# The Characteristics and Statistical Analysis of A Certain Offshore Typhoon Activity in The Past Ten Years

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**Abstract**—There have been many incidents where strong winds and waves caused the capsizing of offshore oil platforms, and serious casualties and property losses occurred. It is of paramount importance to ensure the safe and efficient operation of offshore production facilities and the personal safety of personnel at sea. Based on the intensity, source area and development trend of typhoon, this paper calculates the annual and monthly variation of a typhoon in China from 2010 to 2020 with the method of big data analysis. The results show that the lifetime of typhoon in this sea area is 35 hours on average, and the annual variation of typhoon is large. The peak of active tropical depression is from September to October, the peak of tropical storm is from July to August, and the peak of typhoon is from September to October. Statistics a island reef in the past ten years only two strong typhoon, and a island reef for the atoll, with a good geographical location and natural conditions. It lays a foundation for choosing the place of floating dock, dividing the emergency warning zone of anti-typhoon, planning the evacuation route of offshore platform and ships, and getting the anti-typhoon method of offshore drilling platform.

## 1. Introduction

China is one of the countries that are more severely affected by typhoon disasters in the world. The sea areas it passes through are accompanied by severe weather and sea conditions such as squally winds, heavy rains, and huge waves (surges), which have harmful effects on the safety of offshore oil rigs [1]. In history, severe winds and huge waves (surges) have caused offshore oil rigs to overturn and cause serious casualties and property losses. For these reasons, all offshore oilfield companies will carry out typhoon-prevention emergency treatment before the arrival of the typhoon to ensure the safety of platform personnel and prevent or reduce property losses.

Typhoons that occur on a certain ocean surface often have the characteristics of strong suddenness, high intensity, and changeable paths [2]. The main characteristics of typhoon activity in the Western Pacific and South China Sea in 2018 [3] are: more typhoons are generated, and there are more typhoons that land in my country, but the overall landfall intensity is obviously weaker. The main characteristics of typhoon activity in the Western Pacific and South China Sea in 2019 [4] are: more typhoons are generated, and autumn typhoons are unusually active, but the intensity is weaker than the average intensity of previous years. The main characteristics of typhoon activity in the Western Pacific and South China Sea in 2020 [5] are: the total number of typhoons is small, and the source of generation is obviously westward; among them, August is more lively, and the total number of typhoons generated in October is higher than usual. Therefore, how to protect the life safety of offshore platform operators and offshore drilling platforms to the greatest extent has become the first issue we should face and solve.

Floating dock is a new type of offshore platform, which has the advantages of large water depth, good motion performance and strong resistance to harsh environment [6]. It can be used as a large warehouse to provide supplies for offshore exploration, or as a shelter for evacuations in the event of a severe typhoon.

The main research contents of this paper are as follows: According to the Central Meteorological Typhoon Network (Typhoon Network), the statistical analysis of typhoon activities is carried out. The main statistics are the level, path, sea area and high incidence time of the strongest typhoon in the past ten years. Statistical analysis of typhoon activity patterns. Thus, the foundation is laid for determining the location of floating wharf.

## 2. Materials and Methods

This article mainly USES the central meteorological network (network) typhoon typhoon typhoon data from 2010 to 2020, according to the national standard level of tropical cyclones, affecting our country sea area typhoon has carried on the statistics and analysis, the typhoon

huge network data, research mainly select the level of the typhoon, path, when the waters and high incidence of time were analyzed.

The basic idea of this study is to process the data of multiple groups of samples. 144 tropical cyclones affecting a certain sea were screened, and their life cycle was analyzed statistically and the interannual statistics were made.

# 3. Feature statistics of a certain sea typhoon

## 3.1 Overview of a typhoon in a sea

### 3.1.1 Typhoon intensity characteristics

According to the national standard of "Tropical Cyclone Classification" (GB T 19201–2006), the intensity of tropical cyclones is divided into the following grades [7].

