

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

Prepared by
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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)



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

• Pacific Ocean

- NOAA “ENSO Diagnostic Discussion” on 8 Apr 2021 stated “A transition from La Niña to ENSO-Neutral is likely in the next month or so, with an 80% chance of ENSO-neutral during May-July 2021.”
- La Niña conditions weakened with Niño3.4 = -0.49°C in Apr 2021.
- The negative phase of PDO has persisted since Jan 2020 with PDOI = -1.2 in Apr 2021.

• Indian Ocean

- SSTAs were small in the tropical Indian Ocean in Apr 2021.

• Atlantic Ocean

- SSTs were mostly near average in the tropical Atlantic Ocean in Apr 2021.
- NAO switched to a negative phase in Apr 2021 with NAOI = -1.7.

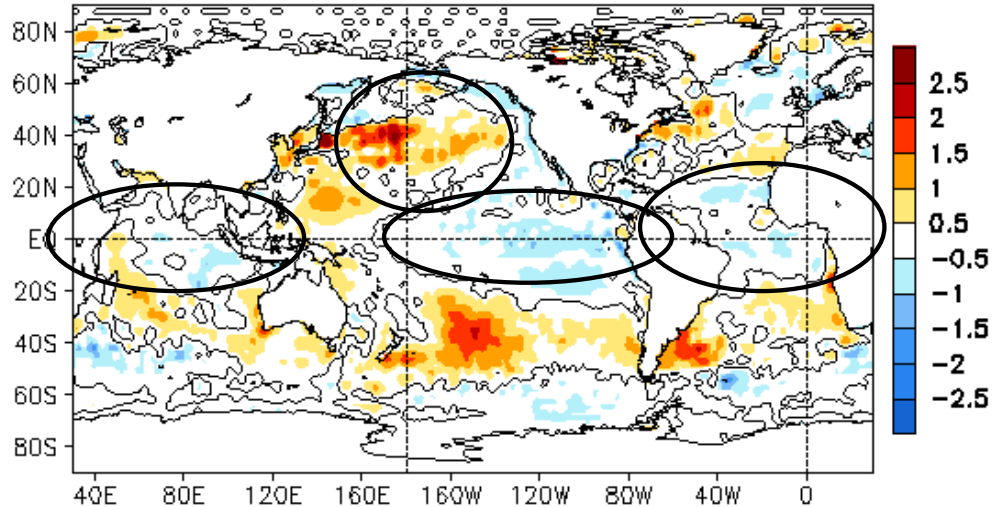
• Arctic Ocean

- The sea ice extent for Apr 2021 was the 6th lowest since 1979.
- With ICs in Apr 2021, NCEP/CPC predicted a below-normal sea ice extent during summer and autumn 2021.

Global Oceans

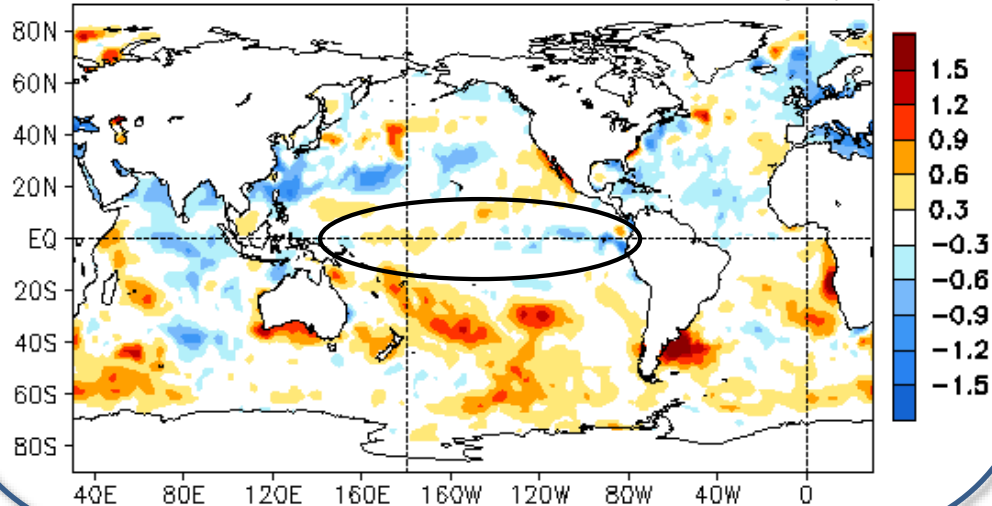
Global SST Anomaly ($^{\circ}\text{C}$) and Anomaly Tendency

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



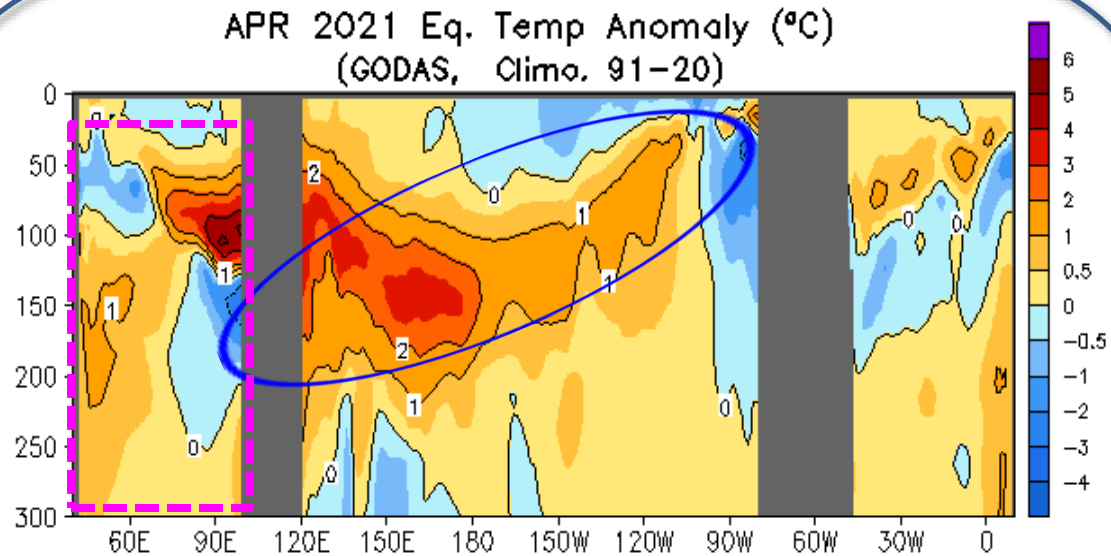
- Negative SSTAs weakened in the central tropical Pacific.
- Positive SSTAs were evident in the NE Pacific.
- Negative SSTAs were present in the tropical Atlantic Ocean.
- SSTAs were small in the tropical Indian Ocean.

APR 2021 – MAR 2021 SST Anomaly ($^{\circ}\text{C}$)

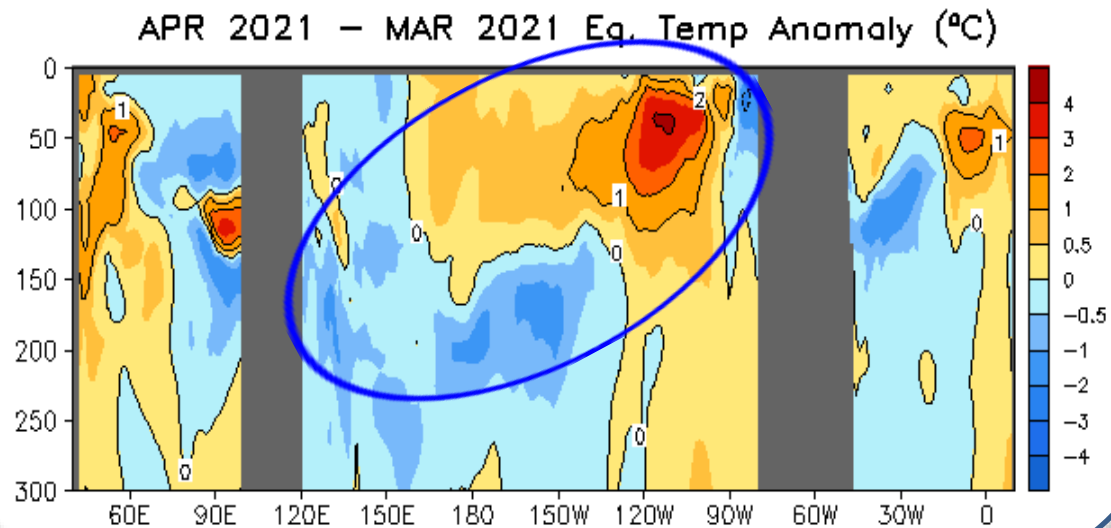


- Positive (negative) SSTA tendencies were present in the central (eastern) equatorial Pacific.

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



- Positive subsurface ocean anomalies dominated along the thermocline in the equatorial Pacific.
- Positive anomalies have been observed in the eastern Indian Ocean since Oct 2020.

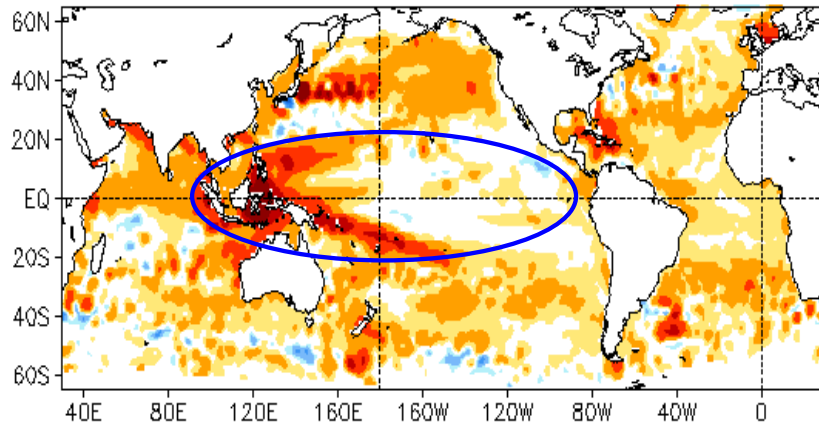


- Temperature anomaly tendency was positive (negative) along the thermocline in the eastern (western) Pacific, implying an eastward propagation of the positive anomalies.

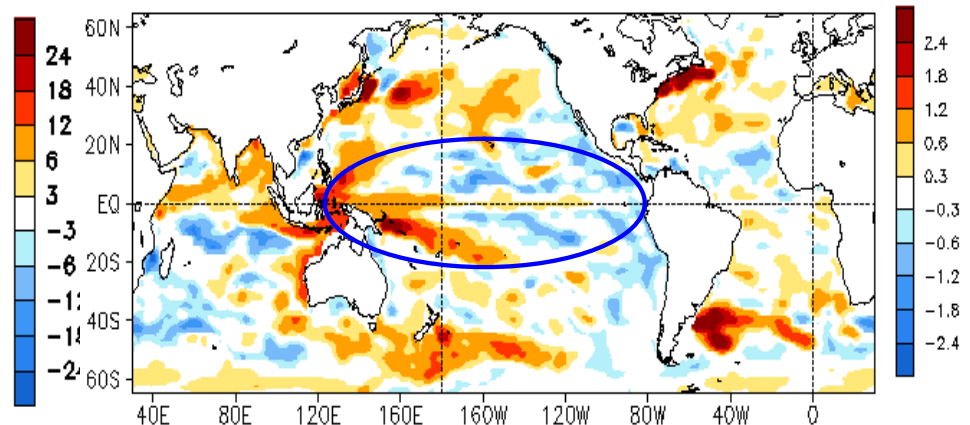
Equatorial depth-longitude section of ocean temperature anomalies (top) and anomaly tendency (bottom). Data is from the NCEP's global ocean data assimilation system. Anomalies are departures from the 1991-2020 base period means.

Global SSH and HC300 Anomaly & Anomaly Tendency

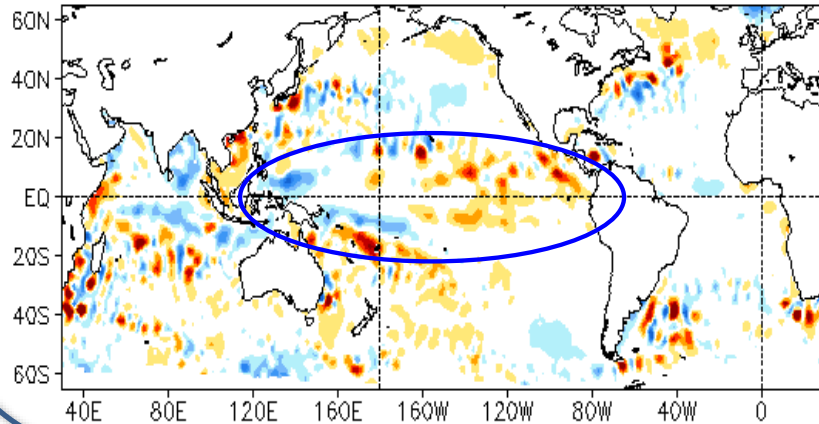
APR 2021 SSH Anomaly (cm)
(AVISO Altimetry, Climo. 93-20)



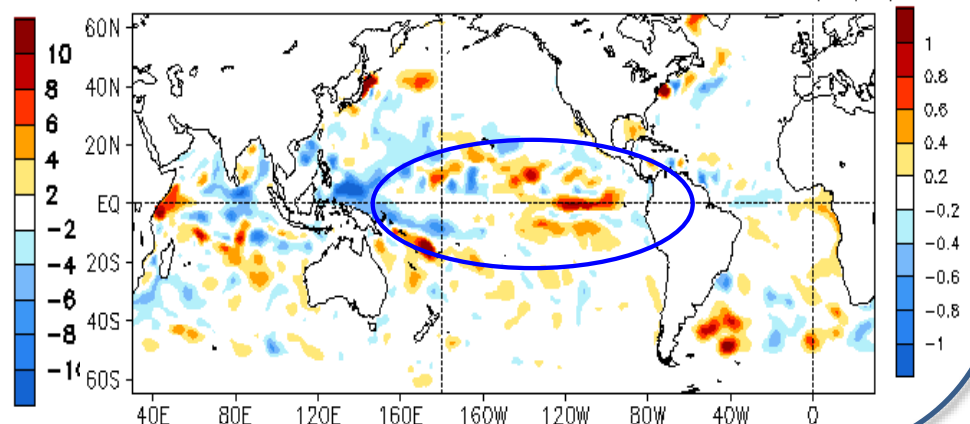
APR 2021 Heat Content Anomaly (°C)
(GODAS, Climo. 91-20)



APR 2021 - MAR 2021 SSH Anomaly (cm)



APR 2021 - MAR 2021 Heat Content Anomaly (°C)



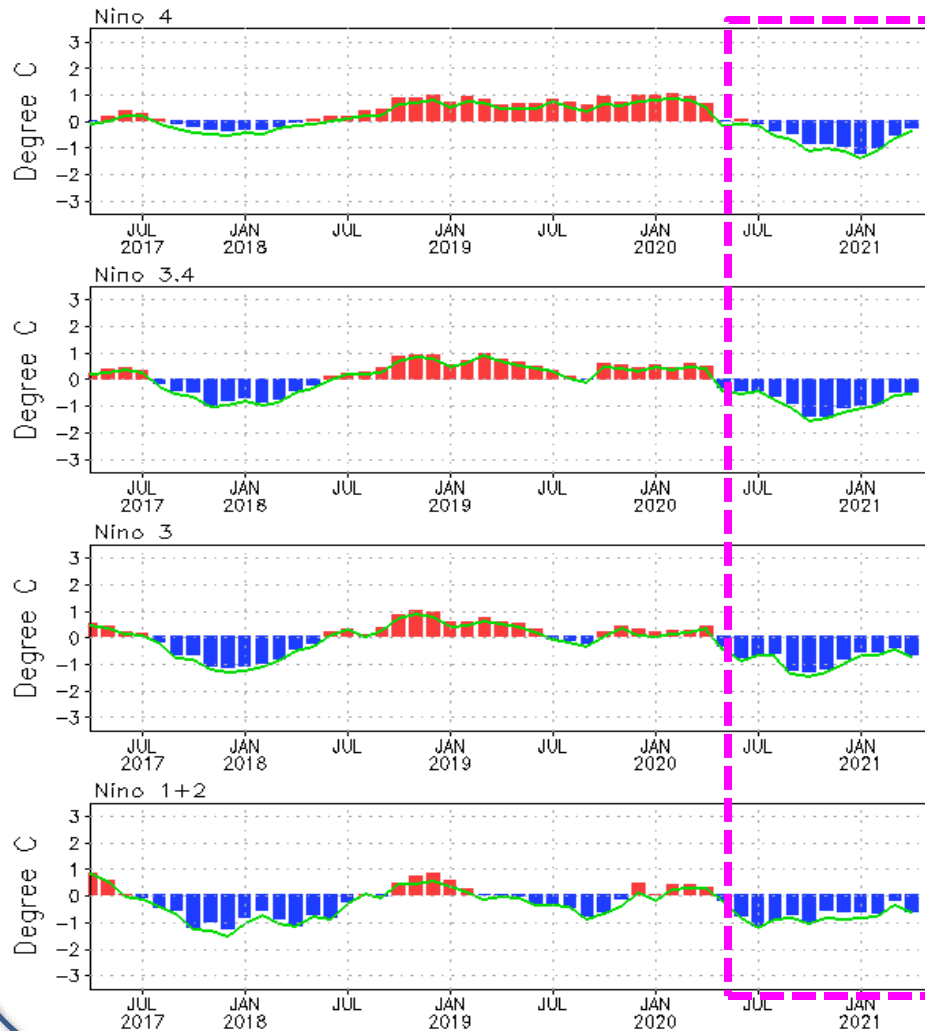
- The SSHA pattern was overall consistent with the HC300A pattern, but with a significant trend component in SSHA.
- La Nina-like pattern persisted.
- Anomaly tendencies: Positive in the eastern tropical Pacific; negative in the western tropical Pacific, consistent with the subsurface ocean temperature anomaly tendency (the previous slide).

Tropical Pacific Ocean and ENSO Conditions

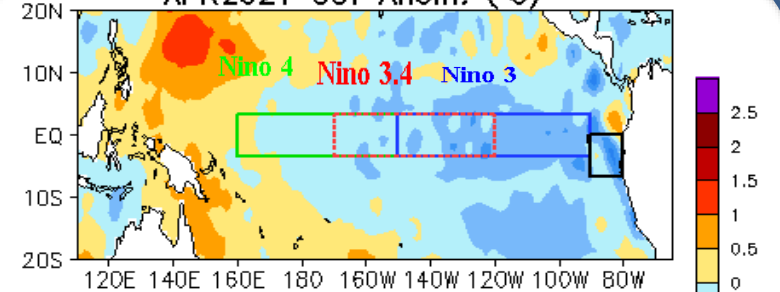
Evolution of Pacific Niño SST Indices

Monthly Tropical Pacific SST Anomaly

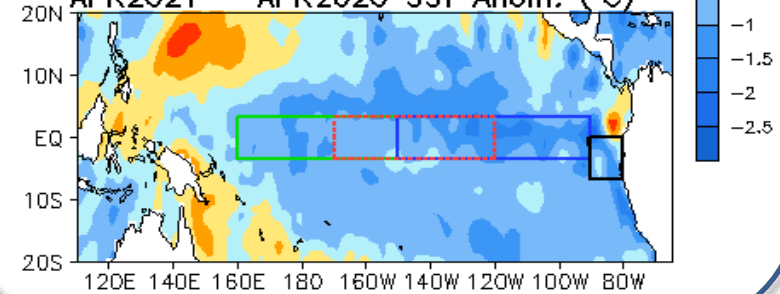
(Bar: 1991–2020 Climatology; Curve: Last 10 YR Climatology)



APR2021 SST Anom. (°C)



APR2021 - APR2020 SST Anom. (°C)

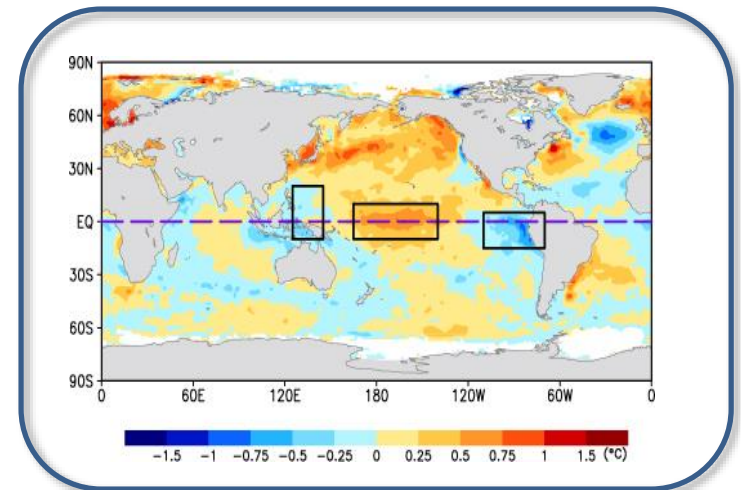
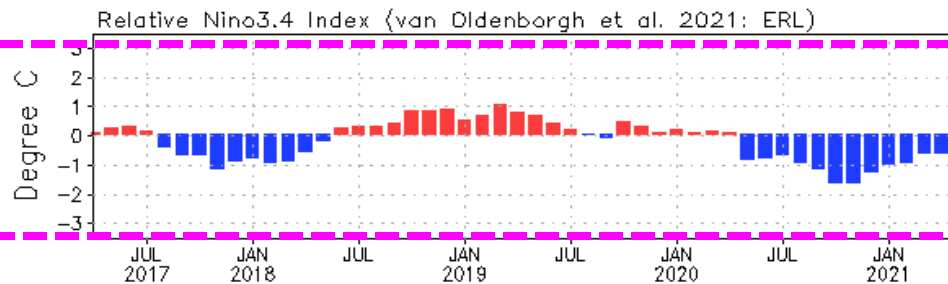
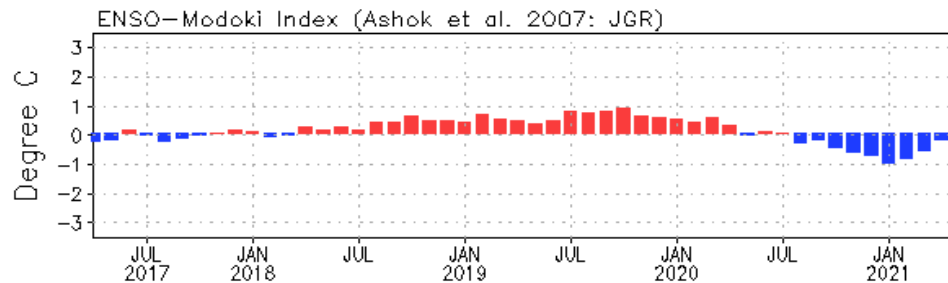
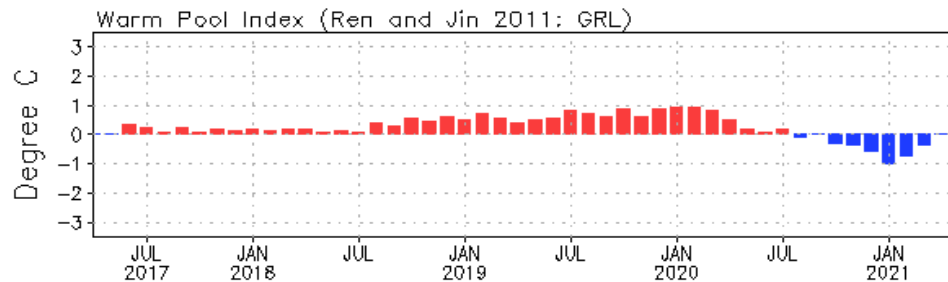
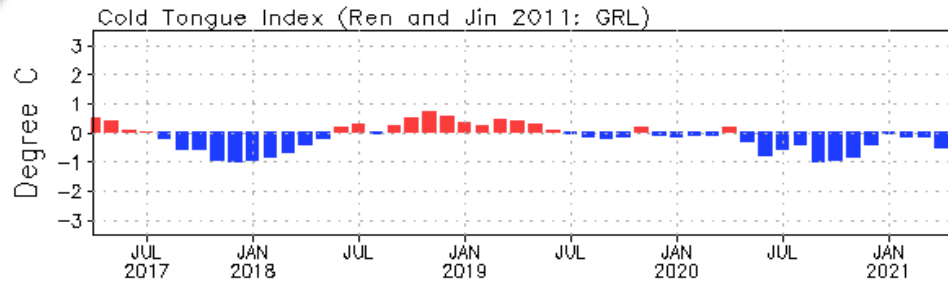


- Niño4 and Niño3.4 indices weakened, and Niño3 and Niño1+2 indices strengthened, with Niño3.4 = -0.49°C in Apr 2021.
- Compared with Apr2020, the central and eastern tropical Pacific was cooler in Apr 2021.
- The indices may have slight differences if based on different SST products.

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.

