Sound field fluctuations in the presence of moving nonlinear internal waves due to mode coupling

Abstract.

Fluctuations of sound intensity in the presence of moving nonlinear internal waves (NIWs) are studied. Prior works revealed the existence of peaks in the spectrum of these fluctuations due to mode coupling. Results of modeling are demonstrated.

Analyses of fluctuations of low frequency signals (300630 Hz) propagating in shallow water in the presence of nonlinear internal waves (NIWs) in the Shallow Water 2006 experiment are carried out. Signals were received by a vertical line array at a distance of _20 km from the source. It is shown that the spectrum of the sound intensity fluctuations contains peaks corresponding to the coupling of pairs of propagating modes. Analysis of spectra at different hydrophone depths, and also summed over depth allows the authors to estimate attenuation in the bottom sediments

The results of experiment ASIAEX 2001 are considered. Episodes are analyzed when soliton-like NIW move for ~ 6 h approximately along an acoustic track of length ~ 30 km. The depth of the ocean changes from ~ 350 m (position of the source) up to ~ 120 m near the receiver (Vertical Line Array). The source, placed near the bottom, transmitted pulses (M-sequences) with a frequency of 224 Hz. Theoretical analysis and numerical modeling show that peak frequencies in the spectrum of intensity fluctuations correspond to the most strongly interacting pairs of modes: in the given case pairs 2–3 and 3–4 and values of dominating frequencies are determined by the spatial scale of interference beating Λ of coupling modes and by the speed v of NIW. Due to the fact that in the narrowing channel velocity v decreases as well as the value of Λ, the predominant frequency as a function of time remains approximately the same. Results of modeling are in a good agreement with experimental data.