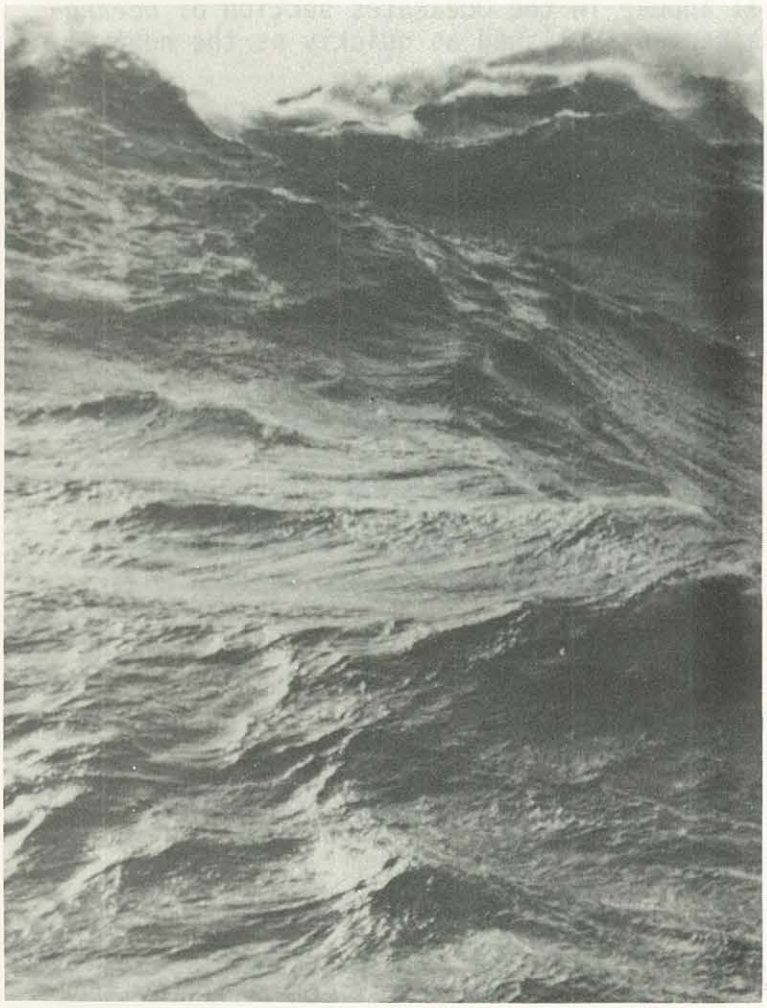
NOAA LISD SEATTLE

OCEANOGRAPHIC Monthly Summary

Volume IV Number 1 January 1984



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Oceanographic Monthly Summary

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National Weather Service, NOAA
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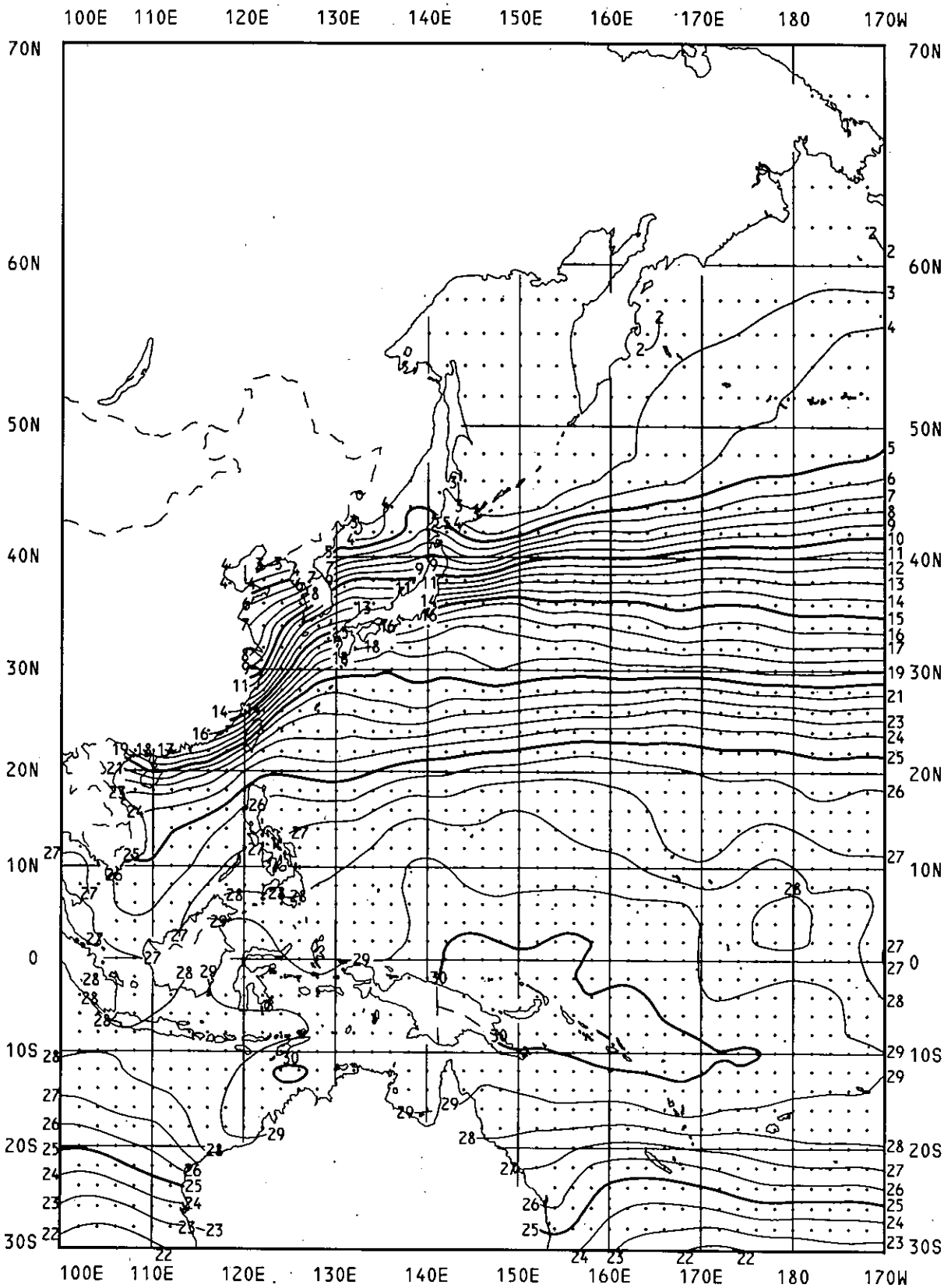
SST CORRECTIONS ALONG SOUTH AMERICA

Please note the objective analysis of the ship data on pages 7 and 11 shows a negative anomaly from 10°S to 30°S and from 80°W to the west coast of South America. Because of inadequate ship reports in that region, the anomalies are too cold. The independent satellite SST analyses on pages 9 and 12 suggest that the temperatures are at least 1°C above normal.



Western Pacific Ocean
SST--MONTHLY MEAN (°C)
SHIP and BUOY DATA
January 1984

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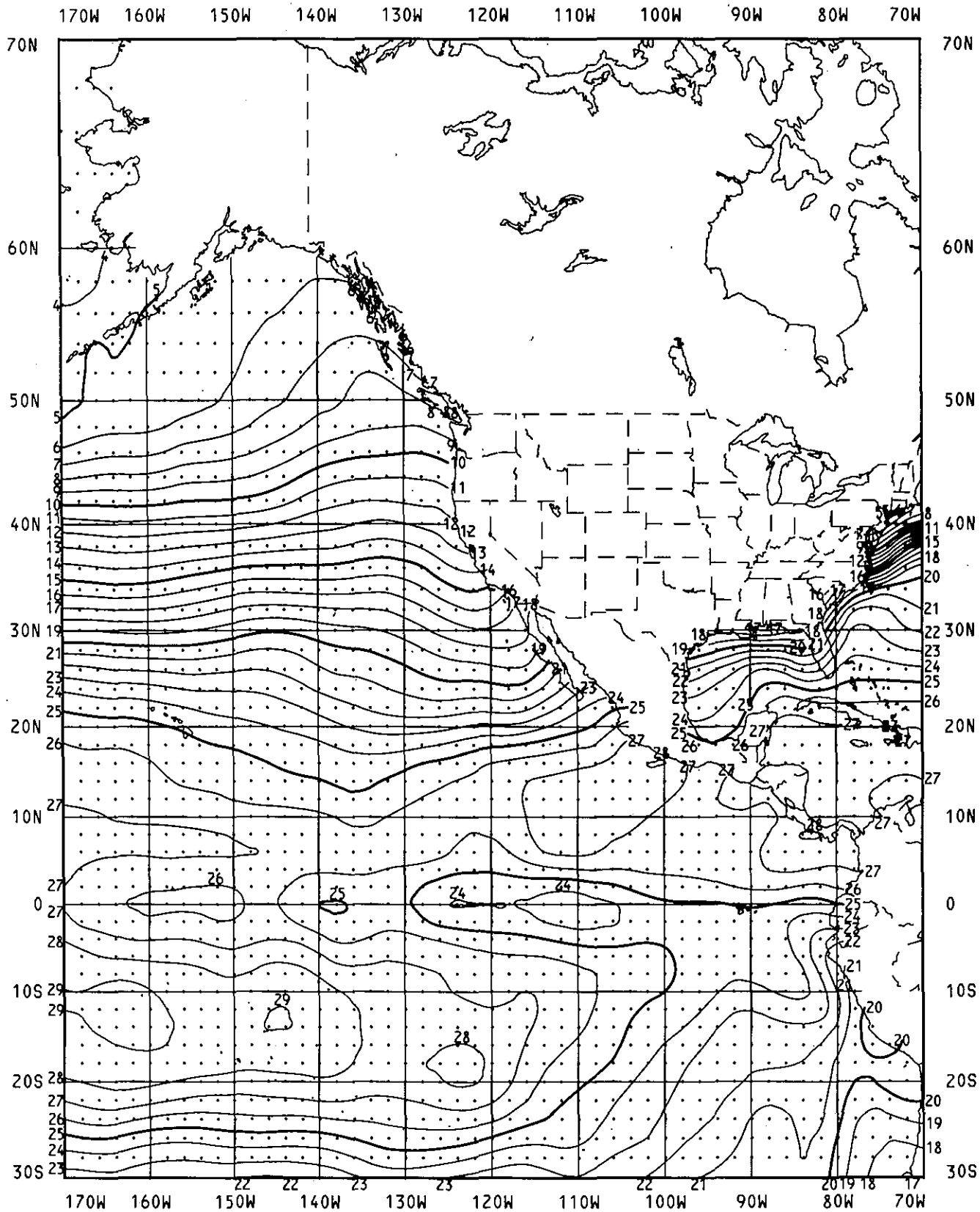

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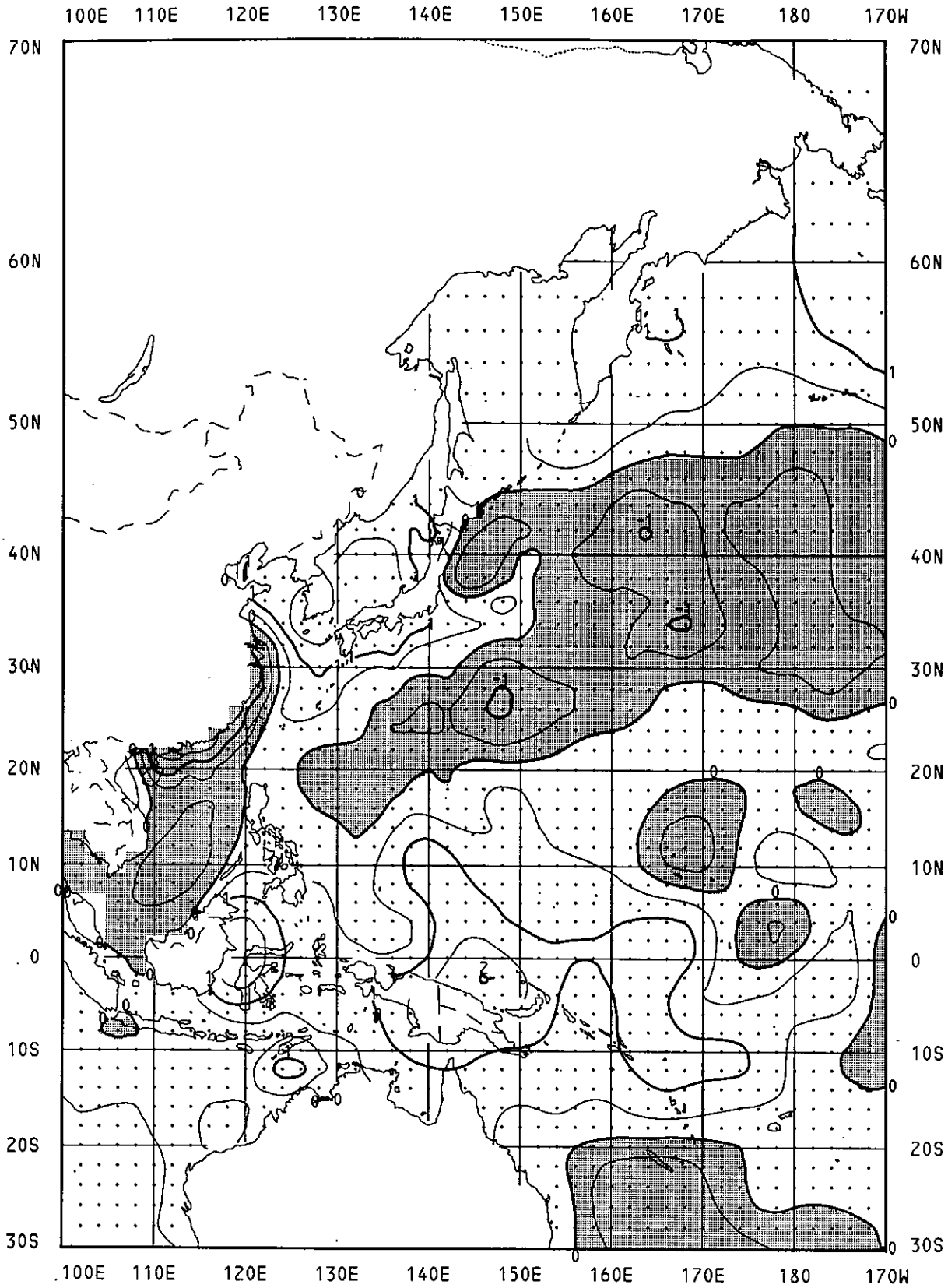

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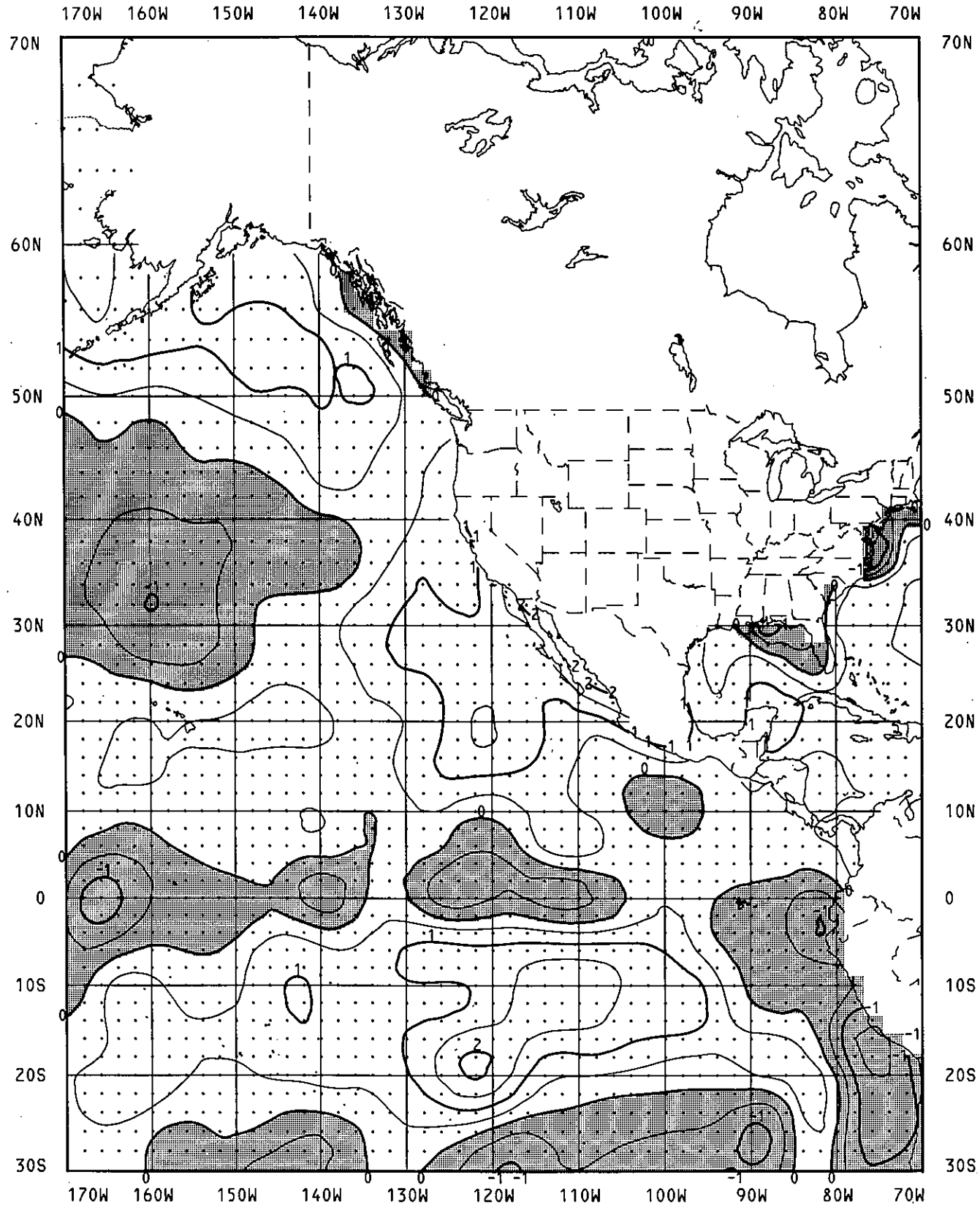

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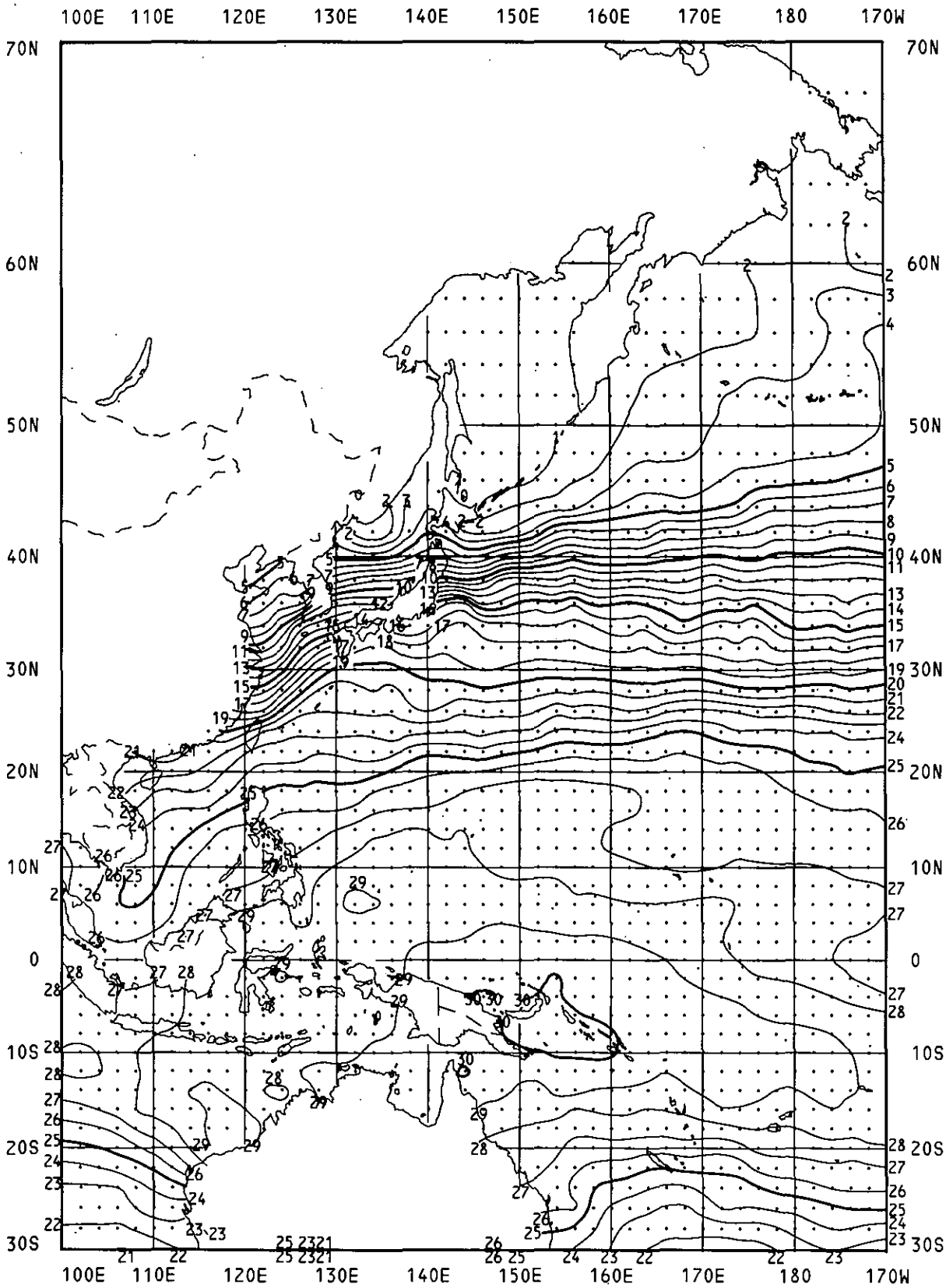

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SST--MONTHLY MEAN (°C)
SATELLITE DATA
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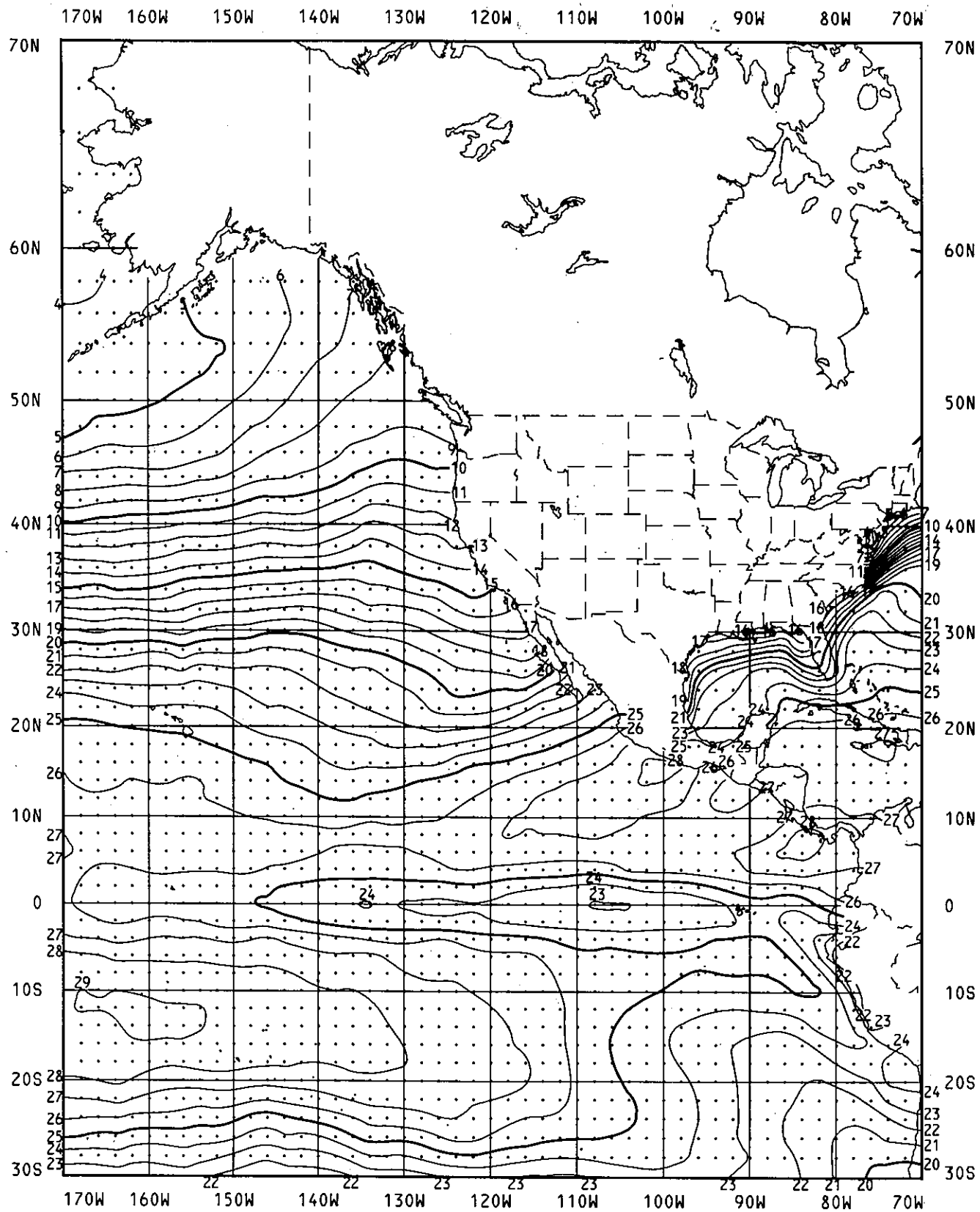

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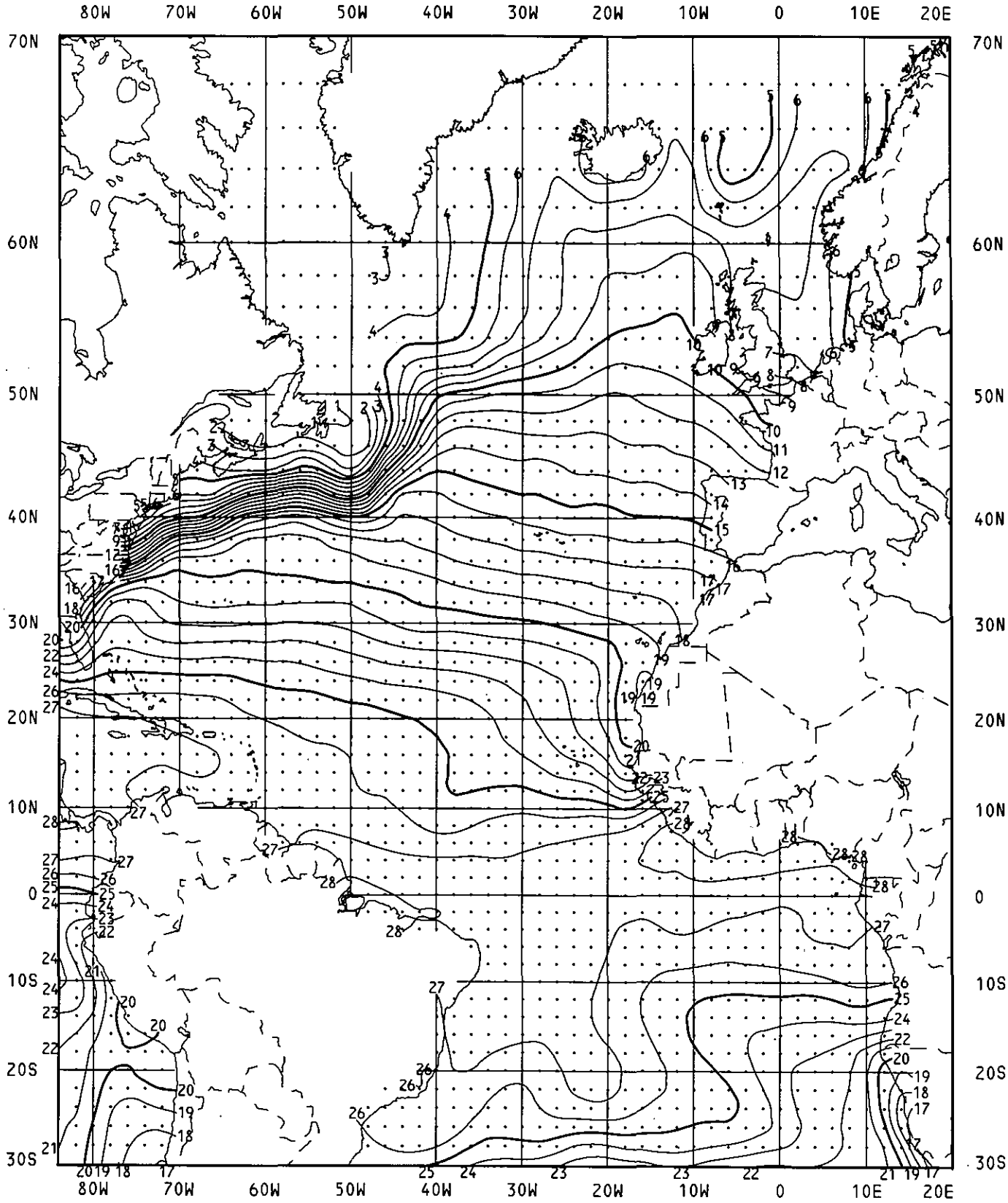

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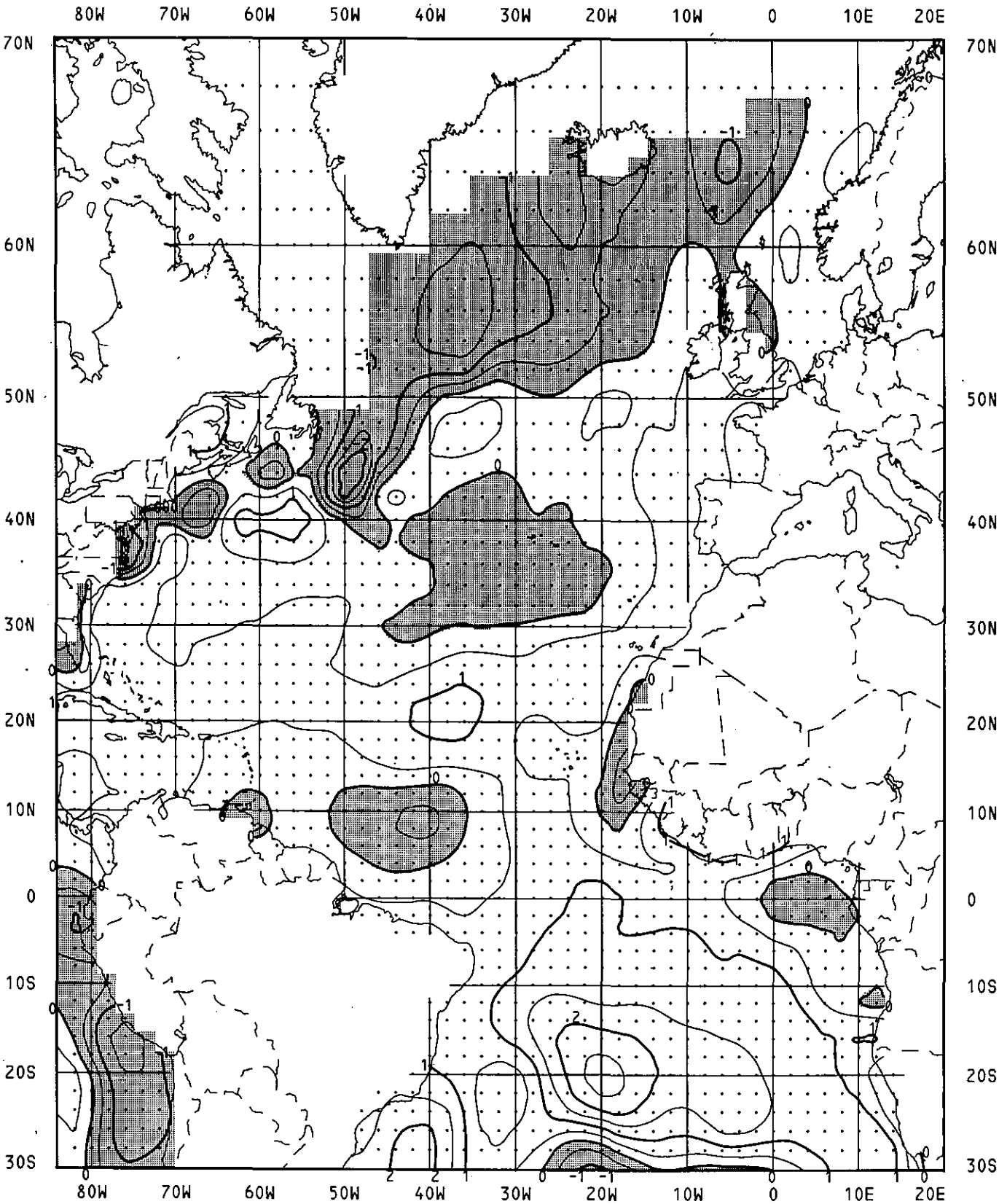

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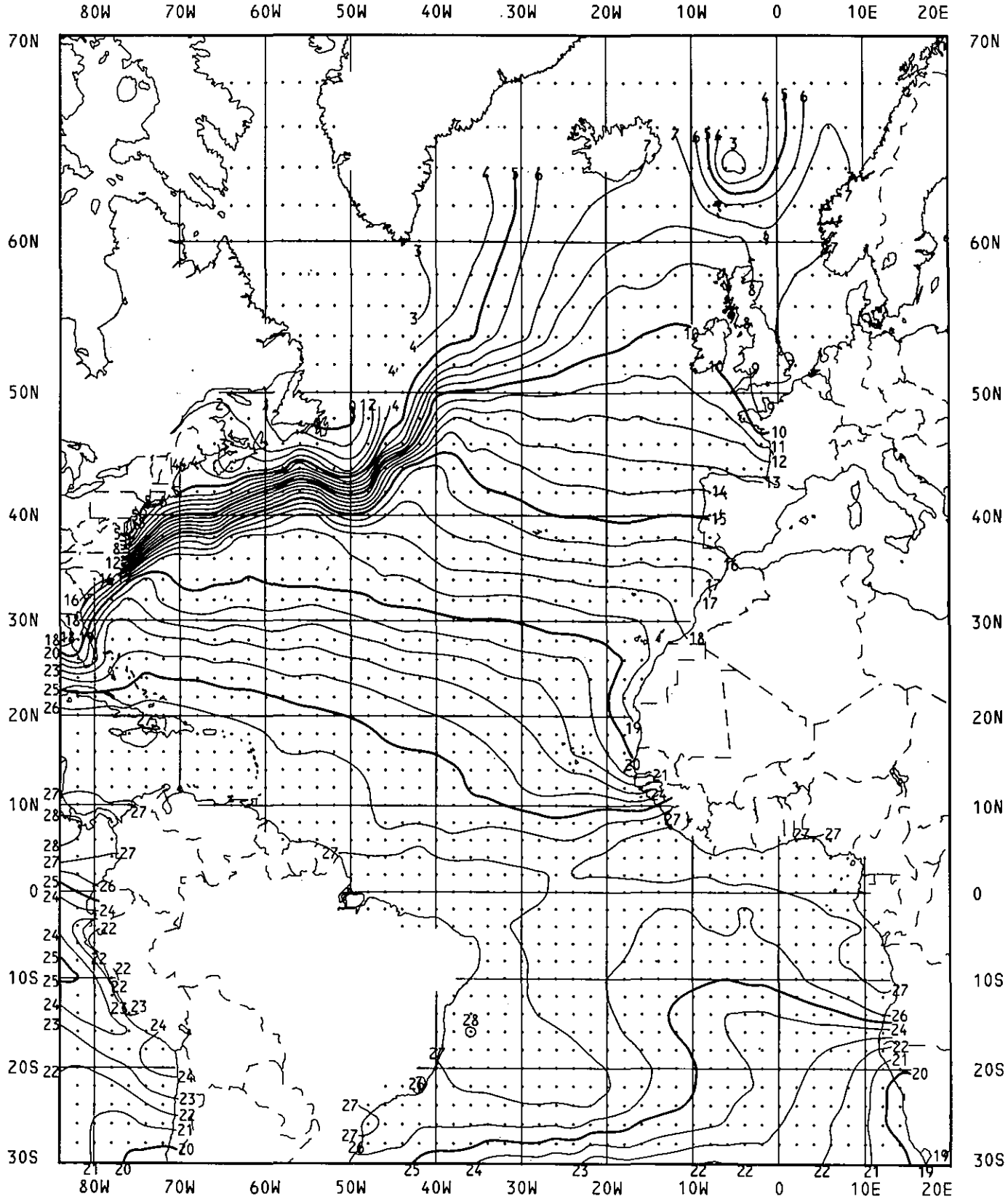

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SATELLITE IMAGE OF THE MONTH

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Environmental Products Branch, E/SP22
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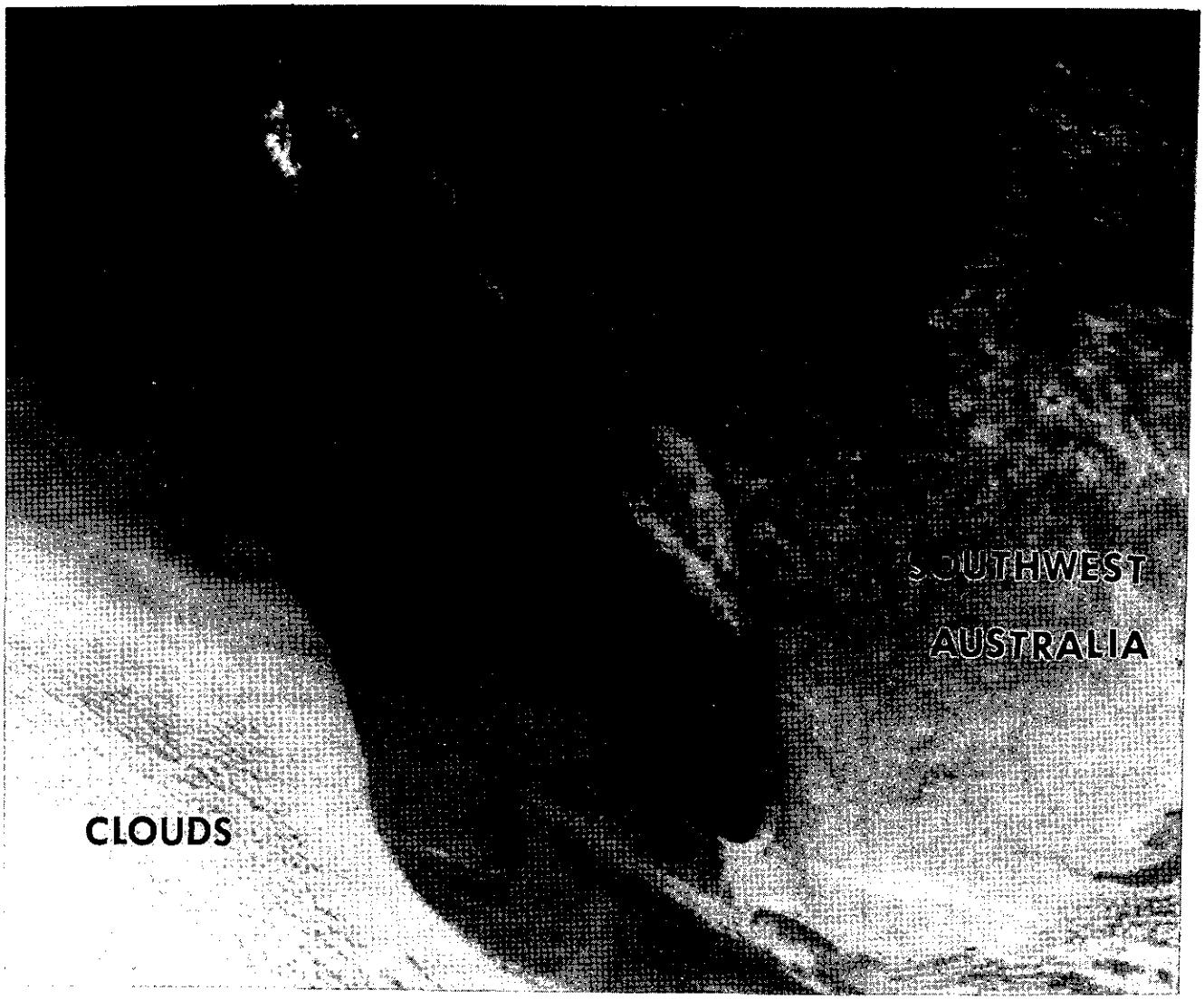
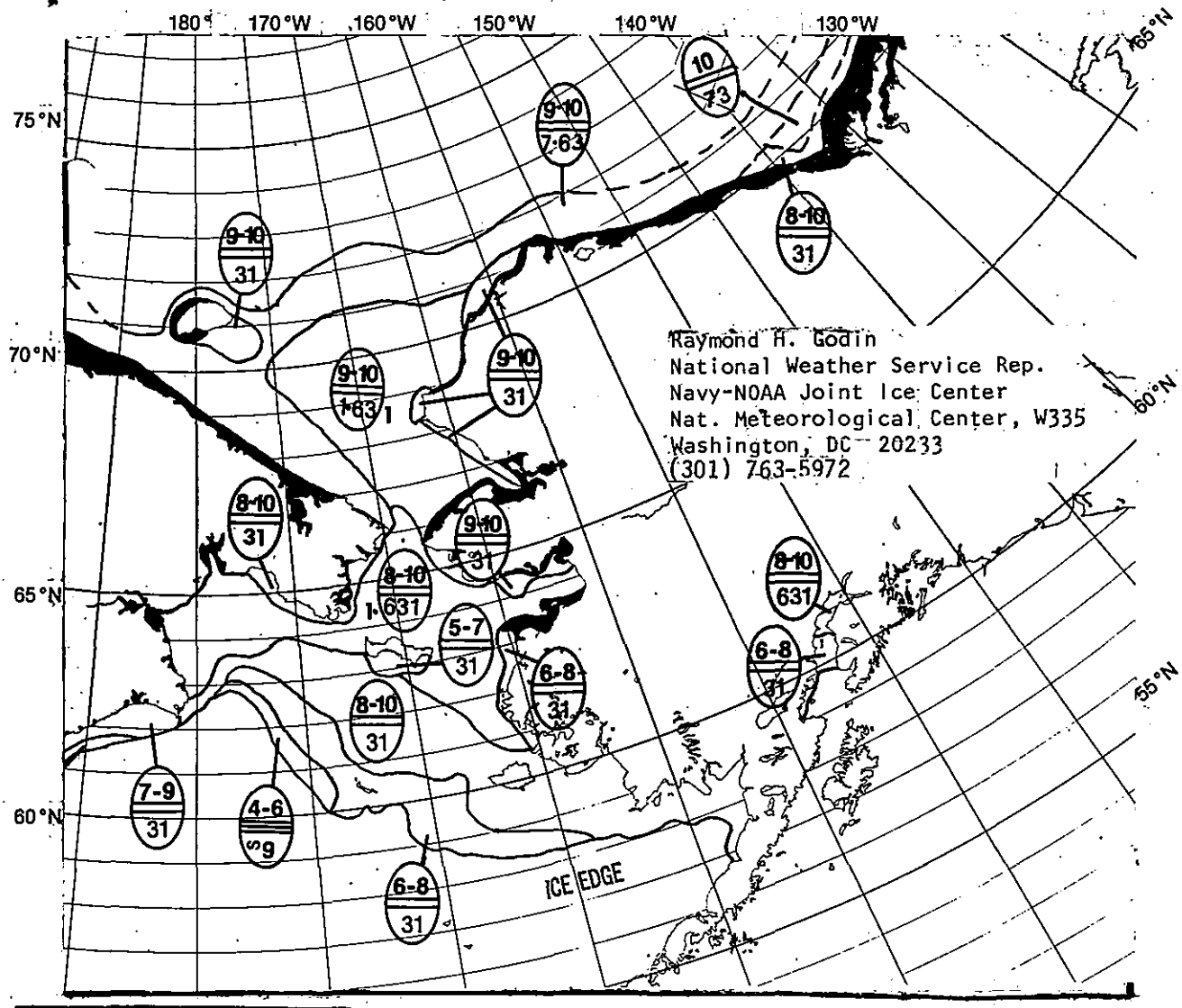
SST STRUCTURE NEAR AUSTRALIA

This NOAA-7 infrared satellite image from January 18, 1984 illustrates sea surface temperature (SST) structure off the southwest coast of Australia. The variation in gray shades represents distinct values of SSTs. The pattern of SSTs may be related to local scale or more regional scale current structure. Comparisons with sea truth data would therefore be desirable. Current patterns in this area are complex and extremely variable. Gross climatological trends indicate a reversal in direction from winter to summer. On the large scale, in summer (January), the West Australian current flows northward and westward. In winter (August), the current flows southward and to the east, joining the eastward flow of the South Indian current. Variability of local scale currents has not been determined, but is the subject of considerable debate.



BERING SEA / NORTH SLOPE ICE ANALYSIS



C = Total ice concentration in the area in tenths.

C_a, C_b, C_c = Concentration of thickest (C_a), 2nd thickest (C_b), and 3rd thickest (C_c) ice

S_a, S_b, S_c = Stage of development of thickest (S_a), 2nd thickest (S_b), and 3rd thickest (S_c) ice.

-C = Concentration of ice within area(s) of strips and patches.

STAGE(S) OF DEVELOPMENT (THICKNESS)

1 = New ice (0-10 cm)
3 = Young ice (10-30 cm)
6 = First year (30-200 cm)
7 = First year thin (30-70 cm)
1. = First year medium (70-120 cm)
4. = First year thick (120-200 cm)
7. = Old ice (survived at least one summer's melt)

EXAMPLES

125 Theoretical thickness of this season's growth (cm).

Fast ice. Sea ice which forms and remains fast along the coast.

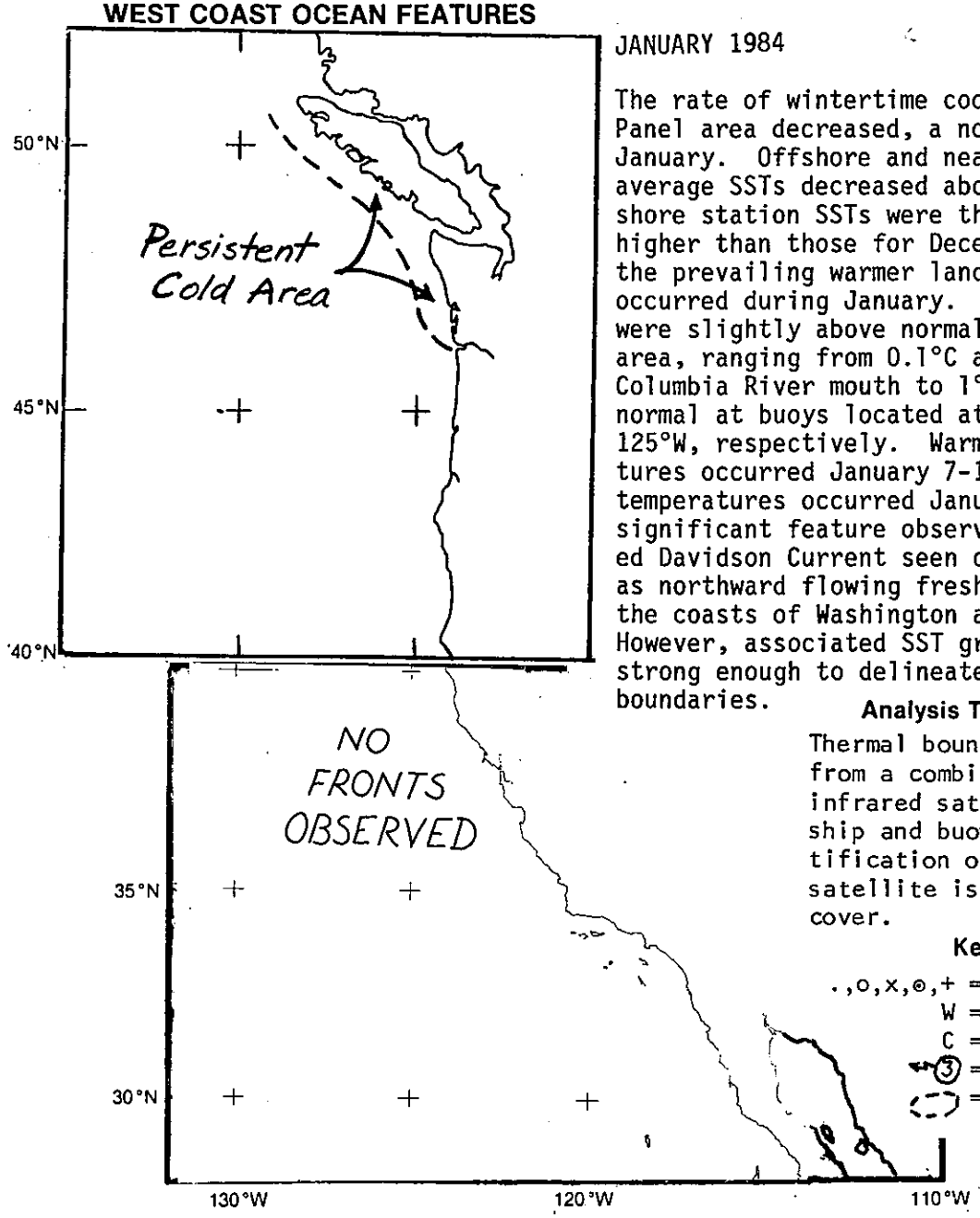
Ice boundary visually or satellite observed.

Ice boundary estimated.

JANUARY 1984

The monthly mean sea level pressure circulation depicts a 997 mb low pressure circulation centered in the central Pacific Ocean near 46°N 177°W. Throughout the ice covered waters of the central and eastern Bering Sea easterly geostrophic surface winds predominate in the monthly mean charts. However 5-day mean charts show predominantly southeasterly flow during the early part of the month and stronger northeasterly winds during the latter part of the month. North of the Bering Strait winds were light and variable. The monthly mean surface air temperatures at routinely monitored Alaskan coastal stations were normal north of the 60°N latitude and above normal south of 60°N. Between 175°W and 165°W the ice edge expanded from 180 to 400 km. East of 165°W expansion was limited from 20 to 100 km. The current ice edge position closely approximates the climatological mean position.

WEST COAST OCEAN FEATURES



JANUARY 1984

The rate of wintertime cooling over the North Panel area decreased, a normal occurrence for January. Offshore and near-coastal buoys showed average SSTs decreased about 1°C. Average shore station SSTs were the same as or slightly higher than those for December, reflecting the prevailing warmer land temperatures which occurred during January. Resulting mean SSTs were slightly above normal over the entire area, ranging from 0.1°C above normal near the Columbia River mouth to 1°C and 1.2°C above normal at buoys located at 46°N 131°W and 41°N 125°W, respectively. Warmest coastal temperatures occurred January 7-12, and coolest coastal temperatures occurred January 16-21. The most significant feature observed was a well-developed Davidson Current seen on satellite imagery as northward flowing freshwater runoff along the coasts of Washington and Vancouver Island. However, associated SST gradients were not strong enough to delineate distinct thermal boundaries.

Analysis Techniques

Thermal boundaries are determined from a combination of enhanced infrared satellite imagery and ship and buoy observations. Identification of these features by satellite is limited by cloud cover.

Key

.,o,x,⊙,+ = thermal boundaries
W = warm
C = cold
③ = date of feature
= outline of water mass feature

North Panel
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NOAA/Northwest Regional Ocean Service Center
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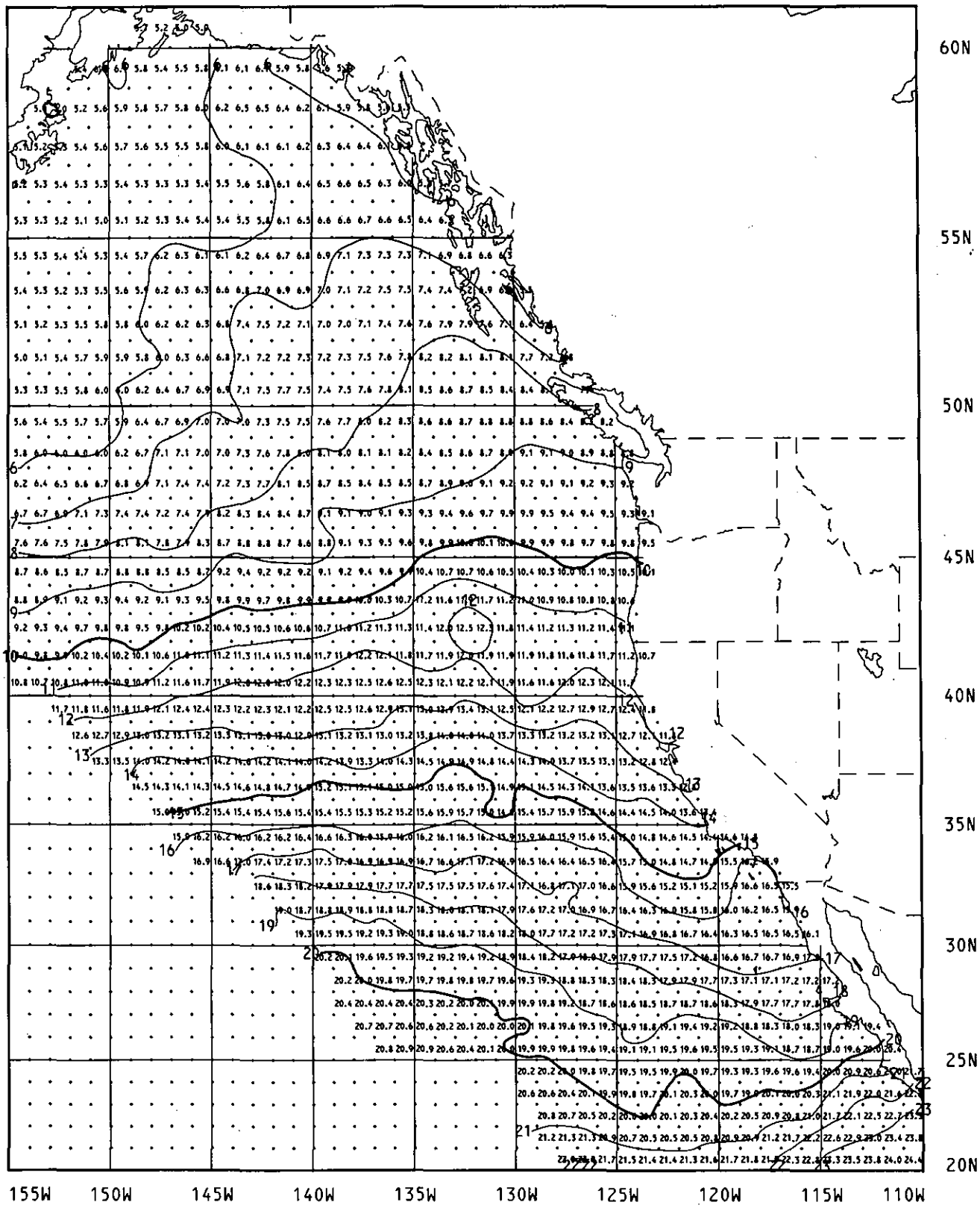
Seattle, WA 98115
(206) 527-6604

South Panel
Ernest Daghir
NOAA/NESDIS
Satellite Field Service Station
660 Price Avenue
Redwood City, CA 94063
(415) 364-2422

SSTs over the South Panel area declined slower than normal during January. With a high pressure ridge along the West Coast for most of the month, air temperatures were above normal and precipitation was below normal. This ridging prevented cold air from penetrating into the South Panel region which could have accentuated the expected seasonal cooling of SSTs. Temperatures over the analysis area declined 0.5°-1.0°C. Therefore, SSTs were greater than 1.5°C above normal from Cape Mendocino south to Baja, California when compared to climatology. The anomalously cool area west of 130°W and between 31°-40°N continues to persist. Upwelling was not observed from infrared satellite data anywhere along the coast of the South Panel region. Minor upwelling was suspected along the northern Baja peninsula from ship data reports.



West Coast
SST--MONTHLY MEAN (°C)
January 1984

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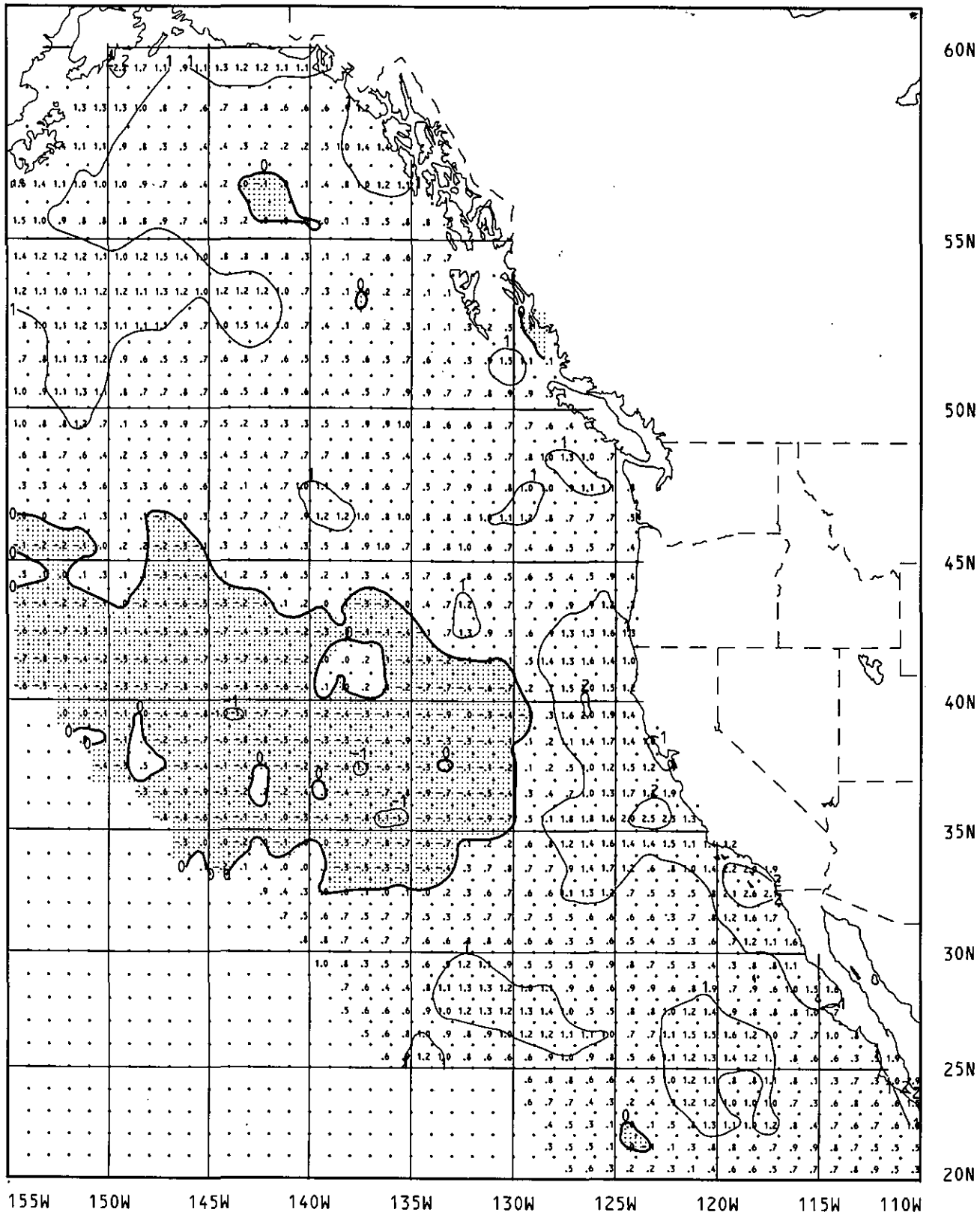

West Coast
SST--MONTHLY ANOMALY (°C)
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Monthly anomaly is the difference between the monthly mean sea surface temperature and the climatological monthly mean value -- shading shows where the monthly mean is colder than climatology. Contour line interval is 1.0°C.

The end of this month's positions of the Gulf Stream System and its associated eddies are shown for the NW Atlantic and the Gulf of Mexico. The Gulf Stream and Loop Current boundaries are located by infrared satellite imagery or XBT (expendable bathythermograph) data. Anticyclonic eddies are labeled a-z in the Gulf of Mexico and 1-99 in the NW Atlantic. Cyclonic eddies are labeled A-Z. Arrows on eddies indicate direction of circulation. Warm-core or anticyclonic eddies rotate clockwise; cold-core or cyclonic eddies rotate counterclockwise. The line to the eddy center shows the net translation since last month or since last observed. Eddies or sections of the Gulf

EAST COAST OCEAN FEATURES

Stream System which were not observed during the month are not shown on the analysis chart. The long arrows at the bottom of the chart indicate the date of data used.

Data used in this analysis include:
- NOAA satellite infrared imagery, NESDIS
- Bathythermograph data, National Meteorological Center of National Weather Service
- Oceanographic Analysis, A daily detailed analysis issued by National Weather Service/NESDIS

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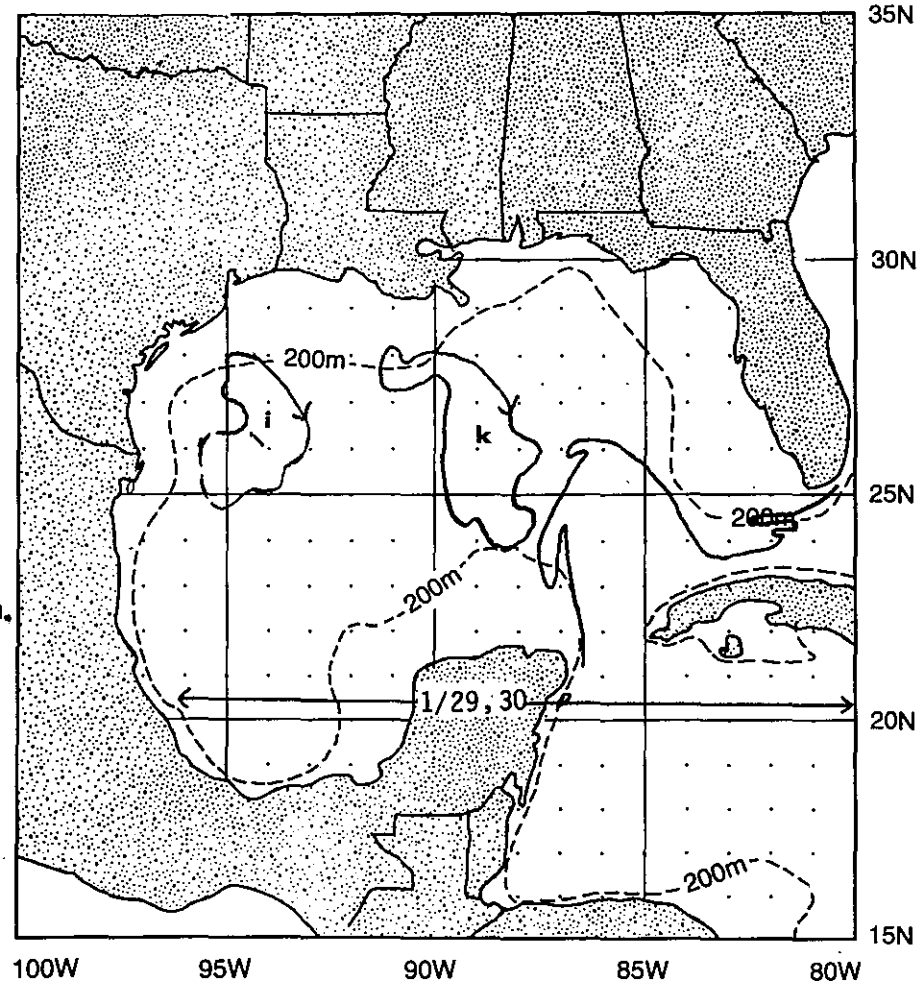
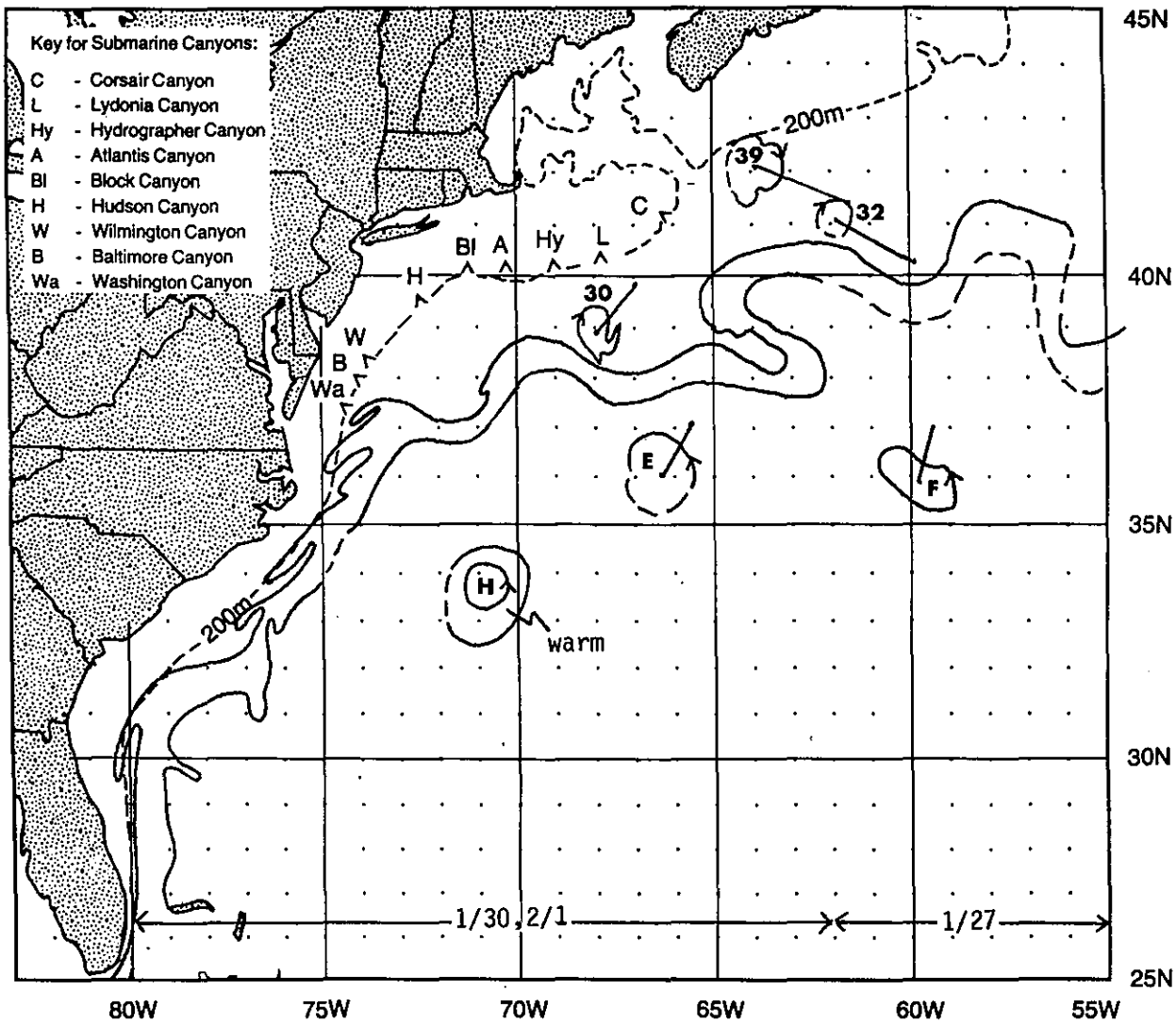


JANUARY 1984

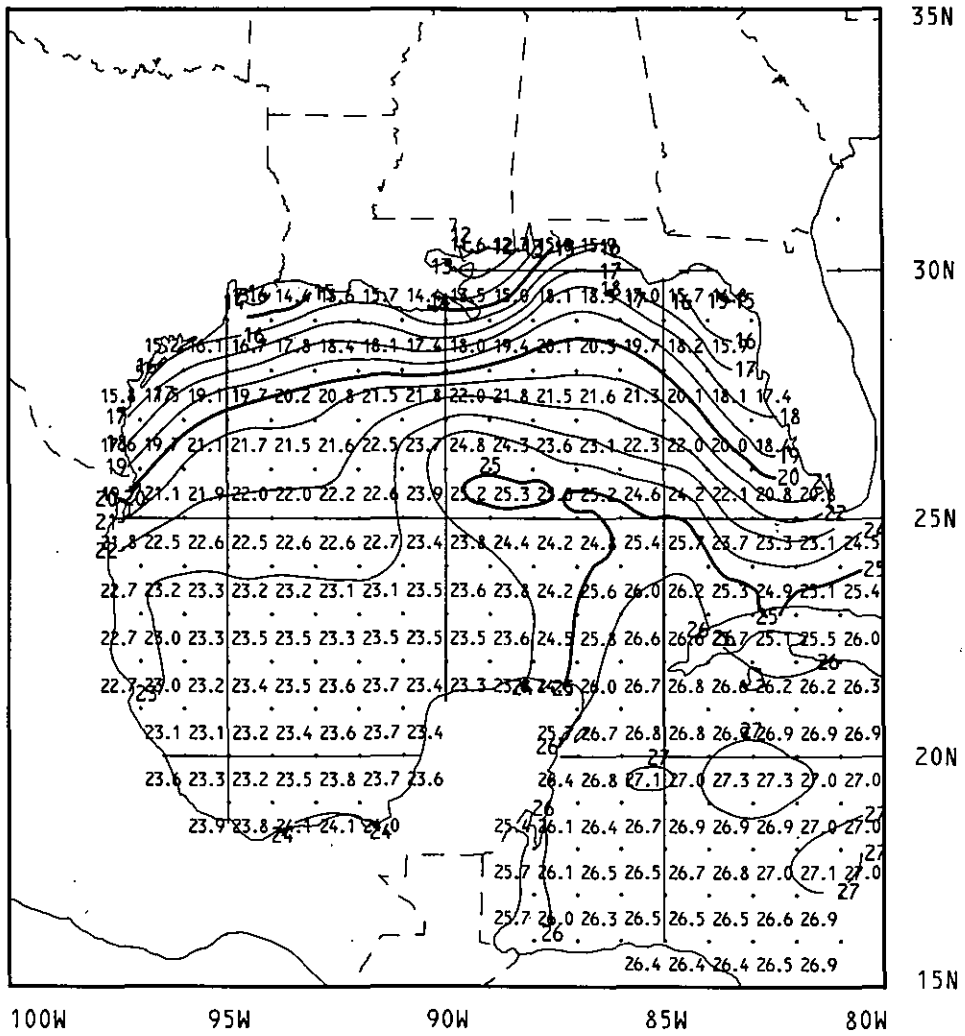
The Loop Current in the Gulf of Mexico pinched off anticyclonic eddy k on January 23. The amplitude of the Loop Current then decreased 165 km from 27°30N to 26°N. Eddy i translated about 35 km SE.



Anticyclonic eddy 36 was not observed during January and apparently dissipated in the slope water near 39°30N 71°30W. Eddy 30 traveled 130 km SW. Eddies 39 and 32 moved 210 km NW and 195 km NW, respectively.

Cyclonic eddy H was newly observed on January 29 near 33°30N 71°W. Its origin is not known. Eddy E translated 130 km SSW when it was last observed on January 27. Eddy F moved 120 km SSW. Eddy D was not observed.

EAST COAST SST-
MONTHLY MEAN



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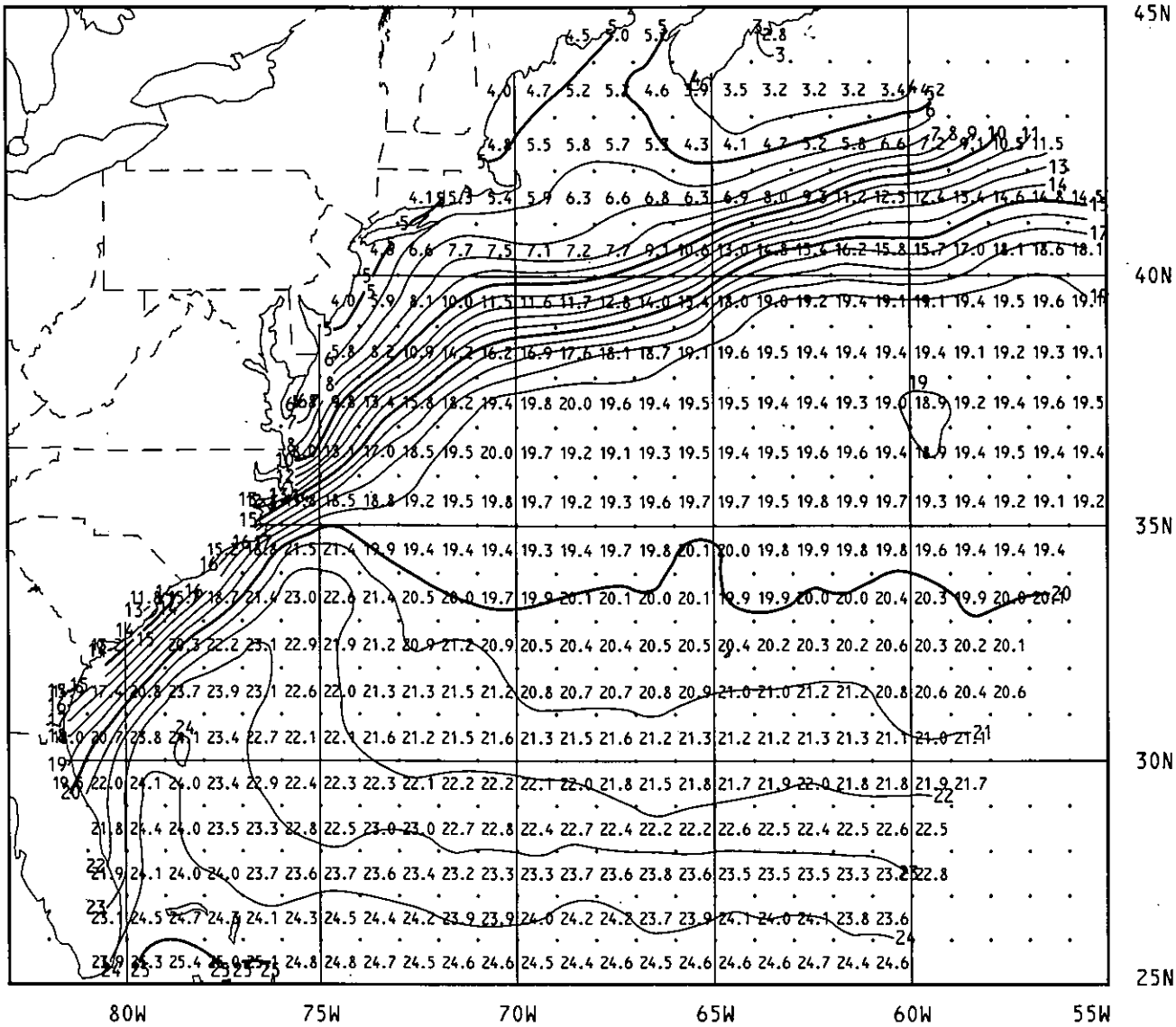

NW Atlantic Ocean
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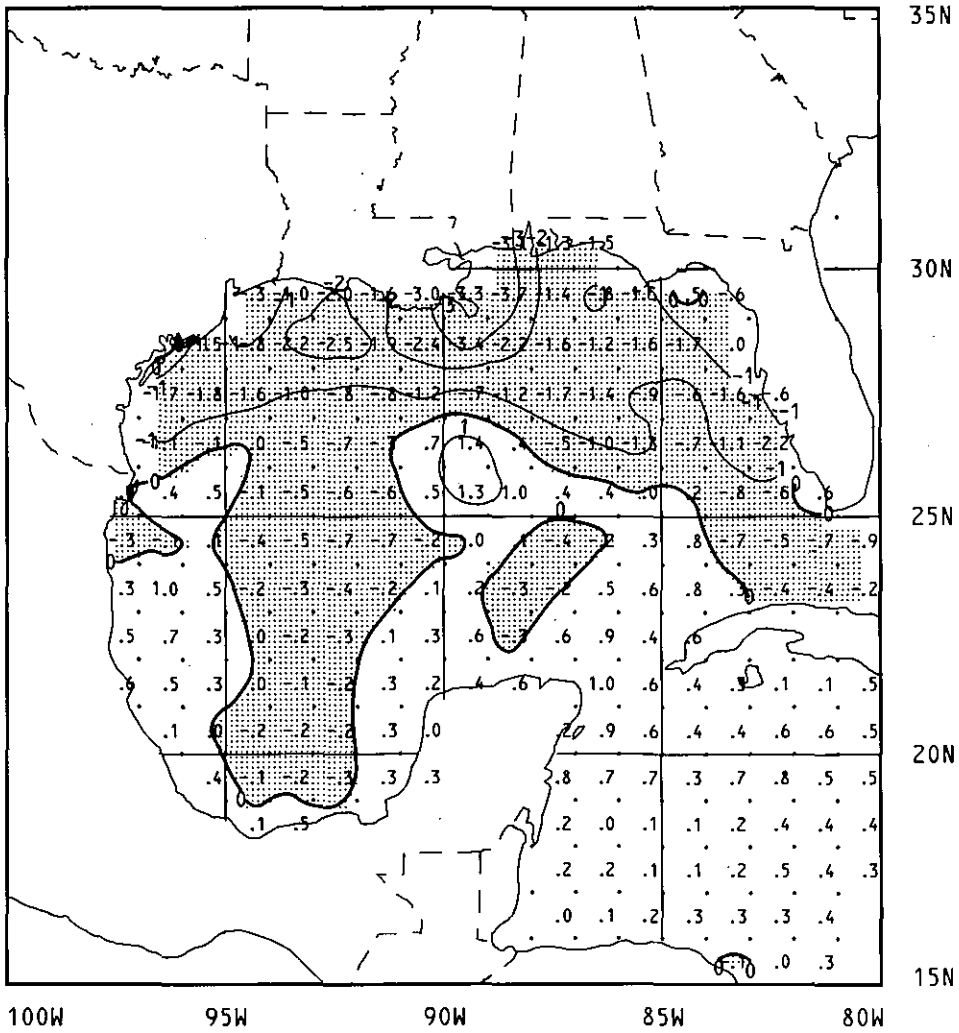
EAST COAST SST-ANOMALY



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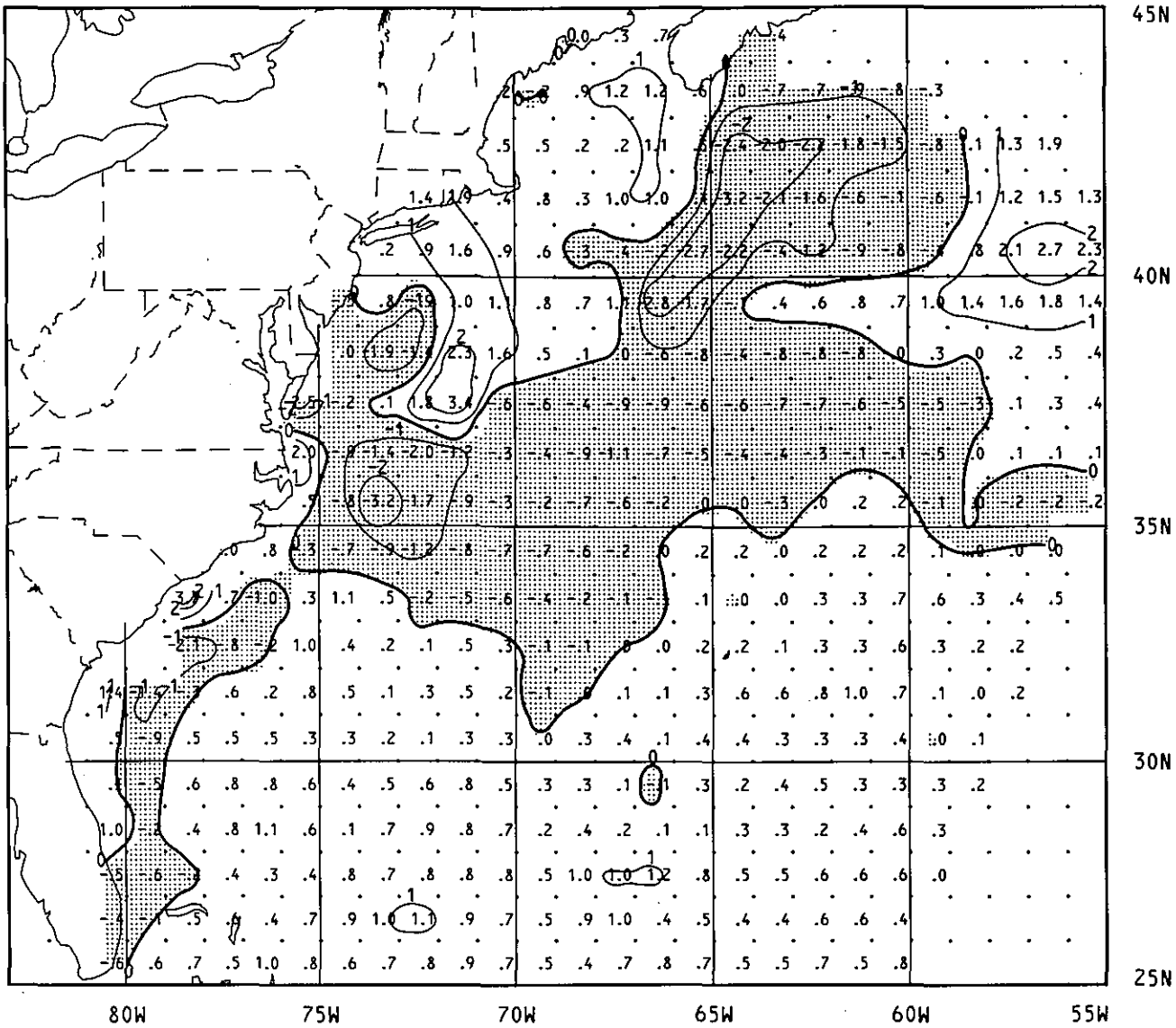

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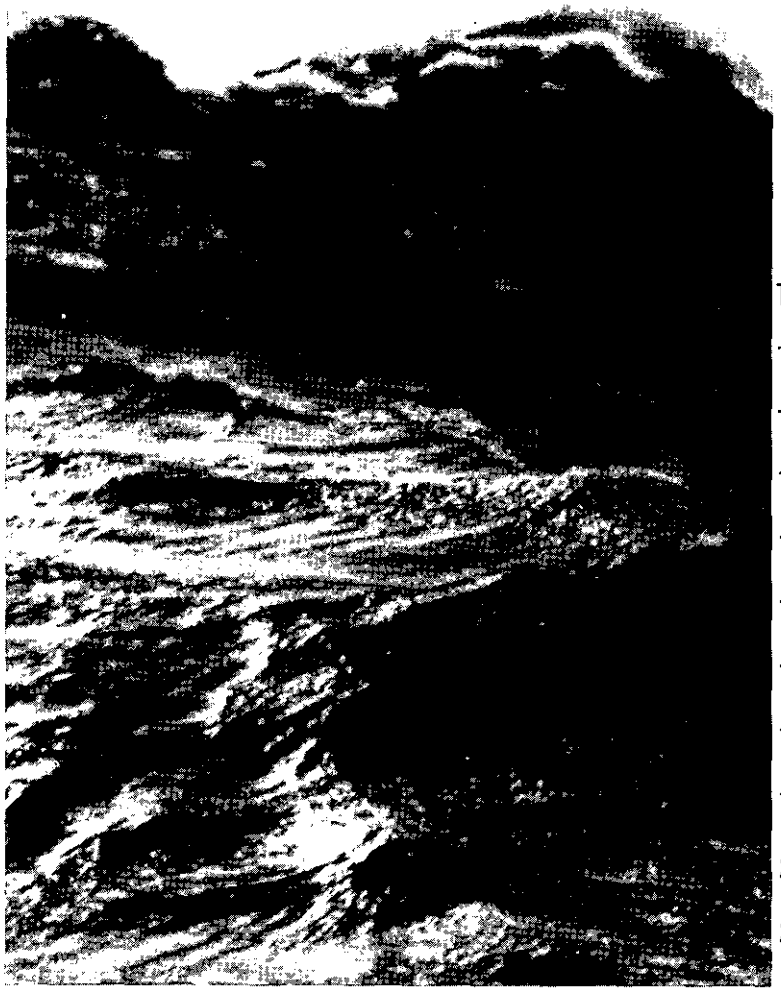

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GLOBAL SST CORRECTIONS

Please note that there are several areas of major differences between ship SST monthly means and satellite SST monthly means. The low SST in the ship data near 2°N 176°W is erroneous. The SST values are too low along the South American coast (6°S - 30°S) in the ship means due to inadequate ship data density in that region. However, in the tropical Atlantic (Equator to 20°N), the satellite data is 1.5°C colder than the ship SST analysis due to contamination of dust blowing off the African continent.

*Reynolds, R.W., 1982. A Monthly Averaged Climatology of Sea Surface Temperatures; *NOAA Technical Report NWS 31*.

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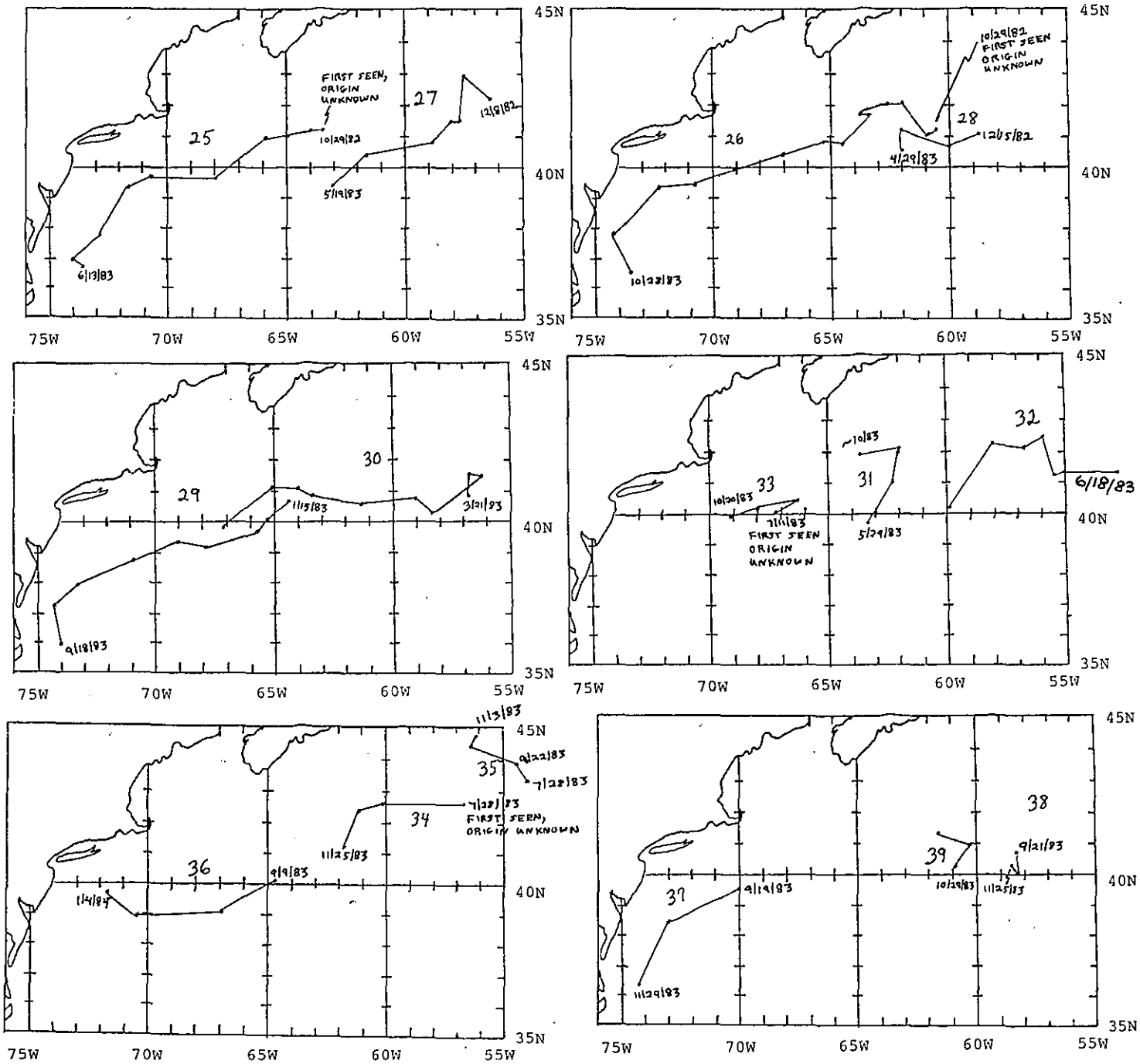
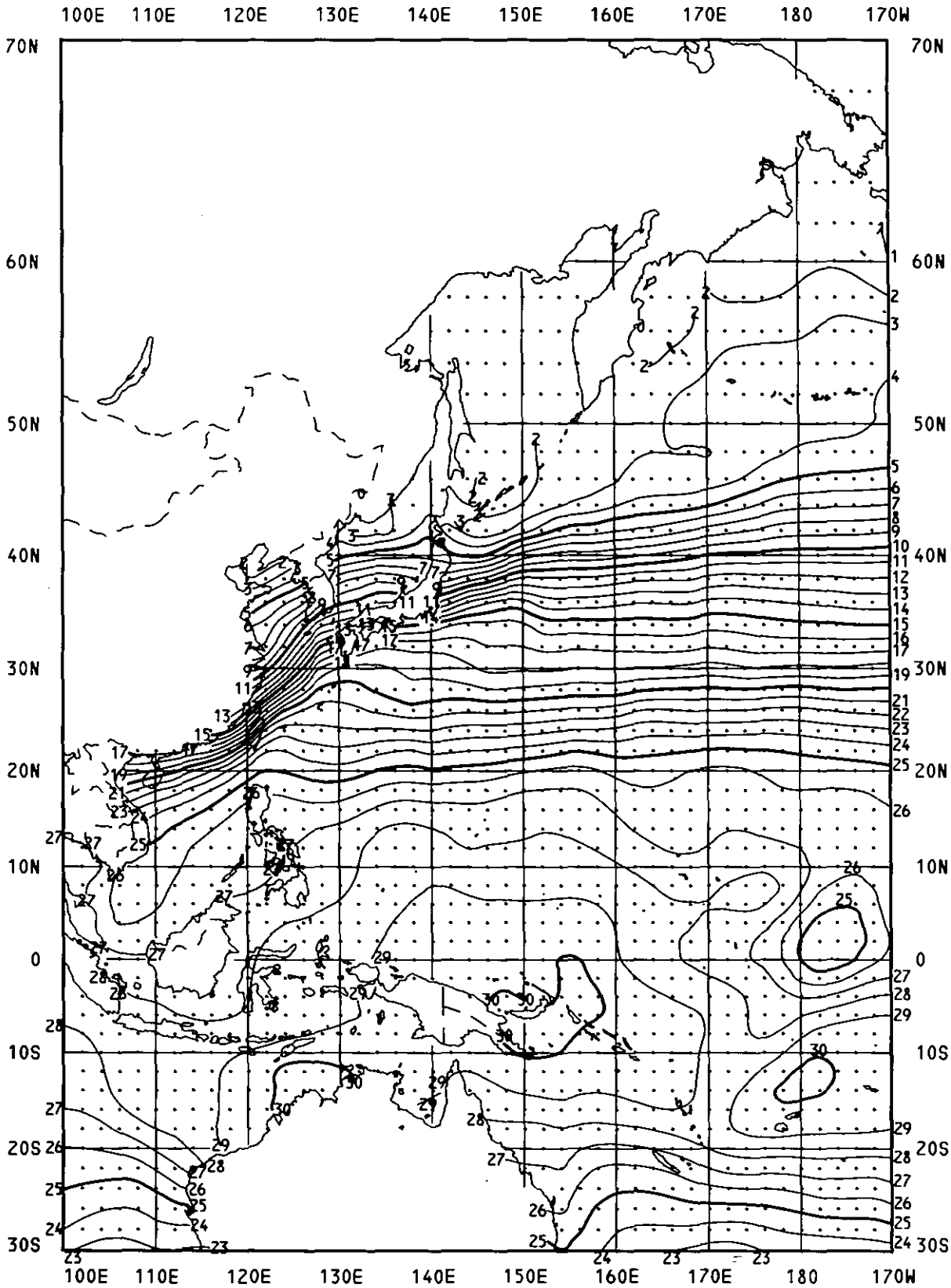
ANTICYCLONIC EDDY CENSUS--1983

Plots show tracks of individual anticyclonic Gulf Stream eddies, from their formation (some prior to 1983) to their absorption or until their end-of-1983 position. Dots shown between formation and absorption dates or end-of-1983 positions represent intervening end-of-month positions. Maximum and minimum duration of the anticyclonic eddies were 12 months and 2 months, respectively. The mean duration was 5 months. Maximum and minimum average speeds were 9 km/day and 2 km/day, respectively. The mean speed was 5 km/day. The eddies generally translated westerly and southwesterly. Eddy data are from the Oceanographic Monthly Summary.





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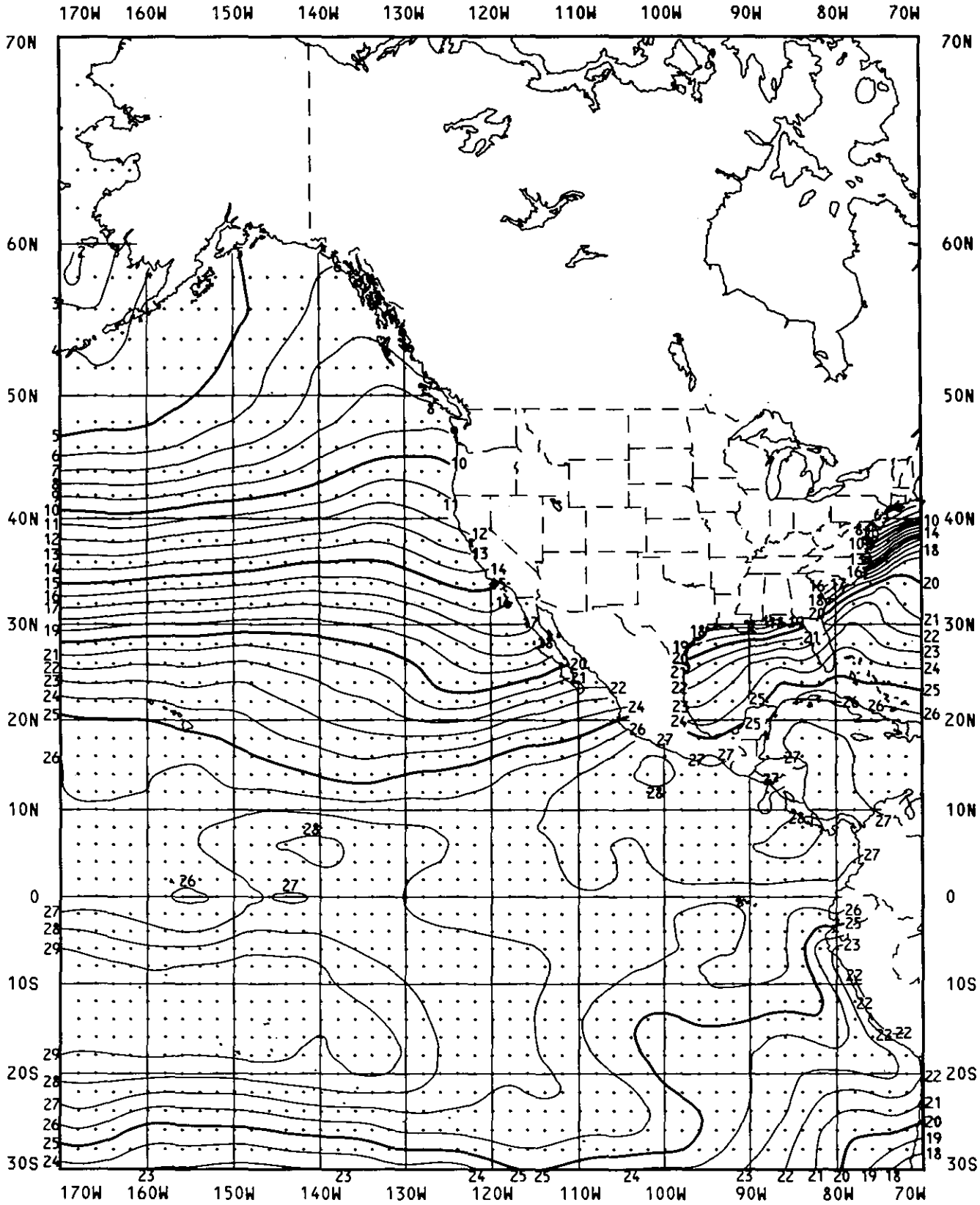

Eastern Pacific Ocean
SST--MONTHLY MEAN (°C)
SHIP and BUOY DATA
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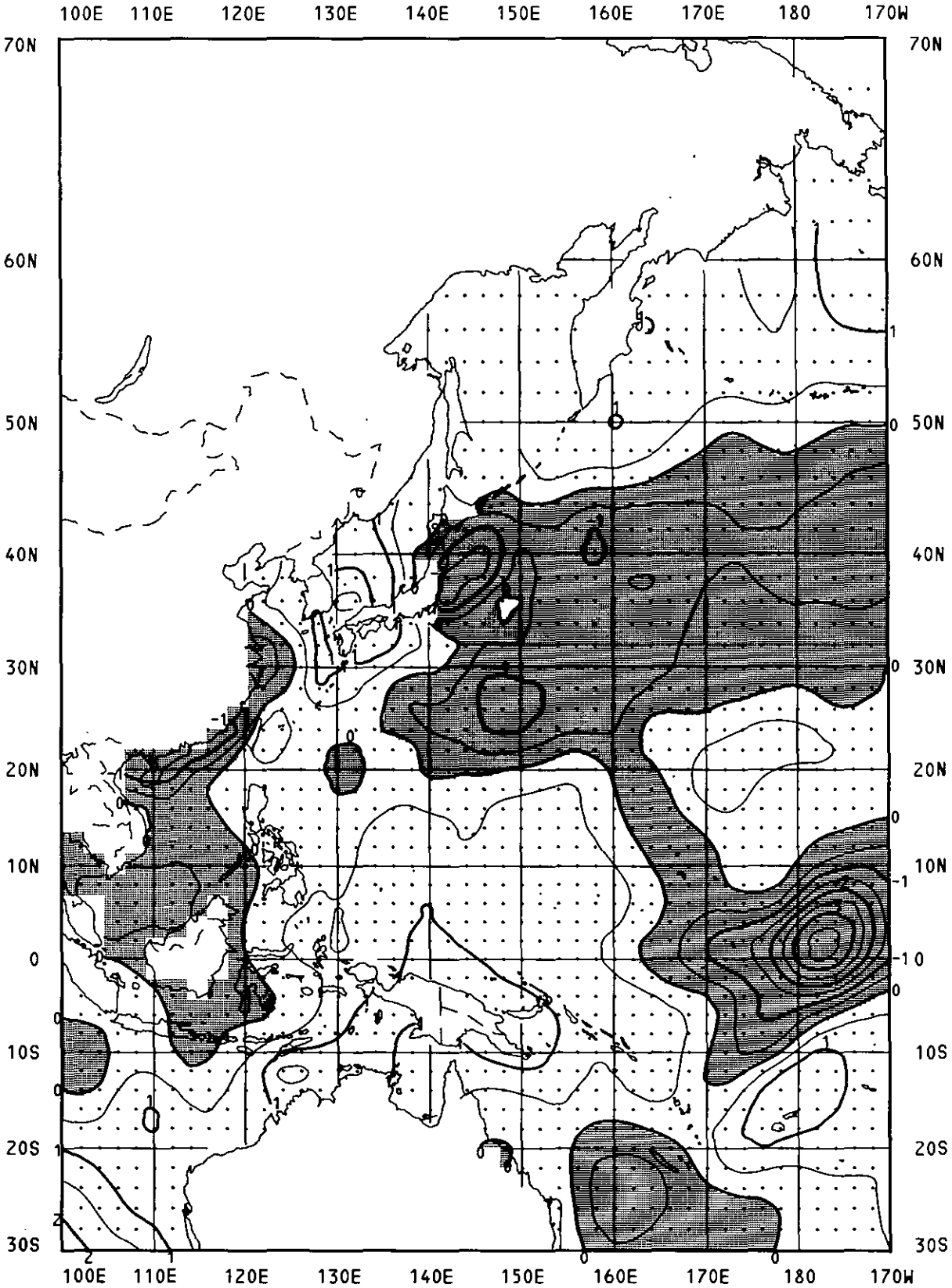

Western Pacific Ocean
SST--MONTHLY ANOMALY (°C)
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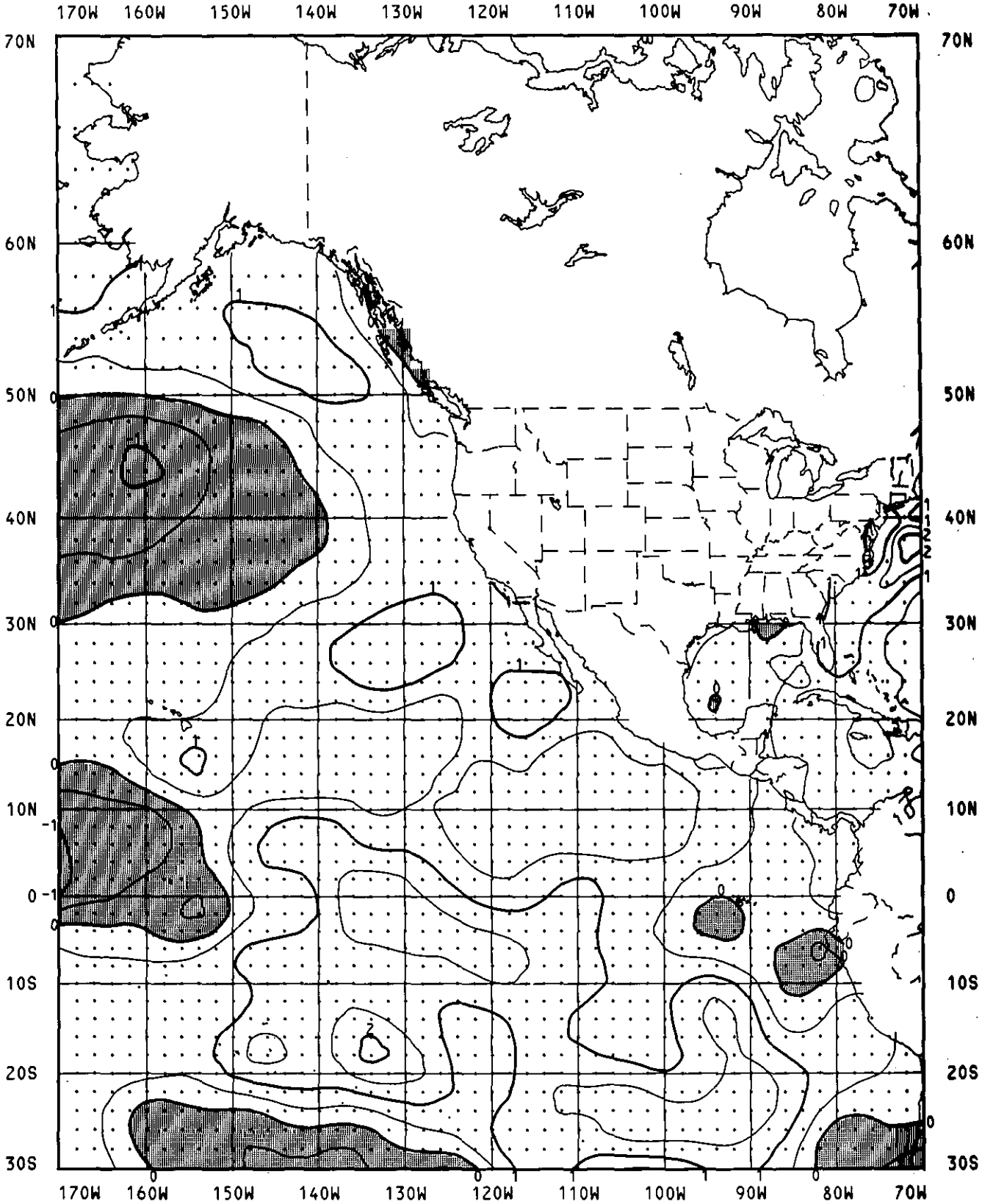

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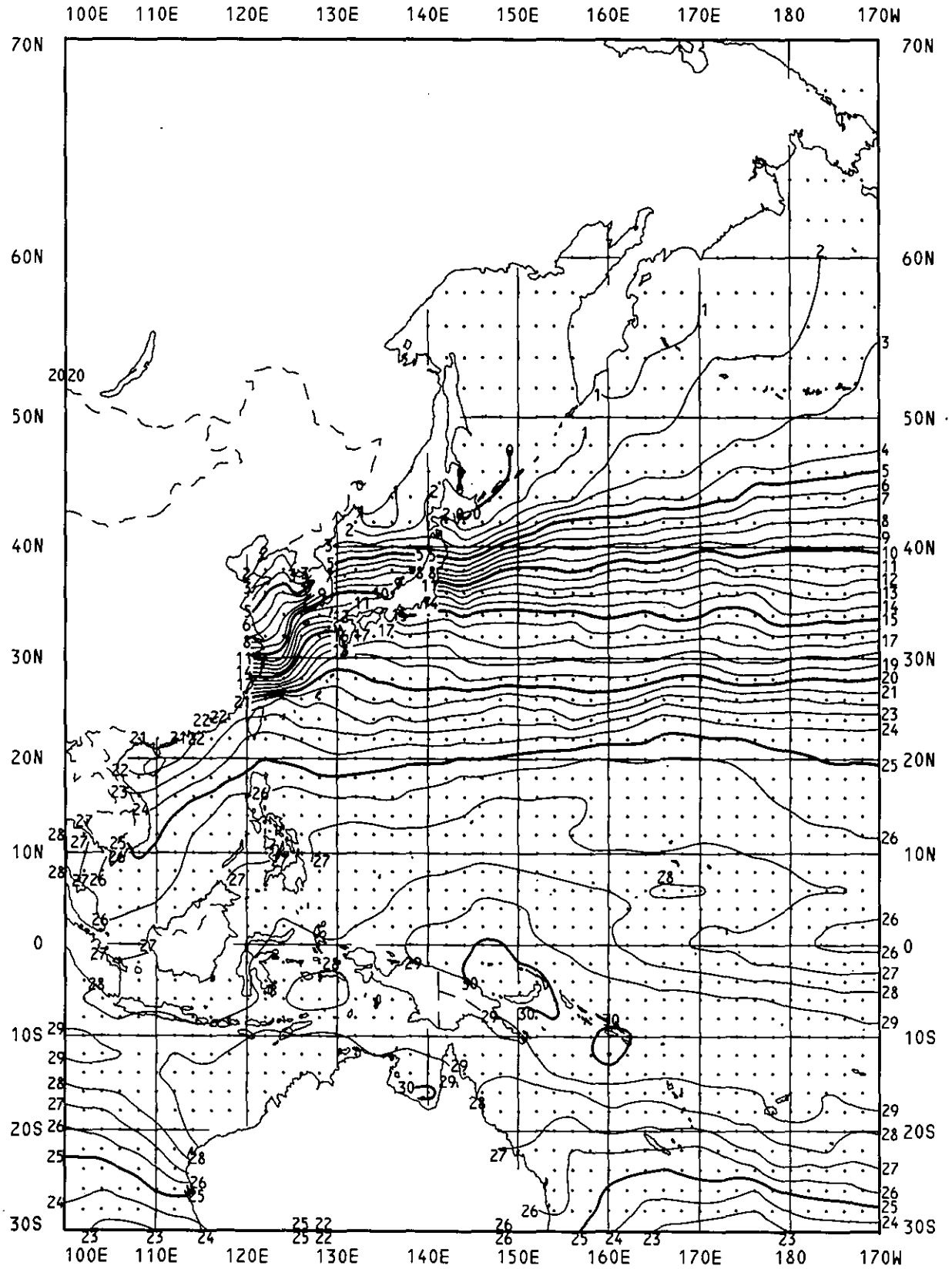

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SST--MONTHLY MEAN (°C)
SATELLITE DATA
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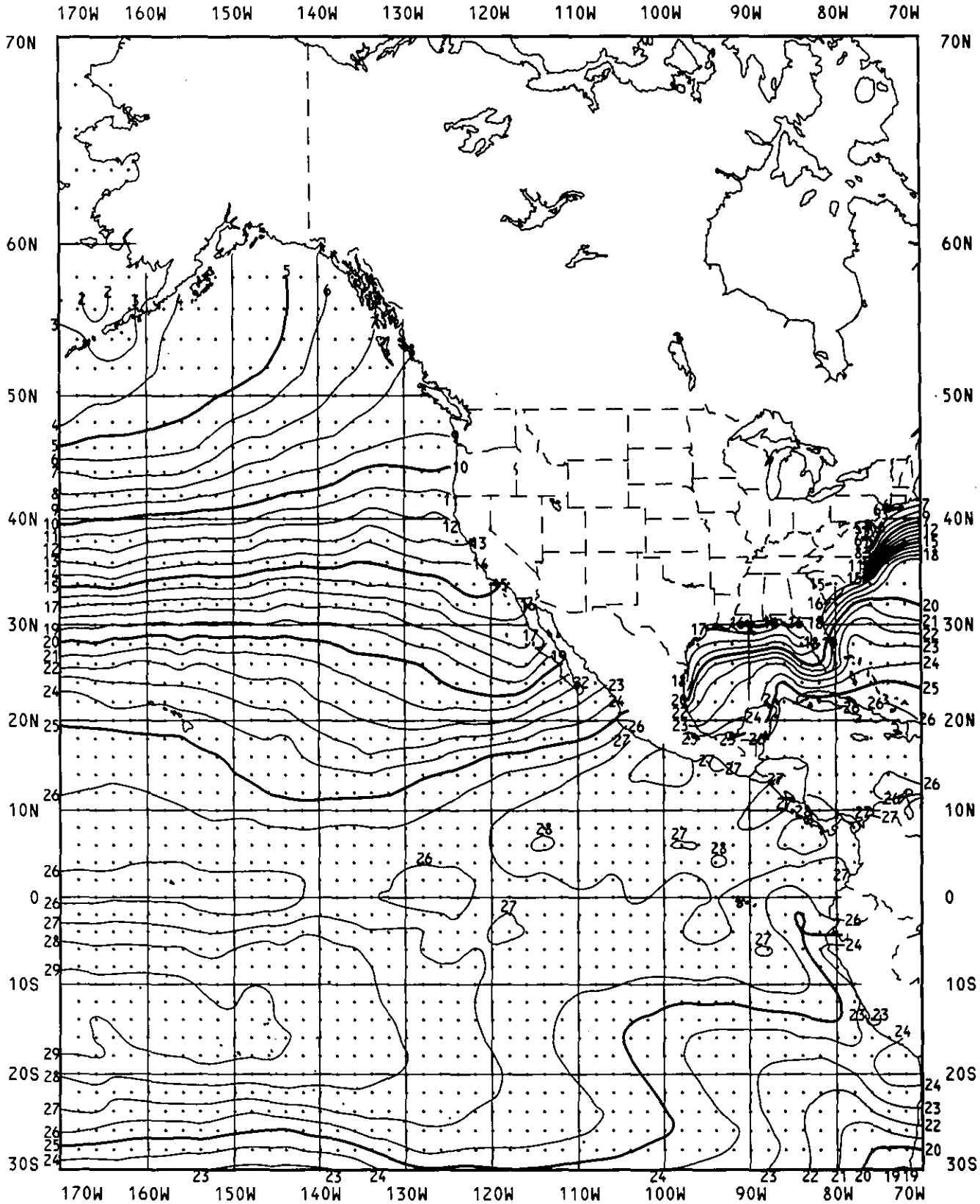

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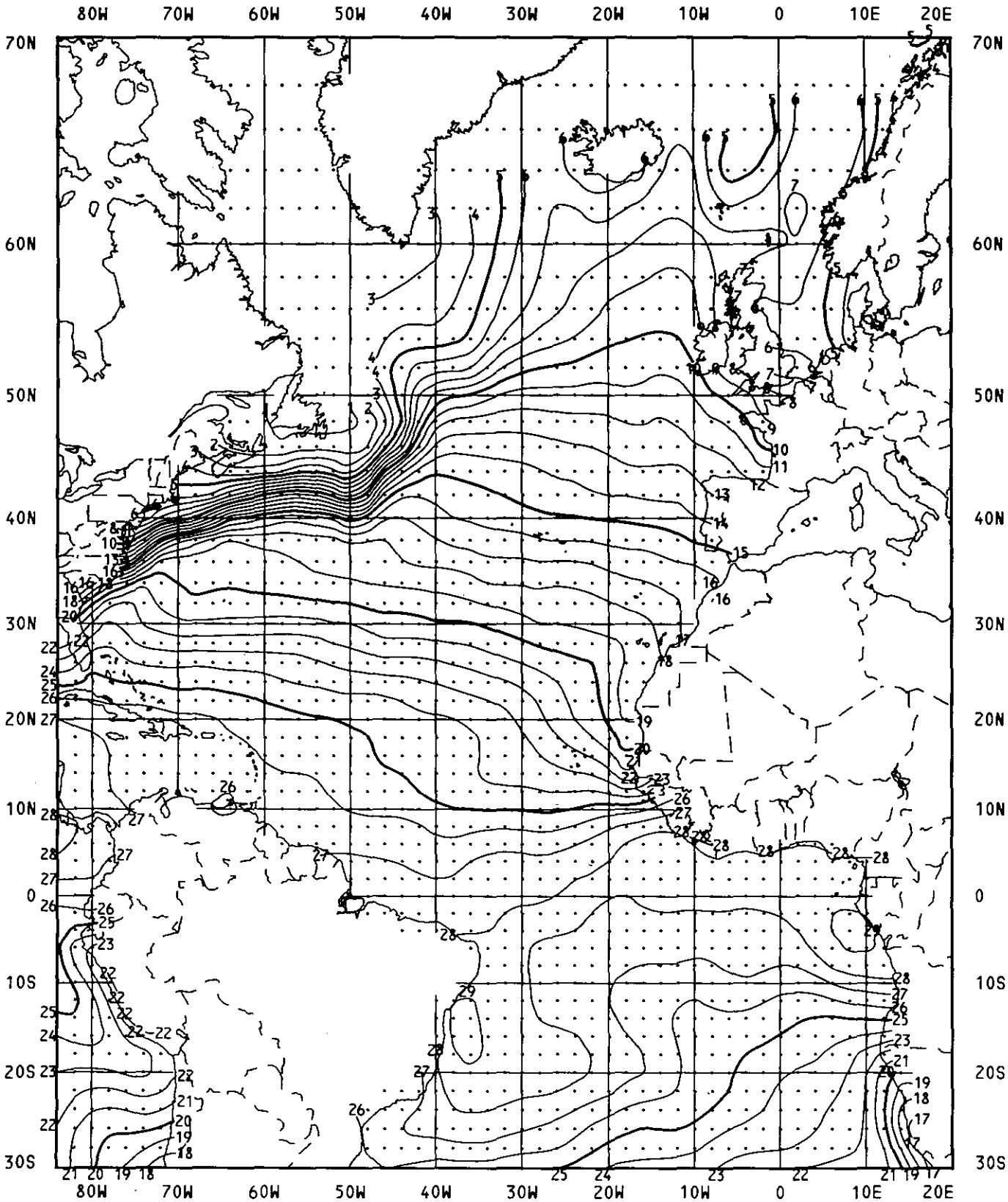

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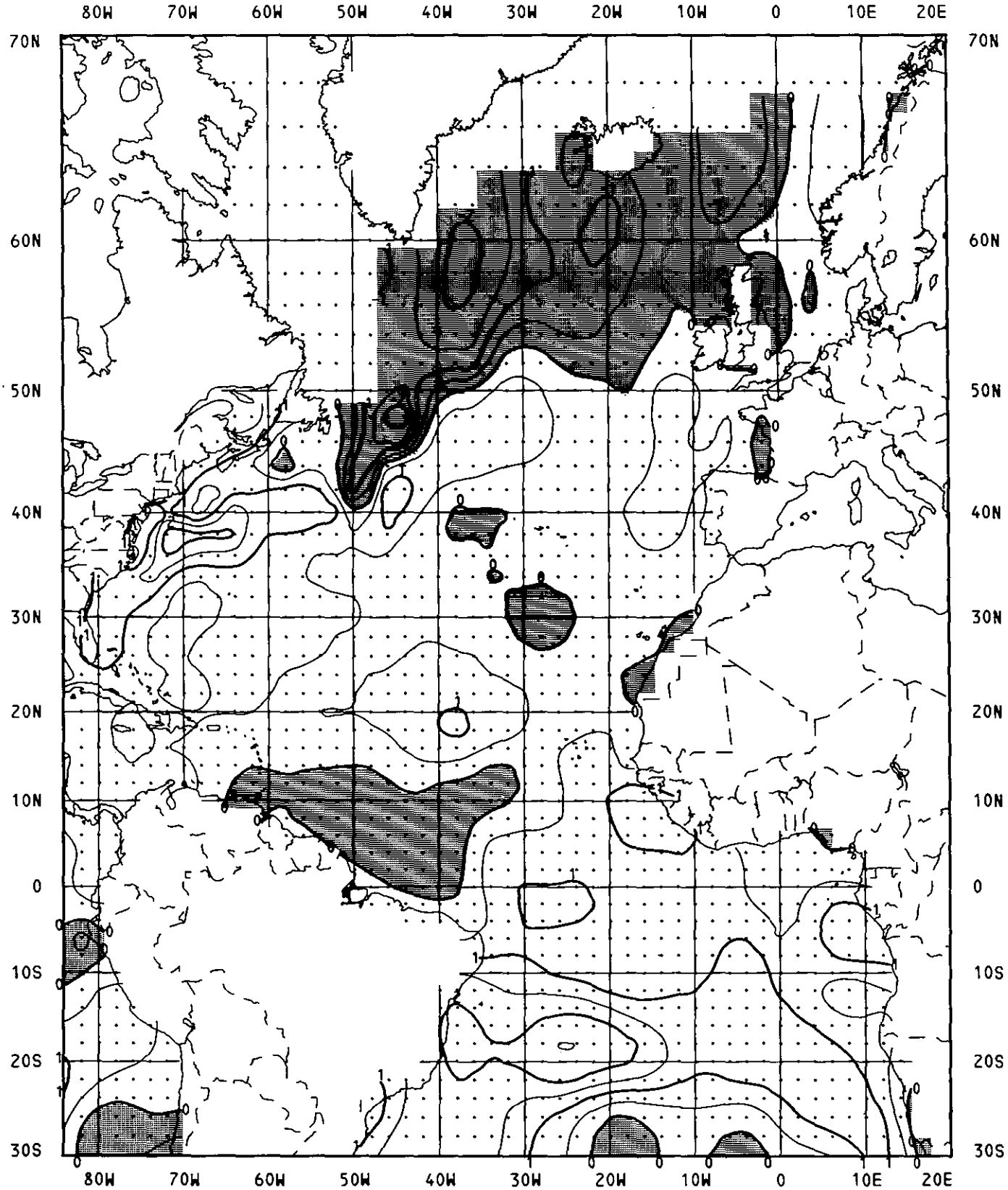

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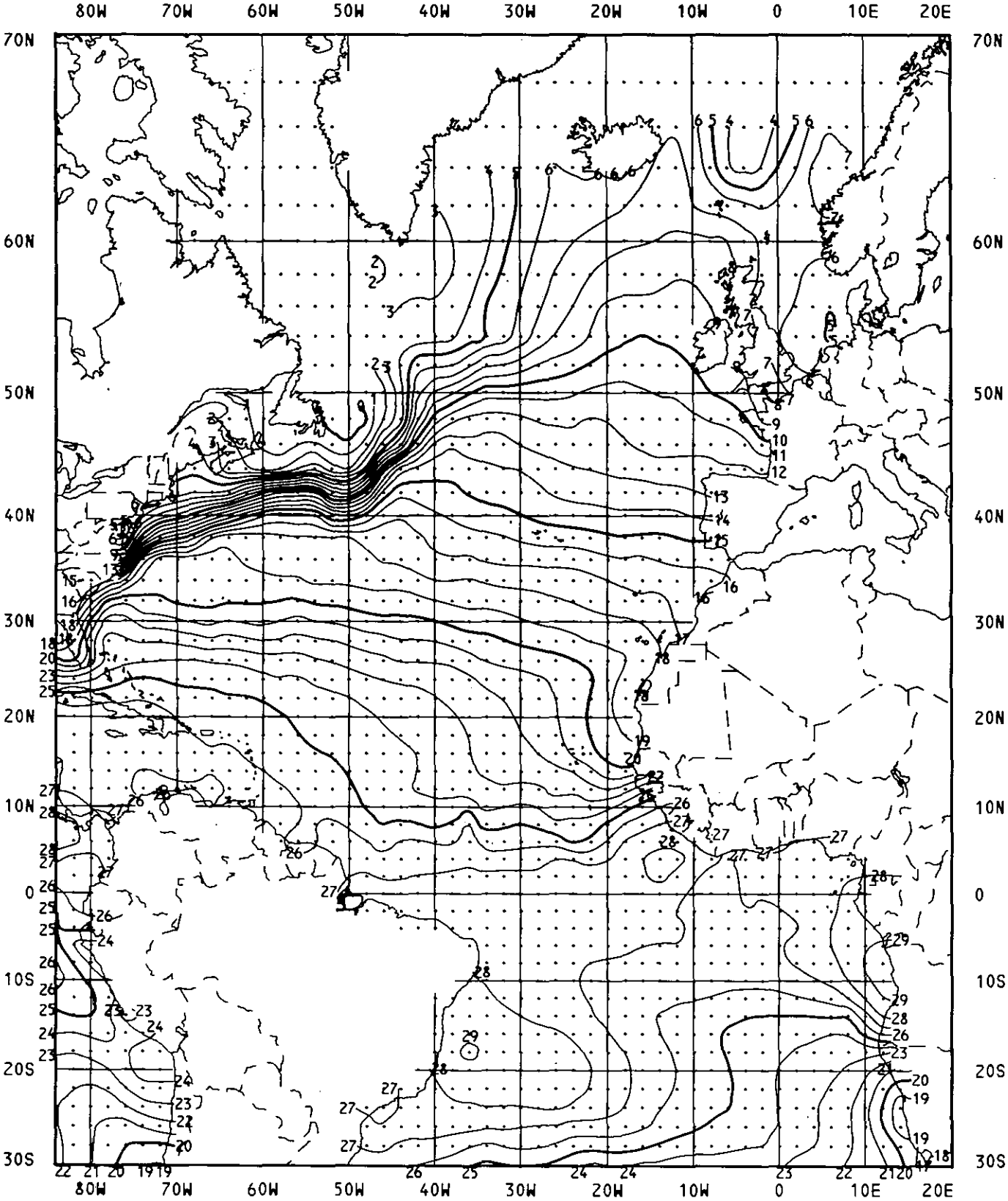

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SATELLITE DATA
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SATELLITE IMAGE OF THE MONTH

Marcia L. Weaks
Interactive Processing Branch E/SP22
NESDIS, NOAA
Washington, D.C. 20233
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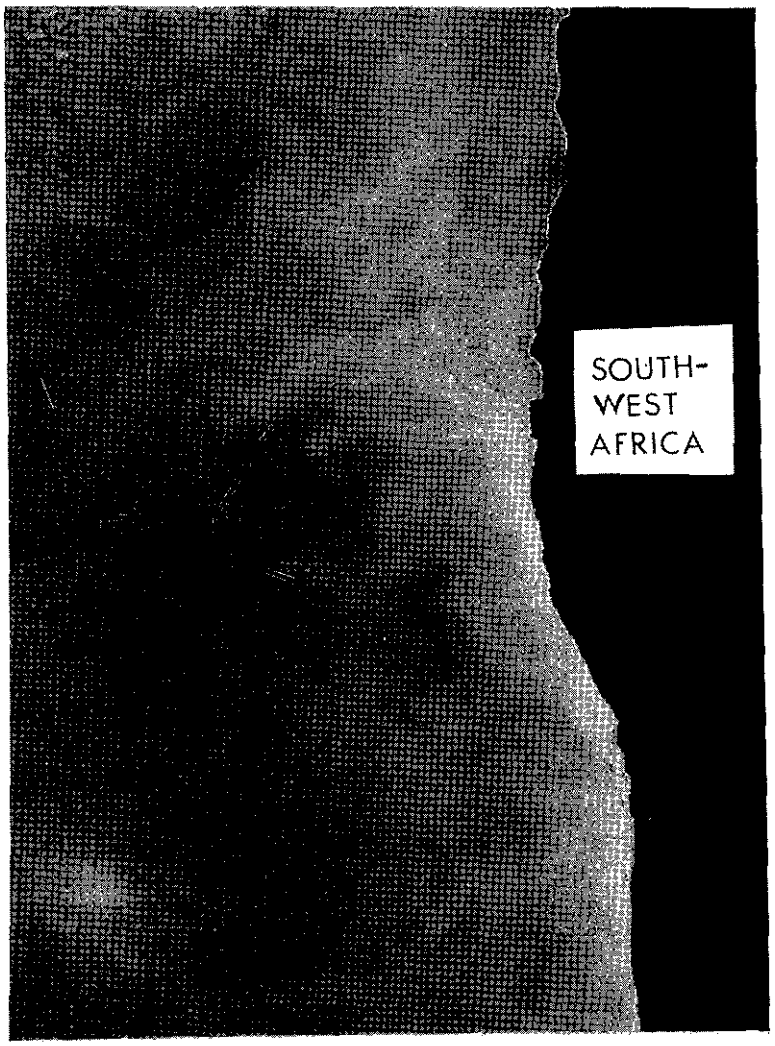
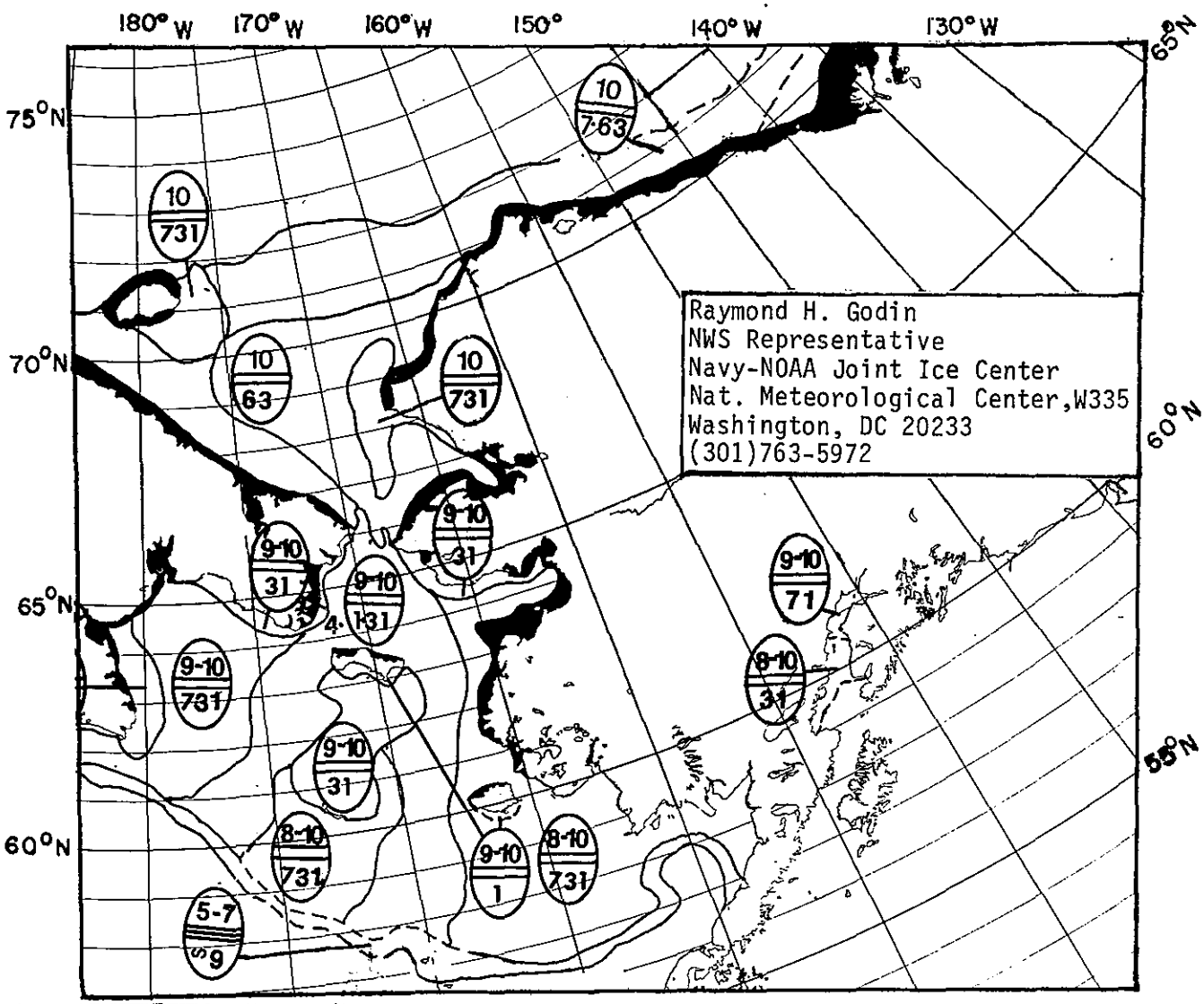
Upwelling Off Southwest Africa

Upwelling off Southwest Africa is shown in this NOAA-7 infrared image taken February 9, 1984. The coastlines of Angola and Namibia are present in the right portion of the image. Cool upwelled water is marked by variations in gray shades; the coolest water is associated with the lightest gray shade. Southerly winds in combination with the Coriolis force transport the surface water away from the coast. Cooler subsurface water replaces the displaced surface water. Upwelling can occur during most seasons of the year and is reinforced by the presence of the Benguela current, which flows toward the north. The most intense upwelling occurs during winter (August). Due to the upwelling, low temperature and low salinity water is found along the coast out to 200 km offshore. This zone is very attractive to fish, since upwelling provides an abundance of plant nutrients.



