Seasonal Predictions of Tropical Cyclones in 2018 using GFDL and NICAM High-Resolution Global Models

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GFDL and JAMSTEC

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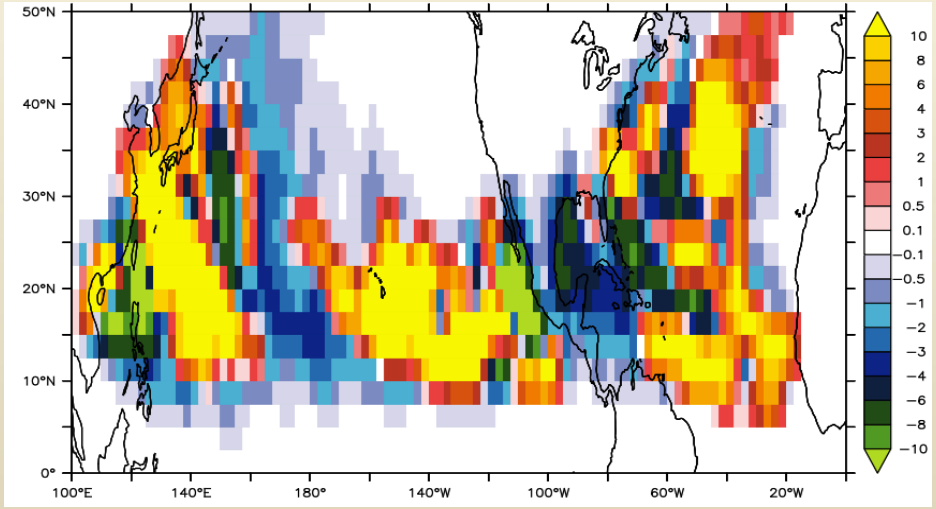
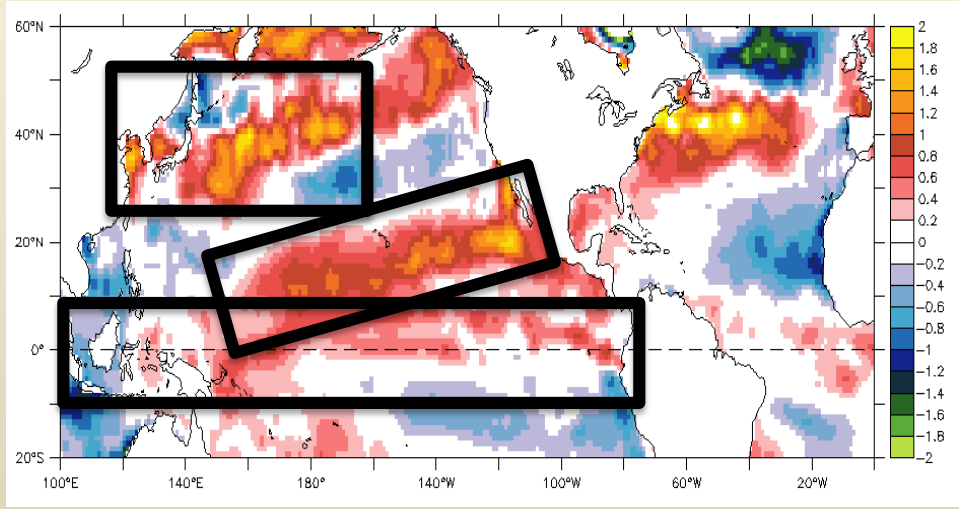
2018 Tropical Cyclone Season

Observed Storm Density Anomaly for 2018 (Jul–Sep)



Observed SST Anomaly for 2018 (Jul–Sep)



