

The feature of double typhoon in South China Sea and ship avoiding measures

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Abstract. Discussion in this article is phenomenon existent features about the double of the South China Sea tropical cyclone, including a variety of meteorological elements and the waves. Meanwhile, considering the influence of various factors and allowing for unforeseen circumstances, we forecast the relative position and movement about the ship and the typhoon. Also, we come up with some efficient scheme and measures related to avoiding double typhoons combined with avoiding measures taken in one typhoon.

1 Introduction

Tropical cyclones occur in tropical or subtropical oceans on the development of a strong warm cyclonic vortex, is the most powerful storms in the troposphere, referred to as the "king" of the storm. It likes rivers in forward vortex, side rapidly spinning around its center, with the surrounding atmosphere to move forward. Tropical cyclones in the northern hemisphere airflow are around the center of a counterclockwise rotation, while clockwise around the center is in the southern hemisphere. In international, if the wind speed in the center of tropical cyclone greater than or equal to 64knots(force greater than or equal to 12classes),it is defined typhoon. The South China Sea is an important channel between China and South Asia, Africa, Europe and other regions, and here occurs tropical cyclone frequently and heavy weather for ship navigation. Once Tropical cyclones come, the storm weather will happen, and the sea generates huge storm and surge, which can deform even disrupt the hull structure. Therefore, major sea accidents happen.

Japanese meteorologist Fujiwara^[1] takes the research about "double typhoons" earliest, and he put forward the famous theory "Fujiwara Effect" according to current field simulation experiments. Later, Chenglan Bao^[2] with his team draws a conclusion according to analyzing and calculating examples and comparing influences between double typhoons and external influences: "Fujiwara Effect" plays a main role within seven degrees in latitude; external influences works in seven to fifteen degrees and if the distance of two typhoons greater than fifteen degrees, "Fujiwara Effect" doesn't work. The other researches further indicates that if two typhoons in five to fifteen degrees in latitude can rotate with each other depend on the orientation of the east typhoon and the west: when the east typhoon is on the west typhoon's northeast, most double typhoons rotate

with each other obviously. And if the east typhoon is on the west typhoon's southeast, a few double typhoons rotate with each other, in other words, external influences and "Fujiwara Effect" work together, and the front is main.

Due to the double of the interaction between tropical cyclones, they tend to be circling counterclockwise, stagnant, or complex paths. According to analysis to three typhoons' abnormal paths, Mei Leng with her team proposes matters needing attention to judging typhoon's abnormal paths which takes advantages of the weather facsimile chart when a ship is in voyage. In general, when double tropical cyclones rotate each other, the position of the pivot point related to two tropical cyclones' intensity, scope and the strength of the external flow field^[3]. If two tropical cyclones' intensity are similar, at the same time, the flow field environment is very weak, two tropical cyclones will rotate around the midpoint of ligature between two typhoons; If the strength of the two tropical cyclones differ not nearly, the pivot point is near the side of a strong tropical cyclone.

2 Feature analyses

Researches show that tropical cyclones' intensity in the South China Sea is a little weak and their average diameters are smaller compared with others. When two tropical cyclones intensity are adjacent, they will rotate around one center. At the beginning, two mature tropical cyclones' cloud system is cirrus、altocumulus、stratocumulus、cumulus、cumulonimbus, when two cyclones rotate around the center, outer cloud system combine gradually, and they will transport and exchange energy and moisture in rotation. Also, the form of cloud system changes with the combination. In general, tropical cyclones in the south China sea's right front is an area

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with widest cloud, thickness cloud layer and abundant rain, and its left behind is inverse. So, we may draw a conclusion that when two tropical cyclones' right front encounter in their rotation, the corresponding area will

have heavy rain; on the contrary, when their left behind encounter, the corresponding area's rain is poorest in all process. The movements of double typhoon are shown in figure 1 and figure 2 [4-5].

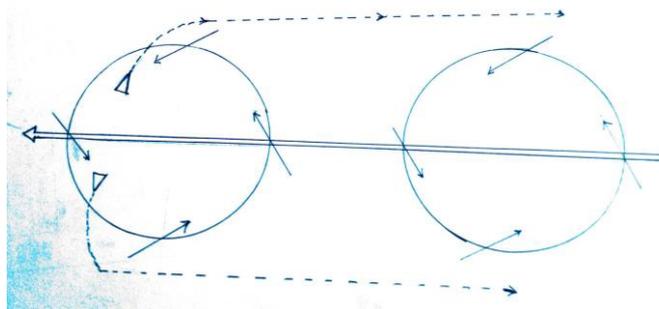


Figure 1. Movements of double typhoon in Northern Hemisphere.

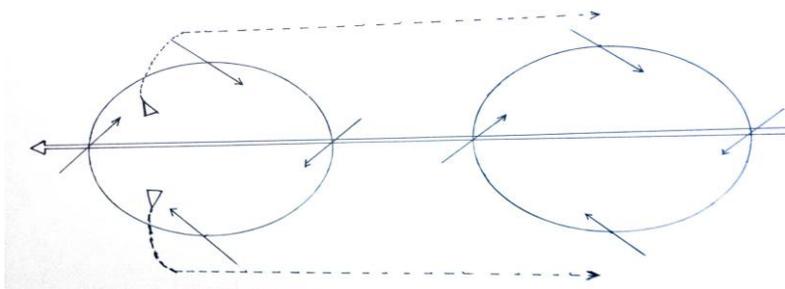


Figure 2. Movements of double typhoon in Southern Hemisphere.

