

Real-time Seasonal Prediction of Tropical Cyclones in 2018 using GFDL High-Resolution Global Coupled Model

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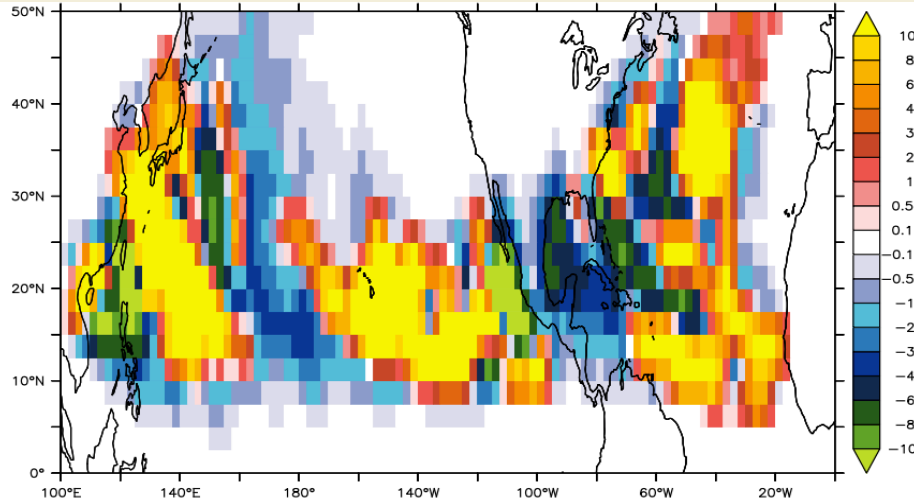
GFDL/UCAR

AGU Fall Meeting, A53E-02
December 14, 2018

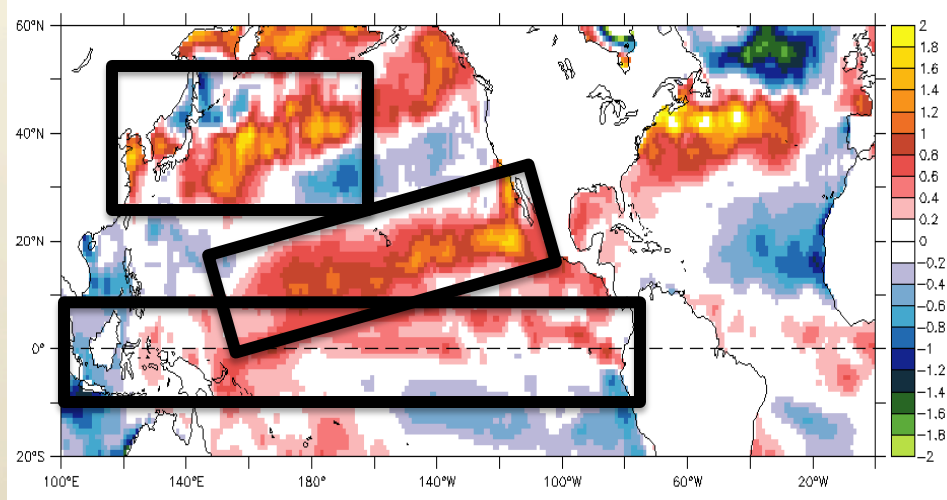


2018 Tropical Cyclone Season

Observed Storm Density Anomaly for 2018 (Jul–Sep)



Observed SST Anomaly for 2018 (Jul–Sep)



