Recovery and analysis of long-term observation data of acoustic Doppler current profiler

音響層別流速計(ADCP)長期観測データの復旧と解析

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1. Introduction

Aiming at comprehensive understanding of environmental fluctuation phenomena at deep seafloor, Japan Agency for Marine-Earth Science and Technology (JAMSTEC) developed the first multidisciplinary cabled observatory off Hatsushima Island in Sagami Bay in central Japan in 1993[1)]. Since then JAMSTEC has deployed several cabled observatories in waters around Japan. In order to achieve multidisciplinary observation, those cabled observatories are equipped with not only ocean bottom seismometers (OBSs) and pressure gauges (PGs) but also various types of sensors, such as hydrophones, acoustic Doppler current profilers (ADCPs), thermometers, and video cameras. Although some observatories have recently been shut down, as a result of continuous observations for more than a quarter century, a huge amount of data have been accumulated. And some of these data are left unanalyzed. In these days, data are generally stored on hard disks, however, depending on the type of data, they are stored on floppy disks, analogue and/or digital magnetic tapes, and magneto-optical disks in the old days when hard disk capacity is limited. Recently, the data on such media cannot be restored because it becomes difficult to ontain the restore device due to the discontinuation of production.

The ADCP data obtained at off Kushiro-Tokachi cabled observatory in Hokkaido is one of these legacy data. In this papaer, we describe the preliminary results obtained through the recovery and the analysis of the data.

2. Recovery and analysis of the ADCP data

The off Kushiro-Tokachi cabled observatory is located southeast offshore of Hokkaido in northeast Japan. It was deployed in 1999 and has three OBSs with a hydrophone attached to each and two PGs along a 240km long submarine. The ADCP (Teledyne RDI Instruments 75 kHz BBADCP) is attached upward to the cable end station at a depth of 2540 m which consists of multidisciplinary sensors including, a CTD (conductivity, temperature and depth of water), hydrophone, electro-magnetic current meter, subbottom thermometer and a video camera[2,3)]. The raw data of ADCP are stored on the magneto-optical disk which themselves are restored successfully this time. The raw data are usually converted to the ASCII data by using the software “WinADCP” which is supplied by Teledyne RDI Instruments. There are other problems with the raw ADCP data. In September 2003, the turbidity current triggered by the Tokachi-oki earthquake of M8, whose epicenter is located at 25 km west-northwest of the cable-end station, occurred[4)]. The ADCP is supposed to play a very important roll to observe the turbidity current. However, the data was interrupted sometime after the detection of the turbidity current. In Ref. 4, it is described that the reason of the interrupt is due to computer failure that followed the ground motion of an aftershock near the land base of the cabled observatory. Actually it was caused by a communication error at RS232C port. The raw data contain check sum bytes at each record obtained at one ping. The WinADCP converts each raw record to ASCII only when the corresponding check sum bytes are normal. In other words, if there is a single bit error in a record, the corresponding whole record including the other part without error cannot be converted. Thus, the data were stored in computer with some errors, but were not converted to ASCII data for use. The bit error can occur at other times in data transmission. This time, we refer to the documentations produced by Teledyne RDI Instruments[5)] and decode the raw binary data directly. As a result, we can convert some raw data that cannot be done with the WinADCP.

The ADCP measures the vertical profile of the current velocities in 48 layers. The thickness of each layer is 8 meters and the height of the bottom layer is 12 meters from the seafloor. One year profile in 2006 and 6 year profile from 2006 to 2011 that are observed at the bottom layer is shown in **Fig.1** and **Fig.2**, respectively. **Fig.3** is one day averaged profile of the one in Fig.2. The ADCP measures not only current velocities but also acoustic backscatter (echo) intensity from each layer and the bottom water temperature, which are also shown in Figs. 1-3. The unit of the echo intensity is receiver signal strength indication (RSSI). The echo intensity indicates the concentration of the suspended materials in each layer[6)]. In Figs. 2 and 3, the echo intensity tends to

increase in late spring or early summer. It may relate to the spring bloom in sea surface as is observed in Sagami Bay[7].

In **Fig. 4**, the horizontal current velocities and the water temperature data are compared to the reanalysis assimilation data of Japan Coastal Ocean Predictability Experiment (JCOPE)[8]. The fluctuation of the current velocities seems to be larger in the JCOPE data and there is an offset of about 0.2 degrees in water temperature. The submarine topography may cause those difference. We will examine in the other layers.

3. Concluding remarks

Preliminary results of the recovery and analysis of the long-term observation data of the ADCP of off Kushiro-Tokachi cabled observatory are reported. We are recovering the data including those that were interrupted at the 2003 Tokachi-oki earthquake event. Through this work we expect to contribute elucidating environmental phenomena in deep sea including turbidity current.

