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NATIONAL WEATHER SERVICE

FORECASTING HURRICANES IN THE CENTRAL PACIFIC

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FORECASTING HURRICANES IN THE CENTRAL PACIFIC

I. INTRODUCTION

Many may feel that Hawaii is free of hurricanes. Unfortunately, this is not true. So far, most of the threatening tropical cyclones have weakened before reaching the Islands and their effects have been minimal in most cases. However, we've had a few that did appreciable damage.

Hurricanes usually invade Hawaiian waters in the dead of summer--August being the favored month in recent years.

A weather satellite poised 22,300 miles high over the equator east of the State will greatly improve hurricane surveillance in 1975 with the availability of cloud pictures every 30 minutes, day and night, over the Eastern Pacific and eastern side of the Central Pacific. In 1976, the Central Pacific will have better coverage with the launching of another weather satellite positioned farther west of the present one.

II. HURRICANES AND TROPICAL STORMS IN HAWAIIAN WATERS DURING THE PERIOD 1950-1974 (Figure 1)

At least 13 tropical storms or hurricanes have intruded within 500 miles of the State during the past 25 years. Luckily, most did little or no damage to the Islands. The following is a brief description, chronologically presented, of some of the more interesting storms.

HIKI, the first hurricane in recorded Hawaiian history, passed within 150 miles northwest of Kauai and its heavy rain caused extensive flooding in Waimea Valley in August 1950. Kilauea Point Lighthouse, located on the northwest point of Kauai, recorded a sustained wind speed of 68 mph.

1957 was probably the most active year for tropical cyclones when six were detected and considered possible threats. However, only two affected the State. DELLA, a September storm, and NINA, an unusual late season storm in December, caused high surf along south Kauai as they passed southwest of the Garden Isle. During NINA's passage, Kilauea Point Lighthouse recorded a peak wind speed of 92 mph and surf heights of 35 feet caused $100,000 damage.

An unnamed tropical storm suddenly appeared immediately off Hawaii island in early August of 1958 and caused $500,000 damage to Hawaii island as the storm moved westward.

Hurricane DOT, in August 1959, was the most devastating hurricane. Kauai bore the brunt of the high winds and heavy rain suffering $5.5 million damages to sugar, pineapple, macadamia and other crops and buildings while Hawaii and Oahu sustained $150,000 in damages. Kilauea Point Lighthouse recorded the highest gust of 103 mph.

In September 1967, SARAH passed 400 miles southwest of Hawaii island aiming straight for Wake Island where it almost totally devastated the small island.

In life cycle and track, tropical storm MAGGIE in August 1970, Hurricane DENISE in July 1971, Hurricane CELESTE and tropical storms DIANA and FERNANDA in August 1972, and Hurricane DOREEN in July-August 1973 were quite similar. All formed off Central America, failed to undergo the northward recurvature in the eastern Pacific, and then traveled thousands of miles westward toward Hawaii.

MAGGIE came within less than a hundred miles of South Point, Hawaii, but was already weak and only heavy rain drenched Hawaii island.

Passing about 380 miles south southwest of South Point, its closest approach to the islands, CELESTE then traced a direct path to Johnston Island leaving behind 15-foot waves pounding the coast of Hawaii island. The storm center passed about 25 miles northeast of Johnston sweeping the island with hurricane-force winds.

Heading straight for Hawaii island, DIANA, at the last minute, turned toward the northwest and weakened 60 miles from land. Waves estimated to be 30 feet high struck the Puna coast.

Diminishing rapidly in strength, FERNANDA passed within 220 miles of Hilo, Hawaii, at its closest point of approach to the islands.

DOREEN passed 300 miles south southwest of South Point, Hawaii, moving west northwest causing 3½-foot surf at Kapoho, Hawaii.

Hurricane IONE of August 1974, after forming off Central America, appeared to recurve northward before reaching Hawaiian waters but turned westward with only a hint of its former strength and ended its career 170 miles south southeast of Hawaii island.

III. HURRICANES AND TROPICAL STORMS IN HAWAIIAN WATERS DURING THE PERIOD 1970-1974 (Figure 2)

Beginning in 1970, an average of two hurricanes or tropical storms a year have invaded Hawaiian waters--a much higher frequency than in prior years. This may be attributed to better weather satellite coverage in the Eastern and Central Pacific and/or a possible change in atmospheric and oceanic circulation patterns in which tropical cyclones move westward into Hawaiian waters more frequently instead of recurving in the Eastern Pacific.

