

Comments on the Accuracy of TIROS Hurricane Locations

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1. Introduction

In a recent article, Hubert and Timchalk (1964) discussed the accuracy of TIROS hurricane locations. They compared estimates made from TIROS pictures with operational aircraft reconnaissance fixes. A slightly different comparison was made on Atlantic tropical storms during the past two summers (1963–1964) at the National Hurricane Center. The approach differs from the earlier study in two ways: 1) the “best track” was used as a standard rather than aircraft positions, and 2) weaker storms were considered, i.e., tropical storms and depressions.

The “best track” for each storm is determined after the hurricane season utilizing the complete collection of data. The objective is to minimize either random or

systematic errors from individual reports. Often it is necessary to adjust reconnaissance positions considerably. In some cases, TIROS data are used to arrive at the “best track.” This is particularly true in the central and eastern Atlantic. Comparisons were made only along that portion of the track for which there was sufficient conventional data to determine an accurate storm position independent of TIROS.

TIROS positions were obtained either from operational nephanalyses or from storm messages issued by the National Weather Satellite Center.

Storms used in this study are listed in Table 1 along with the number of TIROS fixes and range of error. A total of 54 storm positions were examined; 35 hurricanes, 9 tropical storms and 10 depressions. Fig. 1

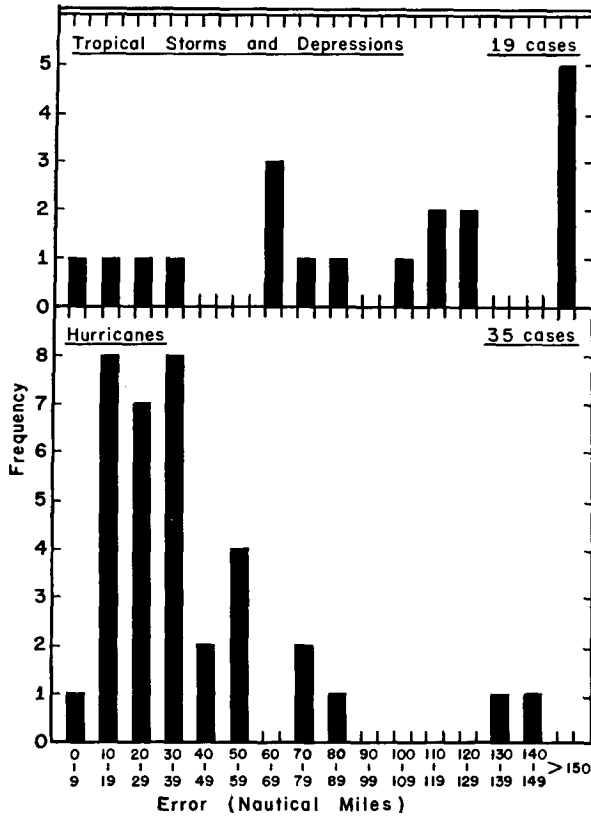


FIG. 1. Frequency of TIROS position errors by 10 nautical mile intervals.

shows the frequency of location errors by 10 nautical mile intervals. Depressions and storms have been grouped together in this figure.

2. Hurricanes

The median error for hurricanes was 30 nautical miles. This compares with a value of 45 miles found by

Hubert and Timchalk (excluding TIROS III estimates). The hurricane errors ranged up to a maximum of 145 miles in hurricane Gladys on 14 September 1964.

The reason for the lower error in the current study is unknown. Possible explanations include:

- a) Systematic differences between typhoons and hurricanes. Most of the storms in the Hubert-Timchalk paper were typhoons. Perhaps hurricane positions are easier to estimate. This seems unlikely.
- b) Errors in the standard of reference. Deviations determined from reconnaissance fixes may be contaminated by aircraft navigation errors. This was suggested in the previous paper when the authors concluded that the deviations from aircraft positions are probably greater than the true error.
- c) Improvement of skill with time. Hubert and Timchalk looked at 1961 and 1962 typhoons while storms examined in this study occurred in 1963 and 1964. Understanding of cloud systems is rapidly improving. This is leading to better interpretation of cloud pictures. Intuitively, one would expect TIROS fixes to show similar progress. The plausibility of this suggestion is enhanced by noting the error reduction in the past two years. The median error for 1963 hurricanes was 37 miles compared with 25 miles in 1964.

3. Tropical storms and depressions

The increased difficulty in choosing a center in weaker cyclones is reflected in the results for tropical storms and depressions where the median errors were 75 miles and 105 miles, respectively. The maximum error in a tropical storm was 300 miles. This occurred at rather high latitudes in the unnamed storm of 1963. Extra-

TABLE 1. Location errors for storms used in the study.

