

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

Prepared by
Climate Prediction Center, NCEP/NOAA
December 10, 2021

<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)



- Overview
- Recent highlights
 - Pacific/Arctic Ocean
 - Indian Ocean
 - Atlantic Ocean
- Global SST Anomaly Predictions

• Pacific Ocean

- La Niña condition continued in Nov 2021.
- NOAA “ENSO Diagnostic Discussion” on 9 Dec 2021 states that “La Niña is favored to continue through the Northern Hemisphere winter 2021-22 (~95% chance) and transition to ENSO-neutral during the spring 2022 (~60% chance during April-June)”
- Strong negative phase of PDO persisted in Nov 2021, with PDOI = -2.1.
- Marine Heat Waves (MHWs) persisted in the north central Pacific, and strong SST warming emerged in the northeast Pacific.

• Indian Ocean

- Negative Indian Ocean dipole (IOD) event continued, with IOD index = -0.5° C in Nov 2021.

• Atlantic Ocean

- 2021 Atlantic Niño conditions intensified in Nov 2021.
- The 2021 Atlantic hurricane season was the third most active season on record, producing twenty-one tropical storms.

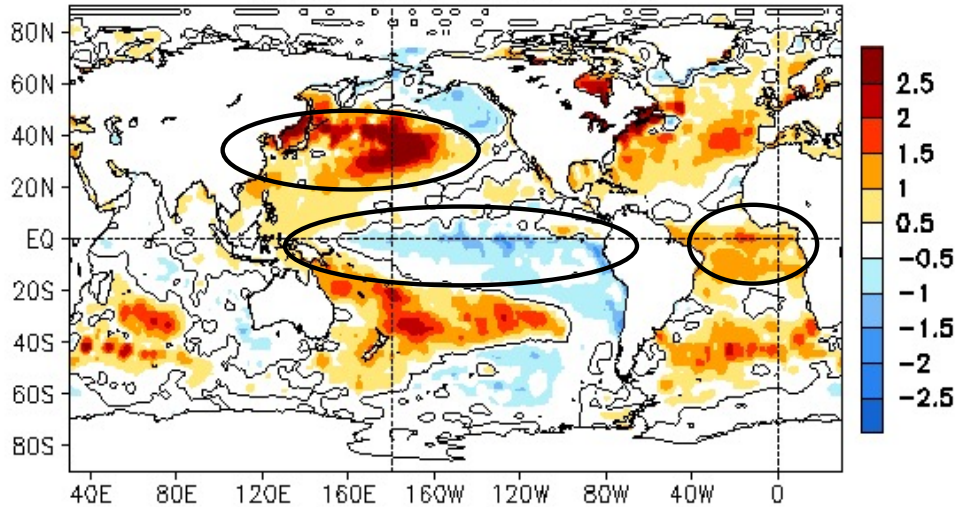
• Arctic Ocean

- The monthly average sea ice extent for Nov 2021 ranks the 10th lowest in the satellite record.

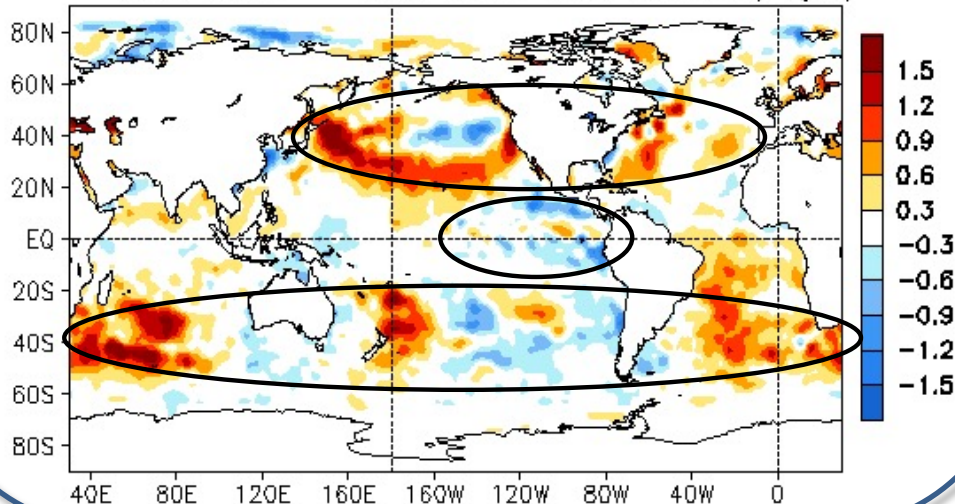
Global Oceans

Global SST Anomaly ($^{\circ}\text{C}$) and Anomaly Tendency

NOV 2021 SST Anomaly ($^{\circ}\text{C}$)
(1991–2020 Climatology)



NOV 2021 – OCT 2021 SST Anomaly ($^{\circ}\text{C}$)

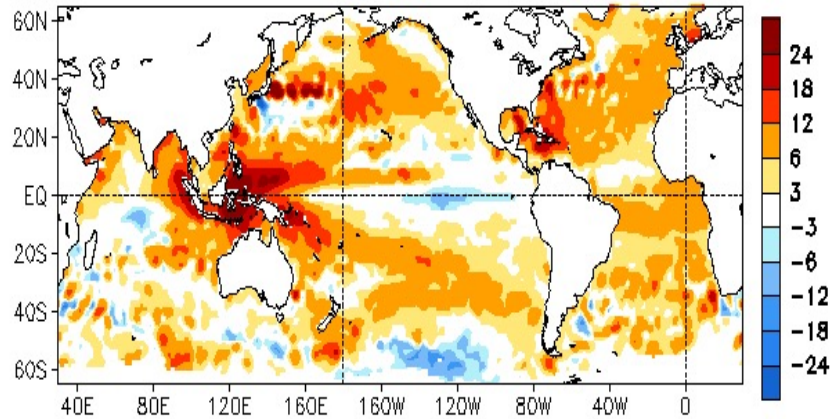


- SSTs remained well-below average in the central-eastern equatorial Pacific.
- Strong SSTAs continued in mid-to-high latitude north Pacific.
- SSTs were above average across most of the Atlantic Ocean.

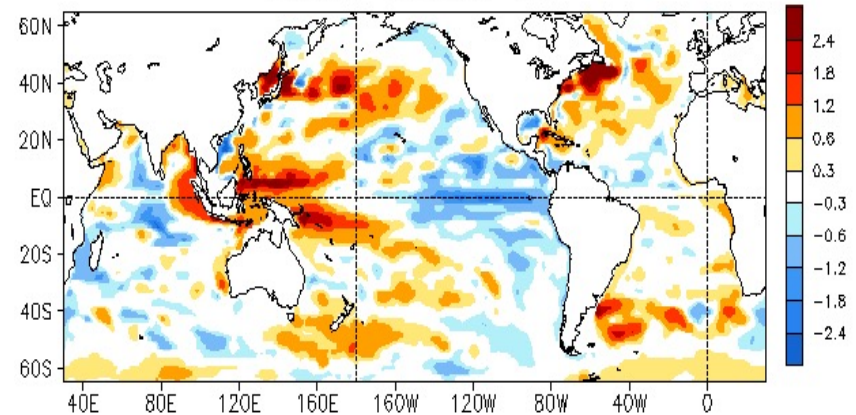
- Negative SSTA tendencies dominated in the central-eastern equatorial Pacific Ocean.
- Large SSTA tendencies were present in the mid latitudes of both hemispheres.

Global SSH and HC300 Anomaly & Anomaly Tendency

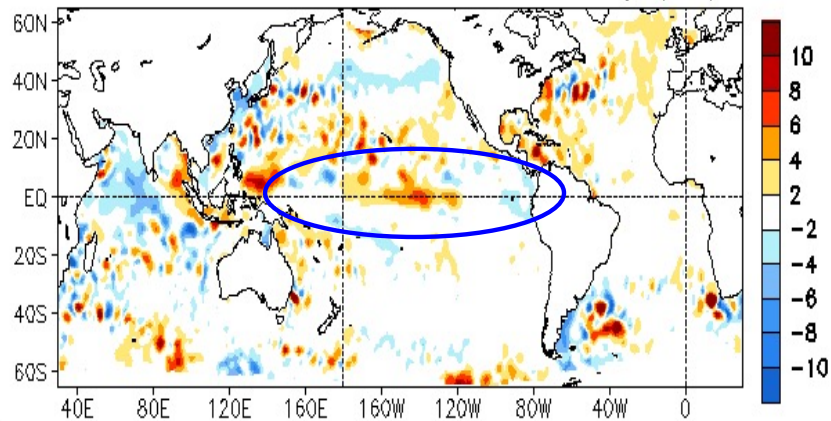
NOV 2021 SSH Anomaly (cm)
(AVISO Altimetry, Climo. 93-20)



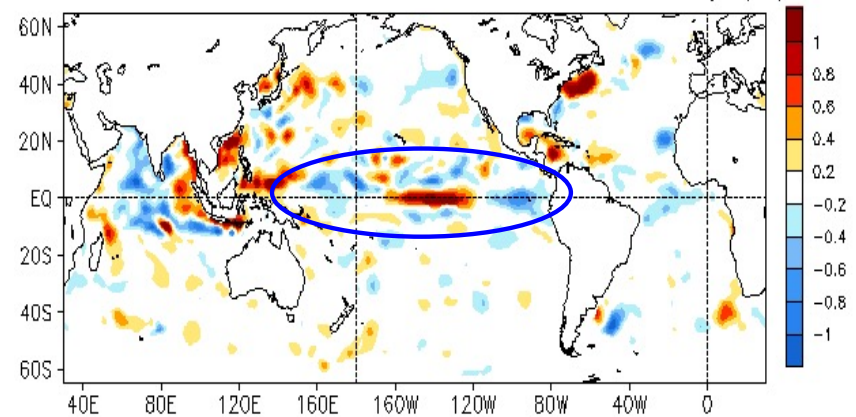
NOV 2021 Heat Content Anomaly (°C)
(GODAS, Climo. 91-20)



NOV 2021 - OCT 2021 SSH Anomaly (cm)

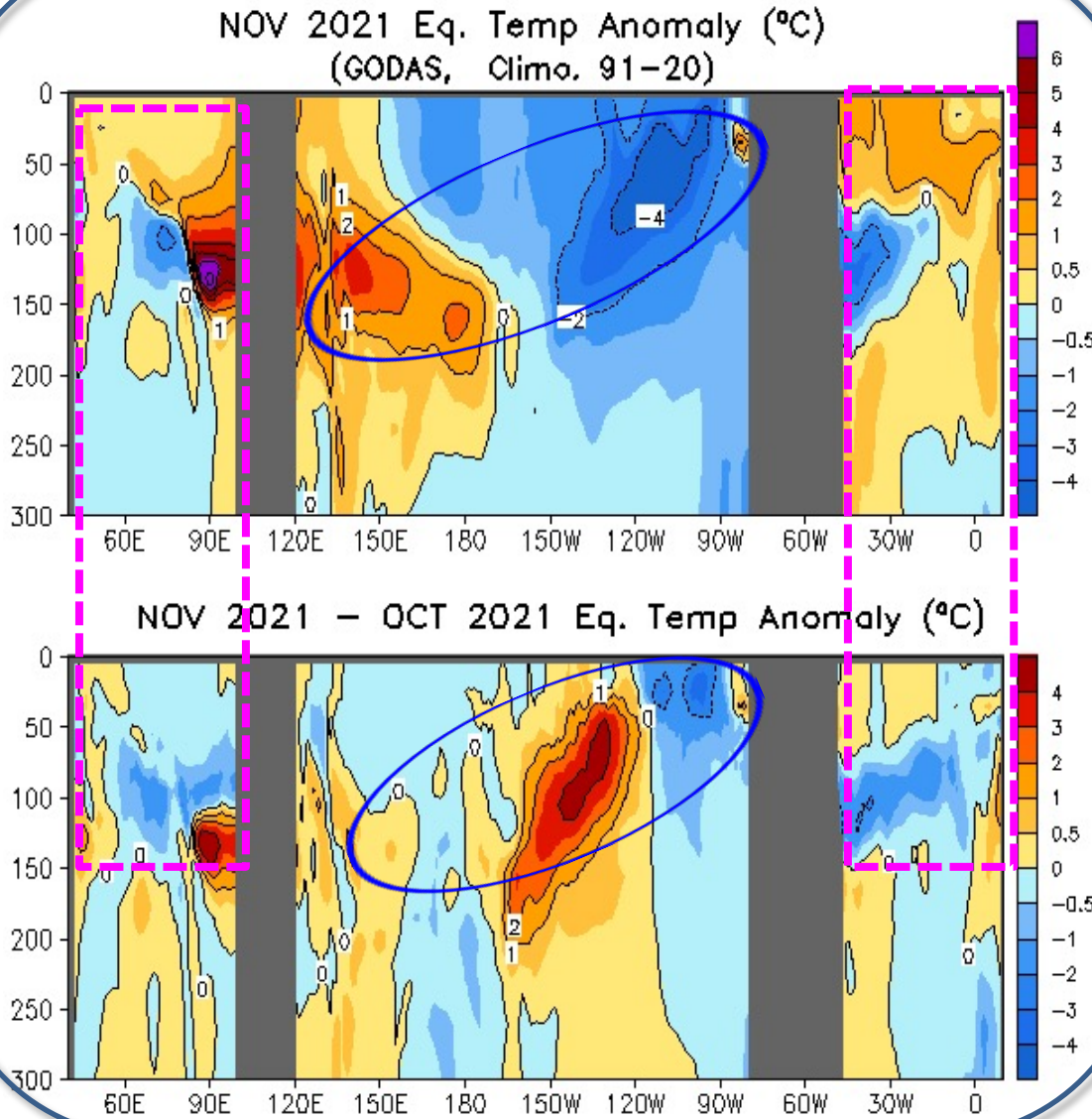


NOV 2021 - OCT 2021 Heat Content Anomaly (°C)



- Overall, the SSHA pattern was consistent with the HC300A pattern, but with a significant trend component in SSHA.
- Positive tendency anomalies were present in the central-eastern Pacific both in AVISO Altimetry and GODAS H300 data.

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



- Negative (positive) subsurface ocean anomalies persisted along the central-eastern (western) thermocline in the Pacific Ocean.
- Positive anomalies continued in the upper 100m of the equatorial Atlantic Ocean.
- Positive subsurface anomalies persisted in the eastern Indian Ocean.

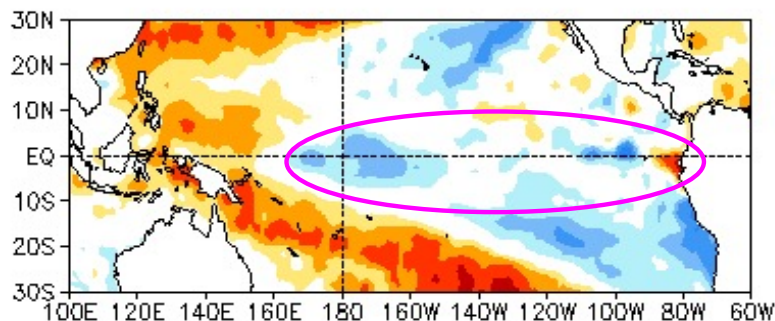
- Strong positive temperature anomaly tendency presented along the thermocline in the central-eastern Pacific Ocean.
- Negative temperature anomaly tendency dominated in the thermocline of Atlantic Ocean.

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

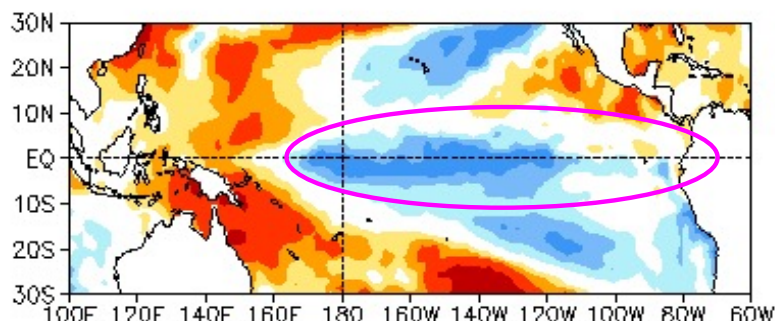
Tropical Pacific Ocean and ENSO Conditions

Latest 3-month Tropical Pacific SST , OLR, & uv925 anomalies

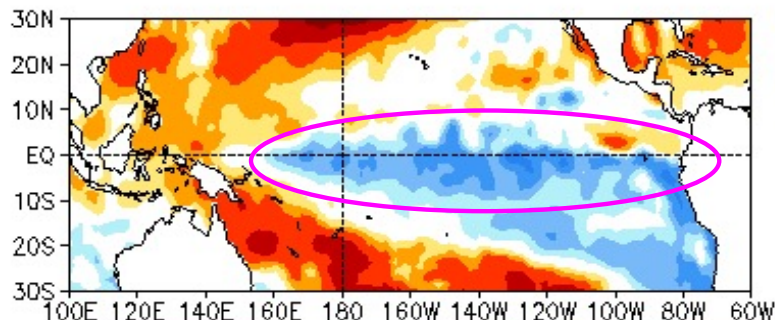
SEP 2021 SST Anom. ($^{\circ}\text{C}$)



OCT 2021 SST Anom. ($^{\circ}\text{C}$)

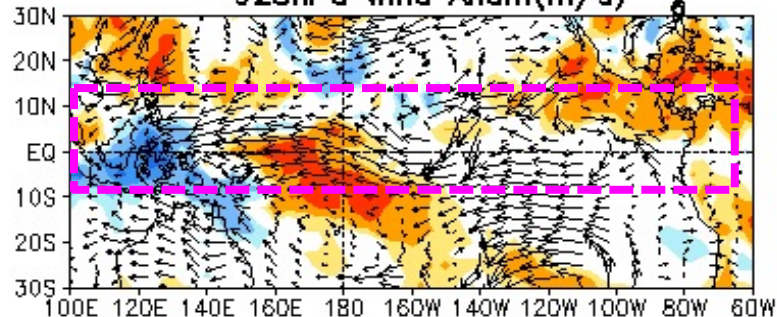


NOV 2021 SST Anom. ($^{\circ}\text{C}$)

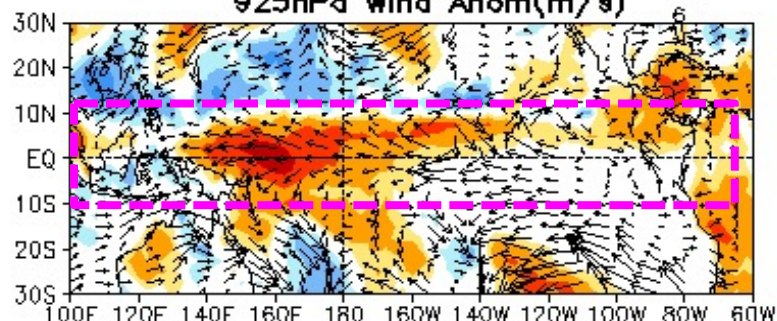


-2.5 -1.5 -0.9 -0.6 -0.3 0.3 0.6 0.9 1.5 2.5

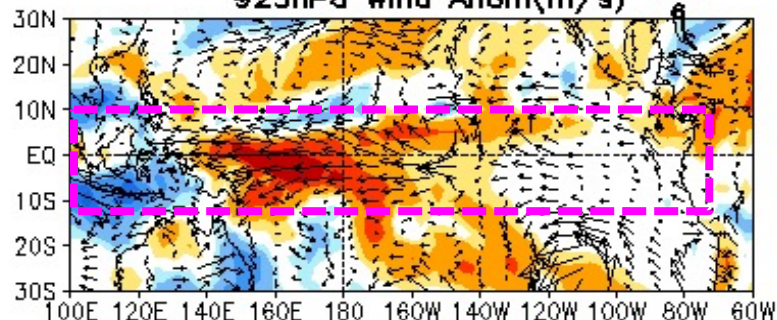
SEP 2021 OLR Anom. (W/m^2)
925hPa Wind Anom. (m/s)



OCT 2021 OLR Anom. (W/m^2)
925hPa Wind Anom. (m/s)

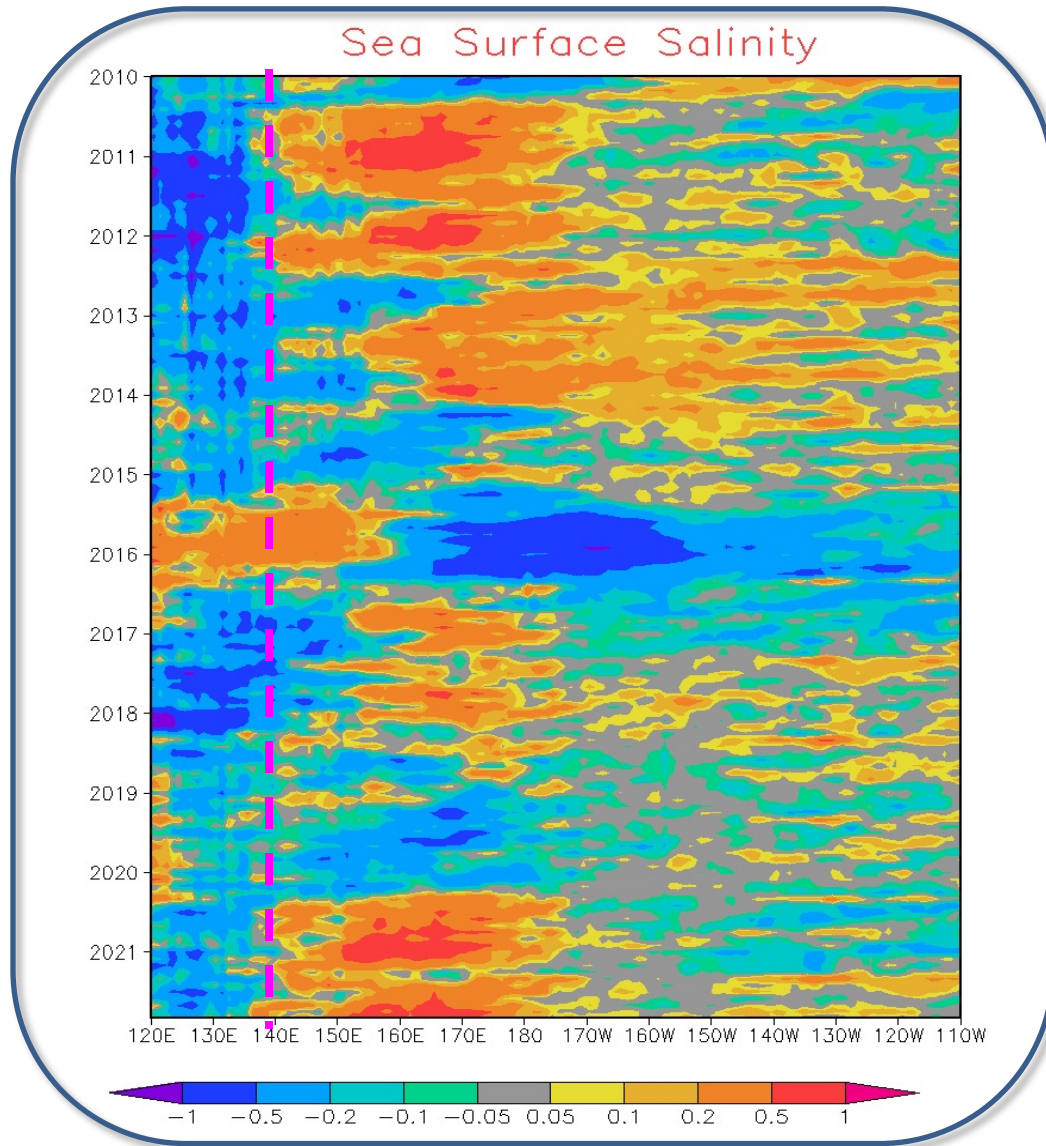


NOV 2021 OLR Anom. (W/m^2)
925hPa Wind Anom. (m/s)



