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Water temperature in the Labrador and Newfoundland areas in 1975

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Abstract

Temperature conditions of waters in the Labrador and Newfoundland areas in 1975 are compared with those of some of the previous years and long-term mean ones.

Negative anomalies of water temperature in the 0-200 m layer predominated in the first half of 1975, while they were positive and small negative in the second half of the year. Considerable positive anomalies (3.0-4.5°) were found in the southern and south-eastern part of the Grand Bank in September. Negative anomalies of water temperature predominated in the 200-500 m layer throughout the year, while positive anomalies were found only in the southern Grand Bank and on the St. Pierre Bank.

Introduction

Hydrological observations in the Labrador and Newfoundland areas were made at the end of 1974 and in 1975 on standard sections (Fig.1). Investigations were conducted by R/V "Gemma" in November 1974-January 1975, by R/V "Perseus III" in December 1974-March 1975 and June-September 1975, by R/V "Ayaks" in September 1975 and R/V "Odyssey" in October 1975. Temperature was measured from the surface to the bottom in the bank areas, and to a depth of 2000 m on the slope of the Continental Shelf. Total of 678 hydrological stations were made.

The data obtained make it possible to reveal differences between the average temperature in the 0-200 m and 200-500 m layers and long term mean^{value}, and to compare the average temperatures with those of some of the previous years.

Methods

Sectors of the standard sections in the Labrador and Newfoundland areas (Fig.1) as previously were used for the calculation of the average temperature (Elizarov,1962;Burmakin,1972) in the 0-50,50-200,0-200 and 200-500 m layers for different branches of the Labrador Current. Temperatures in the 0-200 and 200-500 m layers were plotted against the curves of the average annual run of temperature in these layers. An average annual run of temperature was earlier calculated by the author (Burmakin,1972) for the 0-200 m layer, and it was calculated for the first time for the 200-500 m layer (Fig.2). The anomalies based on the diagrams are shown in Tables 1 and 2.

The average temperature of the layers and branches of the Labrador Current on Section 8-A was adjusted by the 1st November according to the inter-monthly rate of temperature fluctuations (Burmakin,1969) to make them comparable from 1964 to 1975.

Results

The late autumn of 1975 was cold, however, by the summer and autumn temperature increased to positive anomalies (Table 1). As evident from the table, a noticeable increase in the temperature anomalies occurred in the coastal branch of the Labrador Current off Labrador (Section 8-A, sector A), on the North Newfoundland Bank (Section "triangle") and in the main branch of the Labrador Current on the north-eastern slope of the Grand Bank (Section 7-A). However, temperature anomalies in the main and warm branches of the Labrador Current over the shelf and slope of the Labrador Peninsula (Section 8-A, sectors B and C) increased insignificantly. Maximum of temperature was recorded in December in the main branch (B) which was usually observed in October-November (Burmakin,1969).

Solar heating of the surface layers occurred more rapidly than in 1974, but slower than in 1973. Maximum temperatures of the sea surface made up respectively 11.5° in August 1973, 6.8° in 1974 (Burmakin, 1975) and 7.8° in 1975 off the South Labrador coasts.

A sharp increase in temperature on the southern extremity ("tail") of the Grand Bank (Section 2-A) in September when anomaly made up $+4.5^{\circ}$ is of interest. Such high anomalies were recorded here in April 1973 and June 1974 ($+3.4^{\circ}$ and $+2.3^{\circ}$ respectively). They were not present for a long time: in 1973 anomalies decreased to -0.8° in 17 days and in 1974 to -1.8° in 10 days. Such sharp changes in the signs of anomalies for the southern Grand Bank are caused by short-term pulsations of the currents: by flowing over of the Gulf Stream meander and weakening of the Labrador Current.

In 1975 such a meander penetrated within the Grand Bank not only in September but from June to July as well, which can be followed on the facsimile charts by the 10° isotherm (Fig. 3). In July positive anomalies up to $+3.0^{\circ}$ and $+0.2^{\circ}$ respectively were formed on Sections 3-A and 7-A.

