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

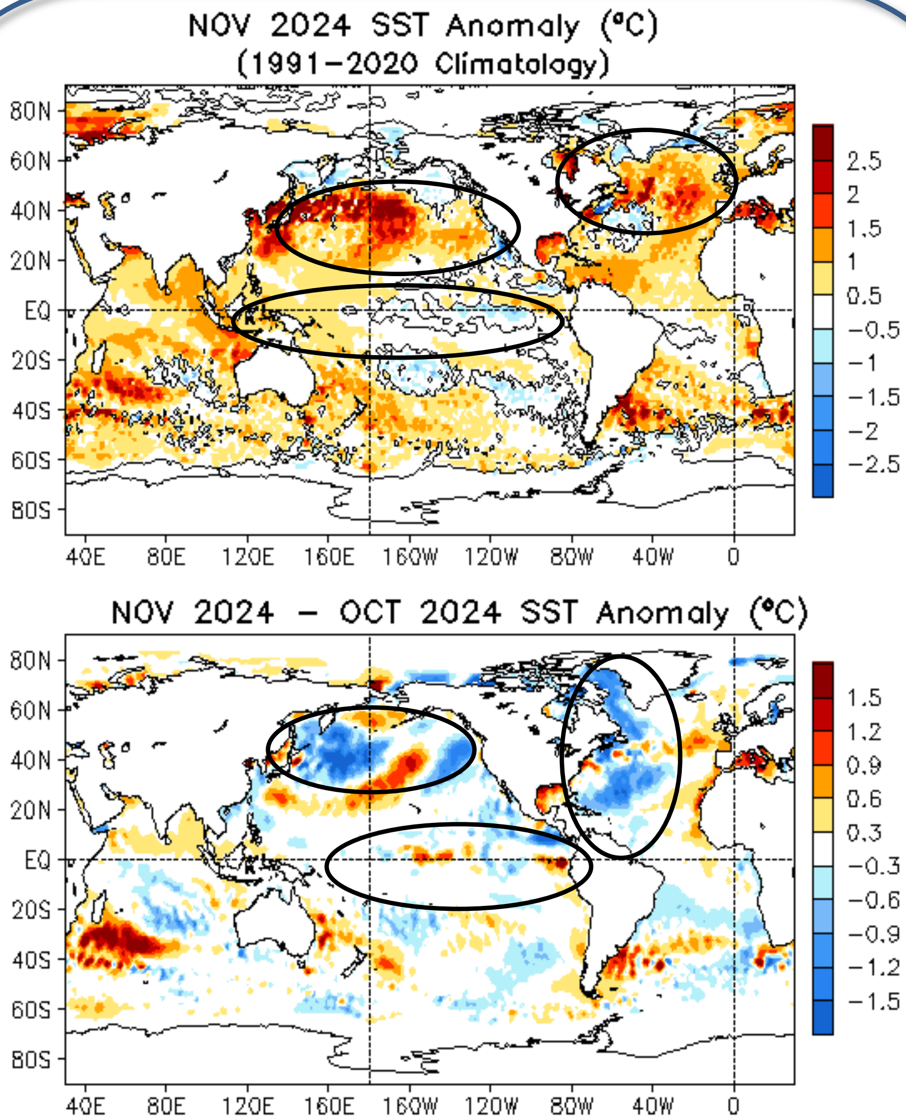
- Overview
- Recent highlights
  - Pacific Ocean
  - Arctic & Antarctic Oceans
  - Indian Ocean
  - Atlantic Ocean
- Global SSTA Predictions

Overview

- Pacific Ocean
  - ENSO neutral conditions continued with Niño3.4 = -0.1^{o}C in Nov 2024.
  - Strong negative phase of the PDO persisted in Nov 2024.
  - Strong subsurface warming has persisted in the central North Pacific Ocean since 2020.
- Arctic & Antarctic Oceans
  - The average Arctic sea ice extent for Nov 2024 was 9.1 million km^2, ranking as the third lowest Nov since 1979.
  - Antarctic sea ice extent for Nov 2024 was 14.2 million square kilometers.
  - CPC forecasts a below-normal Arctic sea ice extent maximum in Mar 2025.
- Indian Ocean
  - Positive SSTAs dominated the tropical Indian Ocean basin in Nov 2024.
  - The Indian Ocean dipole (IOD) index strengthened in Nov 2024.
- Atlantic Ocean
  - 2024 Atlantic hurricane season was the second-costliest Atlantic hurricane season on record.
  - Marine heat waves persisted in the north tropical Atlantic and the central extratropical Atlantic Ocean.

Global Oceans

Global SST Anomaly (°C) and Anomaly Tendency

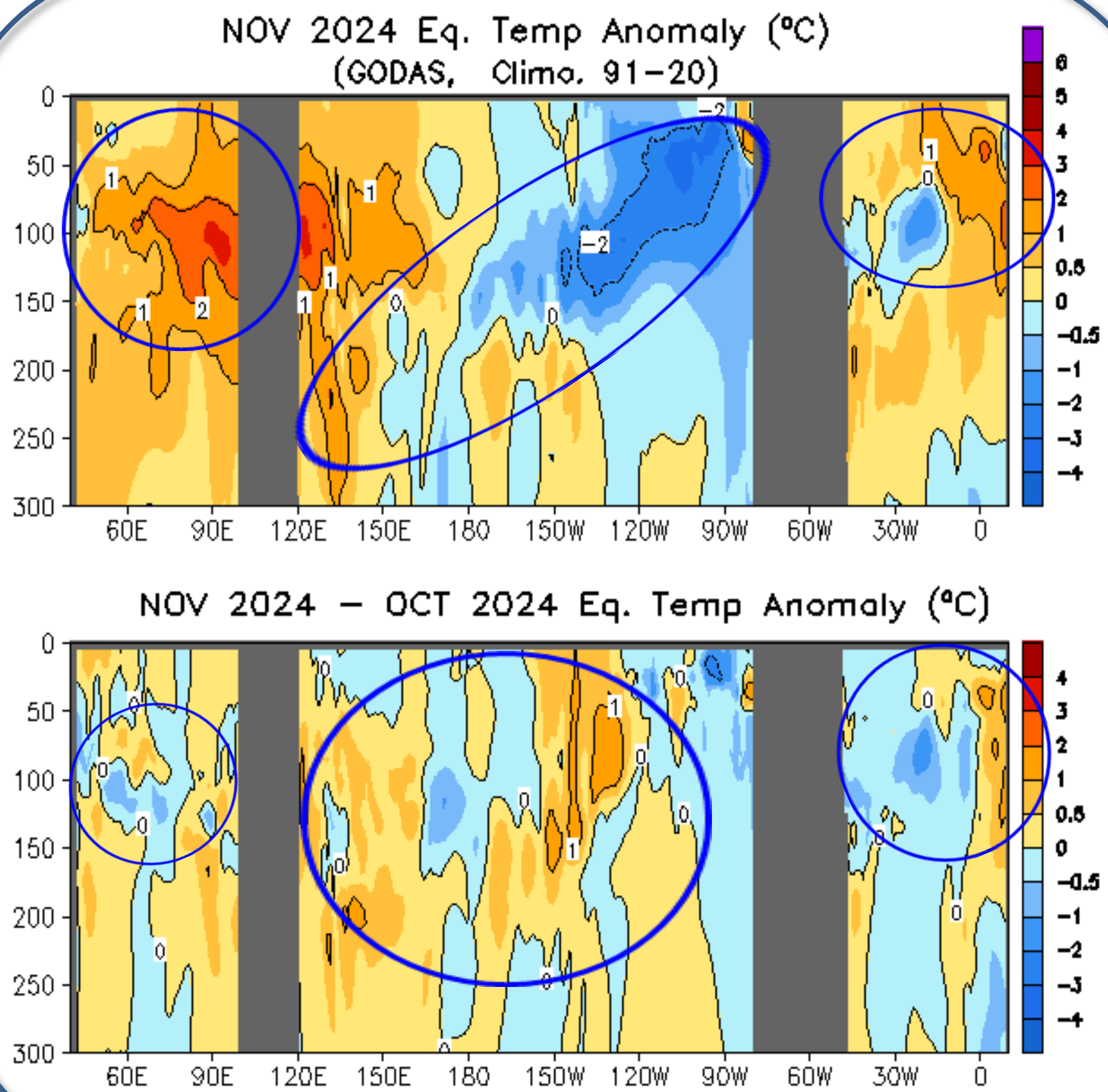


- SSTs were above-average in the tropical western Pacific Ocean, while near-to-below-average in the central-eastern Pacific.
- Strong positive SSTAs continued in the mid-latitude of the North Pacific and North Atlantic current region.
- Positive SSTAs dominated the Atlantic, Indian and Southern Oceans.

- Both strong positive and strong negative SSTA tendencies were observed in the North Pacific Ocean.
- Negative SSTA tendencies dominated in the central North Atlantic and the Labrador basin.
- Both positive and negative SSTA tendencies were present across the equatorial Pacific 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 2ºS-2ºN

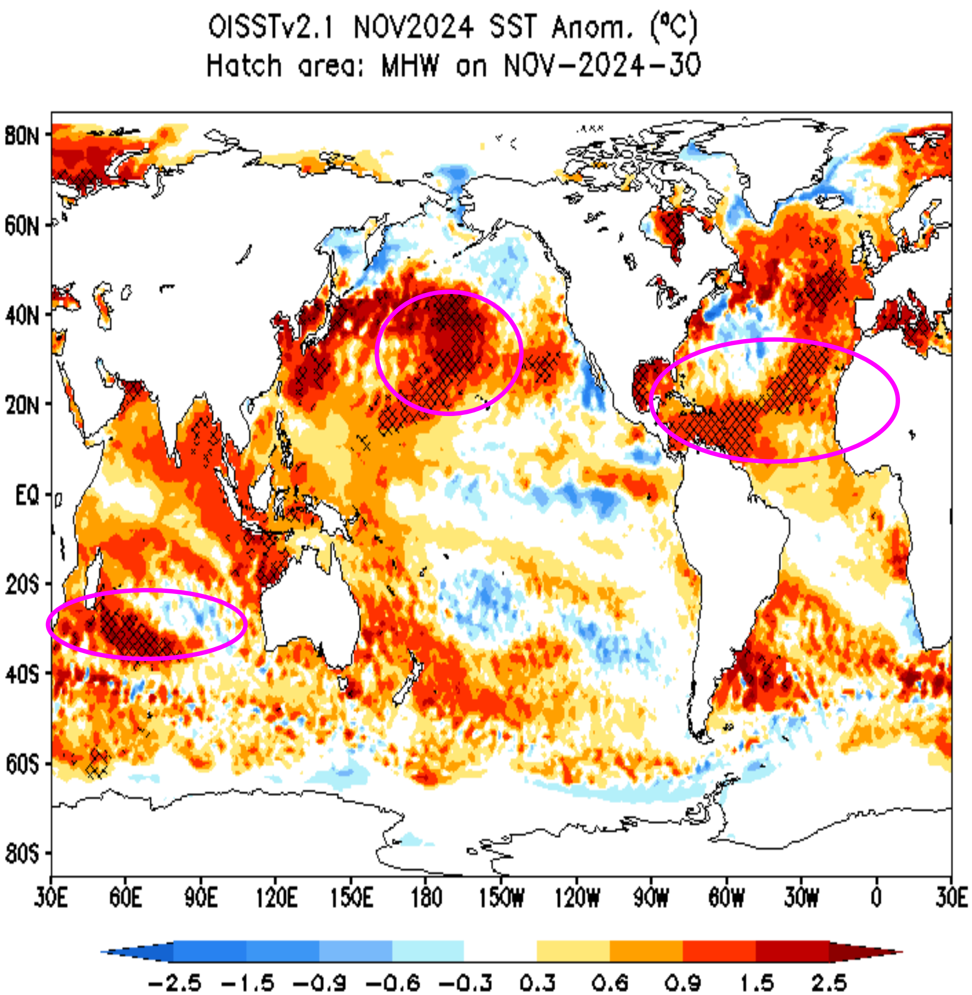


- Negative temperature anomalies persisted along the central-eastern thermocline in the Pacific, while positive temperature anomalies continued in the western Pacific.
- Positive temperature anomalies were observed in the Indian Oceans and the eastern Atlantic Ocean.

- Positive temperature anomaly tendencies dominated in the Pacific Ocean.
- Both positive and negative temperature anomaly tendencies were present in the Indian and Atlantic Oceans.

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.

Global Monthly SST anomaly and Marine Heat Waves

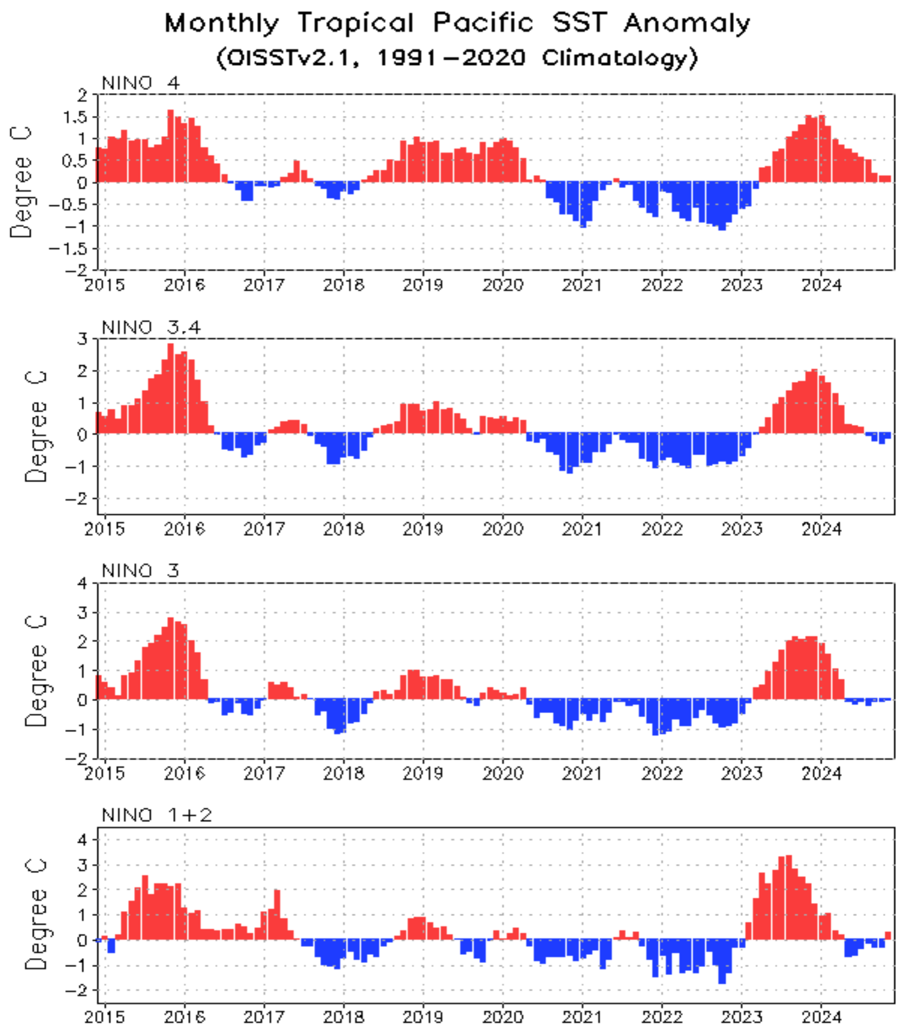


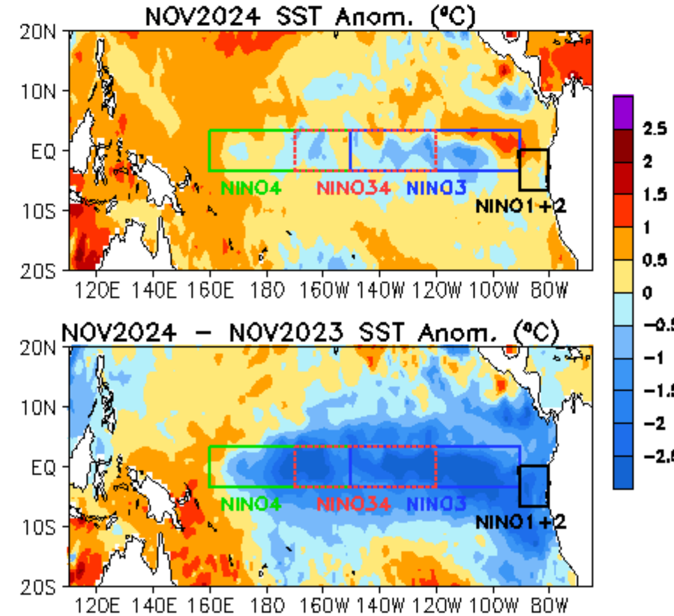
- MHWs continued in much of the north central -western Pacific and tropical North Atlantic.
- MHWs developed in south of Madagascar.

((Left panel) Monthly SST anomaly (shaded) and locations experiencing marine heat waves (hatched) by the end date labelled in the plot. Green line and blue line are the 90th percentile and daily climatology, respectively. Shaded area denotes the periods experiencing MHW. MHW is defined as a prolonged warming exceeding 90th percentile of daily SST for at least 14 consecutive days. Data is derived from NCEI OISSTv2.1 and the reference period is 1991-2020

Tropical Pacific Ocean and ENSO Conditions

Evolution of Pacific Niño SST Indices





- Negative Niño3.4 weakened slightly in Nov 2024, with Niño3.4 = -0.14°C.

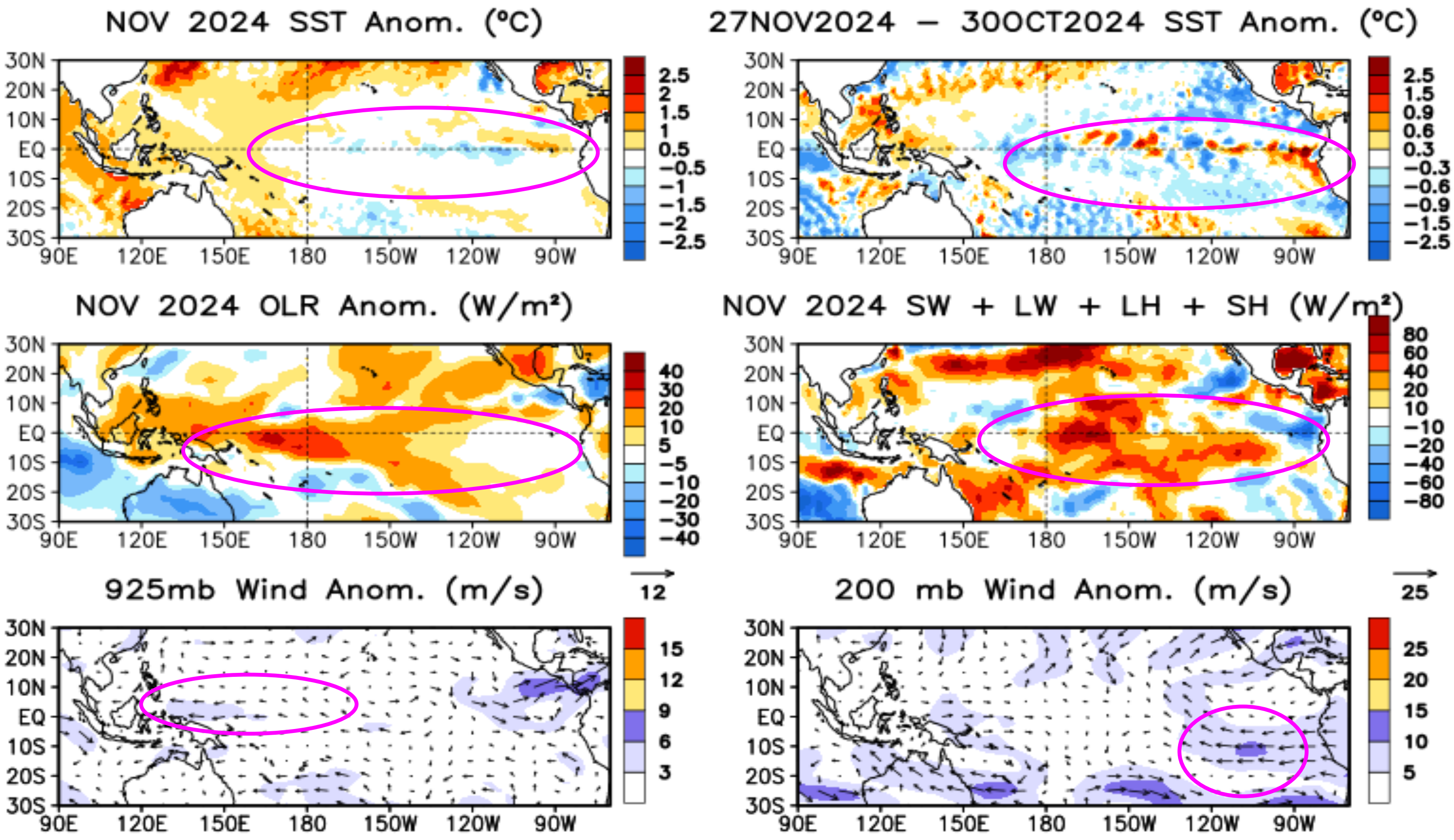
- All NINO indices were near normal in Nov 2024.

- Compared with Nov 2023, the tropical eastern Pacific was cooler in Nov 2024

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

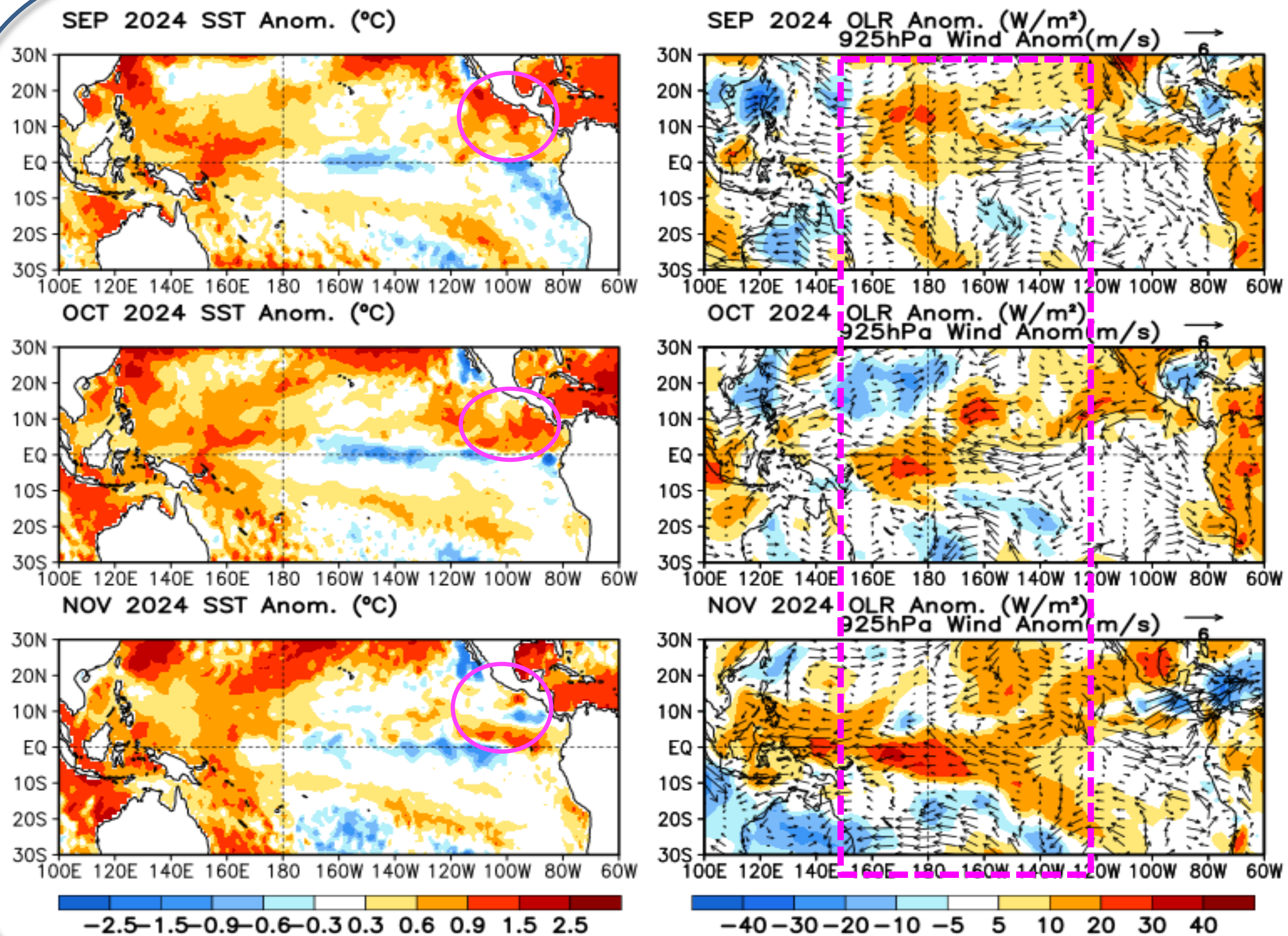
Niño region indices, calculated as the area-averaged monthly mean SSTAs (°C) for the specified region. Data are derived from the OIv2.1 SST analysis, and anomalies are departures from the 1991-2020 base period means.