-40 -30 -20 -10 -5 5 10 20 30 40

Equatorial Pacific Sea Surface Salinity(SSS) Anomaly



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

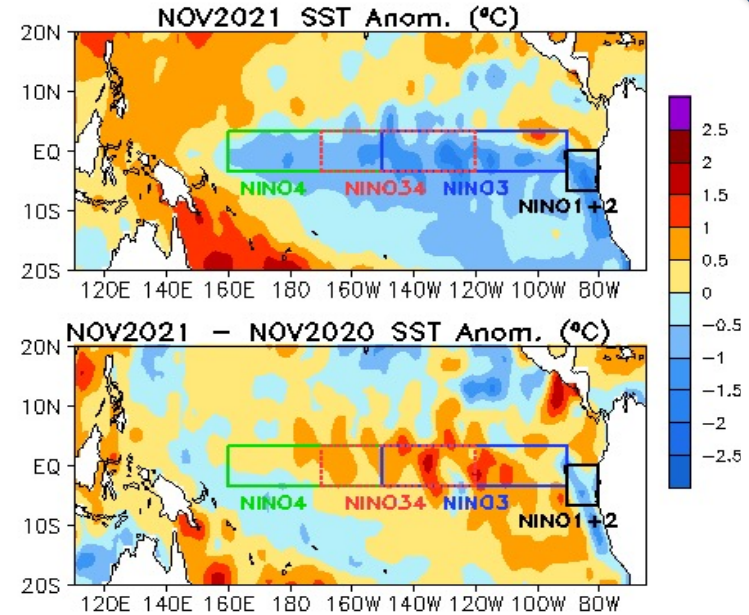
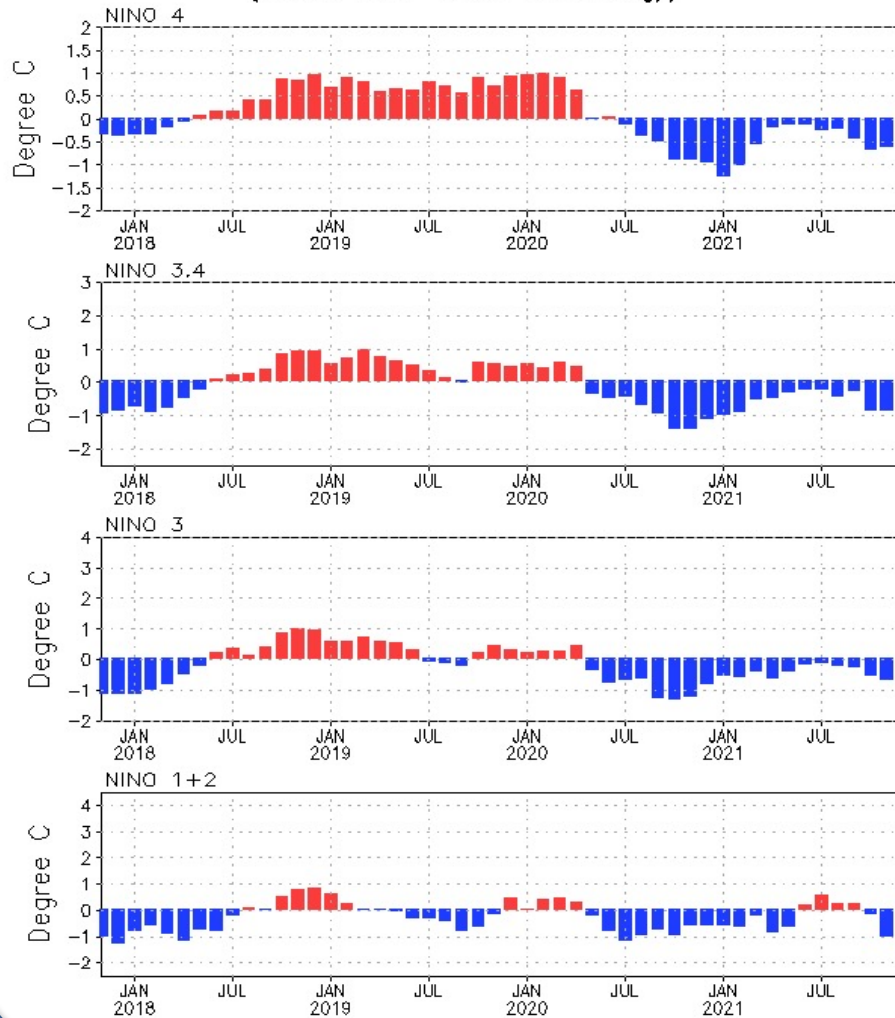
- Positive SSS anomaly persisted around 140E-170W in Nov 2021.

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

<ftp.cpc.ncep.noaa.gov/precip/BAS>.

Evolution of Pacific Niño SST Indices

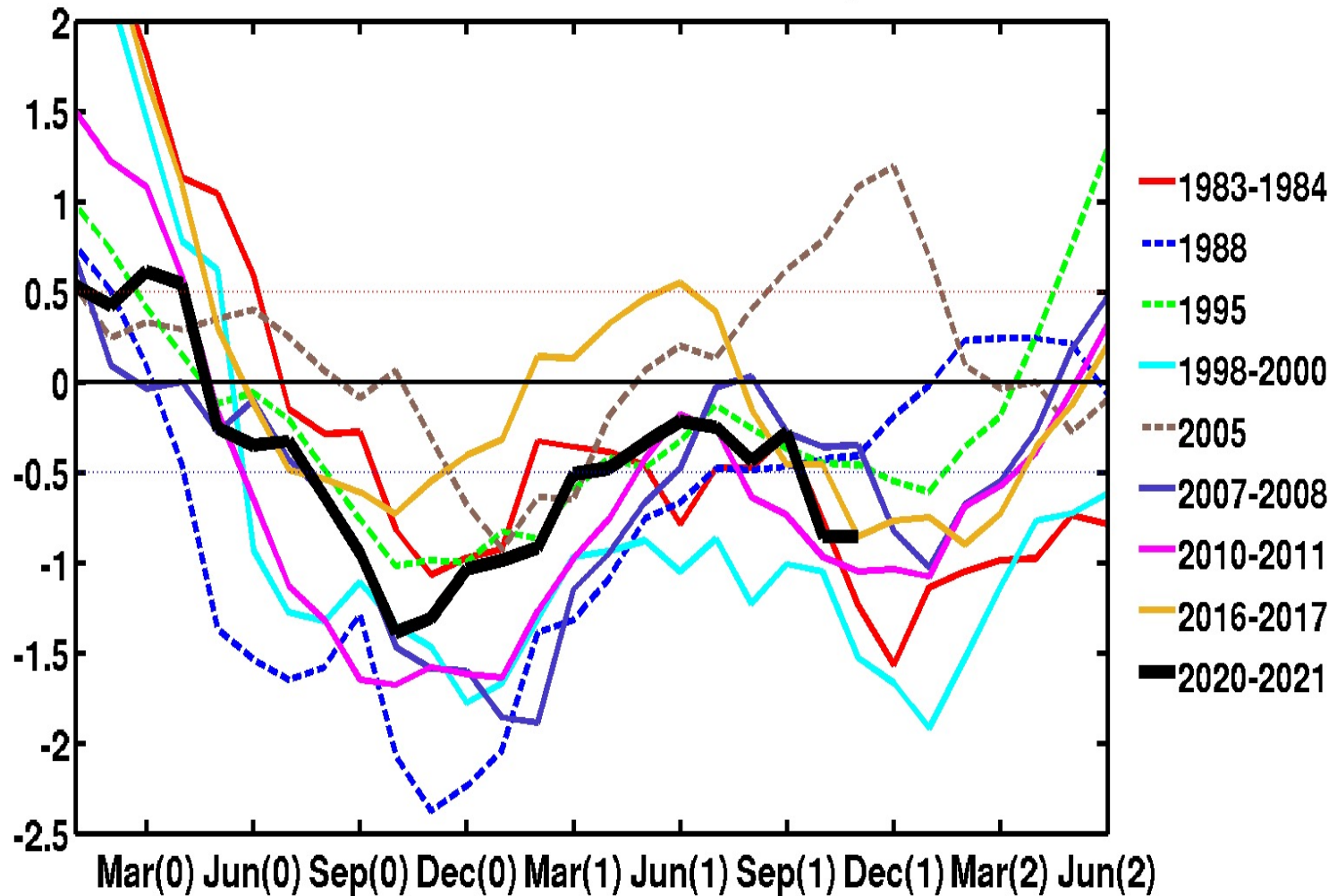
Monthly Tropical Pacific SST Anomaly
(OISST, 1991–2020 Climatology)



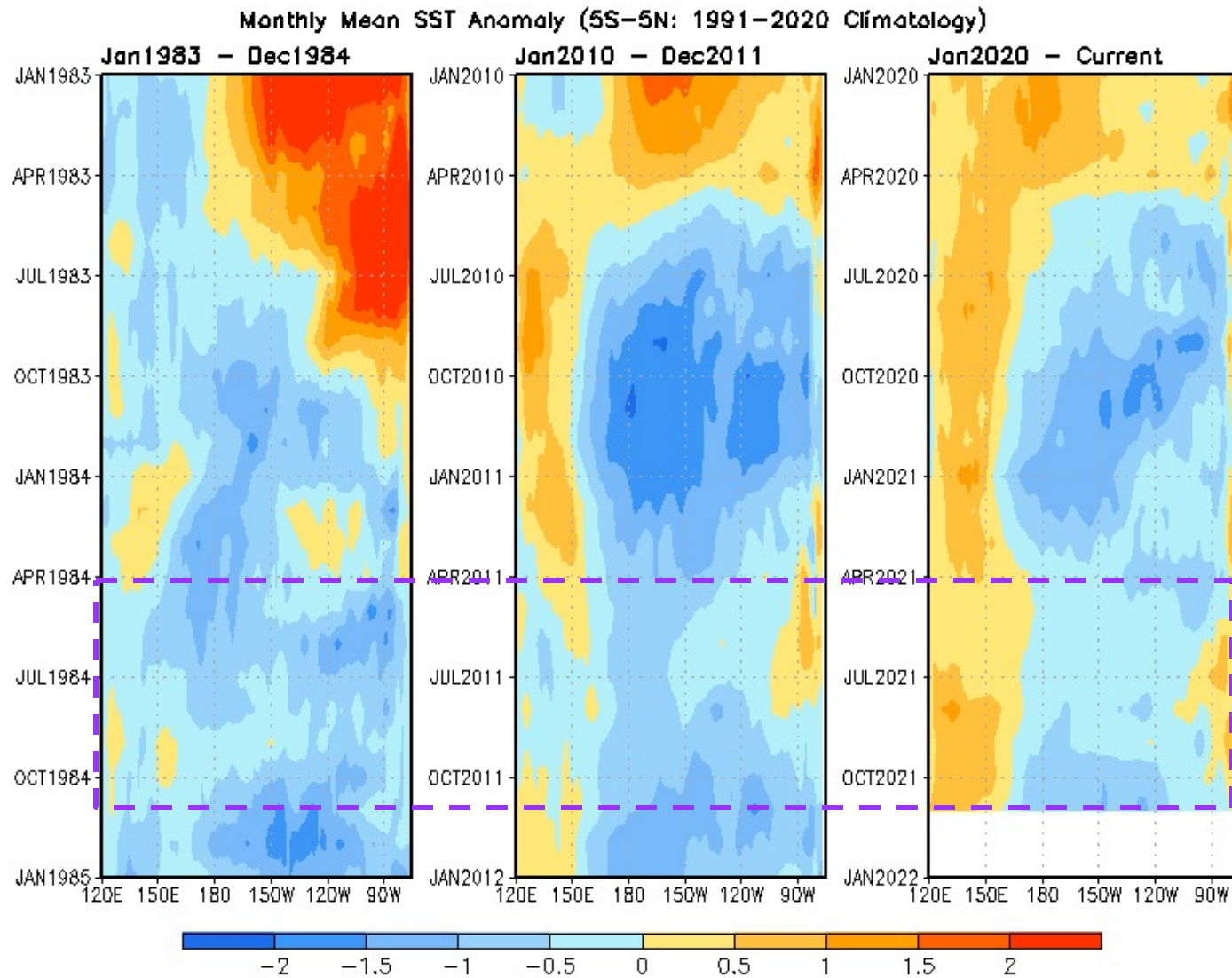
- Negative Niño1+2 increased substantially in Nov 2021.
- Negative Niño3.4 persisted, with Niño3.4 = -0.9°C.
- Compared with Nov 2020, the central and eastern equatorial Pacific was warmer in Nov 2021.
- The indices may have slight differences for different SST products.

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

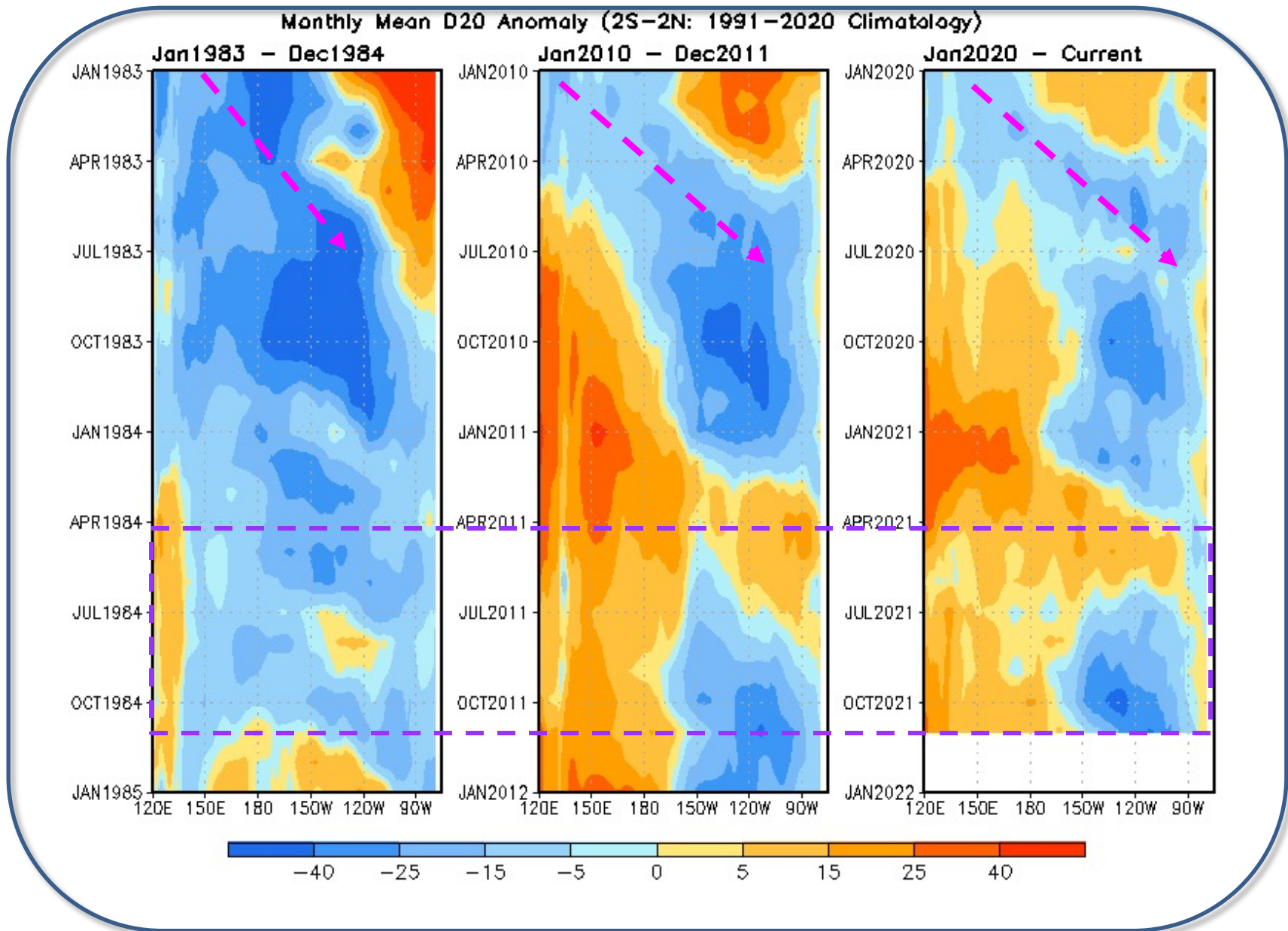
NINO34 SST Anomaly



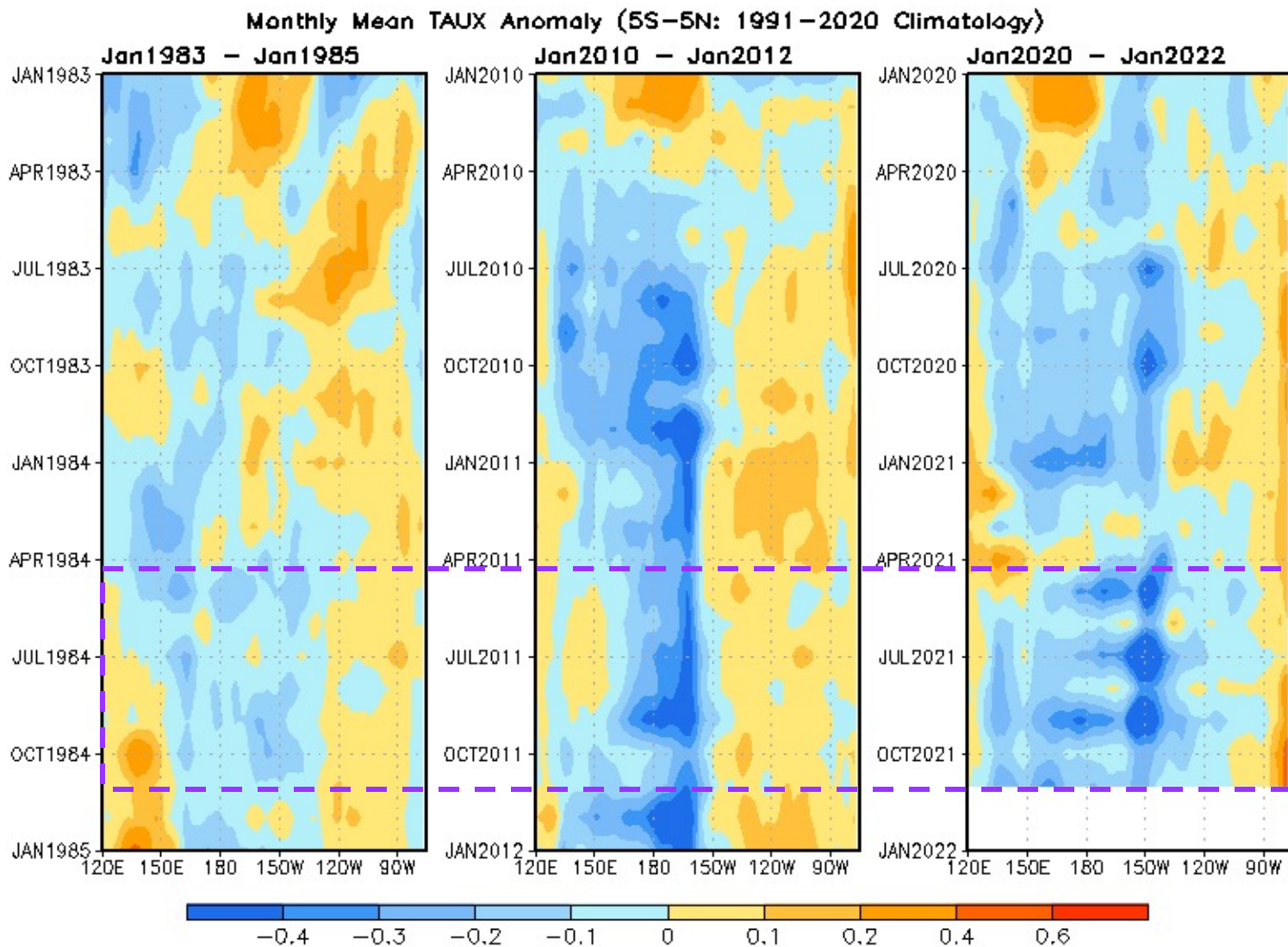
Evolution of Monthly Mean SST Anomaly across [5S-5N]



