Northwest Atlantic Fisheries Organization

Serial No. N1311 NAFO SCR Doc. 87/27

SCIENTIFIC COUNCIL MEETING - JUNE 1987

Warming off West Greenland Continues

by

M. Stein

Institut fur Seefischerei, Palmaille 9
D-2000 Hamburg 50, Federal Republic of Germany

Introduction

As reported during previous years during the Scientific Council Meetings of NAFO, STEIN (1985,1986), STEIN and BUCH (1985), BUCH and STEIN (1987) there is tremendous climatic variability in the waters off West Greenland which is due to the interaction of the two main components of the West Greenland Current system, the East Greenland Current component and the Irminger component, as well as due to the influence of meteorological anomalies, both on the regional and on the global scale. According to DICKSON et al. (1984) a chain of advective processes takes place in the North Atlantic Current system which imports cooling and freshening to the waters between Greenland and Canada. Following their ideas the cool fresh conditions were exported from the North Polar Basin to the open North Atlantic, principally via the expanded East Greenland Current.

The Data

As during previous years, the Institut fur Seefischerei, Hamburg, performed the annual groundfish survey in West Greenland waters during October/November 1986 with FRV "Walther Herwig". Part of this survey was the monitoring of oceanographic parameters along the NAFO Standard Sections Cape Farewell, Cape Desolation, Frederikshaab, Fylla Bank, and Lille Hellefiskebanke. West off Fylla Bank at 63 53'N, 53 22'W Standard Station 4 of the Fylla Bank Section was visited again, leading to nearly 25 years of continous time series of deep temperature/salinity profiles. Parts of the database analysed in the context of this paper are data achieved by the Greenland Fisheries and Environmental Research Institute, Copenhagen. These data, starting in 1963, are the basis to analyse climatic trends in the surface and deep waters off Fylla Bank during the autumn season.

Discussion

Advection of heat to the waters between Greenland and Canada is maintained by the Irminger branch of the West Greenland Current system. By far the largest heat input to the subsurface water masses occurs during the autumn season (BUCH, 1982; STEIN, 1982), and there seems to exist a time lag by a year that the conditions at the Fylla Bank lead the ocean conditions on the western side of the Davis Strait (STEIN, 1986a; AKENHEAD, pers. comm.).
The thermal situation as observed during the 1986 survey at station 4 of the Fylla Bank Section reveals for the upper 200m positive anomalies (fig. 1), which confirm the trend of warming as noted by STEIN (1986). Based on the long-term mean the "normal" T/S values for the 0-200m layer are 2.64 C/33.51. Below 400m depth there is indication for cooling amounting to -0.3K at 500m depth. This deviation is within the r.m.s. deviation of the mean profile. Salinity anomalies (fig. 2) indicate near normal con-ditions. Exept for the 20m value which is -0.1 there are no negative anomalies detected throughout the water column during the 1986 observa-tions. Comparing the temperature and salinity anomalies (fig. 3) in most cases warming is accompanied by increasing haline conditions.

This points at the increased/decreased influence of the Irminger component on the hydrographic conditions at station 4 of the Fylla Bank section. There are, however, years where only temperature indicated anomalous variation. This is during 1966, 1968, 1978 and 1981. BUCH and STEIN (1987) show that along the Fylla Bank section periods of anomalous cooling and freshening differ from station to station. Especially the late sixties/early seventies negative anomaly in both temperature and salinity indicate a rather inconsistent distribution along the section. The conclusion could be drawn that due to the banded structure of the current system off West Greenland the observed anomalies represent the on-shelf/off-shelf variability throughout time. Exept for the early eighties anomaly which affected the entire range of the section from station 1 to station 5, the previous anomalous period was stronger expressed at the on-shelf part of the Fylla Bank section, than at stations 4 and 5. Furthermore, the missing anomalies during the aforementioned years point at the advective part, as well as at the regional part of the complex picture. Due to regional atmospheric cooling the temperature of the surface layer decreases. Further cooling leads to convective mixing. In both years of relatively strong cooling and missing salinity anomaly, 1978 and 1981, there are at depths below 50m negative salinity anomalies which do, however, equal the positive anomalies of the near-surface layer to zero. This in turn points at the advective processes which propagate in the North Atlantic Current system. There is indication of negative salinity anomalies at depths of the core layer of the Irminger branch of the West Greenland Current (300-500m) during 1980, a year which represents positive autumn anomalies for the top 200m of the water column. This subsurface negative anomaly continues throughout the following years and covers the upper 200m completely during 1983, the year of peak cooling, both on-shore and offshore West Greenland.