Evolution of Pacific Niño SST Indices

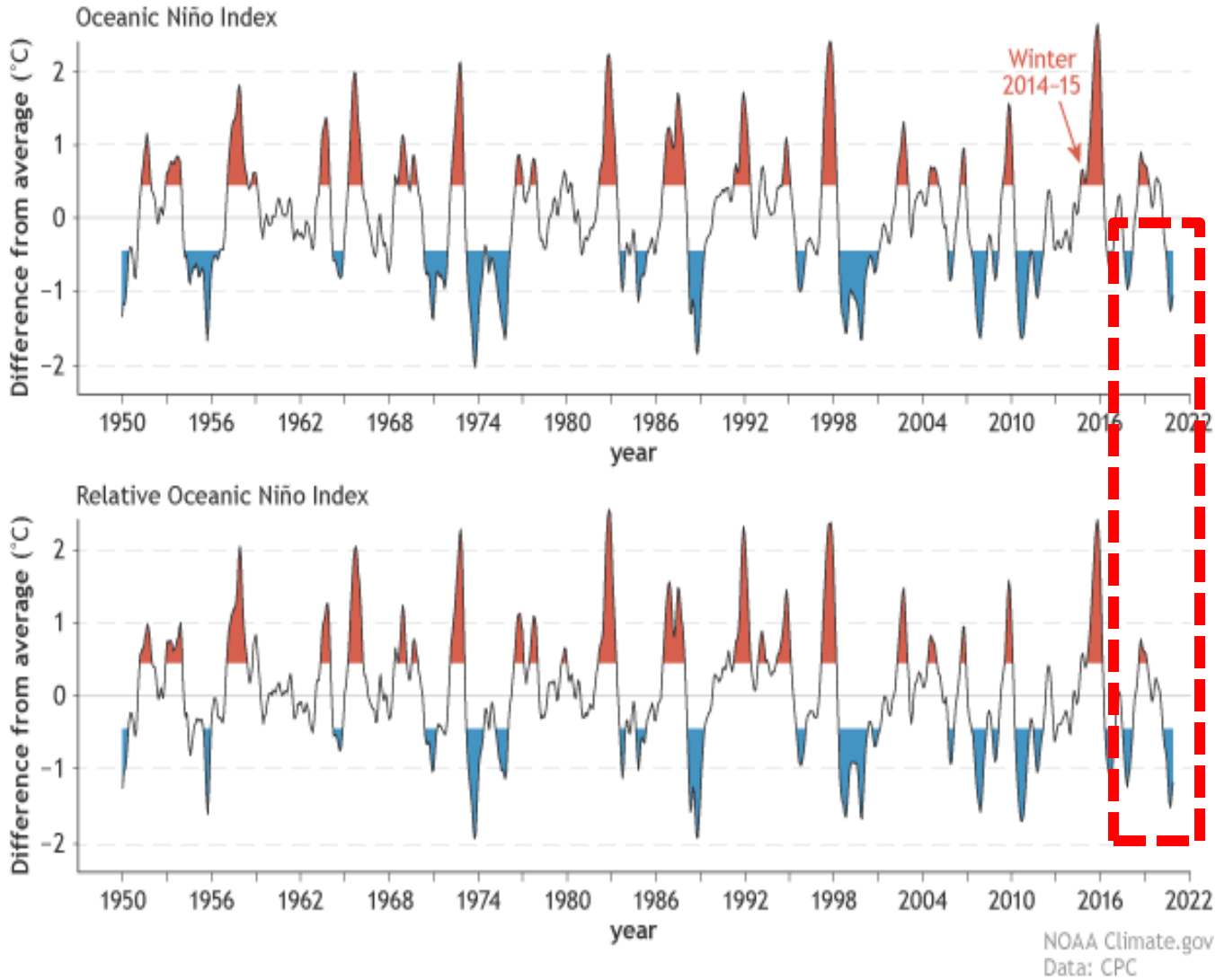
Monthly Tropical Pacific SST Anomaly



- 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 (0° - 360° , 20° S- 20° N), 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](https://www.cpc.ncep.noaa.gov/data/indices/RONI.ascii.txt)

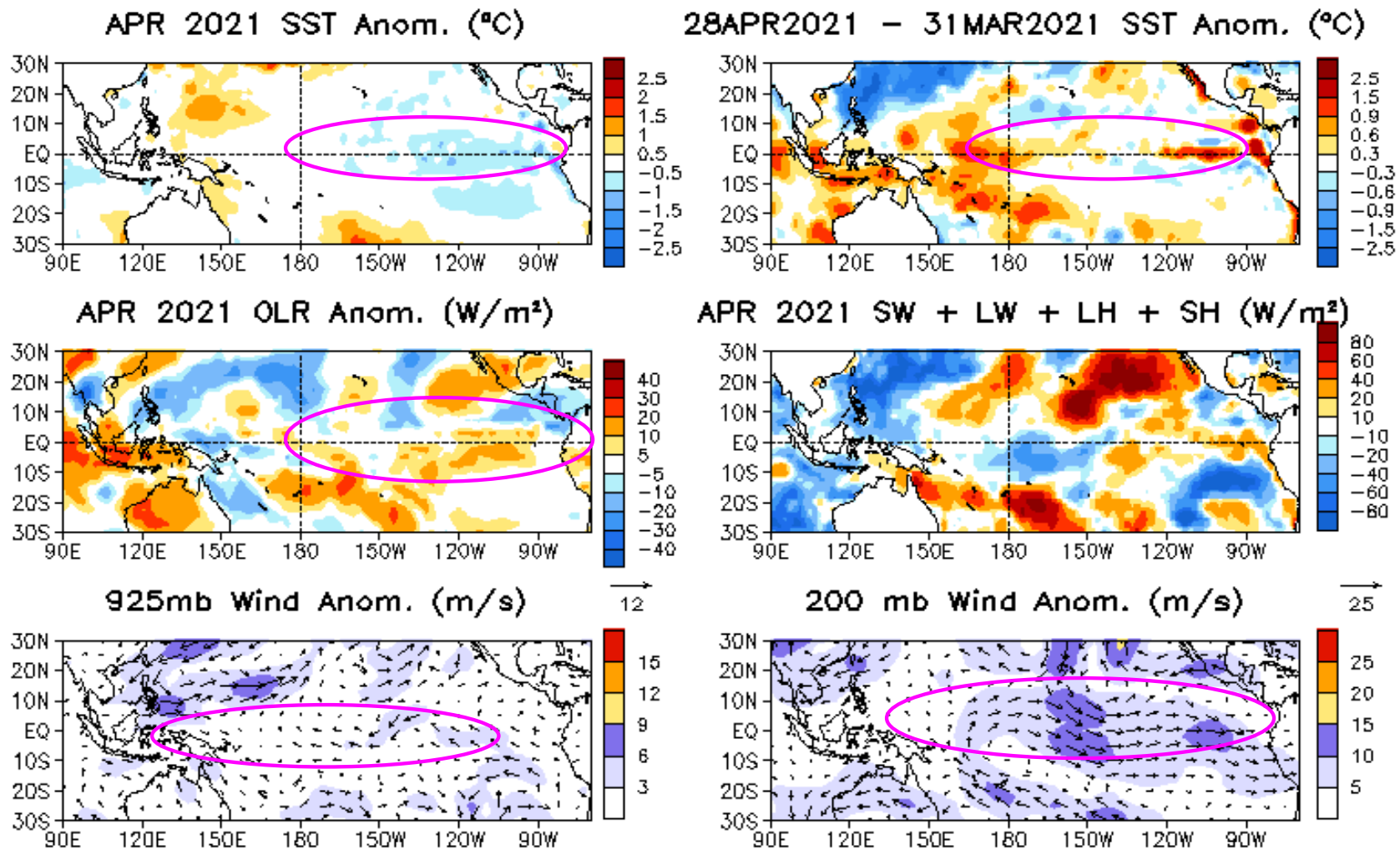
Regular ONI versus relative ONI, 1950–2021



- With the relative Niño3.4 index, the strength of 2020/21 La Niña increased slightly, compared with the Niño3.4 index.

<https://www.climate.gov/news-features/blogs/enso/enso-running-fever-or-it-global-warming>

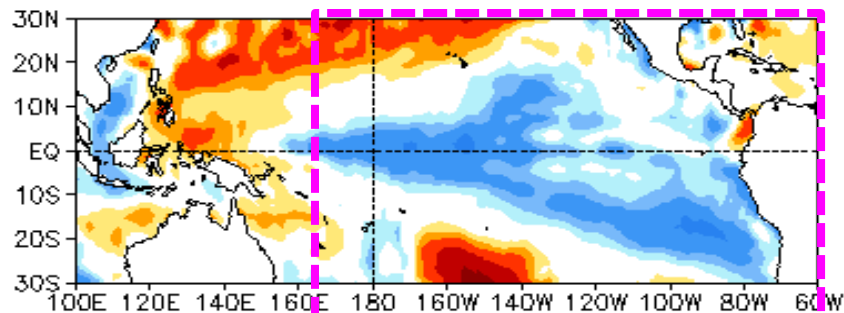
Tropical Pacific: SSTA, SSTA Trend, OLR, heat flux, uv925 & uv200 anomalies



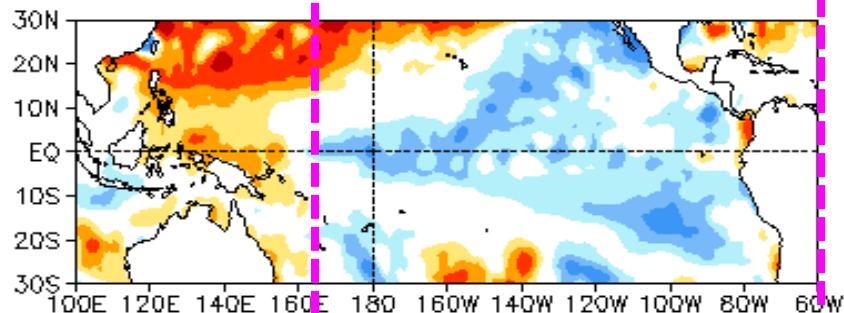
Sea surface temperature (SST) anomalies (top-left), anomaly tendency (top-right), Outgoing Long-wave Radiation (OLR) anomalies (middle-left), sum of net surface short- and long-wave radiation, latent and sensible heat flux anomalies (middle-right; positive means heat into the ocean), 925-mb wind anomaly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

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

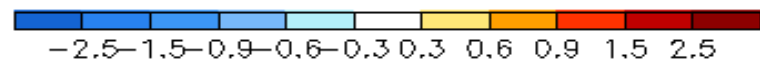
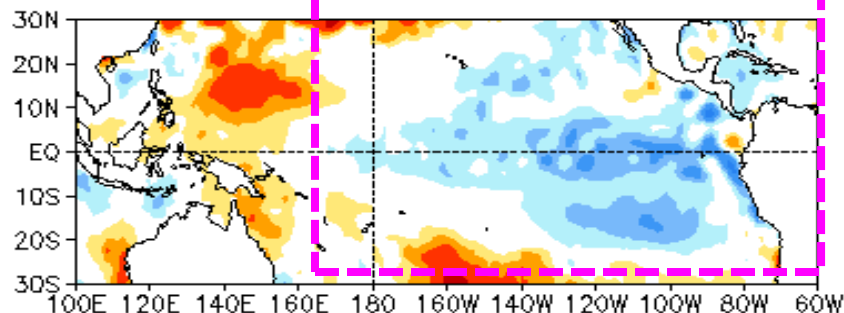
FEB 2021 SST Anom. ($^{\circ}\text{C}$)



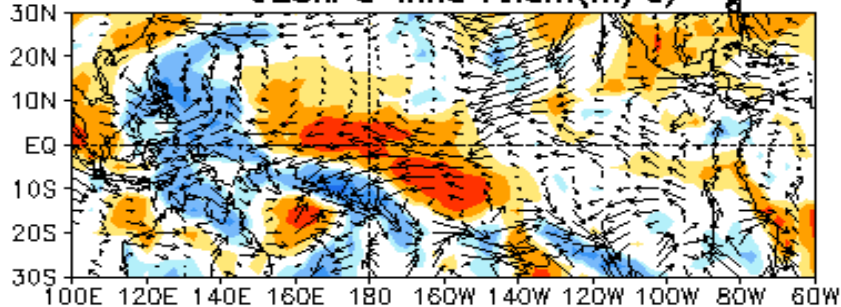
MAR 2021 SST Anom. ($^{\circ}\text{C}$)



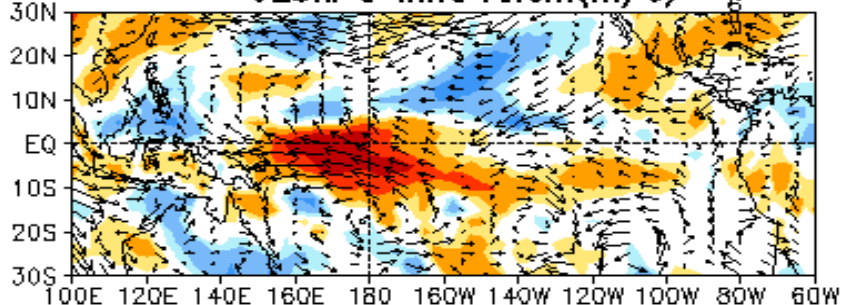
APR 2021 SST Anom. ($^{\circ}\text{C}$)



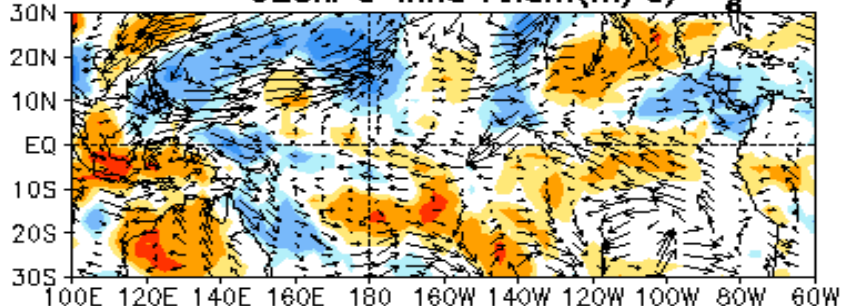
**FEB 2021 OLR Anom. (W/m^2)
925hPa Wind Anom(m/s)**



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

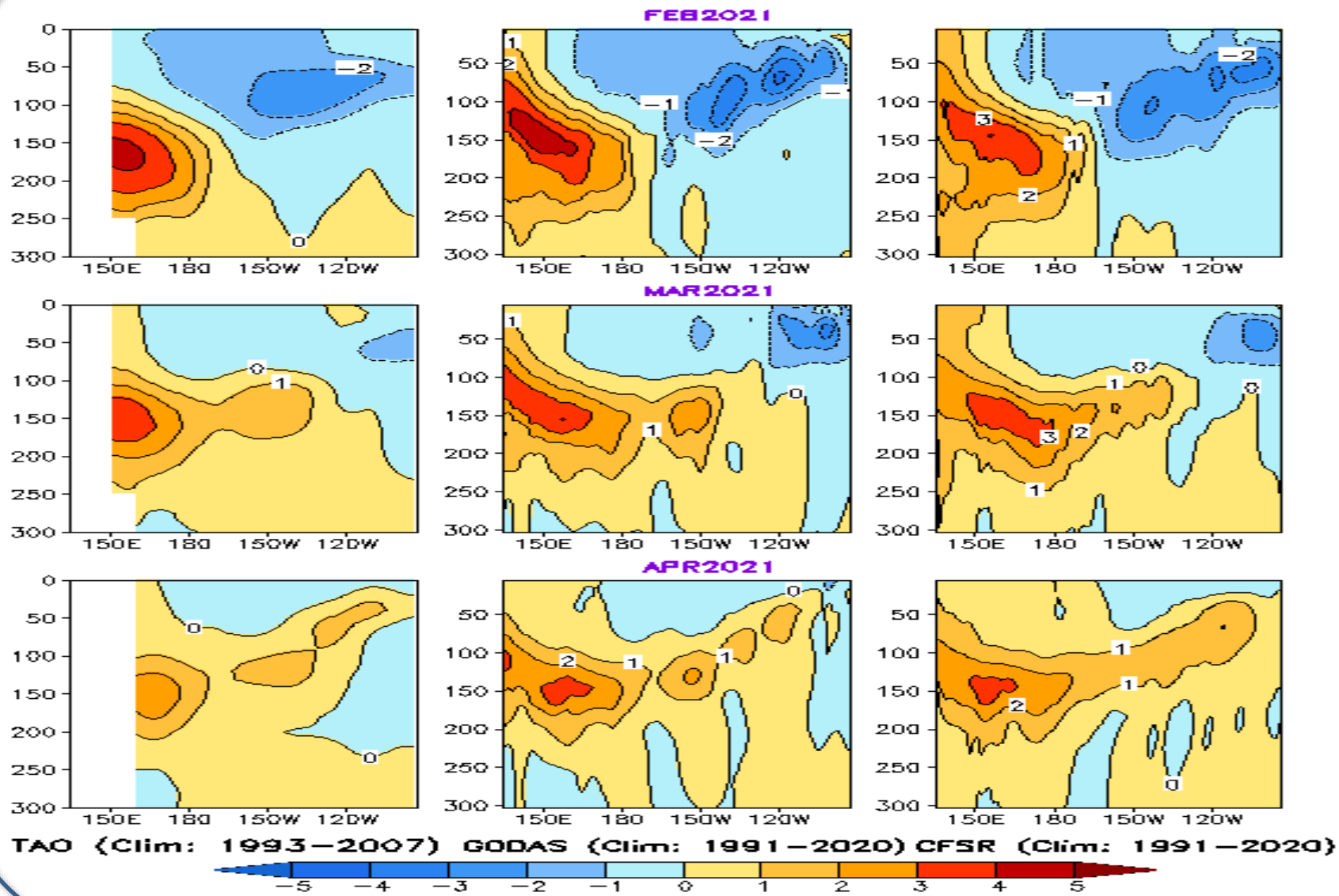


**APR 2021 OLR Anom. (W/m^2)
925hPa Wind Anom(m/s)**



Latest 3-month subsurface temperature anomaly along the Equator

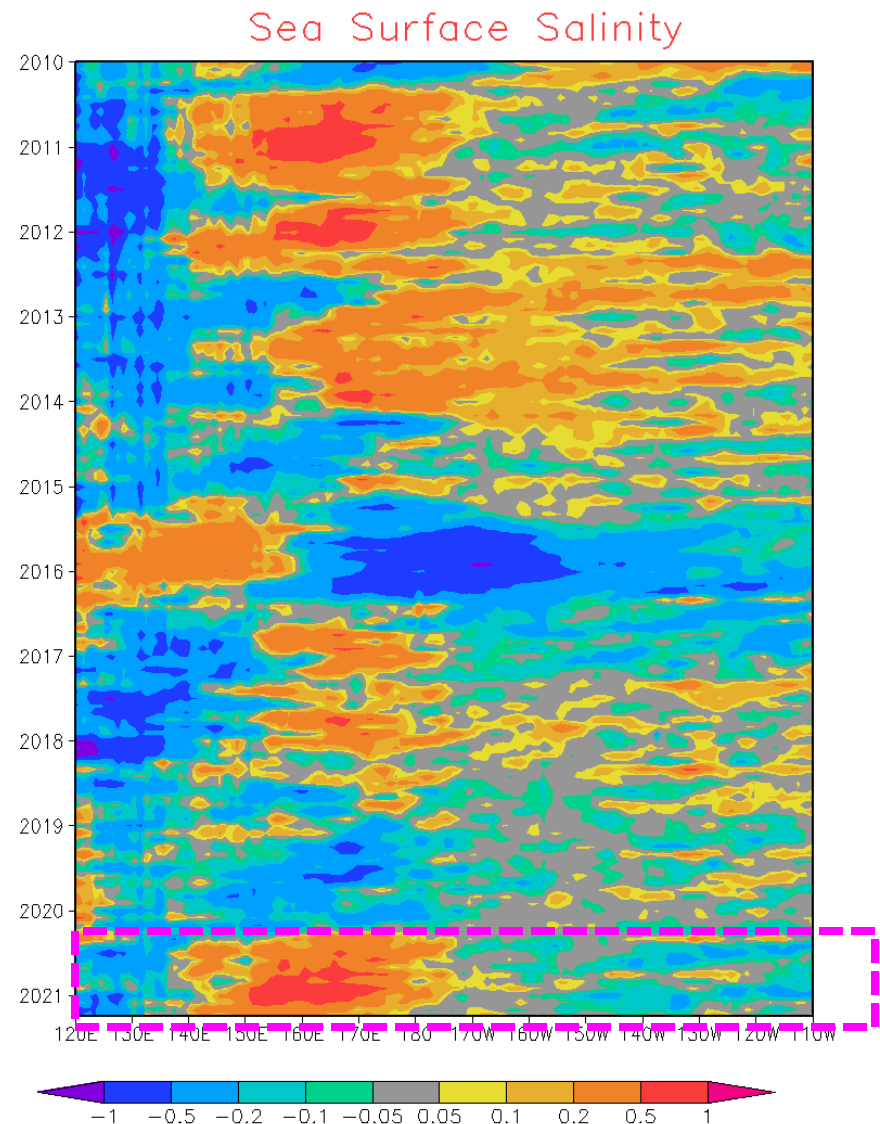
Ocean Temperature Anomaly in 2S–2N (°C)



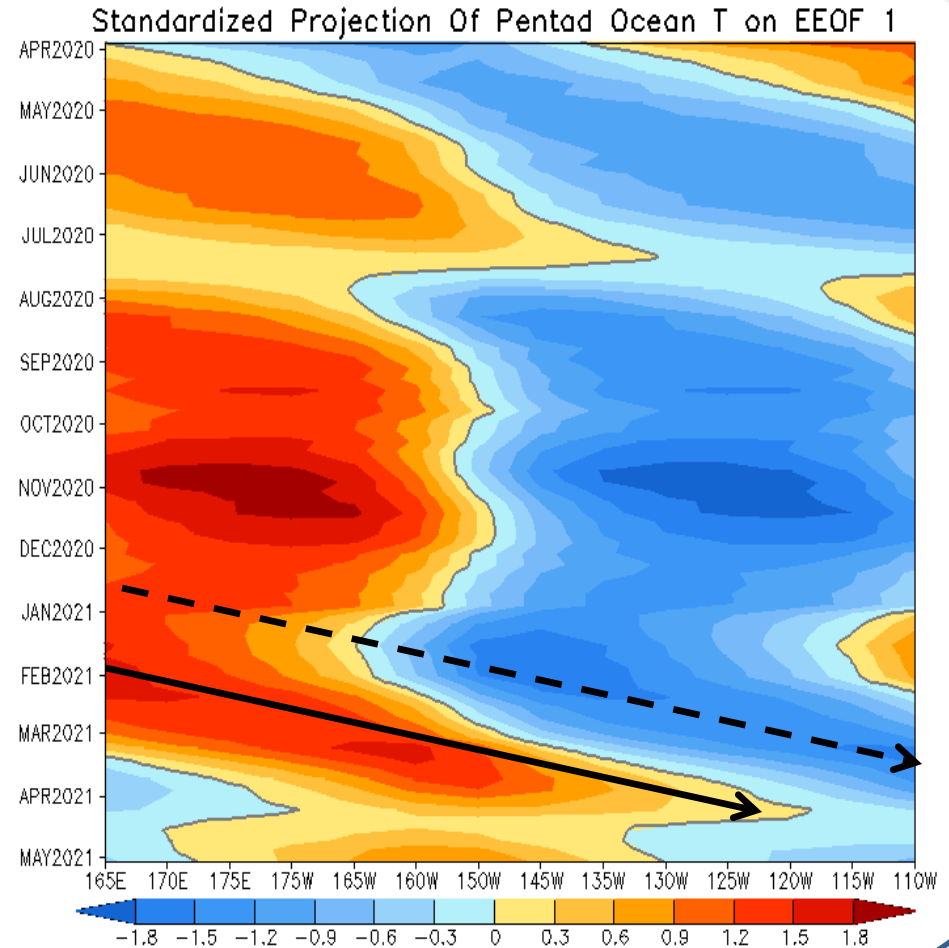
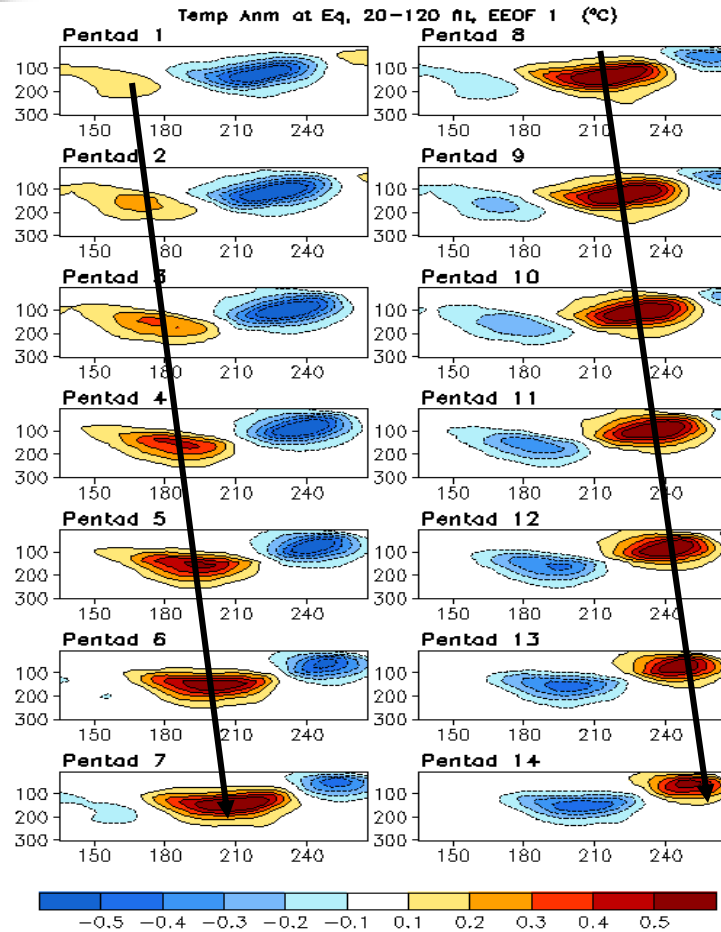
Monthly SSS Anomaly Evolution over Equatorial Pacific

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);
- In the equatorial Pacific Ocean, west of 140° E, negative SSS signal continues; positive SSS signal also continues between 140° E and 170° W; while negative SSS signal continues and likely became weaker east of 160° W.



