CHAPTER III

JTWC STUDIES

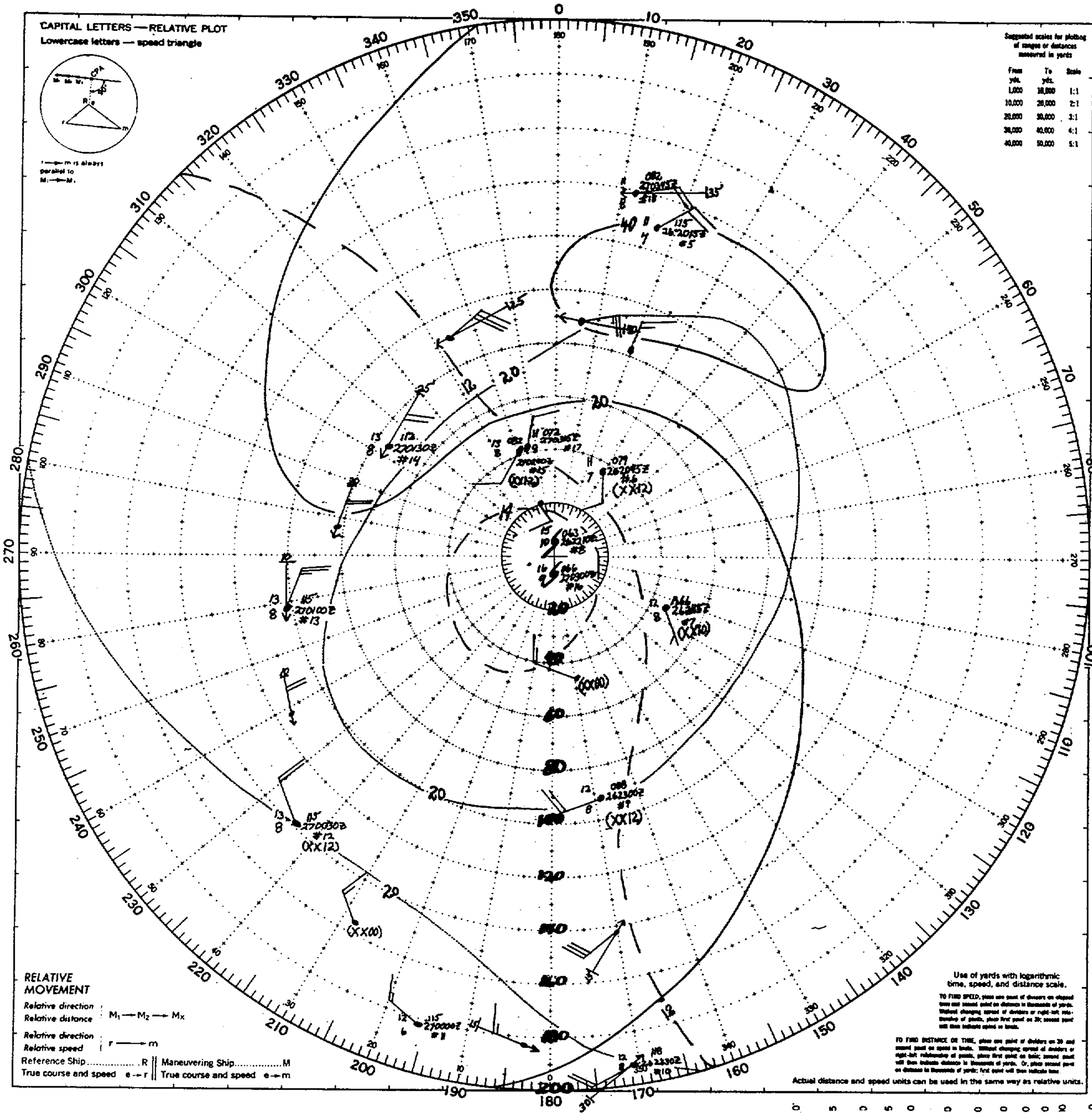
AN EXAMPLE OF "EXTRA-TROPICAL SURGE" IN TYPHOON HOPE

Since the advent of 700mb typhoon reconnaissance, many cases of low level wind surge have been reported. In most cases, these are of relatively short duration and cause at most a 50% increase in wind speeds. However, there appears to be a surge of 6-12 hours duration connected with the first intrusion of extra-tropical air into the system which can increase wind speeds by as much as 300% near the surface. The following example is based on daylight reconnaissance of Typhoon Hope.

The three charts are based on low level (700mb) reconnaissance tracks flown over three successive days by the 56th Weather Recon Sqdn, MATS, using WB-50 aircraft. Supplementary data has been obtained from high level (300mb) tracks flown by the 54th Weather recon sqdn using WB-47 aircraft. On each day the WB-50 was on station in the storm area for approximately 8 hours. The data have been plotted using a moving co-ordinate system based on the typhoon center, with center positions obtained from the JTWC "Best track". Since two penetrations were made on each day, the eye data reports have been plotted above and below the chart center. The charts have been analysed for temperature and isotach values at 700mb and isotach values at the surface.

Chart #1 covers the daylight recon for 27 October. At this time Hope had been moving slowly northward through the subtropical ridge for 24 hours with little change of intensity. The 700mb temperature gradient was almost flat, with a slight max over the storm center. Strongest surface winds were 40-45 knots in the north quadrant, with no 700mb winds above 30 knots reported.

By the next day (Chart #2) Hope was travelling NNE and forward movement had increased from 7 knots to about 15 knots. A wedge of cold air at 700mb was moving south in the west quadrant, while the warm air was being carried north with the storm in the east quadrant. Temperatures and dew points had actually increased in the eye, possibly due to the deepening of the storm center and consequent lowering of the 700mb surface. At this time two surface isotach max centers were observed. One

