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DOUBLE INTENSIFICATION OF TYPHOON GLORIA, 1974 AND A BRIEF REVIEW OF SIMILAR OCCURRENCES

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JANUARY 1976

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ABSTRACT

In November 1974 Typhoon Gloria displayed unusual intensity fluctuations while traversing the Philippine Sea. The typhoon exhibited two marked intensifications separated by a period of weakening lasting 12 hr. A chronological examination of this unusual behavior utilizing aircraft reconnaissance and satellite data is presented with particular emphasis on the evolution of the central core region. A parallel between observed events, and results demonstrated in a tropical cyclone numerical model responding to artificial enhancement of the convective heating functions is noted. Similar occurrences of double deepening of typhoons in the western Pacific are reviewed to determine Gloria's uniqueness.

LIST OF ILLUSTRATIONS

FIGURE 1. Track of typhoon Gloria during the period 2-9 November 1974

FIGURE 2. Central sea-level pressures in typhoon Gloria, reported by reconnaissance aircraft for 03-07 November 1974.

FIGURE 3. Typhoon Gloria, 0241Z 05 November 1974 near first peak intensity (DMSP data).

FIGURE 4. An expanded view of Figure 4 (DMSP data).

FIGURE 5. An expanded view of typhoon Gloria, 2234 GMT 05 November 1974 after marked filling of central pressure (DMSP data). Surface center (A) is located west of hole in cirrus canopy.

FIGURE 6. An expanded view of typhoon Gloria at 1117 GMT 06 November 1974. (Nighttime infrared DMSP data/ Darker shades of gray represent coldest temperatures).

FIGURE 7. Sequence of Aircraft Radarscope sketches of typhoon Gloria's central core region, 5 November 1974.

FIGURE 8. Segment of typhoon tracks displaying double intensification. Segment is period between termination of 1st deepening and commencement of 2nd deepening (1956-1974). Tracks are identified by first letter of name and year of typhoon.

INTRODUCTION

Mature hurricanes or typhoons traversing tropical waters and unaffected by land masses infrequently display two marked intensification periods. Even more infrequent is a reintensification within a day of the first intensity peak.

During 4-7 November 1974 Typhoon Gloria exhibited unusual intensity fluctuations while traversing the Philippine Sea. The typhoon underwent two rapid deepenings separated by a period of filling lasting approximately 12 hr. The unusual character of this event opposed to typical tropical cyclone behavior is worthy of note.

In this paper a chronological examination of Gloria's history is presented. In particular, major changes in the central core region after the first intensification documented by aircraft reconnaissance are examined. A parallel between observed events, and those demonstrated in particular tropical cyclone numerical models is noted while similar occurrences of double deepening of typhoons are reviewed to determine Gloria's uniqueness.

TRACK REVIEW

Typhoon Gloria developed from a monsoon trough circulation in the western Caroline Islands and was first detected on November 2nd (Fig. 1). Intensifying to typhoon force north of Yap Island two days later, Gloria accelerated to 12.3 m/sec on the 4th and deepened at a rate of about 2 mb/hr. Early on the 5th, Gloria terminated its initial deepening stage at 937 mb and slowed to 7.7 m/sec about 835 km east of Luzon (Fig. 2). Sustained surface winds of 54.0 m/sec at this time were estimated based on the central pressure (Atkinson and Holliday, 1975). A sudden pressure rise followed as Gloria continued to decelerate on the 5th, while turning on a track slightly south of west. Late that day, the central pressure leveled off at 955 mb, and the typhoon's forward movement slowed to 3.6 m/sec about 520 km east of Luzon. Sustained surface winds weakened 17% to 44.8 m/sec as estimated from the central pressure. At this time, a second rapid deepening commenced as the typhoon doubled its forward speed to 8.2 m/sec. An extrapolation of the pressure fall rate determined by final aircraft fixes 12 hr from landfall indicated Gloria reached a minimum central pressure of about 916 mb prior to hitting Luzon. Based on this central pressure, the sustained surface winds were estimated to be 64.3 m/sec, a 44% increase during the typhoon's second deepening period.

