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A SURVEY OF TROPICAL CYCLONES IN THE SOUTH PACIFIC

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J.F. GABITES

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for (M.A.F.BARNETT)
DIRECTOR.

N.Z. Meteorological Service,
P.O. Box 722,
WELLINGTON.

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A SURVEY OF TROPICAL CYCLONES IN THE SOUTH PACIFIC

By J. F. Gabites

New Zealand Meteorological Service

Abstract: Tropical cyclones occurring in the South Pacific between longitudes of 150°E and 150°W during the years 1940–56 have been traced from synoptic charts. Those cyclones that are known to have had winds reaching Beaufort force 9 are found to occur in a fairly well-defined cyclone season from December to March and to average four per season.

The initial vortex usually forms west of 170°W, between latitudes 8°S and 18°S, often at some form of intertropical convergence zone. Initial movements to the west predominate in February; to the east in other months.

1. INTRODUCTION

For long the principal source of information on hurricanes of the South Pacific has been the compilation of records by Visher (e.g. 1922) before the days of regular synoptic charts.

The development of air routes across the Pacific led to an improvement in the meagre weather reporting network in the years immediately before World War II, but the most spectacular expansion took place during the war itself; it was, in fact, then that the collection of weather information reached its peak. From about 1940 the reporting network can be regarded as being sufficiently complete to indicate the presence of practically all destructive cyclones, even though their intensities at any time may have been in doubt. Thus in 1953 Hutchings was able to use synoptic charts covering a period of 12 years in his survey of the tropical cyclones in the South-west Pacific between longitudes 150°E and 150°W.

The present survey combines the additional cyclone data for the years 1952–6 with the earlier data for the years 1940–51 already published by Hutchings (1953).

2. DATA

In continuation of the scheme used by Hutchings, the tropical cyclones here discussed are those depressions in which surface winds of Beaufort force 9 or more (i.e. 41 knots or more) were reported. They have been traced from the charts of the General Forecast Office, Wellington.

A number of disturbances suspected of being severe storms have slipped through the reporting network without causing winds of force 9 to be reported in any of the routine 6-hourly reports, and have therefore had to be omitted. It is reasonably certain that several cyclones passing through the gaps between Tonga and the Cook Islands, between the Cook Islands and Society Islands, or off the charts to the east of the Society Islands, are in this category. Some cyclones in these areas owe their inclusion to the fortuitous presence of a ship in their path to confirm their intensity.

Care has been taken that the new data should be as closely comparable as possible with the earlier data assembled by Hutchings. There have been no material changes in the reporting network in recent years.

3. SEASONAL DISTRIBUTION

The cyclone season in the tropical South Pacific is effectively December to March or early April. Over the 16–17 year period examined the average frequency of December cyclones (as here defined) has been about one in two years; of January, February and March cyclones, each slightly over one per year; and of April cyclones, about one in four years. A few cyclones have occurred in May, August, September and November.

Over the same period the number of cyclones per season has averaged four, but has ranged in individual seasons from zero (1944–5) to nine (1955–6).

The normal cyclone season corresponds with the season when the westerly wind flow in the upper troposphere over Fiji (18°S) is weakest. This flow averages between 35 and 55 knots at 40–45,000 feet in the months from May to November, dropping to a minimum of 10–15 knots in February. At this time of the year the sub-tropical jet stream, which appears so prominently in the mean flow in latitude 25–30°S from April to November, is either weak or absent (Gabites, 1953).

4. GEOGRAPHICAL DISTRIBUTION

Figs. 1–4 show the paths of tropical disturbances in the years 1940–56 that are known to have developed into cyclones with winds reaching Beaufort force 9 or more at some stage of their life.

The paths can usually be traced, at least in their broad features, with more confidence than the intensities of the cyclones can be gauged. It is rarely possible to decide with certainty from the available surface reports and without aircraft reconnaissance just when a particular intensity is reached. Each path is therefore shown for the whole life of the vortex and not merely for the period during which its intensity is believed to have exceeded any arbitrary value.

The paths themselves show considerable variety and irregularity. About half start eastwards, half westwards, although the proportions vary through the season. Initial eastward movements predominate in all months except February, when the proportion drops to about 1 in 3.