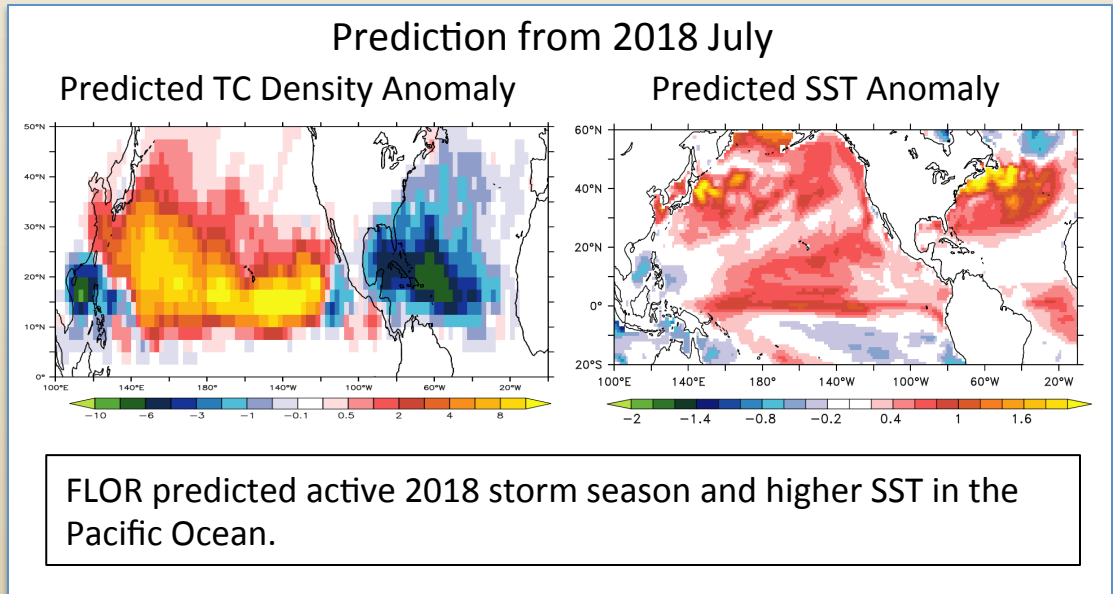
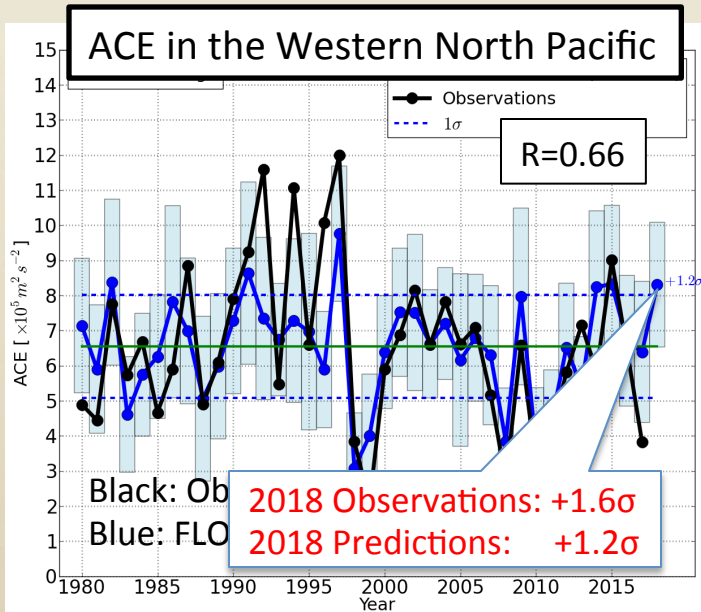
2018 Accumulated Cyclone Energy (ACE)
anomaly relative to 1980–2010 mean

- +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 Kuroshio Current Region
3. Warmer Subtropical Central Pacific (PMM+)

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)



Real-time Seasonal Predictions for 2018

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

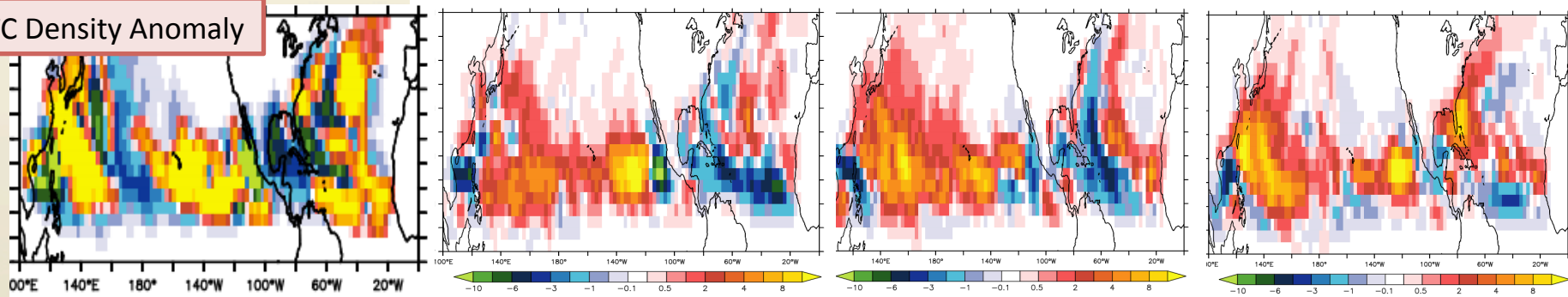
Observations (July-Sep)

