The Philippine Sea Atmospheric Quasi-biweekly Oscillation during the Asian Monsoon Spring to Summer Transition Season and May-June South China Sea Tropical Cyclone Activity

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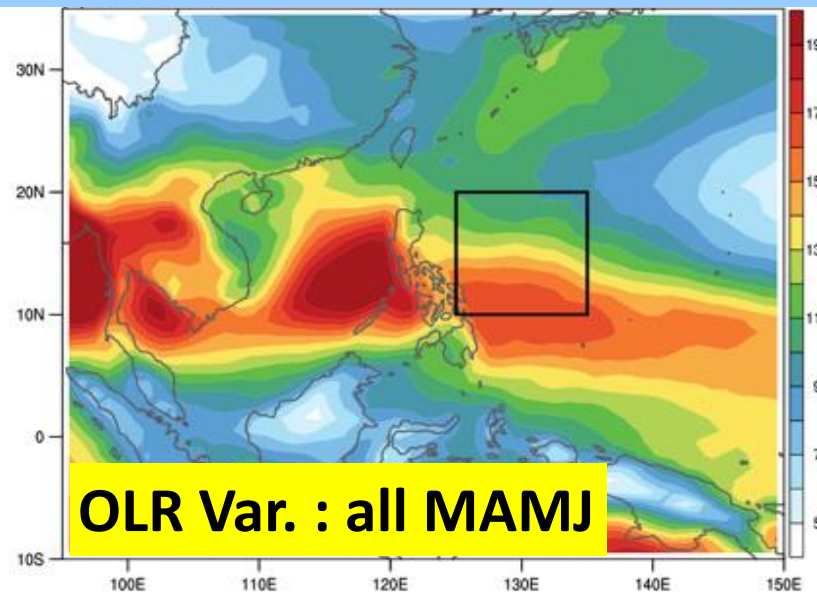
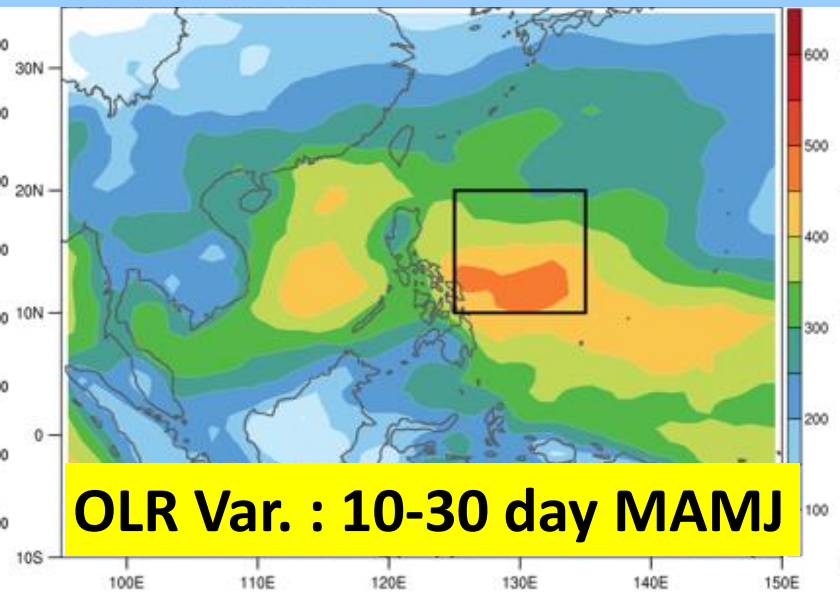
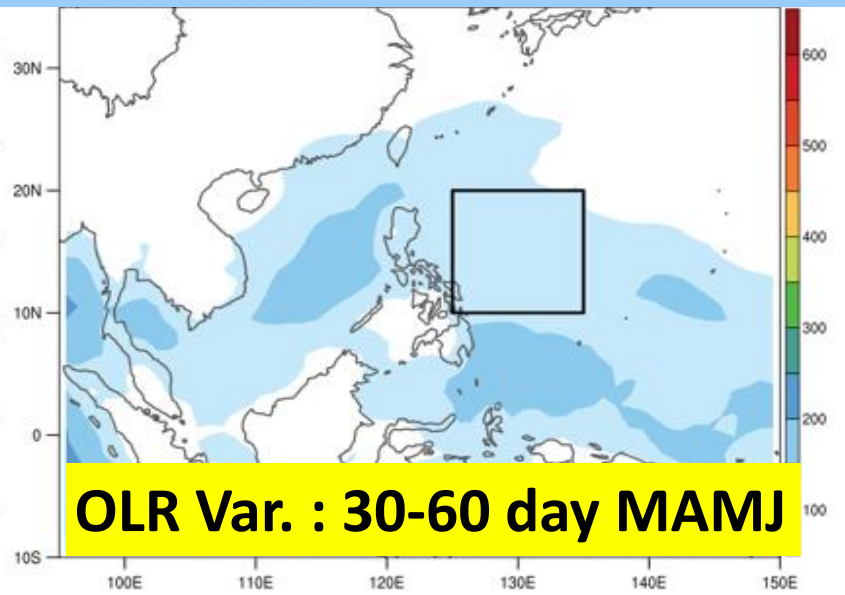
Motivation

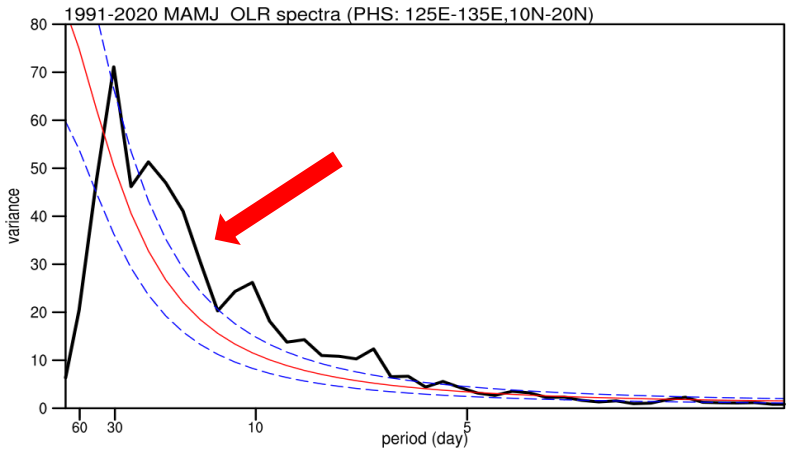
The convection over the Philippine Sea (PHS) is dominated by significant biweekly variability with 10-30 days period.