Of the 10 named tropical cyclones, all except one, Tropical Storm OLIVE, formed east of the 140W. Movement (speed and direction) and intensity have been established before crossing 140W. The general movement is toward the west and west northwest. The three tropical cyclones that came very close to the State were in the dying stage--the upper air westerlies sheared off the "chimney."

IV. HURRICANES AND TROPICAL STORMS IN THE CENTRAL PACIFIC DURING THE PERIOD 1949-1974 (Figure 3)

The storm tracks are generally toward the west or west northwest with a few northward departures. Half of the tropical cyclones died before or near 140W. There is a definite northwestward curvature of four out of the five tracks near the Islands.

V. COMPOSITE CLIMATOLOGICAL TRACKS OF HURRICANES AND TROPICAL STORMS IN THE CENTRAL PACIFIC (Figure 4)

The composite climatological tracks were subjectively derived from the individual tracks in Figure 3. The speed ranged between 4 and 15 knots. The average speed in June was 7 to 8 knots, 8 to 10 knots in July, and 10 to 12 knots in August. The storms' intensity ranged from 35 to 120 knots.

The tropical cyclones with the greatest probability of striking the Islands, if dissipation doesn't occur earlier, would be those located between 15N and 20N crossing 140W. The tropical cyclones located north of 20N at 140W will probably pass at least 300 miles northeast of the Islands, while those located south of 15N at 140W will probably pass at least 300 miles southwest of the Islands.

VI. CLIMATOLOGICAL SYNOPTIC FEATURES WITH TROPICAL CYCLONE LOCATED BETWEEN 10N AND 20N FROM 130W TO 150W.

A. Surface (Figure 5)

1. East to west ridge lies north of tropical cyclone.

2. East to west 1016-mb contour near 20N.

3. High center north of 30N near 135W.

B. 250-Mb (Figure 6)

1. Upper air subtropical ridge line located north of tropical cyclone.

2. Westerlies over the State.

3. Trough in the vicinity of the State.

VII. CLIMATOLOGICAL MOVEMENT (SPEED AND DIRECTION) AND INTENSITY OF HURRICANES AND TROPICAL STORMS IN THE CENTRAL PACIFIC

A. Normally, movement of tropical cyclones in the Central Pacific is not as complicated as that of the Eastern Pacific and especially the Western Pacific. The surface high pressure ridge lies north of the storm and the storm moves westward in the flow of the trade winds. The forecast track is greatly determined by the strength and northward or southward movement of the surface high pressure ridge.

B. Strongest intensity of the tropical cyclone occurs when the upper air outflow is greatest and the tropical cyclone is located south of 20N. Synoptically, this appears to occur when the tropical cyclone is located under the northeast outflow of the anticyclone located above the tropical cyclone. The tropical cyclone loses intensity when it moves under the upper air westerlies just north of the upper air ridge line.

VIII. FORECAST PROCEDURES

A. Base map and acetate

1. Plot all available fix and warning positions on base map as far eastward as possible labeling date/time and source.

2. Attach acetate over base map.

3. On the acetate, using the plotted positions, lay out the "best track" of the tropical cyclone up to the current position. Continue laying out the "best track" as new positions are plotted.

B. Forecast methods (use different colors for different forecast tracks)

1. Extrapolation Method

As the tropical cyclone crosses 140W, extrapolate and plot the forecast track on the acetate from the end of the "best track." Use the past 24-hour rate of travel for the speed.

2. Climatological Method

a. Plot the tropical cyclone's current position on the climatological chart (Figure 4) and lay out the track parallel to the closest climatological track. For speed, use 8 knots for June, 9 knots for July, and 11 knots for August.

b. Plot the track and times on the acetate.

3. FWC computer product

Lay out the forecast track on the acetate.

4. Subjective Method

a. Past 24 hours

(1) If the past 24-hour movement of the tropical cyclone related well to the strength and movement of the surface subtropical high center and ridge, this is a good indication that the forecast track can be related to the forecast strength and movement of the surface subtropical high center and ridge.

(2) If the past 24-hour intensity of the tropical cyclone can be explained by the relationship of the position of the storm to the upper air subtropical ridge line, this relationship is a good indicator in forecasting intensity.

b. Current maps and progs

(1) If the strength of the surface high center and the 1016-mb and 1020-mb contours north of the tropical cyclone are maintained and the subtropical upper air ridge north of the tropical cyclone is maintained (i.e., the tropical cyclone remains south of the upper air subtropical ridge line), use the extrapolated track as the forecast track.