Oceanic Kelvin Wave (OKW) Index

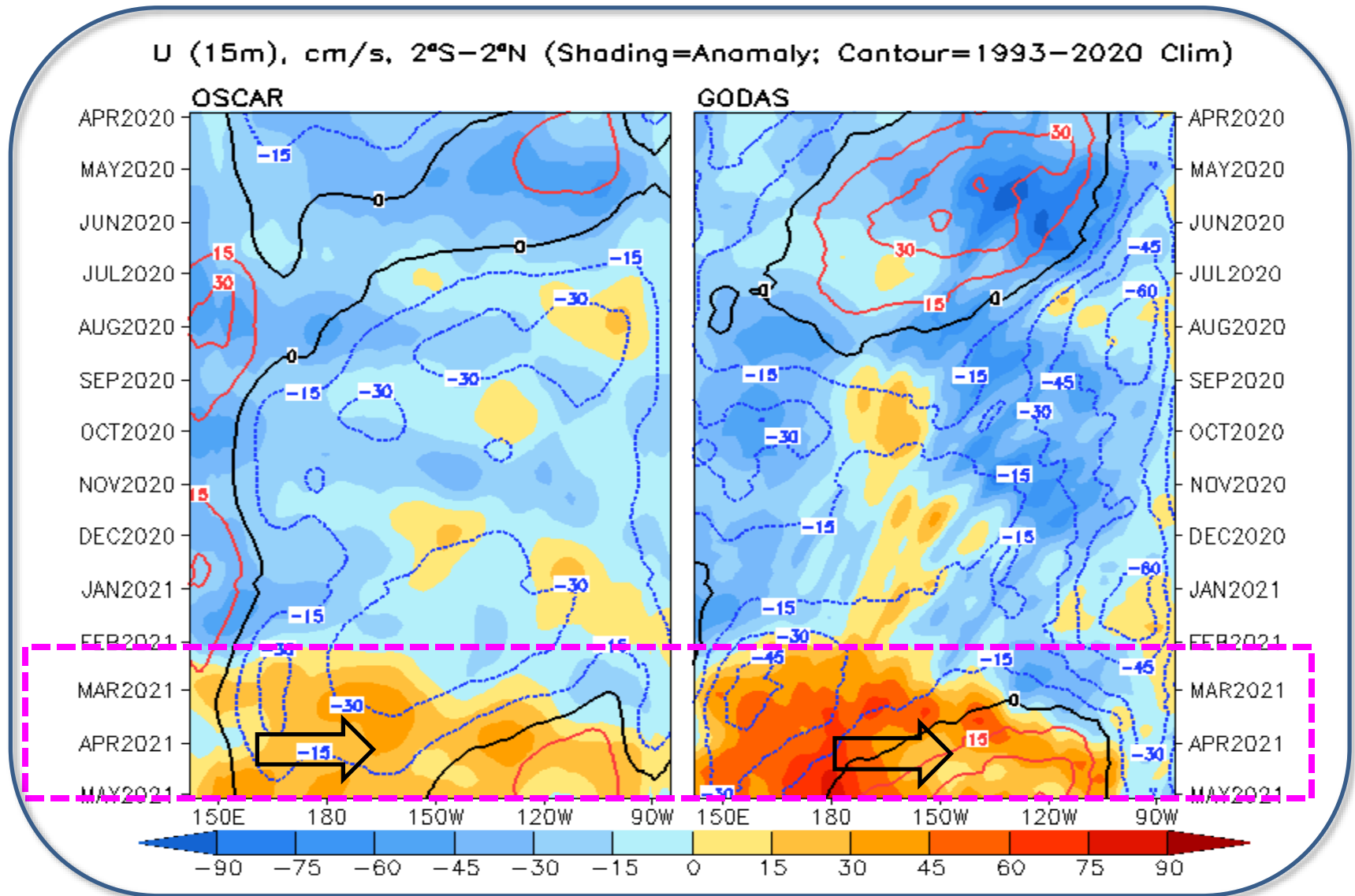


- Upwelling Kelvin waves were initiated in Apr & Jul 2020, leading to the subsurface cooling in the eastern equatorial Pacific.

- Downwelling Kelvin wave was initiated in late Jan or early Feb 2021, consisting with the weakening of La Niña.

(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).)

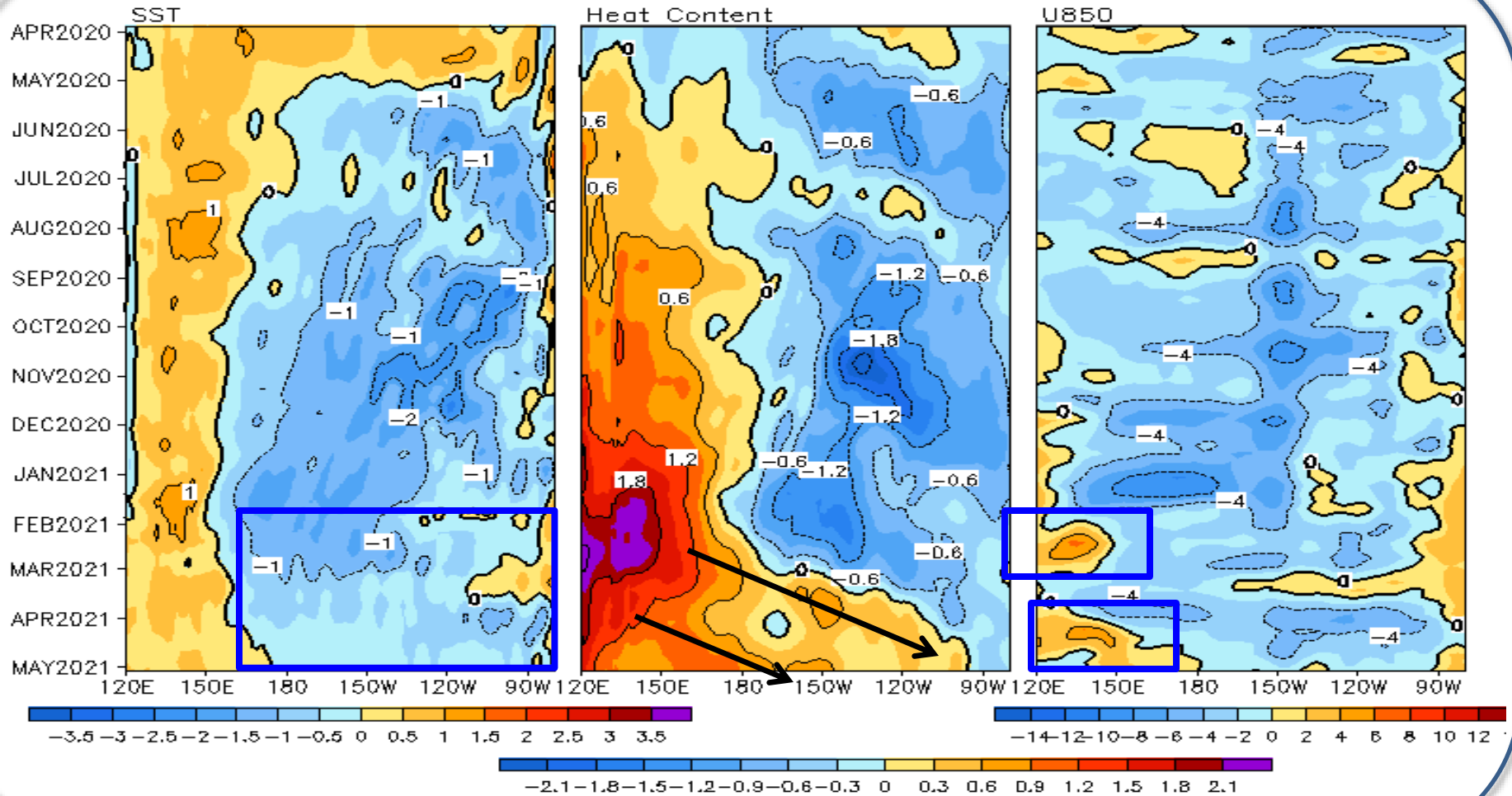
Evolution of Equatorial Pacific Surface Zonal Current Anomaly (cm/s)



- Anomalous eastward currents emerged in the western & central equatorial Pacific in both OSCAR and GODAS in Feb-Apr 2021, contributing to the weakening of the La Niña.

Equatorial Pacific SST ($^{\circ}\text{C}$), HC300 ($^{\circ}\text{C}$), u850 (m/s) Anomalies

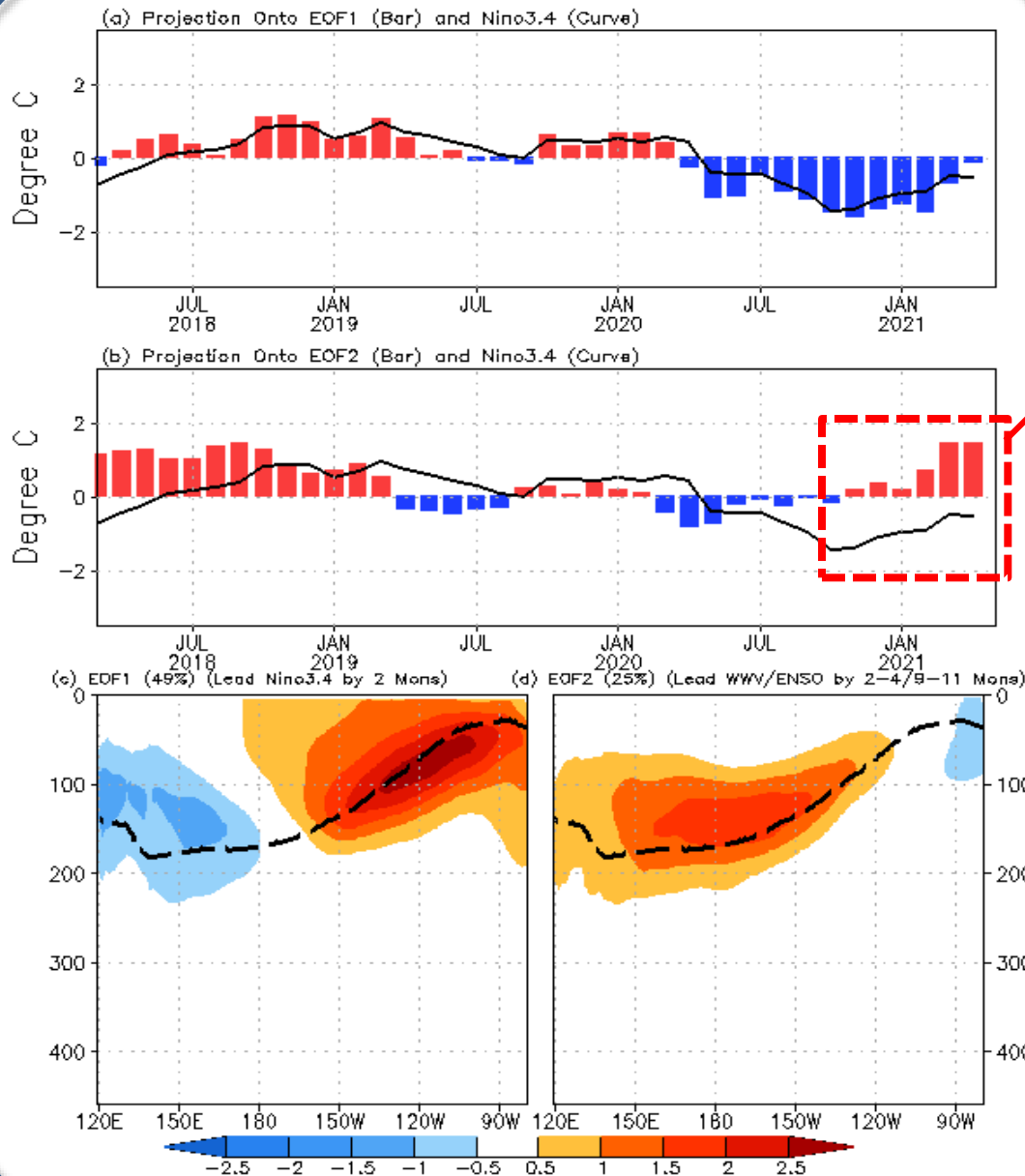
2 $^{\circ}\text{S}$ –2 $^{\circ}\text{N}$ Average, 3 Pentad Running Mean



- Negative SSTAs have weakened since Feb 2021, which may be associated with a downwelling Kelvin wave triggered by a westerly wind burst event.

Equatorial Sub-surface Ocean Temperature Monitoring

GODAS OTA Projection & EOFs (0–459m, 2S–2N, 1979–2012)



- The equatorial Pacific has been in a recharge phase since Nov 2020.

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

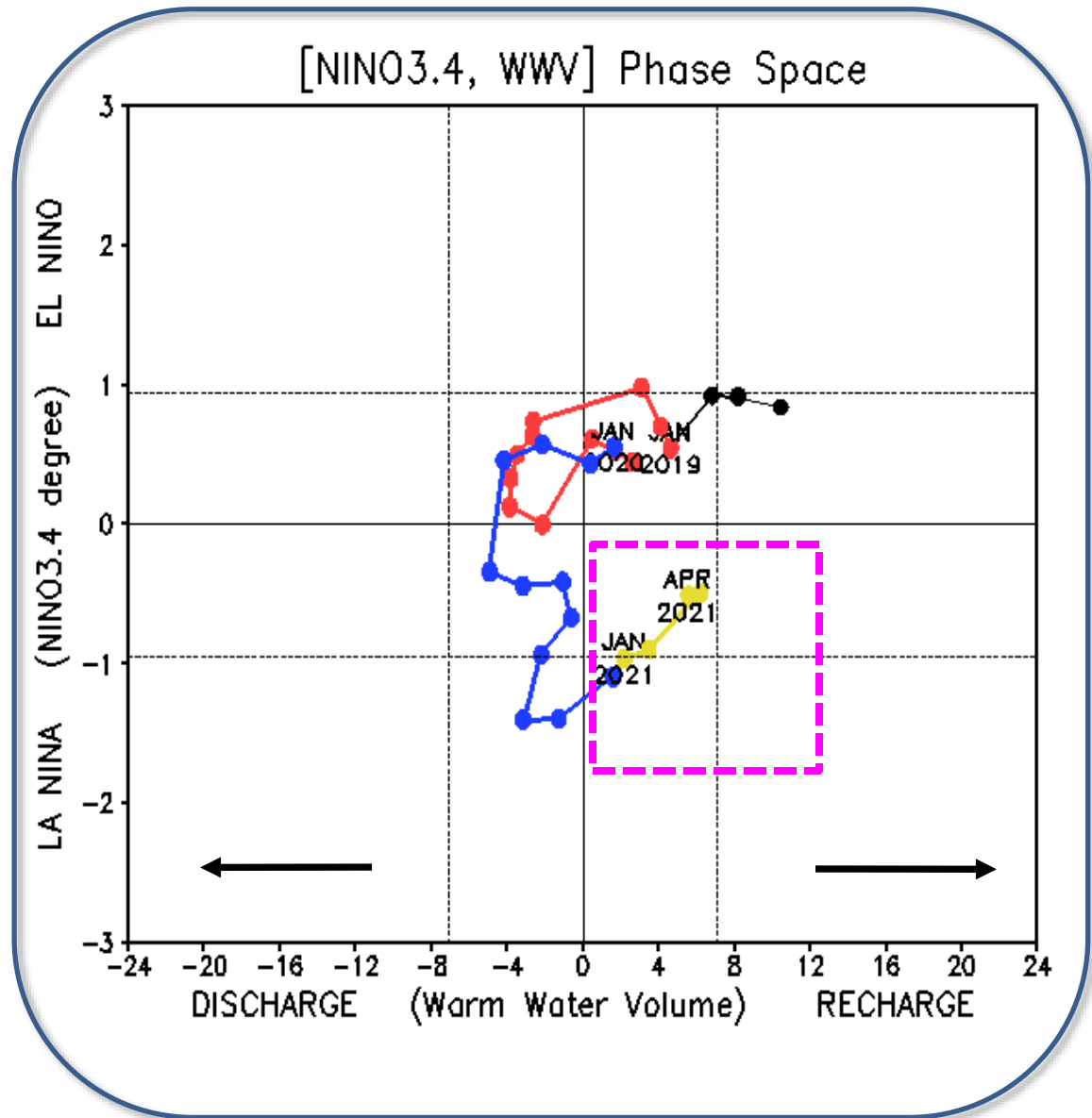
- Recharge/discharge oscillation (ENSO transition phase); Recharge process: heat transport from outside of equator to equator; Negative -> positive phase of ENSO

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

Warm Water Volume (WWV) and Niño3.4 Anomalies

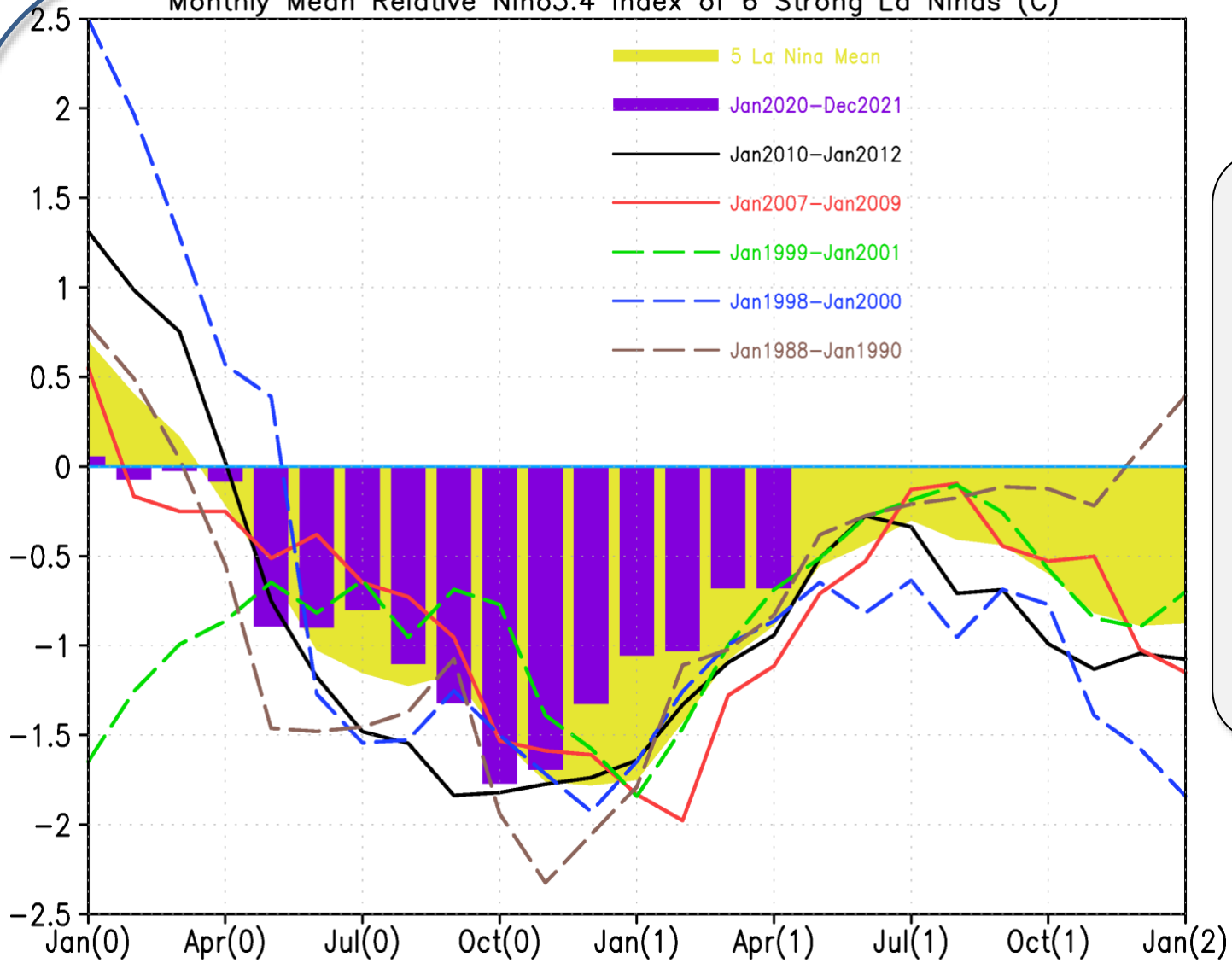
- Equatorial Warm Water Volume (WWV) has been in a recharge phase since Dec 2020.

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



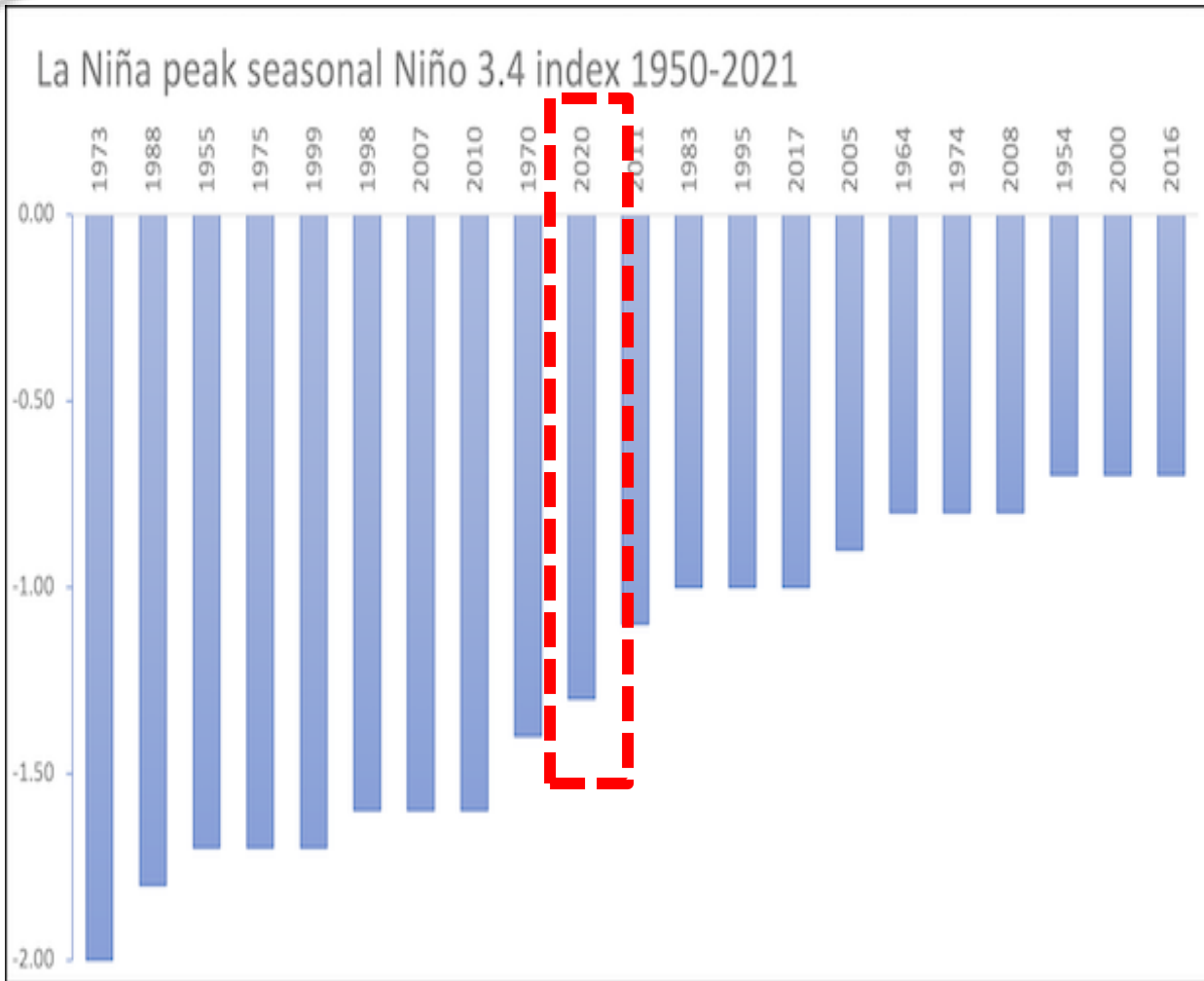
Phase diagram of Warm Water Volume (WWV) and Niño3.4 indices. WWV is the average of depth of 20°C in [120°E-80°W, 5°S-5°N] calculated with the NCEP's GODAS. Anomalies are departures from the 1991-2020 base period means.

