Case Study on Characteristics of Satellite Cloud Maps of a Very Complex Anomalous Typhoon Track

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Abstract

The anomalous typhoon track is very difficult to be forecasted. The very complex, queer typhoon, even though very few, is not able to be predicted and some are difficult to be explained after even the event. In this paper, a case study on a queer track of Typhoon 9119 (Nat) is done. It shows that, satellite cloud maps can not only explain the queer track of Nat very well, but also give a good forecasting during its two stages of tropical storm-typhoon intensity ,

1 Introduction

The movement track of typhoon can be classified into two categories: normal and anomalous. Normal tracks are mainly westward, northwestward and recurve toward north in a parabola-like track. All kinds of forecasting method can basically predict normal typhoon tracks. However, anomalous typhoon tracks are the first difficult forecasting point because they are very difficult to be predicted. There are 8 kinds of anomalous typhoon track features: looping, stagnating, moving eastward or northward in lower latitude, suddenly turning northward near the coast in lower latitude, moving westward in a long distance in middle--higher latitude, suddenly turning westward in middle--higher latitude, snake-like swaying, rotating each other of binary typhoons (Bao, 1980). Statistics of data in 1970--1991 showed that, on the NW Pacific Ocean, normal typhoon track is about 66%, while anomalous is about 34%. Among them, very few, only 8 typhoons had a very complex, queer track which is defined as typhoon track with 3--4 anomalous characteristics (Bao & Xiang, 1993). They were not able to be predicted and some were difficult to be explained even after the event.

2 Typhoon 7203

Typhoon 7203 (Rita) is a very famous example in history. It lived as long as 26 days. During its moving toward northwest process over the NW Pacific, it looped twice. When it entered into the East China Sea, an anomalously track change was observed. Within 4-5days, Rita looped as a very big circle over sea surface of about 500×500 km^2 to the west of Ryukyu Islands, then moved northward. On July 25, 1972, a very strong long-wave trough situated at 110^0-120^0E and extended even to25^0N, and the subtropical high situated at the Sea of Japan and oriented from south to north (Fig. 1a). Therefore, weather services of many countries forecasted that Rita would turn toward northeast and enter into the Sea of Japan. In fact, one day later on July 26, Typhoon 7203 suddenly turned northwest and landed on Tianjin, then passed through Beijing and disappeared at eastern part of Mongolia. It caused a very severe disaster in northern coastal regions of China. Study after event (Chen, 1979) showed that, an upper level cold vortex was suddenly cut off and moved southward while the subtropical high intensified and moved westward (Fig. 1b). As a result, Typhoon 7203 suddenly turned westward.

3 Track of Typhoon 9119

Both of Typhoons 8616 and 9119 lived about 20-21 days. During a time period of about half a month, they moved and turned toward all direction many times over the northwest part of the South China Sea. Their moving tracks are very complex, so that many times of forecasting were wholly wrong. A case study on Typhoon 9119 (Nat) is done in this paper. It appeared to the east of Phillippines on September 14, 1991, moved westward through the Bashi Chain, entered into the South China Sea and developed into a tropical storm on Sept. 16. It suddenly turned eastward on the 18th and out of the Bashi Chain on the 19th. It developed into a typhoon on the 21st, then moved westward again. It passed through the most south part of Taiwan Island and entered into the South China Sea second times on the 23rd. It rapidly weakened on the 24th and moved southward, it moved eastward and turned westward to the west of Phillippines on Sept. 26-27. It intensified as a tropical storm again on the 29th and turned northward and finally, landed on Shantou District, Guangdong Province at nighttime of October 1 (Fig. 2). During its life time, It had developed to tropical storm--typhoon intensity twice. The very complex movement of Typhoon 9119 closely related to the environmental flow field, especially the subtropical high and the binary-typhoons rotation of Typhoon 9118 (Luke) and 9120 (Mireille) to Typhoon 9119 (Fig. 3).

4 Satellite cloud maps during Typhoon 9119

The characteristics variation of satellite cloud maps of Typhoon 9119 is studied detailedly in this paper (Bao, 1981). It is showed that satellite cloud maps can explain the queer track of Typhoon 9119 very well. Both of Luke and Nat intensified into tropical storms on the 16th, moved in an enough distance less than 15 degree latitudes, they rotated each other (Bao et al, 1986). On the 17-18th (Fig, 4a), a very strong and long cloud belt coming from the southwest to the east of Nat-Luke which means a strong lower-level equatorial SW wind. As a result (Bao et al, 1987), Nat first time suddenly turned eastward. And it moved eastward continuously under the effect of Southwest cloud belt until the 21st. After then, another strong typhoon Mireille came nearer and nearer. The relative rotation between binary-typhoons caused Nat suddenly first time turned westward (see Fig. 3b). On the 24-26, Nat moved westward and southward under effect of strong cloud system of typhoon 9120 and the clear sky area of the subtropical high to its north (Fig. 4b). At the same time, Nat weakened very rapidly and became a weak tropical deprssion with very weak cloud system after the 26th. On the 29-30th, Nat intensified again into a tropical storm and appeared as a vortex cloud system with very long and strong cloud belt coming from the equatorial area to its east side (Fig. 4c). As a result, Typhoon 9119 moved northward (Bao et al, 1995) and finally landed on Shantou District on October 1. It means that, even for the very complex track, satellite cloud can not only give a very good explanation, but also give a good forecasting during two stages of tropical storm--typhoon intensity.