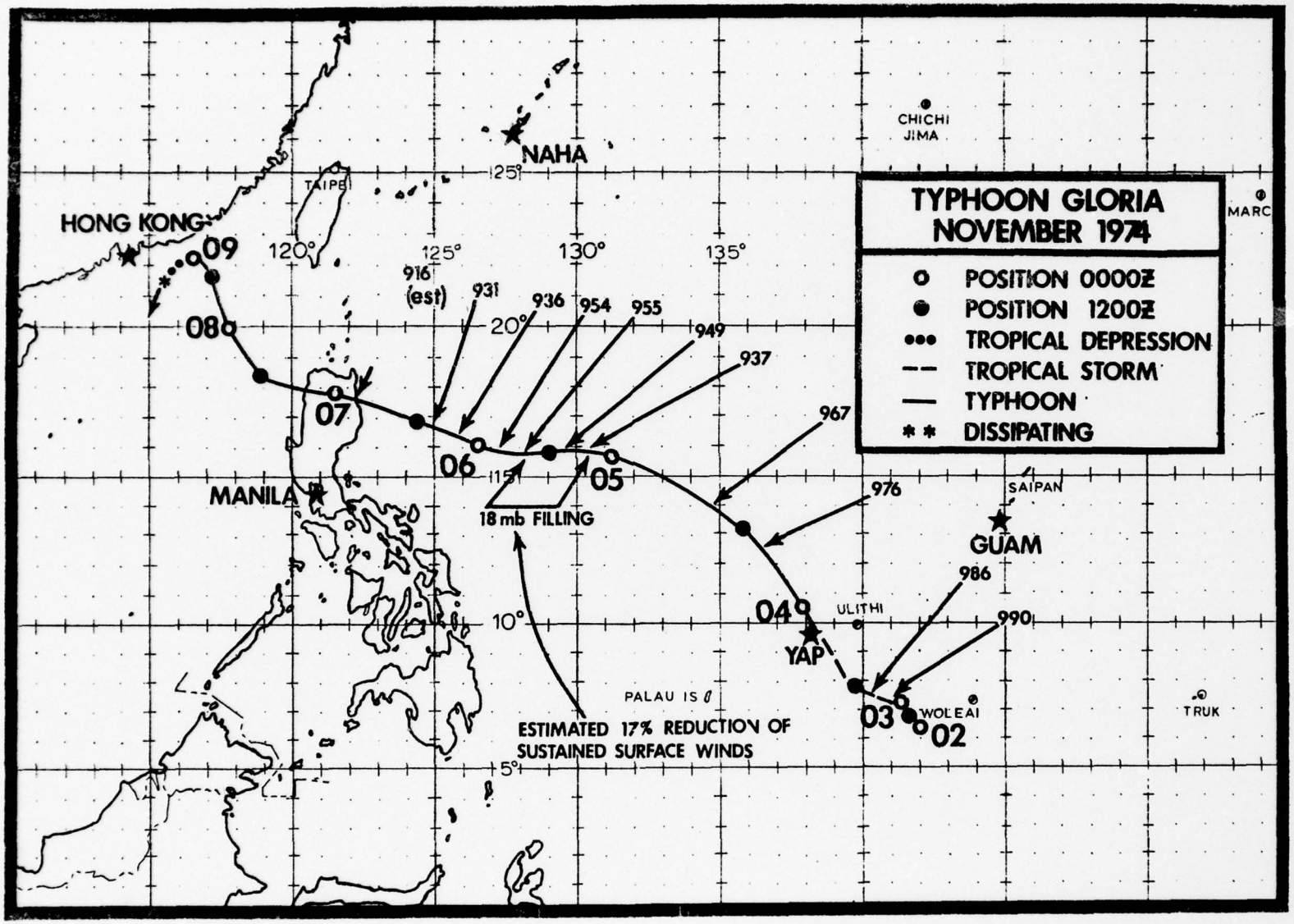
TYPHOON GLORIA
NOVEMBER 1974
POSITION 0000Z
POSITION 1200Z
TROPICAL DEPRESSION
TROPICAL STORM
TYPHOON
DISSIPATING
NAHA
CHICHI JIMA
MARC
TAIPEI
HONG KONG
MANILA
SAIPAN
GUAM
ULITHI
YAP
PALAU IS
WOLEAI
TRUK
09
08
07
06
05
04
03
02
916 (est)
931
936
954
955
949
937
967
976
986
990
18 mb FILLING
ESTIMATED 17% REDUCTION OF SUSTAINED SURFACE WINDS
125°
120°
130°
135°
20°
10°
5°

FIGURE 1

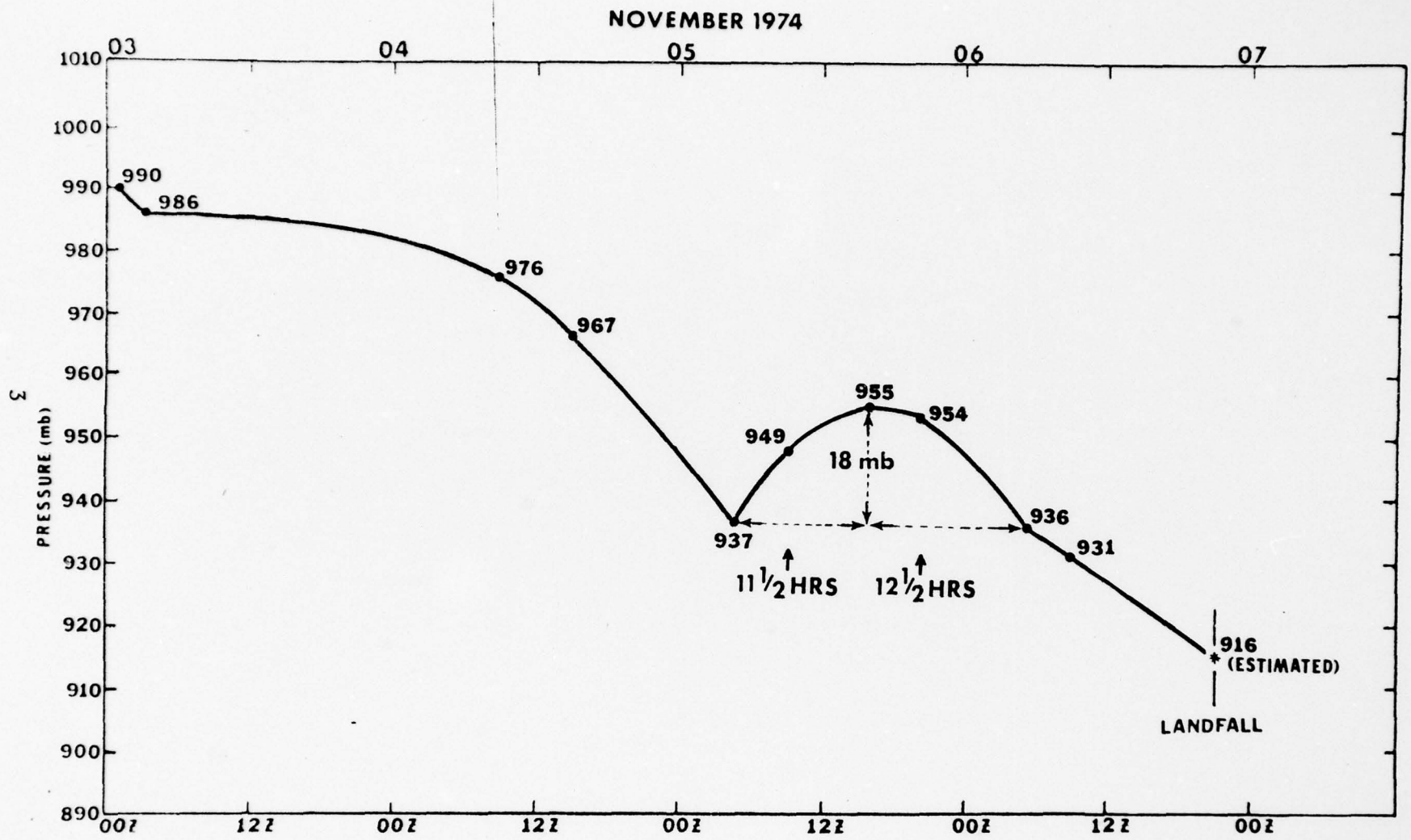
NOVEMBER 1974
03
04
05
06
07
1010
1000
990
980
970
960
950
940
930
920
910
900
890
PRESSURE (mb)
990
986
976
967
937
949
955
954
936
931
916
(ESTIMATED)
LANDFALL
18 mb
11½ HRS
12½ HRS
00Z
12Z
00Z
12Z
00Z
12Z
00Z
12Z
00Z

