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# Wind dependence of oceanic ambient noise measured at the Ieado Ocean Research Station

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## 1. Introduction

Ambient noise always exists in the sea due to sea surface agitation, shipping traffic and marine animal's activities. Ambient noise is used as an input parameter of sonar equation to predict the performance of underwater acoustic equipments such as sonar [1]. Also oceanic ambient noise can be utilized as basic data for monitoring of wind speed and rainfall rate on the sea surface [2, 3]. In order to investigate the effect of wind speed on ambient noise level in the shallow waters around the Korean Peninsula, ambient noise was measured at the Ieado Ocean Research Station (IORS).

## 2. Measurements

The Ieado Ocean Research Station is an integrated meteorological and oceanographic observation base which was constructed on the Ieado underwater rock as shown in Fig. 1. The structure is fixed jacket type installed at a water depth of 40 m. The oceanic ambient noise was measured for 5 minutes every hour during 9 months from April to December 2009 by the automatic ocean noise measurement system. At this time a hydrophone was positioned at a depth of 10 m. The ambient noise was analyzed with one-third octave band from 40 Hz to 20 kHz center frequency. And each noise data was produced by everaging for 5 minutes. The wind speed was measured at 12 m above the sea surface by an anemometer. And each wind speed data was produced by everaging for 10 minutes.

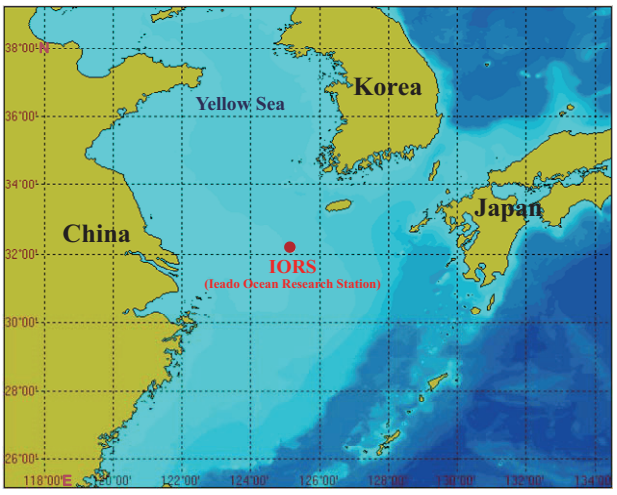


Fig. 1. Location map of the Ieado Ocean Research Station.

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## 3. Results and discussion

It is investigated the relationship between wind speed and ambient noise level at each center frequency of one-third octave band. Figure 2 shows some examples of the relationship between wind speed and noise level. Here, the black circles represent the measured data and the real line is drawn by regression analysis between logarithm of wind speed and noise level [4, 5]. According to the Fig. 2, the measured noise level almost linearly increased with logarithm of the wind speed.

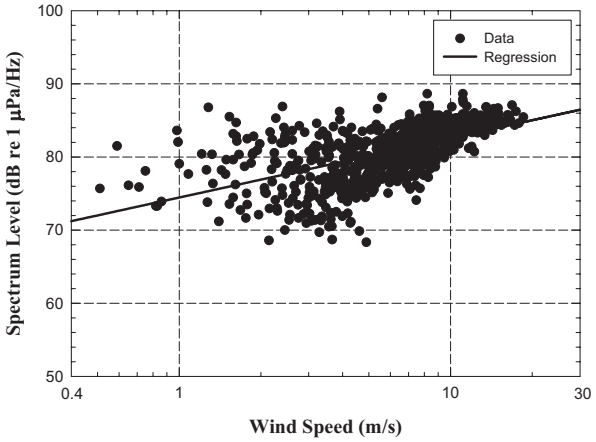
Figure 3 shows the correlation coefficient of the relationship between logarithm of wind speed and ambient noise level as a function of frequency. The correlation coefficient was larger than about 0.5 at the frequency region from 100 Hz to 3.15 kHz. However, the coefficient was smaller than about 0.2 at the higher frequency region of 5 to 20 kHz. This phenomenon was due to the sounds by snapping shrimp [6]. It was seemed that the snapping shrimps' sounds were stronger on calm sea than them on rough sea.

Figure 4 shows measured data on noise level versus wind speed. Here, symbols represent the mean value and the error bars represent two times of standard deviation. The noise levels are not variable below 4 m/s of wind speed, however in case of more than 5 m/s of wind speed the levels are gradually increasing with the increase of the wind speed.