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

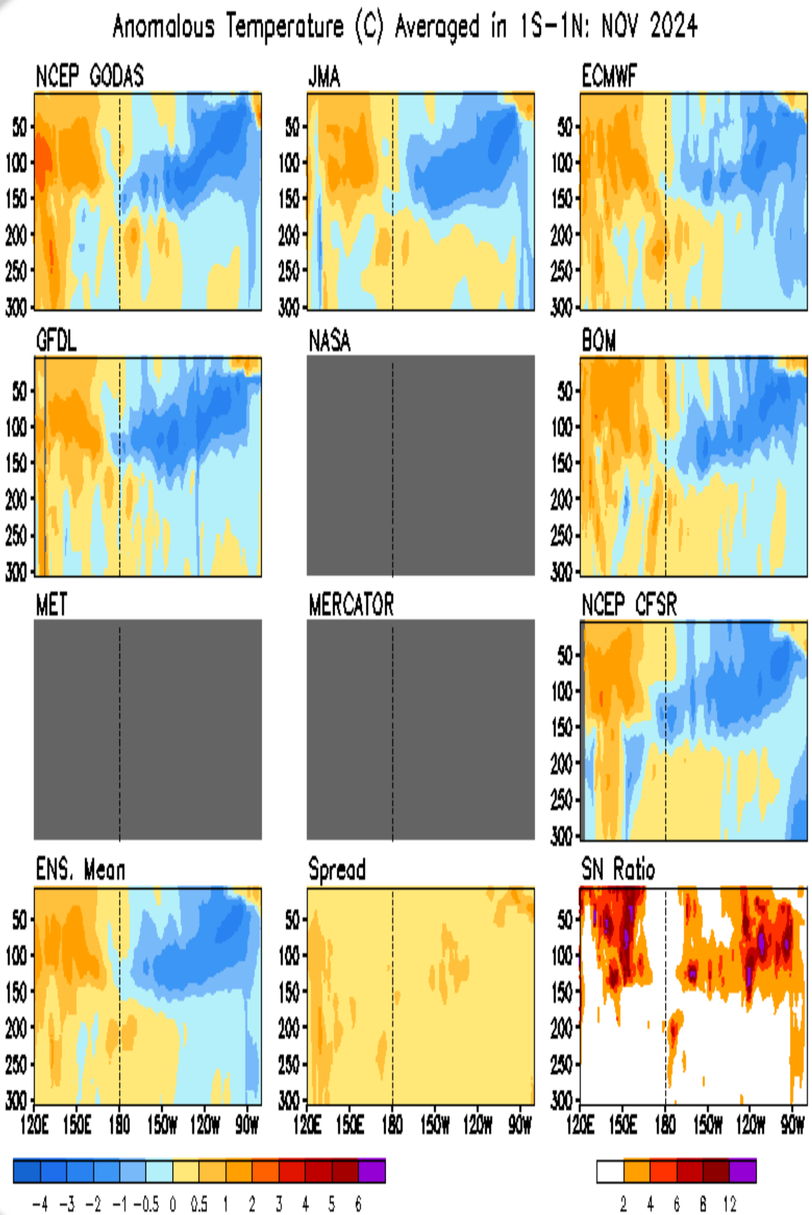


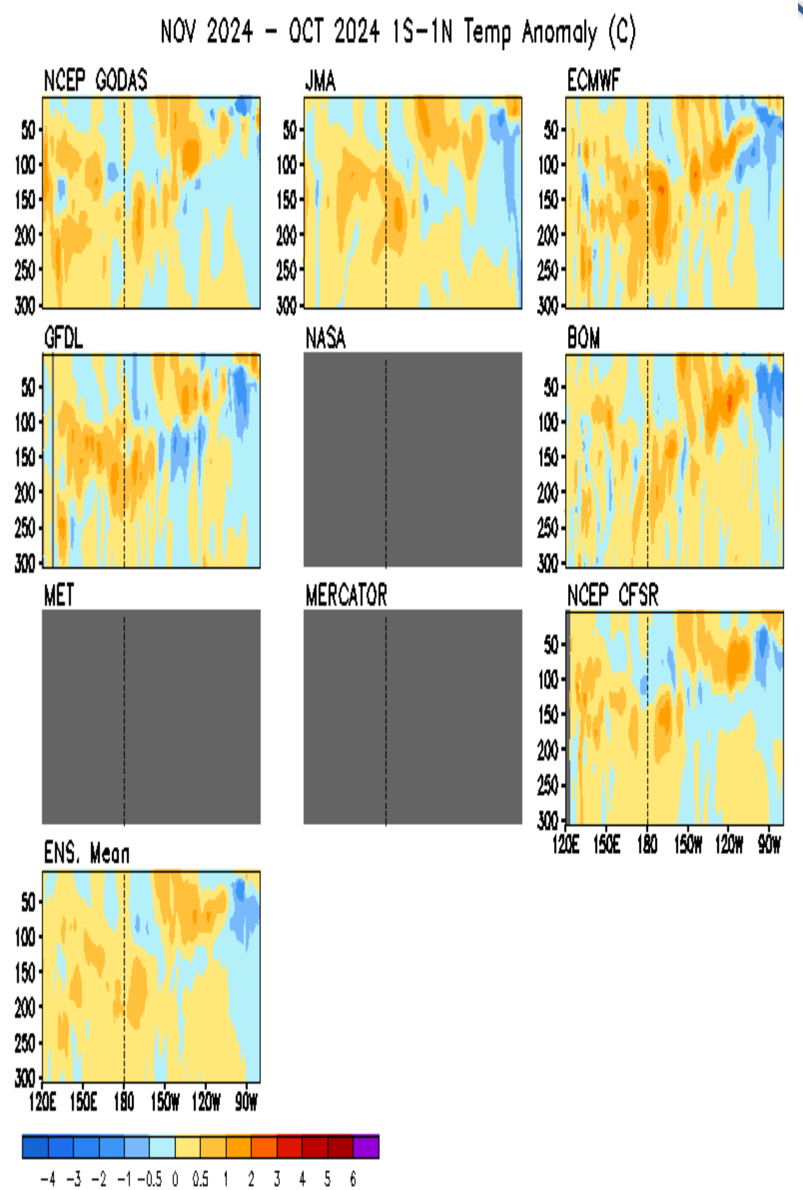
SSTAs (top-left), SSTA tendency (top-right), Outgoing Long-wave Radiation (OLR) anomalies (middle-left), sum of net surface short- and long-wave radiation, latent and sensible heat flux anomalies (middle-right; positive means heat into the ocean), 925-mb wind anomaly vector and its amplitude (bottom-left),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

Last 3- month Tropical Pacific SST, OLR, and uv925 anomalies

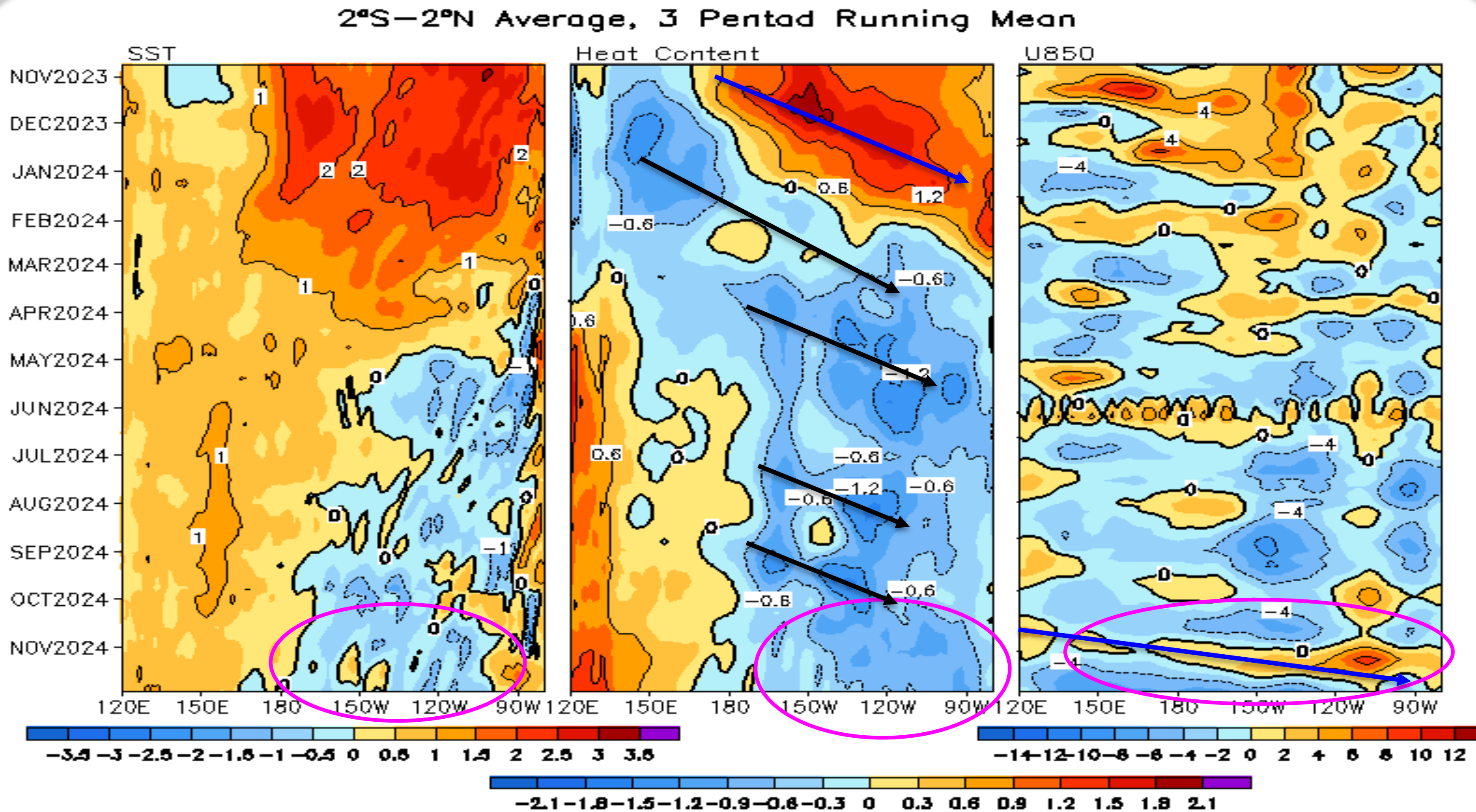


Multiple Ocean Reanalysis Intercomparison: Temperature Anomaly and Tendency at Equator



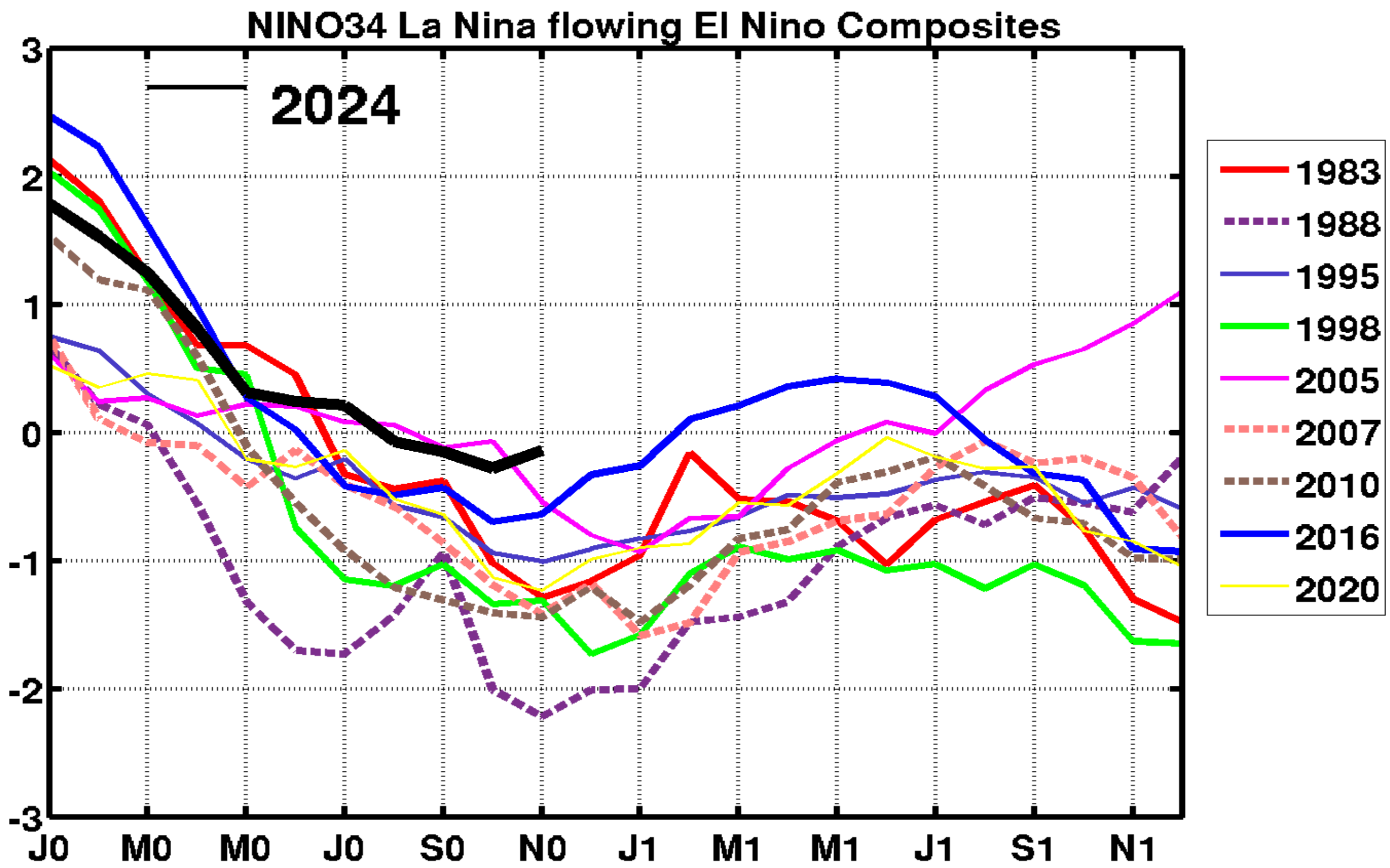


Equatorial Pacific SST (ºC), HC300 (ºC), u850 (m/s) Anomalies



- Negative SSTA weakened in the eastern Pacific during Nov 2024.
- Below-average H300 anomaly persisted in the eastern Pacific during Nov 2024.
- MJO-related westerly wind anomaly propagate from the western Pacific to eastern Pacific during Nov 2024, contributing to weakened negative H300 anomaly in the central Pacific.

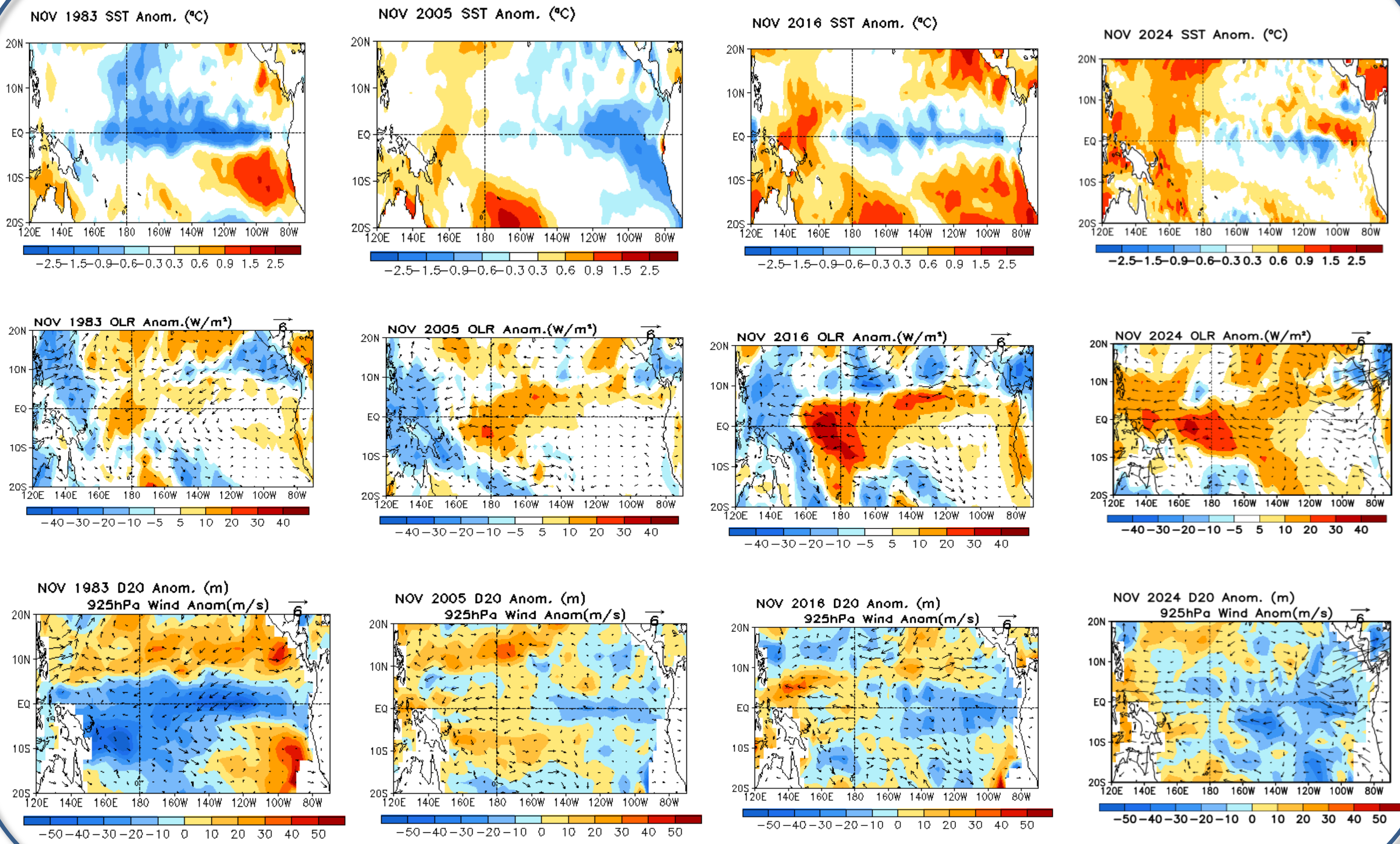
NINO34 in La Nina Years following El Nino conditions



Following strong El Nino events: 1983, 1998,2016
Following moderate El Nino events: 1988, 2007, 2010
Following weak El Nino events: 1995, 2005, 2020

Comparisons with 1983,2005, 2016 La Niña events

1983 | 2005 | 2016 | 2024



Tropical Instability Waves (TIWs) and ENSO

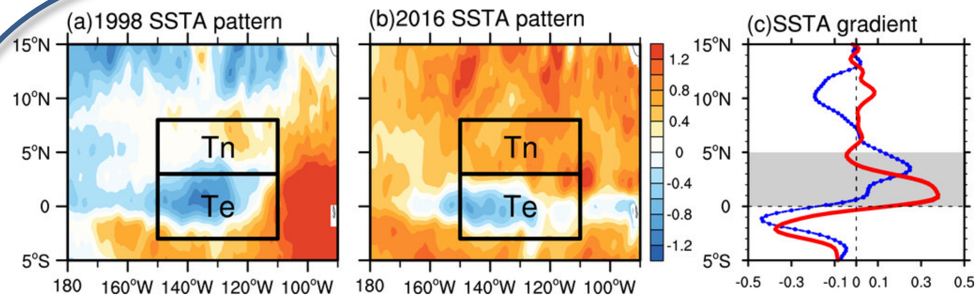


Figure SSTA during ENSO phase transition (May–June) in (a) 1998 and (b) 2016. (c) Meridional SSTA gradient (units: 105 °C m−1) profile averaged over zonal TIW active region (110°–150°W) for 1998 (blue dotted line) and 2016 (red dotted line).

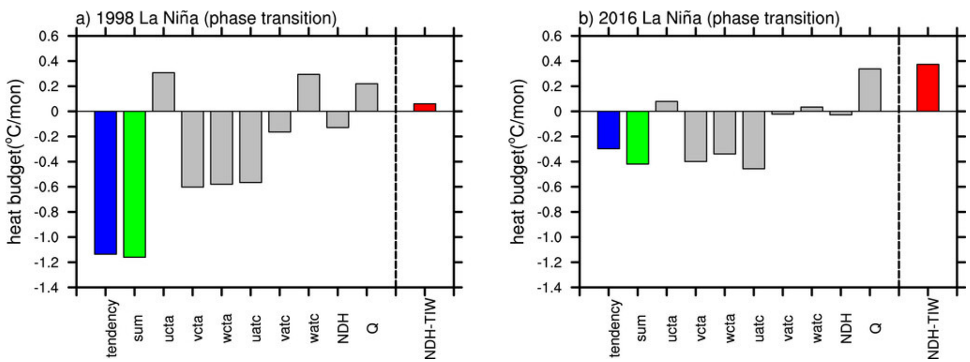
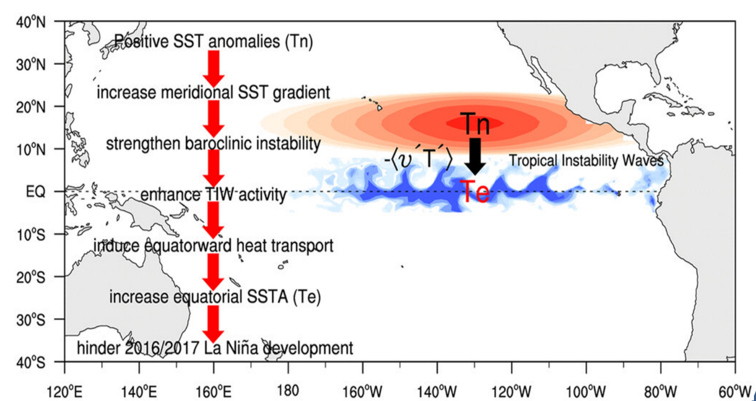


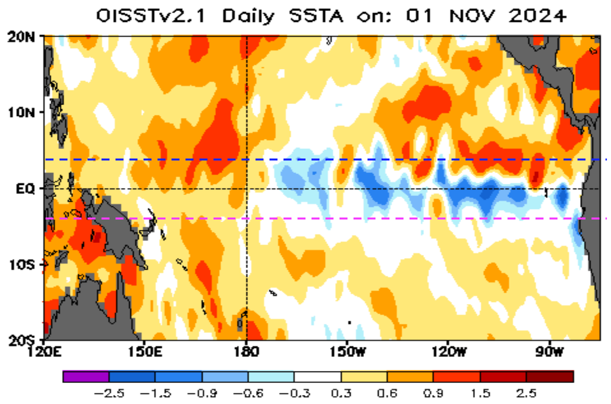
Figure Comparison of the mixed layer SST heat budget analysis over the TIW active region (5°S–5°N, 110°–150°W) (units: °C month^{-1}) during the ENSO phase transition (May–June) of (a) 1998 and (b) 2016. Blue and Green bars represent tendency and sum of heat budget terms. **Red bar** represent ***TIW-induced nonlinear dynamical heating***

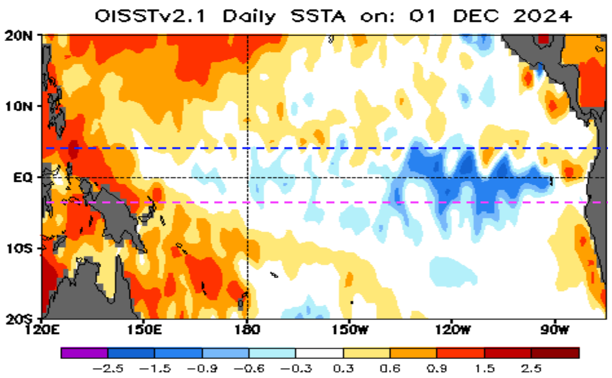
- Strong SST warming in the northeastern off-equatorial Pacific increased meridional SST gradient , which responsible for the strong baroclinic instability and TIW activity during 2026 ENSO phase transition.
- TIW-induced nonlinear dynamical heating (NDH) is an essential inhibiting factor that prevented the 2016 La Nina growth.

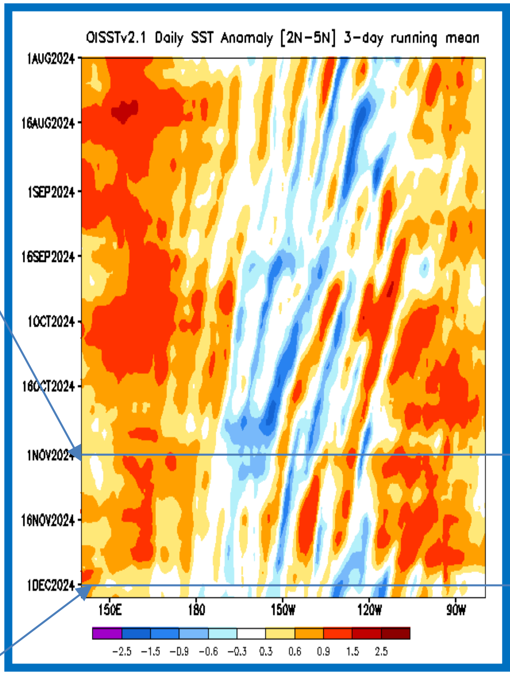


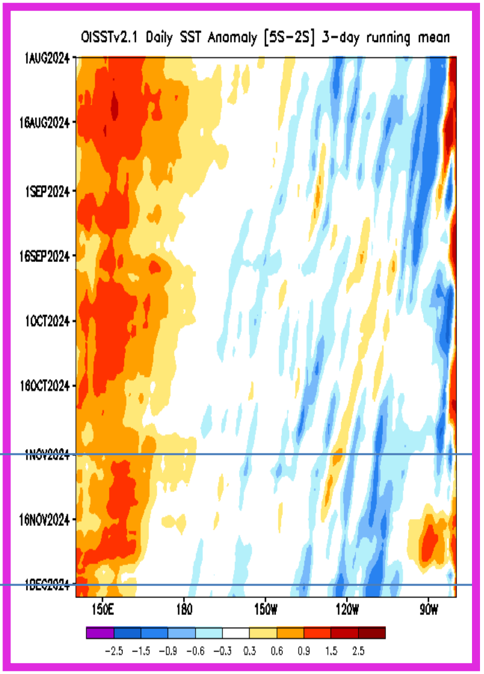
Xue, A., W. Zhang, J. Boucharel, and F.-F. Jin, 2021: Anomalous tropical instability wave activity hindered the development of the 2016/17 La Niña. *J. Climate*, **34**, 5583–5600, https://doi.org/10.1175/JCLI-D-20-0399.1.

