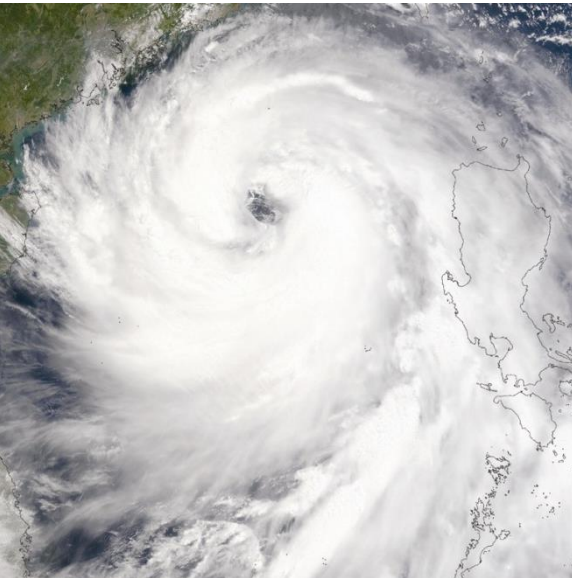




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Dynamical Seasonal Forecasting of Typhoon Landfall Activity

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Outline

- Model description
- Model climatology and interannual variability and hindcasts
- Forecasts and verification for 2014 and 2015
- Predicting seasonal landfall intensity
- Summary

The model

- Modified version of Regional Climate Model Version 3 (RegCM3) developed at ITCP
- Horizontal resolution: 60 km
- Modified Emanuel cumulus scheme
- Domain: 94°E-172°W, 14°S-41°N
- 8 ensemble members with initial conditions separated by 6 hours

The model

- Initial and boundary conditions:
 - NCEP CFS reanalysis (climatology study)
 - NCEP CFS hindcasts (prediction study)
 - NCEP CFS predictions (actual forecast)

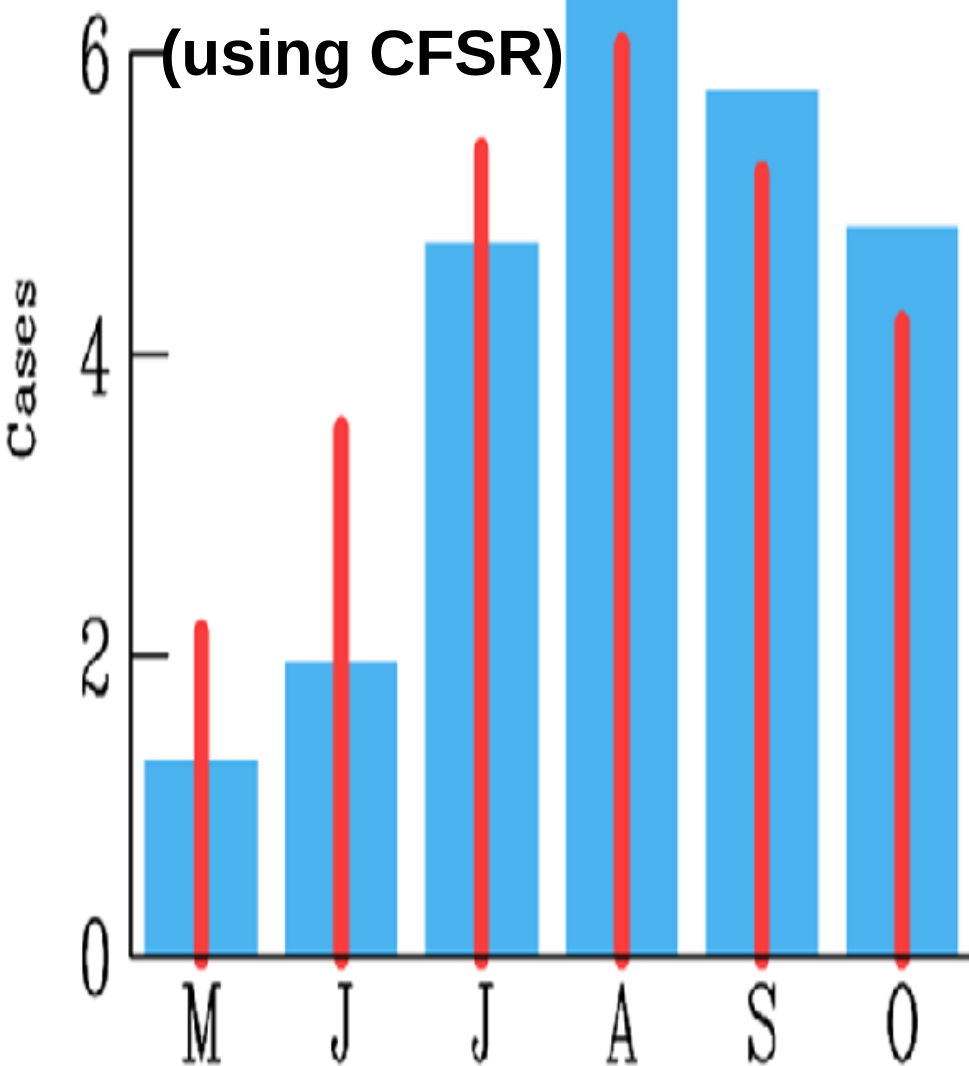
Detection of a tropical cyclone

- Local maximum $\zeta_{850\text{hPa}} \geq 1 \times 10^{-4} \text{ s}^{-1}$
- $T_{300\text{hPa}}$ at centre – $T_{\text{environment}} \geq 1^\circ\text{C}$, where $T_{\text{environment}}$ is the average temperature within 15° latitude radius from the TC centre
- lifetime ≥ 2 days
- Genesis over the ocean

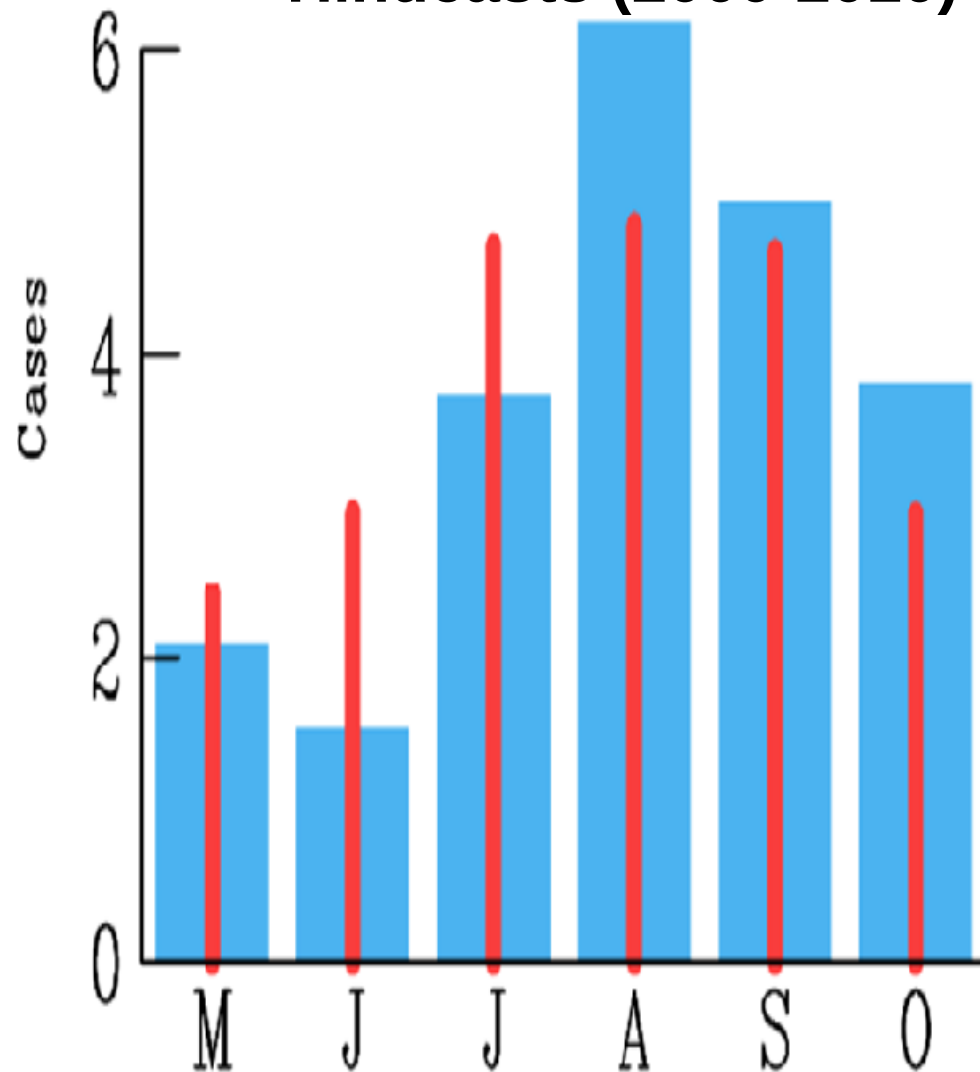
Monthly Distribution

JTWC
model

1982-2001
(using CFSR)

