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Measurement of Continuous Underwater Acoustic Signals in Continental Shelf Break

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1. Introduction

While analyzing mid-frequency acoustic data that were taken in a continental shelf break off the east coast of Korea, we observed significant acoustic signal fluctuation in receiver ranges. Underwater acoustic propagation is strongly affected by a vertical sound speed profile, and ocean boundary charateristics especially bottom properties in summer due to its frequent interactions. Sound interacting with the ocean bottom will normally suffer a loss in acoustic intensity. The amount of energy that is lost into or scattered off of the ocean bottom and its underlying sediments will depend on the bottom roughness, the geoacoustic parameter of the bottom sediments, the frequency of the sound wave, and the angle at which the sound wave striks the bottom. In recent years, the ocean bottom interaction at a mid frequency of underwater acoustic waves has attracted much interest for active detection using bottom bounced signals

2. Sea Experiment

On September 18-19, 2013, the sea experiment was performed in continental shelf break area bounded by 35.80°N to 36.10°N and 129.50°E to 129.90°E. The experiment area is located 63km offshore from the coastline. The experiment area is chosen because small scale oceanographic variability is observed frequently which propagates toward the east coast of Korea.

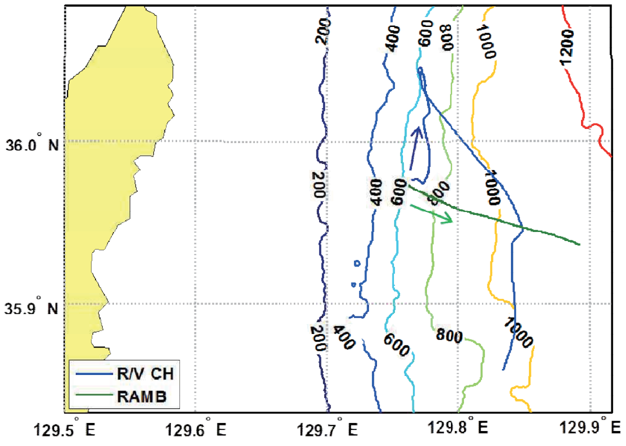

Fig. 1 Area map of the experiment off the east coast of Korea

The water depth is approximately 600m and the bottom is described in a geologic survey of the area as consisting of sandy-mud. Winds were calm and the sea state was nearly zero. For acoustic data acquisition, sound source was towed by research vessel CH (blue line on figure), and as a receiver, vertical line array (RAMB) are floated on site. Fig1 Shows the area map of the experiment. The acoustic signal was composed of 3 narrow band continuous waves at a frequency of 1, 3.5 and 5 kHz. The source level of each tonal is 182 dB and set at a depth of 9m. The Hydrophones are attached on vertical line array at a depth of 30, 50 and 70 m. 7 thermistor sensors are equally spaced at a distance of 10m in the array from 8m to 68m water depth. Acoustic signal and temperature time series were collected during the experiment. Source and receiver positions were determined from the global positioning system (GPS) coordinates measured.

3. Analysis

To investigate the ocean temperature changes during acoustic signal transmission, XBT measurements were performed in the course of R/V CH. Fig 2. Shows XBT drop position and Temperature profiles. There were significant temperature changes between area red and yellow so it is obious there were strong ocean front. Temperature time series measured from thermister string also shows small scale ocean dynamics by time changes in the experiment area. Fig. 3 shows the temperature time series.

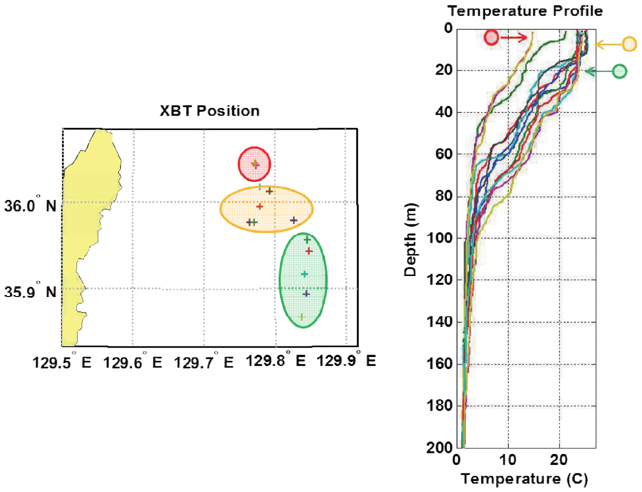

Fig. 2 XBT drop position and temperature profile

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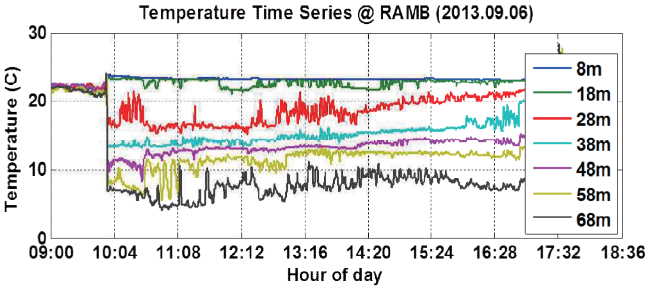

Fig. 3 Temperature time series in 7 water depths

The acoustic signal from the hydrophone is preamplified, filtered in the frequency band of 0–32 kHz, transformed to a digital signal, and stored in an internal memory of the receiver system.

