OPST-8

Seasonal differences in tropical cyclone-induced sea surface cooling in the western North Pacific

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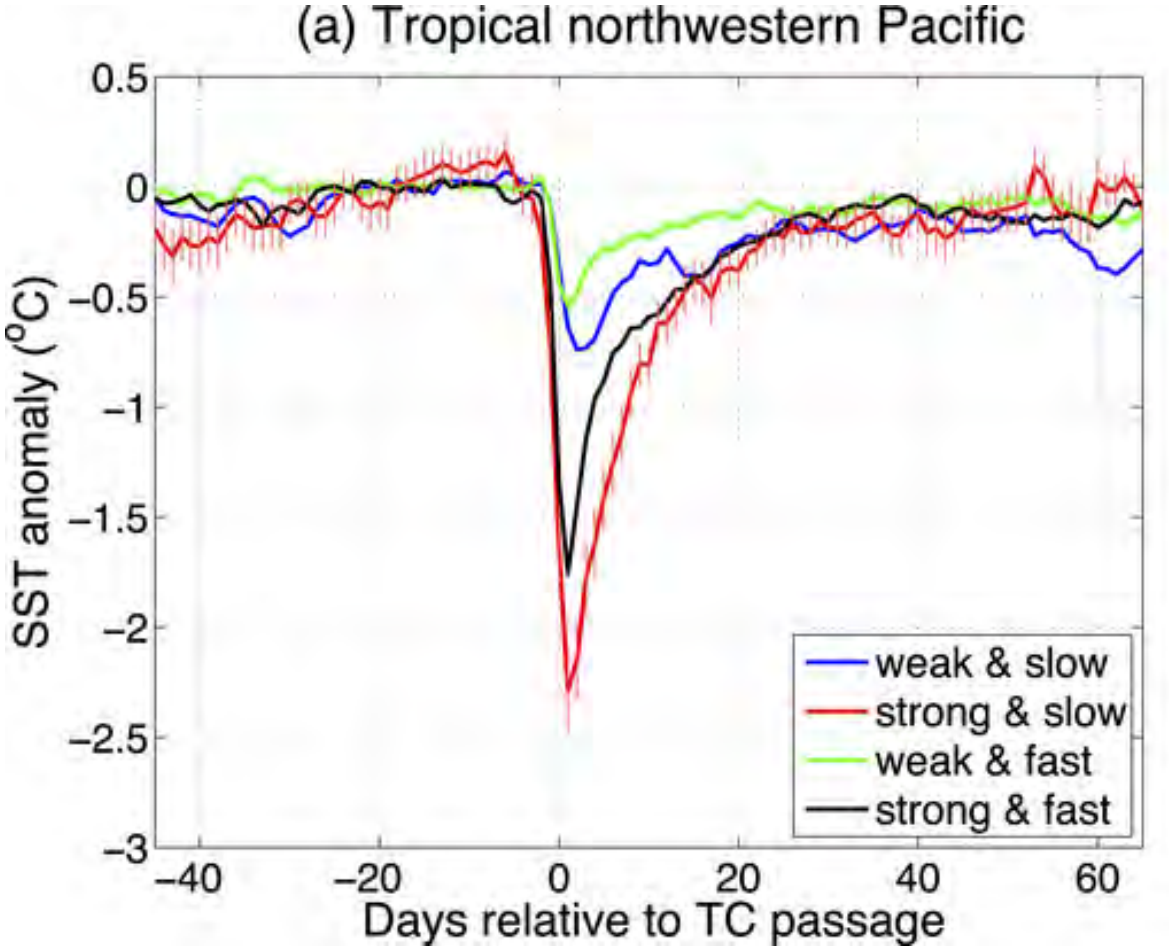
Introduction

Numerous studies carried out to quantifying and understanding the SST cooling generated by individual TCs in the NWP Chu et al. (2000), Lin et al. (2003a,b), Zheng and Tang (2007), Shang et al. (2008), Tseng et al. (2010), Chiang et al. (2011), Tsai et al. (2012), and Ko et al. (2014).