(2) If the surface high center is forecast to weaken and the 1016-mb and 1020-mb contours retreat northward and if the tropical cyclone is in or enters the col of the upper air subtropical ridge or is north of the ridge line, forecast the tropical cyclone to curve slowly northward. For the first six hours, use the extrapolated track as the forecast track. Then use the extrapolated track to the time that the surface ridge is expected to weaken. Then gradually curve the forecast track northward at four knots and at the same time reduce the storm's intensity.

(3) When the upper air westerlies are forecast over the tropical cyclone, decrease the intensity of the storm, move the storm slowly towards the northeast if the surface ridge weakens, or move the storm at about 10 knots towards the northwest if the surface ridge maintains its strength and position. Forecast dissipation within 24 hours after northeast movement.

C. Final Forecast

1. Direction

a. If the tracks of all four methods generally agree, combine them into a single track with main emphasis on the extrapolated track for the first 12 hours and the subjective track for the remainder of the forecast track.

b. If the subjective track disagrees with the other tracks or all tracks disagree, for the first 12 hours, use the average of the extrapolated and climatological positions and then use the subjective track with the other tracks considered.

2. Speed

   a. For westward movement, average the extrapolated and climatological speeds.

   b. For northward movement, use four knots in the col of the upper air subtropical ridge.