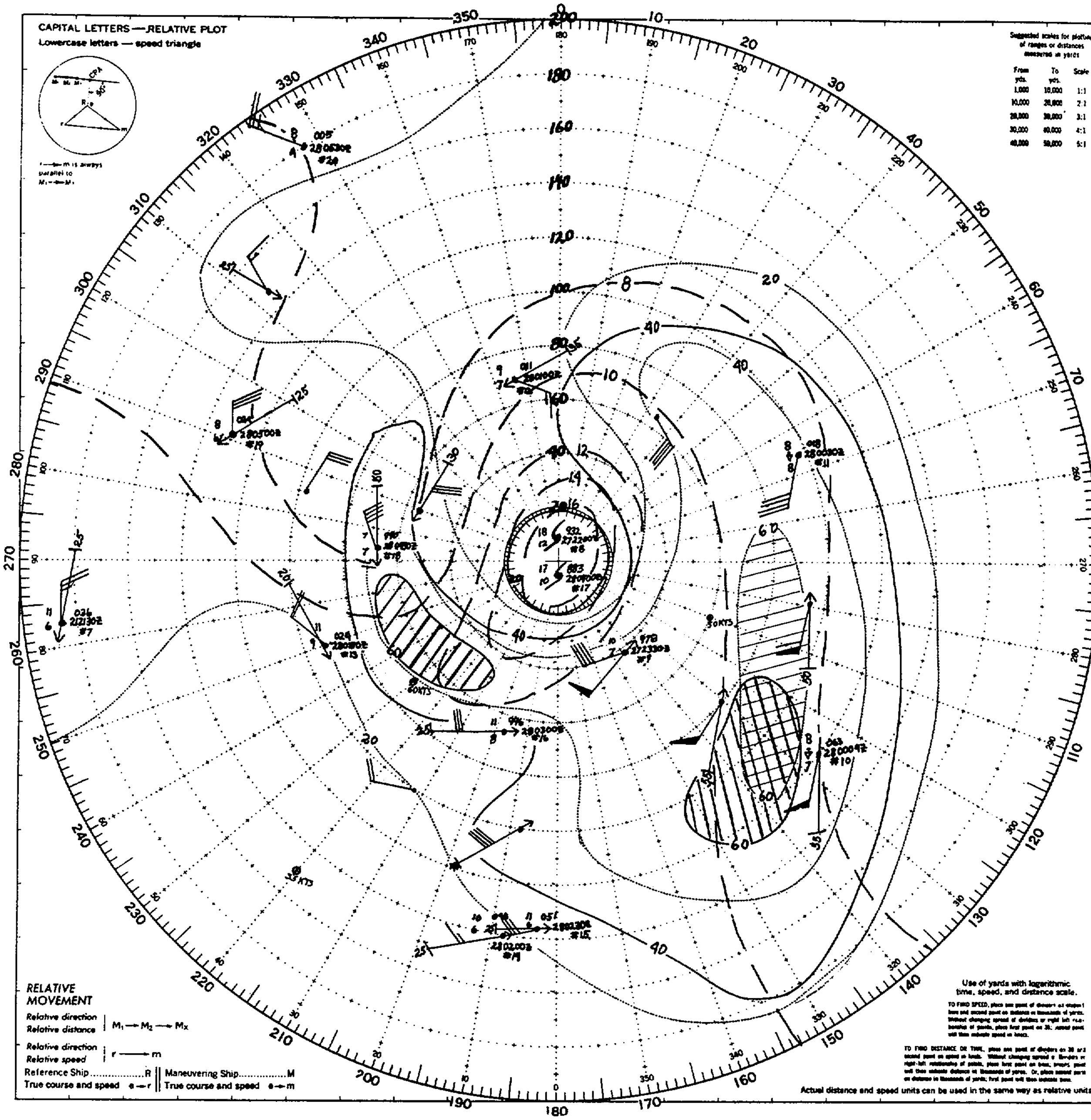


— — 700MB TEMPERATURE

#1 HOPE 27 OCT. 1964

——— SURFACE ISOTACH

——— 700MB ISOTACH

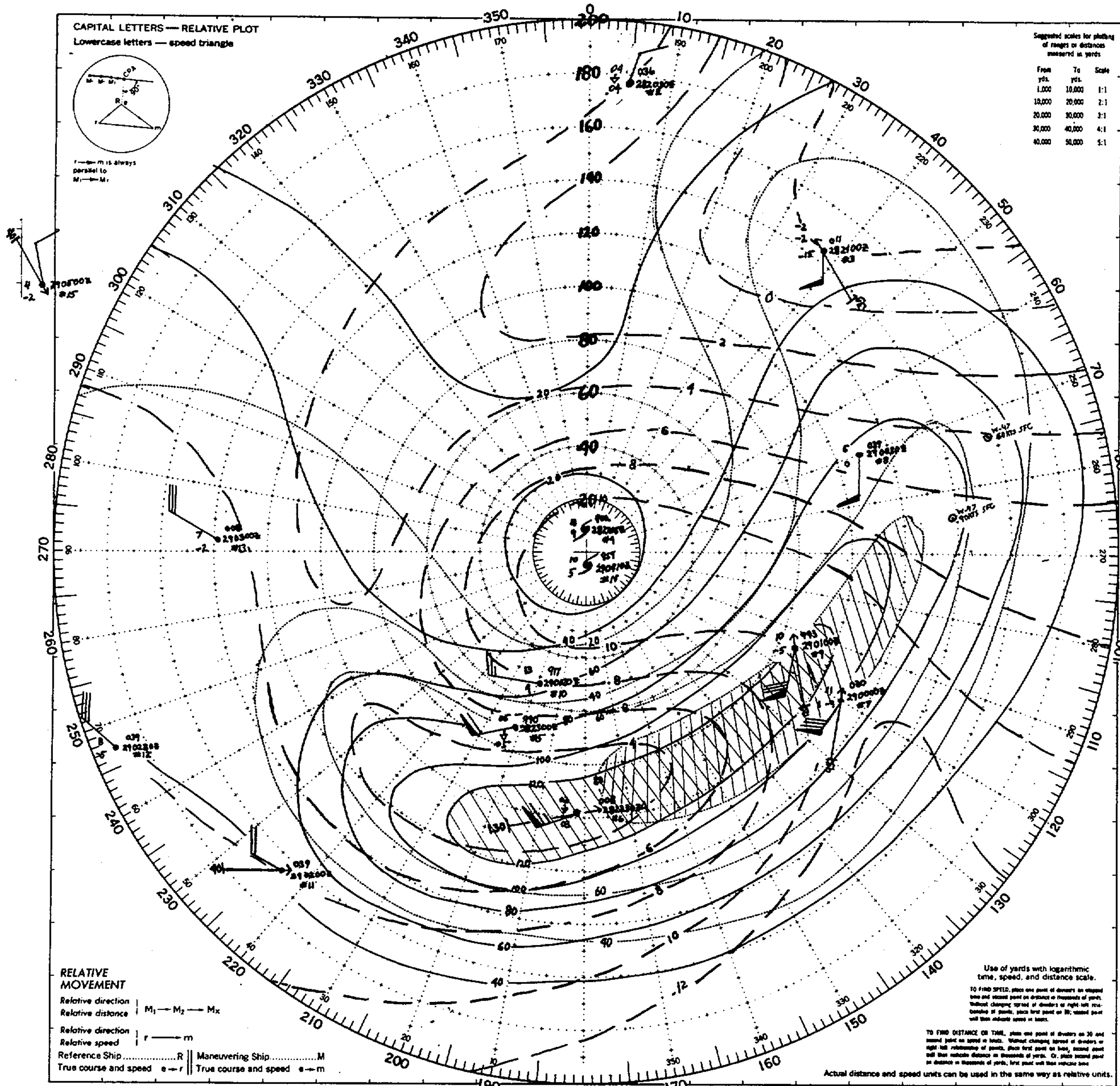


— — 700MB TEMPERATURE

#2 HOPE 28 OCT. 1964

—— SURFACE ISOTACH

········ 700MB ISOTACH



700MB TEMPERATURE

SURFACE ISOTACH

700MB ISOTACH

HOPE

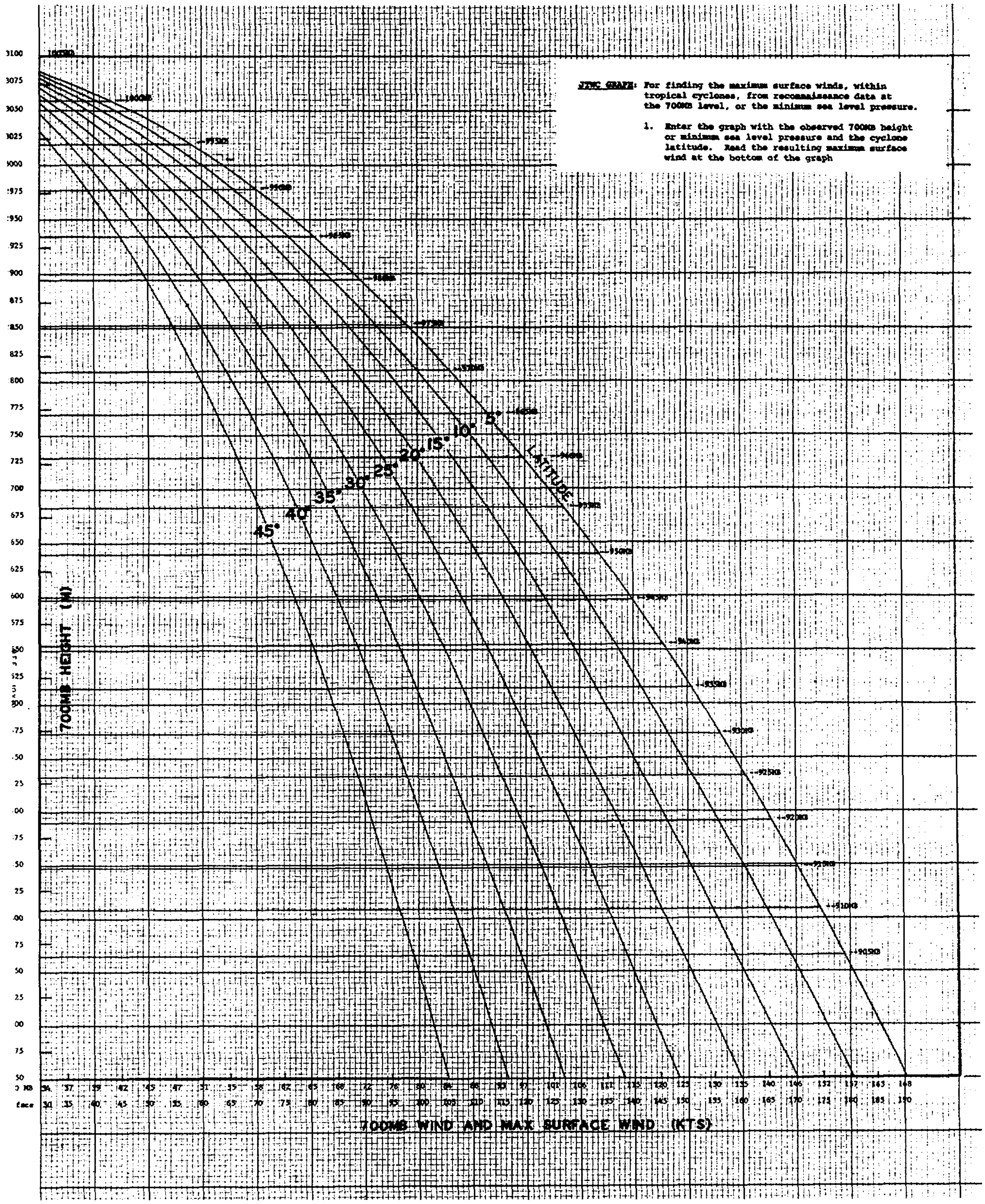
 # 3 29 OCT. 1964

near the leading edge of the warm air being carried north with the storm, the other on the "nose" of the cold air moving to the south. Both centers showed values of approximately 60 knots at the surface, with the eastern center also showing 60 knots at 700mb.

On the third day (Chart #3) the storm was accelerating from 24 to 30 knots toward the NE. The cold air had now penetrated to the south quadrant, and the warm air pocket at the center was weakening and was almost cut off. At this time a single isotach max of at least 80 knots at 700mb was located on the "nose" of the cold air wedge, with a 130 knot surface isotach max below and slightly upwind toward the colder air. An interesting feature of this chart is the tremendous indrafting observed at the surface. Even discounting forward motion of the storm, values as high as 40 knots are found in the southeast quadrant.

Unfortunately, the aircraft aborted on the 30th of October and no recon data is available for the fourth day. However, analysis of a fairly dense network of surface ships showed an extra-tropical system with maximum surface winds of 45 knots.

It is felt by JTWC that this is a classic example of a recurrent event. Since this phenomenom was first identified by Lt. Col. R. C. Lame during the 1963 typhoon season, it has been observed in every case when a typhoon became extra-tropical over open water and reconnaissance aircraft were in the area at the time. While no direct cause has been found for this surge, it is believed to be connected in some manner with the increase in release of latent heat caused by the under-running cold air. If 700mb daylight reconnaissance is available for the 1965 season, further research is planned on this phenomenom.


JTWC GRAPH: For finding the maximum surface winds, within tropical cyclones, from reconnaissance data at the 700MB level, or the minimum sea level pressure.
1. Enter the graph with the observed 700MB height or minimum sea level pressure and the cyclone latitude. Read the resulting maximum surface wind at the bottom of the graph
700MB HEIGHT (M)
5°
10°
15°
20°
25°
30°
35°
40°
45°
LATITUDE
700MB WIND AND MAX SURFACE WIND (KTS)

JTWC GRAPH

The graph for finding maximum surface winds was based on seven years of reconnaissance data. The data, 1956 through 1962, was used to modify the equation of Captain L. E. Fortner, Jr. (1956), Typhoon SARA, Bulletin of the American Meteorological Society, Vol. 39, pp. 633-639. The present graph includes a change in one of the constants in the basic equation. The refinement modifies the graph in the area of higher pressures and lower wind speeds.

