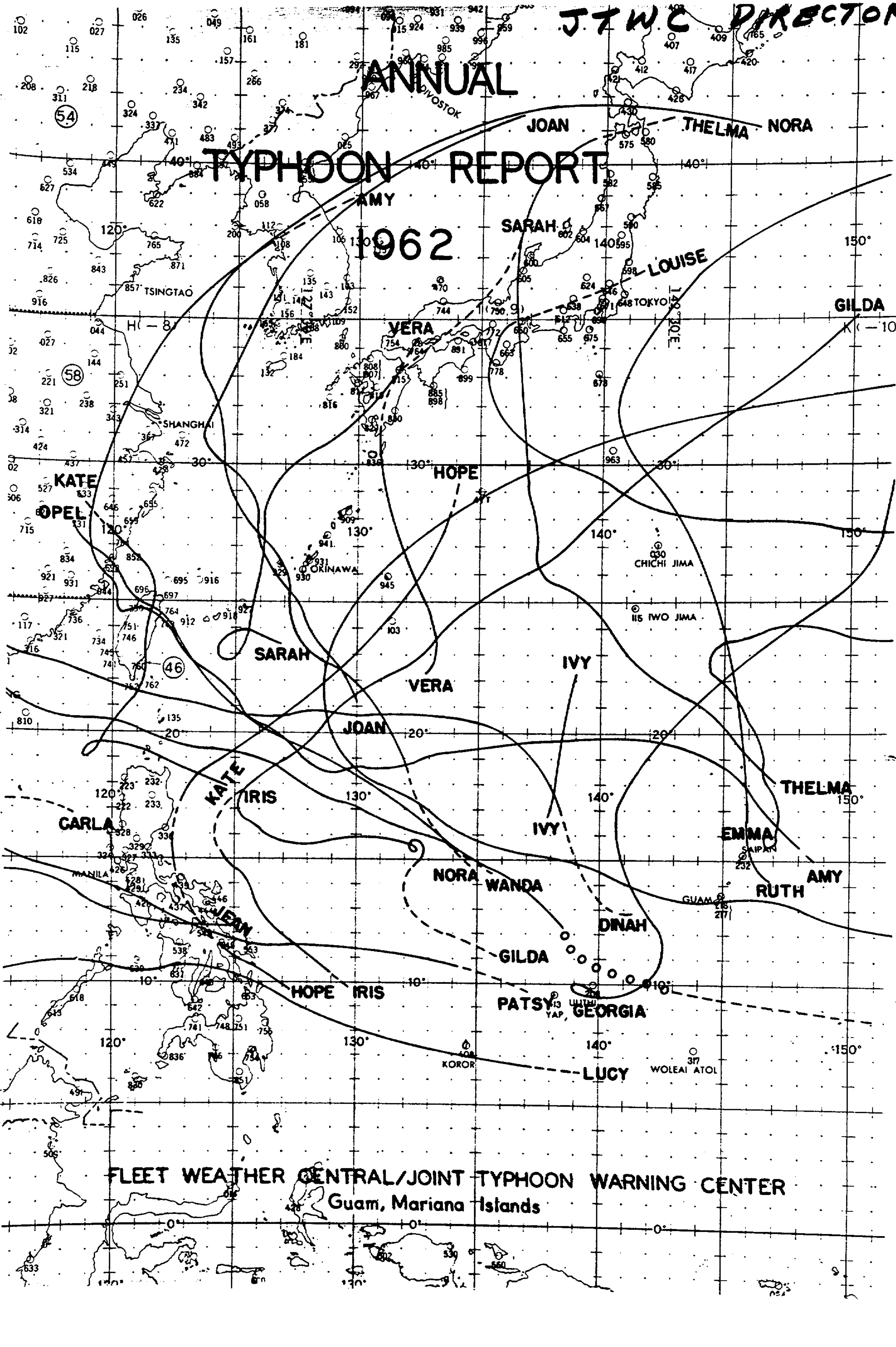
JTWC DIRECTOR

ANNUAL TYPHOON REPORT 1962



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

U. S. FLEET WEATHER CENTRAL/
JOINT TYPHOON WARNING CENTER
COMNAVMARIANAS BOX 12
SAN FRANCISCO, CALIFORNIA

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1962

ANNUAL TYPHOON REPORT

NAVAL WEATHER SERVICE

AIR WEATHER SERVICE

U. S. FLEET WEATHER CENTRAL/
JOINT TYPHOON WARNING CENTER
COMNAVMARIANAS BOX 12
SAN FRANCISCO, CALIFORNIA

FWC/JTWC:WJK:gu
3140
Ser: 46
28 January 1963

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

Subj: Annual Typhoon Report, 1962; submission of

Ref: (a) OPNAV INSTRUCTION 3140.17D

1. The Annual Typhoon Report, 1962 is submitted herewith in accordance with paragraph 4.a. of reference (a).

2. During calendar year 1962, a total of twenty-four destructive typhoons, six tropical storms, and nine tropical depressions threatened the Western Pacific area, necessitating the issuance of 815 individual warnings and the placement of the FWC/JTWC, Guam in "warning status" for 154 calendar days.

3. Despite an unusually active 1962, both politically and meteorologically, and even though the "eye" of Typhoon KAREN passed directly over Guam -- devastating the entire island the night of 11 November 1962 (including this command) -- the resourcefulness and indefatigability of my colleagues have made possible the compilation and publishing of this Report two months ahead of schedule.

William J. Kotsch
WILLIAM J. KOTSCH
CAPTAIN, U. S. NAVY

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FOREWORD

This report is published annually and summarizes Western and Central North Pacific typhoons. During 1962, no typhoons or tropical storms were reported in the Central North Pacific.

The Joint Meteorological Group, Pacific Command, through CINCPACFLT, as executive agent, redesignated Fleet Weather Central, Guam as Fleet Weather Central/Joint Typhoon Warning Center (FWC/JTWC), Guam, effective 1 May 1959, with the following additional responsibilities:

1. To provide warnings to U. S. Government agencies for all tropical cyclones west of 180 degrees longitude north of the equator to the Asiatic coast and Malayan 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.

Fuchu Air Force Weather Central, assisted as necessary by Fleet Weather Facility, Yokosuka, was designated as alternate JTWC in case of failure of FWC/JTWC, Guam.

The JTWC, which is an integral section of FWC/JTWC, Guam, is staffed by three Air Force and three Navy meteorologists and three enlisted men from each service. The senior Air Force officer has been designated as the Director, JTWC.

The Joint Hurricane Warning Center in Hawaii, a coordinated agency composed of the U. S. Weather Bureau, Honolulu, the Air Force Kunia Weather Center, and Fleet Weather Central, Pearl Harbor, is responsible for surveillance and issuance of warnings in the Central North Pacific area north of the equator between 180 degrees and west of 140 degrees west. There were two tropical depressions within this area in warning status in 1962.

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CHAPTER I

OPERATIONAL PROCEDURES

A. GENERAL

Operational procedures take two steps, that of analysis and forecast aids, in the preparation sequence prior to issuing the warning. Within the Fleet Weather Central/Joint Typhoon Warning Center (FWC/JTWC), the basic analysis is the responsibility of the Fleet Weather Central (FWC). Micro-analysis, forecast aid evaluation, and the warnings as described below, are the functions of the Joint Typhoon Warning Center (JTWC).

B. ANALYSIS - FWC/JTWC

1. Types of contour and/or streamline charts with standard times:

a. Surface, 0000Z, 0600Z, 1200Z and 1800Z.
b. Gradient level (2,000 to 3,000 ft above ground) 0000Z and 1200Z.
c. 850mb, 0000Z and 1200Z.
d. 700mb, 0000Z and 1200Z.
e. 500mb, 0000Z and 1200Z.
f. 300mb, 0000Z and 1200Z when required by JTWC.
g. 200mb, 0000Z and 1200Z.
h. 100mb, 0000Z and 1200Z when required.

2. Cross Sections:

a. Checkerboard or Stidd Diagram.
b. Time Cross Sections analyzed for θe.
c. Space Cross Section.

3. Micro-Analysis:

a. Sectional charts, hourly and 3 hourly, as required.
b. Reconnaissance reports.

4. Single and Double Space Mean Charts at 500mb with the M-2 field.

5. Easterly Wave Continuity Graph.

C. FORECAST AIDS

These are listed in alphabetical order so a priority of importance will not be established.

1. Climatology

Once a tropical cyclone has been detected, the first step in preparing to issue the initial warning is to lay out a track based on climatology. This track is laid out on the top acetate of the work chart described below so as to extend it 4 or 5 days at the speed indicated by climatology. Next, the track is modified in accordance with the existing and forecast upper-air pattern, after which the initial warning is prepared and issued. The forecast track is extended and modified with time, as reconnaissance fixes are received and the synoptic upper-air pattern changes.

The finest compilation of typhoon climatological data for the past 78 years is contained in the publication of the Royal Observatory Hong Kong, "Tropical Cyclones in the Western Pacific and China Sea Area." See 10 years of JTWC monthly best tracks in Chapter V.

2. Computer Products

In 1962, the prognoses FU-AS, PH, CI and JP54 Series, product of NMC were used extensively. Long Wave positions and prognoses were received from FNWF. Zonal Index computations are still expected from FNWF and will be evaluated as a forecast aid during the 1963 season.

FNWF and NMC provided the typhoon computer position forecasts in 1962, though irregularly received from the latter. Computer positions were considered for direction and/or speed of movement.

3. Coordination

Coordination with other U. S. agencies is routine to obtain their considerations prior to issuance of a warning. When a circulation for which warnings are being issued is N of 25N, Fuchu Air Force Weather Central transmits coordination forecasts twice daily to JTWC. Coordination with other Air Force and Navy activities is on an "as required" basis, depending upon the location of a particular tropical cyclone.

4. Statistical Methods

See Chapter V for research paper on the Miller-Moore and Arakawa 1962 evaluations.

5. Steering

See Chapters III and IV.

The space mean chart, as discussed herein, is a brief on how it is used at FWC/JTWC. The chart is constructed from the 500mb chart and has the single, double and the M-2 field thereon. During the Typhoon Season, the chart is produced as needed except that between July and November it is constructed twice daily. One great advantage of the chart is that it more nearly portrays that portion of the atmosphere under consideration on one chart than does any other analysis or system of presentation.

The chart is useful for steering S of the ridge line under the following conditions:

a. When the typhoon is moving along the southern periphery of a large quasi-stationary anticyclone, the single space mean may act as a steering tool between 10N and the ridge line.

b. When the synoptic features are performing consistently, a prognostic chart can be constructed from the single space mean to be used as a steering tool from 10N to the ridge line.

c. The double space mean with the M-2 field is usually more reliable than the single space mean above 20N.

The space mean will usually aid in forecasting the point of recurvature but should be used with caution. On large typhoons, this point may be a degree or two N of that indicated by the space mean chart.

After a typhoon recurves, the chart is used to forecast its movement in a similar manner to that of forecasting the movement of extratropical systems.

It is emphasized that the space mean chart is another tool, one of many, and usually cannot be successfully used as the sole device for making typhoon trajectory forecasts.

The space mean chart is used in conjunction with the long wave patterns that are produced and provided by FNWF. They aid in determining the conditions of the major atmospheric features in the Northern Hemisphere and as a guide to the changes that may be expected. These patterns provide a substantial background upon which to base typhoon forecasts.

6. Surveillance Systems

See Chapter II for evaluations of aerial reconnaissance, land radar, and satellites.

7. Wachholz Graph

This is a graphical correlation of measured and observed eye meteorological parameters to maximum surface wind as collected by reconnaissance aircraft. JTWC plans to recompute and readjust the presentation of this graph during 1963.

8. Work Chart

This is an operational and recording tool in preparing tropical cyclone warnings. The basic chart is from the Pacific Airways Plotting Chart series, plus 3 acetate overlays. All aircraft and radar fixes are plotted on the basic chart. Twenty-four hour forecast positions are plotted on the bottom overlay, warning positions are plotted on the second overlay, and the top overlay is utilized as a work sheet. Green, red, and black china marking pencils are used on the three acetates for instantaneous visual reference.

D. WARNINGS

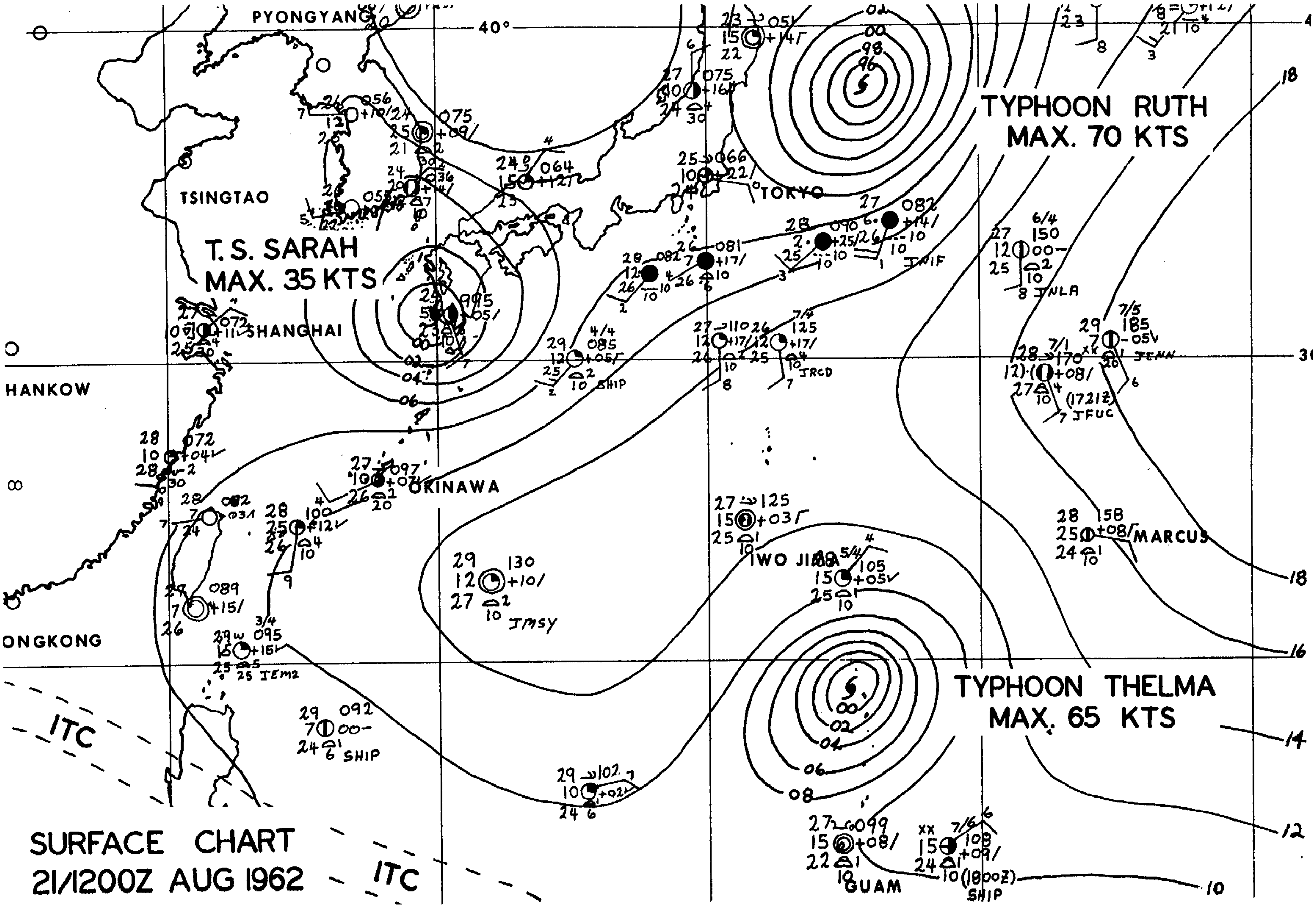
Warnings are filed and transmitted every 6 hours at synoptic times of 0000Z, 0600Z, 1200Z and 1800Z. In accordance with CINCPAC INST 3140.1D, the message contains the present warning position of the tropical cyclone being valid for the scheduled transmission time. This connotes that the 24 and 48-hour warning forecast positions are actually 30 and 54-hour forecasts from the last surface synoptic time.

The warning position of a tropical cyclone is actually a short range forecast from the last "best" position. The last "best" position is usually about 2 hours old based on land radar, 2 to 3 hours old based on reconnaissance fixes, 3 to 6 hours old based on surface synoptic reports, or 6 to 12 hours old based on upper-air synoptic reports. It is for this reason that the 0600Z warning, for example, may not agree with the position of the tropical cyclone as indicated by the 0600Z analysis. Amendments are issued when this difference is significant.

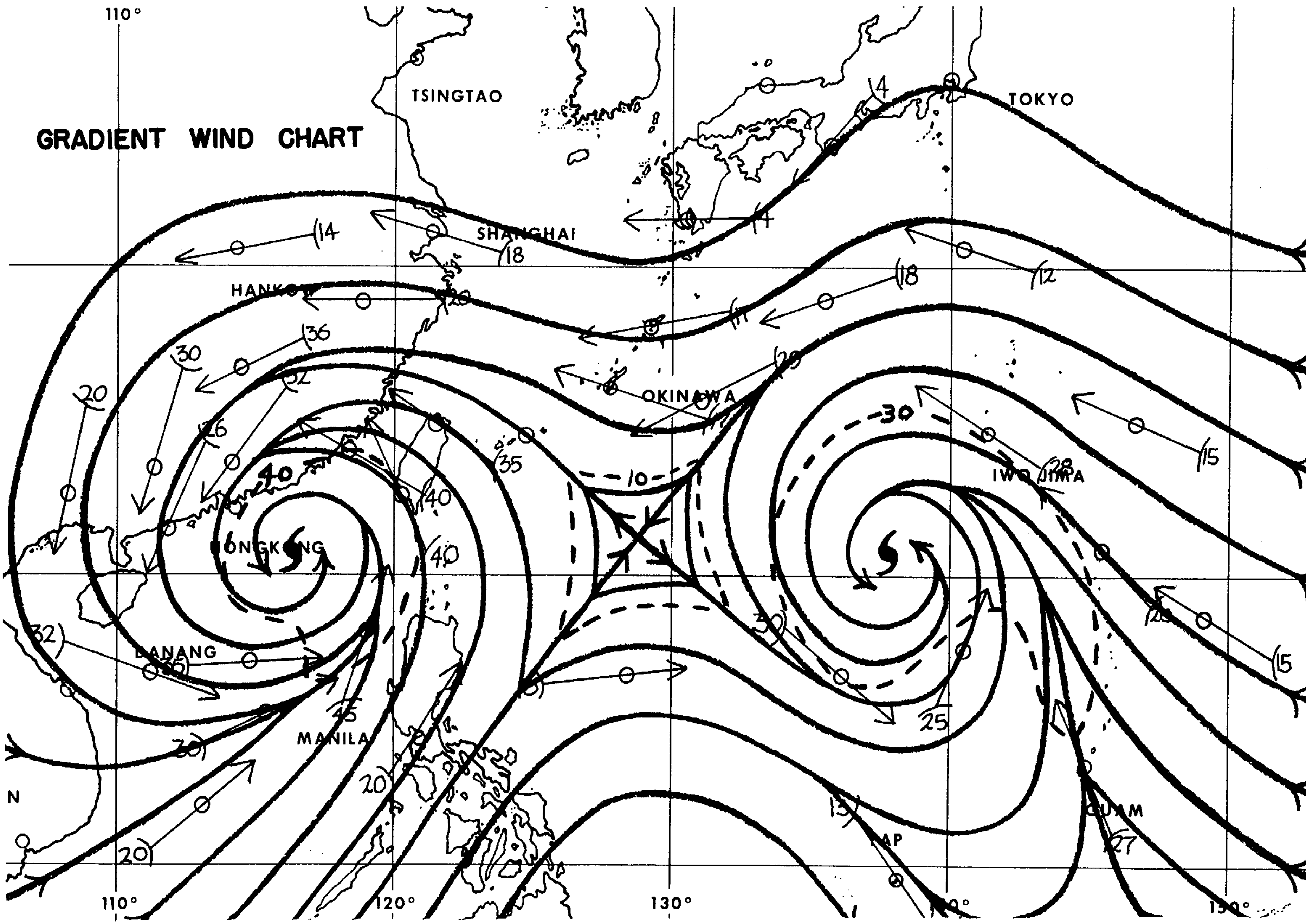
The numbers of tropical warnings run consecutively regardless of whether the cyclone is upgraded or downgraded from tropical depression, tropical storm or typhoon. If warnings are discontinued and the circulation regenerates, the new series of warnings are numbered consecutively from the number of the last warning of the previous series. As required, amendments and corrections are issued, and these are numbered the same as the warning which they amend or correct.

The 1962 Verification Summary is contained in Chapter III.

All 24 and 48-hour forecasts made when a tropical cyclone is of tropical storm or typhoon intensity are verified against the "best" tracks at all latitudes through the last warning issued.



SURFACE CHART
21/1200Z AUG 1962



GRADIENT WIND CHART
110°
120°
130°
150°
TSINGTAO
TOKYO
SHANGHAI
HANKOW
OKINAWA
IWO JIMA
HONGKONG
DANANG
MANILA
GUAM

TIME Z

FWC/JTWC GUAM

DATE	KOROR	YAP	GUAM	TRUK	PONAPE	ENI-WETOK	KWAJ.	MAJURO
08/2100Z	80 122 15 +02 76 5 10 +1.2	81 087 15 +07 76 2 10 +.3	78 090 15 -02 76 2 10 +.9	81 058 15 -02 76 4 10 -.3	77 055 13 00 76 6 10 -.5	84 081 15 +02 77 2 20 +1.0	81 104 15 +01 72 5	78 110 15 00 72 2 8 10 +1.2
09/0000Z	85 102 15 -20 76 7 2 +1.0	85 096 15 +09 77 5 10 +.5	84 084 15 -06 77 2 20 +1.0	83 058 12 00 77 6 10 -.5	85 061 15 +06 76 7 20 -.6	84 081 15 00 77 2 20	84 107 15 +03 73 1 3 20 .8	81 105 15 -05 8 +1.3
09/0300Z	85 091 15 -11 77 6 20 -.5	85 086 15 -10 78 6 -.8	84 065 15 -19 76 2 20 -.5	75 047 3 -11 74 2 -1.1	84 058 15 -03 74 8 +.4	86 068 10 -13 84 65 9 .7	83 102 15 -05 74 2 10	81 100 15 -05 74 2 20 +2.0
09/0600Z	86 071 15 -20 76 8 20 -.8	86 055 15 -31 78 8 10 -1.2	87 057 15 -08 76 2 10 -1.1	88 024 10 -23 2 10 -2.0	76 054 6 -04 75 +2.3	84 068 10 00 76 10 .7	81 098 11 -04 76 2 10 +1.0	81 088 15 -12 81 2 10 +1.5
09/0900Z	82 075 15 +04 75 4 16 -1.2	84 054 15 -01 76 10 -1.7	88 068 15 +11 74 2 10 1.3	80 027 15 +03 73 1 10 -2.0	80 047 15 +10 73 1 10 +2.0	83 088 15 +20 75 3 10 1.5	81 104 15 +06 74 2 20 1.7	81 090 15 +02 76 4 10 +.8
09/1200Z	86 089 15 +14 76 4 12 -1.6	83 076 15 +22 78 4 10 -2.3	89 074 10 +06 76 3 10 -2.2	81 037 10 +10 74 6 10 -2.5	75 081 2 +17 74 10 +2.3	77 088 10 00 76 6 10 +1.9	79 110 15 +06 73 2 10 +.8	79 098 15 +08 74 1 20 +1.1
09/1500Z	86 091 15 +02 76 3 10 -2.1	80 074 15 -02 76 3 10 -2.8	80 059 15 -15 76 3 10 -3.0	75 032 8 -05 73 6 10 -3.0	74 081 4 00 74 6 +3.7	80 088 15 00 76 7 10 2.8	77 102 -08 73 4 10 +1.2	82 102 15 +04 74 10 +1.3
09/1800Z	84 080 15 -11 76 3 12 -2.8	80 062 15 -12 76 3 12 -3.2	80 042 10 -17 75 2 20 -3.3	76 020 10 -12 74 6 10 -3.3	74 070 4 -11 74 8 6 +3.1	80 085 15 -03 76 13 2.1	77 098 -04 74 5 10 +.6	81 104 15 +02 75 4 10 +.4
09/2100Z	82 091 15 +11 72 3 10 -3.1	79 055 15 -07 78 5 10 -3.2	76 041 15 -01 75 2 -4.9	78 025 10 +05 74 6 10 -3.3	76 085 5 +15 75 7 +3.0	82 102 15 +17 74 2 20 +2.1	77 112 15 +14 73 +.8	82 115 15 +11 73 2 20 +.5
10/0000Z	80 091 15 00 75 2 10 -1.1	84 067 15 +12 78 1 10 -2.9	83 051 10 +10 80 4 10 -3.3	79 041 8 +16 74 6 10 -1.7	83 088 15 +03 75 2 10 +2.7	85 105 15 +03 78 2 20 2.4	78 115 15 +03 73 1 10 +.8	86 109 15 -06 77 2 10 +.4
10/0300Z	83 075 15 -16 70 1 10 -1.6	84 055 15 -12 79 2 10 -3.1	86 021 15 -30 77 2 10 -4.4	85 037 15 -04 79 2 8 -1.0	86 071 15 -17 71 10 1.3	87 091 15 -14 76 +2.3	83 110 15 -05 74 1 10 +.8	84 105 15 -04 73 5 20 +.5
10/0600Z	86 051 15 -24 78 4 10 -2.0	85 030 15 -25 79 6 10 -2.5	75 023 4 +02 75 6 35 -3.4	81 036 15 -01 76 10 8 +1.2	84 064 15 -07 75 50 +1.0	86 091 15 00 76 7 15 +2.3	84 102 15 -08 74 2 10 +.4	83 098 15 -07 75 4 20 +1.0
10/0900Z	79 058 10 +07 75 2 10 -1.7	81 033 15 +03 78 4 10 -2.1	76 999 3 -34 76 6 10 -6.9	82 051 10 +15 75 6 8 +2.4	77 085 10 +21 74 2 10 +2.1	85 104 15 +13 77 5 15 +1.6	82 100 15 -02 74 -.4	83 085 10 -13 74 3 10 -.5
10/1200Z	80 071 15 +13 76 -1.8	82 043 15 +10 78 4 10 -3.3	77 990 5 -09 76 2 10 -8.4	76 078 13 +27 74 10 4.1	75 098 15 +13 74 2 20 +1.7	82 112 15 +08 74 2 +2.4	82 098 15 -02 75 -1.2	82 083 15 -02 73 2 10 -1.5
10/1500Z	80 064 15 -07 76 5 10 -2.7	82 030 15 -13 77 2 10 -4.4	80 961 8 -29 74 3 10 -9.8	77 064 15 -14 75 10 8 +3.2	75 091 10 -07 74 3 20 +1.0	77 095 10 -17 74 20 +.7	81 092 15 -06 74 -1.0	91 085 10 +02 73 2 10 -1.7
10/1800Z	82 044 15 -20 76 5 10 -3.6	82 016 21 -14 82 10 -4.6	78 945 -16 75 10 -9.7	76 054 12 -10 73 2 8 +3.4	74 078 15 -13 74 +.8	78 095 5 00 75 3 10 +1.0	81 088 15 -04 75 -1.0	81 092 15 +07 74 2 10 -1.2
10/2100Z	76 051 15 +07 73 2 10 -4.0	78 008 15 -08 76 10 -4.7	78 957 5 +12 77 6 -8.4	82 071 15 +17 75 10 8 +4.6	76 091 15 +13 75 4 +.6	79 105 15 +10 74 4 20 +.3	82 095 15 +07 76 20 -1.7	84 090 15 -02 75 2 20 -2.5
11/0000Z	81 064 15 +13 75 5 10 -2.7	84 016 15 +08 78 8 10 -5.1	78 962 5 +05 77 10 8.9	86 078 15 +07 76 5 10 +3.7	77 105 5 +14 74 6 10 +1.7	79 108 15 +03 74 20 +.3	86 097 15 +02 76 1 20 -1.8	85 093 15 +03 74 10 -1.6
11/0300Z	74 064 3 00 72 8 10 -1.1	78 015 00 -01 76 7 -4.0	78 970 6 +08 76 -5.1	85 067 15 -11 76 5 10 +3.0	82 088 15 -17 75 6 10 +1.7	87 105 15 -03 75 2 20 +1.4	85 100 15 +03 75 2 20 -1.0	86 096 15 +03 76 3 12 -.9
11/0600Z	76 041 10 -23 73 1 10 -1.0	76 996 1 -19 75 5 10 -3.4	81 975 10 +05 74 10 -4.8	84 064 10 -03 77 10 +2.8	81 085 15 -03 73 1 20 +2.1	86 102 10 -03 76 7 20 +1.1	85 098 15 -02 74 1 10 -.4	74 095 15 -01 73 2 10 -.3
11/0900Z	79 047 10 +06 75 3 10 -1.1	74 015 5 +19 73 6 10 -1.8	78 999 3 +24 77 10 0.0	78 081 10 +17 74 10 +3.0	82 100 15 +15 74 1 10 +1.5	81 104 10 +02 74 20 0.0	84 095 15 -03 74 2 20 -.5	83 085 10 -10 72 2 20 0.0
11/1200Z	75 069 7 +22 74 3 6 -.2	76 030 1 +15 75 4 10 -1.3	78 032 5 +33 77 10 +4.2	77 108 8 +27 75 10 +3.0	76 108 15 +08 75 20 +1.0	81 112 15 +08 74 20 0.0	82 098 15 +03 75 2 20 0.0	82 088 15 +03 73 2 10 +.5
11/1500Z	79 075 7 +06 76 7 6 +1.1	79 016 10 -14 75 10 -1.4	77 032 5 00 75 10 +2.1	77 097 7 -11 75 5 10 +3.4	76 098 8 -10 74 1 20 +.7	81 108 10 -04 74 6 20 +1.3	83 100 15 +02 76 2 20 +.8	82 092 10 +04 74 2 10 +.7
11/1800Z	75 068 -07 74 6 +2.4	80 997 15 -19 75 4 10 -1.9	78 035 8 +03 77 10 +9.0	79 095 15 -02 76 3 10 +4.1	78 095 15 -03 75 3 20 +1.7	82 105 10 -03 76 3 10 +1.0	81 102 10 +02 75 3 10 +1.4	80 098 15 +06 73 2 20 +.6
11/2100Z	75 065 -03 69 5 +1.4	80 015 15 +18 77 8 10 +.7	80 048 10 +13 77 10 +9.1	79 108 15 +13 74 2 10 +3.7	81 105 10 +10 76 7 10 +1.4	84 108 15 +03 76 2 20 +.3	82 103 10 +04 76 10 +.8	85 100 15 +02 74 2 20 +1.0
12/0000Z	81 069 15 +04 74 2 10 +.5	82 032 15 +17 75 10 +1.6	86 075 11 +27 77 2 10 +11.3	77 115 15 +07 76 6 +3.7	85 108 15 +03 75 3 20 +.3	85 110 15 +02 75 2 20 +.2	83 106 10 +03 76 10 +.9	87 103 15 +03 76 1 10 +1.0
12/0300Z	84 071 7 +02 74 9 10 +.7	84 033 15 +01 77 6 10 +1.8	80 079 M +04 76 10 +10.9	80 102 15 -13 74 10 +3.5	85 085 15 -23 76 8 20 -.3	88 102 15 -08 77 2 20 -.3	81 112 8 +06 76 7 10 +1.2	87 104 15 +01 74 5 35 +.8
12/0600Z	78 070 15 -01 76 10 +2.9	84 020 15 -13 75 10 +2.4	77 078 10 -01 74 10 +10.3	84 088 15 -14 76 10 +2.4	84 075 15 -10 76 20 -1.0	86 100 15 -02 76 2 20 -.2	82 113 10 +01 77 10 +1.5	84 110 15 +06 75 3 20 +1.5

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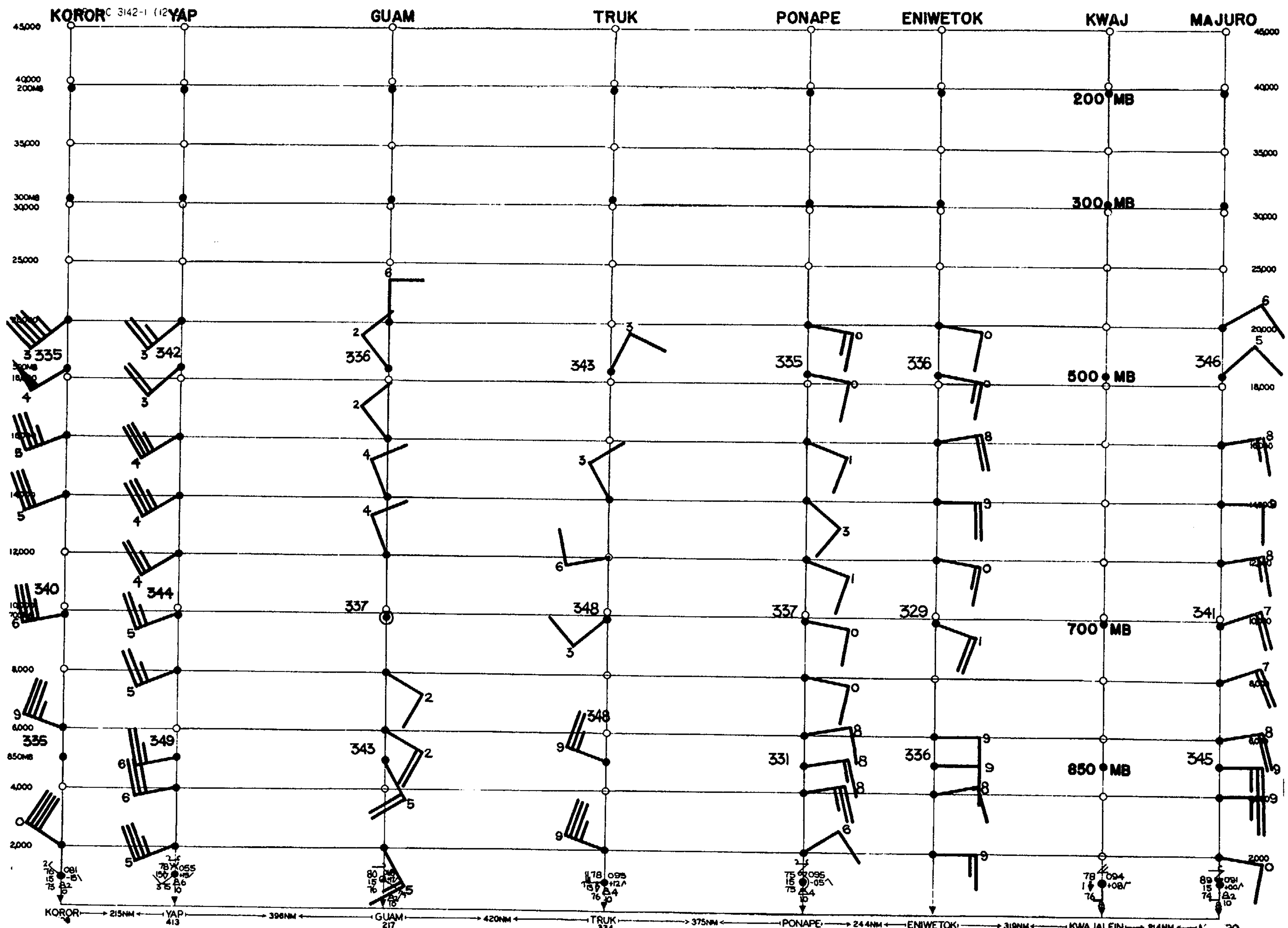
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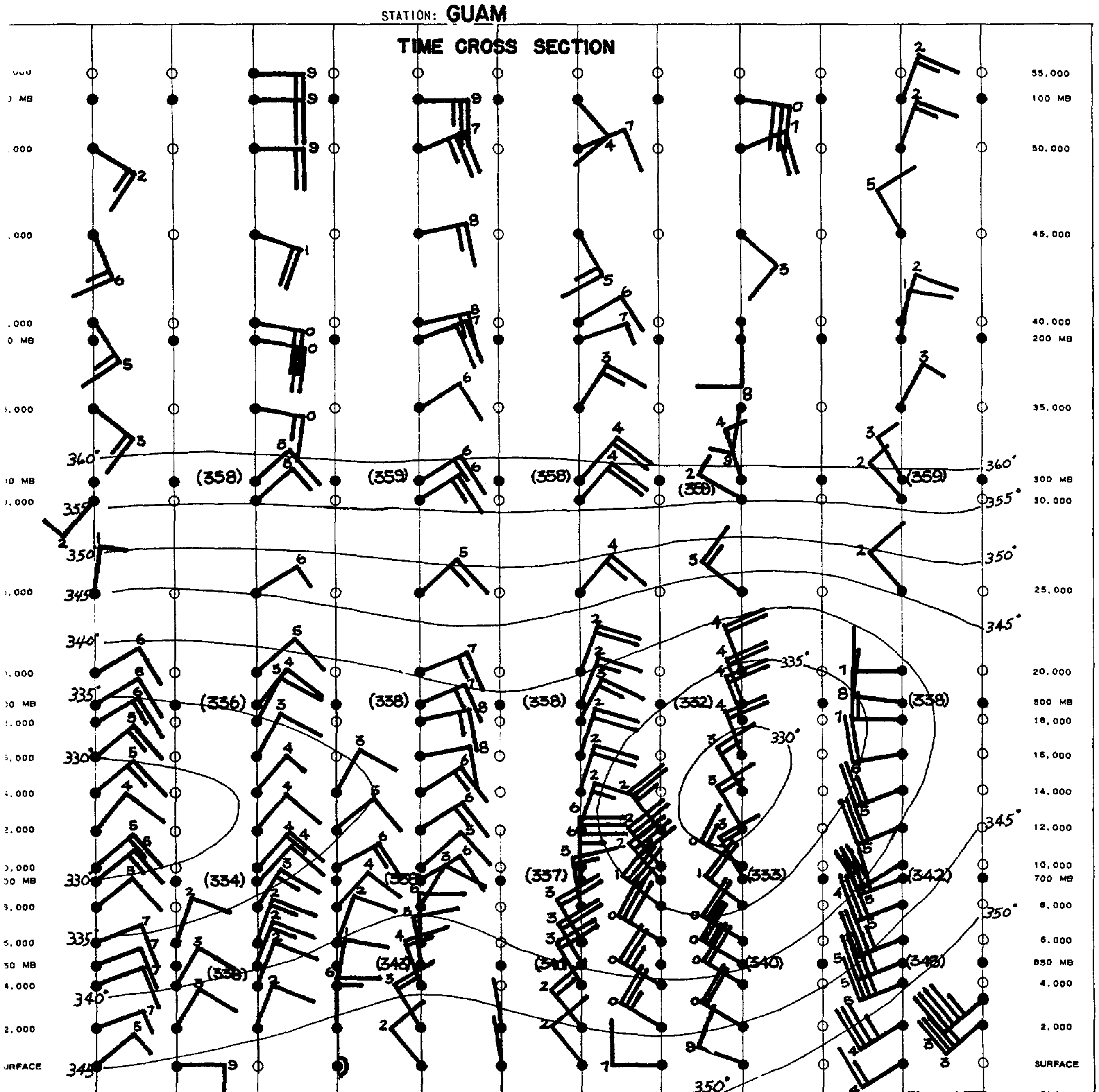
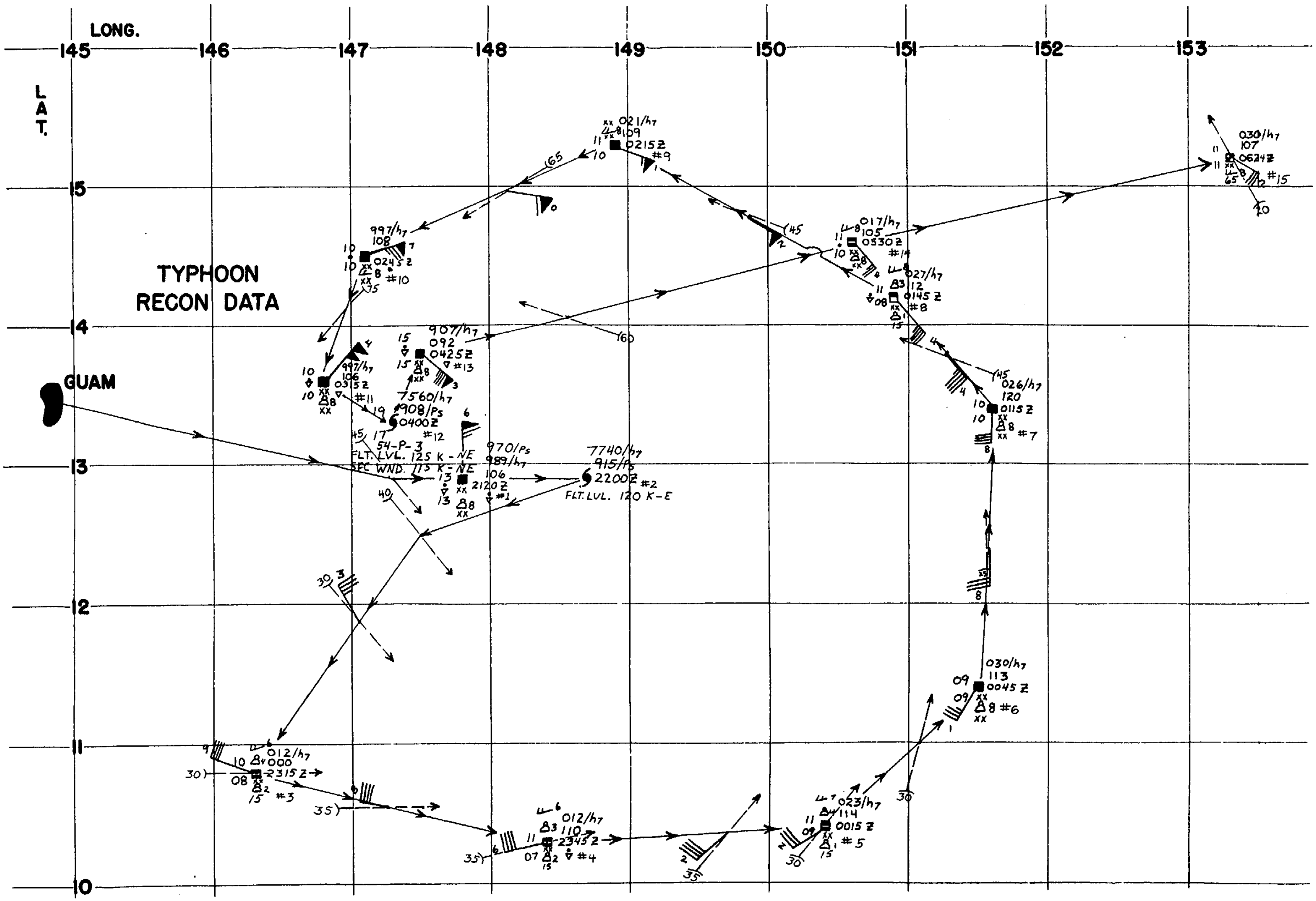


TIME / SFC DATA	00Z	03Z	06Z	09Z	12Z	15Z	18Z	21Z	00Z	03Z	06Z	09Z	12Z	15Z	18Z	21Z	00Z	03Z	06Z	09Z	12Z	15Z	18Z	21Z	TIME / SFC DATA
Ch																									Ch
Cm																									Cm
CL																									CL
N																									N
W																									W
ww																									ww
PPP	1010.5	1010.1	1008.9	1008.4	1010.4	1009.8	1008.0	1009.0	1008.9	1007.7	1006.0	1006.5	1007.0	1005.7	1004.4	1004.8	1005.8	1004.3	1003.7	1004.7	1005.9	1005.7	1004.9	1006.2	PPP
app	+03	-02	-08	+05	+10	-07	-19	+12	-02	-12	-17	+05	+05	-1.9	-1.4	+05	+07	-1.2	-07	+10	+1.2	-02	-08	+1.4	app
RR																.61	.24				.41				RR
24 HR ΔP	-0.2	-0.2	-0.5	-0.6	-0.6	-0.2	-1.9	MSG.	-1.6	-2.8	-2.9	-2.9	-3.4	-4.3	-3.6	-4.2	—	-2.4	-2.3	—	-1.1	±0.0	+0.5	+0.4	24 HR ΔP
$\Delta\bar{p}$																									$\Delta\bar{p}$


LONG.
145
146
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LAT.
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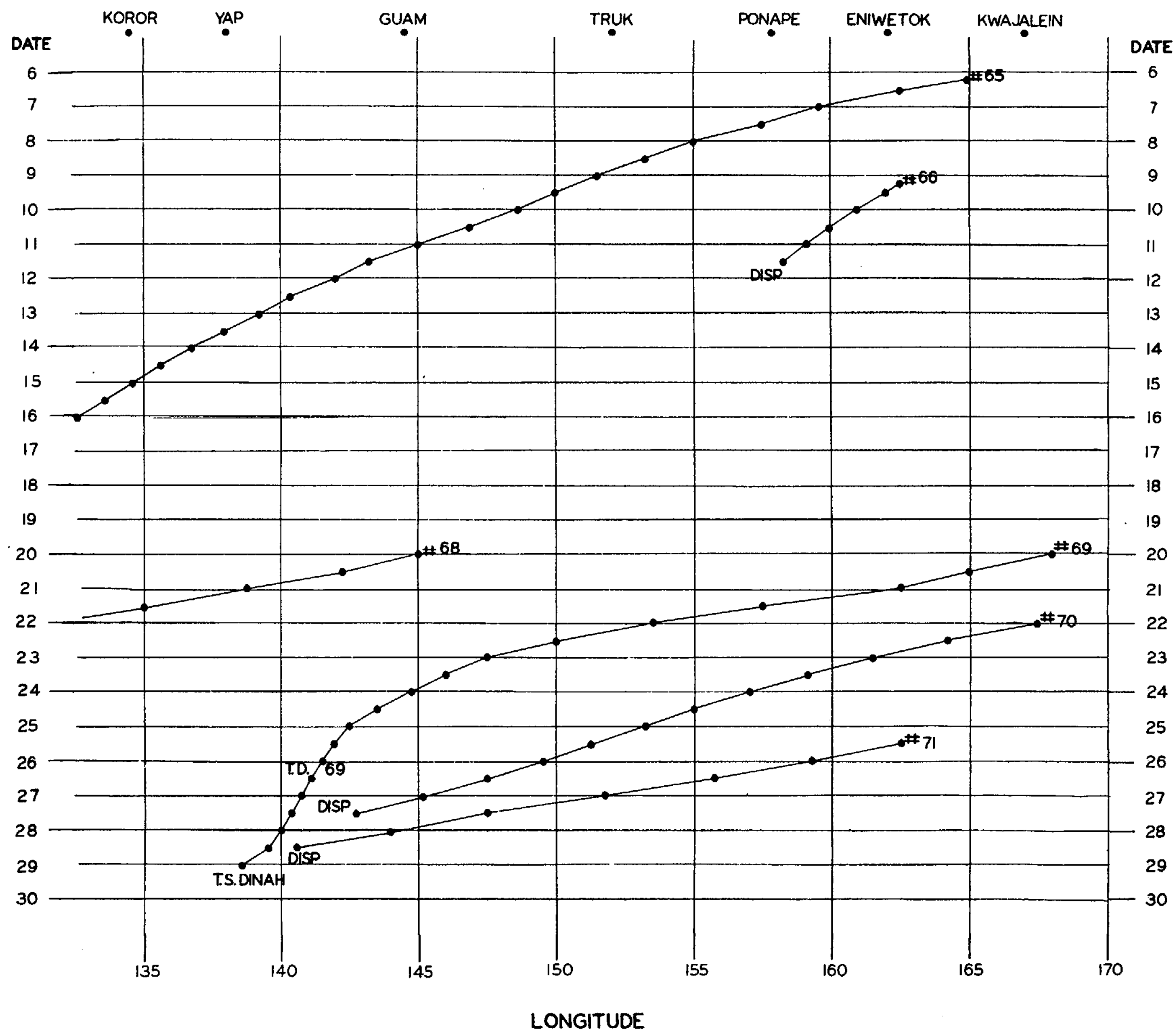
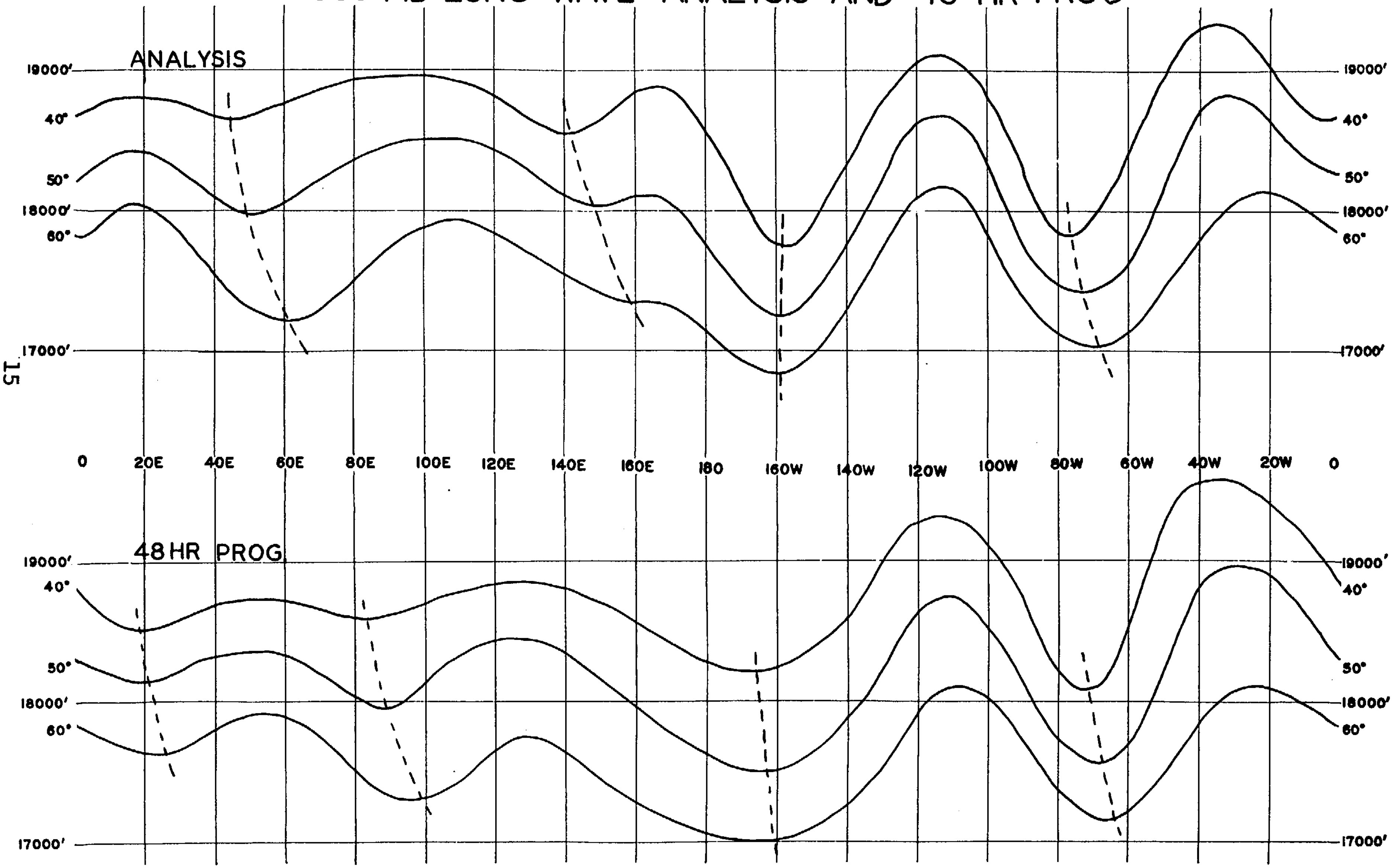
TYPHOON
RECON DATA
GUAM
54-P-3
FLT. LVL. 125 K-NE
SFC WND. 115 K-NE
FLT. LVL. 120 K-E

CONTINUITY GRAPH



500 MB LONG WAVE ANALYSIS AND 48 HR PROG



CHAPTER II

SURVEILLANCE SYSTEMS

SURVEILLANCE SYSTEMS

A. GENERAL

Constant and close observation is required on all tropical areas and on all systems of tropical origin. The obvious need for the observation is evident in the accuracy required for warning positions. Conservation of property and life can be considered as the dividend of time and money invested in proper reconnaissance.

The accuracy of warnings is directly related to the quality and quantity of surveillance. The FWC/JTWC continually reviews methods and effectiveness of surveillance.

Continuous watch on all tropical systems is imperative so that initial warnings are issued at the earliest possible moment to insure adequate preparation in affected areas. Since there are many varied tracks and rates of intensification and the best possible method of detecting the type involved in any particular system is continuous reconnaissance, it is proposed that a minimum of four fixes a day be made on all systems for which warnings are being issued. During the 1962 season, a period of 24 hours was normally required to phase into 4 fixes daily on any system. In certain cases, this left the "rapid intensifiers" without surveillance during the most critical period of their formation to maturity. During the last quarter of the season, the squadron responsible for the required one fix on a Tropical Depression Warning was asked to have fuel aboard to remain in the area 6 hours for a second fix should intensity be 34 kts or above in order to reduce the implementing period. In 1962 the tropical cyclones that reached typhoon intensity remained tropical depressions for an average of only 3.4 warnings and tropical storms for 3.7 warnings.

B. SURVEILLANCE METHODS

Aerial reconnaissance is the primary method used in obtaining the complete data required for proper analysis of a tropical system. Aerial reconnaissance, being mobile, provides the position, intensity, indications of past movement, changes as they occur, and significant features including eye shape, size, slope, and condition of tropical systems. In addition, it provides data, both surface and upper air, normally not available due to lack of reporting facilities in the vast oceanic areas.

During 1962, two aircraft squadrons were assigned primary responsibility of tropical reconnaissance under the requirements of the JTWC Guam. These units were the U. S. Air Force 54th Weather Reconnaissance Squadron (54WRS), Andersen Air Force Base, Guam and the U. S. Navy Airborne Early Warning Squadron One (VW-1), Naval Air Station, Agana, Guam.

The 54WRS was re-established on 18 April 1962 as a result of JTWC recommendations last year concerning the weather reconnaissance priorities system.

The 56WRS, Yokota Air Base, Japan, was primary backup for the 54WRS, and the 315th Air Division was the normal CINCPACAF theater air backup.

The various aircraft used by these squadrons are the WB-50 by the 56WRS and 54WRS, the EC121K (WV-2) Warning Star by VW-1, and the C-130 by the 315th Air Division.

In addition to requested aerial reconnaissance, reports were received from itinerant military and civilian aircraft passing through the storm areas. Although a considerable number of these reports were received, only a few were classified as bonus fixes. To be classified as a bonus fix, it must not confirm a scheduled reconnaissance fix.

Land radar, in conjunction with aerial reconnaissance, was utilized operationally when a tropical system was within radar range. Radar information was available from various CPS9 and GCI tactical radar sites.

In special cases, radar coverage is obtained from ships close enough to a center to provide a radar position. Radar reports from these ships, however, are very infrequent. It is felt that ships fail to understand the need at JTWC for these reports. Reports are requested from ships in critical areas when they are close enough to afford assistance. Peripheral data is as important as the center data and in the case of a developing system, more important. Ships should report radar information describing echoes which are other than the normal scattered pattern. Reports of this type have not been received by JTWC in the past.

The Tiros weather surveillance satellite gives vortex positions when discernible and cloud patterns on its orbital passes over the area in the form of nephanalysis. Two cases in 1962 enabled JTWC to plan early reconnaissance into an area not previously suspect. The first was the initial stages of Typhoon VERA, which did not appear on the surface analysis even though the area was more than adequately covered by surface ship observations. The second was Tropical Cyclone #61, which was reported in an area of sparse reports. An aircraft was deployed, and an investigation was made. No circulation could be found; therefore, Tiros could have initially observed a distal system. Tiros IV, V and VI satellites were launched in 1962, 08 February, 19 June and 19 September, respectively.

C. EVALUATION OF THE 1962 SEASON

Throughout the 1962 Typhoon Season, aerial reconnaissance was divided between the 54WRS and VW-1. Under normal warning status, fixes were scheduled for 4 daily on each typhoon and 2 daily on each tropical storm. One daily investigation was scheduled on each tropical depression and as required on each cyclone. These requirements are as outlined in CINCPAC INST 3140.1D. Synoptic tracks which supplement the surface and upper air reporting stations of the U. S. Trust Territories were required at a mandatory minimum of every third day when the JTWC was not in warning status and as required or requested when in warning status.

The policy of the JTWC for laying fix requirements on the squadrons were as follows: For typhoon fixes, the 54WRS made the 2200Z and 0400Z daylight fixes, and the night aircraft radar fixes were by VW-1 at 1000Z and 1600Z. Tropical Storm fixes were generally scheduled for 2200Z and 0400Z by the 54WRS and/or VW-1. Tropical depression and cyclone investigations were scheduled for daylight hours by a single squadron. Each squadron was assigned every other cyclone. The scheduled times for the fixes were within two hours of the bulletin time providing increased accuracy in the bulletin position. The two hours were found necessary due to communications difficulties. This procedure differed from the previous seasons when fixes were scheduled for 3 fixes in daylight by WB-50's and only 1 radar fix at night by the EC121K's. The previous procedure did not permit complete use of the information provided.

An innovation of the 54WRS was the use of two aircraft for fixing two storms by flying both storms at the same time then alternating aircraft and storms. One aircraft flew clockwise and the other, counter-clockwise. The economical savings in fuel and flight time should permit this procedure to become standard squadron policy.

There were a few exceptions to the 1962 policy of levying requirements between the squadrons. Throughout the year, higher priority missions caused the 54WRS to reduce the number of participating aircraft but did not limit their response to fixes required. During October, VW-1 encountered funding problems and were restricted to 1 fix daily per typhoon and tropical storm system and flew only one out of three cyclones for conservation purposes. Early action by that command, with FWC/JTWC support, limited this problem to less than 2 weeks.

On storms which passed into the Sea of Japan, reconnaissance was continued as normal, even after meteorological indications were that of an extratropical system, until the system passed N of Misawa AB, Japan at 42N. This procedure provided operational coverage for the Japanese Islands and U. S. military installations on those islands.

In October Typhoon GILDA was located in the Philippine Sea, and Typhoon IVY formed SE of GILDA's center. The proximity of these centers allowed the economical use of a single reconnaissance aircraft to make 2 fixes on both centers in a single sortie. This was accomplished by use of on-time fixes on GILDA and then fixes on IVY three hours later. VW-1 aircraft were able to hold both centers on radar at the same time.

D. EVALUATION OF DATA

1. Aerial Reconnaissance Data

Data received from reconnaissance can be divided into two categories, peripheral and eye.

The peripheral data is all information reported by reconnaissance aircraft enroute and around a tropical system, and eye data is the information reported from the center of a system. A synoptic track includes basically the same information as peripheral data, and a cyclone center, the same as eye data.

Peripheral data is provided by all reconnaissance aircraft; eye data is provided only by aircraft penetrating the eye or center. During 1962, daylight penetration of typhoons was scheduled for WB-50 and C-130 aircraft. Night penetration is not permitted. EC121K aircraft, due to airframe limitations, were not scheduled and were not permitted typhoon penetration. All night fixes were scheduled as aircraft radar fixes by EC121K aircraft.

Peripheral data includes weather, clouds, flight level height, wind, temperature, dew point, and estimated surface pressure and wind. Dropsondes are made in the four sectors of the system and in the wall clouds of developed storms. The information received from these is invaluable for proper analysis of pressure gradient for the Arakawa and Miller-Moore objective forecasting techniques and for determination of the intensity outside of the eye. Dropsondes are made only by WB-50 aircraft. EC121K aircraft are authorized drop chambers and will be modified prior to the next typhoon season.

The eye data obtained from a penetration includes the pressure center as found by radar altimeter and the position determined by navigation. A dropsonde is made at this point from the 700mb level. This provides the lapse rate profile to the surface, the sea level pressure, surface temperature and dew point. The surface wind is observed and the flight level wind, minimum 700mb height and maximum 700mb temperature are determined. Eye characteristics such as size, slope and shape are reported when possible and the extent of cloudiness when it occurs. As the year 1962 progressed, a dropsonde pattern, that would be valuable operationally and for research, was established by JTWC and 54WRS. Under this system, as equipment and time permit, a drop is made when the aircraft reaches the 50 kt surface wind band, one in the eye, one just outside the wall cloud, and a fourth in the opposite quadrant from the first drop.

The eye position as determined by aircraft radar provides the center of the radar eye and a description of the radar presentation, which includes the spiral bands and the wall cloud condition. When possible, the height of the wall clouds is reported.

The surface center position, as determined by penetration, was transmitted to JTWC in degrees and tenths throughout most of the season, but during October an evaluation was made of the use of degrees and minutes. This was found to be of considerable help in determining rate of movement, especially of slowly moving systems, and has been incorporated as a standard procedure.

The data received from the 54WRS and 56WRS was generally considered equal in quality and accuracy. The equality of these two squadrons is primarily the result of previous experience in tropical reconnaissance.

The data obtained by VW-1 was equally good with few exceptions. Aircraft radar fixes were obtained from distances up to 180 MI from a center. The radar fixes made at the extreme range were not always compatible with earlier and later fixes. It was recommended and later adopted that aircraft radar fixes should be made at as close a range as possible.

Generally, information received from CINCPACAF backup aircraft, though necessary and invaluable, was inadequate and at times, inaccurate. The problem was one of air crew inexperience in tropical reconnaissance. The aircraft were not equipped for tropical reconnaissance and were unable to provide completely the information desired.

The information received from all reconnaissance aircraft was continually checked for consistency and accuracy. Each piece of information was immediately plotted on the Wachholz Graph for continuity with previous data and for consistency with data in the same report. Discrepancies were rechecked when possible with observing aircraft.

Parameters on the Wachholz Graph are being re-evaluated and some refinements, particularly in the temperature component, will be utilized during the 1963 season.

2. Land Radar

Land Radar coverage applies only to those tropical systems which approach land areas within radar range.

The information which land radar provides includes position, usually range and bearing, and eye characteristics when they can be determined.

Generally, the position as reported by land radar is not as accurate as would be expected. The increase in distance from the radar station increases the amount of error. Land radar positions tend to place the eye closer to the observing station than it actually is. The cause can be placed on a number of variables of which attenuation, operator inexperience, state of equipment maintenance and equipment capability are factors.

During 1962, 45 fixes that would have been scheduled for VW-1 and 54WRS were not requested. Land radar stations provided the information necessary, thus saving 45 fixes which would have necessitated at least two dozen aircraft sorties.

E. COMMUNICATIONS

CW is the primary means of communications between the ground and the aircraft. AIE2, Andersen AFB, Guam is the primary air-ground contact for the aircraft; AIF8, Yokota AB, Japan is secondary; and AIC2, Clark AB, Philippine Islands and AID2, Kadena AFB, Okinawa are tertiary contacts.

AIE2, Andersen AFB, Guam is responsible for getting the reports to JTWC via the local circuit 3L28. This circuit also serves VW-1 and 54WRS. A monitor from 54WRS is on duty at AIE2 whenever a 54WRS aircraft is in the air. This monitor checks the incoming information from 54WRS aircraft and makes any necessary queries or corrections.

VW-1 has equipped some aircraft with single side band equipment for voice communications and will have all of its aircraft so equipped in the coming year. At the present time this equipment supplements the CW facilities.

1962 AIRCRAFT RECONNAISSANCE DATA

UNIT	TROPICAL CYCLONES (56)				SYNOPTIC TRACKS	
	NO. OF SORTIES	NO. OF FIXES/ INVESTIGATIONS		FLYING HOURS	NO. OF SORTIES	FLYING HOURS
		SCHED	BONUS			
VW-1	188	243	1	1704.4	41	382.2
54WRS	151	212	1	1777.8	78	874.4
56WRS	29	36	1	337.8	7	68.8
315 AIRDIV	5	5		42.2		
OTHER USAF			4			
OTHER USN			2			
CIVILIAN			1			
TOTAL						
1962	373	496	10	3862.2	126	1325.4
1961	304	350	27	2801.0		

CHAPTER III

SUMMARY OF TROPICAL CYCLONES OF 1962

A. GENERAL

A record year for typhoons has gone into the climatology books. This year, 24 typhoons crossed the Western Pacific, which exceeds the record of 21 typhoons per year that occurred last in 1952. For additional comparisons, see the following Typhoon Distribution by Month Table.

The FWC analyzed and numbered, for internal record purposes, 78 major easterly waves. Of this number, 42 had embedded or junction vortices that had the potential of possible development and were designated as cyclones by JTWC. Of these 42 cyclones, 21 developed to typhoon intensity, 3 developed to tropical storm intensity, and 7 required tropical depression warnings. Complementary to these 42 cyclones, there were 14 cyclones designated by JTWC that were not definitely related to major easterly waves. Of this number, 3 reached typhoon intensity, 3 became tropical storms, and 2 required tropical depression warnings.

The following data for the JTWC area of responsibility is presented for comparison purposes:

COMPARATIVE WESTERN PACIFIC TROPICAL CYCLONE DATA

	1959	1960	1961	1962
TOTAL NUMBER OF WARNINGS	583	776	738	815
CALENDAR DAYS OF WARNINGS	137	157	165	154
MAJOR EASTERLY WAVES	--	--	--	78
SUSPECT CYCLONES	32	26	27	17
TROPICAL DEPRESSIONS	7	3	11	9
TROPICAL STORMS	9	8	11	6
TYPHOONS	17	19	20	24
TOTAL TROPICAL CYCLONES	65	56	69	56

In the area of responsibility of the Joint Hurricane Warning Center, Hawaii, (North Pacific between 140W and 180°) there were two cyclones, and both required tropical depression warnings.

On the following pages are the 1962 Typhoon Data Summary Charts. The 1962 average typhoon is represented by

TYPHOON DISTRIBUTION BY MONTH

	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC	TOT
1953		1			1	1	1	5	2	4	1	1	17
1954					1		1	4	4	2	3		15
1955	1		1	1		1	5	3	3	2	1	1	19
1956			1	1			2	4	5	1	3	1	18
1957	1			1	1	1	1	2	5	3	3		18
1958	1				1	2	5	3	3	3	1	1	20
1959				1			1	5	3	3	2	2	17
1960				1		2	2	8		4	1	1	19
1961			1		2	1	3	3	5	3	1	1	20
1962				1	2		5	7	2	4	3		24
AVG.	.3	.1	.3	.6	.8	.8	2.6	4.4	3.2	2.9	1.9	.8	18.7

1962 TYPHOON DATA SUMMARY

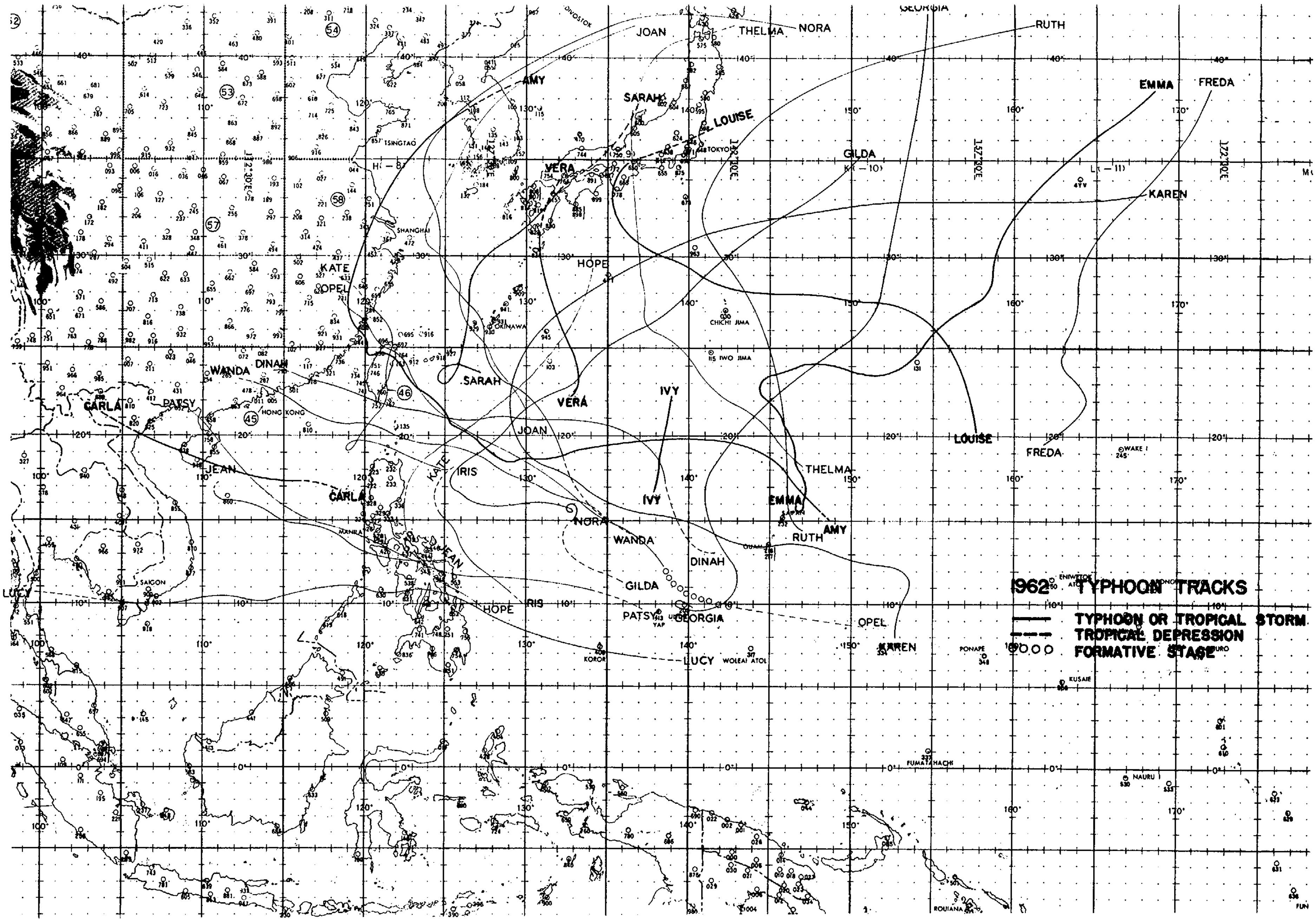
TYPHOON	MONTH	MAX SFC WND SPD	CALENDAR DAYS OF WARNINGS/TYPHOON		DISTANCE TRAVELED WARNING STATUS
GEORGIA	APR	130	7.50	5.75	2472
HOPE	MAY	85	6.25	1.75	1566
IRIS	MAY	65	3.75	.25	630
JOAN	JUL	80	4.00	1.75	1614
KATE	JUL	85	5.50	2.75	1050
LOUISE	JUL	80	8.00	5.25	1962
NORA	JUL	75	8.75	3.00	2622
OPEL	JUL	150	6.25	4.00	2310
PATSY	AUG	65	5.00	1.50	1848
RUTH	AUG	160	9.00	8.00	2316
SARAH	AUG	75	7.50	4.00	1320
THELMA	AUG	120	6.25	3.25	1824
VERA	AUG	75	3.00	1.25	756
WANDA	AUG	95	5.25	3.25	1434
AMY	AUG	140	9.75	6.25	2964
CARLA	SEP	75	4.00	0.25	858
DINAH	SEP	100	9.00	3.50	1860
EMMA	OCT	145	9.75	9.50	2232
FREDA	OCT	100	6.75	5.25	1380
GILDA	OCT	115	11.50	7.25	2706
IVY	OCT	100	1.50	1.00	342
JEAN	NOV	90	6.25	3.25	948
KAREN	NOV	160	10.25	9.50	4176
LUCY	NOV	100	6.75	3.50	2400
TYPHOON	AVG	105	6.75	4.00	1816

1962 TYPHOON DATA SUMMARY

TYPHOON	MONTH	MAX VERT DVLPMENT	FROM RECONNAISSANCE MAX 700MB TEMP (C)	MIN 700MB HGT	MIN 850MB HGT	MIN SLP (MB)
GEORGIA	APR	35000	22	8210	3090	936
HOPE	MAY	25000	20	9530	4285	978
IRIS	MAY	35000	21	10000	4775	991
JOAN	JUL	30000	17	9770	4555	985
KATE	JUL	35000	19	9060	3840	964
LOUISE	JUL	30000	18	9000	3750	958
NORA	JUL	30000	17	9340	4090	968
OPEL	JUL	35000	26	7590	1980	910
PATSY	AUG	30000	16	9900	4510	980
RUTH	AUG	45000	25	7830	2005	916
SARAH	AUG	30000	19	9480	4260	978
THELMA	AUG	35000	22	8540	3865	946
VERA	AUG	30000	16	9730	4455	983
WANDA	AUG	35000	17	8840	3500	949
AMY	AUG	40000	20	8210	2730	935
CARLA	SEP	30000	15	9650	4400	983
DINAH	SEP	35000	21	8880	3580	953
EMMA	OCT	40000	26	7070	1925	903
FREDA	OCT	30000	21	8730	3435	948
GILDA	OCT	30000	24	8700	3275	933
IVY	OCT	25000	17	10130	4860	997
JEAN	NOV	25000	15	9380	3940	960
KAREN	NOV	45000	24	7220	1900	897
LUCY	NOV	30000	19	9340	3830	974
TYPHOON	AVG	32900	20	8920	3620	955

1962 TYPHOON DATA SUMMARY

TYPHOON	MONTH	FROM WARNINGS MAX RADIUS 100 KT WND	MAX RADIUS 50 KT WND	MAX RADIUS 30 KT WND
GEORGIA	APR	75	300	1000
HOPE	MAY	--	50	150
IRIS	MAY	--	25	100
JOAN	JUL	--	200	300
KATE	JUL	--	100	500
LOUISE	JUL	--	150	300
NORA	JUL	--	250	600
OPEL	JUL	30	200	450
PATSY	AUG	--	150	300
RUTH	AUG	50	150	350
SARAH	AUG	20	75	200
THELMA	AUG	20	75	150
VERA	AUG	--	50	100
WANDA	AUG	--	175	400
AMY	AUG	80	250	400
CARLA	SEP	--	50	150
DINAH	SEP	--	300	500
EMMA	OCT	40	300	750
FREDA	OCT	--	150	400
GILDA	OCT	30	175	600
IVY	OCT	--	75	150
JEAN	NOV	--	75	600
KAREN	NOV	50	250	600
LUCY	NOV	25	125	900


1962 TYPHOON TRACKS
TYPHOON OR TROPICAL STORM
TROPICAL DEPRESSION
FORMATIVE STAGE
AMY
CARLA
DINAH
EMMA
FREDA
GEORGIA
HOPE
IRIS
IVY
JEAN
JOAN
KATE
KAREN
LOUISE
LUCY
NORA
OPEL
PATSY
RUTH
SARAH
THELMA
VERA
WANDA
GILDA
HONG KONG
MANILA
SAIGON
SHANGHAI
TSINGTAO
TOKYO
OKINAWA
GUAM
SAIPAN
YAP
KOROR
WOLEAI ATOL
PONAPE
KUSAIE
NAURU
CHICHI JIMA
IWO JIMA
WAKE I

1962 TYPHOON TRACKS

TYPHOON GEORGIA	16 APR - 24 APR
TYPHOON HOPE	16 MAY - 22 MAY
TYPHOON IRIS	26 MAY - 30 MAY
TYPHOON JOAN	07 JUL - 11 JUL
TYPHOON KATE	18 JUL - 24 JUL
TYPHOON LOUISE	20 JUL - 28 JUL
TYPHOON NORA	26 JUL - 04 AUG
TYPHOON OPEL	30 JUL - 06 AUG
TYPHOON PATSY	06 AUG - 11 AUG
TYPHOON RUTH	13 AUG - 22 AUG
TYPHOON SARAH	15 AUG - 22 AUG
TYPHOON THELMA	21 AUG - 27 AUG
TYPHOON VERA	25 AUG - 28 AUG
TYPHOON WANDA	27 AUG - 01 SEP
TYPHOON AMY	29 AUG - 08 SEP
TYPHOON CARLA	19 SEP - 23 SEP
TYPHOON DINAH	25 SEP - 04 OCT
TYPHOON EMMA	01 OCT - 11 OCT
TYPHOON FREDA	03 OCT - 10 OCT
TYPHOON GILDA	19 OCT - 30 OCT
TYPHOON IVY	28 OCT - 29 OCT
TYPHOON JEAN	06 NOV - 12 NOV
TYPHOON KAREN	07 NOV - 18 NOV
TYPHOON LUCY	25 NOV - 01 DEC

the data at the bottom of the first two charts. This data has been rounded off to the nearest values used locally to depict the actual typhoons.

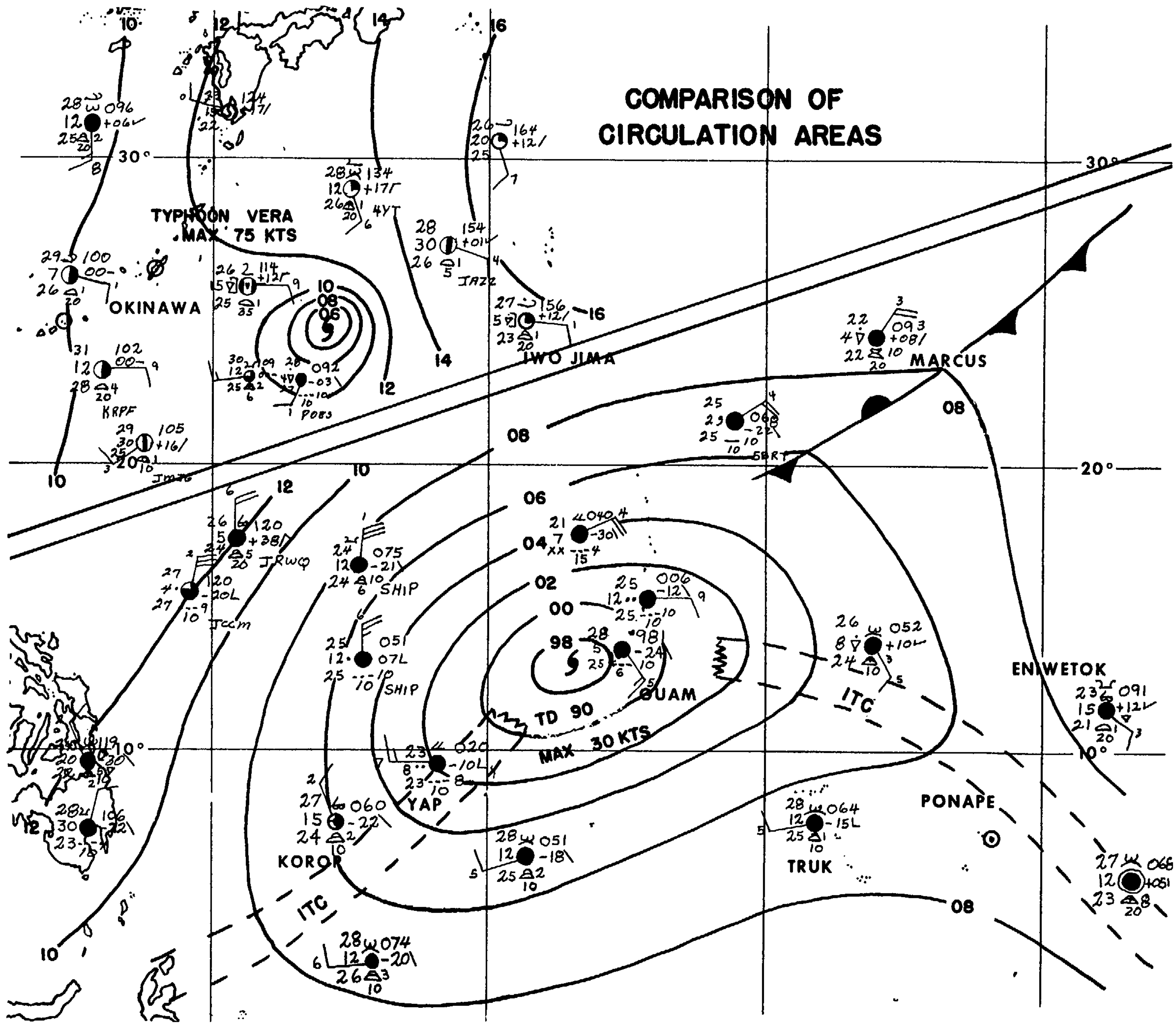
The 6 tropical storms were FRAN (Feb), MARGE (Jul), BABE (Sep), HARRIET (Oct), MARY and NADINE (Dec). For more information on tropical storms and tropical depressions, see Tropical Depressions and Tropical Storms of 1962 and pages following at the end of this chapter.

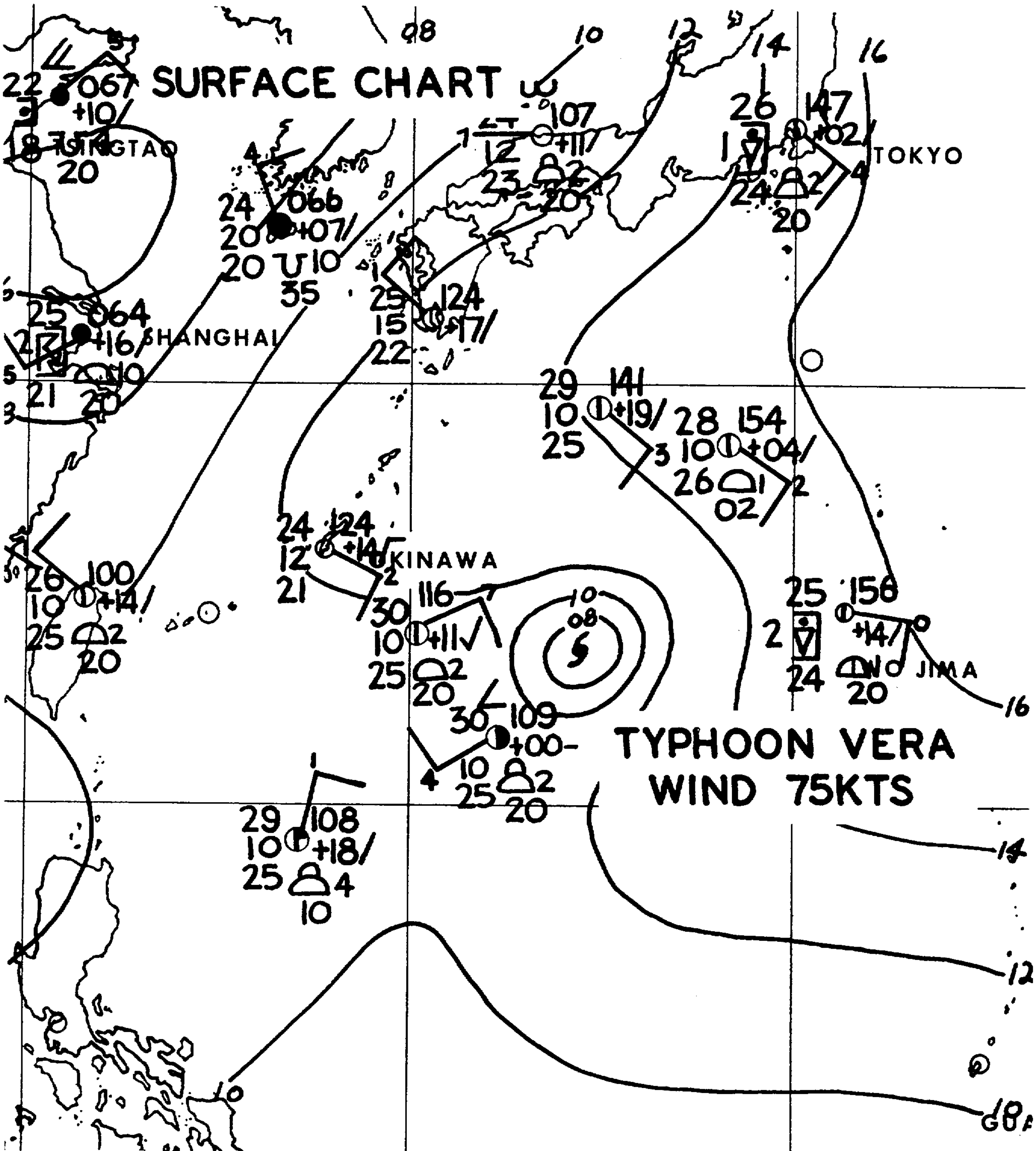
The circulation area of a tropical cyclone will differ from system to system. Thus, it is sometimes observed that the circulation area of a tropical depression is greater than that of a typhoon. Such an occurrence is depicted on the following Comparison of Circulation Areas chart. The wind speed of a cyclone is not necessarily proportional to the circulation area but, in general, is proportional to the pressure gradient. Evidence of the above is readily apparent in the following three charts of Typhoons VERA, WANDA and NORA when they all had a maximum wind speed of 75 kts.

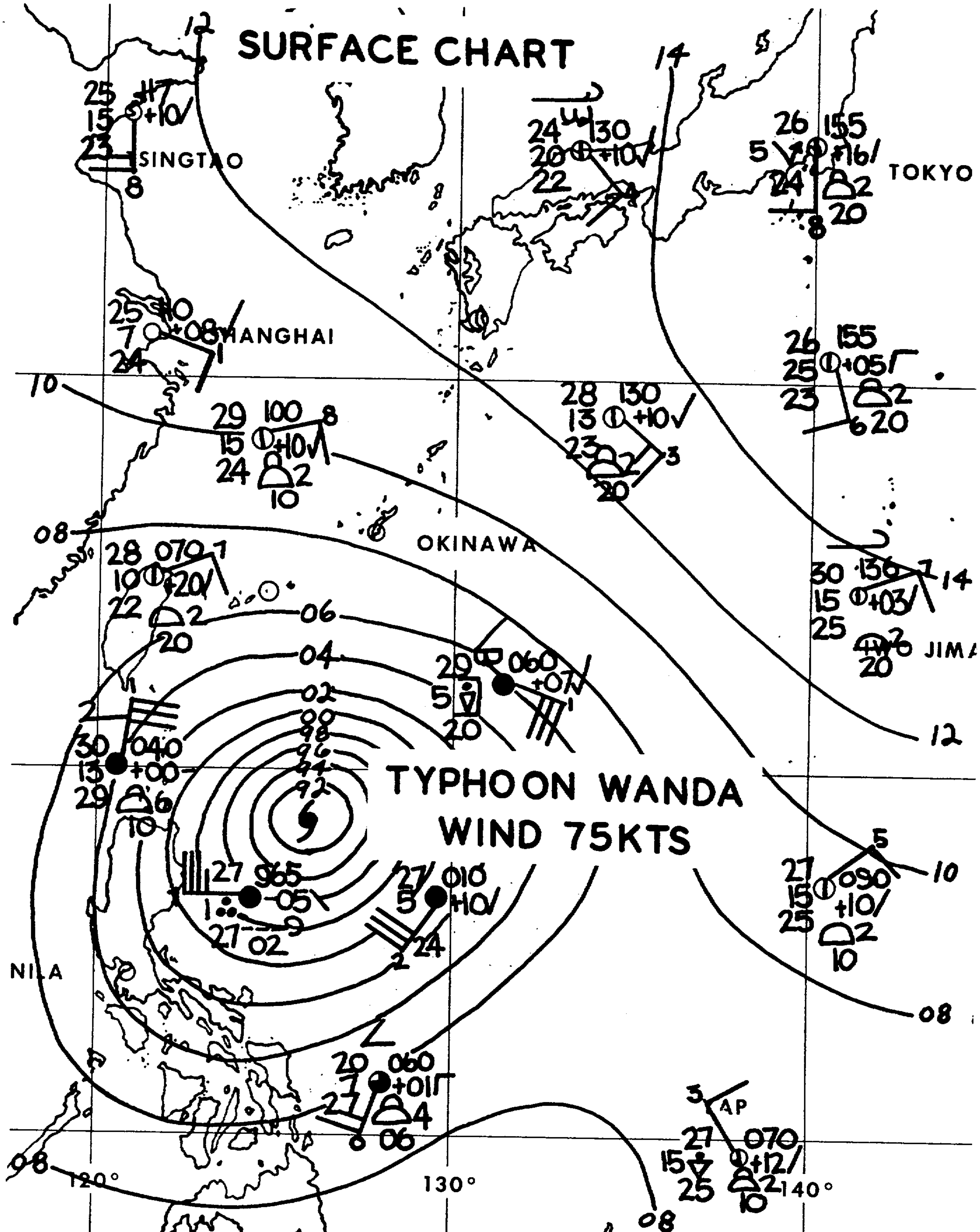
B. DEVELOPMENT

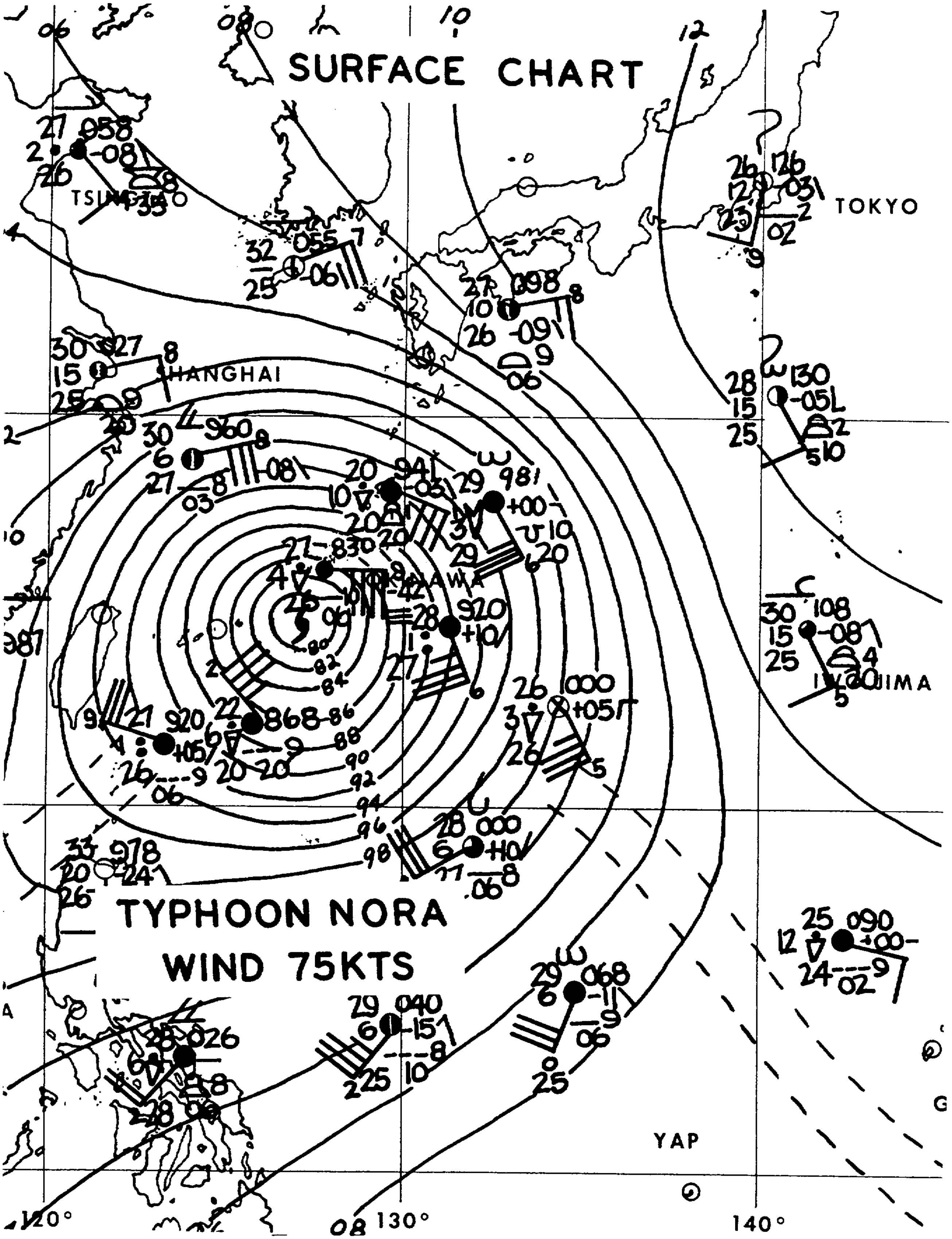
For development to take place, there must be a pre-existing surface perturbation and a large increase of divergence aloft to provide the "kick" to start the "heat engine." Once the heat engine is started, it must have, on a continuing basis, enough divergence aloft to balance the convergence in the low levels or the typhoon will stall out and dissipate (i.e., Typhoons IRIS, JEAN and LUCY). In extreme cases, after initial development, the vortex will be kept in a low state of development for an extended period of time by minimal divergence aloft before the divergence increases sufficiently for full development to take place (i.e., Typhoons OPEL, SARAH, and CARLA).

The apparent complement to these two criteria is the need for the energy level of the easterlies to be increased above normal. This additional energy is usually derived from the westerlies. Of the various methods of energy transfer into the easterlies that are possible, six were observed this season.


COMPARISON OF
CIRCULATION AREAS
TYPHOON VERA
MAX 75 KTS
OKINAWA
IWO JIMA
MARCUS
ENIWETOK
GUAM
TD 90
MAX 30 KTS
YAP
KOROR
TRUK
PONAPE
ITC
SHIP
30°
20°
10°


SURFACE CHART
TSINGTAO
SHANGHAI
OKINAWA
TOKYO
IWO JIMA
TYPHOON VERA
WIND 75KTS


SURFACE CHART
TYPHOON WANDA
WIND 75KTS
SINGTAO
SHANGHAI
OKINAWA
TOKYO
120°
130°
140°


SURFACE CHART
TYPHOON NORA
WIND 75KTS
TOKYO
SHANGHAI
IWO JIMA
YAP
120°
130°
140°

Method I is the low level, below the 400mb level, polar trough and easterly wave interaction in the form of superposition and subsequent fracture (14) (i.e., Typhoons IRIS, JOAN and JEAN).

Method II is the high level, near the 200mb level, energy surge from the westerlies into the easterlies via the MPT (13) (i.e., Typhoons LOUISE, RUTH, AMY, CARLA, DINAH, FREDA, IVY and LUCY).

Method III is the same as Method II only without the MPT. (i.e., Typhoon EMMA).

Method IV is the crossequatorial surge into the 200mb easterlies (i.e., Typhoons GEORGIA and GILDA).

Method V is the high level polar trough-easterly trough interaction (i.e., Typhoon VERA).

Method VI is the MPT fracturing with the fractured extremity becoming an easterly trough (i.e., Typhoon THELMA).

In several cases, there were two energy transfers into the easterlies, though not necessarily at the same time, as follows:

Methods I and II (i.e., Typhoon KAREN)
Methods I and III (i.e., Typhoons KATE, NORA, OPEL and SARAH)
Methods I and IV (i.e., Typhoon HOPE)
Methods II and III (i.e., Typhoon PATSY)
Methods IV and V (i.e., Typhoon WANDA)

A few amplifying remarks are needed in the cases of Typhoons VERA and WANDA. In the case of VERA, there was a surge in the easterlies after the fracture, but the apparent source of the surge could not be determined. In the case of WANDA, the MPT was the polar trough.

Thus, of the 24 typhoons, 11 have histories involving the MPT, 8 have histories of low level polar trough-easterly wave interaction, 1 has a history involving the MPT and low level polar trough-easterly wave interaction, 1 has a history of high level polar trough-easterly trough interaction, and only 3 have histories not involving the MPT or polar trough-easterly wave (trough) interaction.

A good example of an upper level surge in the easterlies was observed at Yap just prior to the initial development of Typhoon PATSY and is as follows:

	031200Z	041200Z	051200Z
45,000 ft	33 kts	80 kts	34 kts
40,000 ft	24 kts	90 kts	27 kts
35,000 ft	25 kts	70 kts	16 kts

All of the initial surface vortices were either junction (i.e., GEORGIA, HOPE, IRIS, KATE, NORA, OPEL, PATSY, RUTH, WANDA, DINAH, FREDA, GILDA, IVY, JEAN and LUCY) or embedded in an easterly wave (i.e., JOAN, LOUISE, SARAH, THELMA, AMY and KAREN), except for those embedded in the ITC (i.e., VERA, CARLA and EMMA). The last three are believed to have initially been junction vortices with the easterly waves subsequently being absorbed in the flow of Typhoon THELMA, T.D. #66, and Typhoon DINAH, respectively. Lack of data prevents complete substantiation of this belief with these cases, but this belief is verified in the case of Typhoon IVY which formed in the wake of Typhoon GILDA.