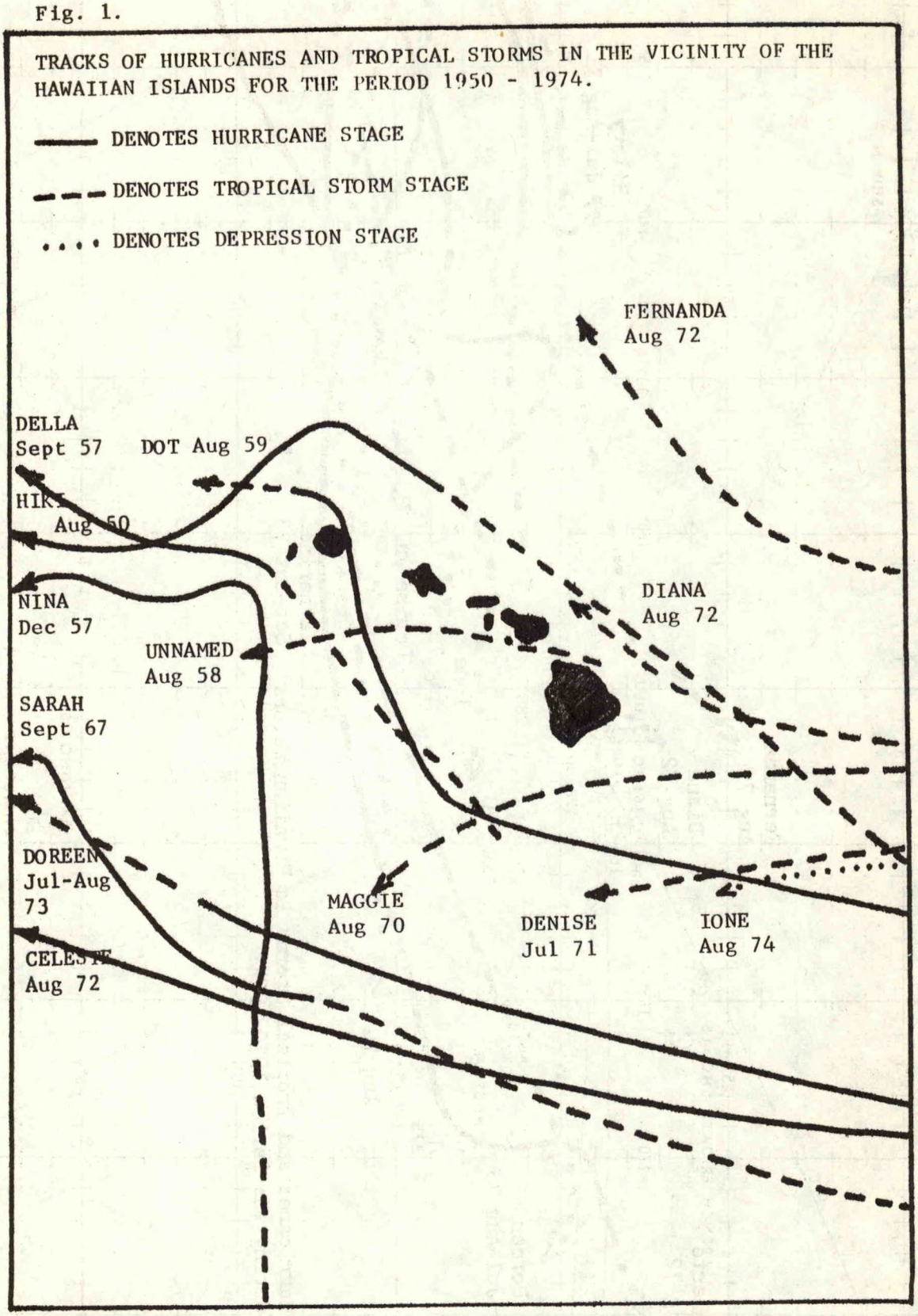
3. Intensity

   a. Determine current intensity of the storm from weather satellite cloud bulletin or interpretation and from aircraft reconnaissance report.

   b. If the forecast track is south of the upper air subtropical ridge line, maintain or increase present intensity if strength is below 50 knots and favorable upper air outdraft is forecast.

   c. If the forecast track is in the col of the upper air subtropical ridge, or north of the ridge line, reduce intensity of the storm.

Fig. 1.


TRACKS OF HURRICANES AND TROPICAL STORMS IN THE VICINITY OF THE HAWAIIAN ISLANDS FOR THE PERIOD 1950 - 1974.
DENOTES HURRICANE STAGE
DENOTES TROPICAL STORM STAGE
DENOTES DEPRESSION STAGE
FERNANDA Aug 72
DELLA Sept 57
DOT Aug 59
HIKI Aug 50
NINA Dec 57
DIANA Aug 72
UNNAMED Aug 58
SARAH Sept 67
DOREEN Jul-Aug 73
MAGGIE Aug 70
DENISE Jul 71
IONE Aug 74
CELESTE Aug 72