FIGURE 2

SATELLITE COVERAGE REVIEW

A review of the satellite imagery provided by the Defense Meteorological Satellite Program (DMSP) illustrates the sequence of intensity changes in Gloria. Figures 3 and 4 depict the typhoon located 890 km east of Luzon (05/0241 GMT) in the Philippine Sea at its first peak intensity. A prominent feature of the central core area is several interlocking spiral rainbands surrounding a small central dense overcast approximately 85 km in diameter. Twenty hr later (05/2234 GMT), Figure 5 shows an early morning view of Gloria located 500 km east of Luzon prior to reintensification. Significant weakening had occurred during the night and the concentric spiral rainbands in the central core viewed earlier were replaced by an amorphous cloud canopy. A prominent 65 km diameter hole in the canopy is located east of the center (A) which lies beneath the overcast. The final satellite coverage in the series (Fig. 6) is a nighttime infrared view of the typhoon 12 hr later (06/1117 GMT) when Gloria was located 280 km east of Luzon. Rapid intensification had taken place with the cirrus canopy now absent, exposing a 37 km diameter eye.

AIRCRAFT RECONNAISSANCE OBSERVATIONS

Probably the most striking changes in Gloria's lifetime occurred after the initial pressure fall terminated on the 5th as evidenced by aircraft reconnaissance observations. Figure 7 shows a series of sketches of the radar presentations of the central core region during this period from two WC-130 aircraft sorties of the U. S. Air Force 54th Weather Reconnaissance Squadron[2]. Although a 3 cm wavelength radar is available on these aircraft, radarscope photography is not, thus leaving sketches as the only means of documentation.

On arrival at the central core region about 0400 GMT on the 5th, the aircraft's radar depicted concentric wall clouds. An extremely small eye only 7.4 km in diameter was encircled by a rainband with a diameter of 56 km. During the 5 hr mission, the radar presentation of the inner eye grew progressively poorer, depicting a very faint return of the remaining northern arc during the last penetration of the storm core at 0900 GMT[3]. It was the impression of the flight meteorologist

2. Guam, Mariana Is.
3. A somewhat similar series of events were documented by Hoose and Colon (1970) based on land radar in hurricane Beulah.

