ICES STATUTORY MEETING 1993 CM 1993/C:47

NORTH SEA SURFACE TEMPERATURE MEANS 1981 to 1990

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ABSTRACT

Since 1968, weekly Sea Surface Temperature (SST) charts of the North Sea have been analysed and distributed by the Federal Maritime and Hydrographic Agency (formerly German Hydrographic Institute). The analysed weekly SST distribution is digitised on a 20 n.m. grid, containing 24 x 30 grid points. The SST data set held on the files contains about 1 MegaByte of data.

The data set was used to compile a 10 year (1971 to 1980) weekly and monthly mean North Sea SST Atlas. The 1971 - 1980 data were presented to ICES in condensed form as C.M.1984/C:1.
The weekly data are also used to provide the boundary conditions at the air-sea interface to simulate thermodynamic processes in the North Sea.

This paper presents the 10 year overall mean for the period 1981 to 1990, its standard deviation, the observed minimum and maximum SST as well as the monthly SST mean charts and their standard deviation maps.

The 1981 to 1990 data are compared with the data of the previous decade and monthly and yearly differences are discussed.

The influence on the North Sea of two large anomaly events in the North Atlantic - the "Great Salinity Anomaly (GSA)" and the "High Salinity Anomaly (HSA)" - is discussed.

The decadal means - the 1970s compared with the 1980s - show no significant SST differences. The influences of the GSA (about 1977/79) on the North Sea SST as well as of the HSA (1989/91) are small on the 10 year overall mean. Looking at the individual years 1979 and 1990, a significant influence on the climate of the North Sea is seen.

Introduction

Since 1968, weekly Sea Surface Temperature (SST) charts of the North Sea have been analysed and distributed by the Federal Maritime and Hydrographic Agency (formerly German Hydrographic Institute). The analysed weekly SST distribution has been digitised since the beginning on a 20 n.m. grid containing 24 x 30 grid points. The SST data set held on the files contains about 1 MegaByte of data.

The data set was used to compile a 10 year (1971 to 1980) weekly and monthly mean North Sea SST Atlas (Becker, G.A.,H.Frey and G.Wegner, 1986). The 1971 - 1980 data were also presented in condensed form to ICES as C.M.1984/C:1.
The weekly data are also used to provide the boundary conditions at the air-sea interface to simulate thermodynamic processes in the North Sea (Pohlmann, 1990).

This paper presents the 10 year overall mean for the period 1981 to 1990, its standard deviation, the observed minimum and maximum SST as well as the monthly SST mean charts and their standard deviation maps.

Discussion

Figure 1 shows the 10 year overall mean SST for the 1980s. Figure 2 shows the standard deviation for that period. Compared with the previous decade, both decadal mean SST and standard deviation are remarkably stable. The differences compared with the 1971 to 1980 decadal mean are shown in Figure 3. In general a small increase - about 0.1 to 0.3 °C - in the areas directly influenced by the Atlantic Ocean can be seen. In the central North Sea and in the Norwegian Trench area, however, a small decrease in the same order of magnitude is noted.

The minimum SST values which occurred during the 1980s are shown in Figure 4. The course of the isotherms reflects the non-synoptic data set (composed from single grid point data from different weekly charts). The differences between these minimum temperatures and those of the previous decade (Fig.5) range from -3 to 1.5 K with rather sharp gradients. This is an indication of more local effects of winter cooling of the SST in single years; no general trend can be decuced from these differences. In the northern entrance, however, the minimum SST in the 1980s was higher than in the previous decade whereas the minimum SST (in the year 1986) in the Southern Bight was significantly colder.

The maximum SST distribution is presented in Figure 6. The pattern of the isotherms is very similar to that of the previous decade; surprisingly in the 1980s the maximum SST was generally lower (up to -2.7 K, Fig.7). The highest temperature observed was found in the Skagerrak (T > 22 °C, 1982), but not in the shallow areas of the German Bight.

Figures 8 to 31 show the monthly means and their corresponding standard deviations. To give an impression of the decadal mean SST changes from the 1970s to the 1980s, four monthly mean SST diffen-

ces are shown in Figures 32 to 35. The slight warming of the northwestern corner of the North Sea is evident. In general, winter and spring SSTs are somewhat lower during the 1980s. Except for the areas influenced by the Atlantic Ocean, the summer SSTs (see also Figure 7) are significantly lower. In general the smallest differences occurred in autumn.

To check the influence of the larger anomaly events (GSA/1979; HSA/1990) in the North Atlantic (Dickson, R.R. et al, 1988; Bekker,G. et al 1992) on the North Sea SST, the overall mean for both years was computed. The GSA had the strongest influence on the central North Sea in 1978 and 1979. The HSA was first noted in 1989 west of Scotland (Ellett and Turrell, 1992), in the northern North Sea and the English Channel. Figures 36 and 39 show the yearly mean temperatures and their standard deviations. The negative influence of the 1979 GSA as well as the opposite effect of the 1990 HSA can clearly be seen. The comparison of the standard deviation for both years shows 1979 to be quite "normal" year; in 1990 the standard deviation is reduced as result of the greater influence of the Atlantic Ocean on the North Sea climate.

Both anomalies occurred at the end of the decade of investigation. The duration of both anomalies seems too short to have a significant influence on the decadal mean.

Conclusion

The decadal means - the 1980s compared with the 1970s - show no significant SST differences. In contrast to the expected warming, a cooling of the decadal mean - within the range of variability - of the North Sea SST is seen. The influences of the GSA (about 1977/79) on the North Sea SST as well as of the HSA (1989/91) are smaller on the 10 year overall mean than previously assumed by the authors. Looking at the individual years 1979 and 1990, however, a significant influence on the North Sea climate is seen. The SST time series (not shown here) indicate a moderate warming of the North Sea starting around 1986, caused by the exceptional mild winters in the second half of the 1980s.

Literature:

Becker,G.A.,Ad Corten and Harry Dooley,1992: Recent High Salinity in the English Channel/Southern North Sea. ICES, C.M.1992/C:6

Becker,G.A., H.Frey and G.Wegner, 1984: North Sea surface temperature mean 1971 to 1980 and their differences compared with the ICES Mean (1905-1954). ICES, C.M. 1984/C:1

Becker, G.A., H.Frey and G.Wegner, 1986:Atlas der Temperatur an der Oberfläche der Nordsee. Wöchentliche und monatliche Mittelwerte für den Zeitraum 1971 bis 1980. Dt.Hydrogr.Z. Ergh.B, Nr.17

Conseil Permanent International pour l'Exploration de la Mer (ICES), 1962: Mean monthly temperature and salinity of the surface layer of the North Sea and adjacent waters 1905-54. Kopenhagen

Dickson, R.R., Jens Meincke, Svend-Aage Malmberg and Arthur Lee, 1988: The "Great salinity Anomaly" in the Northern North Atlantic 1968-1982. Prog.Oceanog. Vol.20, pp.103-151

Ellett,D.J. and W.R.Turrell,1992: Increased salinity levels in the NE Atlantic. ICES, C.M.1992/C:20

Pohlmann, Th.,1990: Untersuchung hydro- und thermodynamischer prozesse in der Nordsee mit einem dreidimensionalen numerischen Modell. Diss. Universität Hamburg, 1990. 116 pp.

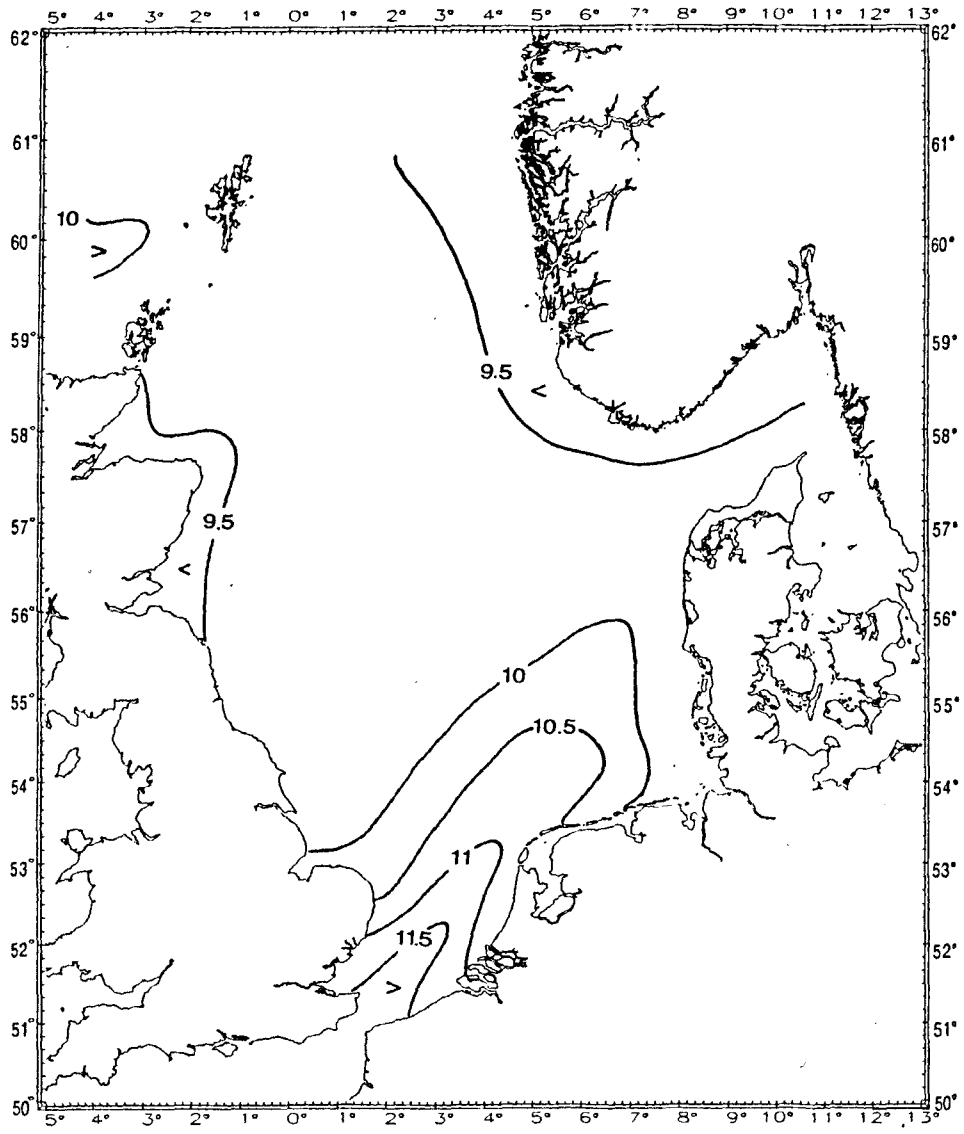

Fig. 1: Mean values of the North Sea surface temperature (in °C) for the period 1981 to 1990

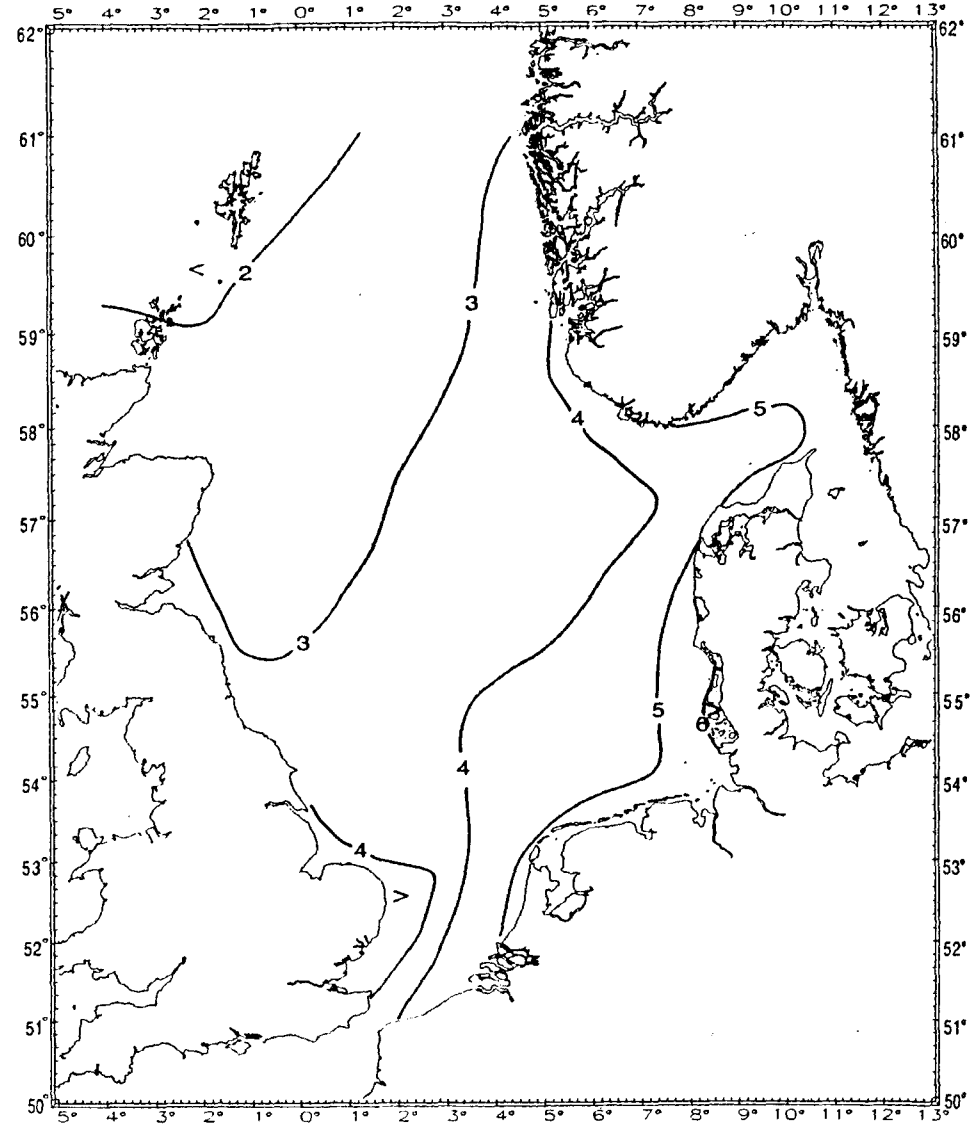

Fig. 2: Standard deviations of the North Sea surface temperature (in °C) referred to the mean 1981 to 1990 (Fig. 1)

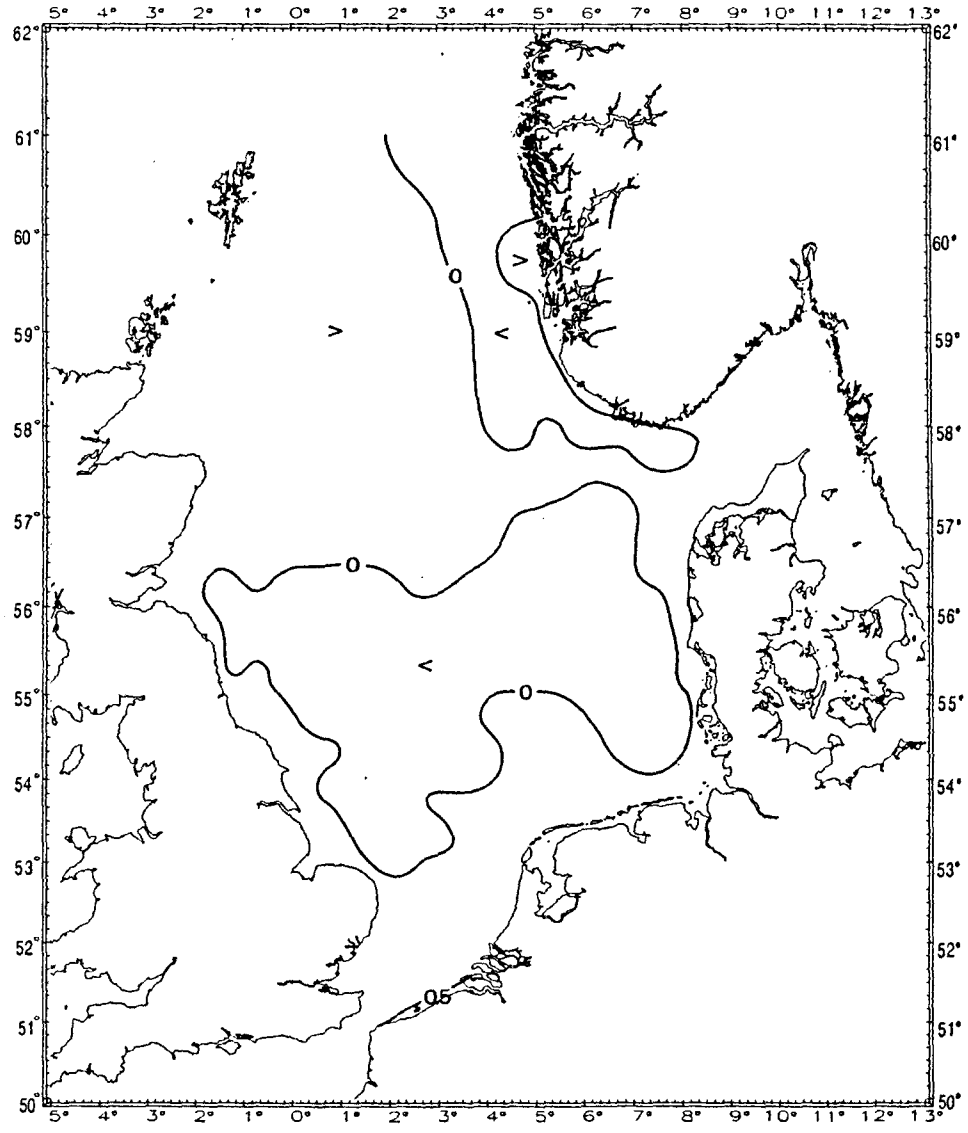

Fig. 3: Differences between the decadal mean SST:
SST (1981 to 1990) minus SST (1971 to 1980)