Monthly Mean Relative Niño3.4 Index of 6 Strong La Ninas (C)



- 2020/21 La Niña ranks 6th strongest La Niña and it is the weakest strong La Niña event since 1982 based on monthly mean relative Niño3.4.

Relative Niño3.4 Index: (van Oldenborgh et al. 2021: ERL, 10.1088/1748-9326/abe9ed)

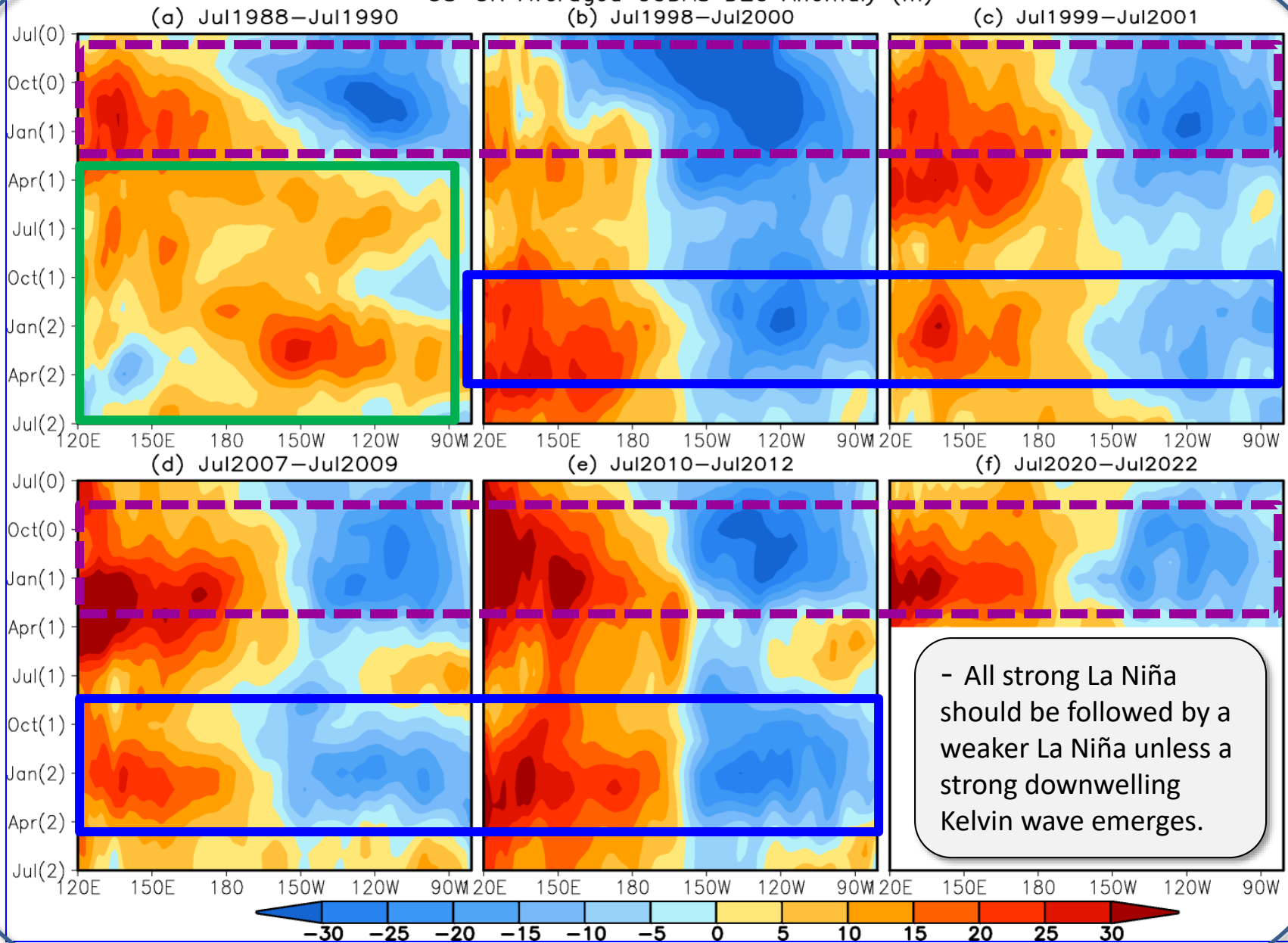


- 2020/21 La Niña ranks 10th strongest La Niña event since 1950 based on 3-month mean Niño3.4.

Peak seasonal (3-month-average) sea surface temperature anomalies in the ENSO 3.4 region for all La Niña events since 1950. The year label is the first year of the event; e.g., "2020" is the "2020–21" La Niña.

<https://www.climate.gov/news-features/blogs/enso/april-2021-enso-update-spring-triathlon>

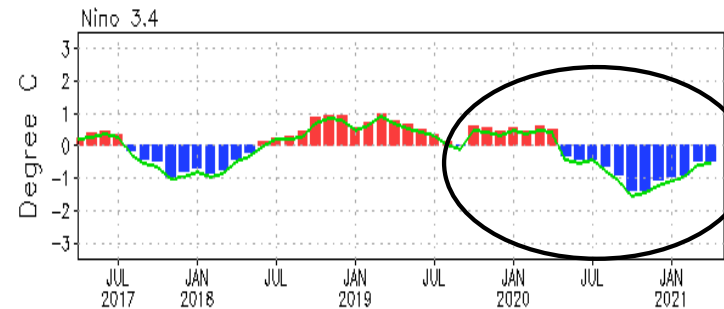
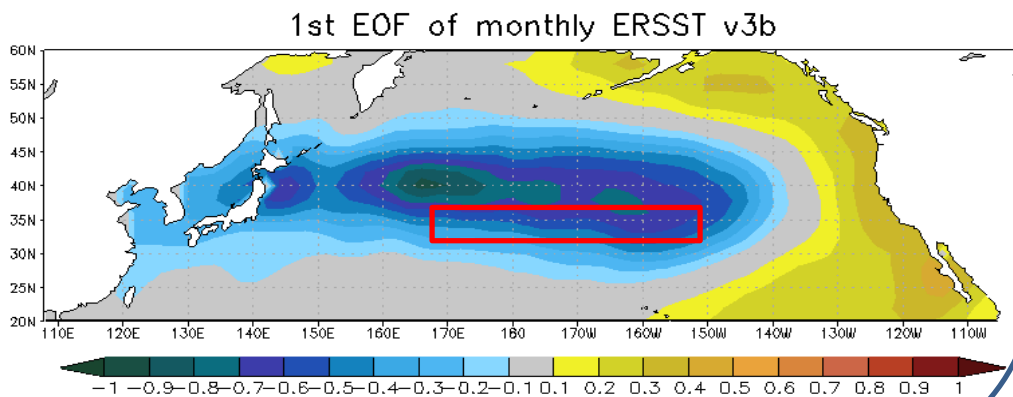
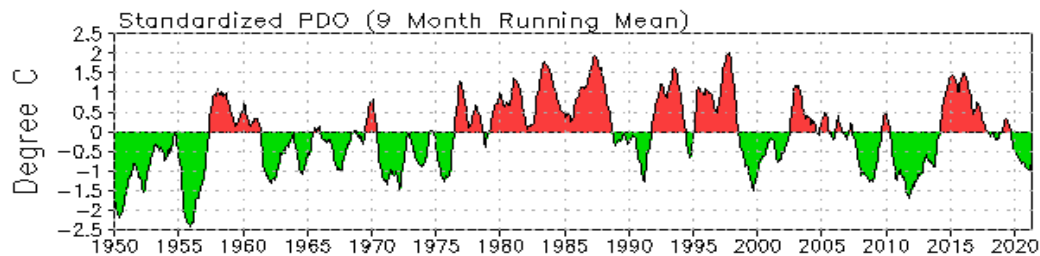
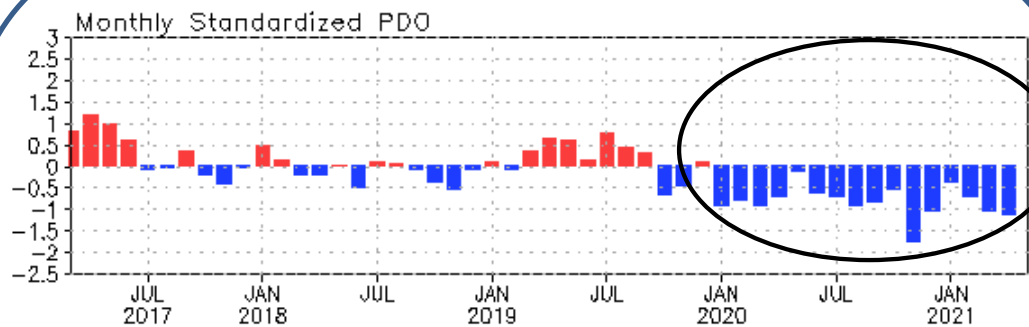
5S~5N Averaged GODAS D2O Anomaly (m)



- All strong La Niña should be followed by a weaker La Niña unless a strong downwelling Kelvin wave emerges.

North Pacific & Arctic Oceans

Pacific Decadal Oscillation (PDO) Index



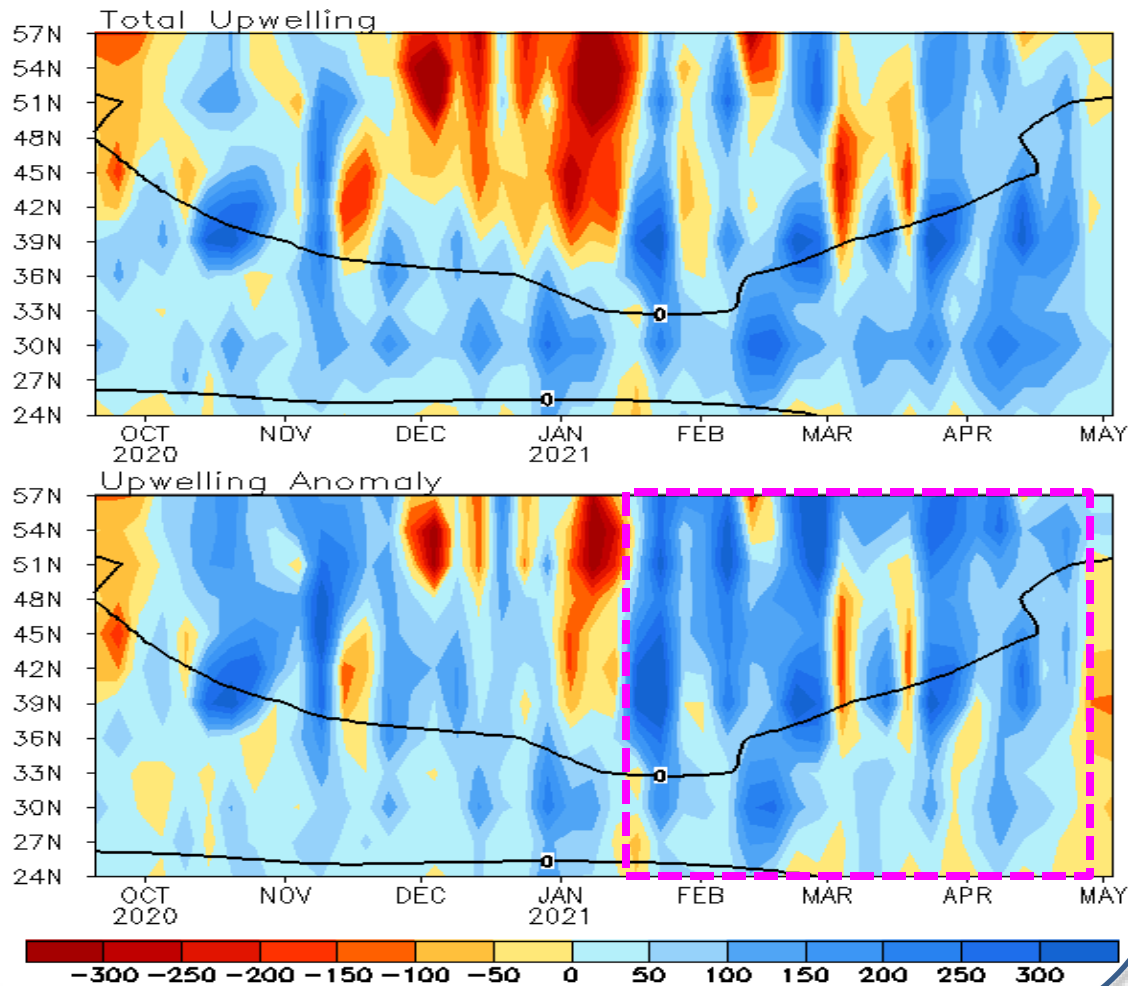
- The negative phase of PDO has persisted since Jan 2020 with PDOI = -1.2 in Apr 2021.

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

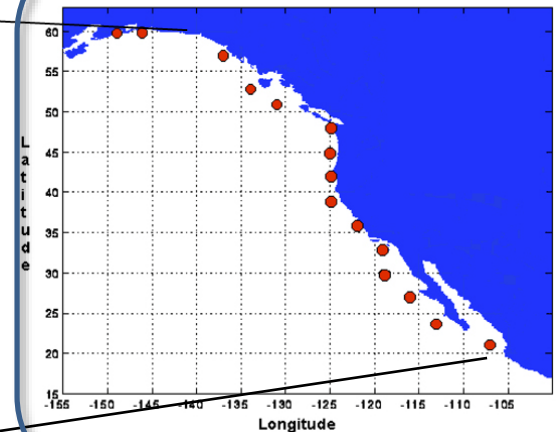
- PDO is defined as the 1st EOF of monthly ERSST v3b in the North Pacific for the period 1900-1993. PDO index is the standardized projection of the monthly SST anomalies onto the 1st EOF pattern.
- The PDO index differs slightly from that of JISAO, which uses a blend of UKMET and Olv1 and Olv2 SST.

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



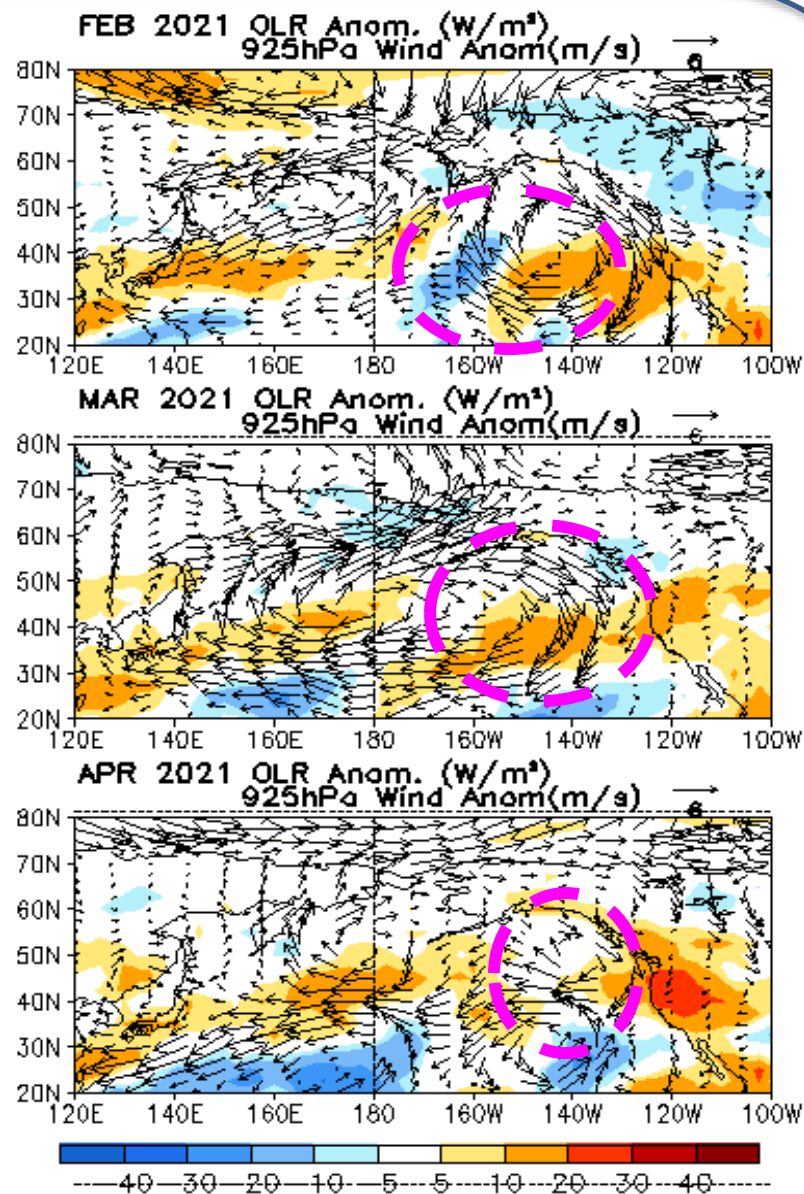
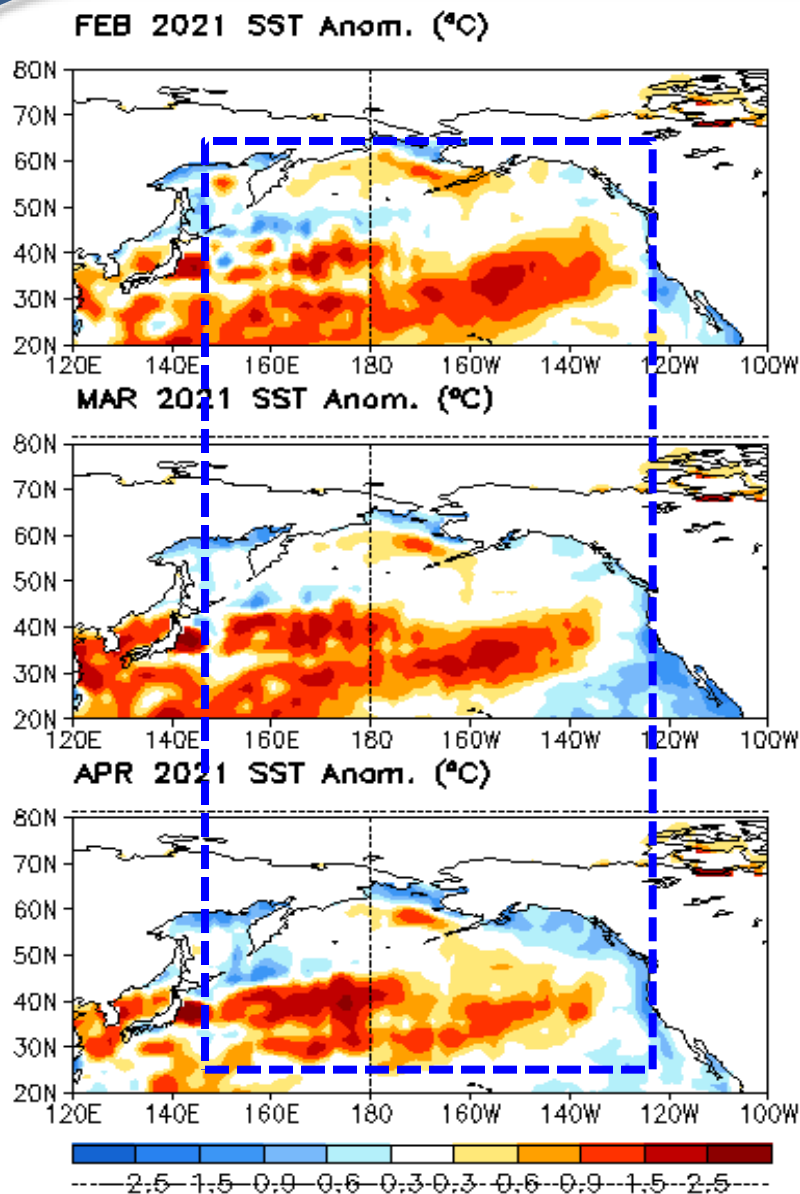
- Coastal anomalous upwelling has been present north of 27°N since 2nd half of Jan 2021.

(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.

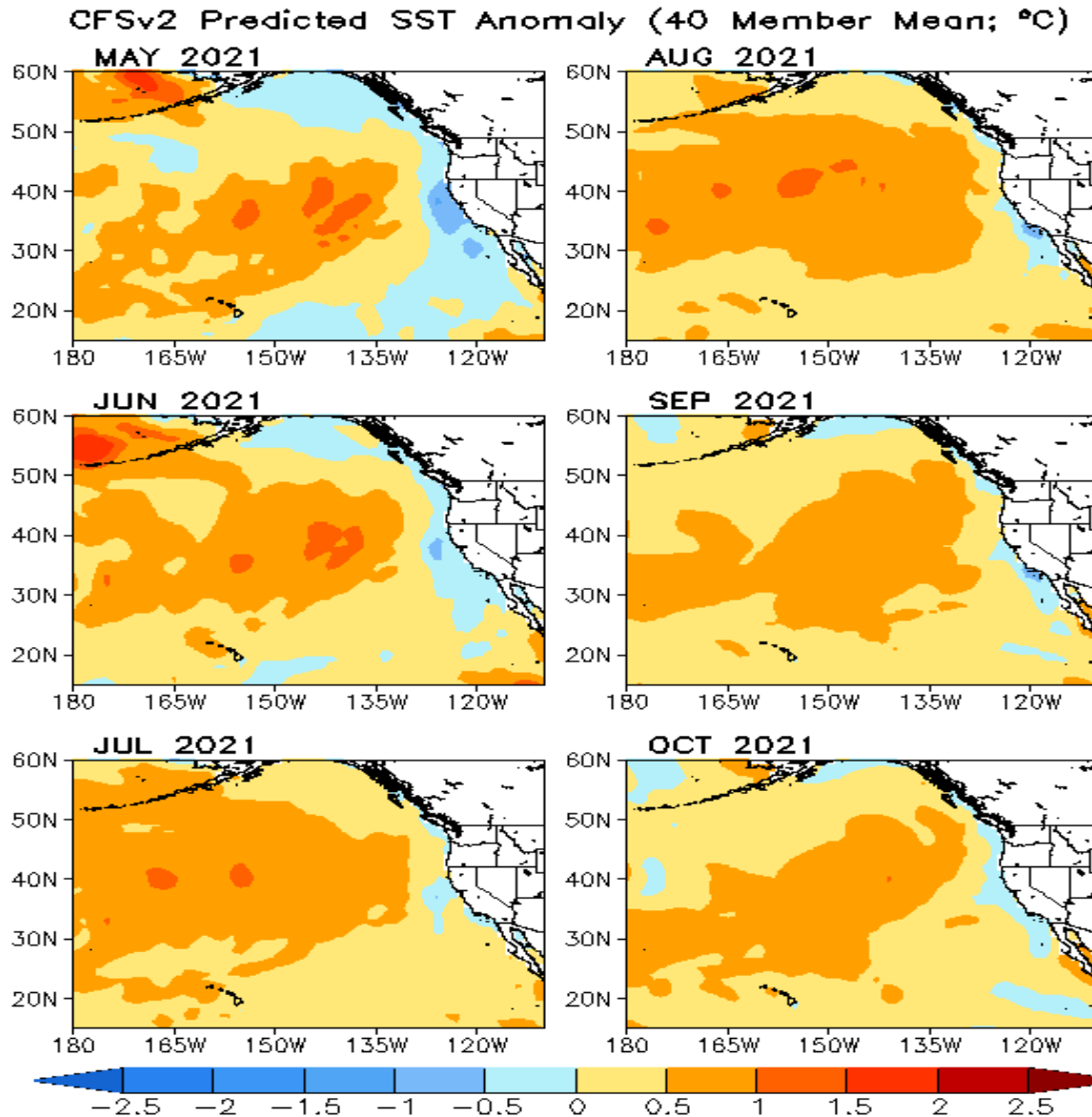
- Area below (above) black line indicates climatological upwelling (downwelling) season.