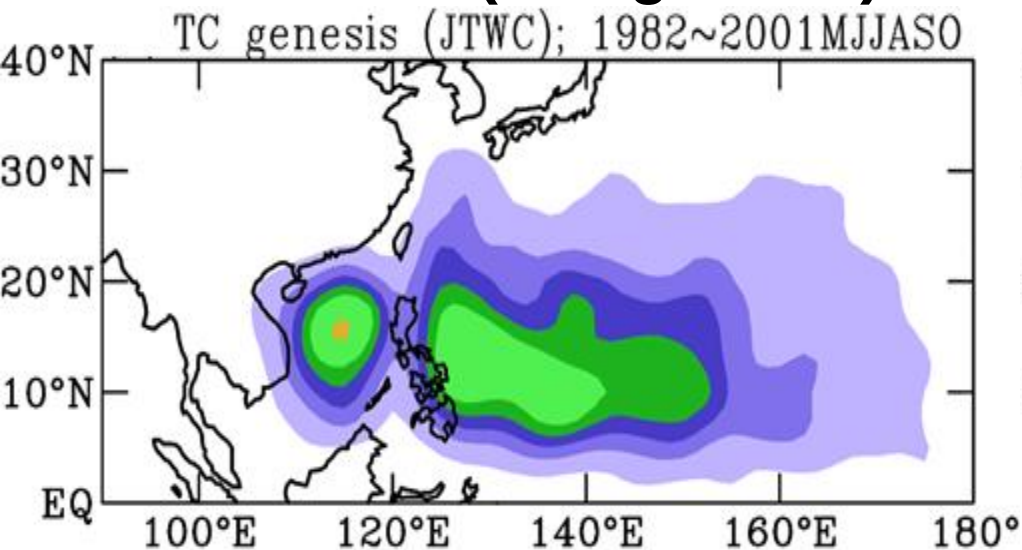


Hindcasts (2000-2010)

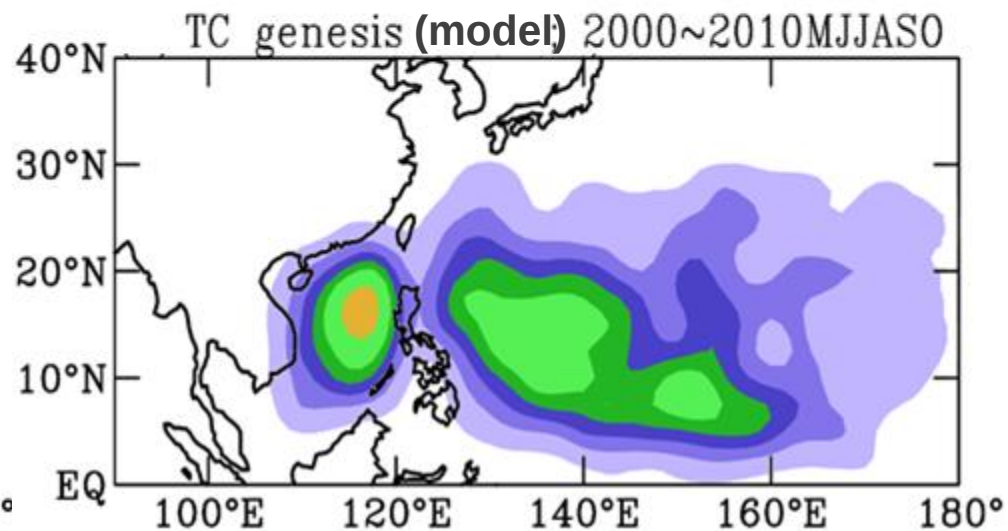
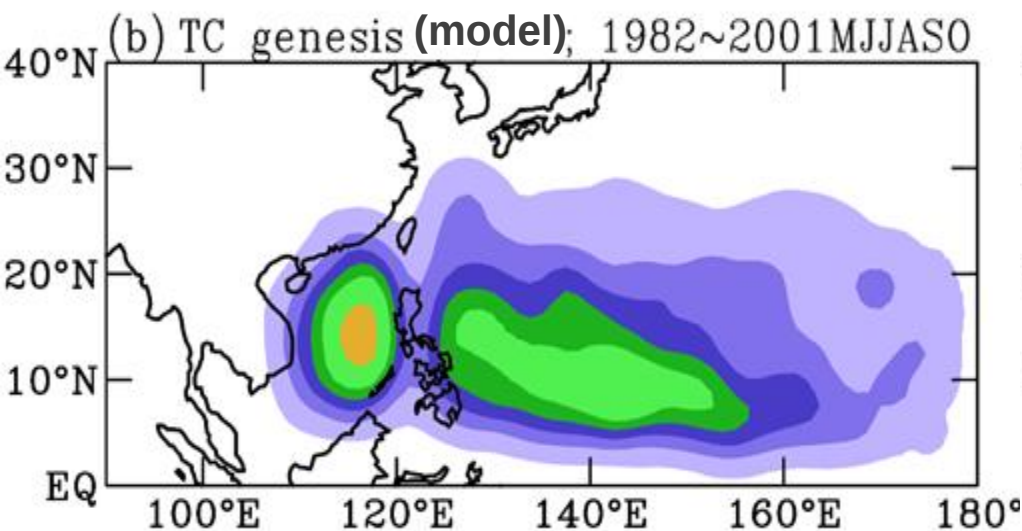
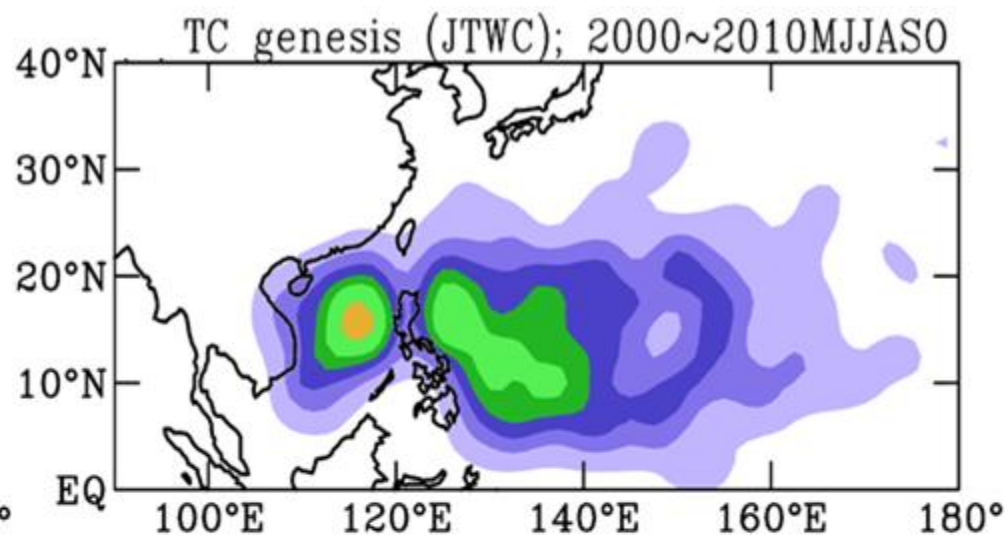


Spatial distribution

1982-2001 (using CFSR)

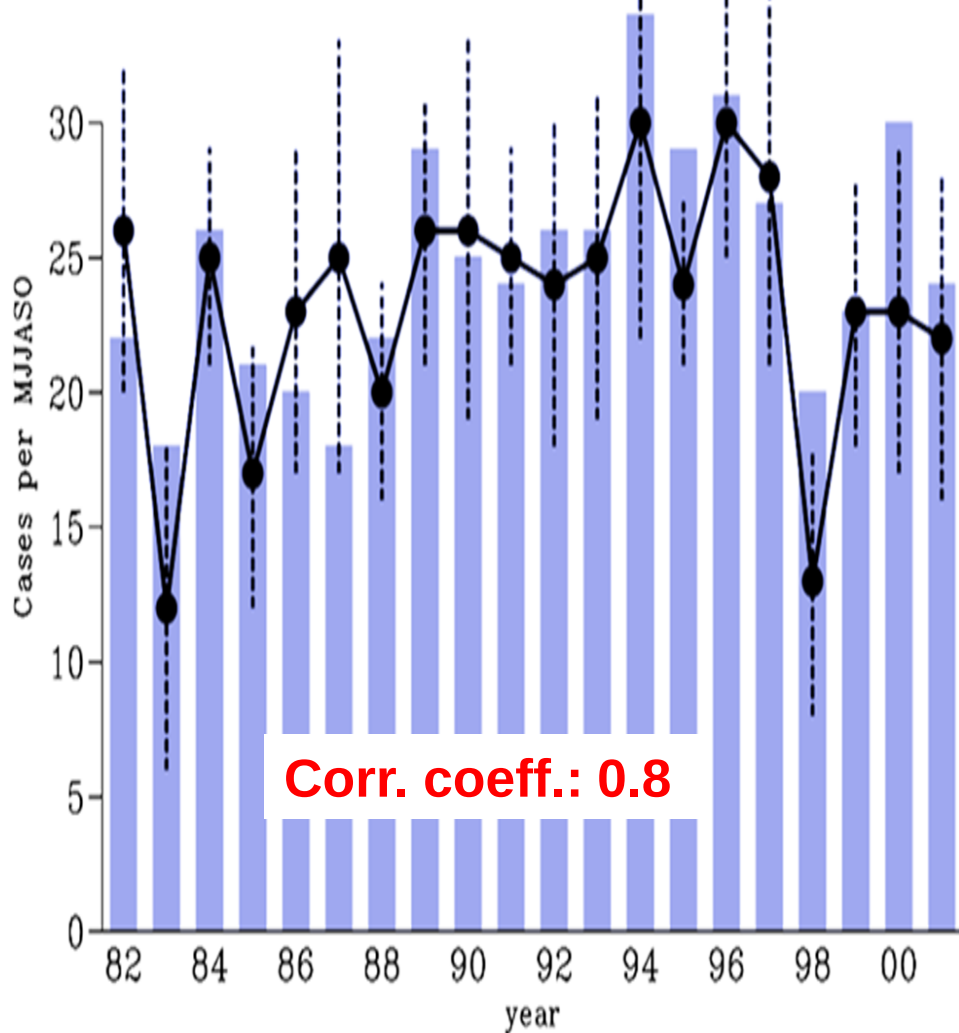


Hindcasts (2000-2010)