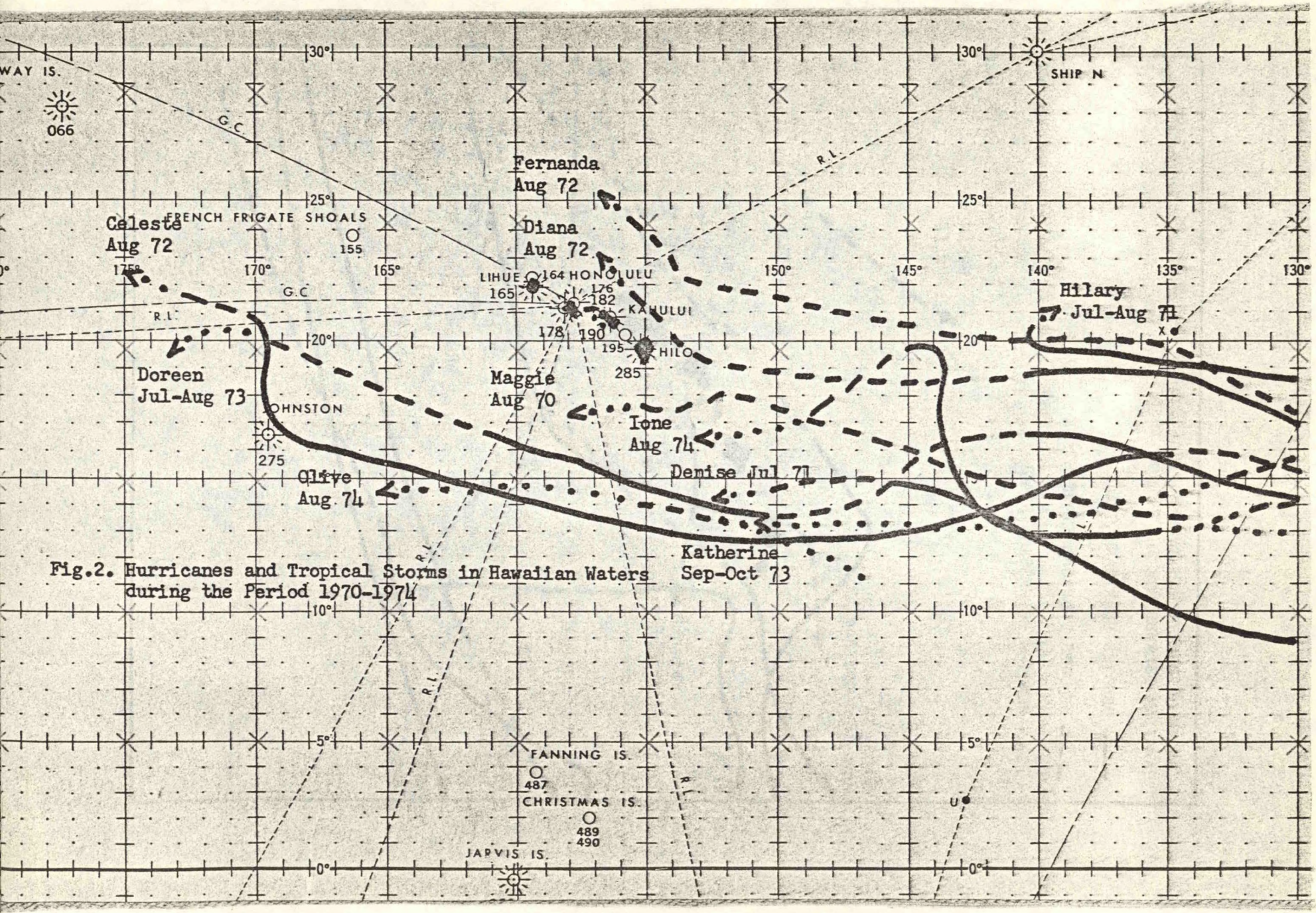


Fig.2. Hurricanes and Tropical Storms in Hawaiian Waters during the Period 1970-1974

