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Sea-surface temperatures in the northwestern atlantic in 1978

by

M. C. Ingham
Atlantic Environmental Group, NMFS/NOAA
South Ferry Road, Narragansett, RI 02852

and

D. R. McLain
Pacific Environmental Group, NMFS/NOAA
c/o Fleet Numerical Weather Central, Monterey, CA 93940

Water temperature 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 Weather Central (FNWC) 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 FNWC and the Pacific Environmental Group of the National Marine Fisheries Service, which is co-located with FNWC. An elementary step in the analysis is the computation of average monthly temperatures and anomalies (from 1948-67 means) for each $1^{\circ} \times 1^{\circ}$ square for which enough data have been reported each month. The average temperatures, anomalies and number of observations are then printed in the $1^{\circ} \times 1^{\circ}$ squares they characterize to produce a map such as the one shown in figure 1. To facilitate interpretation of the data, anomalies greater than $+1^{\circ}\text{C}$ or less than -1°C are shaded.

Monthly maps of this sort for the northwestern Atlantic for 1978 (figs. 1-12) reveal that sea surface temperatures in the area generally were cooler than the long-term (1948-67) mean during the first half of the year. Extensive areas of negative anomalies as great as -7.7°C developed, with the most extensive and intensive occurring in February. The anomalies generally were stronger in the southwest corner of the area, but the cold water extended farthest eastward off the Middle Atlantic Bight and southern New England ($38-41^{\circ}\text{N}$).

In an effort to characterize sea-surface temperature in 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 negative values for all months except August, November and December. However, the magnitudes of the negative area anomalies are significantly less than the standard deviation of the area anomalies for the reference period (1948-67) as shown in table 1. Apparently the negative anomalies in 1978 weren't unusually intense, even though they were widespread and persistent.

In order to characterize the spatial and temporal gradients during the course of the year (1978) in shelf waters, the monthly anomalies from 15 one-degree squares (fig. 13) were plotted on a space-time grid (fig. 14). The plot clearly shows that the shelf water exhibited the greatest negative anomalies in the late winter and spring months (February-May) and in the area off Delaware Bay-Cape Hatteras (squares 12-15). In the New York Bight, however, (squares 9, 10 and 11) the negative anomalies were smaller and developed later in the year. Off southern New England (squares 6, 7 and 8) the negative anomalies developed early, in the winter months, but were smaller in general than those in the southern squares. On Georges Bank (squares 4 and 5) development of negative anomalies was weak and sporadic. The Scotian Shelf (squares 1, 2 and 3) showed no strong anomaly patterns, neither negative nor positive.

In 1977 (fig. 15), by comparison, negative anomalies in shelf waters appeared earlier, being widespread in January (and December 1976). However, they weakened earlier, and by May only two squares showed values stronger than -1°C. By June strong positive anomalies had developed off New Jersey-Virginia (squares 11-13). Geographically, the pattern in 1977 was somewhat similar to 1978, with the negative anomalies extending from southern New England to Cape Hatteras (squares 6-15) and the most intense anomalies occurring at the southern end of the region (square 14) off Virginia-North Carolina.

The previous year, 1976 (fig. 16), did not show an extensive pattern of negative anomalies in the early months of the year. In fact, no

significant areal pattern developed until late summer and fall (August-December). In the northern section, on Georges Bank and the Scotian shelf, a pattern of strong positive anomalies developed in the spring and summer months. This sort of positive anomaly pattern did not develop during the following two years (1977, 1978).

Table 1. Monthly mean sea-surface temperature anomalies ($^{\circ}\text{C}$) from the 1948-67 monthly means for 1978 in the northwestern Atlantic Ocean ($35\text{-}46^{\circ}\text{N}$ $60\text{-}76^{\circ}\text{W}$)

<u>Month</u>	<u>Number of 1° squares</u>	<u>Area Mean Anomaly</u>	<u>Standard deviation of area mean anomalies in 1948-67</u>
Jan	101	-0.29	1.26
Feb	120	-0.80	1.23
Mar	115	-0.75	1.49
Apr	125	-0.47	1.51
May	126	-0.45	1.22
Jun	129	-0.03	0.91
Jul	119	-0.38	0.89
Aug	117	+0.36	0.85
Sep	109	-0.03	0.89
Oct	117	-0.44	0.95
Nov	112	+0.07	0.90
Dec	112	+0.29	0.91

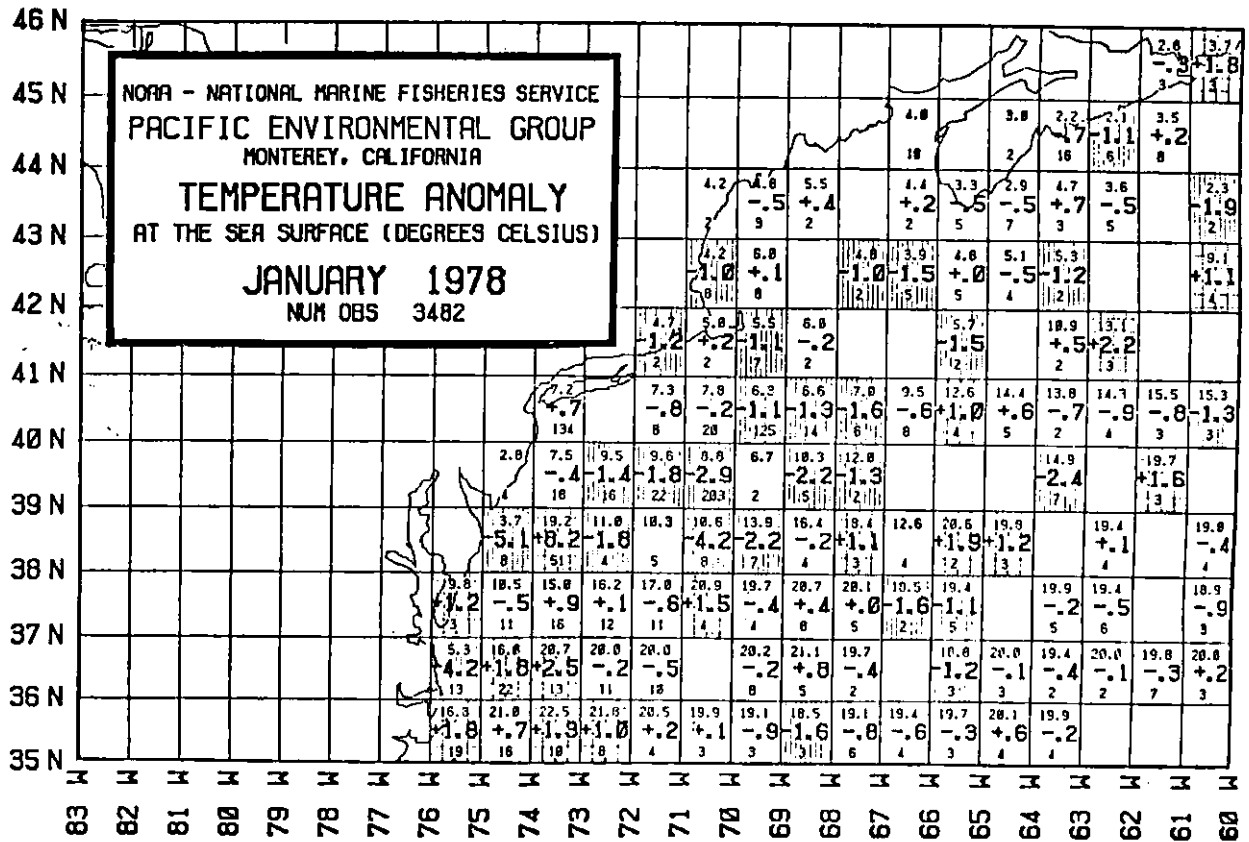


Figure 1. Average sea-surface temperature anomalies (°C) for January 1978. Also shown in each 1° square are average sea-surface temperatures (upper number) and the number of observations (lower number).