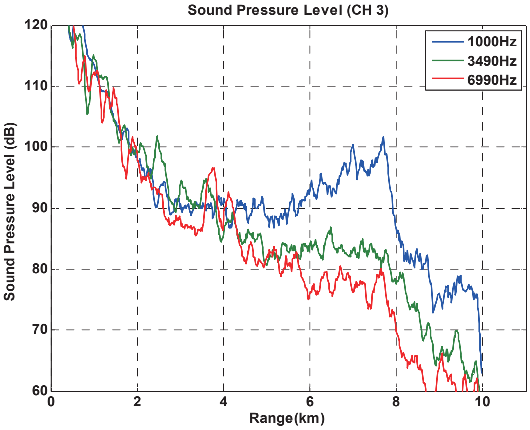

Fig. 4 Sound Pressure Level at 3 frequencies

In signal postprocessing, the calculations of pressure in stored signals are conducted taking into account the hydrophone sensitivity, preamplifier gain, and transfer function of the filter. The stored signals are decimated by a factor of 32, and the number of fast Fourier transforms (FFTs) is 1024 without an overlap in the window. Thus, the sampling frequency is 1024 Hz and the bin resolution is 1 Hz. The moving average method is applied. A 30 length of span is selected to provide the best fit for the smoothed time series from the original pressure time series. Fig. 4 shows the received sound pressure level at 3 frequencies.

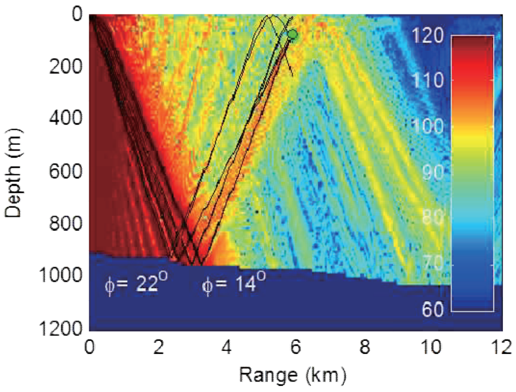

Fig. 5 Sound Pressure Field and Eigenray Tracing

To compare measured signal and simulation results, we use range dependent acoustic model which is adequate for mid-frequency transmission. As temperature structure and bottom slope varies with time, it may cause travel time difference of acoustic signals. Bottom loss will tend to increase with frequency and grazing angle. Fig.5 shows simulated sound pressure field and eigenray tracing.

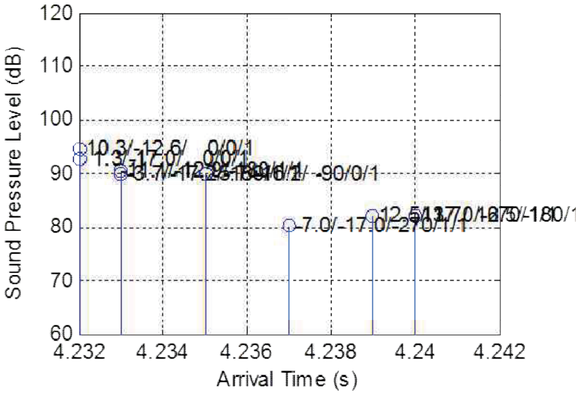

Fig. 6 Eigenray Arrival Structure at a range of 6 km

Fig.6 shows the eigenray arrival structure at a range of 6 km. seven eigenrays are contributed the sound pressure at a range of 6 km, receiver depth of 70m. Lower frequencies of sound generally undergo less reflection loss at the ocean-bottom interface and, when combined with the refracted energy returned to the sediment-water interface, will result in lower loss at all grazing angles.

4. Results

In this study, we analyse mid-frequency acoustic signal fluctuation that were taken in a continental shelf break off the east coast of Korea. We observed significant acoustic signal fluctuation in receiver ranges at 3 defferent frequencies.

References

1. Michael A. Ainslie: Principles of Sonar Performance Modeling (Springer, NY, 2010) p.311
2. Robert J. Urick: Principles of Underwater Sound (McGraw-Hill Book Company, 1983) p.381.
3. H. Medwin and C. S. Clay: *Fundamentals of Acoustical Oceanography* (Academic Press, 1998) p. 92.