The 30-yrs mean power spectra of MAMJ daily OLR anomalies from 1991-2020 over PHS



PHS: 125˚E-135˚E ,10˚N-20˚N (black box)

Spring to Summer transition season: March to June (MAMJ)

Scientific questions

Q1. What is the PHS QBWO during the spring to summer transition season?

Q2. Does the PHS QBWO have strong interannual variability? How does it affect SCS TC activity?

Data

- ✶ Tropical cyclone data: RSMC best track data, 6 hours
- ✶ Atmospheric : ERA5, 0.25° X 0.25°
- ✶ Precipitation: NASA GPCP v2.3, 2.5° X 2.5°
- ✶ Outgoing longwave radiation: NOAA Interpolated OLR v2, 1.0° X 1.0°
- ✶ Sea surface temperature: NOAA OISST v2, 1.0° X 1.0°

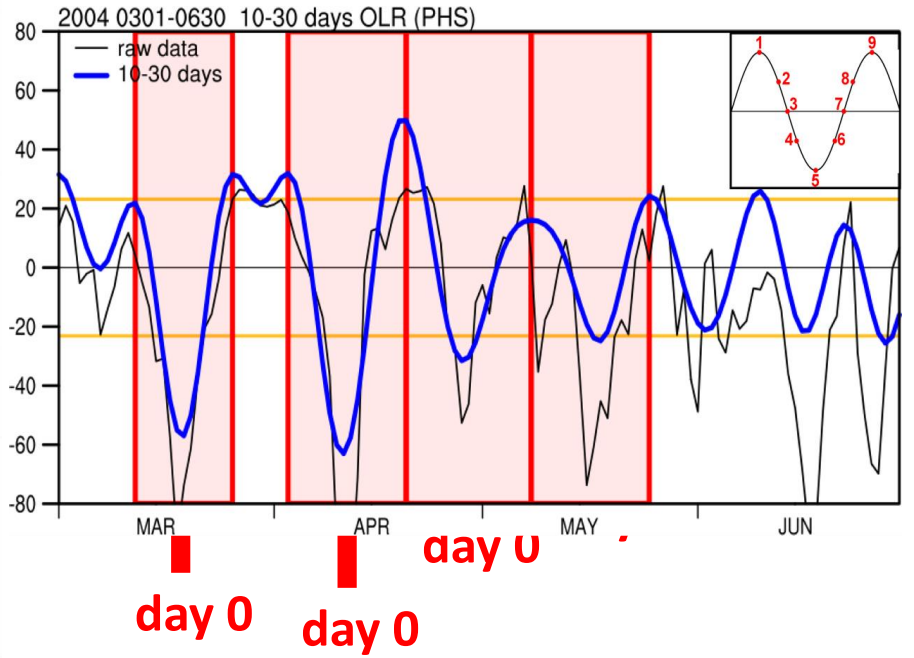
spring to summer transition season: 1991-2023 March to June (MAMJ)

Method

The evolutions of the QBWO can be described by composites based on the filtered time series.

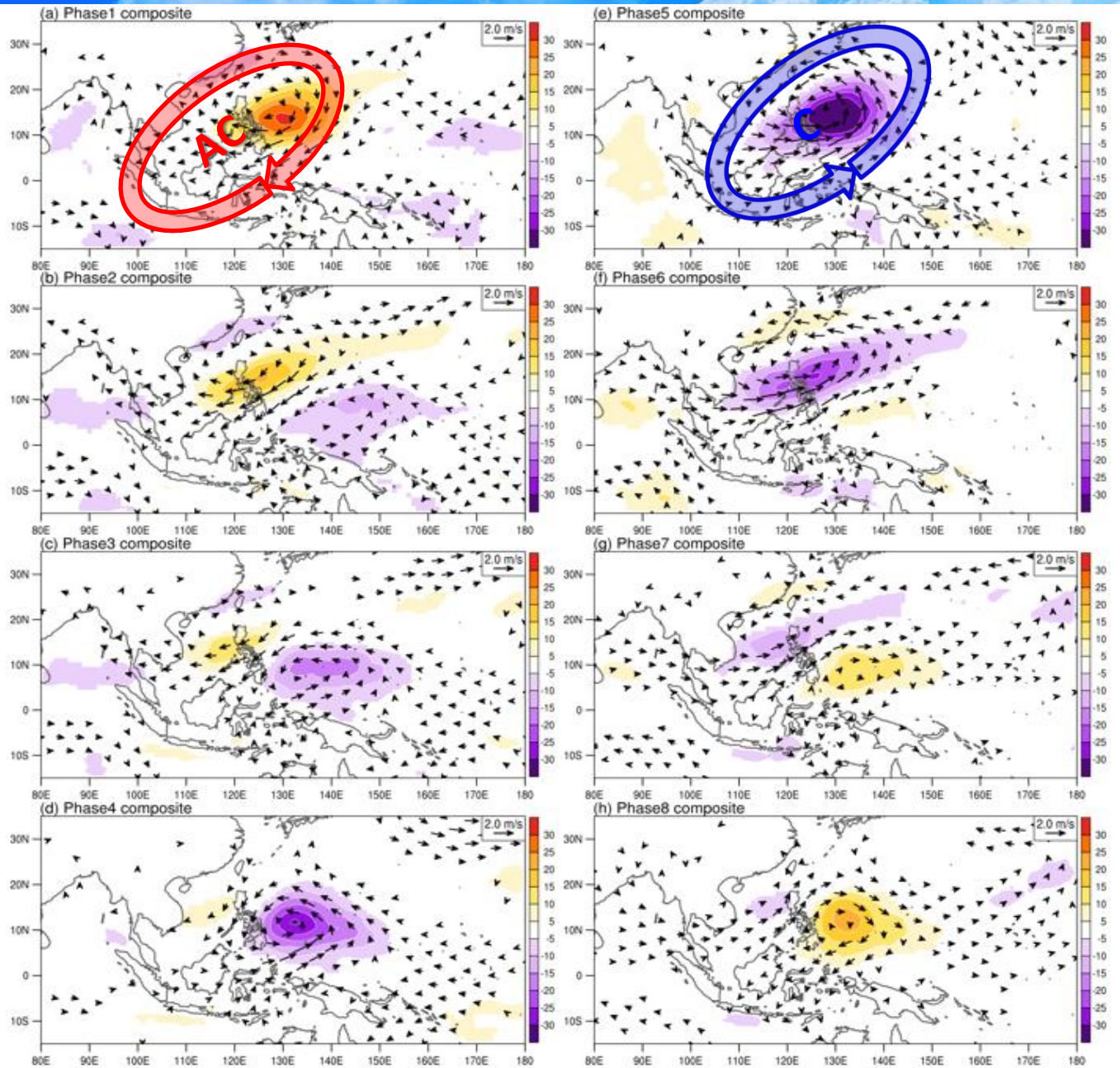
Determination of the strong PHS QBWO:

Step 1	The Lanczos band-pass filter with 10-30 day window is applied to daily anomalies of area mean over PHS (125˚-135˚E, 10˚-20˚N) ➔ extract the quasi-biweekly signals
Step 2	Find the minimum filtered OLR anomaly (day 0) less than the -1.5 STD
Step 3	The filtered OLR anomaly must be greater than the 1.5 STD at least one day within 30 days window from 15 days before day 0 to 15 days after day 0
Step 4	QBWO (71 cases) The OLR anomaly greater than the 1.5 STD (a) before the day 0 (19, 27%) (b) after the day 0 (27, 38%) (a) both (25, 35%)



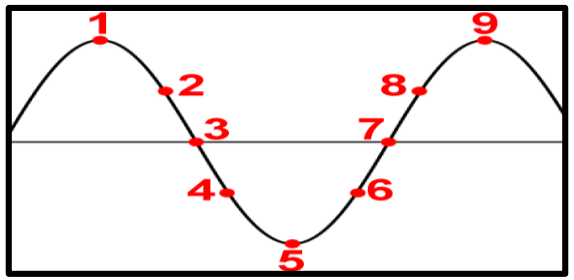
The life time of a cycle on average is about 17 days.

The evolution of convection and circulation of PHS QBWO



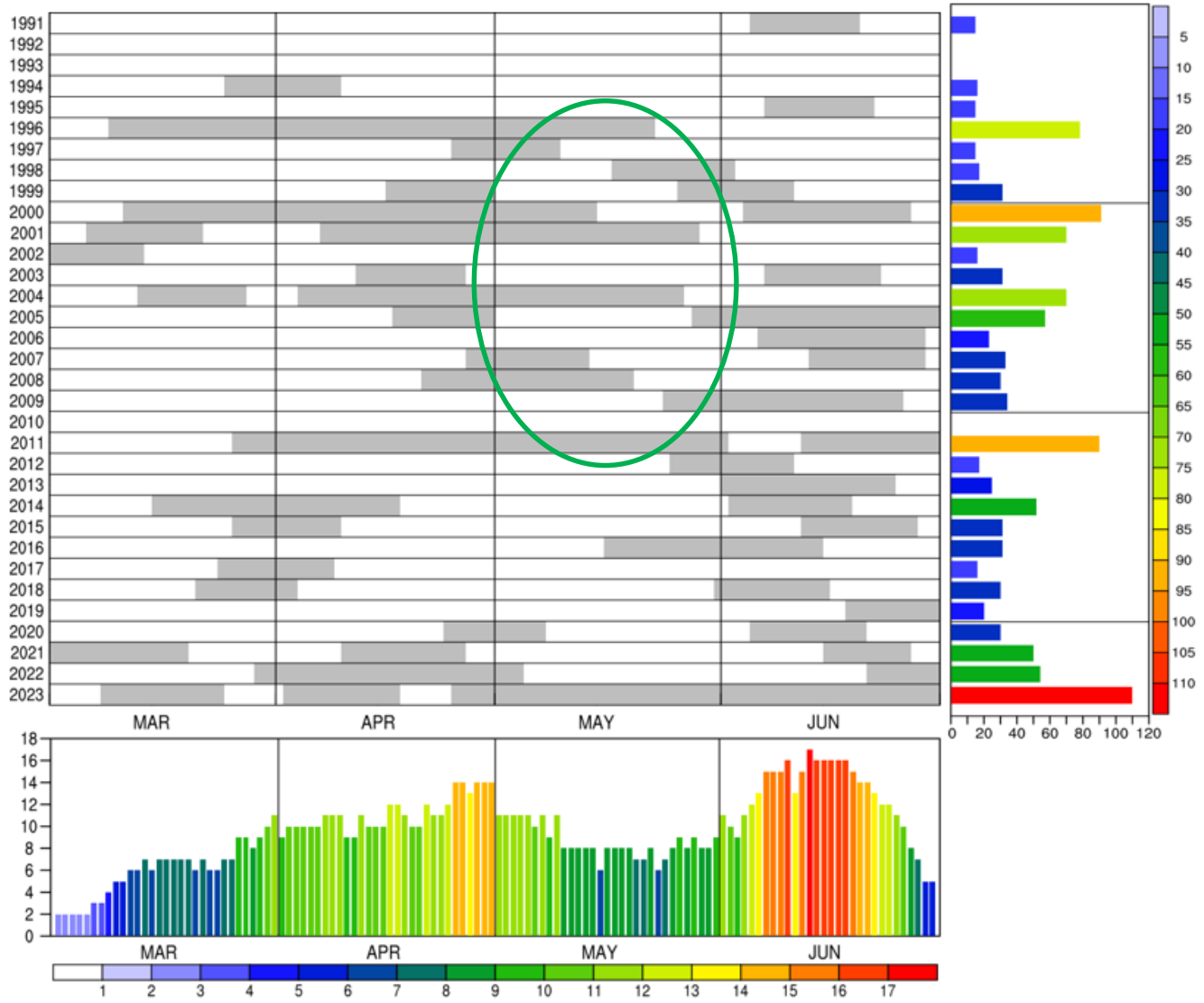
Composite of 10-30 day filtered OLR and 850hPa winds anomalies :

- It is notable that the northwestward propagation feature.
- It shows clear alternation of the enhanced and suppressed phases of the deep convection of the Philippine Sea and the associated anomalous southwesterly and northeasterly winds across the SCS and the PHS.