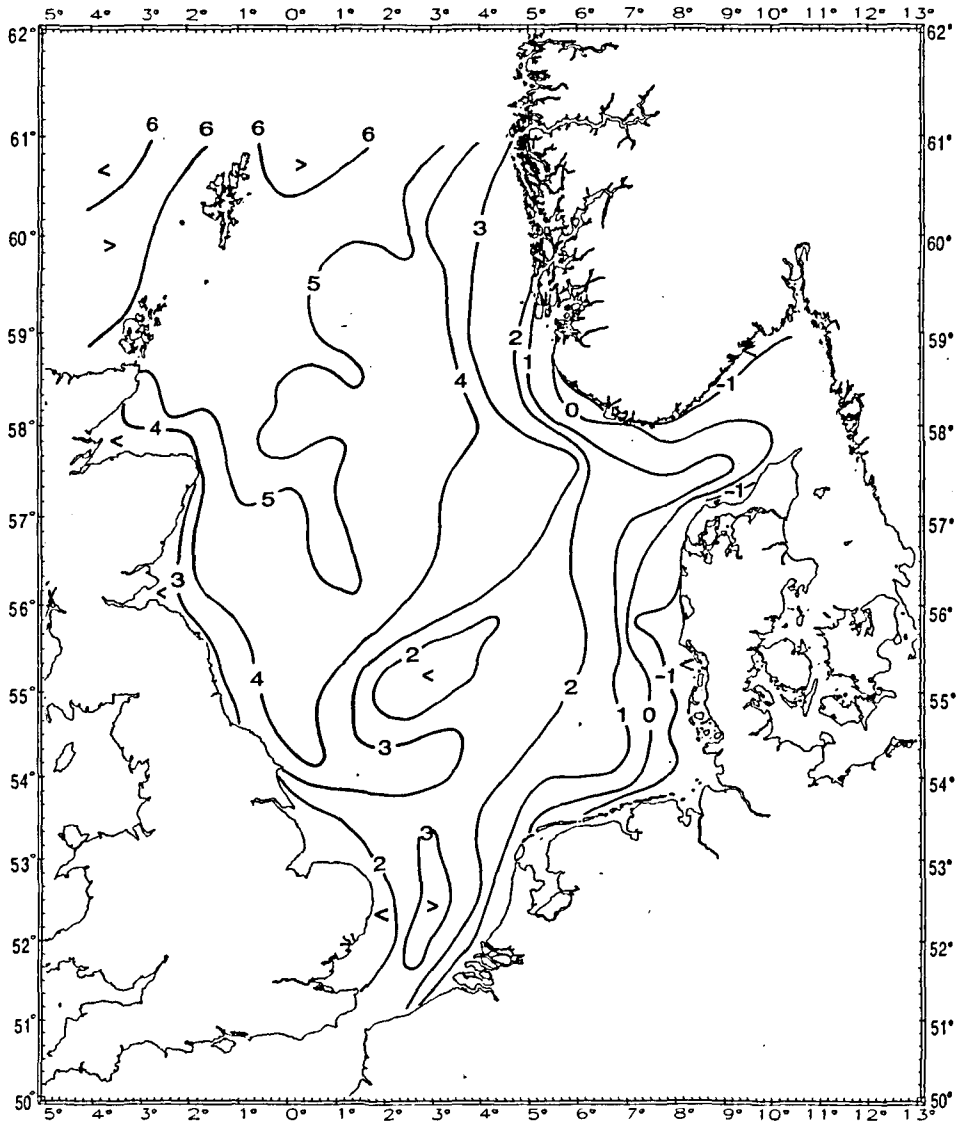

Fig. 4: Minima of the North Sea SST (in °C) in the period 1981 to 1990

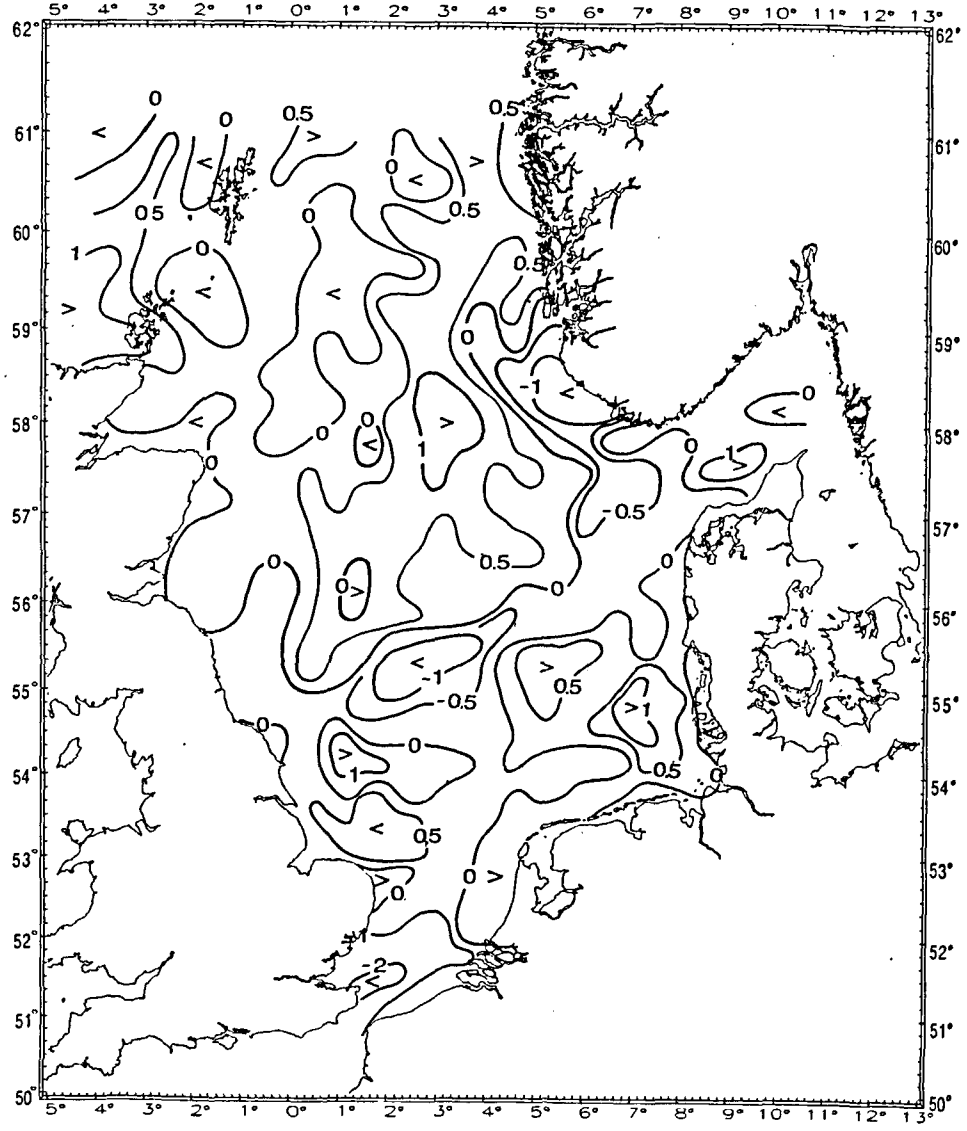

Fig. 5: Differences between the decadal minima SST: Min (1981 to 1990) minus Min (1971 to 1980)

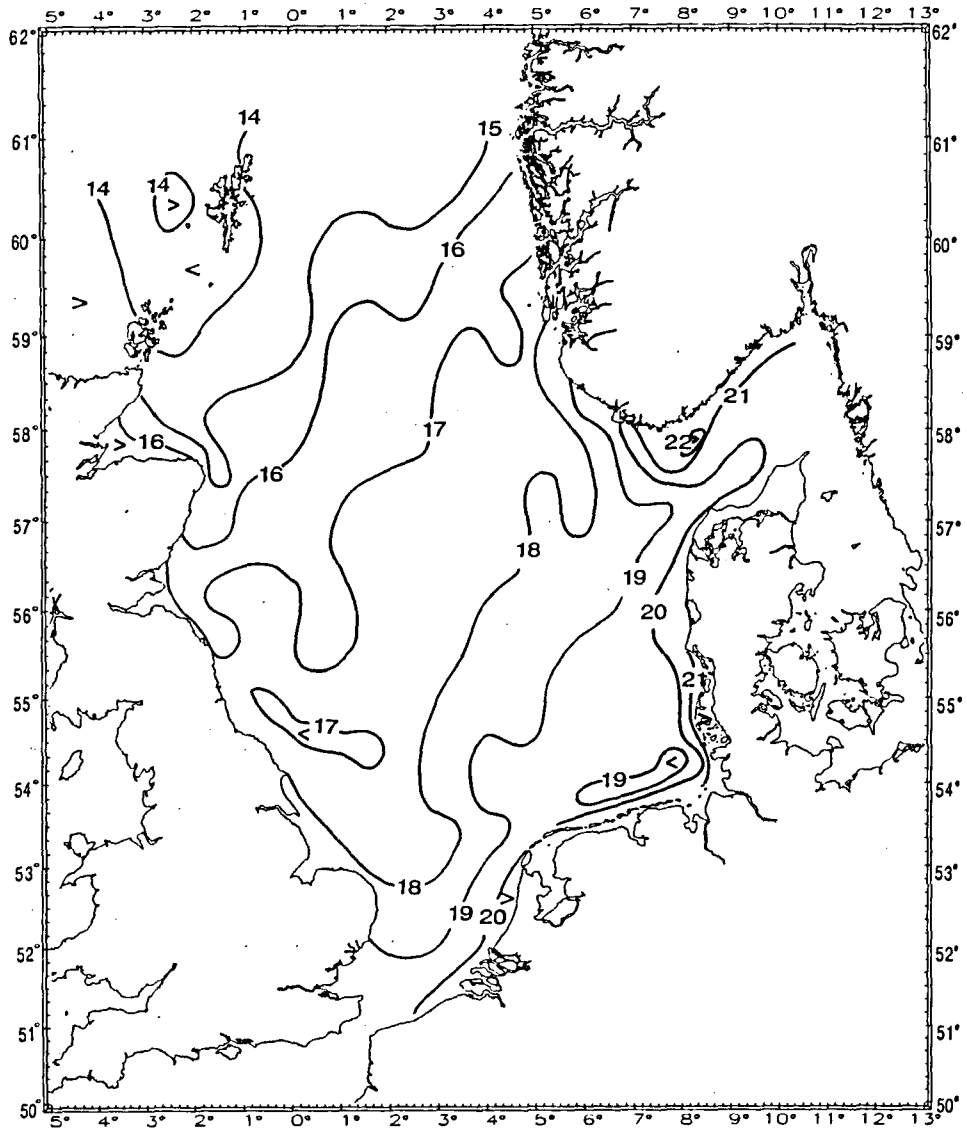

Fig. 6: Maxima of the North Sea SST (in °C) in the period 1981 to 1990

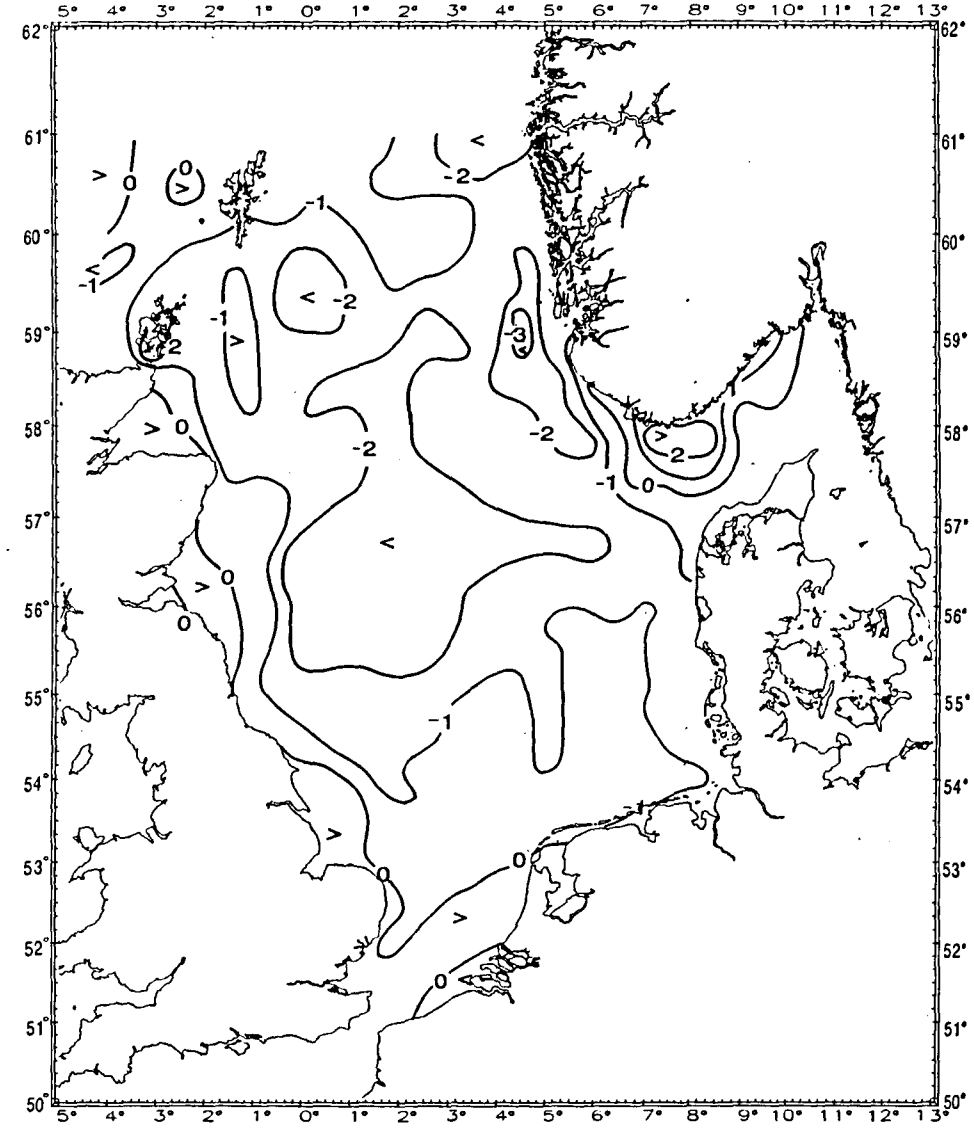

Fig. 7: Differences between the decadal maxima SST: Max (1981 to 1990) minus Max (1971 to 1980)

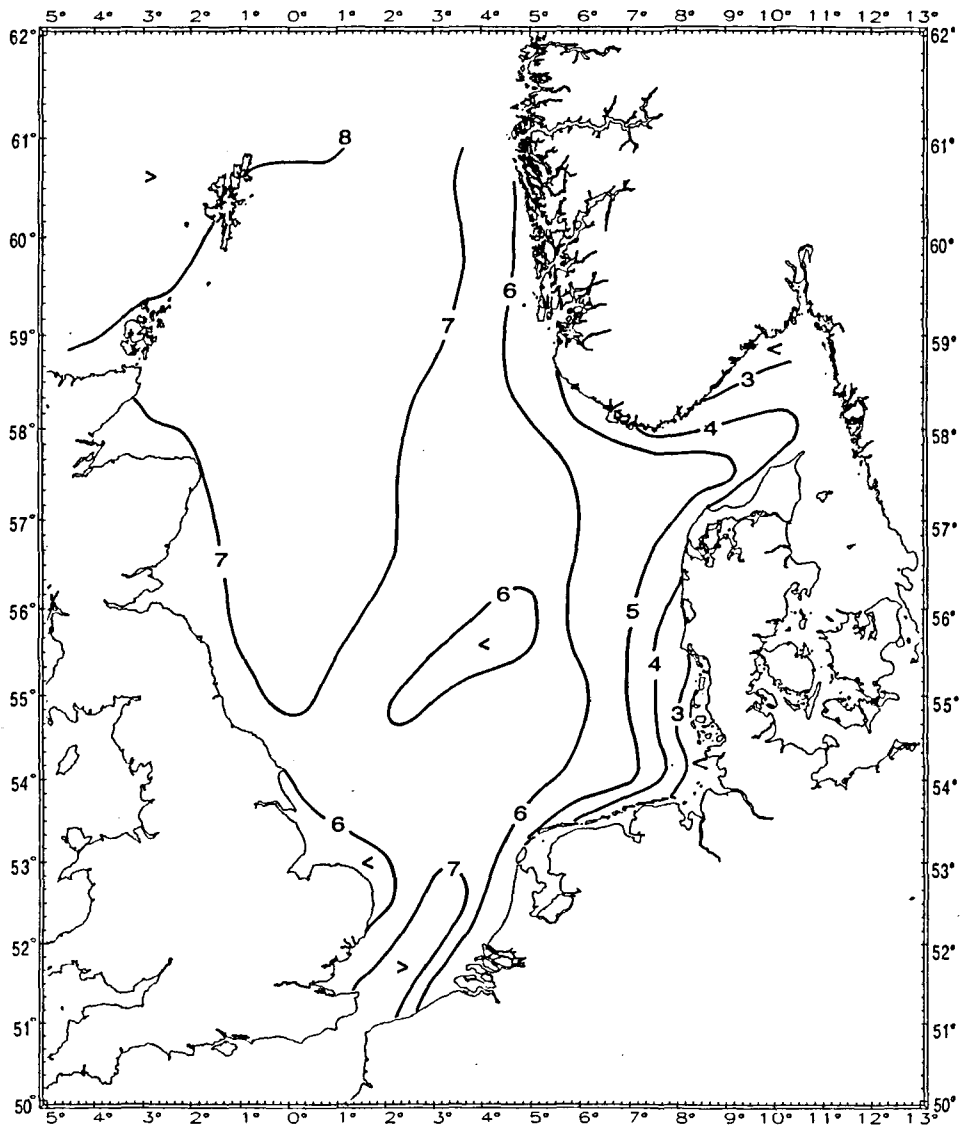

Fig. 8: SST mean values for the month of January (in °C)

