictions from Different Initial Months



- CFSv2 predicts a near-normal IOD through summer 2023.

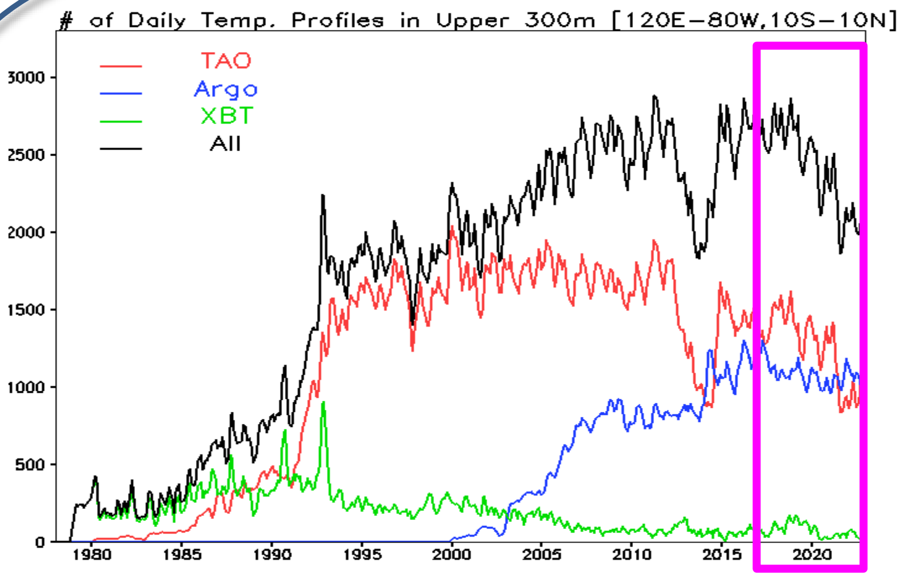
CFS Dipole Model Index (DMI) SST predictions from the latest 9 initial months. Displayed are 40 forecast members (brown) made four times per day initialized from the last 10 days of the initial month (labelled as IC=MonthYear) as well as ensemble mean (blue) and observations (black). The hindcast climatology 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.

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

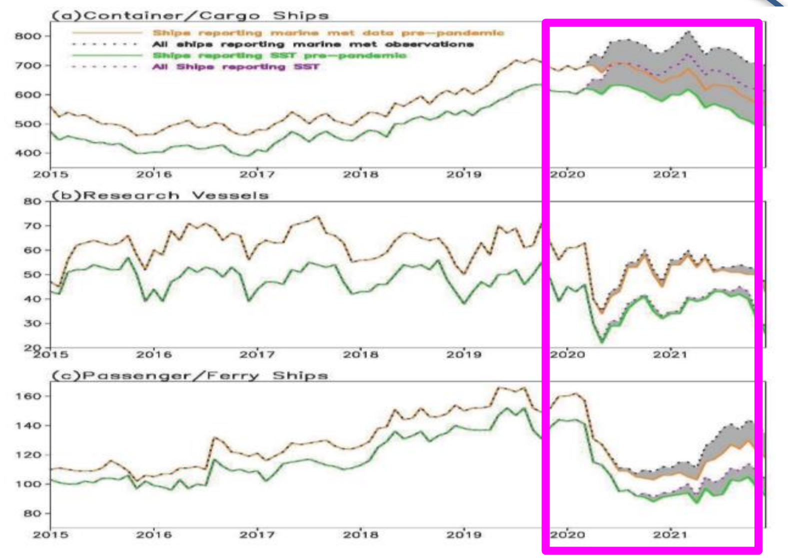


- Latest CFSv2 predictions call for above-normal SSTA in the tropical North Atlantic.

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 1991-2020 base period means. TNA is the SST anomaly averaged in the region of [60oW-30oW, 5oN-20oN].



Hu et al. 2022: Fig. 9: Time series of the number of daily ocean temperature profiles per month accumulated in the tropical Pacific from the Tropical Atmosphere Ocean/Triangle Trans-Ocean Buoy Network (TAO/TRITON; red line), Argo (blue line), the Expendable Bathythermograph (XBT; green line), and TAO/TRITON/Argo/XBT together (black line) since January 1979.



Boyer et al. 2023: Fig. 2. Number of ships with independent WMO call sign numbers since 2015 in the ICOADS R3.0.2 near real-time collection. Top panel (a) is for the container/cargo ships, middle panel (b) for the research vessels/ships, and bottom panel (c) for passenger/ferry ships. The Orange and Black lines are for all ships, compared to the Green and Purple lines which are for subsets of ships reporting SST measurements. The solid lines are for the number of ships that were reporting data pre-pandemic (defined as March 2020) and have continued since then, while the dashed lines are the total number of ships reporting data during the pandemic.

… the pandemic caused critical loss to longer-term (years to decades) observations…

Boyer, T., Zhang, H., O'Brien, K., Reagan, J., Diggs, S., Freeman, E., Garcia, H., Heslop, E., Hogan, P., Huang, B., Jiang, L., Kozyr, A., Liu, C., Locarnini, R., Mishonov, A. V., Paver, C., Wang, Z., Zweng, M., Alin, S., Barbero, L., Barth, J. A., Belbeoch, M., Cebrian, J., Connell, K., Cowley, R., Dukhovskoy, D., Galbraith, N. R., Goni, G., Katz, F., Kramp, M., Kumar, A., Legler, D., Lumpkin, R., McMahon, C. R., Pierrot, D., Plueddemann, A. J., Smith, E. A., Sutton, A., Turpin, V., Jiang, L., Suneel, V., Wanninkhof, R., Weller, R. A., & Wong, A. P. (2023). Effects of the Pandemic on Observing the Global Ocean, BAMS. BAMS-D-21-0210.1/BAMS-D-21-0210.1.xml

BAMS Article

Global Ocean Monitoring and Prediction at NOAA Climate Prediction Center

15 Years of Operations

Zeng-Zhen Hu, Yan Xue, Boyin Huang, Arun Kumar, Caihong Wen, Pingping Xie, Jieshun Zhu, Philip J. Pegion, Li Ren, and Wanqiu Wang

ABSTRACT: Climate variability on subseasonal to interannual time scales has significant impacts on our economy, society, and Earth's environment. Predictability for these time scales is largely due to the influence of the slowly varying climate anomalies in the oceans. The importance of the global oceans in governing climate variability demonstrates the need to monitor and forecast the global oceans in addition to El Niño–Southern Oscillation in the tropical Pacific. To meet this need, the Climate Prediction Center (CPC) of the National Centers for Environmental Prediction (NCEP) initiated real-time global ocean monitoring and a monthly briefing in 2007. The monitoring covers observations as well as forecasts for each ocean basin. In this paper, we introduce the monitoring and forecast products. CPC's efforts bridge the gap between the ocean observing system and the delivery of the analyzed products to the community. We also discuss the challenges involved in ocean monitoring and forecasting, as well as the future directions for these efforts.

