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

Prepared by

Climate Prediction Center, NCEP/NOAA

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

This project, to deliver real-time ocean monitoring products, is implemented

by CPC in cooperation with NOAA's Global Ocean Monitoring and Observing Program (GOMO)

Outline

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

Overview

•Pacific Ocean

- La Niña condition persisted with Niño3.4 = -1.2^{o}C in May 2022.
- NOAA "ENSO Diagnostic Discussion" on 9 June 2022 stated "Though La Niña is favored to continue through the end of the year, the odds for La Niña decrease into the Northern Hemisphere late summer (52% chance in July-September 2022) before slightly increasing through the Northern Hemisphere fall and early winter 2022 (58-59% chance)."
- Positive SSTAs continued in parts of the North Pacific.
- The PDO has been in a negative phase since Jan 2020 with PDOI = -1.8 in May 2022.
- On May 24, 2022, NOAA CPC predicted a below-normal eastern Pacific Hurricane Season.

•Arctic Ocean

- Seasonal sea ice loss slower in May than in the recent years.
- Averaged Arctic sea ice extent for May ranked the 14th lowest in the satellite record.

•Indian Ocean

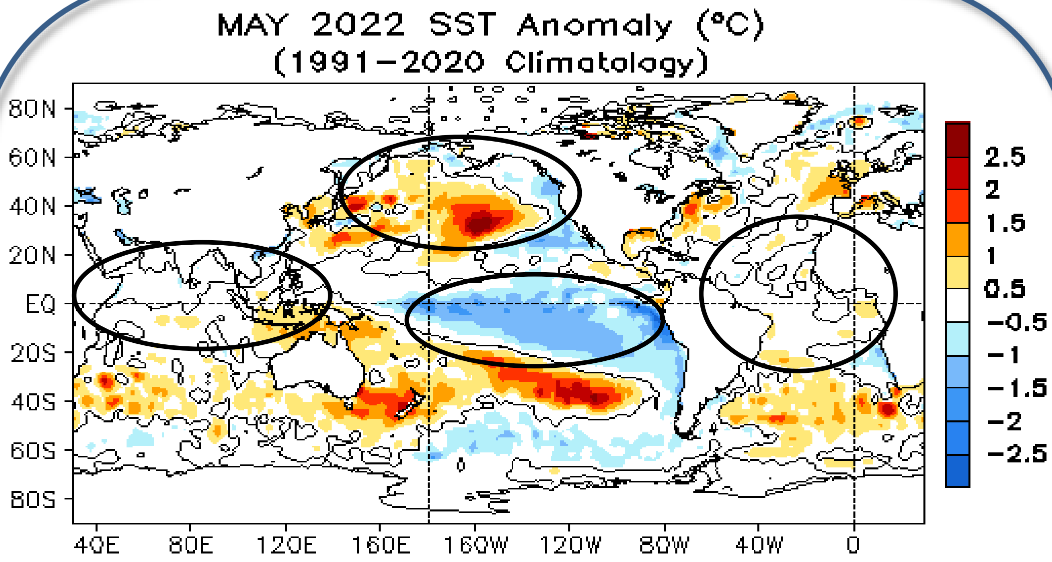
- SSTs were near average in the equatorial Indian Ocean in May 2022.

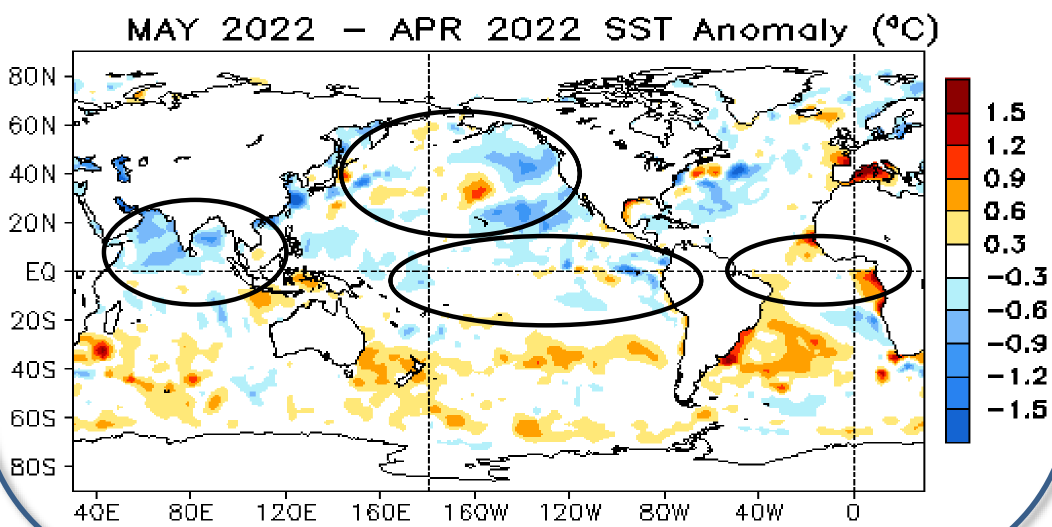
•Atlantic Ocean

- SSTAs were small in the tropical Atlantic Ocean in May 2022.
- NAO switched to a positive phase in May 2022 with NAOI= 0.7.
- On May 24, 2022, NOAA CPC predicted above-normal 2022 Atlantic Hurricane Season.

Global Oceans

Global SST Anomaly (°C) and Anomaly Tendency



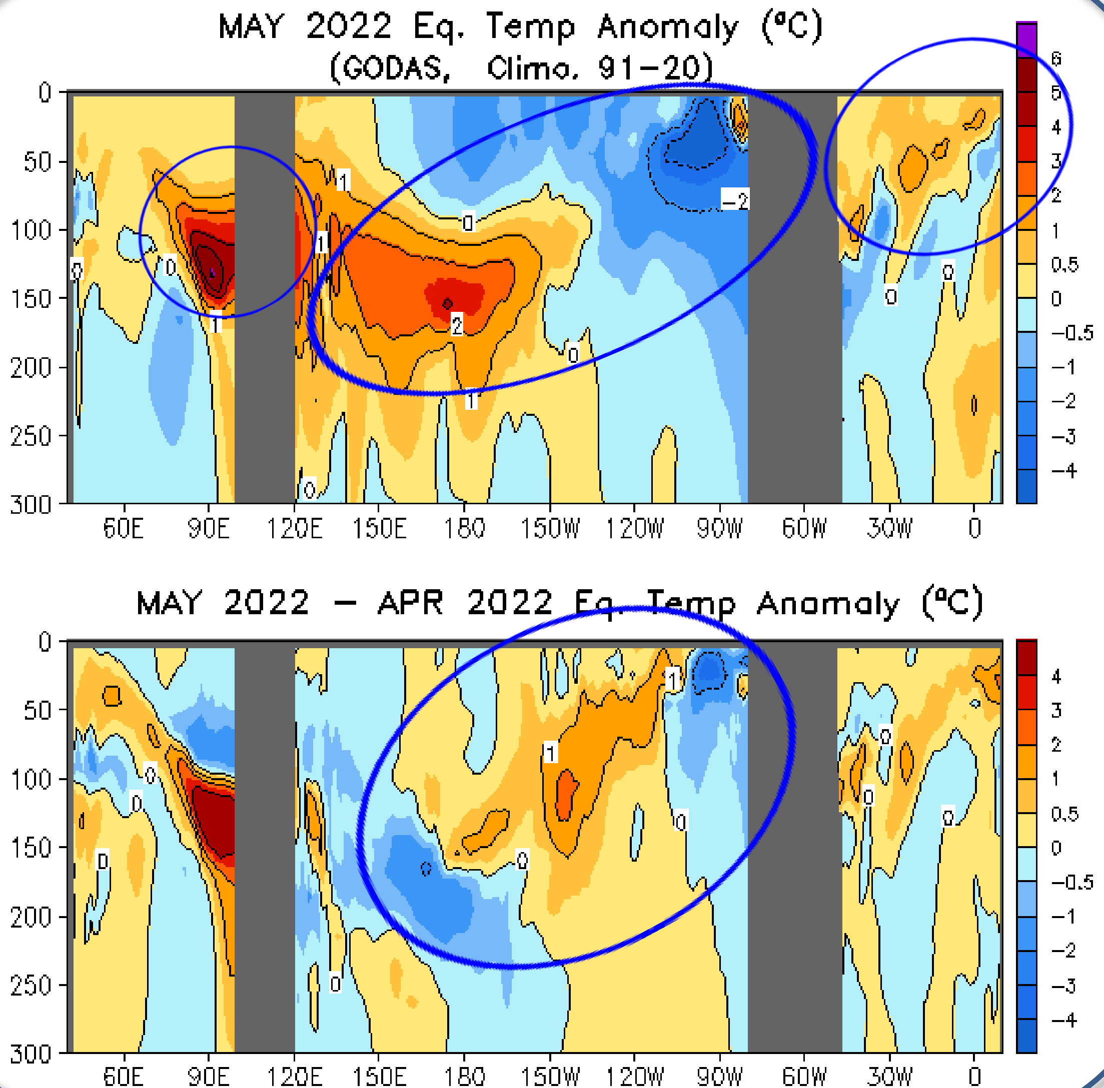


- Negative SSTAs persisted in the central and southeastern tropical Pacific.
- Positive SSTAs persisted in parts of the North Pacific.
- SSTs were near average in the tropical Atlantic and Indian Oceans.

- Both positive and negative SSTA tendencies were observed in the eastern equatorial Pacific.
- Positive (negative) SSTA tendencies were evident in the central (eastern) North Pacific.
- The negative SSTA tendency is large in the northern tropical Indian Ocean.
- SSTA tendencies were small in the equatorial Atlantic 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.

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

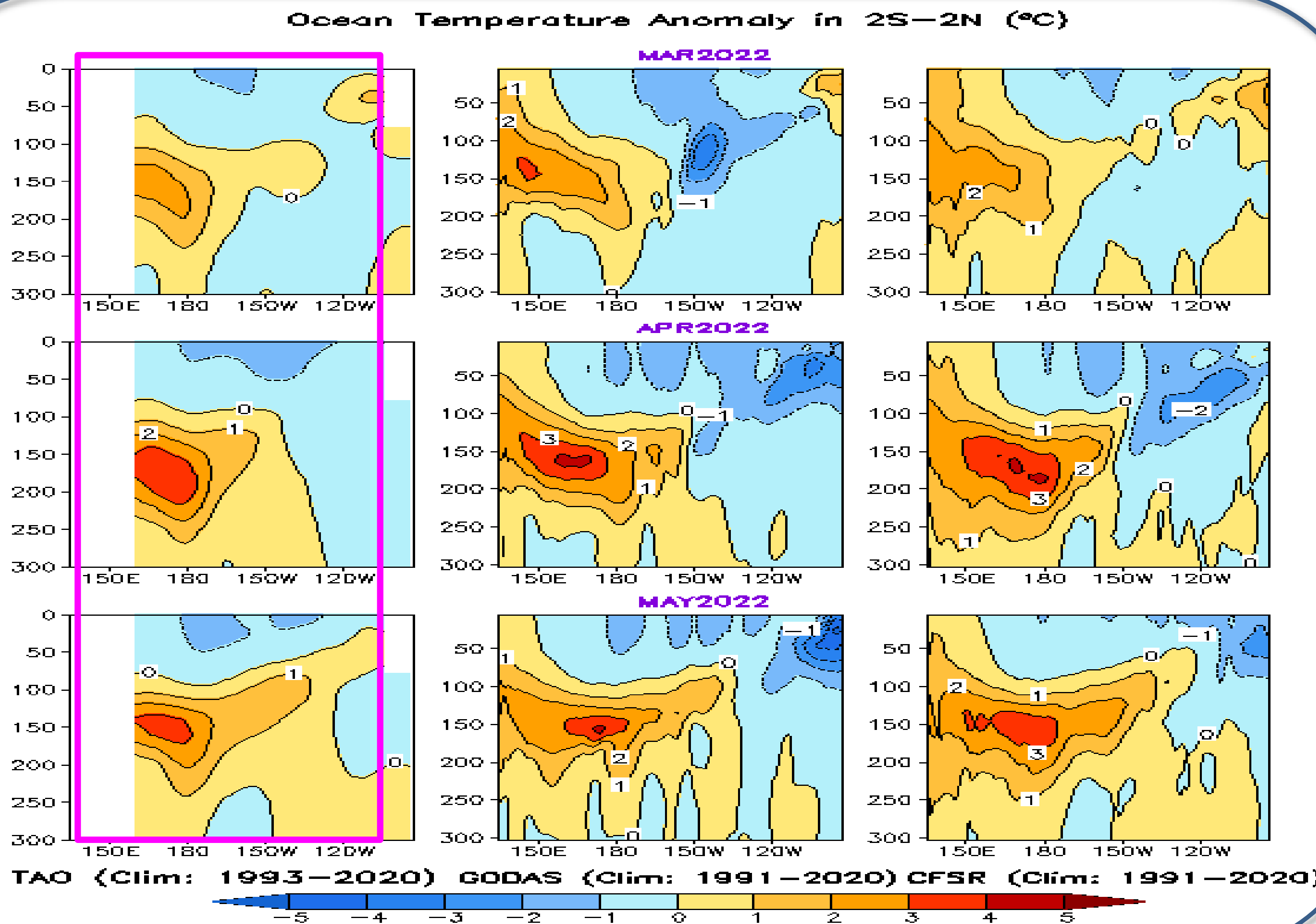


- Positive (negative) temperature anomalies were observed along the thermocline in the western (eastern) equatorial Pacific.
- Small positive temperature anomalies were observed along the thermocline in the equatorial Atlantic Ocean.
- Large positive temperature anomalies were present in the eastern equatorial Indian Ocean.

- Temperature anomaly tendency was positive (negative) along the thermocline in the central (western and far-eastern) equatorial Pacific.

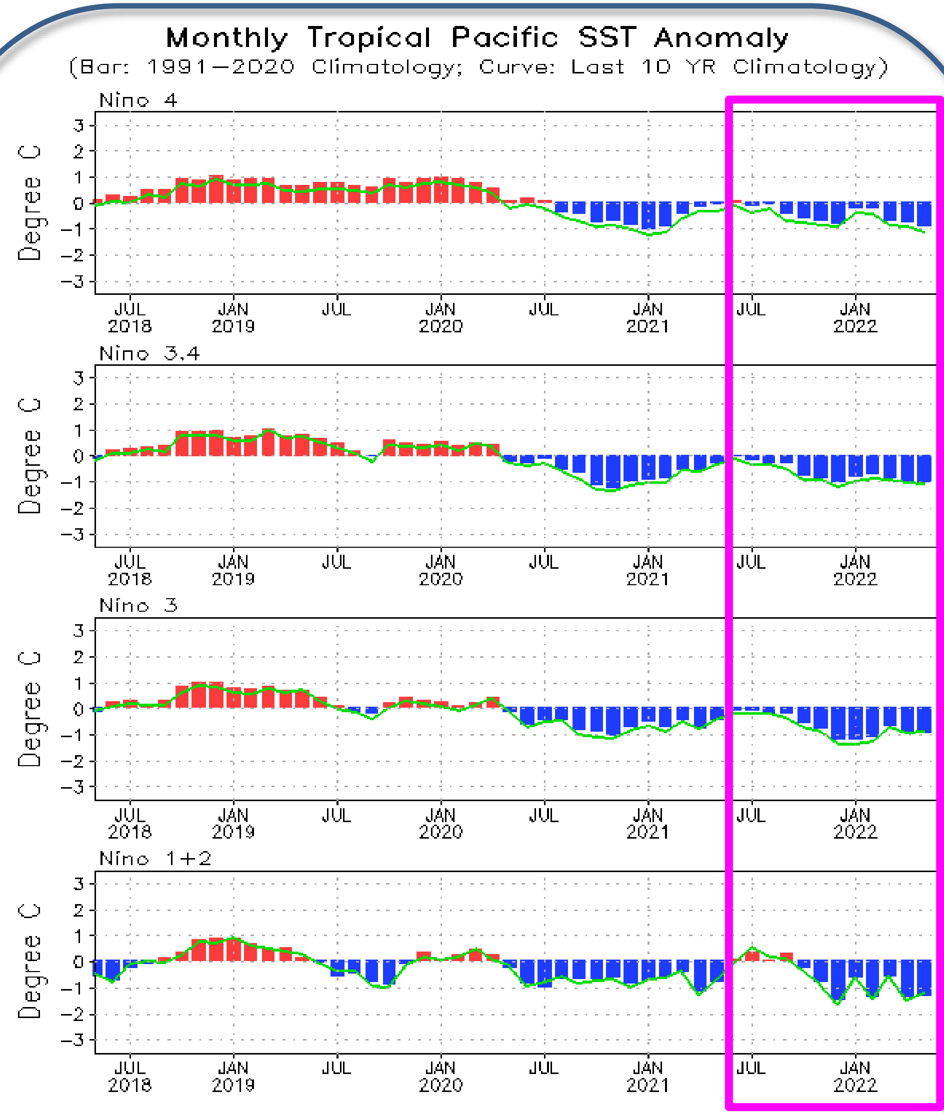
Equatorial depth-longitude section of ocean temperature anomalies (top) and anomaly tendency (bottom). Data is from the NCEP's GODAS. Anomalies are departures from the 1991-2020 base period means.

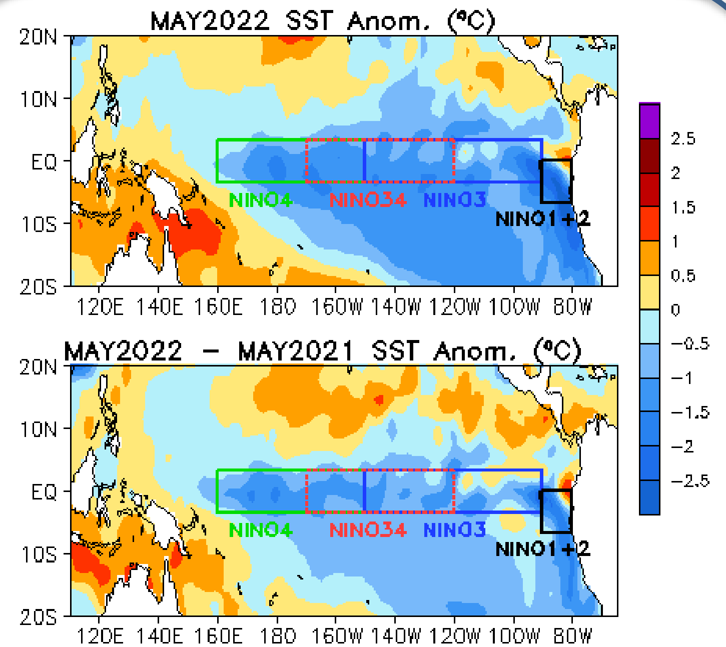
TAO, GODAS, & CFSR monthly mean subsurface temperature anomalies along the Equator during the last 3 months



Tropical Pacific Ocean and ENSO Conditions

Evolution of Pacific Niño SST Indices





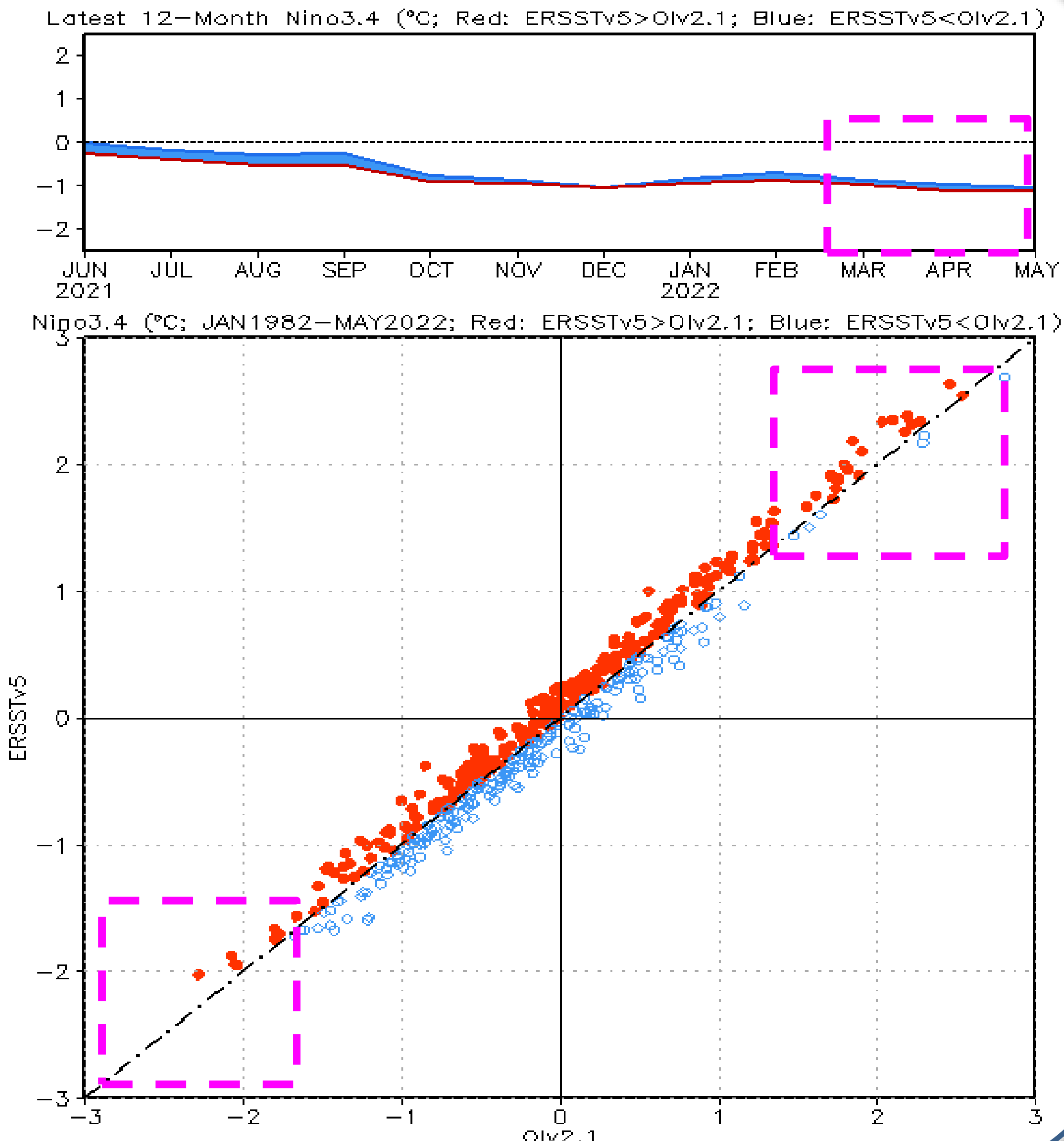
- All Niño indices stayed cold in May 2022, with Niño3.4 = -1.2C.

- Compared with May 2021, the east and southeastern tropical Pacific was cooler in May 2022.

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

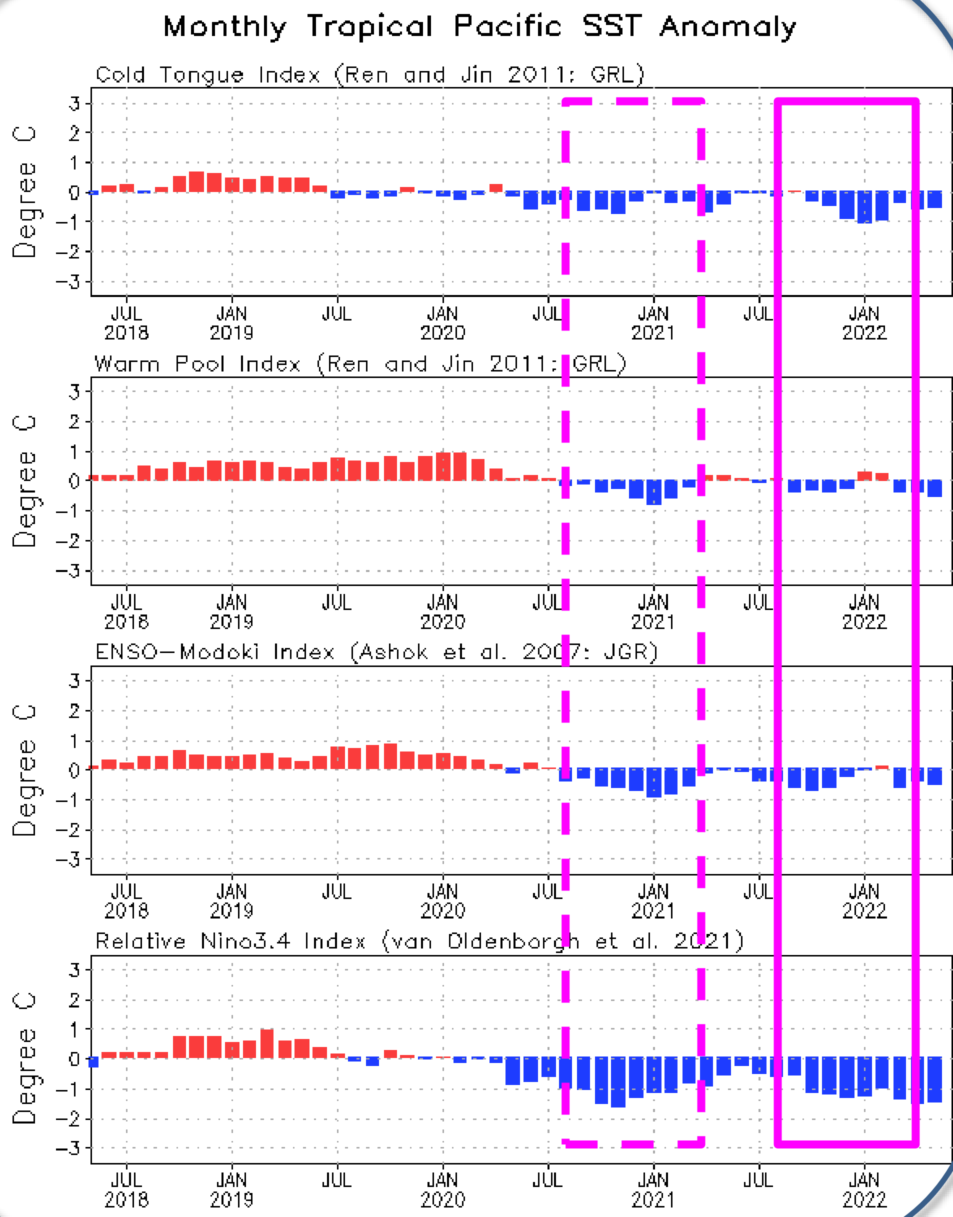
Niño region indices, calculated as the area-averaged monthly mean SSTAs (°C) for the specified region. Data are derived from the OIv2.1 SST analysis, and anomalies are departures from the 1991-2020 base period means.