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

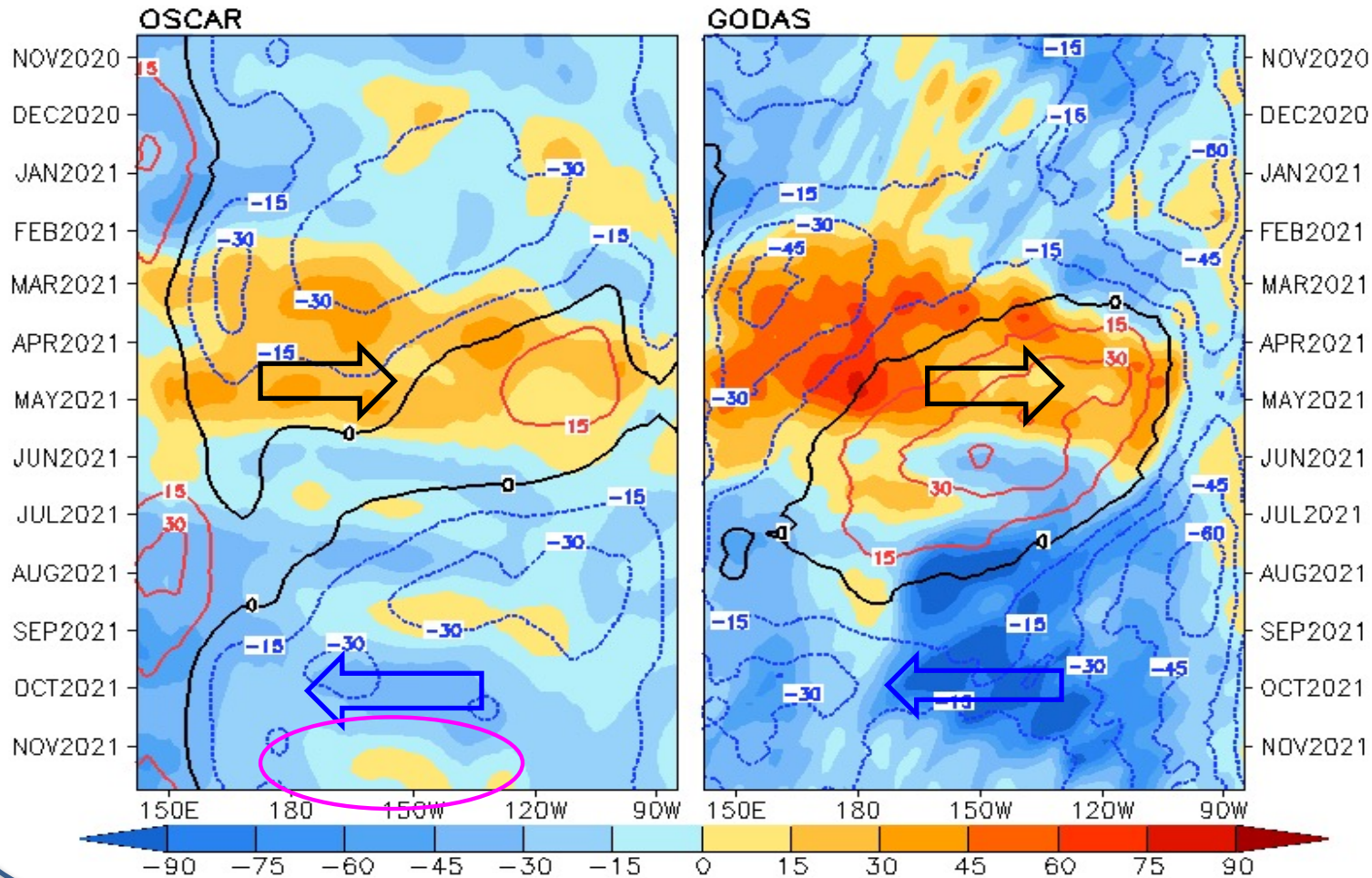


Evolution of Monthly Mean Zonal Wind Stress Anomaly across [5S-5N]



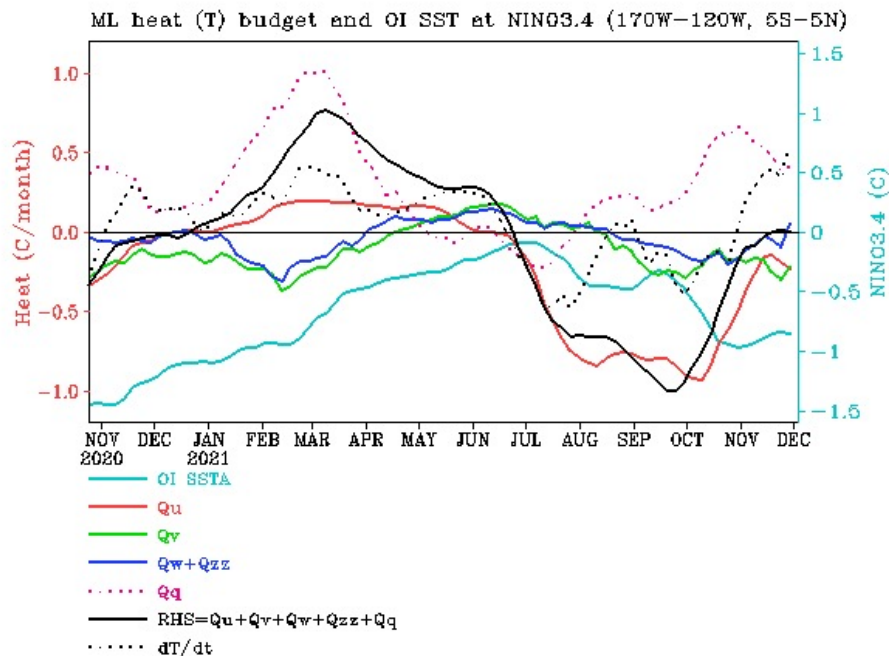
Evolution of Equatorial Pacific Surface Zonal Current Anomaly (cm/s)

U (15m), cm/s, 2°S–2°N (Shading=Anomaly; Contour=1993–2020 Clim)



- Strong anomalous westward currents has persisted most of the equatorial Pacific in GODAS since Jul 2021, while OSCAR data was dominated by subseasonal variations.
- TIW-associated signatures were clearly observed in GODAS.
- Anomalous westward currents weakened in both OSCAR and GODAS in Nov 2021.

NINO3.4 Heat Budget

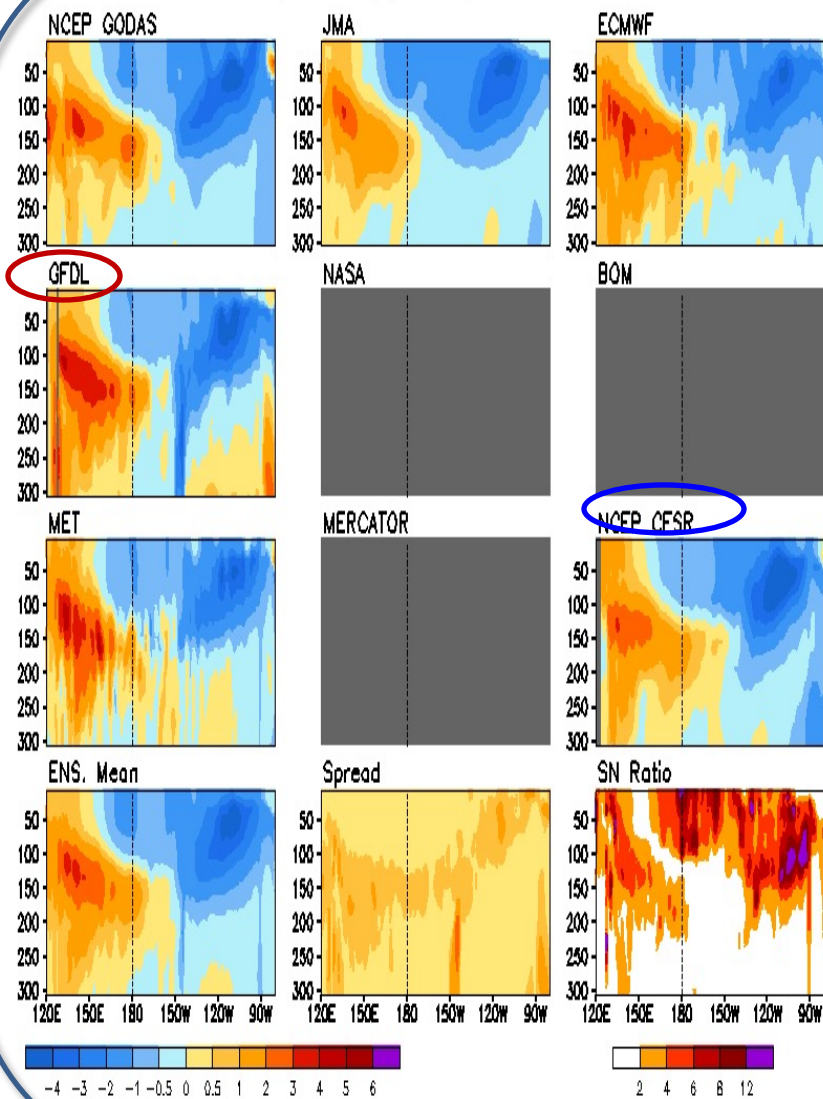


Qu: Zonal advection; Qv: Meridional advection;
Qw: Vertical entrainment; Qzz: Vertical diffusion
Qq: $(Q_{net} - Q_{pen} + Q_{corr})/\rho c_p h$;
 $Q_{net} = SW + LW + LH + SH$;
Qpen: SW penetration;
Qcorr: Flux correction due to relaxation to OI SSTA

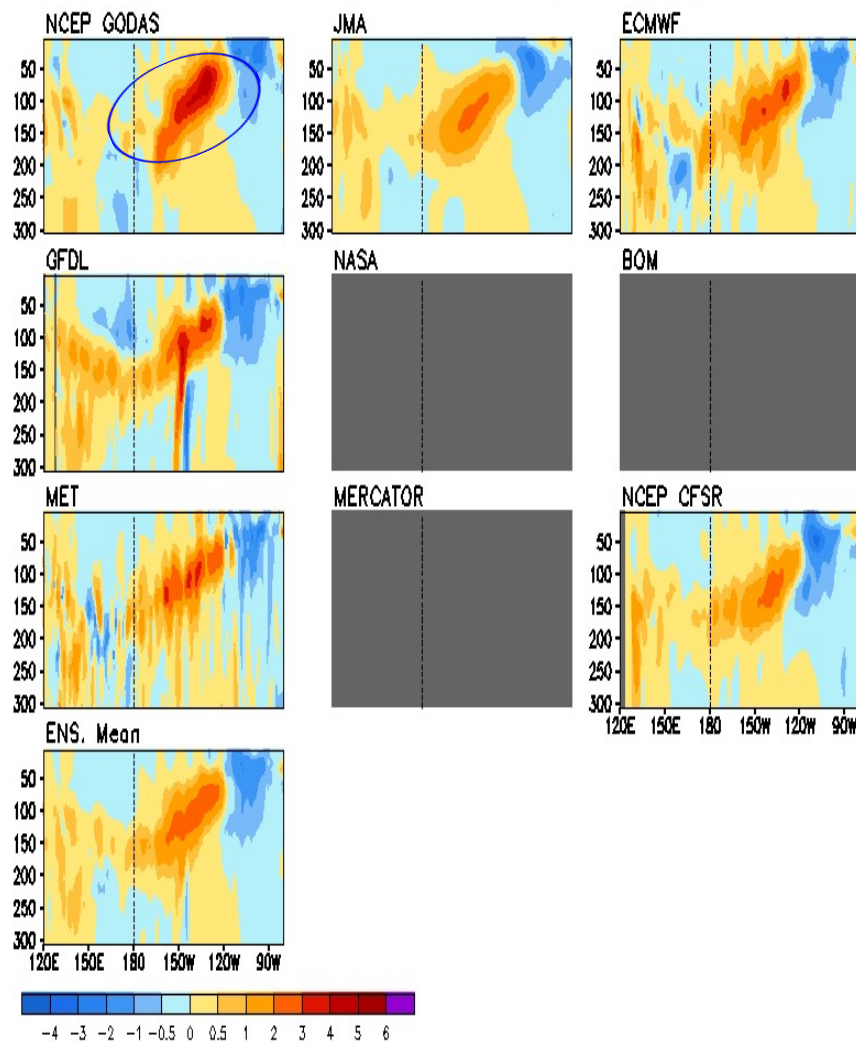
- Observed SSTA tendency (dT/dt) in Nino3.4 region (dotted black line) switched to positive in Nov 2021.
- Zonal advection (Q_u , red line) is the primary term contributing to the total budget tendency (solid black line).
- Zonal advection reduced substantially in recent pentads.

Multiple Ocean Reanalysis: Temperature and Tendency anomalies at Equator

Anomalous Temperature (C) Averaged in 1S-1N: NOV 2021



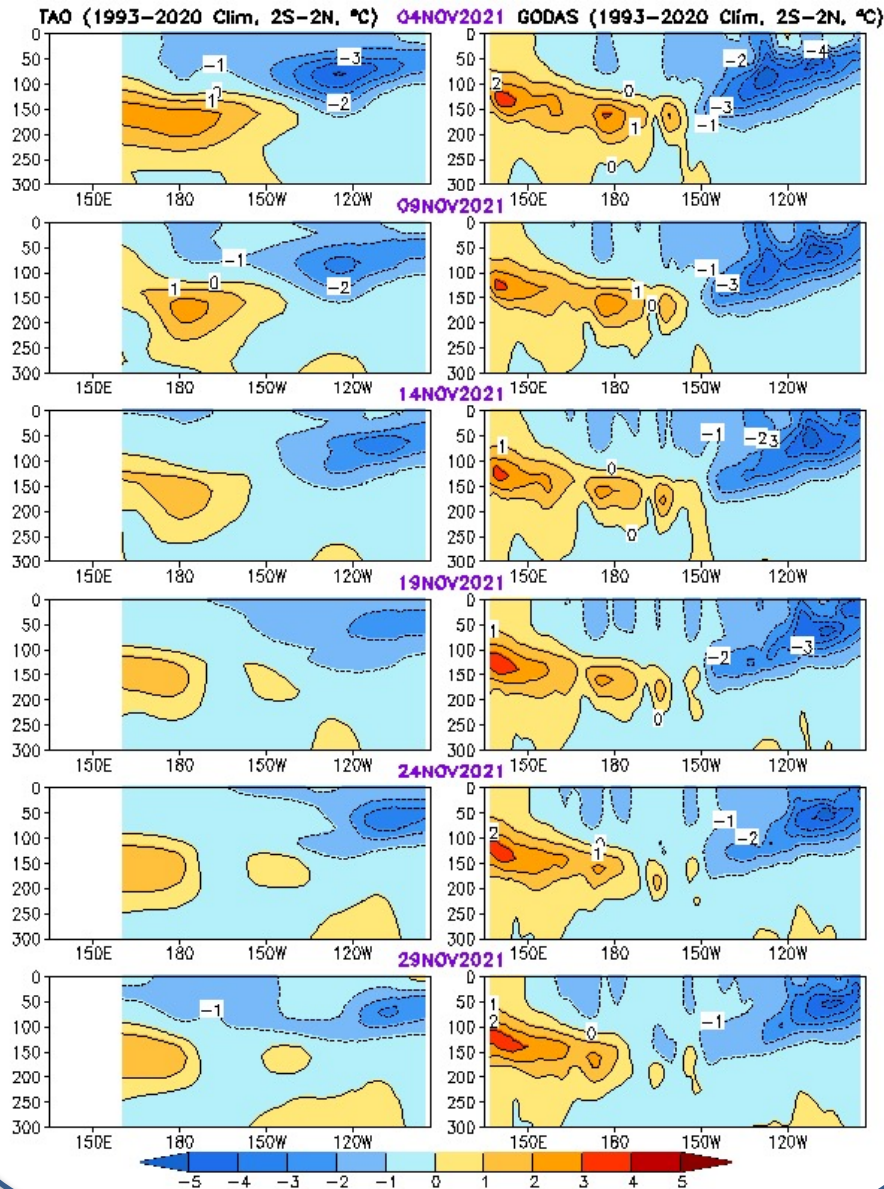
NOV 2021 - OCT 2021 1S-1N Temp Anomaly (C)



Equatorial Pacific Ocean Temperature Pentad Mean Anomaly

TAO

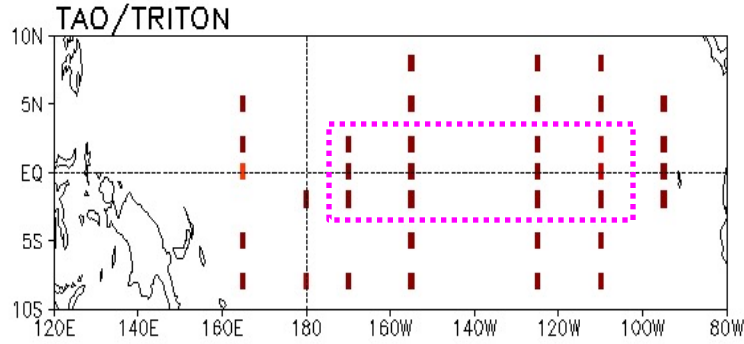
GODAS



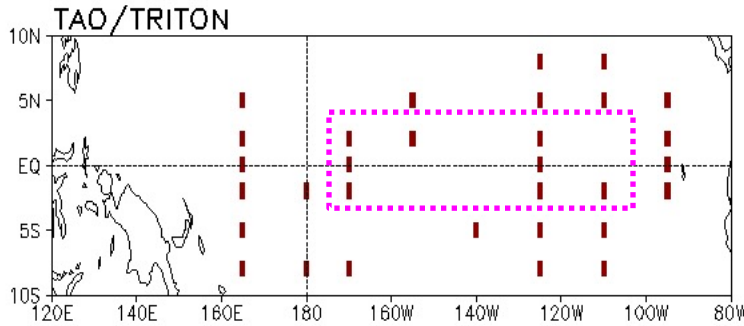
- Positive subsurface temperature in the western Pacific extended eastward near the thermocline in TAO.
- Large negative difference between GODAS and TAO near the central Pacific thermocline [150W-130W] decreased in recent pentads.
- Reduced difference between TAO and GODAS coincides with the return of TAO data near the eastern equator (next slide) that potentially affects the TAO and GODAS analysis.

Potential Impact of Changes in TAO DATA on GODAS

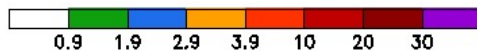
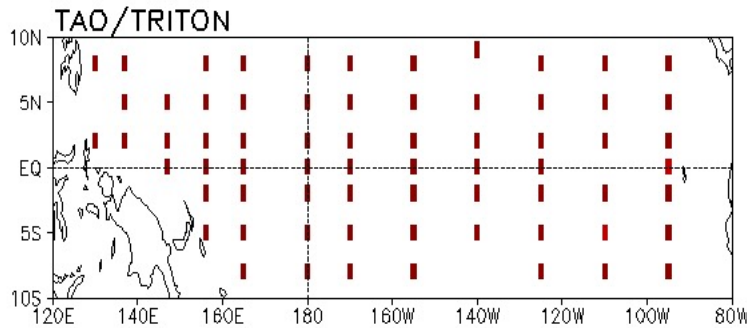
of Daily Temp. Profiles in NOV 2021



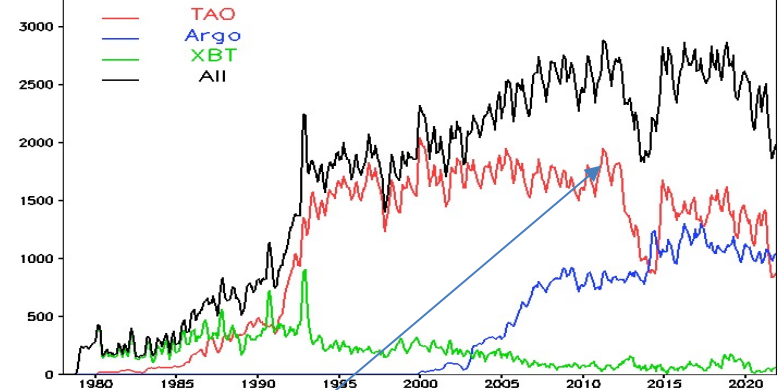
of Daily Temp. Profiles in AUG 2021



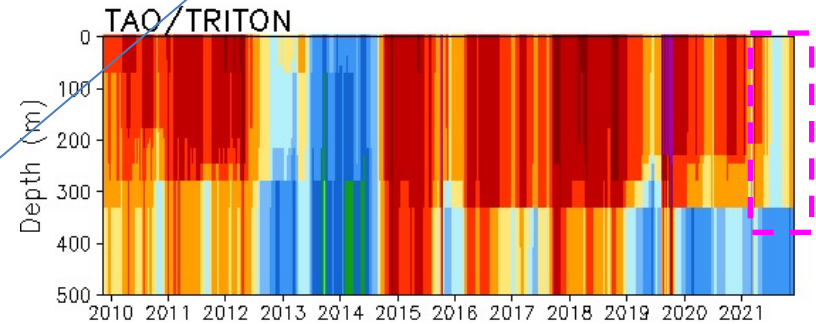
of Daily Temp. Profiles in JUN 2011



of Daily Temp. Profiles in Upper 300m [120E-80W, 10S-10N]



of Daily Temp. Profiles every 5 Days Accumulated in 170E-80W, 3S-3N

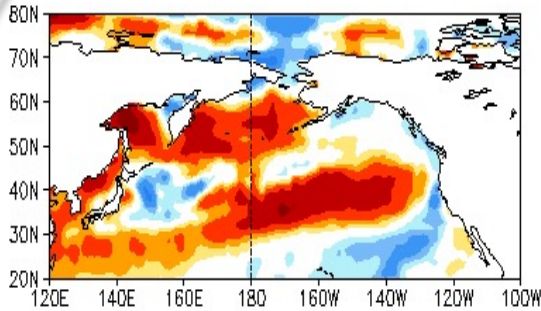


- TAO array declined significantly since March 2021 and TAO mooring profiles number is close to the historical low during 2013-2014.
- Four mooring sites have been fixed in recent TAO cruise service (155W -Sep 2021, 110W-Nov 2021 Courtesy of NDBC Karen Grissom) .