Of the six cases classified as embedded in an easterly wave, four came from easterly waves that had simultaneously embedded and junction vortices; however, the embedded vortices subsequently became dominate and absorbed the junction vortices (i.e., JOAN, LOUISE, THELMA and AMY).

Most of the vortices had their initial development under the SE quadrant of the zenith 200mb outdraft. The next most prevalent for development was the SW quadrant (i.e., Typhoons GEORGIA, HOPE, IRIS, DINAH and GILDA). One had its initial development under the NE quadrant (i.e., AMY). There were two under the influence of the NE quadrants of Southern Hemisphere outdrafts (i.e., WANDA and KAREN), which are equivalent to the flow of the SW quadrants of Northern Hemisphere outdrafts.

C. STEERING

Steering of the typhoon is not provided by any one pressure surface, but is the integrated effect of the whole atmosphere of which the typhoon is embedded. However, the changes on one pressure surface are reflected both up and down, and thus a particular pressure surface may be considered as representative of a finite layer of the atmosphere.

What pressure surface is best to use as a guide for steering? Each typhoon is an entity in itself, but in general it was observed this year that the best steering level was five to ten thousand feet below the maximum vertical extent of the storm at the time of consideration. The best example of this is Typhoon RUTH.

RUTH rapidly developed a closed cyclonic circulation through the 300mb level, and throughout her life the 300mb in conjunction with the 200mb gave the best indication of her course. The rapid veering SSE of Saipan was the result of the reorientation of the MPT to the N of the storm and the development of an upper level high pressure cell NW of Iwo Jima with extensive ridging to the SSE. RUTH established her closed cyclonic winds through the 200mb level after 161200Z and kept this extensive vertical development until 211200Z when she became a trough on this level. Her approximate point of recurvature was indicated 48 hours in advance by the 200mb flow. The 300mb was better than the 200mb for predicting her course from 12 hours prior to recurvature and on through the recurvature phase. On the 300mb level, a high pressure cell moved to the E until it was just N of Tokyo, while the high pressure cell near station ship 4YV went S, allowing RUTH to pick up the upper level trough and continue her recurvature.

The subtropical ridge axis on the 700mb and 500mb levels moved rather steadily northward from 111200Z to 190000Z; it moved from approximately 600 mi S to 120 mi N of Tokyo. After 190000Z, the 700mb and 500mb ridge to the N of the storm started dissipating while extensive ridging commenced from the general area of station ship 4YV until a new high pressure cell formed to the S of RUTH. The subtropical ridge then re-established itself in the approximate position it had at 111200Z, as RUTH churned off into the N portion of the North Pacific Ocean.

Thus, by using the upper levels for primary steering considerations, the JTWC forecasters never forecast a land strike on Japan by Typhoon RUTH.

Typhoons move W or S of W only with an abnormally strong subtropical ridge. The N component of movement is directly related to the weakness of the ridge on the steering level. Typhoons may make a pass at a short wave trough, depending upon the latitudinal distance S of the ridge axis and the strength of the short wave trough, but they will recurve into a long wave trough. Thus, the forecast of recurvature is very critical and involves an accurate direction and speed of movement of the typhoon, long wave and ridge axis in conjunction with the amplitude changes of the long wave and ridge.

An interesting feature of all the non-recurvers this year is that the 500mb was the level that gave the best indication of acting as the steering level for the majority of the length of all the tracks. Usually the larger the typhoon's circulation or the lower the surface pressure, the more difficult the job is of separating the undisturbed steering flow from the typhoon-induced changes. Thus, in general, the 500mb level works best as a steering level when the horizontal extent of the circulation is small or nonexistent on the 300mb level. The best example of this is Typhoon PATSY.

Based on the available data, it is doubtful that PATSY ever extended her closed cyclonic circulation above the 300mb level. The 500mb flow at 060000Z indicated that PATSY would follow in Typhoon OPEL's wake and skirt the eastern side of the Philippines and cross Taiwan before going inland. However, rapid ridging extended SW from the high pressure cell NW of Iwo Jima, and by 070000Z the subtropical ridge was re-established to the SE corner of the Tibetan Plateau. By 071200Z, the 500mb streamline flow ahead of PATSY indicated her course almost to the exact oscillations. In this area, no further major meteorological changes occurred, and the 500mb flow was only disturbed by the flow induced by PATSY. This is the ideal situation and one in which a pressure surface can most easily be used for steering indication.

No one pressure surface is used by the forecasters of JTWC to forecast the course of a typhoon; but in postanalysis, for comparison's sake, the one pressure surface that would have come the closest to predicting the best track in the three phases of movement (pre-recurvature, recurvature, and post-recurvature) was selected for each phase. The Best Steering Levels and Final Disposition chart is presented in lieu of further narration on the subject.

D. DISSIPATION

Complete dissipation is caused by one of two events (or in conjunction with one another): the first is the source of energy (the ocean) being cut off (i.e., large land strike relative to the horizontal extent of the circulation), and the second is the loss of the required minimum divergence aloft. The injection of cold air will lessen the intensity and change the character of the storm from tropical to extratropical with the subsequent possibility of regeneration as an extratropical storm. The final disposition of the typhoons is presented in the Best Steering Levels and Final Disposition chart. FREDA made the newspapers even in her extratropical condition when she crossed into the northwestern portion of the United States on 13 October.

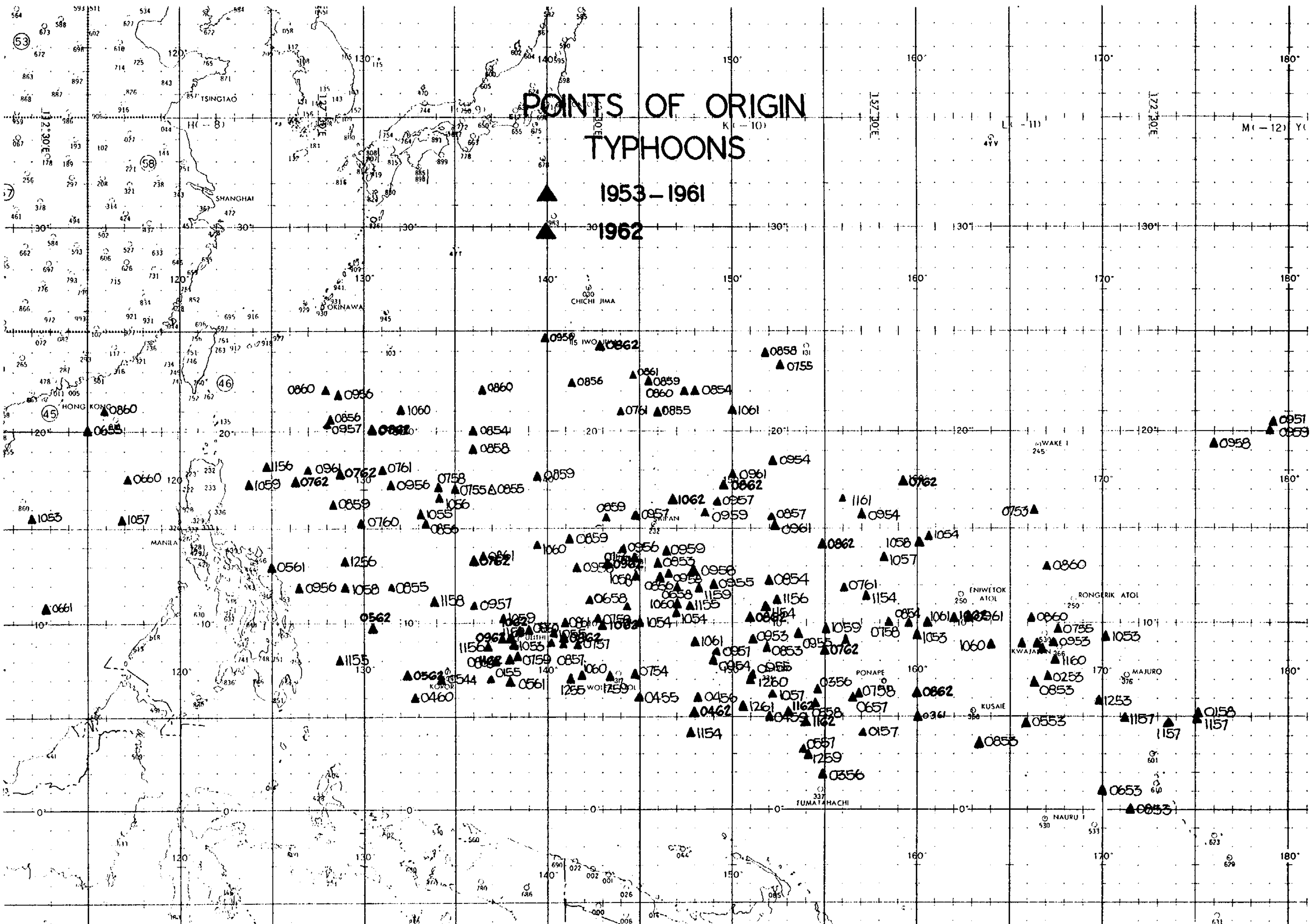
E. DAMAGE

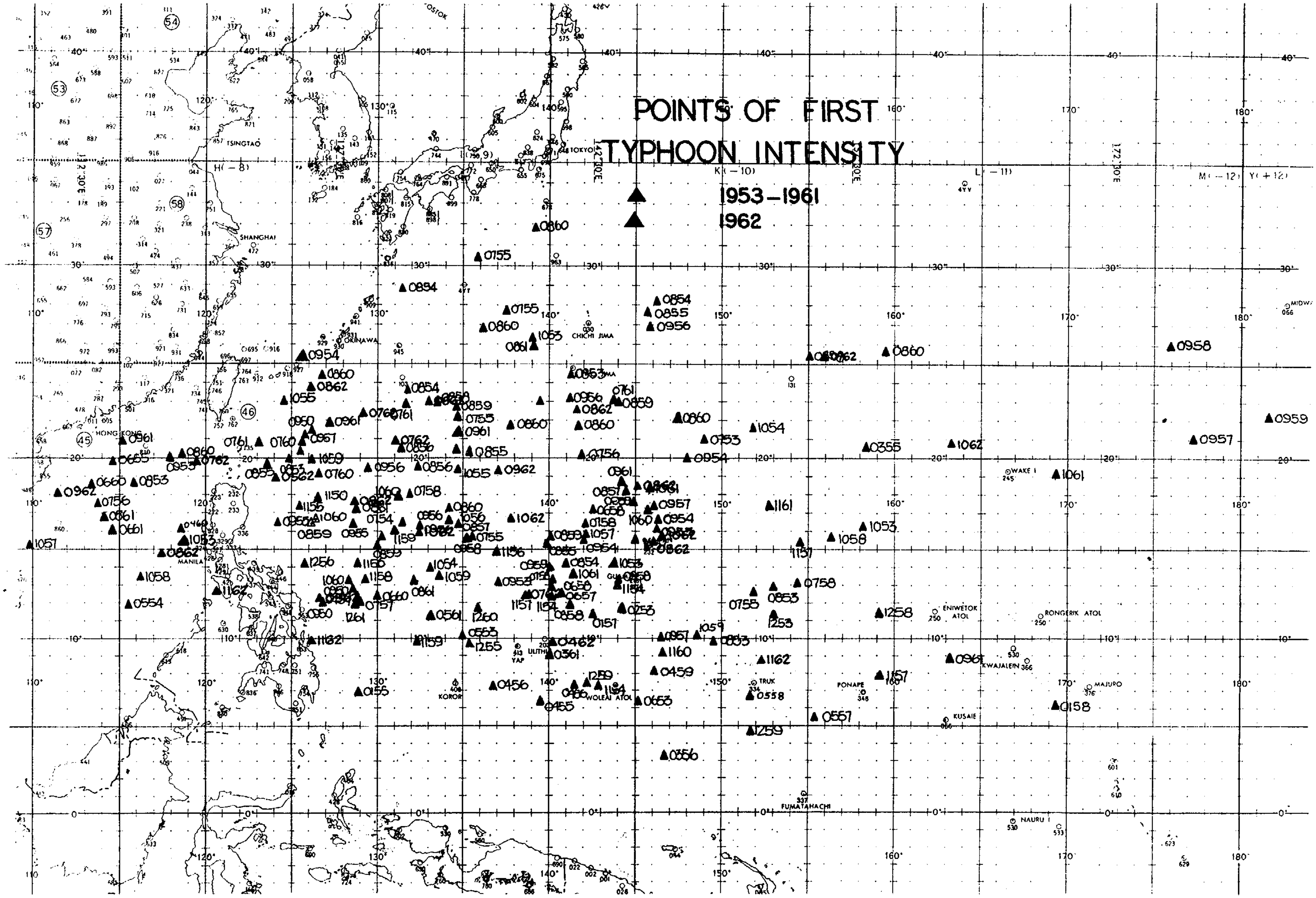
The actual total loss of life and property caused by tropical cyclones of the Western Pacific in 1962 is not known. However, to date, at least 1700 persons are known dead, and over $325,000,000 worth of property has been damaged or destroyed.

BEST STEERING LEVELS AND FINAL DISPOSITIONS

NAME	MAX WND	MAX VERTICAL DVLPMENT	RECURVATURE PRIOR	RECURVATURE DURING	RECURVATURE AFTER	DISSIPATION LAND STRIKE	DISSIPATION LACK OF DIV. ALOFT	EXTRA-TROPICAL
SARAH	75	30,000	2	2	2			X
KAREN	160	45,000	2	2	3			X
RUTH	160	45,000	2	3	3			X
EMMA	145	40,000	3	3	3			X
AMY	140	40,000	3	5	5			X
GEORGIA	130	35,000	5	3	5			X
THELMA	120	35,000	5	5	5			X
GILDA	115	30,000	5	5	5			X
FREDA	100	30,000	5	5	5			X
HOPE	85	25,000	5	5	5			X
JOAN	80	30,000	5	5	7			X
NORA	75	30,000	5	5	7			X
*OPEL	150	35,000	5	NA	NA			X
KATE	85	35,000	5	5	5	X		
LOUISE	80	30,000	5	3	7	X		
VERA	75	30,000	5	5	5	X		
IVY	100	25,000	NA	NA	5	ABSORBED		
IRIS	65	35,000	5	5	NA		X	
LUCY	100	30,000	5	NA	NA		X	
JEAN	90	25,000	5	NA	NA		X	
DINAH	100	35,000	5	NA	NA	X		
WANDA	95	35,000	5	NA	NA	X		
CARLA	75	30,000	5	NA	NA	X		
PATSY	65	30,000	5	NA	NA	X		

*Recurved after becoming extratropical. NOTE: Numbers indicate 100's of MB levels.


POINTS OF ORIGIN
TYPHOONS
1953-1961
1962
HONG KONG
SHANGHAI
TSINGTAO
MANILA
OKINAWA
CHICHI JIMA
WAKE I
ENIWETOK ATOL
RONGERIK ATOL
PONAPE
KUSAIE
MAJURO
NAURU I


POINTS OF FIRST TYPHOON INTENSITY
1953-1961
1962

TROPICAL CYCLONES OF 1962

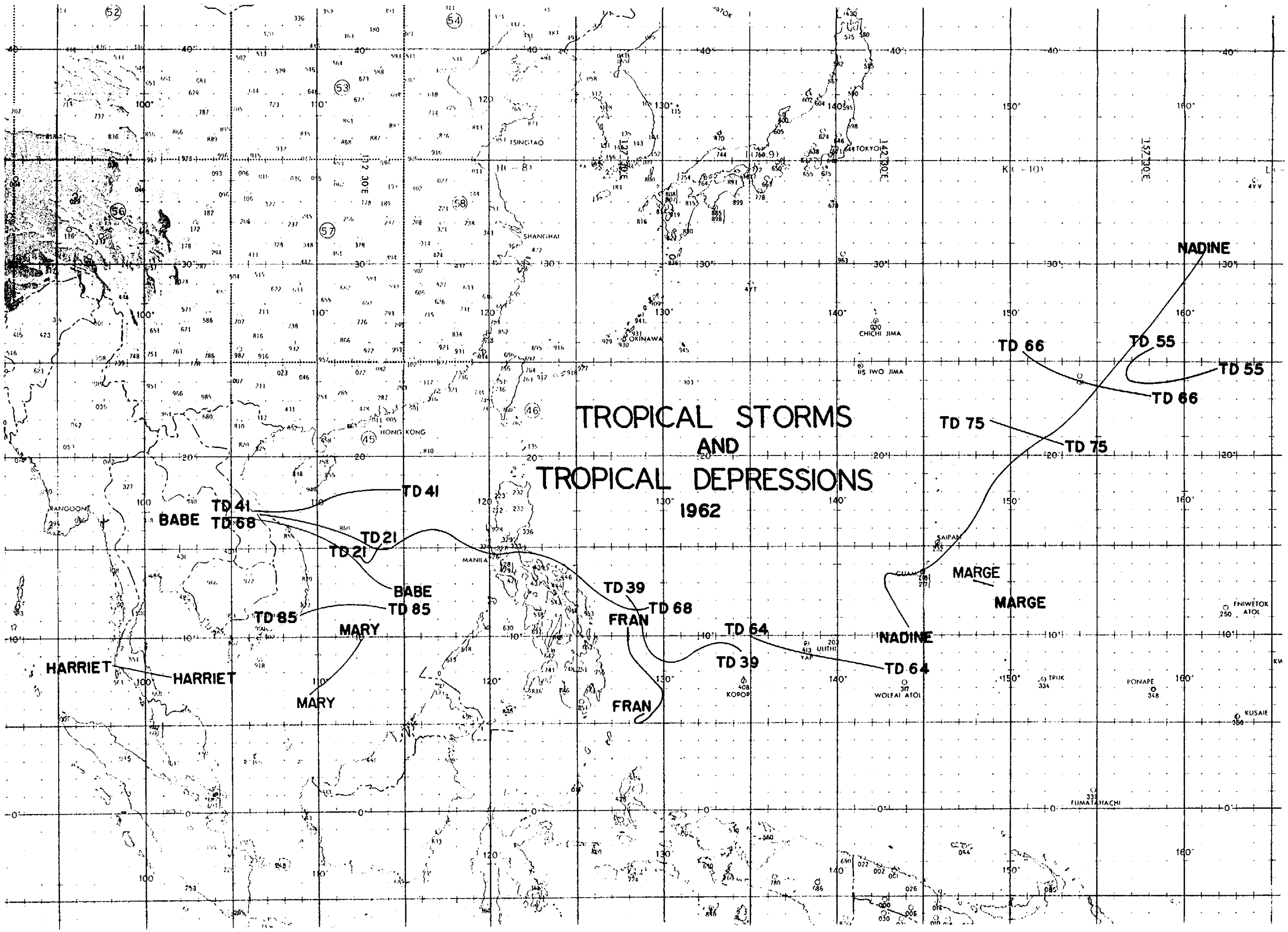
CYCLONE	*PERIOD
01. Investigation	01 Jan - 02 Jan
02. Tropical Storm FRAN	01 Feb - 06 Feb
03. Investigation	11 Feb - 13 Feb
04. Investigation	14 Feb - 17 Feb
05. Investigation	06 Mar - 07 Mar
06. Investigation	09 Mar - 10 Mar
13. Typhoon GEORGIA	16 Apr - 24 Apr
14. Investigation	28 Apr - 30 Apr
16. Investigation	07 May - 08 May
17. Typhoon HOPE	11 May - 22 May
18. Investigation	16 May - 17 May
21. Tropical Depression 21	21 May - 22 May
22. Typhoon IRIS	25 May - 30 May
24. Investigation	28 May - 31 May
26. Investigation	29 May - 30 May
29. Investigation	31 May - 02 Jun
34. Investigation	21 Jun - 28 Jun
36. Investigation	28 Jun - 04 Jul
37. Typhoon JOAN	04 Jul - 11 Jul
39. Tropical Depression 39	07 Jul - 15 Jul
41. Tropical Depression 41	10 Jul - 11 Jul
44. Typhoon KATE	18 Jul - 24 Jul
45. Typhoon LOUISE	19 Jul - 28 Jul
46. Typhoon NORA	2~~2~~6 Jul - 04 Aug
47. Tropical Storm MARGE	25 Jul - 29 Jul
48. Typhoon OPEL	29 Jul - 06 Aug
49. Investigation	30 Jul - 31 Jul
50. Tropical Depression 50 (JHWC Hawaii)	30 Jul - 03 Aug
51. Typhoon PATSY	05 Aug - 11 Aug
53. Typhoon SARAH	15 Aug - 22 Aug
54. Typhoon RUTH	13 Aug - 22 Aug
55. Tropical Depression 55	14 Aug - 15 Aug
56. Investigation	17 Aug - 18 Aug
58. Typhoon THELMA	20 Aug - 27 Aug
59. Typhoon WANDA	23 Aug - 01 Sep

TROPICAL CYCLONES OF 1962 (CONT'D)

CYCLONE	*PERIOD
60. Typhoon VERA	23 Aug - 28 Aug
61. Investigation	26 Aug - 28 Aug
62. Typhoon AMY	28 Aug - 08 Sep
63. Tropical Depression 63 (JHWC Hawaii)	01 Sep
64. Tropical Depression 64	03 Sep - 07 Sep
65. Typhoon CARLA	15 Sep - 23 Sep
66. Tropical Depression 66	11 Sep - 15 Sep
67. Tropical Storm BABE	13 Sep - 17 Sep
68. Tropical Depression 68	22 Sep - 27 Sep
69. Typhoon DINAH	25 Sep - 04 Oct
72. Typhoon FREDA	28 Sep - 10 Oct
73. Typhoon EMMA	01 Oct - 11 Oct
74. Typhoon GILDA	19 Oct - 30 Oct
75. Tropical Depression 75	20 Oct - 22 Oct
76. Typhoon IVY	28 Oct - 29 Oct
78. Tropical Storm HARRIET	25 Oct - 26 Oct
79. Investigation	26 Oct - 27 Oct
81. Typhoon JEAN	03 Nov - 12 Nov
84. Typhoon KAREN	07 Nov - 18 Nov
85. Tropical Depression 85	18 Nov - 20 Nov
86. Typhoon LUCY	24 Nov - 01 Dec
89. Tropical Storm MARY	01 Dec - 03 Dec
90. Tropical Storm NADINE	03 Dec - 10 Dec

* The period shown covers the period from the date the cyclone was first assigned a cyclone number until the final warning was issued, or if no warnings were issued, the date the cyclone dissipated.

Note: The missing numbers were assigned to major easterly waves that did not reach the cyclone stage.


TROPICAL STORMS
AND
TROPICAL DEPRESSIONS
1962
TD 41
TD 68
BABE
TD 21
TD 85
MARY
HARRIET
TD 39
FRAN
TD 64
NADINE
MARGE
TD 75
TD 66
TD 55
SHANGHAI
HONG KONG
MANILA
OKINAWA
CHICHI JIMA
IWO JIMA
SAIPAN
GUAM
YAP
ULITHI
KOROR
WOLEAI ATOLL
TRUK
PONAPE
KUSAIE
ENIWETOK ATOLL
RANGOON
TSINGTAO
TOKYO

TROPICAL STORMS 1962
POSITION DATA

TROPICAL STORM FRAN
02 FEB-06 FEB

DTG	LAT	LONG	DTG	LAT	LONG
020600Z	05.5N	128.9E	041200Z	07.5N	129.5E
021200Z	05.4N	128.8E	041800Z	07.8N	129.2E
021800Z	05.3N	128.6E	050000Z	08.2N	128.8E
030000Z	05.3N	128.5E	050600Z	08.5N	128.5E
030600Z	05.0N	128.5E	051200Z	09.0N	128.2E
031200Z	05.1N	128.9E	051800Z	09.5N	128.1E
031800Z	05.7N	129.6E	060000Z	10.0N	128.0E
040000Z	06.5N	130.0E	060600Z	10.5N	128.0E
040600Z	07.0N	129.9E			

TROPICAL STORM MARGE
28 JUL-29 JUL

DTG	LAT	LONG	DTG	LAT	LONG
280600Z	12.8N	148.9E	290000Z	13.0N	148.2E
281200Z	12.8N	148.7E	290600Z	13.1N	147.9E
281800Z	12.9N	148.4E			

TROPICAL STORM BABE
14 SEP-17 SEP

DTG	LAT	LONG	DTG	LAT	LONG
140000Z	12.7N	114.4E	151800Z	15.6N	110.2E
140600Z	12.9N	113.8E	160000Z	16.0N	109.3E
141200Z	13.2N	113.2E	160600Z	16.3N	108.1E
141800Z	13.7N	112.8E	161200Z	16.5N	107.0E
150000Z	14.2N	112.3E	161800Z	16.6N	105.8E
150600Z	14.7N	111.7E	170000Z	16.6N	104.8E
151200Z	15.2N	111.0E			

TROPICAL STORM HARRIET
25 OCT-26 OCT

DTG	LAT	LONG	DTG	LAT	LONG
251200Z	07.9N	101.5E	260600Z	DISSIPATED	
251800Z	08.1N	99.8E	261200Z	DISSIPATED	
260000Z	08.4N	98.1E			

TROPICAL STORM MARY
01 DEC-03 DEC

DTG	LAT	LONG	DTG	LAT	LONG
011200Z	09.8N	112.4E	021200Z	08.2N	111.4E
011800Z	09.4N	112.3E	021800Z	07.8N	110.9E
020000Z	09.1N	112.1E	030000Z	07.3N	110.3E
020600Z	08.7N	111.9E	030600Z	06.8N	109.5E

TROPICAL STORM NADINE
06 DEC-10 DEC

DTG	LAT	LONG	DTG	LAT	LONG
061200Z	10.4N	144.2E	081200Z	14.4N	146.0E
061800Z	11.3N	143.6E	081800Z	15.9N	147.4E
070000Z	12.0N	143.2E	090000Z	17.7N	148.5E
070600Z	12.8N	142.8E	090600Z	19.6N	150.1E
071200Z	13.4N	142.8E	091200Z	21.2N	152.3E
071800Z	13.4N	143.4E	091800Z	23.1N	154.6E
080000Z	13.4N	144.1E	100000Z	26.5N	157.9E
080600Z	13.6N	144.9E	100600Z	30.5N	161.2E

TROPICAL DEPRESSIONS 1962
POSITION DATA

TROPICAL DEPRESSION TWO ONE
21 MAY-22 MAY

DTG	LAT	LONG	DTG	LAT	LONG
210600Z	15.1N	113.7E	220600Z	14.2N	113.2E
211200Z	14.8N	113.5E	221200Z	14.0N	112.9E
211800Z	14.6N	113.4E	221800Z	14.3N	112.5E
220000Z	14.4N	113.3E			

TROPICAL DEPRESSION THREE NINE
08 JUL-12 JUL

DTG	LAT	LONG	DTG	LAT	LONG
080600Z	09.0N	134.5E	101200Z	08.8N	129.3E
081200Z	09.2N	134.3E	101800Z	09.1N	129.1E
081800Z	09.4N	133.9E	110000Z	09.5N	129.0E
090000Z	09.5N	133.3E	110600Z	10.0N	128.9E
090600Z	09.3N	132.5E	111200Z	10.7N	128.7E
091200Z	08.9N	131.6E	111800Z	11.3N	128.5E
091800Z	08.4N	130.8E	120000Z	11.8N	128.3E
100000Z	08.5N	129.9E	120600Z	12.2N	127.9E
100600Z	08.7N	129.6E			

TROPICAL DEPRESSION FOUR ONE
10 JUL-11 JUL

DTG	LAT	LONG	DTG	LAT	LONG
101200Z	18.1N	114.8E	110600Z	17.1N	109.9E
101800Z	18.2N	113.5E	111200Z	16.9N	108.0E
110000Z	17.9N	111.7E	111800Z	16.9N	106.4E

TROPICAL DEPRESSION FIVE FIVE
14 AUG-15 AUG

DTG	LAT	LONG	DTG	LAT	LONG
140000Z	24.8N	161.9E	141800Z	24.1N	156.8E
140600Z	24.4N	160.0E	150000Z	25.1N	157.0E
141200Z	24.0N	158.3E	150600Z	25.9N	158.1E

TROPICAL DEPRESSION SIX FOUR
05 SEP-06 SEP

DTG	LAT	LONG	DTG	LAT	LONG
050600Z	08.1N	142.8E	060000Z	09.1N	137.4E
051200Z	08.4N	140.9E	060600Z	09.4N	136.1E
051800Z	08.7N	139.2E	061200Z	10.0N	135.0E

TROPICAL DEPRESSION SIX SIX
12 SEP-14 SEP

DTG	LAT	LONG	DTG	LAT	LONG
121800Z	23.2N	158.1E	131800Z	24.2N	153.7E
130000Z	23.2N	157.4E	140000Z	24.8N	152.2E
130600Z	23.4N	156.5E	140600Z	25.6N	150.7E
131200Z	23.6N	155.3E			

TROPICAL DEPRESSION SIX EIGHT
22 SEP-27 SEP

DTG	LAT	LONG	DTG	LAT	LONG
221800Z	11.5N	129.2E	250600Z	15.4N	118.0E
230000Z	11.4N	128.4E	251200Z	15.9N	116.3E
230600Z	11.6N	127.3E	251800Z	15.3N	115.1E
231200Z	12.3N	126.4E	260000Z	14.8N	114.1E
231800Z	13.1N	125.4E	260600Z	15.1N	112.8E
240000Z	13.9N	124.2E	261200Z	15.7N	111.1E
240600Z	14.4N	123.1E	261800Z	16.2N	109.5E
241200Z	14.5N	122.1E	270000Z	16.5N	108.0E
241800Z	14.5N	120.9E	270600Z	16.7N	106.7E
250000Z	14.7N	119.3E			

TROPICAL DEPRESSION SEVEN FIVE
21 OCT-22 OCT

DTG	LAT	LONG	DTG	LAT	LONG
210600Z	20.6N	153.1E	220000Z	21.6N	149.8E
211200Z	20.9N	152.0E	220600Z	21.9N	148.8E
211800Z	21.3N	150.9E			

TROPICAL DEPRESSION EIGHT FIVE
18 NOV-20 NOV

DTG	LAT	LONG	DTG	LAT	LONG
181200Z	11.5N	114.0E	191200Z	11.5N	110.7E
181800Z	11.6N	113.2E	191800Z	11.4N	109.8E
190000Z	11.6N	112.4E	200000Z	11.0N	109.0E
190600Z	11.6N	111.6E			

POSITION DATA FOR TROPICAL DEPRESSION WARNINGS ISSUED BY
JOINT HURRICANE WARNING CENTER, HAWAII

TROPICAL DEPRESSION FIVE ZERO
30 JUL-03 AUG

DTG	LAT	LONG	DTG	LAT	LONG
300600Z	10.5N	161.9W	010600Z	13.3N	171.0W
301200Z	11.0N	163.0W	011200Z	13.5N	171.9W
301800Z	11.3N	164.4W	011800Z	13.8N	173.0W
310000Z	11.7N	165.6W	020000Z	13.9N	174.0W
310600Z	12.1N	167.0W	020600Z	13.9N	175.0W
311200Z	12.5N	168.0W	021200Z	14.0N	176.0W
311800Z	12.9N	168.9W	021800Z	14.0N	177.0W
010000Z	13.1N	169.9W	030000Z	DISSIPATED	

TROPICAL DEPRESSION SIX THREE
1 SEP

DTG	LAT	LONG	DTG	LAT	LONG
010000Z	16.5N	149.0W	011200Z	16.5N	151.0W
010600Z	16.5N	150.0W			

1962 TYPHOON FORECAST ERRORS
(IN MI)

TYPHOON	24 HR FORECASTS NO. OF CASES	24 HR FORECASTS MEAN ERROR	48 HR FORECASTS NO. OF CASES	48 HR FORECASTS MEAN ERROR
GEORGIA	25	269.7	21	500.5
HOPE	22	145.8	18	316.1
IRIS	6	224.2	4	429.0
JOAN	13	114.5	9	314.2
KATE	16	200.2	12	405.4
LOUISE	28	143.7	24	326.0
NORA	20	171.4	16	243.1
OPEL	14	138.7	10	181.1
PATSY	13	113.1	9	175.8
RUTH	32	115.9	28	311.0
SARAH	27	116.6	23	276.7
THELMA	22	112.5	18	147.8
VERA	9	134.8	5	338.8
WANDA	15	140.6	11	222.0
AMY	31	132.1	29	234.4
CARLA	7	152.3	3	297.0
DINAH	18	131.2	14	343.1
EMMA	36	163.3	32	364.4
FREDA	21	136.6	17	268.1
GILDA	31	158.0	27	330.2
IVY	3	146.7	0	--
JEAN	22	147.3	18	262.9
KAREN	38	104.6	34	173.9
LUCY	20	110.2	16	220.7

AVERAGE ERROR-24 HR FORECASTS (489 CASES)..........144.2
AVERAGE ERROR-48 HR FORECASTS (398 CASES)..........287.4

CHAPTER IV

INDIVIDUAL TYPHOONS

OF 1962

TYPHOON GEORGIA - 161200Z-240000Z APRIL 1962

I. DATA

A. Statistics

1. Calendar days of tropical warning - 7½
2. Calendar days of typhoon intensity - 5 3/4
3. Total distance traveled during tropical warning period - 2472 MI

B. Characteristics as a typhoon

1. Min observed SLP - 936mb, 210347Z
2. Min observed 850mb height - 3090 ft, 210347Z
3. Min observed 700mb height - 8210 ft, 201615Z
4. Max vertical development - 35,000 ft, 201200Z

II. DEVELOPMENT

A. Initial impetus - Large surge from Southern Hemisphere outdraft in easterlies

B. Initial surface vortex

1. Junction vortex at 131800Z
2. Surface pressure less than 1007mb
3. Maximum surface wind - 15 kts

C. Zenith flow at 200mb

1. Relative position surface vortex - SW quadrant of anticyclone
2. Wind velocity over vortex - 160/25 kts

III. STEERING

A. Prior to recurvature - 500mb

B. During recurvature - 300mb

C. After recurvature - 500mb

IV. DISSIPATION

A. Causative factor - Cold air

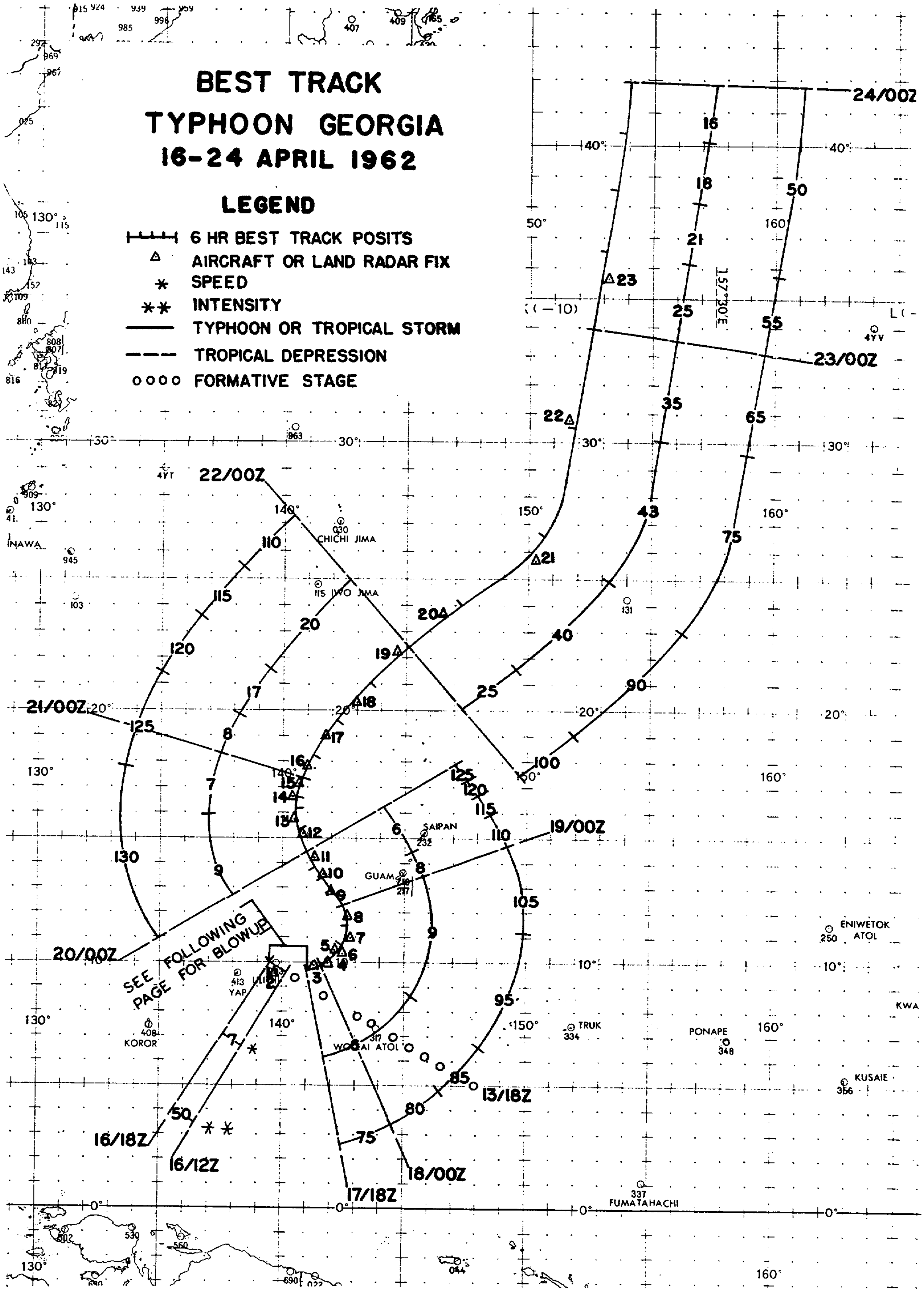
B. Final disposition - Extratropical

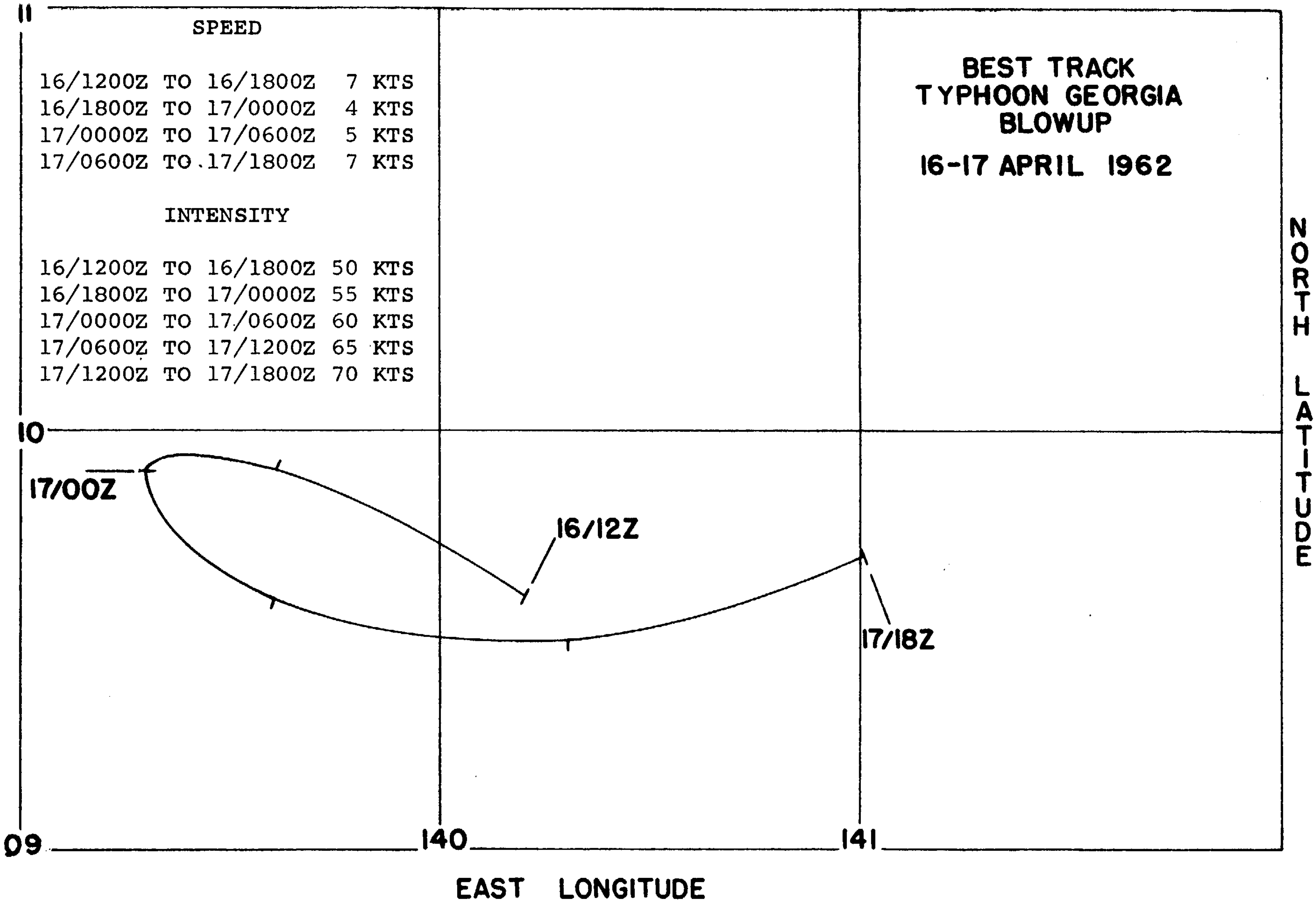
V. DAMAGE

A. Total lives lost - None reported

B. Total monetary value - $28,000

C. Types of property - Ship and its cargo


BEST TRACK
TYPHOON GEORGIA
16-24 APRIL 1962
LEGEND
6 HR BEST TRACK POSITS
AIRCRAFT OR LAND RADAR FIX
SPEED
INTENSITY
TYPHOON OR TROPICAL STORM
TROPICAL DEPRESSION
FORMATIVE STAGE
24/00Z
23/00Z
22/00Z
21/00Z
20/00Z
19/00Z
18/00Z
17/18Z
16/18Z
16/12Z
13/18Z
SEE FOLLOWING PAGE FOR BLOWUP
CHICHI JIMA
IWO JIMA
SAIPAN
GUAM
YAP
KOROR
WOLEAI ATOL
TRUK
PONAPE
ENIWETOK ATOL
KUSAIE
FUMATAHACHI
157°30'E


SPEED
16/1200Z TO 16/1800Z 7 KTS
16/1800Z TO 17/0000Z 4 KTS
17/0000Z TO 17/0600Z 5 KTS
17/0600Z TO 17/1800Z 7 KTS
INTENSITY
16/1200Z TO 16/1800Z 50 KTS
16/1800Z TO 17/0000Z 55 KTS
17/0000Z TO 17/0600Z 60 KTS
17/0600Z TO 17/1200Z 65 KTS
17/1200Z TO 17/1800Z 70 KTS
BEST TRACK
TYPHOON GEORGIA
BLOWUP
16-17 APRIL 1962
11
10
09
140
141
17/00Z
16/12Z
17/18Z
NORTH LATITUDE
EAST LONGITUDE

LAND RADAR AND AIRCRAFT FIXES - TYPHOON GEORGIA

FIX NO.	TIME	LAT.	LONG.	UNIT METHOD & ACCY	MAX SFC WND	MAX 700MB WND	MIN 700MB HGT	MIN SLP MBS	700MB T/Td (°C)	EYE CHARACTERISTICS
1	170201Z	09.8N	139.4E	VW1-P-05	55	-	-	985	- -	OPEN SE
2	170525Z	09.6N	139.6E	VW1-P-01	30	-	9768	982	16/-	DIA 30 MI, OPEN SE
3	172245Z	09.9N	141.4E	56-P-01	50	35	9730	988	21/15	CIRC 50 MI DIA, OPEN SE
4	180415Z	10.0N	141.8E	54-P-03	60	50	9480	994	17/15	ELLIP 30X20 MI
5	180708Z	10.3N	142.1E	54-P-05	80	63	9490	972	17/15	ELLIP 30X20 MI, OPEN N & NE
6	181030Z	10.3N	142.4E	VW1-R-02	-	-	-	-	- -	ELLIP 22 MI N-S & 32 MI E-W
7	181630Z	11.0N	142.8E	VW1-R-02	-	-	-	-	- -	DIA 24 MI
8	182200Z	11.8N	142.6E	54-P-05	80	-	8880	953	22/10	CIRC 25 MI DIA
9	190550Z	12.9N	142.0E	VW1-R-05	-	-	-	-	- -	WELL DEFINED
10	191400Z	13.6N	141.6E	LND/RDR	-	-	-	-	- -	---
11	192230Z	14.3N	141.2E	54-P-05	90	70	9150	965	16/13	CIRC 12 MI DIA
12	200425Z	15.1N	140.9E	54-P-05	110	105	8300	966	17/08	DIA 18 MI
13	201025Z	15.8N	140.5E	VW1-R-02	-	-	-	-	- -	DIA 30 MI
14	201615Z	16.6N	140.4E	VW1-P-01	-	-	8210	-	- -	DIA 26 MI
15	202213Z	17.2N	140.6E	54-P-02	90	105	8420	942	17/17	DIA 20 MI
16	210347Z	17.8N	141.0E	54-P-½	80	120	8400	936	19/15	ELLIP 38 MI E-W & 31 MI N-S
17	210925Z	19.0N	141.8E	VW1-R-05	-	-	-	-	- -	---

LAND RADAR AND AIRCRAFT FIXES - TYPHOON GEORGIA (CONT'D)

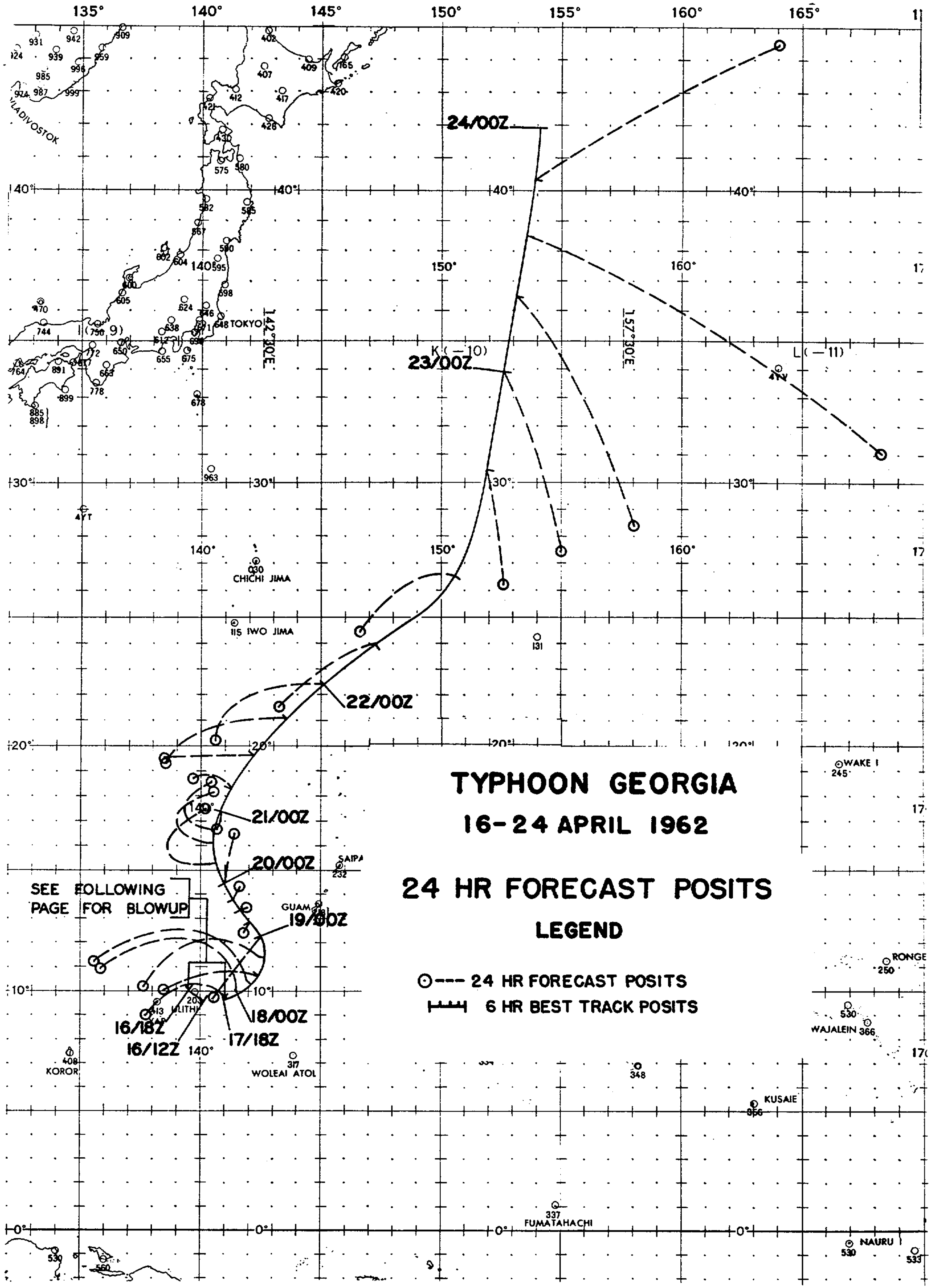
FIX NO.	TIME	LAT.	LONG.	UNIT METHOD & ACCY	MAX SFC WND	MAX 700MB WND	MIN 700MB HGT	MIN SLP MBS	700MB T/Td (°C)	EYE CHARACTERISTICS
18	211525Z	20.3N	143.0E	VW1-R-05	-	-	-	-	- -	DIA 36 MI, WEAK SW-NW
19	212251Z	22.2N	144.6E	54-P-05	80	100	8840	952	21/13	CIRC 35 MI DIA, OPEN E, S & W
20	220431Z	23.6N	146.5E	54-P-05	80	80	8960	956	17/13	NOT WELL DEFINED, DIA 60 MI
21	221053Z	25.8N	150.2E	VW1-R-10	-	-	-	-	- -	POOR DEFINED, DIA 40 MI
22	221812Z	30.7N	151.7E	VW1-R-10	-	-	-	-	- -	DIFFUSE 40 MI DIA
23	230345Z	35.6N	153.1E	54-P-03	50	50	9350	979	14/09	ELLIP ENE-WSW

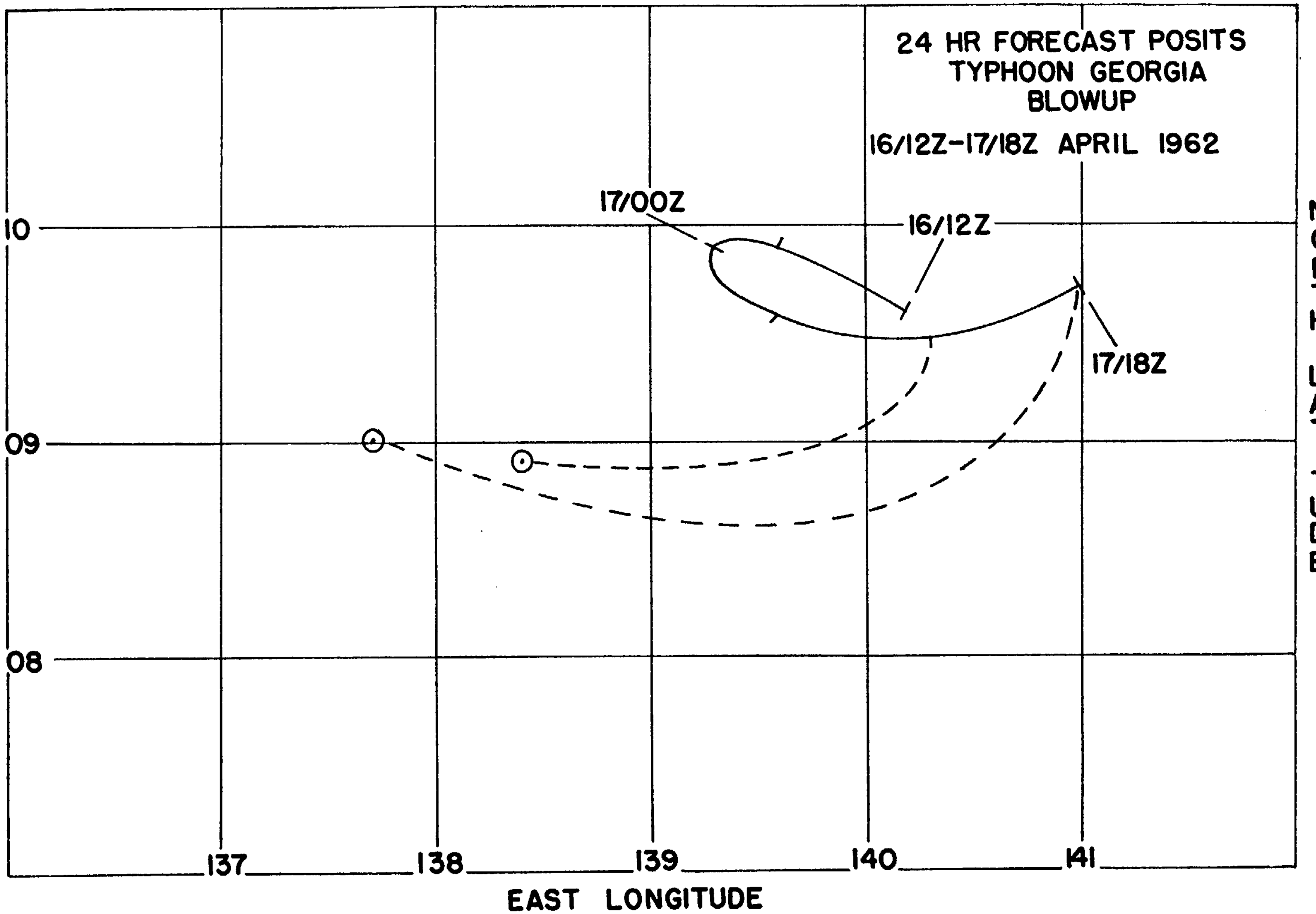
TYPHOON GEORGIA 16-24 APR 1962
POSITION AND FORECAST VERIFICATION DATA

DTG	STORM POSITION LAT.	LONG.	24 HR. ERROR DEG. DISTANCE	48 HR. ERROR DEG. DISTANCE
161200Z	09.6N	140.2E	------	------
161800Z	09.9N	139.6E	------	------
170000Z	09.9N	139.3E	------	------
170600Z	09.6N	139.6E	------	------
171200Z	09.5N	140.3E	------	------
171800Z	09.7N	141.0E	------	------
180000Z	09.8N	141.6E	282-336	------
180600Z	10.1N	142.1E	279-399	------
181200Z	10.5N	142.5E	263-253	------
181800Z	11.3N	142.8E	258-316	------
190000Z	12.2N	142.4E	220-189	271-609
190600Z	12.9N	142.1E	204-31	269-671
191200Z	13.4N	141.7E	090-12	249-399
191800Z	13.9N	141.3E	034-29	250-438
200000Z	14.4N	141.1E	005-125	225-309
200600Z	15.2N	140.6E	348-135	113-75
201200Z	16.1N	140.3E	003-124	019-71
201800Z	16.7N	140.5E	358-104	360-80
210000Z	17.4N	140.8E	200-34	357-289
210600Z	18.1N	141.2E	299-88	359-303
211200Z	19.5N	142.2E	270-218	352-260
211800Z	21.0N	143.6E	252-306	339-215
220000Z	22.4N	145.0E	241-286	236-349
220600Z	24.0N	147.1E	237-269	252-775
221200Z	26.4N	150.6E	244-242	248-737
221800Z	30.6N	151.8E	172-259	241-1080
230000Z	34.0N	152.6E	162-410	223-699
230600Z	36.5N	153.1E	153-550	194-651
231200Z	38.5N	153.6E	122-880	175-525
231800Z	40.3N	153.9E	060-534	126-945
240000Z	41.9N	154.0E	063-613	129-1030

TYPHOON GEORGIA 16-24 APR 1962
POSITION AND FORECAST VERIFICATION DATA (CONT'D)

AVERAGE 24 HOUR ERROR 269.7 MI
AVERAGE 48 HOUR ERROR 500.5 MI


TYPHOON GEORGIA
16-24 APRIL 1962
24 HR FORECAST POSITS
LEGEND
24 HR FORECAST POSITS
6 HR BEST TRACK POSITS
SEE FOLLOWING PAGE FOR BLOWUP
24/00Z
23/00Z
22/00Z
21/00Z
20/00Z
19/00Z
18/00Z
17/18Z
16/18Z
16/12Z
TOKYO
VLADIVOSTOK
CHICHI JIMA
IWO JIMA
SAIPAN
GUAM
ULITHI
KOROR
WOLEAI ATOL
WAKE I
RONGE
WAJALEIN
KUSAIE
FUMATAHACHI
NAURU
142°30'E
157°30'E
K(-10)
L(-11)


24 HR FORECAST POSITS
TYPHOON GEORGIA
BLOWUP
16/12Z-17/18Z APRIL 1962
17/00Z
16/12Z
17/18Z
10
09
08
NORTH LATITUDE
137
138
139
140
141
EAST LONGITUDE

TYPHOON HOPE - 160600Z-221200Z MAY 1962

I. DATA

A. Statistics

1. Calendar days of tropical warning - 6¼
2. Calendar days of typhoon intensity - 1 3/4
3. Total distance traveled during tropical warning period - 1566 MI

B. Characteristics as a typhoon

1. Min observed SLP - 978mb, 202247Z
2. Min observed 850mb height - 4285 ft, 202247Z
3. Min observed 700mb height - 9530 ft, 202247Z
4. Max vertical development - 25,000 ft, 201200Z

II. DEVELOPMENT

A. Initial impetus - Fracture after superposition of polar trough and easterly wave. Slight surge in easterlies apparently originating south of equator - noted on 200mb level.

B. Initial surface vortex

1. Junction vortex at 131800Z
2. Surface pressure less than 1007mb
3. Maximum surface wind - 10 kts

C. Zenith flow at 200mb

1. Relative position surface vortex - SW quadrant of anticyclone
2. Wind velocity over vortex - 140/15 kts

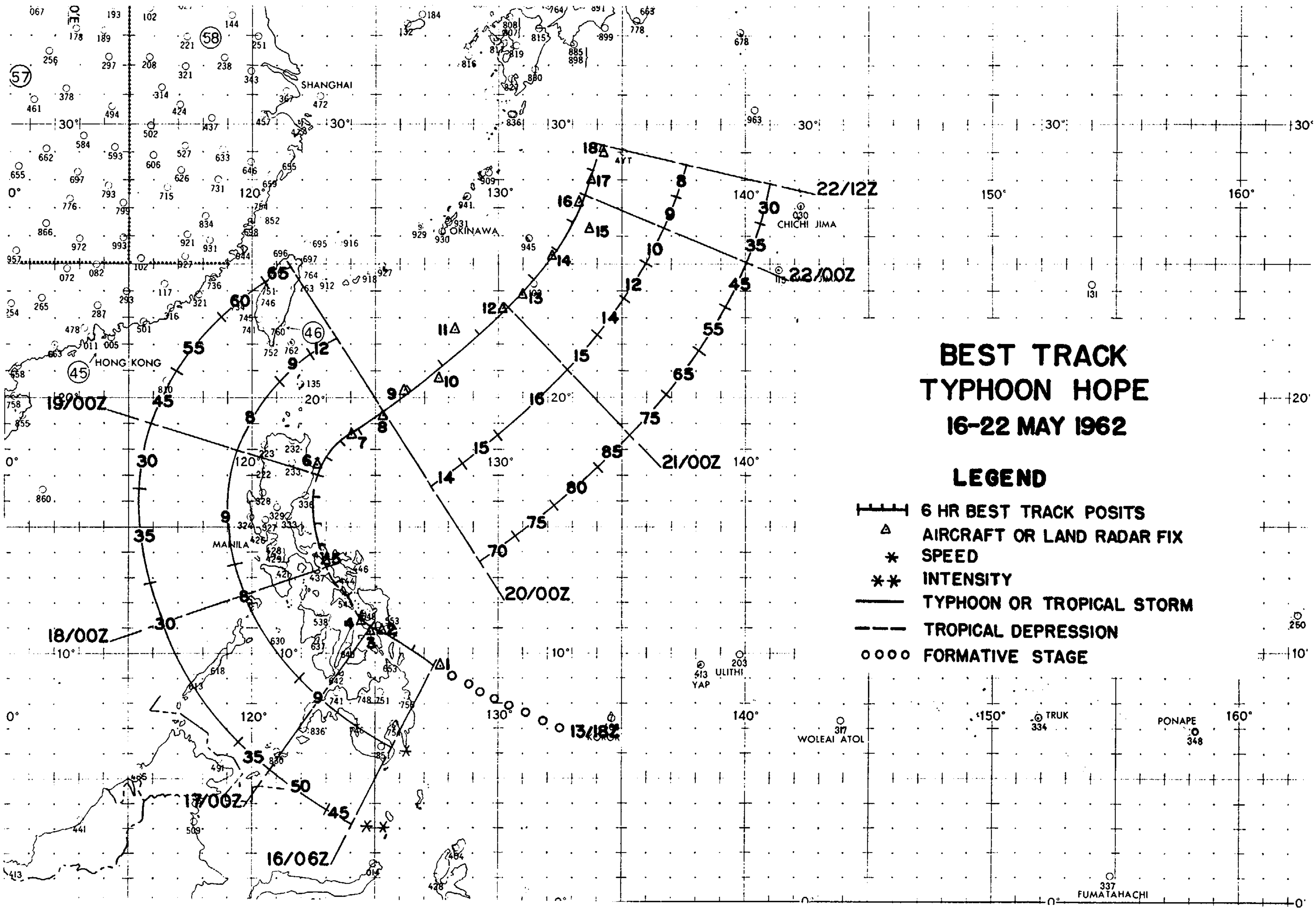
III. STEERING

A. Prior to recurvature - 500mb
B. During recurvature - 500mb
C. After recurvature - 500mb

IV. DISSIPATION

A. Causative factor - Cold air
B. Final disposition - Extratropical

V. DAMAGE - No reports received


BEST TRACK
TYPHOON HOPE
16-22 MAY 1962
LEGEND
6 HR BEST TRACK POSITS
AIRCRAFT OR LAND RADAR FIX
SPEED
INTENSITY
TYPHOON OR TROPICAL STORM
TROPICAL DEPRESSION
FORMATIVE STAGE
SHANGHAI
HONG KONG
OKINAWA
MANILA
CHICHI JIMA
ULITHI
YAP
WOLEAI ATOL
TRUK
PONAPE
FUMATAHACHI
KOROR
16/06Z
17/00Z
18/00Z
19/00Z
20/00Z
21/00Z
22/00Z
22/12Z
13/18Z

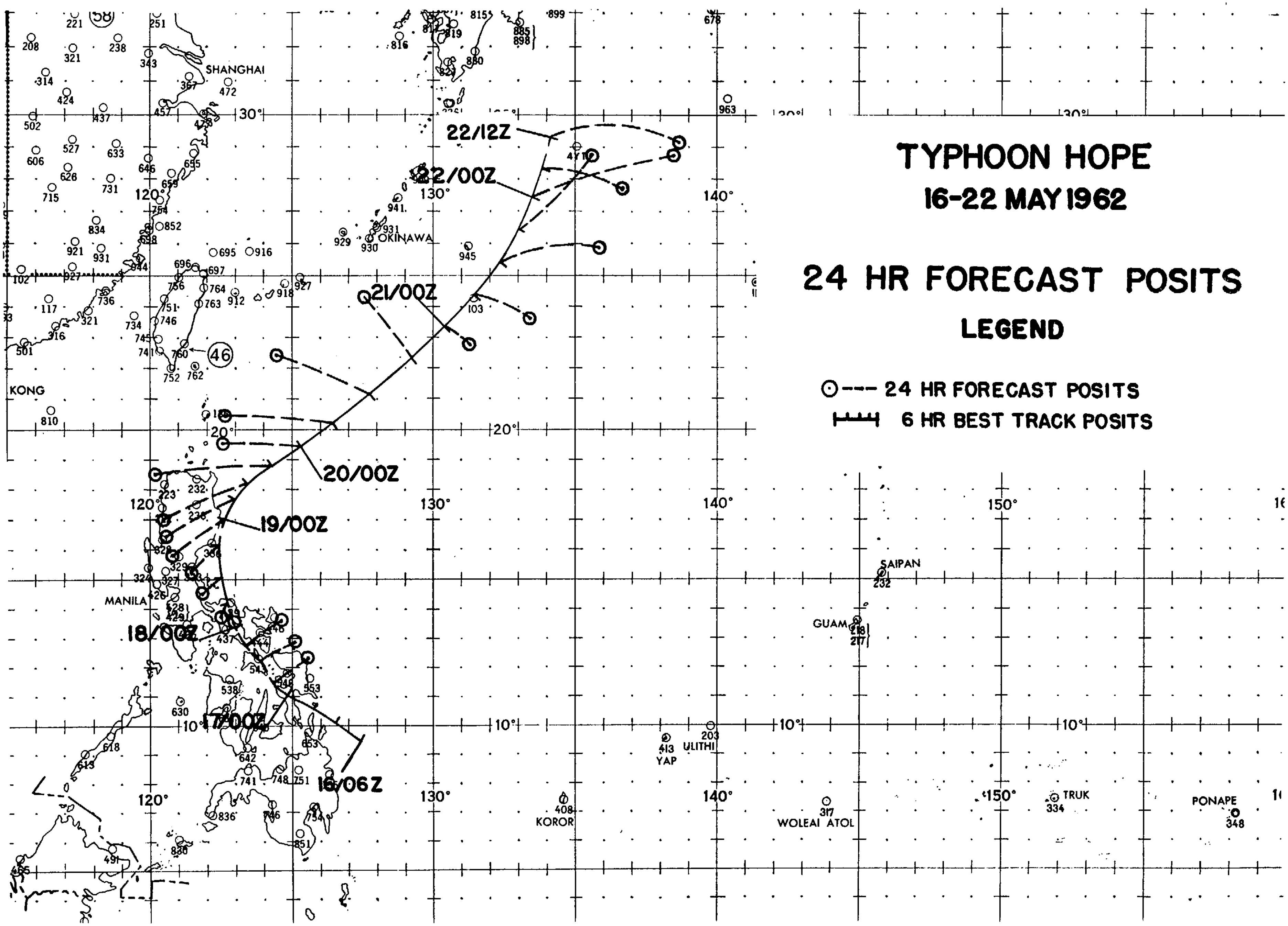
LAND RADAR AND AIRCRAFT FIXES - TYPHOON HOPE

FIX NO.	TIME	LAT.	LONG.	UNIT METHOD & ACCY	MAX SFC WND	MAX 700MB WND	MIN 700MB HGT	MIN SLP MBS	700MB T/Td (°C)	EYE CHARACTERISTICS
1	160400Z	09.6N	127.7E	54-P-05	50	45	10110	1007	10/05	CIRC 40 MI DIA, WALL CLDS NW & SE
2	162155Z	10.9N	125.2E	VW1-R-3	-	-	-	-	- -	---
3	162336Z	10.9N	124.7E	VW1-P-10	-	-	-	-	- -	---
4	170405Z	11.3N	124.3E	VW1-P-02	55	-	-	-	- -	DIA 15 MI, NO WALL CLDS
5	180100Z	13.8N	123.0E	USN-R-U	-	-	-	-	- -	DIA 21 MI, WEAK/DIFFUSED
6	190235Z	17.4N	122.7E	VW1-P-01	50	-	-	983	- -	DIA 5 MI
7	191600Z	18.6N	124.0E	USAF-R-U	-	-	-	-	- -	---
8	192307Z	19.3N	125.3E	VW1-P-05	65	-	-	980	- -	DIA 10 MI
9	200500Z	20.3N	126.2E	VW1-P-05	-	-	9850	-	- -	CIRC 20 MI DIA, BECOMING DIFFUSE
10	201006Z	20.7N	127.6E	VW1-P-03	60	-	-	979	- -	DIA 8 MI, OPEN SW
11	201600Z	22.5N	128.2E	VW1-R-03	-	-	-	-	- -	DIA 16 MI, OPEN S
12	202247Z	23.2N	130.1E	54-P-03	85	90	9530	978	20/15	CIRC 30 MI DIA
13	210400Z	23.9N	131.0E	54-P-05	70	55	9610	983	17/14	DIA 30 MI, OPEN SE-SW
14	211040Z	25.3N	132.2E	VW1-P-03	60	-	-	988	- -	---
15	211630Z	26.2N	133.7E	VW1-R-10	-	-	-	-	- -	VERY POORLY DEFINED
16	212210Z	27.1N	133.2E	54-P-02	45	38	10180	1002	14/09	VERY POORLY DEFINED
17	220401Z	28.0N	133.7E	54-P-02	35	40	10200	1008	10/05	VERY POORLY DEFINED
18	221130Z	29.0N	134.2E	VW1-R-15	-	-	-	-	- -	LITTLE SPIRAL BAND

TYPHOON HOPE 16-22 MAY 1962
POSITION AND FORECAST VERIFICATION DATA

DTG	STORM POSITION LAT.	LONG.	24 HR. ERROR DEG. DISTANCE	48 HR. ERROR DEG. DISTANCE
160600Z	09.7N	127.4E	------	------
161200Z	10.2N	126.6E	------	------
161800Z	10.7N	125.8E	------	------
170000Z	11.0N	124.9E	------	------
170600Z	11.5N	124.2E	062-101	------
171200Z	12.3N	123.9E	068-80	------
171800Z	12.8N	123.4E	067-90	------
180000Z	13.7N	123.1E	212-30	------
180600Z	14.4N	122.9E	214-44	115-78
181200Z	15.3N	122.6E	220-64	110-70
181800Z	16.2N	122.5E	224-90	114-75
190000Z	17.2N	122.6E	240-120	212-125
190600Z	17.8N	123.0E	237-160	224-144
191200Z	18.3N	123.5E	247-195	234-200
191800Z	18.9N	124.3E	268-245	248-260
200000Z	19.4N	125.3E	275-160	254-341
200600Z	20.2N	126.7E	286-235	252-412
201200Z	21.1N	127.9E	291-212	254-526
201800Z	22.2N	129.2E	324-143	260-520
210000Z	23.4N	130.4E	119-49	265-456
210600Z	24.4N	131.4E	114-116	265-448
211200Z	25.5N	132.4E	086-192	283-160
211800Z	26.6N	133.0E	044-200	046-230
220000Z	27.5N	133.5E	074-275	113-415
220600Z	28.3N	133.8E	101-161	100-563
221200Z	29.1N	134.2E	093-245	067-667

AVERAGE 24 HOUR ERROR 145.8 MI
AVERAGE 48 HOUR ERROR 316.1 MI


TYPHOON HOPE
16-22 MAY 1962
24 HR FORECAST POSITS
LEGEND
24 HR FORECAST POSITS
6 HR BEST TRACK POSITS
22/12Z
22/00Z
21/00Z
20/00Z
19/00Z
18/00Z
17/00Z
16/06Z
SHANGHAI
OKINAWA
KONG
MANILA
SAIPAN
GUAM
ULITHI
YAP
KOROR
WOLEAI ATOL
TRUK
PONAPE

TYPHOON IRIS - 260600Z-300000Z MAY 1962

I. DATA

A. Statistics

1. Calendar days of tropical warning - 3 3/4
2. Calendar days of typhoon intensity - ¼
3. Total distance traveled during tropical warning period - 630 MI

B. Characteristics as a typhoon

1. Min observed SLP - 991mb, 270415Z
2. Min observed 850mb height - 4775 ft, 270415Z
3. Min observed 700mb height - 10,000 ft, 270415Z
4. Max vertical development - 35,000 ft, 270415Z

II. DEVELOPMENT

A. Initial impetus - Easterly wave and polar trough fractured after superposition.

B. Initial surface vortex

1. Junction vortex at 260000Z
2. Surface pressure less than 1008mb
3. Max surface wind - 15 kts

C. Zenith flow at 200mb

1. Relative position surface vortex - SW quadrant of anticyclone
2. Wind velocity over vortex - 110/25 kts

III. STEERING

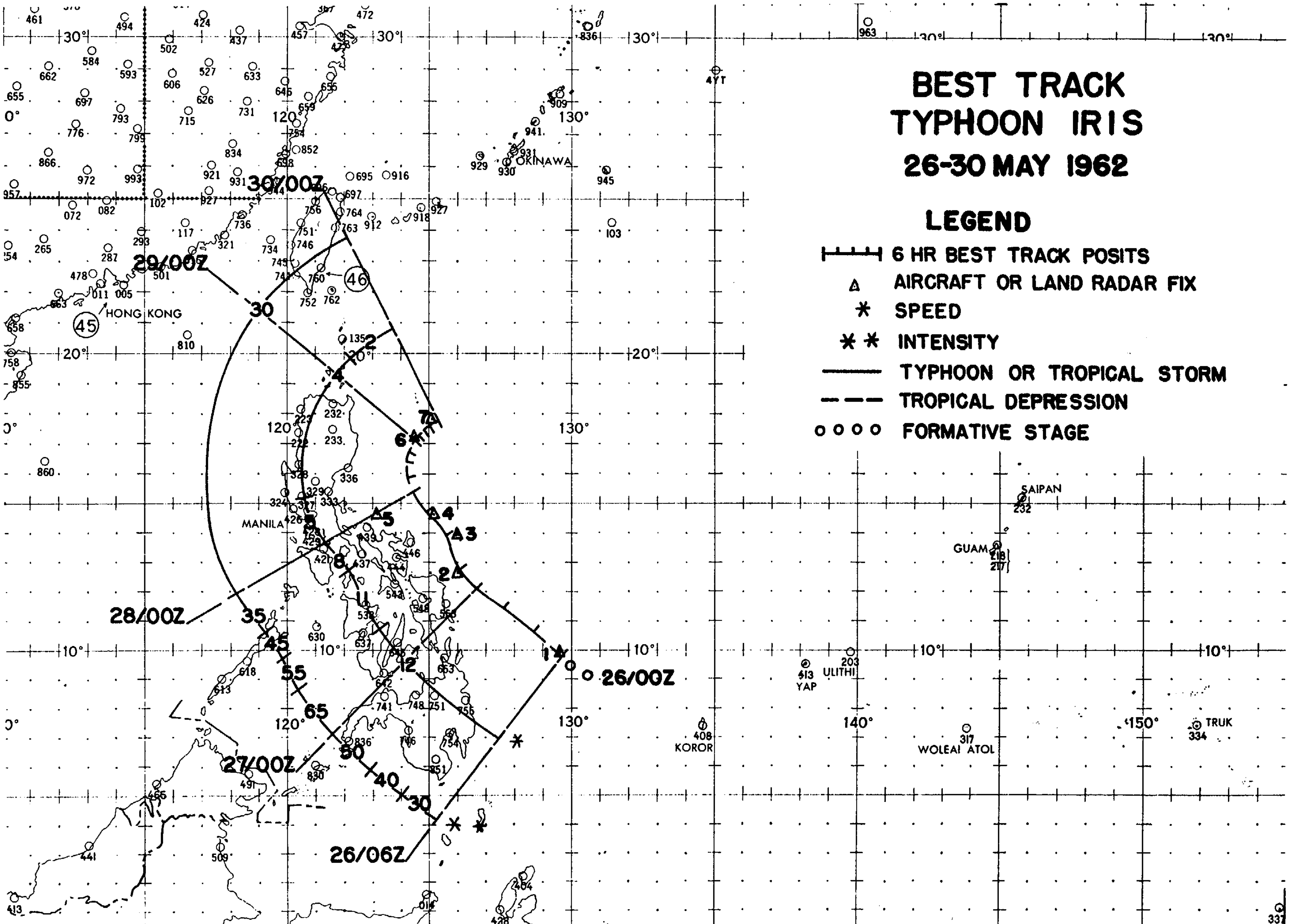
A. Prior to recurvature - 500mb
B. During recurvature - 500mb
C. After recurvature - NA

IV. DISSIPATION

A. Causative factor - Lack of upper level divergence
B. Final disposition - Dissipated

V. DAMAGE

A. Total lives lost - 5
B. Total monetary value - No estimate
C. Types of property - Crops


BEST TRACK
TYPHOON IRIS
26-30 MAY 1962
LEGEND
6 HR BEST TRACK POSITS
AIRCRAFT OR LAND RADAR FIX
SPEED
INTENSITY
TYPHOON OR TROPICAL STORM
TROPICAL DEPRESSION
FORMATIVE STAGE
26/00Z
26/06Z
27/00Z
28/00Z
29/00Z
30/00Z
HONG KONG
MANILA
OKINAWA
SAIPAN
GUAM
ULITHI
YAP
KOROR
WOLEAI ATOL
TRUK
30°
20°
10°
120°
130°
140°
150°

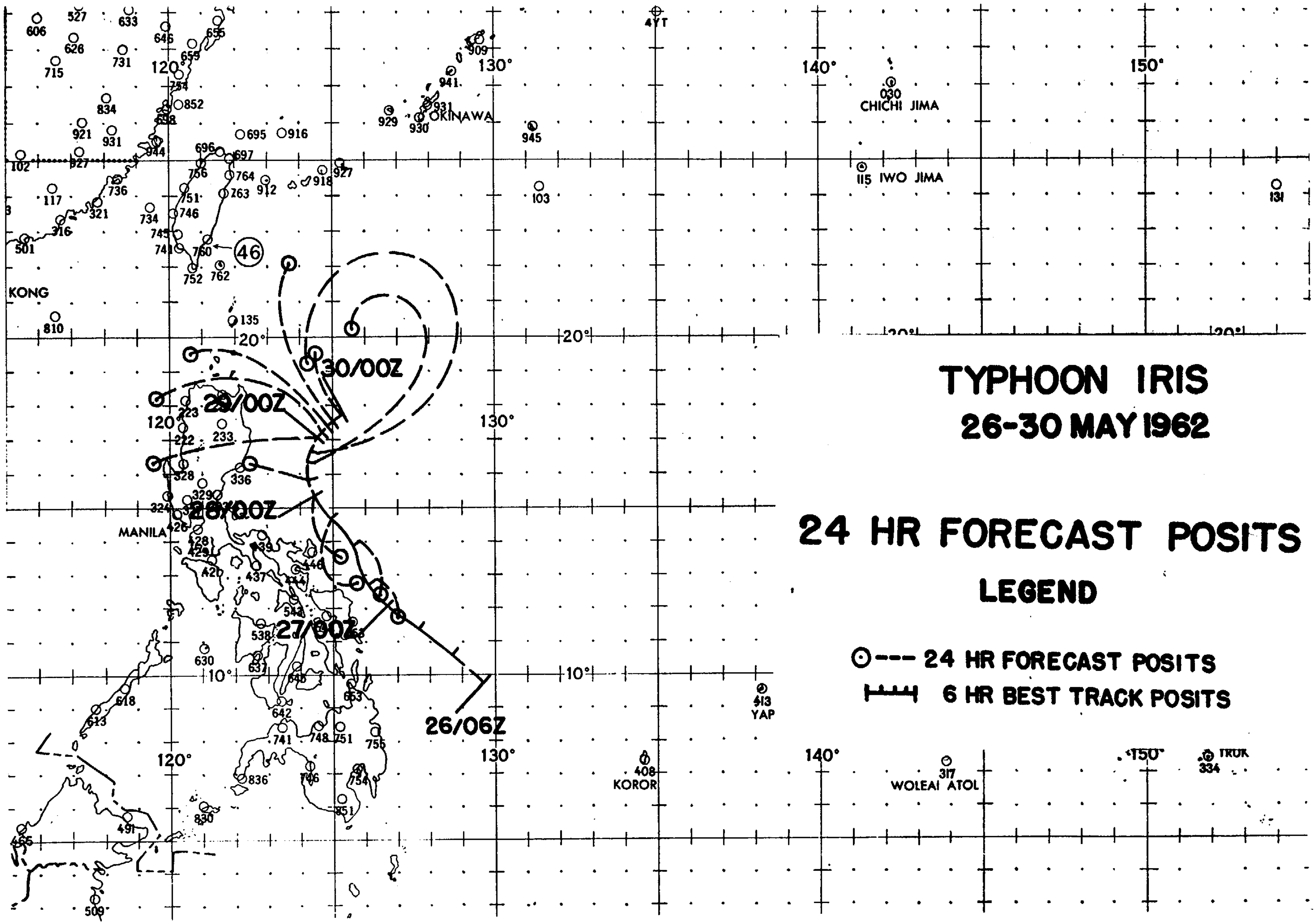
LAND RADAR AND AIRCRAFT FIXES - TYPHOON IRIS

FIX NO.	TIME	LAT.	LONG.	UNIT METHOD & ACCY	MAX SFC WND	MAX 700MB WND	MIN 700MB HGT	MIN SLP MBS	700MB T/Td (°C)	EYE CHARACTERISTICS
1	260552Z	09.9N	129.7E	54-P-05	30	-	-	1001	- -	POORLY DEFINED
2	270415Z	12.6N	126.0E	54-P-04	75	55	10000	991	21/16	CIRC 25 MI DIA,WELL DEFINED,OPEN SW
3	270906Z	14.0N	126.0E	PAWA-P-U	-	-	-	-	- -	---
4	271610Z	14.6N	125.1E	VW1-P-03	-	-	10245	-	- -	NO SPIRAL BANDS
5	272232Z	14.6N	123.1E	54-P-01	35	20	10190	1007	12/12	CIRC 20 MI DIA, NOT WELL DEFINED
6	282345Z	17.1N	124.5E	VW1-P-05	25	-	-	995	- -	30 MI N-S & 10 MI E-W
7	292156Z	17.8N	125.1E	VW1-P-02	15	-	-	-	- -	OVAL NNE-SSW 70X30 MI

TYPHOON IRIS 26-30 MAY 1962
POSITION AND FORECAST VERIFICATION DATA

DTG	STORM POSITION LAT.	LONG.	24 HR. ERROR DEG. DISTANCE	48 HR. ERROR DEG. DISTANCE
260600Z	09.9N	129.7E	------	------
261200Z	10.7N	128.8E	------	------
261800Z	11.4N	127.8E	------	------
270000Z	12.1N	126.8E	------	------
270600Z	12.9N	126.0E	------	------
271200Z	14.0N	125.6E	------	------
271800Z	14.8N	124.9E	------	------
280000Z	15.4N	124.3E	------	------
280600Z	15.9N	124.2E	282-96	------
281200Z	16.3N	124.2E	021-244	------
281800Z	16.7N	124.3E	356-145	------
290000Z	17.1N	124.5E	262-297	------
290600Z	17.4N	124.7E	278-295	294-240
291200Z	17.6N	124.8E	298-268	043-586
291800Z	17.7N	125.0E	------	024-434
300000Z	17.8N	125.2E	------	285-456

AVERAGE 24 HOUR ERROR 224.2 MI
AVERAGE 48 HOUR ERROR 429 MI


TYPHOON IRIS
26-30 MAY 1962
24 HR FORECAST POSITS
LEGEND
24 HR FORECAST POSITS
6 HR BEST TRACK POSITS
26/06Z
27/00Z
28/00Z
29/00Z
30/00Z
KONG
MANILA
OKINAWA
CHICHI JIMA
IWO JIMA
YAP
KOROR
WOLEAI ATOL
TRUK
4YT
120°
130°
140°
150°
20°
10°

TYPHOON JOAN - 070600Z-110600Z JULY 1962

I. DATA

A. Statistics

1. Calendar days of tropical warning - 4
2. Calendar days of typhoon intensity - 1 3/4
3. Total distance traveled during tropical warning period - 1614 MI

B. Characteristics as a typhoon

1. Min observed SLP - 985mb, 081000Z
2. Min observed 850mb height - 4555 ft, 082225Z
3. Min observed 700mb height - 9770 ft, 082225Z
4. Max vertical development - 30,000 ft, 080000Z

II. DEVELOPMENT

A. Initial impetus - Easterly wave and polar trough fractured after superposition

B. Initial surface vortex

1. Embedded vortex at 061200Z, junction vortex absorbed.
2. Surface pressure less than 1006mb
3. Maximum surface wind - 15 kts

C. Zenith flow at 200mb

1. Relative position surface vortex - SE quadrant of anticyclone
2. Wind velocity over vortex - 065/25 kts

III. STEERING

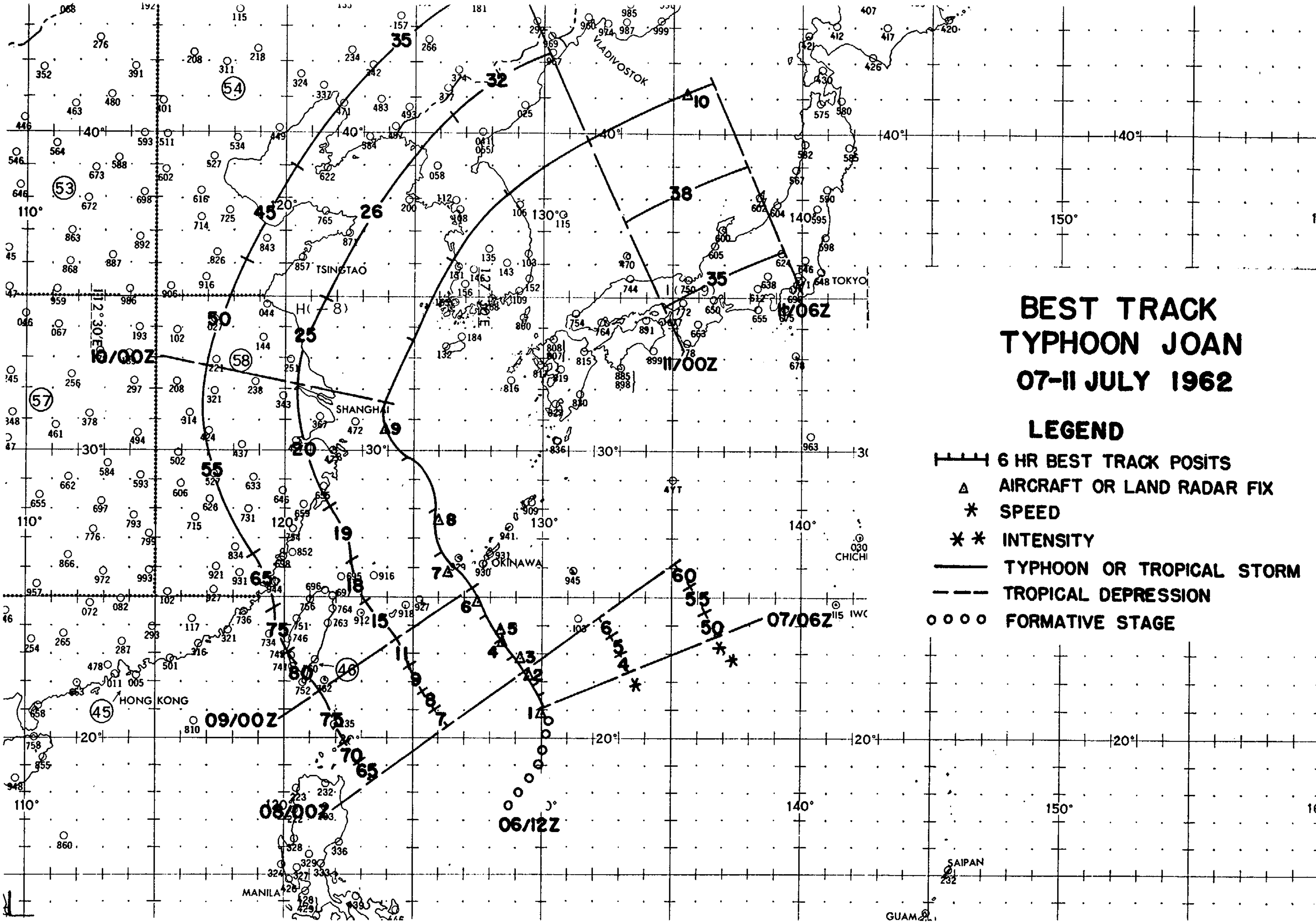
A. Prior to recurvature - 500mb
B. During recurvature - 500mb
C. After recurvature - 700mb

IV. DISSIPATION

A. Causative factor - Cold air
B. Final disposition - Extratropical

V. DAMAGE

A. Total lives lost - None
B. Total monetary value - $500,000
C. Types of property - Crops and communications


BEST TRACK
TYPHOON JOAN
07-11 JULY 1962
LEGEND
6 HR BEST TRACK POSITS
AIRCRAFT OR LAND RADAR FIX
SPEED
INTENSITY
TYPHOON OR TROPICAL STORM
TROPICAL DEPRESSION
FORMATIVE STAGE
VLADIVOSTOK
TSINGTAO
SHANGHAI
OKINAWA
HONG KONG
MANILA
TOKYO
CHICHI
SAIPAN
GUAM
06/12Z
07/06Z
08/00Z
09/00Z
10/00Z
11/00Z
11/06Z

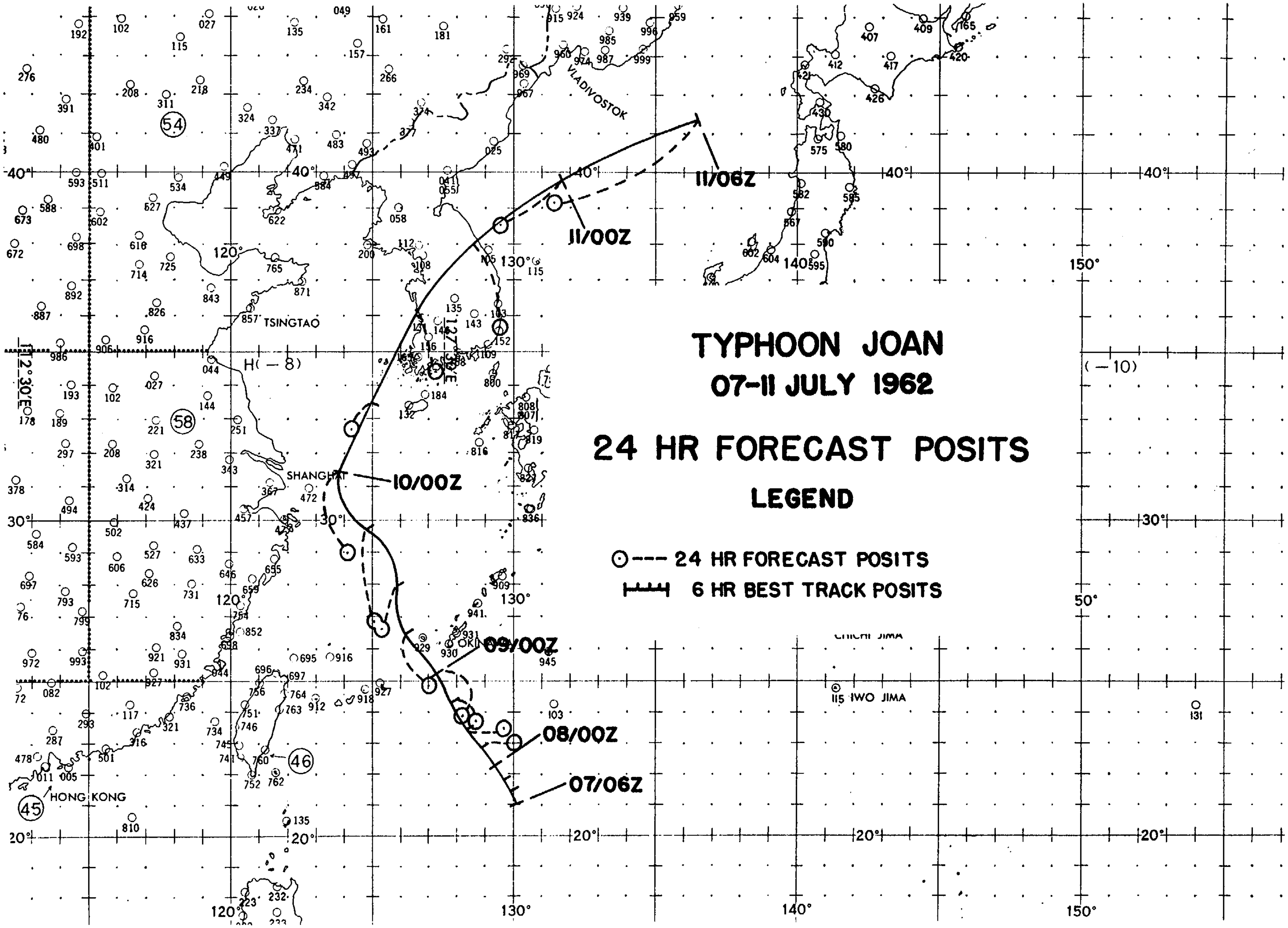
LAND RADAR AND AIRCRAFT FIXES - TYPHOON JOAN

FIX NO.	TIME	LAT.	LONG.	UNIT METHOD & ACCY	MAX SFC WND	MAX 700MB WND	MIN 700MB HGT	MIN SLP MBS	700MB T/Td (^{o}C)	EYE CHARACTERISTICS
1	070415Z	20.9N	130.0E	VW1-P-05	50	-	-	994	- -	CIRC 70 MI DIA, WEAK S & NW
2	072214Z	22.2N	129.5E	VW1-P-05	60	-	9975	985	- -	POORLY DEFINED, 40 MI DIA, OPEN W
3	080330Z	22.8N	129.1E	VW1-P-03	60	-	9870	-	- -	EYE 40 MI NW-SE & 60 MI SW-NE
4	081000Z	23.4N	128.4E	VW1-P-03	75	-	-	985	- -	CIRC 25 MI DIA, OPEN W, CLEAR IN EYE
5	081545Z	23.8N	128.4E	VW1-R-03	-	-	-	-	- -	CIRC 23 MI DIA, OPEN W & N
6	082225Z	24.8N	127.5E	54-P-04	60	50	9770	988	17/12	VERY UNORGANIZED
7	090400Z	25.8N	126.3E	54-P-02	80	75	9810	988	17/13	ELLIP WNW-ESE 60 MI LONG & 40 MI WIDE, OPEN E & S, VERY UNORGANIZED
8	091045Z	27.6N	126.0E	VW1-P-05	75	-	-	986	- -	CIRC 20 MI DIA, OPEN NW
9	092140Z	30.5N	123.9E	54-T-U	-	-	-	-	- -	POORLY DEFINED
10	110430Z	41.1N	135.4E	56-P-02	35	54	10110	997	12/05	NO WALL CLDS, 8/8 CIRC CLD PATTERN AT SFC TOPS 2000 FT

TYPHOON JOAN 07-11 JULY 1962
POSITION AND FORECAST VERIFICATION DATA

DTG	STORM POSITION LAT.	LONG.	24 HR ERROR DEG. DISTANCE	48 HR ERROR DEG. DISTANCE
070600Z	21.0N	130.0E	------	------
071200Z	21.3N	129.8E	------	------
071800Z	21.8N	129.7E	------	------
080000Z	22.4N	129.4E	------	------
080600Z	22.9N	128.9E	086-61	------
081200Z	23.5N	128.4E	095-73	------
081800Z	24.3N	127.9E	133-55	------
090000Z	25.2N	127.2E	149-94	------
090600Z	26.3N	126.0E	142-98	132-181
091200Z	28.0N	126.0E	199-96	154-228
091800Z	29.6N	124.8E	175-163	149-296
100000Z	31.3N	123.9E	178-127	158-383
100600Z	33.7N	124.9E	208-67	183-390
101200Z	36.0N	126.4E	152-106	208-330
101800Z	38.1N	128.3E	155-152	213-339
110000Z	39.8N	131.8E	232-136	227-396
110600Z	41.4N	136.3E	240-260	249-285

AVERAGE 24 HOUR ERROR 114.5 MI
AVERAGE 48 HOUR ERROR 314.2 MI


TYPHOON JOAN
07-11 JULY 1962
24 HR FORECAST POSITS
LEGEND
24 HR FORECAST POSITS
6 HR BEST TRACK POSITS
11/06Z
11/00Z
10/00Z
09/00Z
08/00Z
07/06Z
VLADIVOSTOK
TSINGTAO
SHANGHAI
HONG KONG
IWO JIMA
H(−8)
(−10)
112°30'E
127°30'E

TYPHOON KATE - 181200Z-240000Z JULY 1962

I. DATA

A. Statistics

1. Calendar days of tropical warning - $5\frac{1}{2}$
2. Calendar days of typhoon intensity - 2 3/4
3. Total distance traveled during tropical warning period - 1050 MI

B. Characteristics as a typhoon

1. Min observed SLP - 964mb, 220333Z
2. Min observed 850mb height - 3840 ft, 220333Z
3. Min observed 700mb height - 9060 ft, 220333Z
4. Max vertical development - 35,000 ft, 210000Z

II. DEVELOPMENT

A. Initial impetus - Easterly wave and polar trough fractured after superposition. Surge from westerlies into easterlies at the 200mb level.

