DRAFT REPORT

Preliminary Report No. 5
of PE/TU.6

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FUNAFUTI SEA AND SWELL OBSERVATIONS
Latitude 8°31' S Longitude 179°12'3 E

Baseline Study of Breaking Wave Period and Height Conducted at Fongafale, Funafuti, Tuvalu Analysis of the Daily Observations Over a Three Year Period 1985, 1986, & 1987

by

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Latitude 8°31' S Longitude 179°12:3 E

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Conducted at Fongafale, Funafuti, Tuvalu
Analysis of the Daily Observations
Over a Three Year Period: 1985, 1986, & 1987

INTRODUCTION AND BACKGROUND

The sea and swell observations taken at the Funafuti Airport is a cooperative effort between the Government of Tuvalu, the New Zealand Meteorological Office in Tuvalu, and CCOP/SOPAC. It was begun in November 1984 and daily observations are still being made. The first year of data was reported in CCOP/SOPAC Technical Report No. 56 dated 24 February 1986. Three years of data are now incorporated in this report.

Technical Report No. 56 contained the monthly tables of the daily observations taken during 1984 and 1985. A discussion of the methods used to measure the wave height and period are given in that report. The methods and those data will not be repeated herein. The daily observations taken during 1986 and 1987 are given in the following report.

OBJECTIVES

The objective of this report is to update the previous report and present an analysis of the three years of breaker observations. The data is expected to be used in the design of shore structures located at this latitude in the South Pacific, provide baseline date for planning marine activities, and for comparison with the output of wave models that predict the wave climate in the South Pacific.

PERSONNEL PARTICIPATING

The wave data analysis was made by the Ralf Carter, Marine Scientist on the CCOP/SOPAC Staff. The breaker observations were made under the supervision of Chris Rogers, OIC, Meteorological Office in Tuvalu and various members of the staff. Support and assistance was provided by Mr. Saufatu Sopoanga, Secretary Ministry of Commerce and Natural Resources in Tuvalu.

METHODS AND EQUIPMENT

The method for breaker observation was described in detail in Technical Report No. 56 and will not be repeated in this report. Some modifications to the soft ware have been made to facilitate the handling of the data and the graphical

presentation of the data; however, general method and formulas remain unchanged. The 1985 data was reprocessed and the three years of data were averaged so they weigh equally in the results given.

The location of the observation station (Fig. 1) is on the east side of the airstrip at Funafuti, so the wave exposure is from the north through east and to the south. As the observer is near sea level it is difficult for him to determine the direction of the waves. The occasional reported direction of southwest, northwest and even west indicate that a strong wind was from that direction on those days.

The data is filed on floppy disk by month and year. The attached tables of data are identified as either daily observations or arranged data. Each month of daily observations were sorted on wave height and are listed in descending order in the arranged data tables. Some months have a missing row or day of data. The percent < value is calculated on the actual number of days for which observation are available. The averages are also calculated from the available days of observations.

The average of the upper one-third wave heights each month was used as a wave height parameter (not to be confused with the usual significant wave height for a given wave condition). The reported average wave height was also the average observed wave height for that month. These average monthly values were then averaged for the three years to give an indication of the wave climate at Tuvalu. The maximum and minimum values were the values observed during the month and these monthly values were averaged for the three years. The value reported as the monthly average upper one-third wave height appears to be about 1.39 times the monthly average wave height. A value of 1.5982 is often used to estimate the significant wave height from the average wave height of a given wave condition (U.S.Corp of Engineers).

RESULTS

The daily observation listed by month and year for all of 1986 and through November in 1987 are given in the 23 attached tables. The December 1984 data was used to complete the 36 months or 3 years of averaged data reported in the figures. The same data sorted according to wave height is also given in monthly tables from which the maximum wave height, minimum wave height, average wave height and period, and the average breaker height indicated.

The three year averages of the average monthly wave height and period are given (Fig. 2). The maximum average wave height occurred in August and the minimum in January. The wave heights averaged between 0.47 and 1.12 metres. The maximum average wave period, 11.27 seconds was in January; however, the values for January, February, and March, 11.27, 11.26, and 11.24 seconds did not differ significantly. The average monthly wave period was between 8.89 and 11.27 seconds.