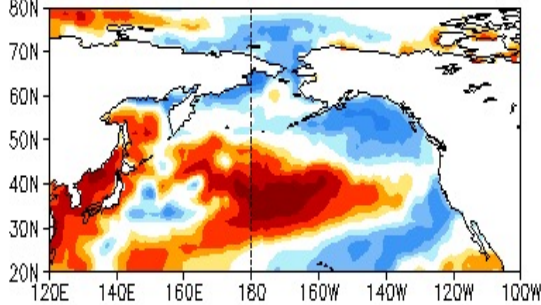
North Pacific & Arctic Oceans

Latest 3-month North Pacific SST, OLR & uv925 anomalies

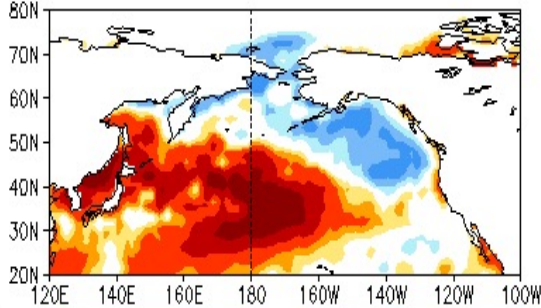
SEP 2021 SST Anom. (°C)



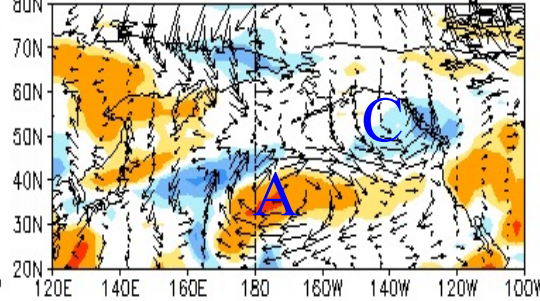
OCT 2021 SST Anom. (°C)



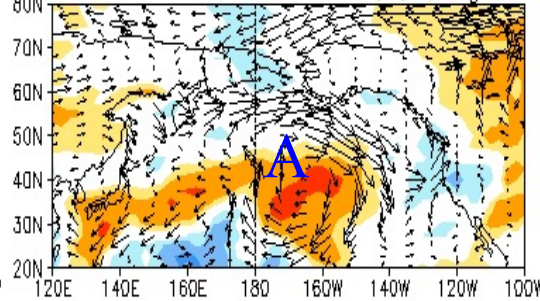
NOV 2021 SST Anom. (°C)



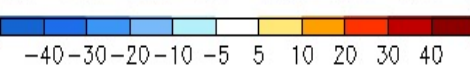
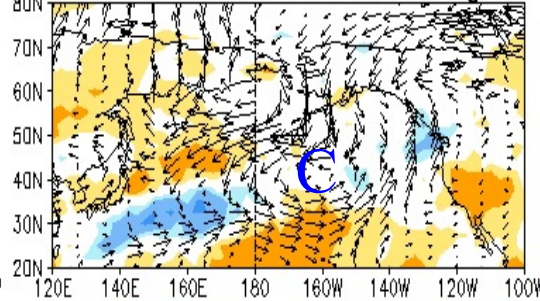
SEP 2021 OLR Anom. (W/m²)
925hPa Wind Anom.(m/s)



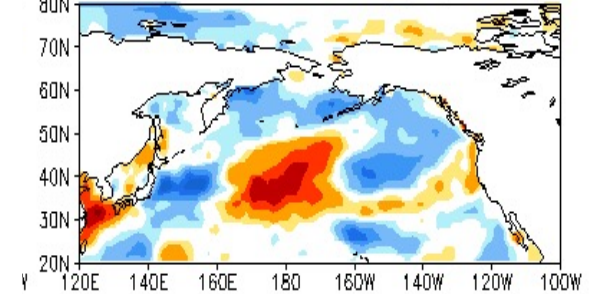
OCT 2021 OLR Anom. (W/m²)
925hPa Wind Anom.(m/s)



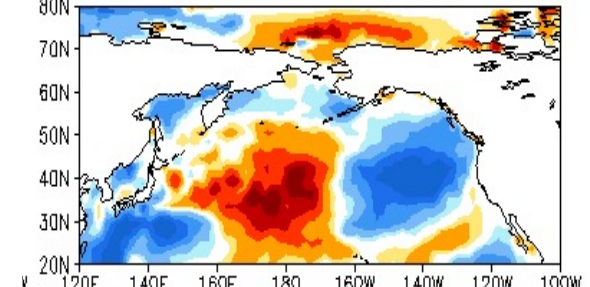
NOV 2021 OLR Anom. (W/m²)
925hPa Wind Anom.(m/s)



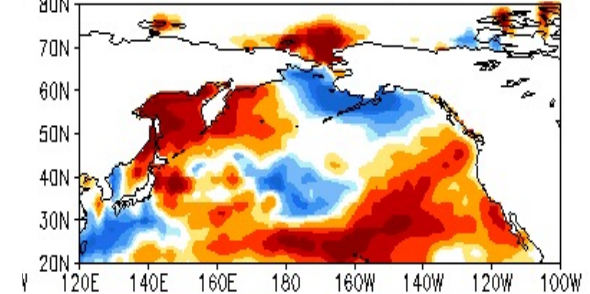
SEP 2021 SW+LW+LH+SH (W/m²)



OCT 2021 SW+LW+LH+SH (W/m²)

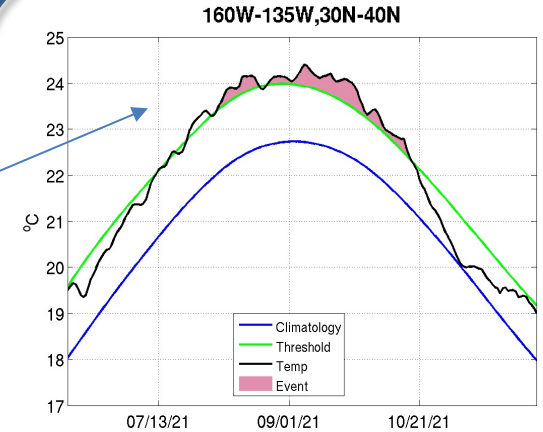
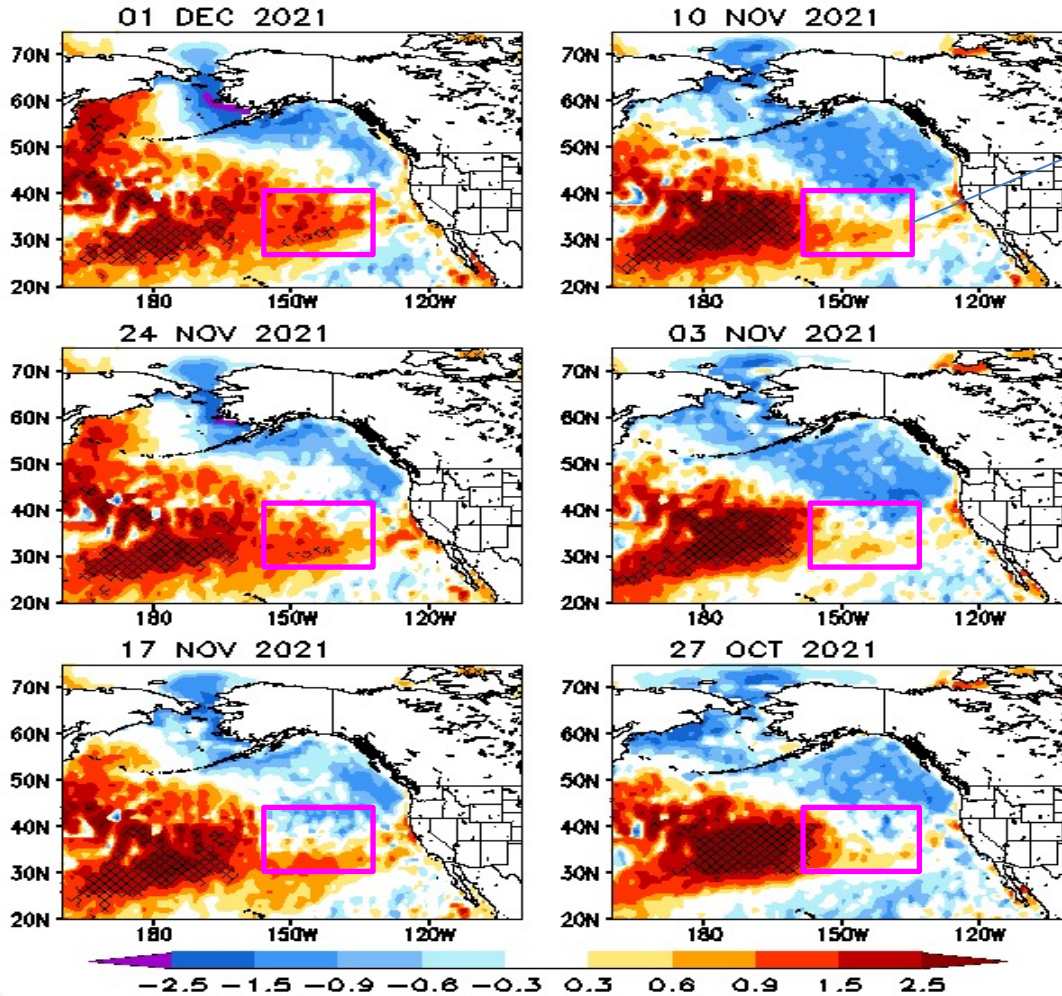


NOV 2021 SW+LW+LH+SH (W/m²)



Weekly SST anomaly and MHWs in the North Pacific

Weekly OISSTv2.1 Anom. ($^{\circ}\text{C}$)
Hatch area: MHW location

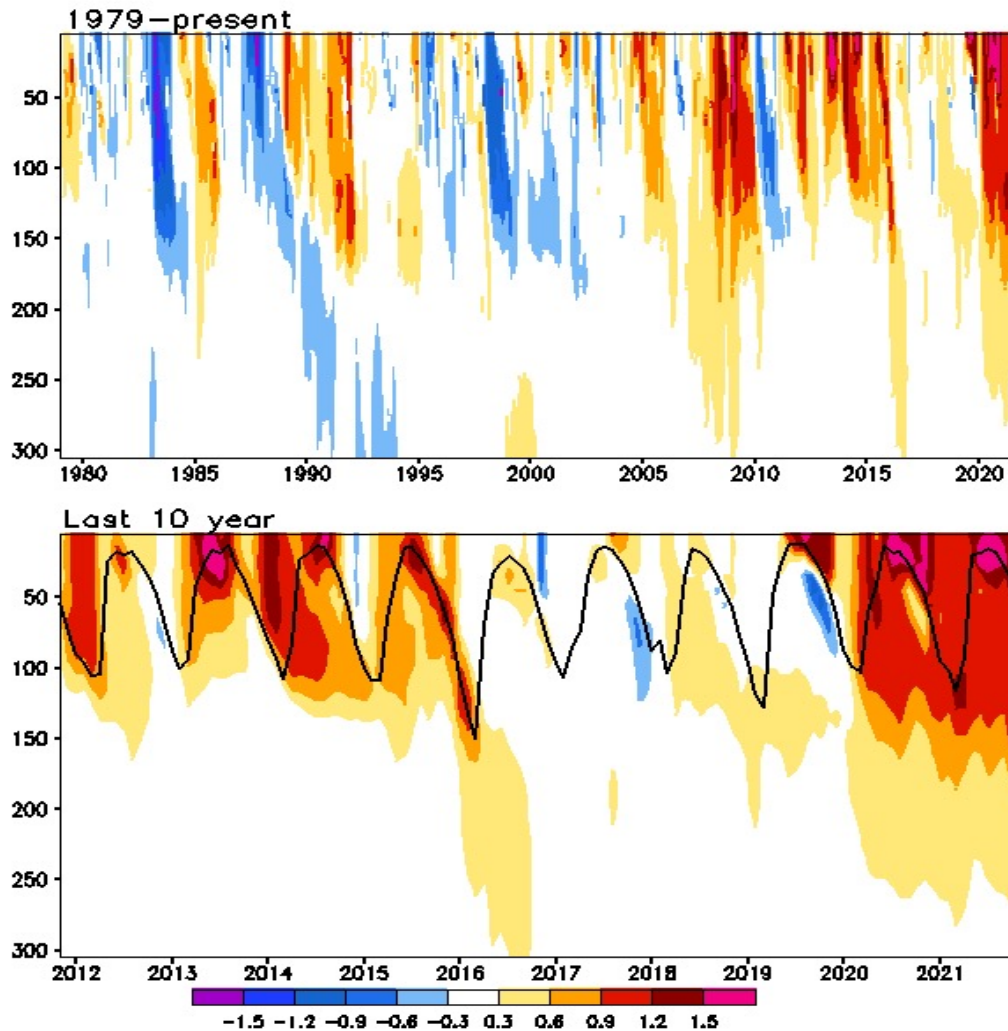


- MHWs continued in the north central Pacific.
- Strong SST warming emerged in northeast Pacific in the last two weeks.

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

Subsurface Temperature Anomaly in N.E. Pacific

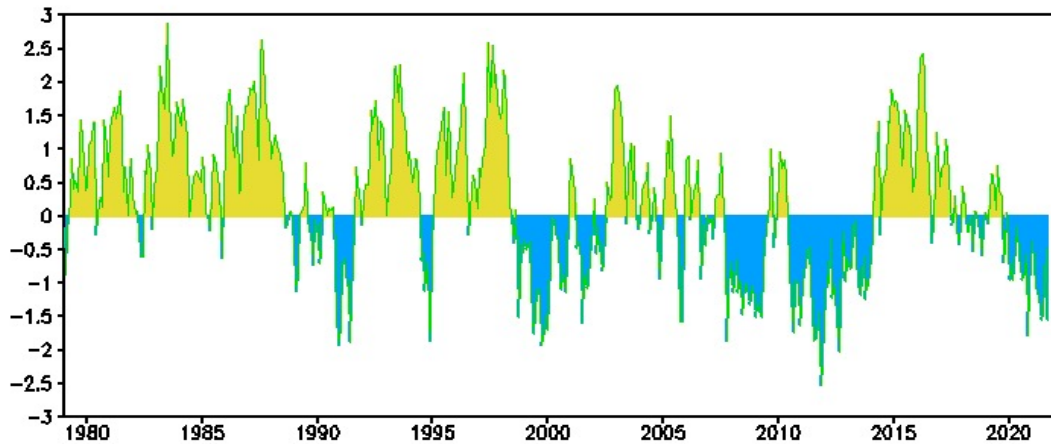
Anomalous Temperature (C) in [160W–135W, 30N–40N]
Black Line: Mixed Layer Depth (m)



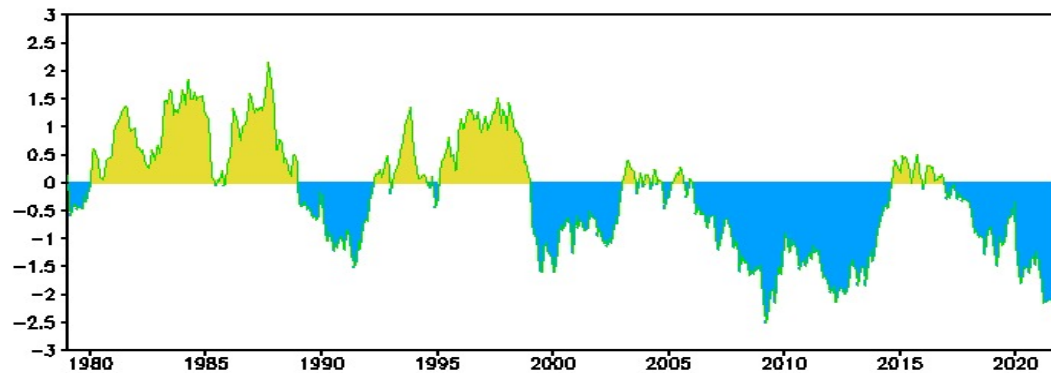
- Positive subsurface temperature anomaly in the northeast Pacific has extended to 200m.

- Subsurface warming after 2019 is the strongest event since 1979.

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



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



- The negative phase of PDO decreased slightly in Nov 2021, with PDOI = -2.1.

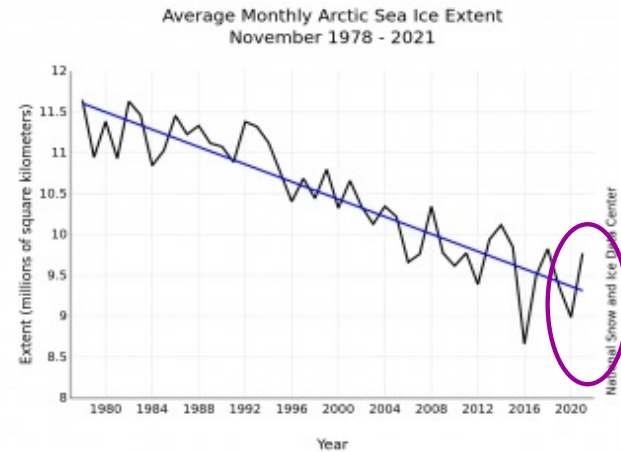
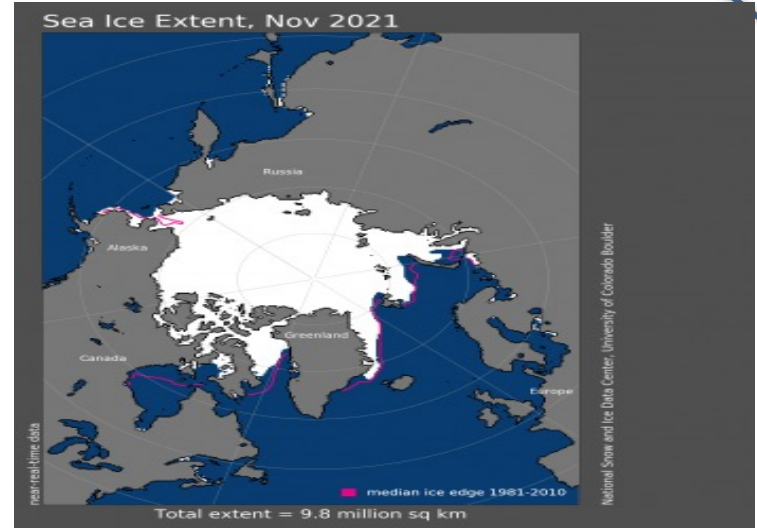
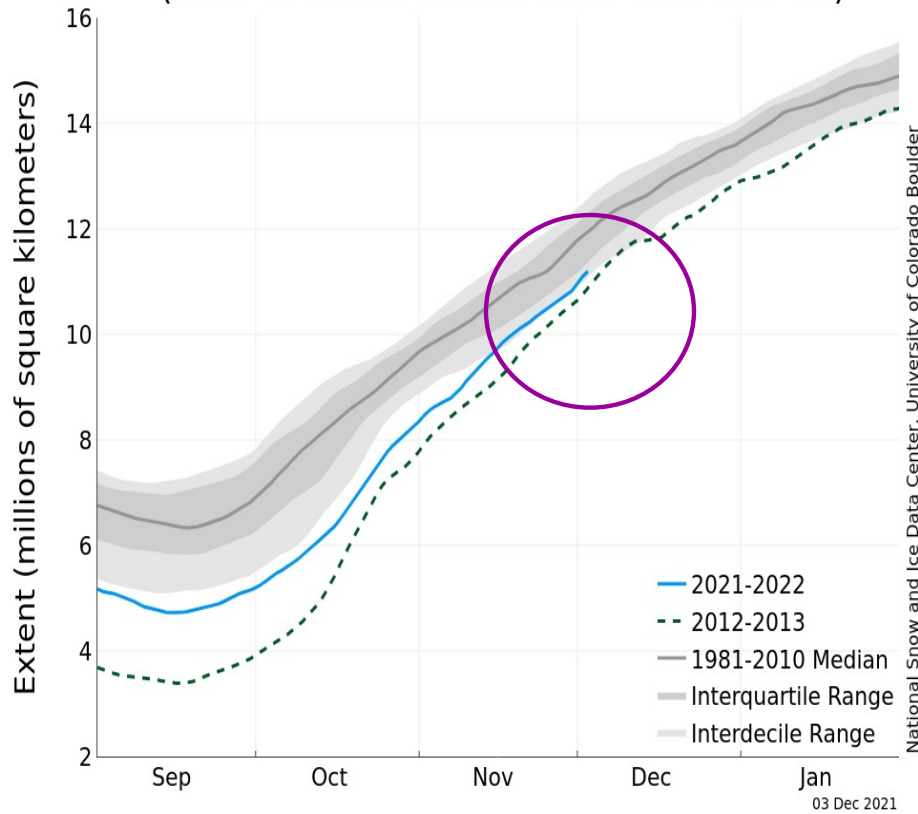
- Negative H300-based PDO index has persisted 62 months since Nov 2016, with HPDO = -2.4 in Nov 2021.

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

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

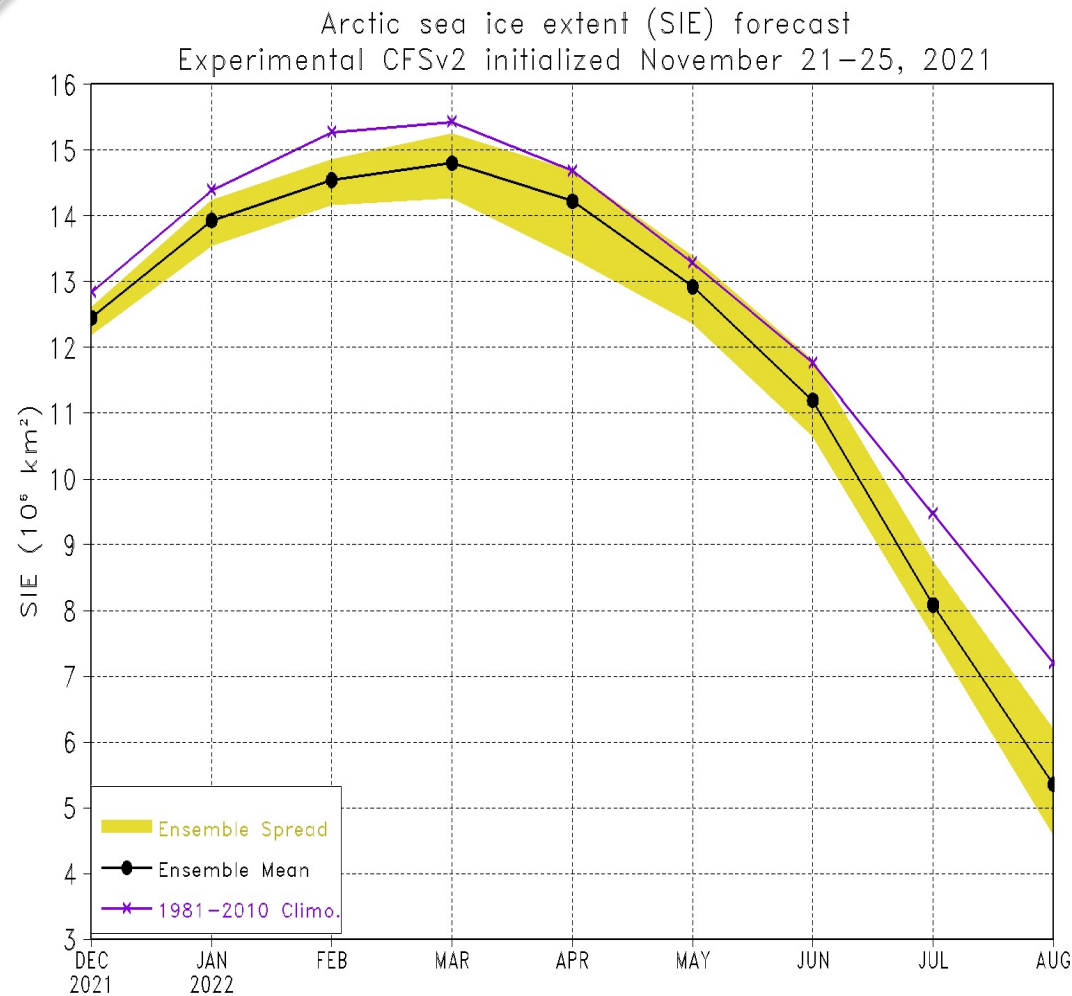
SST-based PDO is defined as the 1st EOF of monthly ERSST v3b in the North Pacific for the period 1900-1993. PDO index is the standardized projection of the monthly ERSSTv5 SST anomalies onto the 1st EOF pattern. H300-based Pacific Decadal Oscillation is defined as the projection of monthly mean H300 anomalies from NCEP GODAS onto their first EOF vector in the North Pacific. PDO indices are downloadable from https://www.cpc.ncep.noaa.gov/products/GODAS/ocean_briefing.shtml.