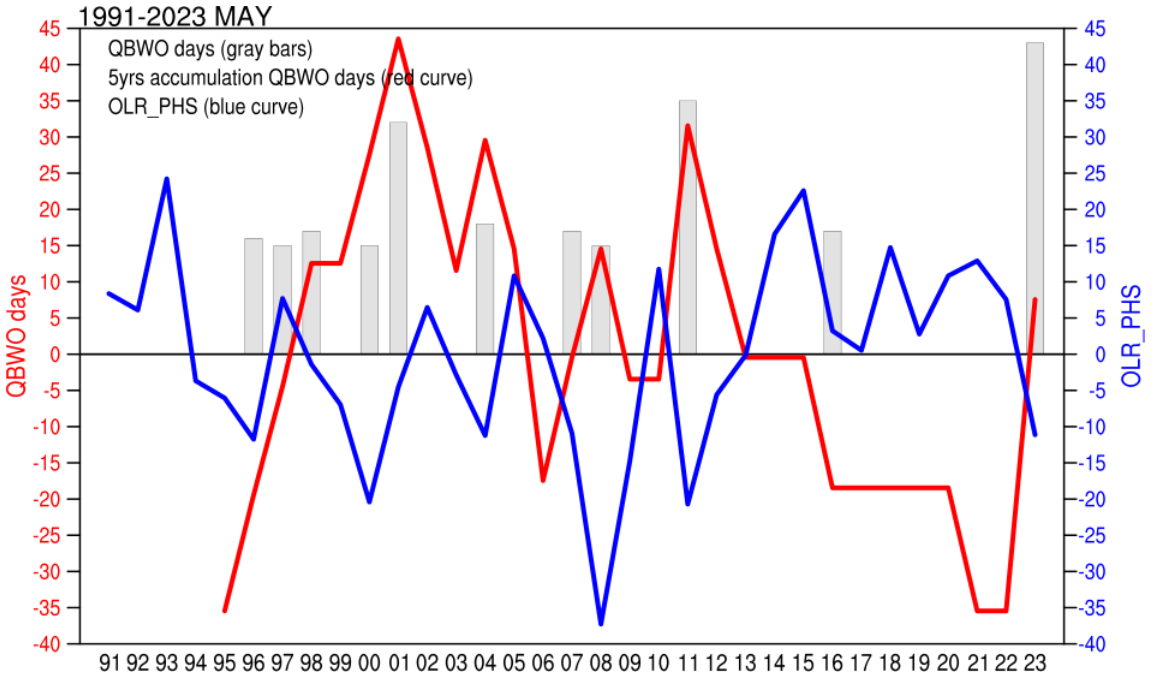
The interannual variability of PHS QBWO activity