BERING SEA / NORTH SLOPE ICE ANALYSIS



C = Total ice concentration in the area in tenths.
C_a, C_b, C_c = Concentration of thickest (C_a), 2nd thickest (C_b), and 3rd thickest (C_c) ice
S_a, S_b, S_c = Stage of development of thickest (S_a), 2nd thickest (S_b), and 3rd thickest (S_c) ice.
~C = Concentration of ice within area(s) of strips and patches.

STAGE(S) OF DEVELOPMENT (THICKNESS)

1 = New ice (0-10 cm)
3 = Young ice (10-30 cm)
6 = First year (30-200 cm)
7 = First year thin (30-70 cm)
1. = First year medium (70-120 cm)
4. = First year thick (120-200 cm)
7. = Old ice (survived at least one summer's melt)

EXAMPLES

125 Theoretical thickness of this season's growth (cm).

Fast ice. Sea ice which forms and remains fast along the coast.

Ice boundary visually or satellite observed.

Ice boundary estimated.

FEBRUARY 1984

The monthly mean sea level pressure circulation depicts a 994 mb low centered in the Gulf of Alaska near 57°N 152°W. Surface geostrophic winds are northeasterly throughout the Bering Sea. Monthly mean surface air temperatures are much below normal at all routinely monitored Bering Sea coastal stations with the exception of the below normal temperatures recorded at King Salmon (57°N 157°W). New and young ice are observed in the northern ice generation areas of St. Lawrence Island and Norton Sound. The ice thickness increases to the first year thick stage of development as it drifts southward under the influence of strong northeasterly winds and unseasonably low temperatures. The ice edge expanded nearly 250 km west of 162°W. In Bristol Bay east of 162°W the ice edge expanded less than 30 km. With the exception of a near mean ice edge position in Bristol Bay the current ice edge position is 100 to 200 km south of the historical mean west of 162°W.

WEST COAST OCEAN FEA' IRES

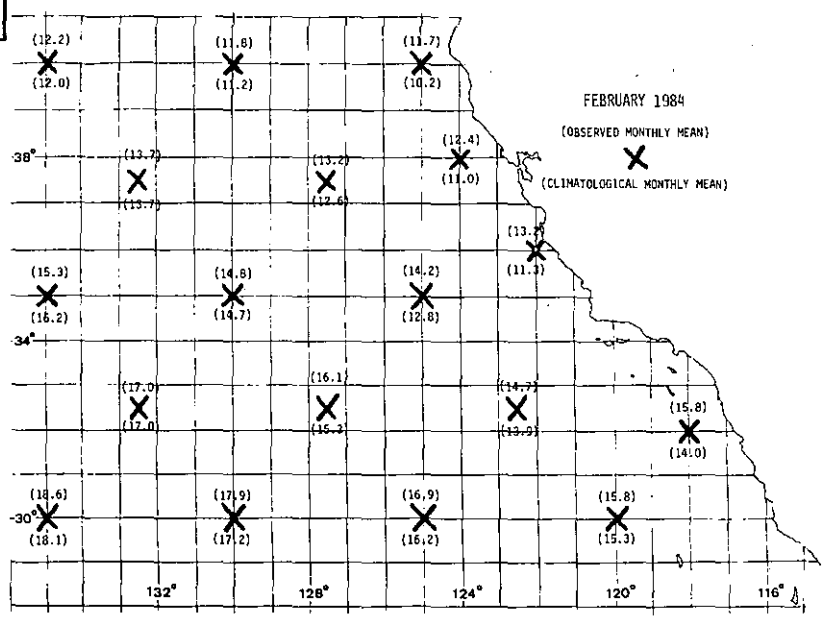
FEBRUARY 1984

MONTHLY SST STATISTICS FOR SELECTED STATIONS

FEBRUARY 1984

Station	Location (Lat/Long)	Mean SST	Standard Deviation	Maximum SST	Minimum SST	Change From Previous Month
Buoy 46005	46.1 N 131.0 W	9.6	0.2	10.1	9.2	-0.5
Buoy 46002	42.5 N 130.3 W	11.4	0.3	11.8	11.0	-0.4
Buoy 46010	46.2 N 124.2 W	9.2	0.8	10.0	7.5	0
Quillayute Riv.	47.9 N 124.6 W	10.8	0.8	13.3	10.0	+0.2
Grays Harbor	46.9 N 124.1 W	8.6	0.7	10.0	7.2	-0.3
Cape Disappointment	46.3 N 124.1 W	8.3	0.6	9.4	7.2	+1.6
Chetco River	42.0 N 124.3 W	10.6	0.1	11.1	10.6	0

SSTs changed very little from January values over the North Panel area. Temperatures remained above normal over most of the area, with nearshore values generally less than 1°C above normal, and offshore values averaging about 1.5°C above normal. A small coastal strip along the central Oregon coast reported slightly below normal SSTs. Monthly SST time series for individual stations showed transient fluctuations, sometimes amounting to 2-3°C, but no consistent trends, and little spatial correlation. Several vigorous low pressure systems moved through the region during the month, mixed the surface water, and kept SST gradients weak. The strongest of these weather systems occurred during the periods February 9-14 and 22-26. Very limited satellite imagery were available during February due to consistent cloud cover and technical acquisition problems.



North Panel
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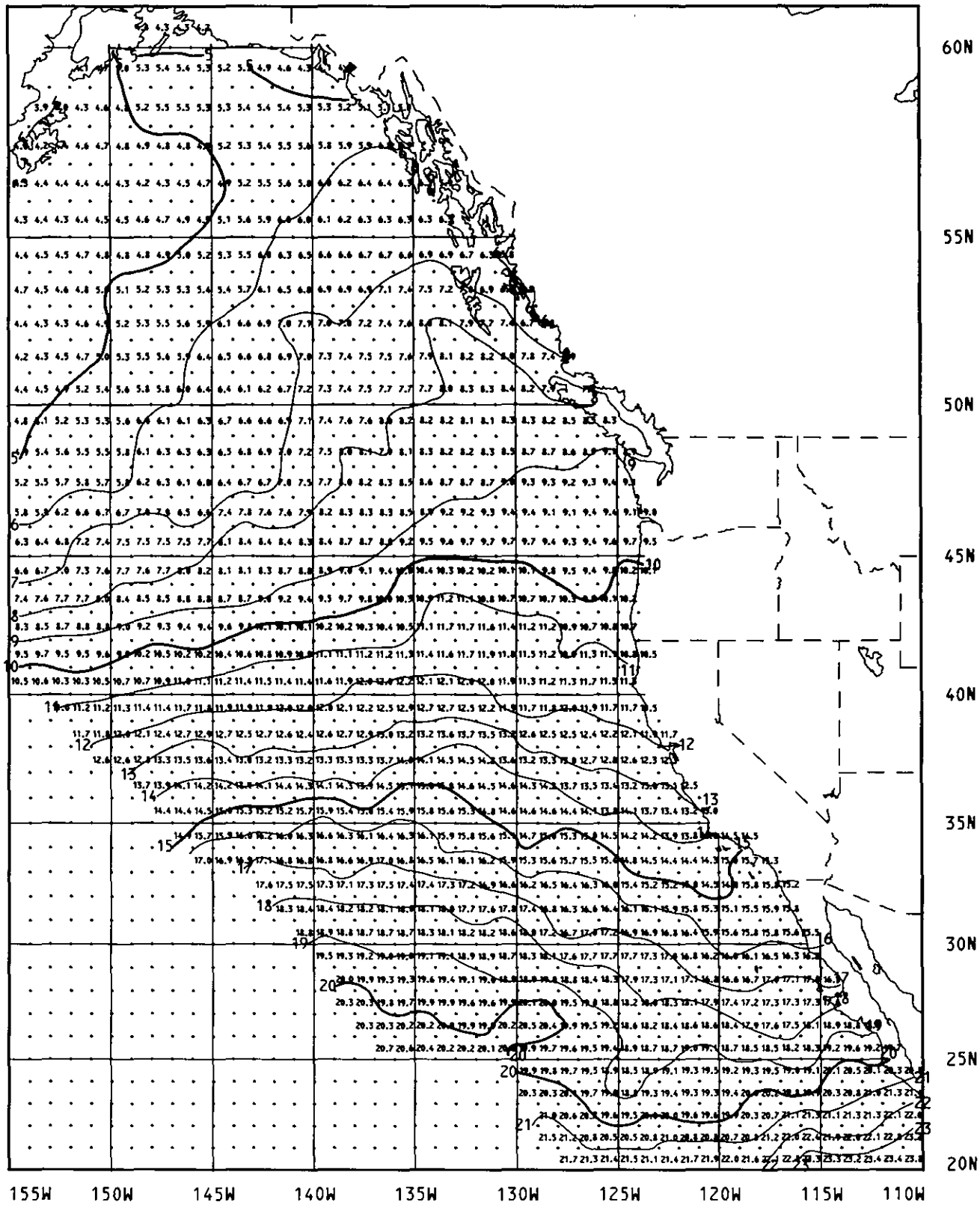
NOAA/Northwest Regional Ocean Service Center
7600 Sand Point Way NE
Bin C15700
Seattle, WA 98115
(206) 527-6604

South Panel
Ernest Daghir
NOAA/NESDIS
Satellite Field Service Station
660 Price Avenue
Redwood City, CA 94063
(415) 364-2422

February SSTs continued to decline slower than normal over the South Panel. During the first week of the month, the high pressure ridge remained anchored along the California coast and prevented cool air from the north from penetrating southward. By the second week of February, the ridge weakened which allowed some frontal passages and associated precipitation into the South Panel region but very little cold air. As a result, SSTs did not cool down as expected. Only one small area near 30°N 120°W cooled by 1.0°C. In other locations, cooling during the month was 0.2 - 0.9°C. When compared to climatology, February mean SSTs remained above normal everywhere except near 35°N 135°W which was about 1°C below the monthly mean value. Temperatures along the entire coast were 1.4-1.9°C above normal; the minimum SSTs occurred near Pt. Arena and the maximum SSTs occurred at Pt. Sur. Due to satellite problems, no upwelling fronts were observed. Ship reports indicated that some upwelling did occur along the Baja peninsula.



West Coast
SST--MONTHLY MEAN (°C)
February 1984

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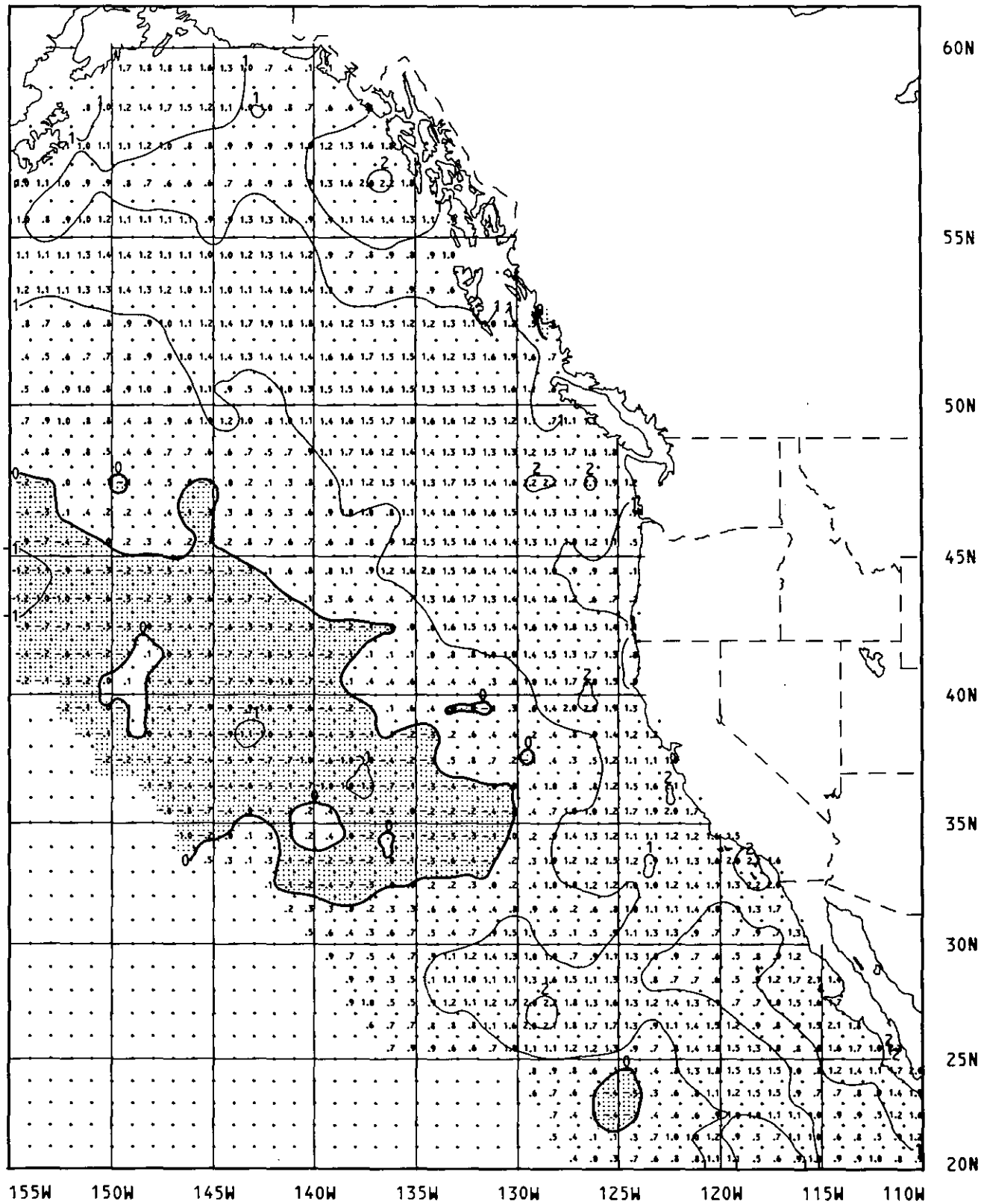

West Coast
SST--MONTHLY ANOMALY (°C)
February 1984

Monthly anomaly is the difference between the monthly mean sea surface temperature and the climatological monthly mean value -- shading shows where the monthly mean is colder than climatology. Contour line interval is 1.0°C.

The end of this month's positions of the Gulf Stream System and its associated eddies are shown for the NW Atlantic and the Gulf of Mexico. The Gulf Stream and Loop Current boundaries are located by infrared satellite imagery or XBT (expendable bathythermograph) data. Anticyclonic eddies are labeled a-z in the Gulf of Mexico and 1-99 in the NW Atlantic. Cyclonic eddies are labeled A-Z. Arrows on eddies indicate direction of circulation. Warm-core or anticyclonic eddies rotate clockwise; cold-core or cyclonic eddies rotate counterclockwise. The line to the eddy center shows the net translation since last month or since last observed. Eddies or sections of the Gulf

EAST COAST OCEAN FEATURES

Stream System which were not observed during the month are not shown on the analysis chart. The long arrows at the bottom of the chart indicate the date of data used.

Data used in this analysis include:
- NOAA satellite infrared imagery, NESDIS
- Bathythermograph data, National Meteorological Center of National Weather Service
- Oceanographic Analysis, A daily detailed analysis issued by National Weather Service/NESDIS

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NOAA/NWS
Washington, DC 20233
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Ann Bell
NOAA/NWS
National Meteorological Cen.
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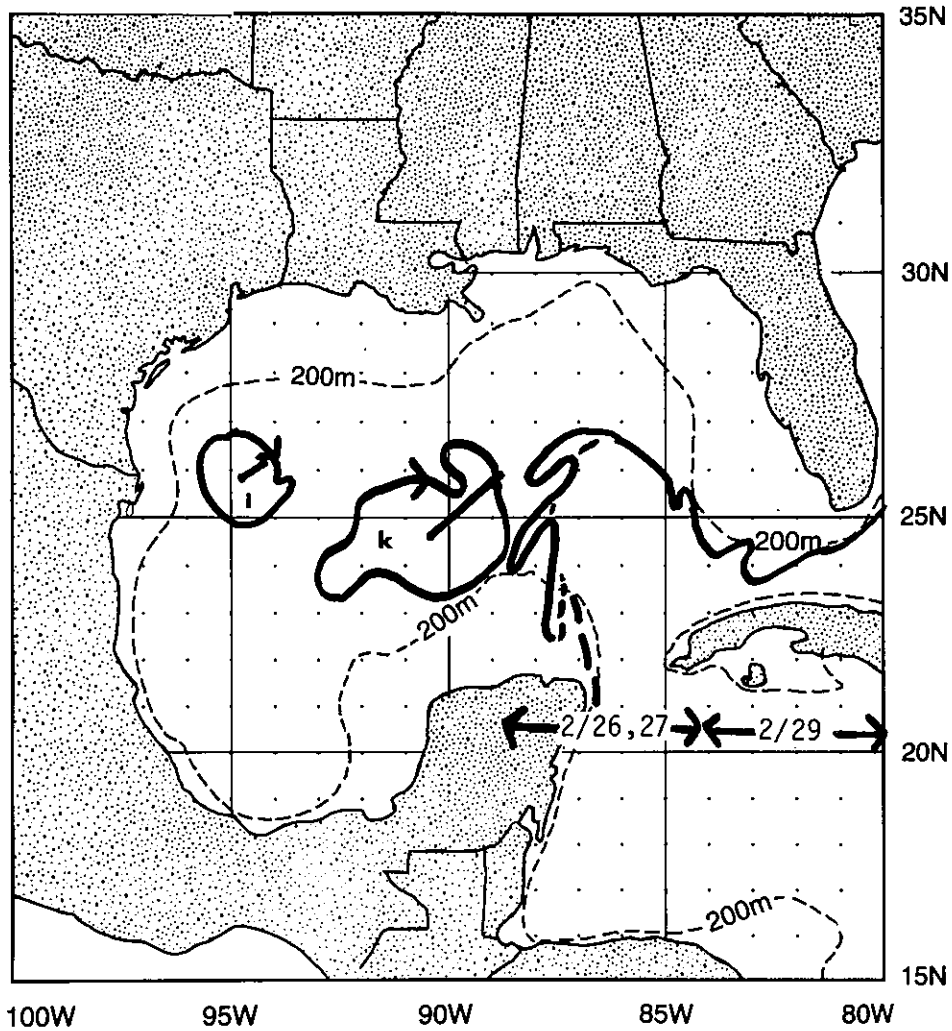
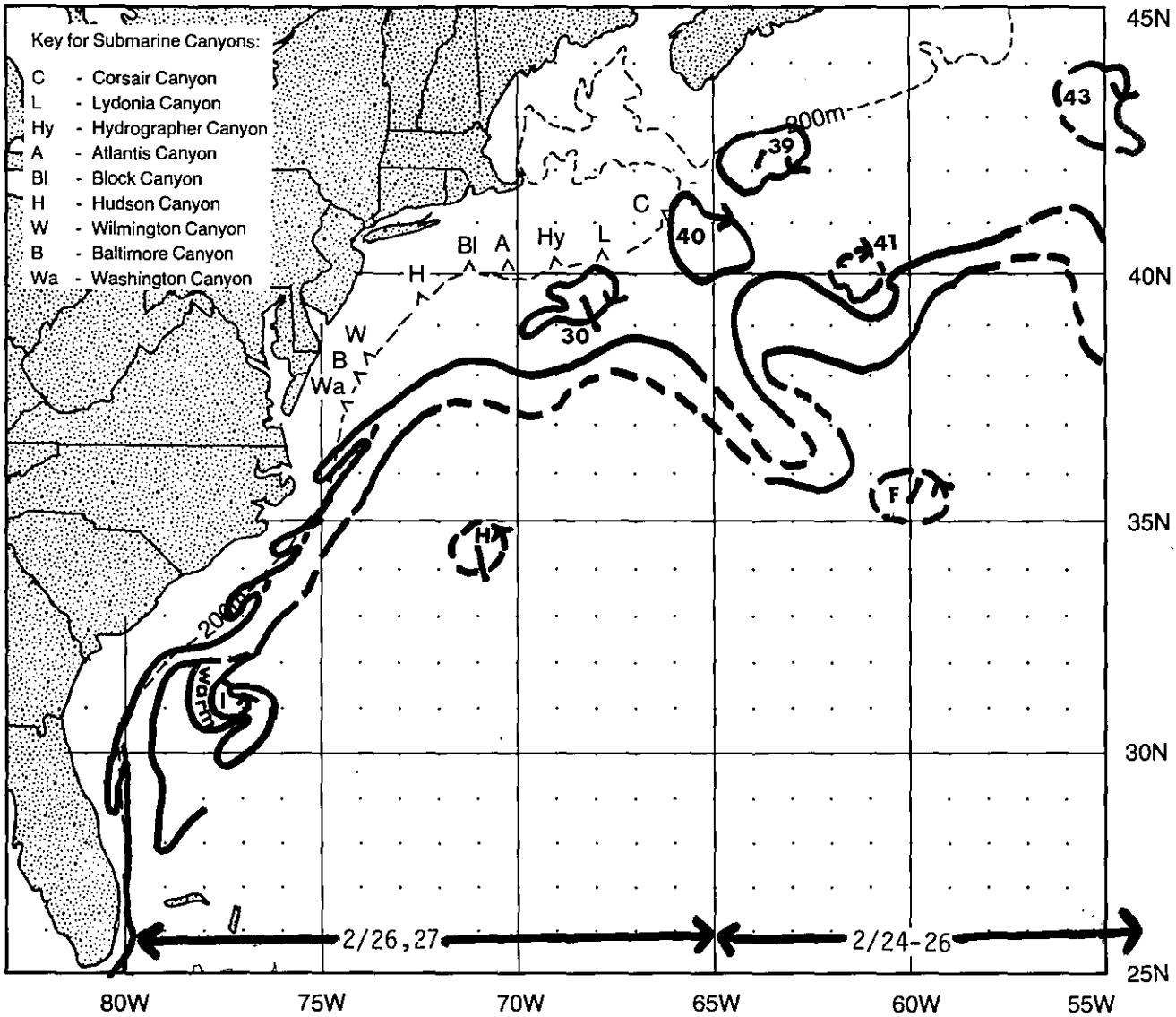


FEBRUARY 1984

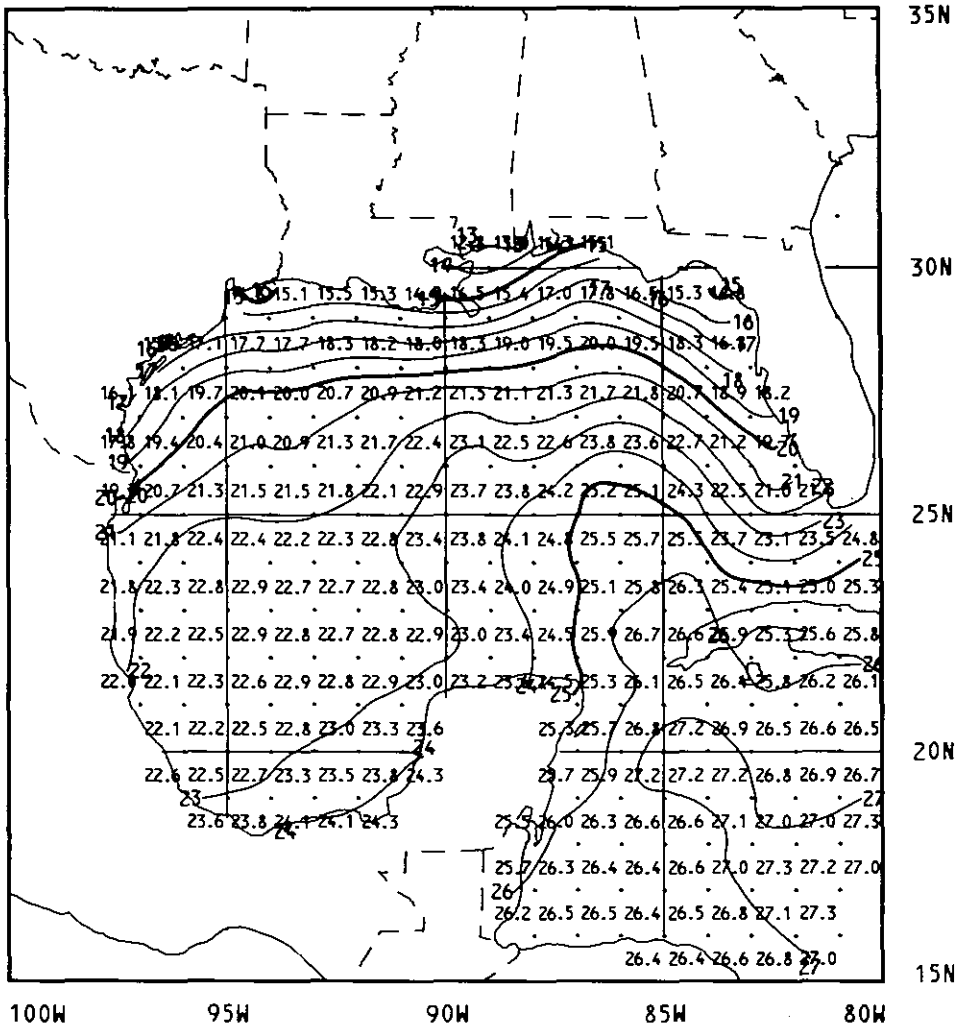
The end-of-February amplitude of the Loop Current in the Gulf of Mexico increased about 90 km NW from the end-of-January position. Eddy i traveled 65 km SW. Eddy k traveled 195 km SW.



Two anticyclonic eddies were formed during February. New eddy 40 formed from a large Gulf Stream meander on February 11 near 40°N 61°W. New eddy 41 apparently formed from eddy 40 on February 22 near 40°N 60°30W. Eddy 32 probably was absorbed by a Gulf Stream meander in mid-February near 40°30N 62°W. Eddy 42 was first observed on February 26 near 43°N 55°30W. It apparently originated in mid-September 1983 near 39°30N 48°30W. Eddy 39 translated 25 km NNE. Eddy 30 apparently translated 75 km NW.

One cyclonic eddy was newly observed and two cyclonic eddies were absorbed by the Gulf Stream during the month. New eddy I was first detected on February 5 near 30°N 79°W. Eddy E was absorbed by a Gulf Stream meander on February 11 near 37°30N 65°30W. Eddy J was first detected on February 14 near 37°N 62°W. Eddy J was absorbed by a Gulf Stream meander on February 25 near 36°30N 63°W. Eddy F moved 45 km SSW when it was last observed on February 14. Eddy H moved 75 km NNW when it was last detected on February 14.

EAST COAST SST-
MONTHLY MEAN



Gulf of Mexico
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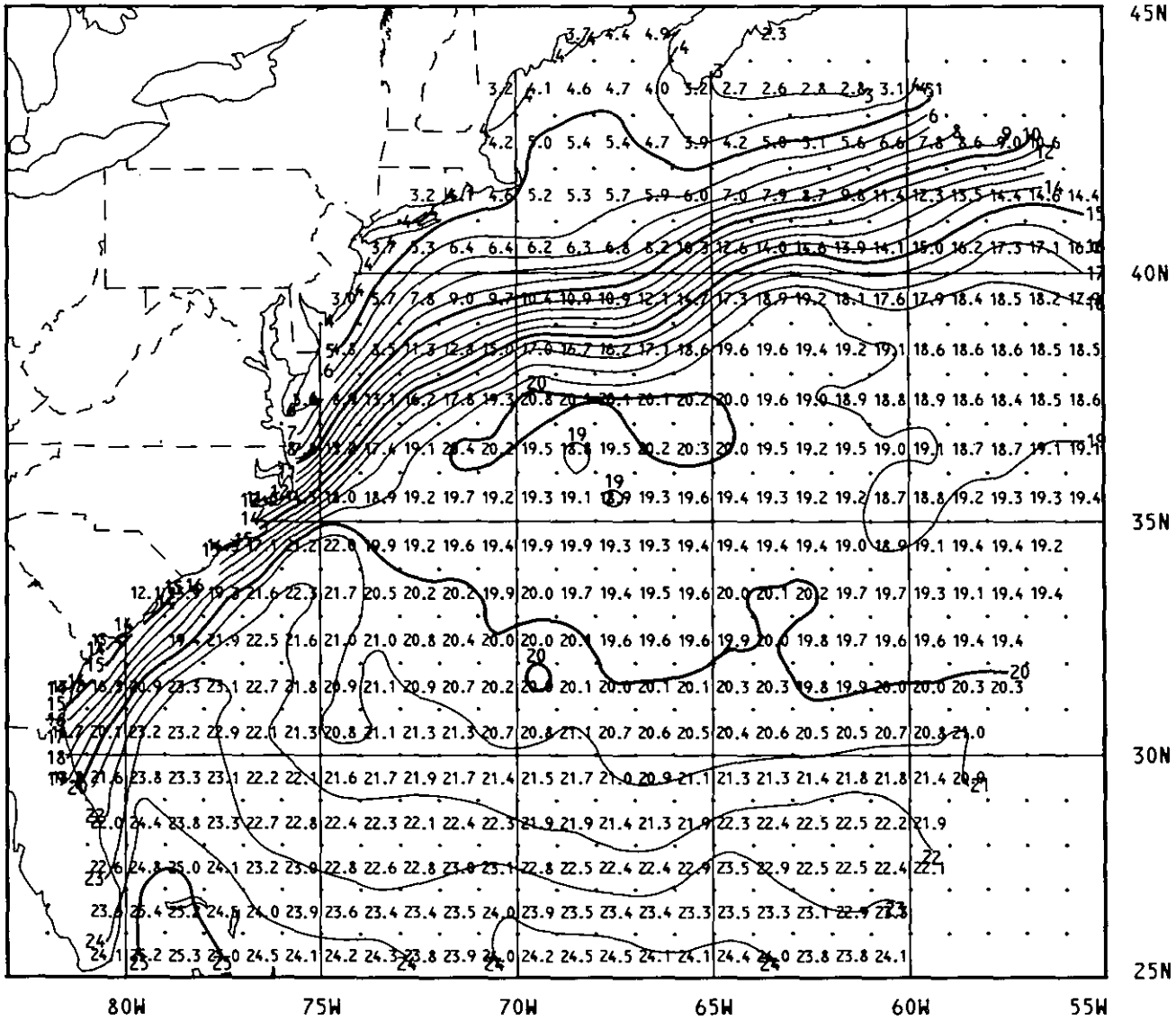

NW Atlantic Ocean
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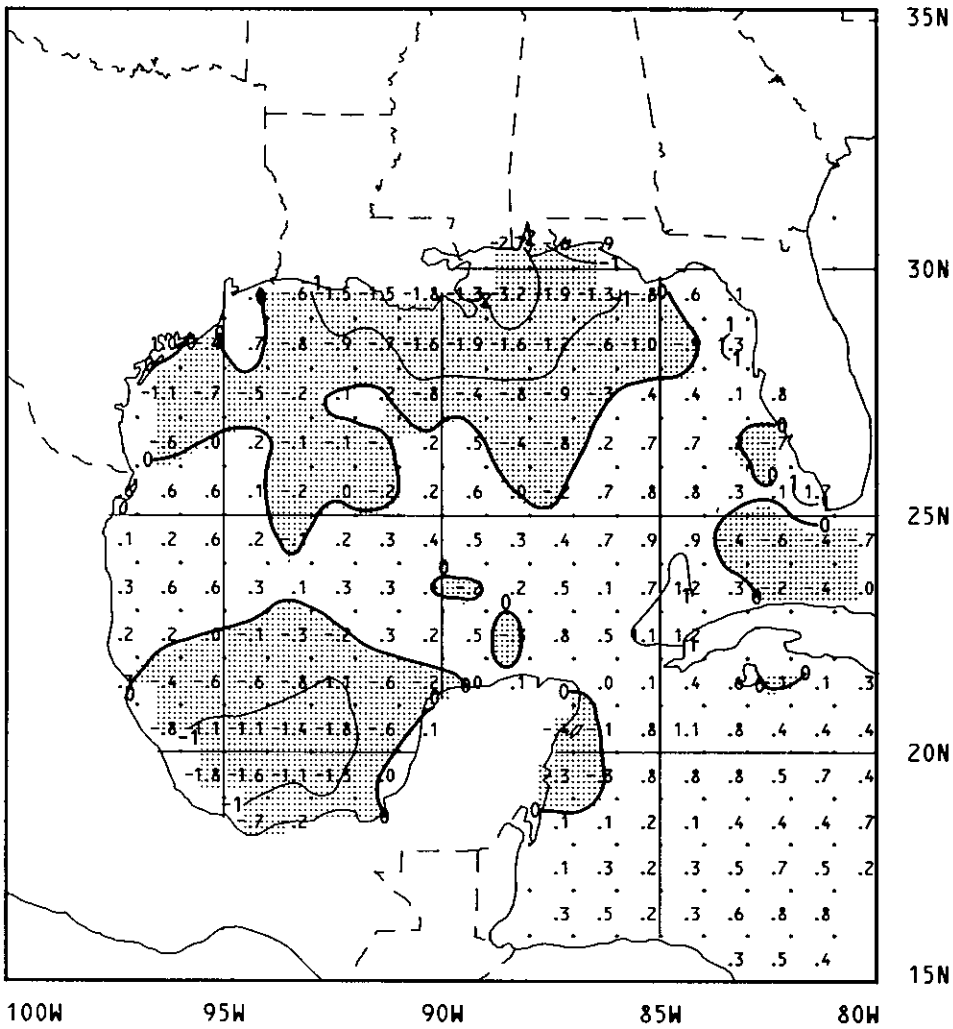
EAST COAST SST-ANOMALY



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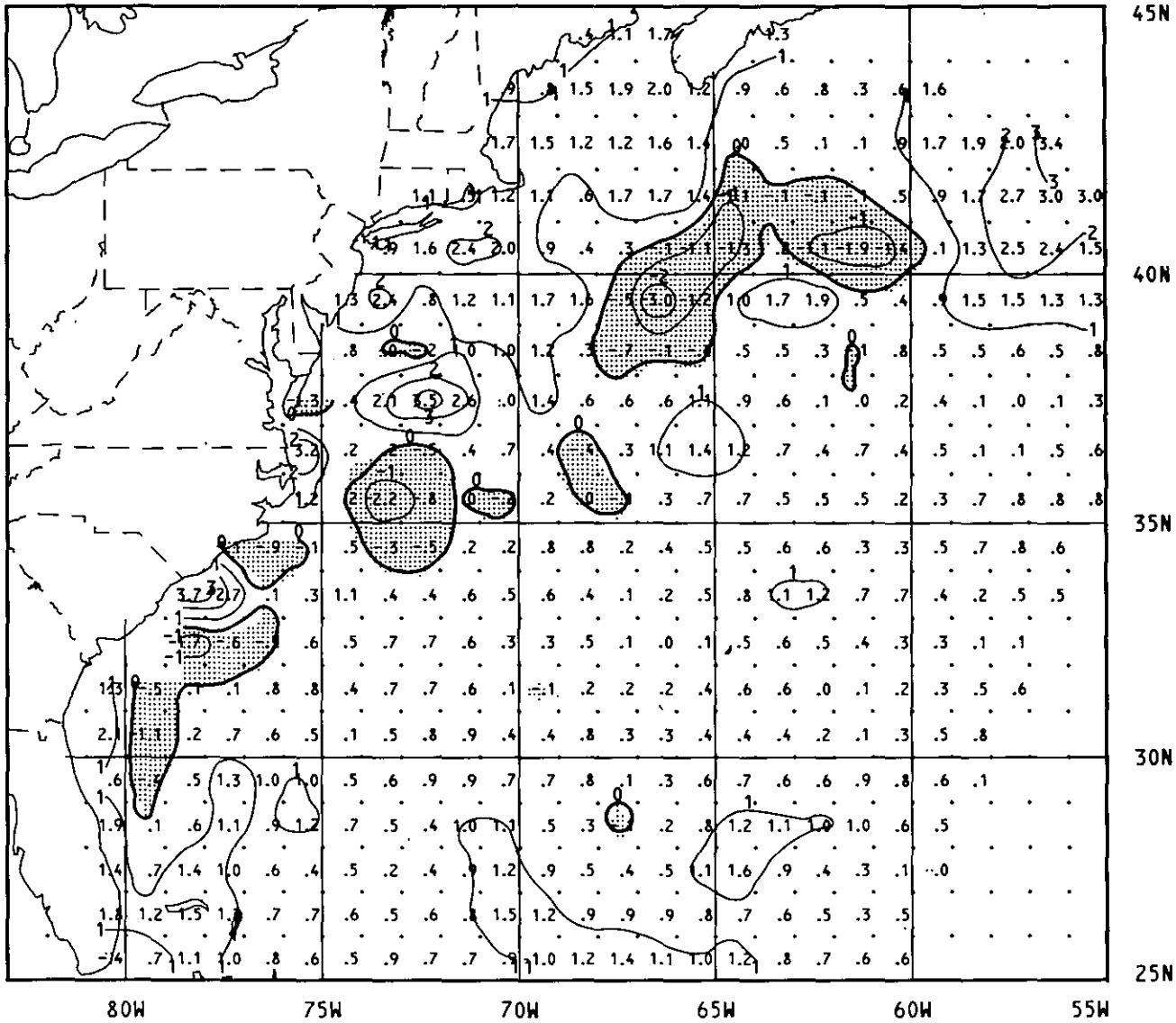

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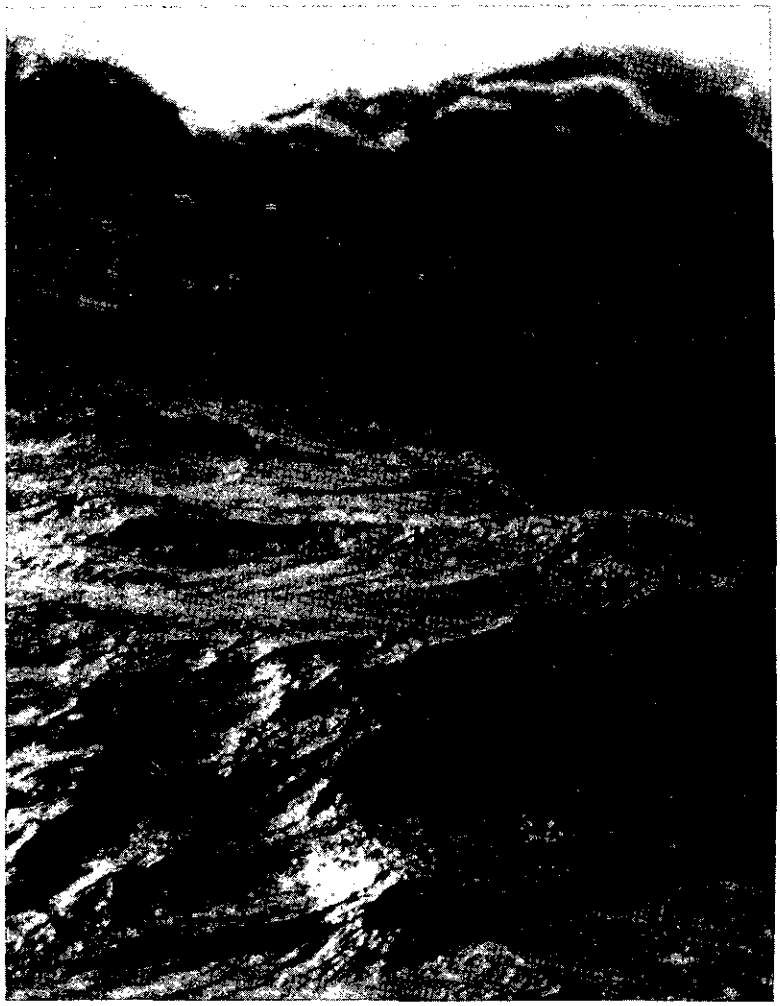
The Secretary of Commerce has determined that the publication of this periodical is necessary in the transaction of the public business required by law of this Department. Use of funds for printing this periodical has been approved by the Director of the Office of Management and Budget through April 1, 1985.

NOAA LISD SEATTLE

OCEANOGRAPHIC Monthly Summary

Volume IV Number 3 March 1984



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National Weather Service
National Environmental Satellite, Data, and Information Service

Oceanographic Monthly Summary is published by the National Weather Service and the National Environmental Satellite, Data, and Information Service (NESDIS). *Oceanographic Monthly Summary* contains sea surface temperature (SST) analyses on both regional and ocean basin scales for the Atlantic and Pacific Oceans. Two ocean basin SST analyses are presented, one based on in-situ data and another based solely on satellite data. An ocean basin SST anomaly derived from the in-situ data is also shown; it uses the National Climatic Center (NCC) Climatology*. The regional SST analyses are based upon a combination of in-situ and satellite data measurements. The regional SST anomalies use the Robinson-Bauer Climatology*. *Oceanographic Monthly Summary* also contains Alaskan sea ice information and ocean feature information for contiguous U.S. ocean regions.

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*Reynolds, R.W., 1982. A Monthly Averaged Climatology of Sea Surface Temperatures; *NOAA Technical Report NWS 31.*

*Robinson, M.K., 1976. Atlas of North Pacific Ocean Monthly Mean Temperatures and Mean Salinities of the Surface Layer; *NavOceano Ref. Pub. 2.*

Robinson, M.K., R. A. Bauer and E.H. Schroeder, 1979. Atlas of North Atlantic-Indian Ocean Monthly Mean Temperatures and Mean Salinities of the Surface Layer; *NavOceano Ref. Pub. 18.*

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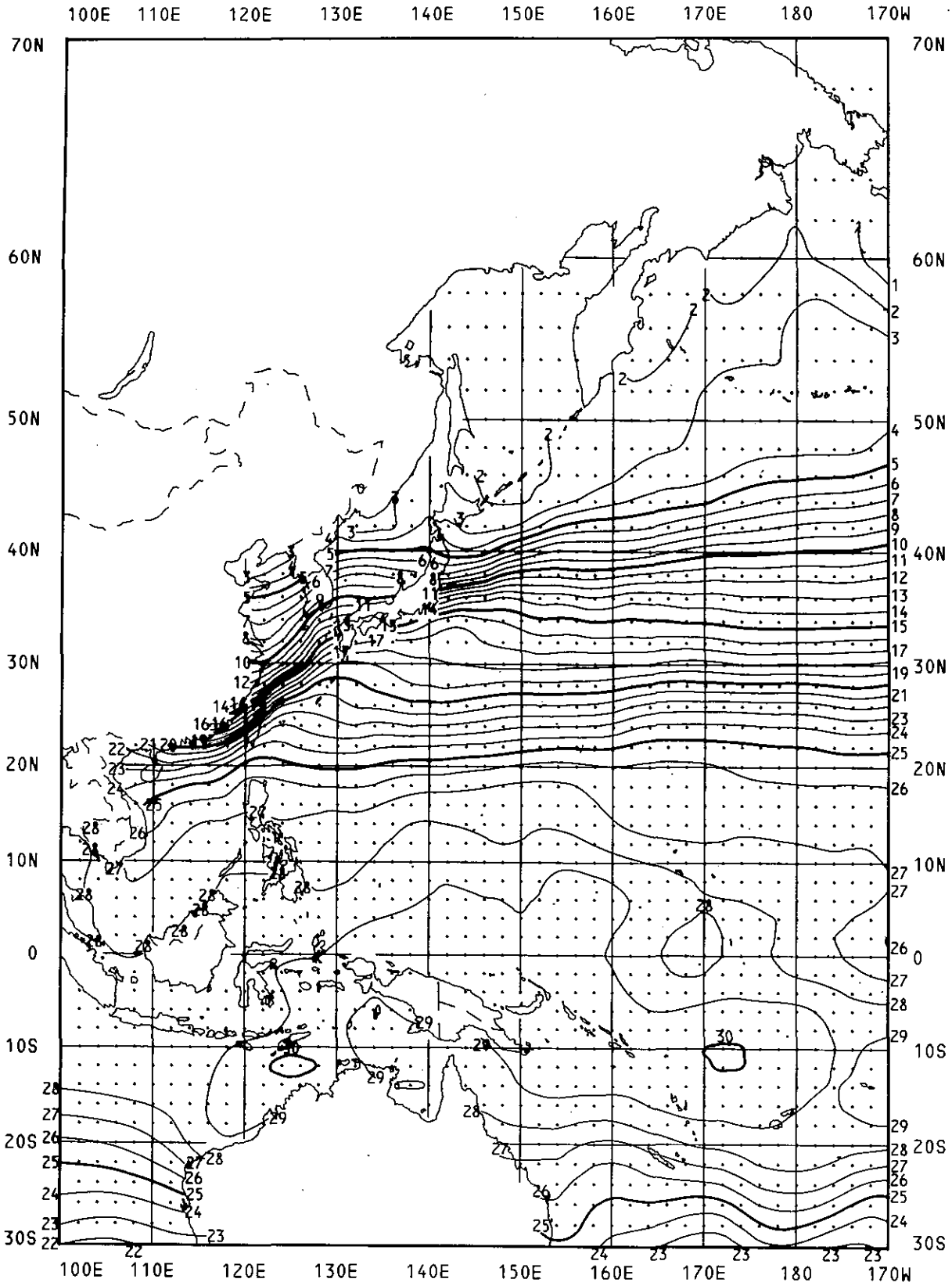

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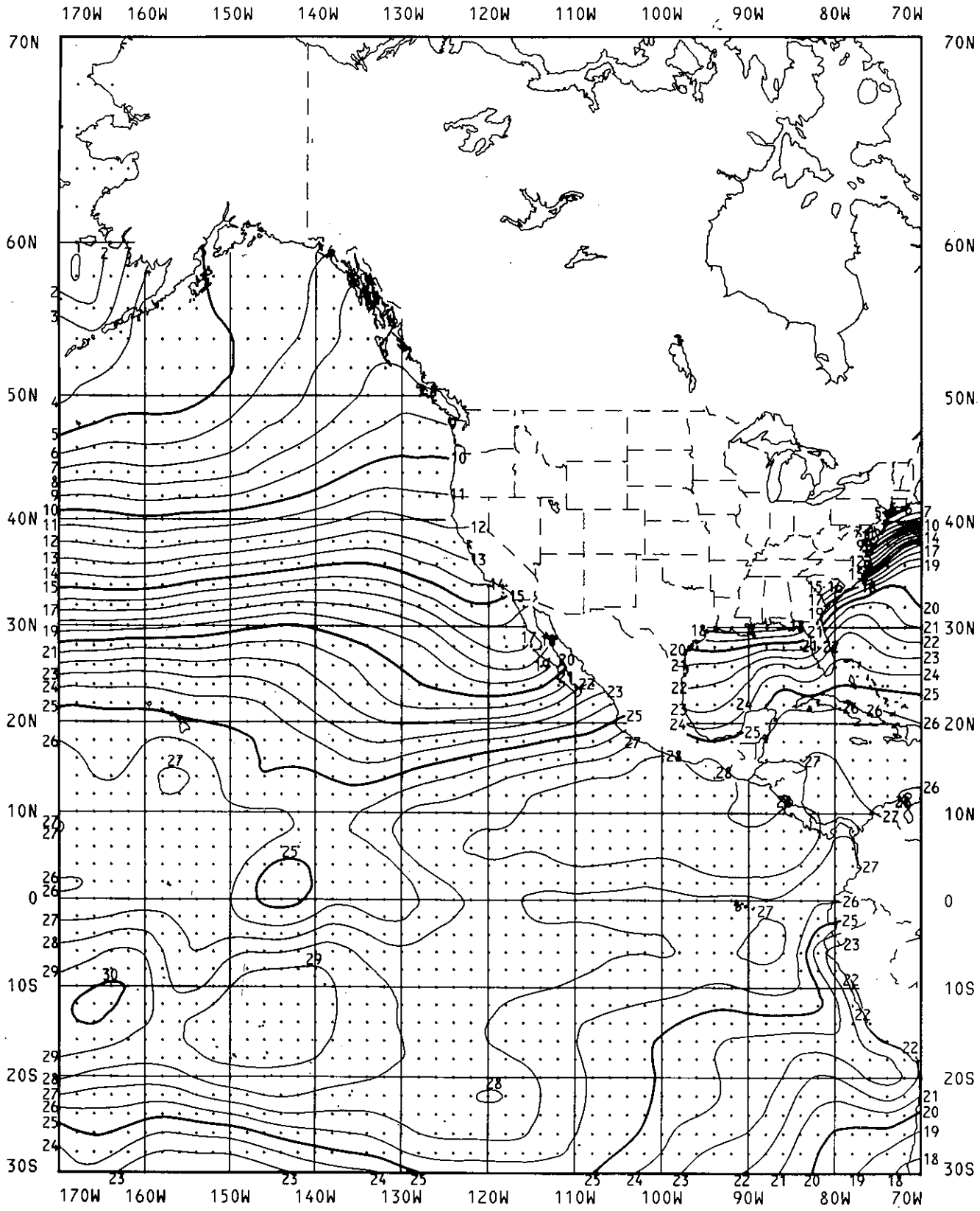

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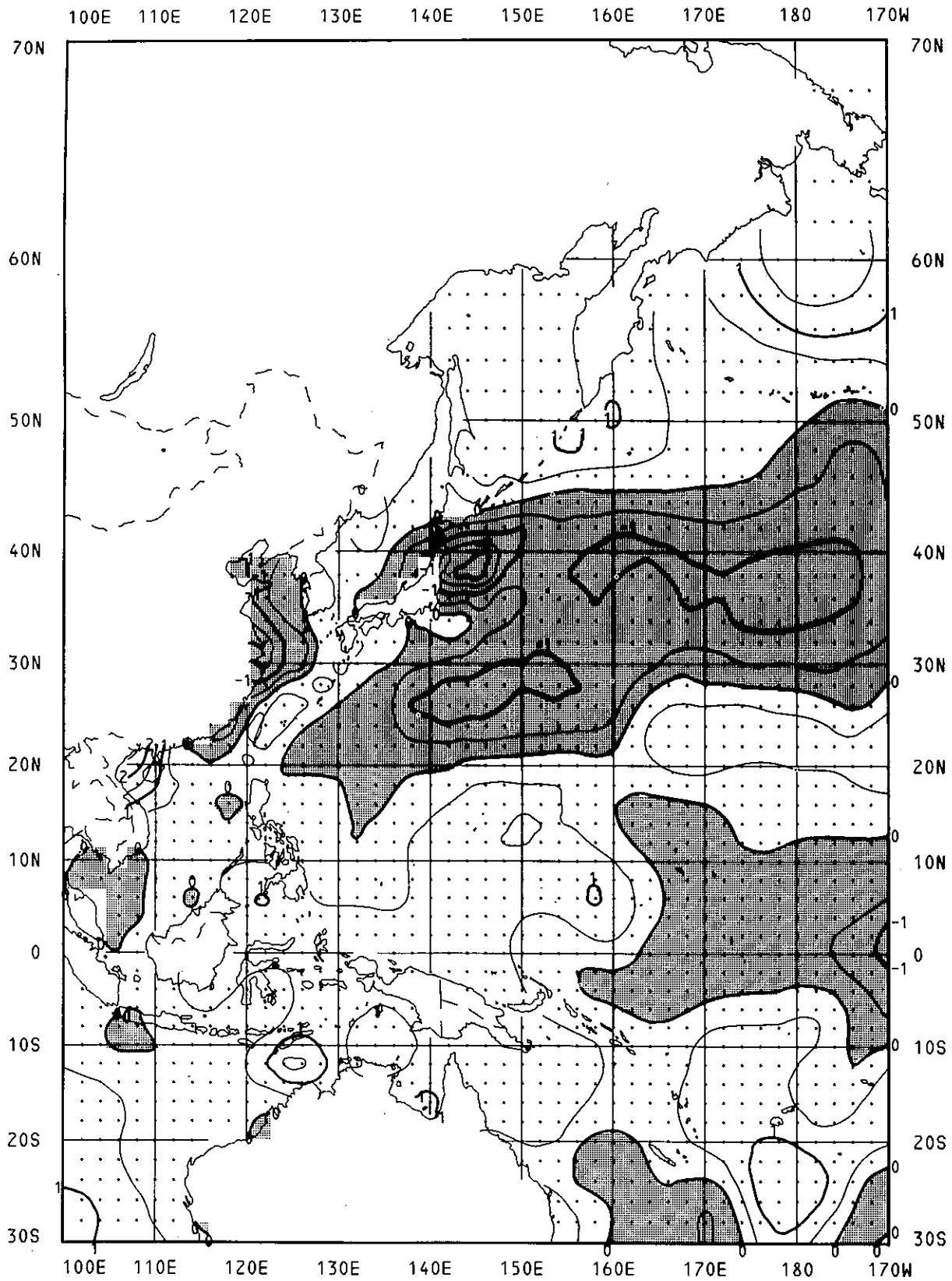

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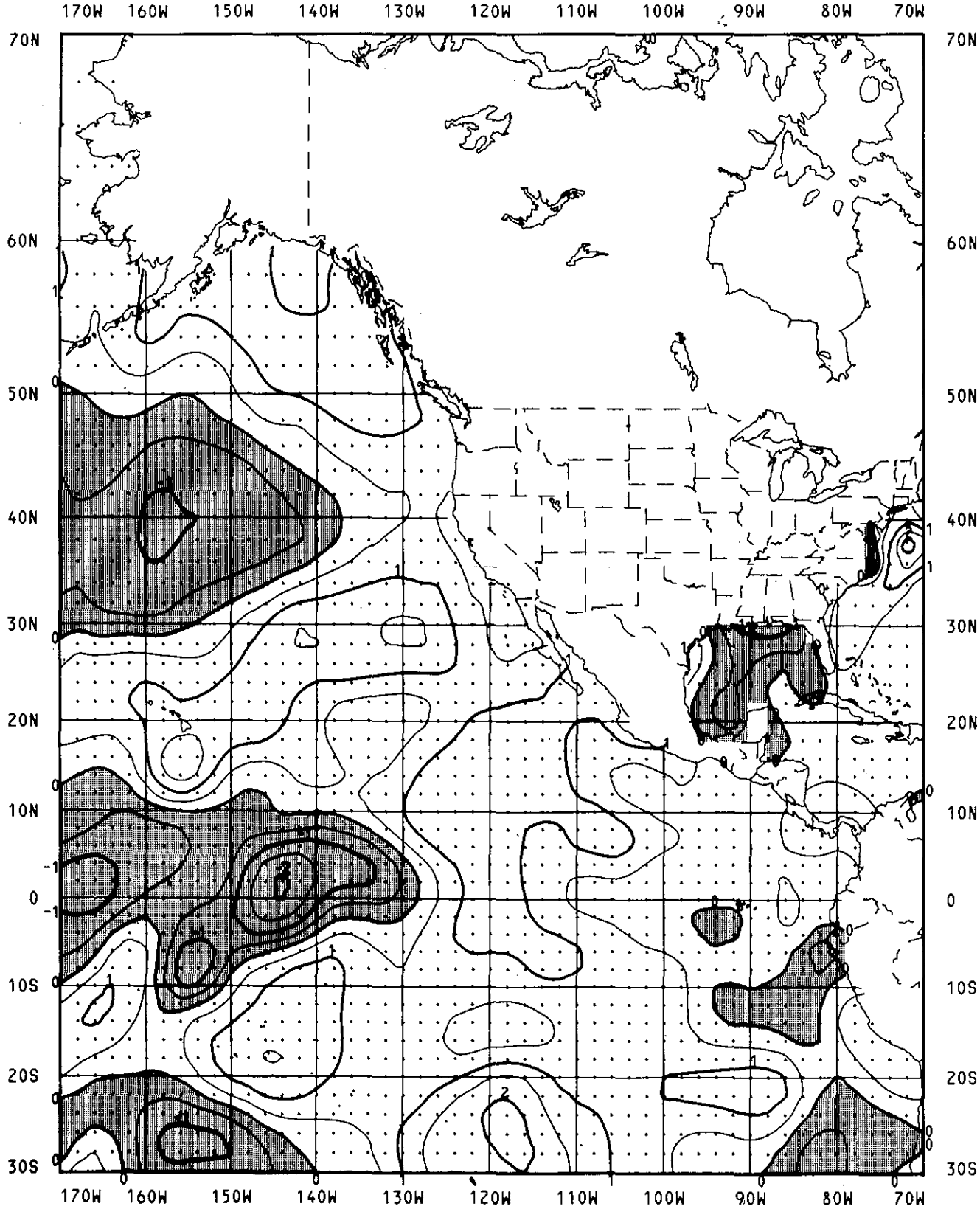

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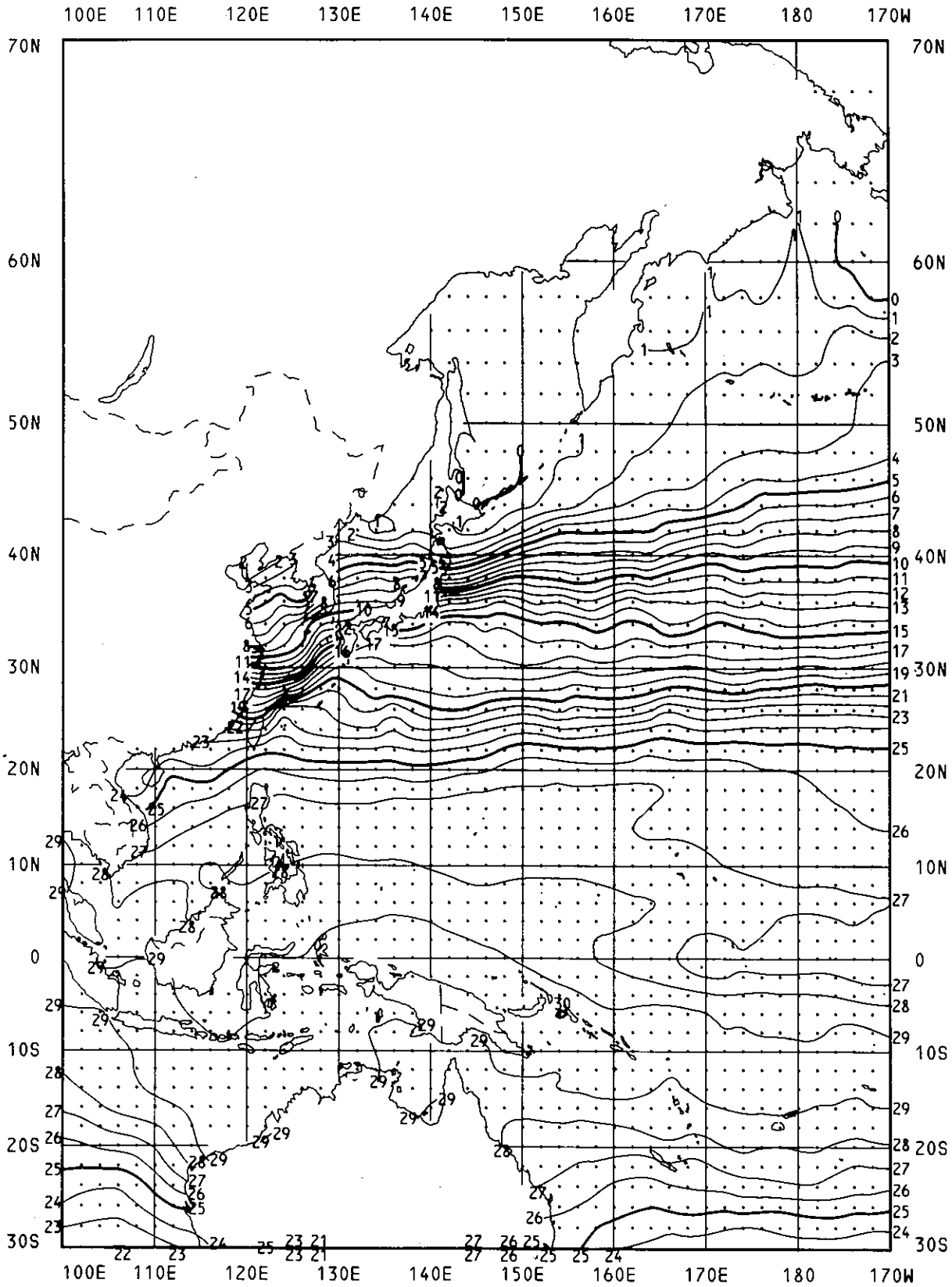

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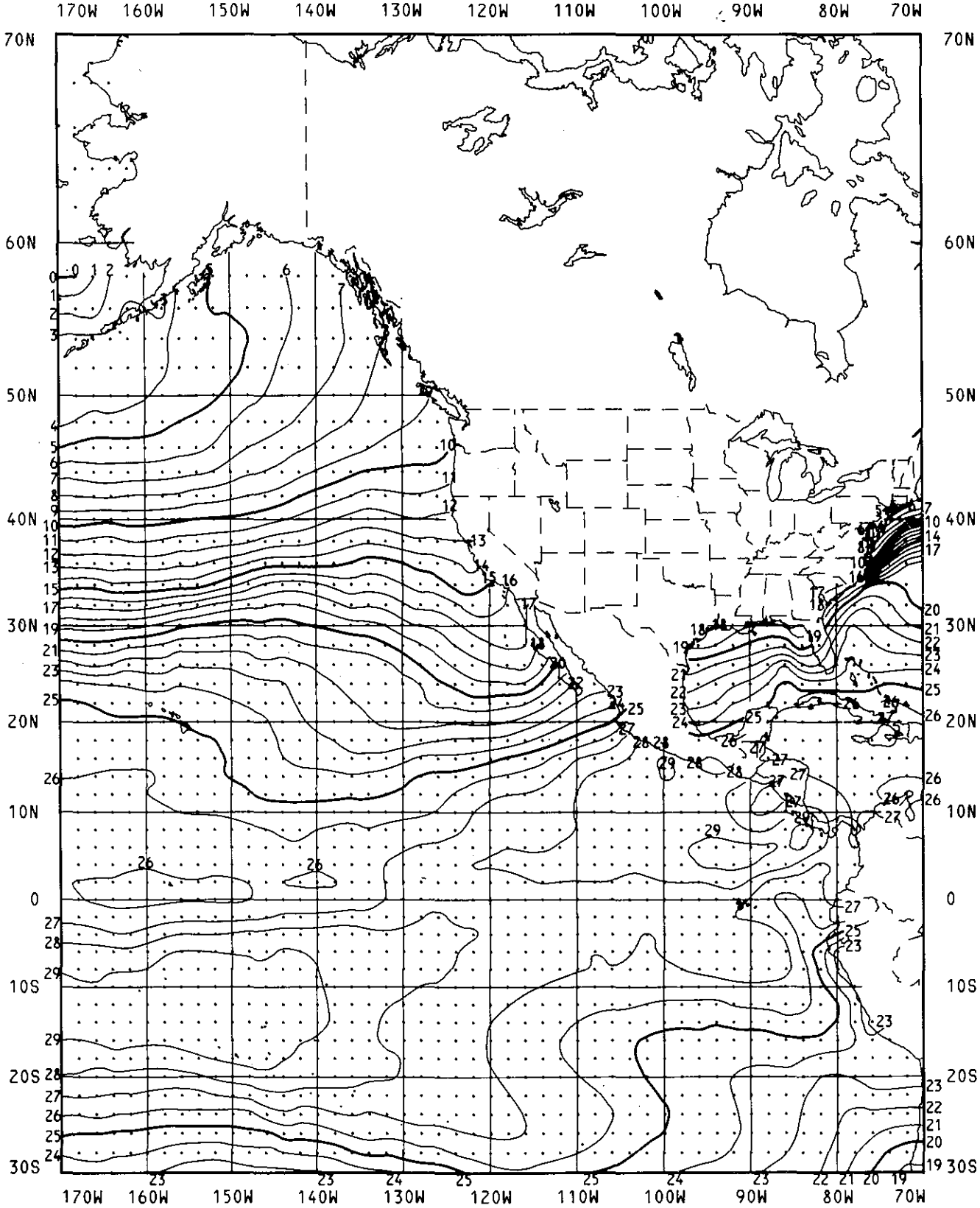
SATELLITE DATA
March 1984

Monthly mean sea surface temperature is the mean of satellite data within two-degree quadrangles. Contour line interval is 1.0°C.



Eastern Pacific Ocean
SST--MONTHLY MEAN (°C)
SATELLITE DATA
March 1984

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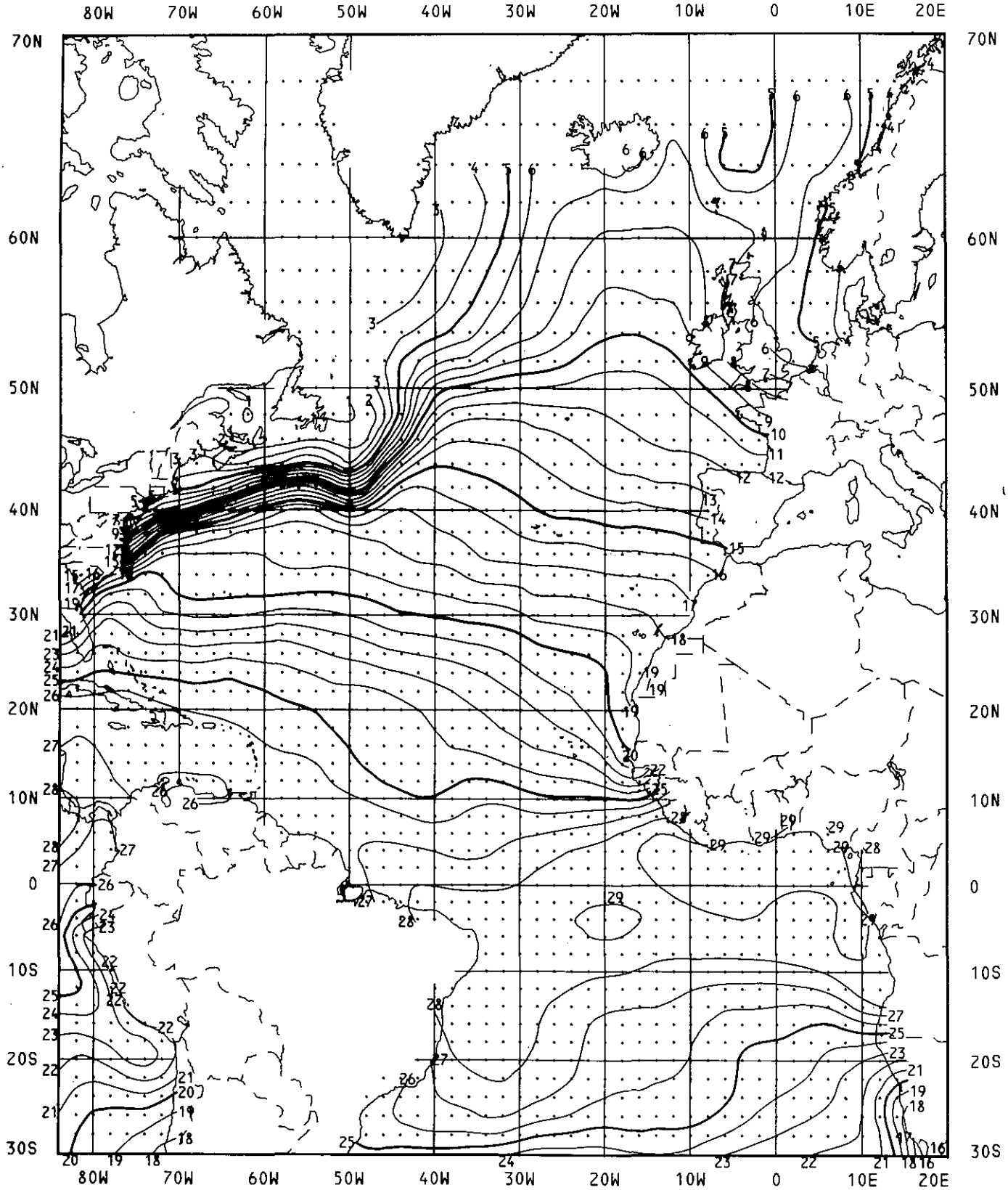
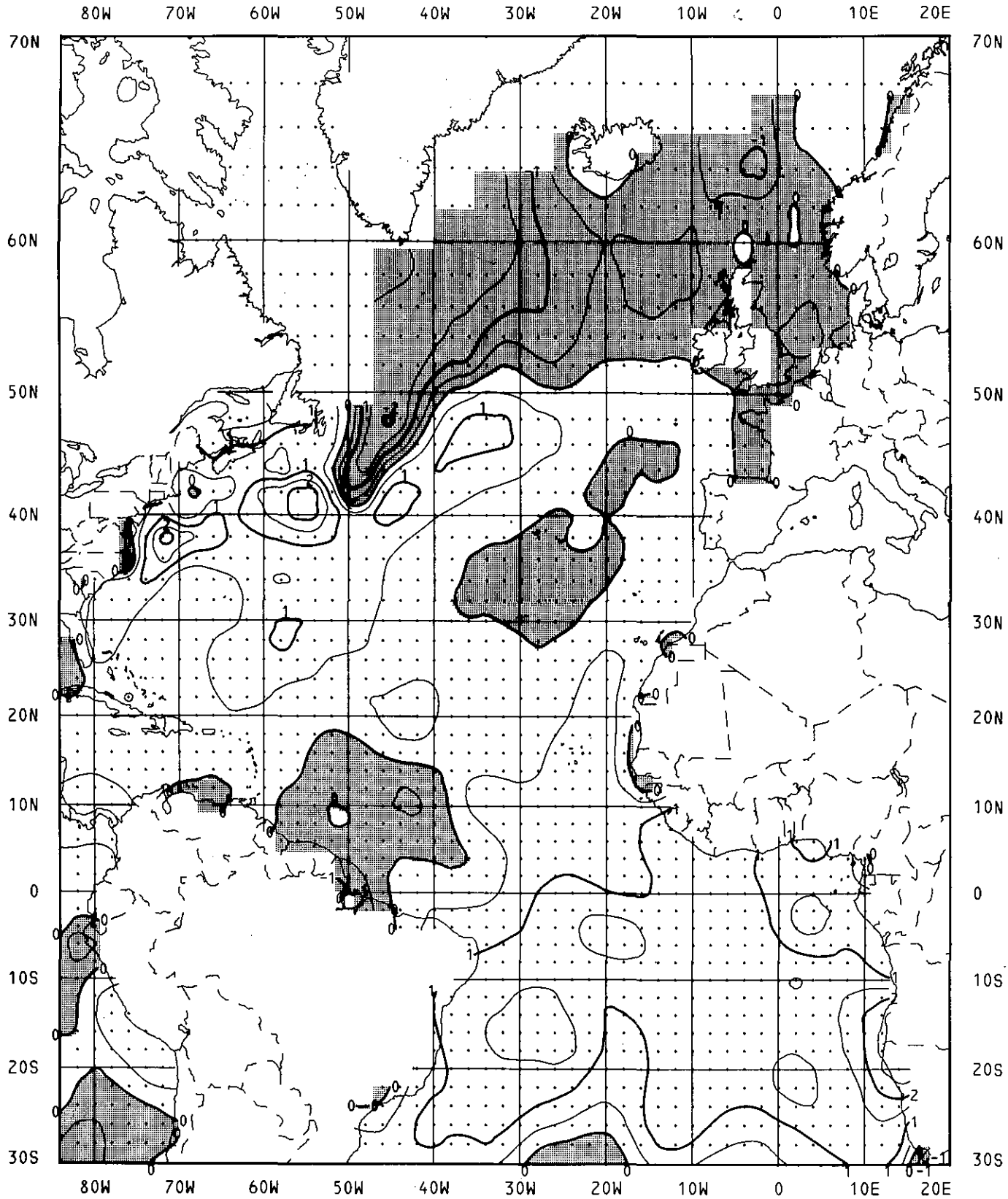


Atlantic Ocean
SST--MONTHLY MEAN (°C)
SHIP and BUOY DATA
March 1984

Monthly mean sea surface temperature is the mean of in-situ data (ships and buoys) within two-degree quadrangles. Contour line interval is 1.0°C.



Atlantic Ocean
SST--MONTHLY ANOMALY (°C)
SHIP and BUOY DATA
March 1984

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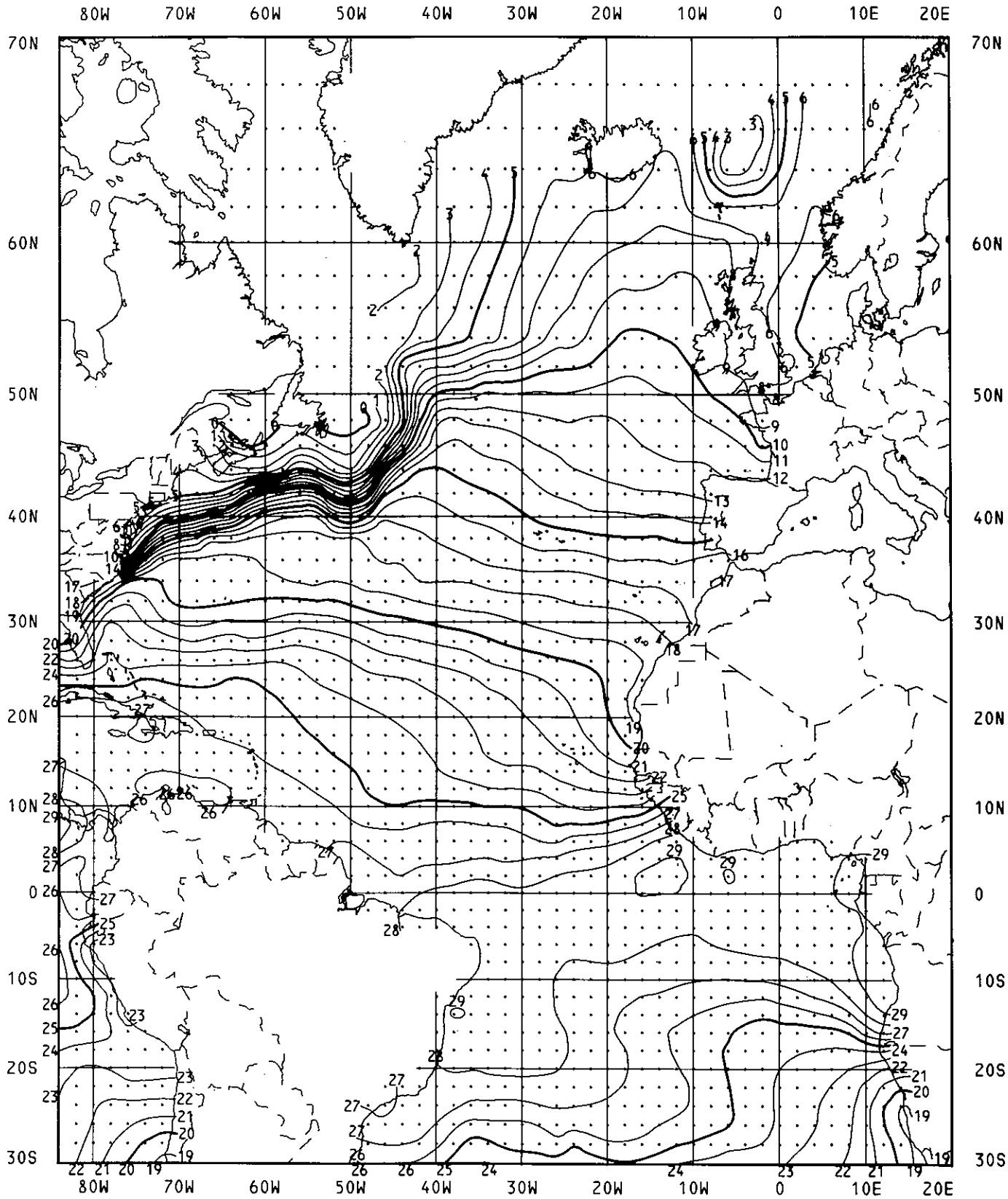

Atlantic Ocean
SST--MONTHLY MEAN (°C)
SATELLITE DATA
March 1984

Monthly mean sea surface temperature is the mean of satellite data within two-degree quadrangles. Contour line interval is 1.0°C.

SATELLITE IMAGE OF THE MONTH

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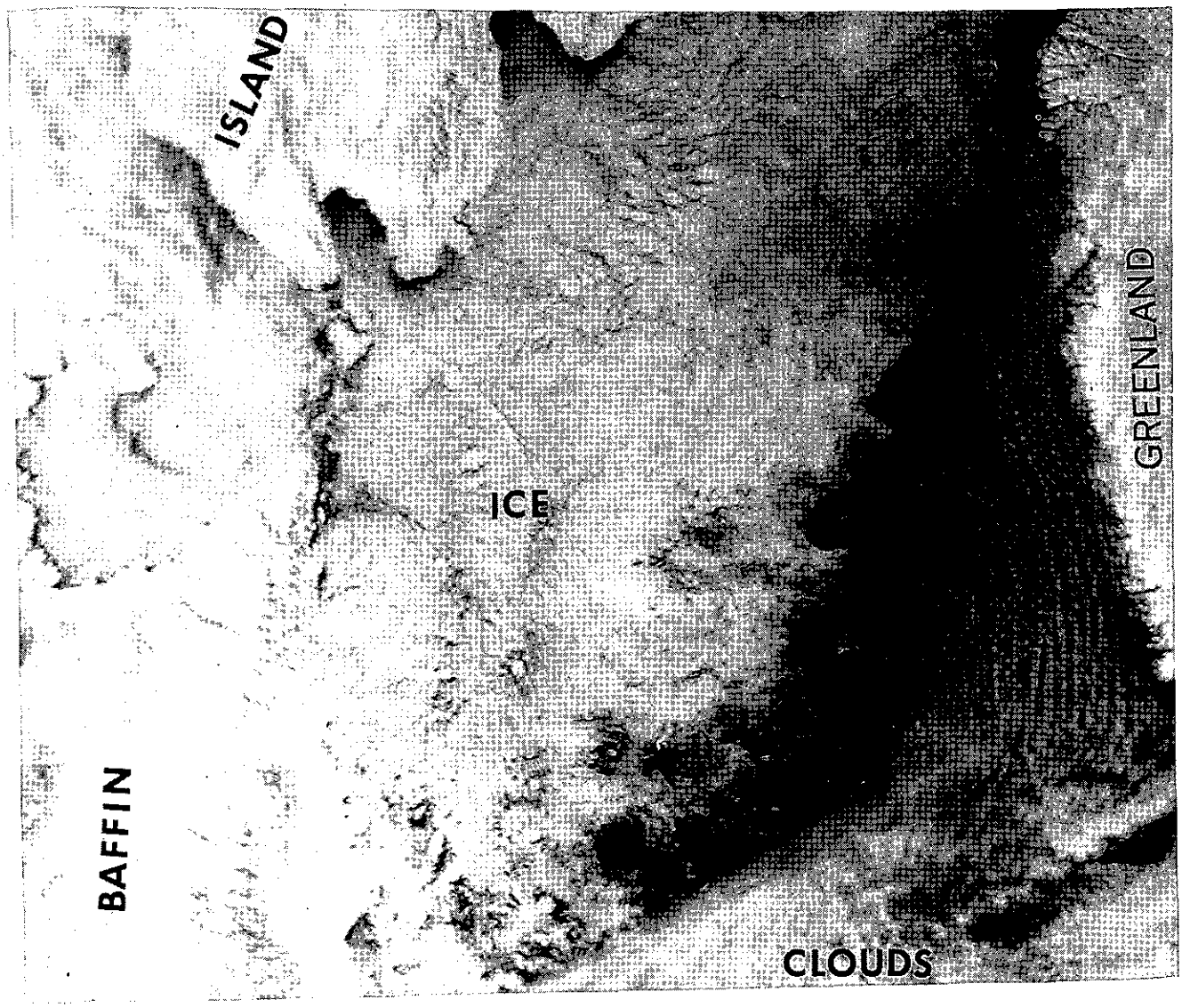
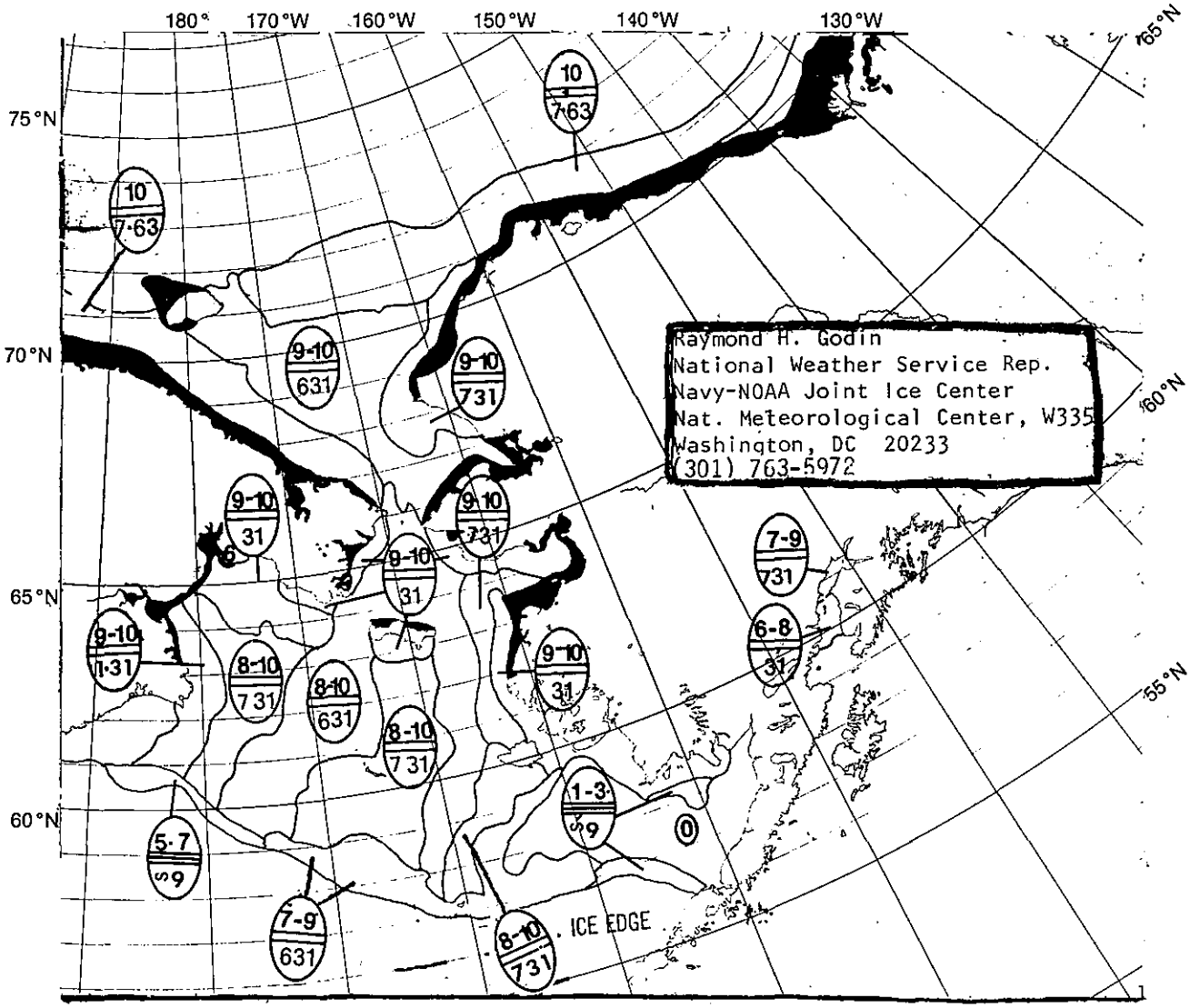
Interactive Processing Branch E/SP22
NESDIS, NOAA
Washington, DC 20233
(301) 763-8142

Ice Edge In The Davis Straits

The ice edge in the Davis Strait area is shown in this NOAA-7 visible satellite image. Davis Strait is located between Baffin Island and Greenland. The anomalous eastward extent of the ice edge is related to several factors. After the most recent summer season, Baffin Bay (located north of the Davis Strait) still contained a significant amount of ice from the previous winter. The "leftover" ice provided a dynamic growth mechanism for this year's ice pack. Persistent northeasterly winds have pushed the ice pack off Baffin Island toward Greenland. The fiberous structure along the ice edge reflects local wind and current interactions, and reflects the presence of the West Greenland current which flows to the south in the central portions of the Strait. The ice season for this area will continue for about 1-2½ months.



BERING SEA / NORTH SLOPE ICE ANALYSIS



C = Total ice concentration in the area in tenths.

C_a, C_b, C_c = Concentration of thickest (C_a), 2nd thickest (C_b), and 3rd thickest (C_c) ice

S_a, S_b, S_c = Stage of development of thickest (S_a), 2nd thickest (S_b), and 3rd thickest (S_c) ice.

~C = Concentration of ice within area(s) of strips and patches.

STAGE(S) OF DEVELOPMENT (THICKNESS)

1 = New ice (0-10 cm)
3 = Young ice (10-30 cm)
6 = First year (30-200 cm)
7 = First year thin (30-70 cm)
1. = First year medium (70-120 cm)
4. = First year thick (120-200 cm)
7. = Old ice (survived at least one summer's melt)

EXAMPLES

125 Theoretical thickness of this season's growth (cm).

Fast ice. Sea ice which forms and remains fast along the coast.

Ice boundary visually or satellite observed.

Ice boundary estimated.

MARCH 1984

The monthly mean sea level pressure circulation depicts a 991 mb low near 50°N 180°W. Surface geostrophic winds are easterly throughout much of the Bering Sea. Monthly mean surface air temperatures are normal at Barrow (71°N 157°W) and above to much above normal at all other routinely monitored coastal stations south of the Bering Strait. Ice conditions adjacent to the fast ice and coastal areas of southwestern Alaska reflect the predominance of new and young ice. The ice edge expanded from 50 to 100 km in the western Bering Sea and changed little in the central and eastern portions. The anomalously warm air temperatures in the southeast Bering Sea have resulted in the very light ice conditions observed south of the ice edge in Bristol Bay. The current ice edge position is between the climatological mean and maximum extremes.

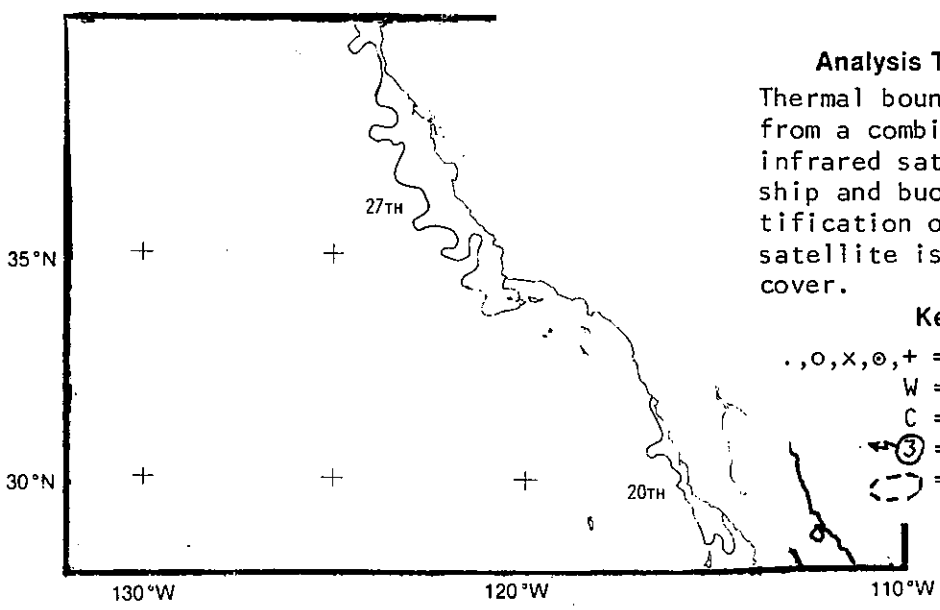
MONTHLY SST STATISTICS FOR SELECTED STATIONS

MARCH 1984

Station	Location (Lat/Long)	Mean SST	Standard Deviation	Maximum SST	Minimum SST	Change From Previous Month
Buoy 46005	46.1 N 131.0 W	9.4	0.1	9.6	9.1	-0.2
Buoy 46002	42.5 N 130.3 W	10.8	0.3	11.2	10.4	-0.6
Buoy 46010	46.2 N 124.2 W	9.8	0.5	10.4	9.1	+0.6
(Data from March 1-18 only. Temporarily out of service thereafter.)						
Grays Harbor	46.9 N 124.1 W	10.5	0.8	11.7	8.3	+1.9
Cape Disappointment	46.3 N 124.1 W	11.3	1.5	13.3	7.8	+3.0
Chetco River	42.0 N 124.3 W	10.8	0.4	11.7	10.0	+0.2

MARCH 1984

SSTs off the Pacific Northwest generally were 1.0 - 1.5°C above normal, continuing the trend of the preceding two months toward widespread warm anomaly over most of the area. Mean winds during the month were more southerly than normal. These southerly winds may partially account for the warm anomaly by northward and shoreward transport of warmer water. No consistent trends were observed at the various reporting stations. Little change from February was observed at either the coastal or offshore stations except at coastal stations near large river outflows. For example, the Columbia River recorded warming of 2-3°C during the month. This is largely caused by warming of freshwater runoff due to springtime heating of land areas. A brief episode of very weak coastal upwelling discernible on satellite imagery occurred near Cape Mendocino (40°N 124°W) during the last week of the month.



Analysis Techniques

Thermal boundaries are determined from a combination of enhanced infrared satellite imagery and ship and buoy observations. Identification of these features by satellite is limited by cloud cover.

Key

.,o,x,⊙,+ = thermal boundaries
W = warm
C = cold
③ = date of feature
= outline of water mass feature

North Panel
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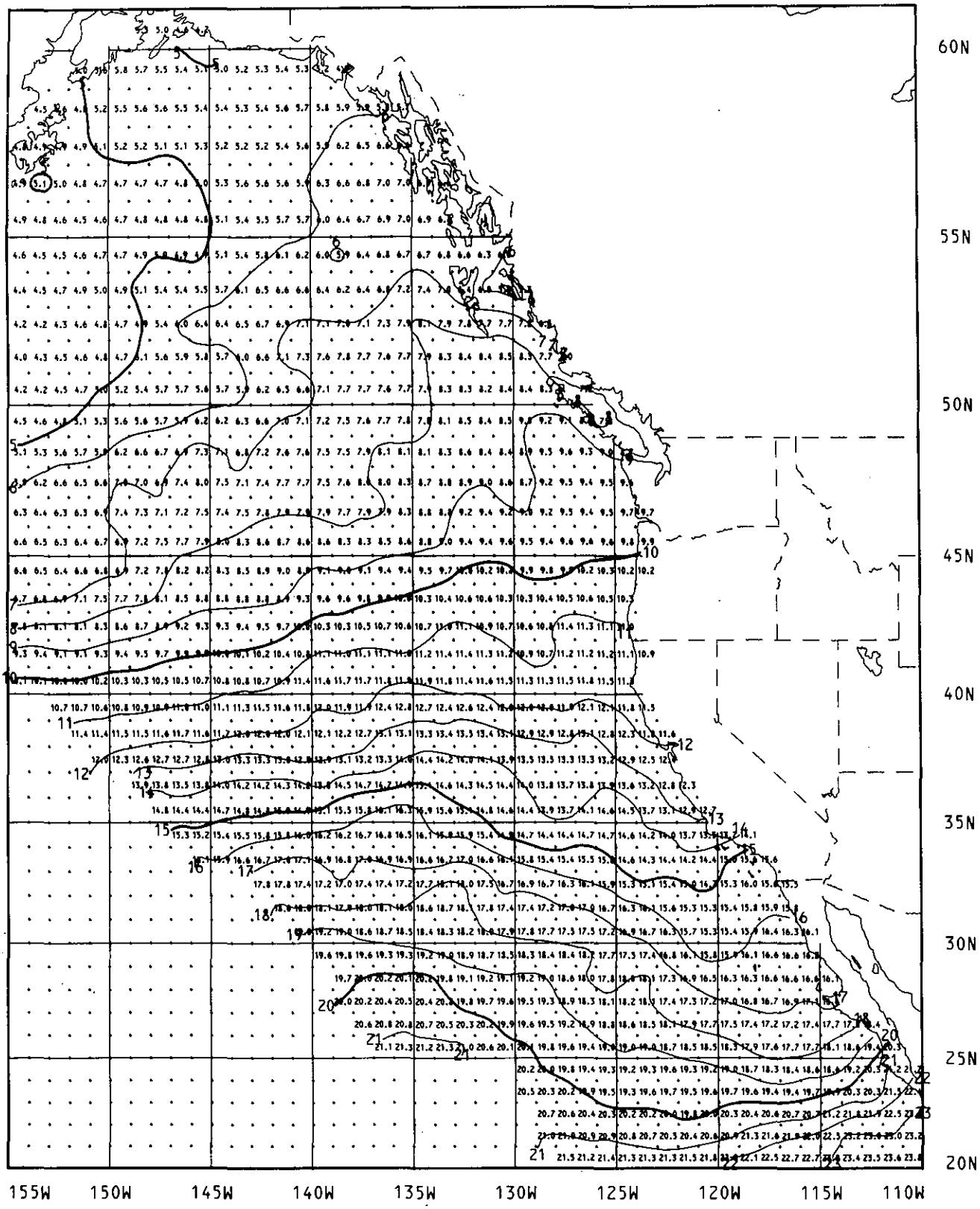
NOAA/Northwest Regional Ocean Service Center
7600 Sand Point Way NE
Bin C15700
Seattle, WA 98115
(206) 527-6604

South Panel
Ernest Daghir
NOAA/NESDIS
Satellite Field Service Station
660 Price Avenue
Redwood City, CA 94063
(415) 364-2422

SSTs began to warm slightly over most of the South Panel region during the month. Only the northwest portion of the analysis remained about the same temperature as February. There was some nearshore cooling of 0.5°C from Pt. Arena to Pt. Conception; this was the result of cold upwelled water. Upwelling was first observed along the California coastline by infrared satellite data on March 22 and was confirmed by fixed buoy reports. Northwesterly winds and the upwelling event persisted until the end of March. Mean SSTs over the South Panel were above normal everywhere when compared to climatology except for one small area near 35°N 135°W. Although this anomalously cool area has persisted for many months, it has abated in intensity and extent. The area much above normal (more than 1.0°C) was east of 130°W toward the coast. The warmest anomaly (over 1.5°C) was between 124° and 126°W and north to San Francisco Bay and along the coast to Cape Mendocino.



West Coast
SST--MONTHLY MEAN (°C)
March 1984

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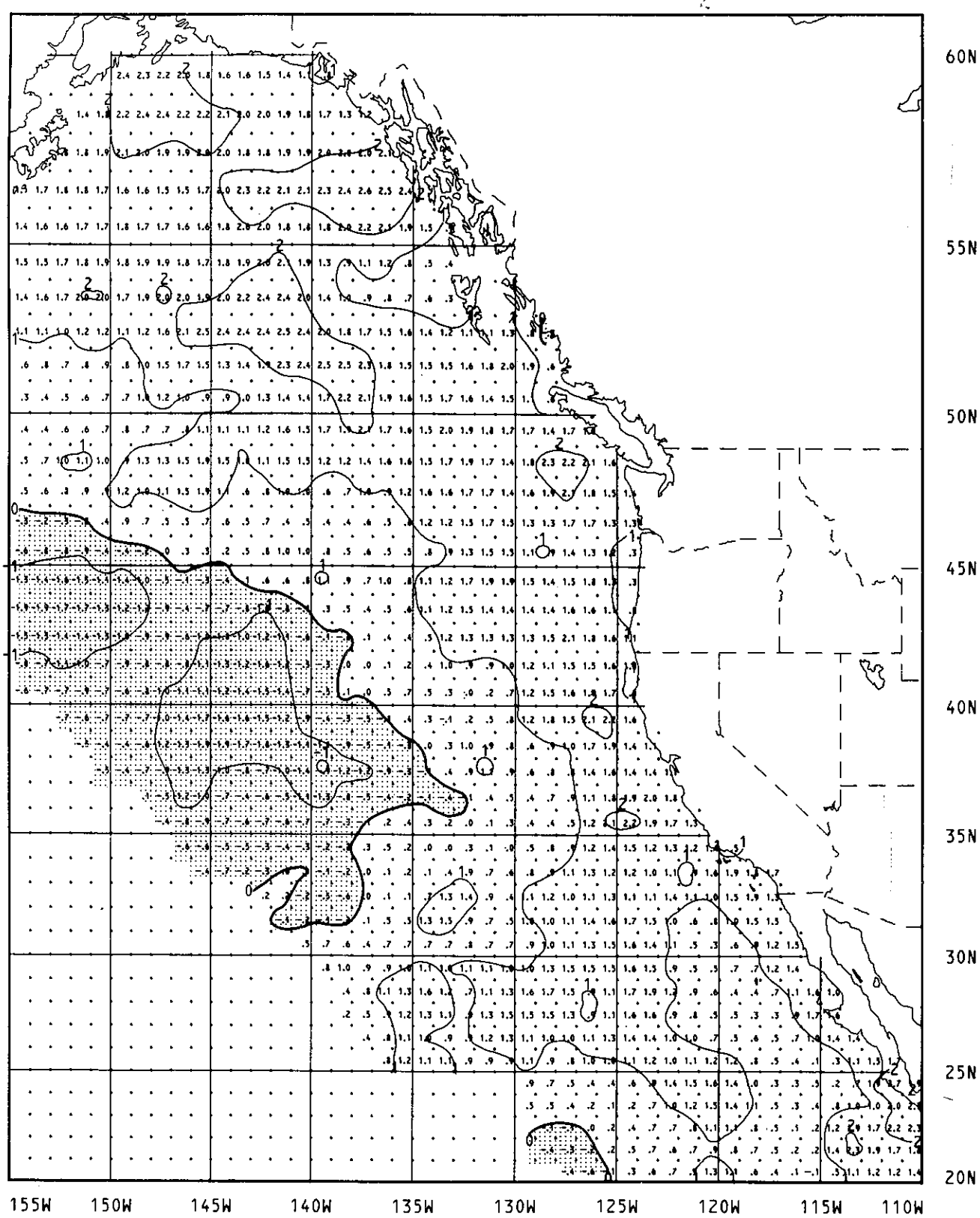

West Coast
SST--MONTHLY ANOMALY (°C)
March 1984

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EAST COAST OCEAN FEATURES

The end of this month's positions of the Gulf Stream System and its associated eddies are shown for the NW Atlantic and the Gulf of Mexico. The Gulf Stream and Loop Current boundaries are located by infrared satellite imagery or XBT (expendable bathythermograph) data. Anticyclonic eddies are labeled a-z in the Gulf of Mexico and 1-99 in the NW Atlantic. Cyclonic eddies are labeled A-Z. Arrows on eddies indicate direction of circulation. Warm-core or anticyclonic eddies rotate clockwise; cold-core or cyclonic eddies rotate counterclockwise. The line to the eddy center shows the net translation since last month or since last observed. Eddies or sections of the Gulf Stream System which were not observed during the month are not shown on the analysis chart. The long arrows at the bottom of the chart indicate the date of data used.

Data used in this analysis include:
- NOAA satellite infrared imagery, NESDIS
- Bathythermograph data, National Meteorological Center of National Weather Service
- Oceanographic Analysis, A daily detailed analysis issued by National Weather Service/NESDIS

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Ann Bell
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National Meteorological Cen.
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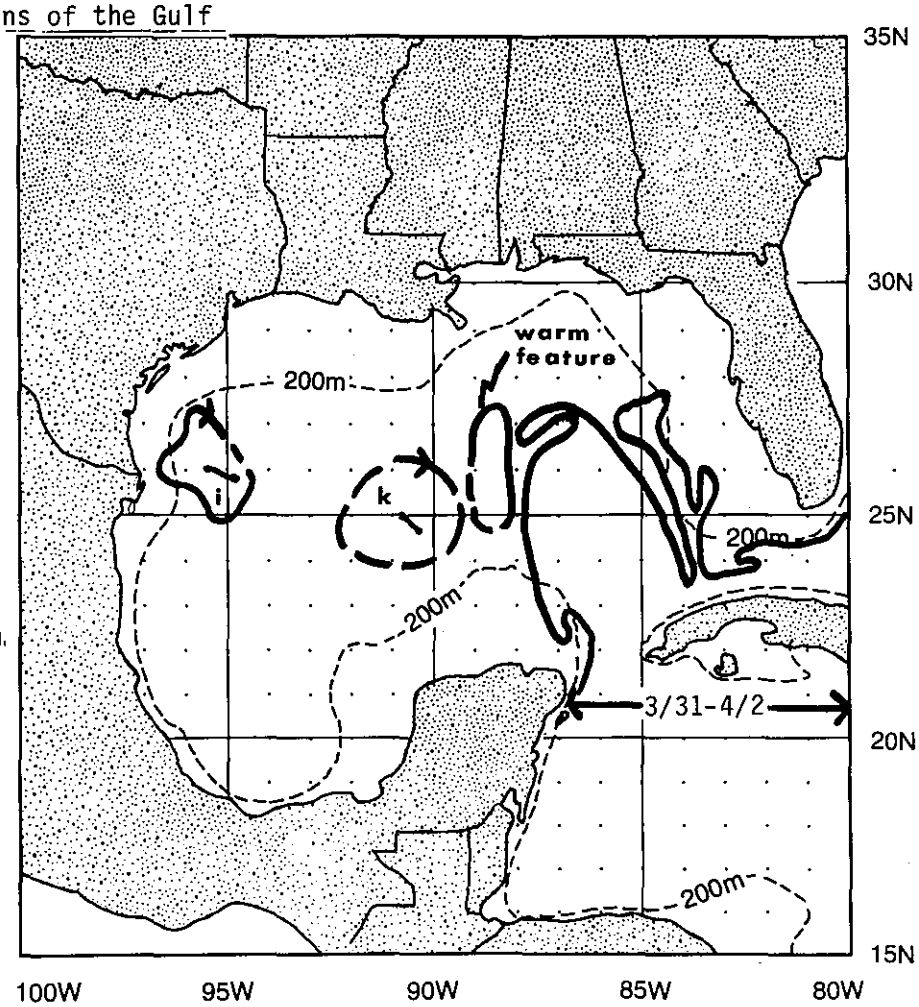
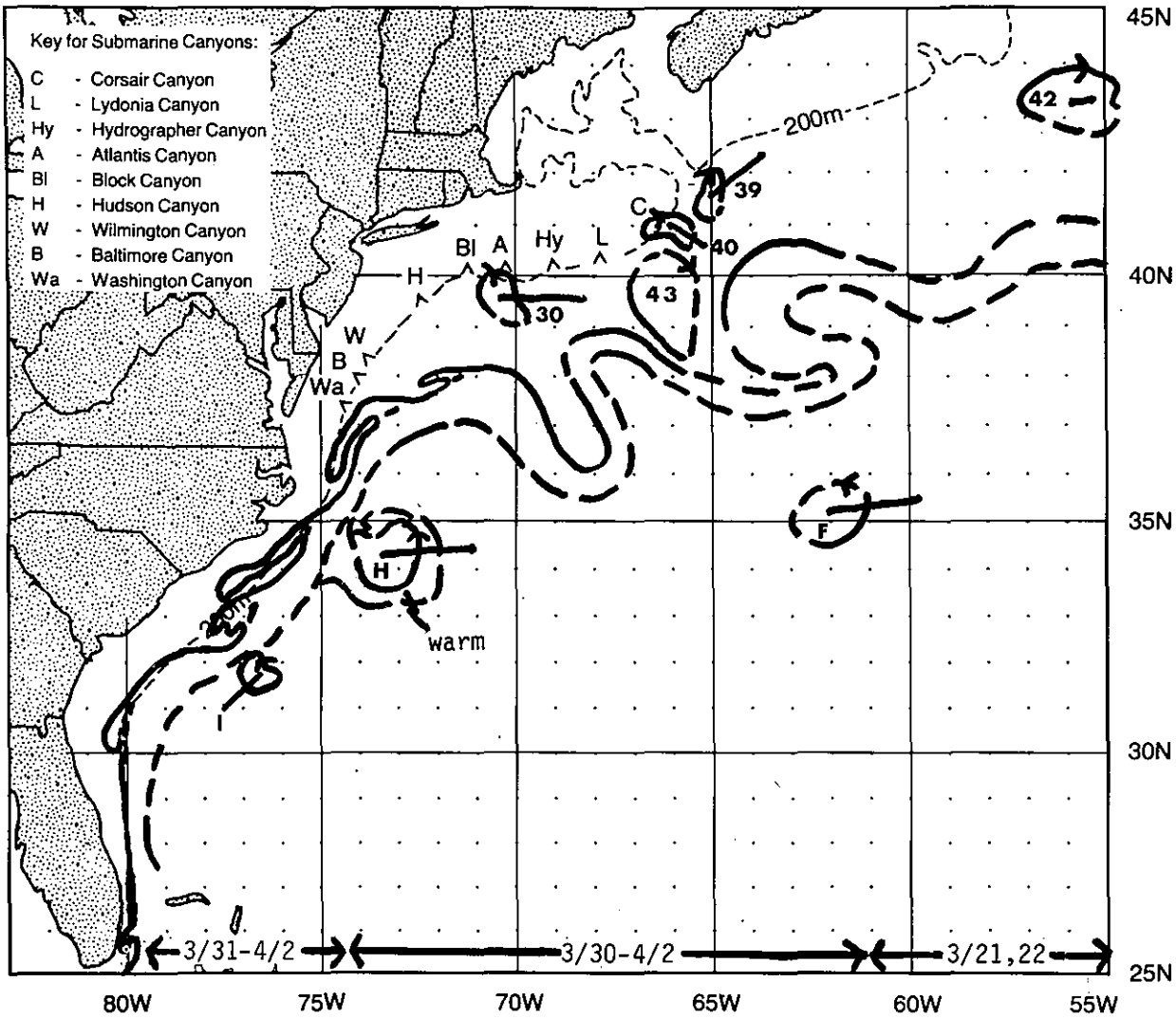


MARCH 1984

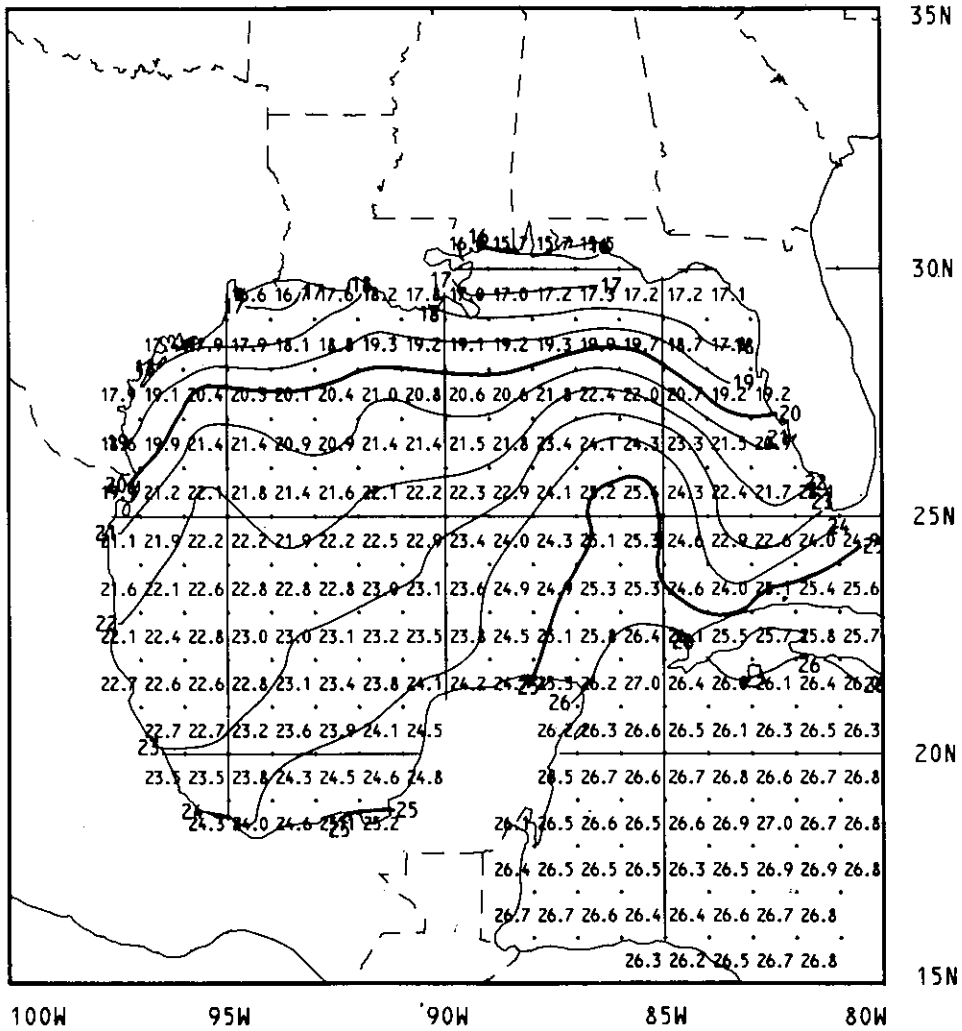
The amplitude of the Loop Current at the end-of-March shows little change compared to the end-of-February position. An elongated tongue of warm mixed Loop Current/slope water persisted near 24°N 83°30W to 27°30N 85°W since March 22. A warm eddy-like feature pinched off from the Loop Current near 26°N 83°30W on March 28. Eddy k traveled 55 km NW. Eddy i traveled 75 km WNW.



Prominent Gulf Stream North Wall features in the end-of-March analysis are the large amplitude Gulf Stream meanders near 36°N 68°W and near 40°N 64°30W. One anticyclonic eddy apparently formed during March. (NOTE: In the February end-of-month analysis, eddy 42 (near 43°N 55°30W) was mislabeled eddy 43.) New eddy 43 apparently formed from a Gulf Stream meander near 40°N 66°W on March 22. Eddy 41 was not observed during the month. Since satellite imagery of the region has shown no trace of eddy 41, it is suspected to have been absorbed by a large Gulf Stream meander near 40°N 61°W on March 21. Eddy 42, last observed on March 17, translated 45 km W. Eddy 30 translated 175 km W. Eddy 40 translated 85 km NW. Eddy 39 translated 140 km SW.

Eddy H moved 210 km W. Eddy I traveled 110 km NE. Eddy F translated 210 km WSW.

EAST COAST SST-
MONTHLY MEAN



Gulf of Mexico
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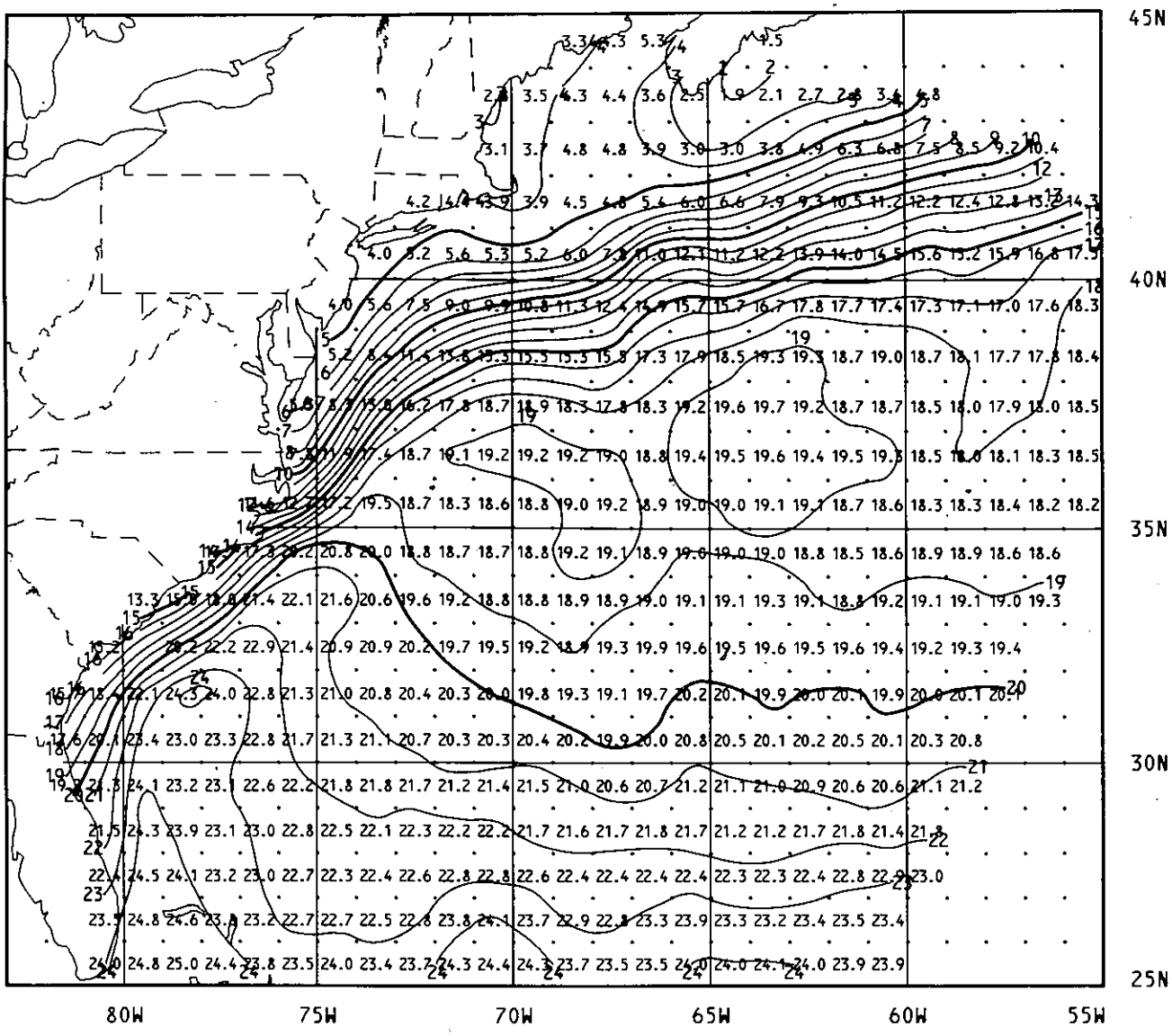

NW Atlantic Ocean
SST--MONTHLY MEAN (°C)
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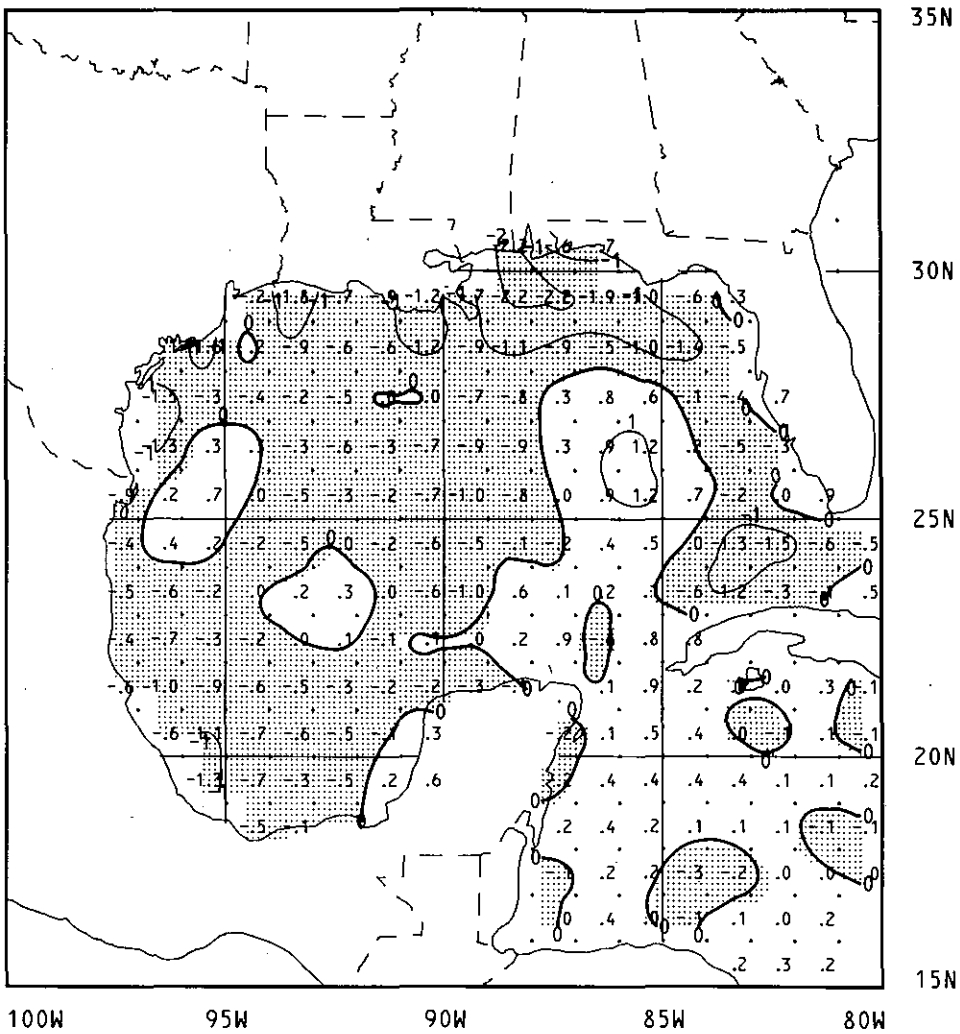
EAST COAST SST-ANOMALY



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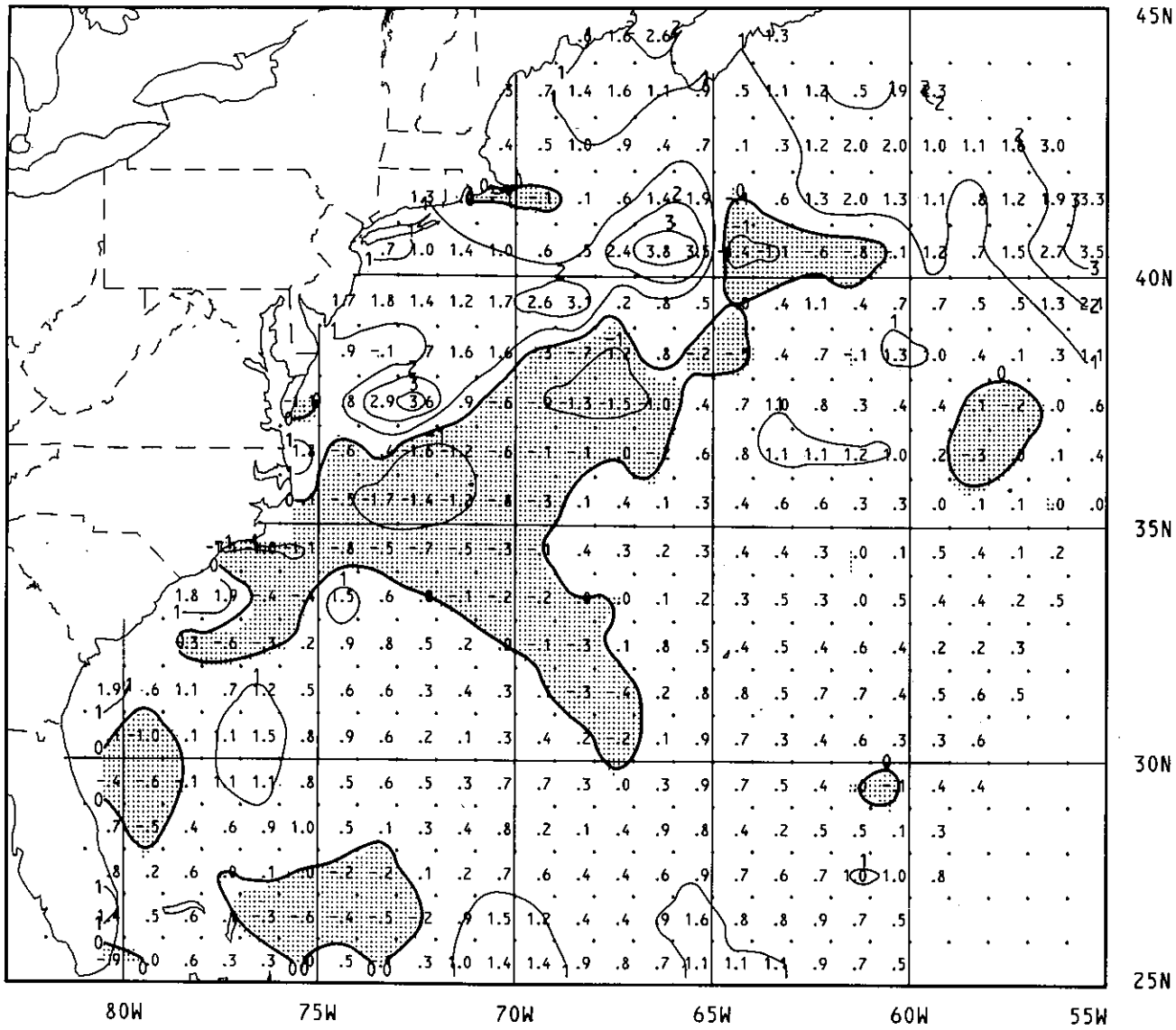

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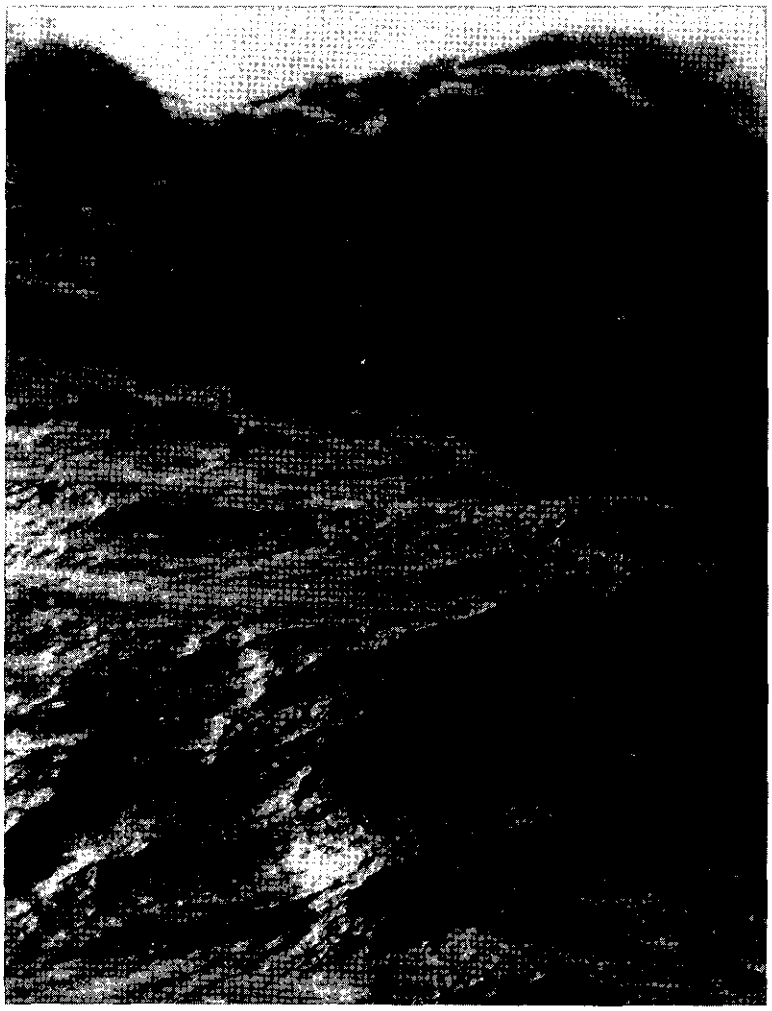
*U.S. GOVERNMENT PRINTING OFFICE : 1984 0-421-013/414

OCEANOGRAPHIC Monthly Summary

Volume IV Number 4 April 1984



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U.S. DEPARTMENT OF COMMERCE • National Oceanic and Atmospheric Administration
National Weather Service
National Environmental Satellite, Data, and Information Service

Oceanographic Monthly Summary is published by the National Weather Service and the National Environmental Satellite, Data, and Information Service (NESDIS). *Oceanographic Monthly Summary* contains sea surface temperature (SST) analyses on both regional and ocean basin scales for the Atlantic and Pacific Oceans. Two ocean basin SST analyses are presented, one based on in-situ data and another based solely on satellite data. An ocean basin SST anomaly derived from the in-situ data is also shown; it uses the National Climatic Center (NCC) Climatology*. The regional SST analyses are based upon a combination of in-situ and satellite data measurements. The regional SST anomalies use the Robinson-Bauer Climatology*. *Oceanographic Monthly Summary* also contains Alaskan sea ice information and ocean feature information for contiguous U.S. ocean regions.

Oceanographic Monthly Summary welcomes articles containing information of interest to *Oceanographic Monthly Summary* readers, such as, news on operational oceanography, unusual ocean feature phenomena, etc. Contributions should be sent to the editor (address below). Accepted material will appear in the OceaNotes section of *Oceanographic Monthly Summary*. Contributions can be published as quickly as the next monthly issue.

If you are interested in receiving *Oceanographic Monthly Summary* regularly, please refer to the back cover for subscription information.

*Reynolds, R.W., 1982. A Monthly Averaged Climatology of Sea Surface Temperatures; *NOAA Technical Report NWS 31.*

*Robinson, M.K., 1976. Atlas of North Pacific Ocean Monthly Mean Temperatures and Mean Salinities of the Surface Layer; *NavOceano Ref. Pub. 2.*

Robinson, M.K., R. A. Bauer and E.H. Schroeder, 1979. Atlas of North Atlantic-Indian Ocean Monthly Mean Temperatures and Mean Salinities of the Surface Layer; *NavOceano Ref. Pub. 18.*

Oceanographic Monthly Summary

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MARINE WEATHER REPORTING James Salevan, Fisheries Specialist

Most of the earth's weather occurs over the oceans, which cover nearly three-fourths of the globe. Yet, most of the surface observations on which the National Weather Service bases its warnings and forecasts are taken over the land. Marine weather observations are provided by such sources as satellite imagery, sea-going merchant ships, automated buoys, offshore platforms, U.S. Coast Guard, and others. But there are many gaps in the reporting network, particularly in the nearshore zones extending out to 200 miles. The lack of adequate observations in the nearshore area and in the larger inland lakes poses a major problem for the marine weather forecaster. Daily, a million commercial fishermen, recreational boaters, and others ply these waters in small vessels. All are highly vulnerable to severe weather.

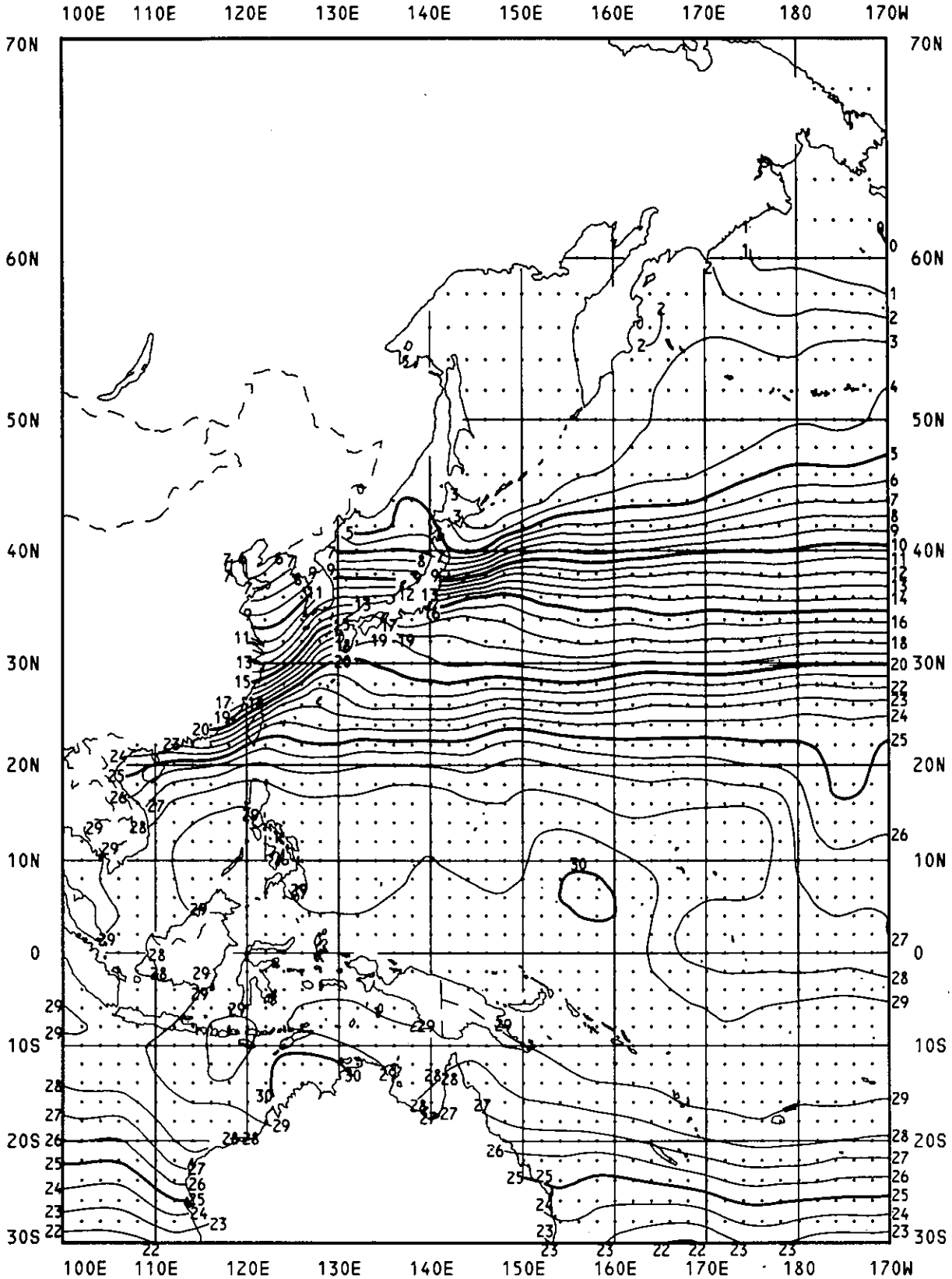
To help improve its marine forecasts for areas of high activity, the National Weather Service has established a nationwide Marine Report Program (MAREP). Through this cooperative effort, professional mariners report timely observations of sea conditions for their area through shore stations, which then send the information to the National Weather Service. In return, the shore stations provide the mariners with current warnings and forecasts which are improved as a result of the Mariner Reports.