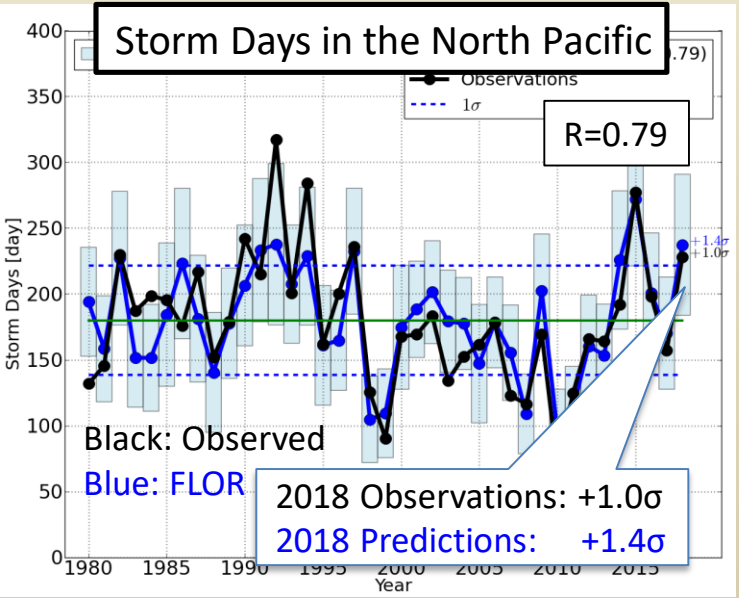
2018 Accumulated Cyclone Energy (ACE) anomaly relative to 1980–2010 mean

- +60% in the Northern Hemisphere
- +27% in the Western North Pacific
- +140% in the Eastern North Pacific

1. El Niño (Central Pacific El Niño) Development
2. Warmer Subtropical Central Pacific (PMM+)
3. Warmer Kuroshio Current Region

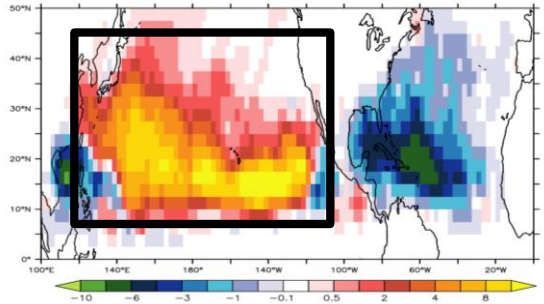
Retrospective Seasonal Forecasts

Model	GFDL-FLOR (50km Atmosphere/Land + 100 km Ocean/Ice)
Prediction Period	1980–2018, 1-year prediction from each month
Initialization	Ocean is initialized, but atmosphere is not initialized
# Ensembles	36 Ensemble Members (perturbed initial conditions)