The days belong to the 71 QBWO cases are marked in gray in this calendar table



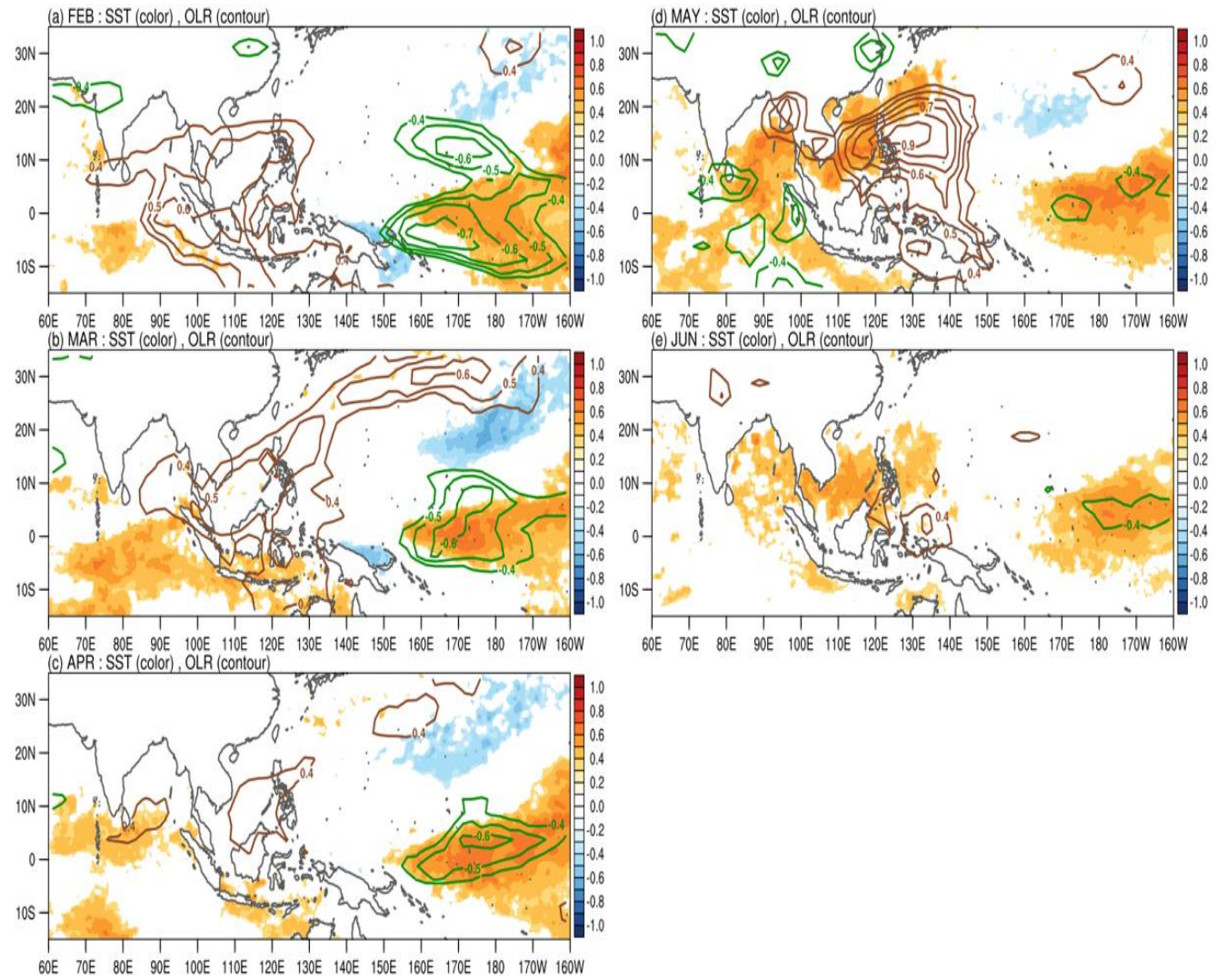
5yrs accumulative QBWO & unfiltered OLR

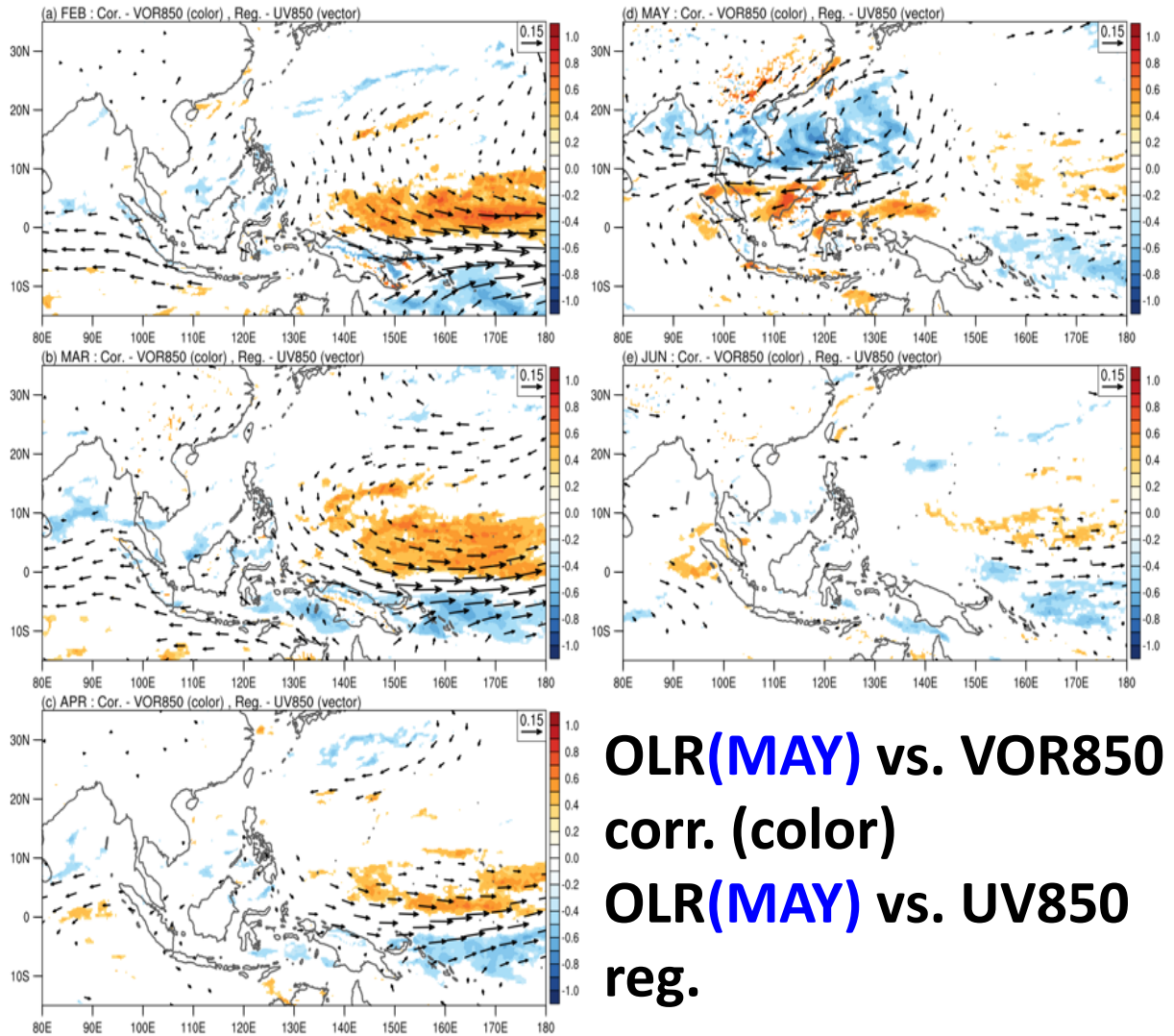
CC. = -0.53



When the PHS is more convective, it sees more QBWO days.

The large-scale circulation associated with PHS QBWO





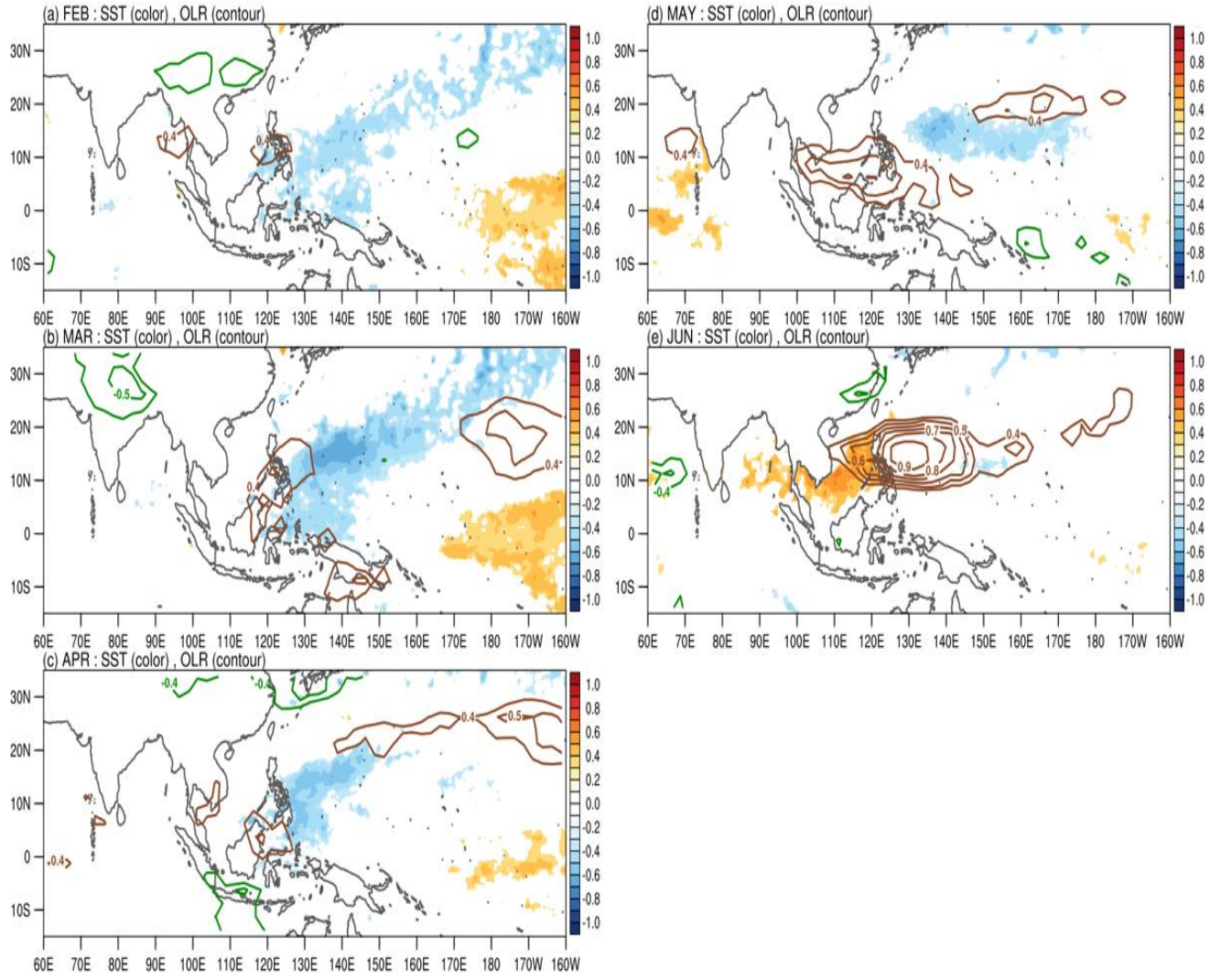
OLR(MAY) vs. VOR850 corr. (color)