References

Chen L. S.: Analysis on the suddenly turning westward of typhoon over the seas east of China, Sci. Atmos. Sinica, 1979 No. 3, 289-298.

Bao C. L.: "Tropical Synoptic Meteorology", China Sci.Press, 1980, 268 pp.

Bao C. L.: Forecasting typhoon movement based on satellite cloud maps, UHMET, 81-03, Univ. of Hawaii, 1-26.

Bao C. L., Ruan J. S., Zhu Y. J.: Fujiwhara effect and environmental flow field affecting on rotation of binary-typhoon, China Sci. Bull., 1986, Vol. 3, No. 1, 49-52.

Bao C. L., Xu H. M., Xu L.: Study on typhoon track suddenly turning eastward and northward at lower latitudes, "Collecting Papers of Conf. on Typhoon in 1985", China Met. Press, 1987, 38-46.

Bao C. L., Xiang Y. Z. : Relationship between El Nino event and atmospheric circulation, typhoon activity and flooding, "Proc. of 2nd Intern. Conf. On East Asia and W. Pacific Met. & Climate, Sept. 1992, Hong Kong", 1993, 239-249.

Bao C.L. Shi G Q.: Characters of typhoon track in summer of 1993, J.of Natural Disasters, 1995, Vol.4, No.2, 91-97.

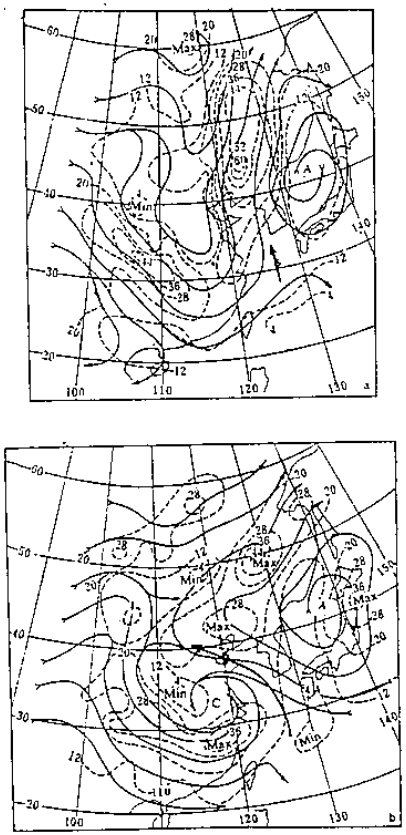


Fig. 1 300 mb streamline and isotach during Typhoon 7203 period
a. 12Z July 25, 1972 b. 12Z July 26, 1972

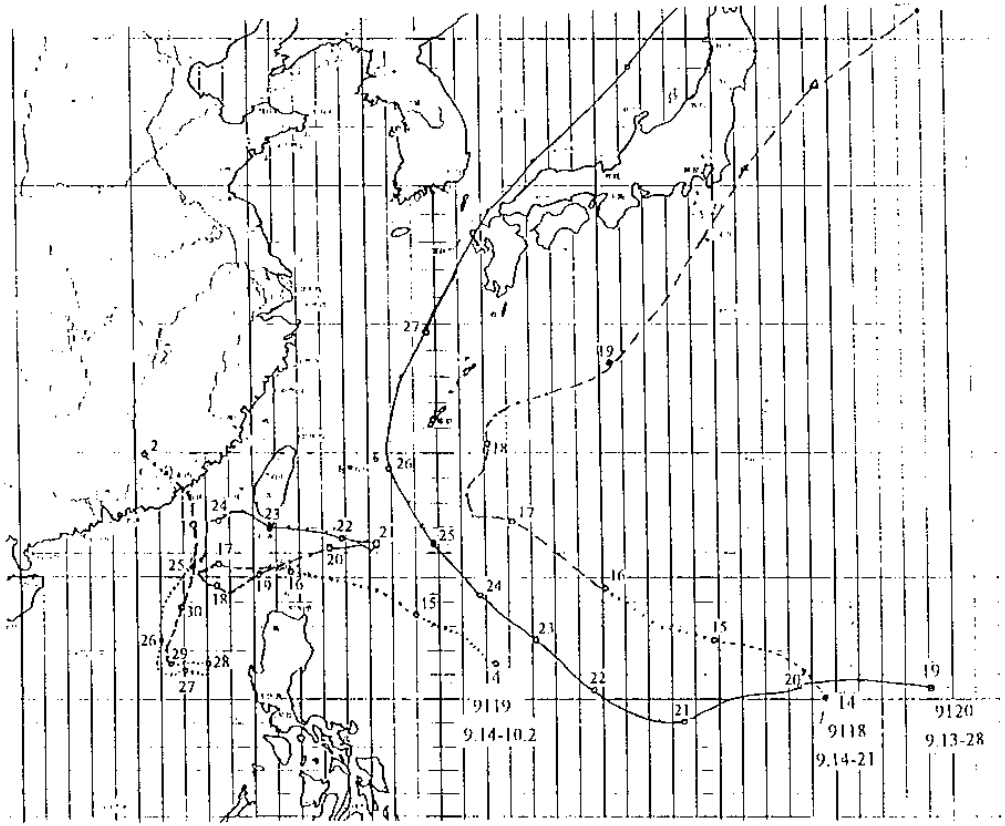
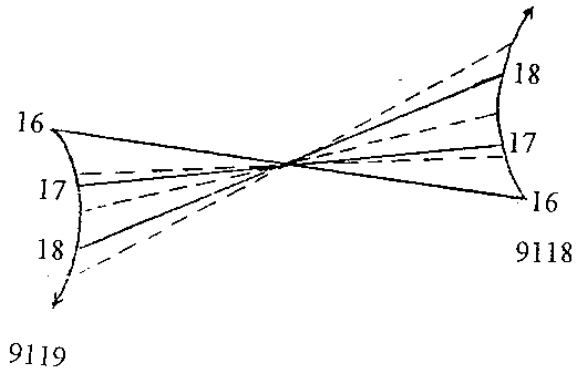