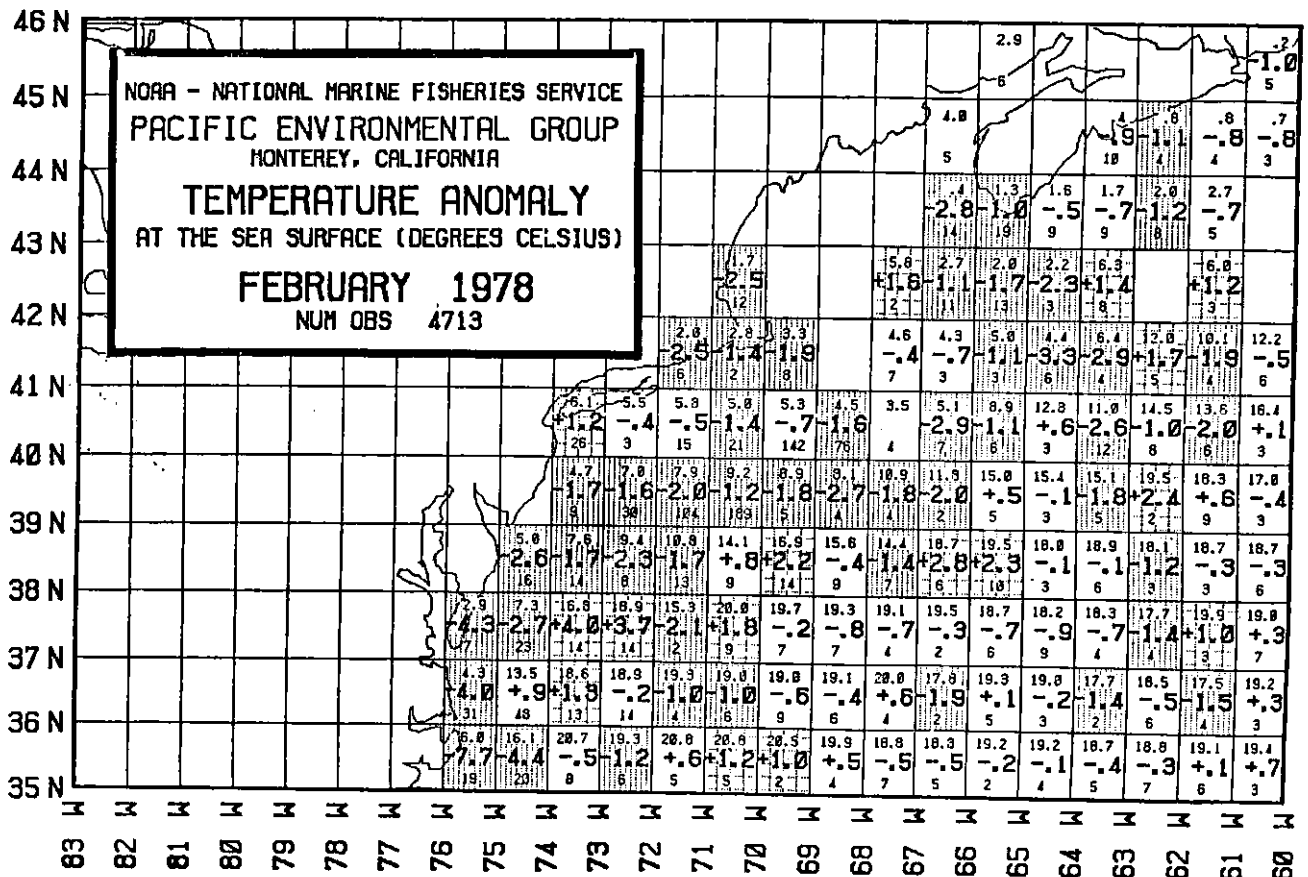


Figure 2. Average sea-surface temperature anomalies (°C) for February 1978. Also shown in each 1° square are average sea-surface temperatures (upper number) and the number of observations (lower number).

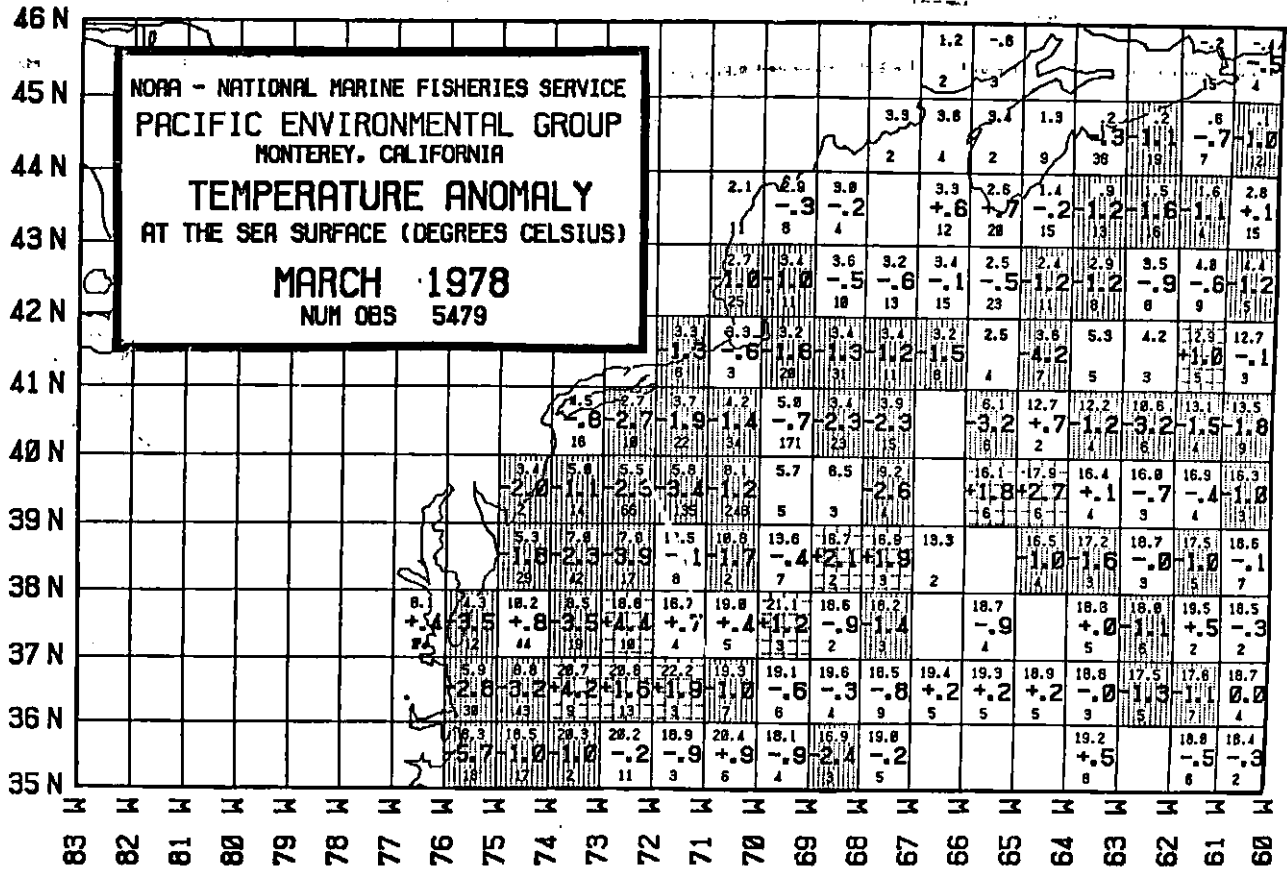


Figure 3. Average sea-surface temperature anomalies (°C) for March 1978. Also shown in each 1° square are average sea-surface temperatures (upper number) and the number of observations (lower number).