Tropical Instability Waves (TIWs) activities



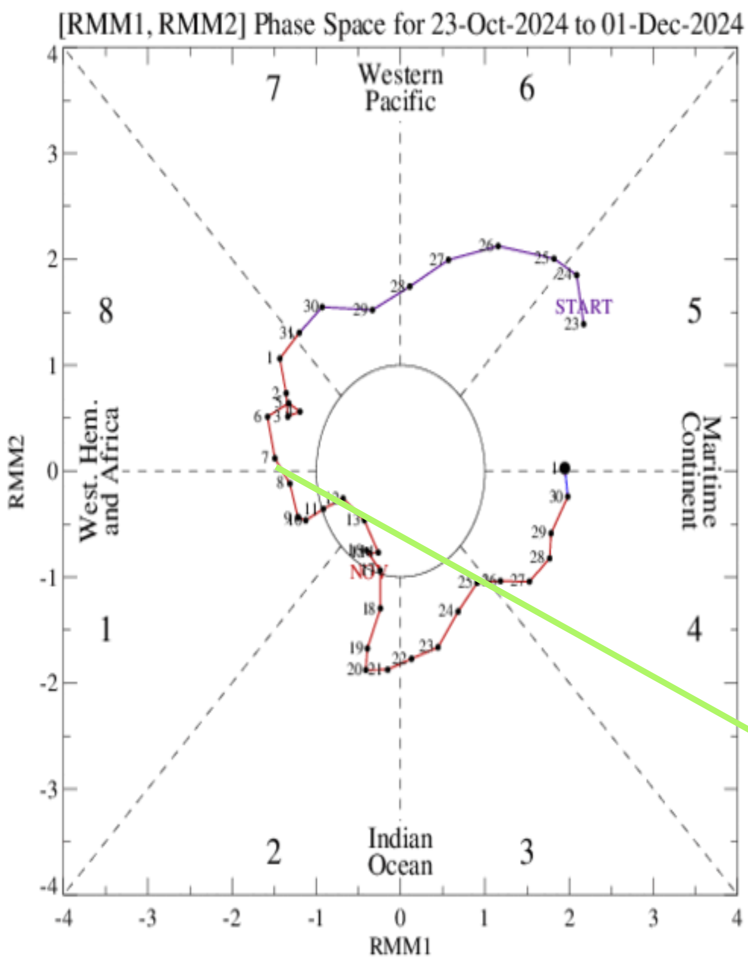


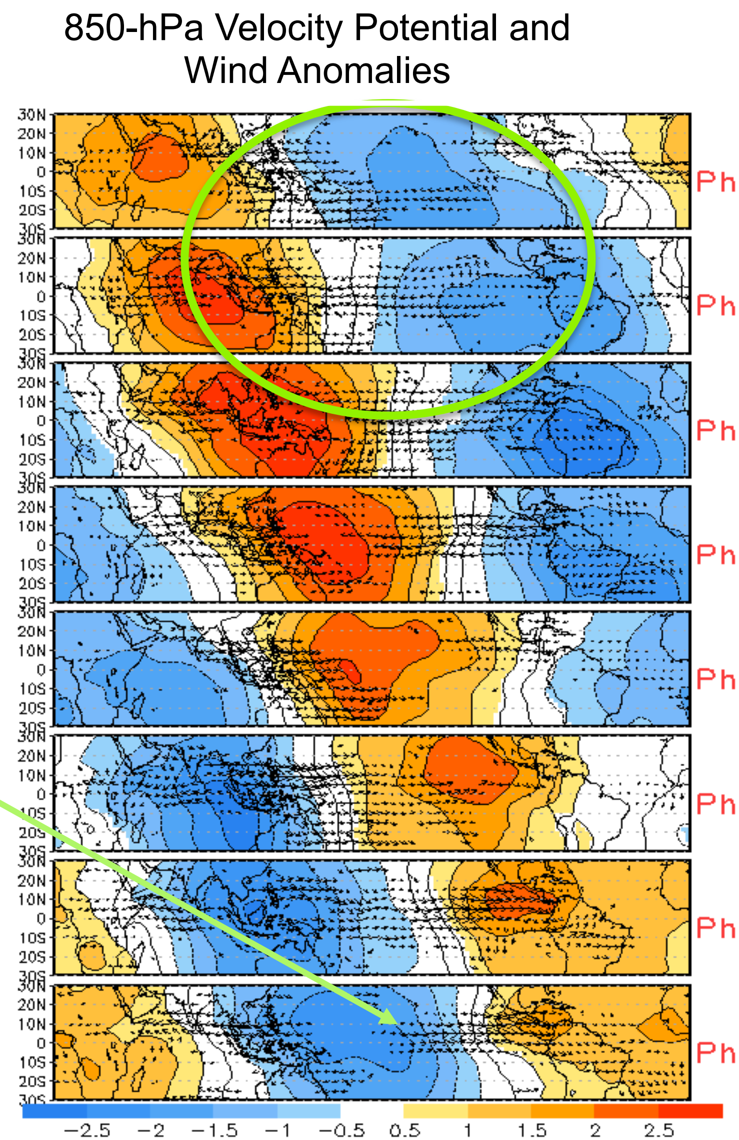




- Negative SSTA just south of the equator was stronger than its northern counterpart, consistent with asymmetric SSTA signals carried by TIWs in the northern and southern hemispheres.
- Nonlinear term related to TIWs contributed to the slowdown of SST cooling tendency in the central-eastern region.

MJO Activities

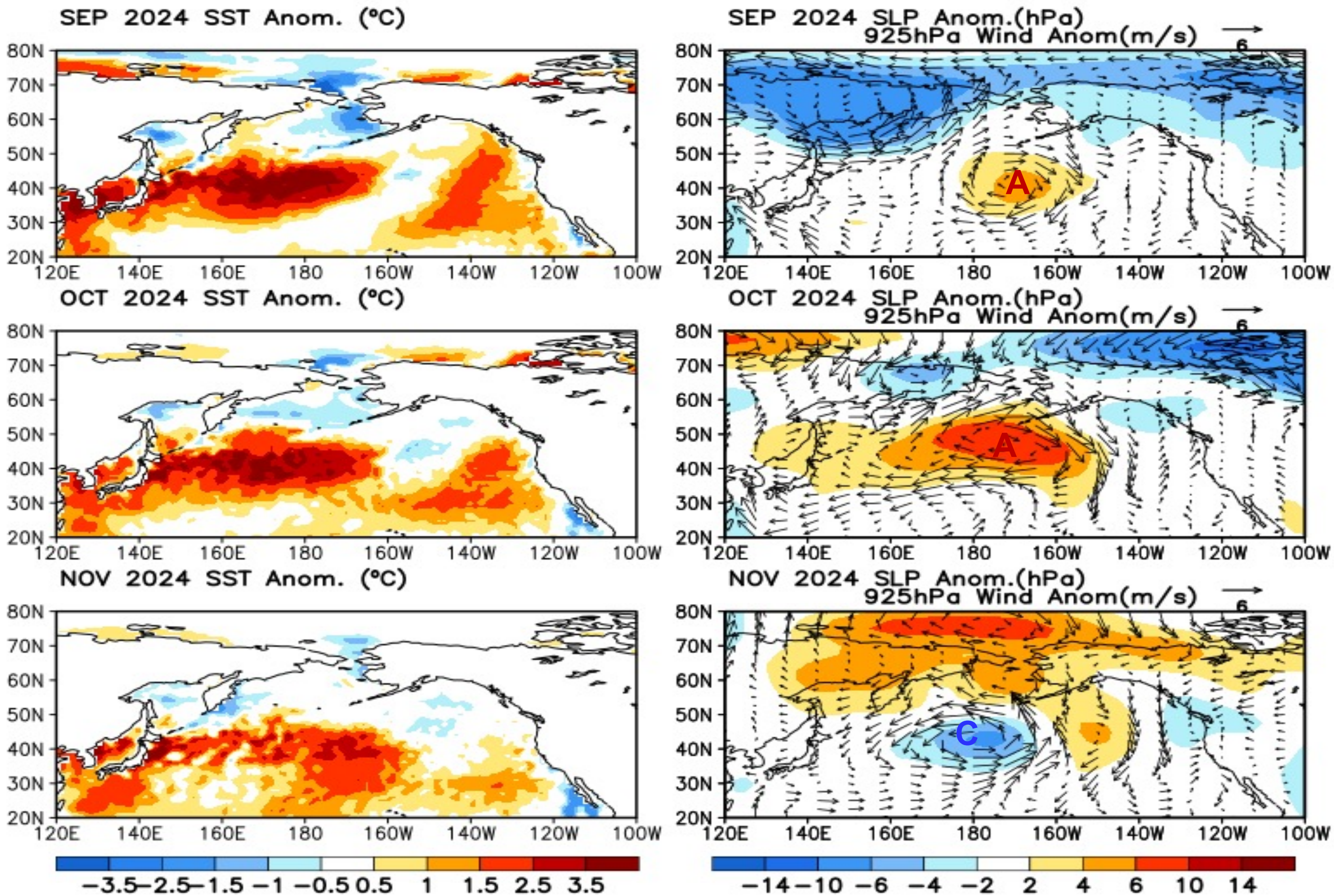




- MJO related westerly wind anomaly disrupted easterly trade winds over the central-eastern Pacific.

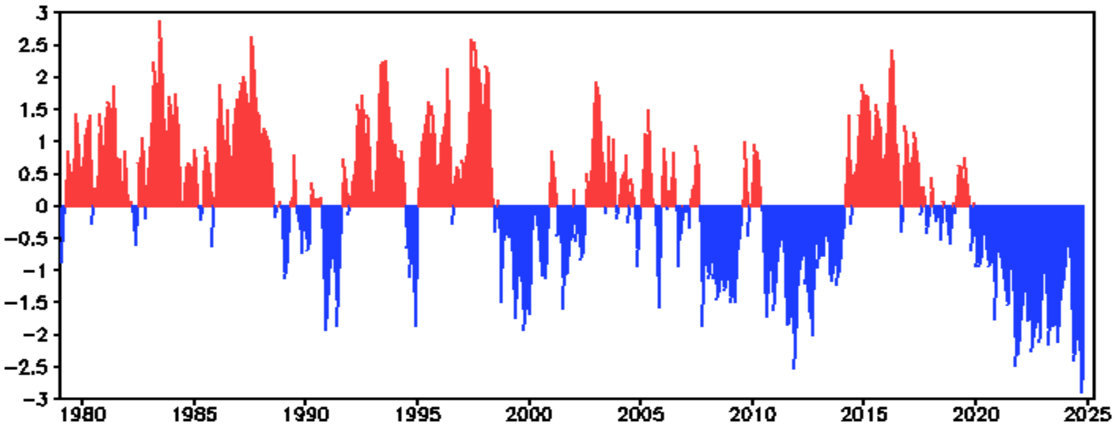
North Pacific & Arctic Oceans

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

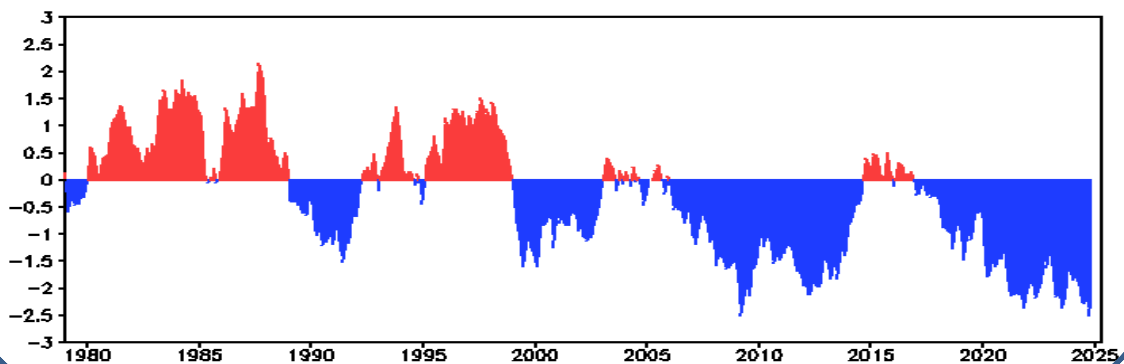


Two Oceanic PDO indices

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.
- PDOI = -2.5 in Nov 2024.

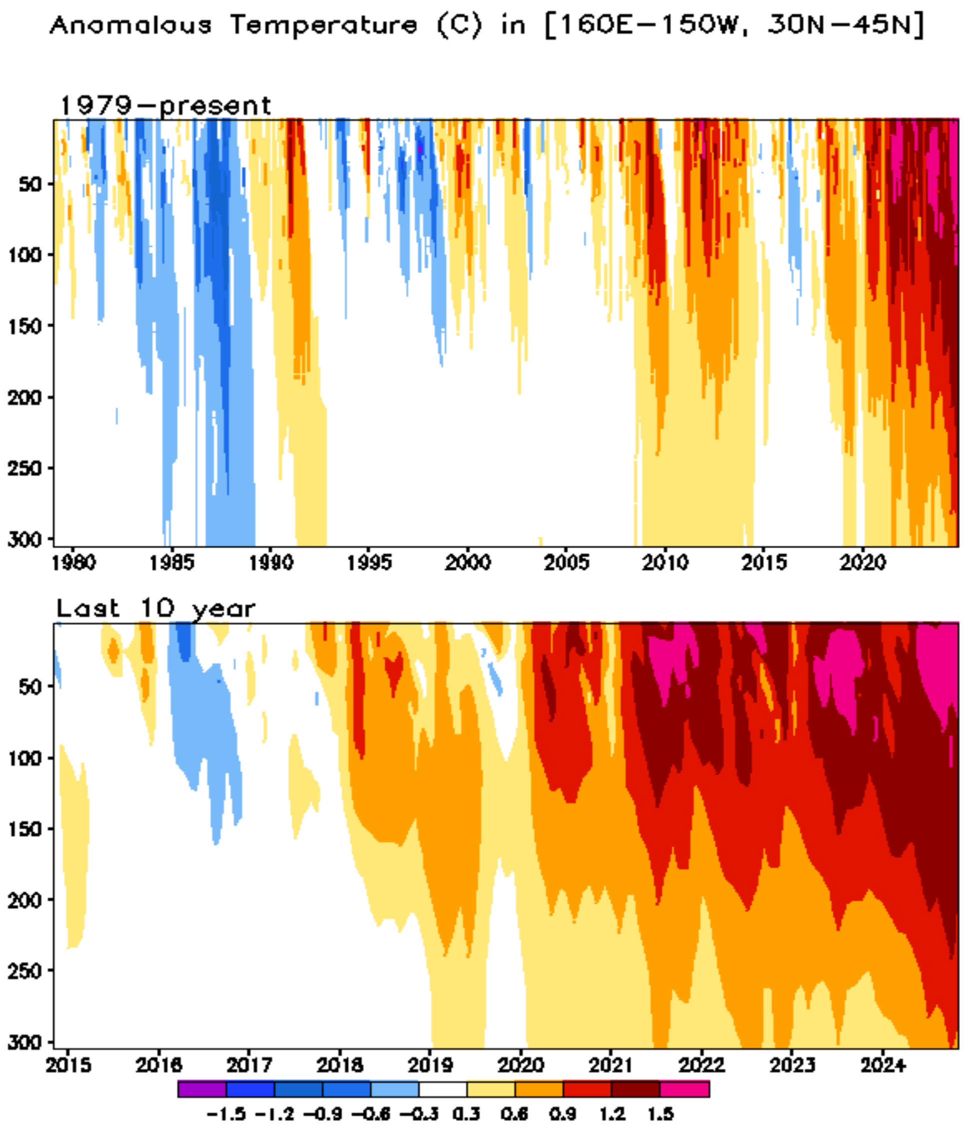
- Negative H300-based PDO index has persisted since Nov 2016, with HPDO = - 2.2 in Nov 2024.

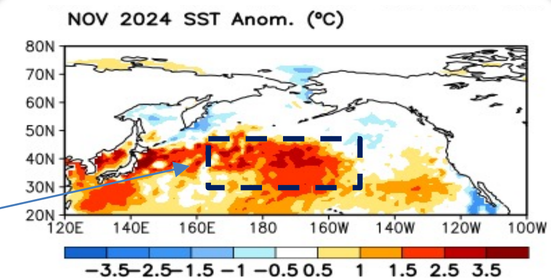
- SST-based PDO index has considerable variability both on seasonal and decadal time scales.

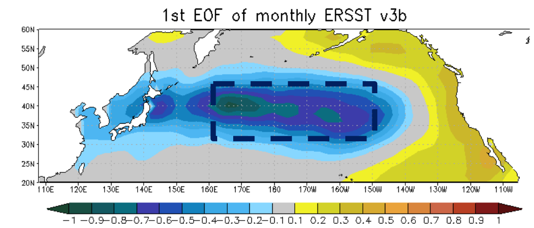
- H300-based PDO index highlights the slower variability and encapsulates an integrated view of temperature variability in the upper ocean.

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.

Subsurface Temperature Anomaly in the Northcentral Pacific



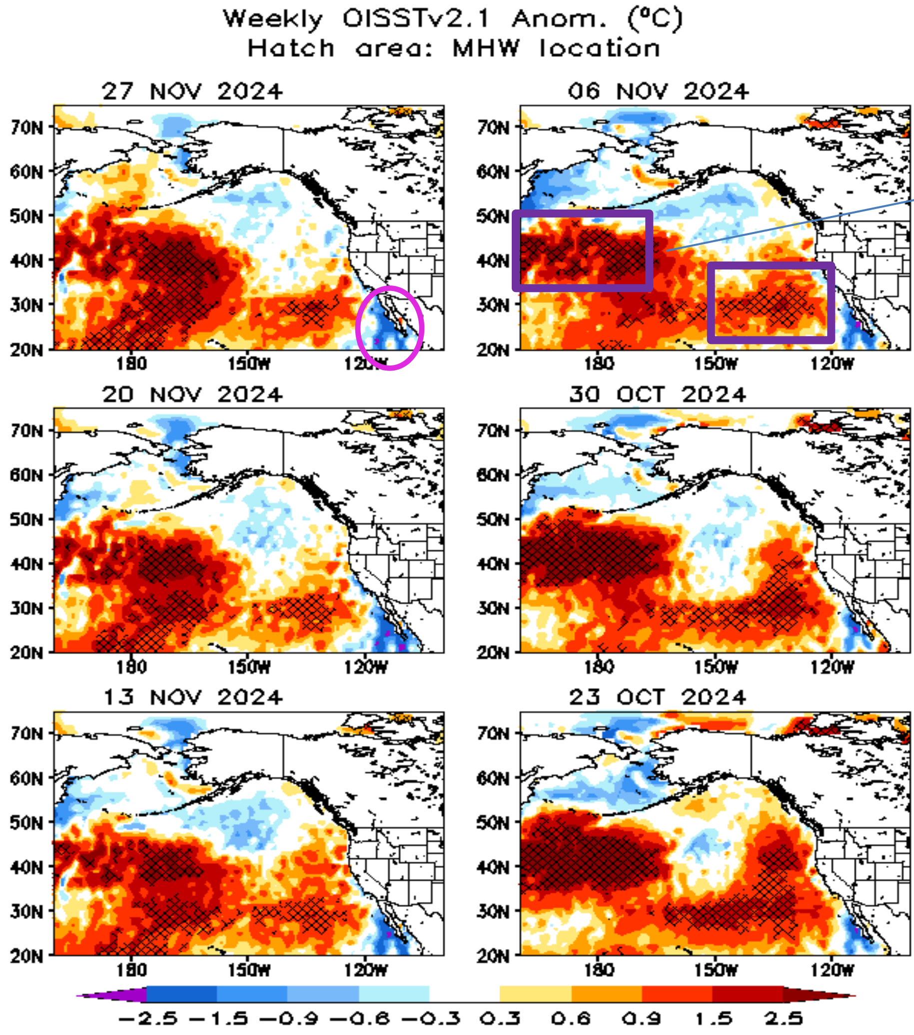


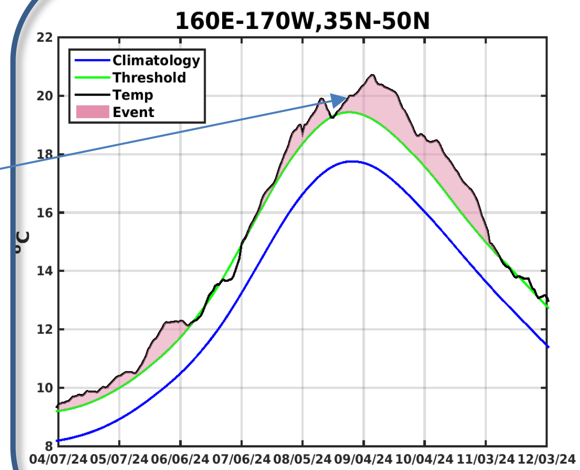


- Positive temperature anomaly (>0.9ºC) has persisted in the upper 100m since 2020 and penetrated to 300m since Jul 2024.

- Subsurface warming in the last four years is the strongest warming episode since 1979.

Weekly SST anomaly and MHWs in the North Pacific

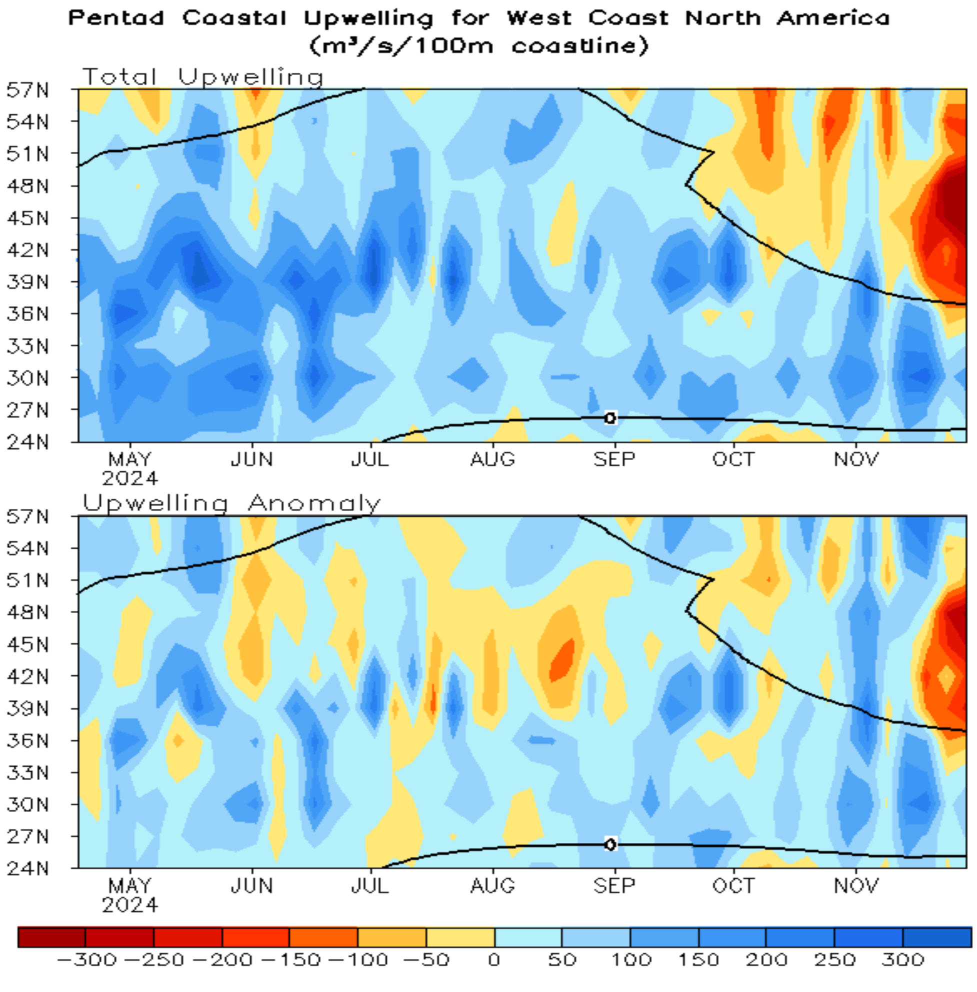


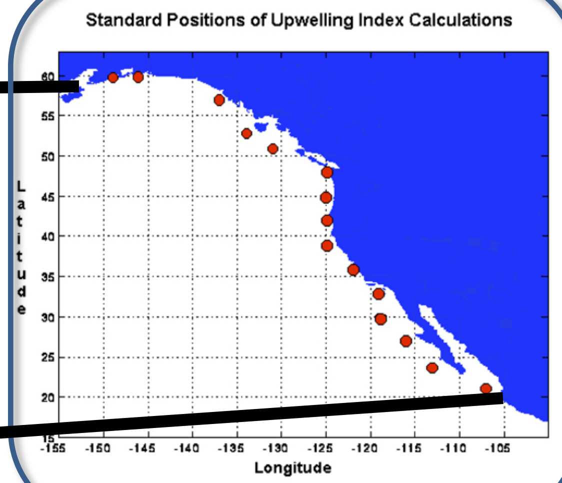


- MHWs in the western-central North Pacific weakened in Nov, 2024.
-MHWs near the west coast of north America persisted during the last six weeks.
- Negative SSTA continued near the California coast.