FIGURE 3

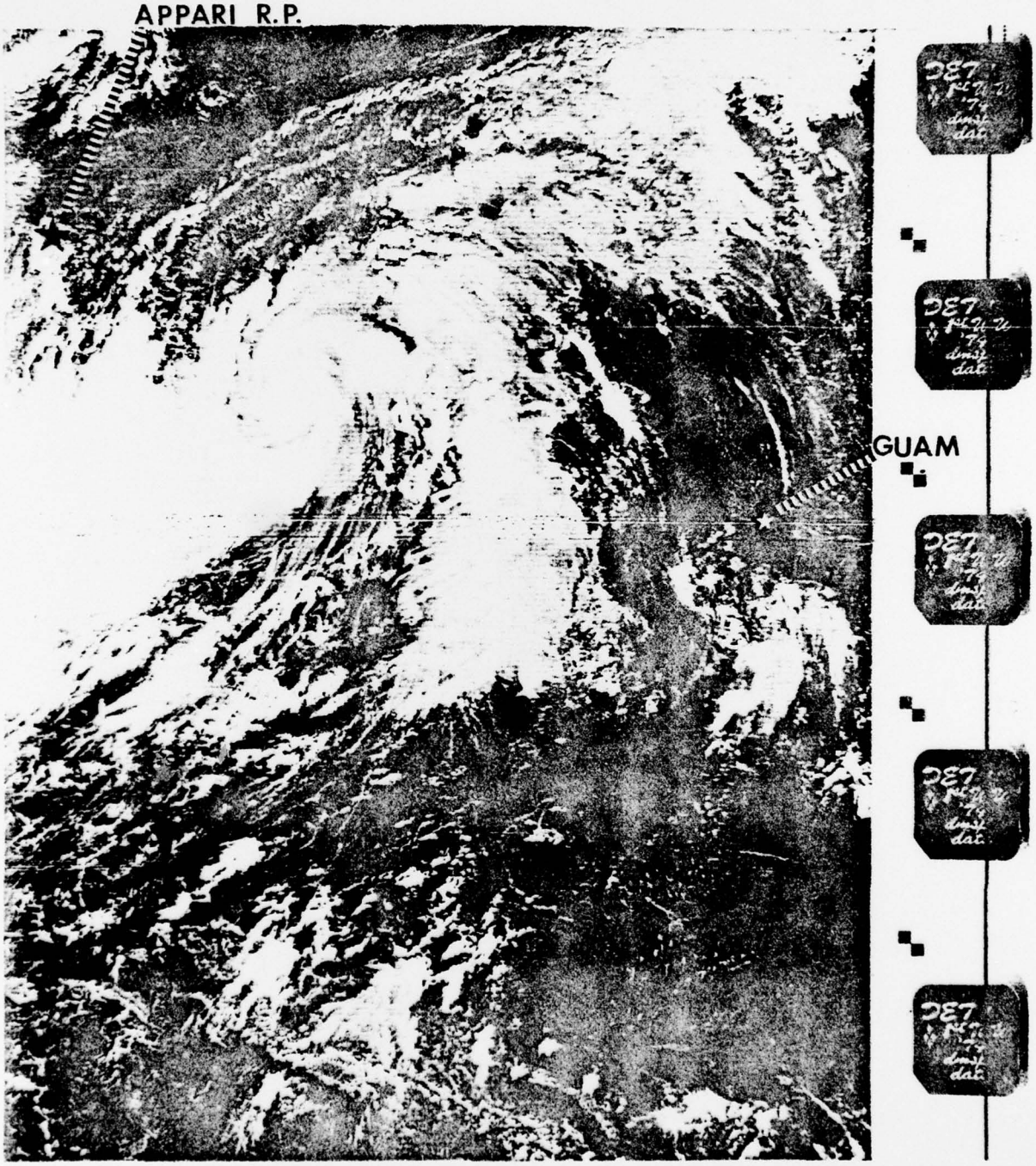

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FIGURE 4

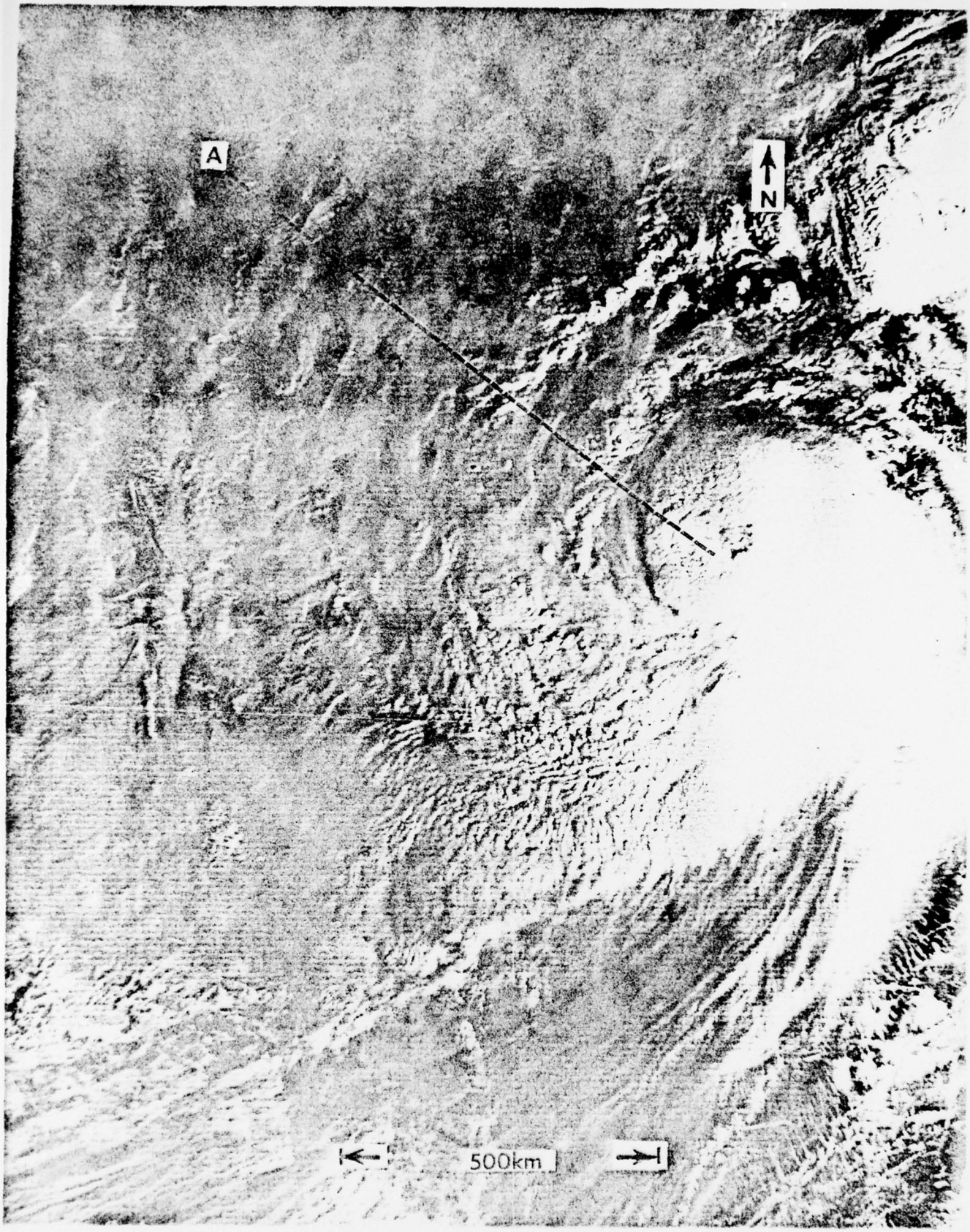

FIGURE 5

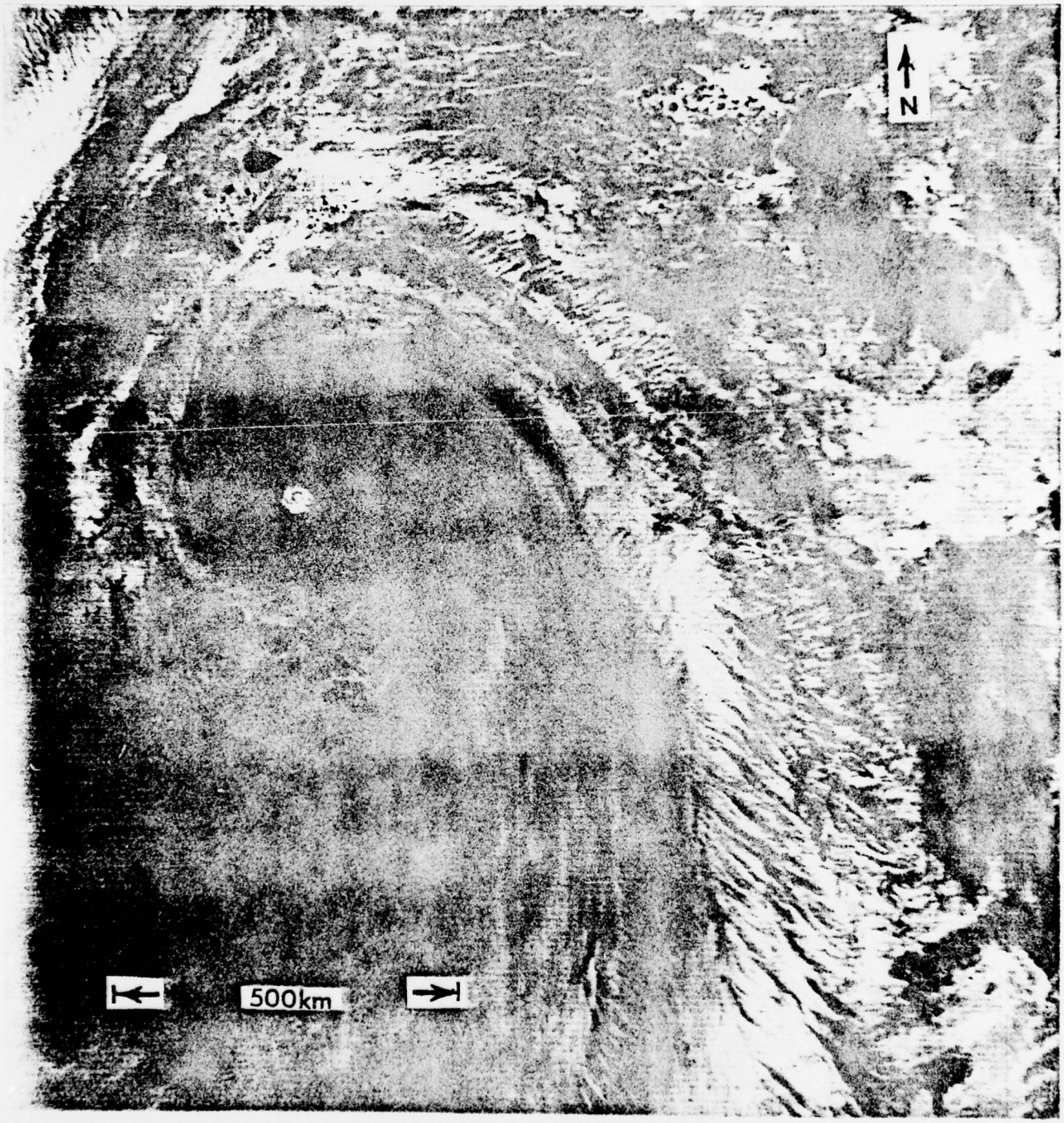

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FIGURE 6

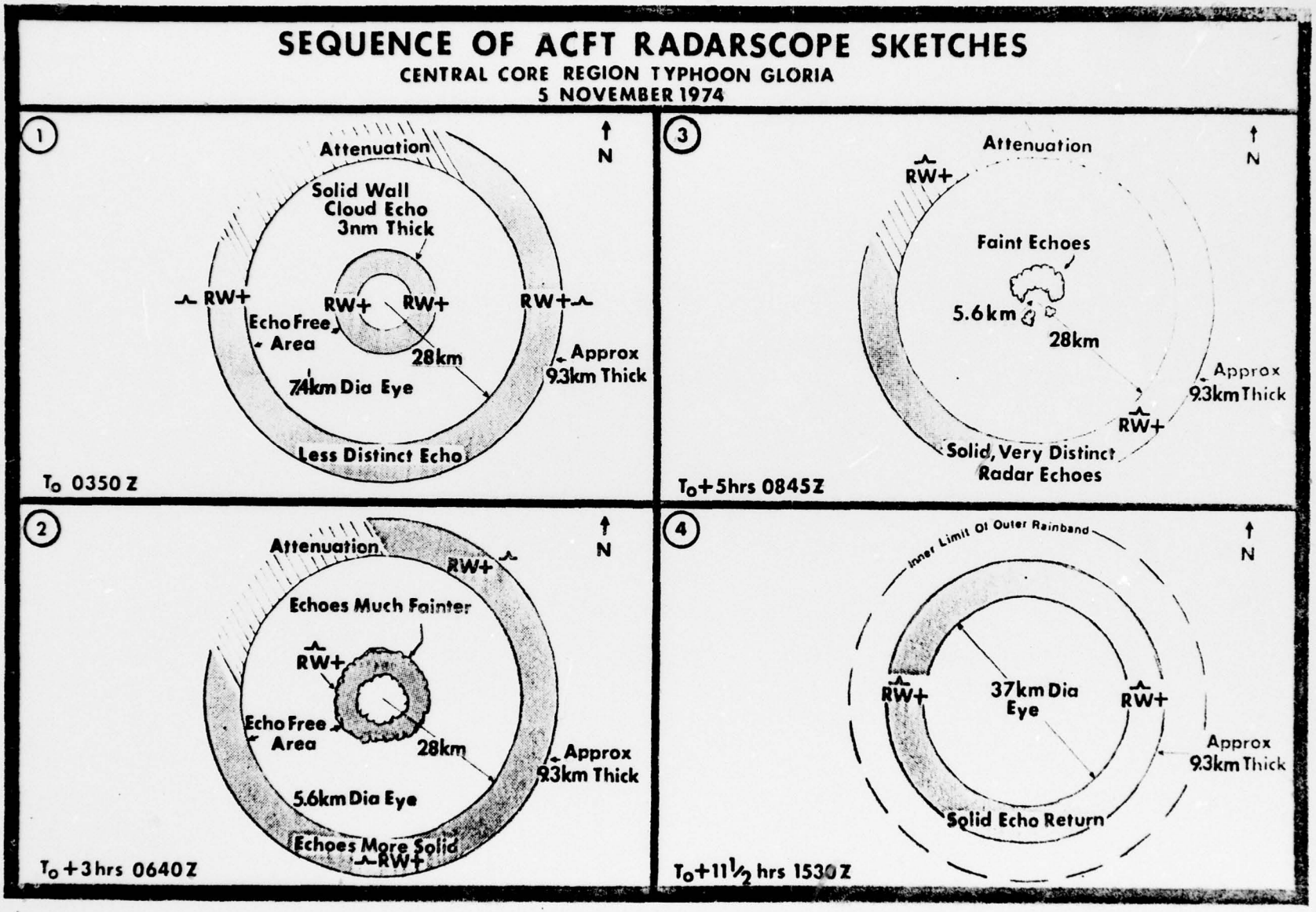
SEQUENCE OF ACFT RADARSCOPE SKETCHES
CENTRAL CORE REGION TYPHOON GLORIA
5 NOVEMBER 1974
1
Attenuation
N
Solid Wall
Cloud Echo
3nm Thick
RW+
RW+
RW+
RW+
Echo Free
Area
28km
Approx
93km Thick
74km Dia Eye
Less Distinct Echo
To 0350 Z
3
Attenuation
N
RW+
Faint Echoes
5.6km
28km
Approx
93km Thick
RW+
Solid, Very Distinct
Radar Echoes
To+5hrs 0845Z
2
Attenuation
N
RW+
Echoes Much Fainter
RW+
Echo Free
Area
28km
Approx
93km Thick
5.6km Dia Eye
Echoes More Solid
RW+
To+3hrs 0640Z
4
Inner Limit Of Outer Rainband
N
RW+
37km Dia
Eye
RW+
Approx
93km Thick
Solid Echo Return
To+11½ hrs 1530Z