To date, the MAREP Program covers the northern Gulf of Alaska and waters along the Aleutian Islands, the coastal waters of Washington and Oregon, and southern New England. Word of this successful program is spreading, and many other mariners are interested in establishing a MAREP for their areas. Through the Sea Grant College Program, the University of Delaware College of Marine Studies in Lewes is now a MAREP collection center. MAREPs are taken from 8-10 am and from 1-3 pm. The following is a list of VHF channels and single side band (SSB) frequencies on which MAREPs will be solicited: VHF - 11, 16, 68; SSB - 2182.0, 2096.5, 4125.0, 4143.6.

Accurate marine weather forecasts help mariners protect their lives, vessels, and valuable cargo. Often, the extra time gained at sea as a result of an accurate forecast can mean the difference between staying in business or going broke. You can help improve the weather forecasts for your area if you are a fisherman, a tug or barge operator, offshore driller, coastal shipper, or anyone who makes a living at sea. The National Weather Service needs your weather observations to help increase the accuracy and timeliness of weather warnings and forecasts for areas of major marine activity.

All observations are useful. A single report can mean early detection of a sudden storm, and it can help the National Weather Service evaluate its forecasts. Observations can be anything from a simple estimate of wind and waves to a full report including atmospheric pressure, temperature, winds, and other measurements such as sea conditions. Your observations can make the difference, but only if you share them. Help us help you. Participate in the MAREP Program in your area.

For more information on the MAREP Program, contact: James F. Salevan, Marine Fisheries Specialist, Sea Grant Advisory Service, University of Delaware, 700 Pilottown Road, Lewes, DE 19958, (302) 645-4250 or Robert J. Werner, National Weather Service, 5200 Auth Road, Room 302, Washington DC 20233, (301) 763-8088.



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April 1984

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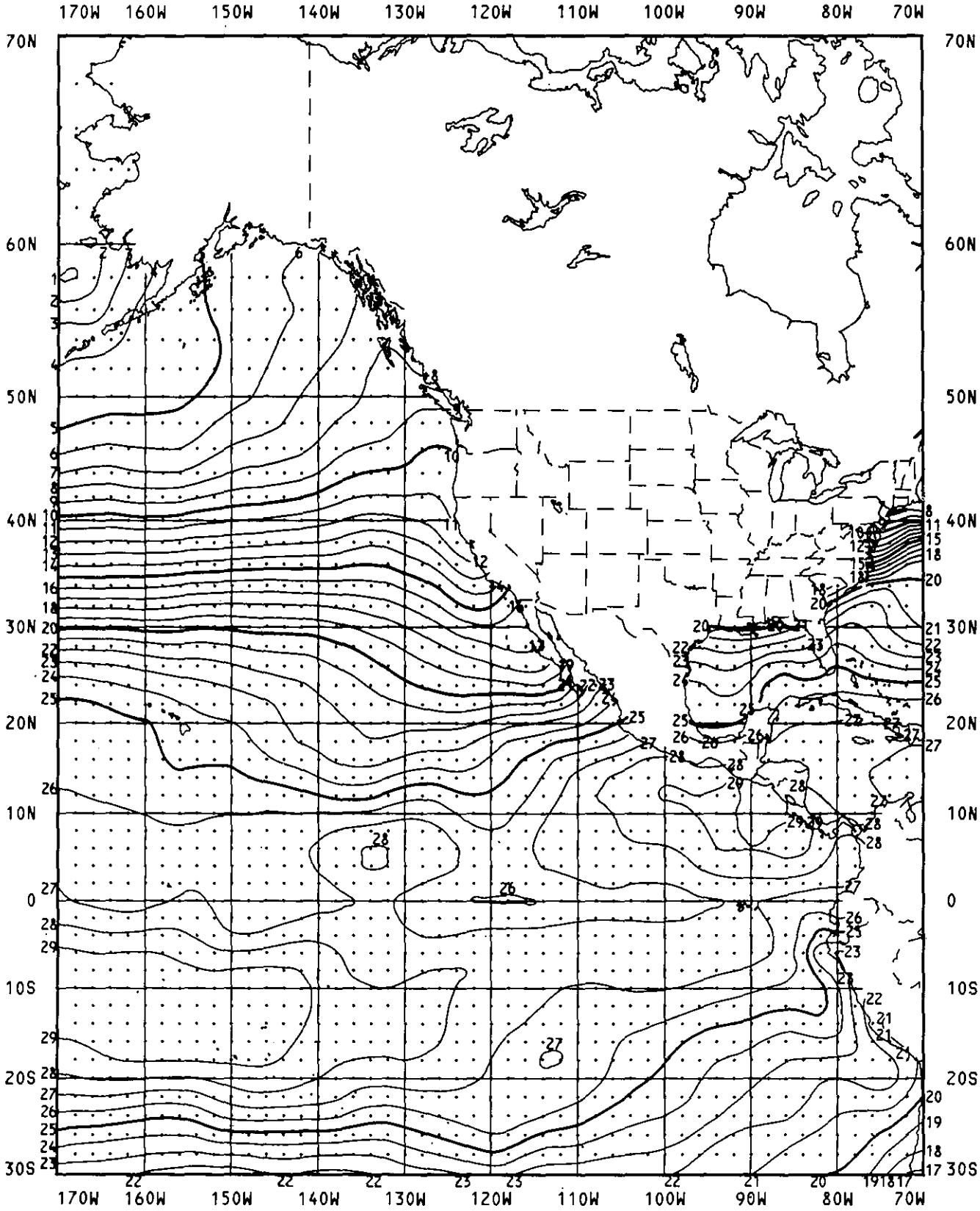

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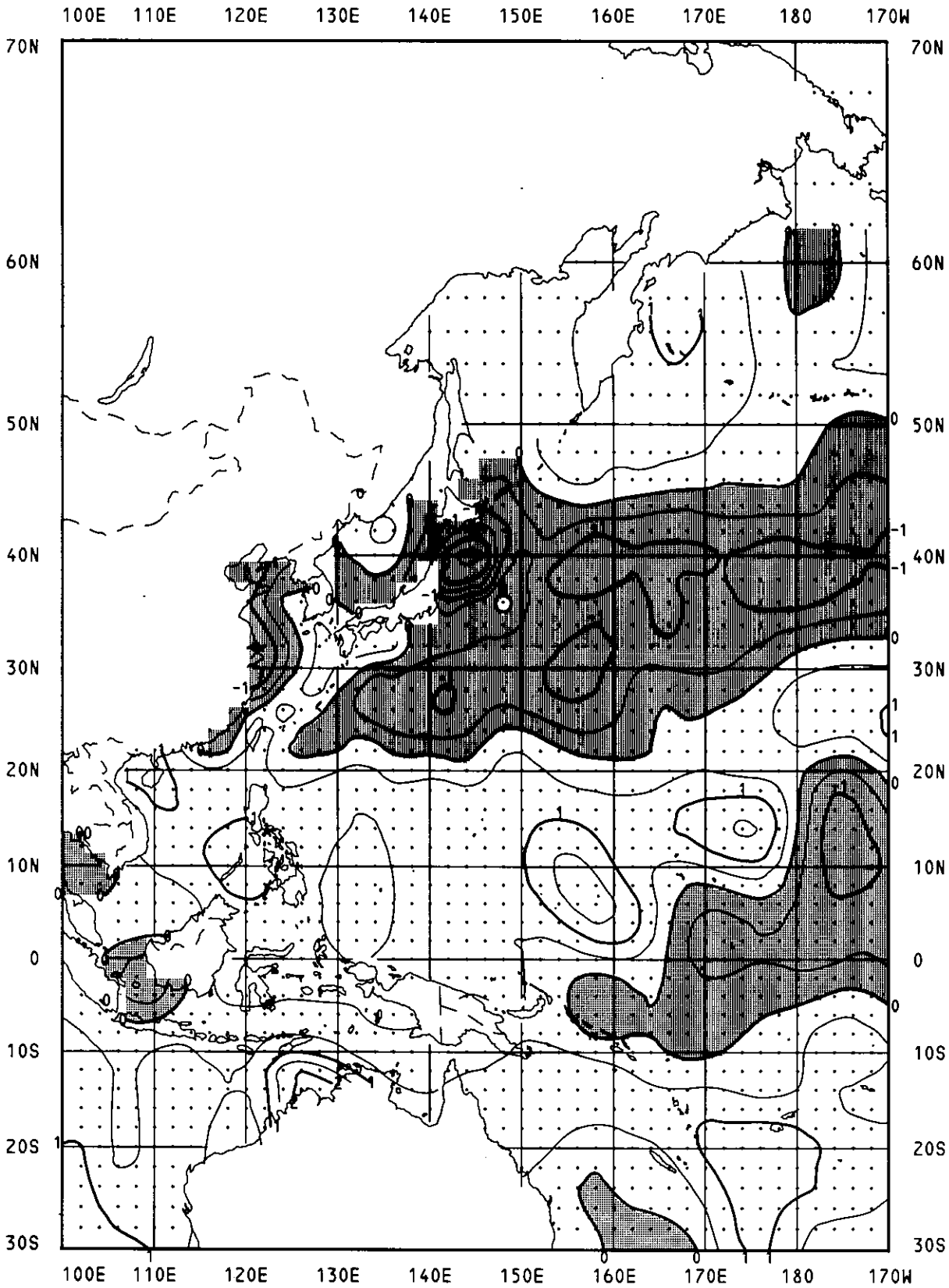

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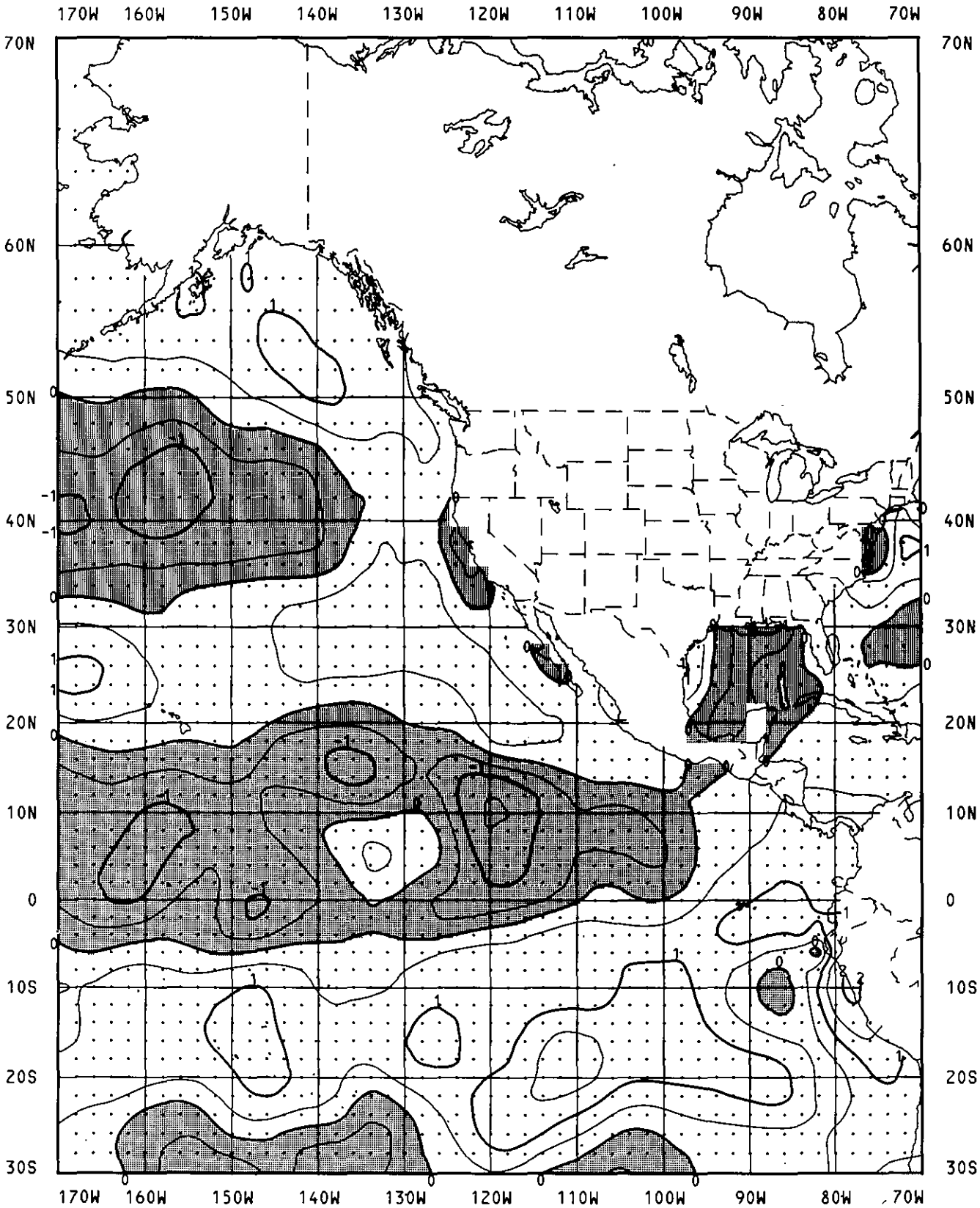

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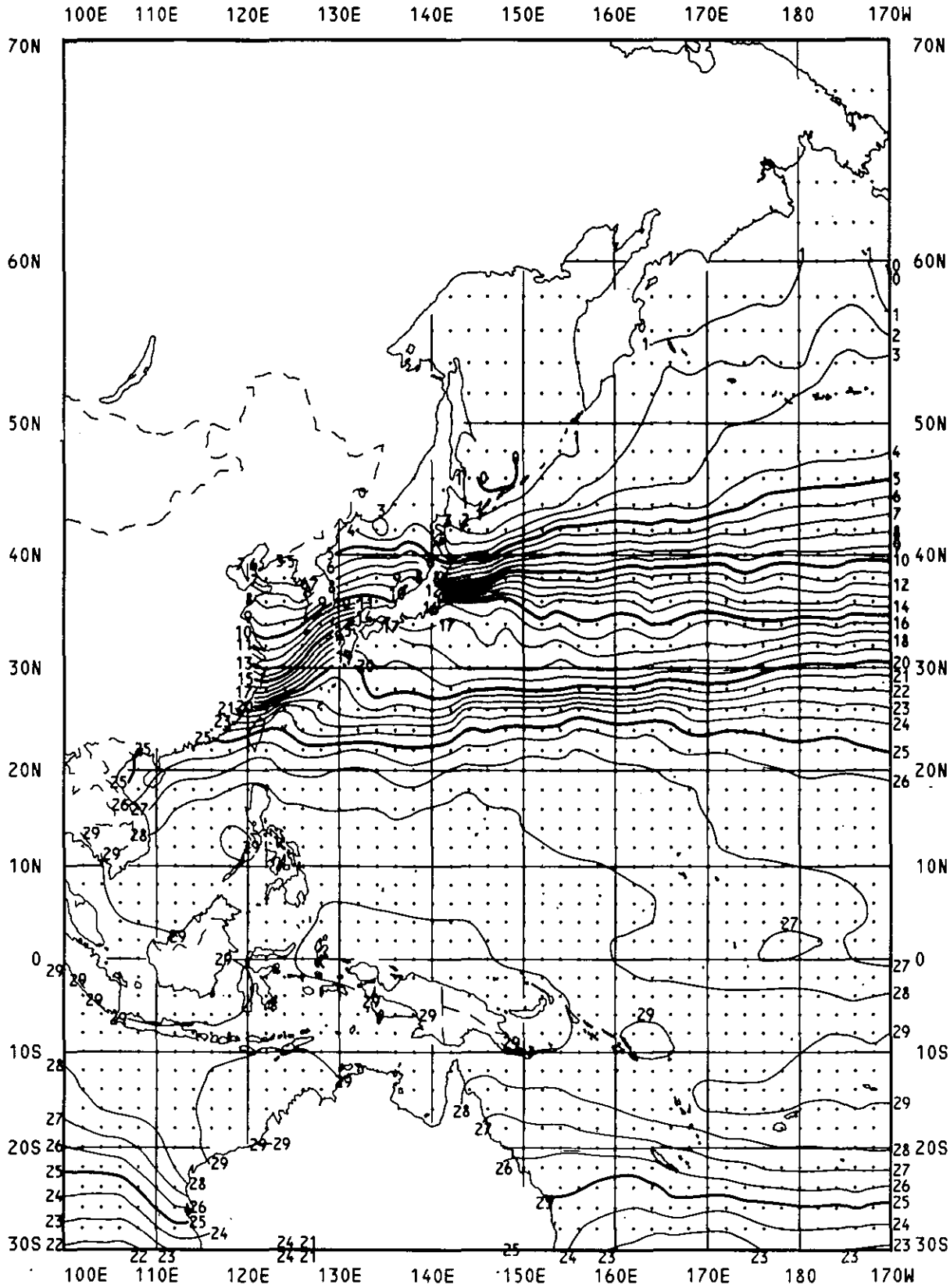

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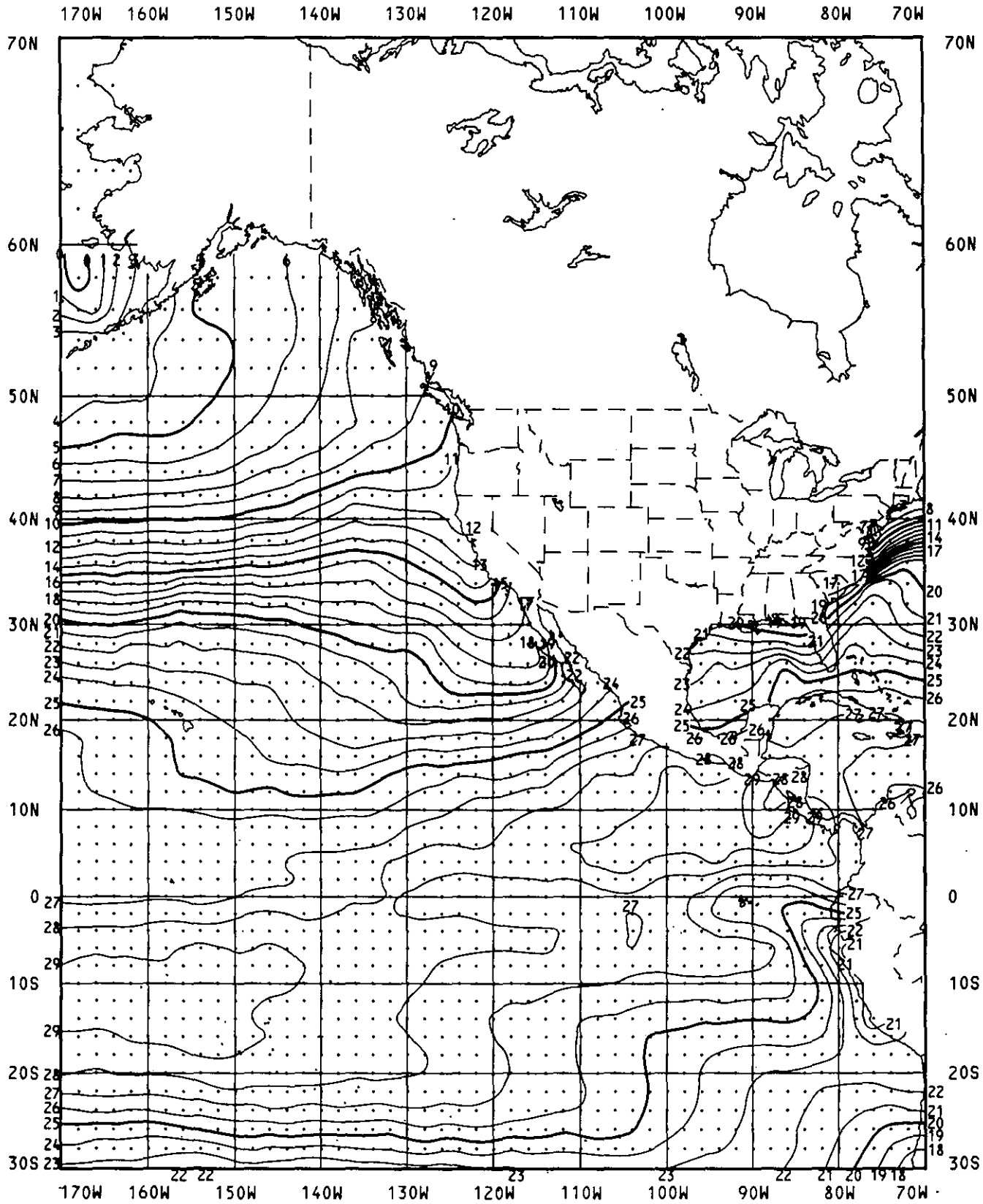

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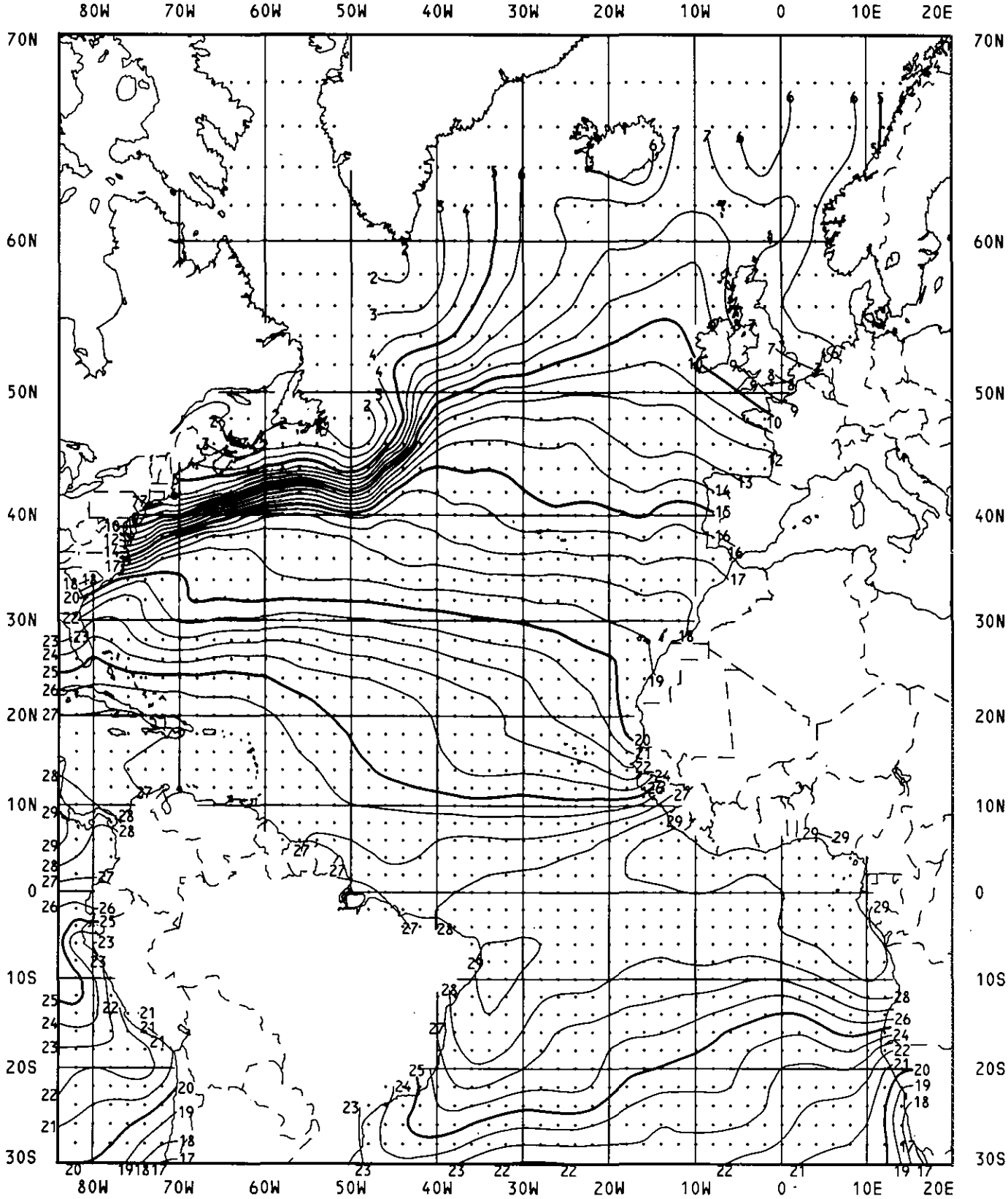

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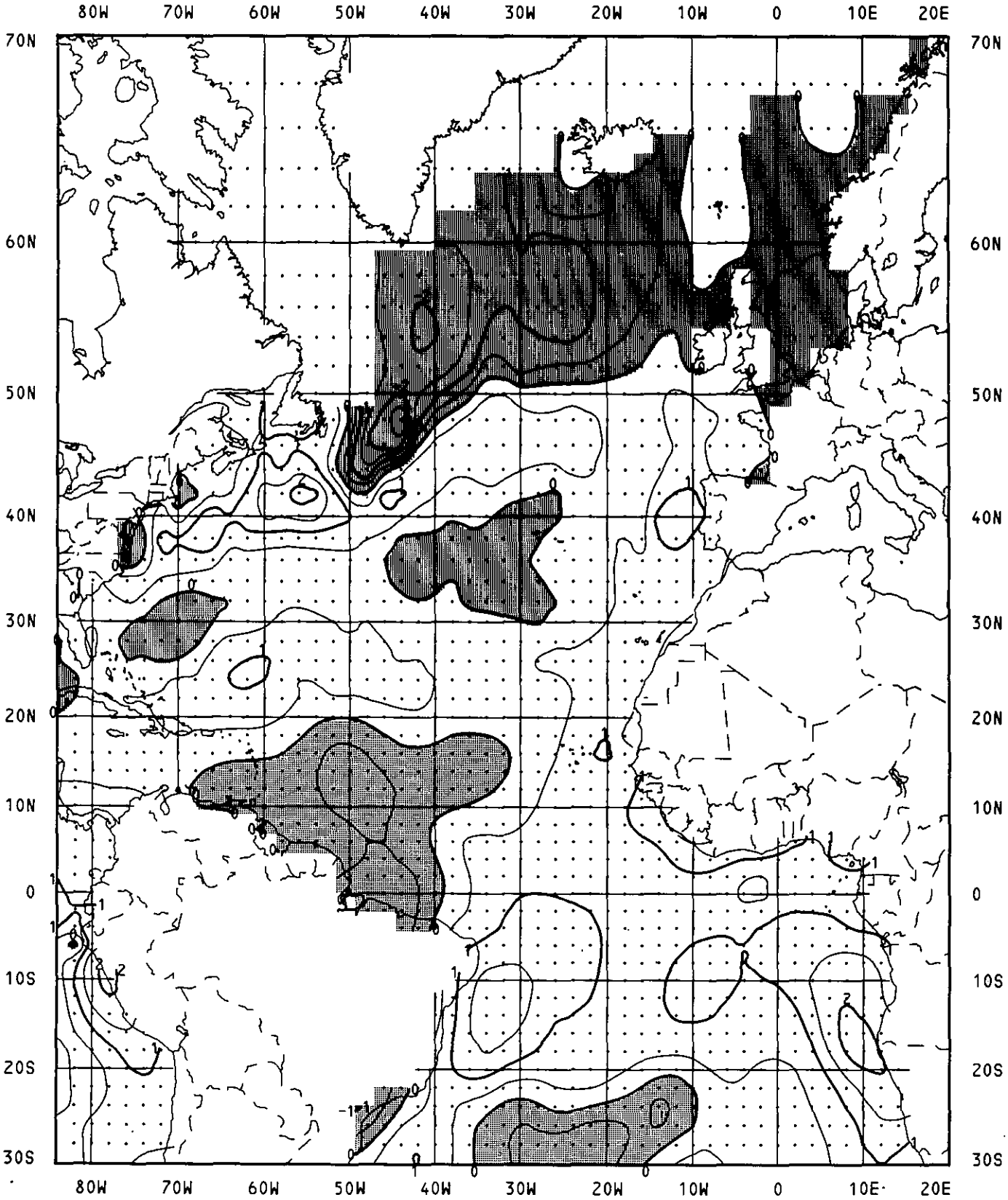
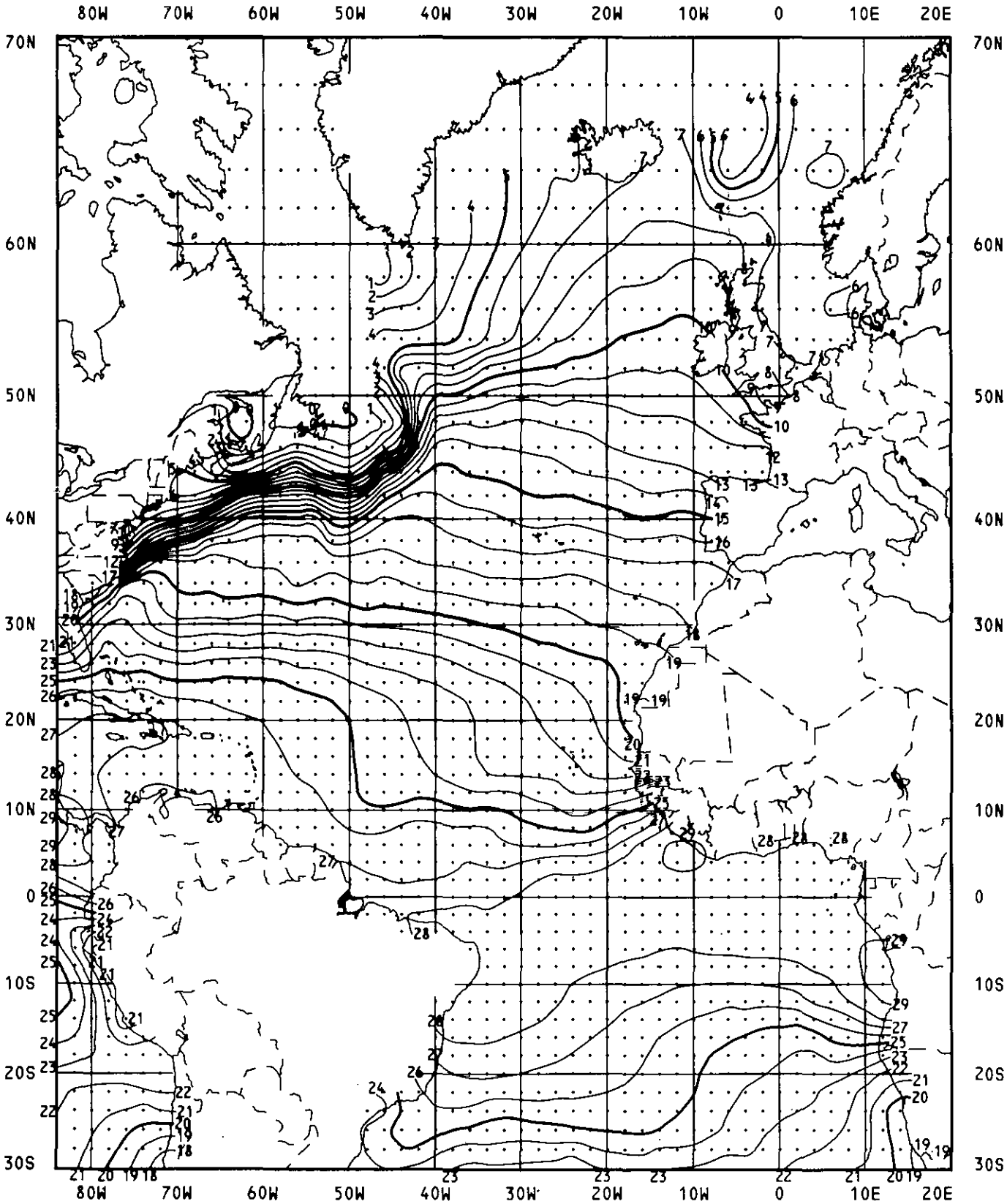


Atlantic Ocean
SST--MONTHLY ANOMALY (°C)
SHIP and BUOY DATA
April 1984

Monthly anomaly is the difference between the monthly mean sea surface temperature and the climatological monthly mean value -- shading shows where the monthly mean is colder than climatology. Contour line interval is 0.5°C.



Atlantic Ocean
SST--MONTHLY MEAN (°C)
SATELLITE DATA
April 1984

Monthly mean sea surface temperature is the mean of satellite data within two-degree quadrangles. Contour line interval is 1.0°C.

SATELLITE IMAGE OF THE MONTH

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Interactive Processing Branch E/SP22
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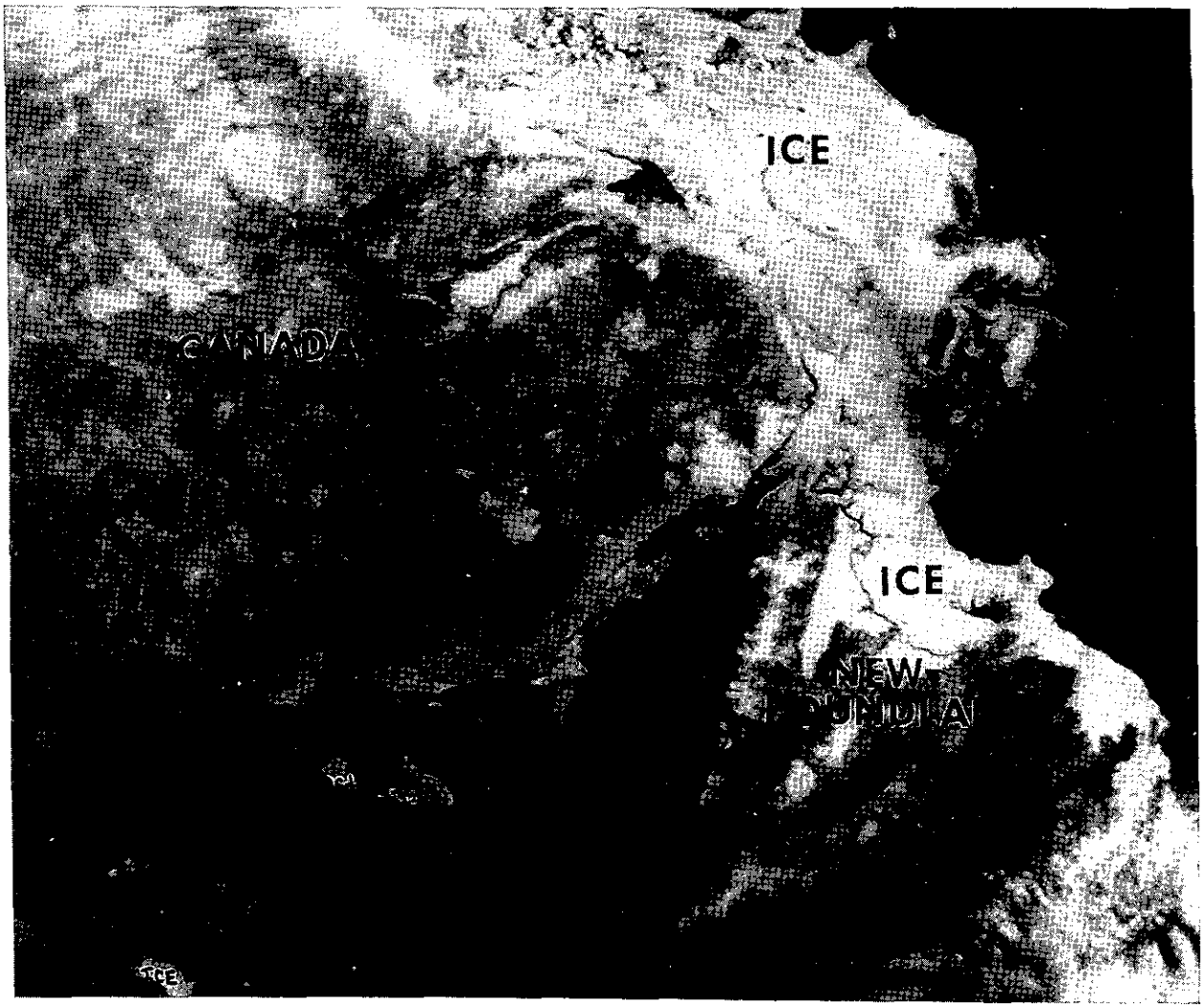
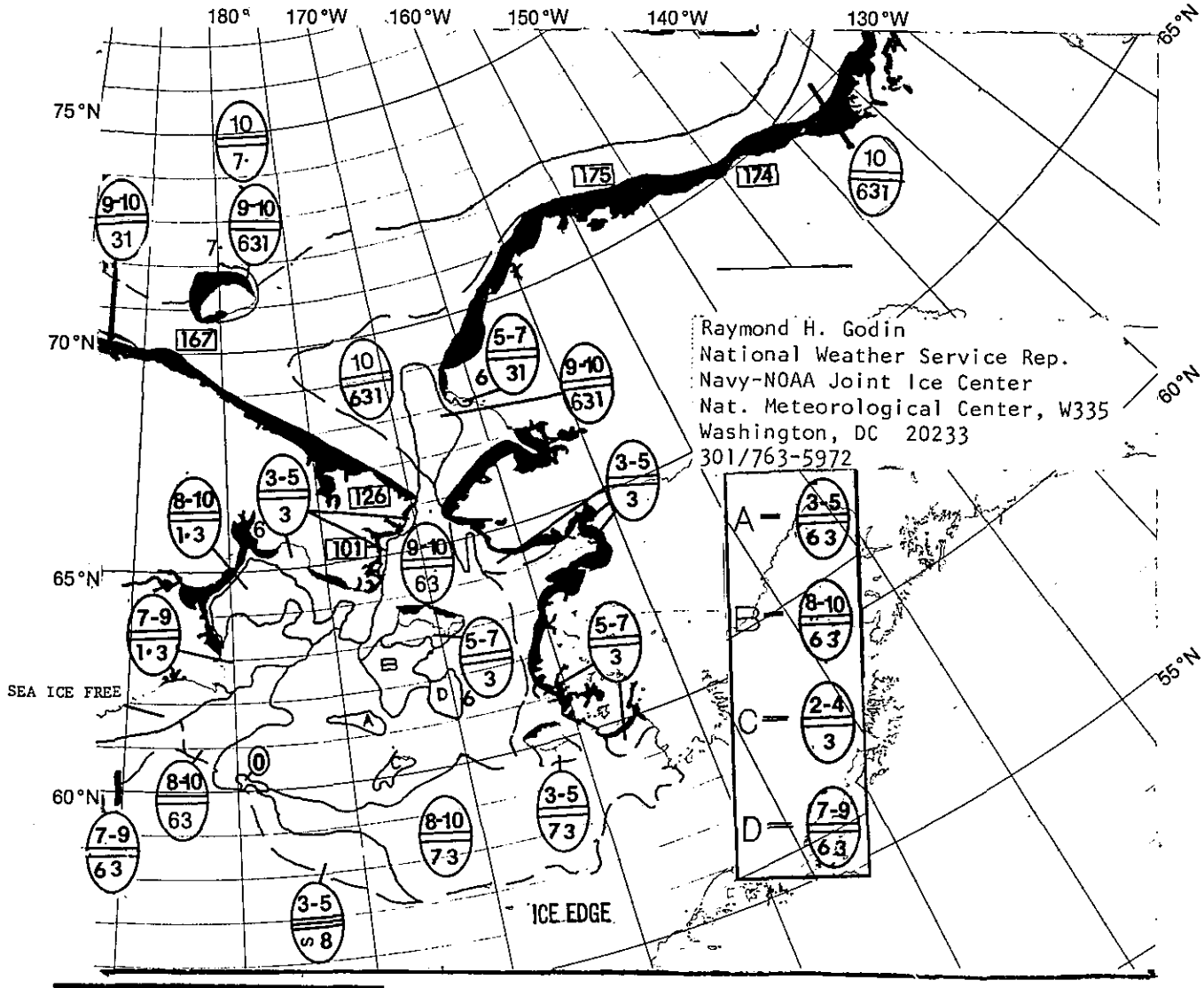
ICE IN THE LABRADOR SEA

This NOAA-8 visible satellite image from April 27, 1984, illustrates ice conditions along the Newfoundland coast and in the Gulf of St. Lawrence. Northeast Canada appears in the upper left portion of the image, part of Canada is in the lower left portion, and the Gulf of St. Lawrence is the dark area in between. The islands of Newfoundland and Anticosti are also identified. Most of the ice is concentrated in a narrow band along the Canadian coast, and around the northern coast of Newfoundland. This pattern conforms to the flow of the Labrador Current, which swings seaward east of Newfoundland to become the North Atlantic Current, or which flows southward as part of deep water circulation. Patches of ice are also found along portions of Canada and along the northeastern coast of Anticosti Island. Ice is easily identified in visible images. It appears as a very bright, almost white grey shade. Unlike clouds, ice will conform to the topography of coastlines, inlets, rivers and bays (i.e., along Newfoundland's northern coast). Note the fibrous structure to the east of the ice. This pattern may result from the influence of light alongshore and offshore winds which move ice away from the ice pack. Paths of individual floes are then easily influenced by the Labrador Current.



BERING SEA / NORTH SLOPE ICE ANALYSIS



C = Total ice concentration in the area in tenths.

C_a, C_b, C_c = Concentration of thickest (C_a), 2nd thickest (C_b), and 3rd thickest (C_c) ice

S_a, S_b, S_c = Stage of development of thickest (S_a), 2nd thickest (S_b), and 3rd thickest (S_c) ice.

~C = Concentration of ice within area(s) of strips and patches.

STAGE(S) OF DEVELOPMENT (THICKNESS)

1 = New ice (0-10 cm)
3 = Young ice (10-30 cm)
6 = First year (30-200 cm)
7 = First year thin (30-70 cm)
1. = First year medium (70-120 cm)
4. = First year thick (120-200 cm)
7. = Old ice (survived at least one summer's melt)

EXAMPLES

125 — Theoretical thickness of this season's growth (cm).

Fast ice. Sea ice which forms and remains fast along the coast.

Ice boundary visually or satellite observed.

Ice boundary estimated.

APRIL 1984

The monthly mean sea level pressure circulation depicts a 1006 mb low in the Gulf of Alaska near 55°N 147°W and a 1008 mb low near 50°N 172°W. Northeasterly mean surface geostrophic winds are prevalent throughout most of Alaska's ice covered waters. Monthly mean surface air temperatures are below normal at Barrow (71°N 157°W), Nome (65°N 165°W), and King Salmon (57°N 157°W). The most significant recession of the monthly ice edge was observed in Bristol Bay. There the ice edge receded from 100 to 300 km. Large areas of young ice are observed on the lee side of St. Lawrence Island and along the fast ice of the Seward Peninsula. The current ice edge position is near the climatological minimum in Bristol Bay, near median between 165°W and 175°W, and near maximum west of 175°W.

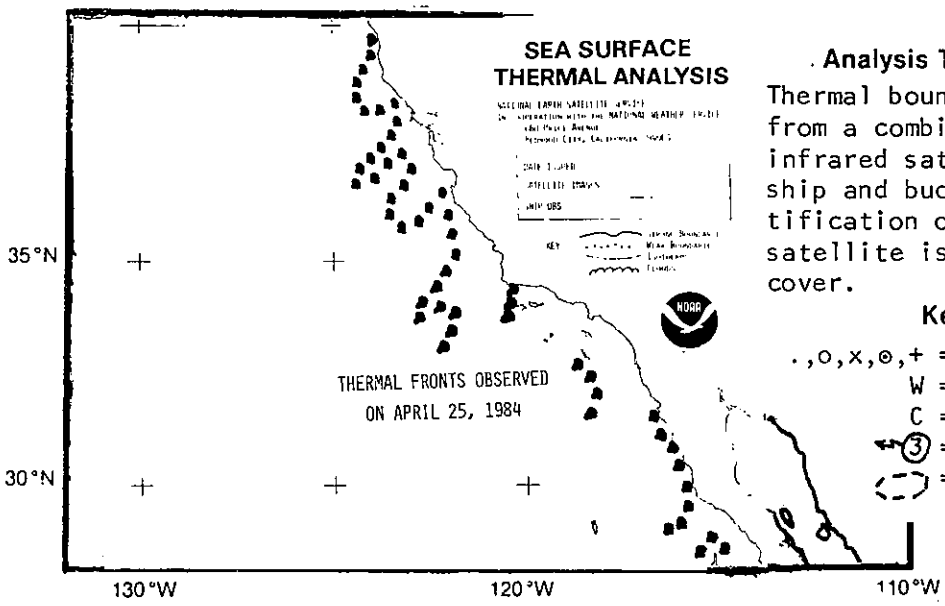
MONTHLY SST STATISTICS FOR SELECTED STATIONS

APRIL 1984

Station	Location Lat/Long	Mean SST	Standard Deviation	Maximum SST	Minimum SST	Change From Previous Month
Buoy 46005	46.1 N 131.0 W	9.3	0.3	9.9	8.4	-0.1
Buoy 46003	42.6 N 130.3 W	10.8	0.2	11.3	10.6	0
Buoy 46029	46.2 N 124.2 W	10.2	0.3	10.6	9.8	+0.4
*Buoy 46029 is temporarily replacing Buoy 46010.						
Grays Harbor	46.9 N 124.1 W	11.4	0.7	12.8	10.6	+0.9
Cape Disappointment	46.3 N 124.1 W	10.4	0.9	12.2	8.9	-0.9
Yaquina Bay	44.6 N 124.1 W	10.9	0.6	12.2	10.0	—
Chetco River	42.0 N 124.3 W	10.9	0.4	11.7	10.0	+0.1

April 1984

Oceanographic conditions off the Pacific Northwest were virtually identical to those of March. SSTs remained above normal over the entire area, with positive anomalies of about 0.5-1.0°C. Prevailing winds, again more southerly than normal over the entire area, are likely a causitive factor in the consistent warm anomaly. A period of moderate to strong coastal upwelling occurred during April 23-26 on the southern Oregon and northern California coasts, and was evident on a number of satellite images. There was no other evidence of the onset of spring transition. SSTs recorded at individual buoys and coastal stations showed fluctuations of 1-2°C, but with no consistent trends or spatial correlations. SST gradients remained quite weak over the area, as strong winds from several low pressure systems actively mixed the surface waters.



Analysis Techniques

Thermal boundaries are determined from a combination of enhanced infrared satellite imagery and ship and buoy observations. Identification of these features by satellite is limited by cloud cover.

Key

.,o,x,⊙,+ = thermal boundaries
W = warm
C = cold
③ = date of feature
= outline of water mass feature

April SSTs were above normal over most of the South Panel when compared to climatology except for in the extreme northwest corner of the analysis and adjacent to the coast from Pt. Reyes to Pt. Conception. These cool anomalies were 0.1°-0.3°C. SSTs were warmer than climatology in two distinct areas near the San Diego coast (1.5°C) and along 125°W from 35°N to the southern boundary of the analysis. When compared to March's monthly mean SSTs, April's mean SSTs declined 1°C or more over half of the South Panel, particularly along the coast from Pt. Conception to Pt. Piedras Blancas. This decline in SSTs was due to continuous upwelling throughout the month. In fact, gale force northwesterly winds from April 23-28 produced an intense upwelling event that caused SSTs to drop below 8°C. These were the coldest temperatures observed along the California coast since May 1981. The area west of 127°W and north of 34°N is slightly warmer (0.1°-0.5°C) than the previous month.

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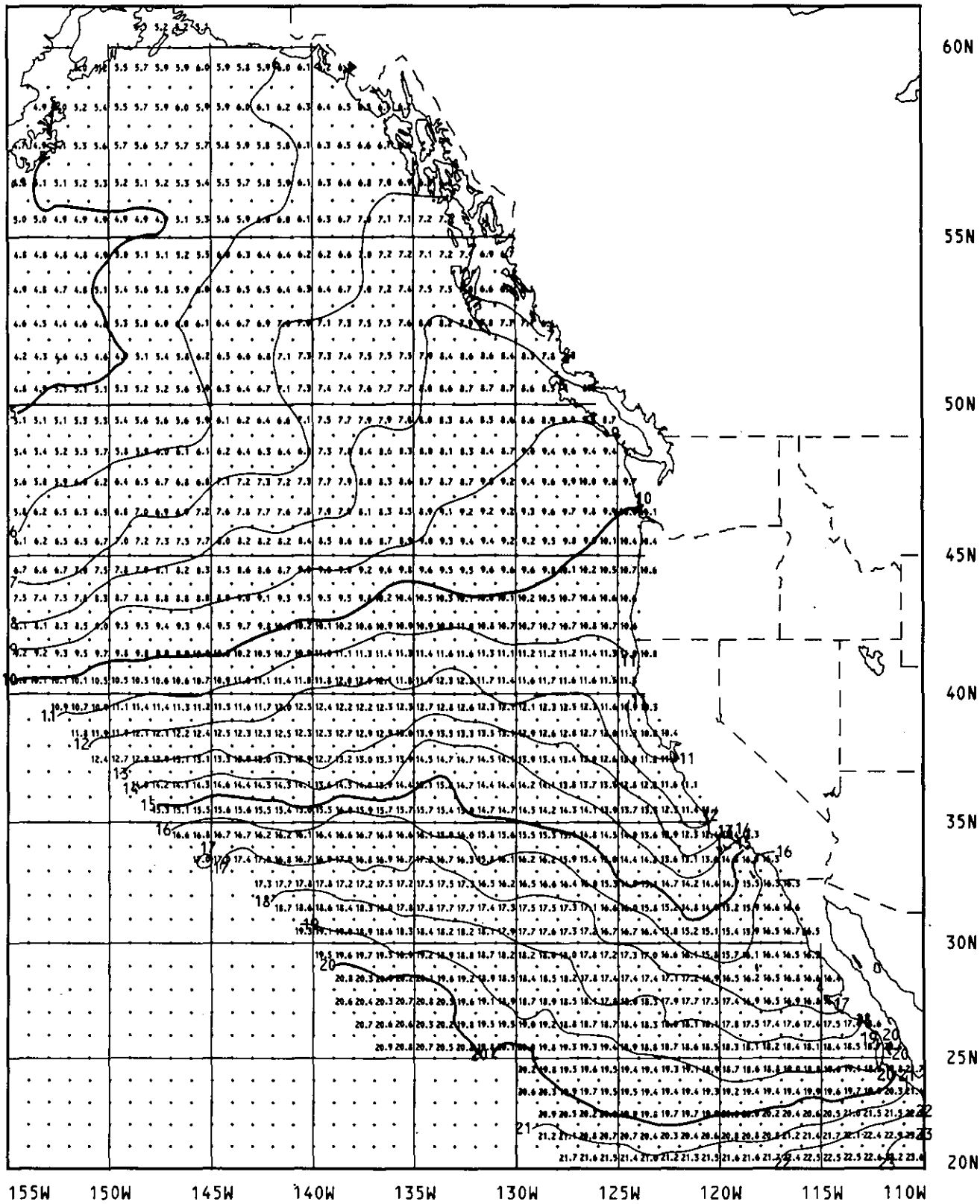

West Coast
SST--MONTHLY MEAN (°C)
April 1984

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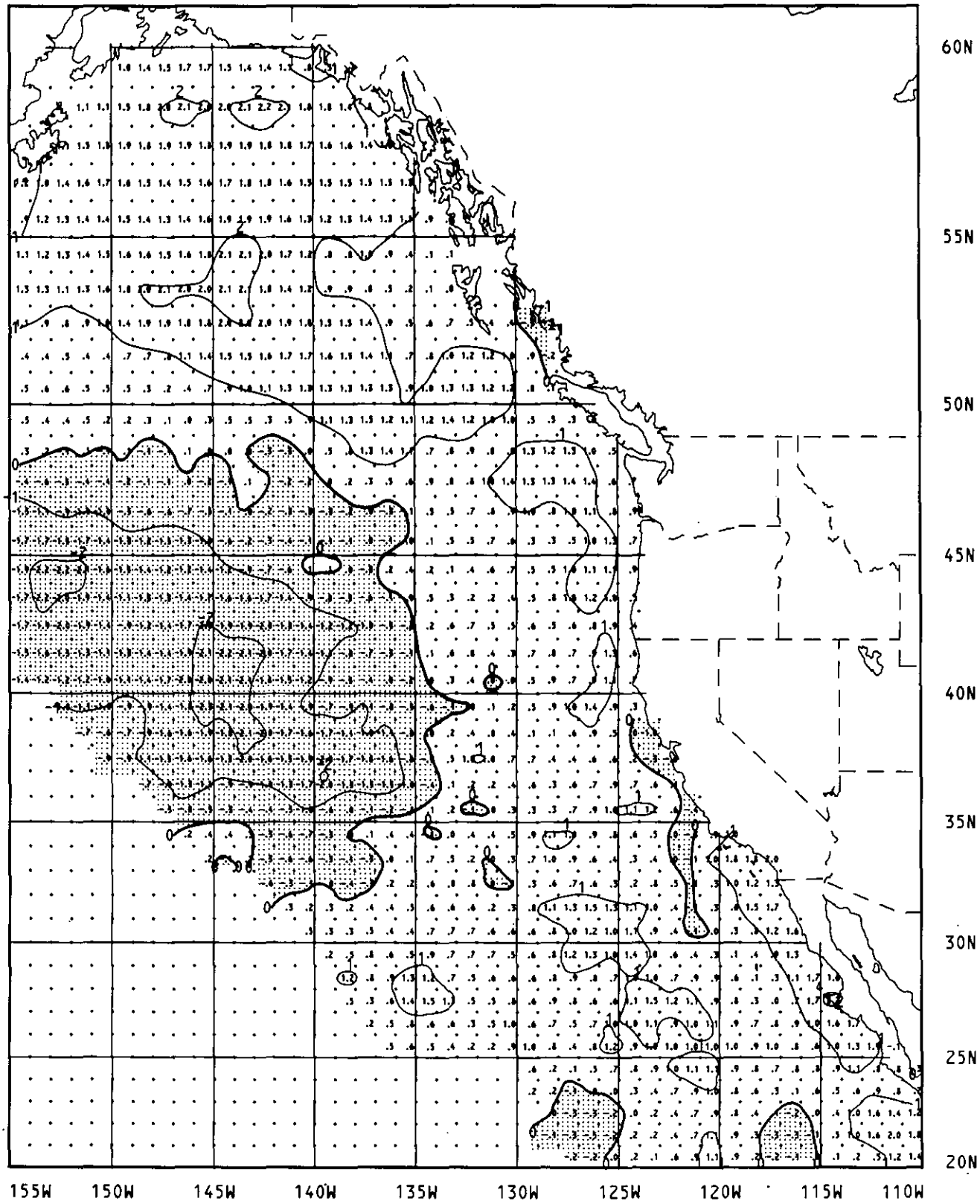

West Coast
SST--MONTHLY ANOMALY (°C)
April 1984

Monthly anomaly is the difference between the monthly mean sea surface temperature and the climatological monthly mean value -- shading shows where the monthly mean is colder than climatology. Contour line interval is 1.0°C.

The end of this month's positions of the Gulf Stream System and its associated eddies are shown for the NW Atlantic and the Gulf of Mexico. The Gulf Stream and Loop Current boundaries are located by infrared satellite imagery or XBT (expendable bathythermograph) data. Anticyclonic eddies are labeled a-z in the Gulf of Mexico and 1-99 in the NW Atlantic. Cyclonic eddies are labeled A-Z. Arrows on eddies indicate direction of circulation. Warm-core or anticyclonic eddies rotate clockwise; cold-core or cyclonic eddies rotate counterclockwise. The line to the eddy center shows the net translation since last month or since last observed. Eddies or sections of the Gulf

EAST COAST OCEAN FEATURES

Stream System which were not observed during the month are not shown on the analysis chart. The long arrows at the bottom of the chart indicate the date of data used.

Data used in this analysis include:
- NOAA satellite infrared imagery, NESDIS
- Bathythermograph data, National Meteorological Center of National Weather Service
- Oceanographic Analysis, A daily detailed analysis issued by National Weather Service/NESDIS

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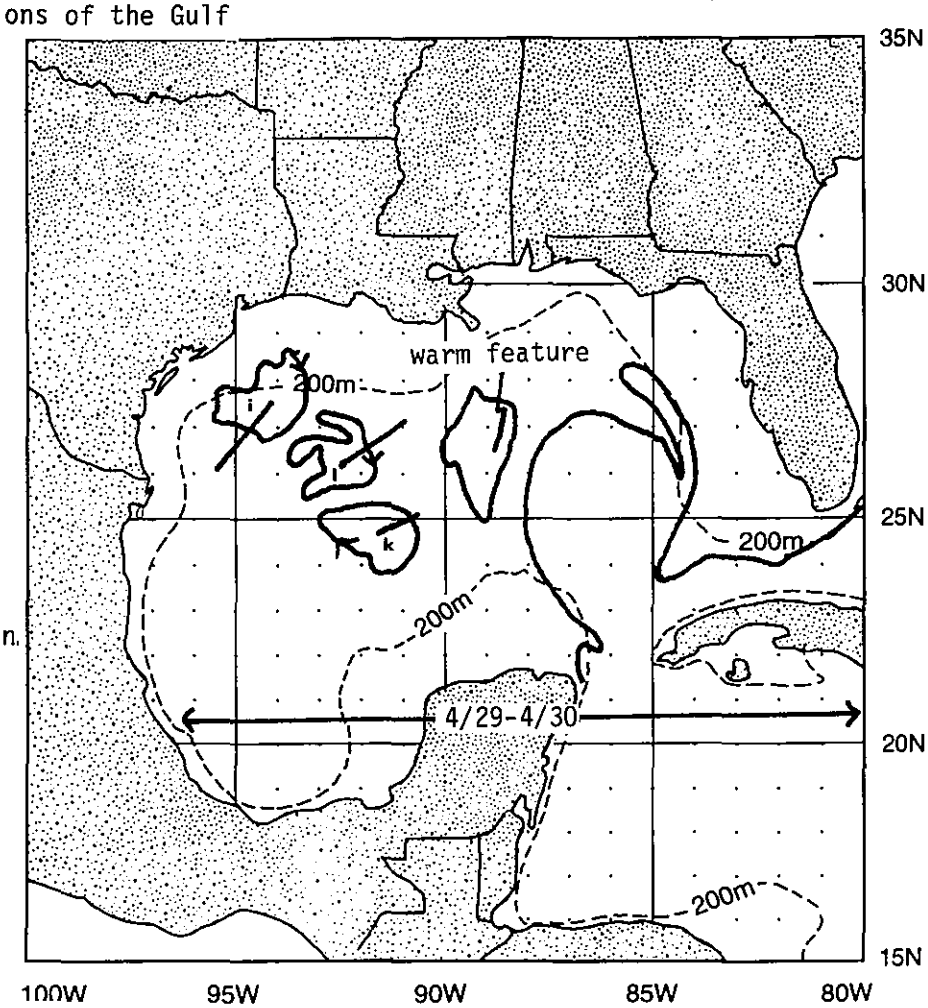
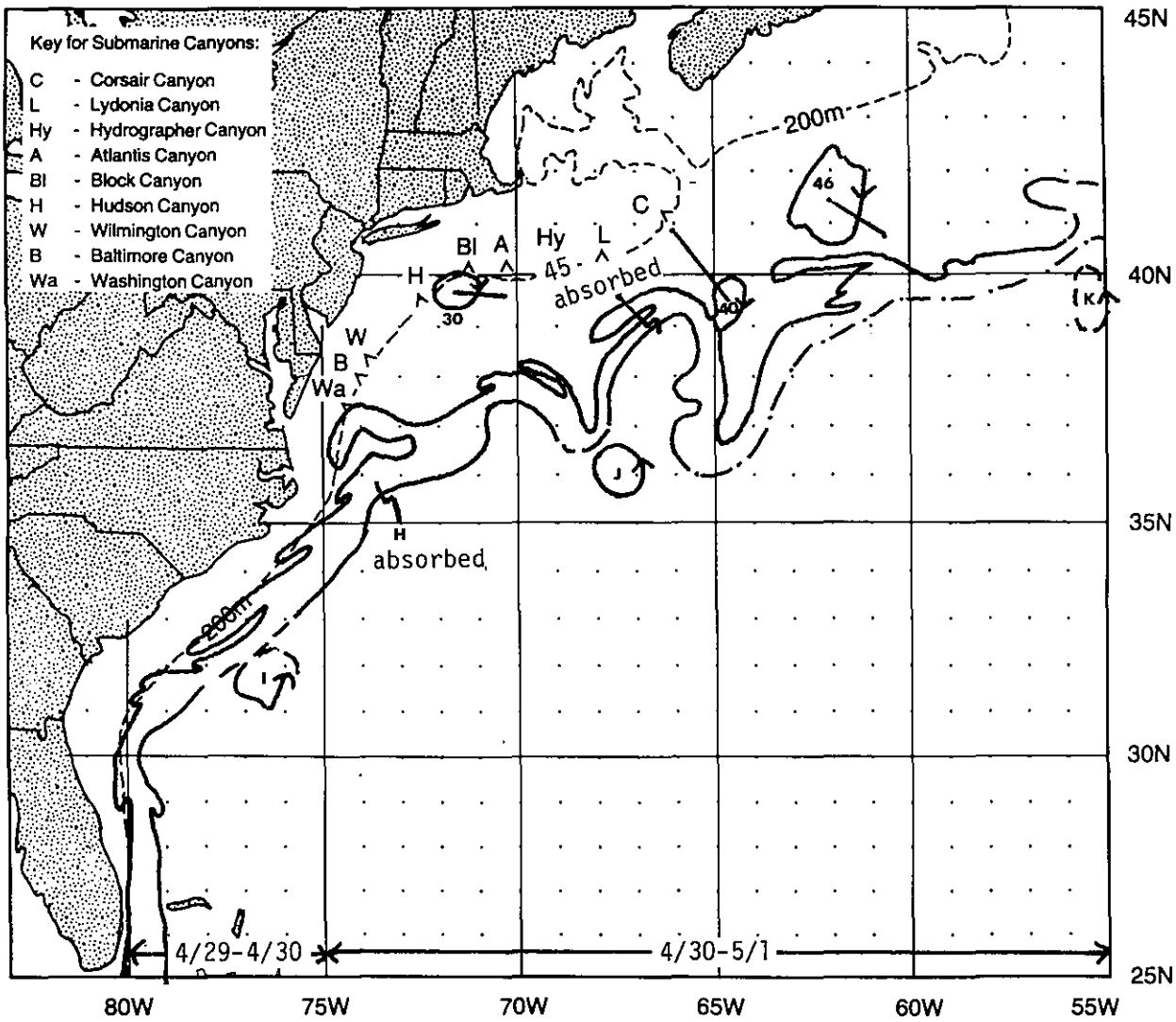


APRIL 1984

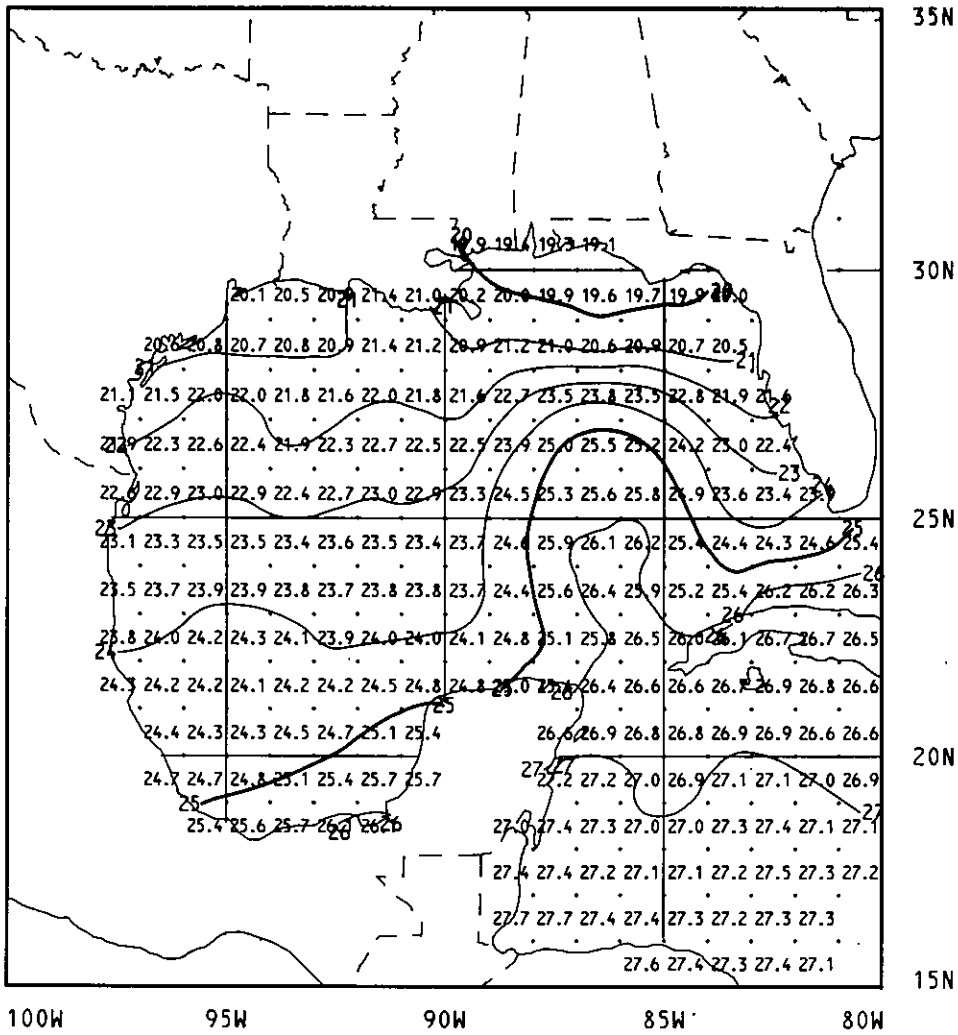
The amplitude of the Loop Current increased 35 km N during April compared to the end-of-March position. The elongated tongue of warm mixed Loop Current/slope water persisted near 25°N 84°30W to 28°N 85°30W since March 22. The warm eddylike feature that pinched off from the Loop Current near 26°N 83°30W on March 28 is still discernible near 26°30N 84°30W. Anticyclonic eddy i translated 185 km NE. Eddy k traveled 90 km WSW. Eddy l was newly observed on April 10 near 27°N 91°W and has since translated 125 km SW. Its origin is not known.



Prominent Gulf Stream North Wall features are the large amplitude meanders near 39°30N 66°W and 36°30N 65°W. Two anticyclonic eddies formed during April. Eddy 44 formed from a Gulf Stream meander near 39°30N 65°W around April 3 and apparently merged with eddy 43. This new combination of eddies 43 and 44 is called eddy 45. Eddy 45, centered at 39°30N 65°30W, apparently traveled 150 km SW by April 16 and was absorbed by the Gulf Stream near 39°N 67°W on April 20. Eddy 46 was first suspected on March 23. Its origin is not known. It was clearly detected on April 7 near 40°30N 60°30W and then moved 130 km NW by the end of April. After translating 110 km W, eddy 30 appears to be weakening. Eddy 40 apparently moved 185 km SE. Eddies 39 and 42 were not observed.

Two cyclonic eddies were newly observed and one cyclonic eddy was absorbed during April. Eddy J formed from a Gulf Stream meander near 36°N 68°W about April 19. Eddy K was newly observed on April 19. Its origin is not known. Eddy H traveled 175 km NNW and was absorbed by the Gulf Stream near 36°N 73°30W on April 28. The resultant translation of Eddy I was not significant. Eddy F was not observed.

EAST COAST SST-
MONTHLY MEAN



Gulf of Mexico
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April 1984

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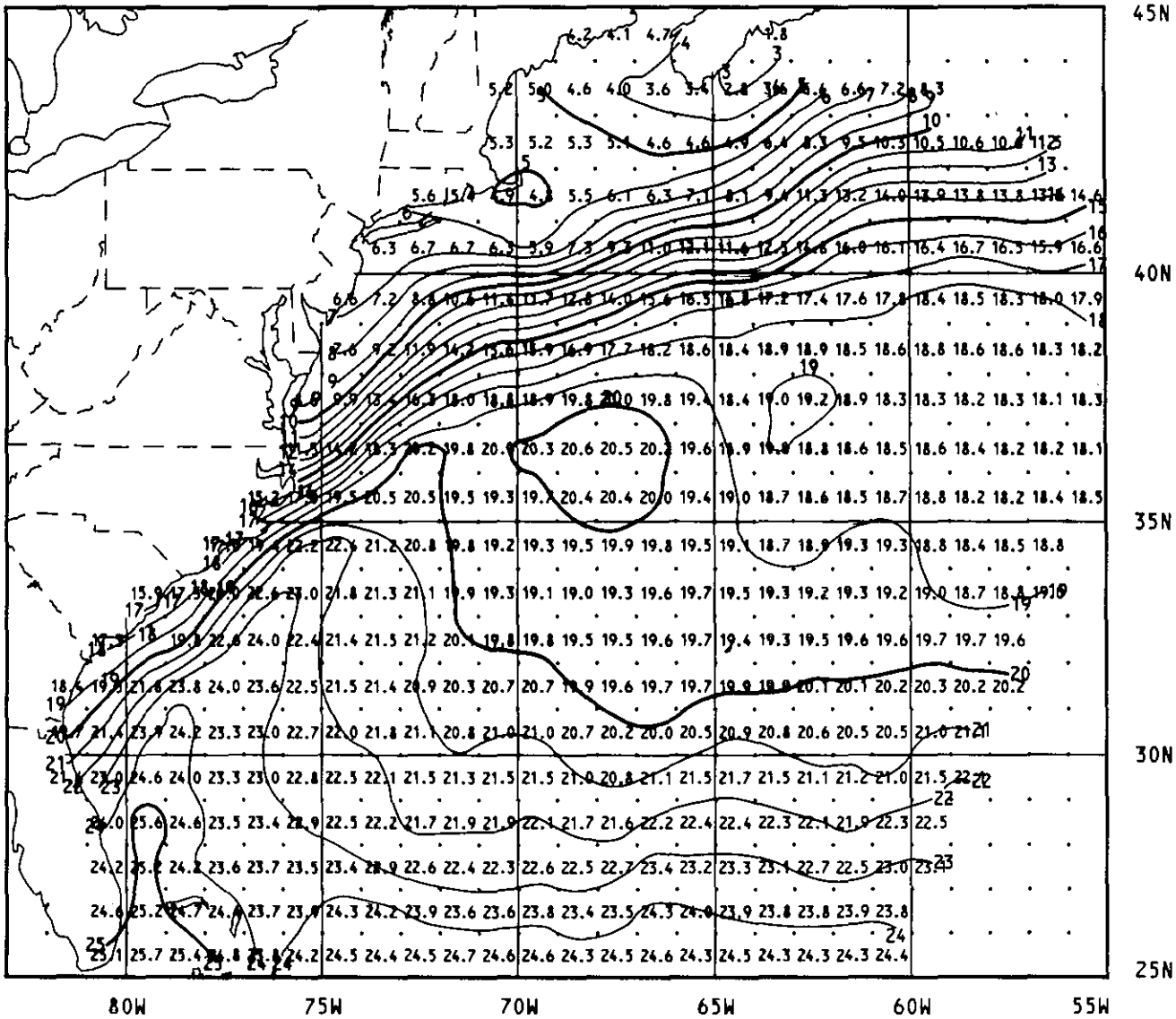

NW Atlantic Ocean
SST--MONTHLY MEAN (°C)
April 1984

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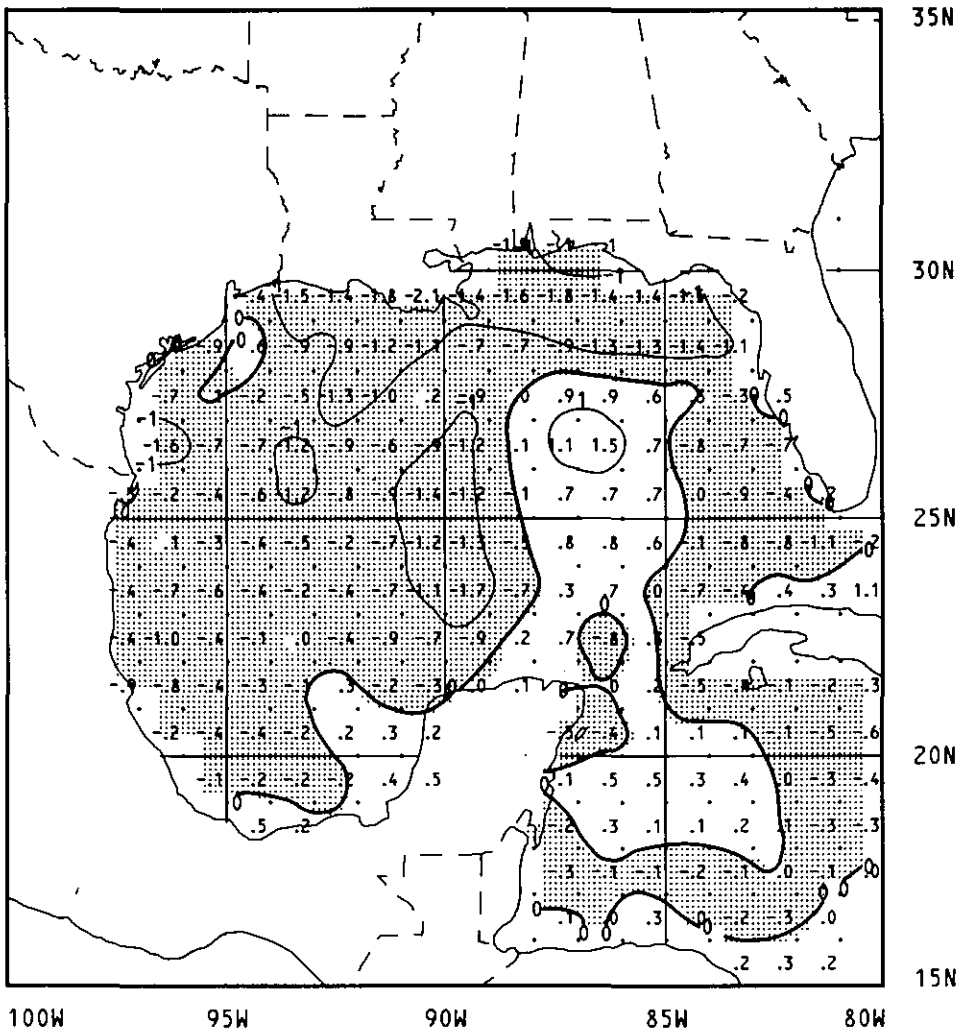
EAST COAST SST-ANOMALY



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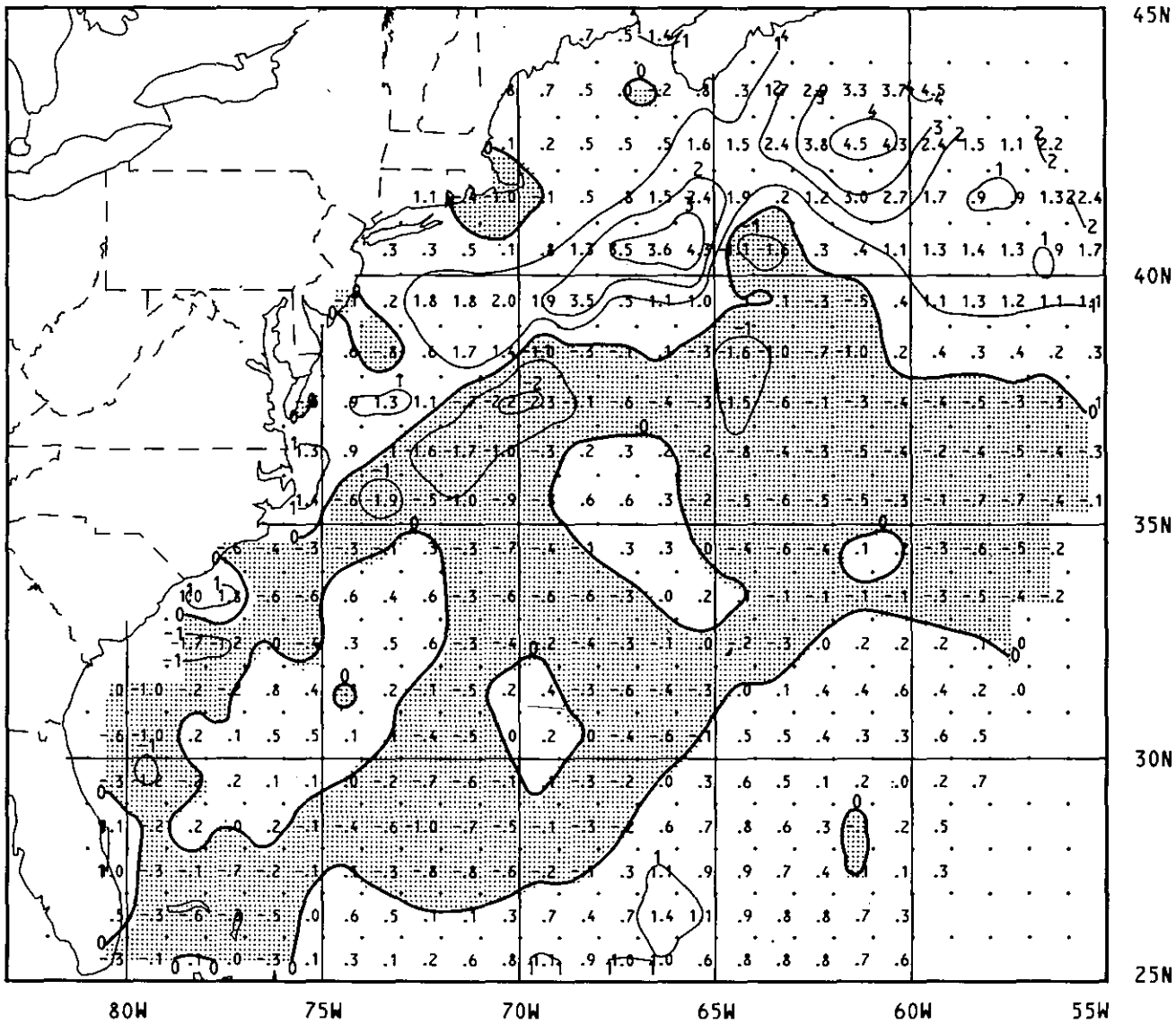

NW Atlantic Ocean
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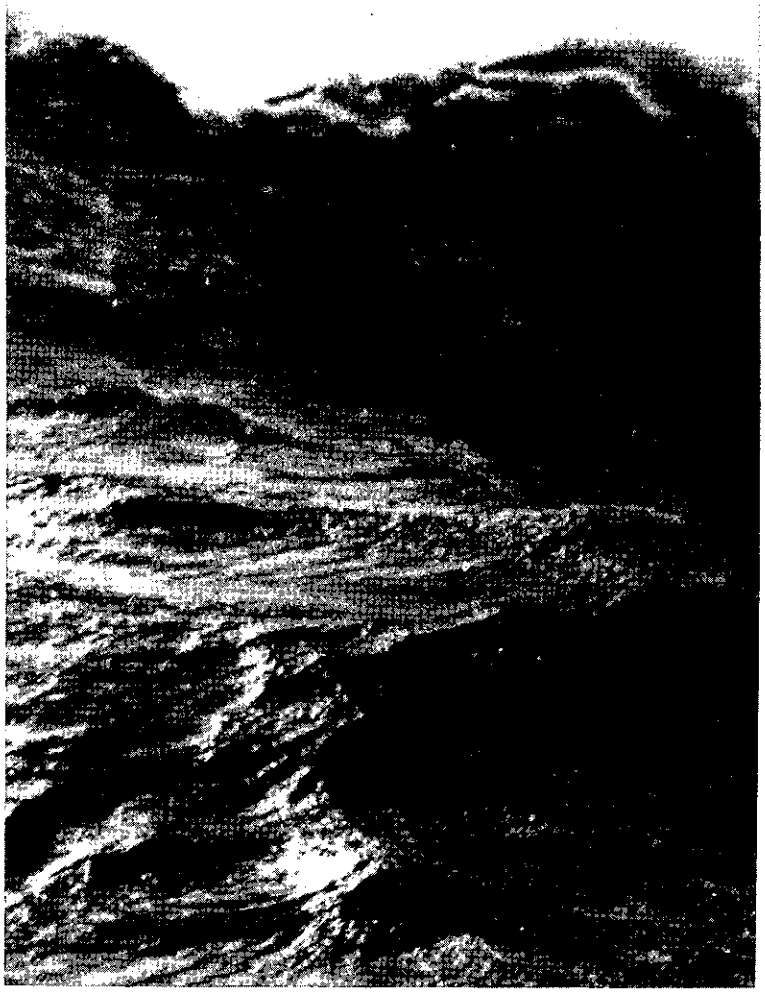
OCEANOGRAPHIC Monthly Summary

Volume IV Number 5 May 1984



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Oceanographic Monthly Summary is published by the National Weather Service and the National Environmental Satellite, Data, and Information Service (NESDIS). *Oceanographic Monthly Summary* contains sea surface temperature (SST) analyses on both regional and ocean basin scales for the Atlantic and Pacific Oceans. Two ocean basin SST analyses are presented, one based on in-situ data and another based solely on satellite data. An ocean basin SST anomaly derived from the in-situ data is also shown; it uses the National Climatic Center (NCC) Climatology*. The regional SST analyses are based upon a combination of in-situ and satellite data measurements. The regional SST anomalies use the Robinson-Bauer Climatology*. *Oceanographic Monthly Summary* also contains Alaskan sea ice information and ocean feature information for contiguous U.S. ocean regions.

Oceanographic Monthly Summary welcomes articles containing information of interest to *Oceanographic Monthly Summary* readers, such as, news on operational oceanography, unusual ocean feature phenomena, etc. Contributions should be sent to the editor (address below). Accepted material will appear in the OceaNotes section of *Oceanographic Monthly Summary*. Contributions can be published as quickly as the next monthly issue.

If you are interested in receiving *Oceanographic Monthly Summary* regularly, please refer to the back cover for subscription information.

*Reynolds, R.W., 1982. A Monthly Averaged Climatology of Sea Surface Temperatures; *NOAA Technical Report NWS 31.*

*Robinson, M.K., 1976. Atlas of North Pacific Ocean Monthly Mean Temperatures and Mean Salinities of the Surface Layer; *NavOceano Ref. Pub. 2.*

Robinson, M.K., R. A. Bauer and E.H. Schroeder, 1979. Atlas of North Atlantic-Indian Ocean Monthly Mean Temperatures and Mean Salinities of the Surface Layer; *NavOceano Ref. Pub. 18.*

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NEW AUTOMATIC TELECOPIER NUMBER AND CHART

Beginning June 4, 1984, the automatic telecopier number (301) 763-8040 (Commercial) or (301) 763-8040 (FTS) changed to (301) 899-1139 (Commercial) or (202) 899-1139 (FTS).

Figure 1 is an example of the expanded NW Atlantic Chart which covers the entire area from 60°-76°W. The expanded NW Atlantic Chart will continue to be telecopied on Monday, Tuesday, and Thursday 1-4p.m. local time at (301) 899-1139 or (202) 899-1139. However, two enlarged expanded NW Atlantic charts are now available.

Figure 2 is an example of the enlarged expanded NW Atlantic Chart telecopied on Monday, Wednesday, and Friday 4p.m.-8a.m. local time at (301) 899-1139 or (202) 899-1139.

Figure 3 is an example of the enlarged expanded NW Atlantic Chart telecopied on Tuesday and Thursday 4p.m.-8:30a.m. local time at (301) 899-1139 or (202) 899-1139.

Figure 1.

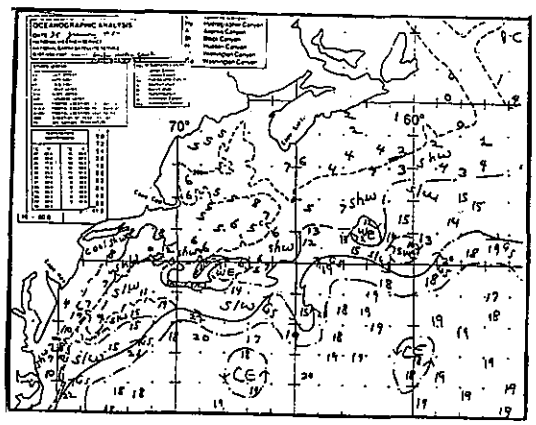


Figure 2.

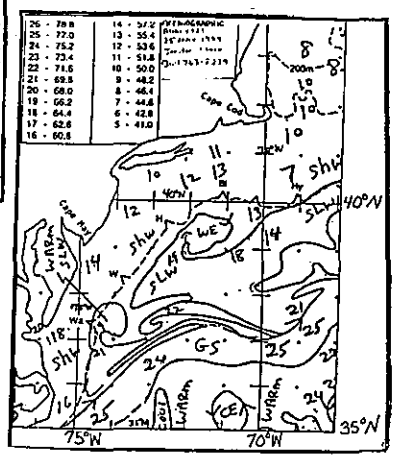
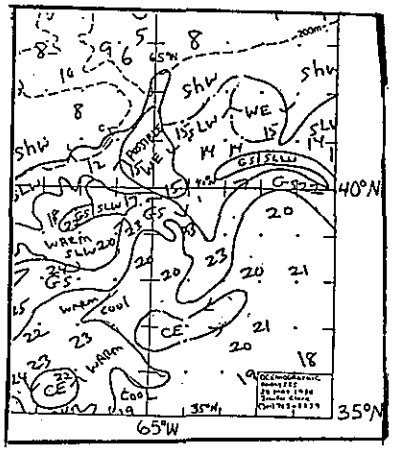
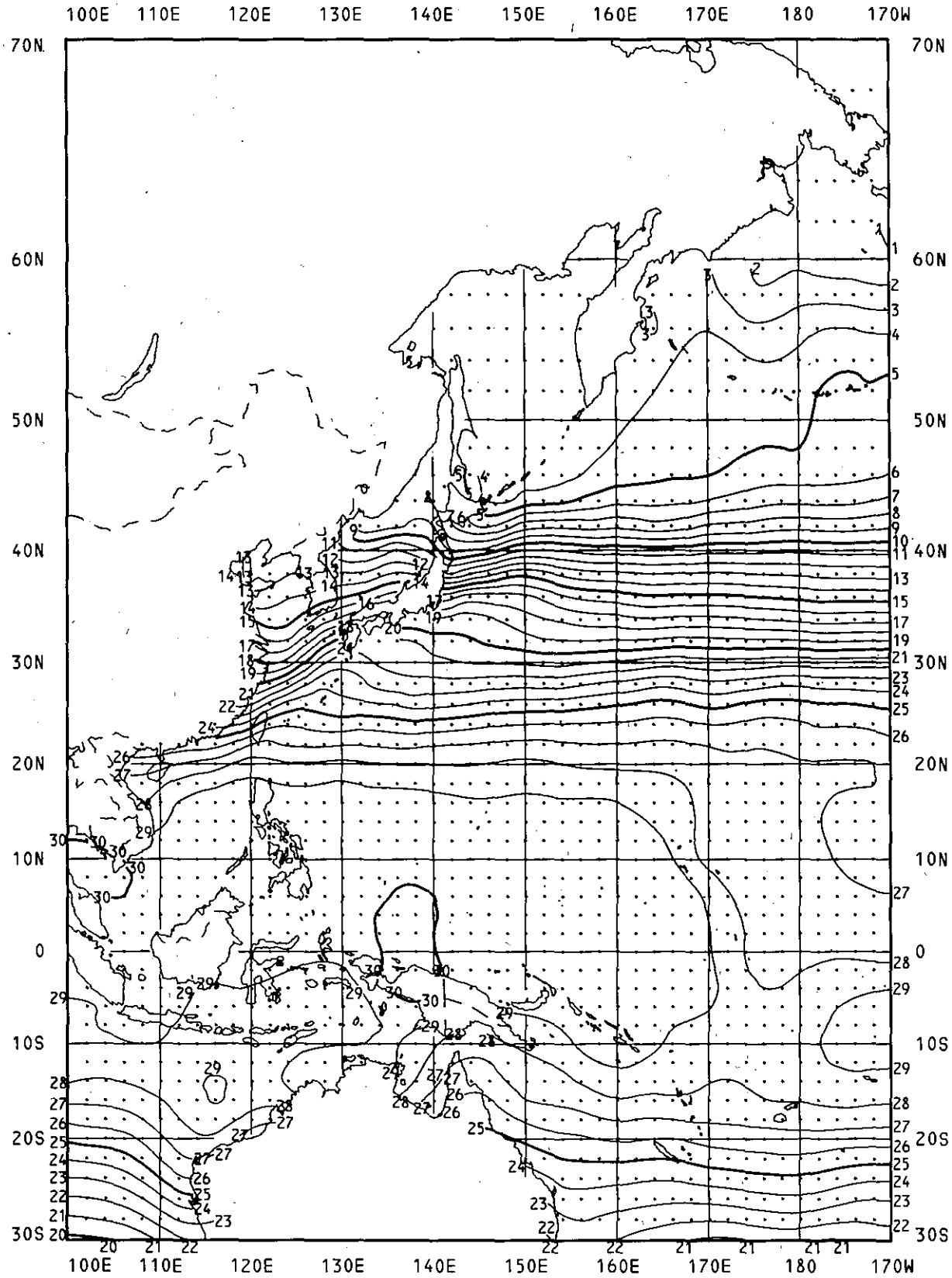


Figure 3.





Western Pacific Ocean
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SHIP and BUOY DATA
May 1984

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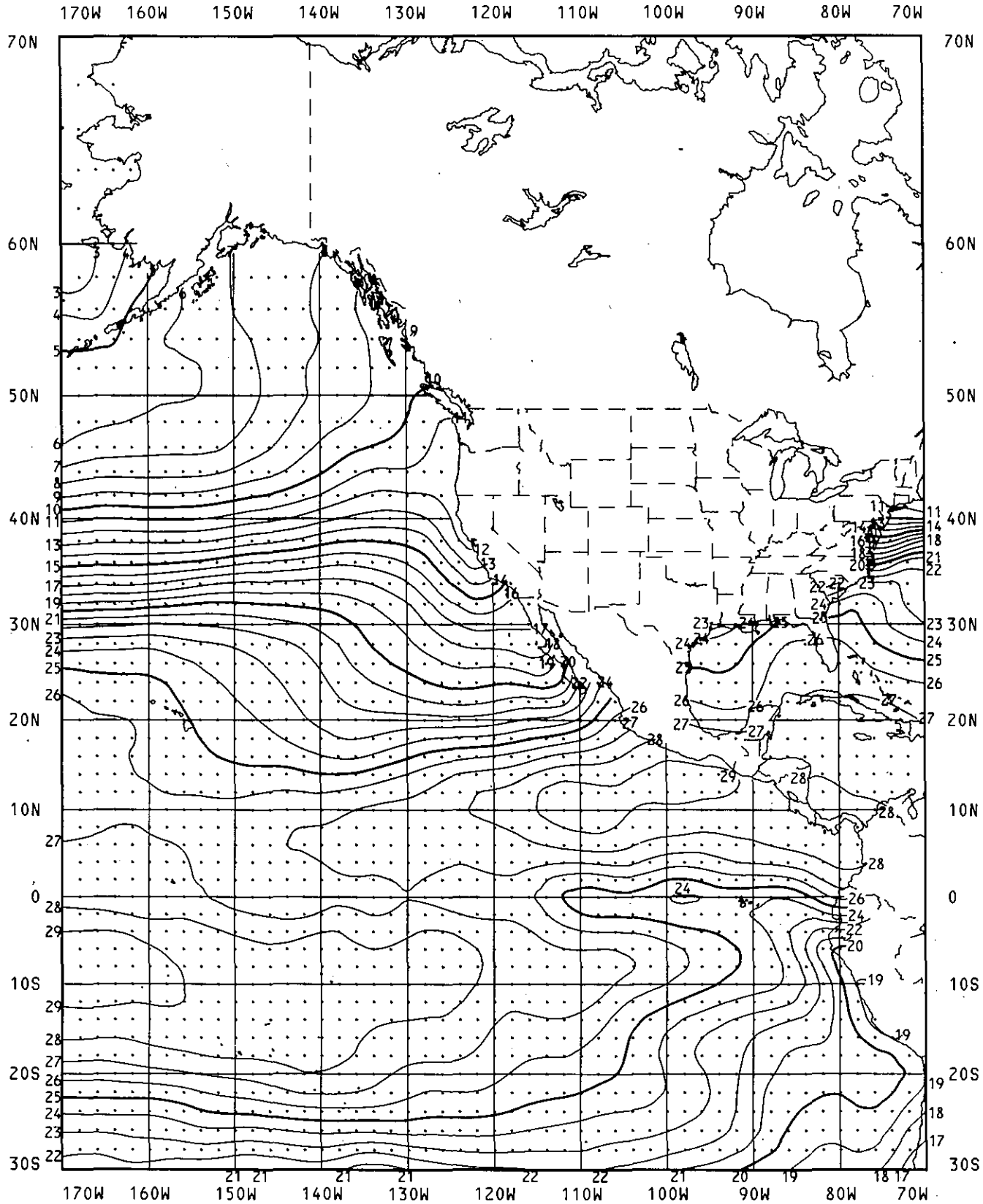

Eastern Pacific Ocean
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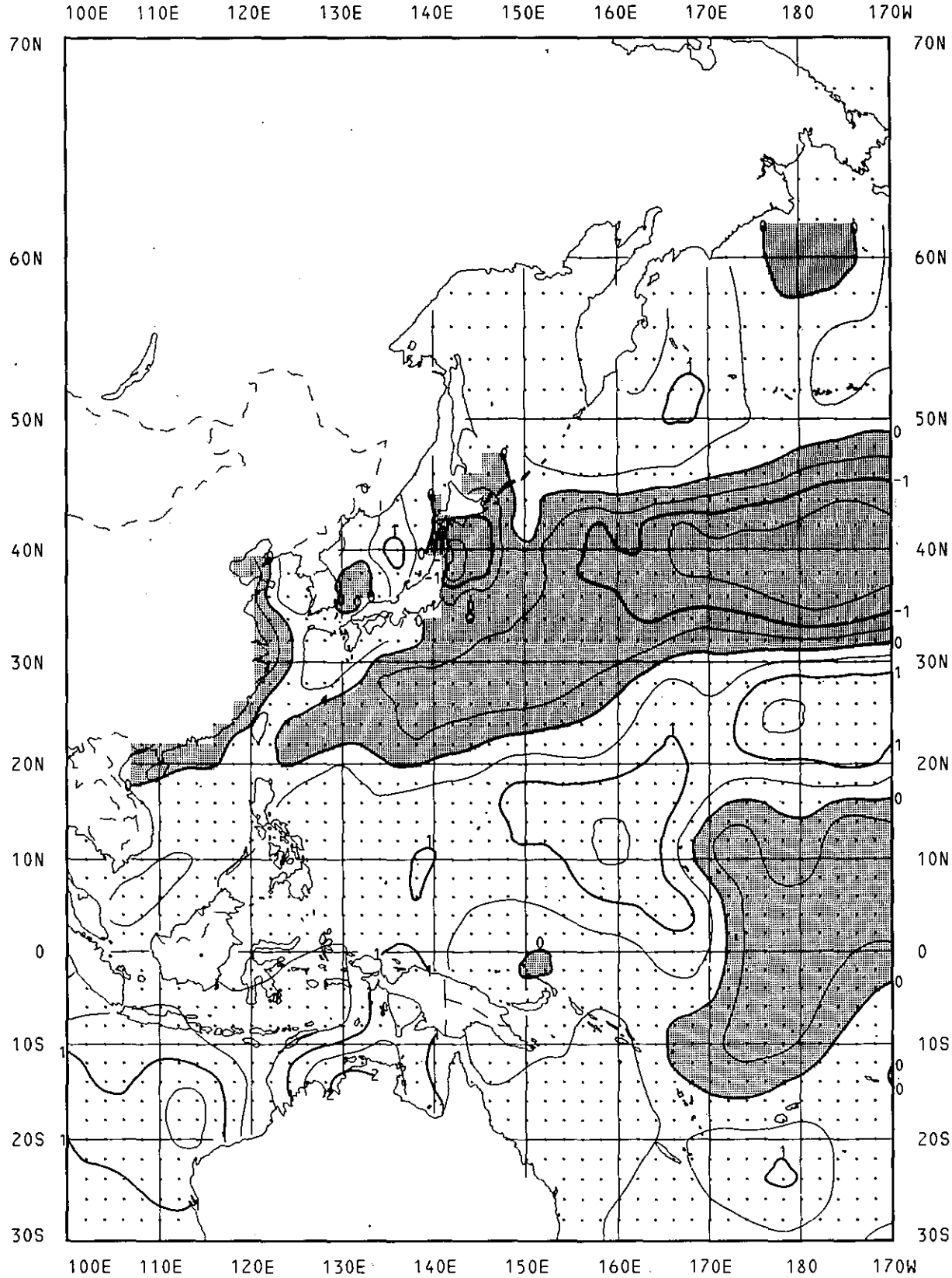

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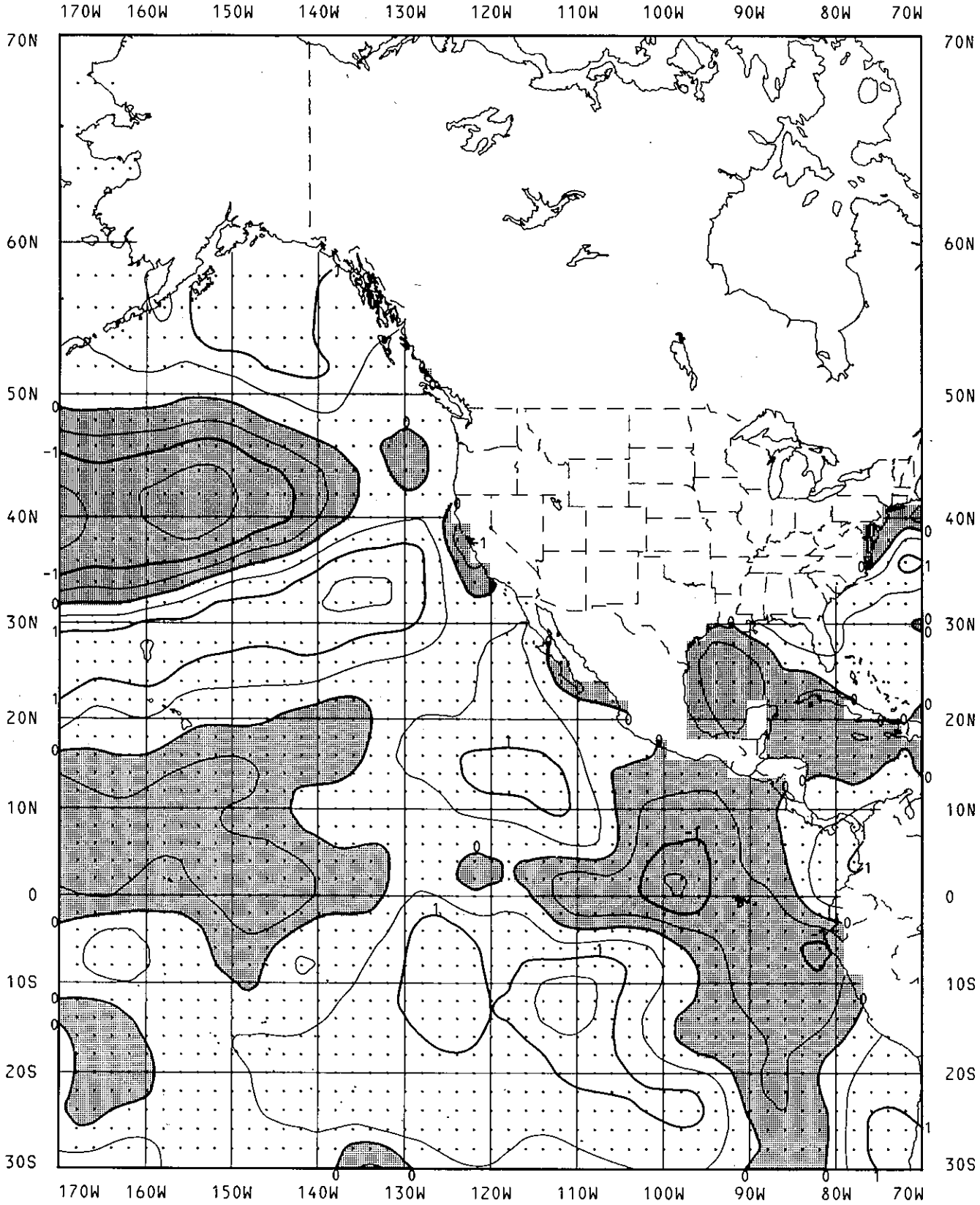

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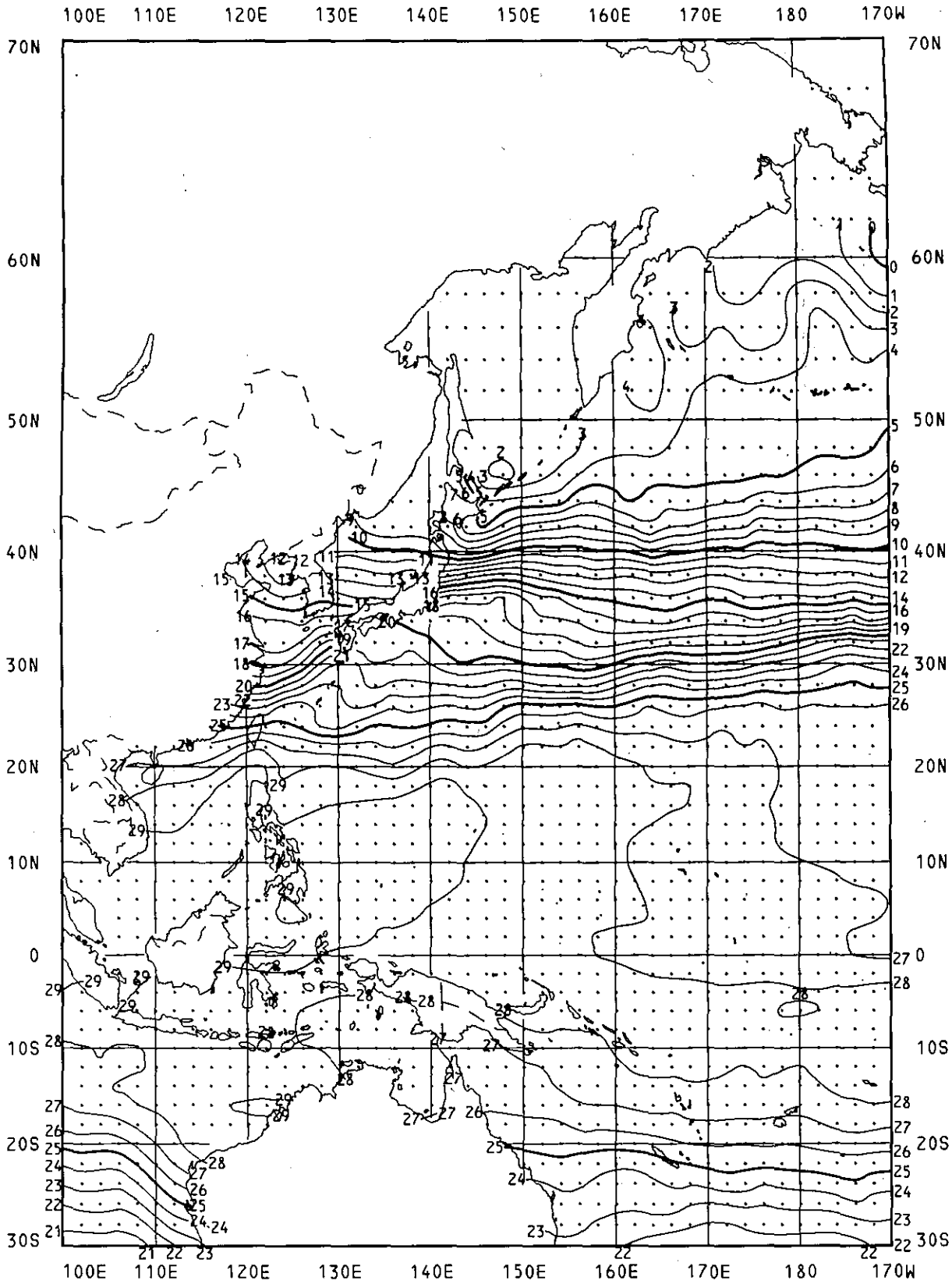

Western Pacific Ocean
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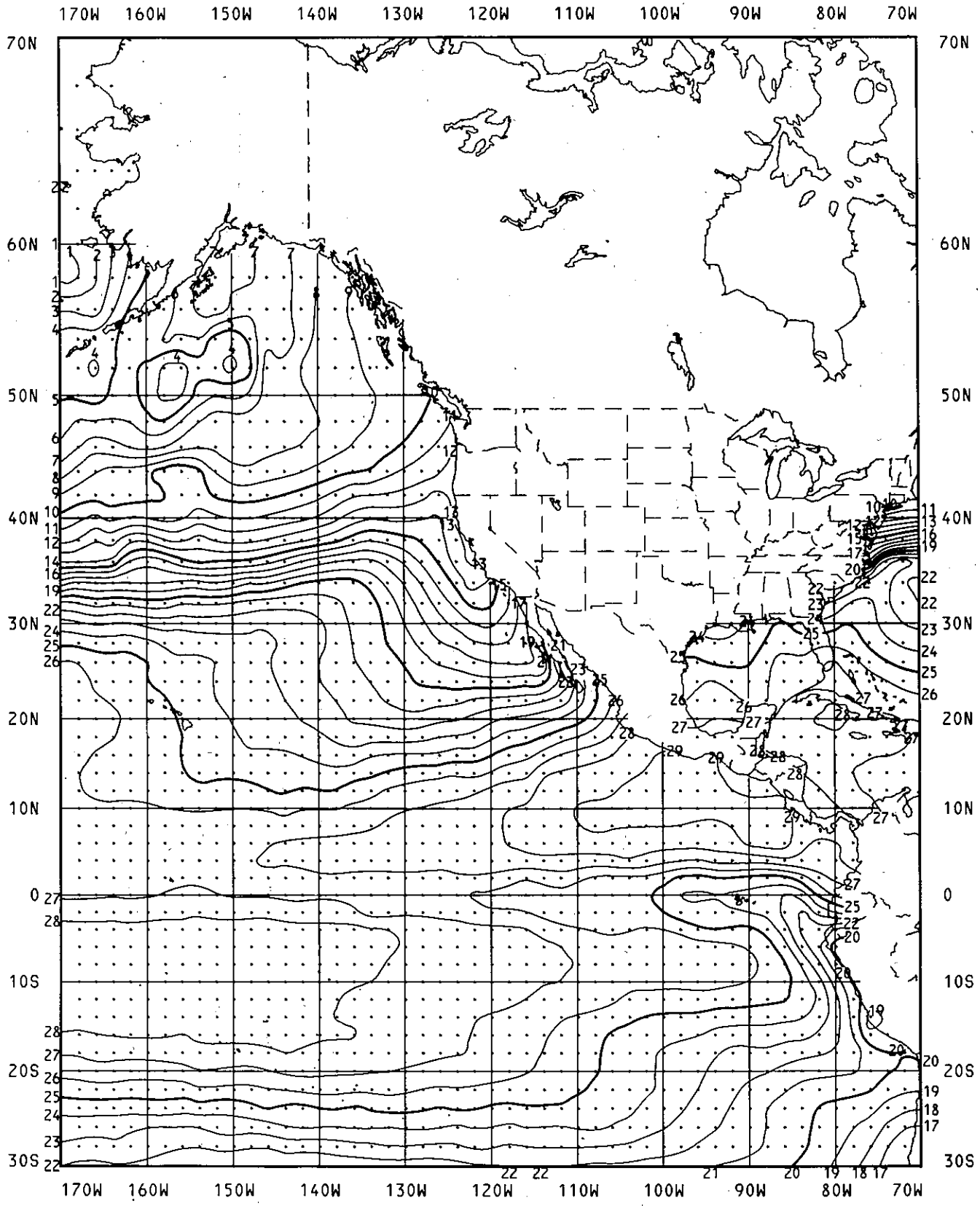

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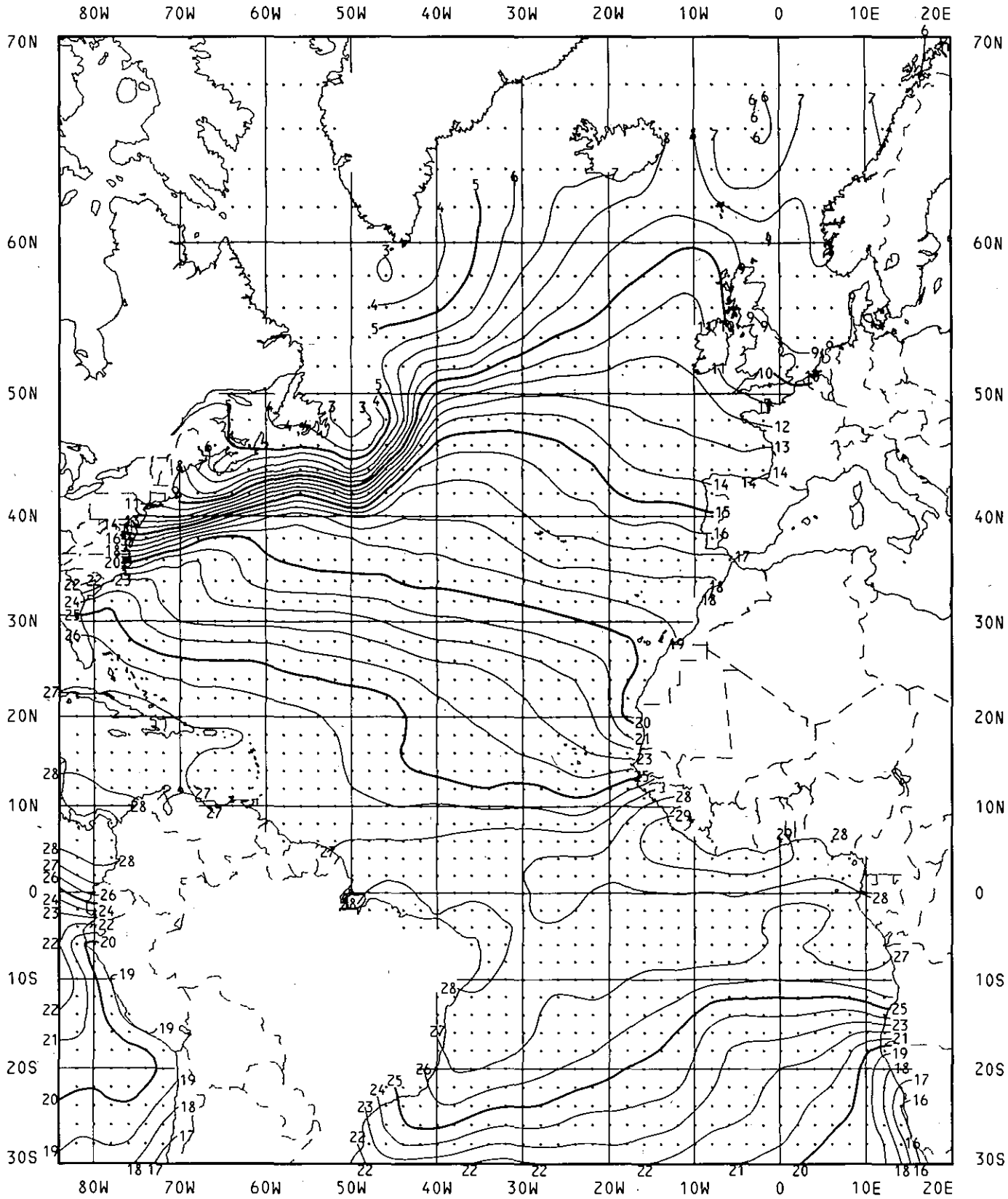

Atlantic Ocean
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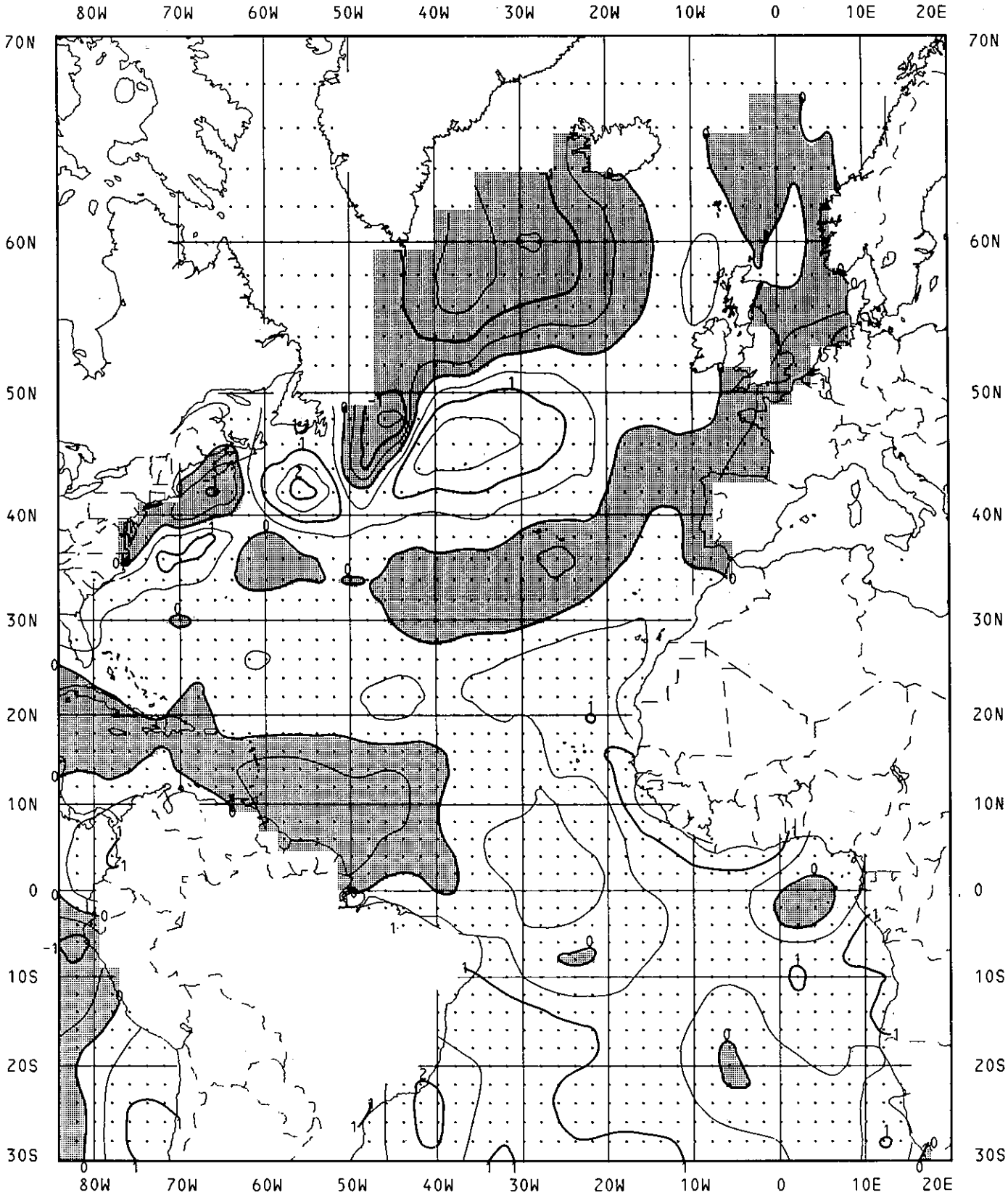

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May 1984

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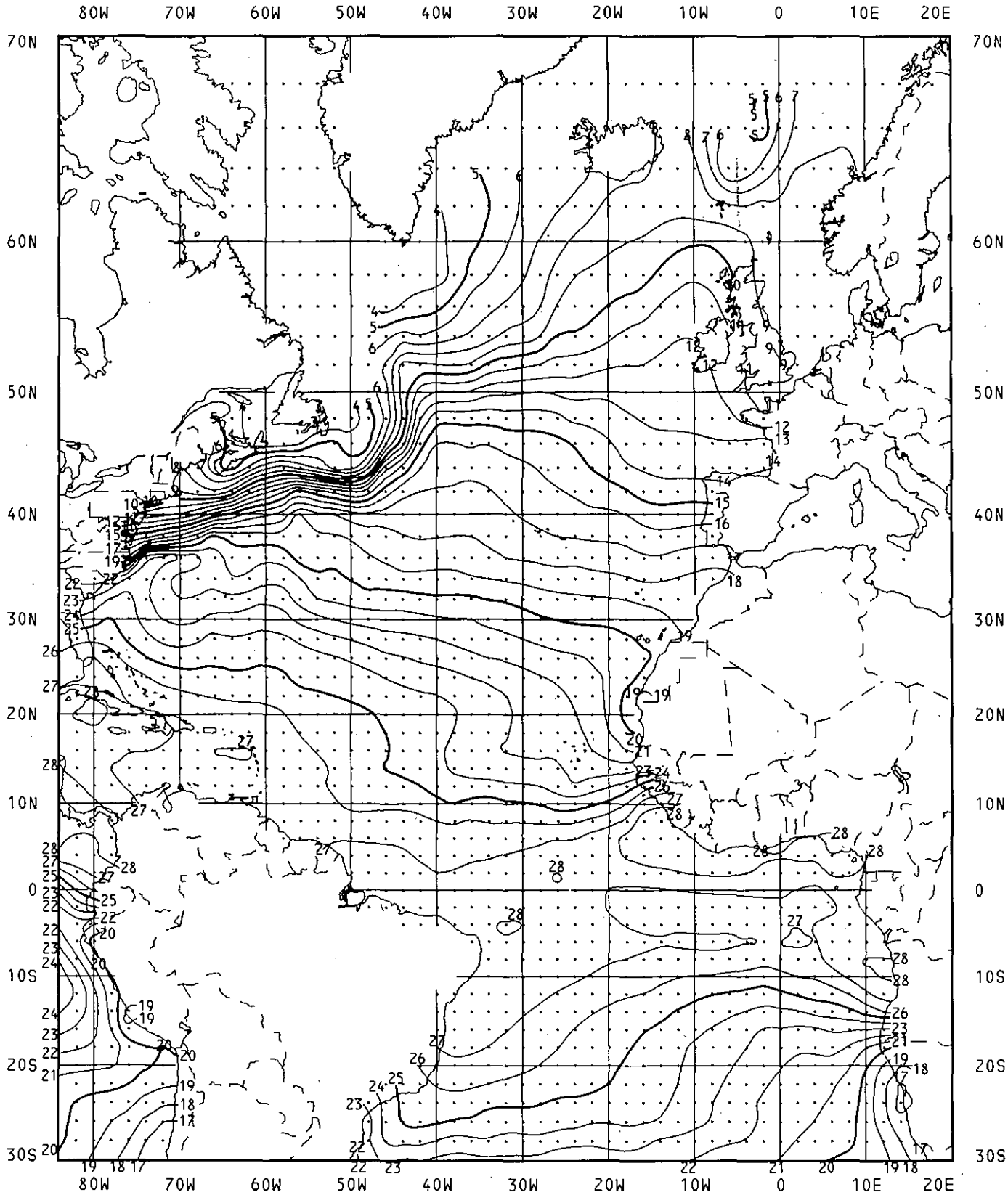

Atlantic Ocean
SST--MONTHLY MEAN (°C)
SATELLITE DATA
May 1984

Monthly mean sea surface temperature is the mean of satellite data within two-degree quadrangles. Contour line interval is 1.0°C.

SATELLITE IMAGE OF THE MONTH

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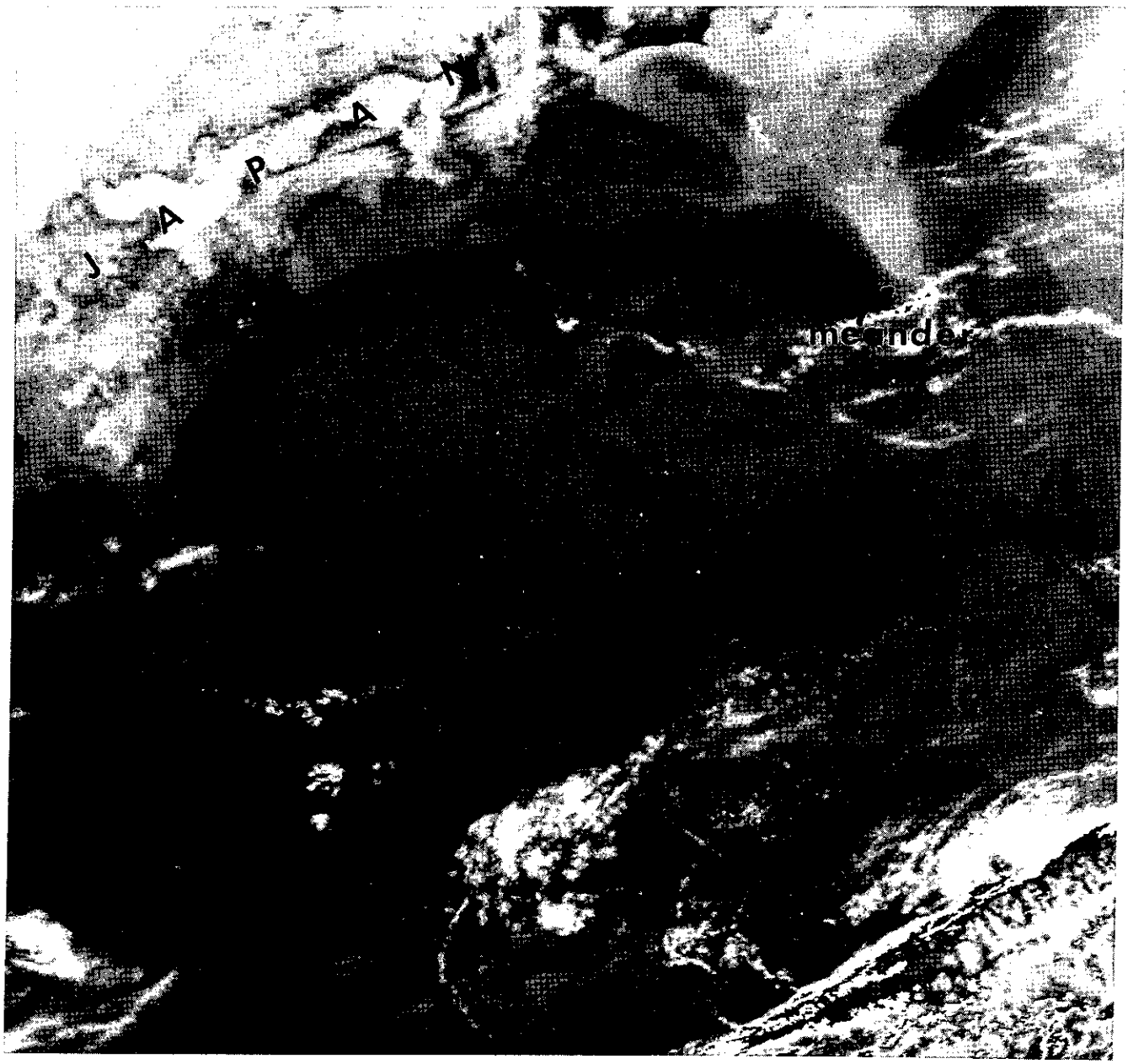
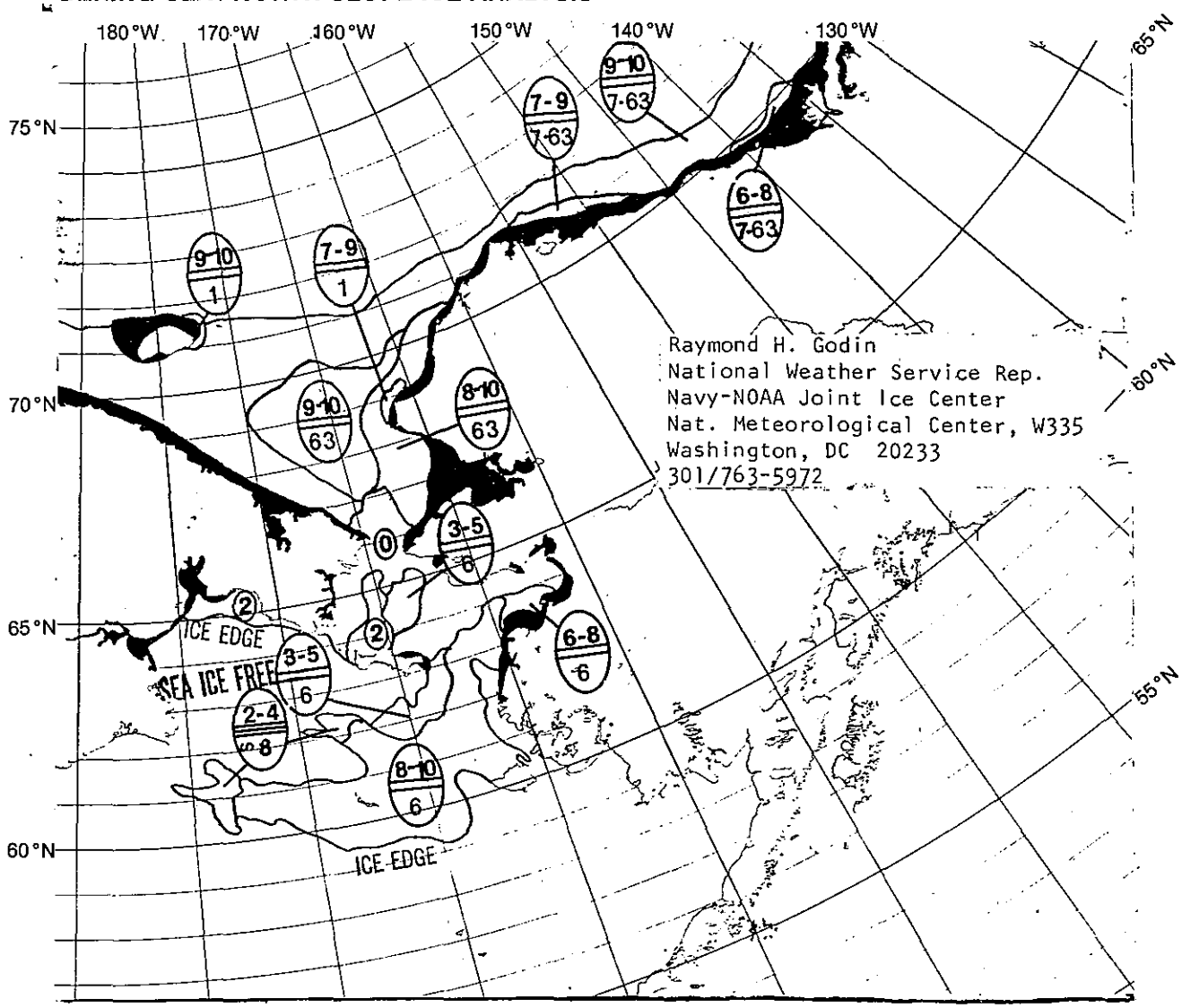
KUROSHIO CURRENT

This NOAA-8 infrared (IR) satellite image from May 9, 1984 depicts the Kuroshio Current south of Japan. The darker band of gray is the Kuroshio; the lighter gray mass to the north is Japan. A warm eddy (WE) circulation is located at 34°N 137°E. Researchers have determined that the Kuroshio exhibits a bimodal pattern where one of two configurations exist for several years. This image depicts the meander pattern that results from interaction of the current with the Izu Ridge along with local wind effects.



BERING SEA / NORTH SLOPE ICE ANALYSIS



C = Total ice concentration in the area in tenths.

C_a, C_b, C_c = Concentration of thickest (C_a), 2nd thickest (C_b), and 3rd thickest (C_c) ice.

S_a, S_b, S_c = Stage of development of thickest (S_a), 2nd thickest (S_b), and 3rd thickest (S_c) ice.

~C = Concentration of ice within area(s) of strips and patches.