5. SOURCE REGION

The region in which the first distinct vortex is identified on the routine synoptic charts lies between about 8°S and 18°S, and extends eastward from the Coral Sea to about 170°W. No significant seasonal shift of the region in either latitude or longitude is apparent.

In Figs. 1–4 the hatching marks the zones indicated in an earlier paper (Gabites, 1943) as the usual location for the intertropical convergence zone in the respective months. These zones were delineated on the basis of the positions on the daily charts, over a period of several years, of the lines designated in the terminology of the day as the intertropical front or intertropical convergence zone. In general the line would mark the line of maximum horizontal shear between moderate or fresh easterly winds

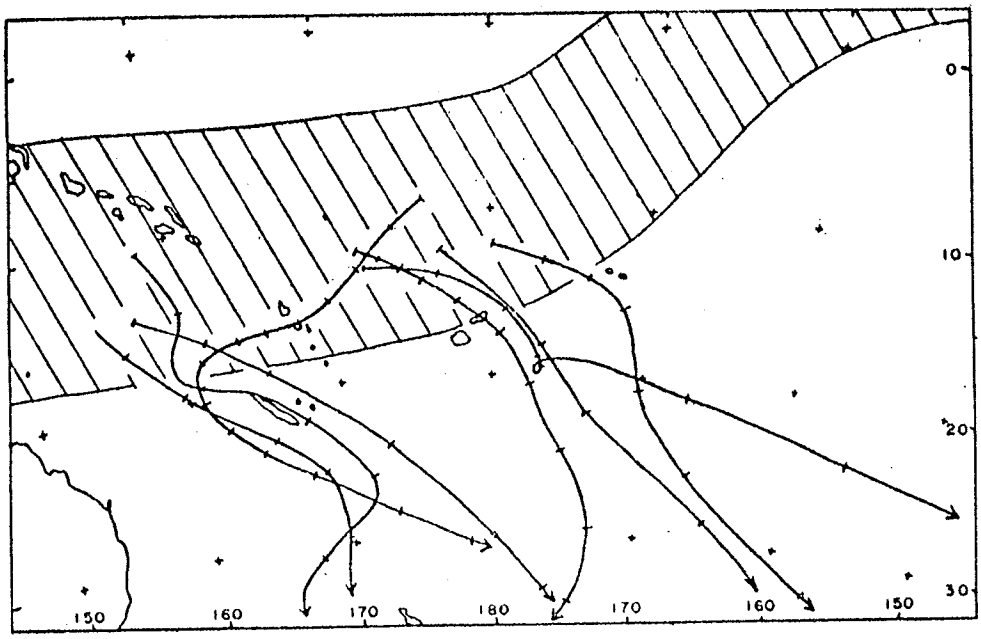

Fig. 1: Tropical cyclone tracks in December (1940–55).