The three year maximum wave period, 18.74 seconds occurred in January 1985. The three year average maximum wave period, 15.91 seconds was also in January (Fig. 3), and the three year minimum wave period, 3.58 seconds was in January 1986. The three year average minimum wave period, 5.63 seconds was in June. The minimum three year average maximum wave period was in September.

The three year maximum wave height, 2.63 metres occurred in July 1986, and the three year average maximum wave height, 2.02 was also in July (Fig. 4). The three year minimum wave height, 0.05 metres was observed in January 1985 and November 1986. The three year average minimum wave height, 0.15 metres was in January.

DISCUSSION

In Technical Report No. 56 emphasis was made on the importance of having several years of wave observations to characterize the wave climate for a given location. While three years of data are much better than one to smooth out the effect of single events, three years is too short a time period to establish reliable baseline conditions. However, as would be anticipated a certain amount of definition of the wave pattern is now appearing. The maximum wave height shown in Figure 4 now indicates that there may be only one period rather than two periods of maximum wave height as seen in the 1985 year of data. The two peak periods of maximum wave height of May and October now appear as a single peak in August. Other smoothing trends can be expected.

The months of March and August were selected for additional comparisons. August was selected as one of the months because the average and minimum wave height peaked at that time, and the average maximum wave height, while in July, is close to that time. The average three year maximum wave height was a minimum in March. The three years of observations for these two months were averaged from the table of arranged values on a daily basis, and these data are shown for percent of time a given value is not exceeded for a given wave period and given wave height (Fig. 5 and Fig. 6). The slope of the data for the two months are quite similar. The geometric mean value of the wave period in March was about 11 seconds and in August it was about 9.5 seconds. These log-probability distribution curves indicate that most of the wave periods will fall between 6 and 18 seconds at this location. The Geometric mean wave height for March was 0.52 metre and for August it was 1.12 metre. The wave height varies much more than the wave period. Most of the waves approaching this side of Funafuti would be expected to be between .2 and 2 meters in height.

The average wave height of the upper one-third of the monthly wave heights was calculated and is plotted with the average monthly wave period in Figure 7. This wave height parameter like the average monthly wave height plots a much smoother curve than the average maximum wave height shown in

Figure 4. The parameter peaks during August and is at a minimum in January. There appears to be a more-or-less steady increase in wave height between January and August then a similar decrease in wave height from September to January.

CONCLUSIONS

The conclusions reached in this report are based upon only three years of sea and swell observations at Funafuti and may be modified as more data becomes available.

1. The program should be continued as the characteristics of the annual wave climate appear to show significant change as more data becomes available.

2. The conclusion that a seasonal pattern of wave period and height exists at Funafuti reached from the 1985 year of data is still true; however, there are some shift in the months when the extreme conditions occur.

3. The wave periods observed suggest that swell is the wave that is being observed, and that swell is generally present and masks local sea conditions.

4. The wave period is typically between 6 and 15 seconds, and averages around 10 seconds. The wave height is typically between .2 and .9 metre in March and .6 to 2 metres in August.

REFERENCES

U.S. Corps (1977) "Shore Protection Manual" Vol 1, pp 3-2

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1. The views expressed in this report are those of the Author and do not necessarily reflect those of the United Nations.