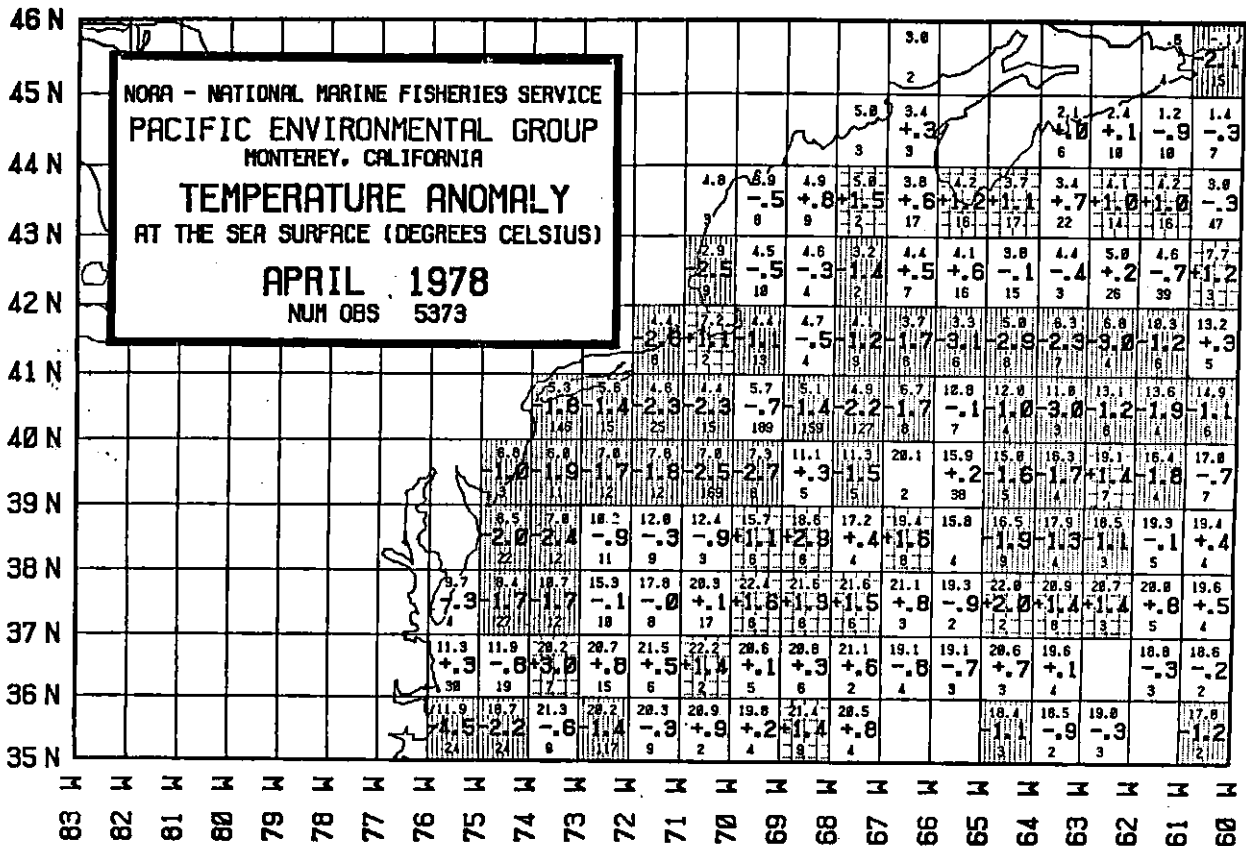


Figure 4. Average sea-surface temperature anomalies (°C) for April 1978. Also shown in each 1° square are average sea-surface temperatures (upper number) and the number of observations (lower number).

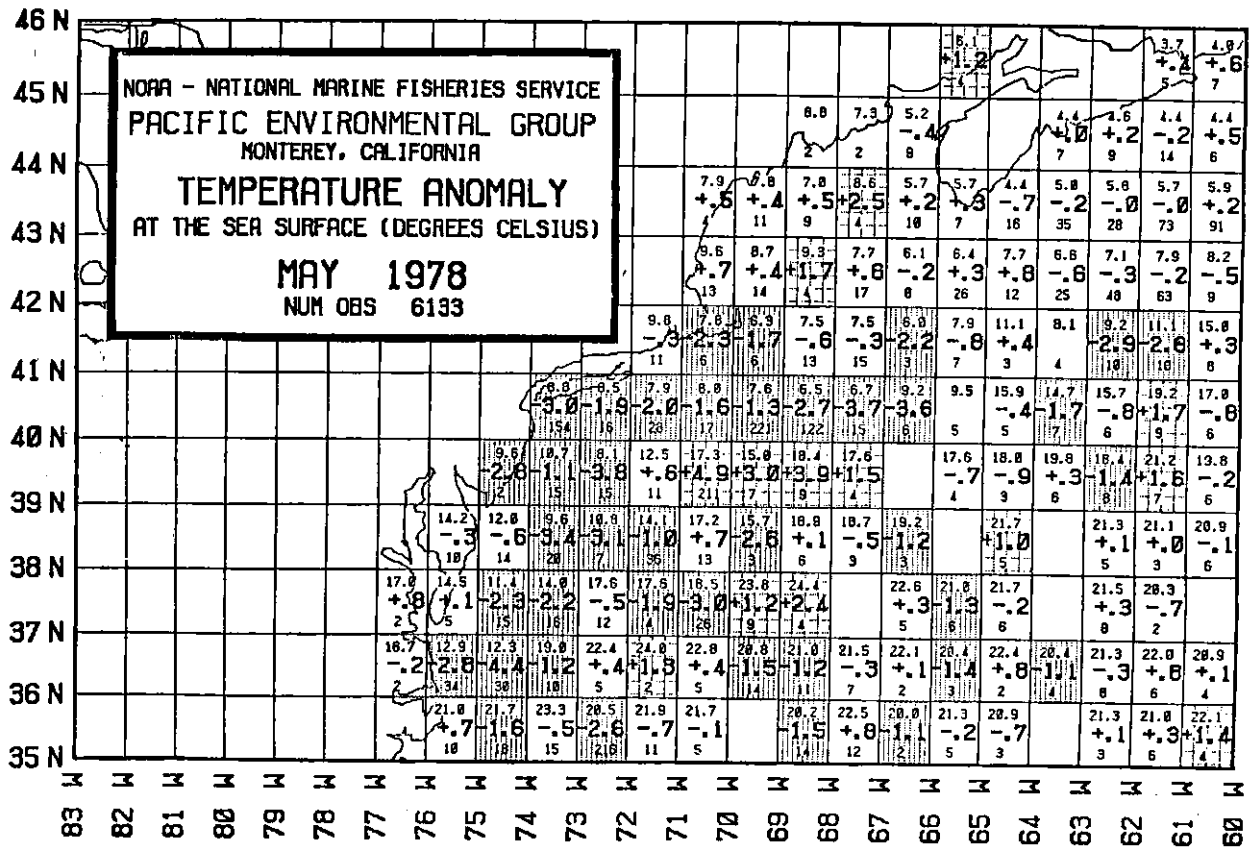


Figure 5. Average sea-surface temperature anomalies (°C) for May 1978. Also shown in each 1° square are average sea-surface temperatures (upper number) and the number of observations (lower number).