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

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

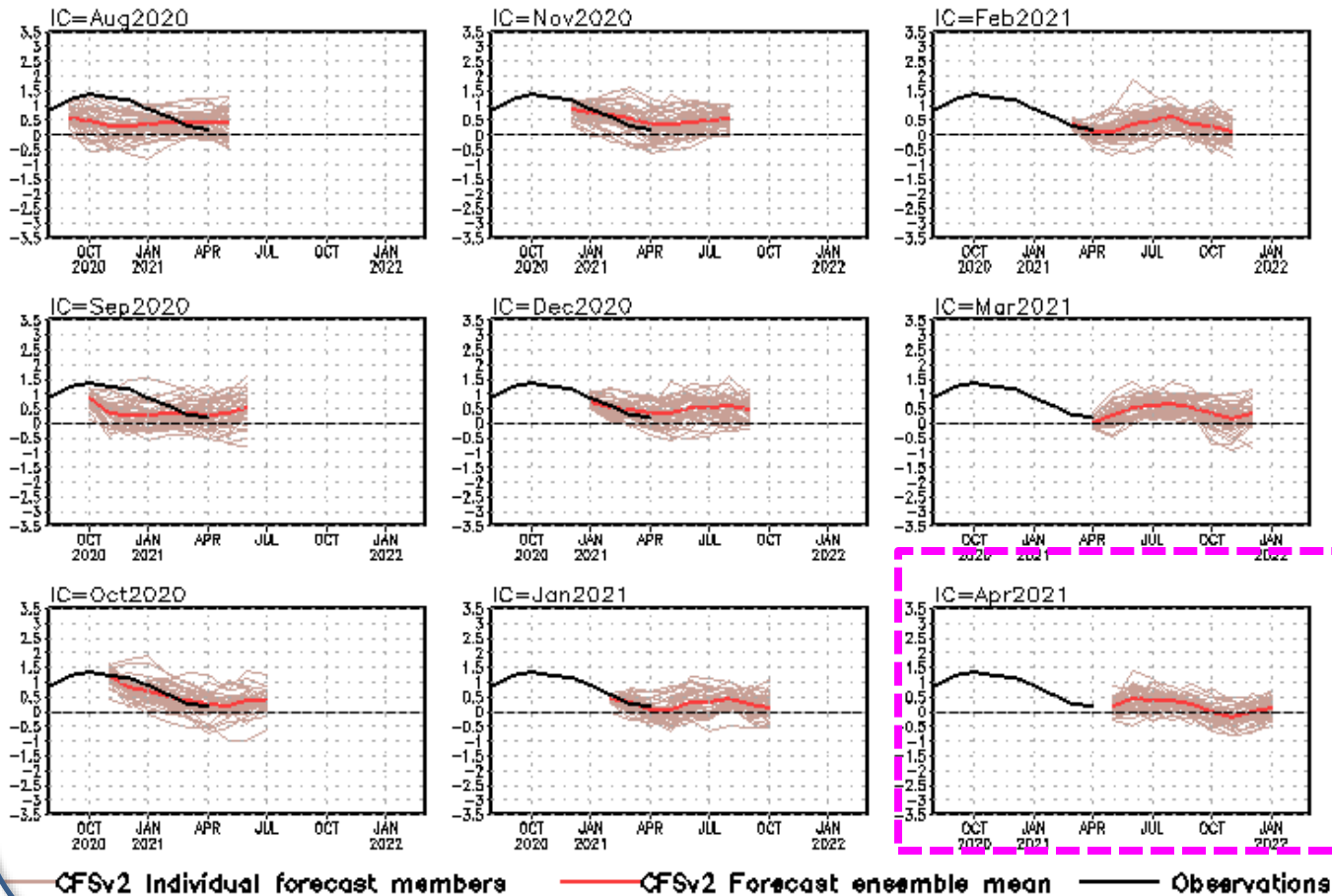


CFSv2 NE Pacific Marine Heatwave Predictions



- Latest CFSv2 predictions suggest that the current warm state will weaken in the next 6 months.

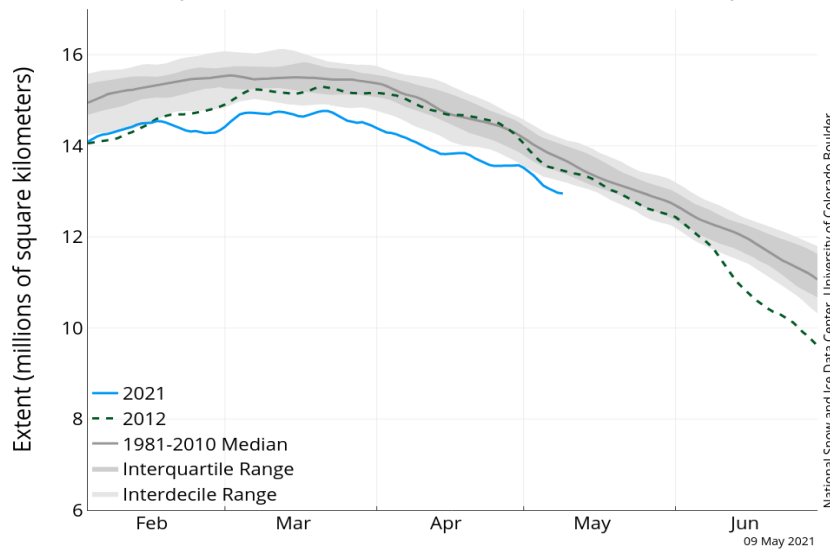
SST anomalies (K) [150W–125W, 28N–50N]



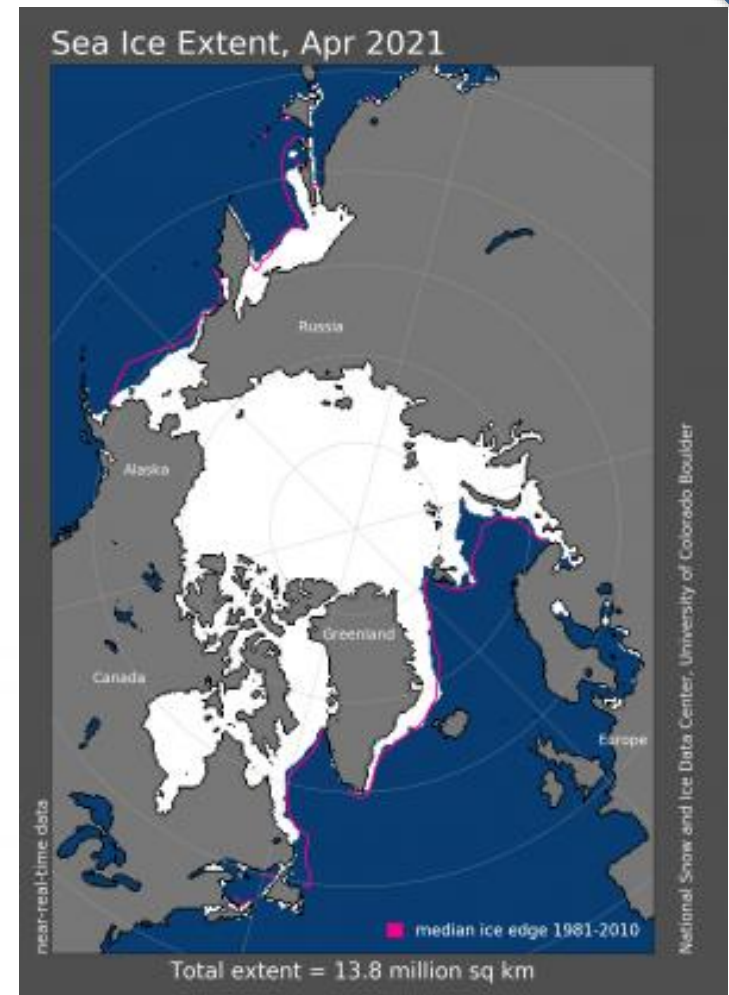
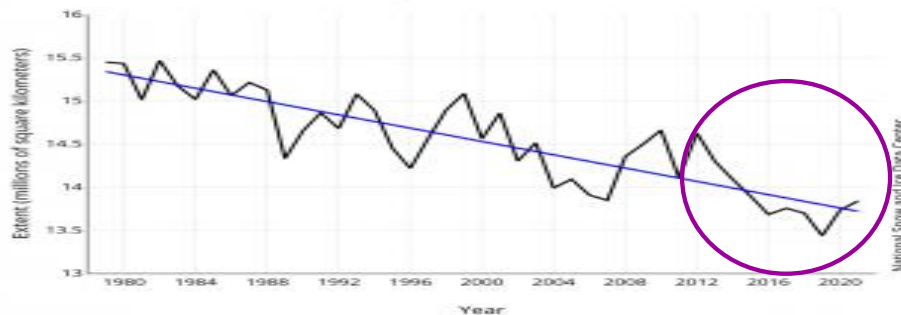
- Latest CFSv2 predictions call weakening of the positive SSTAs in the NE Pacific in 2021.

CFS NE Pacific 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.

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

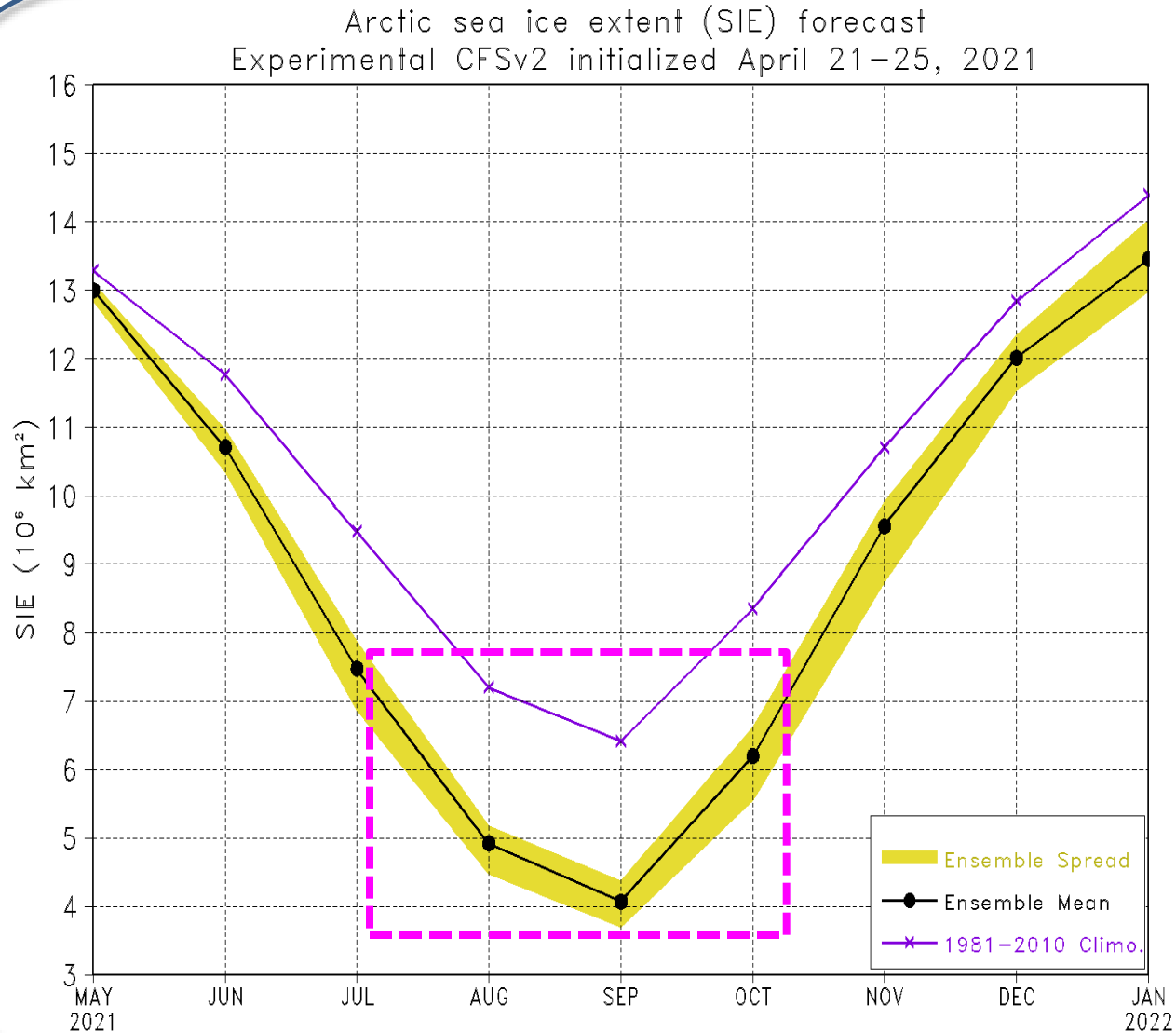


Average Monthly Arctic Sea Ice Extent April 1979 - 2021



- The sea ice extent averaged for Apr 2021 was the 6th lowest in the satellite record.
- Through 2021, the linear rate of decline for Apr sea ice extent is 2.6% per decade.

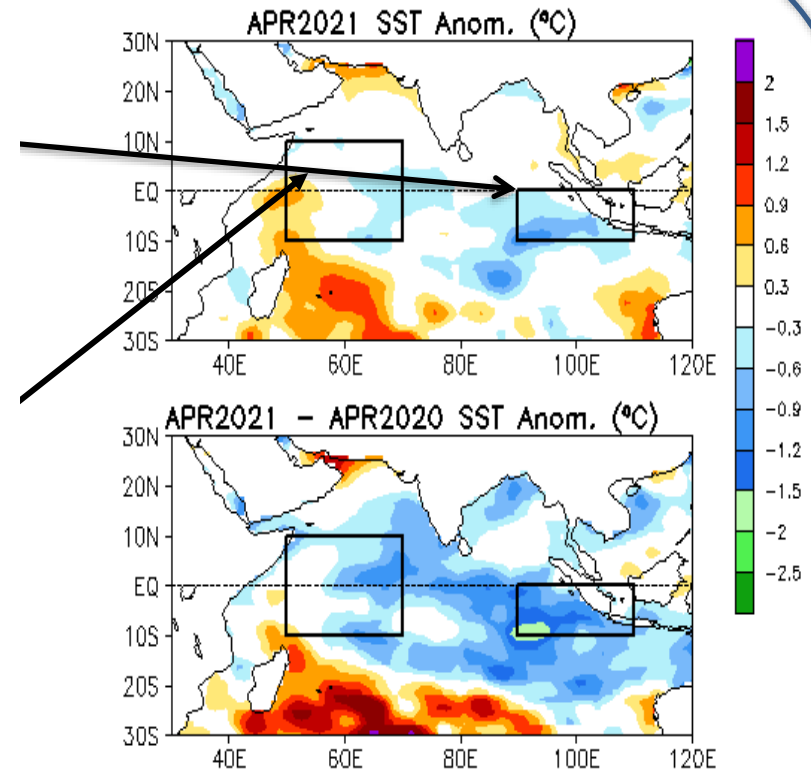
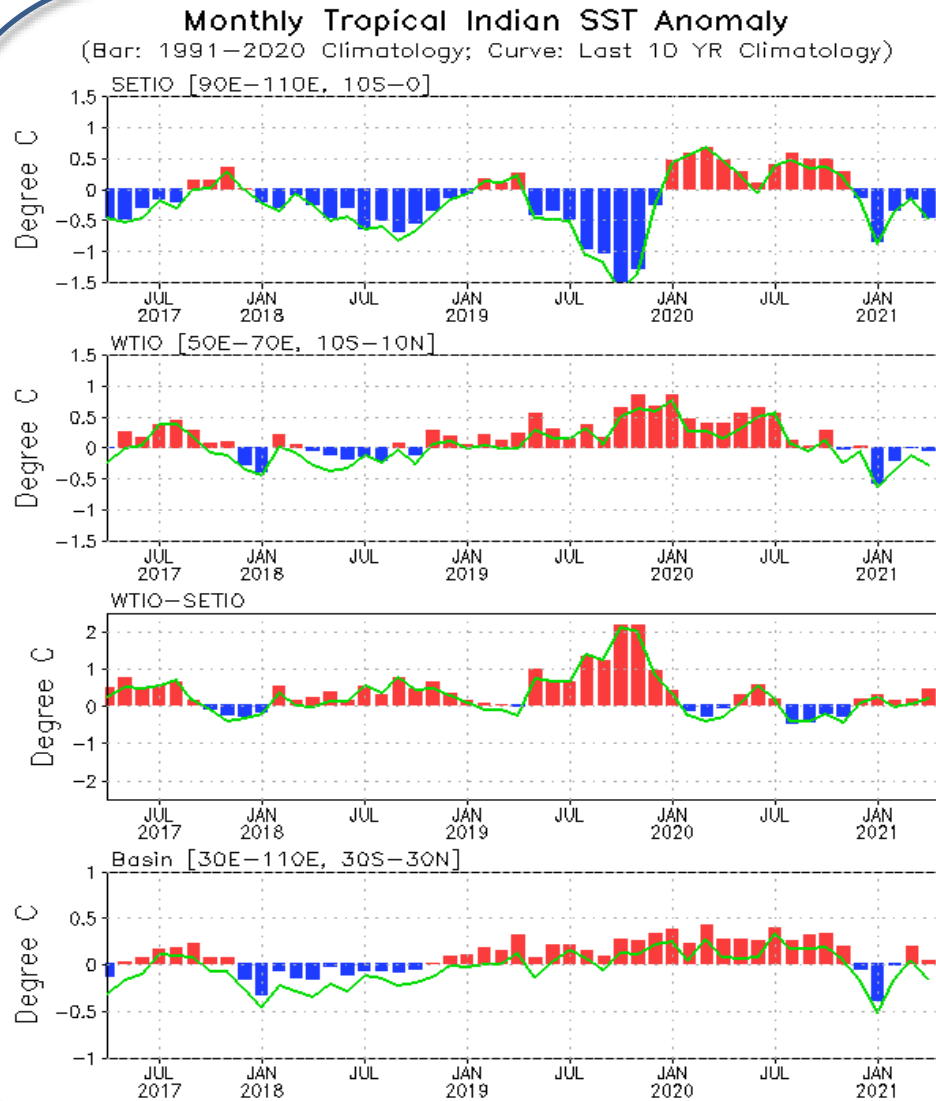
NCEP/CPC Arctic Sea Ice Extent Forecasts



For ICs in Apr 2021, NCEP/CPC predicted a below-normal sea ice extent.

Indian Ocean

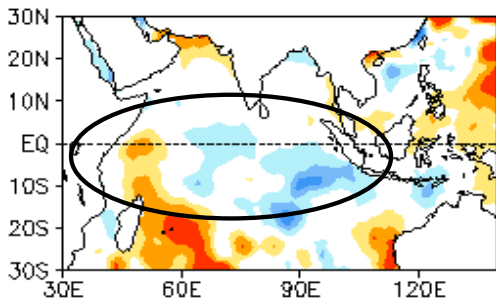
Evolution of Indian Ocean SST Indices



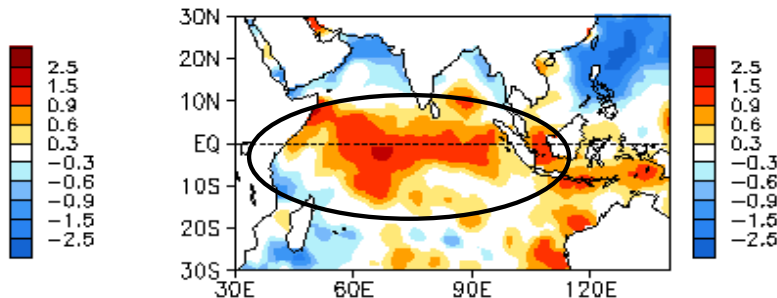
- Overall, SSTAs were small in the tropical Indian Ocean in Apr 2021.

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.

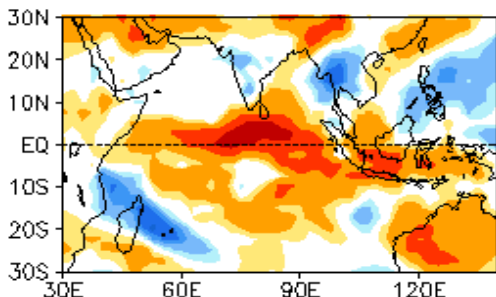
APR 2021 SST Anom. ($^{\circ}\text{C}$)



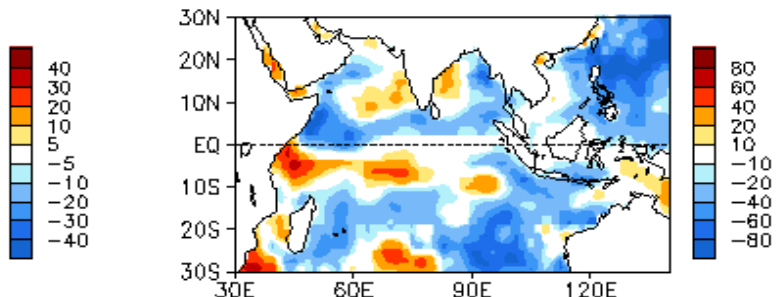
28APR2021 - 31MAR2021 SST Anom. ($^{\circ}\text{C}$)



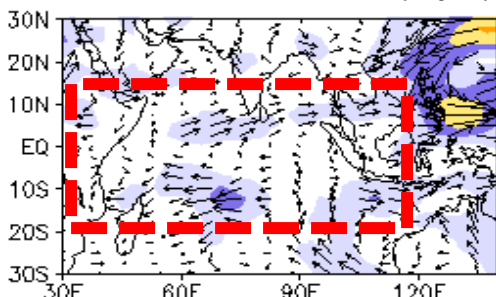
APR 2021 OLR Anom. (W/m^2)



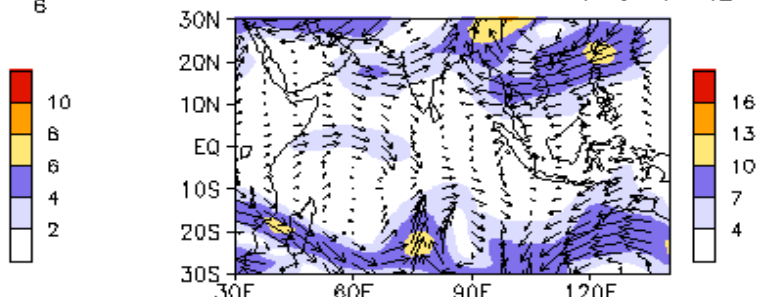
APR 2021 SW + LW + LH + SH (W/m^2)



925mb Wind Anom. (m/s)



200 mb Wind Anom. (m/s)



- SSTAs were small and the tendencies were positive in the tropical Indian Ocean.