In July negative anomalies of -1.1° and -0.9° were observed in the northern part of the south-western slope of the Grand Bank (Section 1-A) and in the Cabot Strait (Section 44-A).

Negative anomalies prevailed in the transformed Atlantic waters (200-500 m layer) of the Labrador Current throughout the period of observations in 1975 (Table 2) except in the southern part of the Grand Bank (Section 2-A) and in the Cabot Strait (Section 44-A) where in September and July high positive anomalies made up $+2.6^{\circ}$ and $+0.4^{\circ}$ respectively that was certainly the influence of the warm Gulf Stream waters. Positive anomalies were recorded in the 0-200 and 200-500 m layers on the southern Grand Bank and in the 200-500 m layer in the Cabot Strait (Tables 1 and 2).

Thus in 1975 temperature was mainly lower than long term mean in the 0-200 and 200-500 m layers in the Labrador and Newfoundland areas with the exception of the tail of the Grand Bank. Small negative anomalies ($0.0-0.4^{\circ}$) were also present north of the bank in summer and autumn.

In summer temperature in the 0-200 m layer in the coastal branch of the Labrador Current (Section 8-A) was 0.46° and 0.34° higher than in 1972 and 1974 respectively, but 0.51° lower than in 1973 (Table 3); on Section I-A and 44-A waters were 0.43° and 0.41° lower in temperature than in 1974, and lower than long term mean value, as in 1973 (Tables 1 and 5, Burmakin, 1975).

Nearly the same decrease in temperature was recorded in the main branch of the Labrador Current off Section 8-A (Table 3), though southwards on Section "triangle" an increase in the Labrador Current temperature was recorded, mainly in the slope waters (Table 4).

In autumn temperatures in all the branches of the Labrador Current (Section 8-A) was higher in the 0-200 m layer and lower in the 200-500 m layer than in 1974 (Fig.4). The highest temperature over the last 4 years was recorded in the 0-200 m layer in the coastal and warm branches of the Labrador Current. Temperature increased in the main branch, compared with 1972 and 1974, but was lower than in 1973. A decrease in temperature to a level of cold years occurred in the 200-500 m layer, especially in the main branch of the current (Fig.4 and Table 3).

Conclusions

In the first half of 1975 negative anomalies of water temperature prevailed in the active 0-200 m layer in the Labrador-Newfoundland areas, while positive and small negative anomalies were found in the second half of the year. Solar heating of the surface layers was more intensive than in 1974 but not so strong as in 1973.

In the southern and southeastern parts of the Grand Bank departures of temperature from long-term mean values made up $3.0-4.5^{\circ}$ in September.

In the near bottom layers (200-500 m) of the Labrador and Newfoundland areas negative anomalies of water temperature were observed throughout the period of observations, with the exception of positive anomalies in the southern Grand Bank and on the St. Pierre Bank.

In the summer of 1975 temperature in the coastal branch of the Labrador Current was higher than in 1974 but lower than in 1973, while it decreased to a level of cold years in the main branch of the current. At the same time of the year temperature was higher on the North Newfoundland Bank and lower on the southwestern slope of the Grand Bank and in the Cabot Strait than in 1973 and 1974; warming up was observed deeper than 200 m, compared with the two years.

In autumn temperature increased in the 0-200 m layer in all the branches of the Labrador Current but decreased in the 200-500 m layer, compared with 1974.