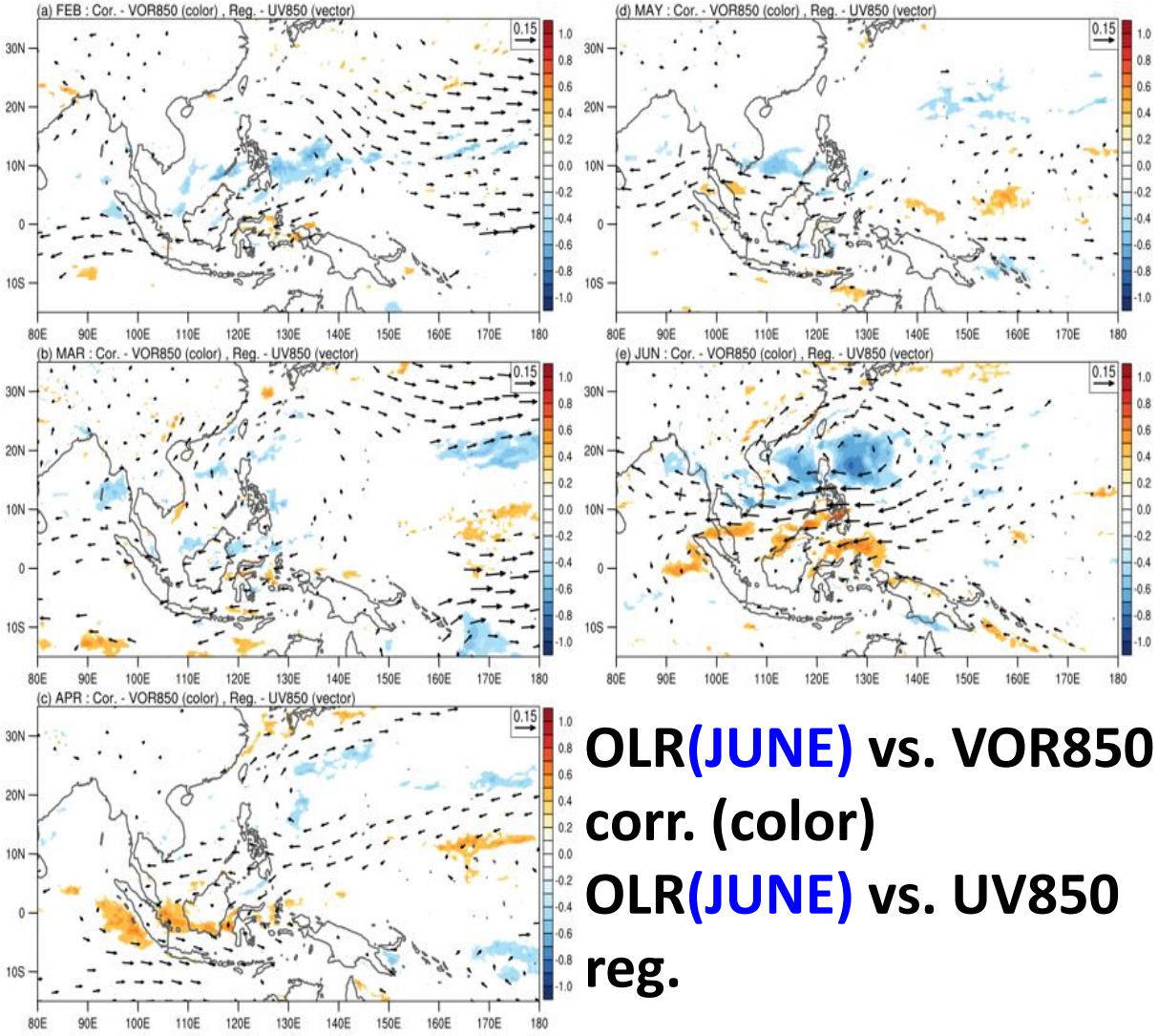
OLR(MAY) vs. UV850 reg.

OLR(MAY) vs. SST corr. (color)

OLR(MAY) vs. OLR corr. (contour: brown-positive, green-negative)