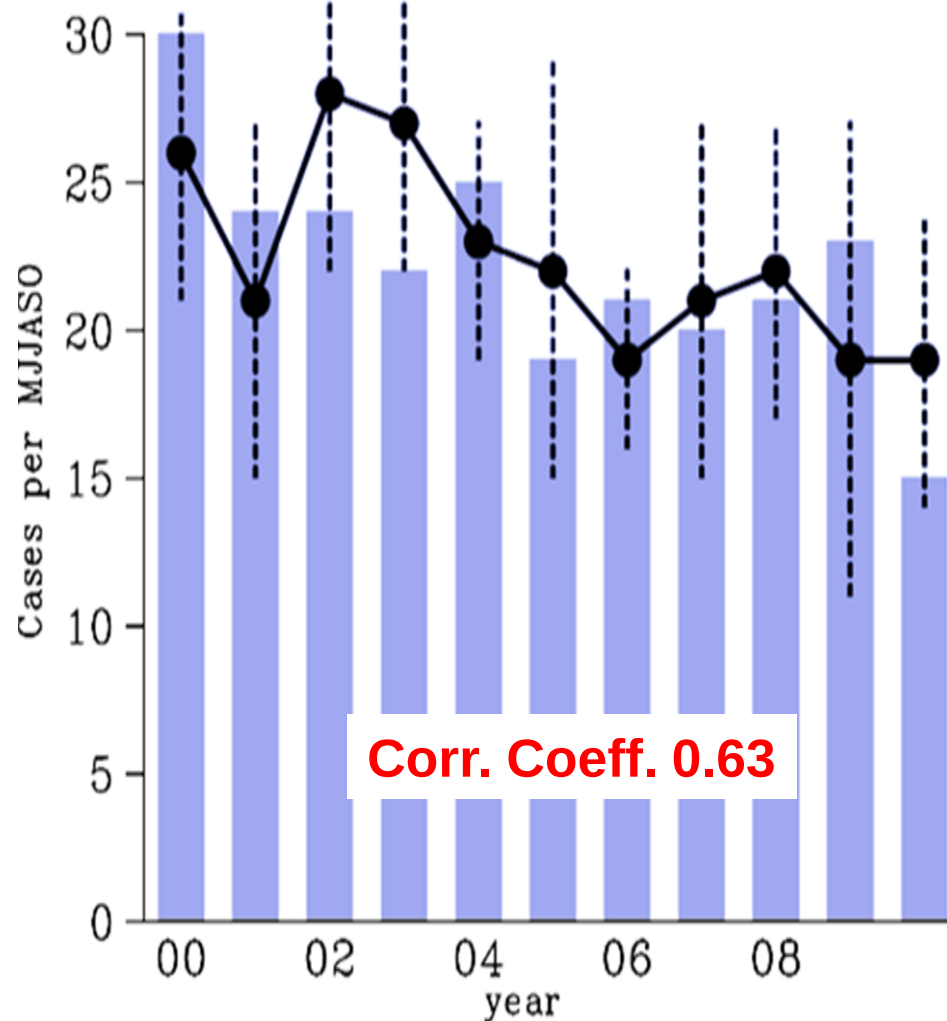


Interannual Variability

1982-2001 (using CFSR)



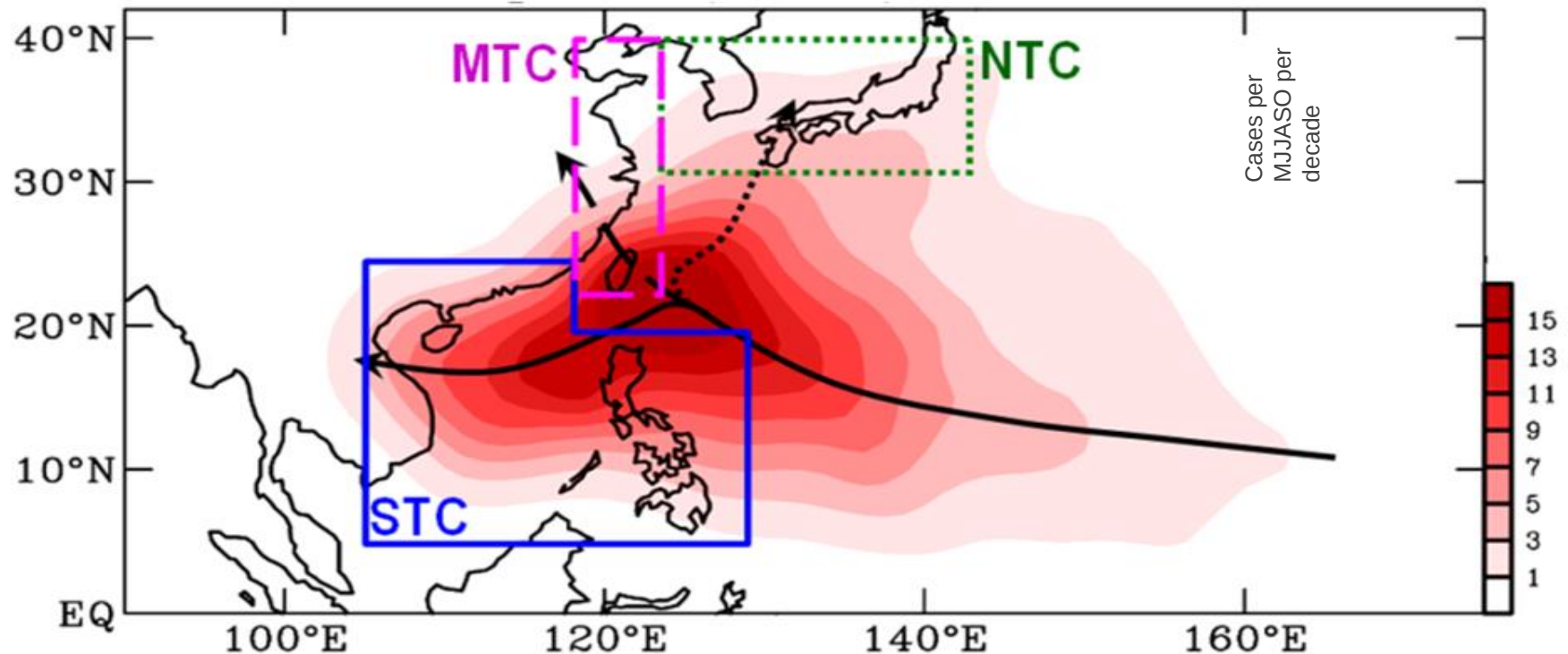
Hindcasts (2000-2010)



TC Landfall

Chan and Xu (2009)

(a) Climatology of percentage of TC occurrence



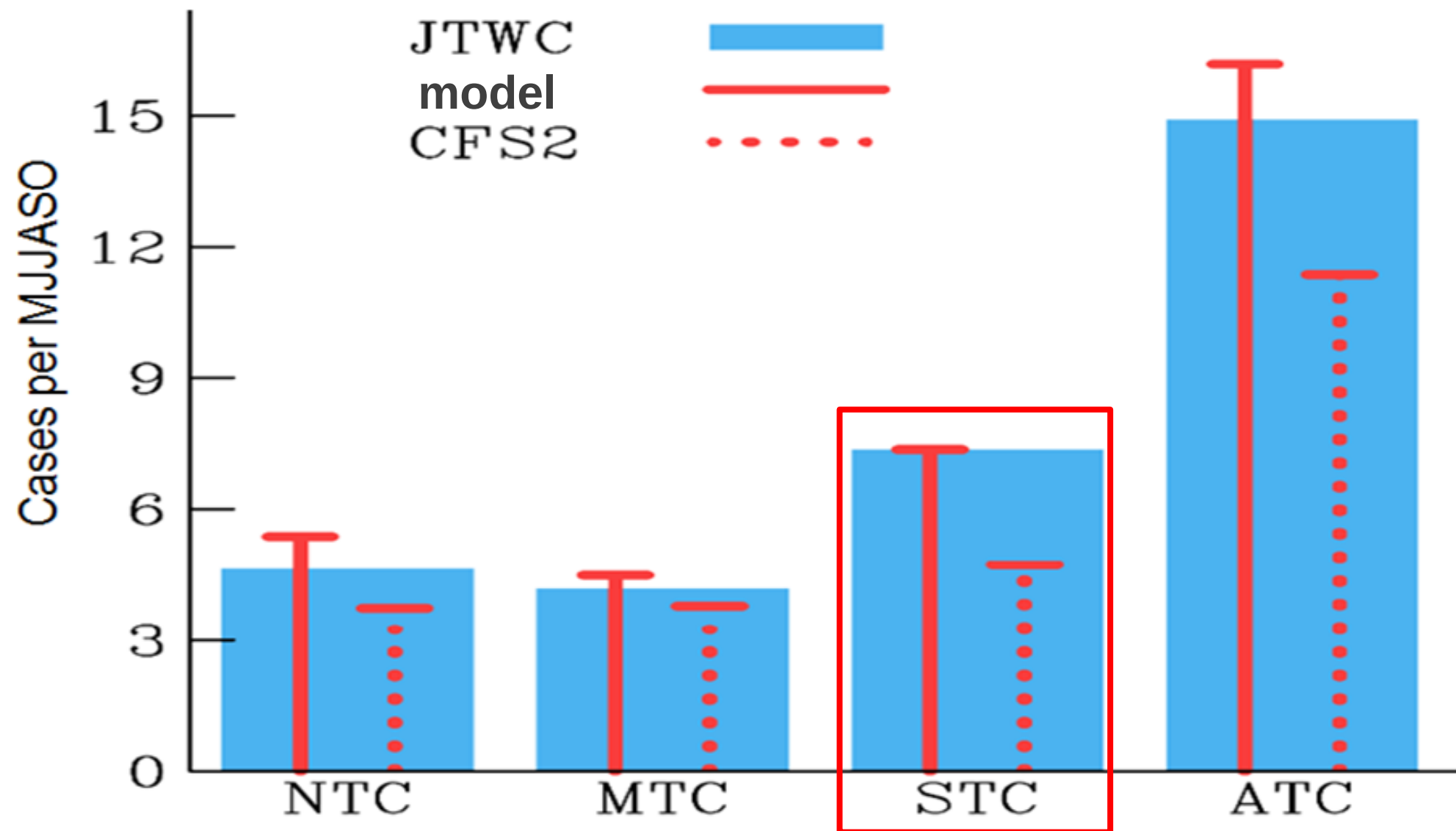
South TCs (STC) – TC landfall in South China, Vietnam and the Philippines

