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Detection of the seasonal variation of the large-scale acoustical environment in the Pacific Ocean by ARGO data
ARGO データによる太平洋の大規模な音響環境の季節変動の検証

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1. Introduction

ARGO system is an observation network by ARGO float of about 3,500 that runs constantly in the ocean of the world. It is the network of observation which made it possible to get water temperature and salinity data in real time via a satellite.[1][2] Thereby, the oceanic structure of a global scale can be grasped easily and immediately.[3][4]

However, number of data from ARGO system is more than 100,000 in one years. Conventionally, we had done manually analysis of this data. In this paper, we constructed the system to automate processing in this big data. Thereby, we tried to detect the seasonal variations (average sound speed, the sound channel axis, etc.) of the sound speed field in the Pacific Ocean.

2. Survey area and analysis methods

Created a program that performs the following procedure to convert to collection, quality control and sound speed structure of the ARGO data.

(1) The ARGO float data of every day is downloaded from the Internet.[5]
(2) Extract the delayed-mode data from the data files. Delayed-mode data is performing advanced high quality control by comparison with the high quality CTD data and climatic data which were obtained by research vessel of JAMSTEC.
(3) Select the data that meets the conditions of quality control indicators from a delayed-mode data.
(4) The sound speed structure is presumed using of the UNESCO algorithm[6][7] from the profile of the water temperature, the salinity, and the pressure.

In this paper, not only when direct use of the value in a layer of observation is carried out, but when less than the depth of 2000m, straight line interpolation was carried out by the Levitu's standard layer.[8] In addition, a sea surface 0m layer is also extrapolated as the 1st layer of the observation.

3. Sound speed distribution

Fig.1 are contour maps of the sound speed obtained from the vertical profile of the float of 500 units in the Pacific Ocean. In this paper, in order to investigate the seasonal variation of sound speed structure in the Pacific Ocean, the seasonal data in the Northern Hemisphere was averaging, and it was created based on the position data of float. As a result, the sound speed has become faster in the eastern sea area, it can be said that it is subject to the influence of sea water

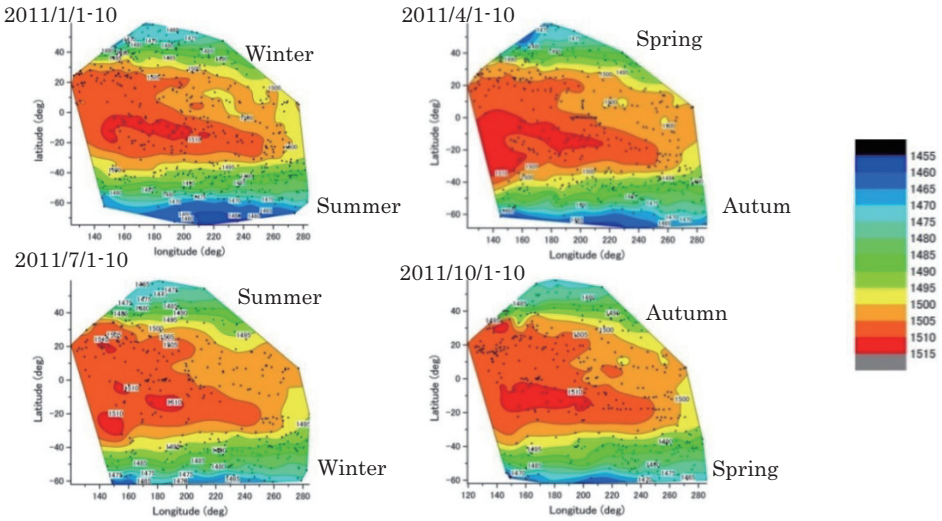

Fig.1 Contour maps of the sound speed distribution, average of up to 2000m depth in the Pacific Ocean.