The resulting equation is:

$$V_{max} = \left(19 - \frac{\theta}{5}\right) \sqrt{364 - \frac{H_7(FT)}{28}}$$

Which was obtained from a best fit of the data from the years 1956 through 1962.

Where: V_{max} = Maximum surface wind
θ = Latitude of tropical cyclone
H_7 = Minimum 700mb height in cyclone center

The equation for converting maximum 700mb wind observed during penetration to maximum surface wind within the cyclone is:

$$V_{max} = -100 + \sqrt{500V_7}$$

Where: V_{max} = Maximum surface wind
V_7 = Maximum 700mb wind observed during penetration*

This equation utilized data for the years 1956 through 1962 also. The equation is not defined when the 700mb wind is less than 20 knots.

*Note: Reconnaissance aircraft pick the weakest portion of the tropical cyclone for penetration; therefore, the observed 700mb wind will, in most cases, be less than the maximum 700mb wind for the cyclone.

A 700mb NUMERICAL GRID FOR TYPHOON MOVEMENT FORECASTING

Since the installation of a CDC 160-A computer at FWC/JTWC Guam, research has been started on a steering forecast based on a hand micro-analysis of the 700mb surface. The 700mb surface was chosen for two reasons: first, because it is apparently one of the better predictors of typhoon movement, and second, because of the mass of additional data available locally as a result of reconnaissance flights.

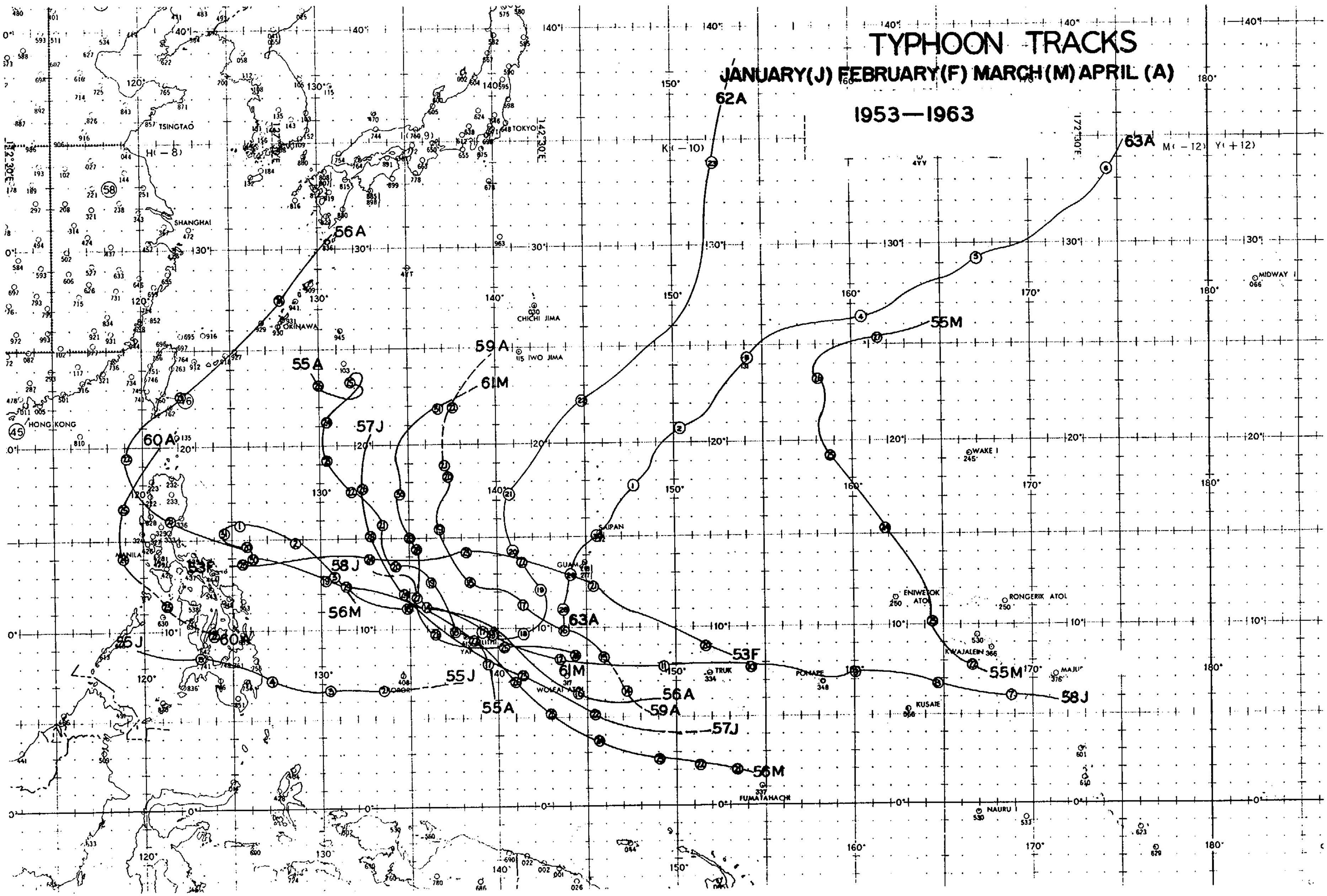
At the present time, the 700mb surface is hand-analyzed for a 10-meter interval every 12 hours and heights picked off an eight (N-S) by nine (E-W) point grid centered over the storm are fed into the computer. At present a grid spacing of 1.4 inches is used on a 1:15,000,000 polar stereographic chart, giving a distance of approximately 180 NM between grid points at 10N. Experiments have indicated that this is the optimum spacing to include all significant features without introduction of extraneous "noise".

The computer program first replaces the value at the center point of the grid (i.e., directly over the storm) with an average of the four surrounding points. This removes most of the storm circulation from the grid on all but the largest storms. Then a smoother is run over the grid and a difference field between analysis and smoothed field produced. The computer then prints the original grid, the smoothed grid, and the difference field. These fields are then hand-analyzed for the grid values and compared to the actual movement of the storm in the next 24 hours.

At first a standard Fjortoft "Z-bar" field was used in place of a smoother, but it was found that considerable mechanical instability was introduced in systems with large circulation areas.

Preliminary experiments with Typhoon KATHY (12-25 Aug) indicate that a useful forecast of 24 hour direction of movement and a rough indication of speed of movement can be evolved from this technique. Experiments are being conducted on varied smoothers in an effort to overcome the instability mentioned above and the method will be tested on other storms before the start of the 1965 season. If further experiments seem justified, a set of objective rules will be drawn up for an operational test.