Middle TCs (MTC) – TC landfall in East China

North TCs (NTC) – TC landfall in the Korean peninsula and Japan

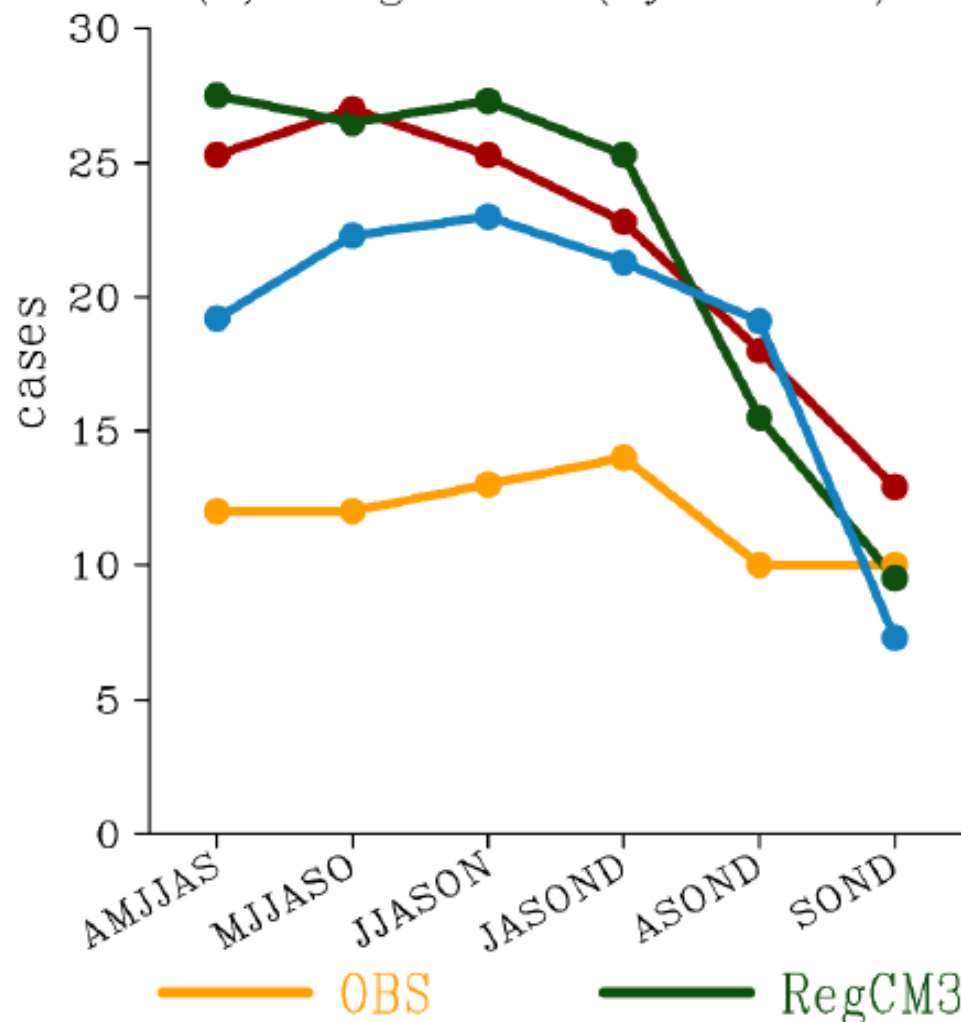
All TC (ATC) – the total number of landfalling TCs in Asia

Hindcasts of TC Landfall (2000-2010)