Storm	Year	No. of fixes	Range of error in nautical miles					
			Hurricane		Storm		Depression	
			Min	Max	Min	Max	Min	Max
Arlene	1963	8	20	130	—	—	30	120
Beulah	1963	3	50	75	—	110	—	—
Unnamed	1963	2	—	—	210	300	—	—
Debra	1963	3	—	—	—	150	—	180
Edith	1963	3	30	—	—	—	65	80
Ginny	1963	7	12	40	—	12	—	—
Depression	1964	1	—	—	—	—	120	—
Cleo	1964	11	6	80	—	60	0	—
Dora	1964	3	23	30	—	60	—	—
Ethyl	1964	4	10	30	—	75	190	—
Gladys	1964	6	12	145	—	—	—	—
Hilda	1964	3	18	30	—	20	—	—

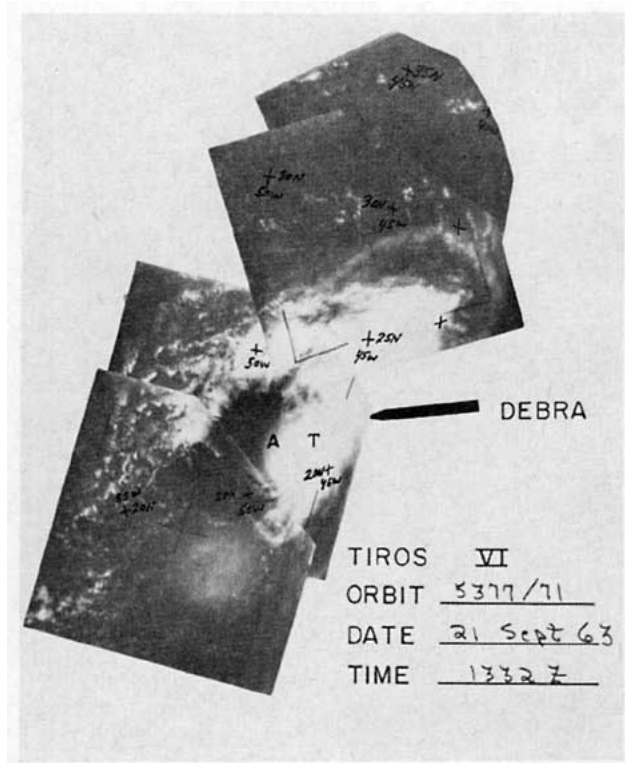


FIG. 2. TIROS picture of tropical storm Debra. The center position estimated from this picture is indicated by the "T." The "A" shows where aircraft found the center.

tropical cyclogenesis complicated the position estimates. The 150 mile error shown for Debra, 1963, is probably more realistic in tropical latitudes. The highest deviation in a depression was 190 miles.

The complications of picture interpretation in weaker lows is illustrated in Fig. 2 which shows tropical storm Debra on 21 September 1963. The TIROS position (T) appears to be a good estimate. However, reconnaissance aircraft found the wind eye (A) 150 miles to the west along the edge of the cloud shield. The flight meteorologist on board stated there was no wall cloud. He observed a heavy cloud band to the east and the western semicircle was clear.

The photograph of Debra also shows a common systematic error in TIROS positions. There is a tendency to place the center within the main overcast area which is generally situated to the east. This is shown in Fig. 3 where the TIROS fixes for tropical storms and

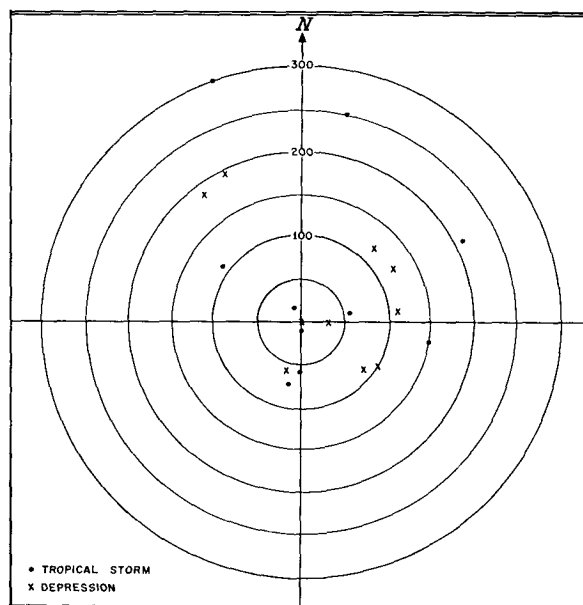


FIG. 3. Apparent TIROS position errors (nautical miles) for Atlantic tropical storms and depressions for 1963-64. The true cyclone position is assumed at the center of the diagram.

depressions are plotted relative to the "best track" position. The true storm location is assumed at the center of the diagram. TIROS estimates are clustered to the east. Hurricanes are very asymmetric in the formative stage with the main cloud bands usually located in the eastern semicircle. The same is true of fully developed hurricanes but to a lesser degree.

4. Conclusions

The results shown in this note substantiate the statement made by Hubert and Timchalk that "the error is probably closer to 30 to 40 miles, although it will deviate from the aircraft fixes, on the average, 50 nautical miles."

The TIROS positions for cyclones of lesser intensity (depressions and tropical storms) are considerably poorer than in hurricanes. There is a systematic tendency to choose the center within the main overcast area which usually lies in the eastern semicircle.

REFERENCE

- Hubert, L. F., and A. Timchalk, 1964: Accuracy of TIROS hurricane location. *J. Appl. Meteor.*, 3, 203-205.