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First Post-FIBEX Hydrographic Data Interpretation Workshop, Hamburg, F. R. G., 20—26 September 1982

1. Introduction

The First Post-FIBEX Hydrographic Data Interpretation Workshop 20—26 September 1982, was held in the Institut for Seefischerei, Hamburg, F. R. G., at the invitation of the Institute's Director, Dr. D. Sahrhage. M. Stein was the Convenor. The Workshop was held concurrently with the Fourth European Ichthyological Congress and the Meeting of the BIOMASS Working Party on Fish Ecology.

2. Background

At the general Post-FIBEX Data Interpretation Workshop, 21 September—9 October 1981, the hydrographic data were not extensively analyzed. The software for the analysis did not exist, and the large, multidisciplinary group was making heavy demands on the computing facilities (see BIOMASS Report Series 20). At this meeting, the Oceanographic Group recommended that the importance of the environmental data to biology be recognized in any future data interpretation workshop. The Oceanographic Group re-iterated the same recommendation at the Meeting of the BIOMASS Scientific Advisory Group for SIBEX (Cambridge, U.K., 21—23 April 1982; see BIOMASS Report Series No. 23). The Oceanographic Group also recommended that they should meet prior to the meetings of any biological groups. At small data workshops, the oceanographers could analyze and interpret the FIBEX data and provide written and graphical descriptions of the physico-chemical environment, water mass origins and areas of particular biological interest. Biologists could then evaluate their data against the physico-chemical background before joining the oceanographers to formulate and evaluate questions arising from FIBEX. The recommendation was endorsed by the Group of Specialists on Southern Ocean Ecosystems and their Living Resources at Nikko, Japan, 31 May—4 June 1982.

3. The Data Handling System

The Oceanographic Database and Data Handling System is implemented on a WANG 2200 MVP computer. The software is written in BASIC. Given a set of oceanographic stations consisting of a station header and vertical profiles of temperature, salinity and density, access to the database is achieved by asking questions on the distribution of stations in space and time. After the program has obtained all the stations within a selected geographical area and time span, questions may be asked on the depth of termocline, the dynamic topography of a given isobaric surface, the analysis of water mass, T—S diagrams, etc. Individual subroutines compute the derived data and plot the values for selected isobaric levels over a geographic map of the area. The interpretation of isolines is left to the oceanographer.

4. The data for the Workshop

The Workshop began with a description of the results of a bilateral evaluation of the Polish and West German FIBEX Oceanographic Data Sets. These sets were presented to the BIOMASS Colloquium in Tokyo, 27—28 May 1982. The participants were introduced to the Oceanographic Database and Data Handling System of the Institute and software systems developed by M. Stein. Although only three data sets were available for analysis (Chile, Poland, West Germany), the workshop was able to analyze the main hydrological features of the Bransfield Strait area. This was "Box A" (see BIOMASS Report Series No. 13, FIBEX Implementation and Coordination, p. 15a) of the designated FIBEX research areas. Lack of time prevented additional, more detailed analysis of the data. For the same reason, the Workshop could not consider the results of an analysis of West German data from "Box B".

5. Analytical procedure adopted by the Workshop

Water in the Bransfield Strait area is the complex product of the interaction of Bellingshausen Sea and Weddell Sea waters and local influences. T—S diagrams were produced for the 118 stations and the main water masses identified. The stations were then grouped into natural classes on the basis of their T—S curves. These water classes are shown in Figure 1. Dynamic heights were then calculated for selected isobaric levels at all stations from 30 January to 14 March 1981. The most significant values were found assuming a horizontal surface at the 100 dbar and 200 dbar levels, and they were plotted over a geographical map of the area. Absolute