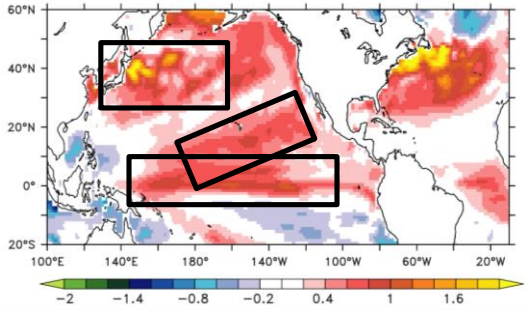


Prediction from 2018 July Initial

Predicted TC Density Anomaly



Predicted SST Anomaly



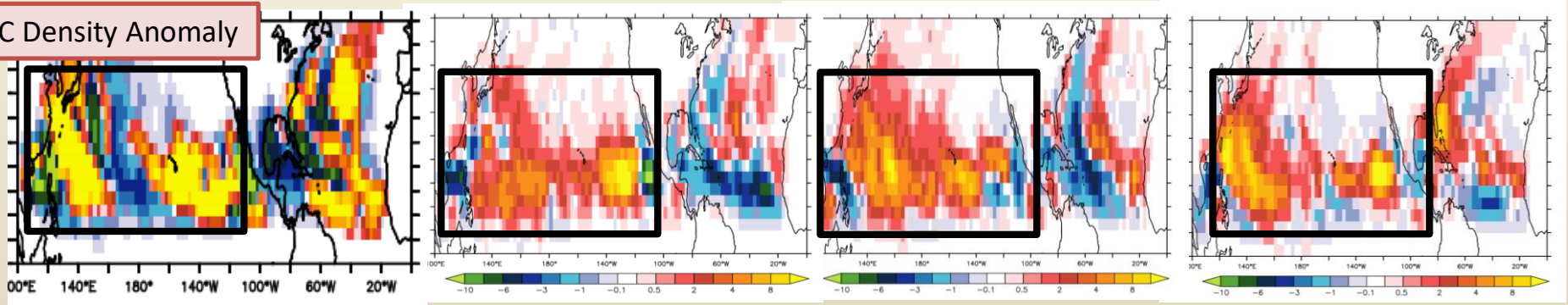
FLOR predicted active 2018 storm season and higher SST in the Pacific Ocean.

Real-time Seasonal Predictions for 2018

Predicted Storm Density Anomaly for **2018 July–November** from different initial months

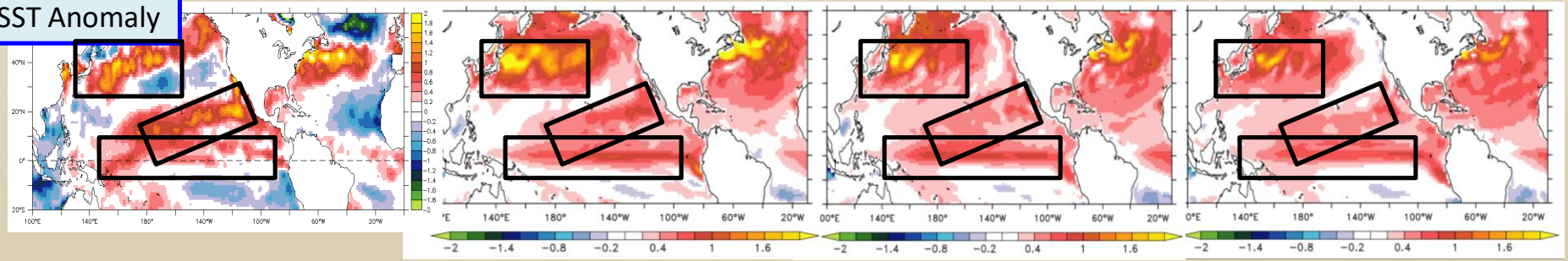
TC Density Anomaly

Observations (July-Sep) | *April* | *March* | *February*



SST Anomaly

Observations (July-Sep) | *April* | *March* | *February*



Active 2018 storm season in the Pacific as well as SST anomaly was well predicted even from Feb 2018.