2. Mention of any firm or licenses process does not imply endorsement by the United Nations.

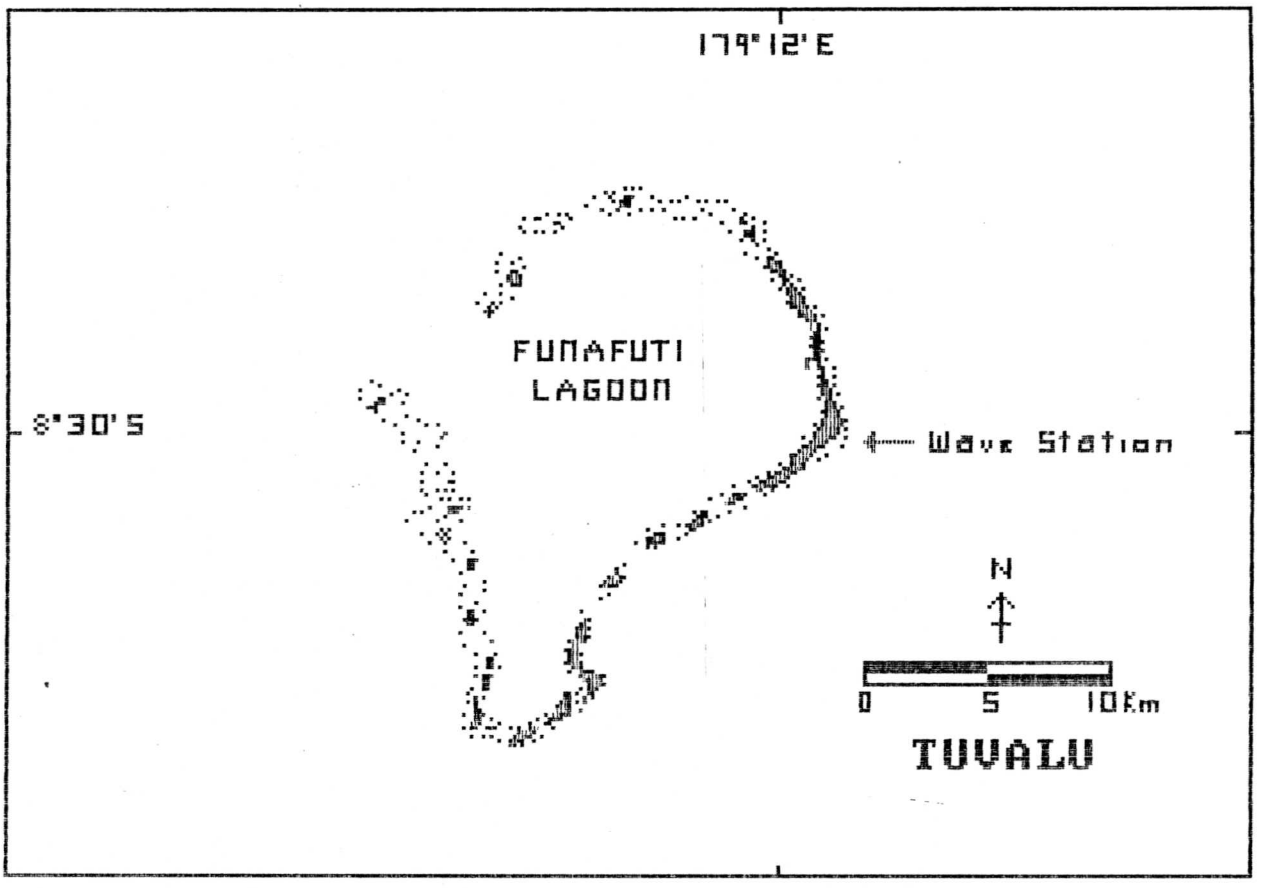

FIGURE 1 - LOCATION MAP OF THE WAVE OBSERVATION STATION ON FONGAFALE ISLAND AT THE AIRPORT IN FUNAFUTI ATOLL IN TUVALU

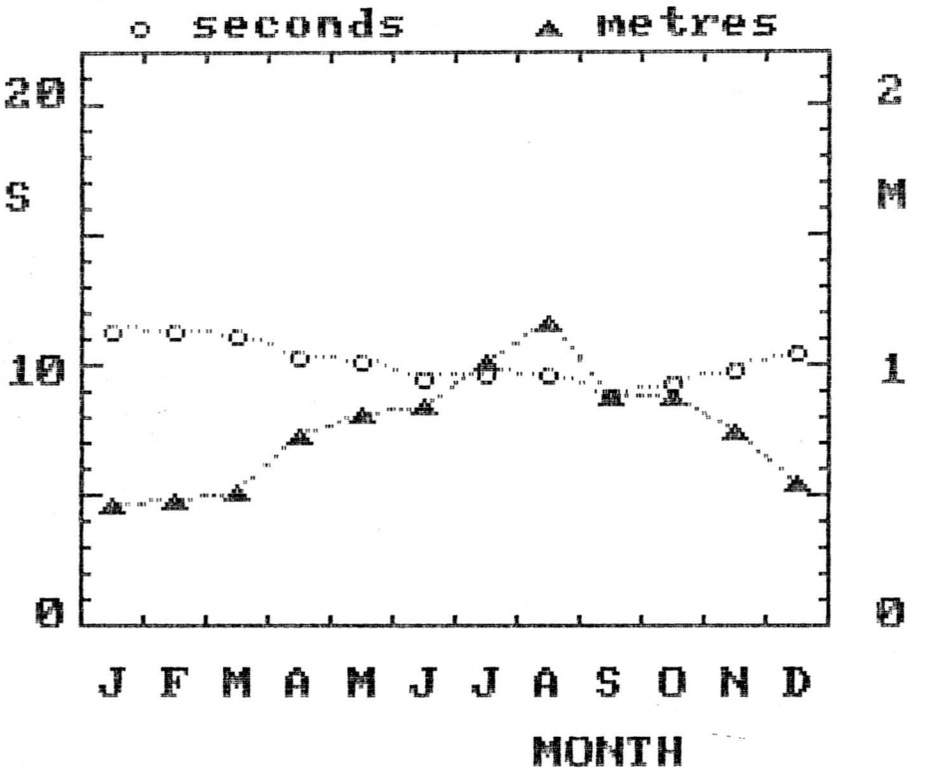