April

March

February

TC Density Anomaly



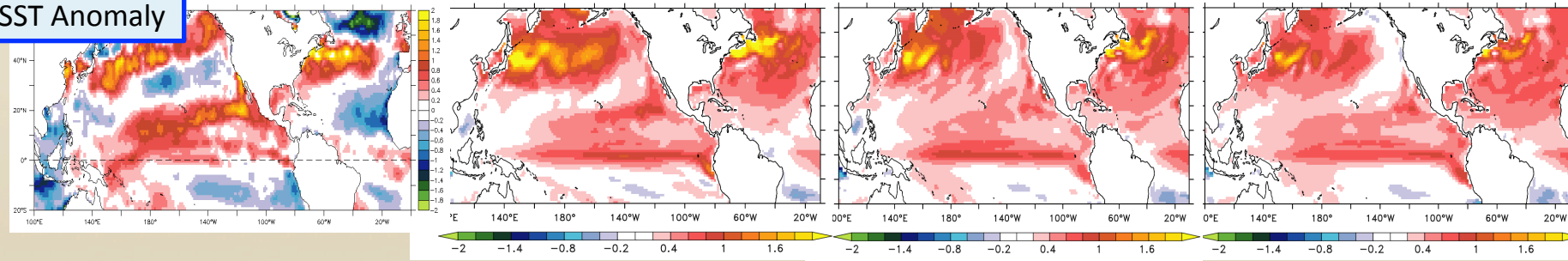
Observations (July-Sep)