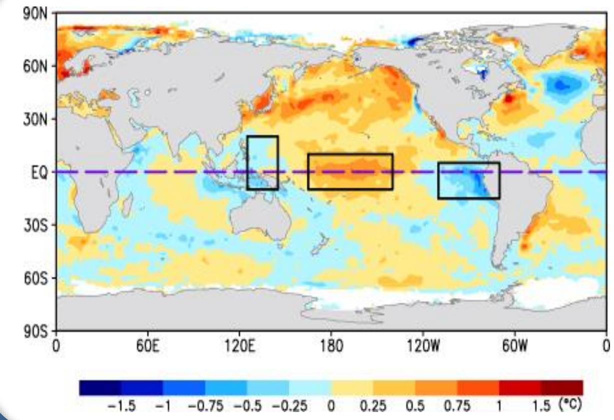
Comparison of ERSSTv5 & OIv2.1 Niño3.4 Index



- 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.
- Since Jan 2022, ERSSTv5 was slightly cooler than OIv2.1.

Evolution of Pacific Niño SST Indices



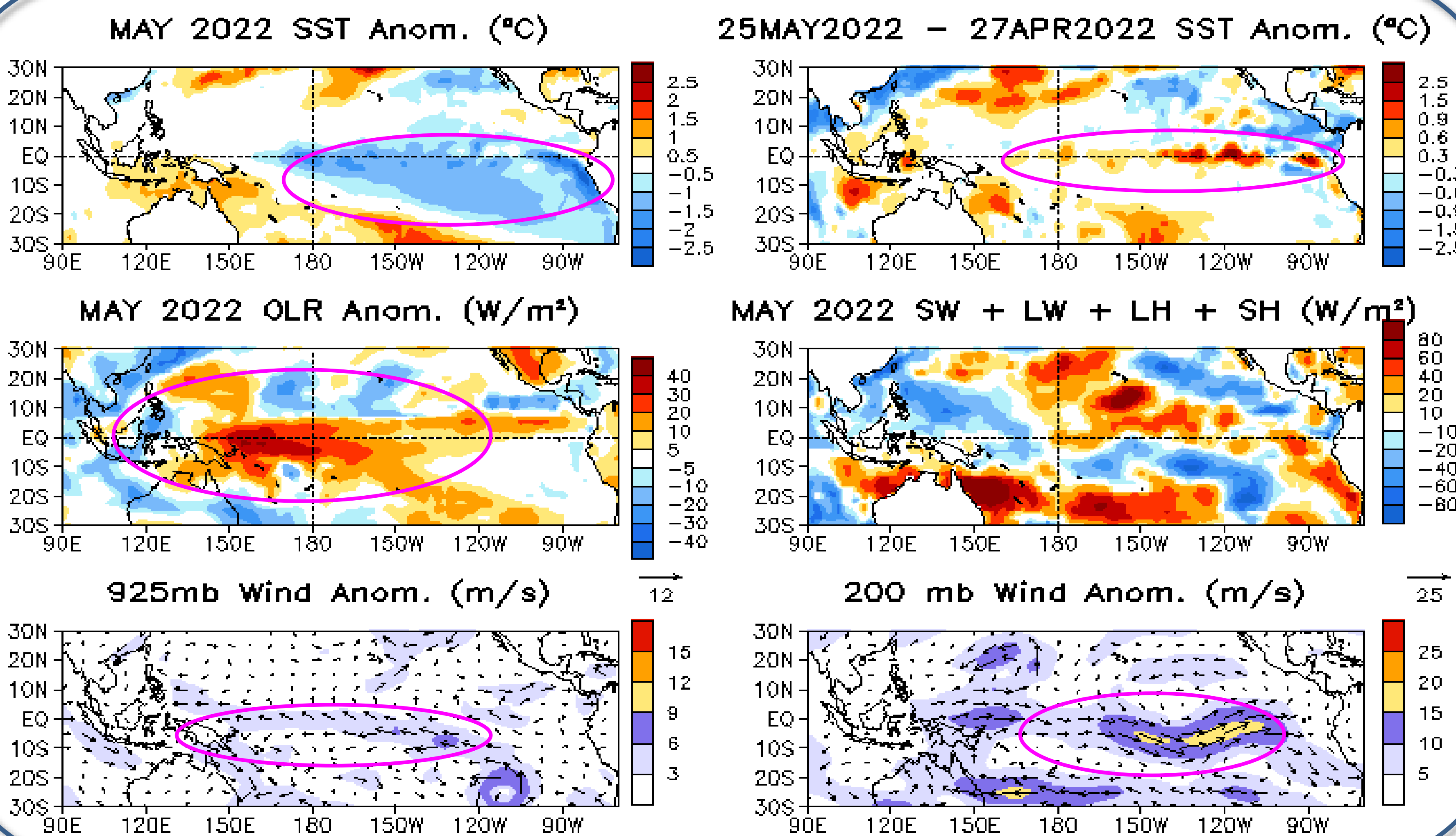


- Relative Niño3.4 index is defined as the conventional Niño3.4 index minus the SSTA averaged in the whole tropics (0º-360º, 20ºS-20ºN), in order to remove the global warming signal. Also, to have the same variability as the conventional Niño3.4 index, the relative Niño3.4 index is renormalized (van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

Relative Niño3.4 data updated monthly at:

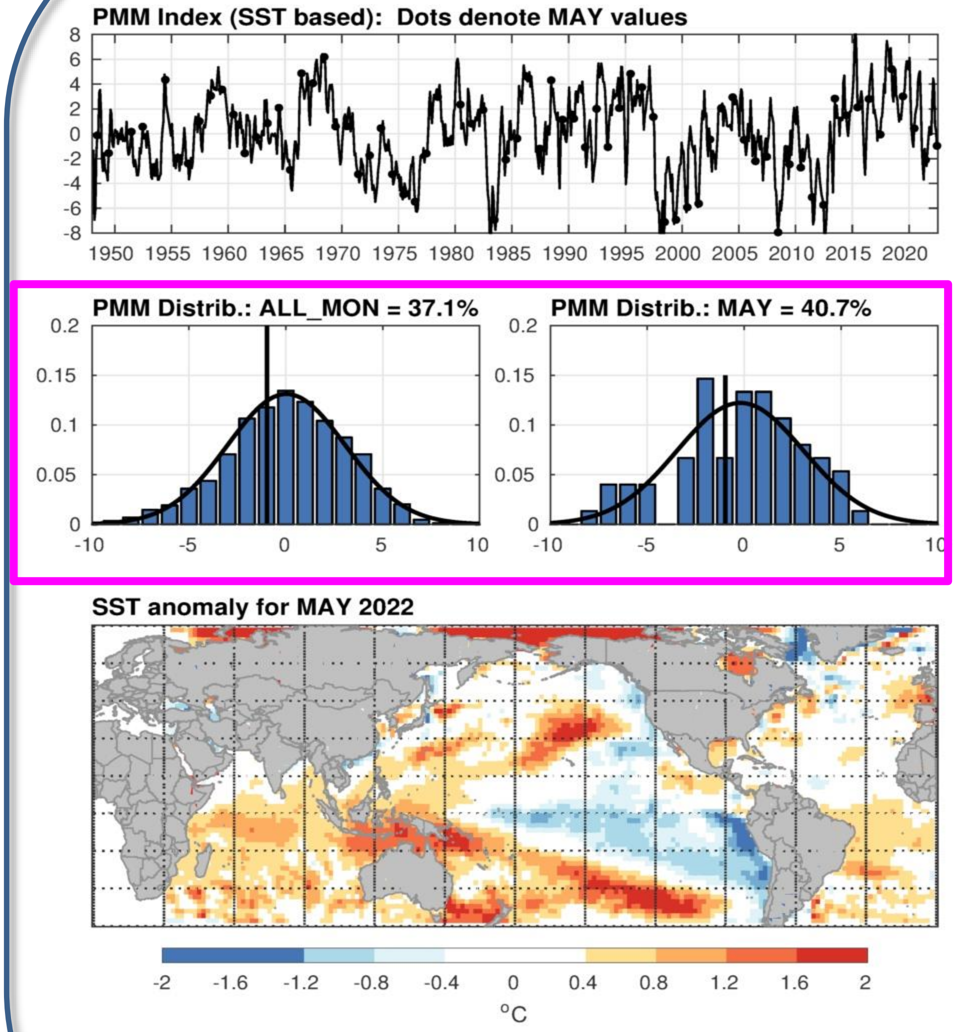
https://www.cpc.ncep.noaa.gov/data/indices/RONI.ascii.txt

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

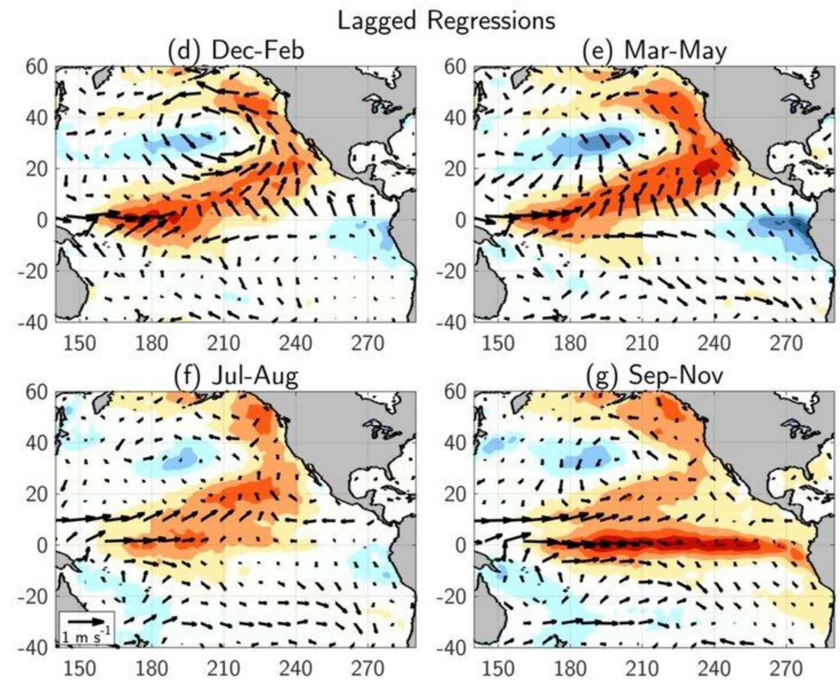


SSTAs (top-left), SSTA tendency (top-right), Outgoing Long-wave Radiation (OLR) anomalies (middle-left), sum of net surface short- and long-wave radiation, latent and sensible heat flux anomalies (middle-right; positive means heat into the ocean), 925-mb wind anomaly vector and its amplitude (bottom-left),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

Current Status of the Pacific Meridional Mode (PMM)



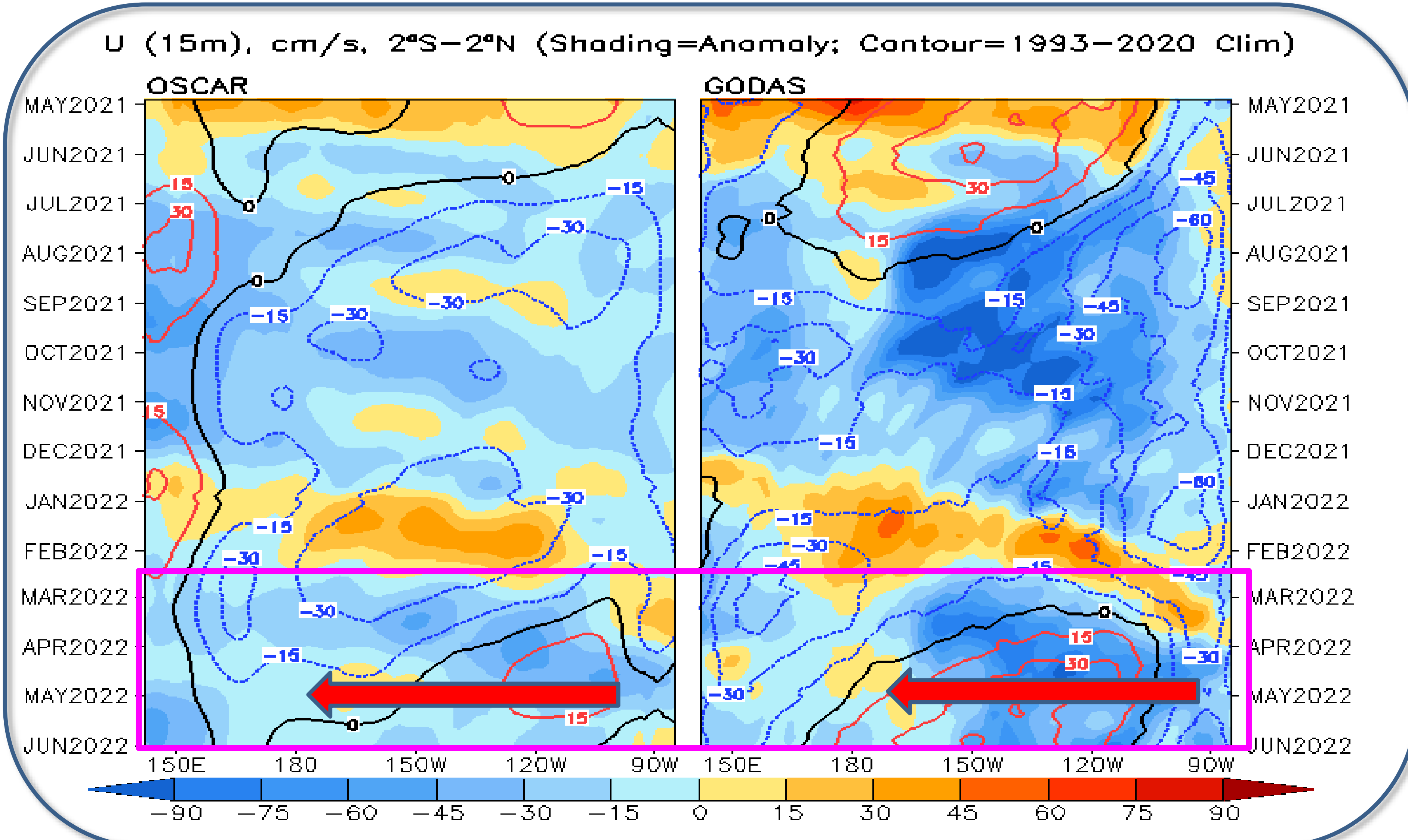
Lagged regressions of seasonally averaged SST and surface wind anomalies on NPMM SST time series calculated from a Maximum Covariance Analysis.



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

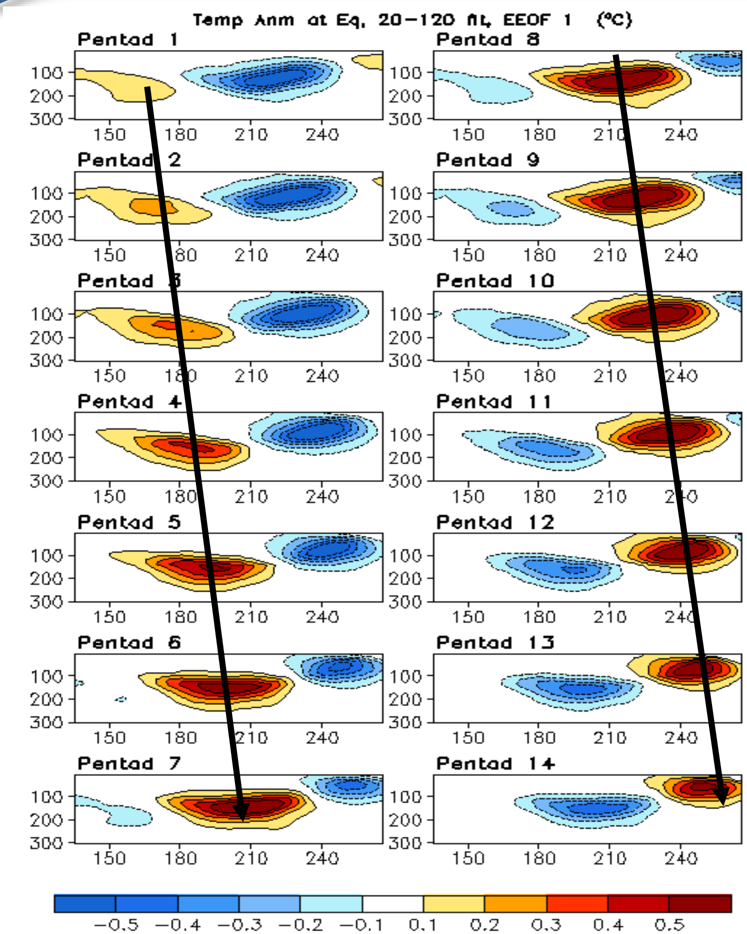
Amaya, D. J., 2019: The Pacific meridional mode and ENSO: A review. Curr. Climate Change Rep., 5, 296–307, 10.1007/s40641-019-00142-x.

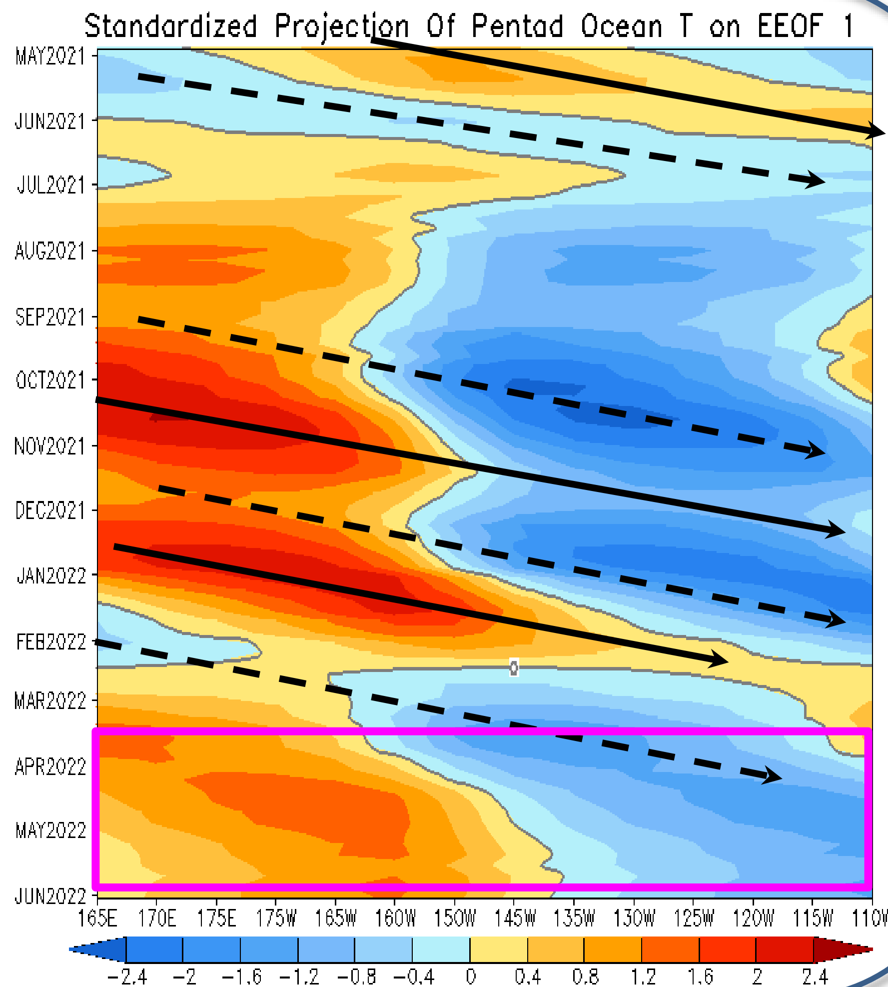
Evolution of Equatorial Pacific Surface Zonal Current Anomaly (cm/s)



- Anomalous westward currents were observed in both OSCAR and GODAS since Feb 2022.

Oceanic Kelvin Wave (OKW) Index

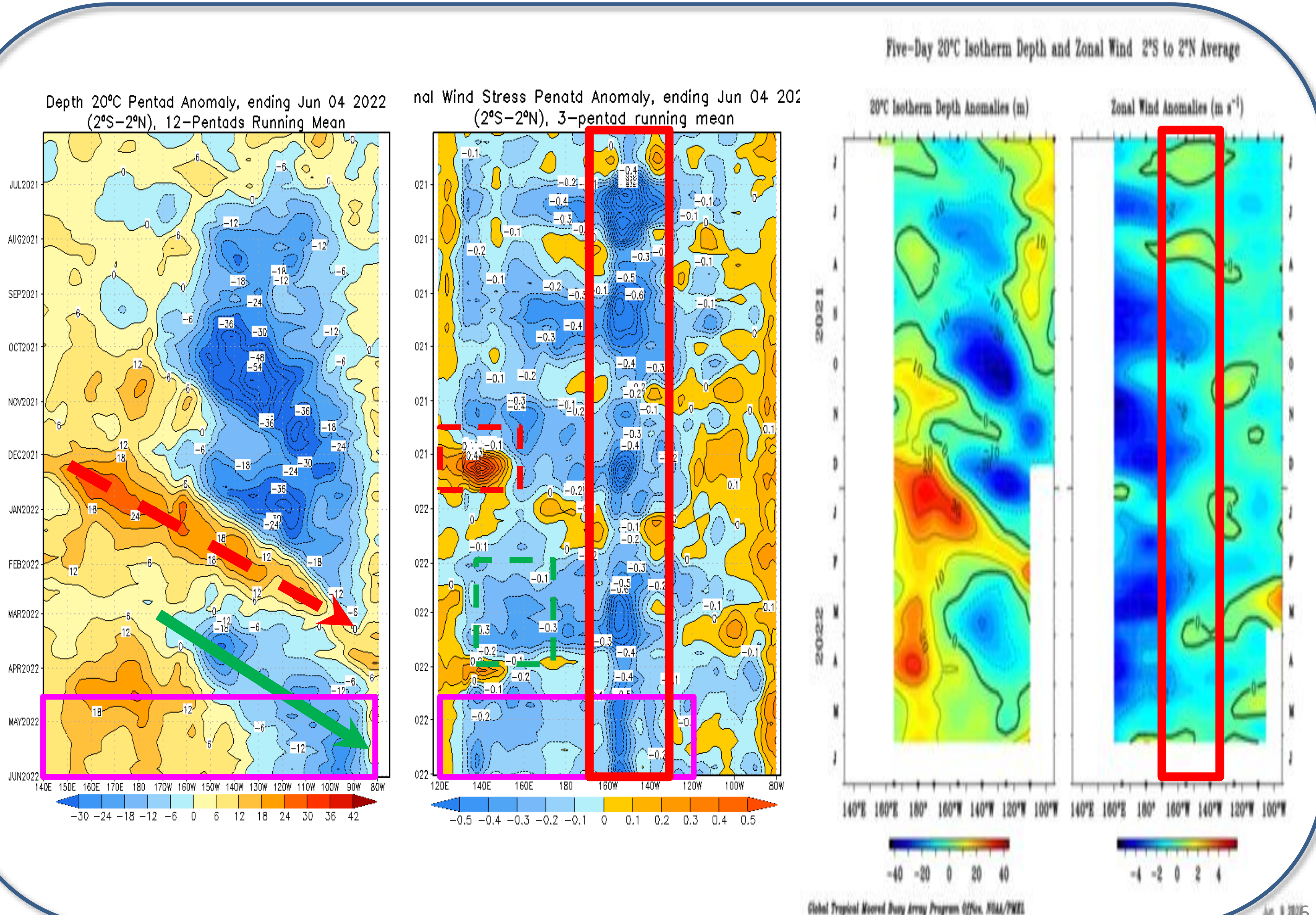




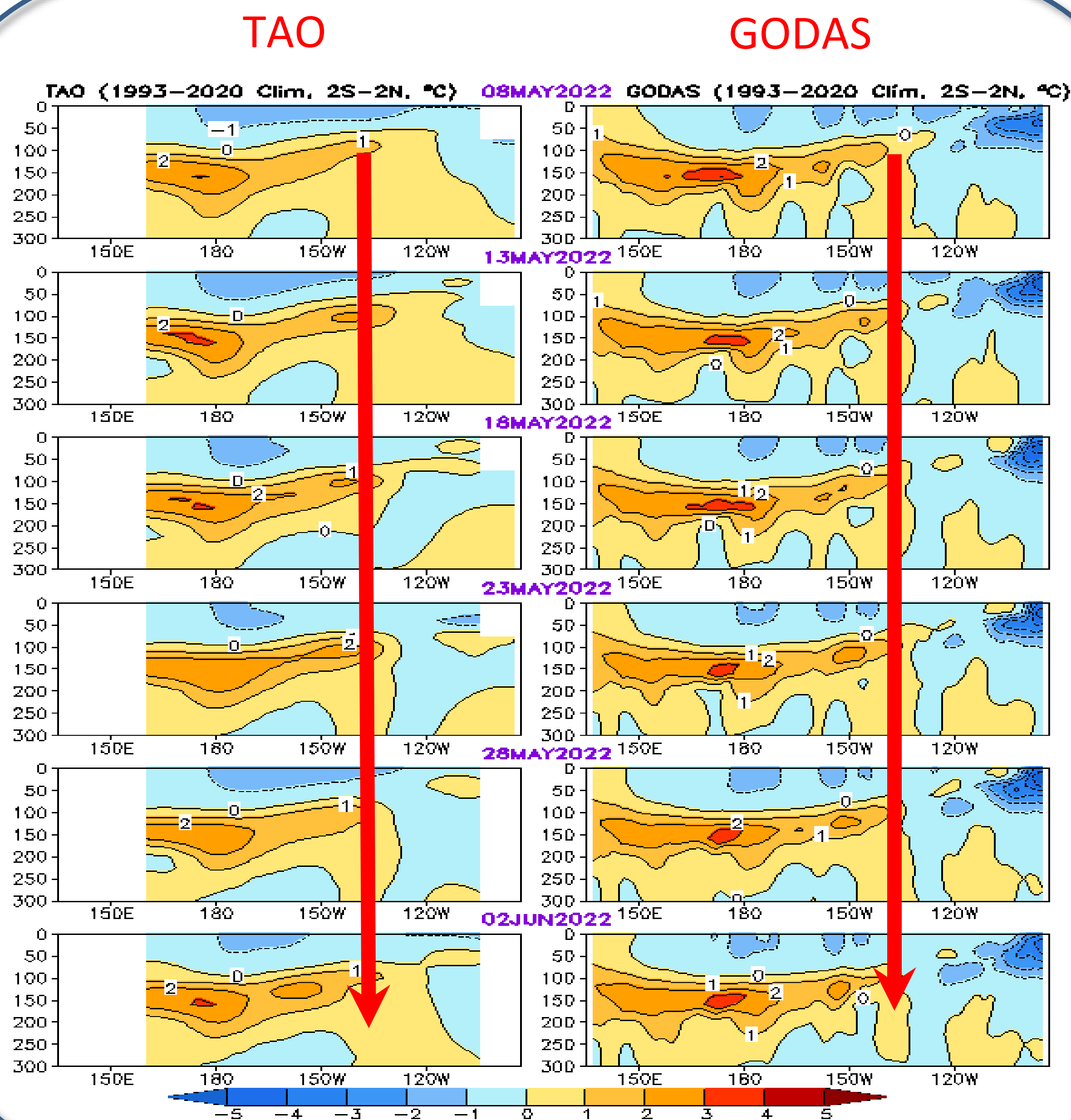
- **A downwelling Kelvin wave initiated in Dec 2021 led to the weakening of 2021/22 La Niña. An upwelling Kelvin wave was initiated in Jan-Feb 2022.**
- **Dipole-like stationary feature with positive (negative) anomalies in the west (east) was observed since Mar 2022.**

(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).)