KEYWORDS: Ocean; Atmosphere-ocean interaction; ENSO; Climate prediction; Oceanic variability; Climate services

https://doi.org/10.1175/BAMS-D-22-0056.1
Corresponding author: Zeng-Zhen Hu, zeng-zhen.hu@noaa.gov
In final form 15 August 2022

Hu, Z.-Z., Y. Xue, B. Huang, A. Kumar, C. Wen, P. Xie, J. Zhu, P. Pegion, L. Ren, and W. Wang, 2022: Global ocean monitoring and forecast at NOAA Climate Prediction Center: 15 Years of Operations. *Bull. Amer. Meteor. Soc.*, **103 (12),** E2701–E2718. DOI: 10.1175/BAMS-D-22-0056.1.

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- ❖ Drs. Jieshun Zhu, Caihong Wen, and Arun Kumar: reviewed PPT, and provide insightful suggestions and comments
- ❖ Drs. Pingping Xie and Eric Sinsky 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:
Arun.Kumar@noaa.gov
Caihong.Wen@noaa.gov
Jieshun.Zhu@noaa.gov
Zeng-Zhen.Hu@noaa.gov

Data Sources (climatology is for 1991-2020)

- **CPC Ocean Briefing Operation (Hu et al., 2022, BAMS)**
- **Weekly Optimal Interpolation SST (OIv2.1 SST; Huang et al. 2021)**
- **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

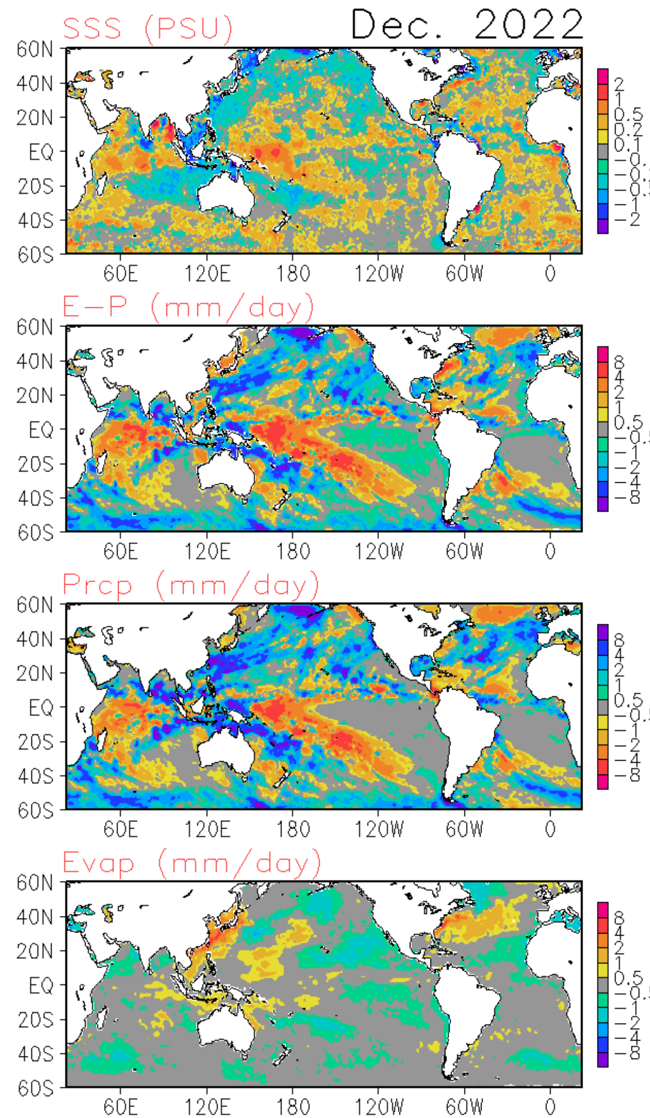
  http://www.cpc.ncep.noaa.gov/products/GODAS/multiora93_body.html

Backup Slides

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

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

The negative precipitation anomalies contribute to the anomalously positive oceanic freshwater flux (E-P) over the West Indian Ocean, resulting in an anomalously salty ocean in that region. The negative precipitation anomalies over major portions of the West Equatorial and South Pacific Ocean are a major contributor to the anomalously positive freshwater flux, resulting in a saltier ocean in that region.



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

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

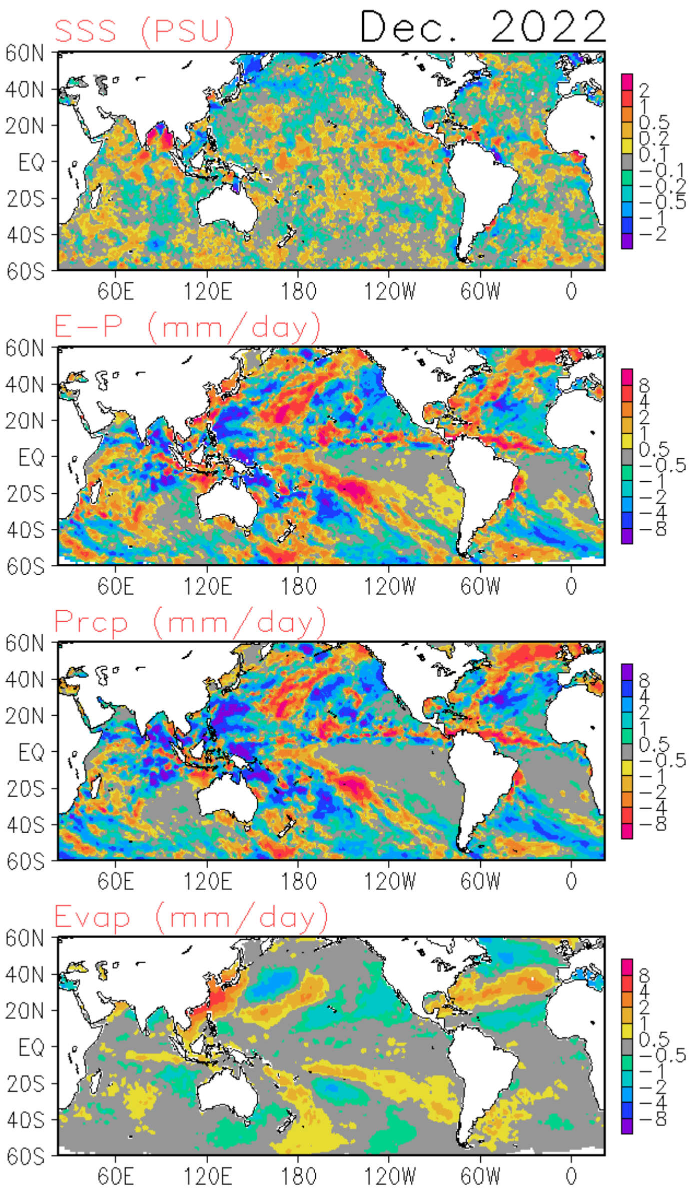
[ftp.cpc.ncep.noaa.gov/precip/BASS](ftp://ftp.cpc.ncep.noaa.gov/precip/BASS)

