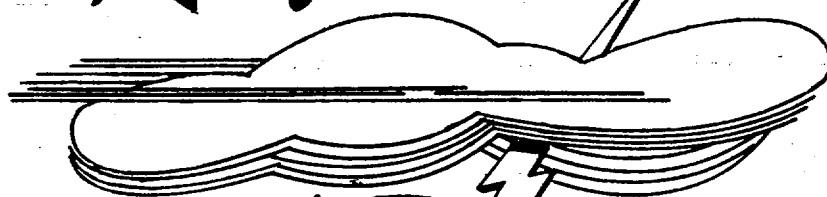


ANNUAL TYPHOON *Report*



19



69



FLEET WEATHER CENTRAL/JOINT TYPHOON WARNING CENTER
Guam, Mariana Islands

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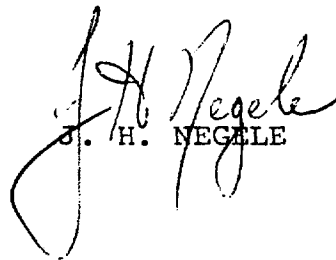
16 JAN 1970

From: Commanding Officer, U. S. Fleet Weather Central/Joint
Typhoon Warning Center, Guam
To: Chief of Naval Operations
Via: Commander, Naval Weather Service Command

Subj: Annual Typhoon Report, 1969; submission of

Ref: (a) OPNAV Instruction 3140.17E of 29 Oct 65
(b) SECNAV Instruction 5600.16 of 2 Nov 60

1. The Annual Typhoon Report, 1969, is submitted herewith in accordance with reference (a).
2. During calendar year 1969, 13 typhoons, 6 tropical storms and 4 depressions were detected in the Western North Pacific from the International Date Line to the Malay Peninsula. A total of 430 warnings were issued during the 108 calendar days of "warning status" for the Joint Typhoon Warning Center, Guam.
3. Reference (a) directs Fleet Weather Central Pearl Harbor and Fleet Weather Central Alameda to forward annual summaries of tropical cyclones in their respective areas to this command for inclusion in Annual Typhoon Reports. Fleet Weather Central Pearl issued no tropical cyclone warnings during 1969. Fleet Weather Central Alameda was in warning status 67 days during 1969 and issued a total of 219 warnings on 4 hurricanes, 6 tropical storms and 5 tropical depressions.
4. This report has been reviewed in accordance with reference (b).


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1969
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FOREWARD

This report is published annually and summarizes Western North Pacific Tropical Cyclones. Annex A summarizes Tropical Cyclones from 180 degrees eastward to the North American Coast.

When directed by CINCPAC in May 1959, CINCPACFLT redesignated Fleet Weather Central Guam as Fleet Weather Central/Joint Typhoon Warning Center (FWC/JTWC), Guam with the following responsibilities:

1. To provide warnings to U. S. Government agencies for all tropical cyclones north of the equator and west of 180 degrees longitude to the coast of Asia and Malay Peninsula.
2. To determine tropical cyclone reconnaissance requirements and assign priorities.
3. To conduct investigative and post-analysis programs including preparation of the Annual Typhoon Report.
4. To conduct tropical cyclone forecasting and detection research as practicable.

Air Force Asian Weather Central at Fuchu, coordinating with U. S. Navy Fleet Weather Facility Yokosuka was designated as alternate JTWC in case of failure of FWC/JTWC Guam.

The JTWC is an integral section of FWC/JTWC Guam and is authorized to be manned by three Air Force and three Navy officers and five enlisted men from each service. The senior Air Force Officer is designated as Director, JTWC.

The Western Pacific Tropical Cyclone Warning System consists of the Joint Typhoon Warning Center (JTWC), the U. S. Air Force 54th Weather Reconnaissance Squadron stationed at Andersen Air Force Base, Guam and U. S. Navy Airborne Early Warning Squadron One (VW-1) stationed at Naval Air Station, Agana, Guam.

The Joint Hurricane Warning Center in Hawaii, a coordinated agency composed of the U. S. Weather Bureau, Honolulu, the Air Force Central Pacific Forecast Center, and Fleet Weather Central Pearl Harbor, is responsible for tropical cyclone surveillance and issuance of warnings in the Central North Pacific area between 180 degrees and 140 degrees west.

U. S. Navy Fleet Weather Central, Alameda, California, is responsible for issuance of warnings from 140 degrees west longitude to the North American Coast.

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CHAPTER I

OPERATIONAL PROCEDURES

A. GENERAL

Services provided by the Joint Typhoon Warning Center (JTWC) include forecasts of tropical cyclone formation, intensification, direction of motion, speed of movement, wind intensity and changes in the size and intensity of the cyclone. The primary product of JTWC providing these services is the tropical cyclone warning issued in 1969 at 05Z, 11Z, 17Z and 23Z whenever tropical cyclones existed in the JTWC area.

FWC Guam provides computer and analysis support for JTWC.

Communications services for JTWC are provided by the Fleet Weather Central Nimitz Hill Division of Naval Communications Station, Guam.

B. ANALYSES AND DATA SOURCES

1. FWC ANALYSES:

a. Surface polar projection isobaric; 0000Z, 0600Z, 1200Z and 1800Z.

b. Surface mercator projection isobaric; 0600Z and 1800Z.

c. Surface micro-analysis of South China Sea region; 0000Z, 0600Z, 1200Z and 1800Z.

d. Sea surface temperature charts; daily.

e. Checkerboards (Stidd Diagrams) of selected tropical stations.

f. Time cross sections of selected tropical stations.

2. JTWC ANALYSES:

a. Sectional surface isobaric charts; hourly and 3 hourly as required.

b. Reconnaissance data.

c. 700 mb mercator projection contours; 0000Z and 1200Z.

d. 500 mb mercator projection contours; 0000Z and 1200Z.

e. 300 mb mercator projection contours; 0000Z and 1200Z.

f. Stidd diagrams of selected stations in the van of an approaching storm.

3. SATELLITE DATA:

The quality and quantity of satellite data available in 1969 was greater than ever before. ESSA 6 (later replaced by ESSA 8) and NIMBUS 3 provided local morning direct readout pictures. Nimbus 3 provided infrared direct readout pictures at night. Local afternoon ATS satellite pictures were available as a rectified digitized mosaic chart after an eight hour delay for processing.

4. RADAR:

Installation of weather radar at FWC Guam was completed in time for the 1969 typhoon season, but did not see much action.

5. COMPUTER PRODUCTS, 0000Z AND 1200Z:

a. Hemispheric analyses and barotropic prognoses for 1000 mb, 700 mb, 500 mb, 300 mb, and 200 mb.

b. Decomposition fields of the 500 mb (SD, SR and SL) analyses and prognoses. The SD, SR, and SL fields correspond to small scale disturbances, mean flow and long wave pattern respectively.

c. Computer analysis of tropical streamlines for the 700 mb, 500 mb, 400 mb, 300 mb, 250 mb, and 200 mb levels from FWC Pearl fields were used in 1969.

d. The HATRACK typhoon steering program based on SR prognostic fields was used on an operational time basis as a forecast aid.

e. The TYRACK typhoon steering program was operationally used during the 1969 season. This program utilizes the FWC Pearl tropical streamline fields for determining forecast movement.

f. Divergence charts based on FWC Pearl streamline fields were produced for evaluation beginning about 20 July. A preliminary report is included in Chapter III.

C. FORECAST AIDS

1. CLIMATOLOGY:

The following climatological publications were utilized:

a. Tropical Cyclones in the Western Pacific and China Sea Area (Royal Observatory, Hong Kong), covering 70 years of typhoon tracks.

b. Climatological Aid to Forecasting Typhoon Movement (1st Weather Wing).

c. Climatological 24-Hour Typhoon Movement (McCabe, J. T., 1961).

d. Western Pacific Typhoon Tracks, 1950-1959 (FWC/JTWC).

e. Far East Climate Atlas (First Weather Wing February 1963).

f. Annual Typhoon Report, 1968 (FWC/JTWC), covering tracks for 1959 - 1968.

2. PERSISTENCE:

Extrapolation of storm movement using average speed and mean direction was the most reliable method for 12 to 24 hour forecasts.

3. COMPUTER PRODUCTS:

a. The HATRACK typhoon steering program was run on the FWC Guam computer on an operational basis during 1969. Steering forecasts were made using the decomposition mean flow fields (SR) of the 700 mb, and 500 mb levels for prognostic fields through 72 hours. Empirical modification based on apparent error in earlier forecasts was used to obtain improved forecast positions.

b. TYRACK computer forecast steering from the 700 mb, 500 mb, 400 mb, 300 mb, mean 700/500 mb and mean 700/500/400/300 mb levels were used during 1969.

4. OBJECTIVE TECHNIQUES

During 1969 the following individual objective forecasting methods were employed:

a. ARAKAWA - surface pressure grid model.

b. HATRACK - based on 700 mb SR prognosis.

c. HATRACK - modified from 700 mb SR prognosis for 12 hour error. (for 24 hour forecasts)

d. HATRACK - modified from 700 mb SR prognosis for 24 hour error. (for 48 hour forecasts)

e. HATRACK - based on 500 mb SR prognosis.

f. TYRACK - based on program-selected best steering level from Pearl tropical fields.

Evaluation of these techniques is contained in Chapter III.

D. FORECASTING PROCEDURES:

An initial track based on climatology and extrapolation is developed for a 3 to 4 day period. The track is modified by considering the existing and forecast upper air patterns, numerical steering forecasts and the ARAKAWA objective method.

Subsequent forecasts become "educated" by longer period averaging of extrapolation error in speed and direction and through modification of computer forecasts to compensate for errors observed in earlier computer forecasts. A combination of extrapolation and climatology is the starting point for each forecast, with mesoscale analysis of the 700, 500 and 300 mb charts and the ARAKAWA objective forecast model used to modify or reinforce the extrapolation forecast. Position of tropical cyclones with respect to the 700 mb high center and ridge to the north and the 700 mb trough or break in the ridge to the west are the primary keys to 24 hour forecasting of recurvature or speed changes. The 200 mb level has been used to anticipate changes in intensity through assumptions of divergence in the southeast quadrant and convergence in the southwest quadrant of anticyclones. Tropical cyclones approaching a 200 mb anticyclone from the southeast are forecasted to intensify and those emerging from the west side of a 200 mb anticyclone are normally forecasted to weaken.

Extended range forecasting is based on extrapolation of the 24 hour track with reversion toward climatology and modified by SR and SL 500 mb forecast contours.

The resulting official forecast is an integration of both objective and subjective techniques with persistence in speed and direction the weighted favorite for short term forecasts.

E. WARNINGS:

Tropical cyclone warnings are numbered consecutively without regard for upgrading or downgrading of the storm between intensity stages. If warnings are discontinued and the storm again intensifies, warnings are numbered consecutively from the last warning issued. Amended or corrected warnings are given the same number as the warnings they modify. Forecast positions are issued as follows:

Tropical depressions	24 hr
Tropical storms	12, 24, and 48 hr (72 hr at 05Z and 17Z only)
Typhoons	12, 24, and 48 hr (72 hr at 05Z and 17Z only)

Forecast periods are stated with respect to warning time. Thus a 24 hour forecast verifies 26 hours after the aircraft fix data, 29 hours after the latest surface synoptic chart and 29 to 35 hours after the latest upper air charts.

Warning forecast positions are verified against the corresponding post analysis "best track" positions. A summary of results from 1969 is presented in Chapter III.

F. PROGNOSTIC REASONING MESSAGE:

Whenever warnings are being issued, an amplifying message is issued at 06Z and 18Z. This prognostic reasoning message is intended to provide meteorological units ashore and afloat with technical and non-technical reasoning appropriate to the behavior of current storms and the logic of the latest JTWC warnings.

G. TROPICAL WEATHER SUMMARY:

This message is issued daily from May through December and otherwise when significant tropical cyclogenesis is forecasted or observed. It is issued at 0600Z and combined with the prognostic reasoning message when warnings are being issued. It describes the location, intensity and likelihood of development of all tropical low pressure areas and significant cloud "blobs" detected by satellite.

CHAPTER II

RECONNAISSANCE

A. GENERAL

Land station and ship reports continue to be scarce in areas of tropical cyclone formation. The tropical cyclone warning system depends upon aircraft reconnaissance data to fix the location and strength of tropical cyclones. Only on rare occasions are land radar fixes or sequential reports available to compare with reconnaissance data. Increased satellite coverage during 1969 proved to be an invaluable aid in scheduling aircraft reconnaissance to achieve maximum effectiveness. Interpretation of storm intensity and center location from satellite pictures only is presently not sufficiently reliable for operational use. Continuous surveillance of tropical cyclones is of the utmost importance as illustrated by the explosive deepening of typhoon Kathy on November 6 from a system requiring great skill and persistence to locate in the afternoon to a nighttime reconnaissance indication of 60 knots only 12 hours later.

Four fixes per day were scheduled on all tropical cyclones following the initial fix which was normally coordinated with the earliest availability of reconnaissance aircraft on the scene. As a general rule VW-1 made fixes at 0900Z and 1500Z at low and intermediate levels and 54WRS made fixes at 2100Z and 0300Z at intermediate (700 mb) level. High level (500 mb) fixes were made on storms in the vicinity of higher terrain. Most storms were taken into warning on the basis of daylight investigative flight data.

B. RECONNAISSANCE RESPONSIBILITY

Squadrons responding to the reconnaissance requirements of JTWC through the TCRC in 1969 were U. S. Air Force 54th Weather Reconnaissance Squadron (54WRS) flying WC-130 aircraft from Andersen Air Force Base, Guam and the U. S. Navy Airborne Early Warning Squadron ONE (VW-1) flying WC 121N aircraft from the Naval Air Station, Agana, Guam.

C. EVALUATION OF DATA

Eye data from tropical cyclones is provided by low level penetration, intermediate level penetration or radar fixes from outside the center. Penetration data provides the best quality data including dropsonde soundings, minimum 700 mb height and sea level pressure, maximum observed wind (estimated), shape and character of the eye and feeder band information. The primary center of the cyclone is based on the location of minimum pressure at the surface, a parameter best obtained by low level penetration, however the nearly vertical structure of most tropical cyclones promises only slight loss of accuracy on intermediate penetration fixes. Radar fixes made outside the center introduce an attenuation and radar accuracy error not present in penetration fixes. Radar fixes are also based on the radar center rather than the pressure center of the storm. Not infrequently reports of centers determined independently by

wind, clouds, pressure and temperature will vary by 10 miles or more. The eye report contains a subjective estimate of fix accuracy which must also be taken into account in the determination of the storm location at warning time. A final factor in this determination is the forecasters ability to accurately forecast the direction and speed of movement of the storm. On a statistical basis this error rate is 4 to 5 miles per hour of forecast time. During 1969 the mean difference between the post analysis warning position and the published operational warning position was 20.7 N.M. Since the mean time difference from fix to warning time is two hours the forecast error contribution is 9 to 10 miles leaving a residual value of 11 N.M. attributed to the mean accuracy of reconnaissance fixes.

Short term variability in the actual cyclone track and the mean amount of "smoothing" incorporated in the best track analysis are subjective factors included within the 11 N.M. accuracy accorded reconnaissance fixes in operation use.

Maximum differences between warning positions and best track positions resulted when reconnaissance was not continuously maintained, when the developing storm has an indistinct and shifting center or when fix positions used for the warning position fell well outside the past season best track analysis.

D. COMMUNICATIONS

The primary means of communication between JTWC and reconnaissance aircraft was voice single sideband through Andersen Airways (AIE 2) serving as the primary air to ground station for both 54WRS and VW-1 weather missions. Secondary air to ground stations were Clark AFB, Fuchu Airways and Kadena Airways. When secondary ground stations were used eye data was passed to JTWC via the Joint Overseas Switch (JOSS). Eye data messages received by Andersen Airways were simultaneously received at JTWC by direct phone patch. A hard copy backup message was transmitted from Andersen over local teletype circuit SDE 9.

Average delay time from time of fix to receipt in JTWC by phone patch was 20 minutes including message preparation time in the aircraft and time to copy the message in JTWC. Maximum delay time by phone patch was 1 hour 21 minutes and minimum delay just a few minutes. Direct communications with reconnaissance aircraft permitted direction of aircraft on synoptic missions into areas of suspicion appearing on satellite.

E. SUMMARY OF RECONNAISSANCE SUPPORT

A reconnaissance fix accreditation system was devised in 1965 in an effort to establish an objective evaluation of reconnaissance effectiveness. The system has been in use with minor modifications since that time.

Fix times are scheduled as near as possible to warning time to still permit receipt of the data for consideration by JTWC

forecasters before release of the official warning. Prior to 1967 it was necessary to schedule fixes three hours before warning time. Improved communications in 1967 made it possible to schedule fixes only two hours before warning time.

AIRCRAFT RECONNAISSANCE DATA
(NUMBER OF FIXES AND INVESTIGATIONS)

<u>1961</u>	<u>1962</u>	<u>1963</u>	<u>1964</u>	<u>1965</u>	<u>1966</u>	<u>1967</u>	<u>1968</u>	<u>1969</u>
350	496	465	772	666	674	845	807	468*

*76 preliminary or intermediate (No Credit) fixes not included.

In addition there were 203 synoptic tracks flown in 1969.

TABLE 2-1

DELAY IN RECEIPT OF RECONNAISSANCE FIX DATA FOR 1969

<u>METHOD</u>	<u>NUMBER OF CASES*</u>	<u>MAX DELAY TIME</u>	<u>MIN DELAY TIME</u>	<u>AVG DELAY TIME</u>
PHONE PATCH	402	1 HR 21 MIN	0 HR 01 MIN	0 HR 20 MIN
SDE 9	49	2 HR 11 MIN	0 HR 10 MIN	0 HR 33 MIN
OTHER	33	1 HR 57 MIN	0 HR 10 MIN	0 HR 30 MIN

*Does not include 60 fixes made on cyclones that did not develop.

TABLE 2-2

COMPARISON OF DELAY TIMES WITH PREVIOUS YEARS

	<u>1965</u>	<u>1966</u>	<u>1967</u>	<u>1968</u>	<u>1969</u>
MAX DELAY TIME	60 HR 09 MIN	4 HR 33 MIN	11 HR 20 MIN	6 HR 25 MIN	2 HR 11 MIN
AVG DELAY TIME	1 HR 05 MIN	1 HR 02 MIN	0 HR 43 MIN	0 HR 25 MIN	0 HR 22 MIN
MIN DELAY TIME	0 HR 09 MIN	FEW MINUTES	FEW MINUTES	FEW MINUTES	0 HR 01 MIN
PERCENT OF EYE MESSAGES DELAYED MORE THAN 1 HR	39%	38%	16%	4%	2.8%
NUMBER OF FIXES RECEIVED AFTER WARNING TIME	34	30	23*	6*	3*
PERCENT OF FIXES RECEIVED AFTER WARNING TIME	5.7%	5.4%	3.1%	0.7%	0.6%

*Since 1967, fixes scheduled 2 hours prior to warning time vice 3 hours prior to warning time during previous years.

TABLE 2-3

DEFINITION OF FIX CREDITS AND EVALUATION OF
TIMELINESS OF RECONNAISSANCE FOR 1969

<u>CLASS</u>	<u>DEFINITION</u>		<u>1969</u>
1	FULL CREDIT	From 1 hour before to 1/2 hour after levied time.	360
2	FULL CREDIT	Aircraft in assigned area within 1 hour before to 1/2 hour after levied time but unable to locate a center.	14
3	EARLY/LATE	Center located 1 to 1 1/2 hours before or 1/2 to 2 hours after levied time.	10
4	VERY EARLY/ VERY LATE	Greater than 1 1/2 hours before or more than 2 hours after levied time.	3
5	ATTEMPTED BUT MISSED FIX	Recon provided some useful peripheral data but no fix was made. Reasons may include clearance problems, mechanical trouble, low fuel, etc.	0
6	MISSED FIX	Missed fixes not falling into any category above.	6
7	FULL CREDIT	Fix made on investigative flight or synoptic track.	32
8	FULL CREDIT	Investigative flight, no fix made.	49
9	NO CREDIT	Preliminary or intermediate fix made between scheduled fixes.	76

TABLE 2-4

CHAPTER III

JOINT TYPHOON WARNING CENTER STUDIES

A. An Analysis of Tropical Cyclone Wind Velocity Forecasting Accuracy.

1. BACKGROUND:

A revised technique for forecasting maximum wind velocities was used in 1969. It is based on a smooth curve extrapolation of central pressures along the forecast track. The forecast central pressure and forecast latitude are used as arguments to enter the JTWC pressure/wind correlation to obtain a forecast velocity. Modification of this initial forecast velocity is made subjectively according to the storms position with relation to the subtropical ridge, divergence patterns along the track, cloud organization as depicted by satellites and the sea surface temperature gradients when appropriate.

2. DISCUSSION:

Errors in forecasting by this technique result from:

- a. Normal instrument and/or reporting error in central pressures reported by reconnaissance aircraft.
- b. Latitude error in the forecast track.
- c. Failure of the intensity curve to follow the pattern established during early phases of the storm.

Aircraft dropsonde pressures are used on the confidence level of ± 5 mb. Both instrument error and minor differences in the placement of the dropsonde relative to the absolute minimum pressure in the eye on consecutive soundings are included in this confidence level. An analysis of the past several soundings is used to determine a consistent trace. Low level aircraft penetrations with direct readings of pressure improve the confidence level somewhat and provide anchor points for the tendency curve.

Errors in forecast latitude displace the entry on the pressure-wind correlation graph but generally contribute only 5 knots or less to the total error.

The primary source of error resulted from the breakdown of the extrapolation assumption when, as with typhoon Ida, a 55 millibar deepening was observed over an 18 hour period. Some typhoons go through more than one phase of intensification or do not follow a simple intensification-decay cycle.

3. DATA:

Table 3-1 records the 1969 season verification of maximum wind forecasts at warning time and all forecast times.

Figure 3-1 is the 24 hour maximum wind forecast

verification for individual typhoons of 1969.

Figure 3-2 is the frequency distribution of errors for 12, 24, and 48 hour forecasts of maximum winds.

Table 3-2 records the 1966 season verification for purposes of comparison.

4. ANALYSIS:

During the first 48 hours of each forecast period in 1969 absolute mean error increased at a mean rate of 2 knots every 6 hours from an initial error of 4.9 knots at warning time. The algebraic mean error was minus in all time categories indicating a forecast bias on the low side. The low bias increased from 1.9 knots at warning time to 6.8 knots at 48 hours.

The largest intensity errors were associated with the two most intense typhoons (Viola and Elsie), together with Typhoon Ida whose rate of intensification was unusually rapid and with Typhoon Susan, an off-season typhoon that ignored climatology in reaching 105-knot sustained velocity. Only these four typhoons significantly exceeded the mean absolute 24 hour forecast error of 13.7 knots.

The 24 hour intensity error distribution ranged from -45 to +35 knots with the median forecast 5 knots low and three-fourths of the forecast errors falling between -25 and +15. The 48 hour intensity error distribution ranged from -55 to +60 with the median forecast 5 knots low and three-fourths of the forecast errors falling between -35 and +10.

It is evident from the appearance of the forecast error distribution curves (Figure 3-2) that maximum wind forecast error increases with time and shows little skill at 48 hours. The median 12 hour forecast is accurate within ± 10 knots; the median 24 hour forecast is accurate within ± 37.5 knots.

In order to evaluate the relative success of the central pressure forecasting technique, the same analysis was made of the 1966 season accuracy of forecasting maximum winds. The results are reported in Table 3-2. Comparison shows a significant improvement in 1969. This is attributed to increased emphasis on forecasting maximum wind velocity and the effectiveness of the central pressure technique devised for this purpose.

5. CONCLUSIONS:

Forecasts of maximum wind for 12 and 24 hour time periods in 1969 have mean absolute accuracies of 9.0 and 13.7 knots respectively with a 5 knot bias toward underforecasting. These figures reflect a significant improvement over the 1966 season and indicate that the procedure described in this section is effective.

6. ACTION:

Continued use of the central pressure method of forecasting maximum winds is indicated for 1970 with an attempt to correct the tendency for slight underforecasting.

a. The algebraic mean values might suggest that forecasts could be improved in 1970 by merely increasing all forecasts by 5 knots, however, the frequency distribution in Figure 3-2 shows a modal value at zero error. Simply displacing the complex curve five knots to the right would not improve the distribution significantly. If the curve were pictured as symmetric with the errors on the positive side, the excess of forecasts in the range 10 to 25 knots too low becomes evident.

b. A study of these cases is indicated as the best way to improve performance in 1970. A further improvement may be realized from a climatological approach to mean rates of intensification. The climatic average values for the season used as minimum intensification forecasts should reduce the number of underforecast cases and produce a slight positive bias in mean values with a better centralized distribution.

TYPHOON INTENSITY VERIFICATION

ABSOLUTE MEAN ERROR (KTS)															ALGEBRAIC MEAN ERROR (KTS)																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																	
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TABLE 3-1

TYPHOON INTENSITY VERIFICATION

1966

	ABSOLUTE MEAN ERROR	ALGEBRAIC MEAN ERROR
	24-HR	24-HR
ANNUAL TOTAL	17.2 KTS	—3.4 KTS

TABLE 3-2

1969 TYPHOON INTENSITY ERRORS FOR 24 HOUR FORECASTS

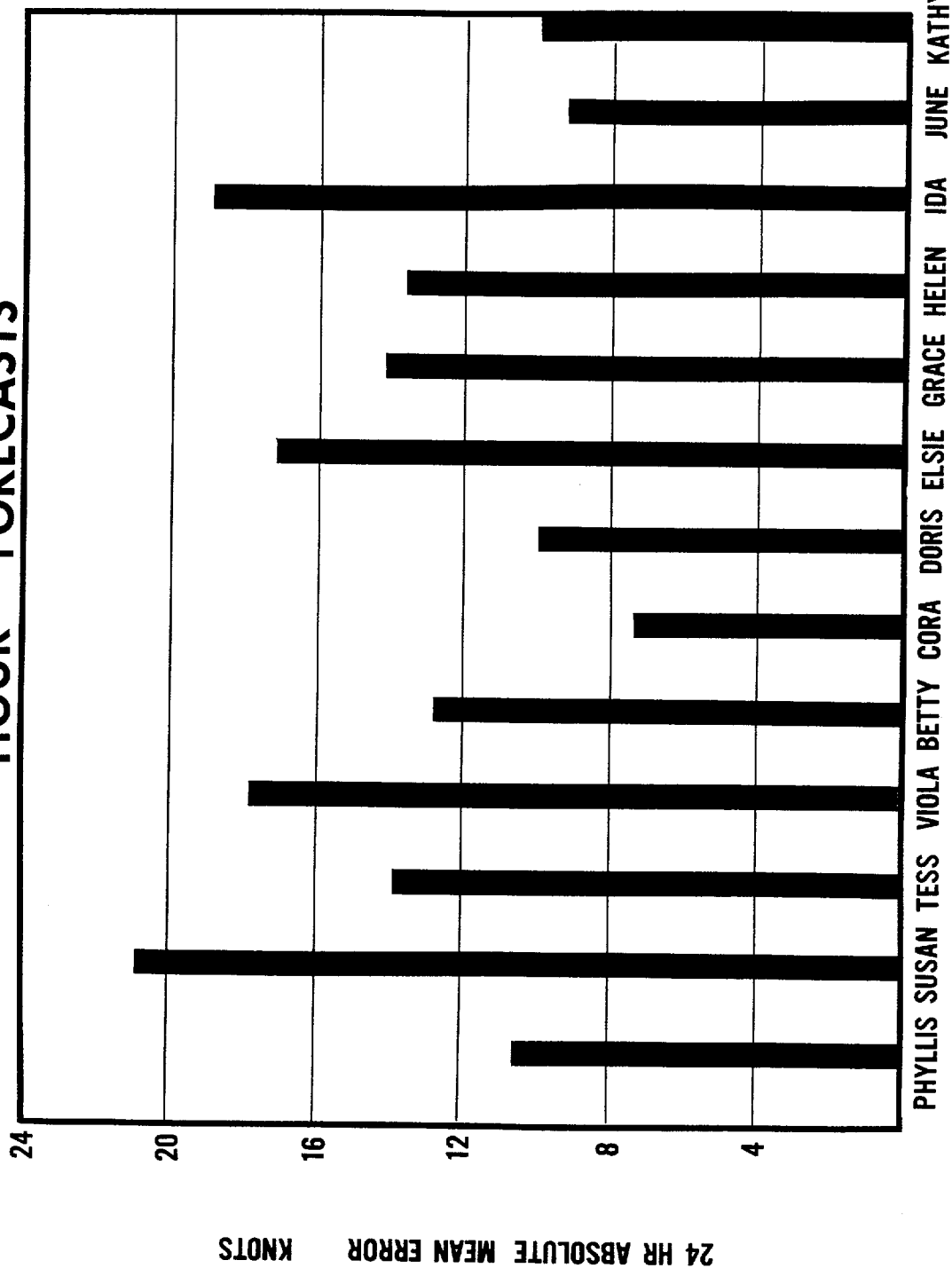


FIGURE 3-1

INTENSITY FORECASTING SKILL 1969

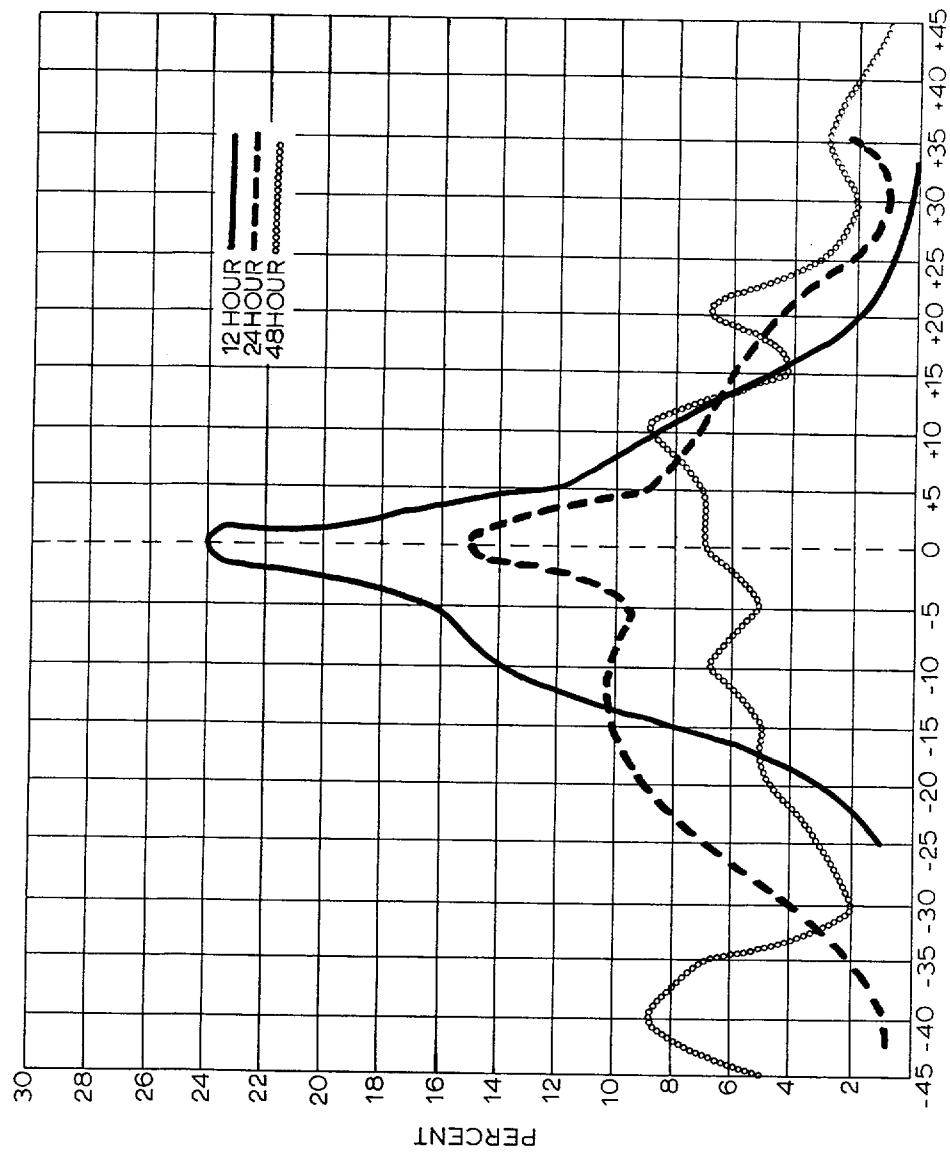


FIGURE 3-2

B. A Discussion of Tropical Cyclone Forecast Verification Methods and Seasonal Differences in Forecasting Difficulty.

1. GENERAL:

a. Mean Error: The verification method for tropical cyclone forecasts used since the establishment of JTWC has been mean absolute error, with the 24 hour error receiving the most attention. (See Figure 4-1)

b. Right Angle Error: Recognition of some basic inadequacies of the mean absolute error led to addition of the right angle error charts (See Figure 4-3) to depict track forecasting ability apart from speed errors.

c. Median Error: Occasional large forecast errors contribute disproportionately to the annual mean error as seen in Figure 3-3. All mean values are greater than their corresponding median values. In 1969 the median error for the over 200 MI cases was 265 MI. Six errors of 70 MI are needed to balance 200 MI errors. The extreme effect of this could be seen in 1960 when multiple storms, overtaxed reconnaissance resources and erratic tracks combined to produce more large forecast errors and resulted in a spread of 46 N.M. between median and mean values. Median error provides a more conservative and meaningful measure of forecast accuracy for the season. Since median error represents the 50 percent confidence level, any desired specific and significant point in the frequency distribution of errors (67%, 75%, 80% or 90%) could be selected as a more valid measure of skill than the mean absolute error. The few large forecast errors that do occur would contribute equally to the combined figure on a one forecast-one vote basis. It is interesting to note that both 1968 and 1969 median scores of 97 N.M. were records for the 11 year period of record.

d. Seasonal Differences: The increased difference in 1969 between the median score of 97 N.M. and the mean score of 111 N.M. illustrates the influence of a few large errors on the annual mean in a "light" typhoon year. The 1968 and 1969 seasons both had six recurving typhoons and a similar number of opportunities for large error during recurvature or on northeasterly accelerating storms even though the total number of warnings issued in 1969 was only about half of the 1968 total. Through midseason 1969 including Typhoon Doris the JTWC absolute mean error was 89 N.M. The influence of recurving Typhoons Grace, Helen, Ida, June, and Kathy was not balanced by any straight-running, late-season cyclones. The year ended with a respectable but disappointing 111 N.M. mean error. The potential for breaking 100 N.M. in mean error for a season remains good but depends on limiting the larger errors and the chance occurrence of well-behaved cyclones. This illustrates a basic difficulty in evaluating forecaster performance from year to year in the tropics. A sample of 100 tropical cyclones might constitute a representative sample of all situations

24 HOUR MEAN AND MEDIAN ERRORS FOR JTWC TYPHOON FORECASTS

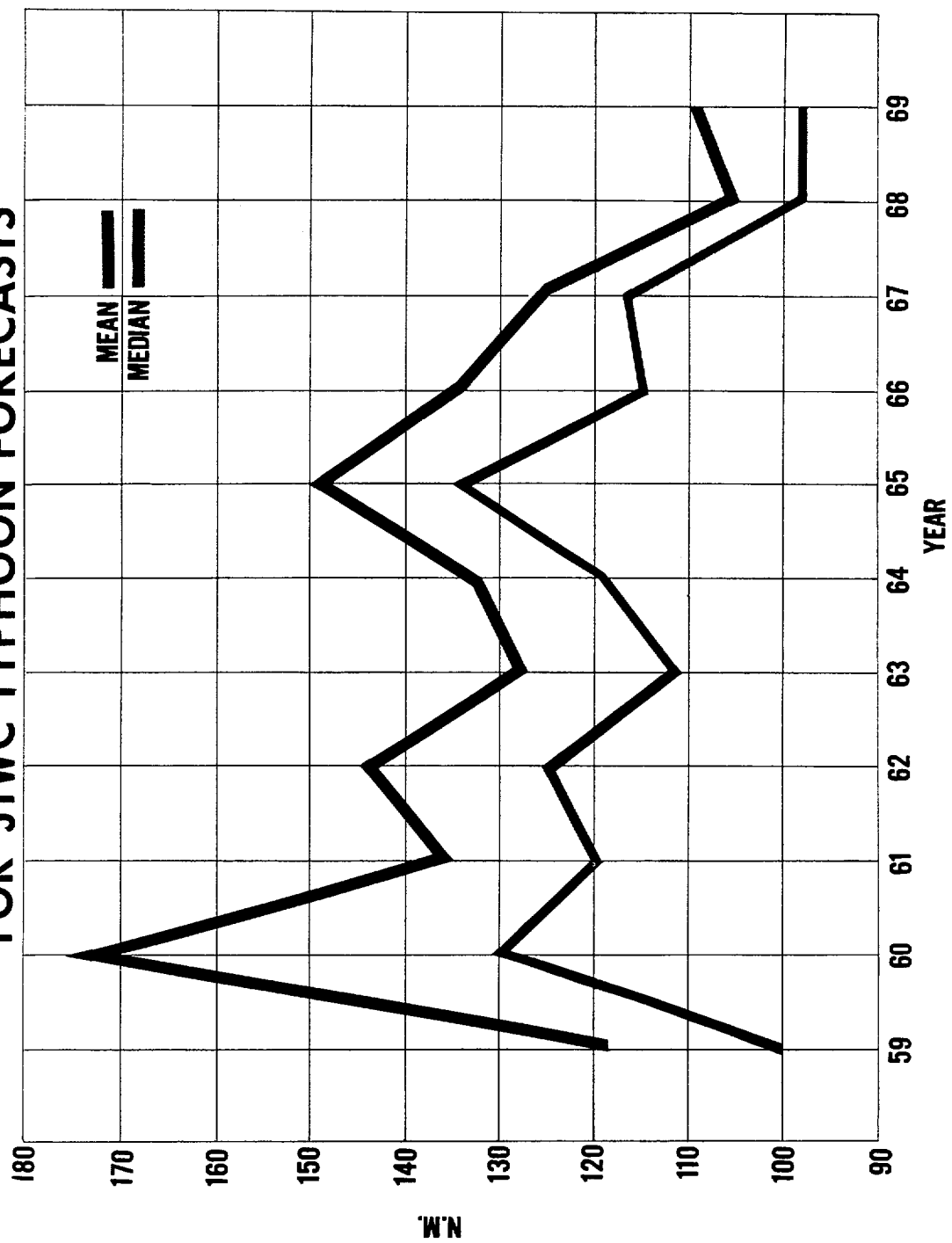


FIGURE 3-3

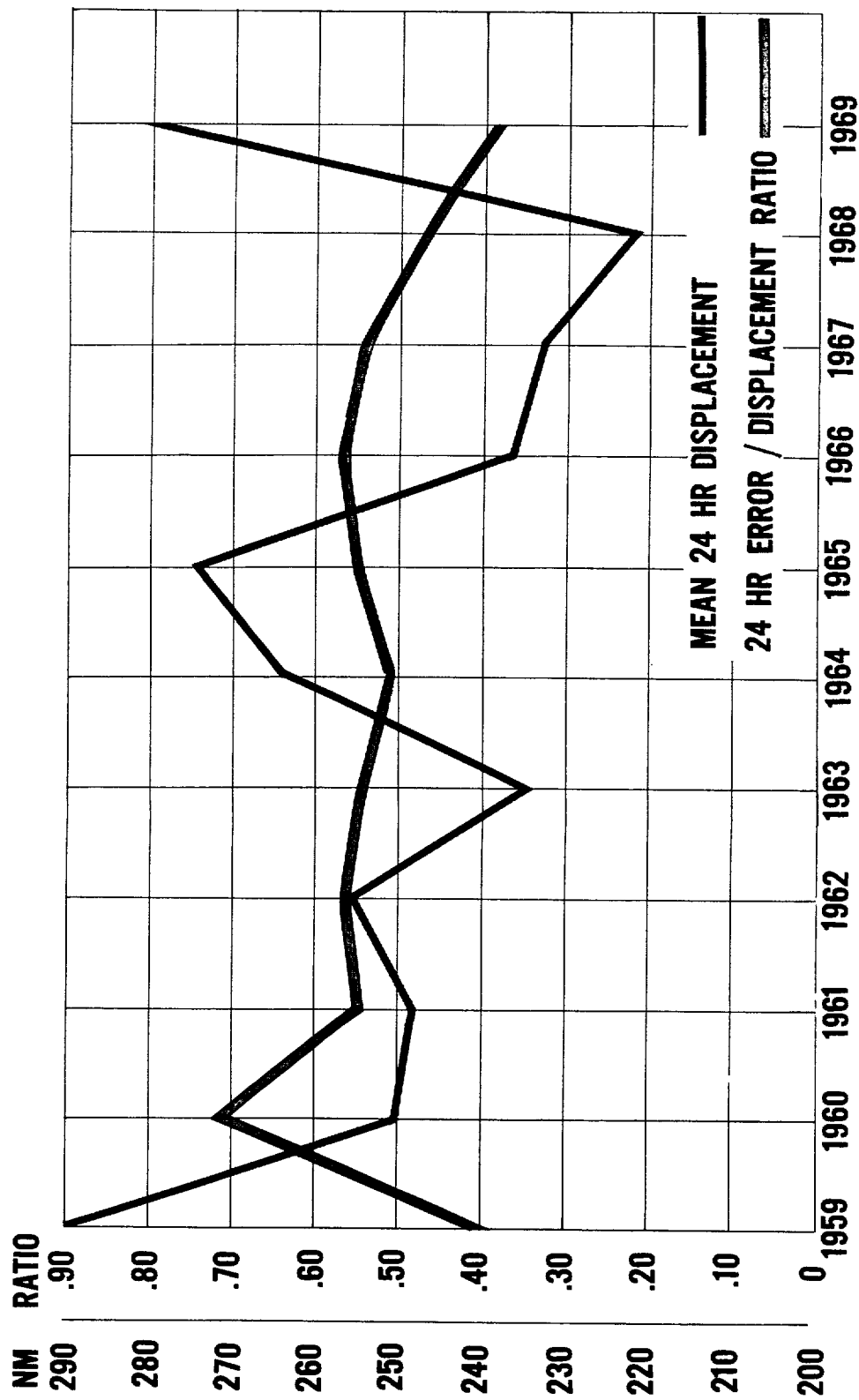
faced by the forecaster at one time or another, but a one-season sample of 20 or 30 cyclones is liable to contain a disproportionate number of recurving or erratic cyclones, resulting in a relatively high mean error. A sample containing straight-running cyclones, on the other hand, would produce a cushion of better than average forecasts. A method of evaluation including a measure of forecast difficulty would provide a more realistic appraisal of forecaster performance.

e. Displacement as Measure of Difficulty: A skill-scoring method sometimes mentioned for extratropical storms is based on error as a ratio of actual displacement during the forecast period. This method was used by LCDR Jerry Jarrell of Naval Weather Research Facility to examine JTWC annual forecast verifications from 1959 through 1967. (unpublished) The study has been updated for 1968 and 1969 and is presented graphically in Figure 3-4. The assumption made in this approach was that if a cyclone moves 500 N.M. in a 24 hour period, an error of 100 N.M. shows more skill than if the cyclone moved only 250 N.M. in the same period. In this system forecast errors are expressed as miles of error per mile of movement rather than the usual miles of error per 24 hour time period. In the first case the error rate would be $100/500$ or .200. The error rate of the second example would be $100/250$ or .400.

An implication of this system applied to individual forecasts is that slow-moving storms are easier to forecast than fast-moving storms. Such is not always the case, as illustrated by recurving storms which execute the greatest change of direction and present the most difficult forecasting situation while moving at their slowest speed. The error-producing combination of deceleration, rapid change of direction and then acceleration challenge the ability of any forecaster. Even though the 24-hour distance moved in a recurve track is the same as that on a straight track, the recurving storm is a much more difficult one to forecast. A quasistationary storm could never score well in the system because of the small denominator in the skill ratio. An excellent verification error of 50 N.M. made while the storm only moved 75 miles would not appear to have much skill. Applied to yearly mean values the system may avoid objections raised on the basis of individual forecasts. In the application of this technique to JTWC forecasts the mean displacement value and mean error are used to produce mean error ratings for each year. The variability of individual years in mean displacement values is evidence of significant differences in mean storm behavior from year to year. Under this rating system the 1969 season with a mean 24-hour speed of 12.4 knots for all typhoons would be more difficult to forecast than the 1968 season when a mean 24-hour speed of 9.2 knots was recorded. Compared with the past 11 years the 1969 season ranked 1st in difficulty and 1st in accuracy by the mean error to displacement ratio.

f. Objective Technique Scores as a Measure of Difficulty: A second indication of basic differences between

MEAN ERROR TO DISPLACEMENT RATIO



YEAR

FIGURE 3-4

seasons is the variability noted in extrapolation and Arakawa objective technique scores in Table 3-3. The samples used in constructing the table included forecasts for tropical cyclones of all classes. (The JTWC values in this sample therefore may differ from official verification figures which include only those cyclones reaching typhoon strength.)

EXTRAPOLATIVE TECHNIQUE SCORES

YEAR	JTWC	EXTRAP	ARAKAWA
1967	121 NM	136 NM	NOT USED
1968	103 NM	108 NM	119 NM
1969	121 NM	131 NM	137 NM

TABLE 3-3

Extrapolation as used at JTWC includes a considerable amount of subjective judgement by the forecaster. The extrapolation forecast is usually the starting point for each official forecast. The fact that official forecasts have improved upon intelligent extrapolation by 5% in 1968, 9% in 1969 and 11% on a small sample in 1967 indicates a consistent mean skill on the part of the JTWC forecasters to do what they purport to do-forecast typhoon movements. A function of the difference between extrapolation error and mean error might serve as a measure of forecaster skill and JTWC performance. The Arakawa technique has consistently proved to be the best of truly objective techniques. This method eliminates the subjectiveness of extrapolation and may reflect the differences in difficulty between seasons better than any other simple method. The technique is firmly based in extrapolation. Errors recorded by this technique should be a good measure of the amount of nonsteady state change occurring. The 1969 mean Arakawa error of 137 N.M. compared to the corresponding 1968 value of 119 N.M. is interpreted to indicate that 1969 cyclones were more irregular in movement than those of the previous year, a fact well supported by personal observation.

2. CONCLUSIONS:

- a. An objective means of rating the difficulty of a typhoon season should be considered in addition to the single value of mean or median accuracy. The Arakawa technique is favored for this purpose.
- b. Median scores should be included in future annual reports as an alternate measure of forecast accuracy.
- c. The error to displacement ratio is not considered an indicator of forecasting skill, but displacement serves to point out the differences in storm behavior between one season and another.

C. Frequency Distribution of Error in JTWC Official Forecasts.

1. BACKGROUND:

Operational use of JTWC tropical cyclone warnings requires an appreciation of the frequency and nature of forecasting error likely to be encountered. This article is an effort to describe the frequency distribution to form a realistic basis of understanding for both the operational user and the JTWC forecaster.

2. PROJECT SCOPE AND DESIGN:

Mean 24-hour absolute errors on all storms designated as typhoons from 1959 to the present were counted and totaled by 10-knot intervals. The total frequencies were graphed and a smooth-curve analysis made (See Figure 3-5). A total of 4236 forecasts were included in the study. In order to provide an operationally useful tool the individual interval totals were converted to cumulative percentages for two periods: 1959-1967 and 1968-1969. (See Figure 3-6.) It is difficult to estimate whether the improved performance of the last two or three seasons can be maintained in future typhoon seasons. Both curves have been presented to show the long-time and recent experience.

3. DISCUSSION:

The cumulative percentages on the Y-axis can be used as desired levels of confidence to find the error margin in N.M. associated with this confidence level on the X-axis.

