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Sea-surface Temperature in the Northwestern Atlantic in 1979

by

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Sea surface temperature (SST) data, principally collected from cooling water intakes of merchant ships, are reported in radio weather messages and log books transmitted to the U.S. Fleet Numerical Oceanography Center (FNOC) and the National Climatic Center for processing and archiving. The "real-time" reports of the data base provided by the radio messages are analyzed by FNOC and the Pacific Environmental Group of the National Marine Fisheries Service, which is co-located with FNOC. An elementary step in the analysis is the computation of average monthly temperatures and anomalies (from 1948-67 means) for each 1° x 1° square for which enough data have been reported each month. The average SST's, anomalies and number of observations are then printed in the 1° x 1° squares they characterize to produce a map such as the one shown in figure 1. To facilitate interpretation of the data, anomalies greater than +1°C or less than -1°C are shaded.

Monthly maps of this sort for the northwestern Atlantic for 1979 (figs. 1-12) reveal that an area of colder-than-average water developed throughout the western section from Cape Hatteras to Nova Scotia in February, weakened slightly in March, and disintegrated in April. The weather changes which produced this sequence are clearly shown in meteoro-

logical data collected at coastal weather stations. For example, data from the Boston, Massachusetts station showed that below normal air temperatures occurred in February (4.1°C colder than normal) and were accompanied by vigorous westerly winds (average speed 8.1 m/sec). This combination of factors caused a strong flow of cold, dry air over coastal waters and caused rapid cooling of the surface water. In March more moderate weather conditions prevailed, particularly in the last 10 days of the month. The average air temperature in March was 2.4°C above normal with weaker westerly winds (average speed 6.6 m/sec). The moderation in weather continued in April, with nearly average air temperatures and less vigorous winds, which became southerly during the latter third of the month.

The most unusual occurrence in the surface layer temperature field in 1979, however, was the development of a band of warm temperature anomalies between 38 and 40°N in the western section in May (fig. 5). One month later, in June, this band appears to have shifted northward and broadened to occupy the area between 41 and 46°N. By July the area of positive anomalies disintegrated except for a small region southwest of Nova Scotia. The link between this warm anomaly and coastal meteorological conditions was not as apparent as was the case in the winter.

In order to characterize the SST of the entire area (35-46°N, 60-76°W) with a single number, the mean of all the mapped anomalies was computed for each month. The resulting monthly area means (table 1) show a strongly negative value only in February and strongly positive ones in May and June.

Spatial and temporal gradients of SST in the nearshore shelf waters can be portrayed by plotting the monthly anomalies from selected coastal one-degree squares on a space-time grid. Figure 13 is a plot such as this for 15 one-degree squares between Cape Hatteras and Nova Scotia for 1979 (fig. 14). The plot clearly shows the widespread effect of the cooling which took place in late January and February; all 15 squares showed negative anomalies in February. The anomalously cold water appears to have persisted longer in the southern squares (13-15) than in the others. The development of warmer-than-usual water in April-July occurred in the northern squares only.

In contrast with the 1979 conditions, those in 1978 (fig. 15) led to the development of a long-lasting (February-July) band of negative anomalies in the southern half of the area (squares 6-15), but only weak positive anomalies appeared in the July-November period.

Table 1. Anomalies of monthly mean sea-surface temperature (°C) from the long-term mean (1948-67) for 1979 in the northwestern Atlantic Ocean (35-46°N, 60-76°W)

Month	Number of 1° Squares	Area Mean Anomaly	Standard Deviation of Area Mean Anom. 1948-67
Jan	117	-0.18	1.26
Feb	109	-0.80	1.23
Mar	121	-0.35	1.49
Apr	126	+0.20	1.51
May	133	+0.60	1.22
Jun	130	+0.65	0.91
Jul	127	-0.39	0.89
Aug	126	0.00	0.85
Sep	128	+0.29	0.89
Oct	126	-0.02	0.95
Nov	121	+0.42	0.90
Dec	105	+0.28	0.91

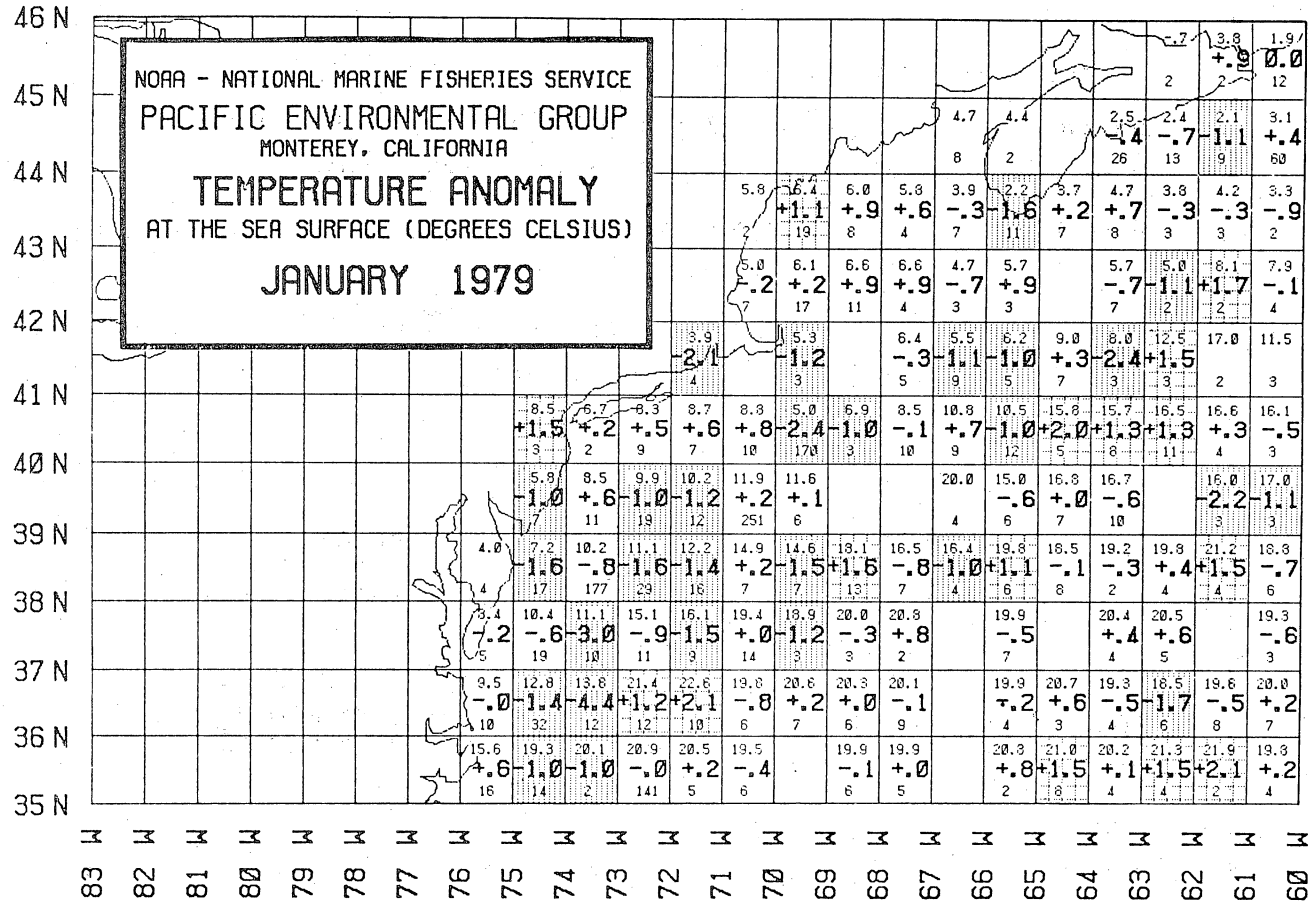

Figure 1. Average sea-surface temperature anomalies (°C) for January 1979. Also shown in each 1° square are average sea-surface temperatures (upper number) and the number of observations (lower number).