Precipitation: CMORPH adjusted satellite precipitation estimates

Evaporation: Adjusted CFS Reanalysis

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

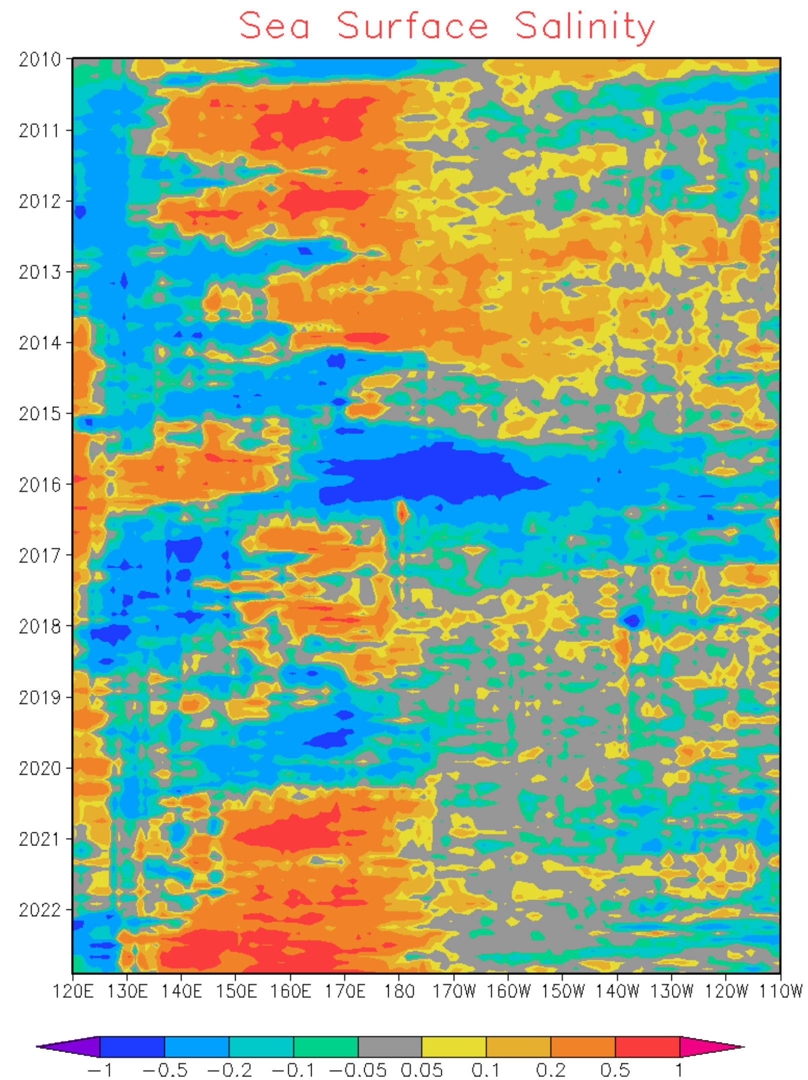
Large-scale SSS tendencies are not well organized compared to the corresponding monthly anomalies. A fresher SSS tendency can be observed over the Sea of Okhotsk, while a saltier SSS tendency can be seen over major portions of the Bay of Bengal. Much of the North Atlantic Ocean is experiencing a positive oceanic freshwater flux tendency, which is because of the negative precipitation tendencies in that region. Furthermore, much of the Central Equatorial Pacific is experiencing a positive oceanic freshwater flux because of the negative precipitation tendencies in that area.