CONFIDENCE TABLE

LEVEL	59-67 (NM)	68-69 (NM)	IMPROVEMENT
50%	118	97	17.8%
67%	162	126	22.2%
75%	186	147	21.0%
80%	206	164	20.4%
90%	260	220	15.4%

TABLE 3-4

FORECAST ERROR FREQUENCY DISTRIBUTION 1959-1969

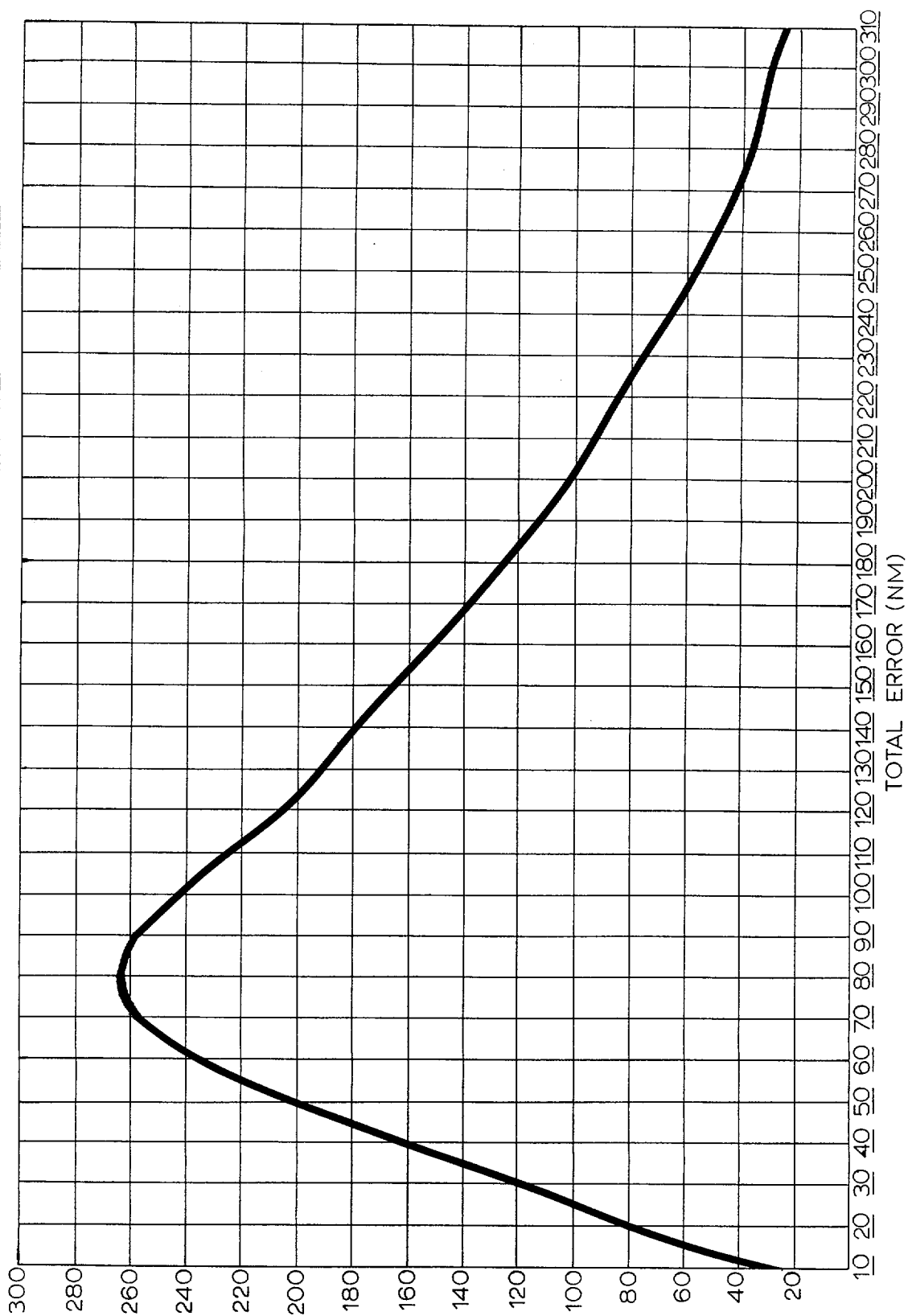


FIGURE 3-5

CUMULATIVE PERCENT OF FORECAST ERROR BY MILES OF ERROR

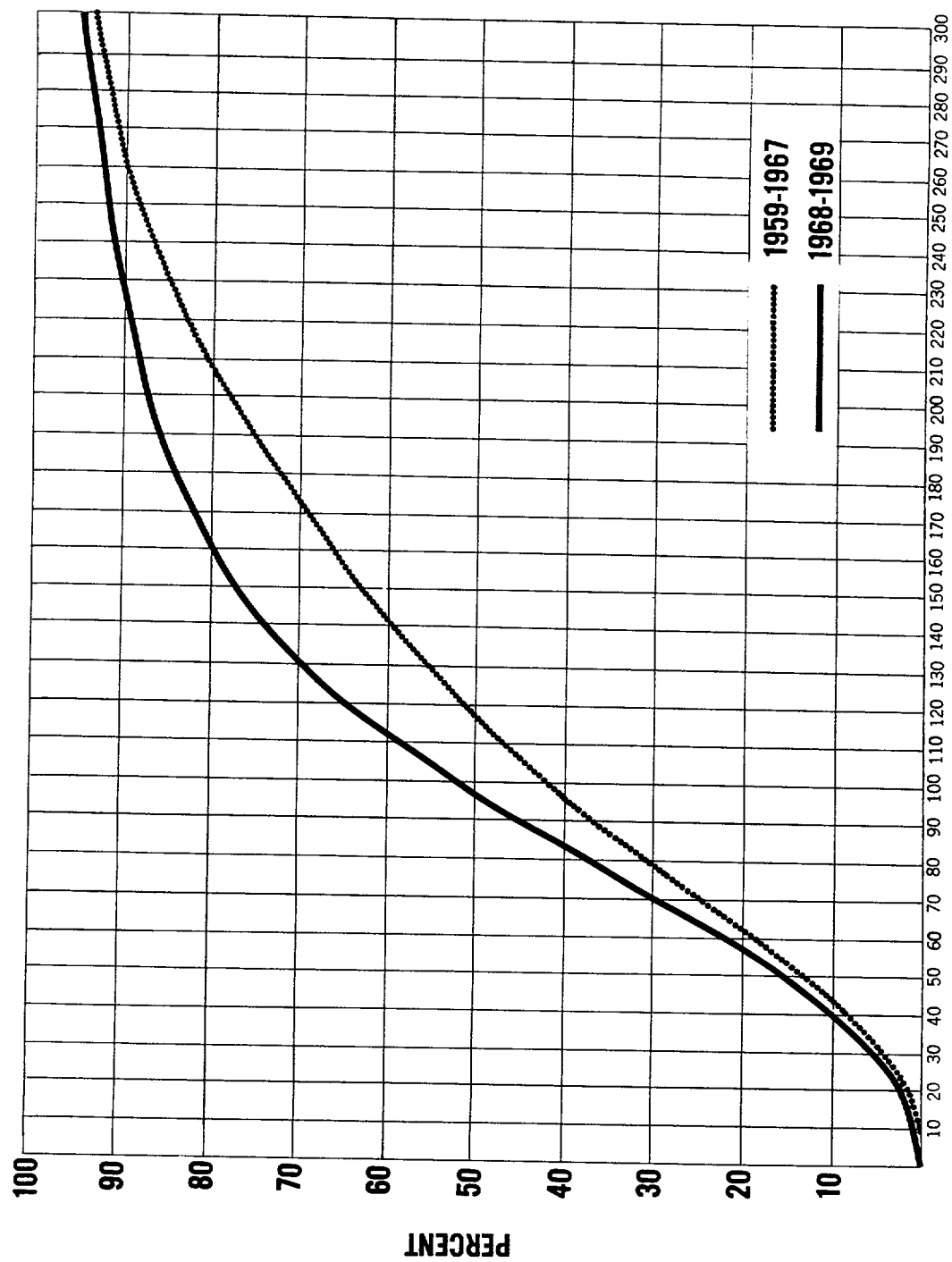


FIGURE 3-6

4. CONCLUSIONS:

a. It is noted that even though median and modal scores have reached record accuracies in 1968 and 1969, they don't measure the full extent of the forecast improvement realized. The maximum improvement is recorded near the one sigma level with over 22% improvement made in two-thirds of all forecasts.

b. The area of major improvement in the curve was between 40 N.M. and 160 N.M. and in this area represents a 30 to 40 N.M. increase in confidence level.

c. The failure to limit large errors is evident as the 90% and greater confidence levels are entered. Less improvement has been made in the upper 10 percent than in the average forecast range.

d. The incidence of errors exceeding 200 N.M. has been reduced from 21% to 12% but remains the necessary area of concern both because of the disproportionate influence on mean values and the potential for severe weather damage due to lack of adequate or timely warnings.

e. Very little improvement has been realized in the upper 5%. About 15 or 20 forecasts per year are so unpredictable that 24-hour errors will exceed 300 N.M.

f. In addition to this graphic approach to confidence level, the nature of each forecast situation should be considered. A storm moving in a northeasterly direction is, for instance, less accurately forecasted than other situations.

D. Causes and Cures for Forecast Errors Exceeding 200 N.M.

1. GENERAL:

A study of errors over 200 N.M. for the 1968 season was made to determine contributory factors and identify areas of possible improvement.

It was noted that the individual characteristics of each storm predispose large forecasting errors. Eleven of the 20 typhoons of 1968 had no forecasting errors greater than 200 N.M. The nature of each storm is, however, more a matter of hindsight rather than an evident feature of a storm prior to onset of looping, acceleration or generally erratic movement. Errors over 200 N.M. occur during all phases of the life cycle of tropical cyclones. In 1968 the early phases of a storm accounted for one-fourth, the late phases for one-fourth and the mature stage for the remaining one-half of large errors. The six identified factors contributing to large errors were:

- | | |
|--|-----|
| a. Forecaster Technique | 1/6 |
| b. Misleading Recon Data | 1/6 |
| c. Lack of Recon Data | 1/6 |
| d. Looping Motion or Quasistationary Periods | 1/6 |
| e. Acceleration on Northeasterly Track | 1/6 |
| f. Unusual Motions to Southwest or Sharp
Recurvature etc. | 1/6 |

Fujiwhara motions would also result in large errors but have not been common in 1968 or 1969.

Improvement of individual forecasts in the six categories is the present subject of JTWC operational research. The study of forecaster confidence reported in this annual points up the basic inability of the forecaster to anticipate large errors in many situations. Even under those circumstances when he can recognize the potential for large error, he is able to limit his error to average values in only half of the cases.

A forecaster's handbook for JTWC is being prepared as an aid to improve forecaster technique in minimizing these errors, particularly those resulting from misleading reconnaissance data.

The lack of reconnaissance data during the first 12 to 18 hours of warning of many developing storms is common. When a daylight investigation locates a depression, continuous reconnaissance is generally planned for the following morning. If the cyclone is moderately well developed when first located

or forecasted to develop rapidly, fixes are requested as soon as possible. During the initial period of development prediction of the direction of movement of tropical cyclones is frequently not very successful. Only after two or three "fixes" are we able to state with good confidence where the cyclone is or is going. The selection of the initial track is made on the basis of climatology, synoptic steering, and various objective techniques. Because of aircraft scheduling problems and the need to place cyclones in warning as soon as their development can be predicted, only small improvement can be expected in this area in the future.

Looping motions are a two-edged sword to forecasting accuracy. The sometimes sudden deceleration finds two or three forecasts far overshooting the storm and a consequent acceleration out of the loop leaves two or three quasistationary forecasts far behind. A study of loop duration, exit speeds and directions and a means of anticipating the breakout will be undertaken to provide a degree of error reduction in this difficult situation.

A study of accelerations on northeasterly tracks reveals a persistent underforecasting of northeast movements during 1968 and 1969 as well as in many years past. The average 24 hour error for northeasterly moving storms in 1968 was 156 N.M. on 52 cases. The 1969 average of 127 N.M. for 45 cases was some improvement, but forecasts remained persistently behind actual acceleration. During 1969 ten of forty-five northeasterly forecasts were in advance of actual movement, none by more than 65 miles. In 1968 ten of fifty-two forecasts were in advance of actual movement, six of them on the same storm and three of these 160 to 180 N.M. in advance of actual movement.

The experience of 1968 and 1969 is being used to identify storms with an expected accelerating track to the northeast and to compensate for the persistent underforecasting of movement seen in past years in 1970 operational forecasting.

The final category of movements to the southwest, sharp recurvatures and other unusual actions will continue to produce a few large errors. The best hope for improvement in these storms that fail to follow extrapolation may be found in the analog technique now under development.

A follow-up study in 1969 found that three typhoons accounted for 72% of the 24-hour errors over 200 N.M. and all of the 24-hour errors exceeding 300 N.M. Elsie, Grace and June were the misbehaving ladies. Elsie settled down after a rather unpromising beginning but Grace and June remained erratic throughout their lifetimes.

E. A Comparison of Objective Techniques for Typhoon Movement.

1. STATUS:

Forecasts using seven different objective techniques were used and verified for all four warning times for all 24 hour forecasts issued by JTWC in 1969. Techniques showing the best results in 1968 were retained and those failing to show promise were discontinued.

2. 24 HR OBJECTIVE TECHNIQUES:

- a. JTWC - official forecast for comparison.
- b. EXTRAPOLATION - a semi-objective method by which forecast points are determined by recent past values of position, speed and direction.
- c. ARAKAWA - grid overlay values of surface pressure are entered into regression equations and hand computed.
- d. 700 mb PROG - HATRACK forecast based on 700 mb SR forecast fields.
- e. 700 mb PROG MOD (12 Hr) - (d.) is modified by twice the recent 12 hr vector error.
- f. 500 mb PROG - HATRACK forecast based on 500 mb SR forecast fields.
- g. 700/500 mb PROG RENARD - method using HATRACK 700 mb longitude and HATRACK 500 mb latitude (reported in 1968 annual).

3. MODIFICATION TECHNIQUES:

a. A single correction vector equal to twice the most recent 12 hour error correction vector is applied to the 700 mb prog forecast to produce the 700 mb prog mod forecast.

b. A 12 hour history position is provided as an input to the TYRACK program. The apparent speed and direction over the past 12 hours is computed and used to select the best steering level and to correct the forecast steering of that level for observed differences from history.

4. TESTING AND RESULTS FOR 24 HOUR FORECASTS:

A homogeneous sample of 210, 24 hour forecasts, for tropical storms and typhoons was assembled for 1969. Results are summarized in Table 3-5. The following general observations are offered:

OBJECTIVE METHODS STATISTICS 1969
(24 HR MEAN VECTOR ERRORS N.M.)

STORM	(CASES)	JTWC	EXTRAP	ARAKAWA	700P	700P*	500P	RENARD	TYRACK
T. PHYLLIS	(13)	150	160	154	183	230	379	160	175
T.S. RITA	(3)	60	56	54	540	162	320	542	292
T. SUSAN	(5)	74	99	63	333	282	398	291	252
T. TESS	(3)	134	96	66	314	150	232	338	90
T. VIOLA	(14)	93	127	129	232	161	194	207	177
T.S. WINNIE	(3)	120	100	108	266	-	242	296	182
T.S. ALICE	(2)	195	222	243	123	-	171	171	276
T. BETTY	(9)	108	115	118	246	267	255	276	250
T. CORA	(25)	88	85	87	187	121	198	198	113
T. ELSIE	(23)	78	97	94	225	57	238	228	267
T. GRACE	(25)	186	254	337	292	222	398	278	505
T. HELEN	(14)	184	242	215	406	158	342	361	337
T. IDA	(20)	88	94	86	138	116	122	129	271
T. JUNE	(25)	140	138	123	170	100	244	141	205
T. KATHY	(17)	146	139	144	240	168	354	192	240
T.S. LORNA	(9)	129	156	108	268	201	314	218	150
ANNUAL MEAN VALUES	(210)	124	142	144	235	154	272	221	251

TABLE 3-5

* 700PROG MOD (12) has only 124 cases. Comparisons cannot be made on a homogeneous basis between this and other objective methods. Many of the missing forecasts involved extreme forecasts and were omitted as not meaningful.

a. JTWC official forecasts are again significantly better than any single objective technique.

b. Extrapolation continues to be the single most reliable objective technique. The 1969 extrapolation error of 142 N.M. increased 28 percent over the 1968 value of 111 N.M. The improvement over extrapolation of the JTWC official forecast increased from 5 percent in 1968 to 13 percent in 1969.

c. Arakawa forecasts remain very close to extrapolation and increased 16 percent over the 1968 value of 121 N.M.

d. The HATRACK 700 mb prog again verified better than the 500 mb prog but total error of 235 N.M. is excessive.

e. The 700 mb prog mod (12 Hr) - again improved on the performance of the unmodified forecast with performance approaching that achieved by the Arakawa surface pressure method.

f. The 700/500 mb prog Renard method again improved upon the performance of both the 700 mb and 500 mb HATRACK forecasts by 7 percent over 700 mb and 19 percent over 500 mb.

g. The TYRACK forecasts were disappointing in total accuracy but provided the most realistic and usable track forecasts during the season, particularly for recurving storms. Large speed errors continue and show need for additional program controls. The continued improvement in 48 and 72 hour right angle error is in part due to guidance from the TYRACK track forecast.

h. Individual forecasts in a non-homogeneous sample were examined from the viewpoint of determining the forecast method producing the individual absolute best verification score. The results are presented in Table 3-6.

BEST INDIVIDUAL OBJECTIVE FORECASTS

	<u>JTWC</u>	<u>EXTRAP</u>	<u>ARAKAWA</u>	<u>700P</u>	<u>700PMOD</u>	<u>500P</u>	<u>RENARD</u>	<u>TYRACK</u>
#TOP	76	49	66	11	29	15	14	34
CASES	282	279	265	235	134	227	224	256
RATE	.270	.176	.249	.043	.217	.066	.063	.133

TABLE 3-6

The JTWC forecast does not always produce the absolute best forecast but is more consistent. Cases where extrapolation or Arakawa produced a best forecast often involved a difference of only a few miles from the official forecast. Mean deviation from the JTWC forecast in these cases was

48 N.M. for extrapolation and 53 N.M. for Arakawa. This points out an area of potential improvement since 115 of 282 cases could have been improved by closer use of extrapolation or Arakawa objective techniques. Since all forecasts begin with extrapolation the remaining 167 forecasts must represent situations where extrapolation was correctly modified to produce a better official forecast. Further research aimed at developing procedural rules for limiting the deviation from Arakawa and extrapolation should improve some of the 18 cases in which the JTWC error was over 100 N.M. greater than extrapolation or Arakawa.

i. Tables 3-7 and 3-8 present stratified analyses of 1969 objective methods. Table 3-9 applies stratification by latitude to JTWC official forecasts. The 1969 sample is not large enough to guarantee representative figures in all stratifications but most results support previous observations. The following tentative conclusions based on stratification are offered:

(1) All computer methods except the 700 mb prog modified for 12 hour error performed best at higher latitudes with northeasterly moving storms. Arakawa did not work well at all for these storms. Extrapolation error was high due to acceleration. The 700P(MOD) provided a fair overall forecast for northeasterly moving storms.

(2) The most forecastable storms were those south of the ridge line. JTWC, Arakawa and extrapolation scored best on these. The 102 N.M. error for Arakawa on 77 westerly moving storms is very convincing.

(3) Stratification by wind extensity shows improved steering with increased intensity for all except the extrapolative techniques.

OBJECTIVE FORECAST STRATIFICATION
ERRORS BY DIRECTION OF MOVEMENT

	001-090°	091-259°	260-300°	301-360°
JTWC	152 (44) *	226 (15)	98 (74)	113 (77)
EXTRAP	179 (44)	246 (15)	110 (74)	130 (77)
ARAKAWA	231 (44)	218 (15)	102 (74)	121 (77)
700P	197 (44)	307 (15)	262 (74)	218 (77)
700P (MOD)	168 (30)	186 (10)	150 (39)	143 (45)
500P	205 (44)	457 (15)	290 (74)	258 (77)
RENARD	187 (44)	299 (15)	247 (74)	200 (77)
TYRACK	224 (44)	249 (15)	260 (72)	259 (77)

* Cases shown in parens

TABLE 3-7

OBJECTIVE FORECAST STRATIFICATION
ERRORS BY INTENSITY

MAX WINDS	<50 KT	≥50 KT	ALL WINDS
JTWC	132 (60)	121 (150)	124
EXTRAP	130 (60)	146 (150)	142
ARAKAWA	128 (60)	151 (150)	144
700P	286 (60)	215 (150)	235
700P (MOD)	186 (26)	146 (98)	154
500P	295 (60)	263 (150)	272
RENARD	277 (60)	198 (150)	221
TYRACK	282 (59)	239 (149)	251

* Cases shown in parens

TABLE 3-8

OFFICIAL JTWC FORECAST
STRATIFIED BY LATITUDE

	24 HR	48 HR	72 HR
SOUTH OF 20N	103 (132)	202 (63)	305 (16)
20N to 30N	117 (96)	240 (82)	346 (31)
SOUTH OF 30N	109 (228)	224 (145)	332 (47)
NORTH OF 30N	134 (20)	330 (21)	429 (10)
ALL CASES	111 (248)	237 (166)	349 (57)

* Cases shown in parens

TABLE 3-9

F. Confidence Forecasting.

1. BACKGROUND:

Forecaster confidence in his product is an often discussed parameter. If a forecaster were able to anticipate his good and bad forecasts, operational users would benefit from this information. In response to discussions of the 1969 Typhoon Conference an operational research project was designed to record and evaluate the accuracy of forecaster confidence at the time of forecast at JTWC.

2. PROGRAM SCOPE AND DESIGN:

The confidence forecast sample was 205 separate confidence forecasts from April through October of 1969. The sample included tropical storms as well as typhoons. The Director, Operations Officer or Typhoon Duty Officer completed a series of objective and subjective forecasts of confidence after each official warning but prior to the next aerial reconnaissance fix. The objective methods used were:

a. Area Climatology of Errors Based on Mean 1968 Experience: The assumption of this approach is that the difficulty of forecasting can be predicted from the location of the cyclone at the time of forecast.

b. Area Climatology by Category: This approach used the same data base as the first but makes only the category forecasts of average (110 N.M.) below average (70 N.M.) or above average (150 N.M.)

c. Mean Climatology: A representative mean climatology of 110 N.M. was applied to all forecasts.

d. Persistence: The 24 hour error determined at forecast time was forecasted to persist for the next 24 hours.

e. Subjective Forecast: Forecaster confidence in the subjective feeling a TDO has about his knowledge of where a cyclone is now, where it has been and where it is going. The following values were suggested from the 1968 season:

1st three warnings (no good 12 hour history)	150 N.M.
20 to 30 knot winds at forecast time	120 N.M.
Northeasterly movement	140 N.M.
Best confidence limit	40 N.M.
Worst confidence limit	200 N.M.

The original impetus for this study was the understand-

able desire to express statistically the increased confidence that was believed to accompany the reduction in forecasting error noted in the last few years thus enabling closer passage by mobile operating forces to tropical cyclones when forecaster confidence was better than average.

3. ANALYSIS:

a. General: Only the subjective method was significantly better than the other four methods tested. On the whole, forecasters' subjective estimates tended to be conservative, averaging 9 N.M. greater than observed mean error. Seventy-five percent (75%) of the confidence forecasts verified with errors no more than 20 N.M. greater than the forecast value. This figure compares with seventy-six point-five percent (76.5%) that would have verified under the same ground rules using a mean error value of 105 N.M. for all forecasts. The second method approximates the manner of applying confidence implied in current SEVENTH FLEET Operations Orders and presents a fair argument for retention of the present doctrine.

The relatively poor performance of the error forecasts by geographic area of origin is undoubtedly due in part to the limited sample size of the error climatology. Whenever 1968 error history was not available the mean value for 1968 was substituted. The relatively poor final performance of the area climatology, both mean values per 2 1/2 degree square and three category assignment, indicates negative correlation between forecast errors in the same geographic location from one year to the next. A tentative hypothesis for these data is that geographic errors are less significant than dynamic errors associated with storm intensity, speed of motion, direction of motion and its relation to large scale synoptic features of current weather charts. The expansion of error climatology based on geographic area would eventually produce a forecast showing some skill due to a concentration of storms with similar characteristics in the same area, but a more direct approach considering the dynamics of intensity or speed and direction of motion should be superior meteorologically.

The poorest of the objective methods is the persistence forecast. The results here indicate that large errors or small errors are unlikely to repeat themselves over a 48 hour period and also that forecasting of extreme values results in larger errors than forecasting mean values. We must conclude with some conviction that yesterdays performance is less indicative of todays confidence than is last years mean error value.

Even though the mean value of subjective forecaster confidence shows little skill over last years single mean value, the possibility of skill in one or more confidence categories is worth investigating.

b. Better Than Average Confidence (25 N.M. or less): Forecasts of good confidence are useful if (1) they can be reliably made and (2) they can result in a significant change in operational decisions. Relative to the first criterion, 12 of 49 confidence forecasts (24% of better than average confidence (85 N.M. or less) verified with greater than average error (135 N.M. or more.) From this we might describe a 76 percent confidence level that our forecast of "better than average" will verify as "average" or "better than average." Relative to the second criterion the best confidence used during the period was 50 N.M. The median error of the confidence forecast was 42 N.M. An operational decision at the 75 percent confidence level would thus involve the difference between a single mean error of 105 N.M. and the adjusted subjective forecast of 92 N.M. A maximum reduction of a "clearance criterion" for tropical storms of only 12 percent or 13 N.M. would result. Any of the 12 "bust" forecasts from the "better than average" forecast group might have encouraged a closer approach than would otherwise be considered prudent to the subsequent track of a typhoon if the confidence forecast were used in determining an evasion course. It is doubtful if the potentially small gain justifies the loss of confidence level.

c. Average Confidence (90 to 130 N.M.): One hundred five (105) of the two hundred five (205) forecasts in the sample were forecasted to be in the average range (90 to 130 N.M.) and only 21 of them (20%) verified with greater than average error. One would normally expect many more "bust" forecasts from the average confidence group than from the better than average group if predictable skill were involved.

d. Below Average Confidence (135 N.M. to 200 N.M.): Twenty-four (24) of fifty-one (51) below average confidence forecasts (47%) verified correctly in the above average error group suggesting considerable skill in the recognition of large error potential at the time of forecast. Even when circumstances of missing or questionable data create doubt in the forecasters mind and lead him to anticipate large potential errors, persistence works toward verifying a conservative extrapolation forecast. Verification of an expected large error with better than average accuracy is no indication of lack of forecaster skill. On the contrary it indicates that a difficult situation was recognized and correctly forecasted. The greater frequency of large errors in cases where they are expected would be valuable information to the Captain desiring to exercise all caution due an uncertain forecast of hazardous weather.

4. CONCLUSIONS:

a. Confidence as a forecast parameter is subject to the same range of inaccuracies experienced with other forecast parameters.

b. The best method of forecasting confidence found in the initial project was the subjective opinion of the forecaster.

c. The only occasion when a subjective confidence forecast showed significant skill was when large errors were anticipated.

G. Fujiwhara Effect - Case Studies.

1. INTRODUCTION:

There are many problems to be faced in tropical cyclone movement forecasting. One of these, which occurs only seldom but which is capable of injecting exceptionally high errors into movement forecasts, is the interaction of vortex centers with one another. This is often referred to as a demonstration of the Fujiwhara effect in honor of the first primary investigator of this phenomenon. This interaction or Fujiwhara effect is characterized by a cyclonic rotation of two vortex centers about some point located along a line connecting their two centers. This rotation is usually co-existent with a mutual attraction of the two vortex systems. The combined effects of rotation and attraction greatly affect forecast accuracy, since cyclone behavior deviates sharply from normal under these conditions.

Before forecast improvement can be achieved through practical application to compensate for the Fujiwhara effect, a better understanding of cyclone behavior under influence of binary interaction is necessary. To aid in this understanding, research was conducted on two cases of previous cyclone interaction. These cases were picked at random with the hope of obtaining cases representative of most occurrences.

Individual cyclone movement was investigated to see if it was feasible to combine cyclone rotation rates and some form of translation of a point common to both cyclones to obtain a reasonable estimate of actual individual cyclone speed of movement.

The first case investigated was that of Typhoons Kathy and Marie during the period 14/0000Z through 19/0000Z August 1964 (See Figure 3-7). The second case was that of Typhoons Marge and Nora during the period 24/1200Z through 28/1200Z August 1967 (See Figure 3-8).

The first case appeared to be a more classical example of binary cyclone interaction than the second case, but there was a definite interaction of the two cyclones in the second case also.

2. PROCEDURE:

The two cyclone tracks within each case were plotted on the same chart so that a visual representation of their relative interaction could be observed. Lines were drawn between each of the cyclone tracks connecting locations at corresponding times, so that angles of rotation could be determined. A midpoint between the cyclones along each connecting line was determined.

Though the use of the midpoint as the rotation pivot is a very simple method, it does not consider relative sizes of the interacting cyclones. Therefore a second set of rotation points was obtained to include a relative size factor. Many authors have theorized that rotation during binary cyclone interaction occurs about a point corresponding to the center of mass of the two interacting systems. Mass of any meteorological system is a very vague term and one which is hard to define. To incorporate this theory into an actual study, a previously suggested method using a maximum wind speed ratio was utilized using the following formula;

$$d_1 = \frac{DV_2}{V_1 + V_2} \quad [1]$$

where

d_1 is the center of mass location from cyclone 1.

D is the total separation distance of the two cyclones.

V_2 is the maximum wind speed of cyclone 2.

V_1 is the maximum wind speed of cyclone 1.

By using these two points, the midpoint and the center of mass point, rates of rotation were determined. Afterward the translation speeds of these points of rotation were added with the rotation speed in hopes that a good approximation of actual cyclone speed could be determined. A twelve hour time period was used for all calculations. The following formulae were used:

$$S = S_r + S_t \quad [2]$$

$$S_r = 1.4 \times 10^{-3} \propto \bar{r} \quad (\text{for 12 hour period}) \quad [3]$$

$$S_t = D^*/12 \quad (\text{for 12 hour period}) \quad [4]$$

where S : total speed of movement

S_r : speed of movement resulting from rotation.

S_t : speed of movement resulting from translation of the point of rotation.

$\propto$: angle of rotation over the 12 hour period.

$\bar{r}$: the average radius of rotation.

D^* : distance point of rotation moves in 12 hours.

NOTE: Direction of movement of the point of rotation relative to the direction of the cyclone rotation was not considered in calculated movement speeds.

3. DISCUSSION:

An analysis of the movement speed calculated by both the center of mass and the midpoint methods showed that in general the computed speed of movement was more accurate for the northernmost cyclone. The computed values for speed of movement for the southernmost cyclone were generally too high (See Figures 3-9 and 3-10).

One cyclone investigated, Typhoon Nora, fit these general observations but the calculated speeds were exceptionally unrealistic up to 27/0000Z. After that time calculated values compared favorably with the actual cyclone speed. At that time Nora became the northernmost cyclone of the pair and also began to show a slow intensification. This large error was probably caused by the fact that prior to 27/0000Z, Nora was just forming and moving very slowly. Her strength was only 20 knots or less during this period and she appeared to be no more than a weak, but well organized, tropical low.

Investigation of Case I (Typhoons Kathy and Marie) indicated that for Typhoon Kathy the center of mass point of rotation method gave exceptionally good results for the entire interaction period with an average error of only 1.5 knots. This was an average percentage of error of 27%. For Kathy the midpoint method gave good results also with an average error of 2.5 knots representing an average percentage of error of 36%.

For both methods, one time period was characterized by an unreasonable error. Estimated speeds for Kathy during the 12 hour period 17/1200Z to 18/0000Z were calculated as 7.5 knots and 7.1 knots for the center of mass method and the midpoint method respectively. During this time period Kathy was moving south, becoming the southernmost cyclone after previously being the northernmost cyclone. During this time the direction of rotation was perpendicular to the point of rotation movement therefore the rotation speed alone should have given the best estimation of the actual movement speed. The rotation speeds for the center of mass method and the midpoint method were 5.6 knots and 6.8 knots, respectively. These compared more favorably to the actual movement speed of 4 knots.

The average results for Typhoon Marie were comparable to the results obtained for Kathy with an average error of 2.7 knots when the midpoint method was used. This corresponded to an average percent of error of 32.9%. When the center of mass method was used a much greater average error of 5.9 knots and an average percent of error of 60.6% was obtained. A look at Figure 3-9 shows that after 17/0000Z the errors for the midpoint method decreased and remained fairly accurate. At that same time the center of mass method increased in accuracy but

after 18/0000Z the accuracy decreased significantly. It was found that for every time there were poor comparisons the cyclone was either moving at large angles to or in the opposite direction to the movement of the rotation point. This indicates that a component of the point of rotation movement speed relative to the direction of movement of the cyclone should be considered in order to achieve the best results.

It was also observed that the original northernmost cyclone actually slowed to a minimum movement speed about 6 to 12 hours after the calculated speeds of both the midpoint and the center of mass methods indicated a minimum in speed. At the time the two interacting cyclones became east and west of each other the cyclone moving south tended to slow sharply in movement while the cyclone moving north began to accelerate. Shortly before this the point of rotation either slowed in movement speed or became erratic in movement.

Investigation of Case II (Typhoons Marge and Nora) indicated that the midpoint method gave slightly better results for both cyclones considered together, but neither method gave good results for Nora until 27/0000Z. As mentioned earlier, before this time Nora was only a weak developing tropical low and as such her movement is considered unrepresentative of normal cyclone movement under Fujiwhara effects.

Excluding the results for Typhoon Nora, the comparison of actual versus computed speeds of movement for this case compared favorably with those of Case I. The speeds of movement calculated for Typhoon Marge indicated that the center of mass method gave slightly better results for the overall investigated time interval. The center of mass method gave an average error of 2.3 knots as compared to 2.5 knots for the midpoint method. The corresponding average percents of error were 31.2% and 38.7%, respectively (See Table 3-10). The midpoint method gave exceptionally good results during the first part of the investigation period up to 27/1200Z with an average error of 1.0 knots and an average percent of error of 8.4%. Both methods were very good until 27/0000Z.

After 27/0000Z, Marge became the southernmost cyclone as the two cyclones slowly rotated. After that time the cyclone's movement was perpendicular to or in the opposite direction of the rotation point movement. This case, therefore, also indicates that more accurate results could be obtained by using the component part of the rotation point movement corresponding to the cyclone movement.

Although Nora was very weak during the initial time period of this case study, she evidently had some definite influence on the movement of Typhoon Marge. Nora was too weak in comparison to Marge to ever cause a full rotation but she was able to alter the track and speed of Marge (See Figure 3-8). At the time when Nora moved north of Marge's 090° bearing, attraction of the two cyclones seemed to cause a rapid decelera-

tion of Marge and shortly thereafter Marge experienced a change in direction to a north of west course.

As noticed in Case I, the points of rotation for Case II slowed in movement or changed direction abruptly approximately 6 to 12 hours preceding a decrease in the speed of movement of the cyclone moving toward the south. (See Figure 3-10.)

The angle of rotation (α) is one of the major variables contributing to the estimation of a cyclone speed of movement while experiencing Fujiwhara effect. Since little is known about what elements cause significant changes in values of α , a short investigation of its characteristics evident in these two case studies was conducted. It appears that there is some influence on α caused by changes in intensity differences of the two interacting cyclones and changes in the average distance of separation. An investigation of this variance of α in relation to values of intensity differences compared with cyclone separation indicated that an increase in α occurs with a decrease in separation distance and an increase in the intensity difference of the two cyclones. It also appears that very little rotation occurs at separation distances greater than 600 or 700 N.M. no matter what the intensity difference is. See Figure 3-11.

4. CONCLUSION:

The results of this research indicate that cyclone speed of movement during interaction can be closely approximated by theoretical calculations which combine the rotational effect of the cyclones and the translation of the point of rotation.

Results were exceptionally good when the cyclone was moving in the same direction as the point of rotation. It was also noticed that when a cyclone was moving in an opposite direction to that of the rotation point better results were achieved by subtracting the translation speed of the rotation point. For inbetween cases, such as when the cyclone was moving at angles to the direction of movement of the rotation point, calculated speeds would be improved by adding or subtracting only that component of movement speed of the rotation point that corresponded to the direction of movement of the cyclone.

Consideration of cyclone intensity by using the center of mass method was necessary only for cases of excessive difference in the intensity of two cyclones. Even for excessive intensity differences the midpoint method will generally give satisfactory results.

By using the translation of the point of rotation as a contributor to the cyclone speed of movement, we are assuming that the speed of movement of the rotation point is in direct proportion to the steering flow. We are also assuming that the steering flow is homogeneous for the entire rotating system, which requires the horizontal shear to be zero. This is a

tenuous assumption since horizontal shears are seldom zero over an area as large as that representing these rotating systems. Therefore it must be concluded that the presence of excessive or large horizontal shears can definitely inject significant errors into speed calculations.

It was noticed during analysis of computed cyclone movement speeds and the corresponding actual cyclone movement speeds that at the time the points of rotation began to slow in translation speed or became erratic in movement, the cyclone pairs reacted much in the same manner for both cases. At the time the point of rotation began to slow or became erratic, the cyclone moving toward the south slowed in movement within the following 6 to 12 hour period while the cyclone moving north began to increase in speed of movement within the next 6 to 12 hours. After firm substantiation by investigation of several more cases, this observed reaction could prove beneficial in the short range forecasting of changes in cyclone speed of movement of two interacting cyclones.

There are definite possibilities for future use of binary cyclone interaction theories for assisting in forecasting movements of interacting cyclones but considerably more research is needed before a reliable forecast tool evolves. From equations [2], [3], and [4], we can see that if S_r and S_t can be predicted with reasonable accuracy for a period of time, say 12 hours, then an average speed of movement of the cyclone can be obtained for that 12 hour period. Keep in mind that a component of S_t would have to be added or subtracted from S_r , depending upon an estimated direction of movement for the cyclone in question. It appears that a reasonable answer could be reached simply by adding S_t to S_r for a westward moving cyclone and subtracting S_t from S_r for an eastward moving cyclone.

Now that the use of the predicted S_r and S_t is necessary, we come to the perplexing problem of how a prediction of S_r and S_t can be reached. Although not researched in this study, it appears that a reasonable value for S_t could be reached by steering the rotation point with the integrated steering flow much as would be done for forecasting the movement of a single cyclone. (The possible errors in using this method were suggested earlier when discussing the assumption of a horizontally homogeneous atmosphere over the interacting system). Prediction of S_t is difficult enough but the prediction of S_r at this state of the art is even more difficult. From equation [3] it is noticed that a value for S_r is dependent upon the angle of rotation for a predetermined time period (α) and upon the average radius of rotation ($\bar{r}$). A reasonable value for $\bar{r}$ can be reached by forecasting the expected distance separating the two cyclones, considering mutual attraction, and if desired, by also using an estimated intensity of each cyclone. A prediction method for α is the major "weak link" in the chain. Present knowledge of the mechanisms causing significant changes in the rotation rates remains at a rather primitive level.

It may be possible in the future to obtain a reasonable approximation for the angle of rotation from a graph similar to that in Figure 3-11. For this to be feasible, investigation of many more case studies will be required to increase the density of data points to obtain consistently reliable estimates of the angle of rotation.

As a result of this investigation, it is definitely indicated that cyclone movement during interaction can not be fully explained or forecasted by the use of simple techniques, but continued research in this area has good potential for assisting in lowering errors in the forecasting of tropical cyclone movement.

MOVEMENT ERROR (CALCULATED VS. ACTUAL)

		MIDPOINT		CENTER OF MASS	
		Average Error	Average % Error	Average Error	Average % Error
CASE I	Kathy	2.5 kts	36.0%	1.5 kts	26.5%
	Marie	2.7 kts	32.9%	5.9 kts	60.6%
CASE II	Marge	2.5 kts	38.7%	2.3 kts	31.2%
	Nora	7.7 kts	223.5%	11.4 kts	361.5%

TABLE 3-10

REFERENCES:

1. Annual Typhoon Report, U. S. Fleet Weather Central/Joint Typhoon Warning Center, Guam, 1964 and 1967.
2. Brand, Samson, Interaction of Binary Tropical Cyclones of the Western North Pacific Ocean, NAVWEARSCHFAC Technical Paper No. 26-68, Norfolk, Va., 1968.
3. Riehl, H., Tropical Meteorology, McGraw-Hill Book Company, Inc., New York, 1954, Pg. 345-347.

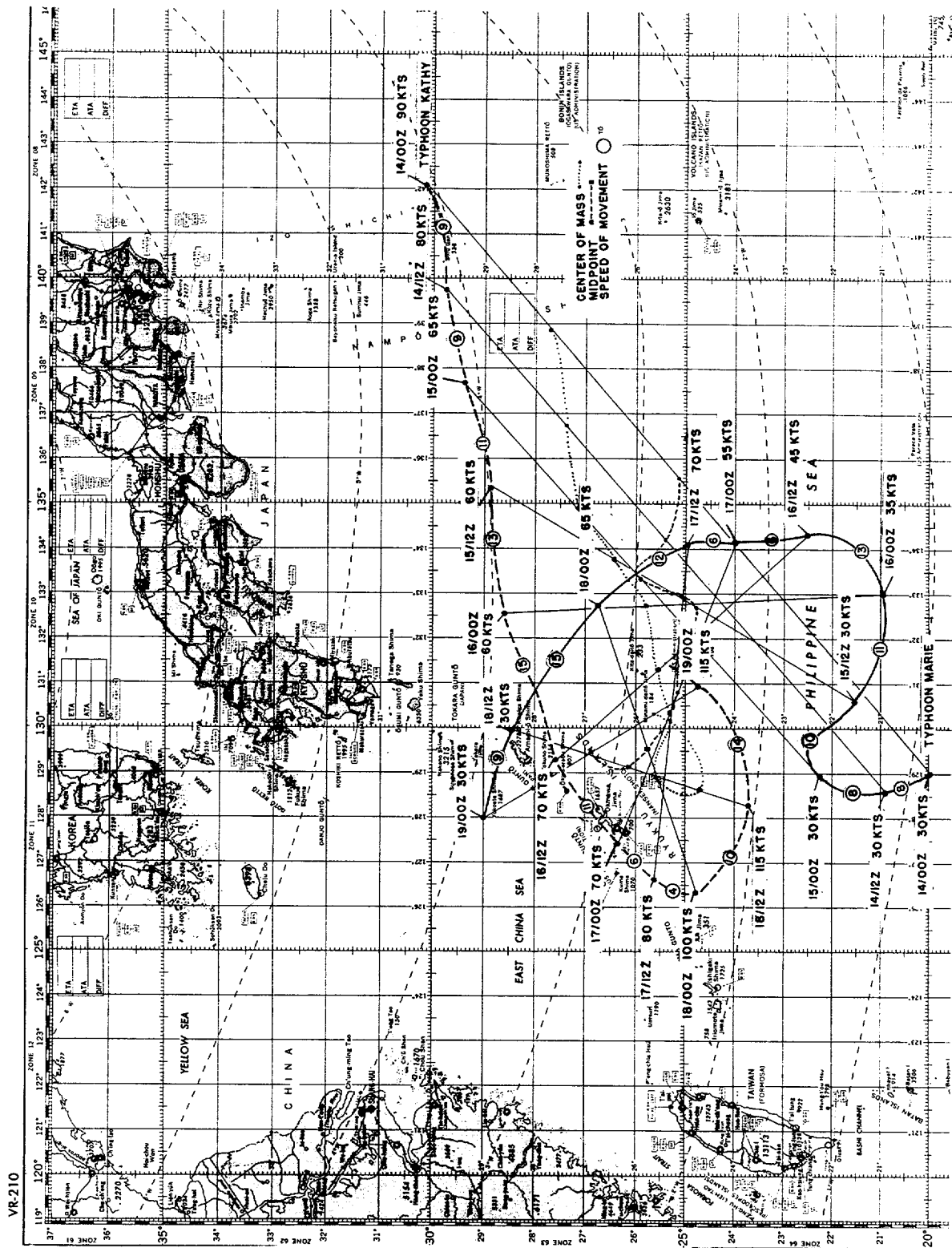


FIGURE 3-7

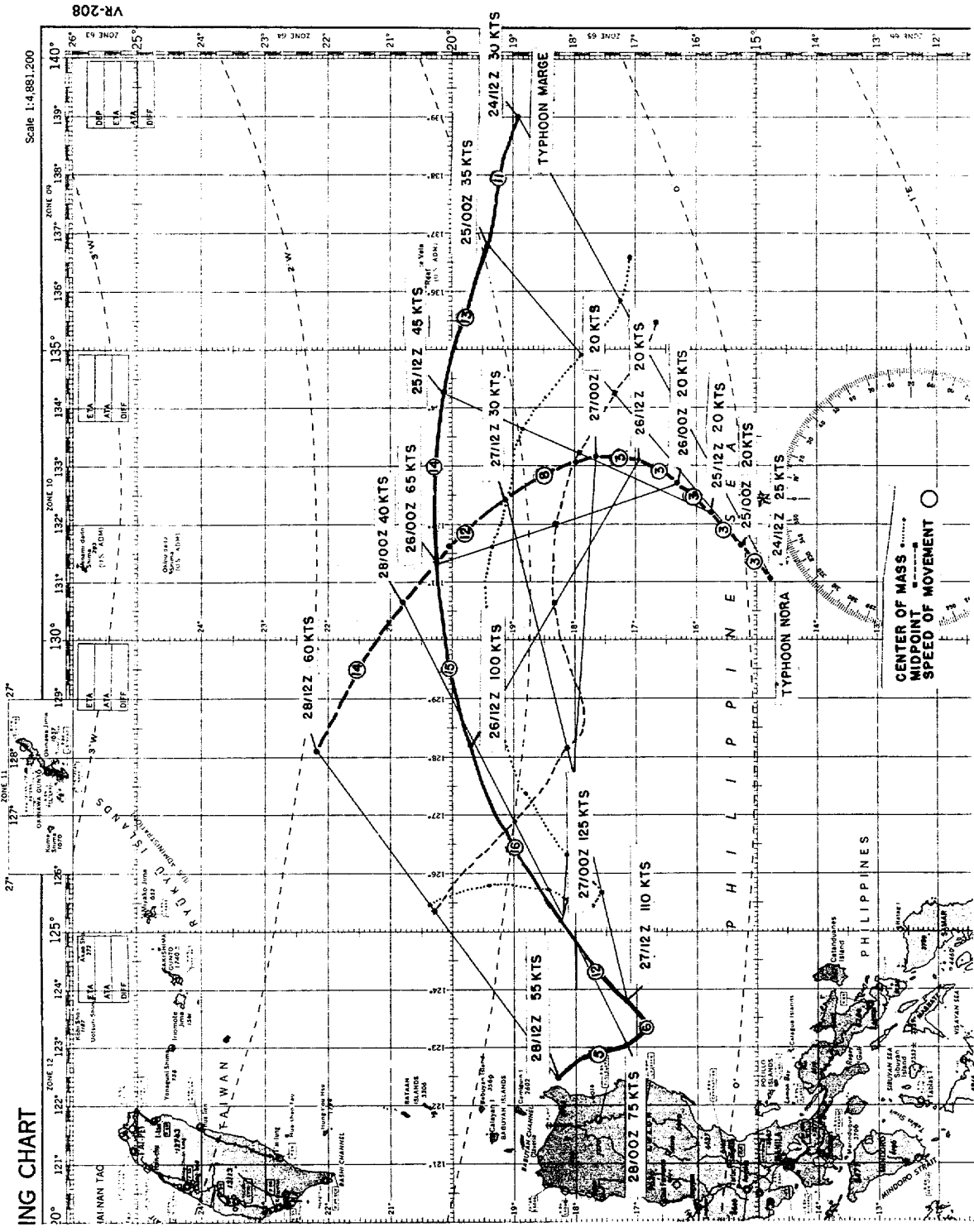


FIGURE 3-8

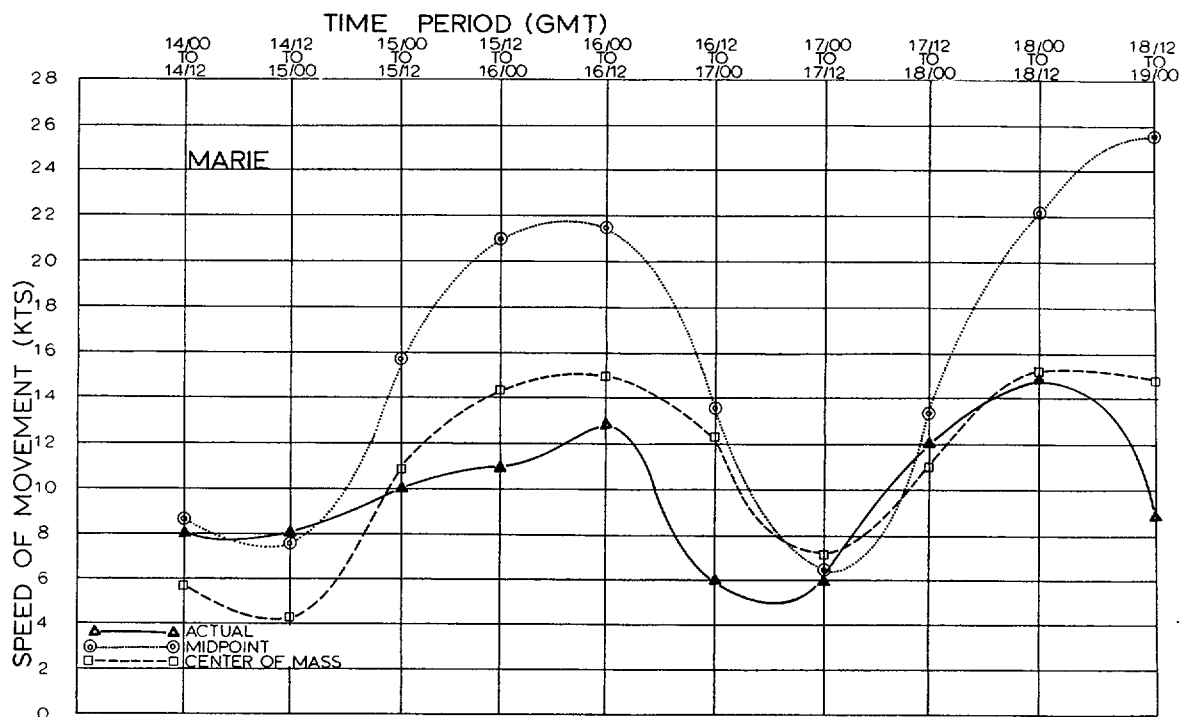
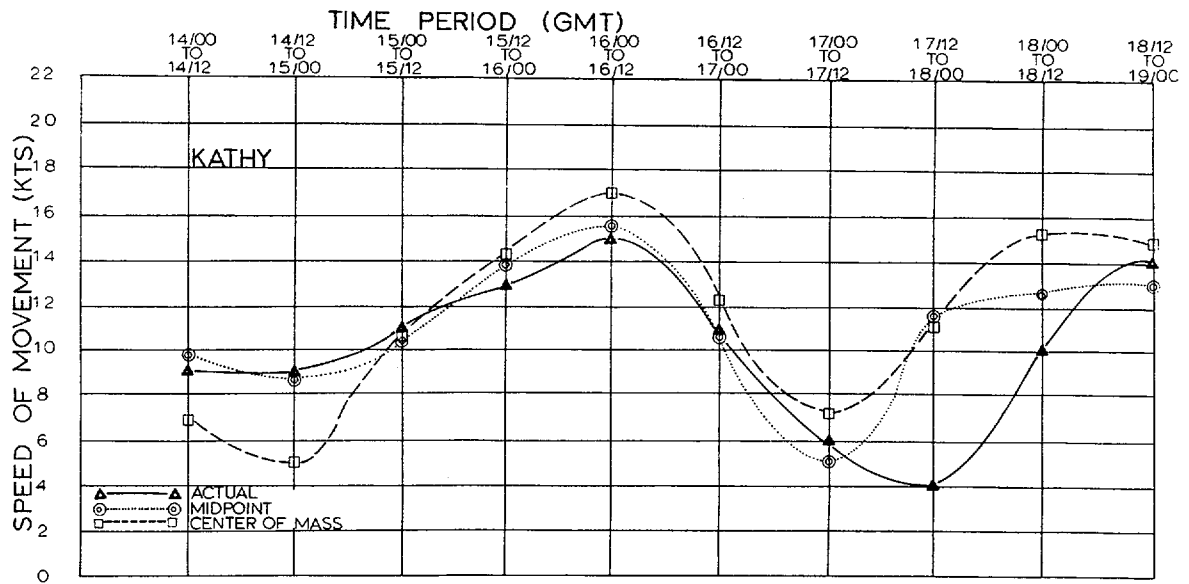