April

March

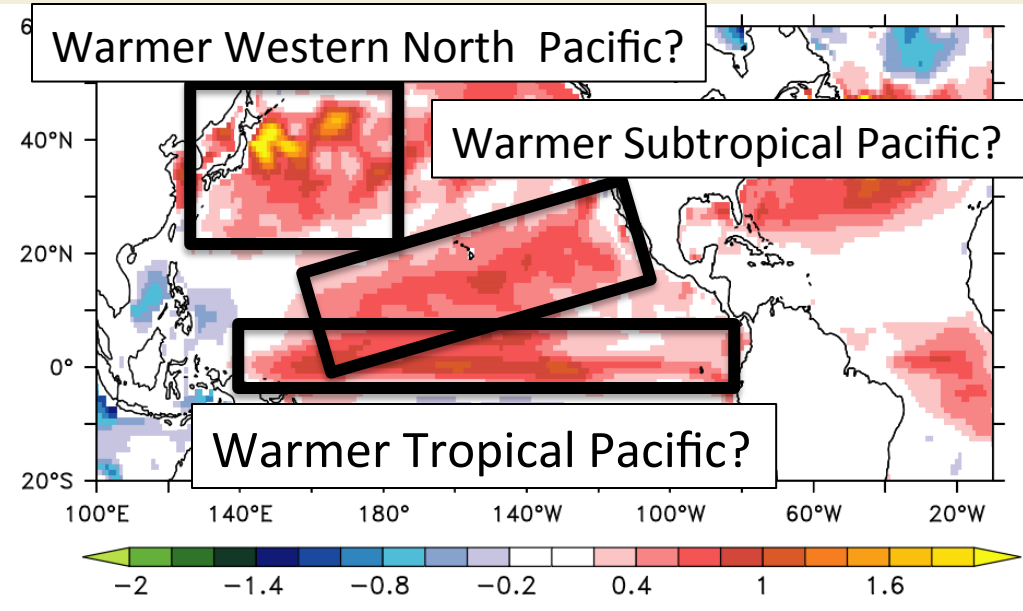
February

SST Anomaly

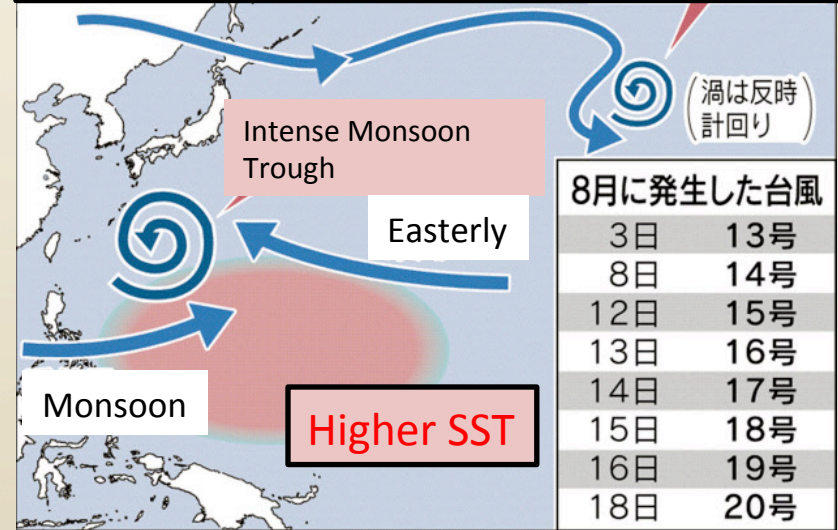


Active 2018 storm season in the Pacific as well as SST anomaly was well predicted even from Feb 2018.

What caused the active storm season in the WNP?



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

Idealized Seasonal Experiments

July 1st, 2018

August

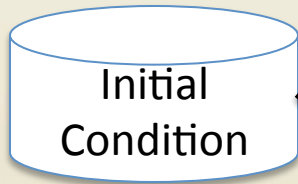
September

October

November

Dec

Real-time
Predictions



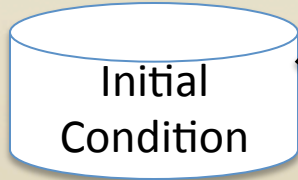
Free Coupled Model Simulation given the Initial Condition



Predicted SST



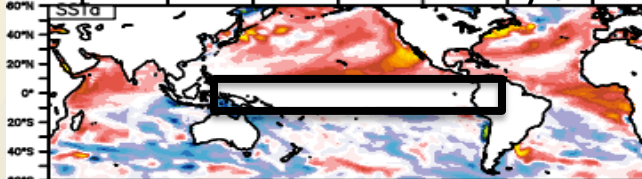
Idealized
Predictions



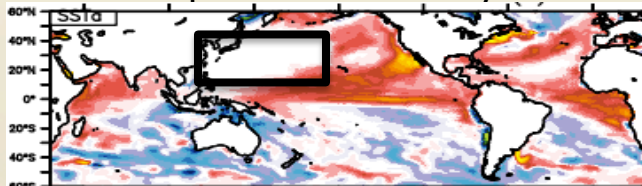
SST is the primary driver to the impact of regional SST

Idealized SST-Prescribed Seasonal Prediction

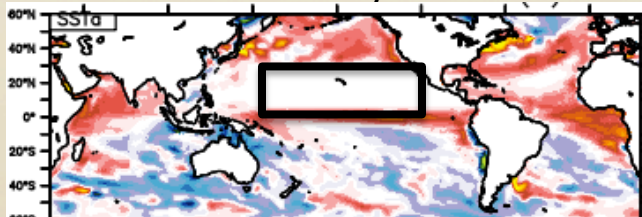
Prescribed SST Anomaly



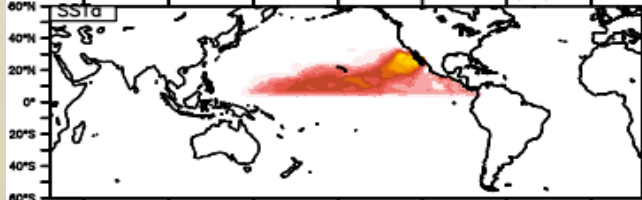
Pacific Tropical SST anomaly was removed.



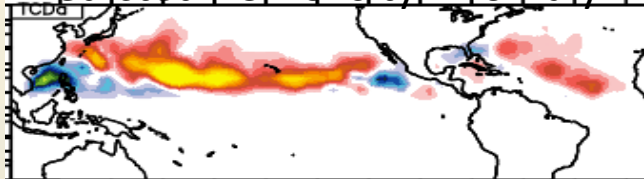
WNP SST anomaly was removed.



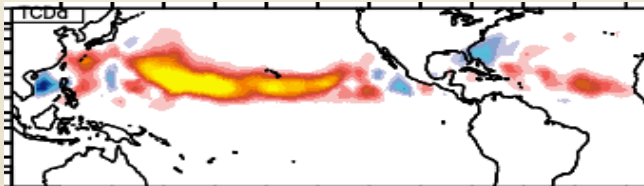
Subtropical SST anomaly was removed.