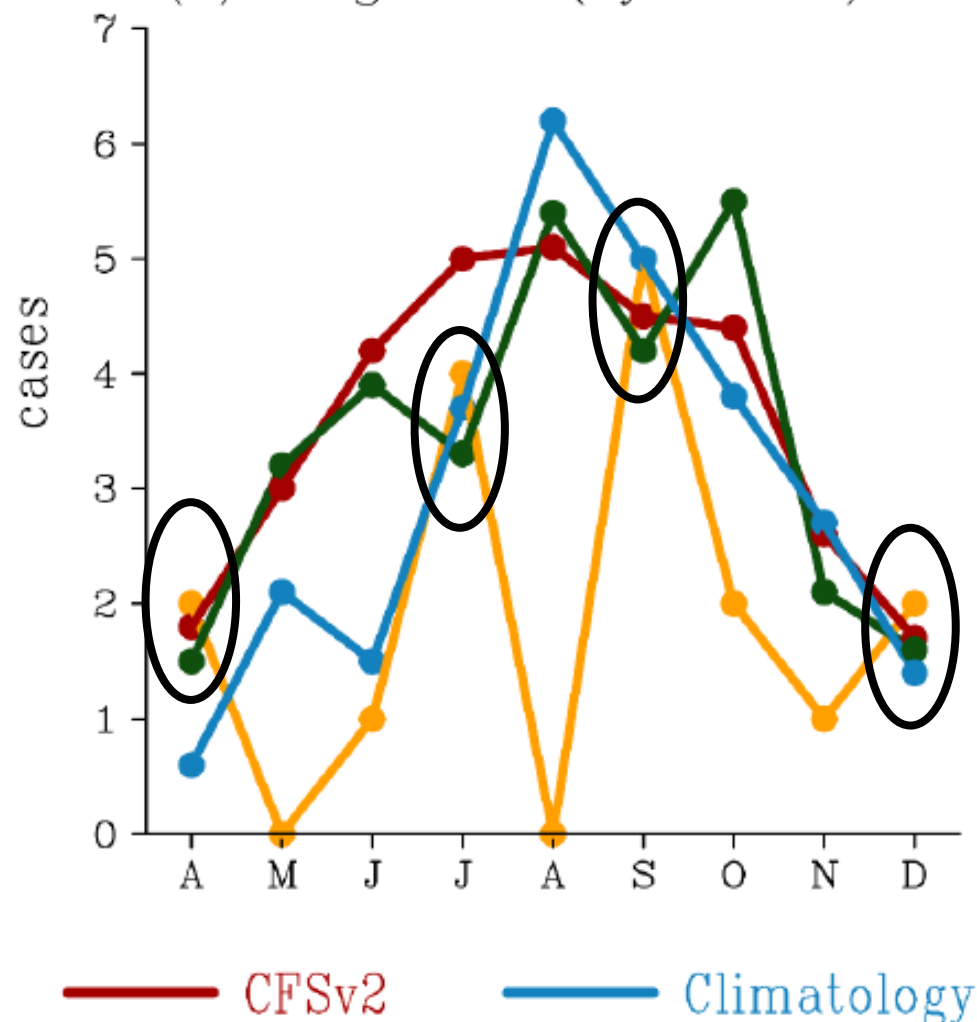


2014 Forecasts and Verification

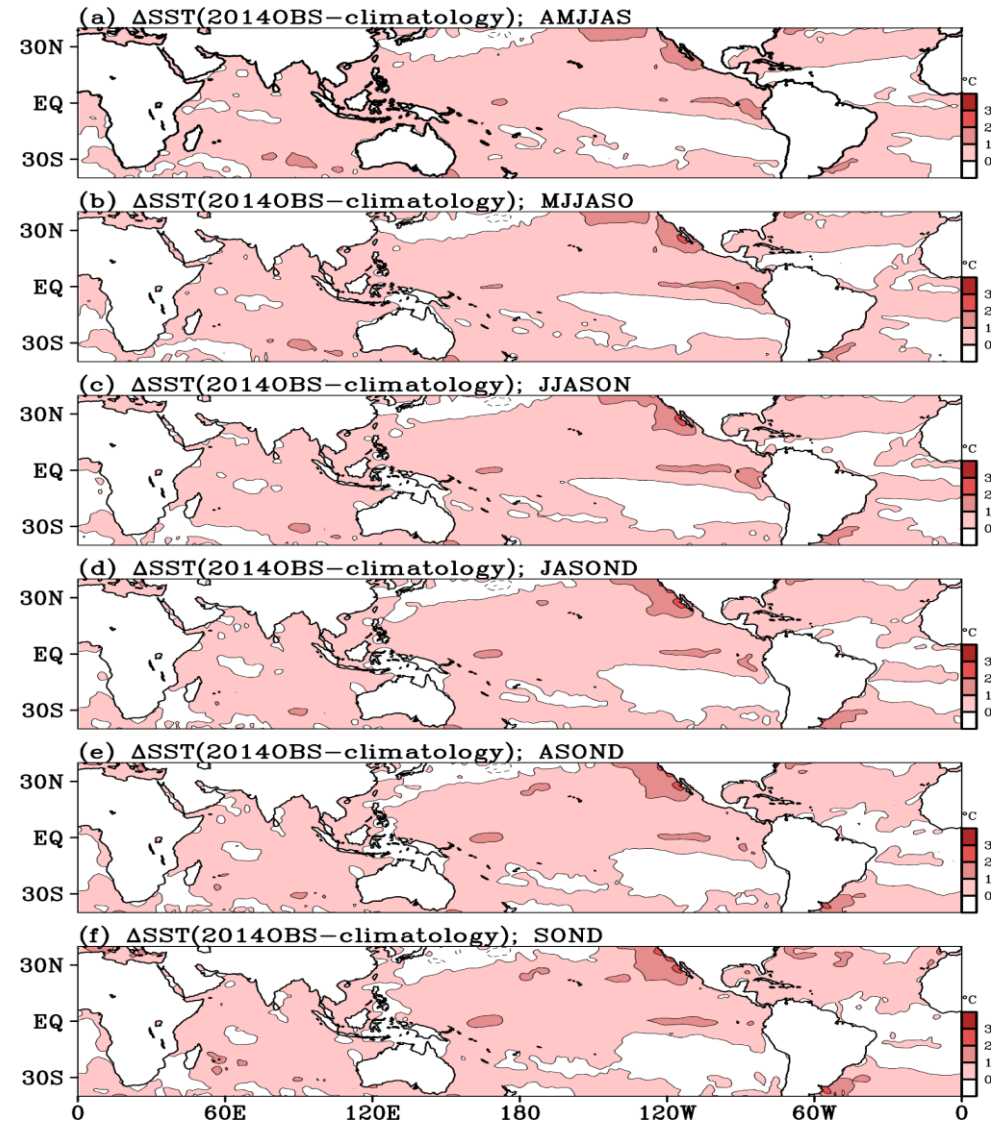
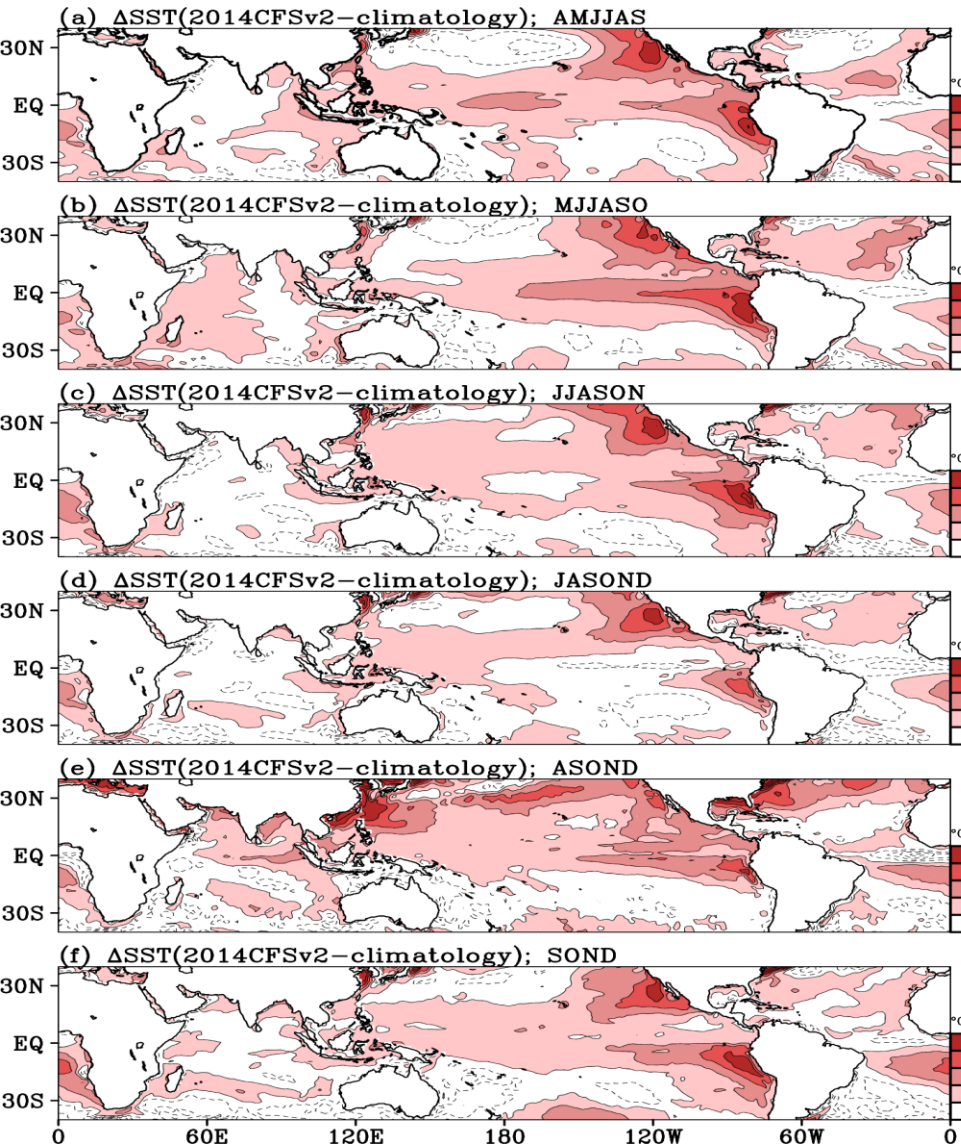
(a) TC genesis (by season)



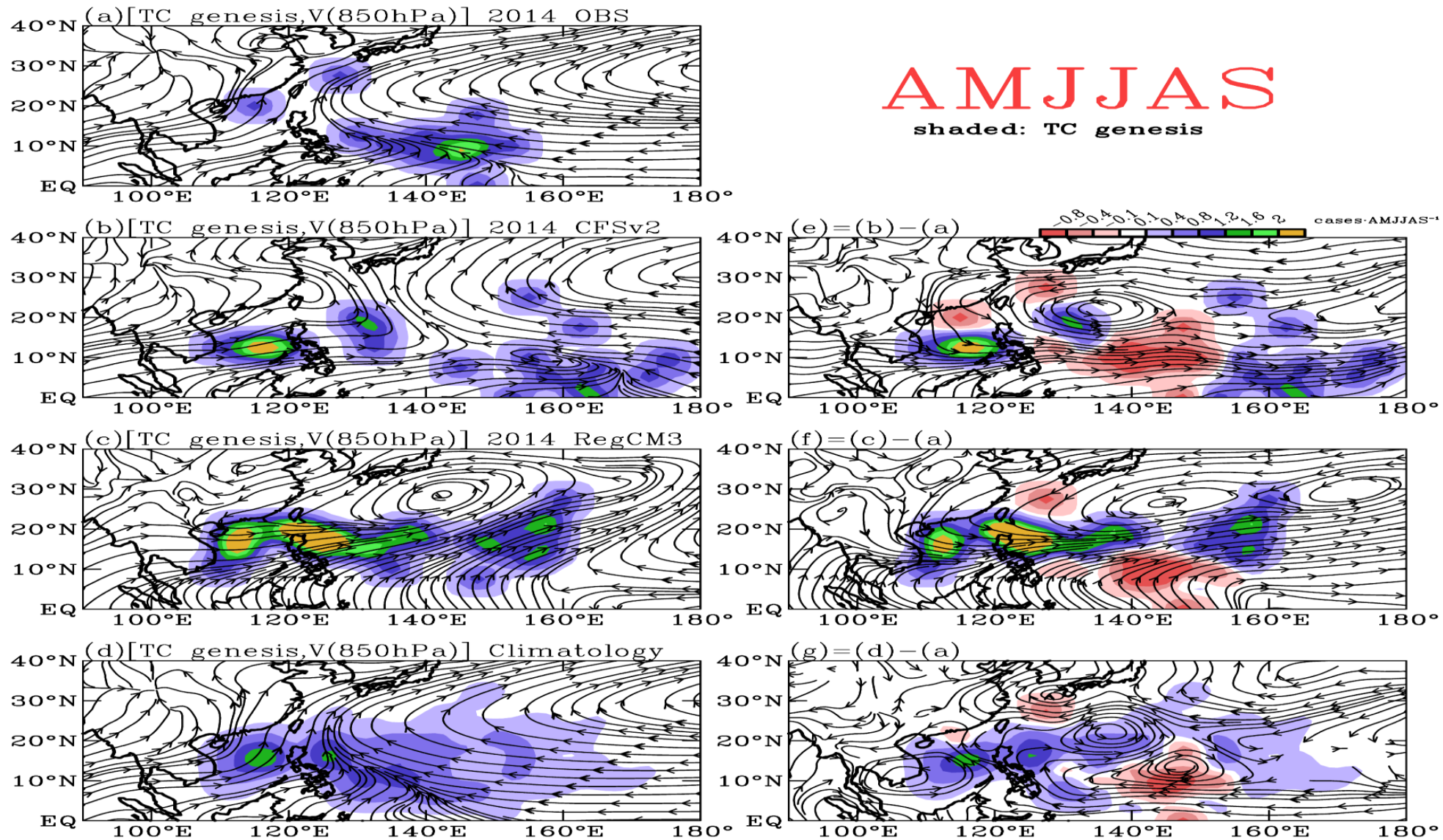
(b) TC genesis (by month)



