



Experimental Forecasts of Seasonal Forecasts of Tropical Cyclone Landfall in East Asia (Updated version with Jun-Dec forecasts)

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02 July 2014

1. Introduction

In a recent study (Huang and Chan 2014), we have shown that it is possible to use a regional climate model (in this case Regional Climate Model Version 3, RegCM3) with initial and boundary conditions driven by a global climate model (in this case US NCEP Climate Forecast System Version 2, CFSv2) to predict both the number of tropical cyclones (TCs) occurring in the western North Pacific as well as the number of TCs making landfall in various parts of East Asia with a lead time of one to six months. The forecast skill from such a dynamical downscaling procedure apparently is higher than that from the CFSv2 especially for predicting the number of TCs making landfall in the Southeast Asian region (see below).

Because of this result, we are now testing the ability of the RegCM3 in making real-time seasonal TC forecasts starting from March 2014. In the following, we will describe how the predictions are carried out and present the forecast results based on the initial conditions since March to June 2014.

2. Methodology

The model setup is exactly the same as that described in Huang and Chan (2014). In each simulation, the integration period is from 1st of the month to the next 6-months. The first month (e.g. March) of the simulation serves as the spin-up period and the downscaling experiments extend through the following 5-months (e.g. April to September). The forecasts are based on 4 ensemble simulations for each month. The landfalling TCs were accordingly grouped into three regions:

- South TCs (STC) – those making landfall in South China, Vietnam and the Philippines
- Middle TCs (MTC) – those making landfall in East China (Taiwan, Fujian, Zhejiang and Jiangsu provinces, and Shanghai municipality)
- North TCs (NTC) – those making landfall in the Korean Peninsula and Japan.

3. Forecasts

a. TC genesis

The climatology and forecasts of TC genesis over the WNP basin for the AMJJAS (initiated on March 1st), MJJASO (initiated on April 1st) JJASON (initiated on May 1st) and JASOND (initiated on June 1st) are shown in Figs. 1-4 respectively. It is noted that the genesis locations for RegCM3 appear to suggest a northward shift of the monsoon trough, as compared to those predicted by the CFSv2. Both forecasts from CFSv2 and RegCM3 suggest that the mean genesis location of TCs in 2014 tends to shift southeastward as compared to the climatology. Such a difference is similar to what has been observed in El Nino years (e.g. Chan 2000; Huang and Chan 2014). This is consistent with most global model results that suggest this year being likely an El Nino year (e.g. Fig. 5).

The numbers of TCs predicted and actually formed in each month are shown in Fig. 6. Summing up this number for the entire period suggests that it is likely that the number of TCs over the WNP region this year will be above normal.

b. TC landfall

The forecast of this year's TC landfalls is given in Fig. 7. Comparing with the climatology extracted from Huang and Chan (2014), it is likely that few TC landfalls will occur in all the areas in East Asia.

4. Summary

The tentative forecasts based in the data in March to June suggest that while more TCs will likely form this year compared with climatology, fewer TCs will make landfall in East Asia in 2014. Updates of the forecasts are planned to be issued in mid-July for Aug-Dec. Verifications will be made at the beginning of next year.

Reference

Chan, J. C. L., 2000: Tropical cyclone activity over the western North Pacific associated with El Niño and La Niña events. *J. Climate*, **13**, 2960-2972.

Chan, J. C. L. and M. Xu, 2009: Interannual and interdecadal variations of landfalling tropical cyclones in East Asia. Part I: Time series analysis. *Int'l J Climatology*, **29**, 1285-1293, DOI: 10.1002/joc.1782.

Huang, W.-R. and J. C. L. Chan, 2014: Dynamical downscaling forecasts of western North Pacific tropical cyclone genesis and landfall. *Climate Dynamics*, **42**, 2227-2237.

Fig. 1. (a) Spatial distribution of the April to September (AMJJAS) accumulated annual frequency of TC genesis averaged during 2000-2010 in the western North Pacific (WNP) extracted from the JTWC data. Ensemble forecast of TC with initial time at 20140301 estimated from (b) CFSv2 and (c) RegCM. The color scale of TC genesis is given in the right top of (d). The unit is cases, per $5^{\circ} \times 5^{\circ}$ square, per 10 years. The difference between (b), (c) and (a) is shown in (d), (e).

