Development of typhoon forecasting system using satellite data

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Abstract

Typhoons were known by contributing to transporting plus heat or kinetic energy from equatorial region to midlatitude region. Due to the strong damage from typhoon, we acknowledged the theoretical study and the importance of accurate forecast about typhoon. In this study, typhoon forecasting system was developed to search the tracks of past typhoons or to display similar track of past typhoon in comparison with the path of current forecasting typhoon. It was programmed using Interactive Data Language(IDL), which was a complete computing environment for the interactive analysis and visualization of data. Typhoon forecasting system was also included satellite image and auxiliary chart. IR, Water Vapor, Visible satellite images helped users analyze an accurate forecast of typhoon. They were further refined the procedures for generating water vapor winds and gave an initial indication of their utility for numerical weather prediction(NWP), in particular for typhoon track forecasting where they could provide important information. They were also available for its utility in typhoon tracer or intensity.

1. Introduction

From 1951 to 1998, it happened about 1300 cases of typhoon. First, it was constructed as typhoon database. Second, typhoon track displaying system was established to visualize yearly typhoons. It could be analyze the characteristics of typhoons per year. There were several forecasting methods of typhoon path. In this study, analogue method was used. Analogue method has played a key role in searching and displaying the track of typhoon which was similar to the path of current typhoon from the past typhoon cases.

Cloud-drift winds using satellite were derived by image at hourly intervals, half-hourly. These techniques could be enhanced path of typhoon, intensity forecast by initialization of the typhoon forecast model or indication of the accurate location for the typhoon center(Le Marshall, 1998). In this case, They were described in section 3 and examples were given of the application and utility of the wind data in August 1999.

2. Typhoon forecasting system

Typhoon forecasting tool established using IDL is summarized in Table 1. It is made of 11 button lists which indicate their functions. The easiest way to allow user to interact with your application is through a button click. Users can have button widgets display window which is selected by its function. Fig. 1. provides an example of main screen generated at typhoon forecasting system. Typhoon forecasting system could display yearly typhoons. It could show typhoon tracers in the year of El Nino or La Nina. It could be also compared with characteristics of yearly tracers about typhoon. A sample of yearly tracers about typhoon based on strong El Nino can be seen. Fig. 2 shows yearly tracers about typhoon in 1982 case(a) and 1997 case(b). Differences of these tracers and occurrence numbers of typhoon are shown in Fig. 2(a) and Fig. 2(b). Case study was examined the tracers of typhoon using satellite image. This analysis includes three typhoon cases. One of the case studies includes typhoon TINA as a normal path in 1997. Other case studies can be analyzed into typhoon TODD, YANNI as a abnormal path in 1998.

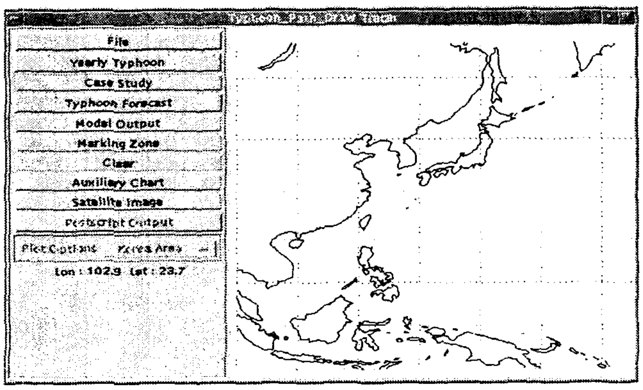
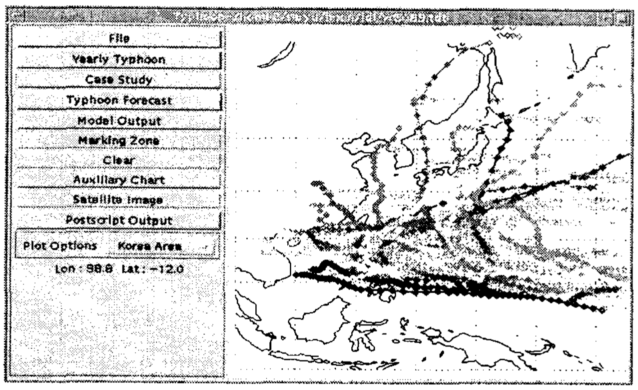


Fig. 1. Typhoon forecasting system main screen

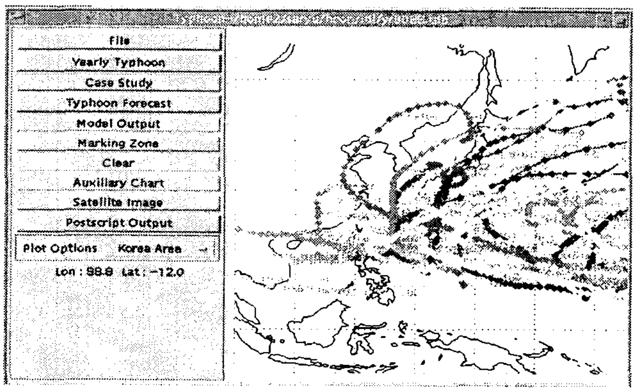
Table 1. Composition of typhoon forecasting tool

