

SHORTER CONTRIBUTIONS

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A NOTE ON THE CLIMATOLOGY OF THE SATELLITE OBSERVED ZONE OF HIGH CLOUDINESS IN THE CENTRAL SOUTH PACIFIC

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1. INTRODUCTION

The series of multiple image mosaics of satellite cloud pictures published by Kornfield et al. (1967) and the somewhat similar products of Taylor and Winston (1968), display averaged cloud cover data for various time spans with a world coverage. A typical example of such data (the "average" for December 1967) is shown in Fig. 1. Attention has been drawn previously (Streten 1968) to some of the large scale features of the cloud patterns of the Southern Hemisphere for the summer and spring season of 1967 as indicated by these mosaics. In particular, the existence of a zone of high cloudiness was noted which, in both seasons examined, was very constant in location and orientation across the central South Pacific Ocean. This band extended eastward from the Inter-Tropical Convergence Zone (ITCZ) over New Guinea, and attained higher and higher latitudes further towards the eastern part of the Ocean.

More detailed data published in a second paper by Kornfield and Hasler (1969) indicate that this zone is prominent in almost all monthly averages for 1967, though more marked in some months than in others. Recently, Hubert, Krueger and Winston (1969) have used cloud data of this type to point out variations in the large scale cloud structure of the ITCZ around the earth. In particular, they indicate that the double banding in the eastern Pacific, as shown in a particular multiple mosaic of ATS 1 data published by Kornfield et al., was not typical of all seasons or years.

This brief investigation attempts to relate the observed cloudy zone in the 1967 seasons to such longer conventional observations as are available for the central South Pacific Ocean.

2. CLIMATOLOGY OF CLOUD AND RAINFALL IN THE CENTRAL SOUTH PACIFIC

Difficulty exists in obtaining suitable reliable climatic data for the ocean area because, apart from the paucity of observation stations in the region, the data of rainfall and cloudiness at island sites are likely to be rather unrepresentative of the ocean area in general, due to the rather irregular topography on many of the islands. This results in rainfall recorded at a single observing point on an island being largely dependent on the siting of the station relative to high ground and prevailing wind. Cloudiness observations for island stations are also influenced to a large extent by the same factors, and also by the very existence of a land mass of different thermal properties from those of the surrounding sea. For these reasons both island and ship observations should be used to obtain the maximum information on these elements for such a region.