B. Initial surface vortex

1. Junction vortex at 180000Z
2. Surface pressure less than 1004mb
3. Maximum surface wind - 10 kts

C. Zenith flow at 200mb

1. Relative position surface vortex - SE quadrant of anticyclone
2. Wind velocity over vortex - 065/30 kts

III. STEERING

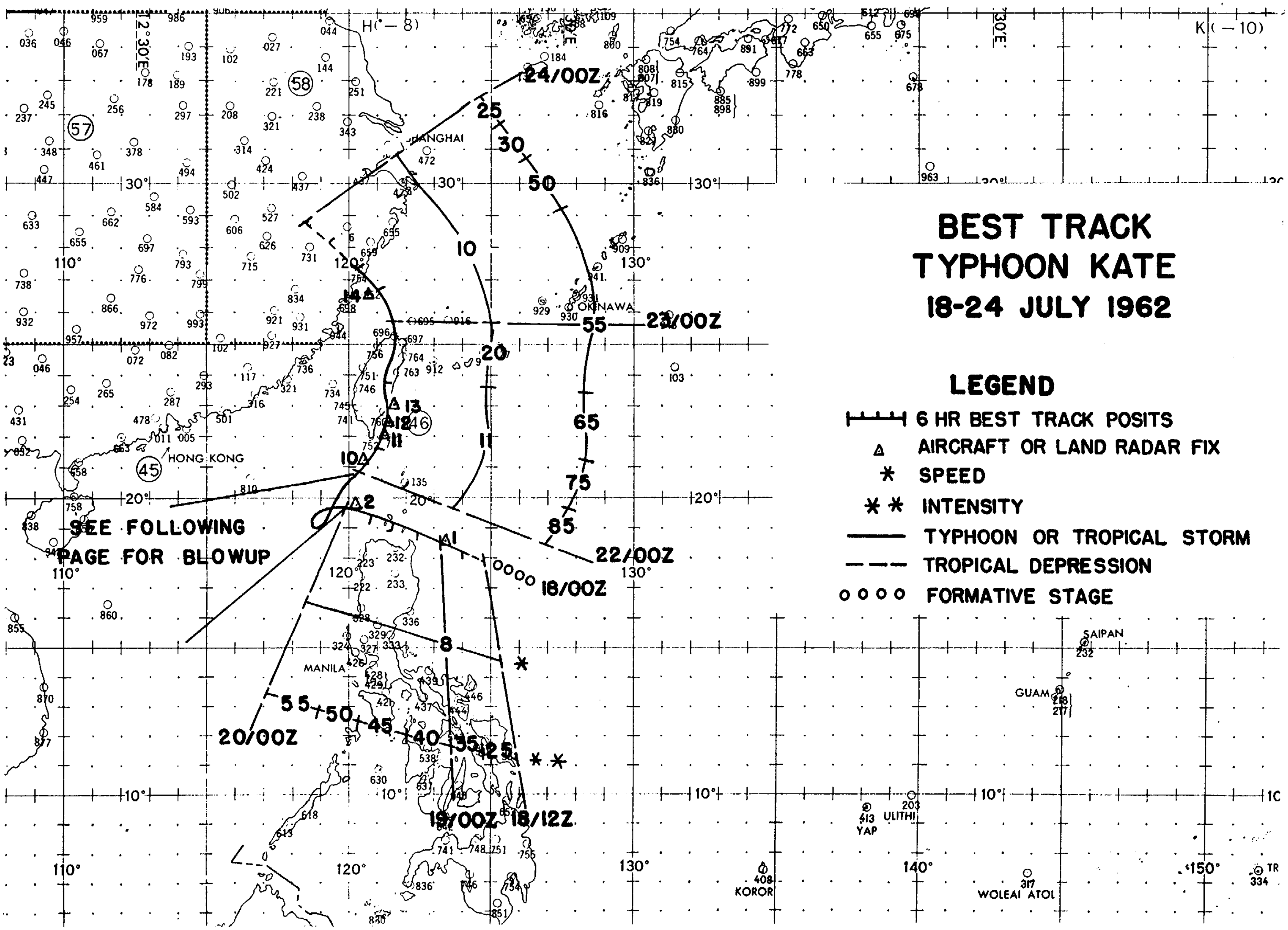
A. Prior to recurvature - 500mb
B. During recurvature - 500mb
C. After recurvature - 500mb

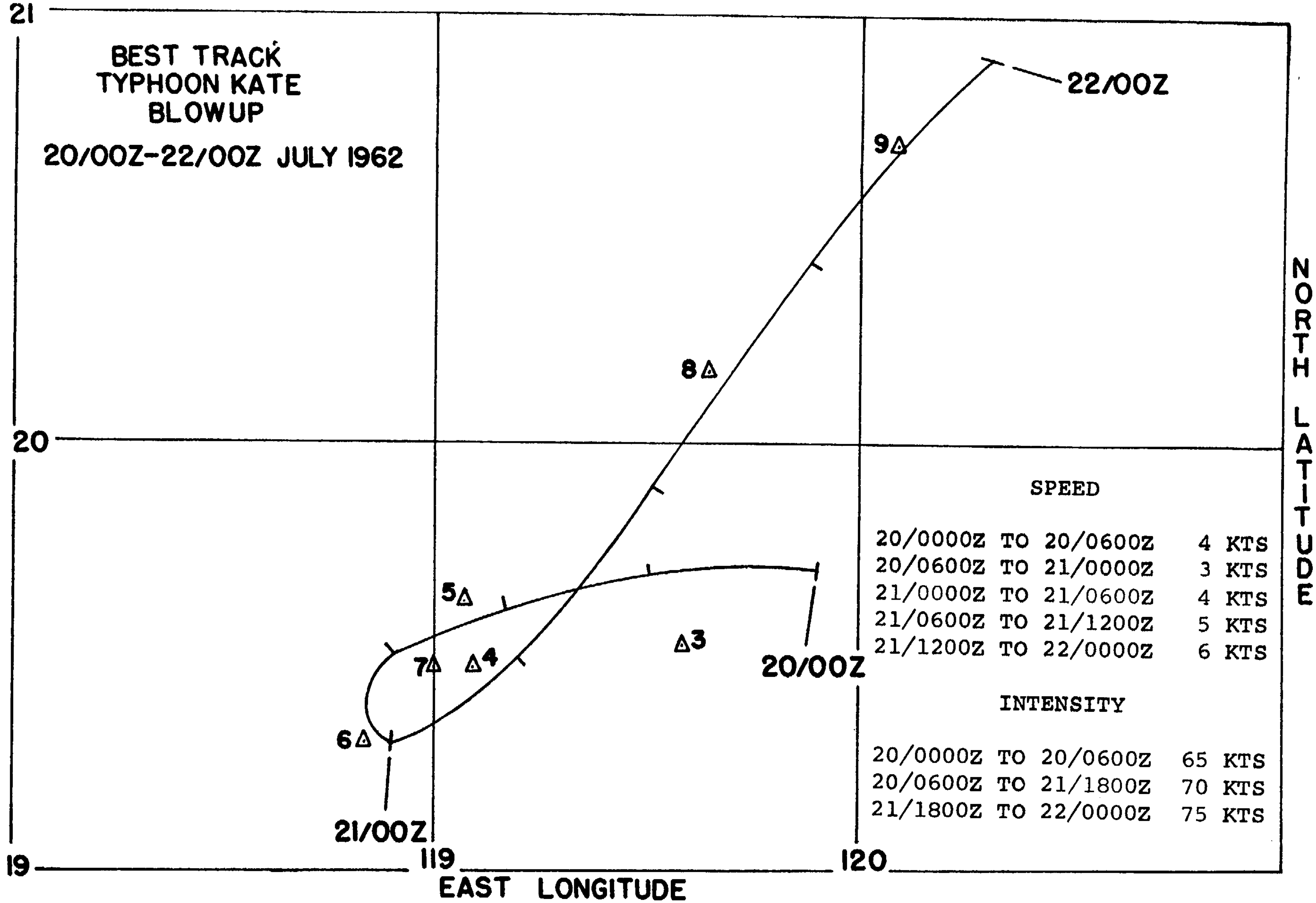
IV. DISSIPATION

A. Causative factor - Land strike
B. Final disposition - Dissipated

V. DAMAGE

A. Total lives lost - 110
B. Total monetary value - $25,000,000
C. Types of property - Crops, homes, rail lines, communications and bridges


BEST TRACK
TYPHOON KATE
18-24 JULY 1962
LEGEND
6 HR BEST TRACK POSITS
AIRCRAFT OR LAND RADAR FIX
SPEED
INTENSITY
TYPHOON OR TROPICAL STORM
TROPICAL DEPRESSION
FORMATIVE STAGE
SEE FOLLOWING PAGE FOR BLOWUP
24/00Z
23/00Z
22/00Z
20/00Z
19/00Z
18/12Z
18/00Z
SHANGHAI
OKINAWA
HONG KONG
MANILA
SAIPAN
GUAM
ULITHI
YAP
KOROR
WOLEAI ATOL
H(-8)
K(-10)



BEST TRACK
TYPHOON KATE
BLOWUP
20/00Z-22/00Z JULY 1962
21
20
19
119
120
EAST LONGITUDE
NORTH LATITUDE
22/00Z
20/00Z
21/00Z
3
4
5
6
7
8
9
SPEED
20/0000Z TO 20/0600Z 4 KTS
20/0600Z TO 21/0000Z 3 KTS
21/0000Z TO 21/0600Z 4 KTS
21/0600Z TO 21/1200Z 5 KTS
21/1200Z TO 22/0000Z 6 KTS
INTENSITY
20/0000Z TO 20/0600Z 65 KTS
20/0600Z TO 21/1800Z 70 KTS
21/1800Z TO 22/0000Z 75 KTS

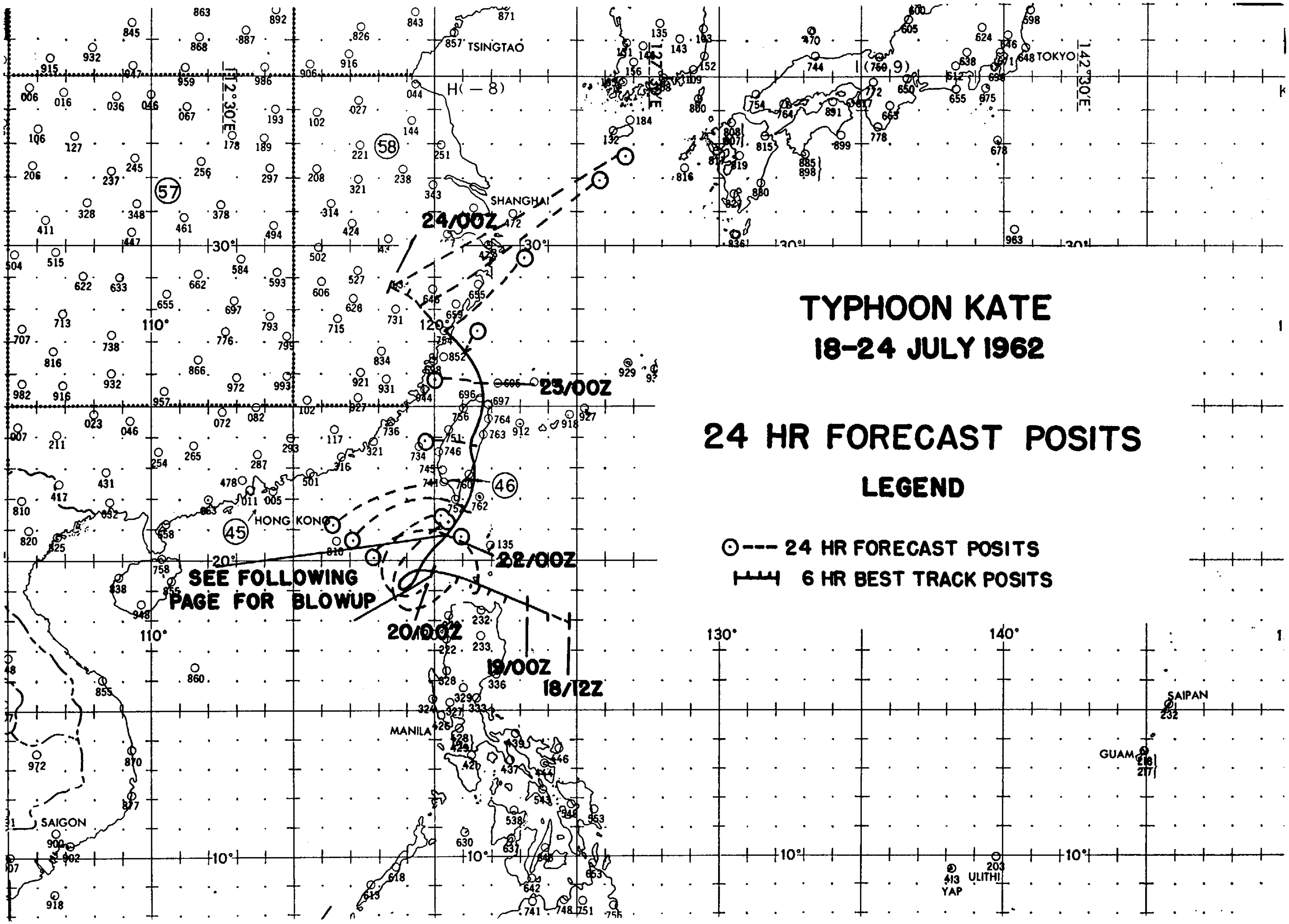
LAND RADAR AND AIRCRAFT FIXES - TYPHOON KATE

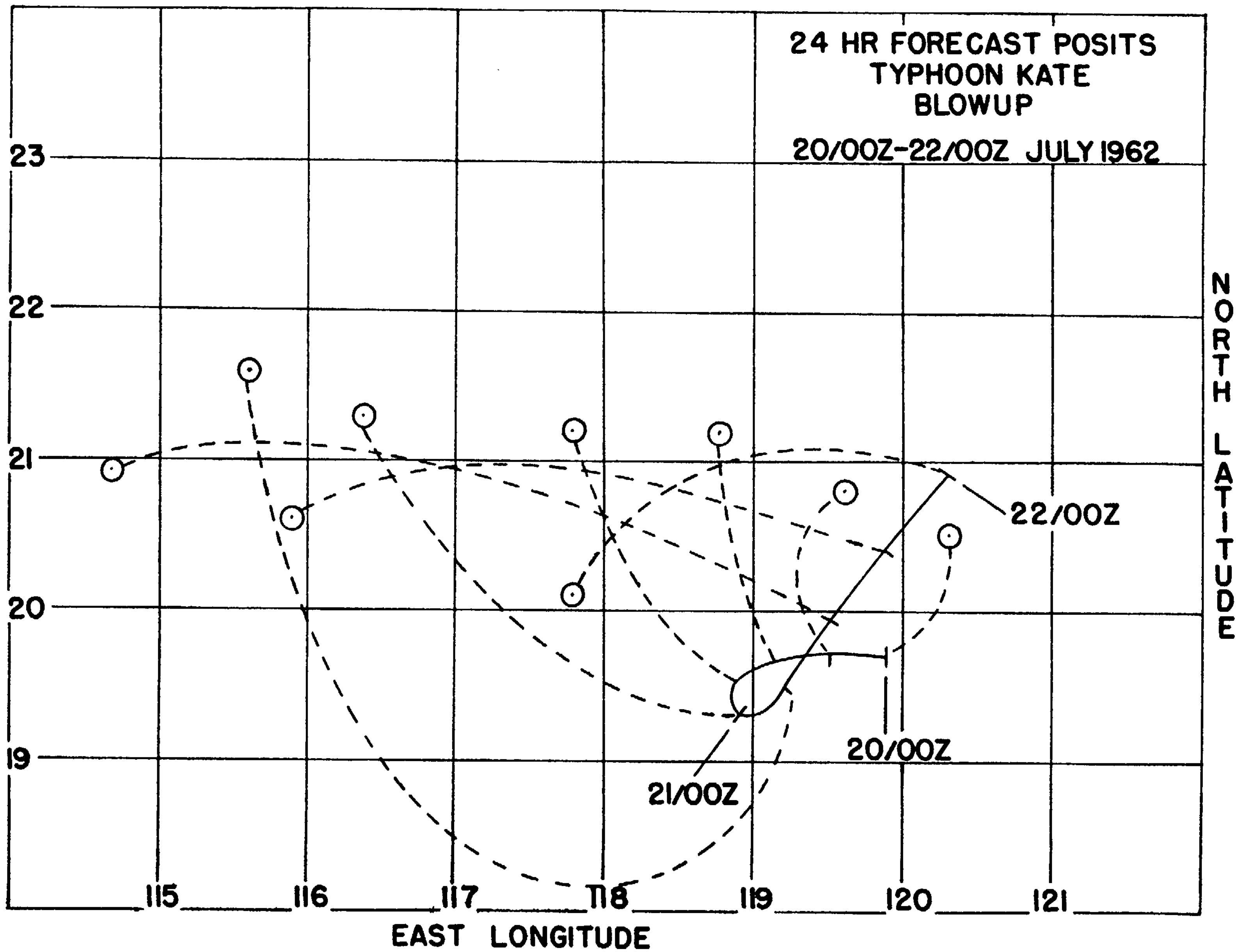
FIX NO.	TIME	LAT.	LONG.	UNIT METHOD & ACCY	MAX SFC WND	MAX 700MB WND	MIN 700MB HGT	MIN SLP MBS	700MB T/Td (^{o}C)	EYE CHARACTERISTICS
1	182320Z	18.5N	123.3E	VW1-P-03	35	-	9808	999	13/	CIRC 40 MI DIA, OPEN N
2	192145Z	19.7N	120.2E	54-P-02	50	45	9910	993	11/08	CIRC 75 MI DIA, OPEN SW TO NW
3	200331Z	19.5N	119.6E	54-P-03	65	53	9640	-	16/10	CIRC 12 MI DIA, OPEN W
4	200655Z	19.4N	119.1E	LND/RDR	-	-	-	-	- -	---
5	201330Z	19.6N	119.1E	VW1-R-03	-	-	-	-	- -	OVAL 75 MI N-S & 25 MI E-W, WEAK WALL CLDS
6	202149Z	19.3N	118.8E	54-P-04	40	50	9510	978	19/17	CIRC 25 MI DIA, OPEN S
7	210310Z	19.4N	119.0E	54-P-05	45	50	9420	976	15/12	OBLONG 15X30 MI, OPEN SW TO NW
8	211420Z	20.2N	119.7E	VW1-R-04	-	-	-	-	- -	CIRC 35 MI DIA
9	212240Z	20.7N	120.1E	54-P-05	-	60	9190	990	13/09	CIRC 20 MI DIA, WALL CLDS ALL QUADS
10	220333Z	21.1N	120.6E	54-P-U	75	80	9060	964	- -	CIRC 12 MI DIA, WALL CLDS ALL QUADS
11	220720Z	22.0N	121.2E	LND/RDR	-	-	-	-	- -	---
12	221040Z	22.5N	121.4E	LND/RDR	-	-	-	-	- -	---
13	221305Z	22.9N	121.5E	LND/RDR	-	-	-	-	- -	---
14	231500Z	26.7N	120.7E	VW1-R-20	-	-	-	-	- -	NO WALL CLDS, OPEN N

TYPHOON KATE 18-24 JULY 1962
POSITION AND FORECAST VERIFICATION DATA

DTG	STORM POSITION LAT.	LONG.	24 HR. ERROR DEG. DISTANCE	48 HR. ERROR DEG. DISTANCE
181200Z	17.9N	124.7E	------	------
181800Z	18.2N	124.0E	------	------
190000Z	18.5N	123.2E	------	------
190600Z	18.9N	122.4E	------	------
191200Z	19.2N	121.6E	------	------
191800Z	19.6N	120.8E	------	------
200000Z	19.7N	119.9E	------	------
200600Z	19.7N	119.5E	005-68	------
201200Z	19.6N	119.2E	350-97	------
201800Z	19.5N	118.9E	330-118	------
210000Z	19.3N	118.9E	312-186	------
210600Z	19.5N	119.2E	302-233	304-204
211200Z	19.9N	119.5E	282-276	295-250
211800Z	20.4N	119.9E	273-223	286-308
220000Z	20.9N	120.3E	253-144	288-493
220600Z	21.7N	121.0E	254-222	284-552
221200Z	22.7N	121.5E	253-302	264-506
221800Z	23.8N	121.5E	272-97	258-537
230000Z	25.8N	121.6E	270-86	243-490
230600Z	26.7N	121.0E	030-51	246-473
231200Z	27.3N	120.2E	050-208	245-482
231800Z	28.0N	119.4E	054-408	294-66
240000Z	28.7N	118.5E	060-484	055-504

AVERAGE 24 HOUR ERROR 200.2 MI
AVERAGE 48 HOUR ERROR 405.4 MI


TYPHOON KATE
18-24 JULY 1962
24 HR FORECAST POSITS
LEGEND
24 HR FORECAST POSITS
6 HR BEST TRACK POSITS
SEE FOLLOWING PAGE FOR BLOWUP
18/12Z
19/00Z
20/00Z
22/00Z
23/00Z
24/00Z
TSINGTAO
SHANGHAI
HONG KONG
MANILA
SAIGON
TOKYO
SAIPAN
GUAM
YAP
ULITHI
H(−8)


24 HR FORECAST POSITS
TYPHOON KATE
BLOWUP
20/00Z-22/00Z JULY 1962
23
22
21
20
19
22/00Z
20/00Z
21/00Z
115
116
117
118
119
120
121
EAST LONGITUDE
NORTH LATITUDE

TRAFFIC CONTINUES AS USUAL THROUGH MANILA'S FLOODED STREETS CAUSED BY TYPHOON KATE. BOATS WOULD BE MORE APPROPRIATE ON MACARTHUR HIGHWAY. (STARS & STRIPES PHOTO)

TYPHOON LOUISE - 201200Z-281200Z JULY 1962

I. DATA

A. Statistics

1. Calendar days of tropical warning - 8
2. Calendar days of typhoon intensity - $5\frac{1}{4}$
3. Total distance traveled during tropical warning period - 1962 MI

B. Characteristics as a typhoon

1. Min observed SLP - 958mb, 240400Z
2. Min observed 850mb height - 3750 ft, 230400Z
3. Min observed 700mb height - 9000 ft, 230400Z
4. Max vertical development - 30,000 ft, 250000Z

II. DEVELOPMENT

A. Initial impetus - Eastward movement of MPT and development of anticyclone over surface vortex.

B. Initial surface vortex

1. Embedded vortex at 190600Z, junction vortex absorbed.
2. Surface pressure less than 1008mb
3. Maximum surface wind - 15 kts

C. Zenith flow at 200mb

1. Relative position surface vortex - SE quadrant of anticyclone
2. Wind velocity over vortex - 050/25 kts

III. STEERING

A. Prior to recurvature - 500mb

B. During recurvature - 300mb

C. After recurvature - 700mb

IV. DISSIPATION

A. Causative factor - Land strike and cold air

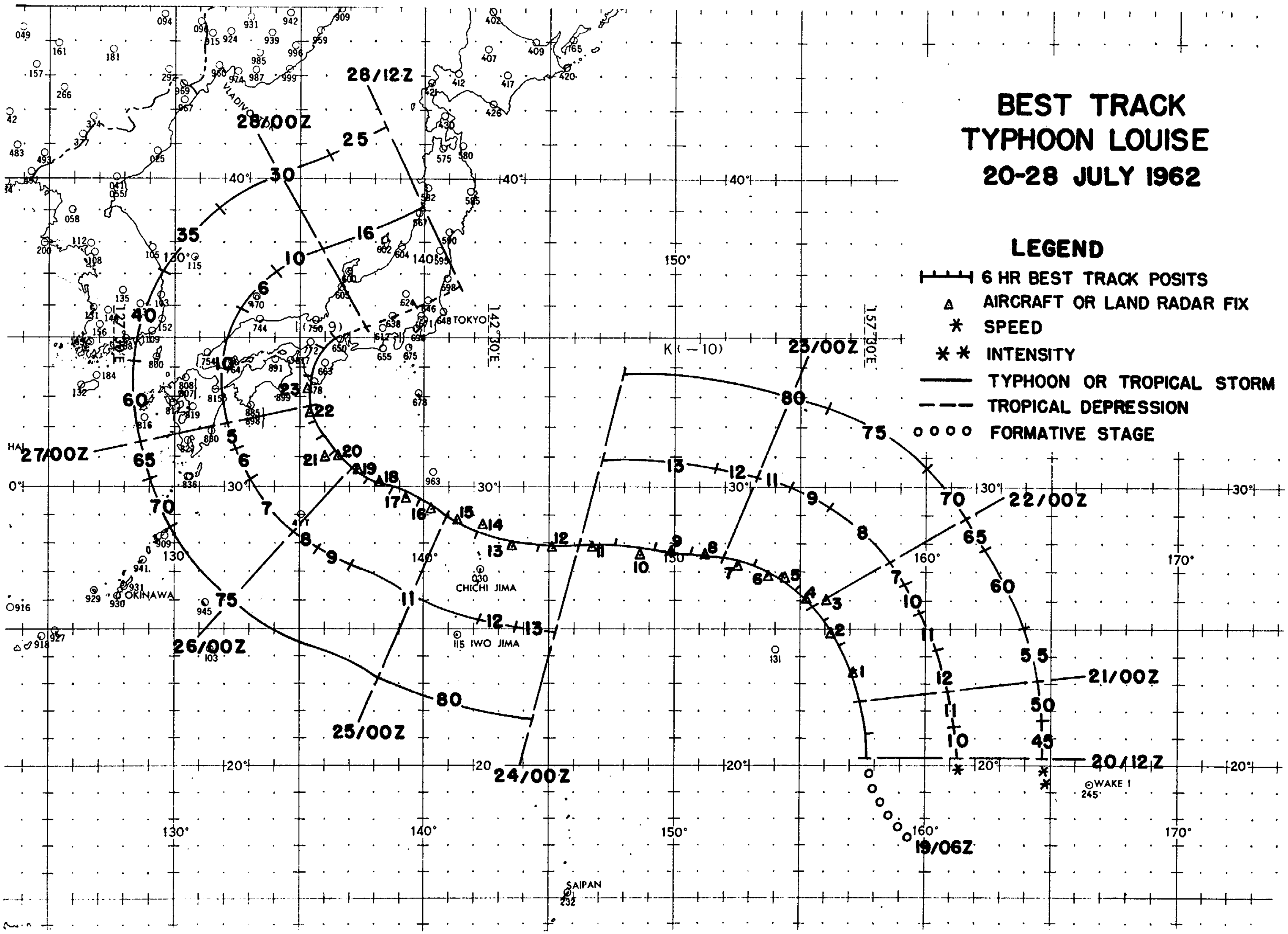
B. Final disposition - Dissipated

V. DAMAGE

A. Total lives lost - 15

B. Total monetary value - $7,500,000

C. Types of property - Crops, homes and bridges



BEST TRACK
TYPHOON LOUISE
20-28 JULY 1962
LEGEND
6 HR BEST TRACK POSITS
AIRCRAFT OR LAND RADAR FIX
SPEED
INTENSITY
TYPHOON OR TROPICAL STORM
TROPICAL DEPRESSION
FORMATIVE STAGE
19/06Z
20/12Z
21/00Z
22/00Z
23/00Z
24/00Z
25/00Z
26/00Z
27/00Z
28/00Z
28/12Z
TOKYO
CHICHI JIMA
IWO JIMA
OKINAWA
WAKE I
SAIPAN
VLADIVO
142°30'E
157°30'E
127°30'E
130°
140°
150°
160°
170°
20°
30°
40°

LAND RADAR AND AIRCRAFT FIXES - TYPHOON LOUISE

FIX NO.	TIME	LAT.	LONG.	UNIT METHOD & ACCY	MAX SFC WND	MAX 700MB WND	MIN 700MB HGT	MIN SLP MBS	700MB T/Td (°C)	EYE CHARACTERISTICS
1	210601Z	23.4N	157.0E	54-P-05	50	60	9450	983	15/15	ELLIP NE-SW 30X60 MI
2	211430Z	24.8N	156.3E	VW1-R-03	-	-	-	-	- -	---
3	212241Z	26.0N	156.0E	54-P-07	50	45	9310	972	18/12	OVAL 50 MI E-W,40 MI N-S,WALL CLDS N & S
4	220430Z	26.0N	155.1E	54-P-U	60	-	9240	967	18/11	CIRC 45 MI DIA
5	220945Z	26.7N	154.4E	VW1-R-03	-	-	-	-	- -	CIRC 40 MI DIA
6	221345Z	26.9N	153.7E	VW1-R-03	-	-	-	-	- -	CIRC 35 MI DIA,WALL CLDS 5 MI THICK
7	222130Z	27.2N	152.5E	54-P-07	70	75	9570	-	17/12	CIRC 29 MI DIA
8	230400Z	27.6N	151.1E	56-P-04	60	65	9000	960	15/11	CIRC 16 MI DIA,WALL CLDS 20 MI THICK
9	231000Z	27.6N	149.9E	VW1-R-03	-	-	-	-	- -	CIRC 37 MI DIA
10	231400Z	27.7N	148.6E	VW1-R-03	-	-	-	-	- -	CIRC 38 MI DIA
11	232145Z	27.9N	146.7E	54-P-10	75	-	9250	961	18/16	CIRC 35 MI DIA,WEAK WALL CLDS N-E
12	240400Z	27.9N	145.1E	54-P-05	75	-	9190	958	18/16	40 MI DIA,OPEN N-SE
13	241000Z	27.8N	143.5E	VW1-R-03	-	-	-	-	- -	CIRC 50 MI DIA
14	241600Z	28.6N	142.2E	VW1-R-01	-	-	-	-	- -	CIRC 54 MI DIA
15	242200Z	28.7N	141.3E	56-P-05	50	70	9430	-	16/16	CIRC 40 MI DIA,WALL CLDS 10 MI THICK
16	250330Z	29.4N	140.2E	56-P-01	-	65	9400	974	17/17	CIRC 30 MI DIA

LAND RADAR AND AIRCRAFT FIXES - TYPHOON LOUISE (CONT'D)

FIX NO.	TIME	LAT.	LONG.	UNIT METHOD & ACCY	MAX SFC WND	MAX 700MB WND	MIN 700MB HGT	MIN SLP MBS	700MB T/Td (°C)	EYE CHARACTERISTICS
17	251000Z	29.6N	139.2E	VW1-R-02	-	-	-	-	- -	CIRC 30 MI DIA,WALL CLDS ALL QUADS
18	251549Z	30.1N	138.1E	VW1-R-05	-	-	-	-	- -	32 MI DIA,OPEN SW
19	252200Z	30.5N	137.3E	56-P-05	70	60	9410	971	15/15	ELLIP 32 MI E-W
20	260340Z	31.0N	136.5E	56-P-05	100	80	9370	970	16/16	ELLIP 30 MI E-W
21	261000Z	31.0N	136.0E	VW1-R-03	-	-	-	-	- -	54 MI DIA,OPEN S&W
22	262315Z	32.5N	135.4E	56-P-20	55	90	9490	974	16/13	CIRC 25 MI DIA,OPEN S
23	270300Z	33.2N	135.3E	LND/RDR	-	-	-	-	- -	---

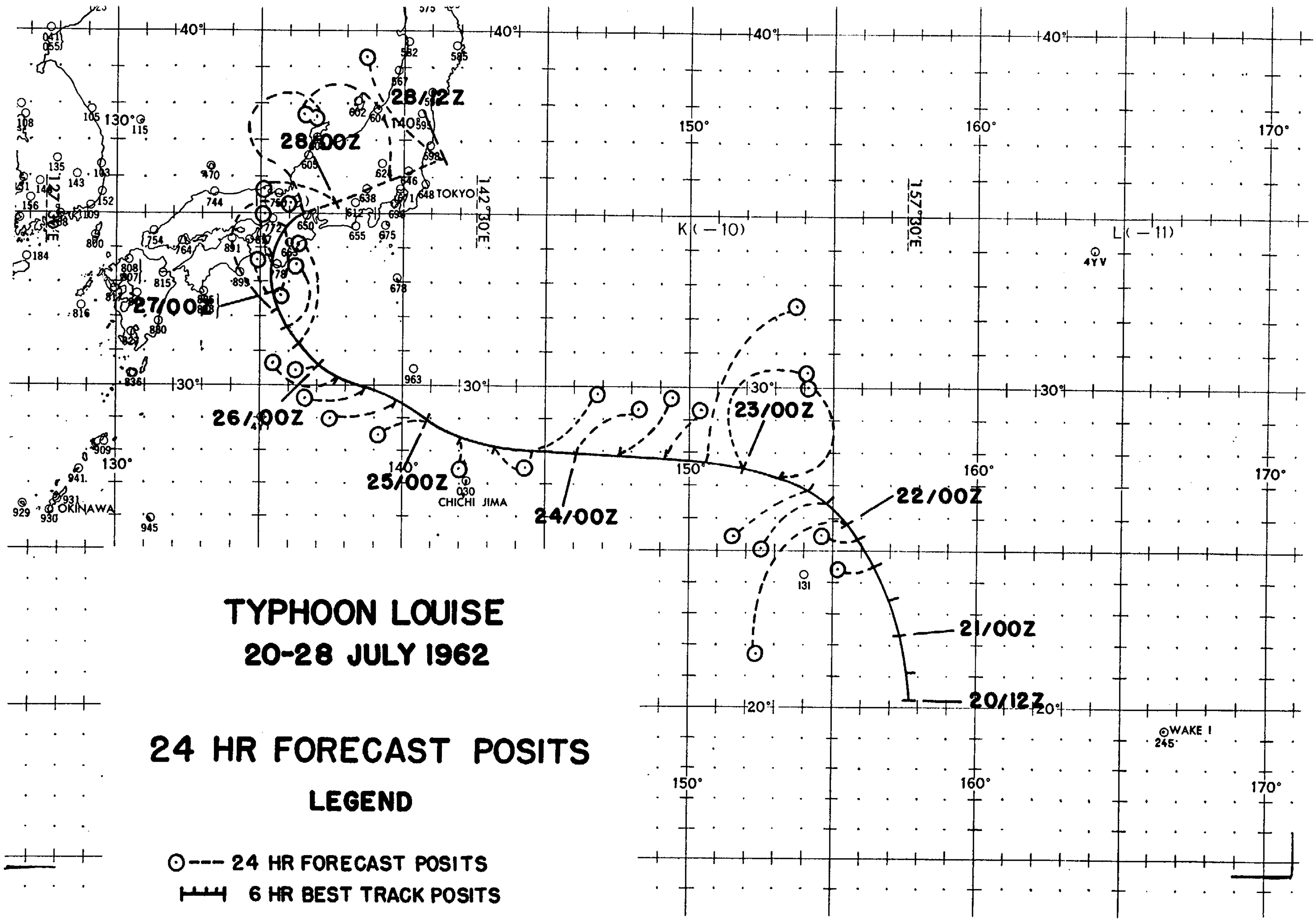
TYPHOON LOUISE 20-28 JULY 1962
POSITION AND FORECAST VERIFICATION DATA

DTG	STORM POSITION LAT.	LONG.	24 HR. ERROR DEG. DISTANCE	48 HR. ERROR DEG. DISTANCE
201200Z	20.2N	157.7E	------	------
201800Z	21.2N	157.5E	------	------
210000Z	22.2N	157.3E	------	------
210600Z	23.4N	157.0E	------	------
211200Z	24.4N	156.5E	------	------
211800Z	25.3N	155.9E	276-74	------
220000Z	25.8N	155.5E	215-306	------
220600Z	26.4N	154.8E	237-146	------
221200Z	26.8N	154.1E	237-157	------
221800Z	27.2N	153.1E	016-180	360-306
230000Z	27.4N	151.9E	033-212	231-286
230600Z	27.6N	150.6E	032-330	273-153
231200Z	27.7N	149.1E	038-114	294-120
231800Z	27.8N	147.6E	040-146	014-527
240000Z	27.8N	146.1E	053-132	043-760
240600Z	27.9N	144.6E	046-166	045-986
241200Z	28.1N	143.3E	127-60	016-276
241800Z	28.3N	142.0E	180-53	043-424
250000Z	28.9N	140.9E	256-100	049-283
250600Z	29.5N	139.8E	255-118	049-337
251200Z	29.9N	138.7E	265-113	206-90
251800Z	30.2N	137.7E	288-127	263-91
260000Z	30.6N	137.0E	249-44	314-247
260600Z	31.2N	136.4E	360-180	315-205
261200Z	31.7N	135.9E	012-123	320-220
261800Z	32.2N	135.5E	012-182	343-323
270000Z	32.7N	135.4E	345-67	333-217
270600Z	33.7N	135.4E	354-76	213-490
271200Z	34.6N	135.9E	192-132	219-430
271800Z	35.0N	136.5E	010-162	214-450

TYPHOON LOUISE 20-28 JULY 1962
POSITION AND FORECAST VERIFICATION DATA (CONT'D)

DTG	STORM POSITION LAT.	LONG.	24 HR. ERROR DEG. DISTANCE	48 HR. ERROR DEG. DISTANCE
280000Z	35.3N	137.6E	282-129	358-160
280600Z	35.8N	139.5E	308-180	338-180
281200Z	36.5N	141.3E	325-214	270-262

AVERAGE 24 HOUR ERROR 143.7 MI
AVERAGE 48 HOUR ERROR 326 MI



TYPHOON LOUISE
20-28 JULY 1962
24 HR FORECAST POSITS
LEGEND
24 HR FORECAST POSITS
6 HR BEST TRACK POSITS
20/12Z
21/00Z
22/00Z
23/00Z
24/00Z
25/00Z
26/00Z
27/00Z
28/00Z
28/12Z
TOKYO
CHICHI JIMA
OKINAWA
WAKE I
142°30'E
157°30'E
K (−10)
L (−11)

TYPHOON NORA - 260600Z JULY-040000Z AUGUST 1962

I. DATA

A. Statistics

1. Calendar days of tropical warning - 8 3/4
2. Calendar days of typhoon intensity - 3
3. Total distance traveled during tropical warning period - 2622 MI

B. Characteristics as a typhoon

1. Min observed SLP - 968mb, 302200Z
2. Min observed 850mb height - 4090 ft, 302200Z
3. Min observed 700mb height - 9340 ft, 010015Z
4. Max vertical development - 30,000 ft, 311200Z

II. DEVELOPMENT

A. Initial impetus - Easterly wave and polar trough fractured after superposition. Surge from westerlies into easterlies at the 200mb level.

B. Initial surface vortex

1. Junction vortex at 260000Z
2. Surface pressure less than 1000mb
3. Maximum surface wind - 20 kts

C. Zenith flow at 200mb

1. Relative position surface vortex - SE quadrant of anticyclone
2. Wind velocity over vortex - 090/25 kts

III. STEERING

A. Prior to recurvature - 500mb

B. During recurvature - 500mb

C. After recurvature - 700mb

IV. DISSIPATION

A. Causative factor - Cold air

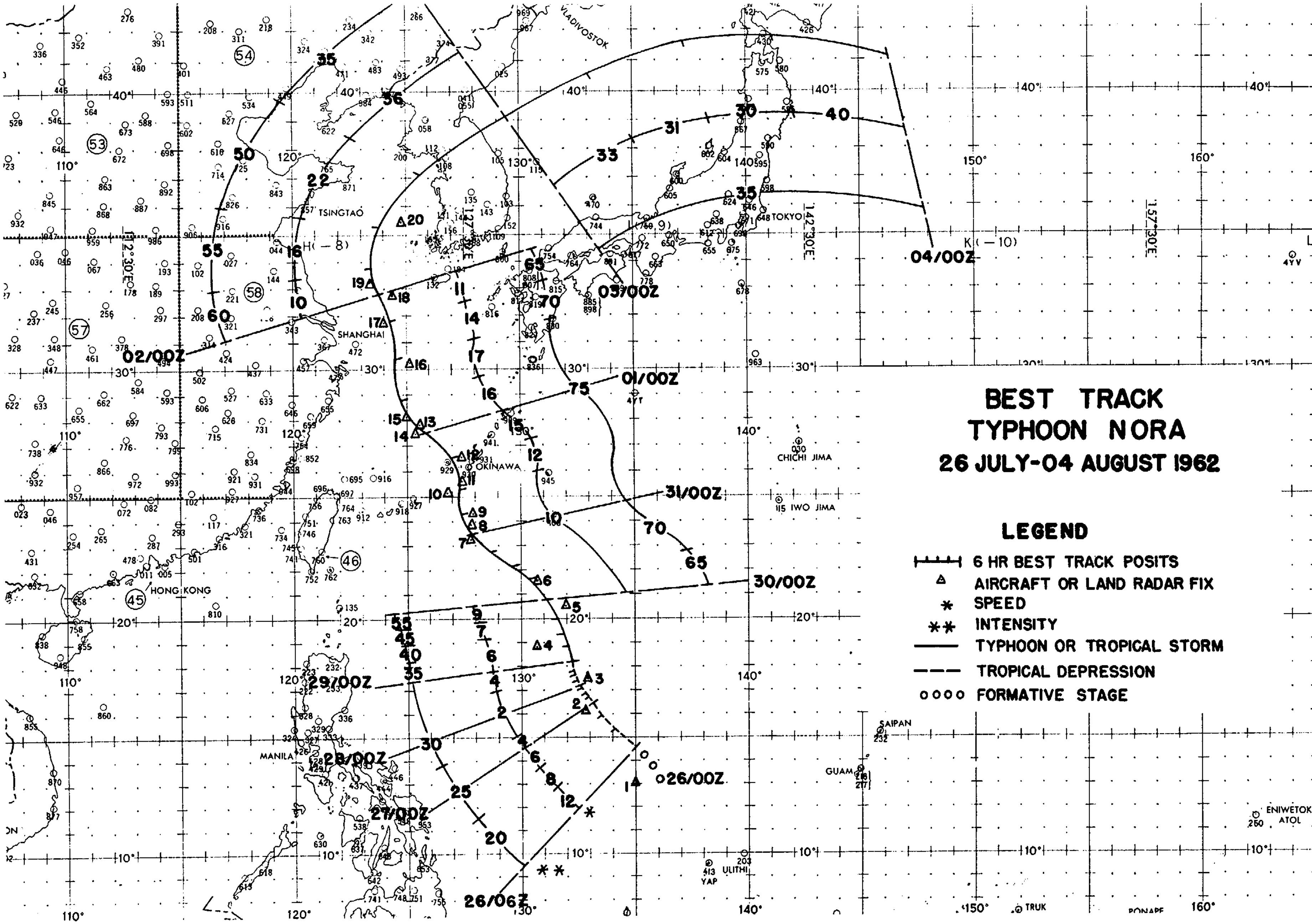
B. Final disposition - Extratropical

V. DAMAGE

A. Total lives lost - 4

B. Total monetary value - $1,000,000

C. Types of property - Homes, crops, railroads and roads


BEST TRACK
TYPHOON NORA
26 JULY-04 AUGUST 1962
LEGEND
6 HR BEST TRACK POSITS
AIRCRAFT OR LAND RADAR FIX
SPEED
INTENSITY
TYPHOON OR TROPICAL STORM
TROPICAL DEPRESSION
FORMATIVE STAGE
26/00Z
26/06Z
27/00Z
28/00Z
29/00Z
30/00Z
31/00Z
01/00Z
02/00Z
03/00Z
04/00Z
VLADIVOSTOK
TSINGTAO
SHANGHAI
OKINAWA
HONG KONG
MANILA
TOKYO
CHICHI JIMA
IWO JIMA
SAIPAN
GUAM
ULITHI
YAP
TRUK
ENIWETOK ATOL

LAND RADAR AND AIRCRAFT FIXES - TYPHOON NORA

FIX NO.	TIME	LAT.	LONG.	UNIT METHOD & ACCY	MAX SFC WND	MAX 700MB WND	MIN 700MB HGT	MIN SLP MBS	700MB T/Td (°C)	EYE CHARACTERISTICS
1	260330Z	13.0N	135.0E	VW1-P-U	-	-	-	998	- -	---
2	262200Z	16.2N	132.8E	VW1-P-U	-	-	-	1000	- -	---
3	280140Z	17.5N	133.0E	VW1-P-10	15	-	-	998	- -	180 MI E-W & 40 MI N-S
4	290045Z	18.7N	130.7E	VW1-P-U	30	-	-	992	- -	ORIEN WNW-ESE 60X150 MI
5	292203Z	20.5N	132.0E	54-P-10	60	75	9730	988	12/12	DIA 10 MI
6	300336Z	21.5N	130.6E	54-P-05	65	52	9700	976	14/13	OVAL 80X120 MI
7	302200Z	23.3N	127.8E	54-P-02	45	50	9420	968	17/16	DIA 25 MI,OPEN E&W
8	310200Z	23.7N	127.8E	54-P-15	60	80	9410	973	15/13	CIRC 30 MI DIA
9	310400Z	24.2N	127.9E	56-P-05	-	-	9420	971	16/15	DIA 30 MI
10	311050Z	25.1N	126.8E	VW1-R-03	-	-	-	-	- -	CIRC 15 MI DIA,NO WALL CLDS
11	311400Z	25.5N	127.4E	LND/RDR	-	-	-	-	- -	DIFFUSE
12	311600Z	26.5N	127.4E	VW1-R-03	-	-	-	-	- -	CIRC 8 MI DIA,OPEN W
13	311940Z	27.8N	125.6E	LND/RDR	-	-	-	-	- -	---
14	010015Z	27.5N	125.4E	56-P-01	60	90	9340	972	16/12	ELLIP 50X20 MI
15	010330Z	28.1N	125.0E	56-P-01	60	90	9370	974	16/13	ELLIP 80X60 MI
16	011101Z	30.2N	125.1E	VW1-P-10	-	-	-	-	- -	CIRC 3 MI DIA,OPEN NE
17	011603Z	31.8N	124.0E	VW1-R-10	-	-	-	-	- -	DIA 39 MI
18	012145Z	32.8N	124.3E	54-P-02	-	80	9470	973	17/10	CIRC WEAK WALL CLDS

LAND RADAR AND AIRCRAFT FIXES - TYPHOON NORA (CONT'D)

FIX NO.	TIME	LAT.	LONG.	UNIT METHOD & ACCY	MAX SFC WND	MAX 700MB WND	MIN 700MB HGT	MIN SLP MBS	700MB T/Td (°C)	EYE CHARACTERISTICS
19	020345Z	33.3N	123.4E	54-P-02	-	60	9490	976	13/10	OPEN ALL QUADS
20	021031Z	35.4N	124.8E	VW1-R-15	-	-	-	-	- -	POORLY DEFINED

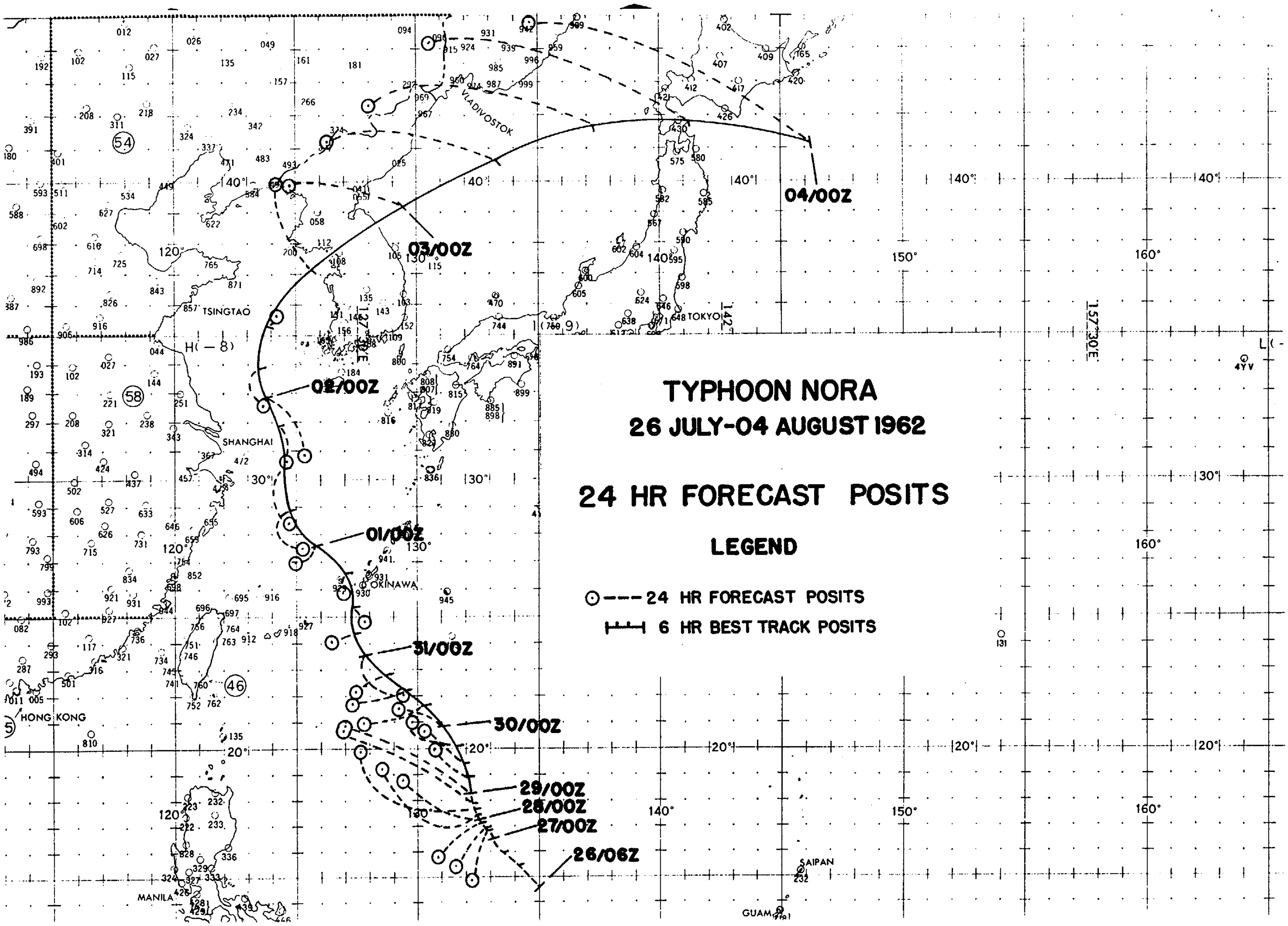
TYPHOON NORA 26 JUL-04 AUG 1962
POSITION AND FORECAST VERIFICATION DATA

DTG	STORM POSITION LAT.	LONG.	24 HR. ERROR DEG. DISTANCE	48 HR. ERROR DEG. DISTANCE
260600Z	14.6N	135.0E	------	------
261200Z	15.4N	134.2E	------	------
261800Z	16.0N	133.5E	------	------
270000Z	16.5N	133.2E	------	------
270600Z	16.8N	132.9E	------	------
271200Z	16.9N	132.8E	------	------
271800Z	17.2N	132.7E	------	------
280000Z	17.3N	132.6E	------	------
280600Z	17.5N	132.5E	------	------
281200Z	17.7N	132.5E	------	------
281800Z	17.9N	132.4E	------	------
290000Z	18.3N	132.3E	------	------
290600Z	18.9N	132.1E	------	------
291200Z	19.4N	131.9E	------	------
291800Z	20.1N	131.6E	------	------
300000Z	20.8N	131.1E	------	------
300600Z	21.6N	130.3E	254-145	------
301200Z	22.2N	129.5E	255-126	------
301800Z	22.8N	128.7E	237-77	------
310000Z	23.5N	127.9E	132-119	------
310600Z	24.4N	127.4E	247-52	255-83
311200Z	25.3N	127.3E	130-48	259-214
311800Z	26.6N	127.0E	180-41	238-110
010000Z	27.5N	125.7E	234-48	168-223
010600Z	28.8N	124.7E	156-90	190-147
011200Z	30.4N	124.5E	173-121	154-270
011800Z	31.8N	124.3E	168-81	163-230
020000Z	32.8N	123.8E	147-145	205-95
020600Z	33.8N	123.4E	171-77	163-113
021200Z	35.3N	123.9E	055-23	168-137
021800Z	37.1N	125.6E	338-185	185-113

TYPHOON NORA 26 JUL-04 AUG 1962 (CONT'D)
POSITION AND FORECAST VERIFICATION DATA

DTG	STORM POSITION LAT.	LONG.	24 HR. ERROR DEG. DISTANCE	48 HR. ERROR DEG. DISTANCE
030000Z	39.2N	129.4E	283-215	206-220
030600Z	40.7N	133.2E	275-314	238-366
031200Z	41.7N	137.1E	275-404	271-415
031800Z	41.8N	141.1E	288-516	279-561
040000Z	41.2N	146.3E	295-600	295-592

AVERAGE 24 HOUR ERROR 171.4 MI
AVERAGE 48 HOUR ERROR 243.1 MI


TYPHOON NORA
26 JULY-04 AUGUST 1962
24 HR FORECAST POSITS
LEGEND
24 HR FORECAST POSITS
6 HR BEST TRACK POSITS
04/00Z
03/00Z
02/00Z
01/00Z
31/00Z
30/00Z
29/00Z
28/00Z
27/00Z
26/06Z
VLADIVOSTOK
TSINGTAO
SHANGHAI
OKINAWA
TOKYO
HONG KONG
MANILA
SAIPAN
GUAM

TYPHOON OPEL - 300600Z JULY-061200Z AUGUST 1962

I. DATA

A. Statistics

1. Calendar days of tropical warning - 6¼

2. Calendar days of typhoon intensity - 4

3. Total distance traveled during tropical warning period - 2310 MI

B. Characteristics as a typhoon

1. Min observed SLP - 910mb, 050340Z

2. Min observed 850mb height - 1980 ft, 050340Z

3. Min observed 700mb height - 7590 ft, 050340Z

4. Max vertical development - 35,000 ft, 051200Z

II. DEVELOPMENT

A. Initial impetus - Easterly wave and polar trough fractured after superposition. Surge from westerlies into easterlies at the 200mb level.

B. Initial surface vortex

1. Junction vortex at 281200Z

2. Surface pressure less than 1007mb

3. Maximum surface wind - 15 kts

C. Zenith flow at 200mb

1. Relative position surface vortex - SE quadrant of anticyclone

2. Wind velocity over vortex - 070/31 kts

III. STEERING

A. Prior to recurvature - 500mb

B. During recurvature - NA

C. After recurvature - NA

IV. DISSIPATION

A. Causative factor - Land strike and cold air

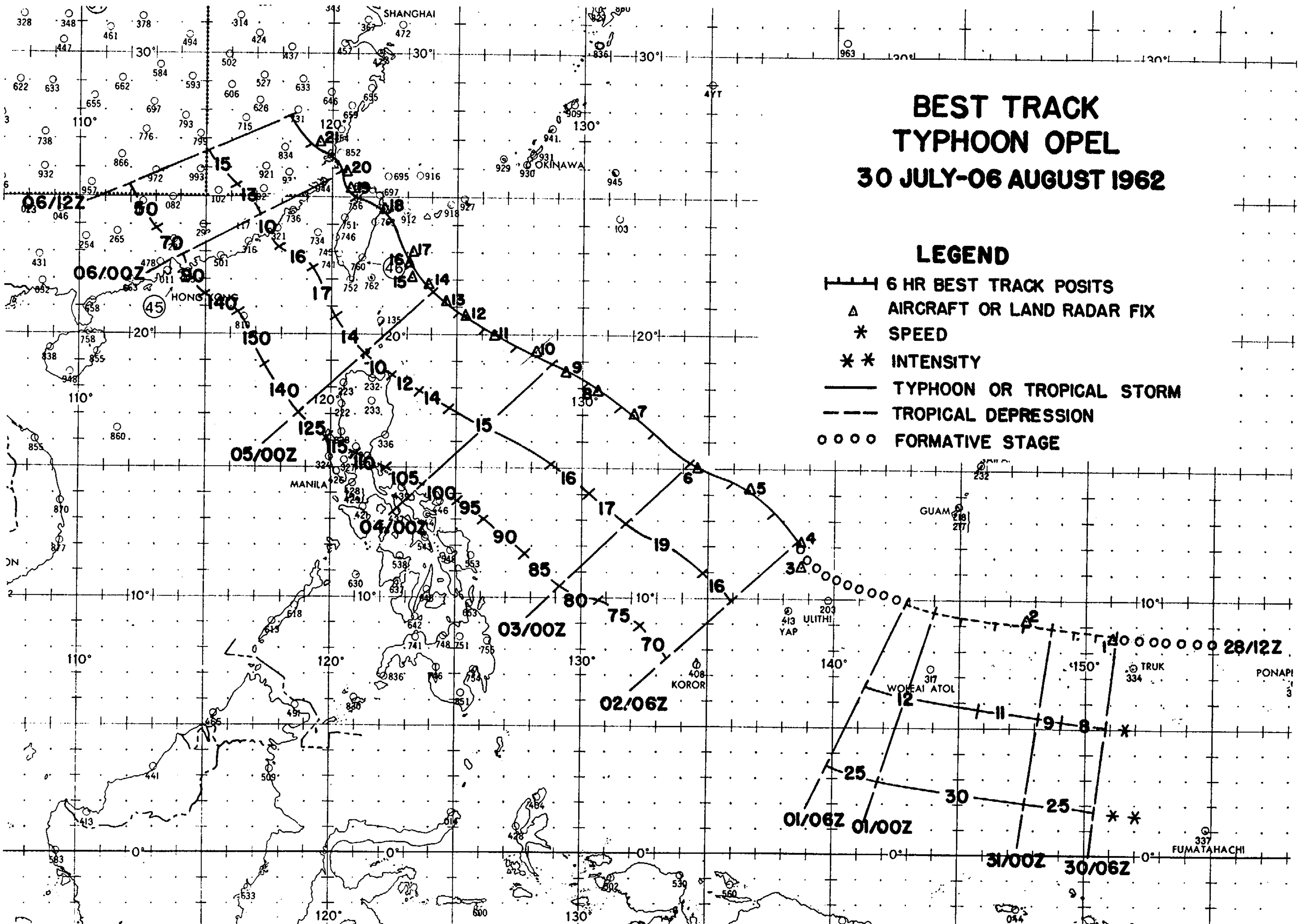
B. Final disposition - Extratropical

V. DAMAGE

A. Total lives lost - 75

B. Total monetary value - $25,000,000

C. Types of property - Crops, homes, power and communications lines, ships and boats


BEST TRACK
TYPHOON OPEL
30 JULY-06 AUGUST 1962
LEGEND
6 HR BEST TRACK POSITS
AIRCRAFT OR LAND RADAR FIX
SPEED
INTENSITY
TYPHOON OR TROPICAL STORM
TROPICAL DEPRESSION
FORMATIVE STAGE
SHANGHAI
OKINAWA
HONG KONG
MANILA
GUAM
ULITHI
YAP
KOROR
WOLEAI ATOL
TRUK
PONAPI
FUMATAHACHI
06/12Z
06/00Z
05/00Z
04/00Z
03/00Z
02/06Z
01/06Z
01/00Z
31/00Z
30/06Z
28/12Z

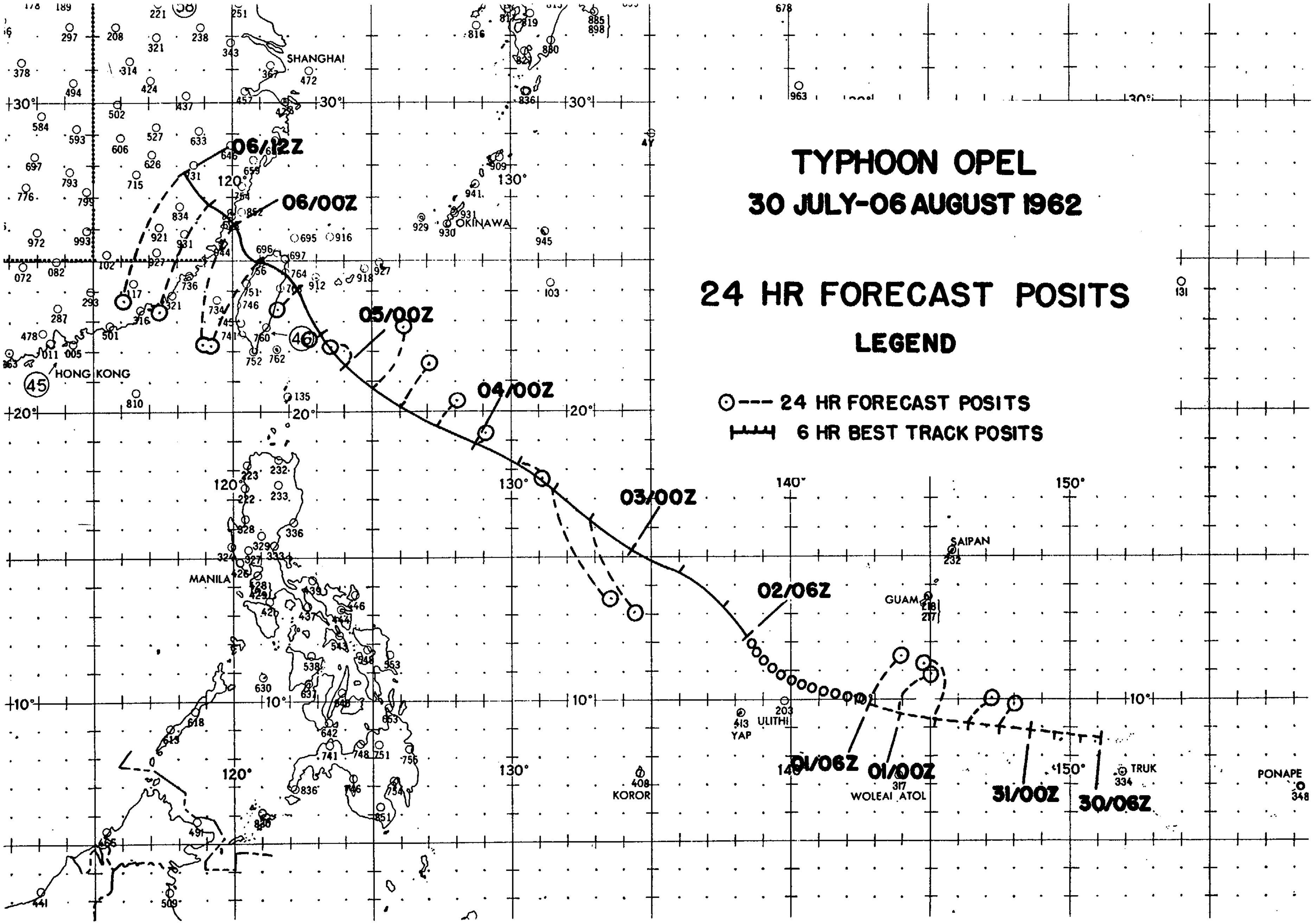
LAND RADAR AND AIRCRAFT FIXES - TYPHOON OPEL

FIX NO.	TIME	LAT.	LONG.	UNIT METHOD & ACCY	MAX SFC WND	MAX 700MB WND	MIN 700MB HGT	MIN SLP MBS	700MB T/Td ($^{\circ}C$)	EYE CHARACTERISTICS
1	300428Z	08.6N	151.3E	VW1-P-01	25	-	10080	1000	15/-	25 MI N-S & 40 MI E-W
2	302300Z	09.2N	147.7E	VW1-P-15	30	-	-	-	- -	NOT WELL DEFINED
3	020245Z	11.3N	138.8E	VW1-P-03	70	-	-	987	- -	DIA 60 MI
4	020550Z	12.1N	138.6E	VW1-P-03	-	-	-	986	- -	10 MI N-S & 20 MI E-W
5	021600Z	14.1N	136.7E	VW1-R-05	-	-	-	-	- -	CIRC 15 MI DIA, OPEN N&S
6	022215Z	15.0N	134.6E	54-P-05	80	60	9850	980	13/12	CIRC 5 MI DIA
7	031000Z	17.0N	132.0E	VW1-R-03	-	-	-	-	- -	CIRC 37 MI DIA, OPEN W
8	031547Z	17.9N	130.6E	VW1-R-03	-	-	-	-	- -	CIRC 30 MI DIA
9	032200Z	18.6N	129.3E	54-P-03	65	80	9230	954	16/11	DIA 30 MI
10	040337Z	19.3N	128.1E	54-P-03	50	90	9060	966	19/17	CIRC 30 MI DIA
11	041000Z	20.0N	126.5E	VW1-R-03	-	-	-	-	- -	DIA 28 MI
12	041600Z	20.7N	125.3E	VW1-R-01	-	-	-	-	- -	DIA 23 MI
13	042120Z	21.2N	124.5E	54-P-02	135	130	7730	-	26/20	CIRC 15 MI DIA
14	050200Z	21.8N	123.9E	LND/RDR	-	-	-	-	- -	---
15	050340Z	22.0N	123.1E	54-P-05	150	130	7590	910	26/22	CIRC 18 MI DIA
16	050600Z	22.6N	123.2E	LND/RDR	-	-	-	-	- -	---
17	050900Z	23.0N	123.1E	LND/RDR	-	-	-	-	- -	---
18	051400Z	24.6N	122.0E	LND/RDR	-	-	-	-	- -	---
19	052100Z	25.3N	120.7E	LND/RDR	-	-	-	-	- -	---
20	052300Z	25.8N	120.5E	LND/RDR	-	-	-	-	- -	---
21	060300Z	26.9N	119.5E	LND/RDR	-	-	-	-	- -	---

TYPHOON OPEL 30 JUL-06 AUG 1962
POSITION AND FORECAST VERIFICATION DATA

DTG	STORM POSITION LAT.	LONG.	24 HR. ERROR DEG. DISTANCE	48 HR. ERROR DEG. DISTANCE
300600Z	08.6N	151.2E	------	------
301200Z	08.7N	150.3E	------	------
301800Z	08.8N	149.5E	------	------
310000Z	08.9N	148.6E	------	------
310600Z	09.0N	147.5E	------	------
311200Z	09.2N	146.4E	------	------
311800Z	09.3N	145.2E	------	------
010000Z	09.5N	144.0E	------	------
010600Z	09.9N	142.8E	------	------
NO WARNINGS ISSUED 011200Z TO 020600Z				
020600Z	12.2N	138.6E	------	------
021200Z	13.4N	137.6E	------	------
021800Z	14.5N	136.0E	------	------
030000Z	15.2N	134.2E	------	------
030600Z	16.3N	132.9E	153-215	------
031200Z	17.3N	131.5E	153-255	------
031800Z	18.2N	130.2E	118-63	------
040000Z	18.9N	128.8E	030-32	------
040600Z	19.6N	127.4E	040-65	138-320
041200Z	20.2N	126.1E	035-102	135-350
041800Z	20.8N	125.0E	030-135	056-122
050000Z	21.5N	124.1E	321-58	037-220
050600Z	22.5N	123.2E	245-27	046-150
051200Z	24.1N	122.4E	226-60	050-127
051800Z	25.0N	120.9E	210-193	054-140
060000Z	25.9N	120.3E	199-234	225-95
060600Z	26.8N	119.3E	208-227	184-132
061200Z	27.9N	118.3E	205-276	190-155

AVERAGE 24 HOUR ERROR 138.7 MI
AVERAGE 48 HOUR ERROR 181.1 MI


TYPHOON OPEL
30 JULY-06 AUGUST 1962
24 HR FORECAST POSITS
LEGEND
24 HR FORECAST POSITS
6 HR BEST TRACK POSITS
06/12Z
06/00Z
05/00Z
04/00Z
03/00Z
02/06Z
01/06Z
01/00Z
31/00Z
30/06Z
SHANGHAI
OKINAWA
HONG KONG
MANILA
SAIPAN
GUAM
YAP
ULITHI
KOROR
WOLEAI ATOL
TRUK
PONAPE

TYPHOON PATSY - 060000Z-110000Z AUGUST 1962

I. DATA

A. Statistics

1. Calendar days of tropical warning - 5
2. Calendar days of typhoon intensity-1½
3. Total distance traveled during tropical warning period - 1848 MI

B. Characteristics as a typhoon

1. Min observed SLP - 980mb, 082220Z
2. Min observed 850mb height - 4510 ft, 082220Z
3. Min observed 700mb height - 9900 ft, 082220Z
4. Max vertical development - 30,000 ft, 090000Z

II. DEVELOPMENT

A. Initial impetus - Surge from westerlies into easterlies and MPT at the 200mb level.

B. Initial surface vortex

1. Junction vortex at 051200Z
2. Surface pressure less than 1010mb
3. Maximum surface wind - 10 kts

C. Zenith flow at 200mb

1. Relative position surface vortex - SE quadrant of anticyclone
2. Wind velocity over vortex - 080/90 kts

III. STEERING

A. Prior to recurvature - 500mb

B. During recurvature - NA

C. After recurvature - NA

IV. DISSIPATION

A. Causative factor - Land strike and cold air

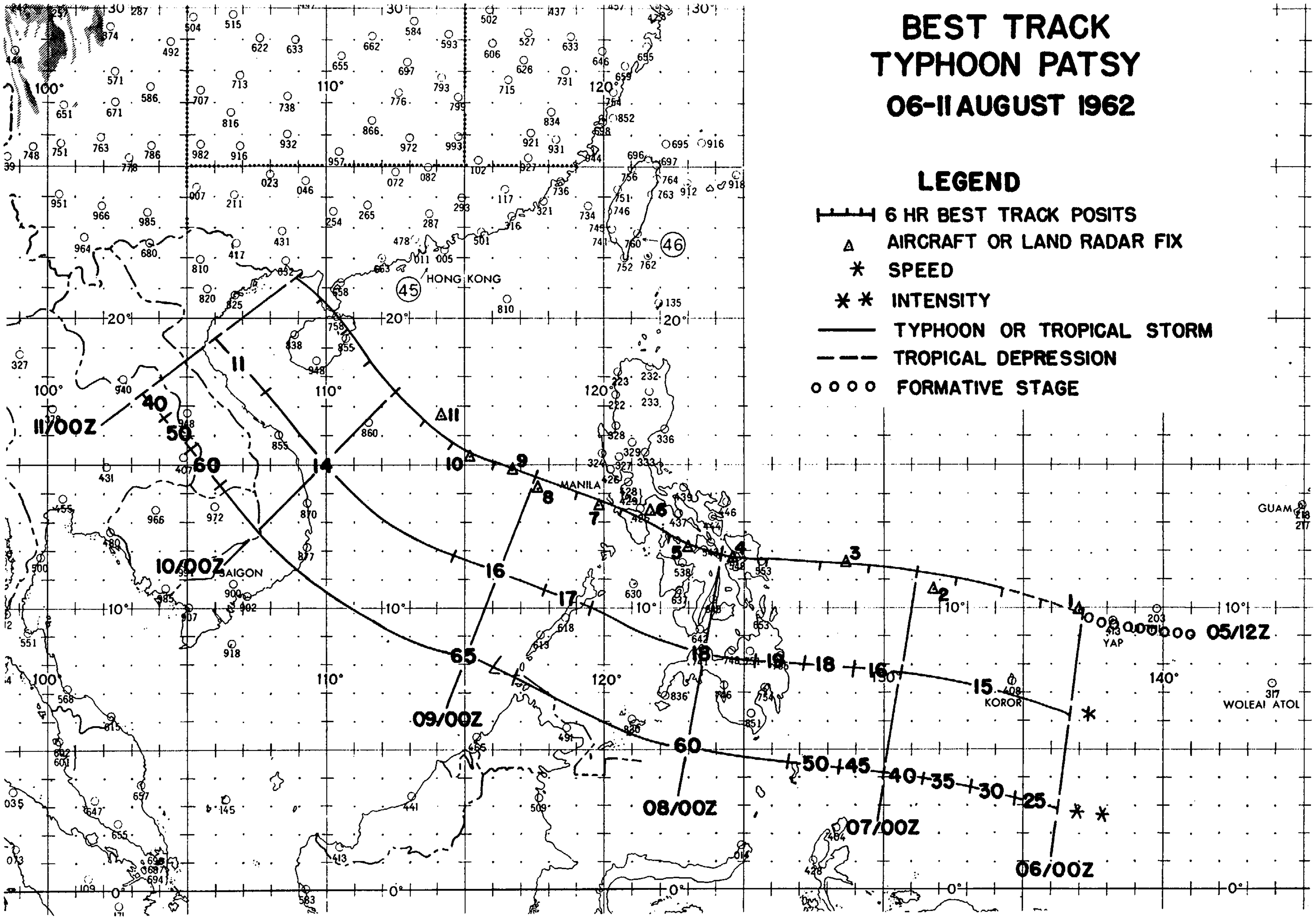
B. Final disposition - Dissipated

V. DAMAGE

A. Total lives lost - 23

B. Total monetary value - $2,500,000

C. Types of property - Crops, homes, ships, boats, communications equipment and highways


BEST TRACK
TYPHOON PATSY
06-11 AUGUST 1962
LEGEND
6 HR BEST TRACK POSITS
AIRCRAFT OR LAND RADAR FIX
SPEED
INTENSITY
TYPHOON OR TROPICAL STORM
TROPICAL DEPRESSION
FORMATIVE STAGE
HONG KONG
MANILA
SAIGON
GUAM
YAP
KOROR
WOLEAI ATOL
05/12Z
06/00Z
07/00Z
08/00Z
09/00Z
10/00Z
11/00Z

LAND RADAR AND AIRCRAFT FIXES - TYPHOON **PATSY**

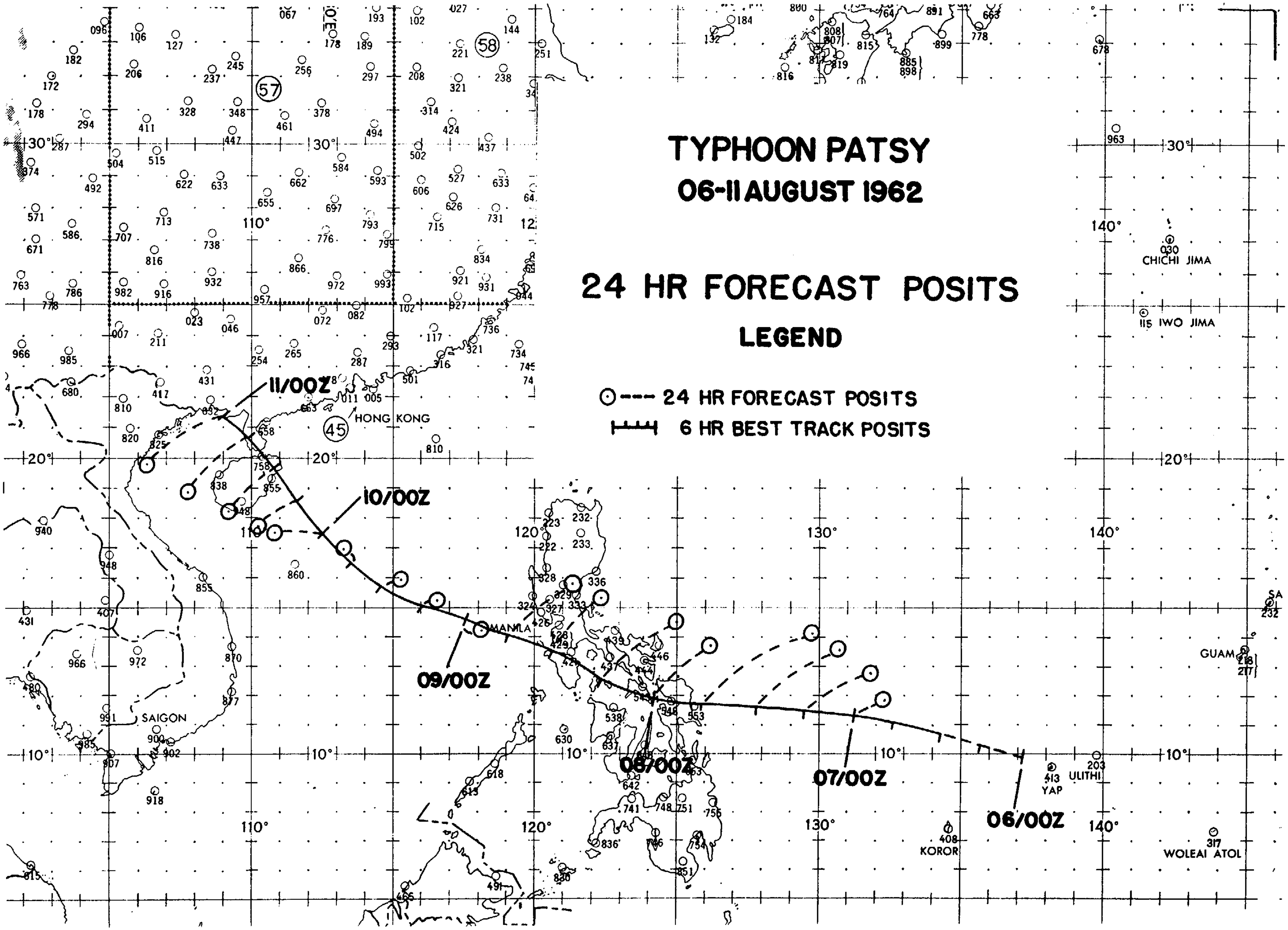
FIX NO.	TIME	LAT.	LONG.	UNIT METHOD & ACCY	MAX SFC WND	MAX 700MB WND	MIN 700MB HGT	MIN SLP MBS	700MB T/Td (°C)	EYE CHARACTERISTICS
1	060035Z	09.9N	137.0E	VW1-P-U	20	-	-	1005	- -	30 MI NW-SE & 10 MI SW-NE
2	062250Z	10.6N	131.7E	VW1-P-03	40	-	-	1001	- -	40 MI DIA
3	070919Z	11.6N	128.6E	VW1-P-03	45	-	-	990	- -	CIRC 45 MI DIA, OPEN NE & E
4	072230Z	11.8N	124.5E	54-P-05	60	60	10000	-	- -	---
5	080415Z	12.1N	123.0E	54-P-02	50	60*	18850*	-	-06/-06*	DIA 20 MI
6	081100Z	13.2N	121.6E	VW1-R-10	-	-	-	-	- -	OVAL 48 MI NW-SE & 34 MI NE-SW
7	081530Z	13.6N	119.8E	VW1-P-03	-	-	-	-	16/15	CIRC 12 MI DIA, OPEN N & NE
8	082220Z	14.1N	117.4E	54-P-05	50	70	9900	980	13/11	16 MI E-W & 12 MI N-S, OPEN N
9	090340Z	14.8N	116.6E	54-P-02	60	60	9990	995	16/14	CIRC 20 MI DIA, WELL DEFINED
10	090955Z	15.3N	115.1E	VW1-P-02	65	-	-	-	- -	CIRC 75 MI DIA
11	091600Z	16.6N	114.1E	VW1-R-10	-	-	-	-	- -	NOT WELL DEFINED

* 500MB DATA

TYPHOON PATSY 06-11 AUG 1962
POSITION AND FORECAST VERIFICATION DATA

DTG	STORM POSITION LAT.	LONG.	24 HR. ERROR DEG. DISTANCE	48 HR. ERROR DEG. DISTANCE
060000Z	09.9N	137.2E	------	------
060600Z	10.3N	135.6E	------	------
061200Z	10.7N	134.3E	------	------
061800Z	11.1N	132.6E	------	------
070000Z	11.3N	131.2E	------	------
070600Z	11.4N	129.5E	------	------
071200Z	11.6N	127.8E	------	------
071800Z	11.7N	125.9E	------	------
080000Z	11.9N	124.1E	050-164	------
080600Z	12.6N	122.3E	053-192	------
081200Z	13.4N	120.7E	039-146	------
081800Z	14.0N	119.1E	053-169	------
090000Z	14.6N	117.5E	122-40	057-242
090600Z	15.1N	116.0E	080-39	054-257
091200Z	15.7N	114.6E	058-44	040-225
091800Z	16.5N	113.5E	332-36	045-212
100000Z	17.5N	112.5E	272-90	240-8
100600Z	18.6N	111.6E	236-95	230-75
101200Z	19.7N	110.7E	225-130	216-119
101800Z	20.6N	109.9E	230-155	236-189
110000Z	21.3N	109.0E	240-170	243-255

AVERAGE 24 HOUR ERROR 113.1 MI
AVERAGE 48 HOUR ERROR 175.8 MI


TYPHOON PATSY
06-11 AUGUST 1962
24 HR FORECAST POSITS
LEGEND
24 HR FORECAST POSITS
6 HR BEST TRACK POSITS
11/00Z
10/00Z
09/00Z
08/00Z
07/00Z
06/00Z
HONG KONG
MANILA
SAIGON
CHICHI JIMA
IWO JIMA
GUAM
YAP
ULITHI
KOROR
WOLEAI ATOL

TYPHOON RUTH - 131800Z-221800Z AUGUST 1962

I. DATA

A. Statistics

1. Calendar days of tropical warning - 9
2. Calendar days of typhoon intensity - 8
3. Total distance traveled during tropical warning period - 2316 MI

B. Characteristics as a typhoon

1. Min observed SLP - 916mb, 160345Z
2. Min observed 850mb height - 2005 ft, 160345Z
3. Min observed 700mb height - 7830 ft, 160345Z
4. Max vertical development - 45,000 ft, 170000Z

II. DEVELOPMENT

A. Initial impetus - Surge from westerlies into MPT followed by a cut-off low from MPT.

B. Initial surface vortex

1. Junction vortex at 111200Z
2. Surface pressure less than 1010mb
3. Maximum surface wind - 10 kts

C. Zenith flow at 200mb

1. Relative position surface vortex - SE quadrant of anticyclone
2. Wind velocity over vortex - 045/16 kts

III. STEERING

A. Prior to recurvature - 200mb

B. During recurvature - 300mb

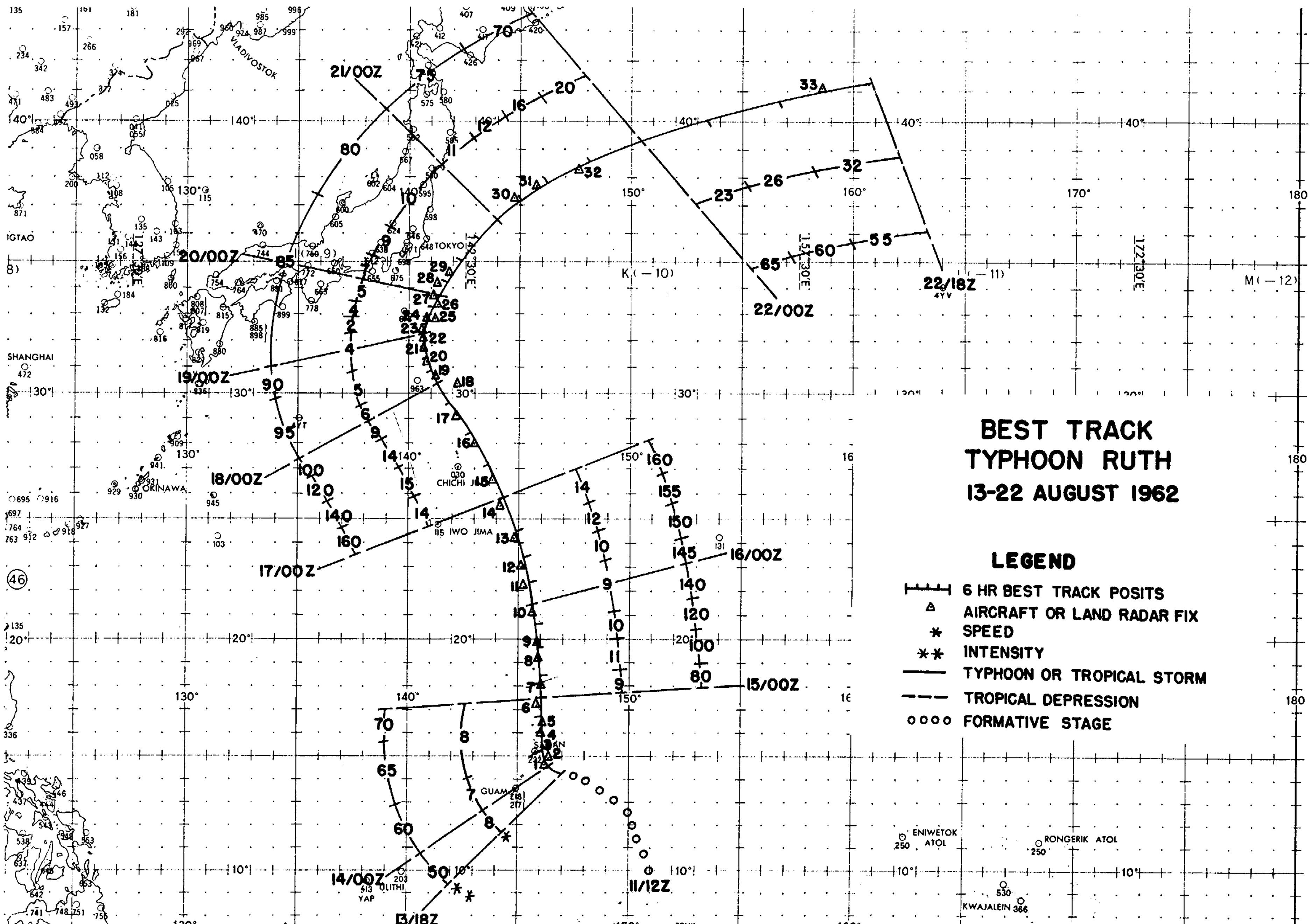
C. After recurvature - 300mb

IV. DISSIPATION

A. Causative factor - Cold air

B. Final disposition - Extratropical

V. DAMAGE - No reports received



BEST TRACK
TYPHOON RUTH
13-22 AUGUST 1962
LEGEND
6 HR BEST TRACK POSITS
AIRCRAFT OR LAND RADAR FIX
SPEED
INTENSITY
TYPHOON OR TROPICAL STORM
TROPICAL DEPRESSION
FORMATIVE STAGE
11/12Z
13/18Z
14/00Z
15/00Z
16/00Z
17/00Z
18/00Z
19/00Z
20/00Z
21/00Z
22/00Z
22/18Z
VLADIVOSTOK
TOKYO
SHANGHAI
OKINAWA
CHICHI JIMA
IWO JIMA
GUAM
SAIPAN
ULITHI
YAP
TRUK
ENIWETOK ATOL
RONGERIK ATOL
KWAJALEIN

LAND RADAR AND AIRCRAFT FIXES - TYPHOON RUTH

FIX NO.	TIME	LAT.	LONG.	UNIT METHOD & ACCY	MAX SFC WND	MAX 700MB WND	MIN 700MB HGT	MIN SLP MBS	700MB T/Td (°C)	EYE CHARACTERISTICS
1	140000Z	14.6N	146.2E	54-P-02	55	50	10040	994	09/09	CIRC 25 MI DIA,OPEN W
2	140100Z	14.9N	146.3E	VW1-R-08	-	-	-	-	- -	BEGINNING TO CLOSE UP
3	140408Z	15.0N	146.1E	54-P-01	60	45	9950	-	12/12	INDEFINITE,OPEN N
4	141105Z	16.0N	146.0E	LND/RDR	-	-	-	-	- -	OPEN N
5	141500Z	16.4N	146.0E	VW1-R-¼	-	-	-	-	- -	DIA 6 MI,WALL CLDS 4 MI THICK
6	142210Z	17.1N	145.9E	54-P-05	70	60	9700	-	14/12	CIRC 15 MI DIA
7	150320Z	18.0N	146.0E	54-P-05	95	60	9560	981	17/11	DIA 12 MI,SATELLITE EYE SW DIA 5 MI
8	151000Z	19.2N	145.9E	VW1-R-02	-	-	-	-	- -	CIRC OPEN SE
9	151530Z	19.9N	145.8E	VW1-R-02	-	-	-	-	- -	ELLIP 19 MI N-S & 12 MI E-W
10	152145Z	21.1N	145.6E	54-P-03	150	120	8050	931	24/18	CIRC 10 MI DIA
11	160345Z	22.1N	145.2E	54-P-U	150	115	7830	916	25/-	CIRC 8 MI DIA
12	161000Z	23.0N	145.1E	VW1-R-05	-	-	-	-	- -	CIRC 11 MI DIA
13	161600Z	24.2N	144.9E	VW1-R-07	-	-	-	-	- -	CIRC 11 MI DIA,WALL CLDS 5 MI THICK
14	162200Z	25.5N	144.1E	54-P-04	170	-	8380	940	14/13	CIRC 10 MI DIA,OPEN E
15	170345Z	26.6N	143.8E	54-P-02	190	145	7890	919	16/15	CIRC 20 MI DIA
16	171000Z	28.0N	143.0E	VW1-R-01	-	-	-	-	- -	CIRC 10 MI DIA, 2ND CLOSED EYE 43 MI DIA

LAND RADAR AND AIRCRAFT FIXES - TYPHOON RUTH (CONT'D)

FIX NO.	TIME	LAT.	LONG.	UNIT METHOD & ACCY	MAX SFC WND	MAX 700MB WND	MIN 700MB HGT	MIN SLP MBS	700MB T/Td (°C)	EYE CHARACTERISTICS
17	171610Z	29.2N	142.2E	VW1-R-05	-	-	-	-	- -	6 MI DIA, LGE EYE 45 MI DIA
18	172200Z	30.3N	142.1E	56-P-10	80	-	8740	950	12/12	CIRC 16 MI DIA, OUTER EYE 40 MI DIA
19	180400Z	30.7N	141.1E	56-P-03	90	90	8830	950	16/13	8X6 MI
20	181000Z	31.2N	140.9E	VW1-R-05	-	-	-	-	- -	31 MI DIA WELL DEFINED
21	181600Z	31.7N	140.7E	VW1-R-01	-	-	-	-	- -	CIRC 25 MI DIA
22	182215Z	32.1N	140.7E	56-P-02	75	75	9000	965	12/12	20X22 MI
23	190314Z	32.4N	140.7E	56-P-02	70	70	-	954	16/-	20X10 MI
24	191000Z	32.7N	140.8E	VW1-R-02	-	-	-	-	- -	CIRC 15 MI DIA
25	191500Z	32.8N	141.1E	VW1-R-03	-	-	-	-	- -	CIRC 23 MI DIA
26	192215Z	33.3N	141.3E	56-P-01	-	80	8800	955	15/11	CIRC 20 MI DIA
27	200000Z	33.6N	141.1E	LND/RDR	-	-	-	-	- -	---
28	200400Z	34.1N	141.3E	LND/RDR	-	-	-	-	- -	---
29	200815Z	34.5N	141.9E	56-P-02	85	80	8810	956	15/-	CIRC 15 MI DIA
30	210647Z	37.3N	144.9E	54-P-03	50	70	8870	957	14/12	OVAL 20 MI E-W/15 MI N-S
31	211000Z	37.6N	145.8E	VW1-R-05	-	-	-	-	- -	CIRC 14 MI DIA
32	211600Z	38.3N	147.7E	VW1-R-05	-	-	-	-	- -	CIRC 25 MI DIA
33	221500Z	41.0N	158.6E	VW1-R-10	-	-	-	-	- -	POORLY DEFINED

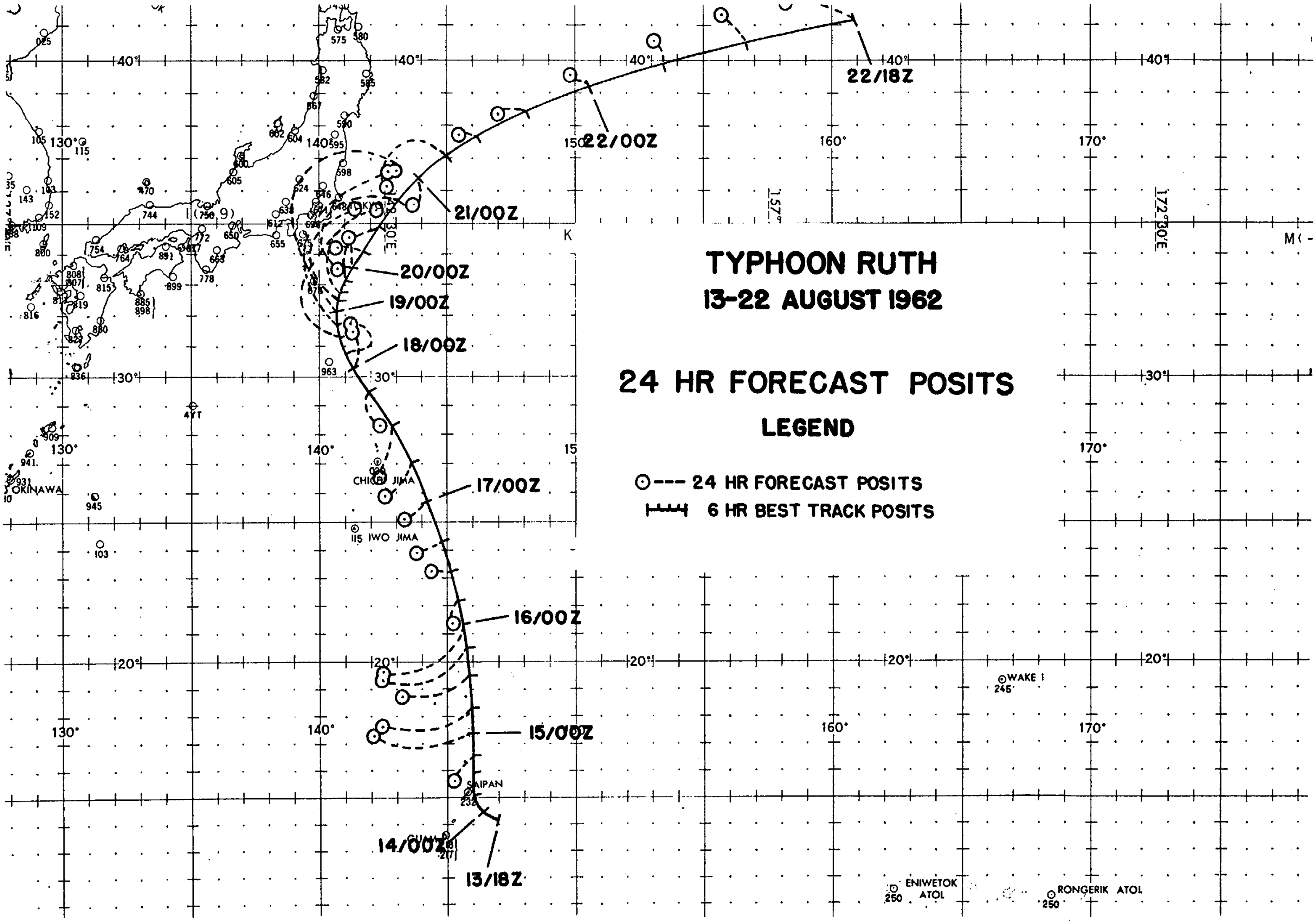
TYPHOON RUTH 13-22 AUG 1962
POSITION AND FORECAST VERIFICATION DATA

DTG	STORM POSITION LAT.	LONG.	24 HR. ERROR DEG. DISTANCE	48 HR. ERROR DEG. DISTANCE
131800Z	14.2N	147.0E	------	------
140000Z	14.5N	146.3E	------	------
140600Z	15.2N	146.0E	------	------
141200Z	16.0N	146.0E	------	------
141800Z	16.8N	146.0E	------	------
150000Z	17.5N	146.0E	264-227	------
150600Z	18.4N	146.0E	257-201	------
151200Z	19.6N	145.9E	256-166	------
151800Z	20.6N	145.8E	247-197	------
160000Z	21.4N	145.6E	239-204	249-372
160600Z	22.3N	145.3E	183-55	241-367
161200Z	23.3N	145.0E	270-37	243-364
161800Z	24.4N	144.7E	239-48	237-403
170000Z	25.8N	144.2E	230-68	237-388
170600Z	27.1N	143.6E	220-84	187-125
171200Z	28.4N	142.8E	192-110	184-147
171800Z	29.6N	141.8E	159-73	175-176
180000Z	30.4N	141.3E	350-73	193-48
180600Z	30.9N	141.0E	005-60	193-32
181200Z	31.3N	140.8E	017-252	025-25
181800Z	31.8N	140.7E	018-310	023-138
190000Z	32.2N	140.7E	022-312	031-438
190600Z	32.6N	140.8E	011-168	033-448
191200Z	32.8N	140.9E	358-78	032-825
191800Z	33.2N	141.0E	003-90	041-900
200000Z	33.6N	141.3E	352-65	034-720
200600Z	34.2N	141.7E	292-42	033-438
201200Z	35.0N	142.3E	253-60	105-139
201800Z	35.8N	143.0E	223-162	026-274

TYPHOON RUTH 13-22 AUG 1962 (CONT'D)
POSITION AND FORECAST VERIFICATION DATA

DTG	STORM POSITION LAT.	LONG.	24 HR. ERROR DEG. DISTANCE	48 HR. ERROR DEG. DISTANCE
210000Z	36.5N	143.9E	240-117	015-187
210600Z	37.2N	145.0E	247-114	267-104
211200Z	37.8N	146.2E	270-42	275-120
211800Z	38.6N	148.0E	258-49	247-294
220000Z	39.4N	150.4E	308-31	247-364
220600Z	40.1N	153.3E	343-42	253-392
221200Z	40.7N	156.6E	313-50	269-202
221800Z	41.3N	160.8E	289-122	273-278

AVERAGE 24 HOUR ERROR 115.9 MI
AVERAGE 48 HOUR ERROR 311.0 MI


TYPHOON RUTH
13-22 AUGUST 1962
24 HR FORECAST POSITS
LEGEND
24 HR FORECAST POSITS
6 HR BEST TRACK POSITS
13/18Z
14/00Z
15/00Z
16/00Z
17/00Z
18/00Z
19/00Z
20/00Z
21/00Z
22/00Z
22/18Z
TOKYO
CHICHI JIMA
IWO JIMA
SAIPAN
GUAM
OKINAWA
WAKE I
ENIWETOK ATOL
RONGERIK ATOL
130°
140°
150
160°
170°
40°
30°
20°

TYPHOON SARAH - 150600Z-221800Z AUGUST 1962

I. DATA

A. Statistics

1. Calendar days of tropical warning - 7½
2. Calendar days of typhoon intensity - 4
3. Total distance traveled during tropical warning period - 1320 MI

B. Characteristics as a typhoon

1. Min observed SLP - 978mb, 180400Z
2. Min observed 850mb height - 4260 ft, 180400Z
3. Min observed 700mb height - 9480 ft, 180400Z
4. Max vertical development - 30,000 ft, 180000Z

II. DEVELOPMENT

A. Initial impetus - Surge from westerlies into easterlies. Fracture following superposition of polar trough and easterly wave.