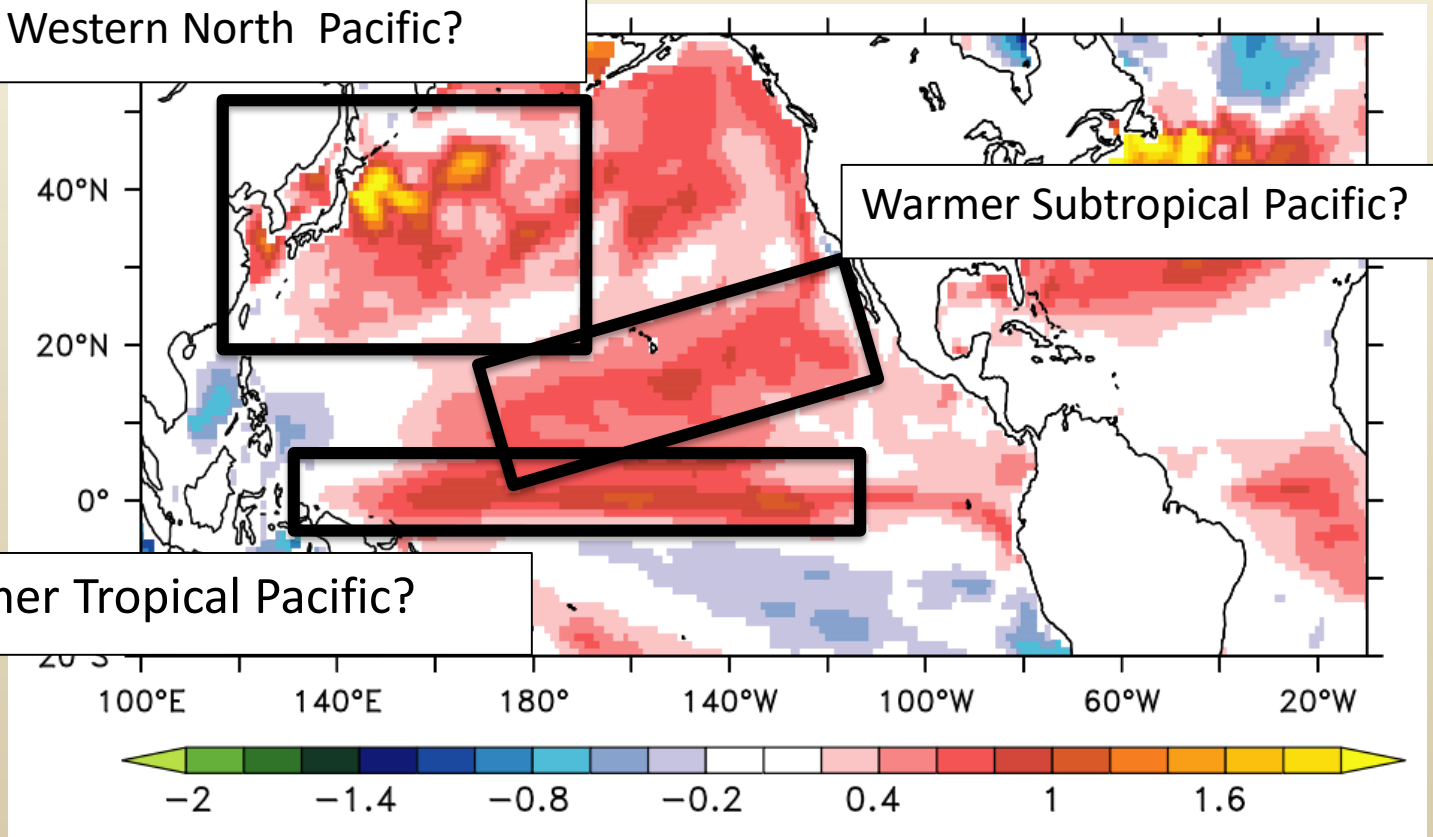
What caused the active storm season in the WNP?