Evolution of Pentad D20 and Taux anomalies along the equator

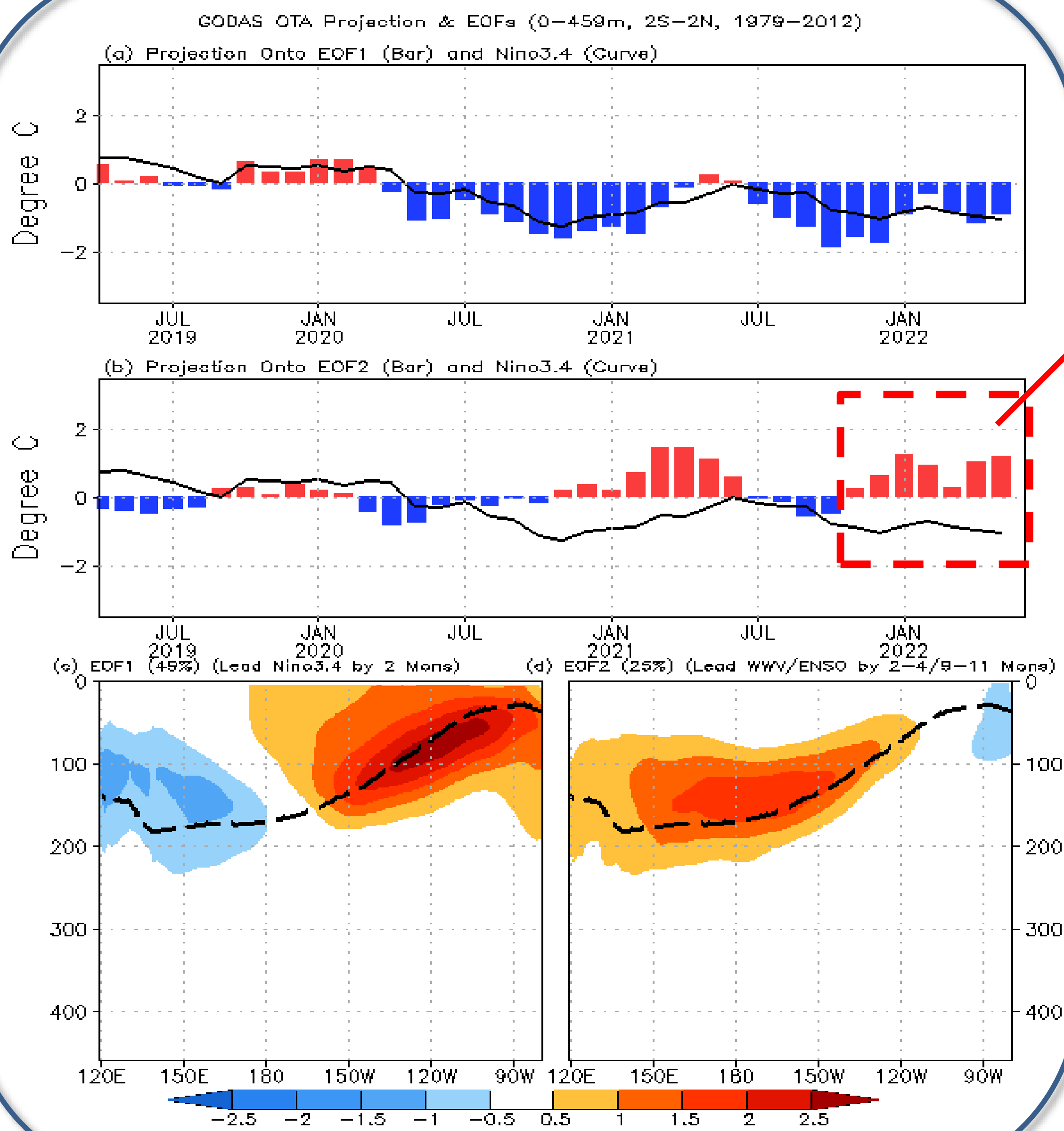


Equatorial Pacific Ocean Temperature Pentad Mean Anomaly



- Positive (negative) ocean temperature anomalies were present in the central and east-central (far-eastern) Pacific.
- It was mostly a stationary pattern.
- The anomalies of GODAS were generally larger than TAO.

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.

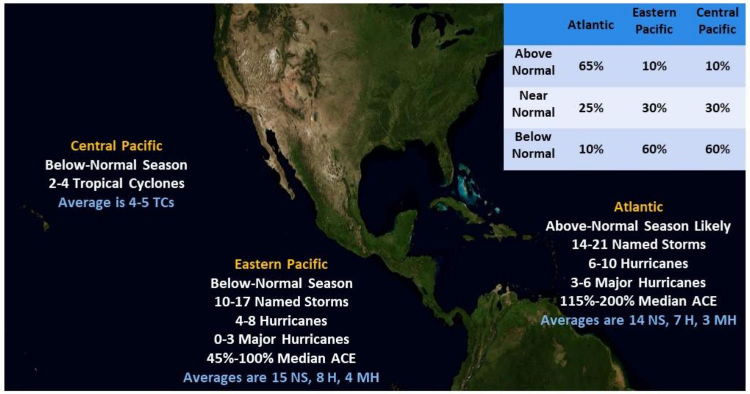
- Recharge/discharge oscillation (ENSO transition phase); Recharge process: heat transport from outside of equator to equator; Negative -> positive phase of ENSO

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

2022 Eastern Pacific Hurricane Season Outlook

- May 24, 2022: NOAA CPC's 2022 eastern Pacific Hurricane Season outlook indicated a below-normal season is most likely (60% chance). There is a 30% chance of a near-normal season and only a 10% chance of an above-normal season.
-10-17 Named Storms; 4-8 Hurricanes; 0-3 Major Hurricanes
-Accumulated Cyclone Energy (ACE) range of 45%-100% of the median.
-The eastern Pacific hurricane season is from May 15th through November 30th. The peak activity months of the season are July-September (JAS).

NOAA's 2022 Hurricane Season Outlooks



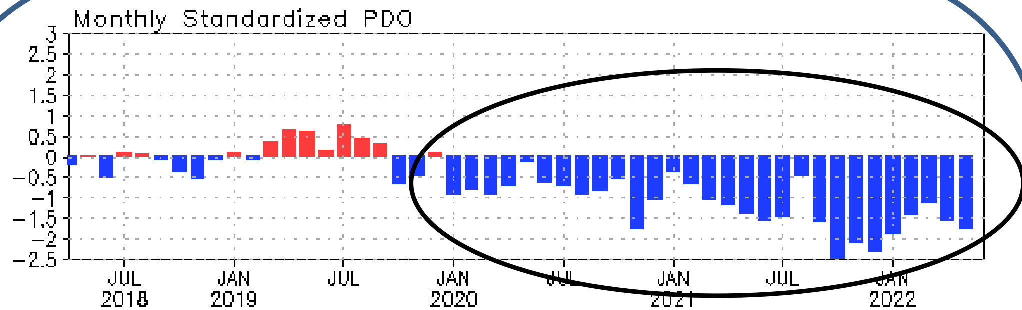
For the Atlantic hurricane regions, the outlooks indicate a 65% change of a above-normal season, a 25% chance of a near-normal season, and a 10% chance of an below-normal season.

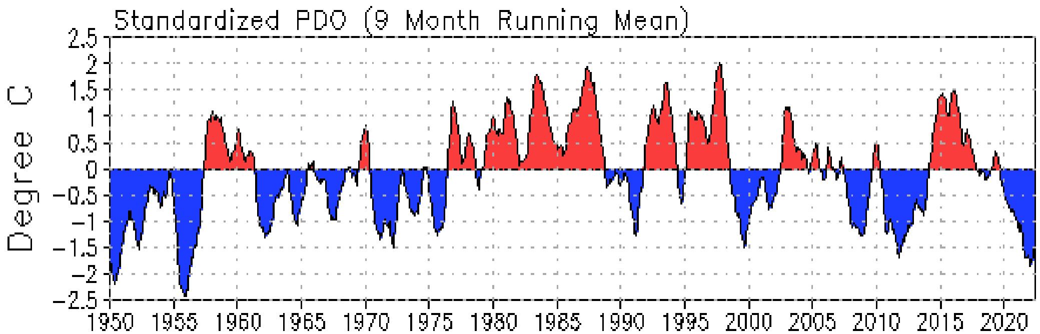
These outlooks are for the overall seasonal activity. They are not a hurricane landfall forecast.

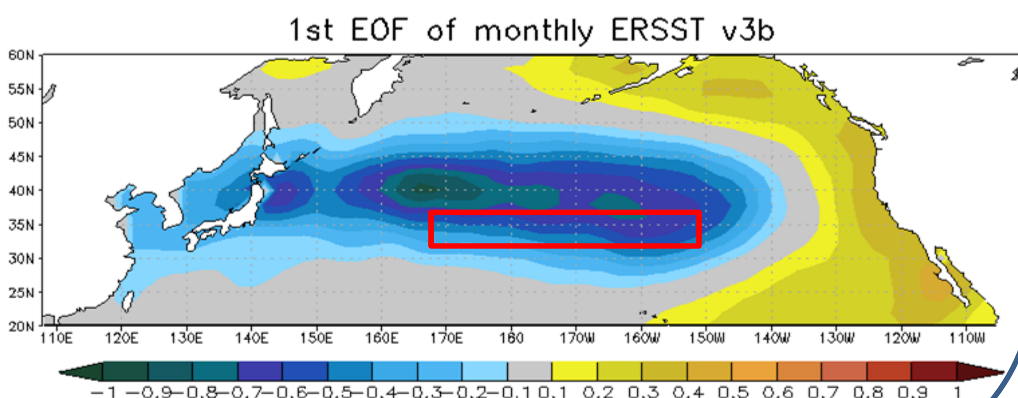
-https://www.cpc.ncep.noaa.gov/products/Epac_hurr/index.shtml

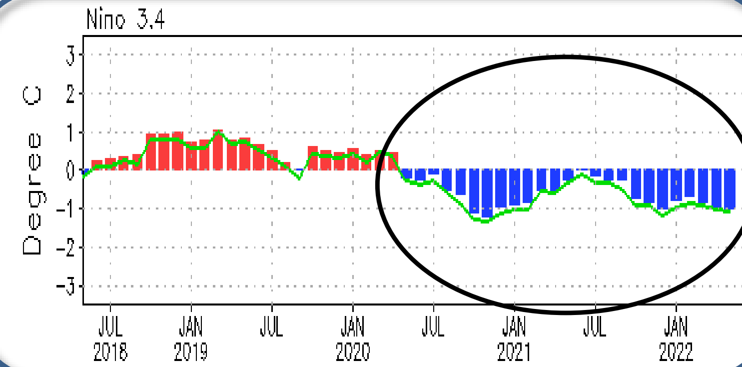
North Pacific & Arctic Oceans

Pacific Decadal Oscillation (PDO) Index







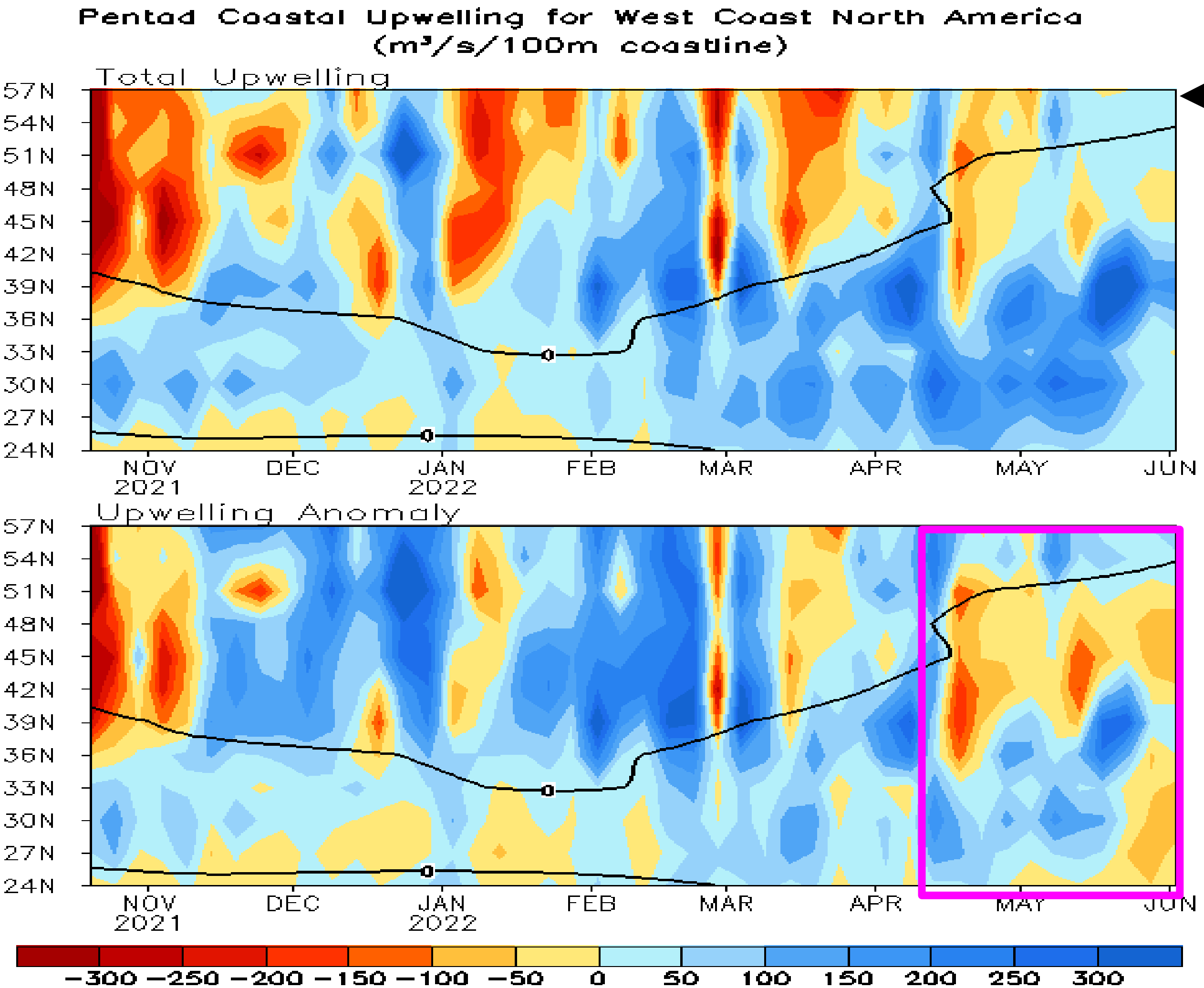


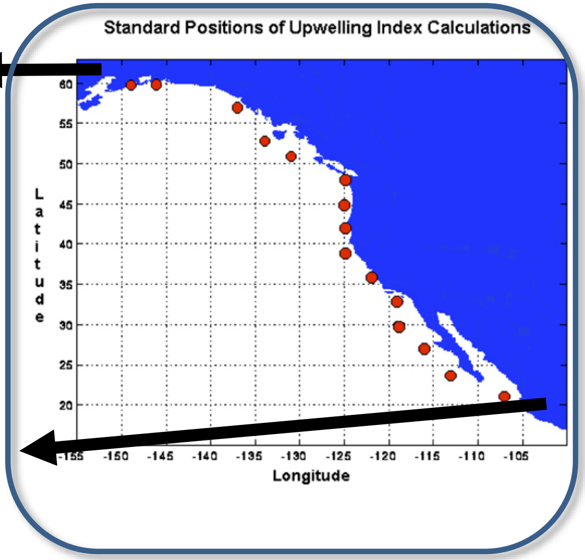
- The PDO has been in a negative phase since Jan 2020 with PDOI = -1.8 in May 2022.

- 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



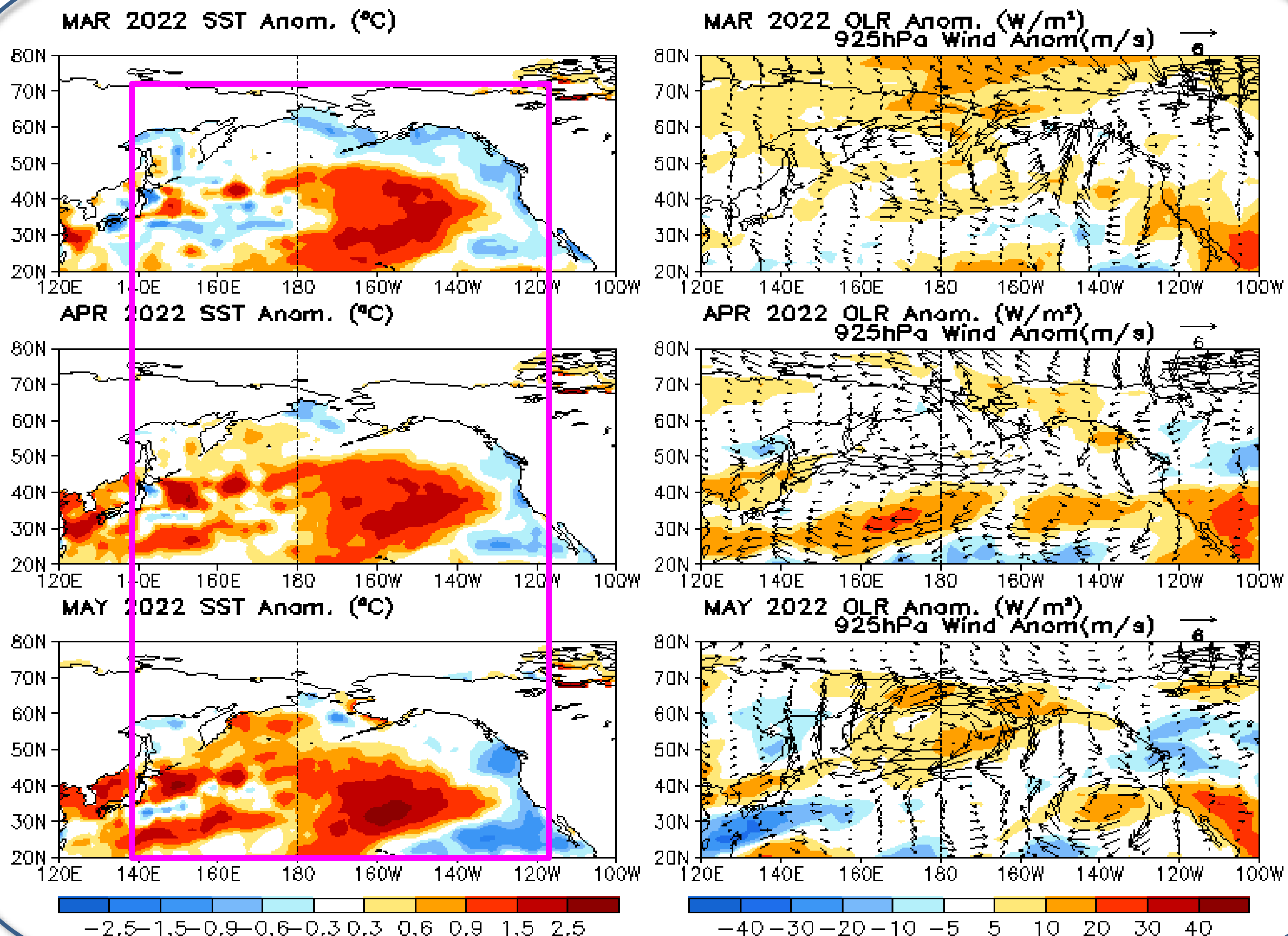


- Both anomalous coastal downwelling and upwelling were observed since mid-Apr 2022.

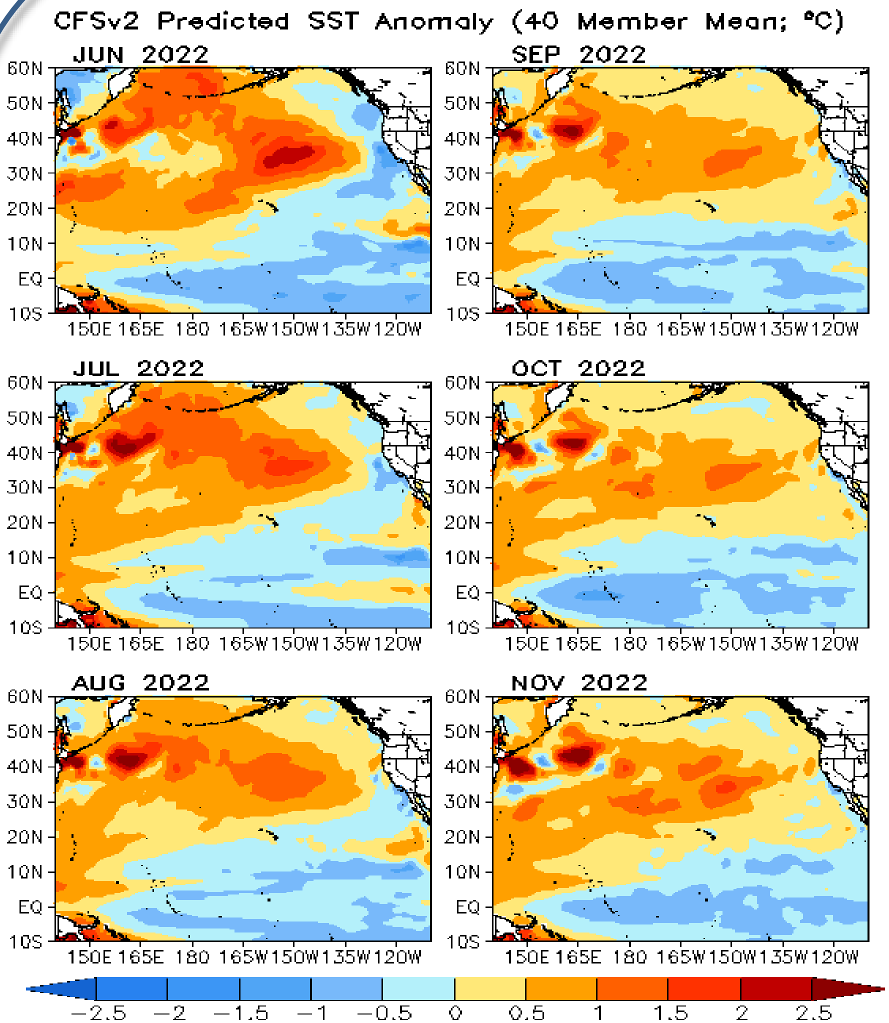
(top) Total and (bottom) anomalous upwelling indices at the 15 standard locations for the western coast of North America. Derived from the vertical velocity of the NCEP's GODAS and are calculated as integrated vertical volume transport at 50-meter depth from each location to its nearest coast point ($m^3/s/100m$ coastline). Anomalies are departures from the 1991-2020 base period pentad means.

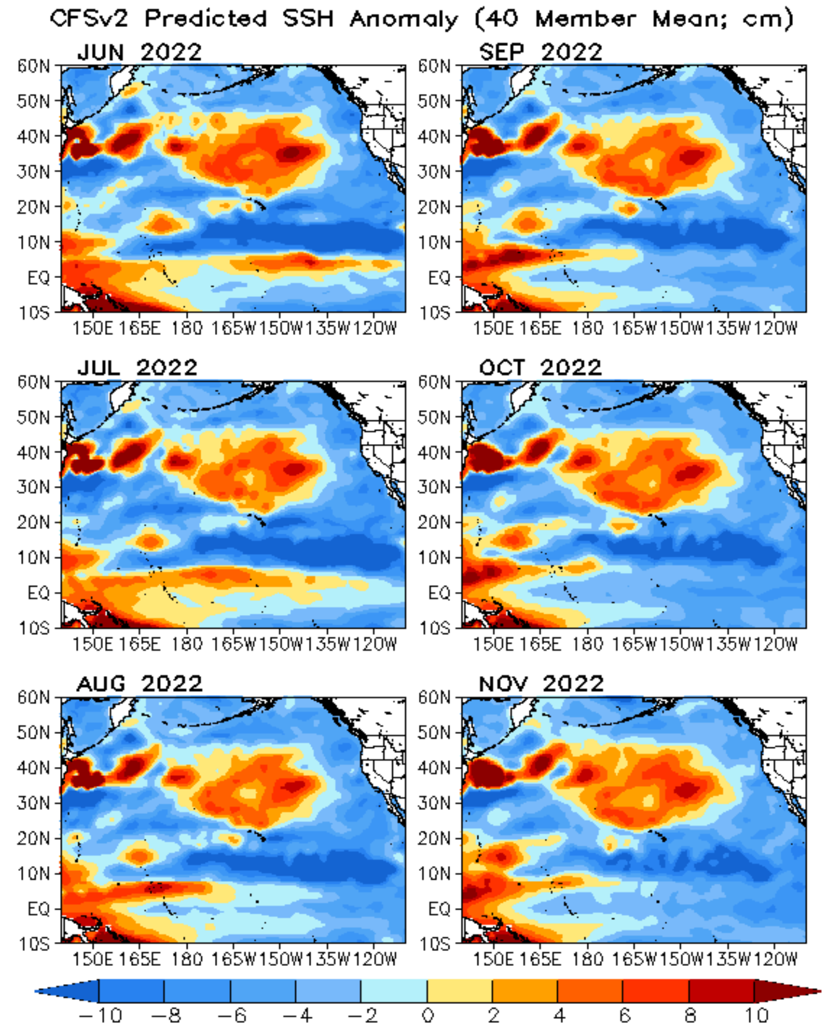
- Area below (above) black line indicates climatological upwelling (downwelling) season.
- Climatologically upwelling season progresses from March to July along the west coast of North America from 36ºN to 57ºN.