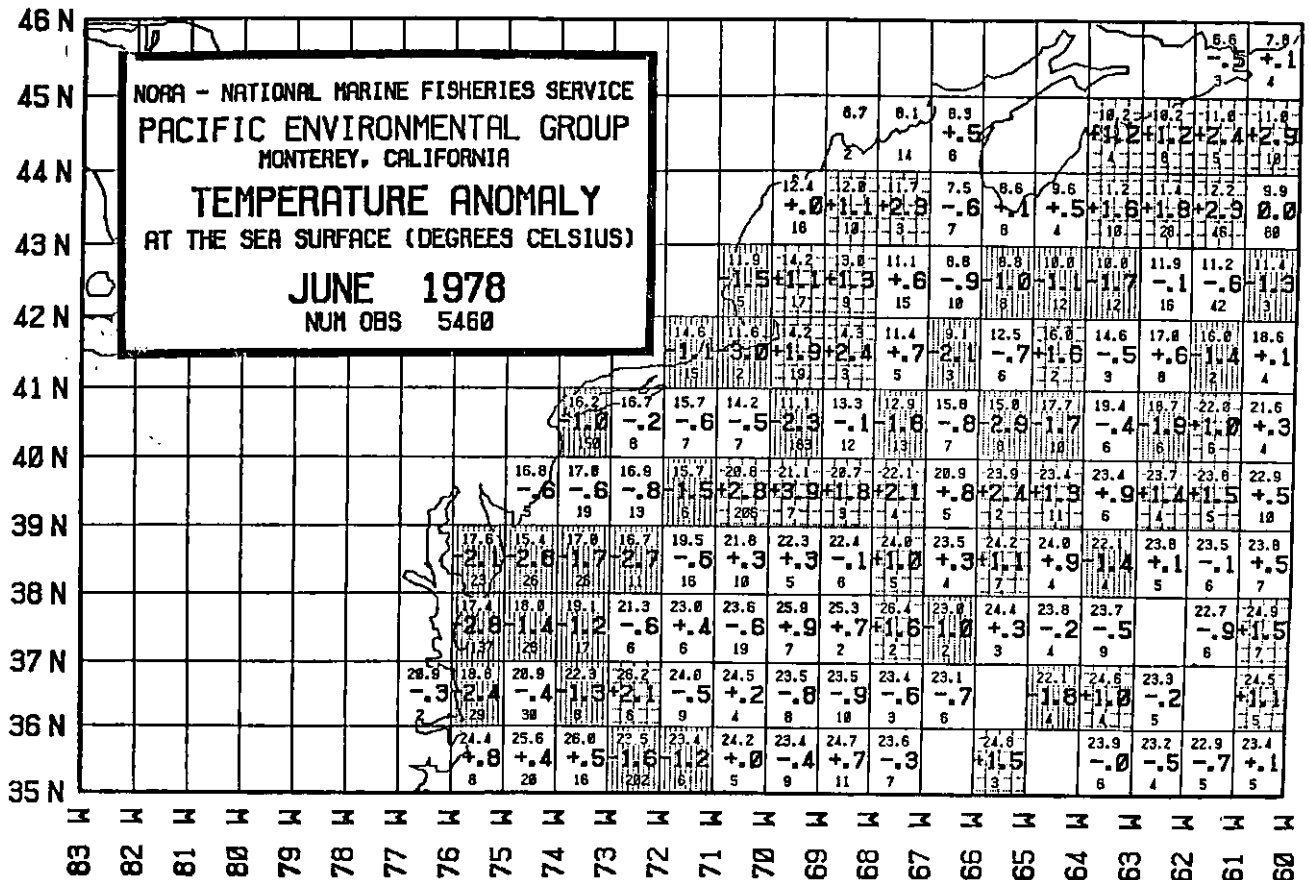


Figure 6. Average sea-surface temperature anomalies (°C) for June 1978. Also shown in each 1° square are average sea-surface temperatures

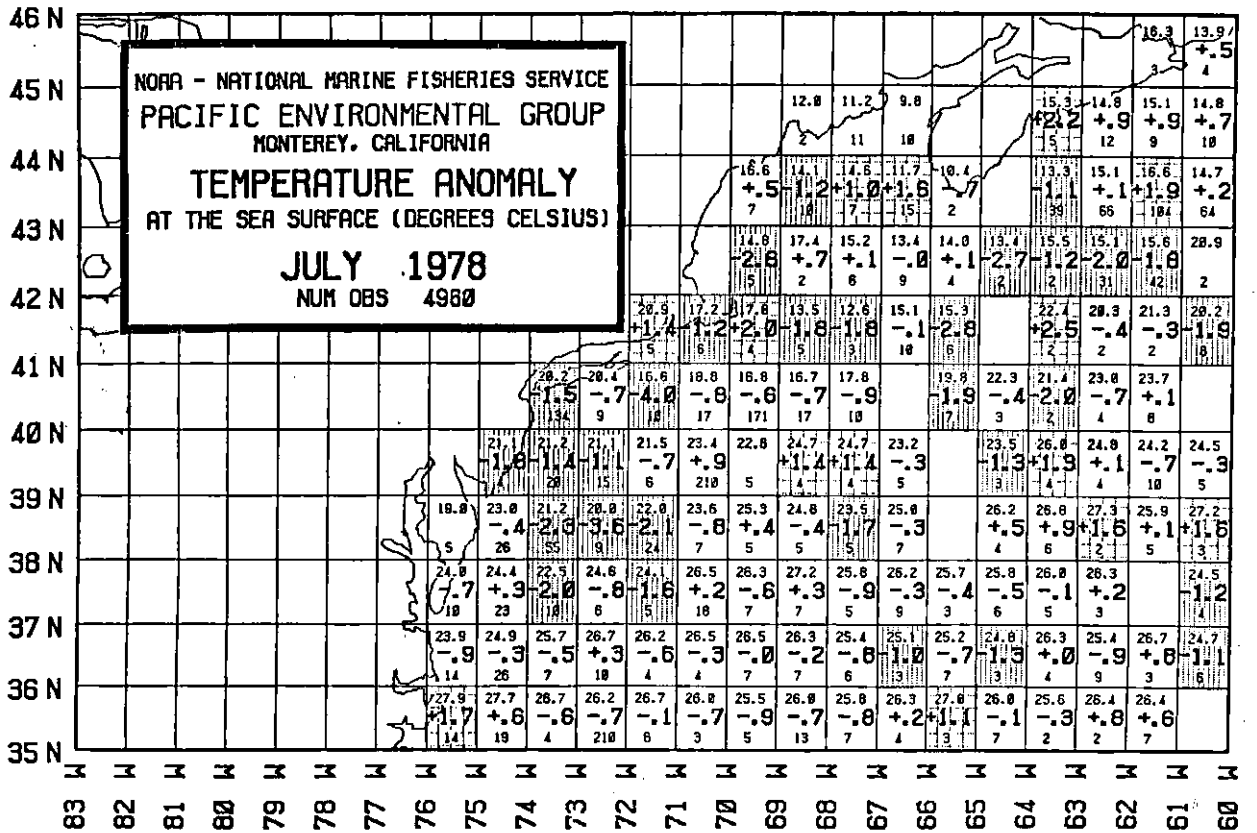


Figure 7. Average sea-surface temperature anomalies ($^{\circ}\text{C}$) for July 1978. Also shown in each 1° square are average sea-surface temperatures (upper number) and the number of observations (lower number).