FIGURE 2 - AVERAGE MEAN WAVE HEIGHT AND PERIOD FOR THE EASTERN SIDE OF THE ATOLL DURING THE YEARS 1985 1986 AND 1987

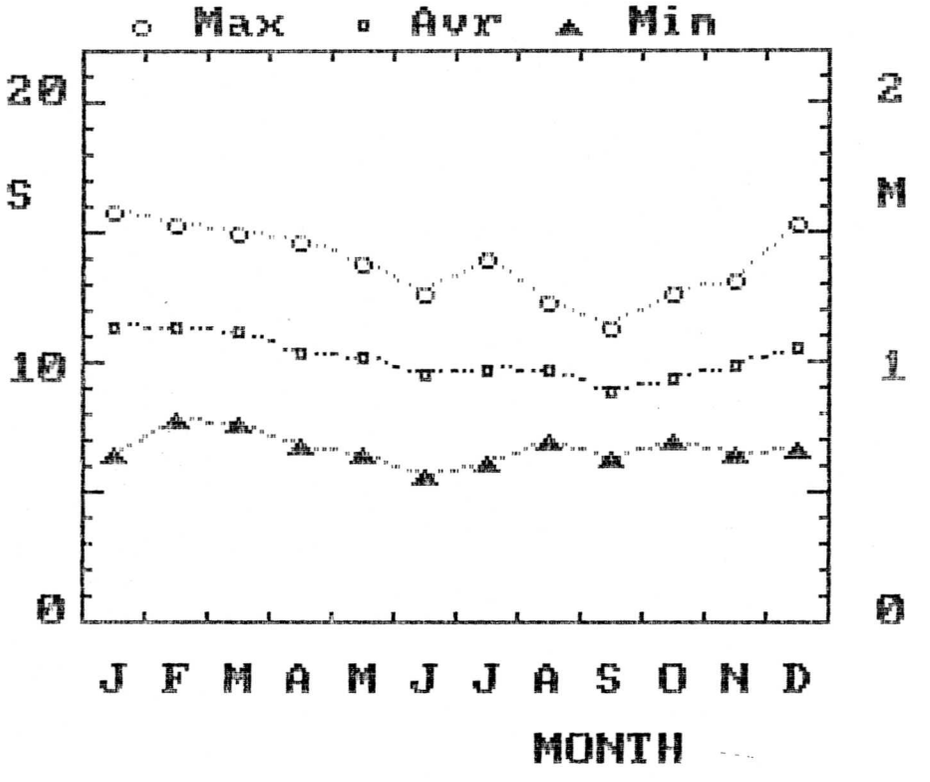

FIGURE 3 - AVERAGED MINIMUM AVERAGE AND MAXIMUM WAVE PERIODS DURING THE YEARS 1985 1986 AND 1987 OBSERVED ON THE EASTERN SIDE OF FUNAFUTI IN TUVALU