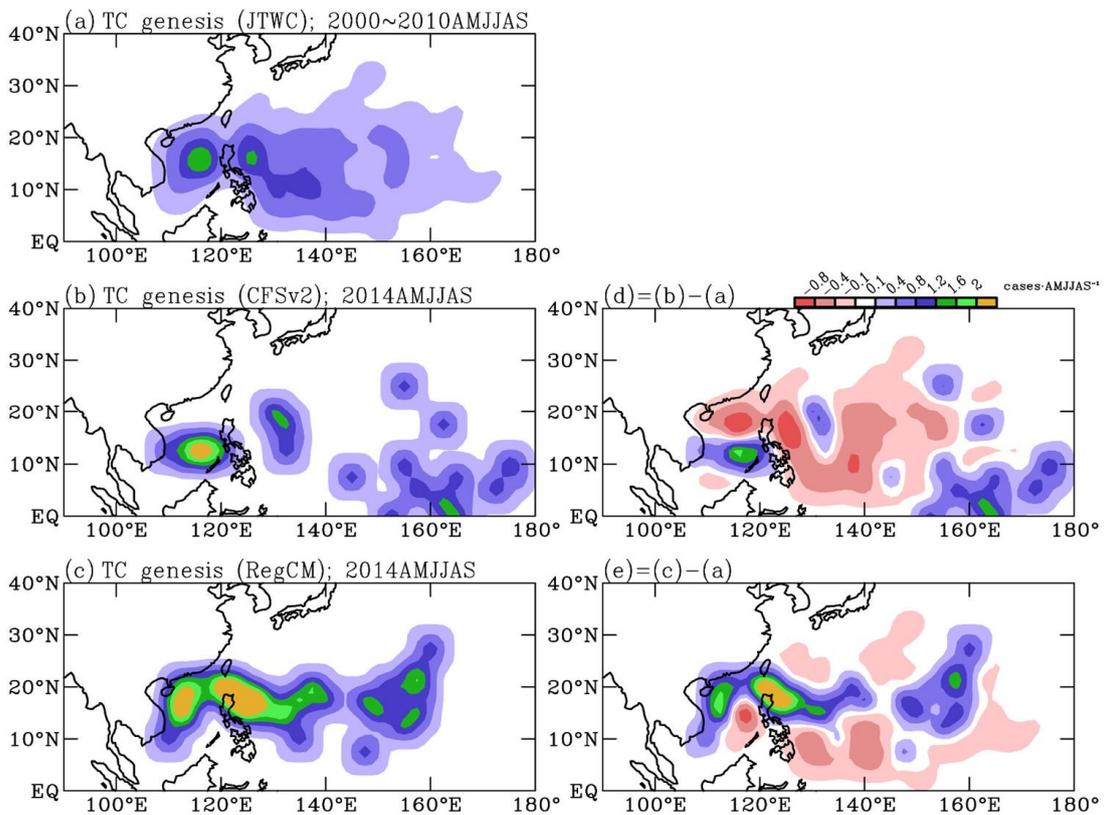


Fig. 2. Similar to Fig. 1, but for the MJJASO (a) climatology and 2014 TC predicted by (b) CFSv2 and (c) RegCM. The difference between (b), (c) and (a) is shown in (d), (e).