2014 Forecasts and Verification (SSTA)

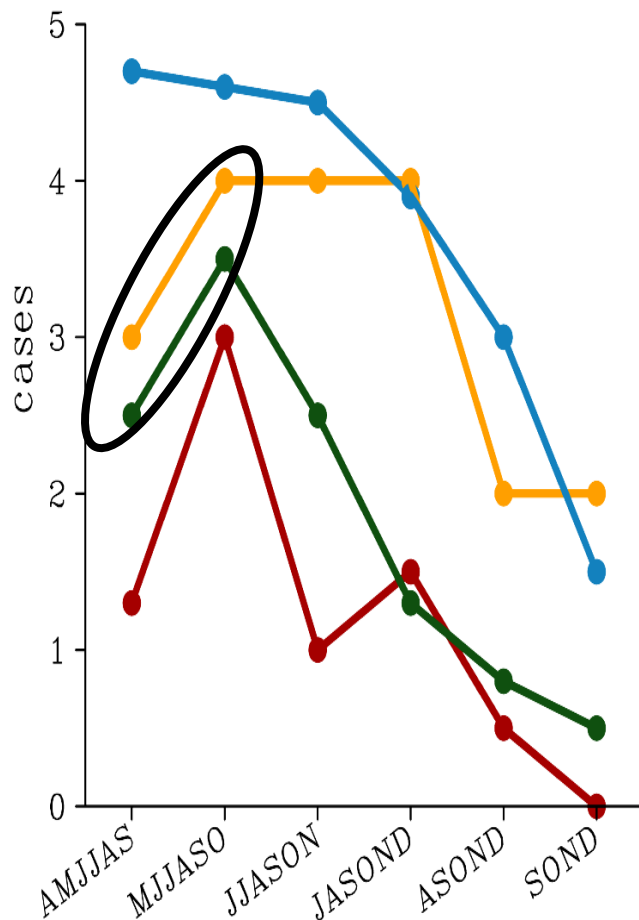


2014 Forecasts and Verification (850-hPa flow and genesis)

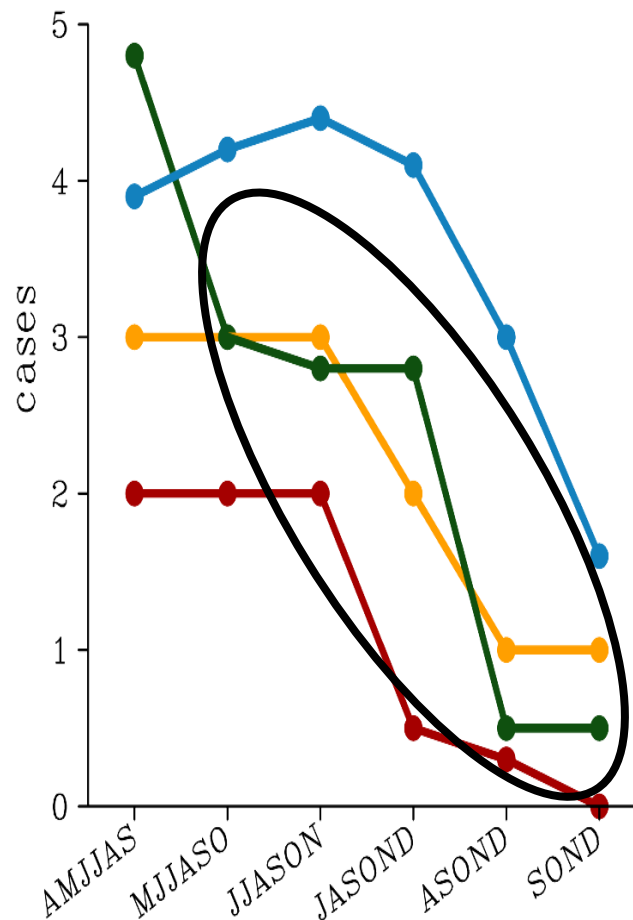


2014 Forecasts and Verification (Landfall)

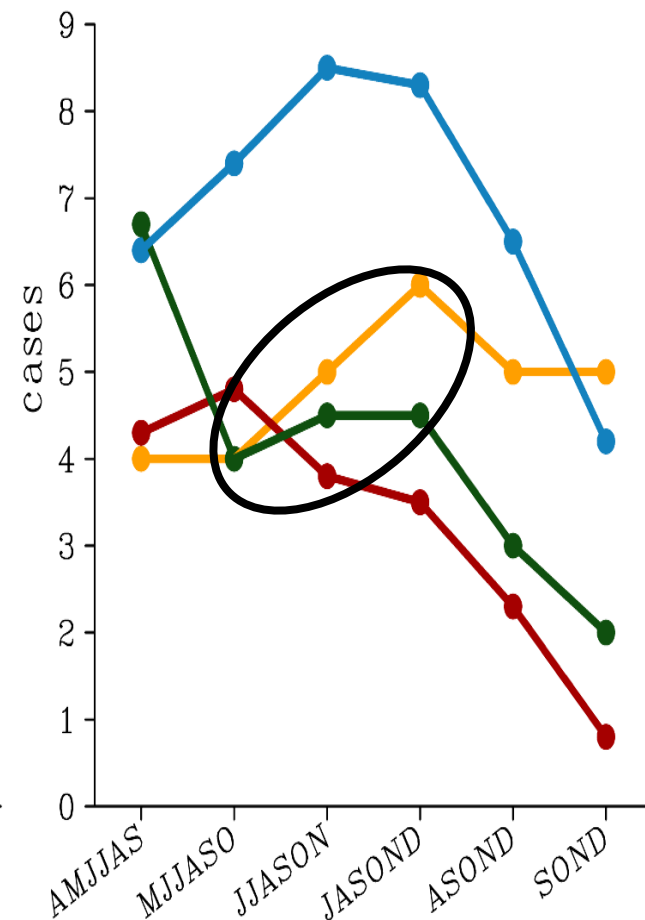
NTC landfall



MTC landfall



STC landfall



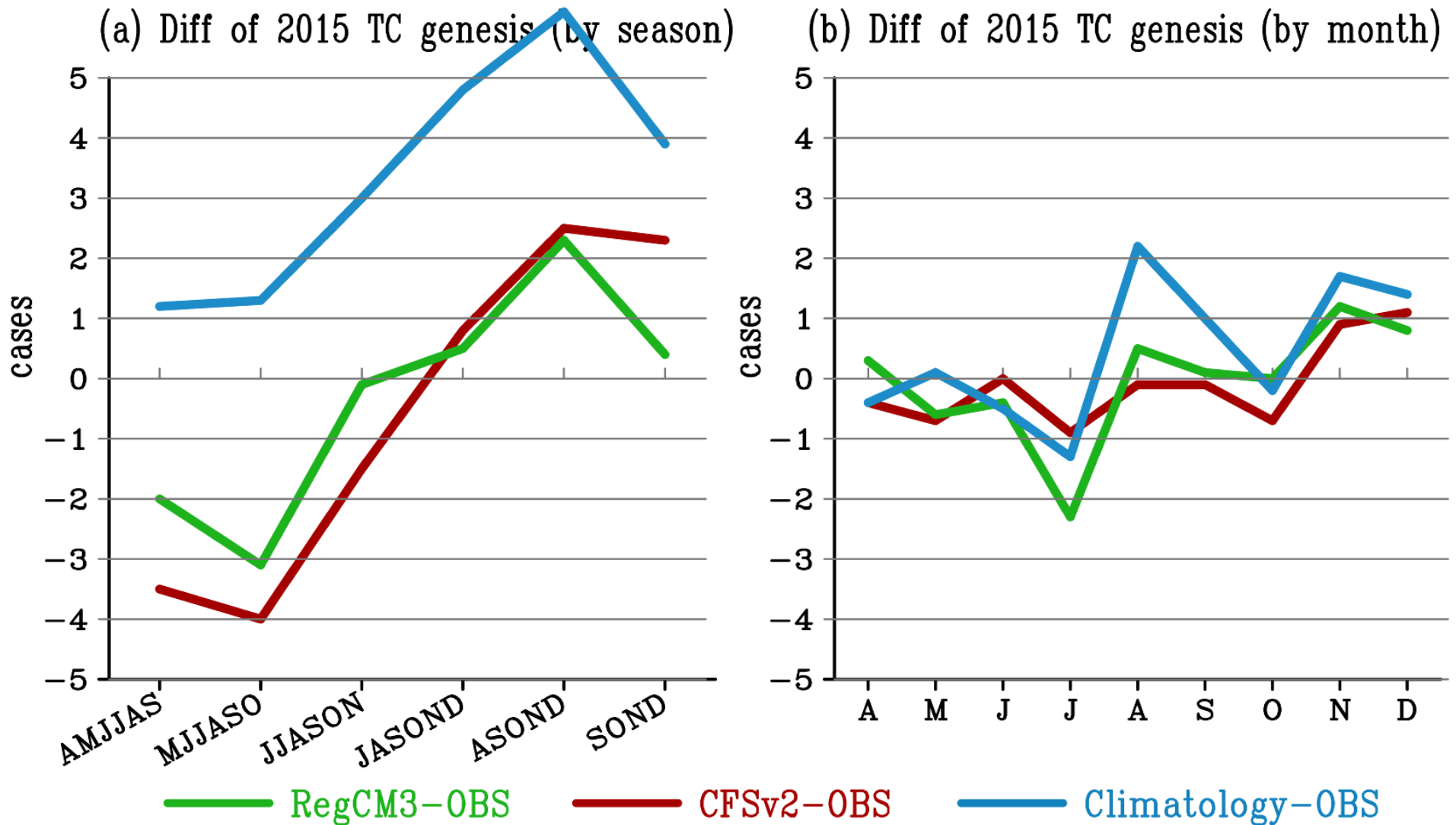
OBS

RegCM3

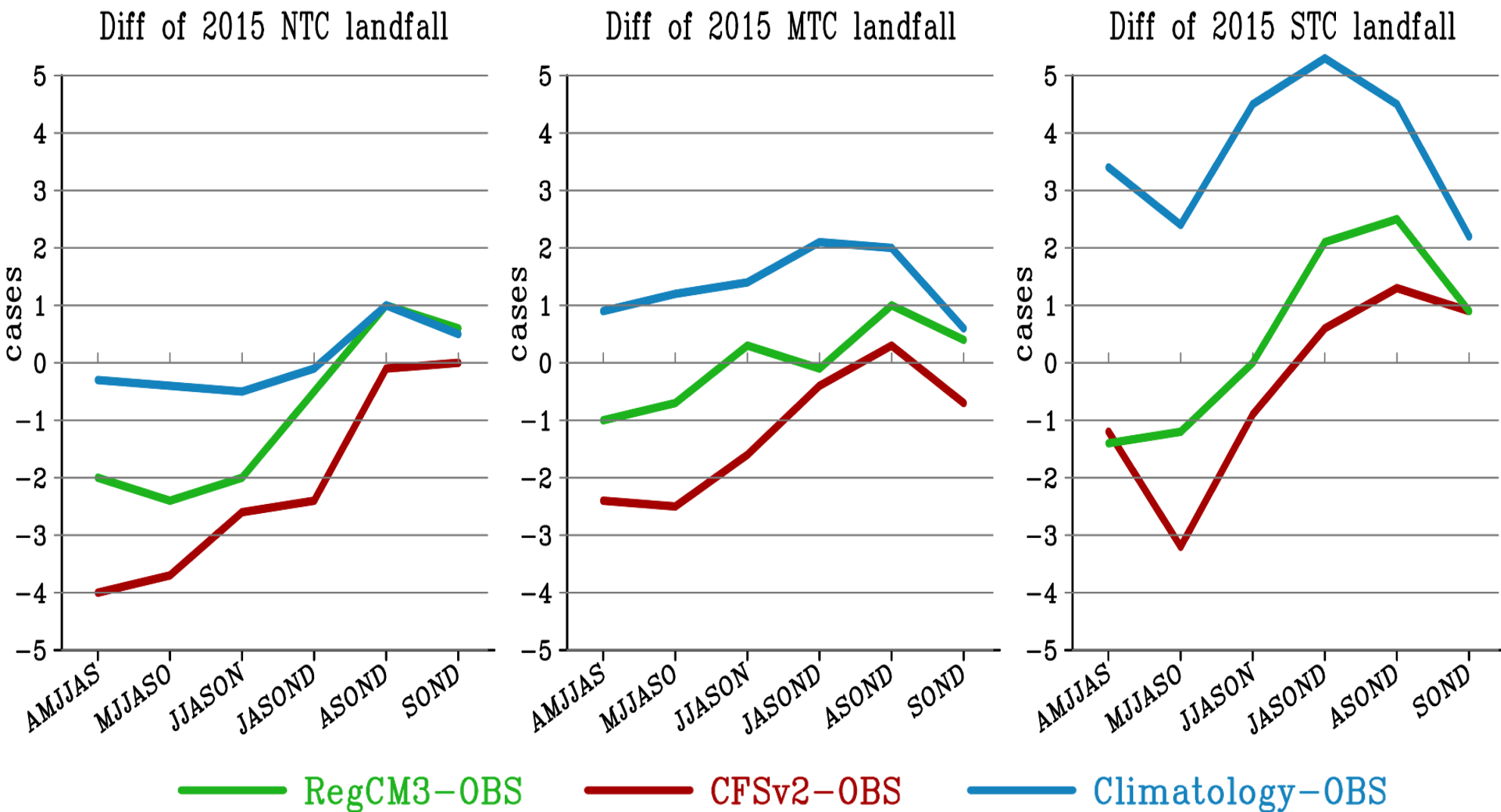
CFSv2

Climatology

2015 Forecasts and Verification



2015 Forecasts and Verification (Landfall)