TABLE 1. Tropical Cyclone Intensity Classification

| abbreviation | describe |
|---|---|
| | Unknown strength or weaker than tropical depression |
| TD | Tropical depression (10.8–17.1m/s, wind level 6–7) |
| TS | Tropical storm (17.2-24.4 m/s, wind level 8-9) |
| STS | Severe tropical storm (24.5–32.6 m/s, wind level 10–11 |
| TY | Typhoon (32.7-41.4 m/s, wind level 12-13) |
| STY | Severe typhoon (41.5–50.9 m/s, wind level 14–15) |
| SuperTY | Super typhoon (≥51.0 m/s, wind level≥16) |

Broadly speaking, "typhoon" does not only mean a tropical cyclone intensity, but refers to tropical cyclones (including tropical storms, severe tropical storms and typhoons in the above table 1) whose center wind speed continues at 17.2 meters per second and above. It's a typhoon.

### 3.1.2 Basic situation of a typhoon in a sea

Typhoons in a certain sea are mostly developed by tropical depressions or tropical depressions that move from the Pacific into the sea. From 2010 to 2020, the total number of tropical cyclones active in a certain sea accounted for 46.9% of the total number of cyclones generated in the entire Northwest Pacific. According to the statistics of the strongest intensity of tropical depression, tropical storm, typhoon, strong typhoon, and super typhoon in a certain sea, according to the statistical results, it is found that: A total of 27 tropical depressions occurred in

a certain sea area in 11 years, with an average of 2.45 times per year; there are 65 tropical storms, 5.9 times a year on average; there are 21 typhoons with an average of 1.9 per year; 25 strong typhoons with an average of 2.27 per year; and 5 super typhoons, with an average of 0.45 per year. It can be seen that tropical cyclones active in a certain sea are mainly tropical storms, accounting for 45% of the total. As shown in Figure 1.
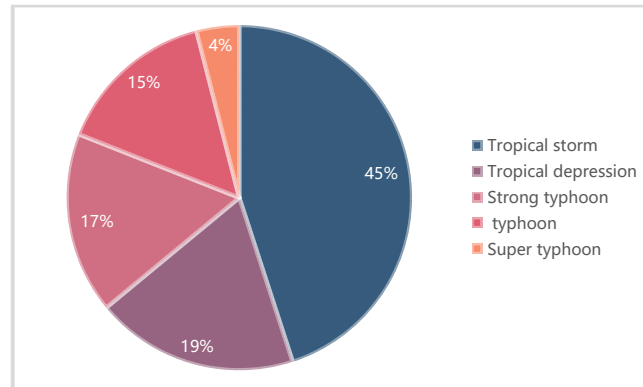


**Figure 1.** Proportion of typhoons of different intensities

Most tropical cyclones active in a certain sea come from the Northwest Pacific. 90 of the 144 tropical cyclones migrated from the Northwest Pacific, accounting for 62.5%. Of the 21 typhoons, 20 were external typhoons, accounting for 95.2% of the total. Among the 25 strong typhoons, 24 were external typhoons, accounting for 96% of the total. Of the 5 super typhoons, all 5 were foreign typhoons. But the tropical depression mainly originated in a certain sea. Among the 27 tropical depressions, a certain sea was generated 20 times, accounting for 74.1% of the total. Among the 66 tropical storms, 34 occurred in a certain sea, accounting for 51.5% of the total.

**TABLE 2.** Statistics On Typhoon Life in The South China Sea

| Lifetime T (hours) | Certain sea | Alien (generated in the Northwest Pacific and Philippine waters) | total |
|---|---|---|---|
| $T \leq 12$ | 4 | 5 | 9 |
| $12 < T \leq 24$ | 6 | 11 | 17 |
| $24 < T \leq 48$ | 19 | 39 | 58 |
| $48 < T \leq 72$ | 13 | 18 | 31 |
| $72 < T \leq 120$ | 6 | 18 | 24 |
| $T > 120$ | 6 | 2 | 8 |