The question, whether the two warm and saline years, 1985 and 1986, mark the onset of a warm interiude like during the mid-seventies would raise speculations. Past years have shown that adverse meteorological conditions over Greenland lead to anomalous situations which are outstanding within the last hundred years (STEIN and BUCH, 1985).

References

BUCH, E., 1982: Review of oceanographic conditions in Subareas 0 and 1 during the 1970-80 Decade.
NAFO Sci.Coun.Stud. (5): 43-50.

BUCH, E. and STEIN, M., 1987: Time Series of Temperature and Salinity at the Fylla Bank Section/West Greenland.
ICES C.M. C:(in press).

DICKSON, R.R., MALMBERG, S.-A.,JONES, S.R. and LEE, A.J., 1984: An investigation of the earlier Great Salinity Anomaly of 1910-14 in waters west of the British Isles.
ICES C.M. 1984 Gen: 4, 1-30, mimeo.

STEIN, M., 1985: Cold Water off West Greenland - Teleconnection with El Nino?
NAFO SCR Doc. 85/17: 1-4 (mimeo).

STEIN, M., 1986: Again Warm Water off West Greenland.
NAFO SCR Doc. 86/20: 1-7 (mimeo).

STEIN, M., 1986a: Cold Water off West Greenland - Teleconnection with El Nino?
Tropical Ocean-Atmosphere Newsletter 34: 7-8.

STEIN, M. and BUCH, E., 1985: 1983: an unusual year off West Greenland?
Arch.FischWiss. 36 (1/2): 81-95.