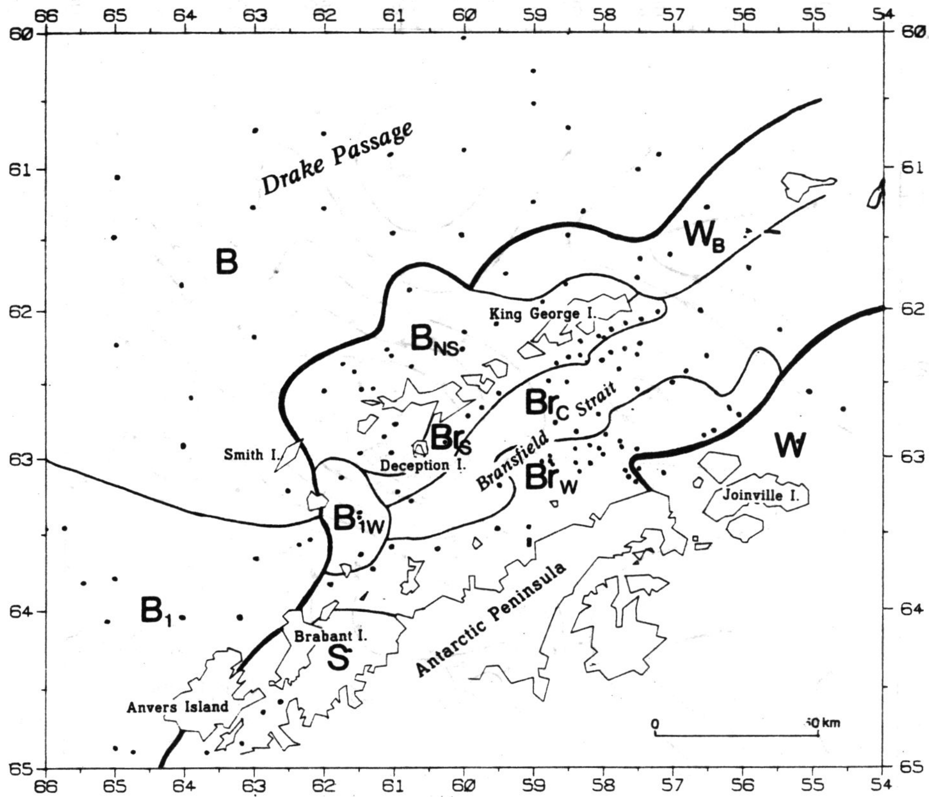

Fig. 1. Water classes in the Bransfield Strait area during FIBEX
B, B_1, B_{1W}, B_{ns} — Bellingshausen Sea waters, Br_c, Br_w, Br_s — Bransfield Strait waters, W, W_B — Weddell Sea waters, S — inshore waters. Oceanographic stations expressed as dots.

values for the geostrophic currents could not be given because a level of no motion could not be defined for the area. Isolines based on the dynamic heights were drawn to indicate current flow and relative motion (Figs. 2 and 3).

6. The hydrology of the Bransfield Strait area during FIBEX

As the Bellingshausen Sea water (B) travelled north-eastwards off the Antarctic Peninsula the summer Antarctic Surface Water Layer was cooled and the underlying winter Antarctic Surface Water Layer was warmed to form the distinctive B_1 water class. This was further changed under the influence of the shelf lying north and south of the South Shetland Islands and the interaction with the Bransfield Strait water to from the waters of classes B_{ns}, Br_s, and B_{lw} respectively.