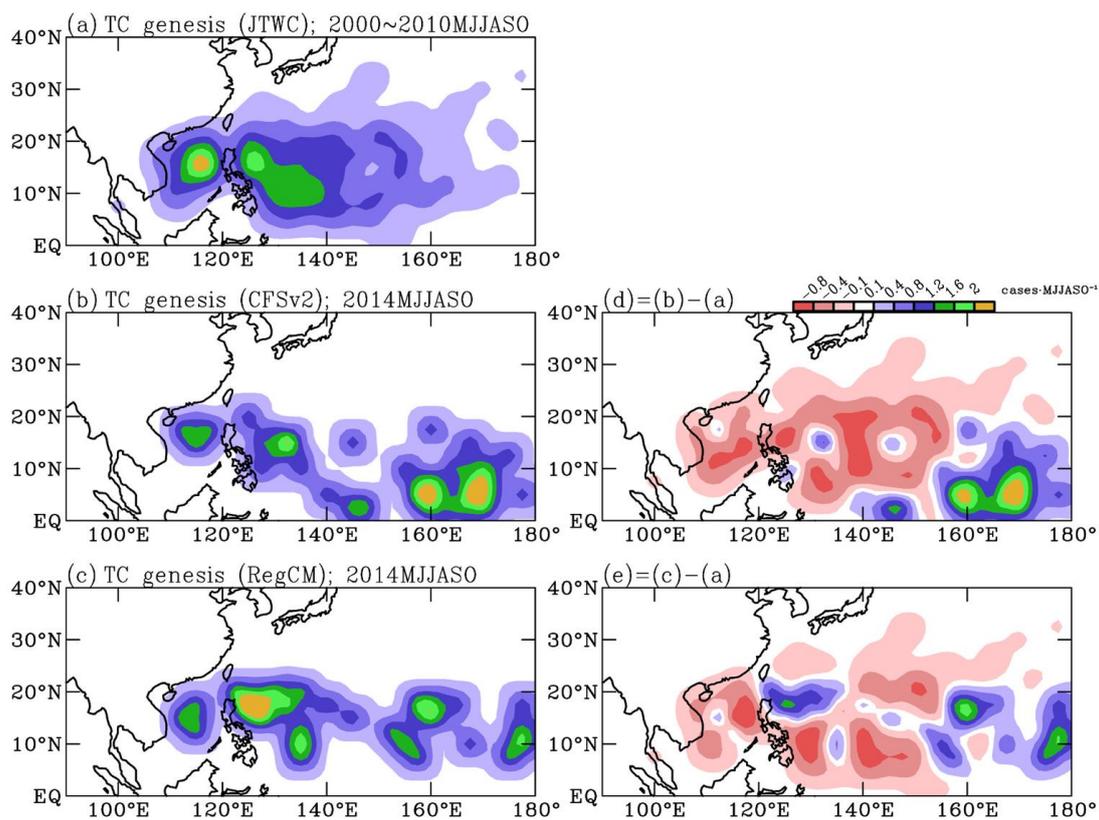


Fig. 3. Similar to Fig. 1, but for the JJASON (a) climatology and 2014 TC predicted by (b) CFSv2 and (c) RegCM. The difference between (b), (c) and (a) is shown in (d), (e).