Observed SST Anomaly in 2018

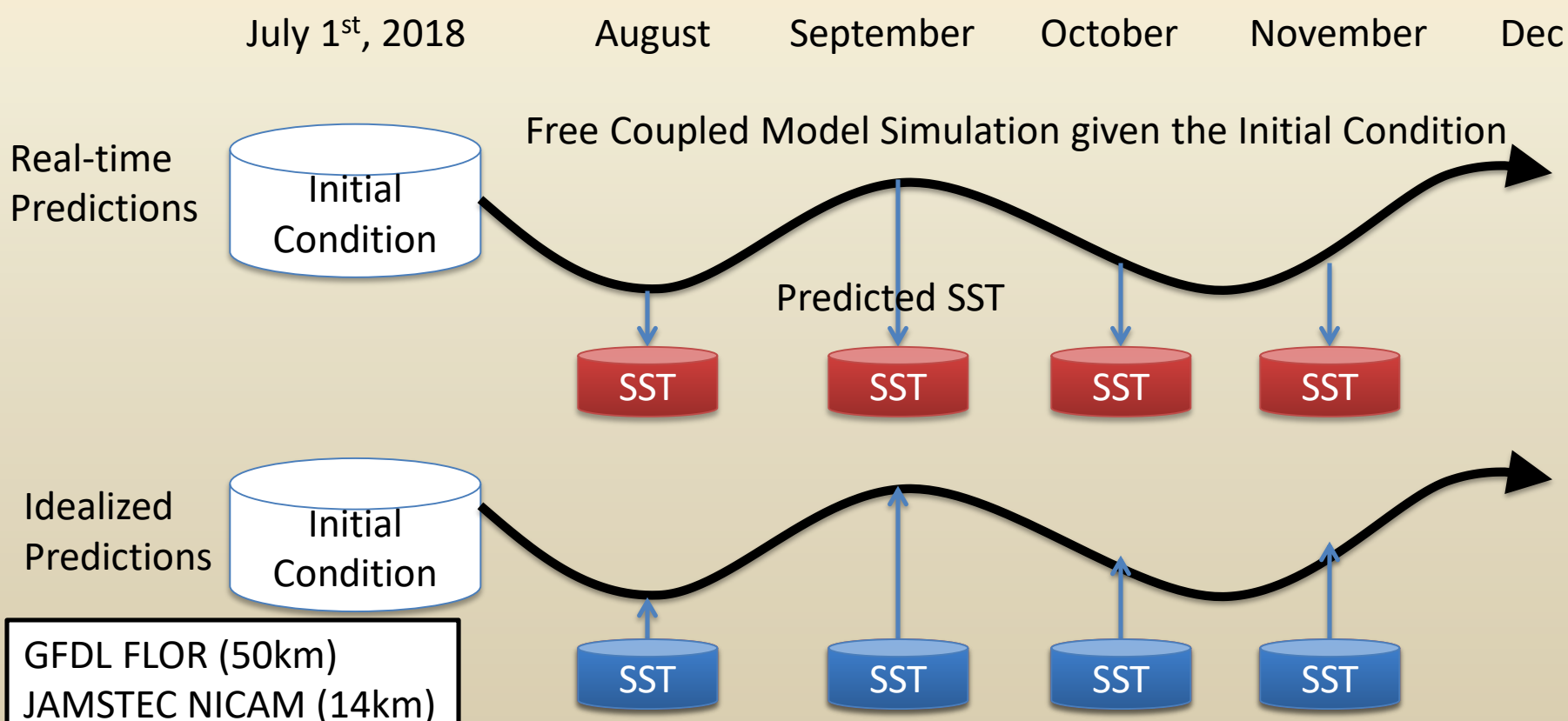
Warmer Western North Pacific?

Warmer Subtropical Pacific?

Warmer Tropical Pacific?