STAGE(S) OF DEVELOPMENT (THICKNESS)

1 = New ice (0-10 cm)
3 = Young ice (10-30 cm)
6 = First year (30-200 cm)
7 = First year thin (30-70 cm)
1. = First year medium (70-120 cm)
4. = First year thick (120-200 cm)
7. = Old ice (survived at least one summer's melt)

EXAMPLES

125 — Theoretical thickness of this season's growth (cm).

Fast ice. Sea ice which forms and remains fast along the coast.

Ice boundary visually or satellite observed.

Ice boundary estimated.

MAY 1984

The monthly mean sea level pressure circulation depicts a 1009 mb low in the Gulf of Alaska near 52°N 143°W and a 1016 mb high in eastern Siberia near 64°N 179°W. Weak northeasterly and easterly mean surface geostrophic winds are observed in the eastern Bering Sea and along the north coast of Alaska. Monthly mean surface air temperatures are normal at both Barrow (71°N 157°W) and King Salmon (58°N 157°W) and below normal at Nome (65°N 165°W). Extensive melt of sea ice is observed in the Bering Sea. The ice edge receded from 100 to 400 km throughout the Bering Sea. An extensive open water area extends from Norton Sound through the Bering Strait and into the Chukchi Sea. The current ice edge position is between median and maximum ice edge extremes in the central and eastern Bering Sea and near minimum in the western Bering Sea.

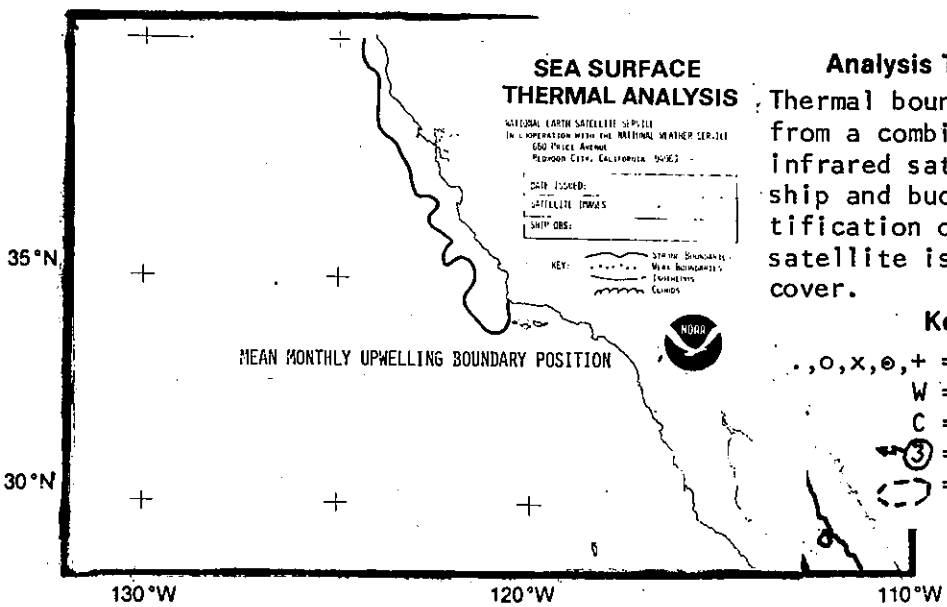
MONTHLY SST STATISTICS FOR SELECTED STATIONS
PACIFIC NORTHWEST

MAY 1984

Station	Location (Lat/Long)	Mean SST	Standard Deviation	Maximum SST	Minimum SST	Change From Previous Month
Buoy 46005	46.1 N 131.0 W	10.0	0.4	10.8	9.2	+0.7
Buoy 46002	42.5 N 130.3 W	11.5	0.5	12.8	11.0	+0.7
Buoy 46029	46.2 N 124.2 W	11.9	0.8	13.3	10.3	+1.7
	(Buoy 46029 is temporarily replacing Buoy 46010.)					
Grays Harbor	46.9 N 124.1 W	13.5	1.3	16.1	11.1	+2.1
Cape Disappointment	46.3 N 124.1 W	DATA MISSING DUE TO TECHNICAL PROBLEMS.				
Tenaine Bay	44.6 N 124.1 W	12.2	0.7	13.3	11.1	+1.3
Chetco River	42.0 N 124.3 W	10.2	0.5	11.1	9.4	-0.7

MAY 1984

A sluggish and somewhat late spring oceanic transition occurred off the Pacific Northwest. This was manifested in three ways: (1) a slow, steady increase of SSTs at offshore stations resulting in average SSTs about 0.7°C higher than in April; (2) a more rapid increase of coastal SSTs from the mid-Oregon coast northward, averaging 1.7°C above April SSTs; and (3) several episodes of coastal upwelling on the southernmost Oregon coast, resulting in a coastal SST decrease in that area. For example, the Chetco River station near the Oregon-California border recorded 9.4°C during the last few days of the month, compared to 11.1°C at the beginning of the month. The uniform warm anomaly over the entire area seen during the last few months has ceased, since SSTs are now very near normal over most of the Pacific Northwest area. However, the warm anomaly of 1.0-1.5°C remains along the central Oregon and southern Washington coasts, where no upwelling has yet occurred.



Analysis Techniques

Thermal boundaries are determined from a combination of enhanced infrared satellite imagery and ship and buoy observations. Identification of these features by satellite is limited by cloud cover.

Key

.,o,x,⊙,+ = thermal boundaries
W = warm
C = cold
③ = date of feature
= outline of water mass feature

SSTs over the South Panel were generally warmer than climatology during May. Two small areas remained cooler than normal: adjacent to the coast from Pt. Arena to Pt. Conception and in the extreme northwest portion of the analysis. Very cold (less than 9°C) upwelled water was responsible for the cool anomaly alongshore. Three areas were much above climatology (between 1.0°C and 1.5°C): from Pt. Conception south along the Baja coast, in the southwest corner of the analysis, and near Cape Mendocino. When compared to April mean SSTs, May SSTs warmed over 90% of the South Panel. The only exceptions were alongshore, from the Golden Gate to south of Pt. Conception and a small area near 30°N 125°W. The maximum warming (over 1.5°C) was near 35°N between 130°-135°W. Upwelling was observed on infrared satellite data throughout the month from Pt. Arena to just south of Pt. Conception. The coldest water along the California coast was near Pt. Cabrillo to Pt. Reyes, just north of San Francisco Bay, where temperatures were consistently below 10°C.

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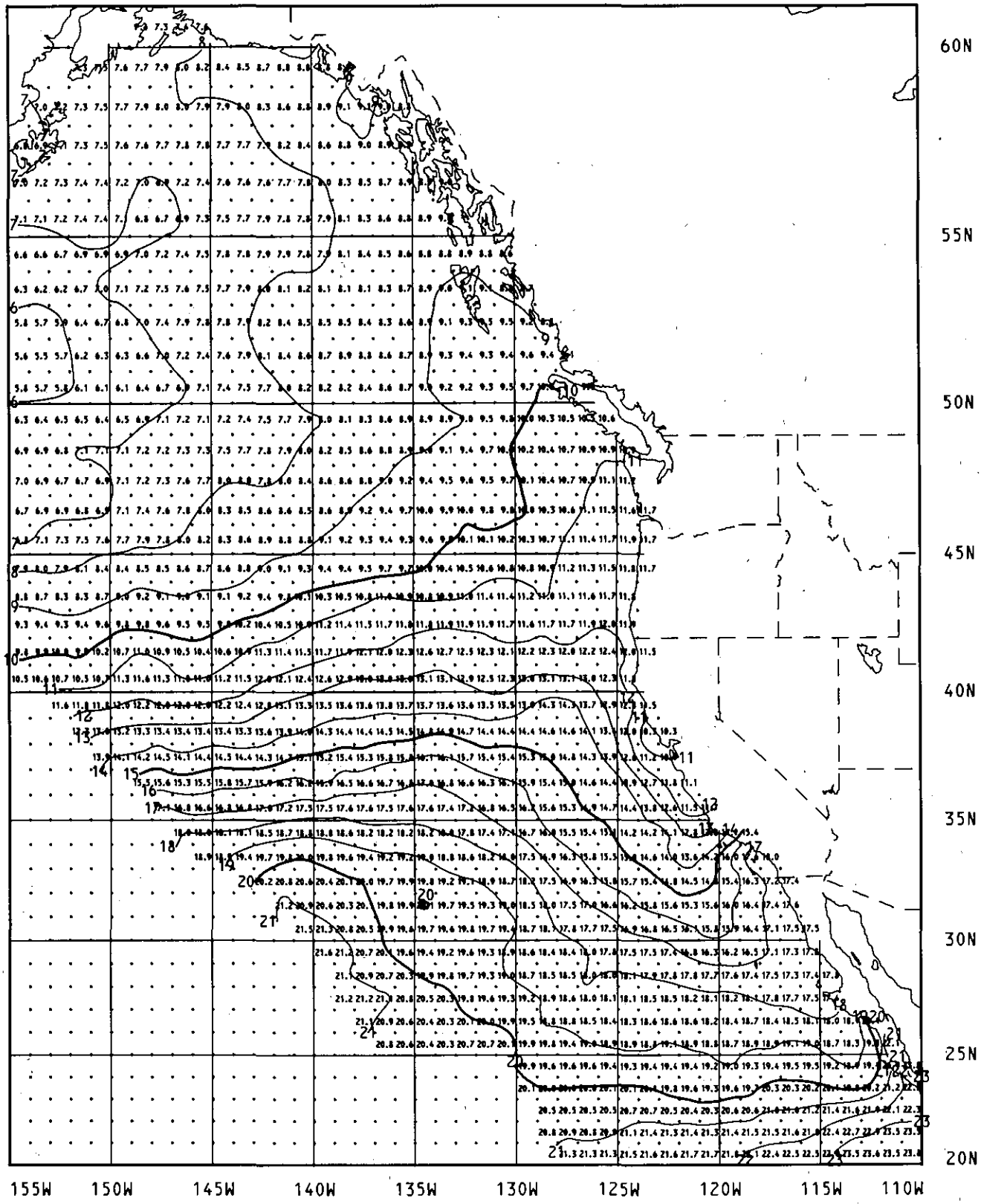
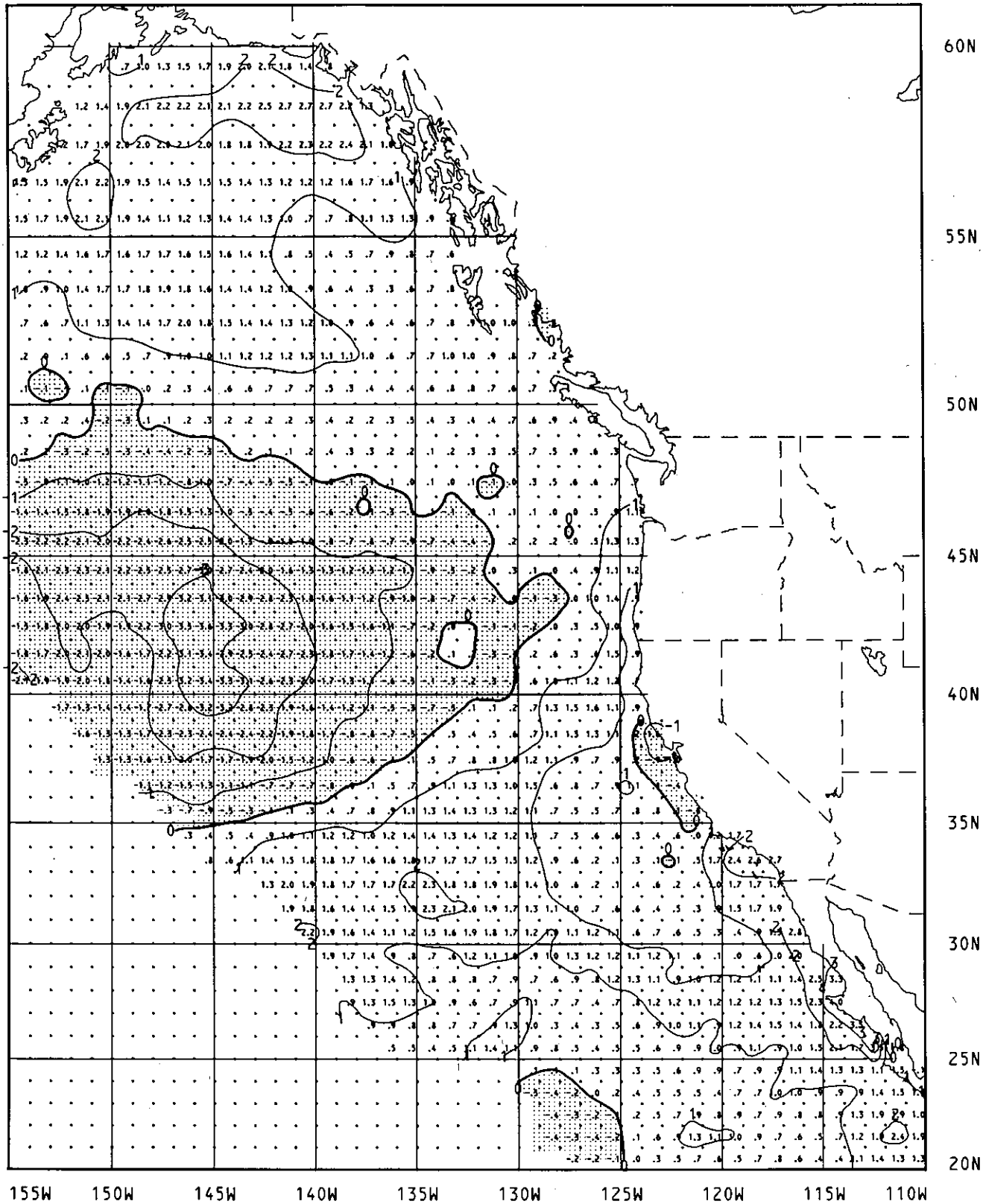


West Coast
SST--MONTHLY MEAN (°C)
May 1984

Monthly mean sea surface temperature is the mean of twice-weekly analyses using ship, buoy, and satellite observations. Contour line interval is 1.0°C.



West Coast
SST--MONTHLY ANOMALY (°C)
May 1984

Monthly anomaly is the difference between the monthly mean sea surface temperature and the climatological monthly mean value -- shading shows where the monthly mean is colder than climatology. Contour line interval is 1.0°C.

The end of this month's positions of the Gulf Stream System and its associated eddies are shown for the NW Atlantic and the Gulf of Mexico. The Gulf Stream and Loop Current boundaries are located by infrared satellite imagery or XBT (expendable bathythermograph) data. Anticyclonic eddies are labeled a-z in the Gulf of Mexico and 1-99 in the NW Atlantic. Cyclonic eddies are labeled A-Z. Arrows on eddies indicate direction of circulation. Warm-core or anticyclonic eddies rotate clockwise; cold-core or cyclonic eddies rotate counterclockwise. The line to the eddy center shows the net translation since last month or since last observed. Eddies or sections of the Gulf Stream System which were not observed during the month are not shown on the analysis chart. The long arrows at the bottom of the chart indicate the date of data used.

Data used in this analysis include:
- NOAA satellite infrared imagery, NESDIS
- Bathythermograph data, National Meteorological Center of National Weather Service
- Oceanographic Analysis, A daily detailed analysis issued by National Weather Service/NESDIS

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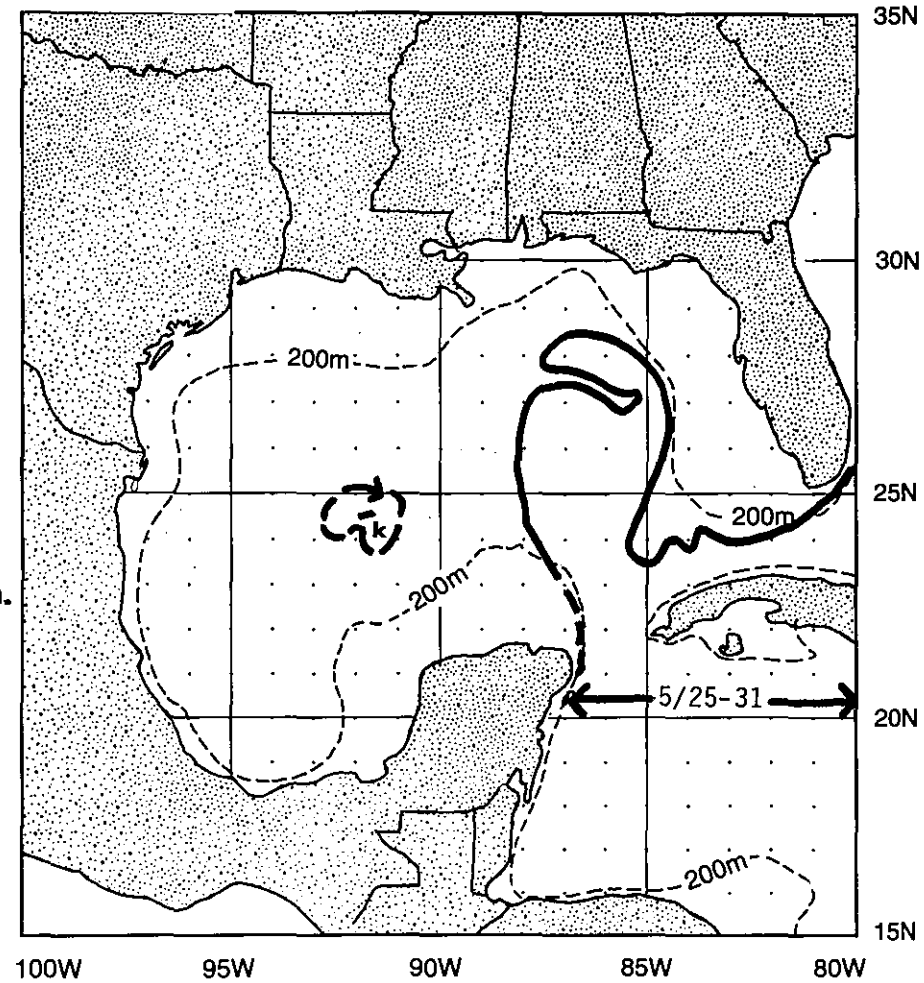
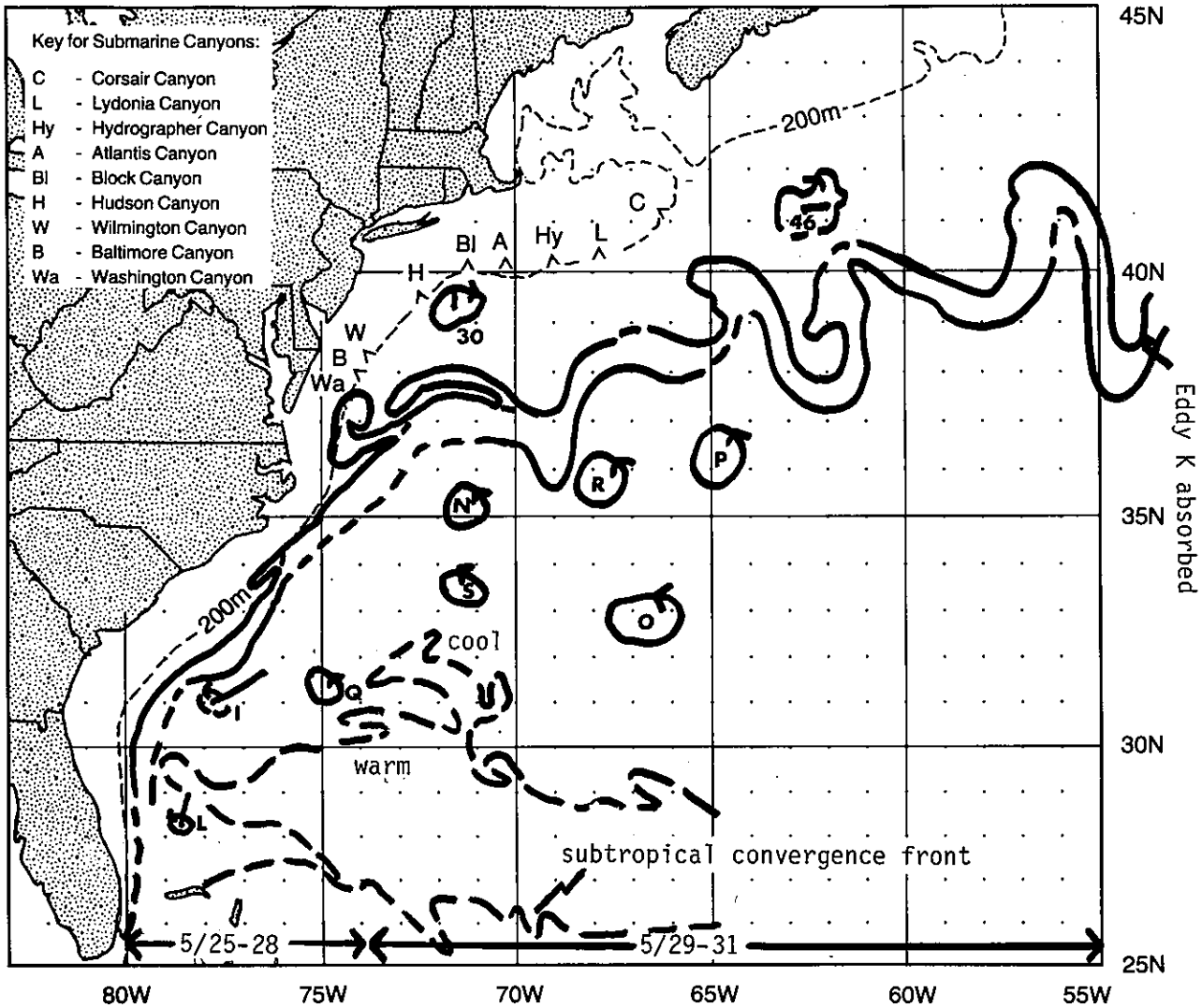


MAY 1984

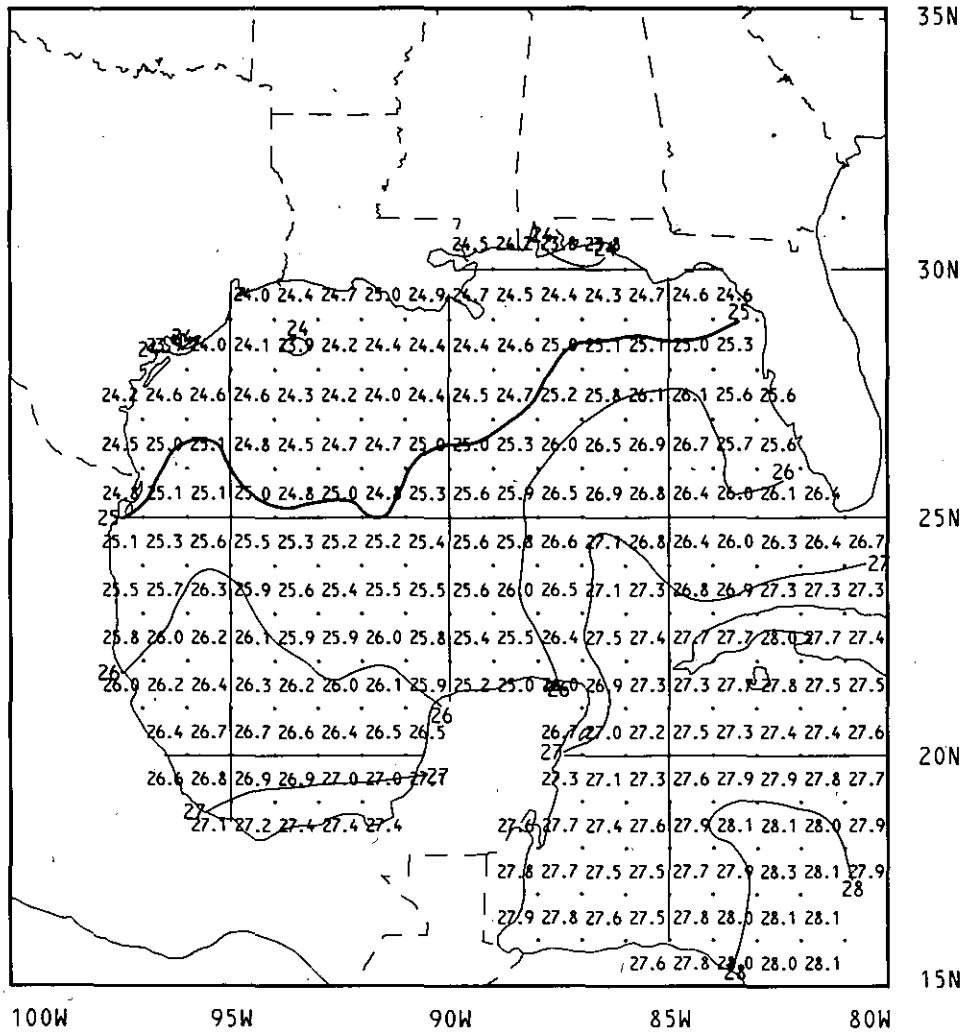
The Loop Current amplitude increased about 55 km NW compared to the end-of April position. The warm mixed Loop Current/slope water persisted near 27°N 85°W to 28°N 87°30W since March. Eddy k, last observed on May 5, moved 25 km WSW. Due to clouds eddy i and l were not observed during the month.



One anticyclonic eddy was absorbed by the Gulf Stream during the month. Eddy 40 apparently traveled 100 km ENE by May 9 and was absorbed by the Gulf Stream near 39°30N 63°W on May 11. Eddy 30 traveled 25 km S. Eddy 46 traveled 45 km W.

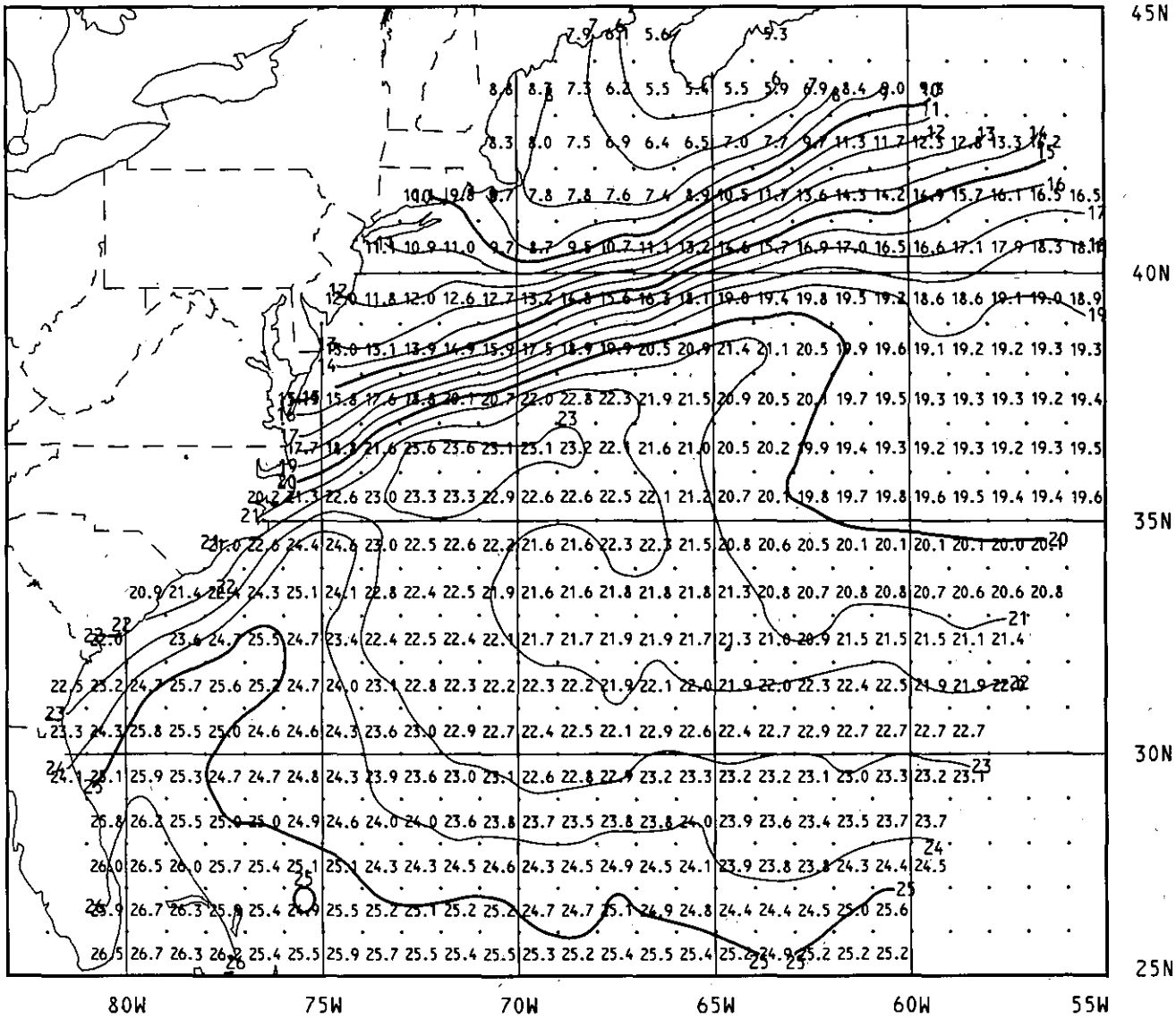
Seven cyclonic eddies were newly observed and two cyclonic eddies were apparently absorbed during May. The origin of eddy L is unknown. It was first suspected near 29°N 78°30W on April 7. Eddy L apparently translated 80 km SSW. Short-lived eddy M was first detected near 34°N 74°W on May 1. Eddy M apparently dissipated in the mixed Gulf Stream/Sargasso water near 34°30N 73°30W around May 18. Eddy N was first detected near 36°N 72°W on May 4. Its origin is unknown. Eddy O was first observed near 33°30N 66°30W on May 4. New eddy P formed from a Gulf Stream meander near 38°N 64°W on May 11. Eddy Q was first observed near 32°N 75°W on May 19. Its origin is unknown. New eddy R pinched off from a Gulf Stream meander near 36°N 67°30W on May 20. Eddy S was first observed on May 27 near 33°30N 71°30W. Eddy J was absorbed by a Gulf Stream meander near 35°30N 67°30W on May 5. Eddy I translated 155 km SW. Eddy K apparently translated 175 km SE by May 6 and was absorbed by the Gulf Stream near 38°45N 53°45W around May 28. The subtropical convergence front was last observed on May 20. A secondary front was last observed along 30°N on May 22.

EAST COAST SST-
MONTHLY MEAN



Gulf of Mexico
SST--MONTHLY MEAN (°C)
May 1984

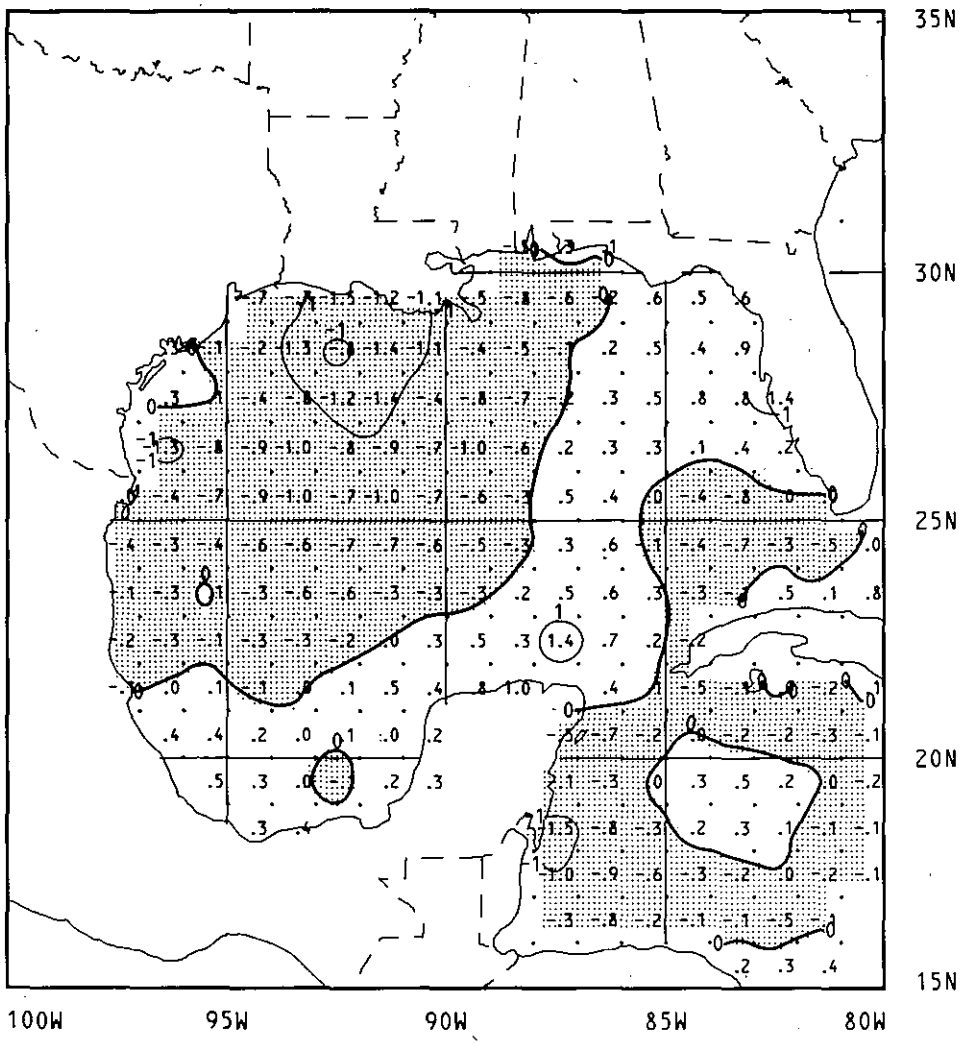
Monthly mean sea surface temperature is the mean of twice-weekly analyses using ship, buoy, and satellite observations. Contour line interval is 1.0°C.



NW Atlantic Ocean
SST--MONTHLY MEAN (°C)
May 1984

Monthly mean sea surface temperature is the mean of twice-weekly analyses using ship, buoy, and satellite observations. Contour line interval is 1.0°C.

EAST COAST SST-ANOMALY



Gulf of Mexico
SST--MONTHLY ANOMALY (°C)
May 1984

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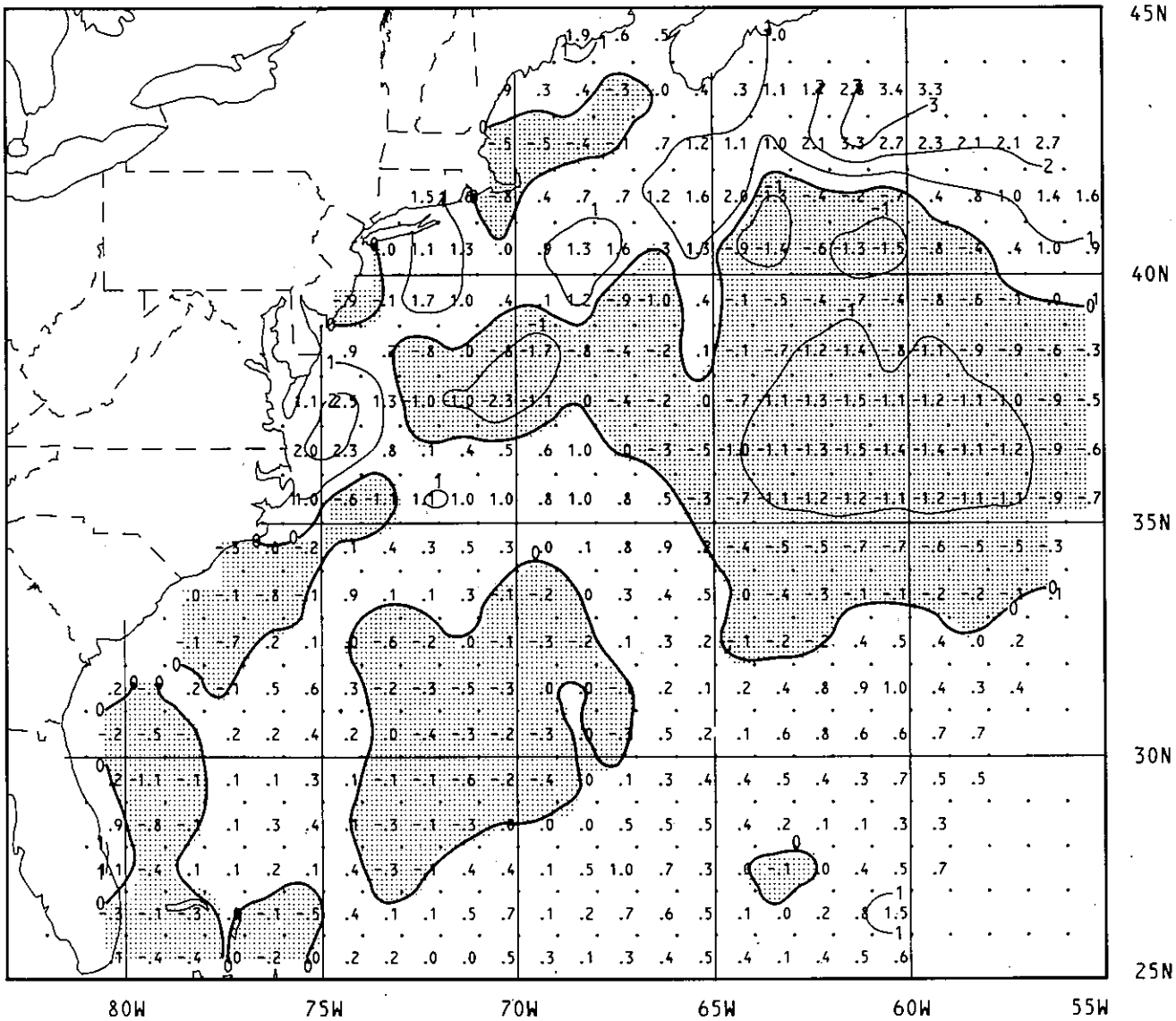

NW Atlantic Ocean
SST--MONTHLY ANOMALY (°C)
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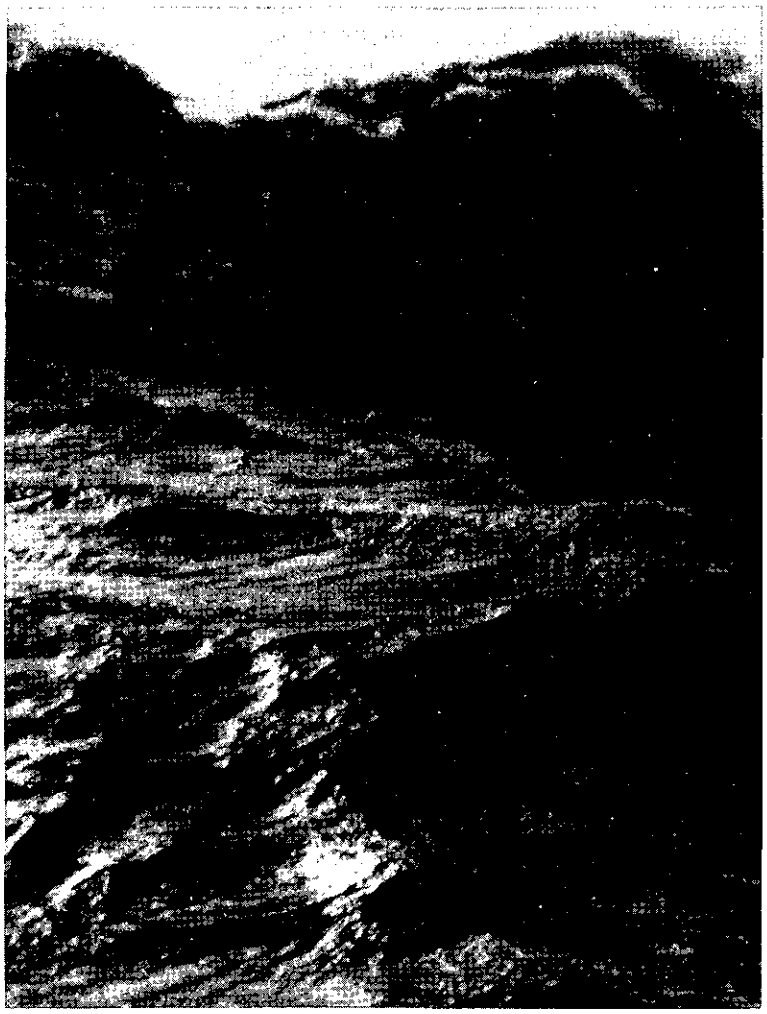
*U.S. GOVERNMENT PRINTING OFFICE : 1984 0-421-013/503

OCEANOGRAPHIC Monthly Summary

Volume IV Number 6 June 1984



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Oceanographic Monthly Summary is published by the National Weather Service and the National Environmental Satellite, Data, and Information Service (NESDIS). *Oceanographic Monthly Summary* contains sea surface temperature (SST) analyses on both regional and ocean basin scales for the Atlantic and Pacific Oceans. Two ocean basin SST analyses are presented, one based on in-situ data and another based solely on satellite data. An ocean basin SST anomaly derived from the in-situ data is also shown; it uses the National Climatic Center (NCC) Climatology*. The regional SST analyses are based upon a combination of in-situ and satellite data measurements. The regional SST anomalies use the Robinson-Bauer Climatology*. *Oceanographic Monthly Summary* also contains Alaskan sea ice information and ocean feature information for contiguous U.S. ocean regions.

Oceanographic Monthly Summary welcomes articles containing information of interest to *Oceanographic Monthly Summary* readers, such as, news on operational oceanography, unusual ocean feature phenomena, etc. Contributions should be sent to the editor (address below). Accepted material will appear in the OceaNotes section of *Oceanographic Monthly Summary*. Contributions can be published as quickly as the next monthly issue.

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*Reynolds, R.W., 1982. A Monthly Averaged Climatology of Sea Surface Temperatures; *NOAA Technical Report NWS 31.*

*Robinson, M.K., 1976. Atlas of North Pacific Ocean Monthly Mean Temperatures and Mean Salinities of the Surface Layer; *NavOceano Ref. Pub. 2.*

Robinson, M.K., R. A. Bauer and E.H. Schroeder, 1979. Atlas of North Atlantic-Indian Ocean Monthly Mean Temperatures and Mean Salinities of the Surface Layer; *NavOceano Ref. Pub. 18.*

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DRIFTING BUOYS USED FOR MAINTAINING SATELLITE-DERIVED SST ACCURACY

With NESDIS's quest in making satellite-derived SSTs more accurate, much of the SST data routinely available from conventional in-situ sources is not sufficiently accurate on a comparison basis to provide the quality needed. This became obvious from statistics comparing Multi-Channel SSTs (MCSSTs) with daily ship SSTs ("intake" temperatures) from NMC data base and with SSTs from fixed buoys. Although the mean differences in SST between data sets were small, the scatter (standard deviation of the differences) was higher with the satellite/ship comparisons than it was with the satellite/buoy comparisons. It is also desirable to verify MCSST observations in areas where no fixed buoys are available. A set of 15 to 20 small drifting buoys with SST probes was identified during 1982 (mostly in the Southern Hemisphere) and incorporated into a verification system. Drifting buoys for satellite validation are made available to the Global Telecommunication System (GTS) through the French Service Argos from many independent research experiments operated by different nations. Match-ups in this case were considered only when satellite and buoy data were taken within 24 hrs and 50 km of one another.

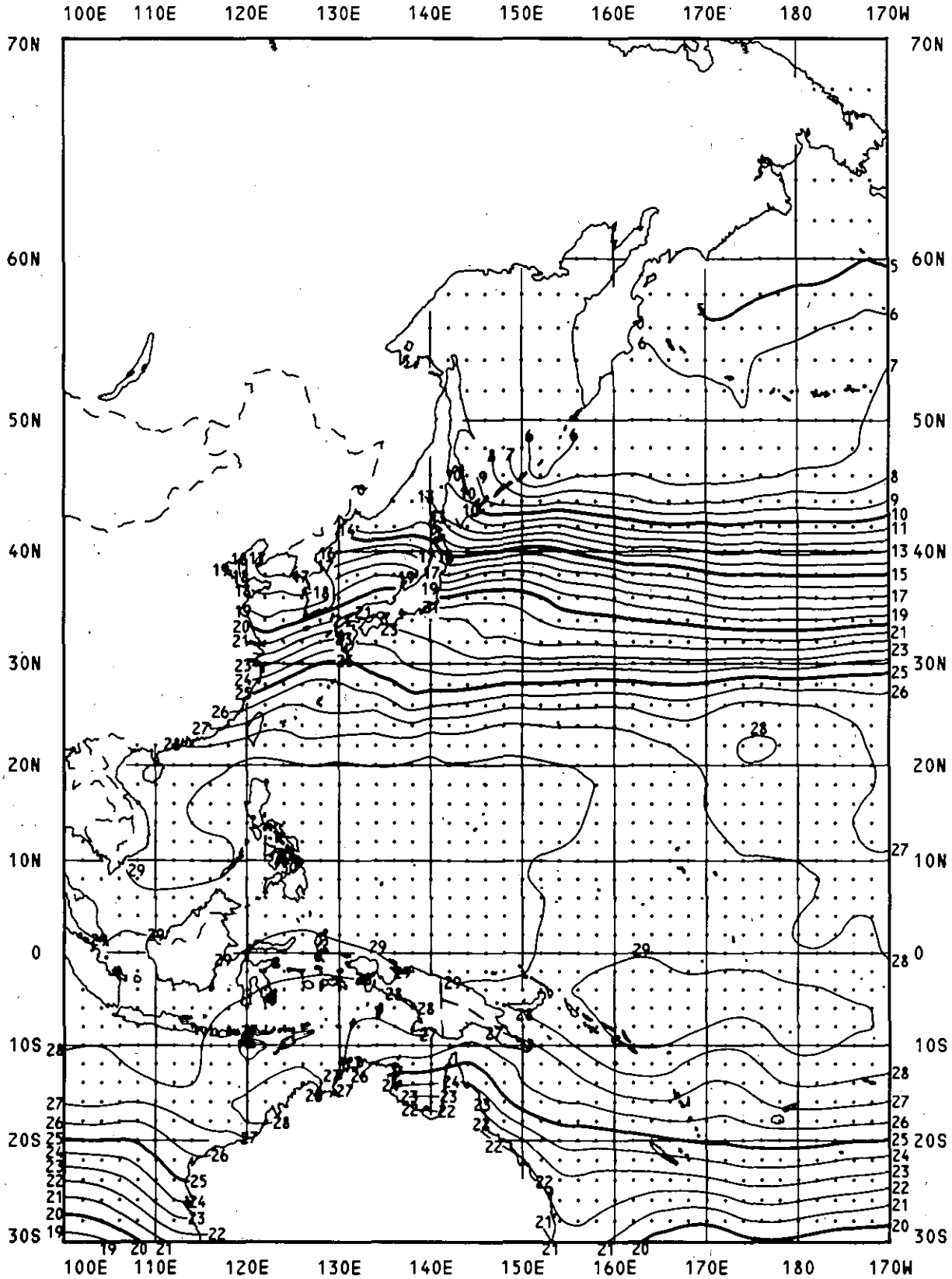
Statistics show excellent agreement with satellite retrievals in nearly every case (Table 1). The root mean square difference (RDM) observed with the MCSST/drifting buoy match-ups is 0.4°C less than with the MCSST/fixed-buoy match-ups, probably resulting from the higher horizontal temperature gradients near the coast where these platforms typically are anchored. Added errors may accrue from lack of exact coincidence in space and time in most matchups.

An observational time series is maintained for each drifting buoy to identify occasional data transmission errors. Because the drifter remains in the same water mass, temperature changes occur slowly and most observations range within +0.1°C daily. The GTS drifting buoy temperatures suggest the buoys are well calibrated. The temperature dependent bias (Table 1) was corrected for September 1982. Although it cannot be demonstrated with the present data, the indicated accuracy (RMSD) is probably better than 0.5°C.

It is important to produce accurate oceanic SST observations and to prepare SST charts (e.g., daily, weekly, monthly). Therefore, MCSSTs go through a multi-day compositing and objective analysis scheme similar to that used for previous single-window SST retrievals. These charts, available weekly at 100 km grid interval, also have been evaluated by means of drifting buoy data. Improvements have resulted in the sharpness of thermal fronts and realistic isotherms near coastlines. Some novel problems associated with extreme amounts of volcanic aerosol at low temperatures in the stratosphere became evident in the form of substantial negative biases in the MCSSTs in the months following the eruptions of El Chichon in Mexico in late March and early April of 1982. These biases were confined to the 0° to 30°N latitudinal band through the summer of 1982, becoming smaller but globally distributed in subsequent months. The success of these satellite MCSSTs with high-quality in-situ data from drifting buoys has established a satellite/buoy match-up SST data base. This data base helps maintain calibration, identifies sensor degradation, and provides smooth transitions between successive satellites.

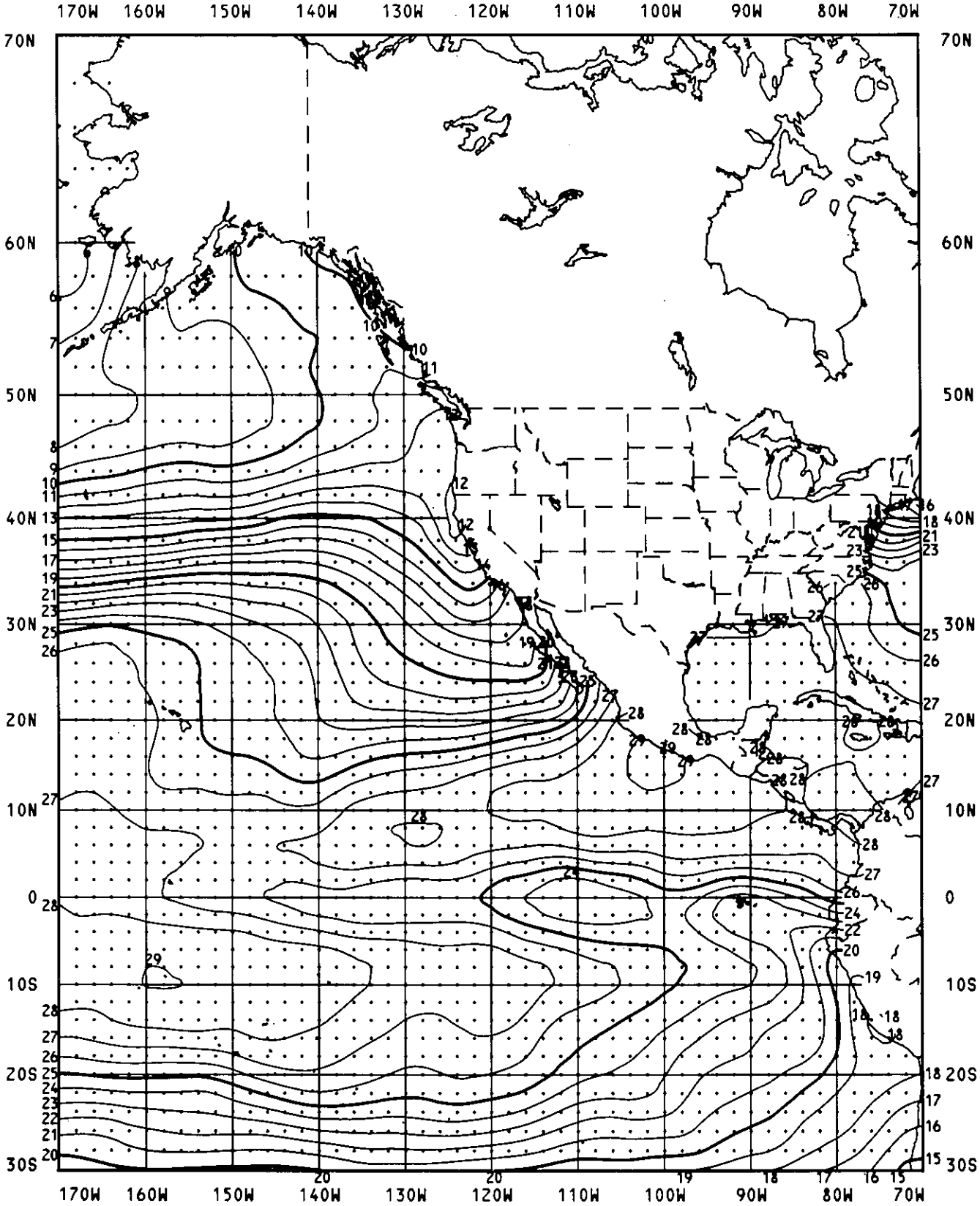
Table 1. Statistics of satellite MCSST match-ups during November 1981 - August 1982 (daytime and nighttime match-ups combined). Reports from latitudinal bands beneath the El Chichon aerosol cloud were excluded. None of the data in Table 1 was used to tune the algorithm prior to computing the statistics.

SATELLITE MATCH-UPS with	NUMBER of MATCH-UPS	BIAS	RMSD
Ships of opportunity	24792	-0.43°C	1.81°C
Moored Buoys	240	-0.47°C	1.05°C
Drifting buoys	472	-0.22°C	0.68°C



Western Pacific Ocean
SST--MONTHLY MEAN (°C)
SHIP and BUOY DATA
June 1984

Monthly mean sea surface temperature is the mean of in-situ data (ships and buoys) within two-degree quadrangles. Contour line interval is 1.0°C.



Eastern Pacific Ocean
SST--MONTHLY MEAN (°C)
SHIP and BUOY DATA
June 1984

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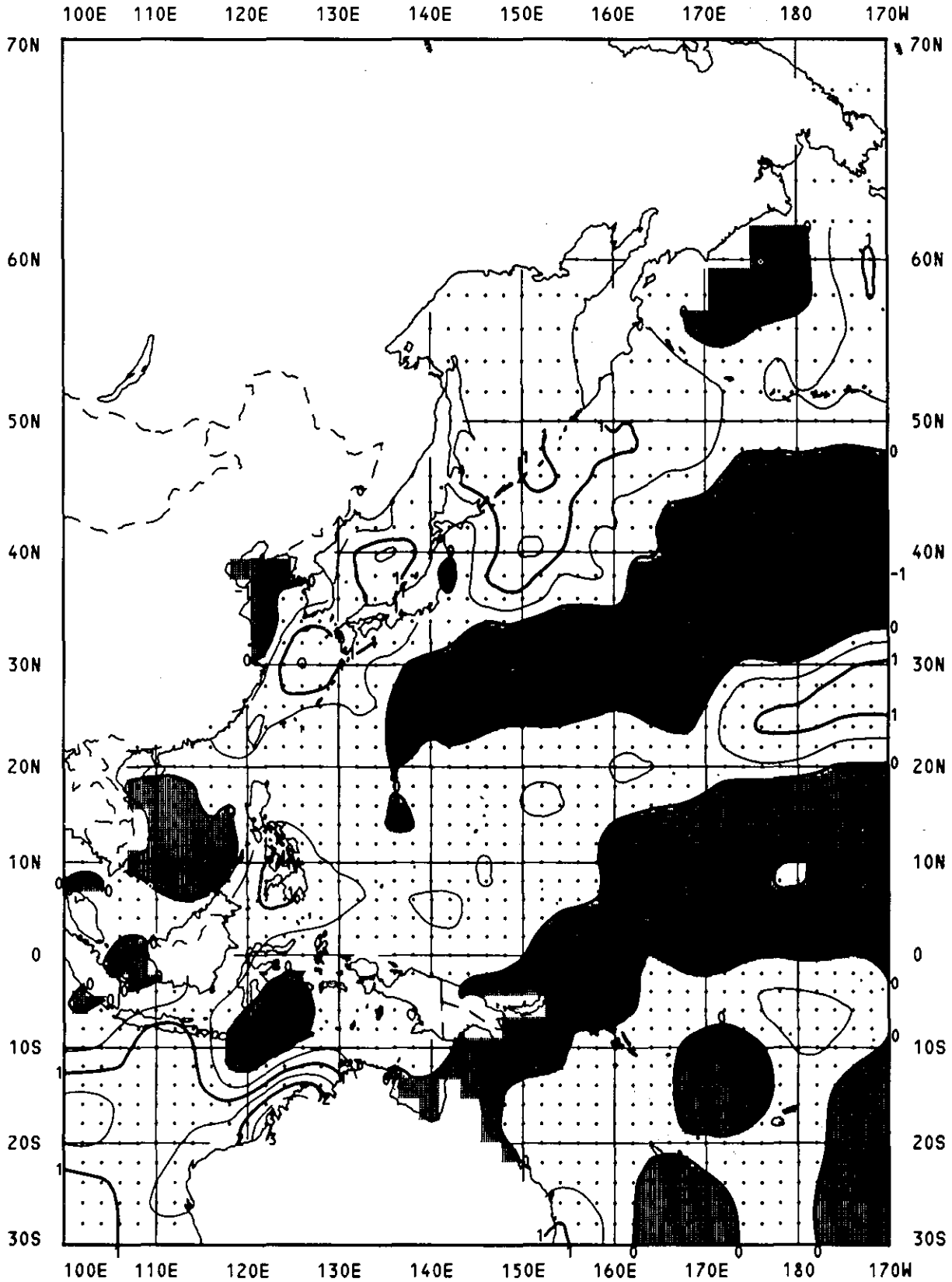

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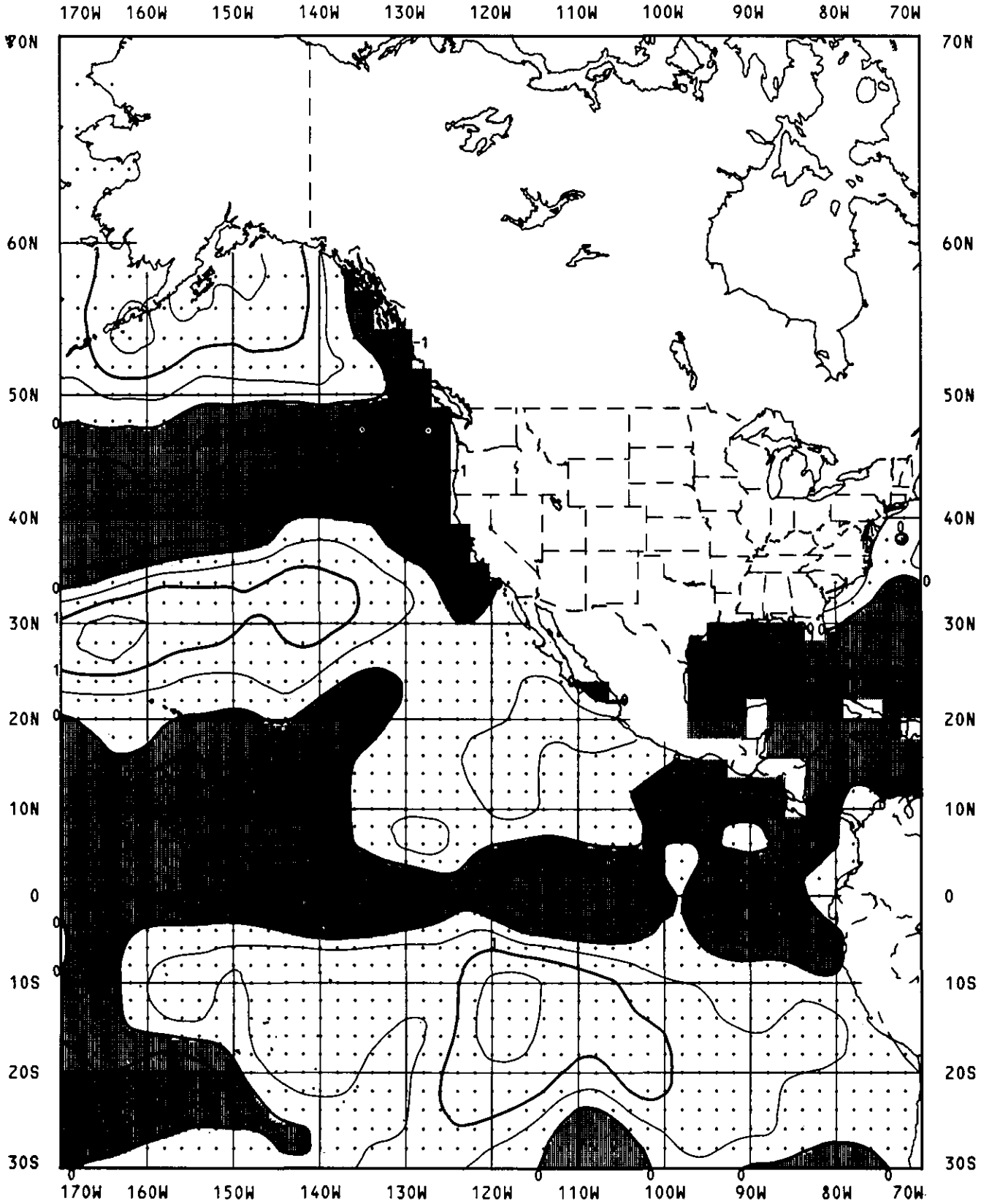

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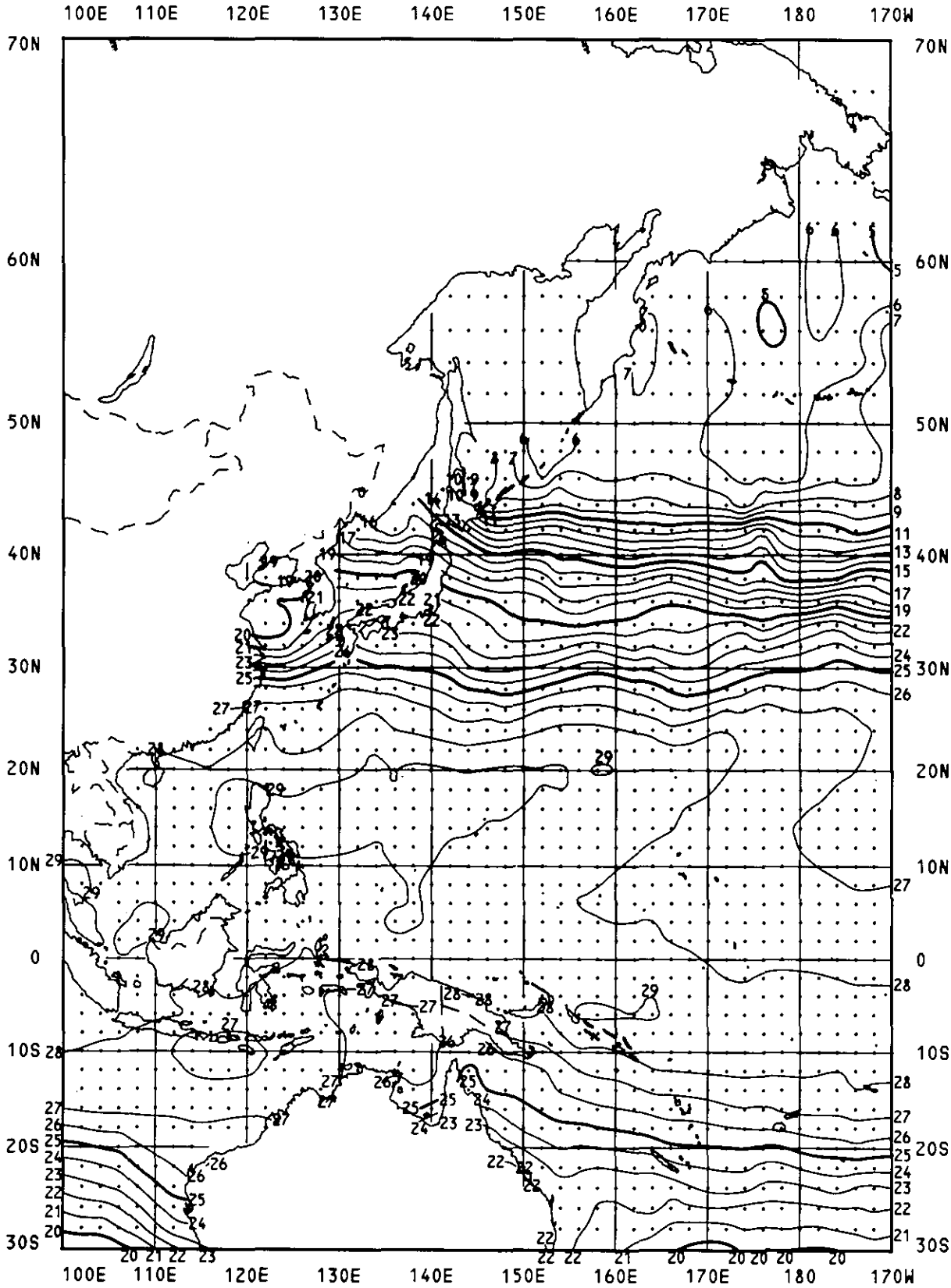

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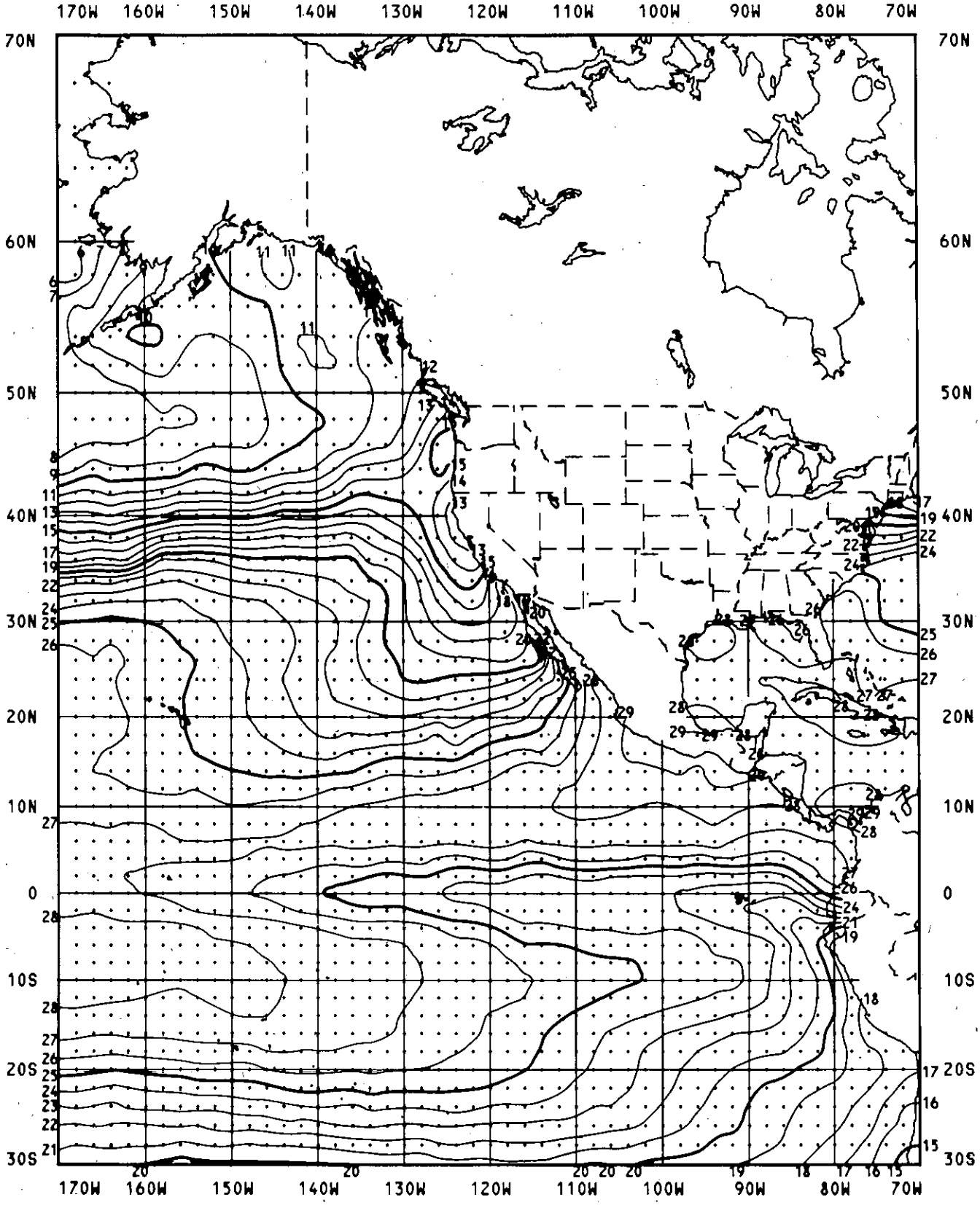

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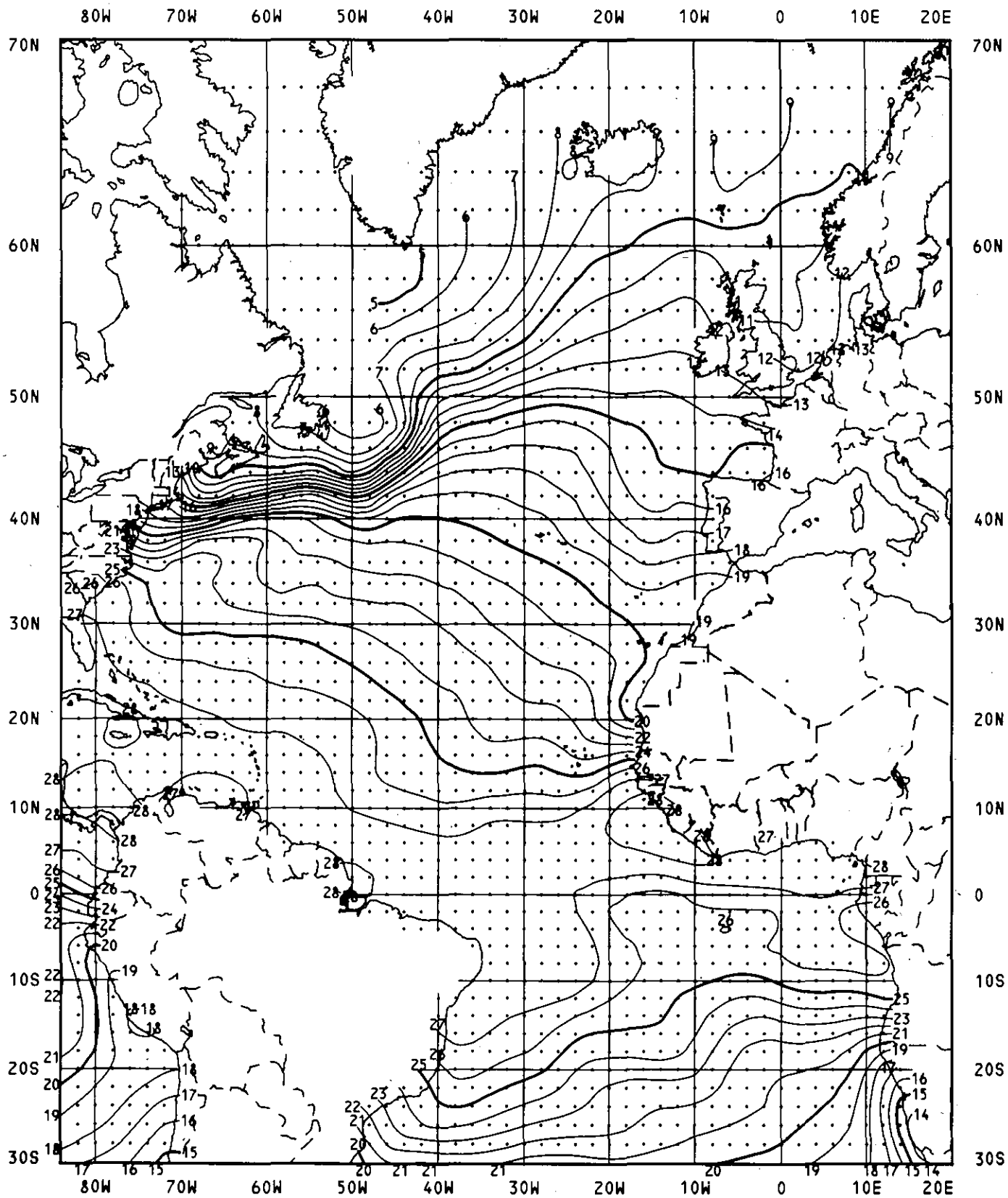

Atlantic Ocean
SST--MONTHLY MEAN (°C)
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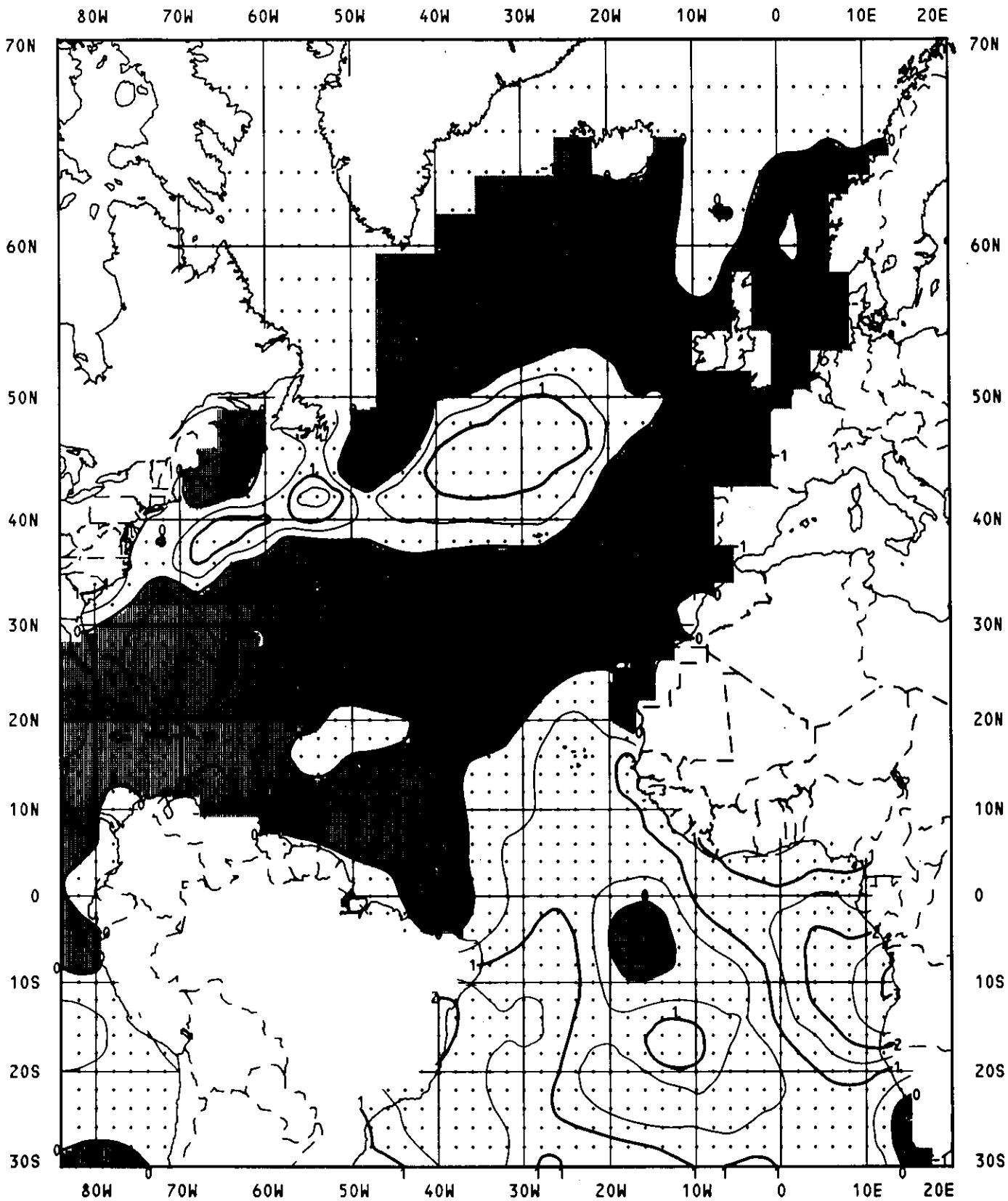

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June 1984

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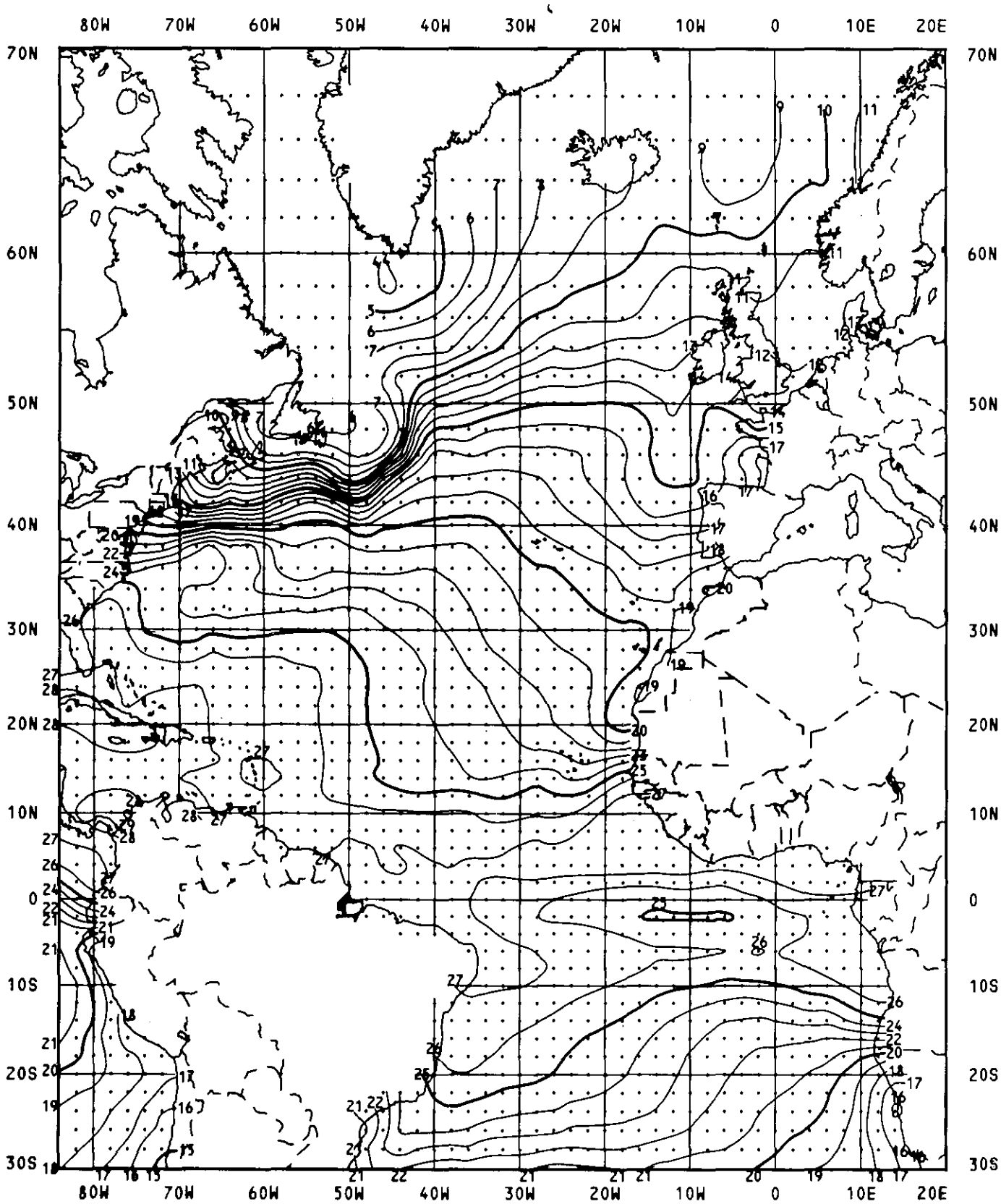

Atlantic Ocean
SST--MONTHLY MEAN (°C)
SATELLITE DATA
June 1984

Monthly mean sea surface temperature is the mean of satellite data within two-degree quadrangles. Contour line interval is 1.0°C.

SATELLITE IMAGE OF THE MONTH

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Interactive Processing Branch E/SP22
NESDIS, NOAA
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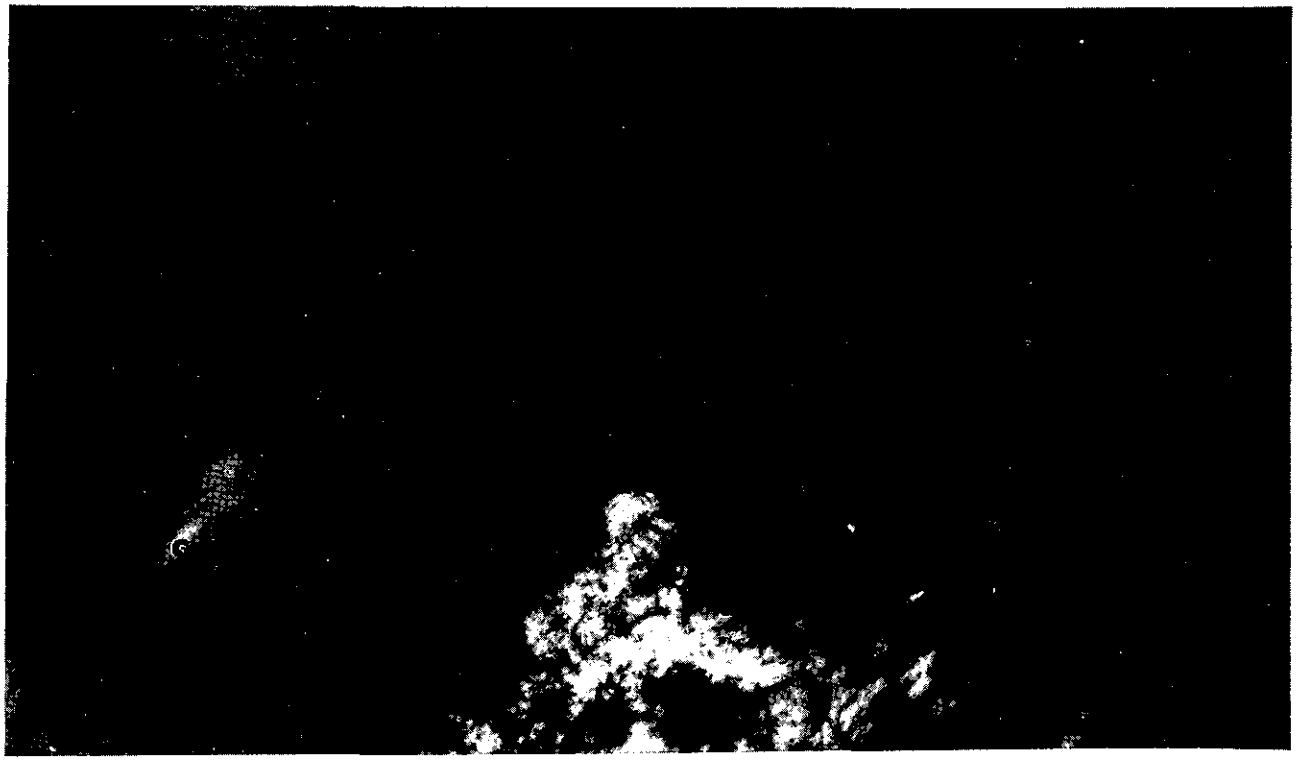
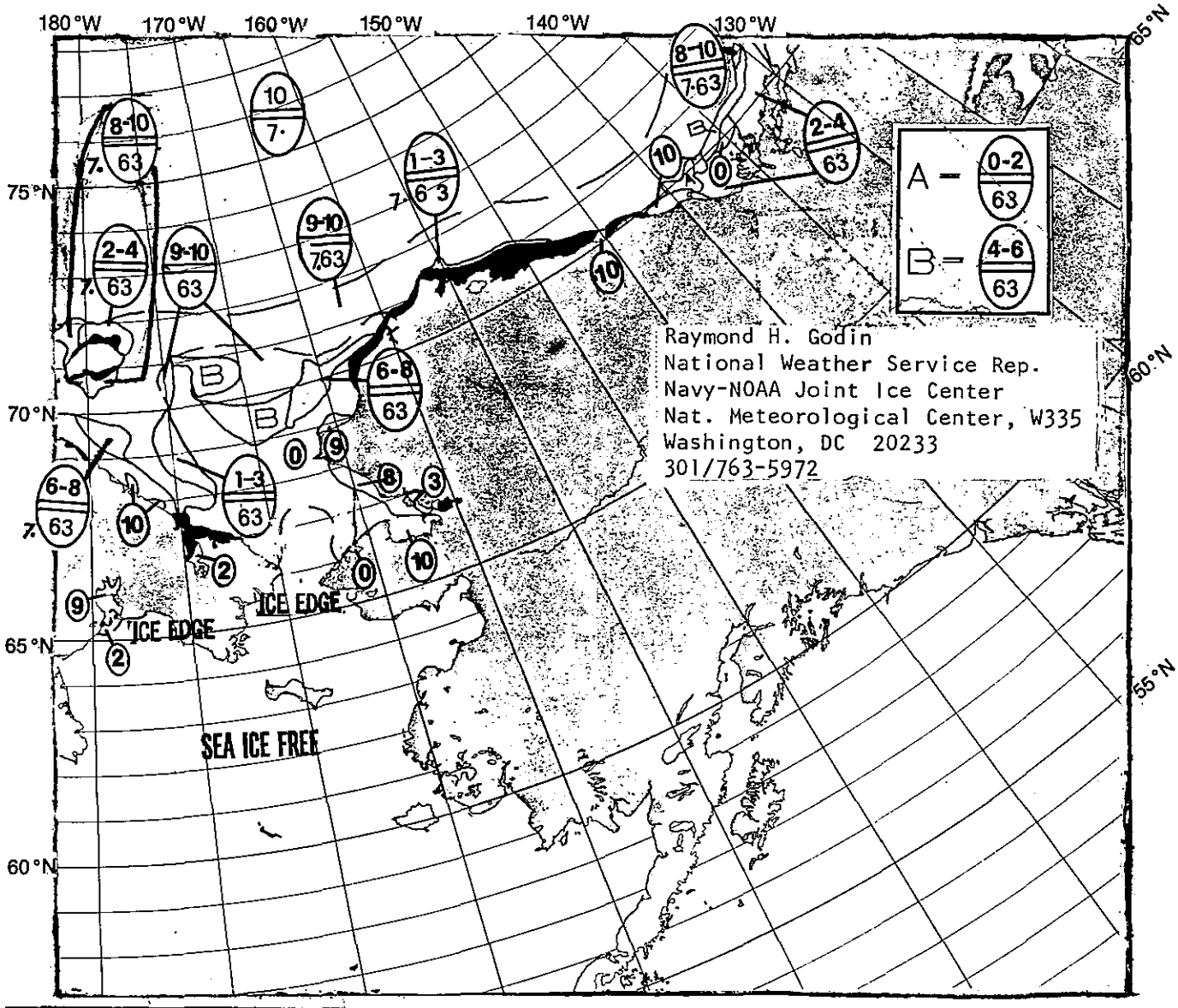
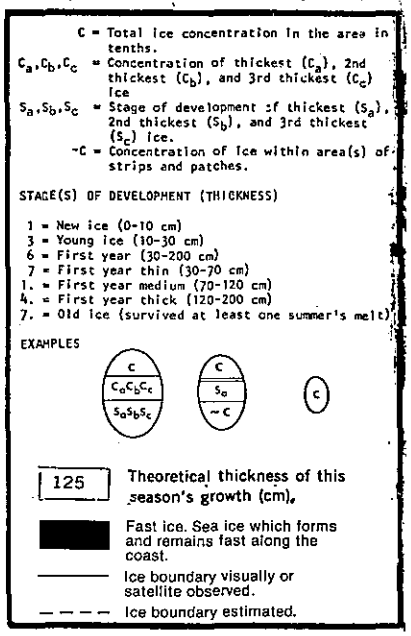
UPWELLING IN THE GULF OF OMAN

This NOAA-7 infrared (IR) satellite image taken June 7, 1984, focuses on upwelling in the Gulf of Oman which is in the northwestern Arabian Sea. Cooler, upwelled water is shown as lighter gray shades along the southern coast of Iran and along the eastern coast of Oman. The "pointed" land mass is part of Oman and it separates the Gulf of Oman to the east from the Persian Gulf to the west. Since the average depth of the Persian Gulf is only 25 m, there is little exchange of water between it and the Gulf of Oman. Upwelling in the Gulf of Oman has been observed in satellite imagery. The most intense events occur in summer and fall. Existence of upwelling is probably due to influences of local wind regimes and topography. High elevations located close to the Iranian coast may direct local winds offshore. In this case, upwelling would be similar to Tehuantepecer events near Mexico. Upwelling along Oman may be related to the synoptic wind regime, where northeasterly winds blow along the Oman coast. This upwelling event would be similar to observed upwelling along the Somali coast, where large anticyclonic eddy circulations develop in summer.



BERING SEA / NORTH SLOPE ICE ANALYSIS





JUNE 1984

The monthly mean sea level pressure circulation depicts a 1008 mb low in the north Pacific near 53°N 178°E and a 1020 mb high in the western Canadian Archipelago near 74°N 120°W. Weak southerly and easterly mean surface geostrophic winds are observed to the west and east of Barrow (71°N 157°W), respectively. Monthly mean surface air temperatures are above normal at Barrow, King Salmon (57°N 157°W) and Nome (65°N 165°W). The rapid ablation of sea ice observed in May continued through June. An extensive open water area is observed in the Chukchi Sea extending to the vicinity of Point Lay (70°N 163°W). The ice edge receded over 800 km from the Bering Sea into the Chukchi Sea. The current ice edge position is near the minimum ice edge extreme in the Chukchi Sea.

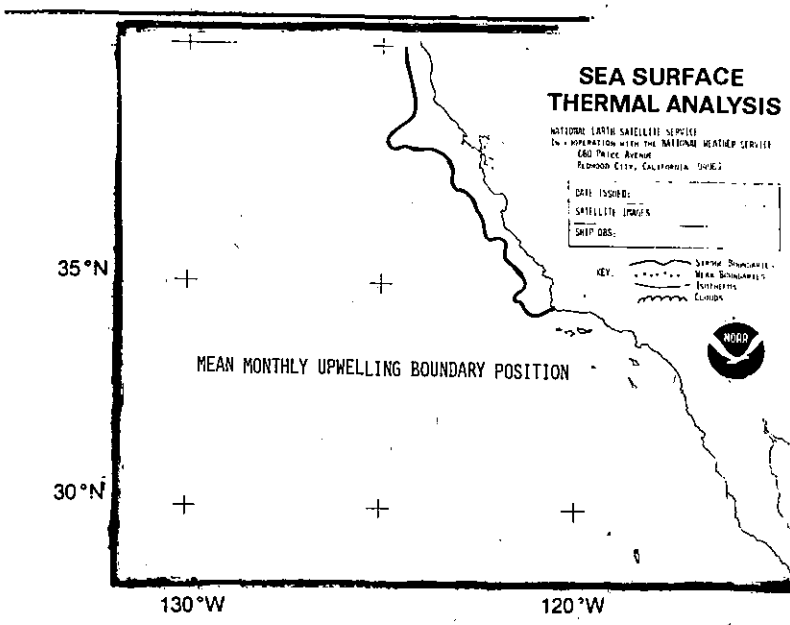
MONTHLY SST STATISTICS FOR SELECTED STATIONS
PACIFIC NORTHWEST
(Area enclosed by 40-52N, Coast-135W)

JUNE 1984

Station	Location (Lat/Long)	Mean SST	Standard Deviation	Maximum SST	Minimum SST	Change From Previous Month
Buoy 46005	46.1 N 131.0 W	11.6	0.7	13.0	10.4	+1.6
Buoy 46002	42.5 N 130.3 W	13.1	0.6	14.5	12.3	+1.6
Buoy 46029	46.2 N 124.2 W	12.7	0.9	15.0	11.5	+0.8
(Buoy 46029 is temporarily replacing Buoy 46010.)						
Buoy 46027	41.8 N 124.4 W	9.1	1.3	12.3	6.9	N/A
Quillayute River	47.9 N 124.6 W	10.6	1.1	13.3	8.9	N/A
Grays Harbor	46.9 N 124.1 W	14.1	1.2	16.7	12.2	+0.6
Cape Disappointment	46.3 N 124.1 W	14.7	1.0	16.7	12.8	N/A
Yaquina Bay	44.6 N 124.1 W	10.9	1.1	13.9	9.4	-1.3
Chetco River	42.0 N 124.3 W	9.6	0.5	10.6	8.9	-0.6

JUNE 1984

SSTs off the Pacific Northwest were generally 0.5° to 1.0°C below normal except for a warm cell near June 8 with temperatures 0.5° to 1.0°C above normal just off the Washington-northern Oregon coast. This warm cell oscillated slightly north and south along the coast throughout the rest of June. Upwelling occurred primarily between June 12-22, corresponding with the lowest SSTs for the month reported between June 16-21. Even though upwelling was weaker than normal overall for June, upwelling effects during this period were verified by cool coastal SSTs as far north as northern Washington. Favorable upwelling conditions diminished and strong warming was seen along the coast the last week in June. SSTs at offshore stations increased about 1.5°C over May with little deviation from a steady increasing trend.



Analysis Techniques

Thermal boundaries are determined from a combination of enhanced infrared satellite imagery and ship and buoy observations. Identification of these features by satellite is limited by cloud cover.

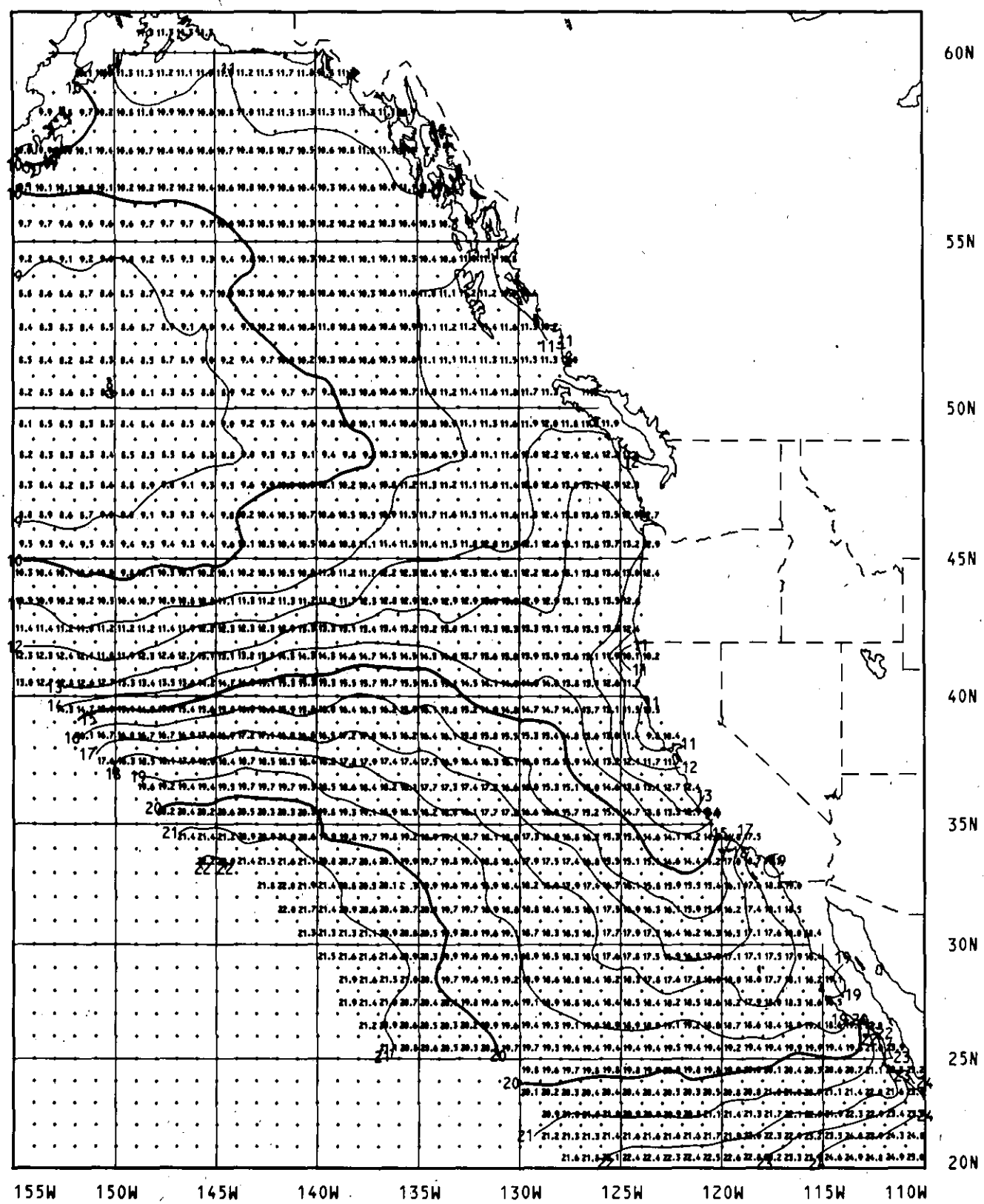
Key

.,o,x,⊙,+ = thermal boundaries
W = warm
C = cold
③ = date of feature
= outline of water mass feature

North Panel
Kent Short
NOAA/Northwest Regional Ocean Service Center
7600 Sand Point Way NE
Bin C15700
Seattle, WA 98115
(206) 527-6604

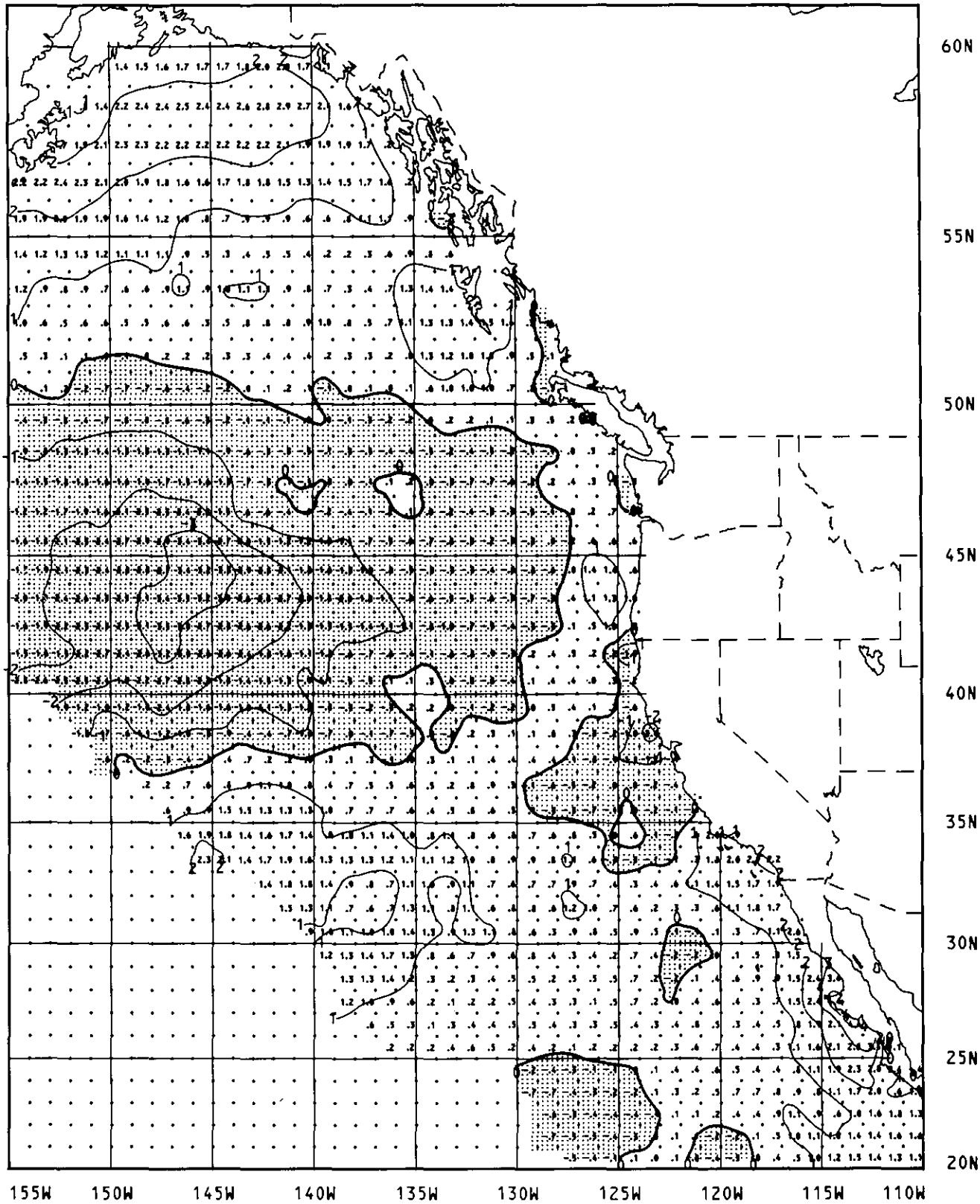
South Panel
Ernest Daghir
NOAA/NWS
Satellite Field Service Station
660 Price Avenue
Redwood City, CA 94063
(415) 364-2422

The averaged mean temperature over the South Panel during the month were slightly warmer (16.3°C) than the climatological normal (16.0°C). The northern half of the analysis area was somewhat cooler than normal and the southern half was somewhat warmer than normal. The coolest anomaly of -0.8°C was along shore near Bodega Bay and the warmest anomaly of 1.8°C was in the San Diego area. Upwelling was observed by satellite over the entire month particularly in central and northern California. SSTs of 9° and 10°C were common from Pt. Arena to Pt. Reyes in the maximum upwelled area. A minor upwelling event was also observed along the Baja coast during the middle of the month. The entire South Panel region warmed in response to the seasonal trend when compared to the previous month. The two areas of maximum warming (1.5°C) were in the extreme northwest and southeast portions of the chart. The areas with the least warming were nearshore and north of the San Francisco Bay.



West Coast
SST--MONTHLY MEAN (°C)
June 1984

Monthly mean sea surface temperature is the mean of twice-weekly analyses using ship, buoy, and satellite observations. Contour line interval is 1.0°C.



West Coast
SST--MONTHLY ANOMALY (°C)
June 1984

Monthly anomaly is the difference between the monthly mean sea surface temperature and the climatological monthly mean value -- shading shows where the monthly mean is colder than climatology. Contour line interval is 1.0°C.

EAST COAST OCEAN FEATURES

The end of this month's positions of the Gulf Stream System and its associated eddies are shown for the NW Atlantic and the Gulf of Mexico. The Gulf Stream and Loop Current boundaries are located by infrared satellite imagery or XBT (expendable bathythermograph) data. Anticyclonic eddies are labeled a-z in the Gulf of Mexico and 1-99 in the NW Atlantic. Cyclonic eddies are labeled A-Z. Arrows on eddies indicate direction of circulation. Warm-core or anticyclonic eddies rotate clockwise; cold-core or cyclonic eddies rotate counterclockwise. The line to the eddy center shows the net translation since last month or since last observed. Eddies or sections of the Gulf Stream System which were not observed during the month are not shown on the analysis chart. The long arrows at the bottom of the chart indicate the date of data used.

Data used in this analysis include:
- NOAA satellite infrared imagery, NESDIS
- Bathythermograph data, National Meteorological Center of National Weather Service
- Oceanographic Analysis, A daily detailed analysis issued by National Weather Service/NESDIS

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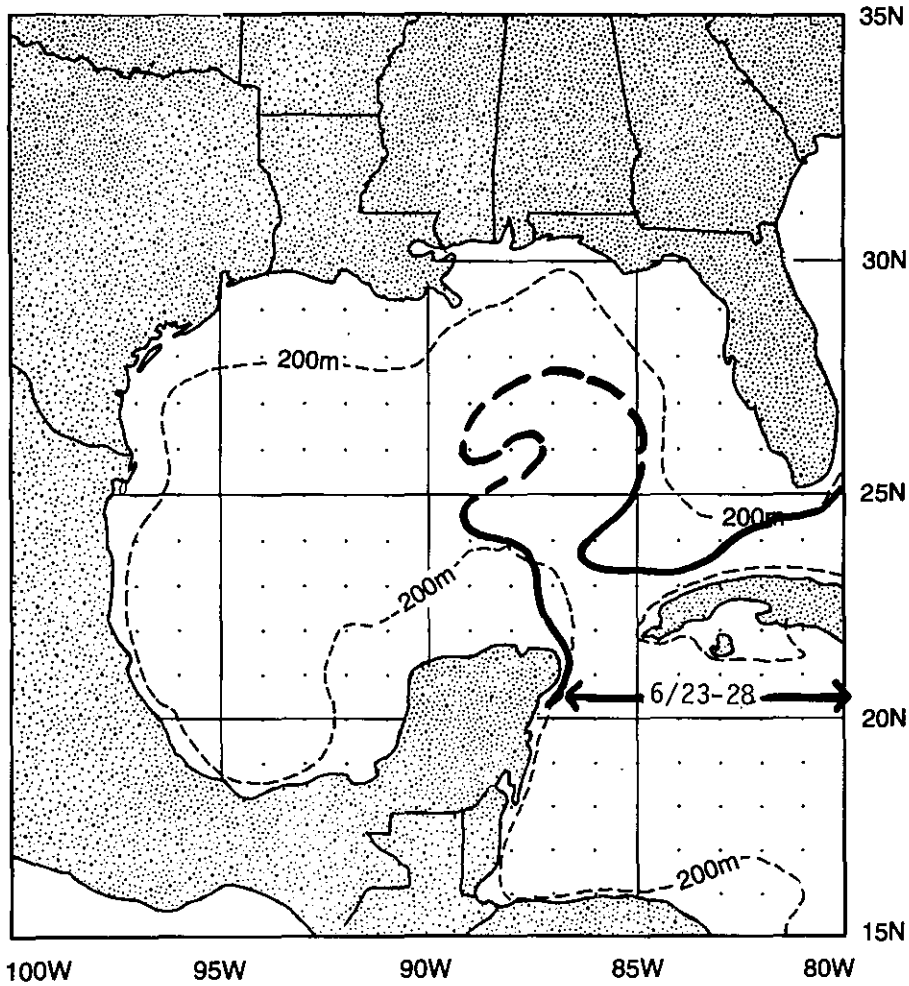
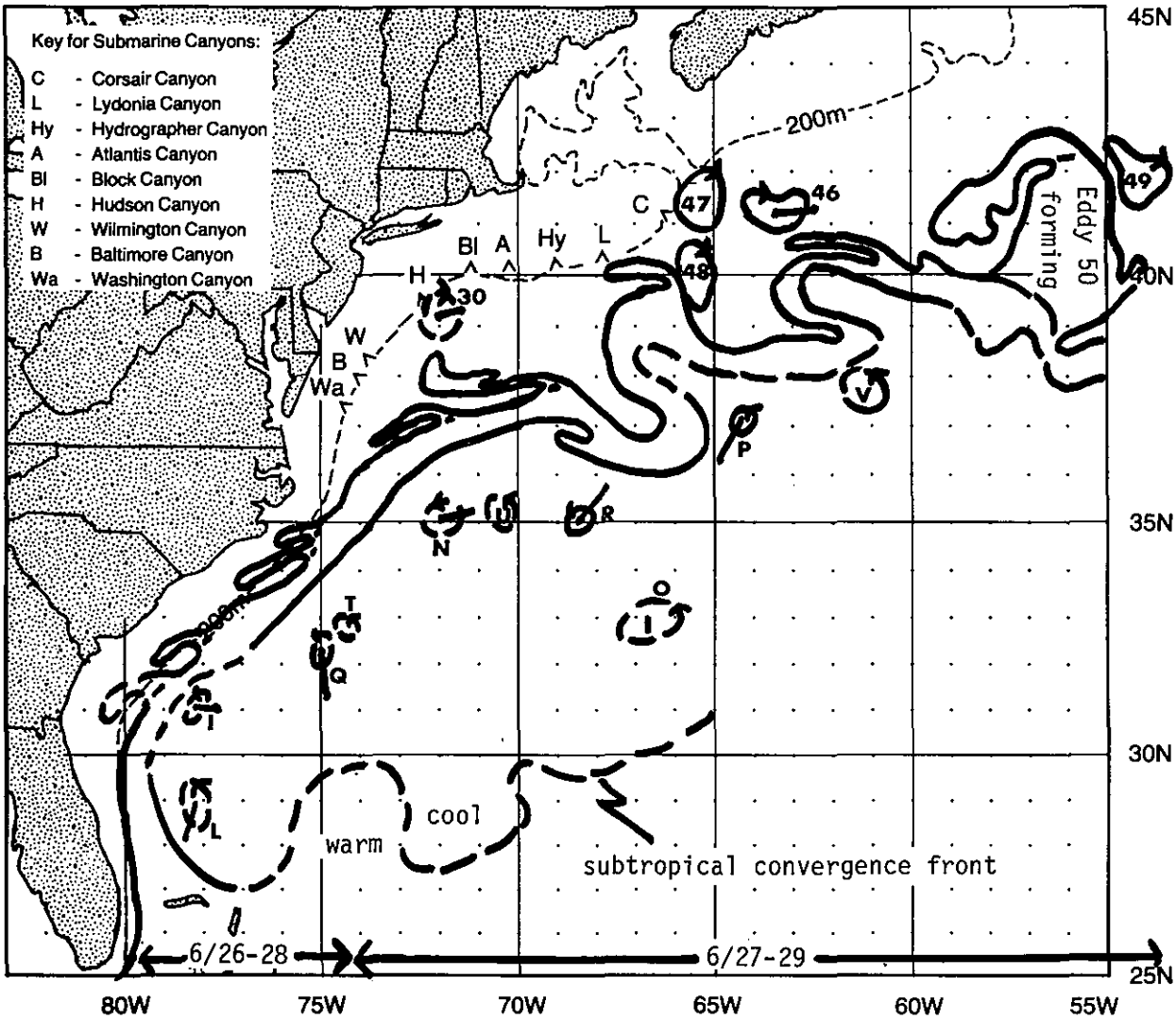


JUNE 1984

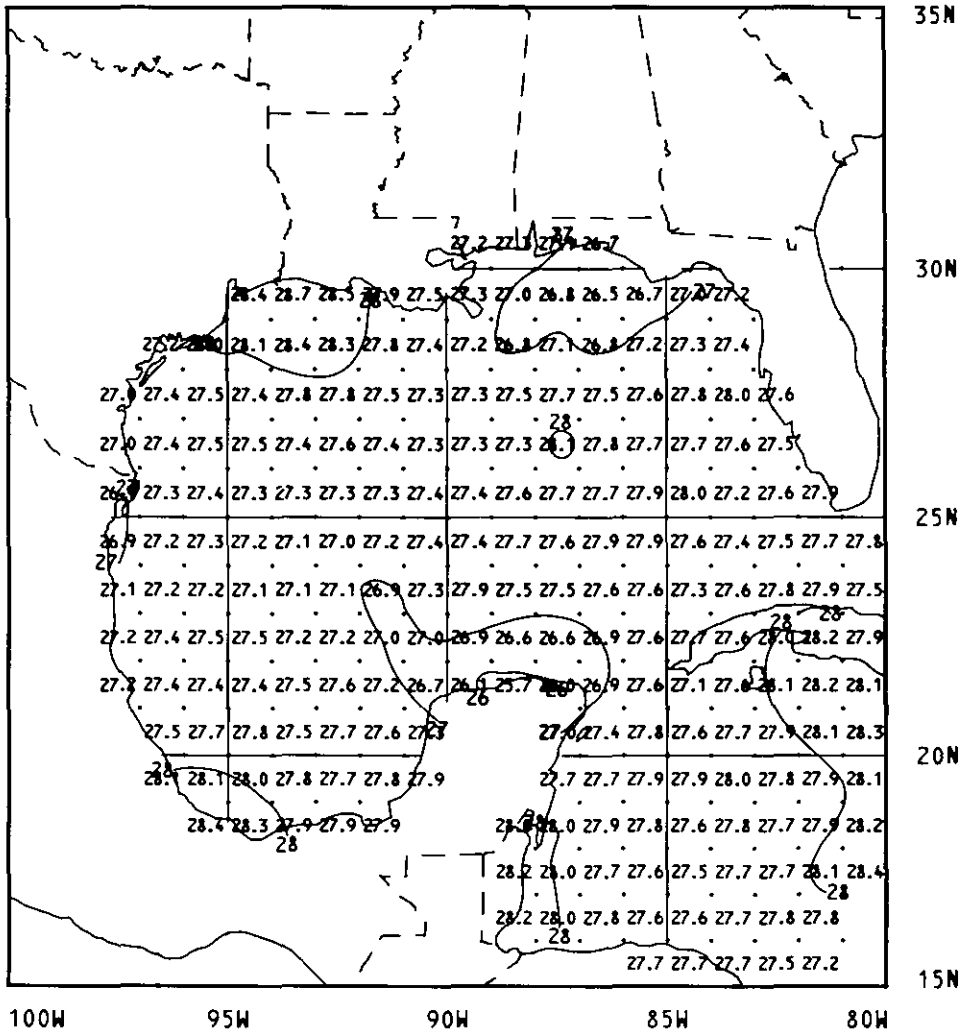
The end-of-month amplitude of the Loop Current increased slightly northward when compared to the end-of-May position. Due to seasonal heating and cloudiness, eddy k was not observed during the month.



Significant Gulf Stream features in the end-of-June analysis are the large meanders near 36°N 65°30W, 40°N 67°W, 40°N 63°W, and the elongated tongue of warm slope water near 40°30N 59°30W to 42°30N 56°W. One anticyclonic eddy was newly observed and three anticyclonic eddies formed during the month. Eddy 47 was first detected near 40°30N 64°30W around June 1. The origin of eddy 47 is uncertain. However, it is suspected to have formed from a long tongue of warm slope water associated with the Gulf Stream in early May. Eddy 48 formed from a Gulf Stream meander near 39°N 65°W on June 10. Eddy 49 apparently formed from the Gulf Stream near 41°30N 54°30W on June 17. Eddy 50 began forming from a Gulf Stream meander near 42°30N 56°W on June 25. Eddy 46 translated 80 km W. After translating 55 km WSW by June 22, eddy 30 appears to be weakening.

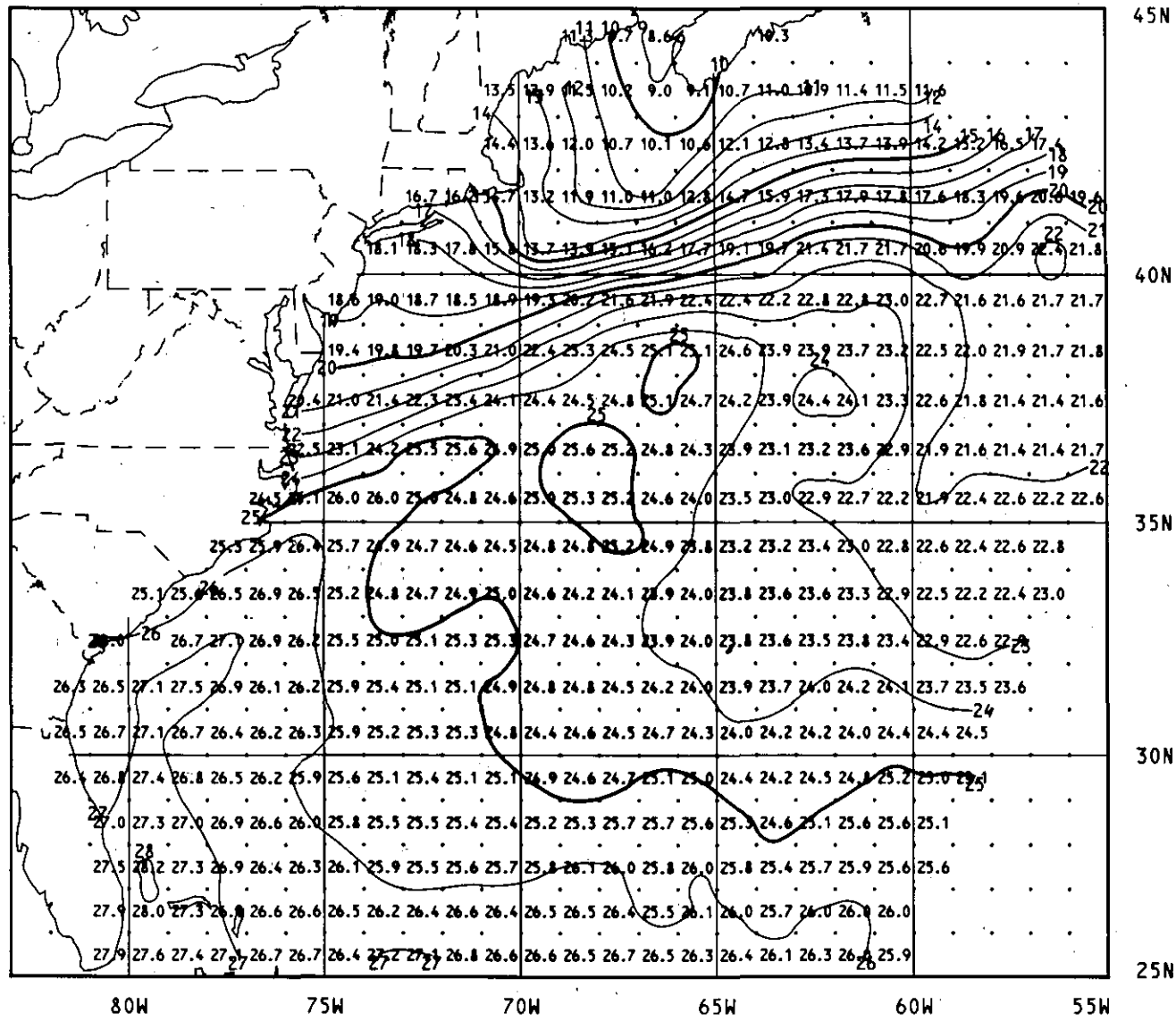
Two cyclonic eddies were newly detected and one cyclonic eddy formed during the month. Eddy T was newly observed near 33°N 74°30W on June 2. Its origin is uncertain. Eddy U was first detected near 35°N 70°30W on June 4. Its origin is uncertain. Eddy V formed from a Gulf Stream meander near 38°N 61°W on June 11. Eddy L, last observed on June 14, presumably traveled 90 km NNE. Eddy I translated 55 km W when it was last detected on June 14. Eddy Q traveled 110 km N. Eddy S presumably dissipated in the mixed Gulf Stream/Sargasso water near 34°N 71°W around June 14. Eddy N, last observed on June 14, traveled 75 km WSW. Eddy R moved 100 km SW. Eddy P traveled 110 km NE. Eddy O traveled 25 km N when it was last observed on June 14. The subtropical convergence front was last observed on June 14.

EAST COAST SST-
MONTHLY MEAN



Gulf of Mexico
SST--MONTHLY MEAN (°C)
June 1984

Monthly mean sea surface temperature is the mean of twice-weekly analyses using ship, buoy, and satellite observations. Contour line interval is 1.0°C.



NW Atlantic Ocean
SST--MONTHLY MEAN (°C)
June 1984

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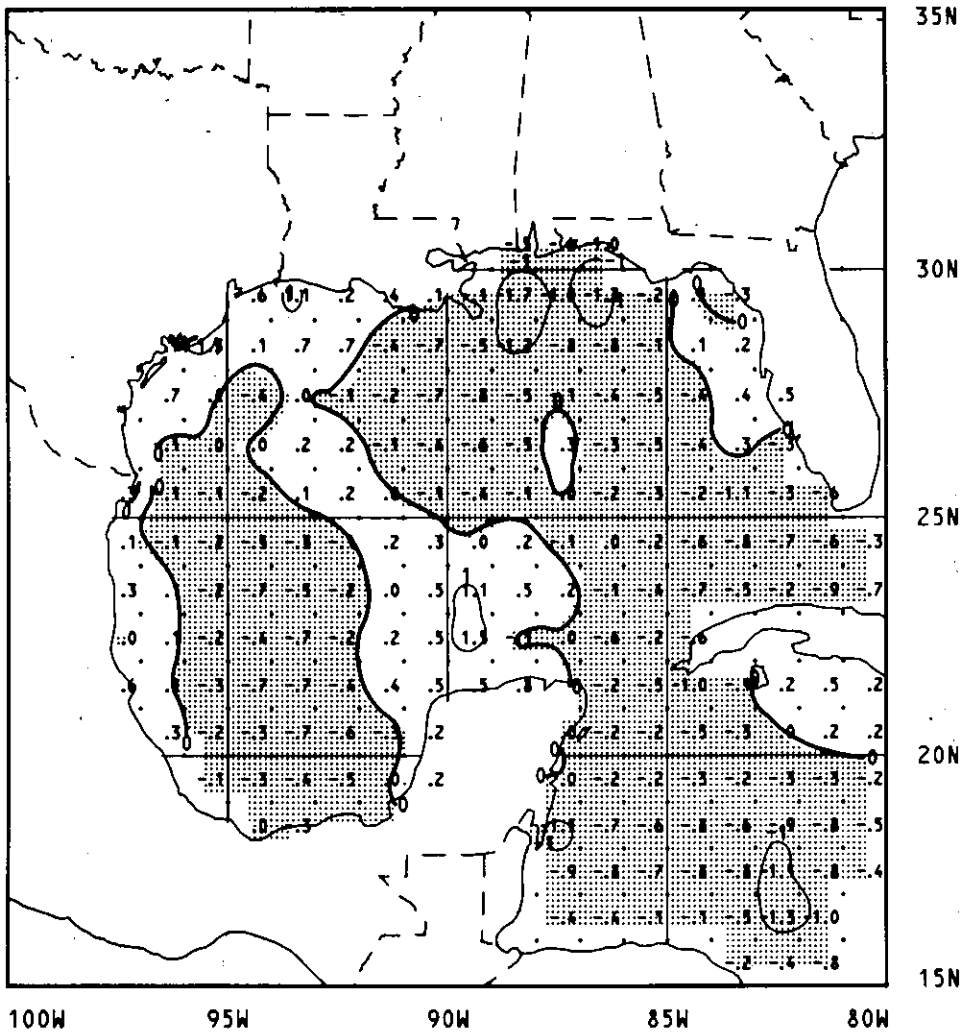
EAST COAST SST-ANOMALY



Gulf of Mexico
SST--MONTHLY ANOMALY (°C)
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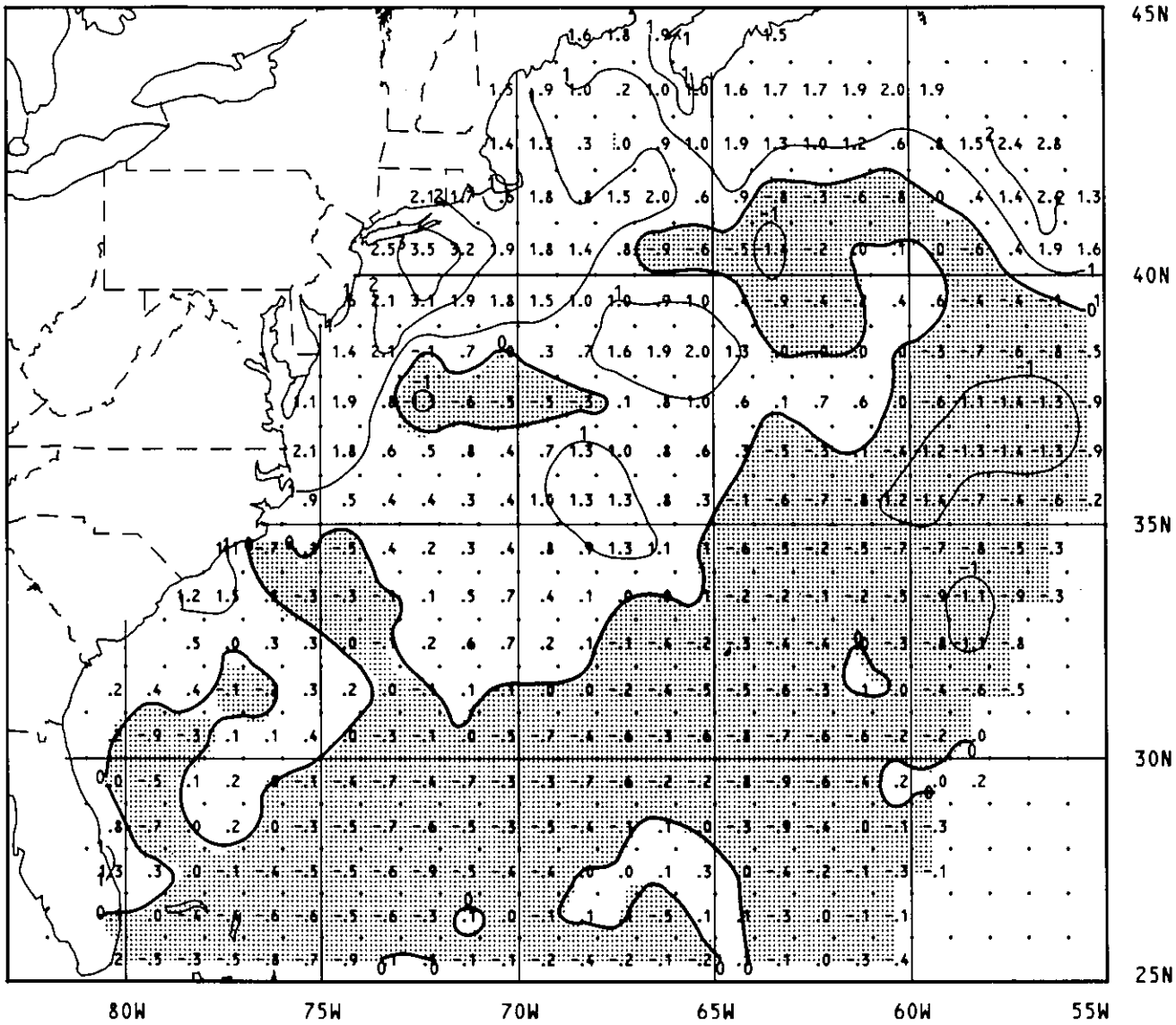

NW Atlantic Ocean
SST--MONTHLY ANOMALY (°C)
June 1984

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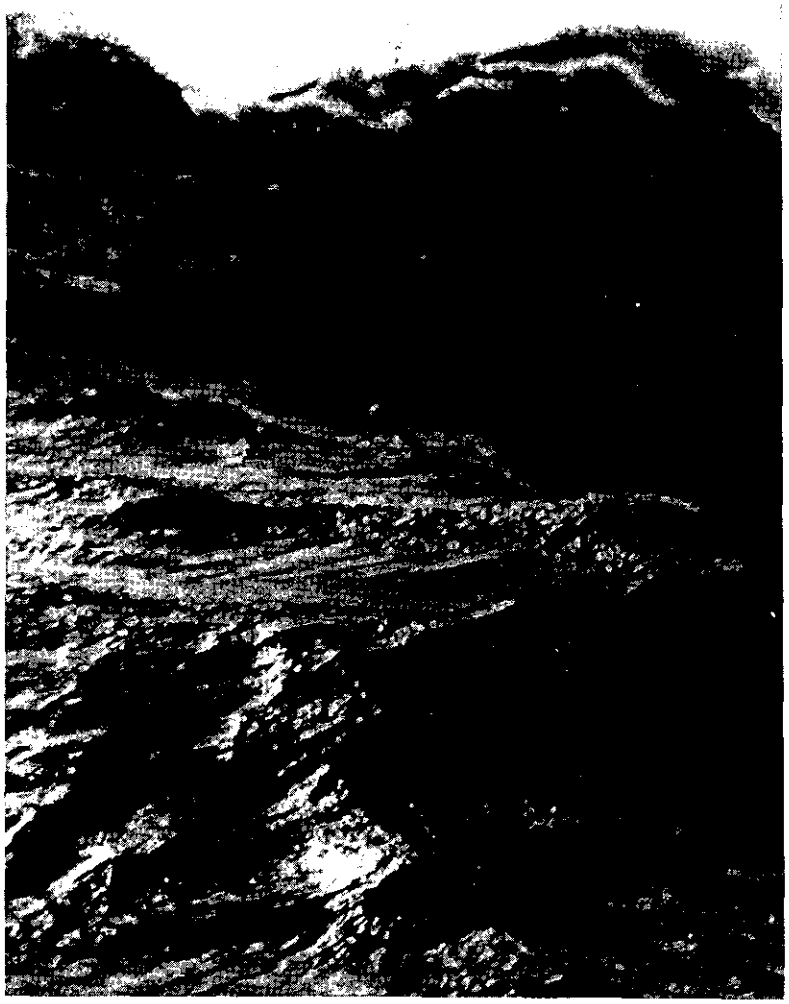
The Secretary of Commerce has determined that the publication of this periodical is necessary in the transaction of the public business required by law of this Department. Use of funds for printing this periodical has been approved by the Director of the Office of Management and Budget through April 1, 1985.

OCEANOGRAPHIC Monthly Summary

Volume IV Number 7 July 1984



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Oceanographic Monthly Summary is published by the National Weather Service and the National Environmental Satellite, Data, and Information Service (NESDIS). *Oceanographic Monthly Summary* contains sea surface temperature (SST) analyses on both regional and ocean basin scales for the Atlantic and Pacific Oceans. Two ocean basin SST analyses are presented, one based on in-situ data and another based solely on satellite data. An ocean basin SST anomaly derived from the in-situ data is also shown; it uses the National Climatic Center (NCC) Climatology*. The regional SST analyses are based upon a combination of in-situ and satellite data measurements. The regional SST anomalies use the Robinson-Bauer Climatology*. *Oceanographic Monthly Summary* also contains Alaskan sea ice information and ocean feature information for contiguous U.S. ocean regions.