Arctic Sea Ice Extent (Area of ocean with at least 15% sea ice)



- The monthly average extent for November 2021 was 9.77 million square kilometers and it ranks the 10th lowest in the satellite record.

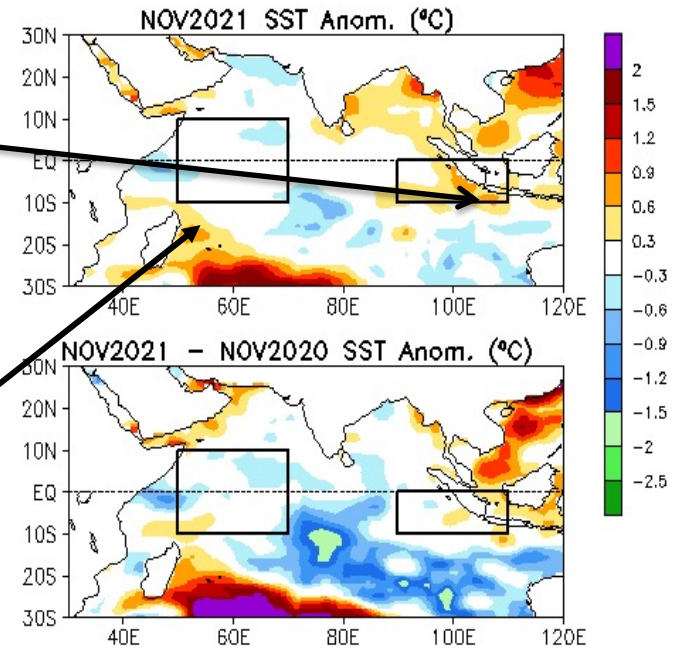
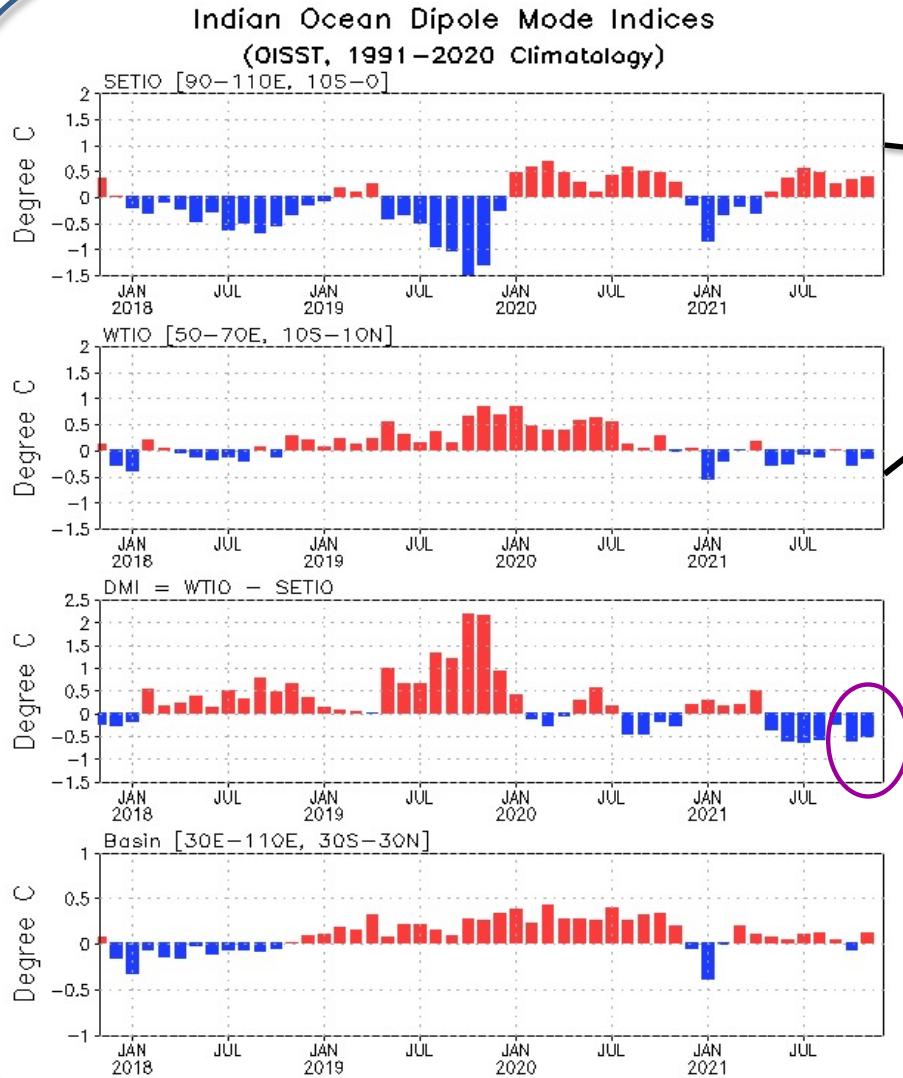
NCEP/CPC Arctic Sea Ice Extent Forecasts



- For ICs in Nov 2021, NCEP/CPC model predicted the 2022 sea ice extent maximum will be slightly below climatology.

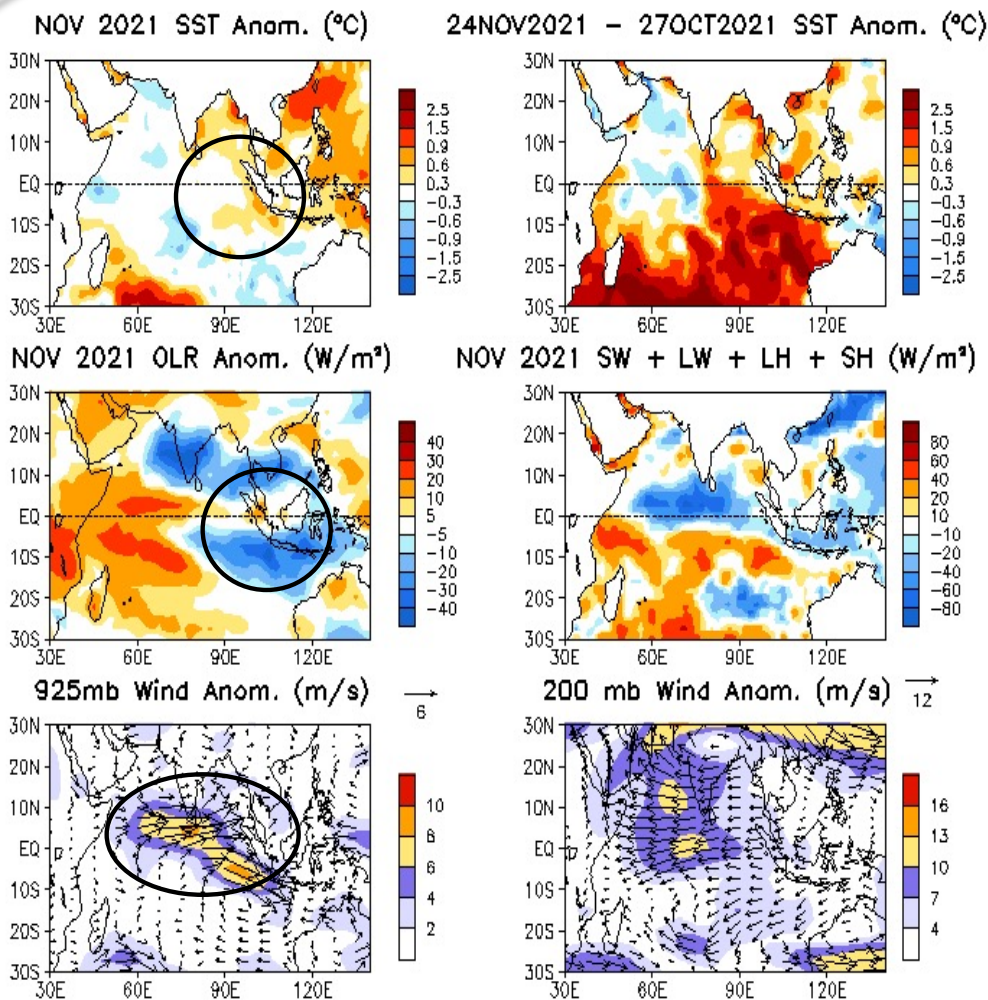
Indian Ocean

Evolution of Indian Ocean SST Indices



- Negative Indian Ocean Dipole Mode index (DMI) continued in Nov 2021, with IODI = -0.5 °C.

Indian Ocean Dipole region indices, calculated as the area-averaged monthly mean sea surface temperature anomalies (OC) for the SETIO [90°E–110°E, 10°S–0] and WTIO [50°E–70°E, 10°S–10°N] regions, and Dipole Mode Index, defined as differences between WTIO and SETIO. Data are derived from the NCEP OI SST analysis, and anomalies are departures from the 1991–2020 base period means.



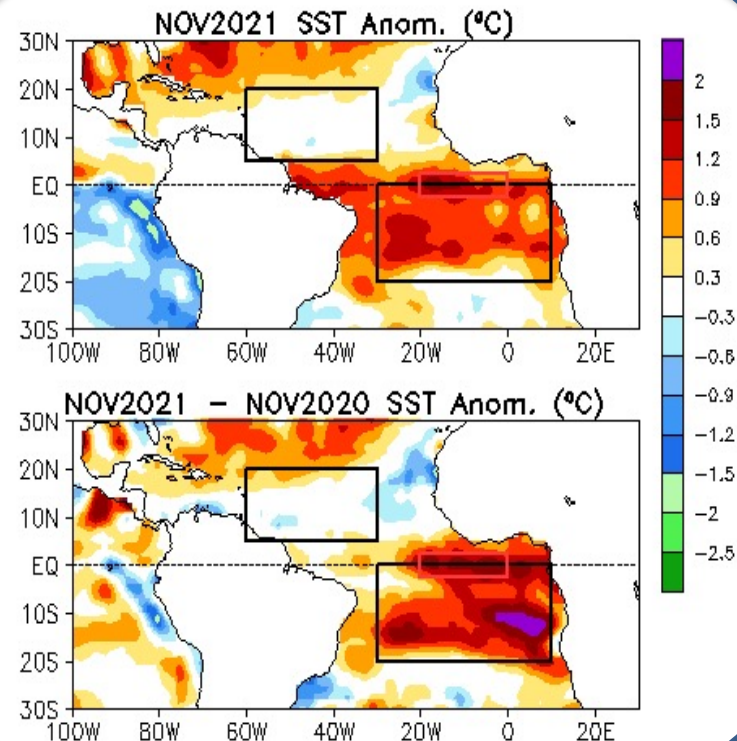
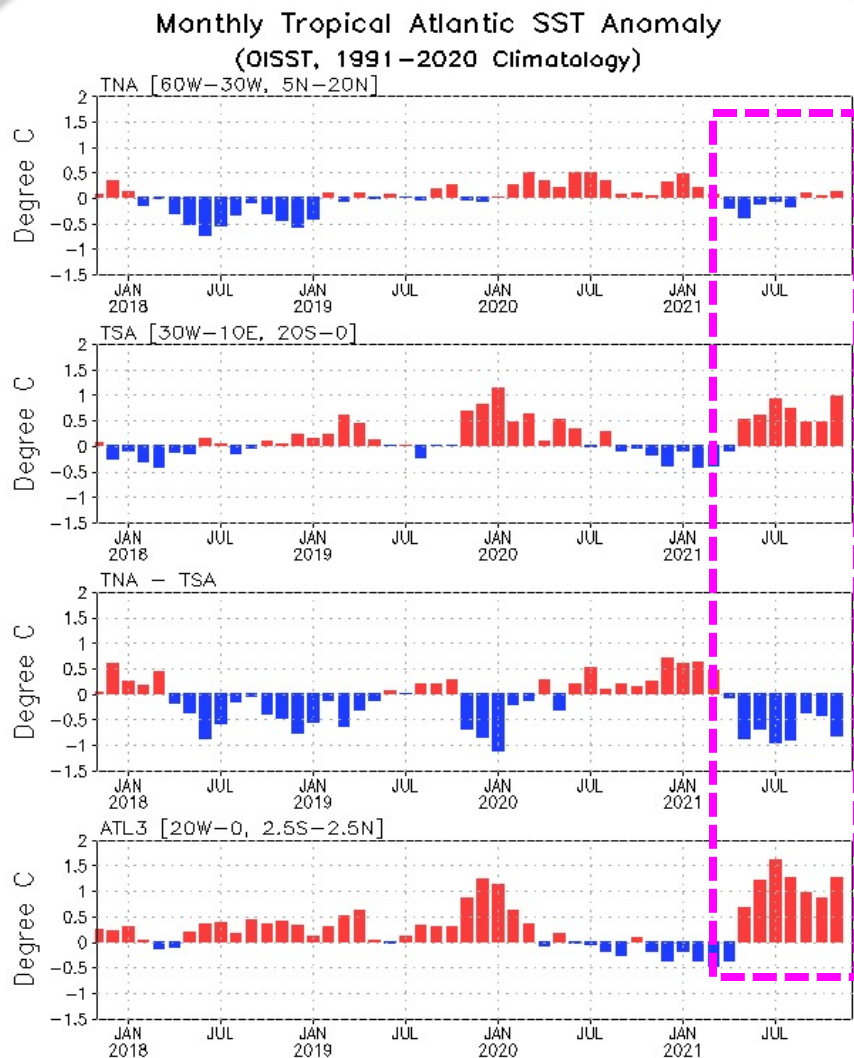
- Weak SST warming persisted in the eastern Indian Ocean.

- Convection was enhanced over the eastern Indian Ocean, consistent with the negative Indian Ocean Dipole condition.

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 OI SST analysis, OLR from the NOAA 18 AVHRR IR window channel measurements by NESDIS, winds and surface radiation and heat fluxes from the NCEP CDAS. Anomalies are departures from the 1991-2020 base period means.

Tropical and North Atlantic Ocean

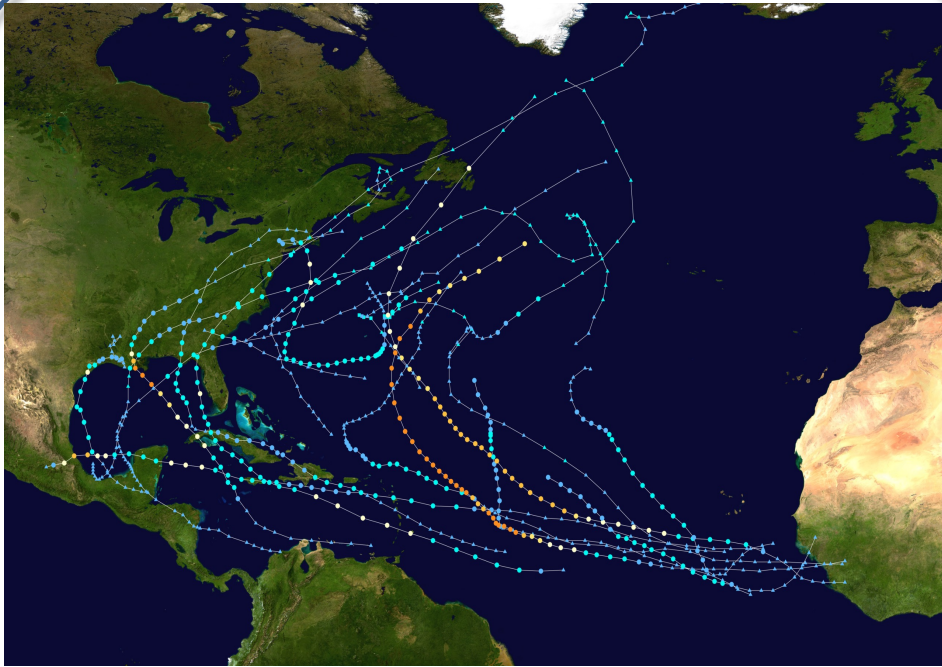
Evolution of Tropical Atlantic SST Indices



- Negative meridional dipole index enhanced substantially in Nov 2021, with MDI = -0.9 °C.
- 2021 Atlantic Niño conditions continued in Nov 2021, with ATL 3 = 1.3 °C.

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

2021 Atlantic Hurricane Season Activities



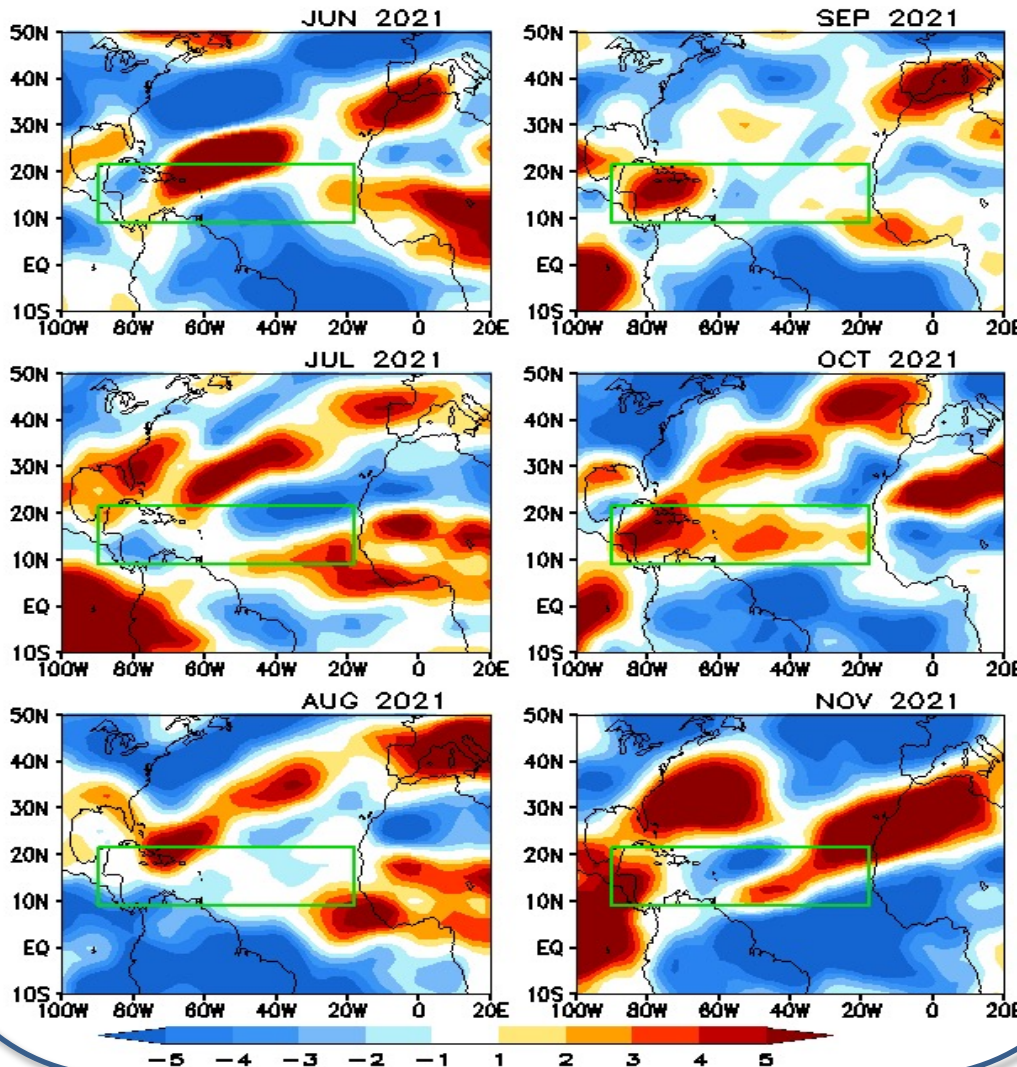
https://en.wikipedia.org/wiki/2021_Atlantic_hurricane_season

- North Atlantic hurricane activity was quiet in Oct – Nov 2021.
- The 2021 Atlantic hurricane season was the third most active season on record, producing twenty-one tropical storms.