Adapted from Mei et al. (2015)

Climatology of TCs in summer and autumn season (1992-2021) in WNP

	Summer season (June–August)	Autumn season (September–November)	Difference (Autumn minus summer)
Total TCs	320	315	5
No. of TC points from genesis to LMI	3297	3414	117
Average LMI (knots)	76.4 ± 34.1	90.0 ± 39.2	13.6 ($p < 0.01$)
Average intensity of TC (averaged from genesis till LMI, knots)	60.7±26.4	67.1 ± 29.9	6.4 ($p < 0.01$)

Cyclones are stronger in autumn season than in the summer season

Singh et al. (2023)

Data and Methodology

Data

SST Data: OISST

Cyclone Data: JTWC

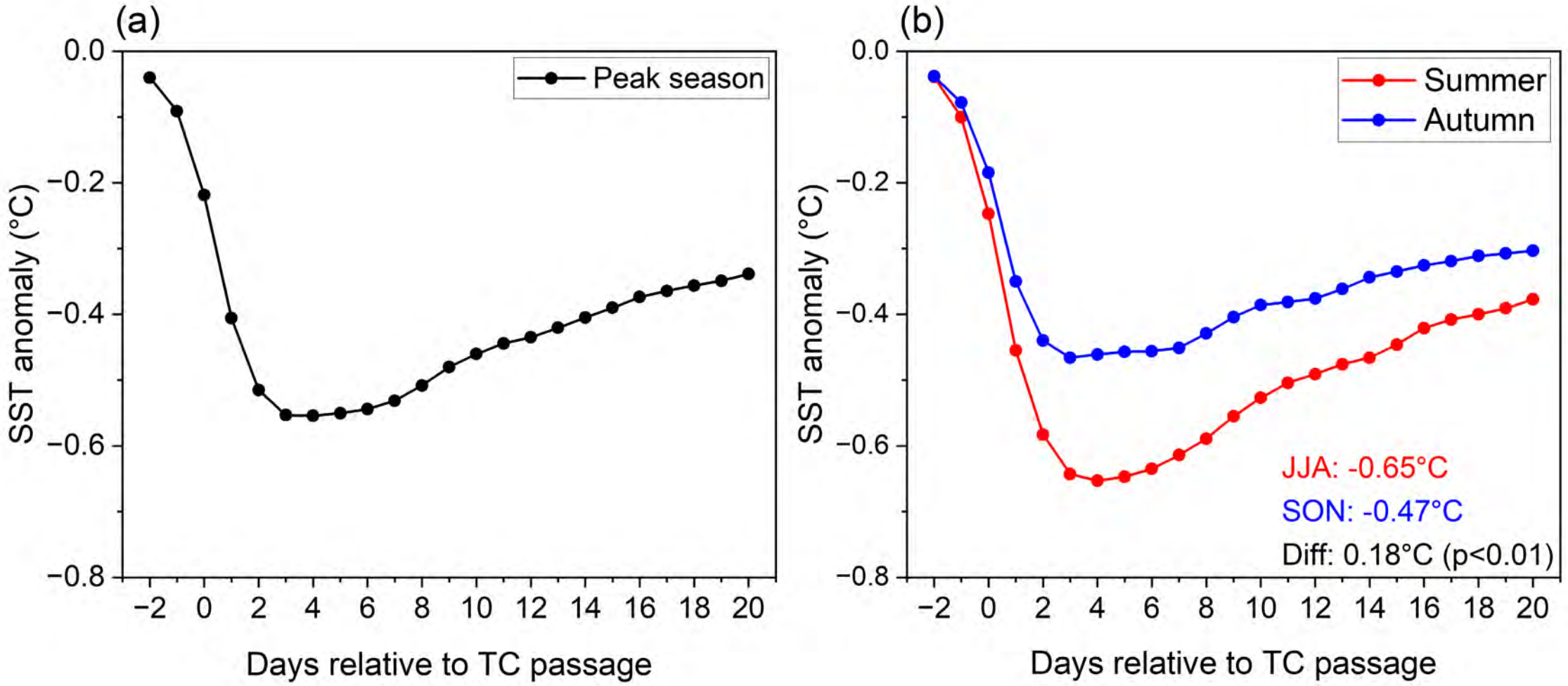
Analysis period: 1992-2021

Ocean subsurface temperature data: GLORYS dataset (1994-2019)