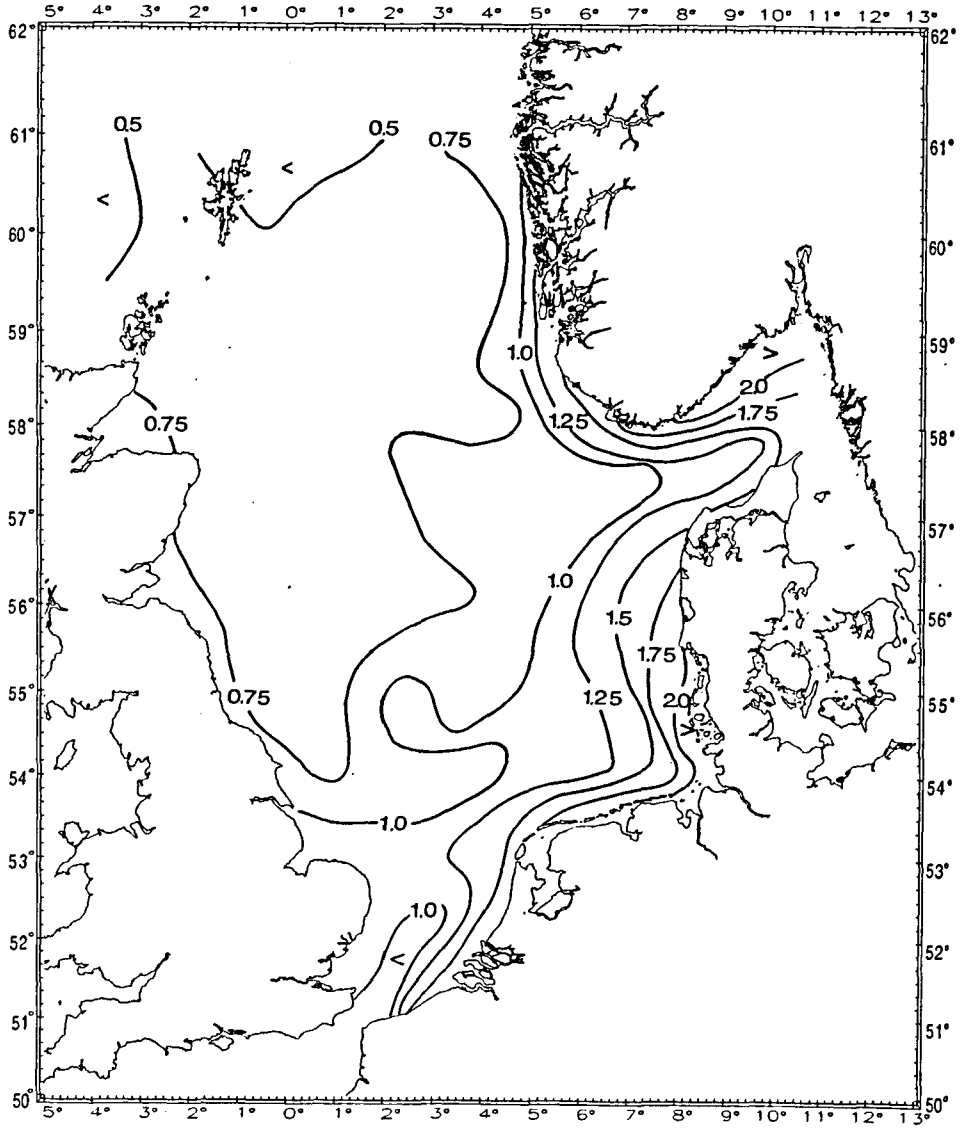

Fig. 9: Standard deviations of mean SST in January

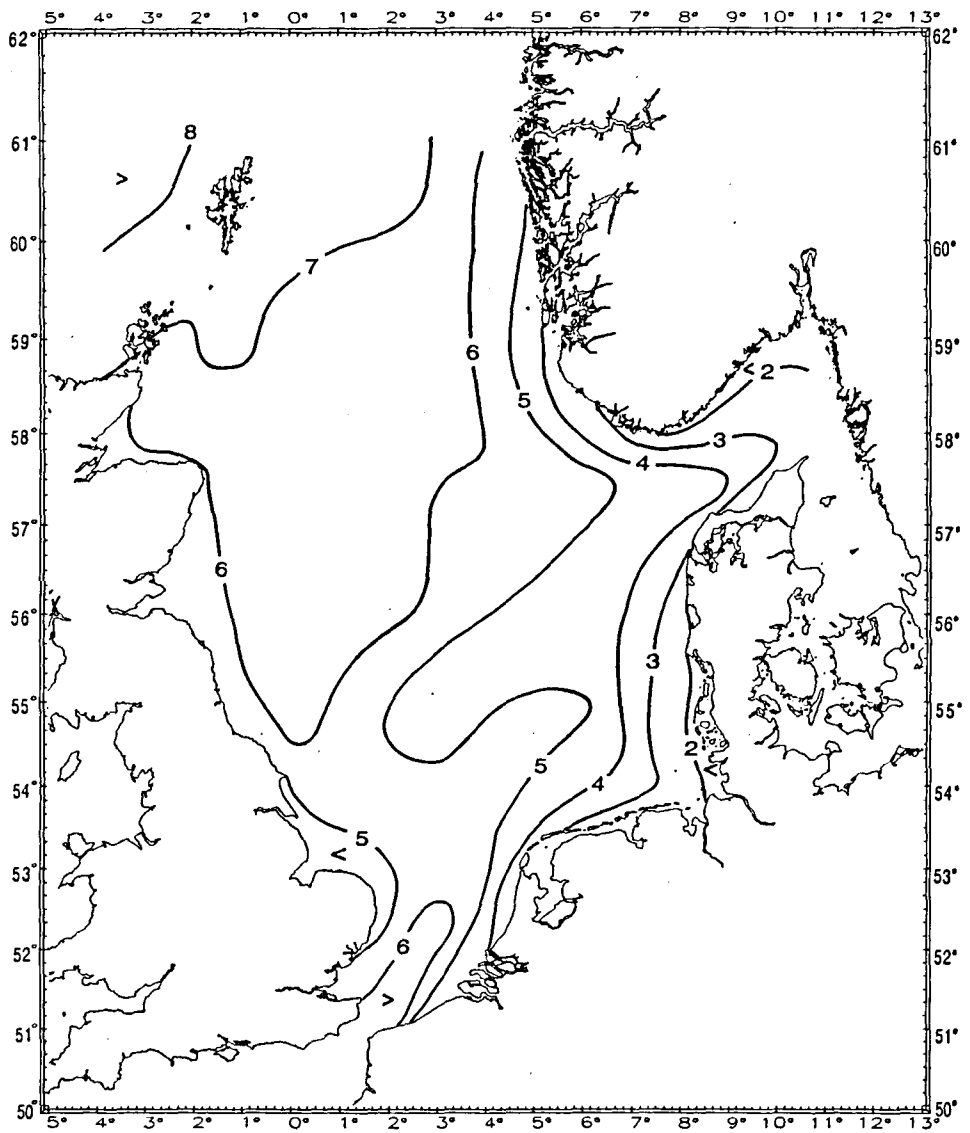

Fig. 10: SST mean values for the month of February (in °C)

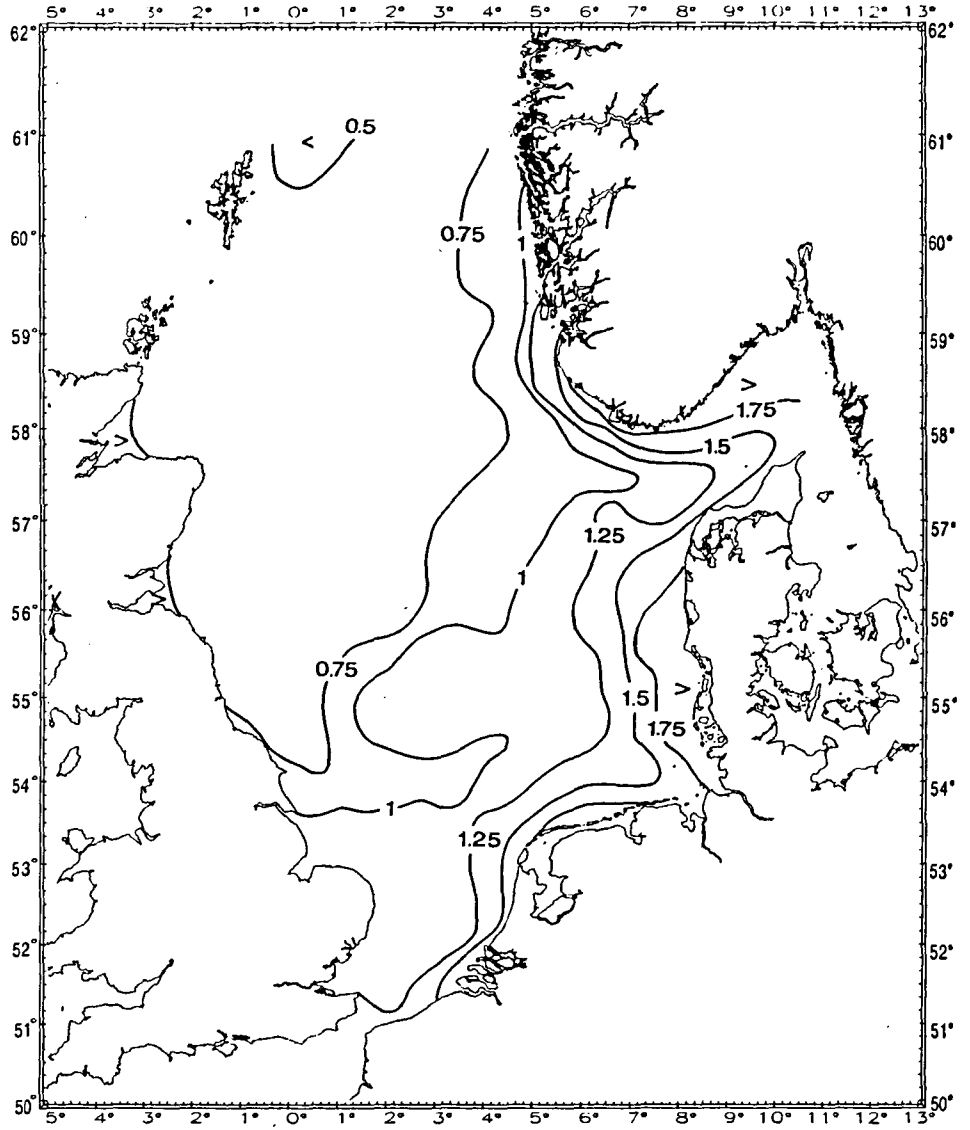

Fig. 11: Standard deviations of mean SST in February

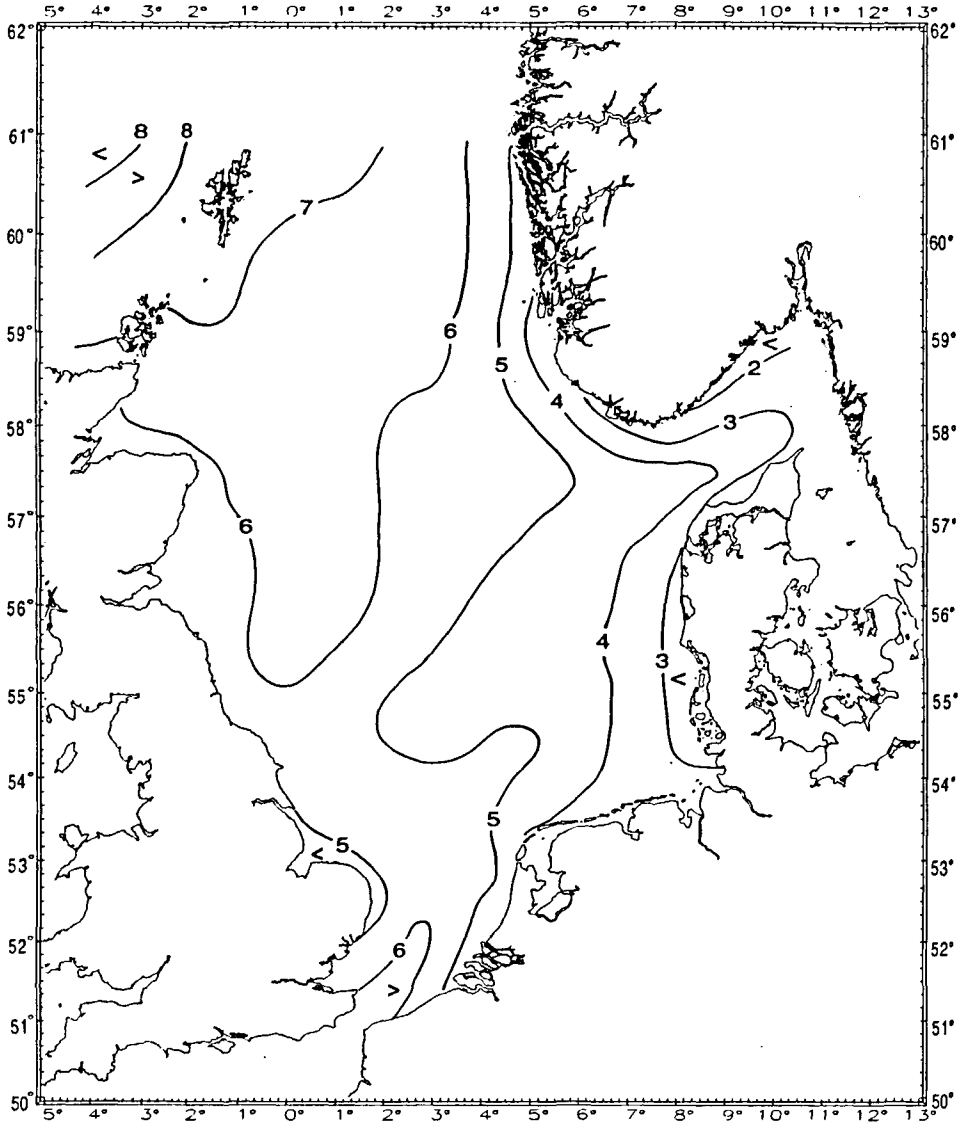

Fig. 12: SST mean values for the month of March (in °C)

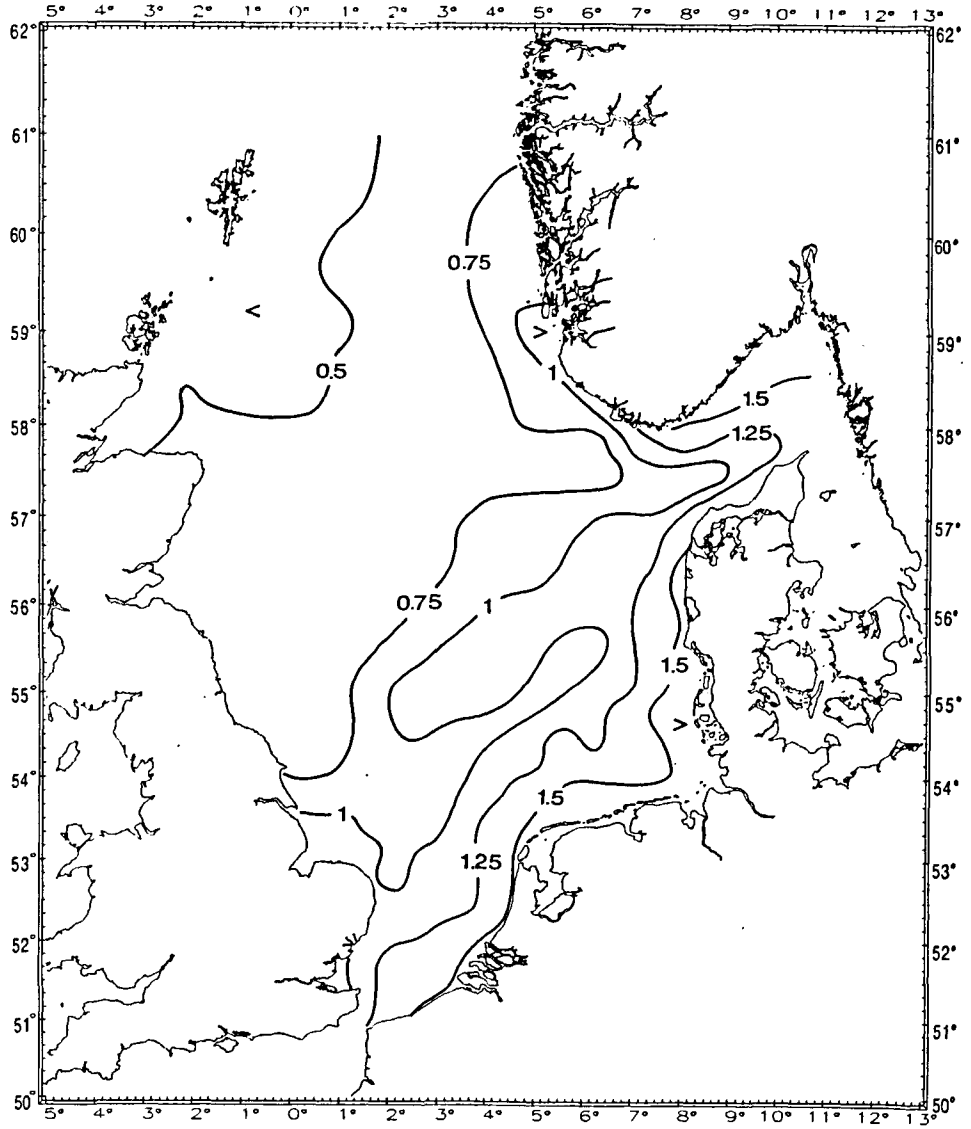

Fig. 13: Standard deviations of mean SST in March

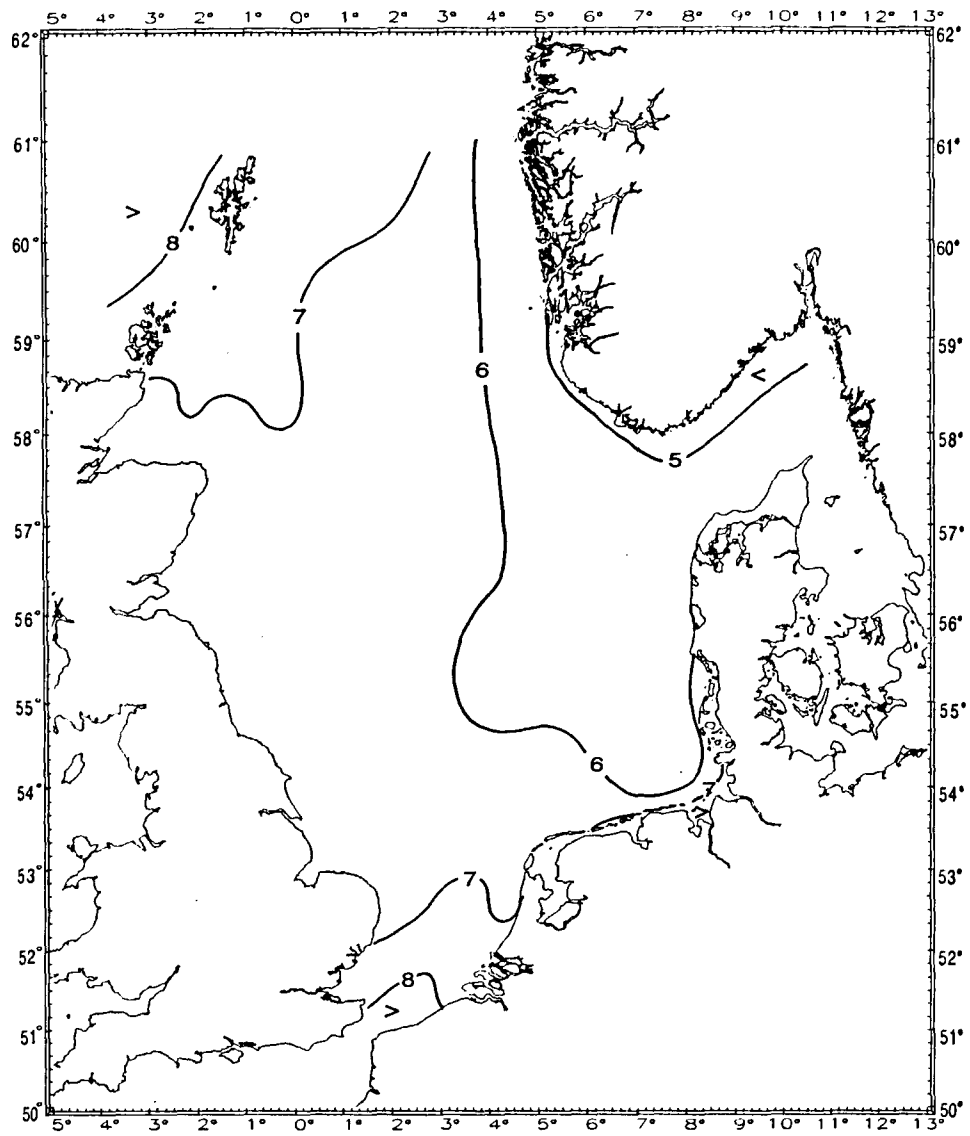

Fig. 14: SST mean values for the month of April (in °C)