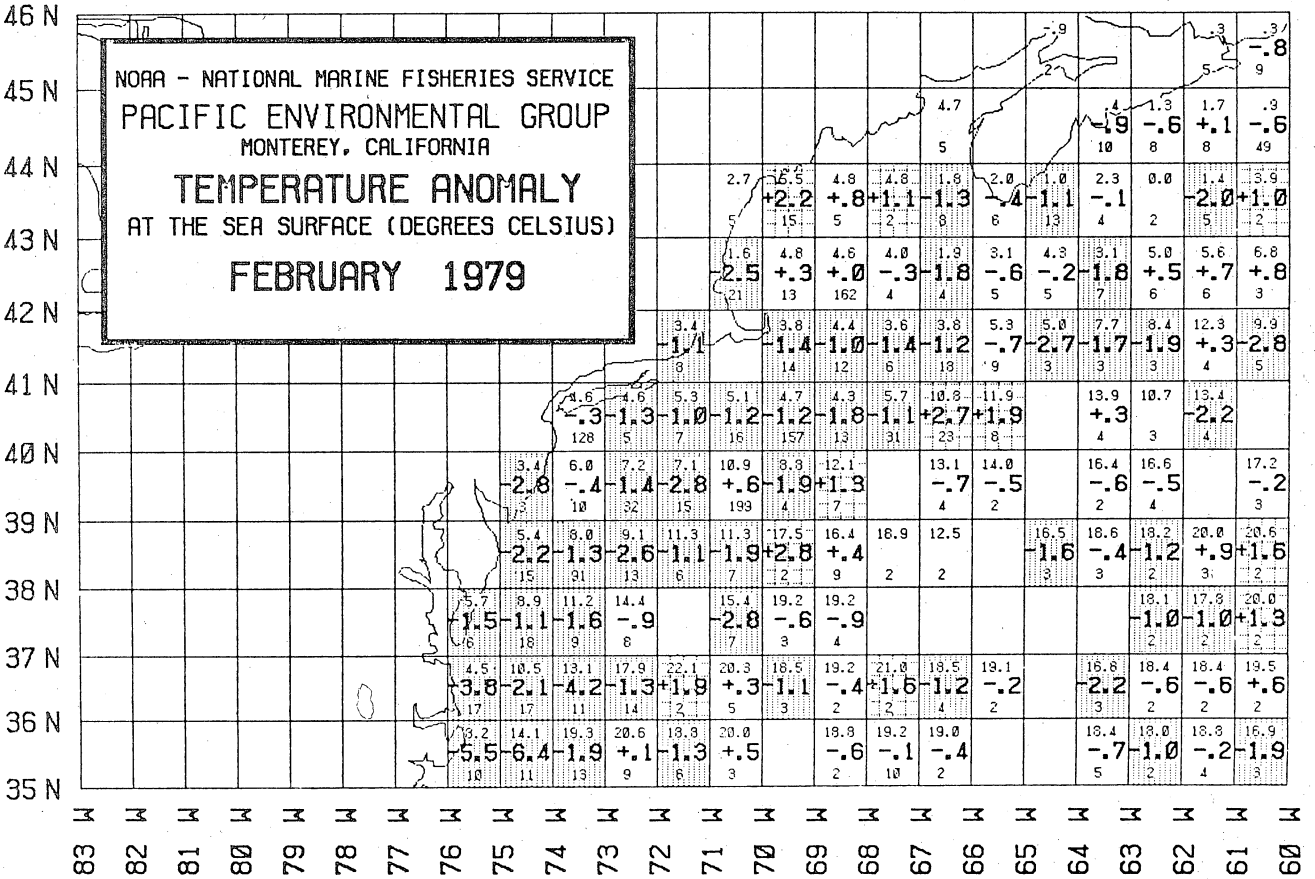

Figure 2. Average sea-surface temperature anomalies (°C) for February 1979. Also shown in each 1° square are average sea-surface temperatures (upper number) and the number of observations (lower number).

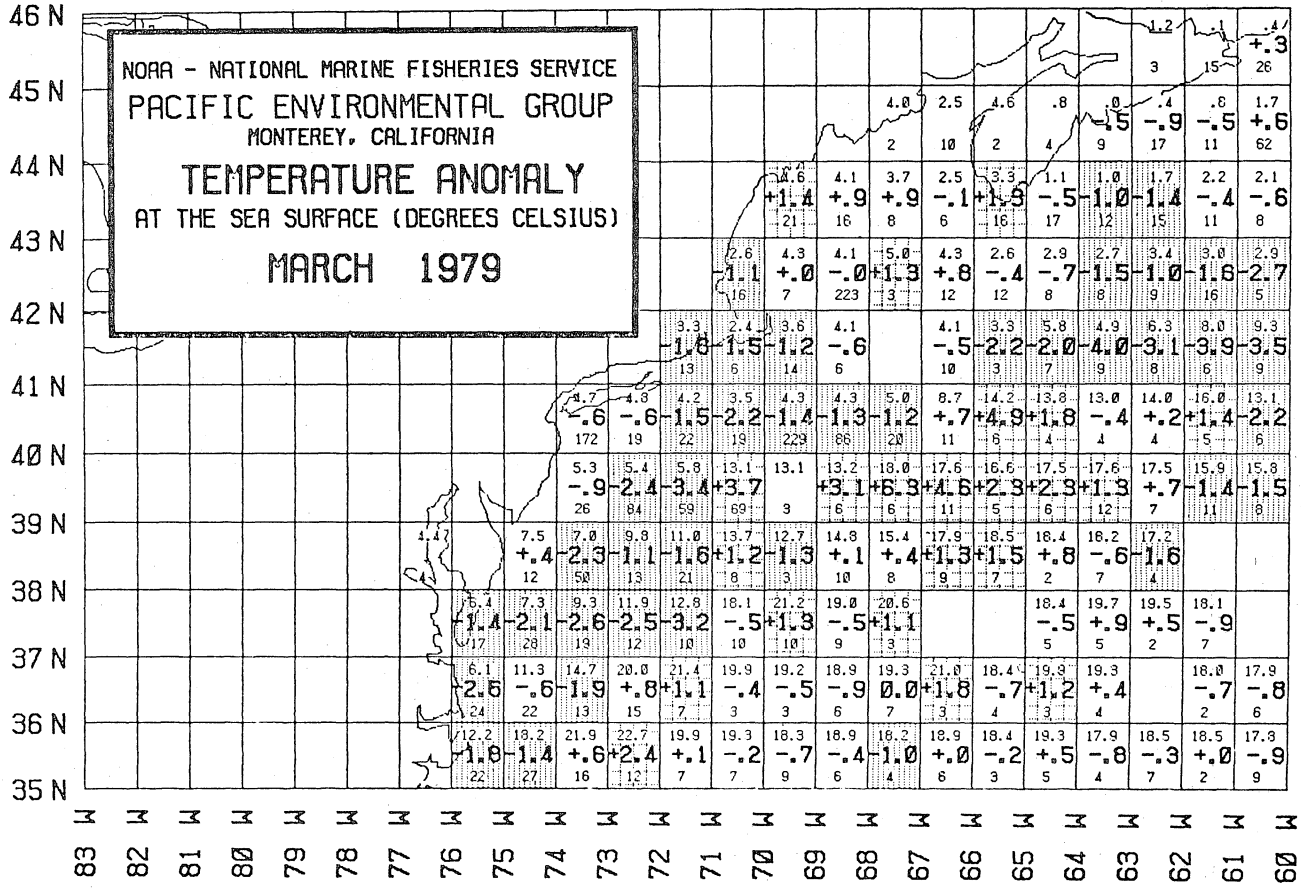

Figure 3. Average sea-surface temperature anomalies (°C) for March 1979. Also shown in each 1° square are average sea-surface temperatures (upper number) and the number of observations (lower number).

