

Observation of oceanic ambient noise at the IEODO ocean research station

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1. Introduction

In the ocean the ambient noise always exists due to water surface agitation, biological activity and shipping traffic. The underwater ambient noise is used as an input parameter[1] to improve the signal-to-noise ratio of underwater acoustic instruments such as sonar, and it is also utilized as basic data for monitoring of rainfall and wind speed[2-3] on the sea surface. Studies on underwater ambient noise have been performed by Knudsen et al.[4] and Wenz[5]. Recently, the study of ambient noise in the sea around the Korean Peninsula is carried out by Kim et al. [6]. In this study the ambient noise was measured at the Ieodo Ocean Research Station (IORS). Wind speed and water current as surrounding environment parameters were measured.

2. Experimental Measurement

The IORS is an integrated meteorological and oceanographic observation base which was first constructed in Korea. It was constructed at the Ieodo underwater rock located at a distance of about 150 km to the south-east of the Mara-do as shown in **Fig. 1(a)**. The structure is a fixed jacket type installed at a water depth of 40 m. In order to understand the characteristics of oceanic ambient noise at the station, the ambient noise was measured for about 70 hours on July 2004. A hydrophone was used to catch the ambient noise at a depth of 20 m as shown in **Fig. 1(b)**. The ambient noise levels at each frequency of one-third octave band from 25 Hz to 12.5 kHz were analyzed and processed to get average and standard deviation on noise levels. The Bruel & Kjaer model 8101, model 2636 and model 7006 were used as a hydrophone, a measuring amplifier and a frequency analyzer, respectively. The spectrum analysis was conducted by using a signal analyzer, the Bruel & Kjaer model 2035. Dependences of wind speed and water current and biological effects on the noise levels were investigated.

3. Results and Discussion

The underwater ambient noise was measured for 70 hours at the IORS. Frequency spectra were obtained with one-third octave band interval from 25 Hz to 12.5 kHz. In **Fig. 2(a)**, the box and the circle marks indicate the wind-dominated noise and the shipping-dominated noise, respectively. The ambient noise in the frequency band from 25 Hz to 400 Hz in **Fig. 2(b)**, appears to be dominated by distant ship traffic. In the frequency band from 400 Hz to 12.5 kHz the noise having a slope of -6 dB/octave mainly seems to be generated by wind on the sea surface. The two peaks in low frequency band(32 Hz and 80 Hz) are assumed to be the effect due to wave break at the IORS. The slight increasing noise level around 10 kHz is considered the snapping shrimp sound.

The linear regression trends and correlation coefficients of the ambient noise for wind speed and water current are shown in **Fig. 3**. In **Fig. 3(a)**, we can see that the ambient noise is highly correlated with the wind speed at around 4 kHz. This is similar to previous results reported by other authors [5-6]. The correlation between ambient noise level and water current was analyzed for the first time here as shown in **Fig. 3(b)**. The water current can make water agitation and it can be underwater noise sources, which is termed a flow noise in a Urick's book[1]. The high correlation between ambient noise and current is shown around 10 kHz. It is considered a flow noise by flow agitation of water bottom and near hydrophone in water.

4. Conclusion

The ambient noise at the Ieodo Ocean Research Station is observed during 70 hours. The wind dependence is dominant at frequencies of a few kHz. The surface current dependence is showed the correlation with the ambient noise in the frequency of 10 kHz.