North Pacific SST, OLR, and uv925 anomalies



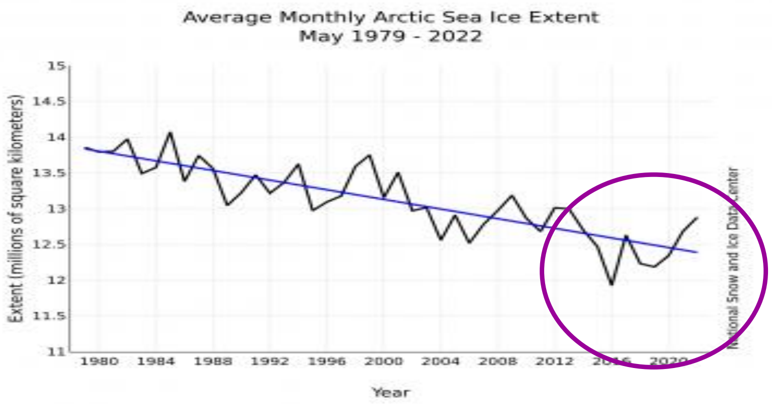
CFSv2 North Pacific SSTA Predictions

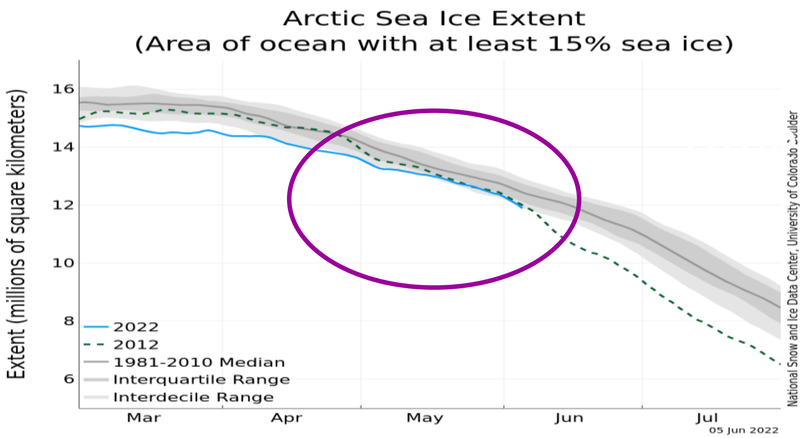


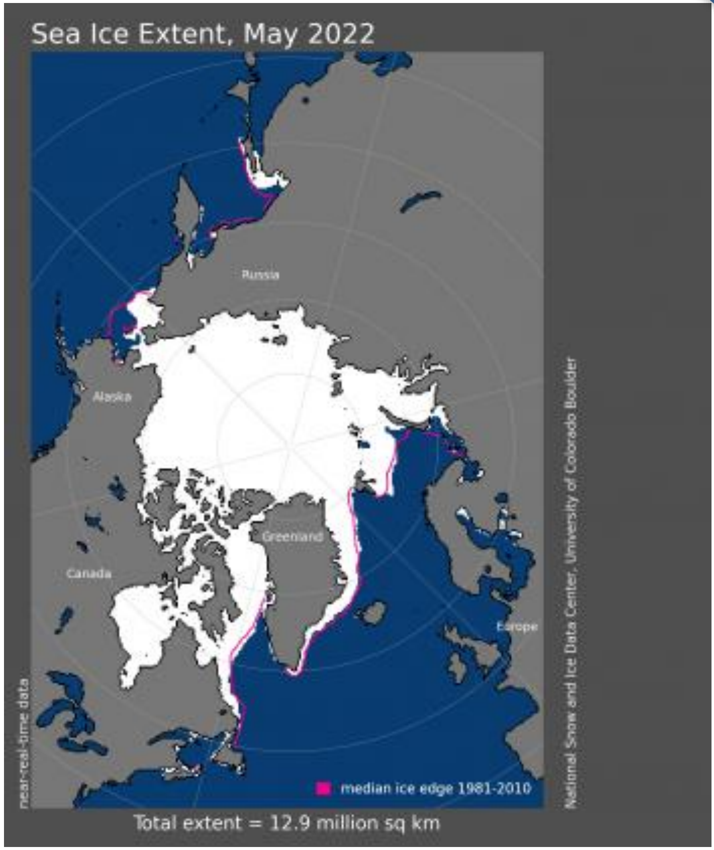


- The CFSv2 predicts that the current SST warm state will continue into the Northern hemisphere late fall.

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

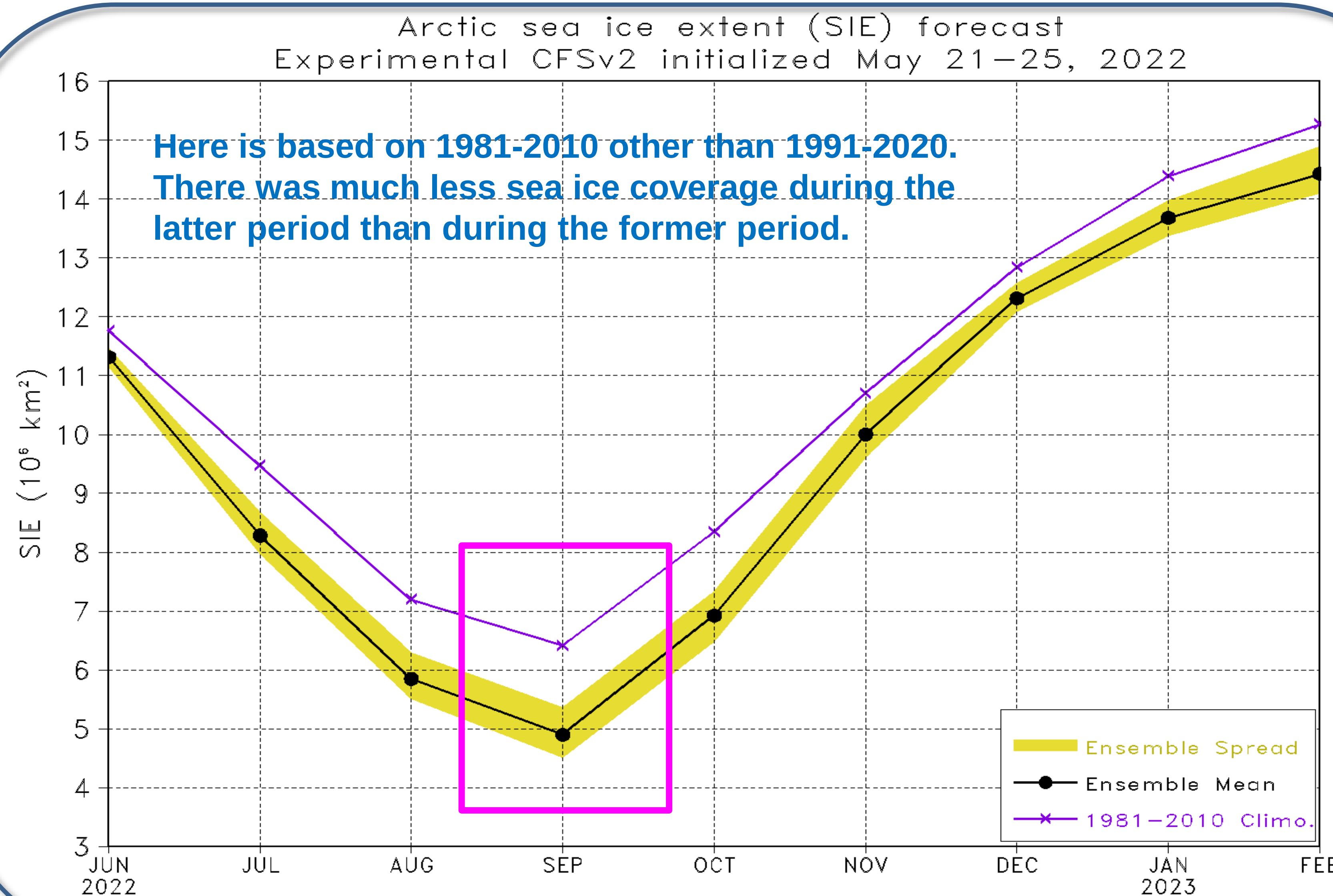






- Seasonal sea ice loss began more slowly in May than in the recent years.
- Average Arctic sea ice extent for May ranked the 14the lowest in the satellite record.
- The downward linear trend in May sea ice extent over the 44-year-satellite record is 2.5% per decade relative to the 1981 to 2010 average.
- Based on the linear trend, since 1979, May has lost 450,000 square kilometers of sea ice. This is equivalent to the size of the state of California.

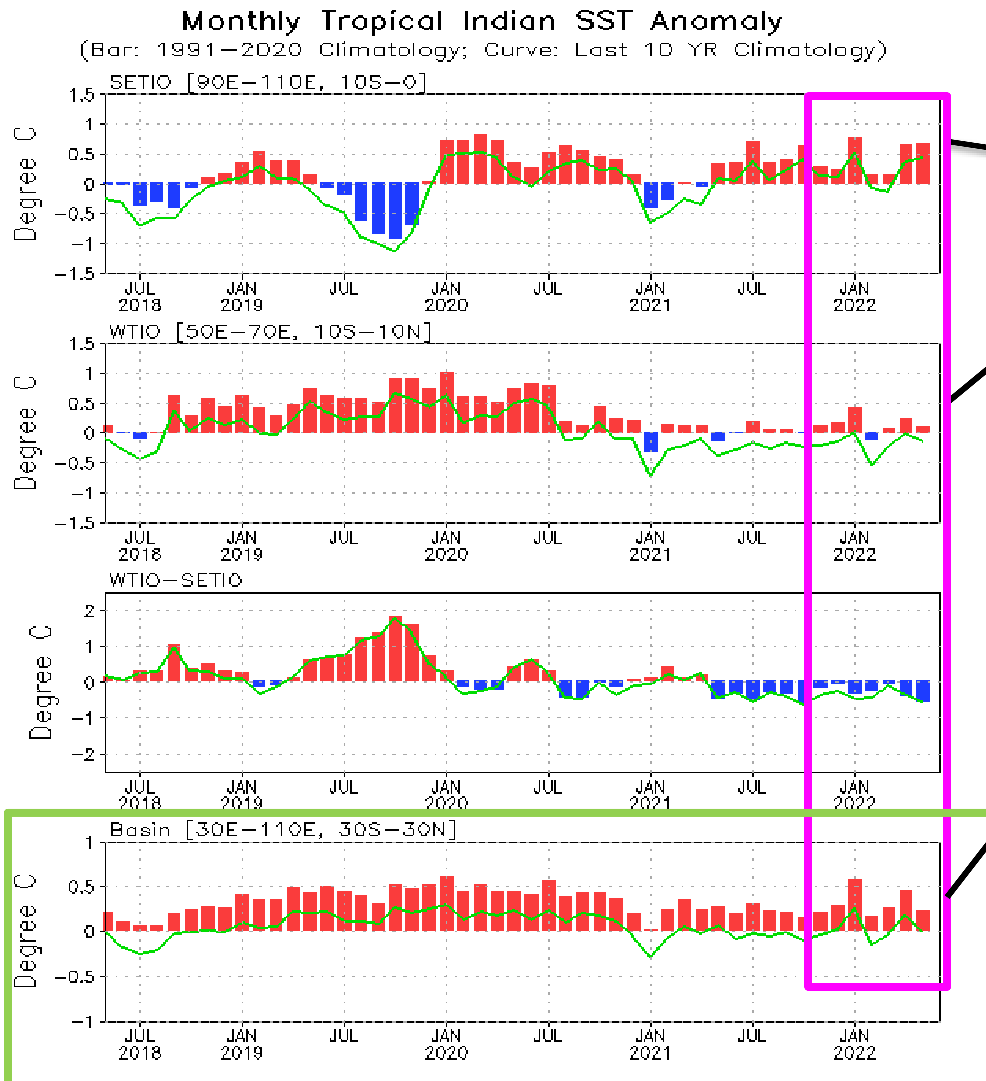
NCEP/CPC Arctic Sea Ice Extent Forecast

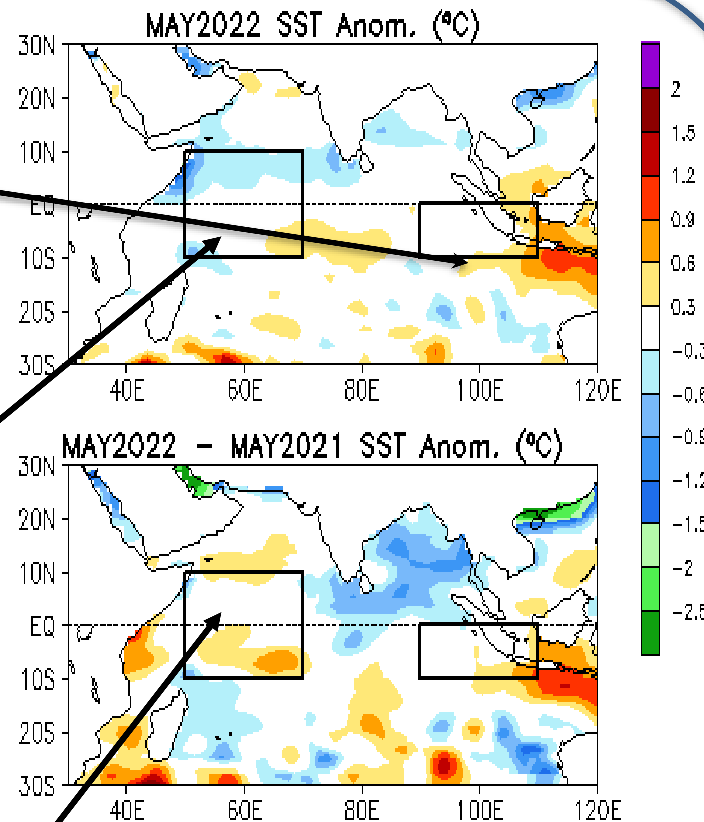


https://www.cpc.ncep.noaa.gov/products/people/wwang/seaice_seasonal/index.html

Indian Ocean

Evolution of Indian Ocean SST Indices

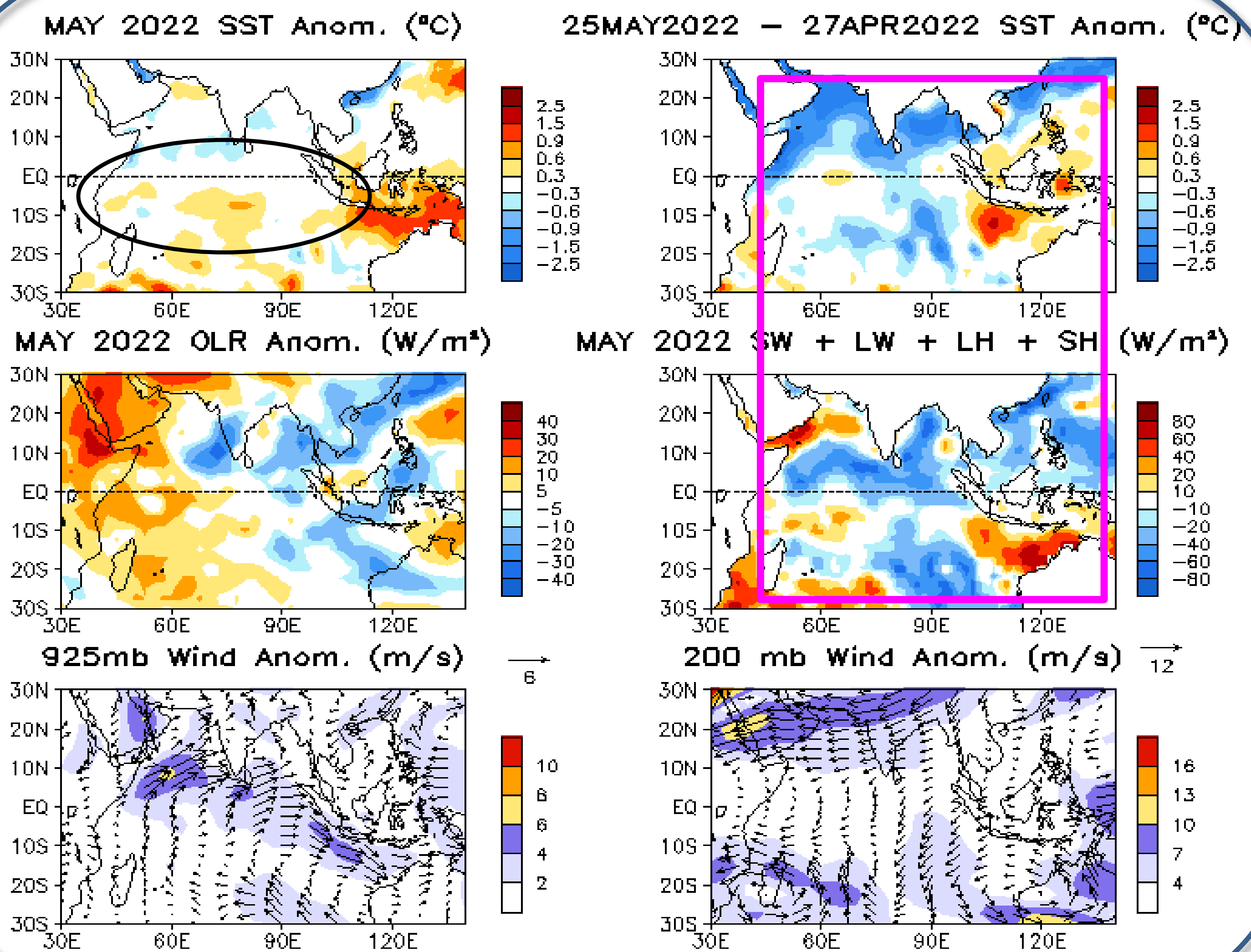




- Overall, SSTs were near or slightly above average in the tropical Indian Ocean in May 2022.

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.

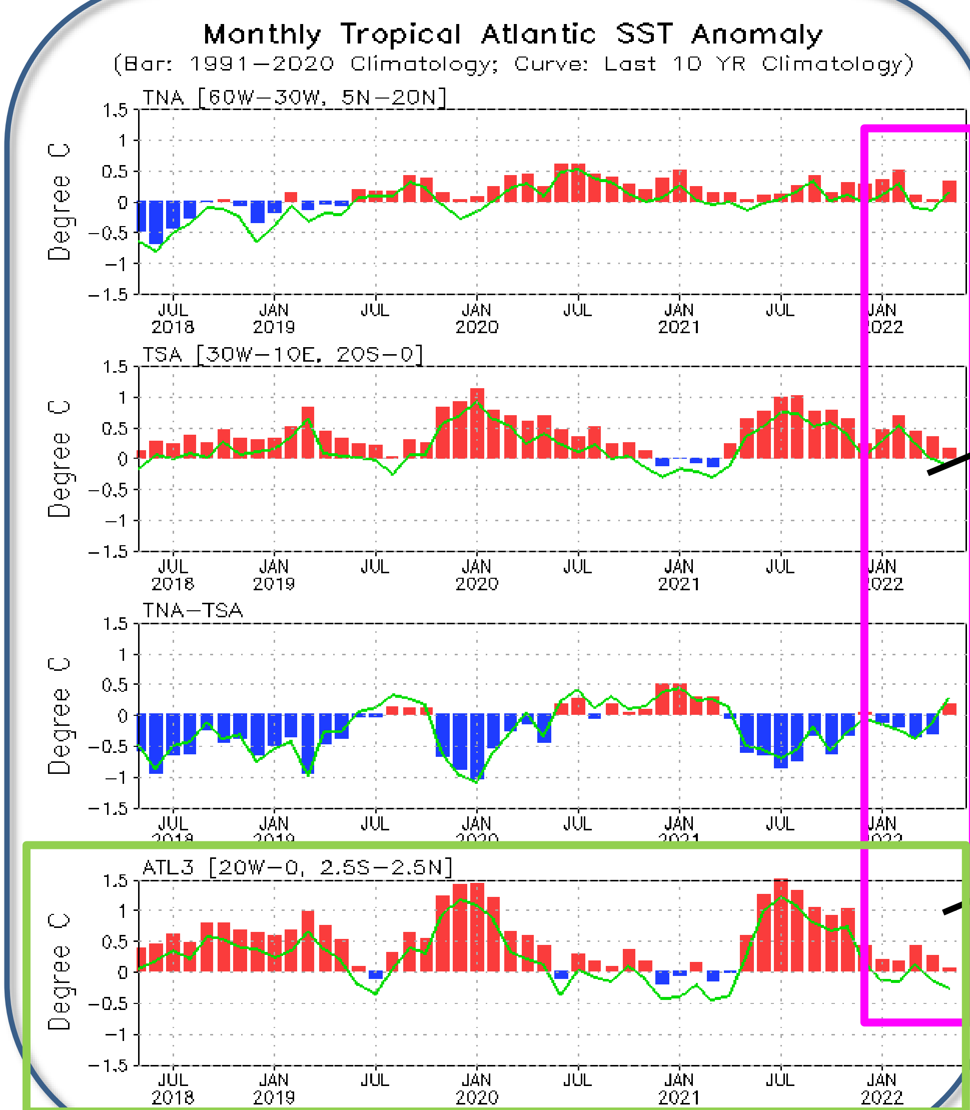


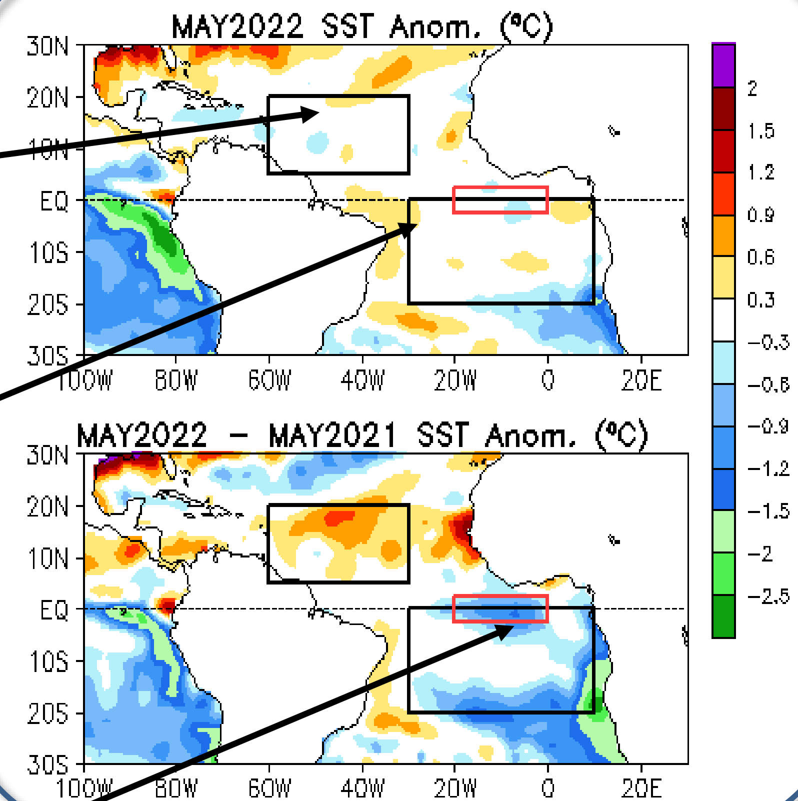
- SSTAs were small in the tropical Indian Ocean.
- SSTA tendencies n the tropics were generally consistent with the net heat flux anomalies.

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 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

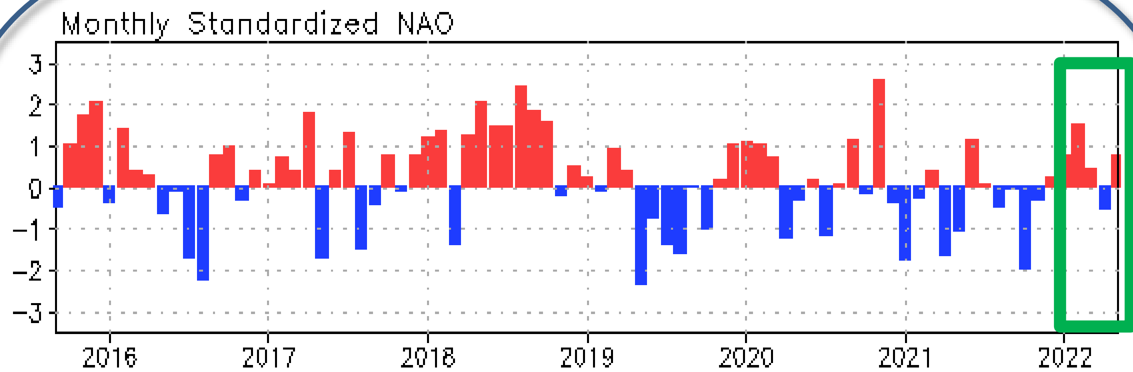


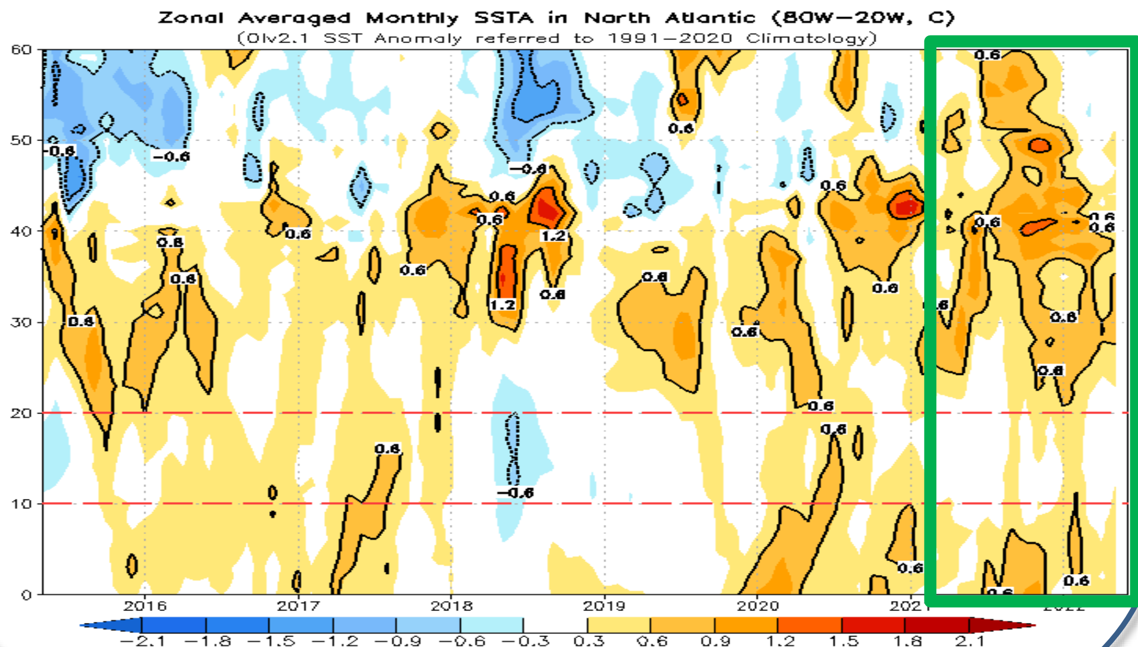


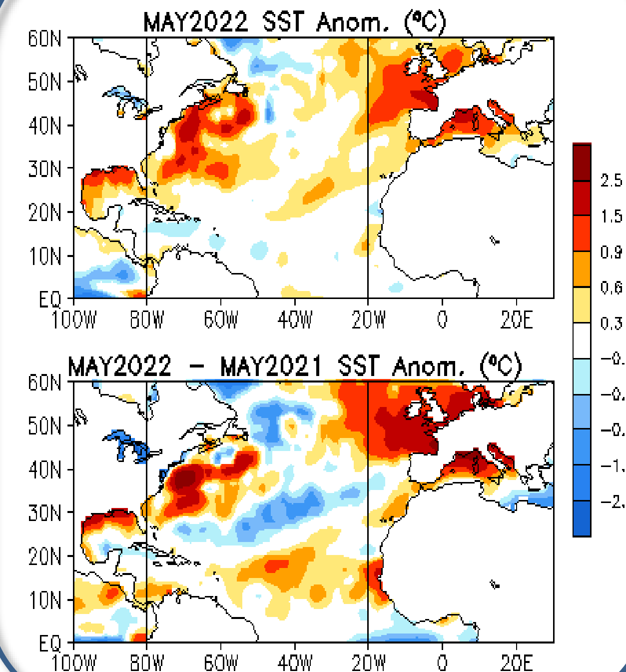
- SSTs were near or slightly above average in the tropical Atlantic Ocean.
- The Atlantic Niño event ended in Dec 2021.