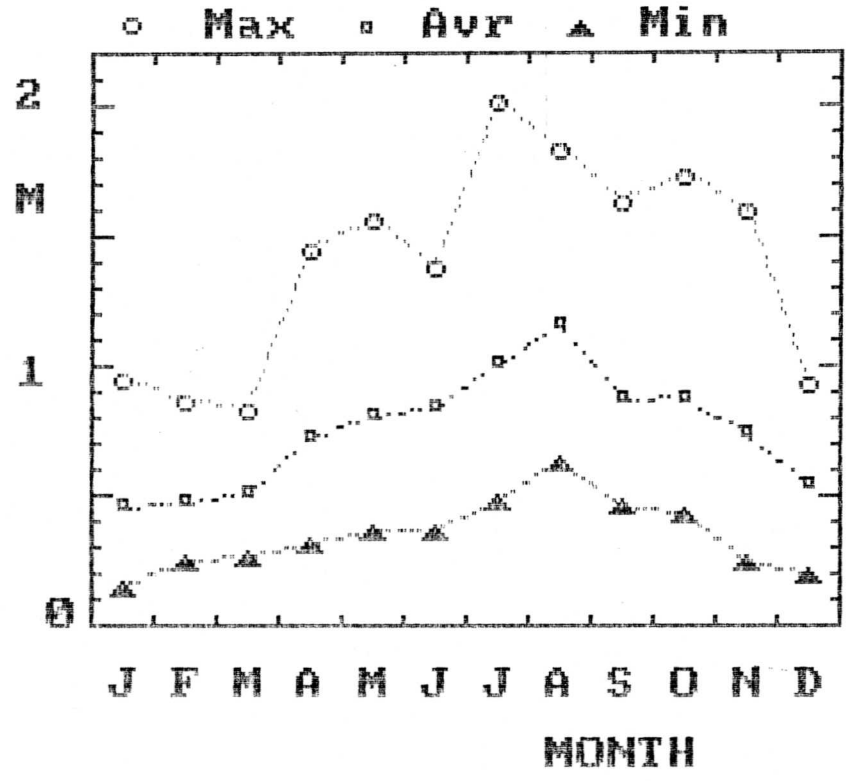

FIGURE 4 - AVERAGED MINIMUM AVERAGE AND MAXIMUM WAVE HEIGHT IN METRES OBSERVED ON THE EASTERN SIDE OF FUNAFUTI TUVALU DURING THE YEARS 1985 1986 AND 1987

