Northwest Atlantic Fisheries Organization

Serial No. N2117 NAFO SCR Doc. 92/63

SCIENTIFIC COUNCIL MEETING - JUNE 1992

A Note on the Consistency of Hydrographic Events off Labrador and off West Greenland

by

M. Stein

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

Introduction

In a recent paper the consistency of thermal events in the East Greenland/West Greenland current system has been analyzed (STEIN, 1992a). The paper concluded that those areas, being primarily under the regime of the Irminger component of the current system, reveal highest consistency in thermal events. The model assumption behind this is that advection of events within the current system, as earlier treated by DICKSON et al. (1988), plays a large role in the interannual variability of hydrographic properties. Filtered air temperature anomalies at Nuuk (Godthaab)/West Greenland, at Iqualuit/N.W.T., and at Cartwright/Labrador show a downward trend which started in the late sixties (DRINKWATER et al., 1992; STEIN, 1992b). All three time-series show large amplitude low-frequency variability with the West Greenland data indicating record anomalies in the early eighties (BUCH and STEIN, 1989). Characteristic high amplitude cold events occur in all three time-series during the early seventies, early eighties and around 1989/1990. Taking into account the coupling of atmosphere and ocean as well as the advective model for events, there should be east/west consistency between events in the hydrosphere which are observed on both sides of the Labrador Sea.

The Data

To test this hypothesis, four data sets were taken and statistically treated. These are the Nuuk (Godthaab) monthly and annual mean air temperatures, the Fylla Bank temperature and salinity time series, and the CIL (cold intermediate layer) time series of the Bonavista Section (DRINKWATER et al., 1992; STEIN, 1988). The location of the sites of observation is given in Fig. 1. The CIL-data represent a measure for the amount of water colder than 0°C crossing the vertical plane of the Bonavista Section. The Fylla Bank data represent October/November conditions, the CIL-data were obtained in July.

Results and Discussion

Correlation between Nuuk monthly mean air temperature and the areal extent of the CIL indicates that only 24% (38%) of the variance of the CIL can be explained by the air temperatures of the previous winter months January (February) in Nuuk. Considering the year previous to the CIL observations, January (February) conditions at Nuuk explain 53% (63%) of the variance. The probability level if given to 0.003 (0.001).

The correlation is, however, based on a short time series of only 14 years. This can imply that the consistency is relevant only for this specific period from 1978 to 1991. In contrast to the entire time series from Nuuk (Godthaab) which starts in 1876 and shows low frequency changes of warmer and colder than normal conditions, with 1923 to 1969 being warmer than normal (STEIN, 1992b), the time span 1978 to 1991 represents parts of decreasing temperature scenario in the Greenland/Labrador region.

Correlation based on the 116 years time series reveals that February conditions explain 57% of the variance of the mean annual air temperature, whereas for the short period January (February) explain 74% (66%) of the variance of the mean annual air temperature.

Taking the conditions in the ocean off Nuuk into account, the temperature/salinity anomaly time series reveal similar correlation results. The results of this calculation are given below:

Correlation Matrix for time series Fylla Bank/CIL (FYLS=Fylla Bank salinity; FYLT=Fylla Bank temperature; CIL=cold intermediate layer along the Bonavista Section)

	FYLS	FYLT	CIL
FYLS	1.0 (11) .000	.77 (11) .006	-.87 (11) .001
FYLT	.77 (11) .006	1.0 (11) .000	-.82 (11) .002
CIL	-.87 (11) .001	-.82 (11) .002	1.0 (11) .000

correlation coefficient, (sample size), significance level

There is evidence that salinity and temperature changes at the Fylla Bank correlate significantly with the extent of the CIL-area at the Bonavista Section. 75 % (67%) of the variance in the CIL-extent may be explained by the changes in salinity (temperature). This high correlation would suggest an intense east/west coupling within the Labrador Sea system. If the coupling would be via the advective event model, the CIL-events would be lagged by about 7 months with the Fylla Bank events.

Low salinities recorded at the Fylla Bank Section station 4 during autumn reflect decrease in salinity of the Irminger branch of the West Greenland Current. Time-series analysis based on standard oceanographic sections around Greenland and off South Iceland, clearly reveal the travel of salinity and thermal events (MALMBERG and KRISTMANNSSON, 1991; STEIN, 1992b) in the northwestern North Atlantic.

Conclusions

Bearing in mind the limited power of statistical analysis, it would appear that there is coupling of thermohaline events which are observed on both sides of the Labrador Sea. However, as shown above, consistency of events might be a question of time-windows. For the time being we have at hand only limited information of 14 years CIL observations. Other CIL data from the Labrador/Newfoundland region are even shorter (DRINKWATER et al., 1992).
This lack of long-term time series requires continuation of field work along the same sampling grids. A dense cover of monitoring sections on both sides of the Labrador Sea, and extended to the East Greenland area would be necessary to answer in more detail the travel of events from east to west. Based on the framework of the NAFO Standard Oceanographic Sections and Stations (STEIN, 1988), as well as along national standard sections (STEIN, 1982), there is predictive power in data sets collected along these lines.
Of potential value for fishery management, these data and their interrelations could serve as statistically significant indicators for environmental changes in the northwestern North Atlantic.