Methodology

- The analysis is done for the TCs from genesis (35 knots) till life time maximum intensity (LMI) of cyclone.
- In order to see the cyclone induced cooling, we are averaging at every 2°x2° box with cyclone at the center. This averaging is done for each cyclone point from genesis (35 knots) till LMI.
- The cyclone induced cooling is calculated as the difference between the pre-cyclone SST anomaly (averaged from day -5 to day -3) with the other days (day -2, day -1, day 0 and so on).
- Here day 0 is the day of cyclone, day -1, day -2…are 1, 2 days before cyclone and day +1, day +2 so on are +1, +2 days after cyclone.
- T_{ssc} is computed as the difference between the SST and the top 100 m average sub-surface ocean temperature

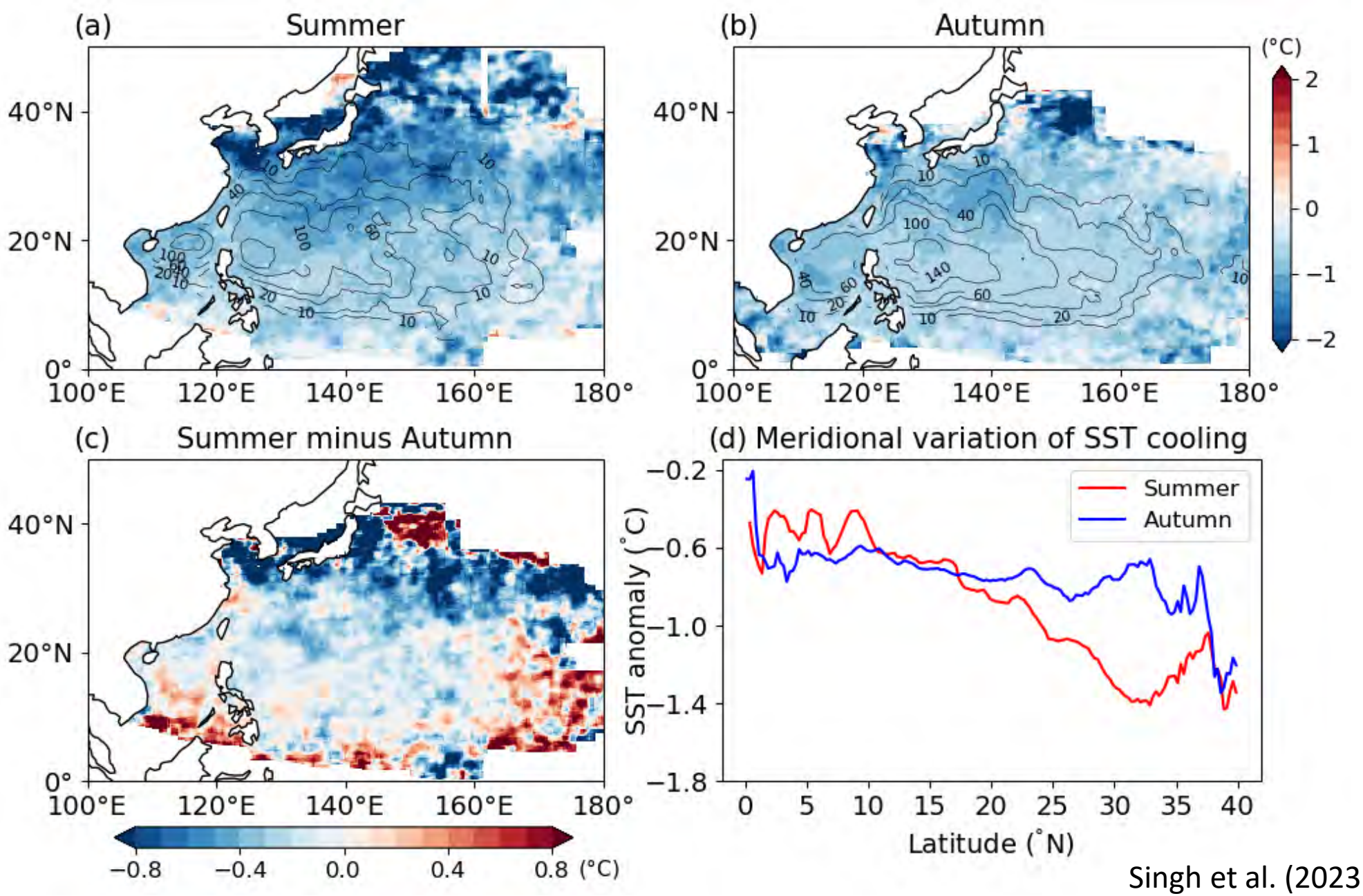
TC-induced cooling in western North Pacific (1992-2021)