Monthly SSS Anomaly Evolution over Equatorial Pacific

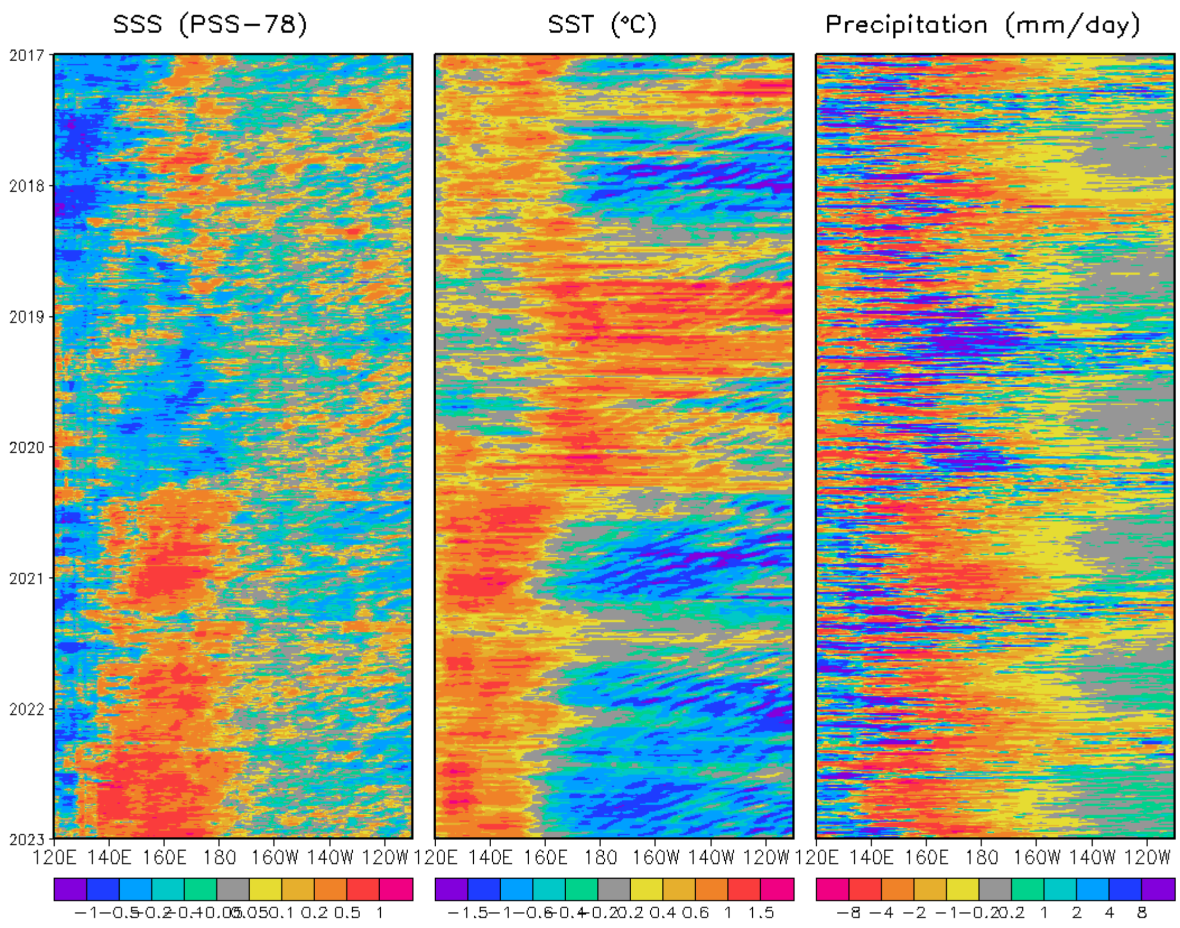
NOTE: Since June 2015, the BASS SSS is from in situ, SMOS and SMAP; before June 2015,The BASS SSS is from in situ, SMOS and Aquarius.

- Hovmoller diagram for equatorial SSS anomaly **(5° S-5° N);**
- Positive SSS anomalies continued and enhanced over the Central and Western Equatorial Pacific between 140°E and 170°W.

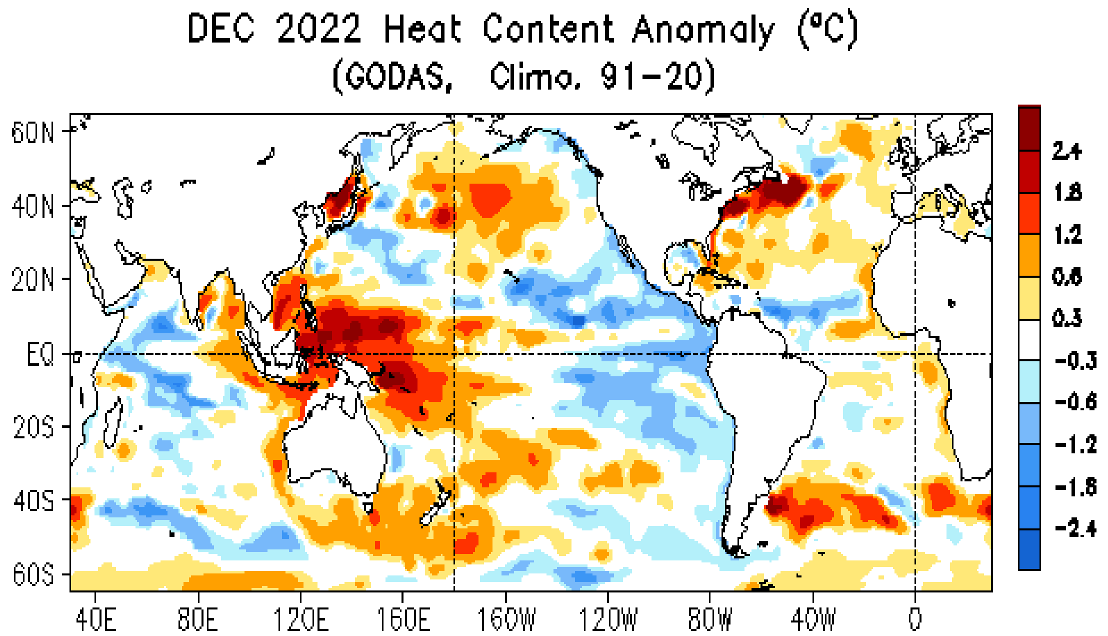


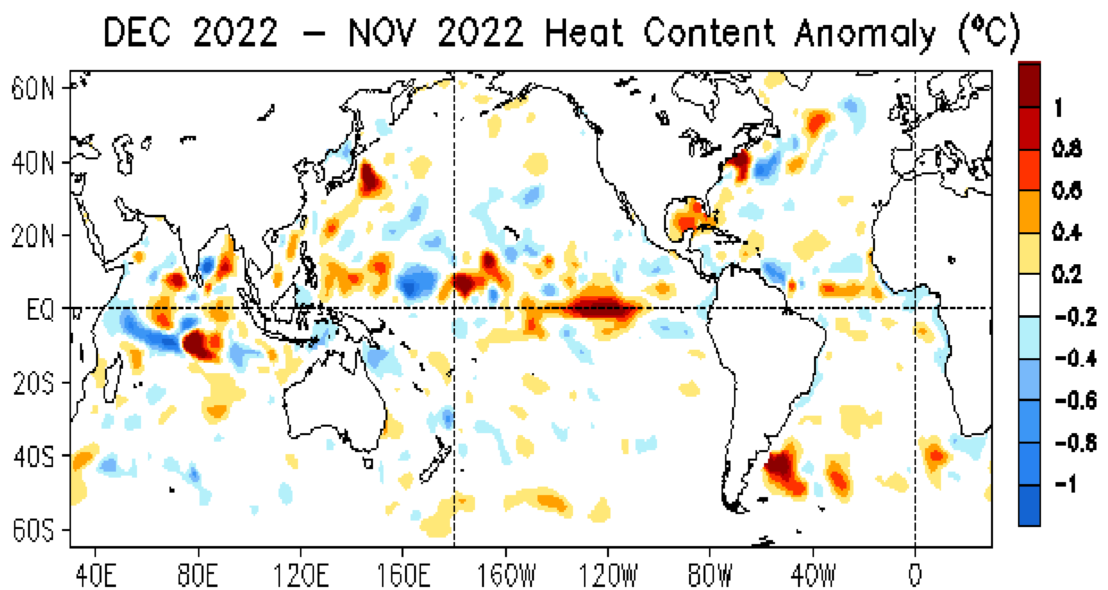
Pentad SSS Anomaly Evolution over Equatorial Pacific

Figure caption: Hovmoller 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.