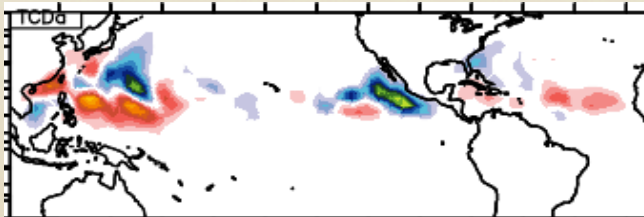
Predicted TC Density Anomaly



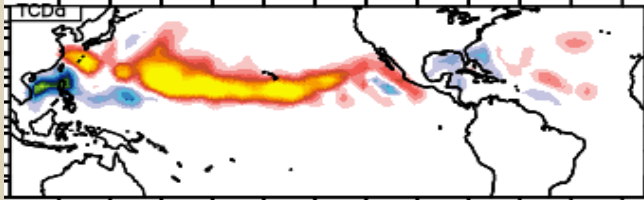
TCs are still active



TCs are still active



TCs become less active



Moderate El Niño



Warmer W.N. Pacific

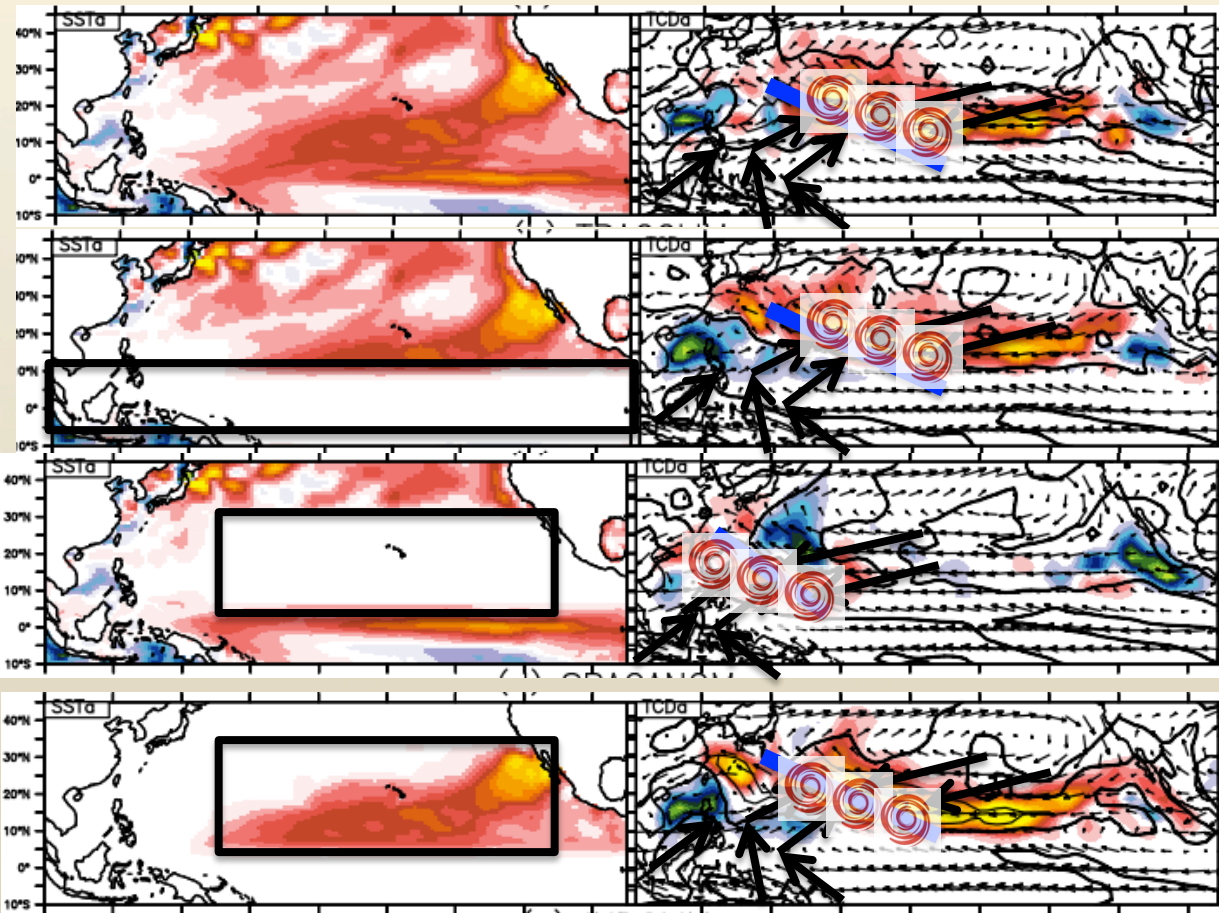


Warmer Subtropical Pacific



SST anomaly over the subtropical Pacific is only important for this active typhoon season in the Pacific

