Abstract View

Volume 12, Issue 6 (June 1982)

Journal of Physical Oceanography
Article: pp. 556–568 | Abstract | PDF (897K)

On the Effects of Finite Depth on Wind-Wave Spectra: 1. A Comparison with Deep-Water Equilibrium-Range Slope and Other Spectral Parameters

C. E. Knowles

Department of Marine, Earth and Atmospheric Sciences, North Carolina State University, Raleigh 27650

(Manuscript received September 2, 1981, in final form March 2, 1982)

DOI: 10.1175/1520-0485(1982)012<0556:OTEOFD>2.0.CO;2

ABSTRACT

Spectral parameters calculated from wind-wave measurements in a finite-depth restricted-fetch estuary are compared with similar deep-water parameters. The equilibrium range of these finite-depth spectral data seems to be fitted more satisfactorily by the −3 slope predicted for constant depth by Kitaigorodskii *et al.* (1975) and measured for shoaling waves by Thornton (1977). Non-dimensional effective-fetch $\tilde{x}_e$ appears to be the parameter of choice for use in displaying other scaled spectral data (like wave energy ϵ and peak frequency ν) because it reconciles differences in ϵ and ν data for short (5–7 km) and long (20–42 km) fetches without having to alter the ϵ and ν data, but the results also suggest that using fetch as a scaling parameter may not be satisfactory. Finite-depth effects were clearly shown in the ϵ-$\tilde{x}_e$ data (the slope of the power-law relation was significantly larger than for deep-water relations) and in the ν-$\tilde{x}_e$ data [the slope was between the relations of Phillips (1977), Ross (1978) and Liu and Ross (1980), but well above these power-law lines]. There was remarkable agreement between this study's finite-depth ϵ-ν equilibrium data and the relations of Ross (1978) and Liu and Ross (1980) when $k_p h$ was 0(1) or greater, with the largest departure when $k_p h \leq 0.7$ (where k_p is the wavenumber associated with the spectral peak). In addition to the expected restriction to wave growth by bottom dissipation, refraction and shoaling, there is evidence in the data supporting the calculations of Hasselmann and Hasselmann (1980) that show that resonant wave-wave interaction cross-spectral transfer rates for finite-depth waves increase rapidly above the deep-water rates when $k_p h < O(1)$, which may help explain the departure from the deep-water power-law relations discussed above.

top

Headquarters: 45 Beacon Street Boston, MA 02108-3693
DC Office: 1120 G Street, NW, Suite 800 Washington DC, 20005-3826
amsinfo@ametsoc.org Phone: 617-227-2425 Fax: 617-742-8718
Allen Press, Inc. assists in the online publication of *AMS* journals.