Abstract View

Volume 4, Issue 3 (July 1974)

Journal of Physical Oceanography
Article: pp. 337–348 | Abstract | PDF (778K)

An Experimental Study of the Resonant Instability of an Internal Wave of Mode 3 Over a Range of Driving Frequencies

Lon E. Hachmeister and Seelye Martin

Dept. of Oceanography, University of Washington, Seattle 98195

(Manuscript received October 29, 1973, in final form March 21, 1974)

DOI: 10.1175/1520-0485(1974)004<0337:AESOTR>2.0.CO;2

ABSTRACT

An experimental study of the stability of a progressive internal wave of mode 3 propagating down a long tank filled with a linearly stratified salt solution is conducted over the range $0.45 \leq \omega_3/N \leq 0.80$, where ω_3 is the paddle frequency and N the Brunt-Väisälä frequency. Our observations show that the generated wave excites resonant triads at frequencies. below and forced triads at frequencies above the paddle frequency. There are two distinct families of resonant triads, corresponding to what Simmons calls set I and set II with modal form (n, n+3, 3) and (n+3, n, 3), n=1, 2, 3,…, respectively. Simmons' theory predicts that the set I triads grow approximately twice as fast as the corresponding triads of set II. In our experiments, we observe the set I triads at low amplitudes, with the set II triads forming as we increase the paddle amplitude. Above the driving frequency, we find only forced waves whose frequency and mode number are the sum of those of the paddle and the more energetic triad members, but whose wavenumber is not that of a free wave. The experiments substantiate Hasselmann's theoretical conjecture: that resonant instabilities alone cannot transfer energy to frequencies above the driving frequency.