The average lifespan of a typhoon in a sea is 35 hours. The average lifespan of a typhoon moving in from the Northwest Pacific is 28 hours. The longest lifespan is 5.3 days (1804 Aiyun EWINIAR), and the shortest is only 3 hours about. The longest life span of a typhoon generated in a certain sea area can reach 7.625 (1816 Bebinca), and the shortest is only 6 hours. The life span of typhoons (tropical cyclones) is mostly only 1-3 days, and the number of typhoons with

a life span of one day accounts for about one-fifth of the total. Typhoons with a lifetime of 5 days or more are more rare, as shown in TABLE 2. And Figure 2.
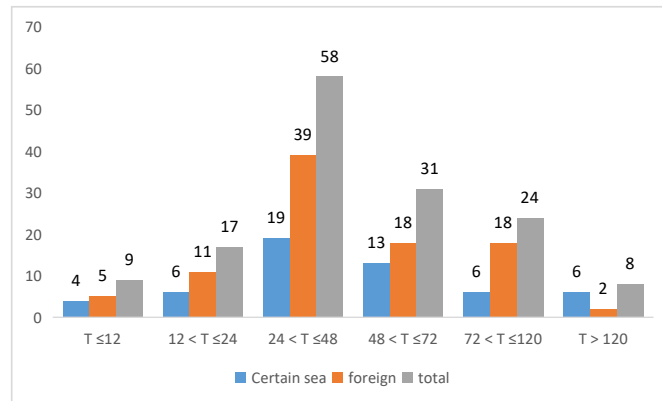


**Figure.2.** Life statistics of a sea

The typhoon in a certain sea varies greatly from year to year. In 2013, 2016 and 2017, there were 7 each, exceeding the average by 4.6; in 2018, the number was the least, with only one. Like typhoons, tropical storms in a certain sea also have obvious inter-annual variability characteristics. For example, there were 11 tropical storms in 2020, but only 3 in 2010 and 2015. A certain sea low pressure has the largest inter-annual difference. For example, there were 5 in 2011, but it did not appear in 2016. As shown in TABLE 3 and Figure 3.

**TABLE 3.** Statistics Of Tropical Cyclone Types Active in a Sea

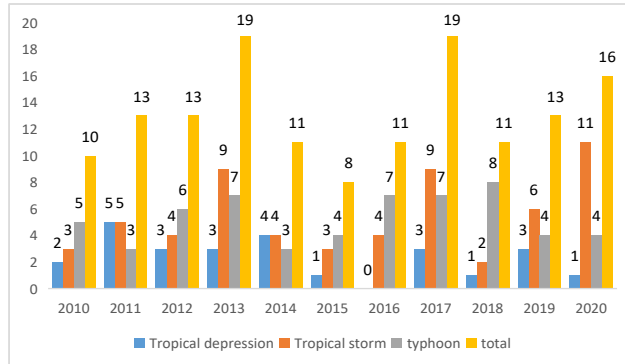| years | Tropical depression | Tropical storm | typhoon | Total |
|-------|---------------------|----------------|---------|-------|
| 2010 | 2 | 3 | 5 | 10 |
| 2011 | 5 | 5 | 3 | 13 |
| 2012 | 3 | 4 | 6 | 13 |
| 2013 | 3 | 9 | 7 | 19 |
| 2014 | 4 | 4 | 3 | 11 |
| 2015 | 1 | 3 | 4 | 8 |
| 2016 | 0 | 4 | 7 | 11 |
| 2017 | 3 | 9 | 7 | 19 |
| 2018 | 2 | 8 | 1 | 11 |
| 2019 | 3 | 6 | 4 | 13 |
| 2020 | 1 | 11 | 4 | 16 |

**Figure 3.** Interannual statistics of tropical cyclones active in a sea

In a certain sea area, there are typhoons (tropical cyclones) activities throughout the year, and there are obvious seasonal changes. According to statistics, there are very few typhoons active in a certain sea from January to April, and the total number of typhoons active in four months in 11 years is only 10 times. In contrast, typhoons active in a certain sea were mainly active from July to October, and the number of active events accounted for 63.9% of the total number of the year. As shown in TABLE 4 and Figure 5..Comparing the data of the typhoon moving in from the Northwest Pacific, it is found that the monthly changes are basically consistent with the changes of a certain sea typhoon, and the peaks are all in August. It can be seen from Figure 4 that the total number of tropical depressions, tropical storms, and typhoons active in a certain sea peaks in October, August, and October, respectively.