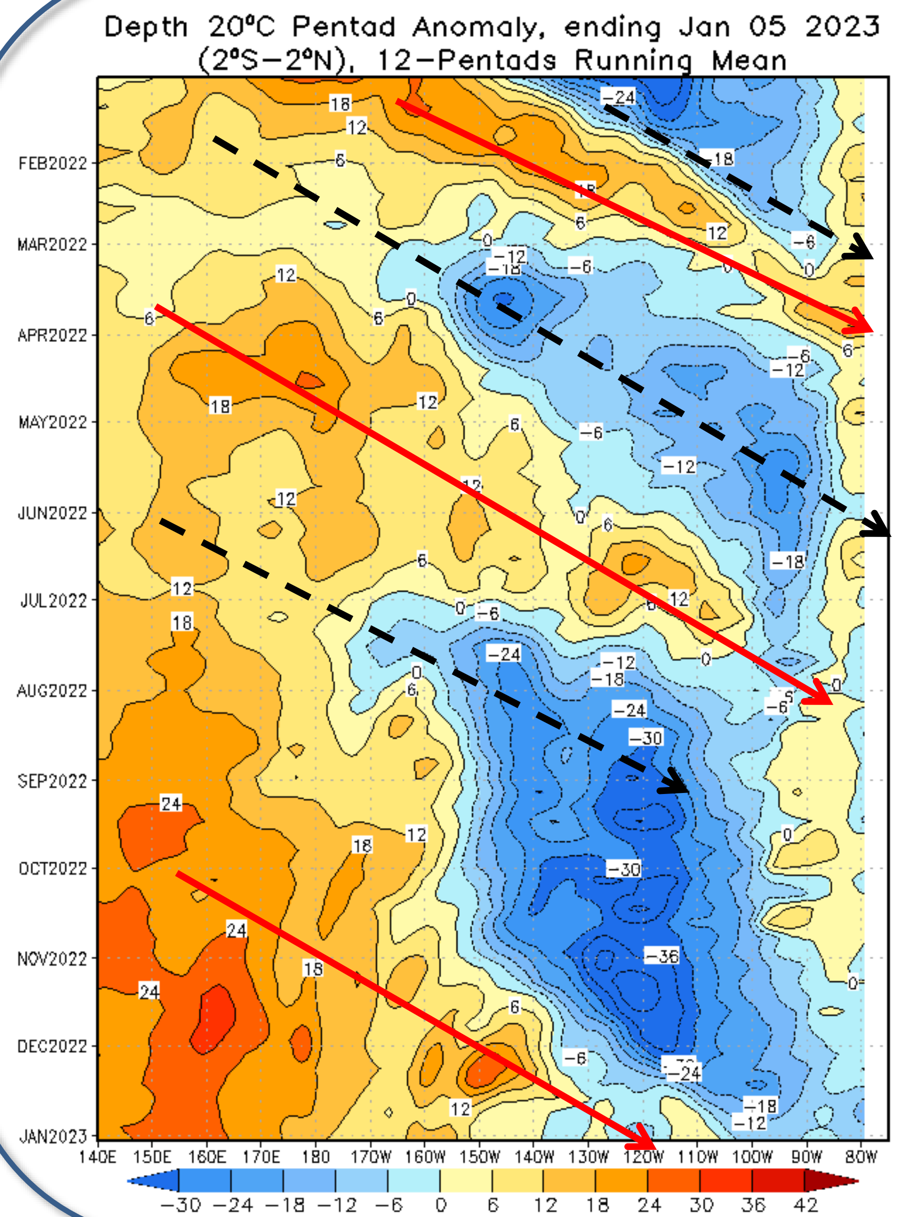


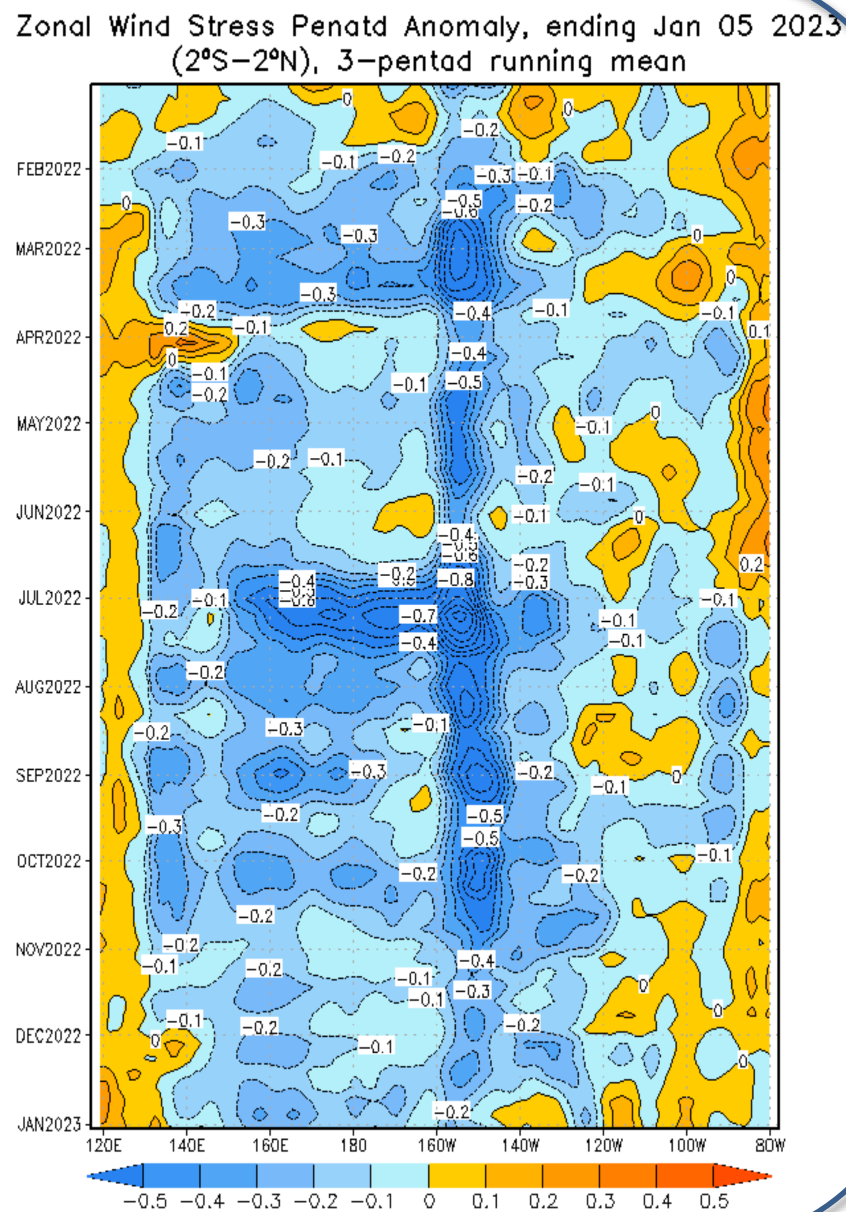
Global HC300 Anomaly & Anomaly Tendency