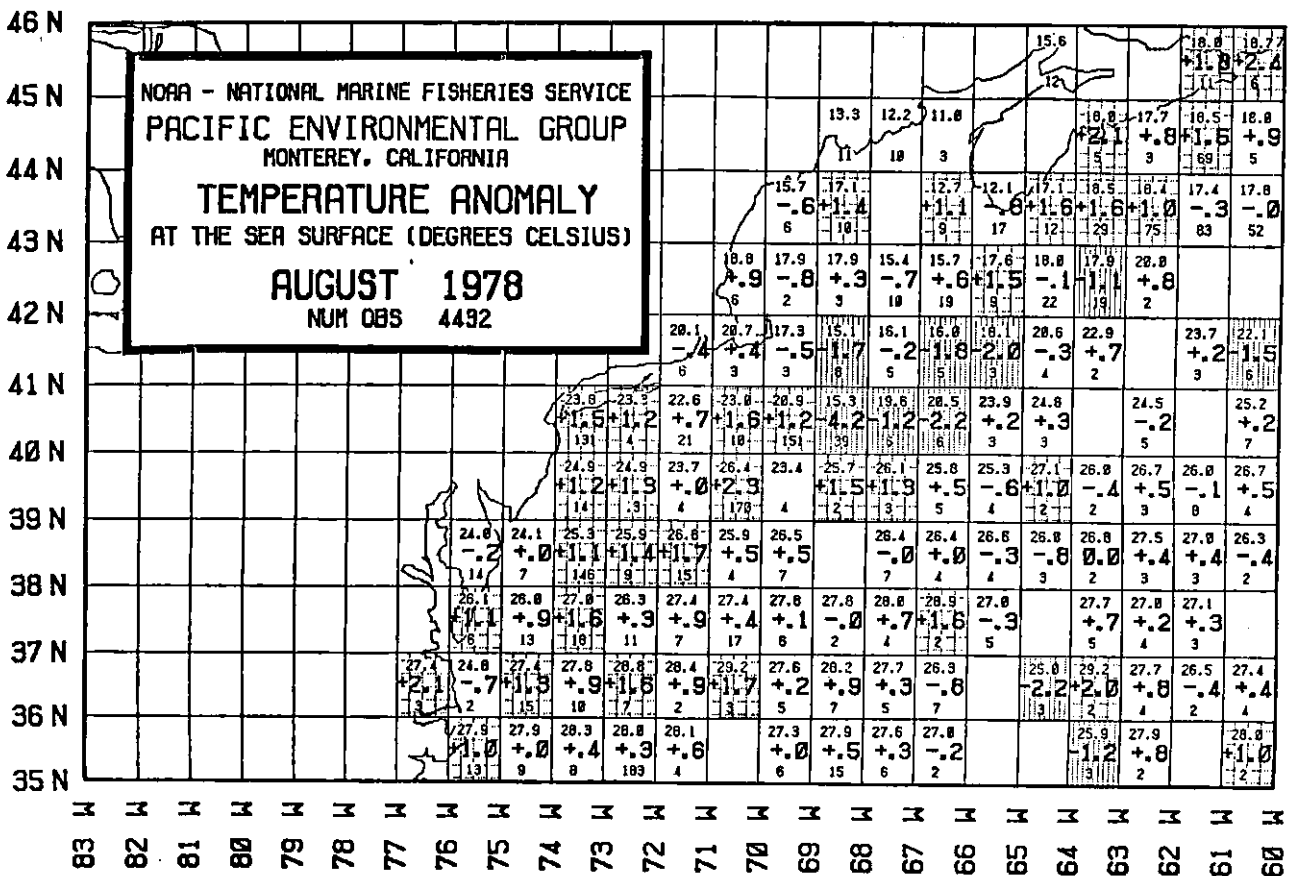


Figure 8. Average sea-surface temperature anomalies ($^{\circ}\text{C}$) for August 1978. Also shown in each 1° square are average sea-surface temperatures (upper number) and the number of observations (lower number).

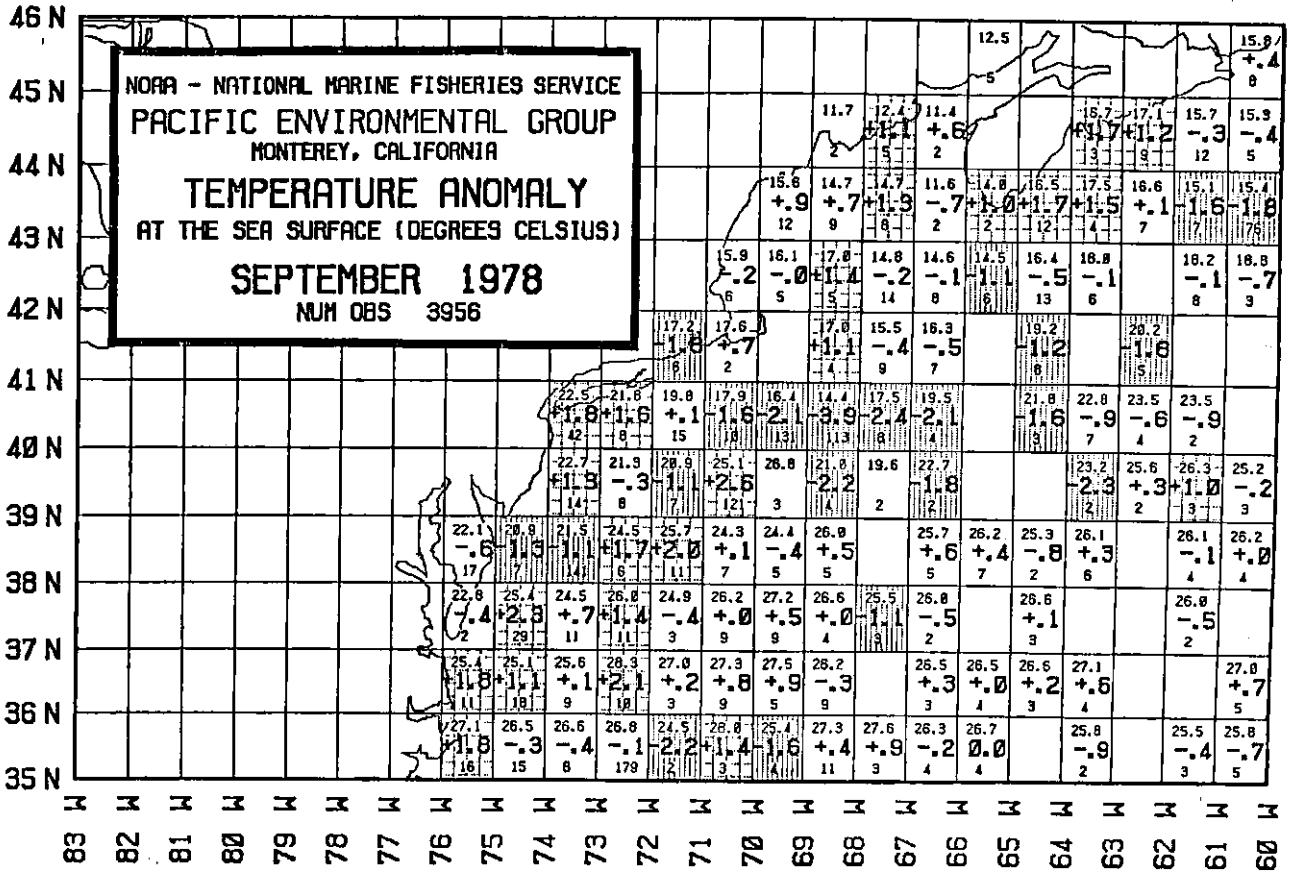


Figure 9. Average sea-surface temperature anomalies (°C) for September 1978. Also shown in each 1° square are average sea-surface temperatures (upper number) and the number of observations (lower number).

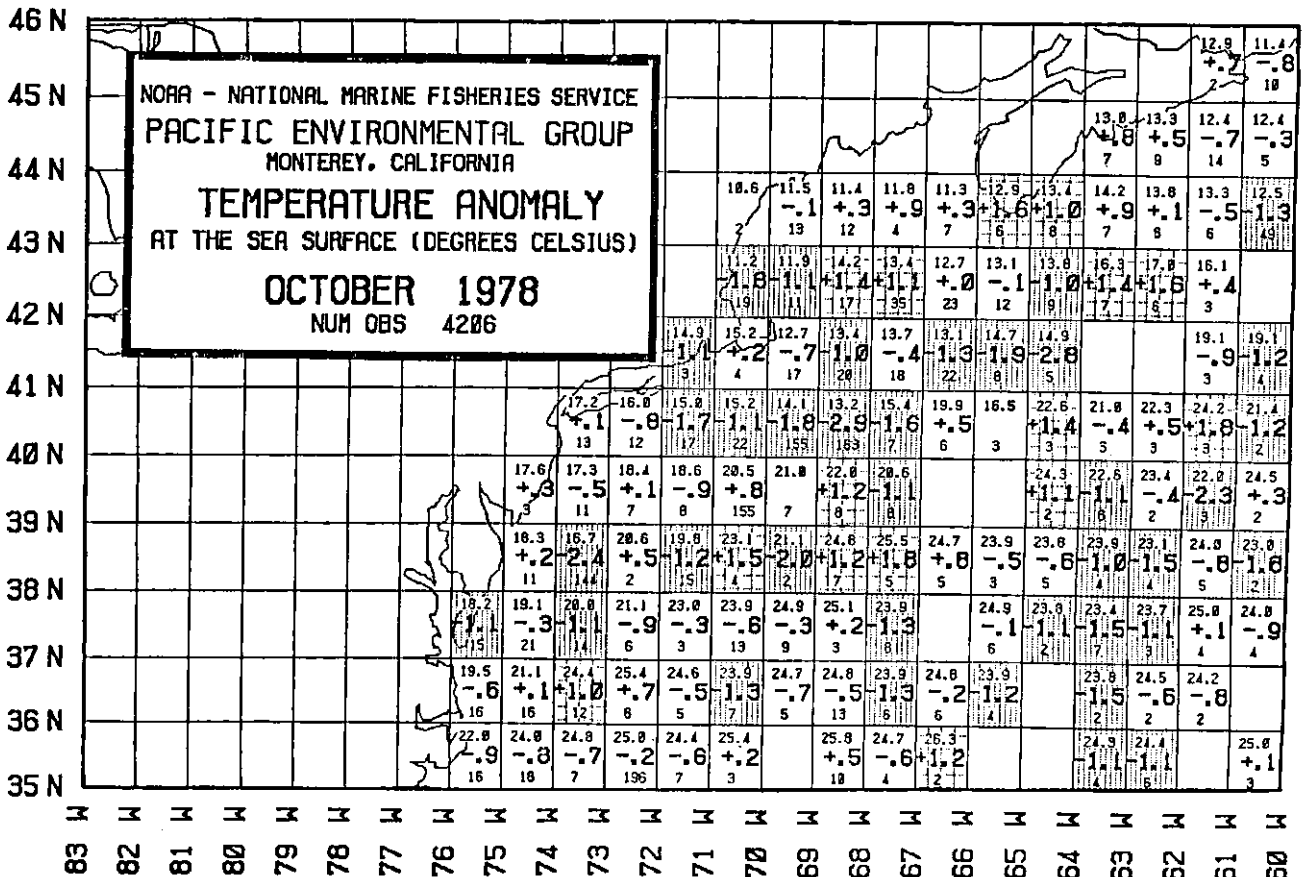


Figure 10. Average sea-surface temperature anomalies (°C) for October 1978. Also shown in each 1° square are average sea-surface temperatures