TYPHOON TRACKS 1953 - 1963



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JANUARY(J) FEBRUARY(F) MARCH(M) APRIL (A)
1953—1963
62A
63A
56A
55M
59A
61M
55A
57J
60A
58J
53F
56M
63A
55J
53F
61M
56A
59A
55J
55A
57J
55M
58J
56M
60A
55J
TSINGTAO
TOKYO
SHANGHAI
OKINAWA
CHICHI JIMA
IWO JIMA
HONG KONG
MANILA
WAKE I
MIDWAY I
SAIPAN
GUAM
ENIWETOK ATOL
RONGERIK ATOL
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TRUK
PONAPE
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KUSAIE
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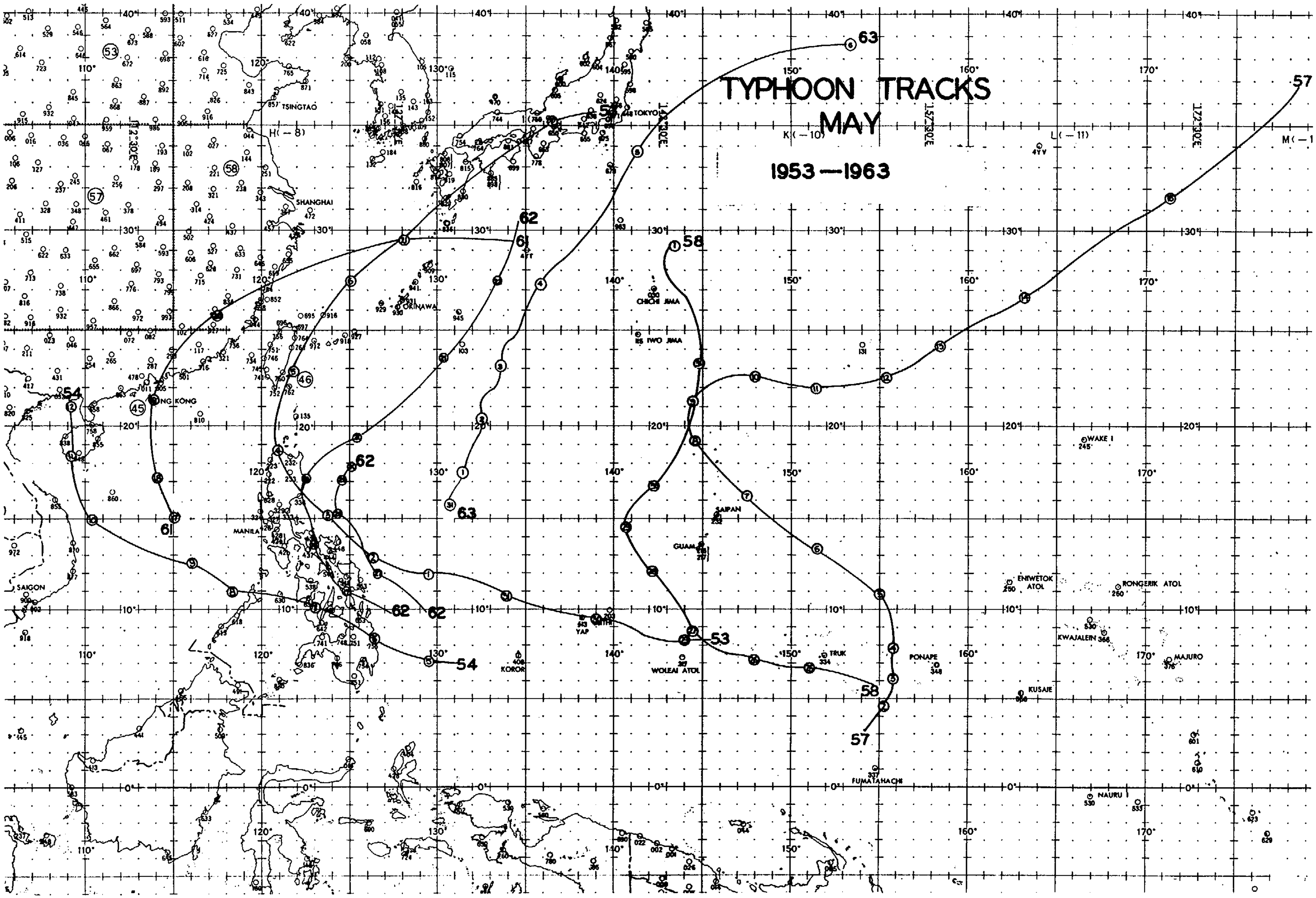
YAP
ULITHI
NAURU
FUMATAHACHI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MAY