3 Avoiding measures for navigation ship

Once the ship enters an area influenced by double tropical cyclone mistakenly, the first thing the captain should do is judge ship's position correctly in the tropical cyclone according to alert published by meteorological department, then take measures and proper course avoiding. Otherwise, at some special circumstances such as cannot receive information about tropical cyclones' center and direction of movement, mariners can judge the position in double cyclones on the basis of true wind and air pressure observed on the ship. In one tropical cyclone, no matter in the Northern Hemisphere or the Southern Hemisphere, the heaving to ship can make several continuous observations, when direction of true wind alters with clockwise change, it indicates that the ship is in the tropical cyclone's right semicircle, and if direction of true wind alters with anticlockwise change, it indicates that the ship is in the tropical cyclones left circle. When the direction of true wind don't change obviously, it can be observed that the ship is on the way of tropical cyclone' advance. If you watch from cyclones behind to its forward, you may find that it can be divided into two semicircles, the left semicircle and the right semicircle. In the Northern Hemisphere, the right semicircle is a dangerous area and the left semicircle is a safe area. However, in the Southern Hemisphere, the right semicircle is a safe area and the left semicircle is a dangerous area.

Because of completed movement paths, we can view the movement path of double tropical cyclones as a line. Meanwhile, change the relative position between the ships and double tropical storms to discuss avoiding measures taken by the ship in double tropical storms. If a ship

mistakenly enters the front cyclone's dangerous semicircle of double tropical cyclones, it should run away by full speed with starboard bow (in the Southern Hemisphere is port bow) towards the true wind, and keep an intersection angle between course and wind at ten degrees to forty-five degrees, as shown in the figure-3 of the ship A [5-6] (in the Southern Hemisphere as shown in the figure-4 of the ship C)

If a ship mistakenly enters the front cyclone's safe circle of double tropical cyclones, it should run away by full speed with starboard quarter (in the Southern Hemisphere is port quarter) towards the true wind, and keep an intersection angle between course and wind at ten degrees to forty-five degrees, as shown in the figure-3 of the ship B (in the Southern Hemisphere as shown in the figure-4 of the ship D).

The point we should pay attention to is that it is relative for two semicircles between danger and safety. A ship navigates in a safety semicircle can also meet violent storms and roaring waves result in threat to ship's security. Once leaves the dangerous area, the captain should receive the weather forecast and alert announced by neighboring coast radio station through GMDSS(Global Maritime Distress Safety System) INMARSAT-C and EGC or according to the direction of true wind to judge if the ship enters the area influenced by the behind cyclone. If the ship may enter the influenced area, considering economy of voyage, it is practicable to navigate in a parallel and opposite line with the path of double cyclones. When moves completely away from areas influenced by double cyclones, the second officer can develop route again. Another measure is dropping anchor away from area influenced by double cyclones until they move away. If a ship enters the behind typhoon's dangerous or safe

semicircle mistakenly, just takes it as one typhoon to avoid.

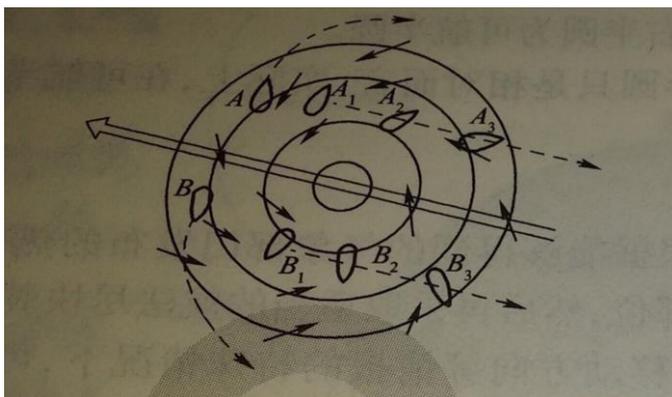


Figure 3. Method of avoiding typhoon in Northern Hemisphere.

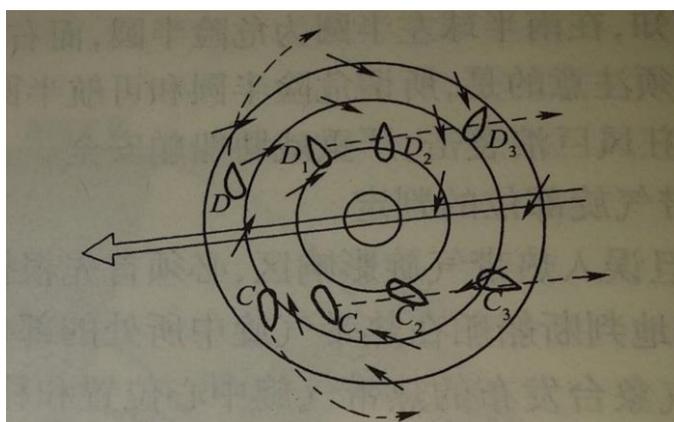


Figure 4. Method of avoiding typhoon in Southern Hemisphere.

4 Conclusions

In northern hemisphere, the wind's direction is anticlockwise, and the left semicircle of typhoon is navigational semicircle, the right semicircle of typhoon is dangerous semicircle, ship ought to avoid the right semicircle. If ship enters navigational semicircle, she can run away by keeping starboard stern by wind; if ship enters dangerous semicircle, she can run away by keeping starboard bow by wind. In southern hemisphere, the wind's direction is clockwise, and the left semicircle of typhoon is dangerous semicircle, the right semicircle of typhoon is navigational semicircle, ship ought to avoid the left semicircle. If ship enters navigational semicircle, she can run away by keeping port stern by wind; if ship enters dangerous semicircle, she can run away by keeping

port bow by wind.

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