# P3.23 THE INFLUENCE OF MONSOON TROUGH ON TROPICAL CYCLONES OVER WESTERN NORTH PACIFIC: ROLE OF TROPICAL WAVES

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### **1. INTRODUCTION**

It has long been recognized that the location of the monsoon trough (MT) exhibits a primary control on the distribution of tropical cyclone (TC) activity over the western North Pacific (WNP). Most of these studies suggested that roughly more than 70% of WNP TC geneses are linked to the MT (Wu et al. 2012; Briegel and Frank 1997; Chen et al. 2004; Ritchie and Holland 1999; Ritchie 1995).

The synoptic-scale disturbances have been presented as a possible forcing mechanism for tropical cyclogenesis (Wu et al. 2012; Chen and Weng 1998). Those synoptic-scale disturbances in the MT environment are often associated with westward-propagating wave disturbances in the easterlies, such as MRG waves and TD-type disturbances.

#### 2. DATA

The best-track dataset from the Joint Typhoon Warn- ing Center (JTWC) for the period 1979–2007 is used to construct the accumulated cyclone energy (ACE) and other indices of TC activity.

The present study uses monthly mean sea surface temperatures (SSTs) from the National Oceanic and Atmospheric Administration (NOAA) Extended Reconstructed Sea Surface Temperature (ERSST) V3b, outgoing longwave radiation (OLR) from NOAA polar-orbiting satellites, and several daily meteorological variables from the National Centers for Environmental Prediction (NCEP) Department of Energy (DOE) reanalysis version 2 during the period 1979–2007. Only the data from July to November, which is the so-called TC season in the WNP, are used in this study.

#### 3. RESULTS

#### 3.1.Possible linkage between the monsoon trough variability and the tropical cyclone activity over the western North Pacific

During strong MT (S-MT) years, the MT extends eastward, and more TCs form within the southeastern quadrant of the western North Pacific. During weak MT (W-MT) years, the MT retreats westward, and less TCs form within the southeastern quadrant of the western North Pacific. (Figs. 1 and 2)

How Strong MT Affect Tropical Cyclone genesis over the WNP?

Such a relationship has been explained by the changes in large-scale environmental factors associated with the movement of the MT (Wu et al. 2012). The present study provides an understanding of the impact of the MT on TC activity over the WNP from synoptic-scale disturbance activities within the MT.



FIG.1. The 850hPa streamline charts with superimposed outgoing longwave radiation (OLR) for average of (a) S-MT years, and (b) W-MT years

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during the TC season (July-November).

FIG.2. Mean number of (a) TC, (b) TY, and (c) TS and TD genesis per year over each region of the left map in S-MT (red), N-MT (white), and W-MT (blue) years.

# *3.2. MT-phase dependent TD-MRG wave activity in the western North Pacific*

During S-MT years, the dominant mode of the synoptic-scale variability exhibits clear а MRG-to-TD type wave transition. This differs markedly from the W-MT years in which only the equatorial MRG waves are clearly presented and the northwest-southeast oriented TD-type disturbance is much weaker. The mechanism phase-dependent associated with the characteristics of the TD-MRG disturbances is investigated through the diagnosis of the barotropic energy conversion. It is found that the change of the monsoon flow associated with MT leads to a strengthening (weakening) of energy conversion from the mean to eddy kinetic energy during S-MT (W-MT), which gives rise to the enhancement (suppression) of the TD-MRG type disturbances in the WNP (no shown).

The phase-dependent TD-MRG wave activity may offer a physical explanation of why more frequent TCs form in the southeast region of the WNP during S-MT.



FIG.3. Average 850-hPa EKE during the TC season (July– November) for the (a) S-MT years, (b) W-MT years, and (c) dif- ference between (a) and (b), in units of m s21. Shadings in (c) indicate areas of difference exceeding the 95% confidence level using a Student's t test.

#### 4. SUMMARY

(1) The present study shows that the frequency of TC formation increases remarkably in the SE region (0°–15°N, 150°E–180°) and decreases in the other regions during the S-MT years. When the MT extends eastward in the tropical WNP to around 160°E, TC activity is above normal over most parts of the WNP east of ~125°E, and slightly fewer TCs tend to occur near the Philippines and the South China Sea (SCS).

(2) The eastward-extending monsoon trough during S-MT may interact with the westward-propagating MRG waves, leading to a transition to a TD-type disturbance that is oriented northwest-southeast direction. The in а strengthened monsoon trough accelerates the growth of the TD perturbation through the barotropic energy conversion, ultimately leading to tropical cyclogenesis in the WNP (Fig. 4).



FIG.4. Conceptual diagram of interaction of westward- propagating MRG and monsoon trough.

## 5. REFERENCES

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