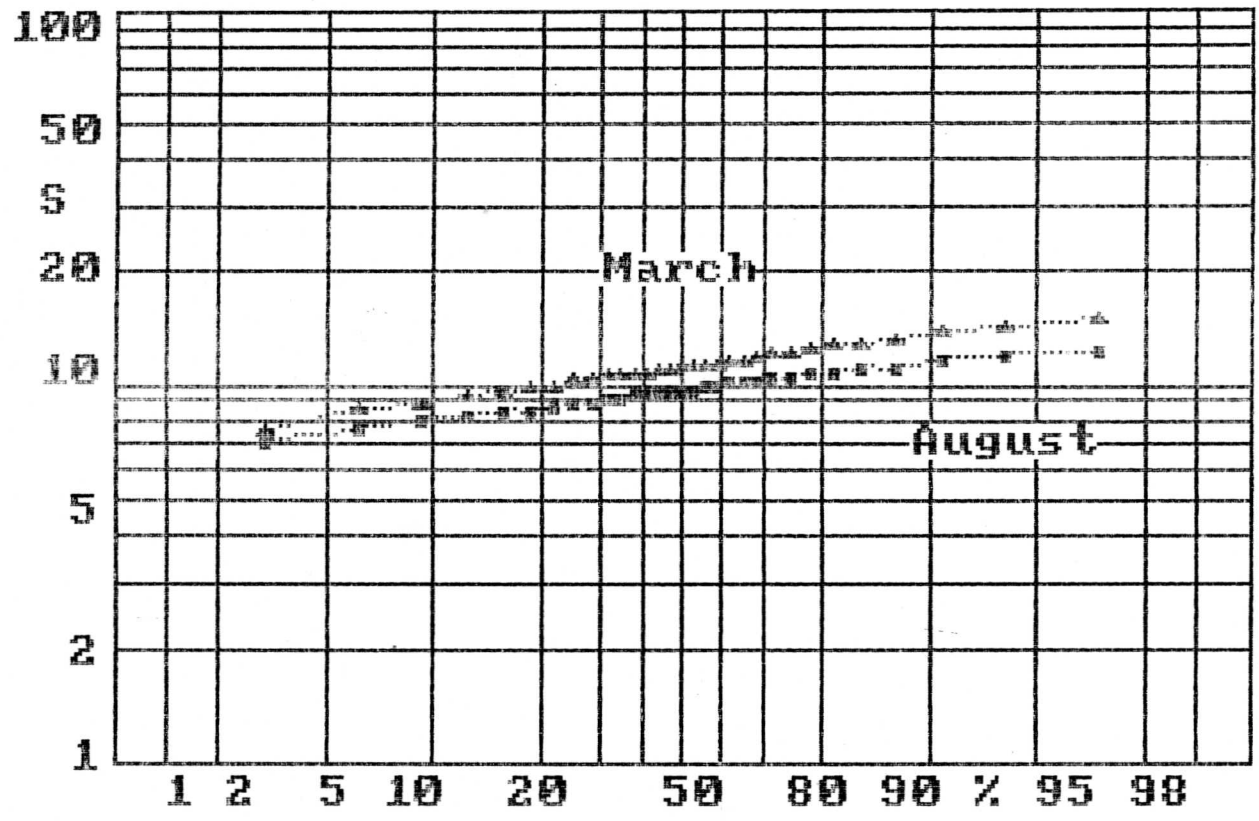

FIGURE 5 - PERCENT OF THE TIME THAT THE INDICATED WAVE PERIOD WAS NOT EXCEEDED DURING THE MONTHS OF MARCH AND AUGUST IN THE YEARS 1985 1986 AND 1987. THE WAVE PERIOD IS GIVEN IN SECONDS