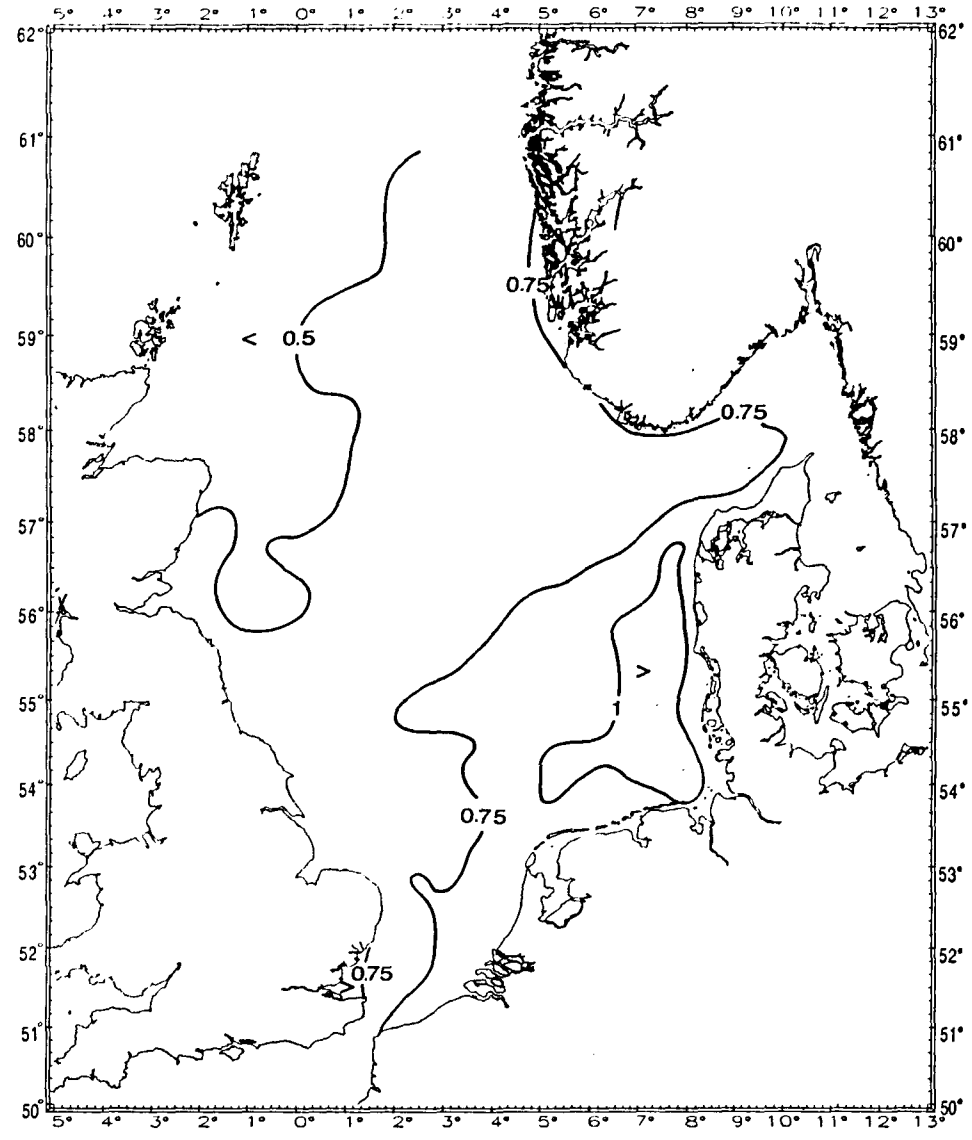

Fig. 15: Standard deviations of mean SST in April

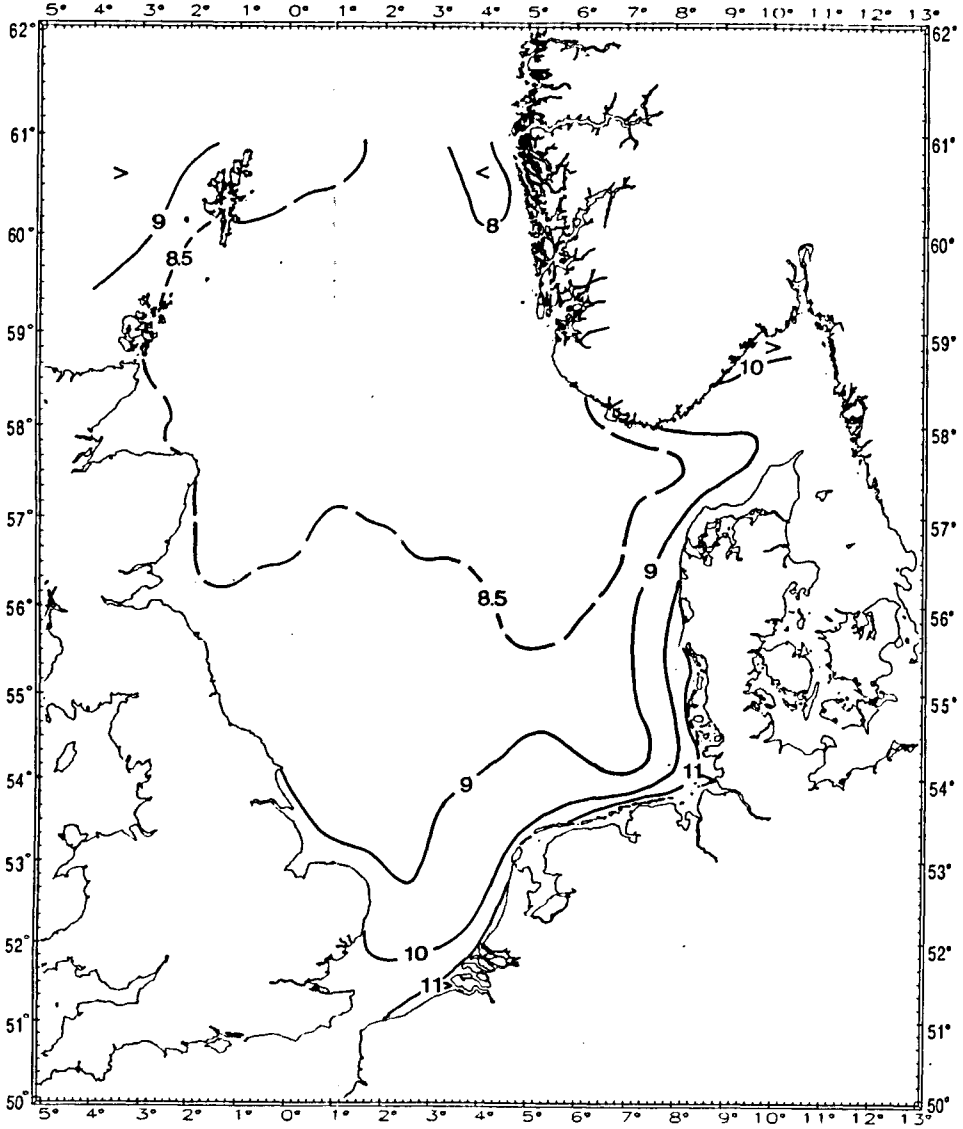

Fig. 16: SST mean values for the month of May (in °C)

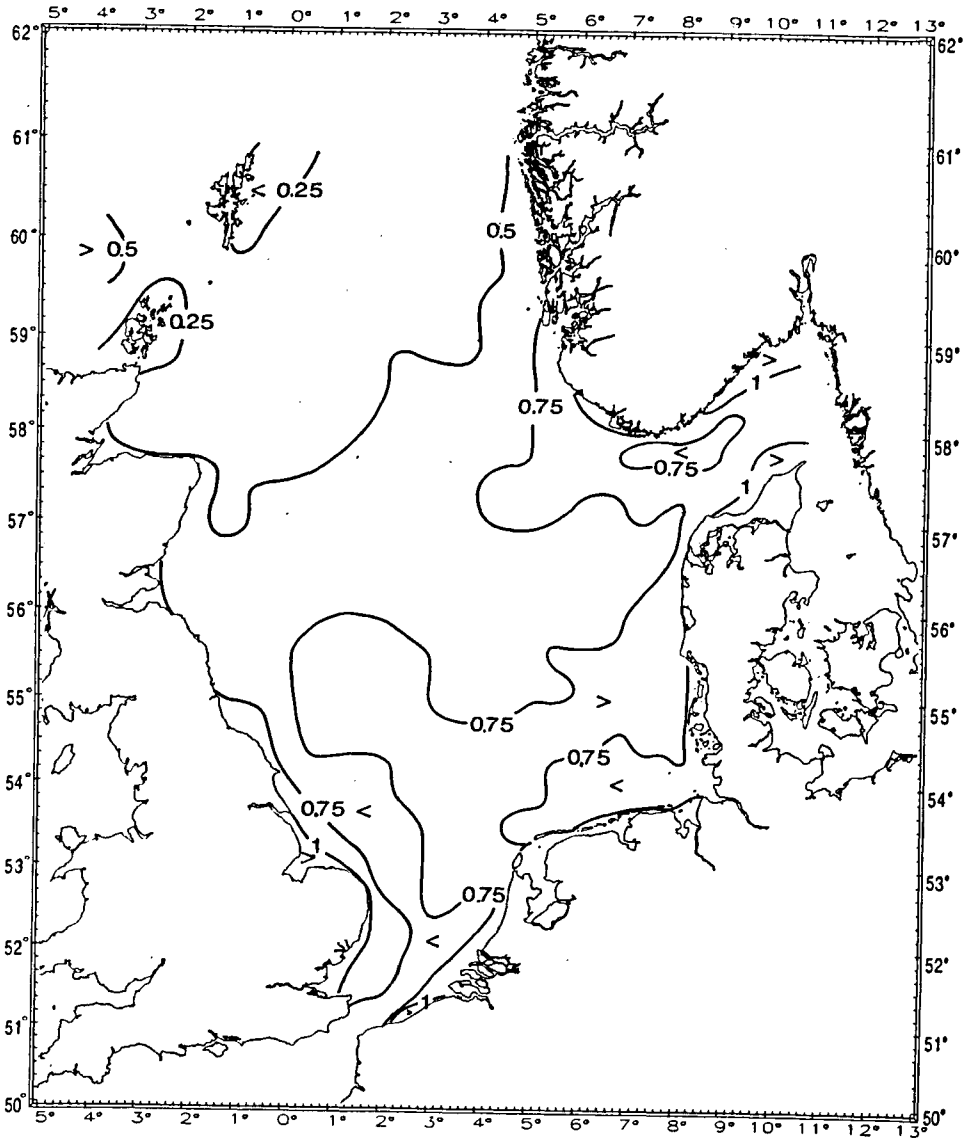

Fig. 17: Standard deviations of mean SST in May

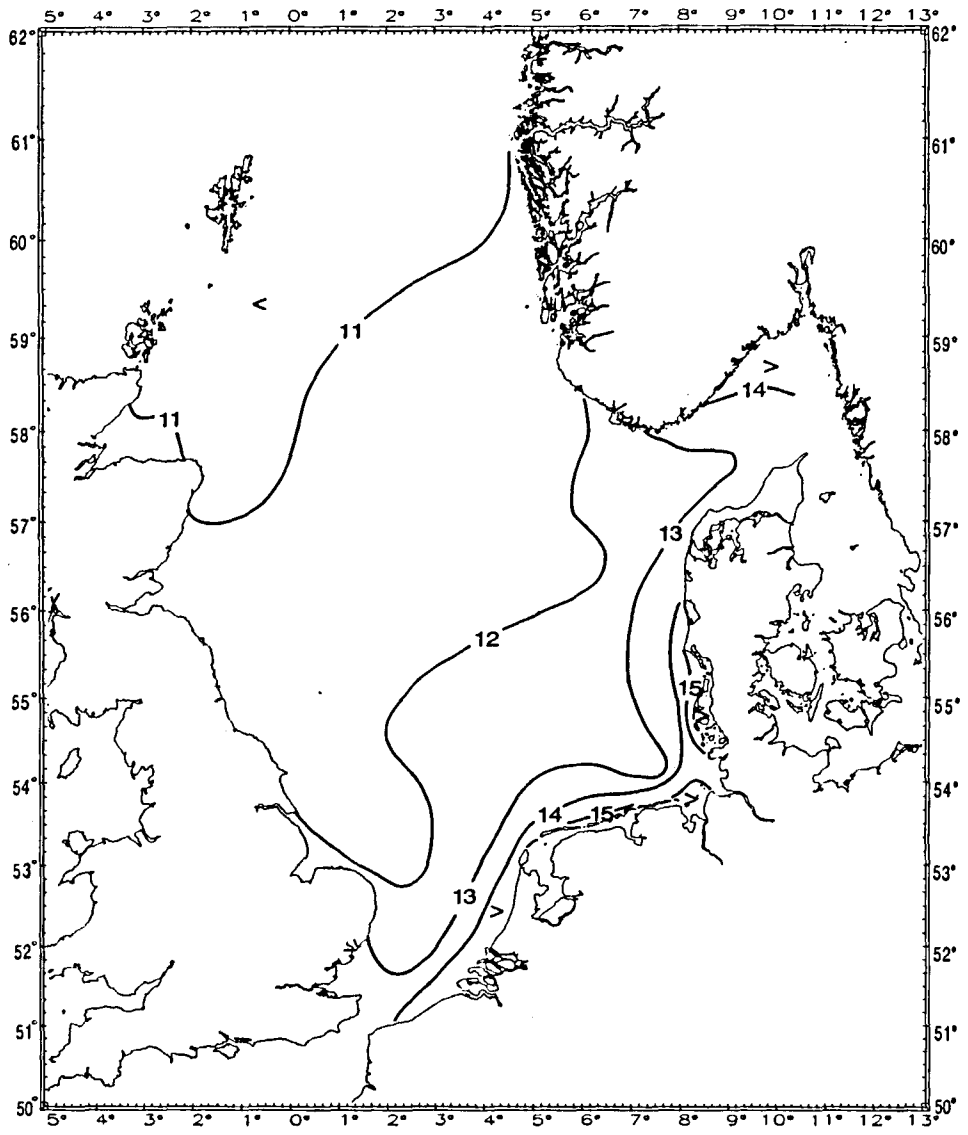

Fig. 18: SST mean values for the month of June (in °C)