Oceanographic Monthly Summary welcomes articles containing information of interest to *Oceanographic Monthly Summary* readers, such as, news on operational oceanography, unusual ocean feature phenomena, etc. Contributions should be sent to the editor (address below). Accepted material will appear in the OceaNotes section of *Oceanographic Monthly Summary*. Contributions can be published as quickly as the next monthly issue.

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*Reynolds, R.W., 1982. A Monthly Averaged Climatology of Sea Surface Temperatures; *NOAA Technical Report NWS 31.*

*Robinson, M.K., 1976. Atlas of North Pacific Ocean Monthly Mean Temperatures and Mean Salinities of the Surface Layer; *NavOceano Ref. Pub. 2.*

Robinson, M.K., R. A. Bauer and E.H. Schroeder, 1979. Atlas of North Atlantic-Indian Ocean Monthly Mean Temperatures and Mean Salinities of the Surface Layer; *NavOceano Ref. Pub. 18.*

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THE REAPPEARANCE OF LONG WAVES IN THE EQUATORIAL PACIFIC AFTER THE EL NINO OF 1982

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Since 1975, long waves were monitored using satellite infrared measurements in the eastern equatorial Pacific. These waves usually appear each year along a zonally oriented SST front north of the equator May-December. The waves were not detectable by satellite sensors during the 1976 and 1982 El Nino events due to the decreased meridional and zonal SST gradients along the equatorial Pacific. This note describes the long waves' reappearance in the equatorial Pacific during 1983. The waves are detectable in a new multi-channel SST analysis (MCSST), which was used since October 1981. An initial evaluation using weekly SST composite charts revealed that the MCSST can detect long waves between October 1981-February 1982. Due to the anomalously warm equatorial Pacific waters during 1982 and the first half of 1983, long waves were not observed in the MCSST analyses.

The first indication of a cooling trend along the equatorial Pacific during 1983 was a zonally oriented band of cooler water (25°-26°C) between 110°W and 130°W the week of June 21 (fig. 1). This band of cooler water appeared to expand eastward and westward with time, and within one month cooler water (24° to 26°C) extended from the Galapagos Islands to 160°W the week of July 19 (fig. 2). This cooling is attributed to upwelling induced by local winds which must be verified by actual wind observations. The equatorial waters continued to cool the week of August 23 (fig. 3). Evidence of cooler water (21°-25°C) off the South American coast may be associated with increased advection of the Peru Current. The pool of 23°C water in the lee of the Galapagos Islands (fig. 3) is interpreted as upwelling induced by the interaction of a westward flowing current with the Islands.

The equatorial long waves (fig. 3) were first evident the week of August 23 with wave peaks estimated at 134°W, 122°W, and possibly 108°W and 97°W. The long waves (fig. 4) became more pronounced the week of September 20. A space-time plot of the wave peak positions provide an estimate of wavelengths (1000-1300 km) and wave speeds (40-50 km/day) between 120°W-140°W during August and September. These estimates of long wave characteristics are based on weekly SST composites at a spatial resolution of 50 km. The weekly time step appears to smooth out the wave crests associated with shorter wavelengths. For example, inspection of nearly instantaneous infrared images from GOES reveals the presence of waves 800-900 km in length between 100°W-120°W the week of September 20. Nevertheless, the weekly time step MCSST analysis illustrates the spatial and temporal evolution of the equatorial SST during 1983 and the reappearance of the long waves in the equatorial Pacific.

Figure 1. Seven day MCSST composite for week ending 6/21/83.

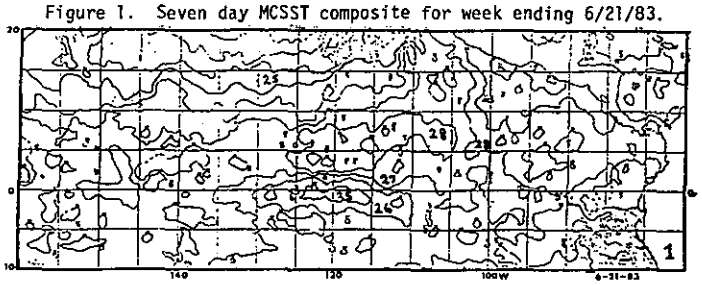


Figure 2. Seven day MCSST composite for week ending 7/19/83.

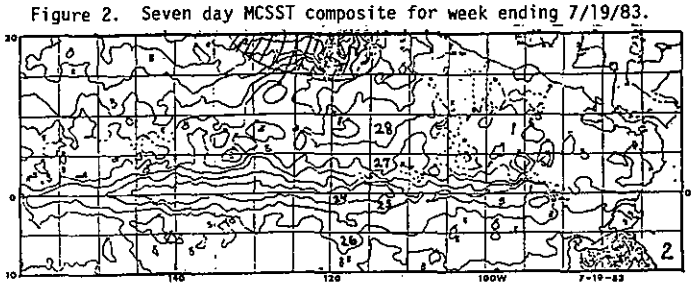


Figure 3. Seven day MCSST composite for week ending 8/23/83.

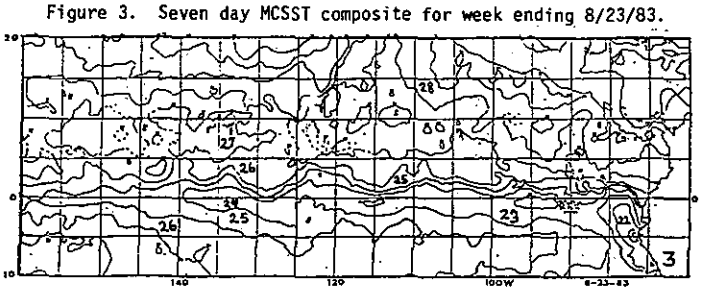
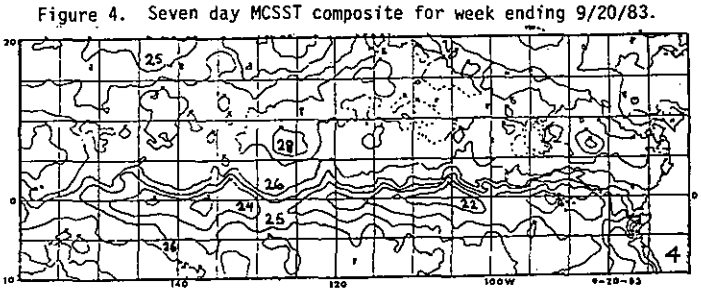
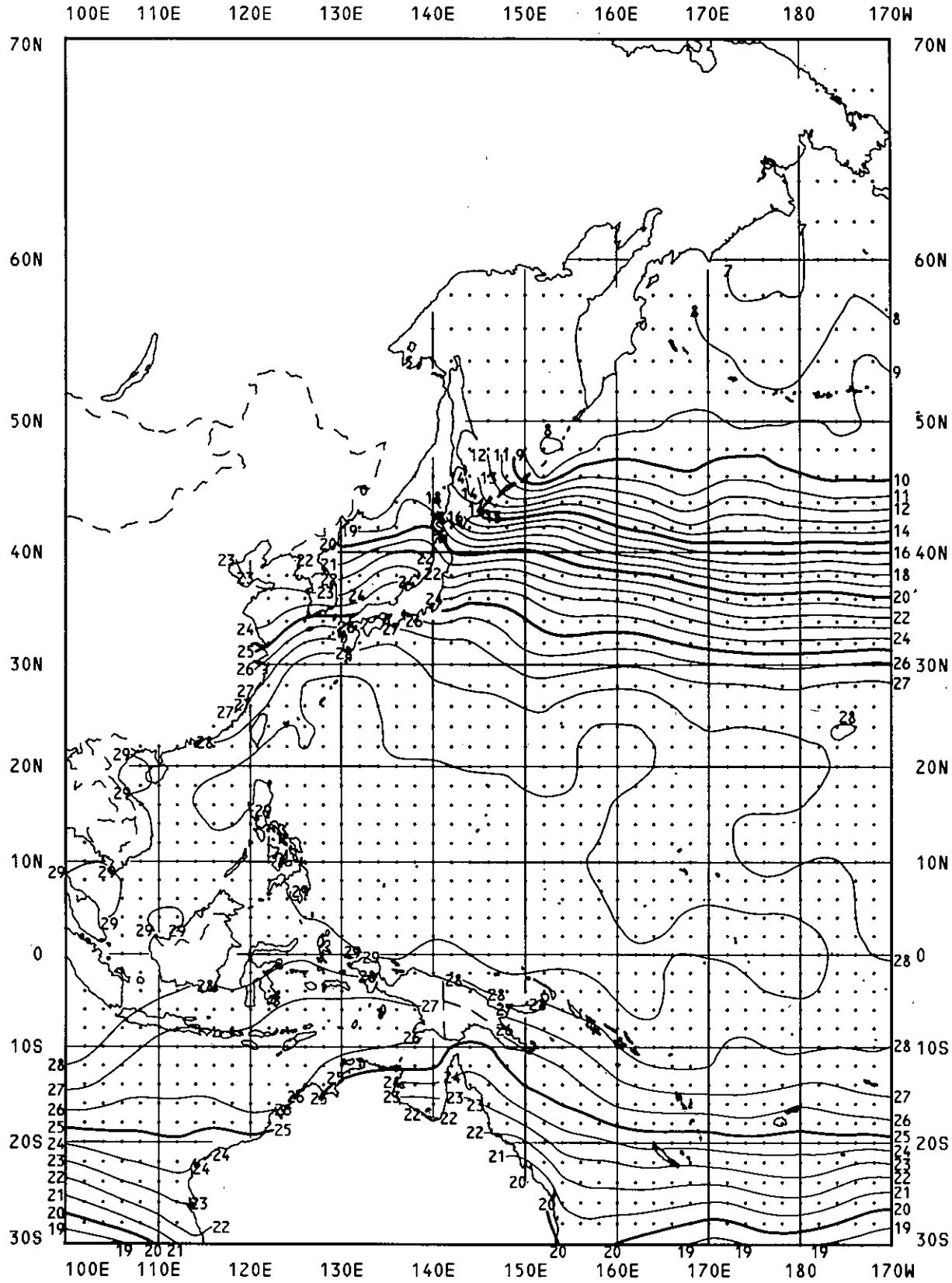


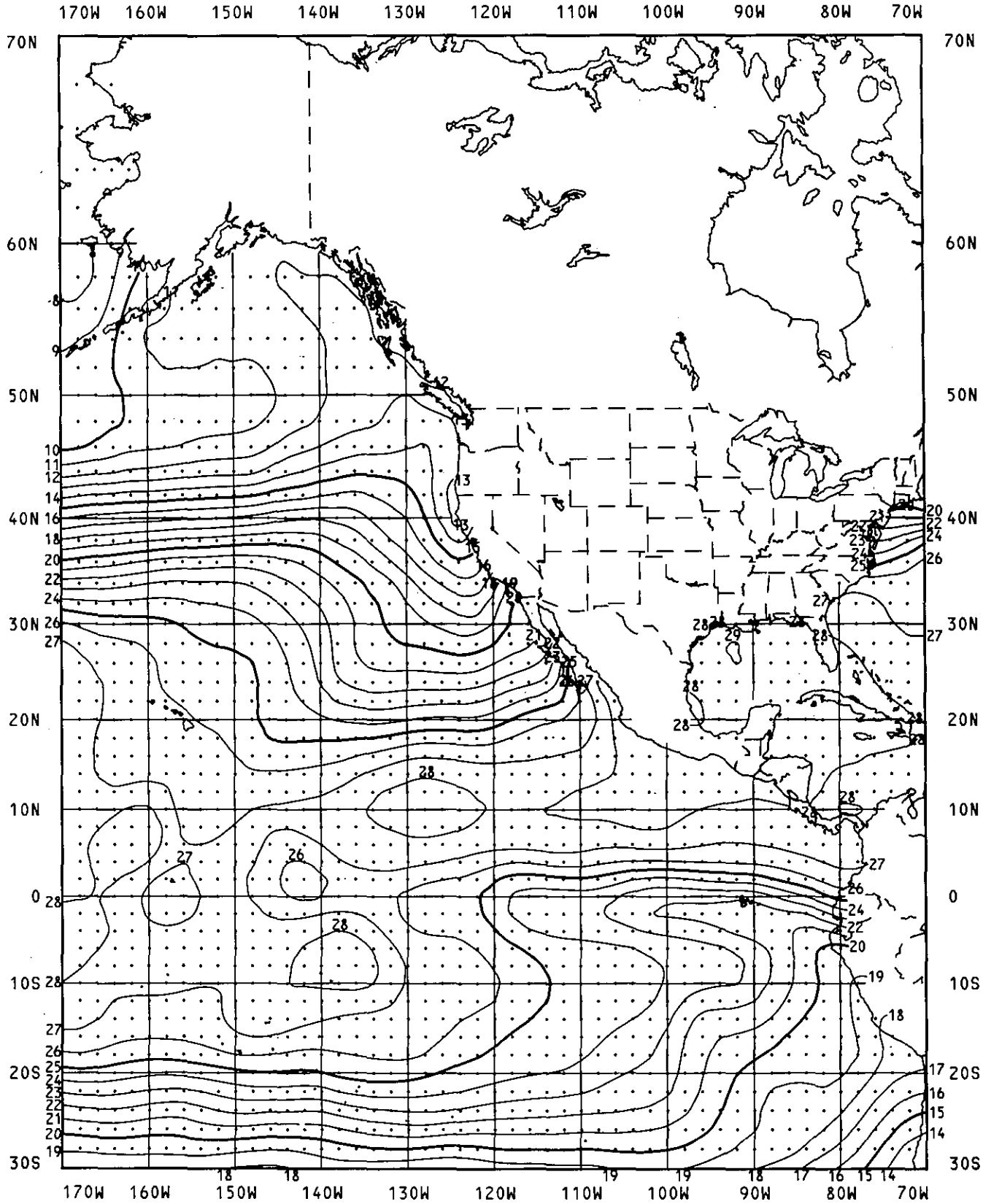
Figure 4. Seven day MCSST composite for week ending 9/20/83.





Western Pacific Ocean
SST--MONTHLY MEAN (°C)
SHIP and BUOY DATA
July 1984

Monthly mean sea surface temperature is the mean of in-situ data (ships and buoys) within two-degree quadrangles. Contour line interval is 1.0°C.



Eastern Pacific Ocean
SST--MONTHLY MEAN (°C)
SHIP and BUOY DATA
July 1984

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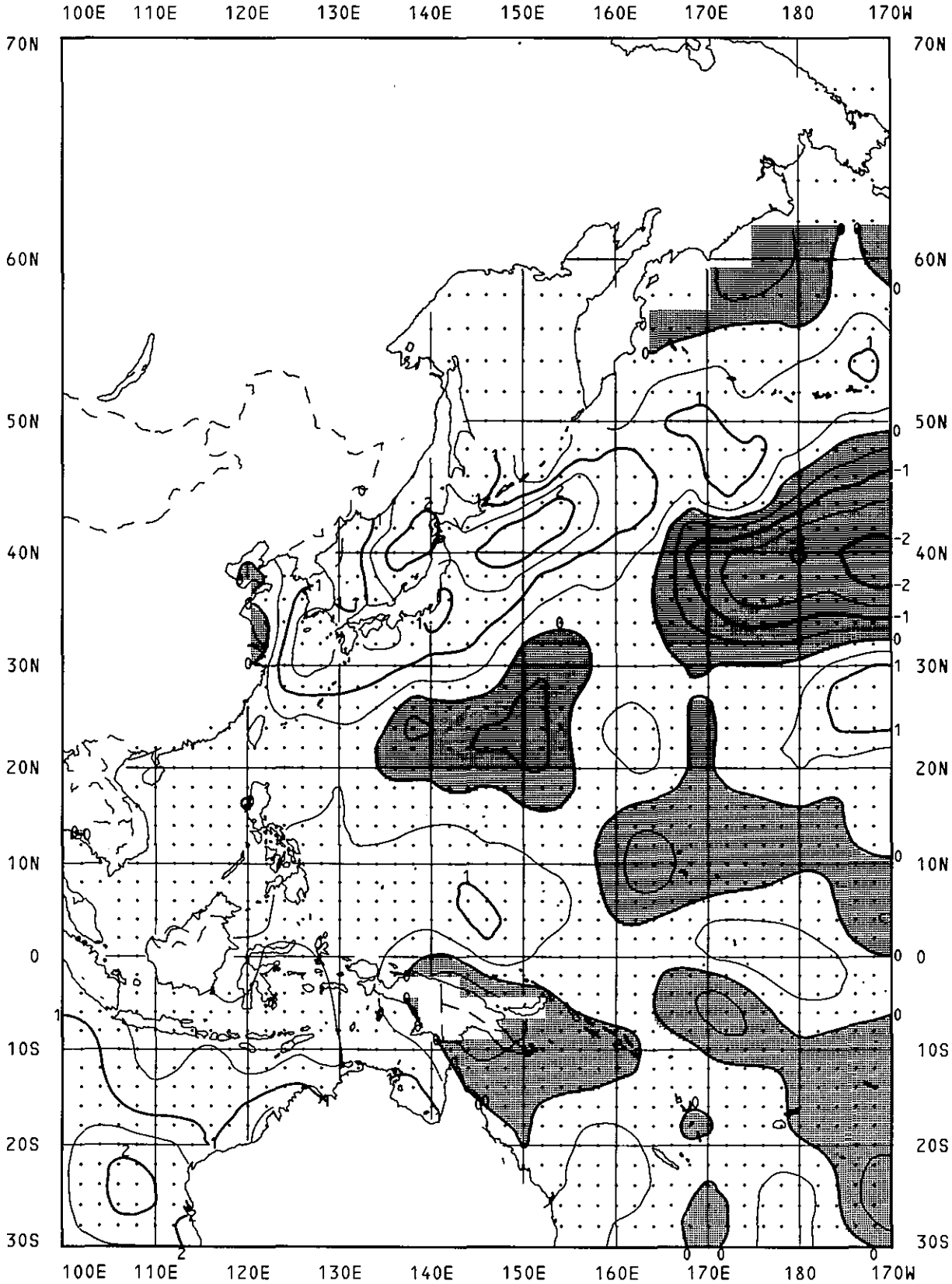

Western Pacific Ocean
SST--MONTHLY ANOMALY (°C)
SHIP and BUOY DATA
July 1984

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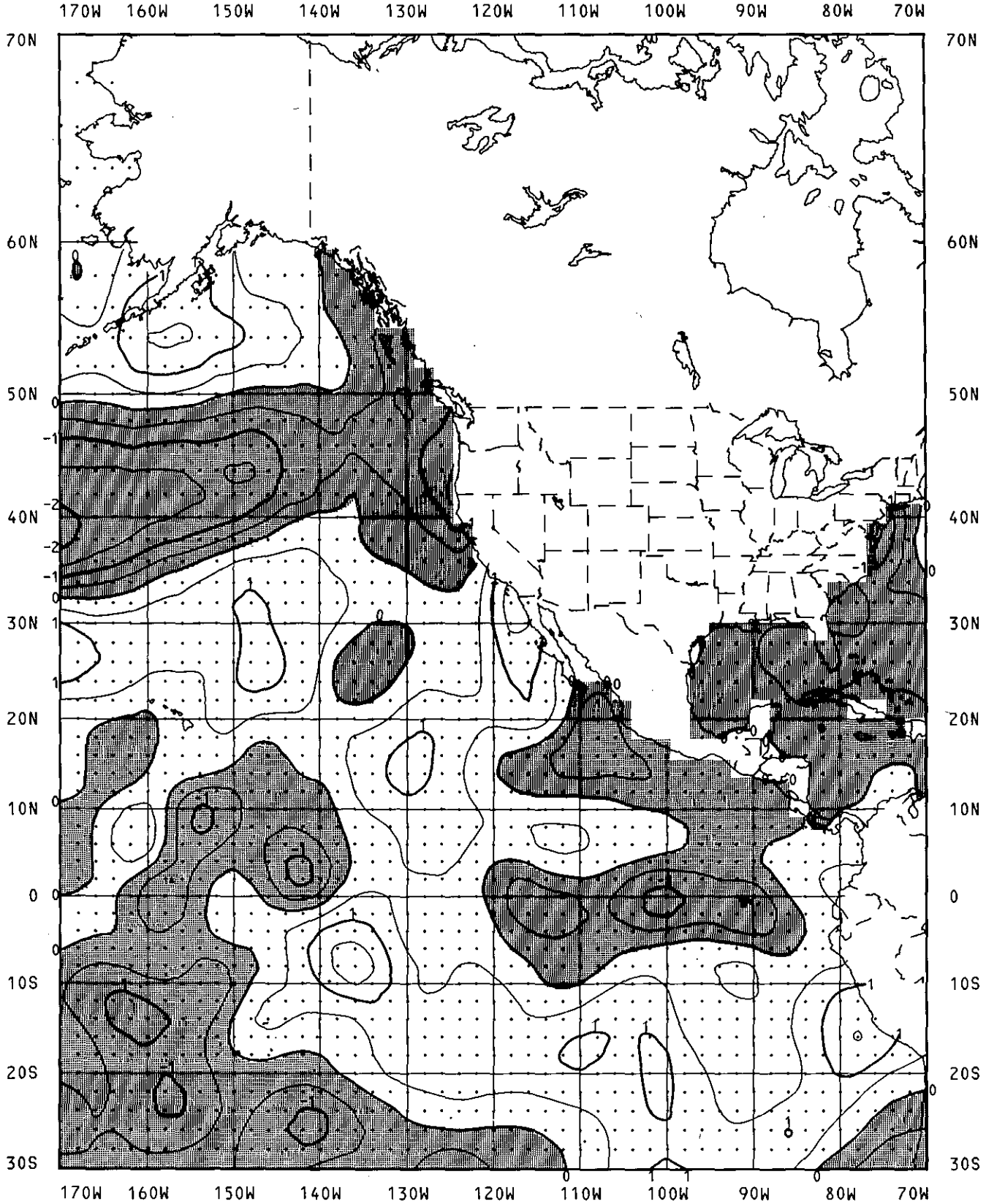

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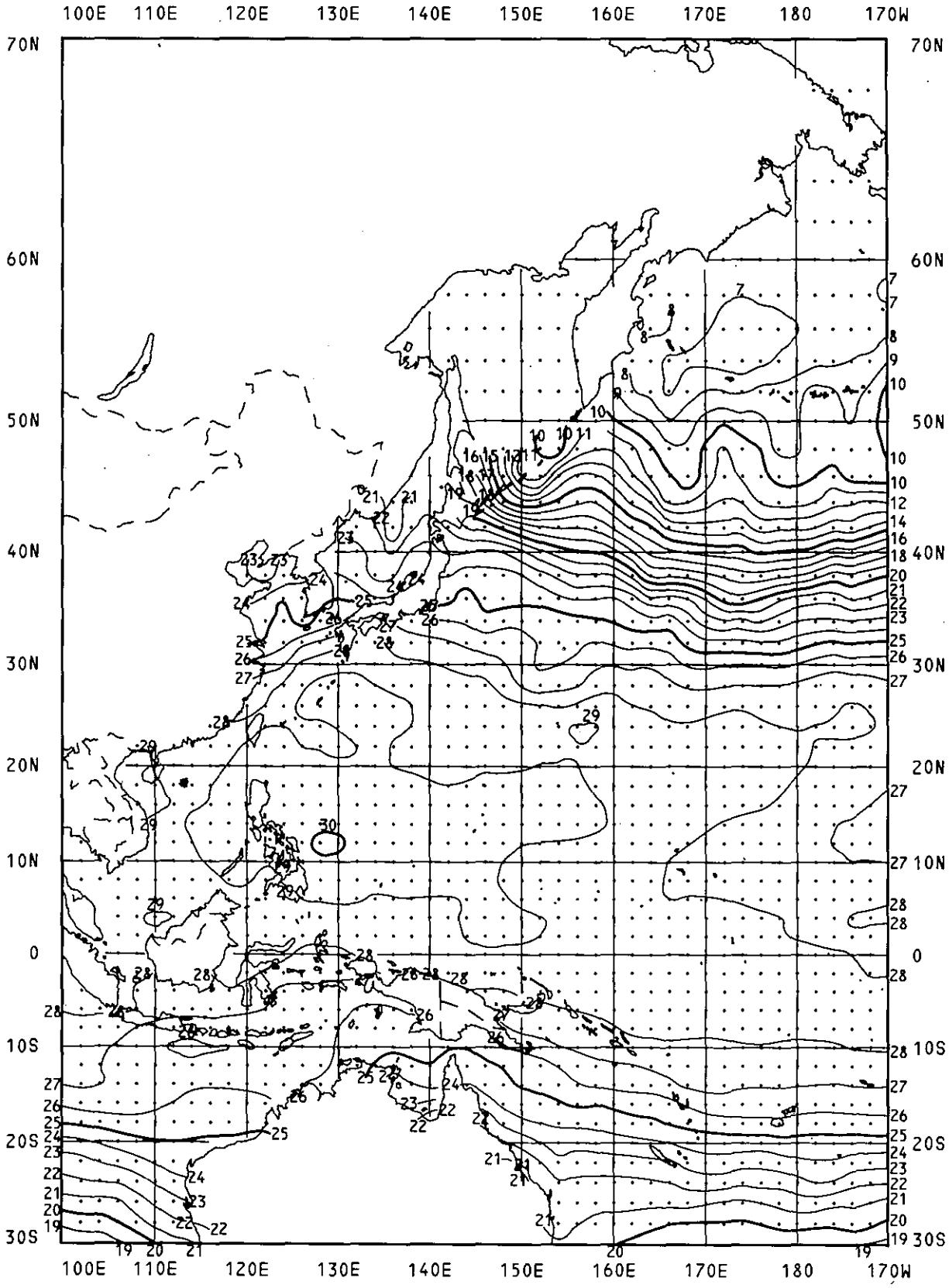
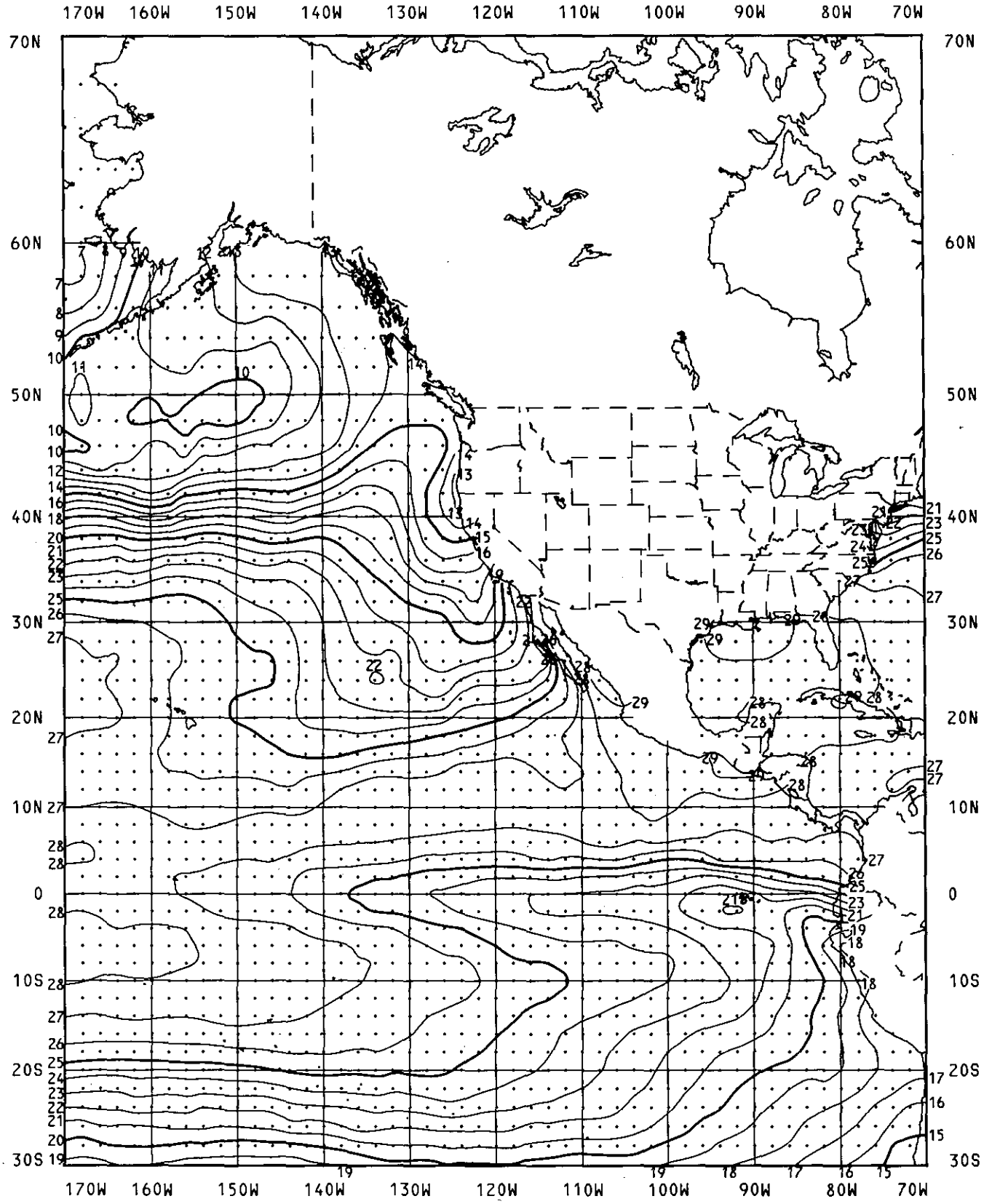


Western Pacific Ocean
SST--MONTHLY MEAN (°C)
SATELLITE DATA
July 1984

Monthly mean sea surface temperature is the mean of satellite data within two-degree quadrangles. Contour line interval is 1.0°C.



Eastern Pacific Ocean
SST--MONTHLY MEAN (°C)
SATELLITE DATA
July 1984

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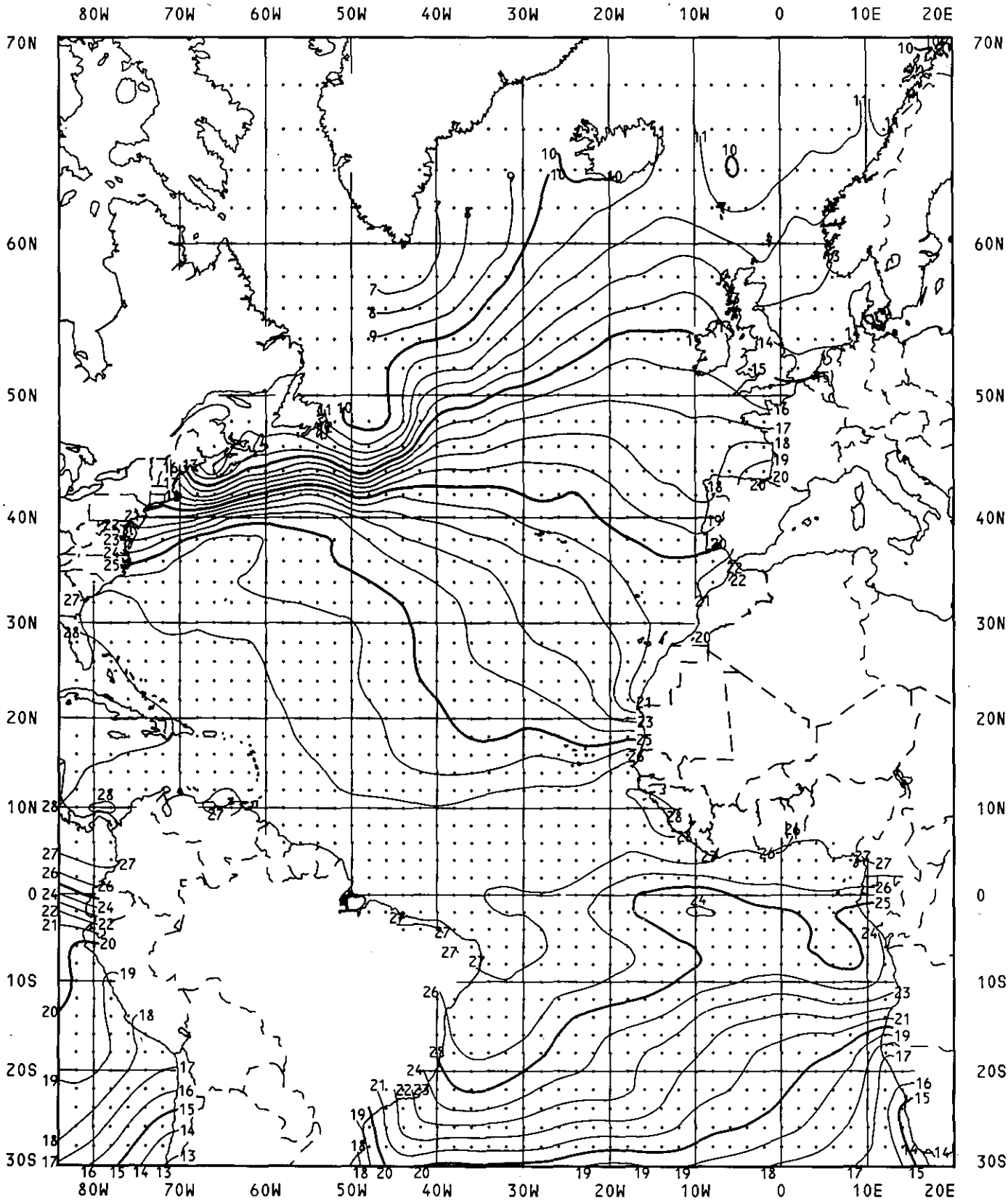
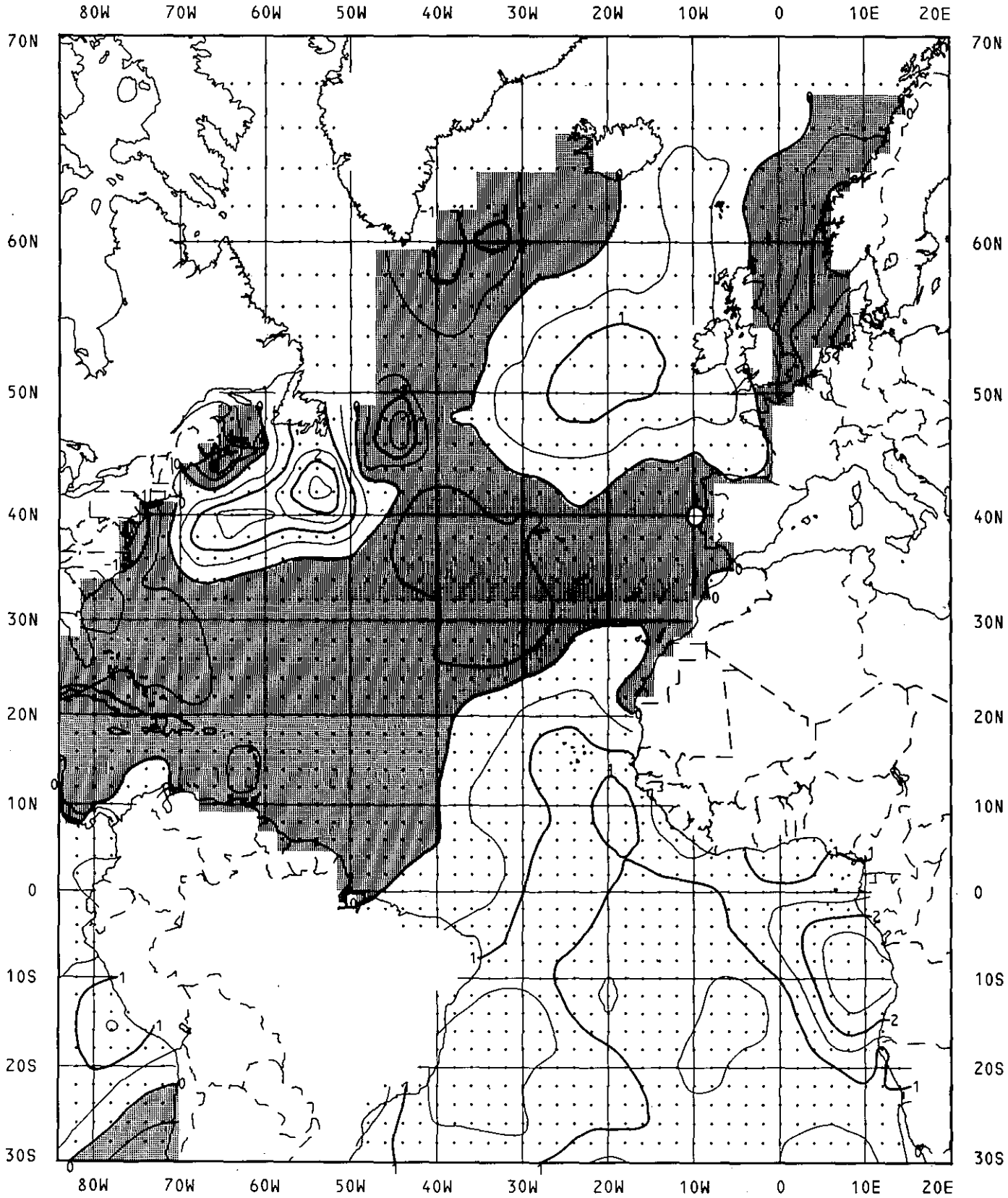


Atlantic Ocean
SST--MONTHLY MEAN (°C)
SHIP and BUOY DATA
July 1984

Monthly mean sea surface temperature is the mean of in-situ data (ships and buoys) within two-degree quadrangles. Contour line interval is 1.0°C.



Atlantic Ocean
SST--MONTHLY ANOMALY (°C)
SHIP and BUOY DATA
July 1984

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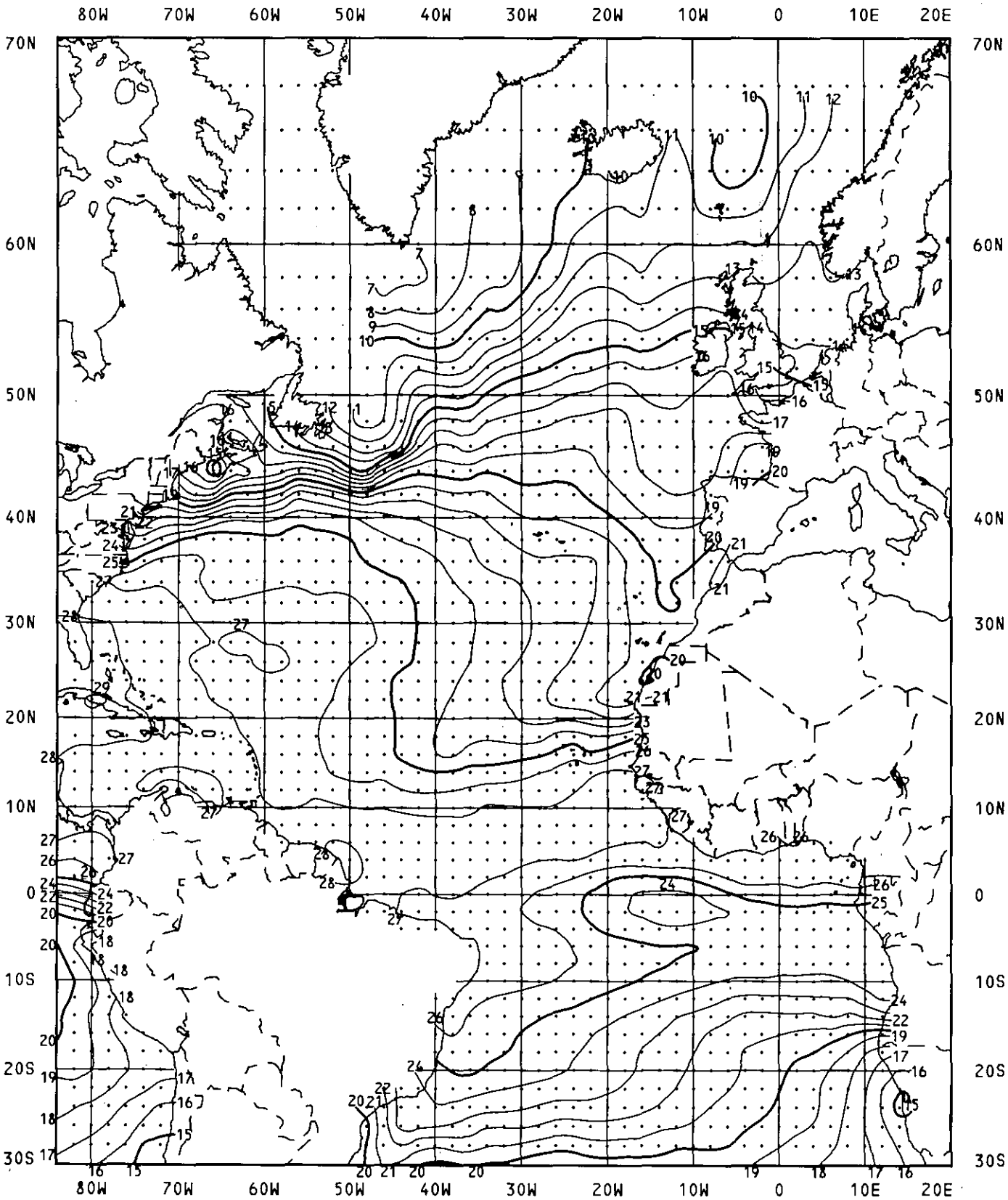

Atlantic Ocean
SST--MONTHLY MEAN (°C)
SATELLITE DATA
July 1984

Monthly mean sea surface temperature is the mean of satellite data within two-degree quadrangles. Contour line interval is 1.0°C.

SATELLITE IMAGE OF THE MONTH

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Interactive Processing Branch E/SP22
NESDIS, NOAA
Washington, DC 20233
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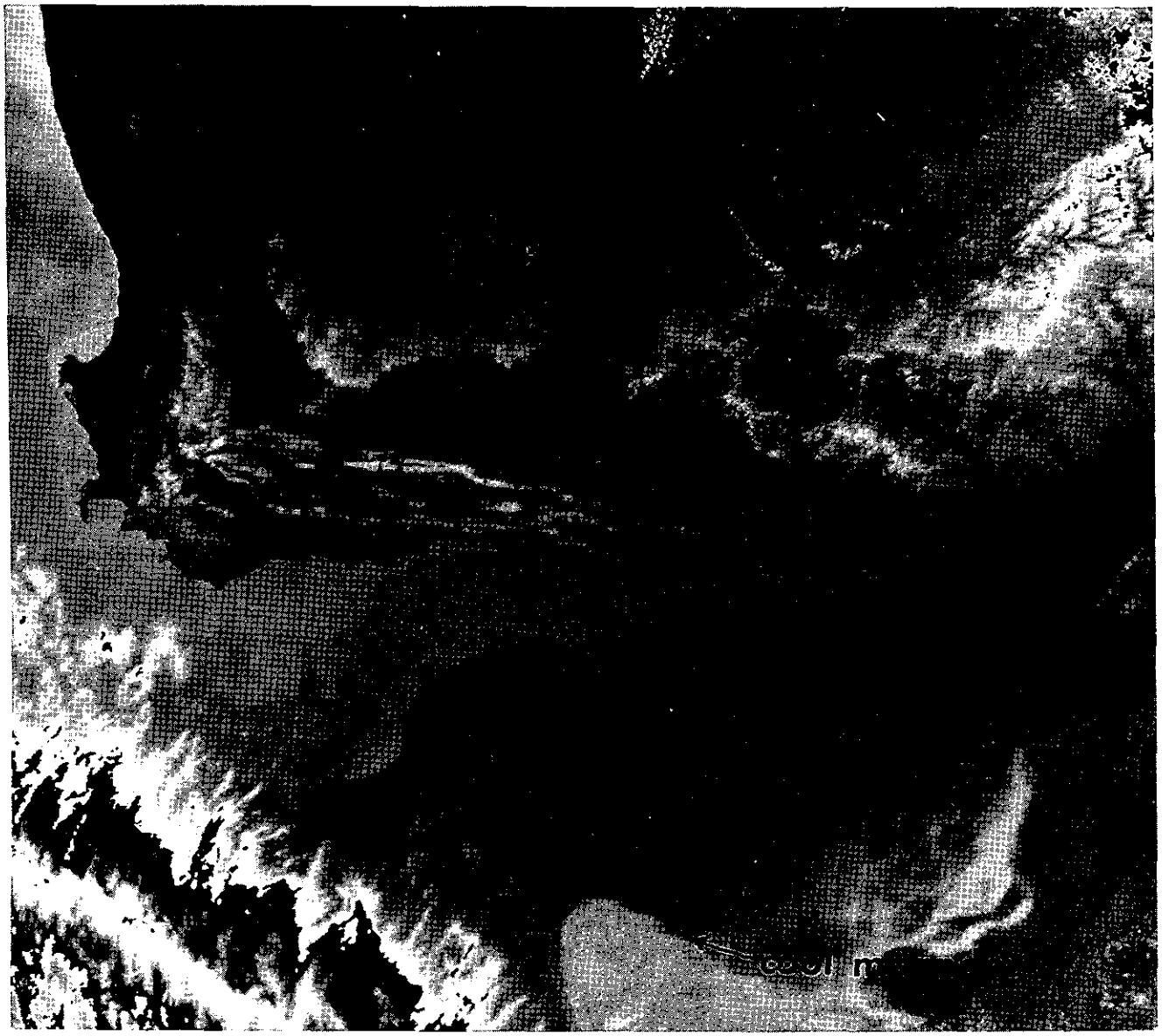
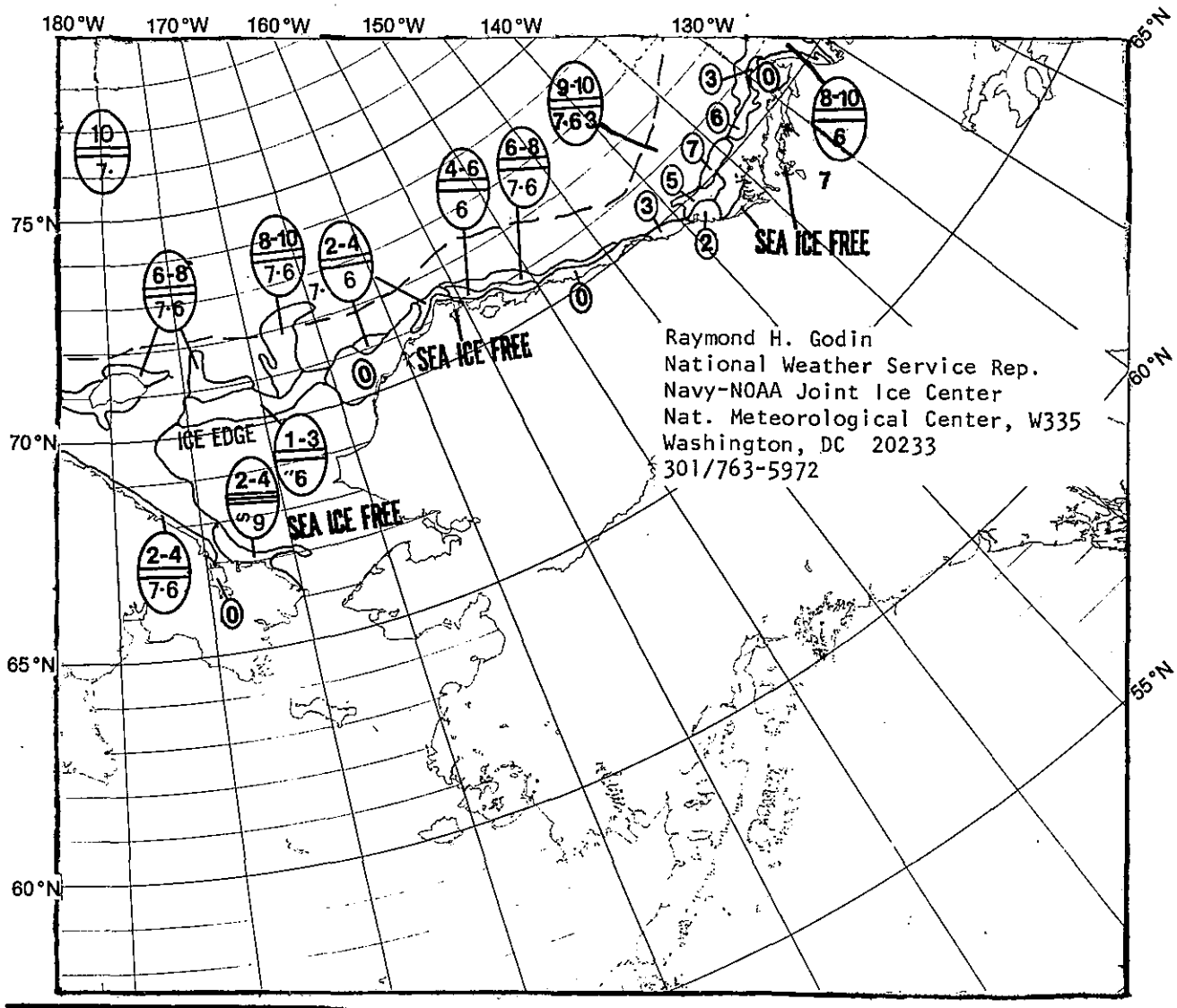
AGULHAS CURRENT

This NOAA-7 infrared (IR) satellite image of southern Africa was taken July 25, 1984. Southern Africa is located over most of the top portion of the image and the Agulhas Current is the dark band of relatively warm water located south of Africa. This current flows to the southwest, then joins the eastward flowing Antarctic Circumpolar Current well south of the coast. An intrusion of cool Antarctic Water is present as a light gray shade. Interaction between the Agulhas and Antarctic Circumpolar Currents has been observed by satellites, in the form of eddy circulations.



BERING SEA / NORTH SLOPE ICE ANALYSIS



C = Total ice concentration in the area in tenths.

C_a, C_b, C_c = Concentration of thickest (C_a), 2nd thickest (C_b), and 3rd thickest (C_c) ice

S_a, S_b, S_c = Stage of development of thickest (S_a), 2nd thickest (S_b), and 3rd thickest (S_c) ice.

~C = Concentration of ice within area(s) of strips and patches.

STAGE(S) OF DEVELOPMENT (THICKNESS)

1 = New ice (0-10 cm)
3 = Young ice (10-30 cm)
6 = First year (30-200 cm)
7 = First year thin (30-70 cm)
1. = First year medium (70-120 cm)
4. = First year thick (120-200 cm)
7. = Old ice (survived at least one summer's melt)

EXAMPLES

125 Theoretical thickness of this season's growth (cm).

Fast ice. Sea ice which forms and remains fast along the coast.

Ice boundary visually or satellite observed.

Ice boundary estimated.

JULY 1984

The monthly mean sea level pressure circulation depicts a 1024 mb high in the north Pacific near 48°N 180°W and a 1014 mb low in the Gulf of Alaska near 58°N 150°W. Mean surface geostrophic winds are westerly south of the Bering Strait and light and variable on the Alaskan North Slope. Monthly mean surface air temperatures are above normal at Barrow (71°N 157°W) and normal at Nome (65°N 165°W). A narrow coastal lead extending from Barrow to the Canadian border developed late in the month. North of the coastal lead a narrow band of first year ice is observed from Barrow eastward to 150°W. Between 150°W and the Canadian border a narrow band of old and first year ice is observed. The current ice edge position is near the climatological median in the Chukchi Sea and is a new minimum in the Beaufort Sea.

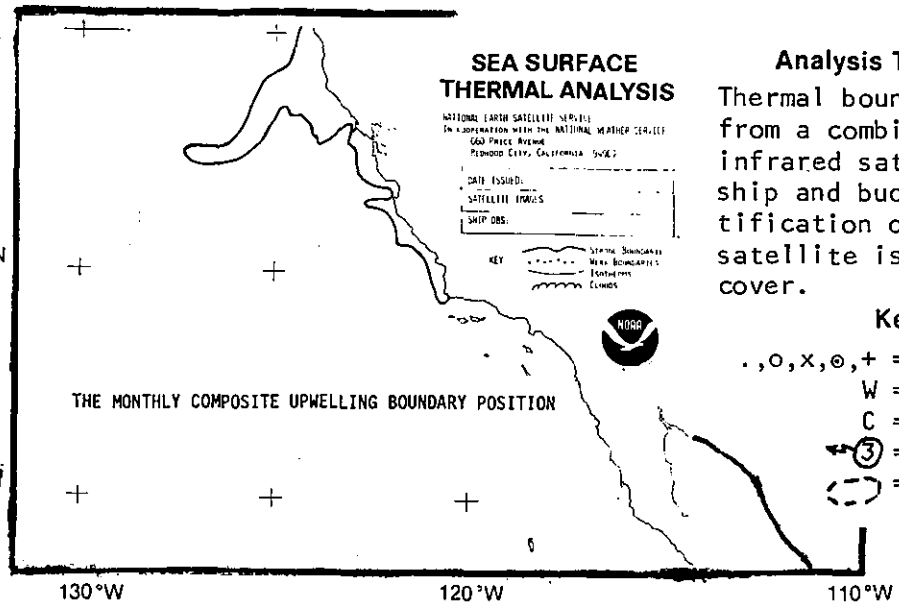
MONTHLY SST STATISTICS FOR SELECTED STATIONS
PACIFIC NORTHWEST
(Area enclosed by 40-52N, Coast-135W)

JUNE 1984

Station	Location (Lat/Long)	Mean SST	Standard Deviation	Maximum SST	Minimum SST	Change From Previous Month
Buoy 46005	46.1 N 131.0 W	13.9	0.7	15.6	12.5	+2.3
Buoy 46002	42.5 N 130.3 W	15.4	0.6	17.1	14.7	+2.3
Buoy 46029	46.2 N 124.2 W	12.8	1.2	15.4	11.0	+0.1
(Buoy 46029 is temporarily replacing Buoy 46010.)						
Buoy 46027	41.8 N 124.4 W	9.4	1.4	12.4	7.6	+0.3
Quillayute River	47.9 N 124.6 W	10.5	1.7	15.0	8.9	-0.1
Grays Harbor	46.9 N 124.1 W	14.9	1.7	18.3	12.2	+0.8
Cape Disappointment	46.3 N 124.1 W	15.2	1.0	16.7	13.3	+0.5
Yaquina Bay	44.6 N 124.1 W	10.7	1.4	14.4	8.9	-0.2
Chetco River	42.0 N 124.3 W	9.2	0.9	11.1	7.8	-0.4

JULY 1984

SSTs off the Pacific Northwest overall were mostly cooler than normal during July; as much as 1.0°C in offshore waters and 3.0°C in coastal waters between Cape Blanco and Pt. St. George. A characteristic weather pattern for the northeast Pacific was prevalent almost the entire month resulting in wind induced coastal upwelling along the Pacific northwest coast, particularly along southern Oregon and northern California. Upwelling diminished slightly about July 21 but increased again about July 26. Although coastal upwelling was not stronger than normal for the month, SSTs near 8.0°C were reported by Buoy 46027 off Pt. St. George, California, during peak upwelling. The SST pattern was similar to June but reflected seasonal warming especially during the last half of the month.



Analysis Techniques

Thermal boundaries are determined from a combination of enhanced infrared satellite imagery and ship and buoy observations. Identification of these features by satellite is limited by cloud cover.

Key

.,o,x,⊙,+ = thermal boundaries
W = warm
C = cold
(3) = date of feature
(- -) = outline of water mass feature

North Panel
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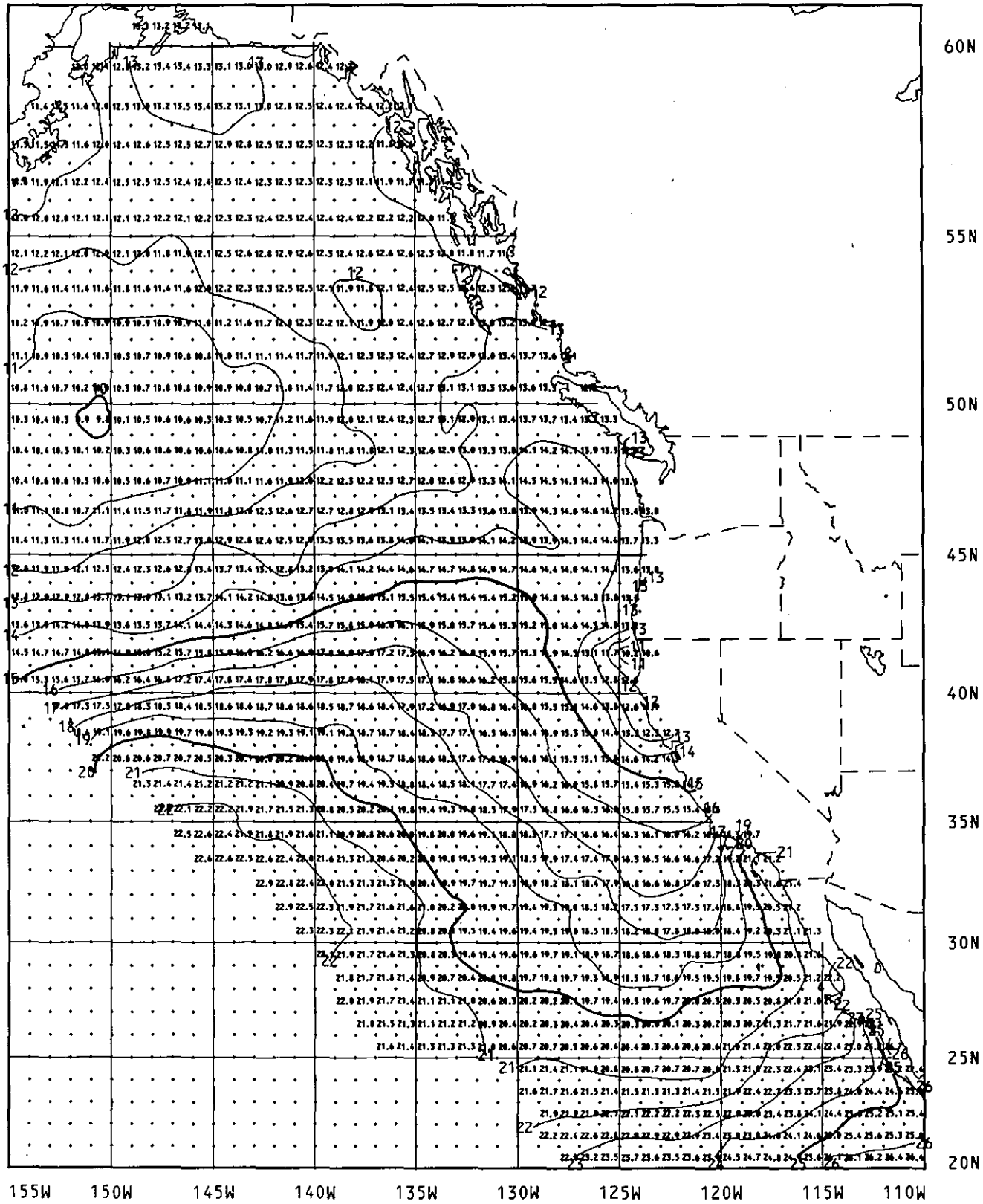
Bin C15700
Seattle, WA 98115
(206) 527-6604

South Panel
Ernest Daghir
NOAA/NWS
Satellite Field Service Station
660 Price Avenue
Redwood City, CA 94063
(415) 364-2422

The average mean temperature over the South Panel during July was cooler (17.8°C) than the climatological normal (18.4°C). SSTs were below normal in most of the analysis area with a minimum of 3.0°C centered at 37°30N 127°30W. A cool plume of upwelled water extended from the coast to this minimum point for almost the entire month which accentuated this anomaly. Water temperatures were above normal from the San Francisco Bay southward and along shore to the Baja peninsula with a maximum of 2.3°C above normal near San Diego. When compared to June, the entire area warmed in response to the season. Warming of 3.0°C was observed in the extreme northwest portion of the chart and also in the southeast portion with a minimum warming of 0.2°C at 37°30N 127°30W in response to the cool plume. Upwelling was strongest at the beginning of the month and then gradually abated. Another minor upwelling event occurred around July 27.



West Coast
SST--MONTHLY MEAN (°C)
July 1984

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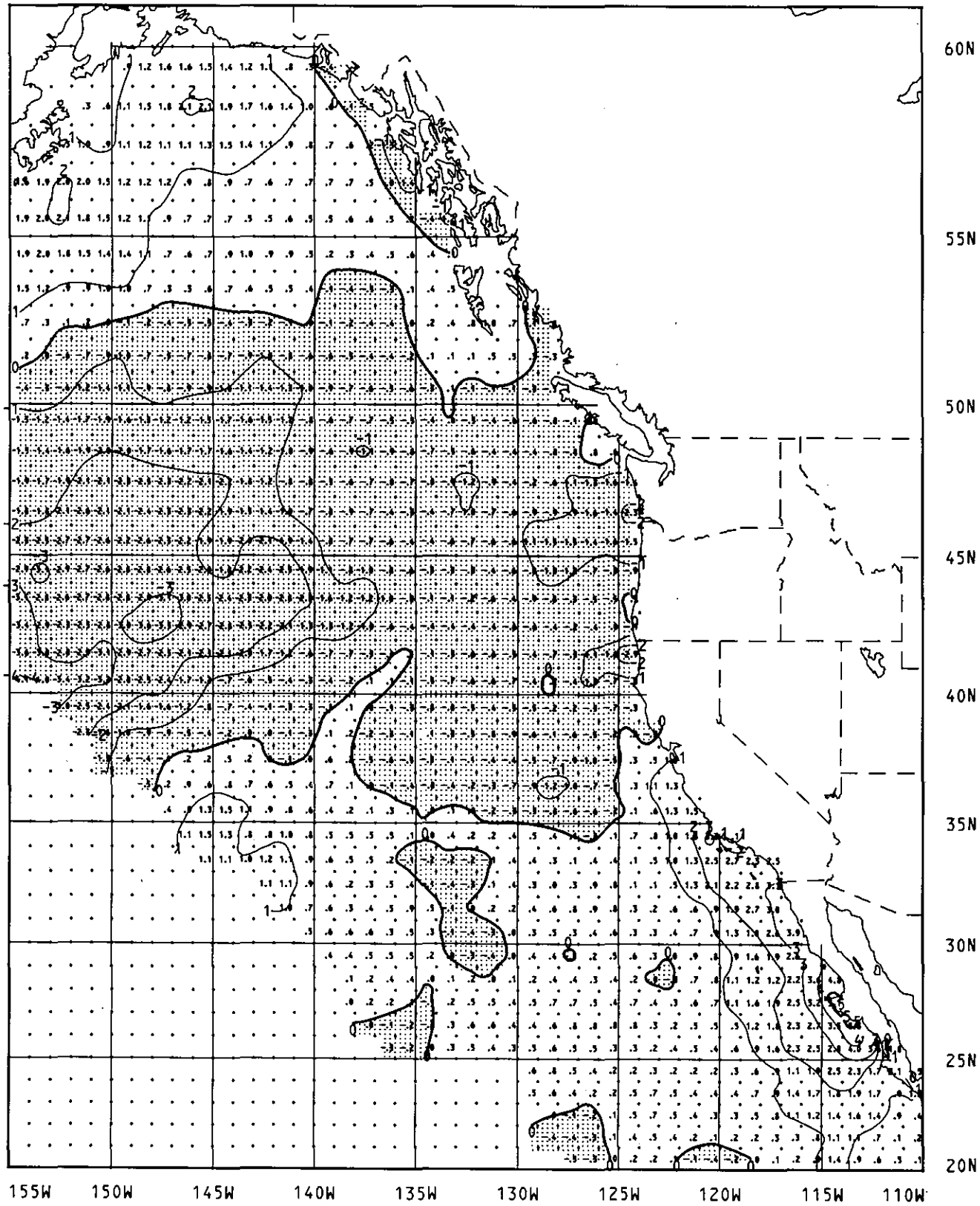

West Coast
SST--MONTHLY ANOMALY (°C)
July 1984

Monthly anomaly is the difference between the monthly mean sea surface temperature and the climatological monthly mean value -- shading shows where the monthly mean is colder than climatology. Contour line interval is 1.0°C.

The end of this month's positions of the Gulf Stream System and its associated eddies are shown for the NW Atlantic and the Gulf of Mexico. The Gulf Stream and Loop Current boundaries are located by infrared satellite imagery or XBT (expendable bathythermograph) data. Anticyclonic eddies are labeled a-z in the Gulf of Mexico and 1-99 in the NW Atlantic. Cyclonic eddies are labeled A-Z. Arrows on eddies indicate direction of circulation. Warm-core or anticyclonic eddies rotate clockwise; cold-core or cyclonic eddies rotate counterclockwise. The line to the eddy center shows the net translation since last month or since last observed. Eddies or sections of the Gulf

EAST COAST OCEAN FEATURES

Stream System which were not observed during the month are not shown on the analysis chart. The long arrows at the bottom of the chart indicate the date of data used.

Data used in this analysis include:
- NOAA satellite infrared imagery, NESDIS
- Bathythermograph data, National Meteorological Center of National Weather Service
- Oceanographic Analysis, A daily detailed analysis issued by National Weather Service/NESDIS

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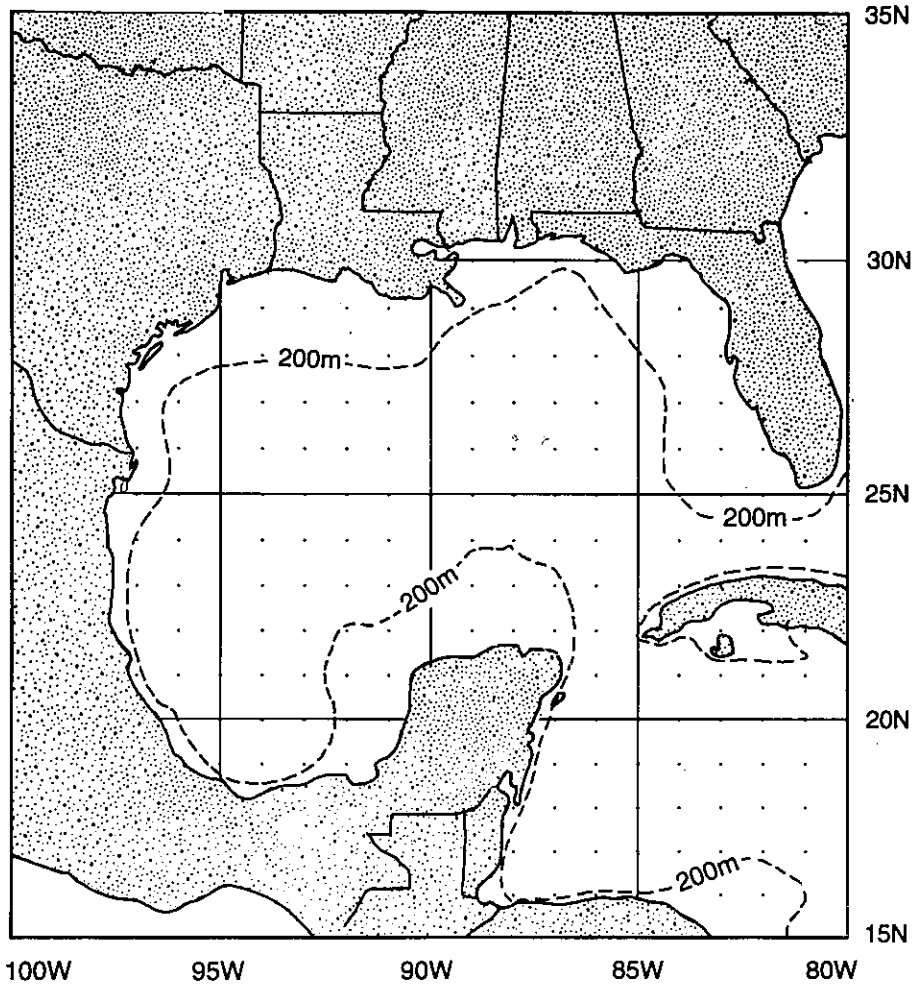
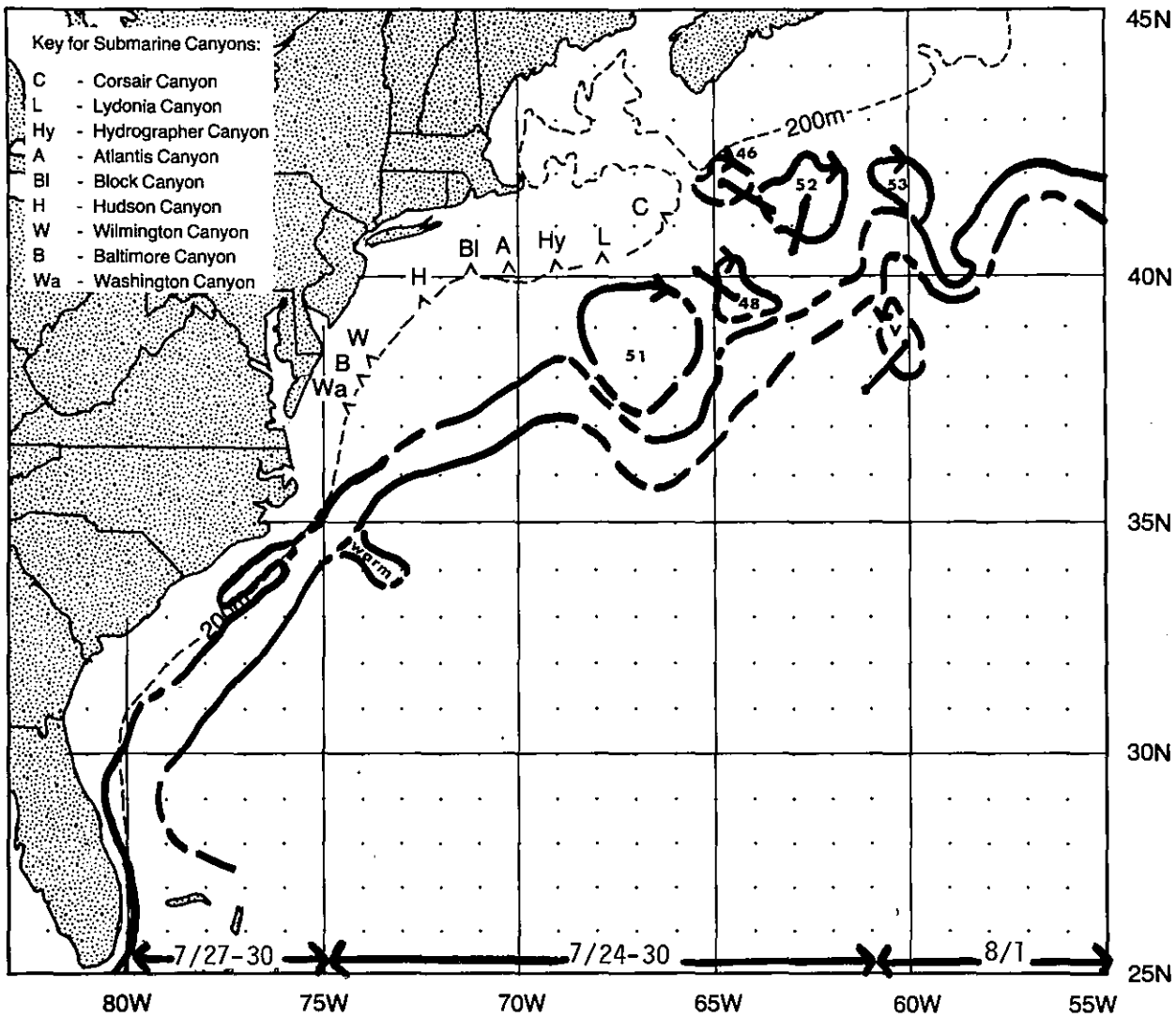


JULY 1984

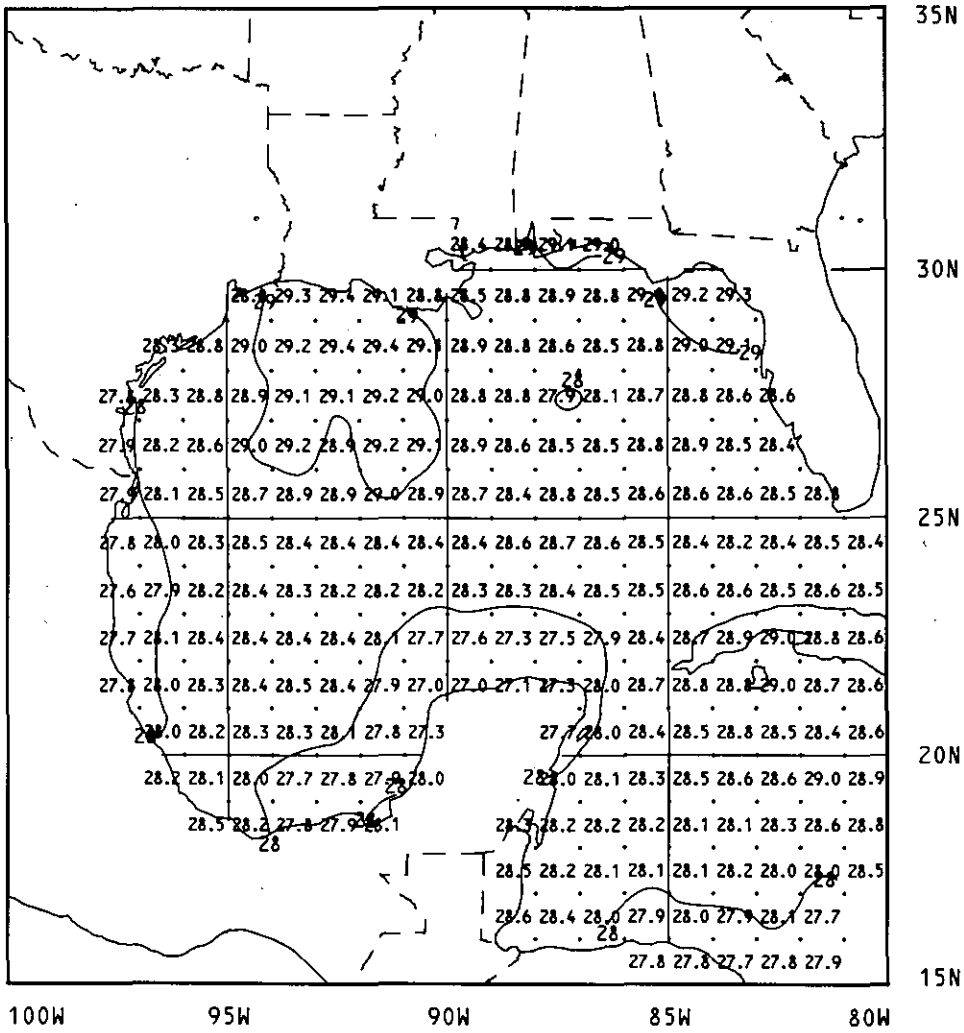
The Loop Current in the Gulf of Mexico was not clearly discernible since June.



Three anticyclonic eddies formed, two anticyclonic eddies were absorbed, and two apparently dissipated during July. Eddy 51 pinched off from the Gulf Stream near 37°30N 65°30W on July 9. Eddy 52 apparently pinched off from the Gulf Stream near 39°30N 62°30W on July 11. Eddy 52 translated 110 km NNE since its formation. Eddy 53 was first detected near 41°N 60°30W on July 26. Eddy 49 apparently translated 65 km SW when it was absorbed by a Gulf Stream meander near 41°30N 54°30W on July 10. Eddy 50 apparently moved 55 km N when it was reabsorbed by the Gulf Stream near 41°N 55°30W on July 26. Eddy 30 was not observed during the month and is suspected to have dissipated near 39°N 72°30W. Eddy 47 seemingly moved 20 km W when it was last observed near 41°30N 65°30W on July 8. By July 13 no evidence of eddy 47 was detected from satellite imagery near 42°N 65°W. Eddy 46 moved 120 km NW when it was last partially observed on July 20. Eddy 48 moved 100 km SE.

Cyclonic eddies I, L, N, O, P, Q, R, T, and U were not detected during the month due to isothermal conditions. Eddy V traveled 140 km NE when it was last observed on July 19.

EAST COAST SST-
MONTHLY MEAN



Gulf of Mexico
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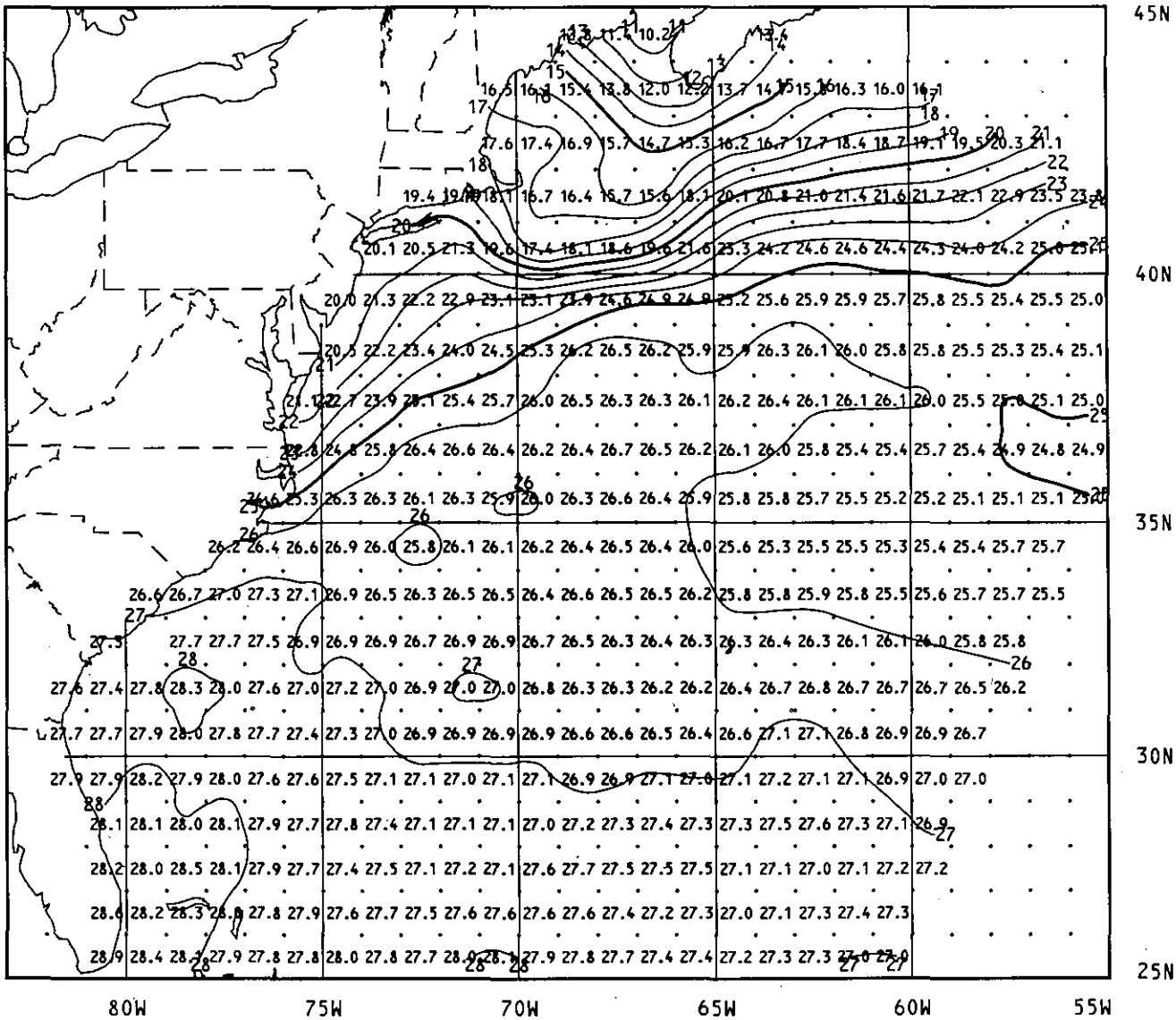

NW Atlantic Ocean
SST--MONTHLY MEAN (°C)
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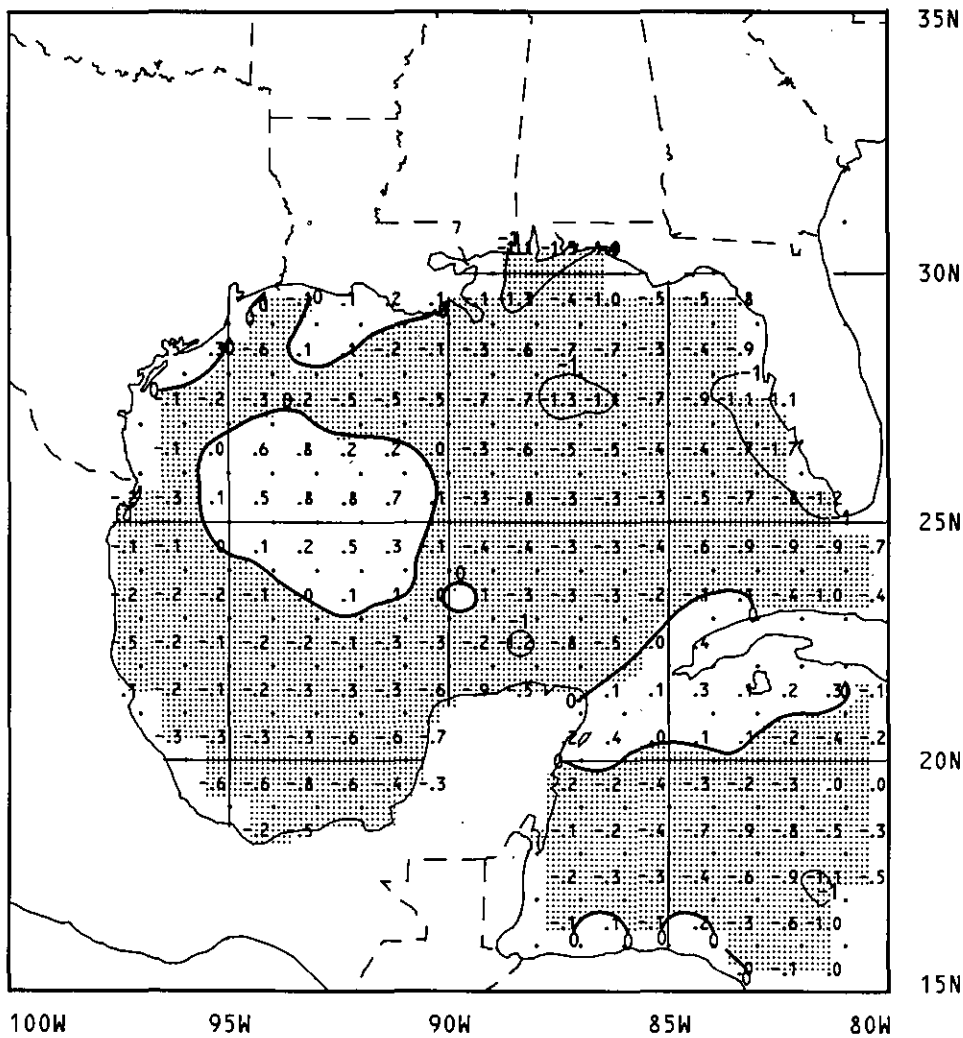
EAST COAST SST-ANOMALY



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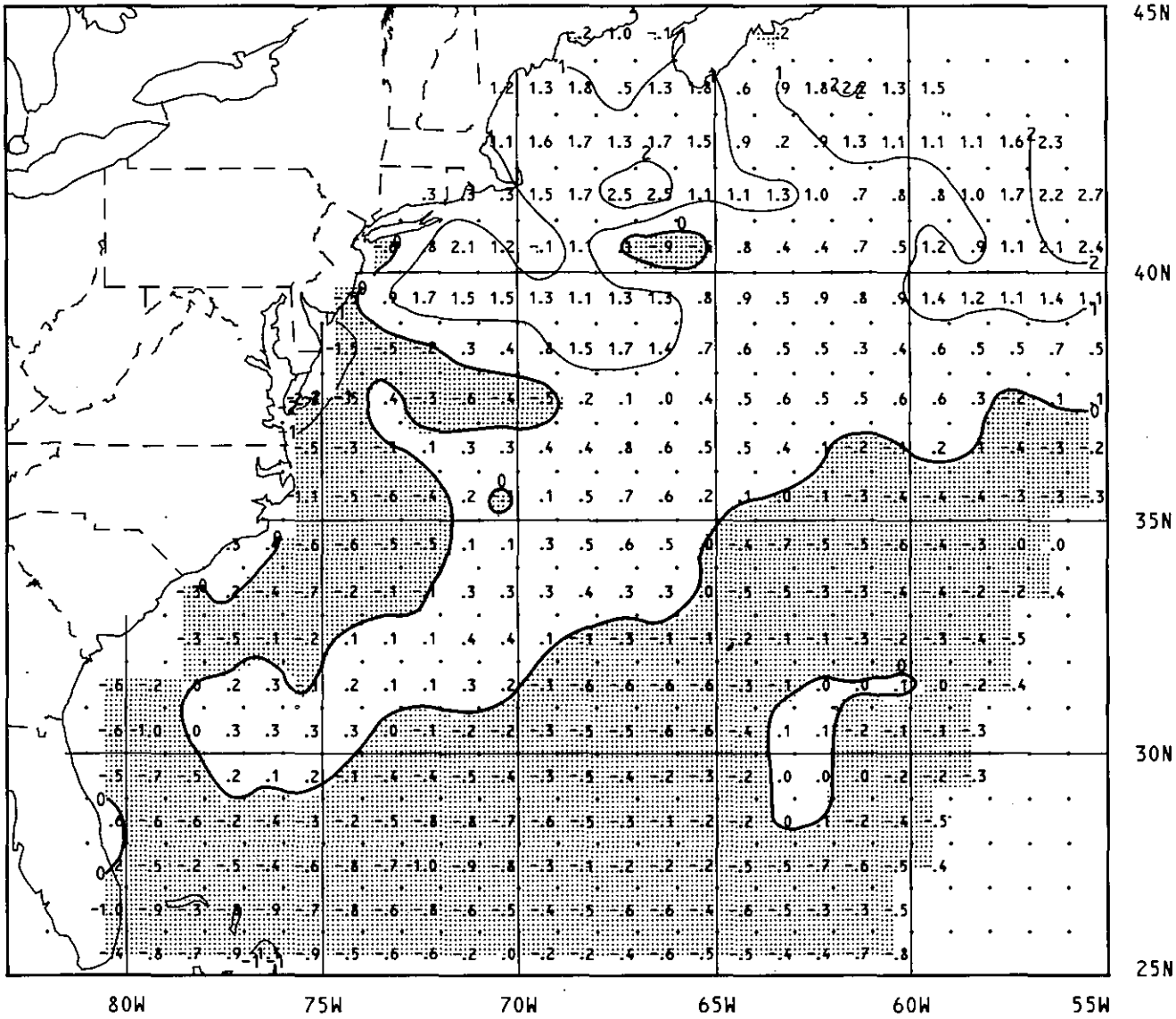

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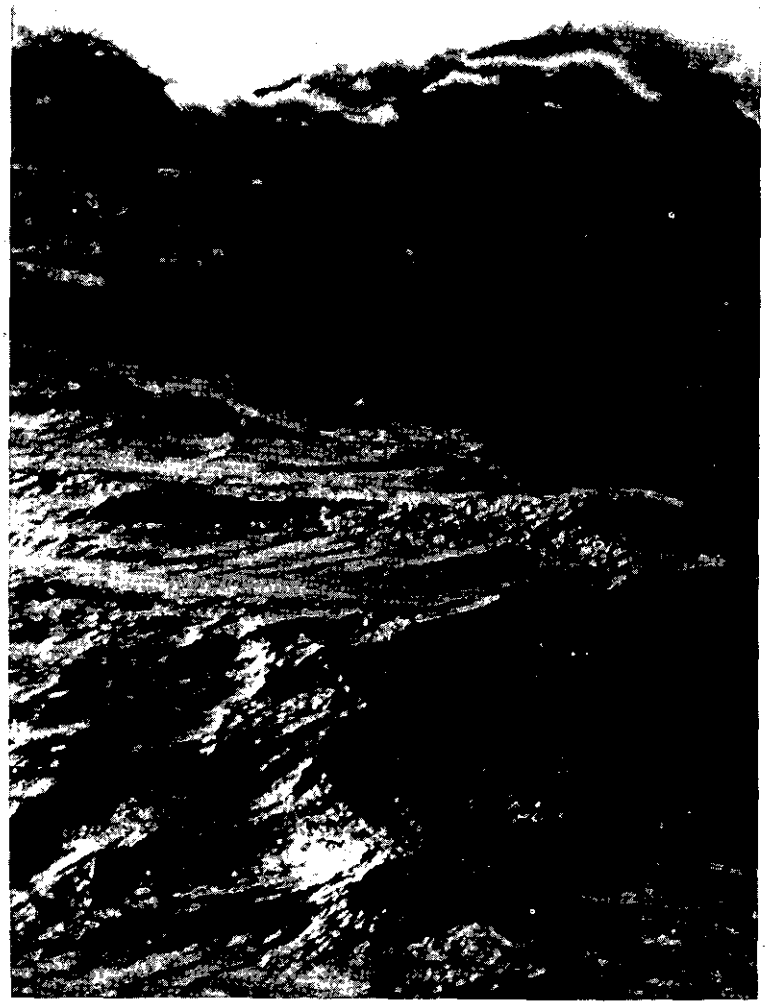
*U.S. GOVERNMENT PRINTING OFFICE : 1984 0-421-013/505

OCEANOGRAPHIC Monthly Summary

Volume IV Number 8 August 1984



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National Weather Service
National Environmental Satellite, Data, and Information Service

Oceanographic Monthly Summary is published by the National Weather Service and the National Environmental Satellite, Data, and Information Service (NESDIS). *Oceanographic Monthly Summary* contains sea surface temperature (SST) analyses on both regional and ocean basin scales for the Atlantic, Pacific, and Indian Oceans. The ocean basin analyses are based on a "blend" of *in situ* and satellite data. An ocean basin SST anomaly is derived from the "blended" SST analysis and the National Climatic Center (NCC) Climatology.[1] (See page 12 for details.) The regional SST analyses are based upon a combination of *in situ* and satellite data measurements. The regional SST anomalies use the Robinson-Bauer Climatology.[2] *Oceanographic Monthly Summary* also contains Alaskan sea ice information and ocean feature information for contiguous U.S. ocean regions.

Oceanographic Monthly Summary welcomes articles containing information of interest to *Oceanographic Monthly Summary* readers, such as, news on operational oceanography, unusual ocean feature phenomena, etc. Contributions should be sent to the editor (address below). Accepted material will appear in the OceaNotes section of *Oceanographic Monthly Summary*. Contributions can be published as quickly as the next monthly issue.

If you are interested in receiving *Oceanographic Monthly Summary* regularly, please refer to the back cover for subscription information.

[1]Reynolds, R.W., 1982. A Monthly Averaged Climatology of Sea Surface Temperatures; *NOAA Technical Report NWS 31*.

[2]Robinson, M.K., 1976. Atlas of North Pacific Ocean Monthly Mean Temperatures and Mean Salinities of the Surface Layer; *NavOceano Ref. Pub. 2*.
Robinson, M.K., R.A. Bauer, and E.H. Schroeder, 1979. Atlas of North Atlantic-Indian Ocean Monthly Mean Temperatures and Mean Salinities of the Surface Layer; *NavOceano Ref. Pub. 18*.

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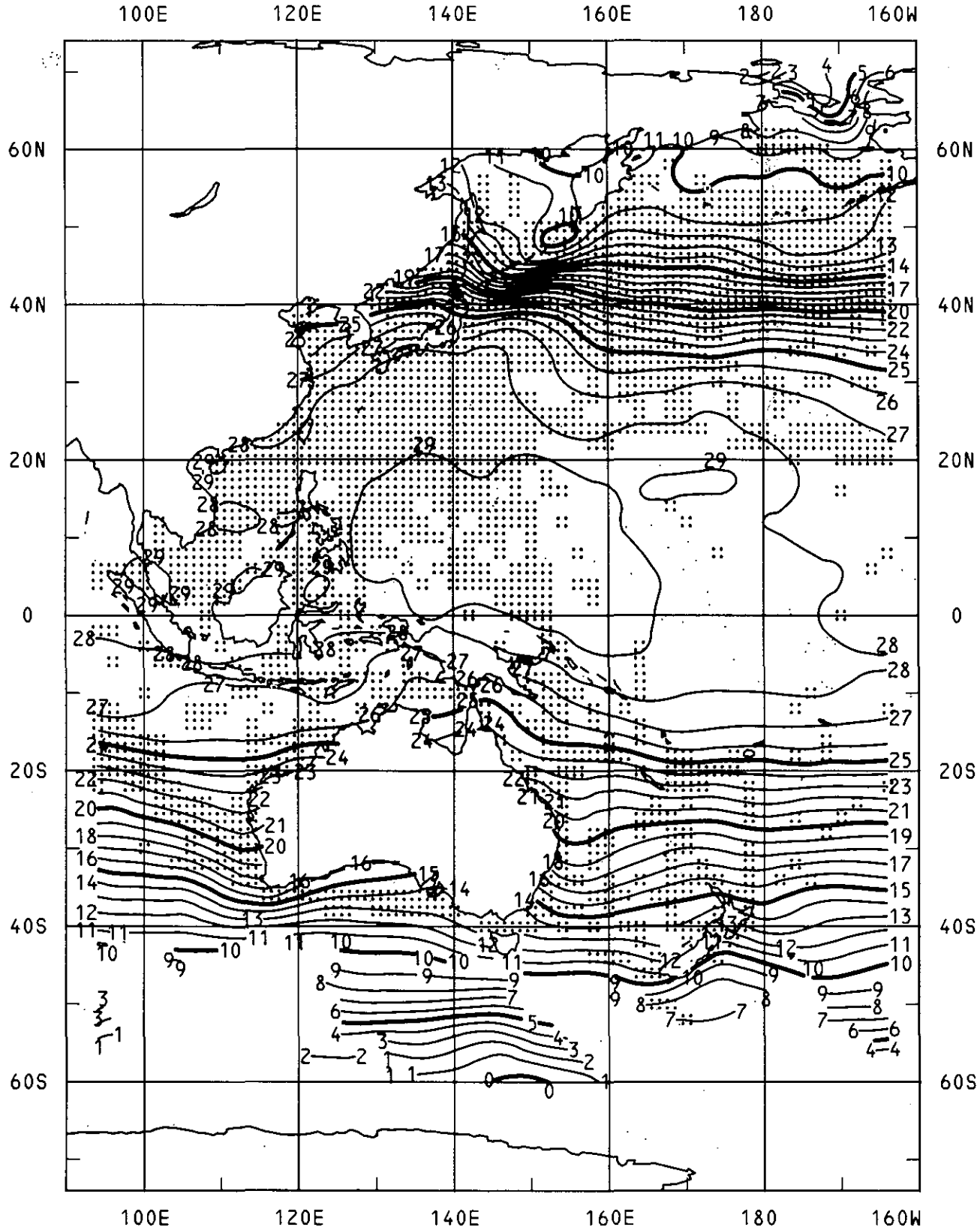
SPECIAL ARCTIC SEA ICE EDGE CLIMATOLOGY ISSUE

A special issue on the June 1984 Oceanographic Monthly Summary entitled "Eastern-Western Arctic Sea Ice Edge Climatology" has recently become available for limited distribution. The special ice issue contains semi-monthly climatological ice edge summaries of maximum, median, and minimum ice edges. The summaries were compiled from eleven years (1972-1982) of weekly operational Joint Ice Center Eastern and Western Arctic Ice Analyses.

Anyone interested in receiving the special issue should contact Raymond H. Godin at (301) 763-5972.



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SHIP, BUOY, and SATELLITE DATA
AUGUST 1984

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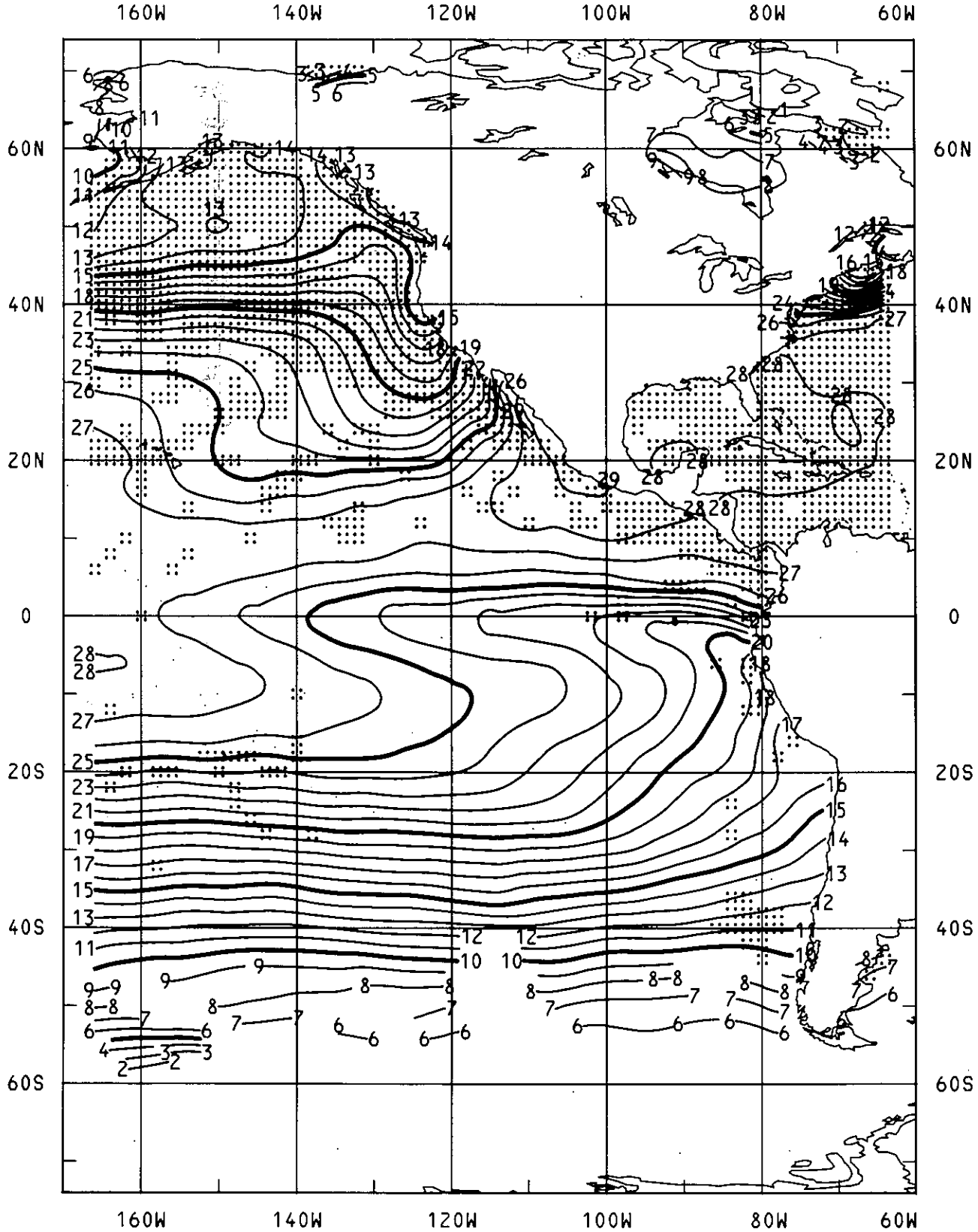

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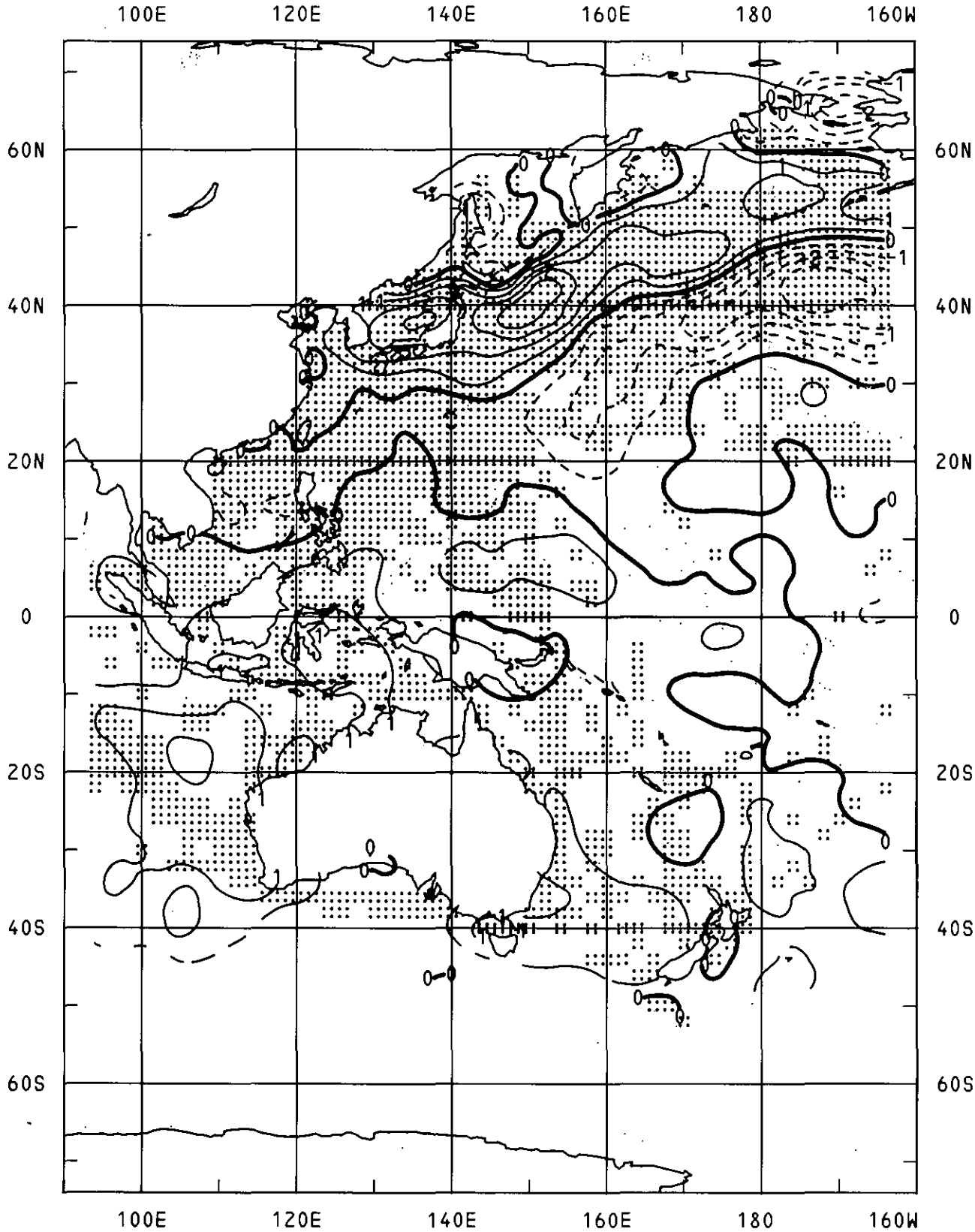

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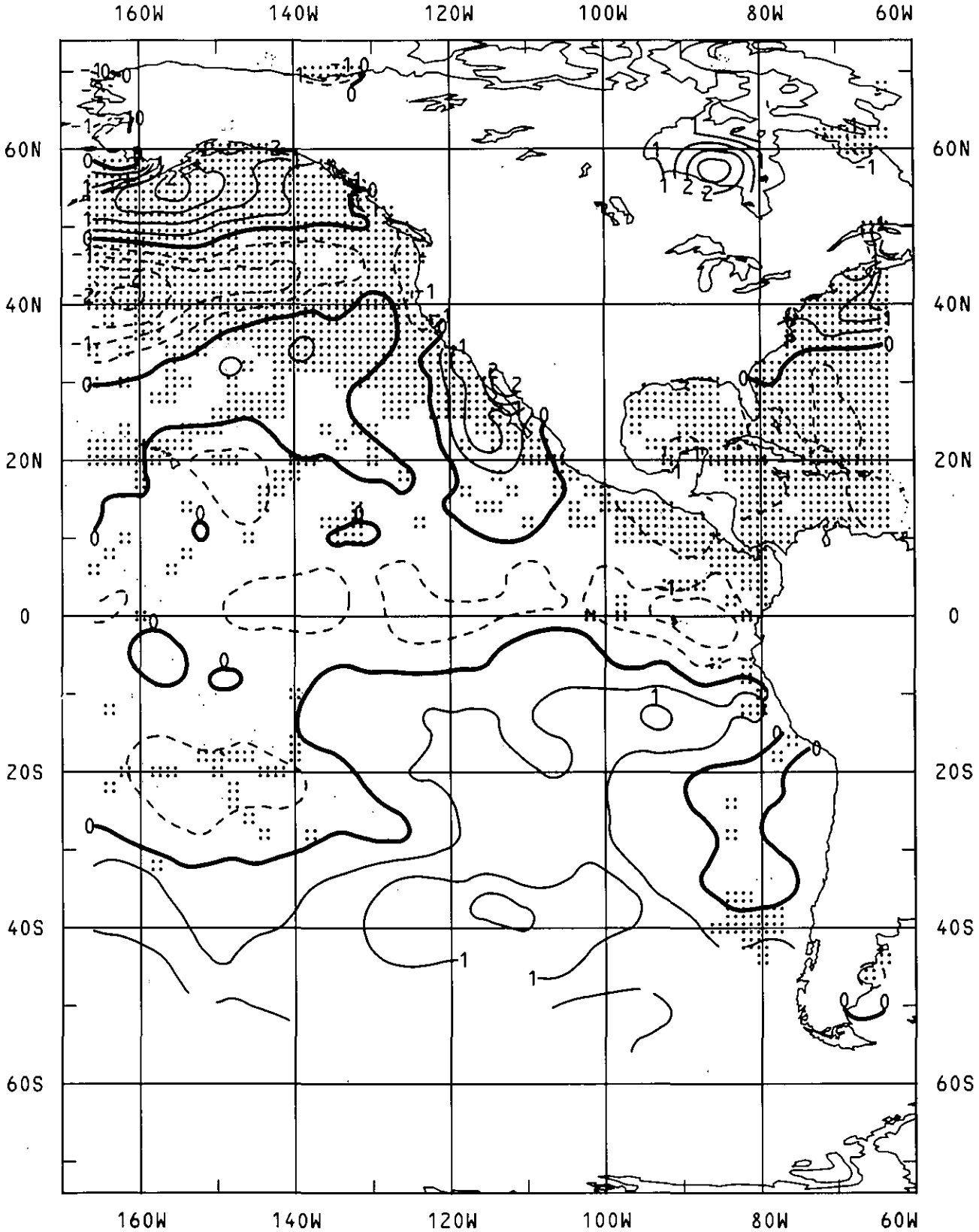

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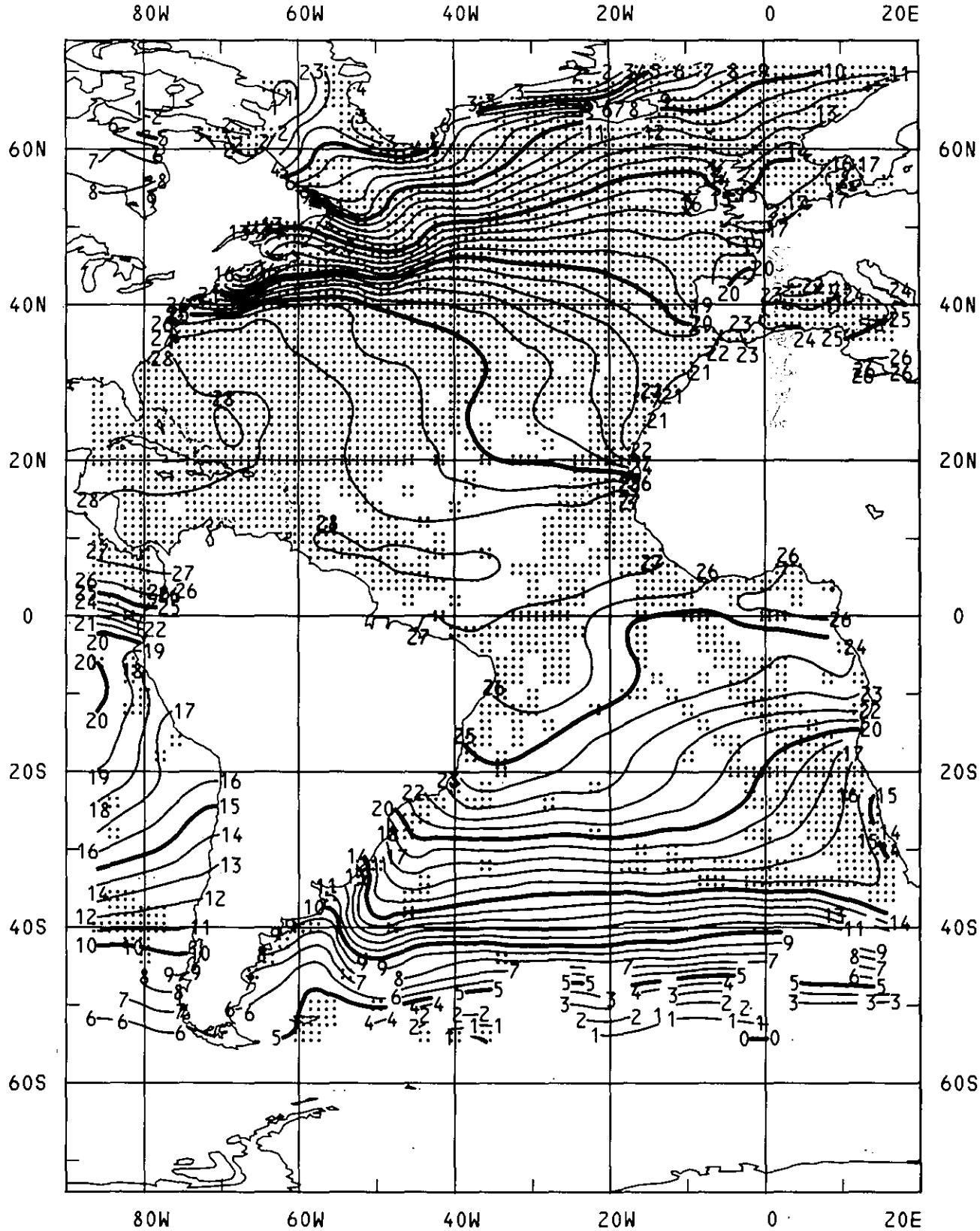

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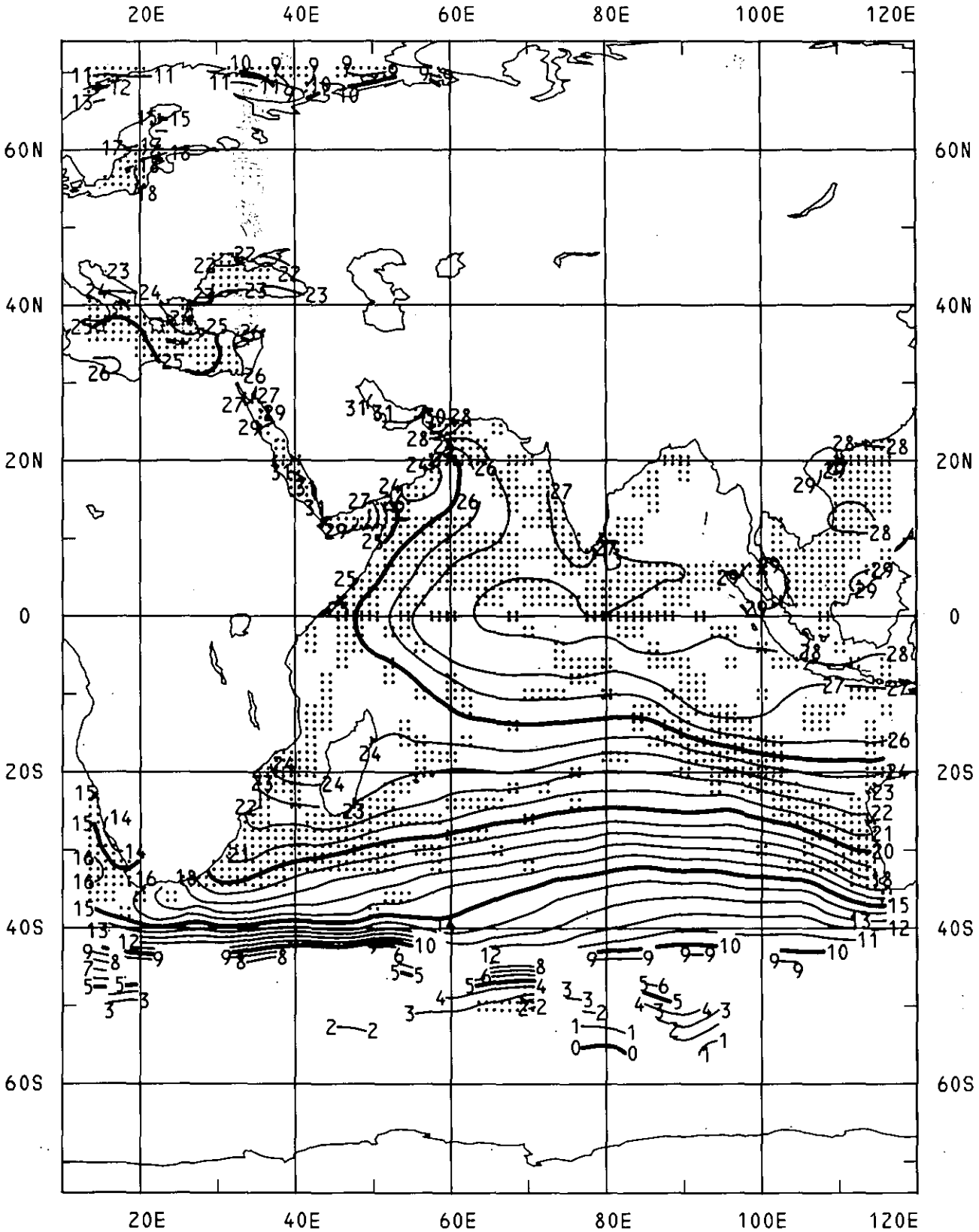

Indian Ocean
SST--MONTHLY MEAN (°C)
SHIP, BUOY, and SATELLITE DATA
AUGUST 1984

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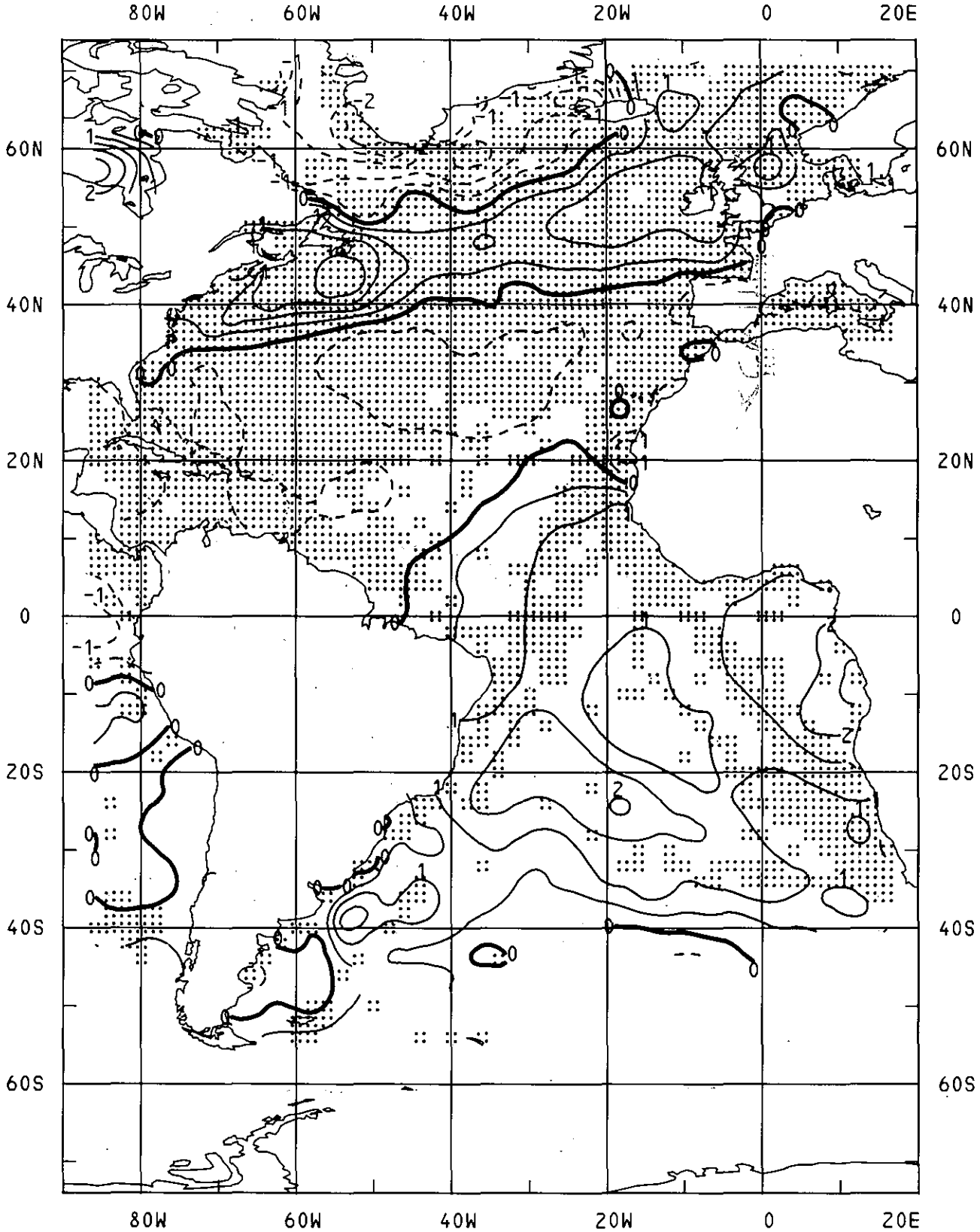

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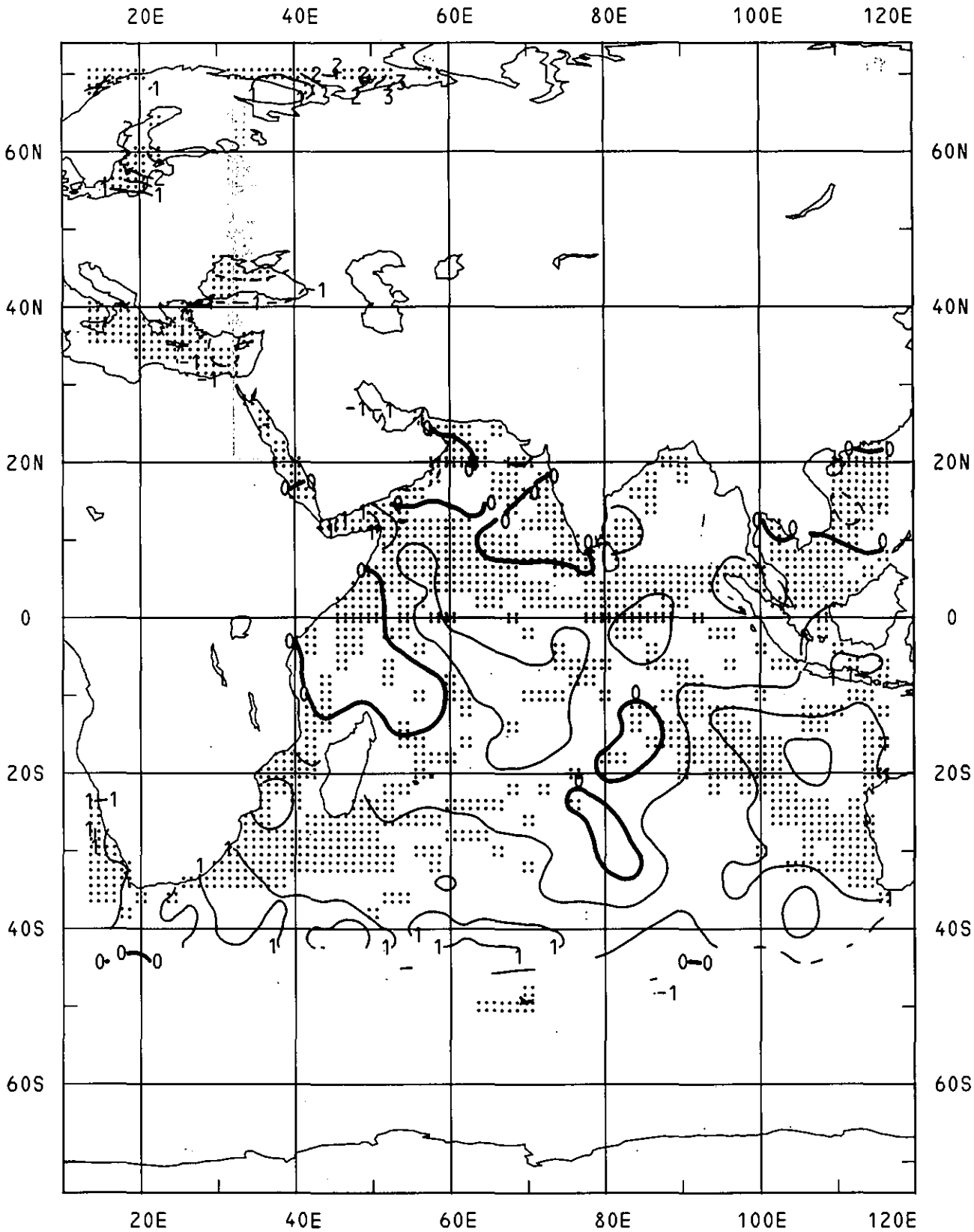

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NEW GLOBAL SEA SURFACE TEMPERATURE MONTHLY MEAN ANALYSIS

Highlights

- o New global analysis using both *in situ* and satellite data
- o Indian Ocean analysis included
- o Global analysis extended further south

Beginning in February 1983 a global SST analysis was presented using *in situ* (ship and buoy) data and a non-linear spatial filter (see Reynolds and Gemmill, 1984). Because the coverage from satellites is superior to the *in situ* coverage, an analysis derived from satellite observations only was added in April 1983. The two types of data were not combined because of significant differences between the *in situ* observations and the satellite retrievals. In the July 1984 *Oceanographic Monthly Summary*, the satellite field showed a negative bias relative to the *in situ* field in the tropics and a positive bias in mid-latitude. Strong (1983) reported that satellite retrievals were cooler than *in situ* observations because of aerosols injected into the atmosphere by the eruption of El Chichon in March-April 1982. Comparisons of the two analyses over the last 30 months show that although the satellite anomalies tend to be more negative than *in situ* anomalies, the differences are <u>not independent of time or location</u>.

A "blended" SST analysis has been developed using *in situ* data to define "benchmark" temperature values in regions of frequent observations and satellite data to define the "shape" of the field between these points. The blended field is found by solving Poisson's equation, $\nabla^2 T = F$, where T is the blended SST field and F is a forcing function given by the Laplacian of the satellite SST analysis, ($\nabla^2 S$); *in situ* data are used as internal boundary values at points of frequent observations. At the poleward boundaries, T is set to the *in situ* (preferred) or the satellite analysis. The resulting anomaly and mean fields are shown on pages 4-11 where the stippling indicates regions where the SST field was fixed by the *in situ* data. The use of the satellite data has allowed the analysis to be extended further south, but necessitated a change in the map projection. Studies with this new analysis suggest that the blended analysis is an improvement over the fields obtained from *in situ* data only or the satellite data only. Since the satellite data affect the field in the interior via the Laplacian, biases or trends in the satellite data can only influence the final solution through the high latitude boundary conditions. In the example above, satellite biases would impact the blended result only south of 40°S, except in the eastern South Pacific where the *in situ* fields is almost undefined.

These results suggest that the blended method may be a useful way to utilize both *in situ* and satellite data. Each monthly blended field will be monitored carefully using individual *in situ* and satellite analyses as diagnostic tools. In future months the blended method may be modified to reflect changes in either the *in situ* observations or the satellite retrievals.

Reynolds, R. W. and W. H. Gemmill, 1984: An objective global monthly mean sea surface temperature analysis. Tropical Ocean-Atmosphere Newsletter, No. 23, 4-5.

Strong, A. E., 1983: Satellite derived sea surface temperature errors due to the El Chichon aerosol cloud. Tropical Ocean-Atmosphere Newsletter, No. 18, 14-15.

SATELLITE IMAGE OF THE MONTH

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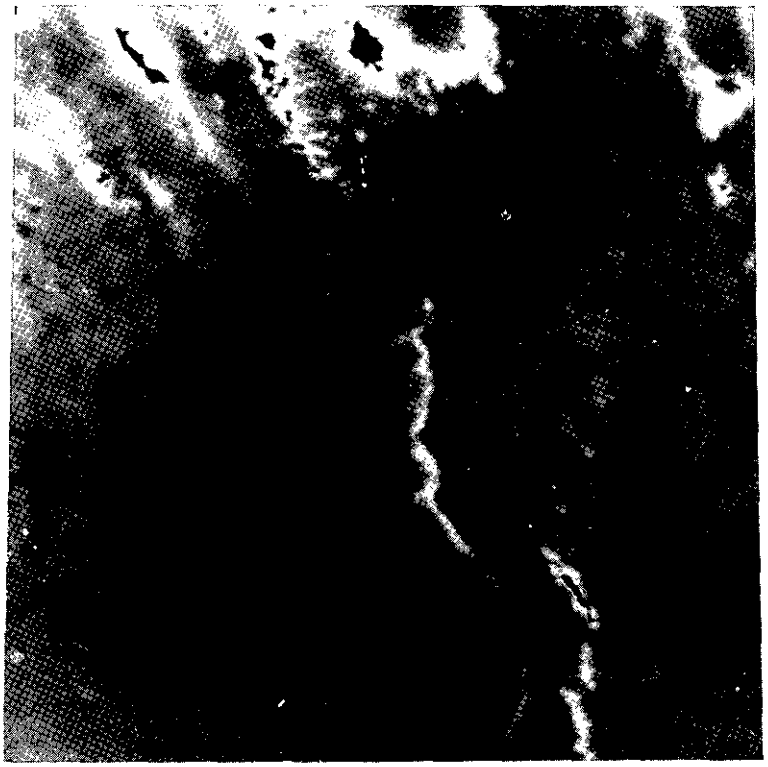
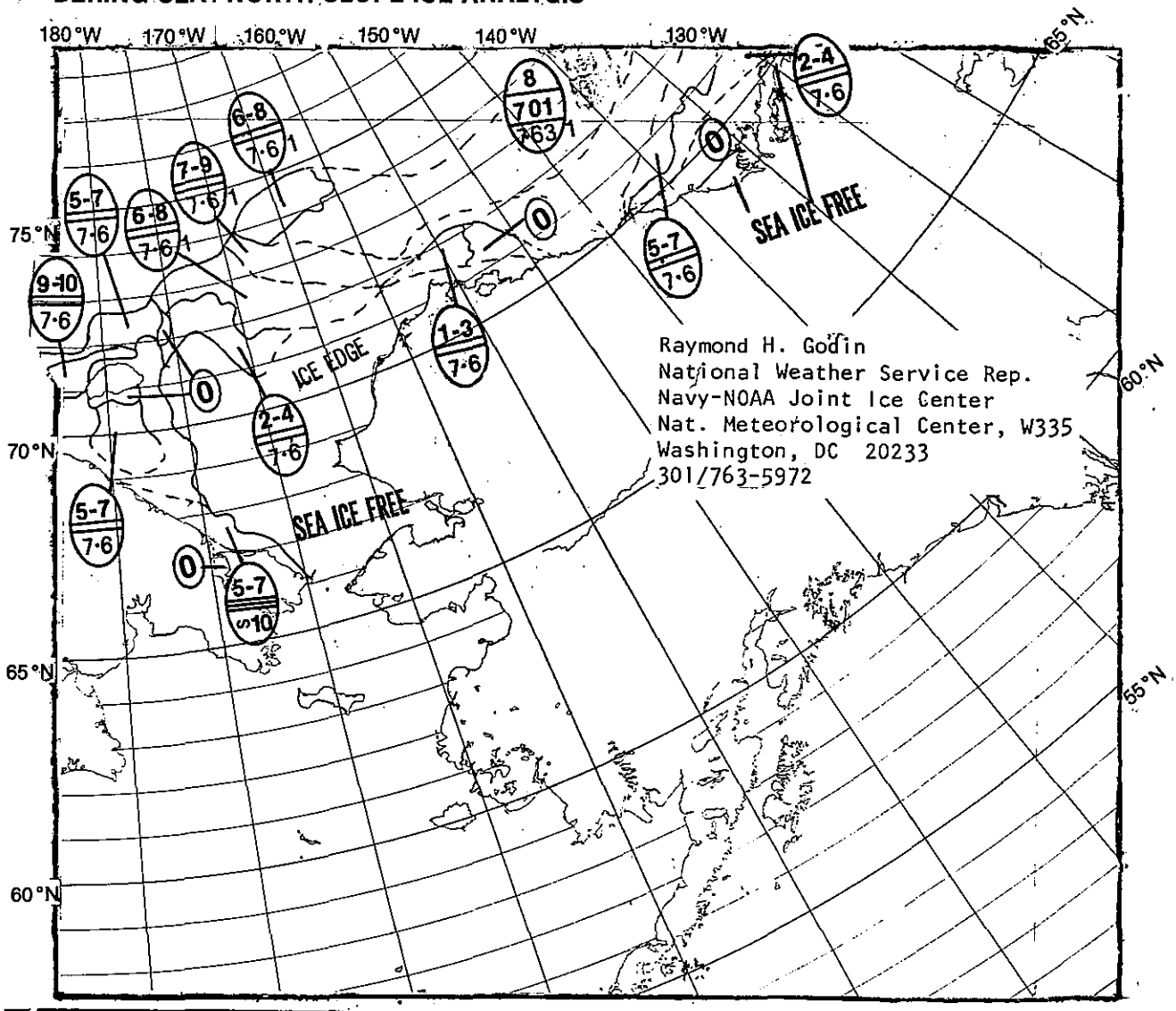
UPWELLING IN LAKE MICHIGAN

This NOAA-6 infrared (IR) satellite image of Lake Michigan was taken August 20, 1984. Most of the lake except along most of the eastern shore appears as a dark gray shade; the range of satellite-derived surface lake temperatures is only 21-24°C. An exception to the homogeneous temperature field is the area of upwelling along most of the eastern shore. Persistent northerly winds have produced an intense zone of upwelling, identified by the light gray or white shades. According to the satellite-derived surface temperature retrievals, temperatures are colder than 10°C very close to shore. Temperatures warm up quickly offshore to 16-17°C.