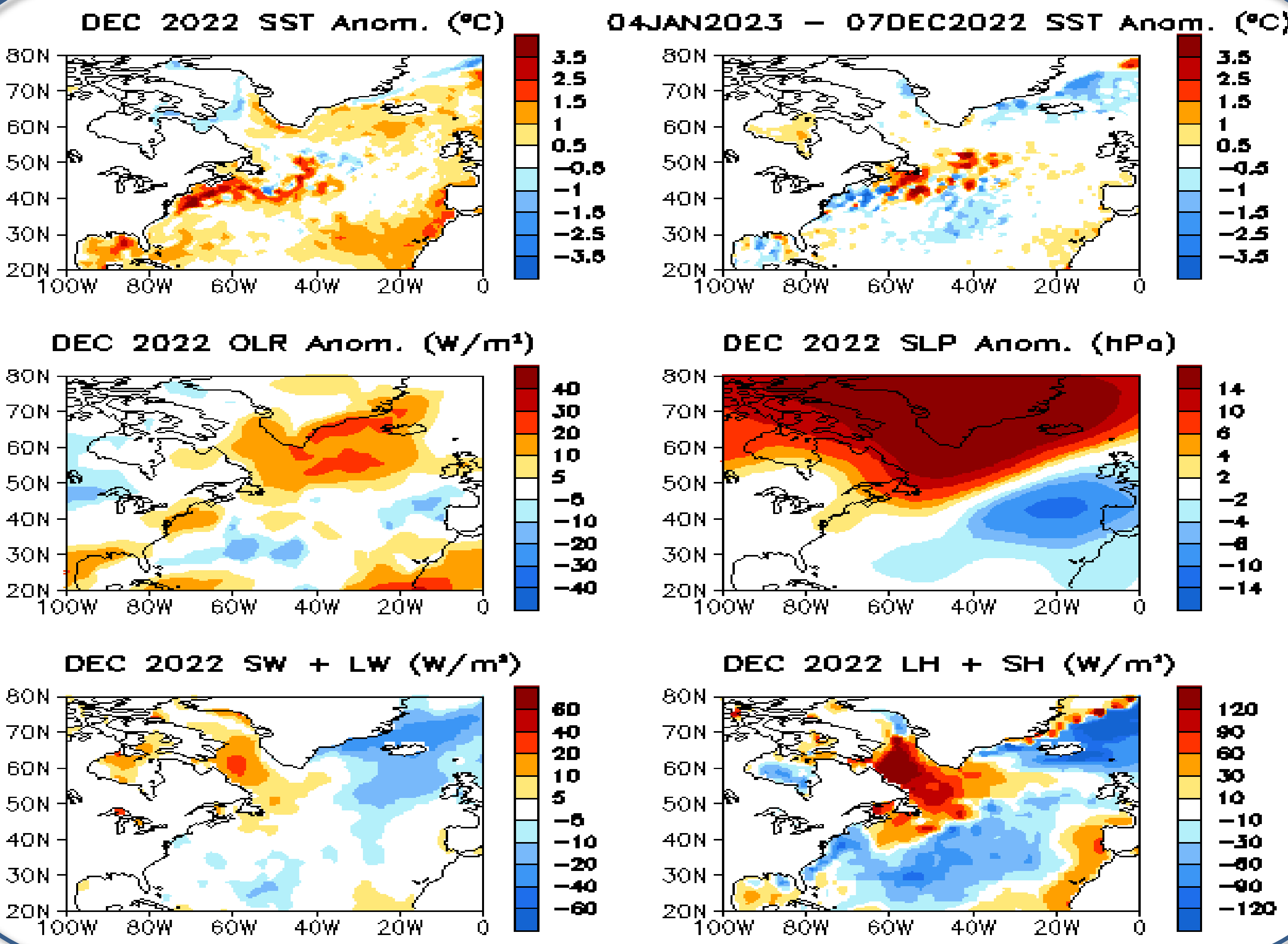




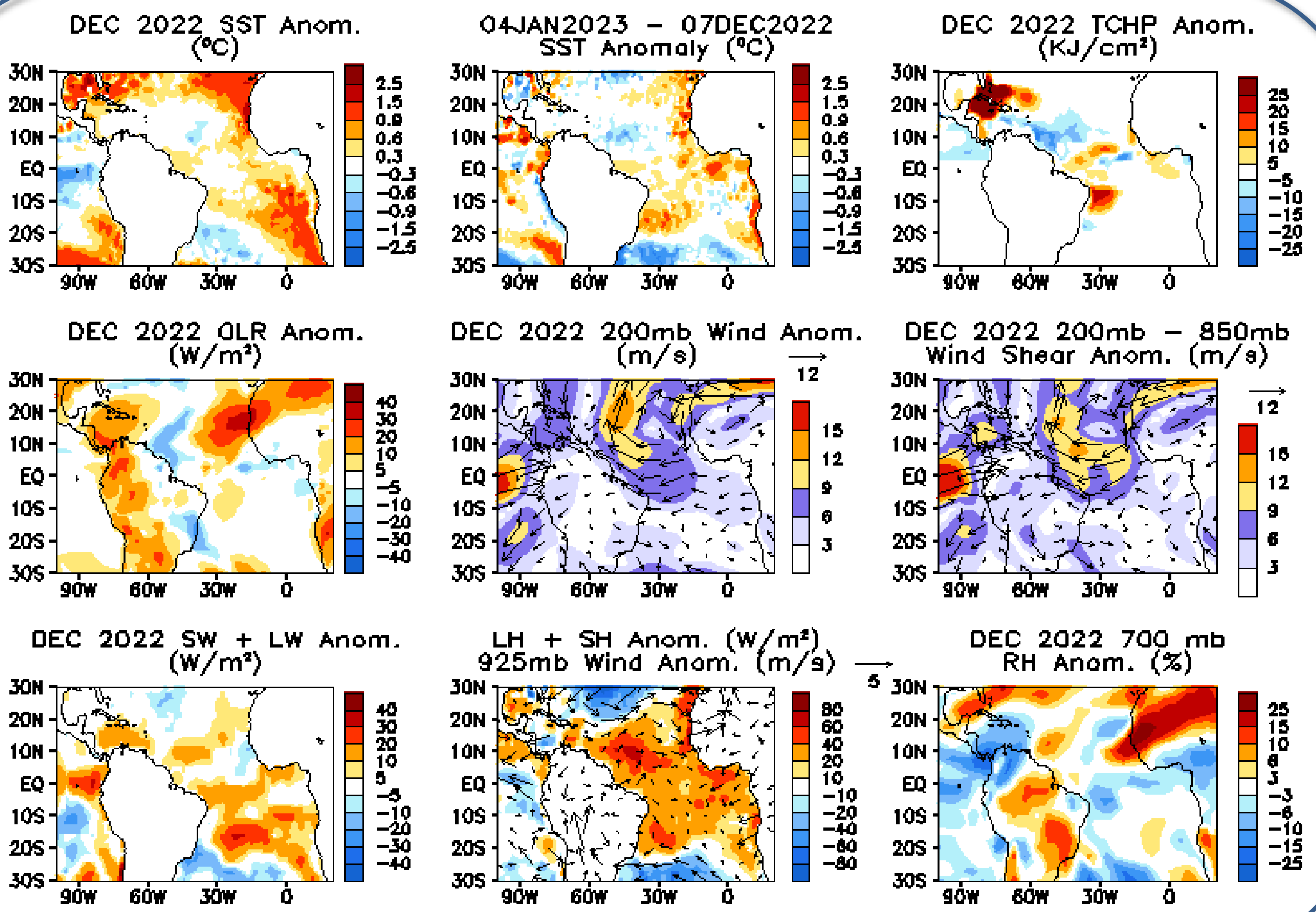
Evolution of Pentad D20 and Taux anomalies along the equator