(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

North America Western Coastal Upwelling

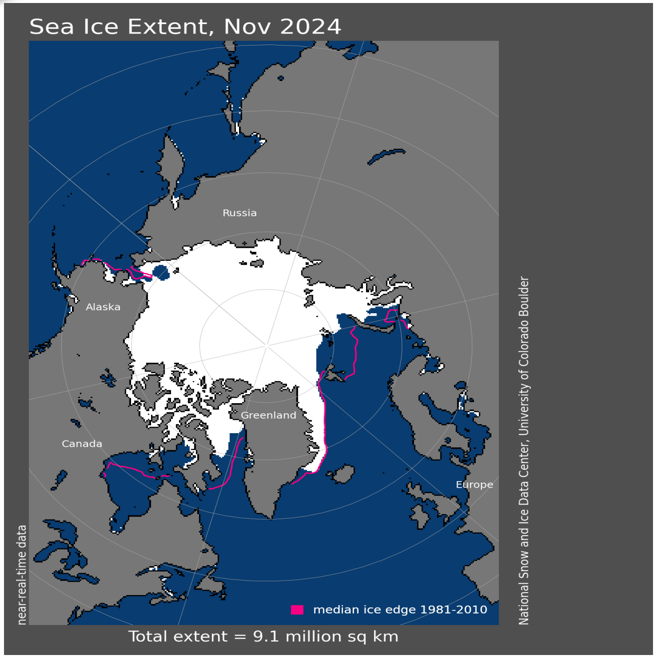


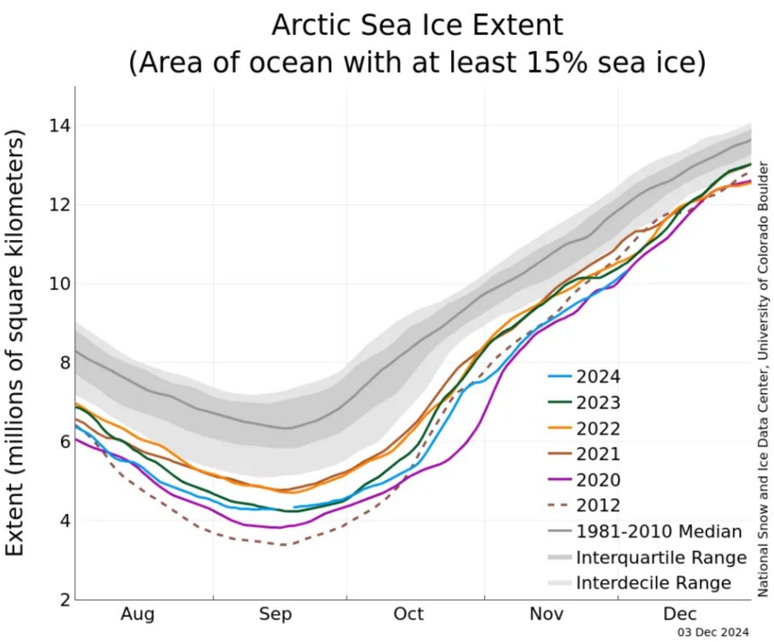


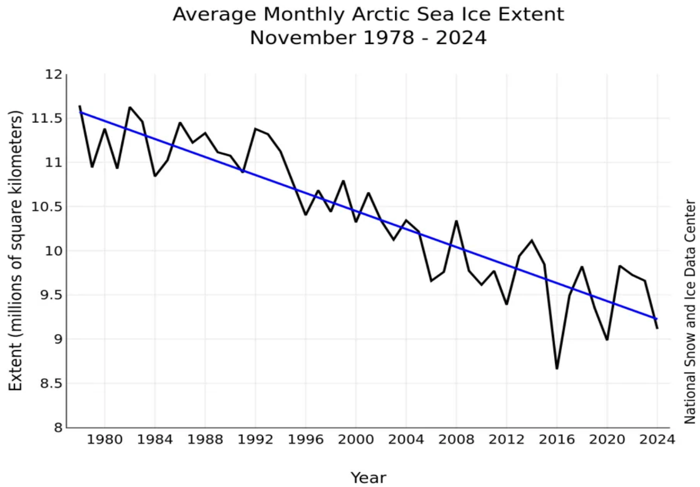
- Anomalous upwelling persisted south to 35N, favoring continuous SST cooling near the California coast.
- Strong downwelling was present between 35-50N.

(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.

Arctic Sea Ice; NSIDC (https://nsidc.org/sea-ice-today)

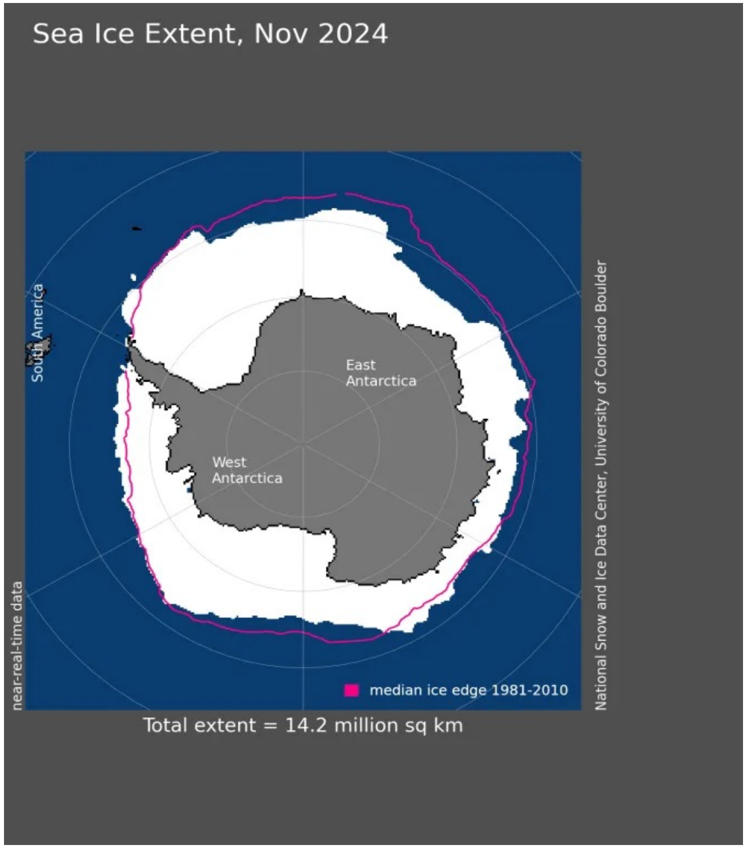


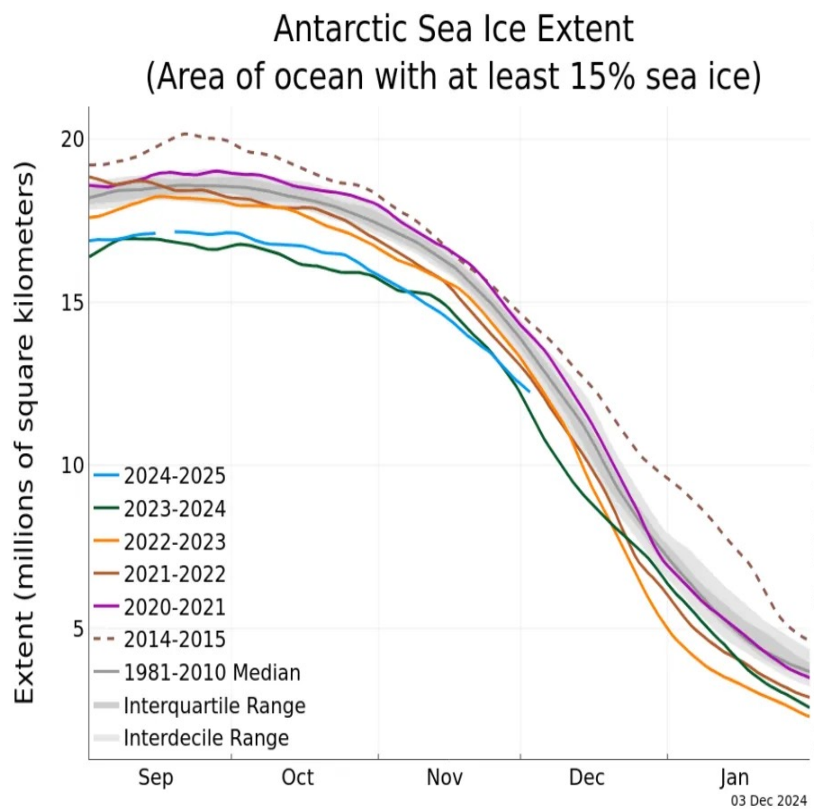




- Average Arctic sea ice extent during Nov 2024 was 9.1 million square kilometers, ranking as the third lowest Nov in the satellite record.

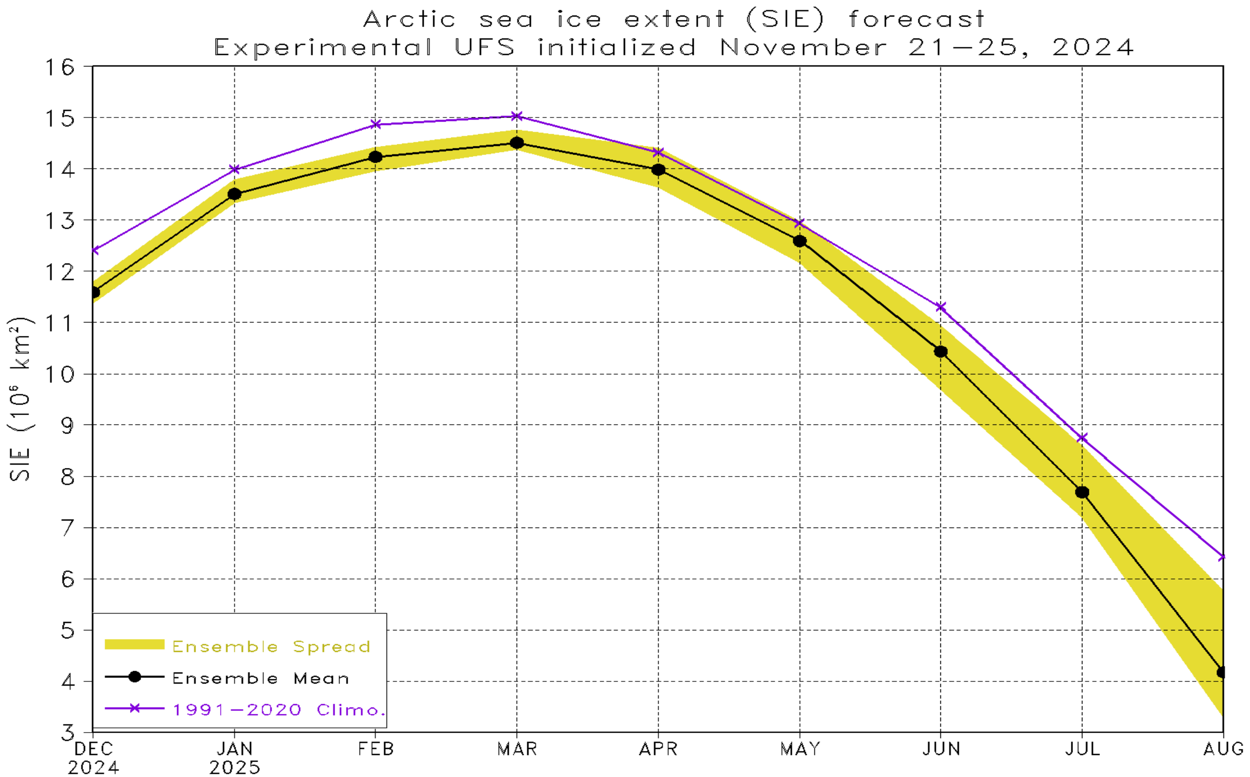
Antarctic Sea Ice; NSIDC (https://nsidc.org/sea-ice-today)





- Antarctic sea ice extent during Nov 2024 was 14.2 million square kilometers, ranking as the third lowest ice extent in the satellite data record.

NCEP/CPC Arctic Sea Ice Extent (SIE) Forecast

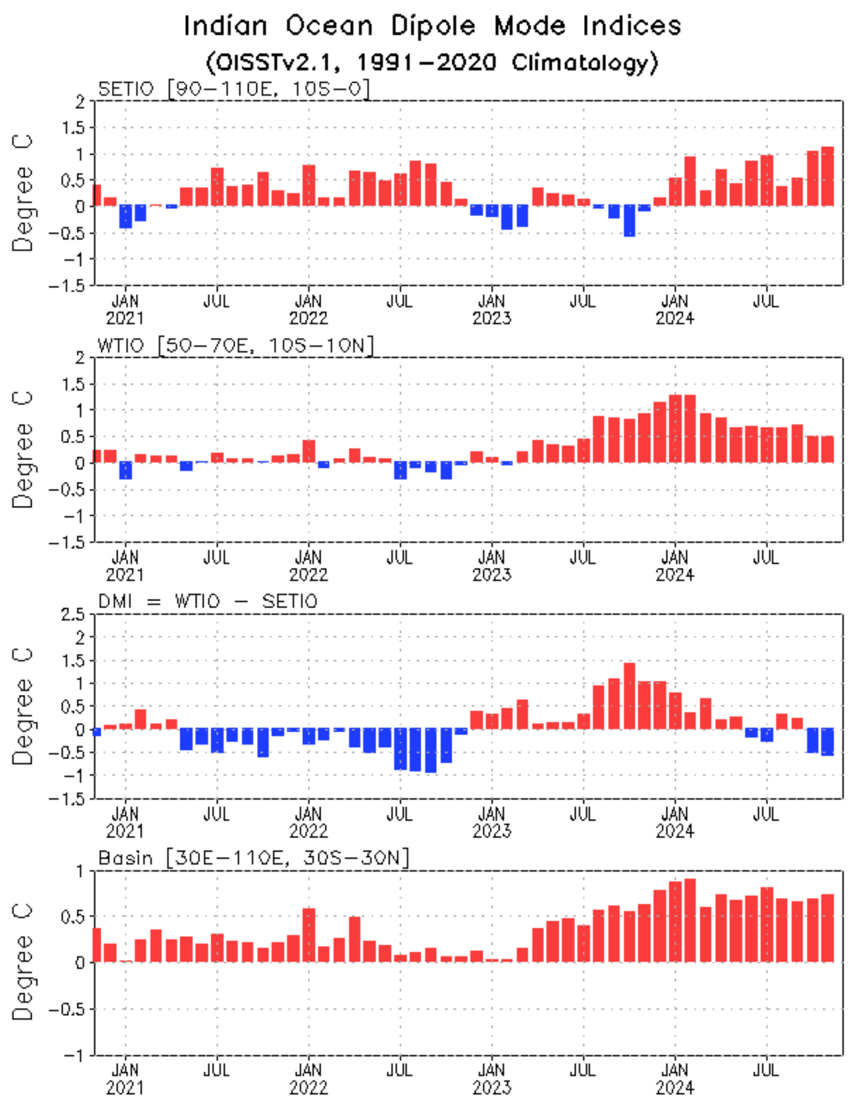


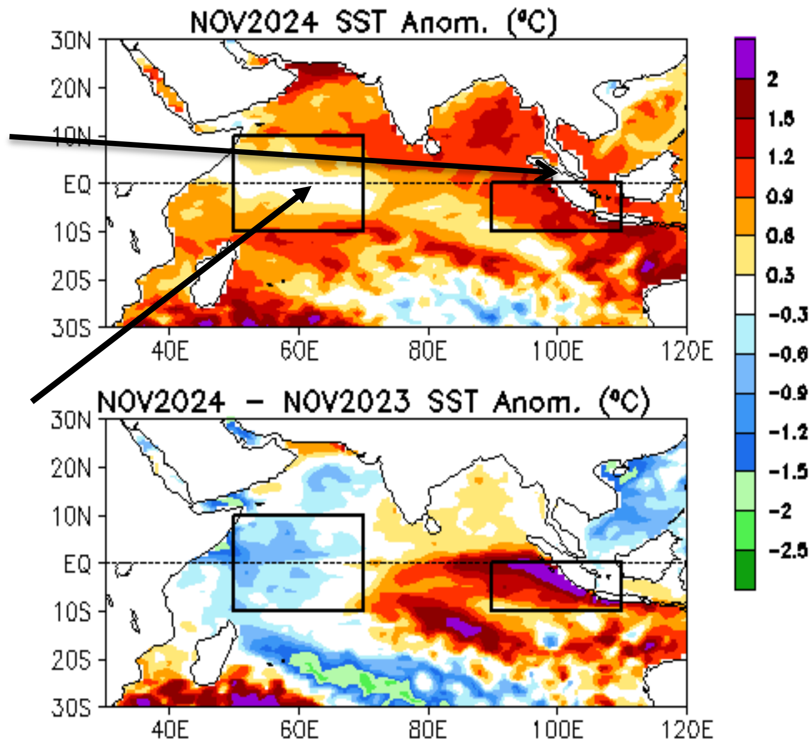
https://www.cpc.ncep.noaa.gov/products/people/jszhu/seaice_seasonal/index.html

- All forecast members predict below-average March maximum in 2025.

Indian Ocean

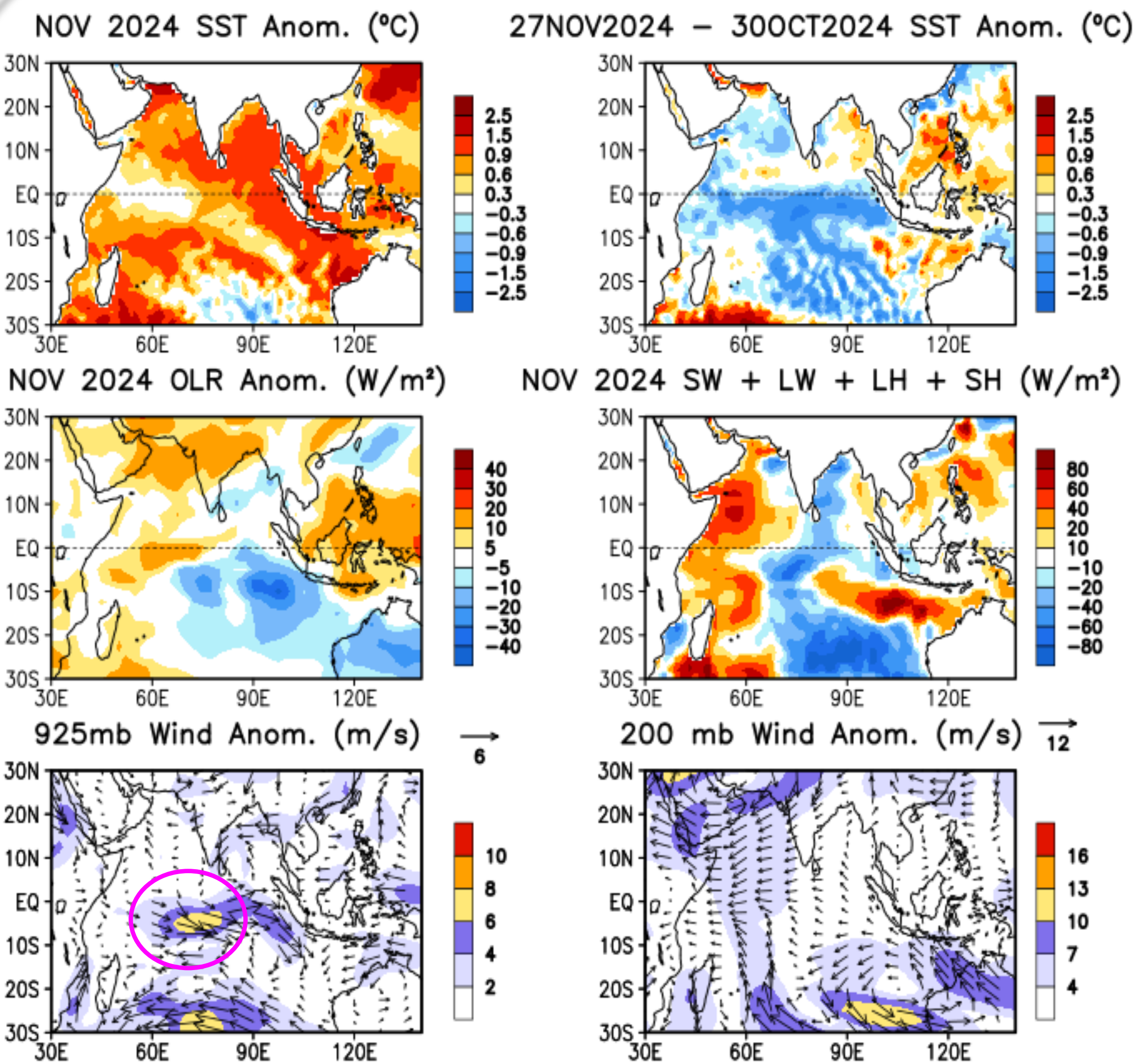
Evolution of Indian Ocean SST Indices





- Basin wide SST warming continued in the tropical Indian Ocean.
- Negative Indian dipole mode index strengthened in Nov 2024.

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.

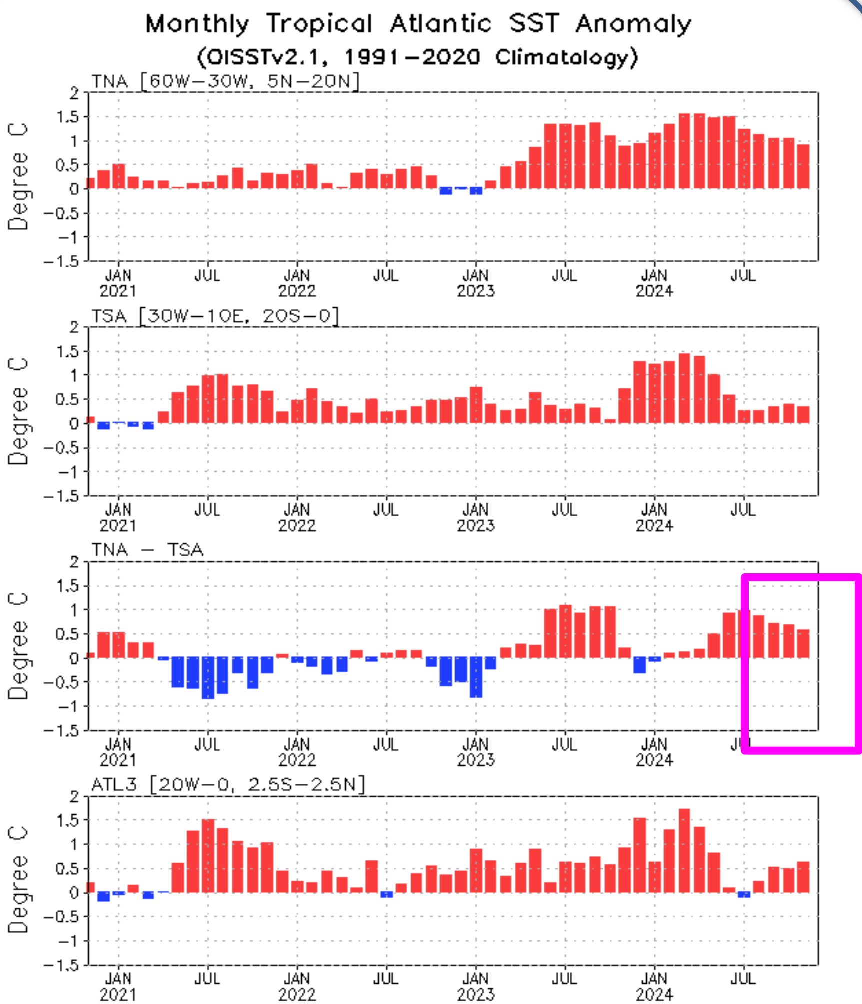


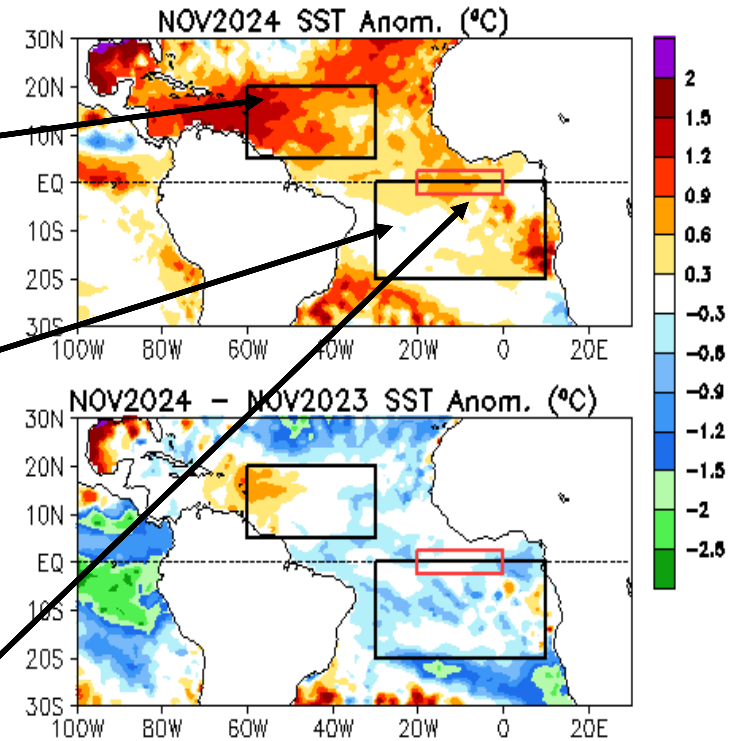
- Strong positive SSTAs were present across much of the tropical Indian Ocean.

- Westerly wind anomaly prevailed over the central Indian Ocean.

