Observations of underwater ambient noise in the ocean generated by unusual source - large-amplitude internal wave are considered. Both parameters of solitary internal wave as and underwater noise characteristics measured in the moment of the internal wave passing near the Mascarene Ridge in the Indian Ocean are presented. It was revealed that in this case main sources of noise are arranged near the sea surface and are generated by rip band, accompanied of internal wave passing.

1. Introduction

Large-amplitude internal waves are wide spreading and striking phenomenon in the World Ocean [1]. They play an important role in different aspects of oceanic dynamics and many applications, including underwater sound propagation. As to concern effect of internal waves on underwater noise it is known that internal waves are manifested in the ambient noise field by modulation of noise level due to variation of sound-speed profile [2]. During our investigations of large-amplitude internal waves in the ocean in 1990 we found that large internal wave can as well generate underwater noise. In this paper we will present results of the observations.

2. Observations

We carried out simultaneous measurements of parameters of internal waves and ambient noise characteristics near the Mascarene Ridge in the Indian Ocean, well-known place of intense internal wave generation [3]. The internal wave observations were made by line temperature sensor in the upper thermocline and by “yo-yo” CTDs sounding from drifting ship. Measurements of noise were made by means of antenna of 4 vertically distributed hydrophones (5-100 kHz) and one low-frequency hydrophone (0.1-20 kHz) arranged at depth of 100 m. On 6 December between 2 h and 7 h of local time a solitary large-amplitude internal wave passed research vessel drifted near the underwater ridge. The solitary internal wave was accompanied by wide rip band on the sea surface moving in the same direction as the internal wave. This internal wave surface manifestation was clear seen on a ship radar images (Fig.1). The internal wave we observed had 50-meter height and propagated to the southeast direction with speed close to 2.5 m/s (relative to the water). Internal wave profile with steep front face points out to strong non-linearity of the wave [4] (Fig.2).

Figure 1: Radar image of the rip band generated by solitary internal wave propagating off the Mascarene Ridge in the Indian Ocean. Radii of small and large circles are 3.7 and 7.4 km, correspondingly. Photo was made at 03:00 (local time) on 6 December, 1990.

Figure 2: Record of 50-m solitary internal wave made by line temperature sensor on 6 December.
Fig. 3 shows how passing of the internal wave reflects in spectral characteristics of ambient oceanic noise. The moment of arising of noise level on receiving hydrophone coincides with the moment of rip band arriving to the position of antenna (Fig.2 and Fig.3(a)). It was revealed that passing of solitary internal wave lead to significant increase (up to 18 dB) of underwater noise level at frequency in a range of 5-15 kHz (Fig.3(b)). In conclusion we can summarize that observed generation of underwater noise by internal wave is connected with generation of rip band on the sea surface by strong internal wave. Rip band consists of chaotic breaking surface waves. So it seems that noise generation mechanism we observed is very similar to the mechanism of the breaking of surface wind waves and the collapsing of air bubbles in the air-saturated surface layer.

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5. References