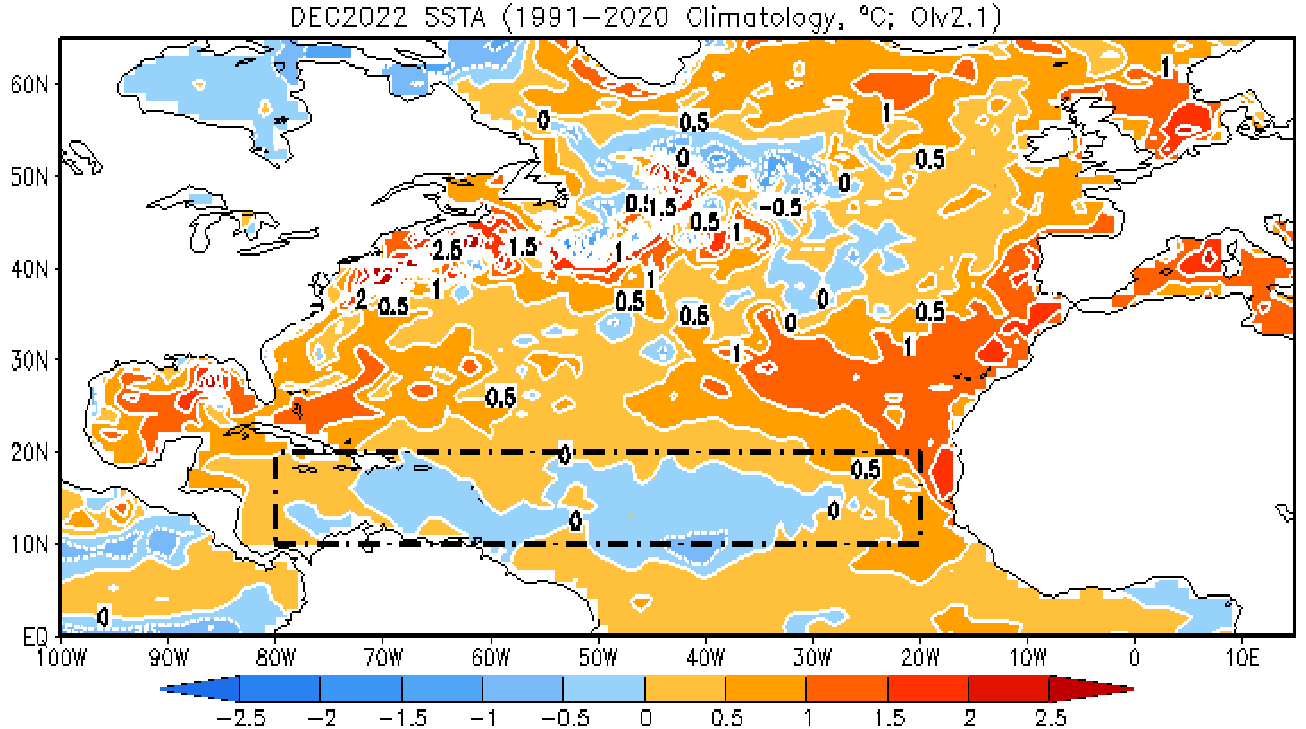


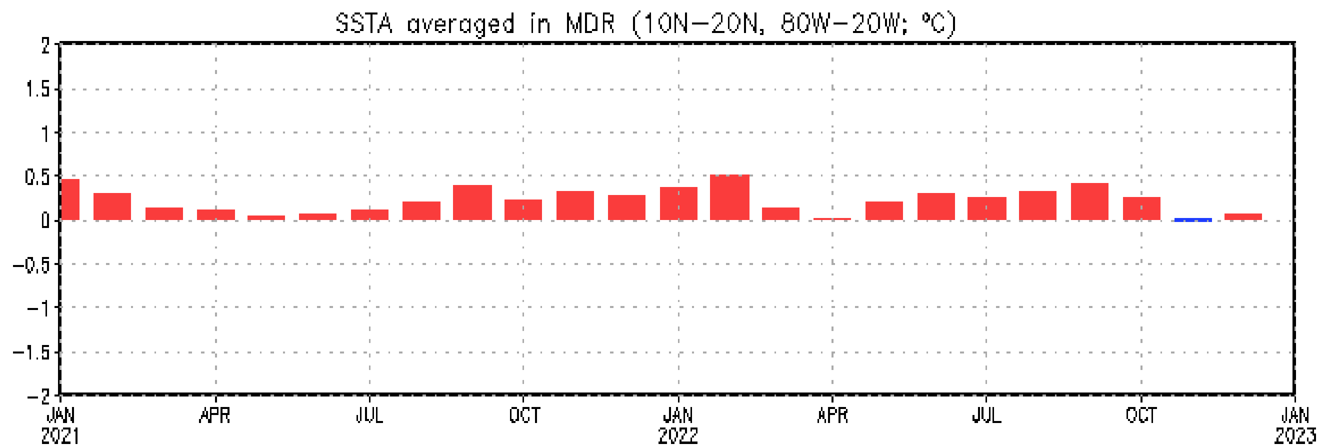

DEC 2022 SST Anom. (°C)
04JAN2023 – 07DEC2022 SST Anom. (°C)
3.5 2.5 1.5 1 0.5 −0.5 −1 −1.5 −2.5 −3.5
DEC 2022 OLR Anom. (W/m²)
40 30 20 10 5 −5 −10 −20 −30 −40
DEC 2022 SLP Anom. (hPa)
14 10 6 4 2 −2 −4 −6 −10 −14
DEC 2022 SW + LW (W/m²)
60 40 20 10 5 −5 −10 −20 −40 −60
DEC 2022 LH + SH (W/m²)
120 90 60 30 10 −10 −30 −60 −90 −120