B. Initial surface vortex

1. Induced low at 081800Z
2. Surface pressure less than 1013mb
3. Maximum surface wind - 5 kts

C. Zenith flow at 200mb

1. Relative position surface vortex - SE quadrant of anticyclone
2. Wind velocity over vortex - 080/25 kts

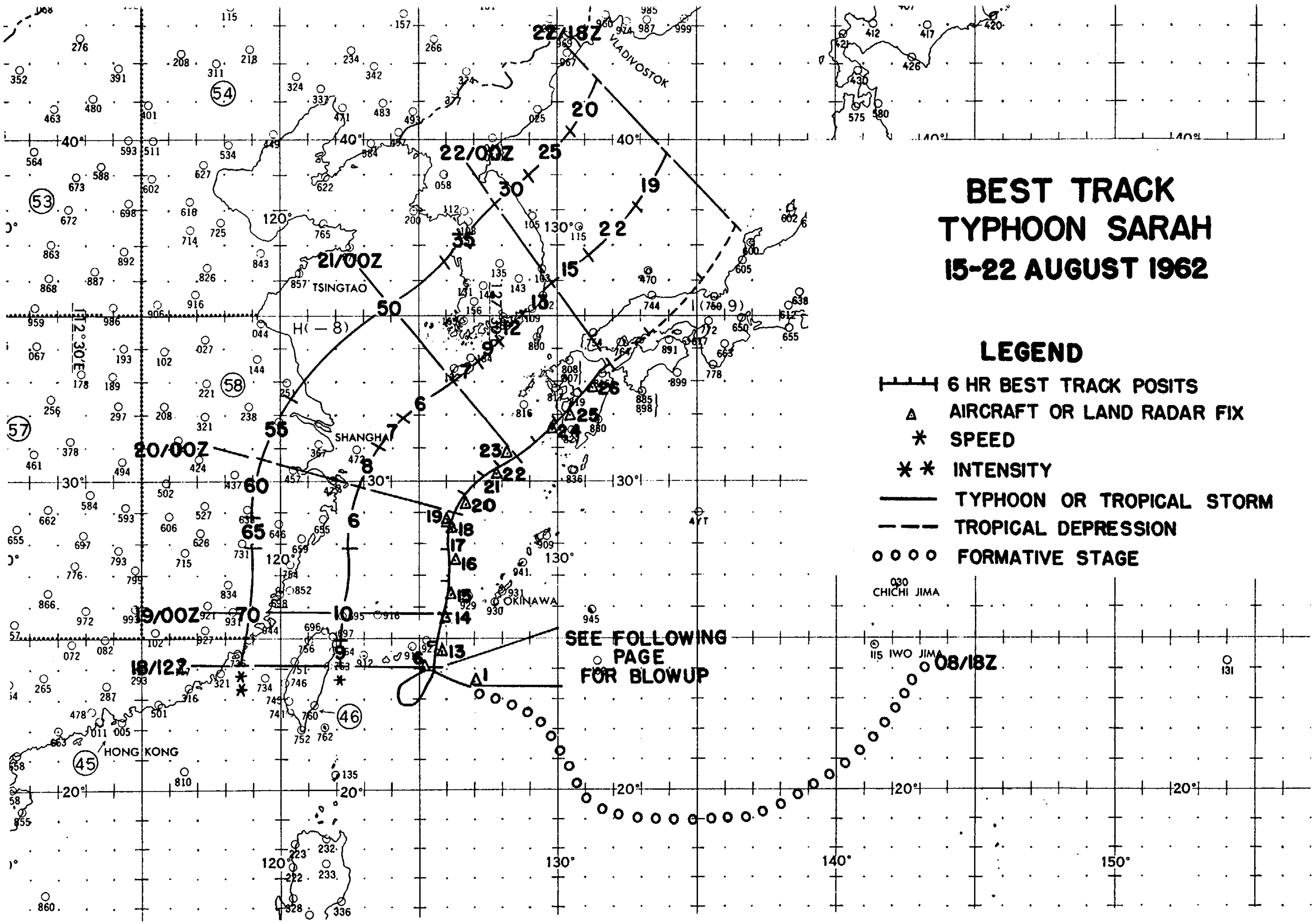
III. STEERING

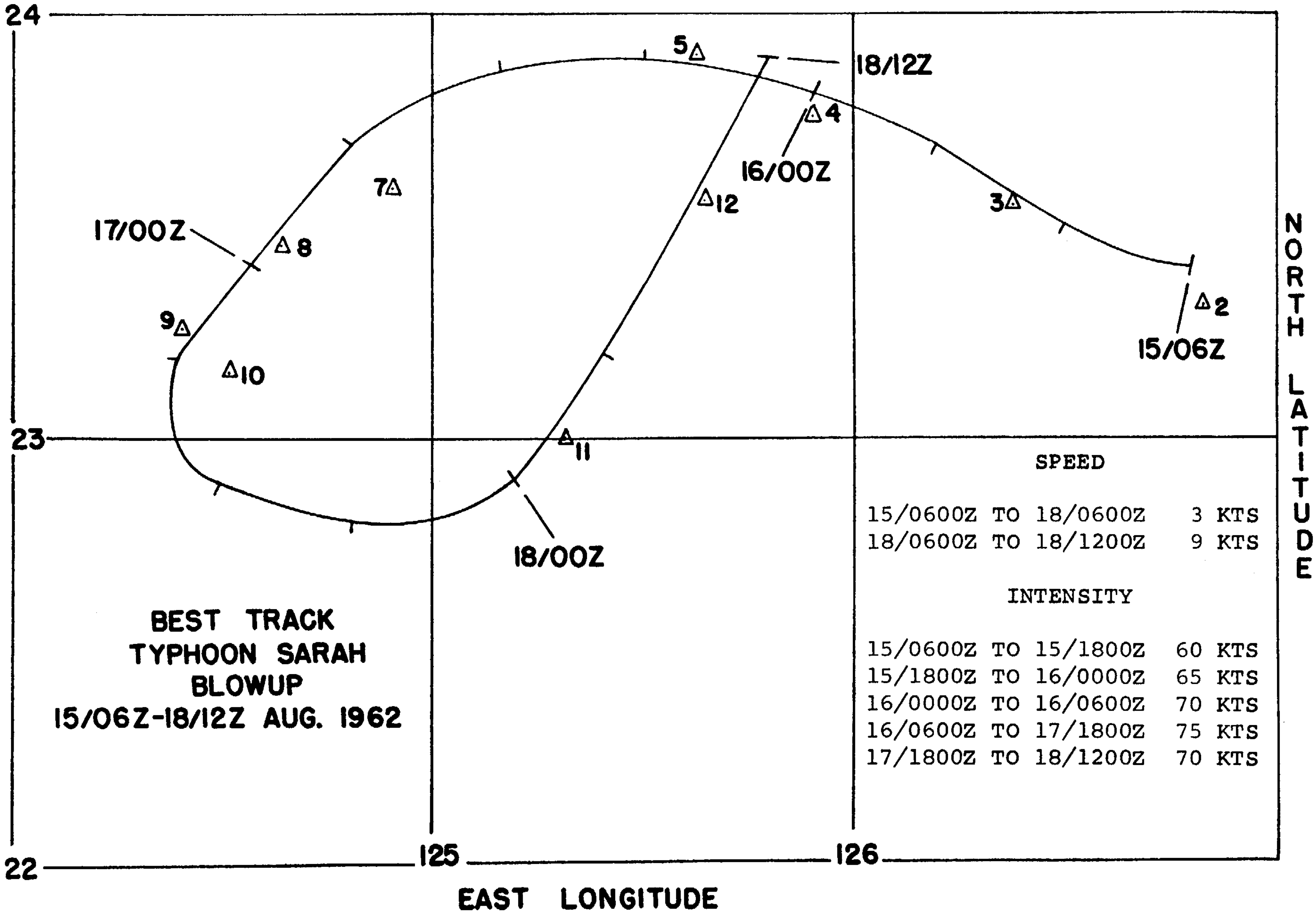
A. Prior to recurvature - 200mb
B. During recurvature - 200mb
C. After recurvature - 200mb

IV. DISSIPATION

A. Causative factor - Cold air and land strike
B. Final disposition - Extratropical

V. DAMAGE - No reports received


BEST TRACK
TYPHOON SARAH
15-22 AUGUST 1962
LEGEND
6 HR BEST TRACK POSITS
AIRCRAFT OR LAND RADAR FIX
SPEED
INTENSITY
TYPHOON OR TROPICAL STORM
TROPICAL DEPRESSION
FORMATIVE STAGE
SEE FOLLOWING PAGE FOR BLOWUP
22/18Z
22/00Z
21/00Z
20/00Z
19/00Z
18/12Z
08/18Z
VLADIVOSTOK
TSINGTAO
SHANGHAI
OKINAWA
HONG KONG
CHICHI JIMA
IWO JIMA
112°30'E


24
23
22
125
126
EAST LONGITUDE
NORTH LATITUDE
5
18/12Z
4
16/00Z
7
12
3
17/00Z
8
2
9
15/06Z
10
11
18/00Z
SPEED
15/0600Z TO 18/0600Z 3 KTS
18/0600Z TO 18/1200Z 9 KTS
INTENSITY
15/0600Z TO 15/1800Z 60 KTS
15/1800Z TO 16/0000Z 65 KTS
16/0000Z TO 16/0600Z 70 KTS
16/0600Z TO 17/1800Z 75 KTS
17/1800Z TO 18/1200Z 70 KTS
BEST TRACK
TYPHOON SARAH
BLOWUP
15/06Z-18/12Z AUG. 1962

LAND RADAR AND AIRCRAFT FIXES - TYPHOON SARAH

FIX NO.	TIME	LAT.	LONG.	UNIT METHOD & ACCY	MAX SFC WND	MAX 700MB WND	MIN 700MB HGT	MIN SLP MBS	700MB T/Td (°C)	EYE CHARACTERISTICS
1	150200Z	23.4N	127.0E	LND/RDR	-	-	-	-	- -	HAS SPIRAL BANDS
2	150645Z	23.3N	126.8E	USN-P-U	60	-	-	-	- -	DIA 14 MI
3	151400Z	23.6N	126.4E	LND/RDR	-	-	-	-	- -	---
4	152317Z	23.8N	125.9E	56-P-01	110	45	9800	981	12/11	CIRC 10 MI DIA
5	160345Z	23.9N	125.7E	56-P-01	125	-	9730	998	13/12	CIRC 18 MI DIA
6	161300Z	24.1N	125.2E	LND/RDR	-	-	-	-	- -	14 MI DIA
7	161845Z	23.6N	124.9E	LND/RDR	-	-	-	-	- -	---
8	162345Z	23.5N	124.6E	LND/RDR	-	-	-	-	- -	---
9	170335Z	23.3N	124.4E	56-P-02	75	65	9490	980	14/10	CIRC 25 MI DIA, WALL CLDS 10 MI THICK
10	171530Z	23.2N	124.5E	LND/RDR	-	-	-	-	- -	30 MI DIA
11	180400Z	23.0N	125.3E	56-P-03	65	60	9480	978	16/14	CIRC 50 MI DIA
12	181000Z	23.6N	125.7E	LND/RDR	-	-	-	-	- -	---
13	181600Z	24.5N	125.8E	LND/RDR	-	-	-	-	- -	---
14	182300Z	25.7N	126.0E	LND/RDR	-	-	-	-	- -	---
15	190403Z	26.4N	126.1E	56-P-02	75	65	9670	983	14/14	ELLIP 20X15 MI
16	191000Z	27.5N	126.2E	VW1-R-10	-	-	-	-	- -	OPEN E SEMICIRCLE
17	191600Z	28.6N	126.0E	VW1-R-03	-	-	-	-	- -	32 MI DIA, OPEN E
18	191830Z	28.4N	126.2E	LND/RDR	-	-	-	-	- -	21 MI DIA
19	192222Z	28.8N	126.0E	54-P-06	50	60	9680	986	13/13	OVAL 35 MI E-W/25 MI N-S

LAND RADAR AND AIRCRAFT FIXES - TYPHOON SARAH (CONT'D)

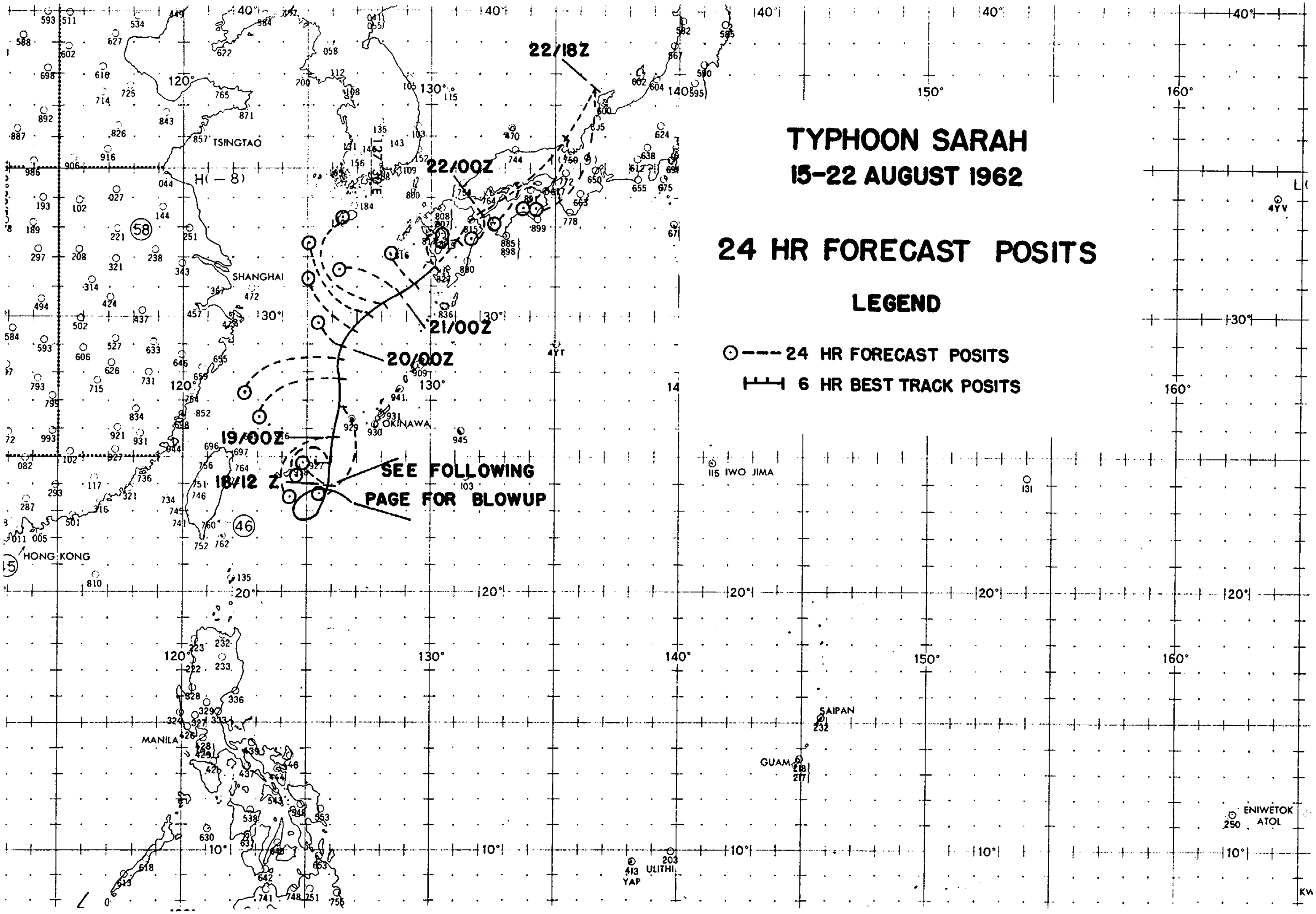
FIX NO.	TIME	LAT.	LONG.	UNIT METHOD & ACCY	MAX SFC WND	MAX 700MB WND	MIN 700MB HGT	MIN SLP MBS	700MB T/Td (°C)	EYE CHARACTERISTICS
20	200305Z	29.3N	126.7E	54-P-05	40	50	9930	978	19/16	OPEN N TO E
21	201000Z	30.1N	127.3E	VW1-P-05	50	-	-	978	- -	CIRC 25 MI DIA, OPEN E
22	201600Z	30.3N	127.8E	VW1-R-03	-	-	-	-	- -	CIRC 32 MI DIA
23	210000Z	30.8N	128.3E	LND/RDR	-	-	-	-	- -	---
24	211100Z	31.7N	129.8E	LND/RDR	-	-	-	-	- -	---
25	211400Z	32.0N	130.3E	LND/RDR	-	-	-	-	- -	---
26	211930Z	32.8N	131.2E	LND/RDR	-	-	-	-	- -	---

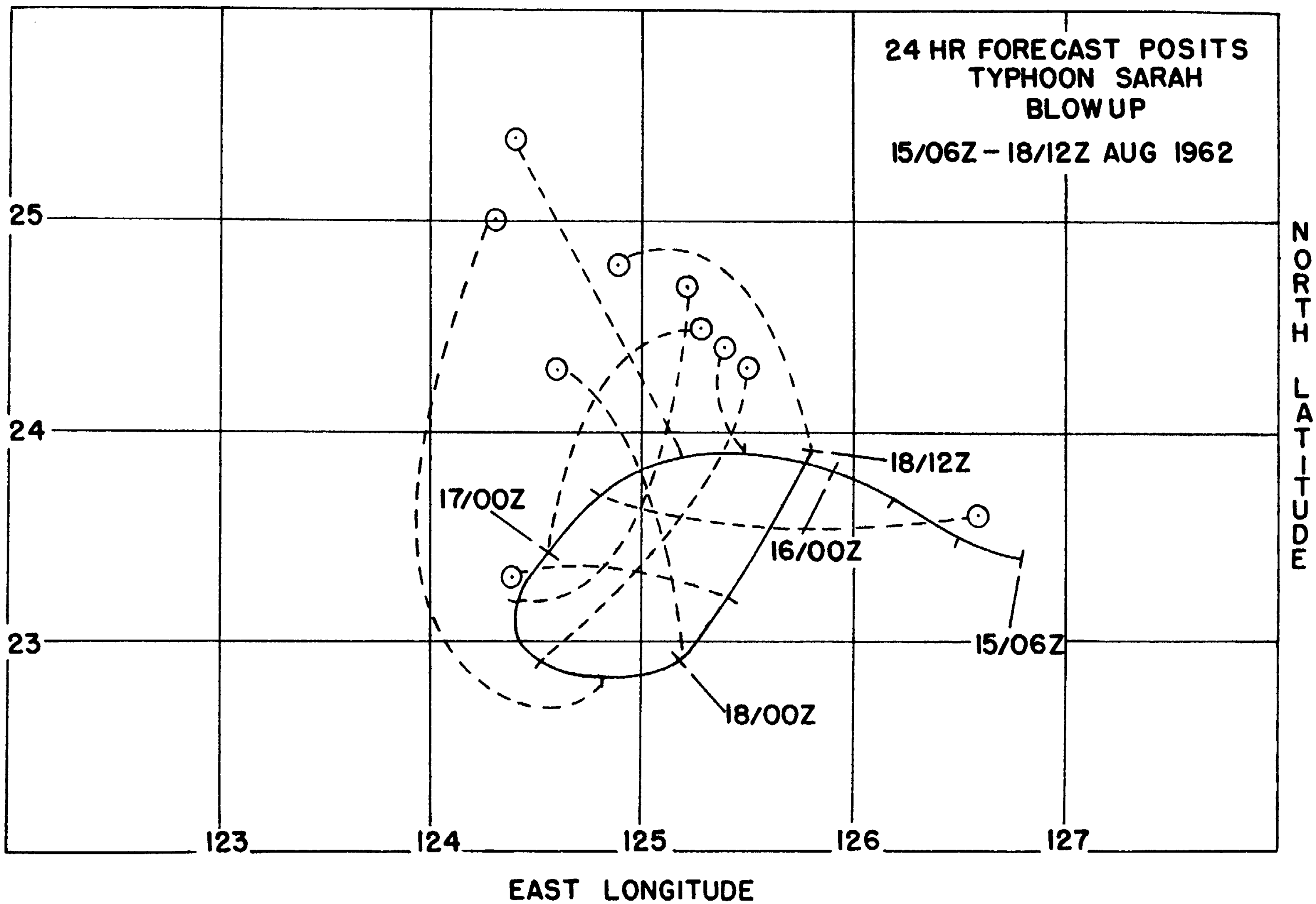
TYPHOON SARAH 15-22 AUG 1962
POSITION AND FORECAST VERIFICATION DATA

DTG	STORM POSITION LAT.	LONG.	24 HR. ERROR DEG. DISTANCE	48 HR. ERROR DEG. DISTANCE
150600Z	23.4N	126.8E	------	------
151200Z	23.5N	126.5E	------	------
151800Z	23.7N	126.2E	------	------
160000Z	23.8N	125.9E	------	------
160600Z	23.9N	125.5E	340-28	------
161200Z	23.8N	125.2E	330-101	------
161800Z	23.7N	124.8E	094-95	------
170000Z	23.4N	124.6E	030-70	------
170600Z	23.2N	124.4E	026-80	347-230
171200Z	22.9N	124.5E	032-100	345-370
171800Z	22.8N	124.8E	354-127	348-170
180000Z	22.9N	125.2E	341-85	338-265
180600Z	23.2N	125.4E	282-48	334-265
181200Z	23.9N	125.8E	315-75	327-260
181800Z	24.8N	125.9E	241-80	323-283
190000Z	25.8N	126.0E	208-168	302-165
190600Z	26.8N	126.1E	191-210	240-115
191200Z	27.8N	126.1E	243-185	259-185
191800Z	28.4N	126.1E	250-212	242-197
200000Z	29.0N	126.3E	315-75	204-260
200600Z	29.6N	126.8E	316-137	210-290
201200Z	30.1N	127.4E	320-190	253-470
201800Z	30.4N	128.0E	334-185	253-535
210000Z	30.8N	128.5E	295-130	334-345
210600Z	31.2N	129.2E	318-80	342-400
211200Z	31.8N	130.0E	017-67	340-400
211800Z	32.6N	131.0E	261-27	340-328
220000Z	33.6N	132.0E	198-60	292-250
220600Z	34.5N	133.4E	215-102	285-138
221200Z	36.0N	135.3E	213-165	224-174
221800Z	37.7N	136.5E	208-265	225-270

TYPHOON SARAH 15-22 AUG 1962
POSITION AND FORECAST VERIFICATION DATA

AVERAGE 24 HOUR ERROR 116.6 MI
AVERAGE 48 HOUR ERROR 276.7 MI


TYPHOON SARAH
15-22 AUGUST 1962
24 HR FORECAST POSITS
LEGEND
24 HR FORECAST POSITS
6 HR BEST TRACK POSITS
22/18Z
22/00Z
21/00Z
20/00Z
19/00Z
18/12 Z
SEE FOLLOWING PAGE FOR BLOWUP
TSINGTAO
SHANGHAI
HONG KONG
MANILA
OKINAWA
IWO JIMA
SAIPAN
GUAM
ULITHI
YAP
ENIWETOK ATOL


24 HR FORECAST POSITS
TYPHOON SARAH
BLOWUP
15/06Z - 18/12Z AUG 1962
25
24
23
123
124
125
126
127
EAST LONGITUDE
NORTH LATITUDE
17/00Z
18/12Z
16/00Z
15/06Z
18/00Z

TYPHOON THELMA - 210000Z-270600Z AUGUST 1962

I. DATA

A. Statistics

1. Calendar days of tropical warning - 6¼
2. Calendar days of typhoon intensity - 3¼
3. Total distance traveled during tropical warning period - 1824 MI

B. Characteristics as a typhoon

1. Min observed SLP - 946mb, 230345Z
2. Min observed 850mb height - 3865 ft, 250300Z
3. Min observed 700mb height - 8540 ft, 250300Z
4. Max vertical development - 35,000 ft, 250000Z

II. DEVELOPMENT

A. Initial impetus - Data inconclusive on surge from westerlies. Fractured portion of MPT became easterly wave.

B. Initial surface vortex

1. Embedded and junction vortex at 200000Z
2. Both vortices had surface pressures of less than 1010mb.
3. Maximum surface wind - 10 kts
4. At 201800Z the embedded vortex had become dominate; both the easterly wave and the junction vortex had dissipated.

C. Zenith flow at 200mb

1. Relative position surface vortex - SE quadrant of anticyclone
2. Wind velocity over vortex - 045/20 kts

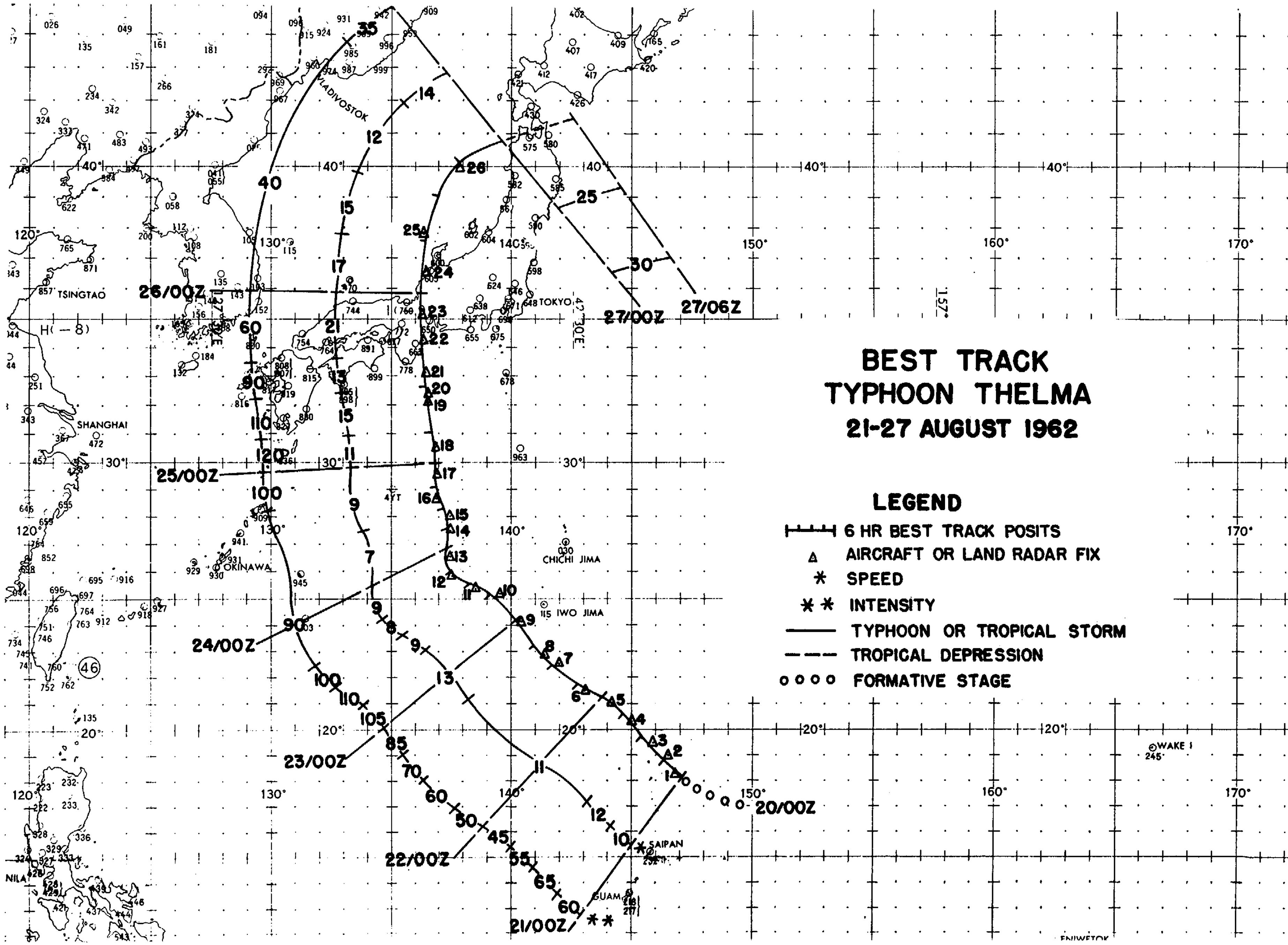
III. STEERING

A. Prior to recurvature - 500mb
B. During recurvature - 500mb
C. After recurvature - 500mb

IV. DISSIPATION

A. Causative factor - Land strike and cold air
B. Final disposition - Extratropical

V. DAMAGE - No reports received


BEST TRACK
TYPHOON THELMA
21-27 AUGUST 1962
LEGEND
6 HR BEST TRACK POSITS
AIRCRAFT OR LAND RADAR FIX
SPEED
INTENSITY
TYPHOON OR TROPICAL STORM
TROPICAL DEPRESSION
FORMATIVE STAGE
20/00Z
21/00Z
22/00Z
23/00Z
24/00Z
25/00Z
26/00Z
27/00Z
27/06Z
VLADIVOSTOK
TSINGTAO
SHANGHAI
TOKYO
OKINAWA
CHICHI JIMA
IWO JIMA
SAIPAN
GUAM
WAKE I
ENIWETOK

LAND RADAR AND AIRCRAFT FIXES - TYPHOON THELMA

FIX NO.	TIME	LAT.	LONG.	UNIT METHOD & ACCY	MAX SFC WND	MAX 700MB WND	MIN 700MB HGT	MIN SLP MBS	700MB T/Td (°C)	EYE CHARACTERISTICS
1	210154Z	18.4N	146.8E	54-P-U	65	-	-	999	- -	CIRC 15 MI DIA
2	210600Z	19.0N	146.5E	54-P-½	70	55	10080	992	16/14	CIRC 20 MI DIA,OPEN S
3	211000Z	19.5N	145.8E	VW1-R-05	-	-	-	-	- -	18 MI DIA
4	211530Z	20.3N	145.0E	VW1-R-05	-	-	-	-	- -	POORLY DEFINED
5	212210Z	21.0N	144.1E	54-P-03	45	40	10070	-	16/10	CIRC 20 MI DIA,OPEN SE-W
6	220355Z	21.6N	143.0E	54-P-05	50	48	9970	-	15/09	CIRC 12 MI DIA
7	220952Z	22.5N	142.0E	VW1-R-05	-	-	-	-	- -	CIRC 16 MI DIA,OPEN N&E
8	221500Z	22.9N	141.4E	VW1-R-05	-	-	-	-	- -	CIRC 23 MI DIA
9	222145Z	24.1N	140.4E	54-P-02	60	80	9420	975	15/09	ELLIP 18X20 MI
10	230345Z	25.1N	139.5E	54-P-02	100	100	8750	946	22/09	CIRC 14 MI DIA
11	231000Z	25.4N	138.5E	VW1-R-03	-	-	-	-	- -	CIRC 12 MI DIA
12	231600Z	25.8N	137.5E	VW1-R-05	-	-	-	-	- -	CIRC 20 MI DIA
13	232152Z	26.6N	137.4E	54-P-04	70	85	9040	959	18/15	DIA 10 MI
14	240410Z	27.7N	137.4E	54-P-06	80	-	8990	-	15/15	CIRC 12 MI DIA
15	240947Z	28.0N	137.4E	VW1-R-05	-	-	-	-	- -	CONCENTRIC INNER DIA 9 MI OUTER DIA 18 MI
16	241545Z	28.7N	136.9E	VW1-R-03	-	-	-	-	- -	DIA 18 MI,OPEN SW
17	242115Z	29.6N	136.9E	56-P-02	120	60	8710	950	15/13	DIA 20 MI
18	250300Z	30.5N	136.9E	54-P-04	120	120	8540	947	13/09	DIA 20 MI
19	251000Z	32.1N	136.6E	VW1-R-03	-	-	-	-	- -	DIA 16 MI,OPEN S
20	251200Z	32.4N	136.5E	LND/RDR	-	-	-	-	- -	---

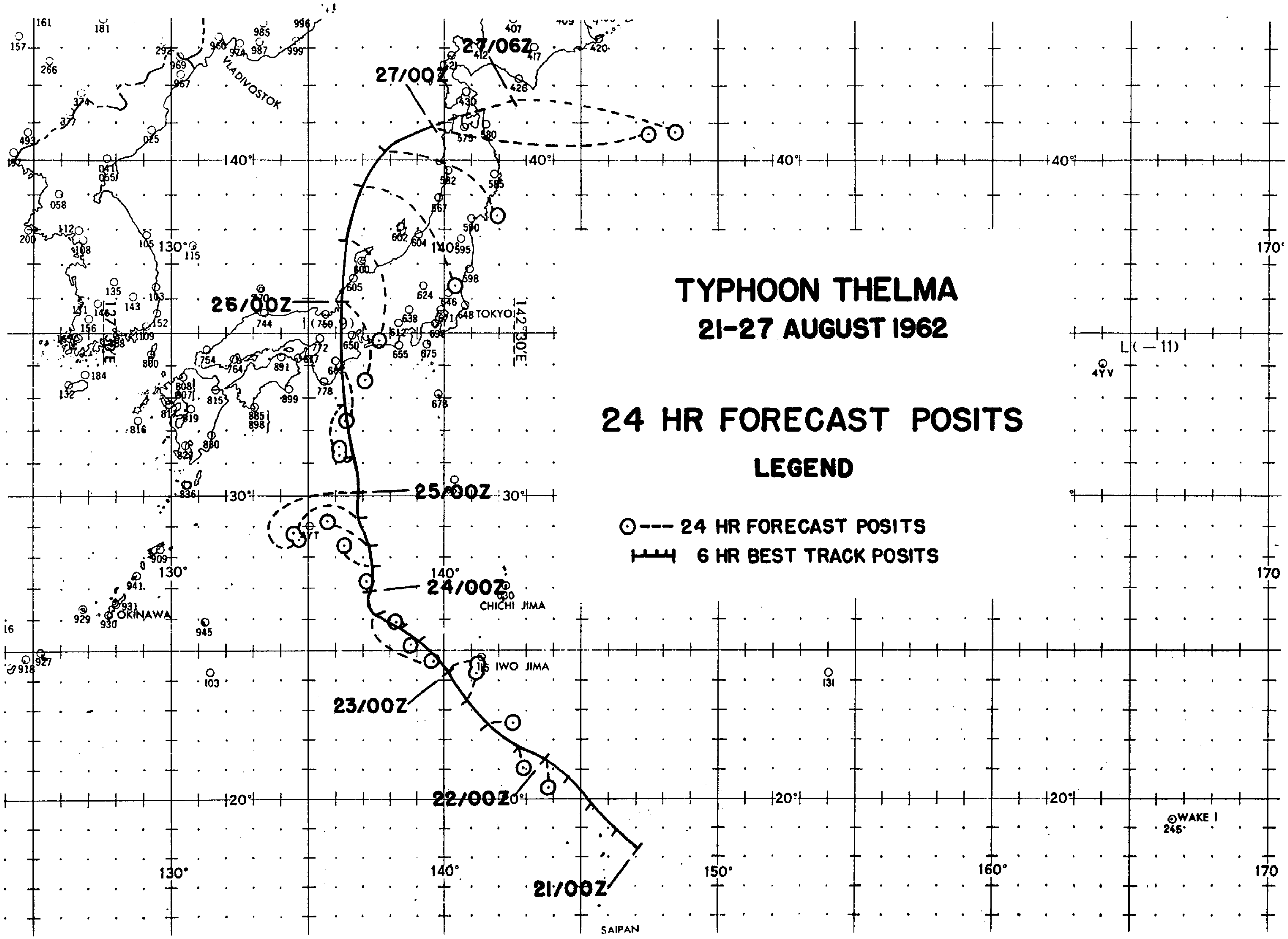
LAND RADAR AND AIRCRAFT FIXES - TYPHOON THELMA (CONT'D)

FIX NO.	TIME	LAT.	LONG.	UNIT METHOD & ACCY	MAX SFC WND	MAX 700MB WND	MIN 700MB HGT	MIN SLP MBS	700MB T/Td ($^{\circ}C$)	EYE CHARACTERISTICS
21	251500Z	33.2N	136.4E	LND/RDR	-	-	-	-	- -	---
22	251900Z	34.2N	136.3E	LND/RDR	-	-	-	-	- -	---
23	252200Z	35.3N	136.2E	LND/RDR	-	-	-	-	- -	---
24	260200Z	36.5N	136.4E	LND/RDR	-	-	-	-	- -	---
25	260652Z	37.8N	136.4E	56-P-01	-	45	10150	1001	12/11	DIA 70 MI
26	261730Z	40.0N	137.9E	LND/RDR	-	-	-	-	- -	---

TYPHOON THELMA 21-27 AUG 1962
POSITION AND FORECAST VERIFICATION DATA

DTG	STORM POSITION LAT.	LONG.	24 HR. ERROR DEG. DISTANCE	48 HR. ERROR DEG. DISTANCE
210000Z	18.2N	147.1E	------	------
210600Z	18.9N	146.4E	------	------
211200Z	19.8N	145.5E	------	------
211800Z	20.6N	144.6E	------	------
220000Z	21.2N	143.8E	170-47	------
220600Z	21.8N	142.7E	165-53	------
221200Z	22.5N	141.8E	075-42	------
221800Z	23.3N	141.0E	010-51	------
230000Z	24.3N	140.2E	075-38	155-150
230600Z	25.2N	139.1E	260-09	155-137
231200Z	25.5N	138.2E	360-26	075-97
231800Z	26.0N	137.4E	125-143	040-110
240000Z	26.9N	137.4E	345-25	080-80
240600Z	27.7N	137.5E	305-70	305-82
241200Z	28.3N	137.3E	305-88	310-100
241800Z	29.1N	136.9E	265-134	170-122
250000Z	30.0N	136.9E	230-142	265-72
250600Z	31.1N	136.8E	295-38	265-87
251200Z	32.6N	136.4E	195-73	240-87
251800Z	33.8N	136.3E	175-87	225-184
260000Z	35.9N	136.2E	165-152	205-320
260600Z	37.6N	136.4E	160-175	128-148
261200Z	39.1N	137.0E	135-222	165-205
261800Z	40.1N	137.9E	115-214	160-217
270000Z	40.9N	139.4E	095-373	160-241
270600Z	41.5N	142.5E	095-274	160-221

AVERAGE 24 HOUR ERROR 112.5 MI
AVERAGE 48 HOUR ERROR 147.8 MI


TYPHOON THELMA
21-27 AUGUST 1962
24 HR FORECAST POSITS
LEGEND
24 HR FORECAST POSITS
6 HR BEST TRACK POSITS
21/00Z
22/00Z
23/00Z
24/00Z
25/00Z
26/00Z
27/00Z
27/06Z
VLADIVOSTOK
TOKYO
OKINAWA
CHICHI JIMA
IWO JIMA
SAIPAN
WAKE I
130°
140°
150°
160°
170
40°
30°
20°

TYPHOON VERA - 250600Z-280600Z AUGUST 1962

I. DATA

A. Statistics

1. Calendar days of tropical warning - 3
2. Calendar days of typhoon intensity - 1¼
3. Total distance traveled during tropical warning period - 756 MI

B. Characteristics as a typhoon

1. Min observed SLP - 983mb, 260330Z
2. Min observed 850mb height - 4455 ft, 260330Z
3. Min observed 700mb height - 9730 ft, 260330Z
4. Max vertical development - 30,000 ft, 261200Z

II. DEVELOPMENT

A. Initial impetus - Superposition and fracture of polar trough and easterly wave at the 200mb level. Surge in easterlies following fracture on the 200mb level.

B. Initial surface vortex

1. Embedded in ITC at 230600Z
2. Surface pressure less than 1008mb
3. Maximum surface wind - 10 kts

C. Zenith flow at 200mb

1. Relative position surface vortex - SE quadrant of anticyclone
2. Wind velocity over vortex - 080/20 kts

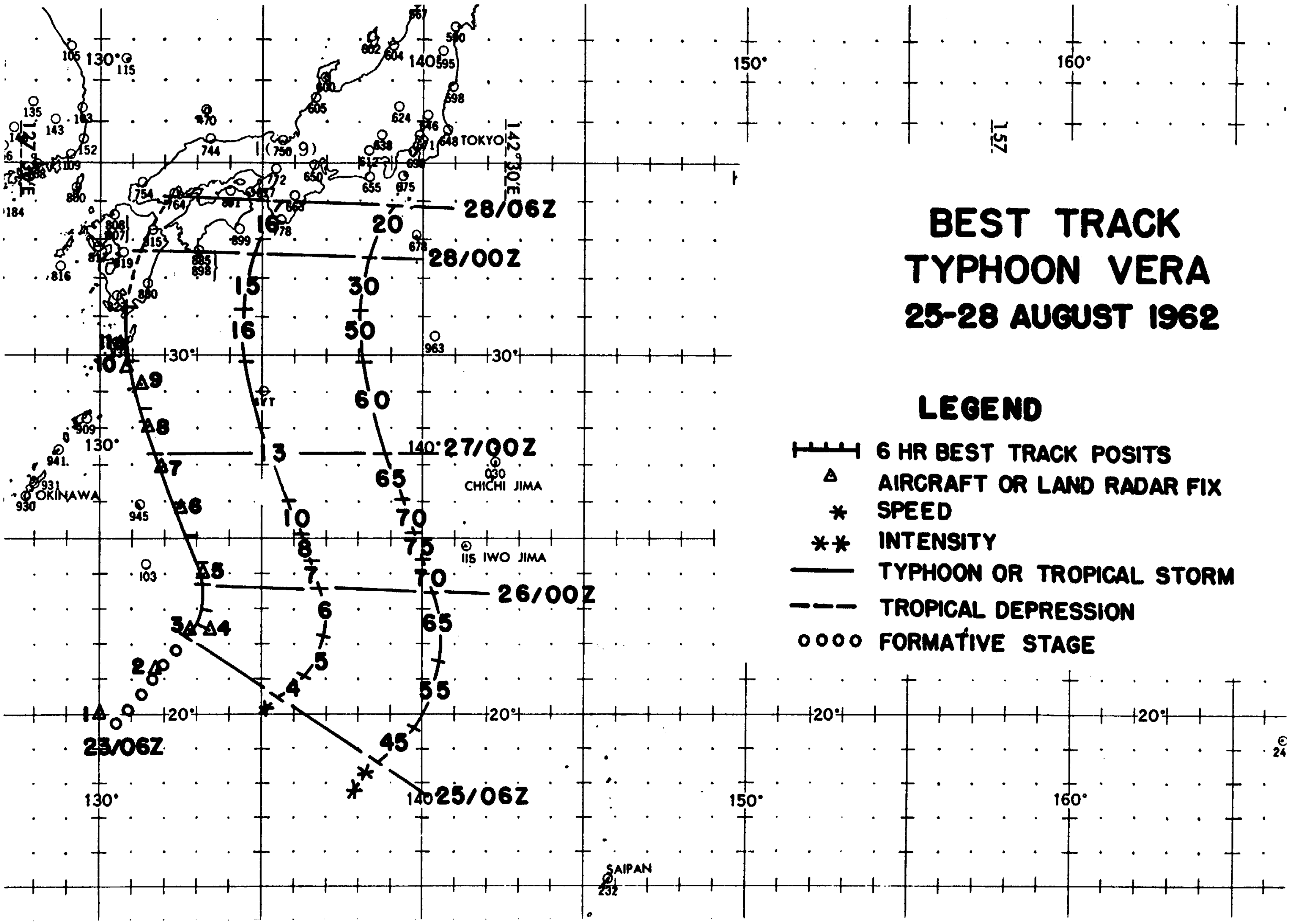
III. STEERING

A. Prior to recurvature - 500mb
B. During recurvature - 500mb
C. After recurvature - 500mb

IV. DISSIPATION

A. Causative factor - Land strike and cold air
B. Final disposition - Dissipated over land

V. DAMAGE - No reports received


BEST TRACK
TYPHOON VERA
25-28 AUGUST 1962
LEGEND
6 HR BEST TRACK POSITS
AIRCRAFT OR LAND RADAR FIX
SPEED
INTENSITY
TYPHOON OR TROPICAL STORM
TROPICAL DEPRESSION
FORMATIVE STAGE
28/06Z
28/00Z
27/00Z
26/00Z
25/06Z
25/06Z
TOKYO
OKINAWA
CHICHI JIMA
IWO JIMA
SAIPAN
130°
140°
150°
160°
30°
20°

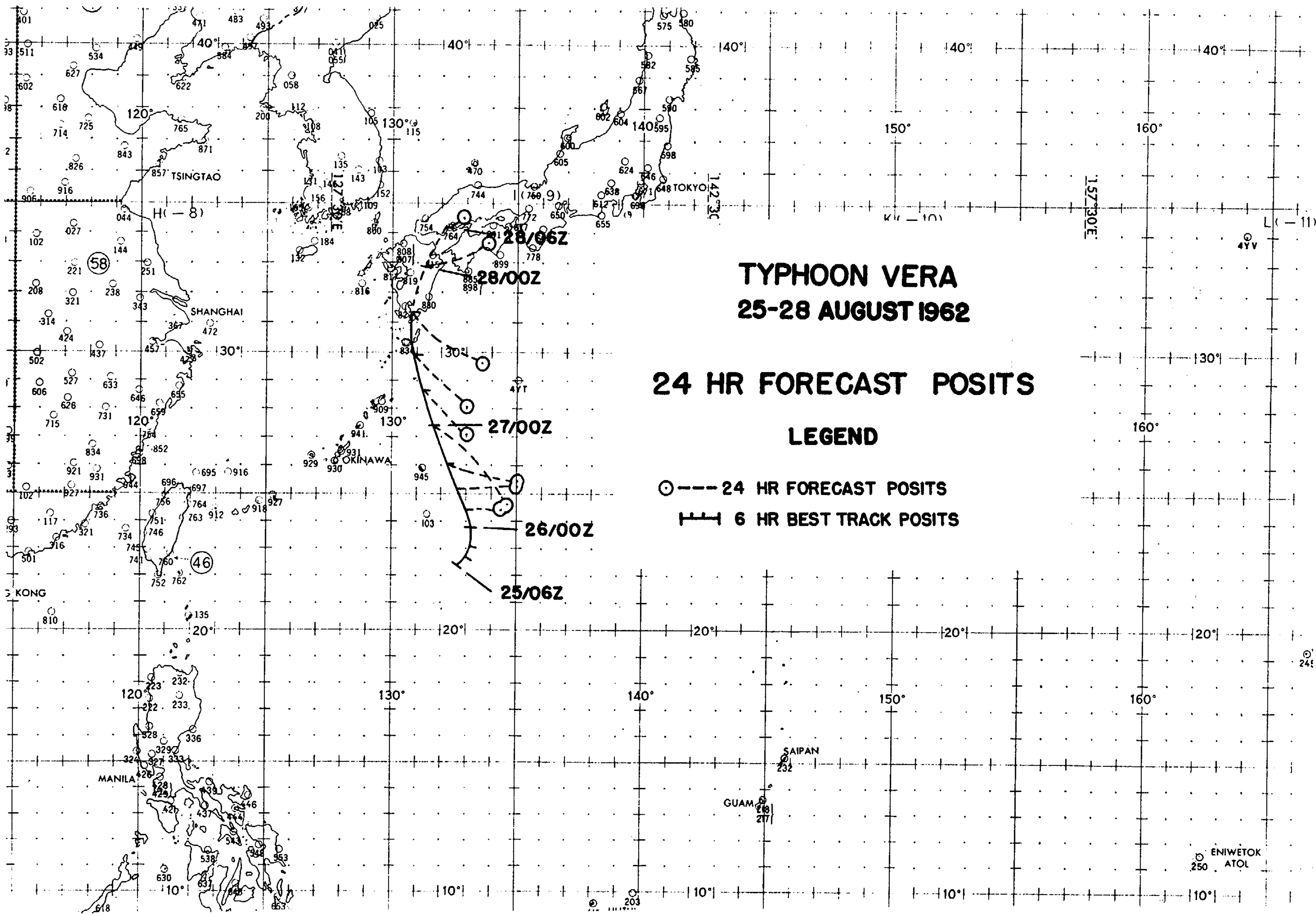
LAND RADAR AND AIRCRAFT FIXES - TYPHOON VERA

FIX NO.	TIME	LAT.	LONG.	UNIT METHOD & ACCY	MAX SFC WND	MAX 700MB WND	MIN 700MB HGT	MIN SLP MBS	700MB T/Td (°C)	EYE CHARACTERISTICS
1	231800Z	20.0N	130.0E	VW1-P-U	-	-	-	-	- -	WEAK ORGANIZED CLD PATTERN
2	241148Z	21.4N	131.8E	VW1-P-05	-	-	10305	-	- -	FEEDER BANDS FORMED SW TO NE
3	250654Z	22.4N	132.8E	54-P-U	45	-	10150	996	- -	CIRC 20 MI DIA, WALL CLDS ALL QUADS
4	251240Z	22.2N	133.3E	VW1-R-03	-	-	-	-	- -	DIA 11 MI, OPEN N
5	260330Z	24.0N	133.1E	54-P-03	75	60	9730	983	10/09	DIA 5 MI
6	261630Z	25.8N	132.3E	VW1-R-03	-	-	-	-	- -	DIA 5 MI, WEAK NW
7	262200Z	26.9N	131.9E	54-P-02	70	60	9780	984	16/12	---
8	270315Z	28.0N	131.4E	54-P-02	55	55	9960	983	15/12	ELLIP MAJOR AXIS N-S, 25 MI DIA
9	270900Z	29.2N	131.2E	LND/RDR	-	-	-	-	- -	---
10	271200Z	29.7N	130.8E	LND/RDR	-	-	-	-	- -	---
11	271500Z	30.3N	130.6E	VW1-R-03	-	-	-	-	- -	DIA 70 MI, VERY DIFFUSE

TYPHOON VERA 25-28 AUG 1962
POSITION AND FORECAST VERIFICATION DATA

DTG	STORM POSITION LAT.	LONG.	24-HR. ERROR DEG. DISTANCE	48-HR. ERROR DEG. DISTANCE
250600Z	22.3N	132.7E	------	------
251200Z	22.6N	133.0E	------	------
251800Z	23.0N	133.3E	------	------
260000Z	23.7N	133.2E	------	------
260600Z	24.3N	133.0E	089-84	------
261200Z	25.1N	132.7E	086-128	------
261800Z	26.0N	132.3E	111-169	------
270000Z	27.3N	131.7E	136-227	------
270600Z	28.5N	131.3E	132-133	095-240
271200Z	29.8N	130.9E	132-158	094-265
271800Z	31.3N	130.7E	135-144	117-296
280000Z	32.7N	131.4E	068-137	154-460
280600Z	34.1N	132.2E	083-33	176-433

AVERAGE 24 HOUR ERROR 134.8 MI
AVERAGE 48 HOUR ERROR 338.8 MI


TYPHOON VERA
25-28 AUGUST 1962
24 HR FORECAST POSITS
LEGEND
24 HR FORECAST POSITS
6 HR BEST TRACK POSITS
28/06Z
28/00Z
27/00Z
26/00Z
25/06Z
TSINGTAO
SHANGHAI
OKINAWA
TOKYO
MANILA
SAIPAN
GUAM
ENIWETOK ATOL

TYPHOON WANDA - 271200Z AUGUST-011800Z SEPTEMBER 1962

I. DATA

A. Statistics

1. Calendar days of tropical warning - 5¼
2. Calendar days of typhoon intensity - 3¼
3. Total distance traveled during tropical warning period - 1434 MI

B. Characteristics as a typhoon

1. Min observed SLP - 949mb, 310930Z
2. Min observed 850mb height - 3500 ft, 310930Z
3. Min observed 700mb height - 8840 ft, 310930Z
4. Max vertical development - 35,000 ft, 311200Z

II. DEVELOPMENT

A. Initial impetus - Superposition and fracture of MPT and easterly wave on the 200mb level followed by surge in easterlies apparently originating from Southern Hemisphere outdraft on the 200mb level.

B. Initial surface vortex

1. Junction vortex at 230000Z
2. Surface pressure less than 1011mb
3. Maximum surface wind - 10 kts

C. Zenith flow at 200mb

1. Relative position surface vortex - NE quadrant of Southern Hemisphere anticyclone
2. Wind velocity over vortex - 120/15 kts

III. STEERING

A. Prior to recurvature - 500mb

B. During and after recurvature - NA

IV. DISSIPATION

A. Causative factor - Land strike and cold air

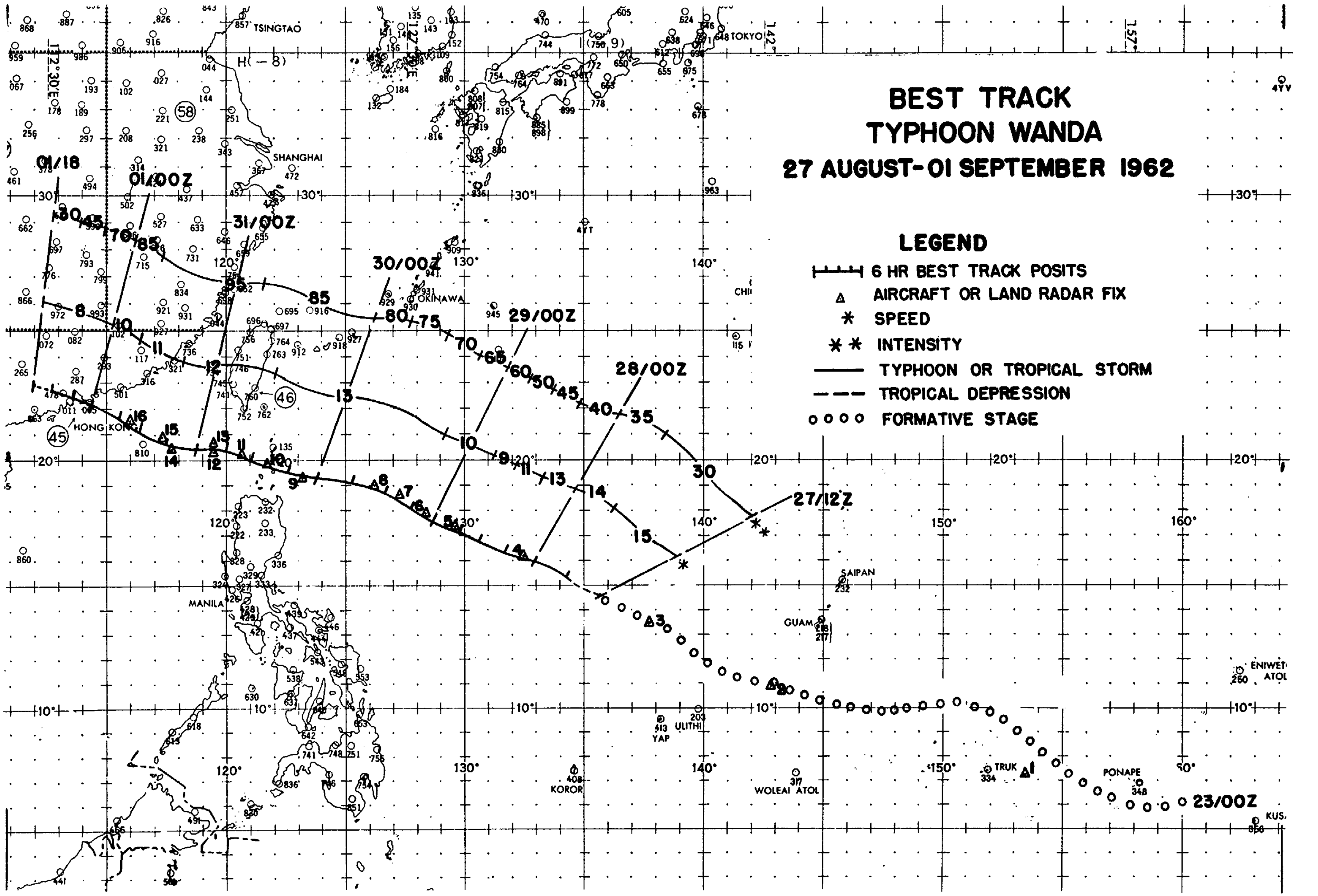
B. Final disposition - Dissipated over land

V. DAMAGE

A. Total lives lost - 434

B. Total monetary value - Millions of dollars

C. Types of property - Ships, boats, buildings, cars, power and communication lines


BEST TRACK
TYPHOON WANDA
27 AUGUST-01 SEPTEMBER 1962
LEGEND
6 HR BEST TRACK POSITS
AIRCRAFT OR LAND RADAR FIX
SPEED
INTENSITY
TYPHOON OR TROPICAL STORM
TROPICAL DEPRESSION
FORMATIVE STAGE
01/18
01/00Z
31/00Z
30/00Z
29/00Z
28/00Z
27/12Z
23/00Z
TSINGTAO
TOKYO
SHANGHAI
OKINAWA
HONG KONG
MANILA
SAIPAN
GUAM
ULITHI
YAP
KOROR
WOLEAI ATOL
TRUK
PONAPE
ENIWETOK ATOL
30°
20°
10°
120°
130°
140°
150°
160°

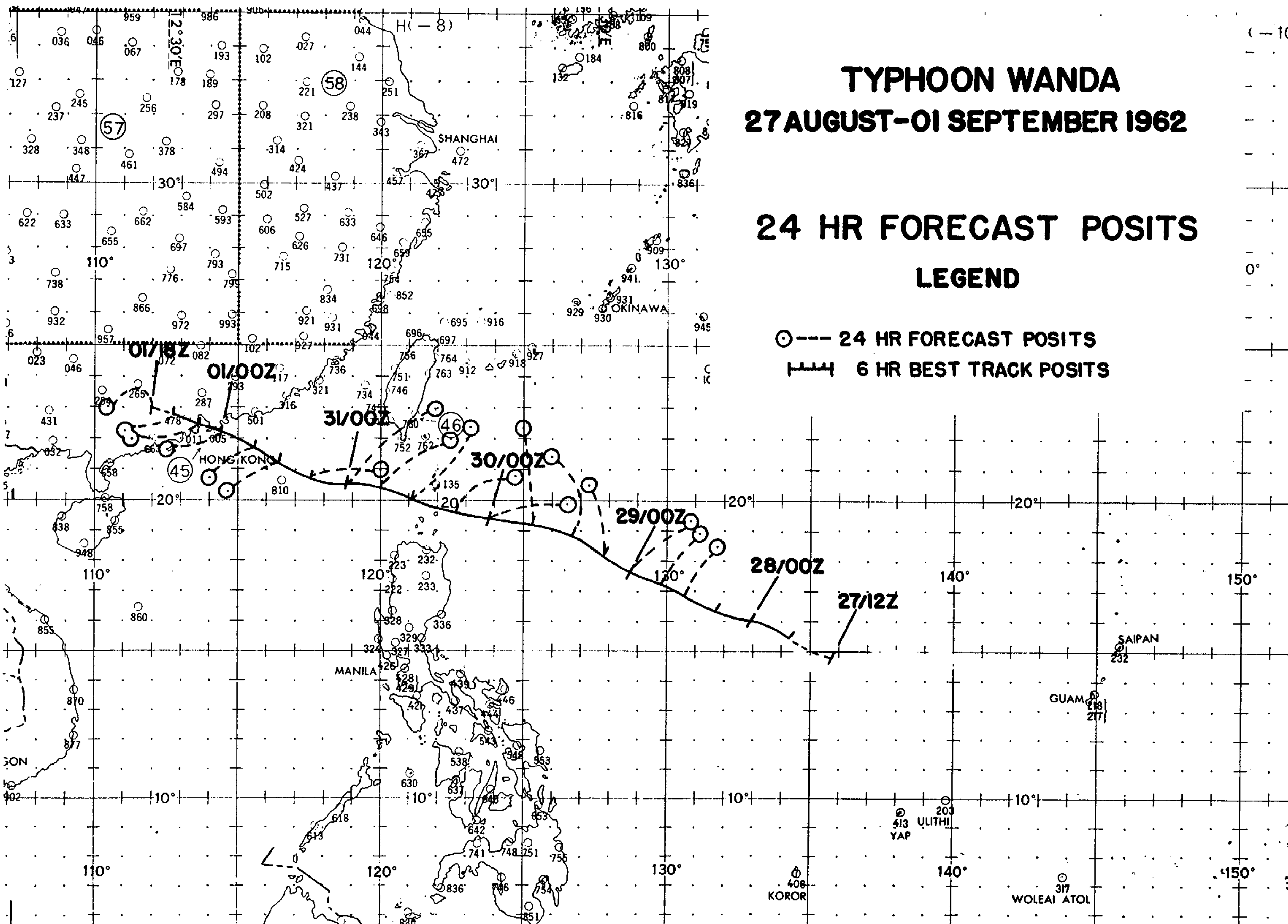
LAND RADAR AND AIRCRAFT FIXES - TYPHOON WANDA

FIX NO.	TIME	LAT.	LONG.	UNIT METHOD & ACCY	MAX SFC WND	MAX 700MB WND	MIN 700MB HGT	MIN SLP MBS	700MB T/Td (°C)	EYE CHARACTERISTICS
1	240415Z	07.2N	153.5E	VW1-P-20	10	-	-	1005	- -	---
2	260345Z	10.8N	142.8E	VW1-P-30	15	-	-	1001	- -	---
3	270300Z	13.5N	137.7E	VW1-P-U	25	-	-	1000	- -	90 MI E-W & 50 MI N-S
4	280211Z	16.2N	132.5E	VW1-P-03	40	-	9745	-	13/07	CIRC 55 MI DIA
5	282300Z	17.4N	129.7E	54-P-03	60	55	9870	992	14/-	CIRC 8 MI DIA
6	290330Z	17.9N	128.3E	54-P-03	65	55	9870	984	15/10	CIRC 20 MI DIA
7	290945Z	18.6N	127.1E	VW1-R-10	-	-	-	-	- -	DIA 20 MI,OPEN N,S&W
8	291600Z	19.0N	126.1E	VW1-R-10	-	-	-	-	- -	DIA 20 MI,OPEN W
9	300334Z	19.4N	123.1E	54-P-02	80	82	9510	982	14/10	CIRC 25 MI DIA
10	301020Z	19.9N	121.6E	VW1-P-05	80	-	9216	-	16/12	CIRC 32 MI DIA
11	301415Z	20.2N	120.6E	LND/RDR	-	-	-	-	- -	---
12	301815Z	20.3N	119.5E	LND/RDR	-	-	-	-	- -	---
13	302200Z	20.6N	119.5E	54-P-03	80	85	9120	970	16/14	CIRC 30 MI DIA,OPEN N-E
14	310400Z	20.4N	117.8E	54-P-03	85	70	9100	970	17/13	CIRC 30 MI DIA
15	310930Z	20.9N	117.4E	VW1-P-03	80	-	8840	949	16/15	CIRC 5 MI DIA
16	311530Z	21.5N	116.0E	VW1-R-05	-	-	-	-	- -	CIRC 23 MI DIA,OPEN W

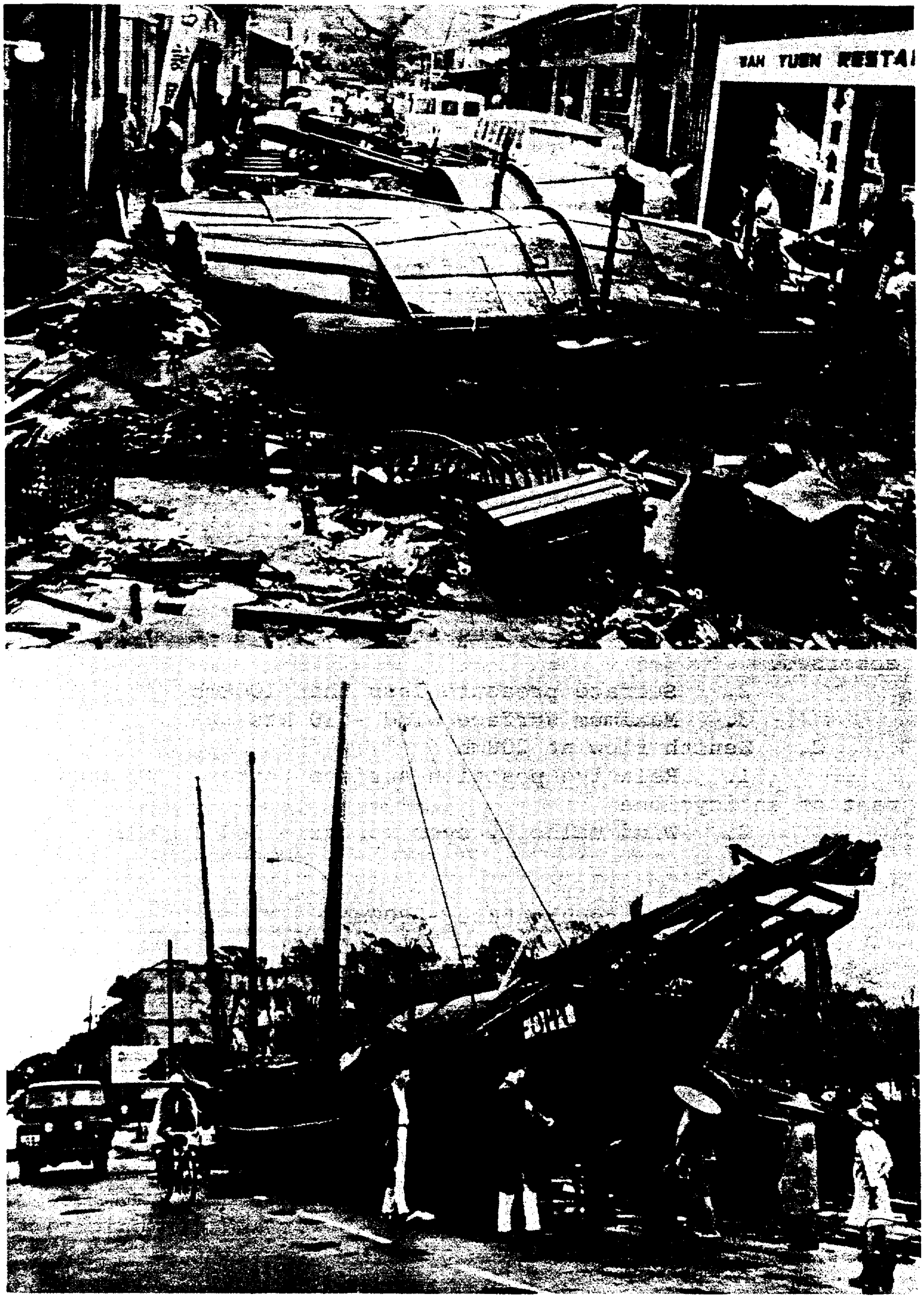
TYPHOON WANDA 27 AUG-01 SEP 1962
POSITION AND FORECAST VERIFICATION DATA

DTG	STORM POSITION LAT.	LONG.	24 HR. ERROR DEG. DISTANCE	48 HR. ERROR DEG. DISTANCE
271200Z	14.7N	135.6E	------	------
271800Z	15.4N	134.2E	------	------
280000Z	16.0N	132.9E	------	------
280600Z	16.4N	131.7E	------	------
281200Z	16.8N	130.6E	------	------
281800Z	17.2N	129.7E	------	------
290000Z	17.6N	128.8E	------	------
290600Z	18.1N	127.9E	344-140	------
291200Z	18.8N	126.7E	347-162	------
291800Z	19.1N	125.3E	355-196	------
300000Z	19.3N	123.9E	078-155	------
300600Z	19.6N	122.6E	061-132	014-252
301200Z	20.0N	121.2E	037-172	012-292
301800Z	20.4N	120.0E	056-167	013-305
310000Z	20.4N	118.7E	050-232	055-305
310600Z	20.6N	117.4E	250-99	045-270
311200Z	21.2N	116.4E	242-118	031-230
311800Z	21.7N	115.5E	230-102	049-237
010000Z	22.2N	114.4E	255-110	050-236
010600Z	22.3N	113.6E	261-133	086-104
011200Z	22.7N	112.8E	254-104	289-115
011800Z	23.0N	112.0E	270-87	304-96

AVERAGE 24 HOUR ERROR 140.6 MI
AVERAGE 48 HOUR ERROR 222.0 MI


TYPHOON WANDA
27 AUGUST-01 SEPTEMBER 1962
24 HR FORECAST POSITS
LEGEND
24 HR FORECAST POSITS
6 HR BEST TRACK POSITS
01/18Z
01/00Z
31/00Z
30/00Z
29/00Z
28/00Z
27/12Z
SHANGHAI
HONG KONG
OKINAWA
MANILA
SAIPAN
GUAM
YAP
ULITHI
KOROR
WOLEAI ATOL

TYPHOON WANDA GUTTED TENEMENTS IN HONG KONG (TOP) AND LEFT CHILDREN ONLY MAKE-SHIFT DEBRIS OF A DAMAGED HOUSE (BOTTOM). (AP PHOTO)



THE HIGH TIDES AND SAVAGE WINDS OF TYPHOON WANDA DEPOSITED SAMPANS (TOP) AND JUNKS (BOTTOM) ON HONG KONG STREETS. (AP PHOTO)

TYPHOON AMY - 290600Z AUGUST - 080000Z SEPTEMBER 1962

I. DATA

A. Statistics

1. Calendar days of tropical warning - 9 3/4
2. Calendar days of typhoon intensity - 6¼
3. Total distance traveled during tropical warning period - 2964 MI

B. Characteristics as a typhoon

1. Min observed SLP - 935mb, 030420Z
2. Min observed 850mb height - 2730 ft, 021200Z
3. Min observed 700mb height - 8210 ft, 030420Z
4. Max vertical development - 40,000 ft, 041800Z

II. DEVELOPMENT

A. Initial impetus - Surge from westerlies into MPT and then into the easterlies.

B. Initial surface vortex

1. Embedded vortex at 270600Z, junction vortex absorbed.
2. Surface pressure less than 1008mb
3. Maximum surface wind - 10 kts

C. Zenith flow at 200mb

1. Relative position surface vortex - NE quadrant of anticyclone
2. Wind velocity over vortex - 340/14 kts

III. STEERING

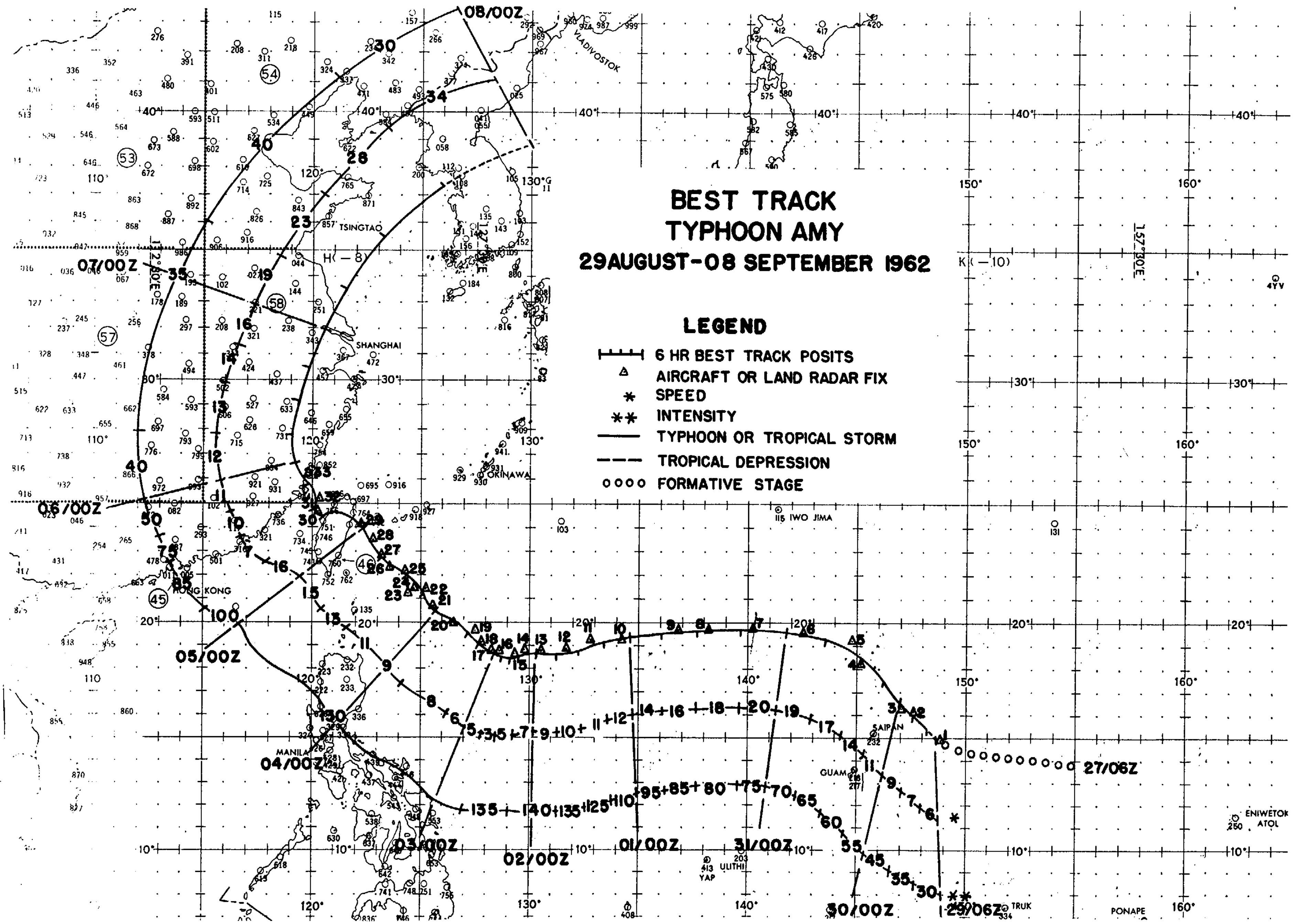
A. Prior to recurvature - 300mb
B. During recurvature - 500mb
C. After recurvature - 500mb

IV. DISSIPATION

A. Causative factor - Cold air
B. Final disposition - Extratropical

V. DAMAGE

A. Total lives lost - 24
B. Total monetary value - Millions of dollars
C. Types of property - Crops, power and communication lines, and buildings


BEST TRACK
TYPHOON AMY
29AUGUST-08 SEPTEMBER 1962
LEGEND
6 HR BEST TRACK POSITS
AIRCRAFT OR LAND RADAR FIX
SPEED
INTENSITY
TYPHOON OR TROPICAL STORM
TROPICAL DEPRESSION
FORMATIVE STAGE
08/00Z
07/00Z
06/00Z
05/00Z
04/00Z
03/00Z
02/00Z
01/00Z
31/00Z
30/00Z
29/06Z
27/06Z
VLADIVOSTOK
TSINGTAO
SHANGHAI
OKINAWA
HONG KONG
MANILA
IWO JIMA
SAIPAN
GUAM
ULITHI
YAP
TRUK
PONAPE
ENIWETOK ATOL

LAND RADAR AND AIRCRAFT FIXES - TYPHOON AMY

FIX NO.	TIME	LAT.	LONG.	UNIT METHOD & ACCY	MAX SFC WND	MAX 700MB WND	MIN 700MB HGT	MIN SLP MBS	700MB T/Td (°C)	EYE CHARACTERISTICS
1	290440Z	14.9N	148.8E	VW1-P-10	30	-	-	1000	- -	POORLY DEFINED 15X30 MI
2	292140Z	16.2N	147.6E	54-P-05	55	55	-	992	15/13	CIRC 12 MI DIA, OPEN SE TO W
3	300200Z	16.3N	147.0E	54-P-01	55	60	9910	984	15/13	CIRC 12 MI DIA, OPEN S TO NW
4	301000Z	18.3N	145.2E	VW1-P-20	-	-	-	985	- -	RDR PRESENTATION POOR
5	301533Z	19.2N	144.8E	VW1-P-03	-	-	9720	-	12/11	CIRC 25 MI DIA, OPEN SW
6	302150Z	19.6N	142.5E	54-P-04	70	65	9630	979	12/07	CIRC 40 MI DIA, OPEN S
7	310350Z	19.7N	140.3E	54-P-03	70	65	9590	978	12/09	CIRC 35 MI DIA, OPEN SW
8	311000Z	19.7N	138.2E	VW1-R-05	-	-	-	-	- -	DIA 21 MI, OPEN S
9	311530Z	19.6N	136.8E	VW1-R-05	-	-	-	-	- -	66 MI E-W & 54 MI N-S
10	010400Z	19.3N	134.1E	54-P-02	130	120	8480	938	11/11	CIRC 20 MI DIA
11	010916Z	19.2N	132.9E	VW1-R-03	-	-	-	-	- -	CIRC 32 MI DIA
12	011536Z	18.8N	131.6E	VW1-R-05	-	-	-	-	- -	CIRC 25 MI DIA
13	012200Z	18.7N	130.5E	54-P-02	-	120	8500	978	20/13	CIRC 20 MI DIA
14	020345Z	18.8N	129.8E	54-P-02	125	-	8420	973	18/17	---
15	020945Z	18.6N	129.4E	VW1-R-03	-	-	-	-	- -	CIRC 46 MI DIA, OPEN N
16	021530Z	18.6N	128.7E	VW1-R-05	-	-	-	-	- -	DIA 45 MI, OPEN NW
17	022225Z	18.8N	128.4E	54-P-03	130	110	8230	936	19/14	DIA 18 MI, POORLY DEF

LAND RADAR AND AIRCRAFT FIXES - TYPHOON AMY (CONT'D)

FIX NO.	TIME	LAT.	LONG.	UNIT METHOD & ACCY	MAX SFC WND	MAX 700MB WND	MIN 700MB HGT	MIN SLP MBS	700MB T/Td (^{o}C)	EYE CHARACTERISTICS
18	030420Z	19.1N	127.9E	54-P-05	120	110	8210	935	17/13	CIRC 19 MI DIA
19	031017Z	19.6N	127.5E	VW1-R-05	-	-	-	-	- -	CONCENTRIC INNER DIA 8 MI,OUTER DIA 28 MI
20	031600Z	20.0N	126.5E	VW1-R-03	-	-	-	-	- -	CIRC 16 MI DIA
21	032150Z	20.6N	125.5E	54-P-03	70	80	8360	941	17/16	CIRC 21 MI DIA,OPEN S
22	040230Z	21.5N	125.1E	USAF-R-U	-	-	-	-	- -	---
23	040630Z	21.2N	124.4E	LND/RDR	-	-	-	-	- -	---
24	041000Z	21.4N	124.7E	VW1-R-01	-	-	-	-	- -	CIRC 19 MI DIA
25	041300Z	22.1N	124.2E	LND/RDR	-	-	-	-	- -	---
26	041600Z	22.4N	123.5E	LND/RDR	-	-	-	-	- -	---
27	041900Z	22.9N	123.1E	LND/RDR	-	-	-	-	- -	---
28	042200Z	23.5N	122.8E	LND/RDR	-	-	-	-	- -	DIA 40 MI
29	050200Z	24.1N	122.2E	LND/RDR	-	-	-	-	- -	---
30	050900Z	24.6N	120.3E	LND/RDR	-	-	-	-	- -	---
31	051100Z	24.7N	120.2E	LND/RDR	-	-	-	-	- -	---
32	051500Z	25.3N	120.3E	LND/RDR	-	-	-	-	- -	---
33	051800Z	26.2N	119.8E	LND/RDR	-	-	-	-	- -	---

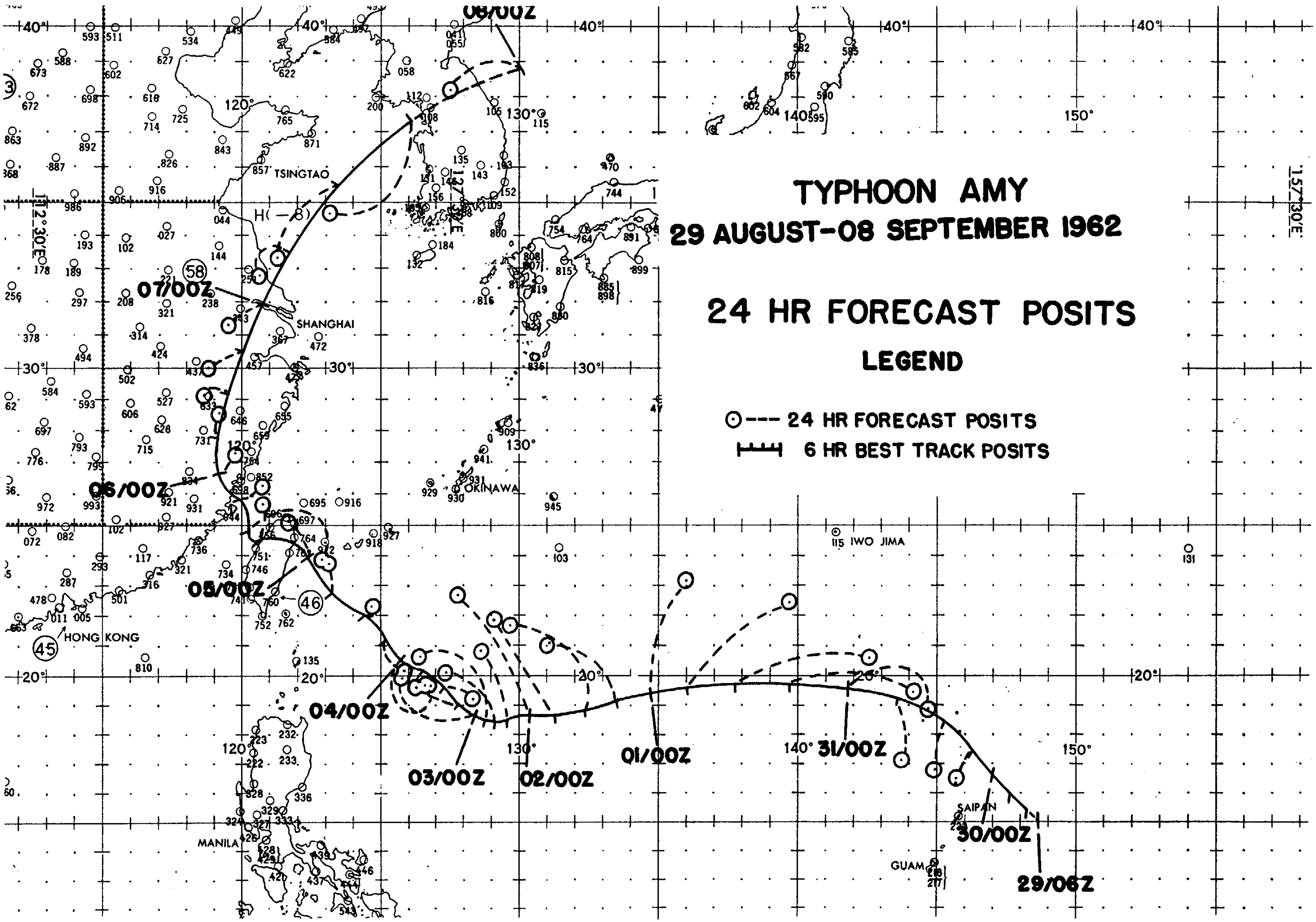
TYPHOON AMY 29 AUG-08 SEP 1962
POSITION AND FORECAST VERIFICATION DATA

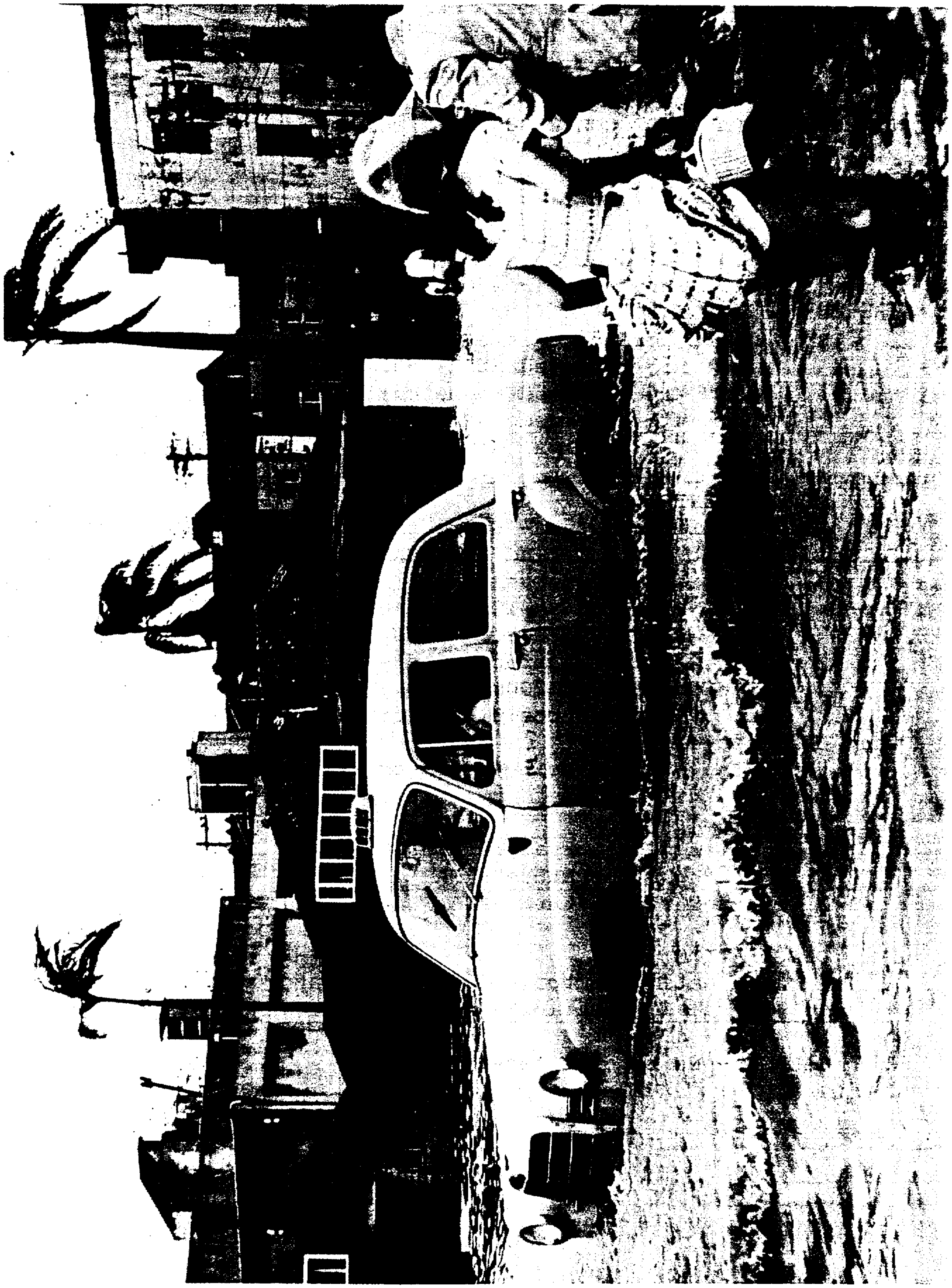
DTG	STORM POSITION LAT.	LONG.	24 HR. ERROR DEG. DISTANCE	48 HR. ERROR DEG. DISTANCE
290600Z	15.0N	148.7E	------	------
291200Z	15.4N	148.2E	------	------
291800Z	16.0N	147.7E	------	------
300000Z	16.7N	147.0E	------	------
300600Z	17.5N	146.2E	------	------
301200Z	18.4N	145.2E	------	------
301800Z	19.3N	143.6E	------	------
310000Z	19.7N	141.7E	105-180	------
310600Z	19.7N	139.6E	094-252	------
311200Z	19.6N	137.7E	078-283	------
311800Z	19.5N	136.0E	052-276	------
010000Z	19.4N	134.6E	020-240	072-396
010600Z	19.2N	133.3E	315-171	069-432
011200Z	18.9N	132.2E	321-222	052-420
011800Z	18.7N	131.1E	331-227	024-441
020000Z	18.7N	130.3E	330-283	008-392
020600Z	18.6N	129.6E	340-136	334-334
021200Z	18.6N	129.1E	314-132	334-464
021800Z	18.6N	128.8E	313-182	336-455
030000Z	18.8N	128.3E	294-147	338-550
030600Z	19.3N	127.8E	291-65	335-276
031200Z	19.8N	127.2E	116-82	315-242
031800Z	20.1N	126.3E	189-27	318-257
040000Z	20.4N	125.6E	122-82	297-181
040600Z	21.2N	125.1E	139-78	275-104
041200Z	22.0N	124.3E	066-29	118-143
041800Z	22.8N	123.2E	360-52	153-71
050000Z	24.0N	122.3E	335-73	147-188
050600Z	24.5N	120.6E	002-70	133-202
051200Z	24.9N	120.2E	112-153	078-88
051800Z	25.9N	119.9E	063-48	330-25

TYPHOON AMY 29 AUG-08 SEP 1962
POSITION AND FORECAST VERIFICATION DATA (CONT'D)

DTG	STORM POSITION LAT.	LONG.	24 HR. ERROR DEG. DISTANCE	48 HR. ERROR DEG. DISTANCE
060000Z	26.7N	119.1E	044-54	328-70
060600Z	27.9N	119.2E	360-38	288-70
061200Z	29.1N	119.6E	274-48	166-125
061800Z	30.5N	120.0E	246-73	215-74
070000Z	32.0N	120.7E	237-66	225-132
070600Z	33.7N	121.6E	------	305-20
071200Z	35.5N	123.3E	------	214-127
071800Z	37.3N	126.0E	222-206	224-202
080000Z	38.9N	130.0E	253-120	233-317

AVERAGE 24 HOUR ERROR 132.1 MI
AVERAGE 48 HOUR ERROR 234.4 MI


TYPHOON AMY
29 AUGUST-08 SEPTEMBER 1962
24 HR FORECAST POSITS
LEGEND
24 HR FORECAST POSITS
6 HR BEST TRACK POSITS
29/06Z
30/00Z
31/00Z
01/00Z
02/00Z
03/00Z
04/00Z
05/00Z
06/00Z
07/00Z
08/00Z
TSINGTAO
SHANGHAI
HONG KONG
MANILA
OKINAWA
IWO JIMA
SAIPAN
GUAM
112°30'E
127°30'E
157°30'E



GONDOLA, ANYONE... A TOUCH OF OLD VENICE COMES TO TAIPEI, TAIWAN IN THE WAKE OF TYPHOON AMY. (STARS & STRIPES PHOTO)

TYPHOON CARLA - 190000Z-230000Z SEPTEMBER 1962

I. DATA

A. Statistics

1. Calendar days of tropical warning - 4
2. Calendar days of typhoon intensity - ¼
3. Total distance traveled during tropical warning period - 858 MI

B. Characteristics as a typhoon

1. Min observed SLP - 983mb, 210630Z
2. Min observed 850mb height - 4400 ft, 210630Z
3. Min observed 700mb height - 9650 ft, 210630Z
4. Max vertical development - 30,000 ft, 211200Z

II. DEVELOPMENT

A. Initial impetus - Surge from westerlies into MPT followed by cut-off low, and then CARLA formed downstream.

B. Initial surface vortex

1. Embedded in ITC at 140000Z
2. Surface pressure less than 1009mb
3. Maximum surface wind - 10 kts

C. Zenith flow at 200mb

1. Relative position surface vortex - SE quadrant of anticyclone
2. Wind velocity over vortex - 060/10 kts

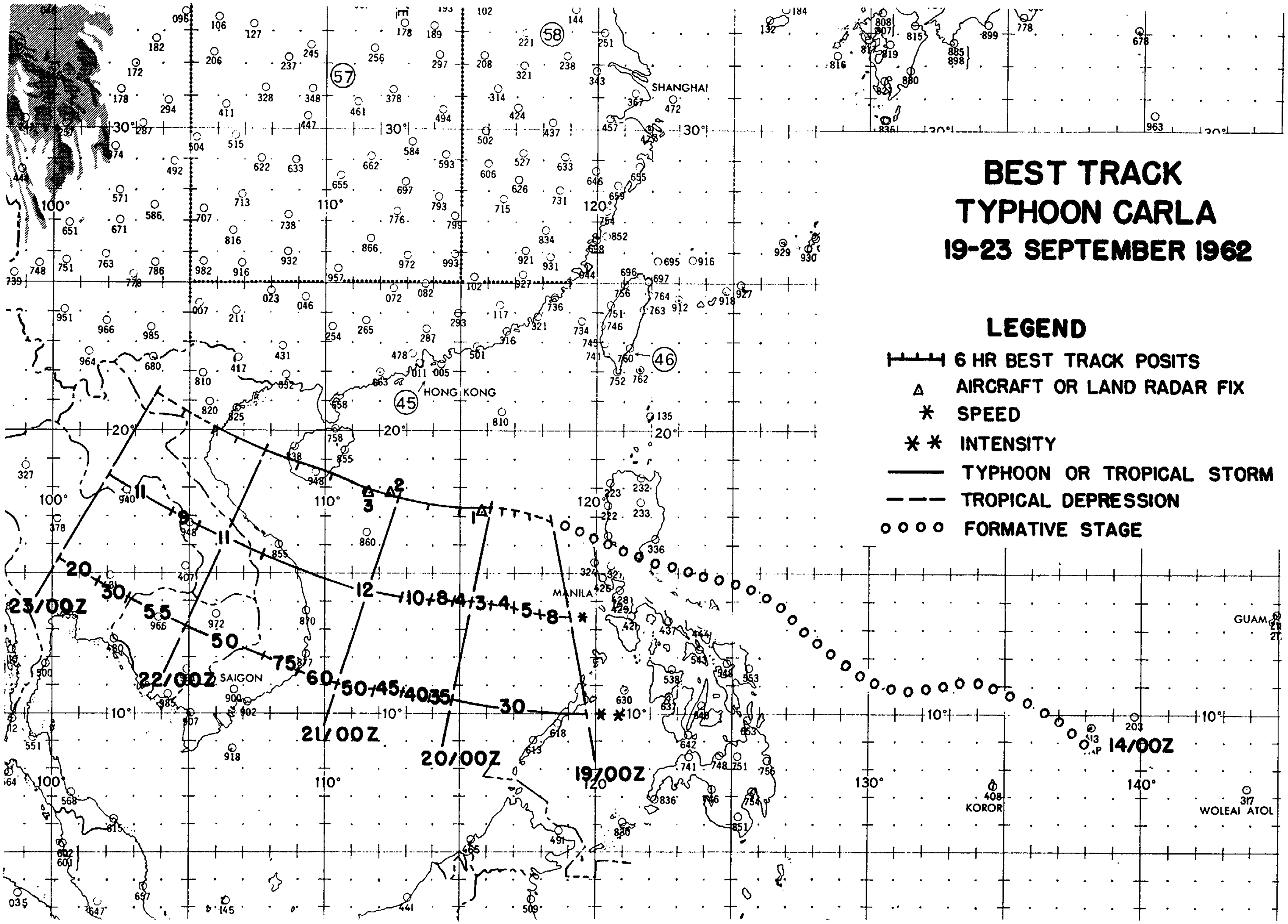
III. STEERING

A. Prior to recurvature - 500mb
B. During recurvature - NA
C. After recurvature - NA

IV. DISSIPATION

A. Causative factor - Land strike and cold air
B. Final disposition - Dissipated over land

V. DAMAGE - No reports received


BEST TRACK
TYPHOON CARLA
19-23 SEPTEMBER 1962
LEGEND
6 HR BEST TRACK POSITS
AIRCRAFT OR LAND RADAR FIX
SPEED
INTENSITY
TYPHOON OR TROPICAL STORM
TROPICAL DEPRESSION
FORMATIVE STAGE
SHANGHAI
HONG KONG
MANILA
SAIGON
GUAM
KOROR
WOLEAI ATOL
23/00Z
22/00Z
21/00Z
20/00Z
19/00Z
14/00Z