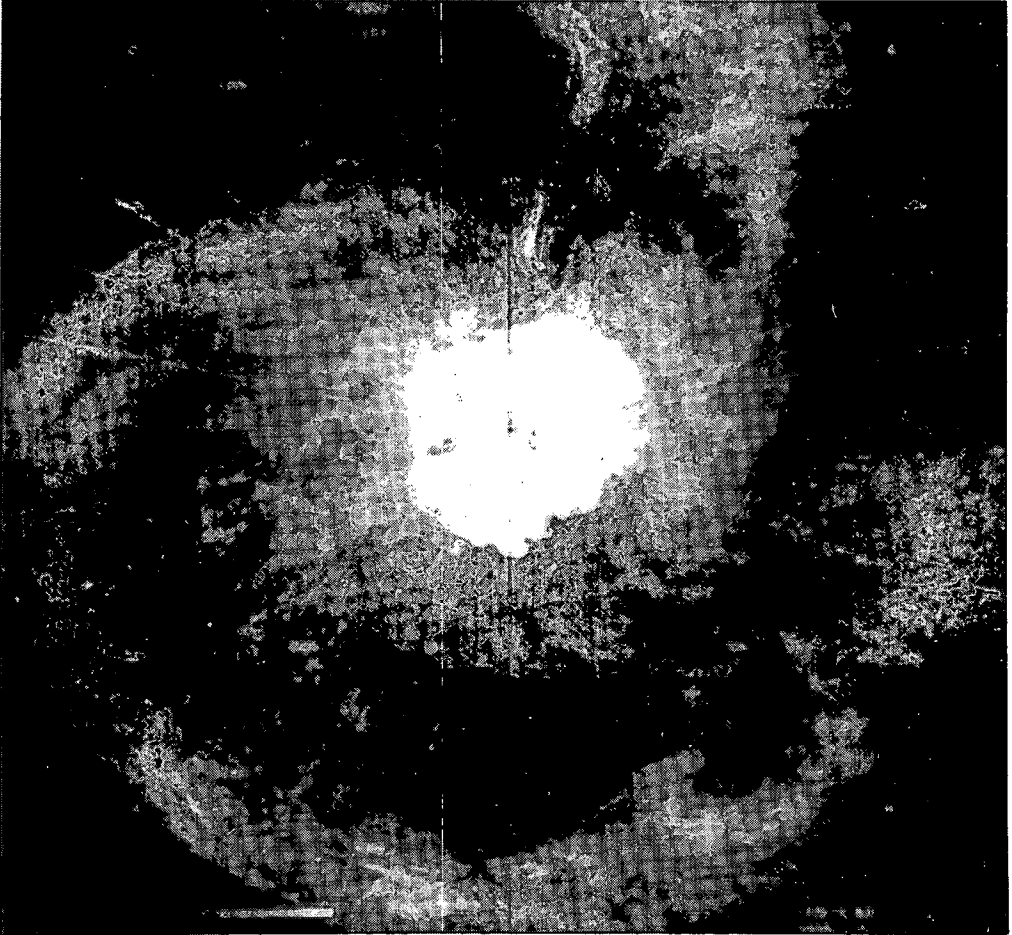


Fig. 1 Multiple image mosaic showing 'averaged' cloud for December 1967.
(Picture produced by J. Kornfield at University of Wisconsin)

Fig. 2 shows monthly rainfall for the period 1951-1960 (ESSA World Weather Records 1968) at available stations between 20°S and 30°S , and from 180° eastward to 110°W . The pattern shows a predominantly summer rainfall, but with higher relative falls in other months at Rapa, Pitcairn Is. and Easter Is. It is apparent that the main region of higher summer rainfall terminates or turns further to the south eastward of about 135°W , with Pitcairn Is. and Easter Is. lying within the influence of the eastern Pacific anticyclone. This summer rainfall pattern is also reflected in the long term annual isohyets published in the most recent climatological study of French Polynesia (D'Hautesserre 1960). These isohyets are reproduced in Fig. 3. In both Figs. 2 and 3 the orientation of the centre of the 1967 cloud band is also shown for each of the four seasons and appears to be fairly closely consistent with the longer term rainfall data for the very limited station network available. For the 1967 case the axis of the cloudy region was at its furthest south and west position in autumn and its furthest east and north position in spring. For the eight months of summer and winter the location was very constant.

A further approach to the problem of obtaining reliable long term precipitation and cloud data for the region may be made through examination of the most recent atlas of ocean climatology based on long periods of ship observations collated by the U.S. Navy (Crutcher and Davis 1969). Cloud and precipitation frequency data based on this source are shown in a composite diagram (Fig. 4) for four mid-season months and for five latitudes at ten-degree intervals between 10°S and 50°S and for the span of longitudes from 150°E eastward to 80°W .

In this diagram an attempt has been made to locate the axis of the zones of higher relative frequency of precipitation observation and of high cloudiness. These areas are not all readily located from this data but, in general, appear to agree reasonably well in location and orientation with the zone of high cloudiness observed in the pictures based on the multiple mosaics for the corresponding months of 1967. In the diagrams for July, and particularly April, the maxima are not so well defined but the orientation appears similar in all four mid-season months.

3. CONCLUSION

The climatological evidence presented above, though rather limited, tends to suggest that the clearly defined banding shown in the multiple image mosaics for the 1967 seasons is not a random climatic occurrence and is probably present to some extent at all seasons. It appears that it could be expected frequently in such mosaics though not often, perhaps, in so striking a form as for example in October 1967 (Streten, 1968). The banding appears to be linked to three large scale zones of disturbed weather:

- (1) The ITCZ which, as Hubert et al. (1969) indicate, tends to be "anchored" by the large tropical islands from Indonesia to New Guinea and which extends probably to about 170°W and 15°S in mid-summer. A cloud line associated with the ITCZ east of 140°W south of the equator, appears to be likely only in late northern winter or spring according to the above authors, and this conclusion is also supported by available ocean climatological data.