FIGURE 3-9

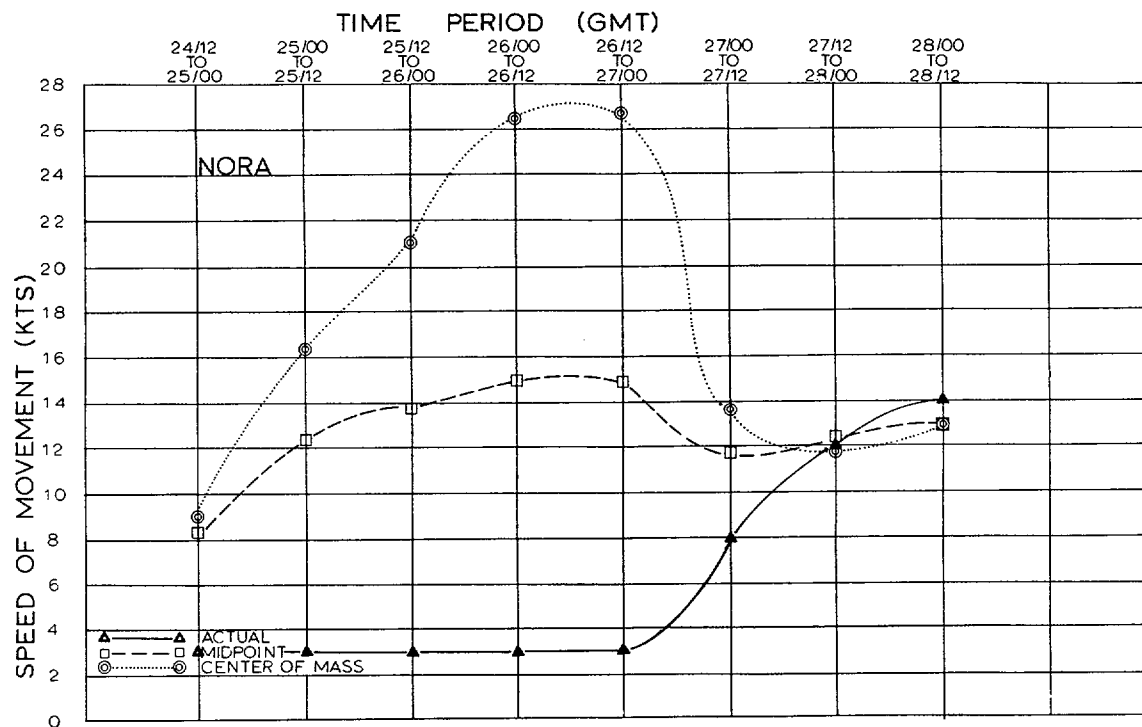
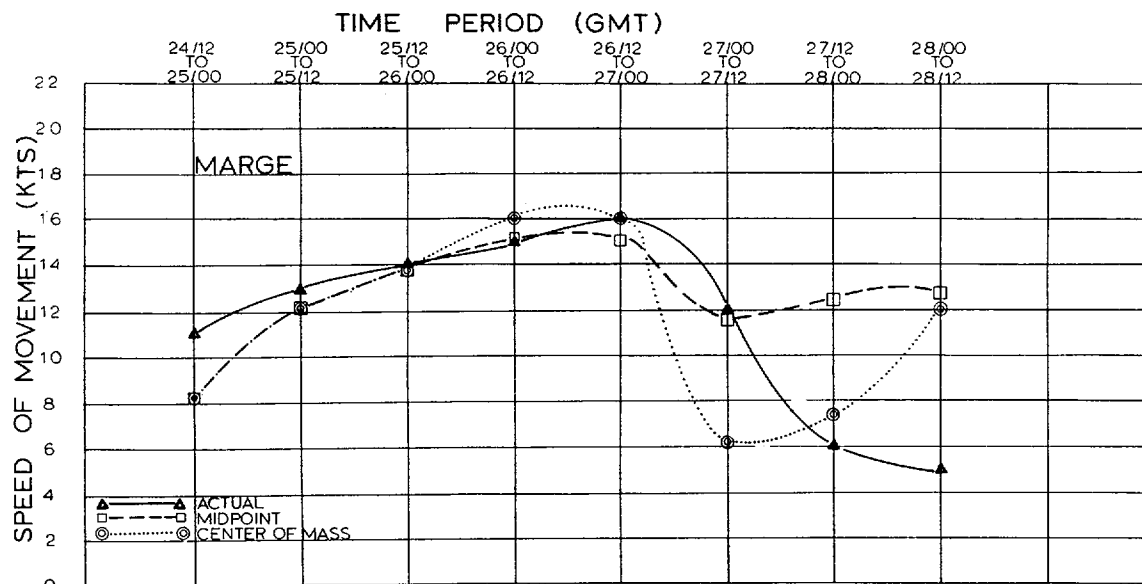


FIGURE 3-10

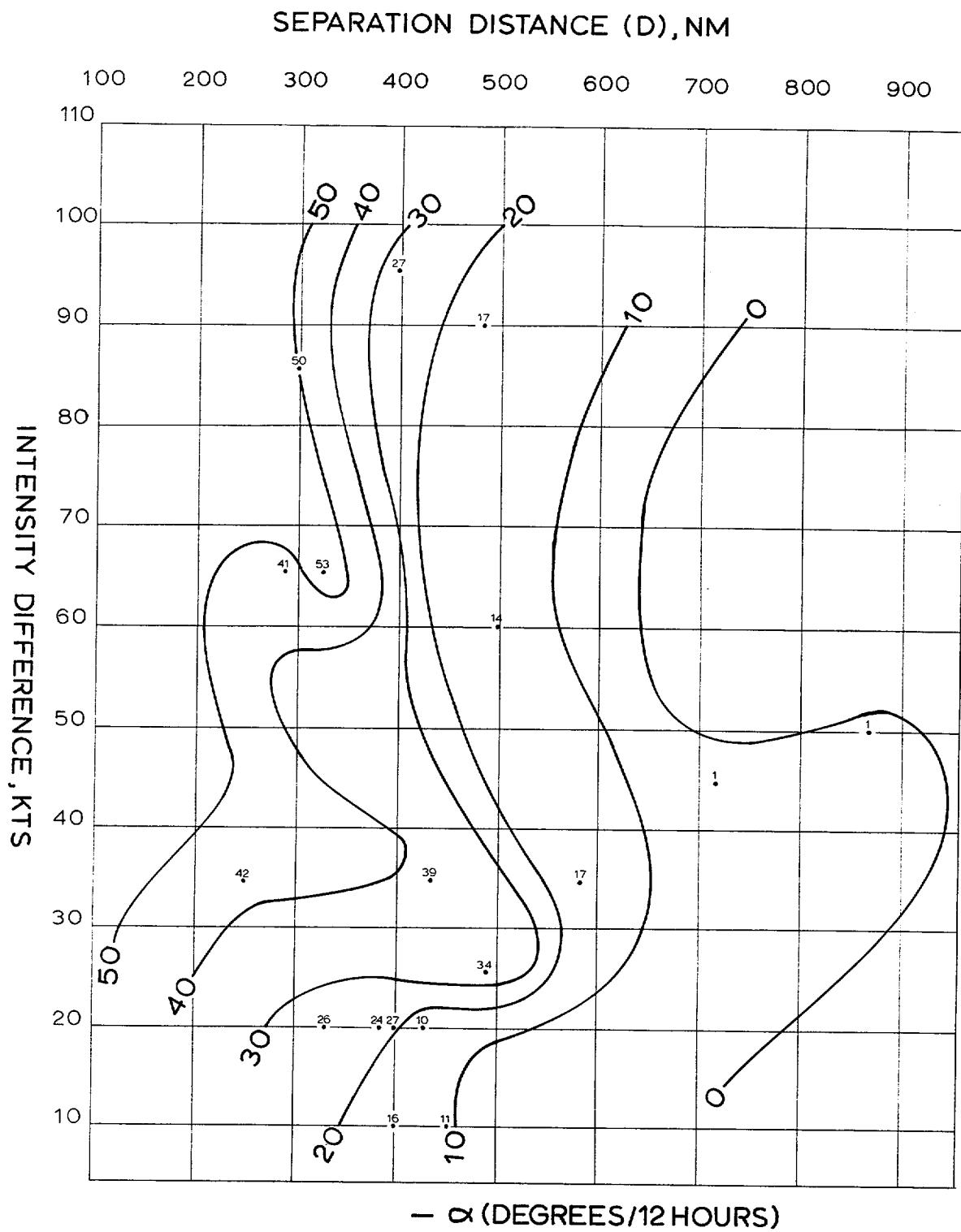


FIGURE 3-11

H. Climatology

1. TYPHOON FREQUENCY:

Typhoon frequency climatology was slightly decreased by the small number of occurrences experienced this season. The average annual typhoon frequency decreased from 20.6 at the end of the 1968 season to 19.9 at the end of this season (See Table 3-11).

2. TYPHOON DISTRIBUTION:

Figure 3-12 depicts the typhoon distribution of 347 typhoons which have been detected over the past 18 year interval. Notice that the months of high formation probability remain the months of July through November after the inclusion of 1969 typhoon data.

TYPHOON FREQUENCY
11 YEAR PERIOD

YEAR	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC	ANNUAL TOTAL
1959	0	0	0	1	0	0	1	5	3	3	2	2	17
1960	0	0	0	1	0	2	2	8	0	4	1	1	19
1961	0	0	1	0	2	1	3	3	5	3	1	1	20
1962	0	0	0	1	2	0	5	7	2	4	3	0	24
1963	0	0	0	1	1	2	3	3	3	4	0	2	19
1964	0	0	0	0	2	2	6	3	5	3	4	1	26
1965	1	0	0	1	2	2	4	3	5	2	1	0	21
1966	0	0	0	1	2	1	3	6	4	2	0	1	20
1967	0	0	1	1	0	1	3	4	4	3	3	0	20
1968	0	0	0	1	1	1	1	4	3	5	4	0	20
1969	1	0	0	1	0	0	2	3	2	3	1	0	13
AVG	.2	0	.2	.8	1.1	1.1	3.0	4.5	3.3	3.3	1.8	.7	19.9

TABLE 3-11

18 YEAR MONTHLY DISTRIBUTION OF 347

WESTERN PACIFIC TYPHOONS

1952 — 1969

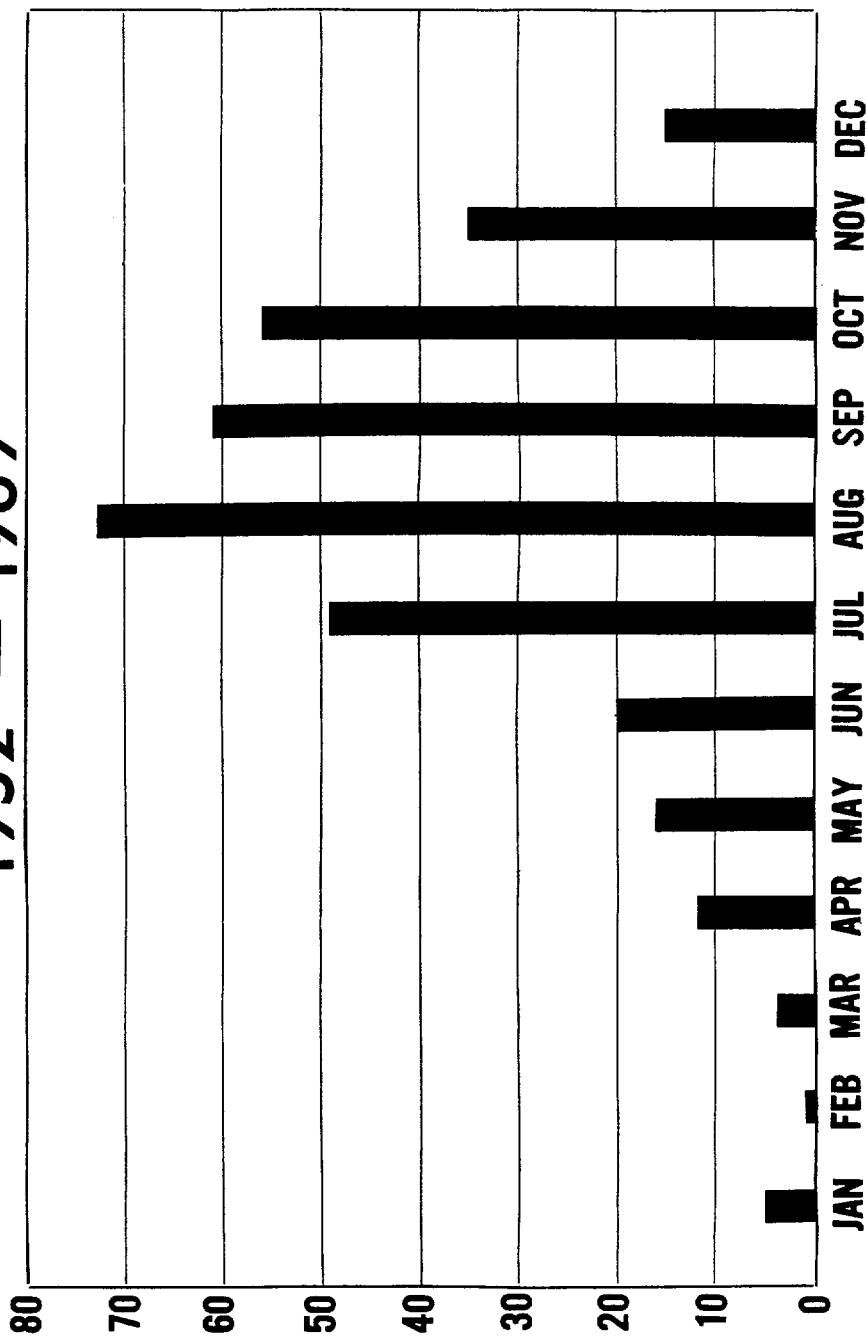


FIGURE 3-12

I. Satellite Data Fix Accuracy.

1. BACKGROUND:

A study of satellite fix accuracy was presented in the 1966 Annual Typhoon Report. Since that time a new generation of space hardware and improved technology have been developed. This study was made to reflect any improvements in terms of fix data reliability.

2. METHOD:

Satellite bulletin fix positions were compared to the JTWC best track positions for the time of the satellite fixes. Results are reported in Table 3-12.

SATELLITE POSITION ERROR (N.M.)

	<u>1965</u>	<u>1966</u>	<u>1969</u>
NUMBER OF CASES	75	71	75
AVERAGE ERROR	81	49	39
MEDIAN ERROR	55	39	34
RANGE OF ERROR	0-425	5-219	5-105

TABLE 3-12

3. CONCLUSIONS:

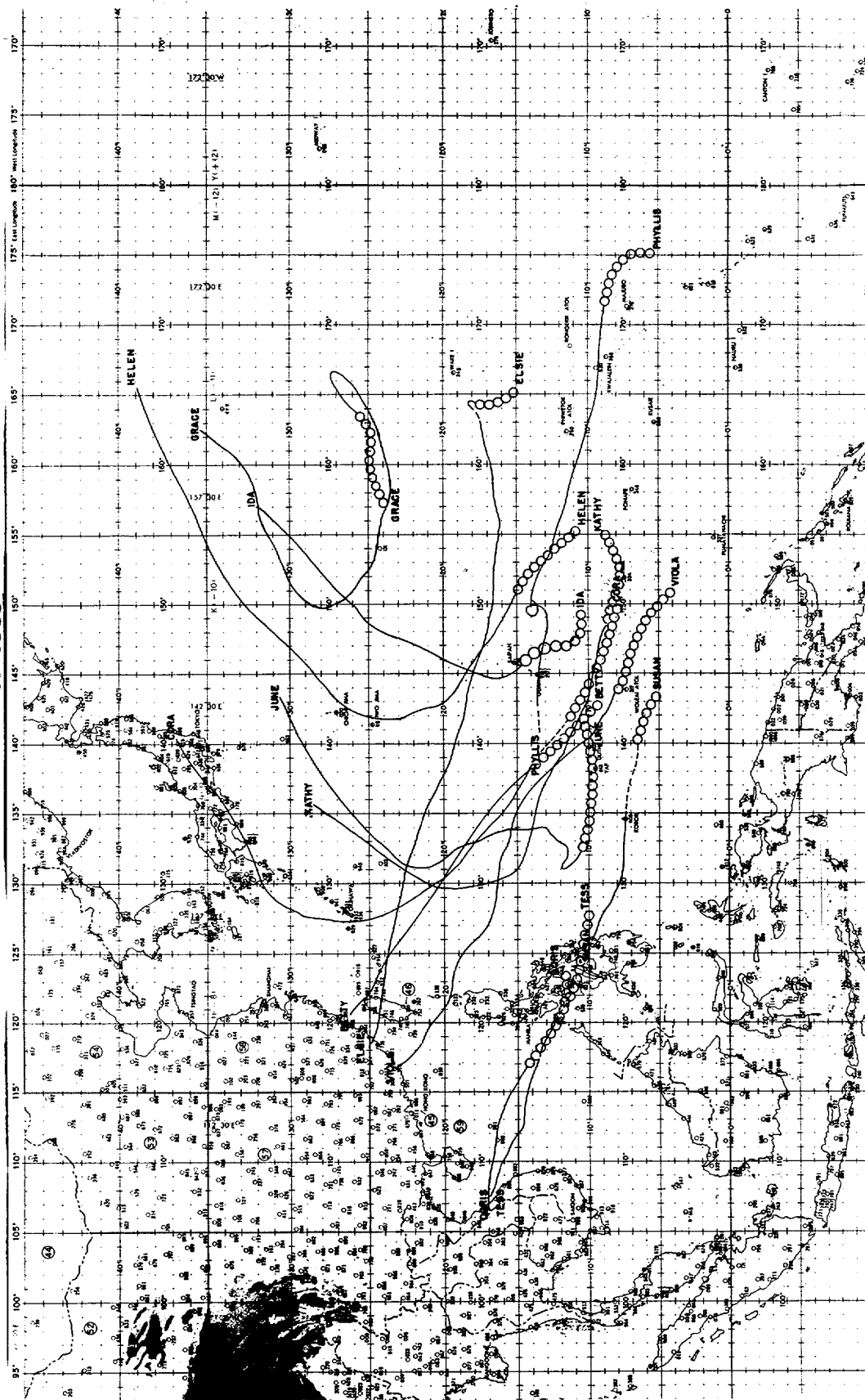
Slight improvement since 1966 is indicated, however, 1969 figures were limited to storms whose best track wind velocities were 35 knots or greater. This eliminates the main source of disproportionately high errors during the formative stages and may account for some apparent gain in accuracy. The 1969 mean and median position errors represent the practical total resolution presently available from satellite systems relative to location of tropical cyclones.

CHAPTER IV

SUMMARY OF TROPICAL CYCLONES 1969

[illegible]

TYPHOONS OF 1969



SUMMARY OF WESTERN PACIFIC TROPICAL CYCLONES OF 1969

During 1969, the Joint Typhoon Warning Center issued 430 warnings on 13 typhoons, 6 tropical storms and 4 tropical depressions while in a warning status for 108 days. When compared with previous years, it is evident that 1969 was an unusually inactive year.

There were no tropical cyclones passed to JTWC from outside its area of responsibility and JTWC passed no tropical cyclones to other agencies.

There were two "Super Typhoons" (maximum sustained surface wind of 130 knots or greater) during the 1969 season compared with five in 1968 and four in 1967. Typhoon Elsie registered a 890 MB center pressure which is one of the lowest ever recorded in the Western Pacific.

The following figures and tables are provided to present representative statistical data from the 1969 tropical cyclone season and provide a ready reference for comparison with previous years.

SUMMARY OF WESTERN PACIFIC
TROPICAL CYCLONES
OF 1969

	1960-1967 (AVE)	1968	1969
TOTAL NUMBER OF WARNINGS	781	822	430
CALENDAR DAYS OF WARNING	160	142	108
NUMBER OF WARNING DAYS WITH TWO OR MORE CYCLONES	59	68	15
NUMBER OF WARNING DAYS WITH THREE OR MORE CYCLONES	15	15	1
TROPICAL DEPRESSIONS	6	4	4
TROPICAL STORMS	11	7	6
TYPHOONS	21	20	13
TOTAL TROPICAL CYCLONES	38	31	23

TABLE 4-1

SUPER TYPHOONS DURING 1969*

<u>CYCLONE NUMBER</u>	<u>NAME</u>	<u>INCLUSIVE DATES</u>	<u>MAX INTENSITY</u>	<u>MIN SLP</u>	<u>MIN 700 MB HT</u>
05	VIOLA	21 - 28 JUL	130 KNOTS	897 MB	2137 m
14	ELSIE	19 - 27 SEP	150 KNOTS	890 MB	2140 m

* Typhoons with maximum sustained surface winds of 130 knots or greater.

TABLE 4-2

1969 TROPICAL CYCLONES

CYCLONE	TYPE	NAME	DATE*	CALENDAR		MIN	MAX	WARNINGS ISSUED		
				DAYS OF	MAX	OBS	RADIUS	TOTAL	NO. AS	DISTANCE
				WARNING	SFC	SLP	SFC	TYPHOONS	TYPHOONS	TRAVELED*
				WIND*			CIRC			
01	T	PHYLLIS	17 JAN-22 JAN	6	85	966	240	24	15	1968
02	TS	RITA	07 MAR-09 MAR	3	40	993	300	12	0	684
03	T	SUSAN	18 APR-25 APR	8	105	943	240	29	12	882
04	T	TESS	08 JUL-11 JUL	4	70	974	300	13	3	906
05	T	VIOLA	21 JUL-28 JUL	8	130	897	420	26	18	1854
06	TS	WINNIE	29 JUL-31 JUL	3	45	984	240	07	0	480
07	TS	ALICE	02 AUG-04 AUG	3	45	982	300	10	0	678
08	T	BETTY	05 AUG-08 AUG	4	70	962	360	14	4	1242
09	T	CORA	14 AUG-23 AUG	10	85	948	330	34	15	2226
10	T	DORIS	31 AUG-02 SEP	3	65	973	240	9	3	612
11	TD		07 SEP-11 SEP	5	30	990	180	18	0	648
12	TD		07 SEP-08 SEP	2	25	996	120	05	0	174
13	TD		11 SEP-12 SEP	2	30	996	150	04	0	216
14	T	ELSIE	19 SEP-27 SEP	9	150	890	600	34	26	2760
15	TS	FLOSSIE	29 SEP-05 OCT 08 OCT-09 OCT	9	60	956	270	32	0	2598
16	T	GRACE	29 SEP-06 OCT	8	95	937	300	29	21	2172

TABLE 4-3

1969 TROPICAL CYCLONES (Cont'd)

CYCLONE	TYPE	NAME	DATE*	CALENDAR DAYS OF WARNING	MAX SFC WIND*	MIN OBS SLP	MAX RADIUS CIRC	WARNINGS ISSUED		NO. AS TYPHOONS TRAVELED*	DISTANCE TRAVELED*
								TOTAL	AS		
17	TD		30 SEP	1	30	997	120	02	0		42
18	T	HELEN	08 OCT-12 OCT	5	105	930	330	20	10		2340
19	T	IDA	15 OCT-22 OCT	8	115	917	360	26	17		1296
20	T	JUNE	28 OCT-05 NOV	9	105	936	500	33	21		1782
21	T	KATHY	03 NOV-08 NOV	6	110	930	420	24	19		2040
22	TS	LORNA	24 NOV-28 NOV	5	50	985	360	17	0		582
23	TS	MARIE	19 DEC-21 DEC	3	40	994	150	8	0		480

1969 TOTALS

108

430

184

*DATA TAKEN FROM BEST TRACK

TABLE 4-3 (Cont'd)

1969 TROPICAL DEPRESSION POSITION DATA

TROPICAL DEPRESSION ELEVEN 07 SEP - 11 SEP

WARNING NO.	DTG	BEST TRACK POSIT		WARNING POSIT		24 HOUR FORECAST POSIT	
		LAT	LONG	LAT	LONG	LAT	LONG
01	070500Z	19.7N	119.2E	20.5N	119.0E	19.7N	112.9E
02	071100Z	18.8N	118.8E	20.3N	117.5E	19.5N	111.3E
03	071700Z	18.2N	119.2E	19.0N	118.0E	18.5N	115.5E
04	072300Z	18.3N	119.6E	18.0N	118.3E	17.4N	117.4E
05	080500Z	18.8N	119.4E	18.5N	119.5E	18.5N	119.5E
06	081100Z	19.2N	119.3E	19.0N	119.0E	18.7N	118.0E
07	081700Z	20.0N	119.6E	19.6N	119.0E	19.1N	117.6E
08	082300Z	20.7N	119.9E	20.2N	120.4E	22.0N	121.3E
09	090500Z	21.5N	120.0E	21.4N	120.1E	23.4N	120.6E
10	091100Z	22.0N	119.9E	22.4N	120.1E	25.9N	121.9E
11	091700Z	22.4N	119.8E	22.8N	120.2E	25.8N	121.7E
12	092300Z	22.8N	119.8E	22.5N	119.5E	-	-
13	100500Z	23.3N	120.3E	23.0N	119.8E	24.5N	120.2E
14	101100Z	23.5N	121.0E	23.9N	121.3E	26.9N	125.3E
15	101700Z	23.2N	121.7E	23.9N	122.5E	27.7N	126.3E
16	102300Z	23.4N	122.4E	24.0N	123.0E	26.3N	126.6E
17	110500Z	23.1N	122.4E	23.5N	122.5E	23.5N	122.5E
18	111100Z	22.6N	122.2E	23.1N	122.4E	23.1N	122.4E

TROPICAL DEPRESSION TWELVE 07 SEP - 08 SEP

WARNING NO.	DTG	BEST TRACK POSIT		WARNING POSIT		24 HOUR FORECAST POSIT	
		LAT	LONG	LAT	LONG	LAT	LONG
01	072300Z	13.5N	111.4E	13.6N	111.4E	13.2N	108.6E
02	080500Z	13.2N	111.0E	13.4N	110.9E	13.0N	108.9E
03	081100Z	12.9N	111.3E	13.3N	110.4E	13.0N	108.3E
04	081700Z	13.1N	112.1E	13.2N	109.9E	12.9N	107.9E
05	082300Z	13.8N	112.8E	14.5N	113.0E	-	-

TROPICAL DEPRESSION THIRTEEN 11 SEP - 12 SEP

WARNING NO.	DTG	BEST TRACK POSIT		WARNING POSIT		24 HOUR FORECAST POSIT	
		LAT	LONG	LAT	LONG	LAT	LONG
01	111100Z	16.3N	130.6E	16.1N	130.8E	19.7N	127.4E
02	111700Z	17.0N	129.5E	16.8N	129.8E	20.9N	127.0E
03	112300Z	17.8N	128.7E	17.8N	129.0E	22.1N	126.8E
04	120500Z	18.8N	128.0E	18.7N	127.6E	22.9N	124.9E

TROPICAL DEPRESSION SEVENTEEN
30 SEP - 01 OCT

WARNING NO.	DTG	BEST TRACK POSIT		WARNING POSIT		24 HOUR FORECAST POSIT	
		LAT	LONG	LAT	LONG	LAT	LONG
01	302300Z	15.4N	118.5E	17.3N	118.0E	19.0N	117.0E
02	010500Z	15.9N	118.1E	16.5N	118.5E	-	-

1969 TROPICAL STORM POSITION DATA

TROPICAL STORM RITA
07 MAR - 09 MAR

WARNING NO.	DTG	BEST TRACK POSIT		WARNING POSIT		24 HOUR FORECAST POSIT	
		LAT	LONG	LAT	LONG	LAT	LONG
01	070500Z	05.3N	168.9E	05.4N	168.6E	06.4N	162.7E
02	071100Z	05.6N	168.2E	05.7N	167.4E	06.4N	161.5E
03	071700Z	05.9N	167.4E	06.0N	165.9E	06.5N	160.0E
04	072300Z	06.2N	166.4E	06.0N	166.0E	06.5N	160.9E
05	080500Z	06.5N	165.4E	06.4N	165.6E	07.0N	161.3E
06	081100Z	06.8N	164.5E	07.1N	164.5E	07.5N	159.5E
07	081700Z	07.1N	163.5E	06.9N	163.0E	07.5N	157.9E
08	082300Z	07.3N	162.5E	07.3N	162.8E	08.0N	158.6E
09	090500Z	07.5N	161.5E	07.5N	161.6E	08.0N	157.0E
10	091100Z	07.7N	160.3E	07.7N	160.4E	08.1N	155.7E
11	091700Z	07.7N	159.1E	07.8N	159.4E	08.1N	154.6E
12	092300Z	07.7N	157.9E	07.8N	157.7E	08.1N	152.8E

TROPICAL STORM WINNIE
29 JUL - 31 JUL

WARNING NO.	DTG	BEST TRACK POSIT		WARNING POSIT		24 HOUR FORECAST POSIT	
		LAT	LONG	LAT	LONG	LAT	LONG
01	292300Z	16.0N	133.4E	16.0N	133.5E	18.8N	129.7E
02	300500Z	17.2N	132.3E	16.6N	132.6E	19.3N	129.2E
03	3001100Z	17.9N	131.1E	18.0N	131.0E	21.2N	127.2E
04	301700Z	18.4N	129.6E	18.9N	129.6E	22.3N	126.2E
05	302300Z	18.7N	128.1E	19.0N	127.9E	22.7N	123.6E
06	310500Z	19.0N	126.8E	19.0N	126.7E	20.1N	123.3E
07	311100Z	19.3N	125.8E	19.0N	126.1E	17.7N	123.5E

TROPICAL STORM ALICE
02 AUG - 04 AUG

WARNING NO.	DTG	BEST TRACK POSIT		WARNING POSIT		24 HOUR FORECAST POSIT	
		LAT	LONG	LAT	LONG	LAT	LONG
01	020500Z	23.7N	137.8E	23.4N	137.6E	25.6N	133.4E
02	021100Z	24.7N	137.0E	24.0N	136.5E	26.0N	132.4E
03	021700Z	25.9N	136.3E	26.7N	135.8E	32.4N	137.5E
04	022300Z	27.0N	135.6E	27.1N	135.5E	30.9N	135.0E
05	030500Z	28.0N	135.2E	28.0N	135.1E	32.1N	134.9E
06	031100Z	29.2N	134.6E	29.0N	134.7E	33.8N	135.5E
07	031700Z	30.3N	134.4E	30.2N	134.3E	34.7N	135.9E
08	032300Z	31.3N	134.5E	31.2N	134.6E	37.0N	137.6E
09	040500Z	32.5N	134.3E	32.5N	134.5E	-	-
10	041100Z	33.6N	135.8E	33.8N	135.8E	-	-

TROPICAL STORM FLOSSIE
29 SEP - 05 OCT
08 OCT - 09 OCT

WARNING NO.	DTG	BEST TRACK POSIT		WARNING POSIT		24 HOUR FORECAST POSIT	
		LAT	LONG	LAT	LONG	LAT	LONG
01	292300Z	15.7N	129.0E	15.7N	128.9E	17.7N	125.3E
02	300500Z	16.8N	127.9E	16.8N	128.0E	20.8N	126.1E
03	301100Z	18.1N	126.8E	18.2N	126.8E	22.5N	125.2E
04	301700Z	18.9N	125.3E	19.1N	125.8E	23.5N	124.8E
05	302300Z	19.8N	123.8E	19.6N	123.4E	20.4N	116.3E
06	010500Z	20.5N	122.9E	21.2N	122.9E	25.0N	122.7E
07	011100Z	20.3N	122.1E	20.5N	122.4E	21.4N	122.1E
08	011700Z	20.8N	121.8E	20.7N	121.6E	21.7N	120.7E
09	012300Z	21.5N	122.0E	21.2N	122.0E	21.2N	122.0E
10	020500Z	22.2N	121.7E	22.1N	121.8E	24.1N	122.3E
11	021100Z	22.8N	121.7E	23.1N	121.8E	25.4N	122.8E
12	021700Z	23.2N	122.1E	23.3N	121.8E	24.8N	122.3E
13	022300Z	23.6N	122.4E	23.6N	122.4E	25.0N	123.3E
14	030500Z	24.1N	122.6E	24.1N	122.6E	25.9N	123.9E
15	031100Z	24.2N	122.8E	24.3N	122.7E	25.5N	123.4E
16	031700Z	24.2N	123.0E	24.0N	122.5E	25.1N	122.8E
17	032300Z	24.3N	123.2E	24.5N	123.2E	25.2N	123.9E
18	040500Z	24.3N	123.4E	24.2N	122.9E	24.2N	122.9E
19	041100Z	24.3N	123.6E	24.2N	123.2E	24.2N	123.2E
20	041700Z	24.3N	123.8E	24.2N	123.3E	24.2N	123.3E
21	042300Z	24.5N	124.2E	24.3N	123.9E	24.3N	124.1E
22	050500Z	24.8N	124.6E	24.8N	124.7E	25.9N	127.7E
23	051100Z	24.8N	125.0E	24.9N	125.1E	25.0N	126.2E
24	051700Z	24.9N	125.4E	24.8N	125.4E	25.0N	126.7E
25	052300Z	25.0N	124.9E	24.8N	125.6E	-	-
26	080500Z	26.8N	131.9E	26.9N	131.4E	28.9N	135.3E
27	081100Z	27.6N	133.5E	27.6N	133.3E	33.1N	139.8E

TROPICAL STORM FLOSSIE (Cont'd)

29 SEP - 05 OCT

08 OCT - 09 OCT

WARNING NO.	DTG	BEST TRACK POSIT		WARNING POSIT		24 HOUR FORECAST POSIT	
		LAT	LONG	LAT	LONG	LAT	LONG
28	081700Z	28.9N	135.5E	29.0N	135.4E	36.4N	142.0E
29	082300Z	31.1N	137.8E	30.8N	137.6E	41.0N	143.3E
30	090500Z	34.0N	141.8E	34.7N	140.8E	-	-
31	091100Z	37.3N	146.5E	37.4N	146.3E	-	-
32	091700Z	41.0N	151.0E	41.3N	150.2E	-	-

TROPICAL STORM LORNA

24 NOV - 28 NOV

WARNING NO.	DTG	BEST TRACK POSIT		WARNING POSIT		24 HOUR FORECAST POSIT	
		LAT	LONG	LAT	LONG	LAT	LONG
01	241100Z	09.9N	133.1E	09.8N	132.9E	11.2N	129.1E
02	241700Z	10.4N	132.6E	10.3N	132.6E	11.9N	129.6E
03	242300Z	10.9N	132.1E	10.8N	132.1E	12.8N	129.4E
04	250500Z	11.6N	131.7E	11.5N	131.7E	13.5N	129.7E
05	251100	12.2N	131.3E	12.4N	131.2E	15.4N	130.2E
06	251700Z	12.9N	131.3E	12.6N	131.0E	15.2N	130.2E
07	252300Z	13.5N	131.5E	13.4N	131.5E	16.2N	131.9E
08	260500Z	14.3N	131.6E	14.5N	131.5E	18.2N	132.3E
09	261100Z	13.7N	131.7E	14.2N	131.8E	15.5N	132.7E
10	261700Z	13.5N	131.3E	13.3N	130.7E	14.8N	131.3E
11	262300Z	13.7N	130.9E	13.9N	131.1E	13.9N	131.1E
12	270500Z	14.1N	130.6E	13.9N	130.7E	13.9N	130.7E
13	271100Z	14.4N	130.1E	14.4N	129.5E	16.1N	128.1E
14	271700Z	14.5N	129.6E	15.5N	128.6E	19.8N	128.4E
15	272300Z	14.8N	129.2E	16.4N	128.2E	20.2N	128.6E
16	280500Z	15.3N	128.9E	14.8N	129.5E	16.5N	128.5E
17	281100Z	15.7N	128.6E	16.3N	128.5E	-	-

TROPICAL STORM MARIE

19 DEC - 21 DEC

WARNING NO.	DTG	BEST TRACK POSIT		WARNING POSIT		24 HOUR FORECAST POSIT	
		LAT	LONG	LAT	LONG	LAT	LONG
01	191100Z	15.2N	141.7E	15.3N	141.7E	19.2N	140.3E
02	191700Z	16.2N	141.4E	16.3N	141.1E	20.3N	140.9E
03	192300Z	17.1N	141.2E	17.1N	141.3E	19.9N	141.3E
04	200500Z	17.9N	141.3E	18.5N	141.0E	22.7N	143.7E
05	201100Z	17.8N	142.3E	17.8N	141.6E	20.1N	142.7E
06	201700Z	18.3N	143.6E	18.3N	143.3E	21.2N	146.7E
07	202300Z	18.9N	145.1E	19.0N	145.2E	-	-
08	210500Z	18.0N	144.4E	17.8N	143.0E	-	-

Forecast positions for the 24, 48 and 72 hour forecasts are verified only as long as the best track analysis estimates winds in excess of 33 knots for tropical cyclones which reach typhoon intensity.

In addition to this method of verifying absolute error distance, a computation of closest distance to the best track (right angle error) has been included to indicate the demonstrated ability to forecast the path of motion without regard to speed.

The following tables and figures are presented to graphically depict the distribution of forecasting error in JTWC forecasts.

FORECAST VERIFICATION
AVERAGE ERROR (NAUTICAL MILES)

	<u>24 HR</u>	<u>48 HR</u>	<u>72 HR</u>
1950-58	170	---	---
1959	*117	*267	---
1960	177	354	---
1961	136	274	---
1962	144	287	476
1963	127	246	374
1964	133	284	429
1965	151	303	418
1966	136	280	432
1967	125	276	414
1968	105	229	337
1969	111	237	349

*FORECAST POSITIONS NORTH OF 35N WERE NOT VERIFIED.

TABLE 4-4

JTWC OFFICIAL FORECAST ACCURACY

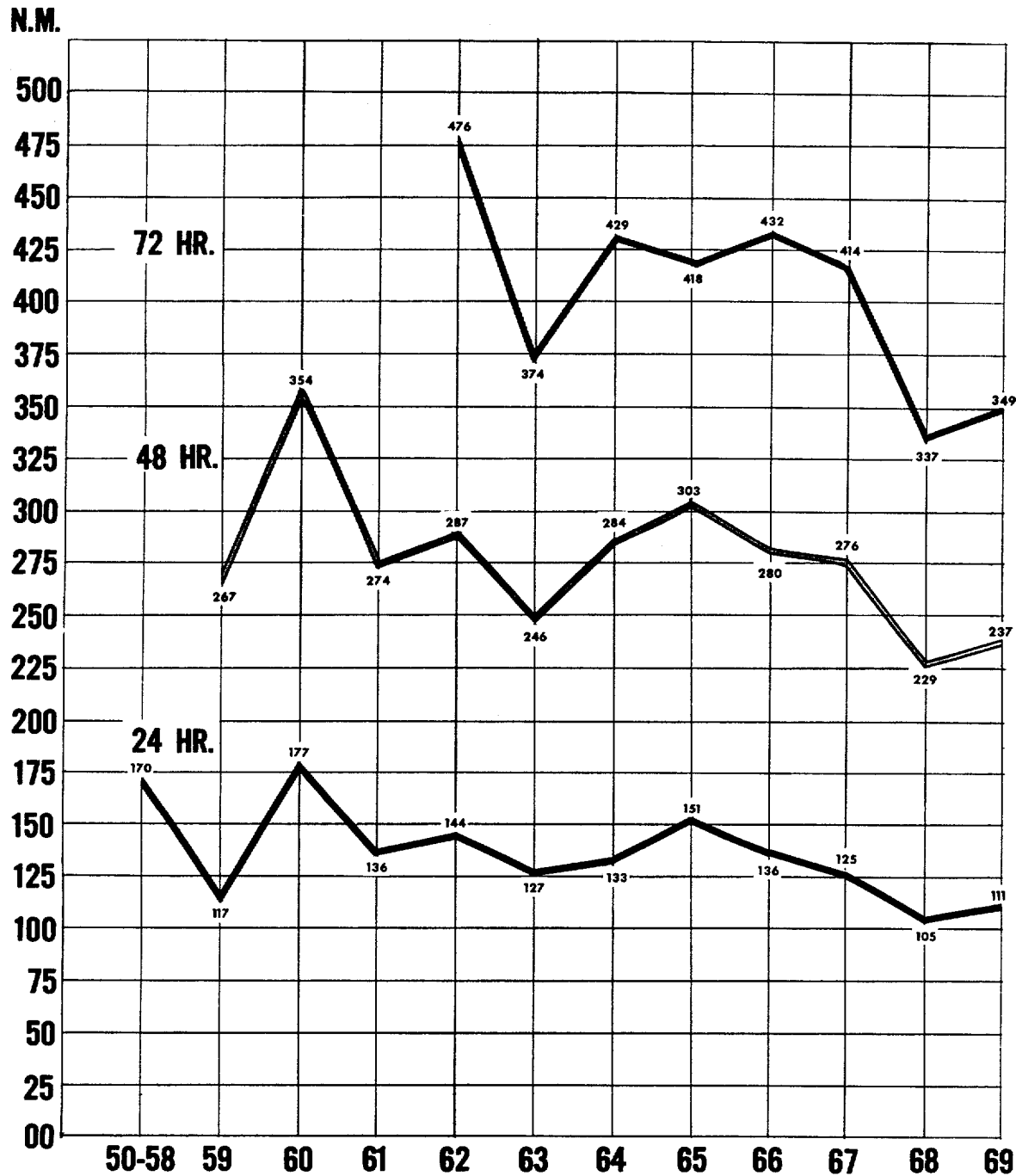


FIG 4-1

FORECAST ERROR TABULATION - 1969

	<u>CASES</u>	<u>MEAN ERROR (N.M.)</u>
<u>24 Hour</u>		
Whole Sample	248	111
Below 20N	132	103
20N - 30N	96	117
Below 30N	228	109
Above 30N	20	134
<u>48 Hour</u>		
Whole Sample	166	237
Below 20N	63	202
20N - 30N	82	240
Below 30N	145	224
Above 30N	21	330
<u>72 Hour</u>		
Whole Sample	57	349
Below 20N	16	305
20N - 30N	31	346
Below 30N	47	332
Above 30N	10	429

TABLE 4-5

DISTANCE BETWEEN OPERATIONAL WARNING
POSITIONS AND BEST TRACK POSITIONS

CYCLONE	NUMBER OF WARNINGS	AVERAGE DISTANCE (NM)	MAXIMUM DISTANCE (NM)	MINIMUM DISTANCE (NM)
1. T. PHYLLIS	24	16	45	01
2. T.S. RITA	12	26	87	08
3. T. SUSAN	29	14	39	03
4. T. TESS	13	29	150	00
5. T. VIOLA	26	16	42	02
6. T.S. WINNIE	07	20	37	08
7. T.S. ALICE	10	19	55	06
8. T. BETTY	14	15	45	05
9. T. CORA	34	14	52	05
10. T. DORIS	09	11	19	03
11. T.D.	18	42	118	06
12. T.D.	05	50	128	05
13. T.D.	04	20	27	17
14. T. ELSIE	34	17	61	04
15. T.S. FLOSSIE	32	19	60	04
16. T. GRACE	29	35	128	03
17. T.D.	02	82	118	45
18. T. HELEN	20	20	88	05
19. T. IDA	26	15	59	03
20. T. JUNE	33	17	71	03
21. T. KATHY	24	19	80	04
22. T.S. LORNA	17	29	104	06
23. T.S. MARIE	08	28	82	05
1969 SEASON	430	20.7	150	00

TABLE 4-6

1969 AVERAGE FORECAST ERRORS (MI) *

TYPHOON	24 HR FORECASTS		48 HR FORECASTS		72 HR FORECASTS	
	CASES	ERROR	CASES	ERROR	CASES	ERROR
PHYLLIS	16	91	12	140	04	220
SUSAN	21	61	13	110	04	184
TESS	08	168	01	360	-	-
VIOLA	22	99	16	181	06	167
BETTY	10	107	06	243	01	330
CORA	29	77	22	203	08	405
DORIS	05	63	01	48	-	-
ELSIE	29	92	22	176	09	316
GRACE	25	186	17	429	05	715
HELEN	14	123	08	438	02	420
IDA	22	87	16	176	06	288
JUNE	27	139	18	267	07	319
KATHY	20	145	14	338	05	498
TOTAL CASES	248		166		57	
MEAN ERROR		111		237		349

* INCLUDES FORECAST ERRORS DURING TROPICAL STORM INTENSITY.

TABLE 4-7

INDIVIDUAL TYPHOONS OF 1969 24 HOUR VERIFICATION ERROR

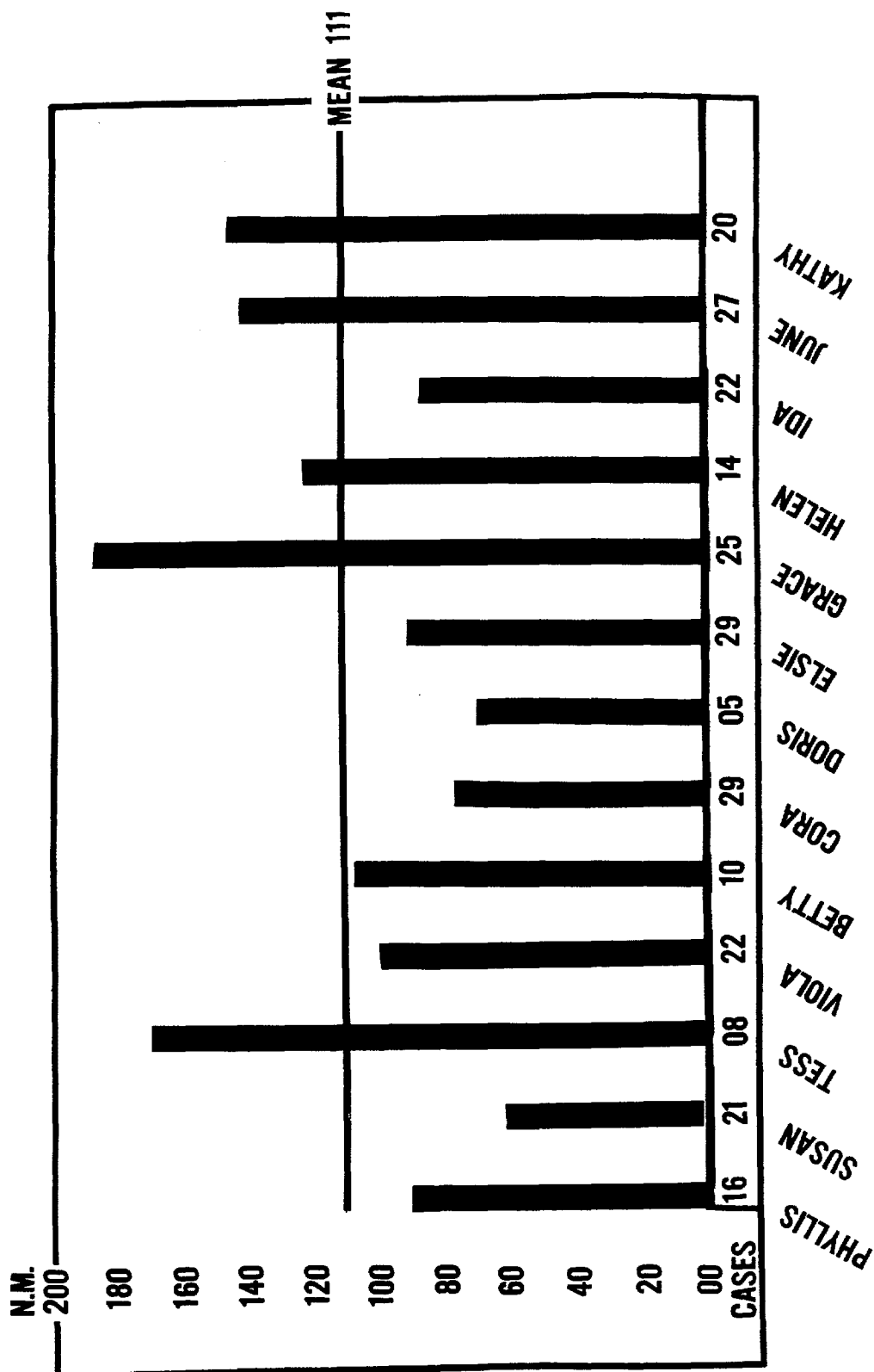


FIG 4-2

1969 RIGHT ANGLE FORECAST ERRORS
(CLOSEST DISTANCE (N.M.) TO BEST TRACK)

<u>TYPHOON</u>	<u>24 HR FORECASTS</u>		<u>48 HR FORECASTS</u>		<u>72 HR FORECASTS</u>	
	<u>CASES</u>	<u>ERROR</u>	<u>CASES</u>	<u>ERROR</u>	<u>CASES</u>	<u>ERROR</u>
PHYLLIS	16	52	12	88	04	129
SUSAN	21	46	13	91	04	178
TESS	08	94	01	268	-	-
VIOLA	22	63	16	109	06	111
BETTY	10	45	06	97	01	33
CORA	29	58	22	180	08	349
DORIS	05	54	01	48	-	-
ELSIE	29	46	22	102	09	151
GRACE	25	117	17	188	05	265
HELEN	14	54	08	18	02	65
IDA	22	72	16	132	06	200
JUNE	27	58	18	123	07	173
KATHY	20	79	14	209	05	409
 TOTAL CASES	 248		 166		 57	
 MEAN ERROR		 65		 130		 209

* INCLUDES FORECAST ERRORS DURING TROPICAL STORM INTENSITY.