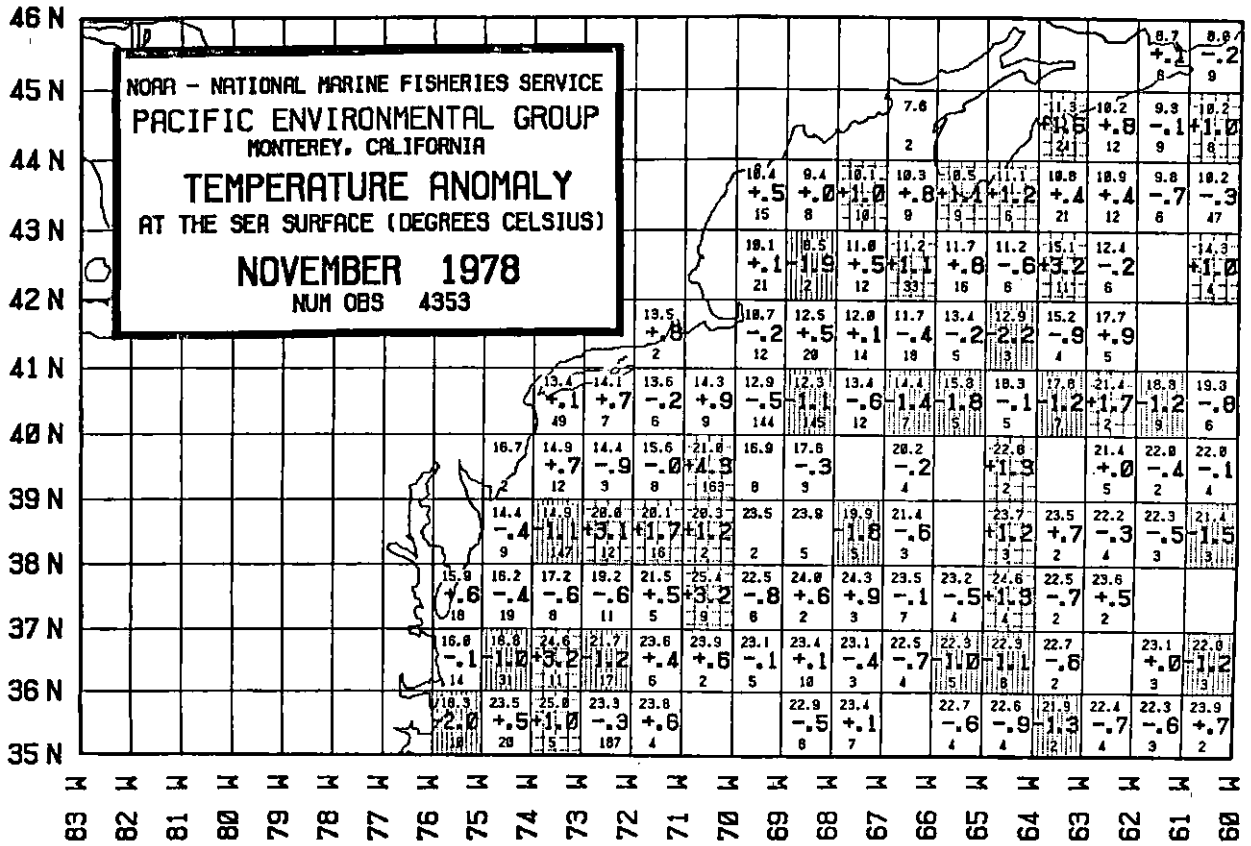


Figure 11. Average sea-surface temperature anomalies ($^{\circ}\text{C}$) for November 1978. Also shown in each 1° square are average sea-surface temperatures (upper number) and the number of observations (lower number).

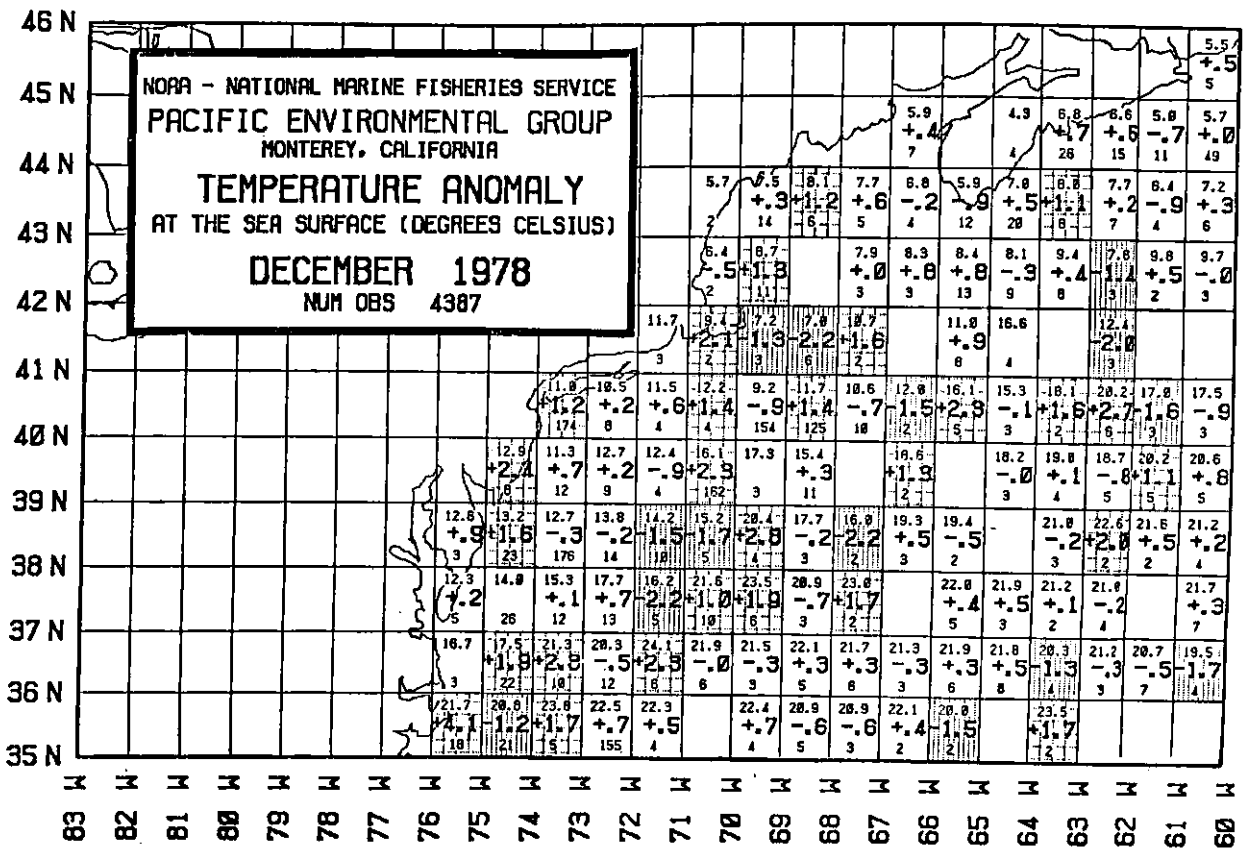


Figure 12. Average sea-surface temperature anomalies ($^{\circ}\text{C}$) for December 1978. Also shown in each 1° square are average sea-surface temperatures (upper number) and the number of observations (lower number).