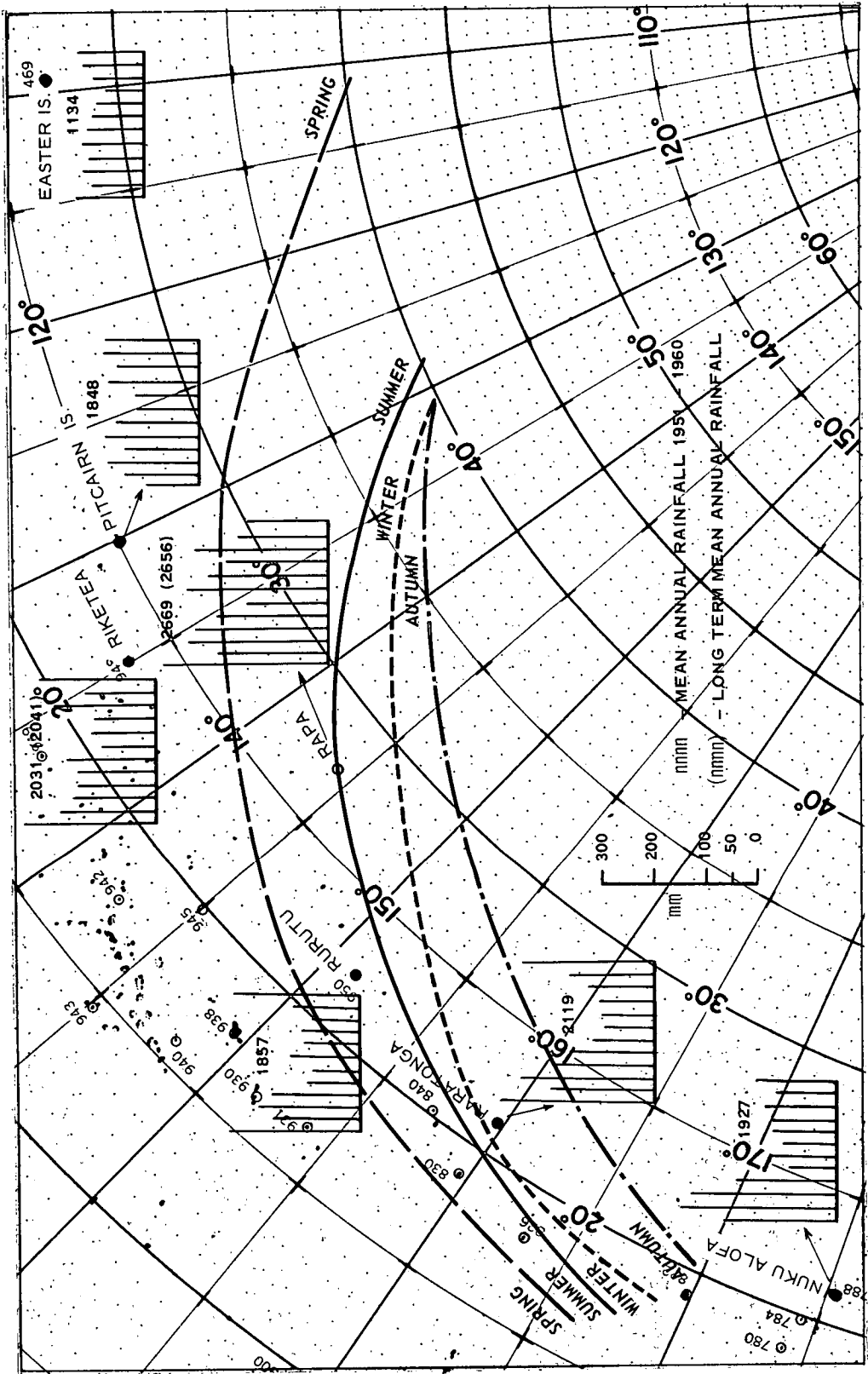


Fig. 2 Mean monthly rainfall at South Pacific stations 1951 - 1960. (Note Easter Island is shown for the available period 1941 - 1950 only). Full and broken lines show mean orientation of the centre of the cloud band in multiple image mosaics for summer (Dec.-March), autumn (April - May), winter (June - Sept.) and spring (Oct.-Nov.) 1967.