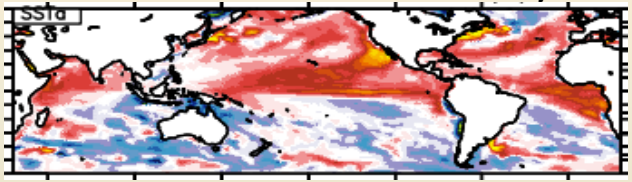
Idealized Seasonal Experiments

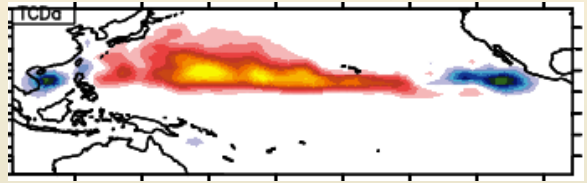


Idealized SST-Prescribed Seasonal Prediction

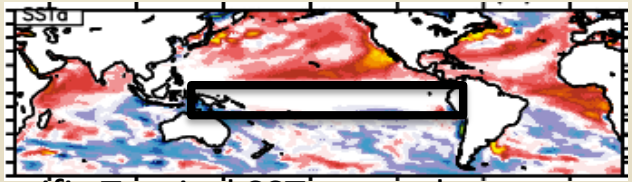
Prescribed SST Anomaly

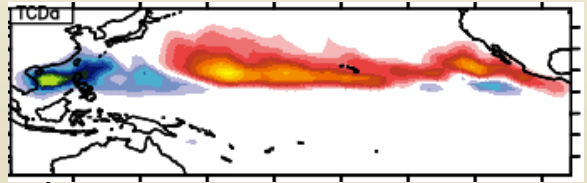
Predicted TC Density Anomaly





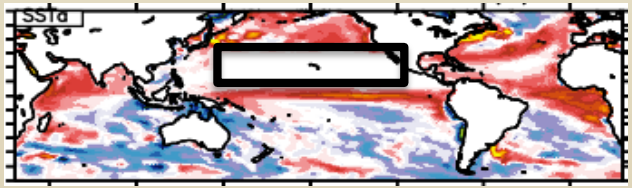
The 2018 active typhoon season in the North Pacific is explained mainly by the SST anomaly over the subtropical Pacific.

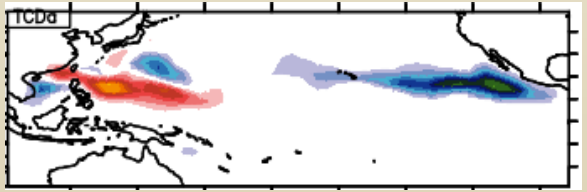




Moderate El Niño ✗

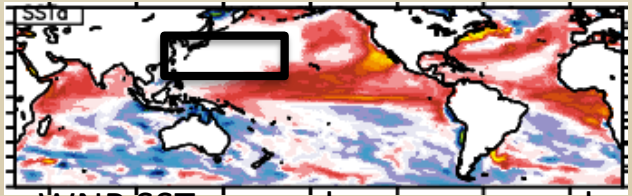
Pacific Tropical SST anomaly was removed.

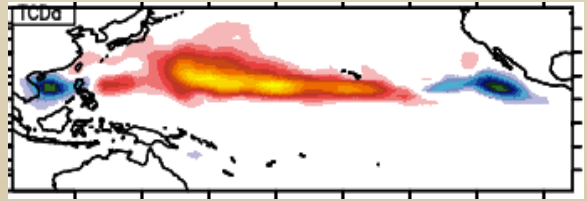




Warmer Subtropical Pacific ✓

Subtropical SST anomaly was removed.

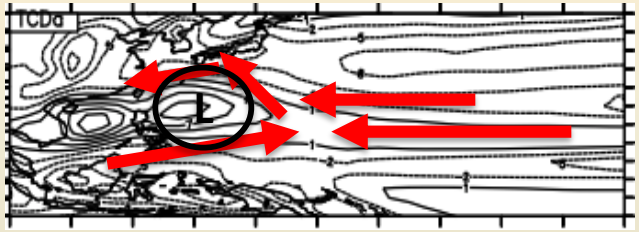




Warmer W.N. Pacific ✗

WNP SST anomaly was removed.