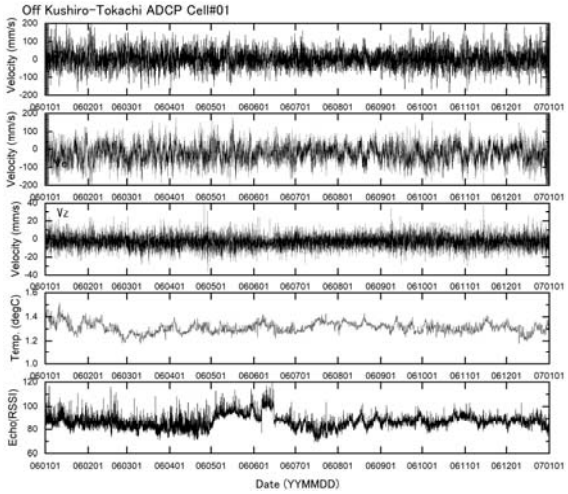

Fig. 1 One year ADCP profile in 2006. From top: current velocities of north, east and upward component, water temperature, and echo intensity, respectively.

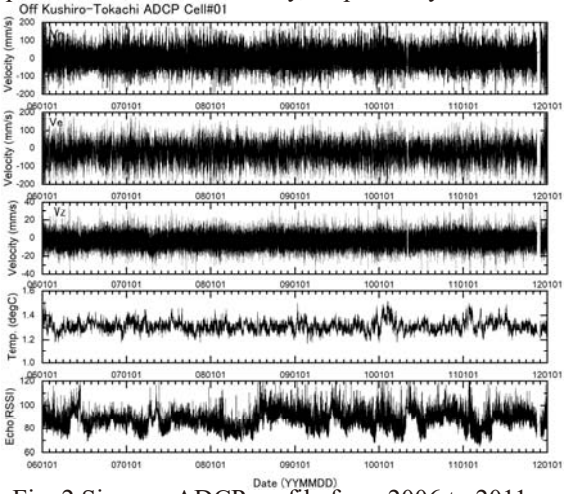

Fig. 2 Six year ADCP profile from 2006 to 2011.

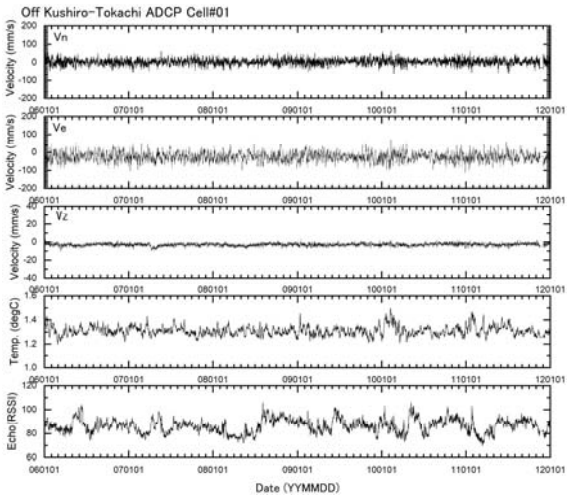

Fig. 3 One day averaged six year ADCP profile from 2006 to 2011.

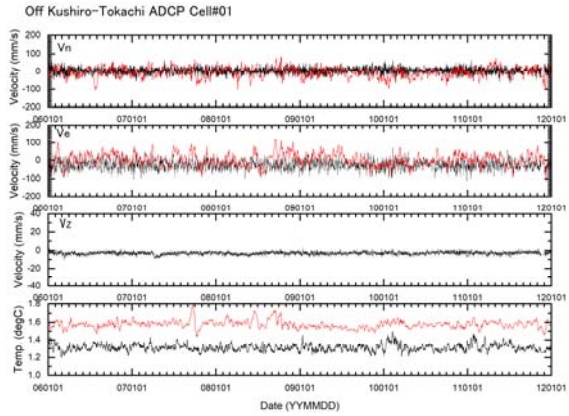

Fig. 4 One day averaged six year ADCP profile (black) and JCORP data (red) from 2006 to 2011.

Acknowledgments

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References

1. H. Momma et al.: Phys. of Earth and Planet. Inter., **108** (1998) 263.
2. K. Hirata et al.: J. Ocean. Eng., **27** (2002) 170.
3. R. Iwase: Jpn. J. Appl. Phys., **54** (2015) 07HG03.
4. H. Mikada et al.: Tectonophysics, **426** (2006) 95.
5. RD Instruments, "Acoustic Doppler Current Profilers - Principles of Operation: A Practical Primer," (1989).
6. P.D. Throne and D.M. Hanes: Continental Shelf Res., **22** (2002) 603.
7. H. Kitazato, et al.: Progress in Oceanography, **57** (2003) 3.
8. Y. Miyazawa et al.: J. Oceanogr, **65** (2009), 737-756.