1953—1963
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IWO JIMA
SAIPAN
GUAM
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TRUK
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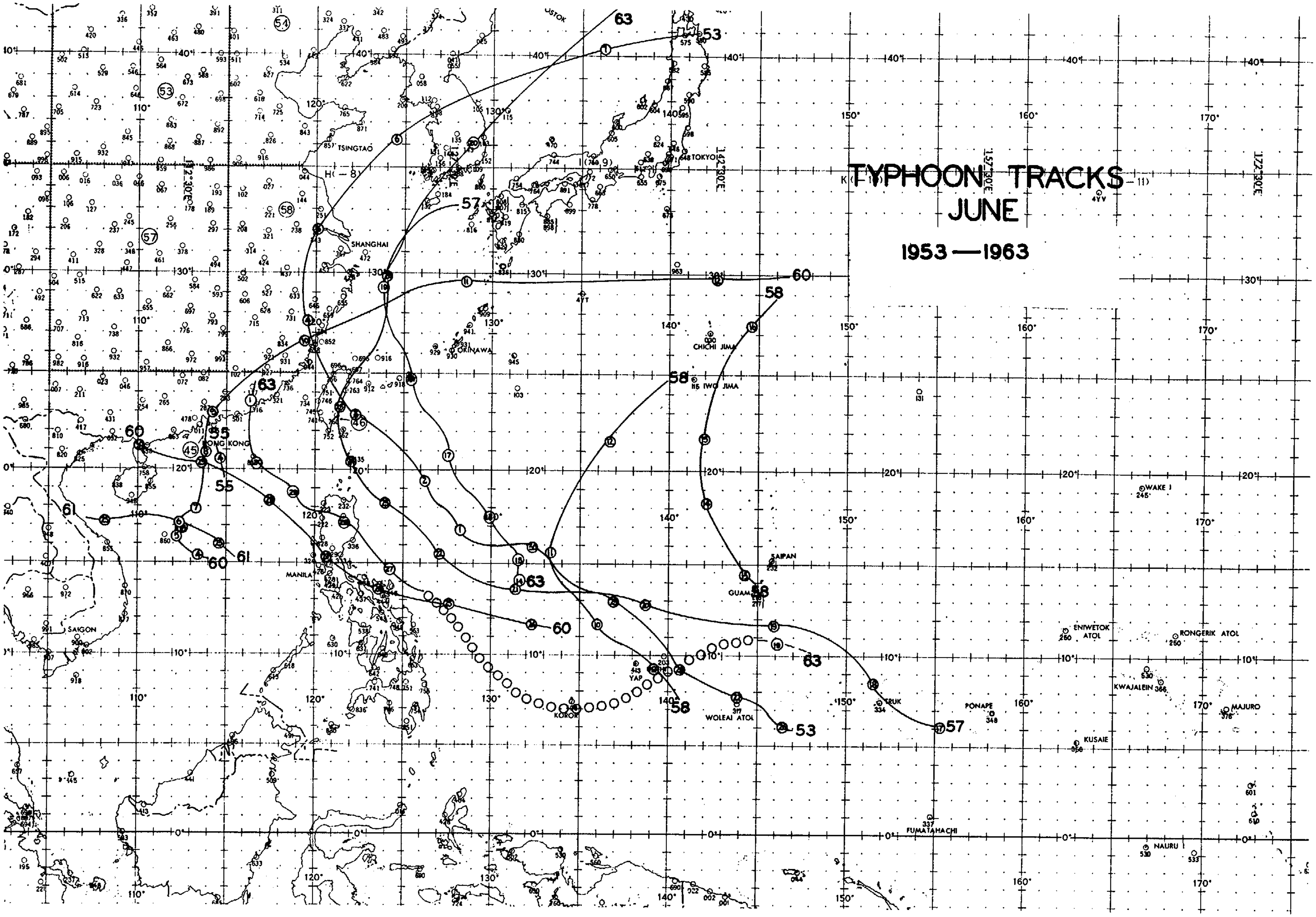
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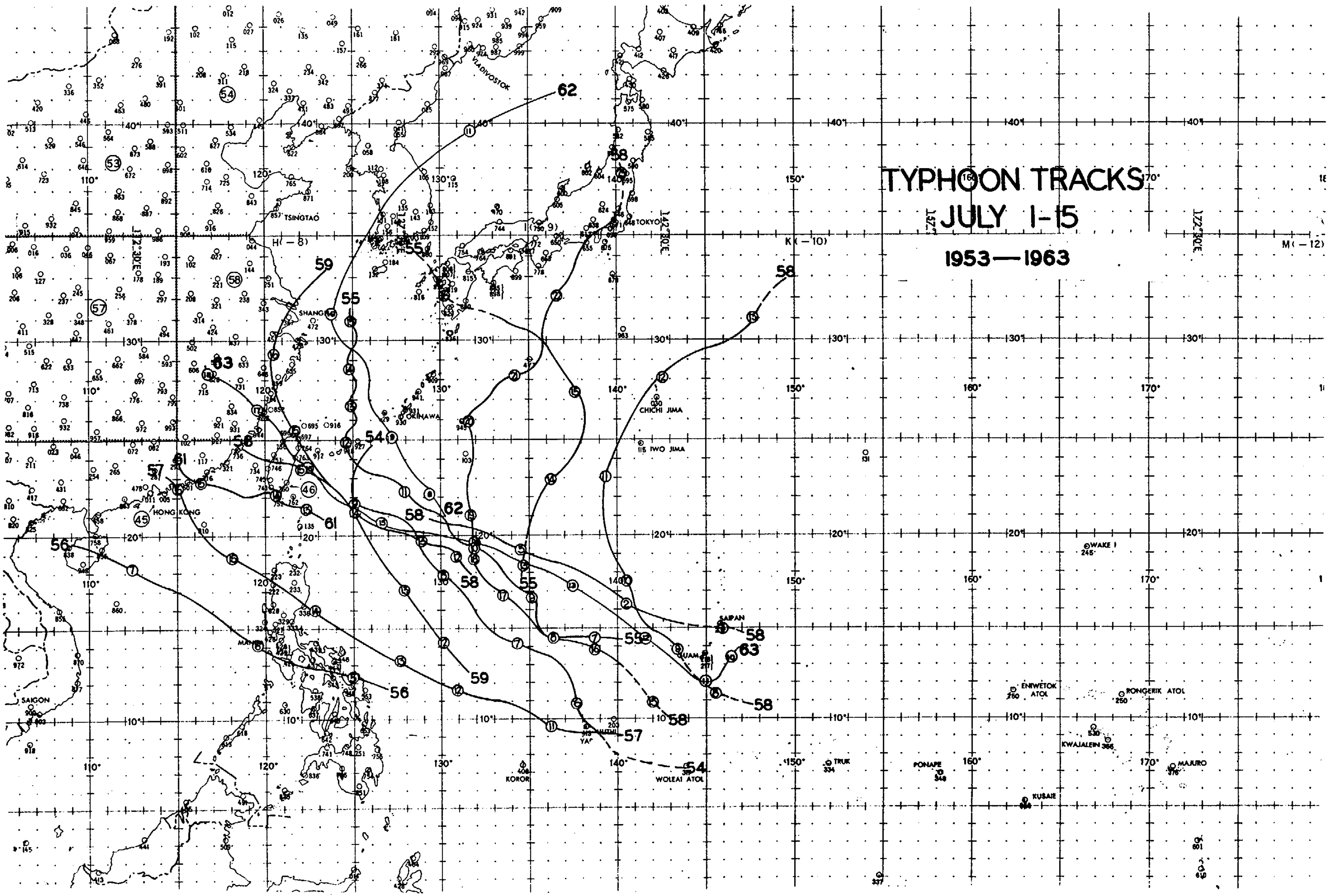
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JULY 1-15
1953—1963
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SHANGHAI
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IWO JIMA
HONG KONG
SAIPAN
GUAM
WAKE I
ENIWETOK ATOL
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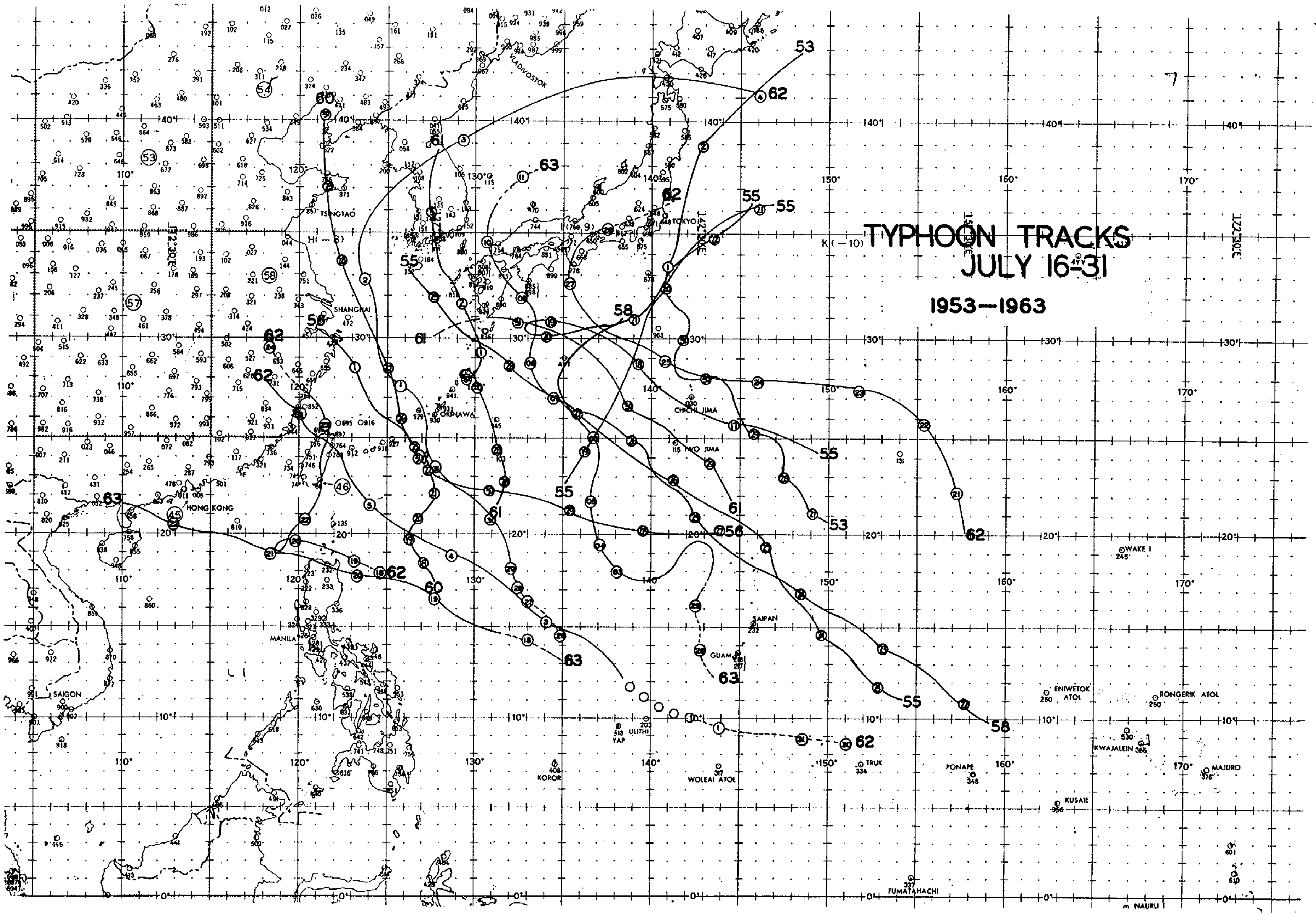