More TC induced SST cooling in summer season than the autumn season

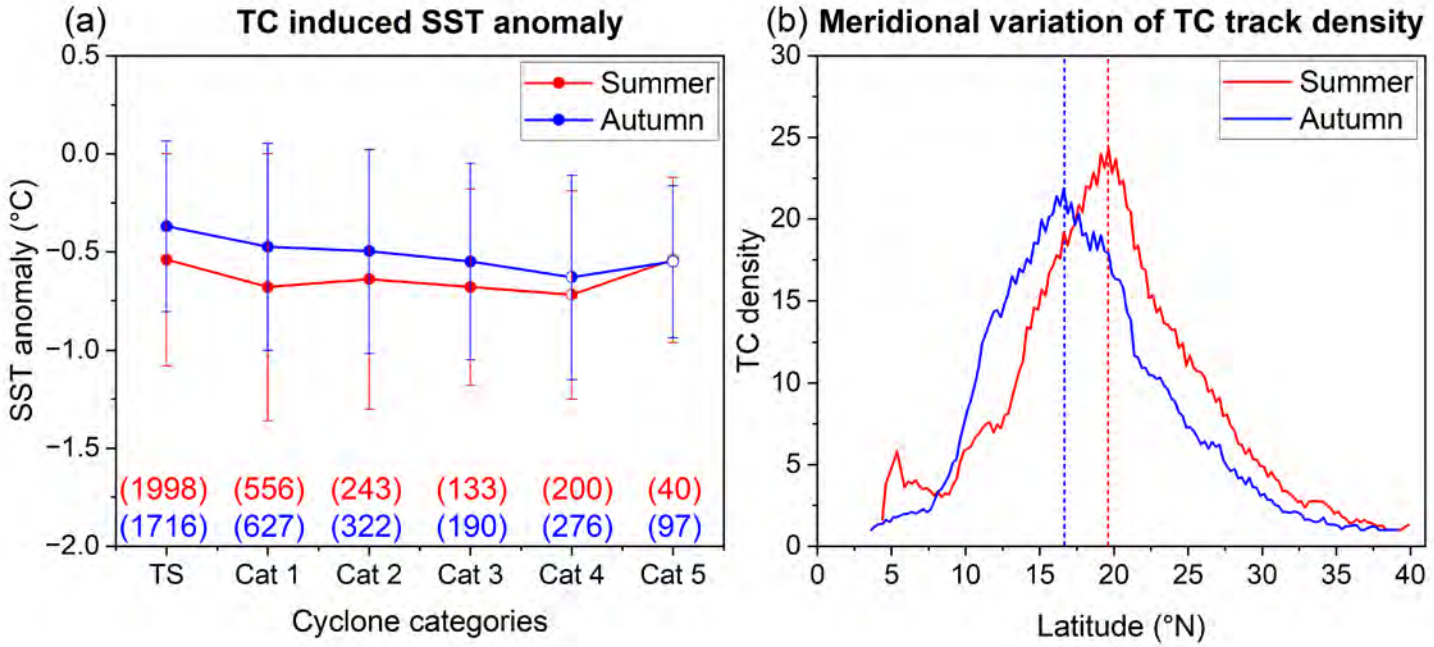
Singh et al. (2023)

TC-induced cooling in western North Pacific (1992-2021)



Singh et al. (2023)

