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THE THERMAL EFFECT OF THE TROPICAL WESTERN PACIFIC ON THE INTERANNUAL VARIABILITY OF MONSOON TROUGH AND TROPICAL CYCLONE ACTIVITY OVER THE NORTHWEST PACIFIC

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1. INTRODUCTION

One of favorable conditions for TCs genesis is SSTs exceeding 26ºC (e.g., Gray, 1968, 1975). However, the SSTs in the TWP are the highest in the global oceans and generally satisfy the thermal condition of TCs genesis.

Why interannual variation of TCs genesis over the WNP?

Many studies showed that ENSO cycles have an important impact on the interannual variation of TCs genesis over the WNP (e.g., Chan, 2000; Chia and Ropelewki, 2002; Wang and Chan, 2002). But (e.g., Lander, 1993, 1994) pointed out that there is not a significant correlation between TCs genesis over the WNP and occurence of ENSO events, only their tracks seem to change during a El Nino year. Actually, mutual phase of ENSO events usually in boreal winter, while the strong signal in the subsurface of the TWP leads by 3-5 months than that in the TWP. In other words, the East Asian summer monsoon coupled with the WNP have established and will be persisted in TCs peak season from July to October.

Therefore, it may be more reasonable to introduce the monsoon circulation corresponding to the thermal states of the TWP into the analysis of the interannual variation causes of TCs activity over the WNP.

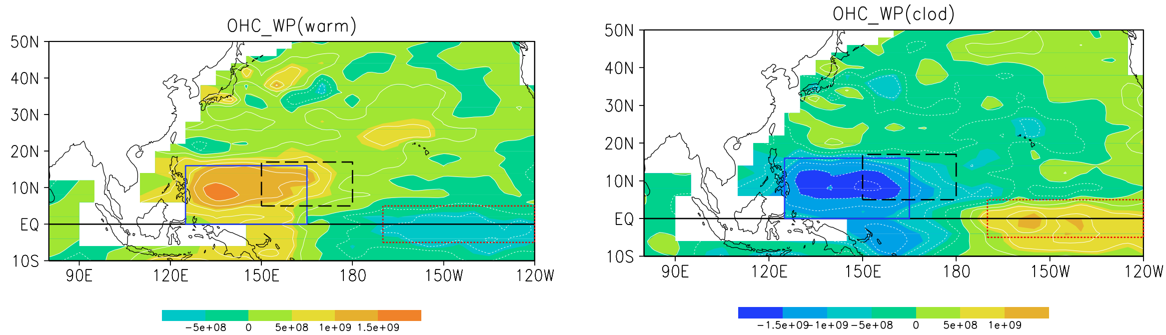

FIG.1. Composite distributions of OHC of the TWP for the high (left) and low (right) subsurface sea temperature in the TWP

2. SUMMARY

(1) The interannual variation of TCs activities over the WNP is very obvious and is closely associated with the thermal states of the WNP, especially the subsurface sea temperature of the WNP.

When the WNP warm pool is in a warming state, then the genesis and tracks of TCs will shift westward over the WNP, thus, the number of typhoons influencing China may be above normal. Oppositely, when the WNP is in a cooling state, then the genesis and tracks of TCs will shift eastward over the WNP, thus, the number of TCs influencing Japan may be above normal, but the number of TCs influencing China may be below normal.

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(2) TC tracks are closely associated with the position of the monsoon trough.

When the WNP is in a warm state, then the monsoon trough shifts westward, thus, the convergent region of zonal wind field also shifts westward over the WNP. In this case, the region of the transition from the MRG wave to the TD–type disturbance also shifts westward, which can lead to the westward shift of TCs geneses and tracks over the WNP. On the contrary, when the WNP is in a cold state, then the monsoon trough shifts eastward and southward, thus, the convergent region of zonal wind field also shifts eastward over the WNP. In this case, the region of the transition from the MRG wave to the TD–type disturbance also shifts eastward, which can lead to the eastward shift of TCs geneses and tracks over the WNP.

(3) The mechanism of the monsoon trough on the TCs activities is discussed from dynamical theory and is simply simulated by using shallow-water wave equations.

Results show:

The monsoon trough over the WNP not only can provide a favorable cyclonic relative vorticity environment for TCs genesis, but also provide a convergence of zonal wind field which is favorable for the transition from the MRG wave to TD-type wave.

The TD-MRG waves in monsoon trough experience trapping of wave energy at low levels and enhanced wave growth, which their scale would shrink and their structure would display a southwest-northeast tilt.

Furthermore, it moves northwestward across the axis of monsoon trough. This moving process can lead to a deformation of the wave structure and acceleration of the wave transition.

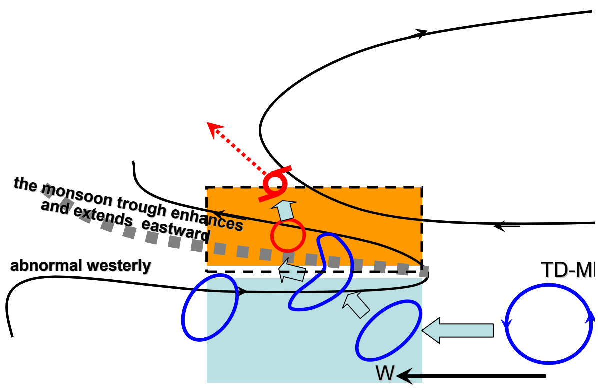

FIG.3. Conceptual diagram of interaction of westward-propagating MRG and monsoon trough.

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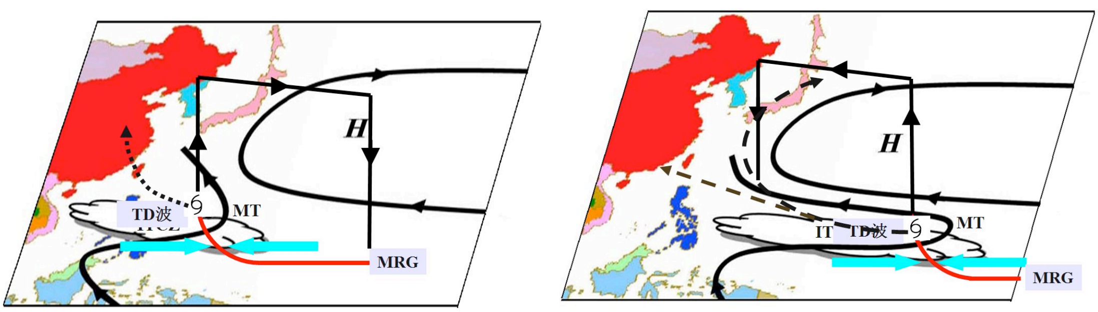

FIG.2. Conceptual diagram showing the major circulation anomalies associated with the high (left) and low (right) subsurface sea temperature in the TWP.

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