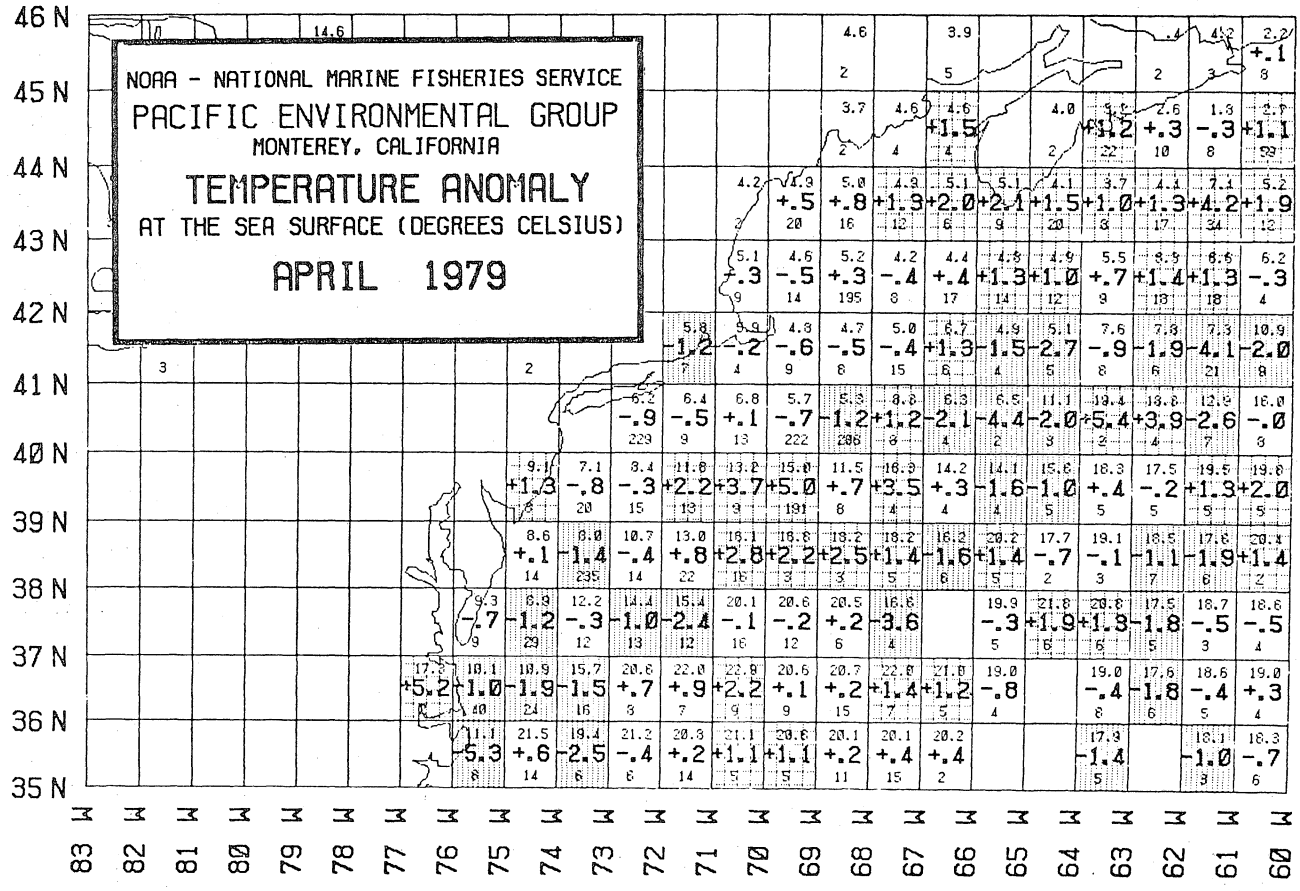

Figure 4. Average sea-surface temperature anomalies (°C) for April 1979. Also shown in each 1° square are average sea-surface temperatures (upper number) and the number of observations (lower number).

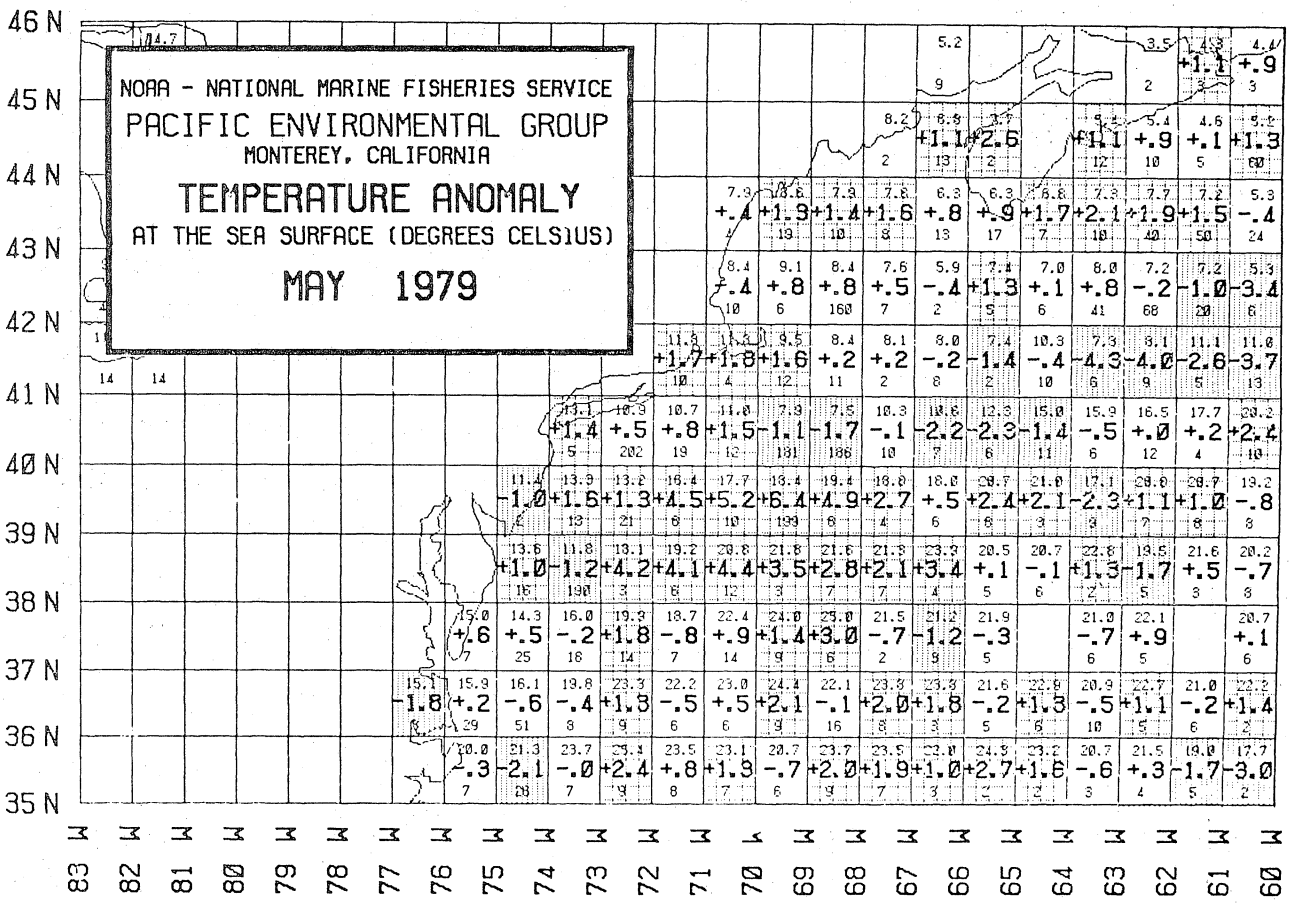

Figure 5. Average sea-surface temperature anomalies (°C) for May 1979.
Also shown in each 1° square are average sea-surface temperatures
(upper number) and the number of observations (lower number).