TABLE 4-8

RIGHT ANGLE ERROR

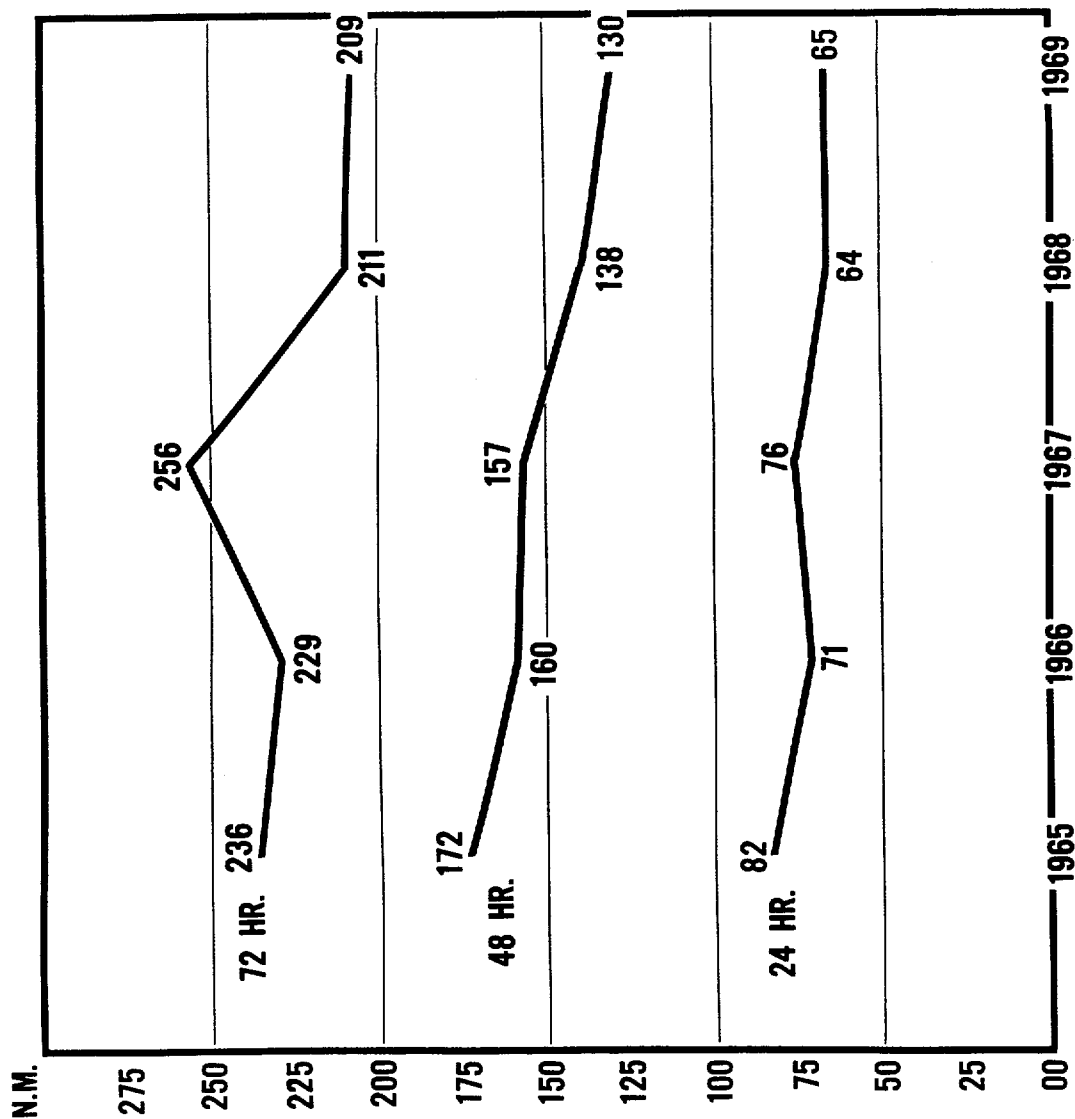


FIG 4-3

CHAPTER V

INDIVIDUAL TYPHOONS OF 1969

NOTE. See Appendix A for definitions or clarification of words or phrases that appear in this chapter.

TYPHOON PHYLLIS - 01/17/0500Z TO 01/22/2300Z

I. DATA

A. STATISTICS

1. NUMBER OF WARNINGS ISSUED - 24
2. NUMBER OF WARNINGS WITH TYPHOON INTENSITY - 15
3. DISTANCE TRAVELED DURING WARNING PERIOD - 1968 MI

B. CHARACTERISTICS AS A TYPHOON

1. MINIMUM OBSERVED SLP - 966 MBS AT 182100Z
2. MINIMUM OBSERVED 700 MB HEIGHT - 2819 M AT 182100Z
3. MAXIMUM SURFACE WIND - 085 KTS (FROM BEST TRACK)
4. MAXIMUM RADIUS OF SURFACE CIRCULATION - 240 MI

II. DEVELOPMENT

- A. INITIAL IMPETUS - LOW LEVEL SURGE INTO CYCLONIC CIRCULATION FROM THE SOUTH WITH SUBSEQUENT DIVERGENCE AT 200 MB LEVEL.

B. INITIAL SURFACE VORTEX

1. EMBEDDED VORTEX AT 140000Z
2. SURFACE PRESSURE LESS THAN 1006 MBS

C. 200 MB FLOW ABOVE SURFACE VORTEX

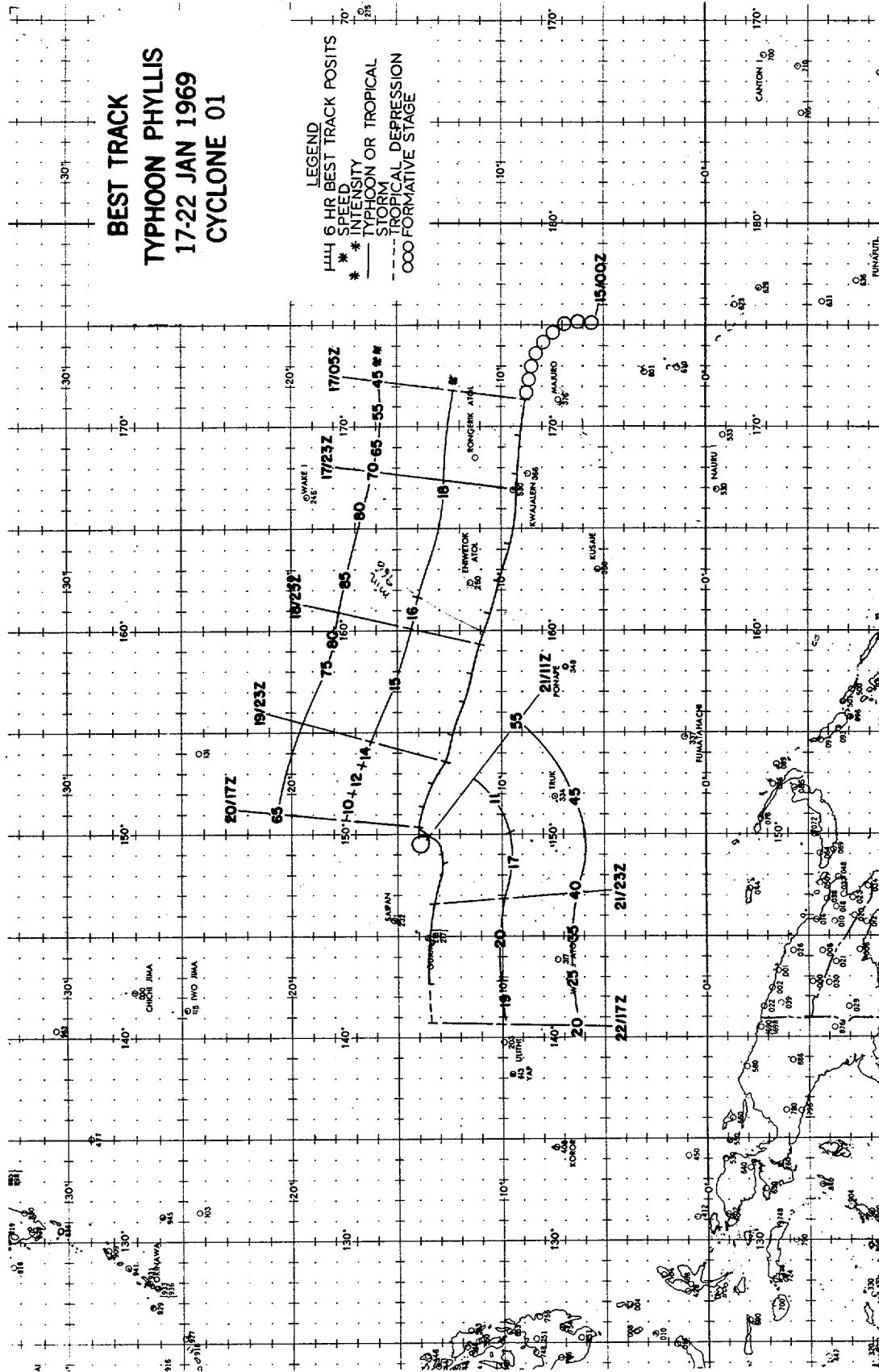
1. INITIAL - SOUTHEAST
2. UPON REACHING TYPHOON INTENSITY - SOUTHEAST

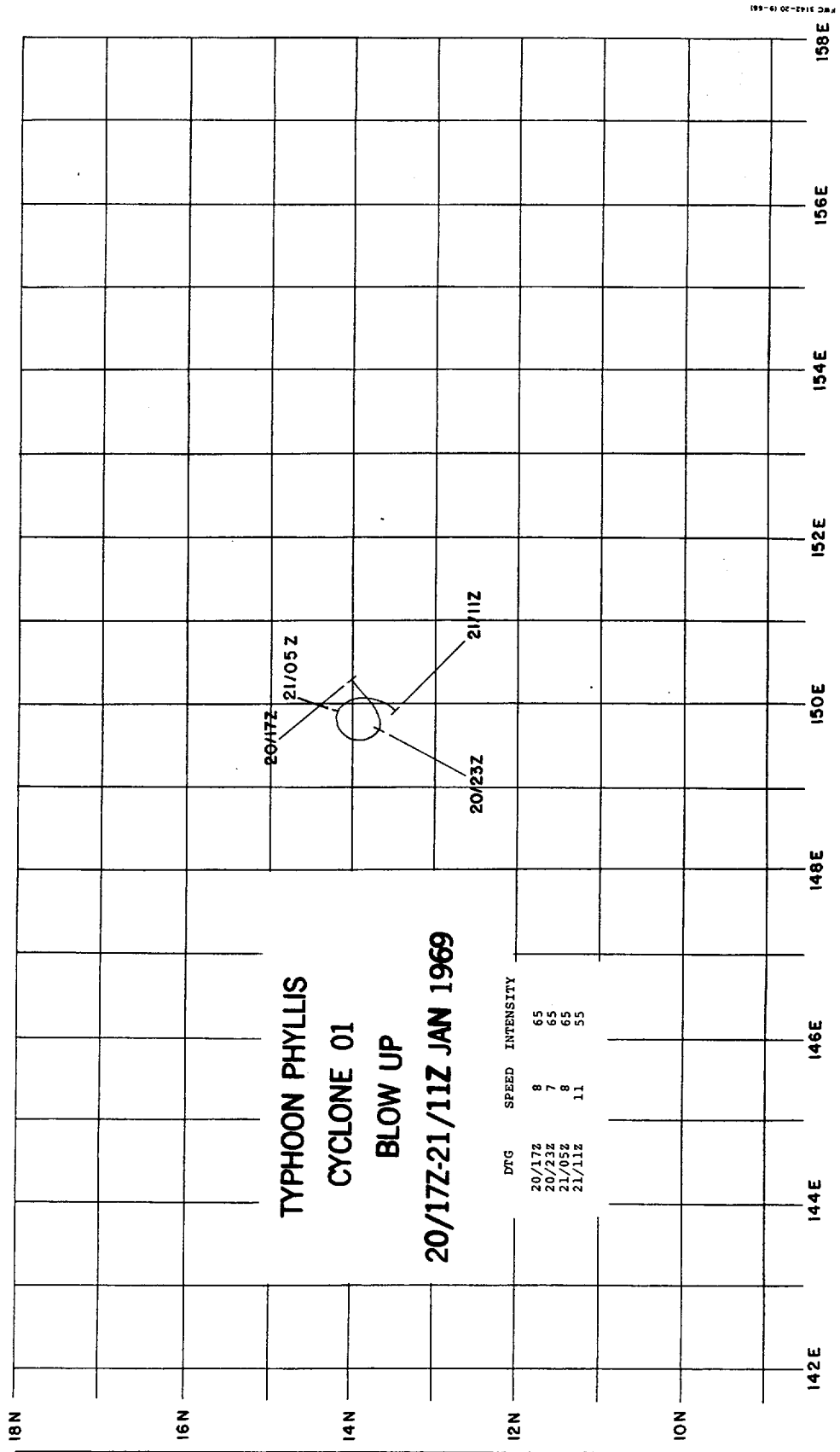
III. FINAL DISPOSITION

- A. DISSIPATED OVER WATER

BEST TRACK TYPHOON PHYLLIS 17-22 JAN 1969 CYCLONE 01

LEGEND
 6 HR BEST TRACK POSITS
 * SPEED
 * INTENSITY
 * TYPHOON OR TROPICAL STORM
 --- TROPICAL DEPRESSION
 --- FORMATIVE STAGE





199-61-20-19-68

FLX NO.	TIME	POS II	UNIT-METHOD-ACCY	FLY FIXES CIRCLE	FLT LVL	WIND	U1	OBS MIN	MIN 700MB HGT	FLT LVL	EYE FORM	ORIENT-TAILON	ETE DIA	THRU'S WALL CLOUD
1	160314Z	08.0N 176.0E	SLTLS	STG X	U1A 02	RNDS 3								
2	170409Z	09.0N 170.5E	SLTLS	STG X	U1A 03	RNDS 3			2899	17/12				
3	170605Z	08.7N 171.1E	54-P-03-05	700MB	080	055	980							
4	170900Z	09.1N 170.0E	LND RDR											
5	171200Z	09.0N 168.8E	LND RDR											
6	171400Z	09.0N 168.5E	LND RDR											
7	171503Z	09.0N 168.2E	LND RDR											
8	171600Z	09.2N 167.9E	LND RDR											
9	171652Z	09.1N 167.8E	LND RDR											
10	172100Z	09.1N 166.6E	54-P-01-03	700MB	080	080	977		2920	17/08				
11	180015Z	09.5N 165.6E	LND RDR											
12	180120Z	09.2N 165.2E	LND RDR											
13	180142Z	09.3N 165.1E	54-P-05-03						2850	10/10				
14	180215Z	09.2N 165.2E	LND RDR											
15	180250Z	09.3N 164.9E	54-P-05-03	700MB	080	090	972		2850	10/10				
16	180309Z	10.0N 163.0E	SLTLS	STG X	U1A 03	RNDS 3								
17	180900Z	10.0N 162.9E	VM-R-05-05											
18	180930Z	10.0N 162.8E	VM-R-10-10											
19	181100Z	09.4N 162.3E	LND RDR											
20	181155Z	09.9N 162.1E	LND RDR											
21	181255Z	10.0N 161.4E	LND RDR											
22	181455Z	10.4N 160.7E	LND RDR											
23	181545Z	10.7N 160.9E	VM-R-05-10											
24	182100Z	11.0N 159.7E	54-P-03-03	700MB	090	085	966		2819	12/12				
25	180230Z	11.3N 158.5E	54-P-05-03	700MB	090	080	973		2868	18/12				
26	190404Z	11.5N 157.5E	SLTLS	STG X	U1A 03	RNDS 4								
27	190905Z	11.6N 157.3E	VM-R-05-05	0450M		065	968			16/22				
28	191415Z	12.1N 155.7E	VM-R-05-10											
29	192100Z	12.6N 154.0E	54-P-03-05	700MB	070	075	971		2880	10/12				
30	200300Z	13.1N 152.5E	54-P-05-06	700MB		080	976		2883	11/10				
31	200459Z	13.0N 152.0E	SLTLS	STG X	U1A 03	RNDS 4								
32	200848Z	13.5N 152.0E	VM-R-10-05											
33	201158Z	13.8N 151.2E	VM-R-10-05	700MB						16/22				
34	201501Z	14.2N 150.5E	VM-R-10-03	700MB						15/15				
35	202000Z	13.7N 150.3E	54-R-05-05											
36	202115Z	13.7N 150.0E	54-P-05-03	700MB	080	085	977		2938	20/12				
37	210000Z	13.8N 149.8E	54-P-05-03	700MB	055	065	980		2951	20/12				
38	210310Z	13.7N 149.6E	54-P-05-03	700MB	085	070	975		2920	18/12				
39	210359Z	13.5N 149.5E	SLTLS	STG X	U1A 02	RNDS 3								
40	210900Z	14.2N 149.8E	VM-R-03-05											
41	211258Z	13.7N 150.0E	VM-R-10-03											
42	211515Z	13.1N 149.6E	VM-R-05-02	0450M		055	987		3063	17/24				
43	211805Z	12.8N 148.5E	VM-R-10-05											
44	212100Z	13.2N 147.1E	54-P-02-03	700MB	030	040	997		3075	16/11				
45	212245Z	13.4N 146.5E	LND RDR											
46	212350Z	13.5N 146.2E	LND RDR											
47	220100Z	13.5N 145.8E	LND RDR											
48	220130Z	13.5N 145.7E	LND RDR											

FIX NO.	TIME	POSII	EYE FIXES CYCLONE		UNIT-FLY		01		OBS MIN SLP	MIN 700MB HGT	FLT LVL	EYE FORM	UNIDENTATION	EYE DIA	THKNS WALL CLOUD
			METHOD	FLY	FLY	FLY	FLY	FLY							
49	220200Z	13.5N 145.5E	LND KUR												
50	220230Z	13.5N 145.3E	LND KUR												
51	220300Z	13.7N 145.3E	LND KUR												
52	220315Z	13.5N 145.3E	54-P-02-10	0450M				995			15/25				P.H.
53	220330Z	13.5N 145.0E	LND KUR												
54	220430Z	13.5N 144.7E	LND KUR												
55	220454Z	13.0N 144.5E	SLTLS	STG C											
56	220530Z	13.5N 144.5E	LND KUR												
57	220725Z	13.4N 144.0E	LND KUR												
58	220905Z	13.6N 143.4E	VW-P-03-05	0450M	033	030	998				26/24				P.H.
59	220920Z	13.4N 143.6E	LND KUR												
60	221447Z	13.6N 141.2E	VW-P-05-05	0450M	050	035	001				25/23				
61	222130Z	13.0N 139.8E	54-P-03-15	0470M	020	015									

TYPHOON PHYLLIS

TROPICAL CYCLONE 01 -- 01/17/1100Z TO 01/22/1700Z
POSITION AND FORECAST VERIFICATION DATA

WARN NO.	DTG	WARNING POSIT		BEST TRACK		24 HR FCST		24 HR ERROR		48 HR FCST		48 HR ERROR		72 HR FCST		72 HR ERROR	
		LAT	LONG	LAT	LONG	LAT	LONG	LAT	DEG DIST	LAT	LONG	LAT	DEG DIST	LAT	LONG	LAT	DEG DIST
01	170500Z	08.7N	171.0E	08.9N	171.3E	09.5N	165.4E	-----	-----	10.1N	160.4E	-----	-----	10.8N	156.0E	-----	-----
02	171100Z	08.9N	169.8E	09.1N	169.5E	09.7N	163.8E	-----	-----	10.5N	157.9E	-----	-----	-	-	-----	-----
03	171700Z	09.2N	167.7E	09.2N	167.7E	10.0N	161.4E	-----	-----	10.5N	155.4E	-----	-----	11.5N	149.6E	-----	-----
04	172300Z	09.3N	166.0E	09.3N	165.9E	09.7N	159.8E	-----	-----	10.0N	154.2E	-----	-----	-	-	-----	-----
05	180500Z	09.5N	164.3E	09.7N	164.1E	10.2N	157.6E	-----	-----	10.7N	151.5E	-----	-----	11.6N	146.4E	-----	-----
06	181100Z	09.7N	162.5E	10.1N	162.4E	10.3N	155.7E	107-0078	-----	10.9N	149.7E	-----	-----	-	-	-----	-----
07	181700Z	10.7N	160.5E	10.7N	160.8E	12.8N	154.1E	144-0048	-----	15.0N	149.4E	-----	-----	18.0N	145.0E	-----	-----
08	182300Z	11.1N	159.2E	11.1N	159.3E	13.0N	153.8E	164-0084	-----	14.6N	150.2E	-----	-----	-	-	-----	-----
09	190500Z	11.5N	158.0E	11.5N	157.9E	12.9N	152.9E	189-0078	-----	14.2N	148.3E	-----	-----	15.3N	144.7E	-----	-----
10	191100Z	11.8N	156.9E	11.9N	156.4E	13.1N	152.1E	201-0102	-----	14.4N	147.9E	-----	-----	-	-	-----	-----
11	191700Z	12.3N	155.2E	12.4N	154.9E	13.6N	150.5E	299-0048	-----	14.9N	146.2E	-----	-----	16.2N	142.0E	-----	-----
12	192300Z	12.8N	153.6E	12.8N	153.6E	14.5N	147.8E	046-0012	-----	15.8N	143.0E	-----	-----	-	-	-----	-----
13	200500Z	13.4N	152.0E	13.3N	152.4E	14.9N	147.0E	134-0030	-----	14.6N	142.4E	-----	-----	14.2N	137.7E	-----	-----
14	201100Z	13.6N	151.4E	13.8N	151.3E	14.8N	147.5E	134-0054	-----	14.8N	144.2E	-----	-----	-	-	-----	-----
15	201700Z	14.1N	150.0E	14.0N	150.3E	14.9N	146.0E	153-0024	-----	14.7N	142.7E	-----	-----	14.3N	139.5E	194-0150	-----
16	202300Z	13.8N	149.8E	13.7N	149.7E	14.9N	146.2E	293-0114	-----	15.3N	142.4E	-----	-----	-	-	-----	-----
17	210500Z	13.8N	149.4E	14.2N	149.9E	14.3N	147.7E	284-0168	-----	14.5N	145.9E	-----	-----	14.4N	144.2E	233-0252	-----
18	211100Z	14.2N	149.8E	13.5N	149.9E	14.2N	149.8E	300-0150	-----	14.5N	148.5E	-----	-----	-	-	-----	-----
19	211700Z	12.9N	148.9E	12.8N	148.7E	12.3N	142.5E	308-0198	-----	12.0N	137.0E	-----	-----	12.0N	132.0E	326-0372	-----
20	212300Z	13.4N	146.4E	13.3N	146.7E	13.5N	140.5E	345-0096	-----	12.9N	135.4E	-----	-----	-	-	-----	-----

AVERAGE 24 HOUR ERROR - 0091 MI.
AVERAGE 48 HOUR ERROR - 0140 MI.
AVERAGE 72 HOUR ERROR - 0220 MI.

TYPHOON SUSAN - 04/18/0500Z TO 04/25/0500Z

I. DATA

A. STATISTICS

1. NUMBER OF WARNINGS ISSUED - 29
2. NUMBER OF WARNINGS WITH TYPHOON INTENSITY - 12
3. DISTANCE TRAVELED DURING WARNING PERIOD - 882 MI

B. CHARACTERISTICS AS A TYPHOON

1. MINIMUM OBSERVED SLP - 943 MBS AT 212130Z
2. MINIMUM OBSERVED 700 MB HEIGHT - 2615 M AT 222130Z
3. MAXIMUM SURFACE WIND - 105 KTS (FROM BEST TRACK)
4. MAXIMUM RADIUS OF SURFACE CIRCULATION - 240 MI

II. DEVELOPMENT

A. INITIAL IMPETUS - 200 MB ANTICYCLONE OVER THE SURFACE CYCLONE

B. INITIAL SURFACE VORTEX

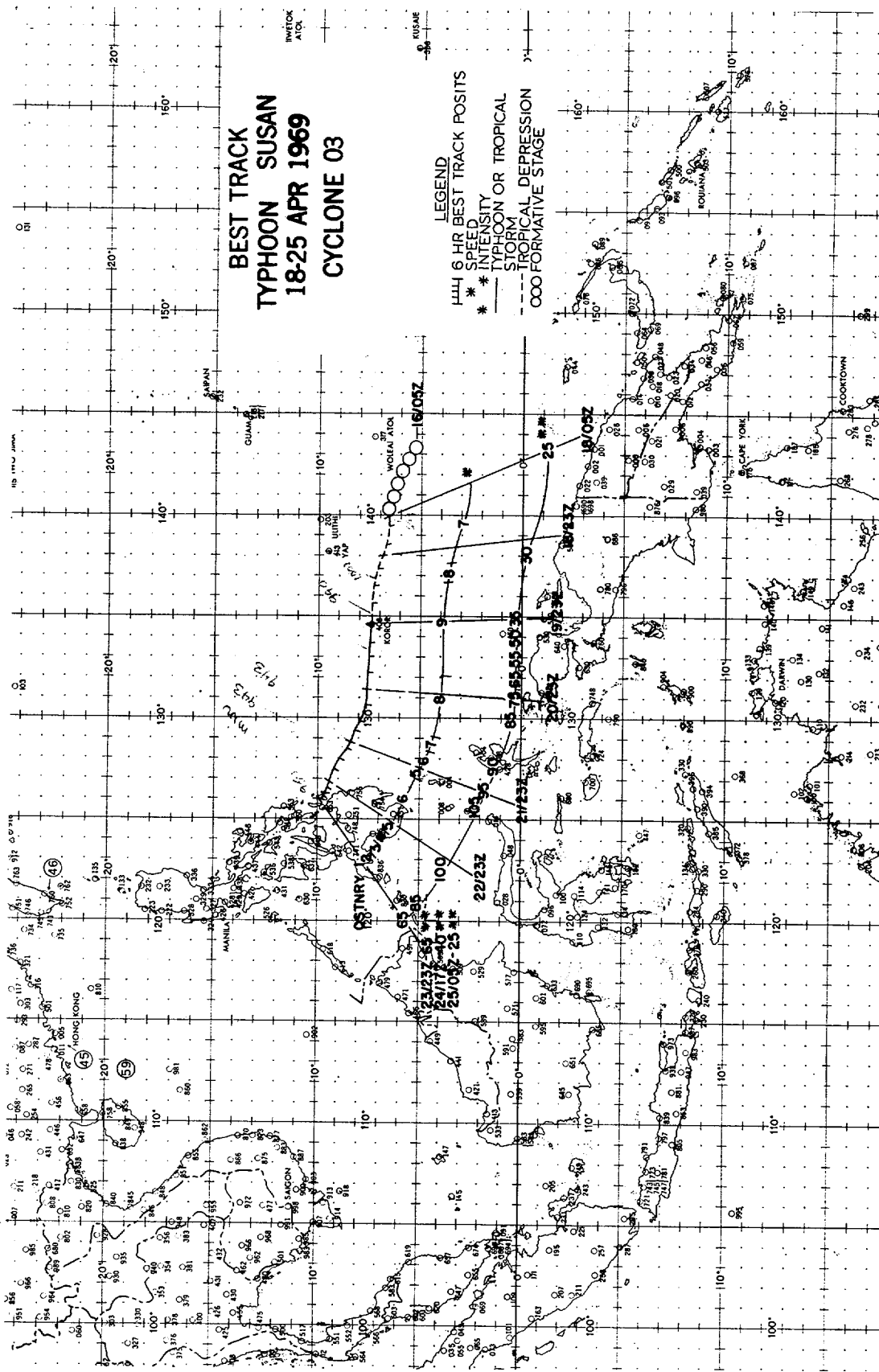
1. EMBEDDED VORTEX AT 160500Z
2. SURFACE PRESSURE LESS THAN 1007 MBS

C. 200 MB FLOW ABOVE SURFACE VORTEX

1. INITIAL - SOUTHEAST
2. UPON REACHING TYPHOON INTENSITY - SOUTH

III. FINAL DISPOSITION

A. DISSIPATED OVER LAND



FIX NO.	TIME	POSIT	EYE FIXES CYCLONE				03			OBS	SLP	700MB	FLY	EYE FORM	ORIENT- TATION	EYE DIA	MARKS
			UNIF- METHUD -ACCY	FLY LVL	FLY LVL	FLY LVL	FLY LVL	FLY LVL	FLY LVL								
1	160508Z	07.0N 143.0E	SLTL	STG C	033	033	033	033	033	033	033	033	033	033	033	033	033
2	170411Z	06.0N 143.0E	SLTL	STG C	033	033	033	033	033	033	033	033	033	033	033	033	033
3	180510Z	09.0N 140.0E	SLTL	STG B	033	033	033	033	033	033	033	033	033	033	033	033	033
4	180530Z	06.4N 139.9E	54-P-03-02	0350.4	033	033	033	033	033	033	033	033	033	033	033	033	033
5	182130Z	07.1N 138.2E	54-P-10-10	700MB	038	038	038	038	038	038	038	038	038	038	038	038	038
6	190255Z	06.9N 137.4E	54-P-10-05	0460.4	030	030	030	030	030	030	030	030	030	030	030	030	030
7	190417Z	08.0N 137.0E	SLTL	SIG B	030	030	030	030	030	030	030	030	030	030	030	030	030
8	190725Z	06.0N 137.6E	VW-R-03-15	0320.4	030	030	030	030	030	030	030	030	030	030	030	030	030
9	190905Z	07.3N 136.8E	VW-P-05-10	0320.4	030	030	030	030	030	030	030	030	030	030	030	030	030
10	192100Z	07.3N 134.9E	54-P-05-04	700MB	048	048	048	048	048	048	048	048	048	048	048	048	048
11	200230Z	07.4N 134.0E	54-P-05-04	700MB	041	041	041	041	041	041	041	041	041	041	041	041	041
12	200512Z	07.5N 133.0E	SLTL	SIG B	030	030	030	030	030	030	030	030	030	030	030	030	030
13	200740Z	07.3N 133.1E	VW-R-03-15	0450.4	030	030	030	030	030	030	030	030	030	030	030	030	030
14	200845Z	07.5N 133.1E	VW-P-05-03	0450.4	030	030	030	030	030	030	030	030	030	030	030	030	030
15	201400Z	07.7N 132.3E	VW-R-05-10	700MB	085	085	085	085	085	085	085	085	085	085	085	085	085
16	202045Z	07.8N 131.5E	54-P-03-03	700MB	085	085	085	085	085	085	085	085	085	085	085	085	085
17	210230Z	07.8N 130.9E	54-P-25-01	700MB	083	083	083	083	083	083	083	083	083	083	083	083	083
18	210611Z	08.0N 130.5E	SLTL	SIG X	030	030	030	030	030	030	030	030	030	030	030	030	030
19	211400Z	08.0N 129.4E	VW-R-20-02	700MB	095	095	095	095	095	095	095	095	095	095	095	095	095
20	212130Z	08.2N 129.0E	54-P-03-02	700MB	085	085	085	085	085	085	085	085	085	085	085	085	085
21	220205Z	08.4N 128.8E	54-P-10-01	700MB	085	085	085	085	085	085	085	085	085	085	085	085	085
22	220518Z	08.5N 128.0E	SLTL	SIG X	030	030	030	030	030	030	030	030	030	030	030	030	030
23	220925Z	09.0N 128.2E	VW-R-05-05	700MB	095	095	095	095	095	095	095	095	095	095	095	095	095
24	221200Z	09.2N 128.2E	VW-R-05-05	700MB	095	095	095	095	095	095	095	095	095	095	095	095	095
25	221450Z	09.4N 127.4E	VW-R-05-05	700MB	095	095	095	095	095	095	095	095	095	095	095	095	095
26	222130Z	09.5N 127.0E	54-P-03-03	700MB	095	095	095	095	095	095	095	095	095	095	095	095	095
27	230315Z	10.1N 126.2E	54-P-05-02	700MB	095	095	095	095	095	095	095	095	095	095	095	095	095
28	230613Z	10.0N 126.0E	SLTL	SIG X	030	030	030	030	030	030	030	030	030	030	030	030	030
29	230827Z	09.7N 126.1E	VW-R-03-01	700MB	095	095	095	095	095	095	095	095	095	095	095	095	095
30	231530Z	09.8N 126.1E	VW-R-05-05	700MB	095	095	095	095	095	095	095	095	095	095	095	095	095
31	232100Z	10.0N 126.0E	54-P-01-03	500MB	095	095	095	095	095	095	095	095	095	095	095	095	095
32	240200Z	10.0N 125.8E	54-P-02-05	500MB	095	095	095	095	095	095	095	095	095	095	095	095	095
33	240520Z	10.0N 125.5E	SLTL	SIG X	030	030	030	030	030	030	030	030	030	030	030	030	030
34	240842Z	10.0N 126.1E	VW-R-05-05	700MB	095	095	095	095	095	095	095	095	095	095	095	095	095
35	240905Z	10.0N 126.0E	VW-R-05-05	700MB	095	095	095	095	095	095	095	095	095	095	095	095	095
36	241400Z	09.9N 125.8E	VW-R-03-03	700MB	095	095	095	095	095	095	095	095	095	095	095	095	095

TYPHOON SUSAN

TROPICAL CYCLONE 03 -- 04/18/0500Z TO 04/25/0500Z
POSITION AND FORECAST VERIFICATION DATA

WARN NO.	DTG	WARNING POSIT		BEST TRACK		24 HR FCST		24 HR ERROR		48 HR FCST		48 HR ERROR		72 HR FCST		72 HR ERROR	
		LAT	LONG	LAT	LONG	LAT	LONG	LAT	DEG DIST	LAT	LONG	LAT	DEG DIST	LAT	LONG	LAT	DEG DIST
08	192300Z	07.4N	134.6E	07.4N	134.7E	08.3N	131.6E	030-0048	09.4N	128.6E							
09	200500Z	07.5N	133.6E	07.5N	133.8E	08.4N	130.3E	060-0030	09.2N	127.1E				10.3N	124.0E		
10	201100Z	07.6N	132.8E	07.5N	133.0E	08.6N	129.3E	055-0048	10.0N	126.7E							
11	201700Z	07.8N	131.9E	07.6N	132.2E	08.9N	128.6E	064-0066	10.3N	126.2E				11.8N	124.4E		
12	202300Z	07.9N	131.2E	07.7N	131.4E	08.8N	128.3E	019-0036	10.4N	126.1E							
13	210500Z	07.9N	130.4E	07.8N	130.6E	08.8N	127.8E	341-0036	09.5N	125.6E				09.5N	123.6E		
14	211100Z	08.1N	129.8E	08.0N	129.9E	09.0N	127.1E	320-0042	09.7N	124.9E							
15	211700Z	08.0N	129.0E	08.2N	129.4E	08.6N	126.3E	314-0054	09.0N	123.7E				08.5N	121.0E		
16	212300Z	08.3N	128.8E	08.4N	128.9E	09.0N	126.5E	308-0036	09.3N	124.6E							
17	220500Z	08.4N	128.6E	08.7N	128.5E	08.7N	127.8E	279-0036	08.9N	125.6E				08.9N	123.6E		
18	221100Z	09.1N	128.1E	09.0N	128.0E	10.3N	126.0E	270-0048	10.8N	123.7E							
19	221700Z	09.5N	127.2E	09.3N	127.5E	09.5N	124.2E	238-0078	08.7N	121.3E				08.2N	118.3E		
20	222300Z	09.5N	126.8E	09.5N	126.9E	09.6N	124.4E	211-0030	08.8N	122.2E							
21	230500Z	10.2N	126.1E	09.6N	126.5E	12.2N	124.4E	114-0126	14.3N	123.6E				17.3N	124.3E		286-0150
22	231100Z	09.9N	126.0E	09.8N	126.2E	10.6N	125.0E	348-0030	12.0N	124.0E							
23	231700Z	09.9N	126.0E	09.8N	126.1E	10.5N	125.1E	261-0108	11.8N	124.1E				13.2N	123.4E		321-0150
24	232300Z	10.0N	126.0E	09.9N	126.0E	10.8N	125.3E	259-0090									
25	240500Z	10.0N	125.8E	09.9N	126.0E			326-0162									261-0138
26	241100Z	10.0N	126.0E	09.9N	126.0E	10.0N	126.0E	307-0066									
27	241700Z	09.9N	125.7E	09.9N	126.0E	09.7N	124.8E	306-0060									255-0300
28	242300Z	09.8N	125.5E	09.9N	126.0E			326-0060									

AVERAGE 24 HOUR ERROR - 0061 MI.
AVERAGE 48 HOUR ERROR - 0110 MI.
AVERAGE 72 HOUR ERROR - 0184 MI.

TYPHOON TESS - 07/08/1100Z TO 07/11/1100Z

I. DATA

A. STATISTICS

1. NUMBER OF WARNINGS ISSUED - 13
2. NUMBER OF WARNINGS WITH TYPHOON INTENSITY - 03
3. DISTANCE TRAVELED DURING WARNING PERIOD - 906

B. CHARACTERISTICS AS A TYPHOON

1. MINIMUM OBSERVED SLP - 974 MBS AT 100840Z
2. MINIMUM OBSERVED 700 MB HEIGHT - 2859 M AT 100215Z
3. MAXIMUM SURFACE WIND - 070 KTS (FROM BEST TRACK)
4. MAXIMUM RADIUS OF SURFACE CIRCULATION - 300 MI

II. DEVELOPMENT

A. INITIAL IMPETUS - DEVELOPMENT OF DIVERGENCE AT 200 MB
OVER SURFACE CYCLONIC CIRCULATION

B. INITIAL SURFACE VORTEX

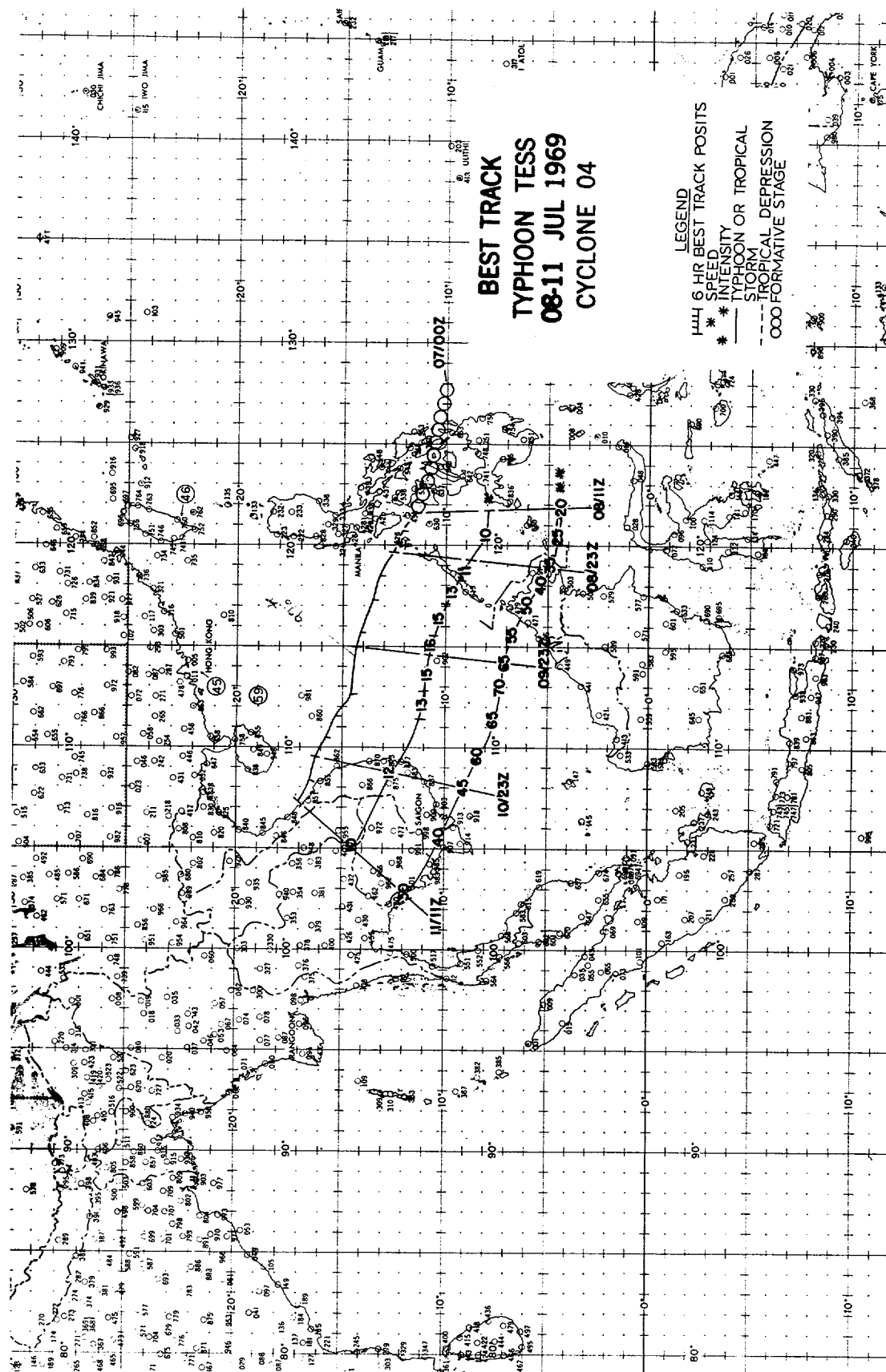
1. JUNCTION VORTEX AT 050000Z
2. SURFACE PRESSURE LESS THAN 1009 MBS

C. 200 MB FLOW ABOVE SURFACE VORTEX

1. INITIAL - NORTHEAST
2. UPON REACHING TYPHOON INTENSITY - EAST

III. FINAL DISPOSITION

A. DISSIPATED OVER LAND



FIX NO.	TIME	EYE FIXES CYCLONE				04				MIN 700MB HGT	ILT I°/10	EYE FORM	ORIENTATION	EYE DIA	HKNWS WALL CLOUD
		UNIT-METHOD	FLT LVL	FLT LVL	FLT LVL	OBS SFC WND	OBS MIN SLP	OBS MIN SLP	OBS MIN SLP						
1	050439Z	SLTLS	STG B	STG B	STG B	01A --	BNDS --	01A --	BNDS --						
2	060638Z	SLTLS	STG B	STG B	STG B	01A --	BNDS --	01A --	BNDS --						
3	080540Z	SLTLS	STG X	STG X	STG X	01A 02	BNDS 2	01A 02	BNDS 2						
4	090400Z	54-P----	10	500MB	500MB	055	045	045	091		01/55	CIRC		10	
5	090445Z	VW-R----	10	700MB	700MB	055	045	045	091		--/--	CIRC		17	
6	090638Z	SLTLS	STG X	STG X	STG X	01A 02	BNDS 2	01A 02	BNDS 2						
7	090905Z	VW-P----	10	2230H	2230H	055	065	065	080		--/--				1-
8	091305Z	VW-R----	10			055	065	065	080		--/--				
9	091400Z	VW-P----	05	700MB	700MB	055	065	065	080		21/13	ELIP	NW-SE	29x25	
10	092120Z	54-R----	0	700MB	700MB	055	065	065	080		--/--	CIRC		20	
11	100000Z	54-P----	05	700MB	700MB	062	070	070	089		19/14	CIRC		20	
12	100215Z	54-P----	05	700MB	700MB	065	070	070	089		20/09	CIRC		20	10
13	100737Z	SLTLS	STG X	STG X	STG X	01A 04	BNDS 2	01A 04	BNDS 2						
14	100745Z	VW-R----	20			055	065	065	080		--/--				
15	100840Z	VW-P----	10	0290.4	0290.4	055	070	070	084		29/25				
16	101200Z	VW-R----	10			055	070	070	084		--/--				
17	101400Z	VW-P----	10	700MB	700MB	065	074	074	084		24/15				
18	101500Z	VW-R----				055	074	074	084		--/--				
19	101725Z	VW-P----	10	700MB	700MB	055	074	074	084		22/15	CIRC		40	
20	102110Z	54-P----	15	700MB	700MB	055	074	074	084		16/12				
21	110000Z	54-P----	05	700MB	700MB	070	060	060	089		20/15	CIRC		15	
22	110245Z	54-P----	05	700MB	700MB	065	060	060	089		16/12	CIRC		10	
23	110254Z	SLTLS	STG X	STG X	STG X	01A 02	BNDS 3	01A 02	BNDS 3						
24	111010Z	VW-R----	05			055	065	065	089		--/--				
25	111030Z	VW-R----	02			055	065	065	089		--/--				

TYPHOON TESS

TROPICAL CYCLONE 04 -- 07/08/1100Z TO 07/11/1100Z
POSITION AND FORECAST VERIFICATION DATA

WARN NO.	DTG	WARNING POSIT		BEST TRACK		24 HR FCST		24 HR ERROR		48 HR FCST		48 HR ERROR		72 HR FCST		72 HR ERROR	
		LAT	LONG	LAT	LONG	LAT	LONG	DEG	DIST	LAT	LONG	DEG	DIST	LAT	LONG	DEG	DIST
03	082300Z	12.4N	119.9E	12.7N	119.7E	13.7N	118.9E	-----	-----	-	-	-----	-----	-	-	-----	-----
04	090500Z	13.3N	118.7E	13.3N	118.6E	16.2N	115.9E	-----	-----	19.0N	114.2E	-----	-----	22.0N	113.2E	-----	-----
05	091100Z	13.8N	117.6E	13.7N	117.2E	17.3N	114.3E	265-0126	20.9N	112.8E	-	-----	-----	-	-	-----	-----
06	091700Z	14.4N	115.9E	14.1N	115.6E	18.4N	112.6E	151-0102	22.0N	111.2E	-	-----	-----	-	-	-----	-----
07	092300Z	14.4N	114.0E	14.4N	114.0E	17.5N	109.0E	098-0282	21.5N	106.3E	-	-----	-----	-	-	-----	-----
08	100500Z	14.8N	112.7E	14.7N	112.6E	17.7N	108.4E	065-0204	20.3N	106.5E	-	-----	-----	-	-	-----	-----
09	101100Z	15.2N	111.9E	15.3N	111.6E	17.6N	108.4E	052-0192	20.2N	106.6E	-	-----	-----	-	-	-----	-----
10	101700Z	15.9N	110.6E	15.9N	110.5E	18.7N	107.4E	039-0192	21.6N	106.1E	-	-----	-----	-	-	-----	-----
11	102300Z	16.5N	109.7E	16.3N	109.4E	18.7N	107.5E	010-0186	21.6N	106.1E	-	-----	-----	-	-	-----	-----
12	110500Z	16.8N	108.3E	16.7N	108.3E	20.0N	105.2E	006-0060	-	-	-	068-0360	-----	-	-	-----	-----
		AVERAGE 24 HOUR ERROR - 0168 MI.															
		AVERAGE 48 HOUR ERROR - 0360 MI.															
		AVERAGE 72 HOUR ERROR - ---- MI.															