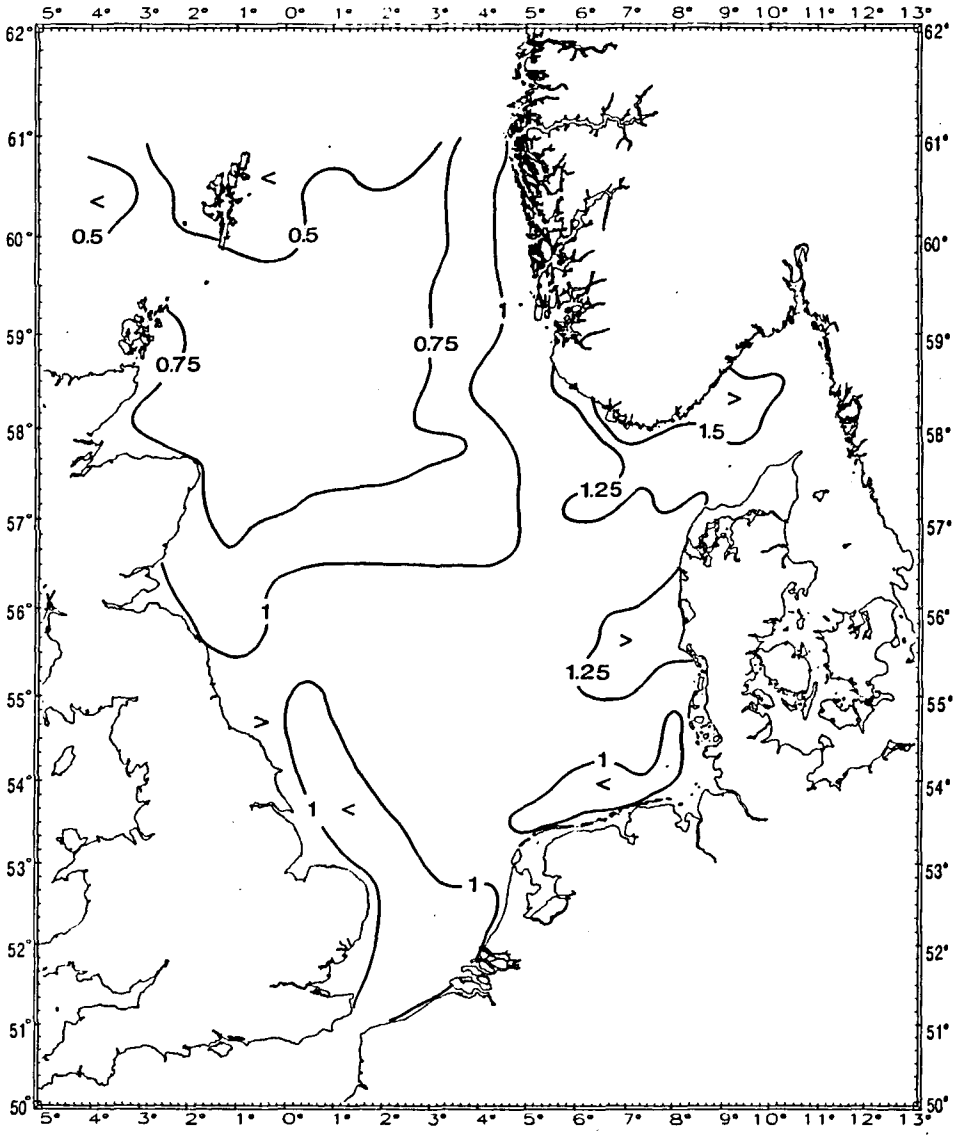

Fig. 19: Standard deviations of mean SST in June

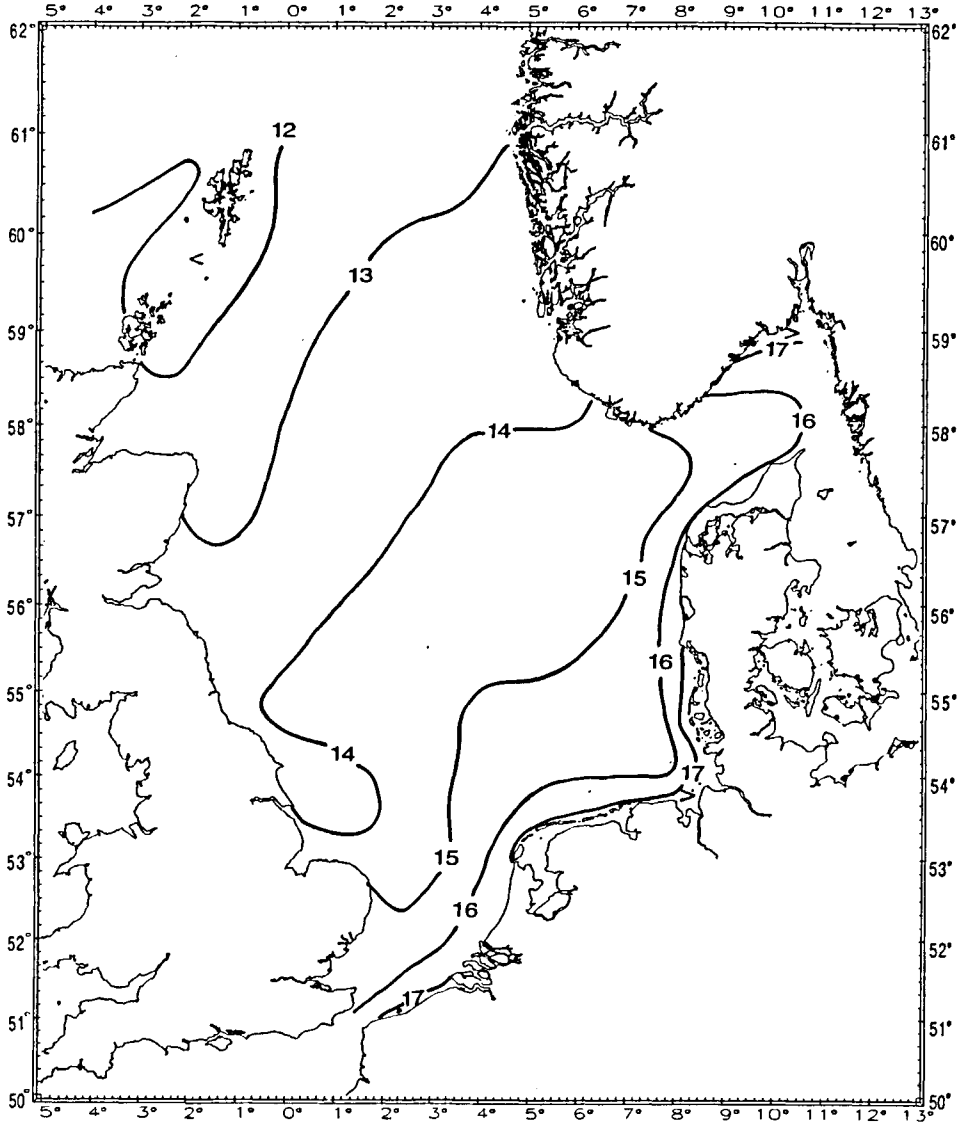

Fig. 20: SST mean values for the month of July (in °C)

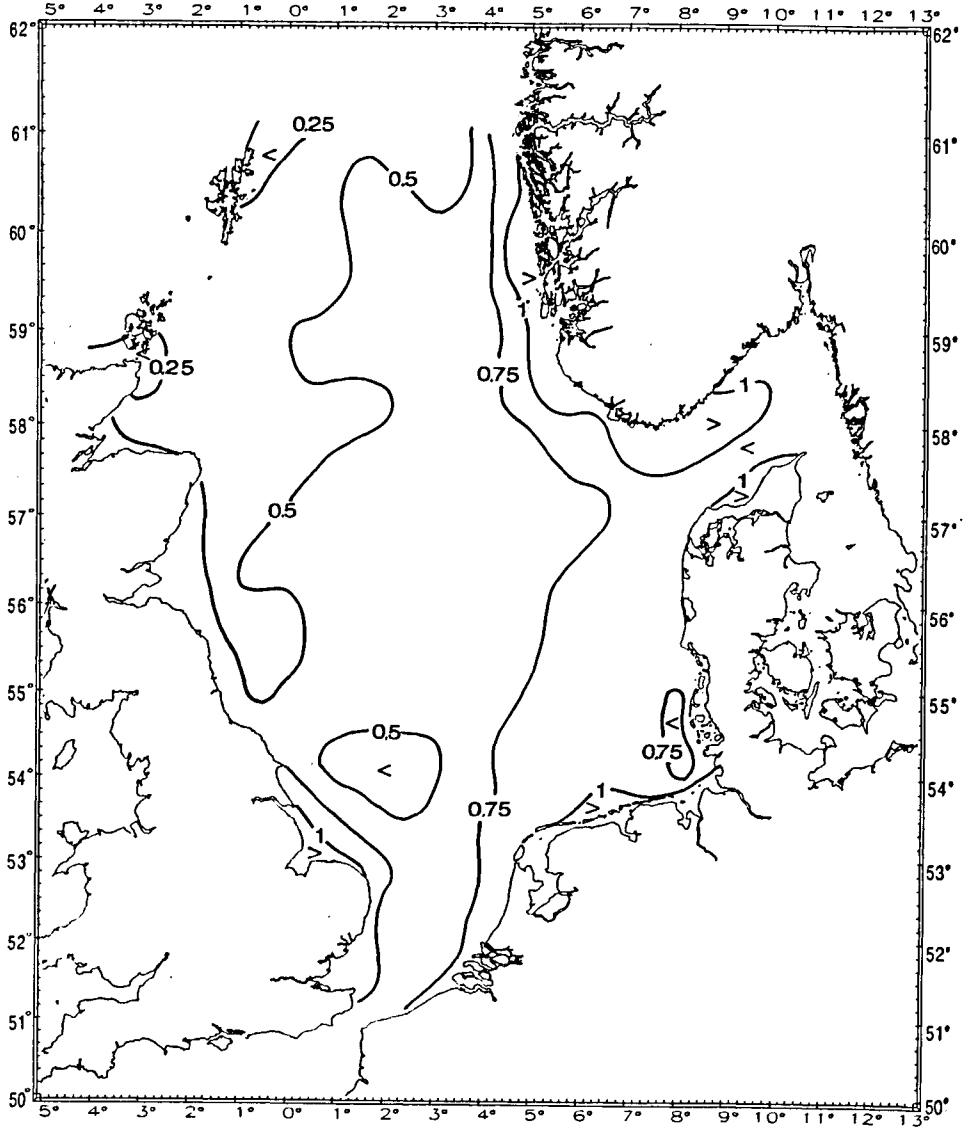

Fig. 21: Standard deviations of mean SST in July

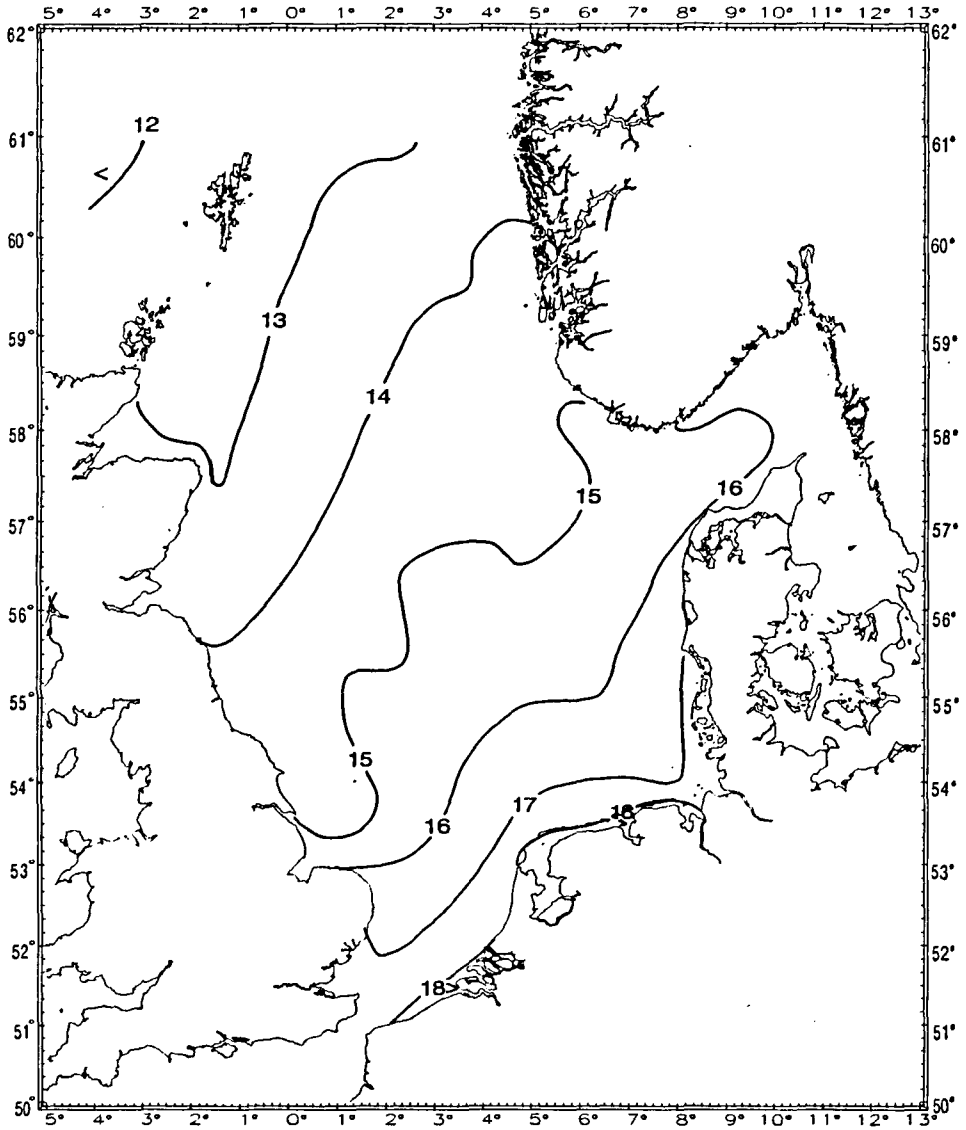

Fig. 22: SST mean values for the month of August (in °C)

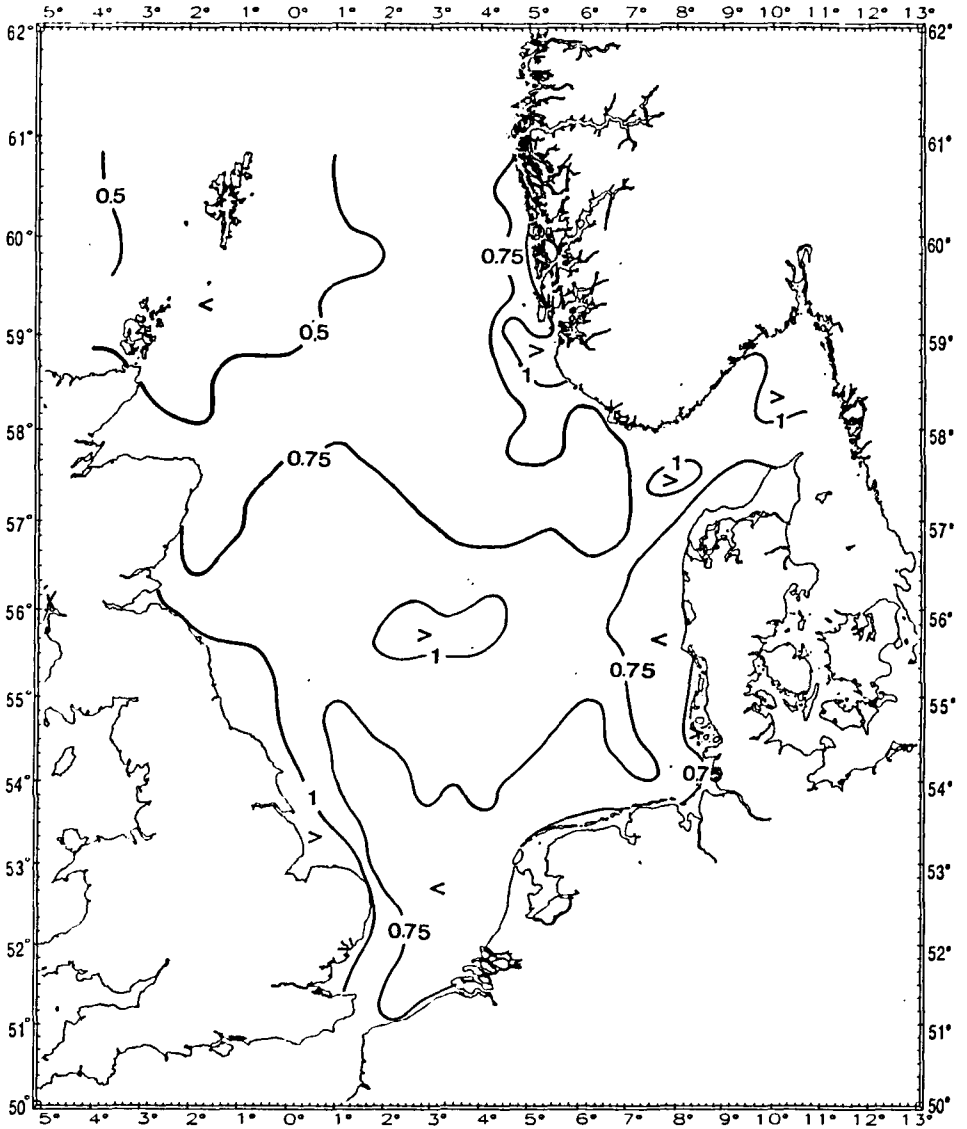

Fig. 23: Standard deviations of mean SST in August

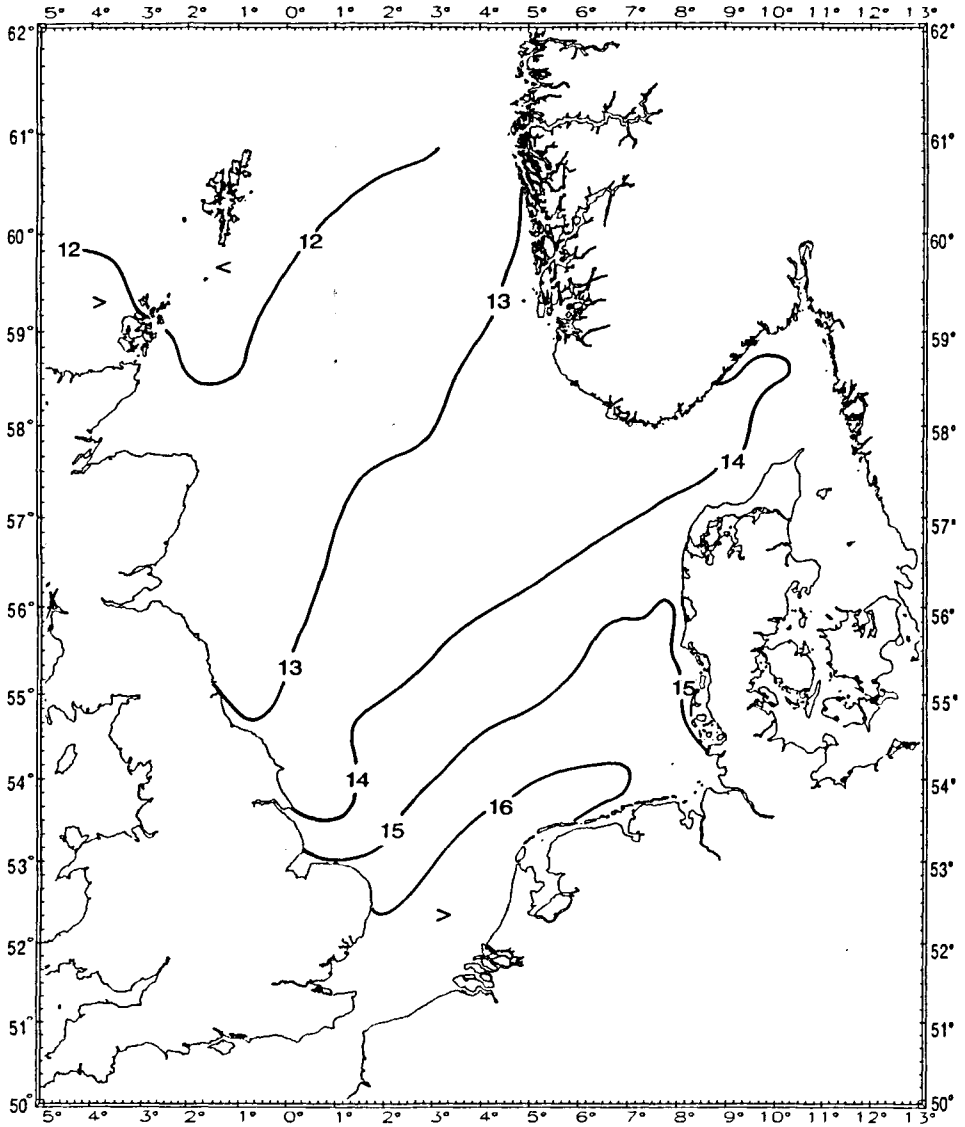

Fig. 24: SST mean values for the month of September (in °C)