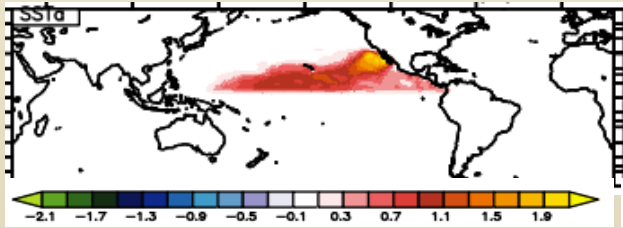
Eastward Shift in Monsoon Trough

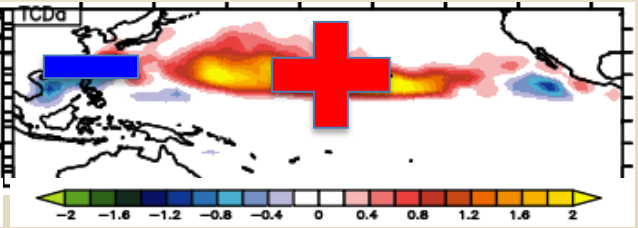


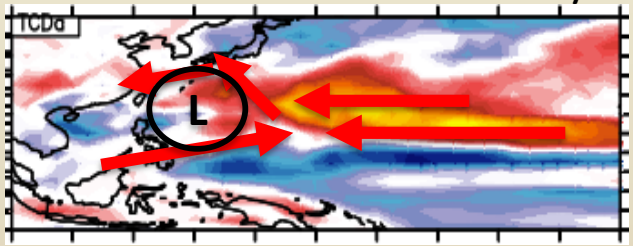
Prescribed SST Anomaly

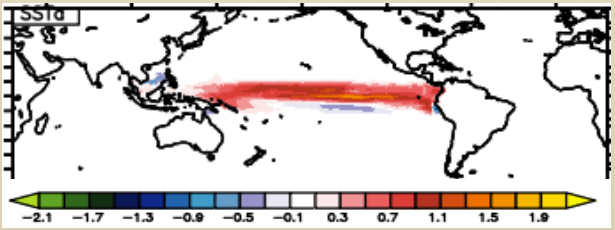
Predicted TC Density Anomaly

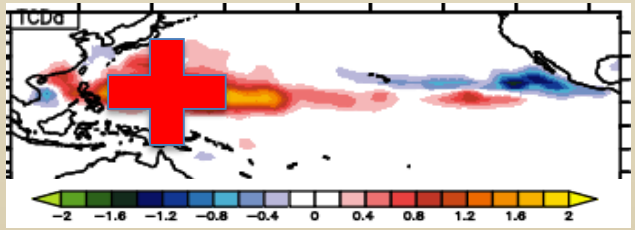
Predicted Vort 850 Anomaly







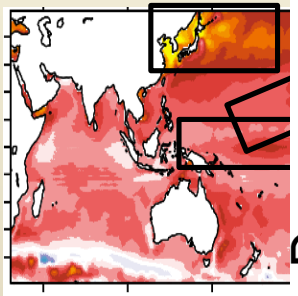




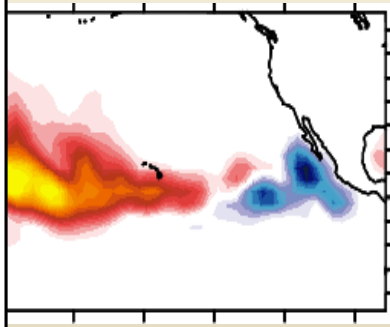
A Similar 2018 Summer in the End of 21st Century