References

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Table 1. Temperature anomalies in the 0-200 m layer (°C)
in 1974 and 1975

Sections and dates	:I974:		:I975 :						
	:Oct	:Nov	:Dec	:Jan	:Jun	:Jul	:Aug	:Sep	:Oct
8-A(A) 30 Oct 1974, 17 Aug 1975, 30 Oct 1975	-0,4	-	-	-	-	-	-0,2	-	0,2
8-A(B) 31 Oct 1974, 19 Dec 1974, 17 Aug 1975, 31 Oct 1975	-1,0	-	0,4	-	-	-	-0,7	-	-0,7
8-A(C) 31 Oct 1974, 17 Aug 1975, 31 Oct 1975	-0,4	-	-	-	-	-	-0,4	-	-0,3
Triangle (NW) 29 Nov 1974, 28 Jun 1975	-	-0,5	-	-	0,1	-	-	-	-
Triangle (SW) 30 Nov 1974, 27 Jun 1975	-	-0,5	-	-	0,0	-	-	-	-
Triangle (SE) 1 Dec 1974, 29 Jun 1975	-	-	-0,5	-	0,4	-	-	-	-
7-A 3 Dec 1974, 8 Sep 1975,-	-	-	-0,9	-	-	-	-	0,2	-
6-A(H ₁) 6 Dec 1974, 26 Jun 1975 -	-	-	0,0	-	0,0	-	-	-	-
6-A(G) 6 Dec 1974, 25 Jun 1975 -	-	-	-1,2	-	-1,4	-	-	-	-
6-A(H ₂) 6 Dec 1974, 25 Jun 1975 -	-	-	-0,6	-	-0,8	-	-	-	-
4-A 13 Dec 1974 -	-	-	-1,0	-	-	-	-	-	-
3-A 30 Dec 1974, 7 Sep 1975 -	-	-	-0,9	-	-	-	-	3,0	-
2-A 1 Jan 1975, 19 Sep 1975	-	-	-	0,5	-	-	-	4,5	-
1-A 19 Jul 1975-	-	-	-	-	-	-1,1	-	-	-
44-A 10 Jul 1975-	-	-	-	-	-	-0,9	-	-	-

Table 2. Temperature anomalies in the 200-500 m layer (°C) in 1974 and 1975

Sections and dates	1974		1975		Jun	Jul	Aug	Sep	Oct
	Oct	Dec	Dec	Jan					
8-A (B) 31 Oct , 19 Dec									
	1974, 17 Aug								
31 Oct 1975	-0,1	0,5	-	-	-	-	0,0	-	-0,6
8-A (C) 31 Oct 1974,									
	17 Aug , 31								
Oct 1975	-0,7	-	-	-	-	-	0,2	-	-0,5
7-A 3 Dec 1974,									
	8 Sep 1975								
	-	-0,4	-	-	-	-	-	-	-0,1
6-A (G) 6 Dec 1974,									
	25 Jun 1975								
	-	0,1	-	-0,3	-	-	-	-	-
6-A (H ₂) 6 Dec 1974,									
	25 Jun 1975								
	-	-0,1	-	-0,3	-	-	-	-	-
4-A 13 Dec 1974	-	-0,3	-	-	-	-	-	-	-
3-A 30 Dec 1974,									
	7 Sep 1975								
	-	-0,5	-	-	-	-	-	-	-0,4
2-A I Jan , 19 Sep									
	1975								
	-	-	-0,2	-	-	-	-	-	2,6
I-A 19 Jul 1975	-	-	-	-	-	-	0,0	-	-
44-A 10 Jul 1975	-	-	-	-	-	-	0,4	-	-

Table 3. Water temperature on Section 8-A in different branches of the Labrador Current in the spring and autumn of 1972-1975