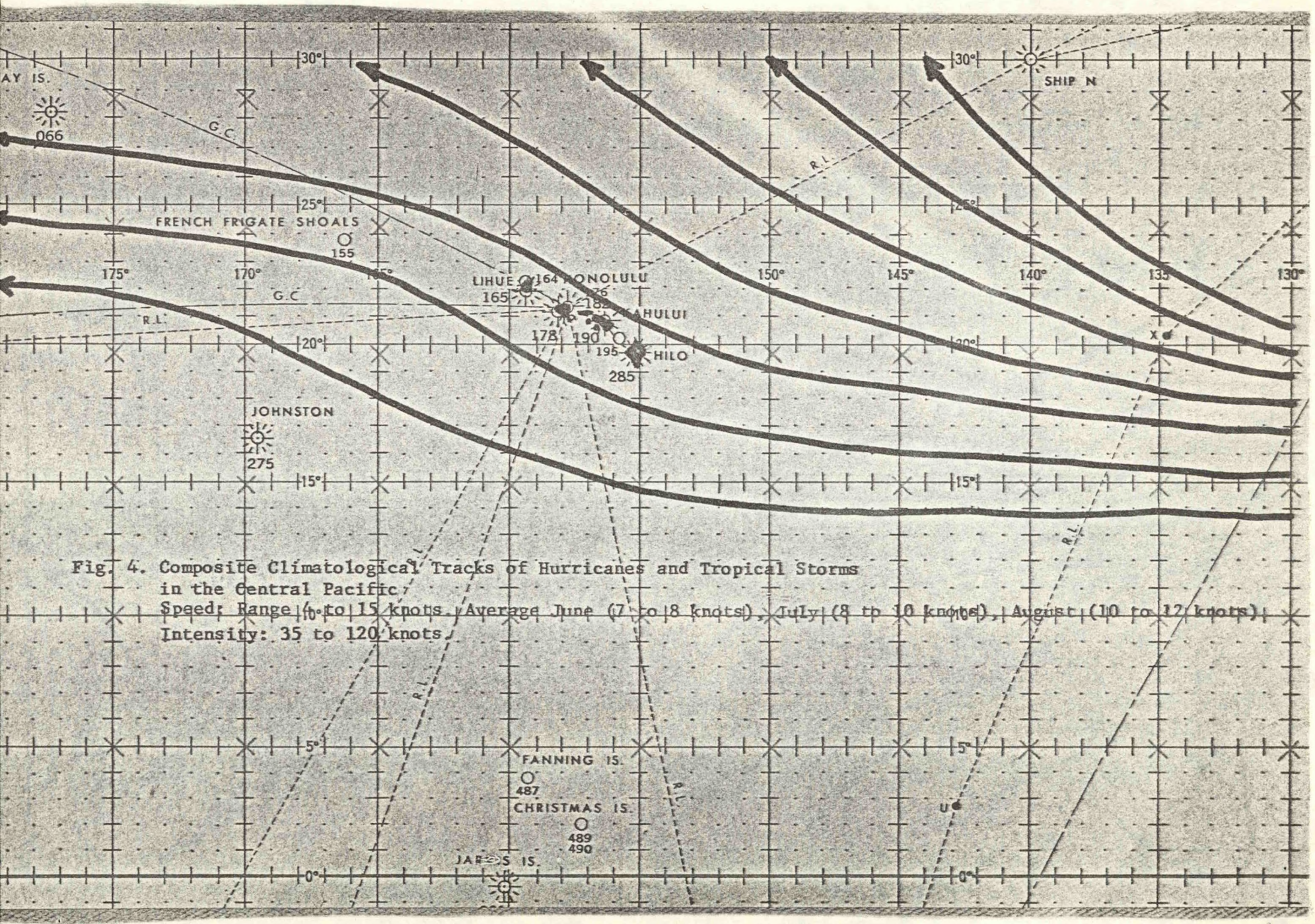


Fig. 4. Composite Climatological Tracks of Hurricanes and Tropical Storms in the Central Pacific.
Speed: Range 4 to 15 knots. Average June (7 to 8 knots), July (8 to 10 knots), August (10 to 12 knots).
Intensity: 35 to 120 knots.