MANILA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HONG KONG
MANILA
SAIGON
SAIPAN
GUAM
YAP
ULITHI
KOROR
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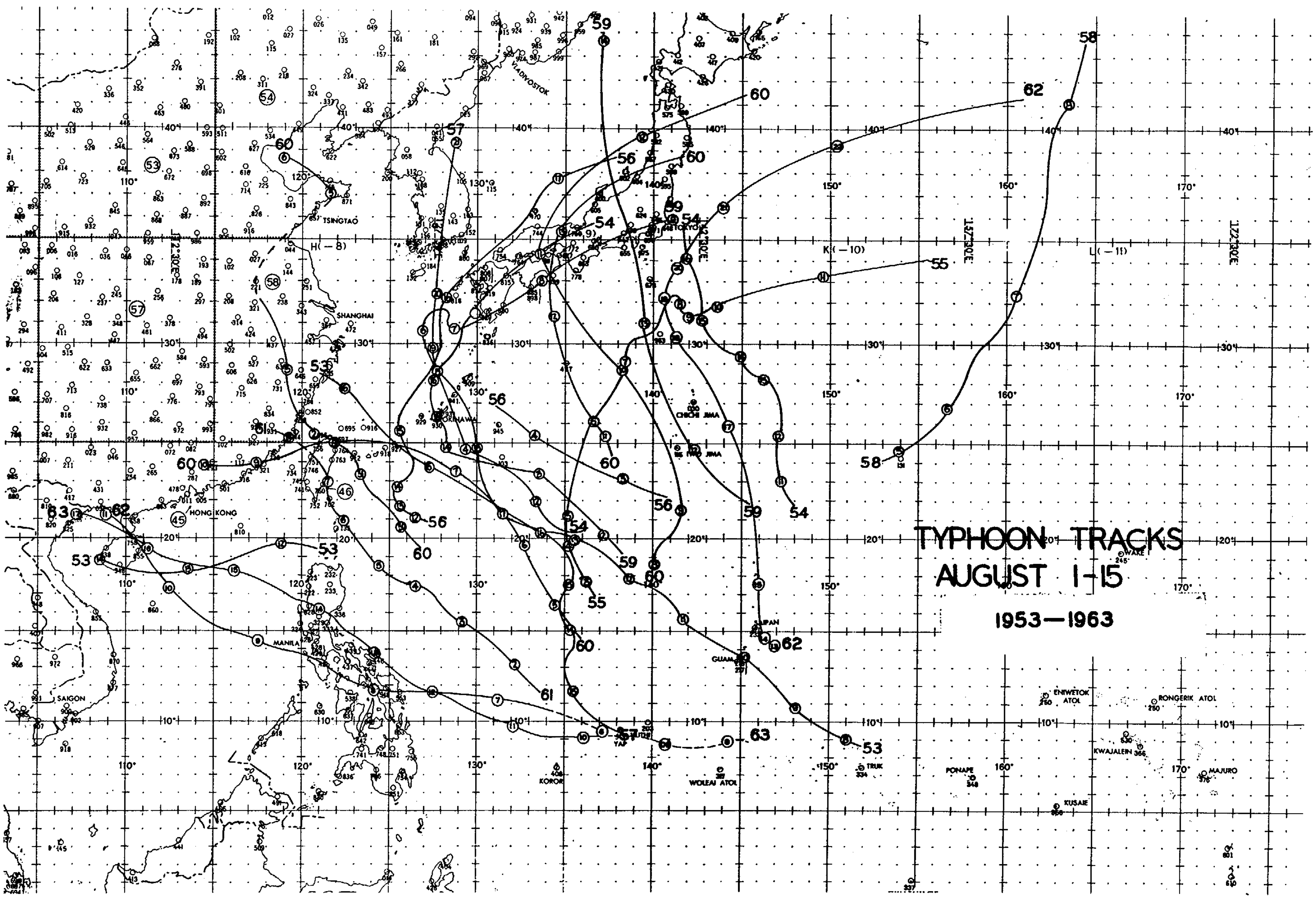
MAJURO
WAKE I
NAURU I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AUGUST 1-15
1953—1963
VLADIVOSTOK
TSINGTAO
SHANGHAI
OKINAWA
HONG KONG
MANILA
SAIGON
TOKYO
CHICHI JIMA
IWO JIMA
SAIPAN
GUAM
YAP
ULITHI
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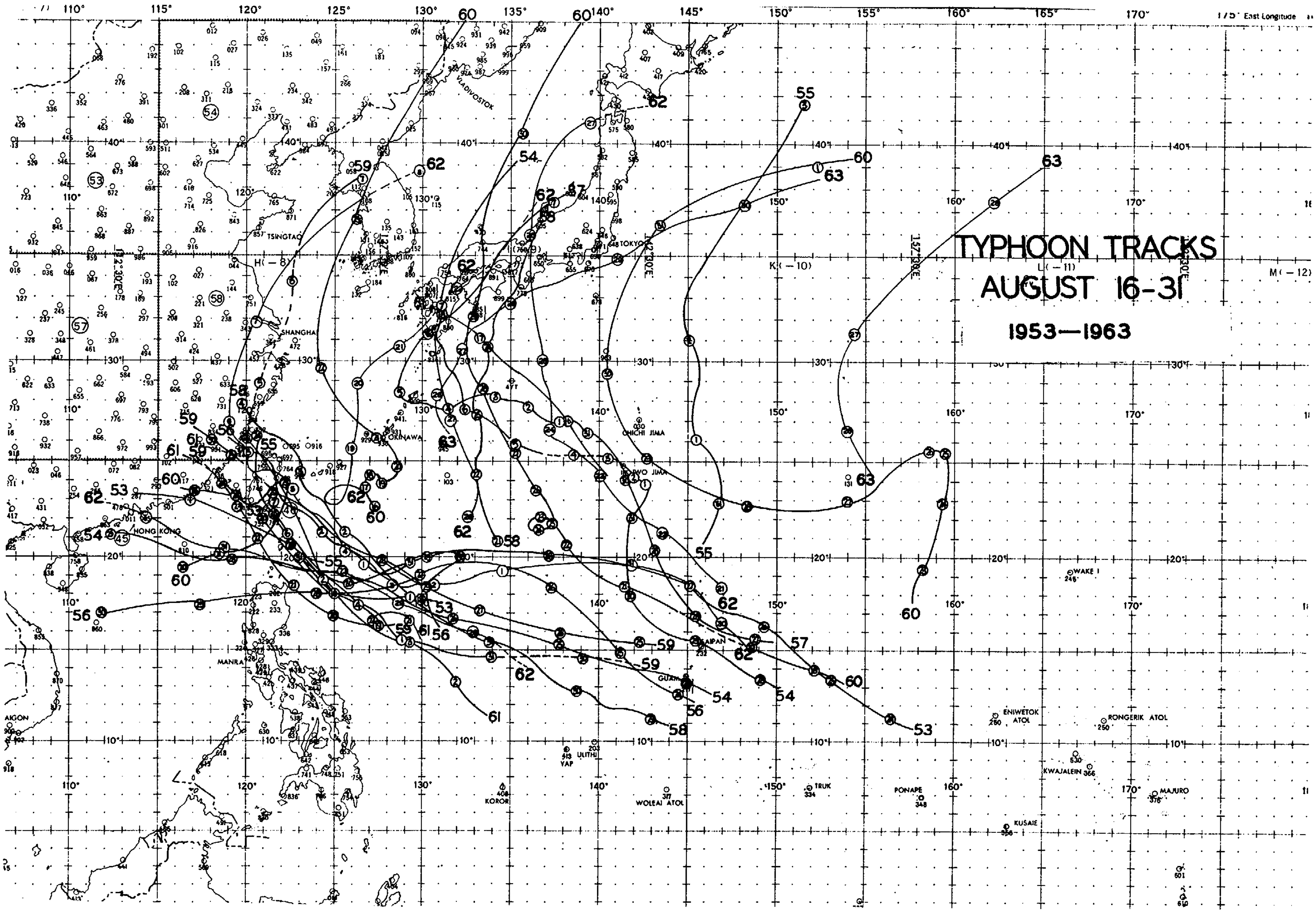
MAJURO
WAKE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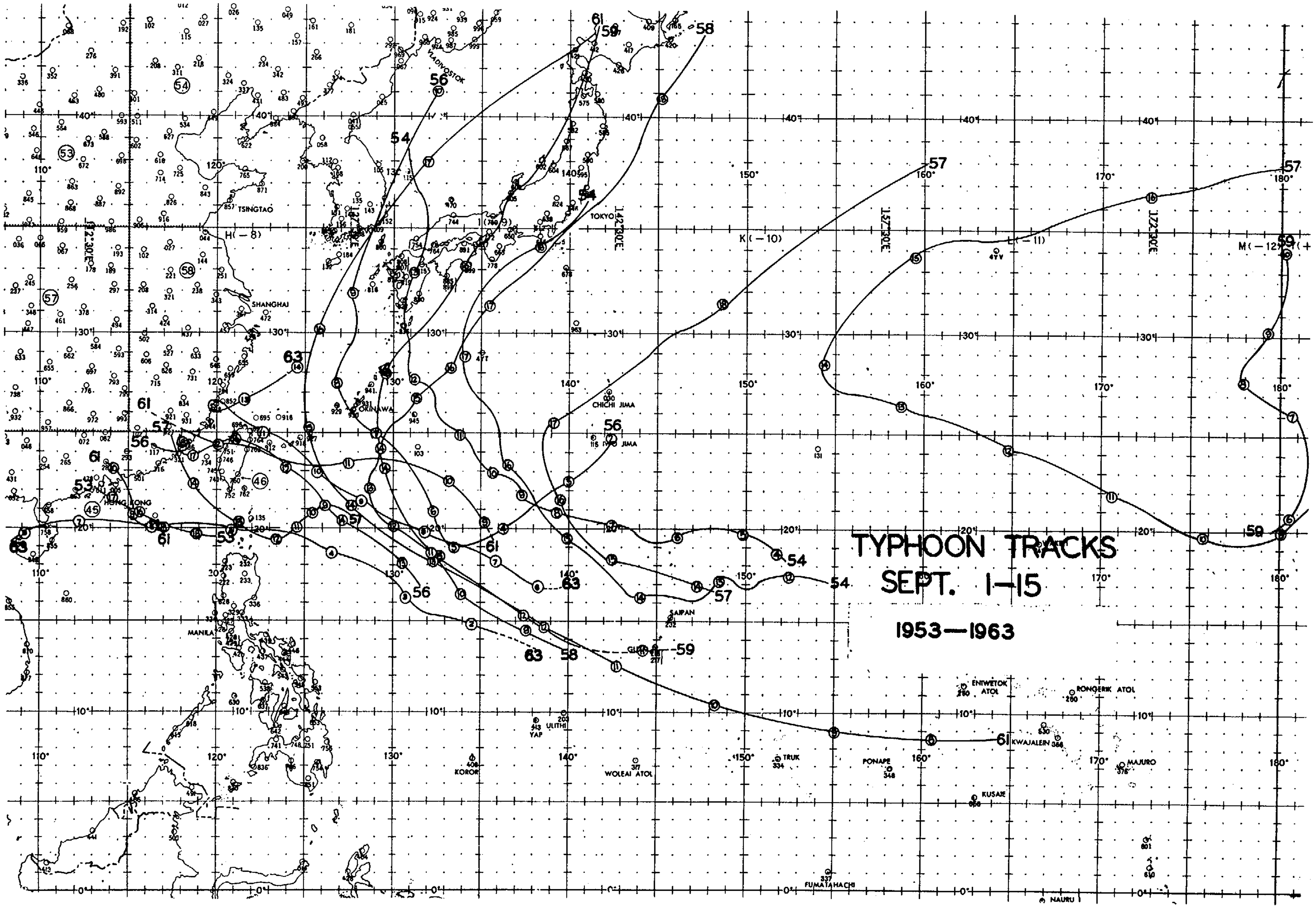
AUGUST 16-31