Dates	Sectors of Section 8-A, layers in m											
	A- coastal branch			B- main branch			C- warm branch					
	0-50	50-200	0-200	0-50	50-200	0-200	200-500	0-50	50-200	0-200	200-500	
I-2 Aug 1972	1,29	-1,42	-0,42	0,84	-1,16	-0,66	0,64	1,10	0,32	0,52	3,68	
9 Aug 1973	3,40	-1,09	0,37	2,41	-0,96	-0,12	0,52	-	-	-	-	
20 Aug 1974	1,79	-1,04	-0,25	1,63	-0,49	0,07	0,90	6,65	3,28	4,19	3,44	
17 Aug 1975	2,05	-0,80	0,09	0,98	-0,75	-0,31	1,09	4,57	2,98	3,38	3,89	
01 Nov 1972	0,50	-0,72	-0,29	0,00	0,04	0,03	1,26	1,86	2,92	2,64	4,07	
"- 1973	0,79	-0,23	0,07	1,22	1,28	1,26	1,41	3,70	3,33	3,43	3,91	
"- 1974	1,12	-0,13	0,24	0,70	0,24	0,40	1,84	3,47	3,41	3,44	3,53	
"- 1975	1,32	0,66	0,89	0,91	0,71	0,75	1,35	3,47	3,55	3,53	3,67	

Table 4. Average temperature of different layers of the Labrador Current on Section "triangle" (SE) over the shelf and slope on 29 June 1972-1975

Years	Layers, m							
	0-50		50-200		0-200		200-500	
	shelf	slope	shelf	slope	shelf	slope	shelf	slope
1972	2,05	0,44	-0,90	0,50	0,45	0,48	0,53	3,46
1973	2,82	2,83	-1,27	0,14	0,28	0,79	0,40	2,74
1974	1,81	1,79	-1,05	0,78	0,29	1,02	0,44	3,08
1975	2,04	4,58	-0,70	2,08	0,54	2,71	1,39	2,96

Table 5. Water temperature on Sections I-A and 44-A in the summer of 1972, 1974 and 1975

Date	Section	Layers, in m			
		0-50	50-200	0-200	200-500
10.07.1974	I-A	7,86	4,05	5,78	5,40
19.07.1975	"	7,85	3,09	5,35	5,57
27.06.1972	44-A	5,19	3,07	3,60	5,80
15.07.1974	"	4,90	2,97	3,65	5,68
10.07.1975	"	5,34	2,44	3,24	5,97

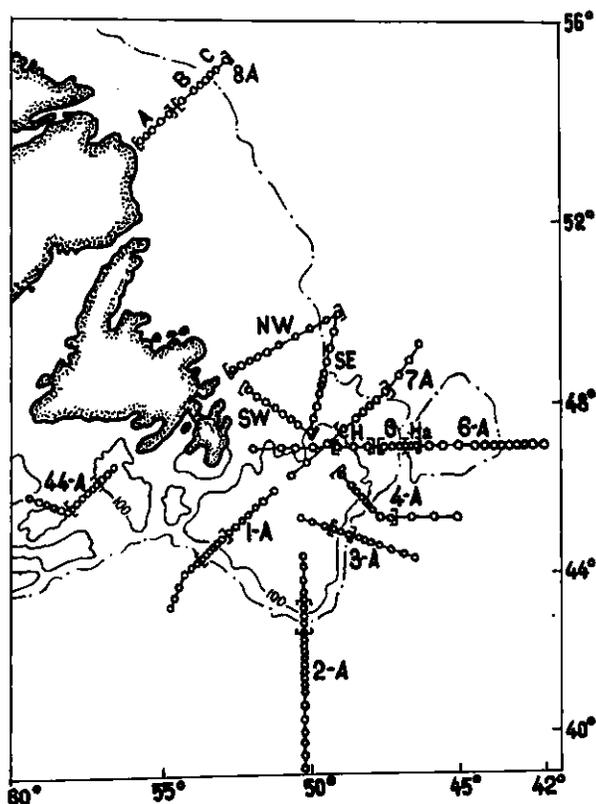


Fig. 1. Location of standard oceanographic sections in the Labrador and Newfoundland areas (sectors of the sections for which the average temperature was calculated are shown by brackets).