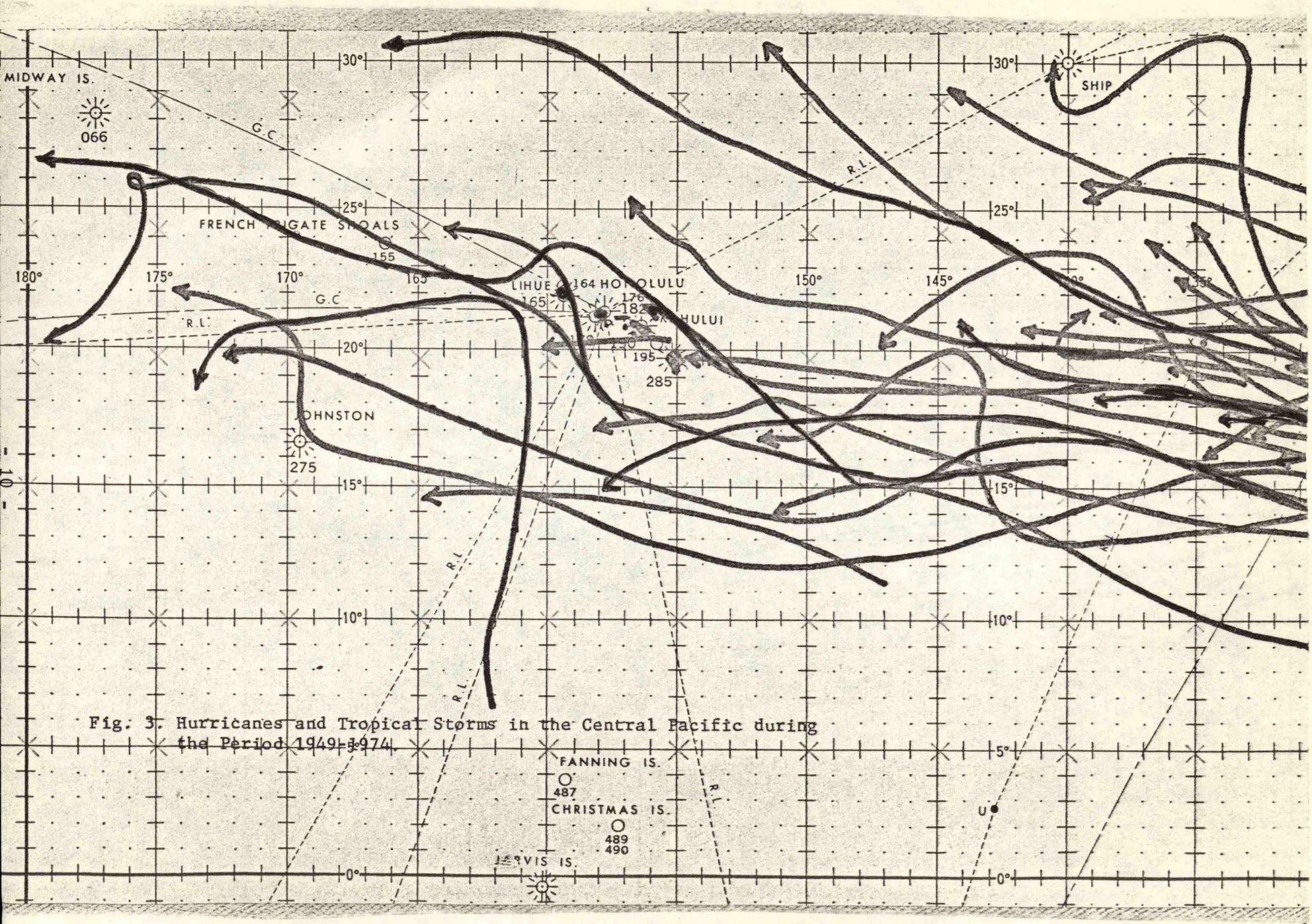


Fig. 3. Hurricanes and Tropical Storms in the Central Pacific during the Period 1949-1974.

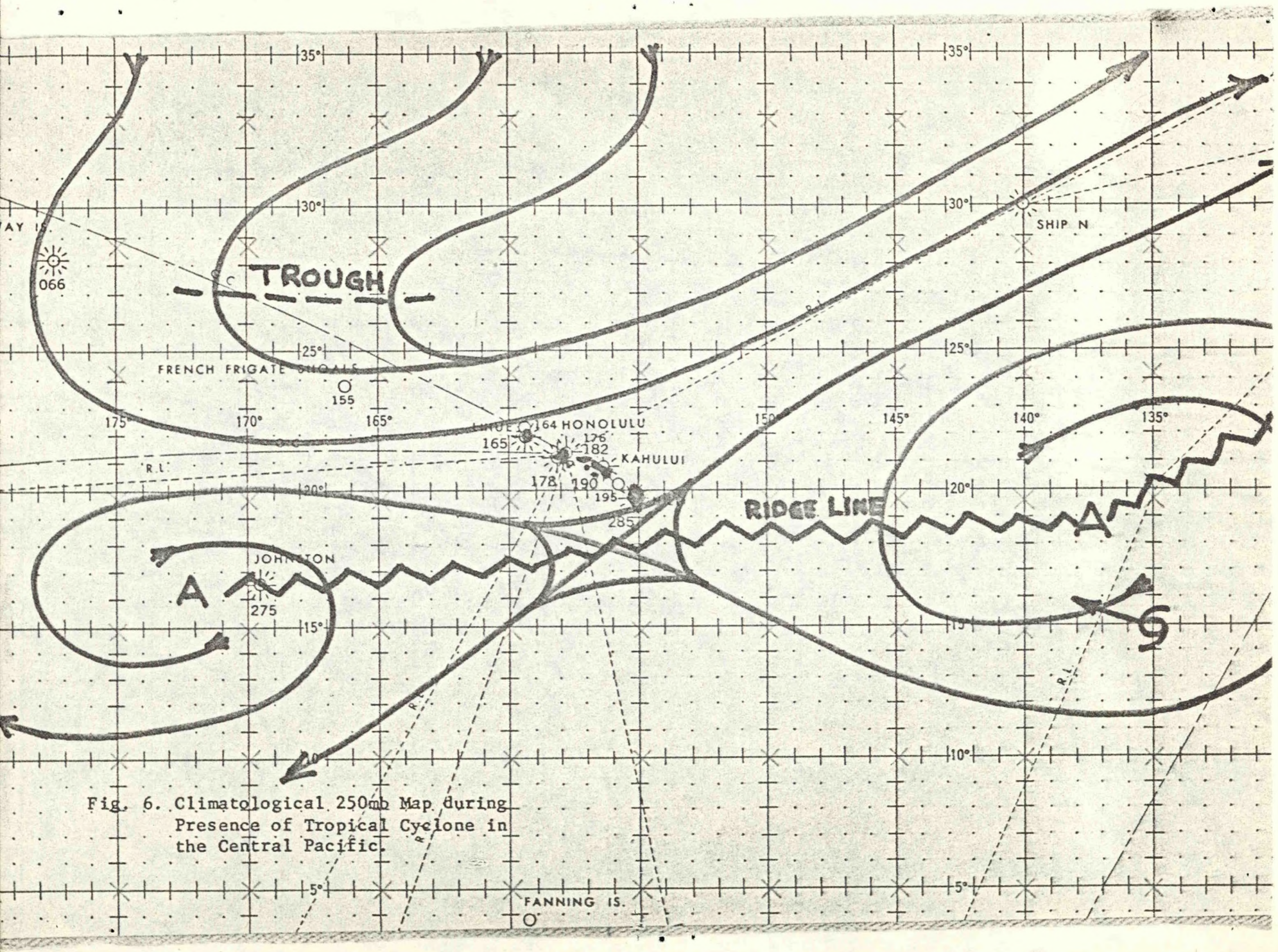


Fig. 6. Climatological 250mb Map during Presence of Tropical Cyclone in the Central Pacific.

