

Temperature Profiles of the Greenland Sea in the Summer of 1993: Oceanographic Observation on the R/V LANCE Cruise

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1993年夏季グリーンランド海の水温分布
— LANCE乗船観測速報 —

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要旨: 1993年8月16日から30日までの間、グリーンランド海において国際共同観測を行った。ノルウェーの観測船 R/V LANCE に同国のほか、ドイツ、日本から計3カ国15名の研究者が乗船し、係留系の設置・回収、採水、CTD観測、XBT観測、海水地上検証、動物計数を実施した。共同観測の概要を報告し、CTD/XBT観測で得られた水温分布の一例を速報する。

Abstract: Oceanographic observations in the Greenland Sea were conducted in summer 1993 as an international cooperative programs. Fifteen scientists, from three countries (Norway, Germany and Japan) participated in the R/V LANCE cruise from August 16 to 30, 1993. Mooring work, CTD measurements, XBT measurements, water sampling, sea ice ground truth and animal observations were carried out en route, both in the pack-ice and open sea regions. Temperature profiles were obtained by XBT at 84 stations, of which those recorded along 79°N are presented.

1. Introduction

The international cooperative observations of the Greenland Sea on board R/V LANCE carried out in 1992 were repeated in a similar manner in August 1993. The objects and the backgrounds of the observations are stated in the report in detail (USHIO *et al.*, 1994). In this article, first the overall on board observations in 1993 are sketched out. Then, the measurements of the water temperature, in which the Japanese participants were mostly involved, are described to some extent.

2. Outline of the Observations

R/V LANCE, which was used as the research vessel also in 1993, transported and accommodated the personnel as well as the instruments en route and served as the working platform for the measurements. Eleven Norwegian scientists (including three students), one German scientist (one student) and three Japanese scientists (one student) comprised a team of fifteen persons from three countries. The observation items included: water temperature and salinity by CTD, water temperature by XBT, mooring and recovering of buoys, ground truth of sea ice remote sensing, counting of birds and mammals, water sampling for biological and

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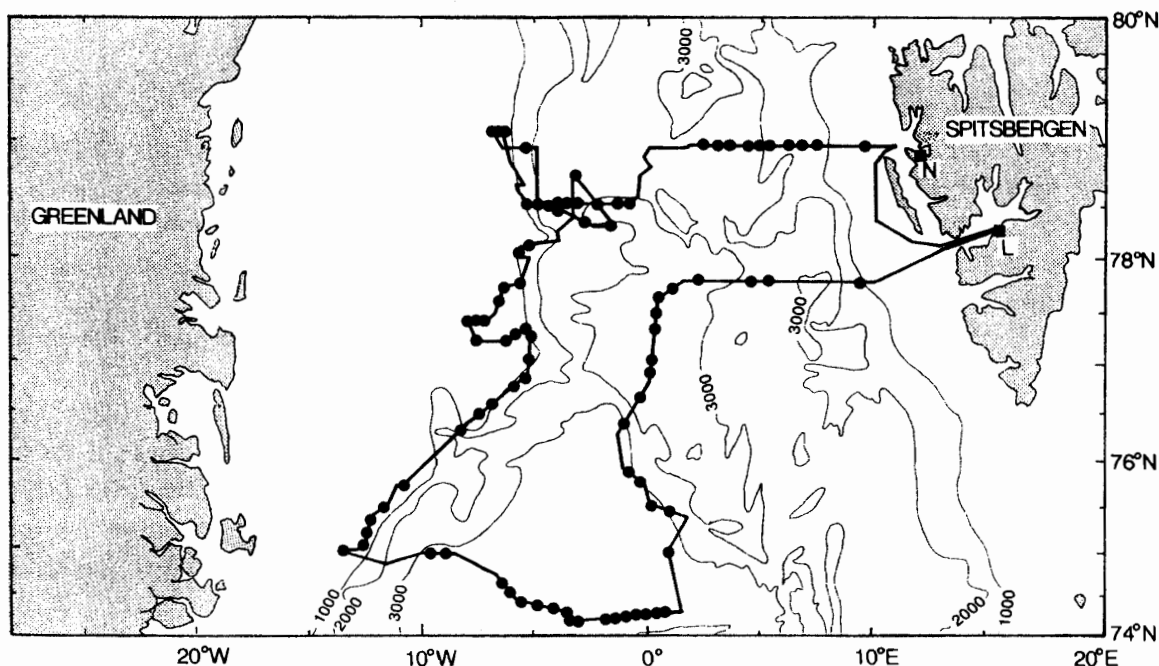


Fig. 1. Ship's track and XBT-observation sites (solid circles) of the R/V LANCE cruise August 16–30, 1993. Isobathymetric lines are in meters. (L: Longyearbyen, N: Ny-Ålesund)

chemical analyses. The cruise route is given in Fig. 1.

August 16, after sailing out from Longyearbyen, the CTD measurements (total of 54 stations during the cruise), water sampling (at each CTD station) and animal counting (continuously during the cruise) were started, while the vessel headed toward 79°N, 11°E.

August 17, latitude 79°N was followed to the west. XBT measurements were started at 9°30'E (total 84 stations en route). At midnight the ice edge was encountered and the ship's route became irregular due to the ice condition.

August 18, the first buoy was recovered at 3°14'W (eight buoys were recovered all together, the recovery rate being 100%).

August 19, the first buoy was deployed at 6°53'W (nine buoys were deployed during this cruise); and the ice condition was investigated as ground truth for remote sensing. The vessel headed toward east after this work.

August 23, the measurements at 79°N were completed. The vessel steamed to 75°N.

August 24, the second and last ground truth observation was done at 75°N, 13°35'W (total 2 ground truths), and 75°N was followed to the east.