BERING SEA / NORTH SLOPE ICE ANALYSIS



C = Total ice concentration in the area in tenths.

C_a, C_b, C_c = Concentration of thickest (C_a), 2nd thickest (C_b), and 3rd thickest (C_c) ice

S_a, S_b, S_c = Stage of development of thickest (S_a), 2nd thickest (S_b), and 3rd thickest (S_c) ice.

~C = Concentration of ice within area(s) of strips and patches.

STAGE(S) OF DEVELOPMENT (THICKNESS)

1 = New ice (0-10 cm)
3 = Young ice (10-30 cm)
6 = First year (30-200 cm)
7 = First year thin (30-70 cm)
1. = First year medium (70-120 cm)
4. = First year thick (120-200 cm)
7. = Old ice (survived at least one summer's melt)

EXAMPLES

125 Theoretical thickness of this season's growth (cm).

Fast ice. Sea ice which forms and remains fast along the coast.

Ice boundary visually or satellite observed.

Ice boundary estimated.

AUGUST 1984

The monthly mean sea level pressure circulation depicts a 1000 mb low in northeastern Canada near 71°N 70°W. Mean surface geostrophic winds are westerly along the Alaskan North Slope and southwesterly north of the Bering Strait west of Barrow (71°N 157°W). Monthly mean surface temperatures are above normal at Barrow and much below normal at Nome (65°N 165°W). The narrow coastal lead from Barrow to the Canadian border present last month was closed by southeasterly drifting old and first year ice the last week of the month. Sea ice free conditions extended east of Point Barrow to approximately 150°W. The current ice edge position in the Chukchi Sea is close to the climatological maximum west of 170°W and south of 70°N and near the median elsewhere. In the eastern Beaufort Sea the ice edge position is between the climatological median and maximum.

WEST COAST OCEAN FEATURES

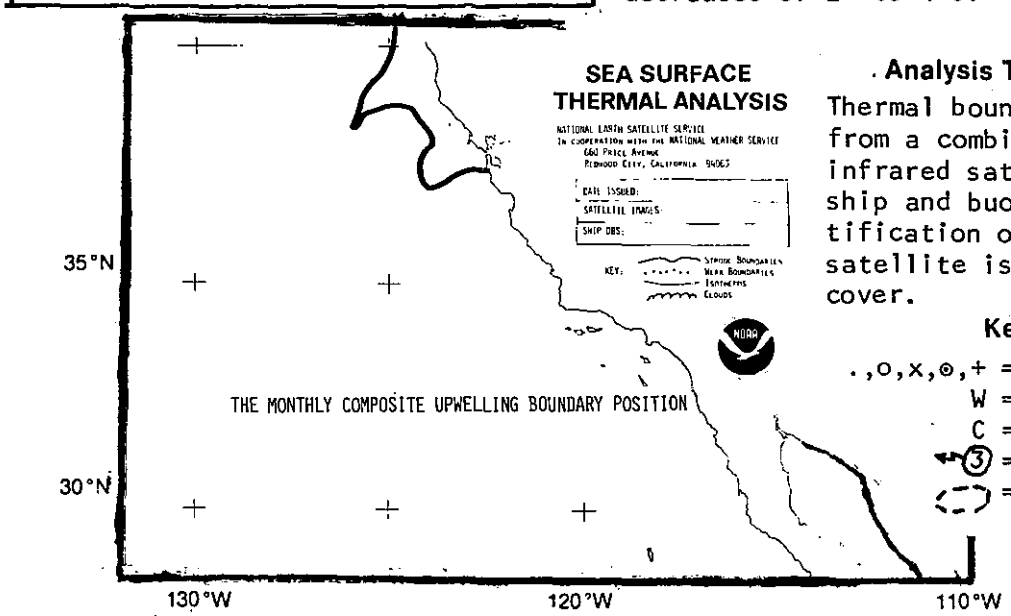
AUGUST 1984

MONTHLY SST STATISTICS FOR SELECTED STATIONS
PACIFIC NORTHWEST
(Area enclosed by 40-52N, Coast-135W)

AUGUST 1984

Station	Location (Lat/Long)	Mean SST	Standard Deviation	Maximum SST	Minimum SST	Change From Previous Month
Buoy 46005	46.1 N 131.0 W	16.1	0.4	16.8	15.3	+2.2
Buoy 46002	42.5 N 130.3 W	17.7	0.3	18.1	17.3	+2.3
Buoy 46029	46.2 N 124.2 W	15.0	1.0	16.8	13.4	+3.0
(Buoy 46029 is temporarily replacing Buoy 46010.)						
Buoy 46027	41.8 N 124.4 W	12.1	0.9	14.3	10.7	+2.7
Quillayute River	47.9 N 124.6 W	11.8	1.5	15.0	9.4	+1.3
Grays Harbor	46.9 N 124.1 W	16.7	1.4	19.4	14.4	+1.8
Cape Disappointment	46.3 N 124.1 W	15.1	0.9	16.7	12.8	-0.1
Yaquina Bay	44.6 N 124.1 W	**** EQUIPMENT MALFUNCTION ****				
Chetco River	42.0 N 124.3 W	**** EQUIPMENT MALFUNCTION ****				

Pacific Northwest coastal and offshore waters warmed about 2°C during August. SSTs were near normal, with three exceptions: First, a persistent warm area of about 18°C (1°C warmer than normal) was found off the central and northern Oregon coast, centered about 140 miles offshore; Second, a nearshore warm anomaly, with SSTs as much as 1.5°C above normal, was observed along the central Vancouver Island coast; Third, an average negative SST anomaly prevailed during the month within about 100 miles of the entire Washington and Oregon coasts. The coolest water, averaging 12°C (2°C below normal) was consistently observed near Cape Blanco. Winds during the month were generally very light, particularly north of 45°N. The only significant wind-driven upwelling event occurred during August 18-21, when SSTs at all Oregon and Washington coastal stations recorded decreases of 2° to 4°C.



Analysis Techniques

Thermal boundaries are determined from a combination of enhanced infrared satellite imagery and ship and buoy observations. Identification of these features by satellite is limited by cloud cover.

Key

.,o,x,⊙,+ = thermal boundaries
W = warm
C = cold
③ = date of feature
= outline of water mass feature

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NOAA/Northwest Regional Ocean Service Center
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Bin C15700
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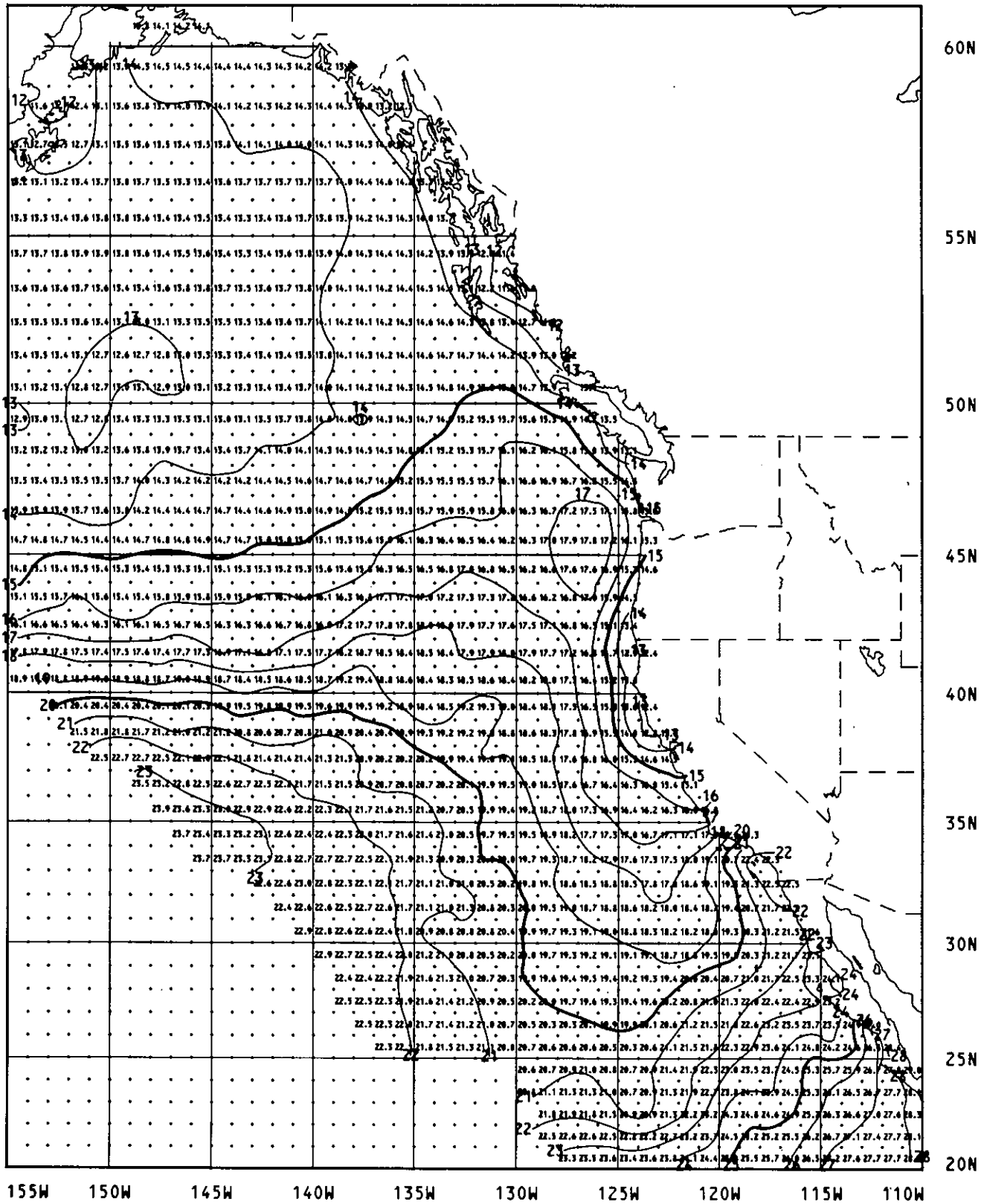
(206) 527-6604

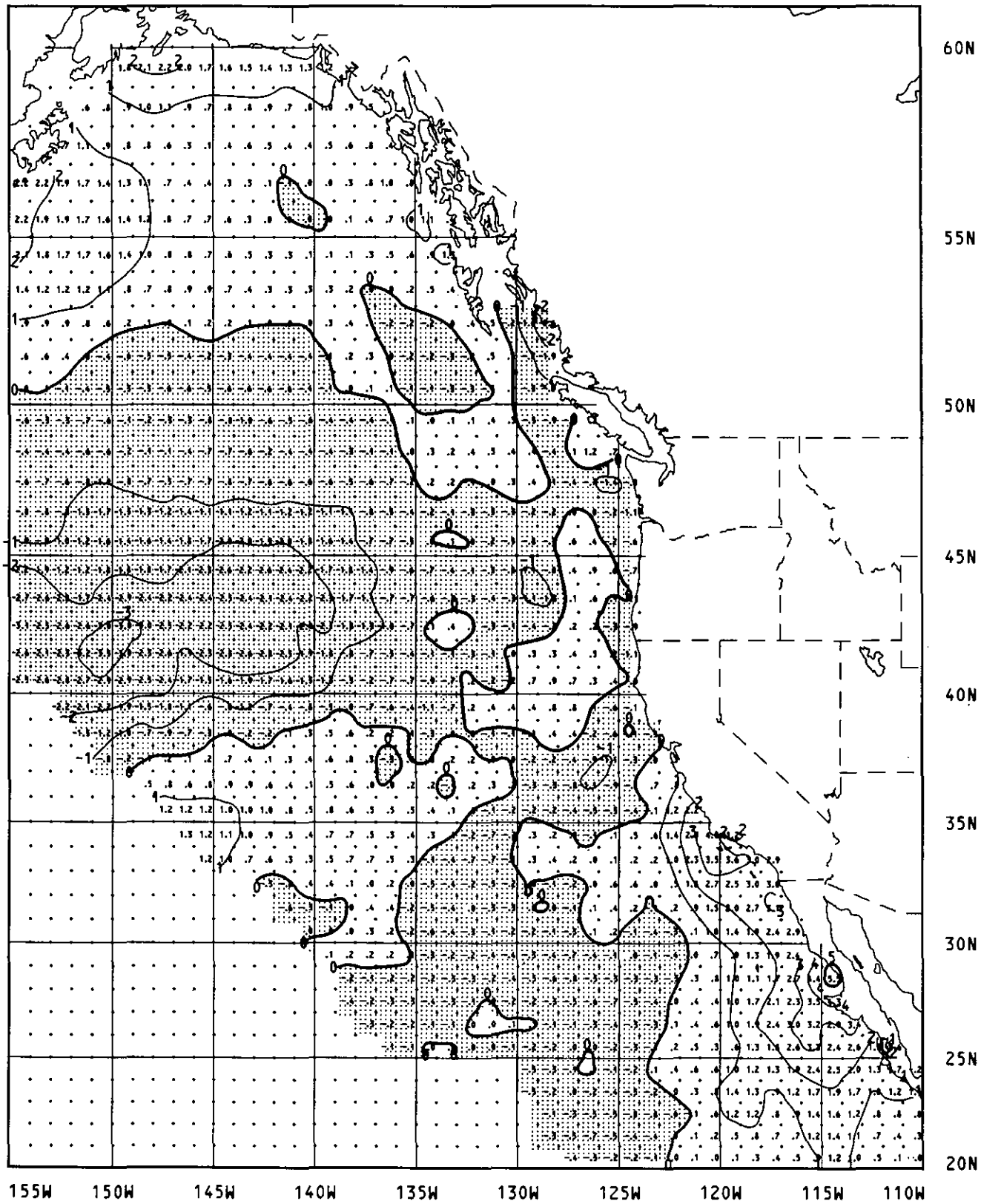
South Panel
Ernest Daghir
NOAA/NWS
Satellite Field Service Station
660 Price Avenue
Redwood City, CA 94063
(415) 364-2422

The average mean temperature over the South Panel during August was warmer (18.8°C) than the climatological normal mean (18.4°C). SSTs were above normal over more than two-thirds of the analysis area with a positive anomaly alongshore from Monterey Bay south to the Baja Peninsula; anomalies were on the order of 0.7°C at San Francisco Bay to 2.7°C near San Diego. The only portion of the South Panel cooler than the climatological normal (-0.25°C) was centered near 31°N 127°W. All areas warmed in response to the seasonal trend when compared to the SSTs in July. The area of maximum warming was centered at 38°N 131°W ; SST increases were 2.0°-2.7°C. Upwelling was observed by satellite from August 3-24. SSTs around Pt. Arena, the coastal point of maximum upwelling activity, consistently remained near 12°C for the entire month.



West Coast
SST--MONTHLY MEAN (°C)
August 1984

Monthly mean sea surface temperature is the mean of twice-weekly analyses using ship, buoy, and satellite observations. Contour line interval is 1.0°C.



West Coast
SST--MONTHLY ANOMALY (°C)
August 1984

Monthly anomaly is the difference between the monthly mean sea surface temperature and the climatological monthly mean value -- shading shows where the monthly mean is colder than climatology. Contour line interval is 1.0°C.

The end of this month's positions of the Gulf Stream System and its associated eddies are shown for the NW Atlantic and the Gulf of Mexico. The Gulf Stream and Loop Current boundaries are located by infrared satellite imagery or XBT (expendable bathythermograph) data. Anticyclonic eddies are labeled a-z in the Gulf of Mexico and 1-99 in the NW Atlantic. Cyclonic eddies are labeled A-Z. Arrows on eddies indicate direction of circulation. Warm-core or anticyclonic eddies rotate clockwise; cold-core or cyclonic eddies rotate counterclockwise. The line to the eddy center shows the net translation since last month or since last observed. Eddies or sections of the Gulf

EAST COAST OCEAN FEATURES

Stream System which were not observed during the month are not shown on the analysis chart. The long arrows at the bottom of the chart indicate the date of data used.

Data used in this analysis include:
- NOAA satellite infrared imagery, NESDIS
- Bathythermograph data, National Meteorological Center of National Weather Service
- Oceanographic Analysis, A daily detailed analysis issued by National Weather Service/NESDIS

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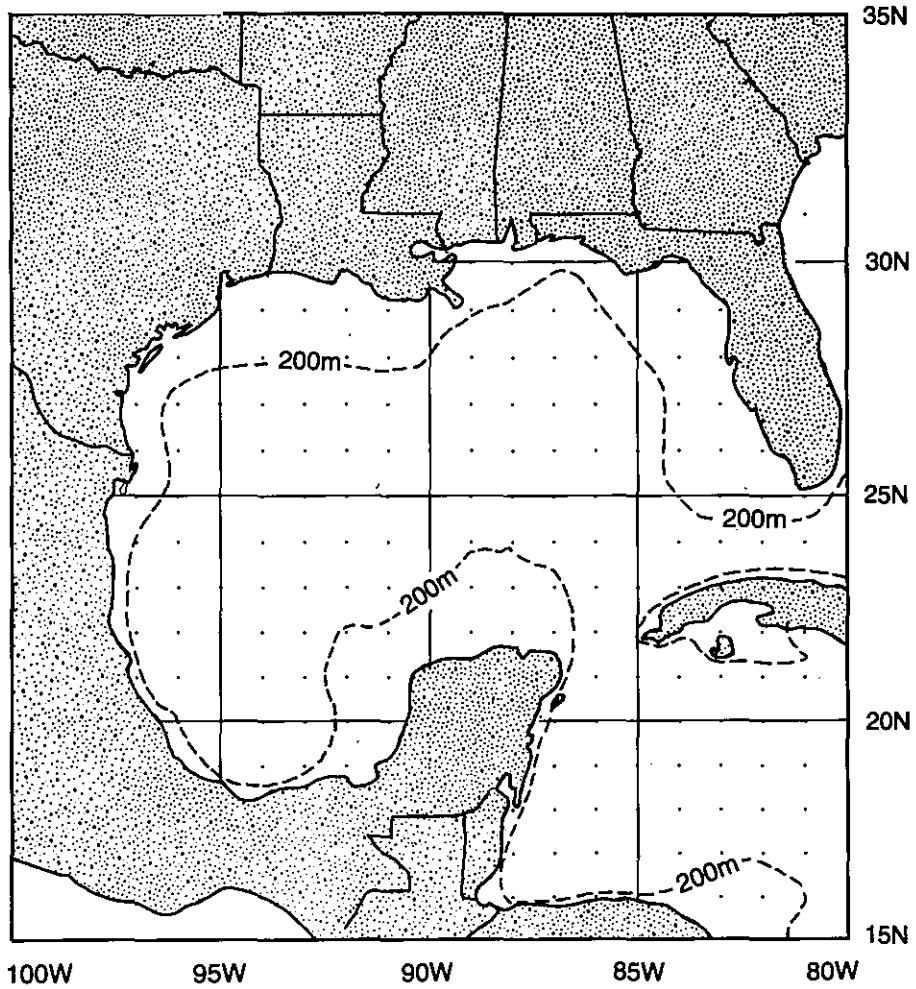
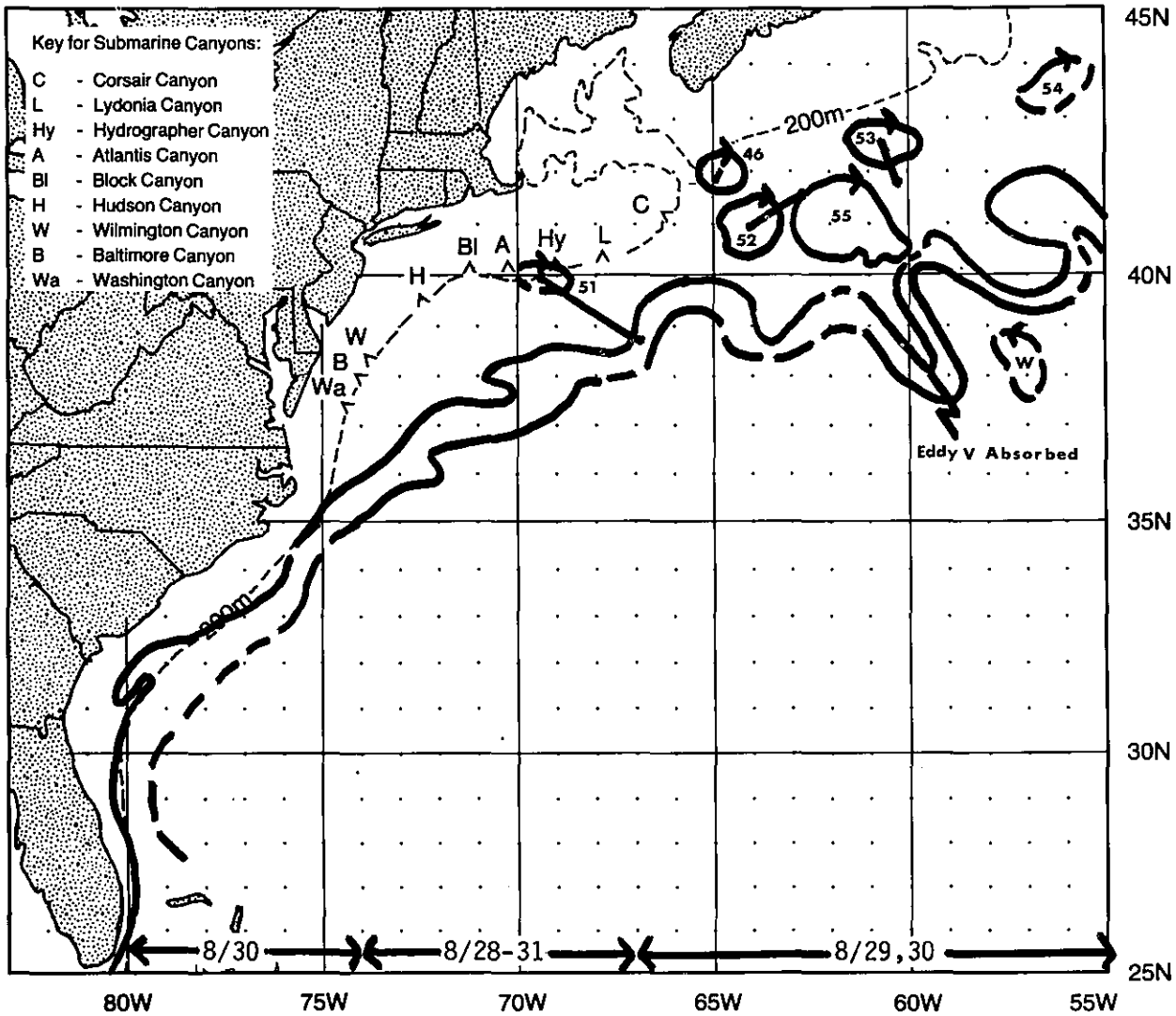


AUGUST 1984

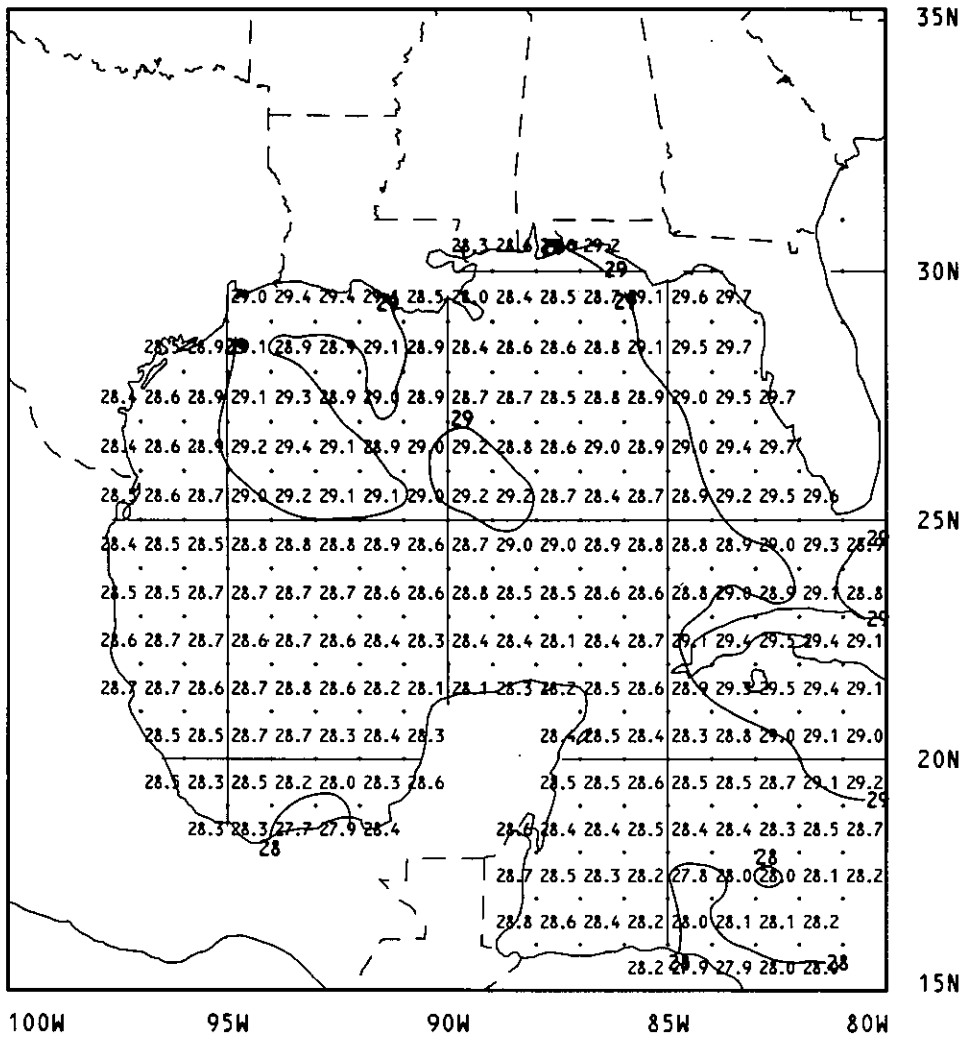
Near isothermal conditions existed in the Gulf of Mexico since June. August mean SSTs ranged from 27°-29°C.



One anticyclonic eddy was newly observed, one anticyclonic eddy formed, and one anticyclonic eddy apparently dissipated during the month. Eddy 54 was first detected near 43°30N 56°W on August 6. Its origin is unknown. Eddy 55 pinched off from the Gulf Stream near 40°N 60°W on August 21. Eddy 48 apparently dissipated in the warm Slope Water near 40°N 64°W on August 4. Eddy 51 apparently interacted with the Gulf Stream around August 1 and reduced in diameter from 240 km on July 26 to 85 km on August 31. Eddy 51 translated 250 km NW. Eddy 46 translated 25 km NNE. Eddy 52 traveled 130 km SW. Eddy 53 traveled 80 km NNW.

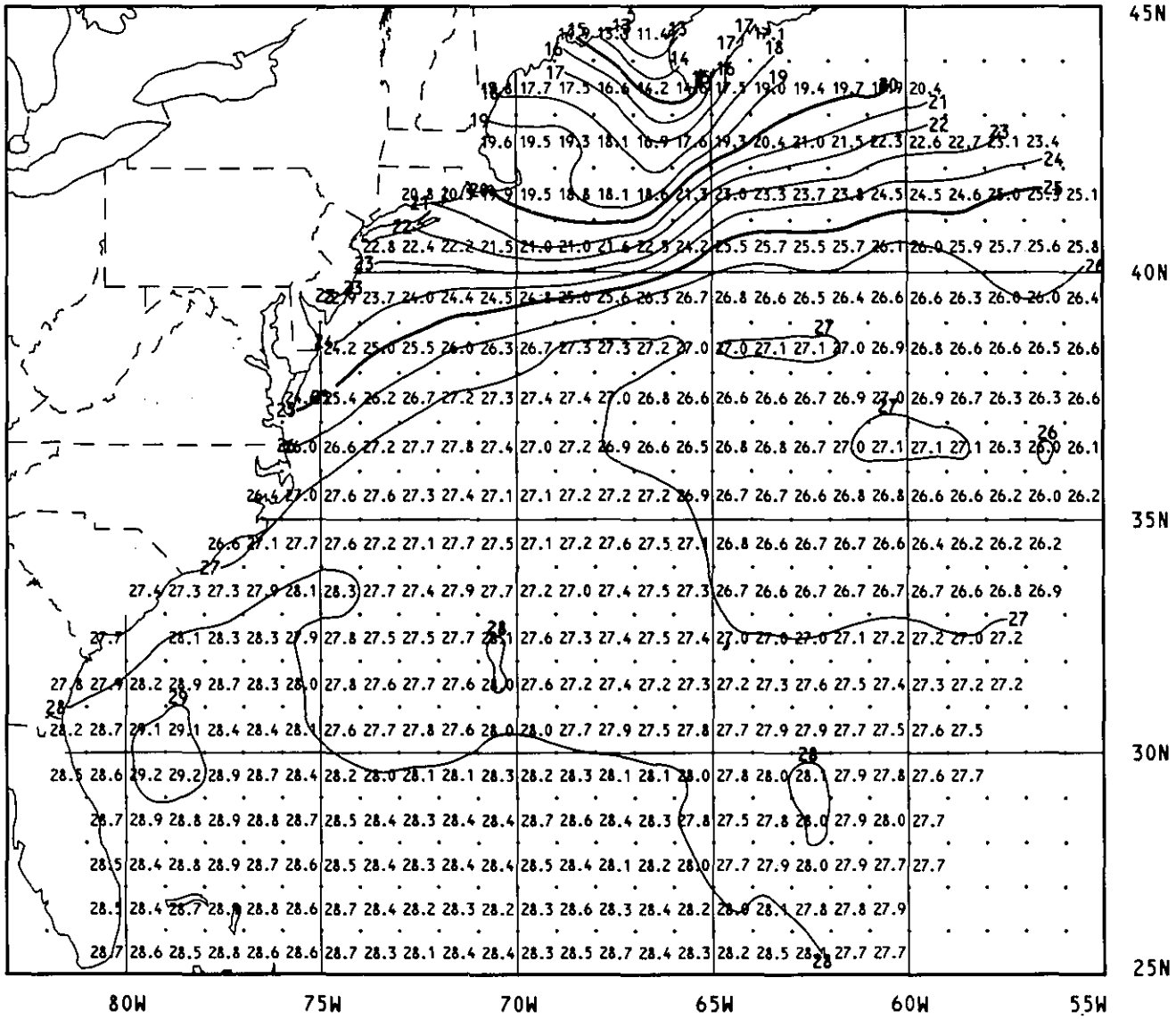
One cyclonic eddy was absorbed during the month. Cyclonic eddy W was first detected near 38°N 55°W on August 14. Eddy W is suspected to have formed from a Gulf Stream meander near 38°30N 56°W on July 22. Due to cloudiness, eddy W was not clearly detected. Eddy V apparently moved 80 km SE when it was absorbed by the Gulf Stream near 38°N 59°30W on August 30.

EAST COAST SST-
MONTHLY MEAN



Gulf of Mexico
SST--MONTHLY MEAN (°C)
August 1984

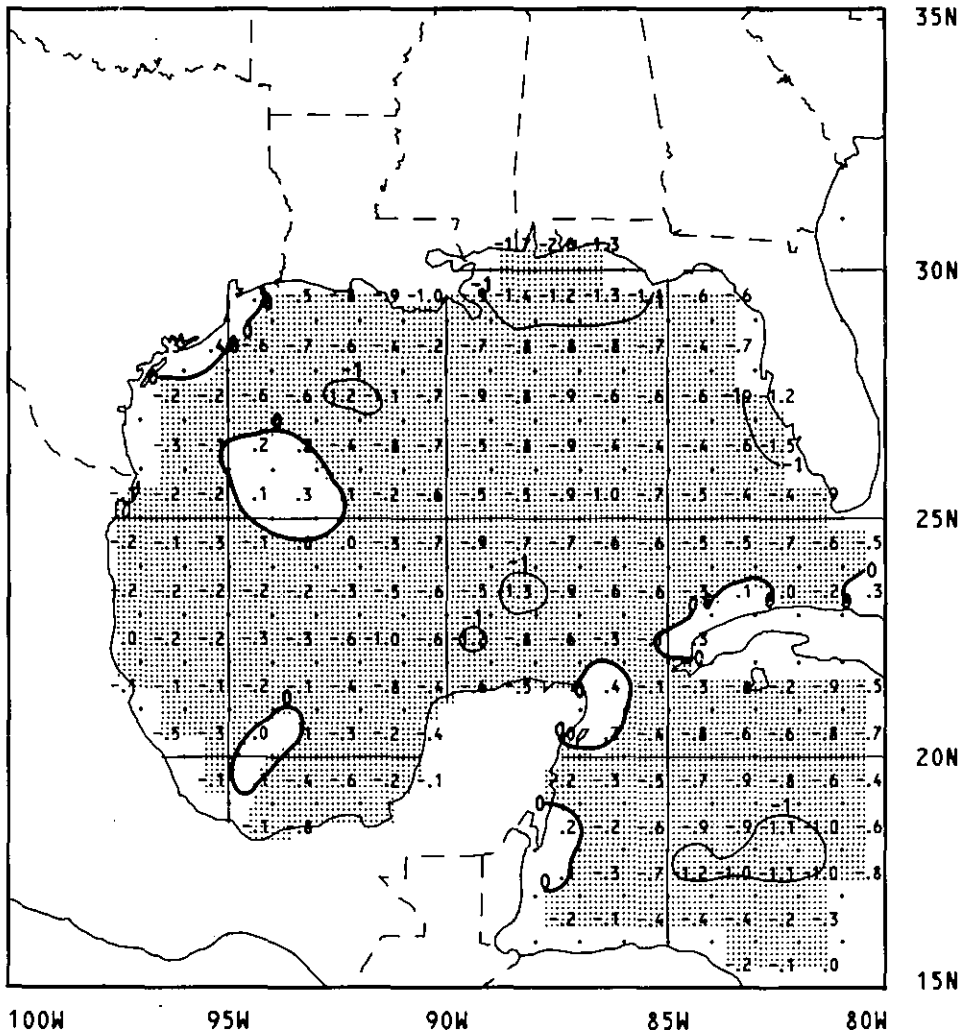
Monthly mean sea surface temperature is the mean of twice-weekly analyses using ship, buoy, and satellite observations. Contour line interval is 1.0°C.



NW Atlantic Ocean
SST--MONTHLY MEAN (°C)
August 1984

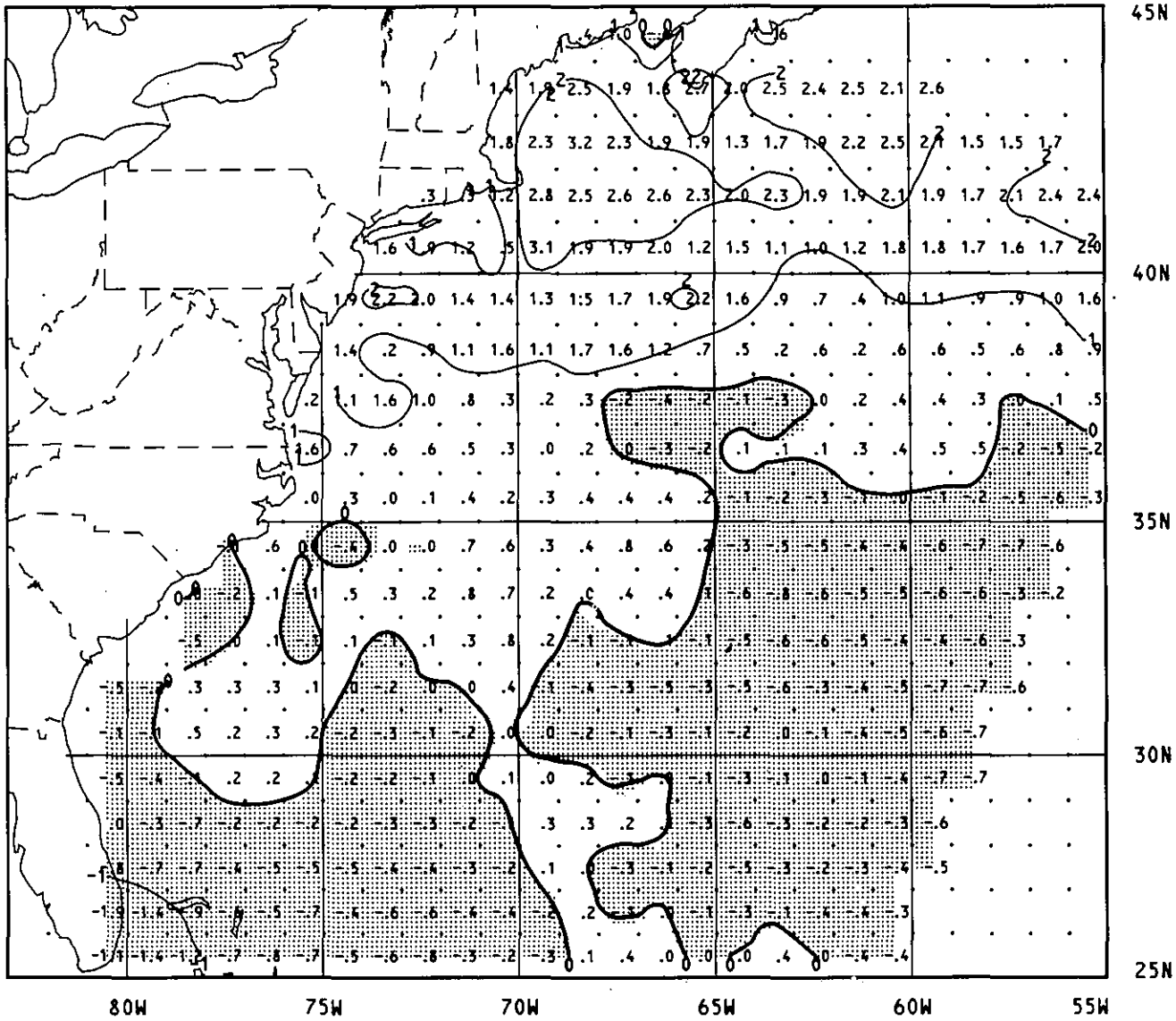
Monthly mean sea surface temperature is the mean of twice-weekly analyses using ship, buoy, and satellite observations. Contour line interval is 1.0°C.

EAST COAST SST-ANOMALY



Gulf of Mexico
SST--MONTHLY ANOMALY (°C)
August 1984

Monthly anomaly is the difference between the monthly mean sea surface temperature and the climatological monthly mean value -- shading shows where the monthly mean is colder than climatology. Contour line interval is 1.0°C.



NW Atlantic Ocean
SST--MONTHLY ANOMALY (°C)
August 1984

Monthly anomaly is the difference between the monthly mean sea surface temperature and the climatological monthly mean value -- shading shows where the monthly mean is colder than climatology. Contour line interval is 1.0°C.

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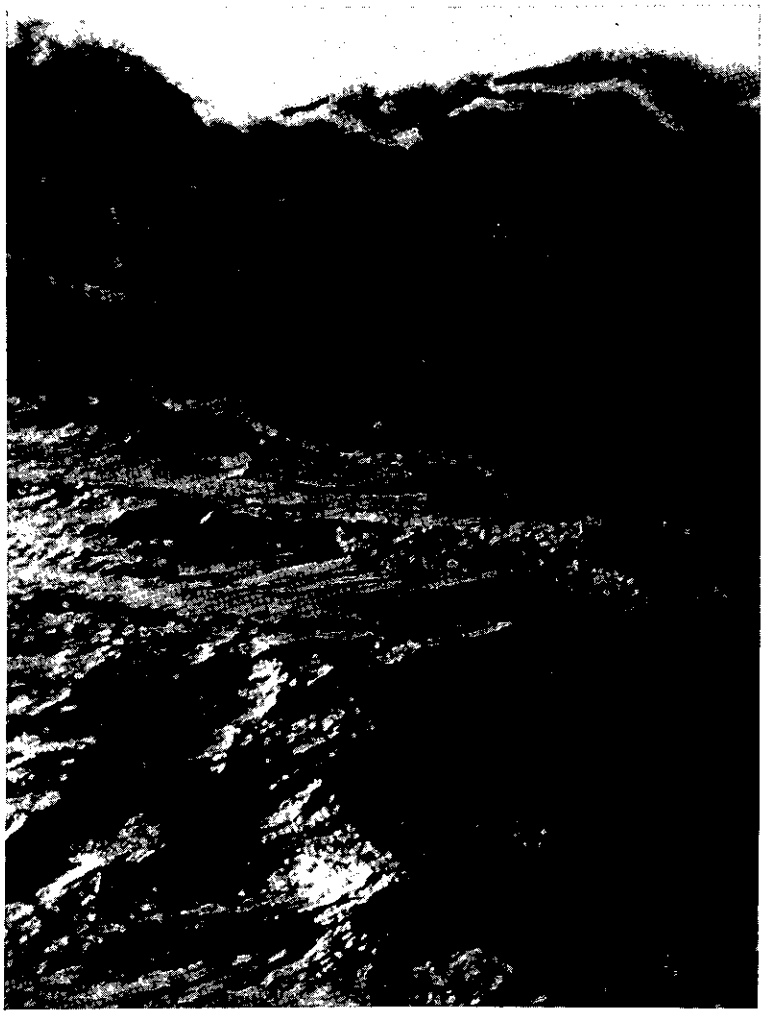
The Secretary of Commerce has determined that the publication of this periodical is necessary in the transaction of the public business required by law of this Department. Use of funds for printing this periodical has been approved by the Director of the Office of Management and Budget through April 1, 1985.

OCEANOGRAPHIC Monthly Summary

Volume IV Number 9 September 1984



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National Weather Service
National Environmental Satellite, Data, and Information Service

Oceanographic Monthly Summary is published by the National Weather Service and the National Environmental Satellite, Data, and Information Service (NESDIS). *Oceanographic Monthly Summary* contains sea surface temperature (SST) analyses on both regional and ocean basin scales for the Atlantic, Pacific, and Indian Oceans. The ocean basin analyses are based on a "blend" of *in situ* and satellite data. An ocean basin SST anomaly is derived from the "blended" SST analysis and the National Climatic Center (NCC) Climatology.[1] (See page 12 for details.) The regional SST analyses are based upon a combination of *in situ* and satellite data measurements. The regional SST anomalies use the Robinson-Bauer Climatology.[2] *Oceanographic Monthly Summary* also contains Alaskan sea ice information and ocean feature information for contiguous U.S. ocean regions.

Oceanographic Monthly Summary welcomes articles containing information of interest to *Oceanographic Monthly Summary* readers, such as, news on operational oceanography, unusual ocean feature phenomena, etc. Contributions should be sent to the editor (address below). Accepted material will appear in the OceaNotes section of *Oceanographic Monthly Summary*. Contributions can be published as quickly as the next monthly issue.

If you are interested in receiving *Oceanographic Monthly Summary* regularly, please refer to the back cover for subscription information.

[1]Reynolds, R.W., 1982. A Monthly Averaged Climatology of Sea Surface Temperatures; *NOAA Technical Report NWS 31*.

[2]Robinson, M.K., 1976. Atlas of North Pacific Ocean Monthly Mean Temperatures and Mean Salinities of the Surface Layer; *NavOceano Ref. Pub. 2*.
Robinson, M.K., R.A. Bauer, and E.H. Schroeder, 1979. Atlas of North Atlantic-Indian Ocean Monthly Mean Temperatures and Mean Salinities of the Surface Layer; *NavOceano Ref. Pub. 18*.

Oceanographic Monthly Summary

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THE PERSIAN GULF VIA SATELLITES

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On March 2, 1983, Iraq aircraft destroyed an Iranian oil rig in the north end of the Persian Gulf. A few weeks later more rigs in this area were destroyed by Iraq. The amount of oil entering the Gulf was estimated at 2,000 barrels/day, but may have reached 18,000 barrels/day as damaged rigs melted down and the oil-consuming fires went out. To help understand the spills' movement, 7 satellite-tracked drifting buoys were launched in the Persian Gulf. The buoys transmitted data to NOAA-7 and 8 satellites. Drifter positions were determined by Doppler shift at the ARGOS processing center in Toulouse, France. The buoys were mounted on slings, fitted with drogues, and deployed from helicopters off the Saudi Arabian coast in late May 1982. They washed ashore from 5 to 29 days later.

Since the Persian Gulf is a shallow isolated sea, winds are an important driving force for the circulation. The Zagros mountains on the northeast shore steer sea level winds northwest to southeast down the axis of the Gulf. This effect is clear in fig. 1 which is a NIMBUS satellite picture showing smoke from the burning oil rigs (in the north) and smoke from normal rigs (near the center) being carried southeast on March 19, 1983. Figure 2 shows the 7 drifters' paths during June 1983. The paths were generally southward, and daily mean speeds ranged from 0 to 70 cm/s with an overall mean of 20 cm/s. During the drift period, winds were consistently from the northwest. One drifter deviated sharply to the southwest at high speeds. Apparently it was towed ashore by a fisherman. After being located on land, it was returned to the Gulf and continued southeast with the other drifters.

Satellite pictures were also reviewed for positions of the spilled oil. The NOAA-7 satellite visible and infrared bands on March 29, 1983 showed a dark, warm streak heading southeast, probably the oil slick from the damaged rigs (fig. 3). The pattern of the drifter tracks and the oil slick suggest a two gyre circulation on the Persian Gulf. Mean currents probably flow southeast in response to the northwesterly winds along both the Iranian and Arabian coasts. A return flow probably runs up the middle of the Gulf toward the northwest, and splits apart near the spill site.

In remote or war-torn regions, satellite observations are invaluable. In addition to providing images, they can also relay the data from robots, such as the drifters. Moreover, the drifters commercially available today are quite sophisticated. A full set of meteorological sensors on the surface float, and a full set of oceanographic sensors on hanging cables below the float can be bought commercially.

Figure 1.

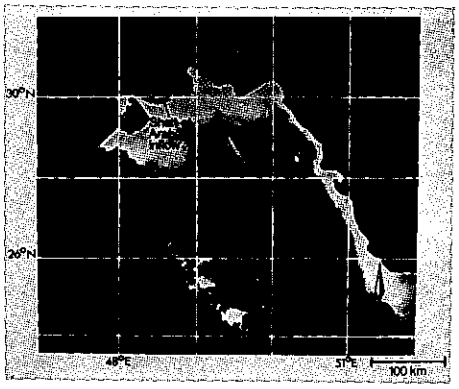


Figure 2.

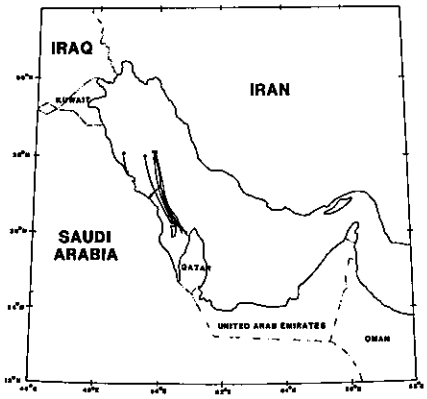
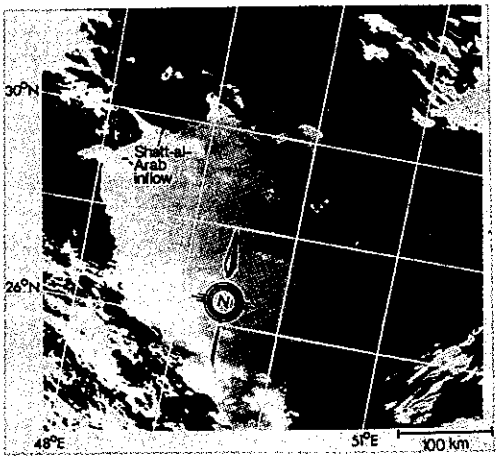
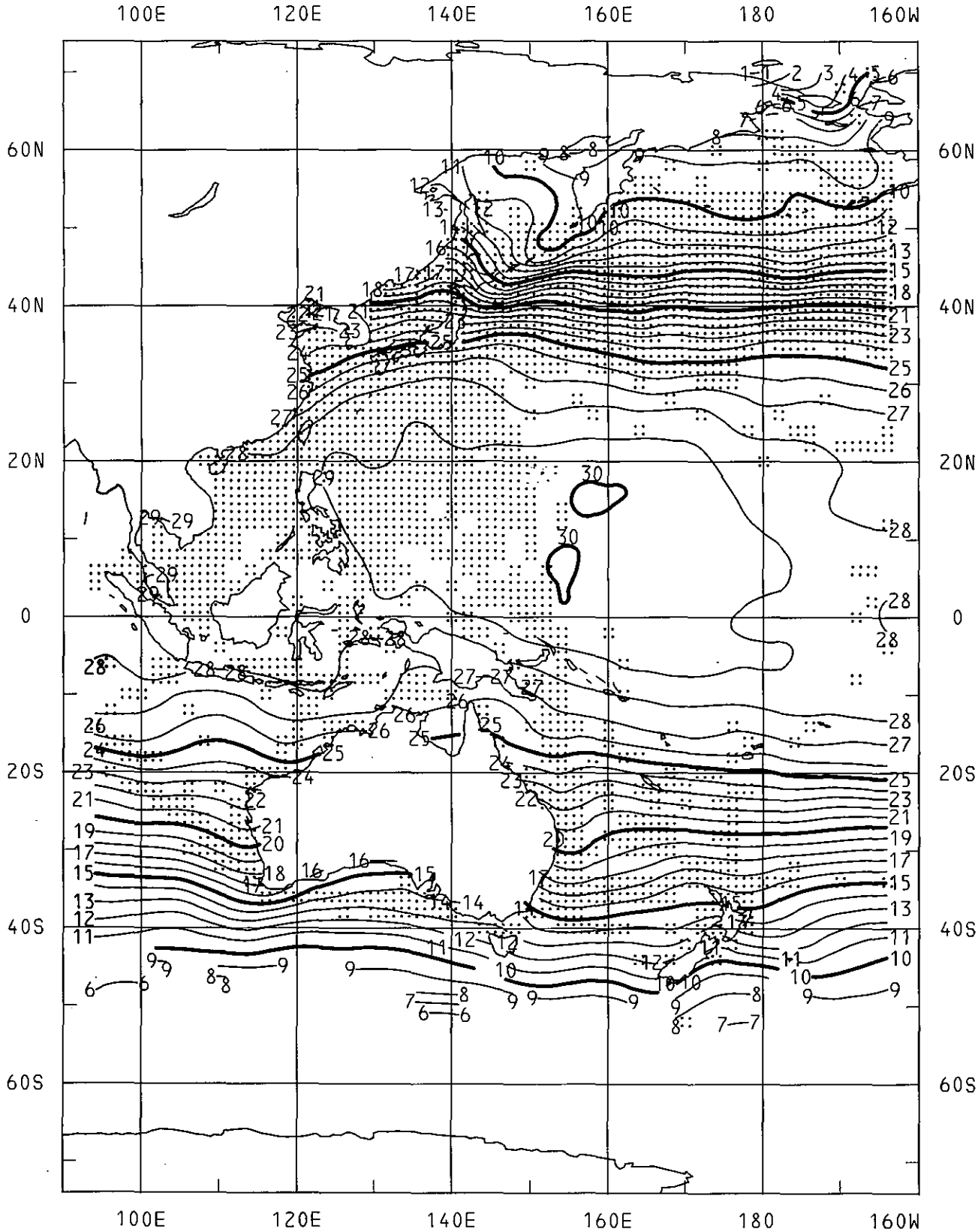


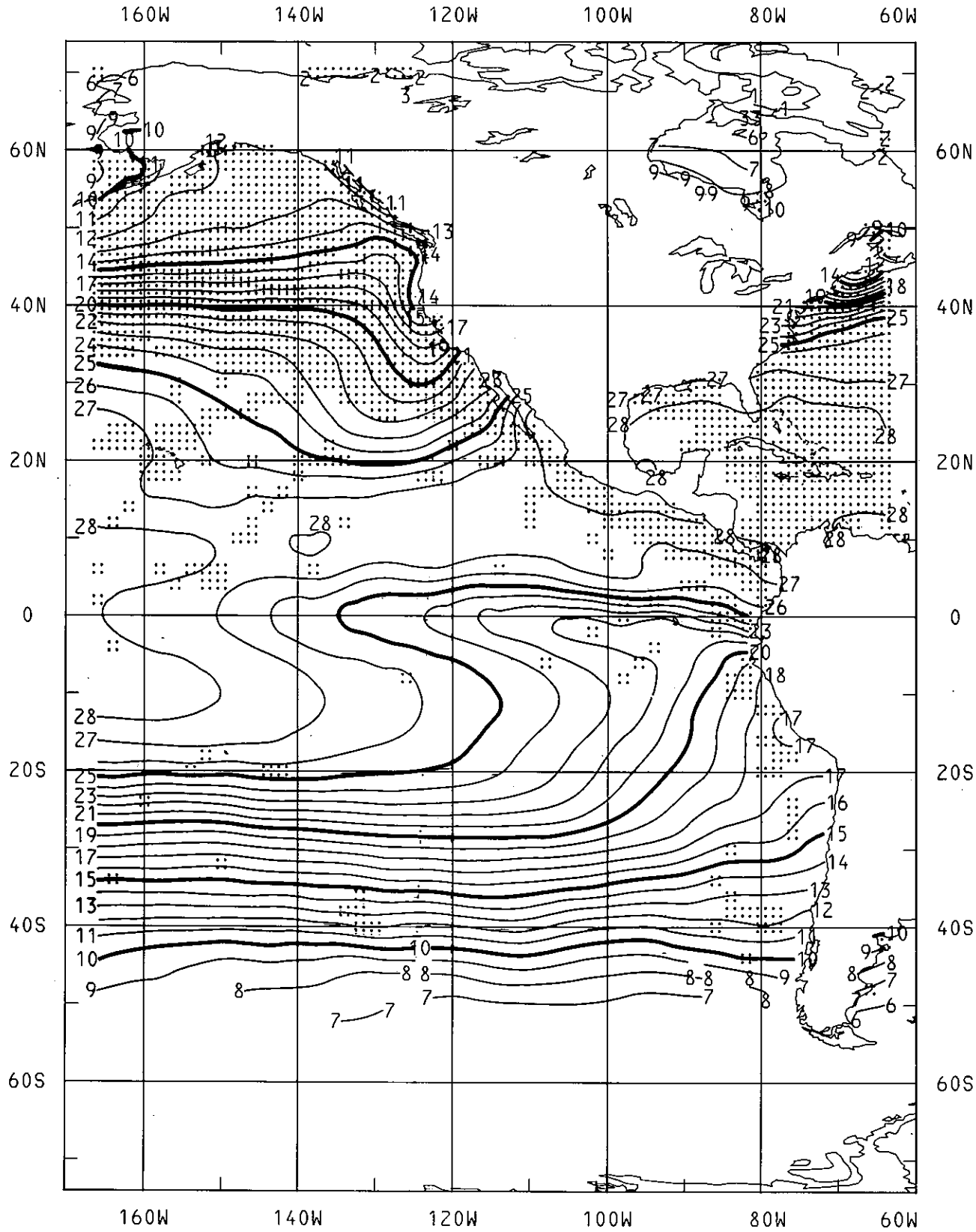
Figure 3.





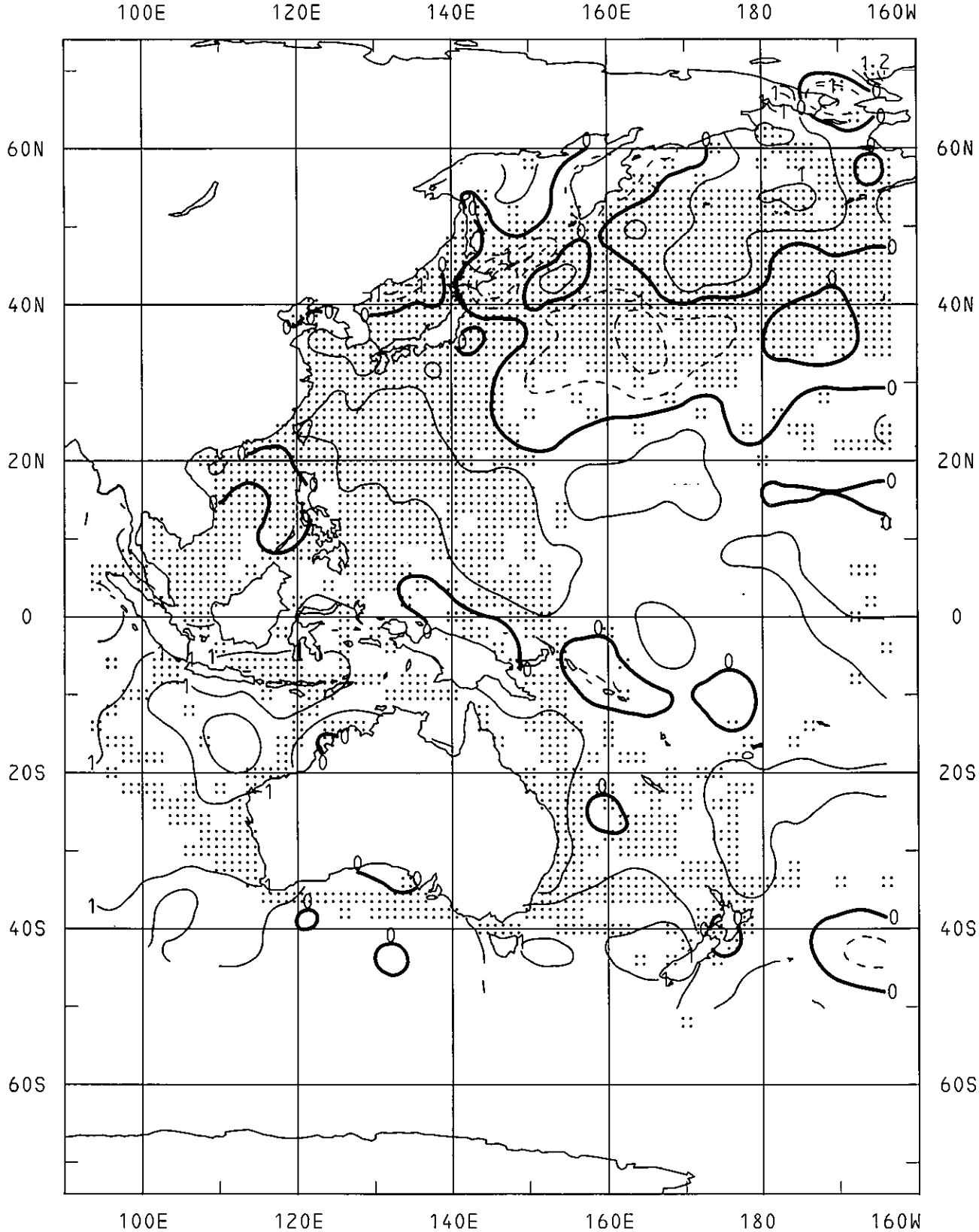
Western Pacific Ocean
SST--MONTHLY MEAN (°C)
SHIP, BUOY, and SATELLITE DATA
SEPTEMBER 1984

Monthly mean sea surface temperature is the mean of *in situ* and satellite data within two-degree quadrangles. Contour line interval is 1.0°C. The stippling indicates where the analysis was fixed by the *in situ* data; contours are not shown in areas without data.



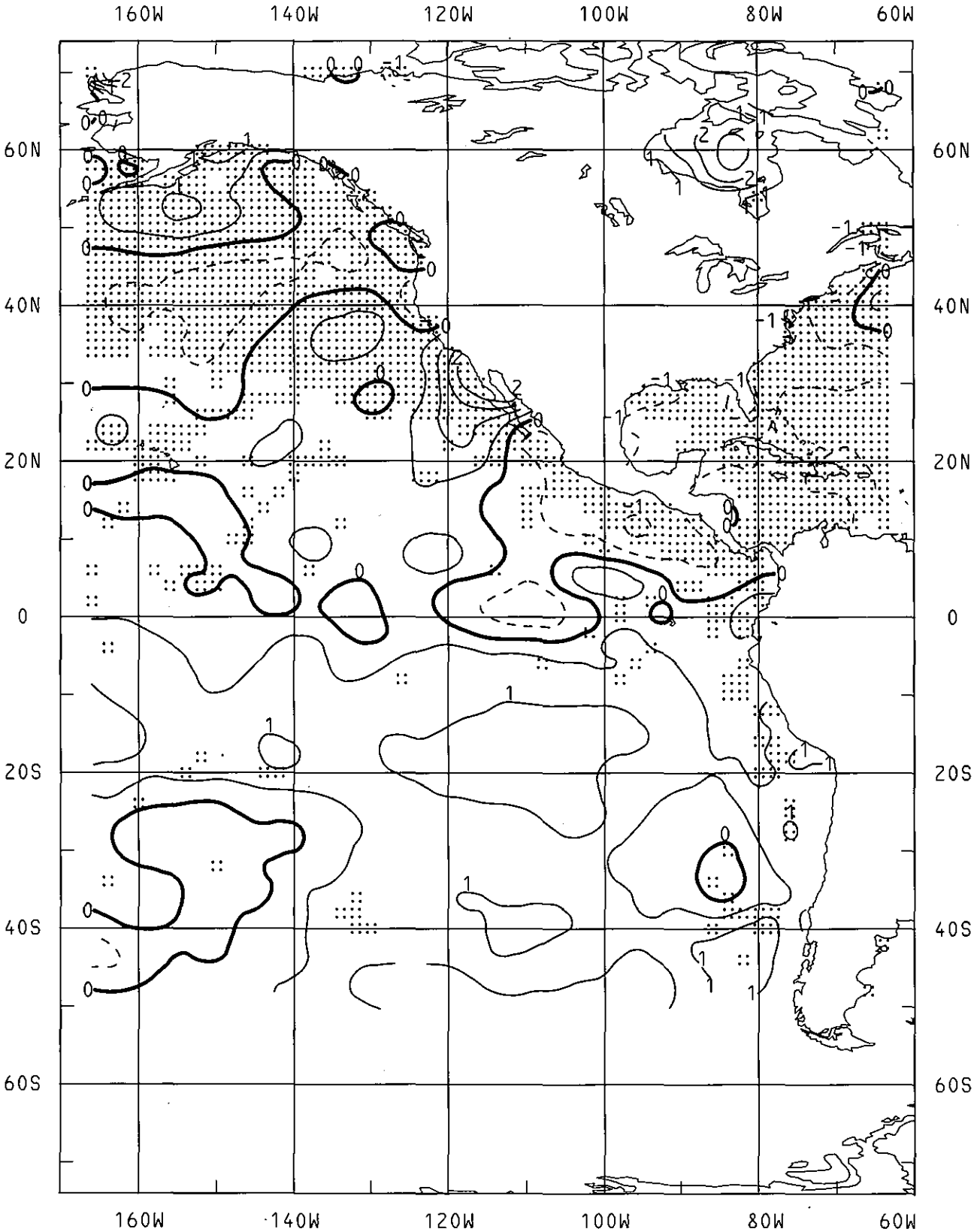
Eastern Pacific Ocean
SST--MONTHLY MEAN (°C)
SHIP, BUOY, and SATELLITE DATA
SEPTEMBER 1984

Monthly mean sea surface temperature is the mean of *in situ* and satellite data within two-degree quadrangles. Contour line interval is 1.0°C. The stippling indicates where the analysis was fixed by the *in situ* data; contours are not shown in areas without data.



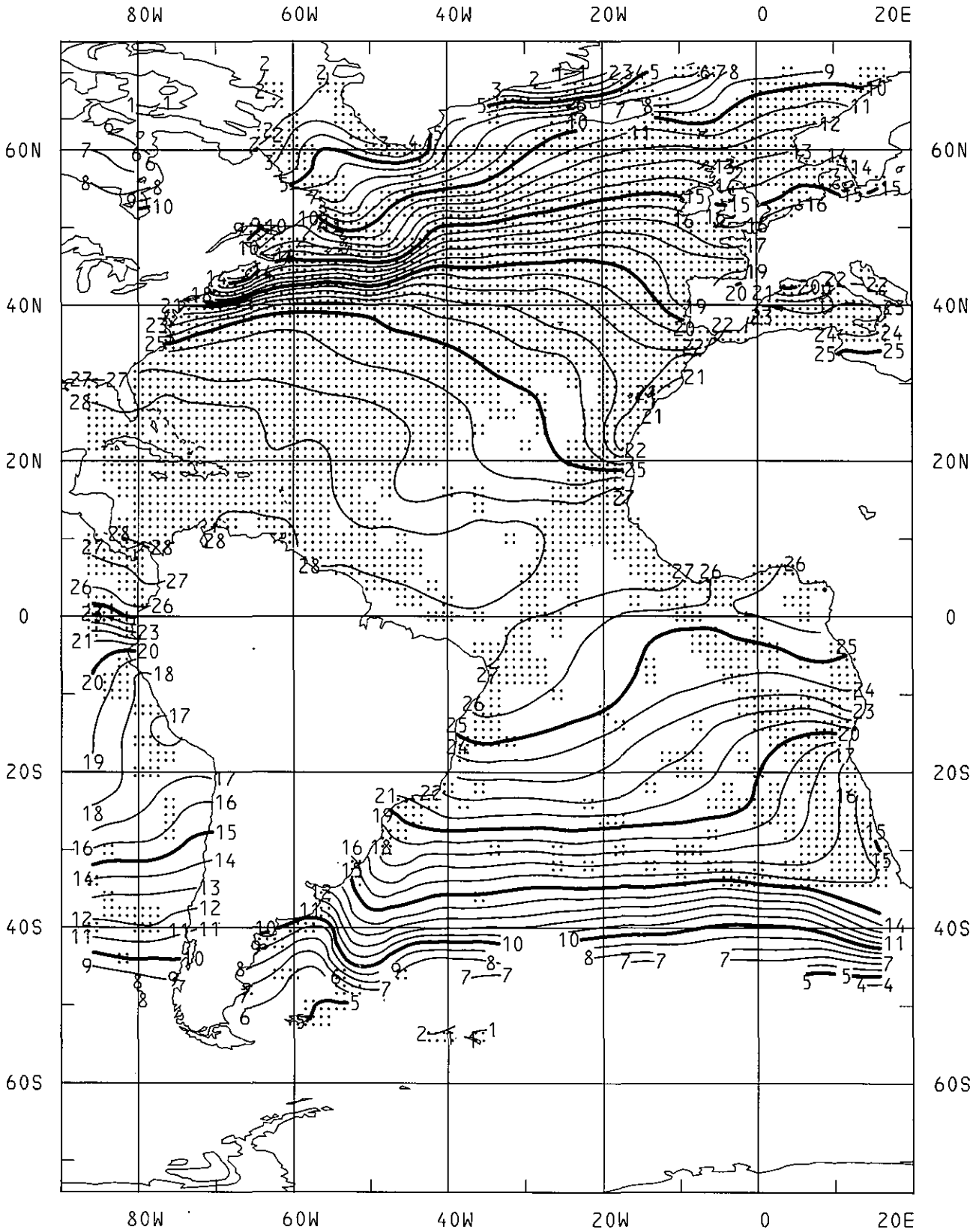
Western Pacific Ocean
SST--MONTHLY ANOMALY (°C)
SHIP, BUOY, and SATELLITE DATA
SEPTEMBER 1984

Monthly anomaly is the difference between the monthly mean sea surface temperature and the climatological monthly mean value. Contour line interval is 0.5°C. The stippling indicates where the analysis was fixed by the *in situ* data; contours are not shown in areas without monthly or climatological data.



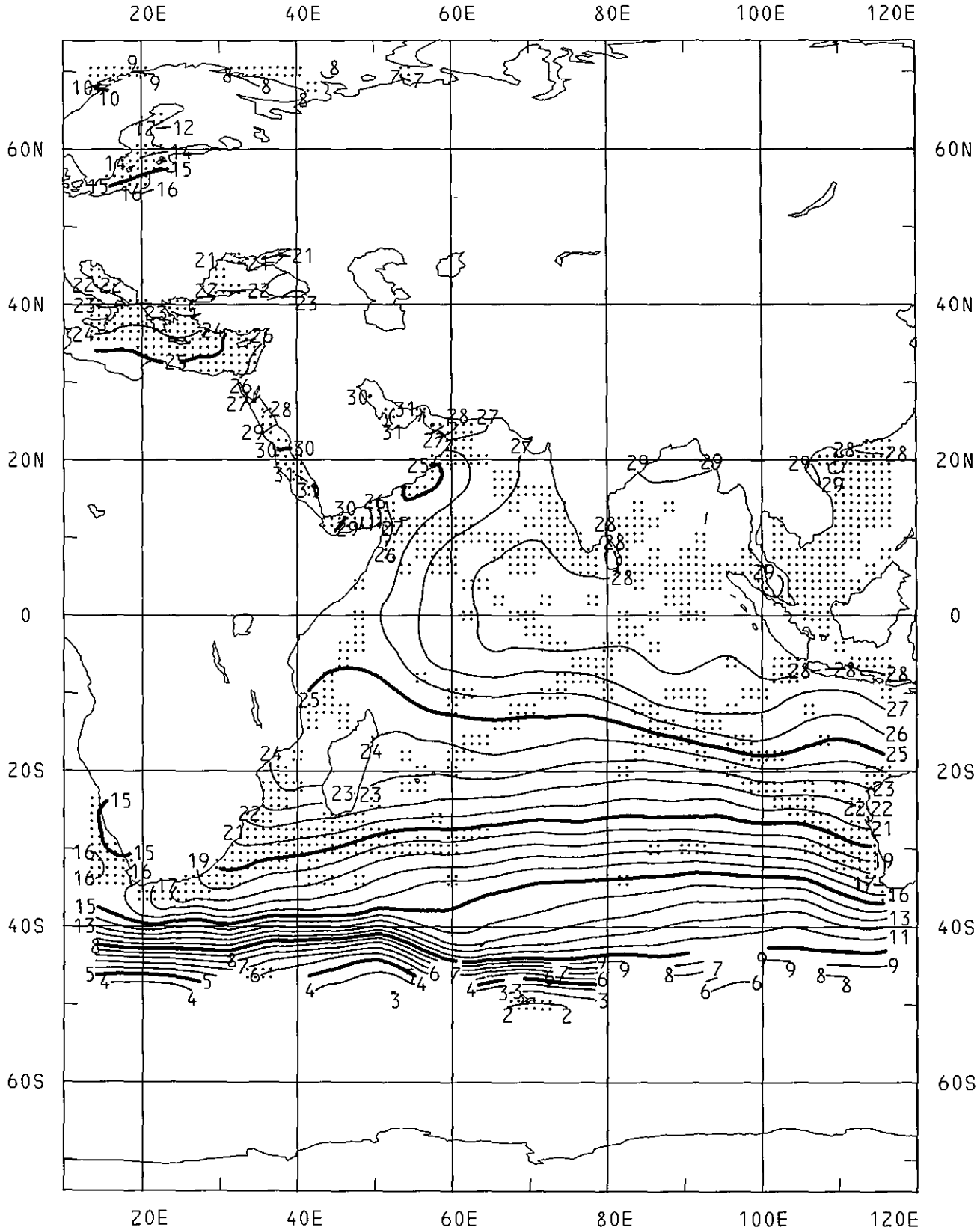
Eastern Pacific Ocean
SST--MONTHLY ANOMALY (°C)
SHIP, BUOY, and SATELLITE DATA
SEPTEMBER 1984

Monthly anomaly is the difference between the monthly mean sea surface temperature and the climatological monthly mean value. Contour line interval is 0.5°. The stippling indicates where the analysis was fixed by the *in situ* data; contours are not shown in areas without monthly or climatological data.



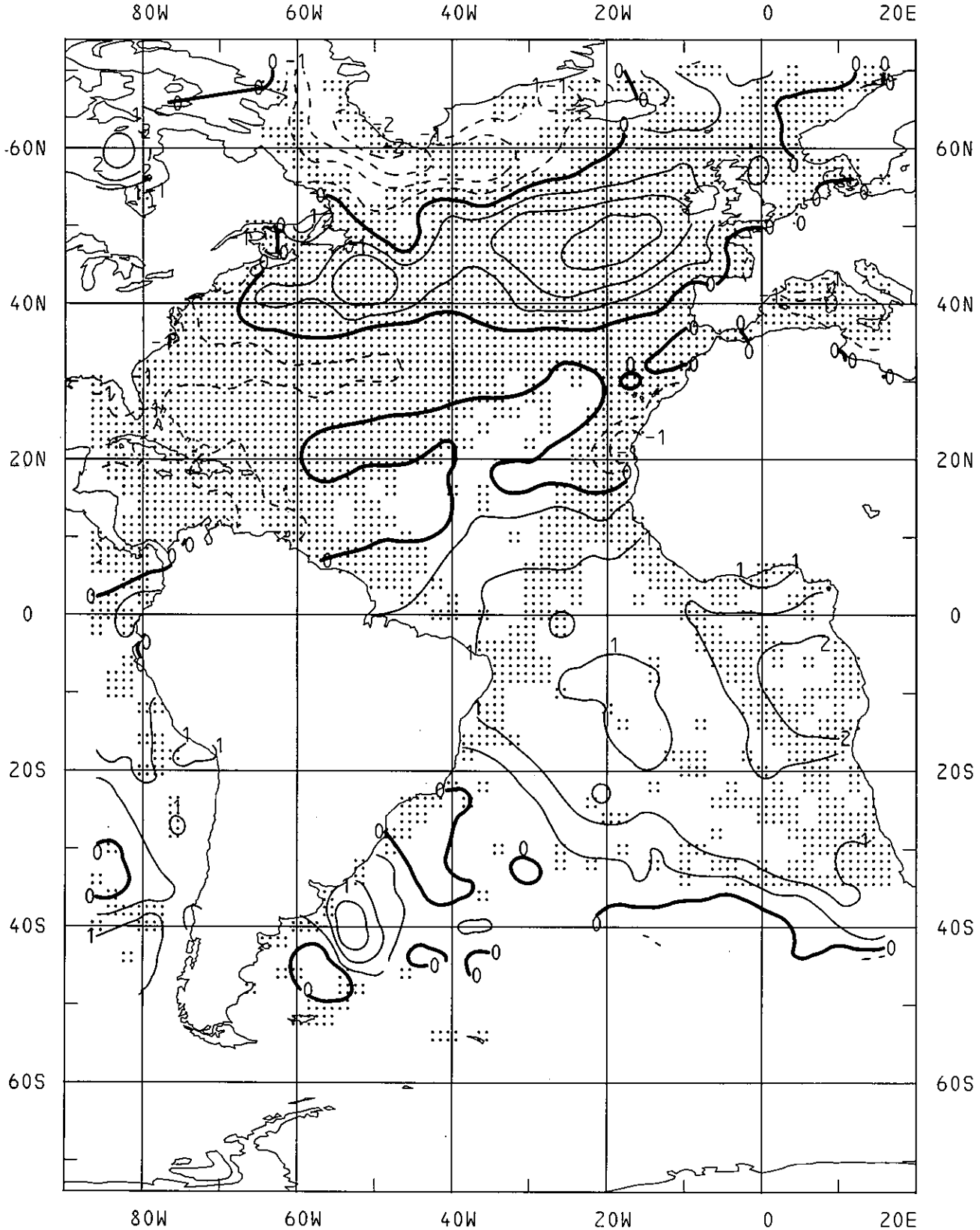
Atlantic Ocean
SST--MONTHLY MEAN (°C)
SHIP, BUOY, and SATELLITE DATA
SEPTEMBER 1984

Monthly mean sea surface temperature is the mean of *in situ* and satellite data within two-degree quadrangles. Countour line interval is 1.0°C. The stippling indicates where the analysis was fixed by the *in situ* data; contours are not shown in areas without data.



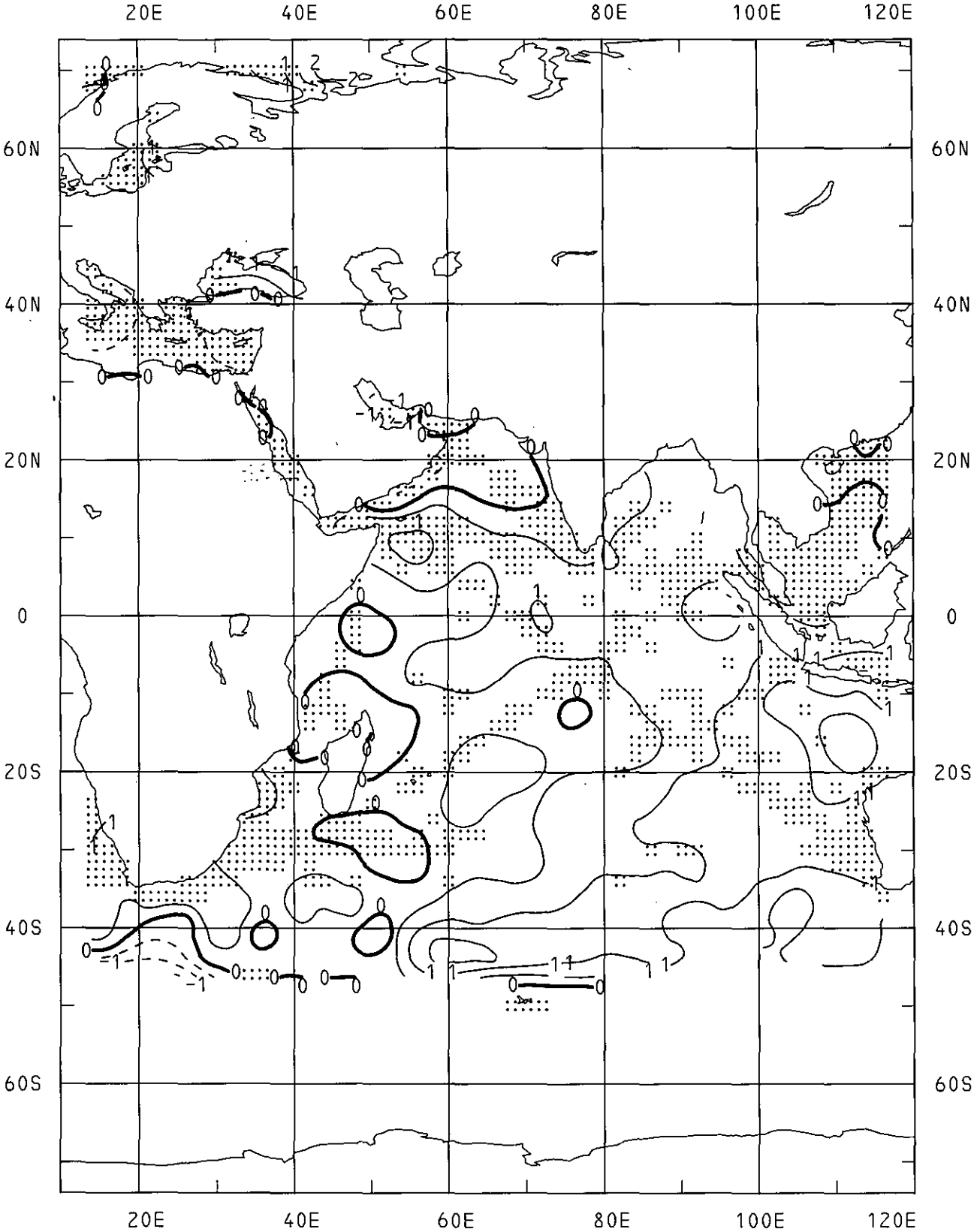
Indian Ocean
SST--MONTHLY MEAN (°C)
SHIP, BUOY, and SATELLITE DATA
SEPTEMBER 1984

Monthly mean sea surface temperature is the mean of *in situ* and satellite sata within two-degree quadrangles. Contour line interval is 1.0°C. The stippling indicates where the analysis was fixed by the *in situ* data; contours are not shown in area without data.



Atlantic Ocean
SST--MONTHLY ANOMALY (°C)
SHIP, BUOY, and SATELLITE DATA
SEPTEMBER 1984

Monthly anomaly is the difference between the monthly mean sea surface temperature and the climatological monthly mean value. Contour line interval is 0.5°C. The stippling indicates where the analysis was fixed by the *in situ* data; contours are not shown in areas without monthly or climatological data.



Indian Ocean
SST--MONTHLY ANOMALY (°C)
SHIP, BUOY, and SATELLITE DATA
SEPTEMBER 1984

Monthly anomaly is the difference between the monthly mean sea surface temperature and the climatological monthly mean value. Contour line interval is 0.5°C. The stippling indicates where the analysis was fixed by the *in situ* data; contours are not shown in areas without monthly or climatological data.

NEW GLOBAL SEA SURFACE TEMPERATURE MONTHLY MEAN ANALYSIS

Highlights

- o New global analysis using both *in situ* and satellite data
- o Indian Ocean analysis included
- o Global analysis extended further south

Beginning in February 1983 a global SST analysis was presented using *in situ* (ship and buoy) data and a non-linear spatial filter (see Reynolds and Gemmill, 1984). Because the coverage from satellites is superior to the *in situ* coverage, an analysis derived from satellite observations only was added in April 1983. The two types of data were not combined because of significant differences between the *in situ* observations and the satellite retrievals. In the July 1984 *Oceanographic Monthly Summary*, the satellite field showed a negative bias relative to the *in situ* field in the tropics and a positive bias in mid-latitude. Strong (1983) reported that satellite retrievals were cooler than *in situ* observations because of aerosols injected into the atmosphere by the eruption of El Chichon in March-April 1982. Comparisons of the two analyses over the last 30 months show that although the satellite anomalies tend to be more negative than *in situ* anomalies, the differences are <u>not independent of time or location</u>.

A "blended" SST analysis has been developed using *in situ* data to define "benchmark" temperature values in regions of frequent observations and satellite data to define the "shape" of the field between these points. The blended field is found by solving Poisson's equation, $\nabla^2 T = F$, where T is the blended SST field and F is a forcing function given by the Laplacian of the satellite SST analysis, ($\nabla^2 S$); *in situ* data are used as internal boundary values at points of frequent observations. At the poleward boundaries, T is set to the *in situ* (preferred) or the satellite analysis. The resulting anomaly and mean fields are shown on pages 4-11 where the stippling indicates regions where the SST field was fixed by the *in situ* data. The use of the satellite data has allowed the analysis to be extended further south, but necessitated a change in the map projection. Studies with this new analysis suggest that the blended analysis is an improvement over the fields obtained from *in situ* data only or the satellite data only. Since the satellite data affect the field in the interior via the Laplacian, biases or trends in the satellite data can only influence the final solution through the high latitude boundary conditions. In the example above, satellite biases would impact the blended result only south of 40°S, except in the eastern South Pacific where the *in situ* fields is almost undefined.

These results suggest that the blended method may be a useful way to utilize both *in situ* and satellite data. Each monthly blended field will be monitored carefully using individual *in situ* and satellite analyses as diagnostic tools. In future months the blended method may be modified to reflect changes in either the *in situ* observations or the satellite retrievals.

Reynolds, R. W. and W. H. Gemmill, 1984: An objective global monthly mean sea surface temperature analysis. Tropical Ocean-Atmosphere Newsletter, No. 23, 4-5.

Strong, A. E., 1983: Satellite derived sea surface temperature errors due to the El Chichon aerosol cloud. Tropical Ocean-Atmosphere Newsletter, No. 18, 14-15.

SATELLITE IMAGE OF THE MONTH

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Interactive Processing Branch E/SP22
NESDIS, NOAA
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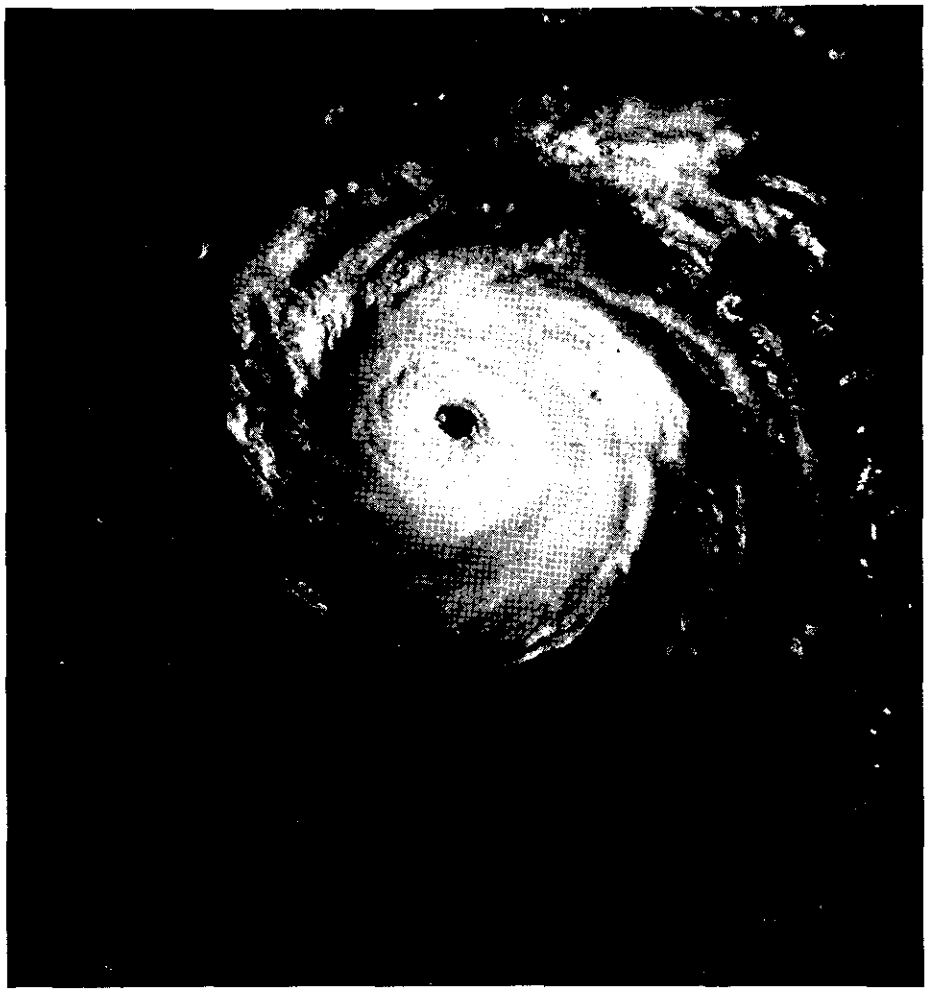
(301) 763-8142

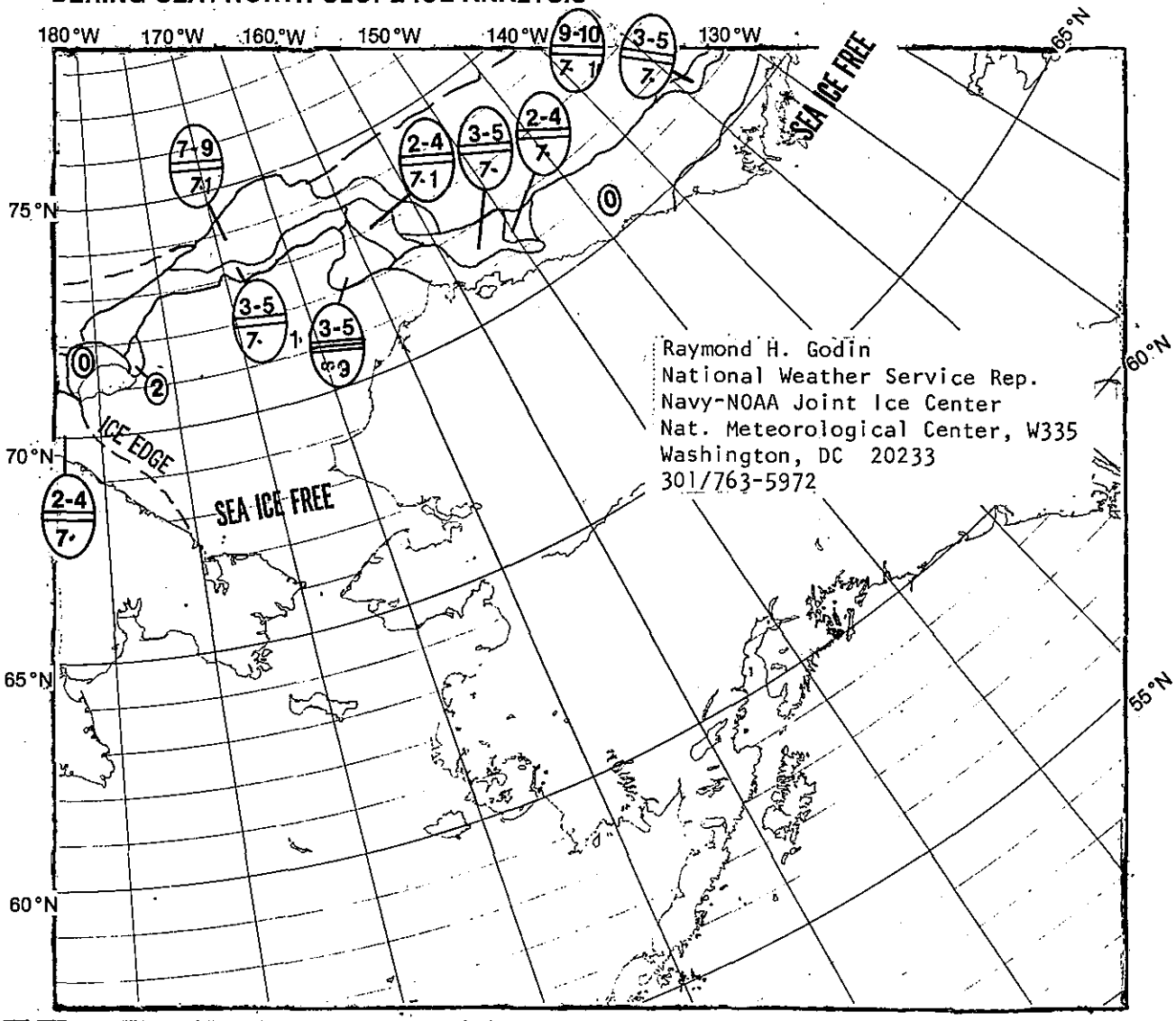
HURRICANE DIANA

This NOAA-6 visible image from September 12, 1984 shows Hurricane Diana east of the North Carolina coast. At 7:45 a.m. EST, the storm's "eye" was about 35 miles southeast of Wilmington, North Carolina. The storm's maximum winds were 115 knots. The visible image clearly shows detail in the cloud structure and central "eye". Shortly after this image was acquired, the storm moved inland and then moved northeastward off the coast.

Hurricane Diana was located over very warm SSTs when she was east of Florida to the time she moved well off the Carolina coast. For some of this time, the storm was in the Gulf Stream, where SSTs were 26° to 28°C. Studies have shown that frequency and intensity of tropical storms are related to the distribution and magnitude of SSTs. In particular, Palmen (1948) suggested that hurricanes tend to develop over water with temperatures of at least 26.1°C. More recent studies have verified Palmen's suggestion. Storm trajectories also show a similar tendency of matching regions of warm SSTs, although relating the path of storms to the location of warm currents such as the Gulf Stream has not been established.



BERING SEA / NORTH SLOPE ICE ANALYSIS



C = Total ice concentration in the area in tenths.
C_a, C_b, C_c = Concentration of thickest (C_a), 2nd thickest (C_b), and 3rd thickest (C_c) ice
S_a, S_b, S_c = Stage of development of thickest (S_a), 2nd thickest (S_b), and 3rd thickest (S_c) ice.
~C = Concentration of ice within area(s) of strips and patches.

STAGE(S) OF DEVELOPMENT (THICKNESS)

1 = New ice (0-10 cm)
3 = Young ice (10-30 cm)
6 = First year (30-200 cm)
7 = First year thin (30-70 cm)
1. = First year medium (70-120 cm)
4. = First year thick (120-200 cm)
7. = Old ice (survived at least one summer's melt)

EXAMPLES

125 Theoretical thickness of this season's growth (cm).

Fast ice. Sea ice which forms and remains fast along the coast.

Ice boundary visually or satellite observed.

Ice boundary estimated.

SEPTEMBER 1984

The monthly mean sea level pressure circulation depicts a 1020 mb high centered in the western Canadian Arctic near 73°N 125°W. Southeasterly mean surface geostrophic winds are observed in the monthly mean. In weekly mean sea level pressure charts alternating easterly and southerly winds were observed throughout Alaskan ice covered waters. Above normal monthly mean surface air temperatures are observed at Barrow (71°N 157°W) and Nome (65°N 165°W). Ice free conditions extend along the Alaskan coast from the Bering Strait to Pt. Barrow. During the month, periods of strong southerly winds and much above normal temperatures contributed to the formation and expansion (ranging from 30 to 180 km) of open water areas along the Alaskan North Coast. The current ice edge position is near the climatological median in the Chukchi Sea west of 175°W, between the minimum and the median from 175°W to 165°W, and close to the median east of 165°W.

WEST COAST OCEAN FEATURES

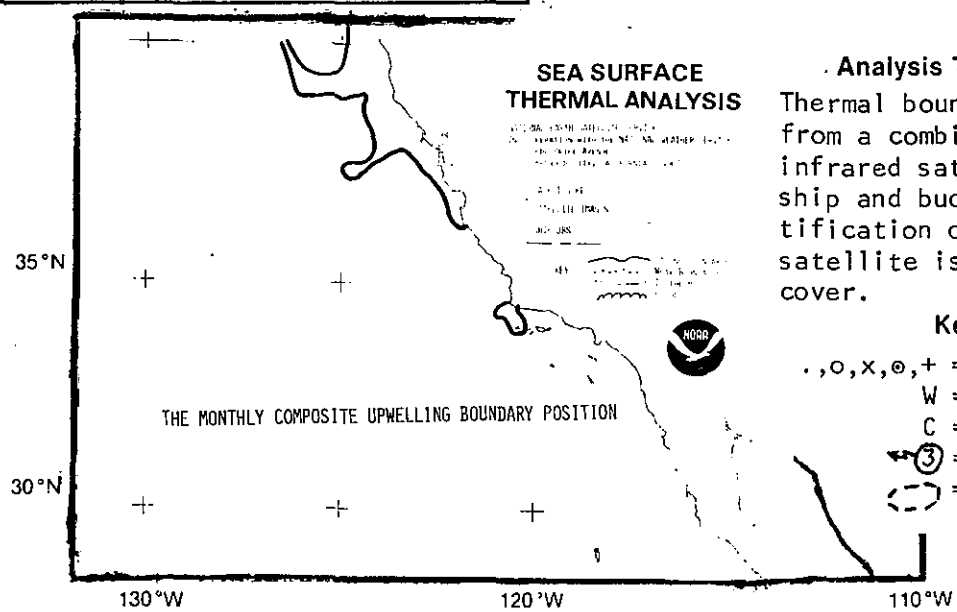
SEPTEMBER 1984

MONTHLY SST STATISTICS FOR SELECTED STATIONS
PACIFIC NORTHWEST
(Area enclosed by 40-52N, Coast-135W)

SEPTEMBER 1984

Station	Location (Lat/Long)	Mean SST	Standard Deviation	Maximum SST	Minimum SST	Change From Previous Month
Buoy 46005	46.1 N 131.0 W	16.0	0.2	16.4	15.5	-0.1
Buoy 46002	42.5 N 130.3 W	18.1	0.3	18.7	17.7	+0.4
Buoy 46010	46.2 N 124.2 W	14.7	1.3	16.5	12.1	-0.3
Buoy 46027	41.8 N 124.4 W	11.3	1.3	13.6	9.5	-0.8
Quillayute River	47.9 N 124.6 W	13.8	2.4	17.2	10.0	+2.0
Grays Harbor	46.9 N 124.1 W	15.6	2.3	18.9	10.6	-1.1
Cape Disappointment	46.3 N 124.1 W	14.7	2.2	17.2	8.3	-0.4
Yaquina Bay	44.6 N 124.1 W	**** EQUIPMENT MALFUNCTION ****				
Chetco River	42.0 N 124.3 W	10.6	1.2	11.1	7.2	N/A

Although the overall average SSTs for the Pacific Northwest for September showed little change from August, there were clear signs of cooling associated with autumn transition by the end of the month. A period of strong ocean cooling occurred during September 18-26. While offshore areas only cooled about 1°C during this period, coastal waters showed dramatic decreases ranging from 4° to 9°C. This strong coastal cooling is explained by moderate coastal upwelling during September 20-24, augmented by the onset of seasonal cooling previously mentioned. Average winds during the month were light and variable from the mid-Oregon coast northward, resulting in slightly less than normal upwelling for the month. Normal winds and upwelling occurred on the southern Oregon coast. SSTs remained below normal within 100 miles of the Washington and Oregon coasts, with a maximum negative anomaly of about -2.5°C persisting near Cape Blanco.



SEA SURFACE THERMAL ANALYSIS

Analysis Techniques

Thermal boundaries are determined from a combination of enhanced infrared satellite imagery and ship and buoy observations. Identification of these features by satellite is limited by cloud cover.

Key

.,o,x,⊙,+ = thermal boundaries
W = warm
C = cold
③ = date of feature
= outline of water mass feature

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NOAA/Northwest Regional Ocean Service Center
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Bin C15700
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(206) 527-6604

South Panel
Ernest Daghir
NOAA/NWS
Satellite Field Service Station
660 Price Avenue
Redwood City, CA 94063
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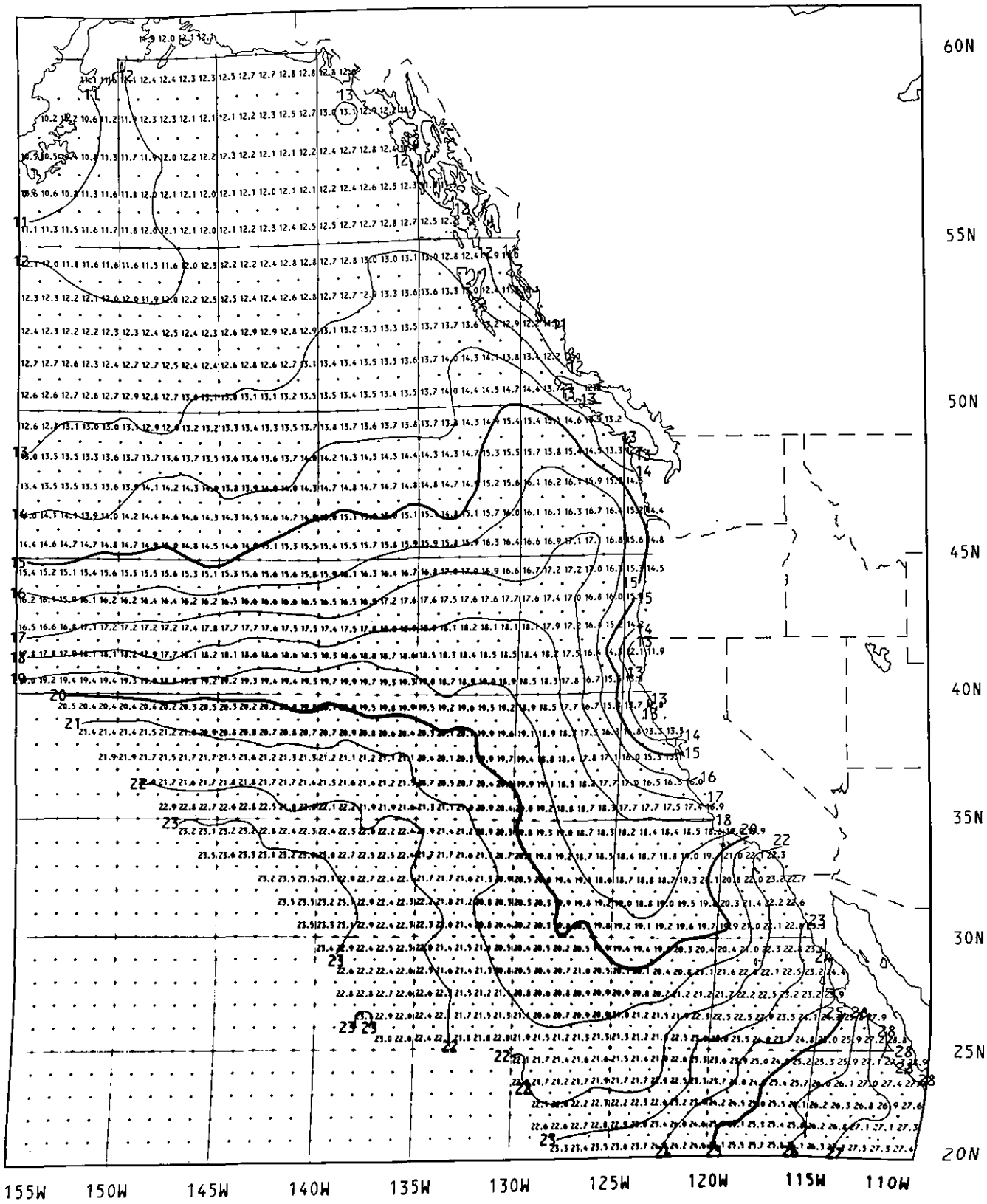
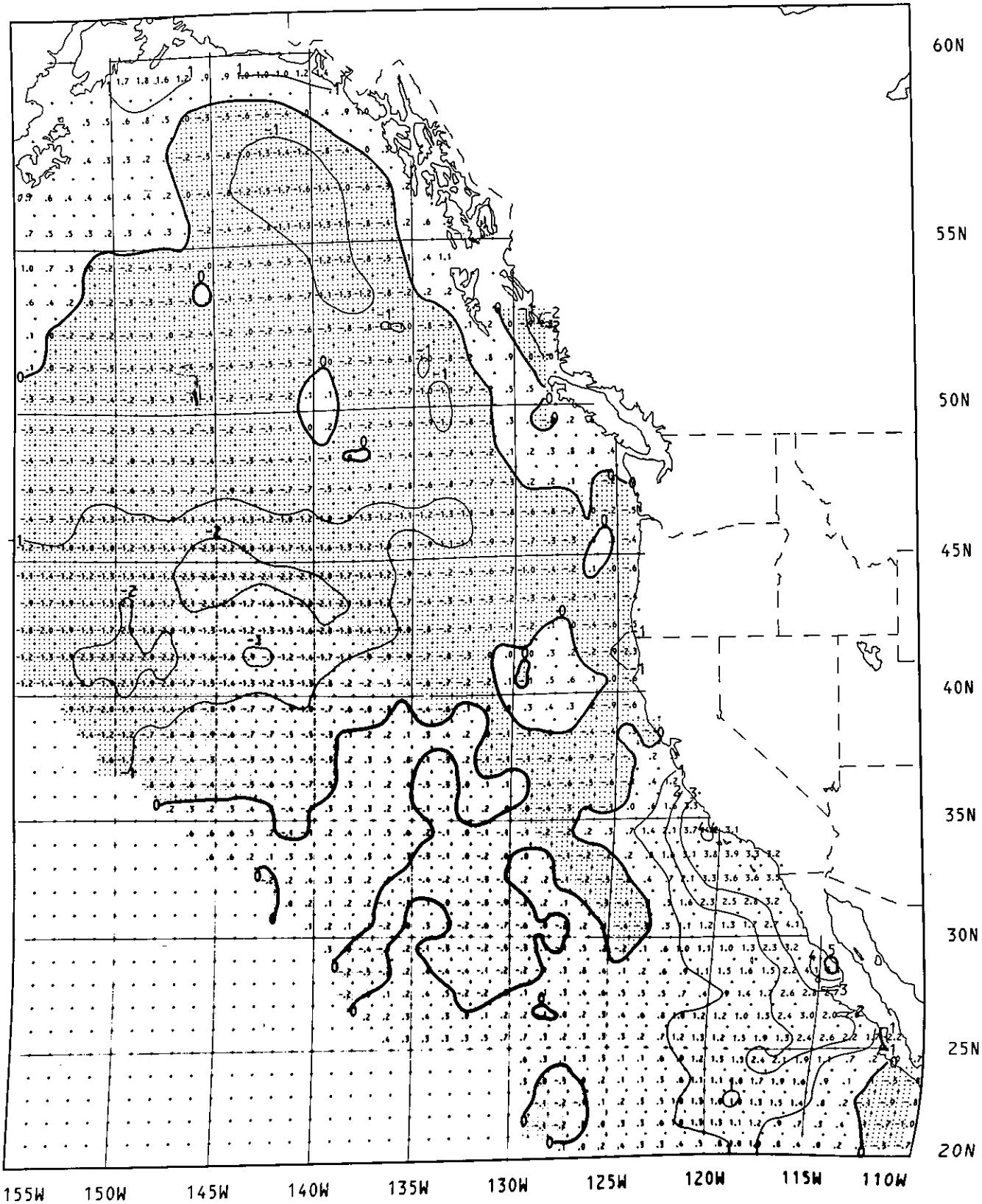
The average mean SSTs over the South Panel during September were warmer (19.5°C) than the climatological normal mean (19.0°C) In two areas the SSTs were slightly lower (0.5°C) than climatology; one near 37°30N 127°30W and the other at 30°N 126°W. The major warm anomaly was east of 123°W with a 3°C anomalous bullseye between the Los Angeles Bight and Northern Baja peninsula. When compared to August, the entire analysis area warmed from 0.3°C to 1.3°C; this is not unusual since SSTs are generally reaching their maximum during September with the upwelling activity abating. Some moderate upwelling activity existed at the beginning of September, but upwelling was weak near the end of September. However, some residual upwelled water remained alongshore north of Pt. Reyes with SSTs around 13°C.



West Coast
SST--MONTHLY MEAN (°C)
September 1984

Monthly mean sea surface temperature is the mean of twice-weekly analyses using ship, buoy, and satellite observations. Contour line interval is 1.0°C.



West Coast
SST--MONTHLY ANOMALY (°C)
September 1984

Monthly anomaly is the difference between the monthly mean sea surface temperature and the climatological monthly mean value -- shading shows where the monthly mean is colder than climatology. Contour line interval is 1.0°C.

The end of this month's positions of the Gulf Stream System and its associated eddies are shown for the NW Atlantic and the Gulf of Mexico. The Gulf Stream and Loop Current boundaries are located by infrared satellite imagery or XBT (expendable bathythermograph) data. Anticyclonic eddies are labeled a-z in the Gulf of Mexico and 1-99 in the NW Atlantic. Cyclonic eddies are labeled A-Z. Arrows on eddies indicate direction of circulation. Warm-core or anticyclonic eddies rotate clockwise; cold-core or cyclonic eddies rotate counterclockwise. The line to the eddy center shows the net translation since last month or since last observed. Eddies or sections of the Gulf

EAST COAST OCEAN FEATURES

Stream System which were not observed during the month are not shown on the analysis chart. The long arrows at the bottom of the chart indicate the date of data used.

Data used in this analysis include:
- NOAA satellite infrared imagery, NESDIS
- Bathythermograph data, National Meteorological Center of National Weather Service
- Oceanographic Analysis, A daily detailed analysis issued by National Weather Service/NESDIS

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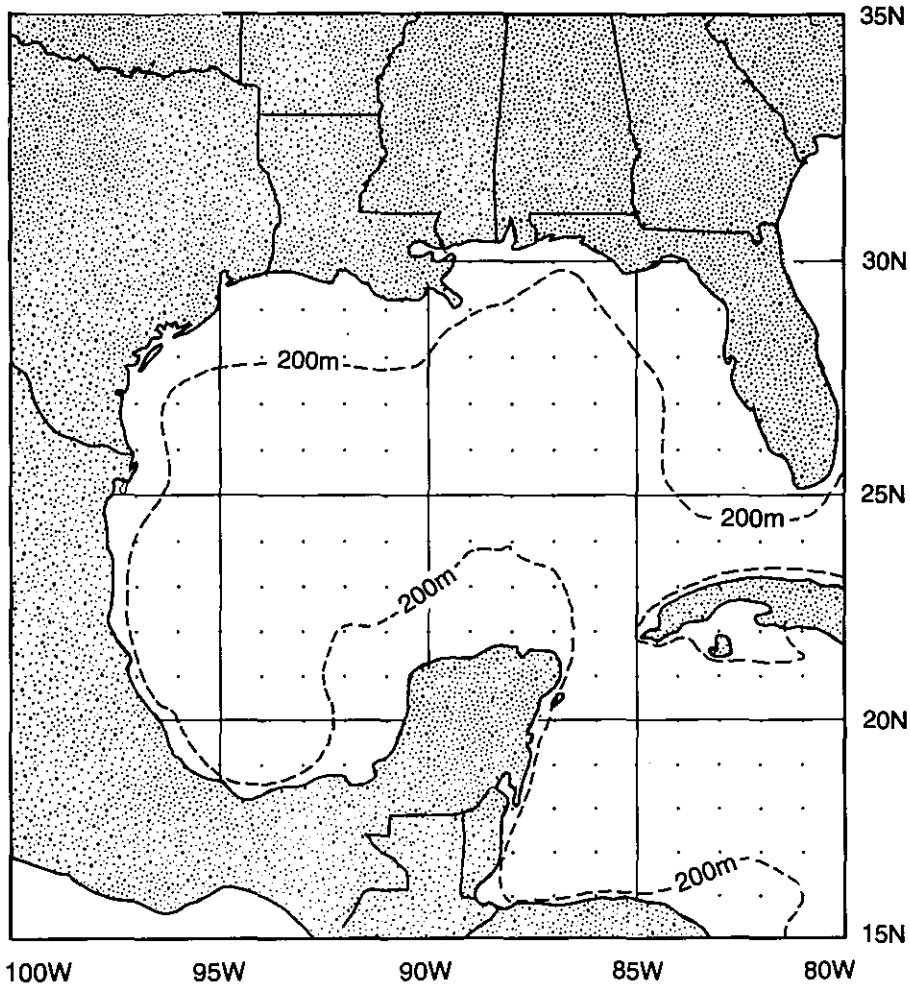
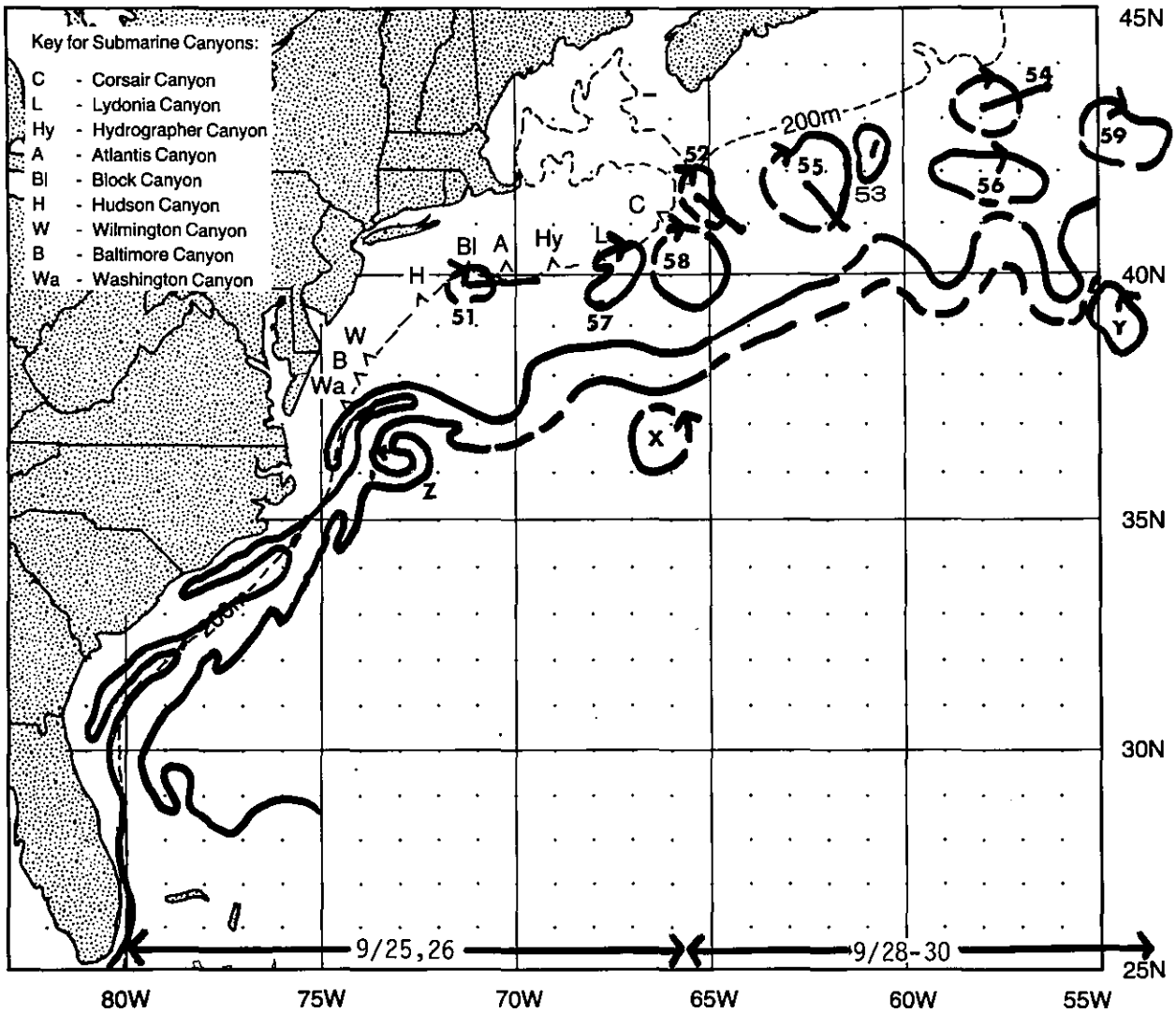


SEPTEMBER 1984

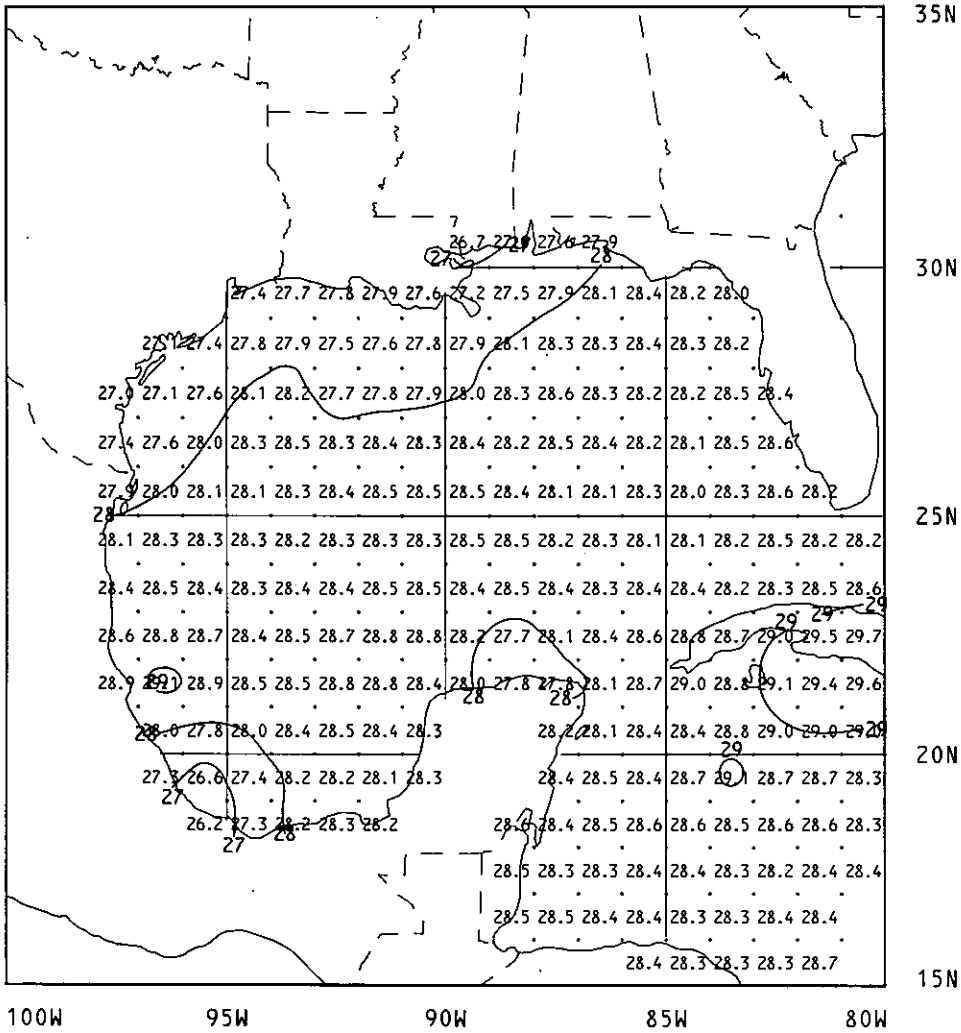
Due to seasonal heating, the Loop Current in the Gulf of Mexico was last observed in June.



Two anticyclonic eddies were newly observed, two anticyclonic eddies were formed, and one anticyclonic eddy was absorbed during the month. Eddy 58 was first detected near 40°N 67°30W on September 9. Its origin is unknown. Eddy 58 seemingly translated 165 km E. Eddy 59 was first observed near 42°30N 54°30W on September 24. Eddy 59 apparently formed from a Gulf Stream meander near 41°N 50°30W in mid-April. New eddy 56 seemingly formed from the Gulf Stream near 41°N 57°30W on September 6. Eddy 57 presumably formed from a Gulf meander near 40°N 66°W on September 9. Eddy 46 apparently was absorbed by eddy 52 near 42°N 65°W on September 13. Eddy 55 was absorbed by the Gulf Stream near 41°45N 62°W on September 9. By September 15, eddy 55 reformed from the Gulf Stream near 40°30N 60°30W. Eddy 55 translated 110 km NW. Eddy 51 translated 155 km W. Eddy 52 translated 110 km NW. Eddy 53 traveled 25 km SSW. Eddy 54 traveled 140 km WSW.

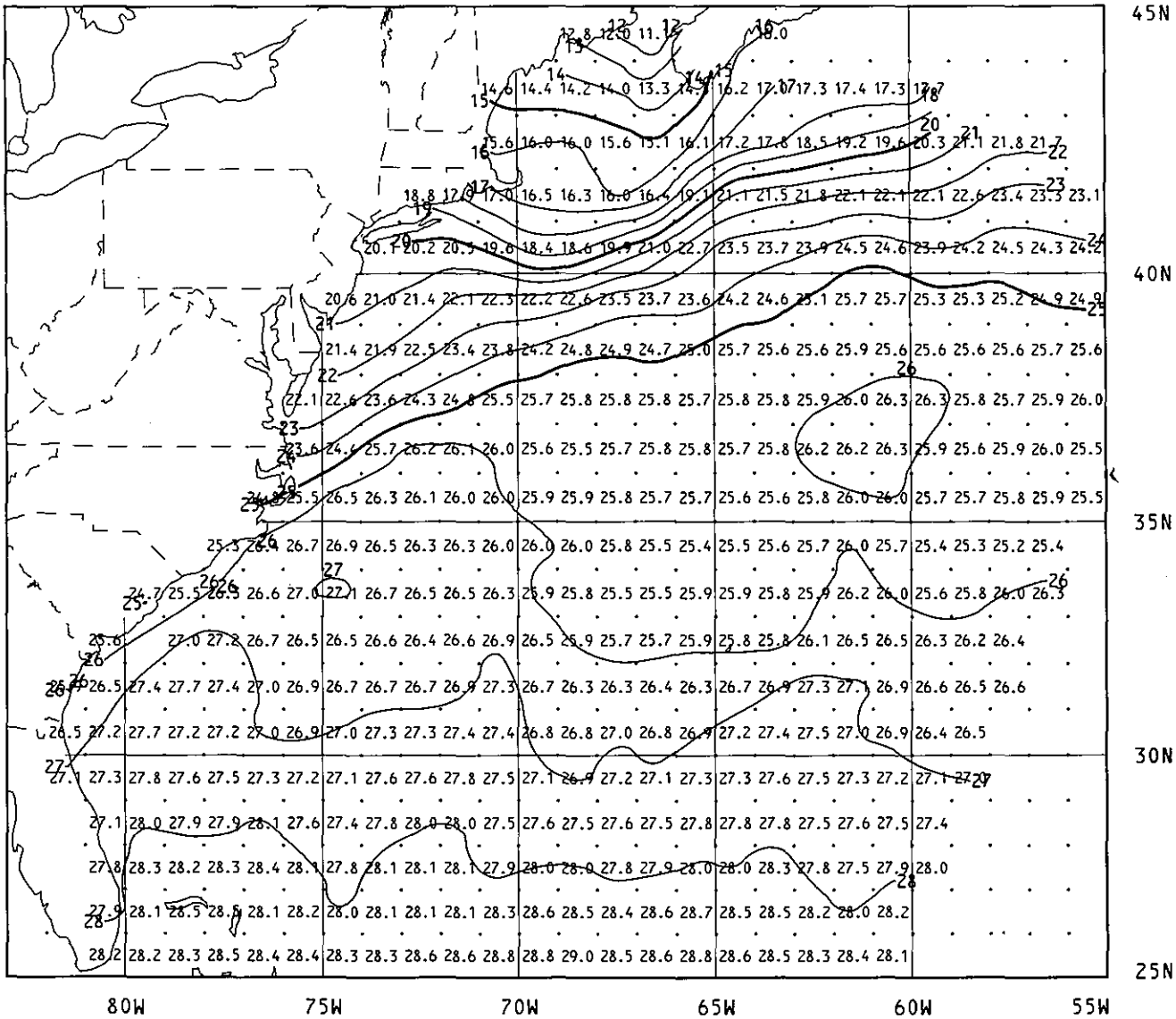
Three cyclonic eddies were observed during September. Eddy X was first clearly observed near 37°30N 64°W on September 13. Its origin is unknown. Eddy Y was first detected near 39°N 55°W on September 24. Its origin is unknown. Eddy Z was first observed near 36°30N 72°30W on September 25. Eddy W was not observed during the month.

EAST COAST SST-
MONTHLY MEAN



Gulf of Mexico
SST--MONTHLY MEAN (°C)
September 1984

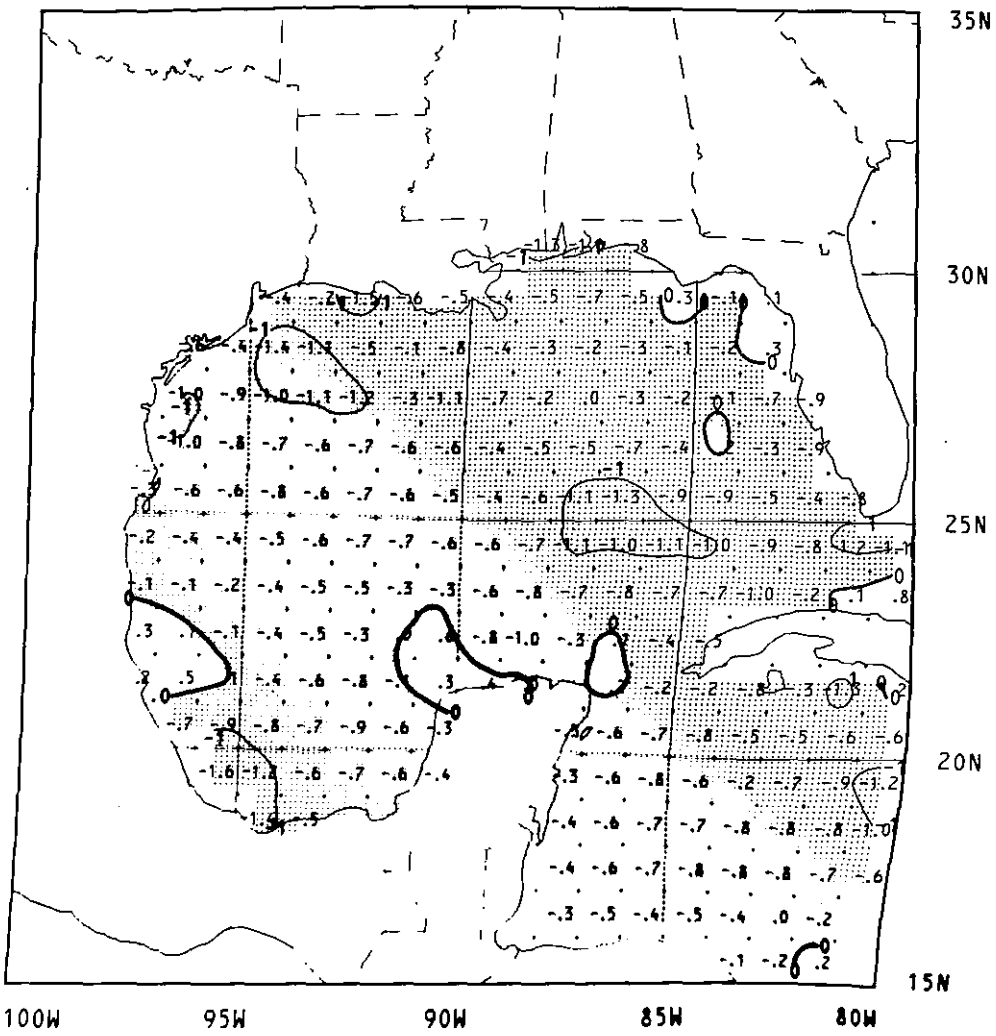
Monthly mean sea surface temperature is the mean of twice-weekly analyses using ship, buoy, and satellite observations. Contour line interval is 1.0°C.



NW Atlantic Ocean
SST--MONTHLY MEAN (°C)
September 1984

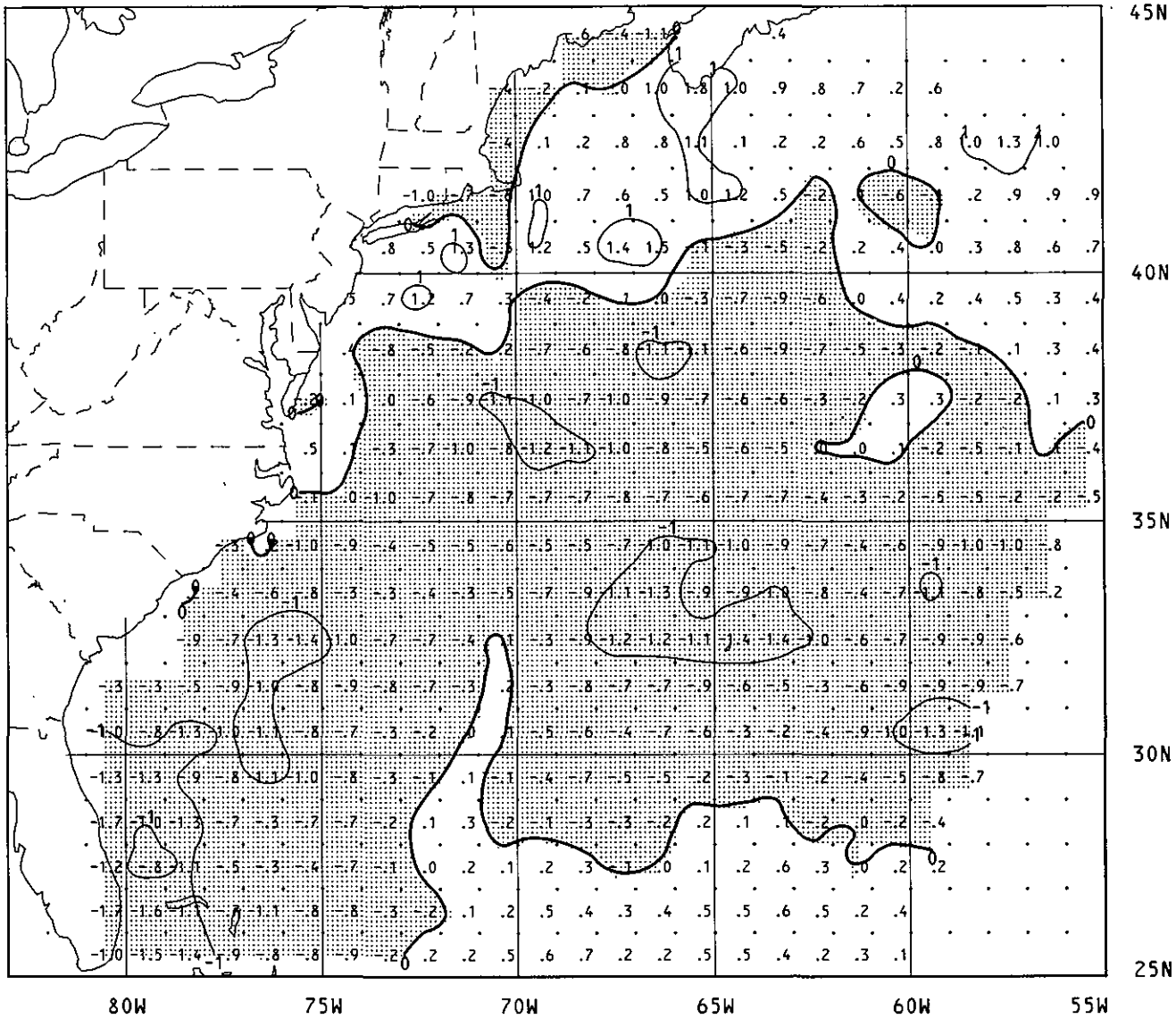
Monthly mean sea surface temperature is the mean of twice-weekly analyses using ship, buoy, and satellite observations. Contour line interval is 1.0°C.