Atlantic	Observations (By Dec 4)	Updated Outlook (Aug 4) 65% above-normal	Outlook (May 21) 60% above-normal	(1991-2020)
Total storms	21	15-21	13-20	14
Hurricanes	7	7-10	6-10	7
Major hurricanes	4	3-5	3-5	3

Last 6-month of North Atlantic zonal wind shear anomaly

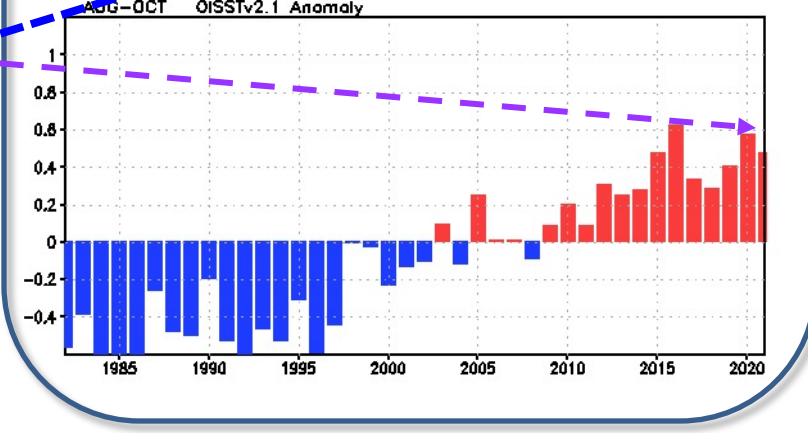
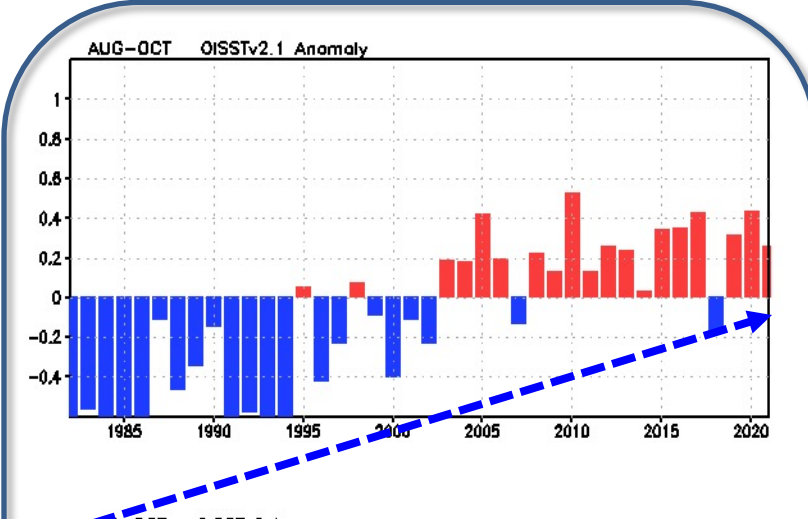
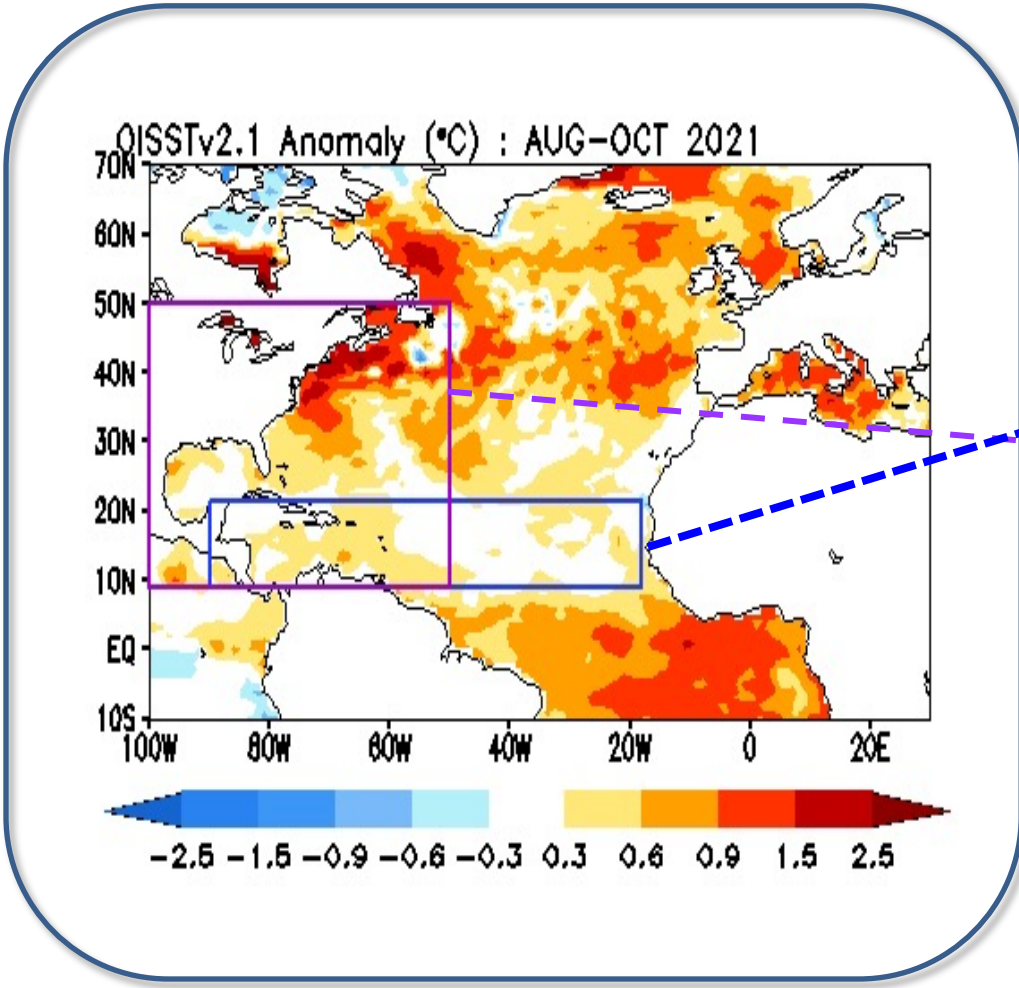
Zonal Wind shear 200mb–850mb Anomaly (m/s)



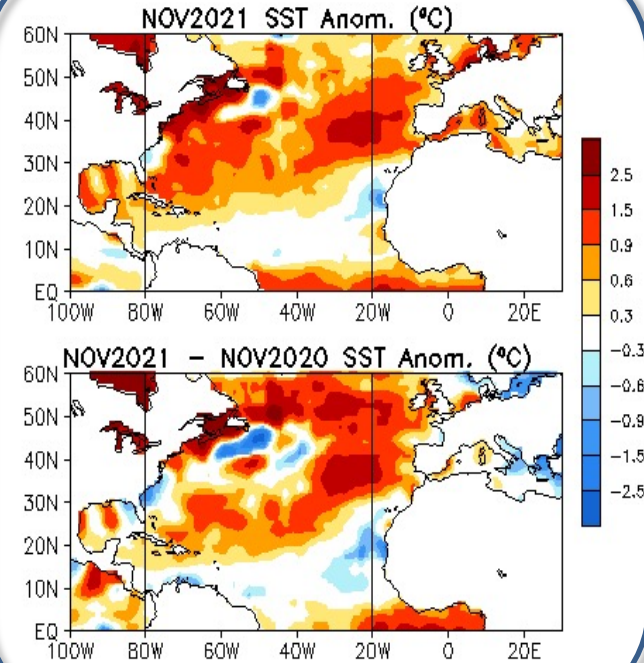
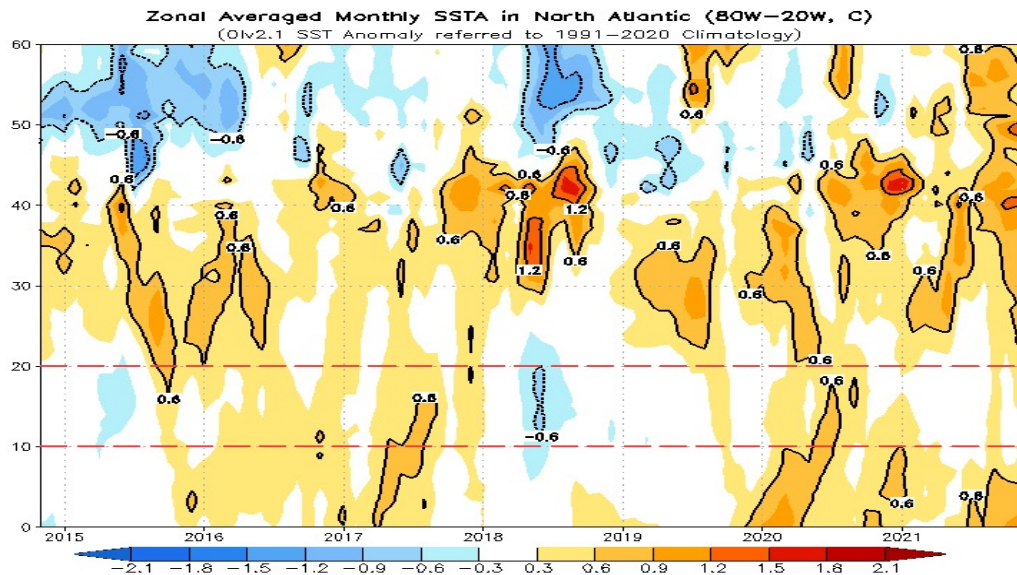
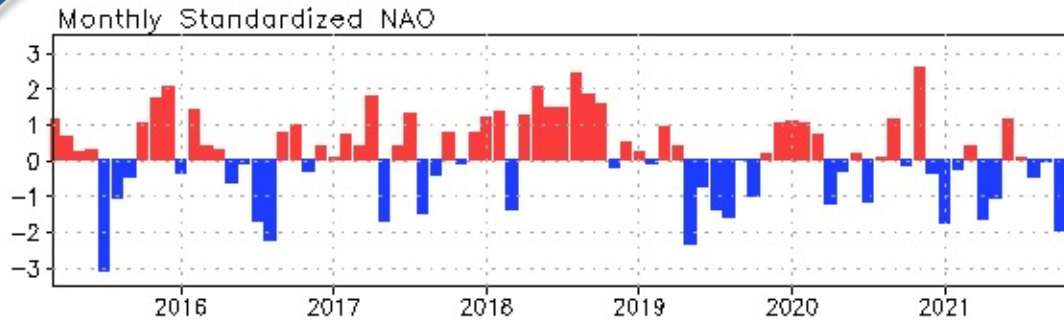
- Negative zonal wind shear anomalies dominated in the hurricane main developing region (MDR, green box) during June-Sep 2021.

- Positive zonal wind shear anomaly was present in the MDR region during Oct 2021, which tends to suppress the tropical storm development.

August-October SST anomaly in the North Atlantic



NAO and SST Anomaly in North Atlantic

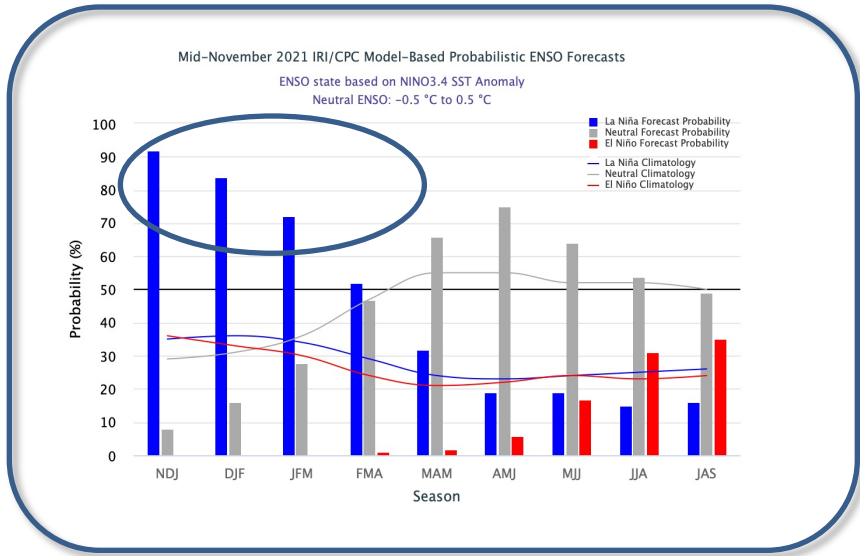
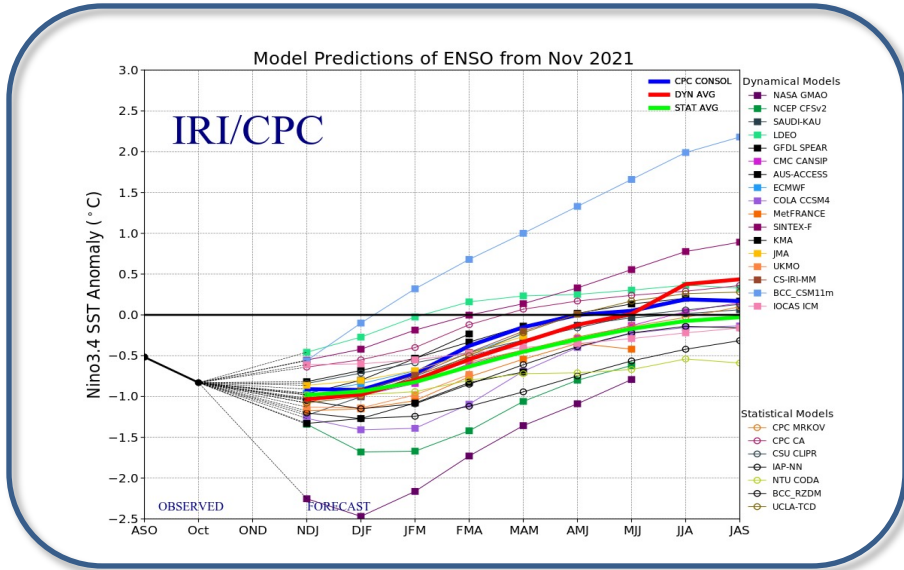


- Negative NAO decreased substantially in Nov 2021, with NAO = -0.3.
- The prolonged positive SSTAs in the middle latitudes were evident, partially due to the dominance of the positive phase of NAO during 2015-2019.

Monthly standardized NAO index (top) derived from monthly standardized 500-mb height anomalies obtained from the NCEP CDAS in 20°N-90°N (<http://www.cpc.ncep.noaa.gov>). Time-Latitude section of SST anomalies averaged between 80°W and 20°W (bottom). SST are derived from the NCEP OI SST analysis, and anomalies are departures from the 1991-2020 base period means.

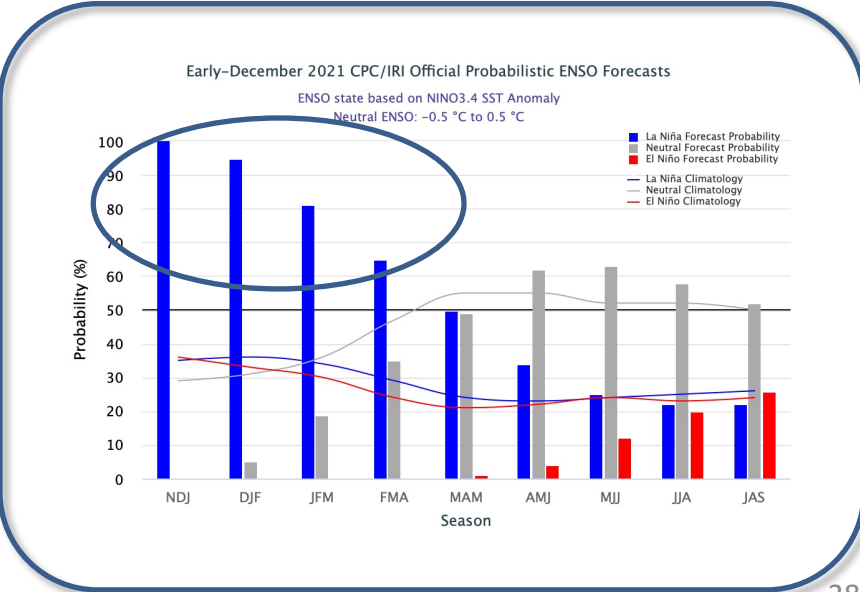
ENSO and Global SST Predictions

IRI/CPC Niño3.4 Forecast

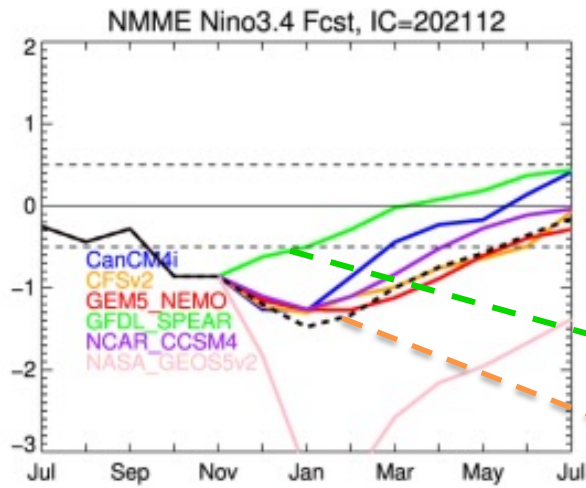


- A majority of dynamical and statistical models predict a continuous La Niña through winter 2021-22 and return to ENSO neutral during spring 2022.

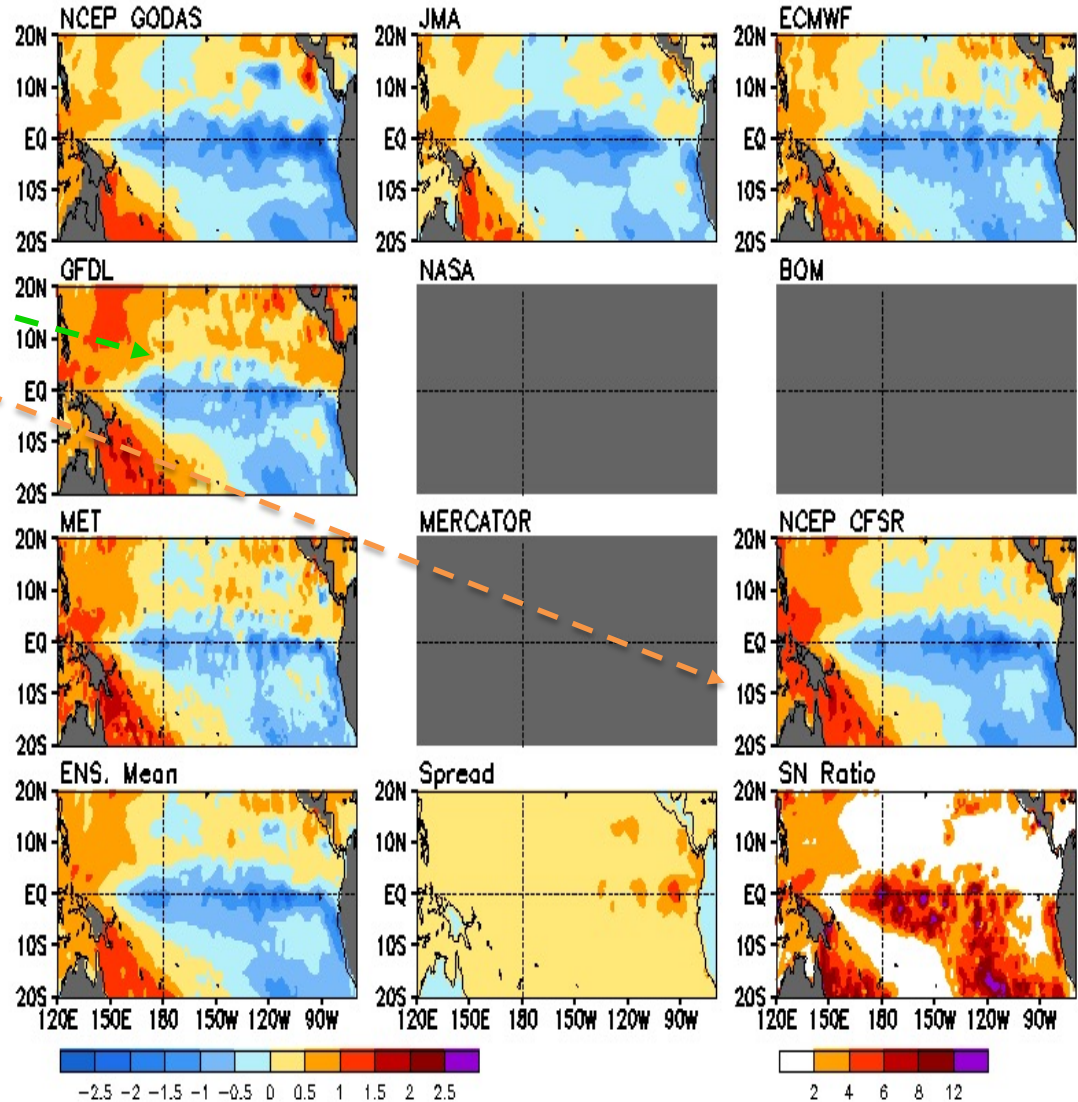
- NOAA “ENSO Diagnostics Discussion” on December 9 stated that “La Niña is favored to continue through the Northern Hemisphere winter 2021-22 (~95% chance) and transition to ENSO-neutral during spring 2022 (~60% chance during April-June)”.