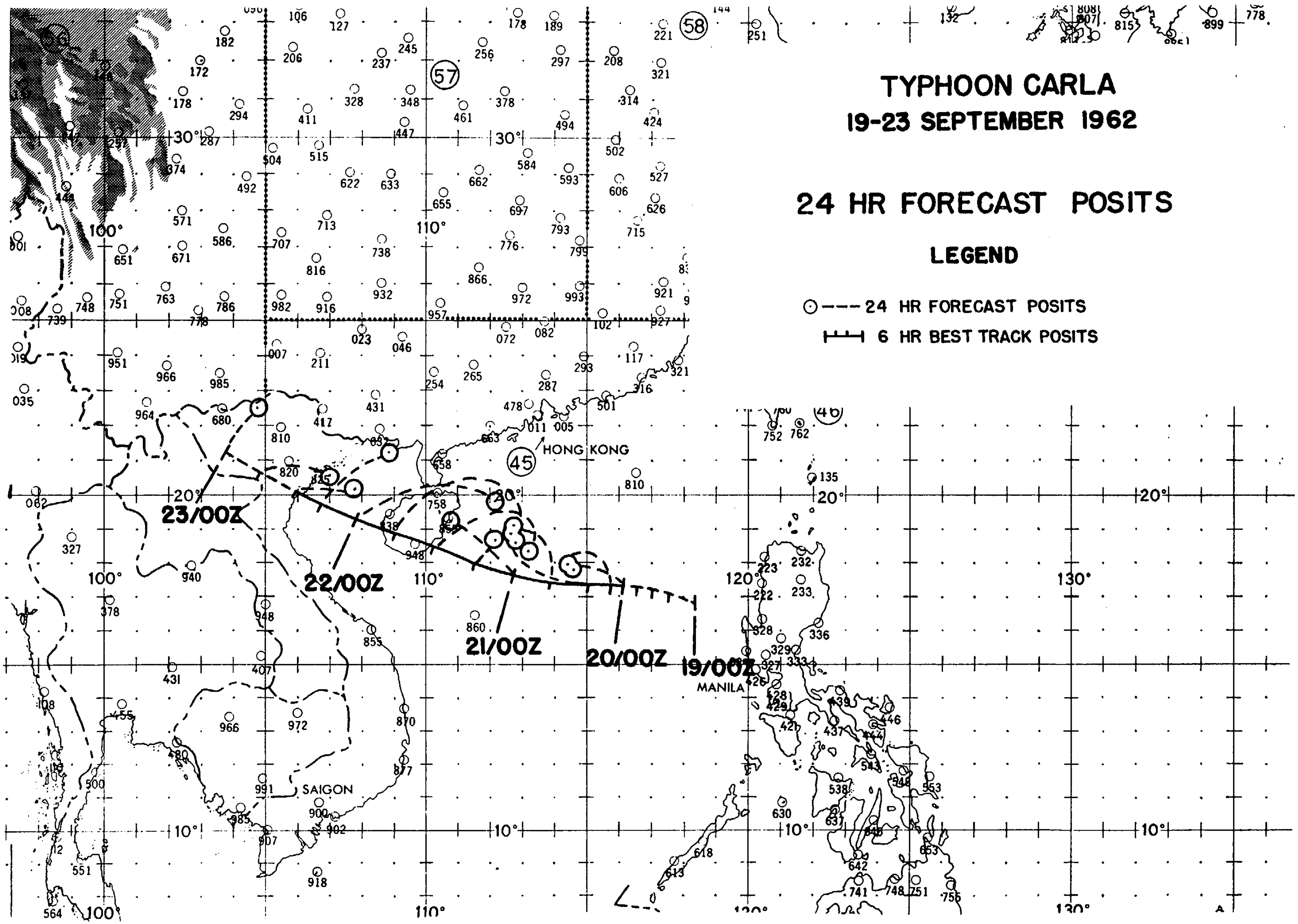
LAND RADAR AND AIRCRAFT FIXES - TYPHOON CARLA

FIX NO.	TIME	LAT.	LONG.	UNIT METHOD & ACCY	MAX SFC WND	MAX 700MB WND	MIN 700MB HGT	MIN SLP MBS	700MB T/Td (°C)	EYE CHARACTERISTICS
1	200628Z	17.2N	115.8E	54-P-02	35	43	10100	1003	12/12	CIRC
2	210200Z	17.8N	112.3E	54-P-05	45	45	9790	990	15/14	CIRC 10 MI DIA, OPEN N & W
3	210630Z	17.9N	111.6E	54-P-04	70	75	9650	983	15/15	CIRC 12 MI DIA

TYPHOON CARLA 19-23 SEP 1962
POSITION AND FORECAST VERIFICATION DATA

DTG	STORM POSITION LAT.	LONG.	24 HR. ERROR DEG. DISTANCE	48 HR. ERROR DEG. DISTANCE
190000Z	16.8N	118.3E	------	------
190600Z	17.1N	117.5E	------	------
191200Z	17.2N	117.0E	------	------
191800Z	17.2N	116.5E	------	------
200000Z	17.2N	116.3E	------	------
200600Z	17.3N	115.8E	------	------
201200Z	17.3N	115.0E	------	------
201800Z	17.5N	113.9E	------	------
210000Z	17.7N	112.7E	------	------
210600Z	18.0N	111.4E	------	------
211200Z	18.5N	110.2E	094-167	------
211800Z	18.9N	109.0E	084-216	------
220000Z	19.3N	107.9E	083-242	------
220600Z	19.8N	106.8E	055-136	------
221200Z	20.2N	106.0E	093-100	079-224
221800Z	20.7N	104.9E	095-113	071-310
230000Z	21.3N	103.9E	035-92	078-357

AVERAGE 24 HOUR ERROR 152.3 MI
AVERAGE 48 HOUR ERROR 297 MI


TYPHOON CARLA
19-23 SEPTEMBER 1962
24 HR FORECAST POSITS
LEGEND
24 HR FORECAST POSITS
6 HR BEST TRACK POSITS
23/00Z
22/00Z
21/00Z
20/00Z
19/00Z
HONG KONG
MANILA
SAIGON

TYPHOON DINAH - 250600Z SEPTEMBER-040600Z OCTOBER 1962

I. DATA

A. Statistics

1. Calendar days of tropical warning - 9
2. Calendar days of typhoon intensity - 3½
3. Total distance traveled during tropical warning period - 1860 MI

B. Characteristics as a typhoon

1. Min observed SLP - 953mb, 012221Z
2. Min observed 850mb height - 3580 ft, 012221Z
3. Min observed 700mb height - 8880 ft, 012221Z
4. Max vertical development - 35,000 ft, 021200Z

II. DEVELOPMENT

A. Initial impetus - Surge from westerlies into MPT followed by cut-off low, and then DINAH developed downstream.

B. Initial surface vortex

1. Junction vortex at 241800Z
2. Surface pressure less than 1008mb
3. Maximum surface wind - 10 kts

C. Zenith flow at 200mb

1. Relative position surface vortex - SW quadrant of anticyclone
2. Wind velocity over vortex - 140/13 kts

III. STEERING

A. Prior to recurvature - 500mb

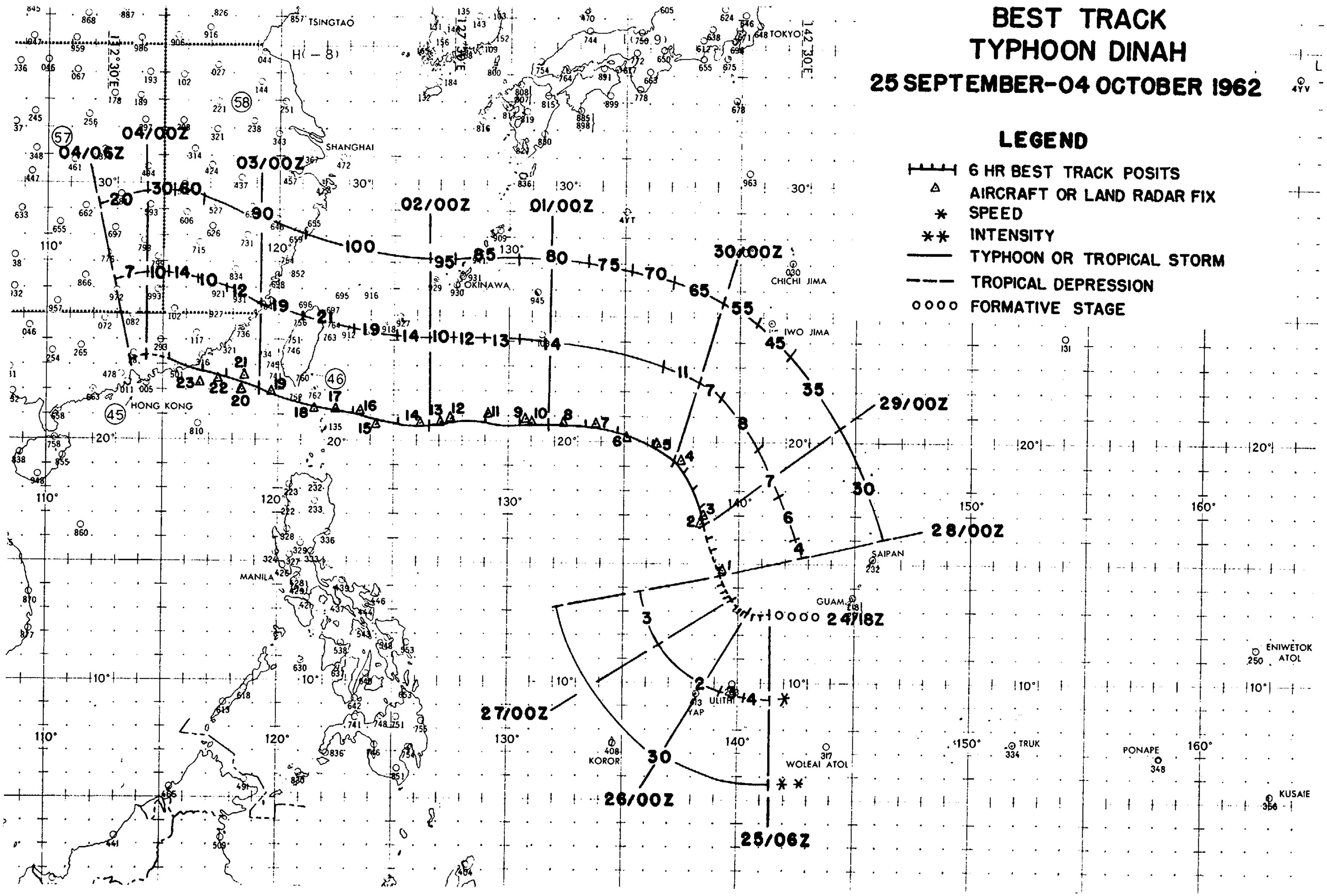
B. During and after recurvature - NA

IV. DISSIPATION

A. Causative factor - Land strike and cold air

B. Final disposition - Dissipated

V. DAMAGE - No reports received


BEST TRACK
TYPHOON DINAH
25 SEPTEMBER-04 OCTOBER 1962
LEGEND
6 HR BEST TRACK POSITS
AIRCRAFT OR LAND RADAR FIX
SPEED
INTENSITY
TYPHOON OR TROPICAL STORM
TROPICAL DEPRESSION
FORMATIVE STAGE
04/06Z
04/00Z
03/00Z
02/00Z
01/00Z
30/00Z
29/00Z
28/00Z
27/00Z
26/00Z
25/06Z
24/18Z
TSINGTAO
SHANGHAI
TOKYO
OKINAWA
CHICHI JIMA
IWO JIMA
HONG KONG
MANILA
SAIPAN
GUAM
ULITHI
YAP
KOROR
WOLEAI ATOL
TRUK
PONAPE
ENIWETOK ATOL
KUSAIE

LAND RADAR AND AIRCRAFT FIXES - TYPHOON DINAH

FIX NO.	TIME	LAT.	LONG.	UNIT METHOD & ACCY	MAX SFC WND	MAX 700MB WND	MIN 700MB HGT	MIN SLP MBS	700MB T/Td (°C)	EYE CHARACTERISTICS
1	280300Z	14.7N	139.2E	VW1-P-10	25	-	9800	1003	12/-	60 MI E-W & 130 MI N-S
2	290020Z	16.6N	138.4E	VW1-P-U	30	-	-	997	- -	---
3	290320Z	17.0N	138.4E	VW1-P-U	30	-	-	994	- -	LARGE & POORLY DEFINED
4	292230Z	19.2N	137.3E	54-P-02	45	60	9850	988	15/14	DIA 15 MI
5	300345Z	19.9N	136.3E	54-P-03	60	90	9740	984	16/13	DIA 12 MI
6	301000Z	20.2N	135.1E	VW1-R-05	-	-	-	-	- -	OVAL NE-SW
7	301530Z	20.6N	133.8E	VW1-R-10	-	-	-	-	- -	CIRC 75 MI DIA
8	302205Z	20.6N	132.3E	54-P-07	85	60	9540	976	14/04	CIRC 100 MI DIA
9	010309Z	20.8N	130.6E	54-P-02	70	70	9380	966	17/10	CIRC
10	010330Z	20.7N	131.0E	54-P-U	-	-	-	969	16/-	WELL DEFINED
11	011000Z	21.0N	129.0E	VW1-R-05	-	-	-	-	- -	CIRC 50 MI DIA
12	011550Z	20.9N	127.5E	VW1-R-05	-	-	-	-	- -	CIRC 45 MI DIA
13	012200Z	20.7N	127.0E	54-P-U	-	-	-	-	- -	---
14	012221Z	20.7N	126.1E	54-P-03	90	82	8880	953	21/12	CIRC 40 MI DIA
15	020601Z	20.6N	124.2E	315-P-02	85	-	-	-	- -	ELLIP E-W
16	021012Z	21.1N	123.5E	VW1-R-05	-	-	-	-	- -	OVAL 54 MI E-W & 42 MI N-S
17	021300Z	21.2N	122.5E	LND/RDR	-	-	-	-	- -	---
18	021625Z	21.3N	121.6E	LND/RDR	-	-	-	-	- -	---
19	022200Z	21.9N	119.7E	LND/RDR	-	-	-	-	- -	---

LAND RADAR AND AIRCRAFT FIXES - TYPHOON DINAH (CONT'D)

FIX NO.	TIME	LAT.	LONG.	UNIT METHOD & ACCY	MAX SFC WND	MAX 700MB WND	MIN 700MB HGT	MIN SLP MBS	700MB T/Td (°C)	EYE CHARACTERISTICS
20	030200Z	22.0N	118.4E	LND/RDR	-	-	-	-	- -	---
21	030340Z	22.6N	118.5E	315-P-U	90	-	9050	-	20/-	DIA 35 MI
22	030800Z	22.5N	117.3E	LND/RDR	-	-	-	-	- -	---
23	031155Z	22.3N	116.6E	VW1-R-05	-	-	-	-	- -	CIRC,OPEN NE SEMICIRC

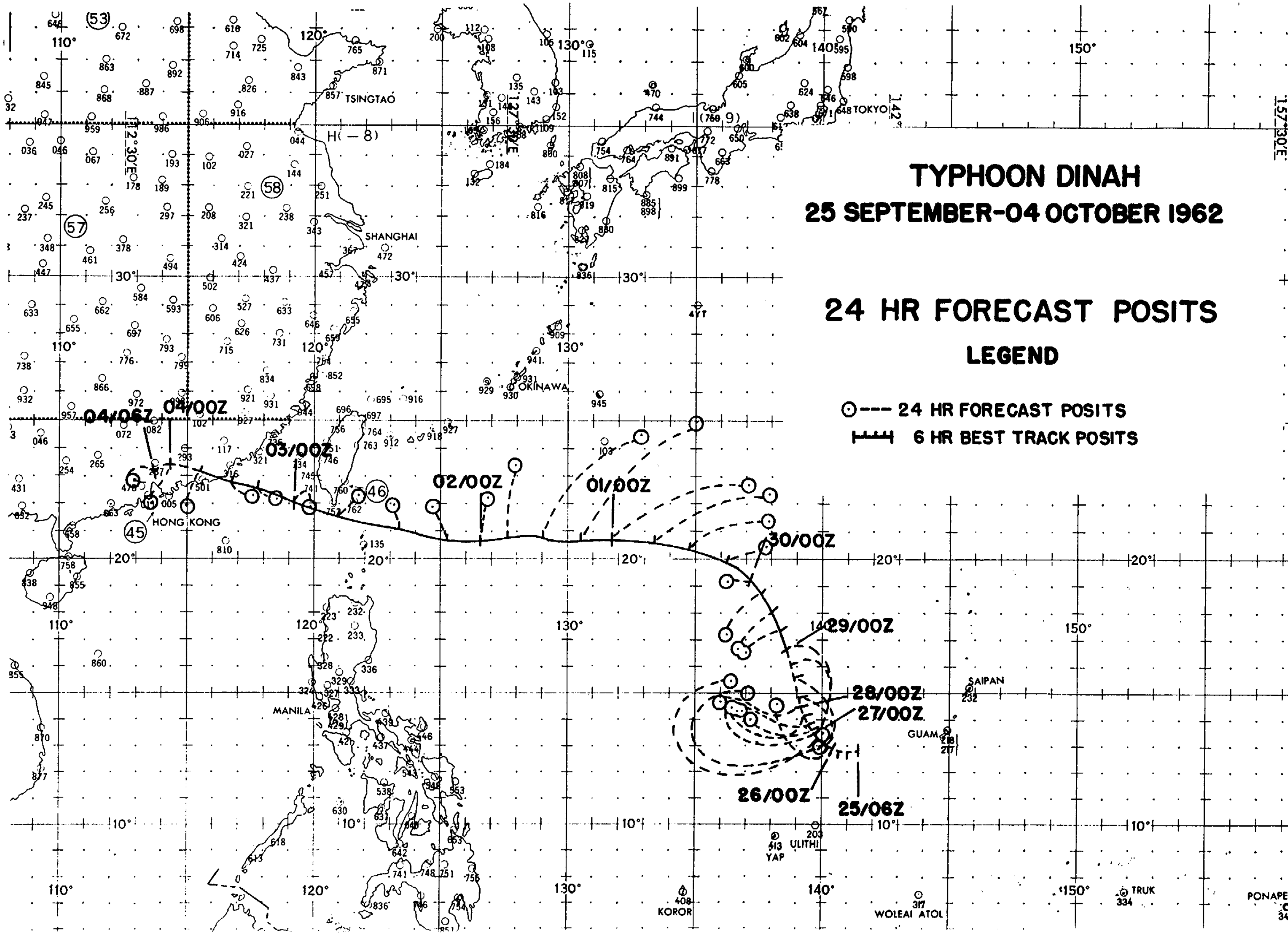
TYPHOON DINAH 25 SEP-04 OCT 1962
POSITION AND FORECAST VERIFICATION DATA

DTG	STORM POSITION LAT.	LONG.	24 HR. ERROR DEG. DISTANCE	48 HR. ERROR DEG. DISTANCE
250600Z	12.8N	141.4E	------	------
251200Z	12.8N	141.0E	------	------
251800Z	12.9N	140.7E	------	------
260000Z	13.0N	140.5E	------	------
260600Z	13.1N	140.3E	------	------
261200Z	13.2N	140.2E	------	------
261800Z	13.3N	140.0E	------	------
270000Z	13.4N	139.8E	------	------
270600Z	13.7N	139.6E	------	------
271200Z	13.9N	139.5E	------	------
271800Z	14.2N	139.4E	------	------
280000Z	14.5N	139.2E	------	------
280600Z	14.8N	139.1E	------	------
281200Z	15.4N	138.9E	------	------
281800Z	16.0N	138.7E	------	------
290000Z	16.6N	138.5E	------	------
290600Z	17.3N	138.3E	------	------
291200Z	18.0N	138.0E	------	------
291800Z	18.7N	137.6E	------	------
300000Z	19.3N	137.2E	258-59	------
300600Z	19.9N	136.2E	071-100	------
301200Z	20.3N	134.8E	073-183	------
301800Z	20.6N	133.3E	068-275	------
010000Z	20.7N	131.8E	068-309	051-165
010600Z	20.7N	130.4E	047-360	062-465
011200Z	20.8N	129.0E	038-285	062-545
011800Z	20.7N	127.7E	005-150	060-635
020000Z	20.6N	126.6E	360-90	058-645
020600Z	20.6N	125.2E	339-80	048-767
021200Z	21.1N	123.2E	355-55	052-750
021800Z	21.4N	121.0E	039-64	019-248

TYPHOON DINAH 25 SEP-04 OCT 1962 (CONT'D)
POSITION AND FORECAST VERIFICATION DATA

DTG	STORM POSITION LAT.	LONG.	24 HR. ERROR DEG. DISTANCE	48 HR. ERROR DEG. DISTANCE
030000Z	22.1N	119.1E	105-46	069-208
030600Z	22.5N	117.9E	115-41	081-112
031200Z	22.8N	116.9E	125-54	093-87
031800Z	23.2N	115.4E	199-85	094-90
040000Z	23.3N	114.3E	212-88	195-36
040600Z	23.1N	113.6E	255-37	250-51

AVERAGE 24 HOUR ERROR 131.2 MI
AVERAGE 48 HOUR ERROR 343.1 MI


TYPHOON DINAH
25 SEPTEMBER-04 OCTOBER 1962
24 HR FORECAST POSITS
LEGEND
24 HR FORECAST POSITS
6 HR BEST TRACK POSITS
04/06Z
04/00Z
03/00Z
02/00Z
01/00Z
30/00Z
29/00Z
28/00Z
27/00Z
26/00Z
25/06Z
HONG KONG
SHANGHAI
TSINGTAO
TOKYO
OKINAWA
MANILA
SAIPAN
GUAM
ULITHI
YAP
KOROR
WOLEAI ATOL
TRUK
PONAPE

TYPHOON EMMA - 011800Z-111200Z OCTOBER 1962

I. DATA

A. Statistics

1. Calendar days of tropical warning - 9 3/4
2. Calendar days of typhoon intensity - 9½
3. Total distance traveled during tropical warning period - 2232 MI

B. Characteristics as a typhoon

1. Min observed SLP - 903mb, 042130Z
2. Min observed 850mb height - 1925 ft, 050000Z
3. Min observed 700mb height - 7070 ft, 050315Z
4. Max vertical development - 40,000 ft, 051200Z

II. DEVELOPMENT

A. Initial impetus - Surge from westerlies into easterlies.

B. Initial surface vortex

1. Embedded in ITC at 301800Z
2. Surface pressure less than 1003mb
3. Maximum surface wind - 15 kts

C. Zenith flow at 200mb

1. Relative position surface vortex - SE quadrant of anticyclone
2. Wind velocity over vortex - 040/30 kts

III. STEERING

A. Prior to recurvature - 300mb

B. During recurvature - 300mb

C. After recurvature - 300mb

IV. DISSIPATION

A. Causative factor - Cold air

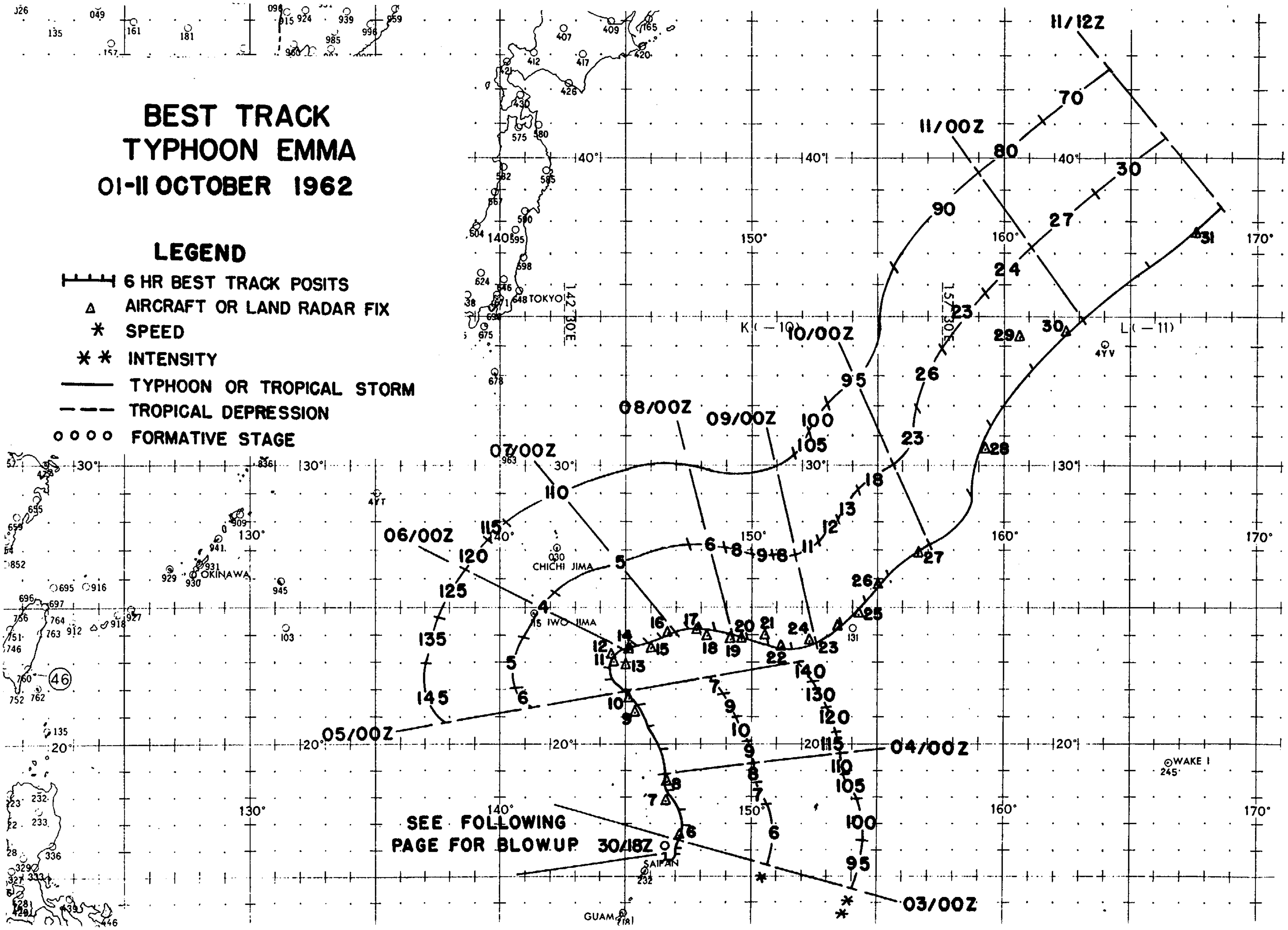
B. Final disposition - Extratropical

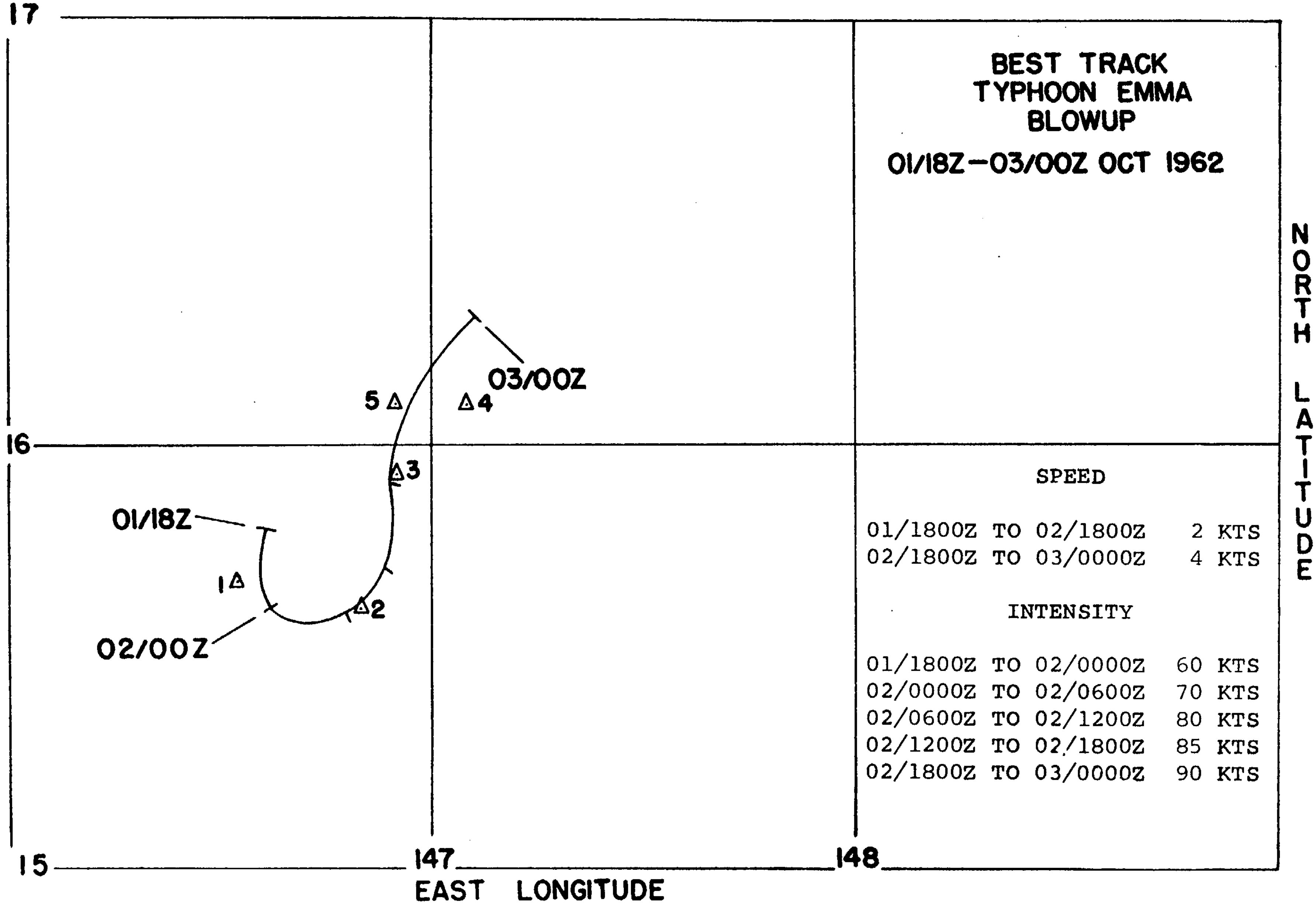
V. DAMAGE

A. Total lives lost - None reported

B. Total monetary value - $250,000

C. Types of property - Buildings, communications equipment, and fishing boats


BEST TRACK
TYPHOON EMMA
01-11 OCTOBER 1962
LEGEND
6 HR BEST TRACK POSITS
AIRCRAFT OR LAND RADAR FIX
SPEED
INTENSITY
TYPHOON OR TROPICAL STORM
TROPICAL DEPRESSION
FORMATIVE STAGE
SEE FOLLOWING PAGE FOR BLOWUP
30/18Z
03/00Z
04/00Z
05/00Z
06/00Z
07/00Z
08/00Z
09/00Z
10/00Z
11/00Z
11/12Z
TOKYO
CHICHI JIMA
IWO JIMA
OKINAWA
SAIPAN
GUAM
WAKE I
142°30'E
157°30'E
K(-10)
L(-11)


BEST TRACK
TYPHOON EMMA
BLOWUP
01/18Z—03/00Z OCT 1962
SPEED
01/1800Z TO 02/1800Z 2 KTS
02/1800Z TO 03/0000Z 4 KTS
INTENSITY
01/1800Z TO 02/0000Z 60 KTS
02/0000Z TO 02/0600Z 70 KTS
02/0600Z TO 02/1200Z 80 KTS
02/1200Z TO 02/1800Z 85 KTS
02/1800Z TO 03/0000Z 90 KTS
01/18Z
02/00Z
03/00Z
1
2
3
4
5
17
16
15
147
148
EAST LONGITUDE
NORTH LATITUDE

LAND RADAR AND AIRCRAFT FIXES - TYPHOON EMMA

FIX NO.	TIME	LAT.	LONG	UNIT METHOD & ACCY	MAX SFC WND	MAX 700MB WND	MIN 700MB HGT	MIN SLP MBS	700MB T/Td (°C)	EYE CHARACTERISTICS
1	020325Z	15.7N	146.5E	LND/RDR	-	-	-	-	- -	---
2	020615Z	15.6N	146.8E	54-P-01	75	-	9650	984	15/11	ELLIP 40 MI E-W & 20 MI N-S
3	021745Z	15.9N	146.9E	VW1-R-U	-	-	-	-	- -	DIA 20 MI,OPEN E
4	021849Z	16.1N	147.1E	54-P-03	-	45	9370	968	14/-	CIRC 10 MI DIA,OPEN NE
5	022145Z	16.1N	146.9E	54-P-03	50	70	9330	966	18/-	OVAL NE-SW 30X15 MI
6	030300Z	16.6N	147.2E	54-P-05	60	60	9150	962	17/16	OVAL NE-SW 30X15 MI
7	031550Z	17.9N	146.7E	VW1-R-03	-	-	-	-	- -	CIRC 7 MI DIA
8	032100Z	18.5N	146.6E	54-P-01	100	90	7980	-	17/15	CIRC 9 MI DIA
9	041600Z	21.1N	145.4E	VW1-R-03	-	-	-	-	- -	CIRC 22 MI DIA
10	042130Z	21.7N	145.1E	54-P-05	135	-	7420	903	25/16	CIRC 15 MI DIA
11	050315Z	23.0N	144.5E	54-P-03	120	120	7070	906	26/17	OVAL 10X6 MI
12	051645Z	23.2N	144.4E	VW1-R-05	-	-	-	-	- -	CIRC 15 MI DIA
13	052230Z	22.8N	145.0E	315-P-05	110	-	7830	-	- -	CIRC 17 MI DIA,OPEN NW
14	060300Z	23.5N	145.1E	54-P-05	110	100	8100	926	17/11	CIRC 30 MI DIA
15	061450Z	23.5N	146.0E	VW1-R-05	-	-	-	-	- -	CIRC 19 MI DIA
16	062145Z	24.0N	146.7E	56-P-07	100	90	8460	942	18/15	DIA 20 MI, POORLY DEF
17	070315Z	24.3N	147.9E	56-P-10	80	70	8430	939	18/17	DIA 20 MI
18	071600Z	23.9N	148.2E	VW1-R-05	-	-	-	-	- -	35 MI N-S & 29 MI E-W

LAND RADAR AND AIRCRAFT FIXES - TYPHOON EMMA (CONT'D)

FIX NO.	TIME	LAT.	LONG	UNIT METHOD & ACCY	MAX SFC WND	MAX 700MB WND	MIN 700MB HGT	MIN SLP MBS	700MB T/Td (°C)	EYE CHARACTERISTICS
19	072230Z	23.8N	149.1E	315-P-05	100	-	8450	-	18/-	CIRC 24 MI DIA,OPEN E & SE
20	080300Z	23.9N	149.5E	54-P-10	-	80	8420	939	18/16	CIRC 15 MI DIA,OPEN SE & WNW
21	080650Z	24.0N	150.5E	UNK-R-U	-	-	-	-	- -	---
22	081530Z	23.5N	151.2E	VW1-R-03	-	-	-	-	- -	DIA 30 MI,OPEN N
23	082245Z	23.7N	152.3E	54-P-05	75	100	8270	929	19/19	CIRC 25 MI DIA,OPEN N, S&W
24	090345Z	24.3N	153.4E	54-P-02	100	115	8300	931	19/19	CIRC 25 MI DIA,OPEN NW
25	090940Z	24.6N	154.2E	VW1-R-05	-	-	-	-	- -	CIRC 25 MI DIA,OPEN N SEMICIRC
26	091600Z	25.8N	155.0E	VW1-R-05	-	-	-	-	- -	DIA 24 MI,OPEN N&W
27	092145Z	26.9N	156.6E	54-P-03	-	60	8560	945	16/16	CIRC 12 MI DIA
28	101000Z	30.5N	159.2E	VW1-R-U	-	-	-	-	- -	DIA 30 MI,OPEN W
29	101715Z	34.3N	160.6E	SHIP-R-U	-	-	-	-	- -	---
30	102230Z	34.5N	162.5E	54-P-06	60	80	8820	953	12/12	NO EYE
31	110920Z	37.5N	167.5E	VW1-P-30	-	-	-	-	- -	VERY POORLY DEFINED

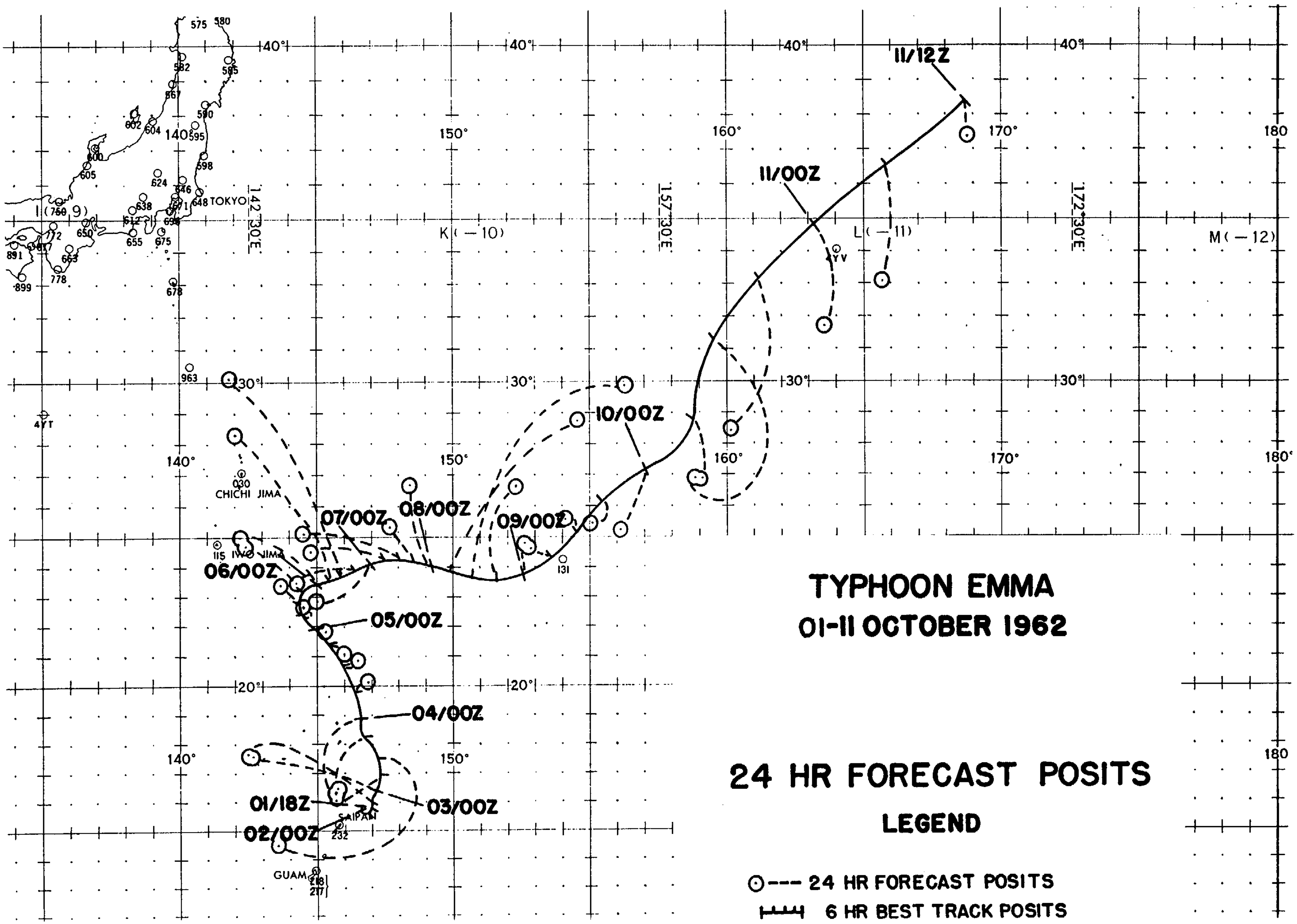
TYPHOON EMMA 01-11 OCT 1962
POSITION AND FORECAST VERIFICATION DATA

DTG	STORM POSITION LAT.	STORM POSITION LONG.	24 HR. ERROR DEG. DISTANCE	48 HR. ERROR DEG. DISTANCE
011800Z	15.8N	146.6E	------	------
020000Z	15.6N	146.6E	------	------
020600Z	15.6N	146.8E	------	------
021200Z	15.7N	146.9E	------	------
021800Z	15.9N	146.9E	291-275	------
030000Z	16.3N	147.1E	286-263	------
030600Z	16.9N	147.2E	250-160	------
031200Z	17.5N	147.0E	228-276	------
031800Z	18.2N	146.6E	205-115	277-475
040000Z	18.9N	146.6E	197-175	268-410
040600Z	19.8N	146.3E	042-40	234-243
041200Z	20.7N	145.8E	076-40	218-440
041800Z	21.4N	145.3E	120-45	211-277
050000Z	21.9N	144.9E	116-23	202-325
050600Z	22.4N	144.4E	141-20	360-108
051200Z	22.8N	144.2E	132-35	029-65
051800Z	23.2N	144.5E	307-143	344-65
060000Z	23.4N	144.9E	303-180	328-120
060600Z	23.6N	145.3E	320-330	310-247
061200Z	23.7N	145.8E	331-435	330-285
061800Z	23.9N	146.4E	250-115	310-410
070000Z	24.1N	146.9E	236-124	309-445
070600Z	24.2N	147.4E	279-147	343-590
071200Z	24.2N	148.0E	287-200	349-650
071800Z	24.1N	148.5E	325-85	296-295
080000Z	24.0N	149.2E	343-160	290-278
080600Z	23.8N	149.8E	042-380	309-418
081200Z	23.7N	150.6E	040-470	064-695
081800Z	23.6N	151.6E	010-187	335-290

TYPHOON EMMA 01-11 OCT 1962
POSITION AND FORECAST VERIFICATION DATA (CONT'D)

DTG	STORM POSITION LAT.	LONG.	24 HR. ERROR DEG. DISTANCE	48 HR. ERROR DEG. DISTANCE
090000Z	23.7N	152.5E	007-64	354-378
090600Z	24.3N	153.5E	296-52	058-765
091200Z	25.1N	154.6E	317-35	041-1120
091800Z	26.2N	155.3E	198-50	018-265
100000Z	27.2N	157.0E	202-130	034-70
100600Z	28.8N	158.8E	176-115	237-163
101200Z	31.4N	159.5E	188-268	200-185
101800Z	33.2N	161.1E	180-280	195-280
110000Z	34.9N	163.1E	178-192	192-423
110600Z	36.5N	165.8E	180-207	180-370
111200Z	38.4N	168.7E	182-63	198-510

AVERAGE 24 HOUR ERROR 163.3 MI
AVERAGE 48 HOUR ERROR 364.4 MI


TYPHOON EMMA
01-11 OCTOBER 1962
24 HR FORECAST POSITS
LEGEND
24 HR FORECAST POSITS
6 HR BEST TRACK POSITS
11/12Z
11/00Z
10/00Z
09/00Z
08/00Z
07/00Z
06/00Z
05/00Z
04/00Z
03/00Z
01/18Z
02/00Z
TOKYO
CHICHI JIMA
IWO JIMA
SAIPAN
GUAM
K(-10)
L(-11)
M(-12)
I(7.9)
142°30'E
157°30'E
172°30'E
140°
150°
160°
170°
180
40°
30°
20°

TYPHOON FREDA - 030600Z-100000Z OCTOBER 1962

I. DATA

A. Statistics

1. Calendar days of tropical warning - 6 3/4
2. Calendar days of typhoon intensity-5 1/4
3. Total distance traveled during tropical warning period - 1380 MI

B. Characteristics as a typhoon

1. Min observed SLP - 948mb, 052100Z
2. Min observed 850mb height - 3435 ft, 052100Z
3. Min observed 700mb height - 8730 ft, 052100Z
4. Max vertical development - 30,000 ft, 051200Z

II. DEVELOPMENT

A. Initial impetus - Outdraft formed in divergent field of the MPT and moved W over the junction of the easterly wave and the ITC.

B. Initial surface vortex

1. Junction vortex at 280000Z
2. Surface pressure less than 1009mb
3. Maximum surface wind - 10 kts

C. Zenith flow at 200mb

1. Relative position surface vortex - SE quadrant of anticyclone
2. Wind velocity over vortex - 010/07 kts

III. STEERING

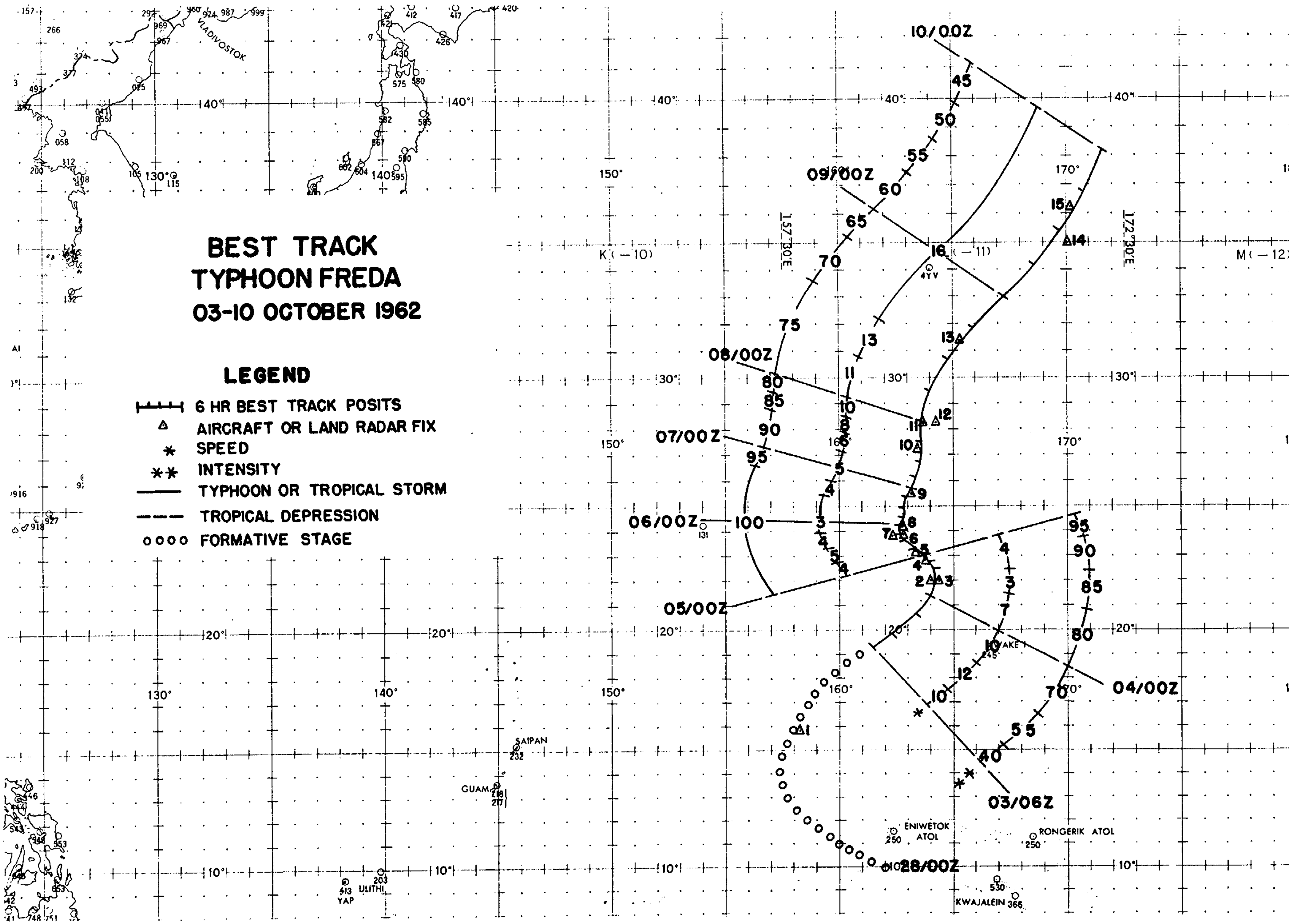
A. Prior to recurvature - 500mb
B. During recurvature - 500mb
C. After recurvature - 500mb

IV. DISSIPATION

A. Causative factor - Cold air
B. Final disposition - Extratropical

V. DAMAGE - No reports received

VI. ADDITIONAL NOTES - FREDA as an extratropical storm hit the West Coast of the United States.



BEST TRACK
TYPHOON FREDA
03-10 OCTOBER 1962
LEGEND
6 HR BEST TRACK POSITS
AIRCRAFT OR LAND RADAR FIX
SPEED
INTENSITY
TYPHOON OR TROPICAL STORM
TROPICAL DEPRESSION
FORMATIVE STAGE
10/00Z
09/00Z
08/00Z
07/00Z
06/00Z
05/00Z
04/00Z
03/06Z
28/00Z
VLADIVOSTOK
SAIPAN
GUAM
ULITHI
YAP
WAKE
ENIWETOK ATOL
RONGERIK ATOL
KWAJALEIN
K(−10)
M(−12)
157°30'E
172°30'E

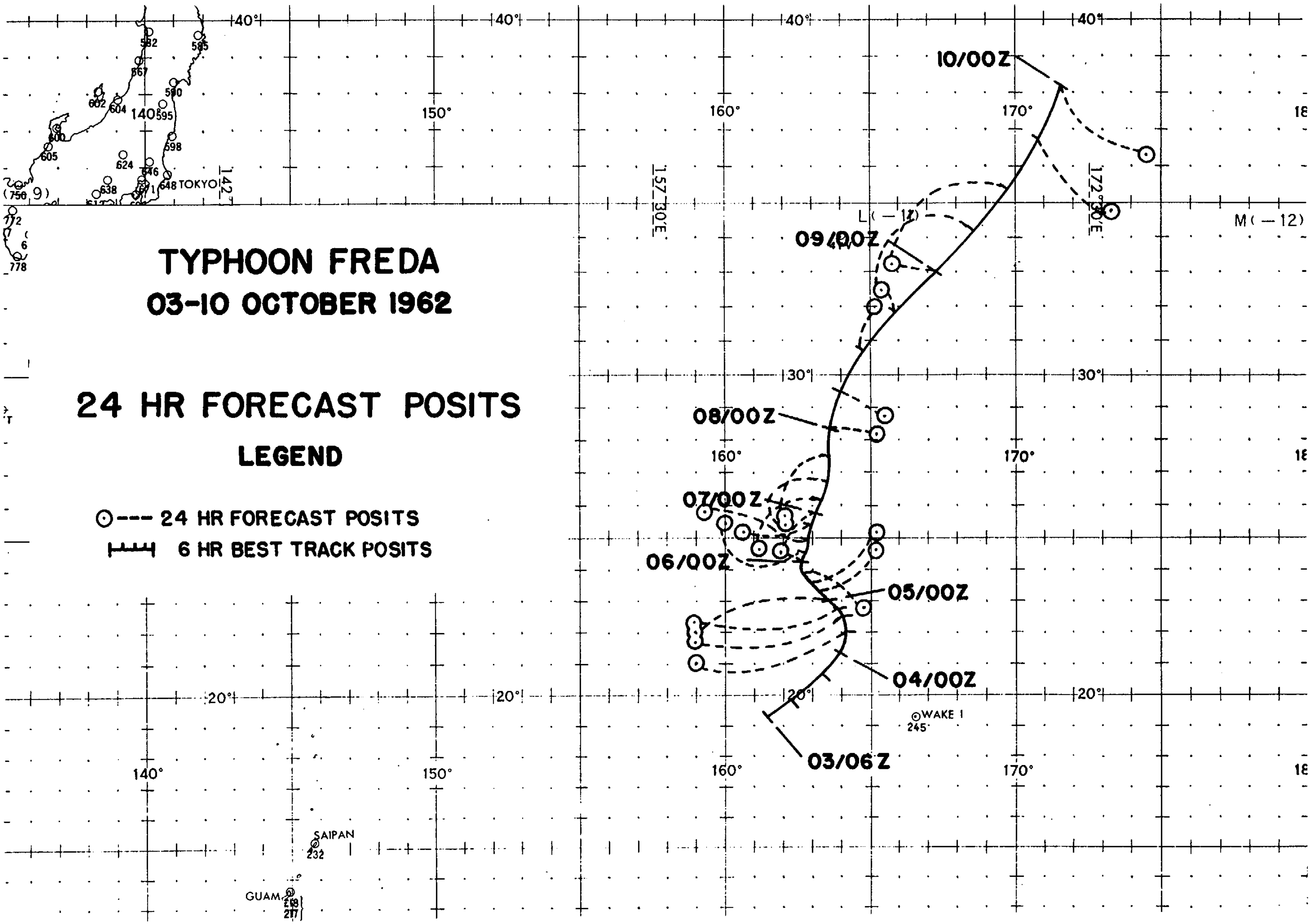
LAND RADAR AND AIRCRAFT FIXES - TYPHOON FREDA

FIX NO.	TIME	LAT.	LONG.	UNIT METHOD & ACCY	MAX SFC WND	MAX 700MB WND	MIN 700MB HGT	MIN SLP MBS	700MB T/Td (°C)	EYE CHARACTERISTICS
1	010706Z	15.8N	158.2E	54-P-05	15	-	-	1003	- -	NO CLD CENTER
2	040319Z	22.0N	164.0E	54-P-05	80	65	9360	-	17/14	DIA 30 MI, WALL CLDS ALL QUADS
3	041600Z	22.0N	164.3E	VW1-R-03	-	-	-	-	- -	CIRC 27 MI DIA
4	042115Z	22.9N	163.9E	54-P-08	45	60	9140	960	13/12	25 MI DIA
5	050300Z	23.2N	163.4E	54-P-05	60	80	8880	953	19/13	CIRC 15 MI DIA, OPEN E
6	051530Z	23.8N	162.8E	VW1-R-05	-	-	-	-	- -	CIRC 18 MI DIA
7	052100Z	23.8N	162.4E	54-P-02	60	80	8730	948	21/13	CIRC 25 MI DIA
8	060930Z	24.2N	162.8E	VW1-R-10	-	-	-	-	- -	CIRC 13 MI DIA, OPEN N
9	062142Z	25.5N	163.1E	54-P-07	50	67	8970	958	17/11	CIRC 15 MI DIA
10	071500Z	27.3N	163.5E	VW1-R-10	-	-	-	-	- -	ELLIP 50 MI E-W & 35 MI N-S
11	072145Z	28.1N	163.7E	54-P-07	65	65	9310	969	17/13	ELLIP 50 MI, OPEN SW & NW
12	080330Z	28.2N	164.3E	54-P-12	75	65	9330	-	17/15	CIRC 30 MI DIA, OPEN N
13	081515Z	31.3N	165.3E	VW1-R-20	-	-	-	-	- -	LGE CNTR POORLY DEFINED
14	091230Z	35.0N	170.0E	VW1-R-U	-	-	-	-	- -	RDR EYE VERY POOR
15	091500Z	36.3N	170.1E	VW1-P-30	-	-	9770	-	12/-	RDR EYE VERY POOR

TYPHOON FREDA 03-10 OCT 1962
POSITION AND FORECAST VERIFICATION DATA

DTG	STORM POSITION LAT.	LONG.	24 HR. ERROR DEG. DISTANCE	48 HR. ERROR DEG. DISTANCE
030600Z	19.3N	161.4E	------	------
031200Z	19.9N	162.3E	------	------
031800Z	20.6N	163.4E	------	------
040000Z	21.4N	164.0E	------	------
040600Z	22.1N	164.1E	------	------
041200Z	22.4N	164.1E	------	------
041800Z	22.7N	163.9E	------	------
050000Z	23.0N	163.6E	257-264	------
050600Z	23.3N	163.3E	049-130	------
051200Z	23.6N	162.9E	054-148	------
051800Z	23.9N	162.7E	121-130	------
060000Z	24.3N	162.7E	304-47	281-260
060600Z	24.5N	162.8E	293-159	047-192
061200Z	24.9N	162.9E	286-195	044-185
061800Z	25.3N	163.0E	268-131	107-118
070000Z	25.7N	163.2E	204-121	276-240
070600Z	26.2N	163.4E	238-137	278-461
071200Z	26.7N	163.6E	218-123	279-479
071800Z	27.5N	163.7E	222-140	259-365
080000Z	28.4N	163.7E	104-80	233-274
080600Z	29.5N	164.0E	123-92	244-410
081200Z	30.7N	164.8E	016-84	228-179
081800Z	31.8N	165.9E	327-45	232-217
090000Z	33.0N	167.3E	273-70	134-151
090600Z	34.2N	168.6E	237-186	109-255
091200Z	35.4N	169.8E	237-239	026-328
091800Z	36.8N	170.8E	133-170	023-244
100000Z	38.2N	171.7E	131-177	027-200

AVERAGE 24 HOUR ERROR 136.6 MI
AVERAGE 48 HOUR ERROR 268.1 MI


TYPHOON FREDA
03-10 OCTOBER 1962
24 HR FORECAST POSITS
LEGEND
24 HR FORECAST POSITS
6 HR BEST TRACK POSITS
10/00Z
09/00Z
08/00Z
07/00Z
06/00Z
05/00Z
04/00Z
03/06Z
L(−12)
M(−12)
TOKYO
WAKE I
SAIPAN
GUAM
157°30'E
172°30'E
142°
40°
30°
20°
140°
150°
160°
170°

TYPHOON GILDA - 190600Z-301800Z OCTOBER 1962

I. DATA

A. Statistics

1. Calendar days of tropical warning - 11½
2. Calendar days of typhoon intensity - 7¼
3. Total distance traveled during tropical warning period - 2706 MI

B. Characteristics as a typhoon

1. Min observed SLP - 933mb, 280200Z
2. Min observed 850mb height - 3275 ft, 280200Z
3. Min observed 700mb height - 8700 ft, 270040Z
4. Max vertical development - 30,000 ft, 271200Z

II. DEVELOPMENT

A. Initial impetus - Surge in easterlies combined with flow from Southern Hemisphere outdraft.

B. Initial surface vortex

1. Junction vortex at 180600Z
2. Surface pressure less than 1004mb
3. Maximum surface wind - 10 kts

C. Zenith flow at 200mb

1. Relative position surface vortex - NE quadrant of Southern Hemisphere anticyclone
2. Wind velocity over vortex - 140/19 kts

III. STEERING

A. Prior to recurvature - 500mb

B. During recurvature - 500mb

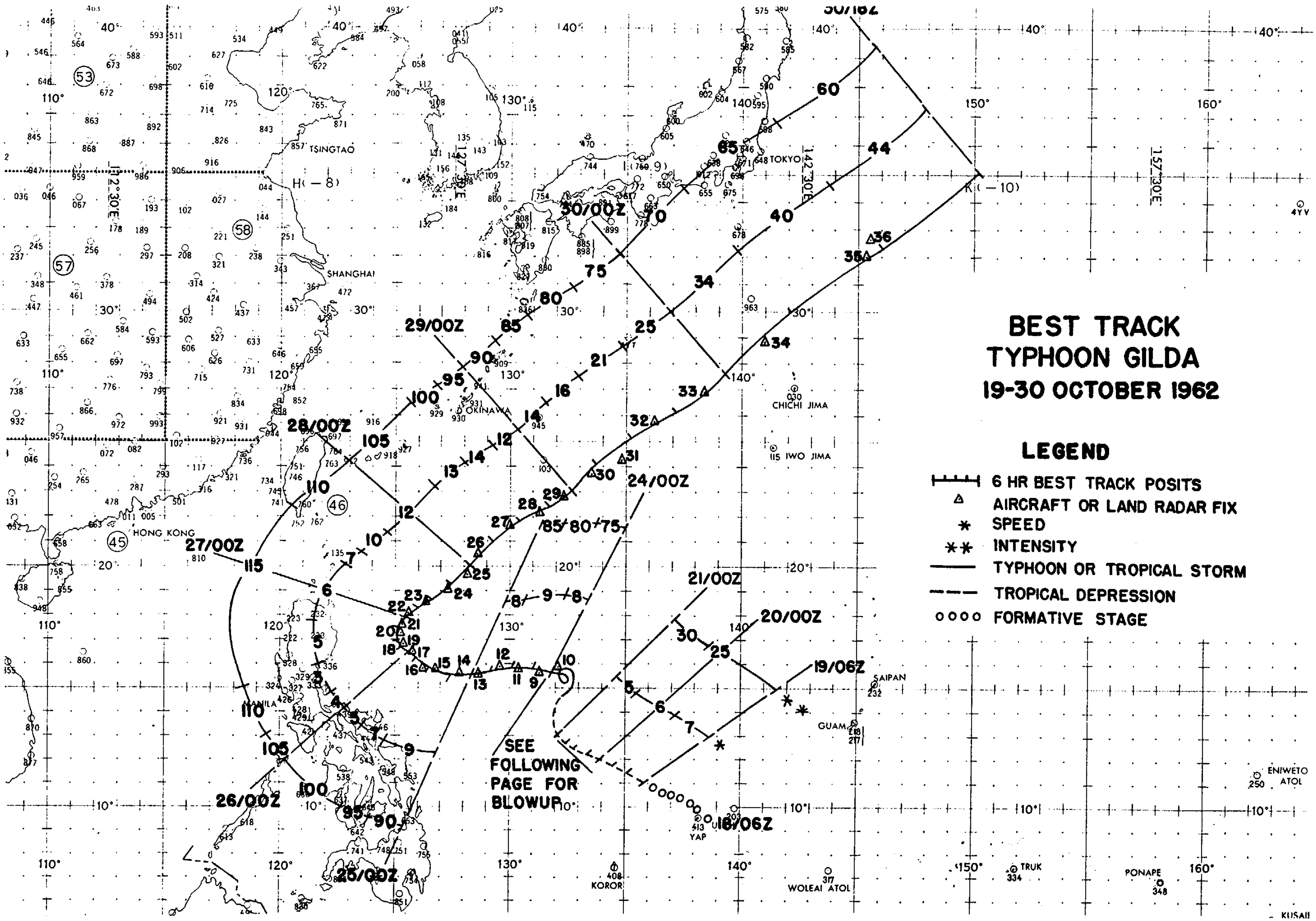
C. After recurvature - 500mb

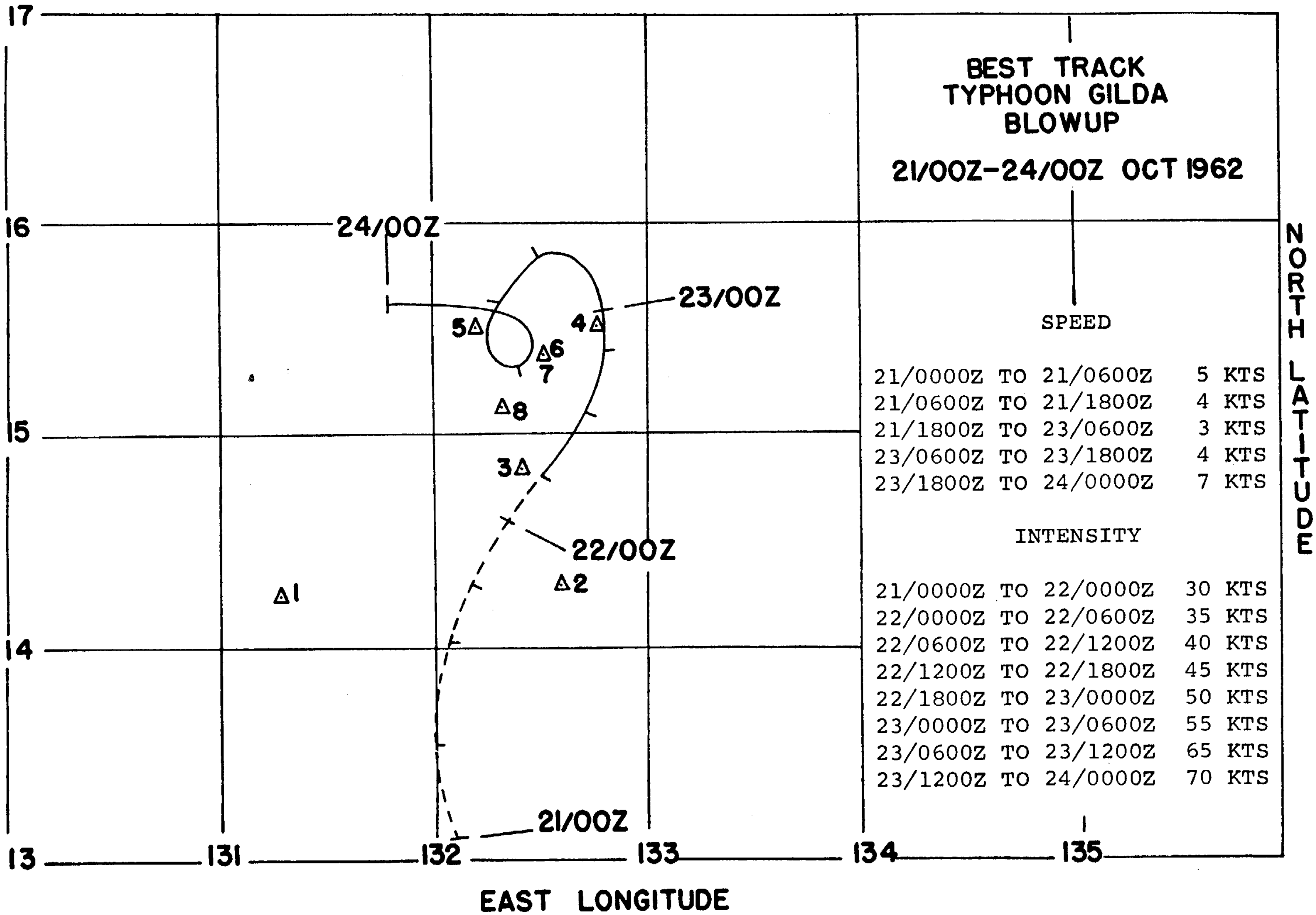
IV. DISSIPATION

A. Causative factor - Cold air

B. Final disposition - Extratropical

V. DAMAGE - No reports received


BEST TRACK
TYPHOON GILDA
19-30 OCTOBER 1962
LEGEND
6 HR BEST TRACK POSITS
AIRCRAFT OR LAND RADAR FIX
SPEED
INTENSITY
TYPHOON OR TROPICAL STORM
TROPICAL DEPRESSION
FORMATIVE STAGE
SEE FOLLOWING PAGE FOR BLOWUP
30/00Z
29/00Z
28/00Z
27/00Z
26/00Z
25/00Z
24/00Z
21/00Z
20/00Z
19/06Z
18/06Z
TOKYO
TSINGTAO
SHANGHAI
HONG KONG
MANILA
OKINAWA
CHICHI JIMA
IWO JIMA
SAIPAN
GUAM
YAP
KOROR
WOLEAI ATOL
TRUK
PONAPE
ENIWETO ATOL
KUSAII



BEST TRACK
TYPHOON GILDA
BLOWUP
21/00Z-24/00Z OCT 1962
SPEED
21/0000Z TO 21/0600Z 5 KTS
21/0600Z TO 21/1800Z 4 KTS
21/1800Z TO 23/0600Z 3 KTS
23/0600Z TO 23/1800Z 4 KTS
23/1800Z TO 24/0000Z 7 KTS
INTENSITY
21/0000Z TO 22/0000Z 30 KTS
22/0000Z TO 22/0600Z 35 KTS
22/0600Z TO 22/1200Z 40 KTS
22/1200Z TO 22/1800Z 45 KTS
22/1800Z TO 23/0000Z 50 KTS
23/0000Z TO 23/0600Z 55 KTS
23/0600Z TO 23/1200Z 65 KTS
23/1200Z TO 24/0000Z 70 KTS
24/00Z
23/00Z
22/00Z
21/00Z
1
2
3
4
5
6
7
8
17
16
15
14
13
131
132
133
134
135
EAST LONGITUDE
NORTH LATITUDE

LAND RADAR AND AIRCRAFT FIXES - TYPHOON GILDA

FIX NO.	TIME	LAT.	LONG	UNIT METHOD & ACCY	MAX SFC WND	MAX 700MB WND	MIN 700MB HGT	MIN SLP MBS	700MB T/Td (^{o}C)	EYE CHARACTERISTICS
1	210245Z	14.2N	131.3E	54-T-05	25	-	-	998	- -	30 MI DIA
2	212200Z	14.2N	132.6E	54-P-U	25	-	-	998	- -	120 MI DIA, NO WALL CLDS
3	220355Z	14.8N	132.4E	54-P-05	40	45	9880	995	12/12	CIRC 10 MI DIA
4	222210Z	15.5N	132.8E	54-P-03	55	50	9890	992	15/08	CIRC 20 MI DIA, OPEN E & N
5	230330Z	15.5N	132.2E	54-P-03	65	60	9760	985	18/10	CIRC
6	231037Z	15.4N	132.4E	VW1-R-05	-	-	-	-	- -	CIRC 15 MI DIA, POORLY DEFINED
7	231534Z	15.4N	132.5E	VW1-R-02	-	-	-	-	- -	VERY DIFFUSE
8	232200Z	15.1N	132.3E	54-P-05	55	60	9740	983	18/07	POORLY DEFINED, OPEN NE & NW
9	240340Z	15.7N	131.4E	54-P-07	50	50	9720	983	20/08	NO WALL CLDS
10	240400Z	15.8N	132.1E	54-P-U	85	-	9820	981	14/-	CIRC 8 MI DIA
11	240950Z	15.8N	130.4E	VW1-R-05	-	-	-	-	- -	45 MI NE-SW & 22 MI NW-SE
12	241530Z	15.9N	129.6E	VW1-R-03	-	-	-	-	- -	CIRC 46 MI DIA
13	242210Z	15.5N	128.6E	54-P-02	75	65	9380	971	18/13	DIA 40 MI
14	250350Z	15.5N	127.8E	54-P-03	90	75	9200	966	16/12	DIA 40 MI
15	251000Z	15.7N	126.8E	VW1-R-05	-	-	-	-	- -	CIRC 30 MI DIA
16	251600Z	15.8N	126.2E	VW1-R-03	-	-	-	-	- -	CIRC 26 MI DIA

LAND RADAR AND AIRCRAFT FIXES - TYPHOON GILDA (CONT'D)

FIX NO.	TIME	LAT.	LONG.	UNIT METHOD & ACCY	MAX SFC WND	MAX 700MB WND	MIN 700MB HGT	MIN SLP MBS	700MB T/Td (°C)	EYE CHARACTERISTICS
17	252200Z	16.5N	125.8E	54-P-02	75	70	8890	958	15/14	30 MI DIA
18	260330Z	16.8N	125.4E	54-P-02	85	90	8840	942	15/13	40 MI DIA
19	261000Z	16.9N	125.2E	VW1-R-03	-	-	-	-	- -	CIRC 45 MI DIA
20	261600Z	17.4N	125.3E	VW1-R-03	-	-	-	-	- -	CIRC 41 MI DIA
21	262145Z	17.6N	125.3E	54-P-05	-	95	8710	956	14/13	CIRC 36 MI DIA
22	270040Z	18.0N	125.6E	54-P-05	65	95	8700	956	14/12	CIRC 36 MI DIA
23	271000Z	18.5N	126.4E	VW1-R-03	-	-	-	-	- -	CIRC 35 MI DIA
24	271600Z	19.1N	127.2E	VW1-R-03	-	-	-	-	- -	CIRC 35 MI DIA
25	272130Z	19.7N	128.1E	54-P-03	95	-	8850	949	18/17	CIRC 40 MI DIA
26	280200Z	20.4N	128.6E	54-P-02	75	90	8870	933	20/15	CIRC 40 MI DIA
27	281000Z	21.6N	130.0E	VW1-R-05	-	-	-	-	- -	DIA 40 MI, OPEN S-W
28	281530Z	22.2N	131.2E	VW1-R-05	-	-	-	-	- -	DIA 48 MI, OPEN S-W
29	282200Z	22.8N	132.4E	54-P-05	85	95	9130	962	24/08	CIRC 60 MI DIA
30	290400Z	23.7N	133.5E	54-P-04	85	72	9200	966	20/16	CIRC 60 MI DIA, OPEN W & N
31	290910Z	24.2N	134.9E	VW1-R-05	-	-	-	-	- -	CIRC 28 MI DIA, OPEN SW
32	291500Z	25.7N	136.1E	VW1-R-05	-	-	-	-	- -	DIA 38 MI, OPEN E, S & SW
33	292130Z	26.9N	138.4E	54-P-05	110	80	9200	969	13/13	WEAK WALL CLDS
34	300330Z	28.9N	141.0E	54-P-03	90	60	9440	-	18/12	OVAL 25 MI NE-SW
35	301100Z	32.0N	145.4E	VW1-P-U	-	-	-	-	- -	VERY DIFFUSE
36	301545Z	32.7N	145.5E	VW1-P-25	-	-	-	-	- -	VERY DIFFUSE

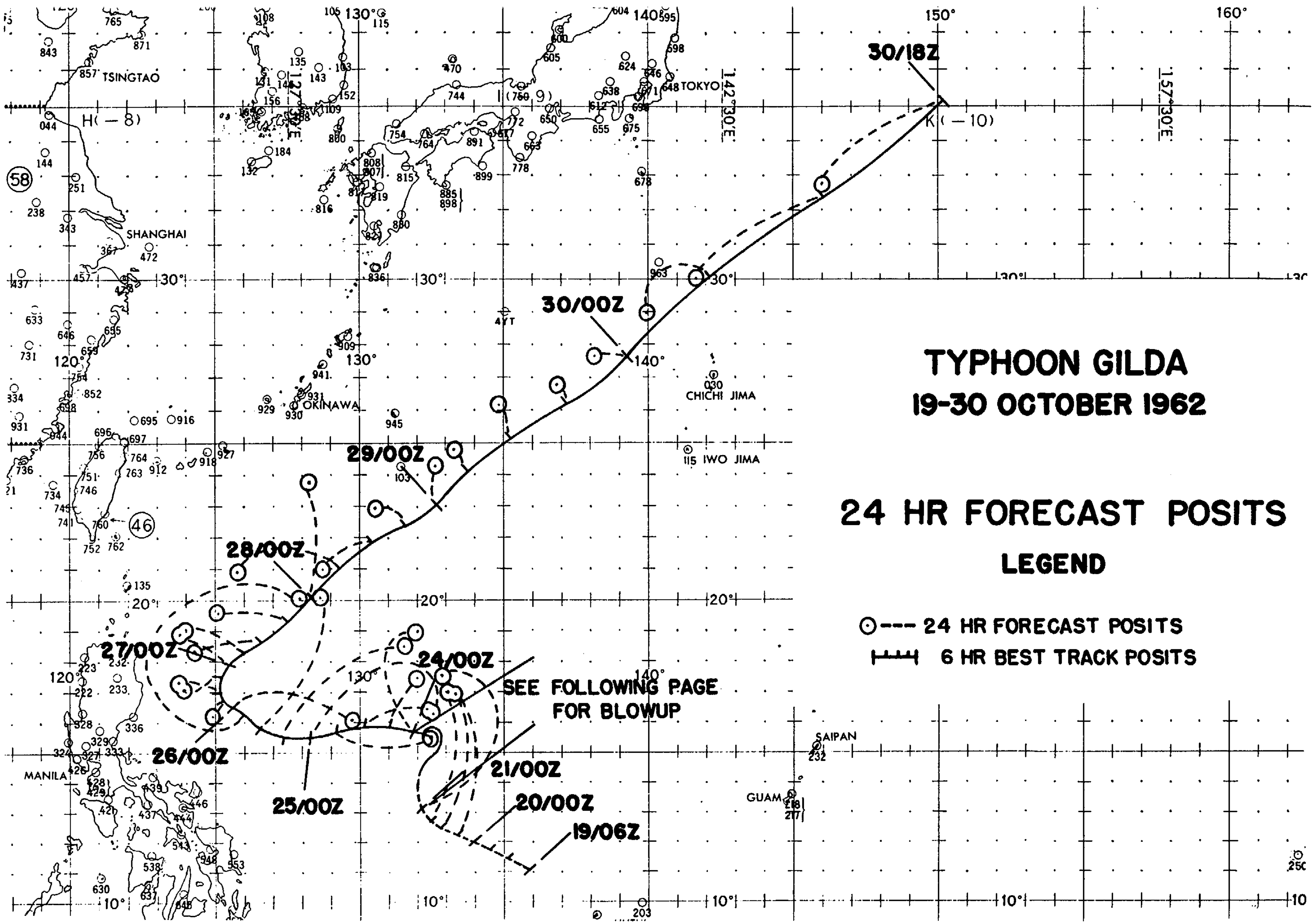
TYPHOON GILDA 19-30 OCT 1962
POSITION AND FORECAST VERIFICATION DATA

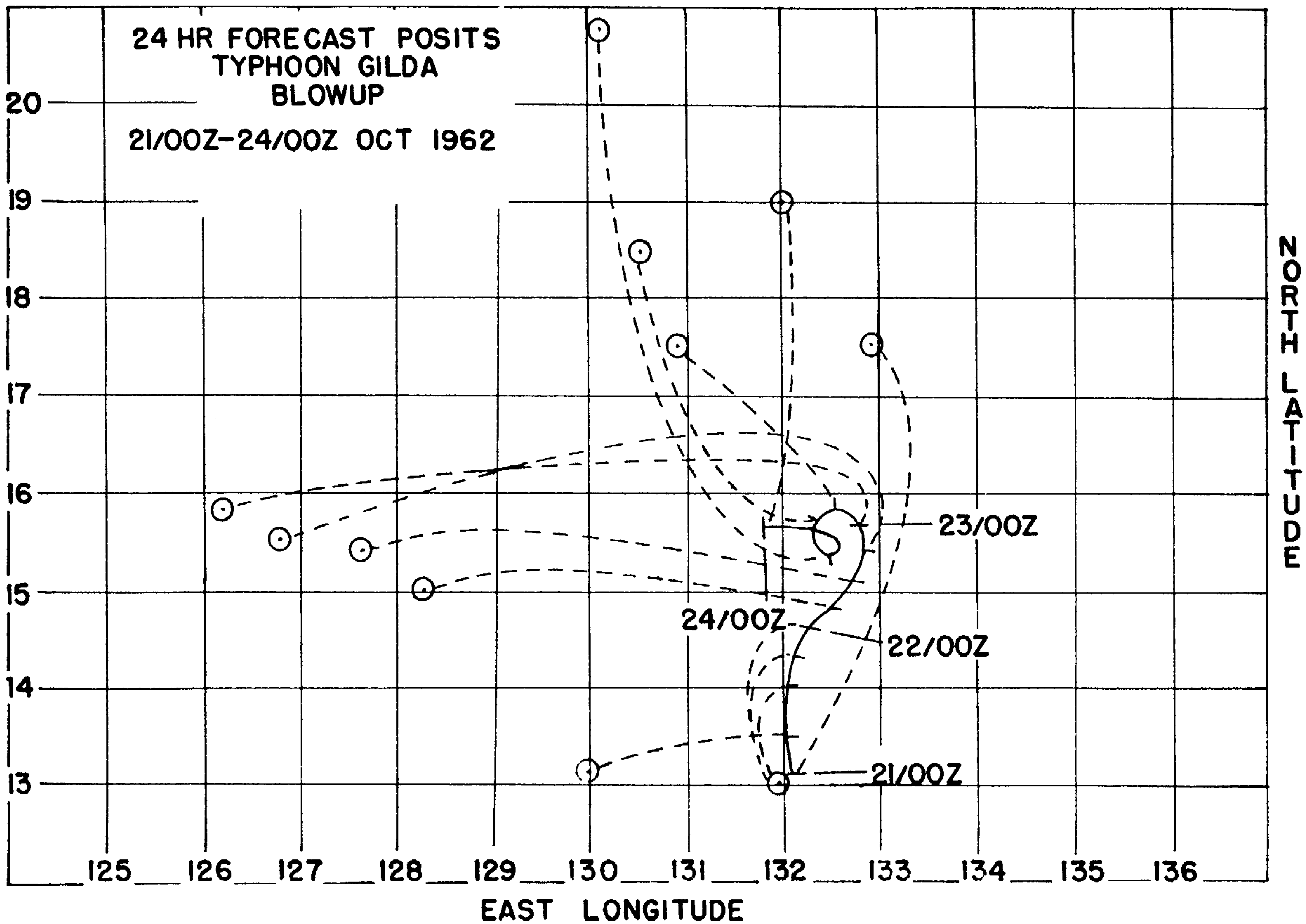
DTG	STORM POSITION LAT.	LONG.	24 HR. ERROR DEG. DISTANCE	48 HR. ERROR DEG. DISTANCE
190600Z	11.1N	135.8E	------	------
191200Z	11.4N	135.1E	------	------
191800Z	11.7N	134.5E	------	------
200000Z	12.0N	133.9E	------	------
200600Z	12.2N	133.4E	------	------
201200Z	12.4N	132.8E	------	------
201800Z	12.7N	132.4E	------	------
210000Z	13.1N	132.1E	------	------
210600Z	13.5N	132.0E	------	------
211200Z	14.0N	132.0E	------	------
211800Z	14.3N	132.2E	------	------
220000Z	14.6N	132.3E	------	------
220600Z	14.8N	132.5E	------	------
221200Z	15.1N	132.7E	------	------
221800Z	15.4N	132.8E	------	------
230000Z	15.6N	132.8E	------	------
230600Z	15.8N	132.5E	318-137	------
231200Z	15.6N	132.3E	330-193	------
231800Z	15.3N	132.4E	339-347	------
240000Z	15.6N	131.8E	003-204	------
240600Z	15.8N	131.0E	031-113	354-377
241200Z	15.8N	130.1E	072-132	005-470
241800Z	15.6N	129.2E	092-190	022-723
250000Z	15.5N	128.4E	078-242	029-525
250600Z	15.5N	127.4E	053-293	035-480
251200Z	15.8N	126.5E	026-294	056-405
251800Z	16.3N	126.0E	027-264	076-383
260000Z	16.5N	125.6E	098-244	063-457
260600Z	16.8N	125.3E	216-44	046-524
261200Z	17.0N	125.2E	282-83	035-655
261800Z	17.5N	125.2E	250-77	036-576

TYPHOON GILDA 19-30 OCT 1962 (CONT'D)
POSITION AND FORECAST VERIFICATION DATA

DTG	STORM POSITION LAT.	LONG.	24 HR. ERROR DEG. DISTANCE	48 HR. ERROR DEG. DISTANCE
270000Z	17.9N	125.6E	298-113	073-235
270600Z	18.3N	126.0E	291-122	300-230
271200Z	18.6N	126.6E	265-135	279-218
271800Z	19.3N	127.5E	277-137	264-262
280000Z	20.1N	128.4E	360-222	278-290
280600Z	21.0N	129.3E	268-190	273-318
281200Z	21.8N	130.4E	240-96	260-380
281800Z	22.4N	131.7E	300-68	268-330
290000Z	23.0N	132.7E	360-69	281-247
290600Z	24.1N	133.8E	330-52	291-208
291200Z	25.2N	135.2E	345-65	270-95
291800Z	26.2N	137.2E	338-38	027-89
300000Z	27.6N	139.3E	270-71	019-135
300600Z	30.0N	142.2E	244-129	294-55
301200Z	32.3N	146.1E	238-270	272-63
301800Z	35.2N	150.2E	236-263	232-185

AVERAGE 24 HOUR ERROR 158.0 MI
AVERAGE 48 HOUR ERROR 330.2 MI


TYPHOON GILDA
19-30 OCTOBER 1962
24 HR FORECAST POSITS
LEGEND
24 HR FORECAST POSITS
6 HR BEST TRACK POSITS
SEE FOLLOWING PAGE
FOR BLOWUP
30/18Z
30/00Z
29/00Z
28/00Z
27/00Z
26/00Z
25/00Z
24/00Z
21/00Z
20/00Z
19/06Z
TSINGTAO
SHANGHAI
TOKYO
OKINAWA
CHICHI JIMA
IWO JIMA
MANILA
SAIPAN
GUAM


24 HR FORECAST POSITS
TYPHOON GILDA
BLOWUP
21/00Z-24/00Z OCT 1962
20
19
18
17
16
15
14
13
23/00Z
24/00Z
22/00Z
21/00Z
125
126
127
128
129
130
131
132
133
134
135
136
EAST LONGITUDE
NORTH LATITUDE

TYPHOON IVY - 280600Z-291800Z OCTOBER 1962

I. DATA

A. Statistics

1. Calendar days of tropical warning - 1½
2. Calendar days of typhoon intensity - 1
3. Total distance traveled during tropical warning period - 342 MI

B. Characteristics as a typhoon

1. Min observed SLP - 997mb, 280505Z
2. Min observed 850mb height - 4860 ft, 280505Z
3. Min observed 700mb height - 10130 ft, 280505Z
4. Max vertical development - 25,000 ft, 281200Z

II. DEVELOPMENT

A. Initial impetus - Surge from westerlies into MPT and then into the easterlies.

B. Initial surface vortex

1. Junction vortex at 260000Z
2. Surface pressure less than 1010mb
3. Maximum surface wind - 10 kts

C. Zenith flow at 200mb

1. Relative position surface vortex - SE quadrant of anticyclone
2. Wind velocity over vortex - 070/17 kts

III. STEERING

A. Prior to recurvature - NA

B. During recurvature - NA

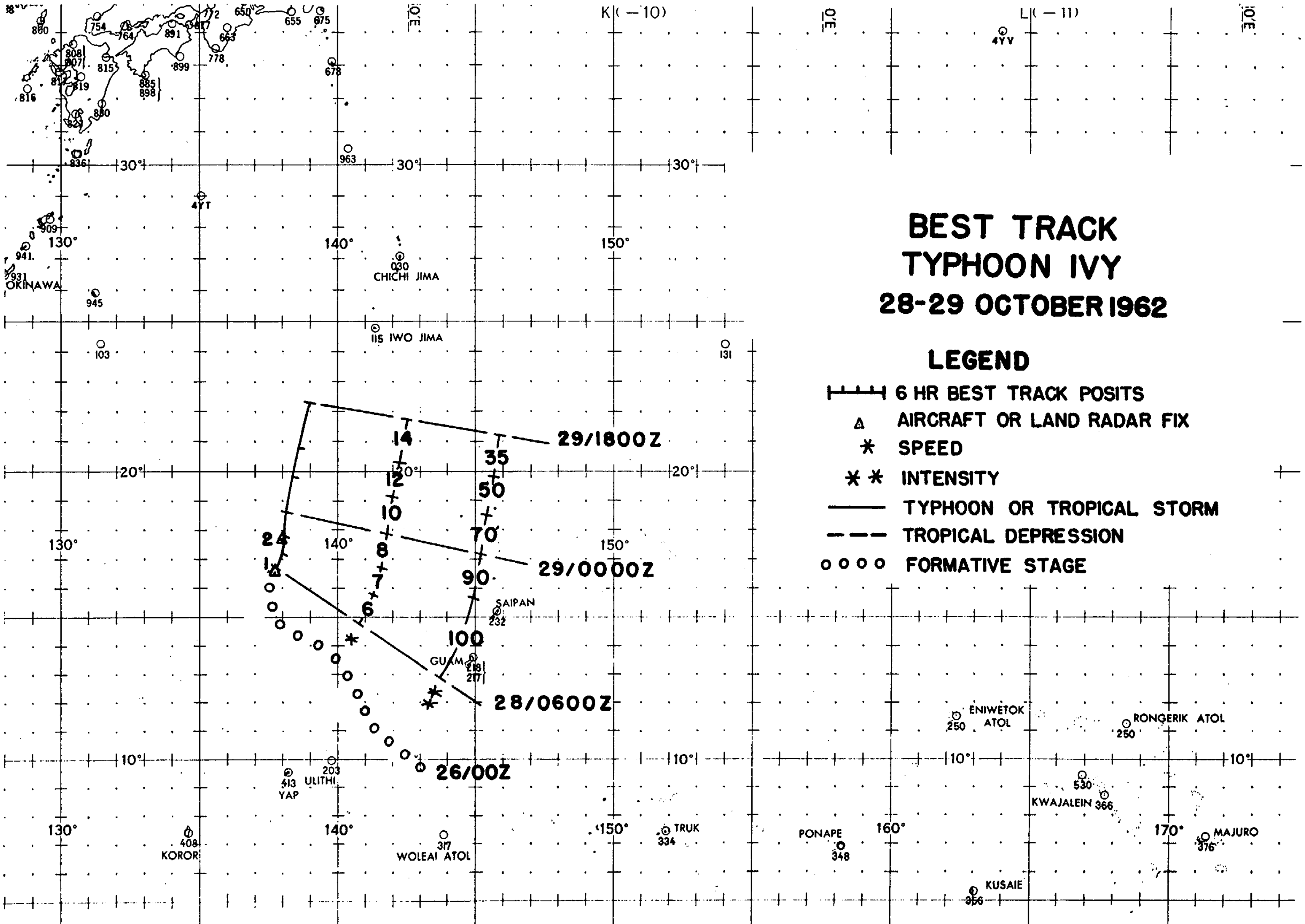
C. After recurvature - 500mb

IV. DISSIPATION

A. Causative factor - Typhoon GILDA

B. Final disposition - Absorbed by Typhoon GILDA

V. DAMAGE - No reports received


BEST TRACK
TYPHOON IVY
28-29 OCTOBER 1962
LEGEND
6 HR BEST TRACK POSITS
AIRCRAFT OR LAND RADAR FIX
SPEED
INTENSITY
TYPHOON OR TROPICAL STORM
TROPICAL DEPRESSION
FORMATIVE STAGE
29/1800Z
29/0000Z
28/0600Z
26/00Z
14
12
10
8
7
6
35
50
70
90
100
24
1
K(-10)
L(-11)
30°
20°
10°
130°
140°
150°
160°
170°
OKINAWA
CHICHI JIMA
IWO JIMA
SAIPAN
GUAM
ULITHI
YAP
KOROR
WOLEAI ATOL
TRUK
PONAPE
KUSAIE
ENIWETOK ATOL
RONGERIK ATOL
KWAJALEIN
MAJURO

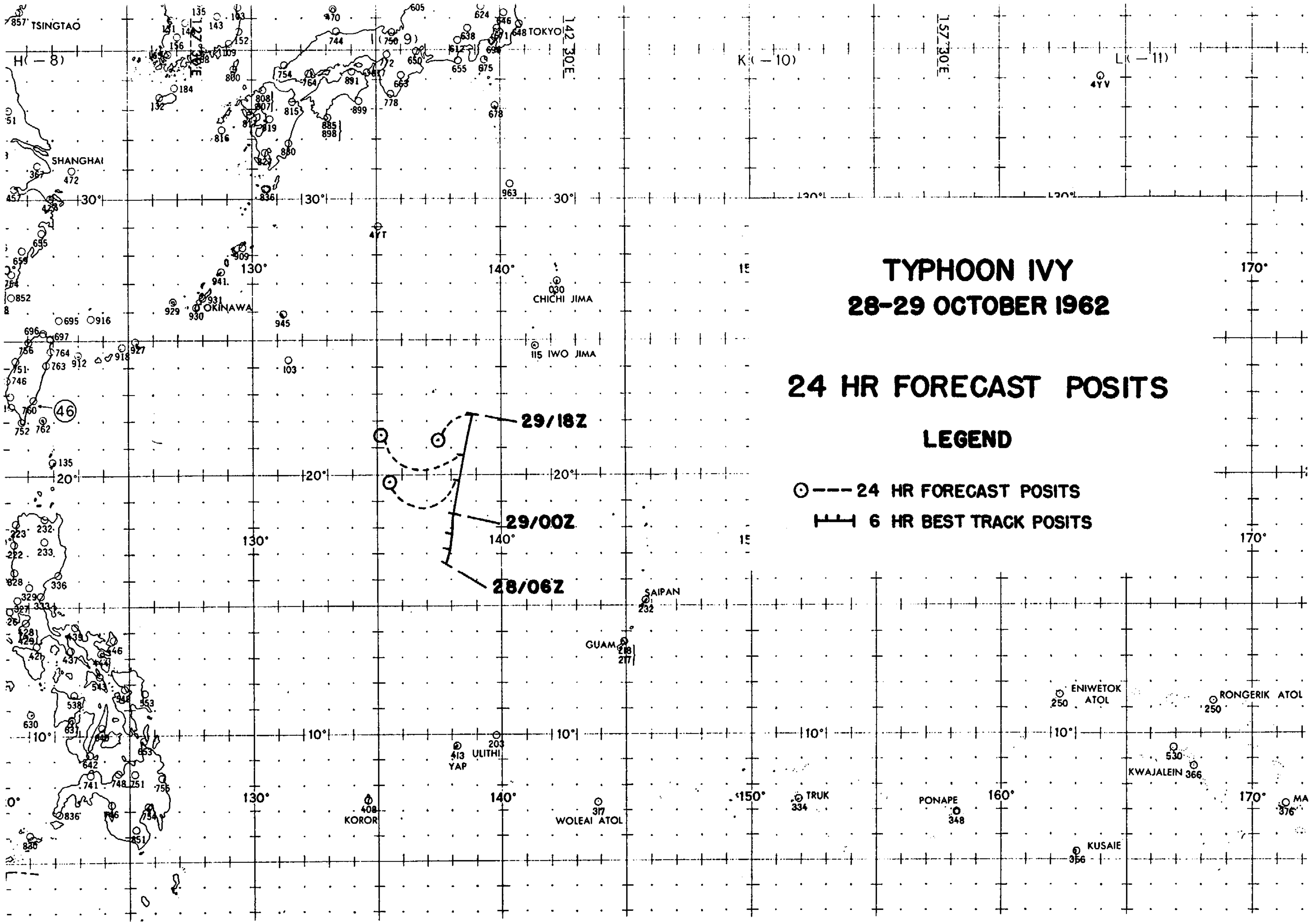
LAND RADAR AND AIRCRAFT FIXES - TYPHOON IVY