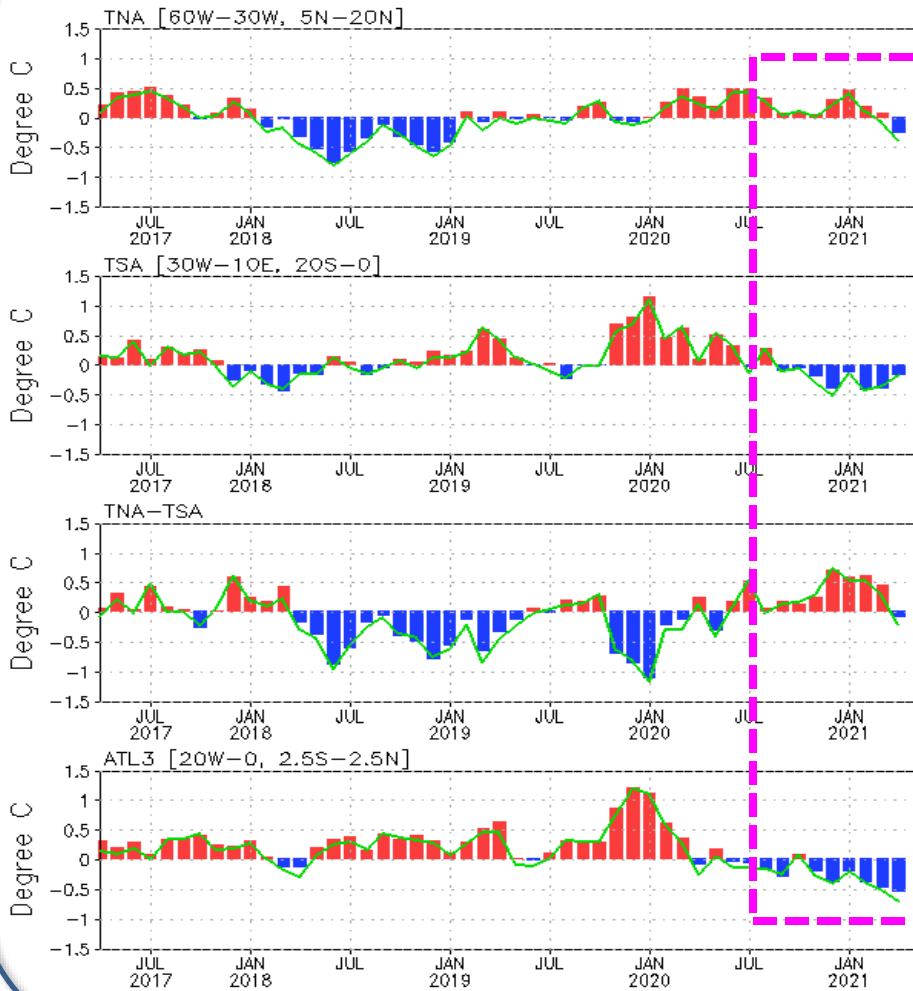
SSTAs (top-left), SSTA tendency (top-right), OLR anomalies (middle-left), sum of net surface short- and long-wave radiation, latent and sensible heat flux anomalies (middle-right), 925-mb wind anomaly vector and its amplitude (bottom-left), 200-mb wind anomaly vector and its amplitude (bottom-right).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

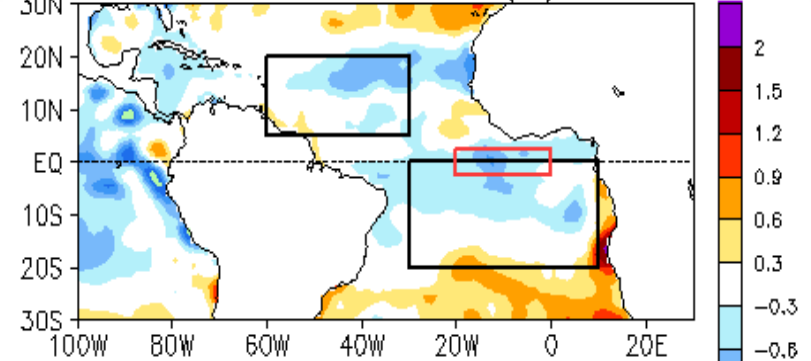
Evolution of Tropical Atlantic SST Indices

Monthly Tropical Atlantic SST Anomaly

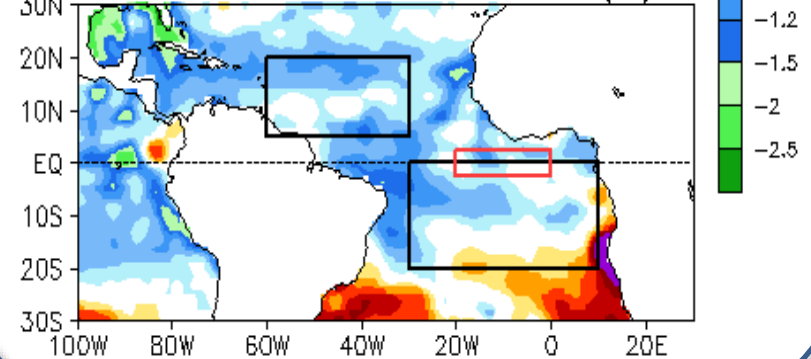
(Bar: 1991–2020 Climatology; Curve: Last 10 YR Climatology)



APR2021 SST Anom. (°C)



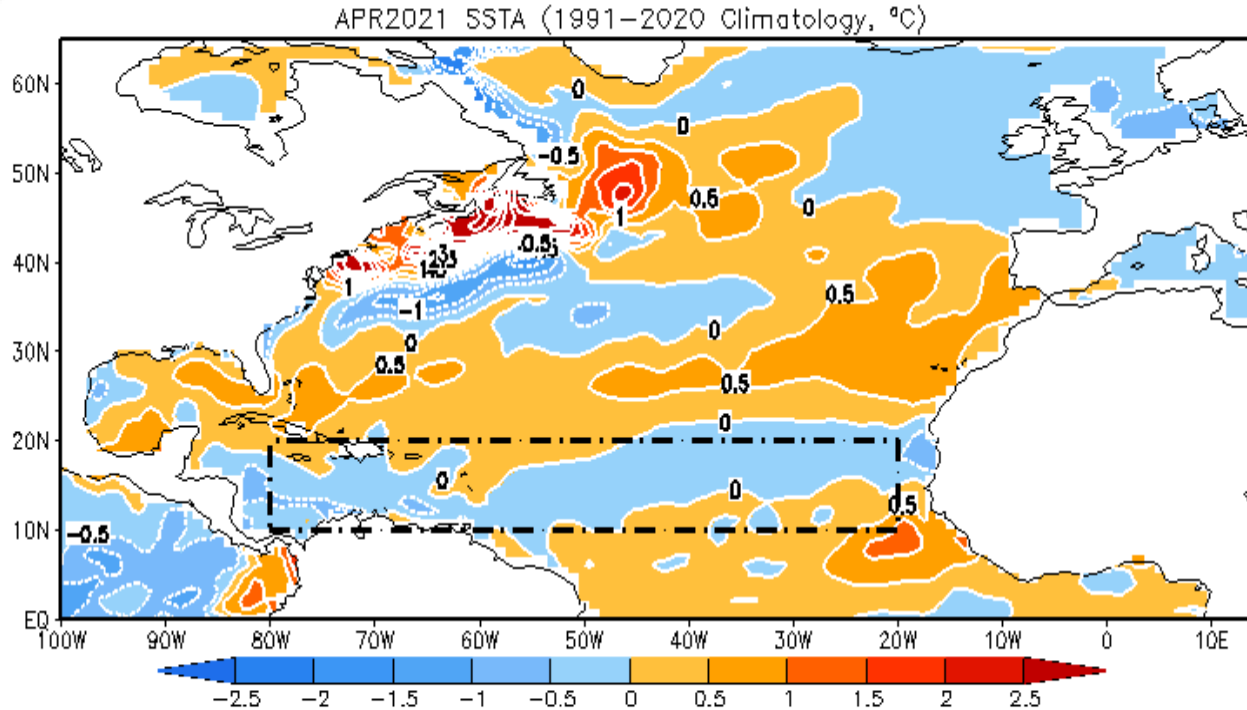
APR2021 - APR2020 SST Anom. (°C)



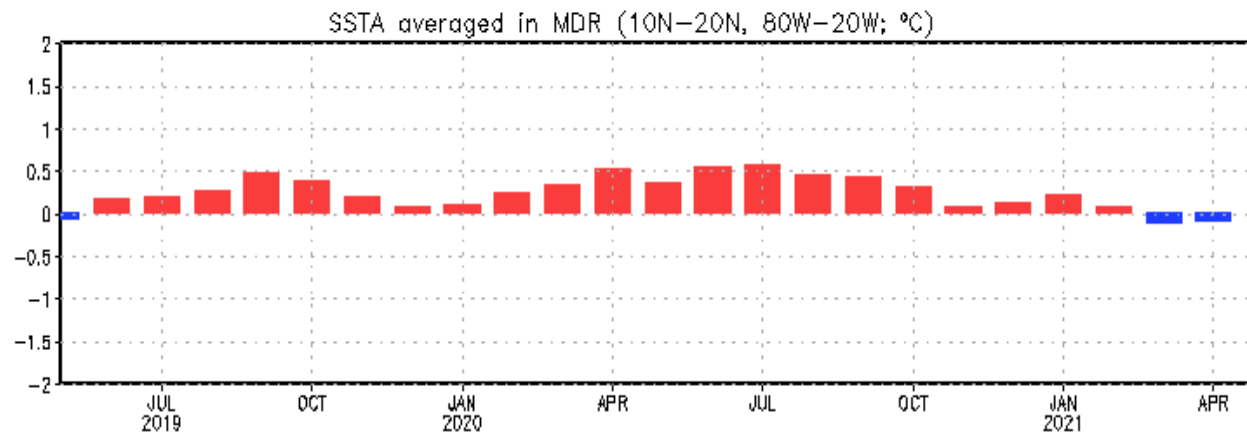
- ATL3 SST has been below average since Nov 2020.

Tropical Atlantic Variability region indices, calculated as the area-averaged monthly mean sea surface temperature anomalies ($^{\circ}\text{C}$) for the TNA [60 $^{\circ}\text{W}$ -30 $^{\circ}\text{W}$, 5 $^{\circ}\text{N}$ -20 $^{\circ}\text{N}$], TSA [30 $^{\circ}\text{W}$ -10 $^{\circ}\text{E}$, 20 $^{\circ}\text{S}$ -0] and ATL3 [20 $^{\circ}\text{W}$ -0, 2.5 $^{\circ}\text{S}$ -2.5 $^{\circ}\text{N}$] 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.

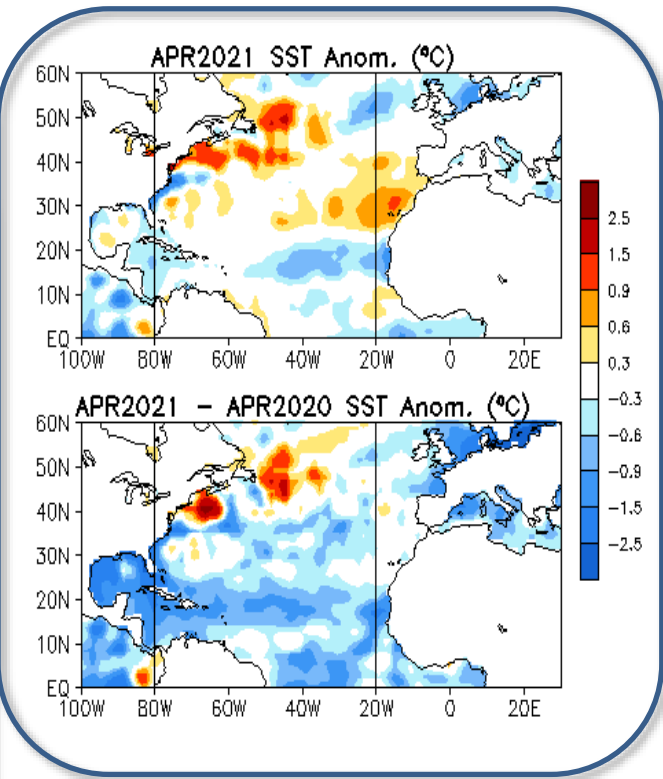
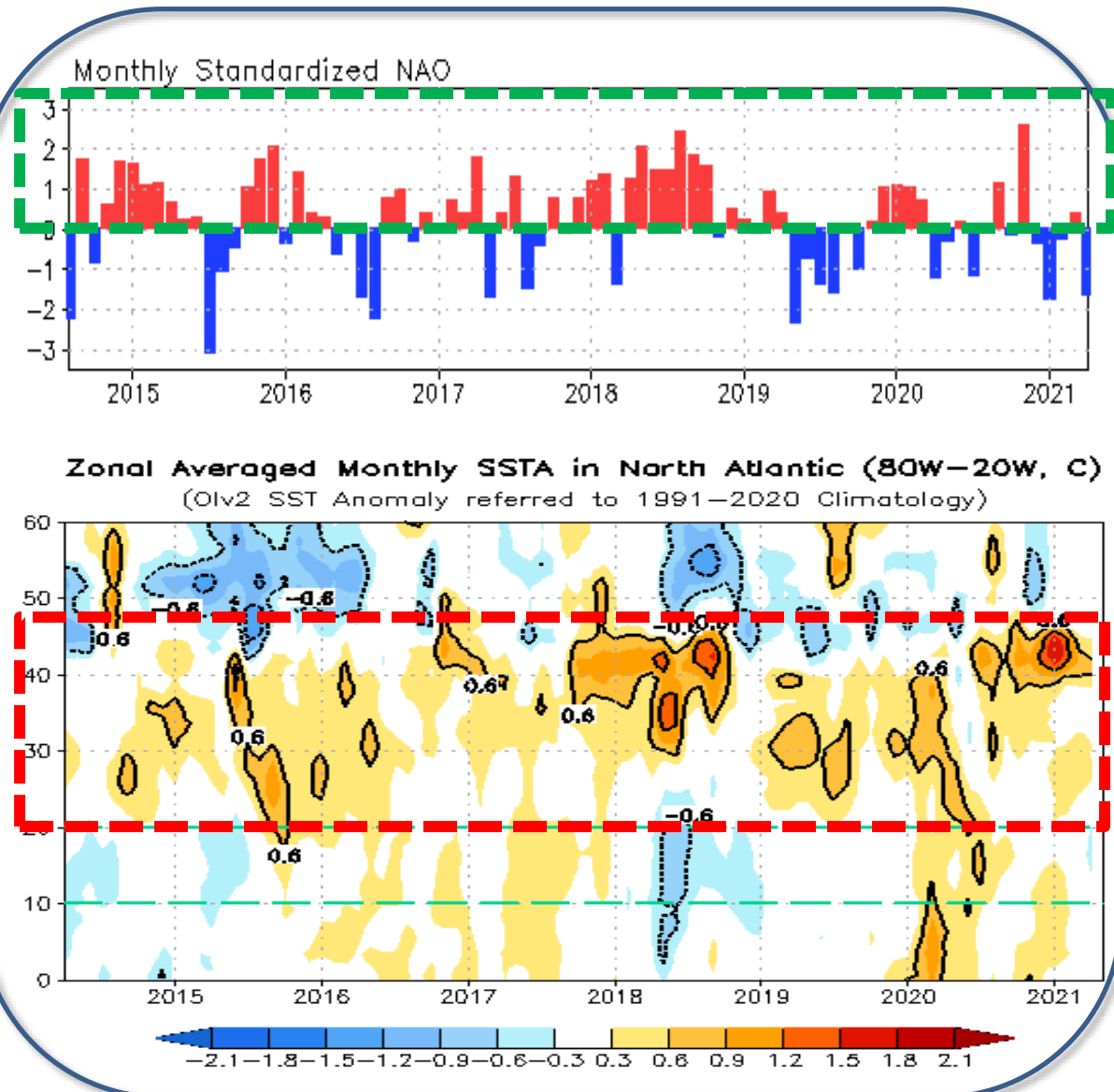
SSTs in the North Atlantic & MDR



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

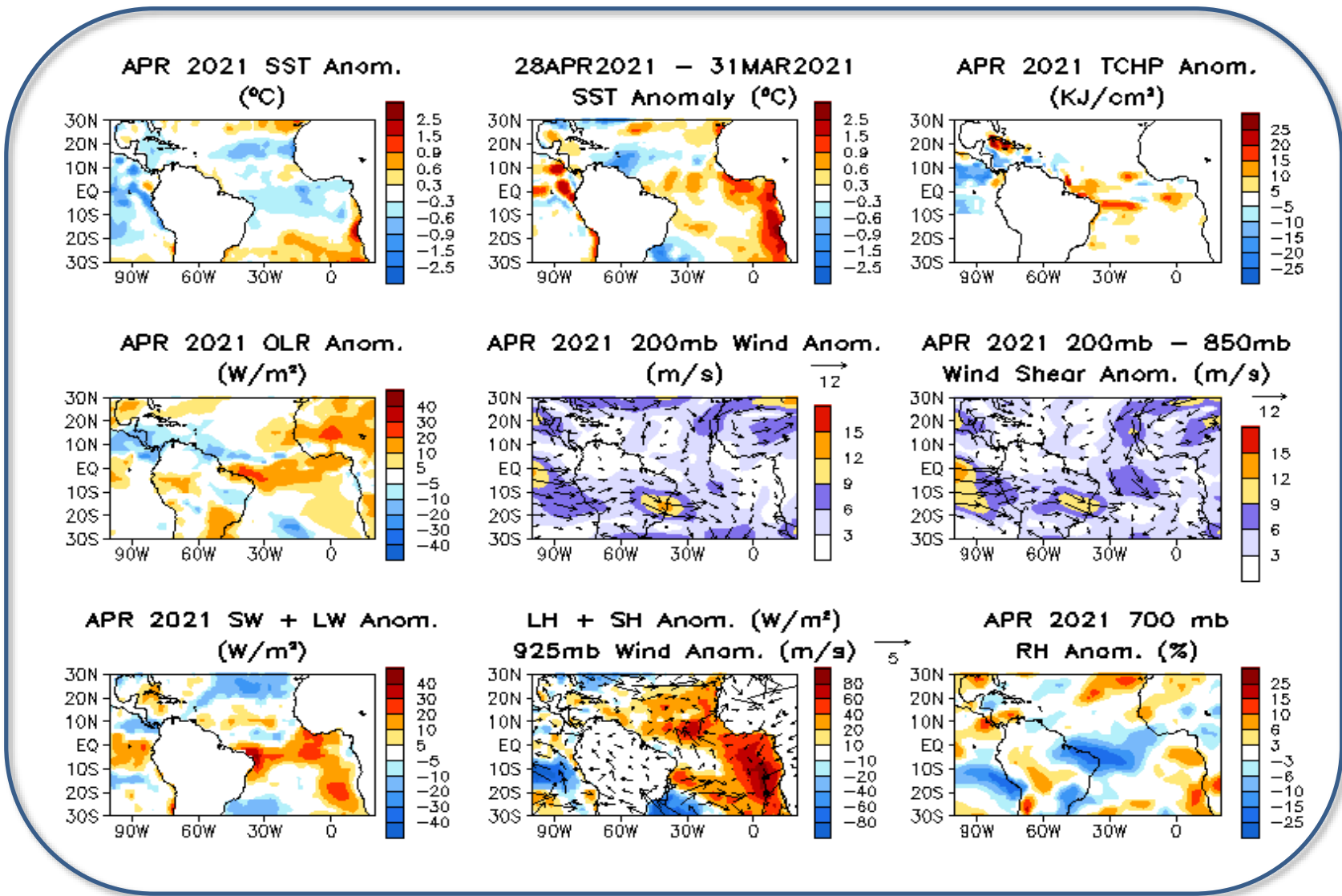


NAO and SST Anomaly in North Atlantic



- NAO switched to a negative phase in Apr 2021 with NAOI = -1.7.
- The prolonged positive SSTAs in the middle latitudes were evident, due to the domination of the positive phase of NAO during the last 5-6 years.

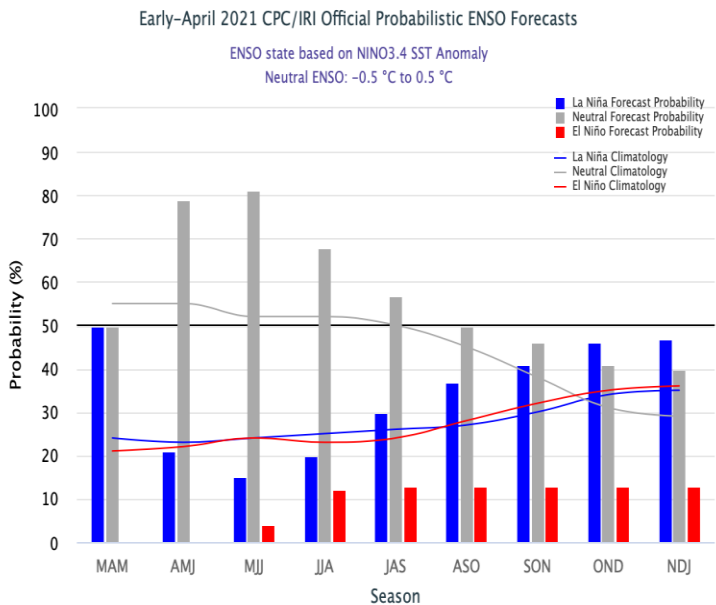
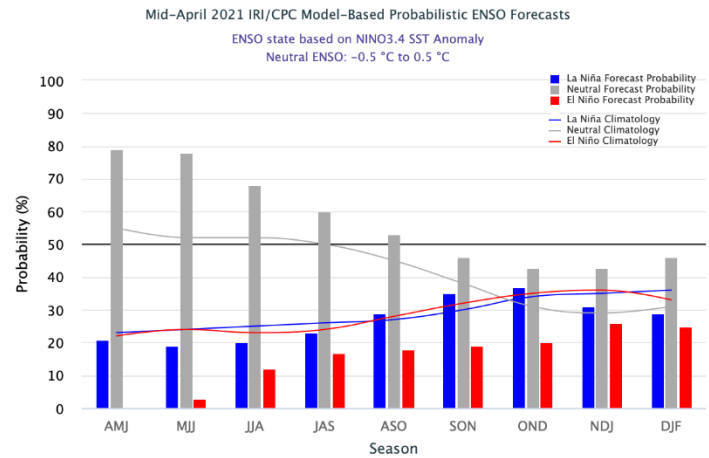
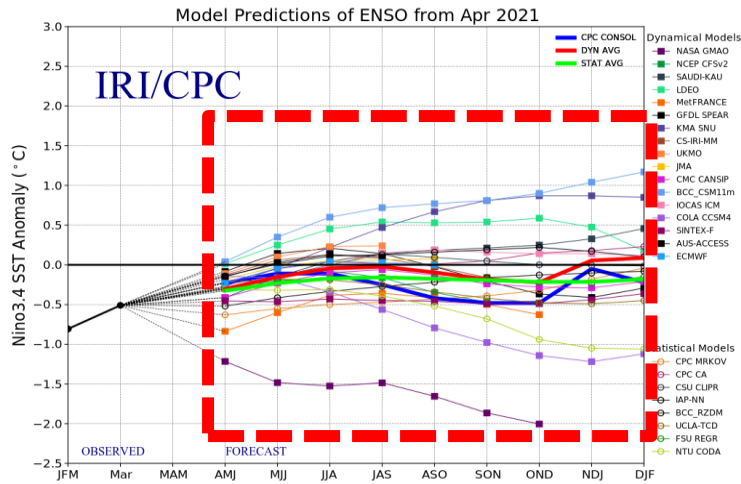
Monthly standardized NAO index (top) derived from monthly standardized 500-mb height anomalies obtained from the NCEP CDAS in 20°N-90°N (<http://www.cpc.ncep.noaa.gov>). Time-Latitude section of SST anomalies averaged between 80°W and 20°W (bottom). SST are derived from the NCEP OI SST analysis, and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



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.

ENSO and Global SST Predictions

IRI/CPC Niño3.4 Forecast

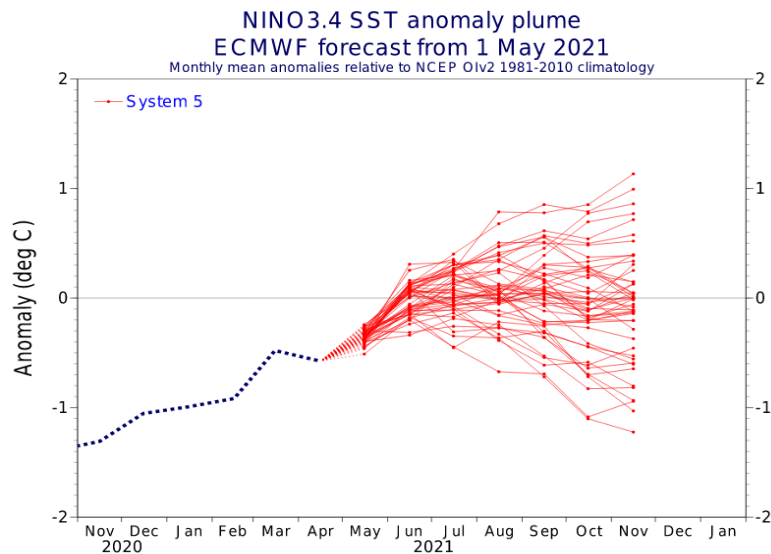


**- ENSO Alert System Status:
La Niña Advisory Issued on 8
Apr 2021**

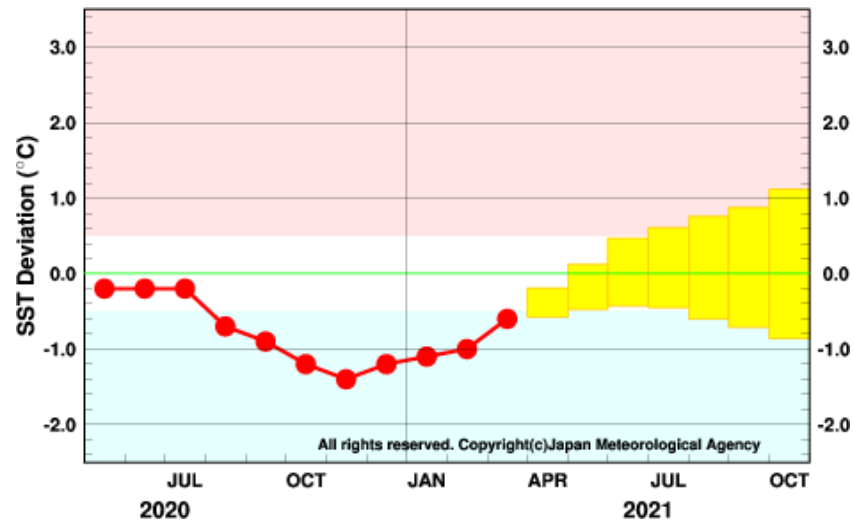
- Synopsis: A transition from La Niña to ENSO-Neutral is likely in the next month or so, with an 80% chance of ENSO-neutral during May-July 2021.