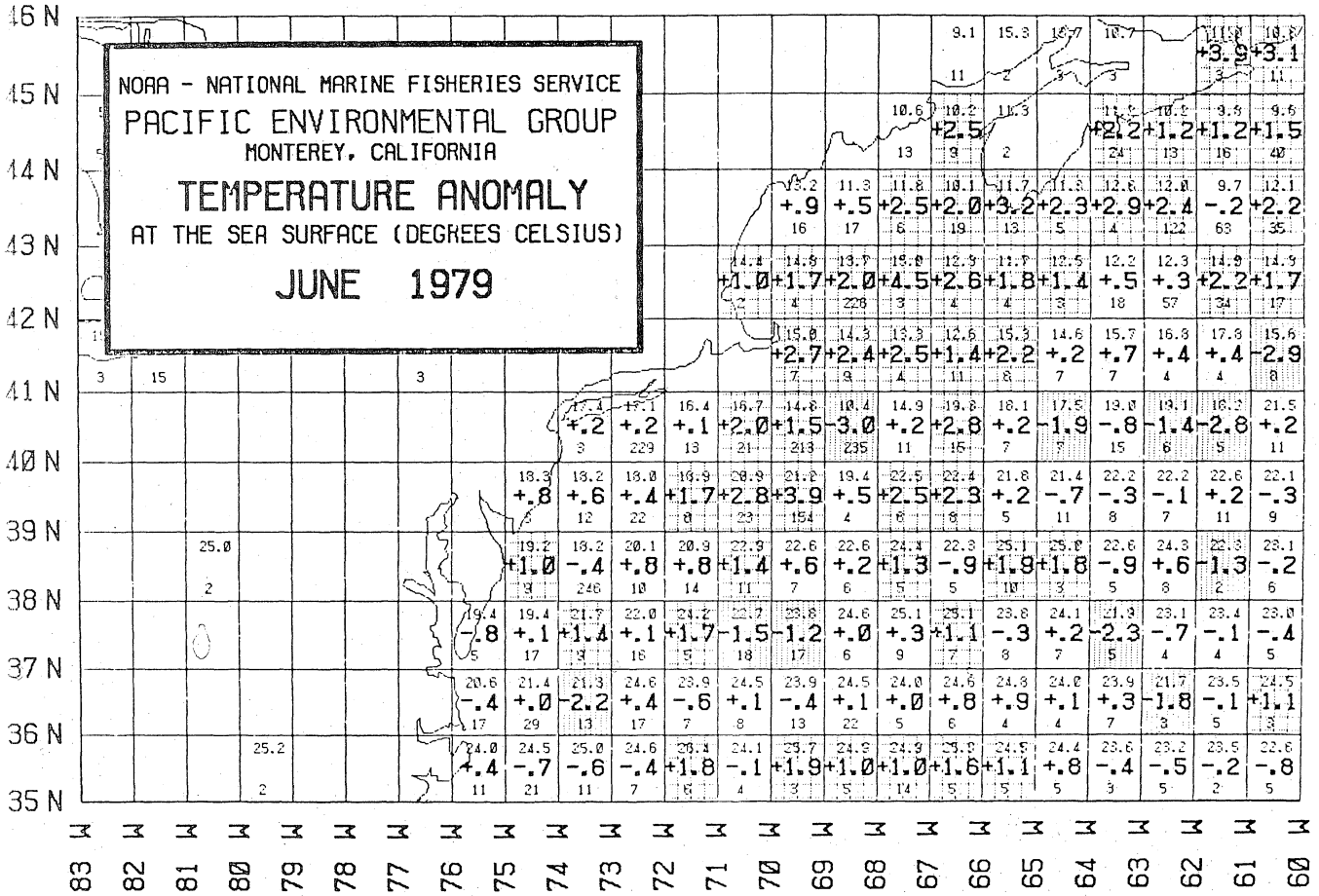

Figure 6. Average sea-surface temperature anomalies (°C) for June 1979.
Also shown in each 1° square are average sea-surface temperatures
(upper number) and the number of observations (lower number).

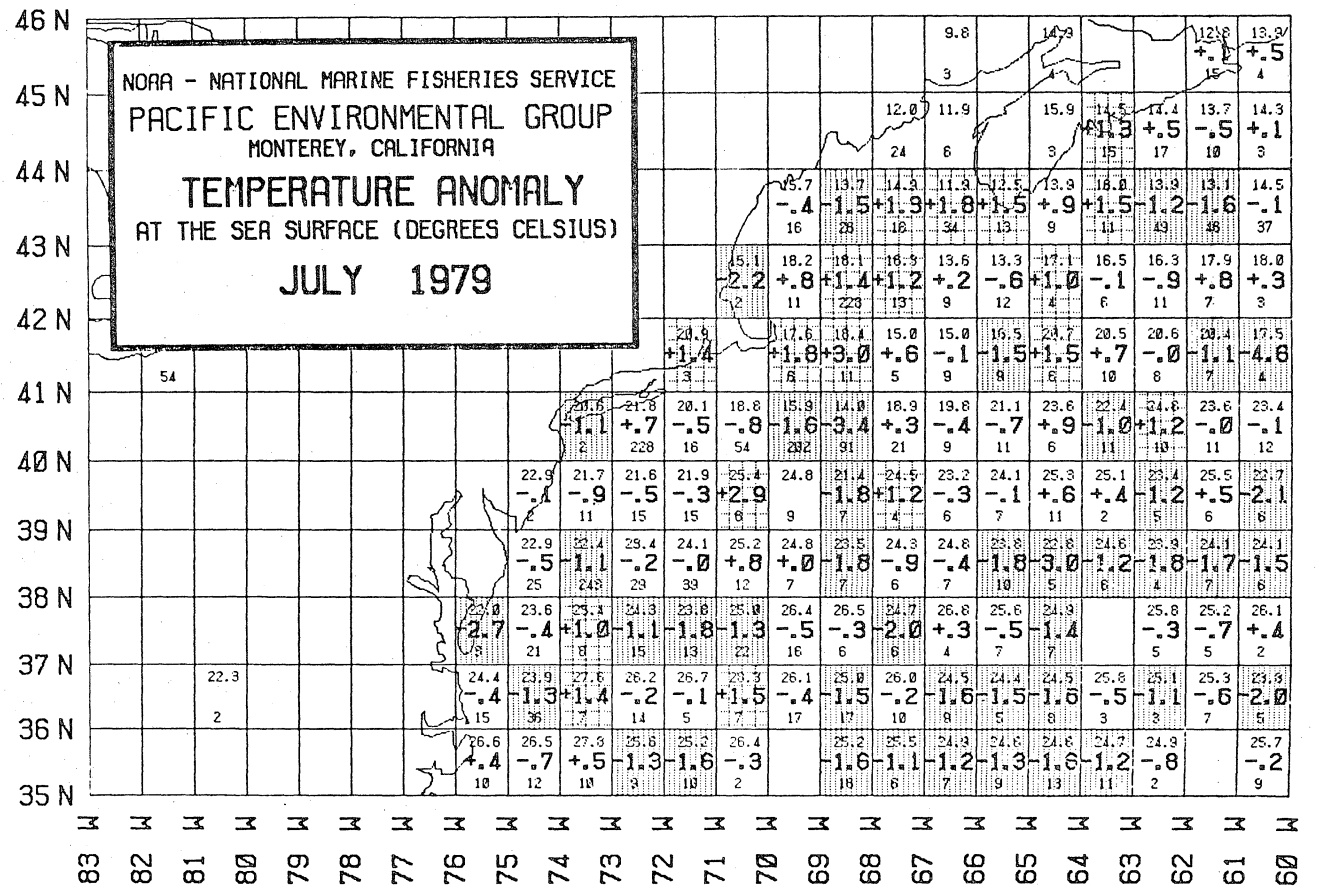

Figure 7. Average sea-surface temperature anomalies (°C) for July 1979. Also shown in each 1° square are average sea-surface temperatures (upper number) and the number of observations (lower number).