The large-scale circulation associated with PHS QBWO





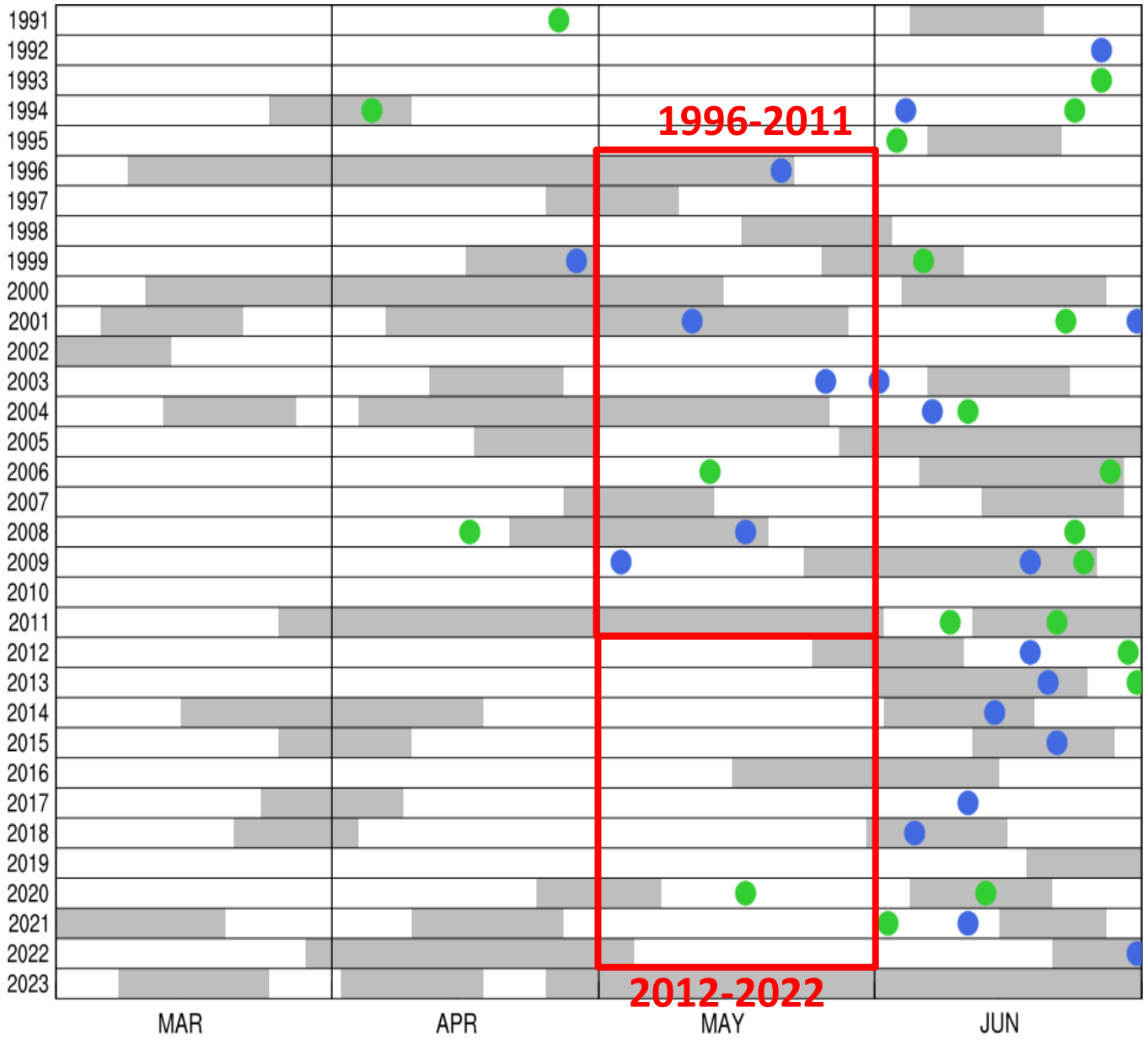
OLR(JUNE) vs. VOR850 corr. (color)

OLR(JUNE) vs. UV850 reg.

OLR(JUNE) vs. SST corr. (color)

OLR(JUNE) vs. OLR corr. (contour: brown-positive, green-negative)

The PHS QBWO and SCS TCs



period	MAMJ TC number	TC number before pentad 31 (05/01 – 06/04)		TC number after pentad 31 (06/05 – 06/30)	
1996-2011	16 (1.0/yr)	9	SCS-born: 7 (78%)	7	SCS-born: 2 (29%)
			WNP-born: 2 (22%)		WNP-born: 5 (71%)
2012-2022	13 (1.4/yr)	2	SCS-born: 0 (0 %)	11	SCS-born: 8 (73 %)
			WNP-born: 2 (100%)		WNP-born: 3 (27%)