TC-induced cooling as function of TC characteristics

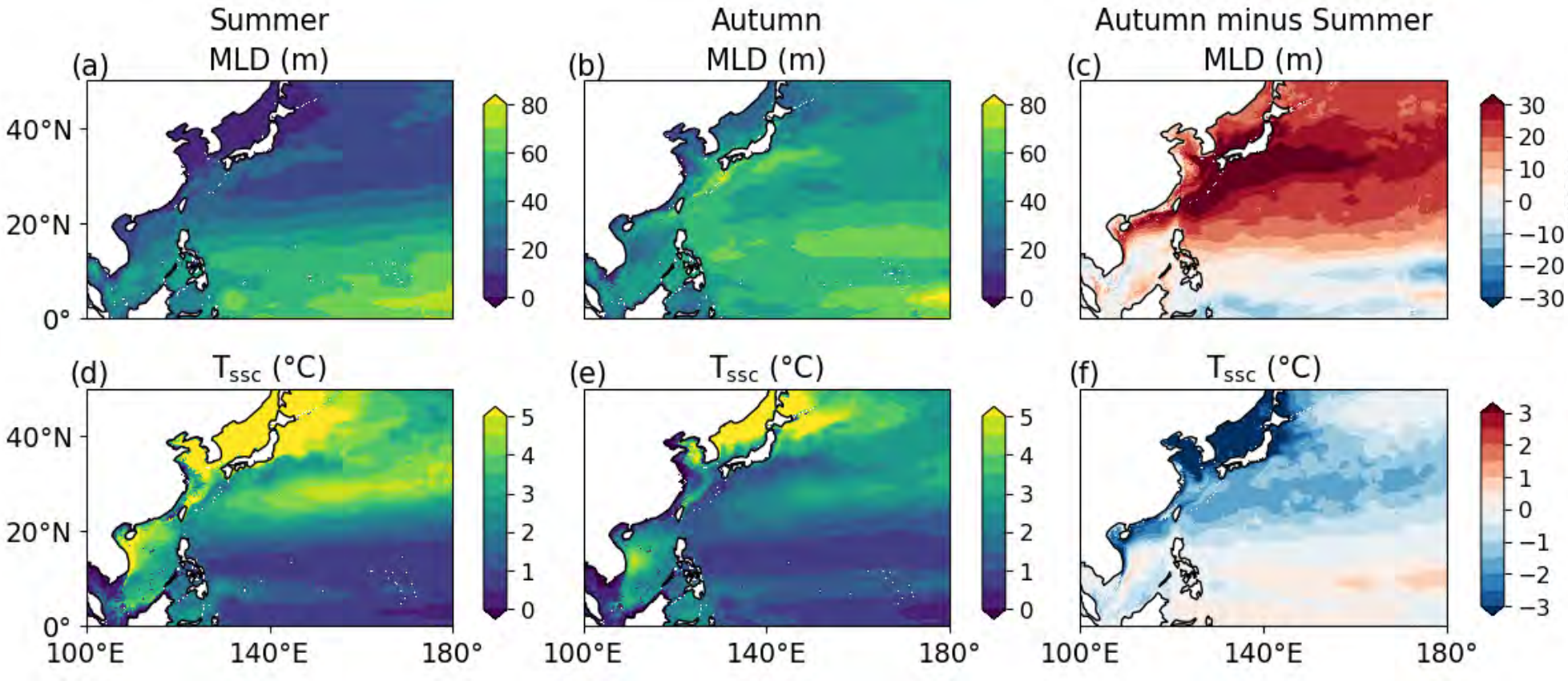


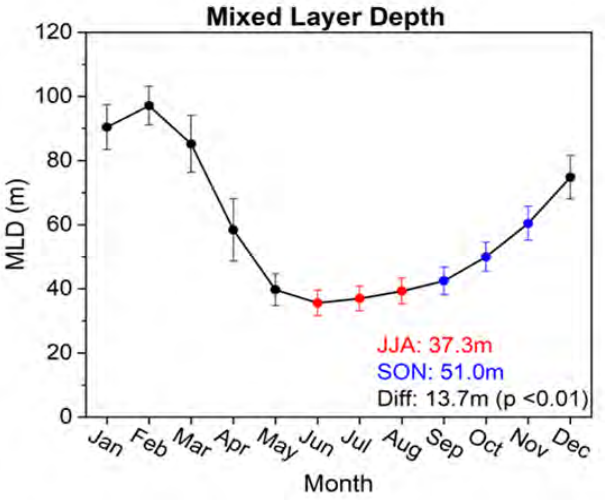
	Summer	Autumn	Diff.
Translation speed (m s^{-1})	5.0	5.2	0.2 (p=0.14)
TC size (R34, km)	172.4	181.5	9.1 (p=0.07)