1953—1963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1953—1963
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TSINGTAO
SHANGHAI
TOKYO
OKINAWA
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IWO JIMA
HONG KONG
MANILA
SAIPAN
ENIWETOK ATOL
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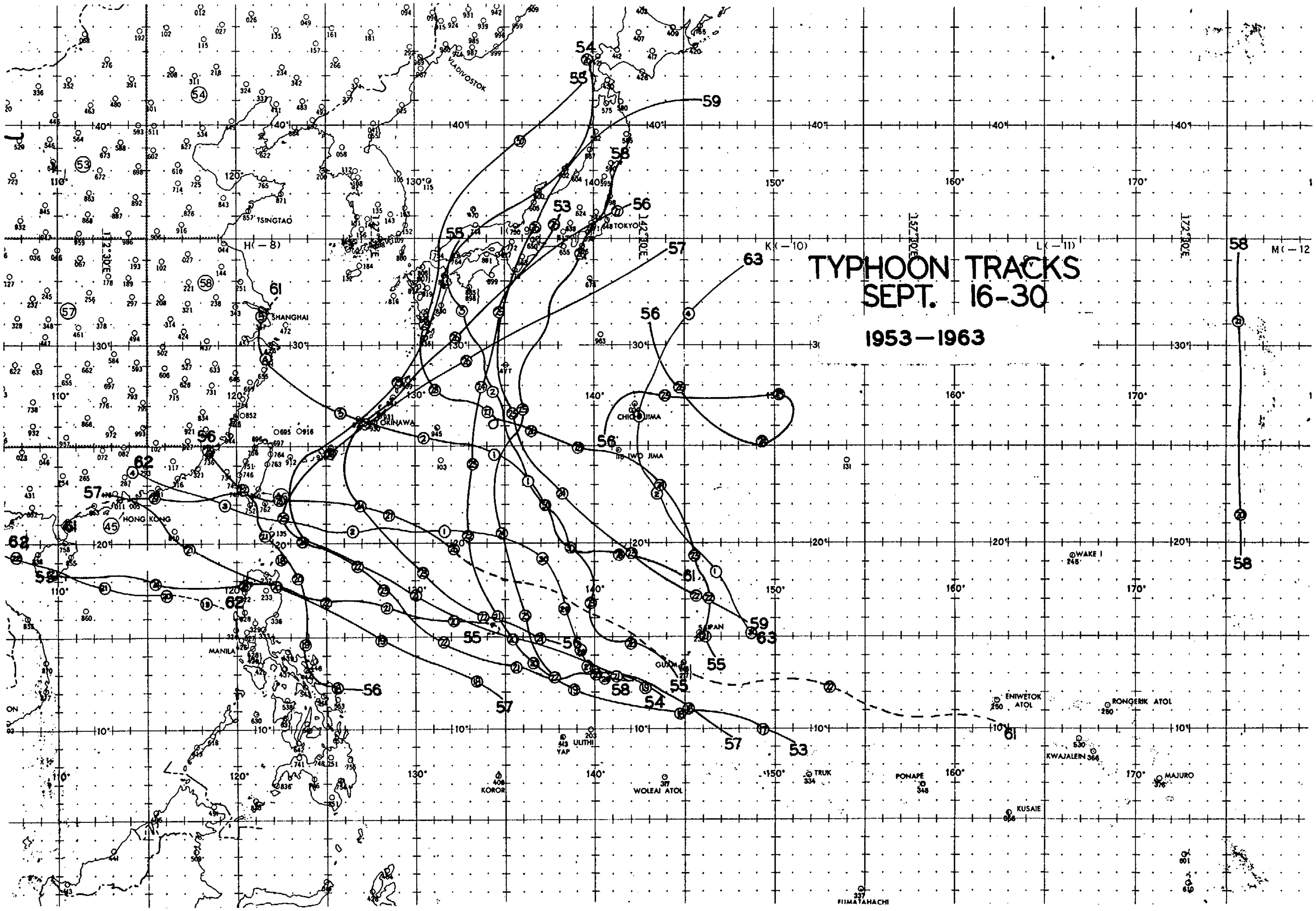
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CHICHI JIMA
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SAIPAN
GUAM
ULITHI
YAP
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WOLEAI ATOL
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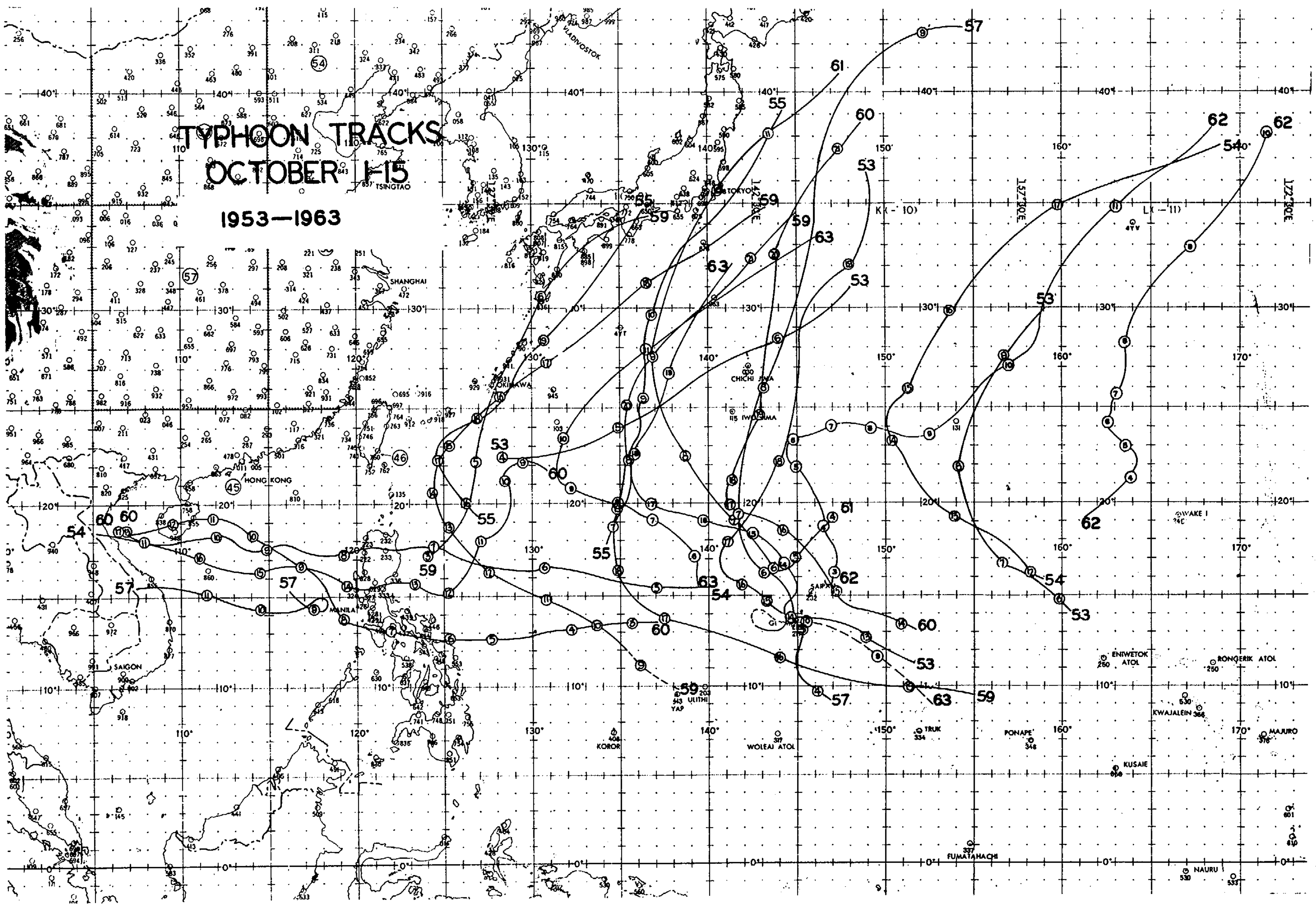
MAJURO
WAKE I
FIJIMATAHACHI