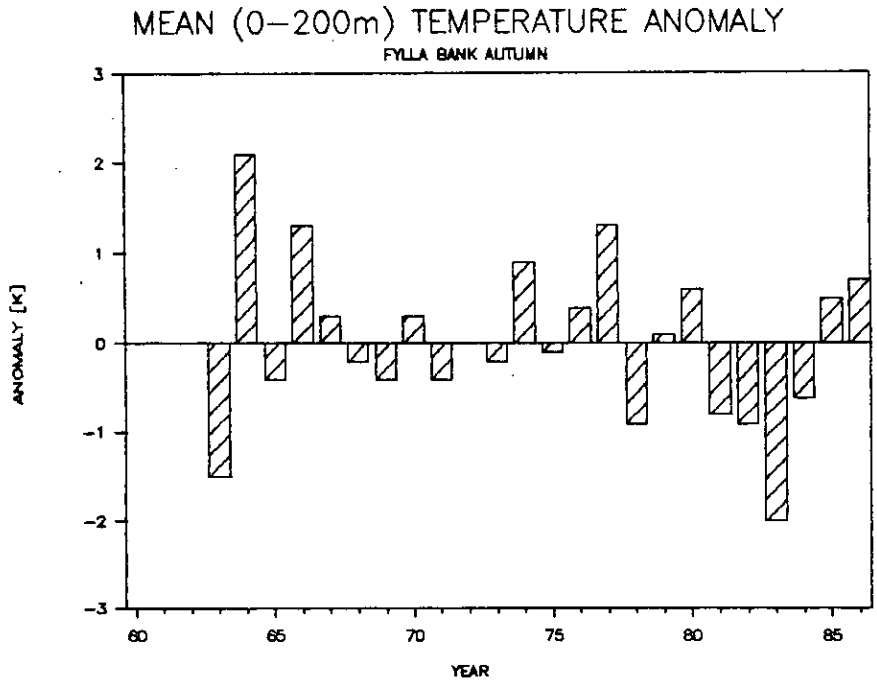

Fig. 1 Mean (0-200m) Temperature Anomaly Fylla Bank Autumn

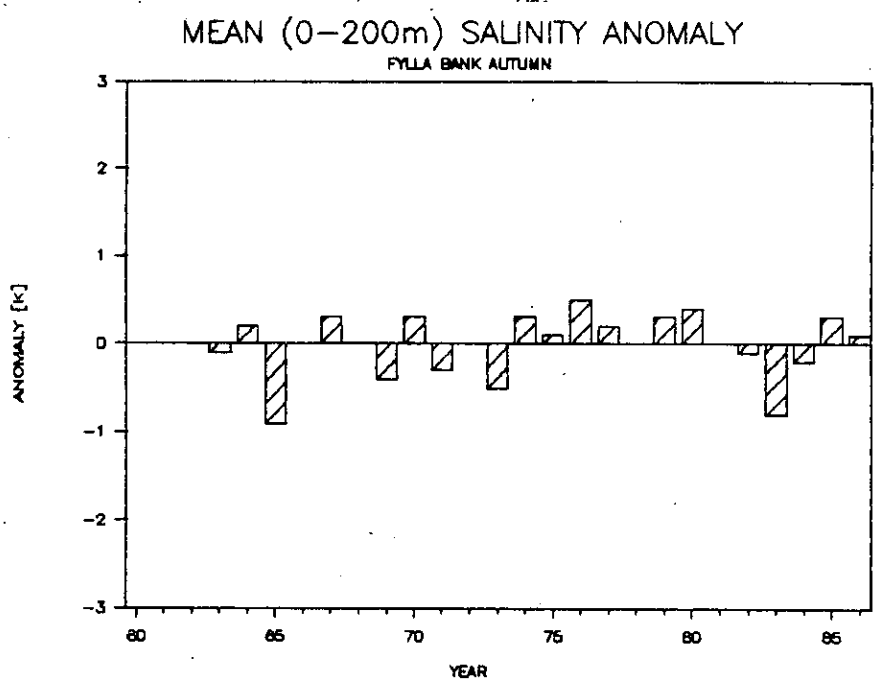

Fig. 2 Mean (0-200m) Salinity Anomaly Fylla Bank Autumn

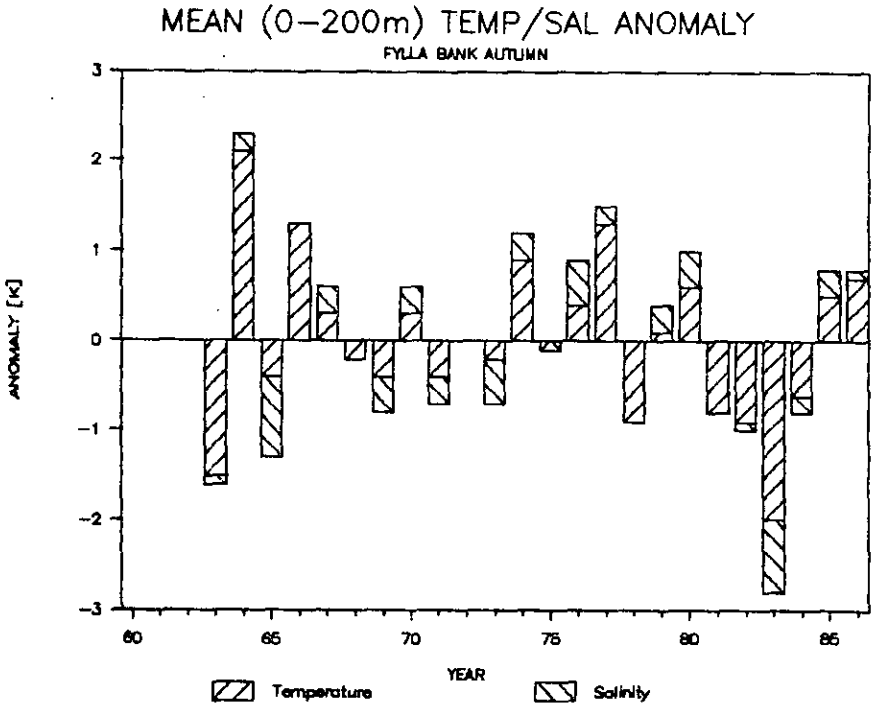

Fig. 3 Mean (0-200m) Temperature/Salinity Anomaly Fylla Bank Autumn