

## Letters to the Editor

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### DECAY OF WAVES OVER ARABIAN SEA GENERATED BY CYCLONIC STORMS

The waves generated in a cyclone field emanate out. While travelling they lose energy; thus wave decay occurs. A theoretical treatment on this subject has been given by Kinsman (1965). The wave-decay can be viewed from another angle. We may fix the wave period and observe the decrease in height of wave of this period with distance. A useful early study was by Barber and Ursell (1948). Bretschneider (1952) drew some empirical graphs of decay of waves of given period. Darbyshire (1957) derived the relationship :

$$H_T/H_{T0} = (300/D)^{1/2}$$

where  $H_T$  is the height of wave of period  $T$  at a distance  $D$  and  $H_{T0}$  is the initial height.

2. In the present note we have tried to find out empirically from the data over the Arabian Sea the decay of wave height of a given period with the distance travelled.

3. In the present investigation all available observations during the storms over Arabian Sea from 1975 and 1977 were taken into account. For calculating the arrival of swells at the point of observations the basic relationships :

$$L=5.12 \times T^2 \text{ and } L=C.T$$

where,  $L$  is the wave length in feet,  $T$  is the wave period in seconds and  $C$  is the velocity of the wave. In all earlier studies  $H_T/H_{T0}$  has been taken as the parameter to study wave-decay. Here also the same has been followed. A plot of this with distance is shown in Fig. 1. The decay of waves with distance is clearly brought out here.

3. To study in detail two arbitrary graphs were made. They are waves (1)  $H \geq 6m$  and (2)  $H \leq 5m$ .

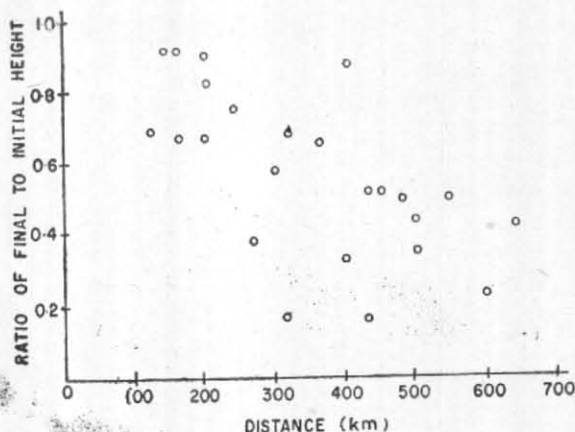


Fig. 1. Decay of waves with distance

The points were plotted again separately for these two groups. They are shown in Figs. 2 and 3 respectively. They give two straight lines though the scatter in Fig. 2 is rather large. However, the slope in Fig. 2 is greater than that in Fig. 3. This suggests that the rate of wave-decay varies with wave height.

4. Let us assume that the rate of wave-decay is proportional to the wave height.

$$-\frac{dH}{dD} \propto H$$

which gives  $\log H = -KD + A$ , where  $K$  and  $A$  are constants.

In order to establish the relationship,  $dH/dD$  for different wave heights should be calculated. Quite accidentally the typical wave heights we came across for which  $dH/dD$  could be reliably calculated are  $H=3, 4, 6$  and  $7$  m, because of availability of large number of observations of these heights. If the relationship is true  $dH/dD$  value should be ascending order. Table 1 shows that this is the case.

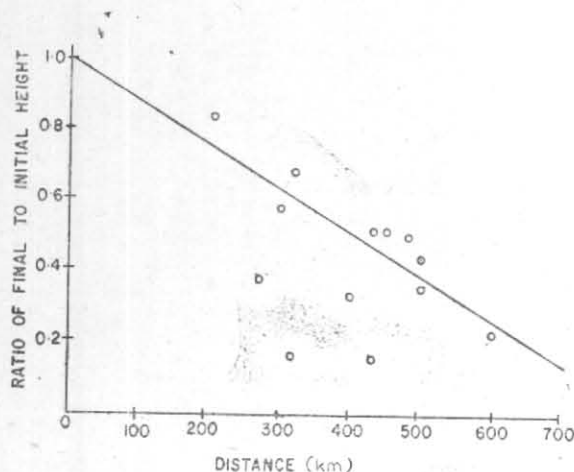


Fig. 2. Decay of waves of height  $> 6$  m with distance

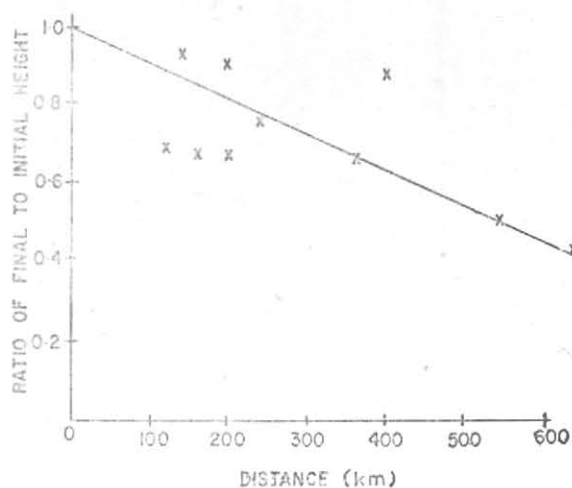


Fig. 3. Decay of waves of height  $< 5$  m with distance

TABLE 1  
Decay rates for waves

	Initial wave height (m)			
	3	4	6	7
Rate of decay ( $\times 10^{-6}$ )	2.0	4.0	7.7	8.5

TABLE 2  
Prediction of wave height from decay rate

Year of study	Decay distance (km)	Wave height (m)	
		Predicted	Observed
1974 (a)	400	3.2	2.5
	540	2.5	2.5
1974 (b)	260	4.3	3.5
	380	3.5	2.0
1978	700	1.6	2.0
	500	2.3	3.0
	400	2.2	2.3

5. To check the validity of the model verification was done with respect to observations during the two depressions in May 1974 and the cyclonic

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storms of November 1978 over Arabian Sea. The results are given in Table 2.

6. It may be seen from this table that the agreement between observed and predicted wave heights is reasonably good. With the type of observations that we can get, it is difficult to get better agreement than above. However, it may be mentioned here that the cases of 1978 indicate that the observed values were higher than the predicted ones. Apparently, this is due to the fact that the case of November 1978 is a case of cyclonic storm whereas the cases of 1974 are those of depressions. It is possible that the ships for which the initial data of the waves in the cyclones field were taken were not on the leeward end of the fetch so that the waves were still building up.

7. This is the first attempt for estimating decay of waves heights of given periods with the distance travelled over Arabian Sea. The conclusions arrived at are rather approximate but, it is hoped that these conclusions will be useful to forecasters.

#### References

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