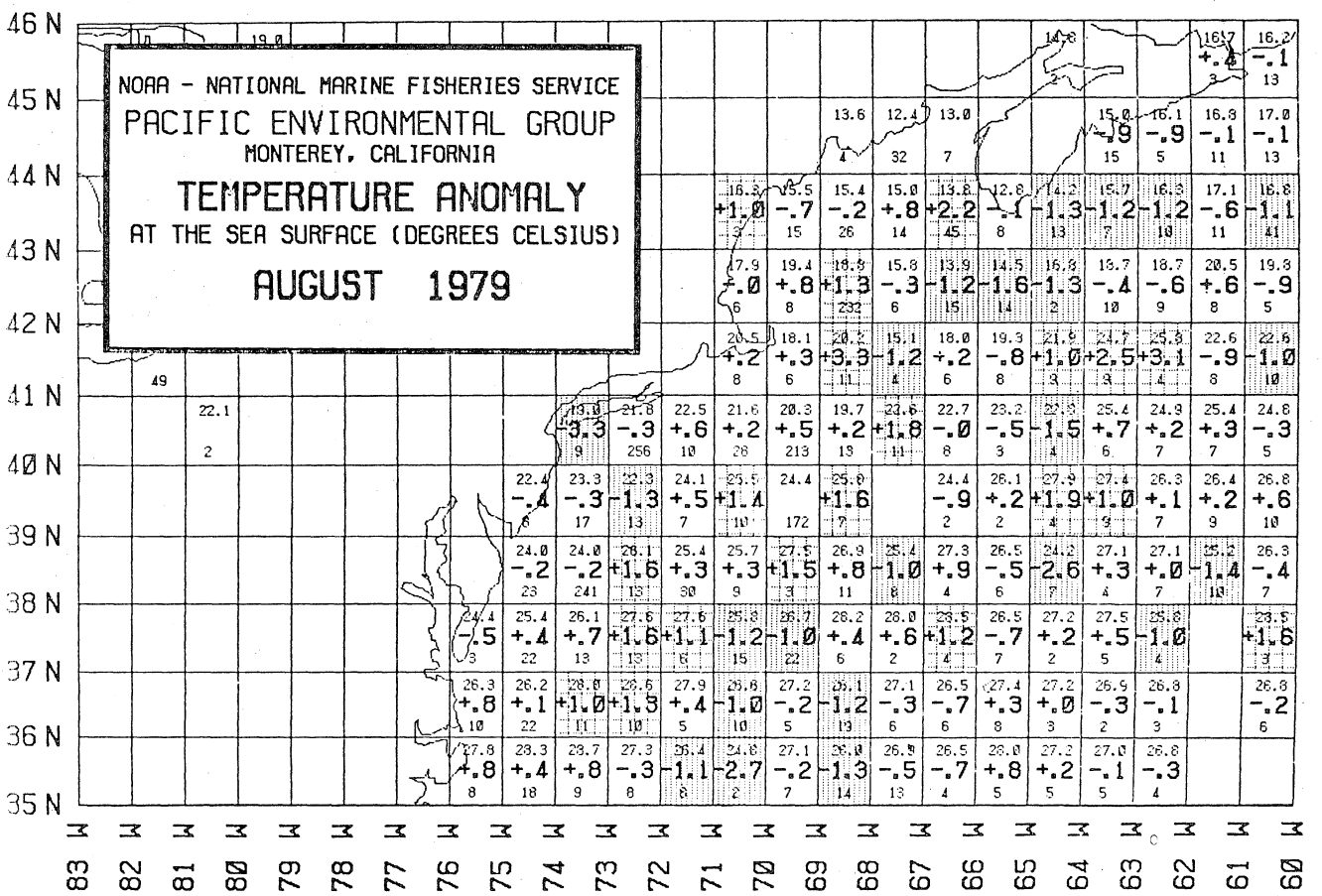

Figure 8. Average sea-surface temperature anomalies (°C) for August 1979. Also shown in each 1° square are average sea-surface temperatures (upper number) and the number of observations (lower number).

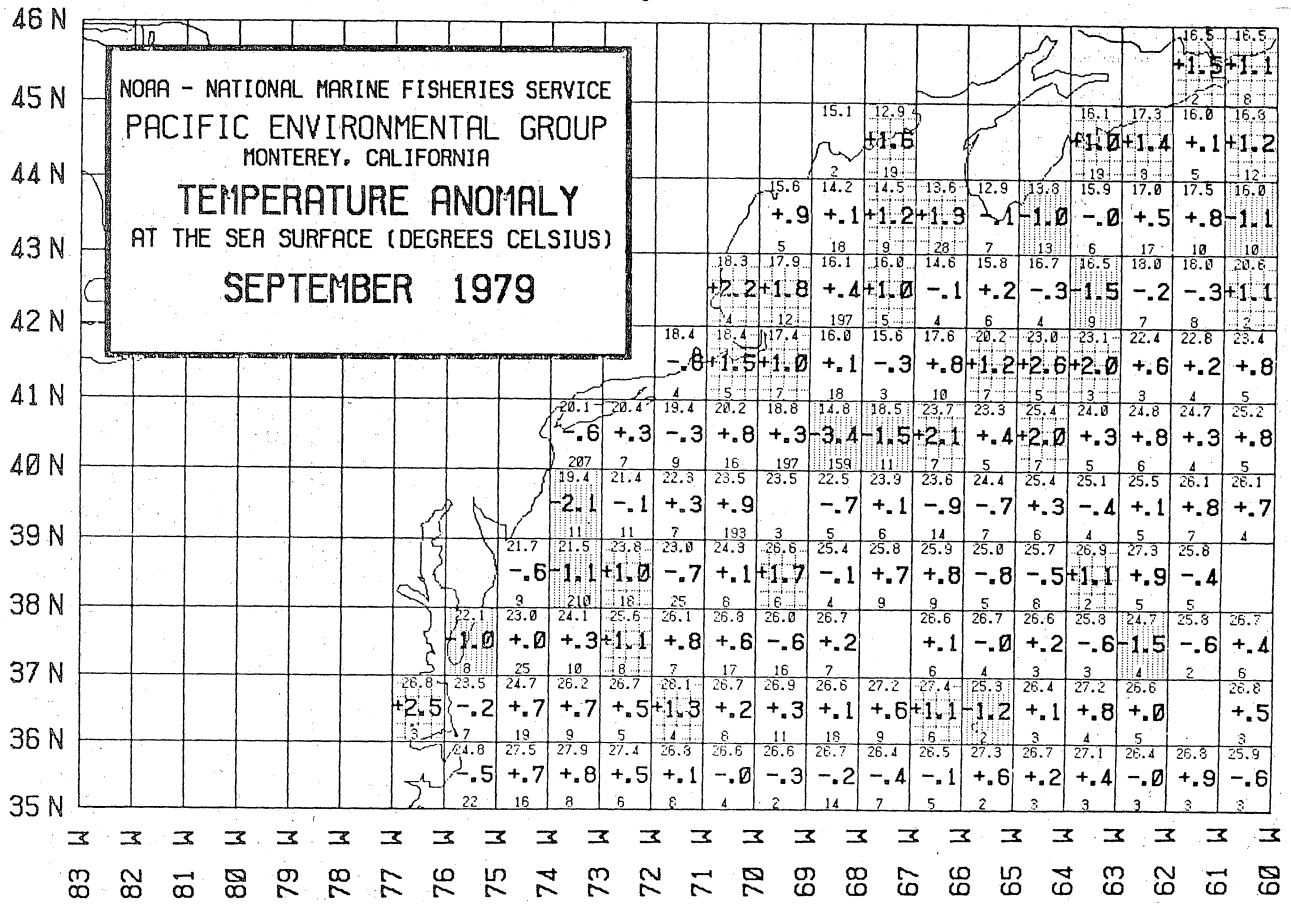

Figure 9. Average sea-surface temperature anomalies (°C) for September 1979. Also shown in each 1° square are average sea-surface temperatures (upper number) and the number of observations (lower number).