Individual Model Niño3.4 Forecasts

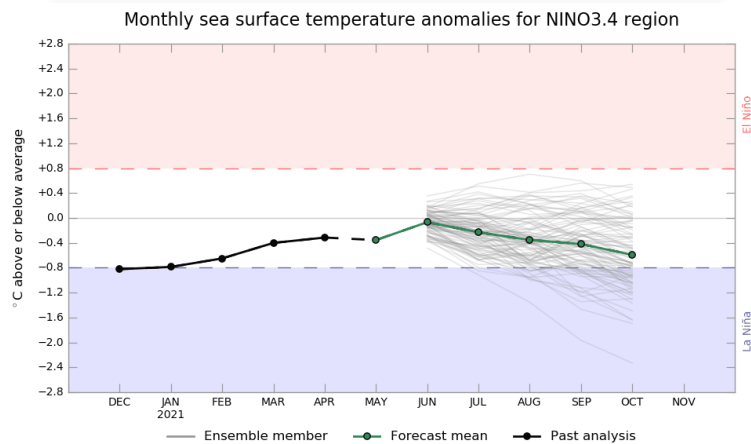
EC: IC= 01 May, 2021



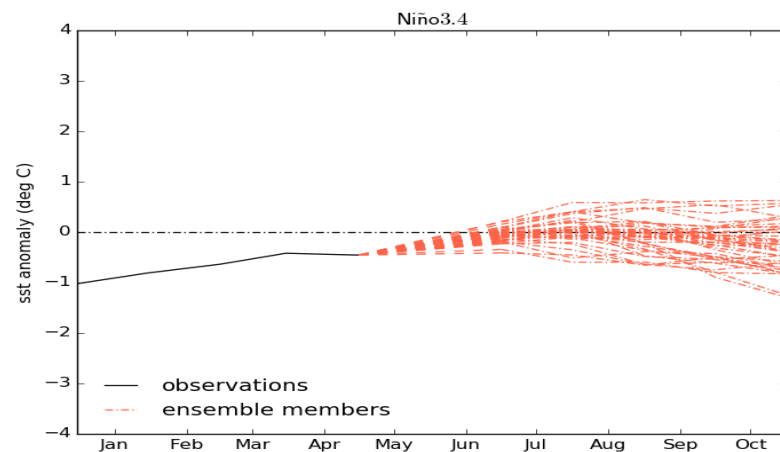
JMA: Updated 9 Apr, 2021



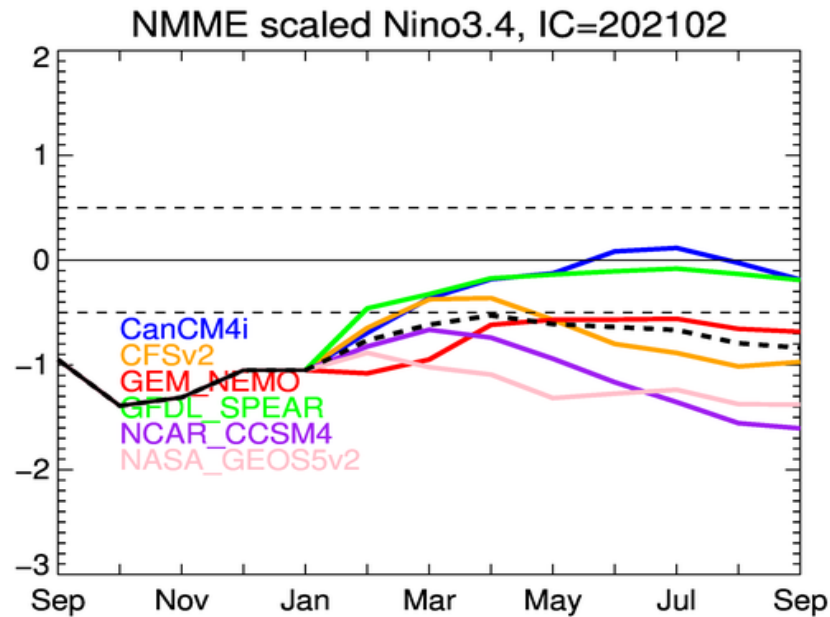
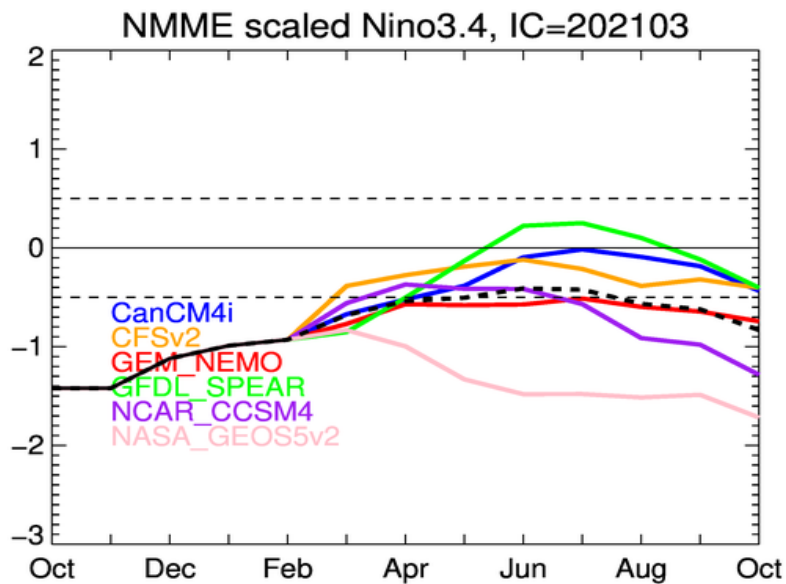
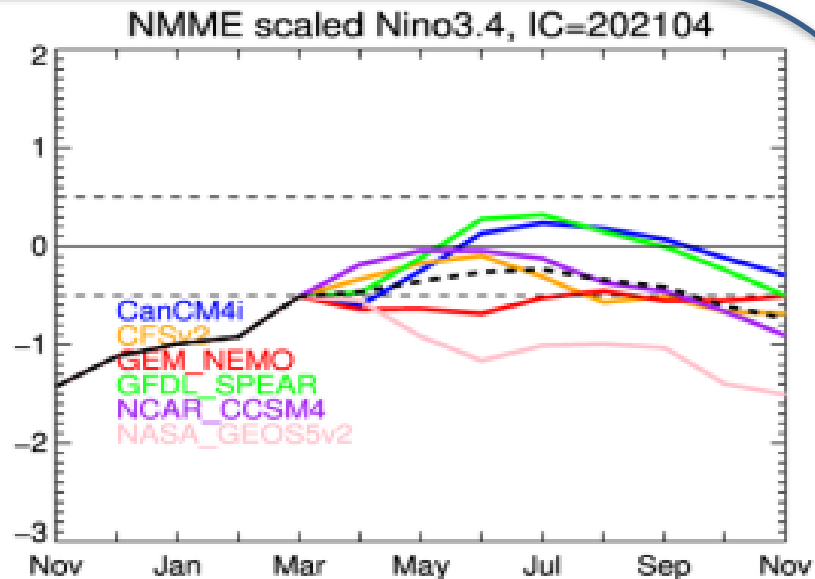
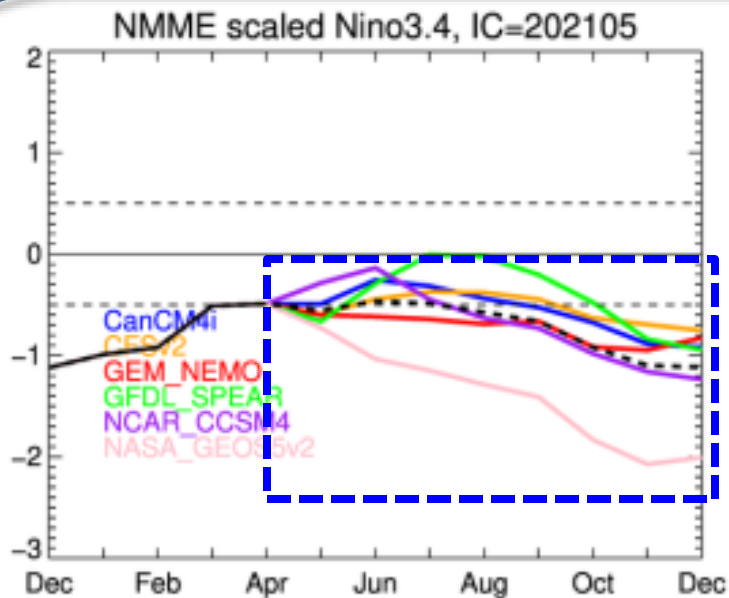
BOM: Updated 08 May, 2021



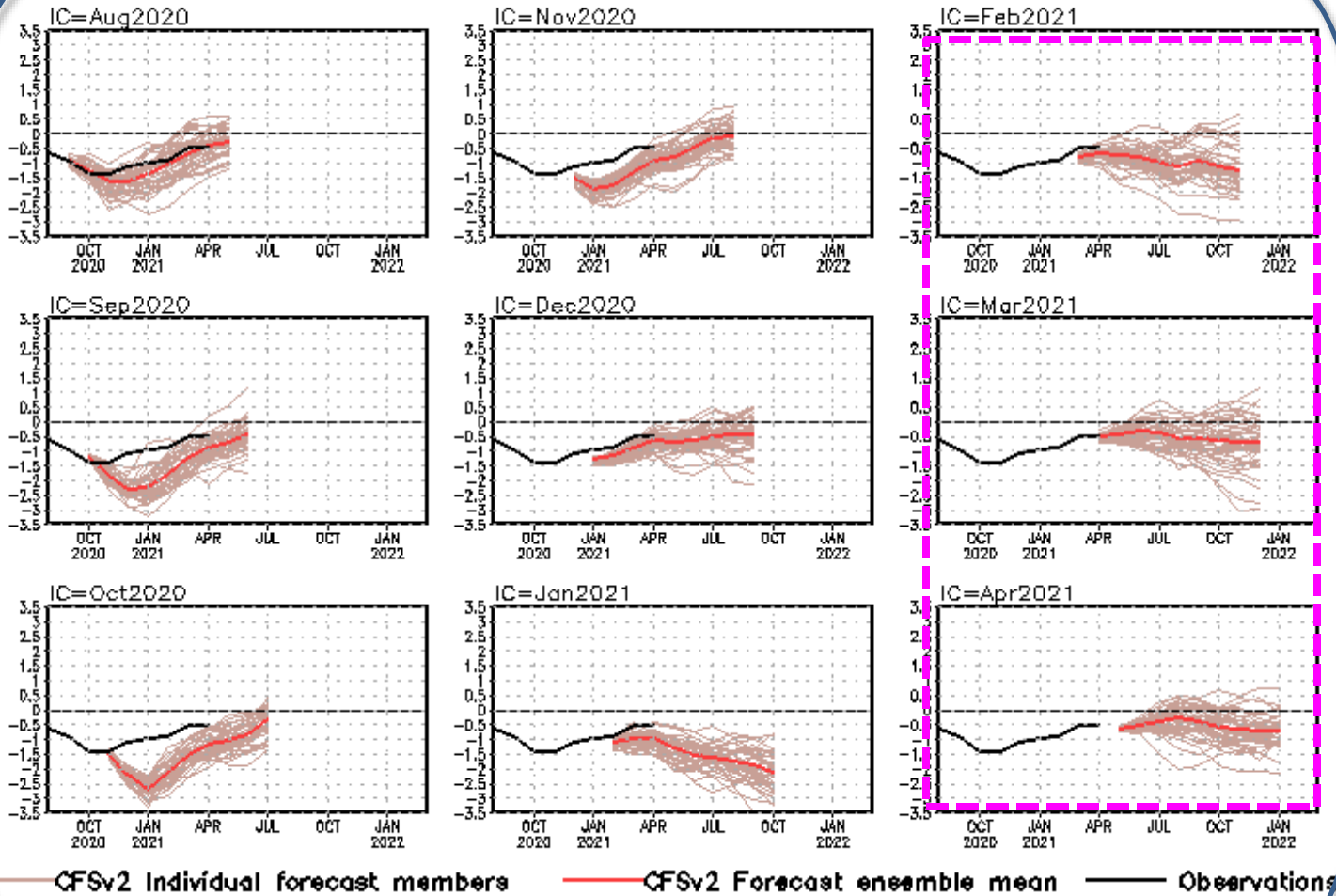
UKMO: Updated 11 May, 2021



NMME forecasts with the latest 4-month initial conditions



NINO3.4 SST anomalies (K)

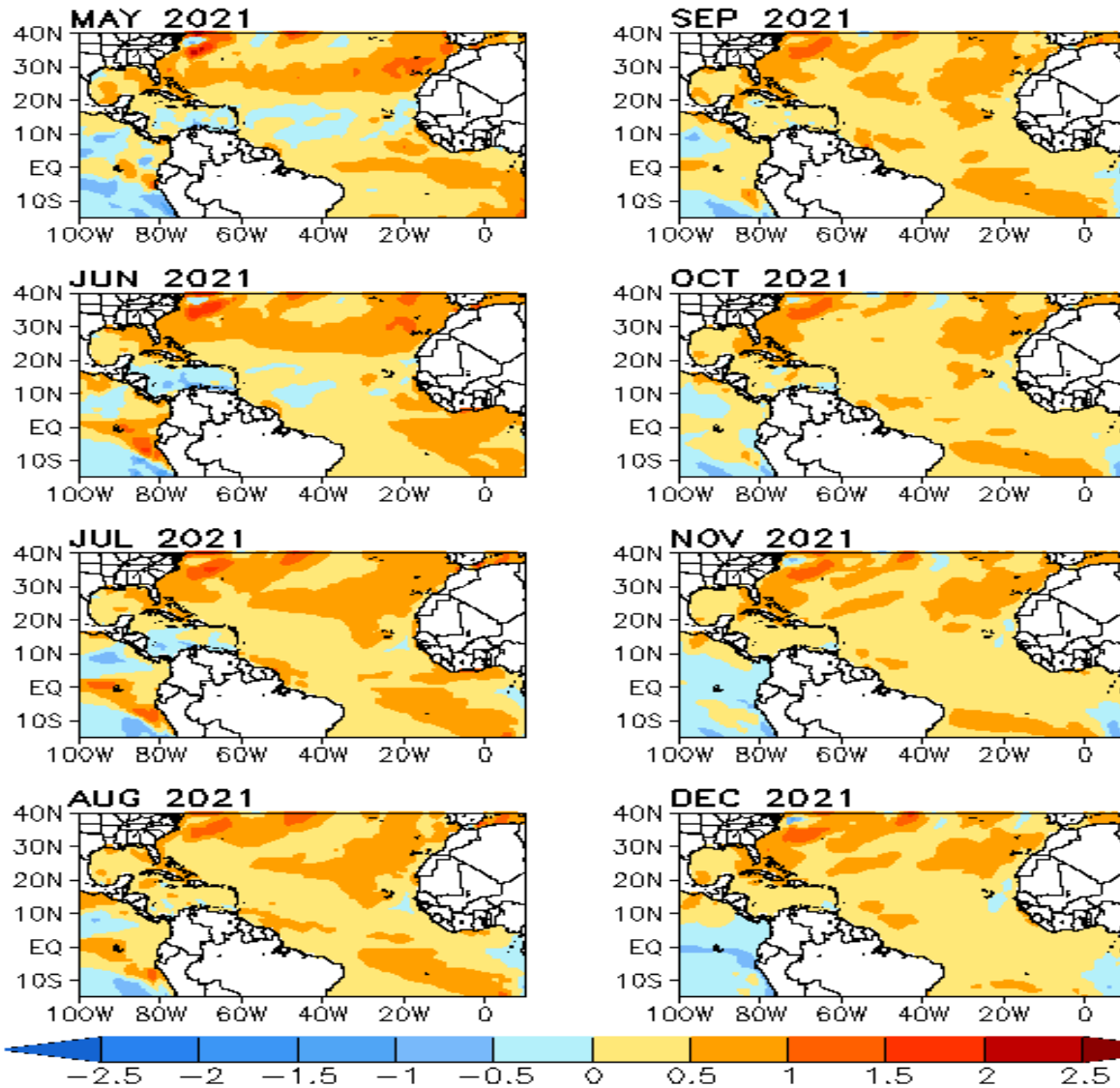


- Latest CFSv2 predictions call for below-normal SSTs, re-occurrence of La Niña in late 2021.

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.

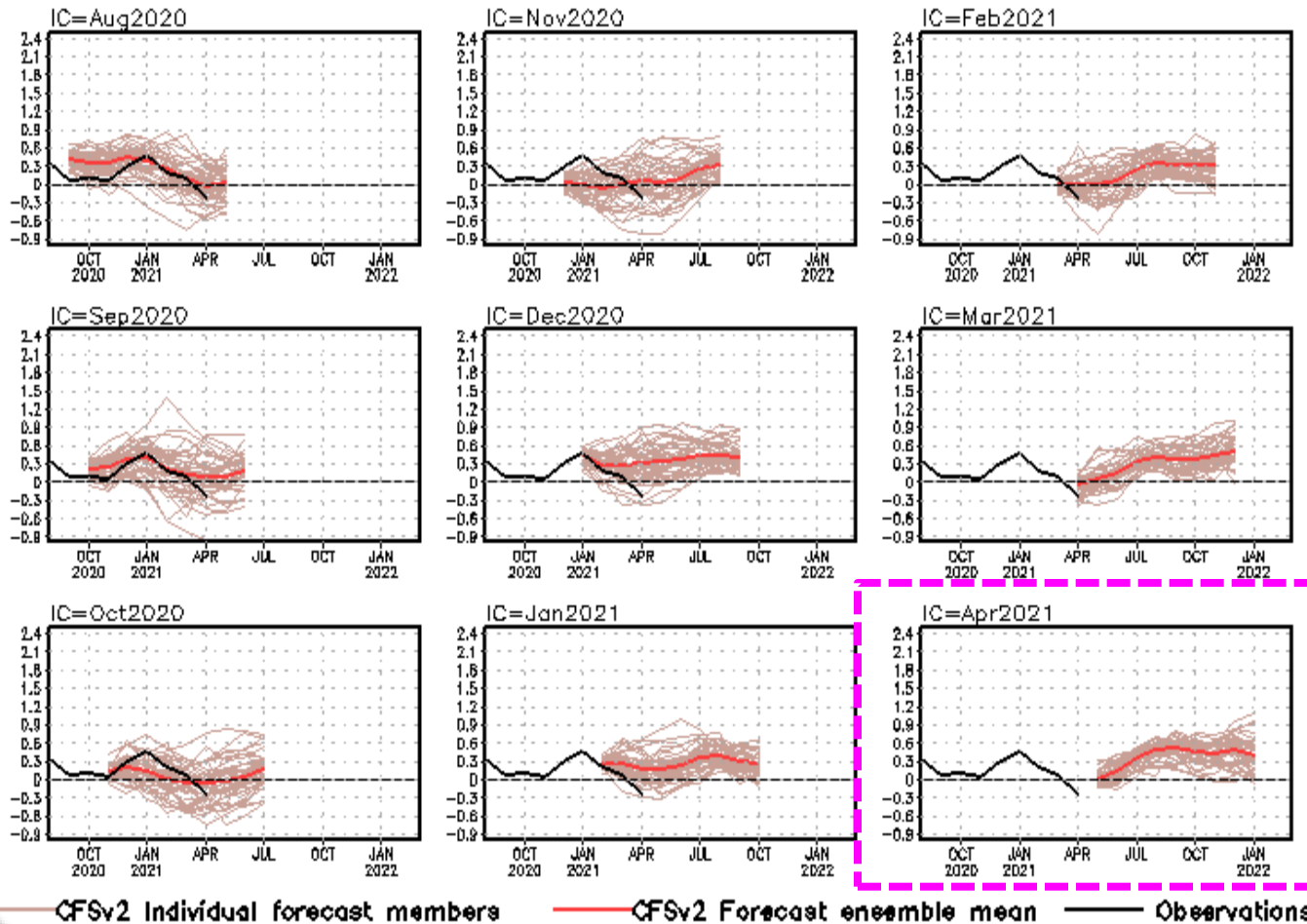
CFSv2 Atlantic SSTA Predictions

CFSv2 Predicted SST Anomaly (40 Member Mean; °C)



- Latest CFSv2 predictions call above-normal SST in the next 8 months (2021 hurricane season).

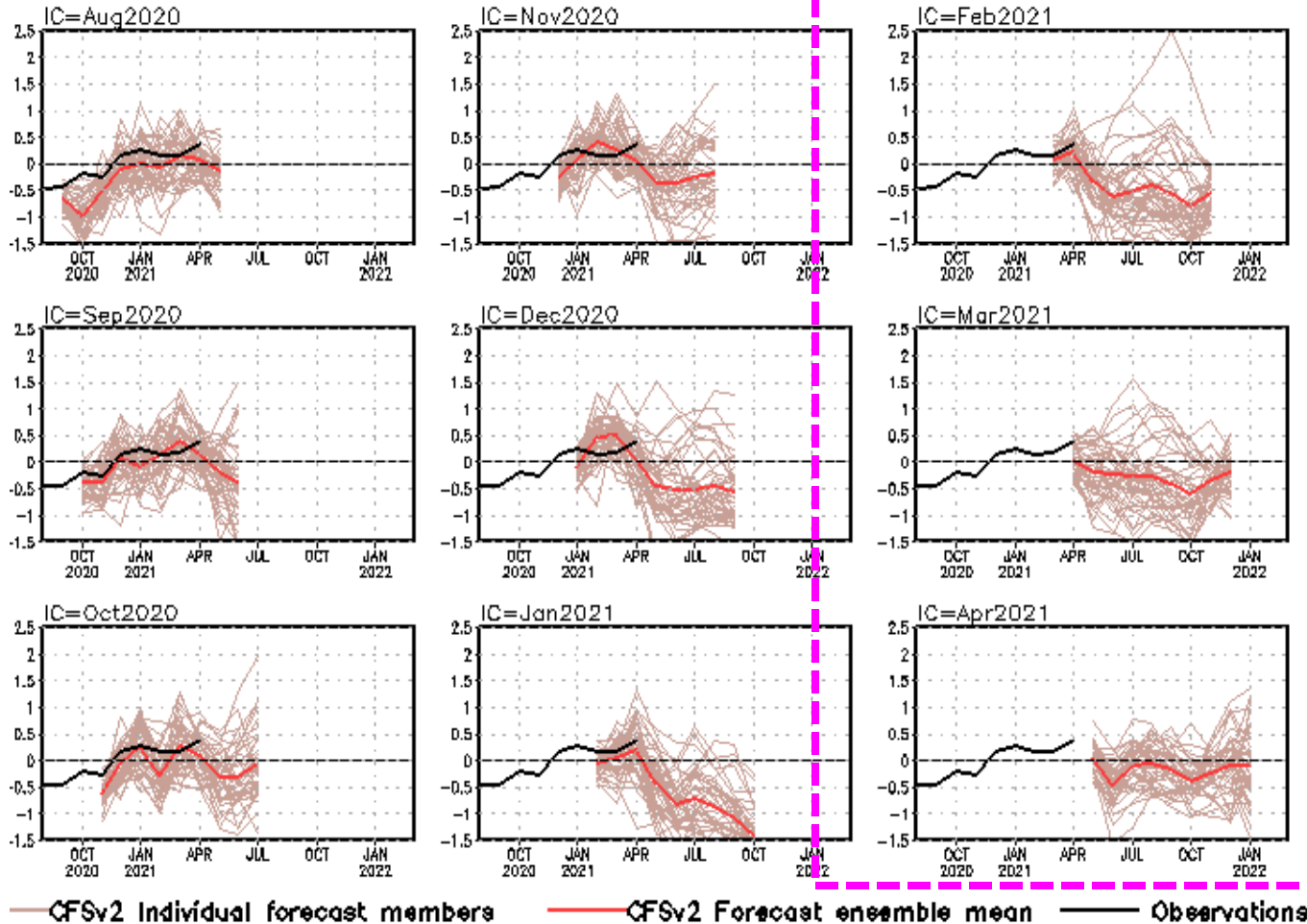
Tropical N. Atlantic SST anomalies (K)



- Latest CFSv2 predictions call for above normal SSTs in the tropical N. Atlantic in 2021 hurricane season.

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 [60°W-30°W, 5°N-20°N].