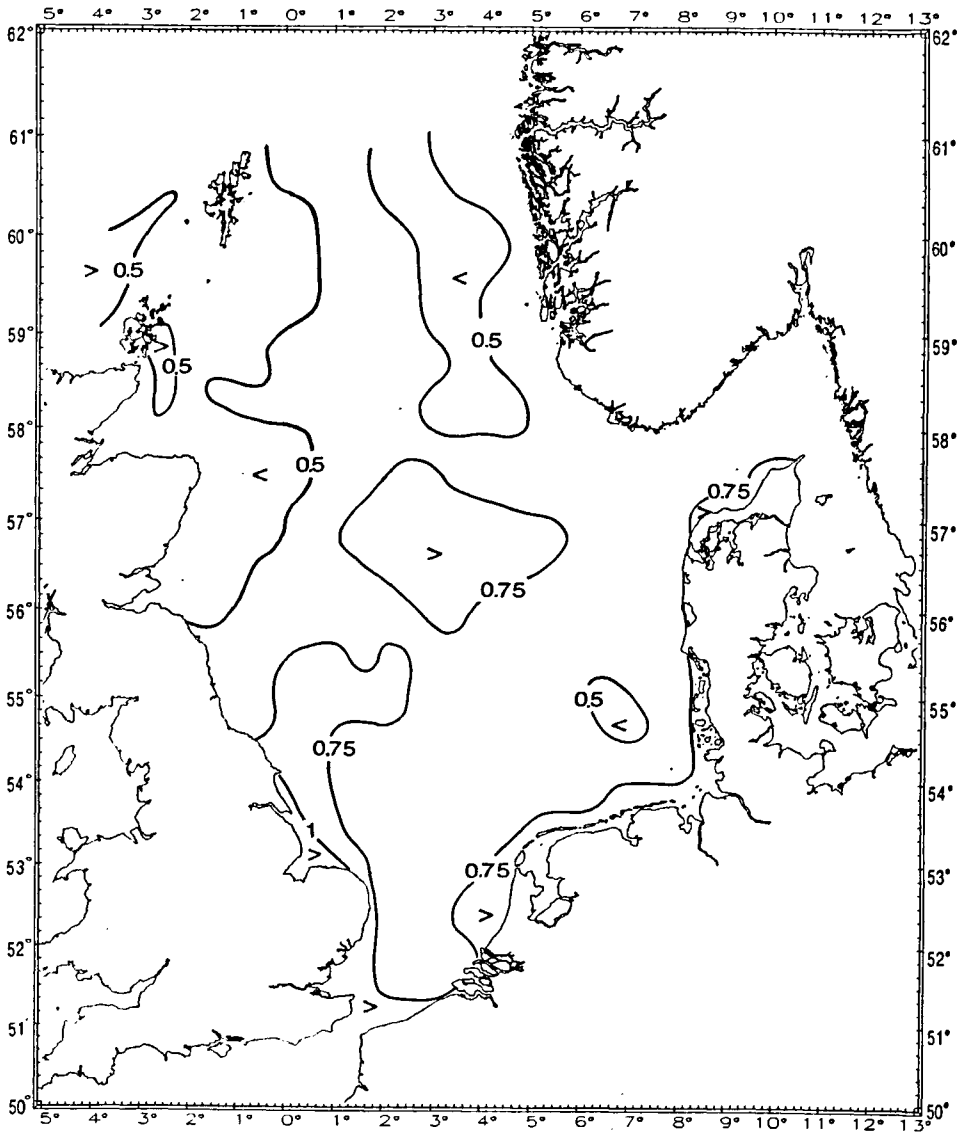

Fig. 25: Standard deviations of mean SST in September

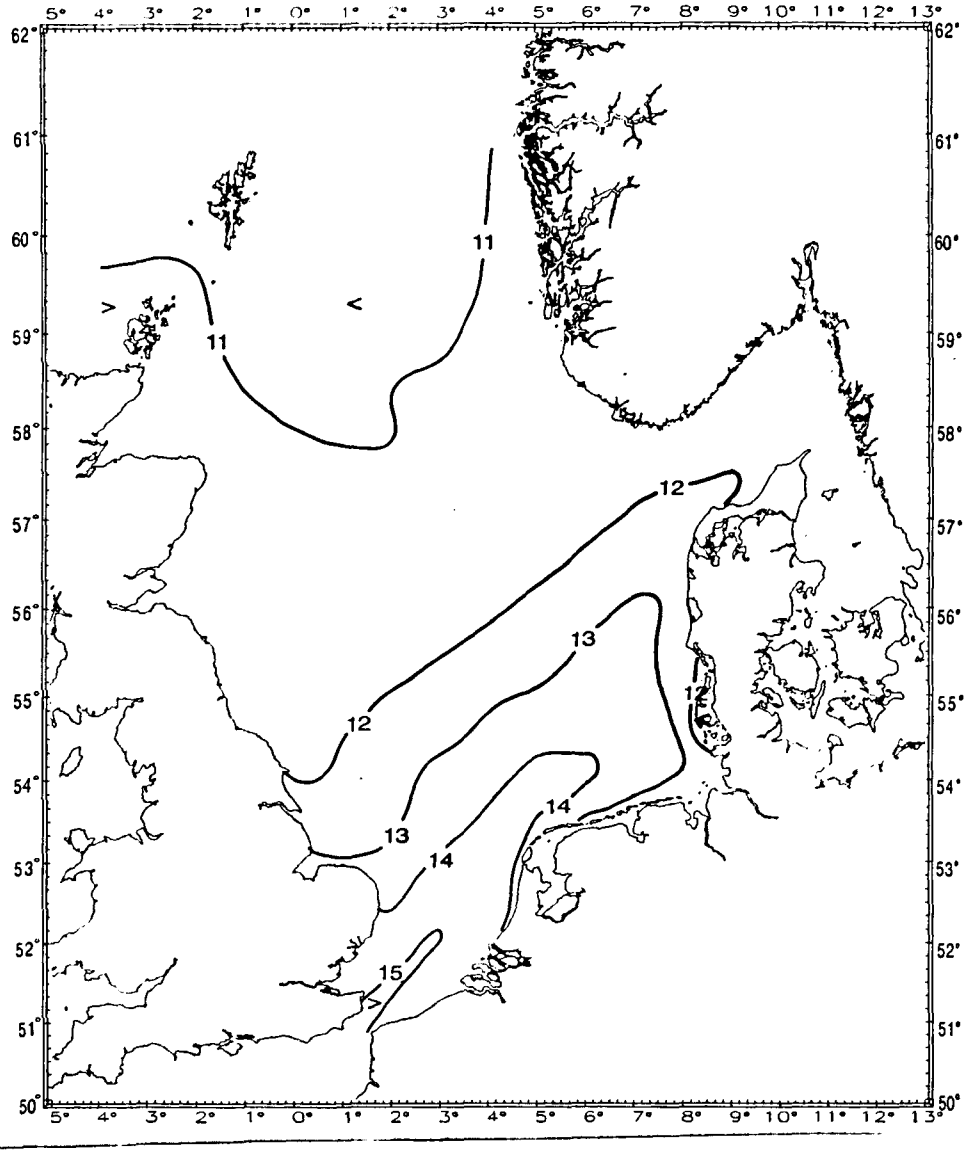

Fig. 26: SST mean values for the month of October (in °C)

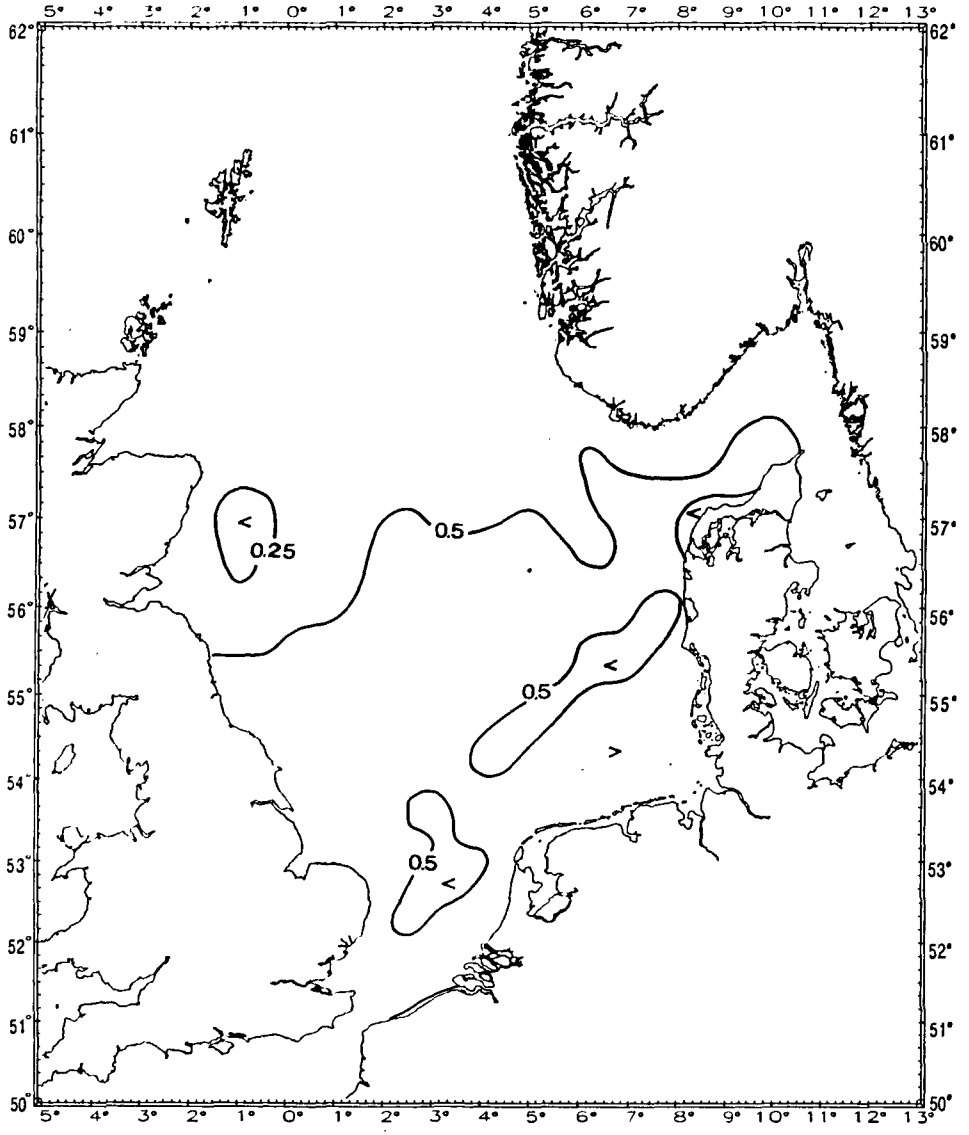

Fig. 27: Standard deviations of mean SST in October

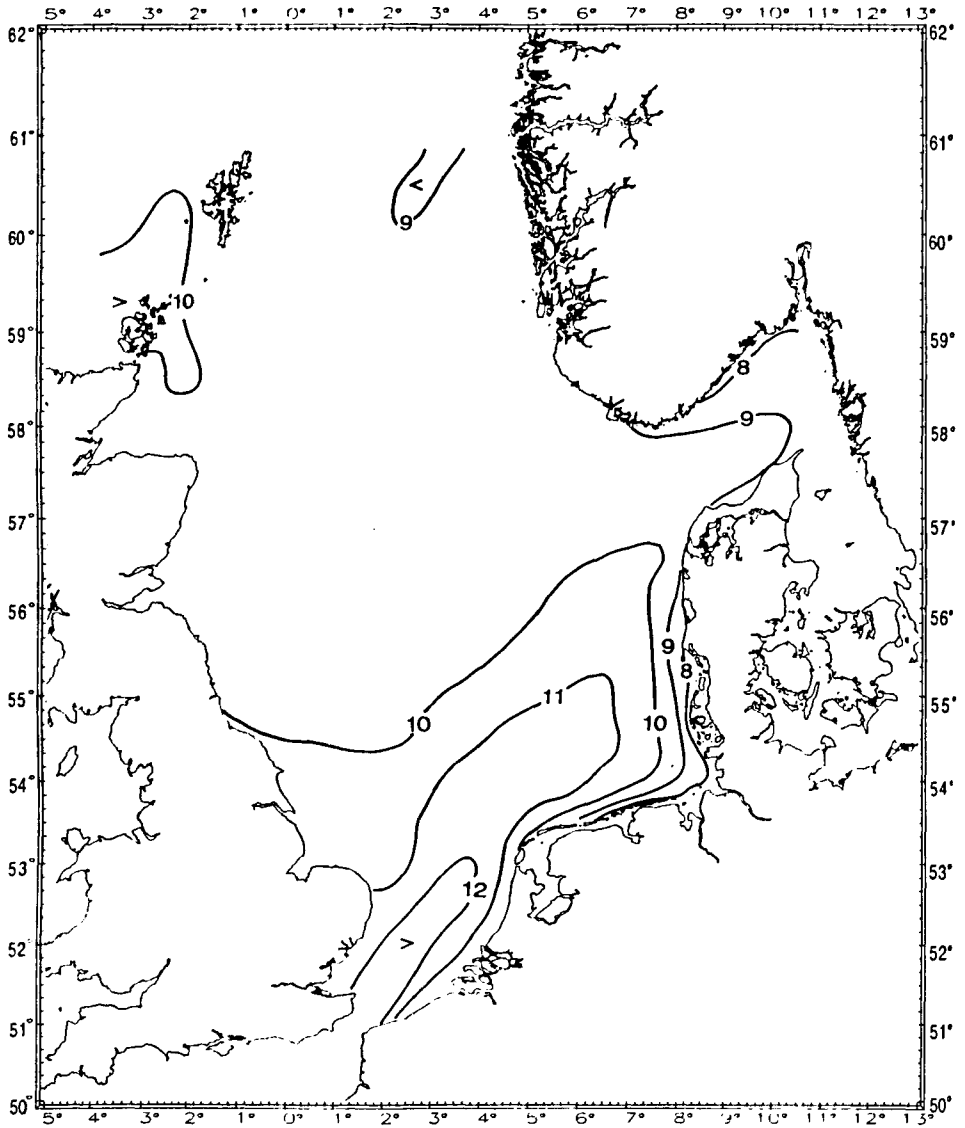

Fig. 28: SST mean values for the month of November (in °C)