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 OIv2.1 SST analysis, and anomalies are departures from the 1991-2020 base period means.

NAO and SST Anomaly in North Atlantic

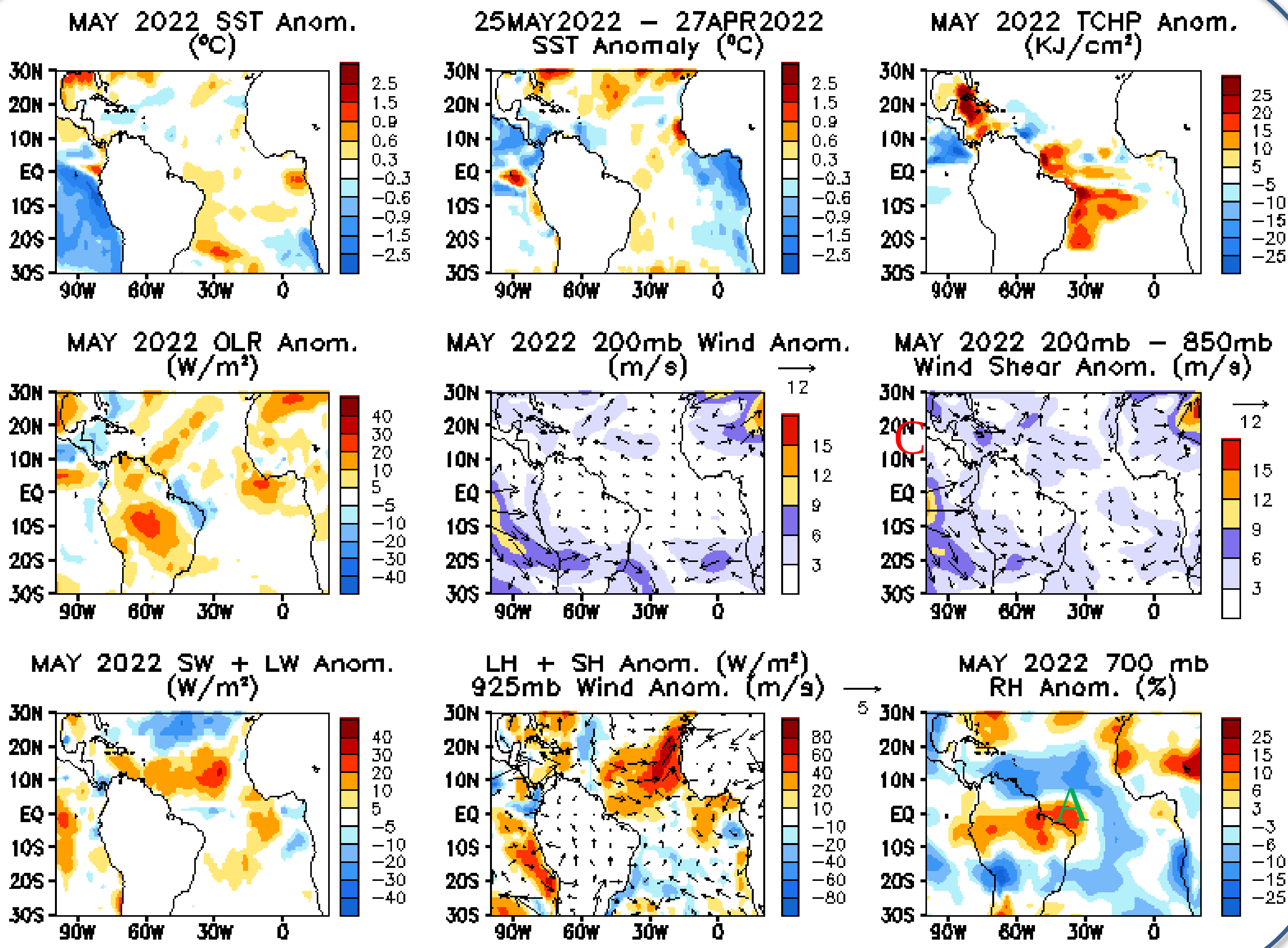




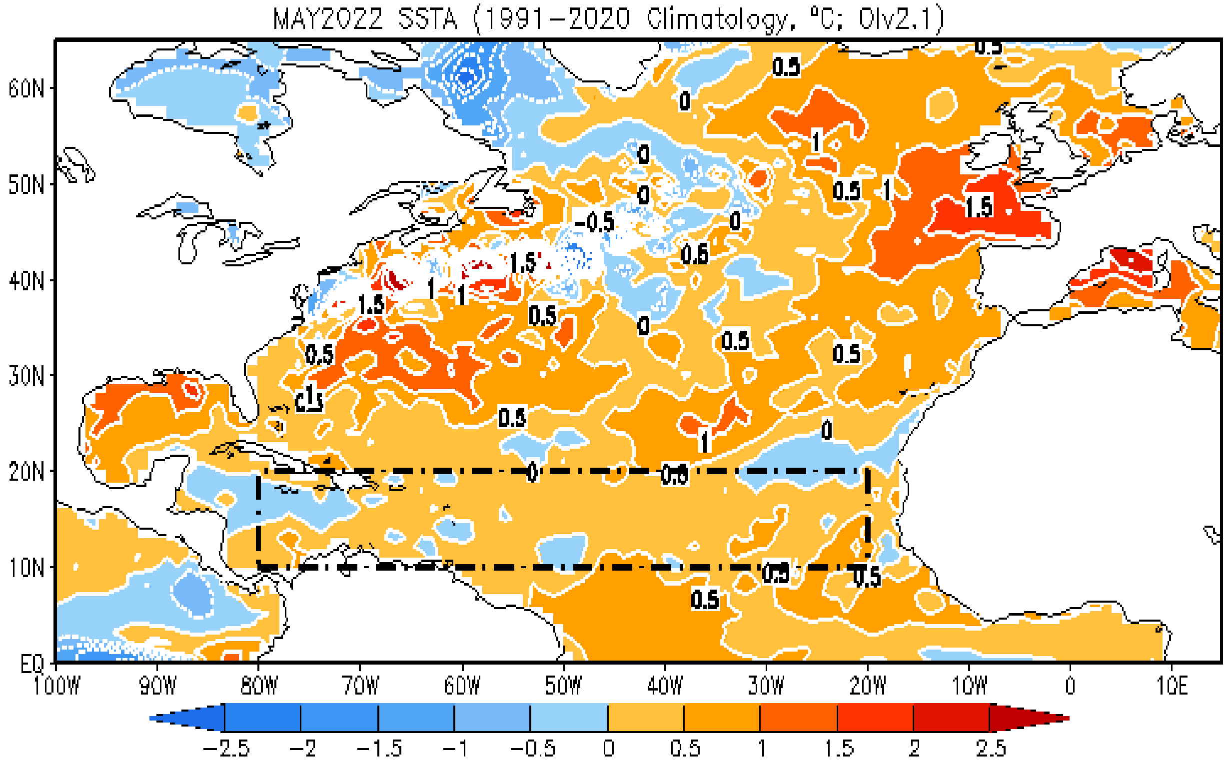


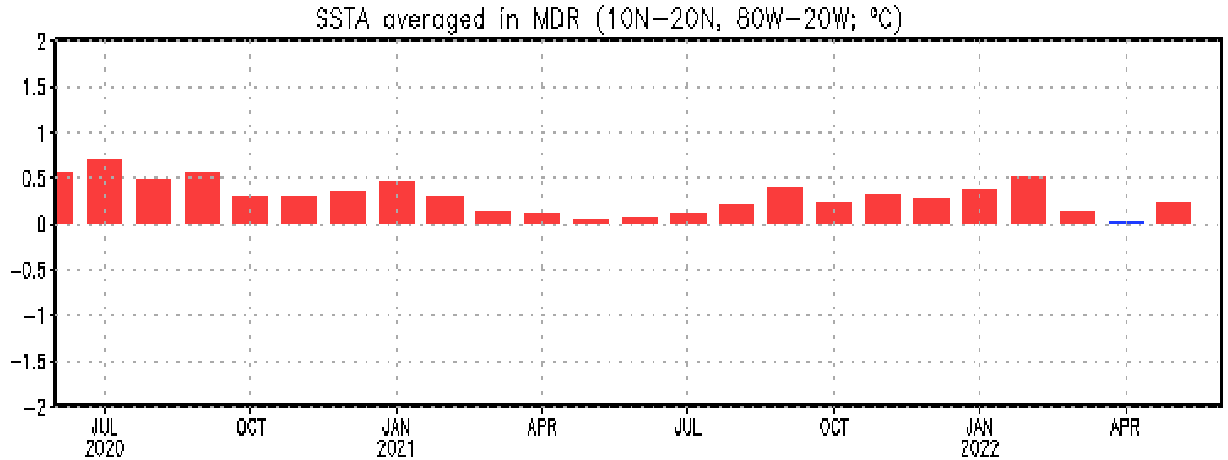
- NAO switched to a positive phase in May 2022 with NAOI= 0.7.
- The positive SSTAs in the mid-high latitudes of the North Atlantic Ocean were evident since 2021.

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.


MAY 2022 SST Anom. (°C)
25MAY2022 – 27APR2022 SST Anomaly (°C)
MAY 2022 TCHP Anom. (KJ/cm²)
MAY 2022 OLR Anom. (W/m²)
MAY 2022 200mb Wind Anom. (m/s)
MAY 2022 200mb – 850mb Wind Shear Anom. (m/s)
C
MAY 2022 SW + LW Anom. (W/m²)
LH + SH Anom. (W/m²) 925mb Wind Anom. (m/s)
MAY 2022 700 mb RH Anom. (%)
A

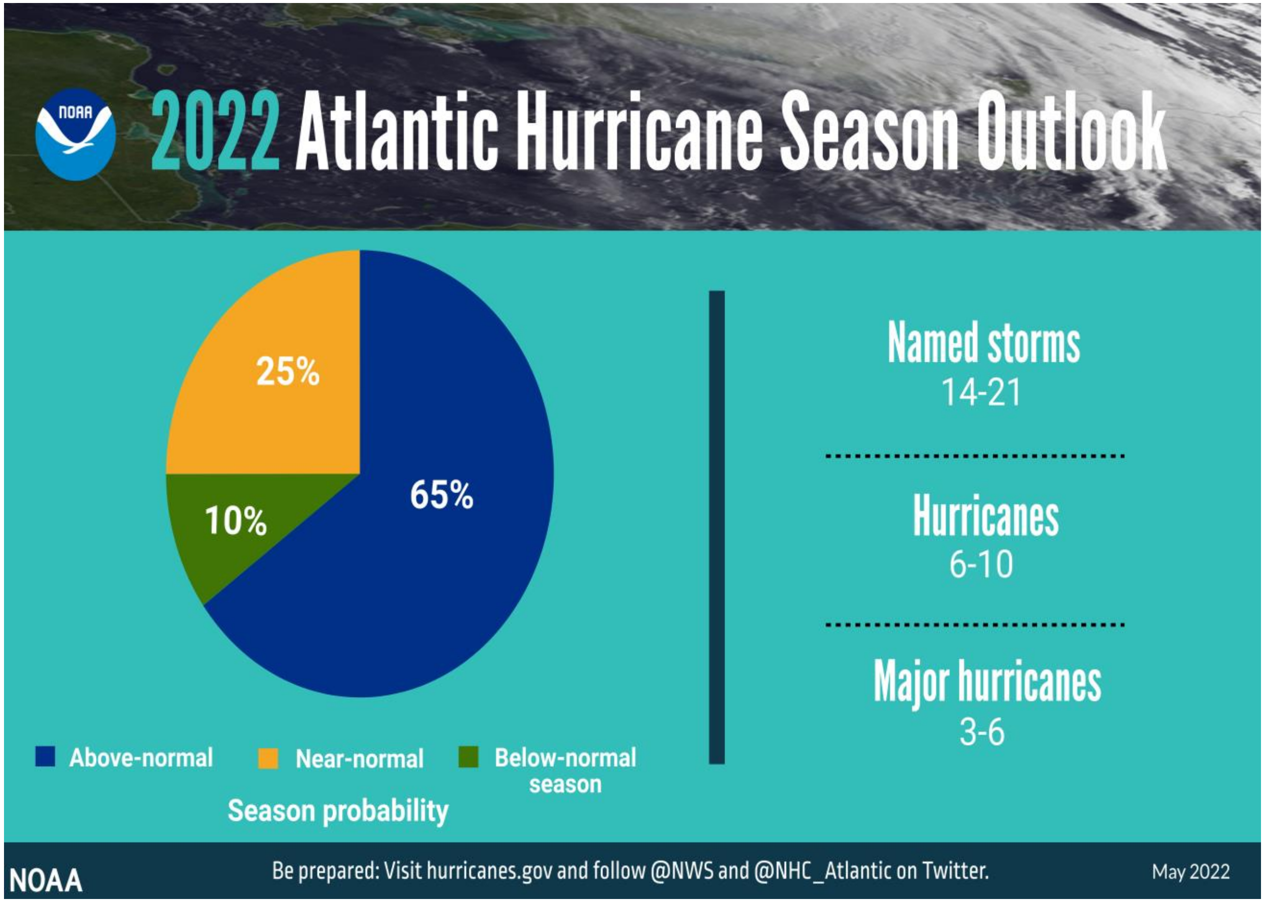
SSTAs in the North Atlantic & MDR





- SST in MDR was mostly above average during the last two years.
- SSTAs were positive in MDR in the last month.

2022 Atlantic Hurricane Season Outlook



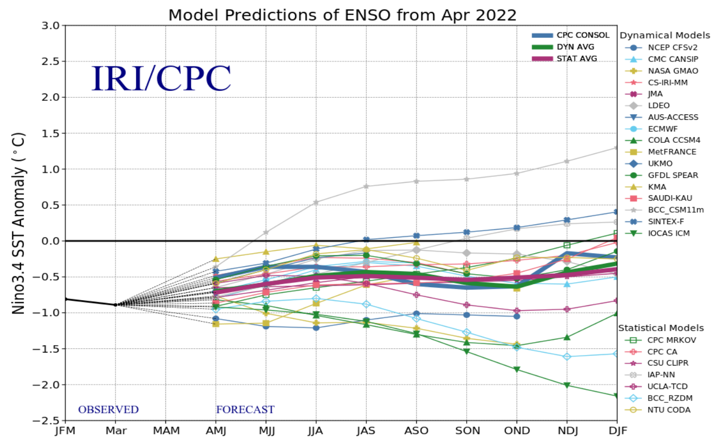
- May 24, 2022: NOAA CPC predicted above-normal 2022 Atlantic Hurricane Season with a 65% chance of an above-normal season, a 25% chance of a near-normal season and a 10% chance of a below-normal season.

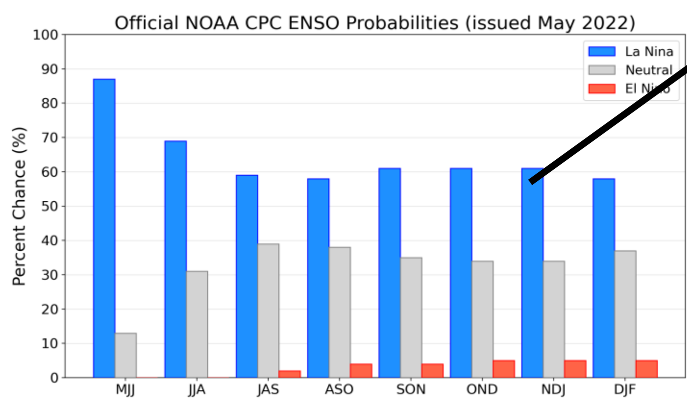
- "The increased activity anticipated this hurricane season is attributed to several climate factors, including the ongoing La Niña that is likely to persist throughout the hurricane season, warmer-than-average sea surface temperatures in the Atlantic Ocean and Caribbean Sea, weaker tropical Atlantic trade winds and an enhanced west African monsoon."

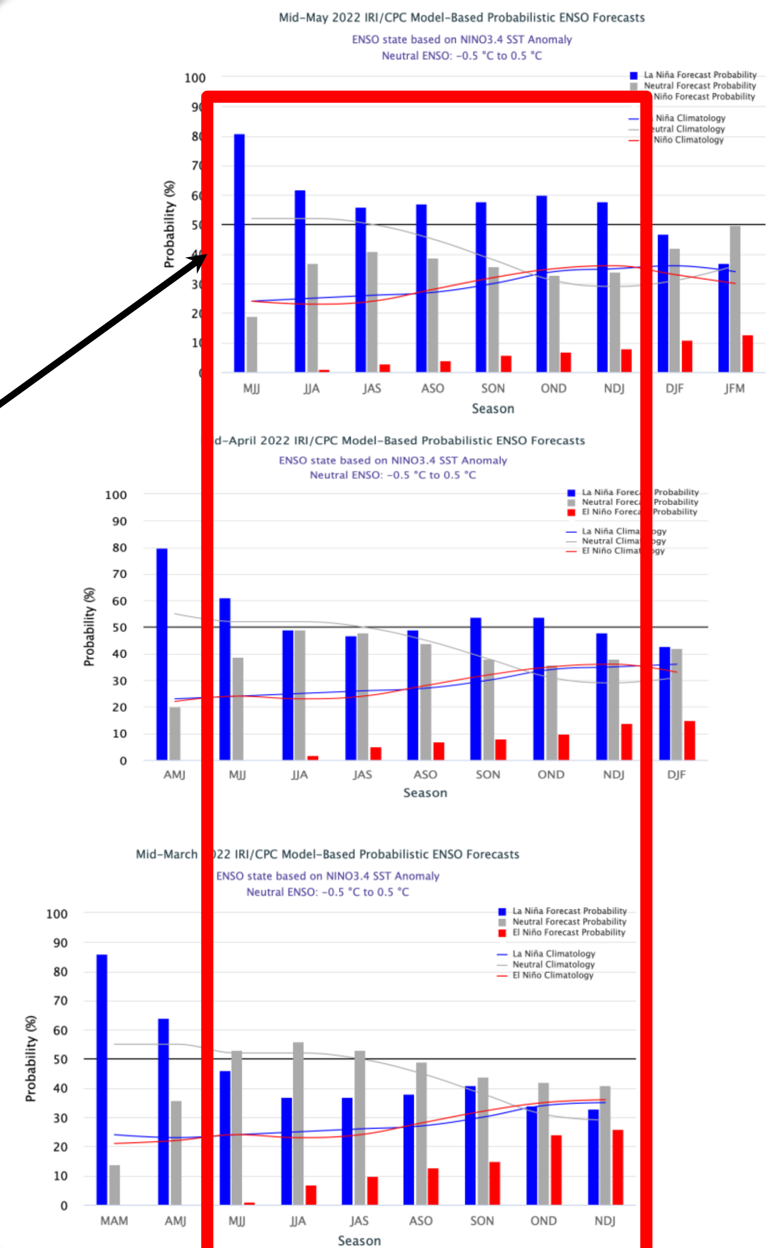
-*(https://www.noaa.gov/news-release/noaa-predicts-above-normal-2022-atlantic-hurricane-season)*

ENSO and Global SST Predictions

IRI/CPC Niño3.4 Forecast: May 2022

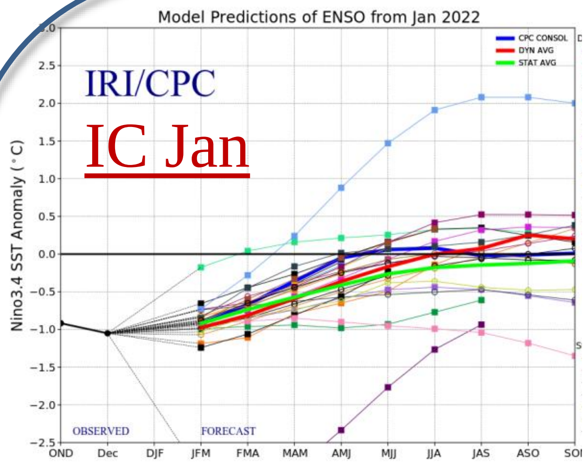


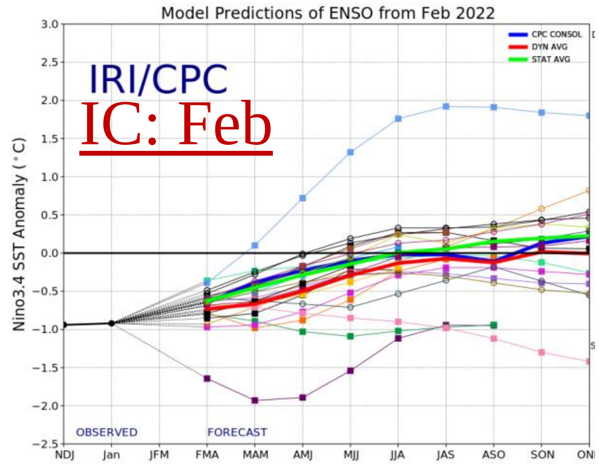


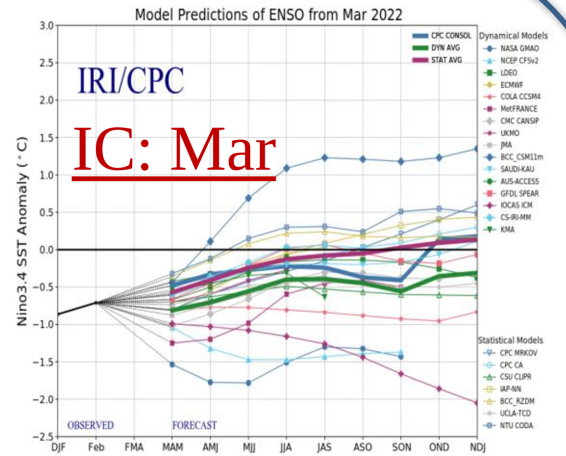


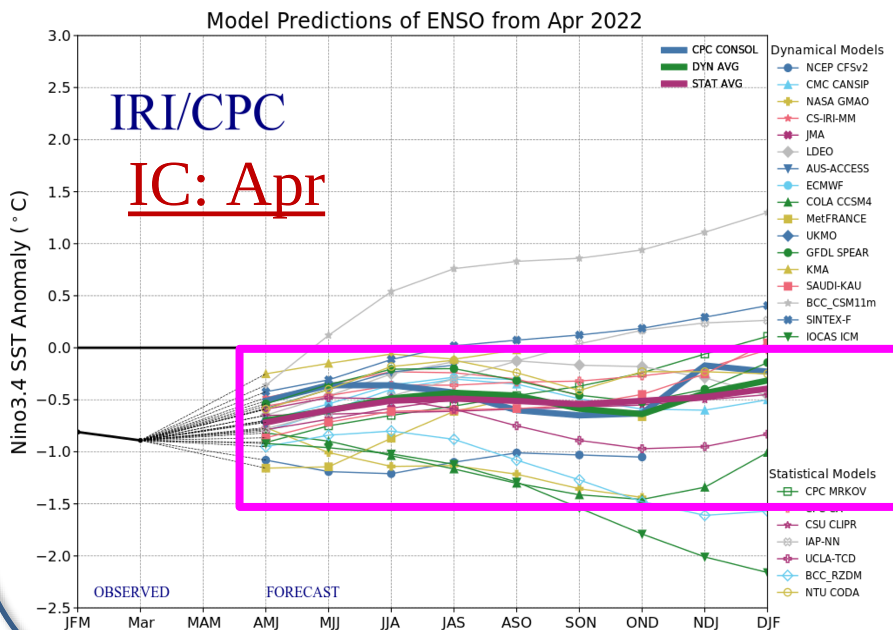
- **ENSO Alert System Status: La Niña Advisory**
- Though La Niña is favored to continue through the end of the year, the odds for La Niña decrease into the Northern Hemisphere late summer (52% chance in July-September 2022) before slightly increasing through the Northern Hemisphere fall and early winter 2022 (58-59% chance).