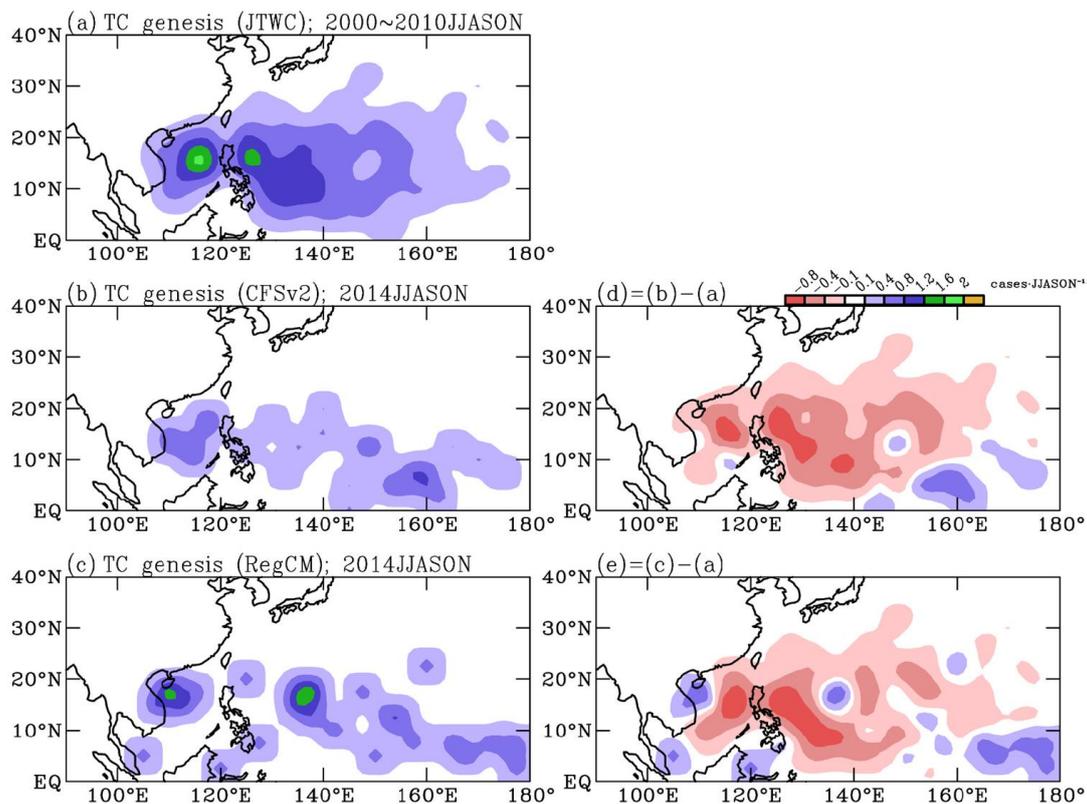


Fig. 4. (a) Spatial distribution of the July to December (JASOND) accumulated frequency of TC genesis averaged during 2000-2010 in the western North Pacific (WNP) extracted from the JTWC data. Ensemble forecast of TC with initial time at 20140601 estimated from (b) CFSv2 and (c) RegCM. The color scale of TC genesis is given in the right top of (d). The unit is cases, per $5^\circ \times 5^\circ$ square, per 10 years. The difference between (b), (c) and (a) is shown in (d), (e).

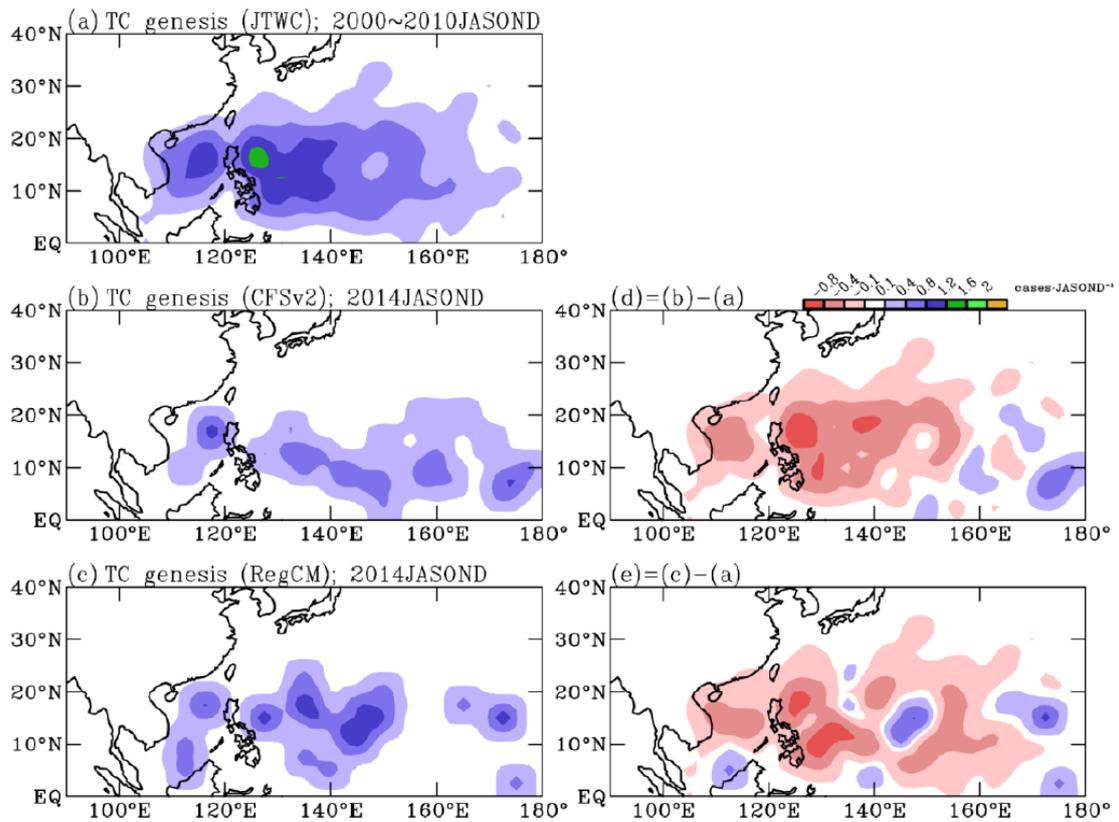


Fig. 5. Differences in sea surface temperature between 2014 MJJASO (CFSv2) and climatology.