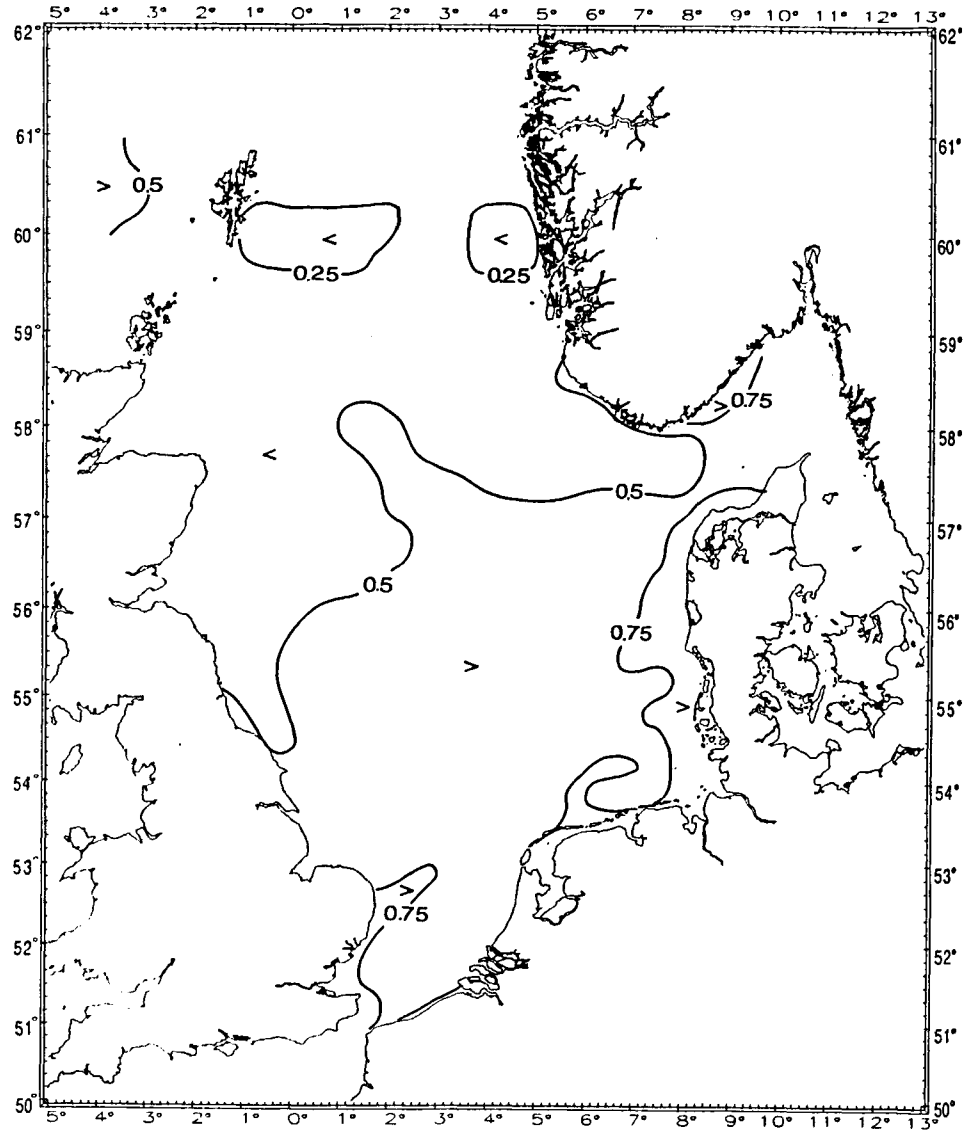

Fig. 29: Standard deviations of mean SST in November

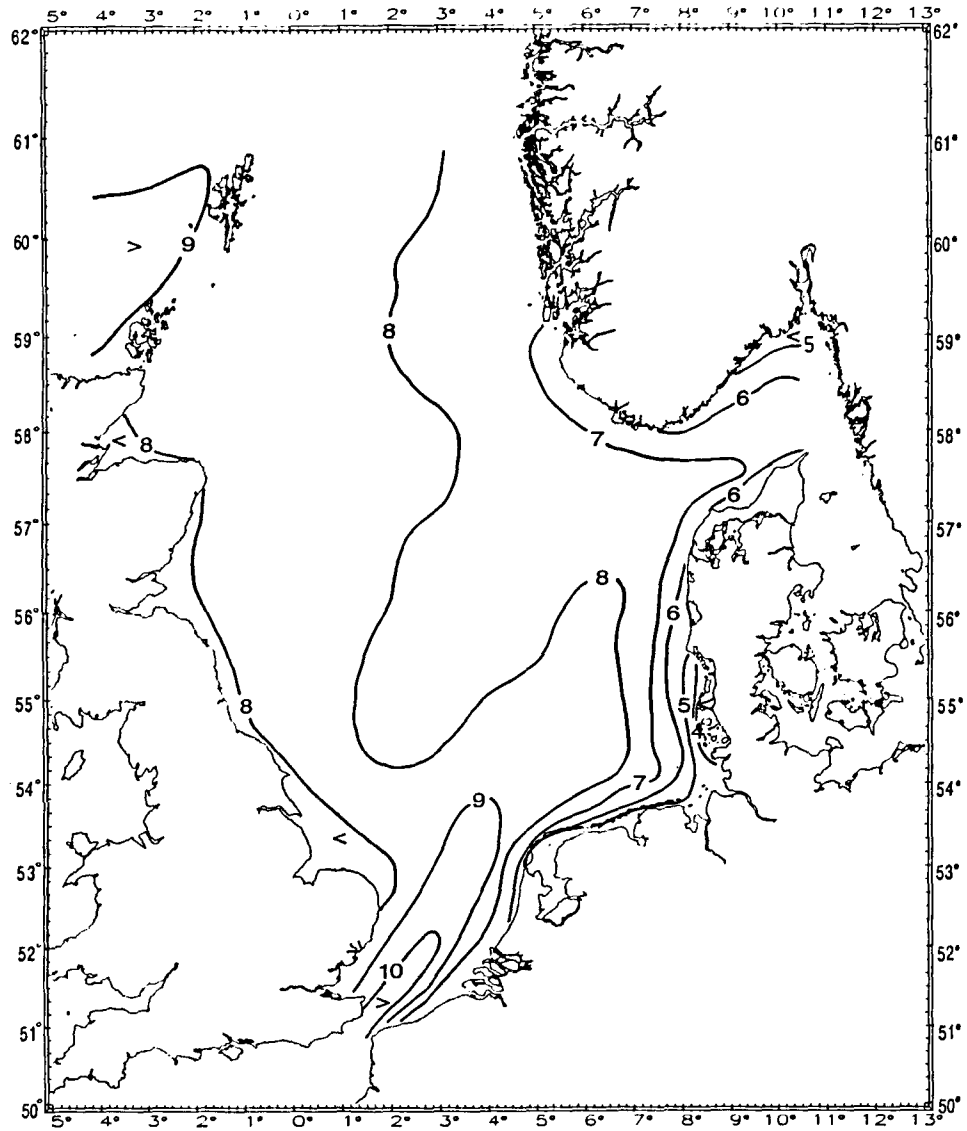

Fig. 30: SST mean values for the month of December (in °C)

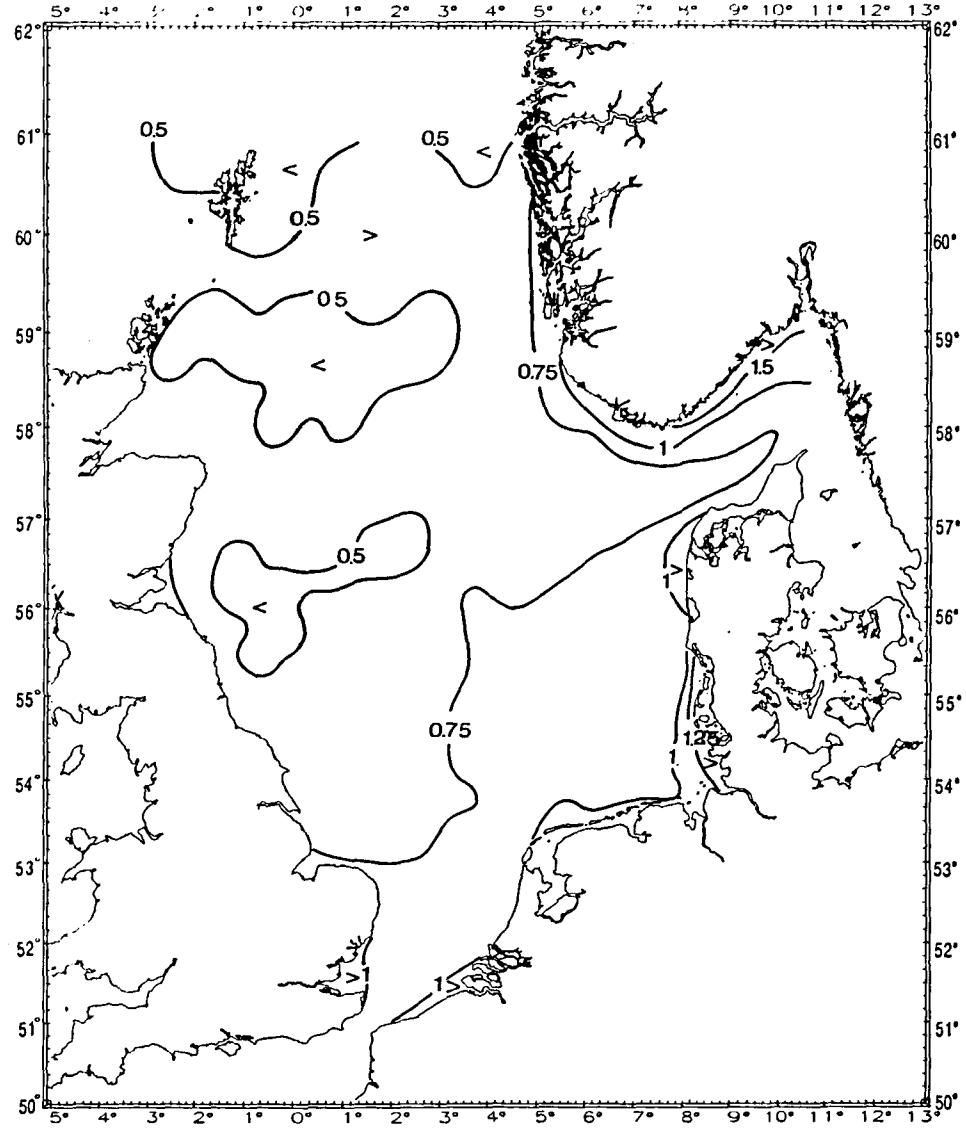

Fig. 31: Standard deviations of mean SST in December

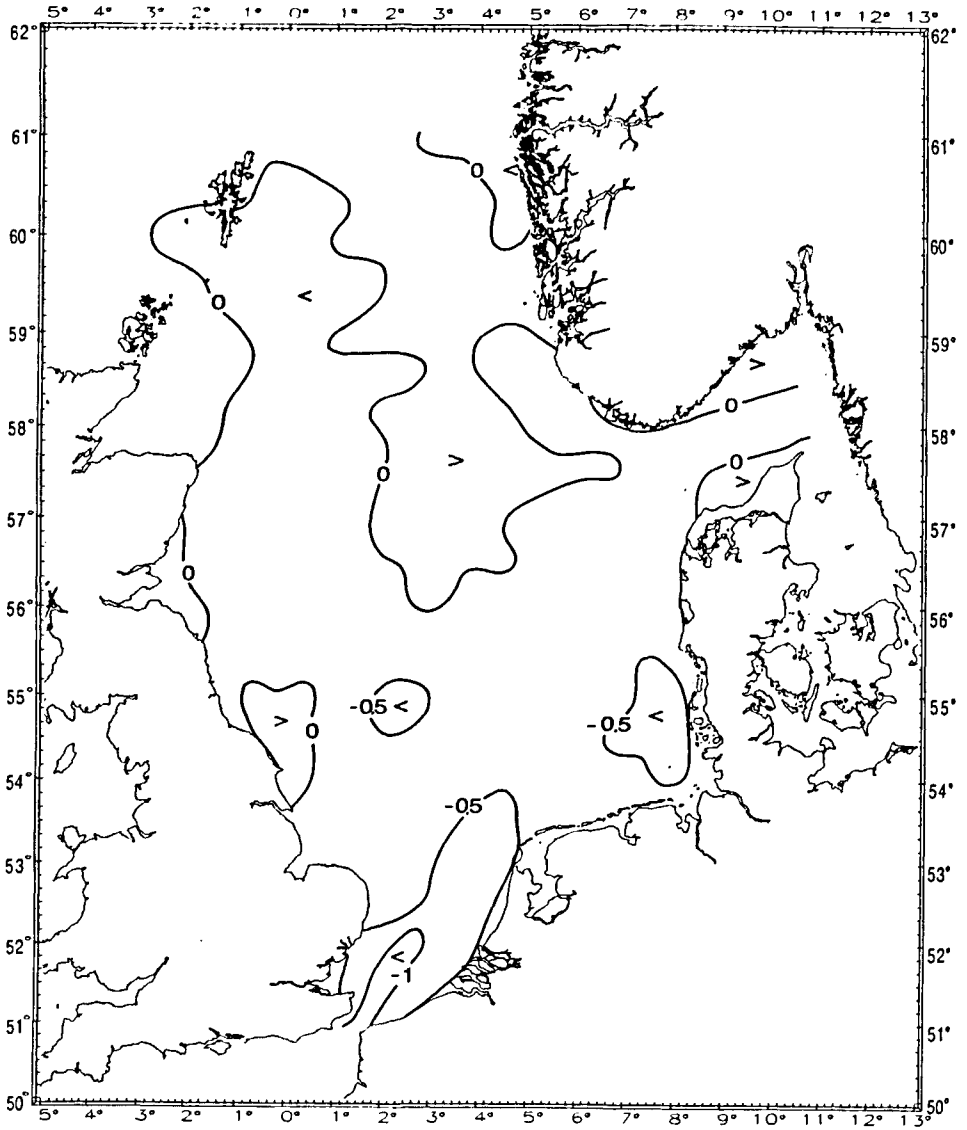

Fig. 32: Differences between the decadal mean SST for the month of February (SST (1981 to 1990) minus SST (1971 to 1980))

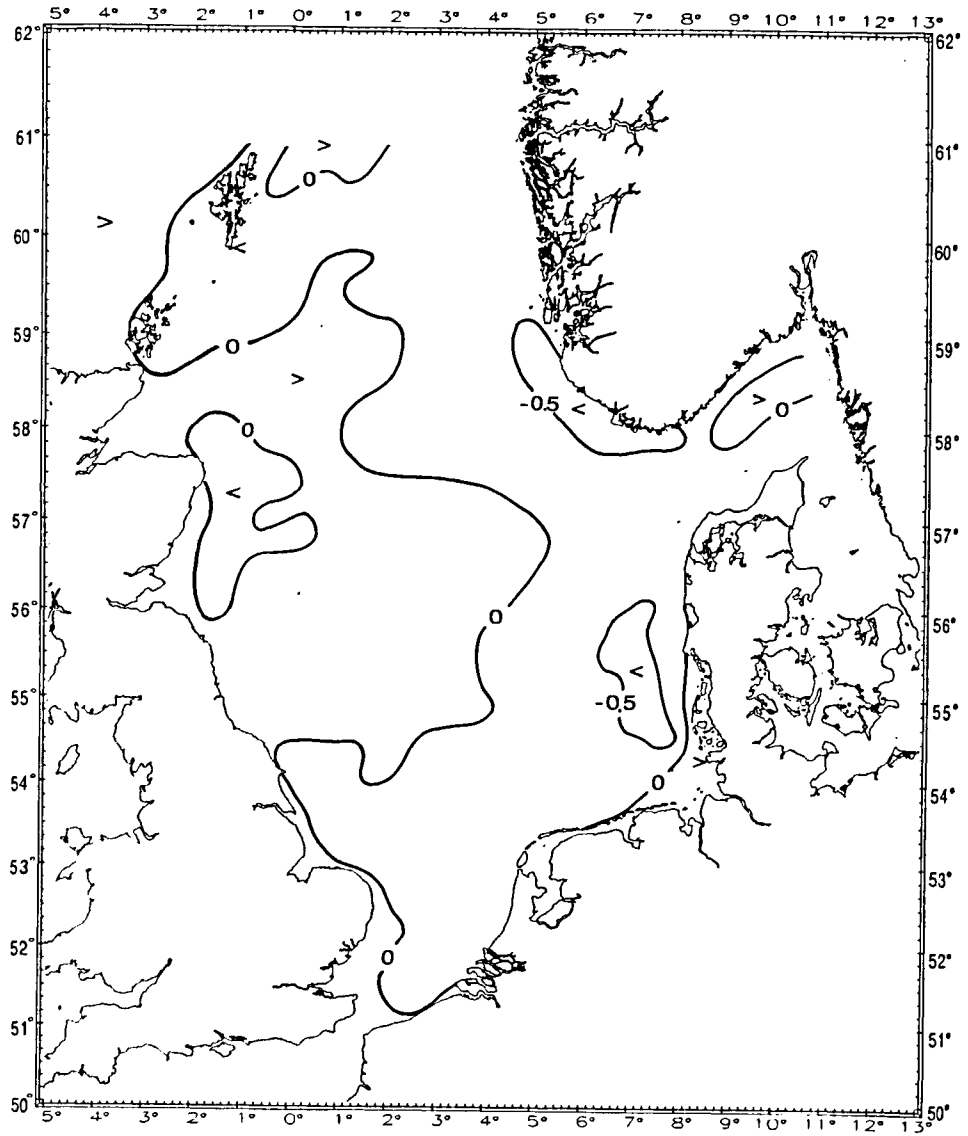

Fig. 33: Differences between the decadal mean SST for the month of May (SST (1981 to 1990) minus SST (1971 to 1980))

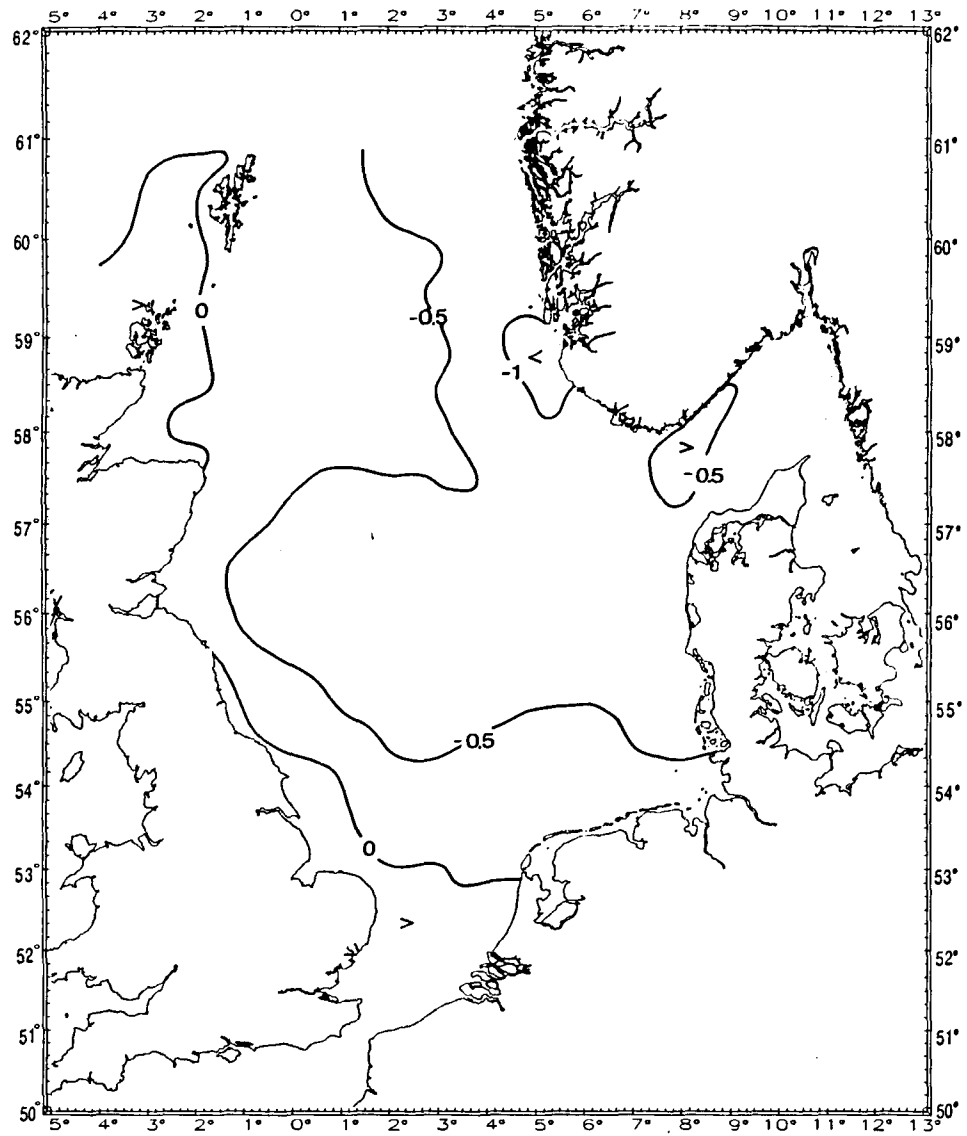

Fig. 34: Differences between the decadal mean SST for the month of August (SST (1981 to 1990) minus SST (1971 to 1980))