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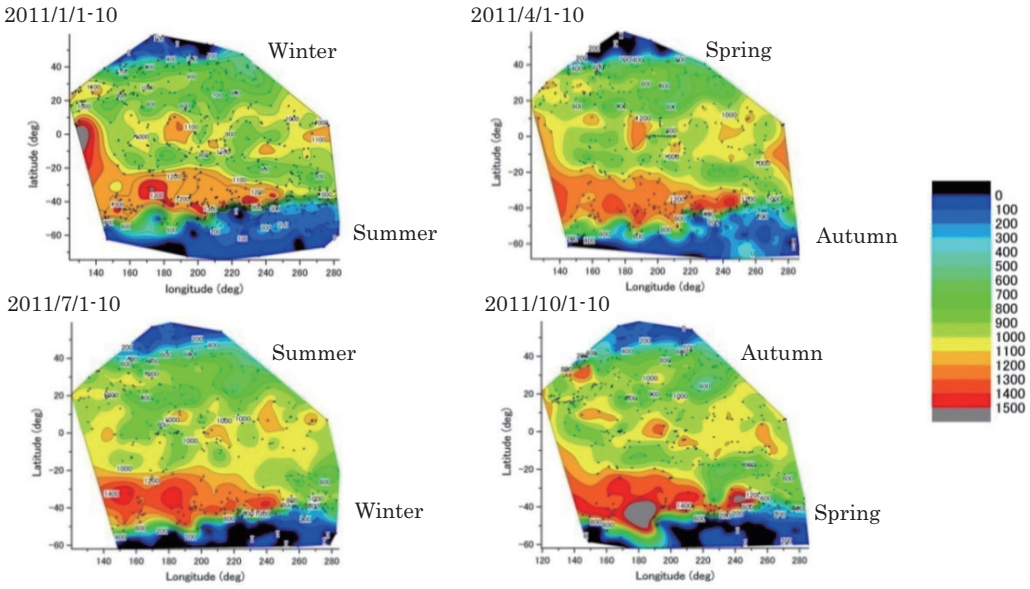

Fig.2 Contour maps of the sound channel-axis Depth distribution seasonal variation of the Pacific region

temperature, such as the Japan Current. However, layer of 1515m/s is small in the Northern Hemisphere of summer. This is considered to be the influence which high salinity ocean area becomes small in the Southern Hemisphere of the winter. Moreover, since a reverse phenomenon is seen in the Northern Hemisphere of the winter, it is considered to have received the seasonal effects in the southern hemisphere large area.

4. Distribution of the sound speed minimum layer

Fig.2 shows, depth distribution of the minimum sound speed layer (sound channel axis) which obtained for the minimum sound speed from the sound speed profile of verticality. From this fig, distribution of the sound speed minimum layer has become a complicated pattern, and can be imagined that taking a complex path by Sound waves propagating through the sound channel axis. Coventionally, it has been supposed that the sound channel axis in low and middle latitude are existed near the depth of about 1000 m. Looking at the high latitudes in the Northern Hemisphere (20~40°) in FIg.2, at the Japan Current or its connection area, there is ocean area shallower than the depth of 1000 m, and it can read also changing the depth sharply according to a season. Moreover, in the high latitude ocean area where a sound channel axis exists near a sea surface, since change of water temperature is large, sound speed is changed of course. Conventionally, the sound channel axis existed in deep sea, and it was thought that water temperature and sound speed hardly changed in the low and middle latitude ocean area. Looking in more detail from the big data, it was found that clear seasonal variation exists in the Pacific Ocean.

5. Summary

Download from the ARGO data that has started full-scale operation, and created a program that allows perform the calculation speed of sound, etc.. As a result, we were able to analyze the sound speed structure of global scale that has been difficult in the past.

As an example, we used the sound speed data of about 500 points in the Pacific Ocean. As a result, we found that the sound speed and depth of the sound channel axis in low and middle latitudes, seasonal variation is present. Seasonal variation of the average sound speed depends largely on changes in water temperature, but the seasonal variation of sound velocity and depth of the sound channel axis is considered greater potential impact of thermohaline engine. The authors will analyze future much more ARGO data and to solve a global acoustical environment change.

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