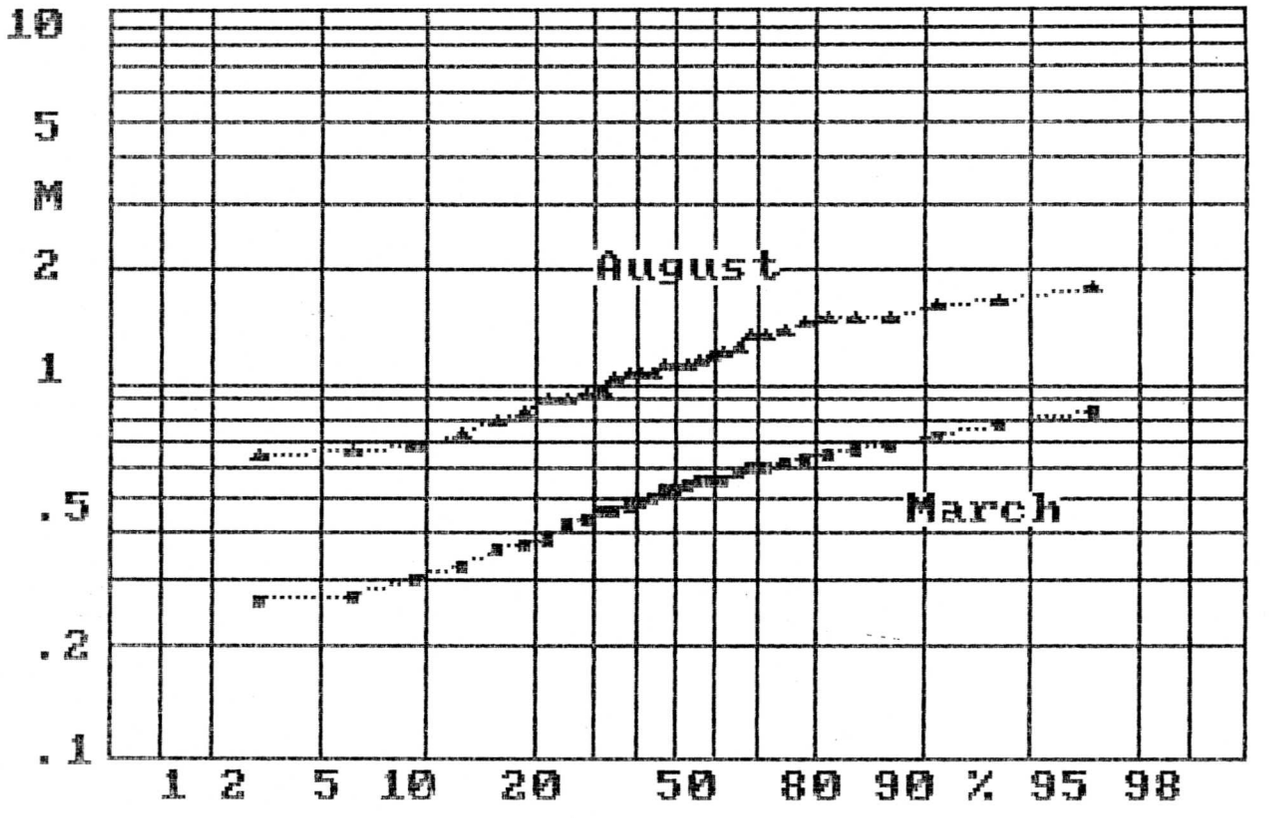

FIGURE 6 - PERCENT TIME THE THREE YEAR AVERAGED WAVE HEIGHT WAS NOT EXCEEDED IN MARCH AND AUGUST DURING 1985 1986 AND 1987. THE WAVE HEIGHT IS GIVEN IN METRES

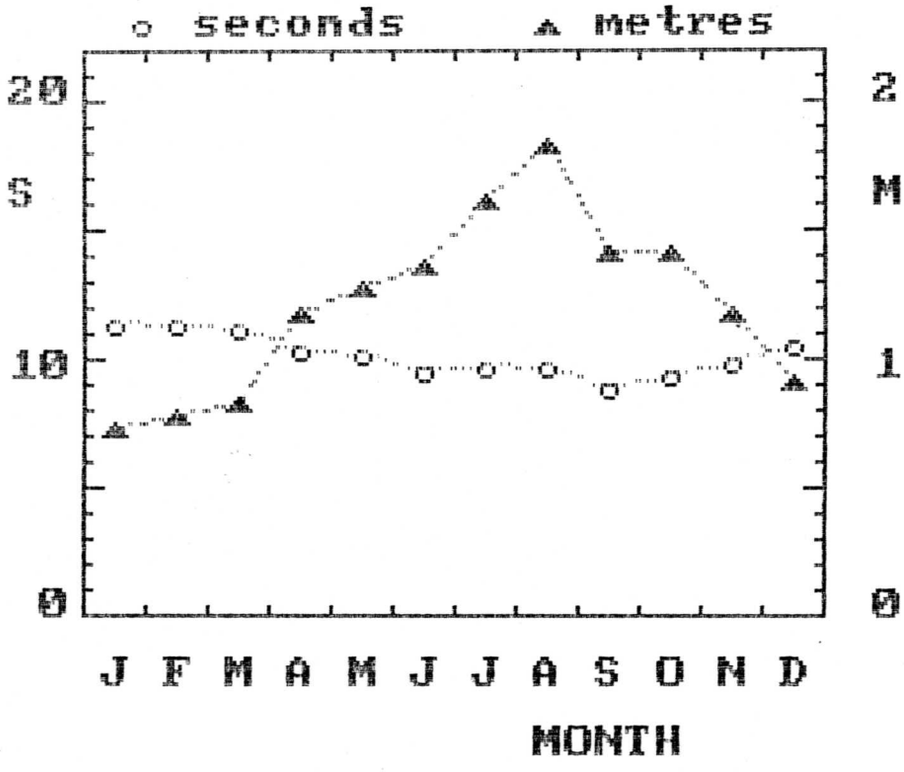

FIGURE 7 - MONTHLY AVERAGED UPPER 1/3 WAVE HEIGHT AND AVERAGE WAVE PERIOD FOR THE YEARS 1985 1986 AND 1987 - Wave height in metres and wave period in seconds