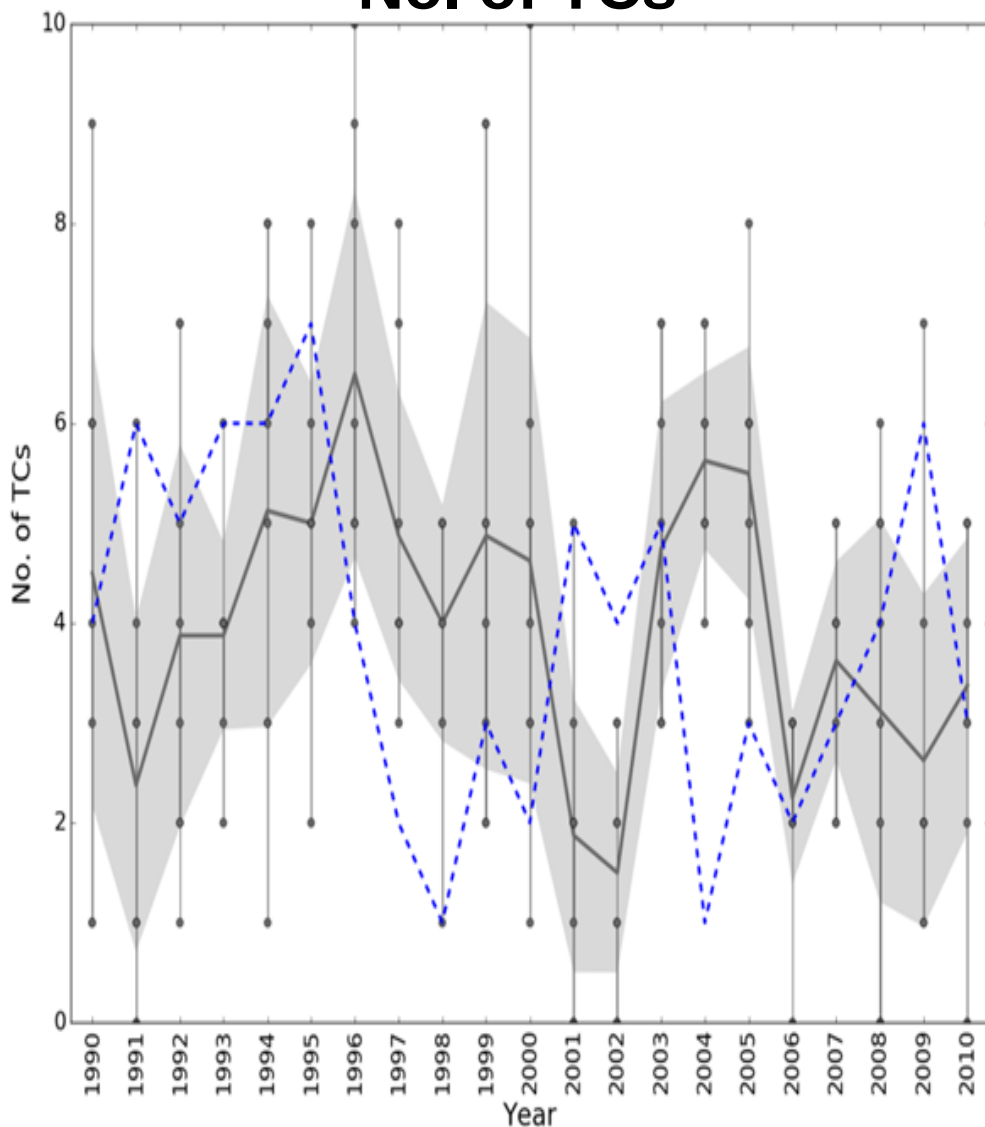


Predicting seasonal intensity

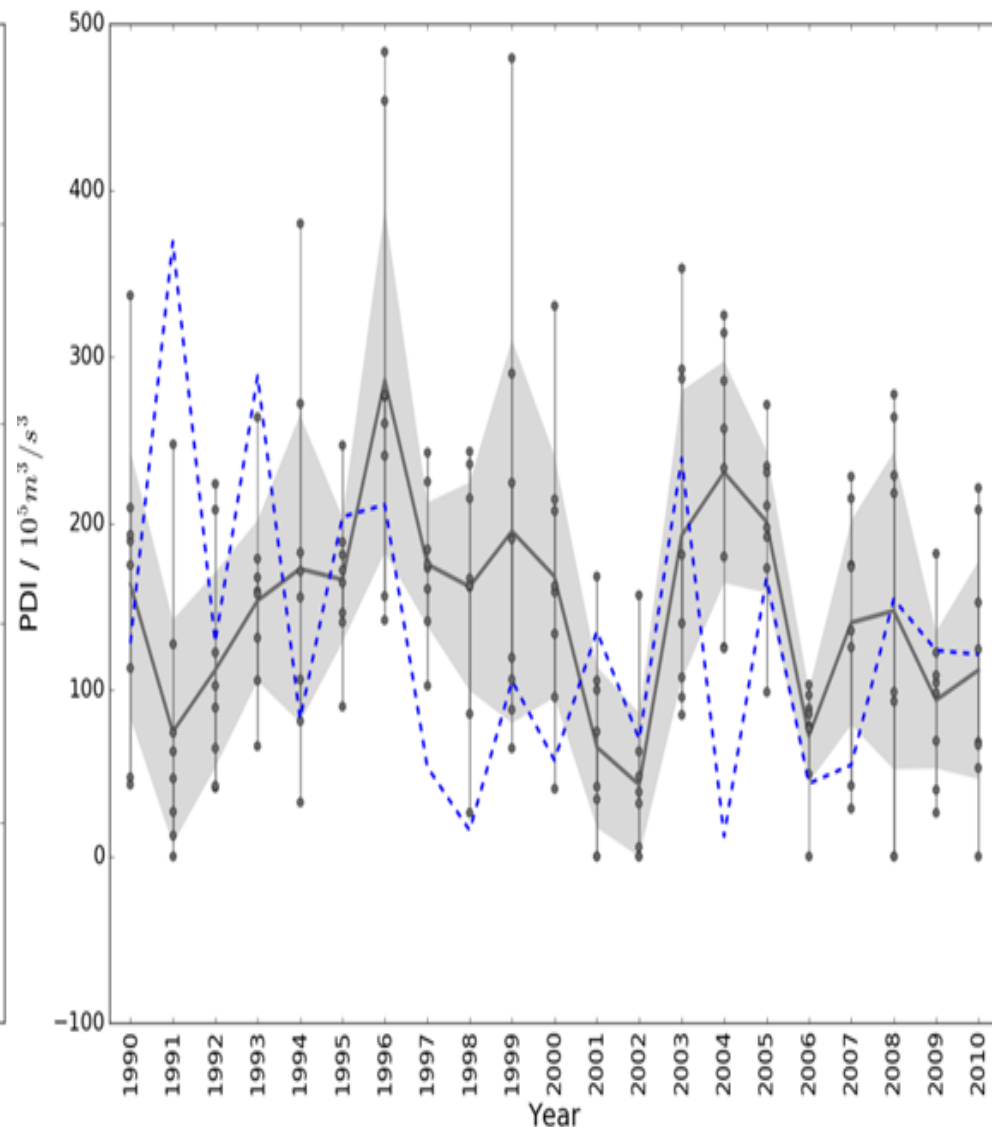
- Nests the WRF model within RegCM3 for each ensemble member and run the model when a predicted TC is within 3 days of landfall
- Horizontal resolution: 9 km
- Estimate the intensity at landfall and calculate the PDI ($= V^3$)
- Calculate the mean PDI for the season by summing up the PDI for each landfalling TC and dividing by the number of landfalling TCs