References

BUCH, E., M. STEIN 1989. Environmental Conditions off West Greenland, 1980-85. J.Northw.Atl.Fish.Sci., Vol. 9: 81-89.

DRINKWATER, K., B. PETRIE and S. NARAYANAN 1992. Environmental Conditions in the Newfoundland Region in 1991. NAFO SC Working Paper 92/18: 1-14.

DICKSON, R.R., J. MEINCKE, S.-A. MALMBERG and A.J. LEE 1988. The "Great Salinity Anomaly" in the Northern North Atlantic 1968-1982. Prog. Oceanog. (20): 103-151.

MALMBERG, S.AA. and S.S. KRISTMANNSSON 1991. Hydrographic conditions in Icelandic Waters 1980-1989. ICES Statutory Meeting 1991, Variability Symposium, Paper no. 6.

STEIN, M. 1982. Hydrographic conditions off East Greenland in autumn 1981 and in spring 1982. Coun. Meet. ICES, Hydrogr. Comm. C6: 1 - 10.

STEIN, M. 1988. Revision of list of NAFO standard oceanographic sections and stations. NAFO SCR Doc. 88/01: 1-9.

STEIN, M. 1992a. On the Consistency of Thermal Events in the East Greenland/West Greenland Current System. NAFO SCR Doc. 92/20: 1-9.

STEIN, M. 1992b. Variability of Climate - Impact on Cod Recruitment off West Greenland? NAFO SCR Doc. 92/19: 1-15.

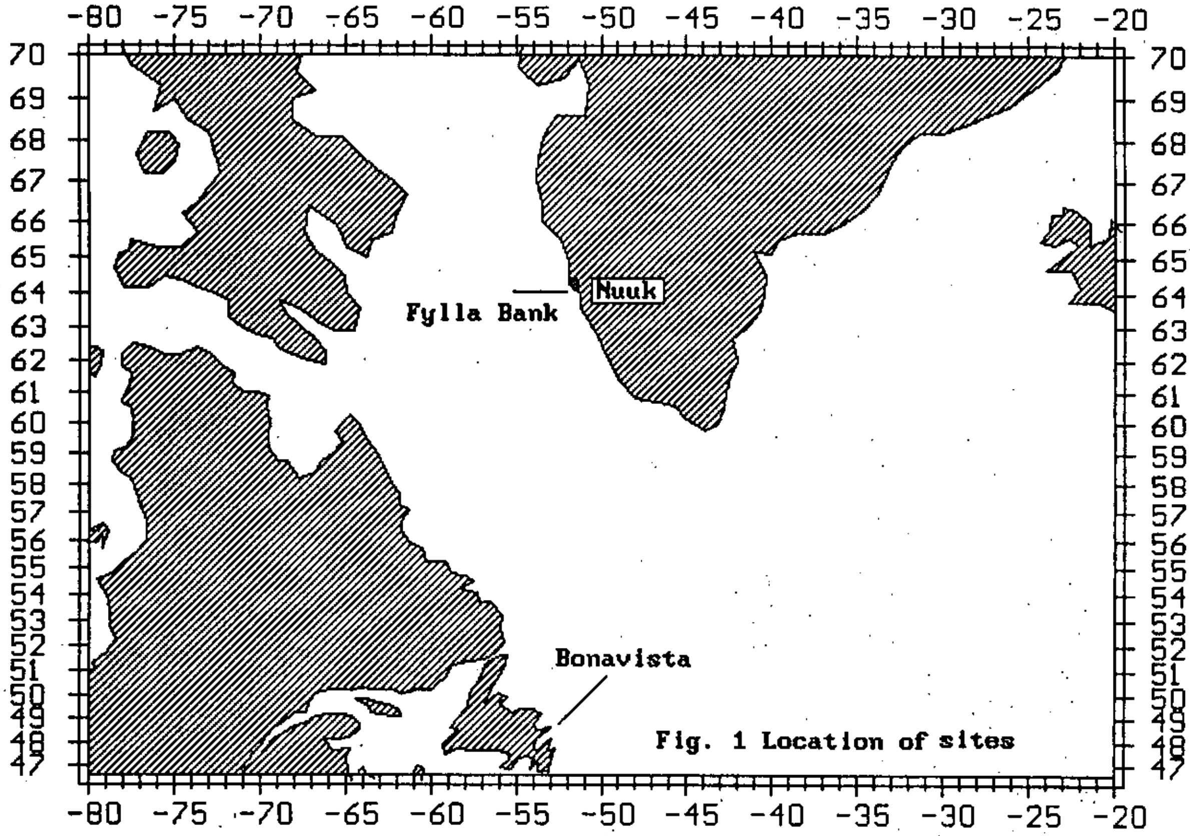

Fig. 1 Location of sites