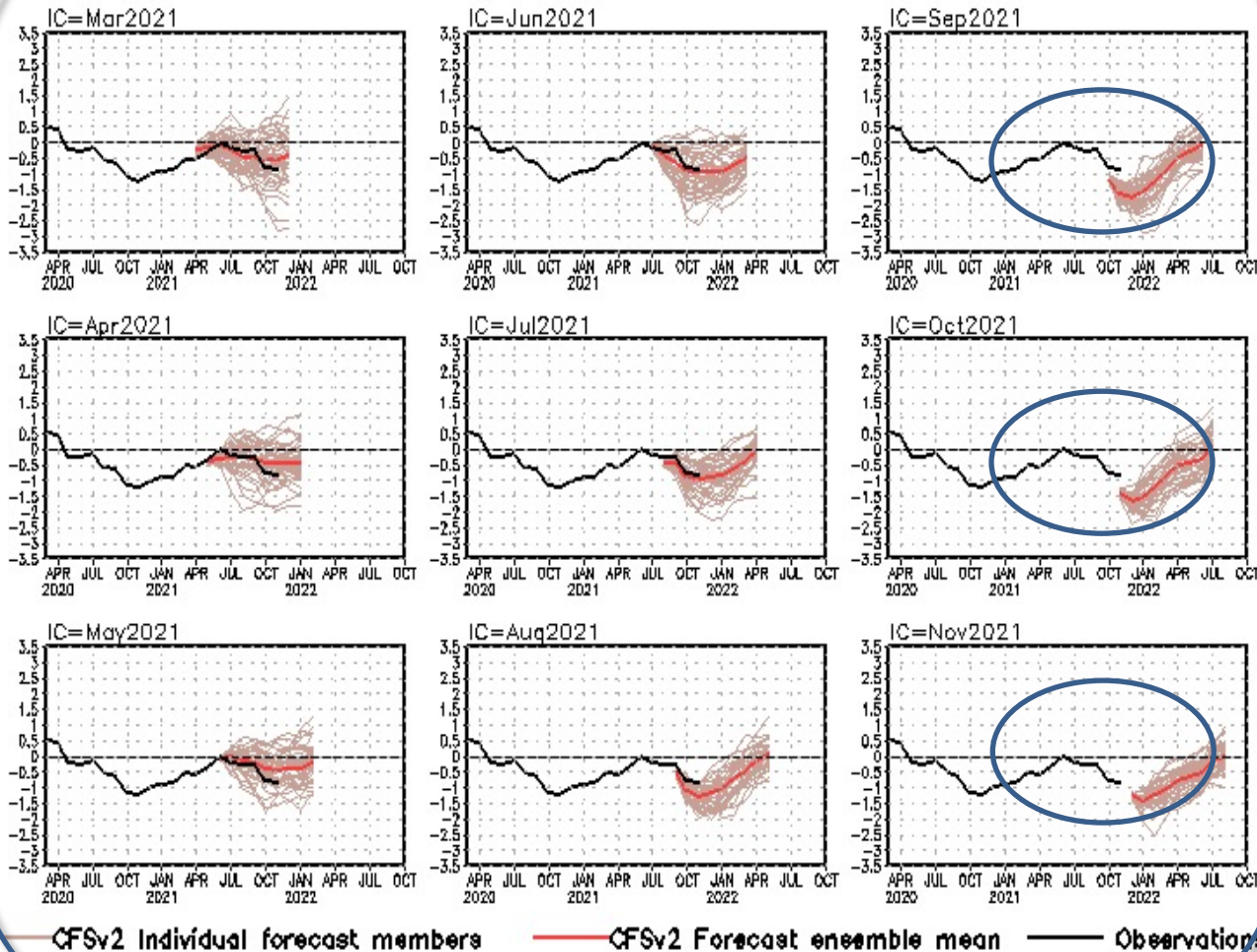
Multiple Ocean Reanalysis: SST Anomalies



Anomalous Temperature (C) at z=5m: NOV 2021



Niño3.4 SST anomalies (K)

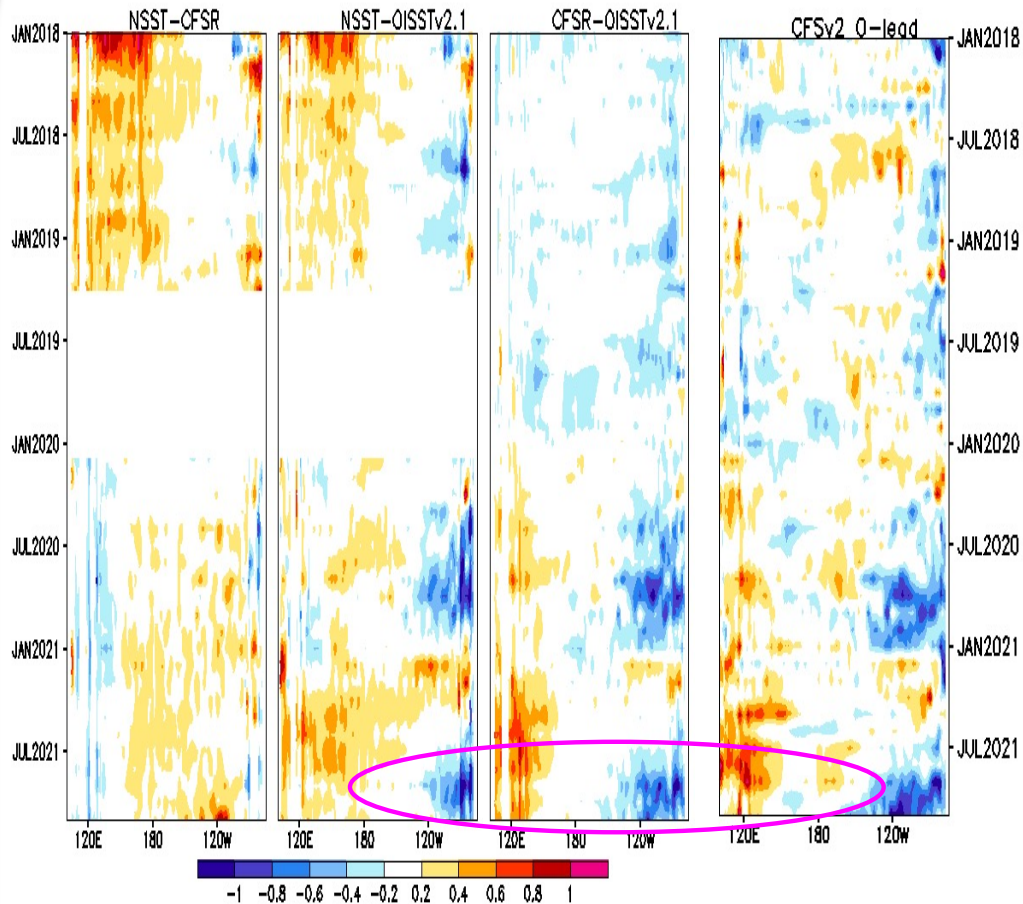


- CFSv2 with IC Sep-Oct overestimated the strength of SST cooling in Oct-Nov.
- Latest CFSv2 predictions call for a strong La Niña in the northern hemisphere 2021/22 winter.

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.

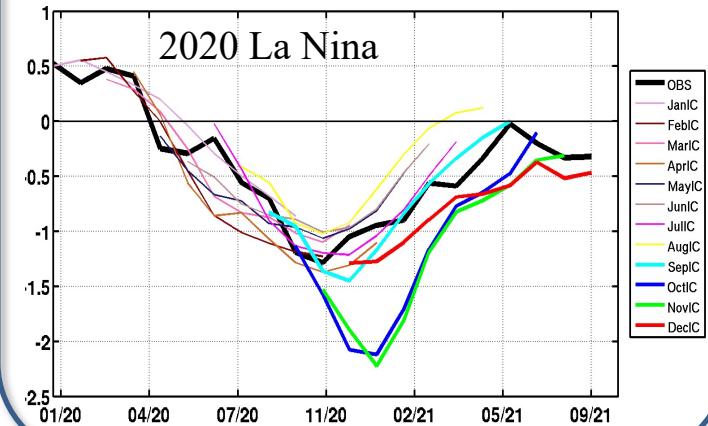
Potential Impact of NSST bias on CFSv2 Predictions

Monthly SST Anomaly Difference ($^{\circ}\text{C}$) in Pacific equator [2s-2N]



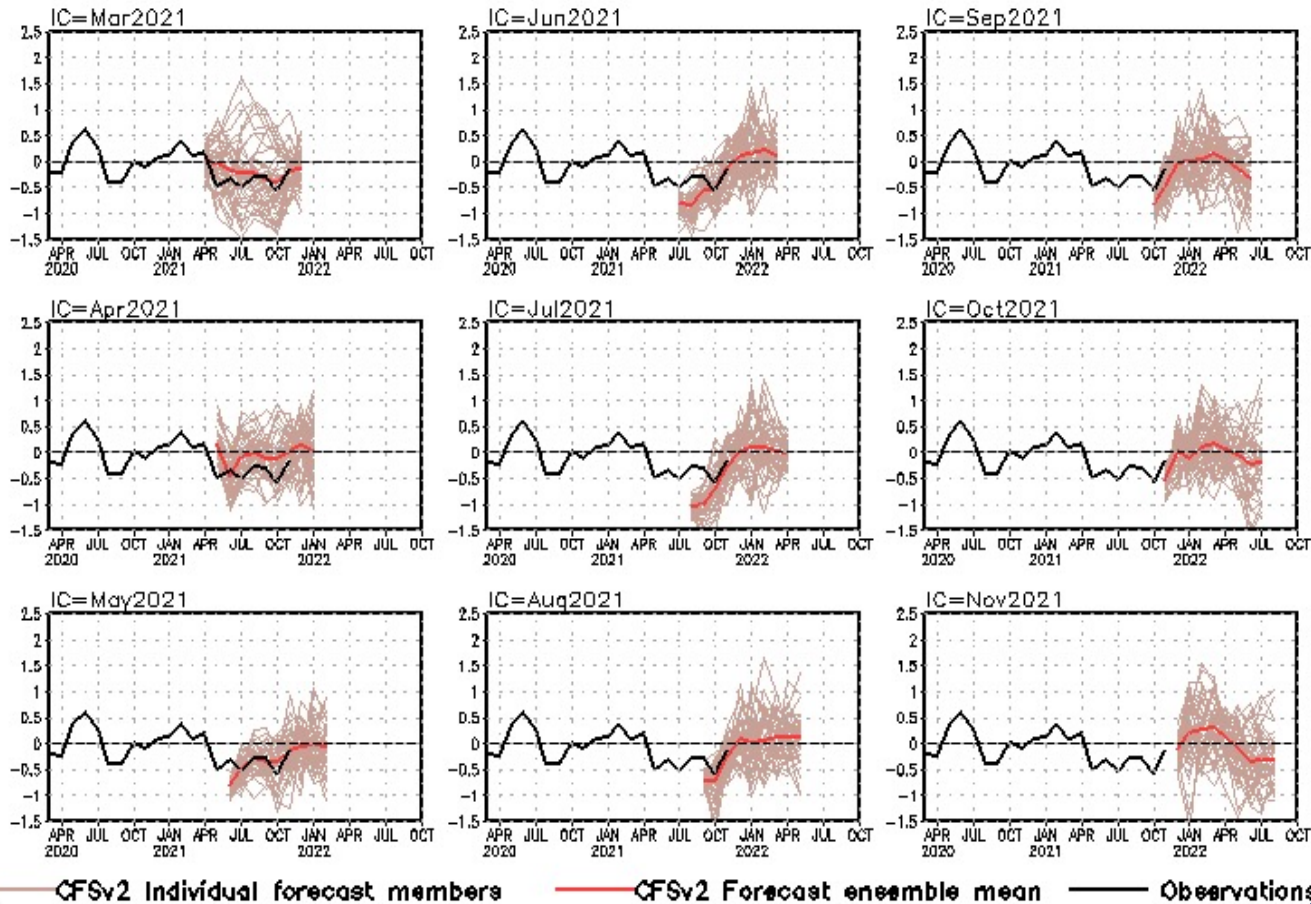
Bias pathway : NSST \longrightarrow CFSR \longrightarrow CFSv2

NINO 3.4 Forecast



- CFSR nudges to NSST since Feb 2020.
- Cold bias in NSST gives rise to the systematic cold bias in CFSR.
- Large cold CFSR SST bias in the E. Pacific during Sep- Oct 2020 is consistent with overshooting La Nina forecast initiated with Oct., Nov. condition.
- CFSv2 might overestimate SST cooling in 2021-22 winter owing to the large cold SST biases in CFSR.
- Cold bias in CFSR weakened in Nov 2021.

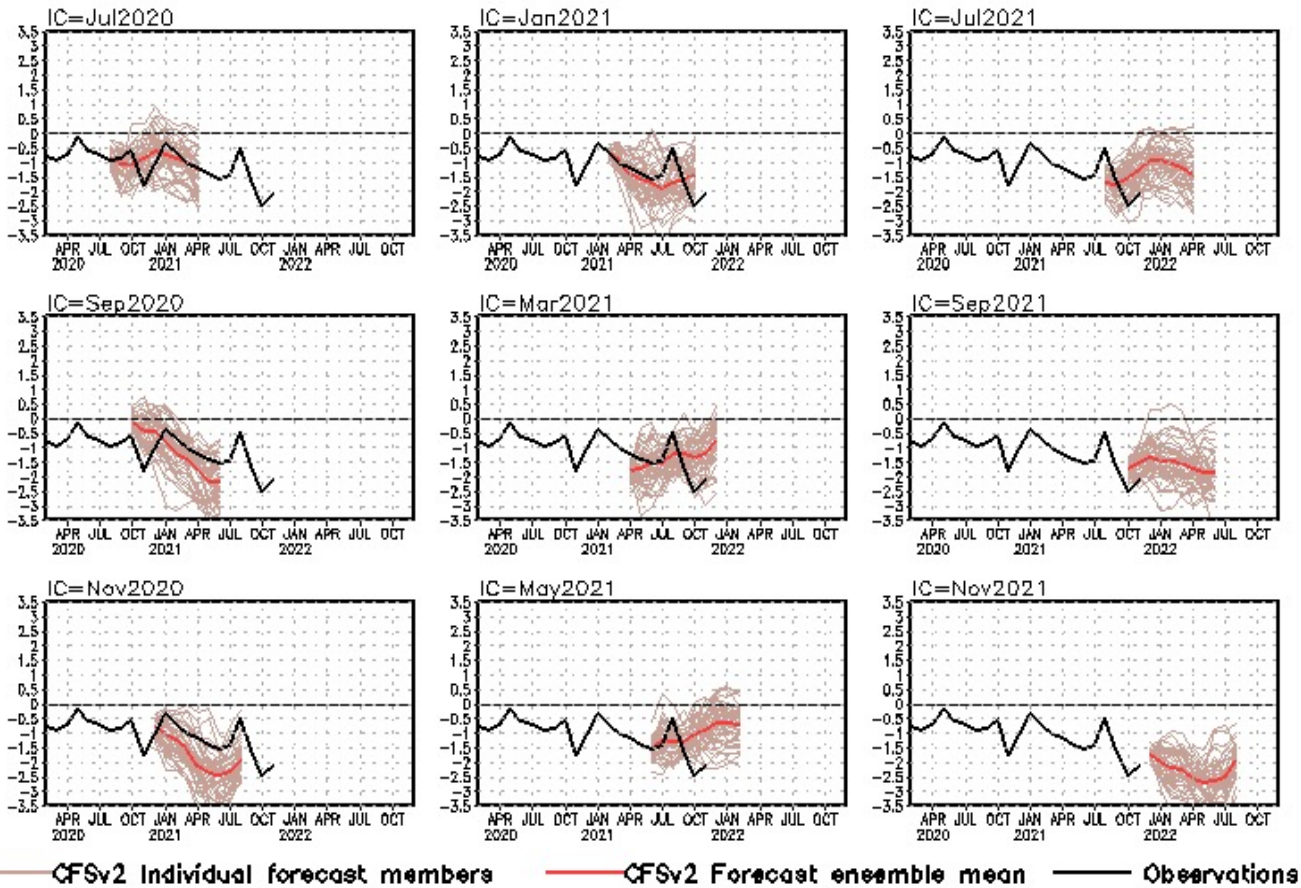
Indian Ocean Dipole SST anomalies (K)



- Latest CFSv2 forecasts favors neutral IOD conditions in winter.

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.

standardized PDO index



- CFSv2 predicts a negative phase of PDO in the coming seasons.

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.

Acknowledgements

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

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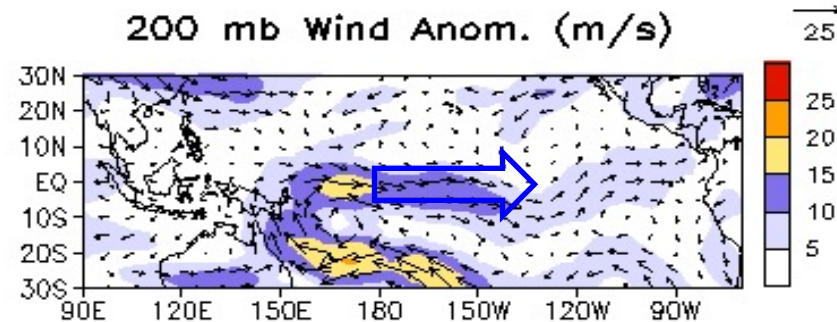
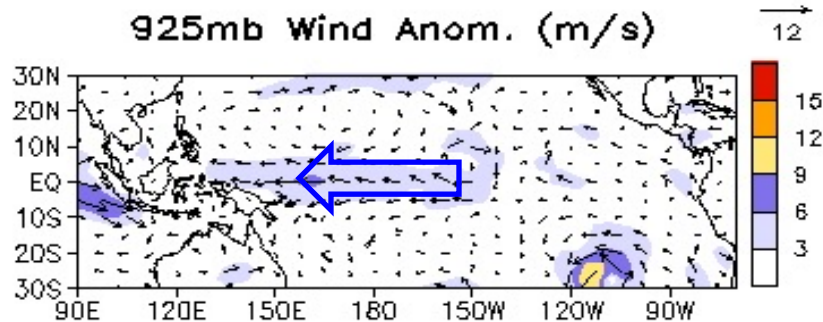
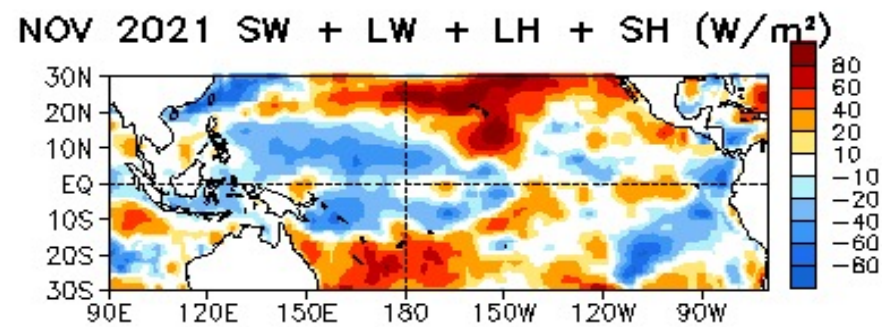
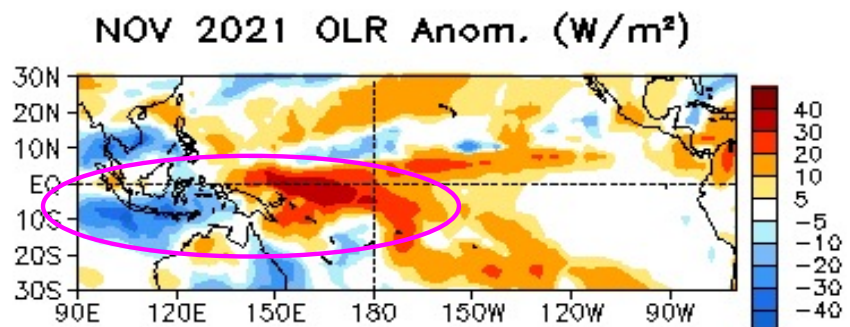
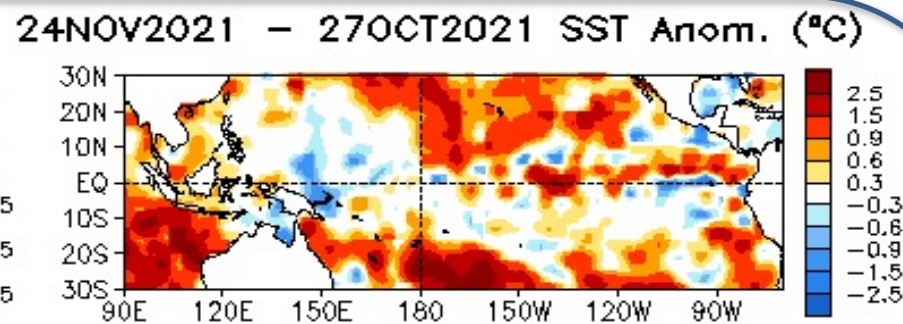
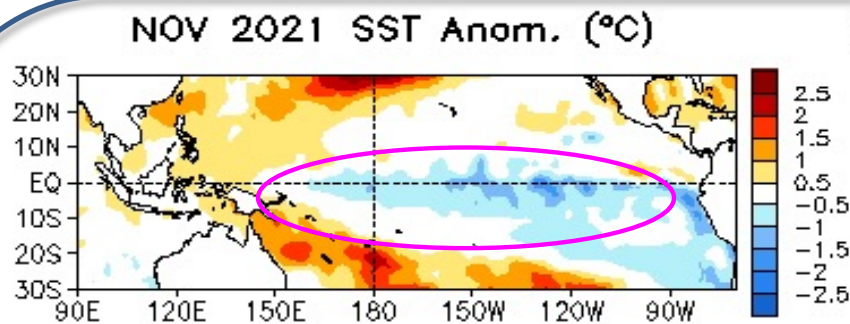
Jieshun.Zhu@noaa.gov

Zeng-Zhen.Hu@noaa.gov

- **Weekly Optimal Interpolation SST (OI SST) version 2 (Reynolds et al. 2002)**
- **Extended Reconstructed SST (ERSST) v5 (Huang et al. 2017)**
- **Blended Analysis of Surface Salinity (BASS) (Xie et al. 2014)**
- **CMORPH precipitation (Xie et al. 2017)**
- **CFSR evaporation adjusted to OAFlux (Xie and Ren 2018)**
- **NCEP CDAS winds, surface radiation and heat fluxes (Kalnay et al. 1996)**
- **NESDIS Outgoing Long-wave Radiation (Liebmann and Smith 1996)**
- **NCEP's GODAS temperature, heat content, currents (Behringer and Xue 2004)**
- **Aviso altimetry sea surface height from CMEMS**
- **Ocean Surface Current Analyses – Realtime (OSCAR)**
- **In situ data objective analyses (IPRC, Scripps, EN4.2.1, PMEL TAO)**
- **Operational Ocean Reanalysis Intercomparison Project**
http://www.cpc.ncep.noaa.gov/products/GODAS/multiora_body.html
http://www.cpc.ncep.noaa.gov/products/GODAS/multiora93_body.html

Backup Slides

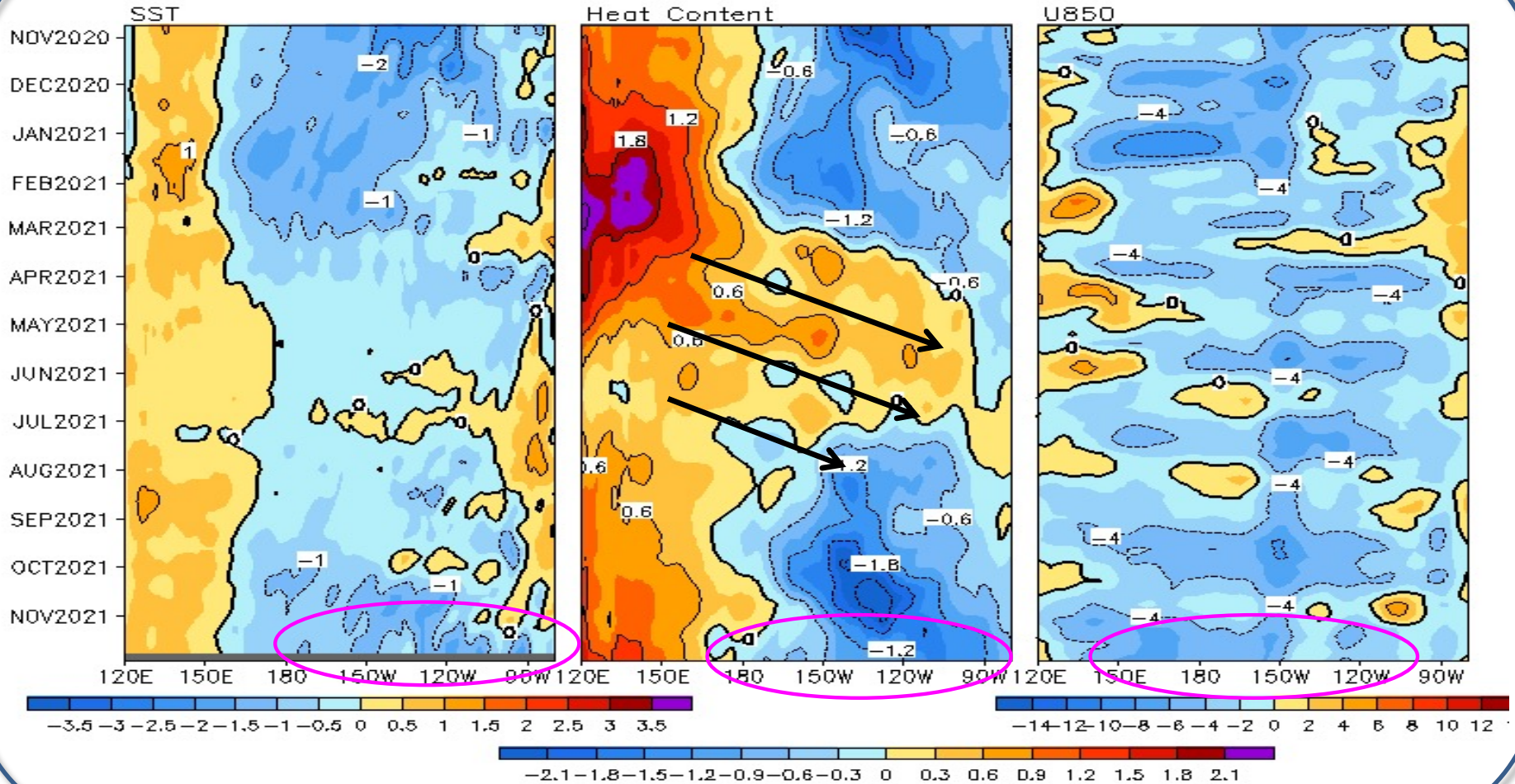
Tropical Pacific: SSTA, SSTA Trend, OLR, heat flux, uv925 & uv200 anomalies



Sea surface temperature (SST) anomalies (top-left), anomaly tendency (top-right), Outgoing Long-wave Radiation (OLR) anomalies (middle-left), sum of net surface short- and long-wave radiation, latent and sensible heat flux anomalies (middle-right; positive means heat into the ocean), 925-mb wind anomaly vector and its amplitude (bottom-left), 200-mb wind anomaly vector and its amplitude (bottom-right). SST are derived from the NCEP OI SST analysis, OLR from the NOAA 18 AVHRR IR window channel measurements by NESDIS, winds and surface radiation and heat fluxes from the NCEP CDAS. Anomalies are departures from the 1991-2020 base period means.