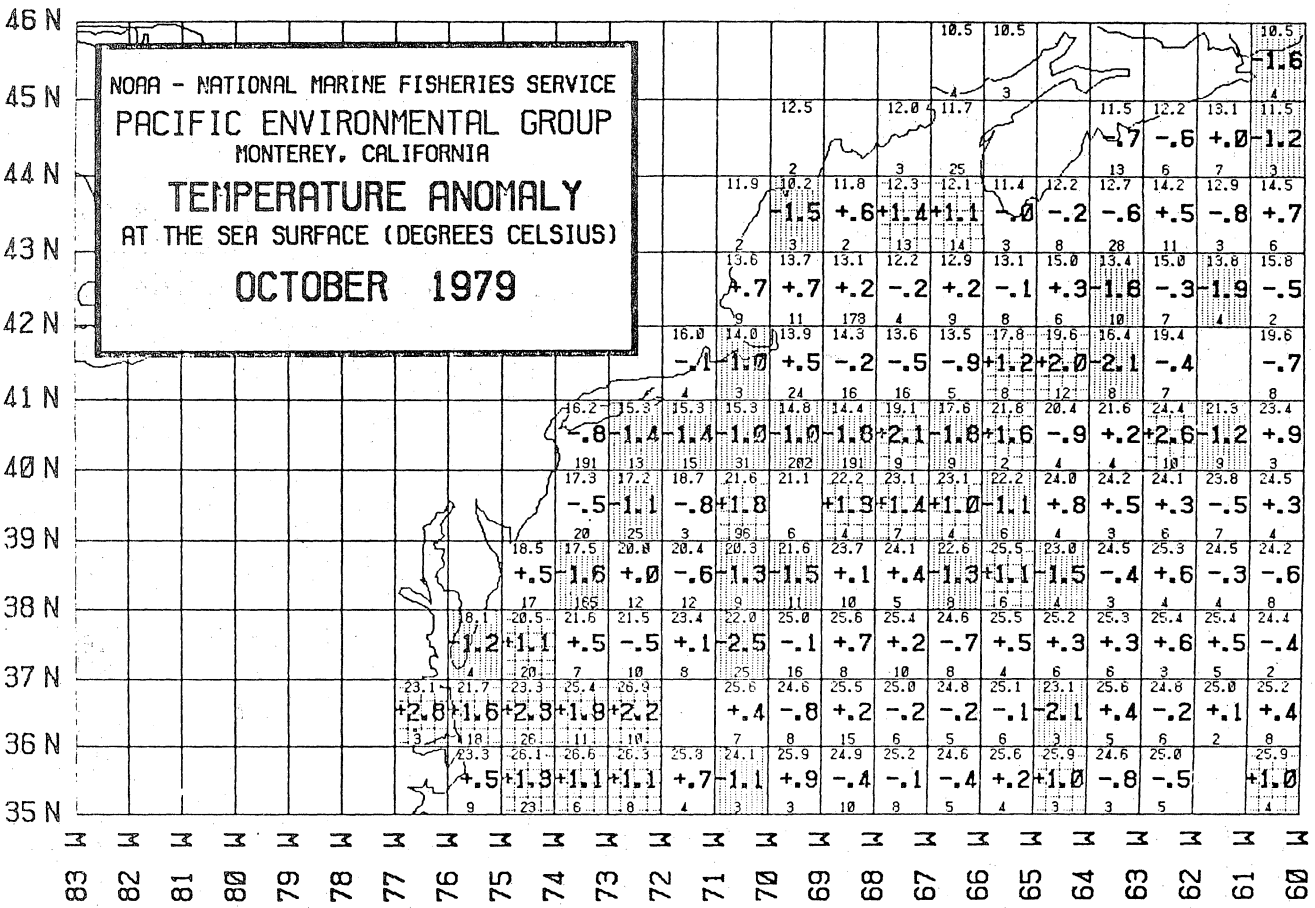

Figure 10. Average sea-surface temperature anomalies (°C) for October 1979. Also shown in each 1° square are average sea-surface temperatures (upper number) and the number of observations (lower number).

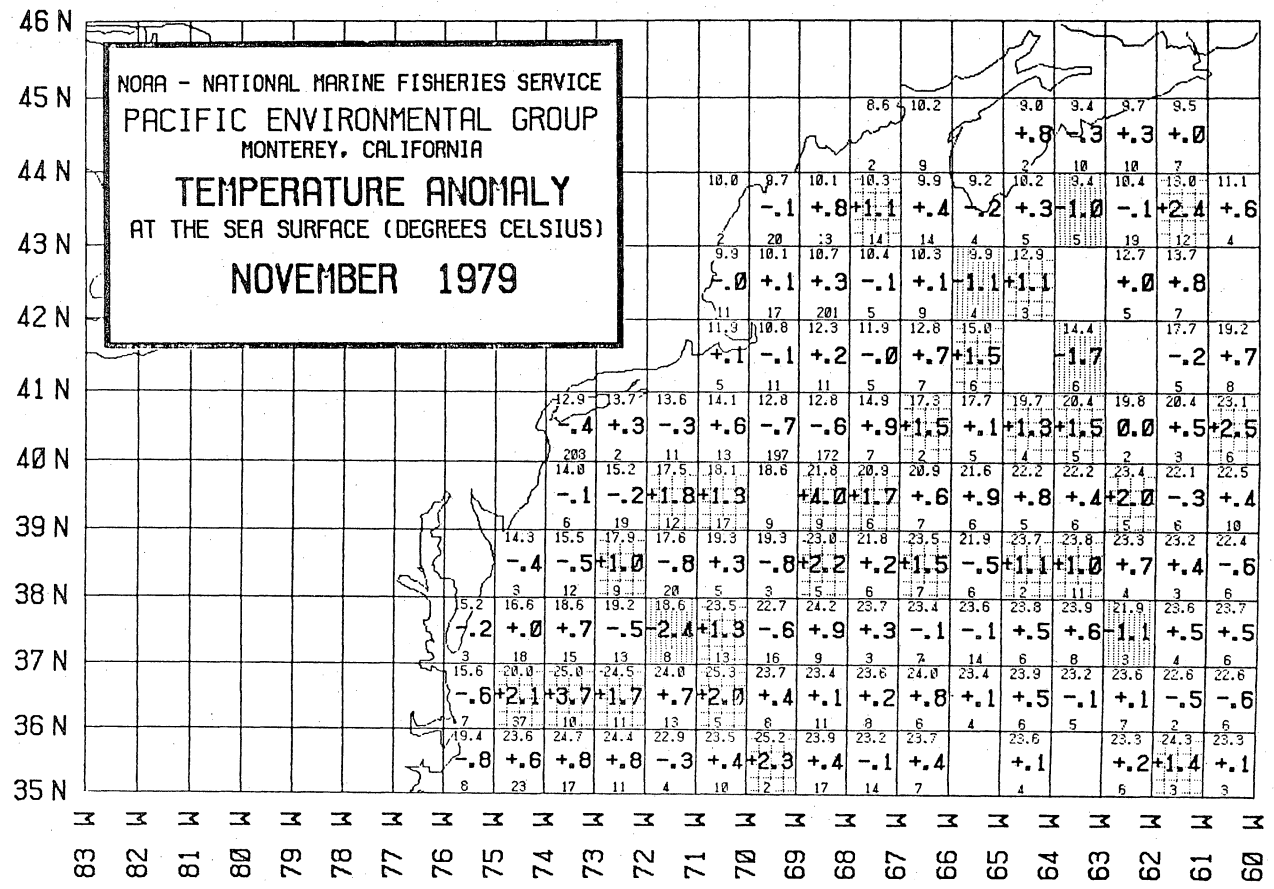

Figure 11. Average sea-surface temperature anomalies (°C) for November 1979. Also shown in each 1° square are average sea-surface temperatures (upper number) and the number of observations (lower number).