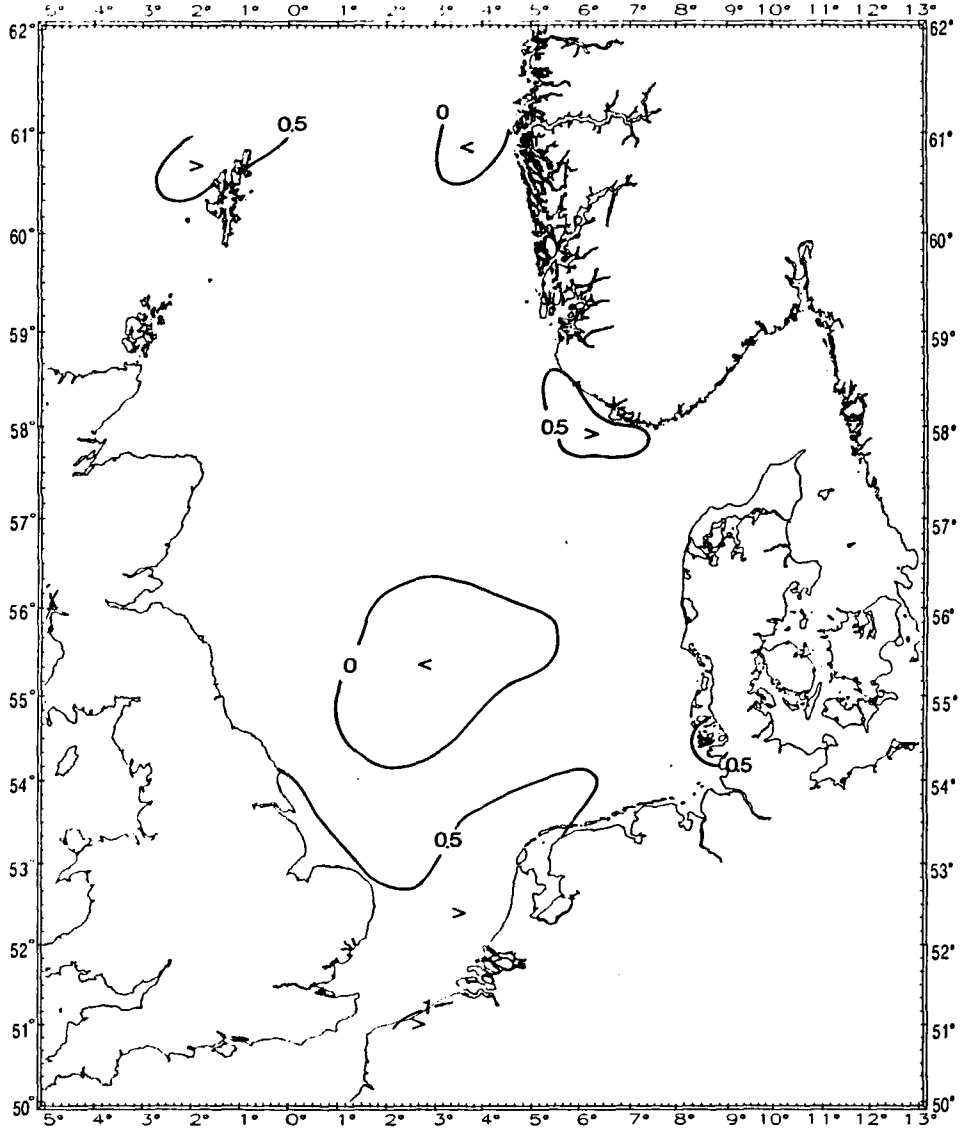

Fig. 35: Differences between the decadal mean SST for the month of November (SST (1981 to 1990) minus SST (1971 to 1980))

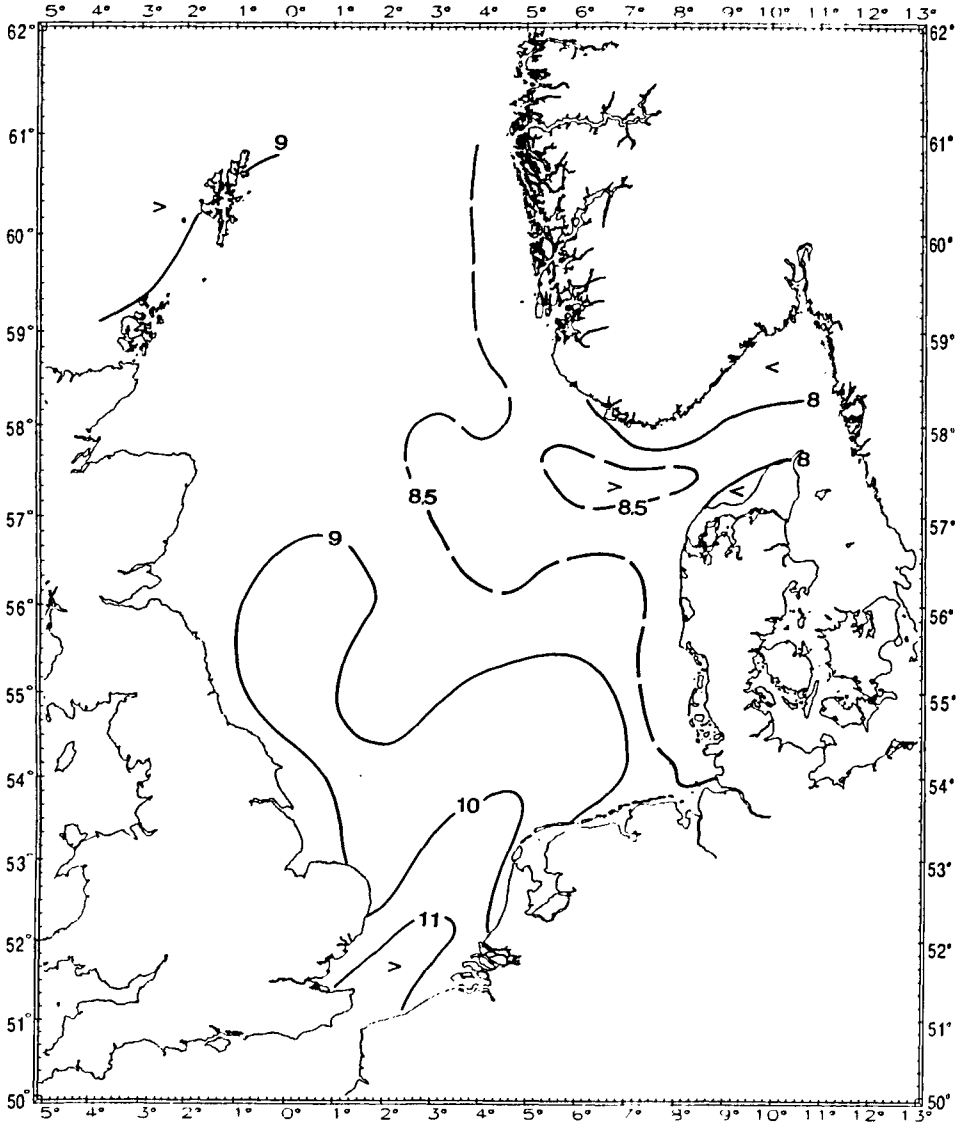

Fig. 36: Mean SST for the year 1979

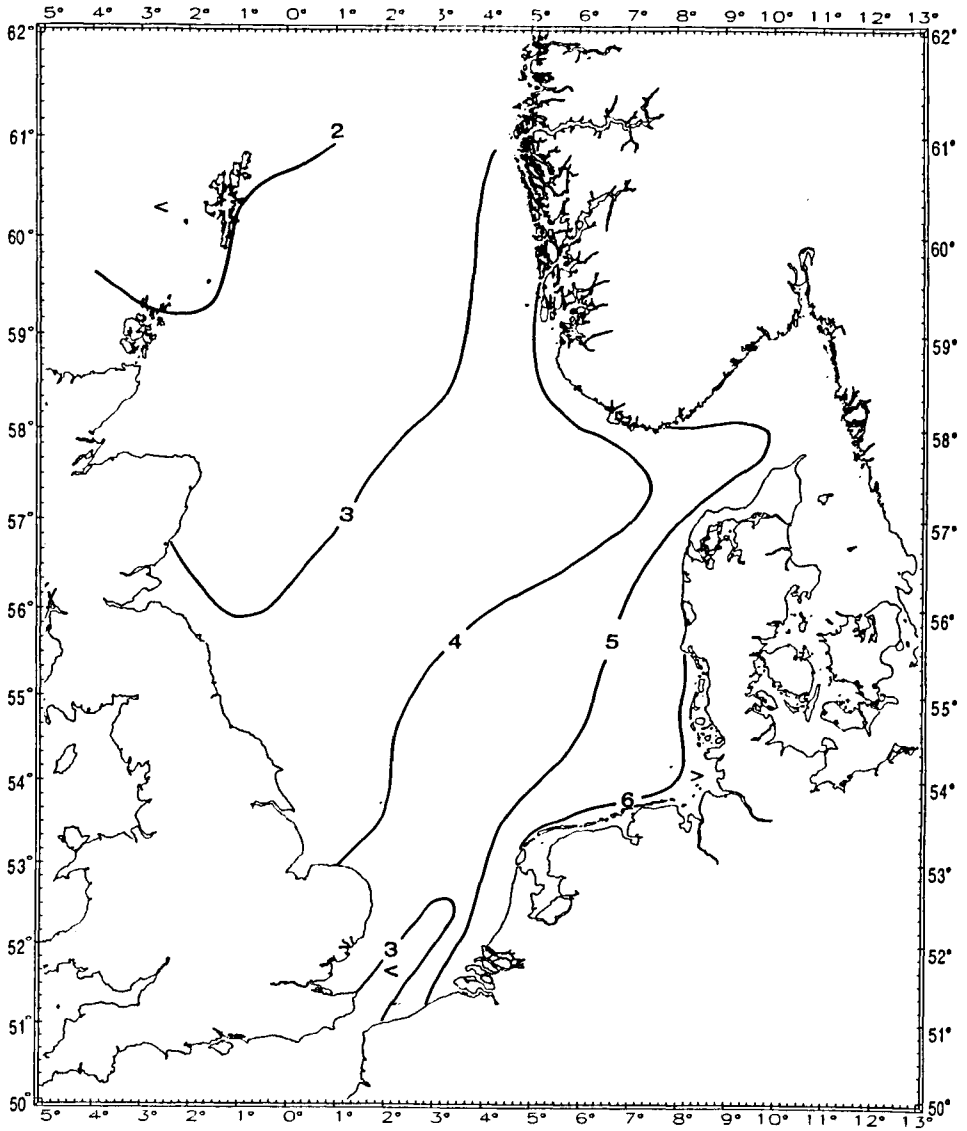

Fig. 37: Standard deviations of the 1979 mean SST

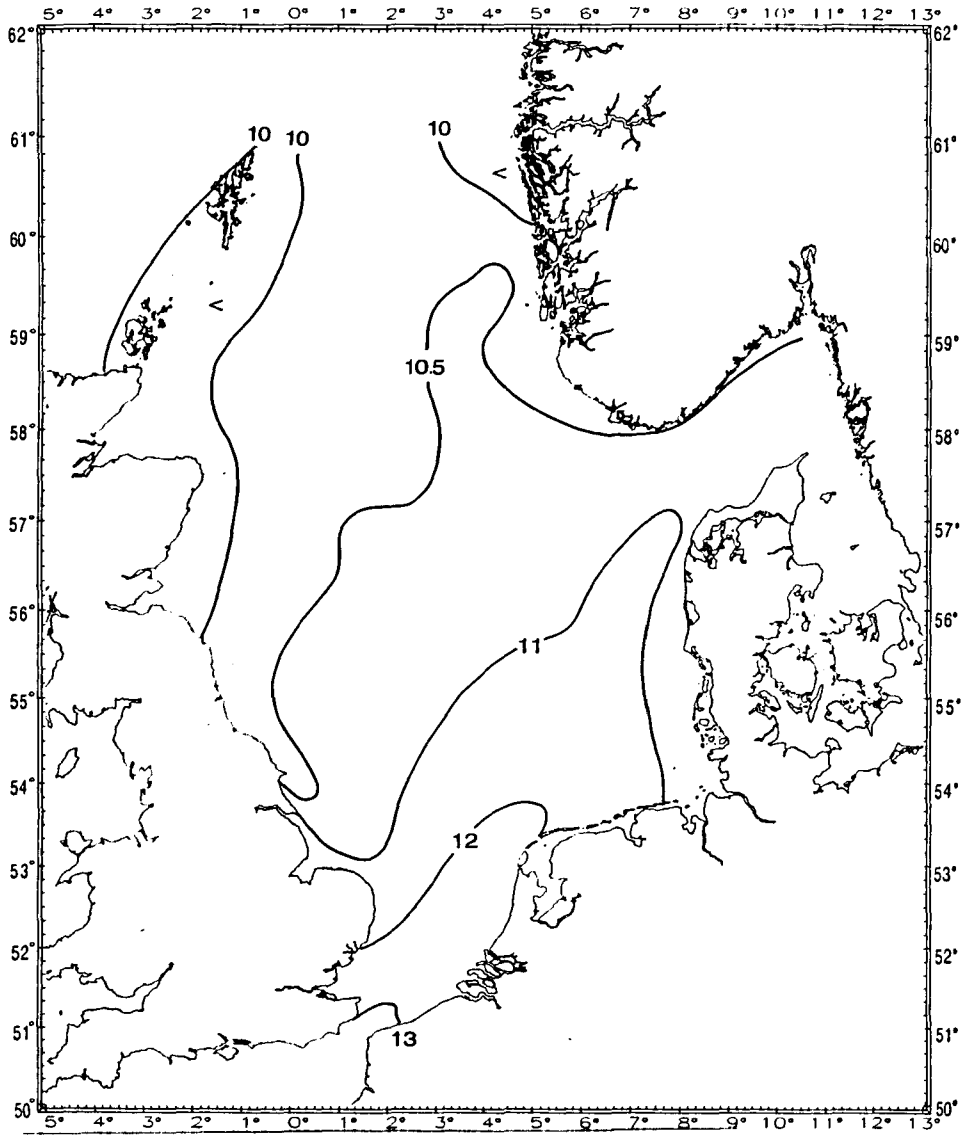

Fig. 38: Mean SST for the year 1990

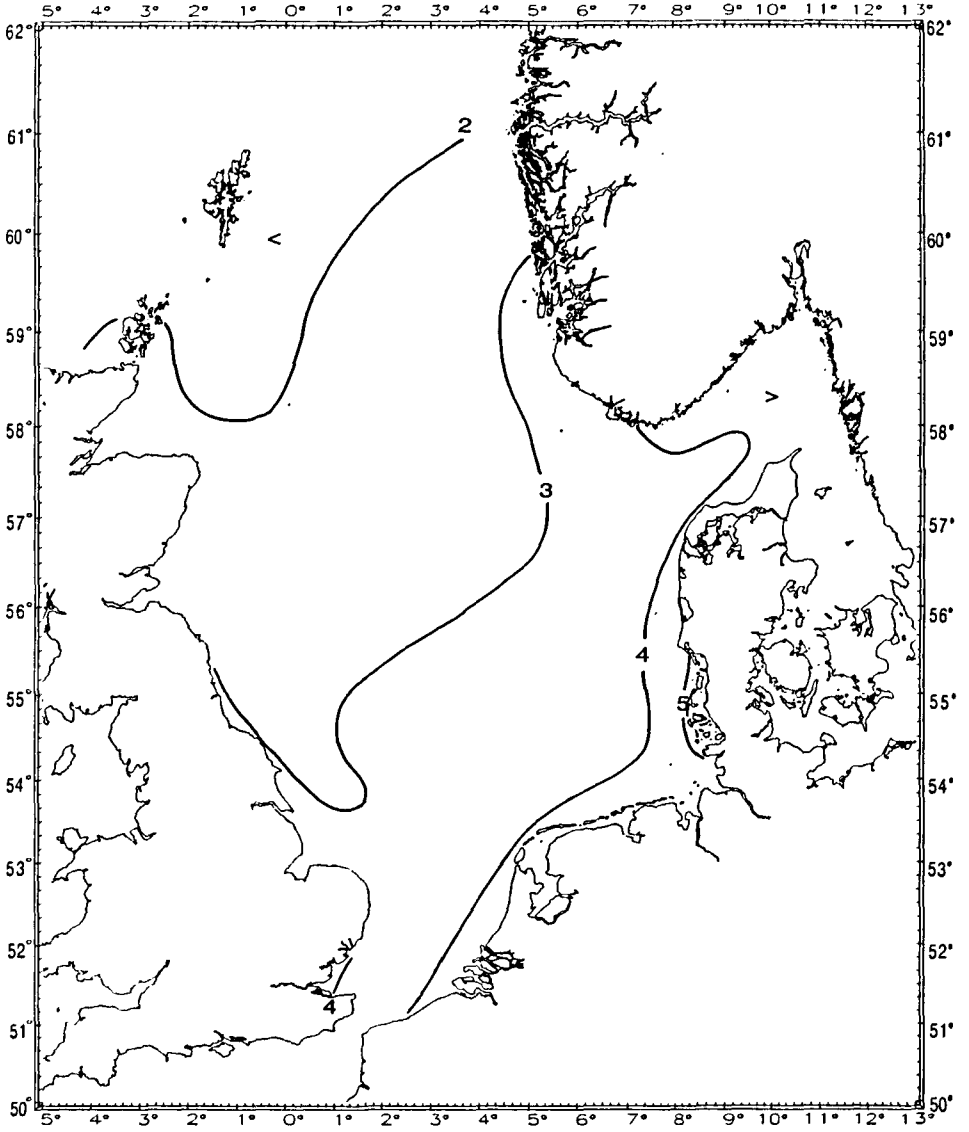

Fig. 39: Standard deviations of the 1990 mean SST