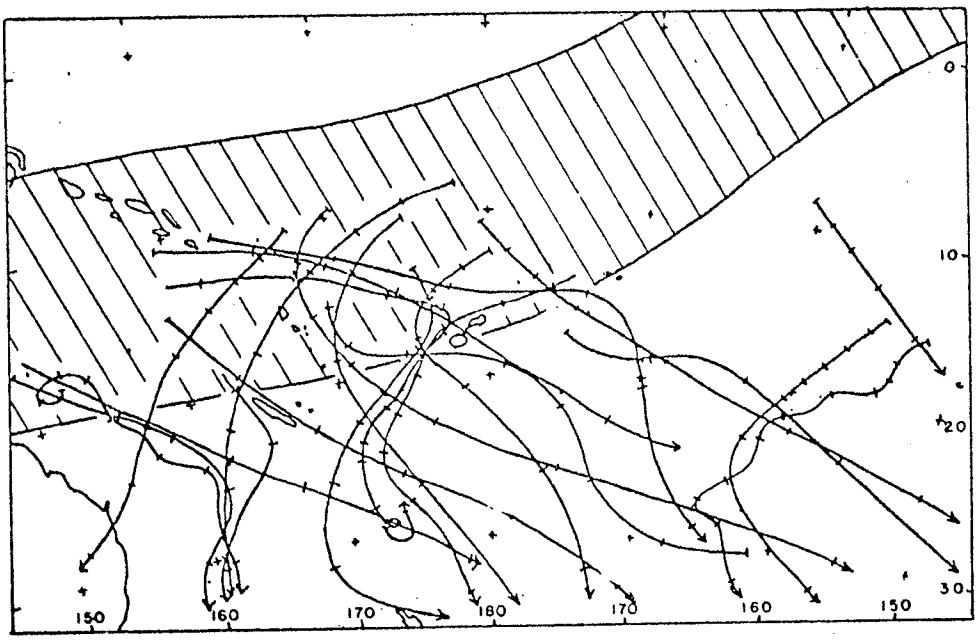

Fig. 2: Tropical cyclone tracks in January (1940–56).

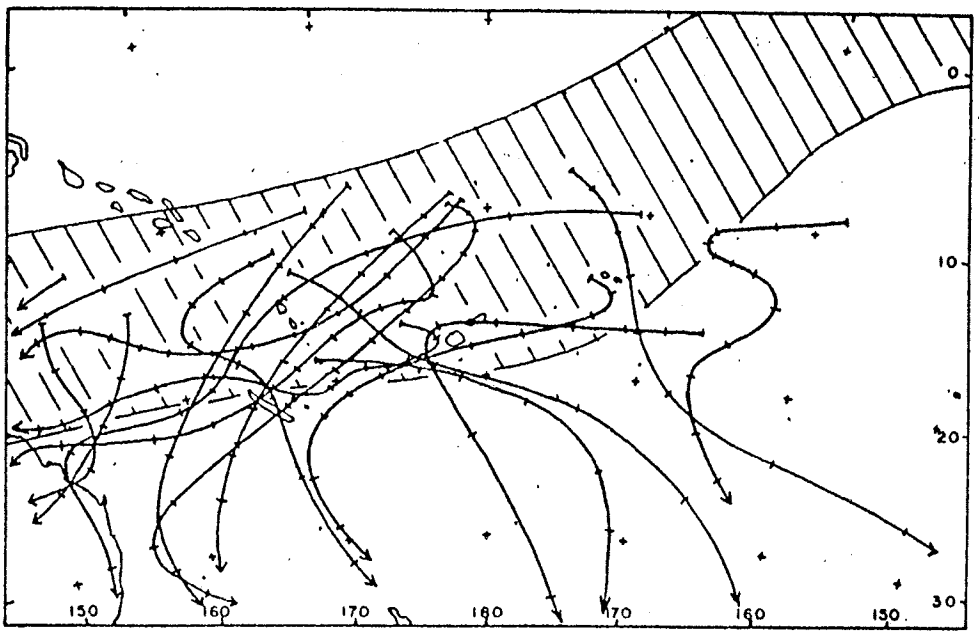

Fig. 3: Tropical cyclone tracks in February (1940–56).