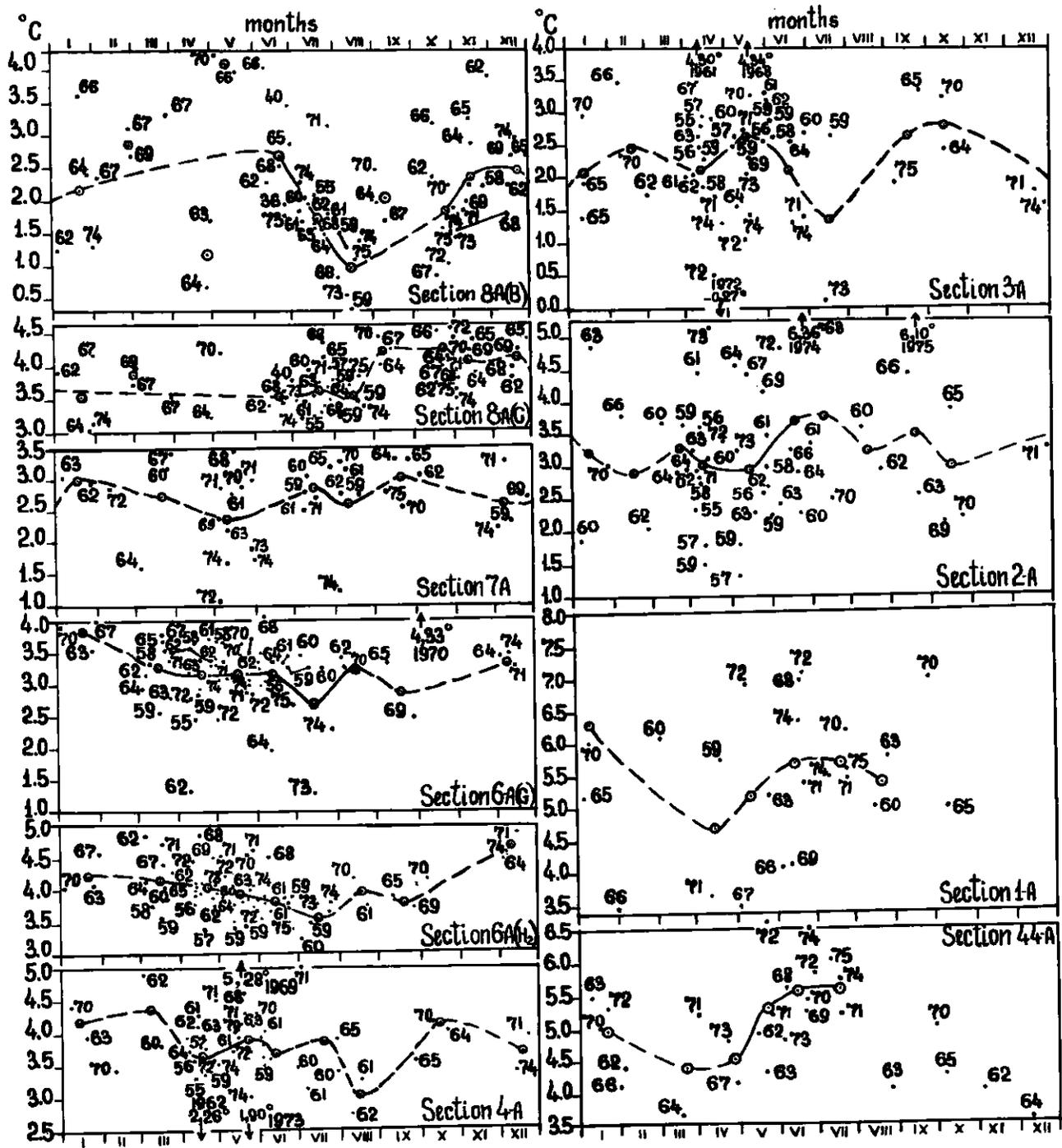


Fig. 2. Average course of water temperature of the 200-500m layer on the standard sections in the Labrador and Newfoundland areas (years of observations are shown by figures).