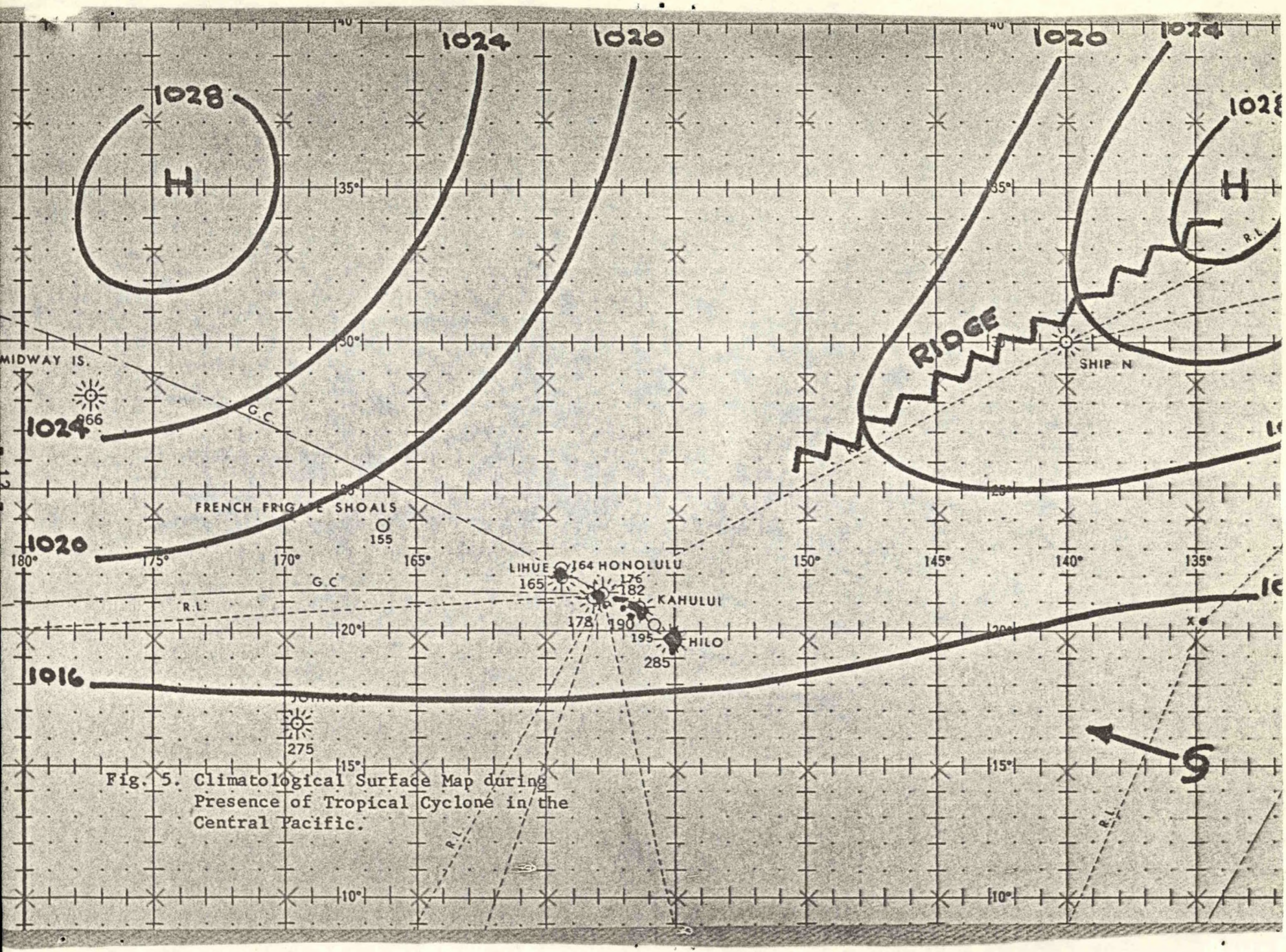


Fig. 5. Climatological Surface Map during Presence of Tropical Cyclone in the Central Pacific.