FIGURE 7

that the outer band had become the active wall cloud at this time. The band had become progressively more solid on radar and the radar return had increased in intensity. Another notable feature was that the relatively light turbulence and precipitation experienced upon penetration (700 mb level) of the remaining northern arc of wall cloud was described as similar to that associated with transit of normal towering cumulus. This was in sharp contrast to the moderate turbulence and torrential rain experienced 5 hr earlier in the inner eye wall and now confined only to the outer rainband or "new" eye wall. Observation of the sea state by the flight meteorologist also indicated that the maximum wind band had relocated outward from the center. On first penetration it was located beneath the inner eye wall at a radius of 5.6 km. Five hr later the band was observed under the inner edge of the new outer eye wall at a radius of 28 km.

By the time the next reconnaissance aircraft arrived at Gloria's core 6 hr later (05/1530 GMT), the inner eye wall had dissipated, and the newly formed outer eye wall had a 37 km diameter circular configuration. The maximum flight level wind band in the northern semicircle coincided with the outer edge of this eye wall at a radius of 28 km. Although the eye wall expanded 2 hr later to a 56 x 74 km ellipse, by the end of the 5 hr mission the eye diameter was once again 37 km. The maximum flight level wind band in the right semicircle once again coincided with the outer edge of this eye at a radius of 28 km. Throughout the mission, and during the subsequent reintensification period, the radius of maximum winds remained at 28 km.

The central pressure rise on November 5th was quite marked. From the initial fix on the first sortie (05/0350 GMT) to the first fix on the subsequent sortie 11 1/2 hr later (05/1530 GMT), the pressure rose from 937 mb to 955 mb. This 18 mb change represents an average pressure rise of almost 1.5 mb/hr over the period. The maximum flight level wind (700 mb) decreased from 61.7 m/sec on the first mission to 43.7 m/sec during the subsequent mission[4].

DISCUSSION

This sequence of events, involving a rare weakening of a typhoon over warm tropical waters (>27°C) followed by a reintensification, is difficult to account for. A thorough discussion of the synoptic environment is beyond the scope of

4. Maximum winds obtained by aircraft are often biased by sampling procedures in which the peak values occurring in the storm may not be measured.

this note, however, a cursory inspection reveals the lack of a synoptic scale upper tropospheric mechanism to constrict Gloria's outflow and cause such an abrupt weakening. It is possible that the fluctuation may have been on the mesoscale and due to an imbalance between the surface pressure gradient forces, and the boundary circulation of the typhoon. Simpson (1971) states that when intensifying hurricanes develop rapidly, "the increase in maximum winds near the center has a tendency to outrun the accelerations at greater radial distances so that dynamic instability develops, angular momentum is transported outward and maximum winds diminish." Perhaps, once this temporary imbalance was readjusted, favorable upper tropospheric conditions (anticyclonic) were able to restore the deepening of Gloria's central pressure, and promote re-intensification of the typhoon prior to landfall.

It is of some interest to note that the sequence of intensity fluctuation observed in typhoon Gloria resemble the results demonstrated in tropical cyclone numerical models in response to artificial enhancement of the convective heating functions (Rosenthal, 1971). When extreme continuous heating is applied at large radii outside the band of maximum winds, the intensity of these winds decreases by approximately 15%. Upon termination of the heating enhancement, a rapid recovery is noted in the model storm to near its original intensity within 6 to 18 hr. In the case of Gloria, the rainband encircling the original eye may have been able to furnish this additional heating as it grew into the new eye wall and became the new channel to the outflow layer.

Due to ascent of moisture laden air at larger radii, the inflow at the boundary layer was lifted before penetrating to the inner eye. With the loss of its moisture supply, the inner eye began to dissipate, and horizontal temperature gradients in the central core weakened. As a result of this weakening, the maximum wind zone propagated outward to the new eye wall and diminished in intensity by the partial conservation of angular momentum. With the heating balance recovered, the typhoon was in a condition to once again intensify. [This closely parallels the Project Stormfury hypothesis (Sheets, 1975)]. In the case of Gloria, its original state was recovered in 13 hr and deepening continued markedly beyond this point.

SIMILAR CASES

In order to determine the frequency of typhoon intensity variations such as Gloria's, an examination of other cases based on central pressure data was undertaken. Developed typhoons with minimum sea level pressures below 970 mb were screened for a filling period limited to a 24 hr interval, and a minimum filling-redeepening cycle of approximately 12 mb to