80N 70N 60N 50N 40N 30N 20N
100W 80W 60W 40W 20W 0

Tropical Atlantic: SST, SST tend., TCHP, OLR, 200 hPa wind, wind share, heat flex, & RH anom.



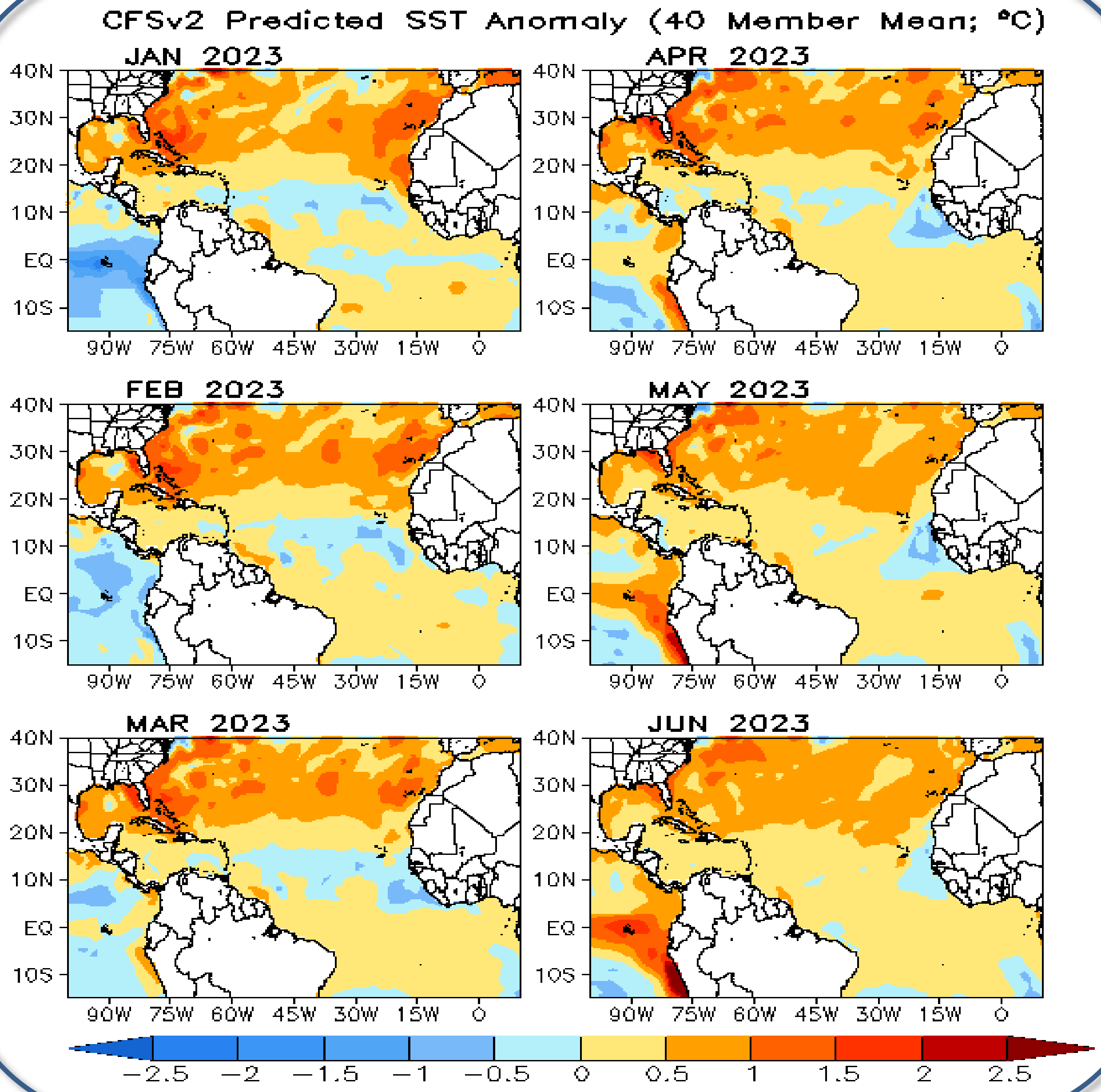
SSTAs in the North Atlantic & MDR





- SST in MDR was near average during the last two months.

CFSv2 Atlantic SSTA Predictions



- Latest CFSv2 predictions call above-normal SST in the middle-latitudes of the N Atlantic in the next 6 months.