Abstract View

Volume 6, Issue 6 (November 1976)

Journal of Physical Oceanography
Article: pp. 925–930 | Abstract | PDF (468K)

On the Interaction Between Long and Short Surface Waves

Christopher Garrett and Jerome Smith

Department of Oceanography, Dalhousie University, Halifax, Nova Scotia, Canada

(Manuscript received May 17, 1976, in final form July 27, 1976)

DOI: 10.1175/1520-0485(1976)006<0925:OTIBLA>2.0.CO;2

ABSTRACT

Short, dissipative, surface waves superposed on longer waves cause a growth of the long wave momentum M_l at a rate where k_l, a_l are the amplitude and wavenumber of the long waves, so that $k_l a_l$ is their steepness; S_a is the radiation stress of the short waves and τ_s, the rate of transfer of momentum to the short waves by the wind; and the angle braces denote an average over the long-wave phase $\theta = k_l x - \omega_l t$.

The first term in the above equation is the radiation stress interaction (Phillips, 1963; Hasselmann, 1971) and is generally negligible compared with the second term, neglected by Hasselmann (1971), which shows that long waves can grow if short wave generation (rather than dissipation) is correlated with the long wave orbital velocity.

Even if the modulation of τ_s is only $O(k_l a_l)$ times $\langle \tau_s \rangle$, this mechanism can contribute a significant fraction of long wave momentum. However, even a substantially greater modulation of τ_s, perhaps due to varying exposure of short waves to the wind, is unlikely to account for all the alleged momentum input to long waves, due to the upper bound $k_l a_l$ on the efficiency of the process.