TYPHOON VIOLA - 07/21/2300Z TO 07/28/0500Z

I. DATA

A. STATISTICS

1. NUMBER OF WARNINGS ISSUED - 26
2. NUMBER OF WARNINGS WITH TYPHOON INTENSITY - 18
3. DISTANCE TRAVELED DURING WARNING PERIOD - 1854 MI

B. CHARACTERISTICS AS A TYPHOON

1. MINIMUM OBSERVED SLP - 897 MBS AT 262100Z
2. MINIMUM OBSERVED 700 MB HEIGHT - 2137 M AT 262100Z
3. MAXIMUM SURFACE WIND - 130 KTS (FROM BEST TRACK)
4. MAXIMUM RADIUS OF SURFACE CIRCULATION - 420 MI

II. DEVELOPMENT

A. INITIAL IMPETUS - 200 MB ANTICYCLONE OVER THE SURFACE CYCLONE

B. INITIAL SURFACE VORTEX

1. JUNCTION VORTEX AT 180000Z
2. SURFACE PRESSURE LESS THAN 1008 MBS

C. 200 MB FLOW ABOVE SURFACE VORTEX

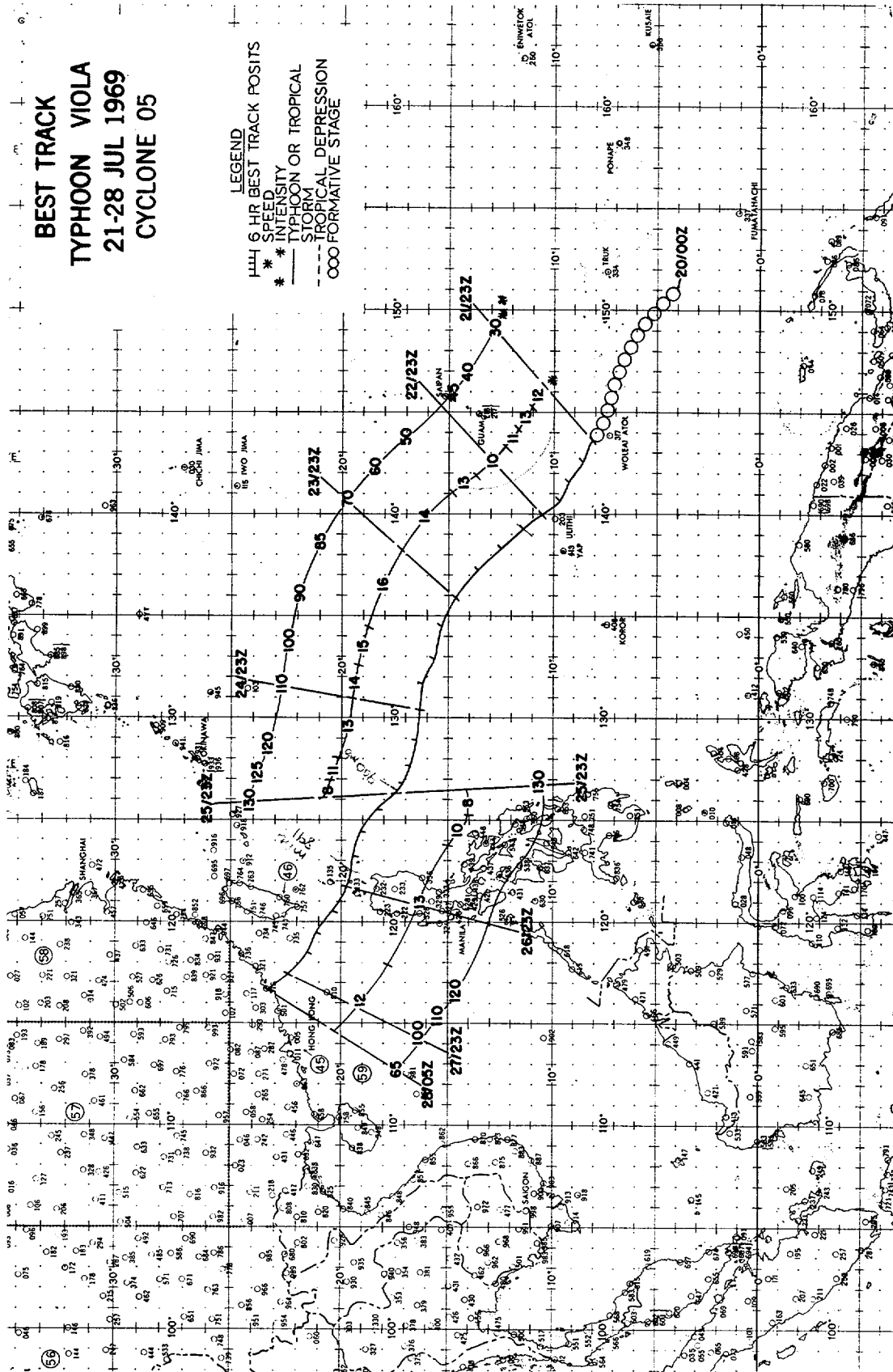
1. INITIAL - EAST
2. UPON REACHING TYPHOON INTENSITY - SOUTHEAST

III. FINAL DISPOSITION

A. DISSIPATED OVER LAND

BEST TRACK
TYPHOON VIOLA
21-28 JUL 1969
CYCLONE 05

LEGEND
 ||||| 6 HR BEST TRACK POSITS
 * SPEED
 * INTENSITY
 --- TYPHOON OR TROPICAL STORM
 --- TROPICAL DEPRESSION
 --- FORMATIVE STAGE



TYPHOON VIOLA

TROPICAL CYCLONE 05 -- 07/21/2300Z TO 07/28/0500Z
POSITION AND FORECAST VERIFICATION DATA

WARN NO.	DTG	WARNING POSIT		BEST TRACK		24 HR FCST		24 HR ERROR		48 HR FCST		48 HR ERROR		72 HR FCST		72 HR ERROR	
		LAT	LONG	LAT	LONG	LAT	LONG	LAT	LONG	LAT	LONG	LAT	LONG	LAT	LONG	LAT	LONG
03	221100Z	09.0N	141.3E	09.3N	141.5E	10.6N	136.9E	-----	-----	12.0N	133.0E	-----	-----	-	-	-----	-----
04	221700Z	09.7N	140.5E	09.8N	140.7E	11.9N	136.4E	-----	-----	13.5N	132.8E	-----	-----	15.1N	129.1E	-----	-----
05	222300Z	10.4N	139.9E	10.6N	140.0E	12.5N	136.4E	226-0066	226-0066	14.7N	132.9E	-----	-----	-	-	-----	-----
06	230500Z	11.3N	139.0E	11.6N	139.2E	13.8N	135.5E	176-0114	176-0114	16.3N	131.8E	-----	-----	18.5N	128.0E	-----	-----
07	231100Z	12.7N	138.3E	12.6N	138.2E	16.6N	135.3E	211-0138	211-0138	19.4N	131.4E	-----	-----	-	-	-----	-----
08	231700Z	13.6N	137.4E	13.7N	137.2E	17.1N	134.1E	202-0114	202-0114	19.9N	130.1E	-----	-----	21.5N	125.5E	-----	-----
09	232300Z	14.9N	135.9E	14.8N	135.9E	18.3N	131.6E	170-0138	170-0138	20.5N	126.4E	-----	-----	-	-	-----	-----
10	240500Z	15.7N	134.7E	15.4N	134.4E	18.8N	129.5E	147-0108	147-0108	20.7N	124.0E	-----	-----	22.0N	118.1E	-----	-----
11	241100Z	16.3N	132.5E	15.7N	132.9E	18.3N	125.9E	069-0144	069-0144	19.3N	119.8E	178-0222	178-0222	-	-	-----	-----
12	241700Z	16.4N	131.3E	16.2N	131.5E	18.2N	125.5E	070-0150	070-0150	19.4N	119.8E	156-0174	156-0174	21.0N	115.0E	-----	-----
13	242300Z	16.4N	130.2E	16.4N	130.3E	17.7N	125.2E	033-0132	033-0132	19.0N	120.2E	124-0180	124-0180	-	-	-----	-----
14	250500Z	16.8N	128.8E	16.7N	128.9E	18.1N	123.6E	014-0126	014-0126	19.7N	118.4E	098-0162	098-0162	22.5N	113.7E	-----	-----
15	251100Z	17.1N	127.8E	16.9N	127.8E	18.3N	123.0E	307-0132	307-0132	20.0N	117.4E	054-0252	054-0252	-	-	-----	-----
16	251700Z	17.3N	126.6E	17.1N	126.9E	18.6N	121.9E	310-0102	310-0102	20.6N	116.5E	047-0246	047-0246	24.0N	112.0E	133-0174	133-0174
17	252300Z	17.3N	126.4E	17.6N	126.3E	18.1N	123.4E	275-0060	275-0060	18.9N	120.2E	002-0174	002-0174	-	-	-----	-----
18	260500Z	18.0N	125.5E	18.3N	125.5E	19.5N	122.4E	264-0108	264-0108	21.0N	118.5E	329-0162	329-0162	23.3N	115.6E	086-0138	086-0138
19	261100Z	19.2N	124.1E	19.1N	124.4E	21.4N	119.2E	239-0090	239-0090	24.7N	114.5E	272-0258	272-0258	-	-	-----	-----
20	261700Z	19.9N	123.0E	19.5N	123.2E	21.9N	118.2E	234-0090	234-0090	24.7N	114.5E	269-0192	269-0192	-	-	047-0174	047-0174
21	262300Z	20.1N	122.0E	19.8N	121.8E	22.2N	117.3E	138-0132	138-0132	-	-	242-0102	242-0102	-	-	-----	-----
22	270500Z	20.4N	120.4E	20.4N	120.6E	22.8N	115.1E	117-0114	117-0114	-	-	251-0126	251-0126	-	-	304-0168	304-0168
23	271100Z	21.0N	119.4E	21.1N	119.6E	22.8N	114.1E	314-0024	314-0024	-	-	242-0132	242-0132	-	-	-----	-----
24	271700Z	21.7N	118.5E	21.7N	118.4E	23.8N	114.0E	333-0012	333-0012	-	-	238-0120	238-0120	-	-	258-0186	258-0186
25	272300Z	22.2N	117.4E	22.4N	117.4E	-	-	180-0012	180-0012	-	-	143-0258	143-0258	-	-	-----	-----
26	280500Z	23.3N	116.3E	23.3N	116.6E	-	-	249-0078	249-0078	-	-	134-0144	134-0144	-	-	253-0162	253-0162

AVERAGE 24 HOUR ERROR - 0099 MI.
AVERAGE 48 HOUR ERROR - 0181 MI.
AVERAGE 72 HOUR ERROR - 0167 MI.

TYPHOON BETTY - 08/05/0500Z TO 08/08/1100Z

I. DATA

A. STATISTICS

1. NUMBER OF WARNINGS ISSUED - 14
2. NUMBER OF WARNINGS WITH TYPHOON INTENSITY - 04
3. DISTANCE TRAVELED DURING WARNING PERIOD - 1242 MI

B. CHARACTERISTICS AS A TYPHOON

1. MINIMUM OBSERVED SLP - 962 MBS AT 080200Z
2. MINIMUM OBSERVED 700 MB HEIGHT - 2796M AT 072110Z
3. MAXIMUM SURFACE WIND - 070 KTS (FROM BEST TRACK)
4. MAXIMUM RADIUS OF SURFACE CIRCULATION - 360 MI

II. DEVELOPMENT

A. INITIAL IMPETUS - UNSTABLE EASTERLY WAVE UNDER 200 MB DIVERGENCE

B. INITIAL SURFACE VORTEX

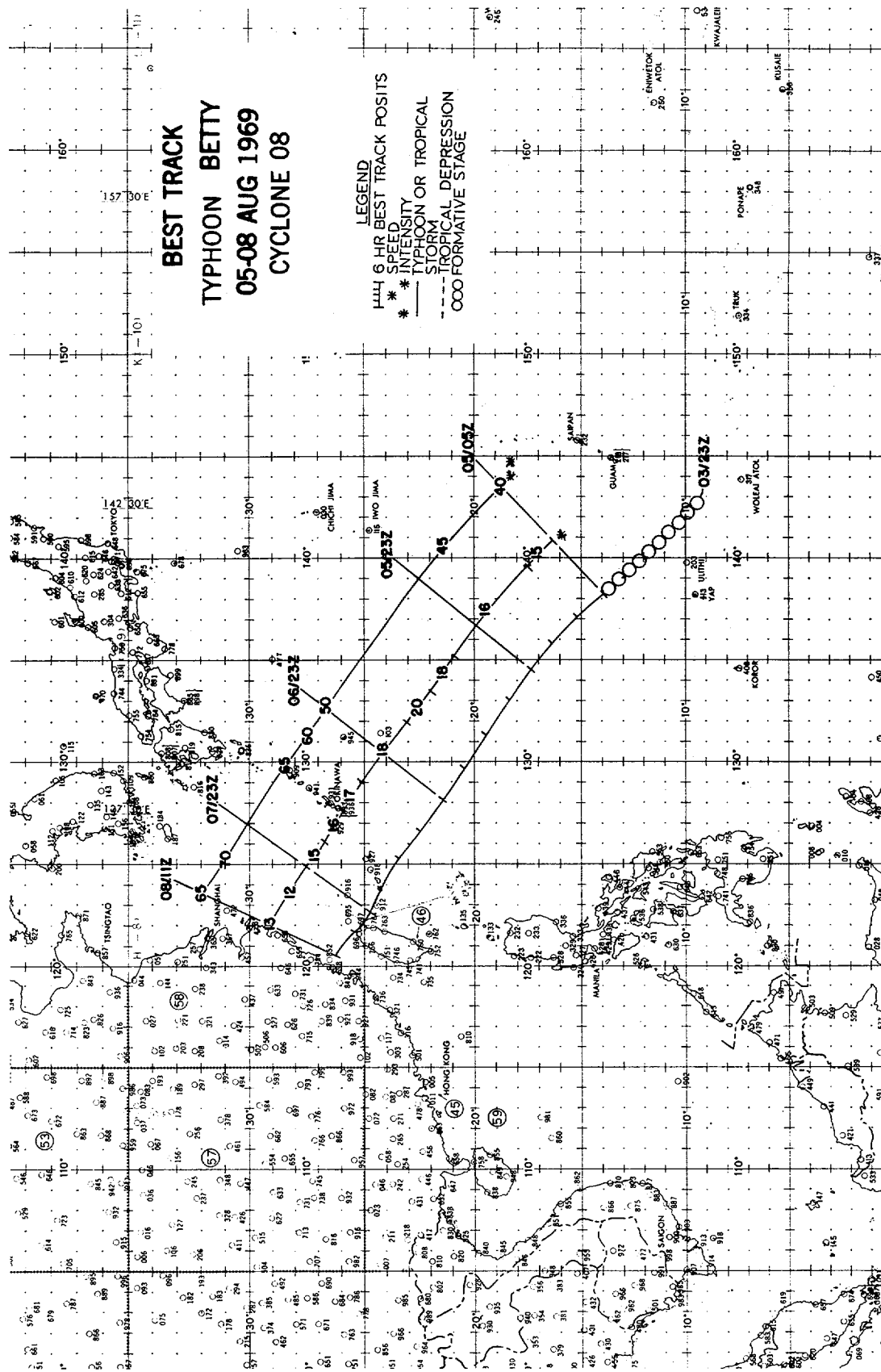
1. JUNCTION VORTEX AT 021800Z
2. SURFACE PRESSURE LESS THAN 1008 MBS

C. 200 MB FLOW ABOVE SURFACE VORTEX

1. INITIAL - NORTHEAST
2. UPON REACHING TYPHOON INTENSITY - EAST

III. FINAL DISPOSITION

A. DISSIPATED OVER LAND



FIX NO.	TIME	POSIT	EYE FIXES CYCLONE				08				EYE FORM	ORIENTATION	EYE DIA	THKNS WALL CLOUD
			UNIT-METHOD-ACCY	FLT LVL	FLT LVL	FLT LVL	WIND	WIND	WIND	WIND				
1	040230Z	09.9N 142.2E	54-P----	30	0460M	030	015	005	---	---	CIRC	---	35	---
2	050028Z	13.4N 138.6E	54-P----	20	0460M	035	025	001	---	---	---	---	---	---
3	050556Z	14.2N 137.9E	VW-P-----	05	0300M	---	055	993	---	---	CIRC	---	05	---
4	052126Z	17.1N 134.8E	54-P-----	15	700MB	055	---	987	2995	---	---	---	---	F.d.
5	060215Z	17.9N 133.7E	54-P-----	20	700MB	045	040	989	2987	---	---	---	---	F.d.
6	060517Z	18.0N 132.5E	SLTSL	---	STG C	---	---	---	---	---	---	---	---	---
7	060800Z	18.9N 131.1E	VW-R-----	20	0240M	040	045	985	---	---	CIRC	---	20	---
8	060930Z	19.6N 131.1E	VW-P-----	20	700MB	055	---	---	---	---	CIRC	---	20	---
9	061445Z	20.3N 130.2E	VW-P-----	10	700MB	045	050	980	2951	---	CIRC	---	12	03
10	062100Z	21.2N 128.5E	54-P-----	03	700MB	050	070	975	2897	---	CIRC	---	12	03
11	070205Z	22.0N 127.2E	54-P-----	03	700MB	---	---	---	---	---	---	---	---	---
12	070500Z	22.6N 126.7E	LND RUR	---	---	---	---	---	---	---	---	---	---	---
13	070600Z	22.9N 126.5E	LND RUR	---	---	---	---	---	---	---	---	---	---	---
14	070615Z	23.0N 126.5E	SLTSL	---	STG X	01A 02	8NWS	---	---	---	---	---	---	---
15	070630Z	22.0N 126.7E	LND RUR	---	---	---	---	---	---	---	---	---	---	---
16	070700Z	23.0N 126.2E	LND RUR	---	---	---	---	---	---	---	---	---	---	---
17	070800Z	23.1N 126.0E	LND RUR	---	---	---	---	---	---	---	---	---	---	---
18	070900Z	23.3N 125.8E	LND RUR	---	---	---	---	---	---	---	---	---	---	---
19	070900Z	23.3N 125.8E	LND RUR	---	---	---	---	---	---	---	---	---	---	---
20	070900Z	23.3N 125.7E	LND RUR	---	---	---	---	---	---	---	---	---	---	---
21	070900Z	23.3N 125.6E	VW-P-----	05	0230M	075	070	973	---	---	CIRC	---	12	06
22	071100Z	23.4N 125.1E	LND RUR	---	---	---	---	---	---	---	---	---	---	---
23	071200Z	23.6N 125.0E	LND RUR	---	---	---	---	---	---	---	---	---	---	---
24	071300Z	23.7N 124.7E	LND RUR	---	---	---	---	---	---	---	---	---	---	---
25	071400Z	23.9N 124.3E	LND RUR	---	---	---	---	---	---	---	---	---	---	---
26	071400Z	24.0N 124.2E	LND RUR	---	---	---	---	---	---	---	---	---	---	---
27	071410Z	23.8N 124.3E	VW-R-----	10	---	---	---	---	---	---	CIRC	---	15	---
28	071500Z	23.9N 124.0E	LND RUR	---	---	---	---	---	---	---	---	---	---	---
29	071600Z	24.1N 123.6E	LND RUR	---	---	---	---	---	---	---	---	---	---	---
30	072000Z	24.5N 122.9E	LND RUR	---	---	---	---	---	---	---	---	---	---	---
31	072110Z	24.6N 122.8E	54-P-----	02	500MH	080	---	965	2796	---	CIRC	---	16	05
32	072200Z	24.7N 122.6E	LND RUR	---	---	---	---	---	---	---	---	---	---	---
33	072300Z	24.8N 122.7E	LND RUR	---	---	---	---	---	---	---	---	---	---	---
34	080200Z	25.4N 122.0E	LND RUR	---	---	---	---	---	---	---	---	---	---	---
35	080200Z	25.2N 122.0E	LND RUR	---	---	---	---	---	---	---	---	---	---	---
36	080200Z	25.4N 122.3E	54-P-----	02	500MH	070	---	962	---	---	CIRC	---	15	05
37	080230Z	25.5N 121.8E	LND RUR	---	---	---	---	---	---	---	---	---	---	---
38	080230Z	25.4N 121.9E	LND RUR	---	---	---	---	---	---	---	---	---	---	---
39	080430Z	25.8N 121.4E	LND RUR	---	---	---	---	---	---	---	---	---	---	---
40	080500Z	25.8N 121.3E	LND RUR	---	---	---	---	---	---	---	---	---	---	---
41	080600Z	25.9N 121.0E	LND RUR	---	---	---	---	---	---	---	---	---	---	---
42	080700Z	26.0N 120.8E	LND RUR	---	---	---	---	---	---	---	---	---	---	---
43	080800Z	26.2N 120.6E	LND RUR	---	---	---	---	---	---	---	---	---	---	---
44	080930Z	26.2N 120.5E	LND RUR	---	---	---	---	---	---	---	---	---	---	---
45	081000Z	26.1N 120.2E	LND RUR	---	---	---	---	---	---	---	---	---	---	---

TYPHOON BETTY

TROPICAL CYCLONE 08 -- 08/05/0500Z TO 08/08/1100Z
POSITION AND FORECAST VERIFICATION DATA

WARN NO.	DTG	WARNING POSIT		BEST TRACK		24 HR FCST		24 HR ERROR		48 HR FCST		48 HR ERROR		72 HR FCST		72 HR ERROR	
		LAT	LONG	LAT	LONG	LAT	LONG	DEG	DIST	LAT	LONG	DEG	DIST	LAT	LONG	DEG	DIST
01	050500Z	14.0N	138.0E	14.0N	138.1E	17.8N	134.9E	-----	-----	20.5N	131.4E	-----	-----	23.0N	126.9E	-----	-----
02	051100Z	15.0N	137.2E	15.2N	137.0E	18.7N	134.0E	-----	-----	21.4N	129.8E	-----	-----	-	-	-----	-----
03	051700Z	16.0N	136.5E	16.4N	135.8E	19.4N	133.0E	-----	-----	22.3N	129.0E	-----	-----	25.0N	125.0E	-----	-----
04	052300Z	17.3N	134.5E	17.4N	134.5E	20.9N	130.1E	-----	-----	24.0N	126.2E	-----	-----	-	-	-----	-----
05	060500Z	18.6N	133.0E	18.4N	133.0E	22.8N	128.4E	108-0108	-----	26.9N	125.6E	-----	-----	31.9N	125.8E	-----	-----
06	061100Z	20.0N	130.7E	19.6N	131.2E	24.2N	125.6E	109-0162	-----	28.4N	122.2E	-----	-----	-	-	-----	-----
07	061700Z	20.6N	129.8E	20.6N	129.6E	24.2N	125.4E	110-0204	-----	27.7N	121.7E	-----	-----	-	-	-----	-----
08	062300Z	21.5N	128.1E	21.6N	128.0E	25.9N	122.5E	110-0120	-----	30.1N	118.0E	-----	-----	-	-	-----	-----
09	070500Z	22.6N	126.5E	22.6N	126.5E	26.7N	120.8E	084-0102	-----	-	-	115-0294	-----	-	-	-----	-----
10	071100Z	23.6N	125.0E	23.5N	125.1E	27.7N	119.4E	030-0048	-----	-	-	116-0282	-----	-	-	-----	-----
11	071700Z	24.6N	123.6E	24.2N	123.6E	28.4N	118.6E	090-0096	-----	-	-	111-0312	-----	-	-	-----	-----
12	072300Z	24.8N	122.4E	24.8N	122.6E	26.6N	117.1E	360-0066	-----	-	-	104-0192	-----	-	-	-----	-----
13	080500Z	25.7N	121.7E	25.7N	121.6E	28.2N	117.9E	325-0072	-----	-	-	072-0222	-----	-	-	119-0330	-----
14	081100Z	26.3N	120.1E	26.3N	120.3E	28.4N	115.9E	330-0096	-----	-	-	038-0156	-----	-	-	-----	-----

AVERAGE 24 HOUR ERROR - 0107 MI.
AVERAGE 48 HOUR ERROR - 0243 MI.
AVERAGE 72 HOUR ERROR - 0330 MI.

TYPHOON CORA - 08/14/2300Z TO 08/23/0500Z

I. DATA

A. STATISTICS

1. NUMBER OF WARNINGS ISSUED - 34
2. NUMBER OF WARNINGS WITH TYPHOON INTENSITY - 15
3. DIATANCE TRAVELED DURING WARNING PERIOD - 2226 MI

B. CHARACTERISTICS AS A TYPHOON

1. MINIMUM OBSERVED SLP - 948 MBS AT 192100Z
2. MINIMUM OBSERVED 700 MB HEIGHT - 2652M AT 200230Z
3. MAXIMUM SURFACE WIND - 085 KTS (FROM BEST TRACK)
4. MAXIMUM RADIUS OF SURFACE CIRCULATION - 330 MI

II. DEVELOPMENT

A. INITIAL IMPETUS - 200 MB ANTICYCLONE OVER THE SURFACE CYCLONE

B. INITIAL SURFACE VORTEX

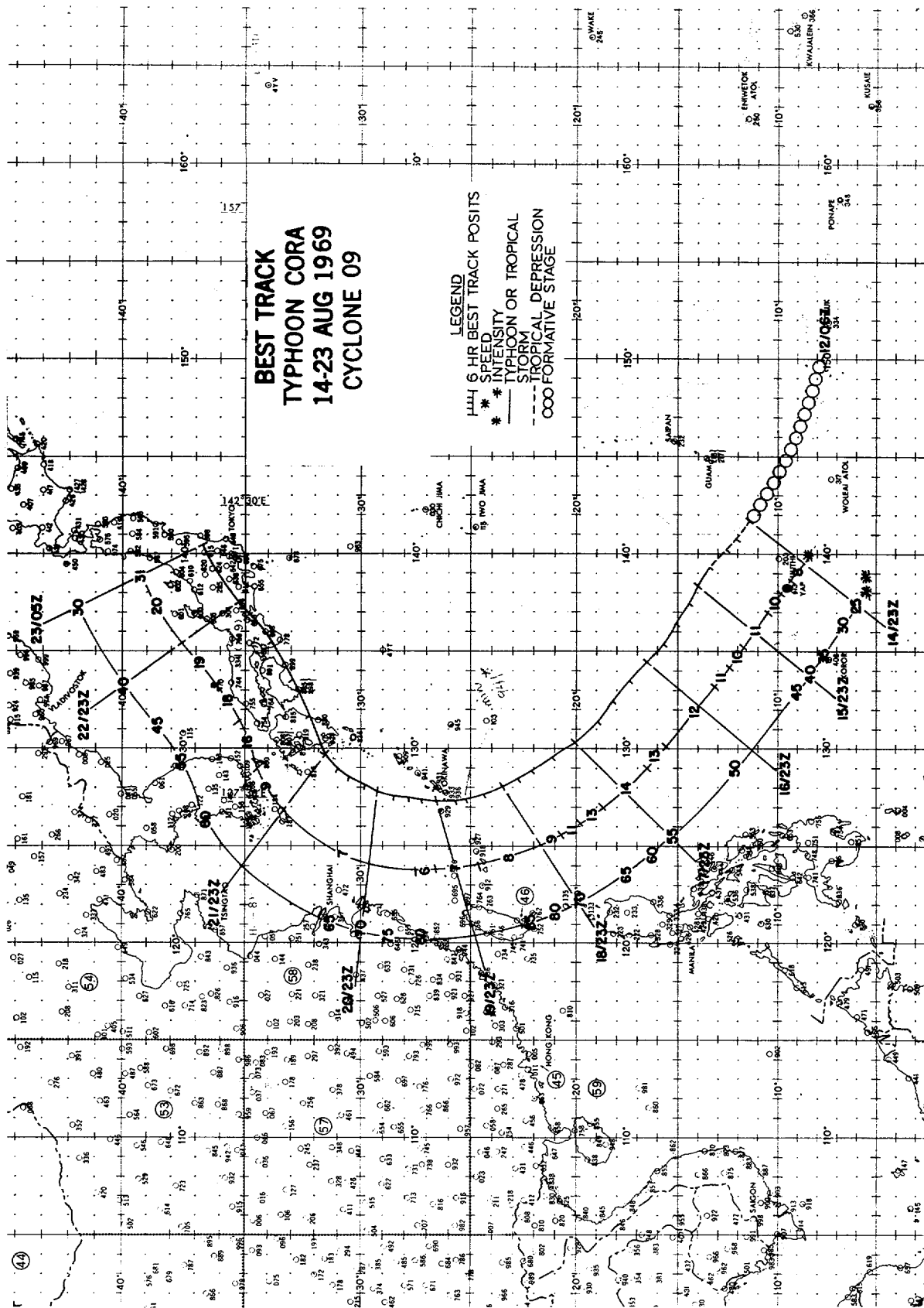
1. JUNCTION VORTEX AT 120600Z
2. SURFACE PRESSURE LESS THAN 1007 MBS

C. 200 MB FLOW ABOVE SURFACE VORTEX

1. INITIAL - SOUTHEAST
2. UPON REACHING TYPHOON INTENSITY - SOUTHEAST

III. FINAL DISPOSITION

A. BECAME EXTRATROPICAL



TYPHOON CORA

TROPICAL CYCLONE 09 -- 08/14/2300Z TO 08/23/0500Z
POSITION AND FORECAST VERIFICATION DATA

WARN NO.	DTG	WARNING POSIT		BEST TRACK		24 HR FCST		24 HR ERROR		48 HR FCST		48 HR ERROR		72 HR FCST		72 HR ERROR	
		LAT	LONG	LAT	LONG	LAT	LONG	DEG	DIST	LAT	LONG	DEG	DIST	LAT	LONG	DEG	DIST
04	151700Z	13.4N	139.1E	13.4N	139.2E	15.9N	134.5E	-----	-----	18.1N	128.4E	-----	-----	20.0N	123.1E	-----	-----
05	152300Z	13.9N	138.5E	14.0N	138.2E	16.1N	135.3E	104-0020	104-0020	18.1N	130.2E	-----	-----	20.0N	123.1E	-----	-----
06	160500Z	14.6N	137.4E	14.5N	137.4E	17.7N	133.0E	236-0072	236-0072	20.1N	126.7E	-----	-----	22.0N	121.1E	-----	-----
07	161100Z	15.1N	136.5E	15.1N	136.4E	17.4N	132.1E	291-0096	291-0096	19.5N	126.2E	-----	-----	22.0N	121.1E	-----	-----
08	161700Z	15.7N	135.2E	15.8N	135.3E	17.9N	130.3E	278-0042	278-0042	20.0N	124.6E	-----	-----	21.9N	119.2E	-----	-----
09	162300Z	16.8N	134.0E	16.6N	134.4E	19.5N	127.9E	122-0054	122-0054	21.4N	122.0E	-----	-----	21.9N	119.2E	-----	-----
10	170500Z	17.2N	133.4E	17.4N	133.5E	19.1N	128.9E	306-0030	306-0030	21.1N	123.3E	-----	-----	23.3N	118.3E	-----	-----
11	171100Z	18.4N	132.2E	18.2N	132.4E	21.0N	127.0E	195-0048	195-0048	22.8N	121.3E	-----	-----	24.4N	115.7E	-----	-----
12	171700Z	19.0N	131.6E	19.0N	131.2E	21.1N	126.8E	217-0078	217-0078	22.8N	121.1E	251-0162	251-0162	24.4N	115.7E	-----	-----
13	172300Z	19.6N	130.0E	20.0N	130.2E	21.4N	124.5E	257-0126	257-0126	23.3N	119.3E	180-0114	180-0114	24.4N	115.7E	-----	-----
14	180500Z	21.0N	129.4E	21.2N	129.5E	24.7N	125.4E	194-0126	194-0126	27.6N	121.5E	248-0168	248-0168	34.2N	127.7E	240-0336	240-0336
15	181100Z	22.0N	128.9E	22.1N	128.9E	25.4N	126.6E	238-0120	238-0120	29.2N	125.2E	224-0216	224-0216	34.2N	127.7E	240-0336	240-0336
16	181700Z	22.6N	128.5E	22.9N	128.4E	26.0N	126.2E	218-0132	218-0132	30.0N	125.0E	231-0270	231-0270	34.2N	127.7E	240-0336	240-0336
17	182300Z	23.6N	127.8E	23.6N	128.1E	27.4N	126.4E	237-0234	237-0234	32.5N	126.8E	249-0360	249-0360	34.2N	127.7E	240-0336	240-0336
18	190500Z	24.4N	127.6E	24.4N	127.7E	27.5N	126.9E	278-0120	278-0120	29.0N	126.8E	231-0306	231-0306	33.0N	127.8E	249-0384	249-0384
19	191100Z	25.0N	127.4E	25.2N	127.4E	26.9N	127.0E	285-0042	285-0042	28.6N	126.9E	247-0360	247-0360	33.0N	127.8E	249-0384	249-0384
20	191700Z	25.8N	127.2E	25.8N	127.3E	27.8N	126.8E	282-0054	282-0054	29.5N	126.7E	243-0384	243-0384	32.2N	127.3E	243-0498	243-0498
21	192300Z	26.2N	127.1E	26.5N	127.2E	27.8N	126.8E	322-0066	322-0066	29.3N	126.7E	247-0468	247-0468	32.2N	127.3E	243-0498	243-0498
22	200500Z	27.1N	127.0E	27.2N	127.2E	30.0N	127.4E	326-0018	326-0018	33.2N	130.5E	274-0300	274-0300	35.5N	137.3E	245-0534	245-0534
23	201100Z	27.9N	127.1E	27.8N	127.3E	30.7N	128.2E	193-0054	193-0054	33.5N	131.8E	307-0132	307-0132	35.5N	137.3E	245-0534	245-0534
24	201700Z	28.3N	127.6E	28.5N	127.5E	31.1N	130.0E	221-0054	221-0054	33.6N	134.2E	305-0150	305-0150	35.7N	140.4E	249-0678	249-0678
25	202300Z	29.1N	127.8E	29.2N	127.8E	31.8N	130.2E	210-0096	210-0096	34.4N	135.0E	346-0198	346-0198	35.7N	140.4E	249-0678	249-0678
26	210500Z	29.7N	128.2E	29.8N	128.1E	32.8N	131.6E	288-0036	288-0036	35.5N	137.8E	234-0078	234-0078	44.0N	145.0E	-----	-----
27	211100Z	30.4N	128.3E	30.5N	128.4E	33.3N	131.2E	333-0012	333-0012	36.0N	137.2E	215-0138	215-0138	44.0N	145.0E	-----	-----
28	211700Z	31.0N	128.8E	31.0N	128.9E	33.7N	131.9E	084-0054	084-0054	36.8N	137.6E	232-0144	232-0144	42.3N	143.0E	342-0198	342-0198
29	212300Z	31.3N	129.6E	31.5N	129.7E	33.6N	136.7E	054-0030	054-0030	39.2N	145.4E	229-0198	229-0198	42.3N	143.0E	342-0198	342-0198
30	220500Z	31.9N	131.5E	32.1N	131.5E	35.8N	139.2E	009-0042	009-0042	42.3N	145.0E	323-0078	323-0078	44.0N	145.0E	286-0192	286-0192
31	221100Z	33.0N	133.3E	33.0N	133.4E	40.0N	140.0E	279-0108	279-0108	-----	-----	291-0078	291-0078	44.0N	145.0E	286-0192	286-0192
32	221700Z	33.7N	135.0E	33.9N	135.4E	39.8N	141.5E	267-0174	267-0174	-----	-----	254-0060	254-0060	44.0N	145.0E	286-0192	286-0192
33	222300Z	35.2N	137.1E	35.2N	137.2E	-----	-----	195-0096	195-0096	-----	-----	247-0114	247-0114	44.0N	145.0E	286-0192	286-0192

AVERAGE 24 HOUR ERROR - 0077 MI.
AVERAGE 48 HOUR ERROR - 0203 MI.
AVERAGE 72 HOUR ERROR - 0405 MI.

TYPHOON DORIS - 08/31/0500Z TO 09/02/0500Z

I. DATA

A. STATISTICS

1. NUMBER OF WARNINGS ISSUED - 09
2. NUMBER OF WARNINGS WITH TYPHOON INTENSITY - 03
3. DISTANCE TRAVELED DURING WARNING PERIOD - 612 MI

B. CHARACTERISTICS AS A TYPHOON

1. MINIMUM OBSERVED SLP - 973 MBS AT 010250Z
2. MINIMUM OBSERVED 700 MB HEIGHT - 2865 M AT 010250Z
3. MAXIMUM SURFACE WIND - 065 KTS (FROM BEST TRACK)
4. MAXIMUM RADIUS OF SURFACE CIRCULATION - 240 MI

II. DEVELOPMENT

A. INITIAL IMPETUS - DEVELOPMENT OF DIVERGENCE AT 200 MB
OVER SURFACE CYCLONIC CIRCULATION

B. INITIAL SURFACE VORTEX

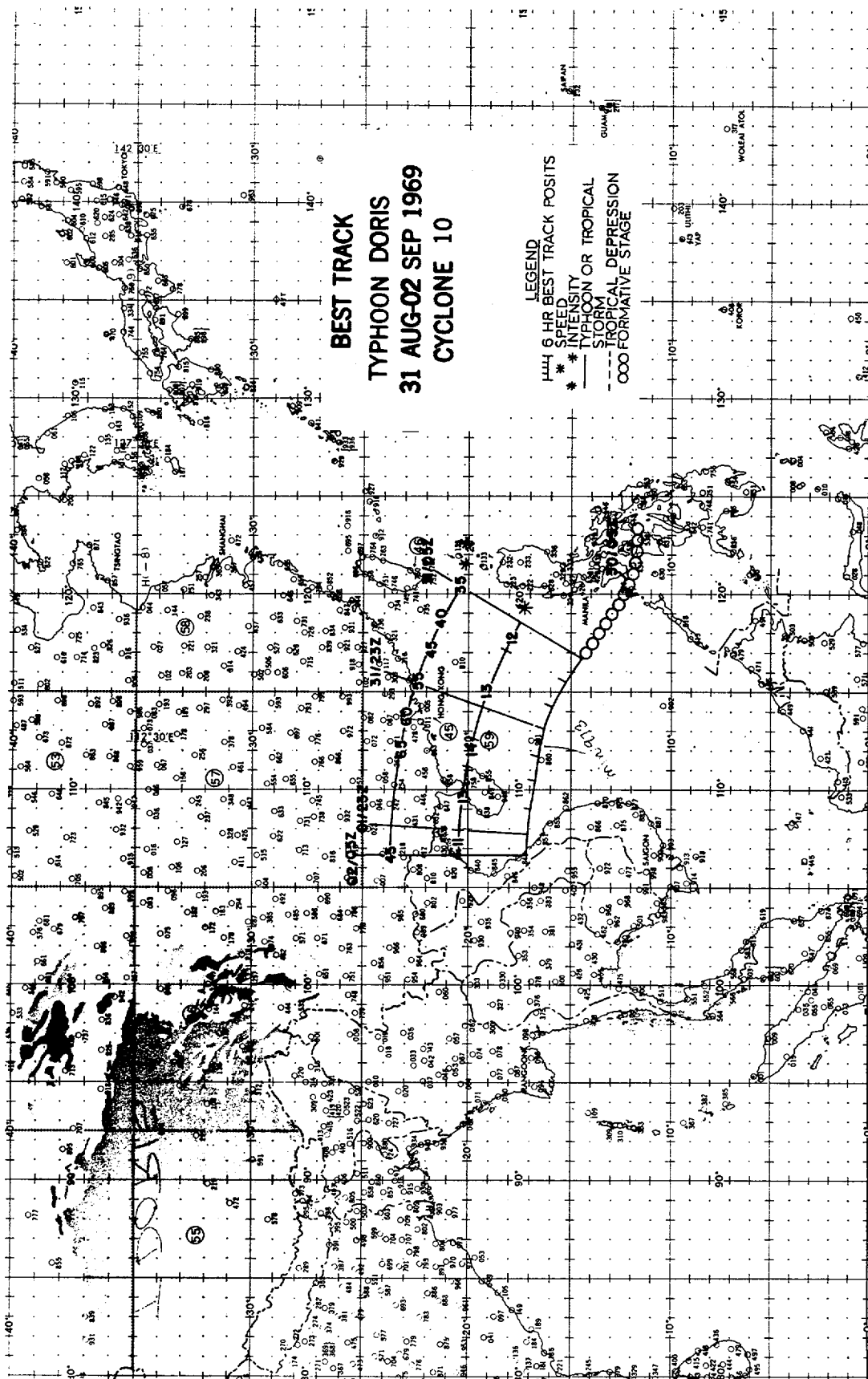
1. INDUCED VORTEX AT 300600Z
2. SURFACE PRESSURE LESS THAN 1006 MBS

C. 200 MB FLOW ABOVE SURFACE VORTEX

1. INITIAL - NORTHEAST
2. UPON REACHING TYPHOON INTENSITY - NORTHEAST

III. FINAL DISPOSITION

A. DISSIPATED OVER LAND



FIX NO.	TIME	POSIT	EYE FIXES CYCLONE				OBS SFC WND	OBS MIN SLP	MIN 700MB HGT	FLT LVL TT/TO	EYE FORM	ORIENTATION	EYE DIA	THKNS WALL CLOUD	
			UNIT-METHOU	FLY LVL	STG C	FLY LVL									
1	300543Z	12.0N 121.0E	SLTSL	---	STG C	050	---	---	3011	12/12	---	---	---	N.F.B.	
2	310445Z	14.6N 116.7E	54-P	---	700MH	---	---	---	---	---	---	---	---	---	
3	310637Z	14.5N 117.0E	SLTSL	---	STG C	---	---	---	---	---	---	---	---	---	
4	311536Z	16.1N 114.2E	VW-R	---	---	---	---	---	---	---	---	---	---	---	
5	311626Z	15.9N 114.2E	VW-P	---	700MH	---	---	995	3055	11/09	CIRC	---	30	---	
6	312020Z	16.2N 113.6E	54-P	---	700MH	031	---	981	2935	15/12	---	---	---	F.B.	
7	010250Z	16.6N 112.0E	54-P	---	700MH	065	045	973	2865	16/12	---	---	---	F.B.	
8	010740Z	17.0N 111.0E	SLTSL	---	STG X	---	---	---	---	---	---	---	---	---	
9	010910Z	16.6N 110.8E	VW-R	---	700MH	---	---	---	---	---	CIRC	---	16	---	
10	010935Z	16.7N 110.5E	LND RDR	---	---	---	---	---	---	---	CIRC	---	30	---	
11	011035Z	16.8N 110.3E	LND RDR	---	---	---	---	---	---	---	CIRC	---	24	---	
12	011205Z	16.9N 110.1E	VW-R	---	700MH	---	---	---	---	---	CIRC	---	17	---	
13	011245Z	16.8N 110.0E	LND RDR	---	---	---	---	---	---	---	CIRC	---	24	---	
14	011335Z	16.9N 109.8E	LND RDR	---	---	---	---	---	---	---	CIRC	---	20	---	
15	011400Z	16.9N 109.8E	VW-R	---	700MH	---	---	---	---	---	CIRC	---	16	---	
16	011435Z	16.7N 109.6E	LND RDR	---	---	---	---	---	---	---	CIRC	---	18	---	
17	011535Z	17.0N 109.3E	LND RDR	---	---	---	---	---	---	---	CIRC	---	20	---	
18	011635Z	17.0N 109.1E	LND RDR	---	---	---	---	---	---	---	CIRC	---	16	---	
19	011735Z	17.1N 108.9E	LND RDR	---	---	---	---	---	---	---	CIRC	---	20	---	
20	011135Z	17.1N 110.0E	LND RDR	---	---	---	---	---	---	---	CIRC	---	12	---	
21	011835Z	17.1N 108.7E	LND RDR	---	---	---	---	---	---	---	---	---	---	---	
22	011935Z	17.2N 108.4E	LND RDR	---	---	---	---	---	---	---	---	---	---	---	
23	012035Z	17.2N 108.2E	LND RDR	---	---	---	---	---	---	---	---	---	---	---	
24	012135Z	17.2N 108.0E	LND RDR	---	---	---	---	---	---	---	---	---	---	---	
25	012235Z	17.1N 107.8E	LND RDR	---	---	---	---	---	---	---	CIRC	---	05	---	
26	012335Z	17.0N 107.6E	LND RDR	---	---	---	---	---	---	---	CIRC	---	03	---	
27	020035Z	16.9N 107.5E	LND RDR	---	---	---	---	---	---	---	---	---	---	---	
28	020135Z	17.0N 107.2E	LND RDR	---	---	---	---	---	---	---	---	---	---	---	
29	020230Z	17.0N 107.0E	LND RDR	---	---	---	---	---	---	---	---	---	---	---	

TYPHOON DORIS

TROPICAL CYCLONE 10 -- 08/31/0500Z TO 09/02/0500Z
POSITION AND FORECAST VERIFICATION DATA

WARN NO.	DTG	WARNING POSIT		BEST TRACK		24 HR FCST		24 HR ERROR		48 HR FCST		48 HR ERROR		72 HR FCST		72 HR ERROR	
		LAT	LONG	LAT	LONG	LAT	LONG	DEG	DIST	LAT	LONG	DEG	DIST	LAT	LONG	DEG	DIST
01	310500Z	14.6N	116.6E	14.6N	116.6E	16.2N	112.0E	-----	-----	17.7N	107.4E	-----	-----	-	-	-----	-----
02	311100Z	15.0N	115.6E	15.3N	115.5E	16.5N	110.9E	-----	-----	18.2N	106.3E	-----	-----	-	-	-----	-----
03	311700Z	15.9N	114.0E	15.9N	114.3E	17.8N	109.7E	-----	-----	19.3N	106.5E	-----	-----	-	-	-----	-----
04	312300Z	16.4N	113.1E	16.4N	113.1E	18.7N	108.7E	-----	-----	21.0N	104.2E	-----	-----	-	-	-----	-----
05	010500Z	16.8N	111.5E	16.5N	111.6E	18.6N	106.4E	134-0024	-----	-	-	-----	-----	-	-	-----	-----
06	011100Z	16.8N	110.3E	16.7N	110.3E	17.4N	105.8E	111-0030	-----	-	-	-----	-----	-	-	-----	-----
07	011700Z	17.0N	108.9E	17.0N	109.0E	-	-	037-0060	-----	-	-	-----	-----	-	-	-----	-----
08	012300Z	17.2N	107.6E	17.0N	107.7E	-	-	028-0114	-----	-	-	-----	-----	-	-	-----	-----
09	020500Z	17.0N	106.6E	17.1N	106.7E	-	-	352-0090	-----	-	-	046-0048	-----	-	-	-----	-----

AVERAGE 24 HOUR ERROR - 0063 MI.
AVERAGE 48 HOUR ERROR - 0048 MI.
AVERAGE 72 HOUR ERROR - ----- MI.

TYPHOON ELSIE - 09/19/0500Z TO 09/27/1100Z

I. DATA

A. STATISTICS

1. NUMBER OF WARNINGS ISSUED - 34
2. NUMBER OF WARNINGS WITH TYPHOON INTENSITY - 26
3. DISTANCE TRAVELED DURING WARNING PERIOD - 2760 MI

B. CHARACTERISTICS AS A TYPHOON

1. MINIMUM OBSERVED SLP - 890 MBS AT 240300Z
2. MINIMUM OBSERVED 700 MB HEIGHT - 2140 M AT 240300Z
3. MAXIMUM SURFACE WIND - 150 KTS (FROM BEST TRACK)
4. MAXIMUM RADIUS OF SURFACE CIRCULATION - 600 MI

II. DEVELOPMENT

A. INITIAL IMPETUS - DEVELOPMENT OF DIVERGENCE AT 200 MB
OVER SURFACE CYCLONIC CIRCULATION

B. INITIAL SURFACE VORTEX

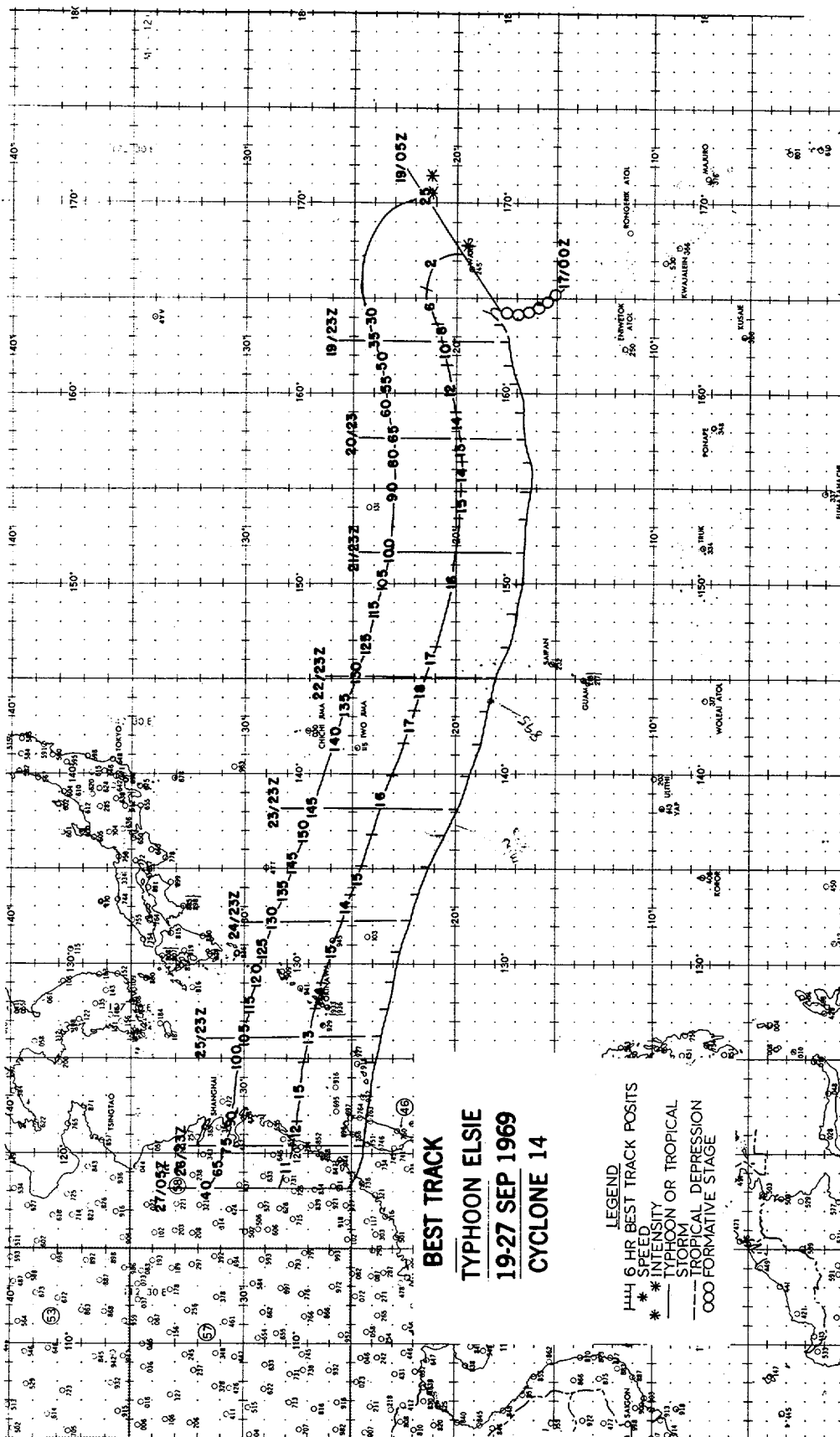
1. EMBEDDED VORTEX AT 170000Z
2. SURFACE PRESSURE LESS THAN 1006 MBS

C. 200 MB FLOW ABOVE SURFACE VORTEX

1. INITIAL - VARIABLE
2. UPON REACHING TYPHOON INTENSITY - EAST

III. FINAL DISPOSITION

A. DISSIPATED OVER LAND



FIX NO.	TIME	EYE FIXES CYCLONE										I4				EYE FORM	ORIGIN- TATION	EYE DIA	HMS ALL CLOUD
		UNII- METHOD	ACCY	FLT	LVL	FLT	LVL	FLT	LVL	FLT	LVL	UWS	SFC	MIN	SLP				
1	170211Z	SLTLS		STG B	U1A	STG B	U1A	STG B	U1A	STG B	U1A	045	045	979		---	---	---	---
2	180310Z	SLTLS		STG B	U1A	STG B	U1A	STG B	U1A	STG B	U1A	045	045	999		---	---	---	F.B.
3	180445Z	54-P	---	0430M	020	0430M	020	0430M	020	0430M	020	015	015	999		---	---	---	F.B.
4	190358Z	54-P	---	0460M	032	0460M	032	0460M	032	0460M	032	025	025	998		---	---	---	
5	190409Z	SLTLS		STG C	U1A	STG C	U1A	STG C	U1A	STG C	U1A	045	045	994		---	---	---	
6	192045Z	54-P	---	0460M	035	0460M	035	0460M	035	0460M	035	040	040	994		---	---	---	
7	200230Z	54-P	---	0460M	052	0460M	052	0460M	052	0460M	052	065	065	984		---	---	---	
8	200312Z	SLTLS		STG C	U1A	STG C	U1A	STG C	U1A	STG C	U1A	045	045	979		---	---	---	
9	200928Z	54-P	---	0460M	030	0460M	030	0460M	030	0460M	030	045	045	979		---	---	---	10
10	201435Z	54-P	---	0460M	055	0460M	055	0460M	055	0460M	055	065	065	974		---	---	---	
11	202130Z	54-P	---	0460M	070	0460M	070	0460M	070	0460M	070	065	065	971		---	---	---	
12	210245Z	54-P	---	0460M	070	0460M	070	0460M	070	0460M	070	080	080	960		---	---	---	
13	210411Z	SLTLS		STG X	U1A	STG X	U1A	STG X	U1A	STG X	U1A	045	045	979		---	---	---	
14	210929Z	54-P	---	0460M	030	0460M	030	0460M	030	0460M	030	045	045	979		---	---	---	10
15	211400Z	54-P	---	0460M	055	0460M	055	0460M	055	0460M	055	065	065	974		---	---	---	
16	212100Z	54-P	---	0460M	070	0460M	070	0460M	070	0460M	070	080	080	960		---	---	---	
17	220300Z	54-P	---	0460M	030	0460M	030	0460M	030	0460M	030	045	045	979		---	---	---	
18	220314Z	54-P	---	0460M	055	0460M	055	0460M	055	0460M	055	065	065	974		---	---	---	
19	220850Z	54-P	---	0460M	070	0460M	070	0460M	070	0460M	070	080	080	960		---	---	---	
20	220903Z	SLTLS		STG X	U1A	STG X	U1A	STG X	U1A	STG X	U1A	045	045	979		---	---	---	
21	221132Z	54-P	---	0460M	030	0460M	030	0460M	030	0460M	030	045	045	979		---	---	---	
22	221450Z	54-P	---	0460M	055	0460M	055	0460M	055	0460M	055	065	065	974		---	---	---	
23	222100Z	54-P	---	0460M	070	0460M	070	0460M	070	0460M	070	080	080	960		---	---	---	
24	230015Z	54-P	---	0460M	030	0460M	030	0460M	030	0460M	030	045	045	979		---	---	---	
25	230245Z	54-P	---	0460M	055	0460M	055	0460M	055	0460M	055	065	065	974		---	---	---	
26	230413Z	54-P	---	0460M	070	0460M	070	0460M	070	0460M	070	080	080	960		---	---	---	
27	230800Z	SLTLS		STG X	U1A	STG X	U1A	STG X	U1A	STG X	U1A	045	045	979		---	---	---	
28	230840Z	54-P	---	0460M	030	0460M	030	0460M	030	0460M	030	045	045	979		---	---	---	
29	231210Z	54-P	---	0460M	055	0460M	055	0460M	055	0460M	055	065	065	974		---	---	---	
30	231442Z	54-P	---	0460M	070	0460M	070	0460M	070	0460M	070	080	080	960		---	---	---	
31	232115Z	54-P	---	0460M	030	0460M	030	0460M	030	0460M	030	045	045	979		---	---	---	
32	240300Z	54-P	---	0460M	055	0460M	055	0460M	055	0460M	055	065	065	974		---	---	---	
33	240511Z	54-P	---	0460M	070	0460M	070	0460M	070	0460M	070	080	080	960		---	---	---	
34	240920Z	SLTLS		STG X	U1A	STG X	U1A	STG X	U1A	STG X	U1A	045	045	979		---	---	---	
35	241207Z	54-P	---	0460M	030	0460M	030	0460M	030	0460M	030	045	045	979		---	---	---	
36	241405Z	54-P	---	0460M	055	0460M	055	0460M	055	0460M	055	065	065	974		---	---	---	
37	242150Z	54-P	---	0460M	070	0460M	070	0460M	070	0460M	070	080	080	960		---	---	---	
38	250000Z	54-P	---	0460M	030	0460M	030	0460M	030	0460M	030	045	045	979		---	---	---	
39	250215Z	54-P	---	0460M	055	0460M	055	0460M	055	0460M	055	065	065	974		---	---	---	
40	250610Z	54-P	---	0460M	070	0460M	070	0460M	070	0460M	070	080	080	960		---	---	---	
41	250840Z	SLTLS		STG X	U1A	STG X	U1A	STG X	U1A	STG X	U1A	045	045	979		---	---	---	
42	250930Z	54-P	---	0460M	030	0460M	030	0460M	030	0460M	030	045	045	979		---	---	---	
43	251045Z	54-P	---	0460M	055	0460M	055	0460M	055	0460M	055	065	065	974		---	---	---	
44	251130Z	54-P	---	0460M	070	0460M	070	0460M	070	0460M	070	080	080	960		---	---	---	
45	251141Z	54-P	---	0460M	030	0460M	030	0460M	030	0460M	030	045	045	979		---	---	---	
46	251455Z	54-P	---	0460M	055	0460M	055	0460M	055	0460M	055	065	065	974		---	---	---	
47	252045Z	54-P	---	0460M	070	0460M	070	0460M	070	0460M	070	080	080	960		---	---	---	
48	252340Z	54-P	---	0460M	030	0460M	030	0460M	030	0460M	030	045	045	979		---	---	---	