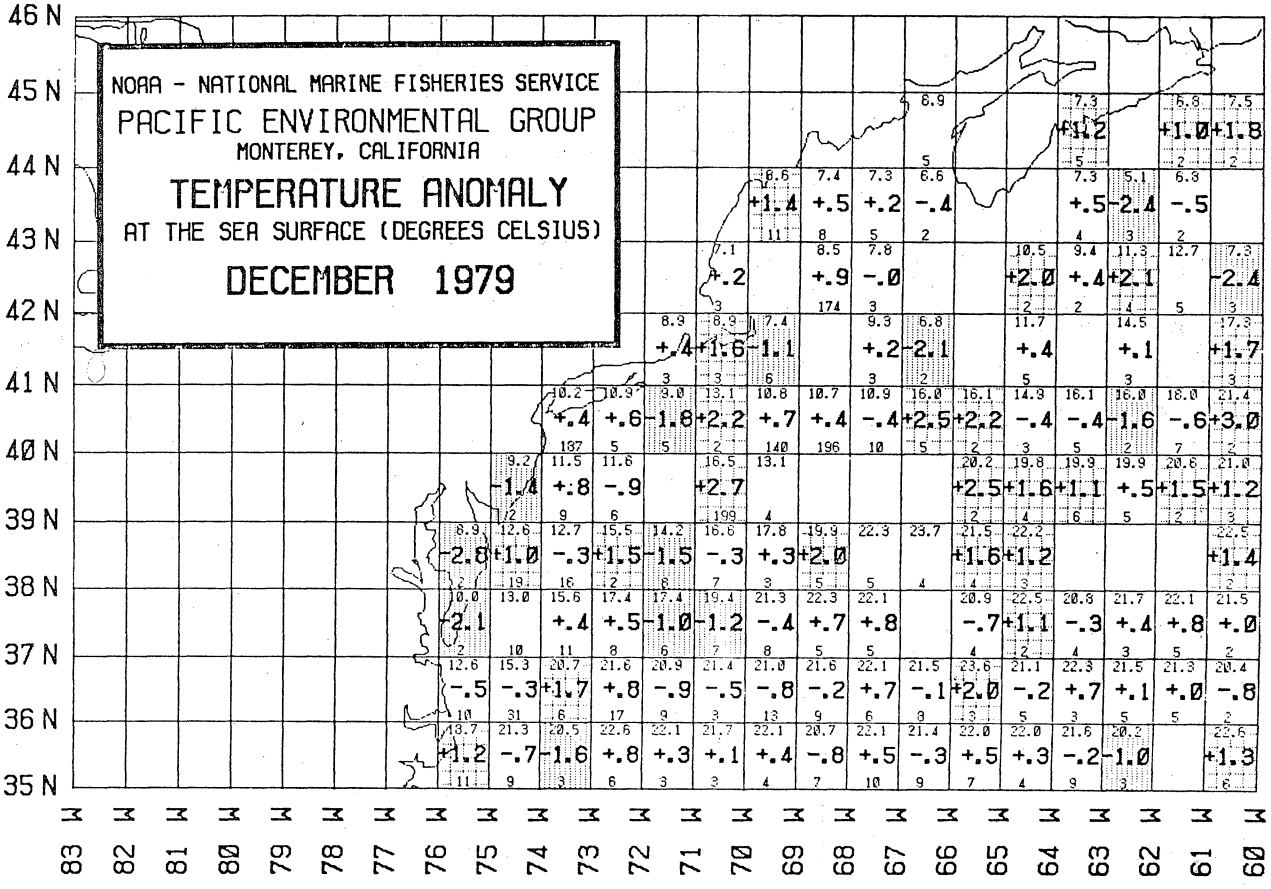

Figure 12. Average sea-surface temperature anomalies (°C) for December 1979. Also shown in each 1° square are average sea-surface temperatures (upper number) and the number of observations (lower number).

1979

	D	J	F	M	A	M	J	J	A	S	O	N	D
1 43 N 64 W	0.5 20	0.2 7	-1.1 13	-.5 17	1.4 16	1.3 8	1.9 5		-1.4 13	-1.2 13	-.2 8	0.3 5	-1.5 1
2 43 N 65 W	-.9 12	-1.6 11	-.4 6	1.3 16	1.8 12	1.1 9	2.7 4	-1.4 3	0.2 9	-.1 7	-.0 3	-.2 4	-.2 1
3 43 N 66 W	-.2 4	-.3 7	-1.3 8	-.1 6	1.6 6	1.0 19	1.4 12	2.1 14	2.4 43	1.3 28	1.1 14	0.4 14	-.4 2
4 42 N 67 W	0.1 3	0.9 4	-.3 4	1.3 3	0.4 5	-.4 6	2.1 3	1.7 1	0.3 5	1.0 5	-.2 4	-.1 5	-.0 3
5 41 N 68 W	-2.2 6	0.5 1	-1.0 12	-.6 6	0.0 9	-1.2 4	1.5 5	1.3 3	0.6 3	0.1 18	-.2 16	0.2 11	-1.1 1
6 40 N 69 W	-.9 154	-2.4 170	-1.2 157	-1.4 229	-.7 225	-1.1 179	1.8 168	-.5 92	0.8 207	0.3 197	-1.0 202	-.7 197	0.7 140
7 40 N 70 W	1.4 4	0.8 10	-1.2 16	-2.2 19	-.4 11	1.0 15	2.2 13	1.6 15	-.7 18	0.8 16	-1.0 31	0.6 13	2.2 2
8 40 N 71 W	0.6 4	0.6 7	-1.0 7	-1.5 22	-.9 9	0.7 18	1.2 11	0.7 6	-1.3 11	-.3 9	-1.4 15	-.3 11	-1.8 5
9 40 N 72 W	0.2 8	0.5 9	-1.3 5	-.6 19	-1.3 14	0.1 8	-.5 5	-.0 6	1.1 11	0.3 7	-1.4 13	0.3 2	0.6 5
10 40 N 73 W	1.2 174	0.2 2	-.3 128	-.6 172	-1.4 215	-.7 199	-.4 170	2.2 107	-1.6 178	-.6 207	-.8 191	-.4 208	0.4 187
11 39 N 73 W	0.7 12	0.6 11	-.4 10	-.9 26	-.7 19	1.1 10	-.1 8	0.3 2	-2.5 12	-2.1 11	-.5 20	-.2 6	0.8 9
12 38 N 74 W	1.6 23	-1.6 17	-2.2 15	0.4 12	0.3 17	1.1 17	1.0 8	-.2 14	-1.6 10	-.6 9	0.5 17	-.4 3	1.0 19
13 37 N 74 W	1.4 26	-.6 19	-1.1 18	-2.1 28	-.7 26	0.1 21	-.5 15	0.7 13	-.4 13	0.0 25	1.1 20	0.0 18	0.4 10
14 36 N 75 W		-.1 10	-3.8 17	-2.6 24	-1.1 38	0.1 35	-.5 13	0.6 12	-.1 9	-.2 7	1.6 18	-.6 7	-.5 10
15 35 N 75 W	4.1 18	0.6 16	-5.5 10	-1.8 22	-3.9 13	-1.5 9	-.4 12	-.0 7	0.7 10	-.5 22	0.5 9	-.9 8	1.2 11

Figure 13. Space-time plot of sea-surface temperature anomalies (°C) for 1979. Also shown are the numbers of observations utilized (lower left corner of squares). Location of one-degree squares (1-15) shown in figure 14.