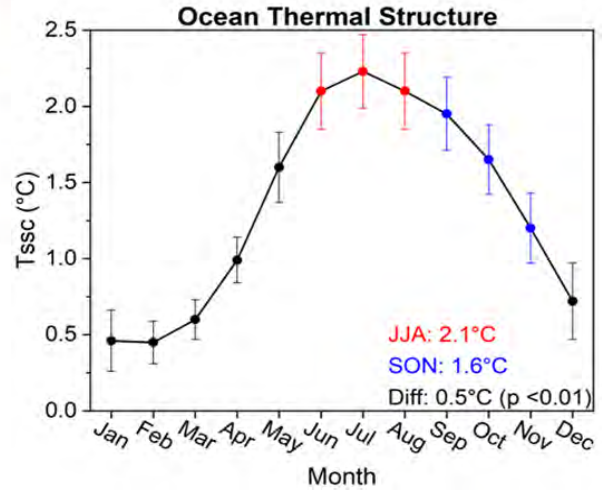
- For same TC intensity higher TC-induced SST cooling in summer season than autumn season.
- TC track shifts equatorward in the autumn season.
- Average translation speed shows no statistical difference between the two seasons.
- Despite of larger TC size in Autumn, more SST cooling is observed in the summer season.

Singh et al. (2023)

Ocean sub-surface characteristics in summer and autumn seasons





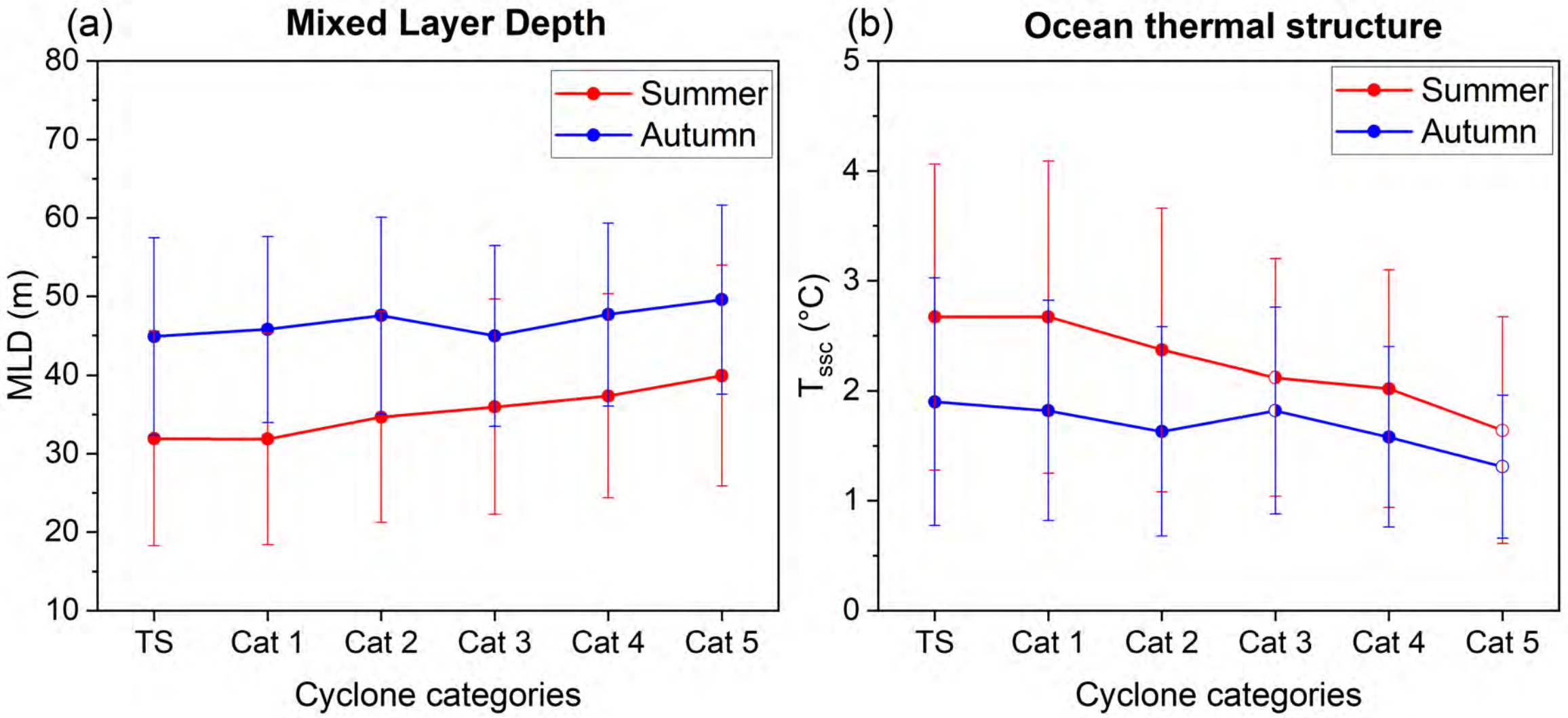


Average ocean variables (10-40°N, 100-180°E)

	Summer	Autumn	Difference
MLD (m)	37.3	51.0	13.7 (p<0.01)
T_{ssc} (°C)	2.16	1.60	0.56 (p <0.01)

Singh et al. (2023)

Ocean sub-surface characteristics in summer and autumn seasons along TC track



For the same TC intensity, in summer, the MLD is shallower (difference: 12 m) and the thermal gradient is shaper (difference: 0.76°C) than autumn.