FIX NO.	TIME	POSIT	UNIT-METHOD-ACCY	FLT LVL	700MB	FLT LVL	OBS MIN SLP	MILE HGT	FLT TT/10	EYE FORM	ORIENTATION	EYE DIA	THIN WALL CLOUD
49	260100Z	23.6N 125.8E	LND MUR	---	---	---	---	---	---/---	---	---	---	---
50	260200Z	23.6N 125.8E	54-P-----0H	700MB	095	---	923	2426	19/14	CIRC	---	30	---
51	260400Z	23.5N 125.0E	LND MUR	---	---	---	---	---	---/---	---	---	---	---
52	260514Z	23.5N 124.0E	SLOTS	SIG X	UJA 05	BWVS 4	---	---	---	---	---	---	---
53	260515Z	23.7N 124.3E	LND MUR	---	---	---	---	---	---/---	---	---	---	---
54	260600Z	23.6N 124.5E	LND MUR	---	---	---	---	---	---/---	---	---	---	---
55	260800Z	23.7N 124.2E	LND MUR	---	---	---	---	---	---/---	---	---	---	---
56	260800Z	23.8N 124.1E	LND MUR	---	---	---	---	---	---/---	---	---	---	---
57	260805Z	23.9N 124.2E	VW-R-----05	---	---	085	---	---	---/---	CIRC	---	30	---
58	260930Z	23.9N 123.5E	LND MUR	---	---	---	---	---	---/---	---	NE-SW	45X25	---
59	261140Z	23.9N 123.2E	VW-R-----05	---	---	---	---	---	---/---	ELLIP	---	40	---
60	261248Z	24.0N 122.8E	VW-R-----	---	---	---	---	---	---/---	CIRC	---	---	---
61	261340Z	24.2N 122.8E	LND MUR	---	---	---	---	---	---/---	---	---	20	15
62	261457Z	24.0N 122.2E	VW-R-----03	---	---	095	---	---	---/---	CIRC	---	---	---
63	261800Z	24.0N 120.7E	LND MUR	---	---	---	---	---	---/---	---	---	---	---
64	261830Z	23.8N 120.5E	LND MUR	---	---	---	---	---	---/---	---	---	---	---
65	261900Z	23.7N 119.8E	LND MUR	---	---	---	---	---	---/---	---	---	---	---
66	262000Z	23.7N 120.3E	LND MUR	---	---	---	---	---	---/---	---	---	---	---
67	262100Z	23.6N 120.3E	LND MUR	---	---	---	---	---	---/---	---	---	---	---
68	262110Z	24.0N 120.2E	54-P-----30	7290.0	035	---	---	---	59/59	---	---	---	---
69	270530Z	24.5N 119.1E	LND MUR	---	---	---	---	---	---/---	---	---	---	---

TYPHOON ELSIE

TROPICAL CYCLONE 14 -- 09/19/1100Z TO 09/19/0500Z
POSITION AND FORECAST VERIFICATION DATA

WARN NO.	DTG	WARNING POSIT		BEST TRACK		24 HR FCST		24 HR ERROR		48 HR FCST		48 HR ERROR		72 HR FCST		72 HR ERROR	
		LAT	LONG	LAT	LONG	LAT	LONG	DEG	DIST	LAT	LONG	DEG	DIST	LAT	LONG	DEG	DIST
04	192300Z	17.5N	163.3E	17.4N	162.7E	18.2N	161.8E	-	-	-	-	-	-	-	-	-	-
05	200500Z	17.7N	161.4E	17.3N	161.5E	19.3N	159.8E	-	-	20.9N	159.5E	-	-	22.9N	159.7E	-	-
06	201100Z	16.9N	161.5E	16.8N	160.4E	18.0N	161.0E	051-0222	-	18.8N	160.1E	-	-	-	-	-	-
07	201700Z	16.7N	159.2E	16.7N	159.0E	16.5N	155.0E	059-0364	-	16.4N	150.9E	-	-	16.5N	146.7E	-	-
08	202300Z	16.6N	157.5E	16.6N	157.6E	16.5N	151.3E	069-0258	-	16.8N	145.9E	-	-	-	-	-	-
09	210500Z	16.4N	156.3E	16.3N	156.3E	16.4N	150.5E	048-0264	-	16.8N	145.8E	-	-	16.9N	140.1E	-	-
10	211100Z	16.2N	154.1E	16.3N	154.9E	16.7N	147.6E	074-0360	-	16.9N	141.5E	-	-	-	-	-	-
11	211700Z	16.4N	153.0E	16.5N	153.3E	16.7N	146.6E	090-0096	-	16.5N	140.4E	-	-	16.2N	133.8E	-	-
12	212300Z	16.5N	151.8E	16.5N	151.7E	16.7N	146.4E	270-0018	-	16.5N	140.8E	-	-	-	-	-	-
13	220500Z	16.6N	150.1E	16.7N	150.0E	16.8N	144.2E	126-0030	-	17.5N	138.4E	065-0594	-	18.9N	133.1E	-	-
14	221100Z	16.9N	148.4E	16.9N	148.4E	17.8N	142.2E	255-0042	-	18.7N	136.0E	081-0672	-	-	-	-	-
15	221700Z	17.1N	146.7E	17.3N	139.9E	17.9N	139.9E	180-0036	-	19.0N	133.2E	102-0246	-	20.0N	126.6E	-	-
16	222300Z	18.1N	144.9E	18.0N	145.1E	20.5N	138.1E	137-0102	-	23.8N	132.8E	149-0078	-	-	-	-	-
17	230500Z	18.3N	143.4E	18.3N	143.2E	19.5N	137.1E	149-0102	-	20.4N	130.9E	122-0168	-	21.4N	124.5E	074-0966	-
18	231100Z	18.6N	141.5E	18.7N	141.5E	19.6N	134.9E	146-0060	-	20.5N	128.2E	180-0108	-	-	-	-	-
19	231700Z	19.3N	140.0E	19.3N	139.9E	20.9N	133.7E	180-0084	-	22.6N	127.2E	171-0168	-	24.2N	120.8E	113-0414	-
20	232300Z	19.8N	138.1E	19.8N	138.2E	21.0N	131.2E	360-0042	-	21.6N	124.4E	143-0240	-	-	-	-	-
21	240500Z	20.3N	136.6E	20.4N	136.7E	21.6N	130.0E	161-0054	-	22.0N	123.2E	151-0198	-	22.0N	116.3E	137-0282	-
22	241100Z	21.1N	135.0E	21.1N	135.1E	23.1N	128.2E	184-0090	-	23.5N	121.1E	161-0150	-	-	-	-	-
23	241700Z	21.8N	133.8E	21.7N	133.6E	23.2N	128.5E	172-0048	-	23.5N	122.0E	187-0162	-	23.5N	115.5E	177-0330	-
24	242300Z	22.2N	132.1E	22.1N	132.2E	23.5N	125.8E	220-0084	-	23.5N	119.3E	017-0102	-	-	-	-	-
25	250500Z	22.7N	130.8E	22.6N	130.6E	24.5N	125.8E	207-0066	-	25.4N	120.4E	174-0132	-	26.2N	115.0E	148-0258	-
26	251100Z	22.7N	129.6E	22.8N	129.0E	23.2N	123.7E	293-0042	-	23.7N	117.6E	197-0144	-	-	-	-	-
27	251700Z	22.9N	128.0E	23.2N	127.6E	23.3N	122.4E	090-0040	-	23.7N	116.7E	207-0036	-	-	-	196-0198	-
28	252300Z	23.4N	126.3E	23.5N	126.2E	24.2N	120.2E	270-0018	-	24.9N	114.8E	221-0144	-	-	-	-	-
29	260500Z	23.7N	124.8E	23.8N	124.8E	24.6N	118.8E	053-0066	-	25.5N	113.5E	218-0132	-	-	-	185-0144	-
30	261100Z	23.9N	123.5E	24.1N	123.2E	24.8N	117.6E	156-0054	-	25.5N	113.3E	253-0114	-	-	-	-	-
31	261700Z	24.2N	121.8E	24.3N	121.5E	25.0N	116.5E	141-0072	-	25.6N	112.2E	153-0048	-	-	-	261-0036	-
32	262300Z	24.4N	119.7E	24.3N	120.3E	25.1N	114.5E	180-0006	-	-	-	229-0072	-	-	-	-	-
33	270500Z	24.5N	119.4E	24.6N	119.1E	25.4N	117.4E	270-0012	-	27.5N	116.1E	054-0078	-	-	-	224-0216	-
34	271100Z	24.8N	118.1E	25.2N	118.1E	-	-	226-0030	-	-	-	195-0090	-	-	-	-	-

AVERAGE 24 HOUR ERROR - 0092 MI.
AVERAGE 48 HOUR ERROR - 0176 MI.
AVERAGE 72 HOUR ERROR - 0316 MI.

TYPHOON GRACE - 09/29/2300Z TO 10/06/2300Z

I. DATA

A. STATISTICS

1. NUMBER OF WARNINGS ISSUED - 29
2. NUMBER OF WARNINGS WITH TYPHOON INTENSITY - 21
3. DISTANCE TRAVELED DURING WARNING PERIOD - 2172 MI

B. CHARACTERISTICS AS A TYPHOON

1. MINIMUM OBSERVED SLP - 937 MBS AT 032130Z
2. MINIMUM OBSERVED 700 MB HEIGHT - 2548 M AT 032130Z
3. MAXIMUM SURFACE WIND - 095 KTS (FROM BEST TRACK)
4. MAXIMUM RADIUS OF SURFACE CIRCULATION - 300 MI

II. DEVELOPMENT

A. INITIAL IMPETUS - A COLD CORE LOW BECOMING WARM CORE
AFTER DEVELOPMENT OF DIVERGENCE AT 200 MB

B. INITIAL SURFACE VORTEX

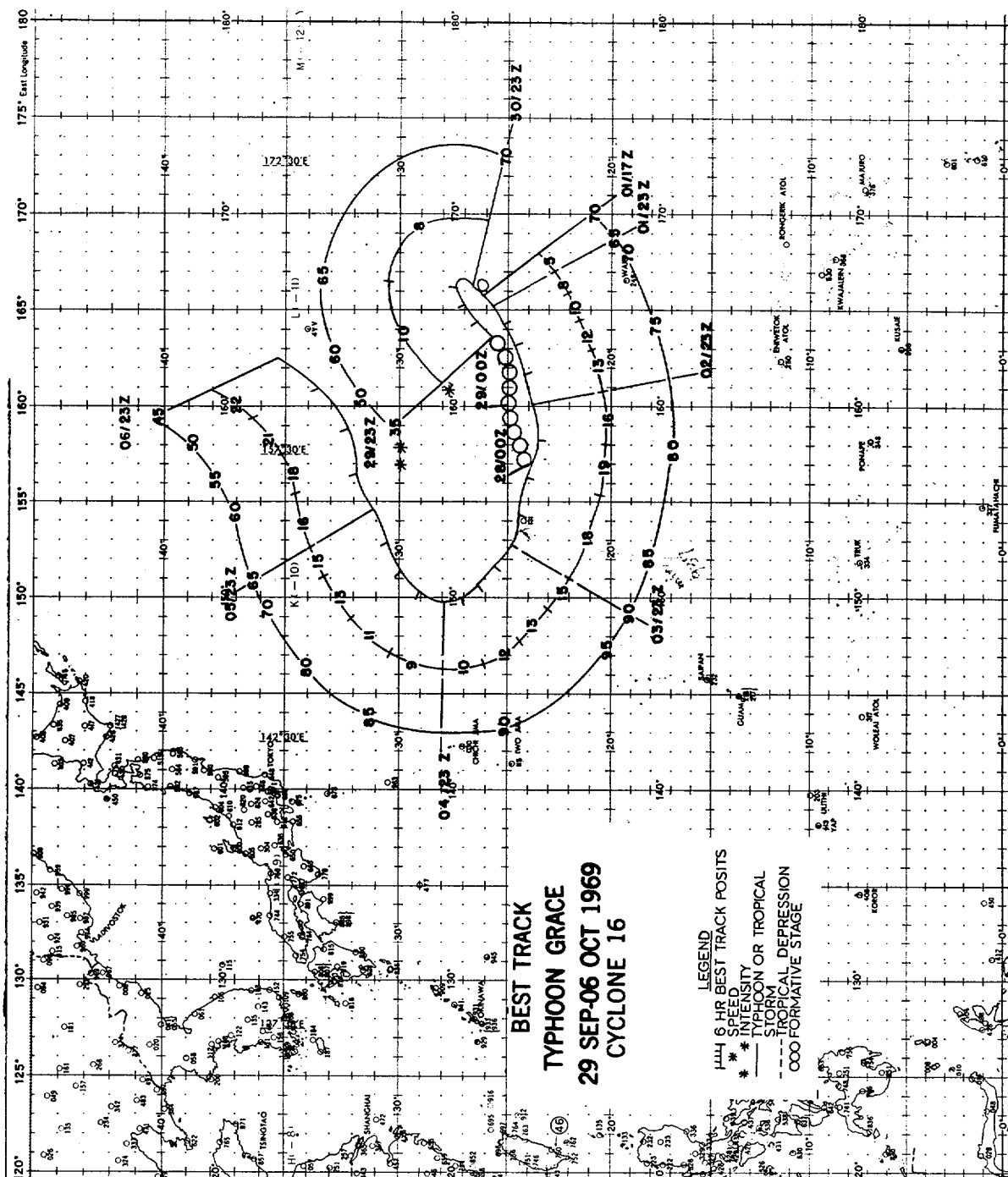
1. COLD VORTEX AT 280000Z
2. SURFACE PRESSURE LESS THAN 1012 MBS

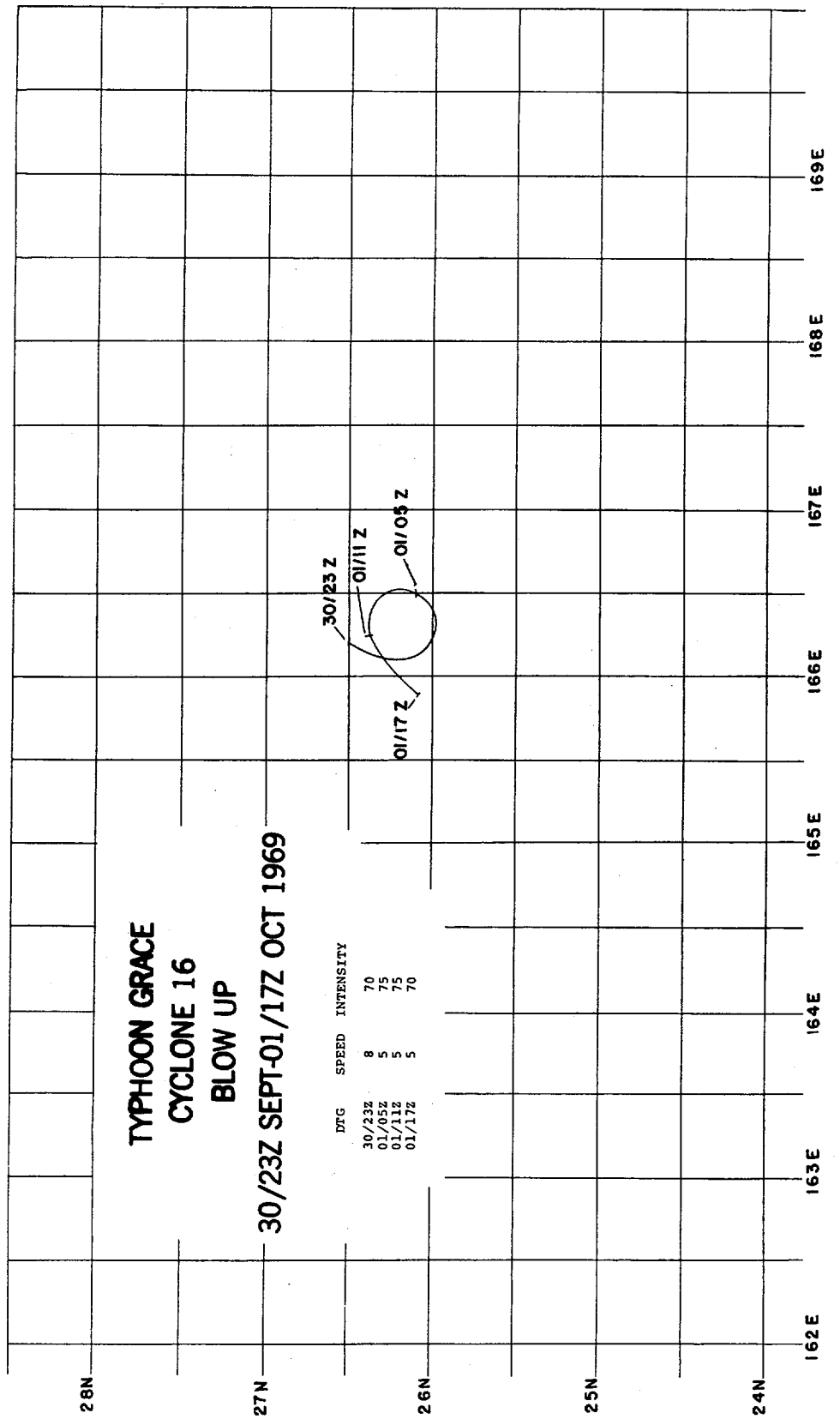
C. 200 MB FLOW ABOVE SURFACE VORTEX

1. INITIAL - VARIABLE
2. UPON REACHING TYPHOON INTENSITY - ANTICYCLONIC

III. FINAL DISPOSITION

A. BECAME EXTRATROPICAL





FIX NO.	TIME	EYE FIXES CYCLONE										16				FLIP	EYE FORM	ORIENT- TATION	EYE DIA	WALL CLOUD
		UNIT- METHUD -ACCY	FLT LVL	FLT LVL	FLT LVL	FLT LVL	FLT LVL	FLT LVL	FLT LVL	FLT LVL	FLT LVL	GPS SFC	OBS MIN	MIN HGT	MIN HGT					
1	170211Z	SLTSL	14.0N 181.0E	STG B	DIA	--	BNDS	--	--	--	--	--	--	--	--	--	--	--	--	--
2	170211Z	SLTSL	14.0N 181.0E	STG B	DIA	--	BNDS	--	--	--	--	--	--	--	--	--	--	--	--	--
3	180105Z	54-P----	14.2N 177.8E	0450M	042	030	998	--	--	--	--	--	--	--	--	26/24	---	---	N.F.B.	N.F.B.
4	180310Z	SLTSL	14.0N 178.0E	STG C	DIA	--	BNDS	--	--	--	--	--	--	--	--	--	---	---	--	--
5	190015Z	54-P----	13.8N 175.8E	0430M	012	015	004	--	--	--	--	--	--	--	--	25/24	---	---	--	N.F.B.
6	220314Z	SLTSL	15.0N 169.0E	STG B	DIA	--	BNDS	--	--	--	--	--	--	--	--	--	---	---	--	--
7	230217Z	SLTSL	16.0N 169.0E	STG C	DIA	--	BNDS	--	--	--	--	--	--	--	--	--	---	---	--	--
8	240316Z	SLTSL	18.0N 165.0E	STG B	DIA	--	BNDS	--	--	--	--	--	--	--	--	--	---	---	--	--
9	250415Z	SLTSL	20.0N 160.5E	STG C	DIA	--	BNDS	--	--	--	--	--	--	--	--	--	---	---	--	--
10	260318Z	SLTSL	20.0N 155.0E	STG B	DIA	--	BNDS	--	--	--	--	--	--	--	--	--	---	---	--	--
11	270220Z	SLTSL	25.0N 160.0E	STG B	DIA	--	BNDS	--	--	--	--	--	--	--	--	--	---	---	--	--
12	280320Z	SLTSL	25.0N 161.0E	STG B	DIA	--	BNDS	--	--	--	--	--	--	--	--	--	---	---	--	--
13	290228Z	SLTSL	26.0N 163.0E	STG B	DIA	--	BNDS	--	--	--	--	--	--	--	--	--	---	---	--	--
14	300322Z	SLTSL	26.0N 164.0E	STG X	DIA	02	BNDS	3	--	--	--	--	--	--	--	--	---	---	--	--
15	302129Z	54-P----	26.6N 166.3E	700MH	090	070	971	--	--	--	--	--	--	2756	18/12	ELIP	N-S	15X10	--	--
16	010226Z	SLTSL	27.0N 166.5E	STG X	DIA	03	BNDS	3	--	--	--	--	--	2704	16/10	CIRC	---	12	--	--
17	010245Z	54-P----	26.2N 166.4E	700MH	090	080	953	--	--	--	--	--	--	2704	16/10	CIRC	---	12	--	--
18	010800Z	VW-R----	26.3N 166.3E	15	--	--	--	--	--	--	--	--	--	---	---	---	---	---	--	--
19	010830Z	VW-R----	26.4N 166.6E	10	--	--	--	--	--	--	--	--	--	---	---	---	---	---	18	13
20	012100Z	54-P----	25.9N 165.7E	700MH	075	070	967	--	--	--	--	--	--	2813	22/14	CIRC	---	20	--	--
21	020255Z	54-P----	25.4N 164.7E	700MH	095	090	985	--	--	--	--	--	--	2801	21/12	CIRC	---	15	--	--
22	020325Z	SLTSL	25.5N 164.5E	STG -	DIA	--	BNDS	--	--	--	--	--	--	---	---	---	---	---	--	--
23	021000Z	VW-R----	24.5N 163.2E	20	--	--	--	--	--	--	--	--	--	---	---	---	---	---	--	--
24	021200Z	VW-P----	24.5N 162.8E	700MH	080	--	958	--	--	--	--	--	--	2838	20/14	CIRC	---	25	--	--
25	022005Z	54-P----	24.1N 160.9E	700MH	071	080	958	--	--	--	--	--	--	2749	20/12	CIRC	---	15	--	--
26	030245Z	54-P----	23.4N 158.7E	700MH	080	085	952	--	--	--	--	--	--	2731	26/16	CIRC	---	15	10	10
27	030423Z	SLTSL	24.0N 158.0E	STG -	DIA	--	BNDS	--	--	--	--	--	--	---	---	---	---	---	15	10
28	030900Z	VW-R----	24.1N 156.3E	07	--	--	--	--	--	--	--	--	--	---	---	CIRC	---	17	12	12
29	031200Z	VW-R----	24.4N 155.4E	10	--	--	--	--	--	--	--	--	--	---	---	CIRC	---	17	12	12
30	031400Z	VW-R----	24.7N 154.2E	05	--	--	--	--	--	--	--	--	--	---	---	CIRC	---	20	--	--
31	032130Z	54-P----	24.4N 153.2E	700MH	085	090	937	--	--	--	--	--	--	2548	16/09	CIRC	---	30	04	04
32	040254Z	54-P----	25.2N 152.2E	10	--	--	--	--	--	--	--	--	--	2624	24/16	CIRC	---	---	--	--
33	040327Z	SLTSL	25.5N 152.0E	STG X	DIA	03	BNDS	4	--	--	--	--	--	---	---	---	---	---	---	---
34	040900Z	VW-R----	26.2N 150.9E	05	--	--	--	--	--	--	--	--	--	---	---	---	---	---	---	---
35	041455Z	VW-R----	26.3N 150.6E	05	--	--	--	--	--	--	--	--	--	---	---	CIRC	---	20	12	12
36	042100Z	54-P----	27.6N 149.9E	12	--	--	--	--	--	--	--	--	--	2600	20/14	CIRC	---	15	--	--
37	050205Z	54-P----	28.5N 149.9E	20	--	--	--	--	--	--	--	--	--	2621	16/12	CIRC	---	15	--	--
38	050426Z	SLTSL	29.0N 150.5E	STG X	DIA	03	BNDS	3	--	--	--	--	--	---	---	---	---	---	---	---
39	051000Z	VW-R----	29.9N 151.1E	05	--	--	--	--	--	--	--	--	--	---	---	---	---	---	---	---
40	051400Z	VW-R----	30.2N 152.2E	05	--	--	--	--	--	--	--	--	--	---	---	---	---	---	---	---
41	052100Z	54-P----	30.7N 153.9E	05	--	--	--	--	--	--	--	--	--	---	---	---	---	---	---	---
42	060100Z	54-P----	31.6N 155.2E	05	--	--	--	--	--	--	--	--	--	---	---	---	---	---	---	---
43	060333Z	SLTSL	31.0N 156.0E	STG X	DIA	03	BNDS	4	--	--	--	--	--	---	---	---	---	---	---	---
44	060930Z	VW-R----	31.7N 158.6E	05	--	--	--	--	--	--	--	--	--	---	---	---	---	---	---	---
45	061000Z	VW-R----	32.5N 159.2E	05	--	--	--	--	--	--	--	--	--	---	---	---	---	---	---	---
46	061230Z	VW-R----	32.4N 159.8E	05	--	--	--	--	--	--	--	--	--	---	---	---	---	---	---	---
47	062105Z	54-P----	34.5N 161.9E	10	--	--	--	--	--	--	--	--	--	3011	08/10	CIRC	---	15	N.F.B.	N.F.B.

TYPHOON GRACE

TROPICAL CYCLONE 16 -- 09/29/2300Z TO 10/06/2300Z
POSITION AND FORECAST VERIFICATION DATA

WARN NO.	DTG	WARNING POSIT		BEST TRACK		24 HR FCST		24 HR ERROR		48 HR FCST		48 HR ERROR		72 HR FCST		72 HR ERROR	
		LAT	LONG	LAT	LONG	LAT	LONG	DEG	DIST	LAT	LONG	DEG	DIST	LAT	LONG	DEG	DIST
01	292300Z	26.7N	165.4E	25.7N	163.6E	28.8N	170.3E	-----	-----	-	-	-----	-----	-	-	-----	-----
02	300500Z	27.2N	166.6E	26.4N	164.4E	29.4N	171.6E	-----	-----	-	-	-----	-----	-	-	-----	-----
03	301100Z	27.4N	167.0E	27.0N	165.3E	29.2N	171.0E	-----	-----	-	-	-----	-----	-	-	-----	-----
04	301700Z	27.9N	168.0E	27.3N	166.2E	29.6N	172.0E	-----	-----	-	-	-----	-----	-	-	-----	-----
05	302300Z	26.9N	166.6E	26.5N	166.2E	29.2N	170.2E	058-0252	32.8N	174.4E	-	-----	-----	-	-	-----	-----
06	010500Z	26.2N	166.4E	26.1N	166.5E	26.2N	166.4E	054-0330	27.6N	167.2E	-	-----	-----	-	-	-----	-----
07	011100Z	26.4N	166.6E	26.4N	166.3E	26.4N	166.6E	056-0294	27.2N	167.4E	-	-----	-----	-	-	-----	-----
08	011700Z	26.4N	166.6E	26.1N	165.9E	26.4N	166.6E	058-0384	27.2N	167.4E	28.0N	168.2E	-	-	-----	-----	
09	012300Z	25.9N	165.7E	25.7N	165.2E	25.9N	165.7E	052-0336	25.9N	165.7E	-	-----	-----	-	-	-----	-----
10	020500Z	25.3N	164.4E	25.2N	164.2E	24.3N	161.2E	063-0126	23.7N	157.8E	23.4N	154.3E	-	-	-----	-----	
11	021100Z	24.7N	162.8E	24.7N	163.1E	23.3N	157.2E	062-0210	23.4N	150.9E	-	-----	-----	-	-	-----	-----
12	021700Z	24.3N	161.6E	24.2N	161.8E	23.2N	156.1E	063-0288	23.5N	150.3E	25.3N	144.8E	-	-	-----	-----	
13	022300Z	23.9N	160.2E	23.7N	160.1E	23.1N	154.4E	067-0330	23.9N	148.3E	-	-----	-----	-	-	-----	-----
14	030500Z	23.3N	158.0E	23.4N	158.1E	23.3N	150.6E	073-0174	24.5N	145.4E	27.1N	141.3E	-	-	-----	-----	
15	031100Z	24.0N	155.7E	24.1N	156.2E	24.2N	147.8E	131-0072	27.5N	142.5E	-	-----	-----	-	-	-----	-----
16	031700Z	24.8N	153.1E	24.5N	154.4E	25.3N	145.3E	130-0114	29.2N	142.0E	33.0N	144.1E	-	-	-----	-----	
17	032300Z	24.6N	152.7E	24.7N	152.7E	25.9N	147.4E	184-0090	28.6N	145.1E	-	-----	-----	-	-	-----	-----
18	040500Z	25.3N	151.7E	25.5N	151.6E	29.3N	149.2E	203-0138	33.9N	153.5E	39.8N	163.1E	-	-	-----	-----	
19	041100Z	26.4N	150.5E	26.3N	150.6E	30.9N	150.6E	230-0192	35.0N	156.0E	-	-----	-----	-	-	-----	-----
20	041700Z	26.5N	150.6E	27.1N	150.0E	29.7N	151.0E	247-0270	34.3N	156.1E	40.0N	166.0E	-	-	-----	-----	
21	042300Z	27.9N	150.0E	27.9N	149.8E	31.8N	153.0E	227-0174	35.8N	158.8E	-	-----	-----	-	-	-----	-----
22	050500Z	29.1N	149.8E	29.0N	150.2E	33.7N	153.2E	290-0048	37.3N	161.9E	41.9N	172.2E	-	-	-----	-----	
23	051100Z	30.2N	151.2E	29.9N	151.3E	34.2N	156.7E	329-0066	38.4N	164.9E	-	-----	-----	-	-	-----	-----
24	051700Z	30.7N	152.8E	30.4N	152.9E	34.3N	159.0E	247-0102	38.9N	166.9E	42.0N	178.0E	-	-	-----	-----	
25	052300Z	30.9N	154.4E	31.1N	154.5E	33.4N	161.3E	300-0078	38.0N	169.3E	-	-----	-----	-	-	-----	-----
26	060500Z	31.9N	156.4E	31.8N	156.4E	36.6N	167.3E	305-0198	-	-	-	-----	-----	-	-	-----	-----
27	061100Z	32.7N	159.6E	32.2N	158.9E	38.9N	172.4E	318-0156	-	-	-	-----	-----	-	-	-----	-----
28	061700Z	33.1N	161.8E	33.5N	161.0E	-	-	296-0102	-	-	-	-----	-----	-	-	-----	-----
29	062300Z	35.0N	162.5E	35.3N	162.5E	-	-	206-0126	-	-	-	-----	-----	-	-	-----	-----

AVERAGE 24 HOUR ERROR - 0186 MI.
AVERAGE 48 HOUR ERROR - 0429 MI.
AVERAGE 72 HOUR ERROR - 0715 MI.

TYPHOON HELEN - 10/08/0500Z TO 10/12/2300Z

I. DATA

A. STATISTICS

1. NUMBER OF WARNINGS ISSUED - 20
2. NUMBER OF WARNINGS WITH TYPHOON INTENSITY - 10
3. DISTANCE TRAVELED DURING WARNING PERIOD - 2340 MI

B. CHARACTERISTICS AS A TYPHOON

1. MINIMUM OBSERVED SLP - 930 MBS AT 110300Z
2. MINIMUM OBSERVED 700 MB HEIGHT - 2481 M AT 110300Z
3. MAXIMUM SURFACE WIND - 105 KTS (FROM BEST TRACK)
4. MAXIMUM RADIUS OF SURFACE CIRCULATION - 330 MI

II. DEVELOPMENT

A. INITIAL IMPETUS - 200 MB ANTICYCLONE OVER THE SURFACE CYCLONE

B. INITIAL SURFACE VORTEX

1. JUNCTION VORTEX AT 060600Z
2. SURFACE PRESSURE LESS THAN 1007 MBS

C. 200 MB FLOW ABOVE SURFACE VORTEX

1. INITIAL - ANTICYCLONIC
2. UPON REACHING TYPHOON INTENSITY - EAST

III. FINAL DISPOSITION

A. BECAME EXTRATROPICAL

FIX NO.	TIME	EYE FIXES CYCLONE										IB				EYE FORM	ORIGIN- FATION	EYE DIA	EYE WALL CLOUD
		UNIT	METHOD	ACCY	FLT LVL	FLT LVL	FLT LVL	FLT LVL	FLT LVL	FLT LVL	FLT LVL	DBS	DBS	DBS	DBS				
1	070423Z	09.0N	150.0E	SLTLS	STG A	U1A	030	025	004	---	---	---	---	---	---	---	---	---	---
2	080216Z	14.5N	151.7E	54-P----	10	0470	030	025	004	---	---	---	---	---	---	---	---	---	---
3	080331Z	15.0N	150.0E	SLTLS	STG B	U1A	030	025	004	---	---	---	---	---	---	---	---	---	---
4	080925Z	15.5N	149.5E	54-P----	05	0450	030	020	003	---	---	---	---	---	---	---	---	---	---
5	081215Z	15.5N	149.1E	54-P----	05	0450	030	020	003	---	---	---	---	---	---	---	---	---	---
6	081510Z	16.0N	148.5E	54-P----	05	0450	030	020	003	---	---	---	---	---	---	---	---	---	---
7	082125Z	16.9N	147.3E	54-P----	10	700MB	035	030	000	---	---	---	---	---	---	---	---	---	---
8	090300Z	17.7N	146.2E	54-P----	05	700MB	045	040	000	---	---	---	---	---	---	---	---	---	---
9	090430Z	17.5N	146.0E	SLTLS	STG X	U1A	030	025	004	---	---	---	---	---	---	---	---	---	---
10	090802Z	19.4N	144.9E	54-P----	10	700MB	030	025	004	---	---	---	---	---	---	---	---	---	---
11	090910Z	18.4N	145.2E	54-P----	10	700MB	030	025	004	---	---	---	---	---	---	---	---	---	---
12	091205Z	18.8N	144.5E	54-P----	05	700MB	030	025	004	---	---	---	---	---	---	---	---	---	---
13	091404Z	18.6N	144.2E	54-P----	10	700MB	030	025	004	---	---	---	---	---	---	---	---	---	---
14	092045Z	19.6N	143.4E	54-P----	10	700MB	030	025	004	---	---	---	---	---	---	---	---	---	---
15	100230Z	20.1N	142.7E	54-P----	12	700MB	030	025	004	---	---	---	---	---	---	---	---	---	---
16	100529Z	20.5N	142.0E	SLTLS	STG X	U1A	030	025	004	---	---	---	---	---	---	---	---	---	---
17	100903Z	21.5N	142.4E	54-P----	03	700MB	030	025	004	---	---	---	---	---	---	---	---	---	---
18	101158Z	21.8N	142.2E	54-P----	05	700MB	030	025	004	---	---	---	---	---	---	---	---	---	---
19	101405Z	22.2N	141.1E	54-P----	03	700MB	030	025	004	---	---	---	---	---	---	---	---	---	---
20	101405Z	22.2N	141.1E	54-P----	03	700MB	030	025	004	---	---	---	---	---	---	---	---	---	---
21	110300Z	25.0N	141.9E	54-P----	05	700MB	030	025	004	---	---	---	---	---	---	---	---	---	---
22	110432Z	25.0N	142.0E	SLTLS	STG X	U1A	030	025	004	---	---	---	---	---	---	---	---	---	---
23	111056Z	26.6N	144.5E	54-P----	10	700MB	030	025	004	---	---	---	---	---	---	---	---	---	---
24	111155Z	27.1N	142.5E	54-P----	10	700MB	030	025	004	---	---	---	---	---	---	---	---	---	---
25	111445Z	28.2N	144.6E	54-P----	10	700MB	030	025	004	---	---	---	---	---	---	---	---	---	---
26	112110Z	30.8N	147.7E	54-P----	05	700MB	030	025	004	---	---	---	---	---	---	---	---	---	---
27	120000Z	32.0N	148.8E	54-P----	05	700MB	030	025	004	---	---	---	---	---	---	---	---	---	---
28	120218Z	33.0N	150.0E	54-P----	10	700MB	030	025	004	---	---	---	---	---	---	---	---	---	---
29	120359Z	33.5N	151.0E	SLTLS	STG X	U1A	030	025	004	---	---	---	---	---	---	---	---	---	---
30	121515Z	36.7N	159.2E	54-P----	05	700MB	030	025	004	---	---	---	---	---	---	---	---	---	---

TYPHOON HELEN

TROPICAL CYCLONE 18 -- 10/08/0500Z TO 10/12/2300Z
POSITION AND FORECAST VERIFICATION DATA

WARN NO.	DTG	WARNING POSIT		BEST TRACK		24 HR FCST		24 HR ERROR		48 HR FCST		48 HR ERROR		72 HR FCST		72 HR ERROR	
		LAT	LONG	LAT	LONG	LAT	LONG	DEG	DIST	LAT	LONG	DEG	DIST	LAT	LONG	DEG	DIST
06	091100Z	18.8N	144.9E	18.6N	144.7E	22.9N	143.0E	259-0060		27.5N	144.1E						
07	091700Z	19.0N	144.0E	19.2N	143.8E	22.9N	142.2E	180-0048		27.1N	143.2E			31.8N	147.6E		
08	092300Z	19.9N	143.2E	19.7N	143.1E	23.0N	141.4E	009-0084		27.1N	143.2E						
09	100500Z	20.4N	142.4E	20.6N	142.5E	23.7N	141.5E	015-0120		27.4N	144.0E			31.9N	149.3E		
10	101100Z	21.8N	142.1E	21.7N	142.2E	25.8N	143.3E	031-0078		29.8N	147.3E						
11	101700Z	22.7N	142.1E	22.6N	141.8E	26.5N	143.9E	046-0020		30.2N	147.9E			34.8N	154.5E		
12	102300Z	23.7N	141.7E	23.9N	141.7E	27.4N	144.1E	193-0050		31.7N	149.5E						
13	110500Z	25.6N	142.3E	25.5N	142.1E	34.0N	149.0E	196-0108				038-0162					
14	111100Z	27.2N	143.5E	27.2N	143.3E	35.8N	152.4E	180-0084				067-0042					
15	111700Z	28.8N	145.2E	28.8N	145.5E	37.2N	154.8E	212-0156				230-0156					
16	112300Z	31.6N	148.6E	31.4N	148.3E			222-0318				226-0366					
17	120500Z	34.3N	151.5E	33.9N	151.9E			272-0144				227-0564				280-0126	
18	121100Z	36.7N	155.1E	35.6N	156.3E			273-0186				233-0570					
19	121700Z	37.2N	160.6E	37.3N	160.5E			269-0270				236-0756				243-0714	
20	122300Z	38.5N	165.4E	38.9N	165.4E							242-0894					

AVERAGE 24 HOUR ERROR - 0123 MI.
AVERAGE 48 HOUR ERROR - 0438 MI.
AVERAGE 72 HOUR ERROR - 0420 MI.

TYPHOON IDA - 10/15/2300Z TO 10/22/0500Z

I. DATA

A. STATISTICS

1. NUMBER OF WARNINGS ISSUED - 26
2. NUMBER OF WARNINGS WITH TYPHOON INTENSITY - 17
3. DISTANCE TRAVELED DURING WARNING PERIODS - 1296 MI

B. CHARACTERISTICS AS A TYPHOON

1. MINIMUM OBSERVED SLP - 917 MBS AT 172050Z
2. MINIMUM OBSERVED 700 MB HEIGHT - 2384 M AT 172050Z
3. MAXIMUM SURFACE WIND - 115 KTS (FROM BEST TRACK)
4. MAXIMUM RADIUS OF SURFACE CIRCULATION - 360 MI

II. DEVELOPMENT

A. INITIAL IMPETUS - DEVELOPMENT OF DIVERGENCE AT 200 MB
OVER SURFACE CYCLONIC CIRCULATION

B. INITIAL SURFACE VORTEX

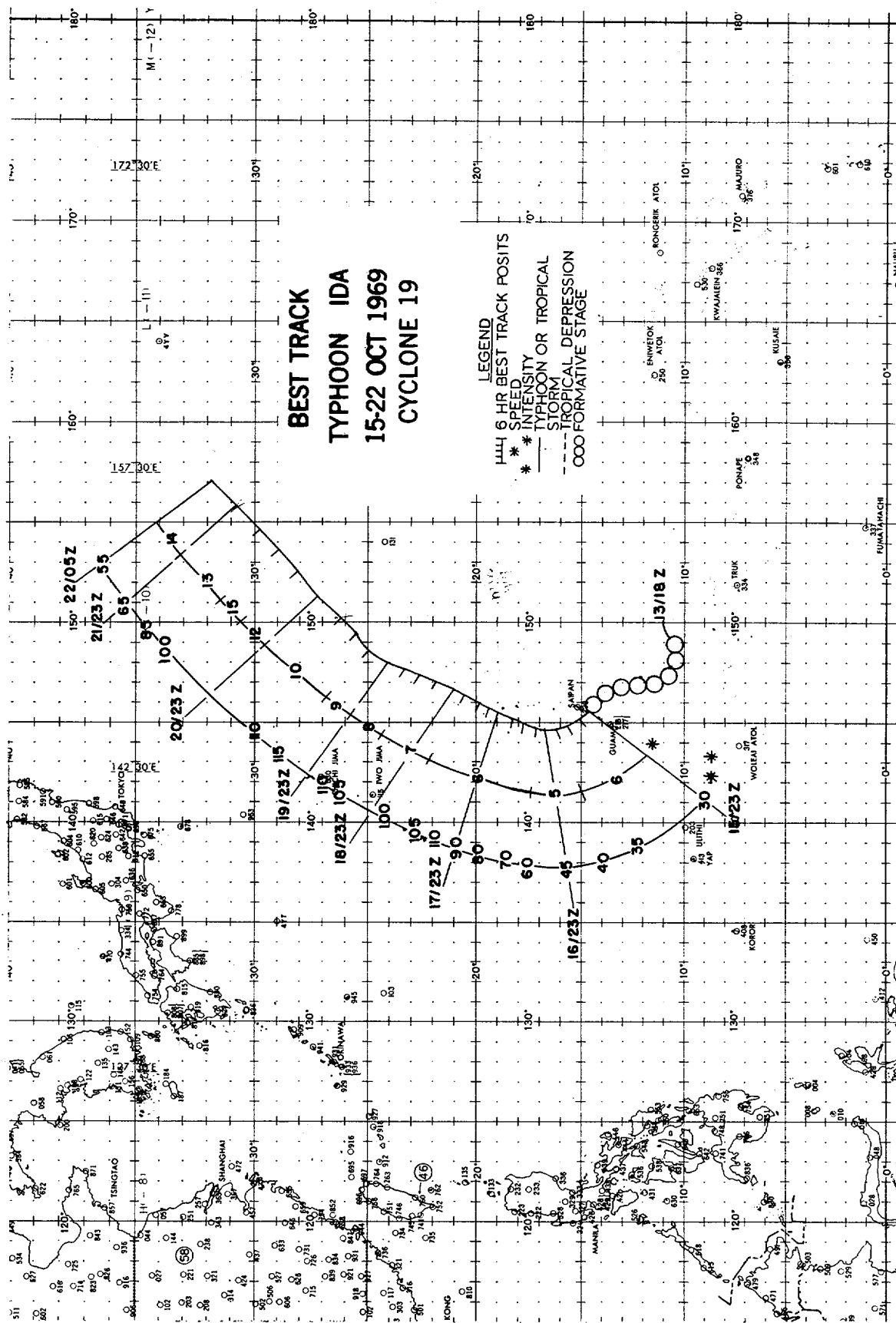
1. JUNCTION VORTEX AT 131800Z
2. SURFACE PRESSURE LESS THAN 1008 MBS

C. 200 MB FLOW ABOVE SURFACE VORTEX

1. INITIAL - SOUTHWEST
2. UPON REACHING TYPHOON INTENSITY - SOUTHWEST

III. FINAL DISPOSITION

A. BECAME EXTRATROPICAL



FIX NO.	TIME	EYE FIXES CYCLONE				19				MIN 700MB	PLT LVL	EYE FORM	ORIENT-TAILON	EYE DIA	THNS	
		UNIT-METHOD	FLT LVL	FLT LVL	FLT LVL	WIND	SFC	WIND	SLP						WALL	CLOUD
1	140337Z	SLTL	13.0N	152.0E	STG A	UJA	---	HNNS	---	---	---	---	---	---	---	---
2	150436Z	SLTL	14.0N	148.0E	STG A	UJA	---	HNNS	---	---	---	---	---	---	---	---
3	152330Z	SLTL	14.7N	145.6E	LND KOR	---	---	---	---	---	---	---	---	---	---	---
4	160010Z	LND KOR	14.9N	145.6E	LND KOR	---	---	---	---	---	---	---	---	---	---	---
5	160025Z	LND KOR	14.8N	145.6E	LND KOR	---	---	---	---	---	---	---	---	---	---	---
6	160040Z	LND KOR	14.8N	145.4E	LND KOR	---	---	---	---	---	---	---	---	---	---	---
7	160050Z	54-P-----04	14.7N	145.4E	0300M	055	035	005	---	---	---	---	---	---	---	---
8	160230Z	54-P-----04	14.9N	145.5E	0390M	058	030	002	---	---	---	---	---	---	---	---
9	160340Z	SLTL	13.5N	144.0E	STG B	UJA	---	HNNS	---	---	---	---	---	---	---	---
10	160505Z	LND KOR	15.2N	145.4E	LND KOR	---	---	---	---	---	---	---	---	---	---	---
11	160625Z	VW-R-----	14.8N	144.9E	VW-R-----	---	---	---	---	---	---	---	---	---	---	---
12	160915Z	LND KOR	15.9N	145.2E	LND KOR	---	---	---	---	---	---	---	---	---	---	---
13	161015Z	LND KOR	15.8N	144.9E	LND KOR	---	---	---	---	---	---	---	---	---	---	---
14	161045Z	VW-R-----05	15.5N	145.0E	VW-R-----05	---	---	---	---	---	---	---	---	---	---	---
15	161140Z	VW-R-----05	15.8N	145.0E	VW-R-----05	---	---	---	---	---	---	---	---	---	---	---
16	161505Z	VW-R-----10	16.0N	144.8E	0320M	037	045	081	---	---	---	---	---	---	---	---
17	162100Z	54-P-----02	16.4N	144.7E	700M	037	045	081	---	---	---	---	---	---	---	---
18	170230Z	54-P-----02	16.9N	144.7E	700M	054	065	972	---	---	---	---	---	---	---	---
19	170438Z	SLTL	17.5N	145.0E	STG X	UJA	03	HNNS 2	---	---	---	---	---	---	---	---
20	171122Z	VW-R-----05	17.8N	144.6E	VW-R-----05	---	---	---	---	---	---	---	---	---	---	---
21	171152Z	VW-R-----03	17.7N	144.8E	VW-R-----03	---	---	---	---	---	---	---	---	---	---	---
22	171500Z	VW-R-----05	18.0N	145.0E	VW-R-----05	---	---	---	---	---	---	---	---	---	---	---
23	172050Z	54-P-----05	18.6N	145.4E	700M	065	070	917	---	---	---	---	---	---	---	---
24	180230Z	54-P-----05	19.2N	145.7E	700M	110	110	918	---	---	---	---	---	---	---	---
25	180342Z	SLTL	19.0N	145.5E	STG X	UJA	03	HNNS 4	---	---	---	---	---	---	---	---
26	180845Z	VW-R-----03	19.8N	145.8E	VW-R-----03	060	050	---	---	---	---	---	---	---	---	---
27	181445Z	VW-R-----03	20.2N	146.1E	VW-R-----03	0400M	---	---	---	---	---	---	---	---	---	---
28	182115Z	54-P-----05	21.0N	146.6E	700M	070	050	919	---	---	---	---	---	---	---	---
29	190239Z	54-P-----15	21.6N	146.8E	700M	110	090	929	---	---	---	---	---	---	---	---
30	190440Z	SLTL	22.0N	147.0E	STG X	UJA	04	HNNS 4	---	---	---	---	---	---	---	---
31	190855Z	VW-R-----10	23.0N	146.2E	VW-R-----10	---	---	---	---	---	---	---	---	---	---	---
32	190915Z	VW-R-----05	22.4N	147.0E	VW-R-----05	---	---	---	---	---	---	---	---	---	---	---
33	191200Z	VW-R-----15	22.4N	147.6E	VW-R-----15	---	---	---	---	---	---	---	---	---	---	---
34	191452Z	VW-R-----15	22.9N	147.4E	VW-R-----15	---	---	---	---	---	---	---	---	---	---	---
35	192030Z	54-P-----10	23.8N	148.0E	700M	100	140	931	---	---	---	---	---	---	---	---
36	192345Z	54-P-----15	24.3N	148.2E	700M	120	140	932	---	---	---	---	---	---	---	---
37	200245Z	54-P-----25	24.9N	148.2E	700M	120	140	930	---	---	---	---	---	---	---	---
38	200346Z	SLTL	24.5N	148.0E	STG X	UJA	04	HNNS 4	---	---	---	---	---	---	---	---
39	200815Z	VW-R-----25	25.2N	148.6E	VW-R-----25	---	---	---	---	---	---	---	---	---	---	---
40	201207Z	VW-R-----05	25.4N	149.6E	VW-R-----05	---	---	---	---	---	---	---	---	---	---	---
41	201405Z	VW-R-----07	25.4N	150.8E	VW-R-----07	---	---	---	---	---	---	---	---	---	---	---
42	202110Z	54-P-----10	26.7N	150.7E	700M	130	150	944	---	---	---	---	---	---	---	---
43	210300Z	54-P-----10	27.8N	152.2E	700M	---	---	---	---	---	---	---	---	---	---	---
44	210352Z	SLTL	27.5N	151.5E	STG X	UJA	05	HNNS 3	---	---	---	---	---	---	---	---
45	211128Z	VW-R-----25	29.0N	152.5E	VW-R-----25	---	---	---	---	---	---	---	---	---	---	---
46	211214Z	VW-R-----10	29.0N	153.8E	VW-R-----10	---	---	---	---	---	---	---	---	---	---	---
47	211415Z	VW-R-----10	28.9N	153.7E	VW-R-----10	---	---	---	---	---	---	---	---	---	---	---
48	212030Z	54-P-----15	30.2N	155.7E	700M	050	080	958	---	---	---	---	---	---	---	---
49	220215Z	54-P-----20	31.3N	156.5E	700M	070	080	971	---	---	---	---	---	---	---	---
50	220350Z	SLTL	31.5N	156.0E	STG X	UJA	05	HNNS 3	---	---	---	---	---	---	---	---

TYPHOON IDA

TROPICAL CYCLONE 19 -- 10/15/2300Z TO 10/22/0500Z
POSITION AND FORECAST VERIFICATION DATA

WARN NO.	DTG	WARNING POSIT		BEST TRACK		24 HR FCST		24 HR ERROR		48 HR FCST		48 HR ERROR		72 HR FCST		72 HR ERROR	
		LAT	LONG	LAT	LONG	LAT	LONG	DEG	DIST	LAT	LONG	DEG	DIST	LAT	LONG	DEG	DIST
03	161100Z	15.7N	144.7E	15.7N	144.9E	18.3N	142.7E	-----	-----	21.3N	141.4E	-----	-----	-	-	-----	-----
04	161700Z	16.2N	144.5E	16.2N	144.8E	19.0N	142.9E	-----	-----	22.0N	141.9E	-----	-----	25.8N	143.1E	-----	-----
05	162300Z	16.6N	144.5E	16.6N	144.7E	18.3N	143.6E	256-0120	-----	20.1N	142.6E	-----	-----	-	-	-----	-----
06	170500Z	17.2N	144.7E	17.2N	144.8E	19.7N	145.3E	219-0114	-----	22.8N	147.9E	-----	-----	25.7N	153.6E	-----	-----
07	171100Z	17.8N	144.6E	17.8N	145.0E	20.3N	145.3E	283-0126	-----	23.2N	148.3E	-----	-----	-	-	-----	-----
08	171700Z	18.2N	145.1E	18.2N	145.2E	20.5N	146.3E	288-0132	-----	23.3N	149.5E	-----	-----	25.4N	154.6E	-----	-----
09	172300Z	18.8N	145.6E	18.8N	145.5E	21.3N	148.1E	255-0108	-----	23.6N	151.8E	-----	-----	-	-	-----	-----
10	180500Z	19.4N	145.9E	19.4N	145.7E	21.9N	148.9E	314-0024	-----	24.4N	153.7E	-----	-----	28.0N	161.6E	-----	-----
11	181100Z	20.1N	146.1E	19.9N	146.0E	22.8N	148.6E	303-0042	-----	25.5N	153.4E	288-0270	-----	-	-	-----	-----
12	181700Z	20.5N	146.3E	20.6N	146.3E	23.0N	149.0E	180-0006	-----	25.8N	153.8E	289-0252	-----	31.0N	161.1E	-----	-----
13	182300Z	21.3N	146.7E	21.2N	146.6E	24.1N	148.8E	086-0078	-----	27.1N	152.9E	254-0238	-----	-	-	-----	-----
14	190500Z	21.9N	146.9E	21.9N	146.9E	24.5N	148.2E	090-0108	-----	27.5N	150.4E	046-0072	-----	30.6N	155.2E	-----	-----
15	191100Z	22.6N	147.2E	22.6N	147.3E	25.5N	148.3E	081-0072	-----	28.8N	149.7E	057-0060	-----	-	-	-----	-----
16	191700Z	23.1N	147.4E	23.3N	147.6E	25.6N	148.3E	104-0072	-----	28.6N	149.5E	090-0102	-----	32.6N	152.5E	301-0288	-----
17	192300Z	24.2N	148.2E	24.1N	148.0E	28.2N	151.0E	090-0042	-----	32.8N	156.2E	098-0204	-----	-	-	-----	-----
18	200500Z	25.3N	148.5E	25.0N	148.5E	29.7N	151.2E	202-0030	-----	33.8N	155.7E	097-0282	-----	-	-	082-0276	-----
19	201100Z	25.8N	149.0E	25.5N	149.4E	28.4N	150.7E	270-0054	-----	30.0N	152.8E	090-0216	-----	-	-	-----	-----
20	201700Z	25.5N	151.0E	26.2N	150.2E	26.7N	155.7E	252-0108	-----	28.2N	160.2E	097-0192	-----	-	-	101-0234	-----
21	202300Z	26.9N	151.0E	27.1N	151.2E	30.0N	154.8E	354-0066	-----	31.8N	161.1E	090-0090	-----	-	-	-----	-----
22	210500Z	28.2N	152.6E	28.1N	152.4E	31.1N	159.1E	327-0108	-----	34.3N	166.8E	251-0108	-----	-	-	090-0486	-----
23	211100Z	29.1N	153.9E	28.9N	153.6E	31.5N	160.7E	259-0150	-----	32.8N	169.0E	269-0204	-----	-	-	-----	-----
24	211700Z	29.6N	155.0E	29.7N	154.8E	31.7N	161.3E	165-0186	-----	-	-	257-0282	-----	-	-	077-0330	-----
25	212300Z	30.5N	156.4E	30.7N	155.9E	-	-	233-0066	-----	-	-	006-0126	-----	-	-	-----	-----
26	220500Z	31.5N	157.2E	31.8N	157.0E	-	-	112-0108	-----	-	-	331-0132	-----	-	-	232-0114	-----

AVERAGE 24 HOUR ERROR - 0087 MI.
AVERAGE 48 HOUR ERROR - 0176 MI.
AVERAGE 72 HOUR ERROR - 0288 MI.