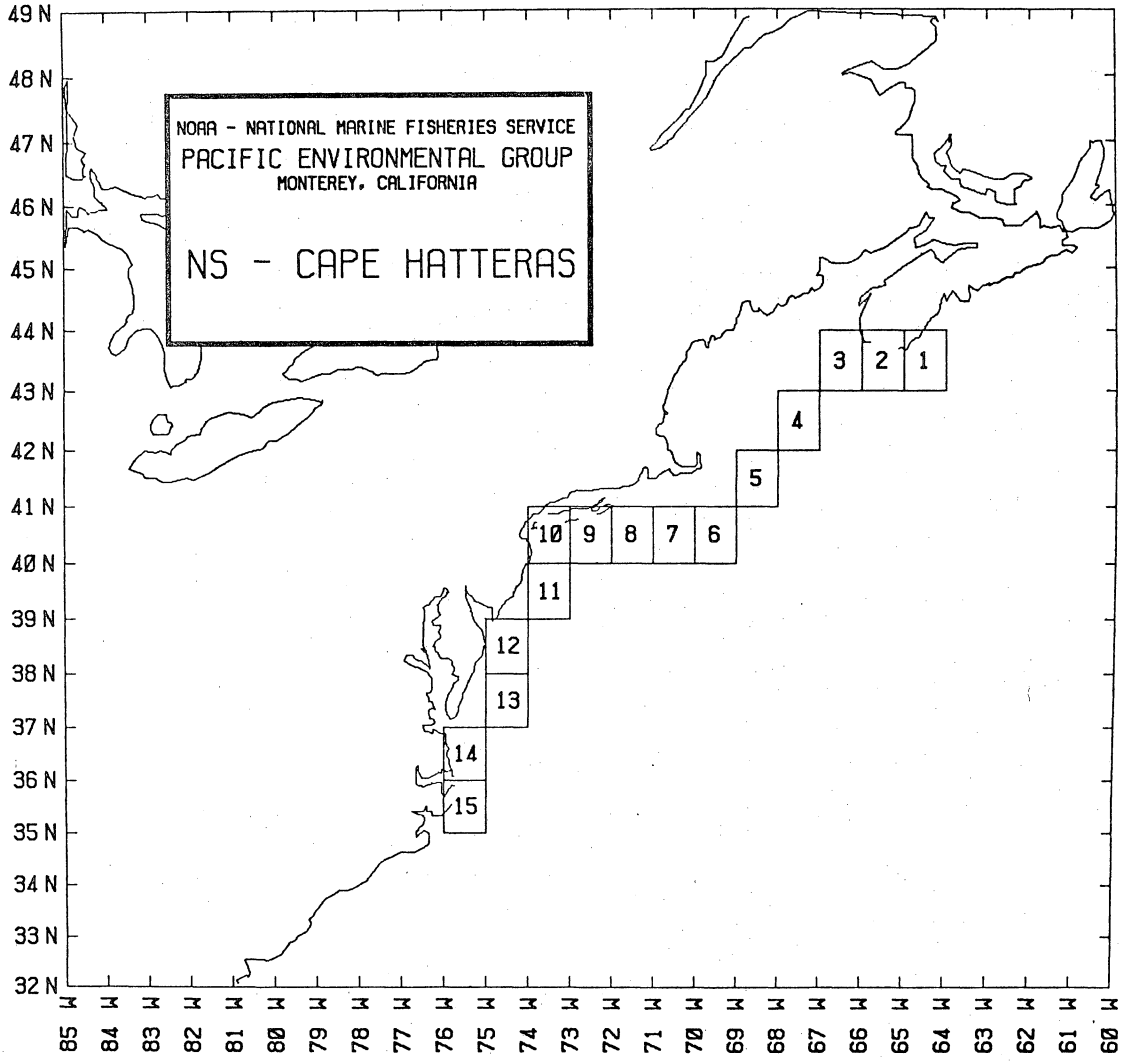

Figure 14. Location of one-degree squares of interest utilized in figures 13 and 15.

1978

	D	J	F	M	A	M	J	J	A	S	O	N	D
1 43 N 64 W		-.5 7	-.5 9	-.2 15	1.1 17	-.7 16	0.5 4	1.0 1	1.6 12	1.7 12	1.0 8	1.2 6	0.5 20
2 43 N 65 W		-.5 5	-1.0 19	0.7 20	1.2 16	0.3 7	0.1 8	-.7 2	-.8 17	1.0 2	1.6 6	1.1 9	-.9 12
3 43 N 66 W		0.2 2	-2.8 14	0.6 12	0.6 17	0.2 10	-.6 7	1.6 15	1.1 9	-.7 2	0.3 7	0.8 9	-.2 4
4 42 N 67 W		-1.0 2	1.6 2	-.6 13	-1.4 2	0.6 17	0.6 15	0.1 6	-.7 10	-.2 14	1.1 35	0.5 12	0.1 3
5 41 N 68 W		-.2 2	-1.7 1	-1.3 31	-.5 4	-.6 13	2.4 3	-1.8 5	-1.7 8	1.1 4	-1.0 20	0.5 20	-2.2 6
6 40 N 69 W		-1.1 125	-.7 142	-.7 171	-.7 189	-1.3 221	-2.3 163	-.6 171	1.2 151	-2.1 131	-1.8 155	-.5 144	-.9 154
7 40 N 70 W		-.2 20	-1.4 21	-1.4 34	-2.3 15	-1.6 17	-.5 7	-.8 17	1.6 10	-1.6 10	-1.1 22	0.9 9	1.4 4
8 40 N 71 W		-.8 8	-.6 15	-1.9 22	-2.3 25	-2.0 28	-.7 7	-4.0 10	0.7 21	0.1 15	-1.7 17	-.2 6	0.6 4
9 40 N 72 W		0.0 1	-.4 3	-2.7 10	-1.4 15	-1.9 16	-.2 8	-.7 9	1.2 4	1.6 8	-.8 12	0.7 7	0.2 8
10 40 N 73 W		0.7 134	1.2 26	-.8 16	-1.8 146	-3.0 154	-1.0 150	-1.5 134	1.5 131	1.8 42	0.1 13	0.1 49	1.2 174
11 39 N 73 W		-.4 18	-1.7 9	-1.1 14	-1.9 11	-1.1 15	-.7 19	-1.4 20	1.2 14	1.3 14	-.5 11	0.7 12	0.7 12
12 38 N 74 W		-5.1 8	-2.6 16	-1.8 29	-2.0 22	-.6 14	-2.8 26	-.4 26	0.0 7	-1.3 7	0.2 11	-.4 9	1.6 23
13 37 N 74 W		-.5 11	-2.7 23	0.8 44	-1.7 27	-2.3 15	-1.4 26	0.3 23	0.9 13	2.3 29	-.3 21	-.4 19	1.4 26
14 36 N 75 W		-4.2 13	-4.0 31	-2.8 30	0.3 30	-2.8 34	-2.4 29	-.9 14	-.7 2	1.8 11	-.6 16	-.1 14	
15 35 N 75 W		1.8 18	-7.7 19	-5.7 18	-4.5 24	0.7 10	0.8 6	1.7 14	1.0 13	1.8 16	-.9 16	-2.0 10	4.1 18

Figure 15. Sqace-time plot of sea-surface temperature anomalies (°C) for 1978. Also shown are the numbers of observations utilized (lower left corner of squares). Location of one-degree squares (1-15) shown in figure 14.