Menu	Function
File	Select typhoon DB which users want to display
Yearly Typhoon	Display yearly tracers about typhoon
Case Study	Case study of typhoon (1997 : typhoon TINA) (1998 : typhoon TODD, YANNI)
Typhoon Forecast	When it occurs a current typhoon, users input the location of typhoon, and then it is generated as a current typhoon DB.
Model Output	Indicate latitude, longitude, maximum wind speed of center, dangerous radius during forecasting time (KMA, USAF, JAPAN Model)
Marking Zone	Classify emergency zone(red), warning zone(blue), watching zone(yellow)
Clear	Use when users are free from anything that displays
Auxiliary Chart	Animate streamline, thickness, pressure in course of auxiliary chart
Satellite Image	Animate IR, Water Vapor, Visible images
Postscript Output	Save image of displayed area as postscript file
Plot Options	Choose the forecasting area which users want to be interested in

Typhoon forecasting tool includes satellite image and auxiliary chart associated with case study. In Fig. 3, to illustrate typhoon YANNI, IR, Water Vapor, Visible satellite images about typhoon YANNI case are selected.



(a) Typhoon tracks of El Nino events in 1982 (occurrence number of typhoon is 25).



(b) Typhoon tracks of El Nino events in 1997 (occurrence number of typhoon is 28).

Fig. 2. A comparison of the yearly typhoons with tracers using typhoon forecasting system. Upper panel (a) is in 1982 case and lower panel (b) is in 1997 case.

Fig. 4 shows a sample of input forecasting location of typhoon OLGA in 1999. This location of circle indicates 6 hours later, 12 hours later, 18 hours later respectively. But in general case the locations of circle indicates 12 hours later, 24 hours later, 36 hours later in typhoon forecasting system. Analogue method was used for searching and displaying the track about typhoon which is similar to the path of

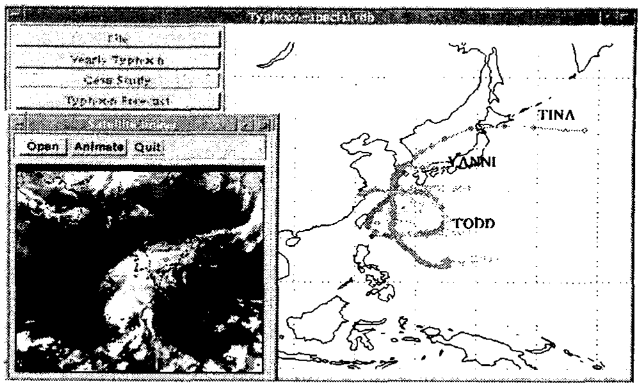


Fig. 3. Case studies of typhoons(normal path: typhoon TINA in 1997, abnormal path: typhoon TODD, YANNI in 1998) using satellite image.

typhoon YANNI from the past typhoon cases. As a consequence, typhoon BRENDA in 1985 was selected as a analogue path of typhoon YANNI. In Fig. 5 typhoon YANNI track is displayed along by similar path for typhoon BRENDA. Once it occurs rain, rain contour will be plotted in typhoon forecasting tool and in this case rain contour is illustrated (Figure not shown). As soon as users click Postscript Output button menu, graphic output will be directed as a postscript file.

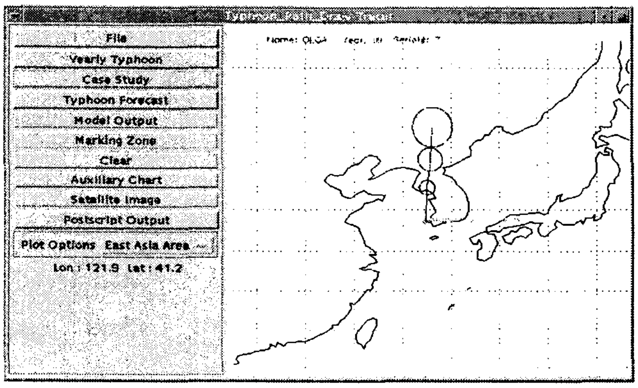


Fig. 4. A sample of input forecasting location of typhoon OLGA in 1999.

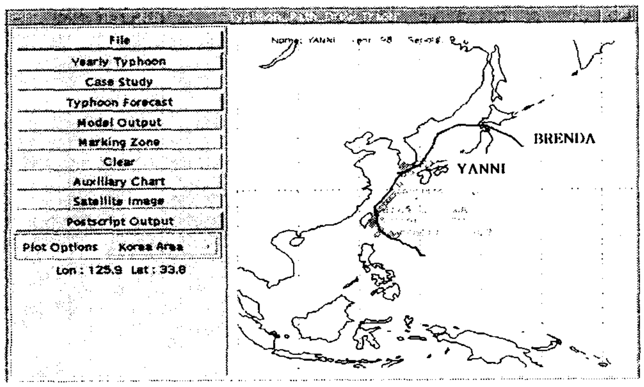


Fig. 5. Example of similar typhoon path using analogue method.

