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Speaker: Pin-Hong Chen

Advisor: Prof. Ching-Yuang Huang

Three-Dimensional Fujiwhara Effect for Binary Tropical Cyclones in the Western North Pacific

Abstract

When the binary tropical cyclones (two TCs) occur with the distance of the TCs center between 1000 to 1200 km, they will interact with each other, which is known as the Fujiwhara effect. This research aims to analyze binary TCs tracks and the three-dimensional structures with the best track and ERA5 reanalysis data in the western North Pacific (WNP) during 1979–2020.

For each TC, the upper-level anticyclonic and lower-level cyclonic circulations generate vertical wind shear (VWS), tending to be directed to the rear-left quadrant from the direction of the counterpart TC, where the maxima of rainfall and diabatic heating could be observed. The VWS depended on the TC intensity, size, circulation, and duration. It buffered the rotating motion in strong TCs through diabatic heating asymmetry resisting horizontal potential vorticity (PV) advection.

The PV budget analysis and the diagnosis of the motion of binary TCs indicate that the motion of binary TCs is largely affected by diabatic heating, causing TC counterclockwise and approaching motion owing to horizontal advection, based on the TC motion can be viewed as the wavenumber-1 asymmetry of the PV tendency.

Keyword

PV budget

References

Ito, K., Hirano, S., Lee, J. D., & Chan, J. C. (2023). Three-dimensional Fujiwhara effect for binary tropical cyclones in the western North Pacific. *Monthly Weather Review*.