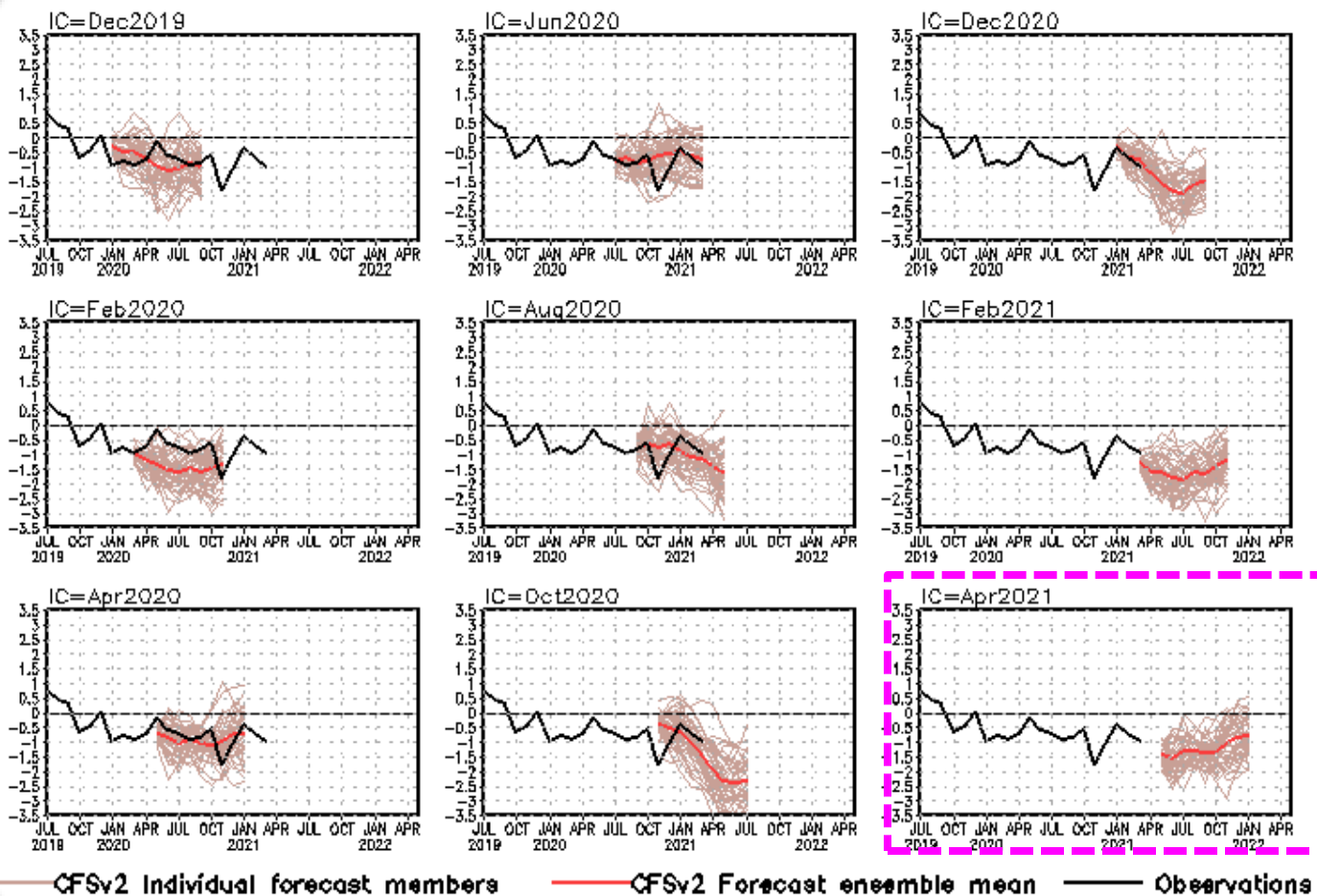
Indian Ocean Dipole SST anomalies (K)



- Latest CFSv2 predicts a negative phase of IOD in 2021.

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.

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

Please send your comments and suggestions to:

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Jieshun.Zhu@noaa.gov

Arun.Kumar@noaa.gov

Caihong.Wen@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

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

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

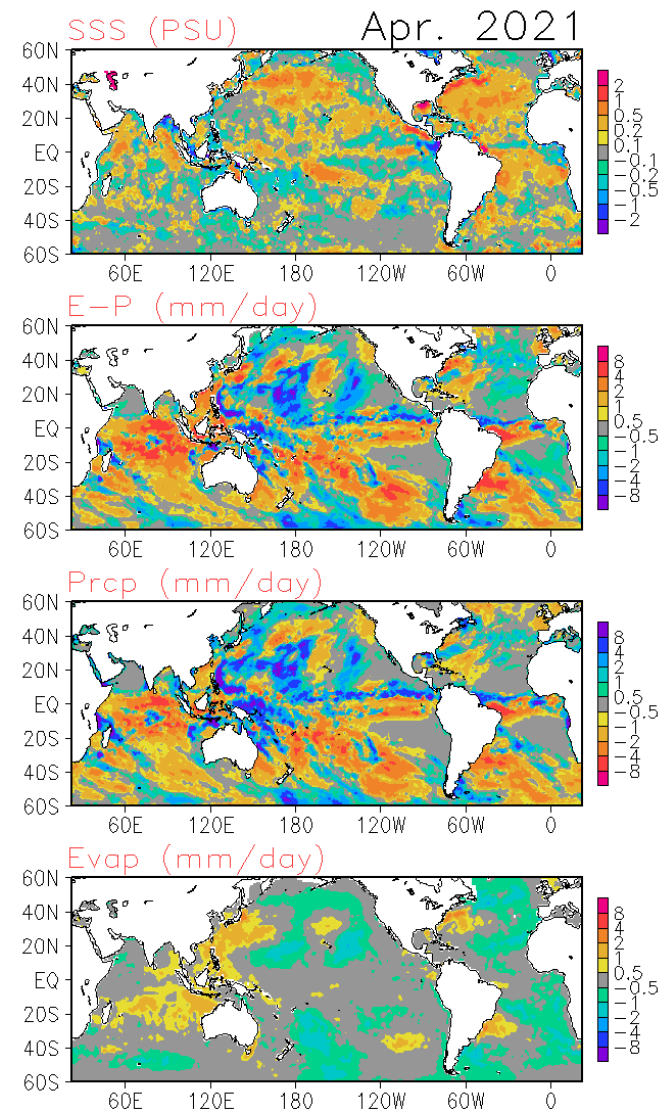
Positive SSS anomaly still continues in the western equatorial Pacific Ocean and SPCZ region. Positive SSS anomaly strengthens and expands along the Equatorial Pacific Ocean east of date line. Also, positive SSS anomaly in the central N. Pacific Ocean between 20° N and 40° N became stronger. Positive SSS anomaly continues and strengthens between equator and 40° N in the North Atlantic Ocean. Positive SSS anomaly appears in the Indian Ocean north of Equator, which is likely cause by reduced precipitation.

**SSS : Blended Analysis of Surface Salinity (BASS) V0.2
(a CPC-NESDIS/NODC-NESDIS/STAR joint effort)**

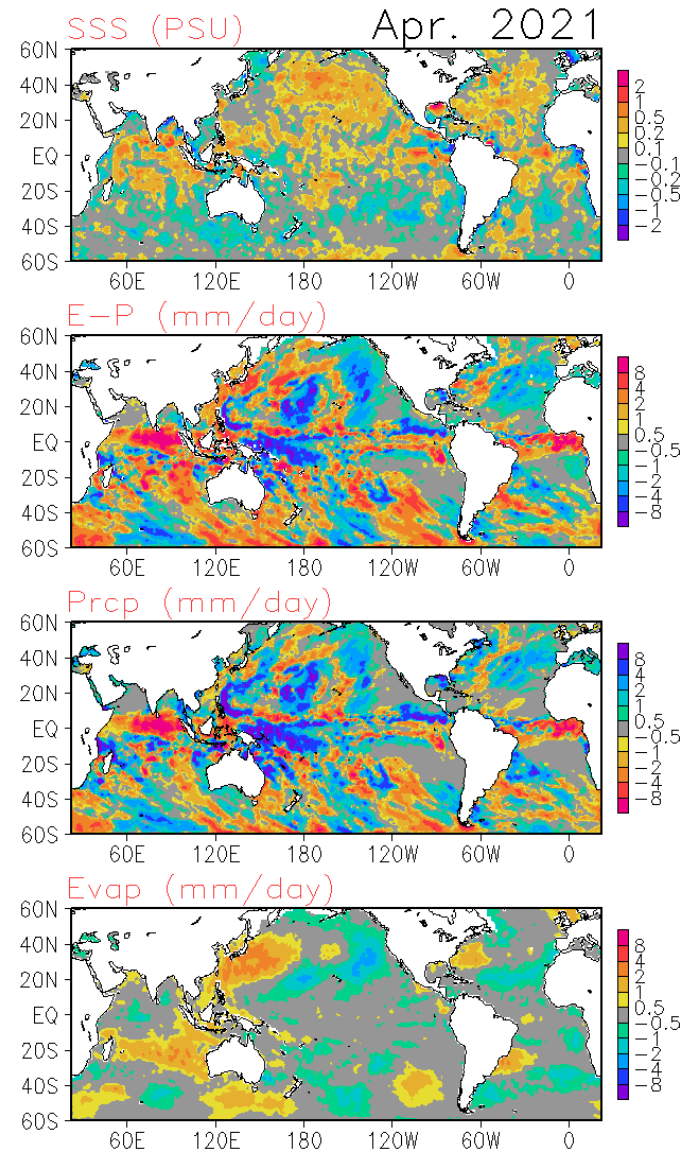
<ftp.cpc.ncep.noaa.gov/precip/BASS>

Precipitation: CMORPH adjusted satellite precipitation estimates

Evaporation: Adjusted CFS Reanalysis



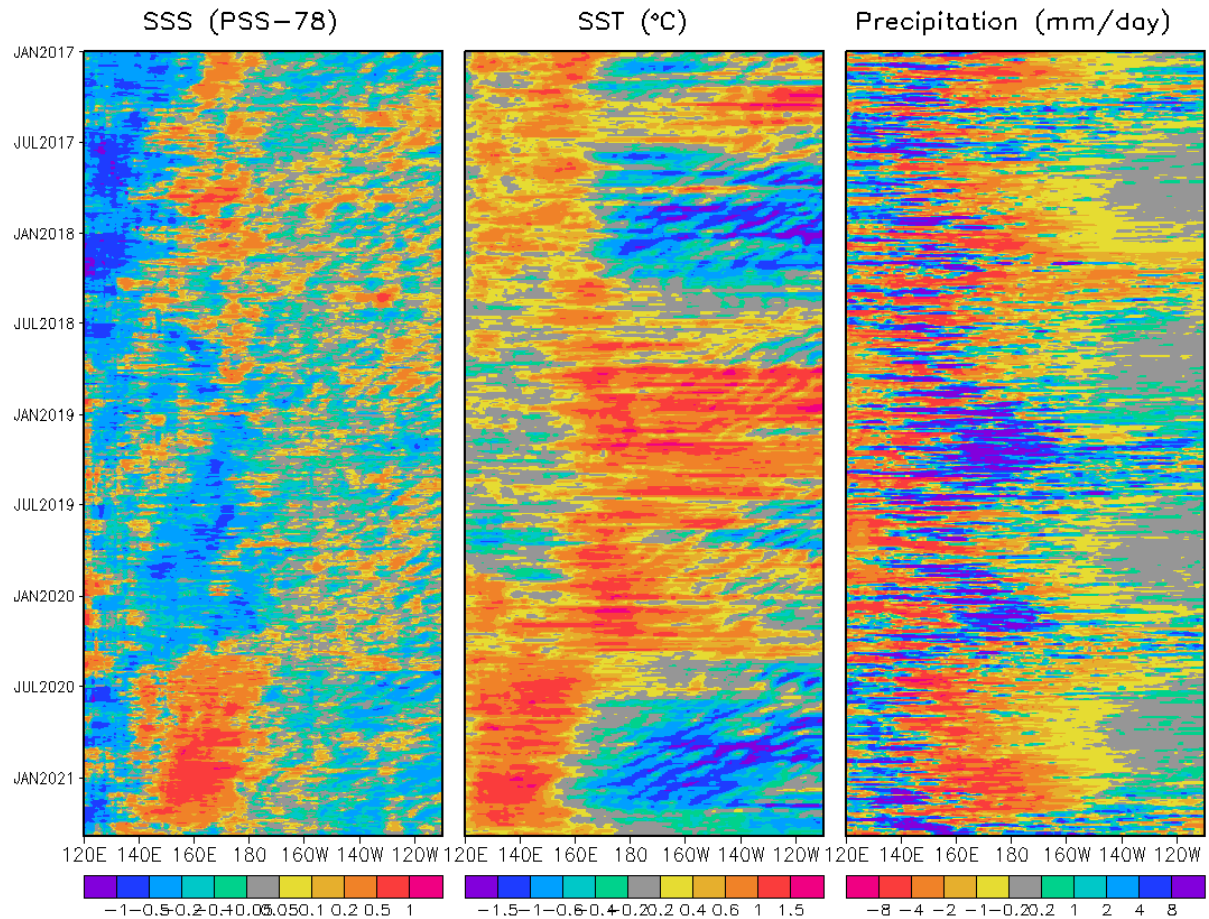
Compared with last month, SSS increased significantly between 20° N and 40° N in the North Pacific Ocean, especially in the central and east basins. SSS increased in the Indian Ocean north of 20° S except the Arabian Sea. SSS also increased in the North Atlantic Ocean between Equator and 40° N. In the Atlantic Ocean, the SSS increased along the equator which is likely due to reduced precipitation.



Pentad SSS Anomaly Evolution over Equatorial Pacific

Figure caption:

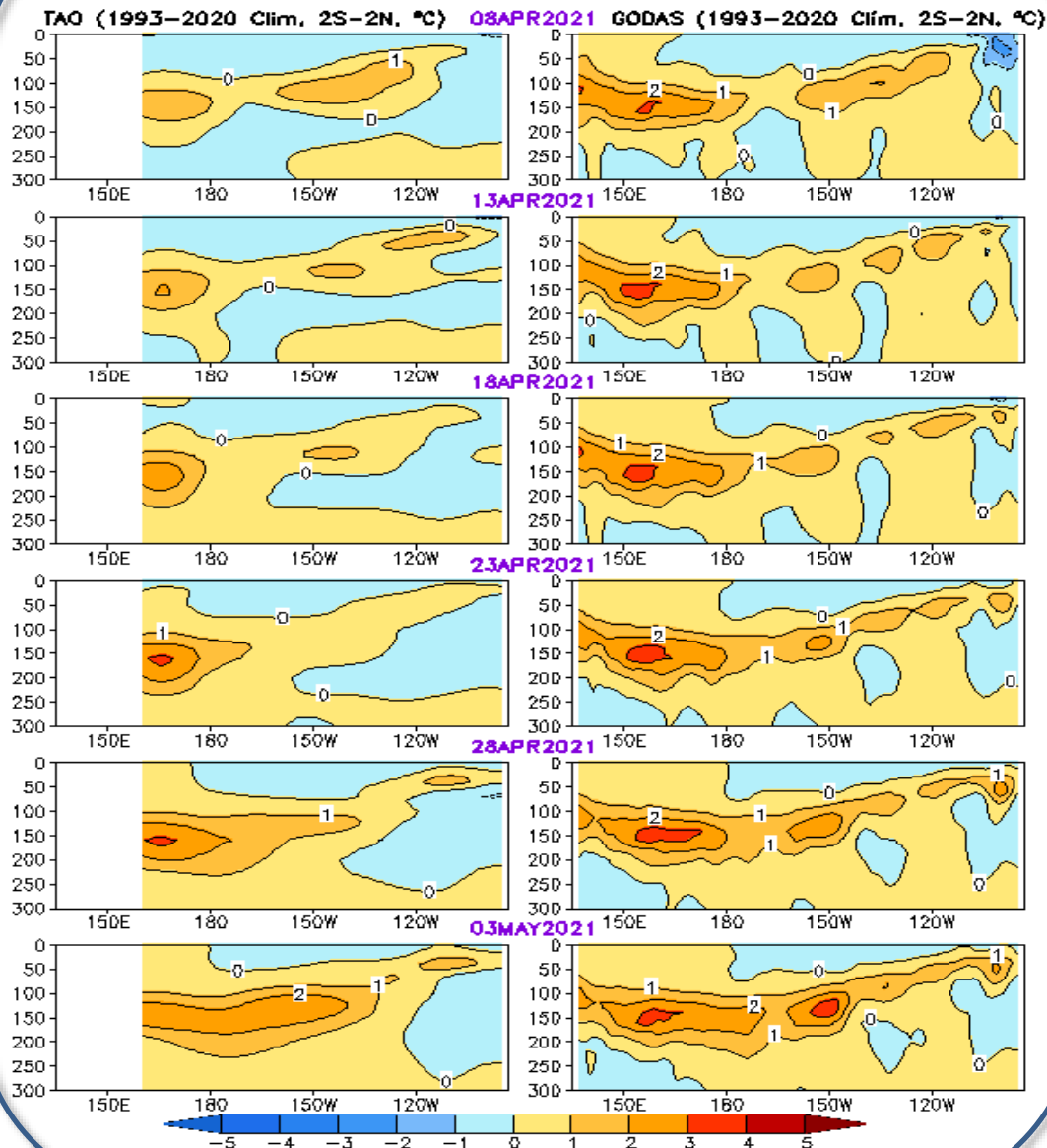
Hovemoller diagram for equatorial (5° S- 5° N) 5-day mean SSS, SST and precipitation anomalies. The climatology for SSS is Levitus 1994 climatology. The SST data used here is the OISST V2 AVHRR only daily dataset with its climatology being calculated from 1985 to 2010. The precipitation data used here is the adjusted CMORPH dataset with its climatology being calculated from 1999 to 2013.



Equatorial Pacific Ocean Temperature Pentad Mean Anomaly

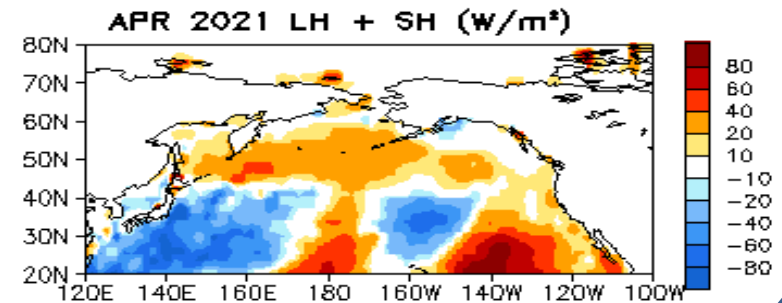
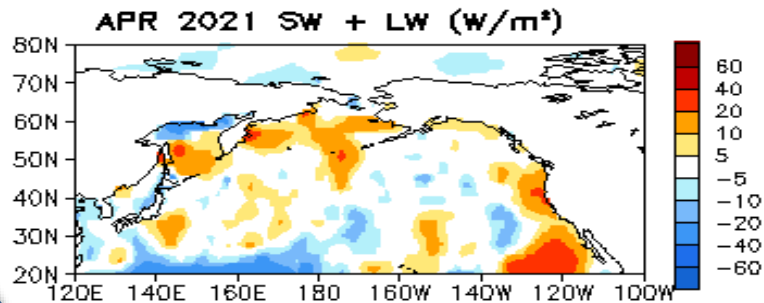
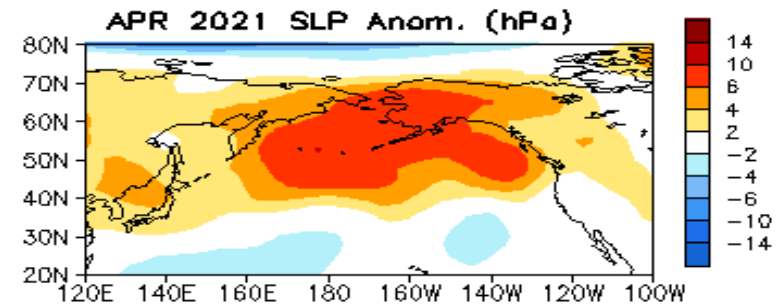
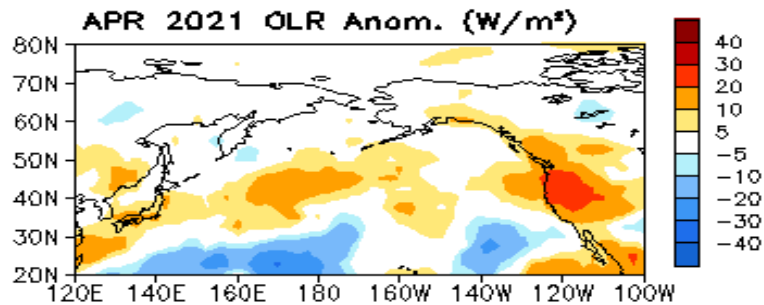
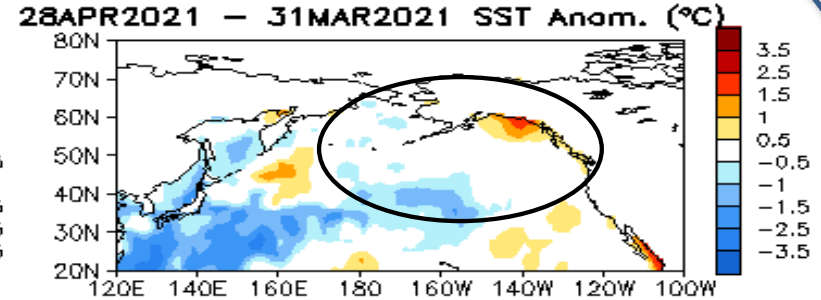
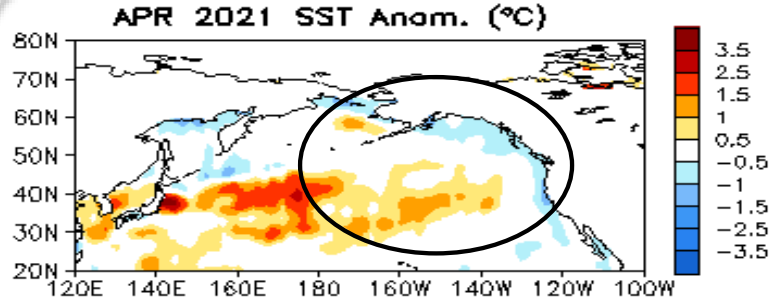
TAO

GODAS



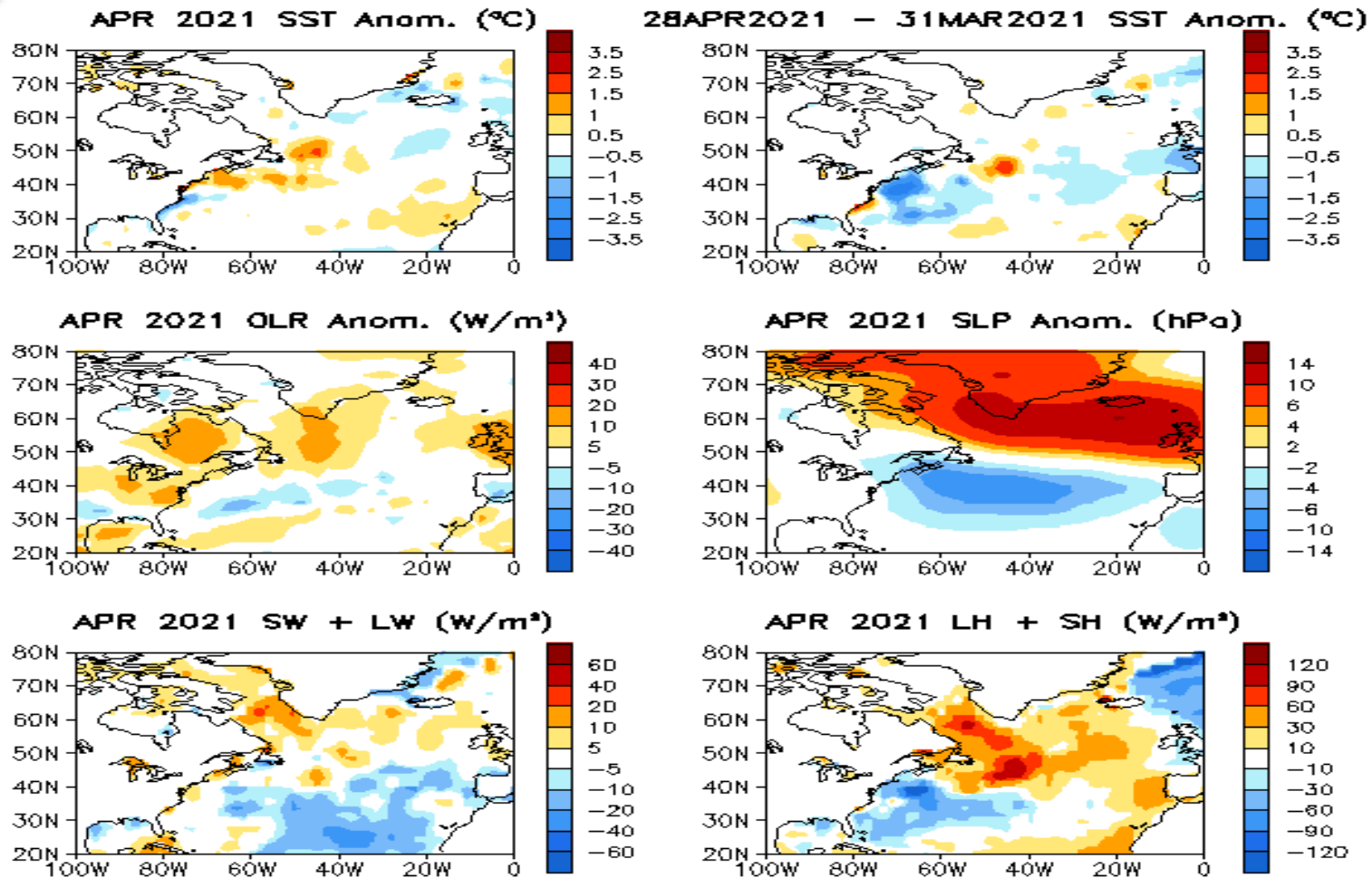
- Positive ocean temperature anomalies along the thermocline in the western and central Pacific persisted and negative anomalies in the far-eastern Pacific weakened in the last 2-months, consistent with the weakening of La Niña
- The features of the ocean temperature anomalies were similar between GODAS and TAO analysis.

North Pacific & Arctic Ocean: SSTA, SSTA Trend, OLR, SLP, Heat Flux Anomalies



Sea surface temperature (top-left; NCEP OI SST Analysis), anomaly 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.

North Atlantic Ocean: SSTA, SSTA Trend, OLR, SLP, Heat Flux Anomalies



Sea surface temperature (top-left; NCEP OI SST Analysis), anomaly 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.