**TABLE 4.** Monthly Statistics of Typhoons in a Sea

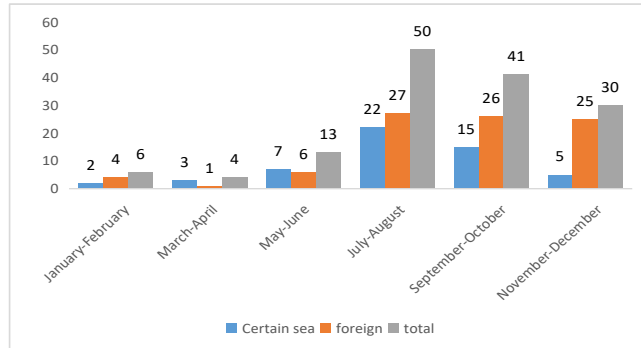|  | Certain sea | foreign | Total |
|---|---|---|---|
| January-February | 2 | 4 | 6 |
| March-April | 3 | 1 | 4 |
| May-June | 7 | 6 | 13 |
| July-August | 22 | 28 | 50 |
| September-October | 15 | 26 | 41 |
| November-December | 5 | 25 | 30 |

**Figure 4.** Monthly statistics of typhoons in a sea

The peak of tropical depression in a certain sea occurred 9 times in September-October; the peak of tropical storm occurred 24 times in July-August; the peak of typhoon occurred 23 times in September-October. As shown in TABLE 5.

**TABLE 5.** Monthly Statistics of Tropical Depression, Tropical Storm and Typhoon Active in a Certain Sea

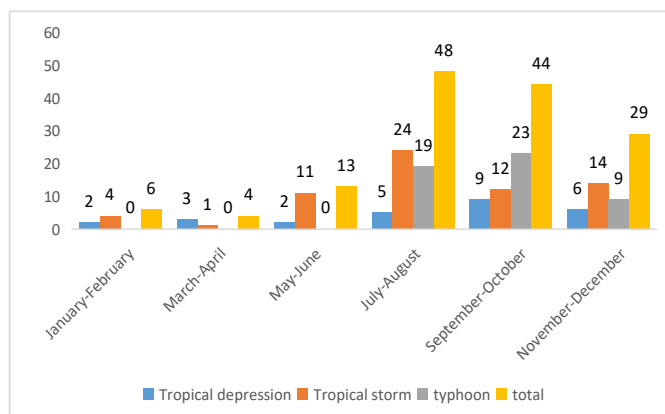|  | **Tropical depression** | **Tropical storm** | **typhoon** | **Total** |
|---|---|---|---|---|
| January-February | 2 | 4 | 0 | 6 |
| March-April | 3 | 1 | 0 | 4 |
| May-June | 2 | 11 | 0 | 13 |
| July-August | 5 | 24 | 19 | 48 |
| September-October | 9 | 12 | 23 | 44 |
| November-December | 6 | 14 | 9 | 29 |



**Figure 5.** Monthly statistics of tropical depression, tropical storm and typhoon active in a certain sea

### 3.2 General situation of typhoon on channel a island

### 3.2.1 A general situation of island reef

A island reef, one of the islands and reefs of a certain sandy archipelago in China [8]. The shape of the reef is an isolated annular reef. The A island reef is 26km southwest of the B island reef, with a shallow lake in the middle and no waterways. This is due to the complete development of the atoll reef. At present, the reef is actually controlled by our country and is administratively subordinate to City A. The water depth in the reef ranges from 10m to 22m, the maximum water depth is about 24m, and the area is about 7 square kilometers. Some reefs of A reef are exposed at low tide and submerged at high tide. There is a narrow reef gate in the southern part of the reef that leads to the sea, so only small boats can enter the inner lagoon, and large ships can only dock outside the atoll.

### 3.2.2 Overview of Typhoon a Island Reef

From 2010 to 2020, according to the longest distance from A island reef not more than 1000km, there are 97 typhoons passing through a island reef, among which the distance of 1829 Usagi USAGI is the closest, which is 21.762km; the 1510 Lotus LINFA is the farthest distance, which is 992.399km. According to the highest intensity, both Haiyan 1330 and MOLAVE 2018 are strong typhoons with a speed of 45m/s, but the 2018 MOLAVE is closer to a island reef at 266.045km. TABLE 6 shows the survey of typhoons on island A through the past ten years.