EAST COAST SST-ANOMALY



Gulf of Mexico
SST--MONTHLY ANOMALY (°C)
September 1984

Monthly anomaly is the difference between the monthly mean sea surface temperature and the climatological monthly mean value -- shading shows where the monthly mean is colder than climatology. Contour line interval is 1.0°C.



NW Atlantic Ocean
SST--MONTHLY ANOMALY (°C)
September 1984

Monthly anomaly is the difference between the monthly mean sea surface temperature and the climatological monthly mean value -- shading shows where the monthly mean is colder than climatology. Contour line interval is 1.0°C.

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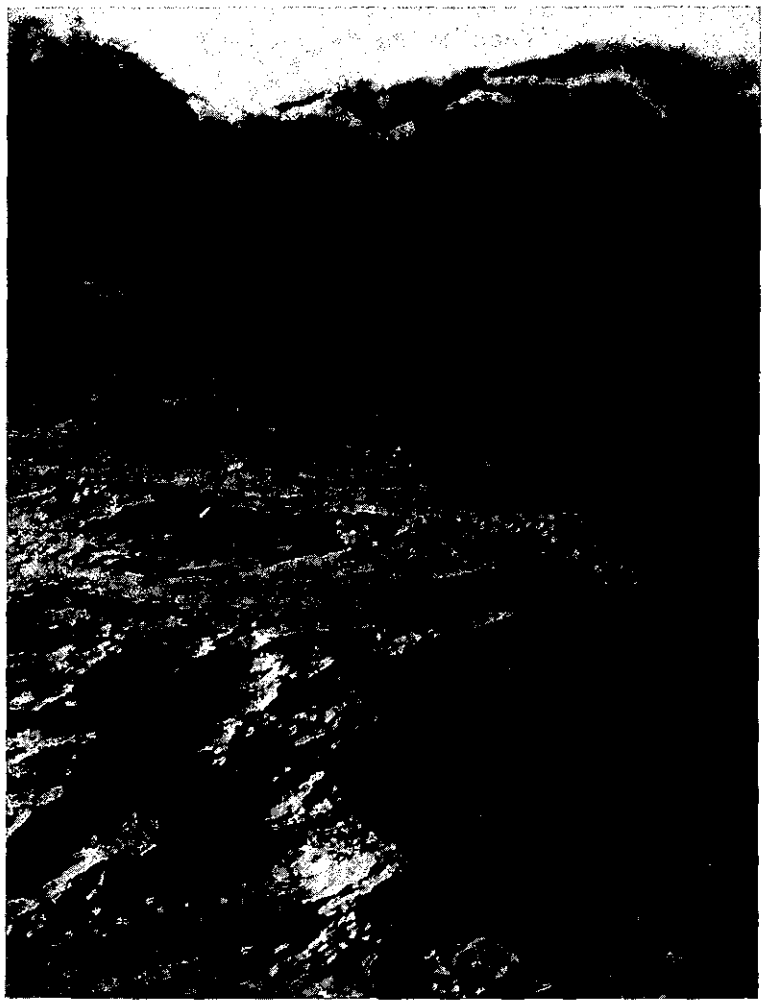
OCEANOGRAPHIC Monthly Summary

Volume IV Number 10 October 1984



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Oceanographic Monthly Summary is published by the National Weather Service and the National Environmental Satellite, Data, and Information Service (NESDIS). *Oceanographic Monthly Summary* contains sea surface temperature (SST) analyses on both regional and ocean basin scales for the Atlantic, Pacific, and Indian Oceans. The ocean basin analyses are based on a "blend" of *in situ* and satellite data. An ocean basin SST anomaly is derived from the "blended" SST analysis and the National Climatic Center (NCC) Climatology.[1] (See page 14 for details.) The regional SST analyses are based upon a combination of *in situ* and satellite data measurements. The regional SST anomalies use the Robinson-Bauer Climatology.[2] *Oceanographic Monthly Summary* also contains Alaskan sea ice information and ocean feature information for contiguous U.S. ocean regions.

Oceanographic Monthly Summary welcomes articles containing information of interest to *Oceanographic Monthly Summary* readers, such as, news on operational oceanography, unusual ocean feature phenomena, etc. Contributions should be sent to the editor (address below). Accepted material will appear in the OceaNotes section of *Oceanographic Monthly Summary*. Contributions can be published as quickly as the next monthly issue.

If you are interested in receiving *Oceanographic Monthly Summary* regularly, please refer to the back cover for subscription information.

[1]Reynolds, R.W., 1982. A Monthly Averaged Climatology of Sea Surface Temperatures; *NOAA Technical Report NWS 31*.

[2]Robinson, M.K., 1976. Atlas of North Pacific Ocean Monthly Mean Temperatures and Mean Salinities of the Surface Layer; *NavOceano Ref. Pub. 2*.
Robinson, M.K., R.A. Bauer, and E.H. Schroeder, 1979. Atlas of North Atlantic-Indian Ocean Monthly Mean Temperatures and Mean Salinities of the Surface Layer; *NavOceano Ref. Pub. 18*.

Oceanographic Monthly Summary

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CATCHING A RIDE WITH WARM EDDIES

By Lieutenant Commander Charles A. Weigand, U. S. Naval Reserve (Reprinted from Proceedings by permission; Copyright 1984 U. S. Naval Institute.)

How can ships realize significant savings in fuel costs on ocean voyages? One way may be to take advantage of warm eddies that are near a ship's route. A test conducted by the Military Sealift Command and the Naval Eastern Oceanography Center routed the cargo ship Admiral William M. Callaghan through a series of warm eddies which had spawned off the Gulf Stream. The result was an estimated reduction in fuel costs of $9,000 over a passage of 900 nautical miles.

Realizing the savings in money and time by using major ocean currents such as the Gulf Stream, the U. S. Navy has pursued and developed techniques to maximize this potential through its optimum track ship routing (OTSR) program, and currently offers this service in both the Atlantic and Pacific Oceans to qualified users through oceanographic centers within the Naval Oceanography Command. Since the inception of this program in the 1950's, both its importance and the numbers of military and government ships using it has increased. While OTSR has typically used the well-known large scale ocean currents, an additional method for obtaining maximum ship routing capability exists in the use of meso-scale oceanic circulations (those currents and features of smaller scale than the broad circulation, but still affecting ship movements). Warm eddies are examples of meso-scale circulations. Their use highlights the advances made in our knowlege of the oceans and the methods employed to obtain oceanographic data, such as the use of satellite imagery and computer-assisted analysis.

The Admiral William M. Callaghan conducted an important test in March 1982 during the transit from New York to Bremerhaven on a track to the north of a typical Gulf Stream assist route. The OTSR division of the Naval Eastern Oceanography Center in Norfolk, Virginia, provided data on warm eddies along the route, which included their center latitude and longitude and the diameter which defined the nominal limits of the eddies. A portion of the Admiral William M. Callaghan's navigation chart (Figure 1) shows the positions of the eddies and the track of the ship. The eddies were assumed to be symmetrical about the central point, and the ship's track cuts a chord across the northern half of the clockwise-rotating eddies. The Admiral William M. Callaghan's master ordered the ship's engine speed set at 120 rpm and, from prior performance results, predicted a speed over ground of nearly 21.2 knots.

The ship fixed her position by using satellite navigation coupled with LORAN "C" (LOng-range Radio Aid to Navigation). Although this procedure should have given dependable positioning, navigational accuracy became more tentative the farther east the Admiral William M. Callaghan steamed as LORAN became unreliable and forced the ship to input speeds manually into the satellite navigation. During the test, the ability to position both the ship and the eddies became a significant consideration.

Characteristically, the accuracy and confidence in positioning ocean current features from satellite imagery decrease as the analysis proceeds farther eastward in the Atlantic. This results from increased cloud cover in the imagery and the decreasing reliability of satellite coverage. The existence and locations of eddies 1, 2, and 3 were well known and more accurate than those of eddies 4 and 5, which were added shortly before the transit, based upon more tenuous satellite and sea surface temperature data. Normally, eddies migrate westward at a rate of about four kilometers per day, but eddy movement after spawning is often erratic and the degree of uncertainty as to an eddy's position increases the longer it remains undetected. Advances in computer-assisted analysis, such as that provided by the Navy's satellite-data

processing and display system, promise to permit greater interaction between the analyst and the satellite imagery and increase the ability and accuracy to locate and track frontal features.

The initial encounter with a warm eddy provided a dramatic example of its characteristics, as reported by the master of the Admiral William M. Callaghan, Captain John Codispoti:

"Transit through the first eddy was classic. A current rip was visible at the time [of] entering; the speed of the vessel increased significantly and the sea temperature rose 19°F during the transit. It dropped 20°F upon exit. The rip was attributed to the fact that the rotary tidal current in the area happened to be directly opposed to the flow of the eddy at the time of entering. Average speed entering the eddy was 20.7 knots and across the eddy was 23.33 knots."

The transit through the remaining eddies was less dramatic, but notable gains in speed, because of favorable eddy currents, did occur through all the five eddies. Average speed through all the eddies was 22.25 knots - a gain of about one knot over the speed of advance. This translates into substantial fuel and time savings when extended over several days of a voyage.

Shipboard observations indicate that a good correlation does not always exist between increasing sea surface temperature and favorable currents. A 17°F rise in sea surface temperature occurred about 47 nautical miles before the anticipated entry into eddy 2, and the area of water temperatures persisted until well after exiting eddy 3. Although little change in speed accompanied the transit of eddy 2, the speed dropped between eddies 2 and 3 and subsequently increased while crossing eddy 3. Another increase in sea surface temperature occurred about six nautical miles before entering eddy 4, accompanied by an increase in speed. Higher water temperatures persisted until well after the ship left eddy 5, when the temperature abruptly dropped 24°F, indicating that this feature probably was farther east than the analyzed position.

The test highlighted several observations and conclusions concerning warm eddies and their use in ship routing:

The surface manifestation of an eddy does not usually conform to a circular or symmetrical shape.

An eddy consists of a complex sea surface temperature structure often characterized by cold and warm tongues and intrusions around the periphery of the eddy. This makes the at-sea determination of whether a ship is in an eddy quite difficult.

Current velocities in an eddy can reach, and possibly exceed, three knots. This observation agrees with estimates of velocities found in the literature, which also indicate that the axis of the maximum current occurs approximately one-half to three-quarters of the distance from the center of the eddy.

The potential exists for using cold eddies formed south of the Gulf Stream in ship routing. To maximize their use, however, a ship must transit the eddy soon after its formation, since a cold eddy will sink because of its greater density in relation to the surrounding water and thus lose much of its surface expression.

The capability to locate accurately the position of an eddy and its boundaries remains a critical consideration in using eddies for routing purposes.

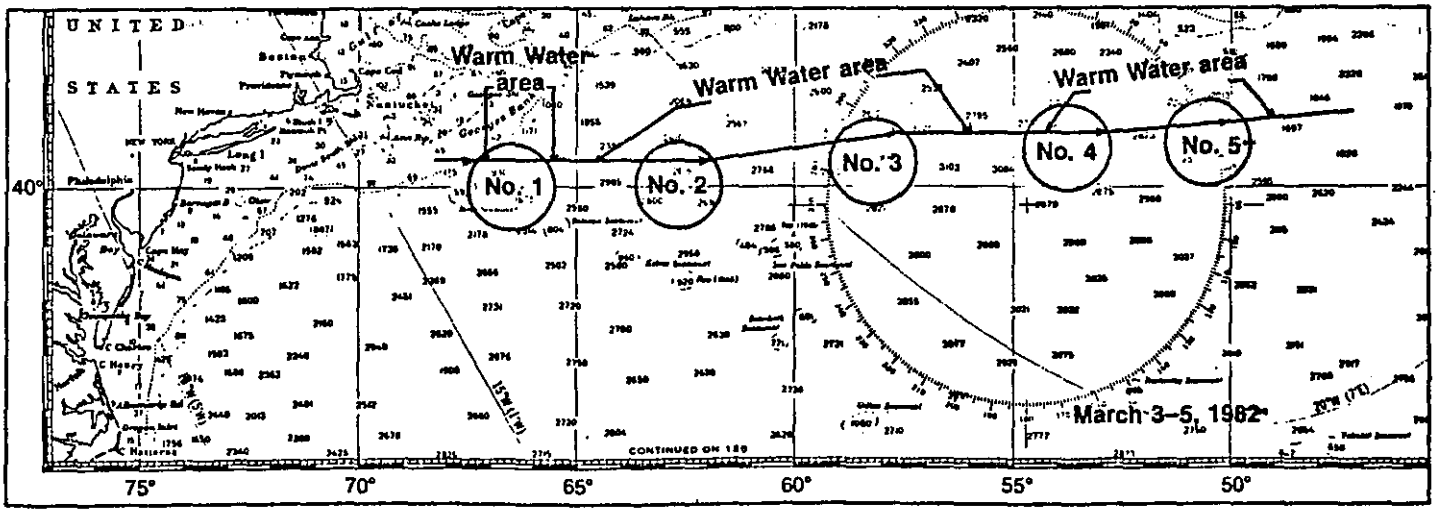
The capability of a ship to locate accurately her position constitutes an equally critical factor in her ability to use eddies successfully for ship routing. Consider the fact that a 40-nautical mile error in navigation could result in a countering current on one chord of the eddy and a favoring current on the other.

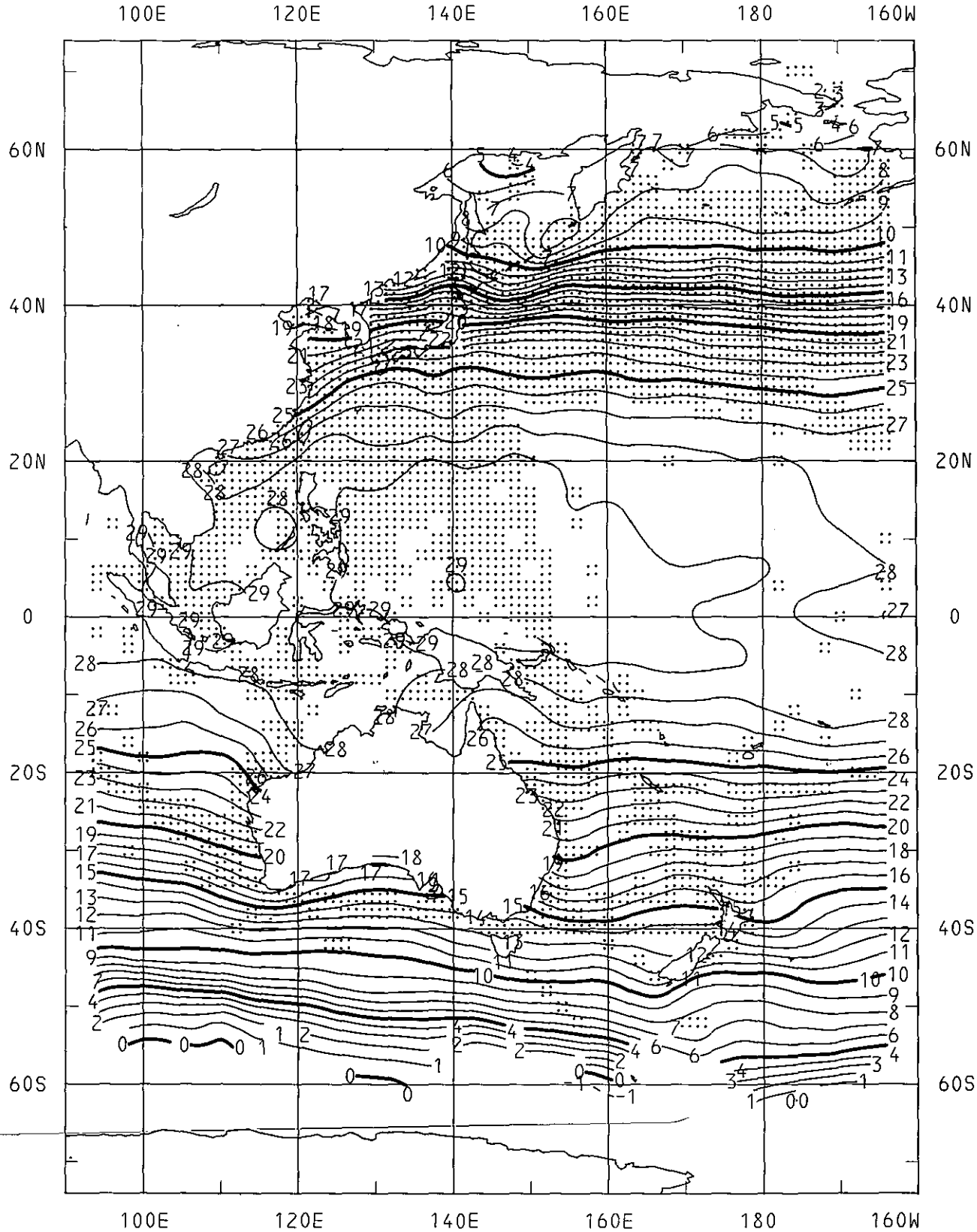
The use of warm eddies in ship routing can result in significant savings.

Since the test, the Naval Eastern Oceanography Center has actively pursued the use of warm eddies in route planning. As the ability to identify accurately, locate, and track eddies improves, ships taking advantage of them in their advance planning and during voyages will increase. Emerging technology, such as remote sensors equipped with microwave or radar altimeters, will further speed the arrival of the day when ships at sea will routinely "catch a ride" with warm eddies to make a more economical transit.

Commander Weigand holds B.S. and M.S. degrees in physical oceanography from the U. S. Naval Academy and Old Dominion University in Norfolk, Virginia. He is currently a physical oceanographer at the Naval Eastern Oceanography Center in Norfolk, where he develops charts of the Gulf Stream system in the Western Atlantic through interpretation and computer-assisted analysis of satellite imagery.

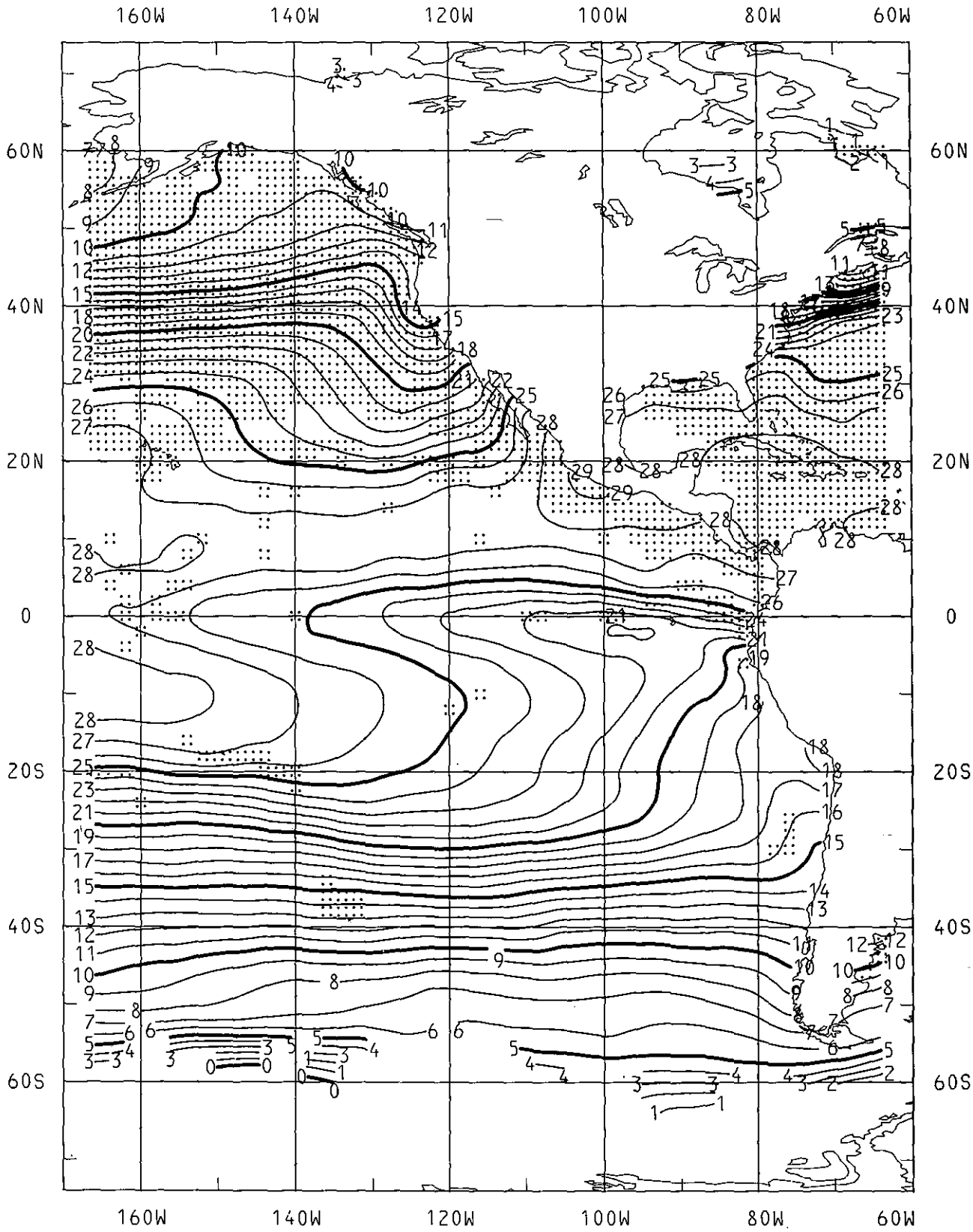
Figure 1 *The* **Admiral William M. Callaghan's** *Track*





Western Pacific Ocean
SST--MONTHLY MEAN (°C)
SHIP, BUOY, and SATELLITE DATA
OCTOBER 1984

Monthly mean sea surface temperature is the mean of *in situ* and satellite data within two-degree quadrangles. Contour line interval is 1.0°C. The stippling indicates where the analysis was fixed by the *in situ* data; contours are not shown in areas without data.



Eastern Pacific Ocean
SST--MONTHLY MEAN (°C)
SHIP, BUOY, and SATELLITE DATA
OCTOBER 1984

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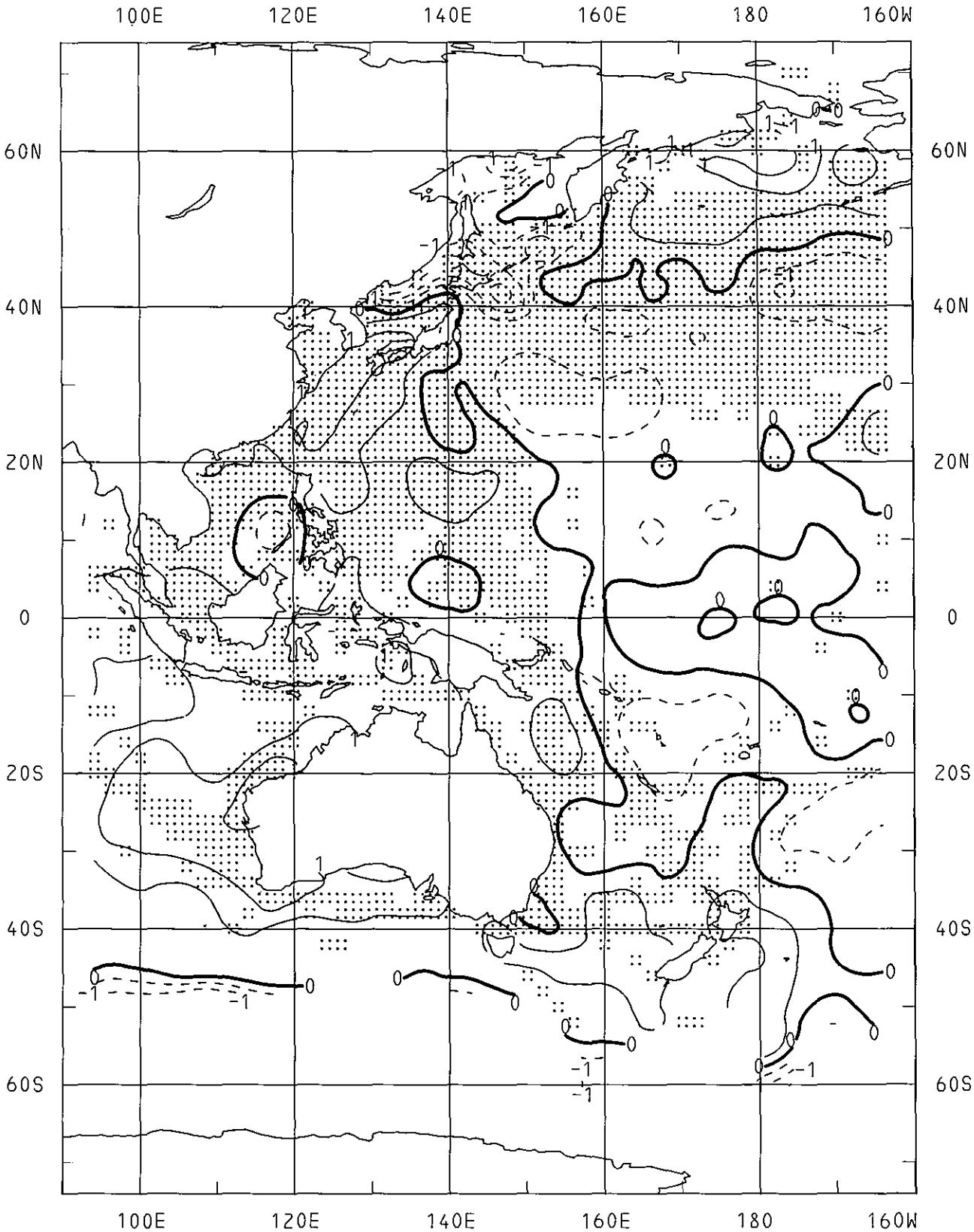
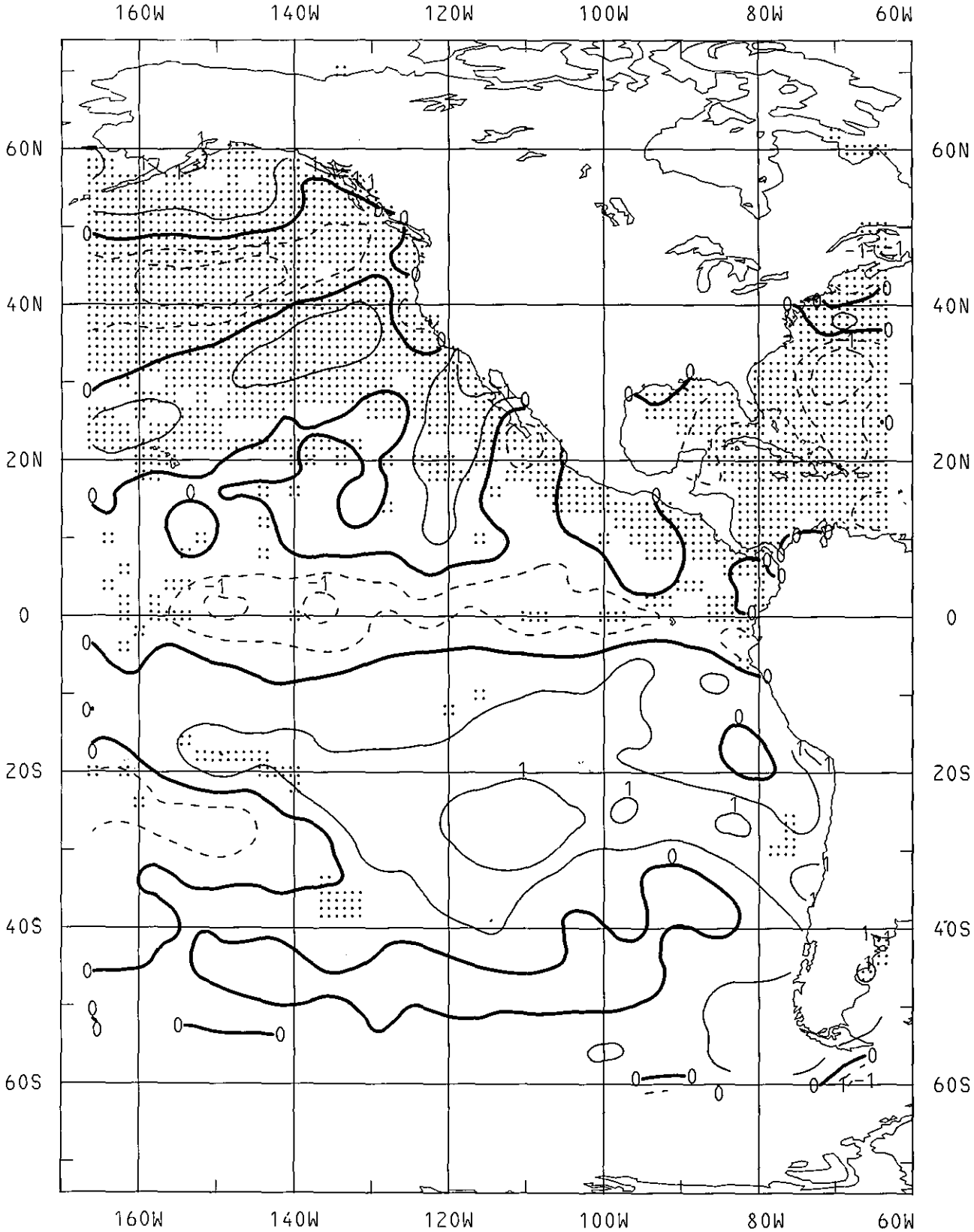


Western Pacific Ocean
SST--MONTHLY ANOMALY (°C)
SHIP, BUOY, and SATELLITE DATA
OCTOBER 1984

Monthly anomaly is the difference between the monthly mean sea surface temperature and the climatological monthly mean value. Contour line interval is 0.5°C. The stippling indicates where the analysis was fixed by the *in situ* data; contours are not shown in areas without monthly or climatological data.



Eastern Pacific Ocean
SST--MONTHLY ANOMALY (°C)
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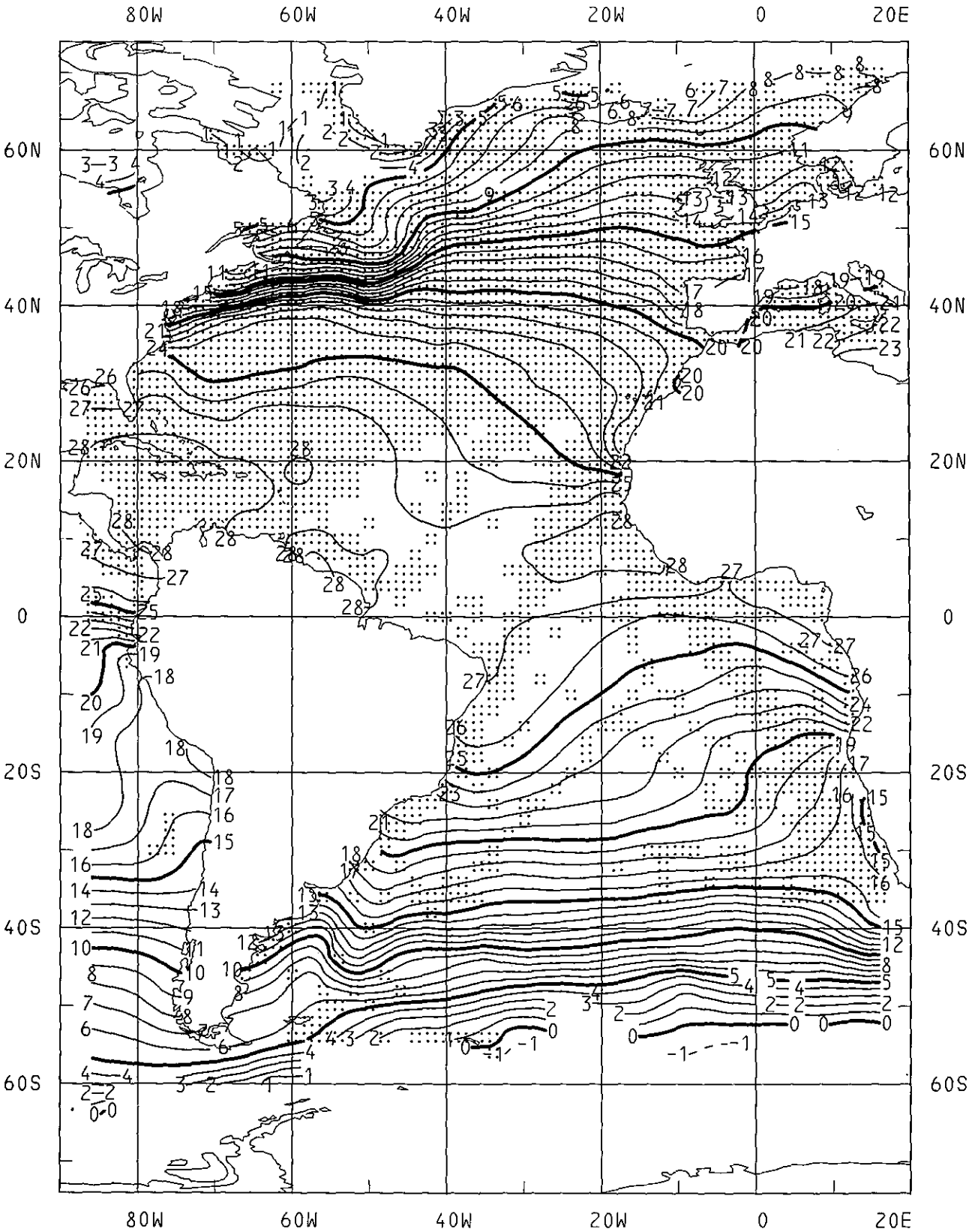

Atlantic Ocean
SST--MONTHLY MEAN (°C)
SHIP, BUOY, and SATELLITE DATA
OCTOBER 1984

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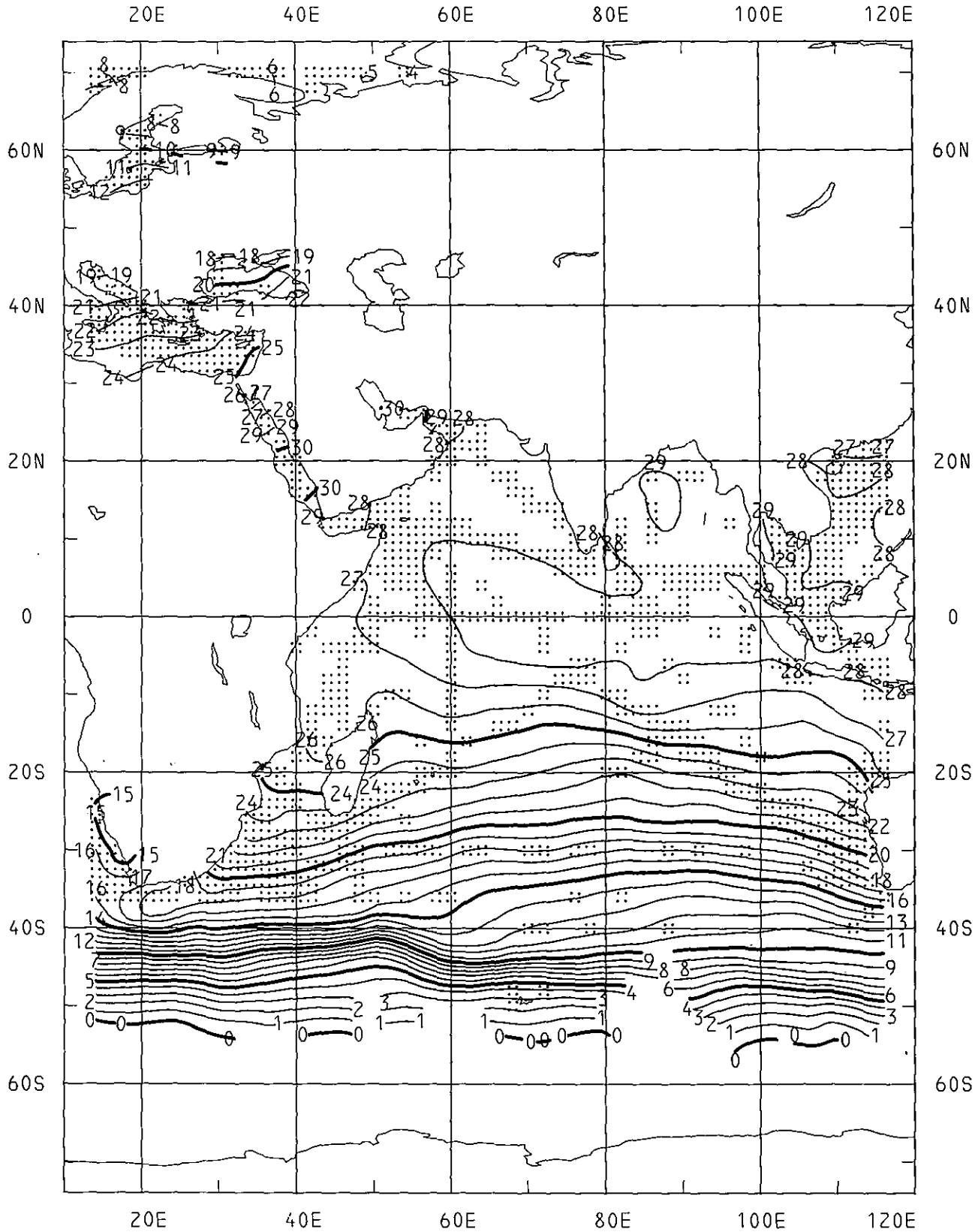
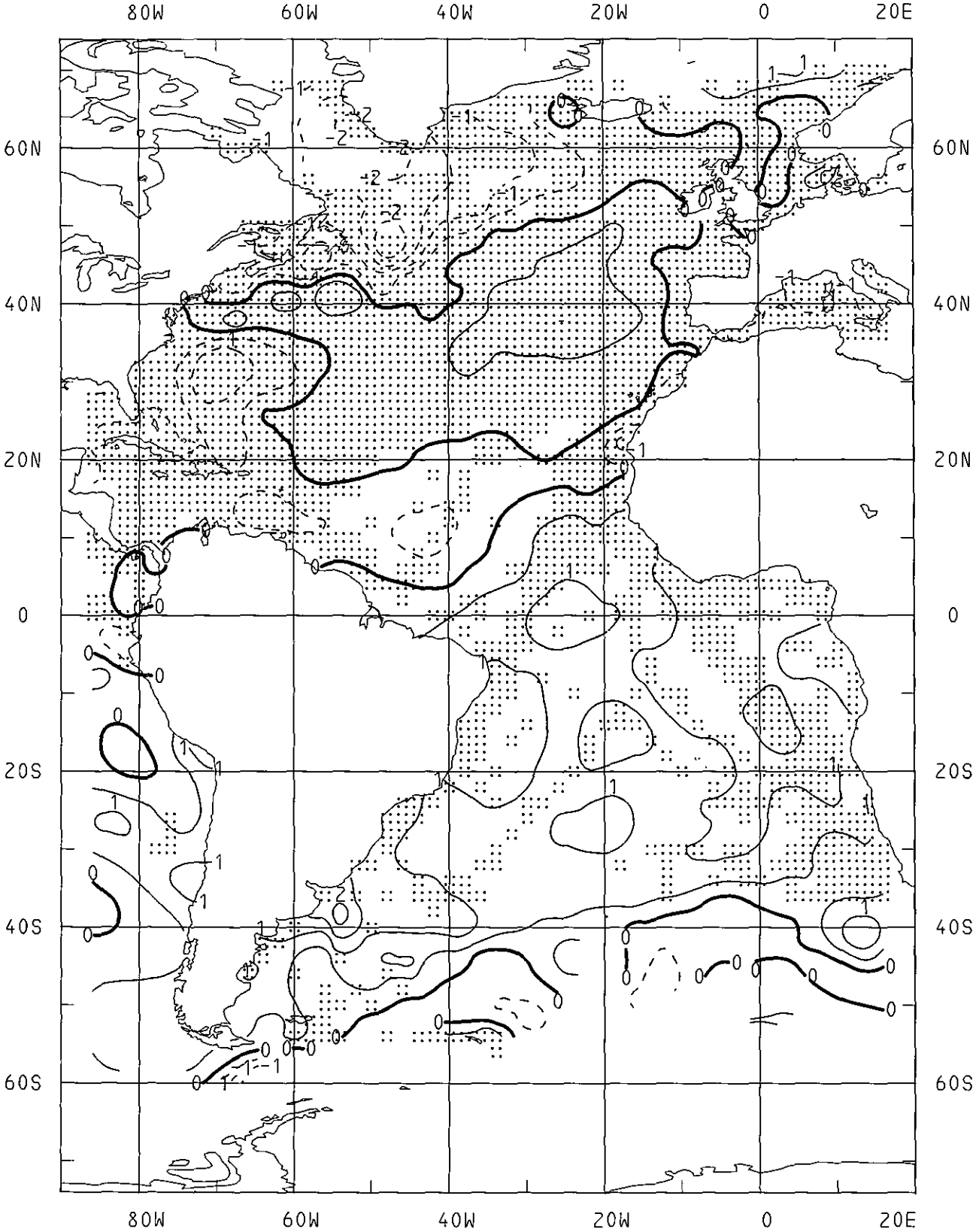


Indian Ocean
SST--MONTHLY MEAN (°C)
SHIP, BUOY, and SATELLITE DATA
OCTOBER 1984

Monthly mean sea surface temperature is the mean of *in situ* and satellite data within two-degree quadrangles. Contour line interval is 1.0°C. The stippling indicates where the analysis was fixed by the *in situ* data; contours are not shown in area without data.



Atlantic Ocean
SST--MONTHLY ANOMALY (°C)
SHIP, BUOY, and SATELLITE DATA
OCTOBER 1984

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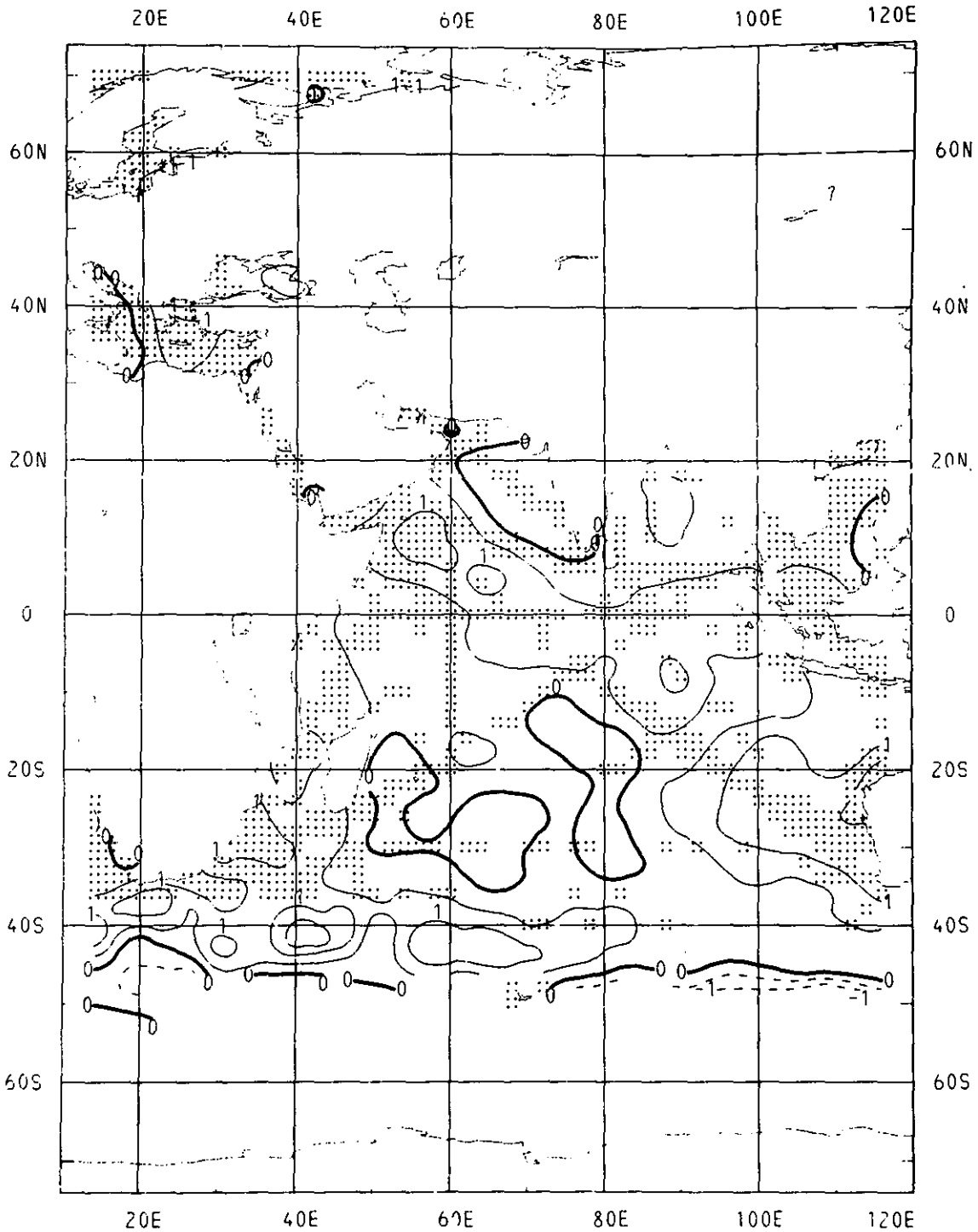

Indian Ocean
SST--MONTHLY ANOMALY (°C)
SHIP, BUOY, and SATELLITE DATA
OCTOBER 1984

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NEW GLOBAL SEA SURFACE TEMPERATURE MONTHLY MEAN ANALYSIS

Highlights

- o New global analysis using both *in situ* and satellite data
- o Indian Ocean analysis included
- o Global analysis extended further south

Beginning in February 1983 a global SST analysis was presented using *in situ* (ship and buoy) data and a non-linear spatial filter (see Reynolds and Gemmill, 1984). Because the coverage from satellites is superior to the *in situ* coverage, an analysis derived from satellite observations only was added in April 1983. The two types of data were not combined because of significant differences between the *in situ* observations and the satellite retrievals. In the July 1984 *Oceanographic Monthly Summary*, the satellite field showed a negative bias relative to the *in situ* field in the tropics and a positive bias in mid-latitude. Strong (1983) reported that satellite retrievals were cooler than *in situ* observations because of aerosols injected into the atmosphere by the eruption of El Chichon in March-April 1982. Comparisons of the two analyses over the last 30 months show that although the satellite anomalies tend to be more negative than *in situ* anomalies, the differences are <u>not independent of time or location</u>.

A "blended" SST analysis has been developed using *in situ* data to define "benchmark" temperature values in regions of frequent observations and satellite data to define the "shape" of the field between these points. The blended field is found by solving Poisson's equation, $\nabla^2 T = F$, where T is the blended SST field and F is a forcing function given by the Laplacian of the satellite SST analysis, ($\nabla^2 S$); *in situ* data are used as internal boundary values at points of frequent observations. At the poleward boundaries, T is set to the *in situ* (preferred) or the satellite analysis. The resulting anomaly and mean fields are shown on pages 4-11 where the stippling indicates regions where the SST field was fixed by the *in situ* data. The use of the satellite data has allowed the analysis to be extended further south, but necessitated a change in the map projection. Studies with this new analysis suggest that the blended analysis is an improvement over the fields obtained from *in situ* data only or the satellite data only. Since the satellite data affect the field in the interior via the Laplacian, biases or trends in the satellite data can only influence the final solution through the high latitude boundary conditions. In the example above, satellite biases would impact the blended result only south of 40°S, except in the eastern South Pacific where the *in situ* fields is almost undefined.

These results suggest that the blended method may be a useful way to utilize both *in situ* and satellite data. Each monthly blended field will be monitored carefully using individual *in situ* and satellite analyses as diagnostic tools. In future months the blended method may be modified to reflect changes in either the *in situ* observations or the satellite retrievals.

Reynolds, R. W. and W. H. Gemmill, 1984: An objective global monthly mean sea surface temperature analysis. Tropical Ocean-Atmosphere Newsletter, No. 23, 4-5.

Strong, A. E., 1983: Satellite derived sea surface temperature errors due to the El Chichon aerosol cloud. Tropical Ocean-Atmosphere Newsletter, No. 18, 14-15.

SATELLITE IMAGE OF THE MONTH

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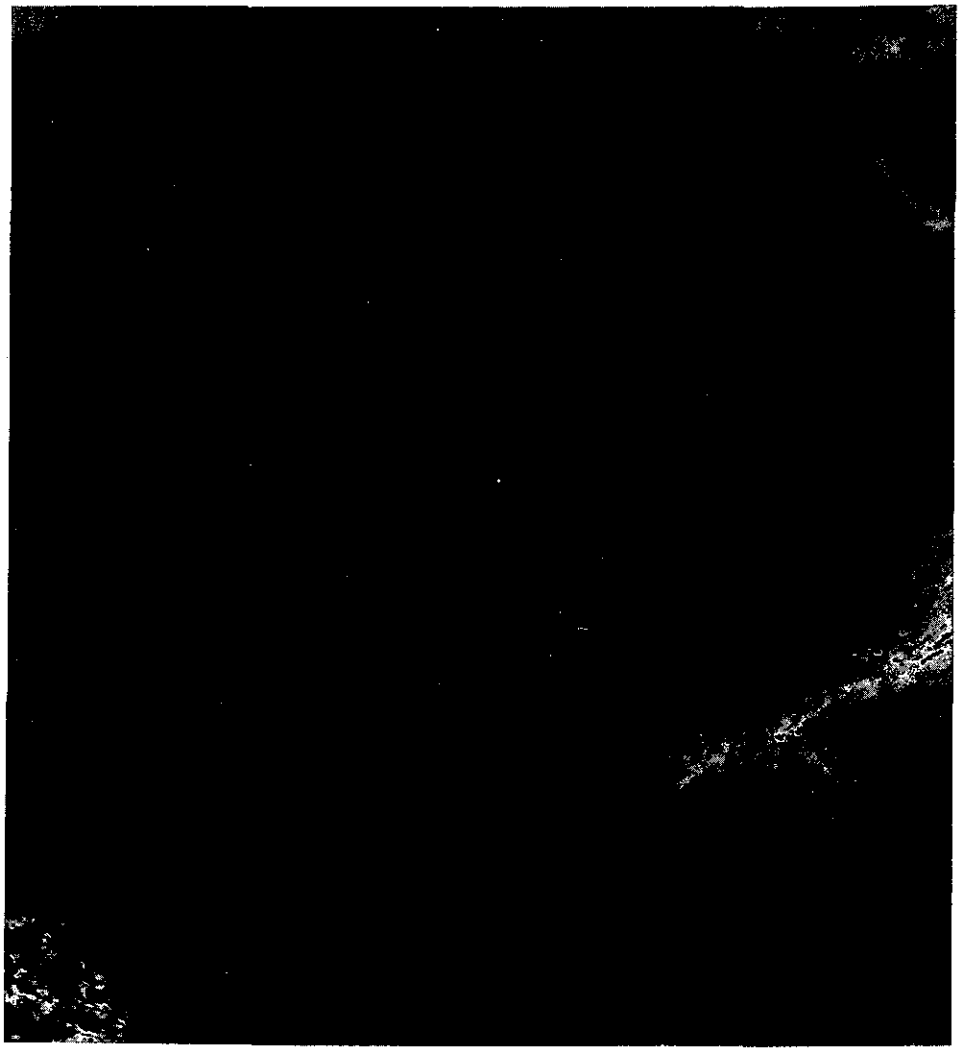
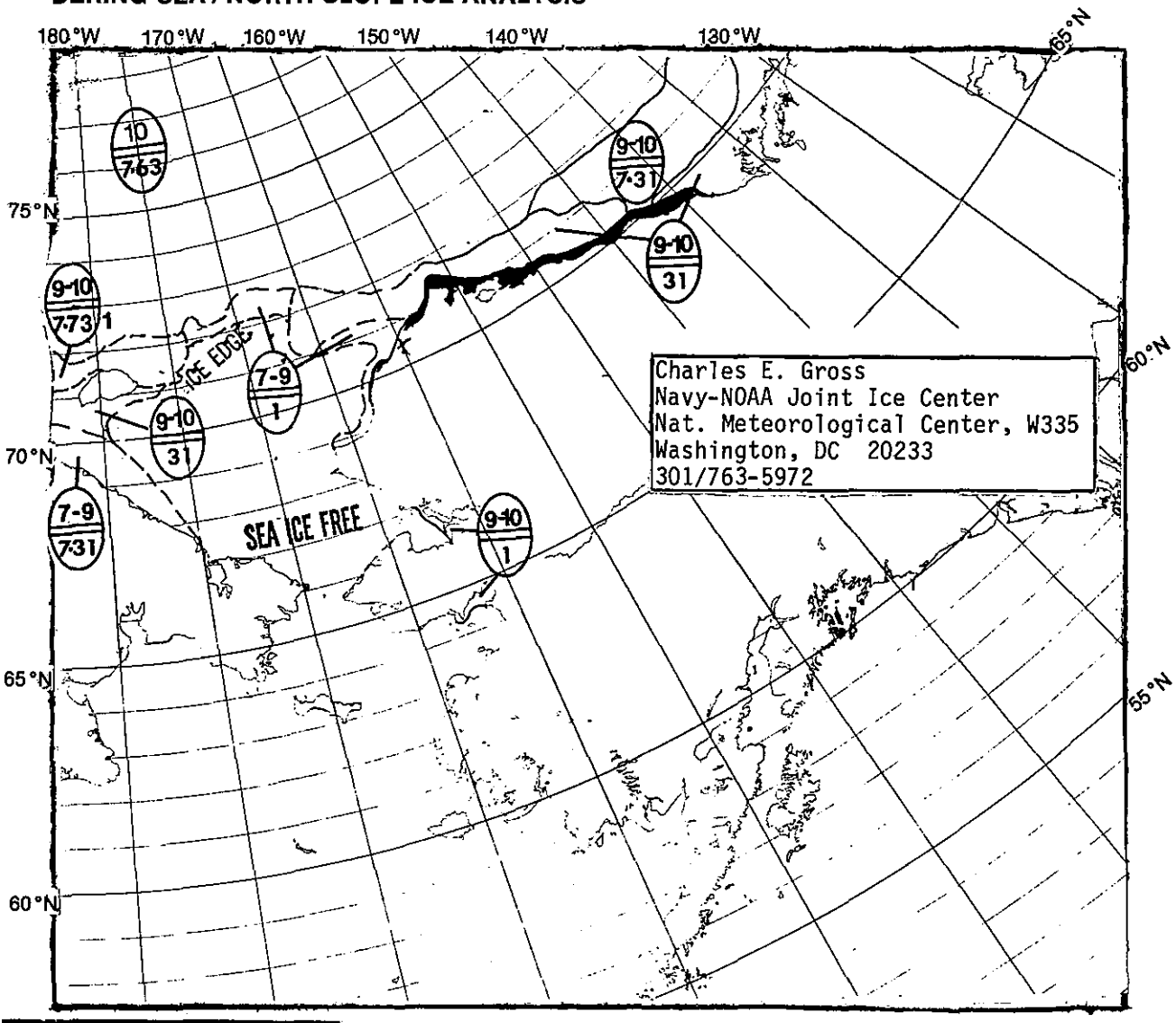
Washington, DC 20233
(301) 763-8142

NORTHWEST AFRICA UPWELLING

This NOAA-6 infrared image from October 10, 1984, was taken of coastal waters off of northwest Africa. Cool upwelled water appears as light gray shades, warmer offshore water corresponds to darker gray shades. Offshore wind flow prior to this date has contributed to the vigor and extent of the upwelling incident. Near the westward extent of upwelling, contours of depth make a sharp transition from shallow to deeper waters (indicated by arrow). Upwelling in this region has been observed on satellite imagery in almost every month of the year. Particularly intense upwelling incidents occur when high pressure systems in the central Atlantic dominate the synoptic scale flow.



BERING SEA / NORTH SLOPE ICE ANALYSIS



C = Total ice concentration in the area in tenths.

C_a, C_b, C_c = Concentration of thickest (C_a), 2nd thickest (C_b), and 3rd thickest (C_c) ice

S_a, S_b, S_c = Stage of development of thickest (S_a), 2nd thickest (S_b), and 3rd thickest (S_c) ice.

-C = Concentration of ice within area(s) of strips and patches.

STAGE(S) OF DEVELOPMENT (THICKNESS)

1 = New ice (0-10 cm)
3 = Young ice (10-30 cm)
6 = First year (30-200 cm)
7 = First year thin (30-70 cm)
1. = First year medium (70-120 cm)
4. = First year thick (120-200 cm)
7. = Old ice (survived at least one summer's melt)

EXAMPLES

125 Theoretical thickness of this season's growth (cm).

Fast ice. Sea ice which forms and remains fast along the coast.

Ice boundary visually or satellite observed.

Ice boundary estimated.

OCTOBER 1984

The monthly mean sea level pressure circulation depicts a 1005 mb low centered in the Gulf of Alaska near 55°N 150°W and a 1022 mb high centered near 75°N 150°W. This typical October pressure pattern produced mean easterly geostrophic winds in the Chukchi Sea. Monthly mean surface temperatures are normal at Nome (65°N 165°W) and Barrow (71°N 157°W). During this period the ice edge began its southerly expansion and is between the climatological minimum and median in the eastern and western Chukchi Sea and near a climatological minimum north of 71°N. Expansion throughout the Chukchi Sea was primarily due to freezing with subsequent new ice formation and not due to expansion of wind driven floes. Fast ice formation was evident along the entire Alaskan northern coast. New ice formed during the latter portion of the month in the eastern portions of Kotzebue and Norton Sounds.

WEST COAST OCEAN FEATURES

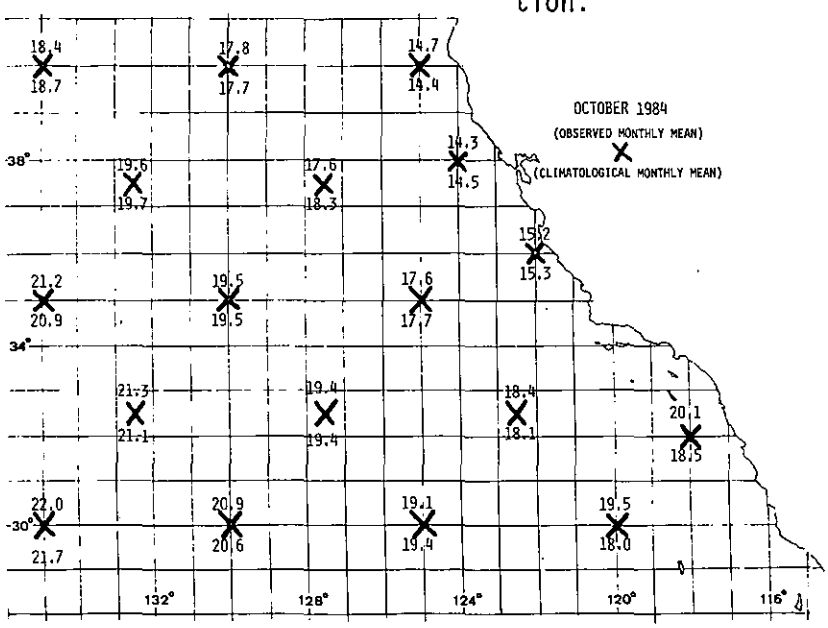
MONTHLY SST STATISTICS FOR SELECTED STATIONS
PACIFIC NORTHWEST
(Area enclosed by 40-52N, Coast-135W)

OCTOBER 1984

Station	Location (Lat/Long)	Mean SST	Standard Deviation	Maximum SST	Minimum SST	Change From Previous Month
Buoy 46005	46.1 N 131.0 W	13.9	1.0	15.7	12.6	-2.1
Buoy 46002	42.5 N 130.3 W	16.4	1.0	18.0	15.0	-1.7
Buoy 46010	46.2 N 124.2 W	13.5	0.6	14.6	11.8	-1.2
Buoy 46027	41.8 N 124.4 W	**** OUT OF SERVICE ****				
Quillayute River	47.9 N 124.6 W	12.5	0.7	13.9	11.1	-1.3
Greys Harbor	46.9 N 124.1 W	13.0	1.5	15.6	10.6	-2.6
Cape Disappointment	46.3 N 124.1 W	10.7	0.2	11.1	10.6	-4.0
Yaquina Bay	44.6 N 124.1 W	**** OUT OF SERVICE ****				
Chetco River	42.0 N 124.3 W	10.2	1.0	11.1	8.9	-0.4

OCTOBER 1984

Pacific Northwest waters displayed clear signs of seasonal cooling in all areas. Monthly mean SSTs in offshore waters were about 2°C less than in September, and daily values at offshore buoys showed a steady decrease of approximately 0.1°C per day. Coastal SSTs were not as steady in their decrease. Some coastal stations along the northern Oregon - southern Washington coasts displayed a significant but temporary warming episode from October 4-13 when a series of intense storm systems moved through the area. Wind-driven transport of warmer offshore water was forced toward shore. The latter half of the month brought a more regular cooling regime. SSTs over almost all of the Pacific Northwest waters were below normal for the month, with anomalies generally ranging between -0.5°C and -1.5°C. The only positive anomalies were found nearshore along Vancouver Island and were quite weak. Coastal upwelling displayed its normal seasonal relaxation.



North Panel
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NOAA/Northwest Regional Ocean Service Center
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Bin C15700
Seattle, WA 98115
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South Panel
Ernest Daghir
NOAA/NWS
Satellite Field Service Station
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Redwood City, CA 94063
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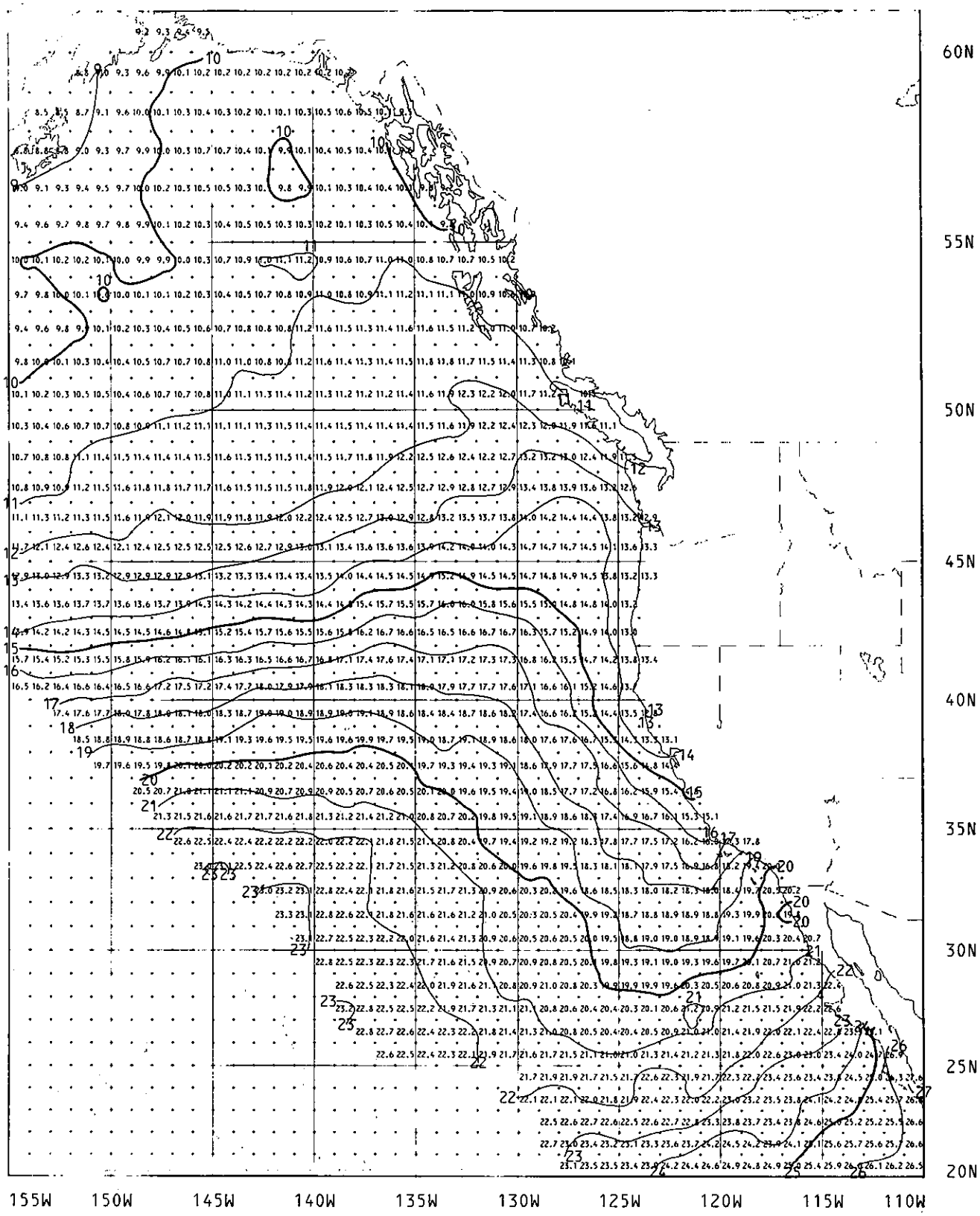
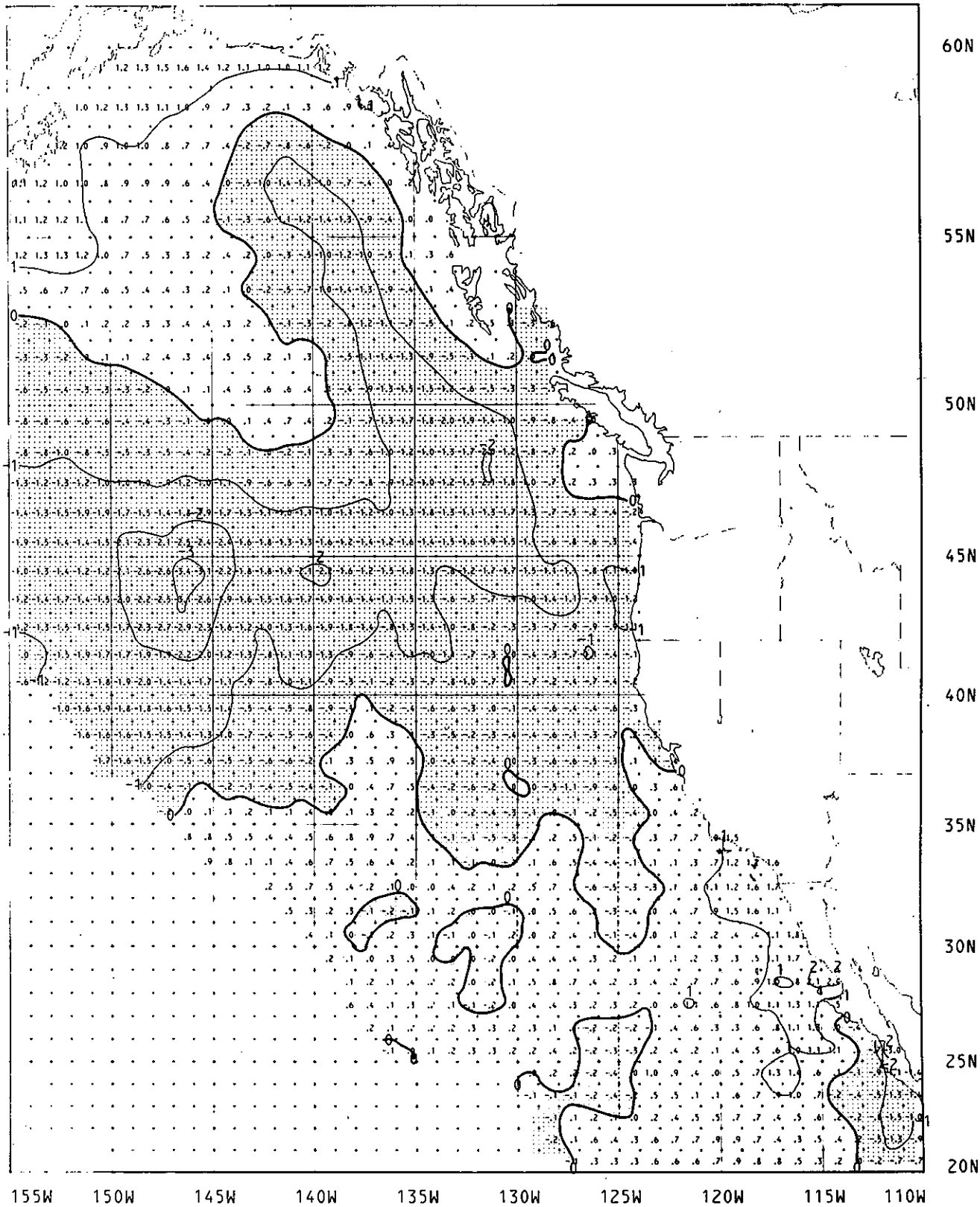
The average mean SSTs over the South Panel during October were slightly warmer (18.7°C) than the climatological normal mean (18.5°C). The area from 40°N to 35°N was generally below normal with a cool anomaly of 1.7°C centered near 37°30N 127°30W. SSTs were warmer than normal south of 35°N with the maximum anomaly (near 1.5°C) east of 121°W; this warm anomaly has persisted in this area for many months. When compared to September, all areas cooled except for the area near 30°N 130°W which warmed by 0.3°C. Almost all areas cooled by at least 0.5°C, with maximum cooling of 2.0°C in the Los Angeles Bight and San Diego coastal regions. These cool temperatures are expected since winter is approaching. Weak to moderate upwelling was observed by satellite infrared sensors in the beginning of October; one major thermal boundary was analyzed near Cape Mendocino. By month's end, upwelling was not significant.



West Coast
SST--MONTHLY MEAN (°C)
October 1984

Monthly mean sea surface temperature is the mean of twice-weekly analyses using ship, buoy, and satellite observations. Contour line interval is 1.0°C.



West Coast
SST--MONTHLY ANOMALY (°C)
October 1984

Monthly anomaly is the difference between the monthly mean sea surface temperature and the climatological monthly mean value -- shading shows where the monthly mean is colder than climatology. Contour line interval is 1.0°C.

EAST COAST OCEAN FEATURES

The end of this month's positions of the Gulf Stream System and its associated eddies are shown for the NW Atlantic and the Gulf of Mexico. The Gulf Stream and Loop Current boundaries are located by infrared satellite imagery or XBT (expendable bathythermograph) data. Anticyclonic eddies are labeled a-z in the Gulf of Mexico and 1-99 in the NW Atlantic. Cyclonic eddies are labeled A-Z. Arrows on eddies indicate direction of circulation. Warm-core or anticyclonic eddies rotate clockwise; cold-core or cyclonic eddies rotate counterclockwise. The line to the eddy center shows the net translation since last month or since last observed. Eddies or sections of the Gulf Stream System which were not observed during the month are not shown on the analysis chart. The long arrows at the bottom of the chart indicate the date of data used.

Data used in this analysis include:
- NOAA satellite infrared imagery, NESDIS
- Bathythermograph data, National Meteorological Center of National Weather Service
- Oceanographic Analysis, A daily detailed analysis issued by National Weather Service/NESDIS

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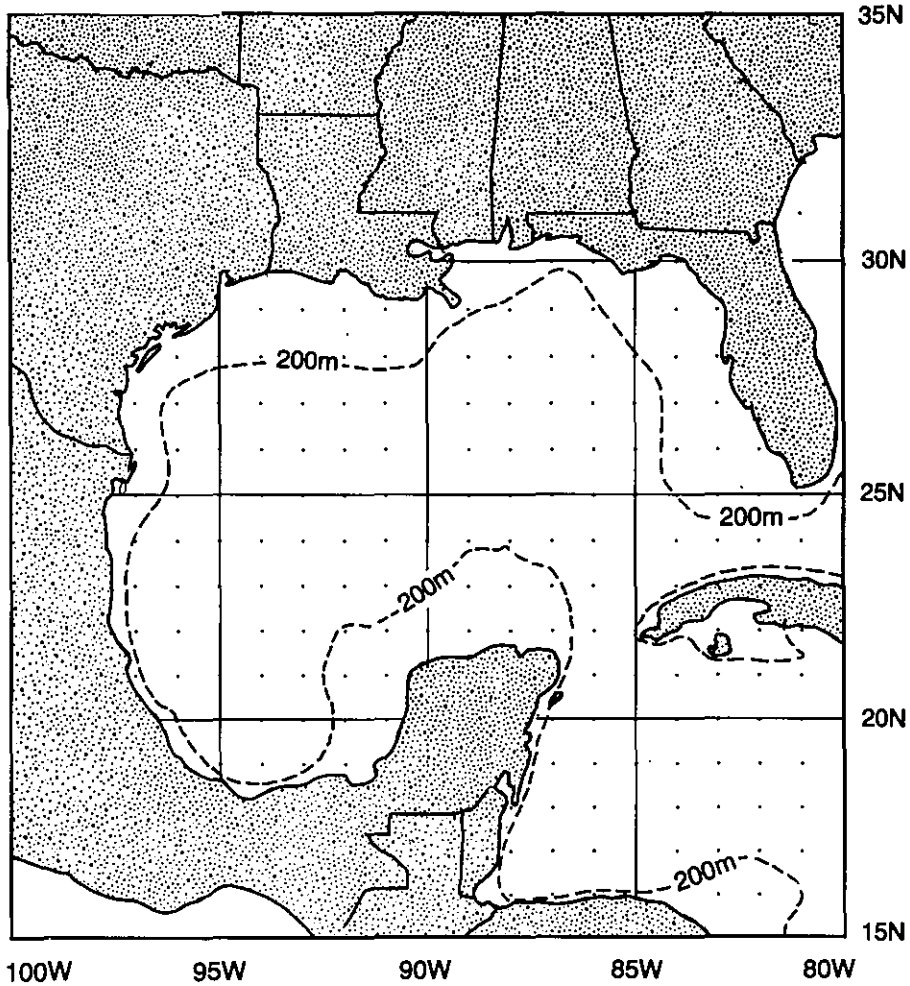
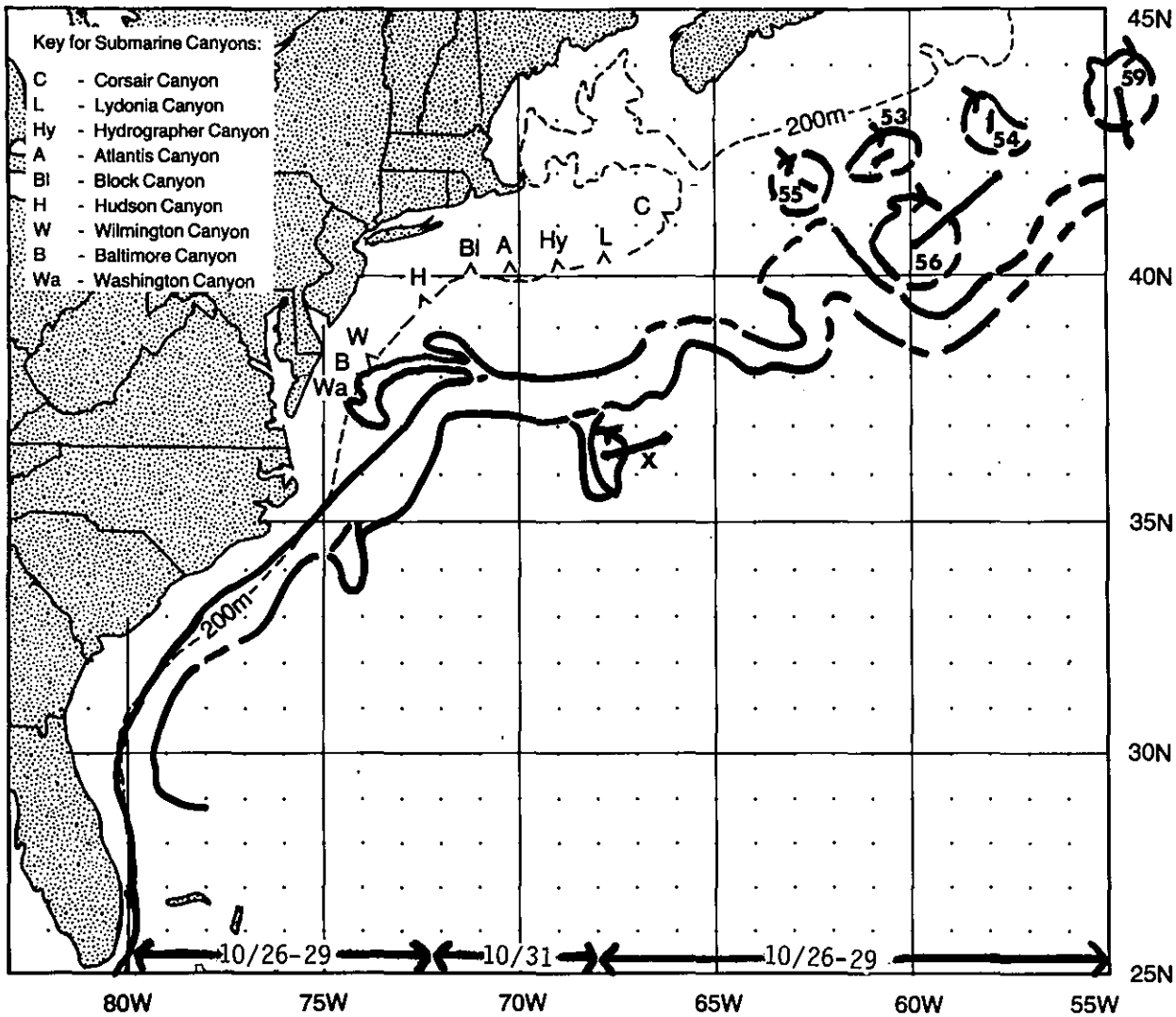


OCTOBER 1984

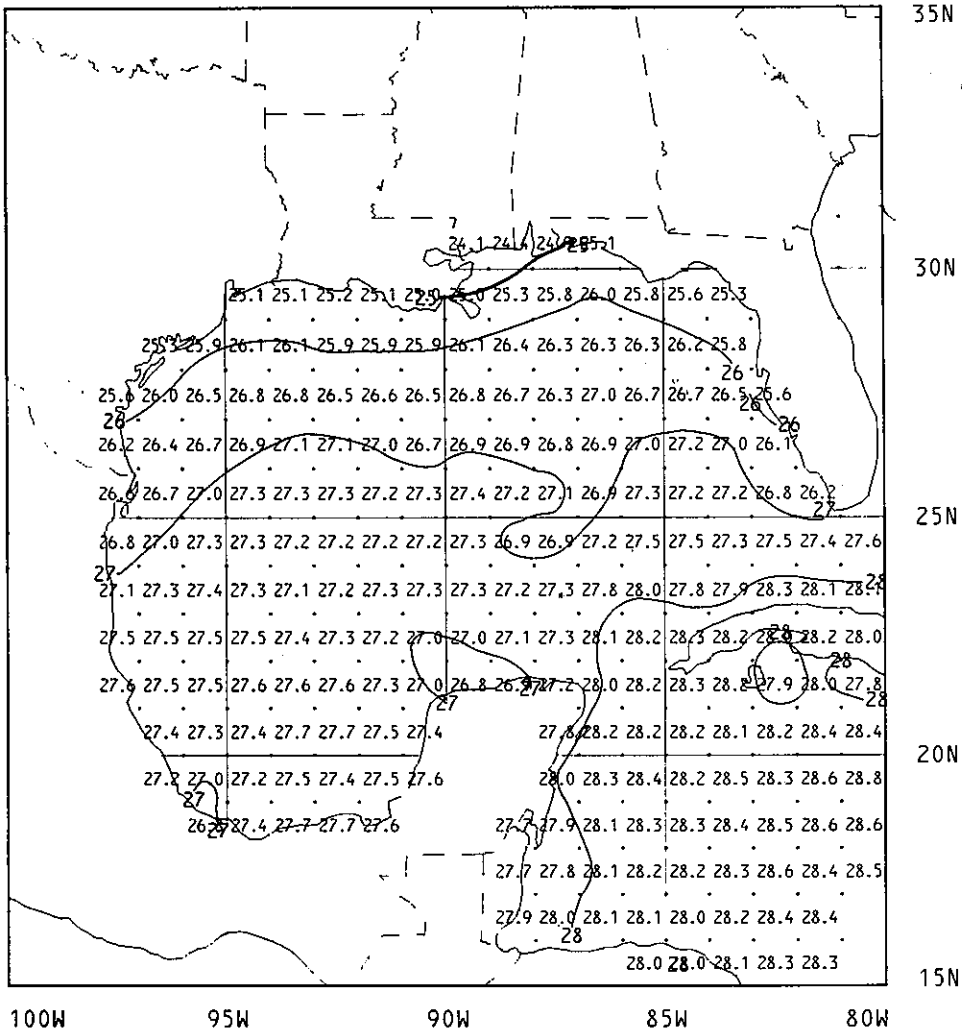
The Loop Current in the Gulf of Mexico has not been observed since June due to cloudiness and isothermal conditions.



Two anticyclonic eddies were absorbed and two anticyclonic eddies apparently dissipated during the month. Eddy 57 moved 110 Km SW when it was absorbed by the Gulf Stream near 39°30N 68°30W on October 4. Eddy 58 apparently moved 90 Km W when it was absorbed by the Gulf Stream near 40°N 66°30W on October 18. Eddy 52 moved 65 Km W when it is suspected to have dissipated near 41°30N 66°W on October 17. Eddy 51 apparently traveled 110 Km WSW when it dissipated near 39°30N 72°30W on October 17. Eddy 55 traveled 25 Km WNW. Eddy 53 presumably traveled 25 Km ENE. Eddy 56 translated 240 Km SW. Eddy 54 moved 35 Km S. Eddy 59 traveled 110 Km NNW.

Cyclonic eddies Y and Z were not observed during October. Eddy Z is suspected to have been absorbed by the Gulf Stream near 35°30N 72°30W on October 19. Eddy X moved 150 Km WSW.

EAST COAST SST-
MONTHLY MEAN



Gulf of Mexico
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October 1984

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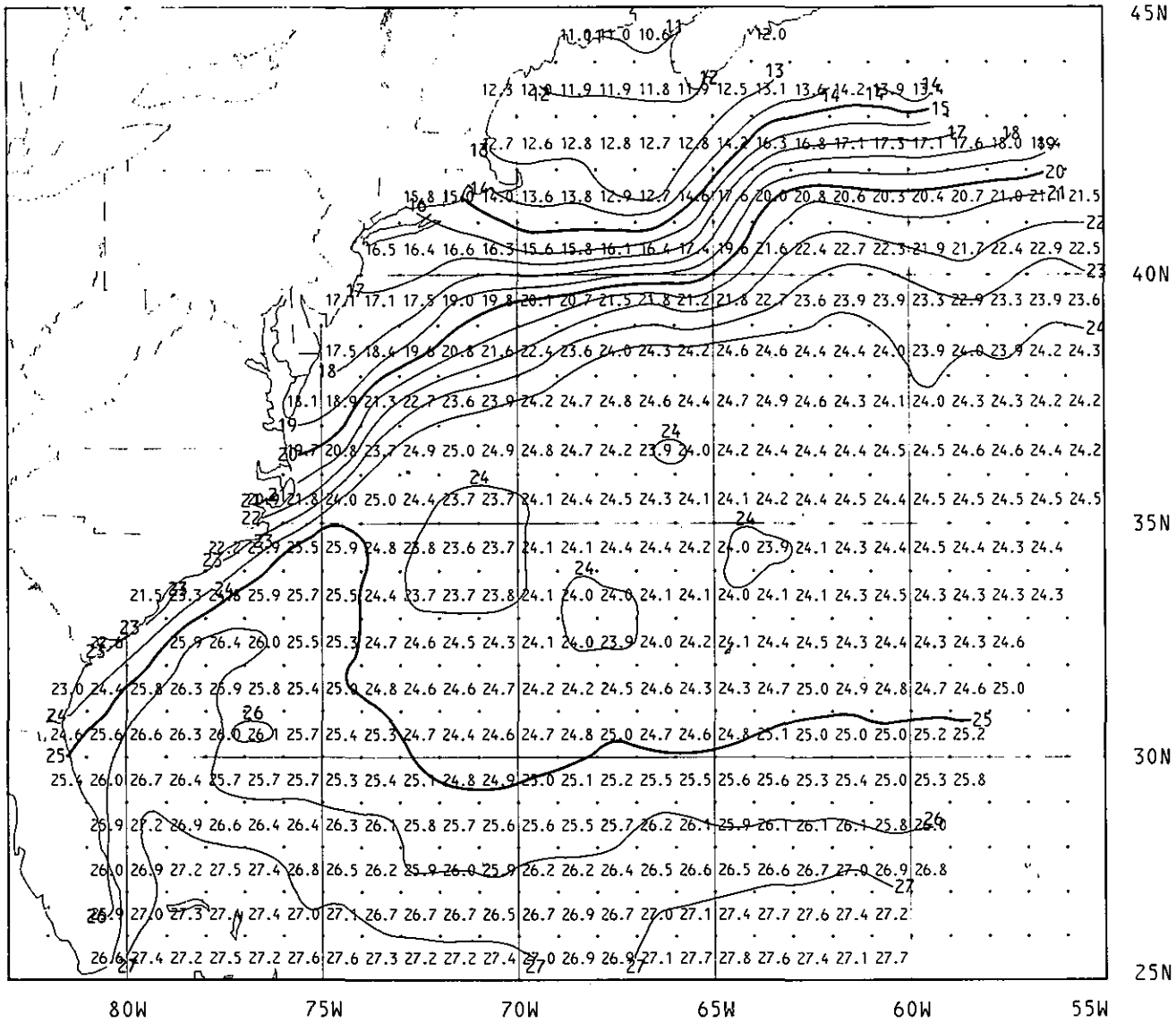

NW Atlantic Ocean
SST--MONTHLY MEAN (°C)
October 1984

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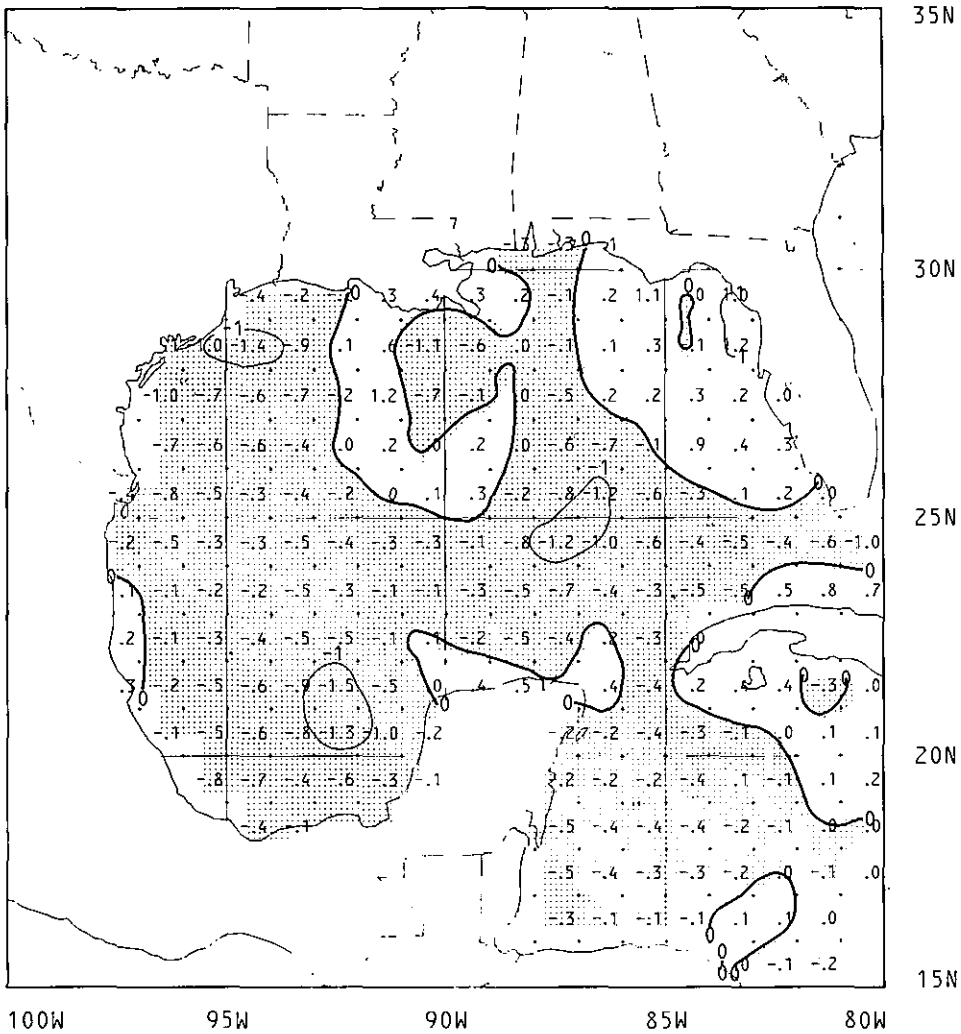
EAST COAST SST-ANOMALY



Gulf of Mexico
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October 1984

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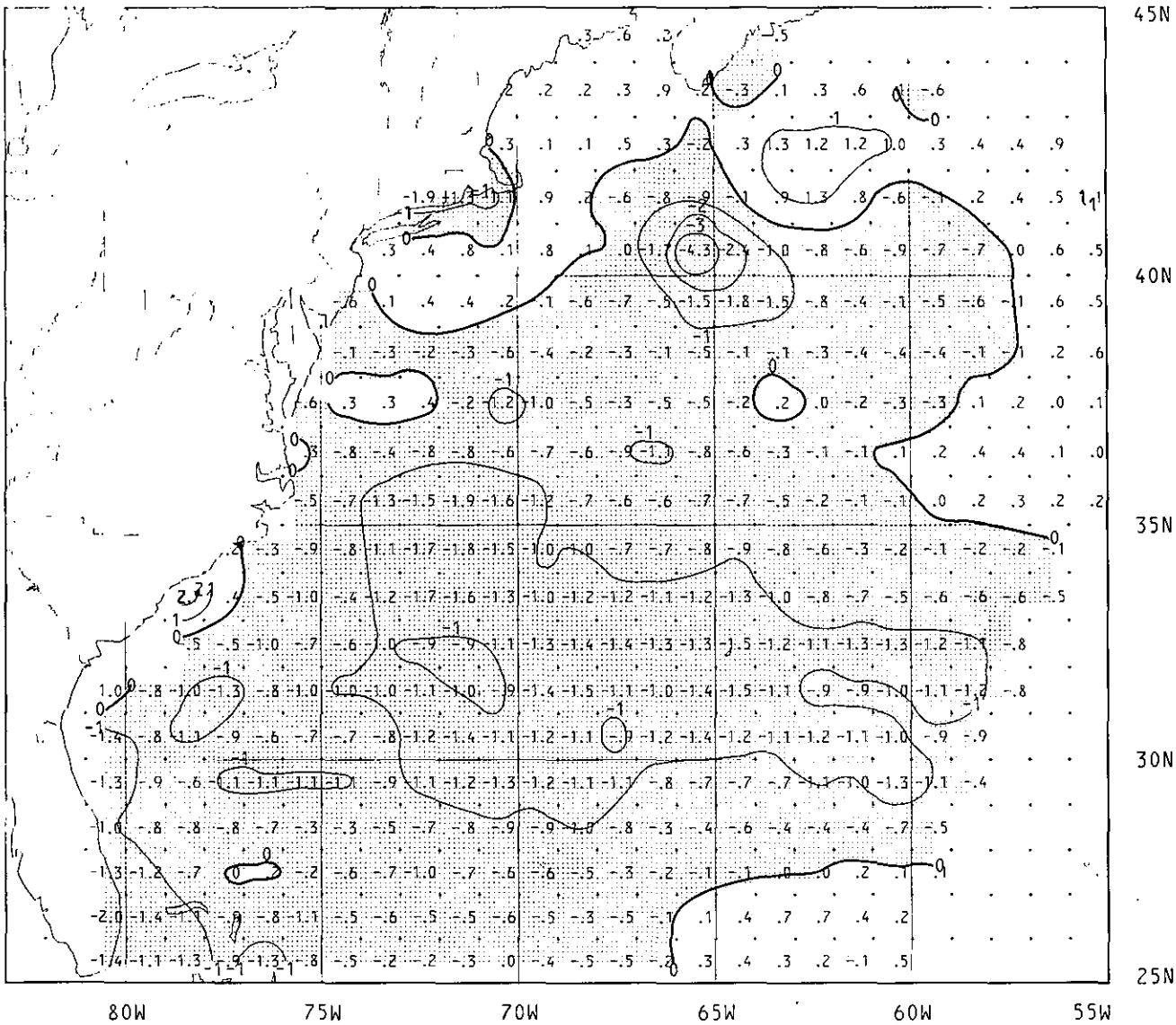

NW Atlantic Ocean
SST--MONTHLY ANOMALY (°C)
October 1984

Monthly anomaly is the difference between the monthly mean sea surface temperature and the climatological monthly mean value -- shading shows where the monthly mean is colder than climatology. Contour line interval is 1.0°C.

LATENESS OF PUBLICATION

This publication is late because we have been experiencing camera and computer problems. These problems are being worked on and should be resolved soon.

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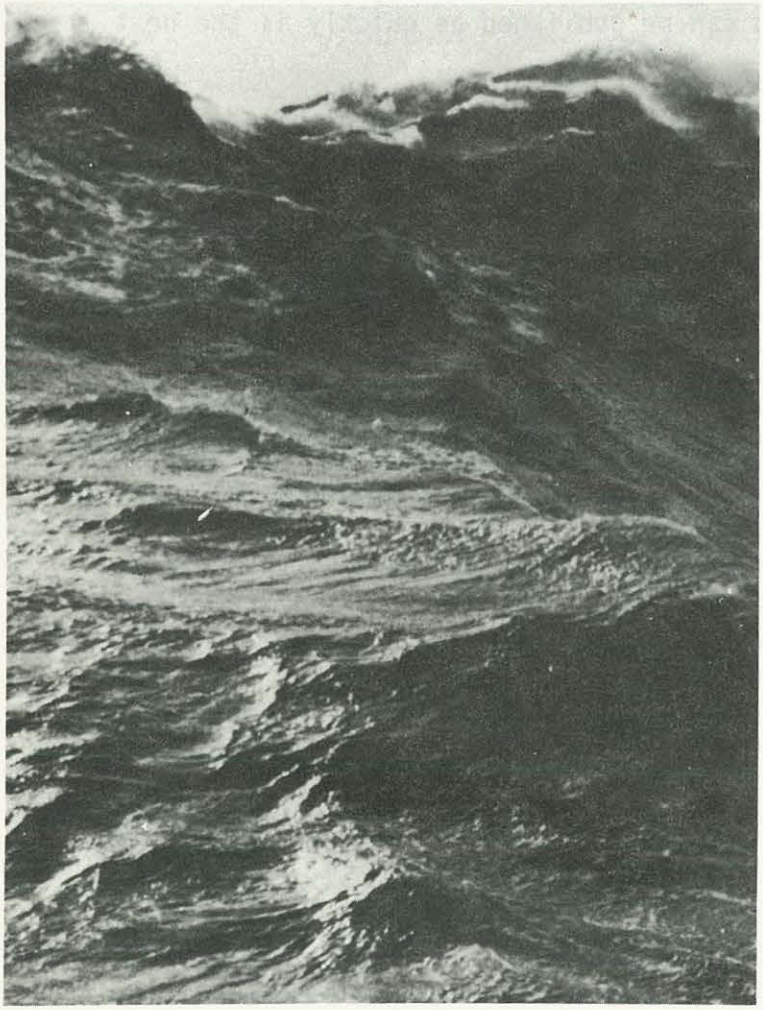
The Secretary of Commerce has determined that the publication of this periodical is necessary in the transaction of the public business required by law of this Department. Use of funds for printing this periodical has been approved by the Director of the Office of Management and Budget through April 1, 1985.

OCEANOGRAPHIC Monthly Summary

Volume IV Number 11 November 1984



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U.S. DEPARTMENT OF COMMERCE • National Oceanic and Atmospheric Administration
National Weather Service
National Environmental Satellite, Data, and Information Service

Oceanographic Monthly Summary is published by the National Weather Service and the National Environmental Satellite, Data, and Information Service (NESDIS). *Oceanographic Monthly Summary* contains sea surface temperature (SST) analyses on both regional and ocean basin scales for the Atlantic, Pacific, and Indian Oceans. The ocean basin analyses are based on a "blend" of *in situ* and satellite data. An ocean basin SST anomaly is derived from the "blended" SST analysis and the National Climatic Center (NCC) Climatology.[1] (See page 12 for details.) The regional SST analyses are based upon a combination of *in situ* and satellite data measurements. The regional SST anomalies use the Robinson-Bauer Climatology.[2] *Oceanographic Monthly Summary* also contains Alaskan sea ice information and ocean feature information for contiguous U.S. ocean regions.

Oceanographic Monthly Summary welcomes articles containing information of interest to *Oceanographic Monthly Summary* readers, such as, news on operational oceanography, unusual ocean feature phenomena, etc. Contributions should be sent to the editor (address below). Accepted material will appear in the OceaNotes section of *Oceanographic Monthly Summary*. Contributions can be published as quickly as the next monthly issue.

If you are interested in receiving *Oceanographic Monthly Summary* regularly, please refer to the back cover for subscription information.

[1]Reynolds, R.W., 1982. A Monthly Averaged Climatology of Sea Surface Temperatures; *NOAA Technical Report NWS 31*.

[2]Robinson, M.K., 1976. Atlas of North Pacific Ocean Monthly Mean Temperatures and Mean Salinities of the Surface Layer; *NavOceano Ref. Pub. 2*.
Robinson, M.K., R.A. Bauer, and E.H. Schroeder, 1979. Atlas of North Atlantic-Indian Ocean Monthly Mean Temperatures and Mean Salinities of the Surface Layer; *NavOceano Ref. Pub. 18*.

Oceanographic Monthly Summary

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COMMENTS NEEDED FOR WEST COAST OCEAN FEATURE PAGE

The marine community's comments and suggestions are urgently needed to improve the West Coast data you are now receiving on page 15 of the *Oceanographic Monthly Summary*. We need to know what format would be most valuable to you. Please indicate which type of information you would prefer to see on the West Coast Ocean Features page (check one):

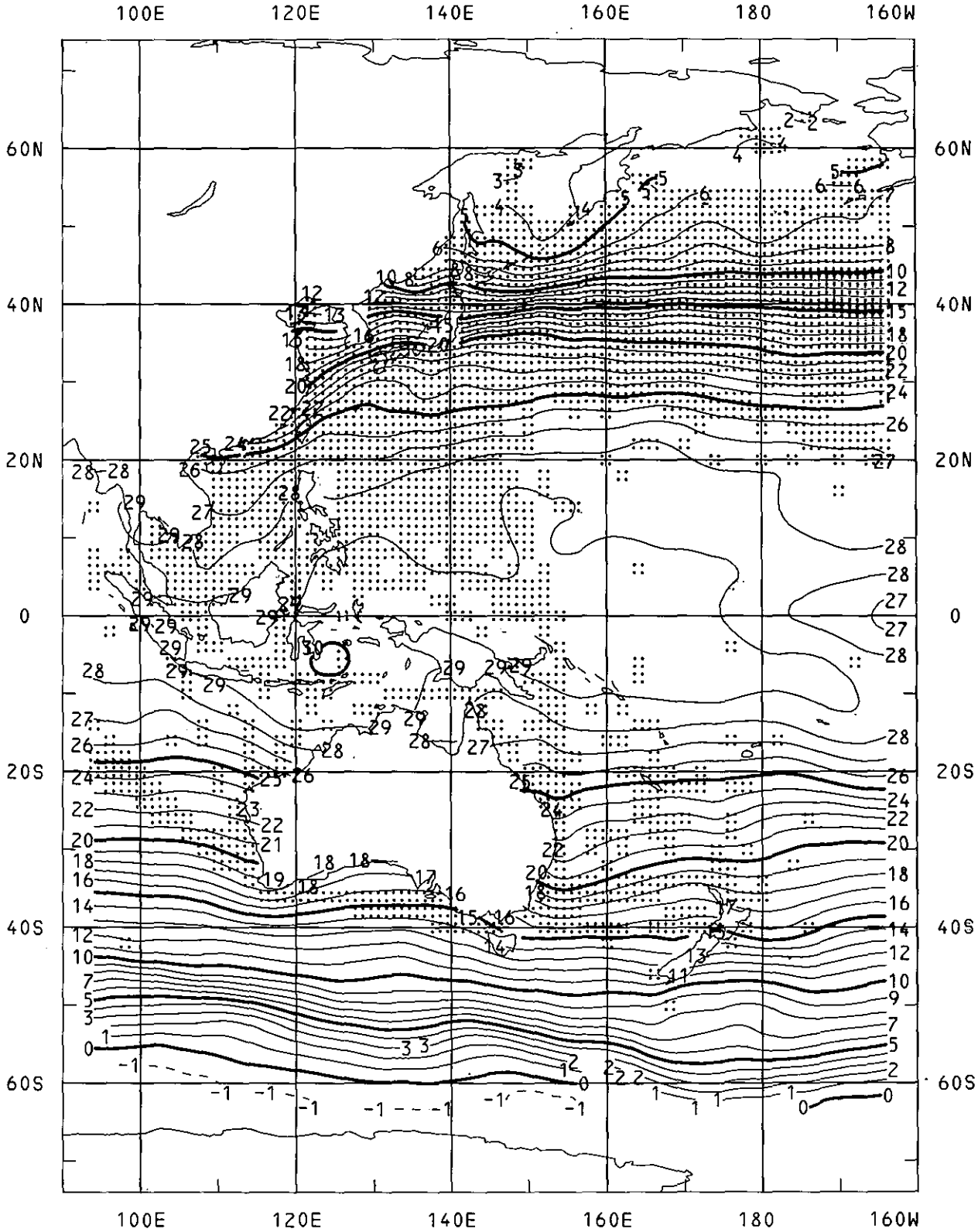
___ Purely narrative - A worded summary for the north and south halves of the U.S. West Coast, documenting trends, anomalies, unusual features and causitive factors.

___ Narrative and statistics - Shorter worded summaries, accompanied by tables summarizing key statistical parameters at specific stations.

___ Narrative plus graphical depiction - Shorter worded summaries, accompanied by some form of graphical ocean features depiction. Please specify desired form of graphic: _____

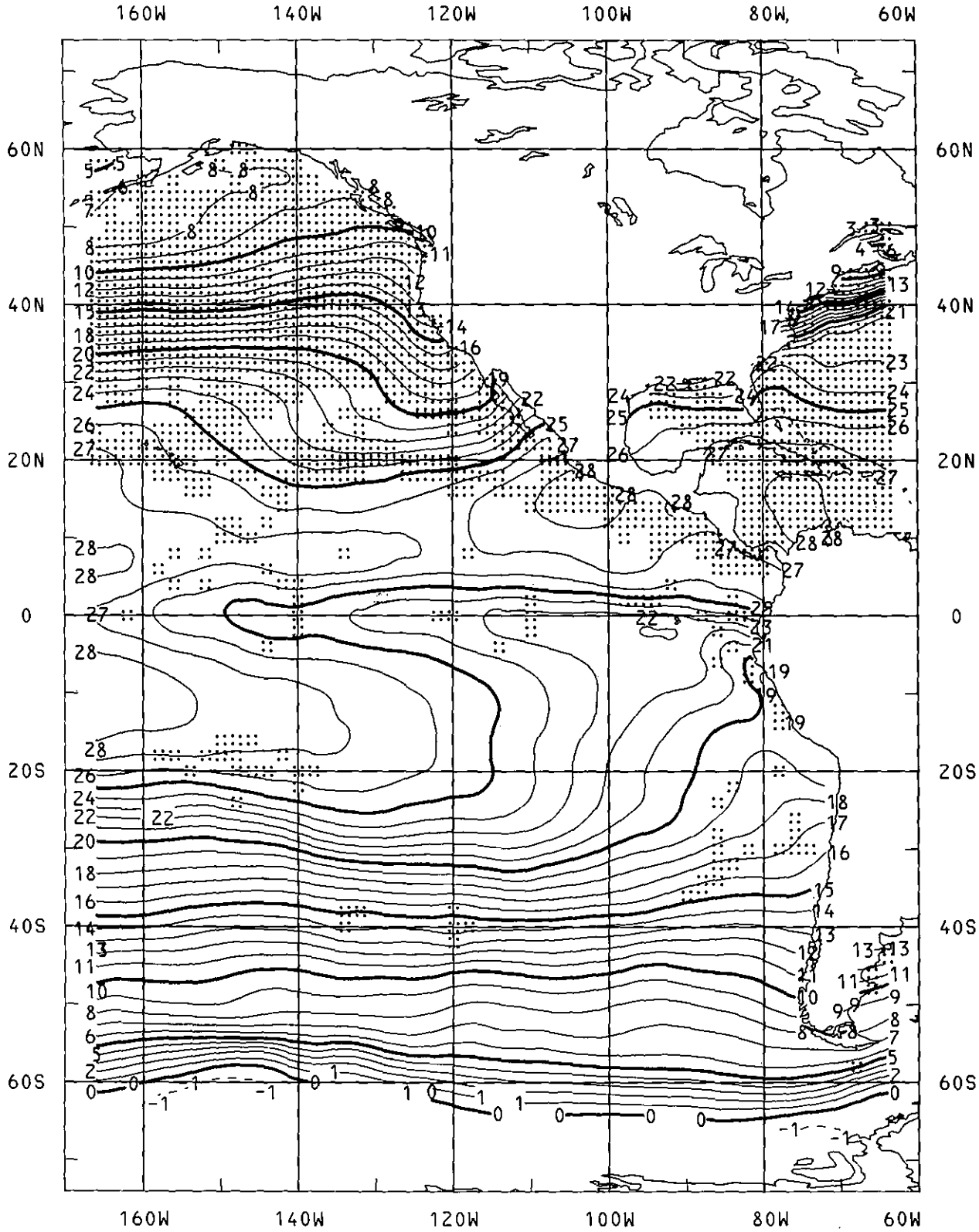
___ Your ideas - Indicate any other ways you would prefer to display the data.

Please send your comments immediately to the Editor.



Western Pacific Ocean
SST--MONTHLY MEAN (°C)
SHIP, BUOY, and SATELLITE DATA
NOVEMBER 1984

Monthly mean sea surface temperature is the mean of *in situ* and satellite data within two-degree quadrangles. Contour line interval is 1.0°C. The stippling indicates where the analysis was fixed by the *in situ* data; contours are not shown in areas without data.



Eastern Pacific Ocean
SST--MONTHLY MEAN (°C)
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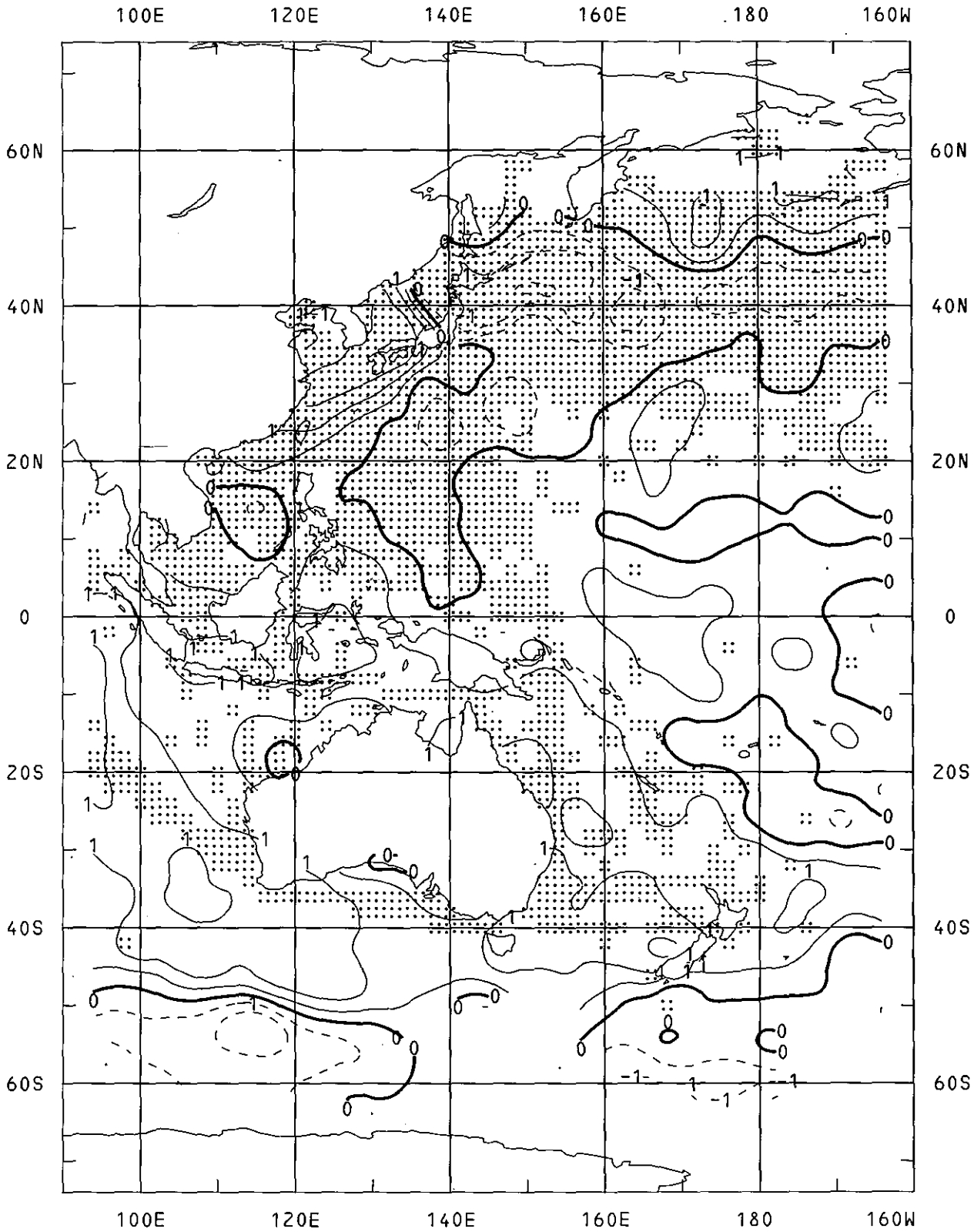

Western Pacific Ocean
SST--MONTHLY ANOMALY (°C)
SHIP, BUOY, and SATELLITE DATA
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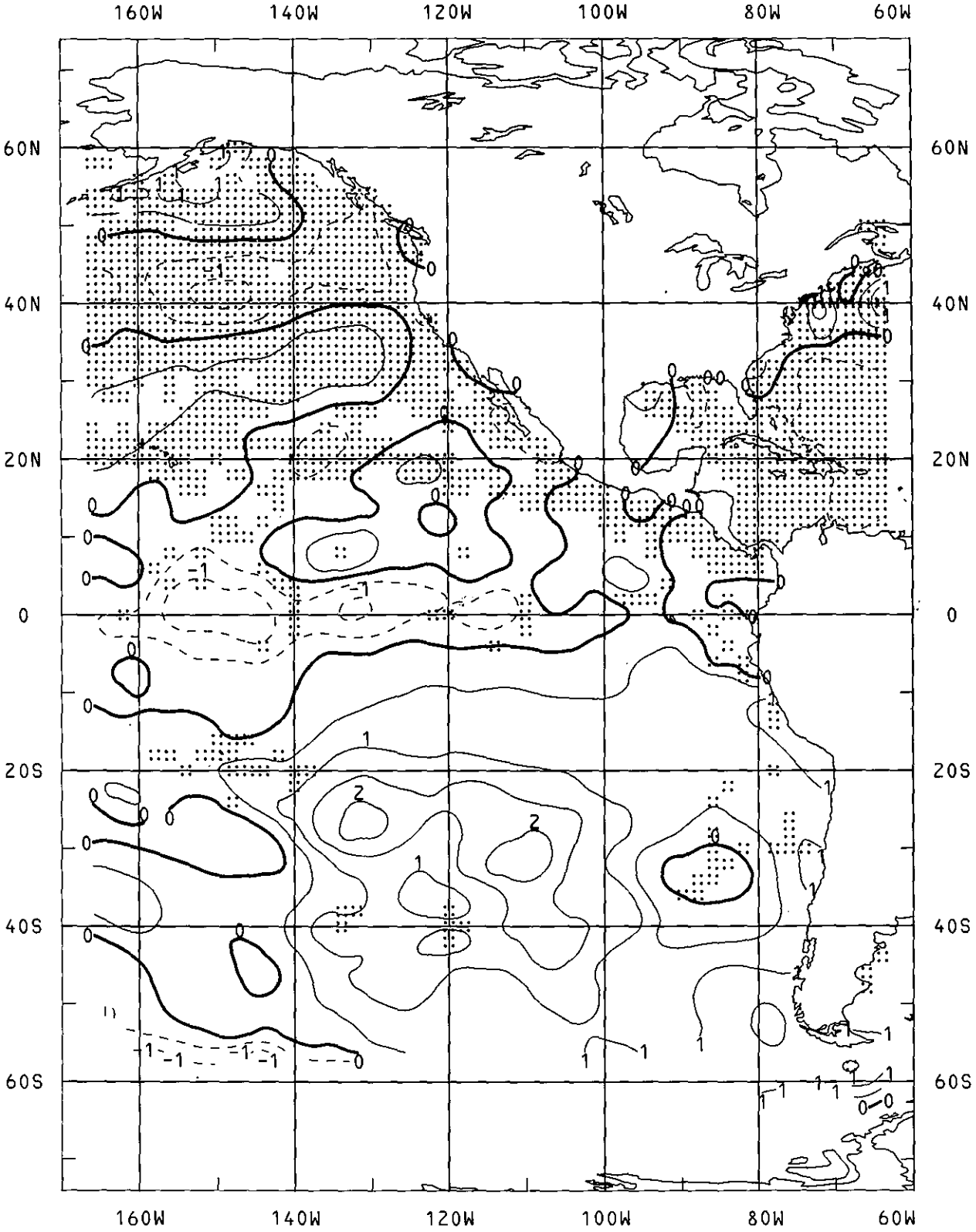

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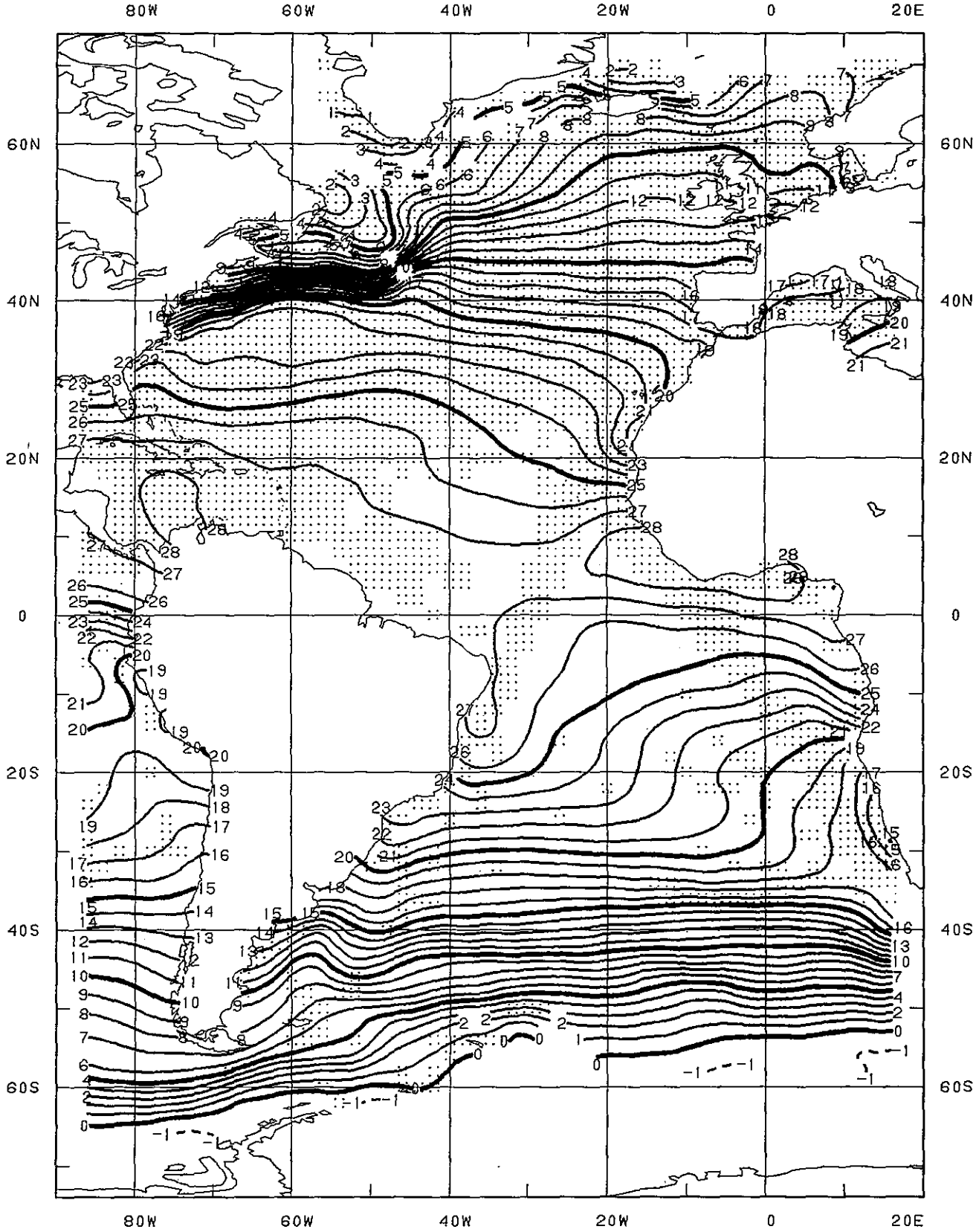

Atlantic Ocean
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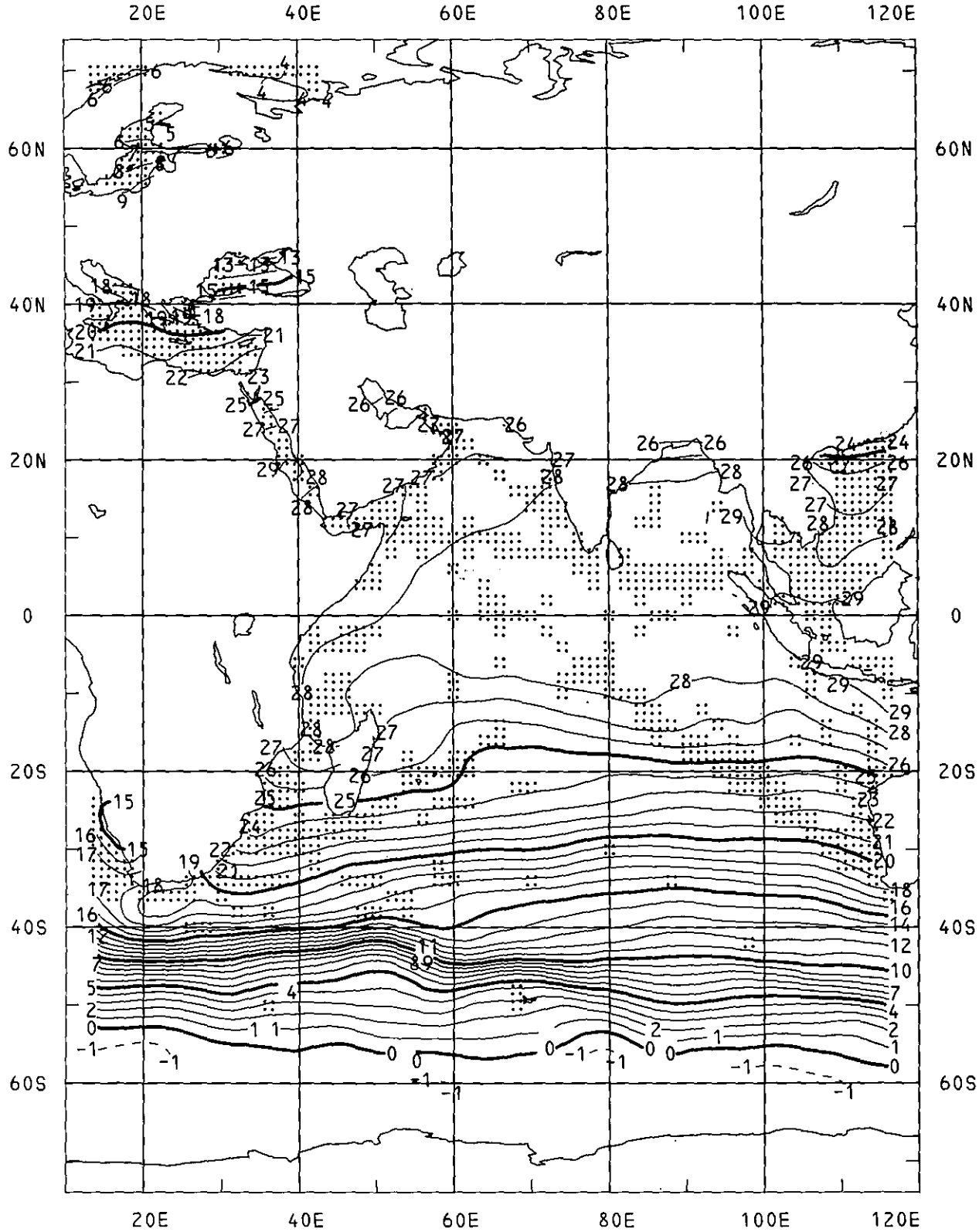

Indian Ocean
SST--MONTHLY MEAN (°C)
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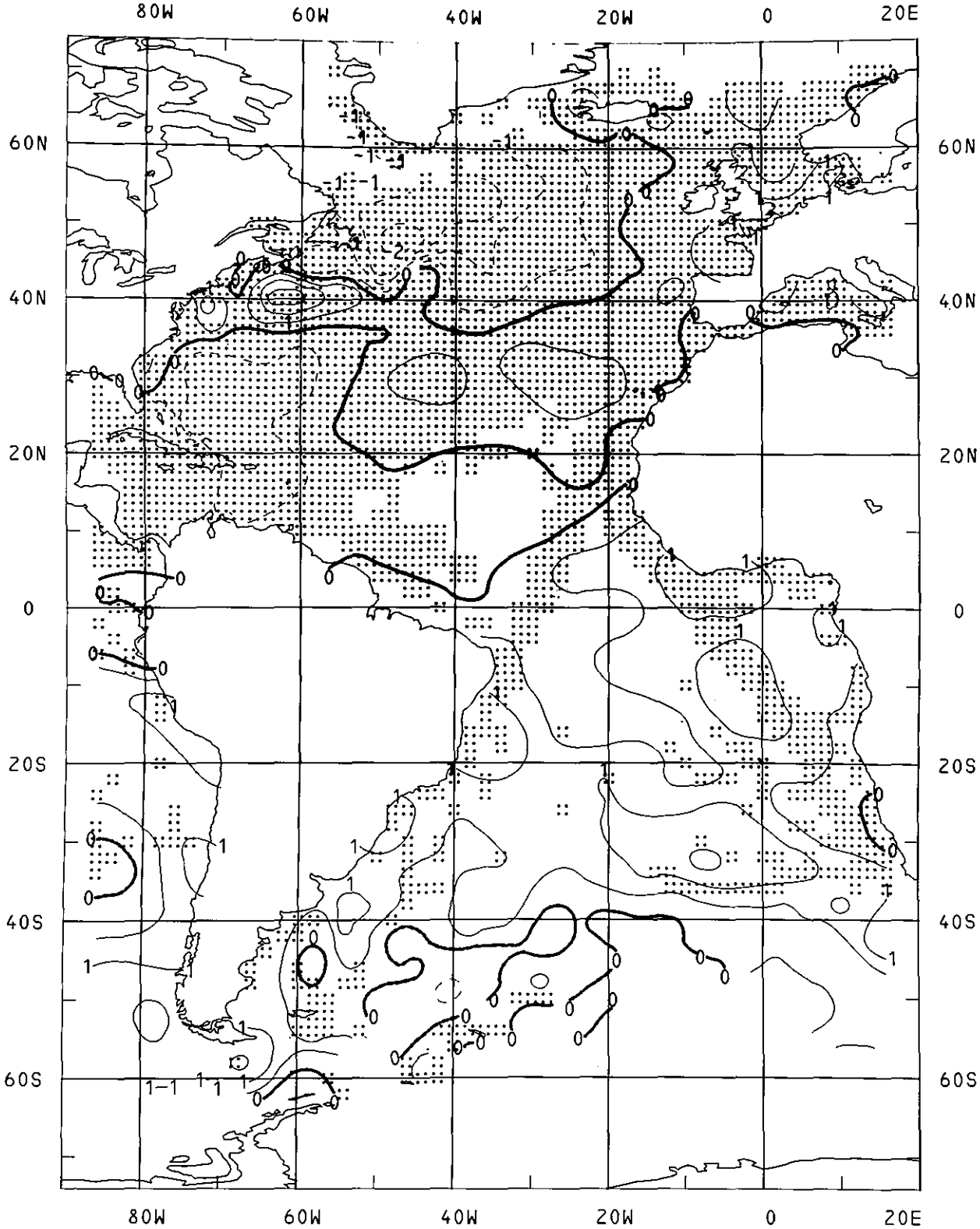

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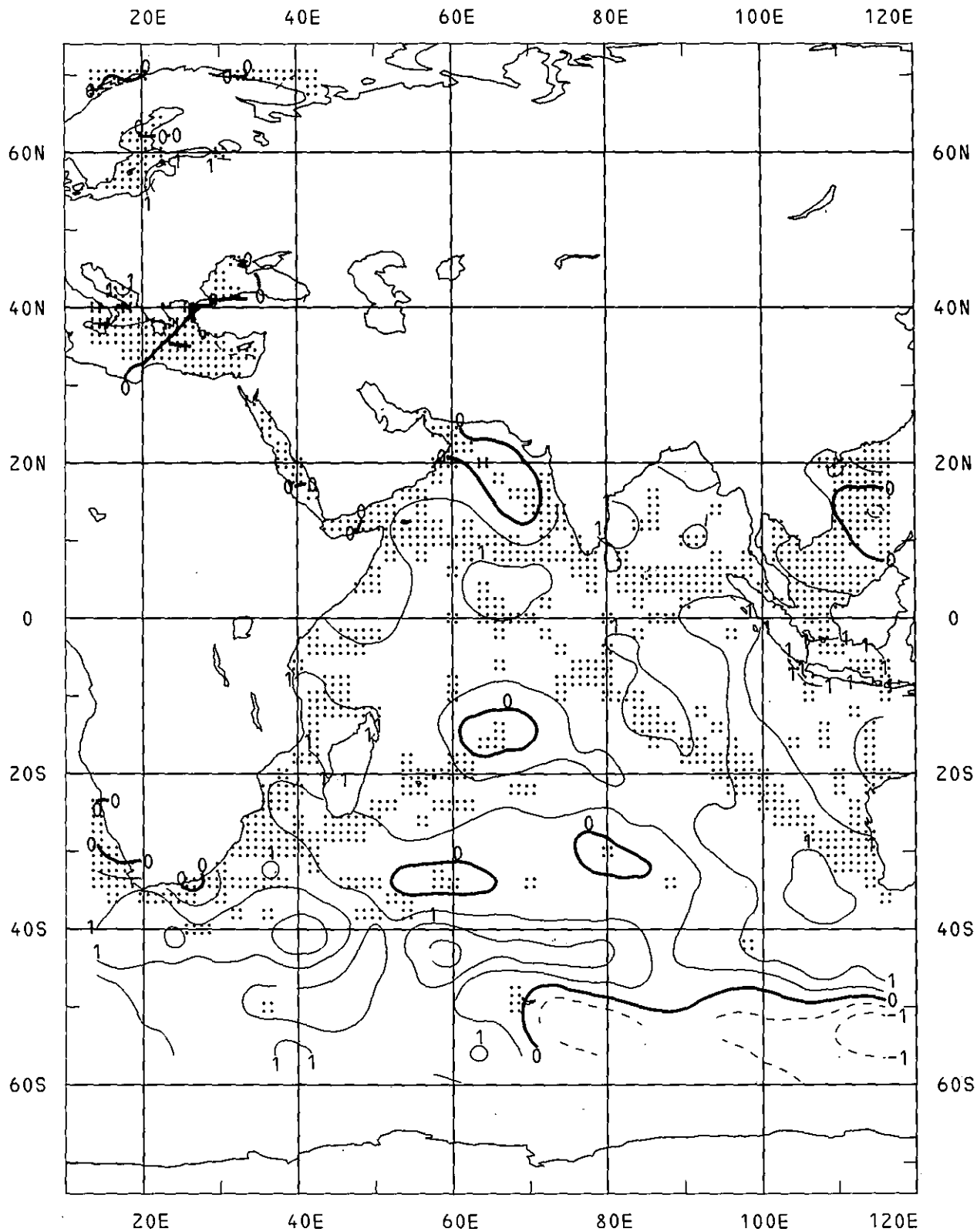

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NEW GLOBAL SEA SURFACE TEMPERATURE MONTHLY MEAN ANALYSIS

Highlights

- o New global analysis using both *in situ* and satellite data
- o Indian Ocean analysis included
- o Global analysis extended further south

Beginning in February 1983 a global SST analysis was presented using *in situ* (ship and buoy) data and a non-linear spatial filter (see Reynolds and Gemmill, 1984). Because the coverage from satellites is superior to the *in situ* coverage, an analysis derived from satellite observations only was added in April 1983. The two types of data were not combined because of significant differences between the *in situ* observations and the satellite retrievals. In the July 1984 *Oceanographic Monthly Summary*, the satellite field showed a negative bias relative to the *in situ* field in the tropics and a positive bias in mid-latitude. Strong (1983) reported that satellite retrievals were cooler than *in situ* observations because of aerosols injected into the atmosphere by the eruption of El Chichon in March-April 1982. Comparisons of the two analyses over the last 30 months show that although the satellite anomalies tend to be more negative than *in situ* anomalies, the differences are <u>not independent of time or location</u>.