FIX NO.	TIME	LAT.	LONG.	UNIT METHOD & ACCY	MAX SFC WND	MAX 700MB WND	MIN 700MB HGT	MIN SLP MBS	700MB T/Td (°C)	EYE CHARACTERISTICS
1	280505Z	16.5N	137.7E	54-P-04	125	35	10130	997	17/10	WALL CLD S
2	281330Z	17.4N	138.0E	VW1-R-10	-	-	-	-	- -	DIFFUSE, DIA 20 MI, NO WALL CLDS

TYPHOON IVY 28-29 OCT 1962
POSITION AND FORECAST VERIFICATION DATA

DTG	STORM POSITION LAT.	STORM POSITION LONG.	24 HR. ERROR DEG. DISTANCE	48 HR. ERROR DEG. DISTANCE
280600Z	16.7N	137.7E	------	------
281200Z	17.2N	138.0E	------	------
281800Z	17.9N	138.0E	------	------
290000Z	18.7N	138.1E	------	------
290600Z	19.8N	138.3E	272-154	------
291200Z	20.9N	138.5E	281-191	------
291800Z	22.3N	138.9E	234-95	------

AVERAGE 24 HOUR ERROR 146.7 MI


TYPHOON IVY
28-29 OCTOBER 1962
24 HR FORECAST POSITS
LEGEND
24 HR FORECAST POSITS
6 HR BEST TRACK POSITS
29/18Z
29/00Z
28/06Z
TSINGTAO
TOKYO
SHANGHAI
OKINAWA
CHICHI JIMA
IWO JIMA
SAIPAN
GUAM
ULITHI
YAP
KOROR
WOLEAI ATOL
TRUK
PONAPE
KUSAIE
ENIWETOK ATOL
RONGERIK ATOL
KWAJALEIN
H(-8)
K(-10)
L(-11)
130°
140°
150°
160°
170°
30°
20°
10°

TYPHOON JEAN - 060600Z-121200Z NOVEMBER 1962

I. DATA

A. Statistics

1. Calendar days of tropical warning - 6¼
2. Calendar days of typhoon intensity - 3¼
3. Total distance traveled during tropical warning period - 948 MI

B. Characteristics as a typhoon

1. Min observed SLP - 960mb, 100515Z
2. Min observed 850mb height - 3940 ft, 100515Z
3. Min observed 700mb height - 9380 ft, 100515Z
4. Max vertical development - 25,000 ft, 100000Z

II. DEVELOPMENT

A. Initial impetus - Easterly wave and polar trough fractured after superposition.

B. Initial surface vortex

1. Junction vortex at 030000Z
2. Surface pressure less than 1008mb
3. Maximum surface wind - 15 kts

C. Zenith flow at 200mb

1. Relative position surface vortex - SE quadrant of anticyclone
2. Wind velocity over vortex - 050/25 kts

III. STEERING

A. Prior to recurvature - 500mb

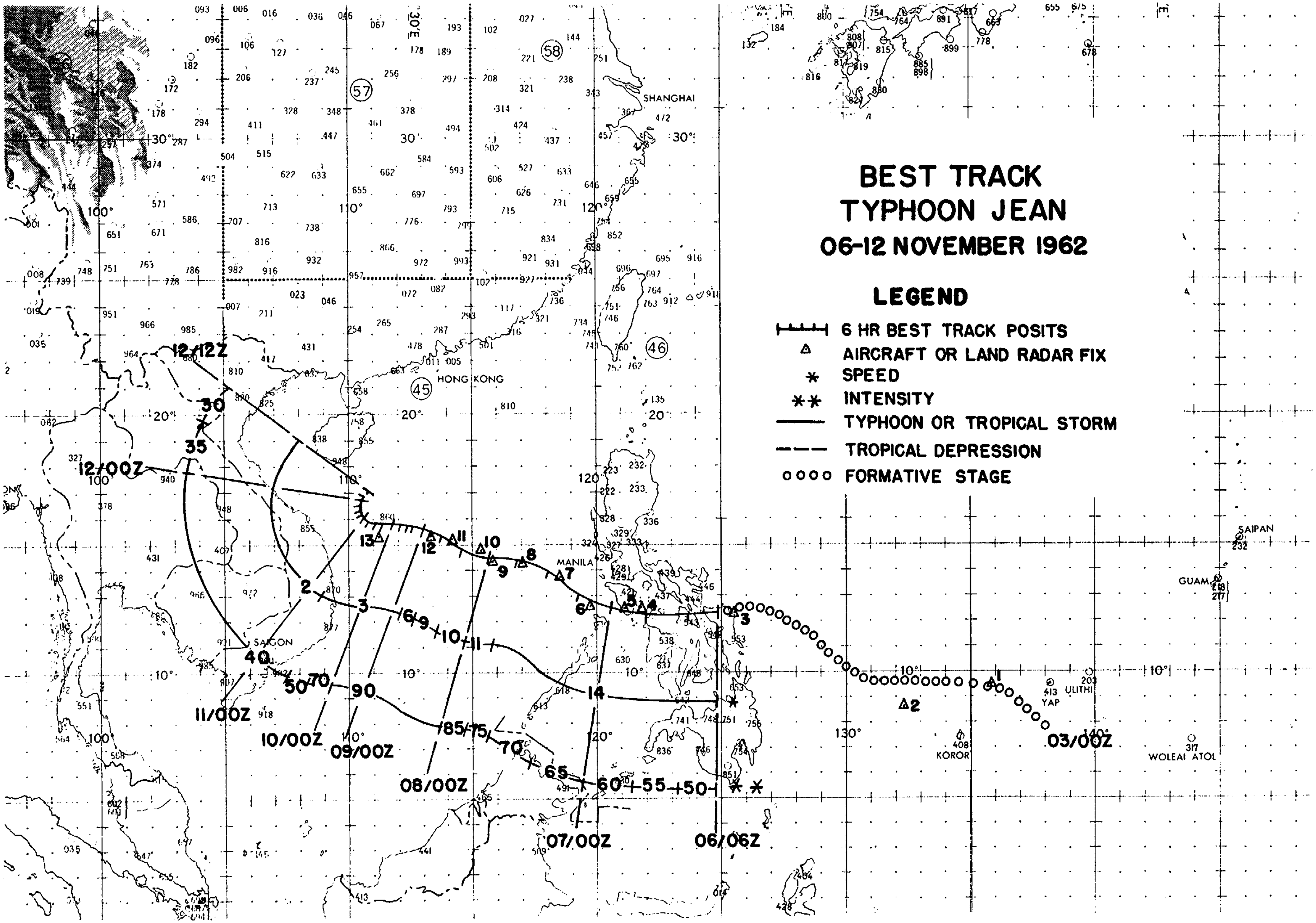
B. During and after recurvature - NA

IV. DISSIPATION

A. Causative factor - Lack of upper level divergence

B. Final disposition - Dissipated

V. DAMAGE - No damage reports received


BEST TRACK
TYPHOON JEAN
06-12 NOVEMBER 1962
LEGEND
6 HR BEST TRACK POSITS
AIRCRAFT OR LAND RADAR FIX
SPEED
INTENSITY
TYPHOON OR TROPICAL STORM
TROPICAL DEPRESSION
FORMATIVE STAGE
SHANGHAI
HONG KONG
MANILA
SAIGON
SAIPAN
GUAM
ULITHI
YAP
KOROR
WOLEAI ATOL
12/12Z
12/00Z
11/00Z
10/00Z
09/00Z
08/00Z
07/00Z
06/06Z
03/00Z

LAND RADAR AND AIRCRAFT FIXES - TYPHOON JEAN

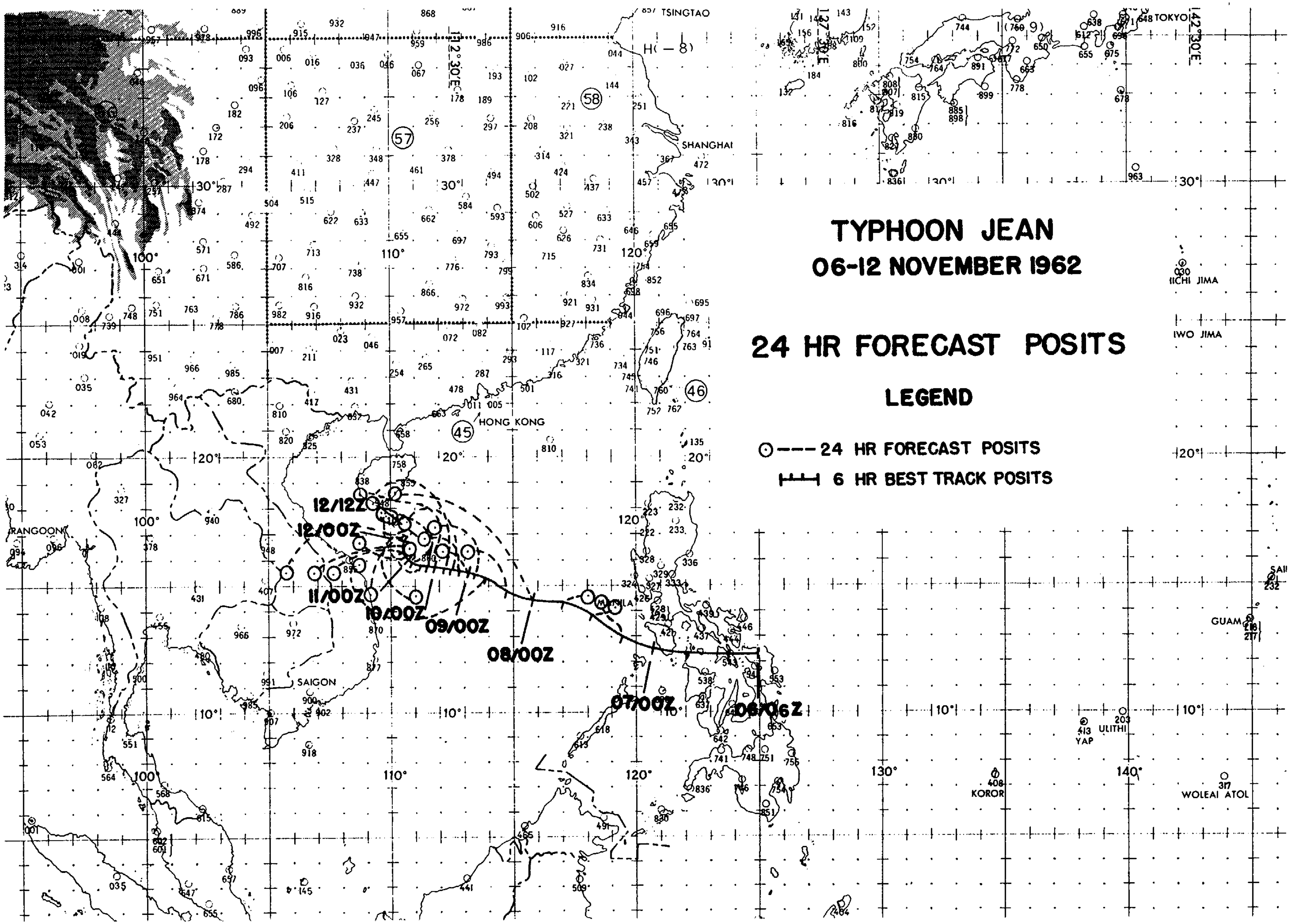
FIX NO.	TIME	LAT.	LONG.	UNIT METHOD & ACCY	MAX SFC WND	MAX 700MB WND	MIN 700MB HGT	MIN SLP MBS	700MB T/Td (^{o}C)	EYE CHARACTERISTICS
1	040450Z	09.5N	135.8E	54-P-02	25	-	-	1003	- -	---
2	050158Z	08.7N	132.2E	54-P-U	15	-	-	1006	- -	---
3	060415Z	12.3N	125.4E	54-P-03	60	30#	4465#	994	- -	WALL CLDS ALL QUADS
4	061735Z	12.5N	121.8E	VW1-R-02	-	-	-	-	- -	CIRC 16 MI DIA
5	062150Z	12.4N	121.1E	54-P-01	-	70*	-	-	00/-01*	---
6	070315Z	12.7N	119.8E	54-P-03	45	55*	19000*	984	01/01*	CIRC 30 MI DIA
7	070930Z	13.7N	118.6E	VW1-R-03	-	-	-	-	- -	CIRC 35 MI DIA
8	071530Z	14.2N	117.0E	VW1-R-03	-	-	-	-	- -	ELLIP 60 MI N-S & 40 MI E-W, OPEN NE
9	072230Z	14.3N	115.9E	54-P-03	75	75	9560	966	15/13	CIRC 12 MI DIA
10	080330Z	14.8N	115.3E	54-P-03	75	90	9480	968	15/13	CIRC 20 MI DIA
11	081000Z	15.2N	114.1E	VW1-P-05	80	-	-	988	- -	CIRC 40 MI DIA, OPEN E
12	081530Z	15.4N	113.4E	VW1-R-03	-	-	-	-	- -	CIRC 45 MI DIA, OPEN NE
13	100515Z	15.4N	111.1E	54-P-05	45	80	9380	960	15/11	CIRC 20 MI DIA, OPEN E & S

\# 850MB DATA
* 500MB DATA

TYPHOON JEAN 06-12 NOV 1962
POSITION AND FORECAST VERIFICATION DATA

DTG	STORM POSITION LAT.	LONG.	24 HR. ERROR DEG. DISTANCE	48 HR. ERROR DEG. DISTANCE
060600Z	12.3N	124.9E	------	------
061200Z	12.3N	123.5E	------	------
061800Z	12.3N	122.0E	------	------
070000Z	12.5N	120.6E	------	------
070600Z	13.1N	119.3E	335-85	------
071200Z	14.0N	118.1E	082-57	------
071800Z	14.3N	116.8E	078-74	------
080000Z	14.4N	115.6E	308-400	------
080600Z	14.8N	114.7E	319-85	328-318
081200Z	15.3N	113.8E	327-70	358-123
081800Z	15.5N	113.3E	327-123	354-152
090000Z	15.5N	113.0E	315-73	318-240
090600Z	15.6N	112.7E	315-104	319-332
091200Z	15.6N	112.3E	313-172	322-274
091800Z	15.7N	112.1E	315-192	320-365
100000Z	15.7N	111.7E	316-239	315-254
100600Z	15.7N	111.4E	322-192	315-288
101200Z	15.8N	111.1E	330-144	312-346
101800Z	15.8N	110.8E	339-118	311-364
110000Z	16.0N	110.6E	015-24	308-406
110600Z	16.2N	110.6E	285-109	331-141
111200Z	16.3N	110.5E	254-175	314-280
111800Z	16.5N	110.5E	254-206	321-178
120000Z	16.7N	110.5E	255-286	294-170
120600Z	16.9N	110.6E	210-160	274-303
121200Z	17.1N	110.7E	171-152	243-198

AVERAGE 24 HOUR ERROR 147.3 MI
AVERAGE 48 HOUR ERROR 262.9 MI


TYPHOON JEAN
06-12 NOVEMBER 1962
24 HR FORECAST POSITS
LEGEND
24 HR FORECAST POSITS
6 HR BEST TRACK POSITS
12/12Z
12/00Z
11/00Z
10/00Z
09/00Z
08/00Z
07/00Z
06/06Z
TSINGTAO
SHANGHAI
HONG KONG
SAIGON
RANGOON
MANILA
TOKYO
IWO JIMA
GUAM
ULITHI
YAP
KOROR
WOLEAI ATOL

TYPHOON KAREN - 071800Z-180000Z NOVEMBER 1962

I. DATA

A. Statistics

1. Calendar days of tropical warning - 10¼
2. Calendar days of typhoon intensity - 9½
3. Total distance traveled during tropical warning period - 4176 MI

B. Characteristics as a typhoon

1. Min observed SLP - 897mb, 122150Z
2. Min observed 850mb height - 1900 ft, 122150Z
3. Min observed 700mb height - 7220 ft, 090340Z
4. Max vertical development - 45,000 ft, 130000Z

II. DEVELOPMENT

A. Initial impetus - Surge from W side of MPT combined with large divergent field of Southern Hemisphere outdraft.

B. Initial surface vortex

1. Embedded vortex at 060000Z
2. Surface pressure less than 1010mb
3. Maximum surface wind 10 kts

C. Zenith flow at 200mb

1. Relative position surface vortex - NE quadrant of Southern Hemisphere anticyclone
2. Wind velocity over vortex - 150/21 kts

III. STEERING

A. Prior to recurvature - 200mb

B. During recurvature - 200mb

C. After recurvature - 300mb

IV. DISSIPATION

A. Causative factor - Cold air

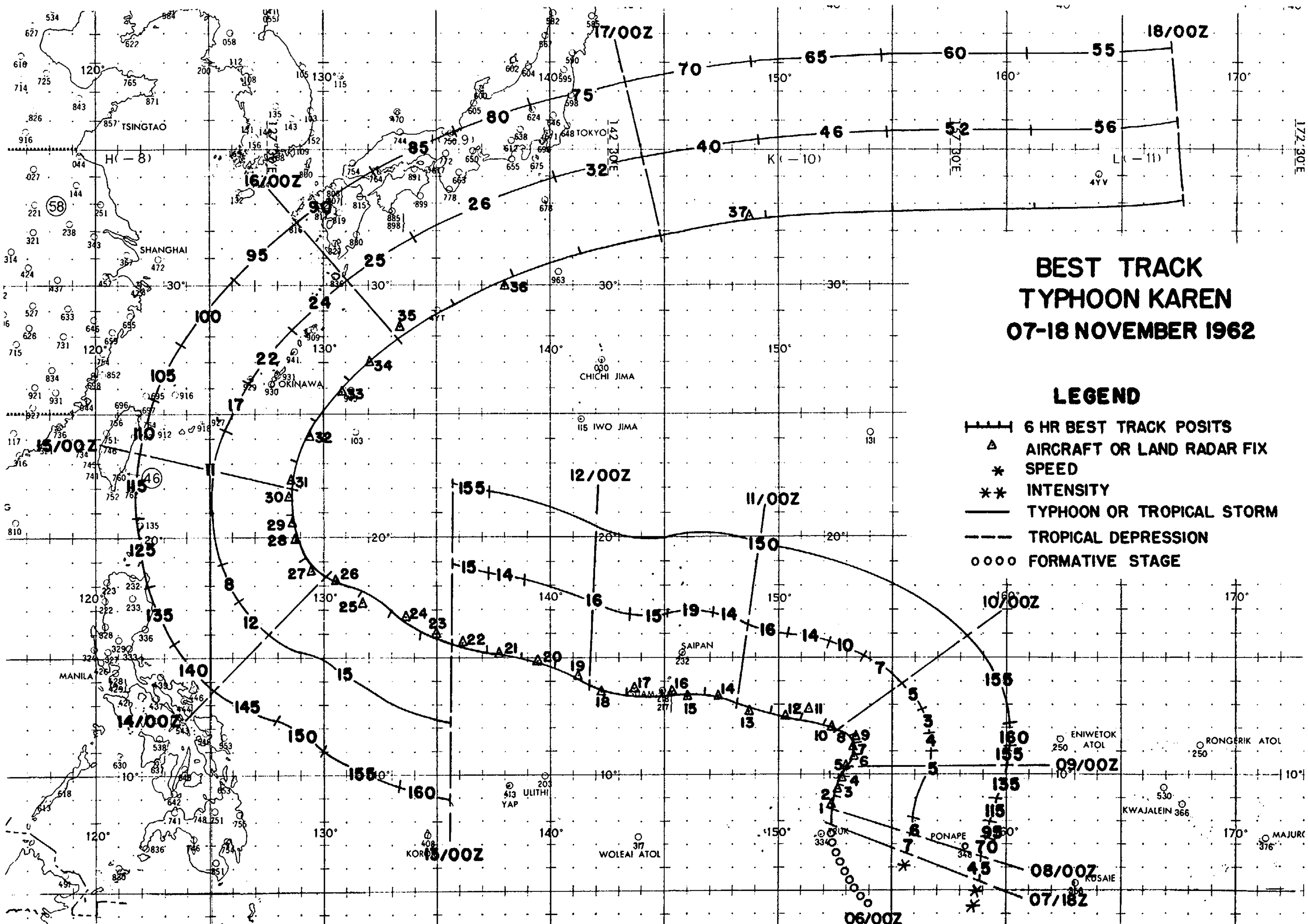
B. Final disposition - Extratropical

V. DAMAGE

A. Total lives lost - 11

B. Total monetary value - $250,000,000

C. Types of property - All types


BEST TRACK
TYPHOON KAREN
07-18 NOVEMBER 1962
LEGEND
6 HR BEST TRACK POSITS
AIRCRAFT OR LAND RADAR FIX
SPEED
INTENSITY
TYPHOON OR TROPICAL STORM
TROPICAL DEPRESSION
FORMATIVE STAGE
06/00Z
07/18Z
08/00Z
09/00Z
10/00Z
11/00Z
12/00Z
13/00Z
14/00Z
15/00Z
16/00Z
17/00Z
18/00Z
TSINGTAO
SHANGHAI
TOKYO
OKINAWA
CHICHI JIMA
IWO JIMA
MANILA
SAIPAN
GUAM
ULITHI
YAP
KOROR
WOLEAI ATOL
TRUK
PONAPE
KUSAIE
ENIWETOK ATOL
RONGERIK ATOL
KWAJALEIN
MAJURO

LAND RADAR AND AIRCRAFT FIXES - TYPHOON KAREN

FIX NO.	TIME	LAT.	LONG.	UNIT METHOD & ACCY	MAX SFC WND	MAX 700MB WND	MIN 700MB HGT	MIN SLP MBS	700MB T/Td (^{o}C)	EYE CHARACTERISTICS
1	080100Z	08.6N	152.4E	VW1-R-02	-	-	-	-	- -	DIA 22 MI, OPEN N & W
2	080430Z	08.8N	152.4E	VW1-R-03	-	-	-	-	- -	DIA 11 MI
3	081040Z	09.4N	152.6E	VW1-R-02	-	-	-	-	- -	CIRC 10 MI DIA, WELL DEF
4	081530Z	09.8N	152.8E	VW1-R-02	-	-	-	-	- -	OVAL 7 MI E-W, 9 MI N-S
5	082220Z	10.3N	153.0E	54-P-05	130	90	7790	917	21/16	CIRC 5 MI DIA
6	090340Z	10.7N	153.2E	54-P-05	150	150	7220	899	24/14	CIRC 6 MI DIA
7	090930Z	11.2N	153.3E	VW1-R-04	-	-	-	-	- -	7 MI DIA
8	091545Z	11.5N	153.2E	VW1-R-04	-	-	-	-	- -	7 MI DIA, CONCENTRIC SPIRAL BANDS 40 MI DIA
9	092200Z	11.7N	153.3E	54-P-05	50	90	9000	926	16/16	CIRC 8 MI DIA
10	100400Z	12.0N	152.4E	54-P-06	90	125	7790	908	18/15	CIRC 17 MI DIA
11	101015Z	12.8N	151.2E	VW1-R-10	-	-	-	-	- -	CIRC 12 MI DIA
12	101550Z	12.4N	150.3E	VW1-R-05	-	-	-	-	- -	CIRC 10 MI DIA, CONCEN-TRIC BAND 70 MI DIA
13	102200Z	12.9N	148.7E	54-P-02	-	120	7740	917	18/15	CIRC 14 MI DIA
14	110400Z	13.3N	147.3E	54-P-03	125	125	7560	908	19/17	CIRC 8 MI DIA, WELL DEF
15	110730Z	13.3N	146.0E	LND/RDR	-	-	-	-	- -	---
16	111015Z	13.5N	145.4E	VW1-R-01	-	-	-	-	- -	8 MI DIA, OUTER CIRCLE 35 MI DIA
17	111545Z	13.7N	143.6E	VW1-R-05	-	-	-	-	- -	8 MI DIA, OUTER CIRCLE 28 MI DIA

LAND RADAR AND AIRCRAFT FIXES - TYPHOON KAREN (CONT'D)

FIX NO.	TIME	LAT.	LONG.	UNIT METHOD & ACCY	MAX SFC WND	MAX 700MB WND	MIN 700MB HGT	MIN SLP MBS	700MB T/Td (^{o}C)	EYE CHARACTERISTICS
18	112320Z	13.5N	142.2E	54-P-05	130	150	7690	917	18/16	OVAL 40 MI N-S,30 MI E-W
19	120410Z	14.3N	141.1E	54-P-06	130	130	7740	-	17/17	25 MI DIA
20	120930Z	14.8N	139.4E	VW1-R-05	-	-	-	-	- -	CIRC 30 MI DIA
21	121530Z	15.2N	137.9E	VW1-R-03	-	-	-	-	- -	CIRC 25 MI DIA
22	122150Z	15.6N	136.1E	54-P	145	120	7240	897	22/18	CIRC 25 MI DIA
23	130300Z	16.0N	135.0E	54-P-02	150	-	7300	898	21/18	CIRC 35 MI DIA
24	130935Z	16.6N	133.6E	VW1-R-10	-	-	-	-	- -	20 MI DIA
25	131545Z	17.4N	131.9E	VW1-R-05	-	-	-	-	- -	CIRC 22 MI DIA
26	132200Z	18.2N	130.6E	54-P-05	130	125	7610	913	18/18	CIRC 30 MI DIA
27	140345Z	18.6N	129.5E	54-P-U	130	120	7700	916	19/17	OVAL 20 MI LONG
28	141130Z	19.8N	128.8E	VW1-R-05	-	-	-	-	- -	CIRC 34 MI DIA
29	141530Z	20.5N	128.7E	VW1-R-03	-	-	-	-	- -	CIRC 70 MI DIA
30	142200Z	21.7N	128.5E	54-P-U	-	-	-	-	- -	---
31	150300Z	22.4N	128.7E	54-P-03	85	85	8380	936	15/14	CIRC 20 MI DIA,POOR DEF
32	151000Z	24.2N	129.3E	VW1-R-05	-	-	-	-	- -	DIA 58 MI,OPEN S-NW
33	151555Z	25.9N	130.9E	VW1-R-05	-	-	-	-	- -	20 MI DIA,OPEN SW SEMI-CIRCLE
34	152225Z	27.0N	132.0E	54-P-08	65	65	8600	948	17/15	CIRC 40 MI DIA,OPEN N&W
35	160055Z	28.4N	133.4E	56-P-03	90	60	8950	960	13/13	30 MI DIA,OPEN SW-N

LAND RADAR AND AIRCRAFT FIXES - TYPHOON KAREN (CONT'D)

FIX NO.	TIME	LAT.	LONG.	UNIT METHOD & ACCY	MAX SFC WND	MAX 700MB WND	MIN 700MB HGT	MIN SLP MBS	700MB T/Td (°C)	EYE CHARACTERISTICS
36	161105Z	30.0N	138.0E	VW1-P-U	-	-	-	-	- -	NO RDR PRESENTATION
37	170516Z	32.5N	148.8E	54-P-05	75	75	9550	-	14/-	ELLIP 10X3 MI

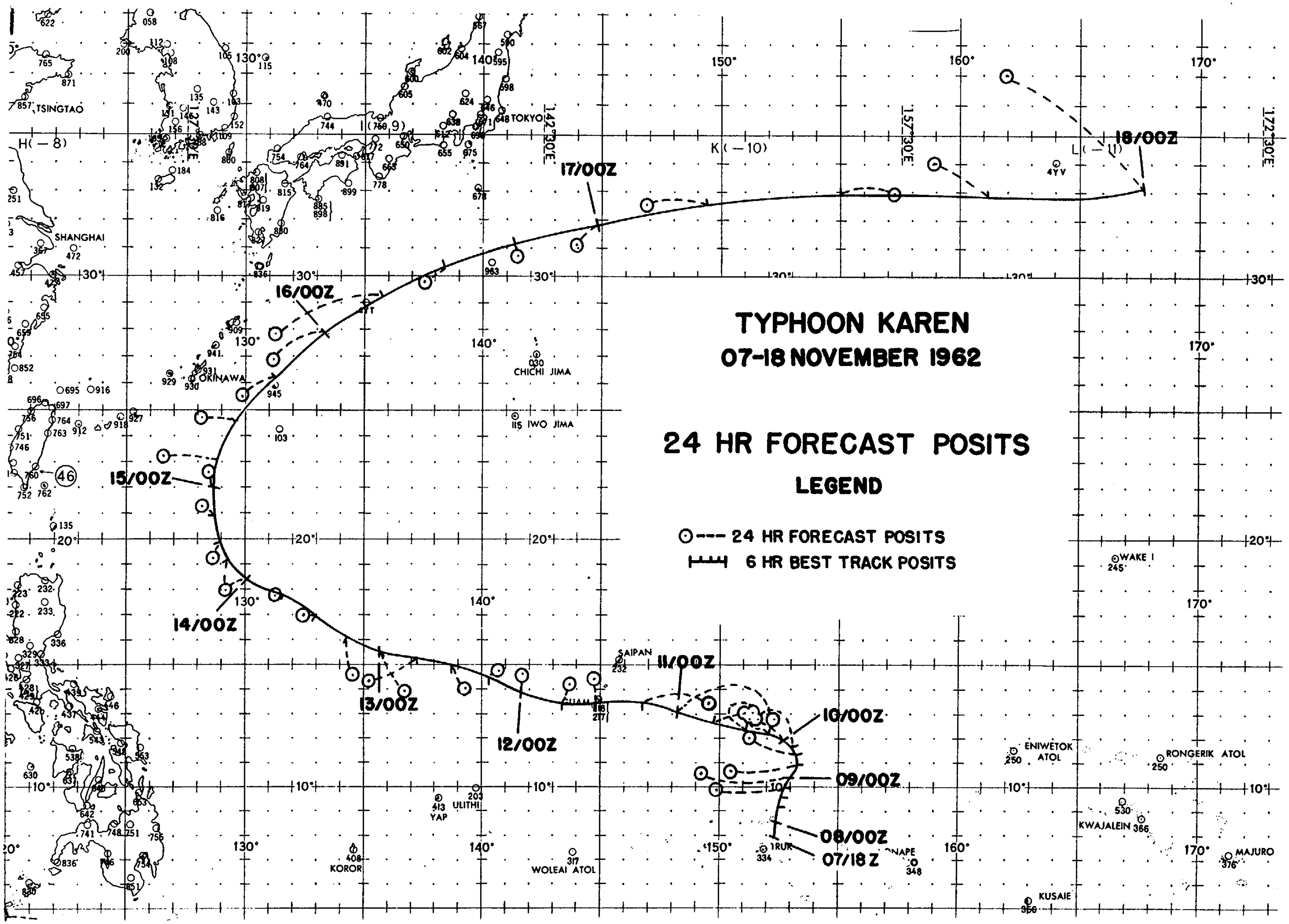
TYPHOON KAREN 07-18 NOV 1962
POSITION AND FORECAST VERIFICATION DATA

DTG	STORM POSITION LAT.	LONG.	24 HR. ERROR DEG. DISTANCE	48 HR. ERROR DEG. DISTANCE
071800Z	07.8N	152.4E	------	------
080000Z	08.5N	152.4E	------	------
080600Z	09.2N	152.5E	------	------
081200Z	09.6N	152.6E	------	------
081800Z	10.0N	152.7E	267-172	------
090000Z	10.4N	153.1E	268-223	------
090600Z	10.9N	153.3E	263-163	------
091200Z	11.4N	153.3E	293-124	------
091800Z	11.6N	153.2E	304-95	283-314
100000Z	11.9N	152.7E	302-73	284-322
100600Z	12.1N	152.0E	317-54	286-246
101200Z	12.3N	151.0E	036-57	308-216
101800Z	12.6N	149.7E	071-91	322-137
110000Z	13.1N	148.2E	097-242	352-96
110600Z	13.4N	146.8E	090-170	026-96
111200Z	13.3N	144.8E	360-60	056-180
111800Z	13.4N	143.3E	033-60	065-245
120000Z	13.9N	141.7E	356-40	091-442
120600Z	14.5N	140.3E	072-35	081-306
121200Z	14.9N	138.7E	146-72	360-52
121800Z	15.2N	137.3E	246-129	045-40
130000Z	15.5N	135.7E	150-124	240-74
130600Z	16.1N	134.3E	170-90	050-36
131200Z	17.0N	133.0E	300-65	130-184
131800Z	17.8N	131.7E	273-15	228-182
140000Z	18.3N	130.1E	248-60	148-280
140600Z	19.1N	129.2E	192-75	166-190
141200Z	19.9N	128.9E	184-30	113-70
141800Z	20.9N	128.6E	314-33	092-25

TYPHOON KAREN 07-18 NOV 1962
POSITION AND FORECAST VERIFICATION DATA (CONT'D)

DTG	STORM POSITION LAT.	LONG	24 HR. ERROR DEG. DISTANCE	48 HR. ERROR DEG. DISTANCE
150000Z	22.0N	128.7E	002-42	210-140
150600Z	23.1N	128.9E	272-125	208-173
151200Z	24.7N	129.7E	272-84	198-126
151800Z	26.3N	131.3E	237-88	139-47
160000Z	27.9N	133.4E	244-132	152-72
160600Z	29.2N	135.7E	252-250	273-142
161200Z	30.3N	138.4E	242-56	333-46
161800Z	31.2N	141.3E	156-32	244-156
170000Z	31.8N	144.9E	229-62	249-213
170600Z	32.5N	149.5E	260-132	254-450
171200Z	32.8N	155.0E	087-114	252-256
171800Z	32.8N	161.2E	305-130	273-268
180000Z	33.1N	167.8E	310-376	008-90

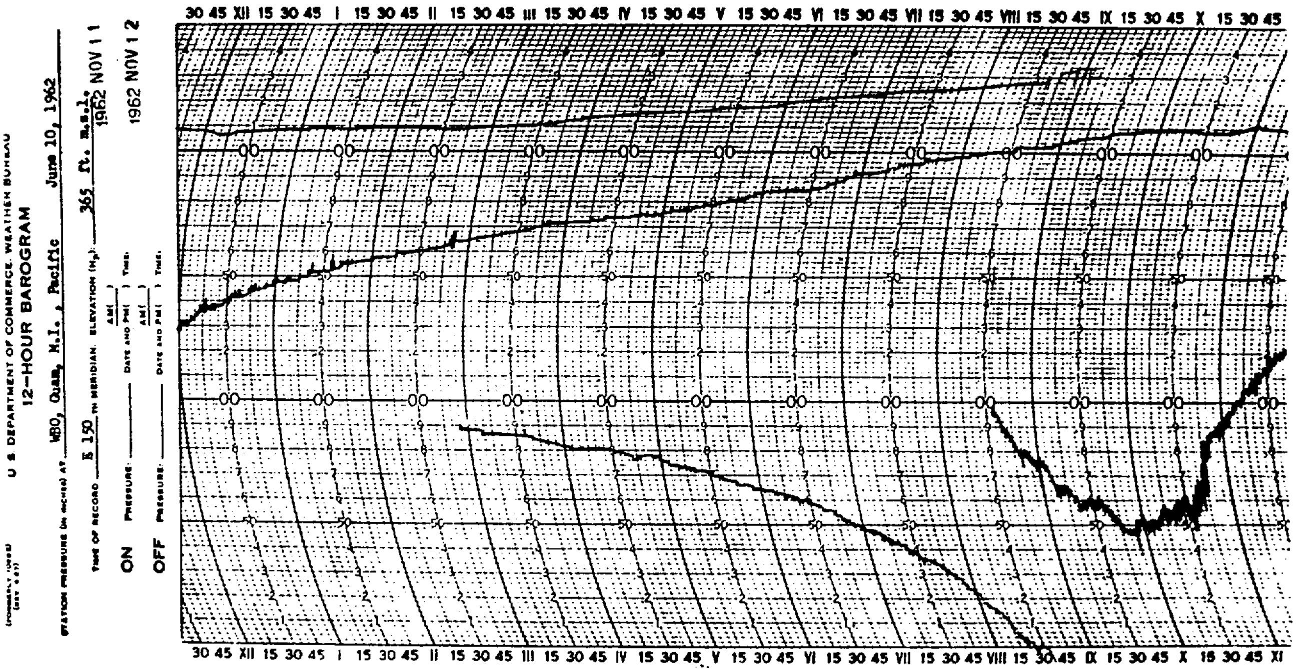
AVERAGE 24 HOUR ERROR 104.6 MI
AVERAGE 48 HOUR ERROR 173.9 MI

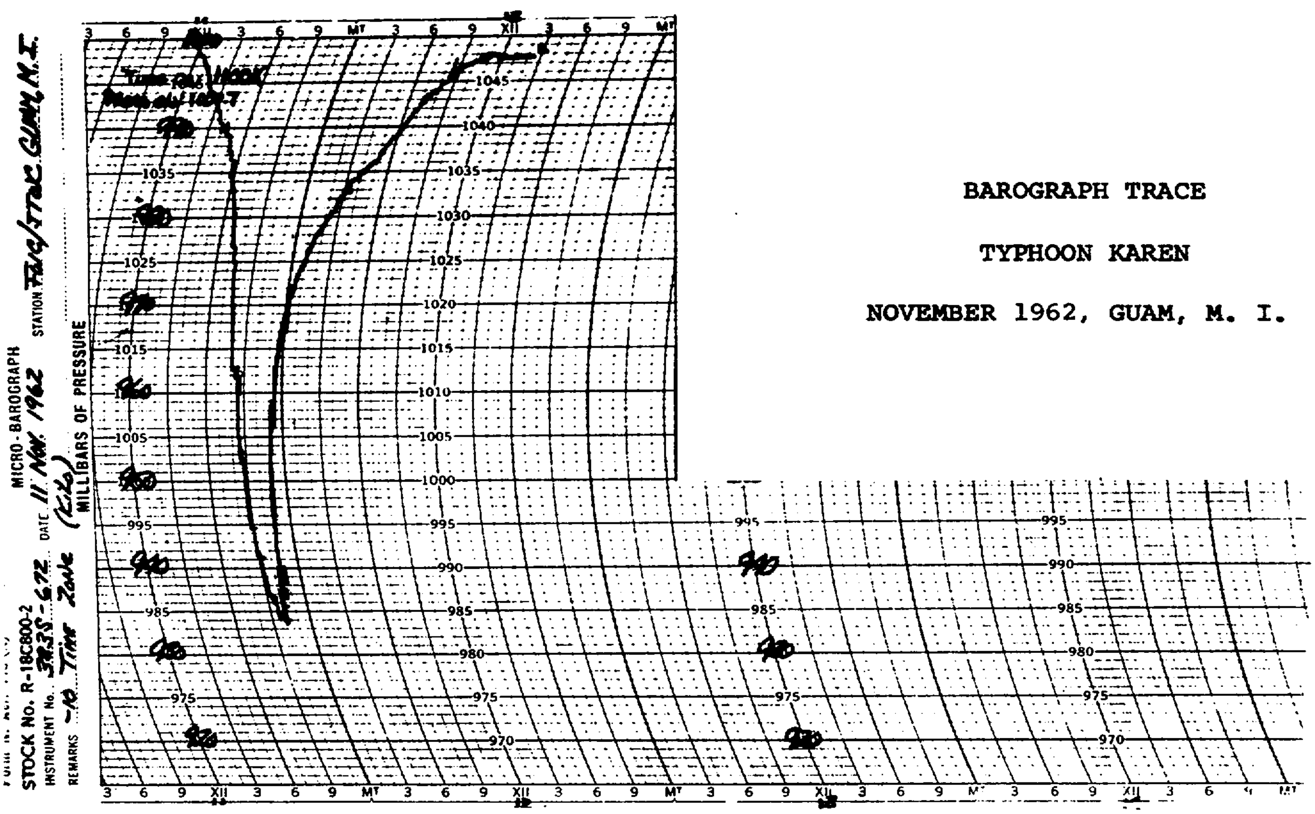

TYPHOON KAREN
07-18 NOVEMBER 1962
24 HR FORECAST POSITS
LEGEND
24 HR FORECAST POSITS
6 HR BEST TRACK POSITS
07/18 Z
08/00Z
09/00Z
10/00Z
11/00Z
12/00Z
13/00Z
14/00Z
15/00Z
16/00Z
17/00Z
18/00Z
TSINGTAO
SHANGHAI
TOKYO
OKINAWA
CHICHI JIMA
IWO JIMA
SAIPAN
GUAM
YAP
ULITHI
KOROR
WOLEAI ATOL
TRUK
PONAPE
KUSAIE
ENIWETOK ATOL
RONGERIK ATOL
KWAJALEIN
MAJURO
WAKE I

TYPHOON KAREN

NOVEMBER 1962, GUAM, M. I.

U. S. WEATHER BUREAU
BAROGRAM TRACE

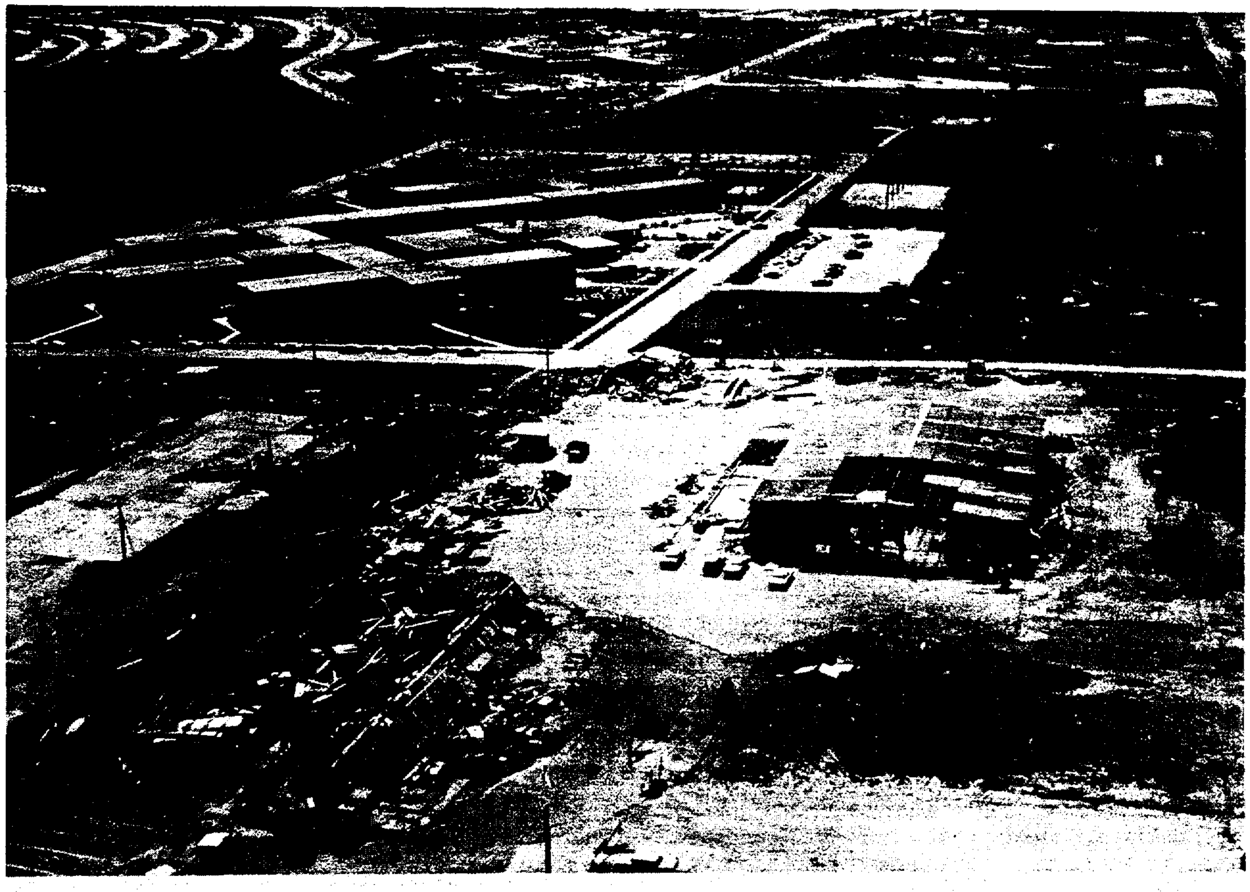




BAROGRAPH TRACE

TYPHOON KAREN

NOVEMBER 1962, GUAM, M. I.



MANY PERMANENT BUILDINGS SUFFERED CONSIDERABLE DAMAGE, AND MOST TEMPORARY STRUCTURES WERE COMPLETELY DESTROYED ON GUAM BY TYPHOON KAREN. (USAF PHOTO)

TYPHOON KAREN LOG
OF
FWC/JTWC GUAM

11 November 1962

0630K Watch relieved by Section A. Typhoon Condition II in effect, and all established requirements for Condition II completed prior to the assumption of this watch. All spaces in FWC/JTWC, except for JTWC research spaces, are manned.

0650K KUAM informed of KAREN's latest position and velocity. Our public advisory indicates that typhoon-force winds will commence between 1500K and 1700K and that eye passage will occur near the northern tip of the island between 2100K and 2300K. This same information is recorded on our public telephone tape.

0800K Typhoon Condition I set in accordance with COMNAVMAR's instructions and all command personnel concerned advised. All officers and enlisted men with telephone communications advised to stay in their quarters if typhoon-proof and to evacuate if quarters not typhoon-proof. Situation report given to CO. Emergency rations ordered and vault area prepared for watch personnel's emergency occupancy.

1000K KUAM advised of present position and intensity of storm. Advice also passed to public concerning action to be taken in event of eye passage over island.

1200K Barracks #2 evacuated. All personnel not retained on watch evacuated to Naval Station Barracks. Security watch posted in Barracks #2. KUAM advised of present position of storm and precautions to take.

1400K KUAM and Guam Daily News advised as above. Telephone tape revised. Pressure shows continuous drop and wind continuing in intensity. All spaces secured properly. Commenced half-hourly radar observations of typhoon eye from FAA radar.

1425K   JTWC called FAFWC and transferred Typhoon KAREN warning responsibility to them valid 111200Z for Warning #16. Advised aerial reconnaissance confirmed through 121600Z and staging basis of aircraft. Recon Plans Message 101200Z reconfirmed for all warning details, aircraft mission numbers and cyclone numbers and names.

1440K   JTWC called FAFWC to transfer warning responsibility for Tropical Storm JEAN, also, as late data indicated the storm was remaining quasi-stationary in the South China Sea and had not crossed the Viet-Nam coast line. Originally, JTWC would have issued last warning #21 on Tropical Storm JEAN at 110600Z.

1553K   JTWC filed Typhoon KAREN Warning #15 and Tropical Storm JEAN Warning #21 with advice that next warnings will be issued by FAFWC, Japan.

1600K   KUAM, telephone tape and Guam Daily News brought up-to-date with current situation. Personnel to remain aboard during passage consists of 39 enlisted men and 4 officers. Continuous radar tracking of eye of storm in effect. Public advised that eye passage now apparently will occur in mid-portion of Guam vice northern tip.

1615K   Barracks #2 security watch evacuated.

1720K   JTWC spaces secured.

1730K   Emergency rations broken out and distributed for watch personnel. Pressure shows continuous drop and wind speed increasing. FWC/JTWC handling all weather advisories on island. Andersen AFB weather station evacuated and USWB advised of weather conditions.

1800K   Commenced continuous use of emergency power.

1830K   Watch not relieved. 39 men and 4 officers (CO, XO, Comm. Officer, and FDO) manning FWC/JTWC until typhoon passes.

1900K   KUAM and Guam Daily News given last advisory as to storm's direction, position and intensity. Severe buffeting of north end of building. Duty section shored up north end of building.

2000K Secured transmission of weather data to Fleet, and Sangley Point has our responsibility. Received last radar position of KAREN. Bears 27 miles 111° from FAA Radar. Severe rattling of overhead in Communications Spaces. Water leakage commencing due to loosening of seams.

2030K Tin on roof commencing to separate. Watch ordered below by FDO and told to abandon equipment. FDO, Communications Officer, and volunteer working party remaining top-side to continue communications and secure as much gear below as possible.

2045K Overhead in Communications Spaces separating from bulkhead. Spaces abandoned by FDO, Communications Officer and working party. Severe water damage occurring in Communications and Supply spaces. Aerovane and mount carried away after indicating gusts over 120 knots and sustained winds of 90+ knots.

2200K Upper spaces checked for fire hazards. ASWEP Charts recovered by FDO. ASWEP interior bulkhead, windows, east side windows and front door carried away.

2215K Eye passage to south apparent by low point reached on Microbarograph, wind shift to east, and speed increase. Pressure 934+ mb. Entire watch section secured inside vault due to severe "pumping" (ears "popping" every 18 seconds) action of 5mb and extreme bowing of bulkheads and overheads. Water damage becoming extreme. Three inches of water over lower deck and water pouring through overhead.

12 November 1962

0000K Entire watch below in vault. Water continuing to rise in all spaces.

0300K Wind speed diminishing. Flashing light contact with COMNAVMAR headquarters established and brief situation report sent to COMNAVMAR in this manner by CO.

0430K Preliminary damage inspection taken. Roof badly damaged and extreme water damage to both decks.

<u>0500K</u> Received Commander, Naval Forces, Marianas aboard for informal visit.

<u>0510K</u> COMNAVMAR departed.

<u>0630K</u> CO departed. FDO temporarily relieved by Communications Officer.

<u>0730K</u> FDO re-assumed watch. Personnel quartered at the Naval Station returned to Command. Commenced clean-up of water and debris from spaces.

<u>1115K</u> Watch relieved.

DEBRIS FROM WOODEN FRAME HOMES AND QUONSETS WAS STREWN OVER THE ISLAND OF GUAM BY TYPHOON KAREN. (USAF PHOTO)

TYPHOON LUCY - 250000Z NOVEMBER-011800Z DECEMBER 1962

I. DATA

A. Statistics

1. Calendar days of tropical warning - 6 3/4
2. Calendar days of typhoon intensity - 3 1/2
3. Total distance traveled during tropical warning period - 2400 MI

B. Characteristics as a typhoon

1. Min observed SLP - 974mb, 290345Z
2. Min observed 850mb height - 3830 ft, 290345Z
3. Min observed 700mb height - 9340 ft, 290345Z
4. Max vertical development - 30,000 ft, 291200Z

II. DEVELOPMENT

A. Initial impetus - Surge from westerlies into MPT followed by a cut-off low, and then LUCY formed downstream.

B. Initial surface vortex

1. Junction vortex at 220600Z
2. Surface pressure less than 1004mb
3. Maximum surface wind - 10 kts

C. Zenith flow at 200mb

1. Relative position surface vortex - SE quadrant of anticyclone
2. Wind velocity over vortex - 010/25 kts

III. STEERING

A. Prior to recurvature - 500mb

B. During and after recurvature - NA

IV. DISSIPATION

A. Causative factor - Cold air

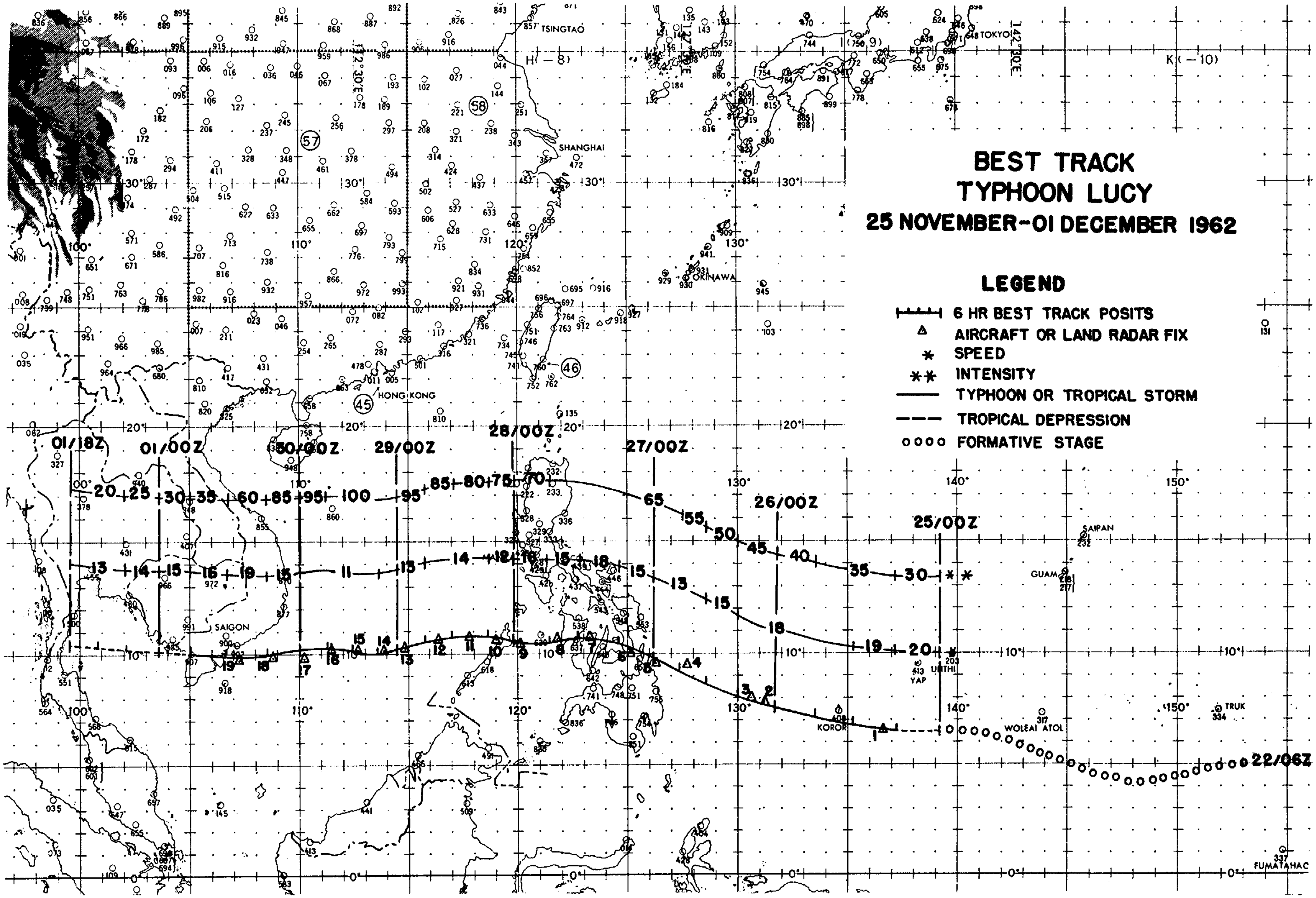
B. Final disposition - Dissipated

V. DAMAGE

A. Total lives lost - 5

B. Total monetary value - $5,000,000

C. Types of property - Crops, homes, roads, bridges, power and communication lines


BEST TRACK
TYPHOON LUCY
25 NOVEMBER-01 DECEMBER 1962
LEGEND
6 HR BEST TRACK POSITS
AIRCRAFT OR LAND RADAR FIX
SPEED
INTENSITY
TYPHOON OR TROPICAL STORM
TROPICAL DEPRESSION
FORMATIVE STAGE
TSINGTAO
SHANGHAI
TOKYO
OKINAWA
HONG KONG
SAIGON
SAIPAN
GUAM
YAP
ULITHI
KOROR
WOLEAI ATOL
TRUK
FUMATAHAC
01/18Z
01/00Z
30/00Z
29/00Z
28/00Z
27/00Z
26/00Z
25/00Z
22/06Z

LAND RADAR AND AIRCRAFT FIXES - TYPHOON LUCY

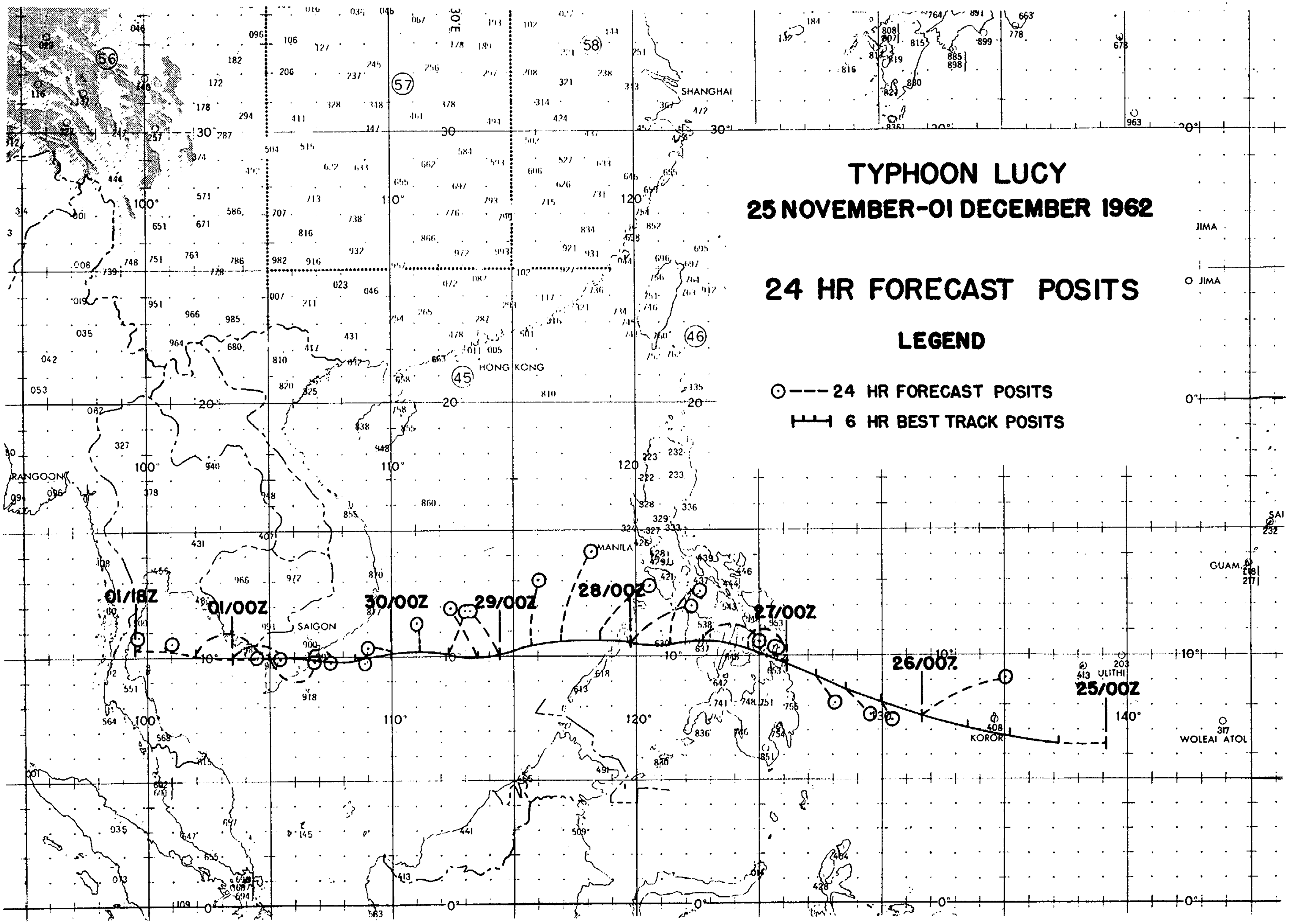
FIX NO.	TIME	LAT.	LONG.	UNIT METHOD & ACCY	MAX SFC WND	MAX 700MB WND	MIN 700MB HGT	MIN SLP MBS	700MB T/Td (°C)	EYE CHARACTERISTICS
1	250700Z	06.5N	136.7E	VW1-P-20	35	-	-	999	- -	CIRC 100 MI DIA
2	252345Z	07.9N	131.1E	54-P-04	40	-	9930	995	16/15	DIA 30 MI, WELL DEFINED
3	260400Z	08.0N	130.6E	54-P-03	45	40	9910	994	17/14	40 MI N-S & 20 MI E-W
4	261627Z	09.6N	127.7E	VW1-R-02	-	-	-	-	- -	DIA 4 MI, POORLY DEF
5	262320Z	09.6N	126.2E	54-P-03	60	60	9830	990	15/14	DIA 5 MI
6	270345Z	10.0N	125.1E	54-P-02	50	45	9820	990	15/15	CIRC 50 MI DIA, WALL CLDS ALL QUADS
7	271000Z	10.6N	123.4E	VW1-R-04	-	-	-	-	- -	CIRC 32 MI DIA, OPEN E & SE
8	271600Z	10.6N	121.8E	VW1-R-02	-	-	-	-	- -	OVAL 8X18 MI
9	272235Z	10.4N	120.1E	54-P-U	65	70*	18908*	985	-1*/-1*	CIRC 10 MI DIA
10	280350Z	10.6N	119.0E	54-P-02	70	65*	18790*	988	-3*/-3*	CIRC 8 MI DIA
11	281000Z	10.7N	117.8E	VW1-R-01	-	-	-	-	- -	CIRC 16 MI DIA
12	281500Z	10.6N	116.4E	VW1-R-05	-	-	-	-	- -	CIRC 8 MI DIA
13	282200Z	10.3N	114.8E	54-P-01	60	90	9360	974	17/06	CIRC 30 MI DIA
14	290345Z	10.1N	113.9E	54-P-02	80	90	9340	974	17/09	CIRC 40 MI DIA
15	291000Z	10.1N	112.6E	VW1-R-03	-	-	-	-	- -	CIRC 20 MI DIA, OPEN E
16	291545Z	10.2N	111.5E	VW1-R-03	-	-	-	-	- -	CIRC 23 MI DIA, OPEN E
17	292335Z	09.9N	110.2E	54-P-06	90	100	9440	975	19/08	CIRC 40 MI DIA
18	300335Z	09.9N	108.9E	54-P-03	90	95	9620	990	18/07	---
19	301000Z	09.8N	107.2E	VW1-R-02	-	-	-	-	- -	CIRC 25 MI DIA

*500MB DATA

TYPHOON LUCY 25 NOV-01 DEC 1962
POSITION AND FORECAST VERIFICATION DATA

	STORM POSITION		24 HR. ERROR	48 HR. ERROR
DTG	LAT.	LONG.	DEG. DISTANCE	DEG. DISTANCE
250000Z	06.5N	139.1E	------	------
250600Z	06.5N	137.1E	------	------
251200Z	06.7N	135.2E	------	------
251800Z	07.1N	133.5E	------	------
260000Z	07.5N	131.7E	------	------
260600Z	08.2N	130.0E	------	------
261200Z	08.7N	128.5E	------	------
261800Z	09.2N	127.3E	------	------
270000Z	09.7N	126.1E	330-52	------
270600Z	10.3N	124.6E	089-82	------
271200Z	10.7N	122.8E	092-135	------
271800Z	10.5N	121.3E	032-156	------
280000Z	10.5N	119.7E	056-177	044-147
280600Z	10.7N	118.5E	044-179	068-217
281200Z	10.7N	117.0E	018-222	069-274
281800Z	10.5N	115.8E	007-160	033-322
290000Z	10.2N	114.5E	328-124	042-357
290600Z	10.0N	113.4E	336-127	030-360
291200Z	10.1N	112.3E	026-118	021-353
291800Z	10.1N	111.1E	360-81	013-240
300000Z	10.0N	110.0E	291-60	319-164
300600Z	09.9N	108.5E	098-27	329-150
301200Z	09.9N	106.5E	092-66	049-192
301800Z	10.0N	105.0E	094-114	060-164
010000Z	10.0N	103.4E	090-122	069-49
010600Z	10.1N	102.0E	094-150	095-170
011200Z	10.3N	100.8E	068-23	094-169
011800Z	10.4N	99.4E	041-28	095-203

AVERAGE 24 HOUR ERROR 110.2 MI
AVERAGE 48 HOUR ERROR 220.7 MI


TYPHOON LUCY
25 NOVEMBER-01 DECEMBER 1962
24 HR FORECAST POSITS
LEGEND
24 HR FORECAST POSITS
6 HR BEST TRACK POSITS
SHANGHAI
HONG KONG
RANGOON
SAIGON
MANILA
ULITHI
KOROR
GUAM
WOLEAI ATOL
JIMA
01/18Z
01/00Z
30/00Z
29/00Z
28/00Z
27/00Z
26/00Z
25/00Z

CHAPTER V

RESEARCH

A. GENERAL

Research as related to tropical cyclones has been limited in the past four years of JTWC's existence; however, during the first half of 1963, significant applied research versus basic research should be accomplished.

The increase of two forecasters in July and August for the 1962 season provided three achievements, meteorologically and operationally, namely:

1. Issuance of JTWC standard operating procedures.
2. Typhoon tracks were our best product through judicious application of operational concepts contained in Chapter I. One by-product of best tracking was the partial isolation of speed of movement as a problem area for future study.
3. Completed preparation of the "Annual Typhoon Report" in January vice April of previous years.

B. ANNUAL REPORT

This "Annual Typhoon Report" was prepared as the 1962 season progressed. The individual typhoon reports of Chapter IV have been put in outline form to highlight the pertinent data particularly for the operators or non-meteorologists. Chapter III has been enlarged to accommodate the meteorologist by consolidating the sequence of events from formation through dissipation stage and correlating them with all 24 typhoons of this season.

A bibliography has been added as Appendix B for cross-reference to all articles and evaluations contained herein, in order to properly credit the forecast techniques or ideas and broaden the base of the report.

An effective major easterly wave analysis and sequential numbering program was started on 1 March by FWC for the 1962 season. Forty percent of these spawned tropical cyclones that required warnings. Since this operational concept is normal for tropical meteorologists, further expansion will not be made except to advise of the many internal references and charts containing easterly wave data within this report. The 1963 FWC easterly wave program includes identification of minor easterly waves on a monthly basis.

"Best Track" evaluation for the charts in Chapter IV is restated for the record. The best track of a tropical cyclone is determined from postanalysis by using the data from the surface, gradient level, 850mb level, pilot reports, land radar reports, and scheduled reconnaissance radar and penetration reports. Tropical cyclones seldom move in a straight line; however, JTWC forecasts a mean track for its warnings. Tropical cyclones usually oscillate to the right and left of a straight line path particularly S of the ridge line while still in the easterlies (18). The amplitude of their oscillatory track varies with forward speed and intensity. The cyclone has a fluid forward movement with expected abrupt changes in the speed and direction of movement. Curvatures and/or loops are a reflection of these abrupt changes. Any "fix" and/or eye passage data that reports the position of the cyclone to be off track is disregarded after thorough investigation (5) (15).

C. RESEARCH

Research will be divided into three types for the 1963 season:

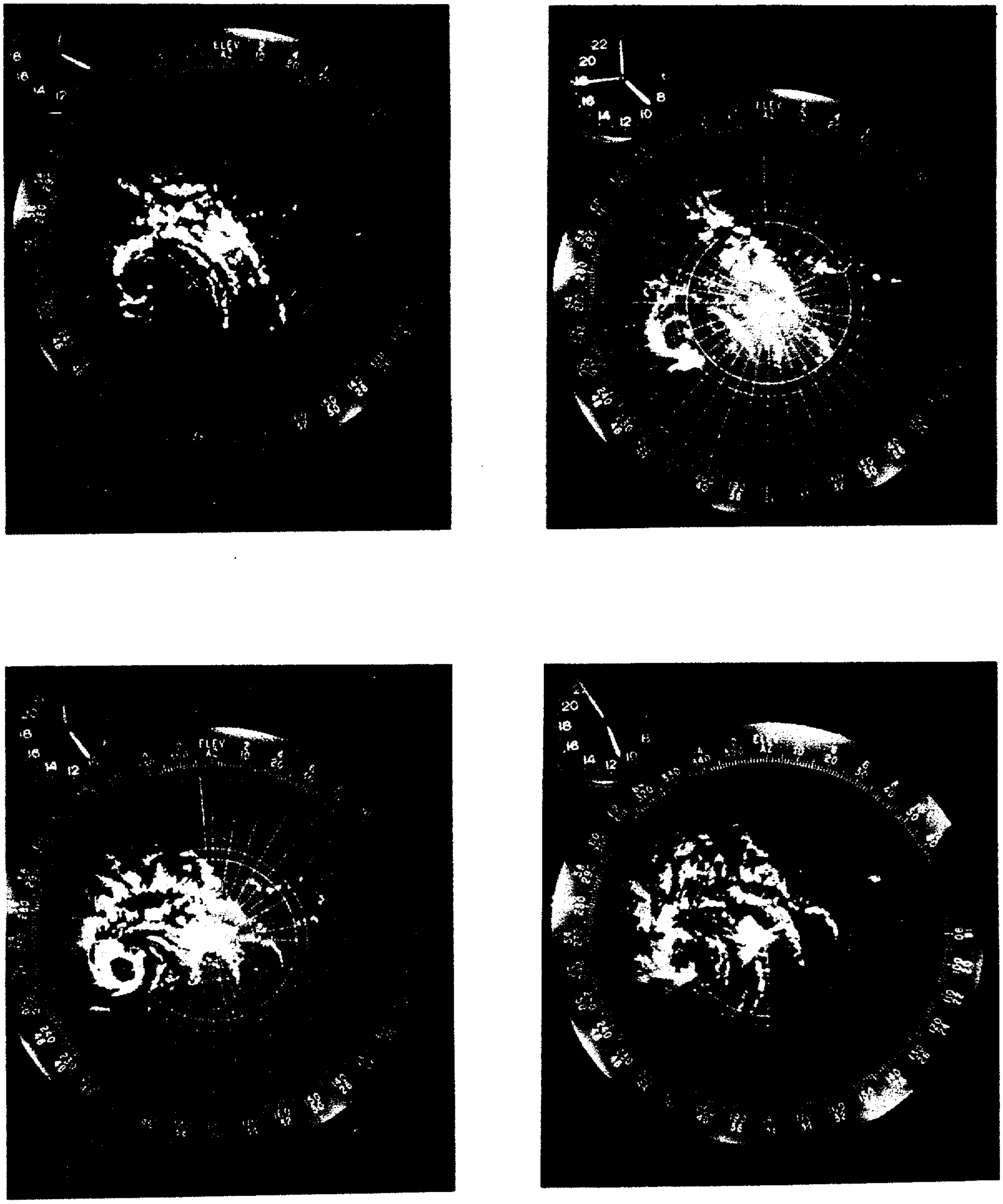
1. Simplification of forecast procedures
2. Improvement of the forecast techniques
3. Examination of the tropical cyclone, which will include a documentation of the cyclone from the formation to typhoon stage, and to obtain more information about the structure of the typhoon eye.

Many peculiarities of eye structure are known to exist: such as, pressure and geographical centers which can be but are not always the same, non-circular eyes, clear and cloudy eyes, non-vertical axis of centers, pulsations of the wall cloud, etc. The latter of these primarily indicates the strength of the typhoon itself as in the case of Typhoon GEORGIA. She provided a 24-hour cycle over a period of 4 days as she passed to the W of Guam. At 0000Z each day, her wall clouds were full and completely circular; whereas, at 1200Z one of the quadrants was open, normally the E quadrant. The surges of GEORGIA to a full eye had a direct correlation with the time of minimum height differential between the surface and the 850mb level. By comparison, Typhoon SARAH's surge cycle was four hours. The pulsation case of Typhoon SARAH is shown in the following Kadena Air Base CPS-9 photographs. These peculiarities should be the topic of a series of papers in future reports.

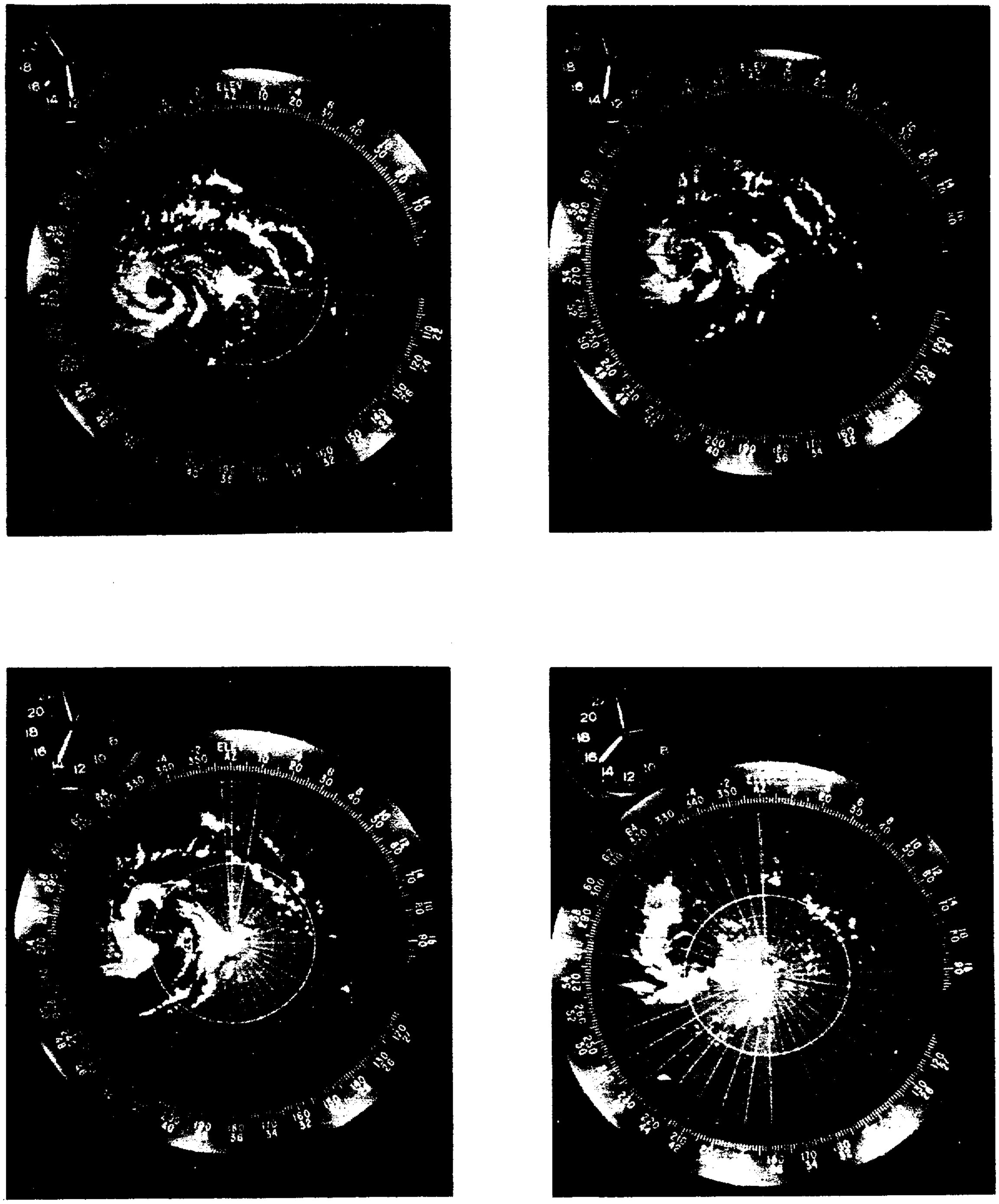
D. PROJECTS AND PAPERS

Projects and papers contained in this chapter are as follows:

1. Typhoon Forecasting
2. Evaluation of Statistical and Computer Typhoon Forecasting Procedures
3. Typhoon Acceleration after Recurvature
4. Typhoon Eye Terminology
5. Investigation of Typhoon Surface Gusts
6. Typhoon Tracks, 1953-1962



TYPHOON SARAH 19 AUGUST 1962
INDIA TIME ZONE
RANGE: 200 MILES



TYPHOON SARAH 19 AUGUST 1962
INDIA TIME ZONE
RANGE: 200 MILES

TYPHOON FORECASTING
by
Lt Colonel Leonard H. Hutchinson, USAF

I. Introduction

Typhoon forecasting is the most challenging and perplexing in the field of meteorology for those who are or have been associated with the program. Sparse upper air coverage, the average of one surface report for every 250,000 square miles in the Western Pacific, and limited aerial weather reconnaissance establish a weak base for analysis and evaluation of the synoptic sequence of events in the formation of tropical cyclones. In addition, the Joint Typhoon Warning Center is austerely manned to meet the operational forecast requirements, excluding the needed basic and applied research to support improvement of forecasting techniques. Research emphasis should be proportional to the frequency of occurrence for these phenomena which in 1962 numbered 24 typhoons in Western North Pacific to 3 hurricanes in the North Atlantic.

This paper is prepared to record the synoptic relationships observed in tropical cyclone formation and movement. Its condensed style provides a summary of many facets in typhoon development which, if singularly expanded with additional data, time, and research personnel, could contribute measurably to this important program. The 1962 season is documented briefly by the consolidated typhoon write-ups and singular data sheets and charts as contained in Chapters III and IV, respectively.

The combined 1962 Air Force and Navy reconnaissance program of two squadrons with six aircraft each stationed on Guam is basically adequate to support only the operational fixes required for tropical cyclones in warning status. In several previous years, these squadrons possessed twelve aircraft each, which provided continued synoptic and special reconnaissance during warning status in addition to the operational fixes.

II. Scope

The interzonal or latitudinal considerations are prerequisites in tropical cyclone forecasting since the position and movement of troughs and ridges in the westerlies affect both formation and movement of tropical cyclones. These features are evident only by meticulous analysis. Examples are pressure or contour changes, latitude of the subtropical ridge, the rate at which the easterlies and westerlies increase or decrease with height, and Northern Hemisphere upper-air analysis of the long waves with particular reference to the number existing and their state of progression.

The interaction between high and low latitudes and between high and low levels within the tropics then becomes the forecasting key. This concept is derived from the long wave analysis (6) which applies from the formation of tropical cyclones through their maturity to dissipation.

III. Formation

Detection of developing tropical cyclones from surface observations (7) becomes routine as pressure, wind, weather, sea swell, and tide observations approach or pass above or below normal criteria for these parameters.

Operational procedures as described in Chapter I guide the analysis from which the resulting aerial investigations are scheduled and/or warnings are issued. Preset tracks, tailored to fit the synoptic situation and performed by the two reconnaissance squadrons, were invaluable in supplementing the seven Trust Territory stations. Analysis of the equivalent potential temperature (θe) on time or space-cross sections (1) was extremely valuable as a routine forecast tool. When θe exceeded $340^{o}A$, formation was possible. Normally, the tropical analysis S of 20N was confined to identifying tropical systems for their type, intensity, and speed of movement. The basic tropical systems are known as the easterly wave, the vortex, and the intertropical zone of convergence (ITC).

Forecasting formation or intensification of tropical depressions, which are tropical systems with less than 34 kts sustained winds, from easterly waves or vortices was initially postulated by Riehl's (14) concept of the superposition of a long wave over a major easterly wave in the tropics. Upon fracture of these systems, subsequent intensification may be expected as early as 24 hours as the surface disturbance moves westward toward or under a high pressure cell or ridge at the 300-200mb level. This superposition relationship of the long wave and easterly wave with the ITC was fundamentally what Deppermann recognized in his triple point theory.

Failure to intensify and subsequent dissipation may be forecast should a low cell or flat pressure field exist at the upper levels when all other relationships as cited above remain the same. Complete deterioration of the depression or loss of convergence pattern associated with it follows and is accompanied by excessive precipitation W of the fracture area. Abnormal rains of one inch per hour or more will occur within the 24 to 30-hour period following with a minimum rainfall of 10 to 16 inches. There were no examples of this sequence of events during 1962.

Future development into a tropical storm being capped by a high level anticyclone is an excellent forecast. Further intensification to a typhoon will be dependent on forecasting a 700mb minimum temperature of 15°C and height of 9900 ft, and a minimum surface pressure of 990mb. The superposition and fracture of long waves with major easterly waves and the intensification under a high level anticyclone verified for approximately 88% of the 1962 typhoons.

Riehl's classical concepts in considering the formative stage also establish the criterion that at time of fracture, the long waves will be slowly progressive or be just starting to move eastward after a stationary period. It has been concluded from the 1962 season that formation will not take place while the long waves are stationary, retrogressive, or fast-moving.

Minor easterly waves are also perturbations in the tropical easterlies but without the associated weather patterns of the major ones. The minor easterly waves consist of a wind shift on the time-cross sections and can be identified by surface isobaric analysis. These waves bear close observance, as major easterly waves can develop on the minor's intensification.

Major and minor easterly waves, as they transit from the Marshall Islands to the South China Sea, will follow each other in random order at a mean speed of 10 kts with a minimum separation of 30 hours or multiples thereof. Bryson (4) identified these perturbation sequences initially in the Guam Symposium of October 1945. Variances toward the seasonal minimum number of perturbation passages at Guam are directly related to the strength and position of the Pacific high pressure cell or ridge.

The ITC also plays an important part in a typhoon's formative stage. Its junction with an easterly wave, identified as the junction vortex, is the initial tropical cyclone from which a tropical depression can be put in warning status. The ITC is a belt of equatorial air, with a normal width of approximately 15° in latitude in the Western Pacific Ocean, which separates the NE trades of the Northern Hemisphere from the SE trades of the Southern Hemisphere. Its boundaries appear as two quasi-parallel lines of intermittent convergence and divergence, which areas vary alternately in length from 300 to 800 miles. This equatorial zone will normally be an area of divergence, but when the width is 10° or less, continuous convergence is expected across the zone. I have, in past years, had soundings which showed a higher moisture content in the equatorial air than that of tropical air at corresponding elevations especially during the formative stage of a tropical storm.

Seasonal effects are observed in the penetration of the northern boundaries of the ITC (NITC) (9) into the Northern Hemisphere. During the summer season, the boundary can surge northward to 25N in the Philippine Sea during low circulation index situations and 15N in high index situations. At these northern positions, the NITC convergence line will dissipate within two days and a new boundary will form in the area between 2N and 5N. This action will follow the movement of long waves from the Asiatic mainland eastward toward Wake Island. Caution is cited for the possible development of the junction vortices in the NITC during these surges, i.e., Typhoon IDA, 1961. During the winter months, the NITC is observed at 2N or S, at the longitude of Guam, as a quasi-stationary system. The convergent boundary of the ITC in the Southern Hemisphere (SITC) (9) has not been ascertained due to lack of data for analysis.

The preceding description of the ITC, major and minor easterly waves, and junction vortex and the inter-action with the long waves brings us to the 48-hour period after fracture time. During this period, the NITC is observed to break or "gate" into the center of the storm. The word, "gate," is used to provide a descriptive term to portray the break of the NITC by opening the flow of high moisture content equatorial air for future development. Also it explains the associated high southerly winds specifically observed in the formation of Typhoons GEORGIA, HOPE, WANDA, GILDA and KAREN in 1962. This phenomenon is illustrated best by streamline analysis at 700mb and below. In addition, special reconnaissance can establish whether the junction vortex or an embedded vortex to the N in the same easterly wave actually becomes the storm. The embedded vortex is the most common case with development expected from 3 to 5 degrees N of the junction vortex. This occurrence is observed in the Philippine Sea and to the SE of the Marianas with a sudden onset of southerly flow into the southern and eastern quadrants of the storm after "gating" time. When "gating" takes place near the time of passage of Guam, increased convective activity continues for an additional 2 or 3 days, with approximately 35 kt surface winds and gusts to 55 kts beginning on the second day.

A higher frequency of synoptic fixed track aerial reconnaissance in several previous years concerning the junction vortex has shown the following analogy and the observed result.

1. Weak or open northern quadrants with strong convergent southern quadrants will upon fracture indicate development of the embedded vortex with subsequent "gating."

2. Strong convergent northern quadrants with weak or

open southern quadrants will upon fracture indicate development of the junction vortex alone, which will normally not exceed tropical storm warning status, if it should intensify.

The junction vortex is initially the stronger and masks the circulation of the embedded vortex to its N. After fracture, the embedded vortex normally develops rapidly at the expense of the junction vortex, except as noted in the preceding paragraph, giving the impression that the storm has suddenly jumped 200 to 300 mi to the N. When final development is ascertained to be from an embedded vortex, the postanalysis track is in error if drawn by connecting the embedded vortex positions with those of the junction vortex. Two tracks should be drawn, if the points can be substantiated, and be connected by a dashed N-S line to show visually this formation phenomenon at the established "gating" time.

IV. Movement of Tropical Cyclones

The initial movement of tropical cyclones in the easterlies has been theoretically developed by Yeh (18) and verified by storm tracks fixed by reconnaissance. Yeh's oscillatory track for tropical cyclones has been a valuable contribution to forecasting movement. Empirical verification of the expected oscillations about the mean tracks in the Pacific gave curves of one degree amplitude with a period of 24 to 40 hours as compared with Yeh's maximum of two-thirds of a degree and 48 to 60 hours in the Atlantic. Maximum amplitudes are found with incipient storms, the amplitudes decrease as the tropical cyclones intensify, recurve, and/or increase their speed of movement.

Fujiwhara effect between two tropical cyclones classically occurred last in 1961 with Typhoons HELEN and IDA. Partial Fujiwhara movement during 1962 occurred with GILDA and IVY, and EMMA and FREDA.

When the long wave progresses E of the Marianas to the vicinity of Marcus and Wake Islands, it leaves a weak pressure gradient over the Philippine Sea between 15N and 25N. This affects the initial movement of typhoons by permitting the storm to move directly N as the subtropical ridge line reforms. Such a synoptic situation has been repeatedly noted during the 48 hours subsequent to fracture in the vicinity of Guam, when a storm is located at approximately 15N. Storms S of this latitude will normally not be affected, but the others are subjected to premature recurvature and being reversed in direction as the ridge line rapidly reforms. Typhoon KAREN, 1962, was an excellent example of this movement pattern.

Persistent movement of tropical cyclones in low latitudes is wholly dependent on the criteria previously set forth with the long waves and the latitudinal position of the cyclone itself. Application of these relationships are normally by inspection, and the resultant forecasts are straightforward.

Recurvature of tropical cyclones (3) N of 15N is always directly associated with the long waves as outlined below.

1. Tropical cyclones will recurve into stationary or slowly progressive long waves.

2. Tropical cyclones will not recurve into fast-moving long waves as the period is too short to allow the storm to be dominated by its influence.

3. Retrogression of the long wave normally does not permit a tropical cyclone to recurve, but it will accelerate the tropical cyclone westward as the anticyclone to the E spreads rapidly westward, i.e., Typhoon GILDA, 1962.

4. Tropical cyclones will not recurve into minor troughs, but they will cause a temporary increase in the northward component of the storm's movement.

Yeh enters the picture again at this point with his four theoretical recurvature trajectories. The four equidistant positions along one segment of the oscillatory track produced only one valid trajectory which occurred after the anticyclonic portion of its track.

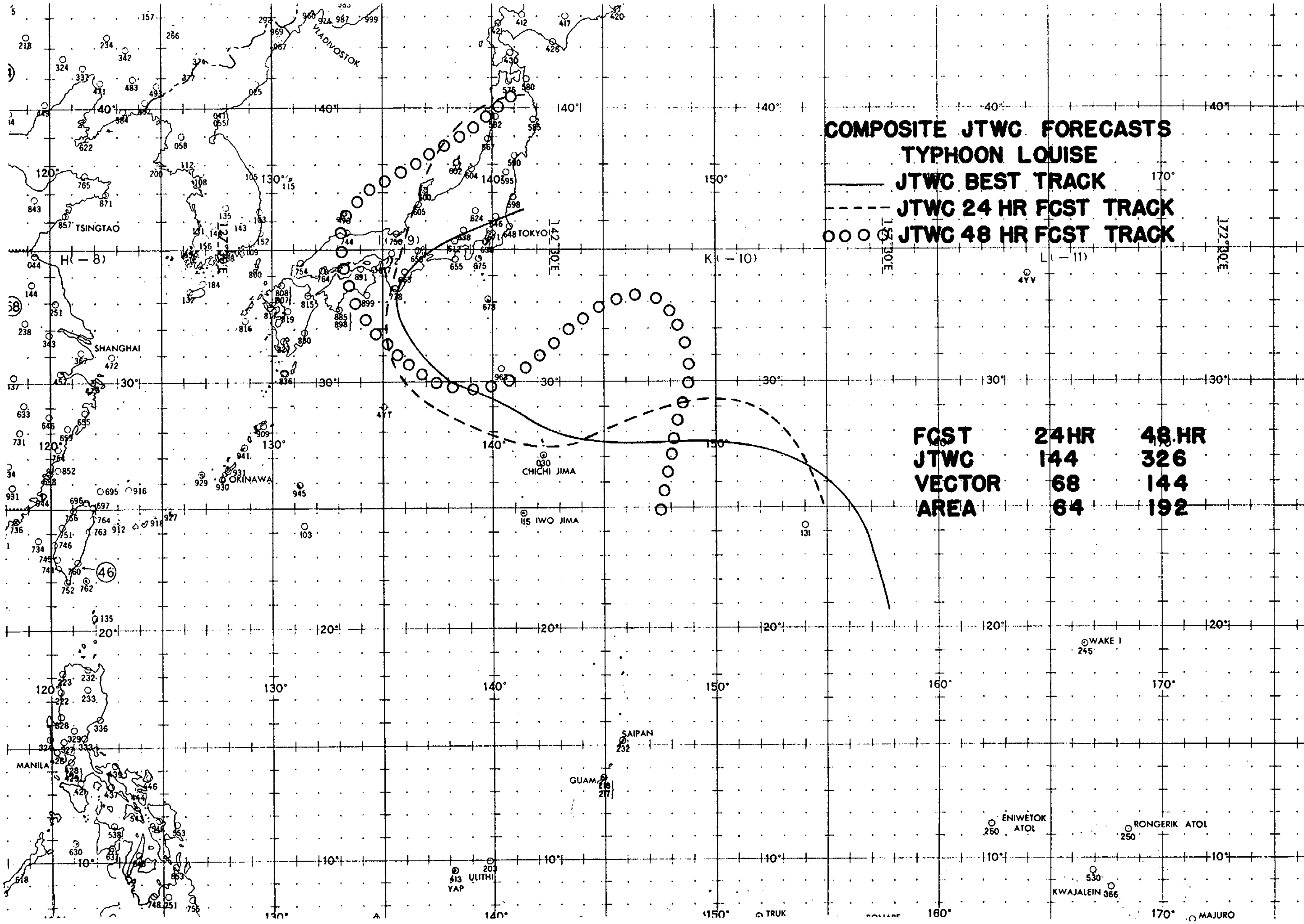
The zonal wind (3) conditions for recurvature, favorable and unfavorable, but not available for use in the

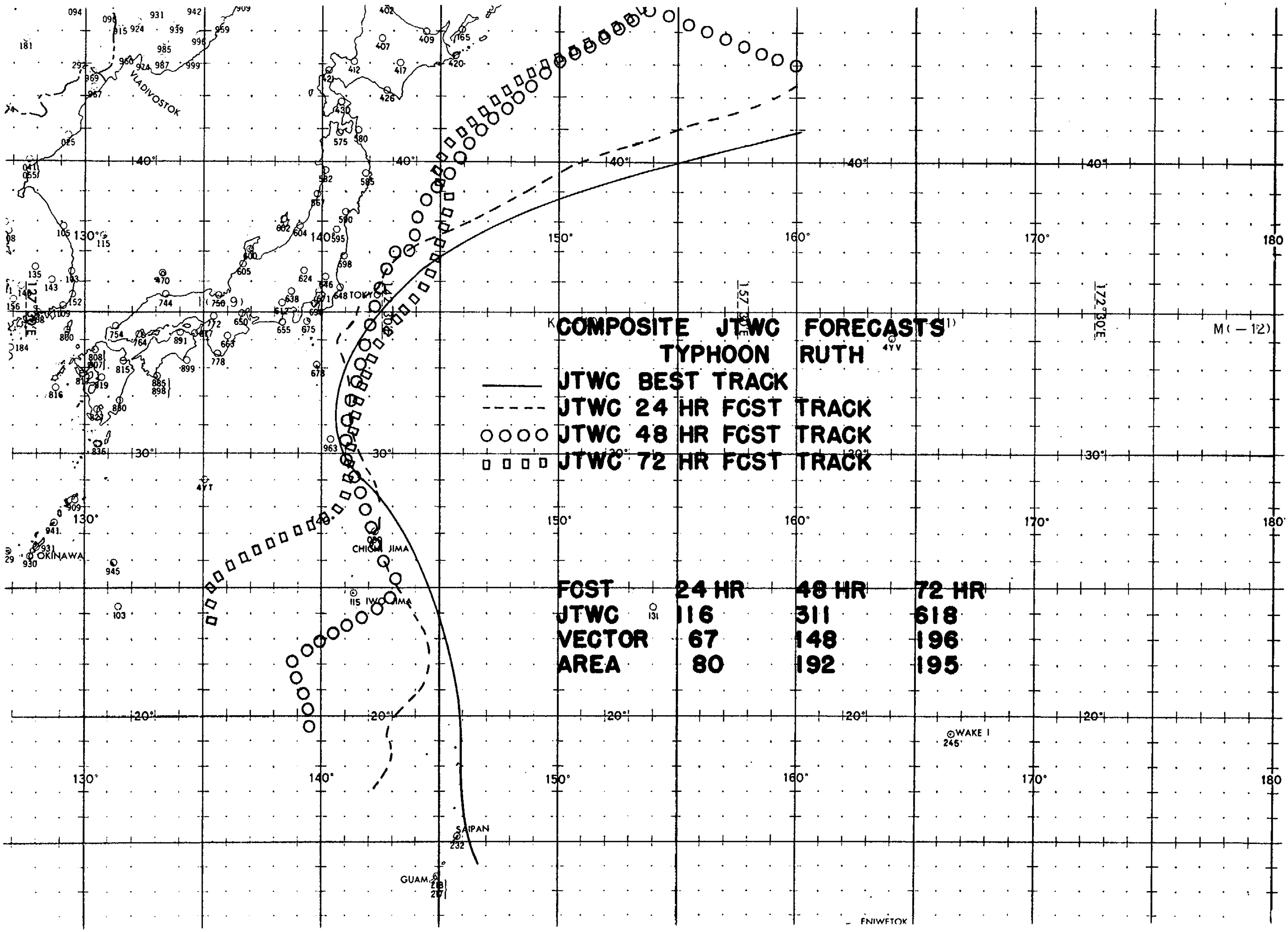
1961 and 1962 seasons.

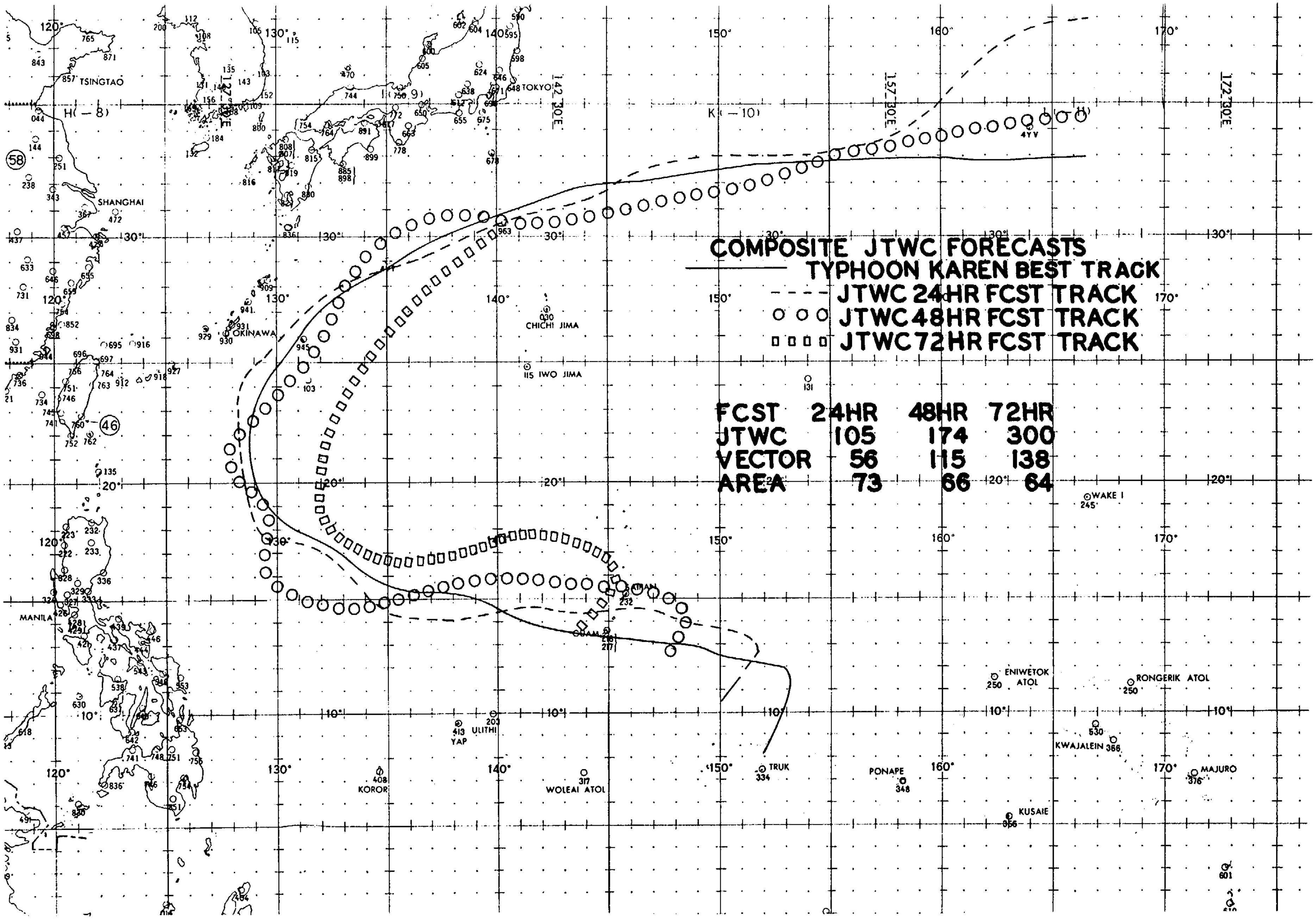
Operationally, 72-hour forecasts were made internally by JTWC and based on 120 cases provided an error of 476 MI, which was within the same tolerance of error as the 24 and 48-hour forecasts. When warning responsibility for Typhoon KAREN was passed to Fuchu Air Force Weather Central, Japan, JTWC's six day forecast track was included. It averaged a degree inside the "best" track on postanalysis. Extended forecasts should be the ultimate goal of every warning center. With them, consumers can make adequate securing and evacuation plans. KAREN's initial 72-hour warning for Guam was JTWC's best example of this capability.

