



Abstract View

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A Study of the Growth of the Wave Spectrum with Fetch

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ABSTRACT

The development of the wave spectrum with fetch in a steady wind has been studied with a line of consecutive wave buoys in the Bothnian Sea in 1976 and 1979. The relationship that was found between dimensionless peak frequency $\omega_m (= \omega_m U_{10}/g)$ and dimensionless fetch $\bar{X} (= gX/U_{10}^2)$ was close to previous observations. The dimensionless energy $\bar{\sigma}^2 (= g^2 \omega^2 / U_{10}^4)$ was about twice that observed in the JONSWAP experiment.

In the saturation range when $\bar{\omega} > 4$ the frequency spectrum was found to have the form $S(\omega) = \alpha_u U_{10} g \omega^{-4}$ where $\alpha_u = 4.5 \times 10^{-3}$, independent of the dimensionless fetch \bar{X} . The deviation from the Phillips -5 power law could not be explained by the influence of currents or finite depth. Near the peak, the spectra were satisfactorily described by the JONSWAP spectrum; above frequencies twice the peak frequency the difference becomes significant. A qualitative explanation is proposed for the dependence of the spectrum on the wind speed in the saturation range. The semi-theoretical method of Longuet-Higgins (1969) to estimate the Phillips saturation-range constant is applied to estimate α_u . The result $(4.4-6.4) \times 10^{-1}$ agrees with the experimental value. The growth of a component of the dimensionless spectrum with the fetch was found to be exponential within the accuracy of the data. The exponential growth parameter agreed with previous observations. A simple model is proposed to predict the growth rate without assuming nonlinear transfer of energy by wave-wave interactions; the results agree well with observations.

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