TYPHOON TRACKS
OCTOBER 1-15
1953—1963
VLADIVOSTOK
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HONG KONG
MANILA
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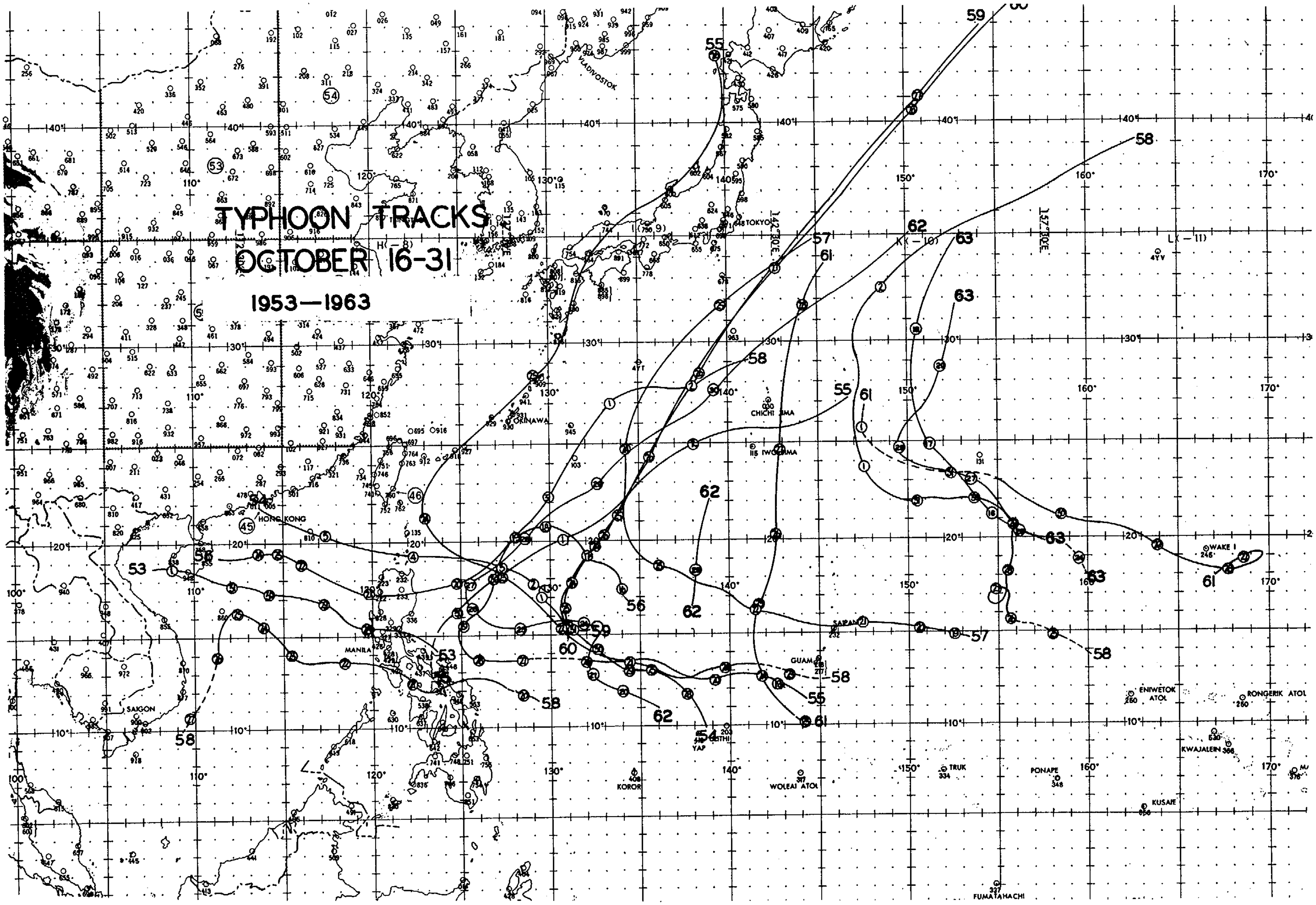
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OCTOBER 16-31
1953—1963
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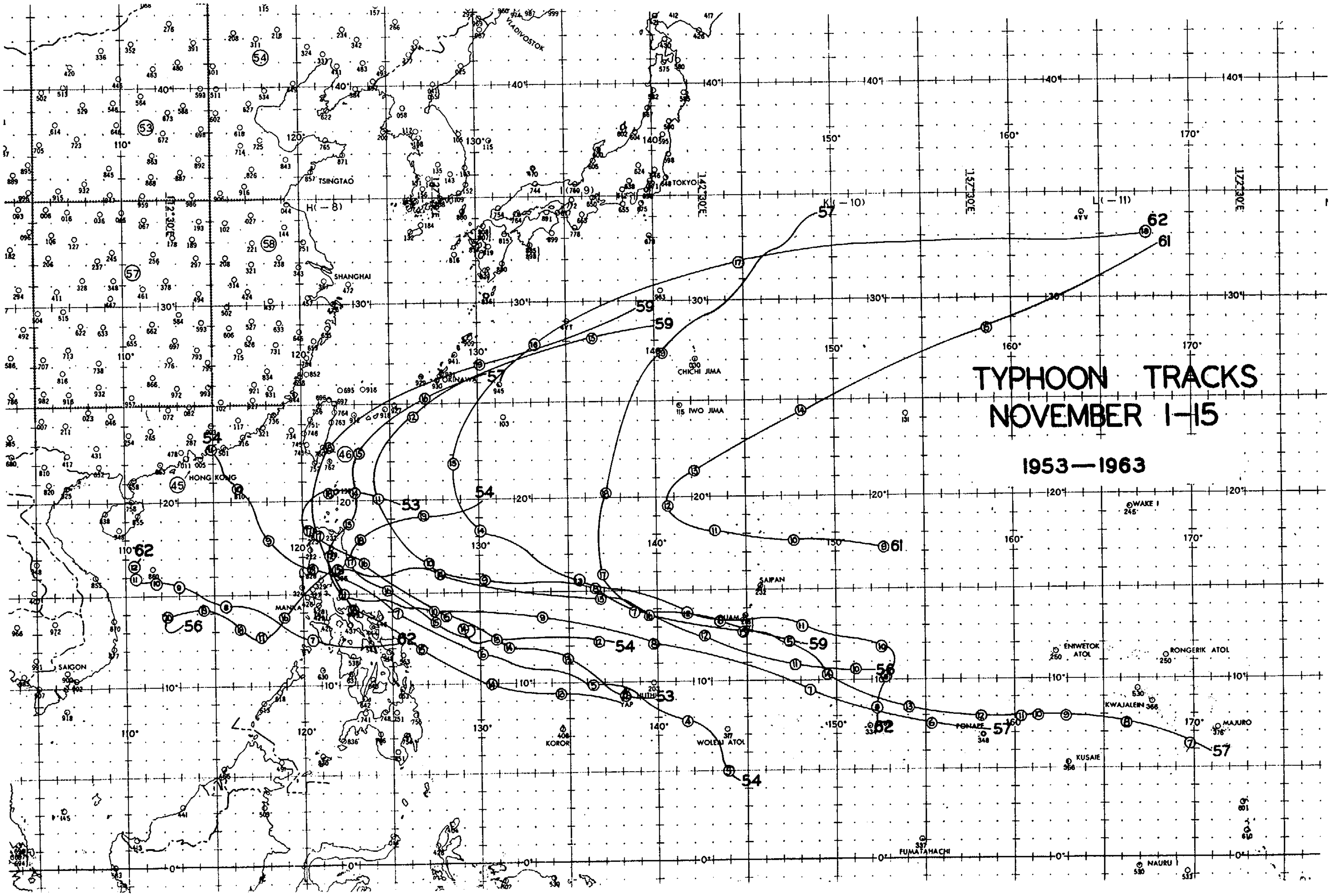
WAKE I
FUMATAHACHI
142°30'E
157°30'E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NOVEMBER 1–15
1953—1963
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RONGERIK ATOL
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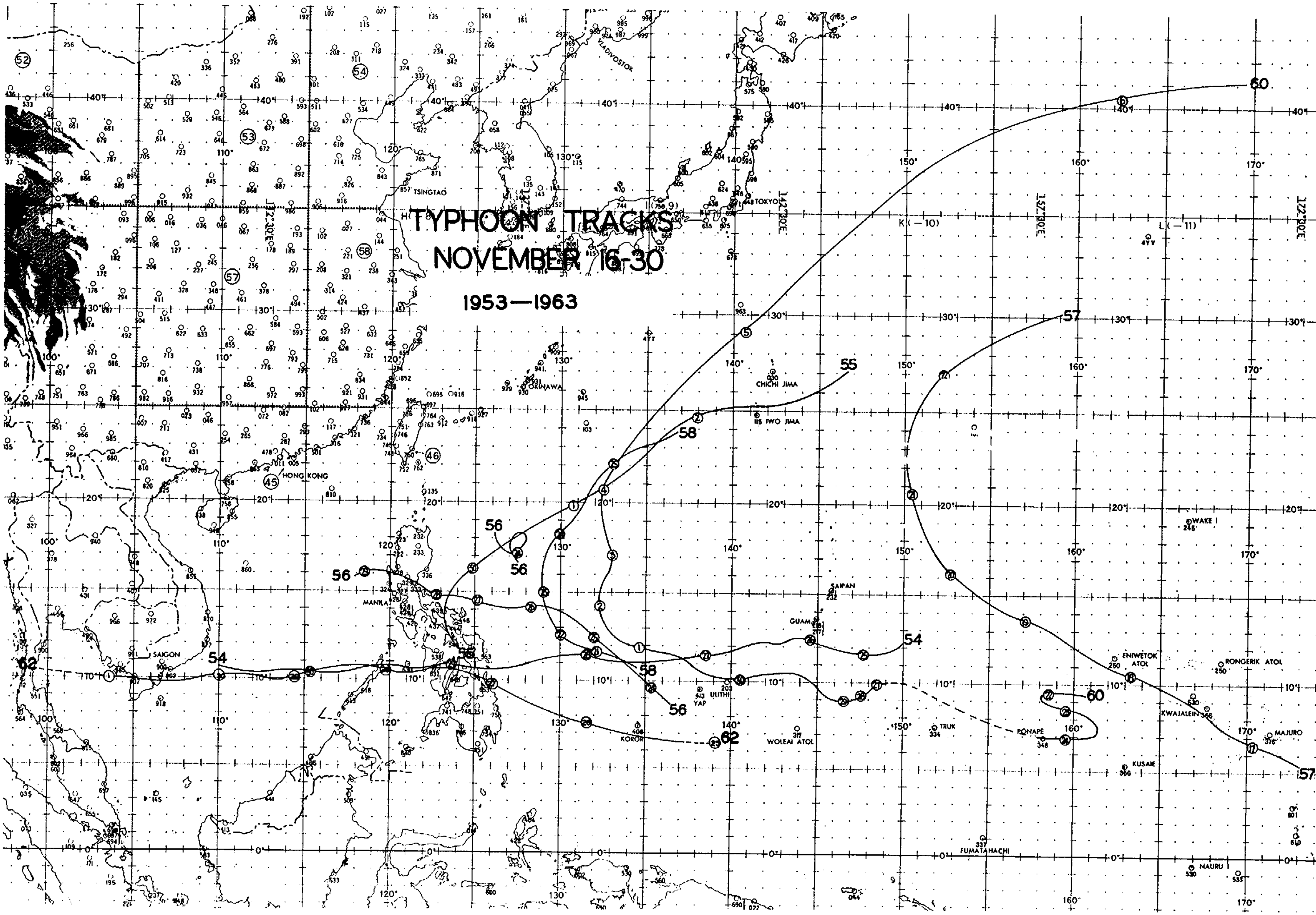
MAJURO
WAKE I
NAURU I
FUMATAHACHI
142°30'E
152°30'E
172°30'E
112°30'E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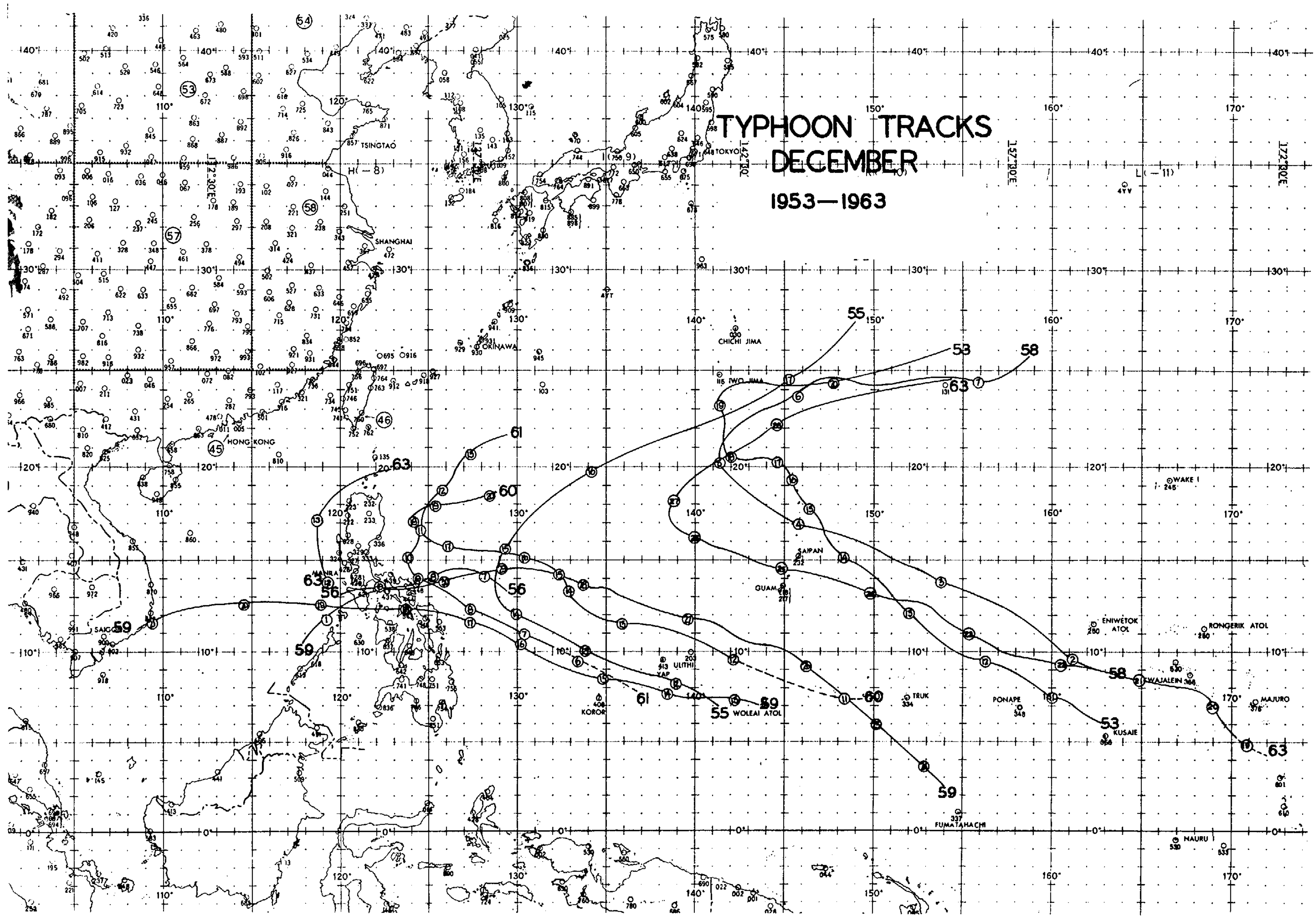
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ULITHI
YAP
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TRUK
PONAPE
KUSAIE
KWAJALEIN
ENIWETOK ATOL
RONGERIK ATOL
MAJURO
WAKE I
NAURU
FUMATAHACHI

TYPHOON DISTRIBUTION BY MONTH

	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC	TOT
1952						3	1	3	3	5	3	3	21
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
1963				1	1	2	3	3	3	4		2	19
1964					2	2	6	3	5	3	4	1	26
AVG.	.23	.08	.23	.54	.85	1.2	2.8	4.1	3.3	3.2	2.0	1.1	19.5