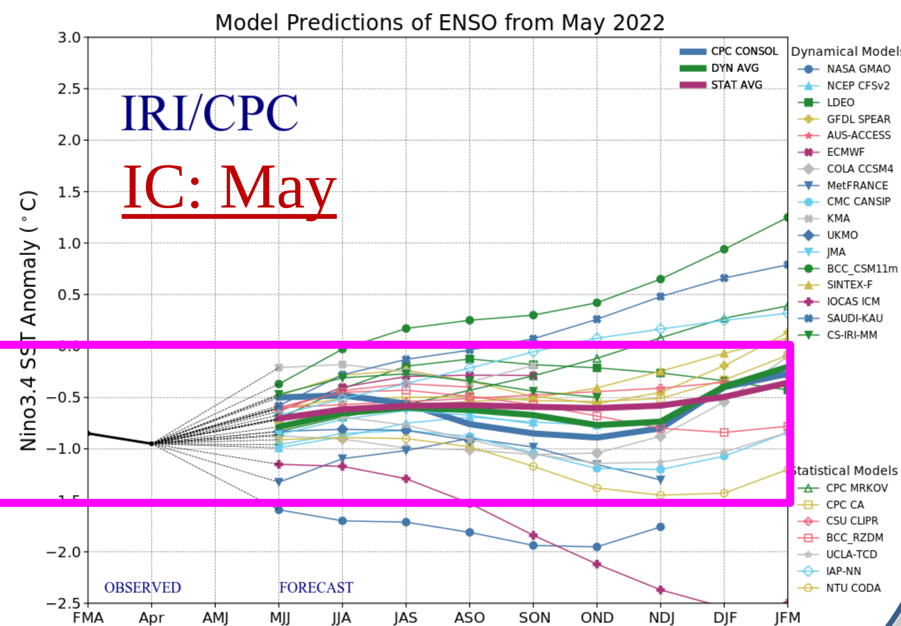
Cooling Tendency: IRI/CPC ENSO Plume with ICs in Jan-May 2022



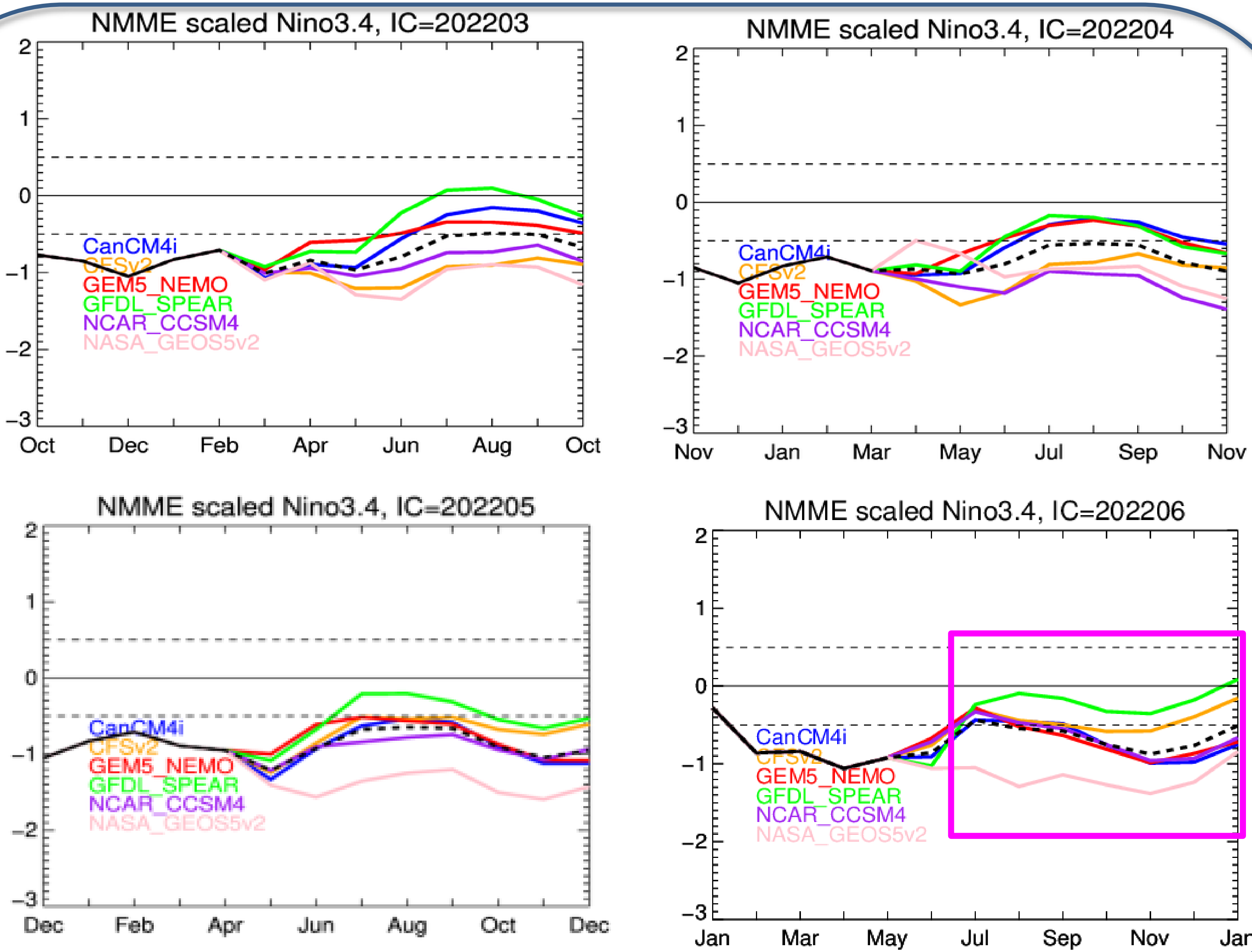






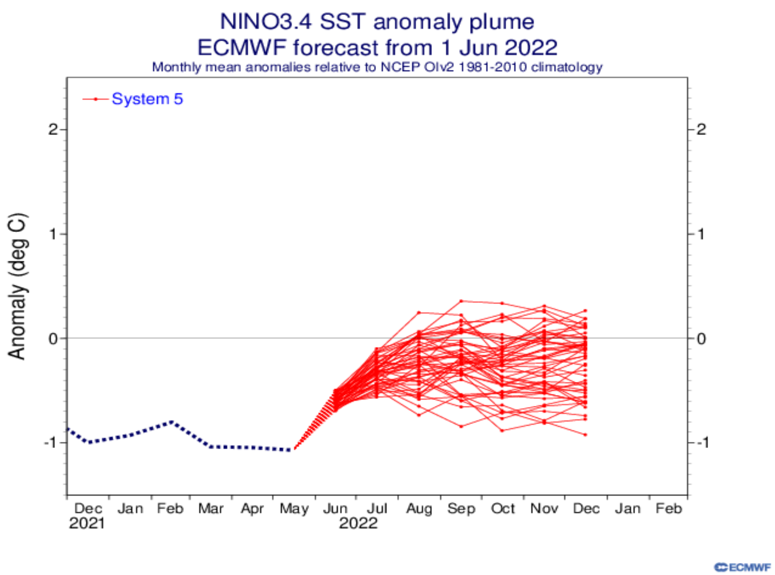


NMME forecasts from different initial conditions

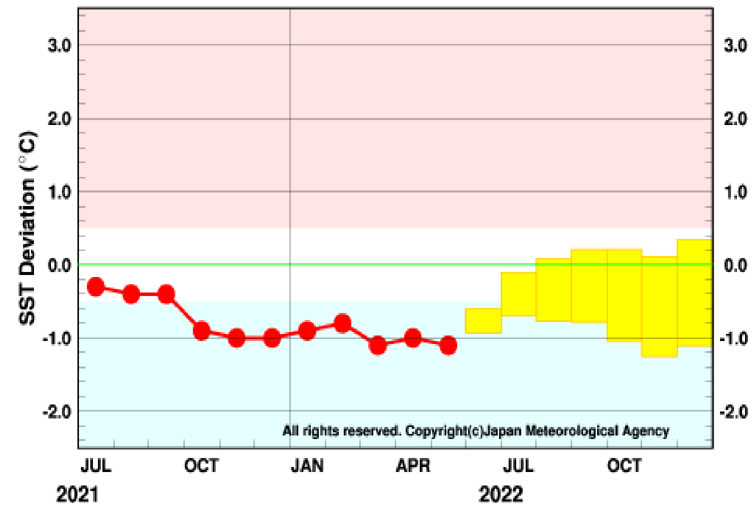


Individual Model Forecasts: ENSO neutral or borderline La Nina

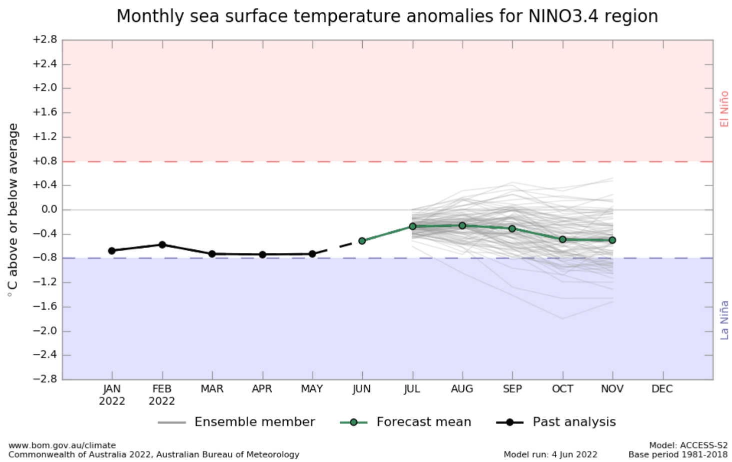
EC: IC= 1 Jun 2022



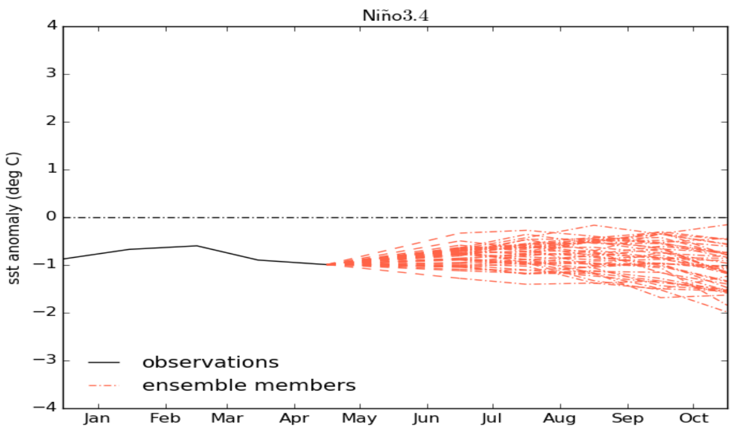
JMA: Updated 10 Jun 2022



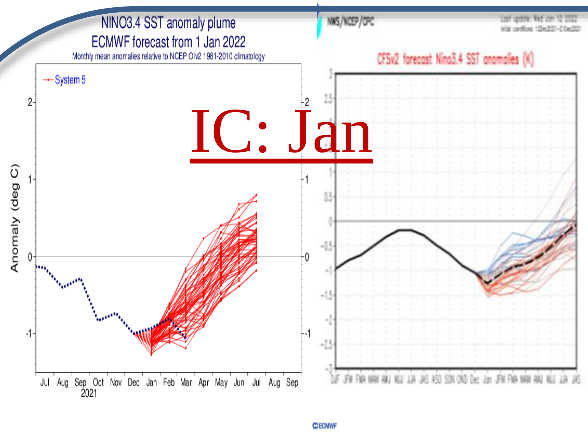
Australian BOM: Updated 4 Jun 2022

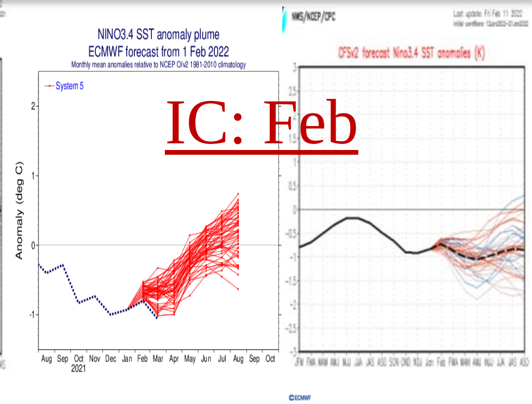


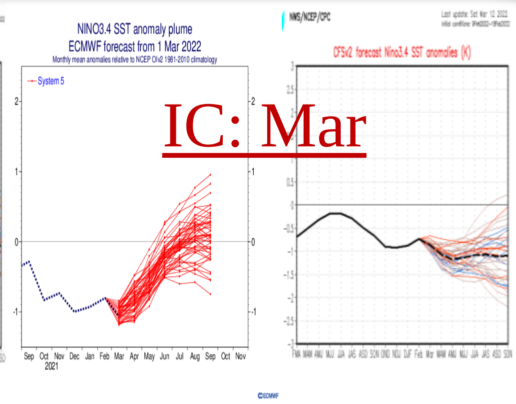
UKMO: Updated 11 My 2022

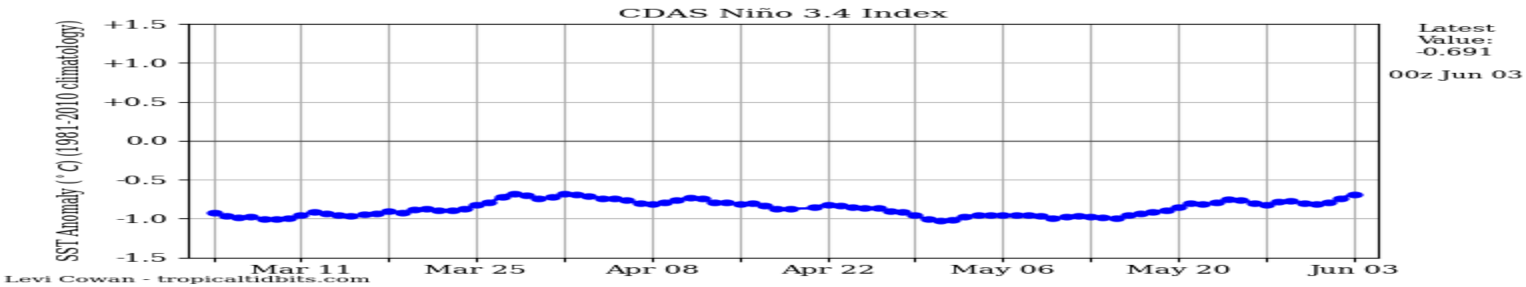


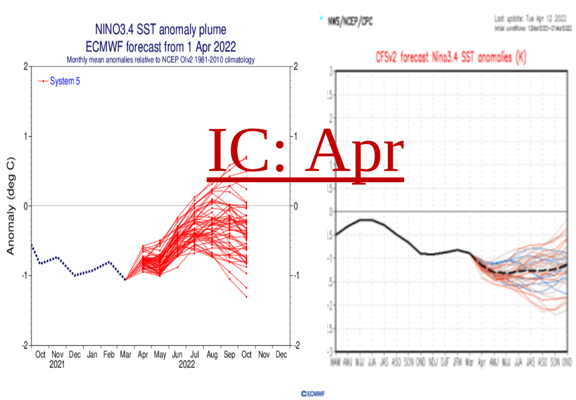
CFSv2 Predicted the cooling tendency earlier & stronger than ECMWF Model

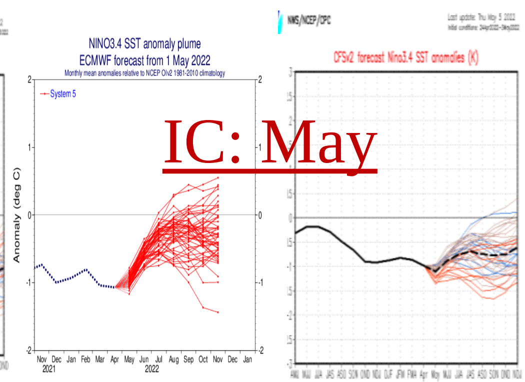


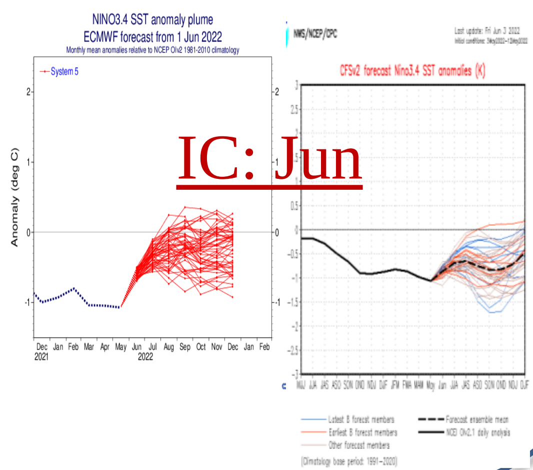




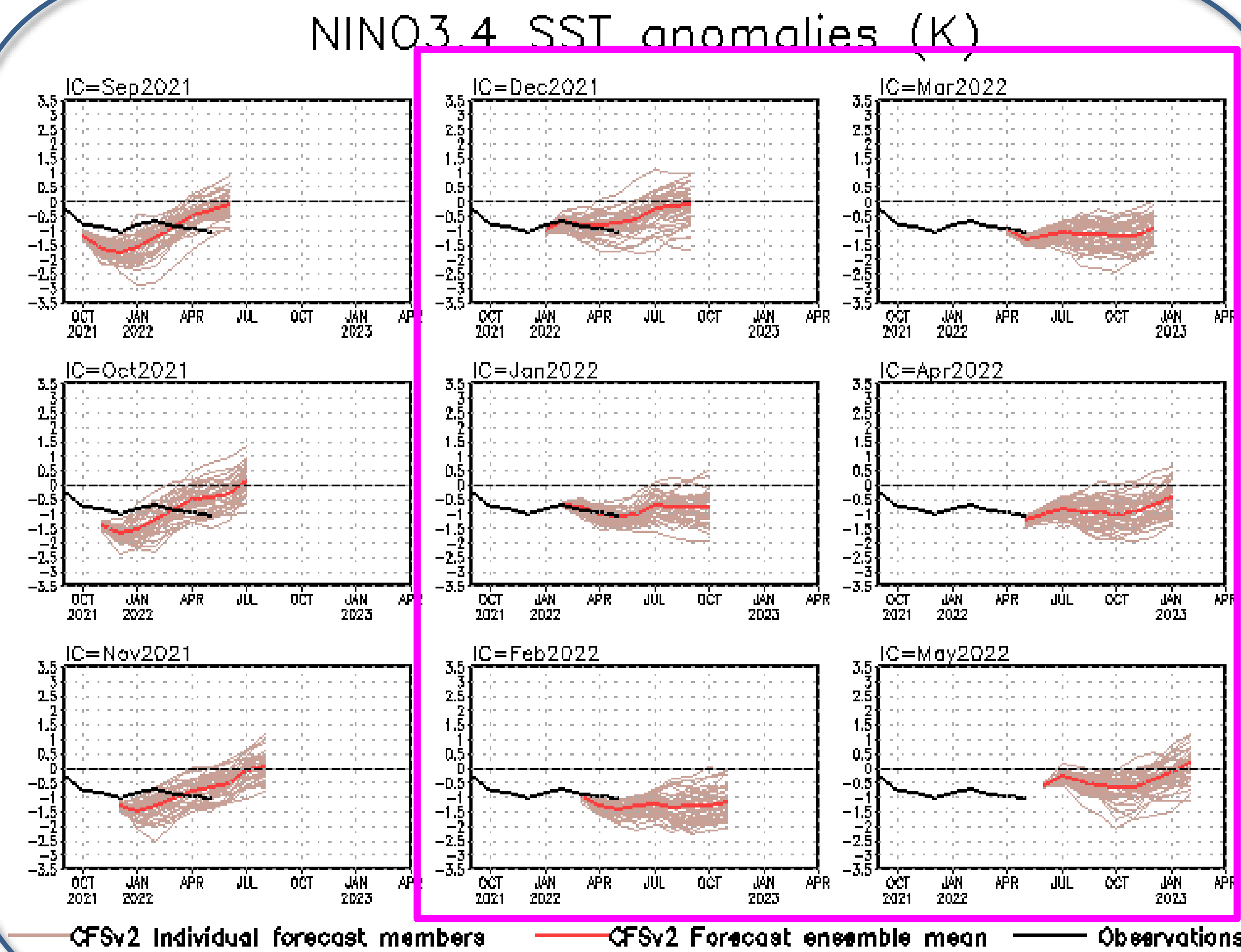






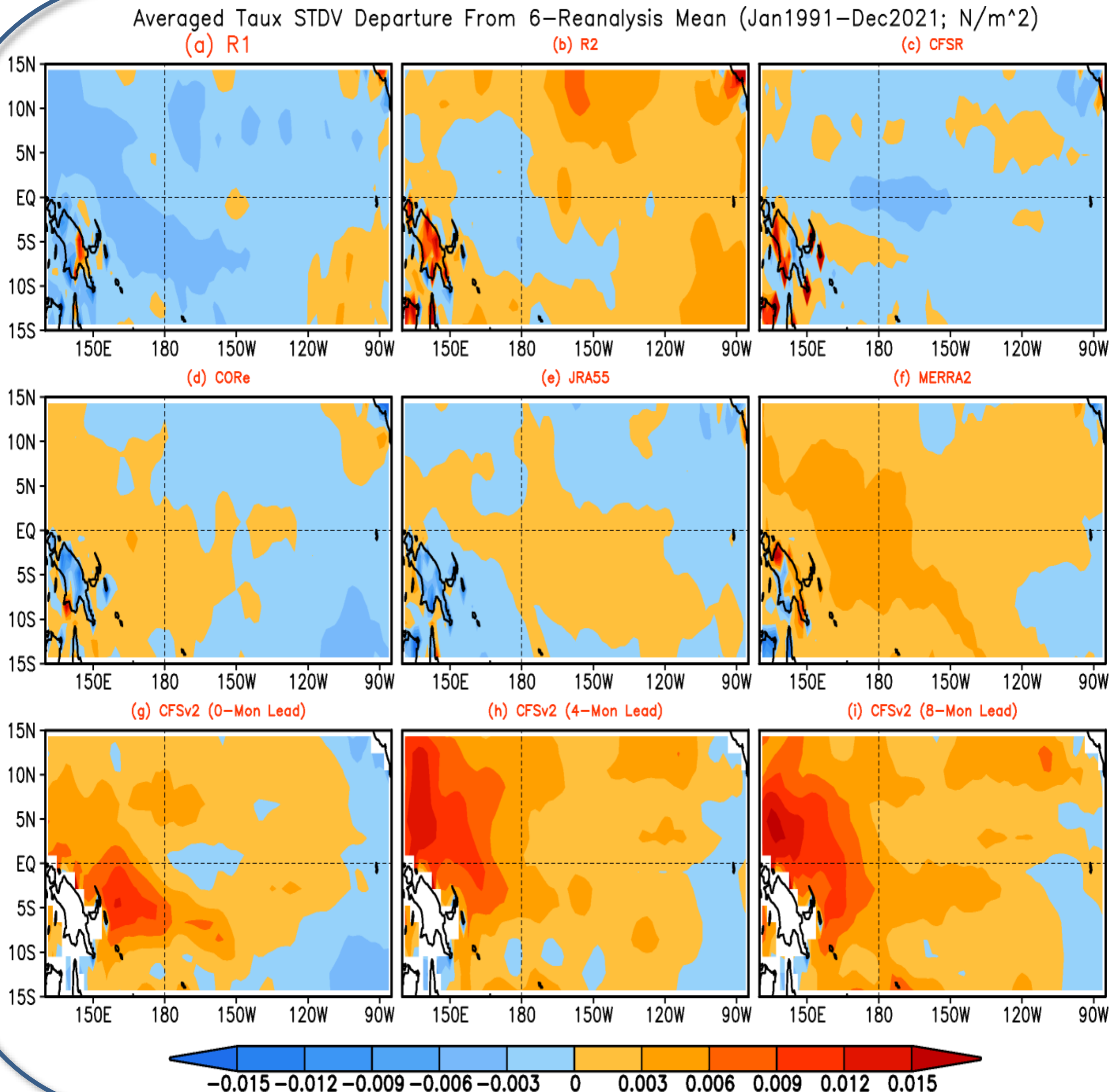


CFS Niño3.4 SST Predictions from Different Initial Months



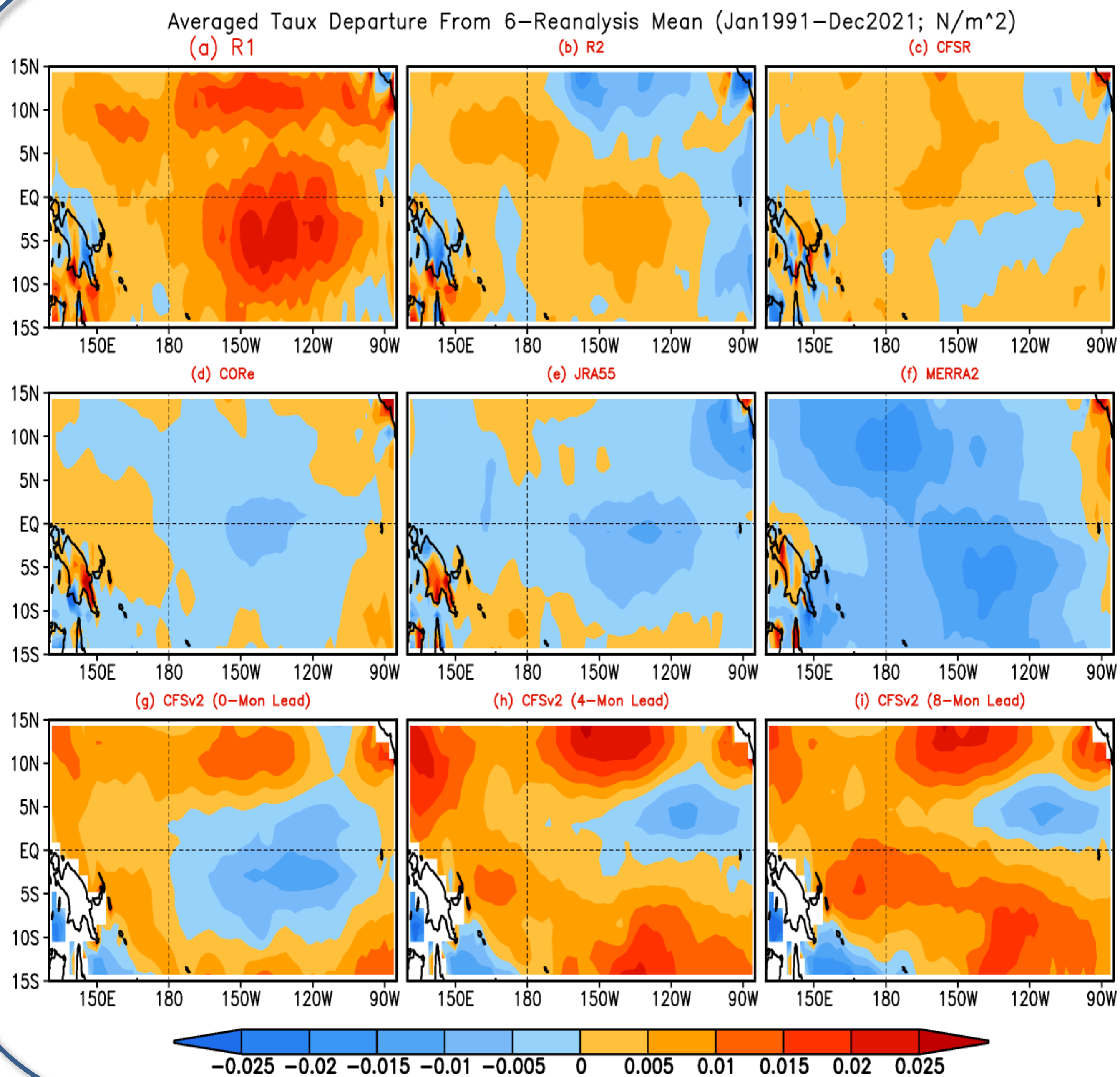
- The latest CFSv2 forecasts call for a borderline La Niña in summer – autumn 2022.

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.