Tropical and North Atlantic Ocean

Evolution of Tropical Atlantic SST Indices

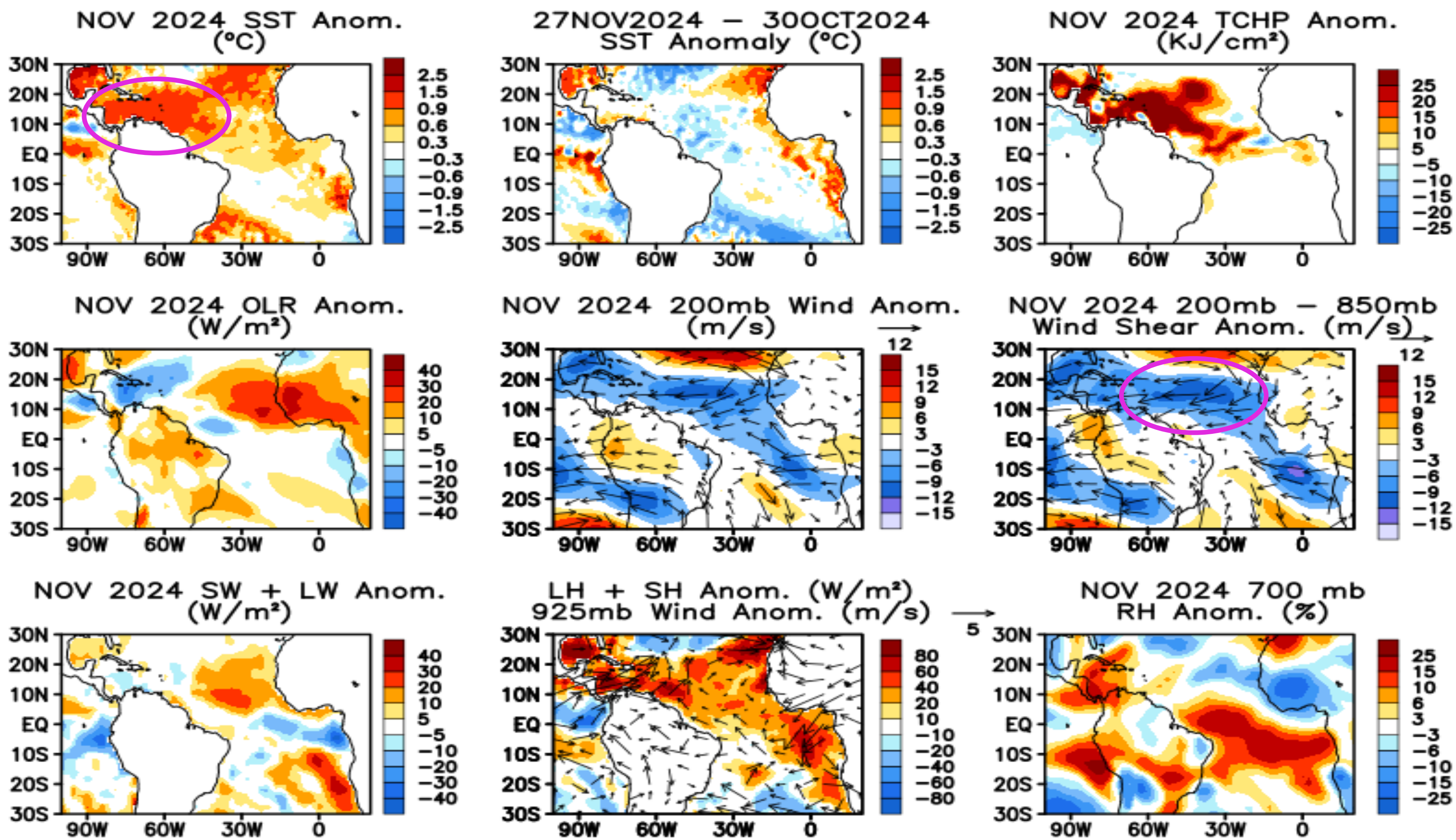




- Meridional gradient mode index weakened in Nov 2024.
- ATL3 index strengthened slightly with ATL3= 0.6°C in Nov 2024.

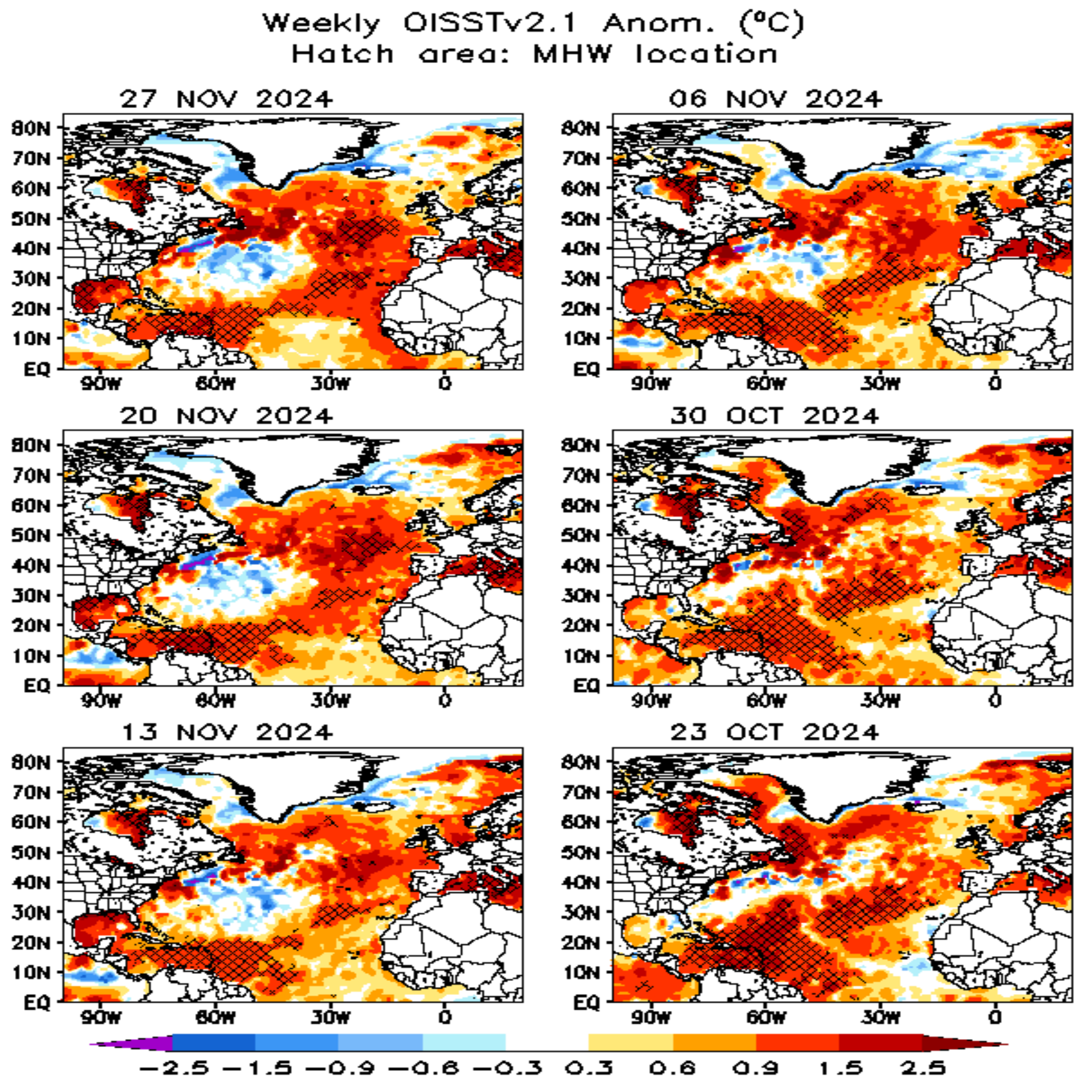
Tropical Atlantic Variability region indices, calculated as the area-averaged monthly mean SSTAs (°C) for the TNA [60°W-30°W, 5ºN-20°N], TSA [30°W-10°E, 20°S-0] and ATL3 [20°W-0, 2.5°S-2.5°N] regions, and Meridional Gradient Index, defined as differences between TNA and TSA. Data are derived from the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

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



Top Row: SSTA (left; OSTIA), SSTA tendency (central), Tropical Cyclone Heat Potential anomaly (right; GODAS).
Middle row: OLR (left; NOAA 18 AVHRR IR), UV200 (central; NCEP CDAS), UV200-UV850 (right; NCEP CDAS) anomalies.
Bottom row: SW+LW (left), LH+SH (central), Relative humidity at 700 hPa (right; NCEP CDAS) anomalies.
Anomalies are departures from the 1991-2020 base period means.

Weekly SST anomaly and MHWs in the North Atlantic



- MHWs persisted in the Caribbean Sea and Gulf of Mexico region.
- MHWs in the Labrador Sea decayed in Nov 2024.
-Negative SSTA emerged near the Gulf stream in Nov 2024.

Weekly SST anomaly (shaded) and locations experience Marine heat waves (hatched) by the date labelled in the plot. MHW is defined as a discrete prolonged warmer than 90th percentile of daily SST for at least 14 days. Data is derived from MET Office OSTIA and the climatology reference period is 1991-2020.

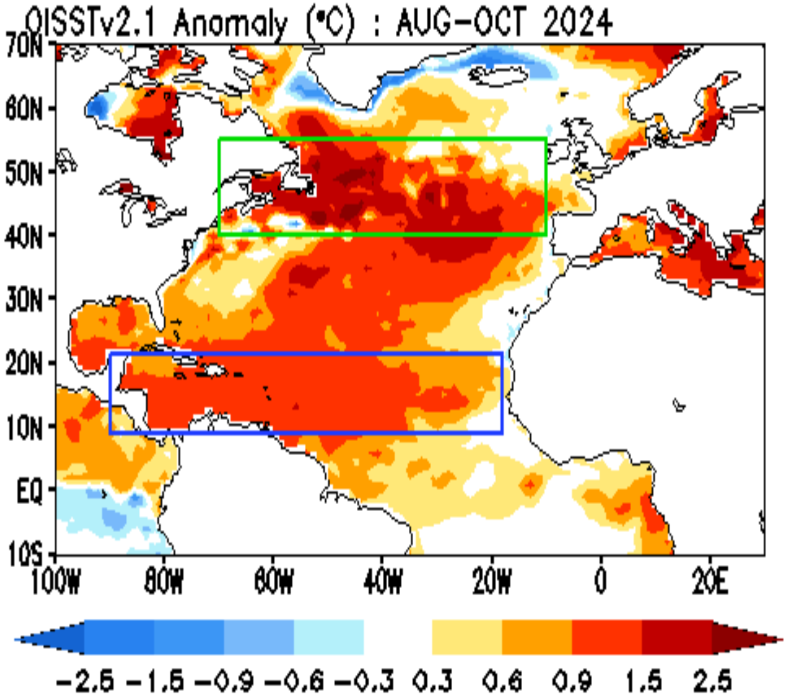
2024 Atlantic Hurricane Season Activities

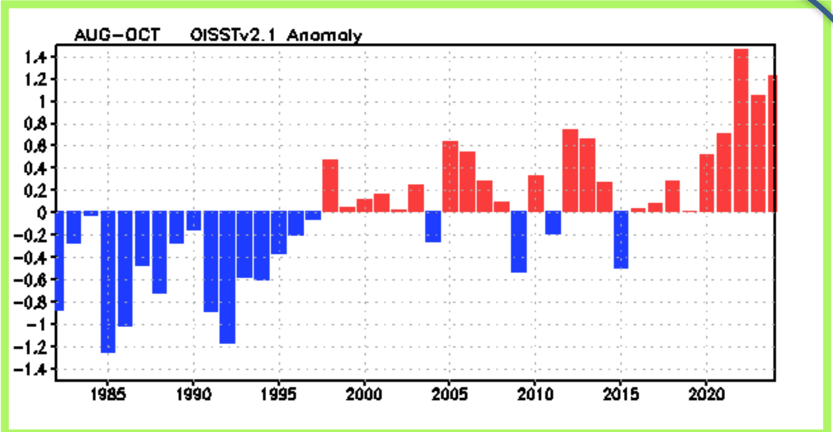
https://en.wikipedia.org/wiki/2024_Atlantic_hurricane_season

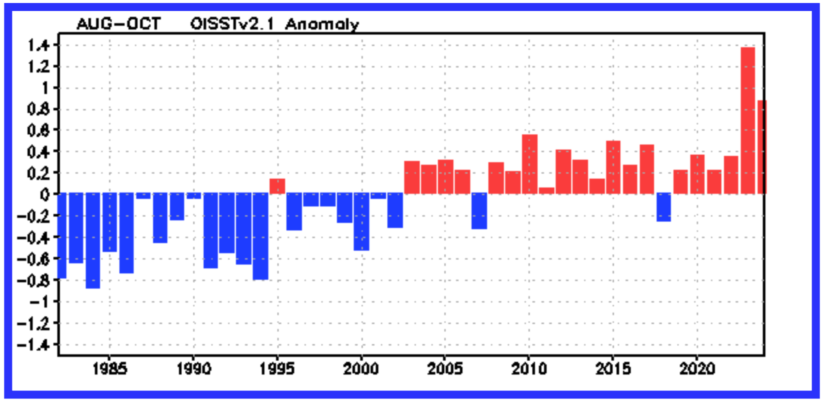
- By Dec 5 2024, eighteen tropical storms formed, with five developing into major hurricanes and eleven into hurricanes.
- The 2024 Atlantic hurricane season was an extremely devastating Atlantic hurricane season, which was the second-costliest season on record.

Atlantic	Observations (By Dec 5)	Updated Outlook (Aug) 90% above-normal	Outlook (May 23) 85% above-normal	(1991-2020)
Total storms	18	17-24	17-25	14
Hurricanes	11	8-13	8-13	7
Major hurricanes	5	4-7	4-7	3

Evolution of SST anomaly in the North Atlantic

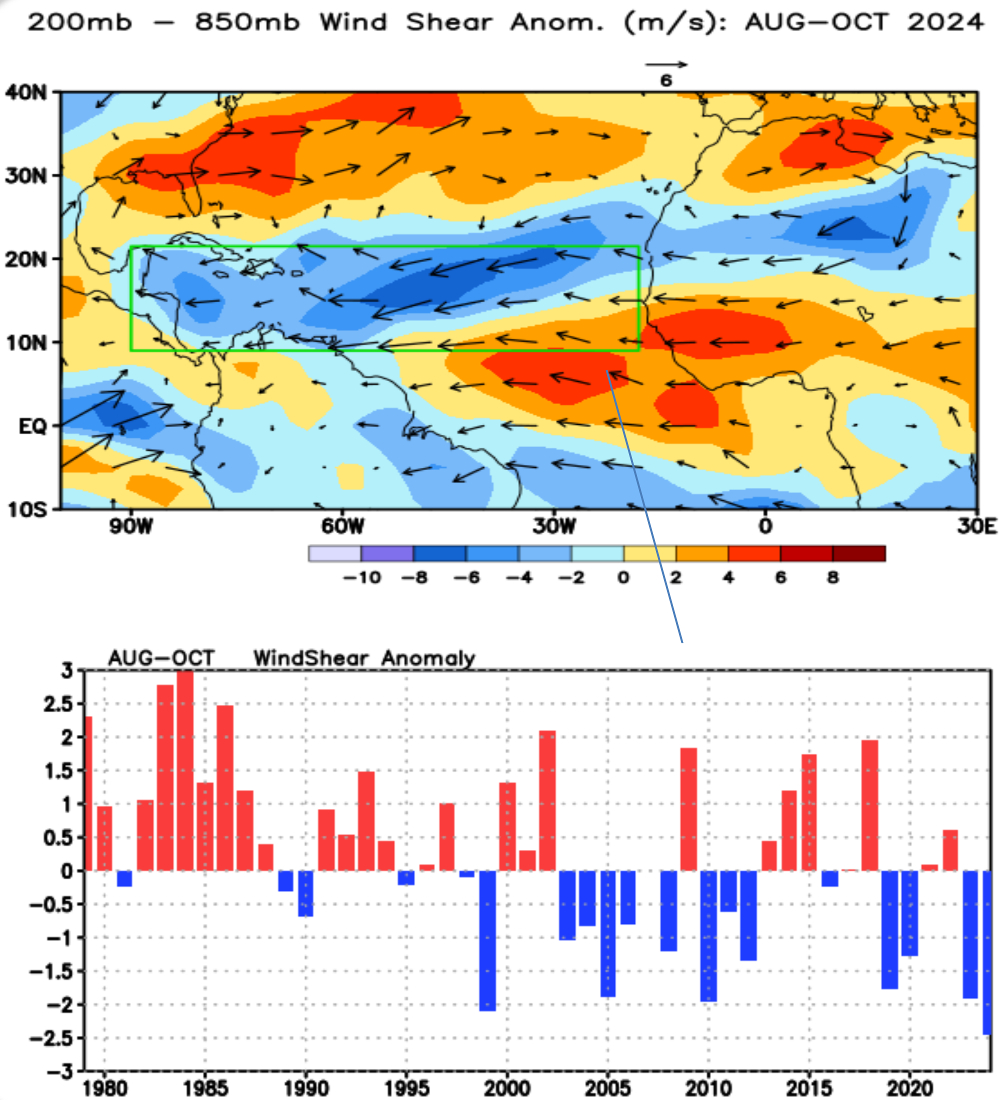






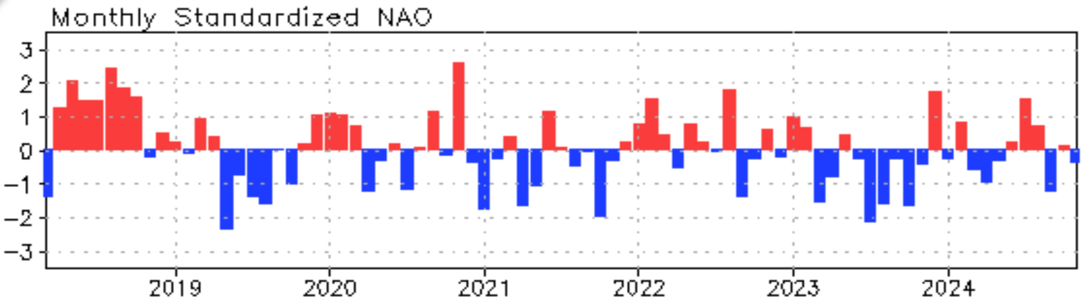
- SST warming in both the hurricane main development region and the extratropical region were the 2nd warmest Aug-Oct since 1982.

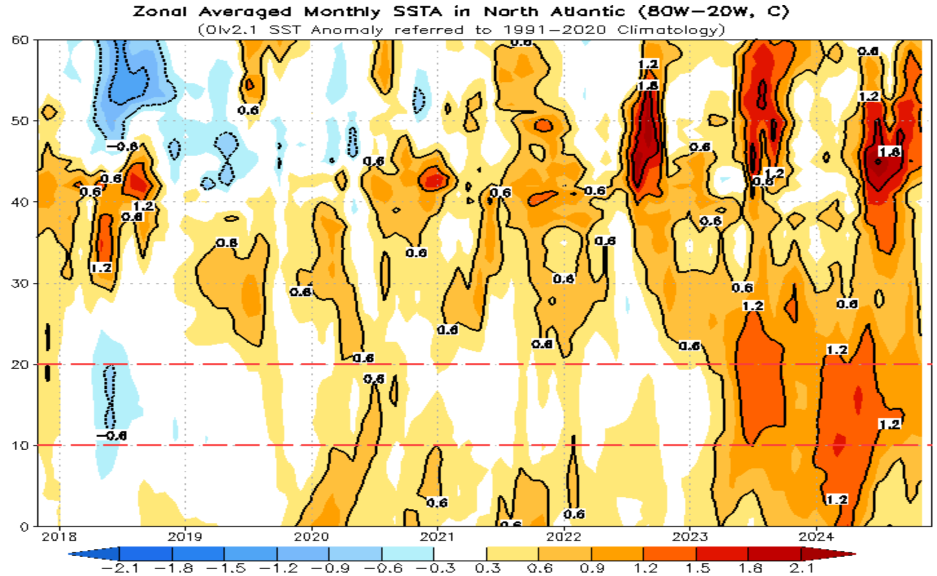
Evolution of 200mb-850mb Wind Shear Anomaly

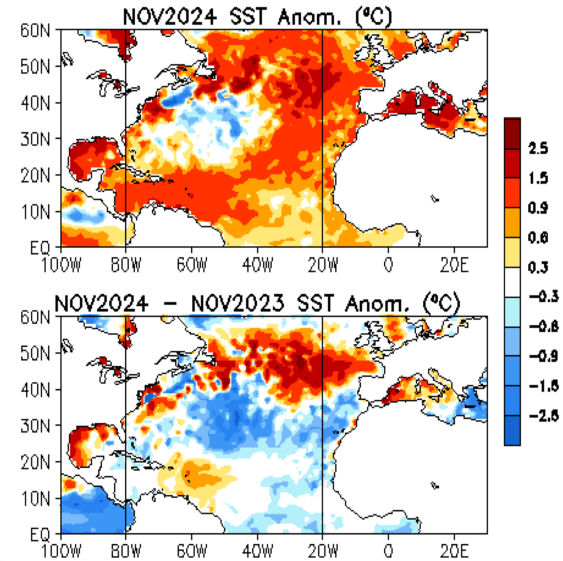


- Statistically, wind shear tends to enhance (weaken) over the Hurricane Main Development region (MDR, green box) during El Niño (La Niña) events.
- Negative wind shear anomalies in the MDR during Aug-Sep 2024 reached a historical low since 1979.

NAO and SST Anomaly in North Atlantic







- NAO was near average in Nov 2024.
- Strong warming continued in high-latitude of the North Atlantic Ocean.

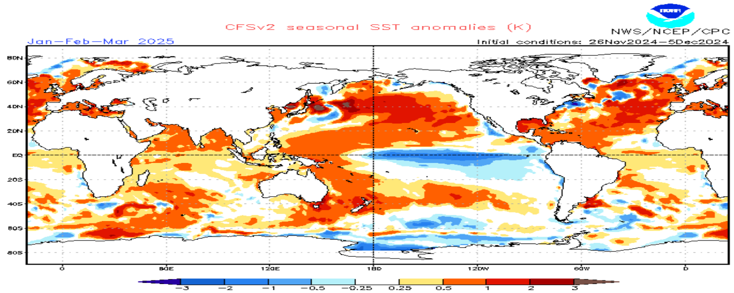
Monthly standardized NAO index (top) derived from monthly standardized 500-mb height anomalies obtained from the NCEP CDAS in 20ºN-90ºN. Time-latitude section of SSTAs averaged between 80ºW and 20ºW (bottom). SST are derived from the OIv2.1 SST analysis, and anomalies are departures from the 1991-2020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

ENSO and Global SST Predictions

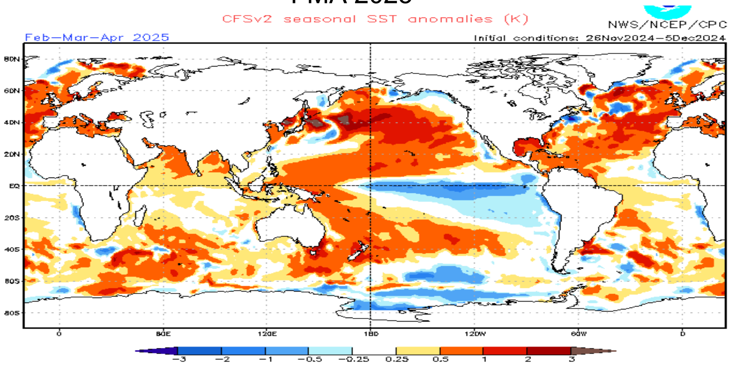
CFSv2 and NMME SST predictions : December Initial Conditions

CFSv2

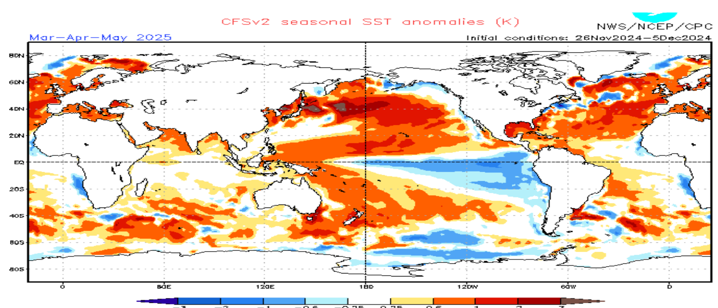
JFM 2025



FMA 2025



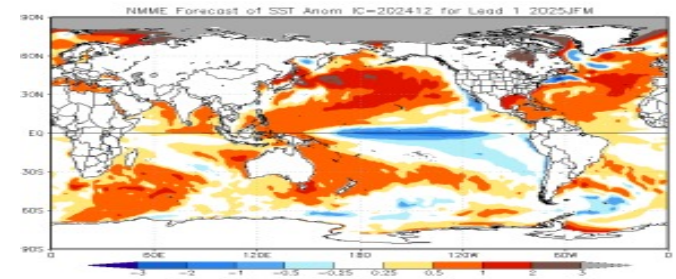
MAM 2025



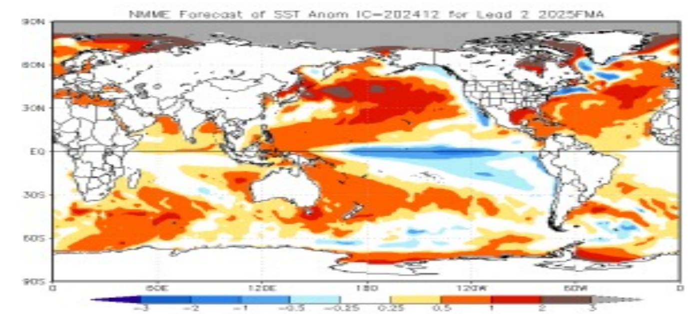
https://www.cpc.ncep.noaa.gov/products/CFSv2/CFSv2seasonal.shtml