Equatorial Pacific SST ($^{\circ}\text{C}$), H300 ($^{\circ}\text{C}$), and u850 (m/s) Anomalies

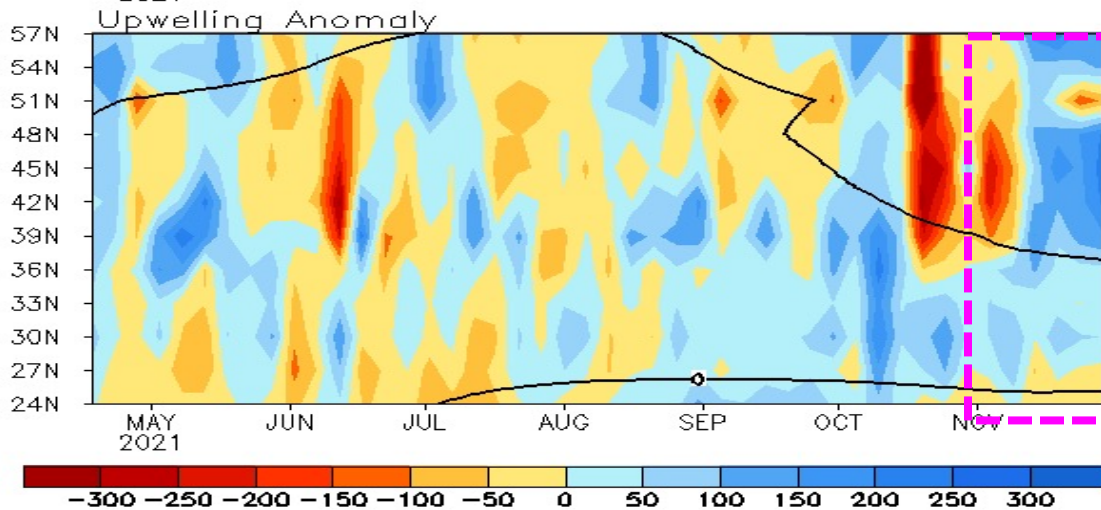
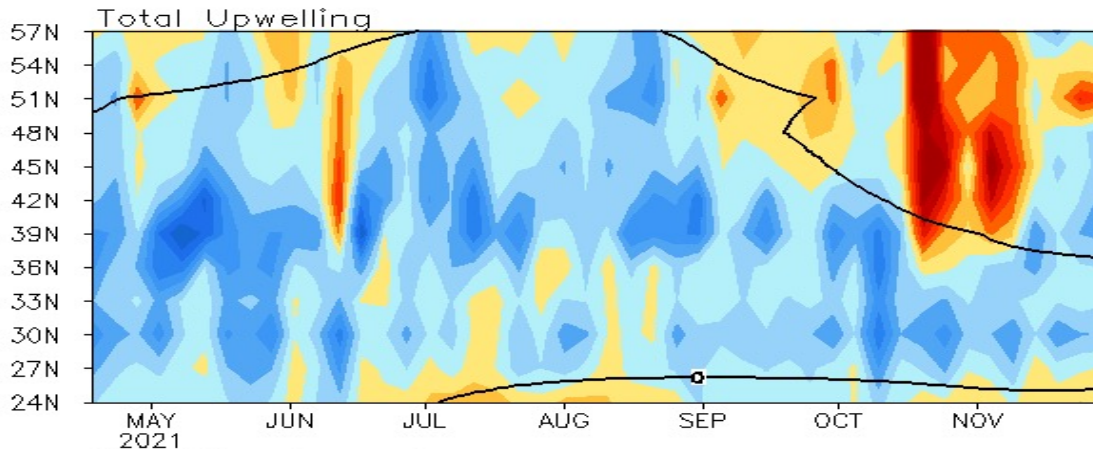
2 $^{\circ}\text{S}$ –2 $^{\circ}\text{N}$ Average, 3 Pentad Running Mean



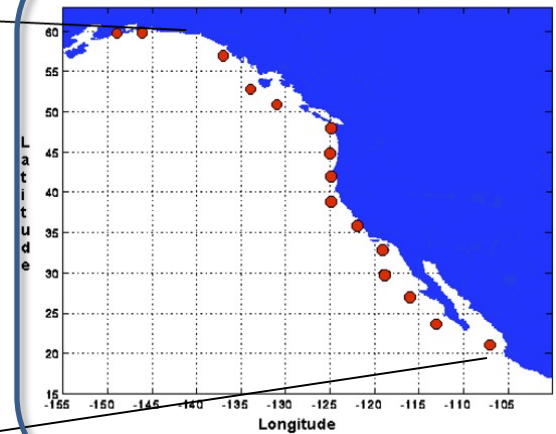
- Negative H300 anomaly continued in the central-eastern Pacific Nov 2021, contributing to further SST cooling.
- Easterly wind anomalies prevailed over the equatorial Pacific.

North America Western Coastal Upwelling

Pentad Coastal Upwelling for West Coast North America
($\text{m}^3/\text{s}/100\text{m}$ coastline)



Standard Positions of Upwelling Index Calculations

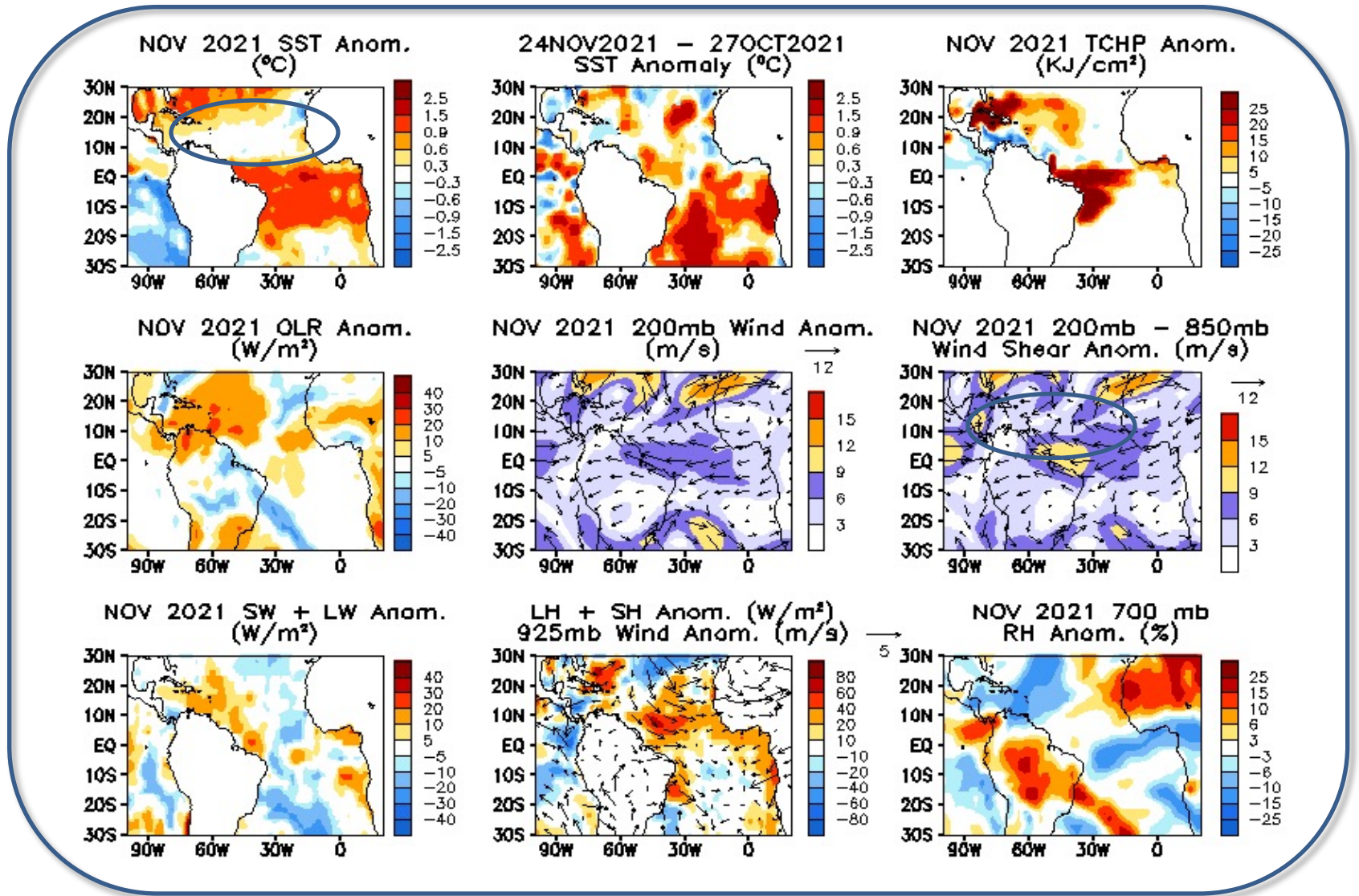


- Upwelling anomaly dominated in Nov 2021.

(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 ($\text{m}^3/\text{s}/100\text{m}$ coastline). Anomalies are departures from the 1991-2020 base period pentad means.

- Area below (above) black line indicates climatological upwelling (downwelling) season.

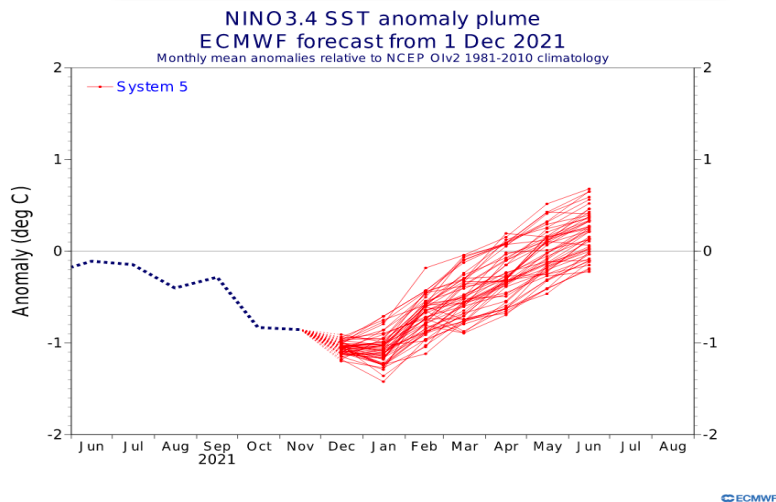
- Climatologically upwelling season progresses from March to July along the west coast of North America from 36°N to 57°N.



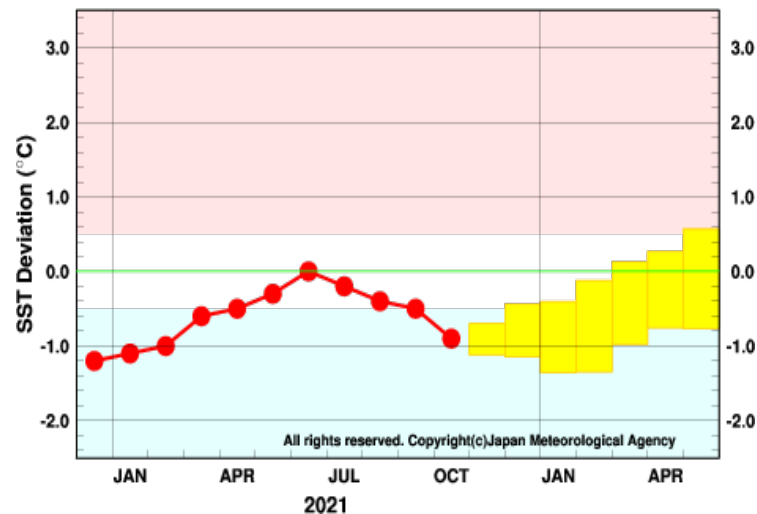
Top Row: SSTA (left; OI SST), SSTA tendency (central), Tropical Cyclone Heat Potential anomaly (right; GODAS).
 Middle row: OLR (left; NOAA 18 AVHRR IR), UV200 (central; NCEP CDAS), UV200-UV850 (right; NCEP CDAS) anomalies.
 Bottom row: SW+LW (left), LH+SH (central), Relative humidity at 700 hPa (right;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

Individual Model Niño3.4 Forecasts

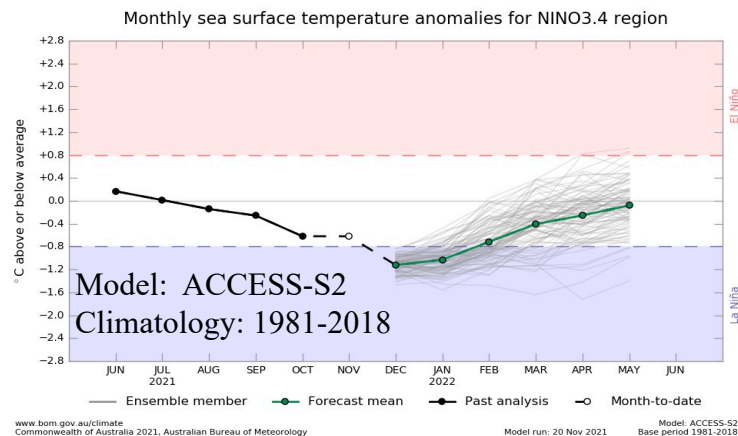
EC: IC= 01 Dec, 2021



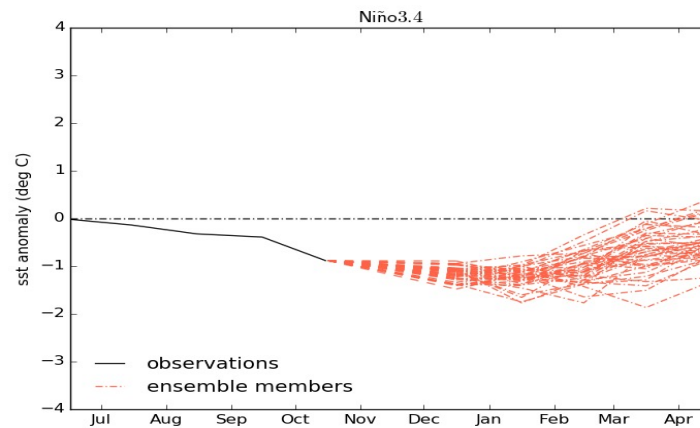
JMA: Updated 11 Nov, 2021



BOM: Updated 20 Nov, 2021



UKMO: Updated 11 Nov, 2021



Global Sea Surface Salinity (SSS): Anomaly for November 2021

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 continues/strengthens in the western equatorial Pacific Ocean with reduced precipitation in this area. While, negative SSS anomaly shows in the eastern equatorial Pacific Ocean (east of 120°W) with increased precipitation in this area. Negative SSS anomaly in the northeast Pacific Ocean continues. Positive SSS anomaly appears between 20°N and 40°N in the Atlantic Ocean. Negative SSS anomaly is accompanied with increased precipitation in the east basin of Indian Ocean south of Equator.

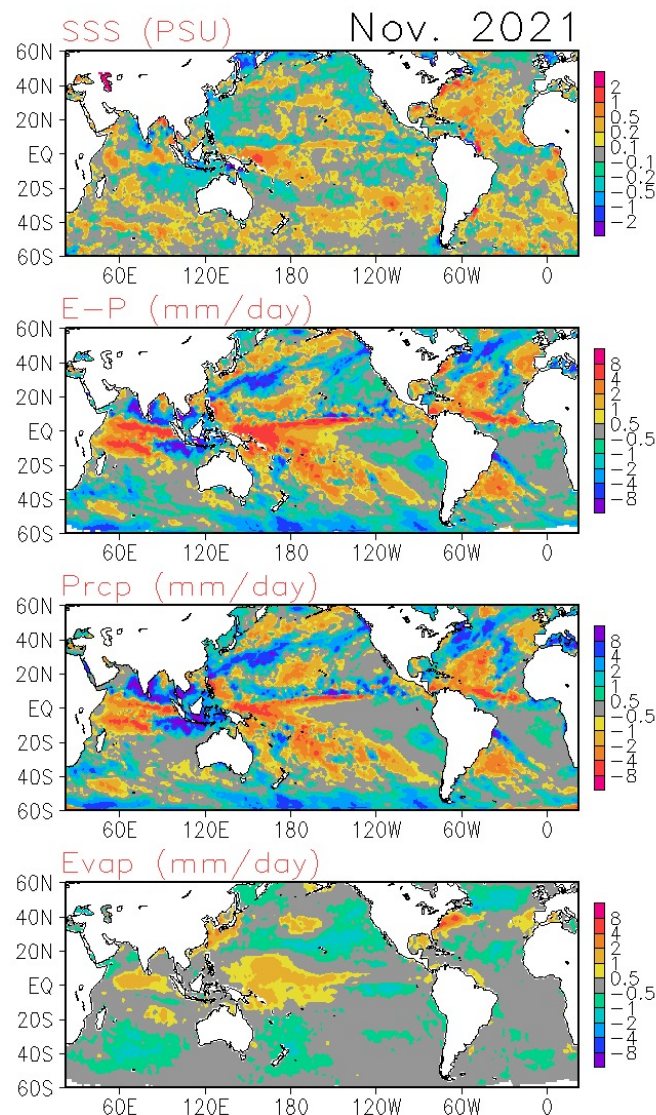
SSS : Blended Analysis of Surface Salinity (BASS) V0.2

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

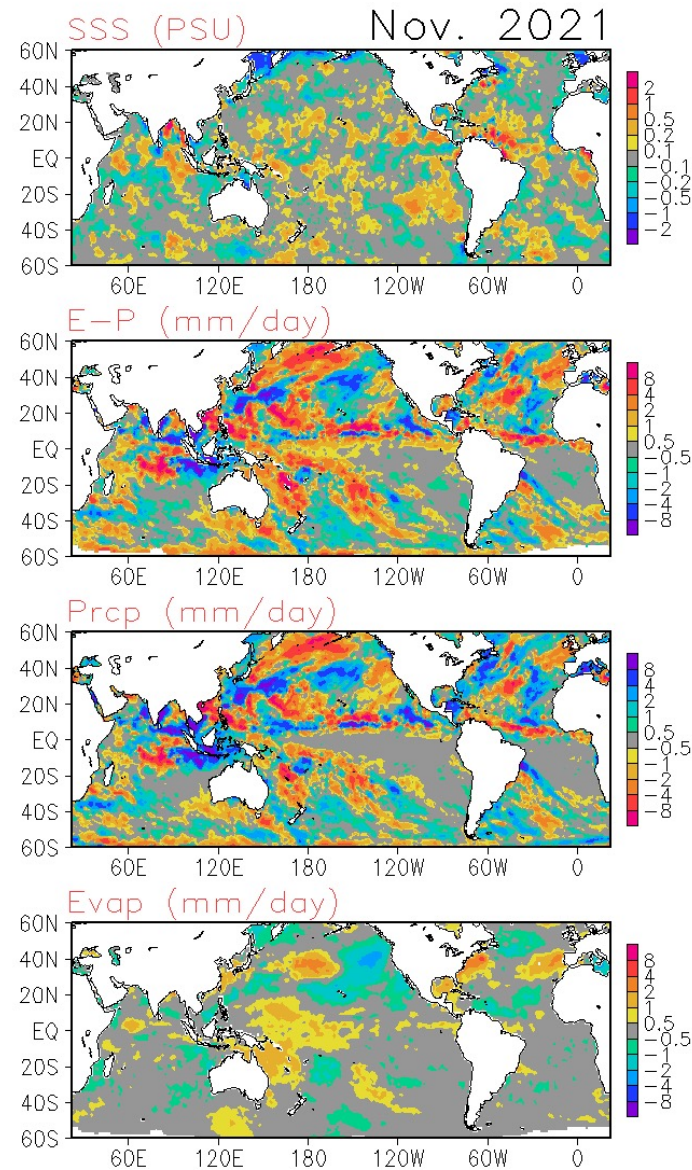
<ftp.cpc.ncep.noaa.gov/precip/BASS>

Precipitation: CMORPH adjusted satellite precipitation estimates

Evaporation: Adjusted CFS Reanalysis



Compared with last month, SSS increased in the western Equatorial Pacific Ocean likely due to reduced precipitation; SSS decreased along the equator in the eastern Equatorial Pacific Ocean. SSS increased between Equator and 20°N in the Atlantic Ocean. SSS increased in the west basin of South Pacific Ocean between 20°S and 40°S, which is possibly due to oceanic advection/entrainment.



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.