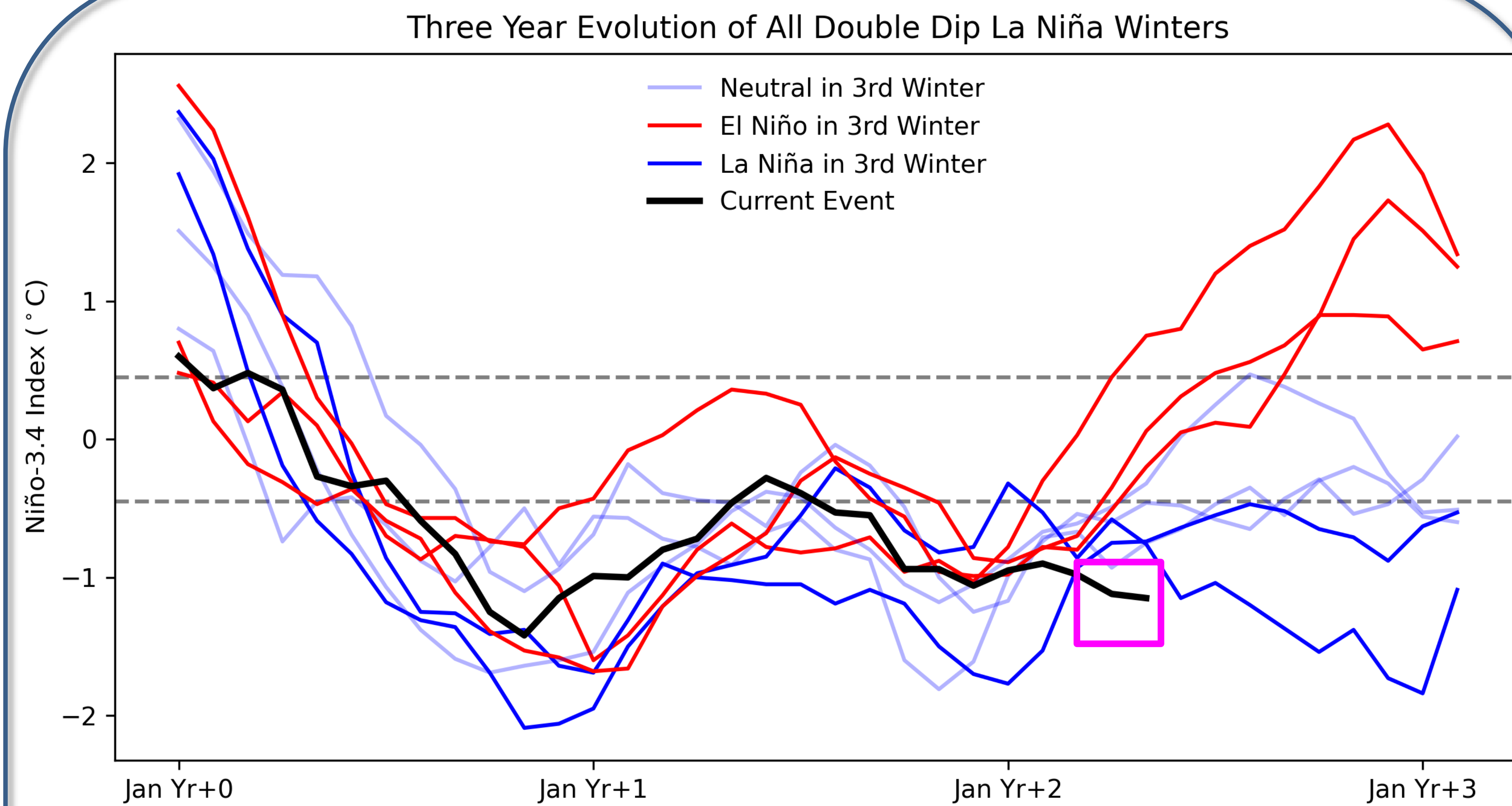
- Overall, taux variability (STDV) is the weakest in R1 and strongest in MERRA2.

- taux variability (STDV) in the tropical (western) Pacific is stronger in CFSv2 than in the reanalyses.



- Overall, taux is weakest in R1 and strongest in MERRA2;
- CFSv2 taux is weaker in the tropical western Pacific than the mean of the 6 reanalyses.

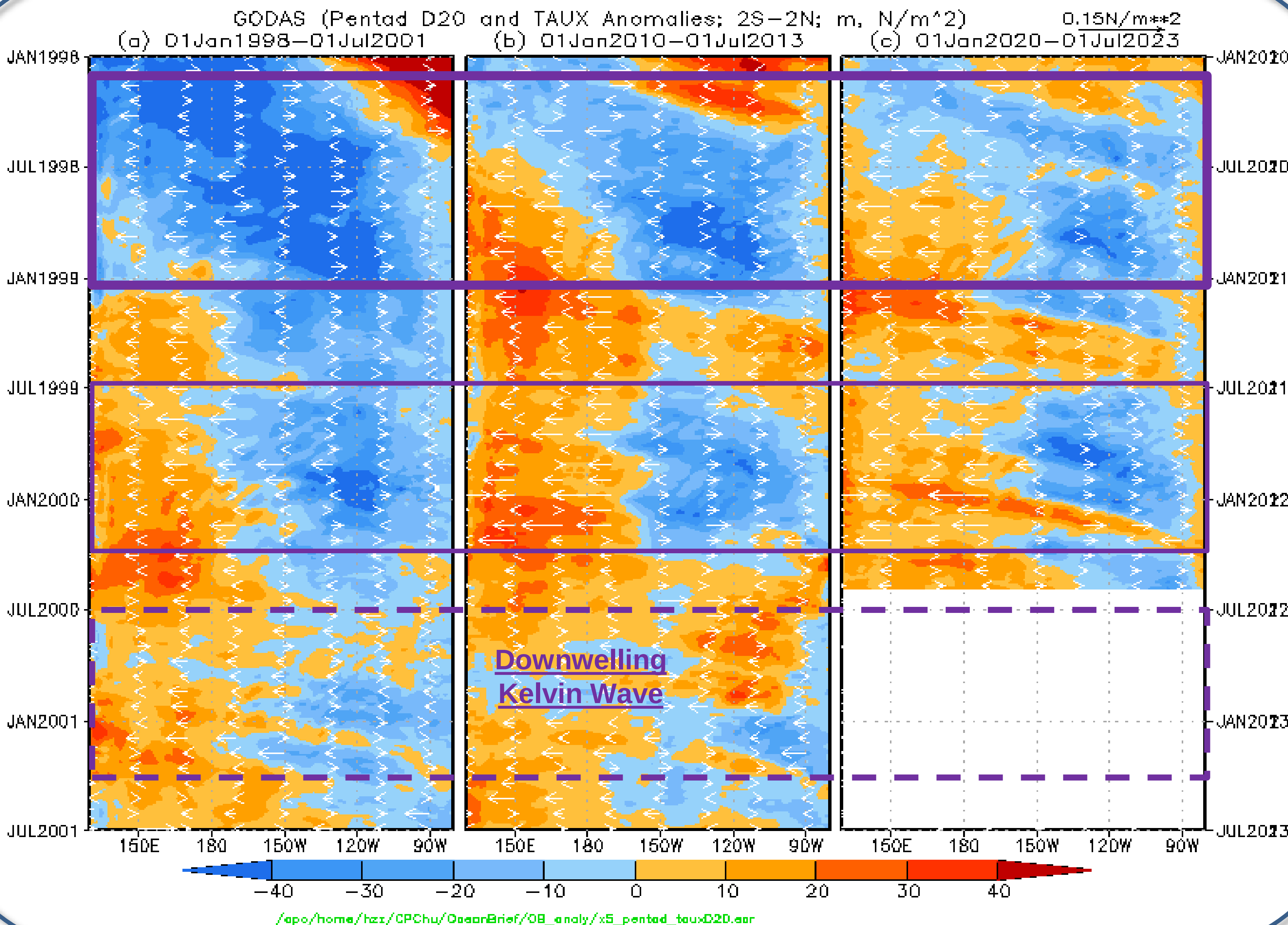
Nino3.4 Index Evolution in two-year La Ninas since 1950 (MICHELLE L'HEUREUX)



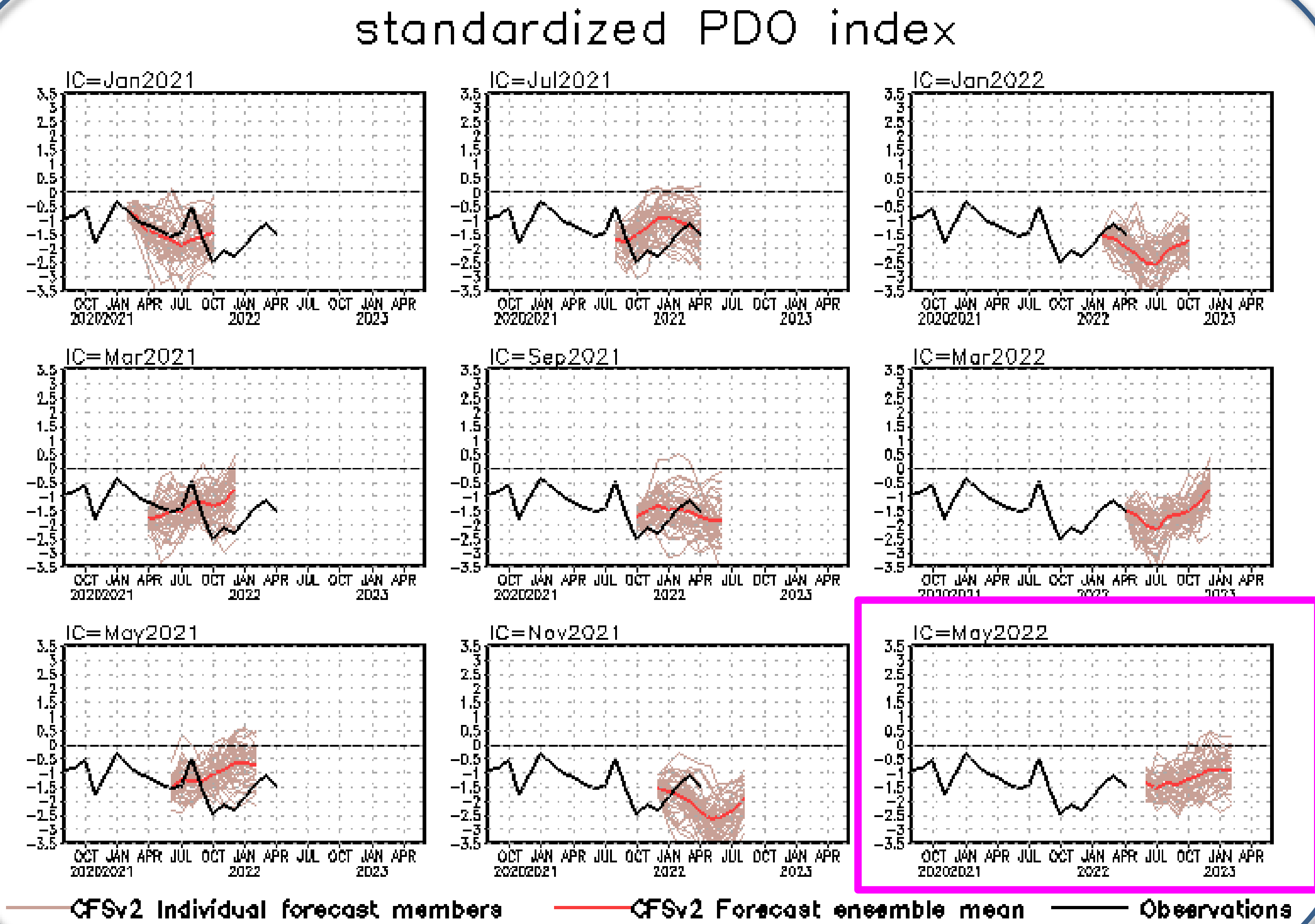
Three-year history of sea surface temperatures in the Niño-3.4 region of the tropical Pacific for 8 previous double-dip La Niña events. The color of the line indicates the state of ENSO for the third winter (red: El Niño, darker blue: La Niña, lighter blue: neutral). The black line shows the current event. Monthly Niño-3.4 index is from CPC using ERSSTv5.

Based on MAM ONI/May Nino-3.4, 2022 is 2nd coolest in ERSSTv5 since 1950 (MICHELLE L'HEUREUX)

D20 & Taux in 3-year (1998-2001) & 2-year (2010-13) & 2020-22 La Nina(Suggested by Eric Blake; NHC/NCEP)



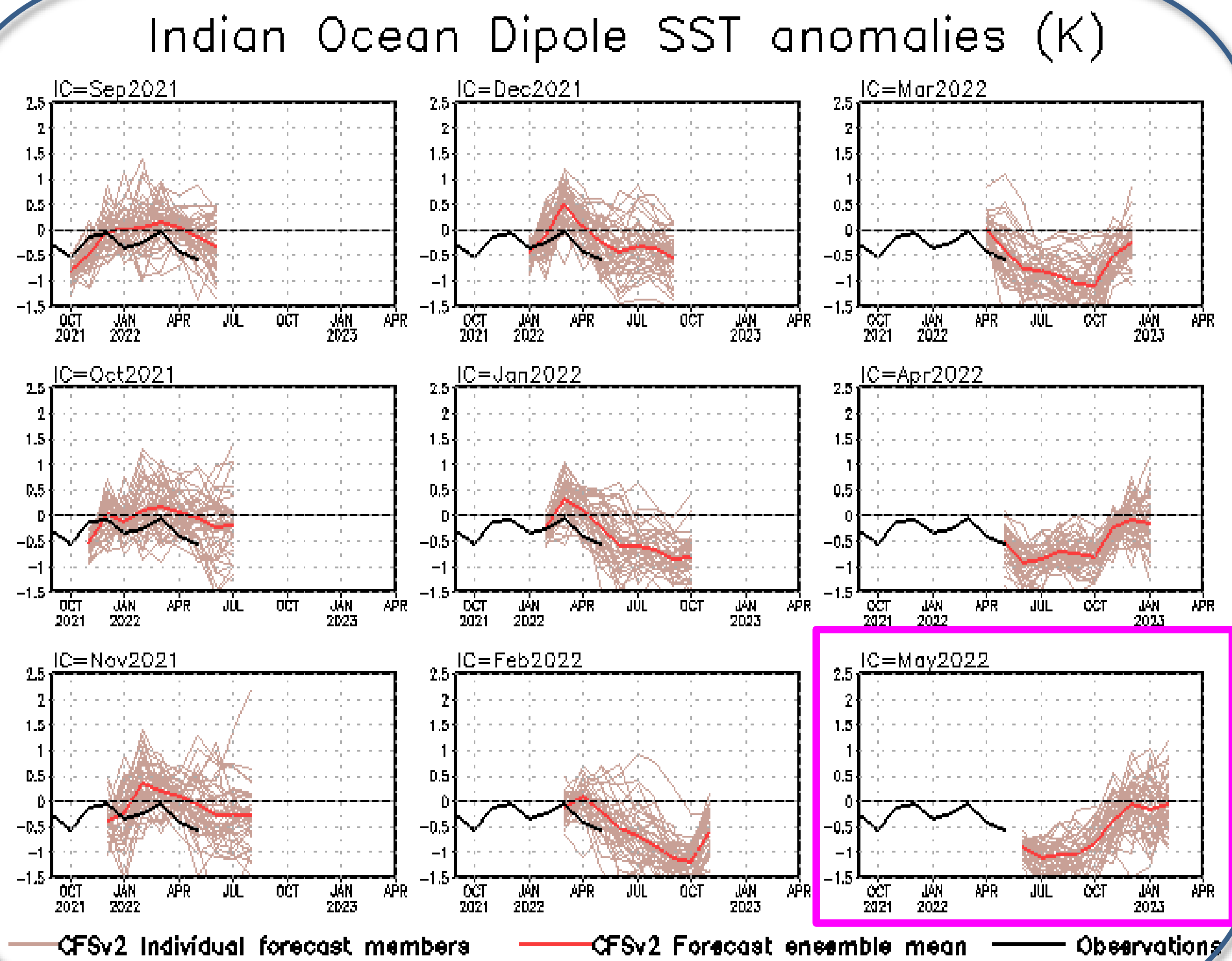
CFS Pacific Decadal Oscillation (PDO) Index Predictions from Different Initial Months

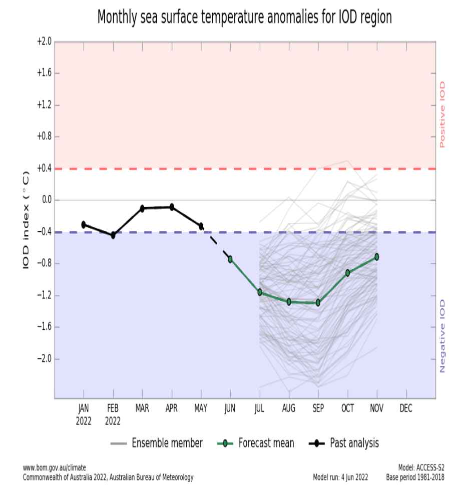


- CFSv2 predicts a negative phase of PDO in 2022.

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

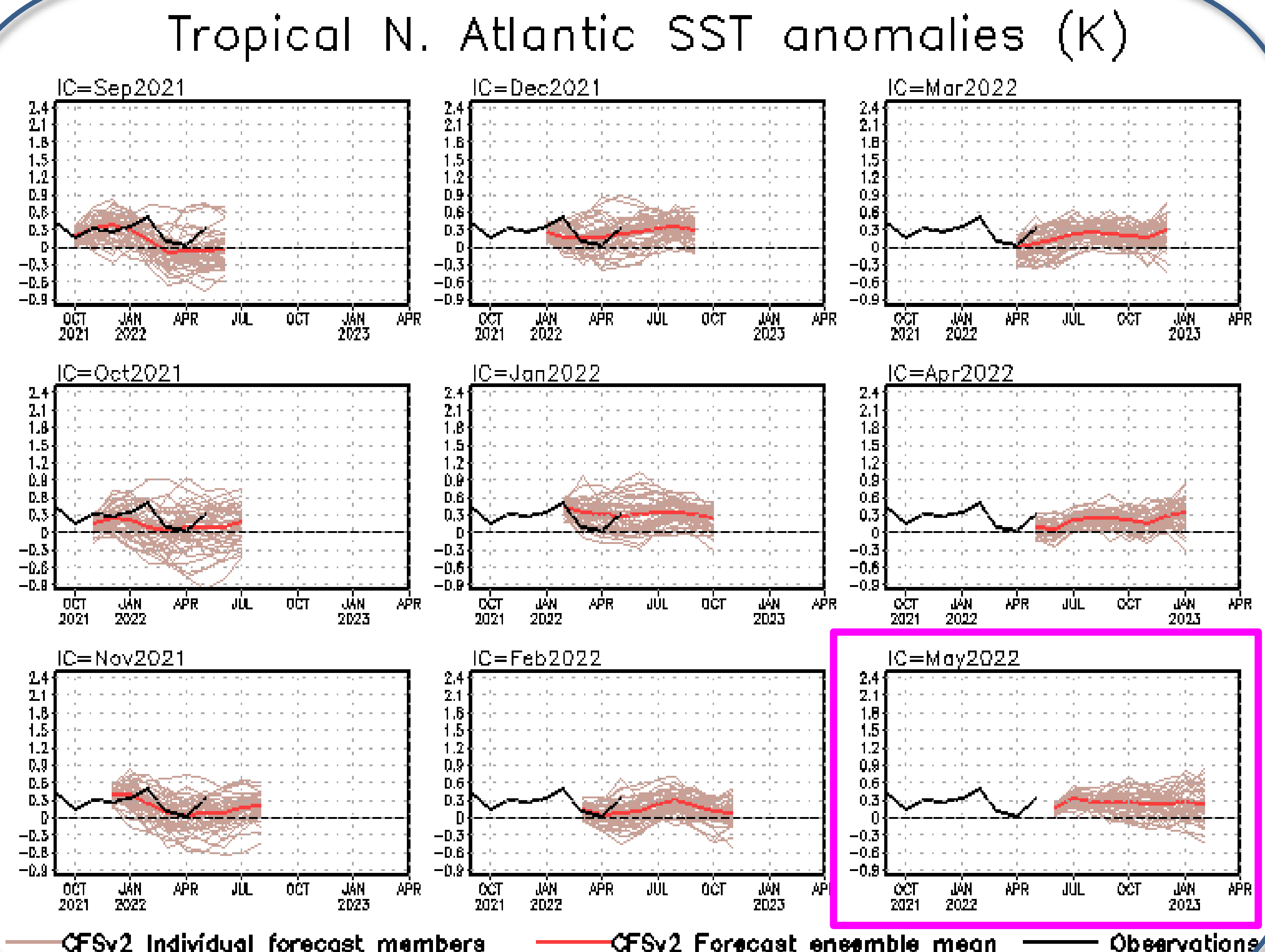




- CFSv2 predicts a negative phase of IOD in summer-autumn 2022.

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.

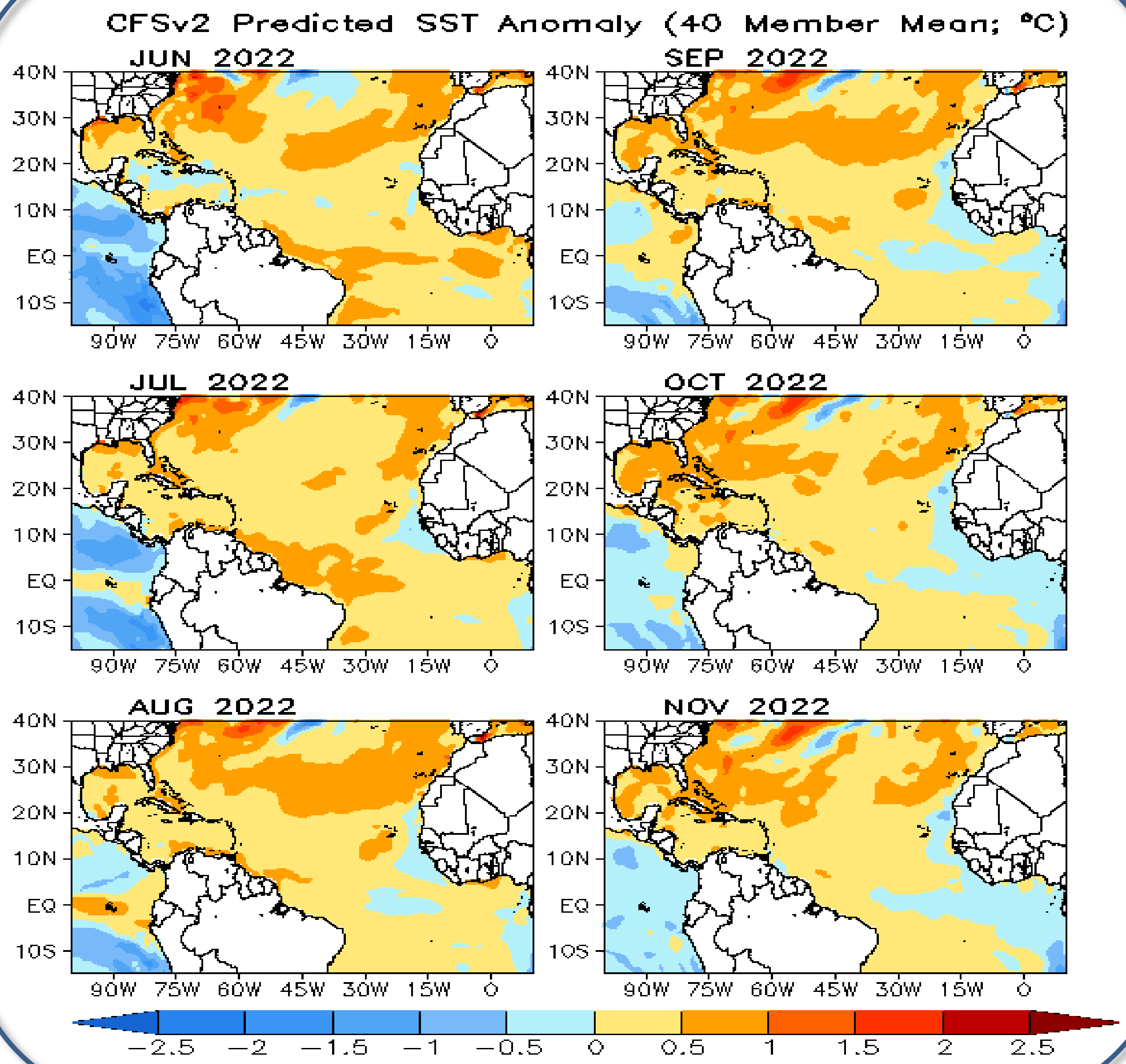
CFS Tropical North Atlantic (TNA) SST Predictions from Different Initial Months



- Latest CFSv2 predictions call for above normal SST in the tropical North Atlantic in 2022.

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].

CFSv2 Atlantic SSTA Predictions



- Latest CFSv2 predictions call for slightly above or near average SST in the tropical North Atlantic in the next 8 months.

Acknowledgement

- ❖ Drs. Jieshun Zhu, Caihong Wen, and Arun Kumar: 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

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Jieshun.Zhu@noaa.gov
Caihong.Wen@noaa.gov
Zeng-Zhen.Hu@noaa.gov

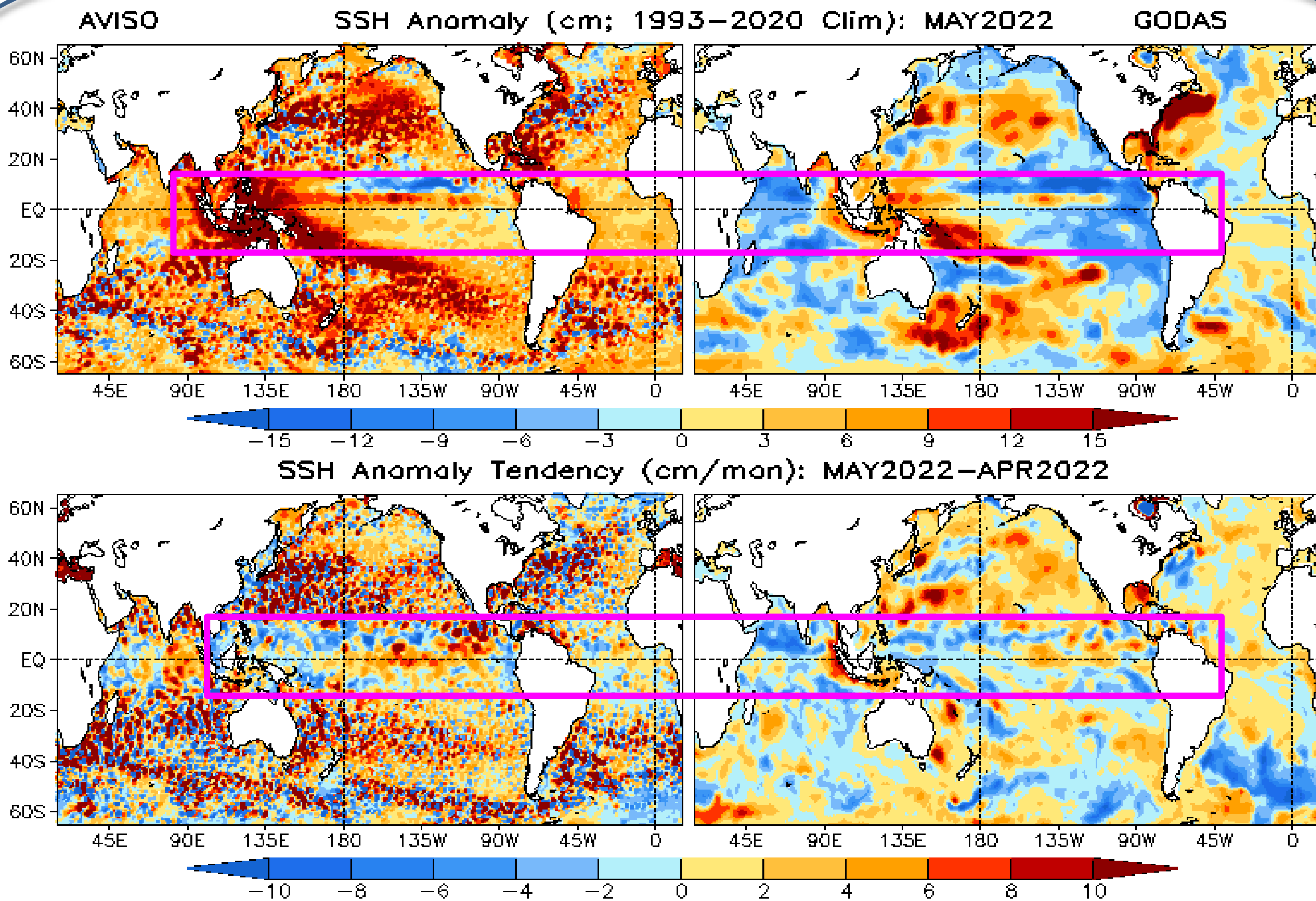
Data Sources (climatology is for 1991-2020)

- Weekly Optimal Interpolation SST (OIv.2.1 SST) version 2 (Huanget al. 2020)
- 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



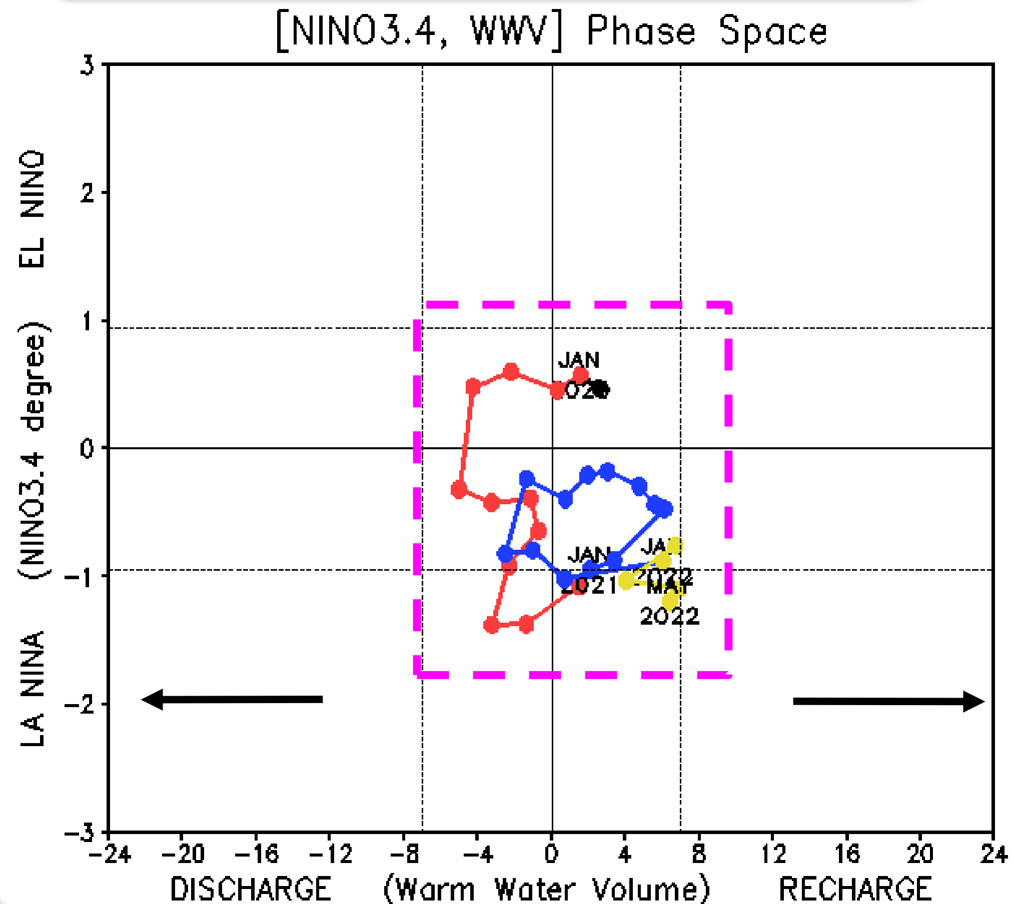
- Basic features in the tropical Pacific associated with La Nina evolution are consistent between AVISO and GODAS.
- Positive (negative) anomalous tendencies were present in the eastern (western) equatorial Pacific.
- There are some differences in details between AVISO & GODAS with small scale features dominating AVISO.