3. The study of winds generated around typhoon using satellite data

Four times per day, around 05, 11, 17 and 2300 UTC, Cloud-drift winds based on GMS-5 satellite image are generated half-hourly, using three successive GMS images, separated by half an hour(Le Marshall *et al.*, 1998). These are tracked using a NWP model forecast of wind velocity to initiate the search for selected targets on subsequent images. The height assignment of these cloud-drift winds uses a method similar to that associated with the determination of height with cloud-drift winds and using based tests and forecast model wind estimates, then provides wind vectors(Le Marshall, 1994). Current study is operated using IR, Water Vapor, Visible satellite images generates winds. An example of the distribution of winds over the korea region is seen in Fig. 6. Cloud-drift winds are derived using Visible, IR, Water Vapor satellite image at half-hourly intervals for 0500 UTC on 6 August 1999 and wind data are extracted from low-level to high-level near the Korea region. The stars(*) indicate the positions of tracers used for tracking. On the other hand, Fig. 7 shows the wind vectors plotted over 6.7μm GMS-5 Water Vapor image. It represents wind height level(hPa) and speed(m/sec) each wind. Fig. 7 illustrates winds near the low pressure located in southern part of Japan. The complementary nature of the cloud-free water vapor motion vectors is evident, with vectors of the cloud-free area providing middle-level wind information.

4. Summary and conclusion

Typhoon forecasting system using satellite data was developed to search the tracks of past typhoons or to display similar track of past typhoon in comparison with the path of current forecasting typhoon. It was a based application designed to optimize the forecasting process at typhoon study. The system provides access to current and past cyclone data. It provides the tools required to track, forecast and generate warnings for typhoon. In conclusion, it can be seen that system has the capacity to enhance current analysis and prognosis accuracy with improving typhoon forecasting technology.

IR, Water Vapor, Visible satellite images help you analyze an accurate forecast about typhoon. They further was refined the procedures for generating water vapor winds and gave an initial indication of their utility for numerical weather prediction, in particular for typhoon track forecasting where they can provide important information. They are also available for their utility in typhoon tracer or intensity.

5. Reference

Le Marshall, J., Pescod, N., Seaman, R., Mills, G. and Stewart, P. 1994. An operational system for generating cloud drift winds in the Australian region and their impact on numerical weather prediction, *Weather forecasting*, 9, 361-370.

Le Marshall, J., Pescod, N., Seecamp, R., Puri, K., Spinoso, C. and Bowen, R., 1998. Local estimation of GMS-5 water vapour motion vectors and their application to Australian region numerical weather prediction. *Aust. Met. Mag.*, 48, 73-77.

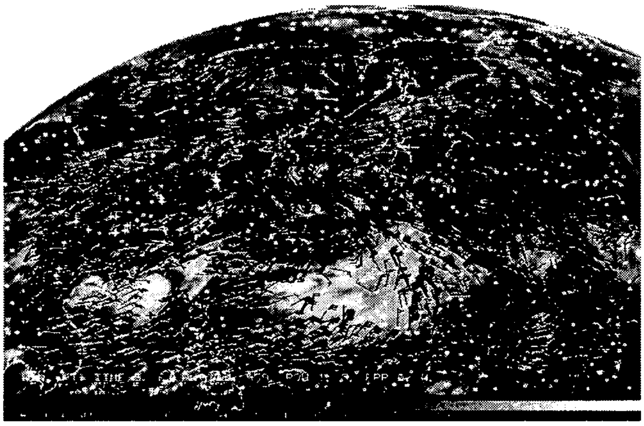


Fig. 6. The results of cloud-drift winds generated from GMS-5 satellite images(Visible, IR, Water Vapor image) around 0500 UTC on 6 August 1999.

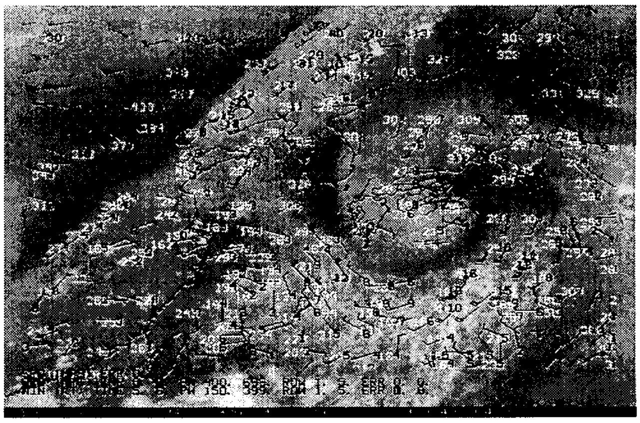


Fig. 7. The results of cloud-drift winds generated from GMS-5 water vapor satellite images around 0500 UTC on 10 August 1999.