blue dots: SCS-born

green dots: WNP-born

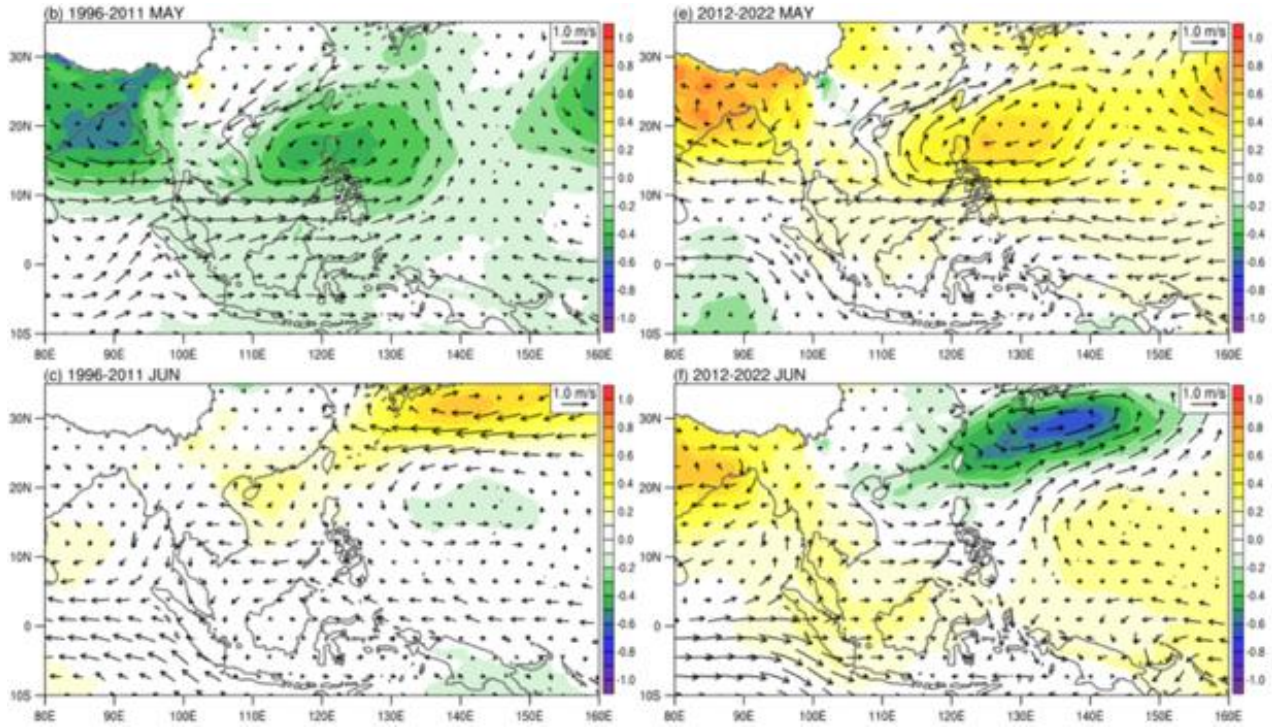
SCS: 110°E-120°E, 0-22.5°N

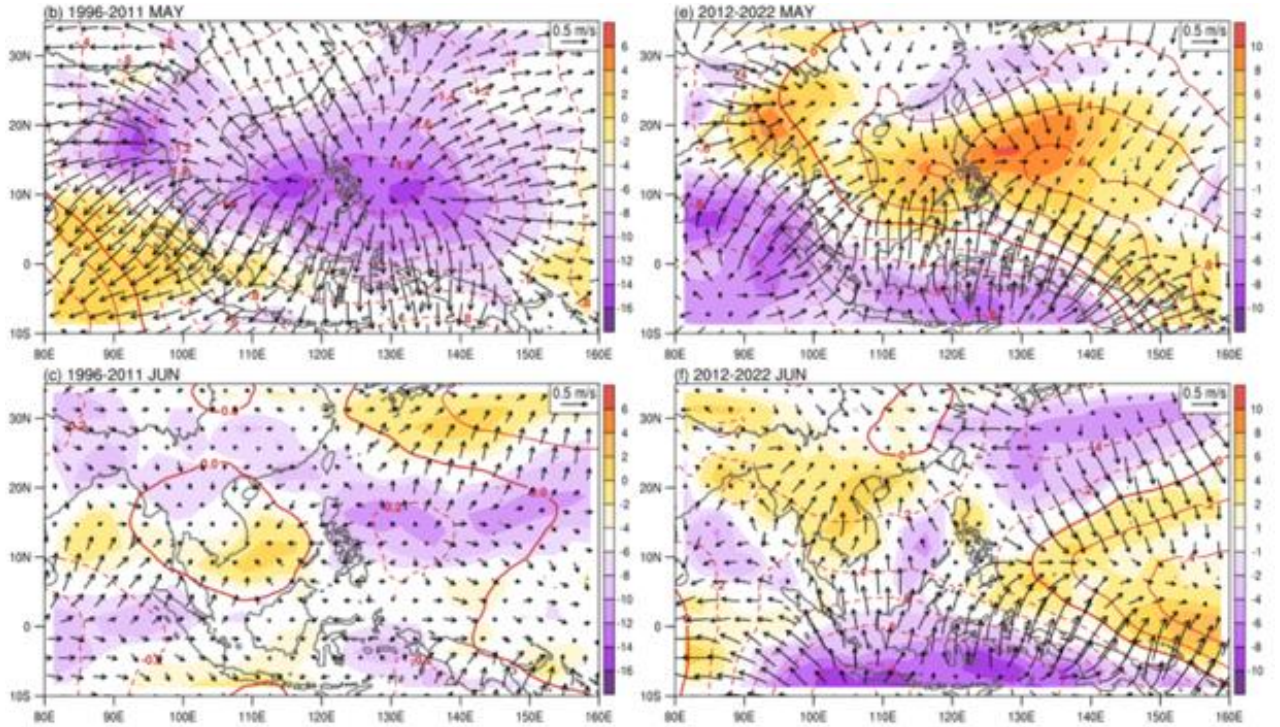
The difference of the sub-seasonal mean state

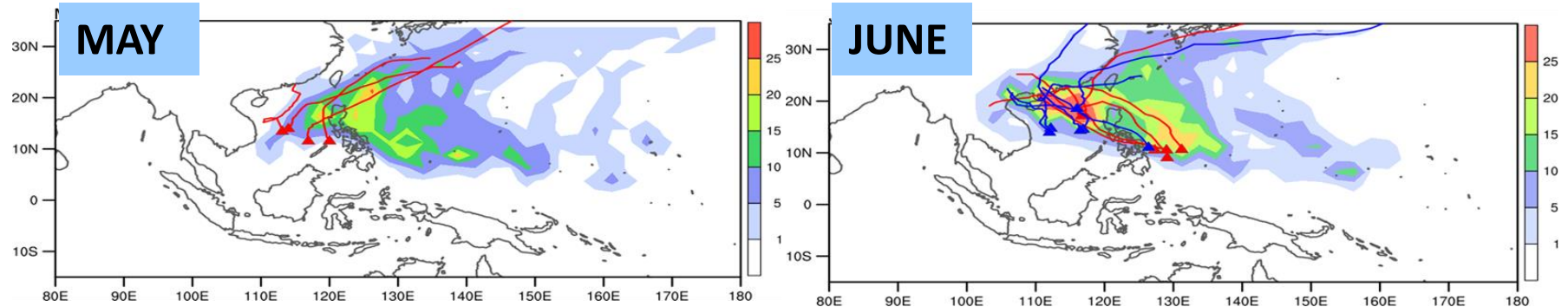
SLP (color) & 850 winds

OLR (color) & CHI200 (contour) & 200 divergence

1996-2011 | **2012-2022** | **1996-2011** | **2012-2022**







1996-2011

2012-2022

Summary

Q1. What is the PHS QBWO during the spring to summer transition season?

1. During the spring to summer transition season, the convection exhibits significant fluctuations with the periods of 10-30 days over the PHS region.

2. The convection and circulation pattern show clear alternation of the enhanced and suppressed phases of the deep convection over the Philippine Sea and the associated anomalous southwesterly and northeasterly winds across the South China Sea and Philippine Sea.

Q2. Does the PHS QBWO have strong interannual variability? How does it affect SCS TC activity?

3. Strong interannual variability of PHS QBWO. We found distinct contrast in the accumulative QBWO days in May during the period of 1996-2011 and 2012-2022. It suggests that the interannual variability of convective activity over the Philippine Sea during May is highly influenced by the climate background condition in the preceding spring season. The spring influence to June becomes much weaker.

4. During the 1996-2011, the TC activity over the SCS during May and June was quite active and so was the PHS QBWO. The majority of the TCs were born over the SCS during May. The entire period of 2012-2022 did not see any TC activity during May over the SCS. The TC activity resumed in June, but the majority are the SCS-born TCs.