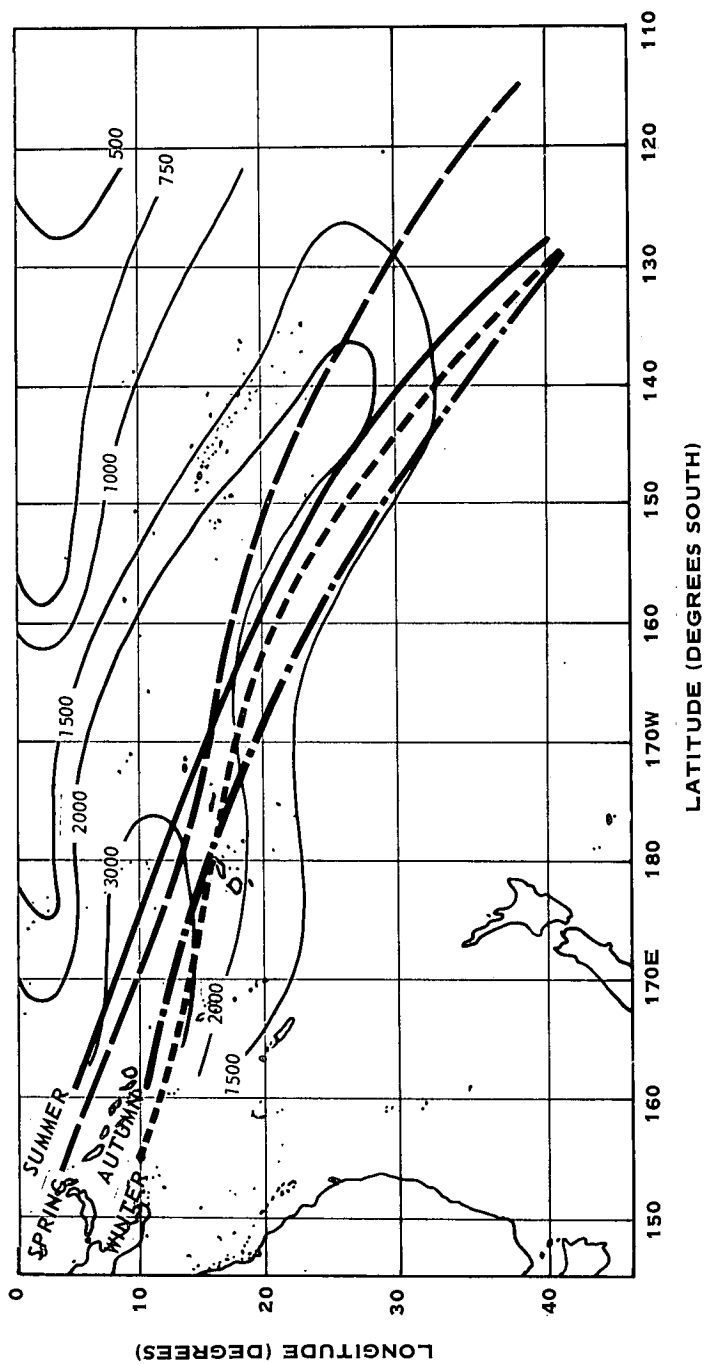


Fig. 3 Long term mean isohyets of annual rainfall - South Pacific stations (after D'Hautesserre 1960). The heavy full and broken lines show mean orientation of the centre of the cloud band in multiple image mosaics for summer (Dec.-March), autumn (April-May), winter (June-Sept.) and spring (Oct.-Nov.) 1967.