RCP4.5

(2080-2099 m

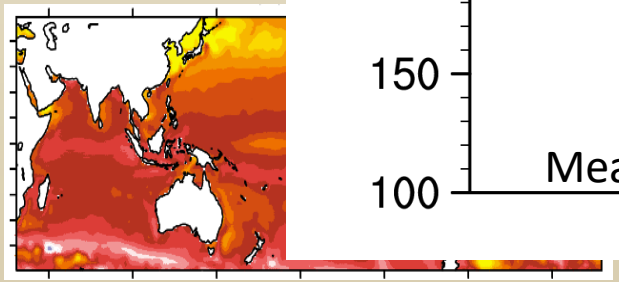


TC Density Change

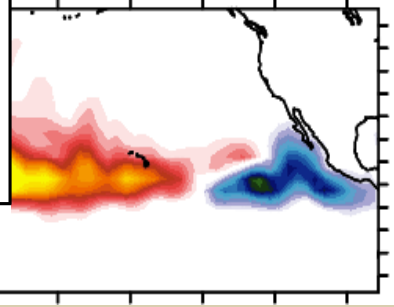


RCP8.5

(2080-2099 m



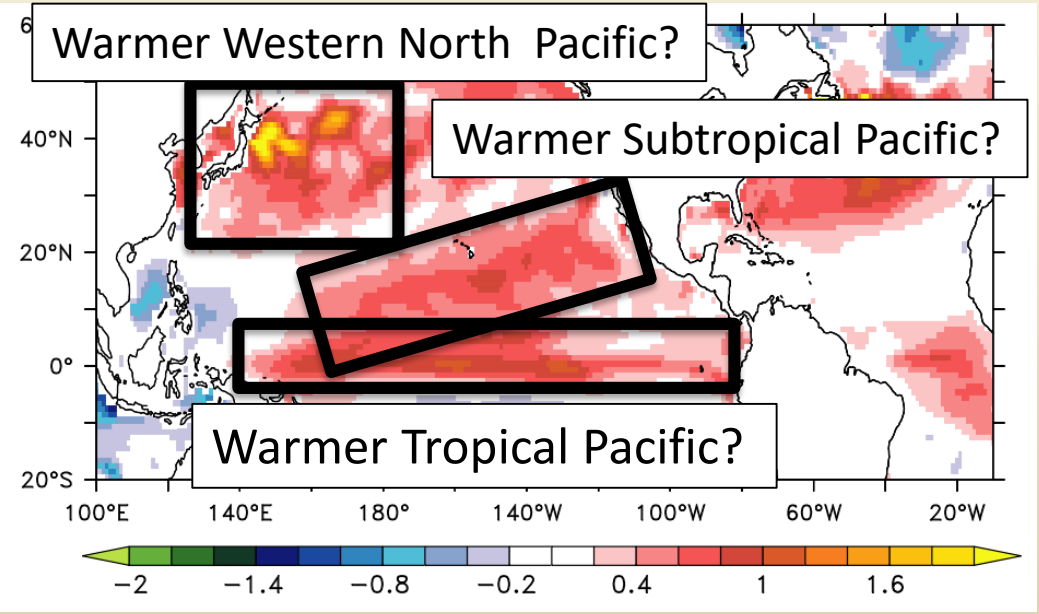
TC Density Change



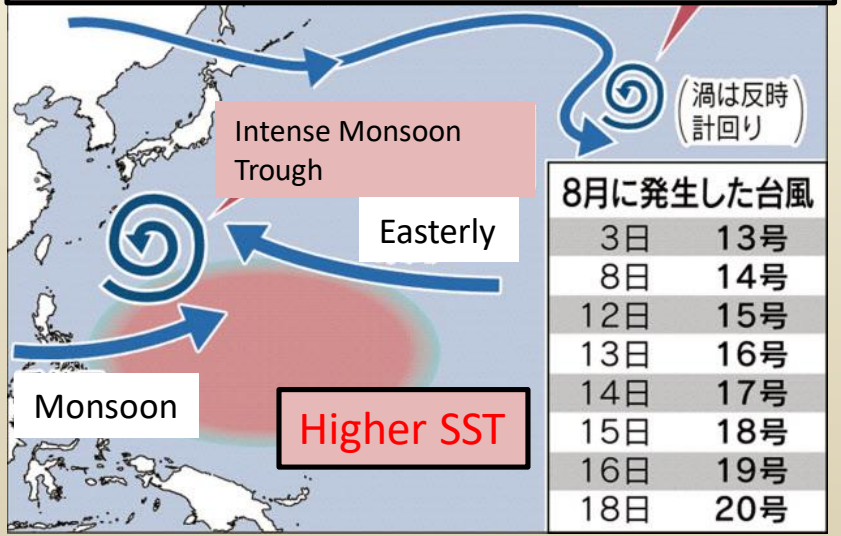
Summary

- Seasonal prediction model (GFDL-FLOR) has skill in predicting storm activity in the North Pacific (r=0.8).
- GFDL-FLOR predicted 2018 active storm season even from the February 2018 initial forecasts.
- Subtropical Pacific SST anomaly associated with positive PMM is a primary reason for the active storm season in the North Pacific.
- In the future, TC could be more active in the North Pacific, amplifying the risk of TC damage.

What caused the active storm season in the WNP?



A report issued by JMA on the active typhoon season in 2018



JMA attributes this active typhoons to

1. Higher SST in the Western North Pacific
2. Intense Monsoon Trough