Fig. 2 Moving tracks of Typhoons 9119, 9118 and 9120 in September, 1991



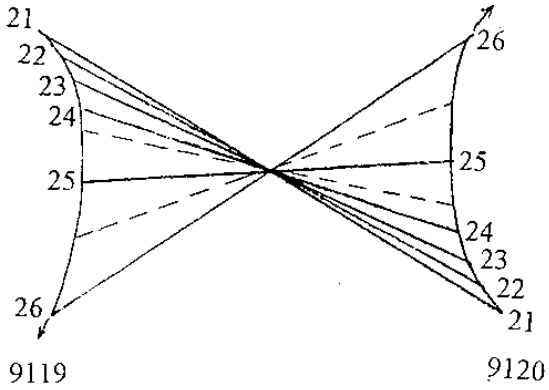


Fig. 3 Relative rotation between Typhoon 9119 with 9118 and 9120

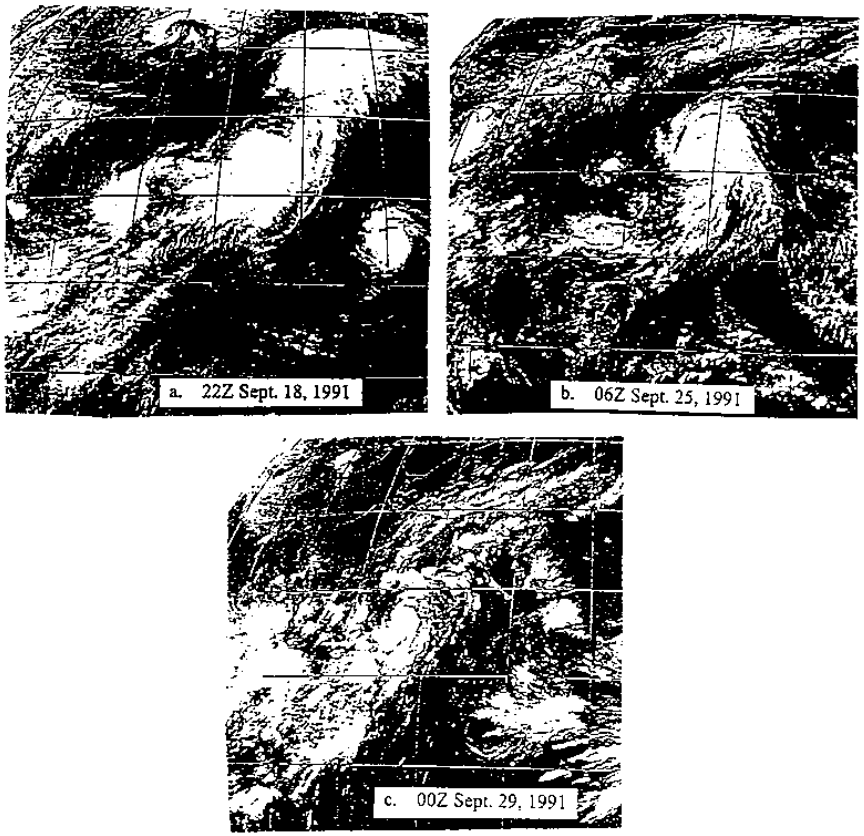


Fig. 4 Satellite cloud maps during Typhoon 9119 period