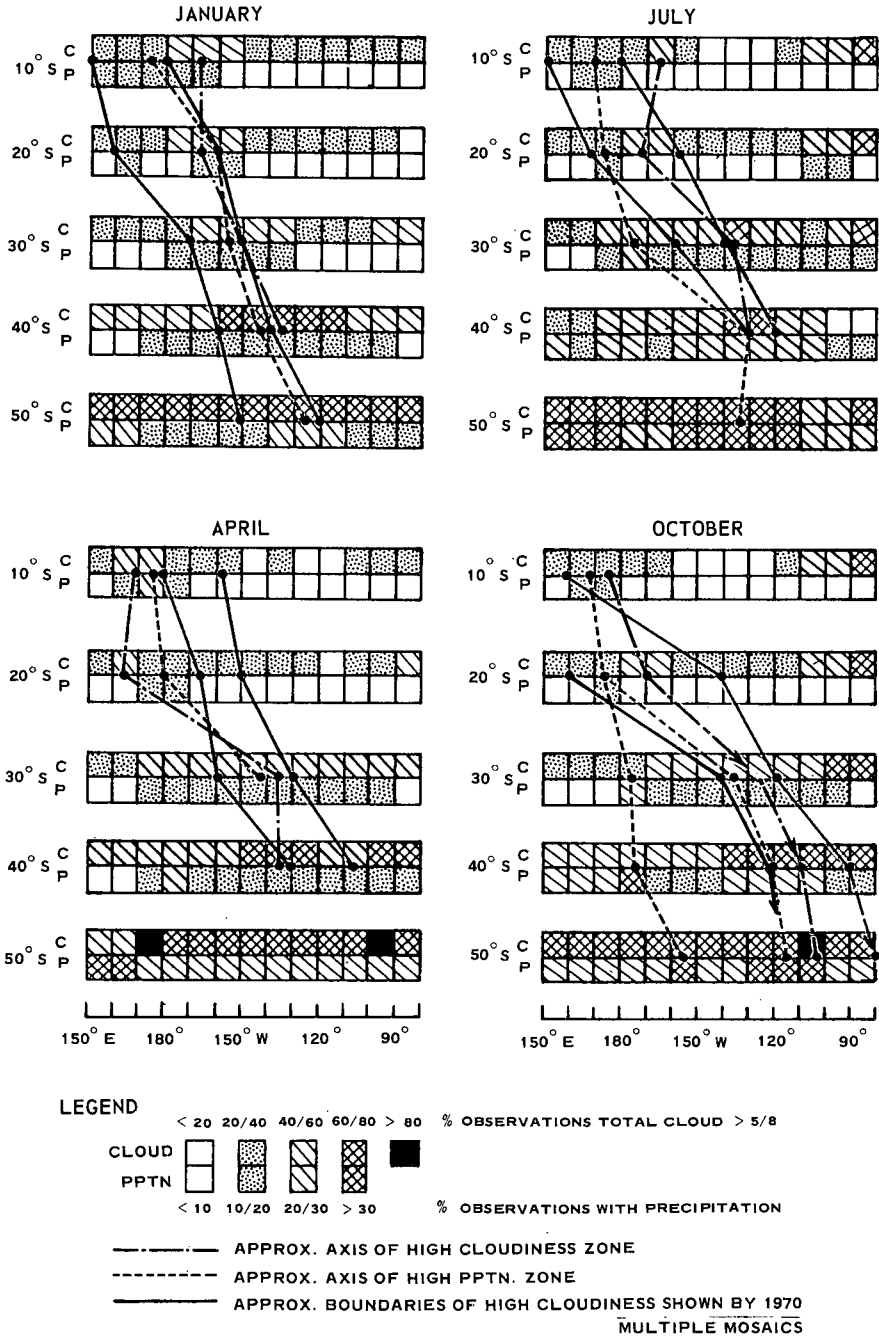


Fig. 4 Cloud and precipitation data for South Pacific stations (based on data given by Crutcher and Davis 1969). Orientation of boundaries of the high cloudiness zones for corresponding month of 1967 are indicated.

- (2) A convergence zone (the so-called "trade wind front") between the N to NE winds to the west of the East Pacific high and the winds with frequent southerly components associated with highs in the South-west Pacific and with more mobile systems moving generally eastward at higher latitudes.
- (3) A zone of cyclonic activity south of about 40°S in all seasons. The extension of the cloud band from lower mid-latitudes to 50°S , and even 60°S as apparent in some of the multiple image mosaics, appears to be related to frequent cyclogenesis in the southern part of Zone (2) as defined above and the movement of the resulting depressions towards the south-east in the most common direction for southern hemisphere cyclones.

Due to the paucity of conventional observational data, the degree of persistence of this cloud band feature and its variations in longitude, orientation and intensity could be more readily studied by longer term multiple image data.

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