NMME

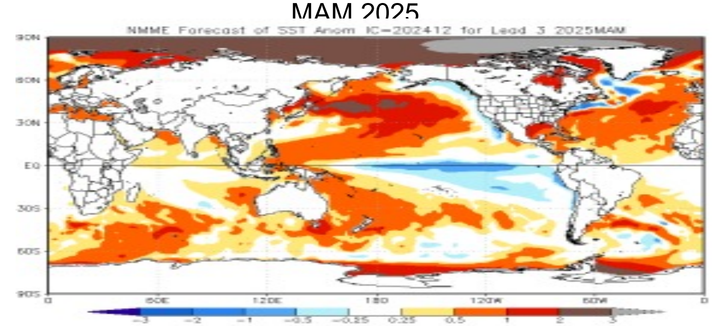
JFM 2025



FMA 2025

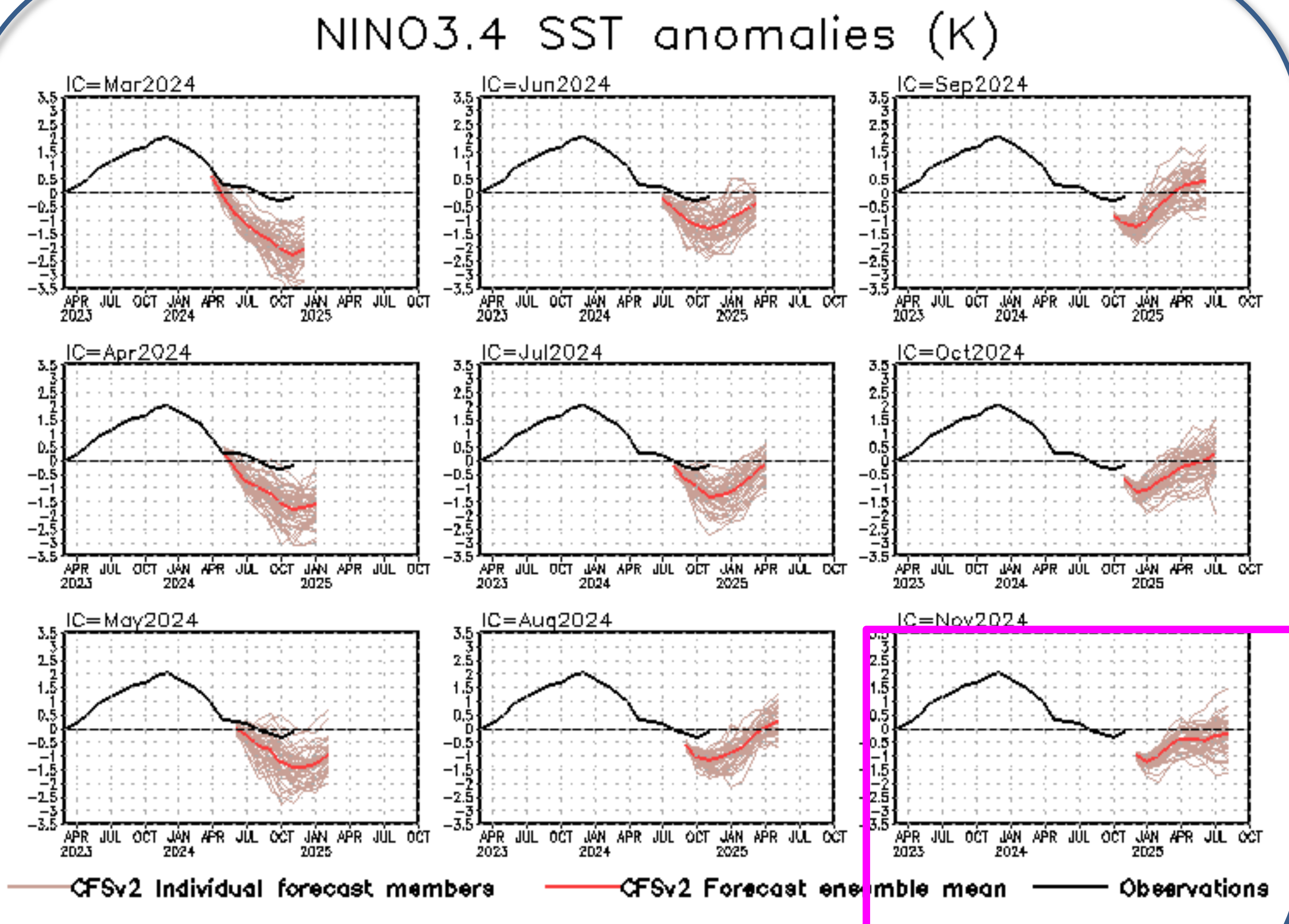


MAM 2025



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

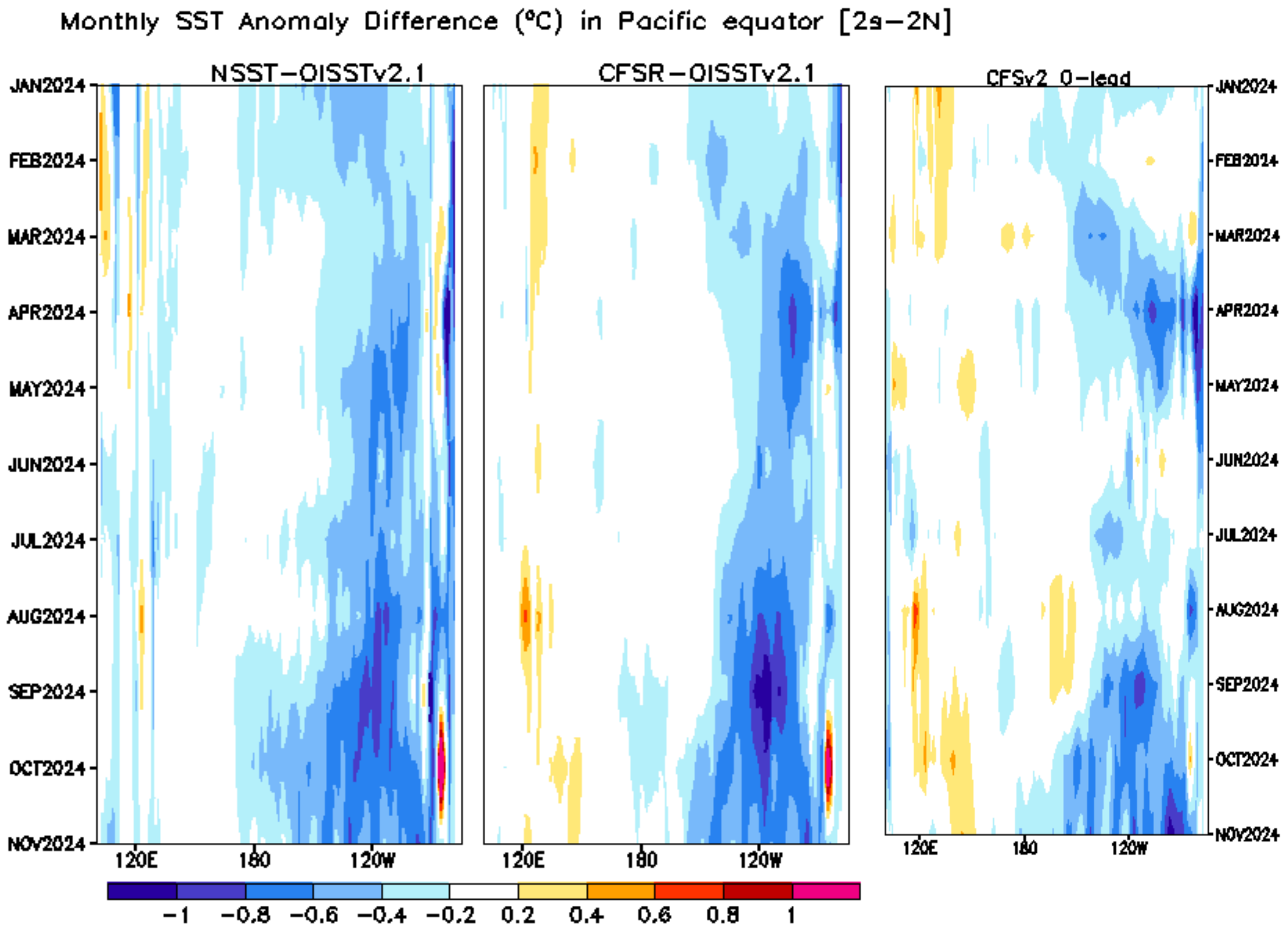
CFS Niño3.4 SST Predictions from Different Initial Months



- The latest CFSv2 forecasts predicted La Nina condition will develop in Dec, 2024
- CFSv2 has large cold bias at 0-month lead since August Initial conditions.

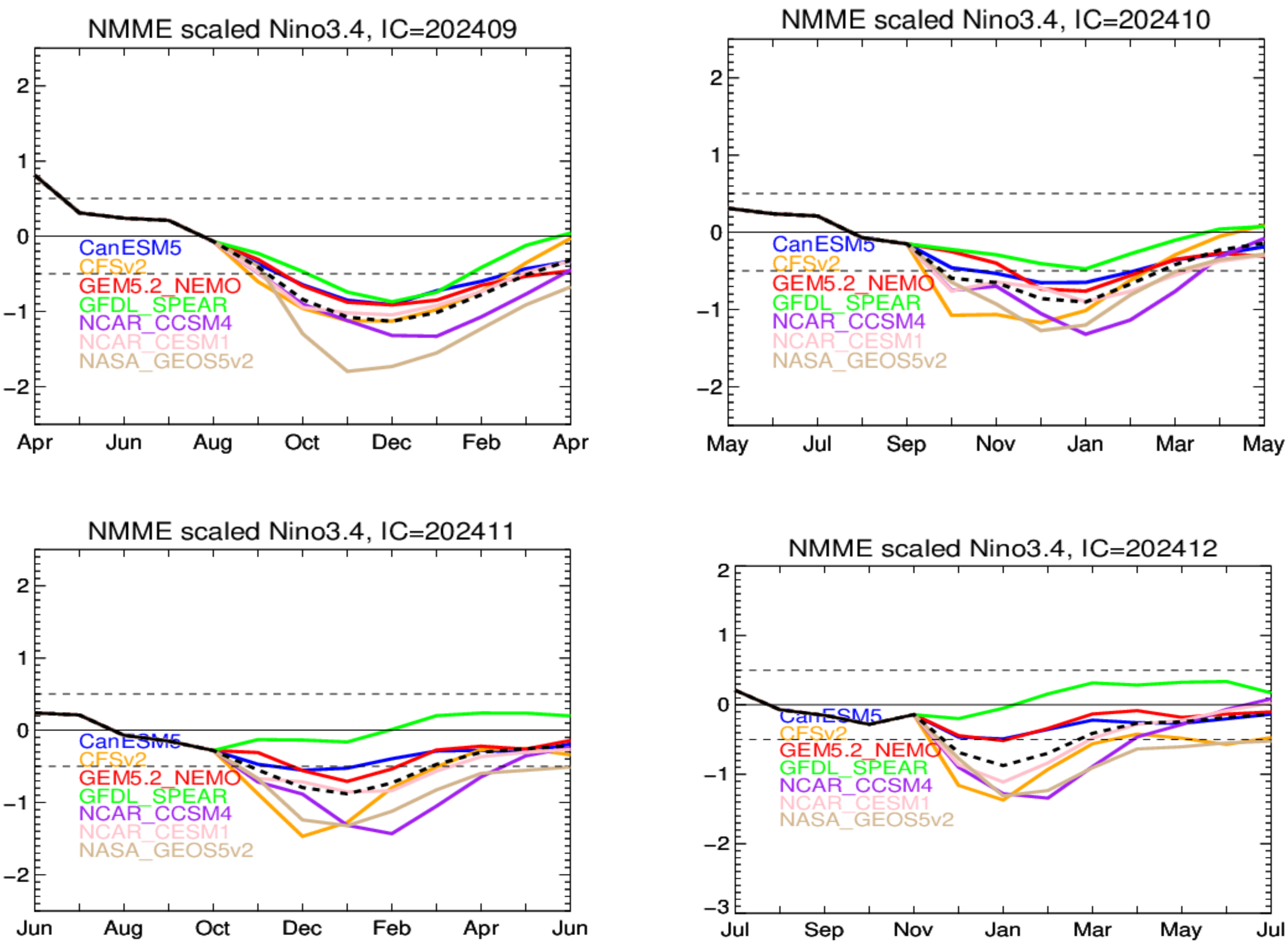
CFS Niño3.4 SST prediction from the latest 9 initial months. Displayed are 40 forecast members (brown) made four times per day initialized from the last 10 days of the initial month (labelled as IC=MonthYear) as well as ensemble mean (blue) and observations (black). Anomalies were computed with respect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

Impact of NSST cold bias on CFSv2



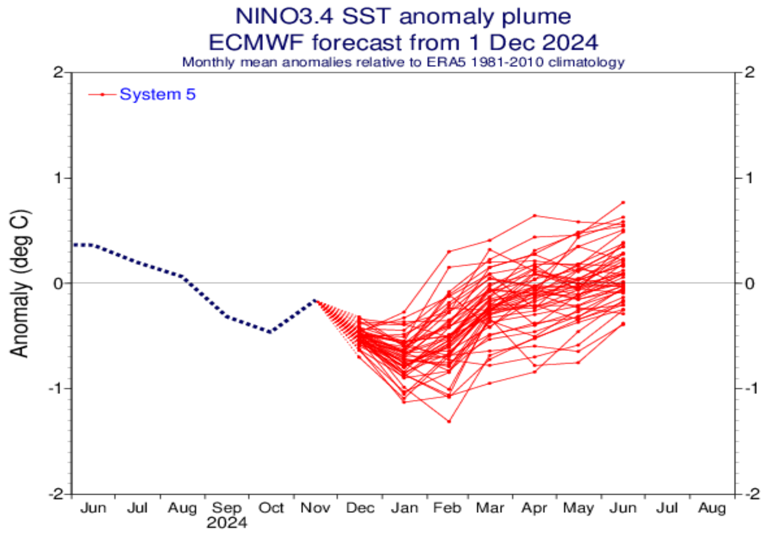
Bias pathway : NSST ⟹ CFSR ⟹ CFSv2

NMME forecasts from different initial conditions

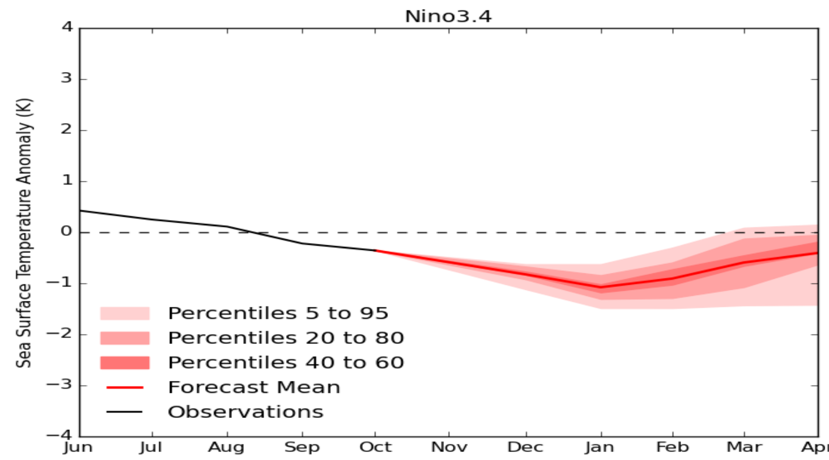


Individual Model Forecasts: Remain neutral or transit to border line La Niña

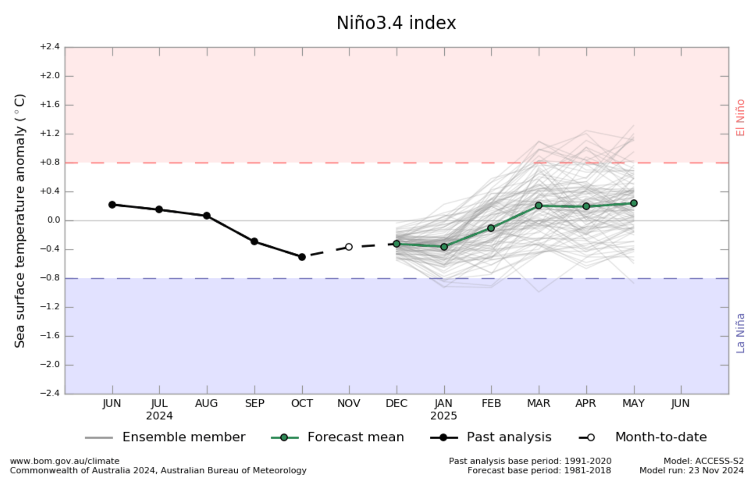
EC: Niño3.4, IC= 1 Dec 2024



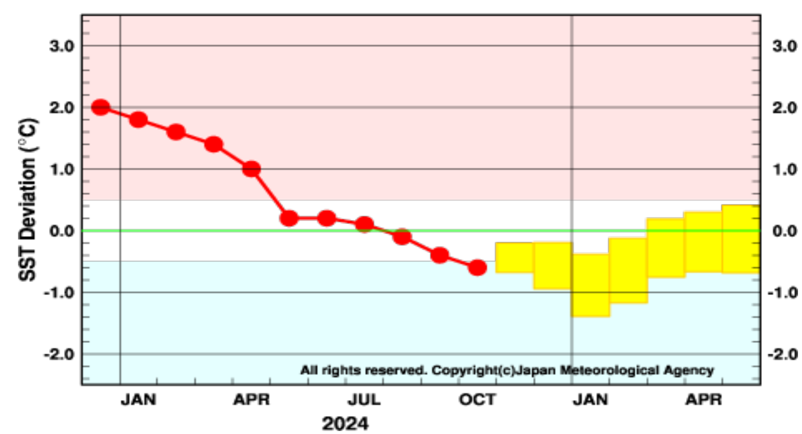
UKMO: Niño3.4, Updated 11 Nov 2024



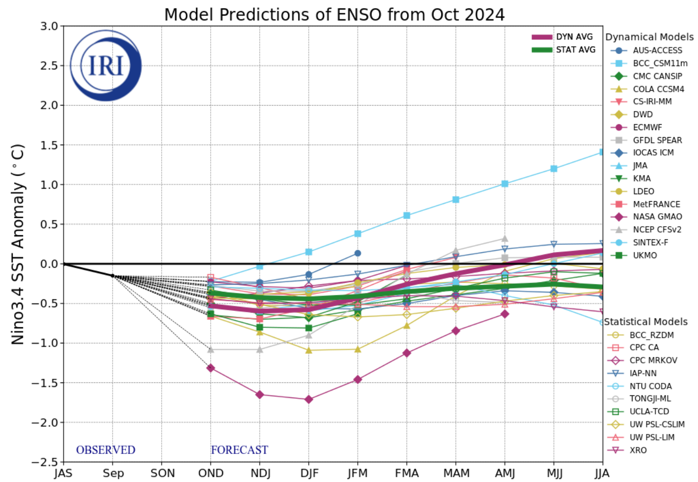
BOM: Niño3.4, Updated 23 Nov 2024

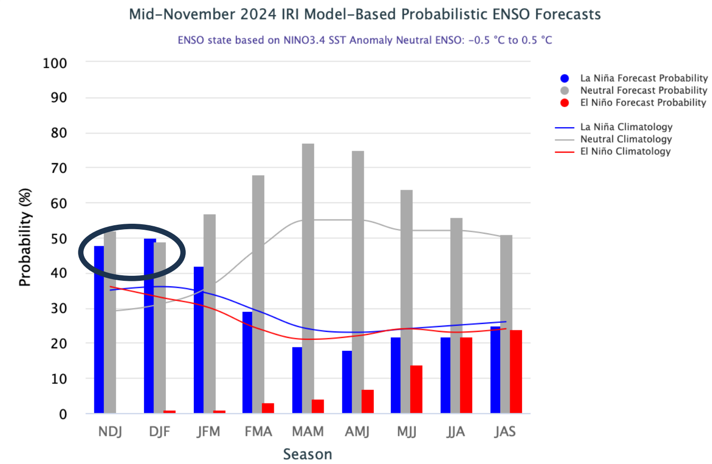


JMA: Niño3.4, Updated 11 Nov 2024



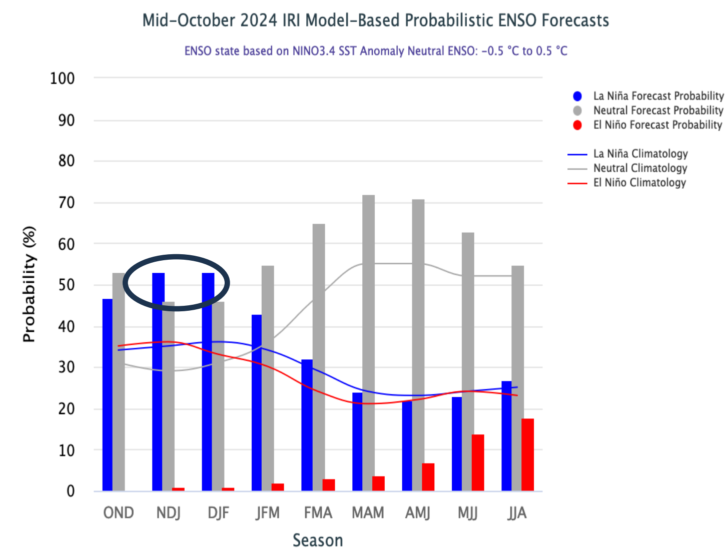
IRI/CPC Niño3.4 Forecast



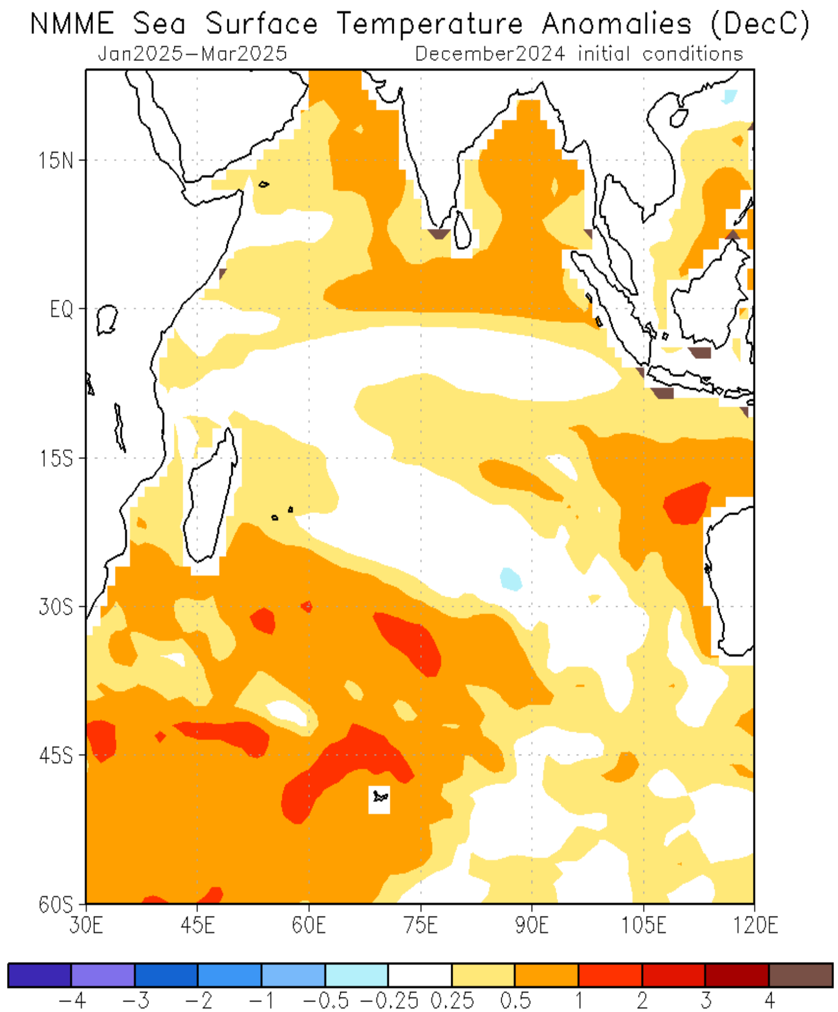


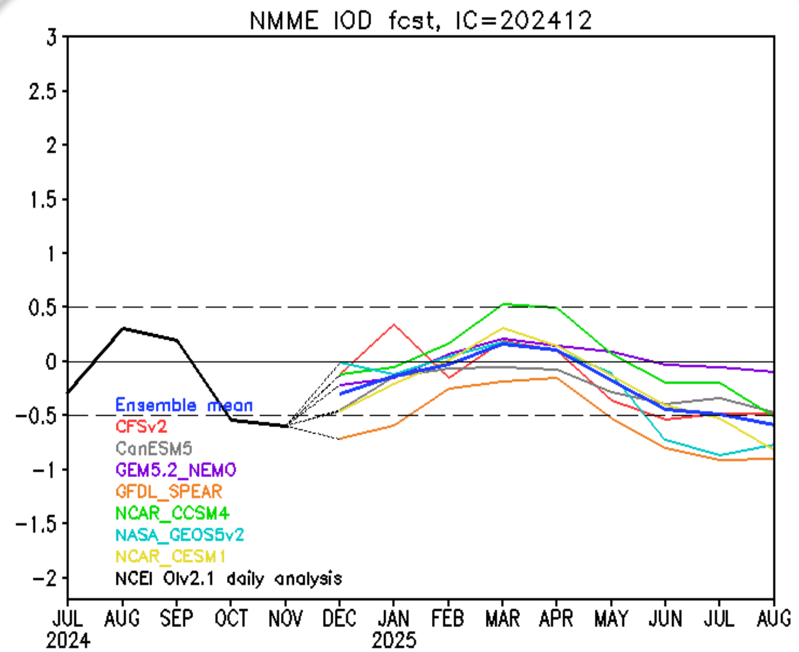
- Most of models predict ENSO neutral condition persisted through Nov-Jan, with 53% chance of borderline La Niña conditions during Dec-Feb 2025, followed by a return to neutral conditions during JFM 2025.