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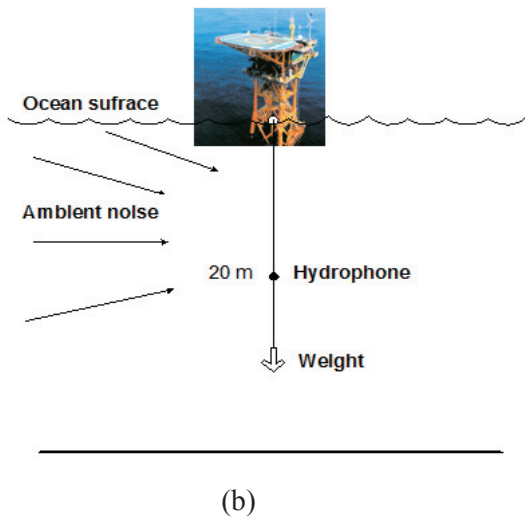
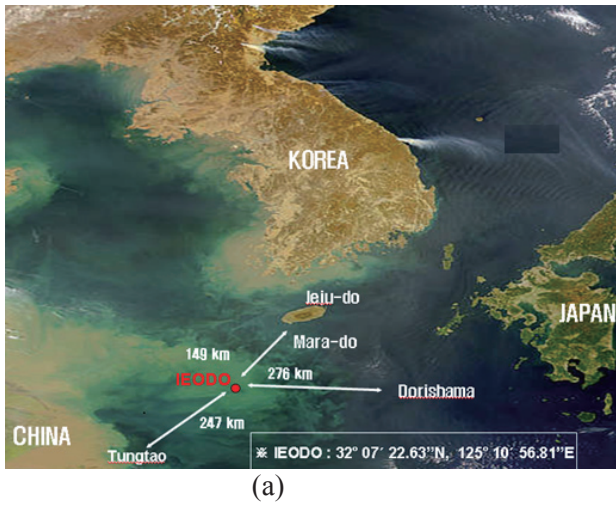


Fig. 1 (a) Location of the Ieodo Ocean Research Station, (b) Schematic diagram of ambient noise

measurement.

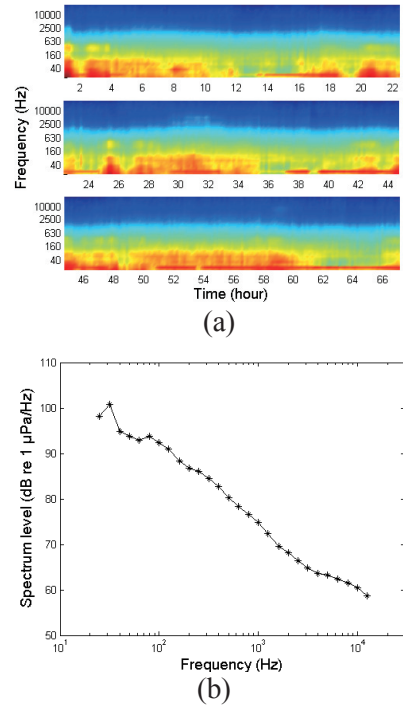


Fig. 2 (a) Spectrogram of ambient noise measured for 70 hours, (b) Total averaged ambient noise level in frequency domain.

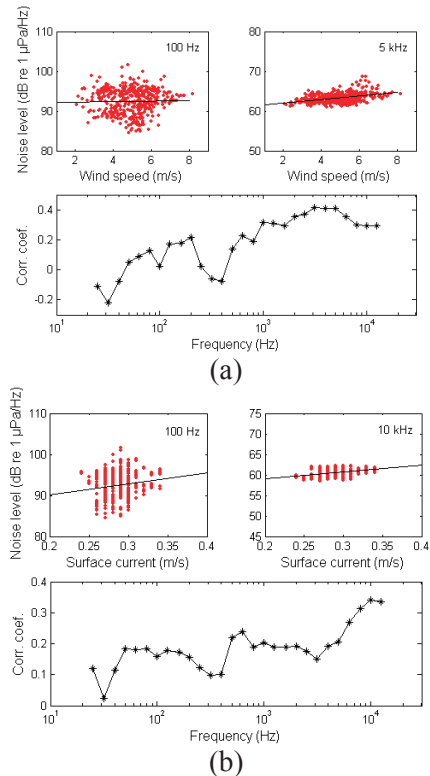


Fig. 4 Linear regression trends and correlation coefficients of the ambient noise for (a)wind speed and (b)water current.