Eastward Shift in Monsoon Trough



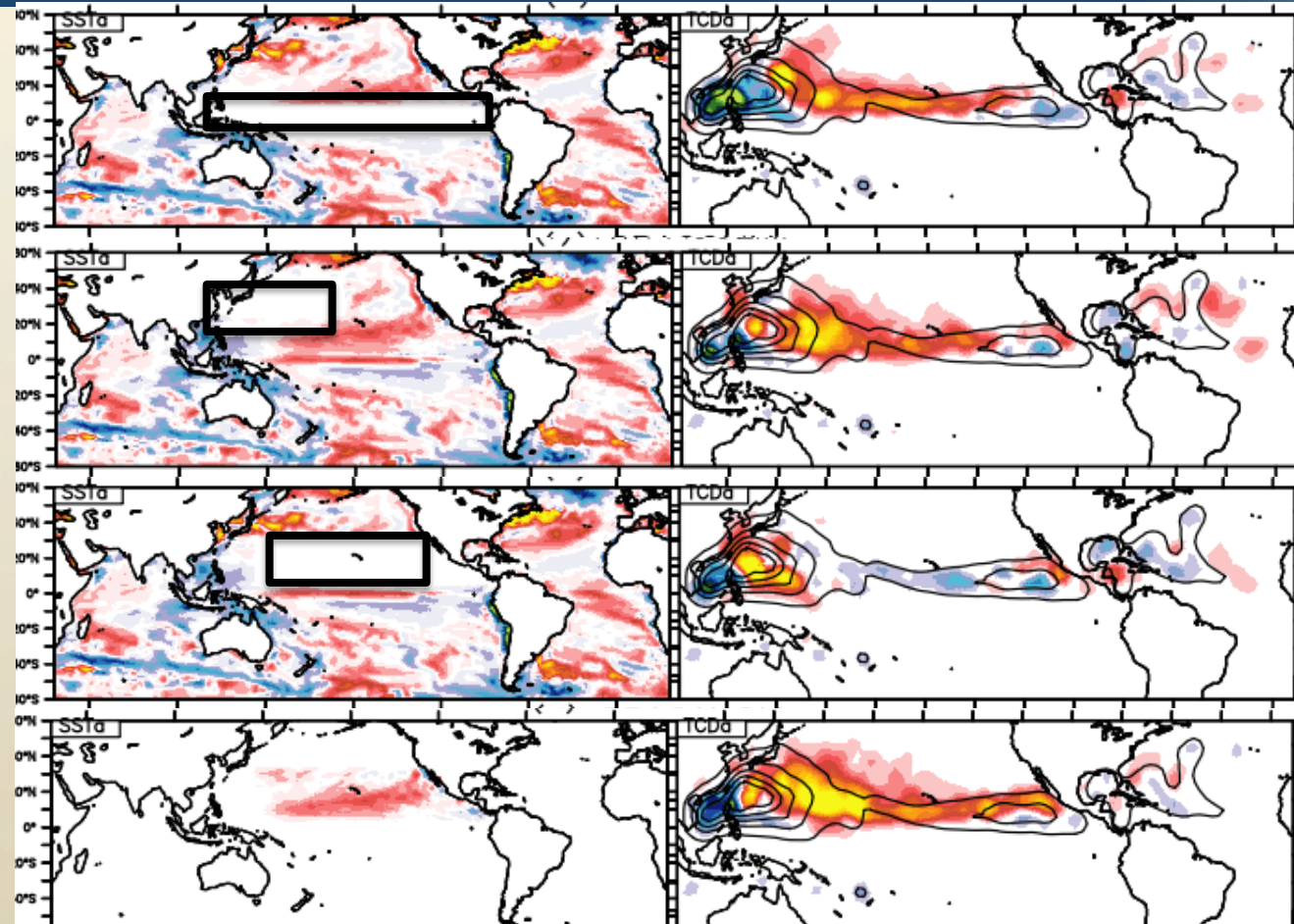
For the 2018 conditions, monsoon trough is located eastern portion of western North Pacific.