A new briefing system is proposed for the customer to basically portray the "best" track with the actual 24, 48, and 72-hour tracked positions and show the actual areas warned by these categories of forecast times. Two approximation systems have been selected for 3 forecast times: first, perpendicular vectors at 60 mile intervals as positive values whether left or right of "best" track were averaged; and secondly, by area which is resolved as a scalar value from the "best" track. Typhoons LOUISE, RUTH and KAREN are so depicted by the following charts.

Acknowledgment: I extend my appreciation to the members of the Typhoon Post-Analysis Board and the Joint Typhoon Warning Center with whom I was associated during my two tours on Guam, 1950-51 and 1961-62, respectively, for their typhoon forecasts, cooperation, and investigations in support of this important meteorological and operational program. I wish to add special mention for the weather reconnaissance squadrons assigned the hazardous mission to penetrate or track typhoons routinely on a fixed schedule. Captain W. J. Kotsch, USN, Commanding Officer FWC/JTWC, has my sincere thanks for his faith, loyalty, and autonomy in my direction of JTWC.


COMPOSITE JTWC FORECASTS
TYPHOON LOUISE
JTWC BEST TRACK
JTWC 24 HR FCST TRACK
JTWC 48 HR FCST TRACK
FCST 24HR 48HR
JTWC 144 326
VECTOR 68 144
AREA 64 192
VLADIVOSTOK
TSINGTAO
SHANGHAI
TOKYO
OKINAWA
CHICHI JIMA
IWO JIMA
MANILA
SAIPAN
GUAM
WAKE I
ENIWETOK ATOL
RONGERIK ATOL
KWAJALEIN
ULITHI
YAP
TRUK
MAJURO


COMPOSITE JTWC FORECASTS
TYPHOON RUTH
JTWC BEST TRACK
JTWC 24 HR FCST TRACK
JTWC 48 HR FCST TRACK
JTWC 72 HR FCST TRACK
FCST 24 HR 48 HR 72 HR
JTWC 116 311 618
VECTOR 67 148 196
AREA 80 192 195
VLADIVOSTOK
TOKYO
OKINAWA
CHICHI JIMA
IWO JIMA
SAIPAN
GUAM
WAKE I
ENIWETOK
40°
30°
20°
130°
140°
150°
160°
170°
180


COMPOSITE JTWC FORECASTS
TYPHOON KAREN BEST TRACK
JTWC 24HR FCST TRACK
JTWC48HR FCST TRACK
JTWC72HR FCST TRACK
FCST 24HR 48HR 72HR
JTWC 105 174 300
VECTOR 56 115 138
AREA 73 66 64
TSINGTAO
SHANGHAI
TOKYO
OKINAWA
CHICHI JIMA
IWO JIMA
MANILA
GUAM
WAKE I
ULITHI
YAP
KOROR
WOLEAI ATOL
TRUK
PONAPE
KUSAIE
ENIWETOK ATOL
RONGERIK ATOL
KWAJALEIN
MAJURO

EVALUATION OF STATISTICAL AND COMPUTER TYPHOON FORECASTING PROCEDURES

by

Capt William D. Roper, USAF

Three techniques, the Arakawa, Miller-Moore and Fleet Numerical Weather Facility Computer forecasts from Monterey, California, were used as aids to assist the Joint Typhoon Warning Center (JTWC) in determining tracks and speeds of movement of typhoons during the 1962 season. The development of the forecasting methods will not be shown in this report; however, one may refer to the 1961 Annual Typhoon Report for background material on the Arakawa method (17) and the re-evaluation of the constants in the regression equations for the Miller-Moore, which was originally developed for hurricanes in the Atlantic (8). Tilden's report at the 1960 Typhoon Symposium has basic information on Miller-Moore's principle (16).

The Arakawa method uses surface parameters to give 24 and 48-hour forecast positions every six hours as well as central pressure forecasts. The Miller-Moore system utilizes 700mb data to give 24-hour forecast positions every 12 hours. FNWF Computer model uses 500mb data supplemented by JTWC's Bulletin positions of the storm's center to give 6, 12, 18, 24, 36, 48 and 72-hour forecast positions every six hours. The synoptic time for upper level winds is used as the base time for the beginning of the forecast periods; thus, at 0000Z and 1200Z, each forecast interval is decreased by 12 hours.

To evaluate the three techniques in comparison with JTWC's forecasts, three typhoons were selected as being representative of the 1962 season. The first and last typhoons and one during the middle part of the year were chosen. The best track of each storm is given and the 24 and 48-hour forecast track for each method is shown as well as the mean error for the typhoon in nautical miles. A mean best track of the recurving typhoons, of which there were 17 during 1962, and a mean best track of the non-recurving typhoons, of which there were 7, is presented with the mean forecasts of each method used as well as

JTWC's prognosis. The vector error of the Arakawa, Miller-Moore, FNWF and JTWC forecasts for all typhoons is tabulated. It should be pointed out that JTWC's forecast is an operational one, which means that in regard to the other systems, our forecast, even though it is valid for the same time periods, is prepared before the data to compute their forecasts is plotted or analyzed.

A 24-hour forecast track is obtained by connecting successive 24-hour forecast positions every six hours. Comparing GEORGIA's best track with Arakawa's 24-hour forecast track (Chart 1), one can see where the best result occurred. The original forecast fell to the N of track; however, no excessive error is shown in relation to variance from the best track. The forecast of GEORGIA's recurvature lagged by nearly 5 degrees. This tends to show the amount of persistence of movement built into the system. After recurvature, GEORGIA moved consistently to the NE, and the Arakawa forecast did quite well. Then near 27N, GEORGIA began to move northward and accelerate. Once again, persistence of movement associated with Arakawa's method came into consideration, and since GEORGIA's speed of movement was near 40 kts in this area, large spreading or error of the forecast track occurred. The same trend is shown from the 48-hour forecast track with recurvature forecast to occur near 25N. As GEORGIA began to pull rapidly toward a mid-latitude trough, she became extratropical before the 48-hour forecast could indicate a northward movement.

The Miller-Moore method and JTWC's forecasts show very similar results in that each lagged in recurvature and both failed to forecast the more northerly movement of GEORGIA near 27N, initially, in varying degrees (Charts 2 & 3). During the beginning of GEORGIA as she was performing a cyclonic loop, both Miller-Moore and JTWC indicated a slow WNW movement. No forecasts were received from FNWF for GEORGIA as their program did not begin until 1 July 1962.

In summary, the largest errors for all systems of forecast occurred after GEORGIA accelerated and changed direction from NE to an almost straight N path. The other errors were made during recurvature and at the beginning when she performed the cyclonic loop. GEORGIA was the first typhoon of 1962 and existed in tropical warning status for 7½ calendar days between 161200Z and 240000Z April. She existed as a typhoon for 5 3/4 calendar days.

AMY, an example of a recurving storm, existed in tropical warning status from 290600Z August to 080000Z September, or for 9 3/4 calendar days of which she remained in typhoon intensity for 6¼ days. The areas affected by the forecast track of AMY for the Arakawa, Miller-Moore and JTWC are almost identical (Charts 4, 5 & 7). Originally, AMY followed the forecast tracks to the NW, but as she began to move more westerly, all forecasts fell to the N of the best track. A slight lag on forecasting recurvature is shown; however, in general, the forecast path was very near the best track until dissipation.

FNWF Computer forecast track was good in the beginning, picking up the W trend; however, as AMY began to move NW in the vicinity of Taiwan and recurve, the forecast path became somewhat erratic (Chart 6).

LUCY, the final typhoon of the season, existed in tropical warning status for 6 3/4 calendar days between 250000Z November and 011800Z December, maintained typhoon intensity for 3½ calendar days and was a non-recurving storm. The Arakawa and FNWF forecast tracks follow the best track in an almost exact manner (Charts 8 & 10); however, the Miller-Moore and JTWC forecasts show a tendency to fall to the N of LUCY's actual path (Charts 9 & 11).

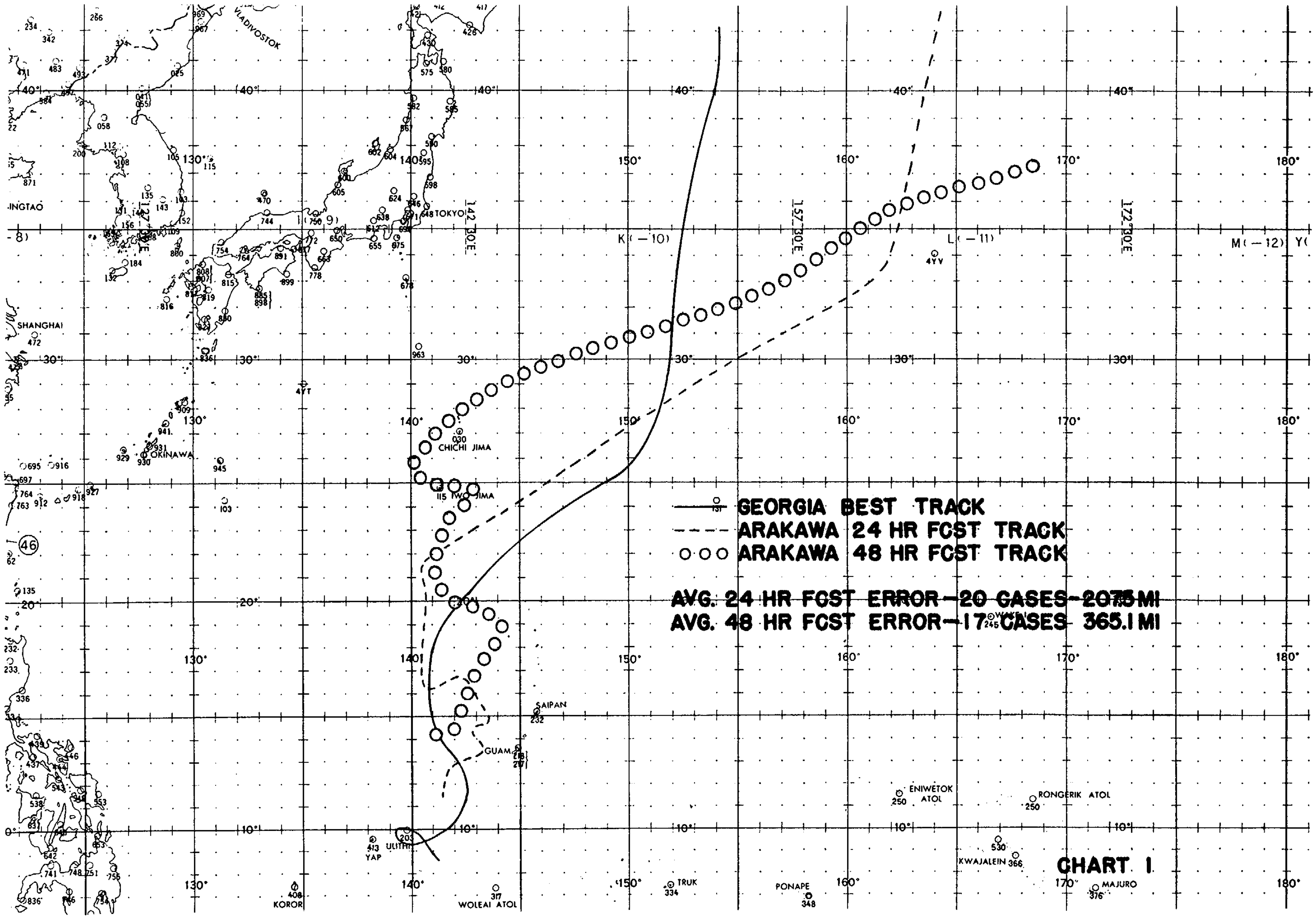
The mean best track for all recurving storms extends between the islands of Truk and Yap, then is bounded by 135E and 140E until 100 mi S of Tokyo, thence NE to 41N (Chart 12). Two points of recurvature are shown, one near 16N and the other near 27N. The mean best track and mean forecast tracks for each method were computed for the recurving storms by averaging all longitudinal positions for each degree of latitude. The closest part of mean forecast track to mean best track of the recurving typhoons is found in the Miller-Moore technique with the two paths very nearly coinciding N of 24N (Chart 14). Some difficulty is noted near the first point of recurvature and at the beginning of the Miller-Moore forecast track. The Arakawa, FNWF and JTWC mean forecasts show a greater variance from the best track during recurvature and by falling N of the actual positions in the beginning (Charts 13, 15 & 16). FNWF forecast is the only system which has a mean track penetrating Japan.

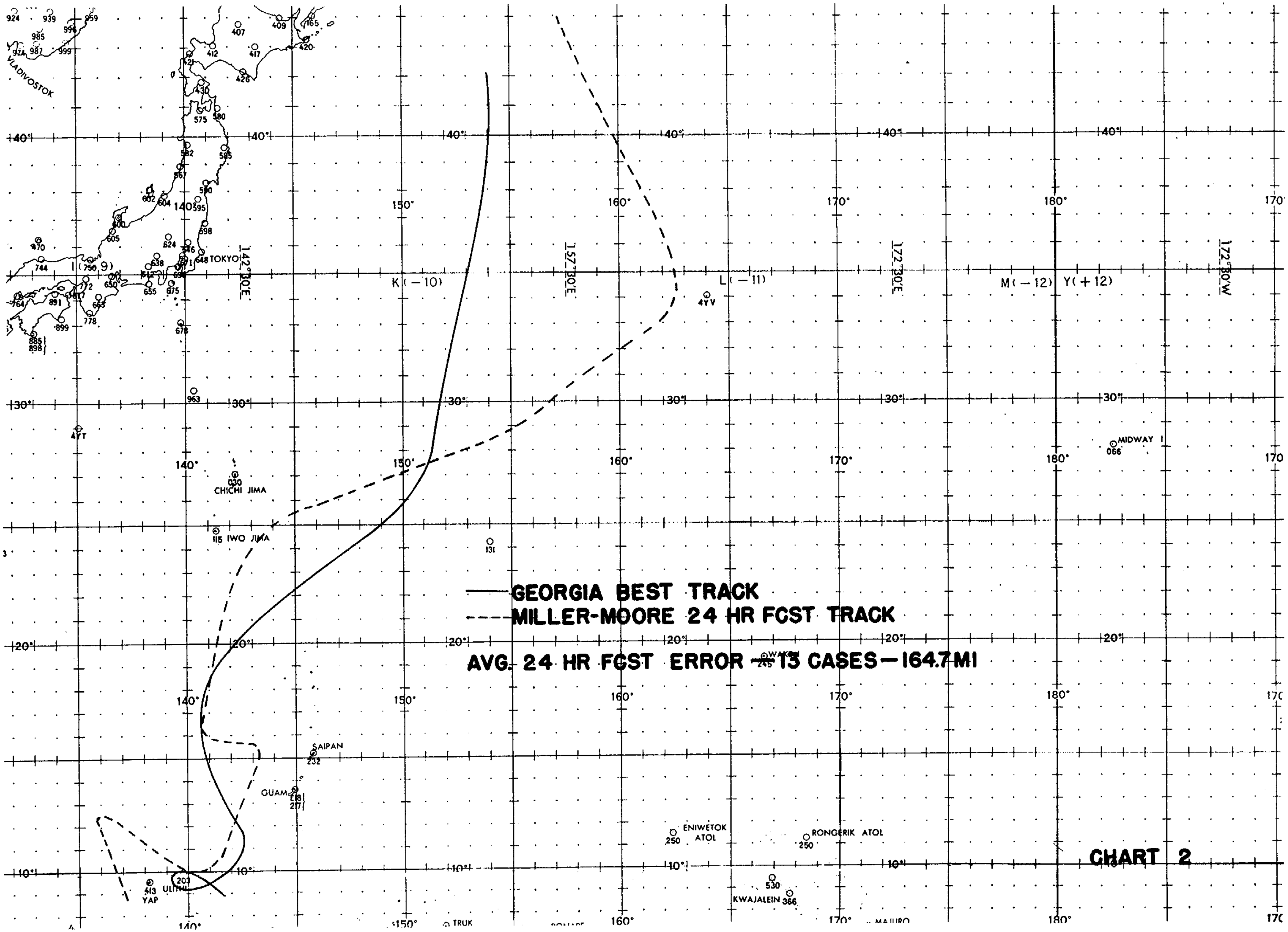
The mean best track and mean forecast tracks for the non-recurving storms was obtained by averaging all latitudinal positions for each degree of longitude. The mean best track extends from just N of Yap Island through the northern part of Luzon, westward to 115E and then drops southwestward into Indo-China near 15N (Chart 12). The Arakawa 24 and 48-hour forecast track is similar to JTWC's in that both forecast too great a N component on the storm's positions, especially E of the Philippines (Charts 17 & 20). This is much more evident on the 48-hour forecast. The best mean forecast tracks for 24 hours is by the Miller-Moore and FNWF Computer model with the latter's 48-hour forecast also showing excellent results (Charts 18 & 19).

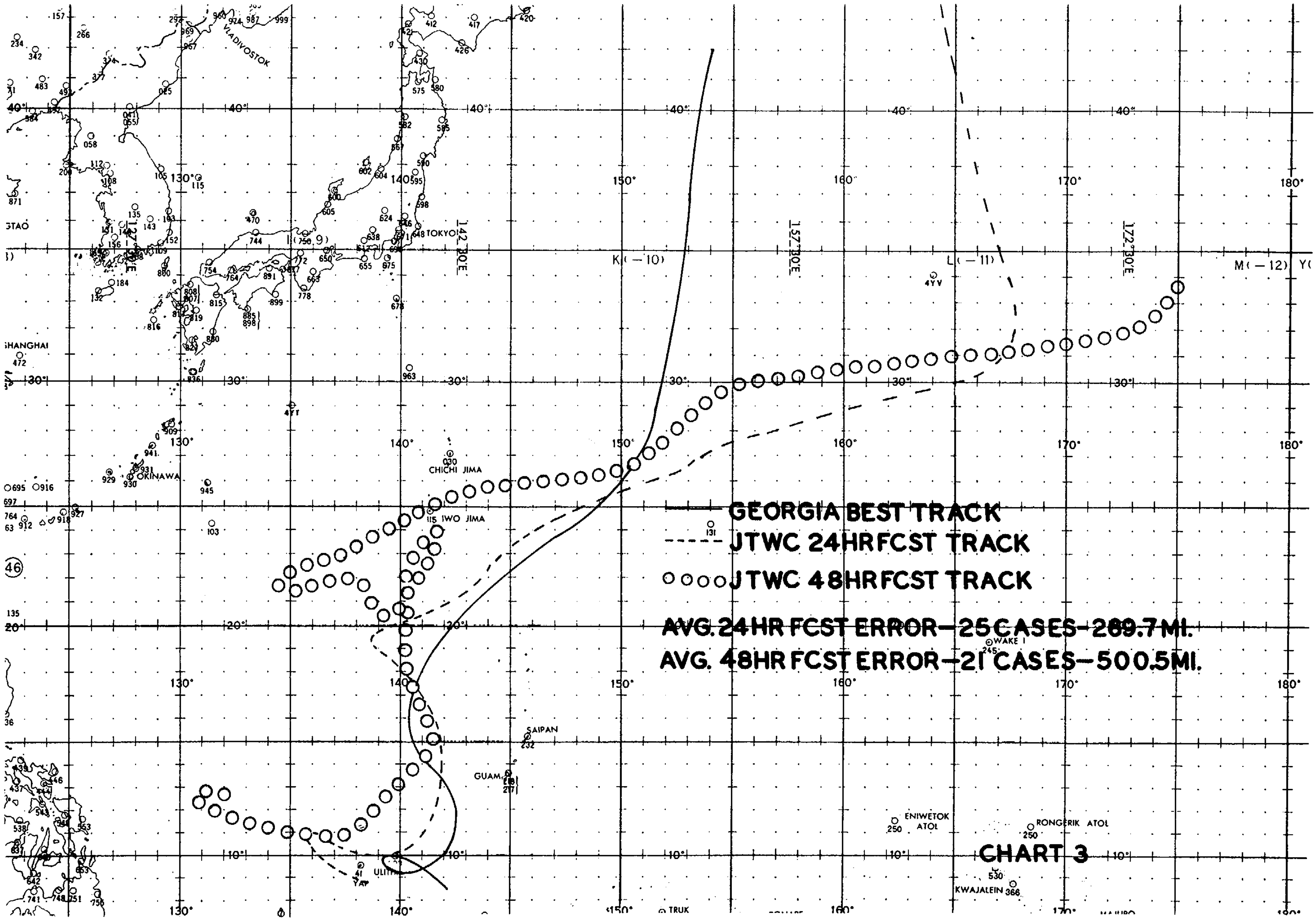
In conclusion, the Miller-Moore method was the most accurate aid that JTWC had available for recurving storms with the Arakawa giving the best forecast for non-recurving storms. Weaknesses of all systems are most evident in the beginning and through recurvature. The Miller-Moore and Arakawa rely heavily upon persistence of movement. When the storm is changing direction, accelerating or decelerating, the largest errors occur. Normally, as the storm recurves, both systems fall to the left of track and the forecast speed of movement is excessive. In general, a typhoon that accelerates will cause the Miller-Moore and Arakawa forecasts to be short of the existing position while one that decelerates will cause both methods to overshoot the actual position. By looking at the mean error of the recurvature vs. the non-recurvature storms, one can see that the recurving storms prove to be the most difficult for all forecasting methods. The excessive number of recurving storms during the past season explains why the mean forecast error of JTWC for 1962 was higher than in 1961. Eleven recurving and 9 non-recurving typhoons occurred during the 1961 season vs. 17 and 7, respectively, in 1962.

Another point of interest is that FNWF track forecasts for the non-recurving storms, even though at lower latitudes, was considerably better than the recurving storms in higher latitudes. This, in part, could be caused by the fact that the non-recurving storms, on the average, were not nearly as strong or well developed in the vertical. Correspondence during the year from Monterey indicated that their model worked best when the storm's closed circulation was weak at the 300mb level. The forecast speed of movement of the typhoons was, as a whole, much slower than the verified speed. LUCY can be cited as an example of this fact. Excellent direction forecast is evident, yet the average forecast error for 24 and 48 hours was 208 MI and 476 MI, respectively.

The greatest variance in track forecast of all methods occurred, for both recurving and non-recurving storms, in the area bounded by 15N and 25N, 130E and 140E. This would indicate the need for a new forecasting technique to determine whether a typhoon is going to recurve or continue on a more westerly track early in the storm's beginning phase. At the present time, JTWC is considering the feasibility of developing an analogue system based on climatology to assist the forecaster in steering typhoons below 20N.


GEORGIA BEST TRACK
ARAKAWA 24 HR FCST TRACK
ARAKAWA 48 HR FCST TRACK
AVG. 24 HR FCST ERROR—20 CASES—207.5 MI
AVG. 48 HR FCST ERROR—17 CASES 365.1 MI
CHART I
VLADIVOSTOK
TOKYO
SHANGHAI
OKINAWA
CHICHI JIMA
IWO JIMA
SAIPAN
GUAM
ULITHI
YAP
KOROR
WOLEAI ATOL
TRUK
PONAPE
ENIWETOK ATOL
RONGERIK ATOL
KWAJALEIN
MAJURO
WAKE


GEORGIA BEST TRACK
MILLER-MOORE 24 HR FCST TRACK
AVG. 24 HR FCST ERROR — 13 CASES — 164.7 MI
CHART 2
VLADIVOSTOK
TOKYO
CHICHI JIMA
IWO JIMA
SAIPAN
GUAM
ULITHI
YAP
MIDWAY I
ENIWETOK ATOL
RONGERIK ATOL
KWAJALEIN
TRUK
142°30'E
157°30'E
172°30'E
172°30'W
K (−10)
L (−11)
M (−12)
Y (+12)


GEORGIA BEST TRACK
JTWC 24HR FCST TRACK
JTWC 48HR FCST TRACK
AVG. 24HR FCST ERROR—25 CASES—269.7 MI.
AVG. 48HR FCST ERROR—21 CASES—500.5 MI.
CHART 3
VLADIVOSTOK
TOKYO
SHANGHAI
OKINAWA
CHICHI JIMA
IWO JIMA
SAIPAN
GUAM
WAKE I
ENIWETOK ATOL
RONGERIK ATOL
KWAJALEIN
ULITHI
TRUK

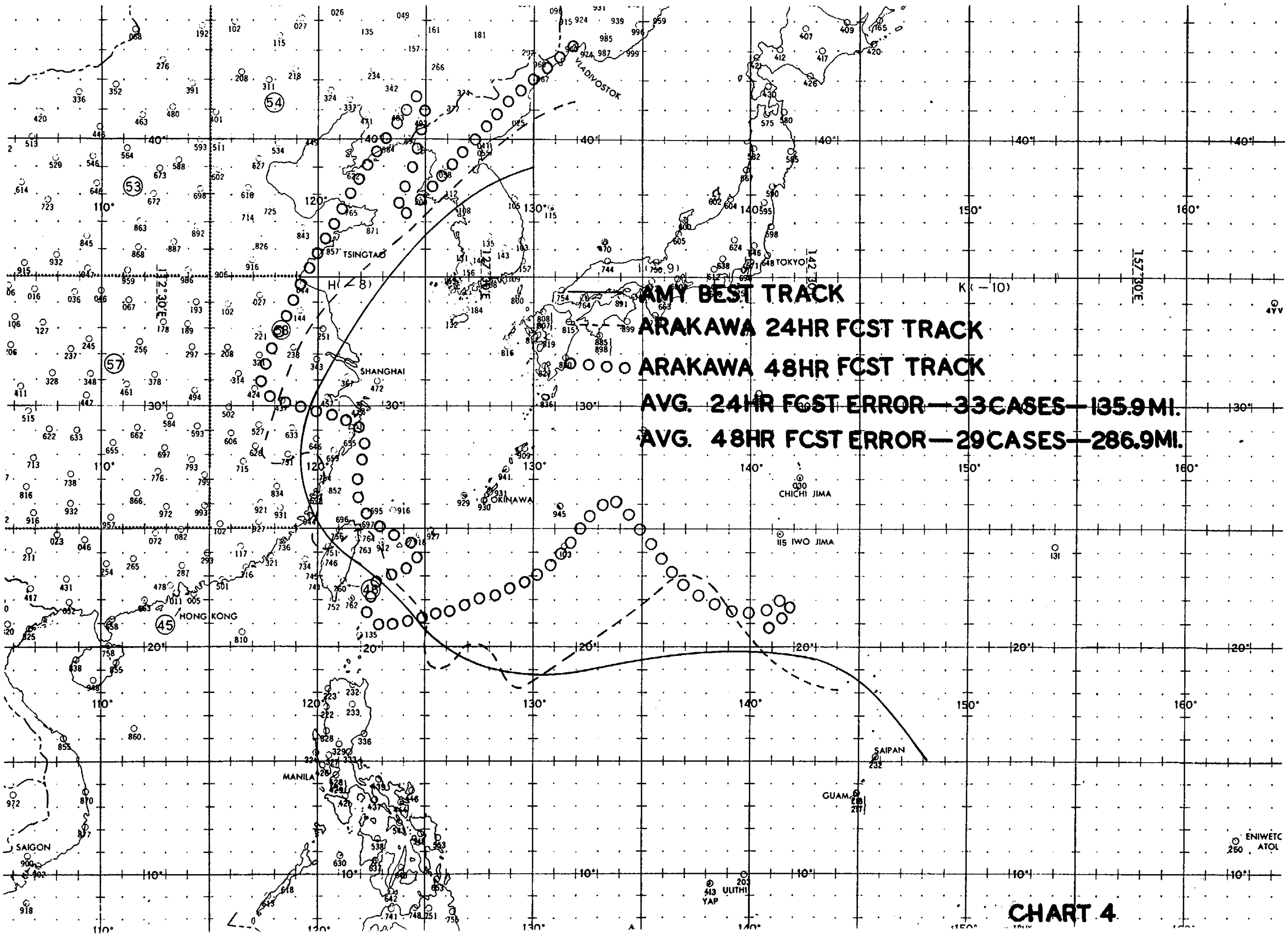
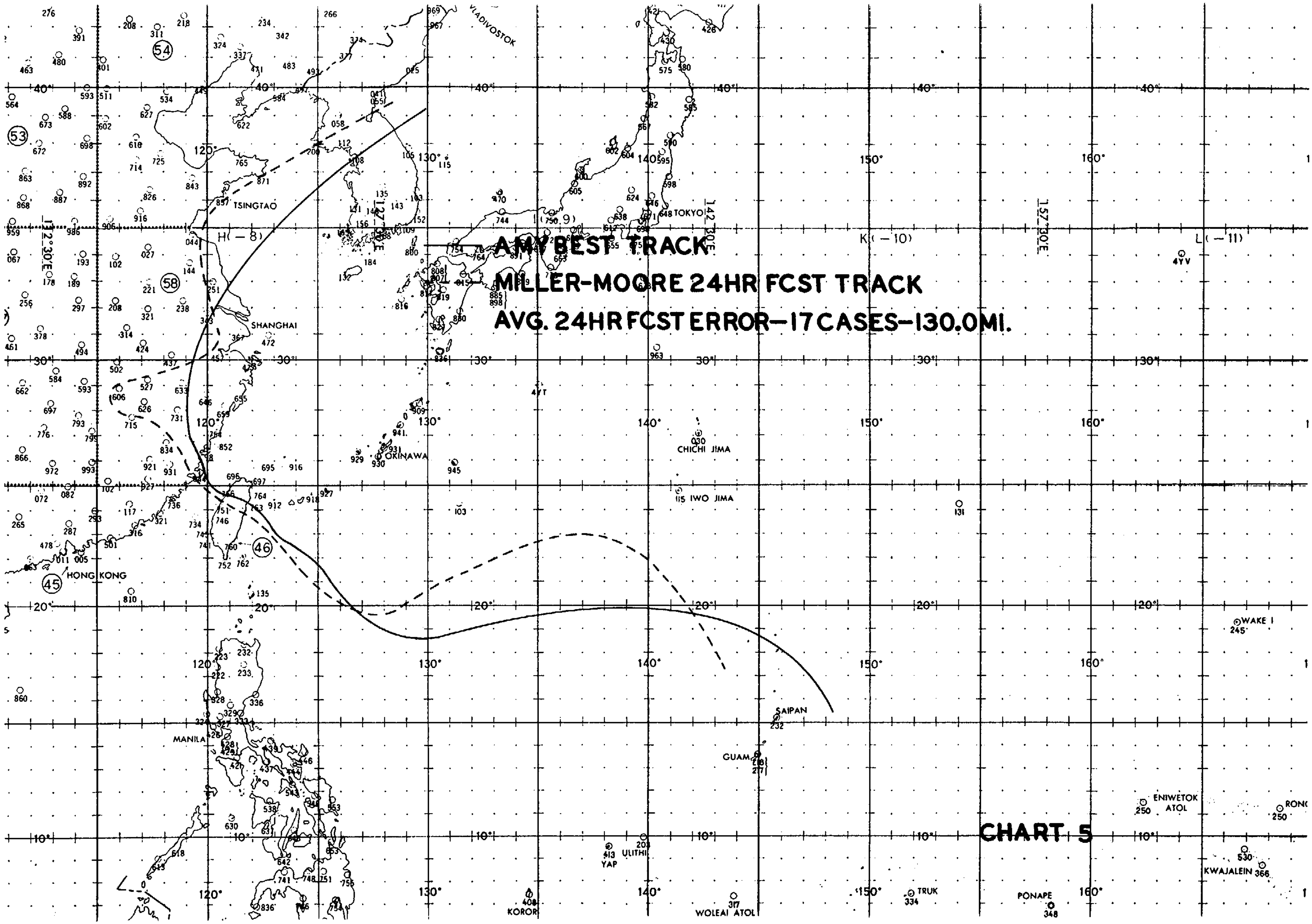
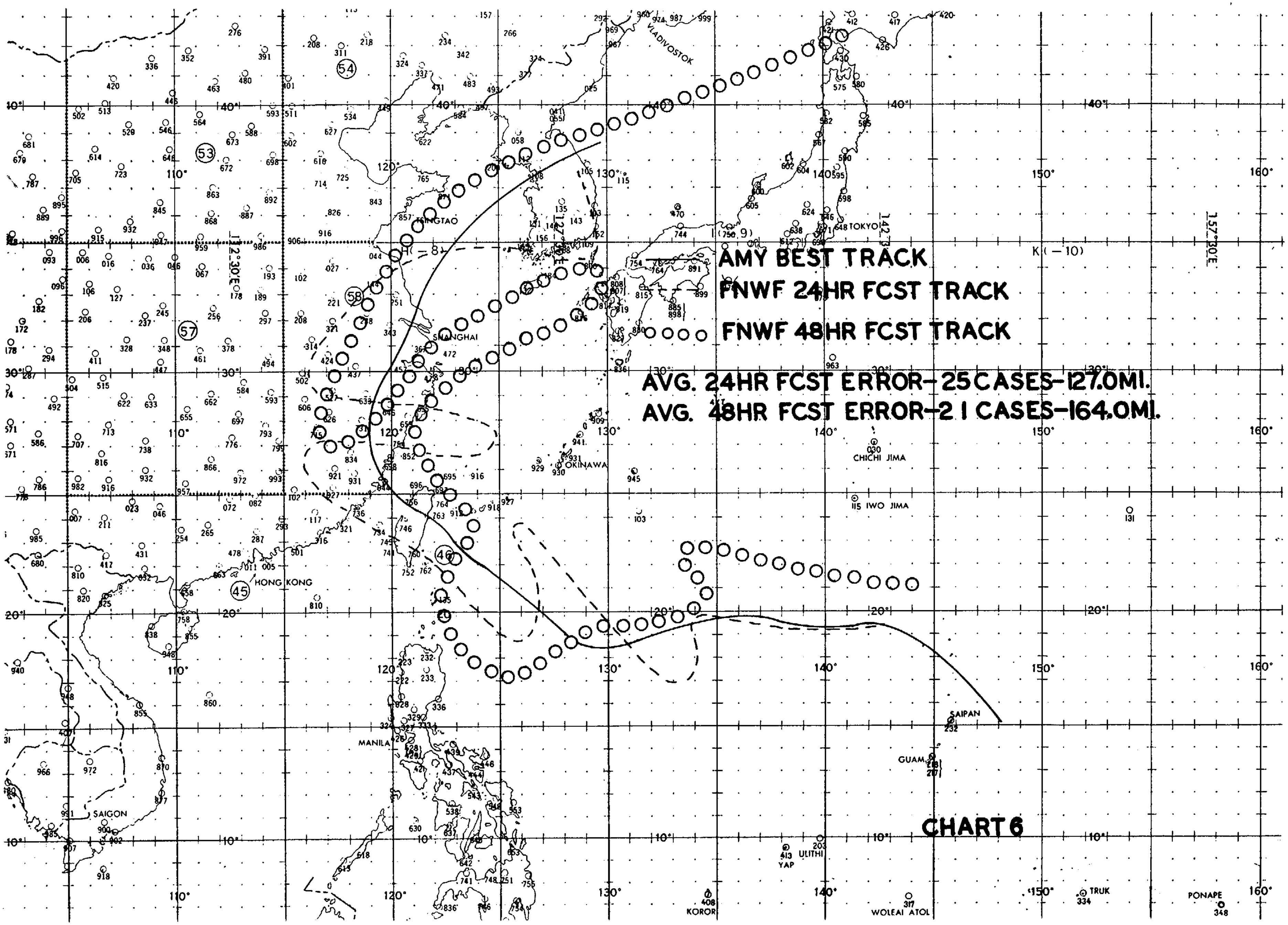
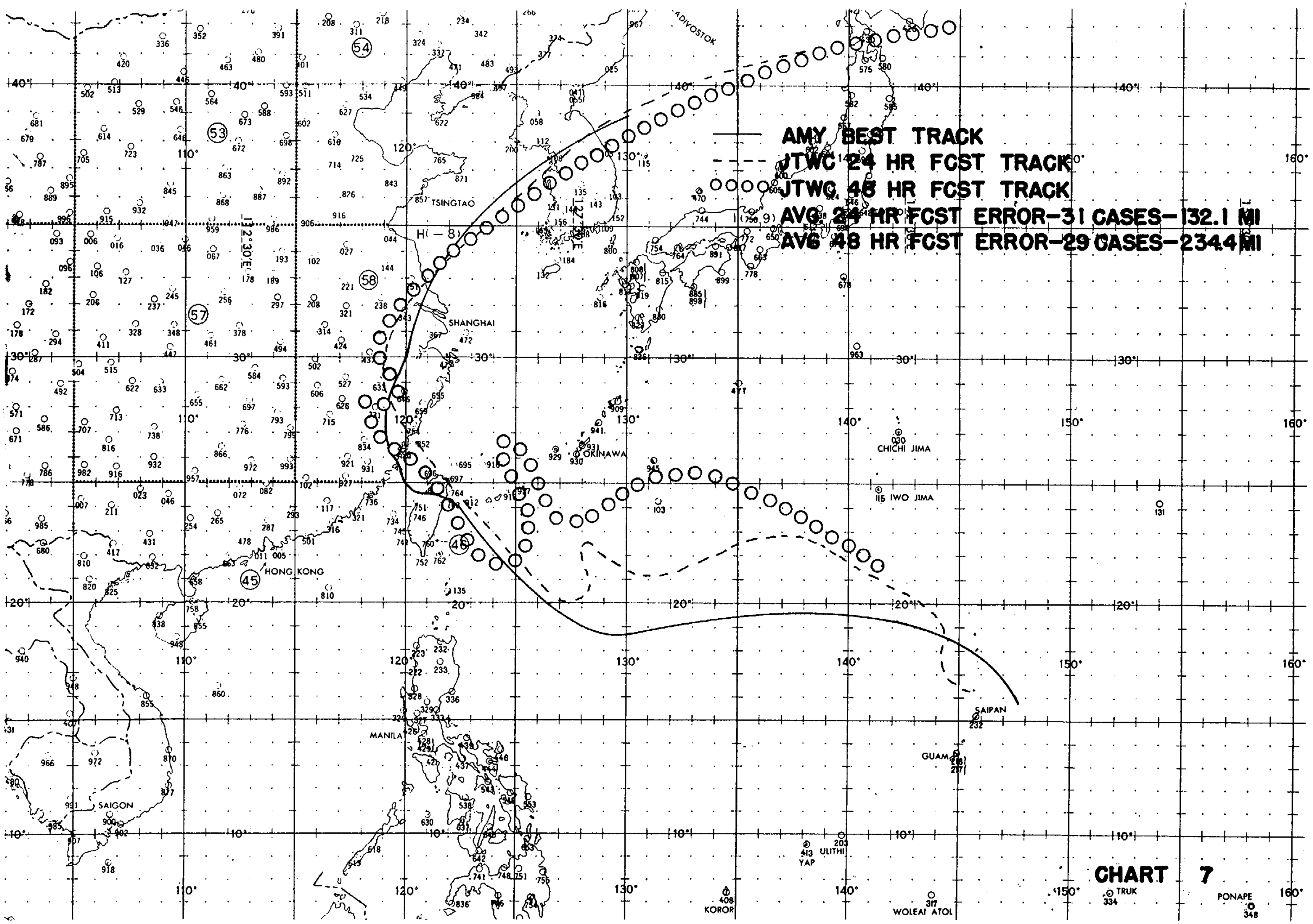
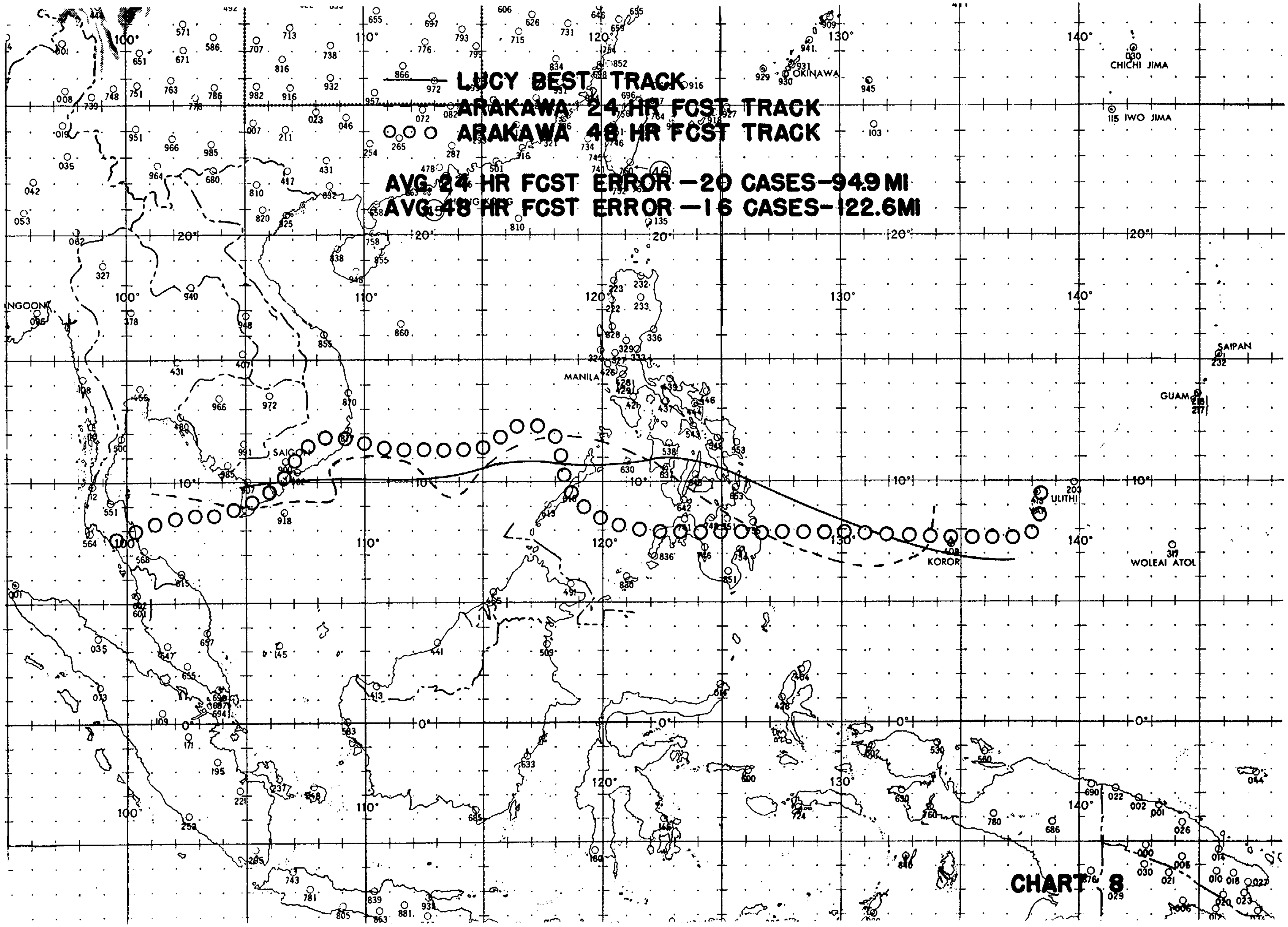

AMY BEST TRACK
ARAKAWA 24HR FCST TRACK
ARAKAWA 48HR FCST TRACK
AVG. 24HR FCST ERROR—33CASES—135.9MI.
AVG. 48HR FCST ERROR—29CASES—286.9MI.
VLADIVOSTOK
TSINGTAO
SHANGHAI
HONG KONG
OKINAWA
TOKYO
CHICHI JIMA
IWO JIMA
MANILA
SAIGON
SAIPAN
GUAM
ULITHI
YAP

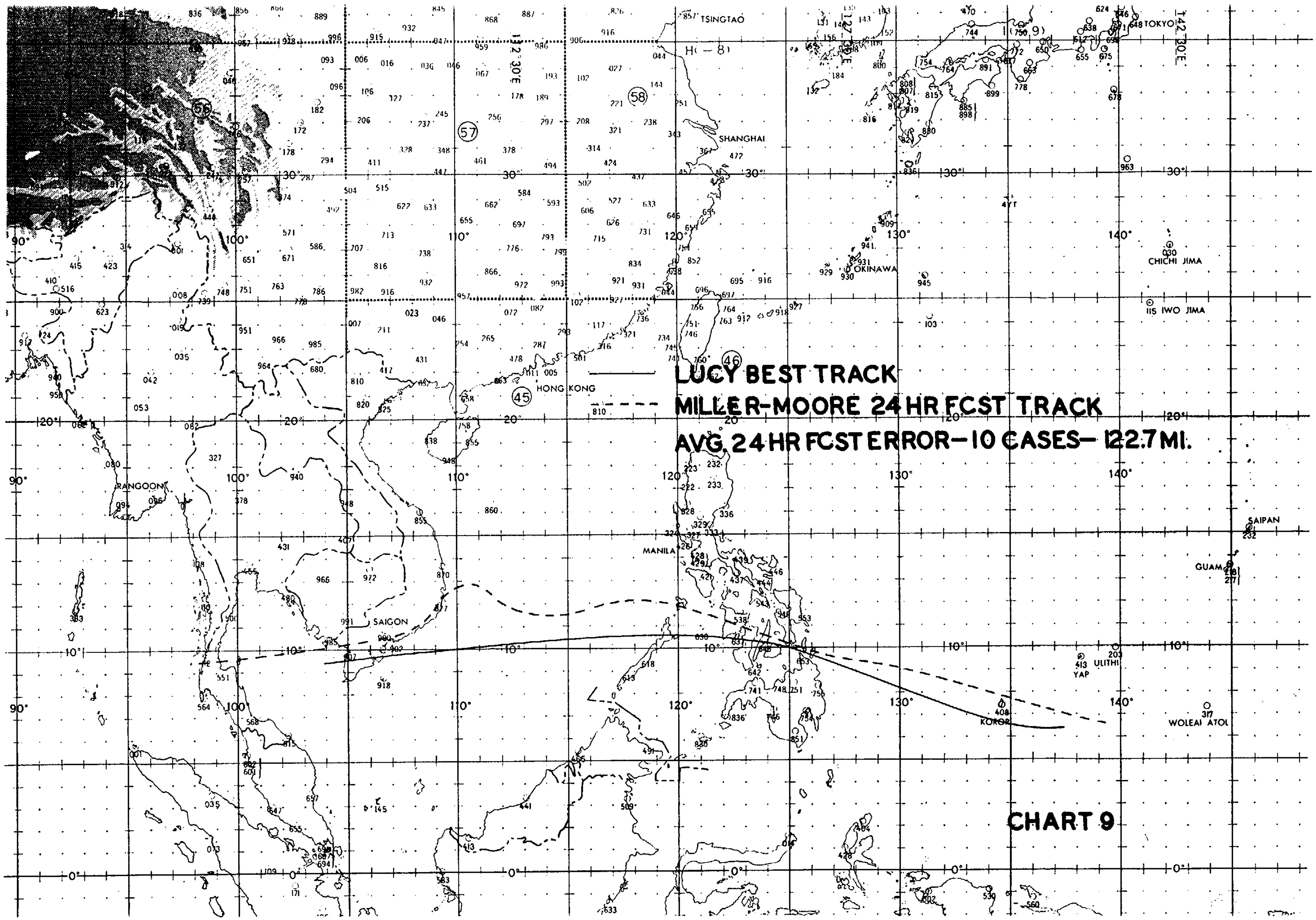
CHART 4

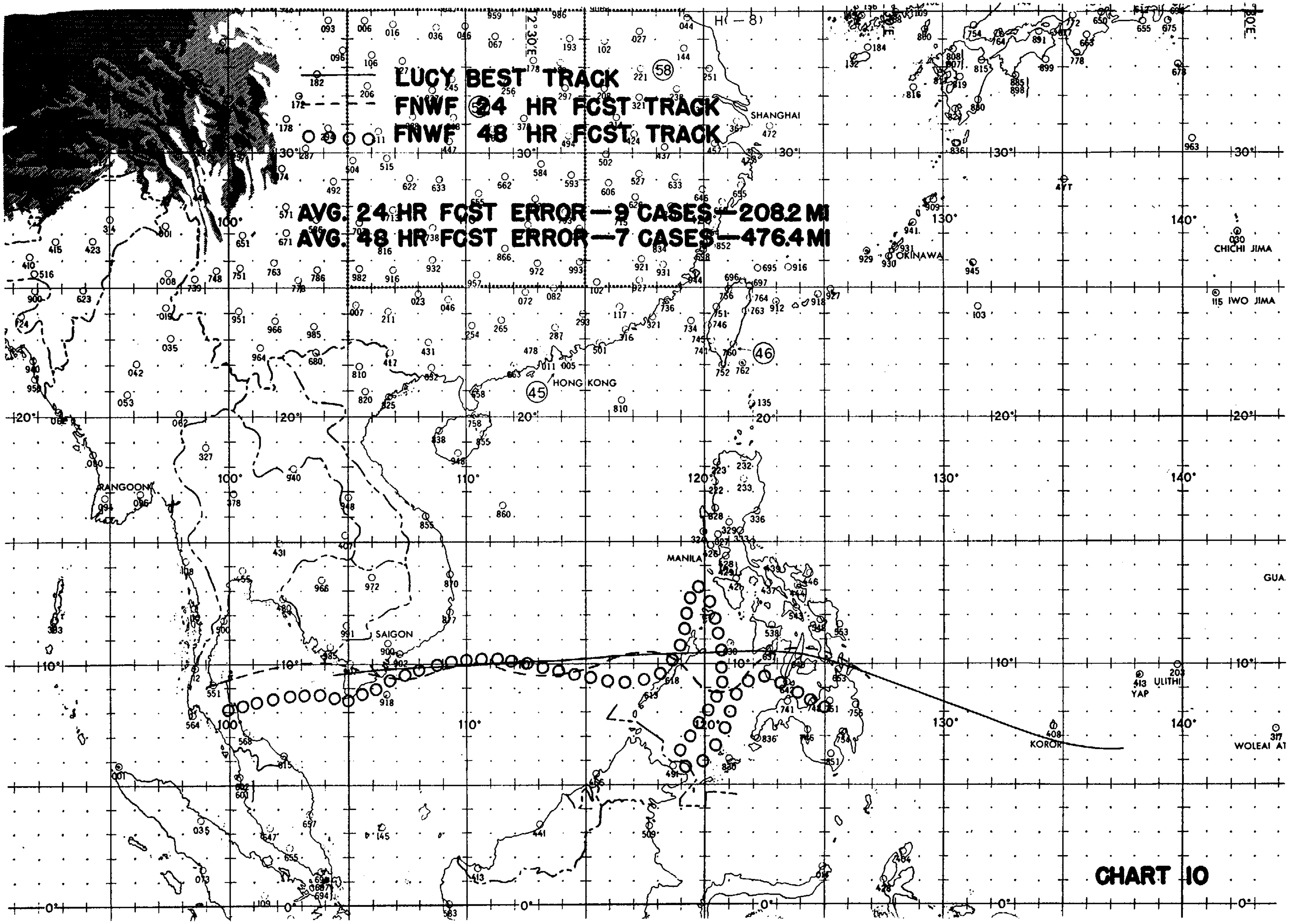

AMY BEST TRACK
MILLER-MOORE 24HR FCST TRACK
AVG. 24HR FCST ERROR—17 CASES—130.0MI.
CHART 5
VLADIVOSTOK
TSINGTAO
SHANGHAI
HONG KONG
MANILA
OKINAWA
TOKYO
CHICHI JIMA
IWO JIMA
SAIPAN
GUAM
YAP
ULITHI
KOROR
WOLEAI ATOL
TRUK
PONAPE
ENIWETOK ATOL
KWAJALEIN
WAKE I


AMY BEST TRACK
FNWF 24HR FCST TRACK
FNWF 48HR FCST TRACK
AVG. 24HR FCST ERROR- 25 CASES-127.0MI.
AVG. 48HR FCST ERROR-21 CASES-164.0MI.
CHART 6
VLADIVOSTOK
TSINGTAO
SHANGHAI
TOKYO
HONG KONG
OKINAWA
CHICHI JIMA
IWO JIMA
MANILA
SAIGON
SAIPAN
GUAM
ULITHI
YAP
KOROR
WOLEAI ATOL
TRUK
PONAPE


AMY BEST TRACK
JTWC 24 HR FCST TRACK
JTWC 48 HR FCST TRACK
AVG 24 HR FCST ERROR-31 CASES-132.1 MI
AVG 48 HR FCST ERROR-29 CASES-234.4 MI
CHART 7
TSINGTAO
SHANGHAI
HONG KONG
OKINAWA
CHICHI JIMA
IWO JIMA
MANILA
SAIGON
SAIPAN
GUAM
ULITHI
YAP
KOROR
WOLEAI ATOL
TRUK
PONAPE
VLADIVOSTOK


LUCY BEST TRACK
ARAKAWA 24 HR FCST TRACK
ARAKAWA 48 HR FCST TRACK
AVG 24 HR FCST ERROR -20 CASES-94.9 MI
AVG 48 HR FCST ERROR -16 CASES-122.6MI
CHICHI JIMA
IWO JIMA
OKINAWA
MANILA
SAIGON
ULITHI
KOROR
SAIPAN
GUAM
WOLEAI ATOL
CHART 8


LUCY BEST TRACK
MILLER-MOORE 24 HR FCST TRACK
AVG. 24 HR FCST ERROR—10 CASES—122.7 MI.
CHART 9
TSINGTAO
SHANGHAI
TOKYO
HONG KONG
OKINAWA
CHICHI JIMA
IWO JIMA
RANGOON
MANILA
SAIGON
SAIPAN
GUAM
YAP
ULITHI
KOROR
WOLEAI ATOL


LUCY BEST TRACK
FNWF 24 HR FCST TRACK
FNWF 48 HR FCST TRACK
AVG. 24 HR FCST ERROR—9 CASES—208.2 MI
AVG. 48 HR FCST ERROR—7 CASES—476.4 MI
SHANGHAI
HONG KONG
MANILA
SAIGON
RANGOON
OKINAWA
CHICHI JIMA
IWO JIMA
ULITHI
YAP
KOROR
WOLEAI AT
CHART 10

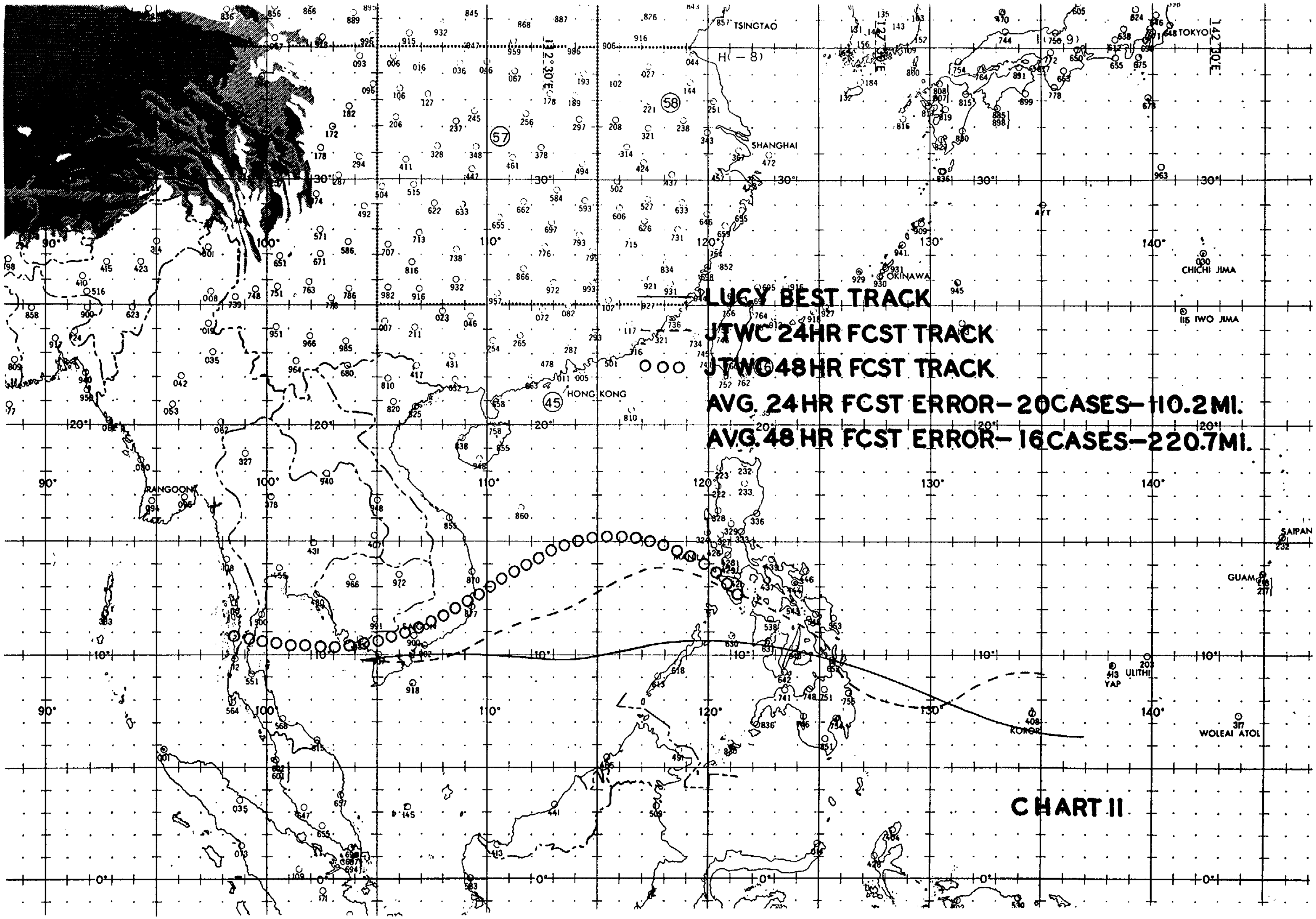

LUCY BEST TRACK
JTWC 24HR FCST TRACK
JTWC 48HR FCST TRACK
AVG. 24 HR FCST ERROR- 20CASES-110.2MI.
AVG. 48 HR FCST ERROR- 16CASES-220.7MI.
TSINGTAO
TOKYO
SHANGHAI
OKINAWA
CHICHI JIMA
IWO JIMA
HONG KONG
RANGOON
SAIGON
MANILA
SAIPAN
GUAM
ULITHI
YAP
KOROR
WOLEAI ATOL
112°30'E
142°30'E

CHART II

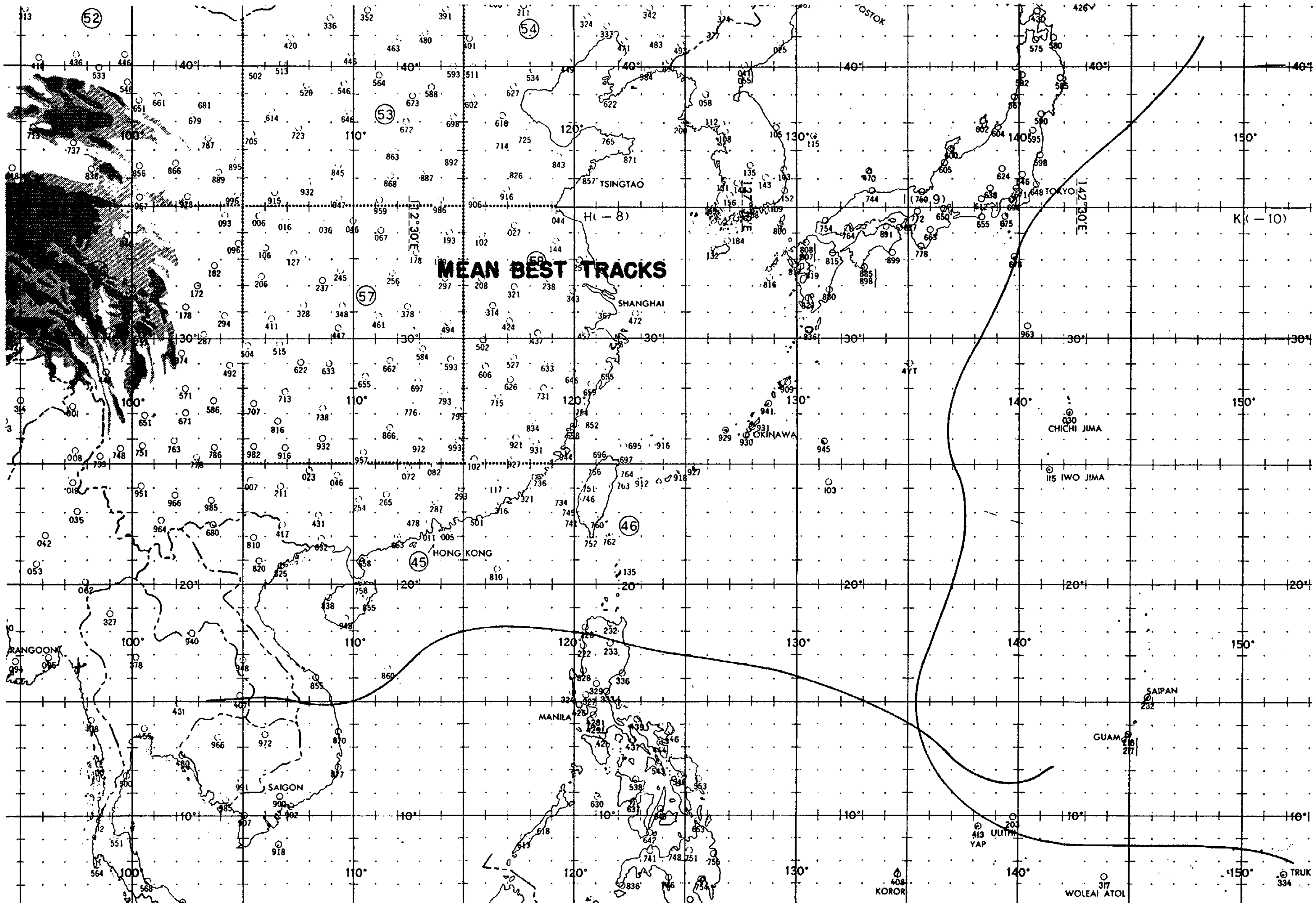
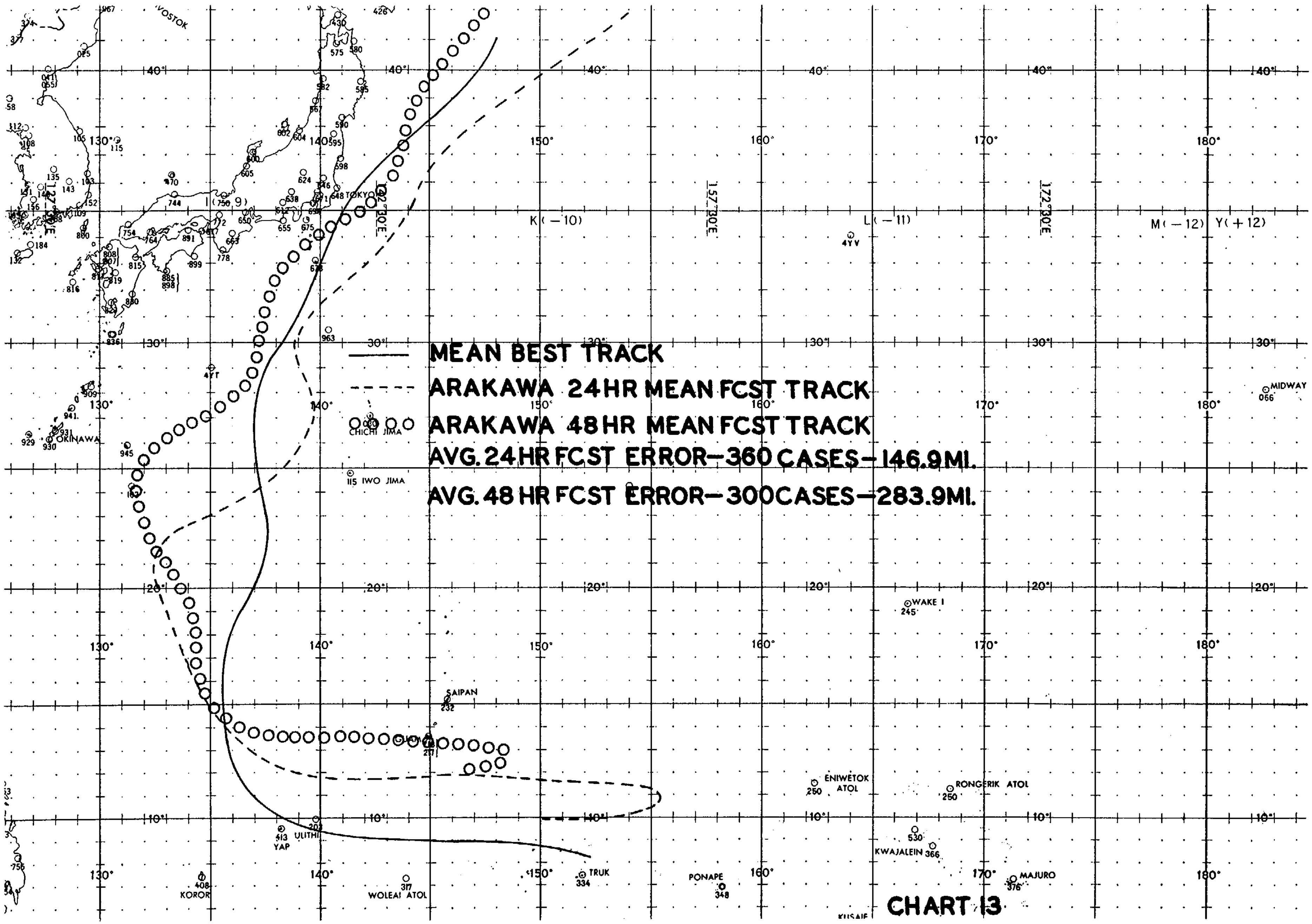
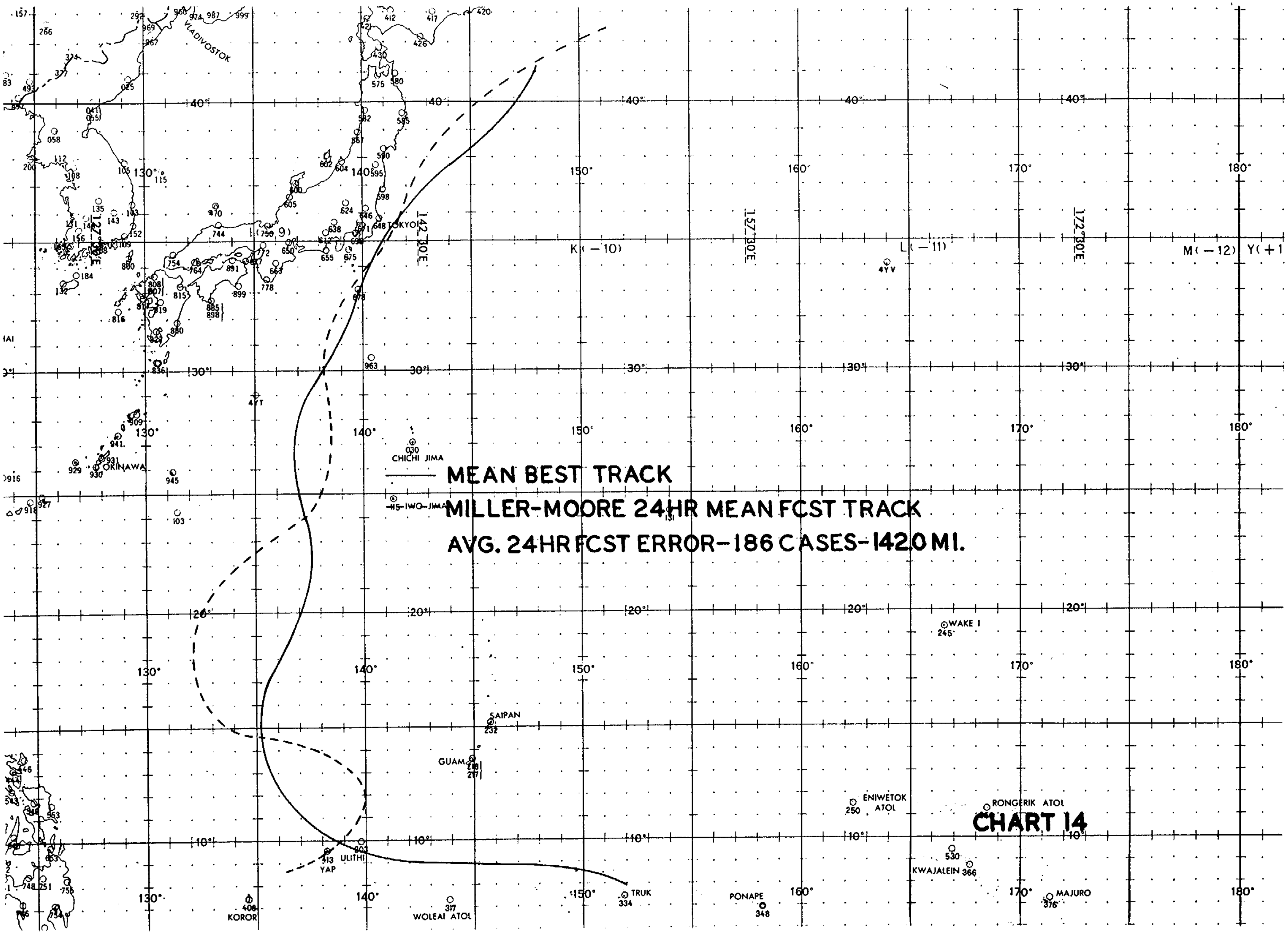
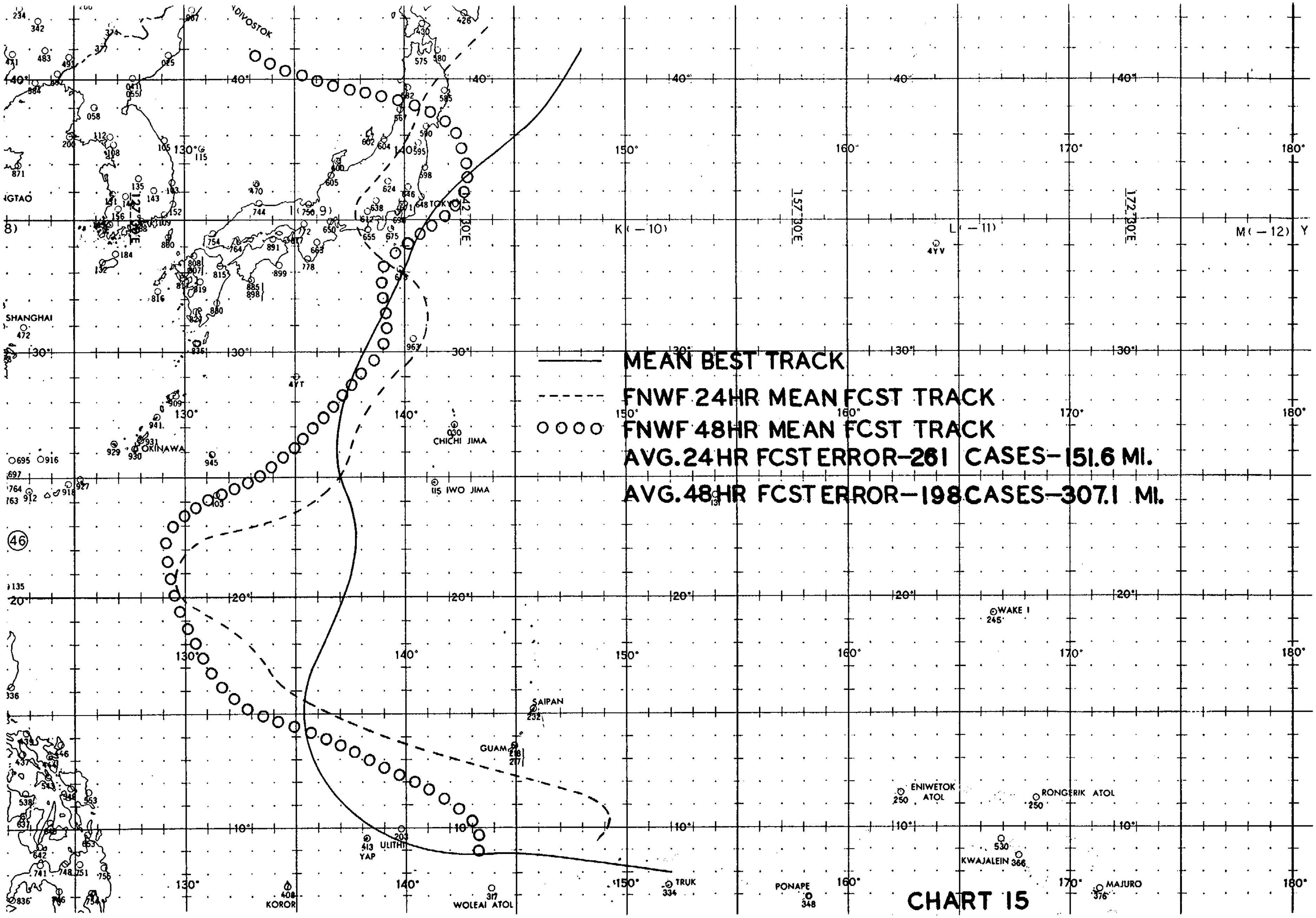

MEAN BEST TRACKS
TSINGTAO
SHANGHAI
HONG KONG
OKINAWA
TOKYO
CHICHI JIMA
IWO JIMA
MANILA
SAIGON
RANGOON
SAIPAN
GUAM
ULITHI
YAP
KOROR
WOLEAI ATOL
TRUK
H(−8)
K(−10)
112°30'E
142°30'E

CHART 12


MEAN BEST TRACK
ARAKAWA 24HR MEAN FCST TRACK
ARAKAWA 48HR MEAN FCST TRACK
AVG. 24HR FCST ERROR—360 CASES—146.9MI.
AVG. 48HR FCST ERROR—300CASES—283.9MI.
TOKYO
CHICHI JIMA
IWO JIMA
OKINAWA
SAIPAN
GUAM
ULITHI
YAP
KOROR
WOLEAI ATOL
TRUK
PONAPE
WAKE I
ENIWETOK ATOL
RONGERIK ATOL
KWAJALEIN
MAJURO
MIDWAY
K(−10)
L(−11)
M(−12) Y(+12)
CHART 13


MEAN BEST TRACK
MILLER-MOORE 24HR MEAN FCST TRACK
AVG. 24HR FCST ERROR-186 CASES-142.0 MI.
CHART 14
VLADIVOSTOK
TOKYO
CHICHI JIMA
IWO-JIMA
OKINAWA
SAIPAN
GUAM
WAKE I
ENIWETOK ATOL
RONGERIK ATOL
KWAJALEIN
MAJURO
PONAPE
TRUK
WOLEAI ATOL
ULITHI
YAP
KOROR
K(−10)
L(−11)
M(−12)
142°30'E
157°30'E
172°30'E


MEAN BEST TRACK
FNWF 24HR MEAN FCST TRACK
FNWF 48HR MEAN FCST TRACK
AVG.24HR FCST ERROR-261 CASES-151.6 MI.
AVG.48HR FCST ERROR-198 CASES-307.1 MI.
CHART 15
VLADIVOSTOK
TOKYO
SHANGHAI
OKINAWA
CHICHI JIMA
IWO JIMA
SAIPAN
GUAM
ULITHI
YAP
KOROR
WOLEAI ATOL
TRUK
PONAPE
ENIWETOK ATOL
RONGERIK ATOL
KWAJALEIN
MAJURO
WAKE I

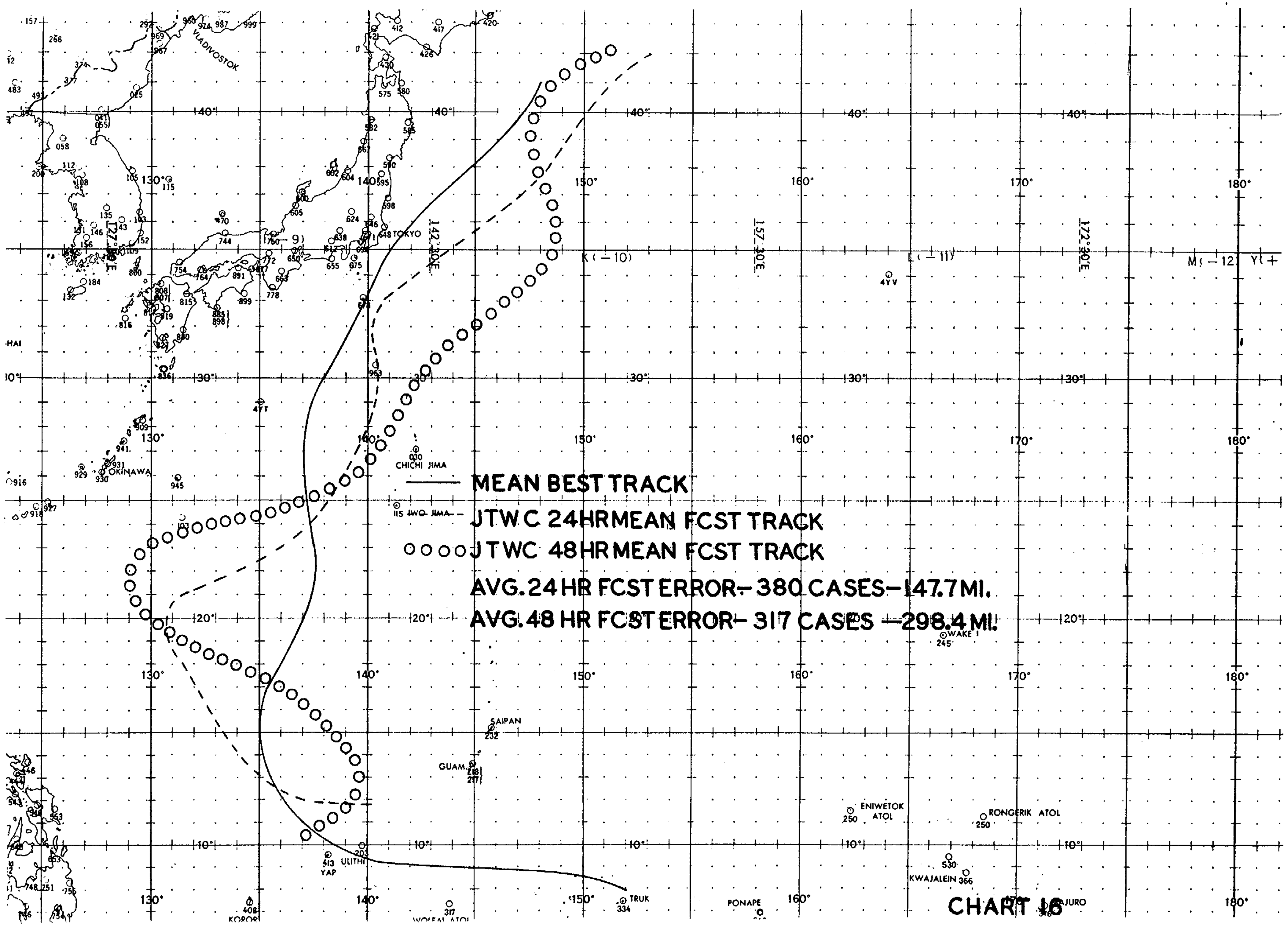
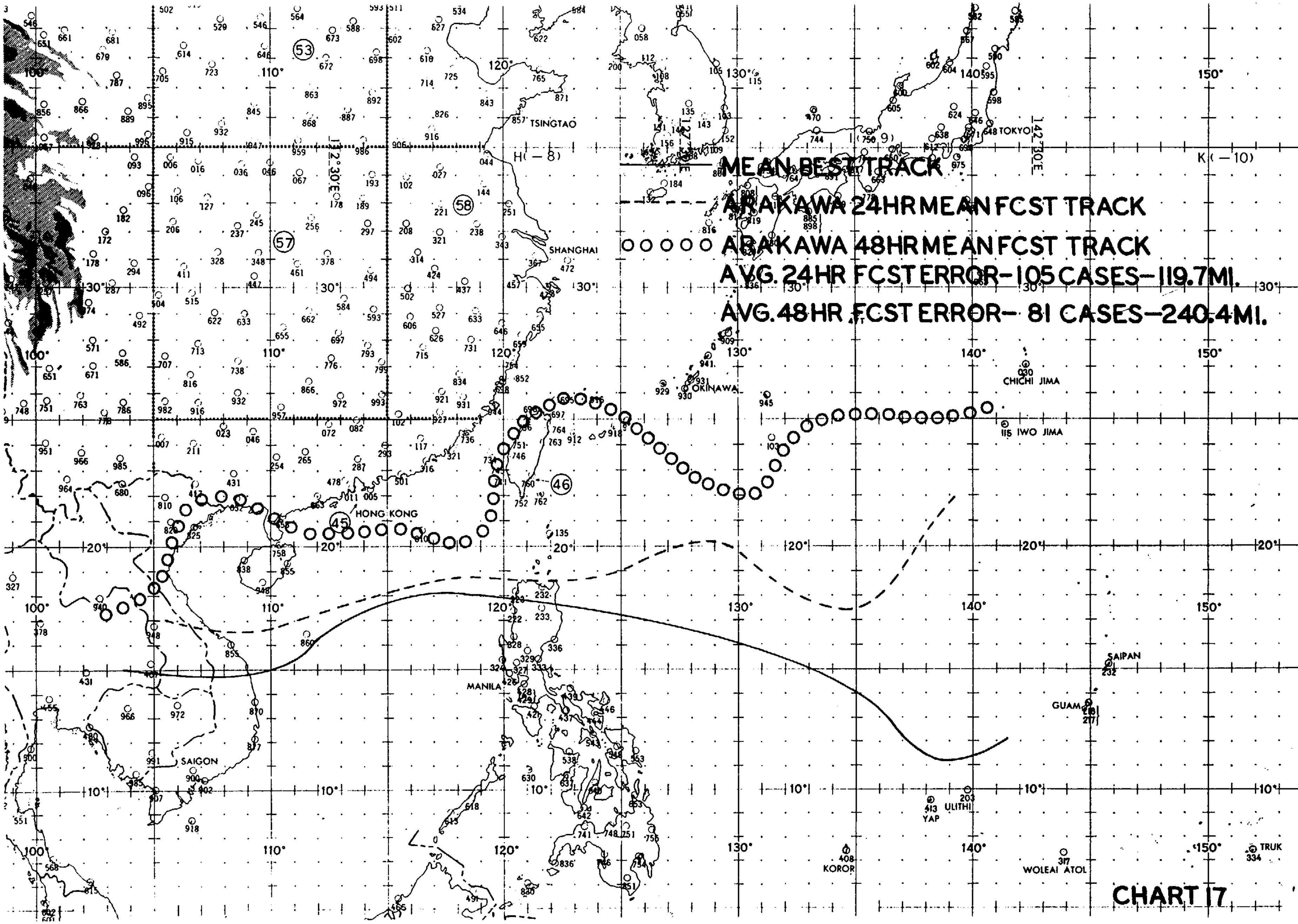
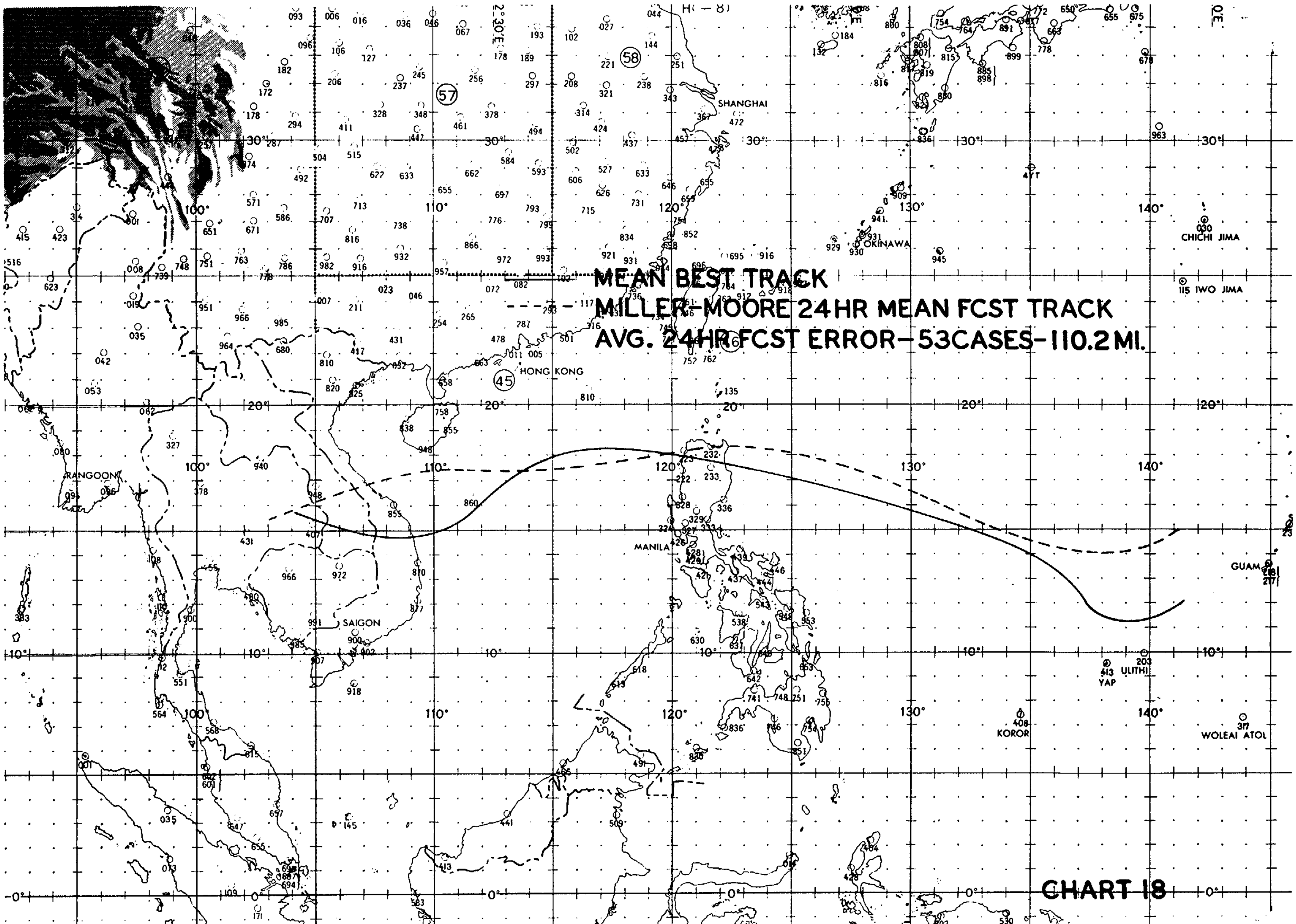
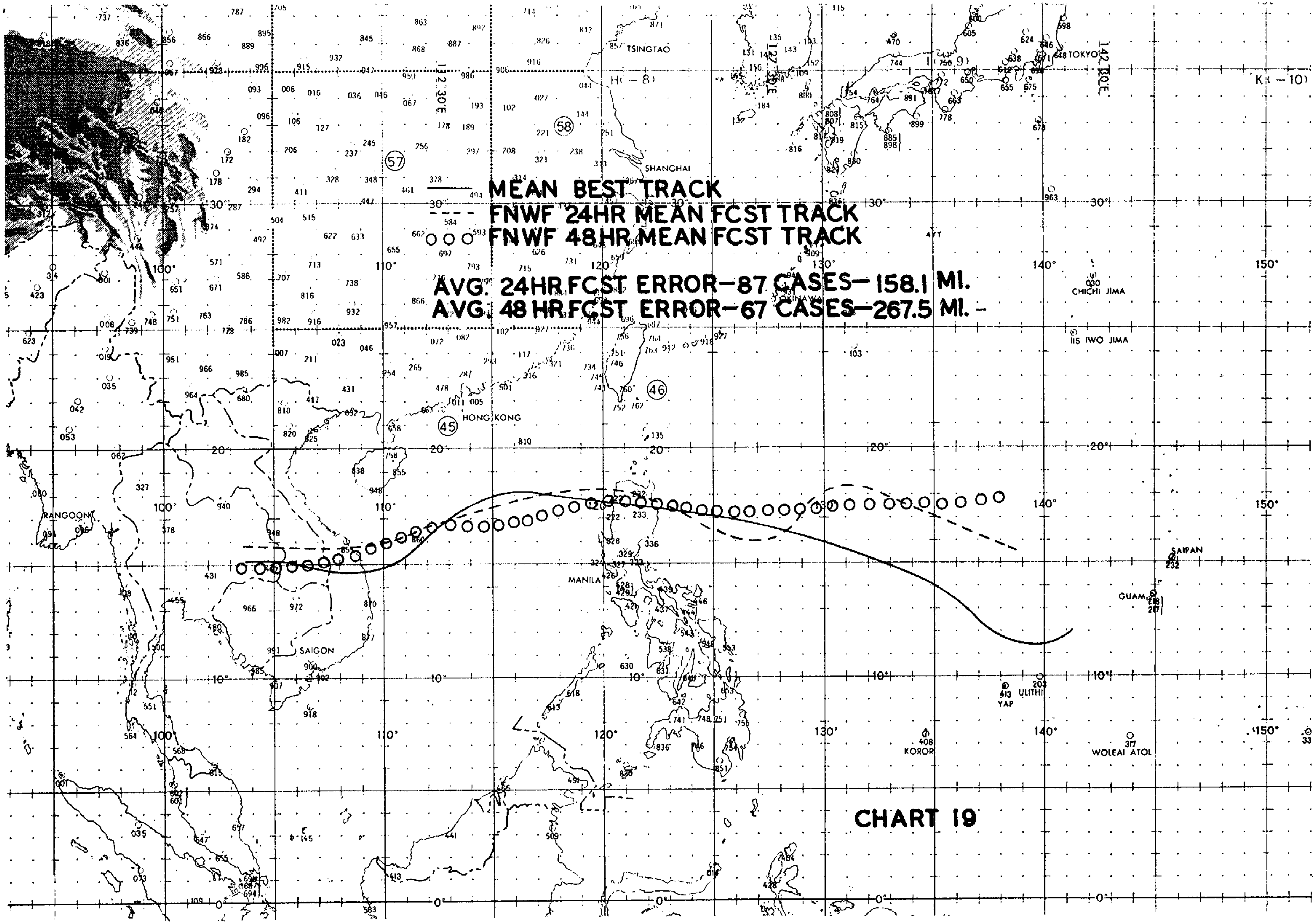

MEAN BEST TRACK
JTWC 24HR MEAN FCST TRACK
JTWC 48HR MEAN FCST TRACK
AVG. 24 HR FCST ERROR - 380 CASES - 147.7 MI.
AVG. 48 HR FCST ERROR - 317 CASES - 298.4 MI.
VLADIVOSTOK
TOKYO
CHICHI JIMA
IWO JIMA
OKINAWA
SAIPAN
GUAM
WAKE I
ENIWETOK ATOL
RONGERIK ATOL
KWAJALEIN
ULITHI
YAP
TRUK
PONAPE
KOROR
40°
30°
20°
10°
130°
140°
150°
160°
170°
180°

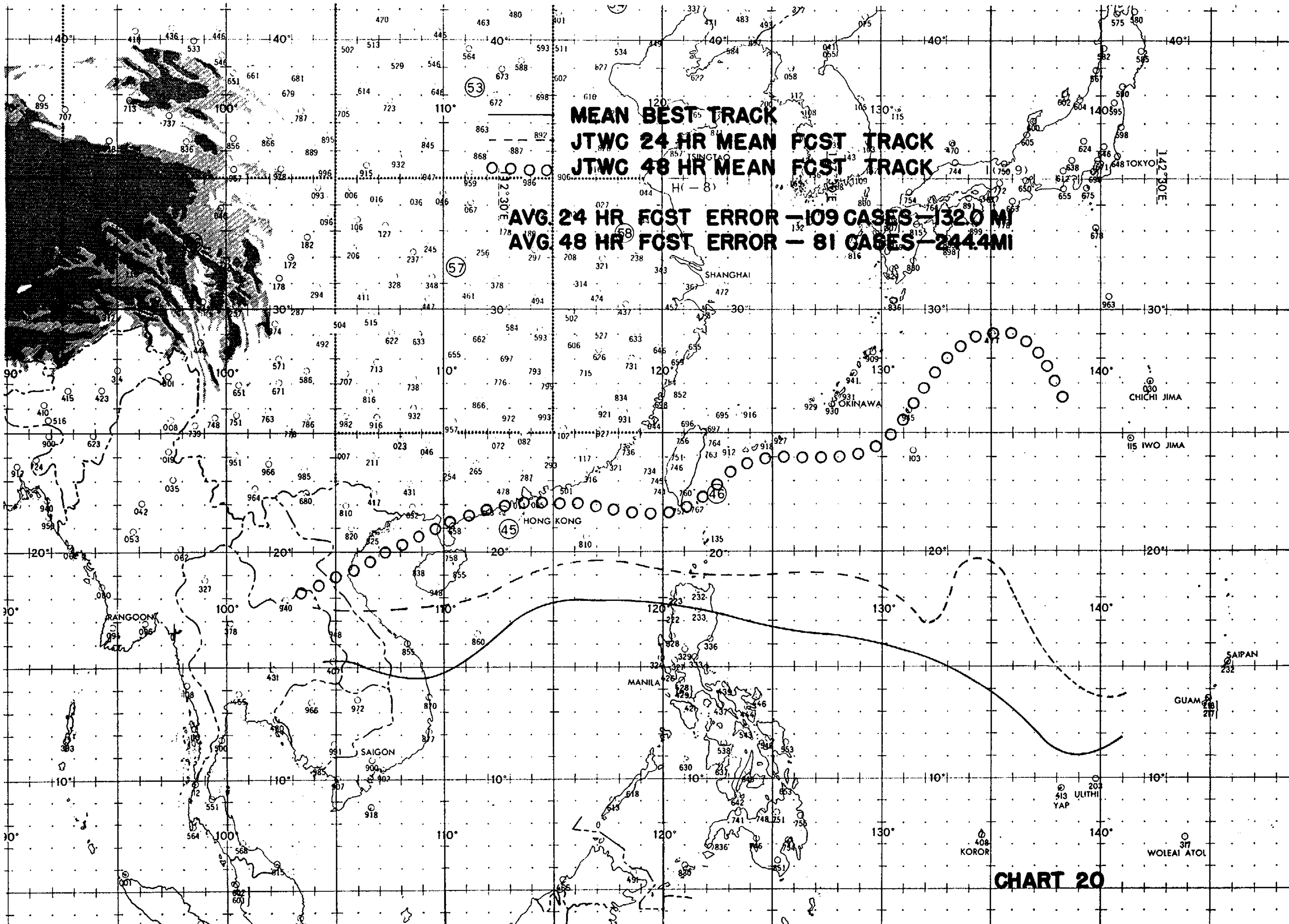
CHART 16


MEAN BEST TRACK
ARAKAWA 24HR MEAN FCST TRACK
ARAKAWA 48HR MEAN FCST TRACK
AVG. 24HR FCST ERROR-105 CASES-119.7MI.
AVG. 48HR FCST ERROR- 81 CASES-240.4MI.
TSINGTAO
SHANGHAI
HONG KONG
TOKYO
OKINAWA
CHICHI JIMA
IWO JIMA
MANILA
SAIGON
SAIPAN
GUAM
ULITHI
YAP
KOROR
WOLEAI ATOL
TRUK
CHART 17



MEAN BEST TRACK
MILLER-MOORE 24HR MEAN FCST TRACK
AVG. 24HR FCST ERROR-53CASES-110.2MI.
SHANGHAI
HONG KONG
RANGOON
SAIGON
MANILA
OKINAWA
CHICHI JIMA
IWO JIMA
GUAM
YAP
ULITHI
KOROR
WOLEAI ATOL
CHART 18


MEAN BEST TRACK
FNWF 24HR MEAN FCST TRACK
FNWF 48HR MEAN FCST TRACK
AVG. 24HR FCST ERROR-87 CASES-158.1 MI.
AVG. 48 HR FCST ERROR-67 CASES-267.5 MI.
CHART 19
TSINGTAO
SHANGHAI
TOKYO
OKINAWA
CHICHI JIMA
IWO JIMA
HONG KONG
RANGOON
MANILA
SAIGON
SAIPAN
GUAM
YAP
ULITHI
KOROR
WOLEAI ATOL


MEAN BEST TRACK
JTWC 24 HR MEAN FCST TRACK
JTWC 48 HR MEAN FCST TRACK
AVG. 24 HR FCST ERROR — 109 CASES — 132.0 MI
AVG. 48 HR FCST ERROR — 81 CASES — 244.4MI
SHANGHAI
HONG KONG
OKINAWA
CHICHI JIMA
IWO JIMA
TOKYO
RANGOON
SAIGON
MANILA
SAIPAN
GUAM
ULITHI
YAP
KOROR
WOLEAI ATOL
CHART 20

24-HOUR TYPHOON FORECAST ERRORS OF 1962

TYPHOON	ARAKAWA NO. OF CASES	ARAKAWA MEAN ERROR	FNWF NO. OF CASES	FNWF MEAN ERROR	MILLER-MOORE NO. OF CASES	MILLER-MOORE MEAN ERROR
GEORGIA	20	208	--	---	13	165
HOPE	21	128	--	---	11	158
IRIS	6	225	--	---	2	87
JOAN	13	155	5	184	7	114
KATE	16	201	8	286	7	154
LOUISE	28	168	12	148	13	149
NORA	20	183	22	172	10	234
OPEL	14	114	15	228	7	103
PATSY	13	119	11	294	7	88
RUTH	32	134	24	139	16	108
SARAH	27	132	17	190	13	139
THELMA	22	124	20	118	11	79
VERA	9	128	8	97	4	252
WANDA	15	92	16	134	7	118
AMY	33	136	25	127	17	130
CARLA	7	173	7	79	4	77
DINAH	18	172	18	130	9	93
EMMA	36	143	34	163	18	148
FREDA	21	145	21	121	11	91
GILDA	31	93	31	109	15	139
IVY	--	---	--	---	--	---
JEAN	18	102	20	103	9	147
KAREN	25	154	34	190	18	157
LUCY	20	95	--	---	10	123

AVERAGE ERROR-ARAKAWA (465 CASES)................. 141
AVERAGE ERROR-FNWF (348 CASES)..................... 153
AVERAGE ERROR-MILLER-MOORE (239 CASES)............ 135

48-HOUR TYPHOON FORECAST ERRORS OF 1962

TYPHOON	ARAKAWA NO. OF CASES	ARAKAWA MEAN ERROR	FNWF NO. OF CASES	FNWF MEAN ERROR
GEORGIA	17	365	--	---
HOPE	18	270	--	---
IRIS	4	429	--	---
JOAN	9	375	1	150
KATE	12	360	--	---
LOUISE	24	264	--	---
NORA	16	238	17	322
OPEL	10	216	11	350
PATSY	9	222	7	560
RUTH	27	337	19	305
SARAH	23	237	15	380
THELMA	18	241	15	280
VERA	5	280	4	170
WANDA	11	261	12	175
AMY	29	287	21	164
CARLA	3	339	3	130
DINAH	14	434	16	273
EMMA	32	271	31	361
FREDA	17	252	17	254
GILDA	27	220	27	277
IVY	--	---	--	---
JEAN	18	188	18	183
KAREN	22	309	31	399
LUCY	16	123	--	---

AVERAGE ERROR-ARAKAWA (381 CASES).................. 274
AVERAGE ERROR-FNWF (265 CASES)..................... 297

TYPHOON ACCELERATION AFTER RECURVATURE
by
LTJG E. A. Erdei, USN

One of the primary problems which confronted JTWC during 1962 was forecasting the speed of movement of typhoons. A method is presented here for determining accelerations of typhoons after recurving into the westerlies.