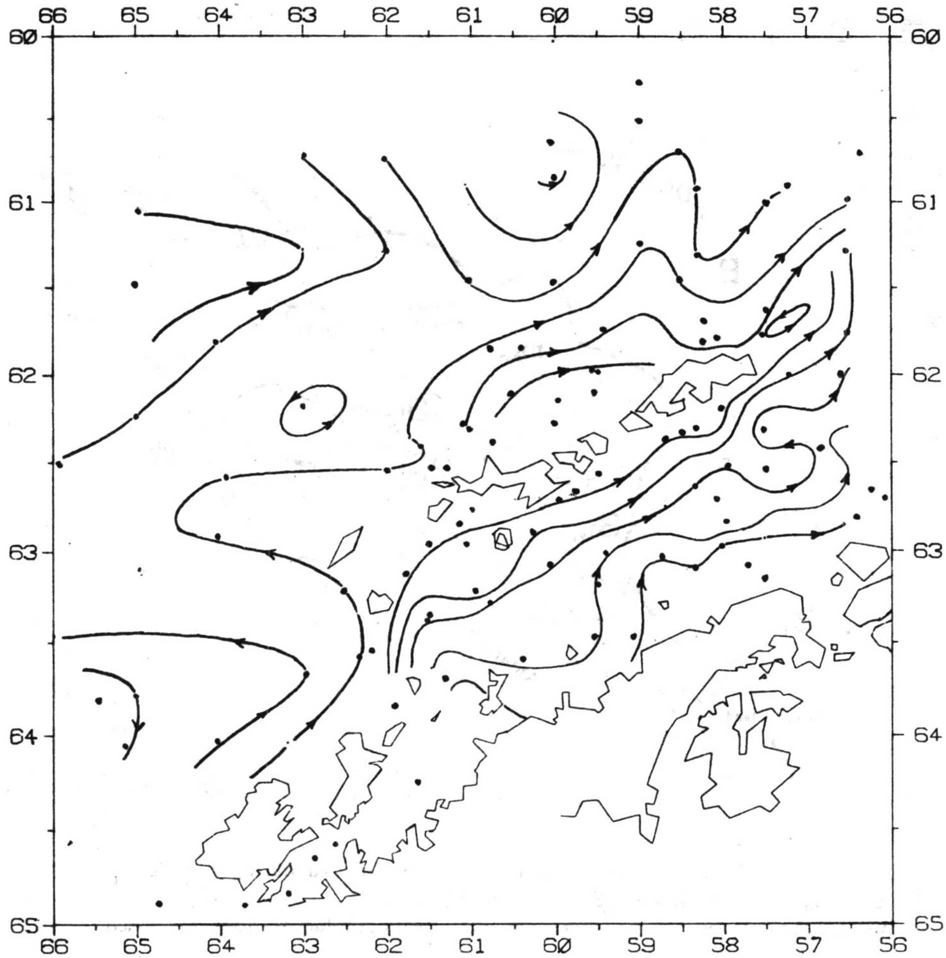

Fig. 2. Relative dynamic topography of the 100 dbar surface in the Bransfield Strait area during FIBEX

Weddell Sea water (W) entered the Bransfield Strait after rounding Joinville Island and flowing through the Antarctic Sound to mix with the Bellingshausen Sea water. Under the influence of locally produced bottom water and the Antarctic Peninsula shelf, it formed the distinctive waters of classes Br_c and Br_w respectively. There was evidence that the Weddell Sea water had also penetrated around the north-west of King George Island to form with B_{ns} the distinctive water of class W_b. In the confined waters between the Antarctic Peninsula, Anvers Island and Brabant Island, an inshore water (S) had formed from the interaction of the waters Br_w and B_1 Examples of the characteristic T—S curves for these water classes are given in Fig. 4 (a—j).