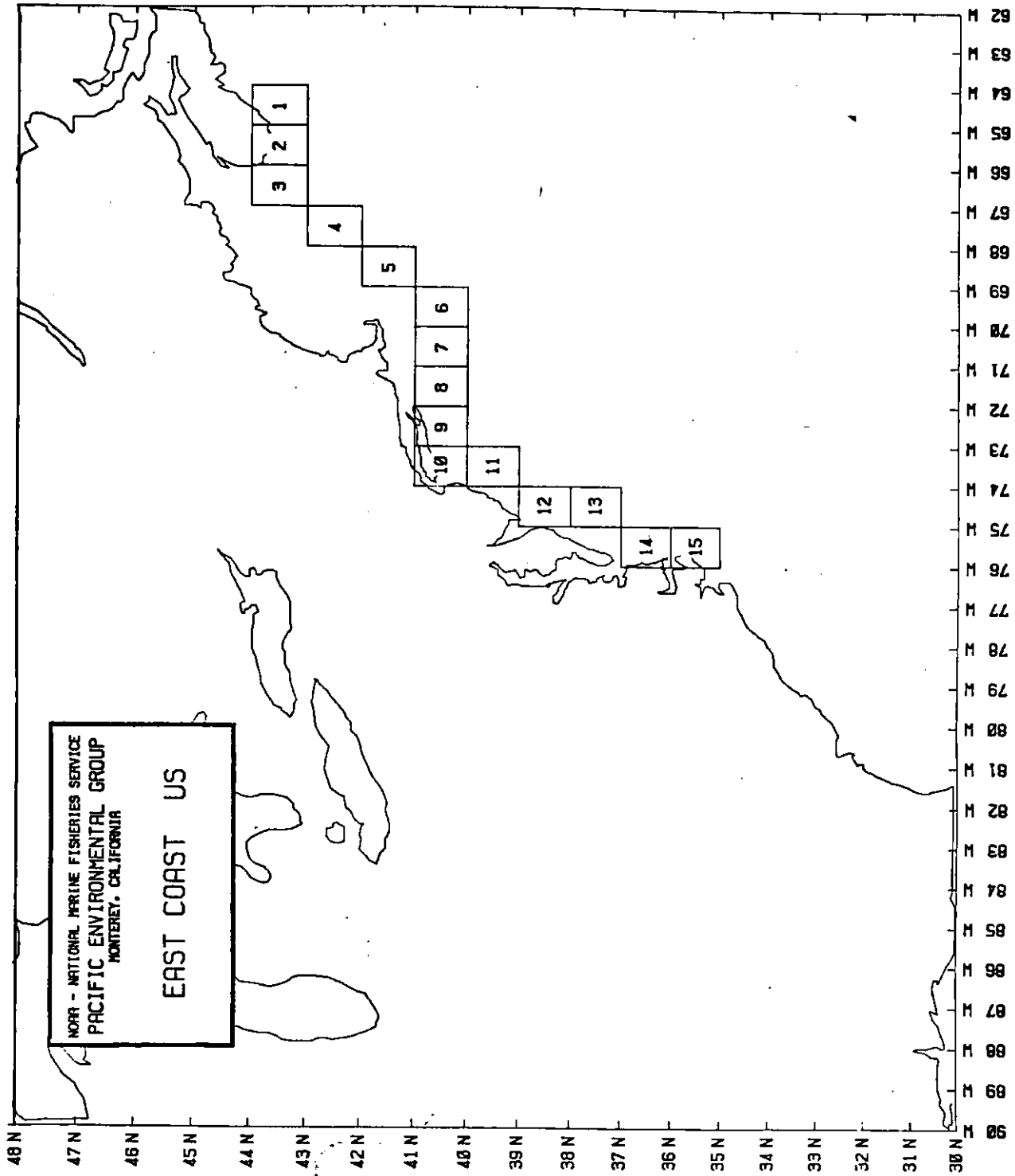
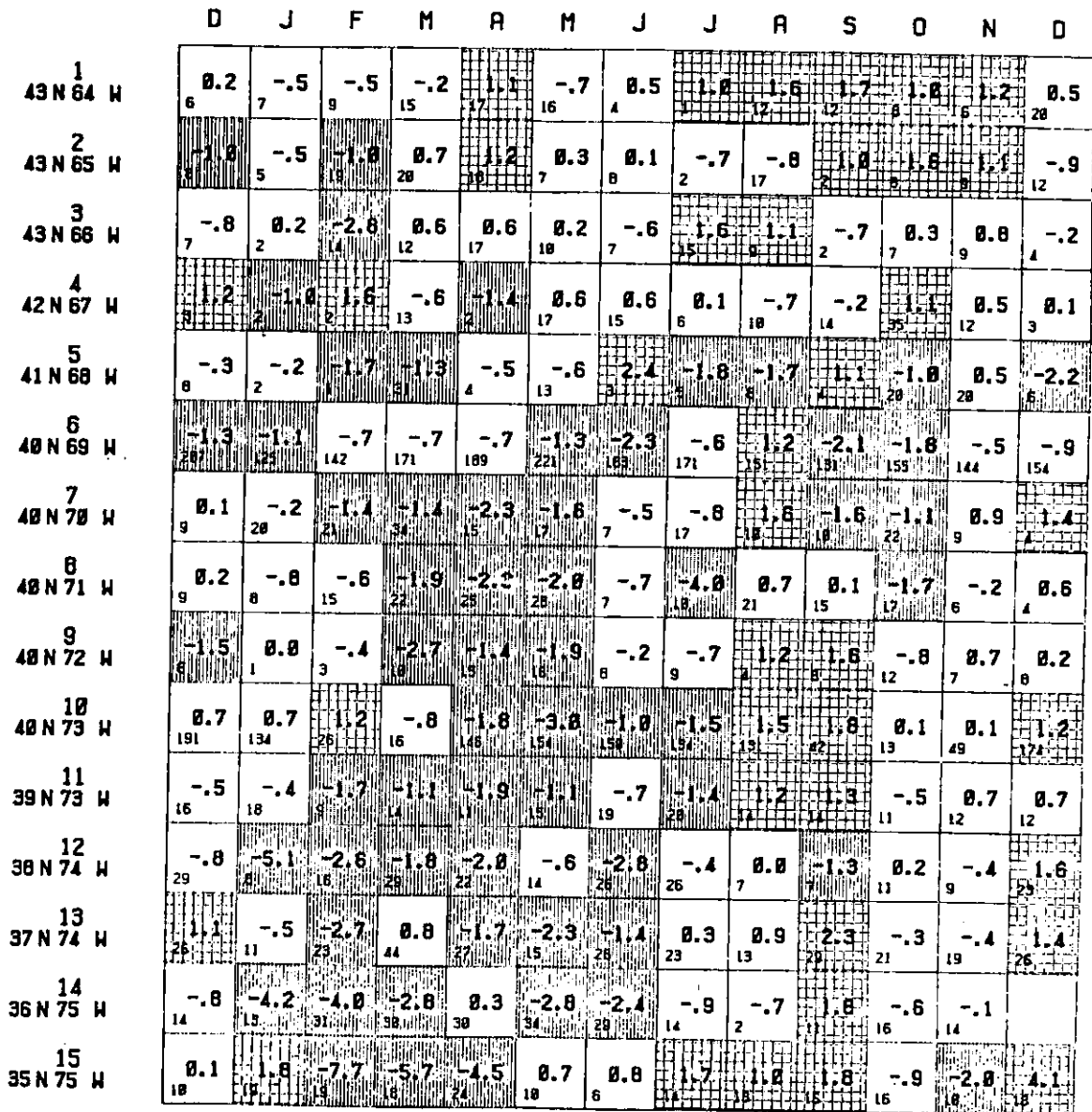


Figure 13. Location of 1° squares of interest utilized in figures 14, 15 and 16.