Data was initially selected from the 1959 and 1960 seasons, which produced 17 typhoons that recurved. Numerous methods were tried using 47 cases from the 17 typhoons. Twelve and 24-hour cyclone speed differences were compared to the maximum winds at the 700, 500, 300 and 200mb levels. The best correlation was obtained by using the cyclone speed difference over a 24-hour period and comparing this value with the maximum wind speed difference for the past 12 hours at the "capping level." This comparison produced the curve shown herein.

A hypothetical example follows:

1 DTG	2 MAX WND SPD	3 12HR WND SPD DIFF (2C-2B)	4 SPD FROM ACCEL CURVE (Abscissa Value)		5 CYC SPD AT TIME Col #1		6 24HR SPD DIFF (5C-5A)		7 FCST SPD AT 1C+24 4C+5C+6C
A.2000Z	X	X	X		10		X		X
B.2012Z	20	X	X		X		X		X
C.2100Z	25	5	3	+	20	+	10	=	33

1. Time of upper level chart being used to obtain maximum winds.

2. Maximum wind speeds are taken from the "capping level," which is defined as the lowest standard level the cyclone is not a closed system. This level may not be the same from one 12-hour period to the next, and in no case should a standard level above 200mb be used, whether the system appears to be closed at 200mb or not.

Locate the surface position of the tropical cyclone at the selected "capping level" and draw a circle from this point with a 300 mi radius. Should the cyclone be in the ridge line, estimate the maximum wind present in the NW quadrant of the circle. If it has recurved, use the W quadrant for the maximum wind value.

3. Maximum wind speed difference during the past 12 hours (Note: the maximum speeds may have come from different levels).

4. Enter the figure obtained from 3C on the Acceleration curve abscissa and move up to the curve and read the ordinate value.

5. Cyclone speed at the time shown in Column 1.

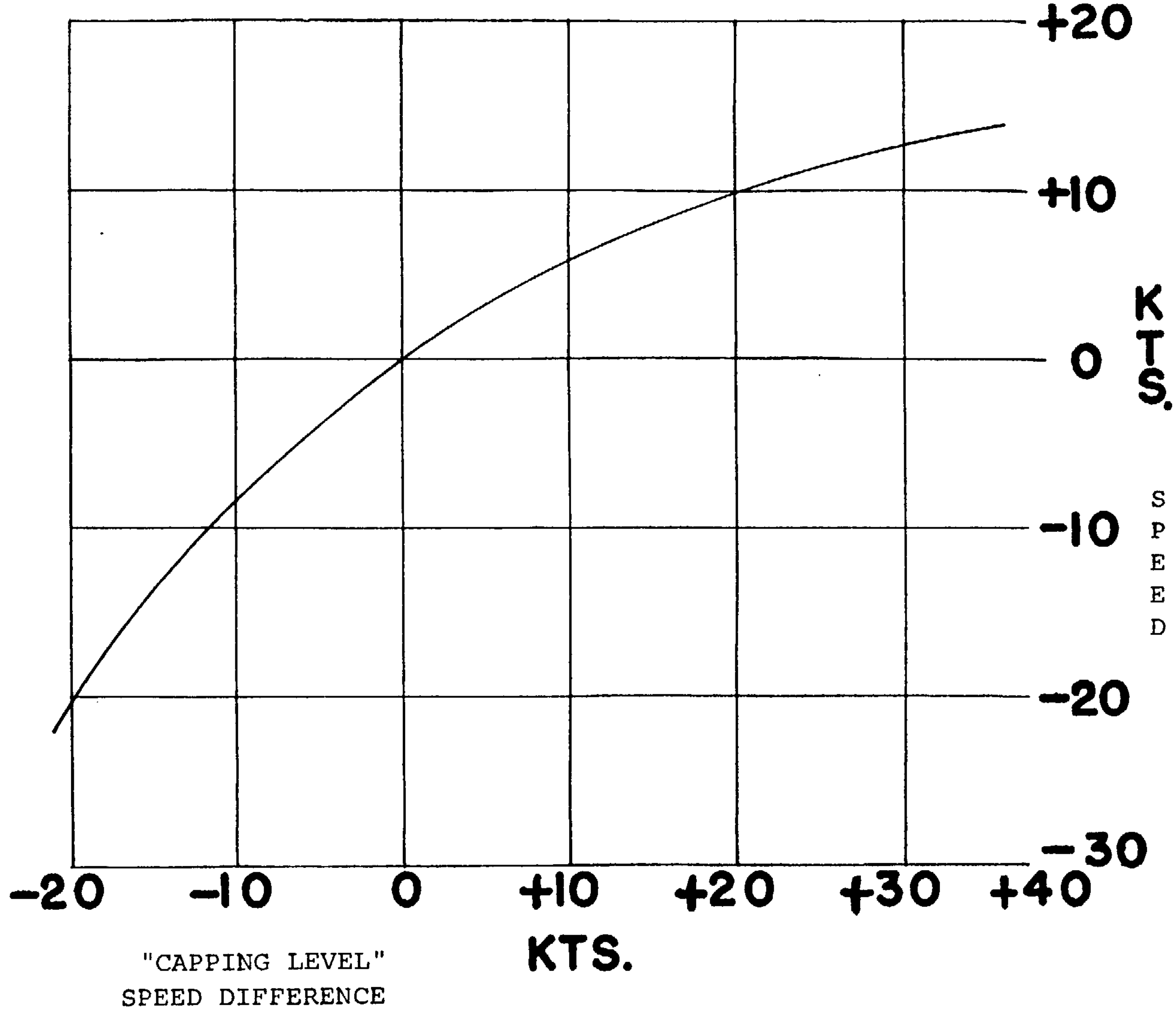
6. Cyclone speed difference during the past 24 hours.

7. Add the figures from 4C, 5C and 6C. This should be the speed of the cyclone 24 hours after the time 1C.

This technique was first evaluated in 1961. There were 31 cases with an average error of 7 kts. Twenty of the cases averaged 8 kts low while 11 of the cases averaged 6 kts high as compared to the best track speed. These cases were incorporated into the previous two years of data.

In 1962 there were 41 cases with an average error of 7 kts. Twenty-two of the cases averaged 8 kts low while 14 of the cases averaged 8 kts high as compared to the best track speed. It has been observed that the forecaster is usually on the low side of the verified speed when forecasting the speed of movement of a cyclone after recurvature. As noted above, this system produces a higher, more accurate, forecast speed; therefore, as a forecast aid, it will assist the forecaster in terms of higher speeds in 1963.

ACCELERATION AFTER RECURVATURE
24 HOUR
FORECAST



TYPHOON EYE TERMINOLOGY

by

LT Harry D. Hamilton, USN

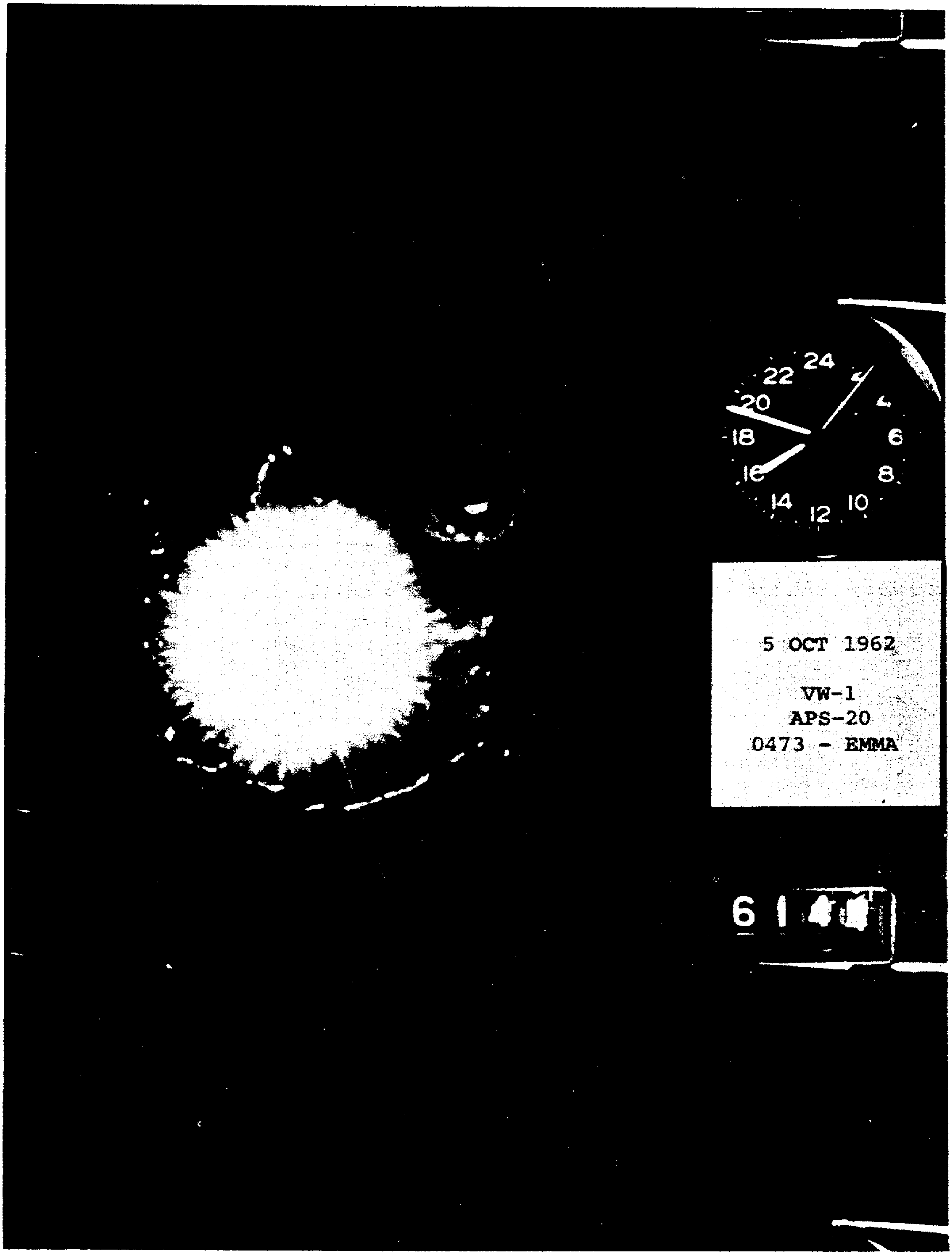
In the field of meteorology, as in other scientific fields of endeavor, the need for standardization of terminology is ever present. The time for standardization is before a double standard is in practice. This alleviates the necessity of explaining the terminology to insure that the correct "standard" is being conveyed to the receiver (12). This latter need is mandatory in terse aircraft reconnaissance reports. The requirement for standardized meanings for "concentric eye" and "double eye" is imperative in that a particular typhoon can have a concentric eye or double eye in their true sense, thereby eliminating the possibility of the dual use of the latter term. During 1962 in the Western Pacific, it was not unusual for typhoons to have concentric eyes when they had wind speeds in excess of 120 kts. More rarely, they had double eyes, usually when they were less intense. The typhoons with a concentric eye were THELMA, AMY and EMMA, with a double eye were DINAH and GILDA, and those that were both concentric eyed and double eyed at different times were RUTH and KAREN. All of the above typhoons were also single eyed at various times during their typhoon cycle.

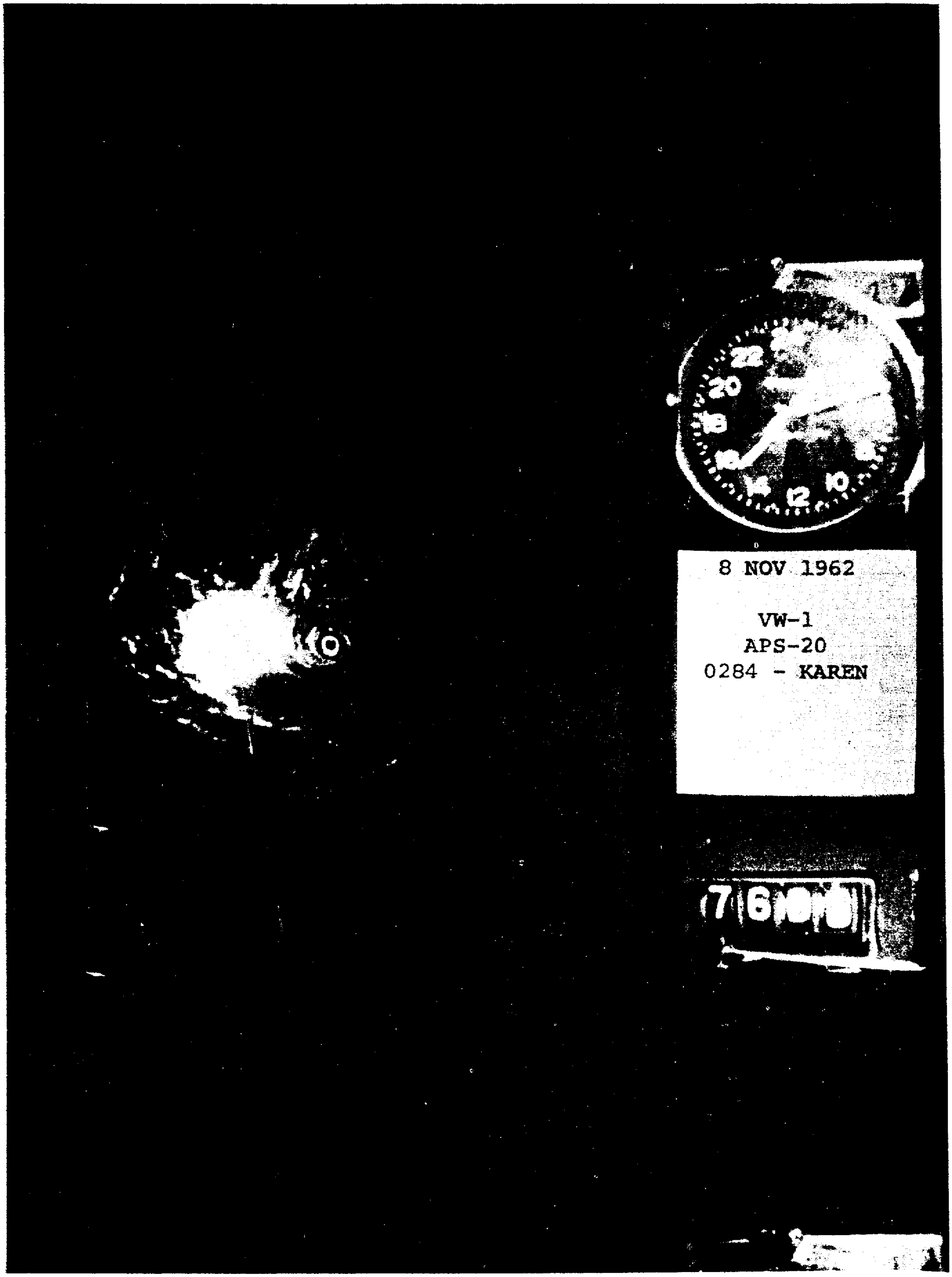
When describing the eye of a typhoon, the term "concentric eye" should be used only to describe a typhoon which has one eye circumscribed by another eye. The term "double eye" should be used only to describe a typhoon which has two separate eyes, neither of which is contained within the other. Both the "concentric eye" and "double eye" typhoons have their singular or dual centers within the lowest pressure area; whereas, a false eye can exist outside the wall clouds of the above eyes. Thus, a typhoon with one real eye and one false eye should not be described as a typhoon with a "double eye." The best examples this year of false eyes causing inexperienced ground radar observers to make erroneous reports were Typhoons NORA and EMMA. In both of these cases, the false eye life span was less than twelve hours.

The "double eye" typhoon puts an additional burden on both the reconnaissance squadrons and on the typhoon forecasters. To insure consistent meteorological intensification parameters and enable a more accurate movement to be determined, one eye must be selected for fixes. This particular eye should be the primary eye, if such exists, or an arbitrarily selected eye because of a discernible feature. The reconnaissance aircraft must then insure that its primary report is on the primary eye and that any information on the secondary eye is definitely isolated. Forecasting may be complicated by the cyclonic rotation of the eyes about an apparent mass center. This may be described as a meso-scale Fujiwhara effect.

Pictorial examples of "concentric eye" typhoons are EMMA and KAREN. "Double eye" typhoon negatives were not available for printing and confirmation was extracted from reconnaissance logs.

It is strongly recommended that the terminology presented in this paper be adopted as the standard by all tropical meteorologists.


24
22
20
18
16
14
12
10
8
6
5 OCT 1962
VW-1
APS-20
0473 - EMMA


8 NOV 1962
VW-1
APS-20
0284 - KAREN
76

INVESTIGATION OF TYPHOON SURFACE GUSTS

by

Mr. George Taniguchi
1st Weather Wing Staff
Fuchu Air Station, Japan

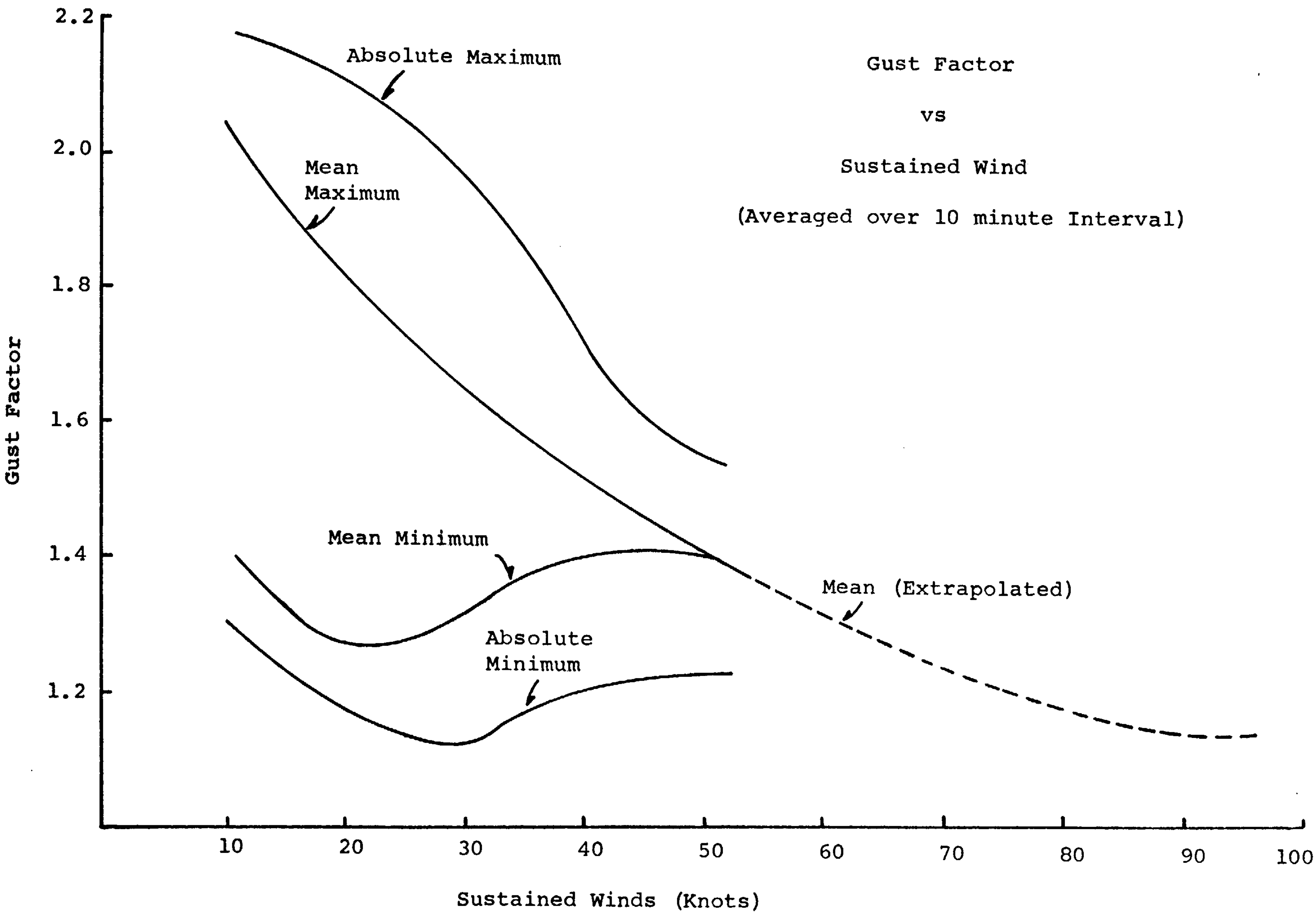
An investigation was made to determine the existence of suitable parameters which may be correlated with surface gusts in a typhoon. Data used for this investigation was extracted from the hourly sequence reports given in the typhoon reports issued by the Japan Meteorological Agency's Tokyo International Airport Aviation Weather Service from 1955 to 1962. The sequence reports were from the various stations within Japan and Okinawa which were affected by the typhoons.

Gust factors were computed and plotted against sustained wind (defined as the mean wind over an interval of 10 minutes), and also against sea level pressure reported by the stations. No apparent correlations were seen from either of the set of plots made, except for a vague trend of higher gusts with lower sustained winds. The curves for absolute maximum and minimum and mean maximum and minimum values are given in the following chart. The curves are based on observed data of ten typhoons (1955-1962) which affected Okinawa and Japan. As can be seen from the chart, there is a wide range of variation in the gust factors from 10 to 30 kts of sustained winds. From 30 kts, the upper and lower limits of the mean decrease and merge at about 50 kts. Beyond 50 kts, the gust factor seems to decrease exponentially when extrapolated. The report on Typhoon VERA (11) by JMA states that difficulty was encountered in attempting to correlate maximum gusts with maximum mean winds in a typhoon since the occurrence of maximum gusts often does not coincide with maximum mean winds. Furthermore, the local terrain features seem to have a much greater influence on the magnitude of gusts than the mean winds. This report concludes that the gust factors range between 1.2 and 1.5 for all land stations (mean of 1.4) and between 1.2 and 1.8 for just the coastal stations (mean of 1.3 sic) in the case of Typhoon VERA (September 1959).

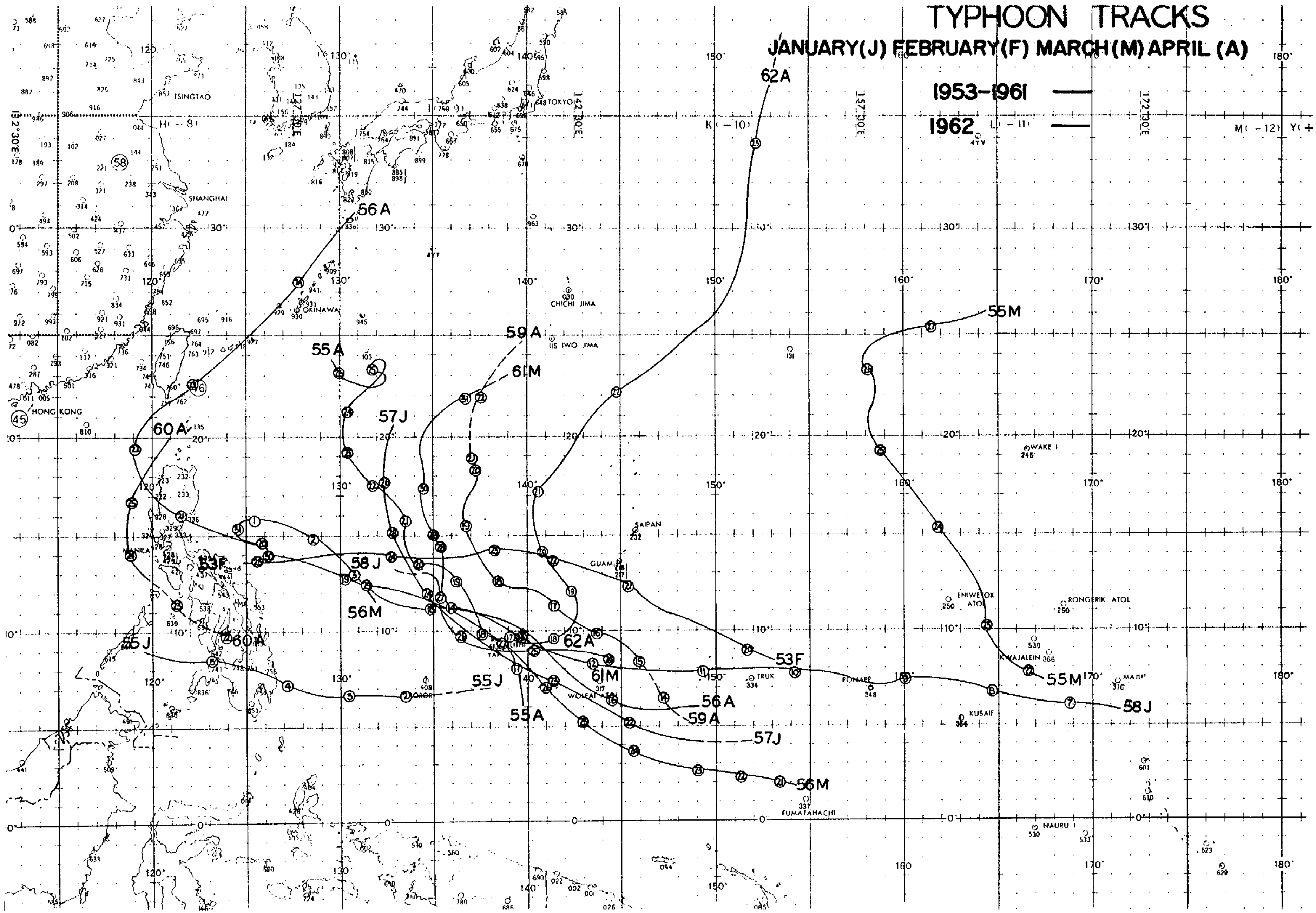
JMA's first order observatories are equipped with the Dines pressure anemometer in addition to the Robinson type 3 cup anemometer. The Dines anemometer is used specifically for recording gusty winds. The diameter of the pressure tube used by JMA is approximately 1.0 cm. The mean gust factor of 1.40 for all land stations, as reported by JMA, is substantiated by G. J. Bell's (2) mean gust factor of 1.47 for typhoons affecting Hong Kong. Bell based his investigation of gust factors (maximum gust/mean hourly wind speed) on data spanning a period of 7 years. The observations of gusts were made using the Dines anemometer with a pressure tube having a diameter of 1.27 cm. The fact that the mean gust factor reported by JMA is slightly less than that reported by Bell may be attributed to the smaller tube diameter used by JMA. This conclusion is based on Bell's assumption that a smaller tube diameter has a dampening effect. Bell obtained a mean of 1.69 using a 2.54 cm tube over a 7 year period versus 1.47 with a 1.27 cm tube over the same period. Based on Bell's estimate, the difference in the mean gust factor between the "mean over an hour" (H - 30 minutes to H + 30 minutes) as used by Bell, and the "mean over a 10 minute period" as used by JMA, results in a higher mean wind for the latter by 2 to 6 percent of the former. Thus, this also may be a contributing factor to JMA's lower mean gust factor.

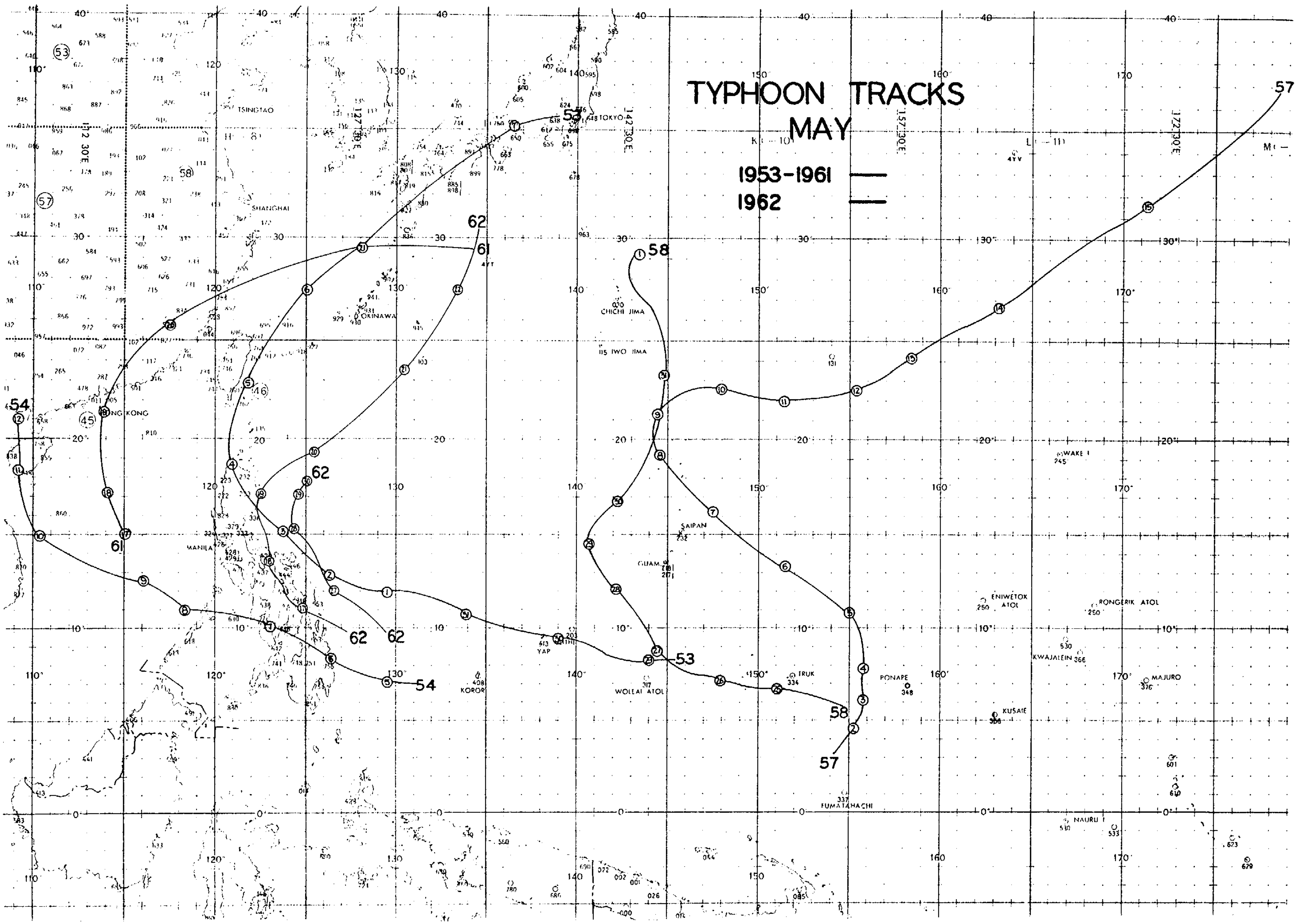
The most probable gust factors associated with hurricane winds as given by Mook (10) are 1.65 at a mean wind speed (over 5 minutes) of 30 to 40 kts, 1.5 at 50 kts and 1.4 at 60 kts, with maximum gust factors of 2.2 at 30 kts decreasing to 1.45 at 60 kts. No mention is given as to how these figures were derived.

Difficulty is encountered in establishing a feasible method of forecasting typhoon gusts which may be applicable to any one or more stations affected by typhoon winds. This is due to the fact that local terrain features have a considerable influence on the magnitude of gusty winds. Exposure conditions of anemometers may differ considerably among observation sites, such as the height of the anemometer and the nature of the surrounding area. Different types of anemometers may give different values. Furthermore, a certain amount of difference in mean values exists with different definitions of the mean wind. For instance, Bell uses the mean over a one hour period in his report, JMA uses an interval of 10 minutes, while the USAF Air Weather Service uses a one minute interval. Coupled with these differences are factors involving typhoon intensities and the position of typhoon centers with respect to the observation sites. Thus, a statistical study using past wind data from all of the stations under different agencies during periods of typhoons will, at best, give only a generalized mean value.


Gust Factor
vs
Sustained Wind
(Averaged over 10 minute Interval)
Absolute Maximum
Mean
Maximum
Mean Minimum
Absolute
Minimum
Mean (Extrapolated)
Gust Factor
2.2
2.0
1.8
1.6
1.4
1.2
10
20
30
40
50
60
70
80
90
100
Sustained Winds (Knots)

TYPHOON TRACKS, 1953-1962


TYPHOON TRACKS
JANUARY (J) FEBRUARY (F) MARCH (M) APRIL (A)
1953-1961
1962
TSINGTAO
TOKYO
SHANGHAI
OKINAWA
CHICHI JIMA
IWO JIMA
HONG KONG
MANILA
SAIPAN
GUAM
YAP
WOLEAI
TRUK
PONAPE
KUSAIE
ENIWETOK ATOL
RONGERIK ATOL
KWAJALEIN
MAJURO
WAKE I
NAURU I
FUMATAHACHI
62A
56A
55A
59A
61M
57J
60A
58J
56M
53F
55J
55M
62A
61M
56A
59A
57J
56M
58J
55M
53F
55A
55J
60A


TYPHOON TRACKS
MAY
1953-1961
1962
TOKYO
SHANGHAI
TSINGTAO
OKINAWA
HONG KONG
MANILA
CHICHI JIMA
IWO JIMA
SAIPAN
GUAM
YAP
KOROR
WOLEAI ATOL
TRUK
PONAPE
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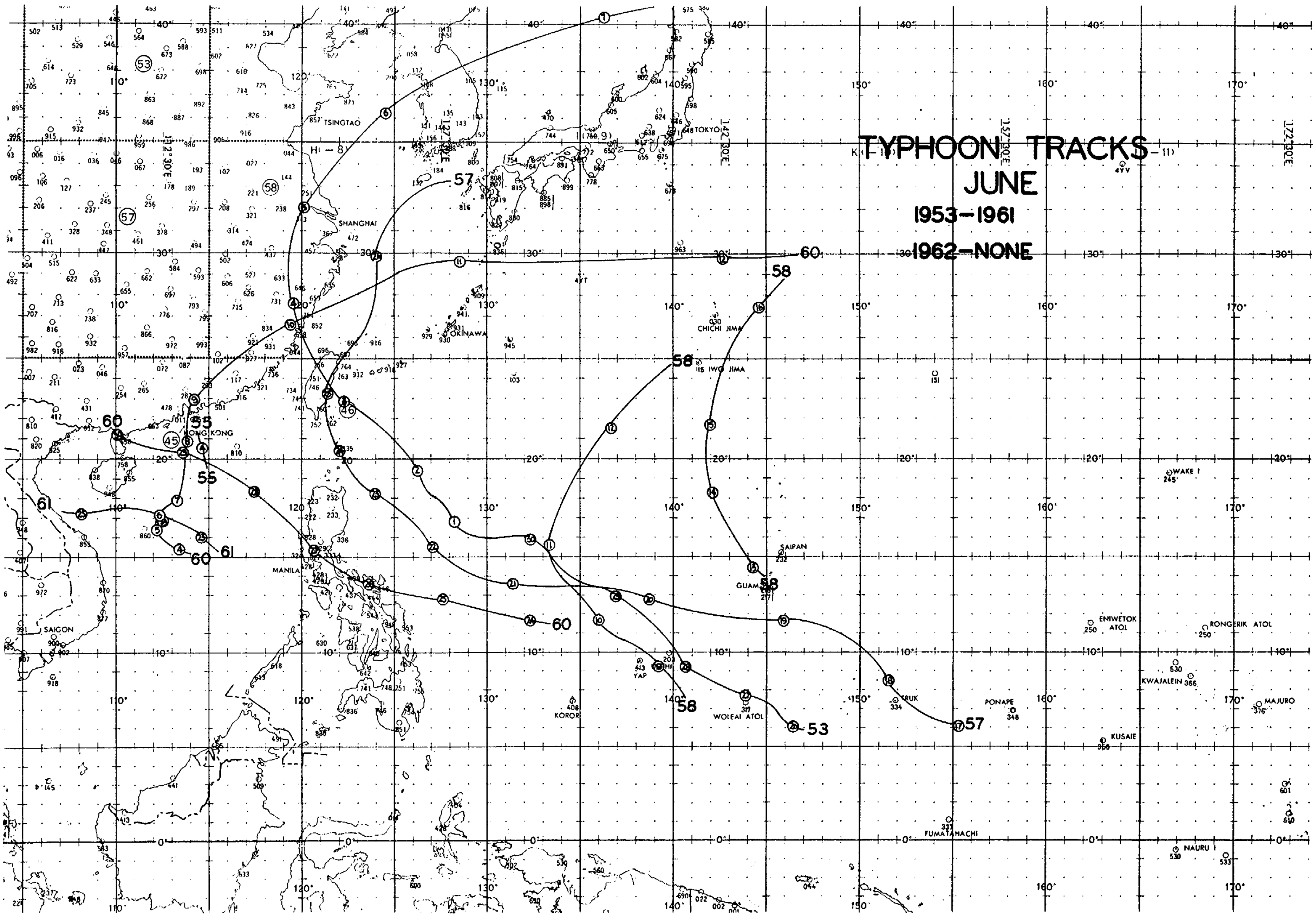
ENIWETOK ATOL
RONGERIK ATOL
KWAJALEIN
MAJURO
WAKE I
NAURU I
FUMATAHACHI


TYPHOON TRACKS
JUNE
1953-1961
1962-NONE
TSINGTAO
SHANGHAI
TOKYO
OKINAWA
CHICHI JIMA
IWO JIMA
HONG KONG
MANILA
SAIGON
SAIPAN
GUAM
YAP
KOROR
WOLEAI ATOL
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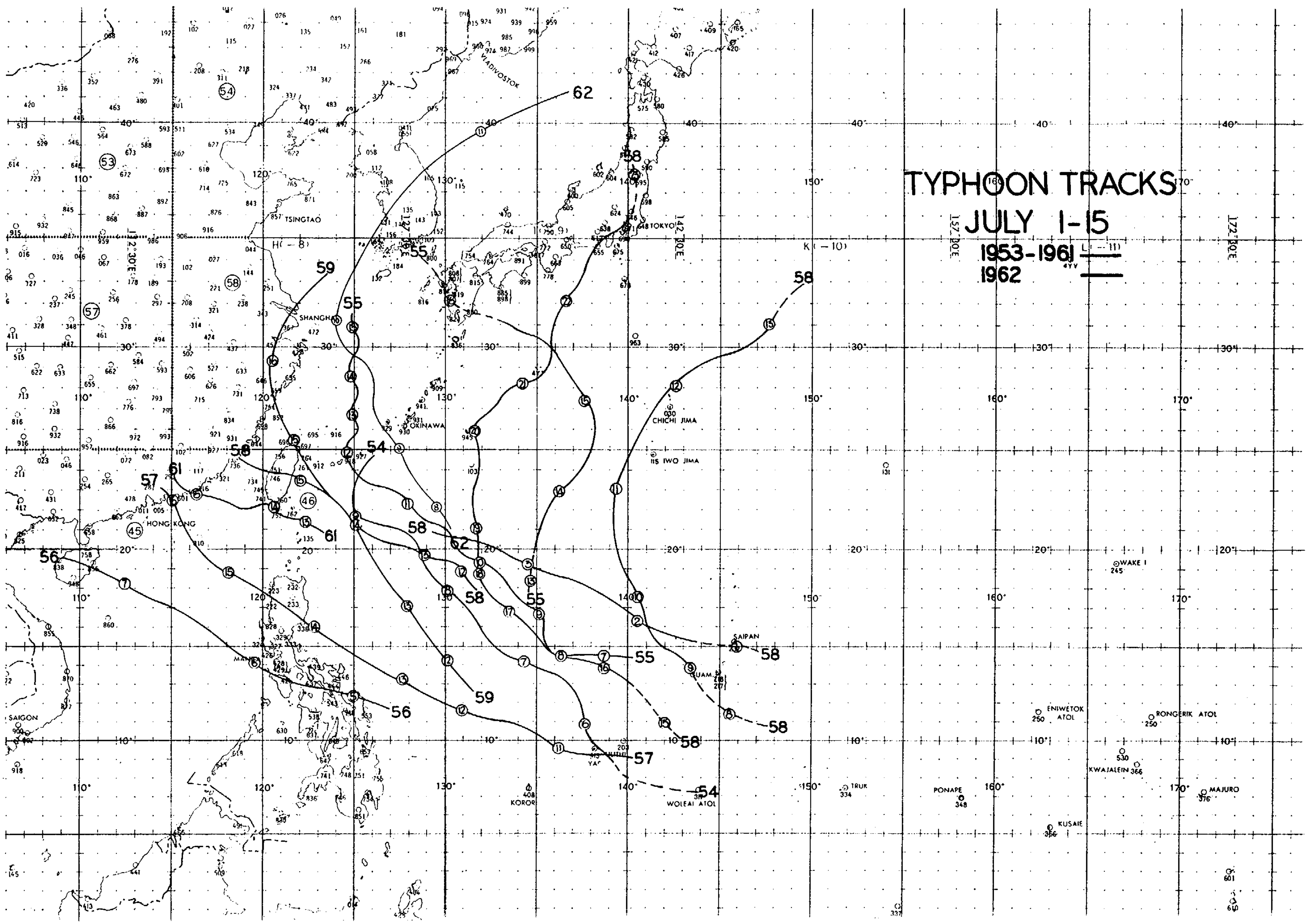
KUSAIE
ENIWETOK ATOL
RONGERIK ATOL
KWAJALEIN
MAJURO
WAKE I
NAURU I



TYPHOON TRACKS
JULY 1-15
1953-1961
1962
VLADIVOSTOK
TSINGTAO
SHANGHAI
TOKYO
OKINAWA
CHICHI JIMA
IWO JIMA
HONG KONG
WAKE I
SAIPAN
GUAM
MANILA
SAIGON
ENIWETOK ATOL
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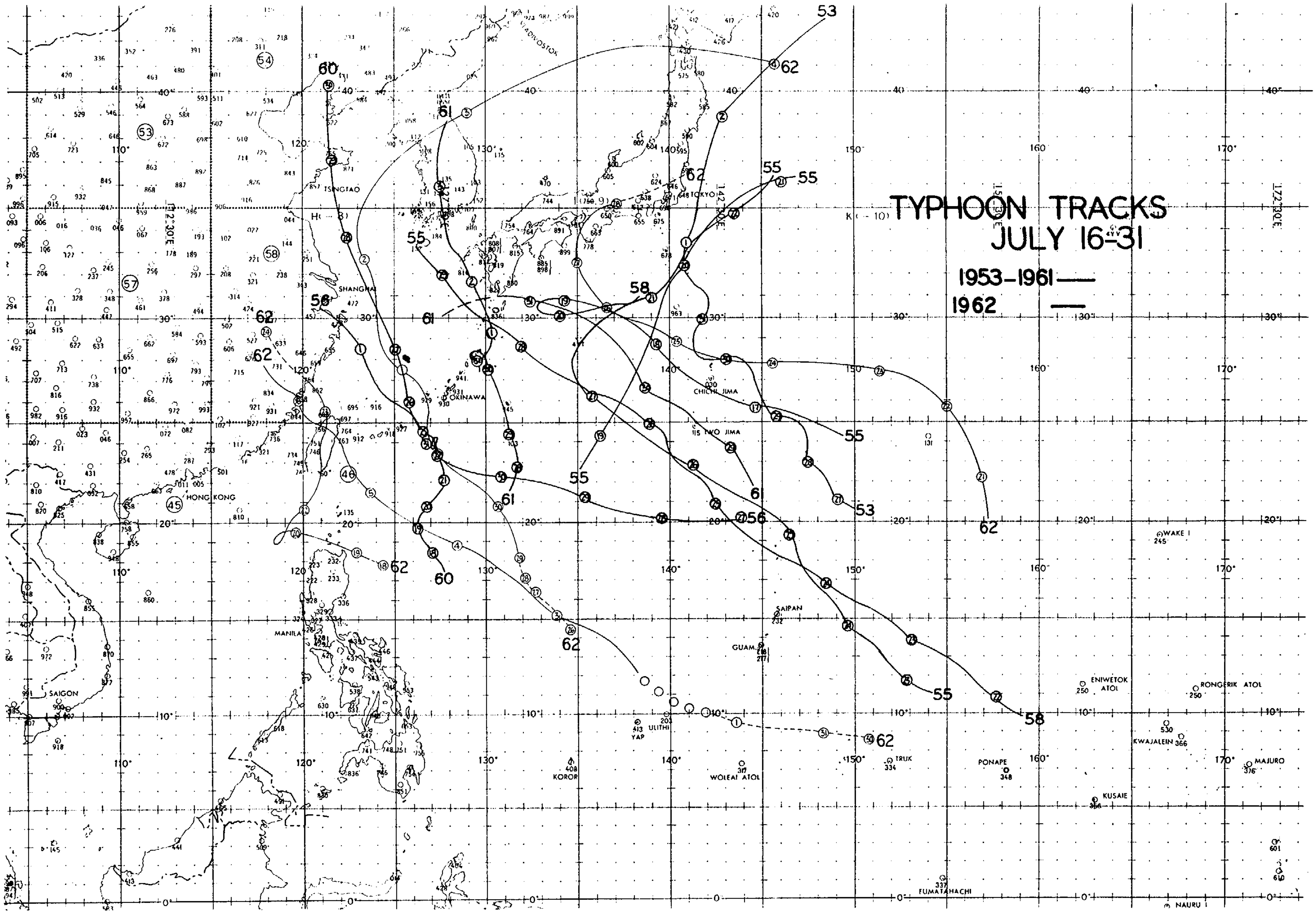
KWAJALEIN
MAJURO
PONAPE
TRUK
KUSAIE
KOROR
WOLEAI ATOL
YAP


TYPHOON TRACKS
JULY 16-31
1953-1961
1962
TSINGTAO
SHANGHAI
HONG KONG
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TOKYO
CHICHI JIMA
IWO JIMA
SAIPAN
GUAM
YAP
ULITHI
KOROR
WOLEAI ATOL
TRUK
PONAPE
KUSAIE
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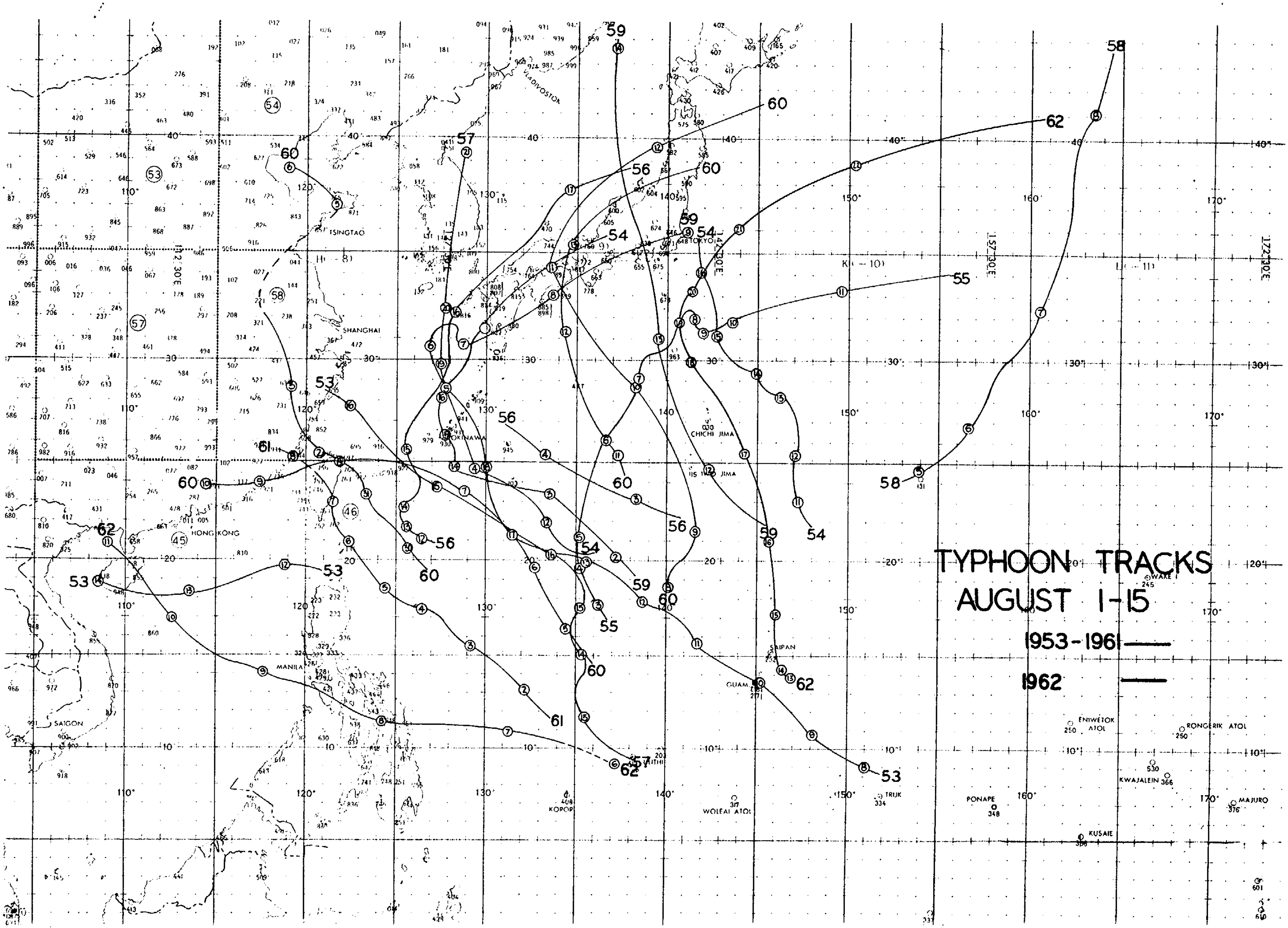
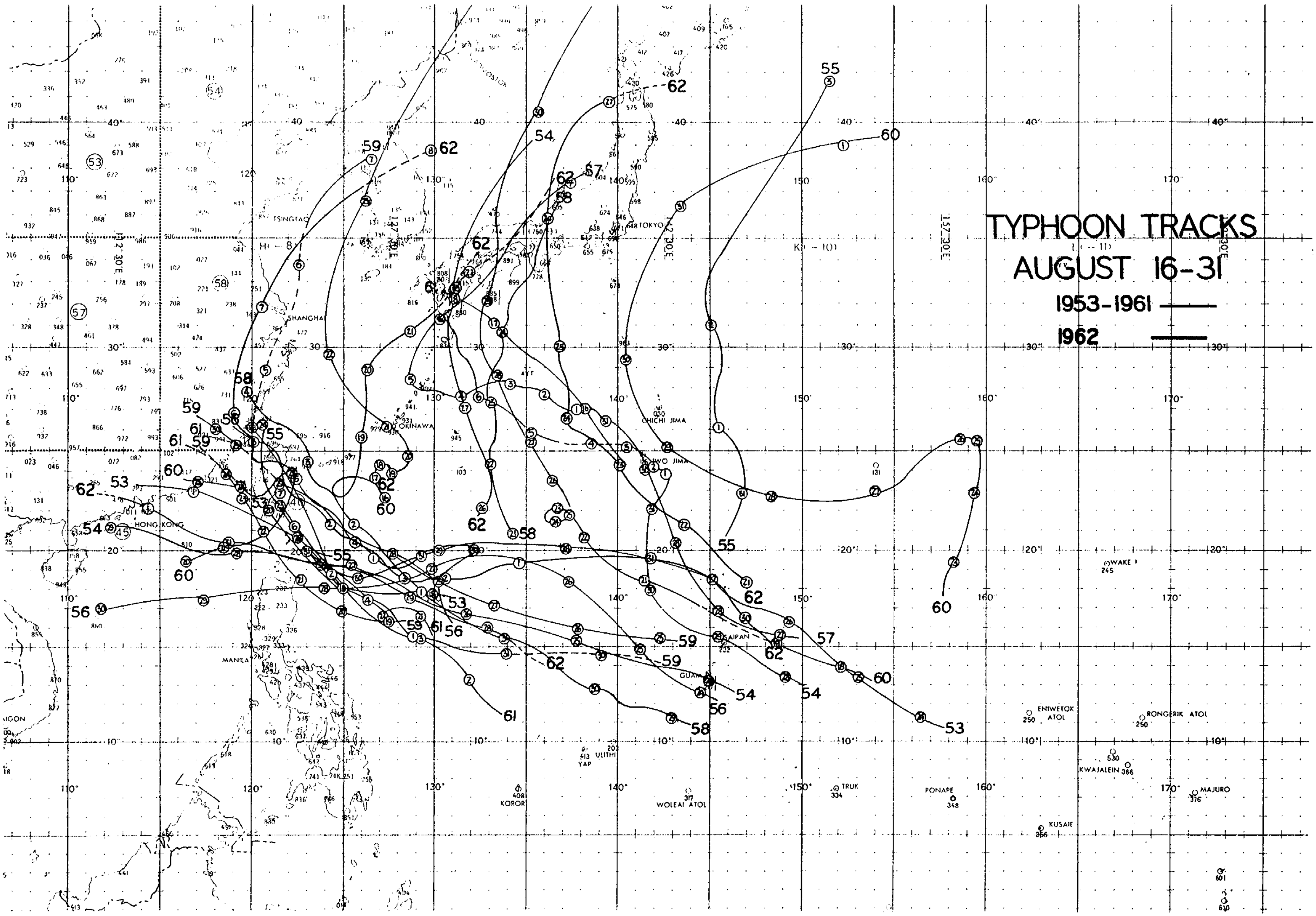
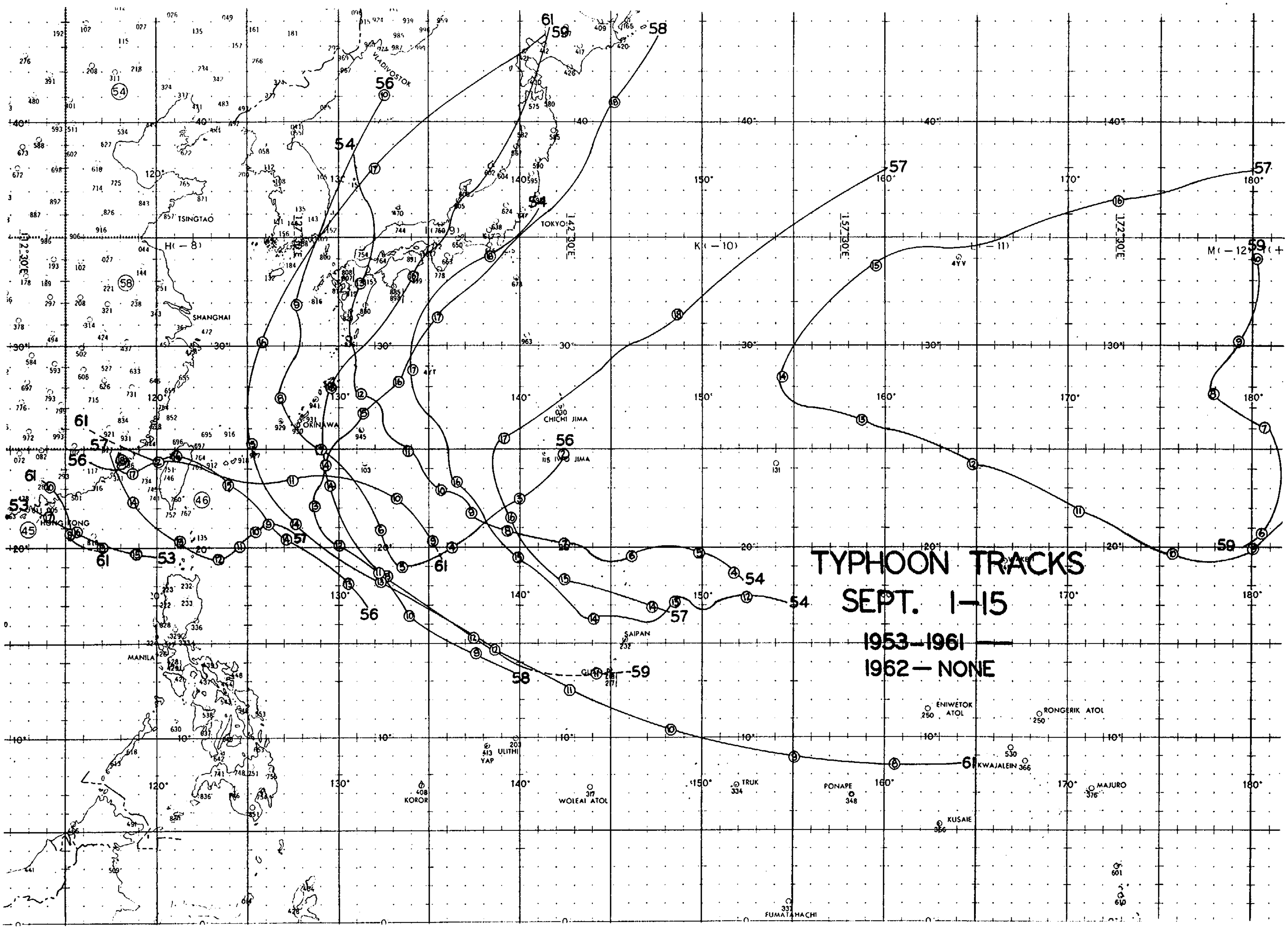
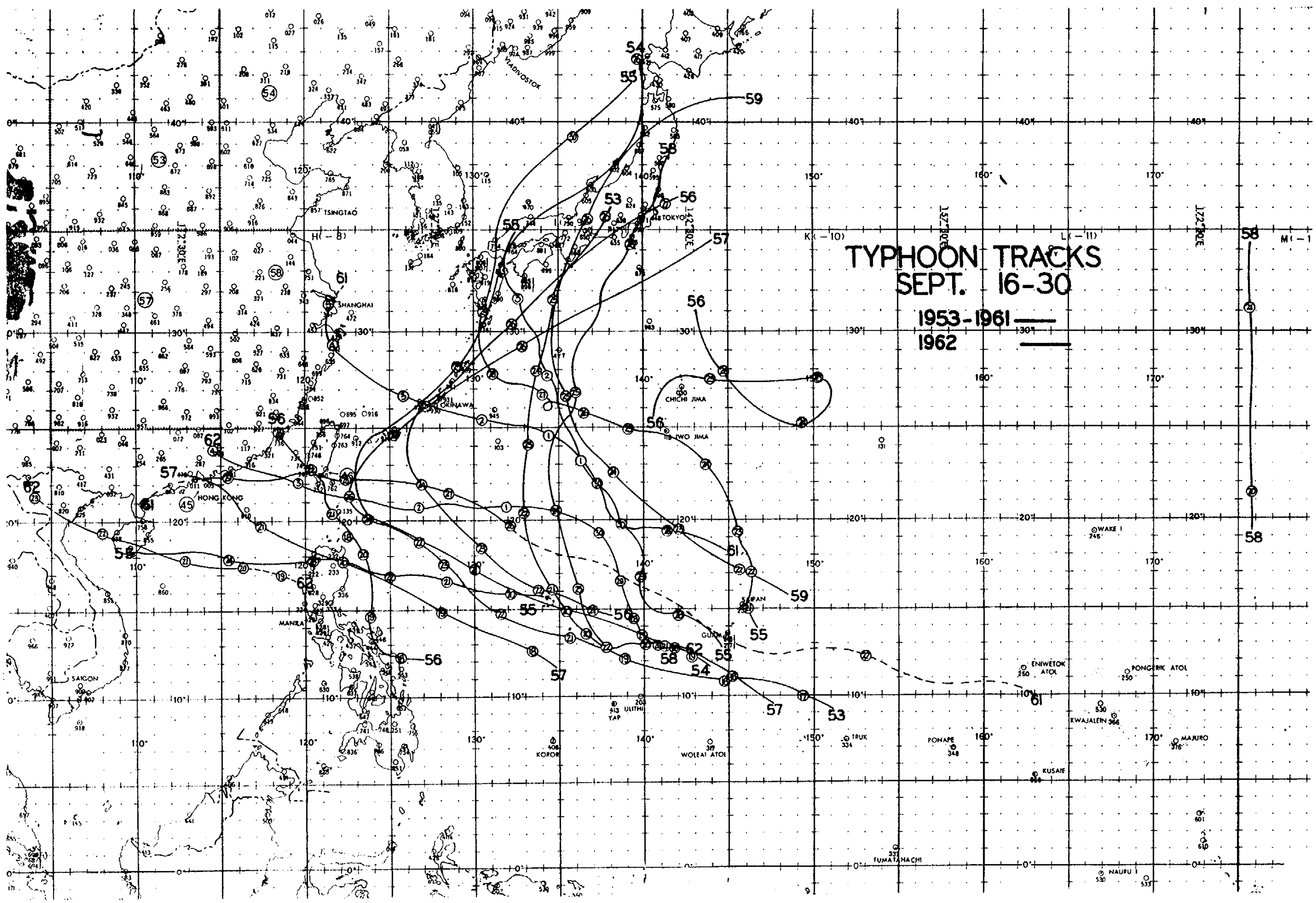
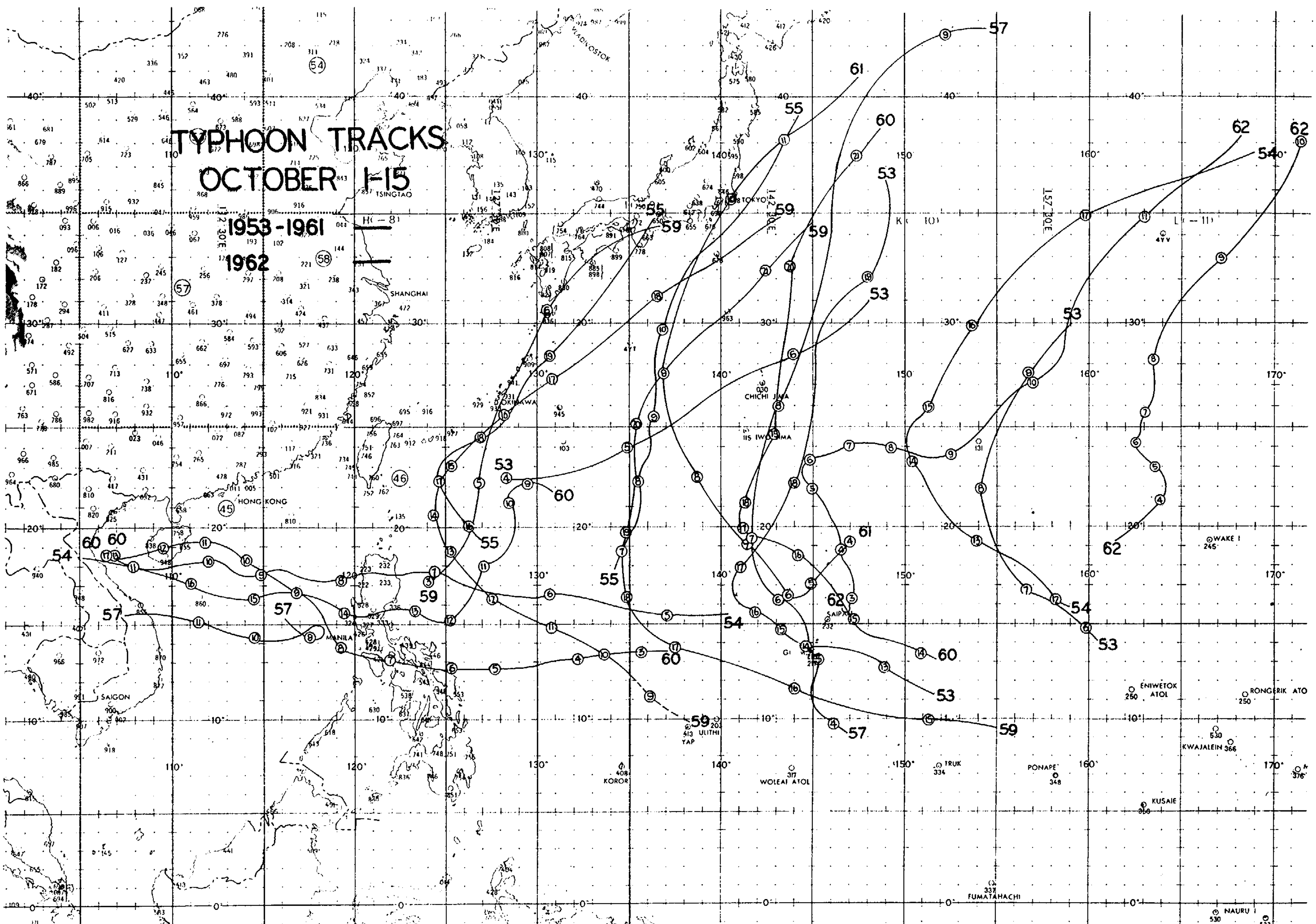
RONGERIK ATOL
KWAJALEIN
MAJURO
WAKE I
NAURU
FUMATAHACHI


TYPHOON TRACKS
AUGUST 1-15
1953-1961
1962
VLADIVOSTOK
TSINGTAO
SHANGHAI
HONG KONG
MANILA
SAIGON
TOKYO
OKINAWA
CHICHI JIMA
SAIPAN
GUAM
ULITHI
KOROR
WOLEAI ATOL
TRUK
PONAPE
KUSAIE
KWAJALEIN
MAJURO
ENIWETOK ATOL
RONGERIK ATOL
WAKE I


TYPHOON TRACKS
AUGUST 16-31
1953-1961
1962
TSINGTAO
SHANGHAI
OKINAWA
TOKYO
CHICHI JIMA
IWO JIMA
HONG KONG
MANILA
SAIPAN
GUAM
YAP
ULITHI
KOROR
WOLEAI ATOL
TRUK
PONAPE
KUSAIE
WAKE I
ENIWETOK ATOL
RONGERIK ATOL
KWAJALEIN
MAJURO


TYPHOON TRACKS
SEPT. 1—15
1953–1961 —
1962— NONE
VLADIVOSTOK
TSINGTAO
SHANGHAI
TOKYO
OKINAWA
CHICHI JIMA
HONG KONG
MANILA
SAIPAN
GUAM
YAP
ULITHI
KOROR
WOLEAI ATOL
TRUK
PONAPE
KUSAIE
ENIWETOK ATOL
RONGERIK ATOL
KWAJALEIN
MAJURO
FUMATAHACHI


TYPHOON TRACKS
SEPT. 16-30
1953-1961
1962


TYPHOON TRACKS
OCTOBER 1-15
1953-1961
1962
TSINGTAO
SHANGHAI
HONG KONG
MANILA
SAIGON
TOKYO
OKINAWA
CHICHI JIMA
IWO JIMA
SAIPAN
YAP
ULITHI
KOROR
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WAKE I
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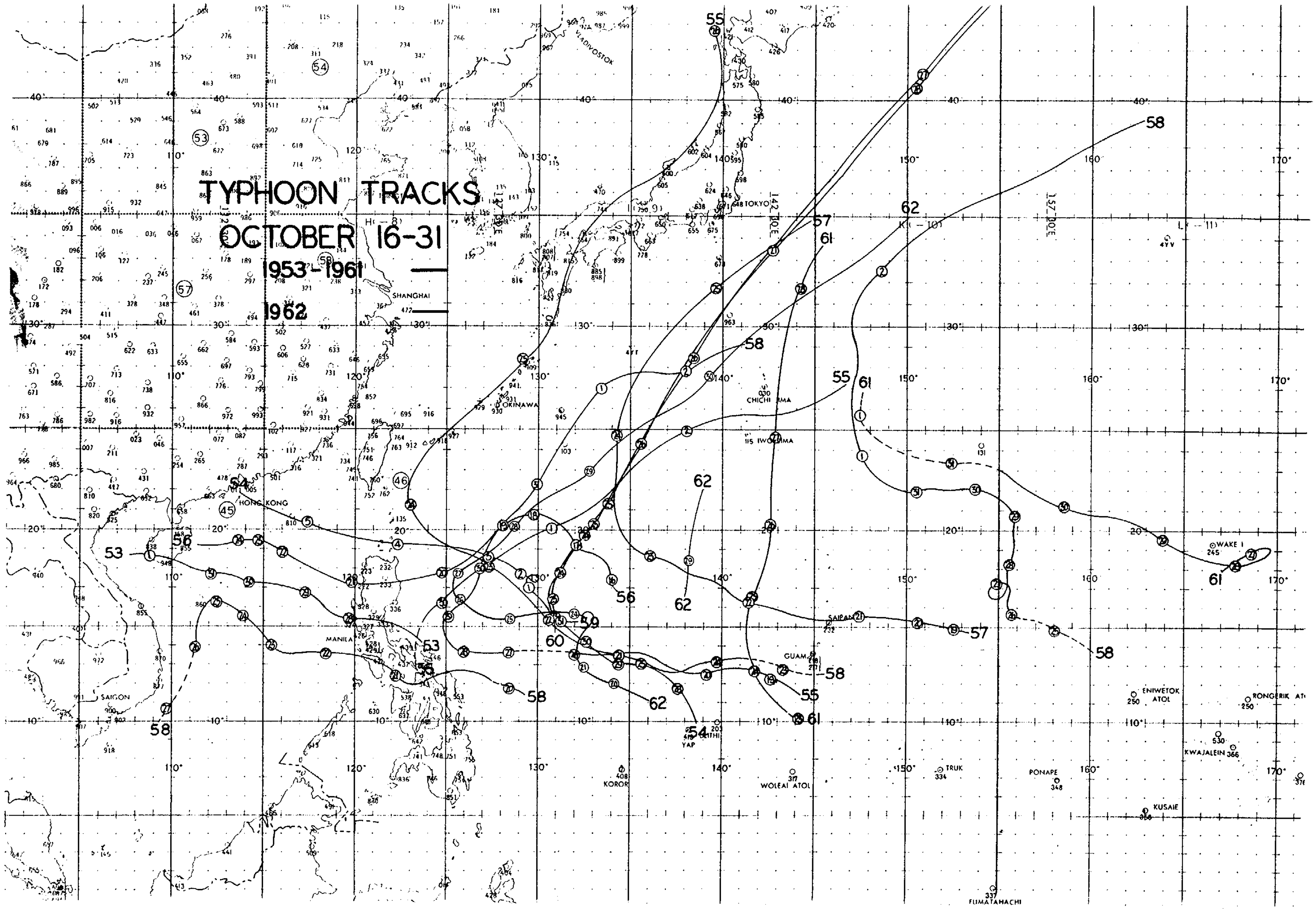
TYPHOON TRACKS
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TOKYO
SHANGHAI
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WAKE I
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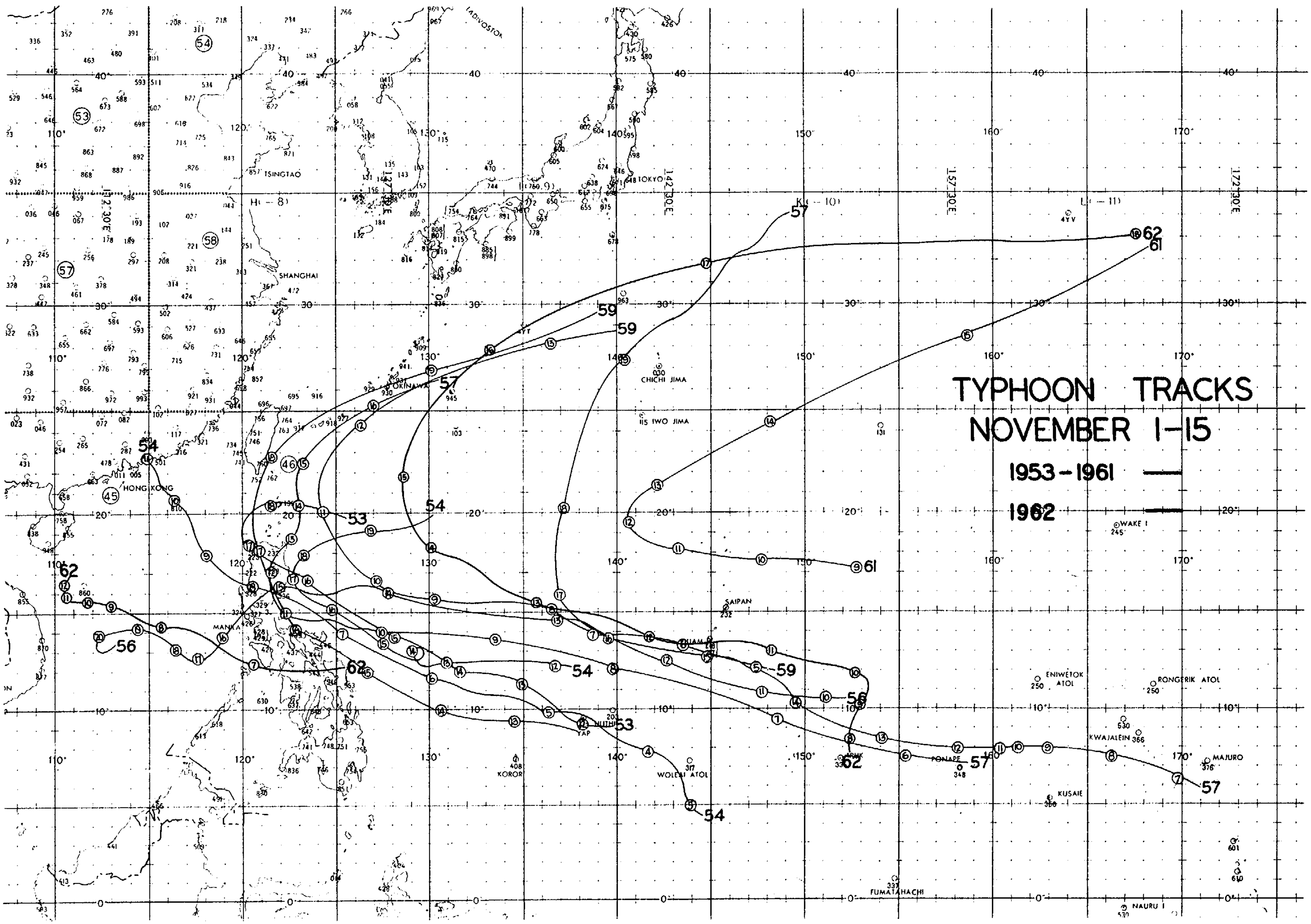
TYPHOON TRACKS
NOVEMBER 1-15
1953-1961
1962
TSINGTAO
SHANGHAI
HONG KONG
MANILA
OKINAWA
TOKYO
CHICHI JIMA
IWO JIMA
SAIPAN
GUAM
YAP
ULITHI
KOROR
WOLEAI ATOL
PONAPE
TRUK
KUSAIE
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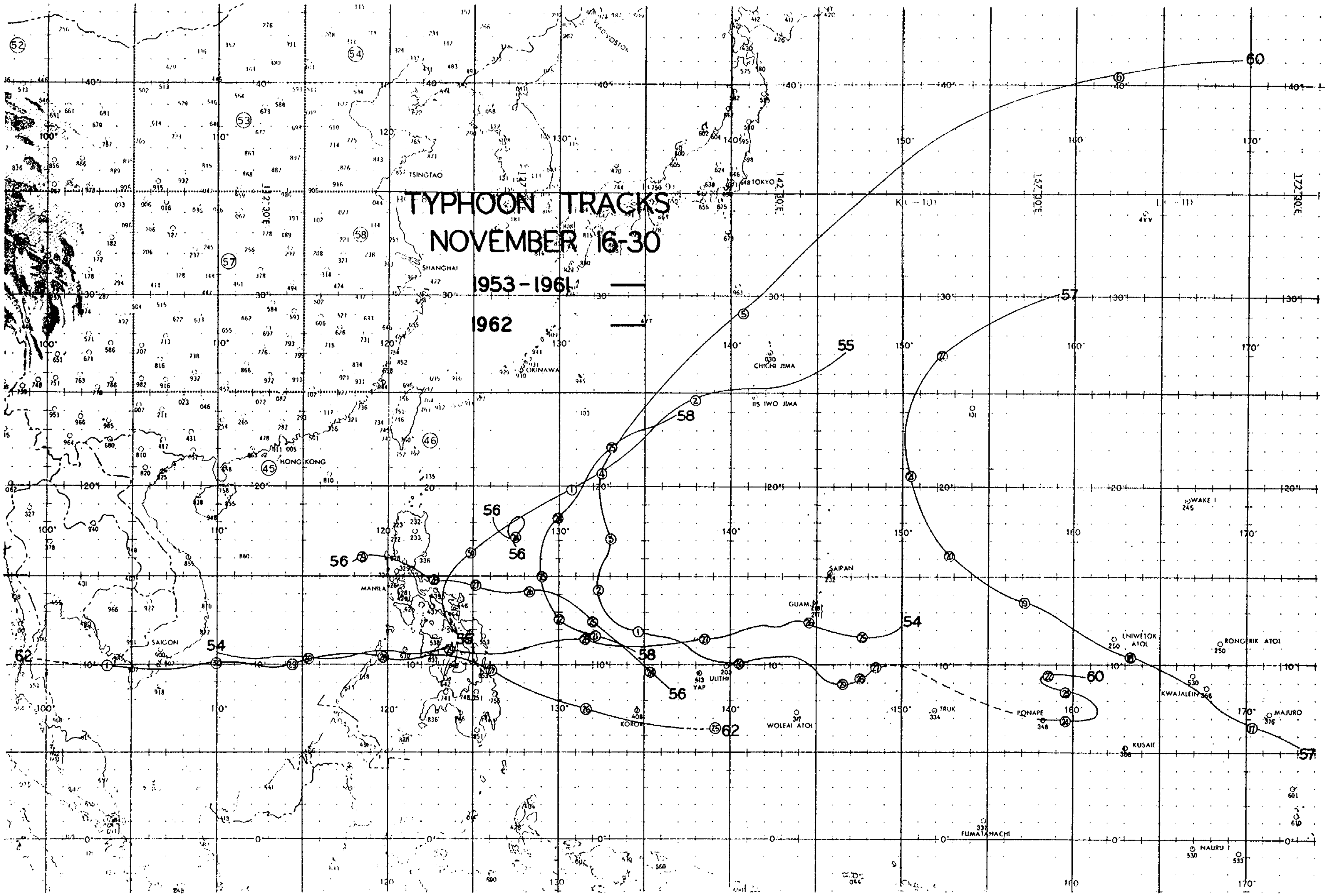
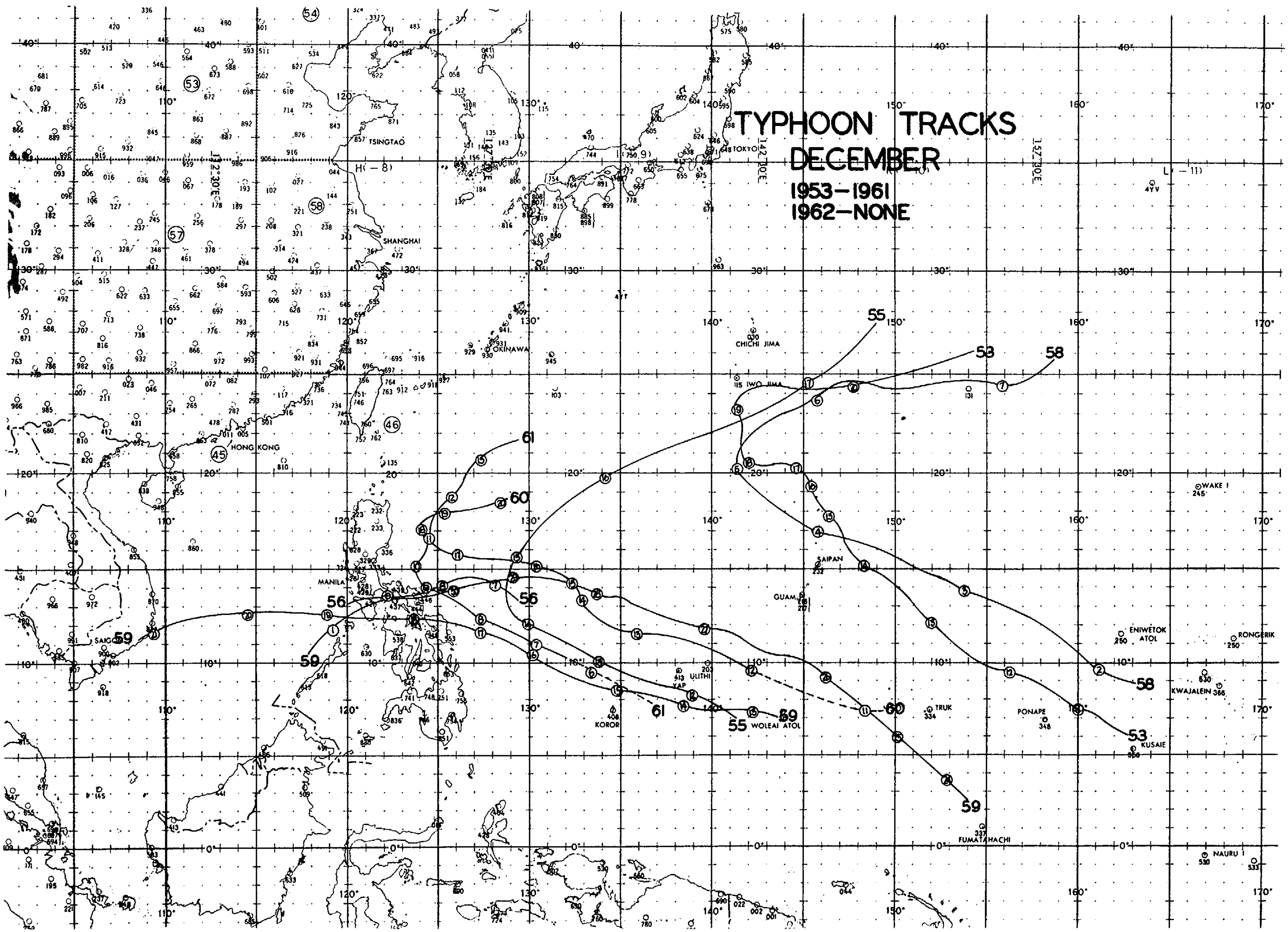
KWAJALEIN
MAJURO
WAKE I
NAURU I
FUMATAHACHI
VLADIVOSTOK


TYPHOON TRACKS
NOVEMBER 16-30
1953-1961
1962
TSINGTAO
SHANGHAI
OKINAWA
HONG KONG
MANILA
SAIGON
TOKYO
CHICHI JIMA
IWO JIMA
SAIPAN
GUAM
YAP
ULITHI
KOROR
WOLEAI ATOL
TRUK
PONAPE
KUSAIE
ENIWETOK ATOL
RONGERIK ATOL
KWAJALEIN
MAJURO
WAKE I
NAURU I
FUMATAHACHI
VLADIVOSTOK
132°30'E
142°30'E
157°30'E
172°30'E


TYPHOON TRACKS
DECEMBER
1953-1961
1962-NONE
TSINGTAO
SHANGHAI
TOKYO
HONG KONG
OKINAWA
CHICHI JIMA
IWO JIMA
MANILA
SAIPAN
GUAM
ULITHI
YAP
KOROR
WOLEAI ATOL
TRUK
PONAPE
KUSAIE
KWAJALEIN
ENIWETOK ATOL
RONGERIK
WAKE I
NAURU I

APPENDIX A

ABBREVIATIONS AND DEFINITIONS

1. Certain words that appear frequently in this report are abbreviated as follows:

CINCPAC	Commander in Chief, Pacific
CINCPACAF	Commander in Chief, Pacific Air Force
CIRC	circular
CLD(S)	cloud(s)
CTR	center
DEF	defined
DEG	degree
DIA	diameter
DIV	divergence
ELLIP	elliptical
ELONG	elongated
FAFWC	Fuchu Air Force Weather Central, Fuchu Air Station, Japan
54WRS	54th Weather Reconnaissance Squadron, Andersen Air Force Base, Guam, M. I.
56WRS	56th Weather Reconnaissance Squadron, Yokota Air Base, Japan
FNWF	Fleet Numerical Weather Facility, Monterey, California
FT, ft	feet
FWC/JTWC	Fleet Weather Central/Joint Typhoon Warning Center, Guam, M. I.
INDEF	indefinite
ITC	Intertropical Zone of Convergence
JMA	Japan Meteorological Agency
JMG/PACOM	Joint Meteorological Group, Pacific Command
K(KILO) Time	Mariana Islands local time
KT(S), kt(s)	knot(s)
MI, mi	nautical miles
MB(S), mb(s)	millibar(s)
MPT	Mid-Pacific trough
NA	not applicable
NMC	National Meteorological Center (formerly JNWP, Joint Numerical Weather Prediction)
NWSC	National Weather Satellite Center (formerly METSATLAB)
ORIEN	oriented

QUAD(S)	quadrant(s)
RAD	radius
SFC	surface
θe	Equivalent Potential Temperature
VW-1	Airborne Early Warning Squadron One, NAS Agana, Guam
WESTPAC	Western North Pacific Area
WND	wind
Z(Zulu) Time	Greenwich mean time

2. Points of the compass are abbreviated: N, SE, WNW, etc.

3. Latitude and longitude are abbreviated: 30N 140E, etc.

4. The following define and clarify certain words and phrases that appear in the tables, "Land Radar and Aircraft Fixes," Chapter IV.

A. FIX NO. - This number corresponds to the number of the fix plotted on the "Best Track Chart."
B. TIME - The date-time group of the fix
C. LAT. - Latitude of the fix
D. LONG. - Longitude of the fix.
E. UNIT, METHOD & ACCY -
(1) UNIT - The unit that made the fix: 54 - 54WRS, 56 - 56WRS, 315 - 315th Air Division
(2) METHOD - The method used to make the fix: P - penetration, R - radar, T - triangulation, LND/RDR - land radar
(3) ACCY - The estimated accuracy of the fix in nautical miles
F. MIN SLP MB - The minimum sea level pressure in millibars
G. MAX SFC WND - The maximum observed surface wind in knots
H. MIN 700MB HGT - The minimum 700mb height in feet
I. MAX 700MB WND - The maximum 700mb wind in knots
J. 700MB T/Td (^{o}C) - The maximum 700mb temperature and dewpoint in degrees centigrade

5. Synoptic tracks in the JTWC tropic area are:

A. Round Robin to two coordinates and flight time 10 plus hours with synoptic reports normally every hour. Legs are flown at 1500 ft, 700mb and 500mb at JTWC request.

B. TRANSPAC diversion to one coordinate not less than 5 DEG off course. Flight altitude will normally be 700mb or 500mb.

6. An investigation is the traverse of a reconnaissance aircraft over an area containing a suspected circulation that has been assigned a cyclone number.

7. A fix is the determination of the position of a tropical cyclone at a precise time. Generally, the term "fix" is used when the position of the cyclone has been determined by a reconnaissance aircraft penetration or by airborne, land or ship radar. In the case of a reconnaissance aircraft penetration, the actual fix may be based on one or all of the following: visual observation, radar, surface pressure, surface or upper level winds, constant pressure height, and temperature/dew point.

8. A sortie is defined as a flight by one aircraft with one or more objectives; i.e., it may make one or more fixes and/or one or more investigations on one or more tropical cyclones.

9. The term "tropical cyclone" or "cyclone" as used in this publication has two definitions dependent upon usage.

A. "Tropical cyclone" or "cyclone" is used to describe a suspected tropical cyclonic circulation which appears capable of intensification, and to which has been assigned a "cyclone number" for the purposes of reconnaissance and to assure that records regarding it are not confused with those of another circulation.

B. "Tropical cyclone" or "cyclone" is used in the general sense, e.g., "Typhoon JOAN was the most intense tropical cyclone of 1959," or "Tropical cyclones more frequently develop during August and September."

(1) A "Tropical Depression" as used by JTWC is a tropical cyclone with a confirmed cyclonic circulation for which warnings are being issued and whose surface wind speeds do not exceed 33 kts. Tropical depressions are numbered and often abbreviated TD.

(2) A "Tropical Storm" is a tropical cyclone in which the maximum surface wind speed is no more than 63 kts

but greater than 33 kts in warning status. Tropical storms are named and sometimes abbreviated TS.

(3) A "Typhoon" is a tropical cyclone located W of 180 DEG longitude in which the maximum surface wind speed is 64 kts or greater in warning status. Typhoons are named.

10. A "Stidd Diagram" or "checkerboard" is a chart on which a continuous plot of surface observations is maintained for a series of stations. The observations for each individual station are plotted in either a horizontal or vertical line.

11. The "M-2 Field" is the correction for the coriolis parameter applied to the 500mb double space mean.

12. Recurvature - that point at which the cyclone ceases movement to the W of N and commences moving to the E of N.

13. Vortices:

A. Embedded vortex of easterly wave - closed cyclonic circulation along easterly wave and separated from ITC

B. Junction vortex - closed cyclonic circulation at the junction of easterly wave and ITC

C. Embedded vortex of ITC - closed cyclonic circulation along ITC with absence of easterly wave

APPENDIX B

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Vera Due To Rip Into Shikoku

The Endless Battle Between Men and Typh

'Nora' Batters Korea

yphoon Smacks Philippines; 18 Missing

Flood, Fire Ravage Luzon, P.I.

MANILA, July 21 (AP)—Flood and fire battered the Philippines main island of Luzon today.

Tens of thousands were homeless and damage ran into millions of dollars...

Taipei Braces For Amy

Typhoon-Buffeted Boats Radio SOS

2 Typhoons Stand Still In Pacific

China-Bou... After Hitting ...

phoon Heads for Japan

Thousands Homeless In Wake of Opel

I IS SUPPOSED TO HOLD UP

Typhoon Destroys 95 Pct. Of Guam Civilian Buildings

Gilda Winds Hit 133 MPH

Guam Havoc 'Worse Than WW II'

HEADS FOR KOREA

Amy Floods U.S. Sites in Taipei

Typhoon Heading For Iwo

PACIFIC STARS AND STRIPES AIR EDITION

Storms Peril Japan, Korea

Typhoon Batters East USSR

Storm Harriet Killed 700 In Thai Areas

Typhoon Routs Thousands In P.I., Veers Toward China

WANDA KILLS 39

Typhoon Disaster Hits Hong Kong

HONG KONG (AP)—Typhoon Wanda swooped down on this crowded British colony Saturday. In a few nightmarish hours it le...

Whips Formosa--Scores Dead

Guam Named Disaster Area

Joan Losing Force; New Storm Off P.I.

Sea Battle

Typhoon Crosses Vietnam

Thailand Storm Toll Soaring— 1,000 Dead, Lost

BANGKOK (AP)—The toll of dead and missing in the vicious storm that raked southern Thailand last

Typhoon Lashes Tiny Isle

Kate Fades After Hitting P.I., Taiwan

Opel Kills 30 on Taiwan

TAIPEI (UPI) — Typhoon Opel shrieked across Taiwan during the night at murderous speeds of up to 170 miles and moved westward toward the China mainland Monday morning.

New Storm Born in Pacific

TRACKING 'KILLERS'

Typhoon Hits R...

...Eye Peeled for Typhoon

Dinah Due To Skirt Taiwan

80-MPH Typhoon Skims Past Okinawa

TOKYO (S&S)—Typhoon Louise took over the storm spotlight from a suddenly docile Kate Tuesday as her center winds increased to 104 miles an hour about 360 miles north east of Iwo Jima.

Dinah Misses Taiwan

Homeless Toll 70,000 In Luzon

MANILA, July 24 (AP)—An estimated 70,000 people were homeless today on the Philippines' main island of Luzon after six days of monsoon rains — and still the rains came.

The Social Welfare Administration was attempting

Floods Threaten Wide Area of P.I.

Lucy's Wake—Cholera

Typhoon Amy Took 12 Lives in P.I.