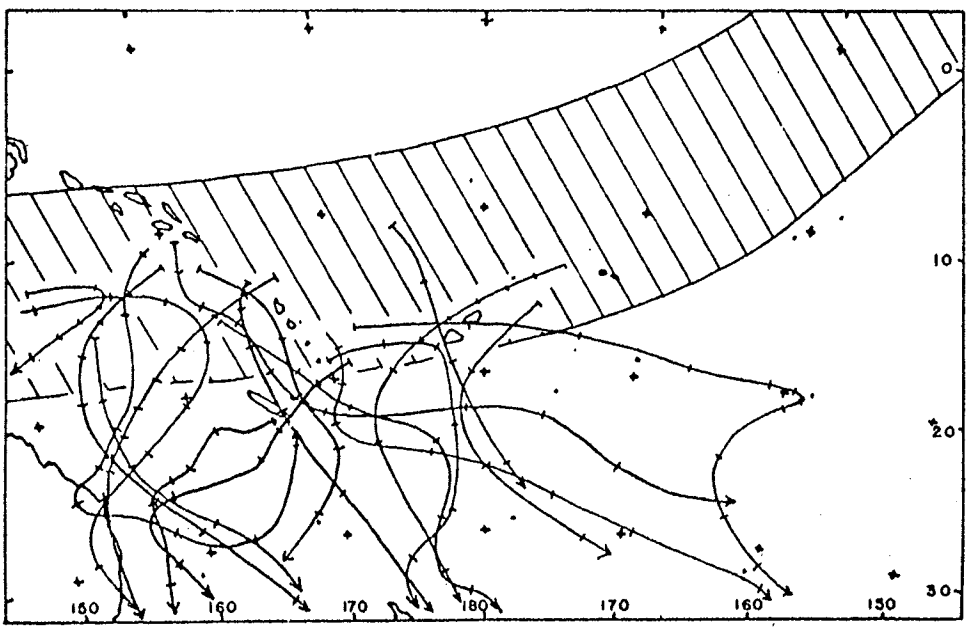

Fig. 4: Tropical cyclone tracks in March (1940–56).

(trades) and lighter easterlies nearer the equator or between easterlies and westerlies, or it would mark the line of confluence between easterly trade winds and winds from some northerly quarter. Sometimes it would mark a band of bad weather, and often it might coincide with the equatorial pressure trough.

Almost all of the tropical cyclones traced during the period had their origin in the region so described as the normal location of the intertropical convergence zone in the months December to March.

6. MODE OF FORMATION

The tropical cyclones commonly form at the line of confluence between winds from the north-east or north-west with the easterly or south-easterly trades further south. A good example of this is given by Hutchings (1953). A somewhat similar situation preceding cyclone formation appears in the streamline chart given by Gabites (1947); in this case a vortex formed at the point of convergence north-west of Fiji and in about four days had developed into a tropical cyclone, by that time moving south-eastward away from the Tonga Group.

Sometimes the cyclones develop at the line of demarcation between moderate or fresh easterlies and weaker equatorial easterlies, which appear to turn to westerlies over a wide area (often measured in hundreds of miles) at about the same time as the initial vortex forms. At other times, however, the westerlies may have been present for several days before a distinct vortex can be discovered.

Hutchings has drawn attention to the development of the initial vortex in what appears to be a fairly homogeneous although shallow easterly current, i.e. one characterized by a high positive value of vertical shear. This process appears to be much more important in the South-west Pacific region than development from the "easterly waves" that are characteristic of the deep easterly currents of the Atlantic and North Pacific.

Neither the three-dimensional structures of the developing disturbances nor the upper air patterns during the formation process can be defined with any certainty. There are only two aerological stations (radiosonde, radio-wind) in the tropical South Pacific (Canton Island and Nandi), and only one of these is in the region traversed by tropical cyclones. Surface charts necessarily constitute the primary source of information at the present time.

7. CONCLUSION

This survey indicates that:

(a) tropical cyclones in which the wind reaches Beaufort force 9 occur principally from December to March or early April, and average about four per season;

(b) the cyclone path shows great variety, the majority of cyclones initially moving westward in February, eastward in other months;

(c) the source region lies between 8°S and 18°S, and westward of longitude 170°W;

(d) the majority of cyclones appear to originate at some form of inter-tropical convergence zone rather than as waves in a deep easterly current as found in the Atlantic and North Pacific;

(e) the inadequacy of the upper air observation network hampers progress in understanding the formation of cyclones, but the close proximity of island communities to the source region makes detection of the initial intensification particularly urgent.

REFERENCES

Gabites, J. F.	1943	*Flying Conditions in the Tropical South Pacific.* N.Z.M.O. Series A, No. 3.
	1947	*Weather Forecasting Today.* N.Z. Science Congress, 1947, p. 60. (N.Z. Met. S. Office Note No. 32.)
	1953	"Mean Westerly Wind Flow in the Upper Levels Over the New Zealand Region." *N.Z. Jour. Sci. Tech.*, **B. 34**, p. 384. (N.Z. Met. S. Met. Office Note No. 38.)
Hutchings, J. W.	1953	"Tropical Cyclones in the South-west Pacific." *N.Z. Geographer*, **9** (1), p. 37. (N.Z. Met. S. Met. Office Note No. 37.)
Visher, S. S.	1922	"Tropical Cyclones in Australia and the South Pacific and Indian Oceans." *Mon. Whr. Rev.*, U.S.W.B., **50**, p. 288.