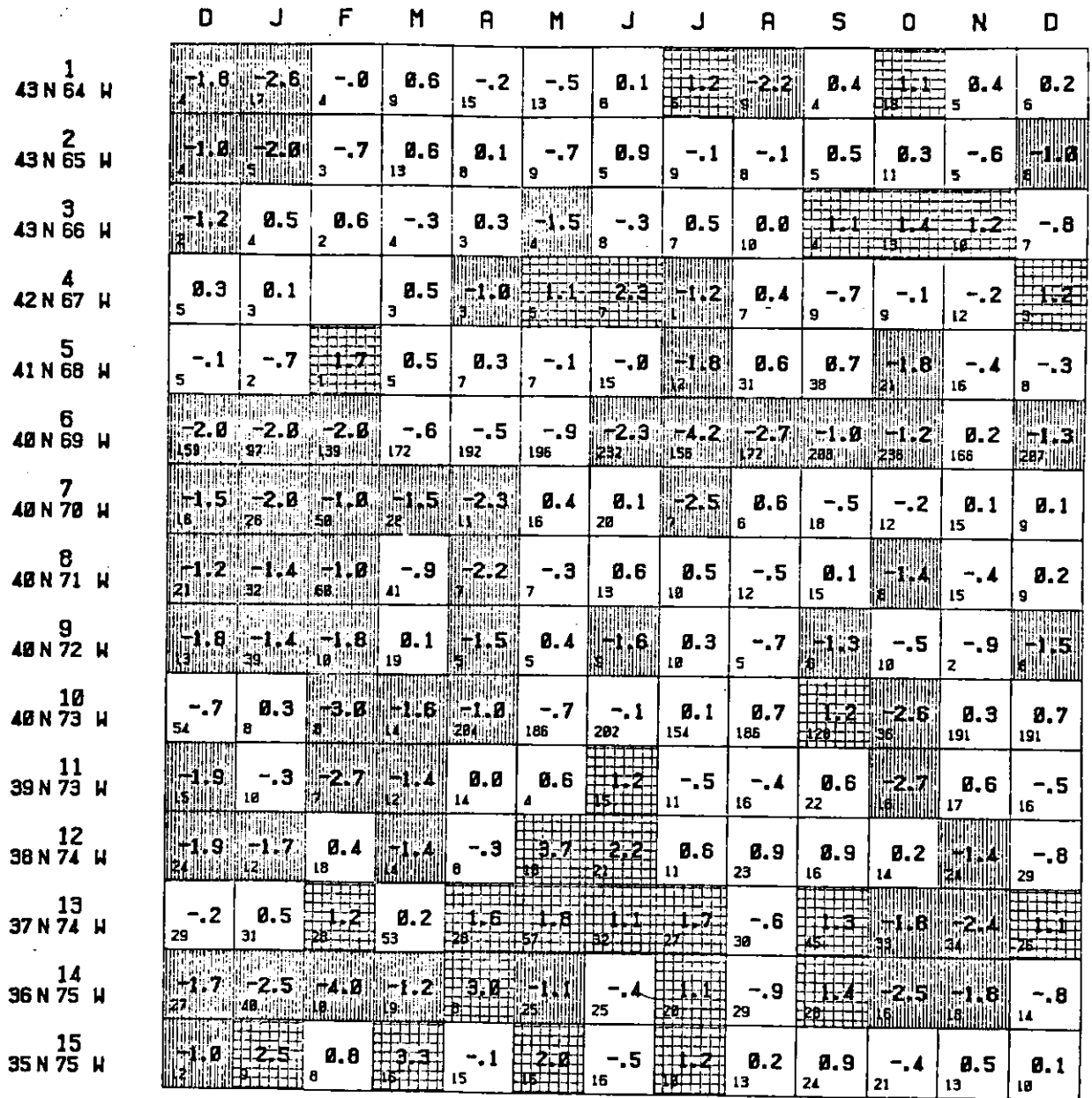
1978



SEA SURFACE TEMPERATURE MONTHLY ANOMALIES

Figure 14. Space-time plot of sea-surface temperature anomalies for 1978. Also shown are the numbers of observations utilized (lower left corner of squares).

1977

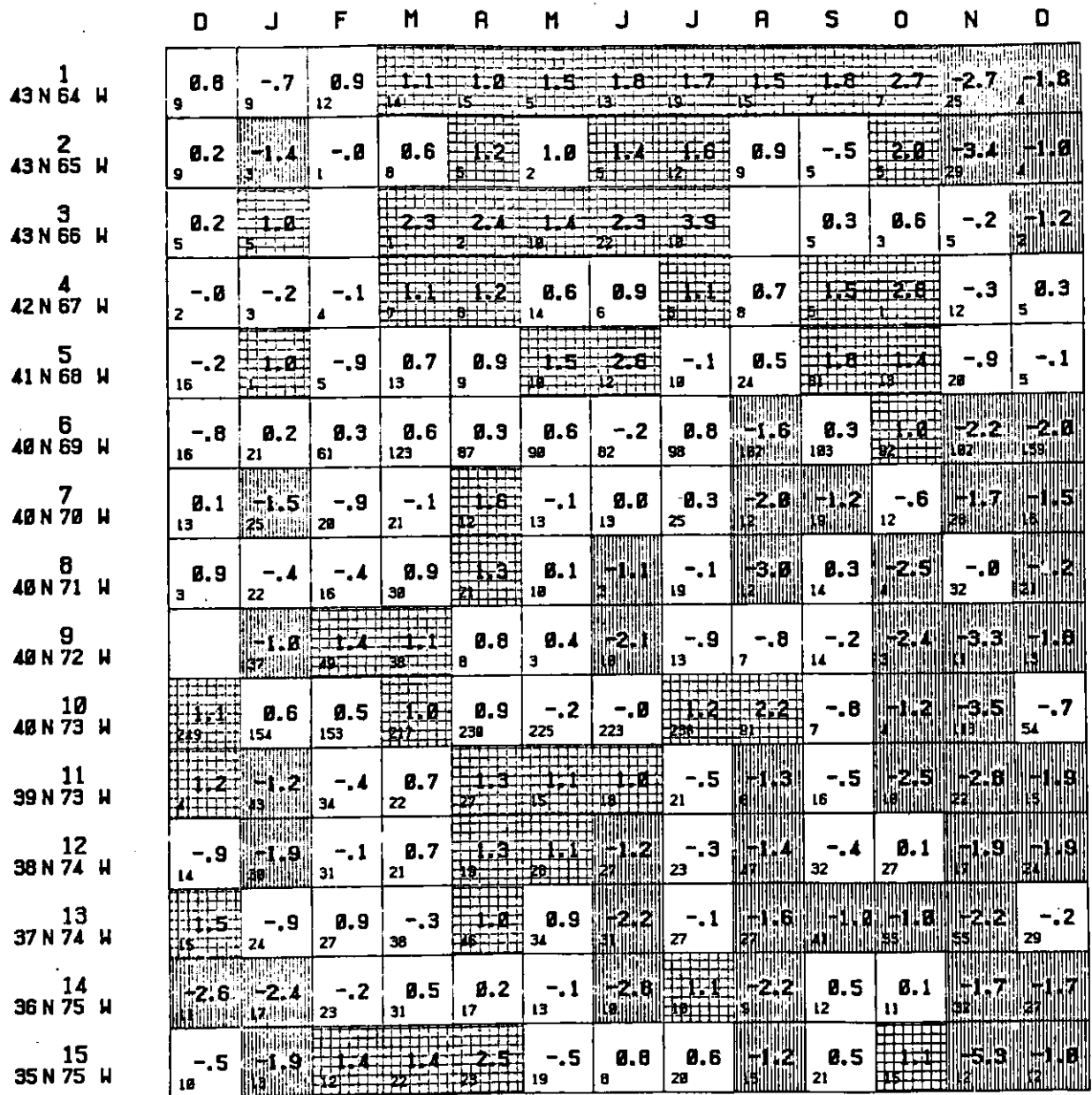


SEA SURFACE TEMPERATURE

MONTHLY ANOMALIES

Figure 15. Space-time plot of sea-surface temperature anomalies for 1977. Also shown are the numbers of observations utilized (lower left corner of squares).

1976



SEA SURFACE TEMPERATURE

MONTHLY ANOMALIES

Figure 16. Space-time plot of sea-surface temperature anomalies for 1976. Also shown are the numbers of observations utilized (lower left corner of squares).