TYPHOON JUNE - 10/28/0500Z TO 11/05/0500Z

I. DATA

A. STATISTICS

1. NUMBER OF WARNINGS ISSUED - 33
2. NUMBER OF WARNINGS WITH TYPHOON INTENSITY - 21
3. DISTANCE TRAVELED DURING WARNING PERIOD - 1782 MI

B. CHARACTERISTICS AS A TYPHOON

1. MINIMUM OBSERVED SLP - 936 MBS AT 020820Z
2. MINIMUM OBSERVED 700 MB HEIGHT - 2643 M AT 021420Z
3. MAXIMUM SURFACE WIND - 105 KTS (FROM BEST TRACK)
4. MAXIMUM RADIUS OF SURFACE CIRCULATION - 500 MI

II. DEVELOPMENT

A. INITIAL IMPETUS - 200 MB ANTICYCLONE OVER THE SURFACE CYCLONE

B. INITIAL SURFACE VORTEX

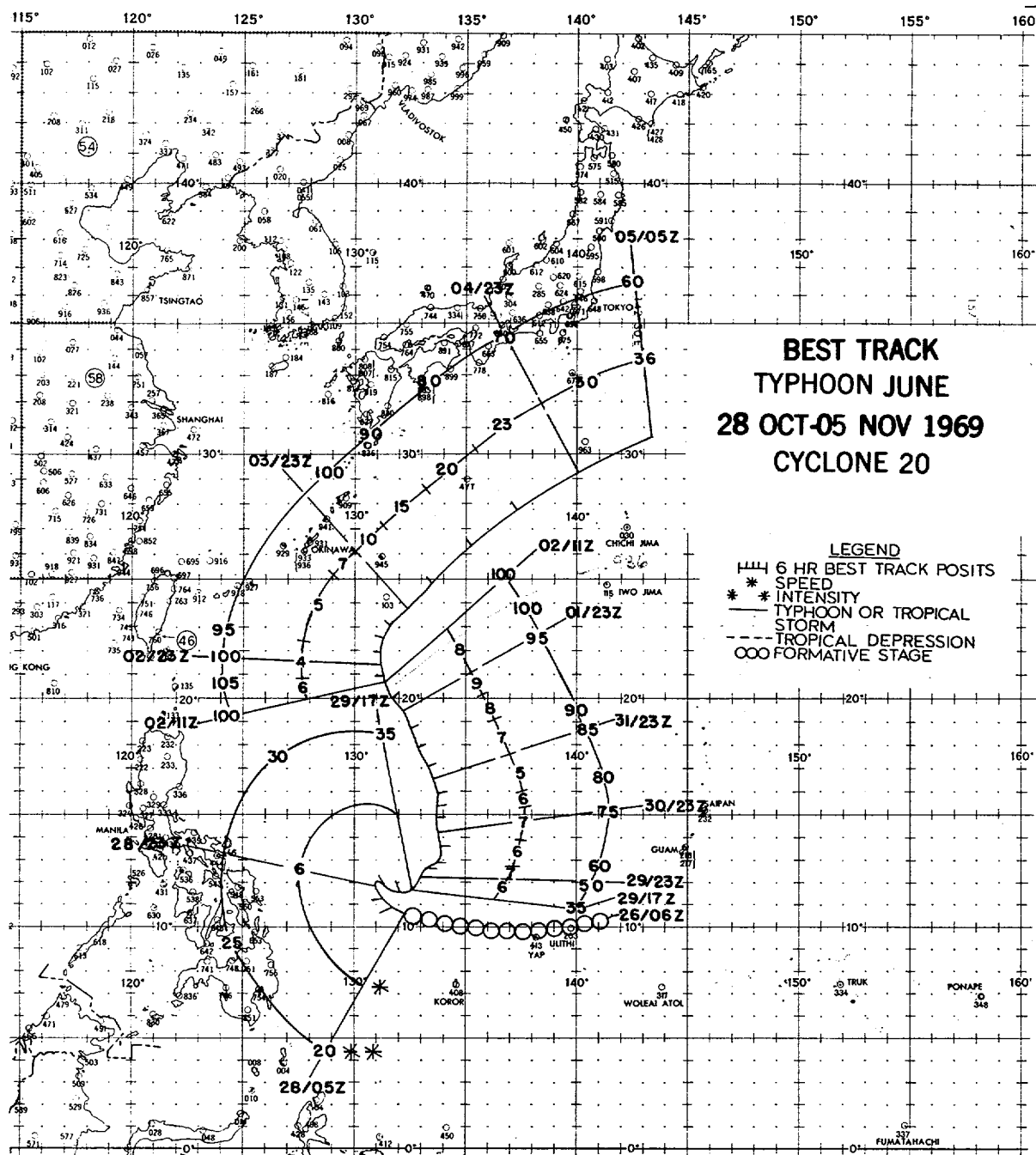
1. JUNCTION VORTEX AT 260600Z
2. SURFACE PRESSURE LESS THAN 1005 MBS

C. 200 MB FLOW ABOVE SURFACE VORTEX

1. INITIAL - SOUTHEAST
2. UPON REACHING TYPHOON INTENSITY - ANTICYCLONIC

III. FINAL DISPOSITION

A. BECAME EXTRATROPICAL



FIX NO.	TIME	POST	EYE FIXES CIRCLE				20				PLT	OBS	MIN	700MB	LVL	EYE FORM	ORIGIN- LATION	EYE DIA	THKNS WALL CLOUD
			UNIT-METHOD	FLF LVL	FLT LVL	FLT LVL	UNIT-METHOD	FLF LVL	FLT LVL	FLT LVL									
1	270445Z	10.0N 135.0E	SLTSL	STG 3	U1A	U1A	SLTSL	STG 3	U1A	U1A	U1A	U1A	U1A	U1A	U1A	U1A	U1A	U1A	N.F.B.
2	280245Z	10.5N 132.4E	SLTSL	STG 3	U1A	U1A	SLTSL	STG 3	U1A	U1A	U1A	U1A	U1A	U1A	U1A	U1A	U1A	U1A	N.F.B.
3	280544Z	10.5N 132.0E	SLTSL	STG 3	U1A	U1A	SLTSL	STG 3	U1A	U1A	U1A	U1A	U1A	U1A	U1A	U1A	U1A	U1A	N.F.B.
4	281458Z	12.1N 131.5E	VM-P	STG 3	U1A	U1A	VM-P	STG 3	U1A	U1A	U1A	U1A	U1A	U1A	U1A	U1A	U1A	U1A	N.F.B.
5	290245Z	11.5N 131.7E	SLTSL	STG 3	U1A	U1A	SLTSL	STG 3	U1A	U1A	U1A	U1A	U1A	U1A	U1A	U1A	U1A	U1A	N.F.B.
6	290447Z	13.0N 132.0E	SLTSL	STG 3	U1A	U1A	SLTSL	STG 3	U1A	U1A	U1A	U1A	U1A	U1A	U1A	U1A	U1A	U1A	N.F.B.
7	290911Z	12.0N 131.0E	VM-R	STG 3	U1A	U1A	VM-R	STG 3	U1A	U1A	U1A	U1A	U1A	U1A	U1A	U1A	U1A	U1A	N.F.B.
8	291045Z	11.8N 131.2E	VM-P	STG 3	U1A	U1A	VM-P	STG 3	U1A	U1A	U1A	U1A	U1A	U1A	U1A	U1A	U1A	U1A	N.F.B.
9	291448Z	11.6N 131.8E	VM-P	STG 3	U1A	U1A	VM-P	STG 3	U1A	U1A	U1A	U1A	U1A	U1A	U1A	U1A	U1A	U1A	N.F.B.
10	292045Z	12.0N 133.1E	SLTSL	STG 3	U1A	U1A	SLTSL	STG 3	U1A	U1A	U1A	U1A	U1A	U1A	U1A	U1A	U1A	U1A	N.F.B.
11	292330Z	12.3N 133.1E	SLTSL	STG 3	U1A	U1A	SLTSL	STG 3	U1A	U1A	U1A	U1A	U1A	U1A	U1A	U1A	U1A	U1A	N.F.B.
12	300300Z	12.7N 133.1E	SLTSL	STG 3	U1A	U1A	SLTSL	STG 3	U1A	U1A	U1A	U1A	U1A	U1A	U1A	U1A	U1A	U1A	N.F.B.
13	300546Z	12.5N 133.0E	SLTSL	STG 3	U1A	U1A	SLTSL	STG 3	U1A	U1A	U1A	U1A	U1A	U1A	U1A	U1A	U1A	U1A	N.F.B.
14	300852Z	12.2N 134.0E	VM-R	STG 3	U1A	U1A	VM-R	STG 3	U1A	U1A	U1A	U1A	U1A	U1A	U1A	U1A	U1A	U1A	N.F.B.
15	300935Z	12.6N 133.7E	VM-P	STG 3	U1A	U1A	VM-P	STG 3	U1A	U1A	U1A	U1A	U1A	U1A	U1A	U1A	U1A	U1A	N.F.B.
16	301200Z	13.2N 134.1E	VM-R	STG 3	U1A	U1A	VM-R	STG 3	U1A	U1A	U1A	U1A	U1A	U1A	U1A	U1A	U1A	U1A	N.F.B.
17	301440Z	13.0N 134.0E	VM-P	STG 3	U1A	U1A	VM-P	STG 3	U1A	U1A	U1A	U1A	U1A	U1A	U1A	U1A	U1A	U1A	N.F.B.
18	302040Z	14.0N 133.8E	SLTSL	STG 3	U1A	U1A	SLTSL	STG 3	U1A	U1A	U1A	U1A	U1A	U1A	U1A	U1A	U1A	U1A	N.F.B.
19	310245Z	14.6N 133.6E	SLTSL	STG 3	U1A	U1A	SLTSL	STG 3	U1A	U1A	U1A	U1A	U1A	U1A	U1A	U1A	U1A	U1A	N.F.B.
20	310454Z	14.5N 132.5E	SLTSL	STG 3	U1A	U1A	SLTSL	STG 3	U1A	U1A	U1A	U1A	U1A	U1A	U1A	U1A	U1A	U1A	N.F.B.
21	310901Z	15.3N 133.4E	VM-R	STG 3	U1A	U1A	VM-R	STG 3	U1A	U1A	U1A	U1A	U1A	U1A	U1A	U1A	U1A	U1A	N.F.B.
22	311445Z	15.5N 133.8E	VM-R	STG 3	U1A	U1A	VM-R	STG 3	U1A	U1A	U1A	U1A	U1A	U1A	U1A	U1A	U1A	U1A	N.F.B.
23	312100Z	16.3N 133.4E	SLTSL	STG 3	U1A	U1A	SLTSL	STG 3	U1A	U1A	U1A	U1A	U1A	U1A	U1A	U1A	U1A	U1A	N.F.B.
24	010230Z	16.8N 133.2E	SLTSL	STG 3	U1A	U1A	SLTSL	STG 3	U1A	U1A	U1A	U1A	U1A	U1A	U1A	U1A	U1A	U1A	N.F.B.
25	010548Z	17.0N 132.5E	SLTSL	STG 3	U1A	U1A	SLTSL	STG 3	U1A	U1A	U1A	U1A	U1A	U1A	U1A	U1A	U1A	U1A	N.F.B.
26	010715Z	17.3N 132.9E	VM-R	STG 3	U1A	U1A	VM-R	STG 3	U1A	U1A	U1A	U1A	U1A	U1A	U1A	U1A	U1A	U1A	N.F.B.
27	010925Z	17.1N 133.0E	VM-R	STG 3	U1A	U1A	VM-R	STG 3	U1A	U1A	U1A	U1A	U1A	U1A	U1A	U1A	U1A	U1A	N.F.B.
28	011000Z	17.5N 132.9E	VM-P	STG 3	U1A	U1A	VM-P	STG 3	U1A	U1A	U1A	U1A	U1A	U1A	U1A	U1A	U1A	U1A	N.F.B.
29	011503Z	18.5N 132.6E	VM-P	STG 3	U1A	U1A	VM-P	STG 3	U1A	U1A	U1A	U1A	U1A	U1A	U1A	U1A	U1A	U1A	N.F.B.
30	011503Z	18.5N 132.6E	VM-P	STG 3	U1A	U1A	VM-P	STG 3	U1A	U1A	U1A	U1A	U1A	U1A	U1A	U1A	U1A	U1A	N.F.B.
31	020200Z	19.8N 131.9E	SLTSL	STG 3	U1A	U1A	SLTSL	STG 3	U1A	U1A	U1A	U1A	U1A	U1A	U1A	U1A	U1A	U1A	N.F.B.
32	020456Z	20.0N 131.5E	SLTSL	STG 3	U1A	U1A	SLTSL	STG 3	U1A	U1A	U1A	U1A	U1A	U1A	U1A	U1A	U1A	U1A	N.F.B.
33	020755Z	20.2N 131.4E	VM-R	STG 3	U1A	U1A	VM-R	STG 3	U1A	U1A	U1A	U1A	U1A	U1A	U1A	U1A	U1A	U1A	N.F.B.
34	020820Z	20.4N 131.5E	VM-R	STG 3	U1A	U1A	VM-R	STG 3	U1A	U1A	U1A	U1A	U1A	U1A	U1A	U1A	U1A	U1A	N.F.B.
35	020820Z	20.4N 131.5E	VM-P	STG 3	U1A	U1A	VM-P	STG 3	U1A	U1A	U1A	U1A	U1A	U1A	U1A	U1A	U1A	U1A	N.F.B.
36	021420Z	20.8N 131.4E	VM-P	STG 3	U1A	U1A	VM-P	STG 3	U1A	U1A	U1A	U1A	U1A	U1A	U1A	U1A	U1A	U1A	N.F.B.
37	022110Z	21.3N 130.9E	SLTSL	STG 3	U1A	U1A	SLTSL	STG 3	U1A	U1A	U1A	U1A	U1A	U1A	U1A	U1A	U1A	U1A	N.F.B.
38	030100Z	21.4N 131.1E	SLTSL	STG 3	U1A	U1A	SLTSL	STG 3	U1A	U1A	U1A	U1A	U1A	U1A	U1A	U1A	U1A	U1A	N.F.B.
39	030903Z	22.2N 131.2E	VM-P	STG 3	U1A	U1A	VM-P	STG 3	U1A	U1A	U1A	U1A	U1A	U1A	U1A	U1A	U1A	U1A	N.F.B.
40	031200Z	22.4N 131.2E	VM-R	STG 3	U1A	U1A	VM-R	STG 3	U1A	U1A	U1A	U1A	U1A	U1A	U1A	U1A	U1A	U1A	N.F.B.
41	031510Z	22.8N 131.4E	VM-P	STG 3	U1A	U1A	VM-P	STG 3	U1A	U1A	U1A	U1A	U1A	U1A	U1A	U1A	U1A	U1A	N.F.B.
42	032015Z	23.3N 132.0E	SLTSL	STG 3	U1A	U1A	SLTSL	STG 3	U1A	U1A	U1A	U1A	U1A	U1A	U1A	U1A	U1A	U1A	N.F.B.
43	040325Z	24.5N 133.0E	SLTSL	STG 3	U1A	U1A	SLTSL	STG 3	U1A	U1A	U1A	U1A	U1A	U1A	U1A	U1A	U1A	U1A	N.F.B.
44	040454Z	25.5N 133.0E	SLTSL	STG 3	U1A	U1A	SLTSL	STG 3	U1A	U1A	U1A	U1A	U1A	U1A	U1A	U1A	U1A	U1A	N.F.B.
45	040850Z	26.9N 134.7E	VM-P	STG 3	U1A	U1A	VM-P	STG 3	U1A	U1A	U1A	U1A	U1A	U1A	U1A	U1A	U1A	U1A	N.F.B.
46	040930Z	25.8N 134.8E	VM-P	STG 3	U1A	U1A	VM-P	STG 3	U1A	U1A	U1A	U1A	U1A	U1A	U1A	U1A	U1A	U1A	N.F.B.
47	041230Z	26.6N 135.6E	VM-P	STG 3	U1A	U1A	VM-P	STG 3	U1A	U1A	U1A	U1A	U1A	U1A	U1A	U1A	U1A	U1A	N.F.B.
48	041450Z	27.1N 136.2E	VM-P	STG 3	U1A	U1A	VM-P	STG 3	U1A	U1A	U1A	U1A	U1A	U1A	U1A	U1A	U1A	U1A	N.F.B.
49	041450Z	27.1N 136.2E	VM-P	STG 3	U1A	U1A	VM-P	STG 3	U1A	U1A	U1A	U1A	U1A	U1A	U1A	U1A	U1A	U1A	N.F.B.
50	050200Z	30.3N 141.8E	VM-P	STG 3	U1A	U1A	VM-P	STG 3	U1A	U1A	U1A	U1A	U1A	U1A	U1A	U1A	U1A	U1A	N.F.B.

TYPHOON JUNE

TROPICAL CYCLONE 20 -- 10/28/0500Z TO 11/05/0500Z
POSITION AND FORECAST VERIFICATION DATA

WARN NO.	DTG	WARNING POSIT		BEST TRACK		24 HR FCST		24 HR ERROR		48 HR FCST		48 HR ERROR		72 HR FCST		72 HR ERROR	
		LAT	LONG	LAT	LONG	LAT	LONG	DEG	DIST	LAT	LONG	DEG	DIST	LAT	LONG	DEG	DIST
07	291700Z	11.6N	131.4E	11.7N	132.6E	12.4N	130.5E	305	-0270	-	-	-	-	-	-	-	-
08	292300Z	12.2N	133.1E	12.2N	133.0E	14.1N	133.7E	273	-0198	16.1N	134.0E	-	-	-	-	-	-
09	300500Z	12.9N	133.2E	12.7N	133.2E	15.7N	134.5E	247	-0132	19.2N	136.4E	-	-	23.1N	139.7E	-	-
10	301100Z	12.8N	133.7E	12.8N	133.8E	14.4N	134.8E	271	-0258	16.2N	135.7E	-	-	-	-	-	-
11	301700Z	13.2N	134.1E	13.5N	133.9E	15.0N	135.0E	252	-0204	16.5N	135.5E	-	-	18.0N	136.2E	-	-
12	302300Z	14.2N	134.0E	14.2N	133.7E	16.0N	134.8E	180	-0006	17.8N	135.7E	-	-	-	-	-	-
13	310500Z	14.7N	133.8E	14.8N	133.7E	16.9N	134.4E	038	-0066	19.4N	135.9E	-	-	22.4N	138.7E	-	-
14	311100Z	15.5N	133.5E	15.3N	133.8E	18.2N	133.7E	134	-0072	21.2N	135.2E	-	-	-	-	-	-
15	311700Z	15.8N	133.6E	15.8N	133.7E	18.4N	133.9E	123	-0084	21.4N	135.2E	-	-	24.7N	137.3E	-	-
16	312300Z	16.5N	133.5E	16.4N	133.4E	19.1N	134.1E	107	-0078	22.5N	135.9E	-	-	-	-	-	-
17	010500Z	17.0N	133.4E	17.0N	133.2E	19.5N	133.6E	095	-0066	22.4N	134.6E	-	-	25.6N	137.3E	-	-
18	011100Z	17.6N	133.0E	17.8N	132.8E	20.0N	133.1E	064	-0048	22.8N	134.7E	-	-	-	-	-	-
19	011700Z	18.8N	132.5E	18.6N	132.5E	21.8N	133.2E	098	-0078	24.6N	136.3E	-	-	27.9N	140.1E	-	-
20	012300Z	19.5N	132.3E	19.4N	132.2E	22.6N	132.5E	099	-0102	25.5N	135.5E	-	-	-	-	-	-
21	020500Z	20.2N	131.8E	20.0N	131.7E	23.3N	132.1E	106	-0102	26.3N	134.2E	-	-	29.5N	137.4E	-	-
22	021100Z	20.8N	131.4E	20.6N	131.4E	23.8N	132.2E	111	-0096	26.7N	134.5E	-	-	-	-	-	-
23	021700Z	21.0N	131.3E	20.9N	131.3E	23.9N	132.3E	063	-0114	27.4N	135.2E	-	-	30.9N	139.5E	-	-
24	022300Z	21.5N	130.8E	21.3N	131.1E	23.1N	130.0E	046	-0108	24.7N	129.9E	-	-	-	-	-	-
25	030500Z	21.5N	130.9E	21.8N	131.1E	22.7N	130.6E	051	-0138	23.9N	130.7E	-	-	25.7N	131.7E	-	-
26	031100Z	22.4N	131.0E	22.4N	131.2E	24.3N	131.9E	033	-0096	26.8N	134.2E	-	-	-	-	-	-
27	031700Z	23.0N	131.5E	23.0N	131.6E	25.2N	133.4E	034	-0060	27.7N	136.1E	-	-	30.7N	139.7E	-	-
28	032300Z	23.5N	132.2E	23.7N	132.3E	26.1N	135.2E	255	-0126	29.3N	139.4E	-	-	-	-	-	-
29	040500Z	24.7N	133.2E	24.8N	133.4E	29.3N	137.6E	230	-0192	34.2N	144.8E	-	-	-	-	-	-
30	041100Z	26.2N	135.2E	26.2N	135.1E	34.4N	144.8E	237	-0204	-	-	-	-	-	-	-	-
31	041700Z	27.6N	136.9E	27.7N	137.1E	34.6N	144.9E	233	-0246	-	-	-	-	-	-	-	-
32	042300Z	29.2N	140.0E	29.2N	140.0E	-	-	234	-0312	-	-	-	-	-	-	-	-
33	050500Z	31.3N	143.6E	31.5N	143.3E	-	-	246	-0318	-	-	-	-	-	-	-	-

AVERAGE 24 HOUR ERROR - 0139 MI.
AVERAGE 48 HOUR ERROR - 0267 MI.
AVERAGE 72 HOUR ERROR - 0319 MI.

TYPHOON KATHY - 11/03/0500Z TO 11/08/2300Z

I. DATA

A. STATISTICS

1. NUMBER OF WARNINGS ISSUED - 24
2. NUMBER OF WARNINGS WITH TYPHOON INTENSITY - 19
3. DISTANCE TRAVELED DURING WARNING PERIOD - 2040 MI

B. CHARACTERISTICS AS A TYPHOON

1. MINIMUM OBSERVED SLP - 930 MBS AT 072100Z
2. MINIMUM OBSERVED 700 MB HEIGHT - 2478 M AT 072100Z
3. MAXIMUM SURFACE WIND - 110 KTS (FROM BEST TRACK)
4. MAXIMUM RADIUS OF SURFACE CIRCULATION - 420 MI

II. DEVELOPMENT

A. INITIAL IMPETUS - DEVELOPMENT OF DIVERGENCE AT 200 MB
OVER SURFACE CYCLONIC CIRCULATION

B. INITIAL SURFACE VORTEX

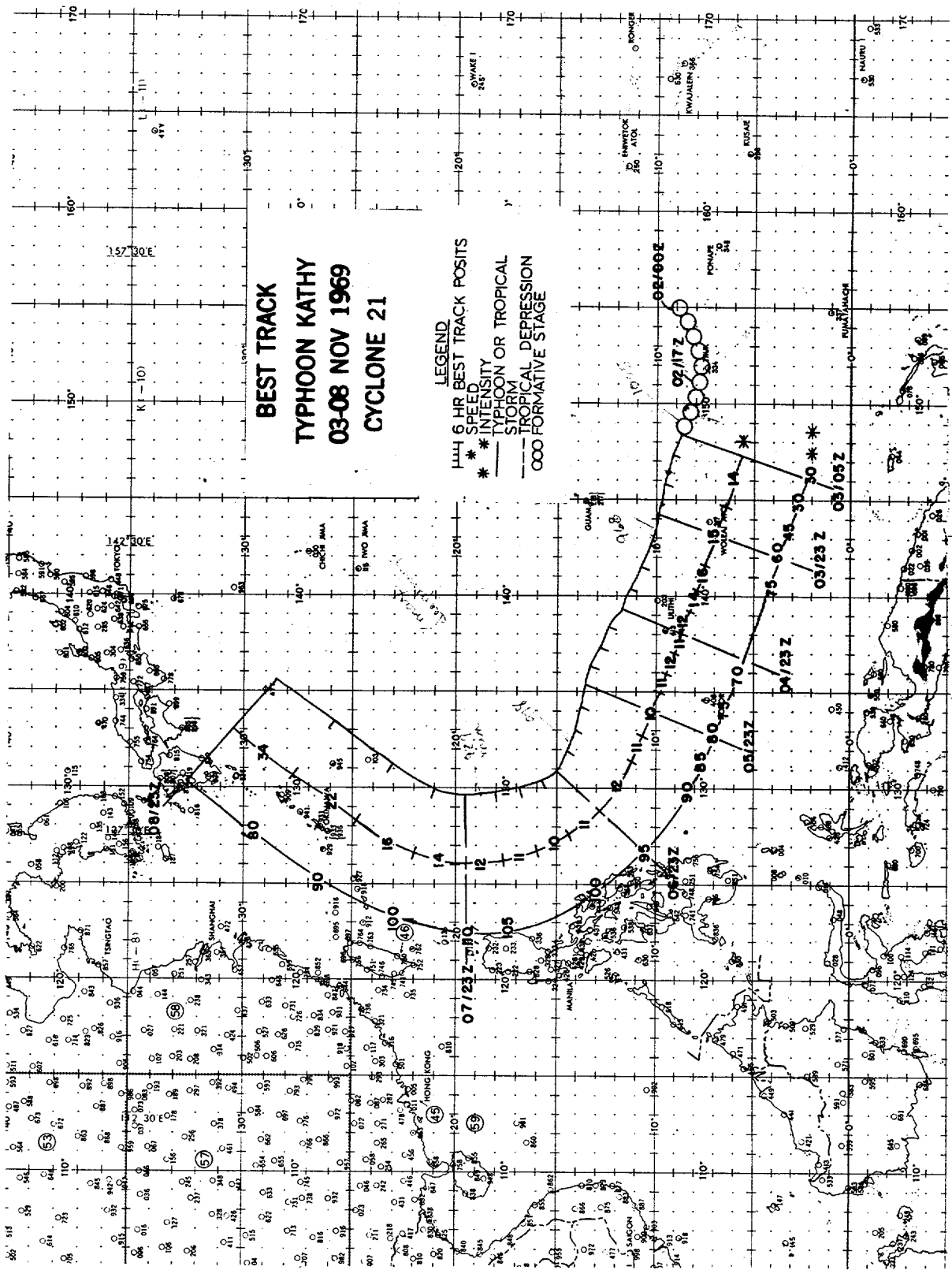
1. JUNCTION VORTEX AT 020000Z
2. SURFACE PRESSURE LESS THAN 1006 MBS

C. 200 MB FLOW ABOVE SURFACE VORTEX

1. INITIAL - NORTHEAST
2. UPON REACHING TYPHOON INTENSITY - ANTICYCLONIC

III. FINAL DISPOSITION

A. BECAME EXTRATROPICAL



5-59

TYPHOON KATHY

TROPICAL CYCLONE 21 -- 11/03/0500Z TO 11/08/2300Z
POSITION AND FORECAST VERIFICATION DATA

WARN NO.	DTG	WARNING POSIT		BEST TRACK		24 HR FCST		24 HR ERROR		48 HR FCST		48 HR ERROR		72 HR FCST		72 HR ERROR	
		LAT	LONG	LAT	LONG	LAT	LONG	DEG	DIST	LAT	LONG	DEG	DIST	LAT	LONG	DEG	DIST
03	031700Z	09.5N	145.8E	09.6N	145.8E	12.7N	141.6E	-----	-----	15.4N	140.6E	-----	-----	17.8N	140.5E	-----	-----
04	032300Z	09.9N	144.6E	09.9N	144.3E	12.6N	141.6E	-----	-----	15.3N	140.6E	-----	-----	-	-	-----	-----
05	040500Z	10.4N	142.7E	10.3N	142.7E	13.0N	137.1E	101-0060	-----	15.2N	131.8E	-----	-----	16.0N	126.0E	-----	-----
06	041100Z	11.2N	140.9E	10.7N	141.4E	13.3N	133.9E	094-0144	-----	14.1N	127.5E	-----	-----	-	-	-----	-----
07	041700Z	11.9N	139.1E	11.2N	140.3E	13.6N	132.2E	039-0114	-----	14.2N	125.7E	-----	-----	14.4N	119.6E	-----	-----
08	042300Z	11.5N	139.2E	11.7N	139.3E	12.7N	135.4E	068-0138	-----	13.0N	131.3E	-----	-----	-	-	-----	-----
09	050500Z	12.6N	138.1E	12.4N	138.3E	16.3N	135.8E	298-0072	-----	20.3N	137.5E	-----	-----	24.1N	141.3E	-----	-----
10	051100Z	13.2N	136.8E	12.8N	137.3E	16.7N	134.6E	278-0198	-----	20.0N	136.7E	-----	-----	-	-	-----	-----
11	051700Z	13.4N	136.5E	13.2N	136.3E	16.4N	134.4E	275-0234	-----	19.8N	136.3E	062-0276	-----	22.7N	140.8E	-----	-----
12	052300Z	13.6N	135.6E	13.5N	135.3E	15.4N	133.0E	172-0048	-----	17.7N	132.7E	071-0324	-----	-	-	-----	-----
13	060500Z	13.6N	134.4E	13.7N	134.2E	15.3N	130.8E	030-0180	-----	17.9N	129.1E	303-0162	-----	20.8N	130.9E	-----	-----
14	061100Z	14.0N	133.1E	14.0N	133.0E	16.0N	129.0E	030-0180	-----	18.6N	126.6E	271-0318	-----	-	-	-----	-----
15	061700Z	14.5N	131.6E	14.4N	131.9E	16.8N	127.8E	051-0186	-----	20.2N	126.3E	269-0360	-----	23.7N	127.6E	068-0528	-----
16	062300Z	14.9N	130.6E	14.9N	130.9E	17.8N	127.0E	067-0120	-----	21.7N	126.5E	171-0114	-----	-	-	-----	-----
17	070500Z	15.4N	130.0E	15.7N	130.3E	18.1N	127.4E	134-0030	-----	21.2N	127.1E	056-0492	-----	26.3N	131.4E	274-0246	-----
18	071100Z	16.4N	129.8E	16.8N	130.0E	19.6N	129.2E	229-0072	-----	23.9N	131.9E	064-0420	-----	-	-	-----	-----
19	071700Z	18.0N	129.6E	18.0N	129.8E	23.0N	131.4E	238-0132	-----	29.8N	139.5E	074-0378	-----	39.8N	152.9E	250-0624	-----
20	072300Z	19.5N	129.7E	19.4N	129.7E	25.6N	133.8E	238-0174	-----	32.8N	143.9E	121-0192	-----	-	-	-----	-----
21	080500Z	21.0N	130.1E	21.0N	130.0E	27.2N	135.7E	220-0222	-----	35.0N	146.7E	195-0192	-----	-	-	074-0648	-----
22	081100Z	22.9N	131.2E	23.0N	131.2E	30.0N	139.9E	208-0228	-----	-	-	225-0366	-----	-	-	-----	-----
23	081700Z	25.5N	133.4E	25.7N	133.4E	34.8N	147.0E	214-0192	-----	-	-	230-0510	-----	-	-	113-0444	-----
24	082300Z	28.8N	134.5E	28.4N	135.7E	-	-	212-0190	-----	-	-	232-0636	-----	-	-	-----	-----

AVERAGE 24 HOUR ERROR - 0145 MI.
AVERAGE 48 HOUR ERROR - 0338 MI.
AVERAGE 72 HOUR ERROR - 0498 MI.

ANNEX

A

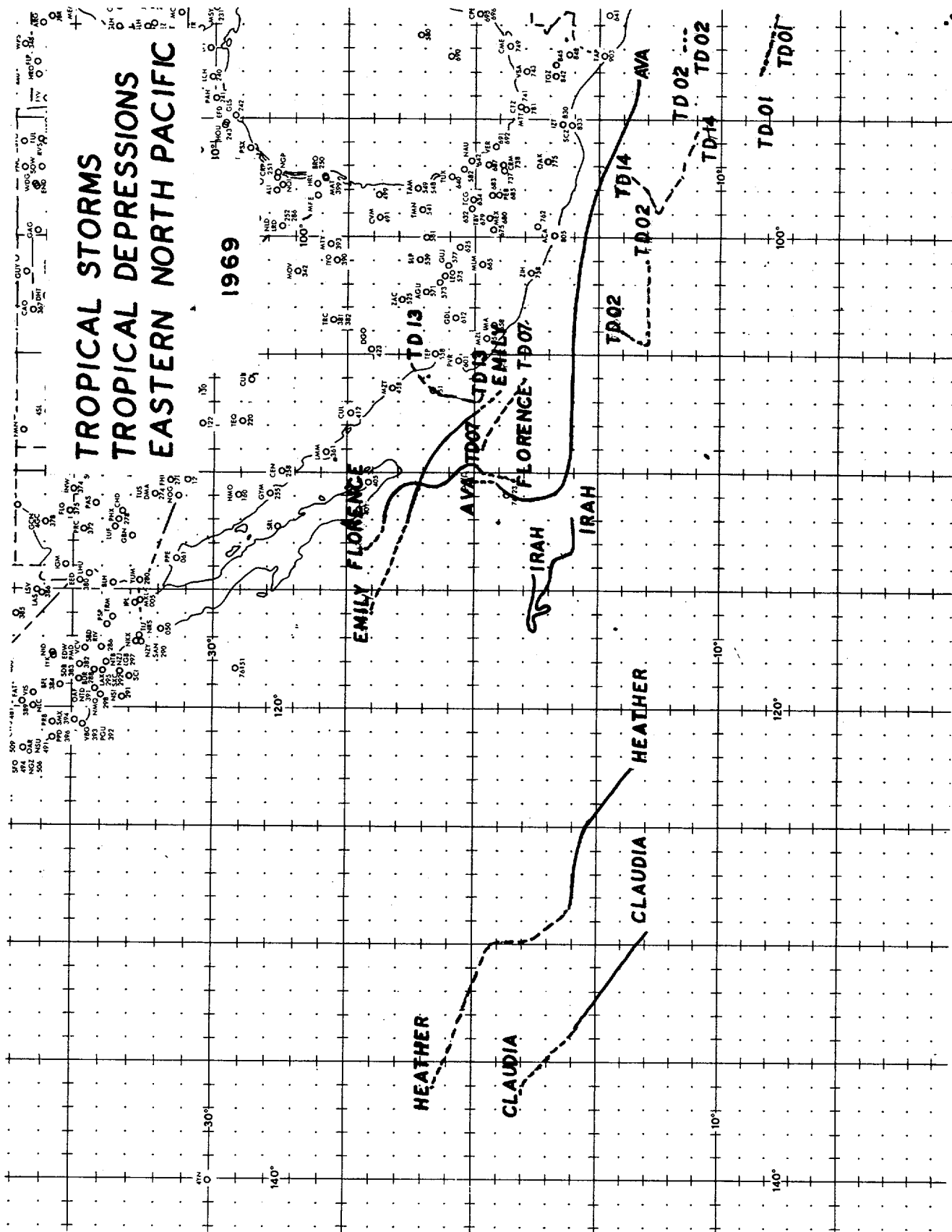
SUMMARY OF TROPICAL CYCLONES

IN THE

EASTERN NORTH PACIFIC OCEAN

FOR

1969



9691

EASTERN NORTH PACIFIC



During the 1969 EastPac Tropical Cyclone season, Fleet Weather Central, Alameda, issued a total of 219 Tropical Warnings on four hurricanes, six tropical storms and five tropical depressions. No tropical cyclones originating in Fleet Weather Central, Alameda's area moved out of the area. The 15 tropical cyclones identified this year is the lowest number since 1965 and the number of warnings was the lowest since 1964, reflecting an unusually inactive season. No specific reasons for this apparent inactivity have been determined.

The following eight year summary covering tropical cyclones originating in Fleet Weather Central, Alameda's area of responsibility is presented for comparison. Included are warnings issued by Fleet Weather Central, Pearl Harbor, when the tropical cyclone originated in the Alameda area.

	<u>1962</u>	<u>1963</u>	<u>1964</u>	<u>1965</u>	<u>1966</u>	<u>1967</u>	<u>1968</u>	<u>1969</u>
Total Number of Warnings*	122	80	60	244	342	474	531	219
Calendar Days of Warnings*	35	26	21	73	70	119	126	67
Tropical Depressions*				2	6	2	6	5
Tropical Storms	6	5	4	9	6	12	13	6
Hurricanes	2	4	2	1	7	6	6	4
Total Tropical Cyclones*	8	9	6	12	19	20	25	15

*Tropical Depression information not available 1962-1964

Jennifer was the only tropical cyclone that caused damage on land. One person was killed, 15 injured and a large ferry and 12 shrimp boats were reported swamped at Mazatlan, Mexico. Thirty other shrimp boats were reported lost in smaller harbors nearby. There was extensive property damage along a 100 mile section of the coast but information on money amounts and specific losses are not available. The highest reported winds at Mazatlan Airport were 50 knots with gusts to 70 at 2100Z, 11 October.

Forecasting tools used included twice daily readouts of the Fleet Numerical Weather Central's "HATRACK" steering program, extrapolation and subjective reasoning. While a definitive study of the various techniques has not been made, the latter two methods, coordinated with the Hurricane Warning Office, ESSA Weather Bureau, San Francisco, appear to be the most successful.

This season marked the inauguration of U. S. Navy responsibility in the Eastern Pacific for tropical cyclone reconnaissance. Efforts were limited by resources (two EC-131 aircraft and two meteorological crews operating from the Pacific Missile Range, Pt. Mugu, California) and no routinely available staging points from which to base aircraft to cover distant storms (more than 1200 nautical miles from Pt. Mugu). Early in the season Acapulco, Mexico was used but 48 hours advance notification was required. Later in the season, limited funds precluded the use of Acapulco except in an emergency. Because of the aircraft configuration (EC-121 vice WC-121), penetrations could not be made and low level eye data was not available. The USAF continued to fly tropical cyclone reconnaissance missions in addition to scheduled Navy flights. High level reconnaissance data are available from that source.

Limited resources, coupled with the great distance at which most of the tropical cyclones were found caused APT data to remain as in previous years, the primary source of fixes. Insufficient reconnaissance data were available to make any meaningful verification of tropical cyclone intensity estimates based on satellite pictures.

TROPICAL CYCLONES FOR THE 1969 SEASON

ORIGINATED BY FLEET WEATHER CENTRAL, ALAMEDA

	<u>CYCLONE</u>	<u>PERIOD</u>
01	Tropical Depression 01	31 May 1969
02	Tropical Depression 02	04 June-05 June 1969
	REGENERATED	07 June-08 June 1969
03	Tropical Storm AVA	02 July-07 July 1969
04	Hurricane BERNICE	08 July-17 July 1969
05	Tropical Storm CLAUDIA	21 July-23 July 1969
06	Hurricane DOREEN	04 August-09 August 1969
07	Tropical Depression 07	09 August 1969
08	Tropical Storm EMILY	22 August-24 August 1969
09	Tropical Storm FLORENCE	02 September-07 September 1969
10	Hurricane GLENDA	08 September-12 September 1969
11	Tropical Storm HEATHER	18 September-22 September 1969
	REGENERATED	23 September-25 September 1969
12	Tropical Storm IRAH	30 September-03 October 1969
13	Tropical Depression 13	03 October-04 October 1969
14	Tropical Depression 14	03 October-05 October 1969
15	Hurricane JENNIFER	08 October-12 October 1969

Below is a summary of aircraft fixes made on hurricanes and tropical storms during the 1969 season.

<u>CYCLONE</u>	<u>DATE/TIME REQ.</u>	<u>DATE/TIME FIX</u>	<u>REMARKS</u>
DOREEN 4-9 Aug	061800Z 071800Z 081800Z	061730Z 071800Z 081905Z	USAF FIX ALSO AT 071800Z 071800Z
EMILY 22-24 Aug	240000Z	232300Z	USAF FIX ALSO AT 231840Z
FLORENCE 2-7 Sep	031800Z 050000Z 060000Z 080000Z	031755Z 042340Z 052315Z CANCELED	USAF FIX ALSO AT 041824Z USAF FIX ALSO AT 951732Z USAF FIX AT 061805Z. NAVY RECON CANCELED DUE STORM DISSIPATION
GLENDIA 8-12 Sep	091800Z 110000Z 120000Z	091800Z 110000Z 120030Z	USAF FIX ALSO AT 091748Z USAF FIX ALSO AT 101730Z USAF FIX ALSO AT 111713Z
HEATHER 18-25 Sep	NO NAVY RECON REQUESTED		USAF FIX AT 201825Z USAF FIX AT 211809Z
IRAH 30 Sep- 3 Oct	011800Z 030000Z	011900Z NO FIX	USAF FIX ALSO AT 011800Z ACFT FLEW BUT UNABLE TO LOCATE DISCERNABLE CENTER
JENNIFER 8-12 Oct	110000Z 120000Z	NO FIX CANCELED	ACFT NOT AVAIL FOR RECON FLIGHT. USAF FIXED AT 091800Z AND 101740Z STORM DISSIPATED. USAF FIX AT 111800Z

A total of 15 requests for Navy reconnaissance were made and two were subsequently canceled. Of the 13 remaining requests, only one could not be met and that was due to non-availability of aircraft. Twelve Navy reconnaissance flights were made. During the same period the U.S. Air Force 9th Weather Reconnaissance Wing flew 14 missions.