**TABLE 6**. Typhoon Statistics on Route a Island Reef

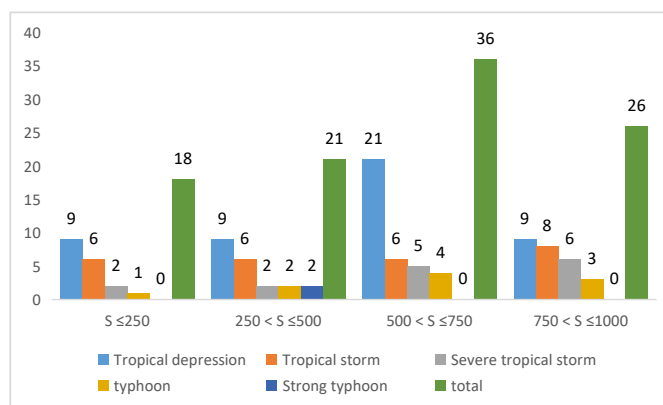|  | Tropical depression | Tropical storm | Severe tropical storm | typhoon | Strong typhoon | total |
|---|---|---|---|---|---|---|
| *S ≤250* | 9 | 6 | 2 | 1 | 0 | 18 |
| *250    S ≤500* | 9 | 6 | 2 | 2 | 2 | 21 |
| *500    S ≤750* | 21 | 6 | 5 | 4 | 0 | 36 |
| *750    S ≤1000* | 9 | 8 | 6 | 3 | 0 | 26 |



**Figure 6.** Statistical Chart of Typhoon Situation on Island Reef A

In the past ten years, a island reef has only experienced two strong typhoons, the distance from a island reef is more than 250km, and a island reef is a circular island reef, which has good natural conditions. As shown in Figure 6.Thus, it can be used as an alternative to the placement of floating piers.

## 4. Conclusions and Outlook

### 4.1 Conclusions

Based on the fact that the frequent occurrence of typhoons in a certain sea has a great impact on the safe operation of offshore drilling platforms, and because offshore exploration cannot quickly evacuate to land when encountering strong typhoons, the structure of the platform is damaged, equipment damage, and even casualties. We research on related issues to protect the life safety of the drilling platform and the personnel on the platform to the greatest extent. The conclusions are as follows:

The statistics of the relevant basic situation of a certain sea typhoon year by year and month by month in the past ten years are as follows:

1） From 2010 to 2020, the total number of tropical cyclones in a particular sea area accounted for 46.9 per cent of the total number of cyclones generated in the entire northwest Pacific region. Tropical cyclones are active all year round, and the majority of tropical cyclones originate in the Northwest Pacific, and show obvious seasonal variation.

2） Tropical cyclones in a sea are mainly tropical storms, accounting for 45% of the total number.

3） The peak of tropical depression, the peak of tropical storm and the peak of typhoon occurred from September to October.

4） Most of the typhoons generated in a certain sea are exotic typhoons, and the annual variation of a certain sea typhoon is large,

5） The average life span of a sea typhoon is 35 hours, among which the average life span of the typhoon moving from the northwest Pacific Ocean is 28 hours, the longest life span can reach 5.3 days, and the shortest is only about 3 hours.

6） A island reef has only experienced two strong typhoons in ten years, and A island reef is a circular island reef, which has good geographical location and natural conditions. Therefore, A island reef can be listed when choosing the location of the floating pier. Taken into consideration

### 4.2 Outlook

• With the development of offshore oil and gas exploration, it is a problem that we must face and solve to ensure the safe and efficient operation of offshore production facilities and the personal safety of offshore personnel after an offshore drilling platform encounters a typhoon.

Although this article has studied the characteristics of a certain sea typhoon, there are still some shortcomings, which need to be further studied and improved in the future:

• Due to insufficient data from the weather station, it is impossible to determine the wind circle radius of the typhoon at each level and the wind field of the typhoon, which will have a certain impact on the choice of evacuation path.

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