The advantage of a close network of hydrographic stations, achieved by

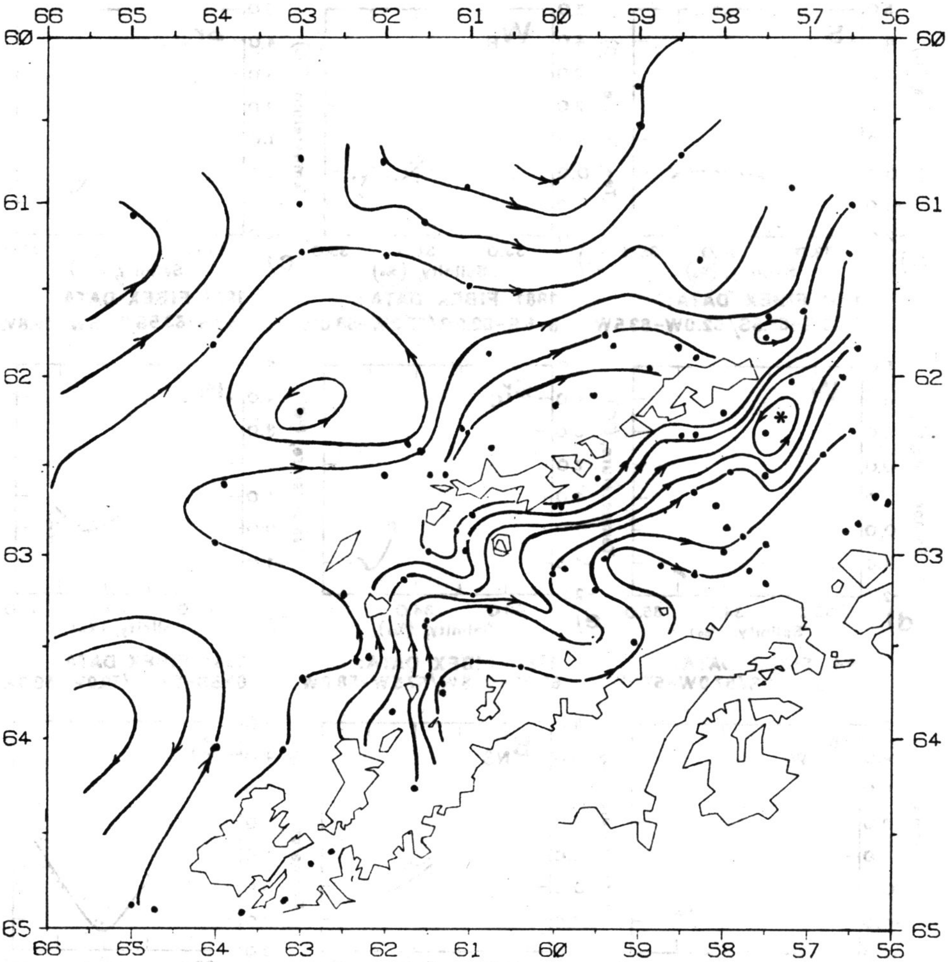

Fig. 3. Relative dynamic topography of the 200 dbar surface in the Bransfield Strait area during FIBEX

* — water masses demonstrate an inverted pattern of circulation in this region.

three ships working within the same area and time, can be seen from the maps of dynamic heights. The meander in the vicinity of Deception Island, first described by Clowes (1934), is very clearly defined, as are small gyres in the vicinity of King George Island. There is also a large gyre north of Smith Island.

Professor S. Rakusa-Suszczewski had kindly made available the Polish "Atlas of Oceanographic Results of the Southern Part of the Drake Passage and Bransfield Strait". The biological data in the atlas enabled the Workshop's participants to identify the significance of their results to the BIOMASS program. The densest krill concentrations were clearly associated with the Bransfield Strait waters of classes Br_c and Br_w. High krill concentrations were also associated with water of class Br_s, with the boundary