CFSR RegCM-WRF 1990-2010 STC

No. of TCs

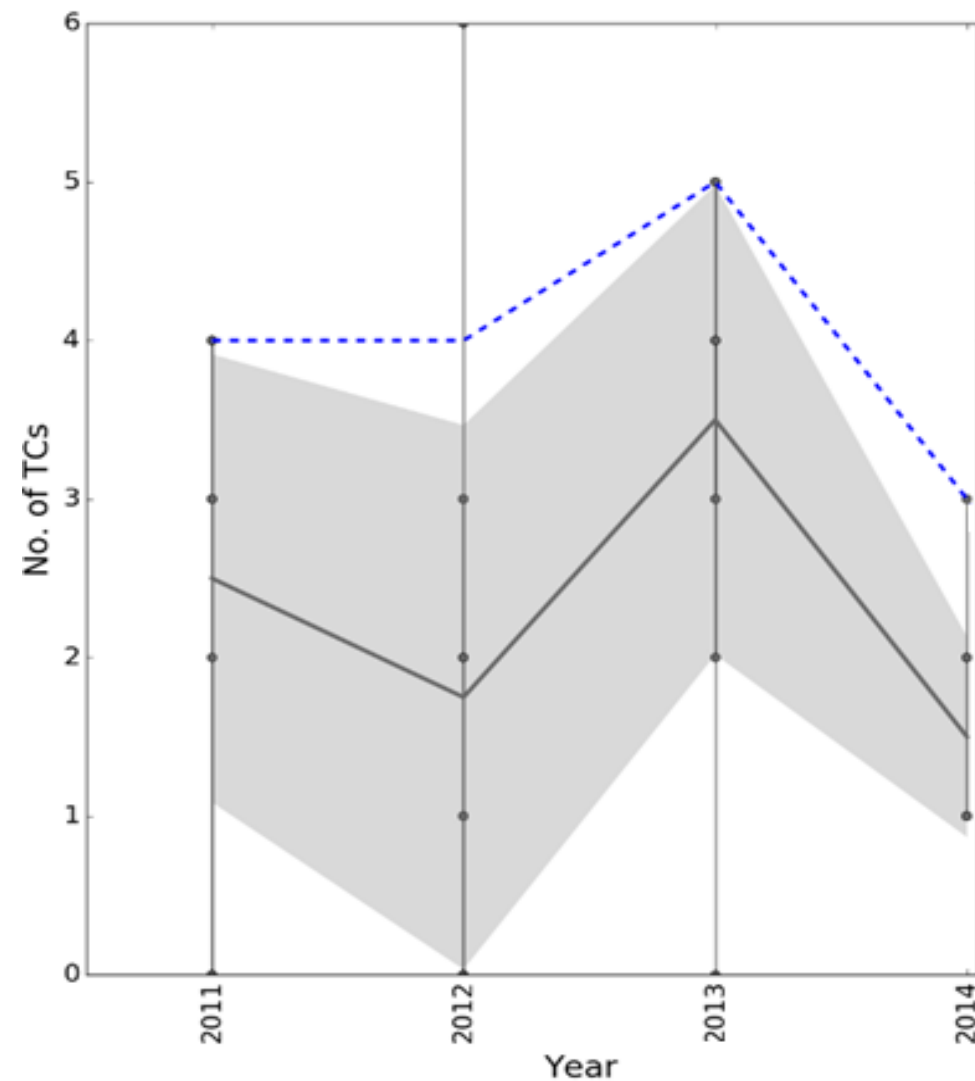


PDI

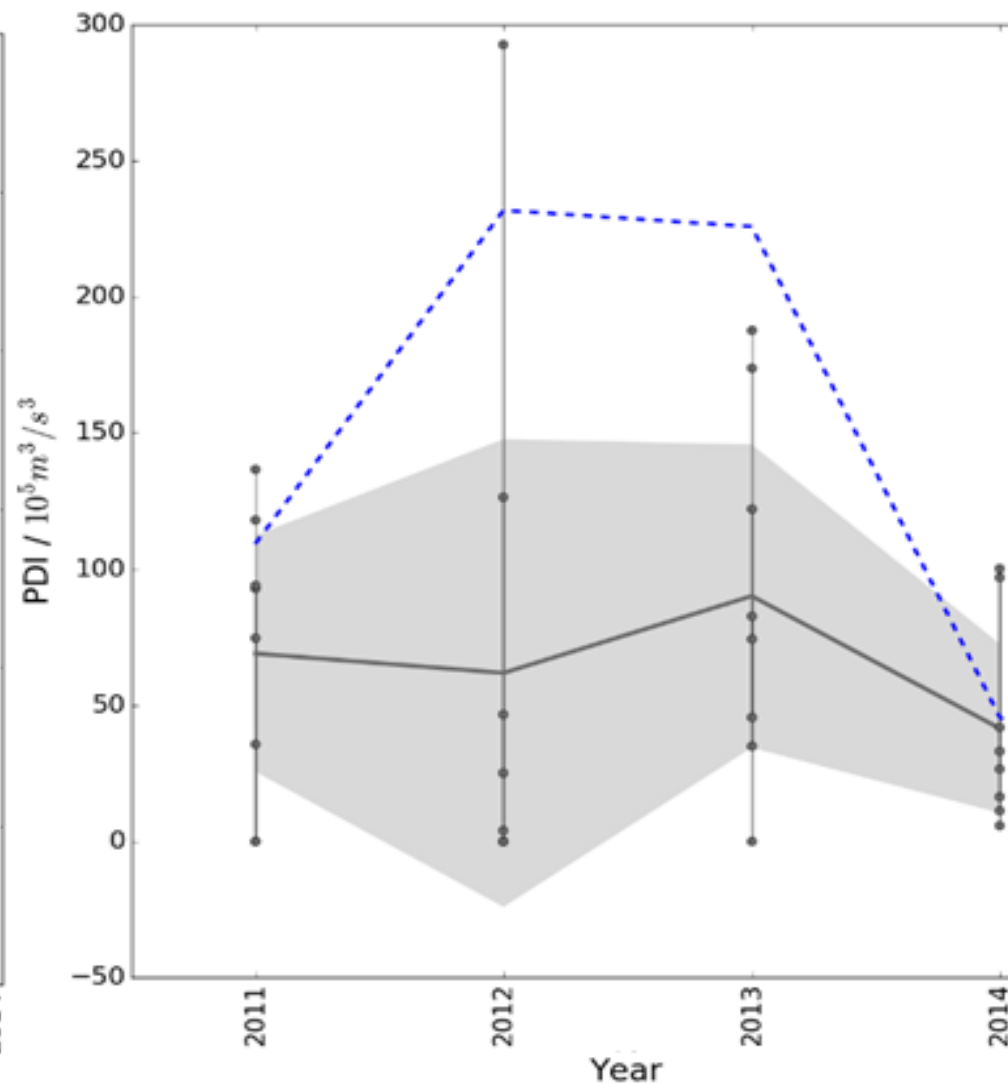


CFS RegCM-WRF 2011-2014 STC

No. of TCs



PDI



Summary

- Even with a 60-km resolution, RegCM3 is able to generate vortices with structures that resemble those of real tropical cyclones.
- The model is capable of reproducing the basic climatology and interannual variability of tropical cyclones in the western North Pacific, and producing good hindcasts.
- Landfall hindcasts are also good especially in the South China region.

Summary

- 2014 real-time forecasts and verifications suggest that the ability of the regional model to predict seasonal activity depends strongly on the ability of the global model to predict the large-scale atmospheric and ocean conditions; 2015 gave better results because the global model performed much better in terms of predicting the occurrence of El Niño.
- Nesting WRF into the RegCM3 appears to have the potential of predicting seasonal intensity in a region, although more studies need to be carried out to ascertain this conclusion.