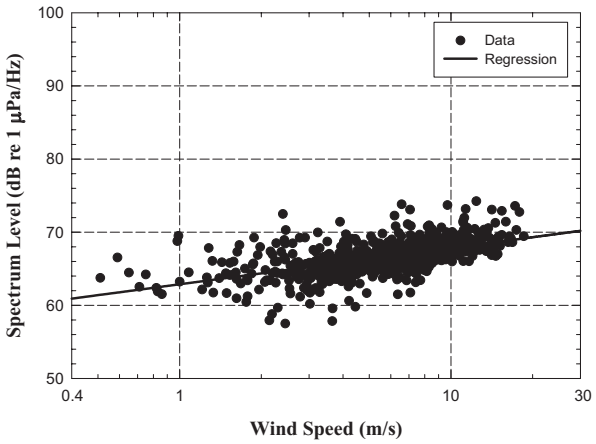
Figure 5 shows measured ambient noise spectrum level versus the Beaufort Number. The noise levels are gradually increasing with the increase of the Beaufort Number, however the levels at the higher frequency region of 5 to 20 kHz are not increasing with the increase of the Number due to the snapping shrimps' sounds.

## 4. Summary

Oceanic ambient noise was measured at the Ieado Ocean Research Station during several months. And the relationship between ambient noise level and wind speed is investigated at each center frequency of one-third octave band.




(a) 315 Hz




(b) 2500 Hz

Fig. 2. Relationship between logarithm of wind speed and ambient noise level at frequency of (a) 315 Hz and (b) 2500 Hz, respectively.

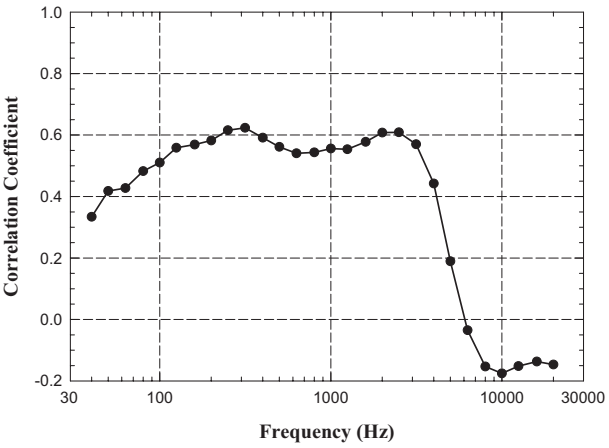



Fig. 3. Correlation coefficient on relationship between logarithm of wind speed and ambient noise level as a function of frequency.

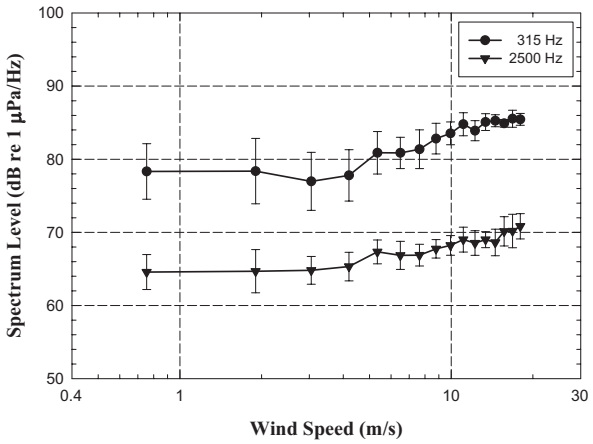



Fig. 4. Measured noise spectrum level versus wind speed at frequency of 315 Hz and 2500 Hz, respectively.

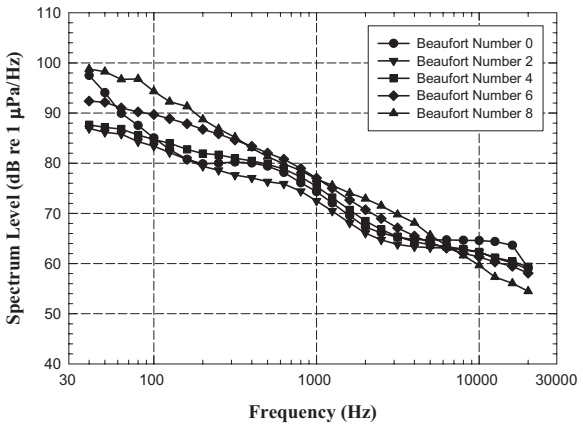



Fig. 5. Measured ambient noise spectrum level versus Beaufort Number.

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