ON THE SATURATION RANGE OF WAVE SPECTRA AND WIND SPEED DEPENDENCE IN THE NORTH ADRIATIC

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The slope of the high-frequency part of wave spectra was studied using data from the North Adriatic. It was found that the slope is very close to -4. Some evidences of the wind speed dependence of the high-frequency part of wave spectra are presented.

On a analysé la pente de la partie des fréquences hautes des spectres de la houle dans l'Adriatique du Nord. On a trouvé que cette pente est tres proche a -4. On a également trouvé des évidences que la forme de la partie des fréquences hautes des spectres de la houle depend de la vitesse du vent.

The saturated range of wind wave spectra is that part where all the input energy is dissipated or transferred to other frequencies. It is accepted that this part of wave spectra has the general form: $S(f)=\alpha\;^{\beta}$, but different authors have proposed different values for both α and β coefficients. Whether the coefficient α is a function of wind speed(Kahma, 1981; Naeser, 1981), dimensionless fetch (Hasselman et at., 1973) or if it is really a constant as proposed by Phillips (1958) remains unresolved.

Data obtained from the oil-drilling platform "Panon" in the North Adriatic (Fig.1) by waverider buoy were used to determine both α and β coefficients, as well as to verify wind speed dependence of the coefficient α. About 200 spectra were calculated (Blackman and Tukey method) for wind speeds between 5 and 25 ms^{-1}. Wind velocity was recorded continuously at the study site. Synoptical situations were characterized by SE or NE winds, which are the most efficient wave-generating winds in the Adriatic. From the position of waverider bouy it was obvious that the fetch for these two winds is different. The SE-wind fetch is by, almost, an order of magnitude larger than NE-wind fetch. This enabled us to conclude something about the fetch dependence of the coefficient α.

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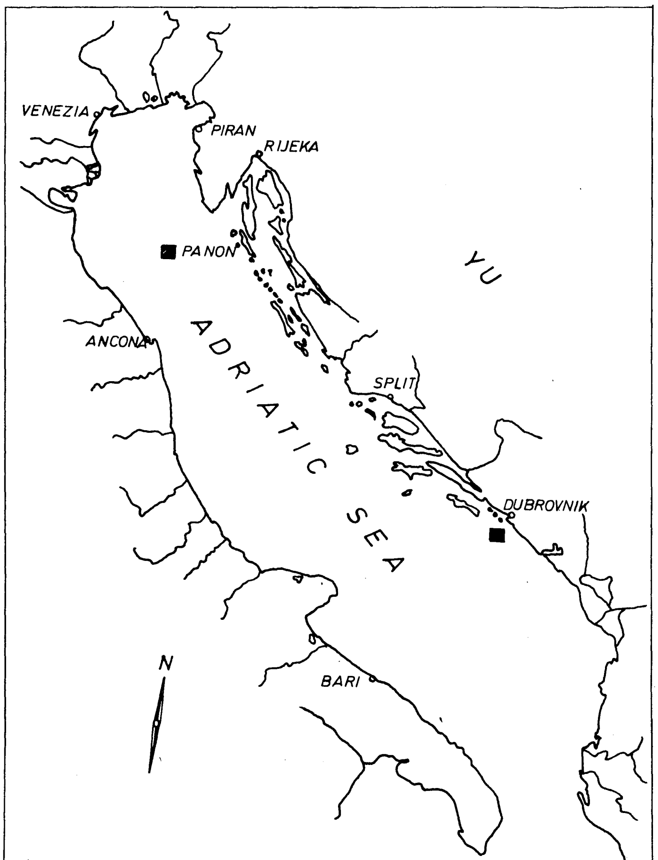

Fig. 1.: Locations of wave measurement stations

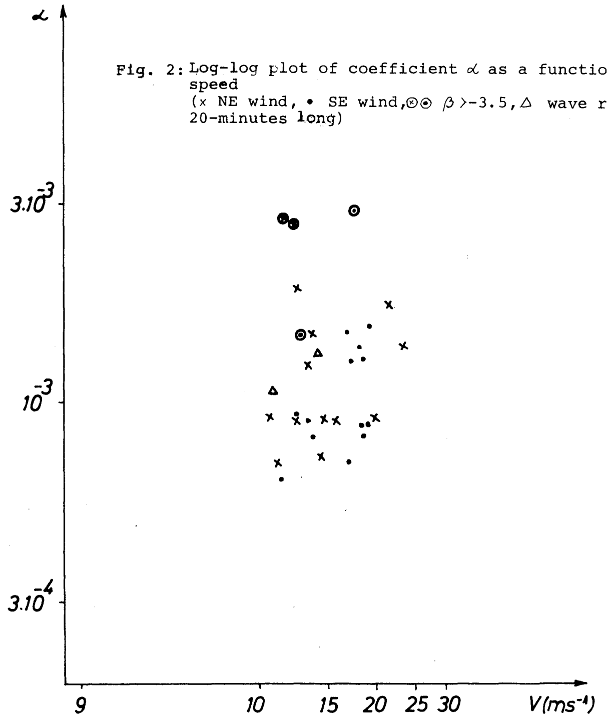

Fig. 2: Log-log plot of coefficient α as a function of wind speed (x NE wind, • SE wind, ⊗⊙ $\beta > -3.5$, △ wave records 20-minutes long)

The digitization rate for all the data sets was 1 Hz and since an anti-aliasing filter was not used the slope of the high-frequency part of the spectra could not be calculated for low energy waves, therefore spectra for wind speeds below 9 ms^{-1} were not analysed. Spectra obtained from records shorter than 10 minutes were not analysed either. Also spectra with a dimensionless frequency smaller than 0.13 were not taken into consideration as they were in the swell region. Finally 30 spectra were used to calculate coefficients α and β by the least square method for the frequency interval above 1.35 f_m, where f_m is the peak frequency in each of the studied spectra. The mean slope of the saturated range of the used spectra has the value of -3.89 with standard deviation of 0.33 which is close to the -4 slope obtained by several authors like o.g. Kawai et al. (1977).

In Fig.2 the log-log plot of the coefficient α as a function of wind speed is shown. Since there is no difference between the group of points for NE and SE winds (Fig. 2) there is no evidence about the fetch dependence of the coefficient α. There is, however, evidence that the coefficient α is a function of wind speed. Generally, the correlation between the coefficient α and the wind speed is poor probably because most of the spectra were calculated from data sets 10-minute long making spectral estimates unreliable. For comparison, two values of the coefficient α for the Dubrovnik station where data sets were 20 minutes long are shown in the same figure. The coefficient α obtained from these data sets does not differ from coefficients obtained from data sets 10-minutes long.It would be necessary to have many more coefficients α calculated from data sets longer than 10 minutes in order to conclude whether the record langth causes low correlation between wind speed and coefficient α. Fig. 2 illustrates also that α-points for a slope smaller than -3.5(marked by circles)are dispersed more than the other α-points. This indicates either that spectra from which these values of coefficient α were obtained, have a high noise level or that aliasing is strong which makes the estimate of the high-frequency tail of spectra unreliable.

So far it can be concluded that the slope of high-frequency part of wave spectra is close to -4 and that there are some evidences that the coefficient α is a function of wind speed. No evidences were found about the fetch dependence of the coefficient α.

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