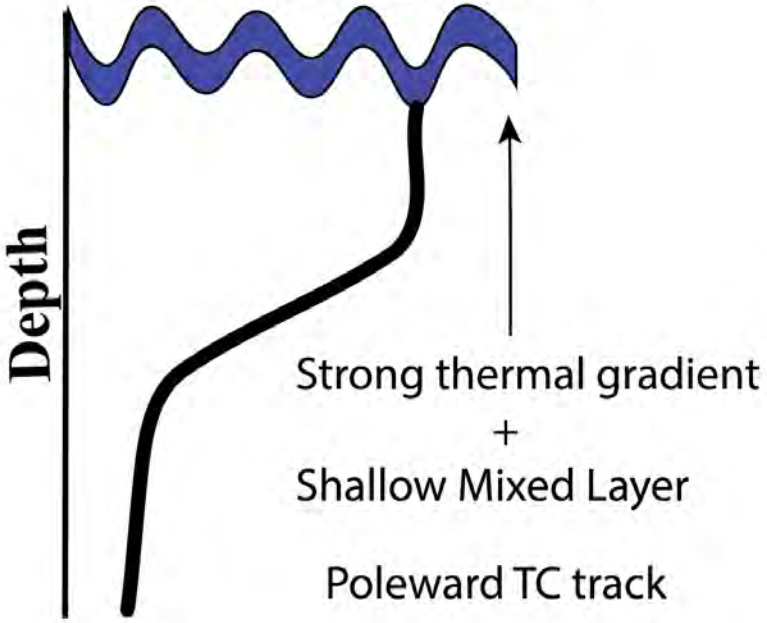
Singh et al. (2023)

Summary

Summer

Weak cyclones

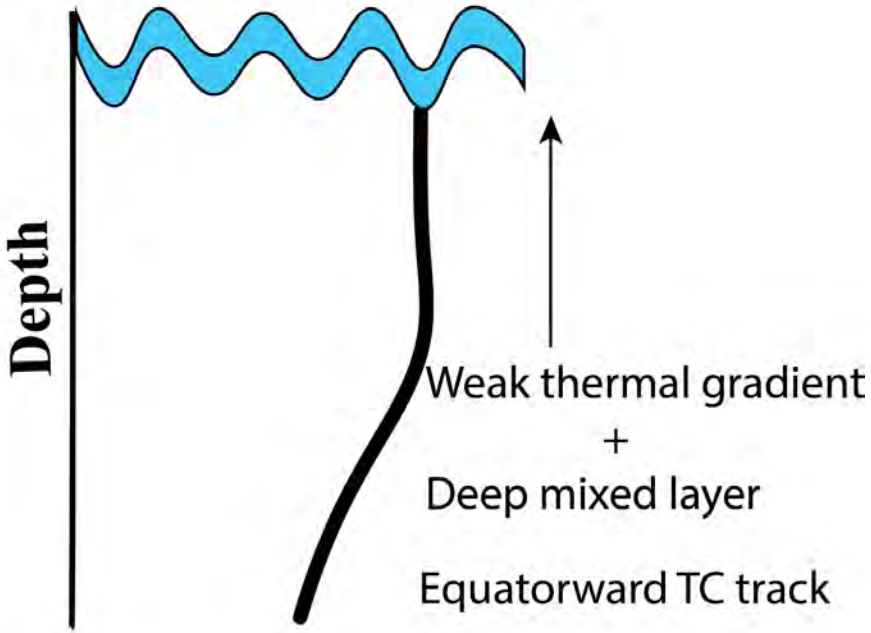
Strong SST cooling ~ -0.65°C



Autumn

Strong cyclones

Weak SST cooling ~ -0.48°c



Singh et al. (2023)

Thank You for listening

Questions are welcome

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RESEARCH ARTICLE

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