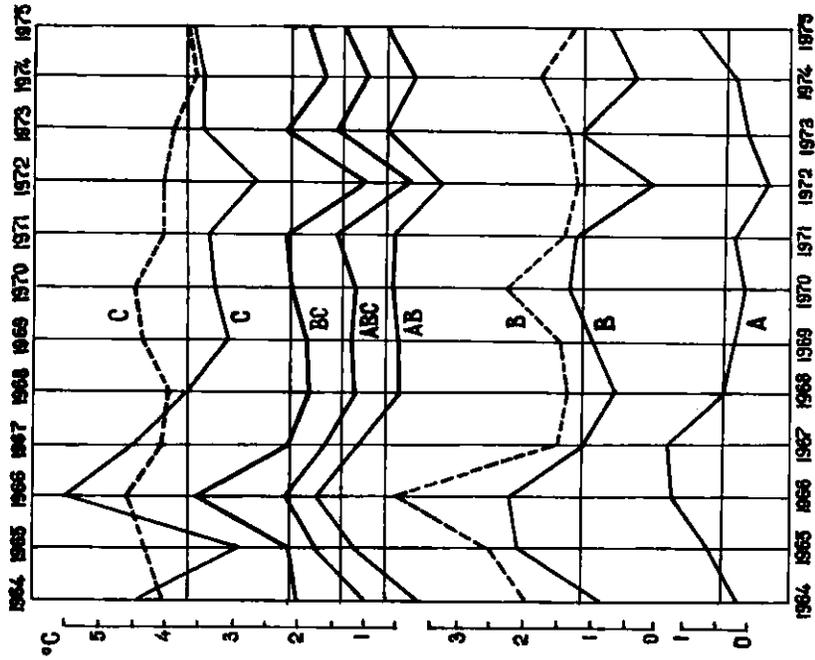


Fig. 4. Inter-annual variations of the average temperature in the 0-200 m layer (broken line) in the coastal Labrador Current on Section 8-A on the 1st November 1964-1975.

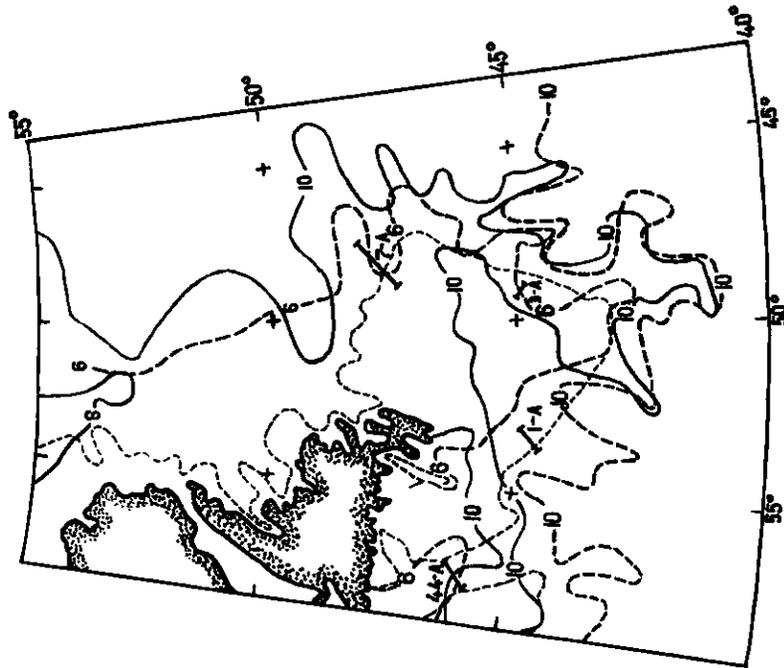


Fig. 3. Position of the 6° and 10° surface isotherms in the Newfoundland area on the 23-29th June (broken line) and on the 14-20th July 1975 (solid line).