August 25, latitude 75°N was left at 8°W and 74°N was followed from 5°W to the east.

August 27, the last buoy was deployed at 1°30'E. Longitude 0° was followed northbound along a zigzag path.

August 28, 77°45'N was followed to the east from 3°50'E.

August 29, the last station was taken at 77°50'N, 10°30'E.

August 30, the ship arrived in Longyearbyen.

3. Measurement of Water Temperature

3.1. XBT measurements

The instruments and the method employed for the measurements were identical to those in 1992. USHIO *et al.* (1994) describes them in full detail.

Various types of probes with different maximum depths were used. Type T-5, with the largest maximum depth of 1830 m, was found to be suitable at most stations. This probe is designed to be launched from a ship sailing at 7 kt or slower. When the vessel did not reduce speed for some reason and sailed at 11 kt, the probe wire was cut at the depth of around 1200 m.

The launcher cable was insufficiently long to reach the stern from the observation room where the recording unit was set up. The launcher was fixed at midship. No problem was encountered in the open sea, as the launcher protruded from the vessel for one meter so the wire would not touch the ship. However, when the ice concentration exceeded some critical value and the vessel started to push the ice aside to proceed, launching was difficult.

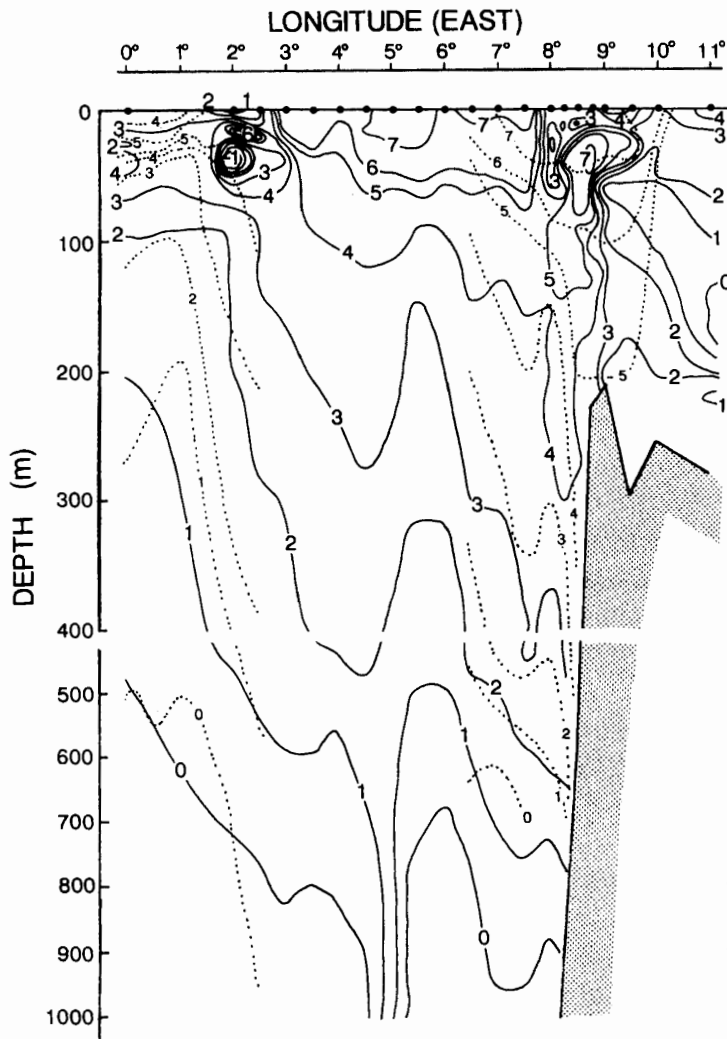


Fig. 2. Temperature section along 79°N. The closed circles indicate the positions of XBT and CTD observations.

The observations were made in August 1993. Isotherms (solid line) are indicated in degrees Celsius. The dotted line shows the section obtained in 1992 along 78°30' N for comparison.

3.2. Selected results

Before the complete analysis was done, a pilot study was done on selected data to obtain the general view quickly. This is presented below.

The water temperature is given in Fig. 2. The stations are at latitude 79°N, between 0°E and 11°E. XBT and CTD measurements were planned to complement each other, and some data were taken from the CTD measurements when the profile was plotted. (The CTD measurements reached the sea bottom, and of course included salinity data. Only the data which complement the XBT data, *i.e.* temperature data down to 1000 m, are used here. A separate report will be prepared for the CTD measurements.) The observation line 78°30'N of 1992 runs parallel to this but is 30 min of latitude to the south. The data obtained along this line are also plotted in the figure for comparison.

Various interesting phenomena in the 1992 data also appeared in 1993: thermocline, surface temperature gradient (west-east), influence of sea ice, intrusion/mixing of water masses, circulation, etc. As the detailed analysis proceeds, each of them will be reported and discussed in full.

4. Conclusions

The oceanographic structure of the Greenland Sea and its change are important elements to describe the Arctic environment. Further, the air-ice-sea interaction can be revealed only through investigation of the sea. An opportunity was given to realize the desired investigation *IN SITU* in the form of an international cooperative observation using a vessel.

The data obtained in 1992 and 1993 are kept at the National Institute of Polar Research and Norsk Polarinstitut, and are available for cooperative research.

Torgny VINJE of Norsk Polarinstitut, who was at the same time the cruise leader, provided the Japanese scientists with various types of support both during the preparation and on board. Captain Jan H. OLSEN and his crew were helpful all the time during the cruise. This research was supported by a Grant of International Scientific Research Program of Ministry of Education, Science and Culture, Japan (No. 05044065).

Reference

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