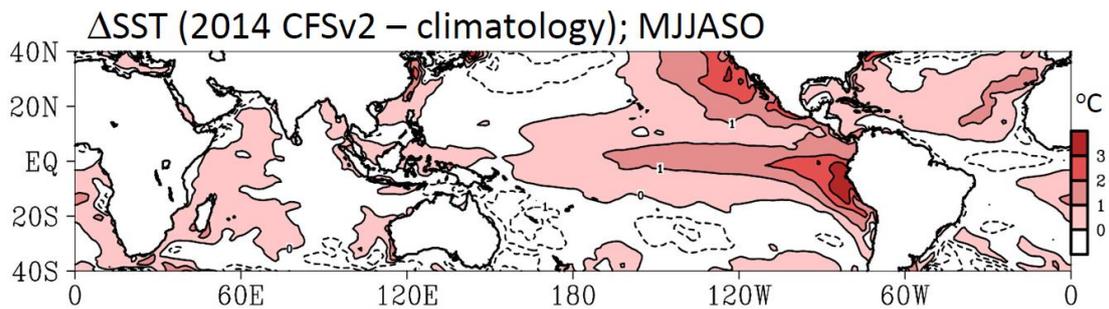


Fig. 6. Month to month evolution of TC genesis number obtained from (a) 2014 RegCM forecasts, and (b) 2014 CFSv2 forecasts for AMJJAS (green), MJJASO (brown), JJASON (light blue) and JASOND (purple). The climatology of JTWC (thick blue line) and the observed numbers (light blue bars) are also shown in each figure.

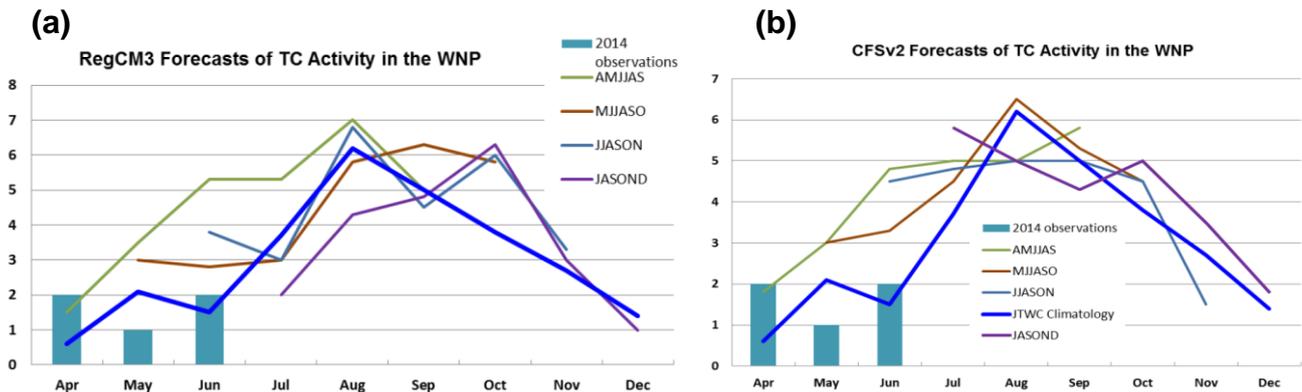


Fig. 7. In (a), the boxes mark the different groups of landfalling TCs (STC – south TCs, MTC – middle TCs, and NTC – north TCs) studied in the report, following Chan and Xu (2009). (b) is the number of AMJJAS, MJJASO, JJASON and JASOND TCs making landfall in the identified regions estimated from JTWC (blue bar), CFSv2 (red solid line) and RegCM (green dotted line).