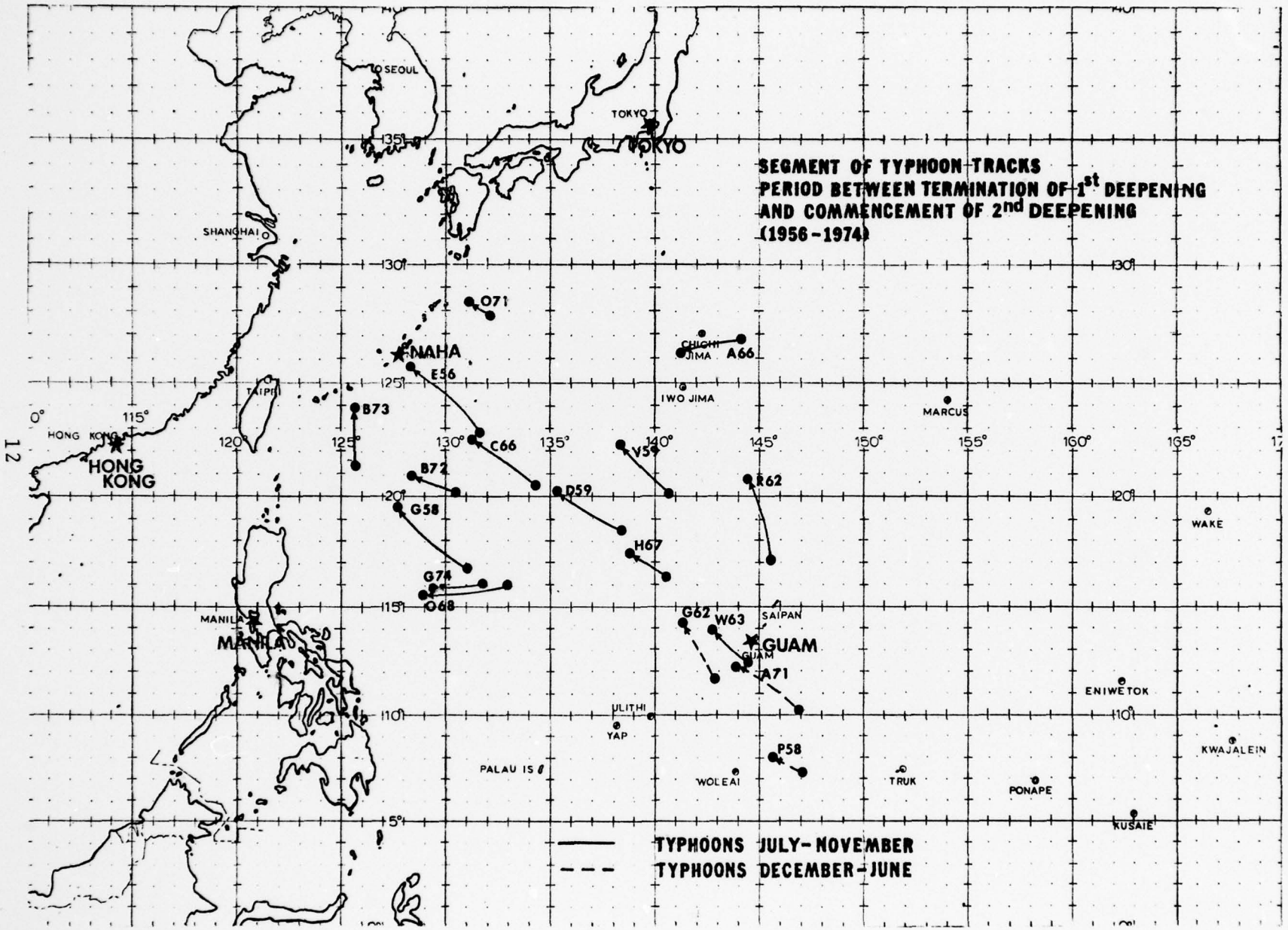
SEGMENT OF TYPHOON TRACKS
PERIOD BETWEEN TERMINATION OF 1st DEEPENING
AND COMMENCEMENT OF 2nd DEEPENING
(1956-1974)
SEOUL
TOKYO
TOKYO
SHANGHAI
NAHA
O71
E56
B73
C66
B72
D59
G58
H67
G74
O68
V53
R62
A66
CHICHI JIMA
IWO JIMA
MARCUS
WAKE
HONG KONG
HONG KONG
TAIPEI
MANILA
MANILA
G62
W63
SAIPAN
GUAM
GUAM
A71
ENIWETOK
ULITHI
YAP
P58
PALAU IS
WOLEAI
TRUK
PONAPE
KWAJALEIN
KUSAIE
TYPHOONS JULY-NOVEMBER
TYPHOONS DECEMBER-JUNE

FIGURE 8

indicate a significant deviation. Available records since 1956[5] indicate 17 such cases (see Appendix). This represents 4.5% of the total storms reaching typhoon force in the western North Pacific (east of 120°E) inclusive of 1975.

Figure 8 shows the geographical distribution of these 17 cases. (The line segments are between points when the 1st deepening terminated and the 2nd commenced.) The most poleward cases (Olive, 1971 and Alice, 1966) occurred in August, a month when the warm waters (>27°C) of the Philippine Sea extend to 30N. Those tracks occurring equatorward of 15N, with the exception of Wendy (July), appeared in spring months (Apr/May), and are the only cases of the entire sample occurring outside the period July - November. These typhoon intensity variations are notably absent in the South China Sea and east of 150E. The primary factor precluding occurrence in the South China Sea, of course, is the minimal overwater track period available to a typhoon before being influenced by a landmass. Compared with the Philippine Sea, the probability of typhoons traversing waters east of 150E is significantly lower (<1.0 typhoon/year) as indicated by climatology (Crutcher and Quayle 1974) and is a consequence of upper tropospheric circulation factors (Ramage, 1959).

Of the typhoons identified, seven (including Gloria) exhibited intensity fluctuations whereupon the maximum wind weakened then increased by 15% or greater. This signifies less than 2% of the total typhoon count since 1956 (east of 120E) and emphasizes the uniqueness of such occurrences.

The most extreme of these were Emma (Sep, 1956), Alice (Aug, 1966) and Billie (July, 1973) each of which displayed maximum wind variations of 30% or greater during the filling and reintensification stages. Alice, however, did not approach the deeper central pressures (>935 mb) exhibited by either Emma or Billie. It is unfortunate that absence of adequate aircraft radar documentation of these typhoons precludes any comparison with the Gloria eye evolution.

SUMMARY

In this paper, the unusual double intensification of typhoon Gloria in November 1974 was examined. Among some of the anomalies

5. Data earlier than 1956 were not considered since 700 mb minimum height measurements in the eye were not readily available to check the consistency of the dropsonde derived sea level pressure.

noted were the rapid filling of central pressure in a 12 hr period as the typhoon's forward motion temporarily slowed and turned westerly, and a significant decrease in maximum sustained surface and 700 mb winds. This initial decrease in intensity was followed by a marked reintensification period as the typhoon increased in forward speed. An estimated central pressure drop to 916 mb occurred in a period of a day while maximum sustained surface winds were estimated to have increased by 44% during the reintensification.