Warm Water Volume (WWV) and Niño3.4 Anomalies

- As WWV is 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.
- Different color curves represent different years.

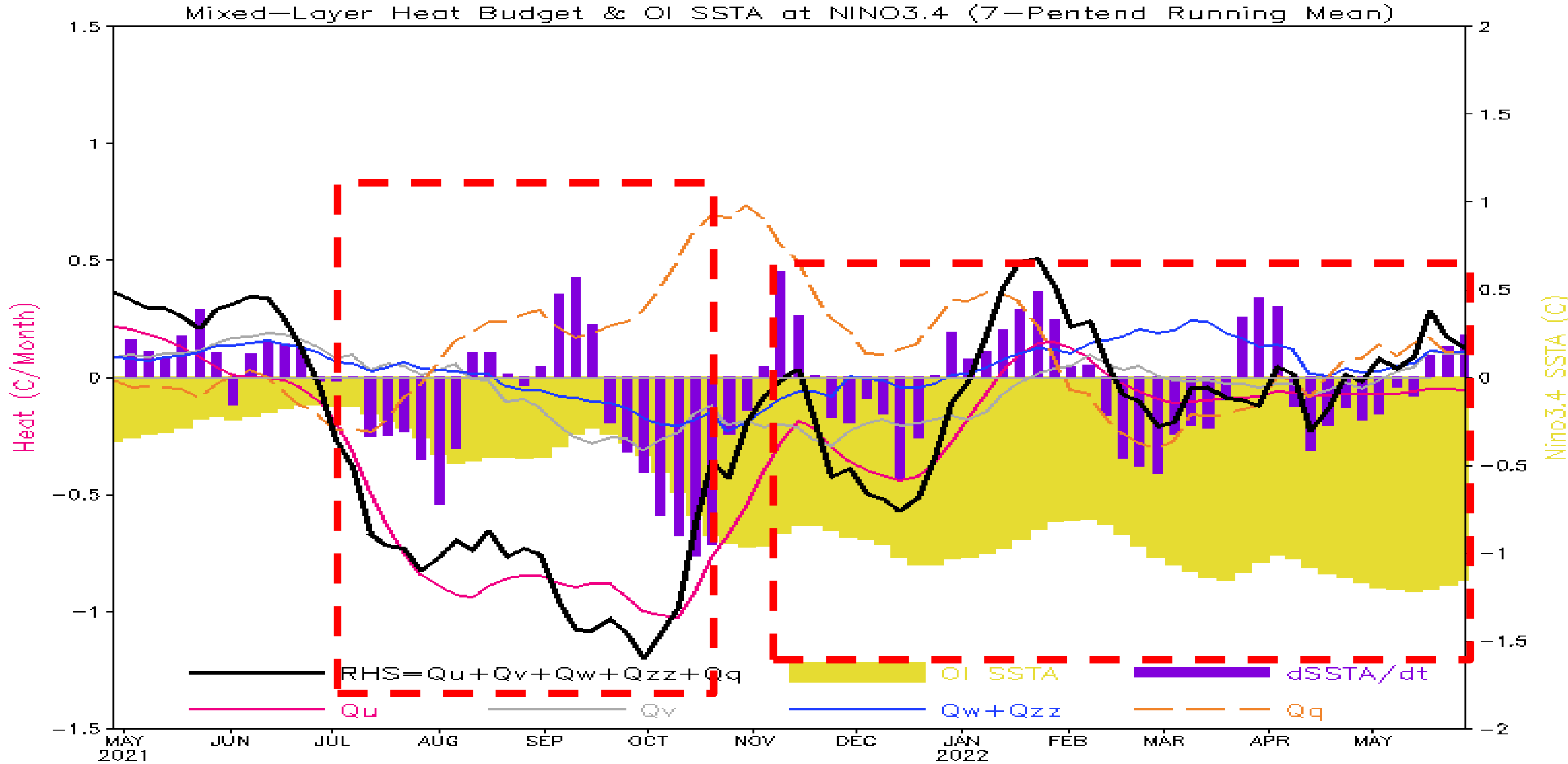
- In the WWV index definition, it is the average of ocean temperature anomaly along the whole equatorial Pacific, which sometimes have no coherent variations.

- Equatorial Warm Water Volume (WWV) was the recharge phase in May 2022.



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.

Ocean Mixed-Layer Heat Budget



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.

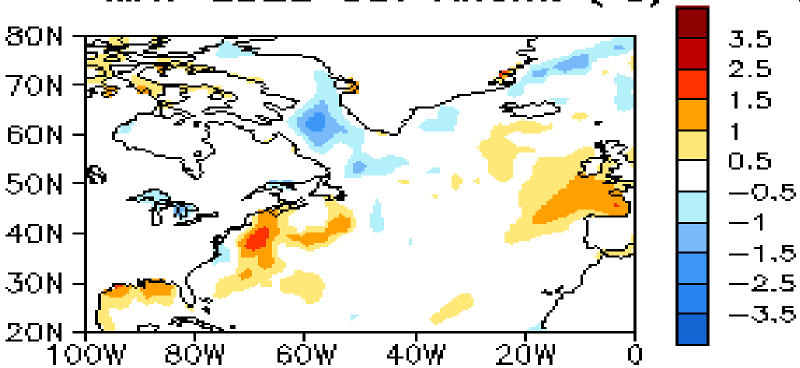
Qu: Zonal advection; Qv: Meridional advection;

Qw: Vertical entrainment; Qzz: Vertical diffusion

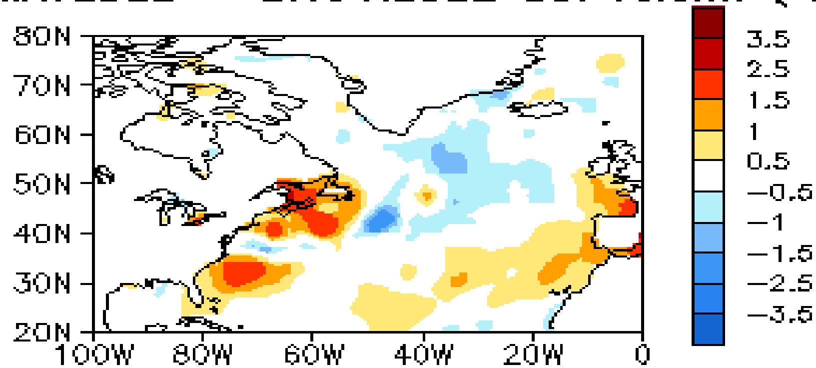
Qq: (Qnet - Qpen + Qcorr)/ρcph; Qnet = SW + LW + LH +SH;

Qpen: SW penetration; Qcorr: Flux correction due to relaxation to OIv2.1 SST

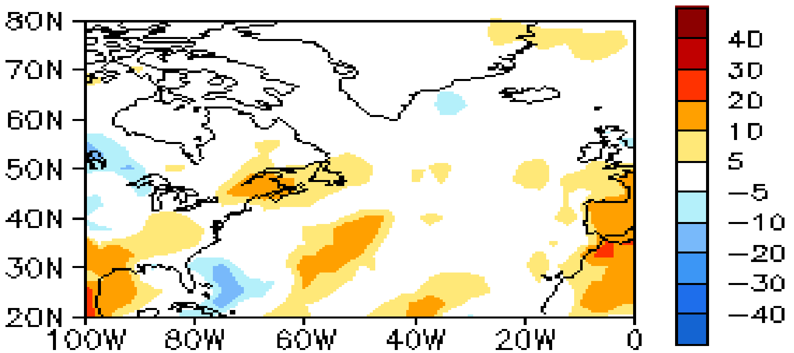
MAY 2022 SST Anom. (°C)



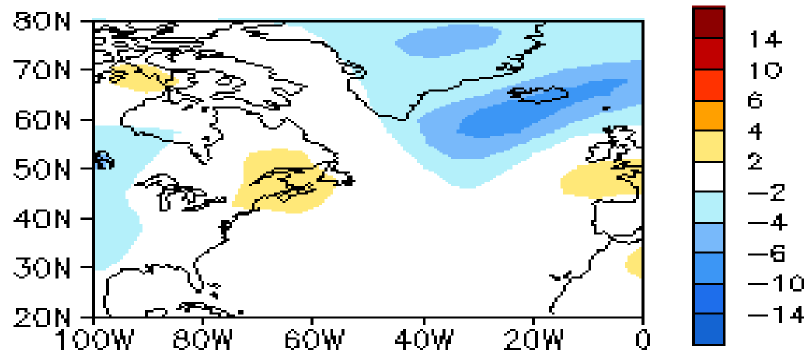
25MAY2022 – 27APR2022 SST Anom. (°C)



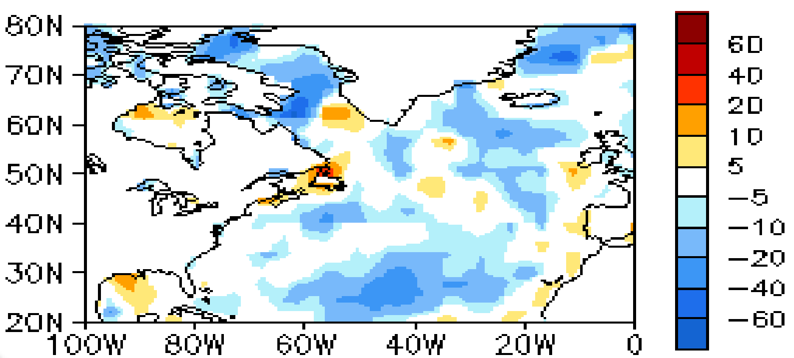
MAY 2022 OLR Anom. (W/m²)



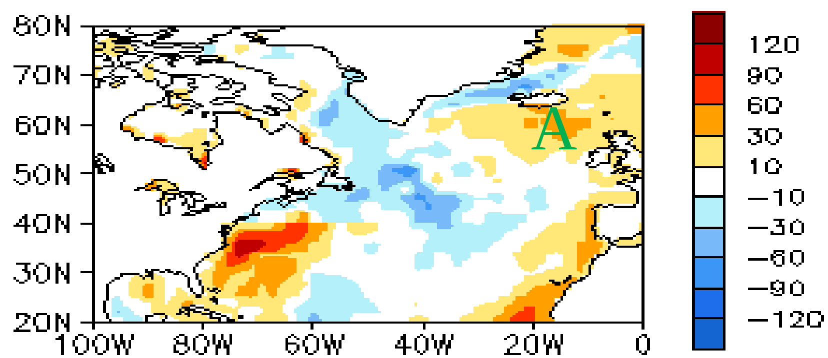
MAY 2022 SLP Anom. (hPa)



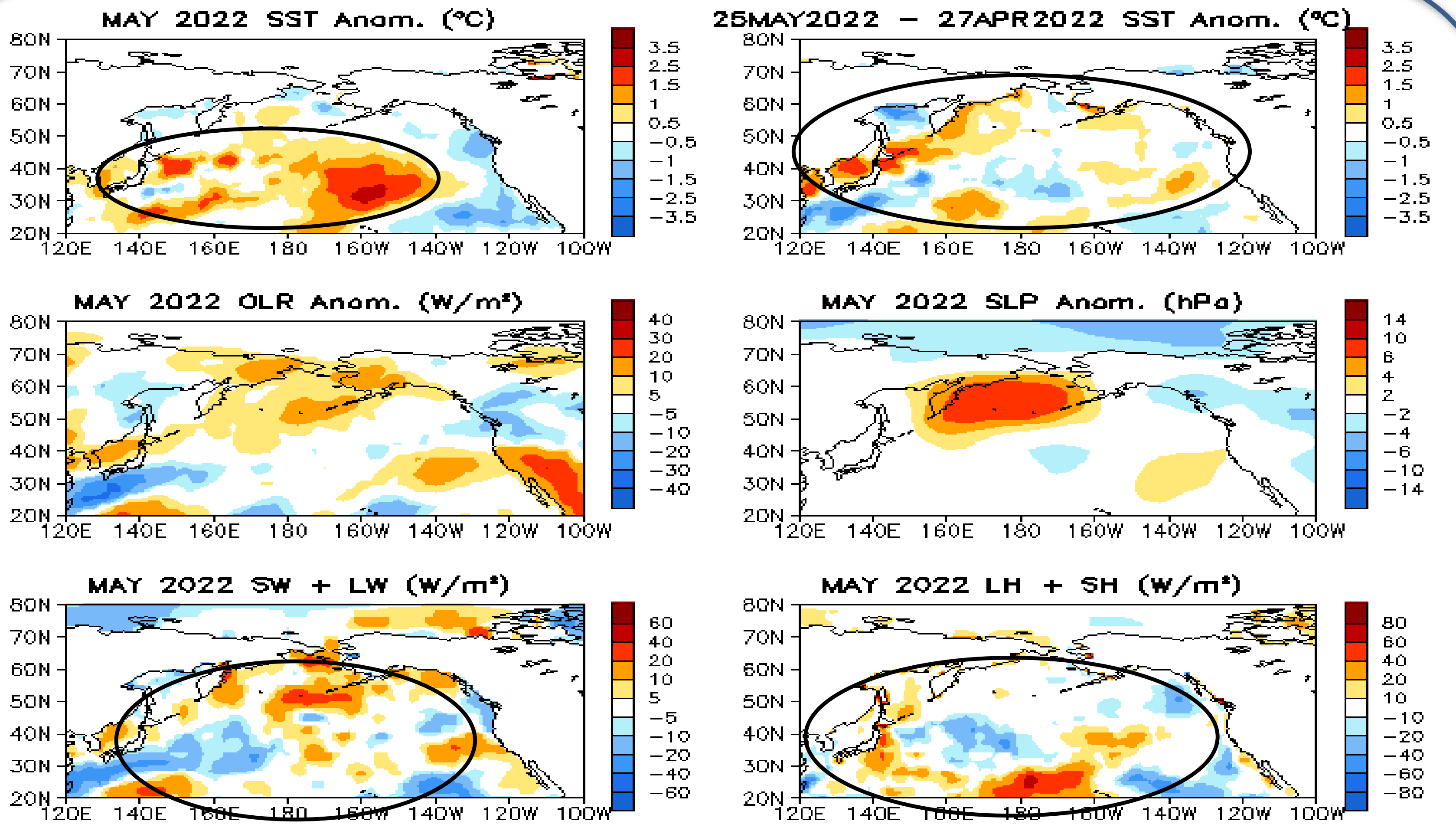
MAY 2022 SW + LW (W/m²)



MAY 2022 LH + SH (W/m²)



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.

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

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

Positive SSS anomaly remains over the western equatorial Pacific Ocean and over the NE side of the SPCZ regions, maintained largely by the weaker than normal precipitation in these areas and the SW shift of the SPCZ. Negative SSS anomalies are observed over the SW side of the SPCZ, majority of the northern Pacific and southern tropical Indian ocean between the EQ and 30ºS. SSS over the Bay of Bengal shows freshened anomaly, consistent with the negative E-P over the region.

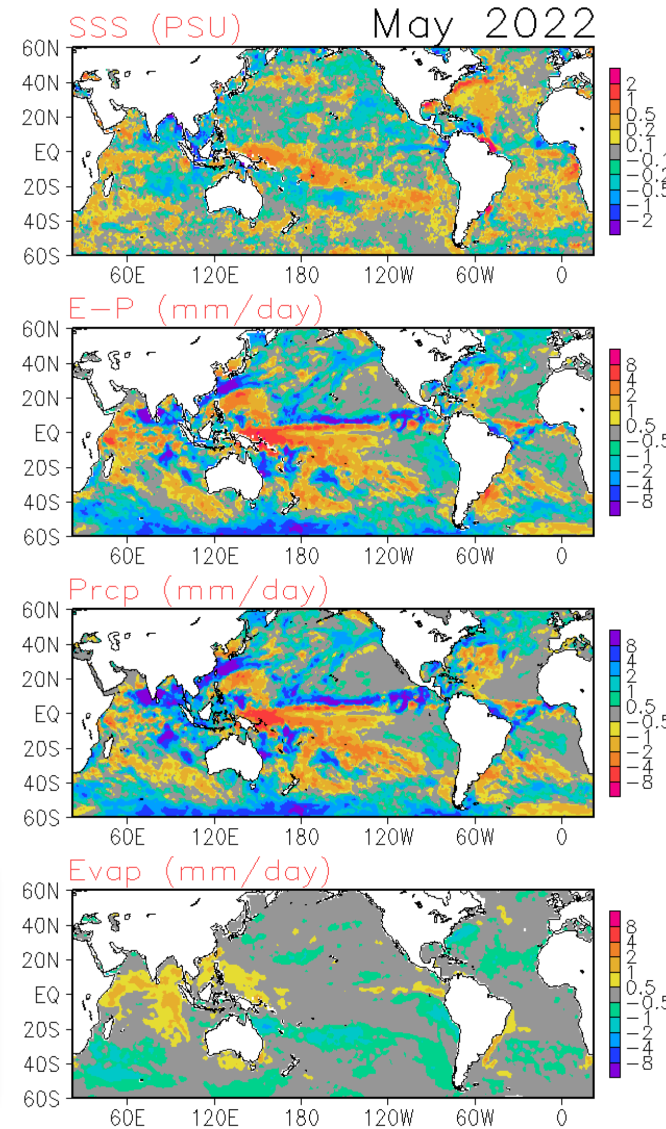
SSS : Blended Analysis of Surface Salinity (BASS) V0.Z

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

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

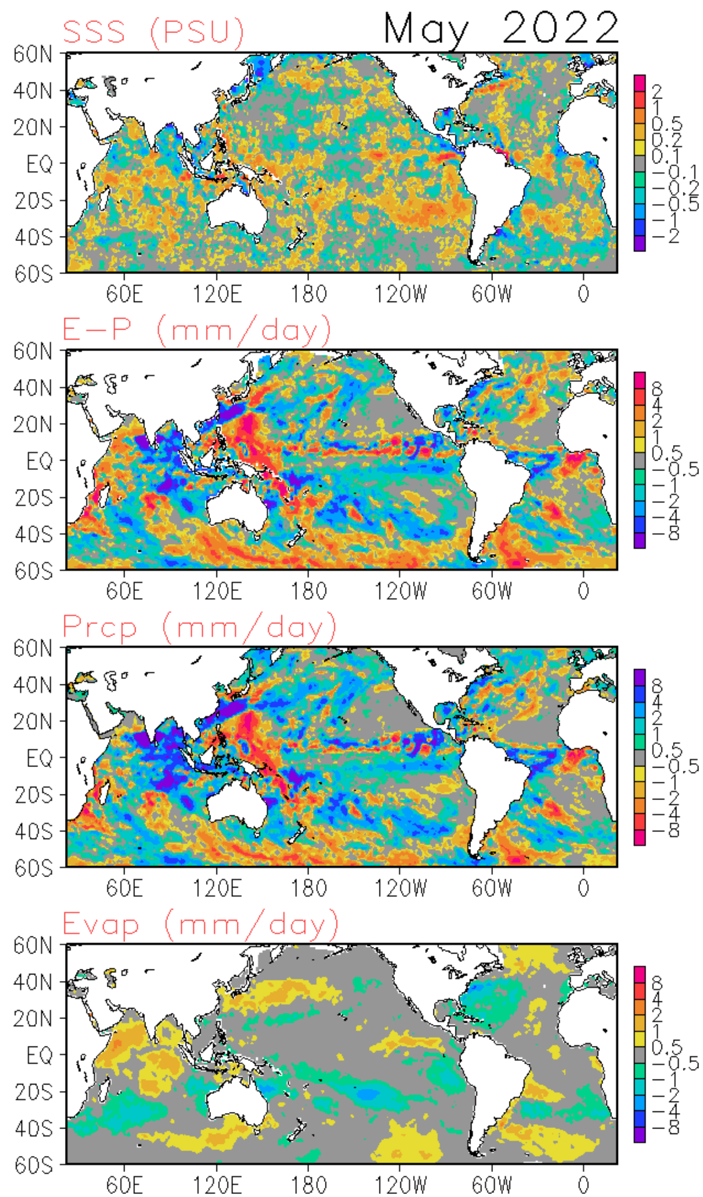
Precipitation: CMORPH adjusted satellite precipitation estimates

Evaporation: Adjusted CFS Reanalysis



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

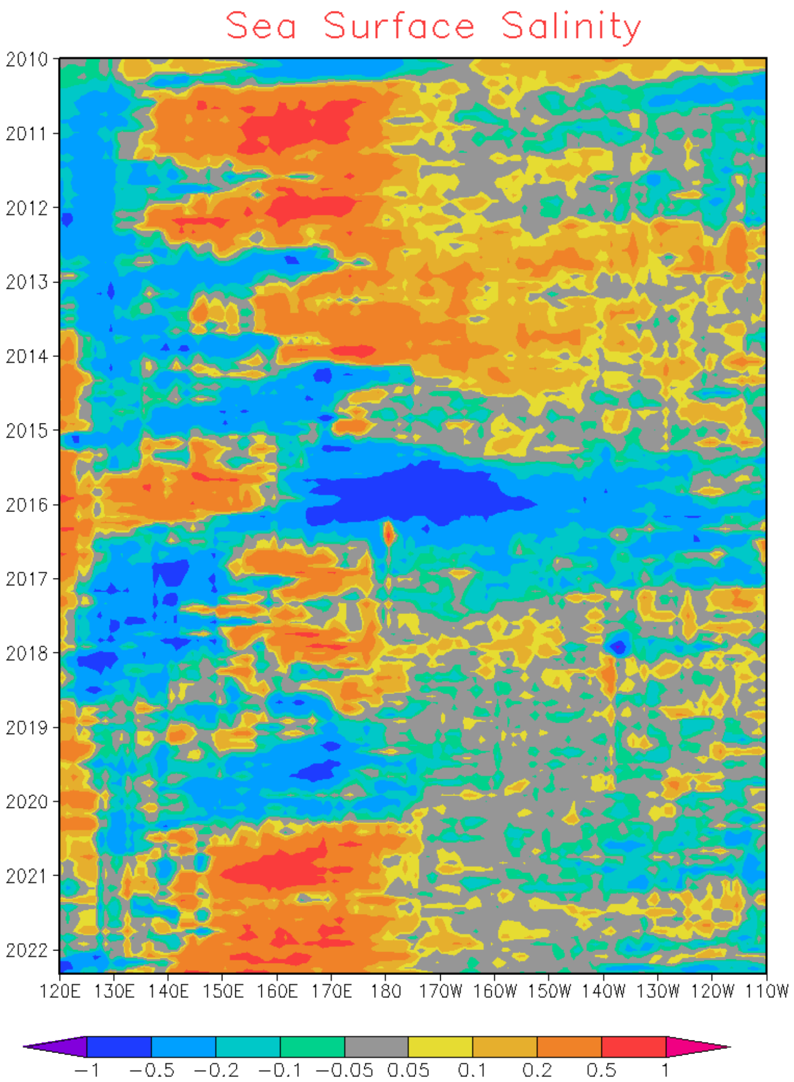
Over the equatorial eastern and central Pacific, the southern branch of the double ITCZ is intensifying, while the northern branch is shifted northward. These create weakened and intensified SSS tendencies over the regions. Over the western tropical Pacific, precipitation is suppressed greatly compared to the previous month, resulting in positive SSS tendency. SSS over the Bay of Bengal is freshened, consistent with the E-P tendency. SSS over the equatorial Atlantic Ocean, however becomes soldier, despite the increased fresh water influx caused by enhanced precipitation.



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);**
- Over the equatorial Pacific, negative SSS signal continues west of 140° E; while positive SSS signal remains between 140° E and 170° W although showing some weakening tendency; neutral or likely negative anomalies present east of 150°W when averaged over the latitude band.



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.