- On 14 Nov 2024, CPC maintained a "***La Niña Watch***".
- <u>Synopsis</u>: ***"La Niña is most likely to emerge in October-December 2024 (57% chance) and is expected to persist through January-March 2025 ."***



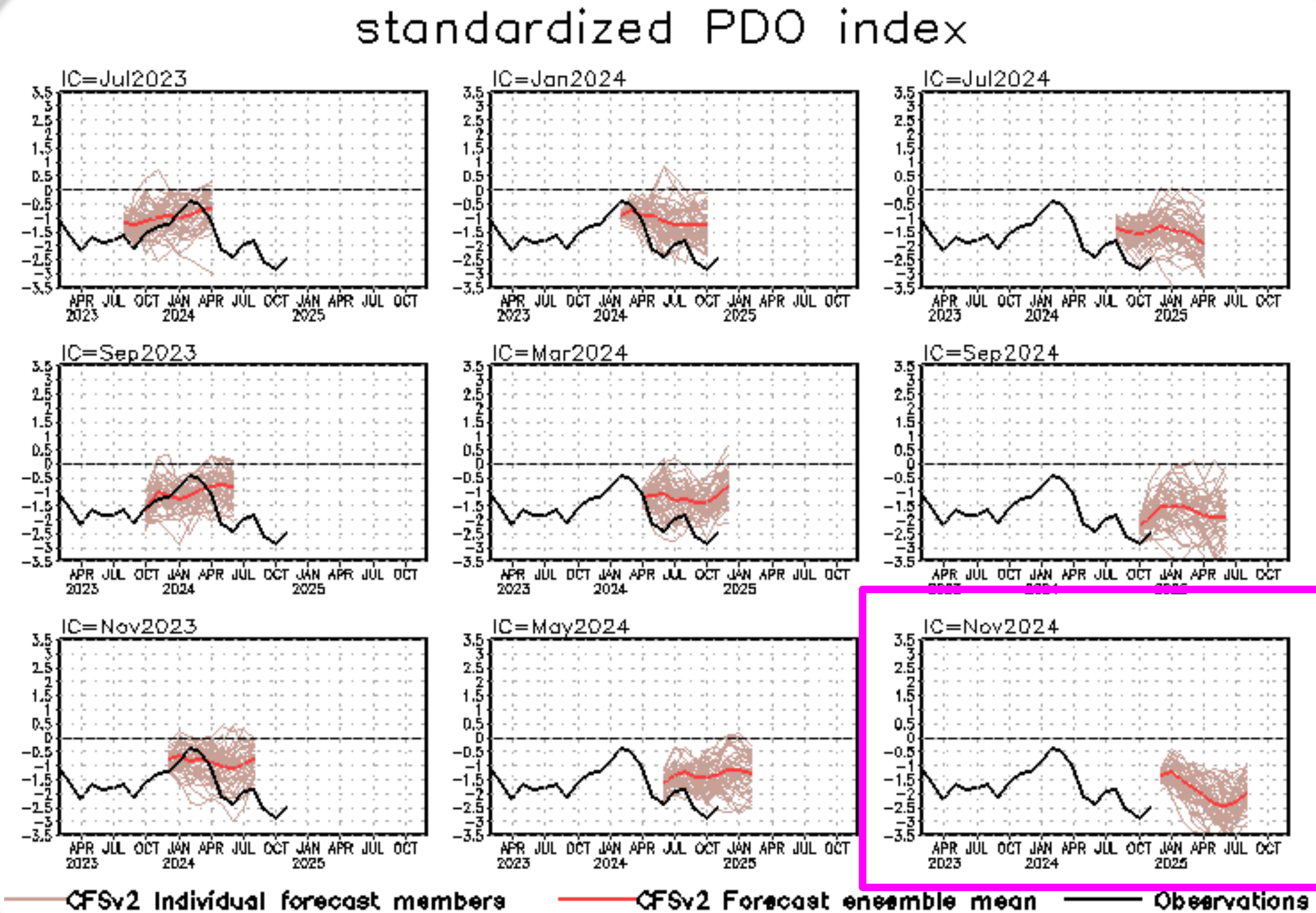
NMME Forecasts in the Indian Ocean





- Most NMME models predict IOD will return to near normal in the next two months.

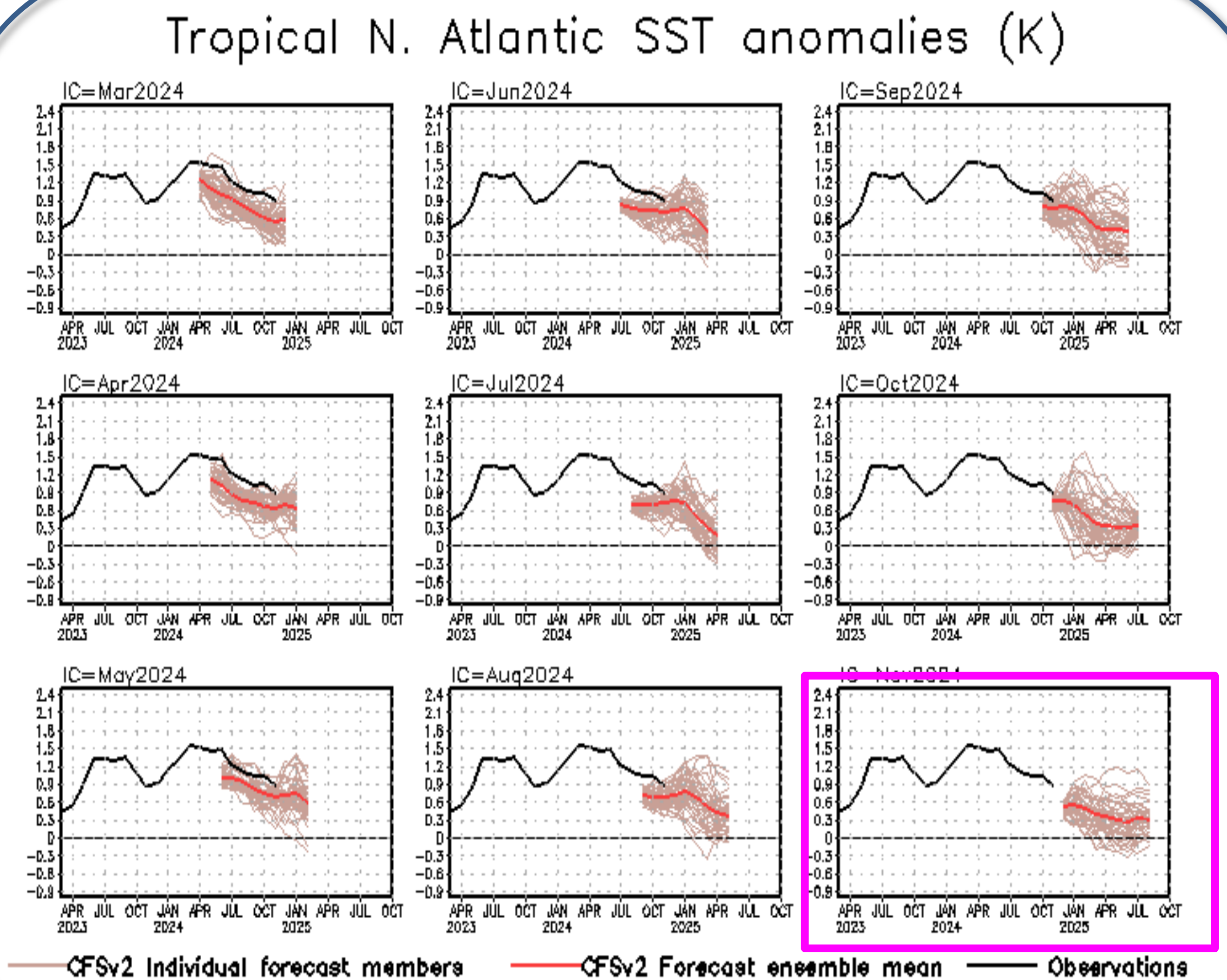
CFS Pacific Decadal Oscillation (PDO) Index Predictions from Different Initial Months



- CFSv2 predicts the negative phase of PDO will continue through Summer 2025.

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.

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



- Latest CFSv2 predictions call for above-normal SST 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].

Acknowledgement

- Drs. Arun Kumar, Zeng-Zhen Hu and Jieshun Zhu: reviewed PPT, and gave insightful suggestions and comments

- Drs. Yanjuan Guo and Pingping Xie provided the BASS/CMORPH/CFSR EVAP package

- Drs. Jieshun Zhu & Wanqiu Wang maintained the sea ice forecasts

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)

- **NCEP/CPC Ocean Monitoring & 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

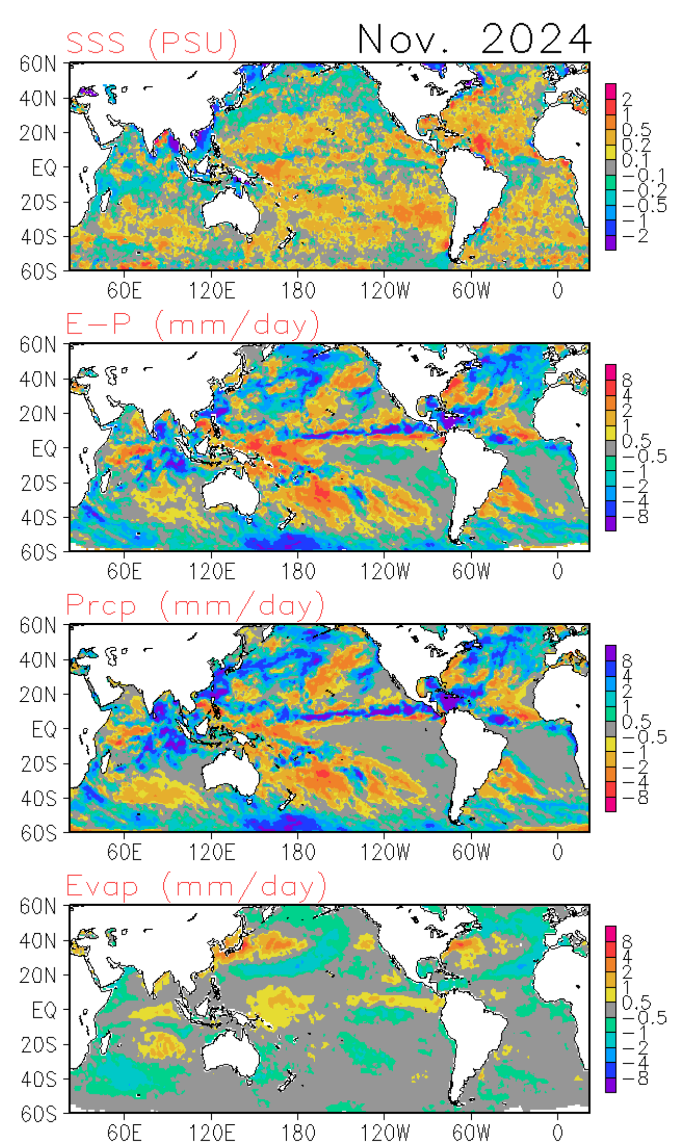
  http://www.cpc.ncep.noaa.gov/products/GODAS/multiora93_body.html

Backup Slides

Global Sea Surface Salinity (SSS): Anomaly for November 2024

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

Increased precipitation is found over the mid to high latitudes in both Pacific and Atlantic oceans, which corresponds to active storm track activities over these regions. Over the storm track core region, the evaporation is also increased, likely due to the storm associated wind effects. As a result, the salinity displays negative anomalies over large regions of the mid-high latitude oceans. On the other hand, oceanic regions more controlled by the subtropical high activity display overall positive salinity anomalies.



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

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

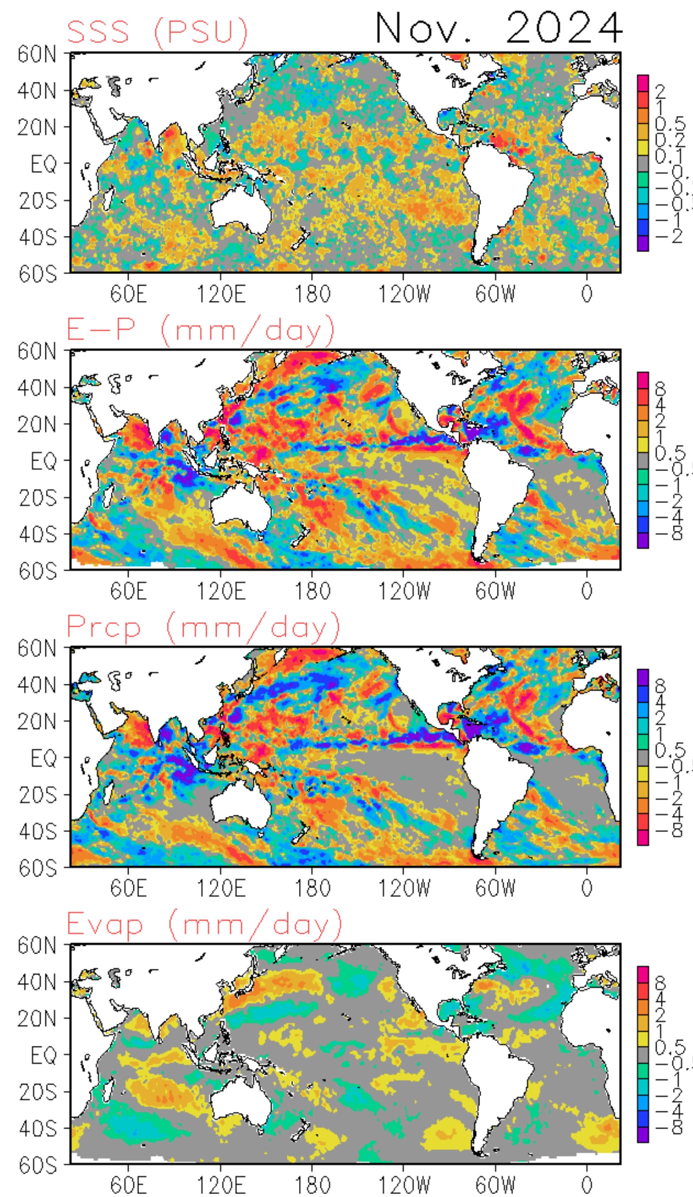
ftp.cpc.ncep.noaa.gov/precip/BASS

Precipitation: CMORPH adjusted satellite precipitation estimates

Evaporation: Adjusted CFS Reanalysis

Global Sea Surface Salinity (SSS): Tendency for November 2024

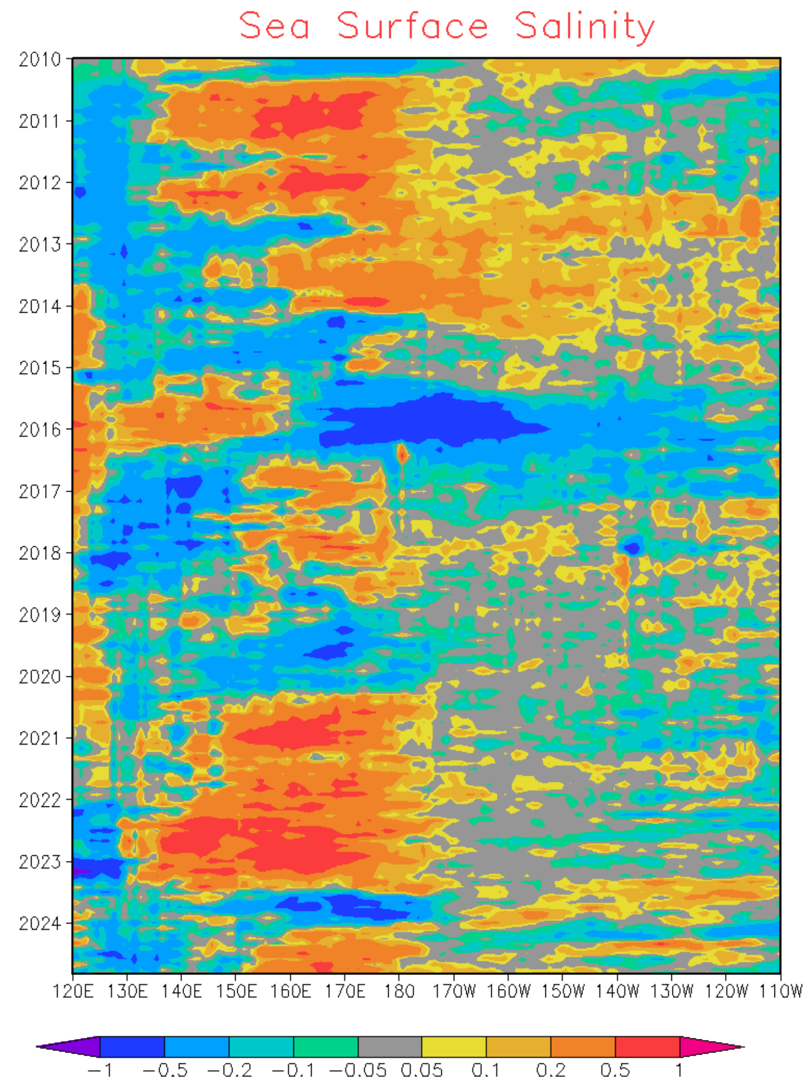
The global SSS tendency map shows more mixed signs and is much noisier than the SSS anomaly pattern. The SSS tendency exhibits reducing salinity over many regions of the mid-high latitudes, which is consistent with increased storm track activities over these regions. Subtropical regions overall display more positive values, indicating increasing salinity, which is likely due to the subtropical high controlling.



Monthly SSS Anomaly Evolution over Equatorial Pacific

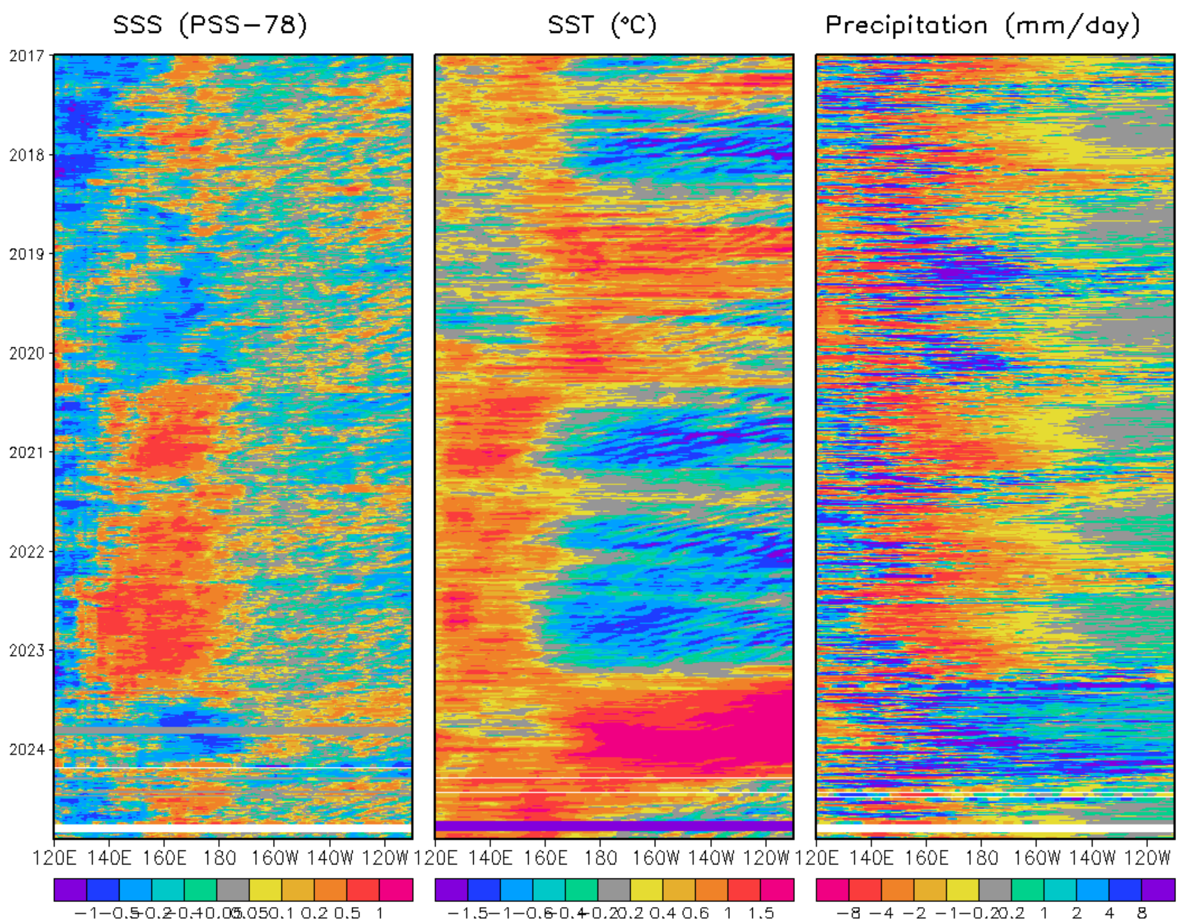
NOTE: Since June 2015, the BASS SSS is from in situ, SMOS and SMAP; before June 2015,The BASS SSS is from in situ, SMOS and Aquarius.

- Hovermoller diagram for equatorial SSS anomaly **(5S-5˚N);**
- Decreased SSS is found over the warm pool region, but increased over the central Pacific. SSS decreasing is also found over the equatorial eastern Pacific.

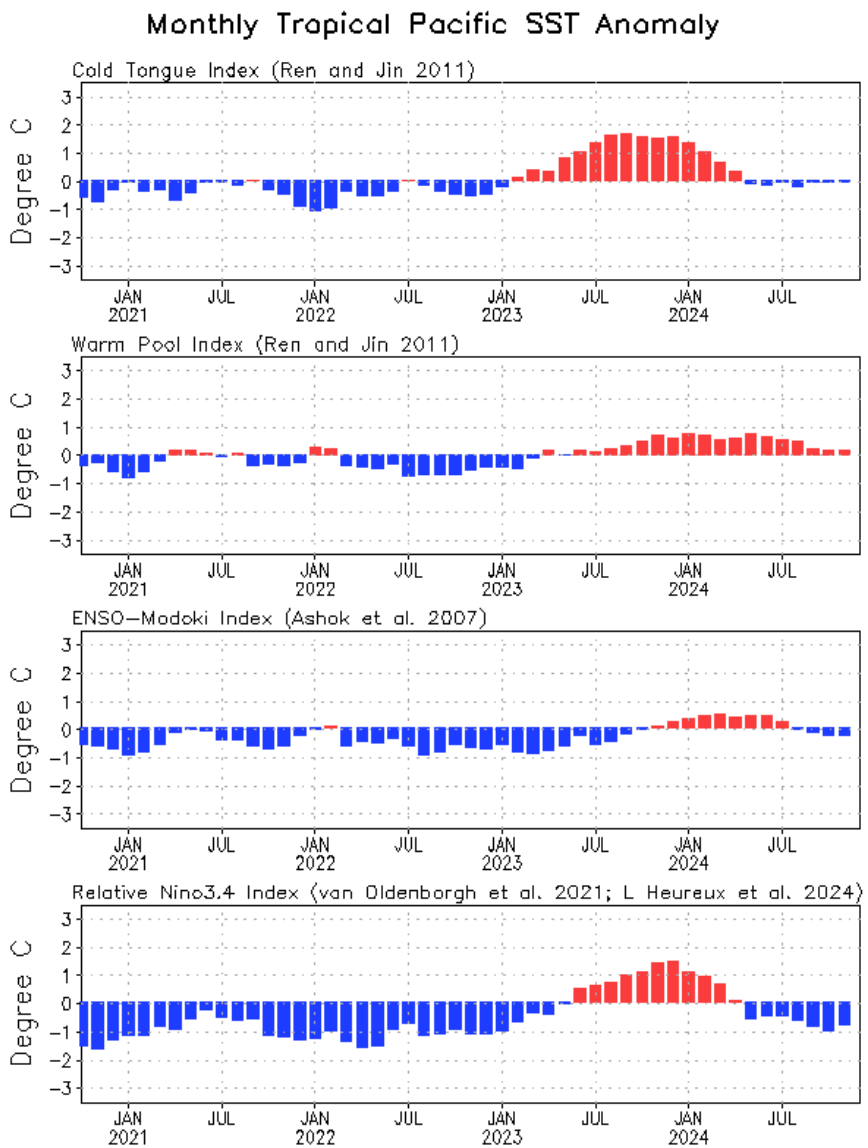


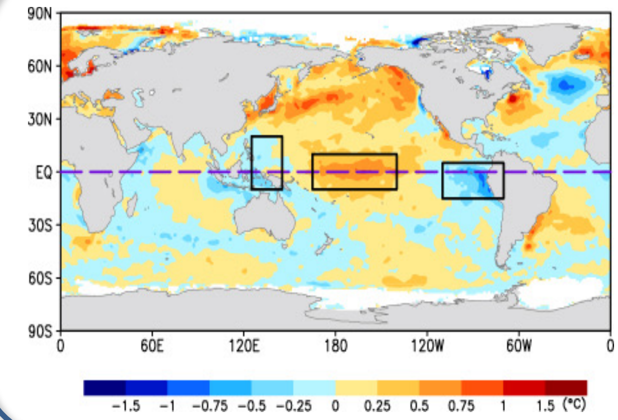
Pentad SSS Anomaly Evolution over Equatorial Pacific

Figure caption: Hovermoller 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.