The intensity variations of Gloria were believed to be a result of a temporary imbalance of forces on the mesoscale between the surface pressure gradient and the boundary circulation of the typhoon. The sequence of intensity fluctuations also take a noticeable similarity to particular tropical cyclone numerical models responding to artificial enhancement of the convective heating.

Similar occurrences of double deepening of typhoons are relatively infrequent and account for less than 5% of the typhoon incidences since 1956. However, at least 4 storms were identified which exceeded the magnitude of Gloria's fluctuations with 30% variation of the maximum winds between the filling and subsequent redeepening cycle.

REFERENCES

Atkinson, G. and Holliday, C., (1975); Tropical Cyclone Minimum Sea Level Pressure - Maximum Sustained Wind Relationship for Western North Pacific, Fleet Weather Central/Joint Typhoon Warning Center Tech Note 75-1.

Crutcher, H. and Quayle, R., (1974); Mariners Worldwide Climate Guide to Tropical Storms at Sea, NAVAIR 50-1C-61 published by Naval Weather Service Command.

Hoose, H. and Colon, J., (1970); Some Aspects of the Radar Structure of Hurricane Beulah on September 9, 1967, Monthly Weather Review, Vol. 98, No. 7, pp 529-533.

Ramage, C. S., (1959); Hurricane Development, J. of Meteor., Vol. 16, pp 227-237.

Sheets, R. C., (1975); Hurricanes - Can Their Destructive Force be Reduced?, Mariners Weather Log, Vol. 19, No. 5, pp 269-276.

APPENDIX

TYPHOONS DISPLAYING DOUBLE INTENSIFICATION UNAFFECTED BY LAND MASSES
SUMMARY OF DATA

TYPHOON	DATES BTWN OBS MIN CNTR PRESS	CENTRAL PRESSURE VARIATIONS								
		1ST MIN	MAX	DIFF	NO OF HRS	EST % DECREASE IN MAX WINDS*	2ND MIN	DIFF	NO OF HRS	EST % INCREASE IN MAX WINDS*
#EMMA	06-07 SEP 56	921	959	38mb	18 hr	30%	931	28mb	11 hr	33%
PHYLLIS	26-27 MAY 58	945	963	18mb	4 hr	18%	946	17mb	18 hr	23%
GRACE	01-02 SEP 58	903	918	15mb	19 hr	10%	905	14mb	9 hr	11%
VERA	23-24 SEP 59	900	914	14mb	12 hr	9%	901	13mb	15 hr	10%
DINAH	17-20 OCT 59	938	947	11mb	18 hr	7%	918	29mb	43 hr	26%
GEORGIA	18-20 APR 62	953	965	12mb	12 hr	16%	933	32mb	18 hr	42%
#RUTH	16-17 AUG 62	916	940	24mb	18 hr	18%	919	21mb	6 hr	19%
#WENDY	11-12 JUL 63	948	965	17mb	18 hr	18%	938	33mb	29 hr	35%
#ALICE	28-30 AUG 66	966	989	23mb	12 hr	37%	966	23mb	24 hr	58%
CORA	01-03 SEP 66	927	938	11mb	18 hr	9%	924	14mb	24 hr	12%
#HARRIET	20-21 NOV 67	963	978	15mb	6 hr	22%	953	26mb	18 hr	45%
ORA	26-28 NOV 68	955	966	11mb	24 hr	12%	947	19mb	12 hr	24%
#AMY	02-03 MAY 71	894	920	26mb	18 hr	15%	899	21mb	18 hr	15%
OLIVE	03 AUG 71	935	949	14mb	6 hr	9%	936	13mb	11 hr	14%
BETTY	14-15 AUG 72	915	926	11mb	12 hr	8%	910	16mb	12 hr	13%
#BILLIE	15-16 JUL 73	916	952	36mb	19 hr	29%	917	35mb	14 hr	39%
#GLORIA	05-06 NOV 74	936	954	18mb	18 hr	17%	916+	39mb	26 hr	32%

*SUSTAINED SURFACE WINDS (1 MIN AVG) - BASED ON FWC/JTWC TECH NOTE 75-1
#MAXIMUM WIND FLUCTUATIONS OF 15% OR GREATER
+EXTRAPOLATED

Unclassified

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TYPHOON GLORIA, NOVEMBER 1974
MONSOON TROUGH
CENTRAL PRESSURE
MAXIMUM SUSTAINED SURFACE WINDS
REINTENSIFICATION

20. ABSTRACT *(Continue on reverse side if necessary and identify by block number)*

IN NOVEMBER 1974 TYPHOON GLORIA DISPLAYED UNUSUAL INTENSITY FLUCTUATIONS WHILE TRAVERSING THE PHILIPPINE SEA. THE TYPHOON EXHIBITED TWO MARKED INTENSIFICATIONS SEPARATED BY A PERIOD OF WEAKENING LASTING 12 HR. A CHRONOLOGICAL EXAMINATION OF THIS UNUSUAL BEHAVIOR UTILIZING AIRCRAFT RECONNAISSANCE AND SATELLITE DATA IS PRESENTED WITH PARTICULAR EMPHASIS ON THE EVOLUTION OF THE CENTRAL CORE REGION. A PARALLEL BETWEEN OBSERVED EVENTS, AND RESULTS DEMONSTRATED IN A TROPICAL CYCLONE NUMERICAL MODEL RESPONDING TO

CONT →

DD FORM 1 JAN 73 1473 EDITION OF 1 NOV 65 IS OBSOLETE

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ARTIFICIAL ENHANCEMENT OF THE CONVECTIVE HEATING FUNCTIONS IS NOTED. SIMILAR OCCURRENCES OF DOUBLE DEEPENING OF TYPHOONS IN THE WESTERN PACIFIC ARE REVIEWED TO DETERMINE GLORIA'S UNIQUENESS.