Removing tropical SSTA does not alter above results.

Removing central Pacific SSTA causes westward shift of monsoon trough.

Just central Pacific SSTA can reproduce the 2018 conditions (top panel).

Model Dependency I (HiFLOr)



The same experiments using HiFLOr (25-km mesh Atmosphere and 1 degree ocean) results in the same results.

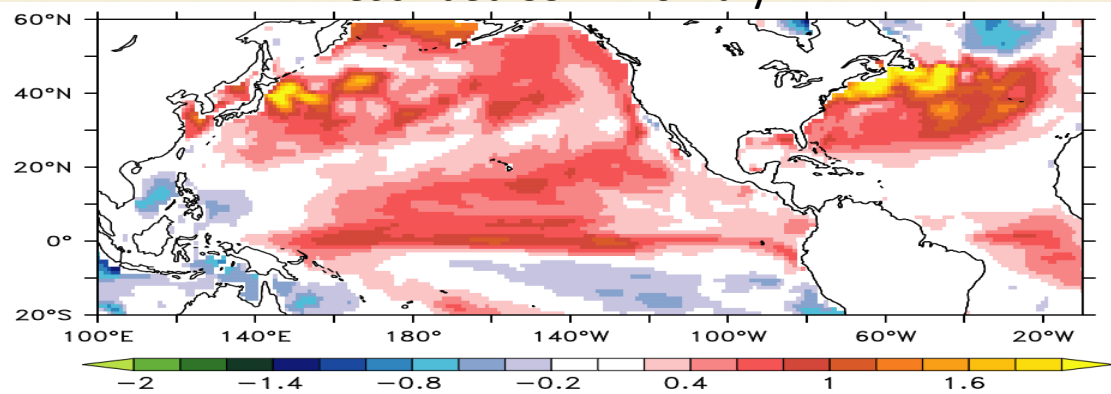
Model Dependency II (NICAM Model)

We try to address if the results from idealized experiments are dependent on dynamical model.

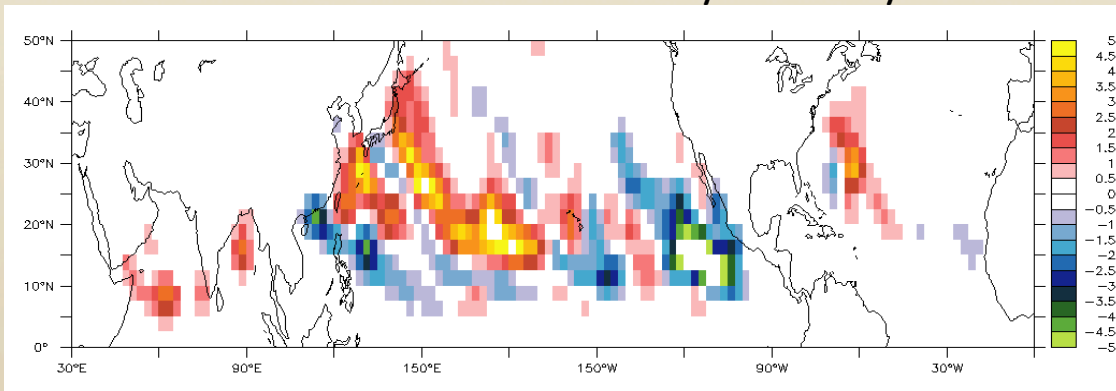
GFDL collaborates with JAMSTEC in Japan. We plan to do the same Idealized experiments using NICAM (Nonhydrostatic Icosahedral Atmospheric Model, 14 km)

Preliminary experiment shows active typhoons in the WNP using 2018 anomaly by NICAM

Prescribed SST Anomaly



Predicted TC Density Anomaly



Summary

- Seasonal prediction model (GFDL-FLOR) has skill ($r=0.7$) in predicting storm activity in the Pacific.
- GFDL-FLOR predicted 2018 active storm season even from the February 2018 initial forecasts.
- Subtropical Pacific SST anomaly associated with positive PMM is a key for the active storm season in the western North Pacific.