Evolution of Pacific Niño SST Indices



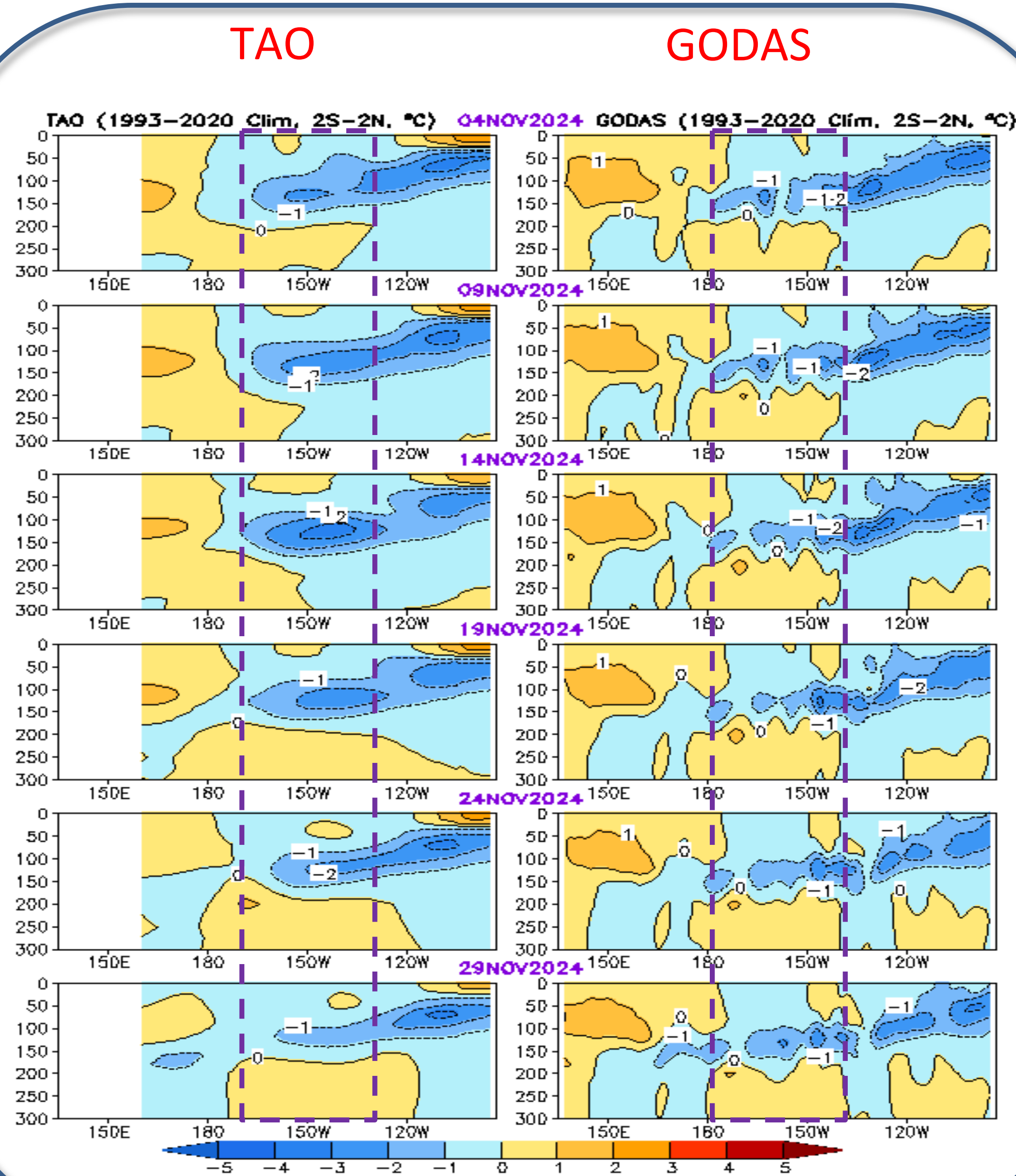


- Relative Niño3.4 index is now included in ENSO monitoring, which is defined as the conventional Niño3.4 index minus the SSTA averaged in the whole tropics (0º-360º, 20ºS-20ºN), in order to remove the global warming signal. Also, to have the same variability as the conventional Niño3.4 index, the relative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

Relative Niño3.4 data updated monthly at:

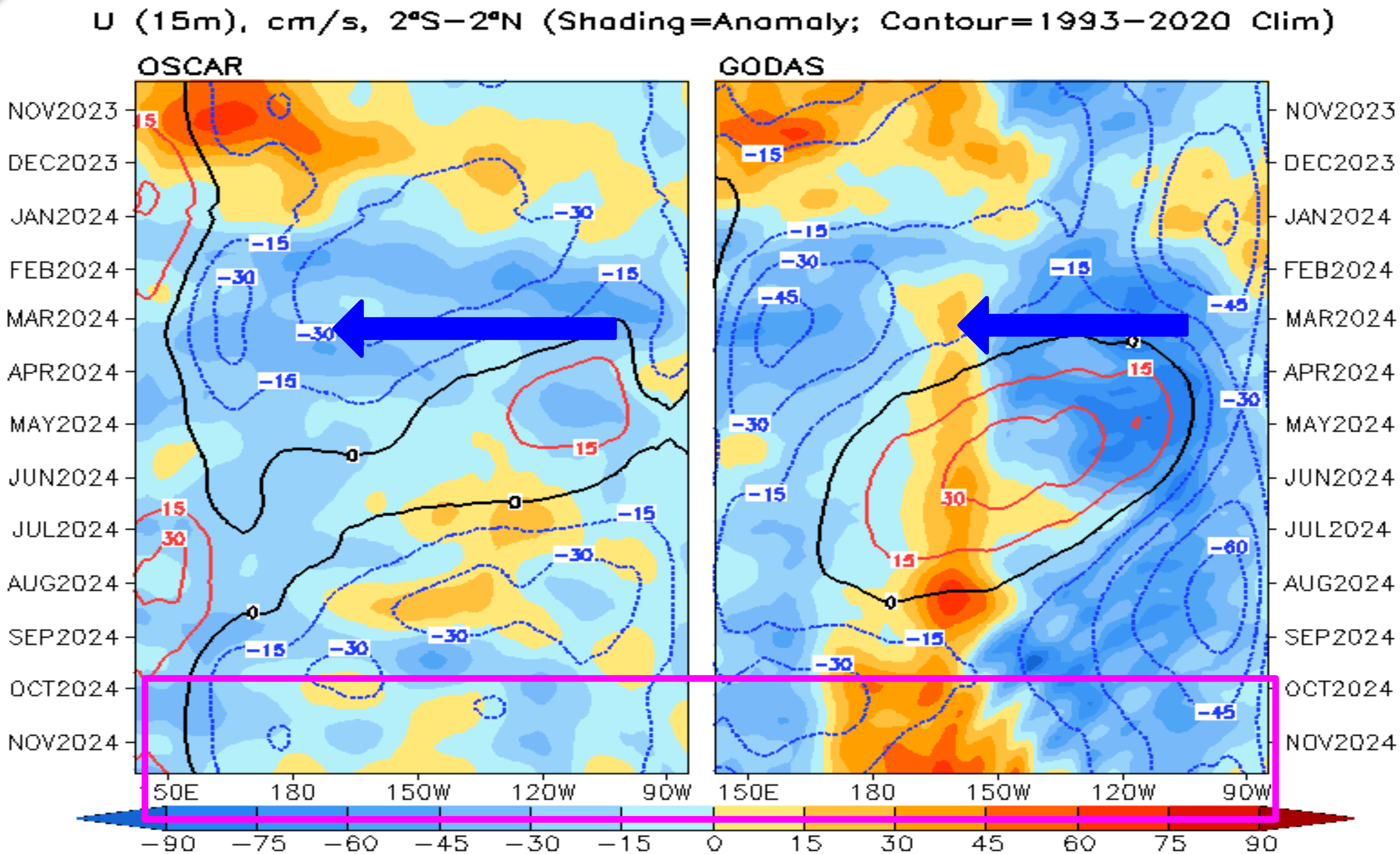
https://www.cpc.ncep.noaa.gov/data/indices/RONI.ascii.txt

Equatorial Pacific Ocean Temperature Pentad Mean Anomaly



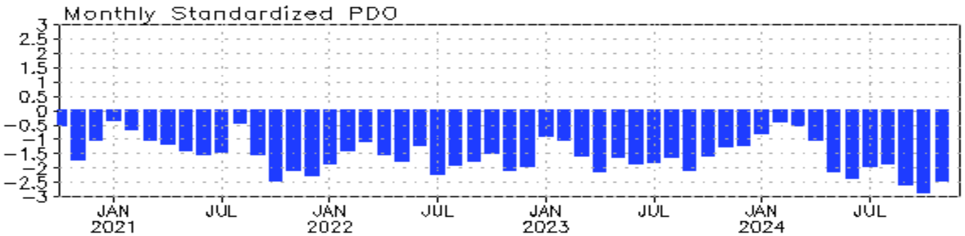
- Both TAO and GODAS show negative subsurface temperature weakened in the central-eastern Pacific during the last six pentads.

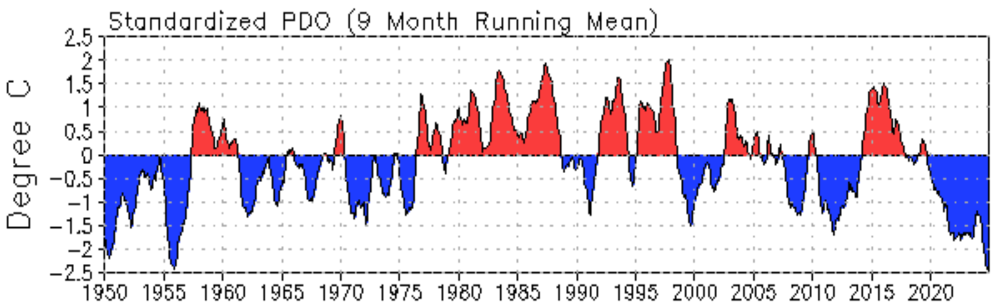
Evolution of Equatorial Pacific Surface Zonal Current Anomaly (cm/s)

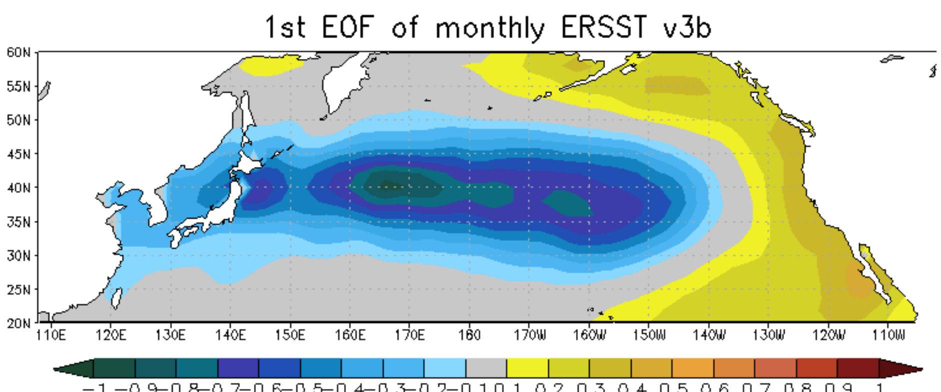


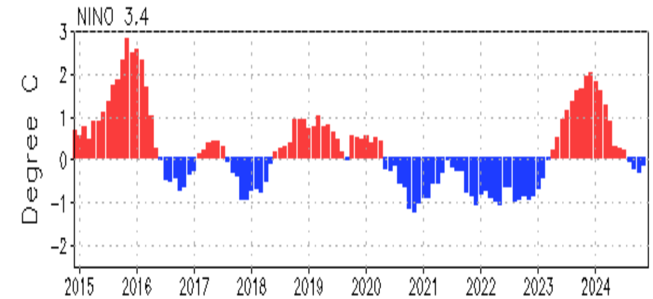
- Anomalous westward currents have been observed since mid-Dec 2023 with a weakening since May 2024 in OSCAR.
- Anomalous westward currents persisted east of 150W during Oct 2024 in GODAS, while were near average in OSCAR.

Pacific Decadal Oscillation (PDO) Index



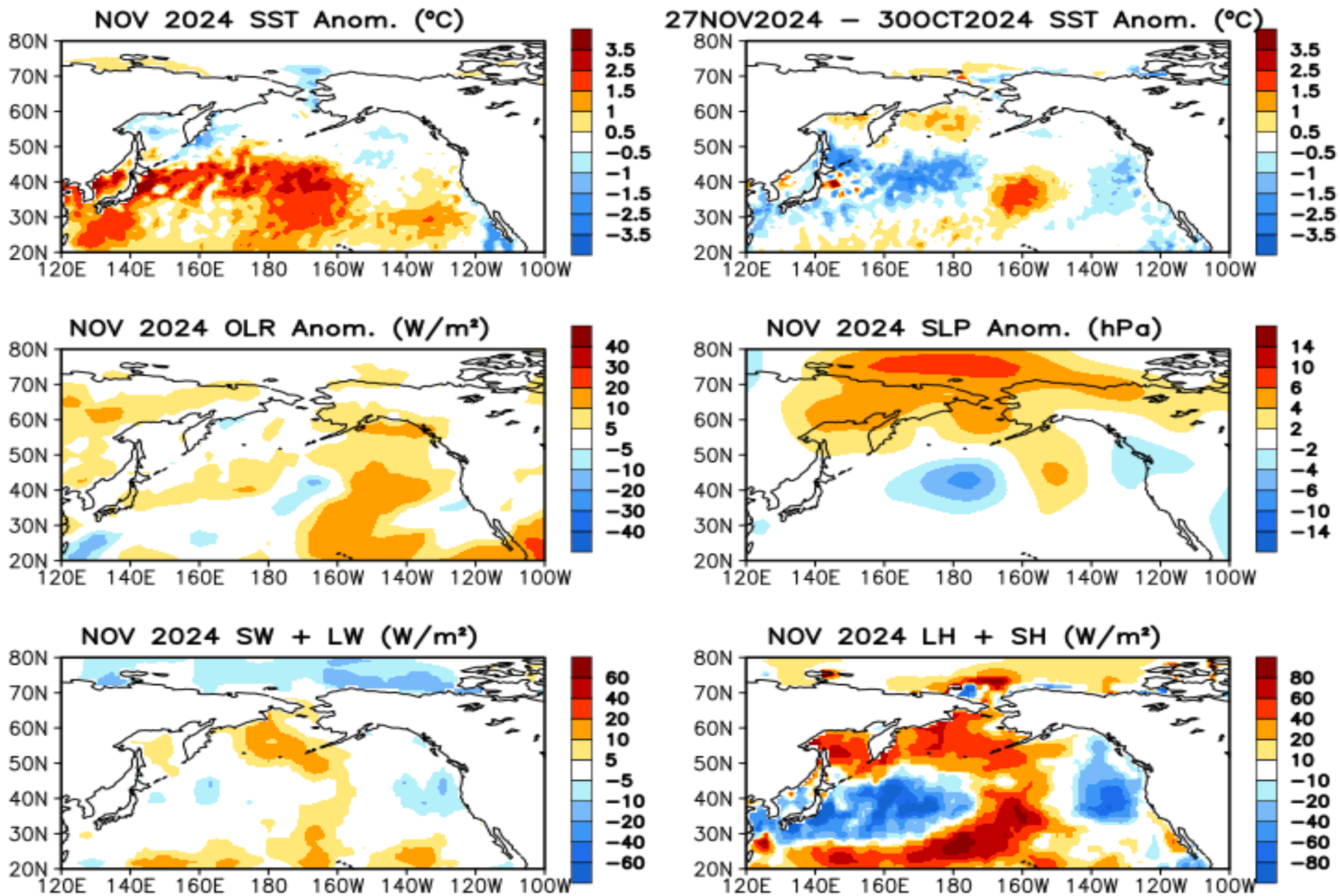






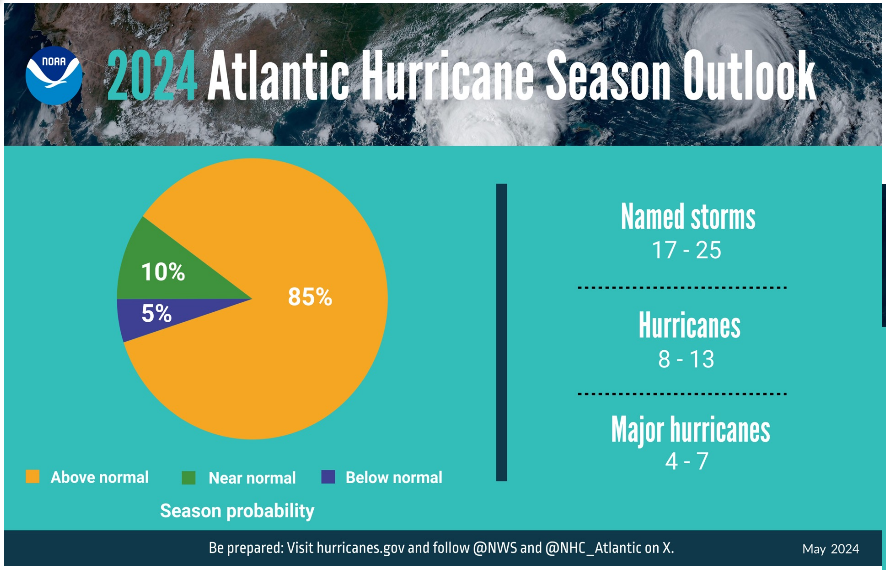
- The PDO has been in a negative phase since Jan 2020 and weakened slightly with PDOI = -2.9 in Oct 2024.
- Statistically, ENSO leads PDO by 3-4 months, through teleconnection via atmospheric bridge, with El Niño (La Niña) associated with positive (negative) PDO Index, but this relationship has weakened in recent years.

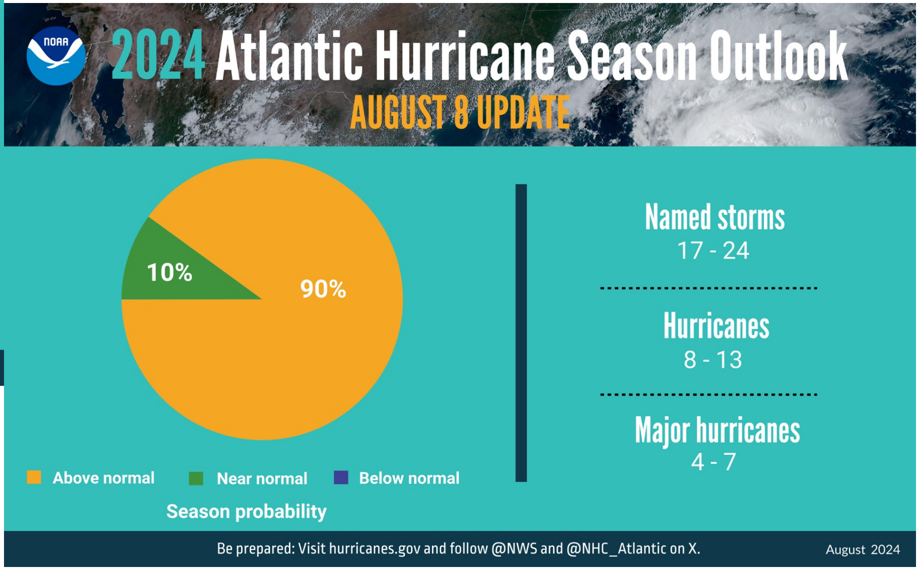
• PDO is defined as the 1st EOF of monthly ERSST v3b in the North Pacific for the period 1900-1993. PDO index is the standardized projection of the monthly SST anomalies onto the 1st EOF pattern.



SSTA (top-left; OSTIA 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.

2024 Atlantic Hurricane Season Outlook Update



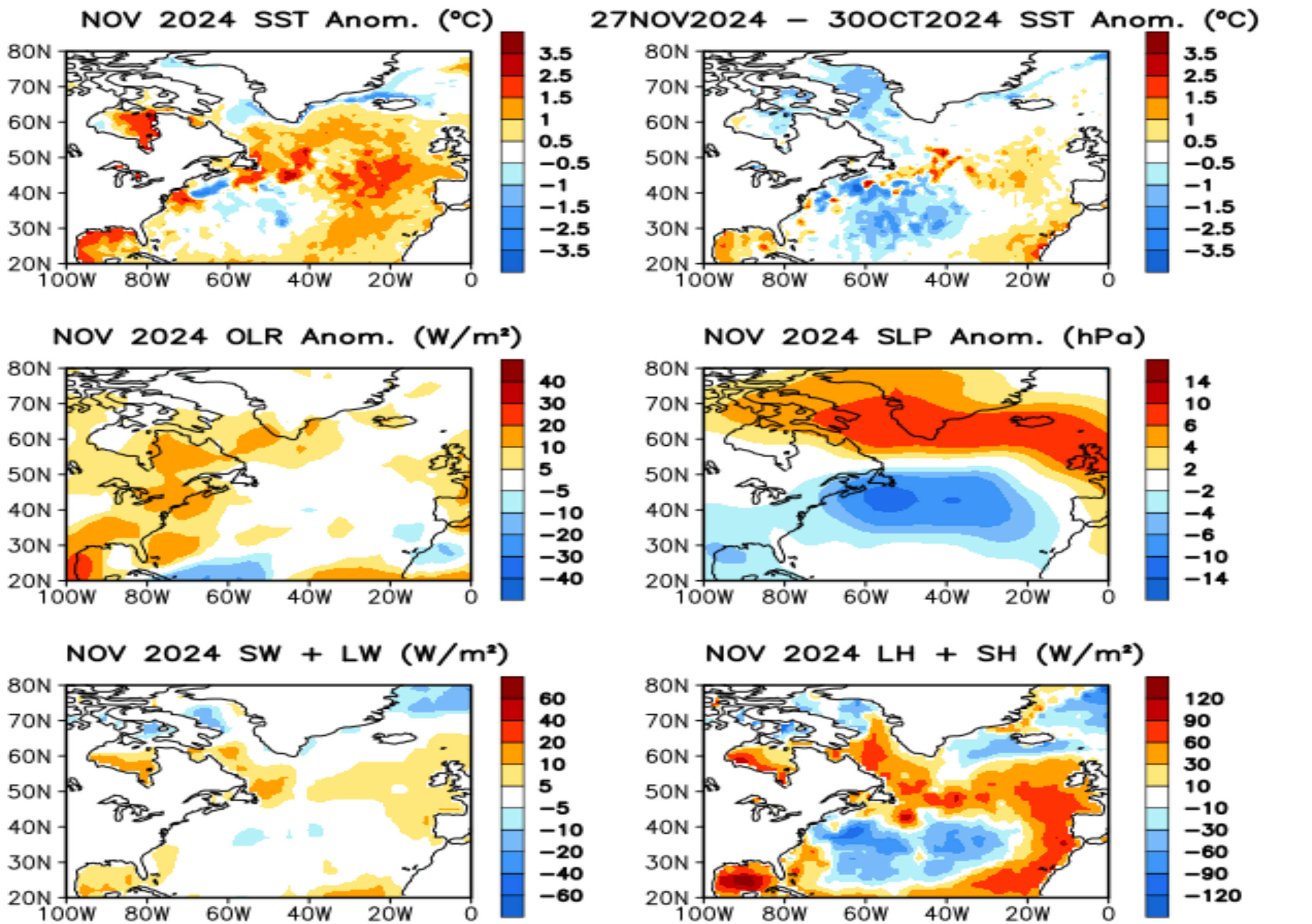


- NOAA forecasters have increased the likelihood of an above-normal Atlantic hurricane season from 85%in outlook issued in May to 90% in August outlook update.
- Main climate factors expected to influence the 2024 Atlantic hurricane activity are :

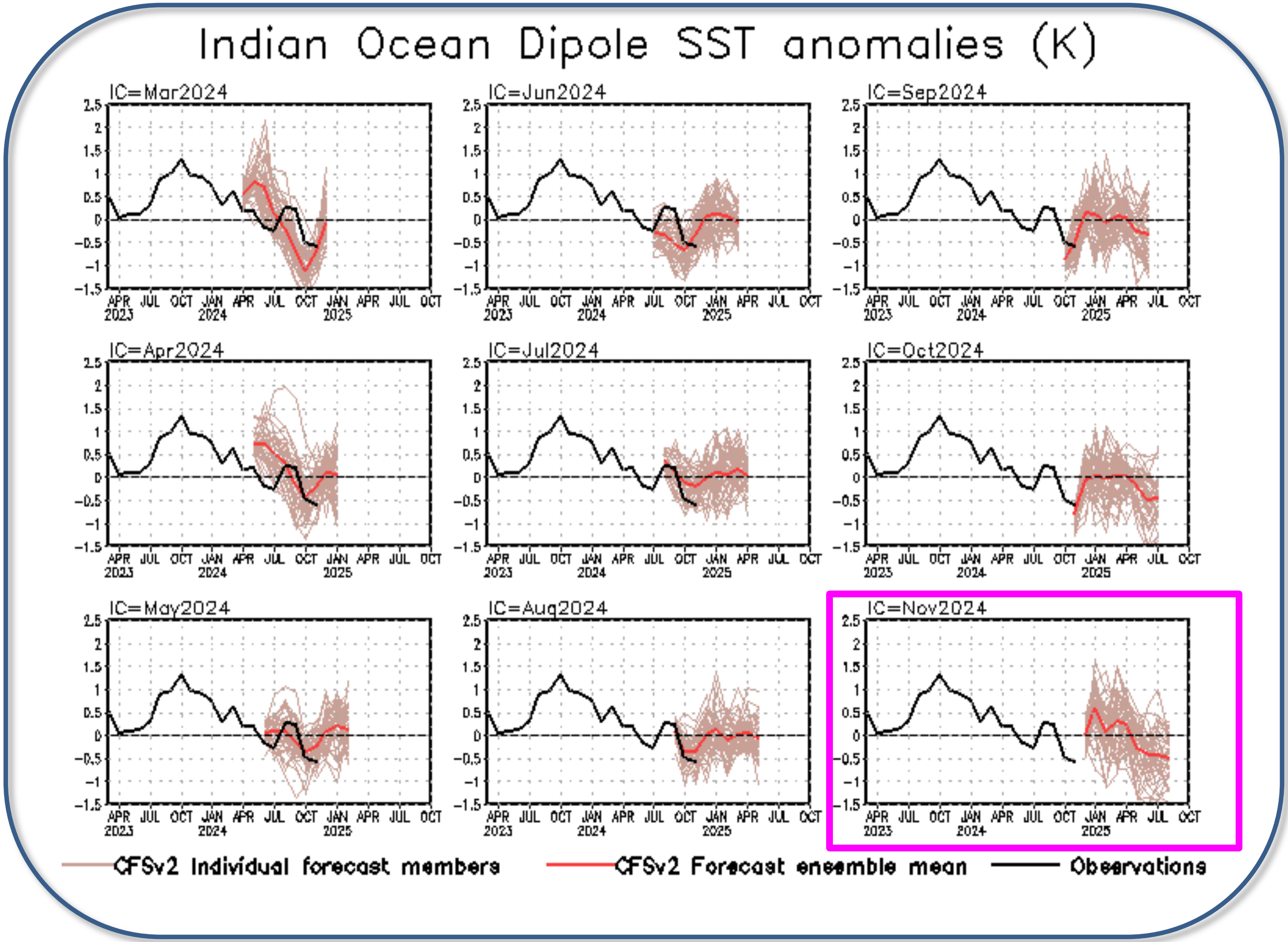
Continuous of warm phase of AMO
Near historical high record of SST over the MDR
Below normal 200-850hPa wind shear
Enhanced west African monsoon
High chance of La Nina development during peak of the hurricane season

(https://www.cpc.ncep.noaa.gov/products/outlooks/hurricane.shtml)

North Atlantic Ocean: SSTA, SSTA Tend., OLR, SLP, Sfc Rad, Sfc Flx Anomalies



NCEP CFS DMI SST Predictions from Different Initial Months



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.