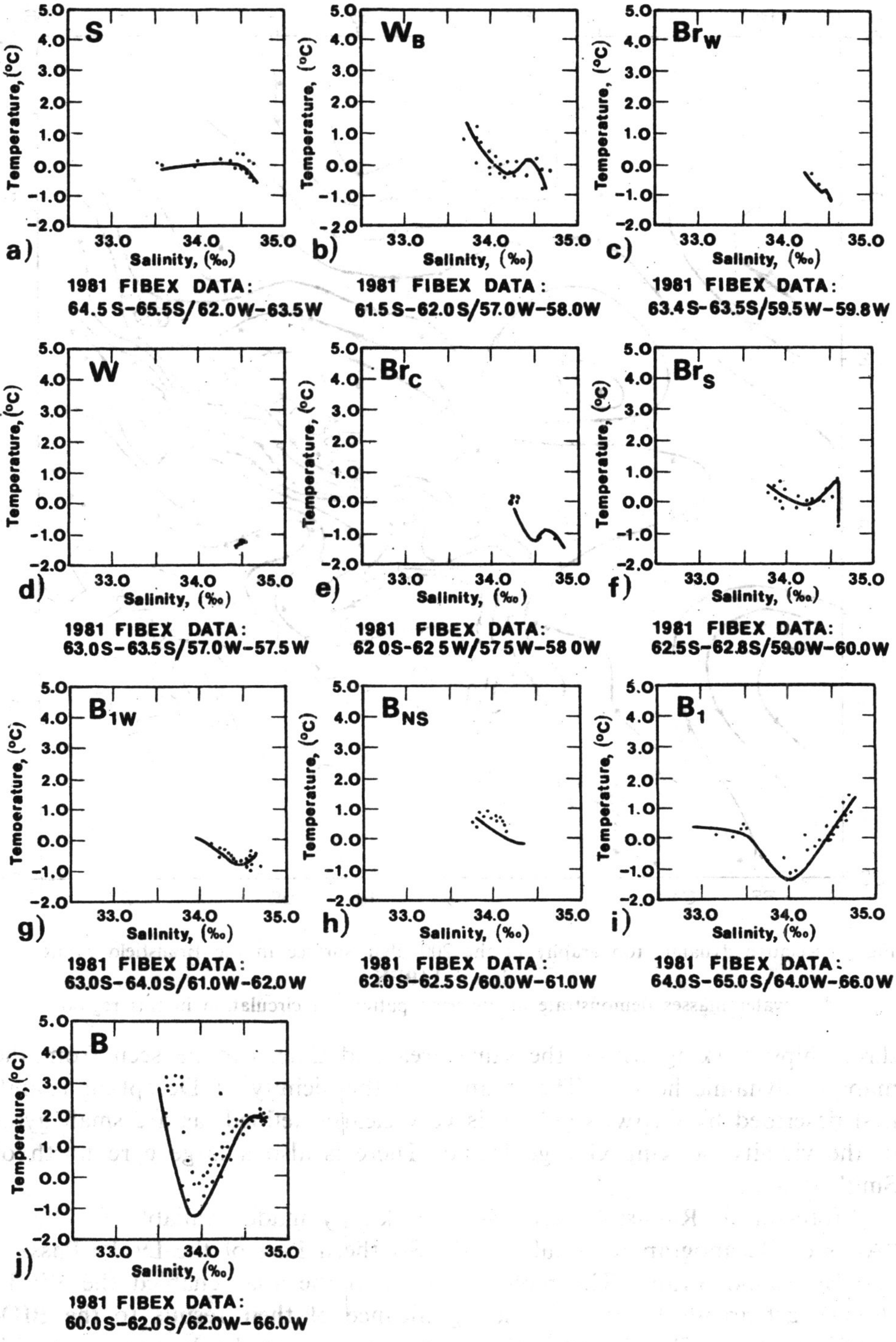

Fig. 4(a—j) Example of the characteristic T—S curves for the water classes as given in Fig. 1

between the waters of B_{ns} and with the large gyre located north of Smith Island. An apparent tongue of high krill concentration coincided with the northward movement of water off the north coast of King George Island. Certain zooplankton species, particularly carnivorous copepods, indicate Weddell Sea water. They had been found off the northern end of King George Island and were now seen to be in water of class W_b, which was formed partly of Weddell Sea water.

7. Recommendations

1. A second Hydrography Workshop should be held as soon as possible, preferably in the Institut für Seefischerei, Hamburg, to complete the analysis of "Box A" data, and to analyze the data from other FIBEX areas.
2. A hydrographer should be present at all biological workshops and meetings to discuss the implications of hydrographic phenomena, and to assist in the evaluation of questions and the design of an integrated multidisciplinary program of SIBEX.
3. Further studies should be carrierd out in the Bransfield Strait area, where high concentration of krill appear to be correlated with distinctive hydrographic phenomena.
4. A list of standard hydrographic stations, selected from those worked during FIBEX, should be adopted, and monitored not only during SIBEX but also whenever research vessels are in the area. This will establish seasonal and annual trends and will provide the necessary environmental data record for and understanding of krill distribution dynamics.

8. References

1. Clowes A. J. 1934 — Hydrology of the Bransfield Strait. — Discovery Rep. 9: 1—64.

Attendance at the Workshop

CHILE
E. Uribe
Instituto Antartico Chileno
Luis Thayer Ojeda 814
Santiago 9

FEDERAL REPUBLIC OF GERMANY
M. Stein (Convenor)
Bundesforschungsanstalt für Fischerei
Institut für Seefischerei
Palmaille 9
2000 Hamburg 50

POLAND
S. Rakusa-Suszczewski
Institute of Ecology
Polish Academy of Sciences

Dziekanów Leśny
05-092 Łomianki

UNITED KINGDOM — R. B. Heywood
British Antarctic Survey
Madingley Road
Cambridge CB3 OET

Apologies were received from: M. I. Ortiz de Zarate (Argentina) and V. V. Maslennikov (USSR).

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