TROPICAL DEPRESSIONS 1969
POSITION DATA

TROPICAL DEPRESSION ZERO ONE
31 MAY 1969

DTG	LAT	LONG	DTG	LAT	LONG
310600Z	07.8N	90.4W	311800Z	08.2N	93.0W
311200Z	08.0N	92.0W			

TROPICAL DEPRESSION ZERO TWO
04 JUN - 05 JUN 1969

DTG	LAT	LONG	DTG	LAT	LONG
041600Z	11.5N	91.0W	*071800Z	13.0N	104.5W
041800Z	11.5N	91.3W	080000Z	13.5N	105.0W
050000Z	11.5N	92.0W	080600Z	13.7N	105.7W
**070000Z	13.5N	102.5W	081200Z	13.7N	106.0W
*070600Z	13.0N	101.0W	081800Z	14.0N	104.0W
071200Z	13.3N	102.0W			

TROPICAL DEPRESSION ZERO SEVEN
09 AUG 1969

DTG	LAT	LONG	DTG	LAT	LONG
090000Z	18.0N	106.0W	091200Z	18.6N	107.6W
090600Z	18.4N	106.8W	091800Z	19.8N	109.0W

TROPICAL DEPRESSION ONE THREE
03 OCT - 04 OCT 1969

DTG	LAT	LONG	DTG	LAT	LONG
031800Z	20.0N	107.0W	040600Z	22.5N	105.5W
040000Z	21.2N	106.8W			

TROPICAL DEPRESSION ONE FOUR
03 OCT - 05 OCT 1969

DTG	LAT	LONG	DTG	LAT	LONG
031800Z	11.0N	95.5W	041800Z	13.0N	97.0W
040000Z	11.5N	97.3W	050000Z	13.5N	97.5W
040600Z	12.0N	98.0W	050600Z	DISSIPATED	
041200Z	12.6N	99.0W			

*RELOCATED
**REGENERATED

TROPICAL STORMS 1969
POSITION DATA

TROPICAL STORM AVA
2 JUL - 7 JUL

DTG	LAT	LONG	DTG	LAT	LONG
020600Z	13.4N	93.4W	050000Z	16.0N	109.0W
021200Z	13.5N	94.1W	050600Z	16.0N	110.0W
021800Z	13.6N	95.5W	051200Z	16.0N	112.5W
030000Z	13.8N	96.6W	*051800Z	16.5N	111.5W
030600Z	14.0N	97.6W	060000Z	16.7N	112.0W
031200Z	14.2N	98.6W	060600Z	16.8N	112.5W
*031600Z	15.8N	102.0W	061200Z	17.0N	113.0W
031800Z	16.0N	102.5W	*061800Z	18.5N	110.0W
040000Z	16.0N	103.5W	070000Z	19.2N	110.2W
040600Z	16.5N	104.5W	070600Z	19.9N	110.2W
041200Z	16.8N	105.5W	071200Z	20.0N	110.3W
*041800Z	16.0N	108.3W	071800Z	20.0N	110.3W

TROPICAL STORM CLAUDIA
21 JUL - 23 JUL

DTG	LAT	LONG	DTG	LAT	LONG
211800Z	13.0N	129.5W	*221800Z	15.7N	133.5W
220000Z	12.5N	131.0W	230000Z	16.5N	134.4W
220600Z	12.5N	132.0W	230600Z	17.3N	135.3W
221200Z	12.5N	133.0W	231200Z	18.0N	136.2W

TROPICAL STORM EMILY
22 AUG - 24 AUG

DTG	LAT	LONG	DTG	LAT	LONG
221800Z	19.0N	106.5W	240000Z	22.7N	112.1W
230000Z	20.2N	106.6W	240600Z	23.1N	113.2W
230600Z	21.1N	107.3W	241200Z	23.6N	114.5W
231200Z	22.0N	108.2W	241800Z	24.0N	116.0W
231800Z	22.2N	110.8W			

* RELOCATED

TROPICAL STORM FLORENCE
02 SEP - 07 SEP

DTG	LAT	LONG	DTG	LAT	LONG
021800Z	18.5N	110.2W	050600Z	21.1N	110.0W
030000Z	19.3N	110.5W	051200Z	21.4N	110.0W
030600Z	20.0N	110.8W	051800Z	21.6N	110.6W
031200Z	20.8N	111.0W	060000Z	22.2N	110.4W
031800Z	19.6N	110.0W	060600Z	23.0N	111.6W
040000Z	20.0N	109.5W	*061200Z	23.1N	111.7W
040600Z	20.4N	109.3W	061800Z	23.5N	112.1W
041200Z	20.9N	109.1W	070000Z	23.8N	112.5W
041800Z	20.7N	110.0W	070600Z	24.2N	113.2W
050000Z	20.8N	110.0W			

TROPICAL STORM HEATHER
18 SEP - 22 SEP
23 SEP - 25 SEP

DTG	LAT	LONG	DTG	LAT	LONG
181800Z	13.5N	122.5W	220000Z	16.0N	128.5W
190000Z	13.8N	123.8W	*220600Z	17.0N	130.0W
190600Z	14.0N	124.8W	221200Z	17.3N	130.5W
191200Z	14.2N	125.8W	221800Z	17.6N	129.8W
*191800Z	15.3N	124.8W	**231800Z	19.2N	130.0W
200000Z	15.6N	125.5W	240000Z	20.0N	130.5W
200600Z	16.1N	126.3W	240600Z	20.4N	130.8W
201200Z	16.1N	126.8W	241200Z	20.7N	131.1W
201800Z	16.0N	127.5W	241800Z	20.4N	132.8W
210000Z	16.0N	127.7W	250000Z	20.7N	133.2W
210600Z	16.0N	128.4W	250600Z	21.0N	133.6W
211200Z	16.0N	129.0W	251200Z	21.3N	134.0W
211800Z	16.0N	128.0W	251800Z	21.5N	136.1W

TROPICAL STORM IRAH
30 SEP - 03 OCT

DTG	LAT	LONG	DTG	LAT	LONG
300000Z	16.0N	112.0W	020000Z	17.5N	116.0W
300600Z	16.0N	112.5W	020600Z	17.5N	116.5W
301200Z	16.0N	113.3W	021200Z	17.5N	117.0W
301800Z	16.8N	113.6W	021800Z	17.5N	114.5W
010000Z	16.9N	114.2W	030000Z	17.5N	114.5W
010600Z	17.2N	115.0W	030600Z	17.5N	114.5W
011200Z	17.5N	115.8W	031200Z	17.5N	114.5W
011800Z	17.0N	115.5W	031800Z	17.5N	114.5W

*RELOCATED
**REGENERATED

INDIVIDUAL HURRICANE TRACKS
FOR 1969
IN THE EASTERN NORTH PACIFIC OCEAN

NOTE: Due to a lack of reconnaissance data, accurate intensities could not be determined and thus are not included with the hurricane best tracks.

HURRICANE BERNICE - 07/08/1800Z TO 07/17/0600Z

I. DATA

A. STATISTICS

1. NUMBER OF WARNINGS ISSUED - 35
2. NUMBER OF WARNINGS WITH HURRICANE INTENSITY - 8
3. DISTANCE TRAVELED DURING WARNING PERIOD - 1994 MILES

B. CHARACTERISTICS

1. MINIMUM OBSERVED SLP - UNKNOWN
2. MINIMUM OBSERVED 700 MB HEIGHT - UNKNOWN
3. MAXIMUM SURFACE WIND - 75 KT (EST.)
4. MAXIMUM RADIUS OF SURFACE CIRCULATION - 150 MILES

II. DEVELOPMENT

A. INITIAL IMPETUS - ITCZ

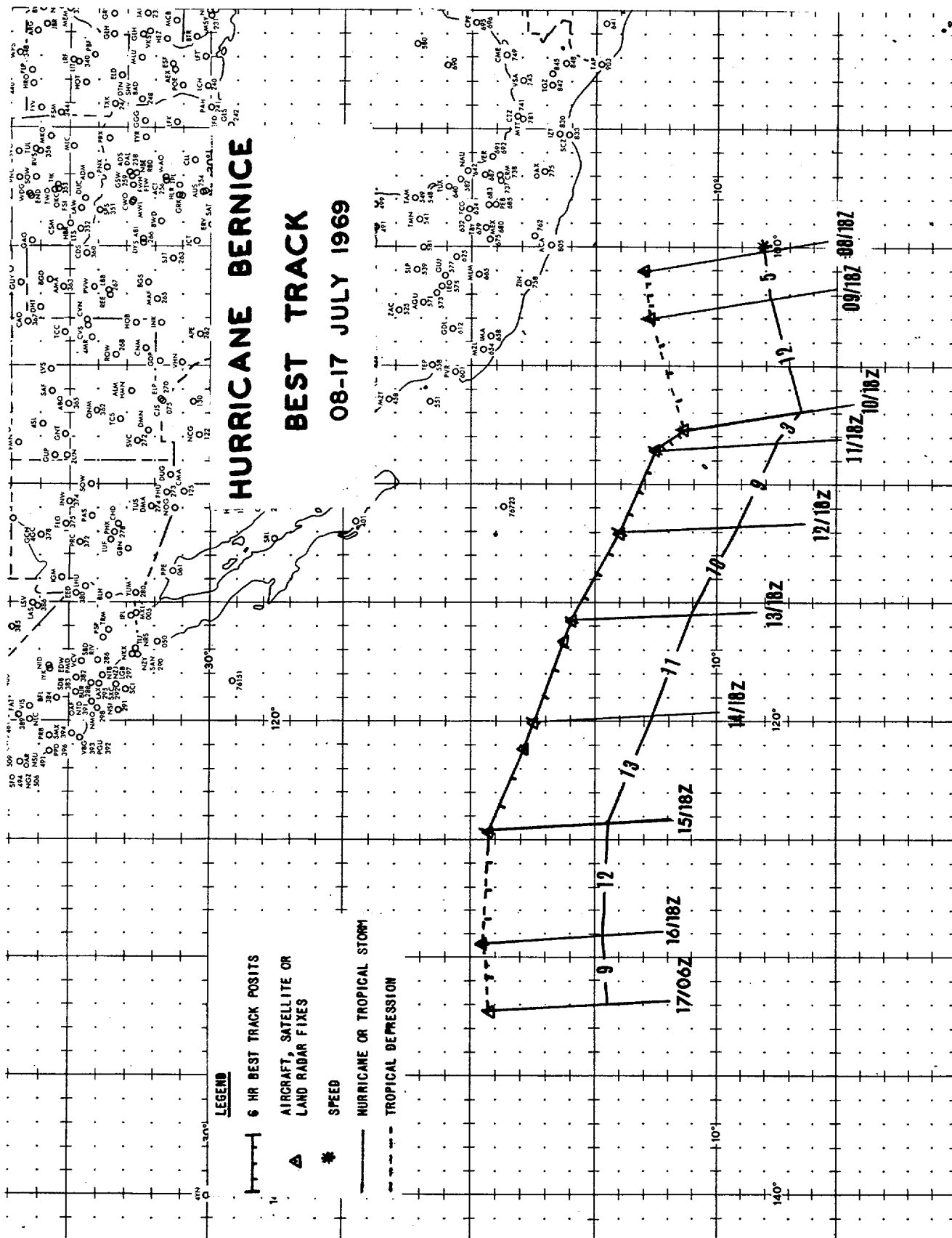
B. INITIAL SURFACE VORTEX

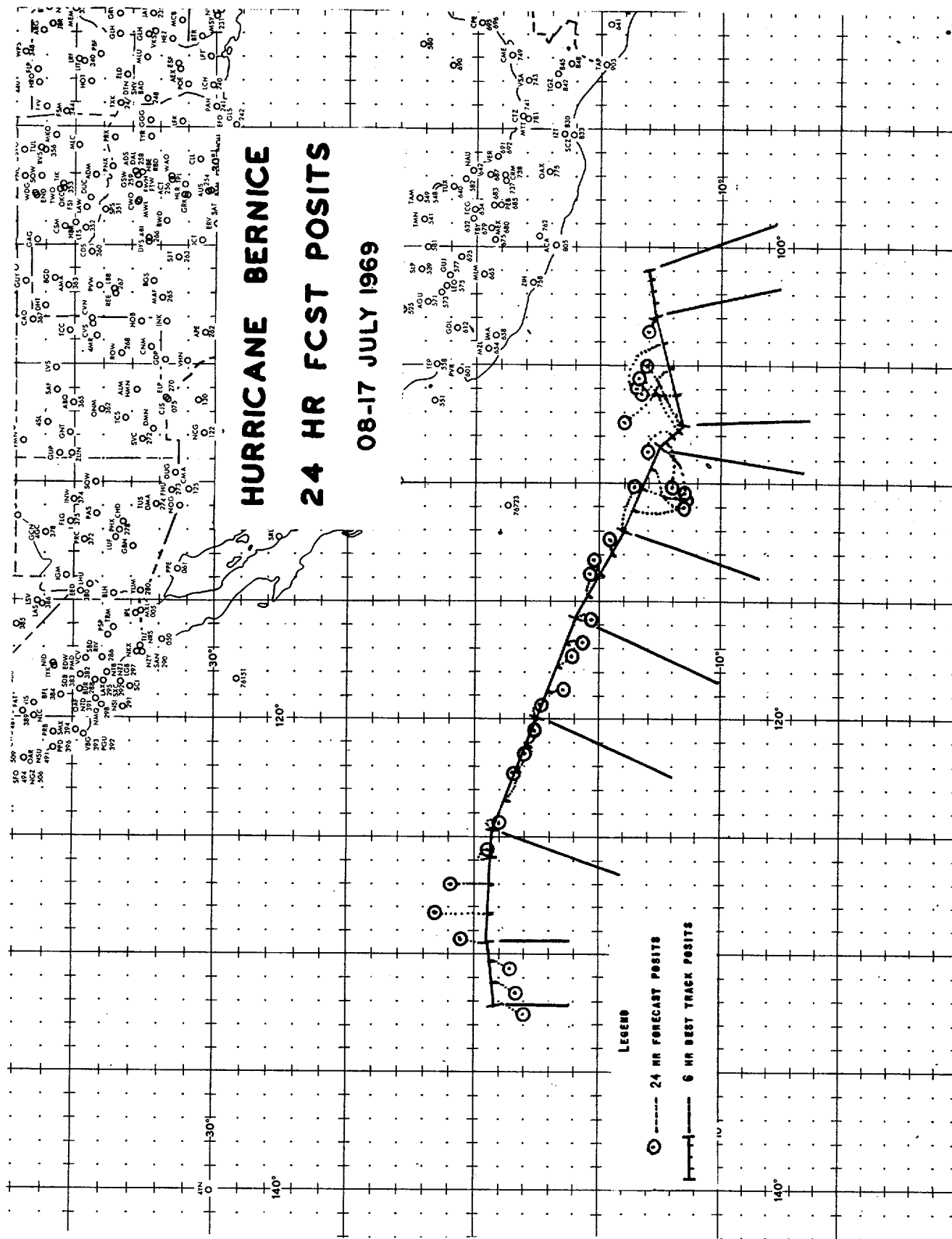
1. 081800Z
2. SURFACE PRESSURE LESS THAN 1008 MB

C. TIME STORM REACHED HURRICANE INTENSITY - 121800Z

III. FINAL DISPOSITION

A. DISSIPATED OVER WATER





HURRICANE BERNICE
08-17 JULY 1969

DTG	LAT	LONG	24 HR ERROR	48 HR ERROR	72 HR ERROR
081800Z	13.0N	101.0W	-	-	-
090000Z	13.0N	102.5W	-	-	-
090600Z	13.2N	102.5W	-	-	-
091200Z	12.5N	102.5W	-	-	-
091800Z	12.8N	103.0W	300/33	-	-
100000Z	13.0N	103.5W	280/154	-	-
100600Z	13.0N	105.5W	295/134	-	-
101200Z	12.0N	107.0W	040/112	-	-
101800Z	11.5N	107.5W	060/178	-	-
110000Z	11.5N	108.2W	055/212	-	-
110600Z	11.5N	107.5W	320/114	-	-
111200Z	11.5N	108.0W	285/135	-	-
111800Z	12.5N	108.5W	240/123	-	-
120000Z	13.0N	109.5W	225/127	-	-
120600Z	13.5N	110.2W	190/122	-	-
121200Z	13.8N	111.0W	205/152	-	-
121800Z	14.0N	112.0W	105/110	200/162	-
130000Z	14.4N	113.0W	065/44	195/180	-
130600Z	14.8N	114.0W	060/58	125/210	-
131200Z	15.2N	114.9W	085/68	165/231	-
131800Z	16.0N	115.7W	190/42	110/238	-
140000Z	16.3N	116.6W	200/38	090/84	185/286
140600Z	16.6N	117.5W	220/40	075/72	-
141200Z	17.0N	118.5W	200/33	095/113	165/340
141800Z	17.5N	120.0W	100/31	120/58	-
150000Z	17.9N	121.1W	110/46	115/50	095/180
150600Z	18.5N	122.3W	115/65	115/78	-
151200Z	19.0N	123.5W	200/34	110/87	095/208
151800Z	19.3N	124.8W	110/25	120/90	-
160000Z	19.3N	126.0W	070/32	100/108	120/98
160600Z	19.1N	127.1W	005/106	005/123	-
161200Z	18.9N	128.2W	360/154	135/87	120/114
161800Z	19.5N	129.5W	010/60	045/41	-
170000Z	19.5N	130.7W	175/60	025/106	075/170
170600Z	19.3N	132.2W	115/72	010/226	-

24 HOUR FORECAST ERROR = 87.6 MILES
48 HOUR FORECAST ERROR = 123.4 MILES
72 HOUR FORECAST ERROR = 199.4 MILES

HURRICANE DOREEN - 08/04/1800Z TO 08/09/1200Z

I. DATA

A. STATISTICS

1. NUMBER OF WARNINGS ISSUED - 20
2. NUMBER OF WARNINGS WITH HURRICANE INTENSITY - 6
3. DISTANCE TRAVELED DURING WARNING PERIOD - 875 MILES

B. CHARACTERISTICS

1. MINIMUM OBSERVED SLP - UNKNOWN
2. MINIMUM OBSERVED 700 MB HEIGHT - NOT OBSERVED
3. MAXIMUM SURFACE WIND - 75 KT (EST.)
4. MAXIMUM RADIUS OF SURFACE CIRCULATION - 300 MILES

II. DEVELOPMENT

A. INITIAL IMPETUS - ITCZ

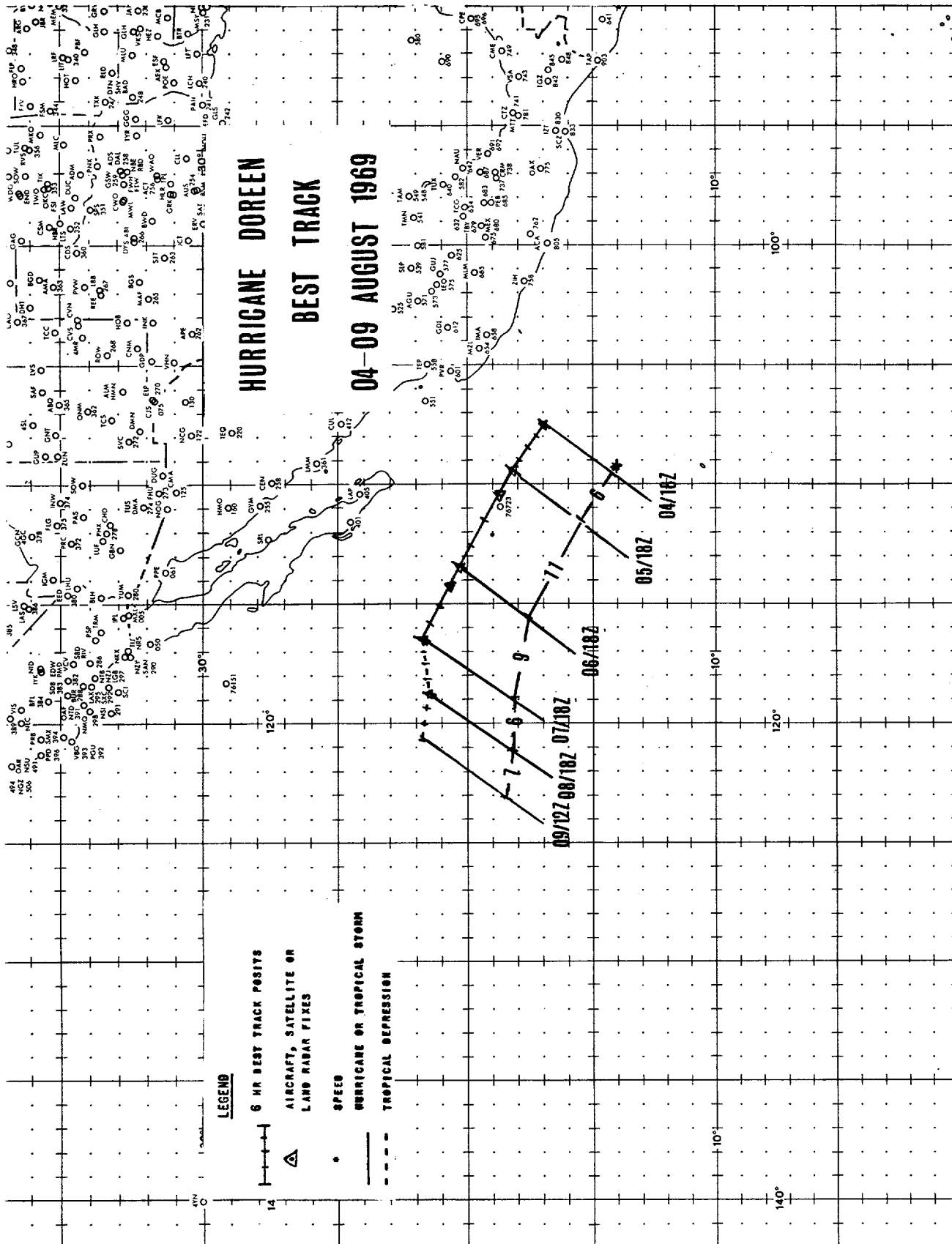
B. INITIAL SURFACE VORTEX

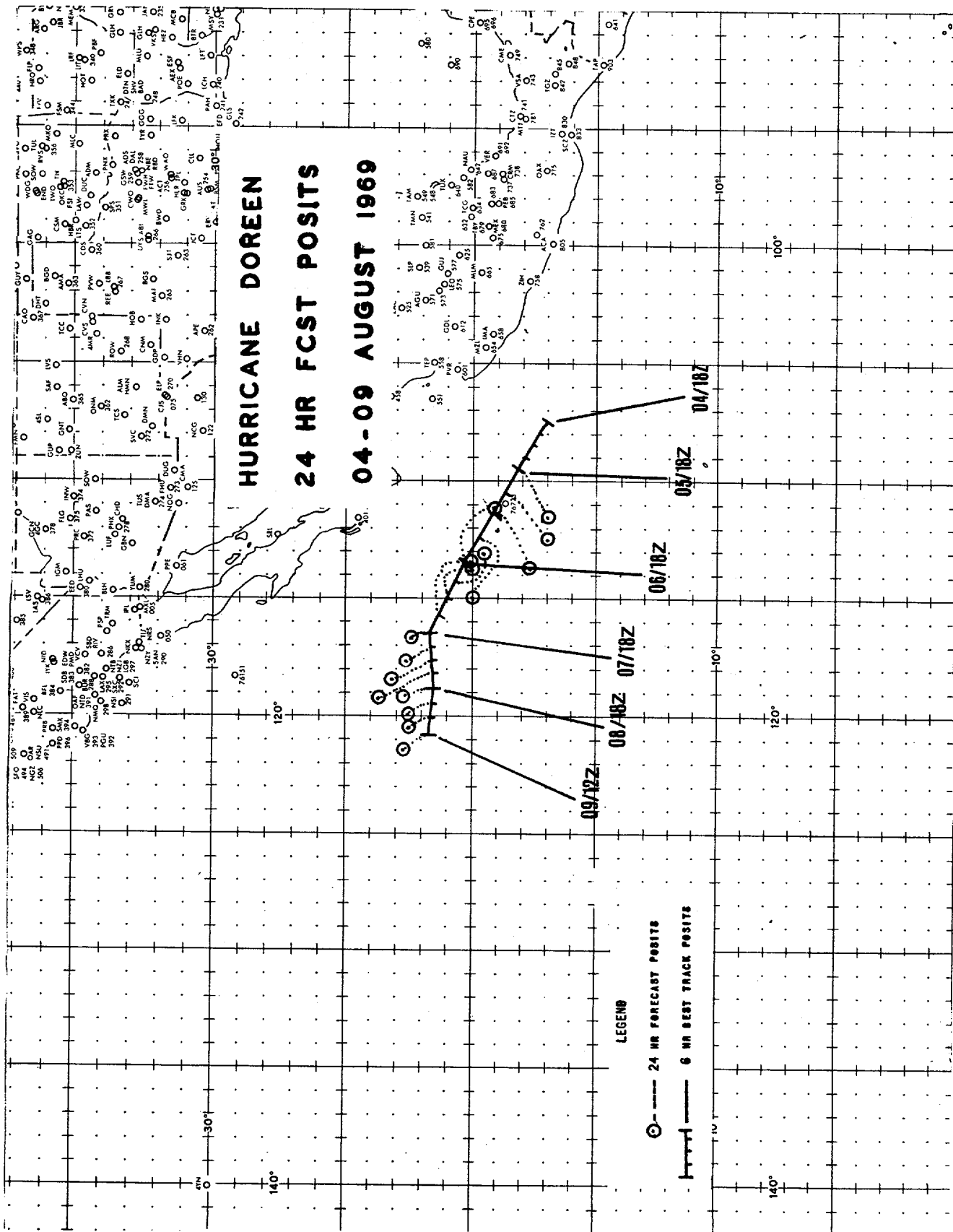
1. 041800Z
2. SURFACE PRESSURE LESS THAN 1008 MB

C. TIME STORM REACHED HURRICANE INTENSITY - 051800Z

III. FINAL DISPOSITION

A. DISSIPATED OVER WATER





HURRICANE DOREEN
04-09 AUGUST 1969

DTG	LAT	LONG	24 HR ERROR	48 HR ERROR	72 HR ERROR
041800Z	17.0N	107.5W	-	-	-
050000Z	17.0N	108.5W	-	-	-
050600Z	17.0N	109.5W	-	-	-
051200Z	17.7N	110.7W	-	-	-
051800Z	18.2N	109.5W	240/135	-	-
060000Z	18.7N	110.0W	220/133	-	-
060600Z	18.8N	111.5W	240/144	-	-
061200Z	19.1N	111.9W	285/192	-	-
061800Z	20.3N	113.4W	115/150	215/235	-
070000Z	20.6N	114.1W	135/75	220/210	-
070600Z	21.1N	115.0W	132/96	222/238	-
071200Z	21.6N	115.8W	125/158	280/204	-
071800Z	21.8N	116.5W	340/36	115/230	-
080000Z	22.0N	117.0W	315/52	130/115	230/270
080600Z	22.1N	117.7W	323/74	118/117	-
081200Z	22.2N	118.4W	330/96	110/195	290/355
081800Z	21.5N	118.8W	350/75	335/192	-
090000Z	21.6N	119.7W	355/57	330/195	080/120
090600Z	21.6N	120.3W	355/60	335/226	-
091200Z	21.7N	120.8W	330/74	335/250	075/260

24 HOUR FORECAST ERROR = 100.4 MILES
48 HOUR FORECAST ERROR = 200.6 MILES
72 HOUR FORECAST ERROR = 251.3 MILES

HURRICANE GLENDA - 09/08/0000Z to 09/12/0600Z

I. DATA

A. STATISTICS

1. NUMBER OF WARNINGS ISSUED - 18
2. NUMBER OF WARNINGS WITH HURRICANE INTENSITY 1
3. DISTANCE TRAVELED DURING WARNING PERIOD - 1248 MILES

B. CHARACTERISTICS

1. MINIMUM OBSERVED SEA LEVEL PRESSURE - UNKNOWN
2. MINIMUM OBSERVED 700 MB HEIGHT - UNKNOWN
3. MAXIMUM SURFACE WIND - 65 KT
4. MAXIMUM RADIUS OF SURFACE CIRCULATION - 125 MILES

II. DEVELOPMENT

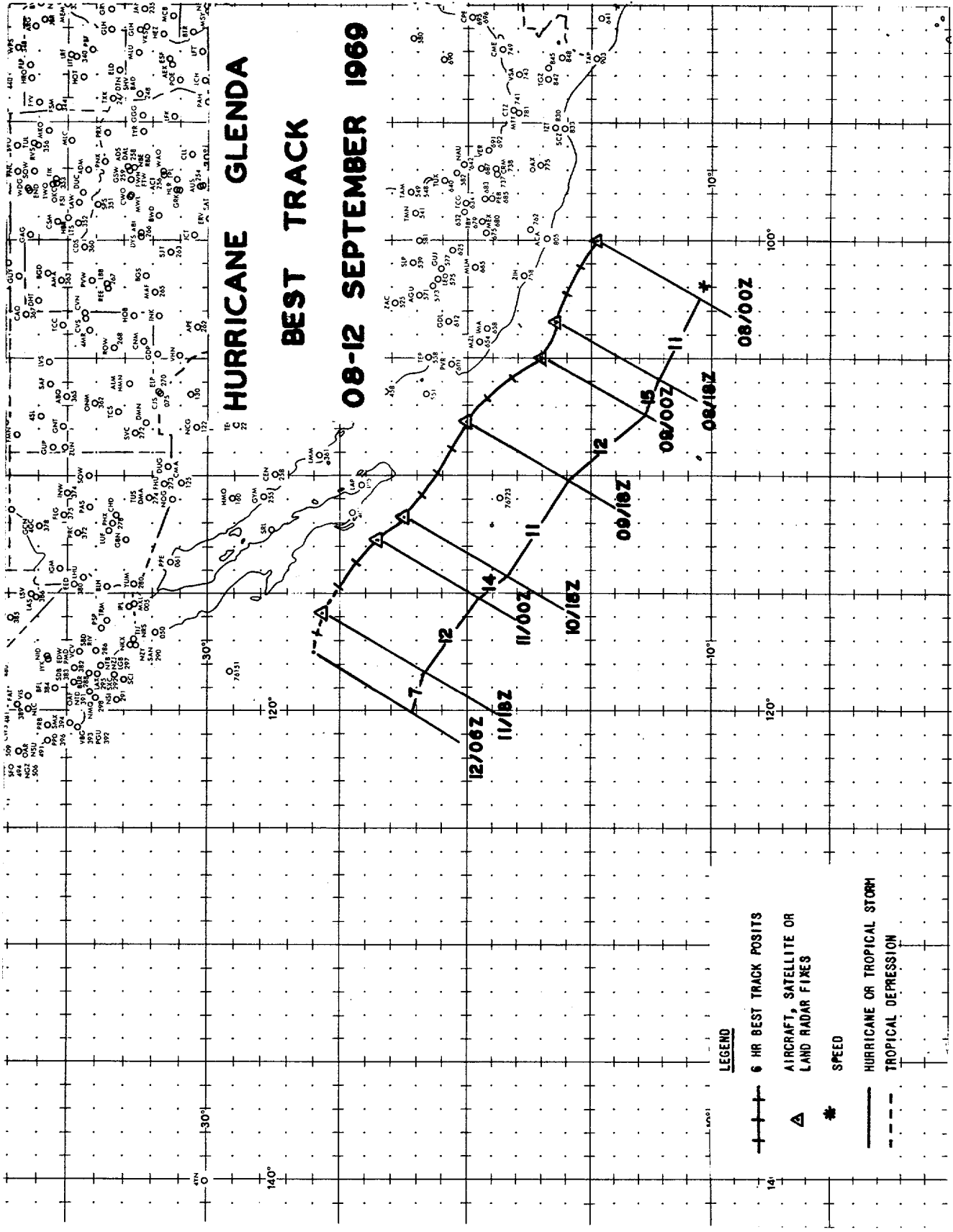
A. INITIAL IMPETUS - ITCZ

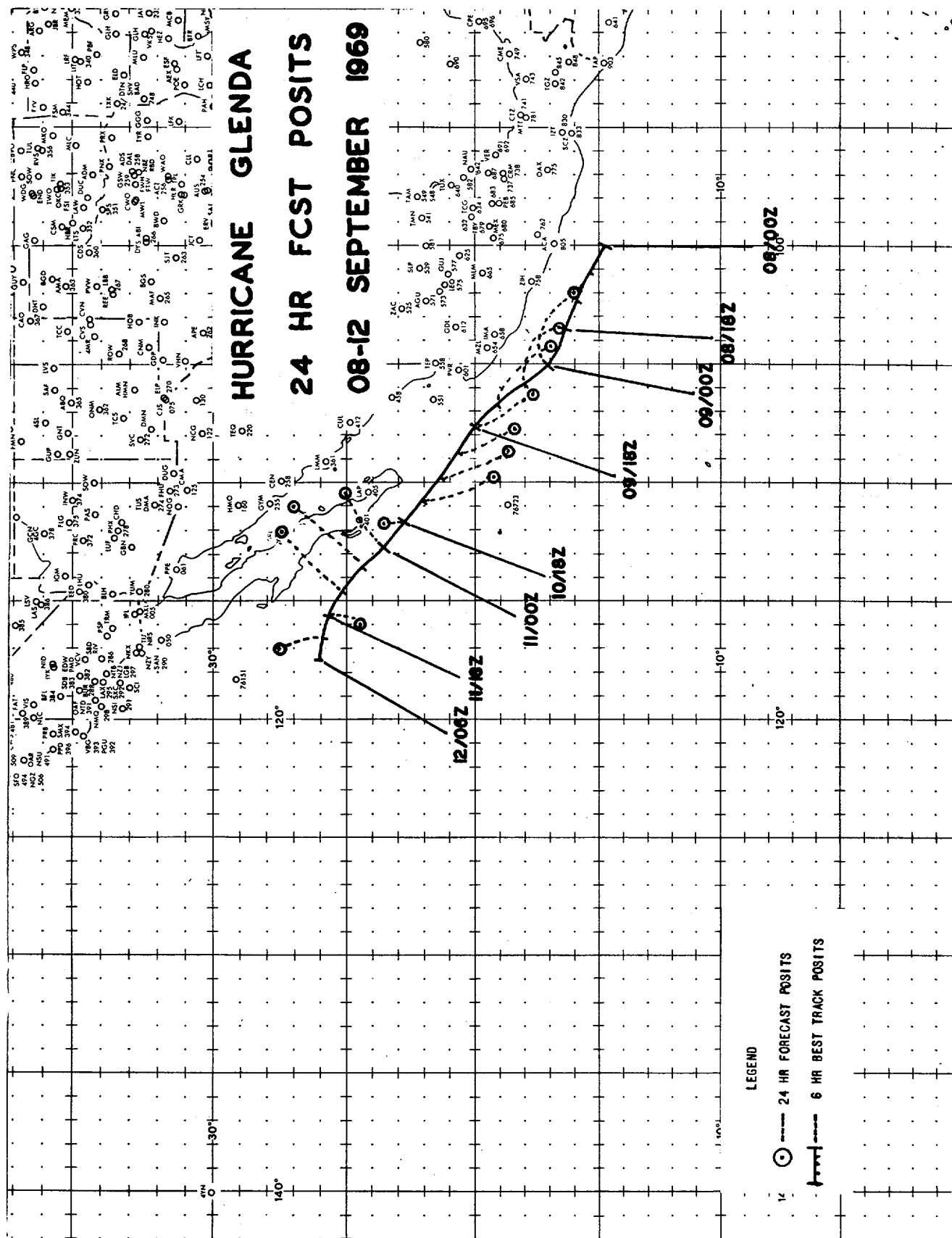
B. INITIAL SURFACE VORTEX

1. 080000Z
2. SURFACE PRESSURE LESS THAN 1008 MB

III. FINAL DISPOSITION

A. DISSIPATED OVER WATER





HURRICANE GLEND
08-12 SEPTEMBER 1969

DTG	LAT	LONG	24 HR ERROR	48 HR ERROR	72 HR ERROR
080000Z	14.8N	100.0W	-	-	-
080600Z	15.4N	101.5W	-	-	-
081200Z	15.7N	102.1W	-	-	-
081800Z	16.4N	103.5W	-	-	-
090000Z	17.0N	105.0W	110/185	-	-
090600Z	17.3N	105.7W	110/137	-	-
091200Z	17.7N	106.5W	110/145	-	-
091800Z	20.1N	107.7W	150/165	-	-
100000Z	21.0N	108.4W	170/165	150/258	-
100600Z	22.4N	109.1W	175/225	140/350	-
101200Z	23.5N	109.4W	185/258	150/372	-
*101800Z	22.6N	111.8W	325/45	155/230	-
110000Z	23.5N	112.7W	055/160	150/258	130/504
110600Z	24.4N	113.7W	055/270	160/280	-
111200Z	25.5N	114.0W	050/190	165/360	135/516
111800Z	25.7N	115.7W	195/78	360/68	-
120000Z	25.3N	116.6W	350/130	055/190	140/335
120600Z	26.0N	117.5W	DISSIPATED		

24 HOUR FORECAST ERROR = 165.6 MILES
48 HOUR FORECAST ERROR = 262.9 MILES
72 HOUR FORECAST ERROR = 451.7 MILES

* RELOCATED

HURRICANE JENNIFER - 11/08/1800Z TO 11/12/0300Z

I. DATA

A. STATISTICS

1. NUMBER OF WARNINGS ISSUED - 15
2. NUMBER OF WARNINGS WITH HURRICANE INTENSITY - 8
3. DISTANCE TRAVELED DURING WARNING PERIOD - 754 NM

B. CHARACTERISTICS

1. MINIMUM OBSERVED SEA LEVEL PRESSURE - N/A
2. MINIMUM OBSERVED 700 MB HEIGHT - N/A
3. MAXIMUM SURFACE WIND - 70 KTS
4. MAXIMUM RADIUS OF SURFACE CIRCULATION - 65 NM

II. DEVELOPMENT

A. INITIAL IMPETUS - ITCZ

B. INITIAL SURFACE VORTEX

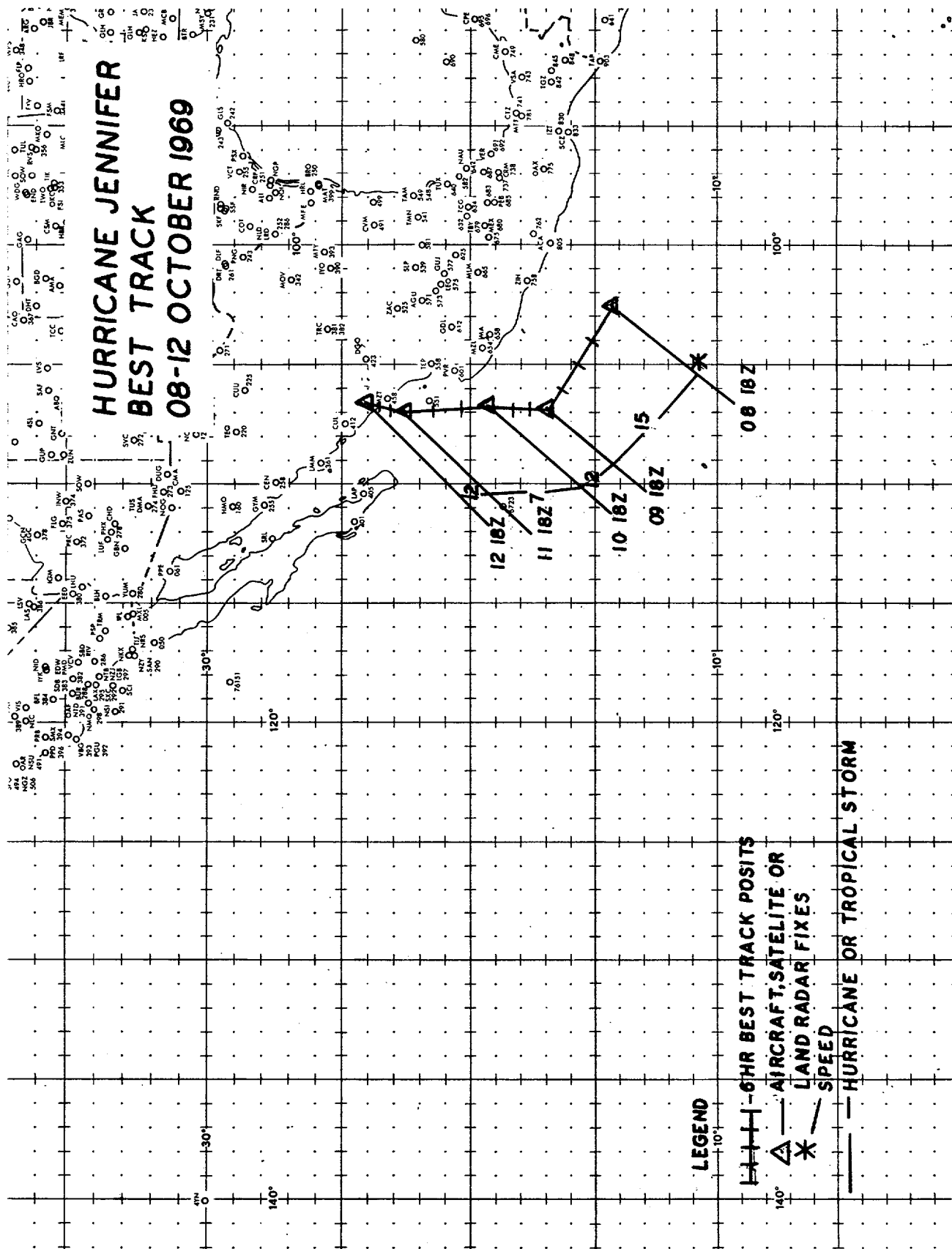
1. 08/1800Z
2. SURFACE PRESSURE LESS THAN 1008 MB

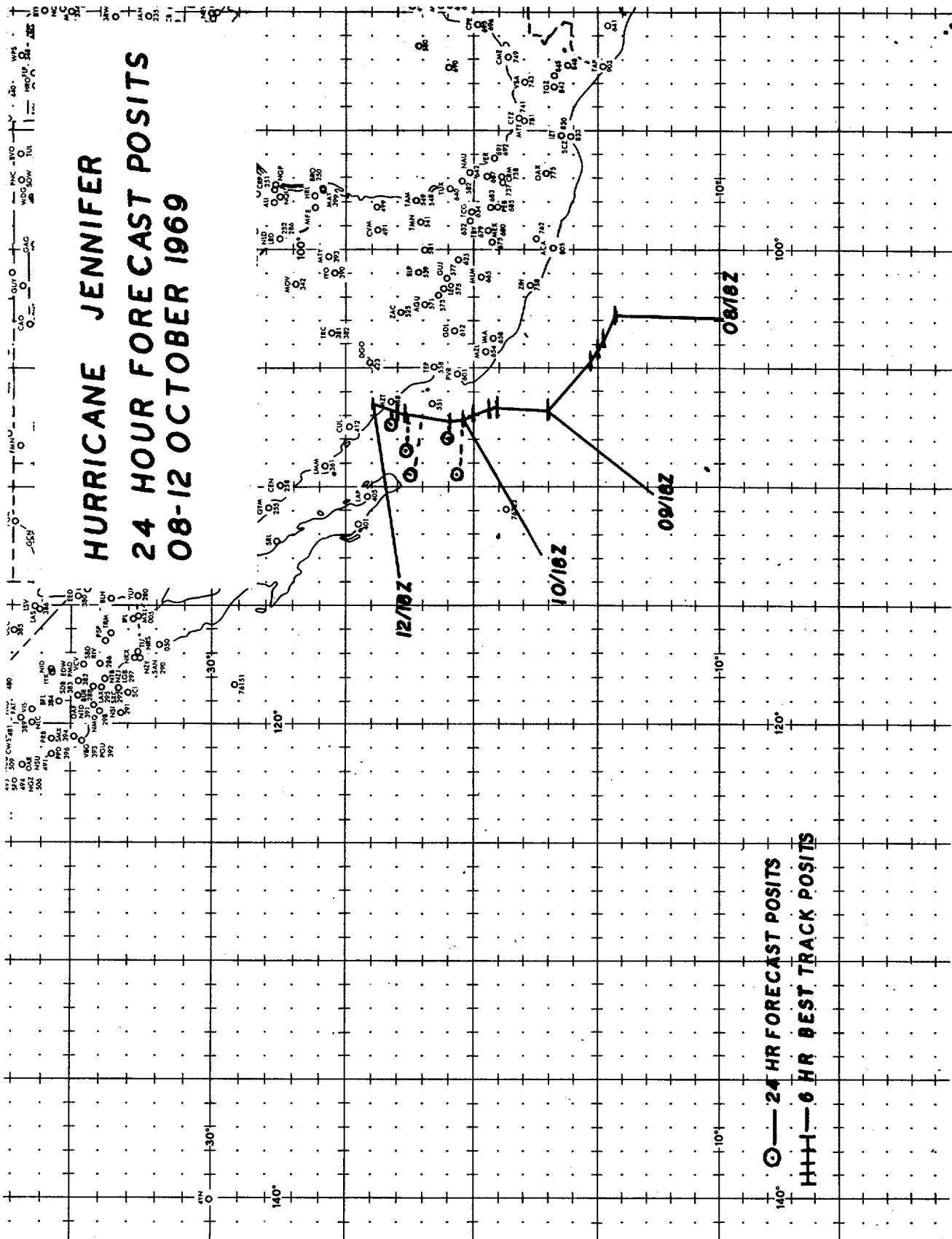
C. TIME STORM REACHED HURRICANE INTENSITY - 09/1800Z

III. FINAL DISPOSITION

A. DISSIPATED OVER LAND.

HURRICANE JENNIFER BEST TRACK 08-12 OCTOBER 1969





HURRICANE JENNIFER
08-12 NOVEMBER 1969

DTG	LAT	LONG	24 HR ERROR	48 HR ERROR	72 HR ERROR
081800Z	14.0N	102.5W	-	-	-
090000Z	14.2N	102.7W	-	-	-
090600Z	14.8N	104.6W	-	-	-
091200Z	15.2N	106.2W	-	-	-
091800Z	17.0N	106.9W	170/132	-	-
100000Z	18.1N	107.3W	190/175	-	-
100600Z	19.2N	107.8W	200/246	-	-
101200Z	19.5N	107.8W	220/270	-	-
101800Z	19.3N	108.6W	320/115	220/252	-
110000Z	20.0N	108.8W	330/187	240/330	-
110600Z	20.3N	109.0W	360/213	240/393	-
111200Z	20.9N	109.1W	020/138	240/437	240/509
111800Z	22.7N	107.0W	-	-	-
120000Z	24.0N	106.5W	-	-	-

24 HOUR FORECAST ERROR = 185 MILES
48 HOUR FORECAST ERROR = 353 MILES
72 HOUR FORECAST ERROR = 509 MILES

APPENDIX A

ABBREVIATIONS AND DEFINITIONS

1. Words and phrases that appear frequently in this report are abbreviated as follows:

ANAL	Analysis
APT	Automatic Picture Transmission
ATS	Applications Technology Satellite
CINCPAC	Commander in Chief, Pacific
CINCPACAF	Commander in Chief, Pacific Air Force
CINCPACFLT	Commander in Chief, Pacific Fleet
CIRC	Circulation
CPA	Closest Point of Approach
DEG	Degree(s)
DTG	Date-Time Group
ESSA	Environmental Science Services Administration
FNWC	Fleet Numerical Weather Central, Monterey, California
FWC/JTWC	Fleet Weather Central/Joint Typhoon Warning Center, Guam
ITCZ or ITC	Intertropical Convergence Zone
JHWC	Joint Hurricane Warning Center, Hawaii
KT(S)	Knot(s)
MAX	Maximum
MB(S)	Millibar(s)
MIN	Minimum
MI or N.M.	Nautical Miles
MOD	Modification
NEDN	Naval Environmental Data Network
NESC	National Environmental Satellite Center, Suitland, Maryland
POSIT(S)	Position(s)
PROG	Prognosis
RECON	Reconnaissance
SLP	Sea Level Pressure
T.	Typhoon
T. D.	Tropical Depression
T. S.	Tropical Storm
VW1	Airborne Early Warning Squadron ONE
54WRS	54th Weather Reconnaissance Squadron

2. The following items define and clarify certain words and phrases that appear in the Eye Fix Summaries in Chapter V. Several definitions in this section have special meanings with regard to the machine prepared Eye Fix Summaries and may not necessarily have the same meaning as used elsewhere in the report.

a. FIX NO. - the chronological order of fixes for each individual tropical cyclone.

b. TIME - the date-time of the fix.

c. POSIT - the latitude and longitude of the fix.

d. UNIT - METHOD - ACCY:

(1) UNIT - the unit that made the fix if made by a reconnaissance squadron; 54-54WRS, VW-VW1.

(2) METHOD - the method used to make the fix; P - penetration, R - radar (these two refer to fixes by reconnaissance squadrons), LND RDR - land radar, SHP RDR - ship radar, SLTIS - satellite cloud picture location.

(3) ACCY - center determination and estimated navigational accuracy of the fix (in nautical miles).

e. FLT LVL - altitude of aircraft at time of fix in whole meters above mean sea level or given as a constant pressure surface; or, stage (STG) of development for a satellite location.

f. FLT LVL WND - maximum observed flight level wind speed in knots; or, diameter (DIA) in whole degrees of latitude for a satellite location.

g. OBS SFC WND - maximum observed surface wind speed in knots; or, number of bands (BNDS) for a satellite location.

h. OBS MIN SLP - minimum observed sea level pressure in whole millibars (reported on penetration fixes only).

i. MIN 700 MB HGT - minimum observed 700 mb level height in whole meters.

j. FLT LVL TT/TD - flight level temperature (TT) and dewpoint (TD) at fix location.

k. EYE FORM - description of cloud eye; CIRC - circular, ELIP - elliptical.

l. ORIENTATION - direction of orientation of an elliptical eye to an eight point compass.

m. EYE DIA - eye diameter or major/minor axes of an elliptical eye, in N. M.

n. THKNS WALL CLOUD - thickness of wall cloud in N. M. if observed. F. B. (feeder bands) or N. F. B. (no feeder bands) may be entered if wall cloud thickness not observed.

3. The following definitions are given to clarify usage in this report:

a. VORTICES:

(1) Cold vortex - a closed cyclonic circulation identified as having originated as a cold core system removed from the ITCZ or any easterly wave.

(2) Embedded vortex - a closed cyclonic circulation along an easterly wave and separated from the ITCZ.

(3) Junction vortex - a closed cyclonic circulation at the junction of an easterly wave and the ITCZ.

b. RECONNAISSANCE FLIGHTS:

(1) Synoptic track - a set reconnaissance pattern between specified coordinates scheduled to gather and report Meteorological data.

(2) Investigative flight - weather reconnaissance of an area containing a suspected circulation.

(3) Fix mission - aircraft reconnaissance scheduled to fix the center position of and gather peripheral data about a known tropical cyclone.

c. FIX - the determination of the position of a tropical cyclone at a precise time, generally by reconnaissance aircraft penetration of the center or by airborne, land, or ship radar. In the case of a reconnaissance aircraft penetration the actual fix may be based on any of the following: visual observation of the cloud pattern and sea surface, radar, surface pressure, surface or flight level winds, constant pressure height or temperature.

d. The term "tropical cyclone" has two definitions as used herein depending on usage:

(1) "Tropical cyclone" may be used to describe a suspect cyclonic circulation which appears to be capable of intensification.

(2) "Tropical cyclone" may be used in the general sense e.g., "Typhoon Agnes was the most intense tropical cyclone of 1968", or "tropical cyclones most frequently develop during August and September".

e. TROPICAL DEPRESSION (T.D.) - as used by JTWC this is a numbered tropical cyclone in which the maximum sustained surface wind speed is 33 knots or less and whose winds are expected to increase to 34 knots or more within 48 hours.

f. TROPICAL STORM (T.S.) - a named tropical cyclone in which the maximum sustained surface wind speed is greater than 33 knots but less than 64 knots.

g. TYPHOON/HURRICANE - a named tropical cyclone in which the maximum sustained surface wind speeds are 64 knots or greater. West of 180 degrees longitude these are called typhoons, east of

180 degrees they are called hurricanes. All references to typhoons apply equally to hurricanes.

h. Recurvature - that point at which a tropical cyclone ceases movement to the west of north and commences moving east of north.