Abstract View

Volume 17, Issue 9 (September 1987)

Journal of Physical Oceanography
Article: pp. 1317–1338 | Abstract | PDF (1.01M)

Computations of the Response of a Wave Spectrum to a Sudden Change in Wind Direction

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(Manuscript received September 2, 1986)

DOI: 10.1175/1520-0485(1987)017<1317:COTROA>2.0.CO;2

ABSTRACT

The response of a wind-sea spectrum to a step function change in wind direction is investigated theoretically for a sequence of direction changes ranging from 30° to 180°, in increments of 30°. Two spectral energy balance models are used: the model EXACT-NL, in which the nonlinear transfer is represented exactly, and the model 3G-WAM, in which the nonlinear transfer is approximated by the discrete interaction parameterization. In both modes the input and dissipation source functions are taken from the energy balance proposed by Komen et al. The operational model 3G-WAM reproduces fairly closely the EXACT-NL results. For wind direction changes less than 60°, the wind-sea direction adjusts smoothly. The high-frequency components relax more rapidly to the new wind direction than the low-frequency components. The computed relaxation rates are generally consistent with the analysis of measured directional spectra by D.E. Hasselman et al. and Allender et al. However, the relaxation rate is found to be a function of wind speed as well as frequency. For wind direction changes greater than 60°, a second, independent wind-sea spectrum is generated in the new wind direction, while the old wind-sea gradually decays as swell.