A "blended" SST analysis has been developed using *in situ* data to define "benchmark" temperature values in regions of frequent observations and satellite data to define the "shape" of the field between these points. The blended field is found by solving Poisson's equation, $\nabla^2 T = F$, where T is the blended SST field and F is a forcing function given by the Laplacian of the satellite SST analysis, ($\nabla^2 S$); *in situ* data are used as internal boundary values at points of frequent observations. At the poleward boundaries, T is set to the *in situ* (preferred) or the satellite analysis. The resulting anomaly and mean fields are shown on pages 4-11 where the stippling indicates regions where the SST field was fixed by the *in situ* data. The use of the satellite data has allowed the analysis to be extended further south, but necessitated a change in the map projection. Studies with this new analysis suggest that the blended analysis is an improvement over the fields obtained from *in situ* data only or the satellite data only. Since the satellite data affect the field in the interior via the Laplacian, biases or trends in the satellite data can only influence the final solution through the high latitude boundary conditions. In the example above, satellite biases would impact the blended result only south of 40°S, except in the eastern South Pacific where the *in situ* fields is almost undefined.

These results suggest that the blended method may be a useful way to utilize both *in situ* and satellite data. Each monthly blended field will be monitored carefully using individual *in situ* and satellite analyses as diagnostic tools. In future months the blended method may be modified to reflect changes in either the *in situ* observations or the satellite retrievals.

Reynolds, R. W. and W. H. Gemmill, 1984: An objective global monthly mean sea surface temperature analysis. Tropical Ocean-Atmosphere Newsletter, No. 23, 4-5.

Strong, A. E., 1983: Satellite derived sea surface temperature errors due to the El Chichon aerosol cloud. Tropical Ocean-Atmosphere Newsletter, No. 18, 14-15.

SATELLITE IMAGE OF THE MONTH

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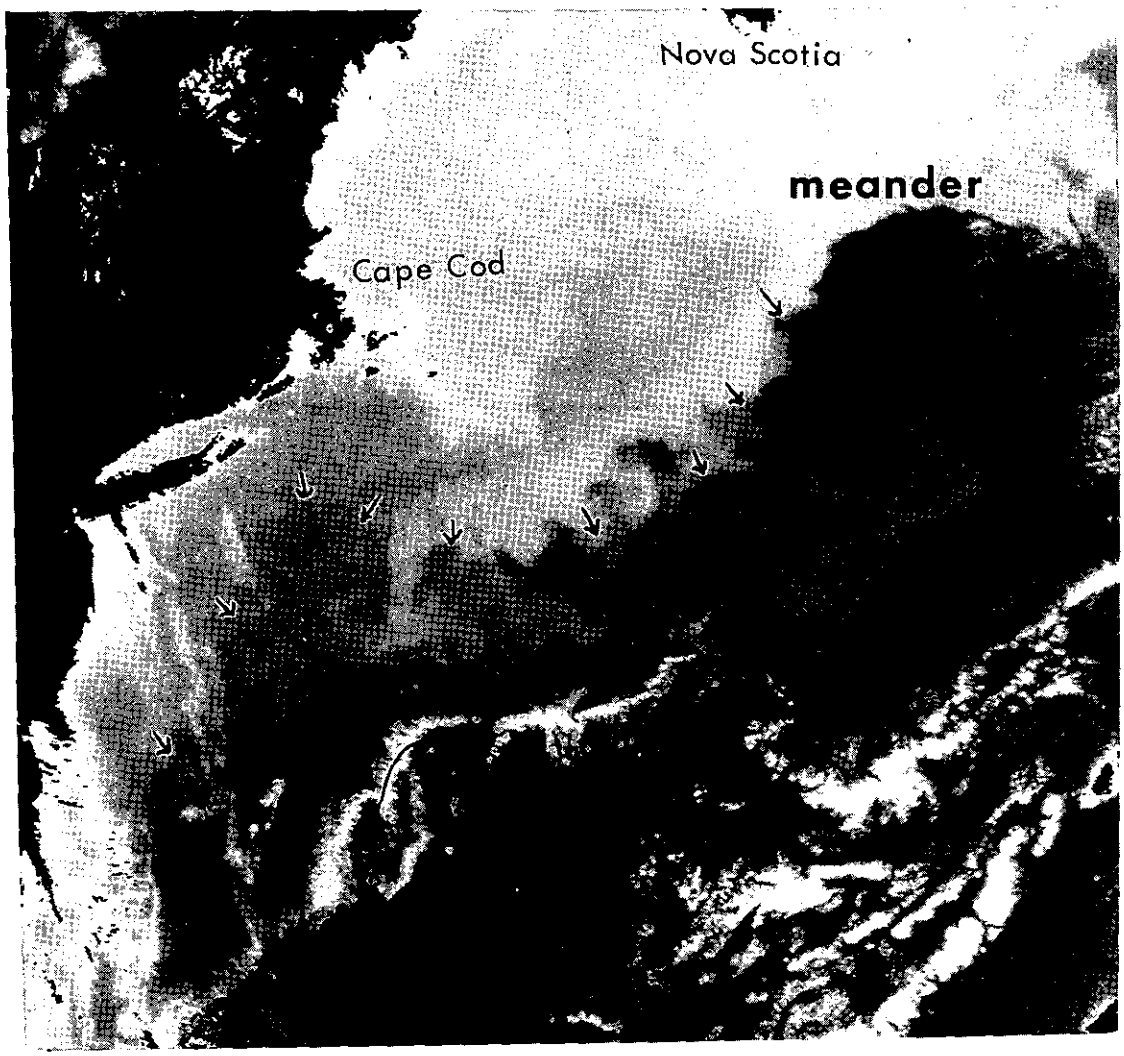
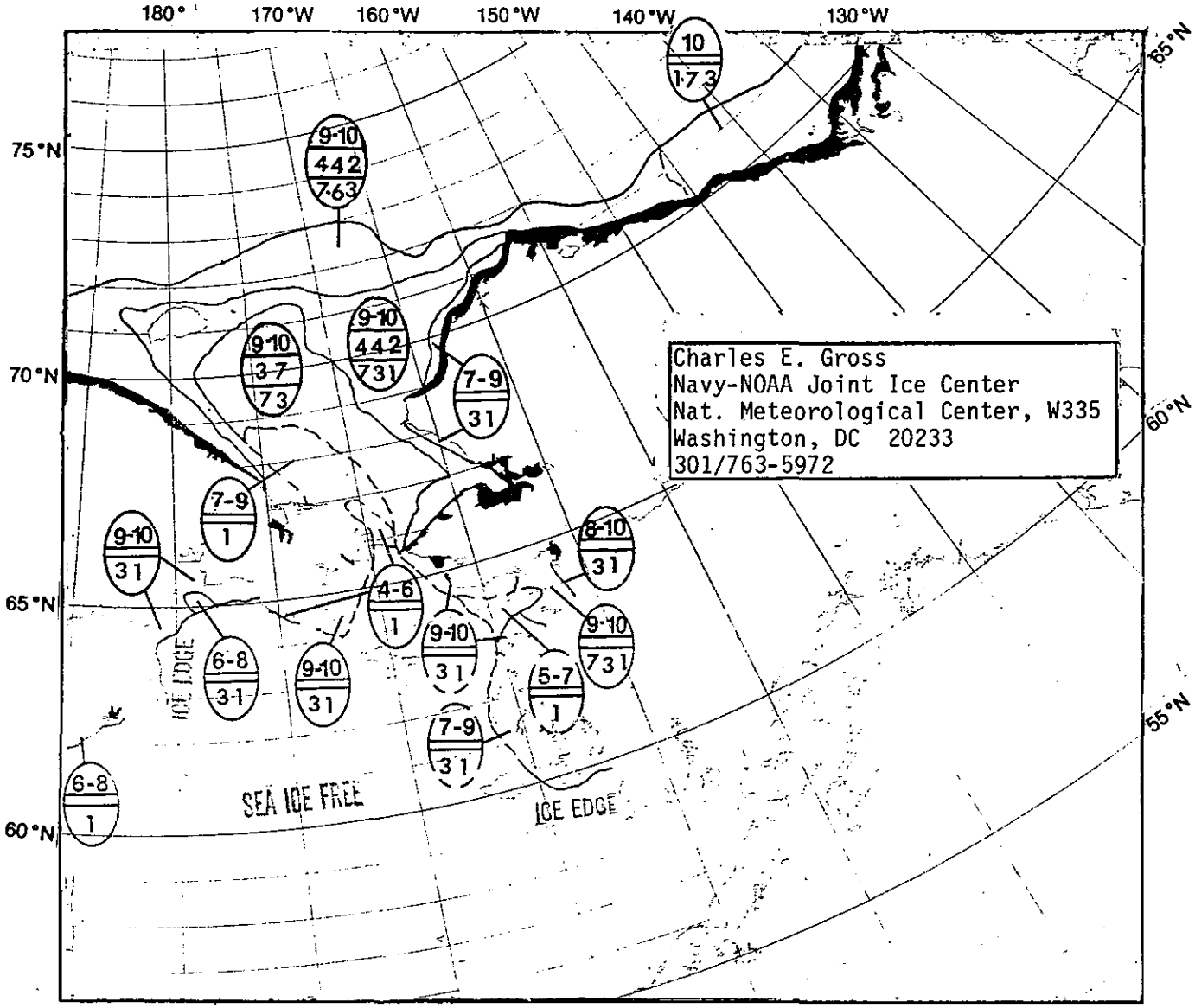
GULF STREAM CURRENT

The Gulf Stream current is present in this NOAA-6 infrared satellite image taken November 27, 1984. This relatively warm western boundary current appears as dark gray shades, while the cool Shelf and Slope Waters on the shoreward side appear as light gray shades. The distinct boundary between the Shelf and Slope Waters - the shelf/slope front - is indicated by the shorter arrows. This boundary is a prime location for fishing because of the prevalence of nutrients. To the south of the Gulf Stream, the Sargasso Sea is fairly uniform in temperature, appearing as an intermediate gray. The meandering behavior of the Gulf Stream has been well documented by a variety of research methods, including *in situ* data sets as well as satellite infrared imagery. The large meander south of Nova Scotia resulted from interaction with a warm eddy. Dramatic changes in the Gulf Stream paths have been associated with eddy development or interactions with eddies as the eddies propagate to the southwest. Note the presence of small scale cloud formations along portions of the Stream south of Cape Cod. Researchers are investigating the role of the Gulf Stream in cases of air-sea interactions as illustrated here.



BERING SEA / NORTH SLOPE ICE ANALYSIS



C = Total ice concentration in the area in tenths.

C_a, C_b, C_c = Concentration of thickest (C_a), 2nd thickest (C_b), and 3rd thickest (C_c) ice

S_a, S_b, S_c = Stage of development of thickest (S_a), 2nd thickest (S_b), and 3rd thickest (S_c) ice.

-C = Concentration of ice within area(s) of strips and patches.

STAGE(S) OF DEVELOPMENT (THICKNESS)

1 = New Ice (0-10 cm)
3 = Young ice (10-30 cm)
6 = First year (30-200 cm)
7 = First year thin (30-70 cm)
1. = First year medium (70-120 cm)
4. = First year thick (120-200 cm)
7. = Old Ice (survived at least one summer's melt)

EXAMPLES

125 Theoretical thickness of this season's growth (cm).

Fast ice. Sea ice which forms and remains fast along the coast.

Ice boundary visually or satellite observed.

Ice boundary estimated.

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The monthly mean sea level pressure circulation depicts a 989 mb low centered in the western Bering Sea near 55°N 170°E and a 1027 mb high near 81°N 170°W. Mean monthly surface geostrophic winds are easterly throughout the Chukchi and Bering Seas. During the first half of the month, intense low pressure systems centered in the western Bering Sea produced strong southeasterly winds and retarded ice expansion in the western Chukchi Sea. In the latter half of the month a more normal northeasterly wind pattern was established. This pattern combined with below normal air temperatures recorded at Barrow (71°N 157°W) produced rapid ice expansion in the Chukchi Sea extending through the Bering Strait by November 26. Below normal air temperatures were also recorded at Nome (65°N 165°W). The current ice edge position in the eastern Bering Sea extending from Norton Sound south along the Alaskan coast is near the climatological median. To the west the ice edge ranges from near minimum between 166°W and 172°W to near median in the northwestern Bering Sea along the Soviet coast.

WEST COAST OCEAN FEATURES

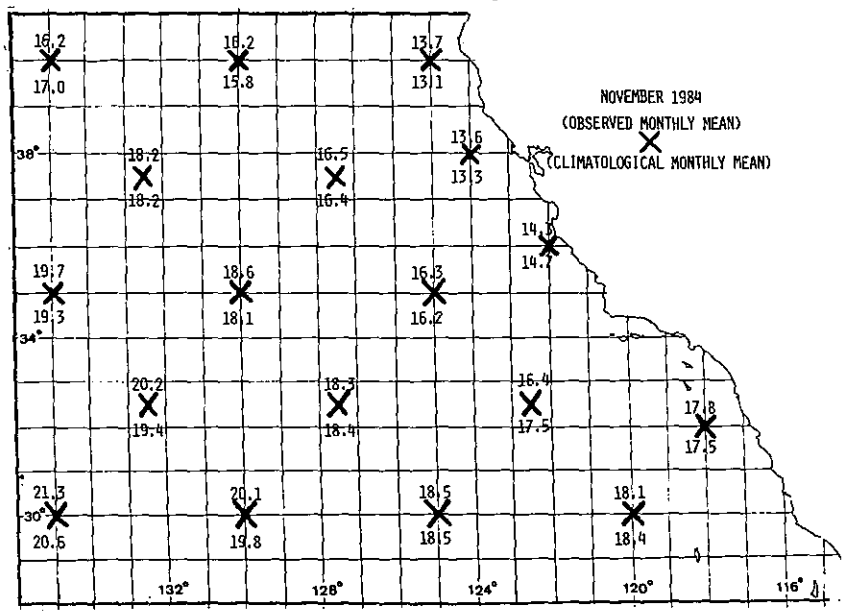
NOVEMBER 1984

MONTHLY SST STATISTICS FOR SELECTED STATIONS
PACIFIC NORTHWEST
(Area enclosed by 40-52N, Coast-135W)

NOVEMBER 1984

Station	Location (Lat/Long)	Mean SST	Standard Deviation	Maximum SST	Minimum SST	Change From Previous Month
Buoy 46005	46.1 N 131.0 W	11.6	0.5	12.7	10.7	-2.3
Buoy 46002	42.5 N 130.3 W	14.2	0.3	15.0	13.9	-2.2
		(Note: Data through 11/17 only.)				
Buoy 46010	46.2 N 124.2 W	11.8	0.6	12.7	10.2	-1.7
Quillayute River	47.9 N 124.6 W	10.7	1.4	12.2	7.8	-1.8
		(Note: Data through 11/24 only.)				
Grays Harbor	46.9 N 124.1 W	10.4	0.9	12.2	8.9	-2.6
Cape Disappointment	46.3 N 124.1 W	10.6	0.3	11.1	10.0	-0.1
Chetco River	42.0 N 124.3 W	10.9	0.5	11.7	9.4	+0.7

Autumn cooling and the passage of numerous weather frontal systems characterized the Pacific Northwest coastal ocean region. SSTs decreased steadily at offshore buoy locations, averaging about 2°C less than for October. Coastal stations, however, while showing an overall mean SST decrease, exhibited pronounced fluctuations. These fluctuations appeared unrelated spatially along the coast, and can likely be attributed to variations in cold freshwater runoff and the differential effects of transport and mixing of surface water during the passage of weather systems. SSTs were near normal close to the coast, with the exception of the southernmost Oregon coast, where a -1.0°C monthly anomaly occurred. Negative SST anomalies exhibited a significant westward strengthening toward offshore areas. The coolest anomaly area, with SSTs as much as 2.5°C below normal, was centered near 49°N 133°W. Persistent cloud cover for most of the month limited the use of satellite imagery in observing ocean features.



North Panel
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NOAA/Northwest Regional Ocean Service Center
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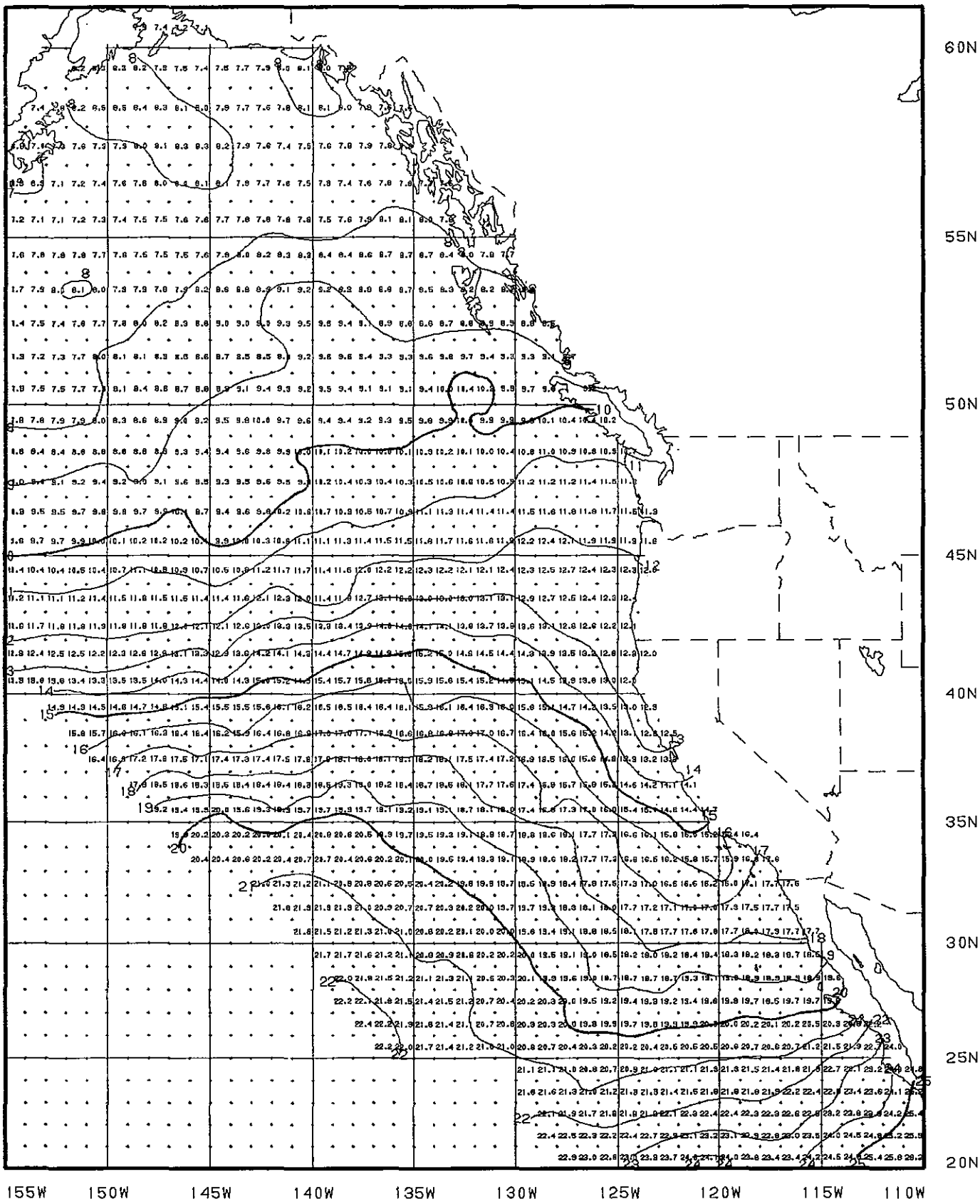
Seattle, WA 98115
(206) 526-6604

South Panel
Ernest Daghir
NOAA/NWS
Satellite Field Service Station
660 Price Avenue
Redwood City, CA 94063
(415) 364-2422

Average mean SSTs of 17.4°C over the South Panel during the month were near the normal of 17.3°C even though there were areas both above and below the climatological normals. Cool anomalies of 0.8°C and 0.5 -1.1°C were in the extreme northwest corner of the analysis and near-shore extending from San Francisco Bay south to the Santa Barbara Channel, respectively. All other locations were from 0.1 to 0.8°C above normal. The warm anomaly that has persisted for many months in the Los Angeles Bight and San Diego areas has virtually disappeared. When compared to November, all areas cooled at least 0.6°C. Areas of maximum cooling of 2.2°C were again in the extreme northwest corner of the chart and cooling of 2.0-2.3°C from Pt. Conception to northern Baja. Upwelling was not analyzed along coastal California during November, but some minor activity was observed by satellite in northern Baja, California.



West Coast
SST--MONTHLY MEAN (°C)
November 1984

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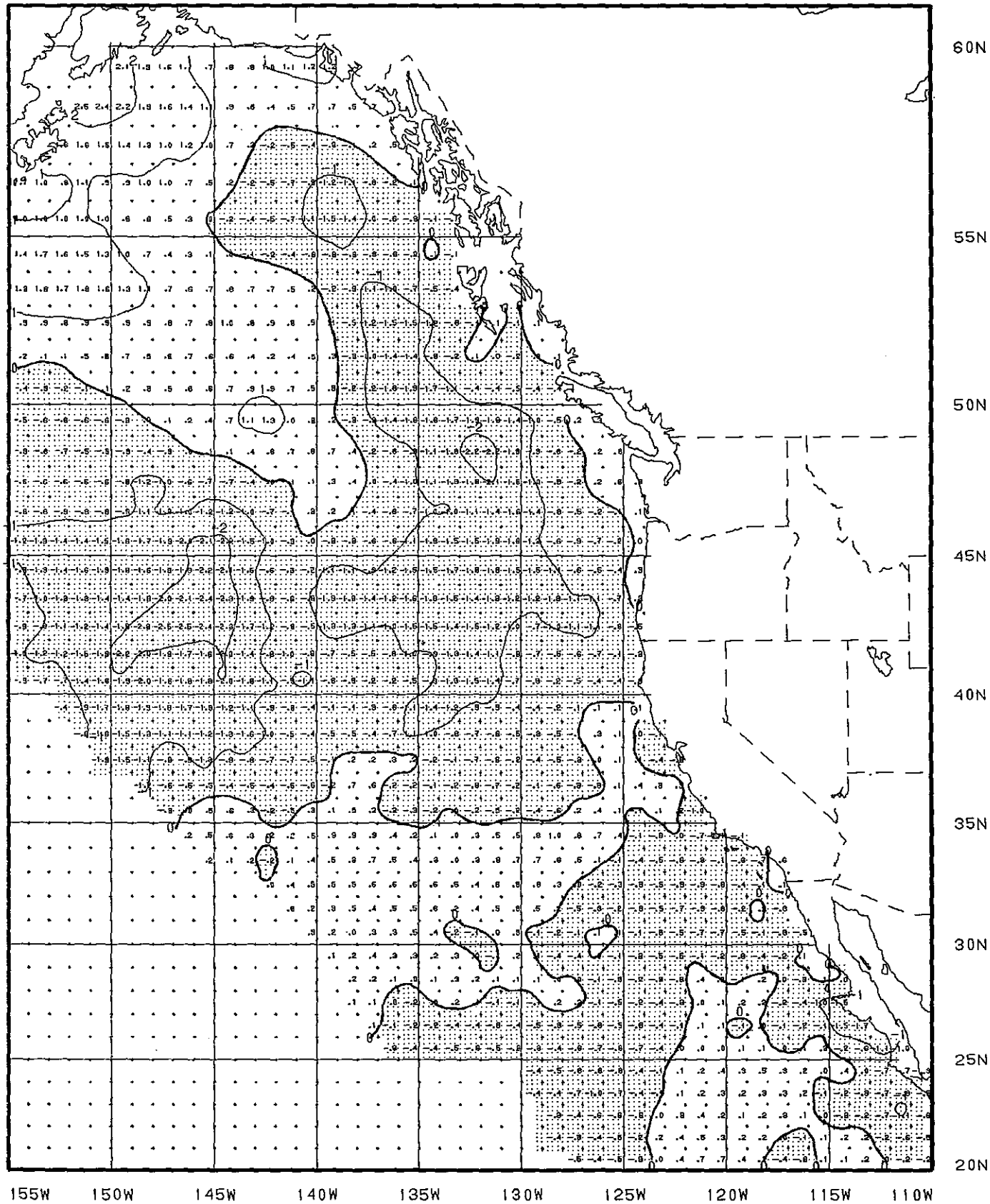

West Coast
SST--MONTHLY ANOMALY (°C)
November 1984

Monthly anomaly is the difference between the monthly mean sea surface temperature and the climatological monthly mean value -- shading shows where the monthly mean is colder than climatology. Contour line interval is 1.0°C.

The end of this month's positions of the Gulf Stream System and its associated eddies are shown for the NW Atlantic and the Gulf of Mexico. The Gulf Stream and Loop Current boundaries are located by infrared satellite imagery or XBT (expendable bathythermograph) data. Anticyclonic eddies are labeled a-z in the Gulf of Mexico and 1-99 in the NW Atlantic. Cyclonic eddies are labeled A-Z. Arrows on eddies indicate direction of circulation. Warm-core or anticyclonic eddies rotate clockwise; cold-core or cyclonic eddies rotate counterclockwise. The line to the eddy center shows the net translation since last month or since last observed. Eddies or sections of the Gulf Stream System which were not observed during the month are not shown on the analysis chart. The long arrows at the bottom of the chart indicate the date of data used.

Data used in this analysis include:
- NOAA satellite infrared imagery, NESDIS
- Bathythermograph data, National Meteorological Center of National Weather Service
- Oceanographic Analysis, A daily detailed analysis issued by National Weather Service/NESDIS

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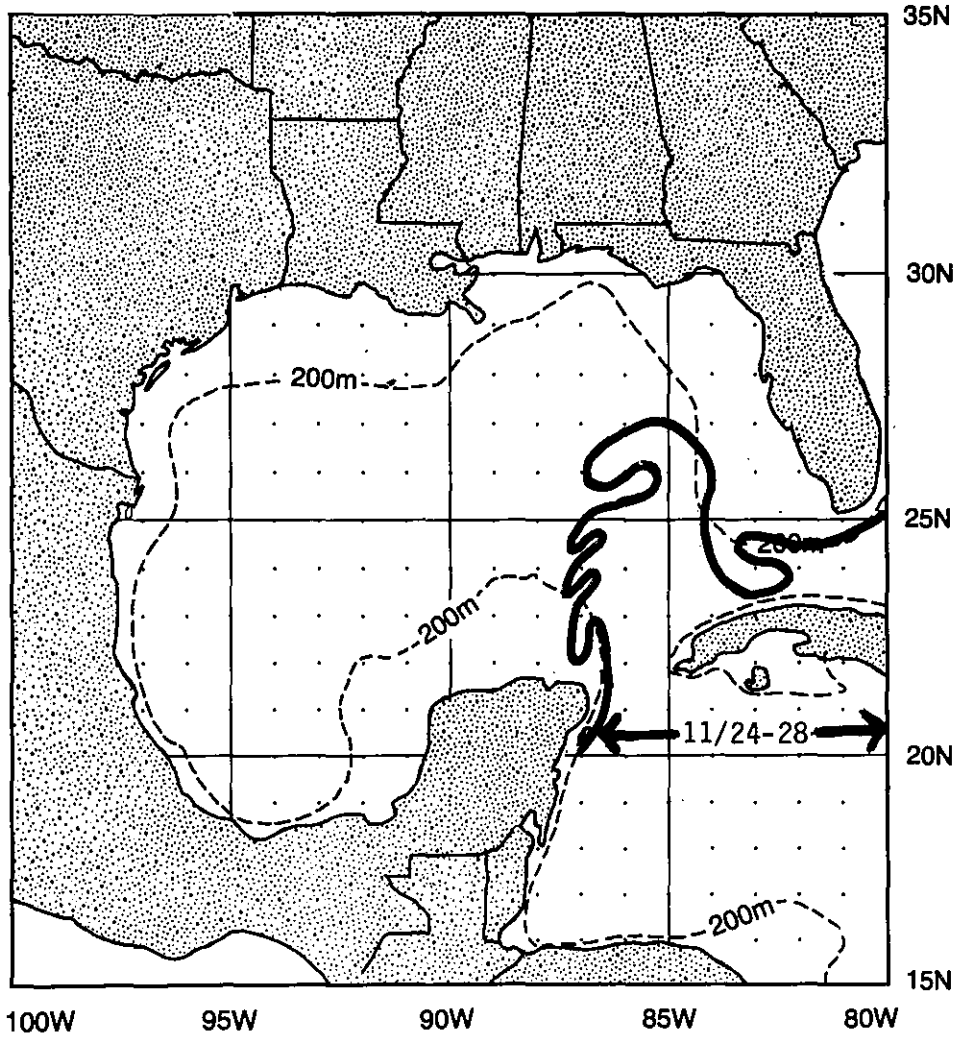
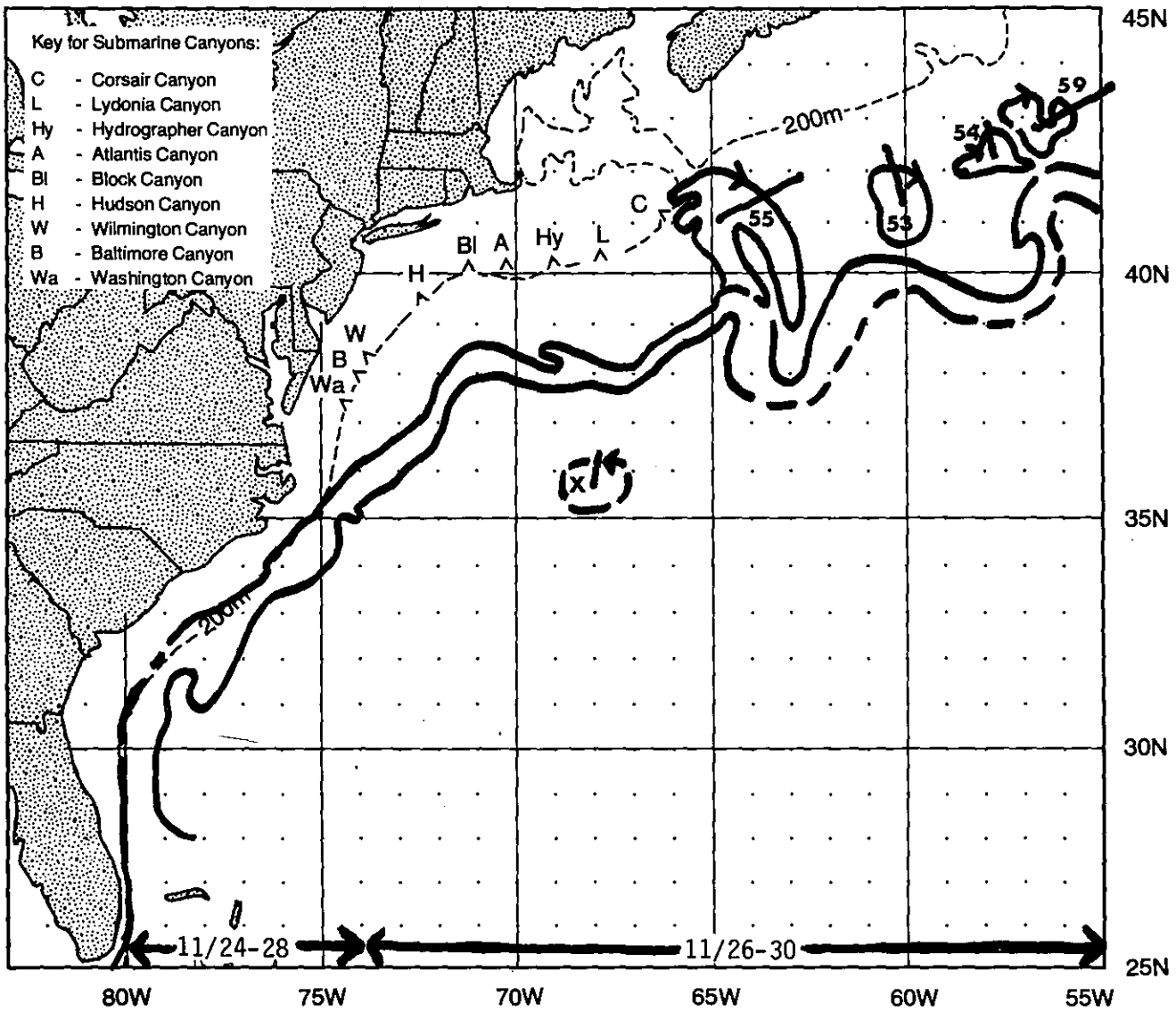


NOVEMBER 1984

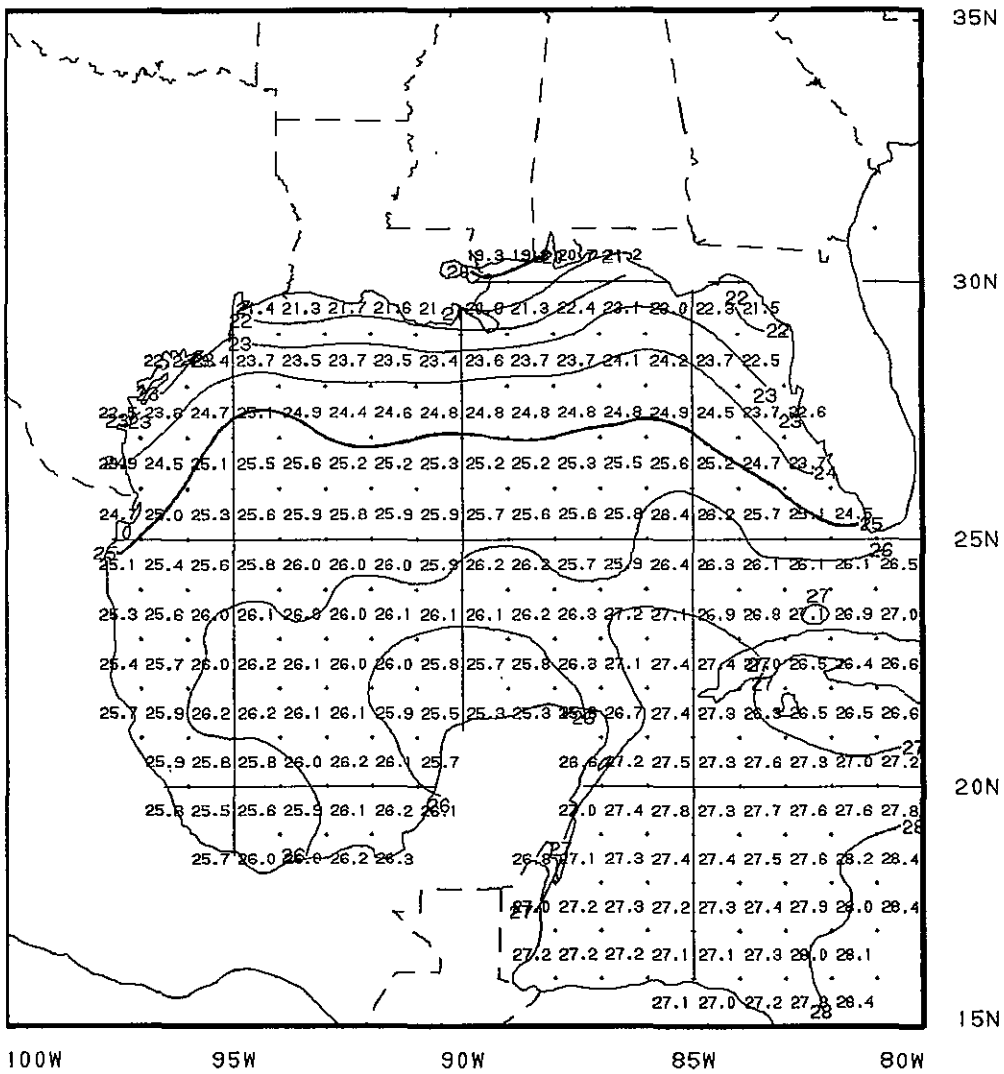
Due to seasonal heating, the Loop Current in the Gulf of Mexico had not been observed since June. Due to seasonal cooling, the Loop Current was clearly observed again on November 5.



One anticyclonic eddy was absorbed during the month. Eddy 56 translated 35 Km NW when it was last detected on November 1. Eddy 56 is suspected to have been absorbed by the Gulf Stream near 41°N 61°W on November 11. Eddy 55 translated 185 Km SW and apparently is interacting with the Gulf Stream near 39°30°N 64°30°W. Eddy 53 traveled 120 Km SSE. Eddy 54 moved 75 Km S. Eddy 59 traveled 185 Km SW.

Cyclonic eddy X translated 75 Km S when it was last detected on November 15.

EAST COAST SST-
MONTHLY MEAN



Gulf of Mexico
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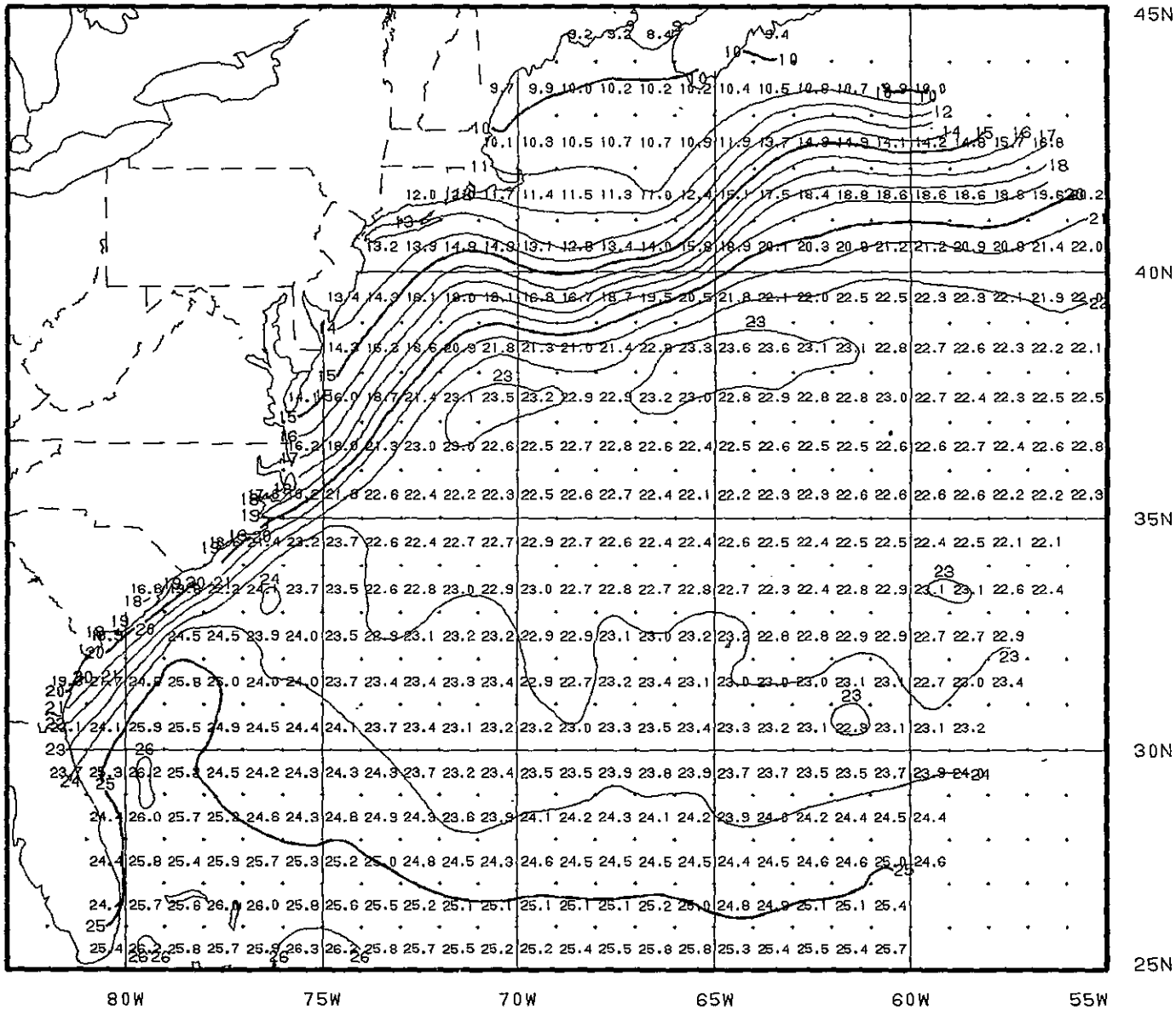

NW Atlantic Ocean
SST--MONTHLY MEAN (°C)
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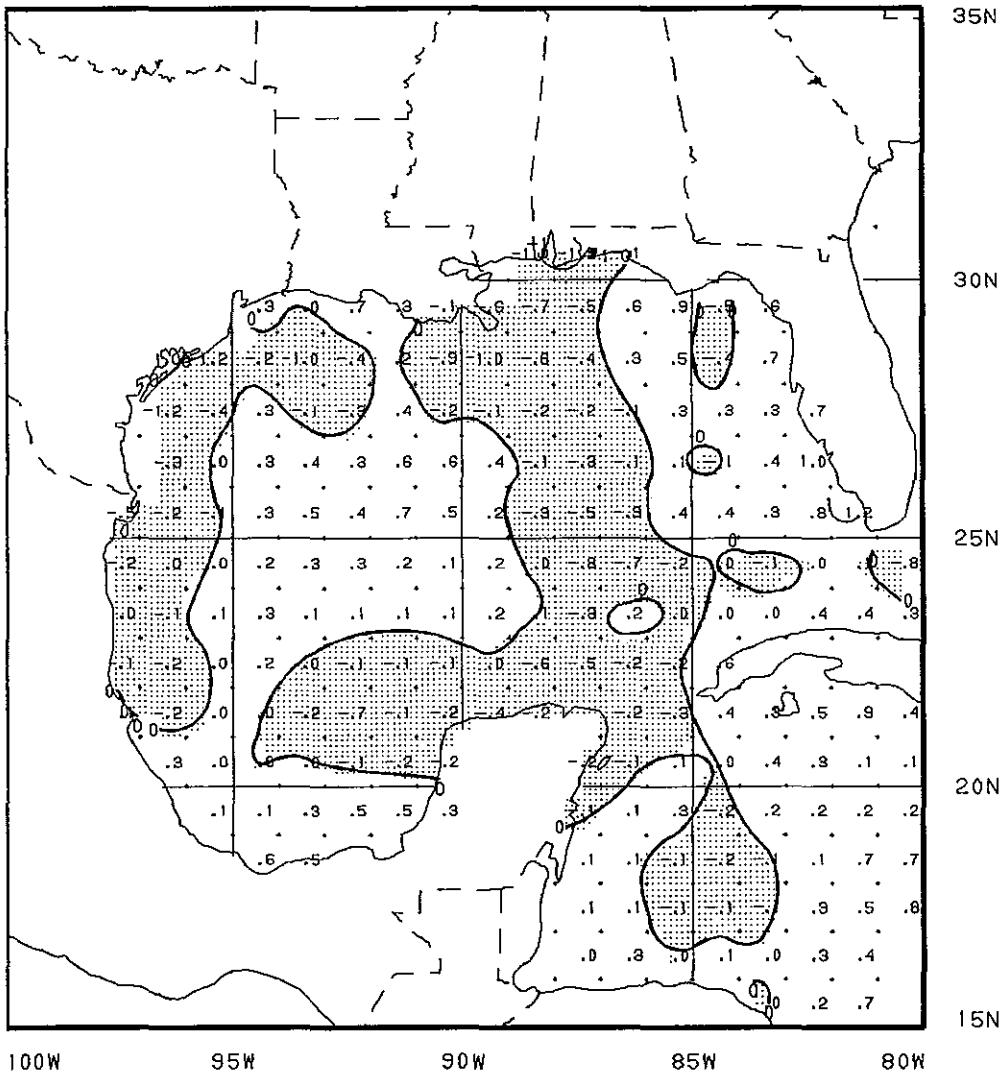
EAST COAST SST-ANOMALY



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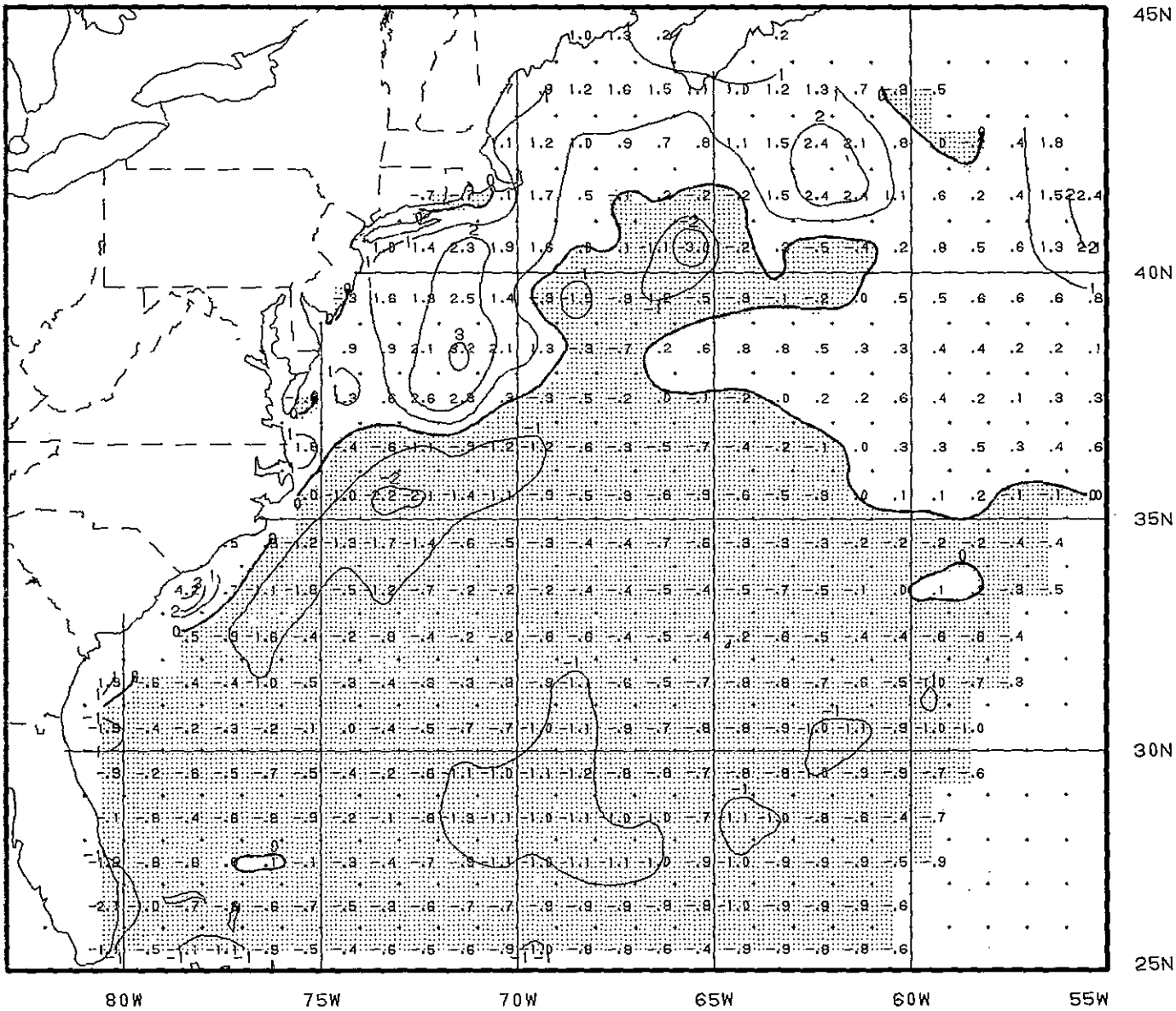

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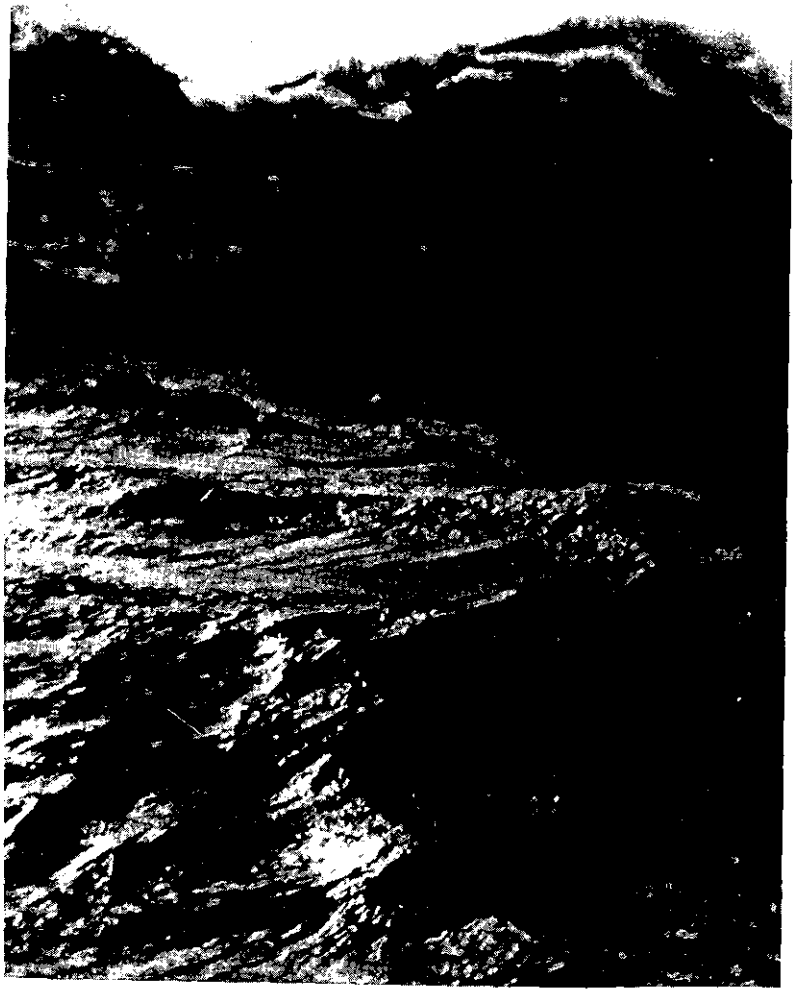
The Secretary of Commerce has determined that the publication of this periodical is necessary in the transaction of the public business required by law of this Department. Use of funds for printing this periodical has been approved by the Director of the Office of Management and Budget through April 1, 1985.

OCEANOGRAPHIC Monthly Summary

Volume IV Number 12

December 1984



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National Weather Service
National Environmental Satellite, Data, and Information Service

Oceanographic Monthly Summary is published by the National Weather Service and the National Environmental Satellite, Data, and Information Service (NESDIS). *Oceanographic Monthly Summary* contains sea surface temperature (SST) analyses on both regional and ocean basin scales for the Atlantic, Pacific, and Indian Oceans. The ocean basin analyses are based on a "blend" of *in situ* and satellite data. An ocean basin SST anomaly is derived from the "blended" SST analysis and the National Climatic Center (NCC) Climatology.[1] (See page 12 for details.) The regional SST analyses are based upon a combination of *in situ* and satellite data measurements. The regional SST anomalies use the Robinson-Bauer Climatology.[2] *Oceanographic Monthly Summary* also contains Alaskan sea ice information and ocean feature information for contiguous U.S. ocean regions.

Oceanographic Monthly Summary welcomes articles containing information of interest to *Oceanographic Monthly Summary* readers, such as, news on operational oceanography, unusual ocean feature phenomena, etc. Contributions should be sent to the editor (address below). Accepted material will appear in the OceaNotes section of *Oceanographic Monthly Summary*. Contributions can be published as quickly as the next monthly issue.

If you are interested in receiving *Oceanographic Monthly Summary* regularly, please refer to the back cover for subscription information.

[1]Reynolds, R.W., 1982. A Monthly Averaged Climatology of Sea Surface Temperatures; *NOAA Technical Report NWS 31*.

[2]Robinson, M.K., 1976. Atlas of North Pacific Ocean Monthly Mean Temperatures and Mean Salinities of the Surface Layer; *NavOceano Ref. Pub. 2*.
Robinson, M.K., R.A. Bauer, and E.H. Schroeder, 1979. Atlas of North Atlantic-Indian Ocean Monthly Mean Temperatures and Mean Salinities of the Surface Layer; *NavOceano Ref. Pub. 18*.

Oceanographic Monthly Summary

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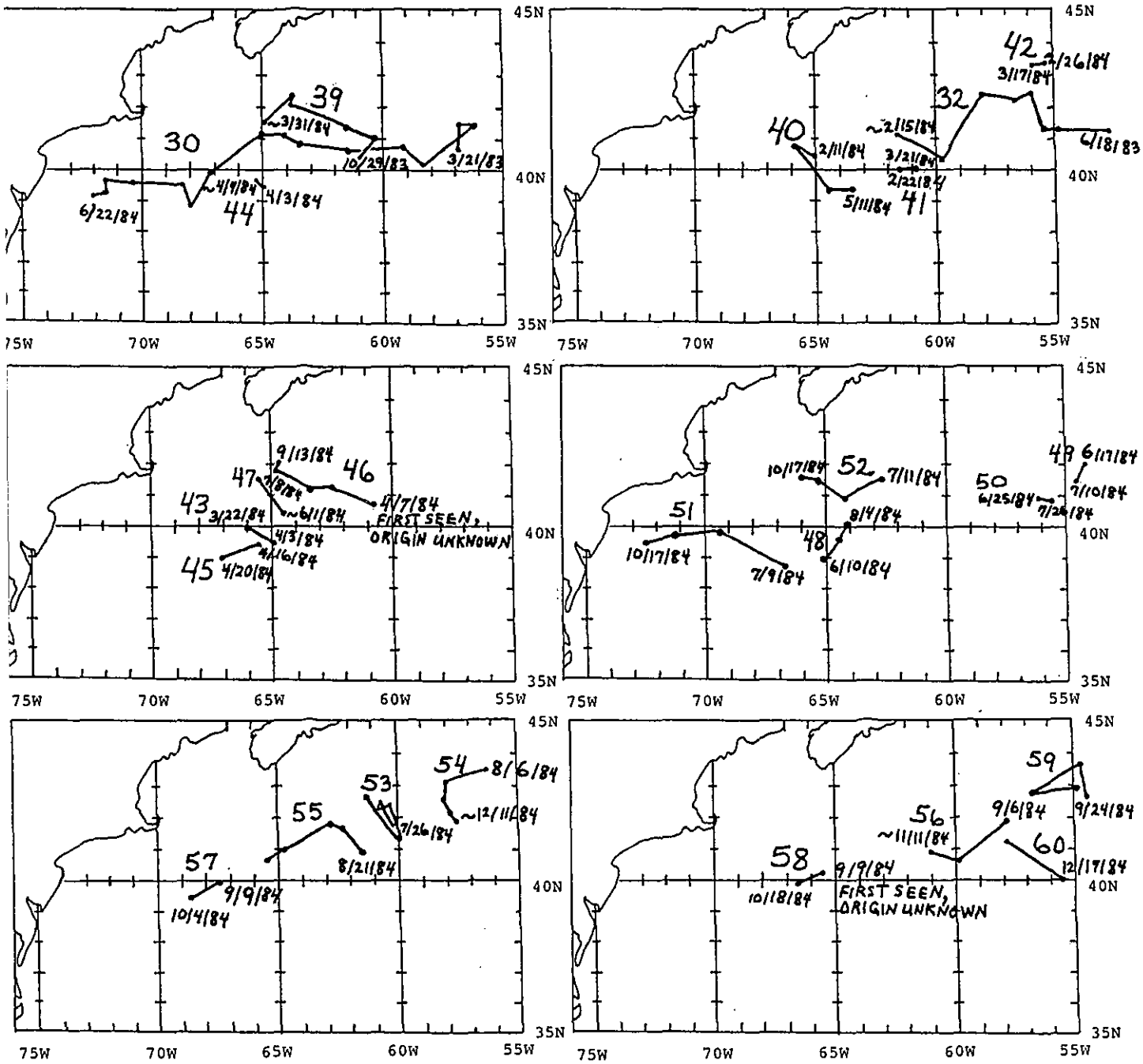
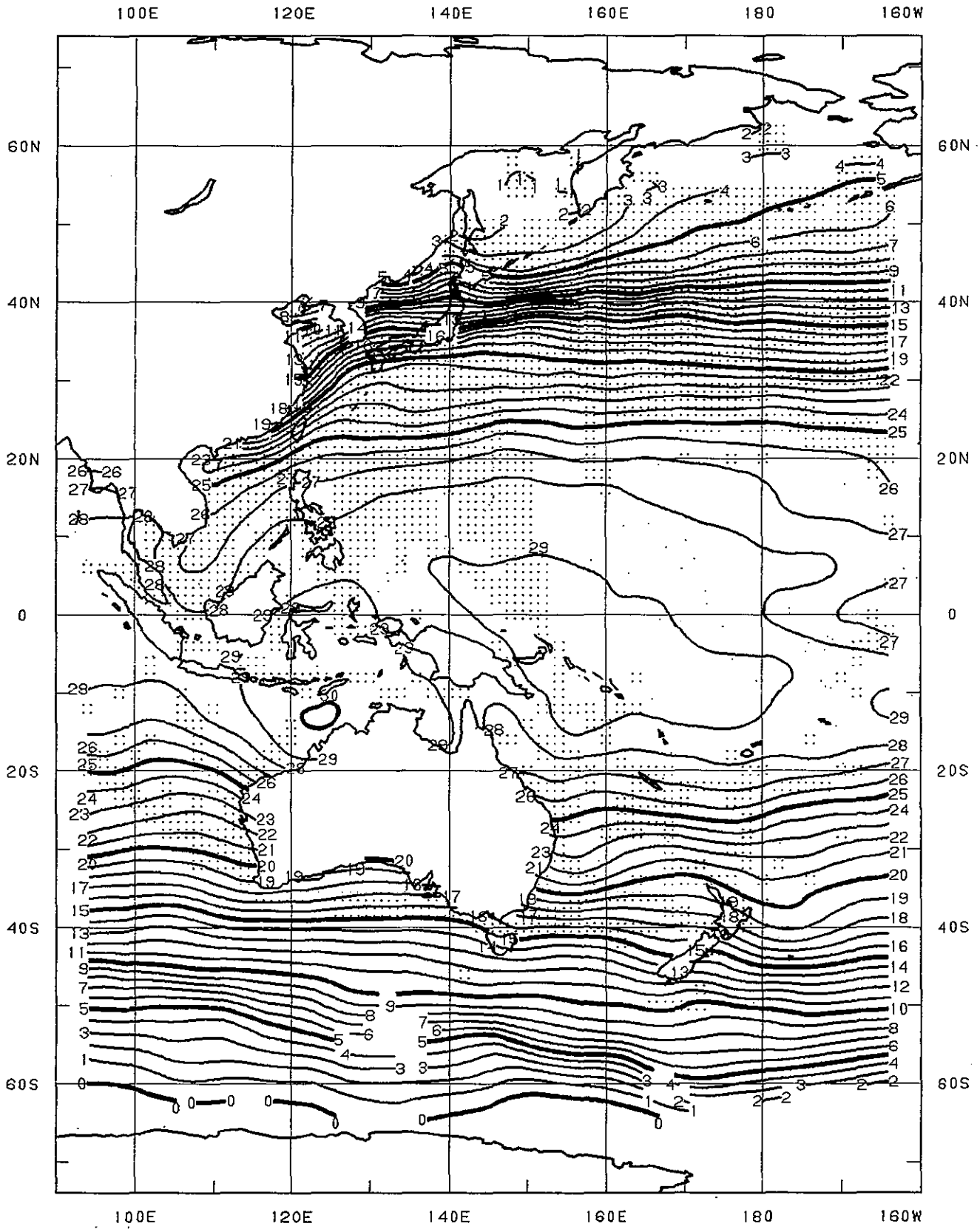
ANTICYCLONIC EDDY CENSUS--1984

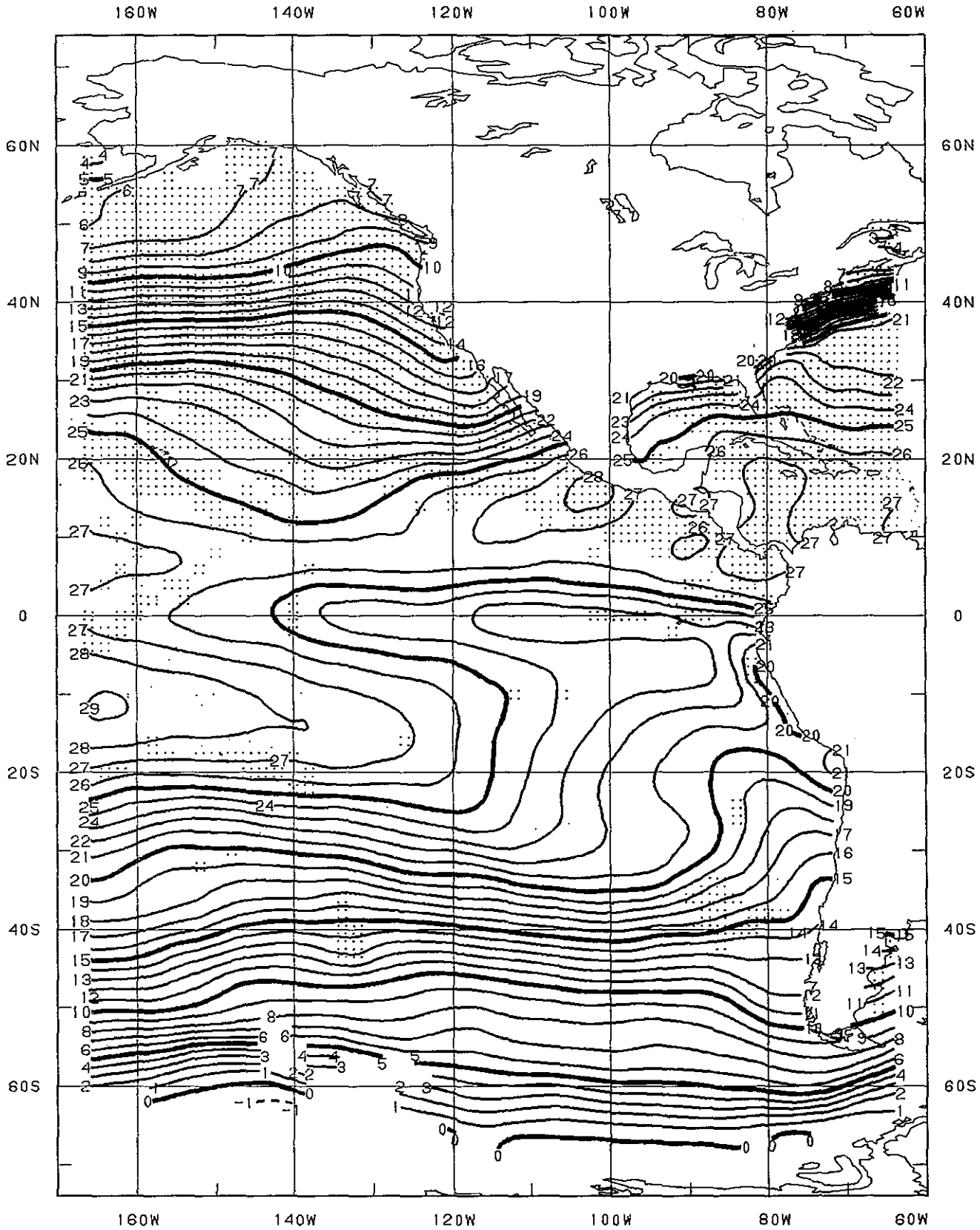
Plots show tracks of individual anticyclonic Gulf Stream eddies, from their formation (some prior to 1984) to their absorption or until their end-of-1984 position. Eddies 31 and 33-38 were absorbed before 1984. Dots shown between formation and absorption dates or end-of-1984 positions represent intervening end-of-month positions. Maximum and minimum duration of the anticyclonic eddies were 15 months and 1 month, respectively. The mean duration was 4 months. Maximum and minimum average speeds were 6 km/day and 2 km/day, respectively. The mean speed was 4 km/day. The eddies generally translated westerly and southwesterly. Eddy data are from the Oceanographic Monthly Summary.





Western Pacific Ocean
SST--MONTHLY MEAN (°C)
SHIP, BUOY, and SATELLITE DATA
DECEMBER 1984

Monthly mean sea surface temperature is the mean of *in situ* and satellite data within two-degree quadrangles. Contour line interval is 1.0°C. The stippling indicates where the analysis was fixed by the *in situ* data; contours are not shown in areas without data.



Eastern Pacific Ocean
SST--MONTHLY MEAN (°C)
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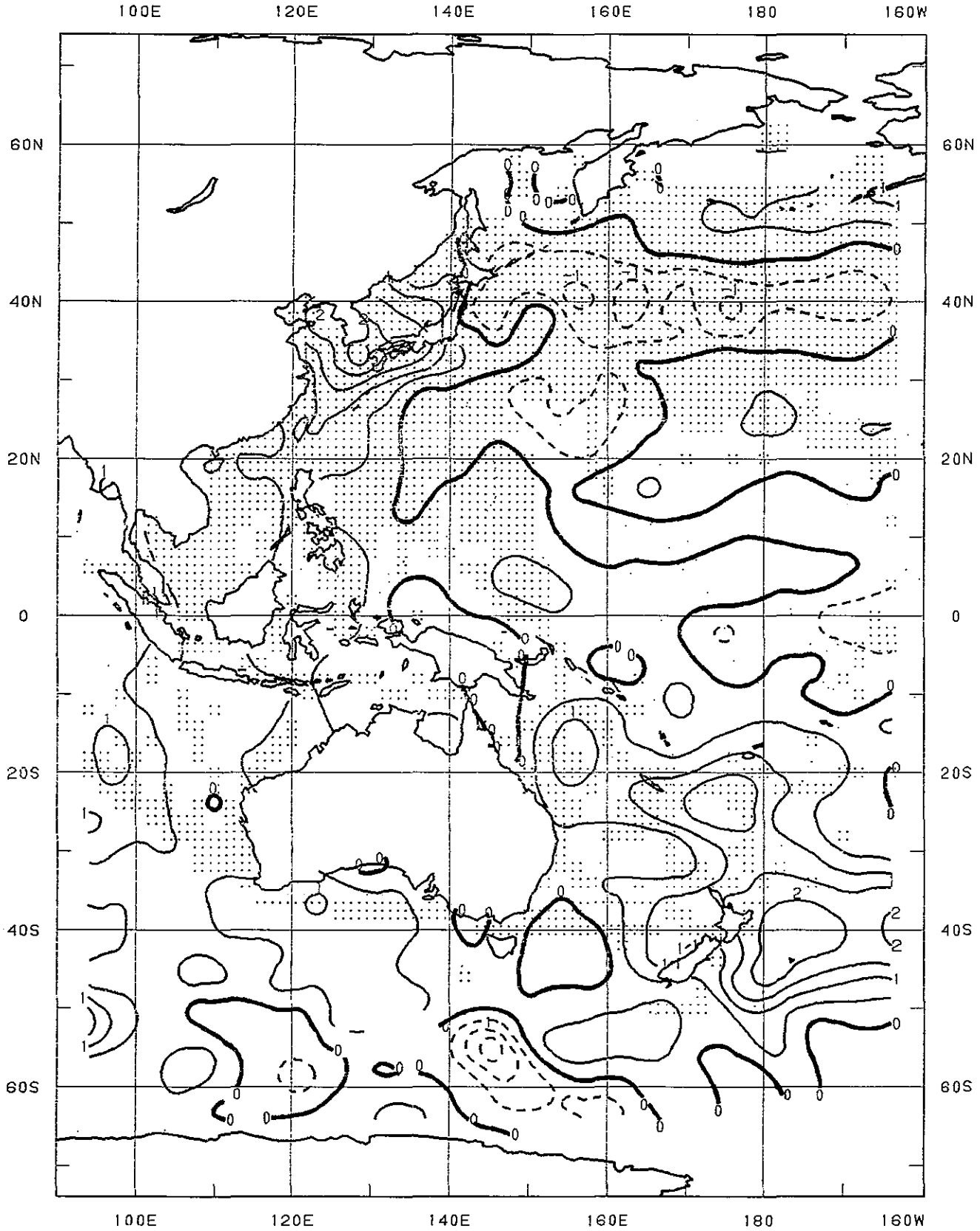
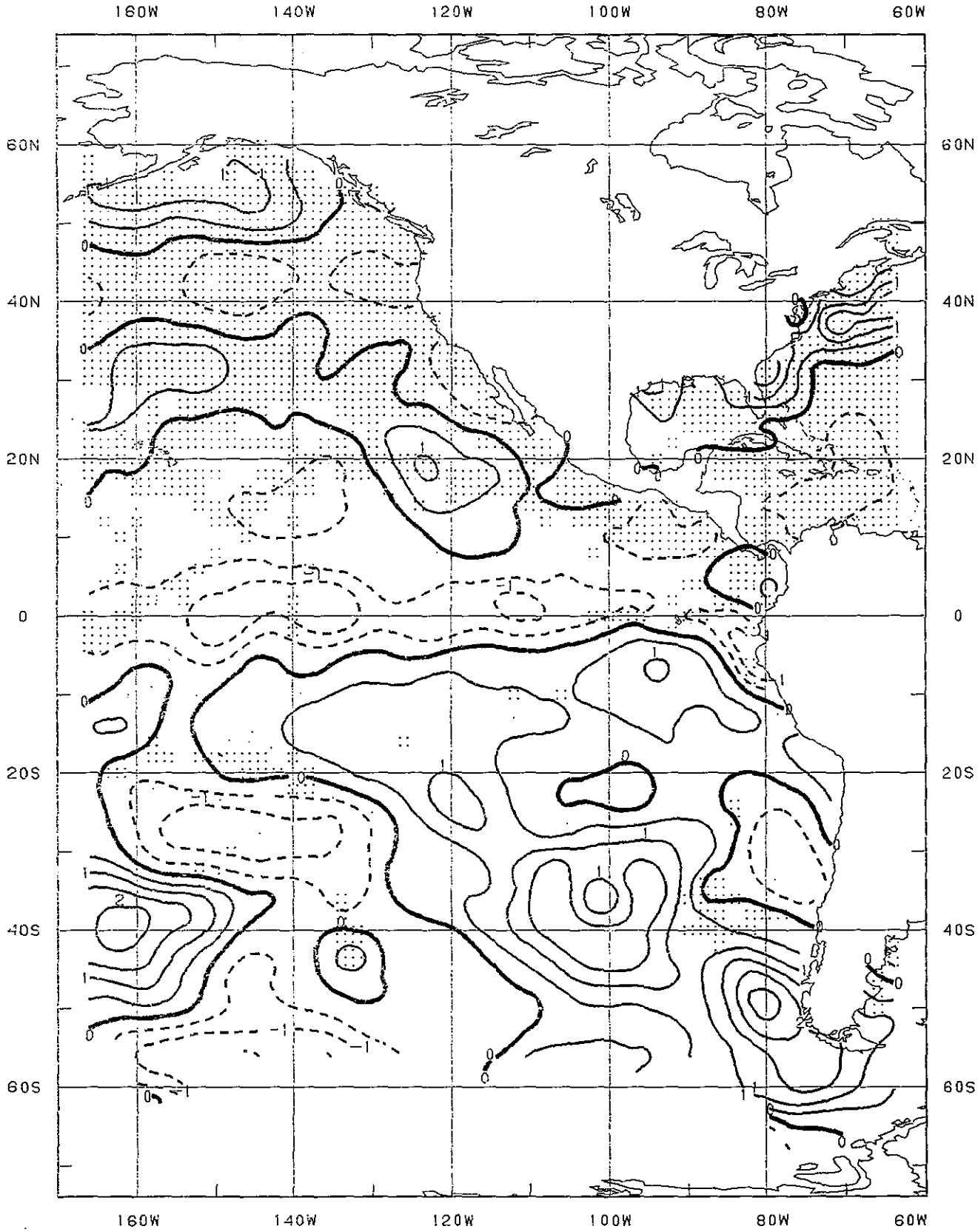


Western Pacific Ocean
SST--MONTHLY ANOMALY (°C)
SHIP, BUOY, and SATELLITE DATA
DECEMBER 1984

Monthly anomaly is the difference between the monthly mean sea surface temperature and the climatological monthly mean value. Contour line interval is 0.5°C. The stippling indicates where the analysis was fixed by the *in situ* data; contours are not shown in areas without monthly or climatological data.



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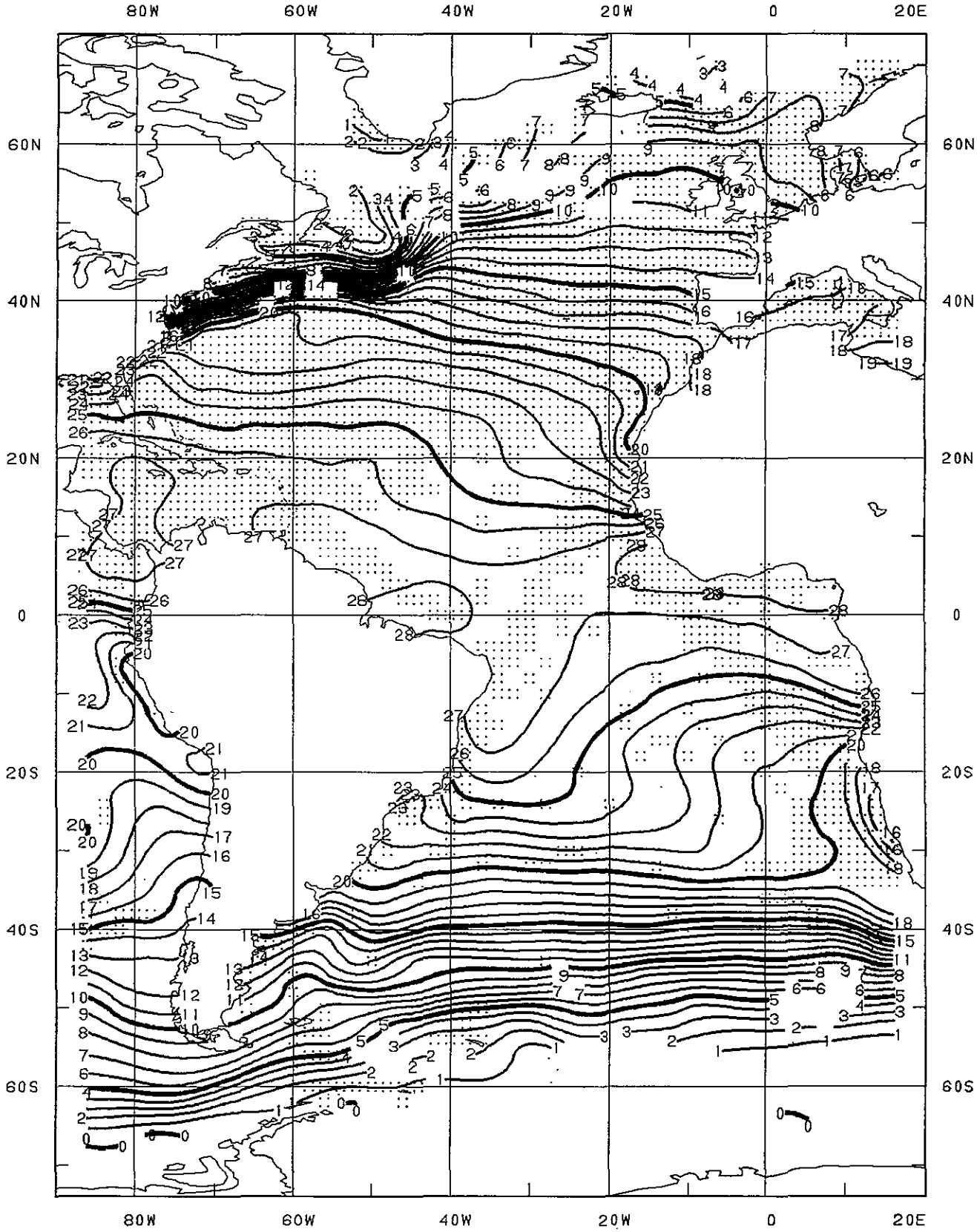

Atlantic Ocean
SST--MONTHLY MEAN (°C)
SHIP, BUOY, and SATELLITE DATA
DECEMBER 1984

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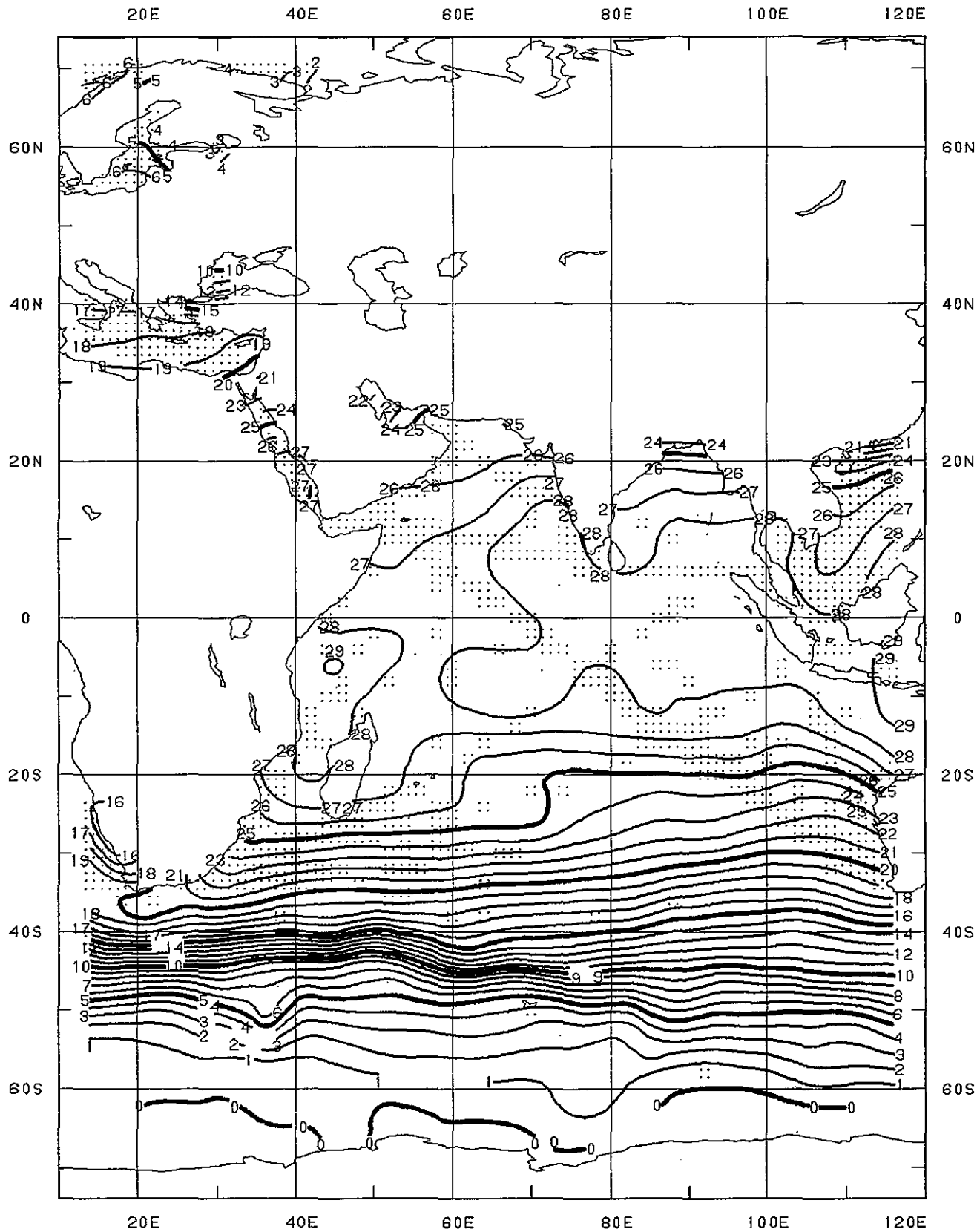

Indian Ocean
SST--MONTHLY MEAN (°C)
SHIP, BUOY, and SATELLITE DATA
DECEMBER 1984

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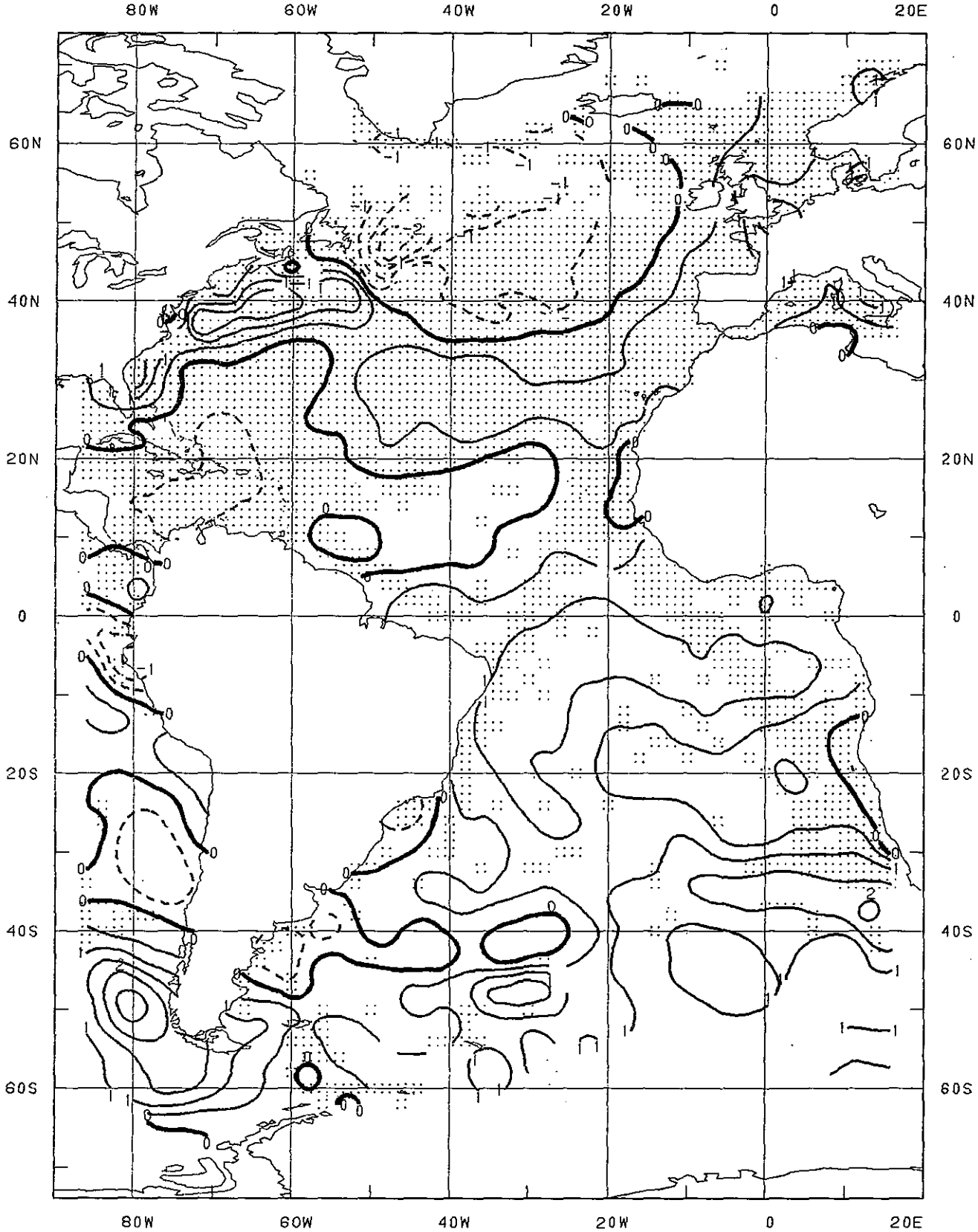

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SHIP, BUOY, and SATELLITE DATA
DECEMBER 1984

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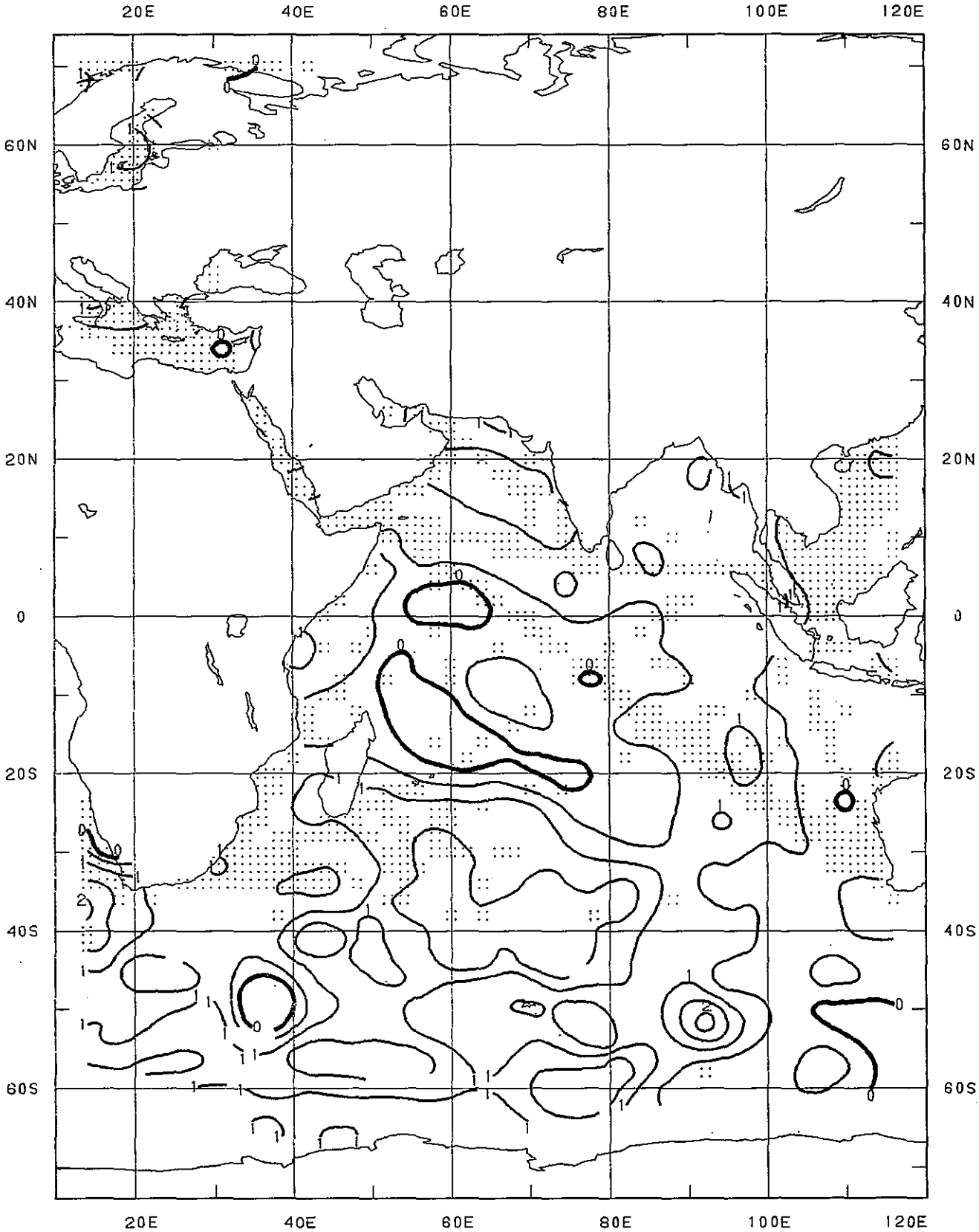

Indian Ocean
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SHIP, BUOY, and SATELLITE DATA
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NEW GLOBAL SEA SURFACE TEMPERATURE MONTHLY MEAN ANALYSIS

Highlights

- o New global analysis using both *in situ* and satellite data
- o Indian Ocean analysis included
- o Global analysis extended further south

Beginning in February 1983 a global SST analysis was presented using *in situ* (ship and buoy) data and a non-linear spatial filter (see Reynolds and Gemmill, 1984). Because the coverage from satellites is superior to the *in situ* coverage, an analysis derived from satellite observations only was added in April 1983. The two types of data were not combined because of significant differences between the *in situ* observations and the satellite retrievals. In the July 1984 *Oceanographic Monthly Summary*, the satellite field showed a negative bias relative to the *in situ* field in the tropics and a positive bias in mid-latitude. Strong (1983) reported that satellite retrievals were cooler than *in situ* observations because of aerosols injected into the atmosphere by the eruption of El Chichon in March-April 1982. Comparisons of the two analyses over the last 30 months show that although the satellite anomalies tend to be more negative than *in situ* anomalies, the differences are <u>not independent of time or location</u>.

A "blended" SST analysis has been developed using *in situ* data to define "benchmark" temperature values in regions of frequent observations and satellite data to define the "shape" of the field between these points. The blended field is found by solving Poisson's equation, $\nabla^2 T = F$, where T is the blended SST field and F is a forcing function given by the Laplacian of the satellite SST analysis, ($\nabla^2 S$); *in situ* data are used as internal boundary values at points of frequent observations. At the poleward boundaries, T is set to the *in situ* (preferred) or the satellite analysis. The resulting anomaly and mean fields are shown on pages 4-11 where the stippling indicates regions where the SST field was fixed by the *in situ* data. The use of the satellite data has allowed the analysis to be extended further south, but necessitated a change in the map projection. Studies with this new analysis suggest that the blended analysis is an improvement over the fields obtained from *in situ* data only or the satellite data only. Since the satellite data affect the field in the interior via the Laplacian, biases or trends in the satellite data can only influence the final solution through the high latitude boundary conditions. In the example above, satellite biases would impact the blended result only south of 40°S, except in the eastern South Pacific where the *in situ* fields is almost undefined.

These results suggest that the blended method may be a useful way to utilize both *in situ* and satellite data. Each monthly blended field will be monitored carefully using individual *in situ* and satellite analyses as diagnostic tools. In future months the blended method may be modified to reflect changes in either the *in situ* observations or the satellite retrievals.

Reynolds, R. W. and W. H. Gemmill, 1984: An objective global monthly mean sea surface temperature analysis. Tropical Ocean-Atmosphere Newsletter, No. 23, 4-5.

Strong, A. E., 1983: Satellite derived sea surface temperature errors due to the El Chichon aerosol cloud. Tropical Ocean-Atmosphere Newsletter, No. 18, 14-15.

SATELLITE IMAGE OF THE MONTH

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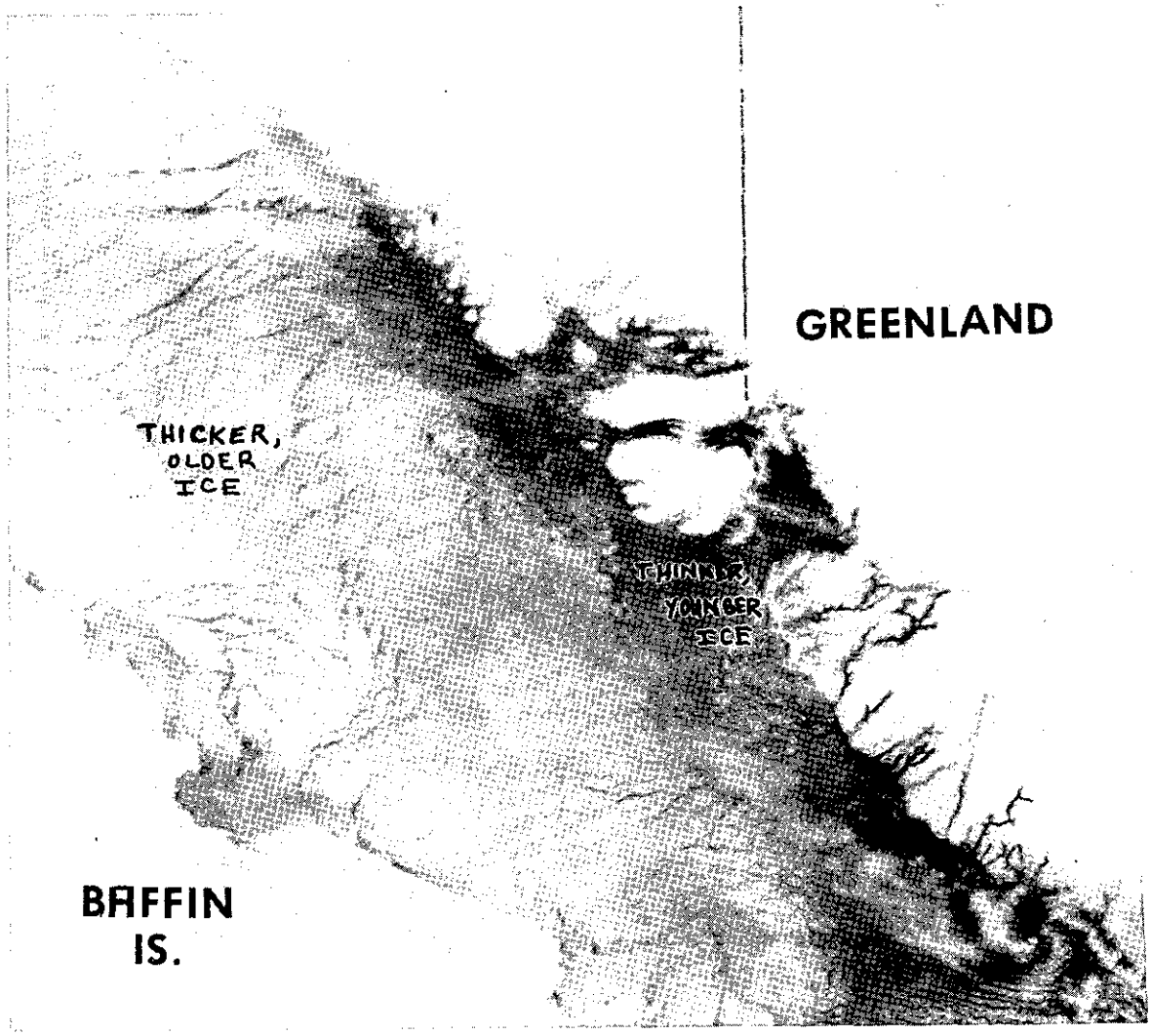
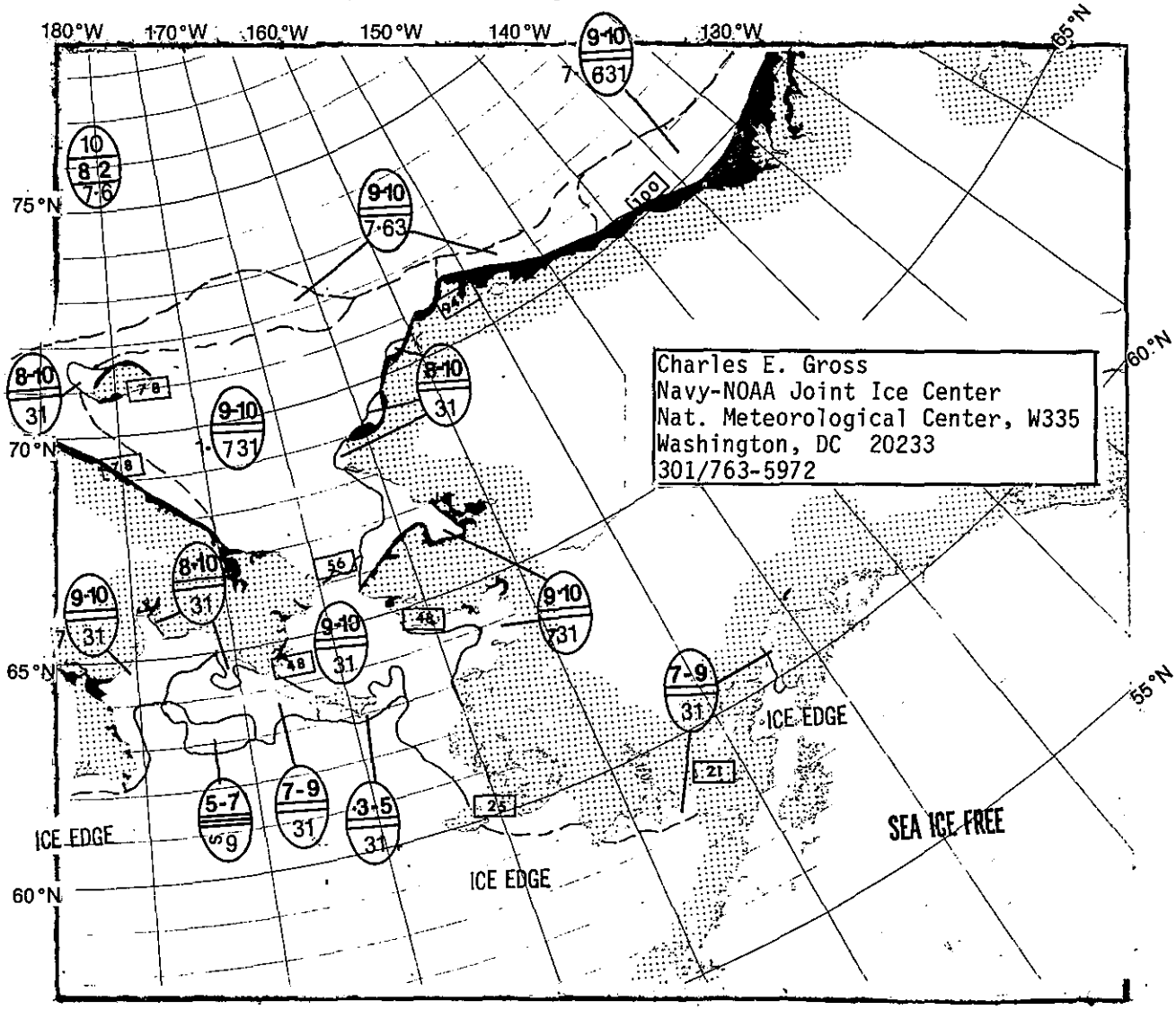
BAFFIN BAY/DAVIS STRAITS ICE FIELD

This NOAA-6 infrared satellite image of ice in the southern portion of Baffin Bay and in northern Davis Strait was taken December 21, 1984. Except for ice along the western Greenland coast, the ice field is a combination of first year medium (70-120 cm thick), first year thin (30-70 cm), young ice (10-30 cm) and new ice (0-10 cm). First year medium ice is by far the dominant ice thickness within the ice field. Along the western Greenland coast to approximately 70°N, young and new ice forms and is normally pushed off the coast by a combination of easterly flow and counterclockwise surface water circulation. Current flow along Greenland is northward, while flow along Baffin Island is toward the south. Therefore, the eastern Bay may remain relatively ice-free well into the winter ice season, while the northern and western sections retain thick ice concentrations. Ice conditions are affected by the presence of icebergs, which form from the glacial ice field along the western Greenland coast. Icebergs separate from the coast and become integrated into the surface water circulation, eventually flowing into the north Atlantic by way of the Labrador coast. Ice conditions on this date are near normal.



BERING SEA / NORTH SLOPE ICE ANALYSIS



C = Total ice concentration in the area in tenths.

C_a, C_b, C_c = Concentration of thickest (C_a), 2nd thickest (C_b), and 3rd thickest (C_c) ice

S_a, S_b, S_c = Stage of development of thickest (S_a), 2nd thickest (S_b), and 3rd thickest (S_c) ice.

~C = Concentration of ice within area(s) of strips and patches.

STAGE(S) OF DEVELOPMENT (THICKNESS)

1 = New ice (0-10 cm)
3 = Young ice (10-30 cm)
6 = First year (30-200 cm)
7 = First year thin (30-70 cm)
1. = First year medium (70-120 cm)
4. = First year thick (120-200 cm)
7. = Old ice (survived at least one summer's melt)

EXAMPLES

125 Theoretical thickness of this season's growth (cm).

Fast ice. Sea ice which forms and remains fast along the coast.

Ice boundary visually or satellite observed.

Ice boundary estimated.

DECEMBER 1984

The monthly mean sea level pressure circulation depicts a 998 mb low centered in the western Bering Sea near 57°N 170°E. Southeasterly mean surface geostrophic winds in the northern Bering Sea are observed in the monthly mean. Weekly mean sea level pressure charts depict a succession of low pressure systems transiting the Bering Sea from southwest to northeast tracking north of the Aleutian Islands and crossing the Alaskan coast near Norton Sound. This series of lows disrupted the normal northeasterly windflow pattern and are responsible for above normal air temperatures and southwesterly on-pack winds in the Bering Sea. Above normal monthly mean surface air temperatures are observed at Nome (65°N 165°W) and King Salmon (59°N 156°W). Theoretical ice thickness at Nome is at the climatological minimum and between normal and minimum at Bukhta Provideniya, USSR (64°N 173°W). The current ice edge position is near the climatological minimum in most of the Bering Sea and at a new minimum near 168°W and 179°W.

WEST COAST OCEAN FEATURES

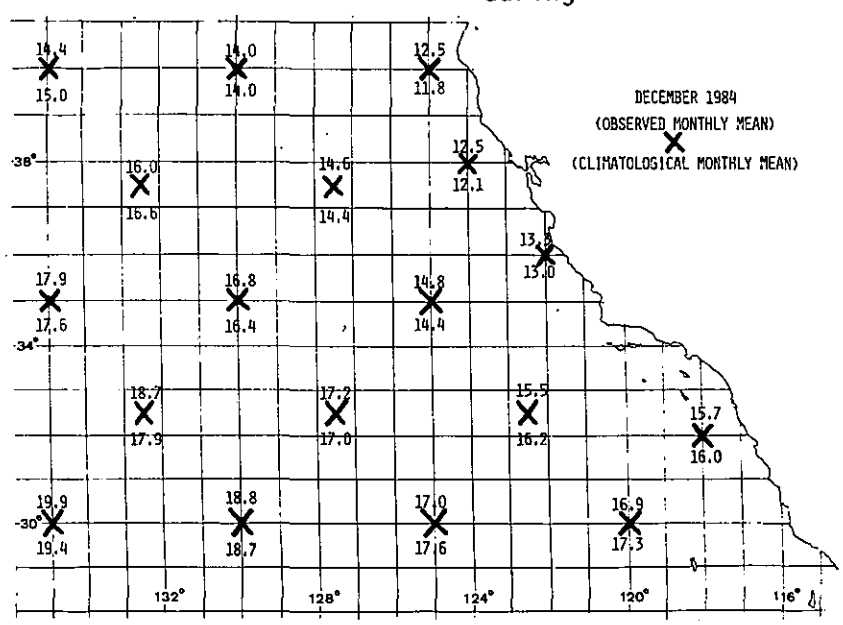
MONTHLY SST STATISTICS FOR SELECTED STATIONS
PACIFIC NORTHWEST
(Area enclosed by 40-52N, Coast-135W)

DECEMBER 1984

Station	Location (Lat/Long)	Mean SST	Standard Deviation	Maximum SST	Minimum SST	Change From Previous Month
Buoy 46005	46.1 N 131.0 W	10.1	0.4	10.7	9.5	-1.5
Buoy 46010	46.2 N 124.2 W	9.4	1.1	11.0	7.6	-2.4
Buoy 46030	40.4 N 124.5 W	10.8	0.6	12.1	9.7	N/A
Cape Disappointment	46.3 N 124.1 W	10.5	0.3	11.1	9.4	-0.1
Chetco River	42.0 N 124.3 W	11.4	0.4	12.2	11.1	+0.5

DECEMBER 1984

The rate of seasonal cooling diminished during December in the offshore ocean waters of the Pacific Northwest. Meanwhile, coastal SSTs exhibited little change during the first three weeks of the month, then cooled during the final week. This cooling was slight (less than 1°C) south of the Columbia River, but was more significant (1.5-2.0°C) north of the Columbia River, where cold northerly winds prevailed during the last few days of the month. The Davidson Current, which flows northward along the coast in winter, was evident in several satellite images that showed cold Columbia River runoff flowing northward along the Washington coast. SSTs in this cold band reached as low as 8°C near the end of the month. In offshore waters, negative SST anomalies as high as -2°C continued west of 130°W. Winds were lighter than normal, and weather systems were relatively weak during December.



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Bin C15700
Seattle, WA 98115
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South Panel
Ernest Daghir
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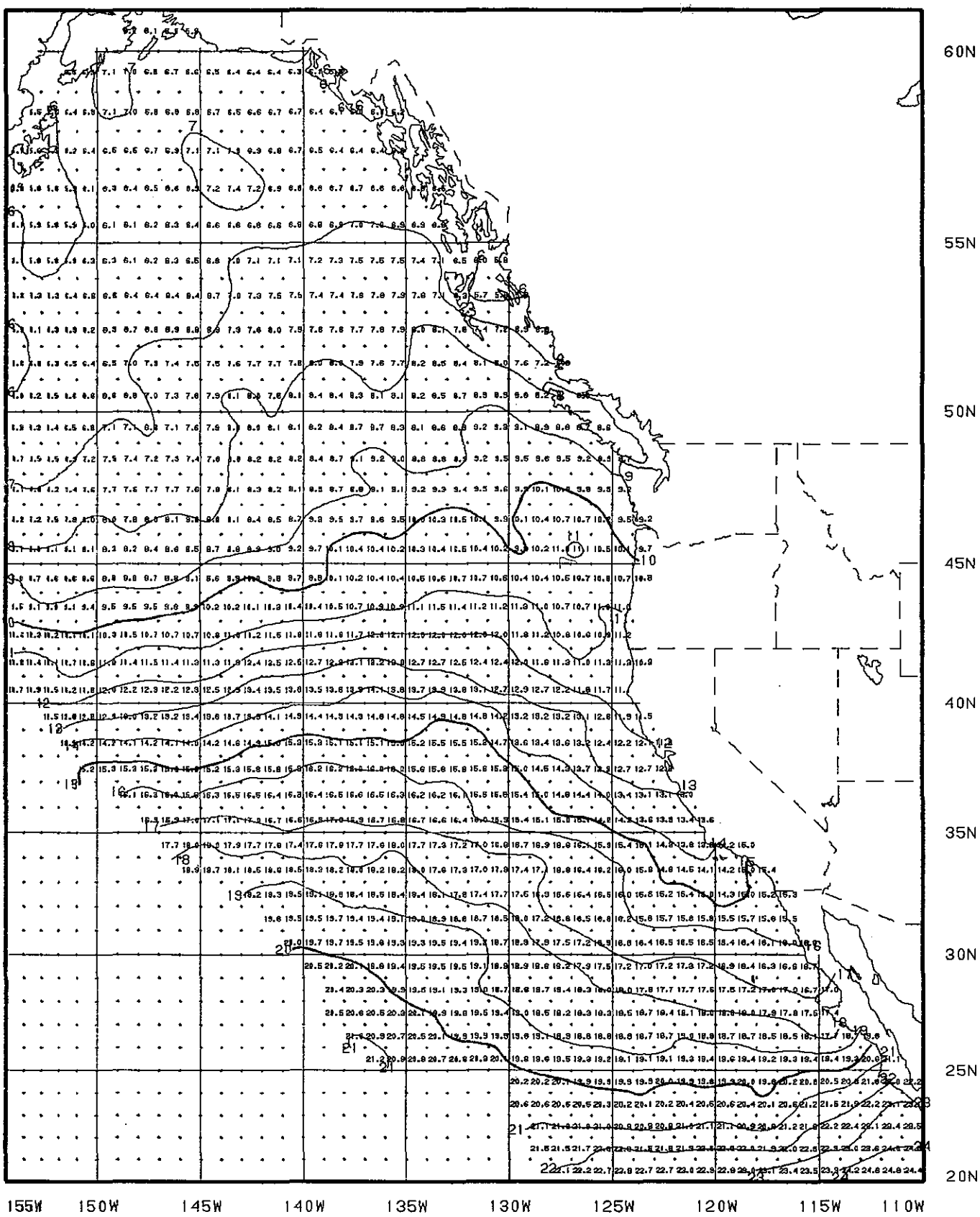
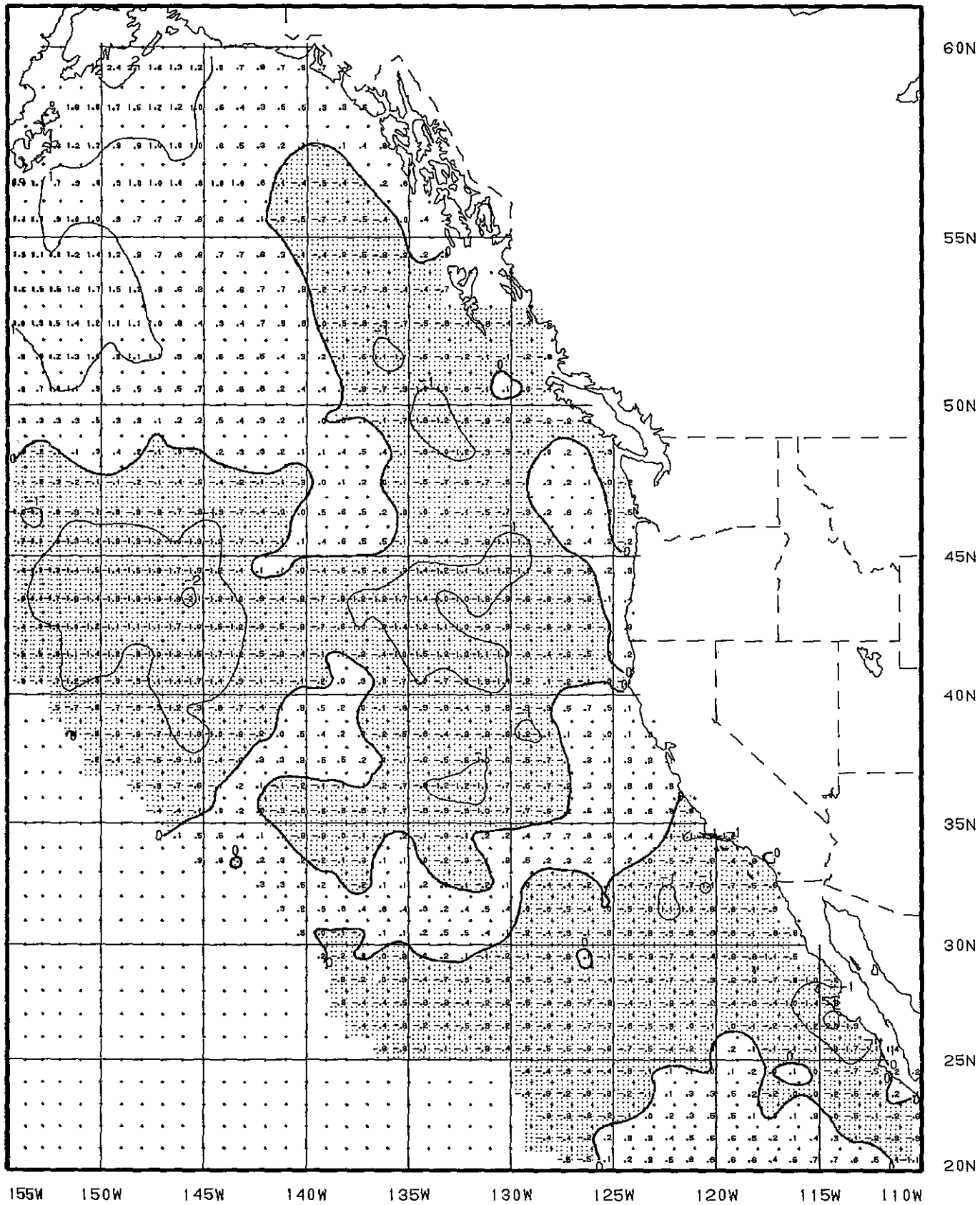
Satellite Field Service Station
660 Price Avenue
Redwood City, CA 94063
(415) 364-2422

The seasonal cooling of waters off the California coast was evident in all areas during December. Average mean SSTs over the South Panel were normal (15.9°C) for the first time in many months. SSTs in the nearshore and offshore waters decreased between 1.0° and 2.2°C when compared to November. The two areas of maximum cooling were centered at 39°N 131°W and 32°30N 118°W. Minimum cooling occurred alongshore from Pt. Arena to Pt. Conception. The northwest and southeast corners of the chart were below normal by about 0.6°C, while the northeast and southwest corners of the chart were above normal by about 0.7°C. A storm system around the middle of the month brought an outbreak of cold air into California; the result was a mean decrease of 0.5°C between the analysis prepared on December 14 and 18. After December 18, SSTs decreased more gradually.



West Coast
SST--MONTHLY MEAN (°C)
December 1984

Monthly mean sea surface temperature is the mean of twice-weekly analyses using ship, buoy, and satellite observations. Contour line interval is 1.0°C.



West Coast
SST--MONTHLY ANOMALY (°C)
December 1984

Monthly anomaly is the difference between the monthly mean sea surface temperature and the climatological monthly mean value -- shading shows where the monthly mean is colder than climatology. Contour line interval is 1.0°C.

The end of this month's positions of the Gulf Stream System and its associated eddies are shown for the NW Atlantic and the Gulf of Mexico. The Gulf Stream and Loop Current boundaries are located by infrared satellite imagery or XBT (expendable bathythermograph) data. Anticyclonic eddies are labeled a-z in the Gulf of Mexico and 1-99 in the NW Atlantic. Cyclonic eddies are labeled A-Z. Arrows on eddies indicate direction of circulation. Warm-core or anticyclonic eddies rotate clockwise; cold-core or cyclonic eddies rotate counterclockwise. The line to the eddy center shows the net translation since last month or since last observed. Eddies or sections of the Gulf

EAST COAST OCEAN FEATURES

Stream System which were not observed during the month are not shown on the analysis chart. The long arrows at the bottom of the chart indicate the date of data used.

Data used in this analysis include:
- NOAA satellite infrared imagery, NESDIS
- Bathythermograph data, National Meteorological Center of National Weather Service
- Oceanographic Analysis, A daily detailed analysis issued by National Weather Service/NESDIS

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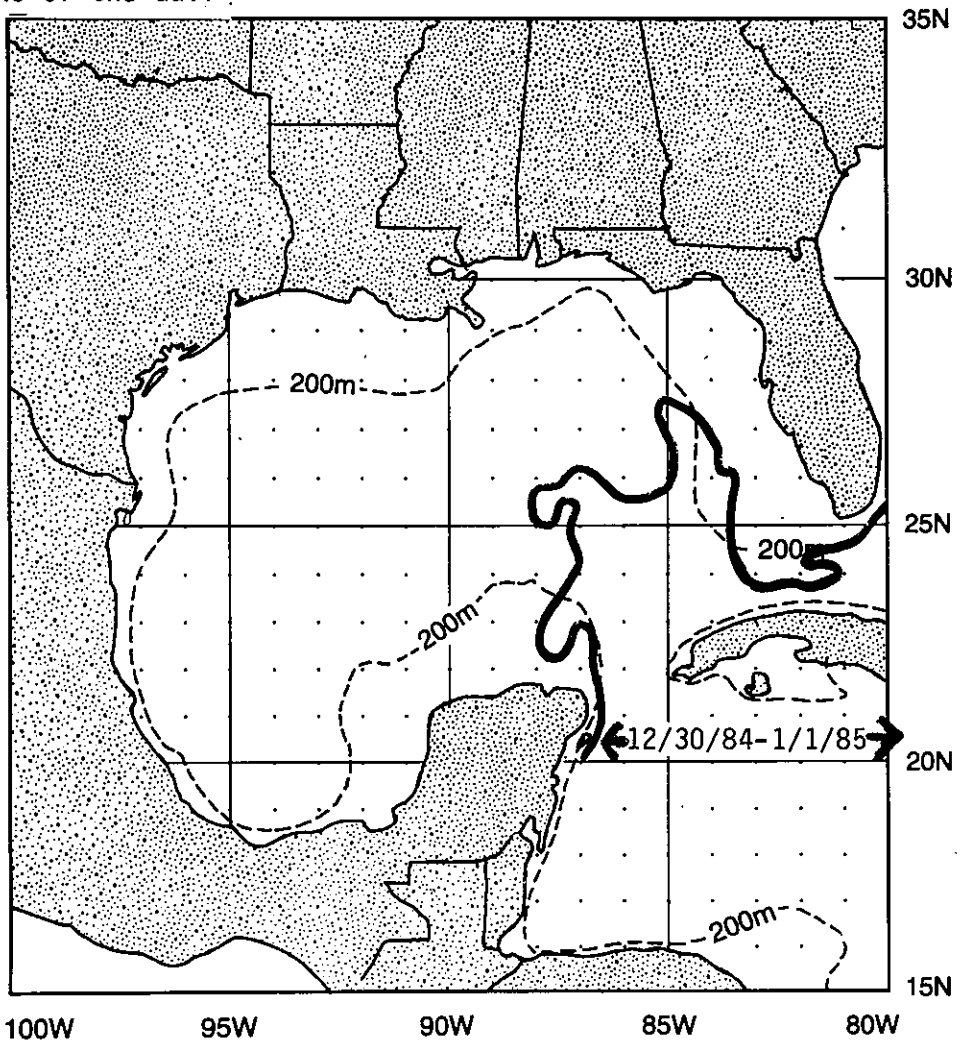
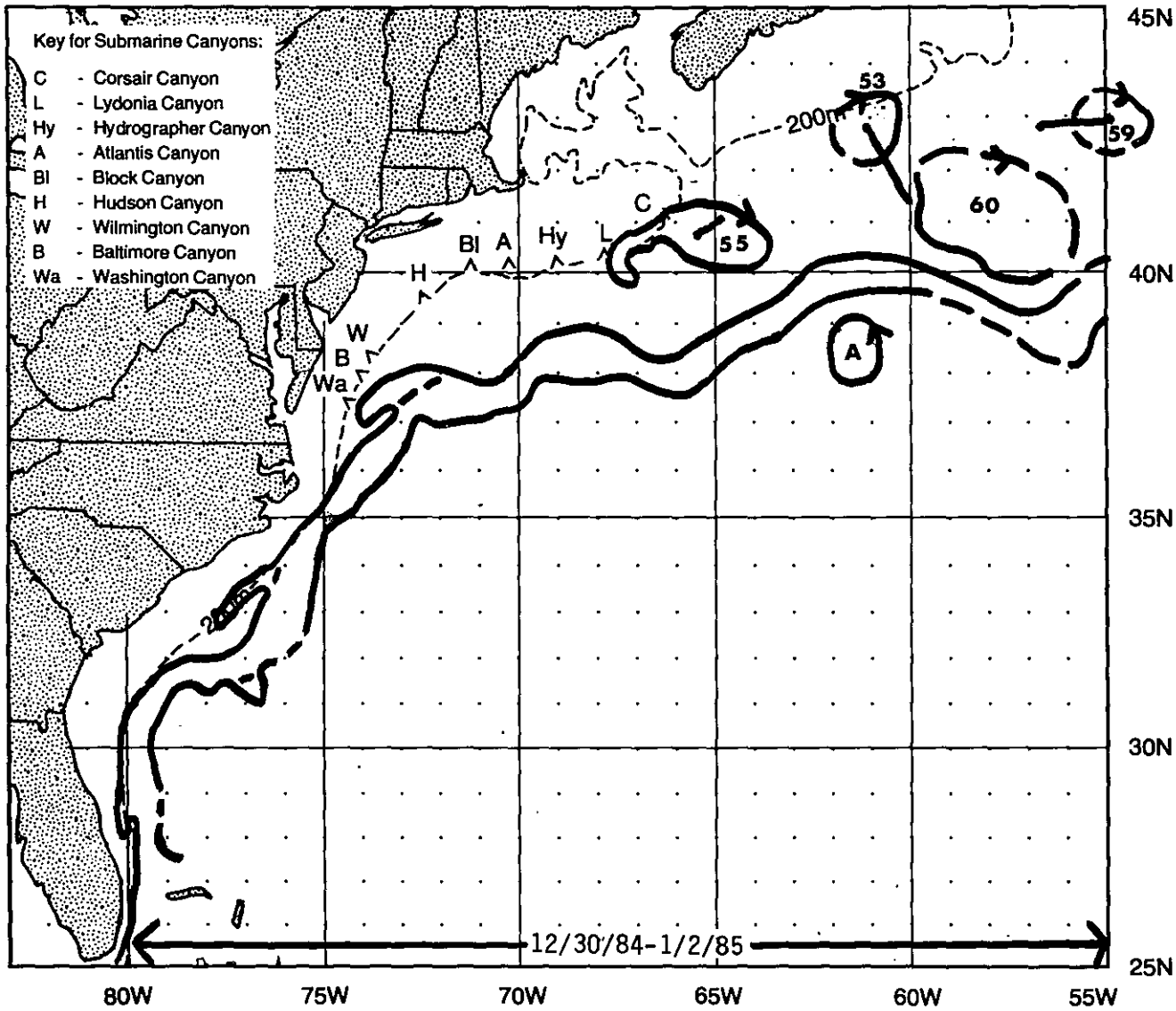


DECEMBER 1984

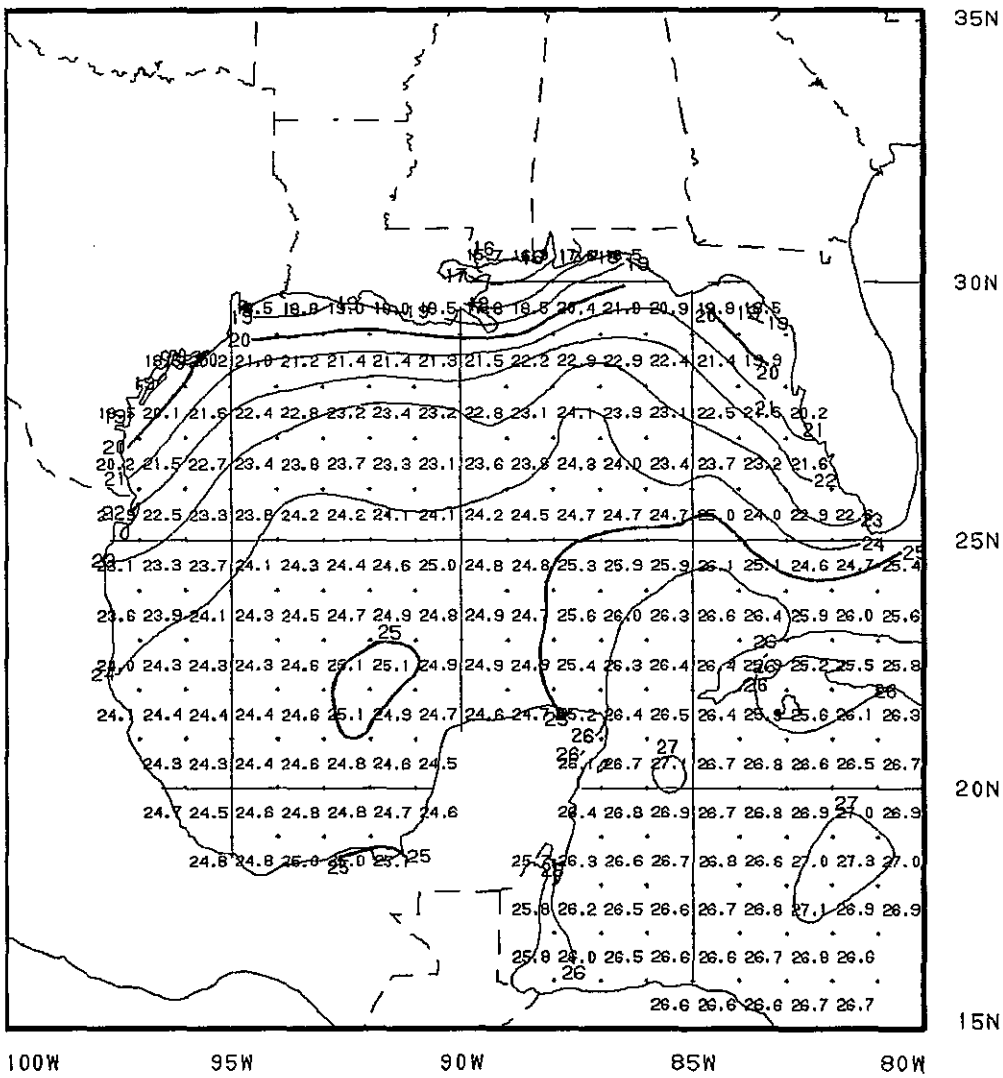
The amplitude of the Loop Current at the end-of-December shows a slight decrease compared to the end-of-November position.



One anticyclonic eddy formed and one anticyclonic eddy apparently was absorbed during the month. Eddy 60 apparently formed from the Gulf Stream near 40°N 55°30W on December 17. Eddy 54 was not observed during the month. Eddy 54 is suspected to have been absorbed by a Gulf Stream meander near 42°N 57°30W on December 11. Eddy 55 moved 55 Km SW. Eddy 53 translated 165 Km NW. Eddy 59 traveled 150 Km E.

One cyclonic eddy formed during December. Eddy A apparently pinched off from the Gulf Stream near 38°30N 62°30W on December 17. Eddy X was not observed during the month.

EAST COAST SST-
MONTHLY MEAN



Mexico
THLY MEAN (°C)
1984

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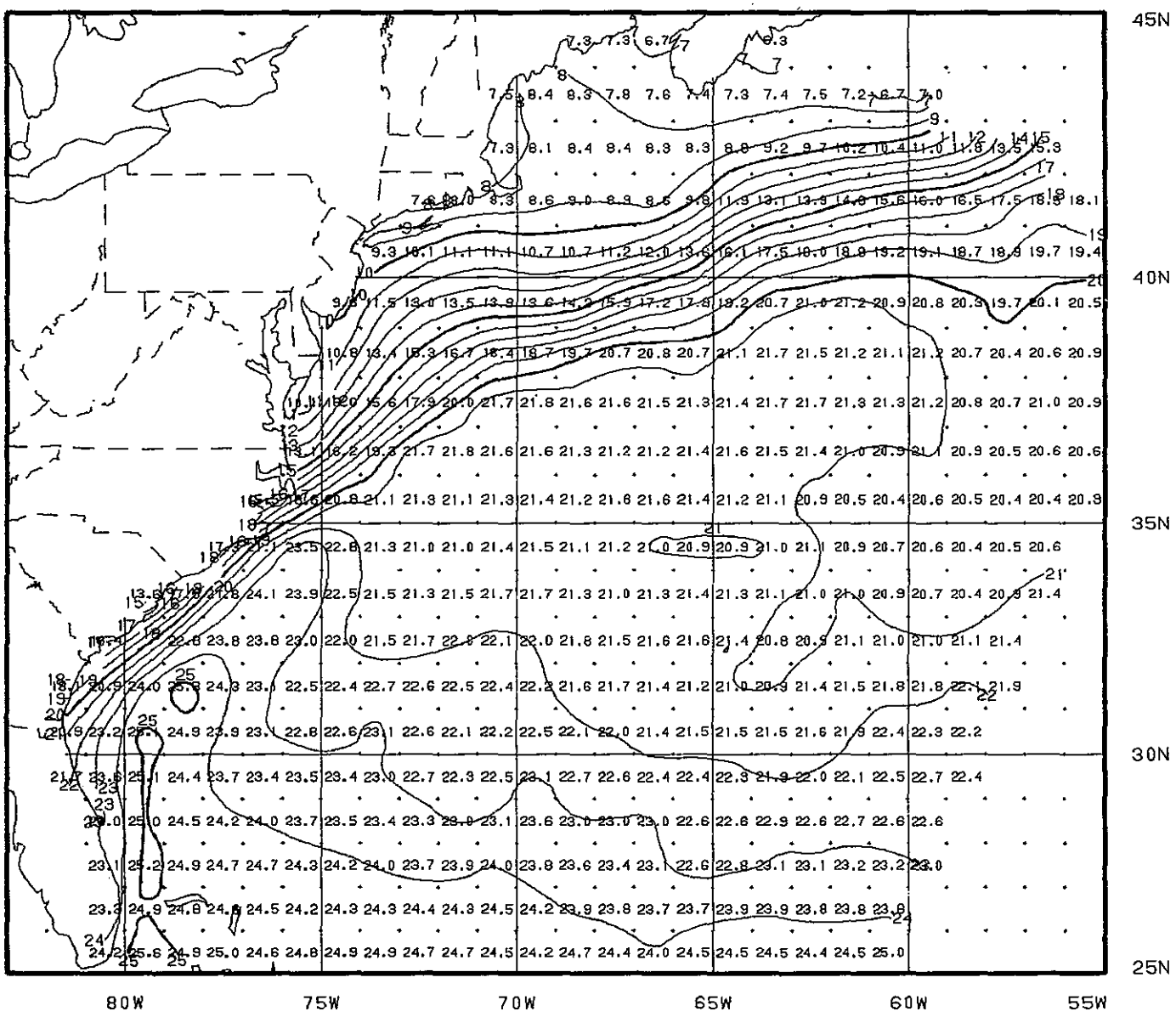

NW Atlantic Ocean
SST--MONTHLY MEAN (°C)
December 1984

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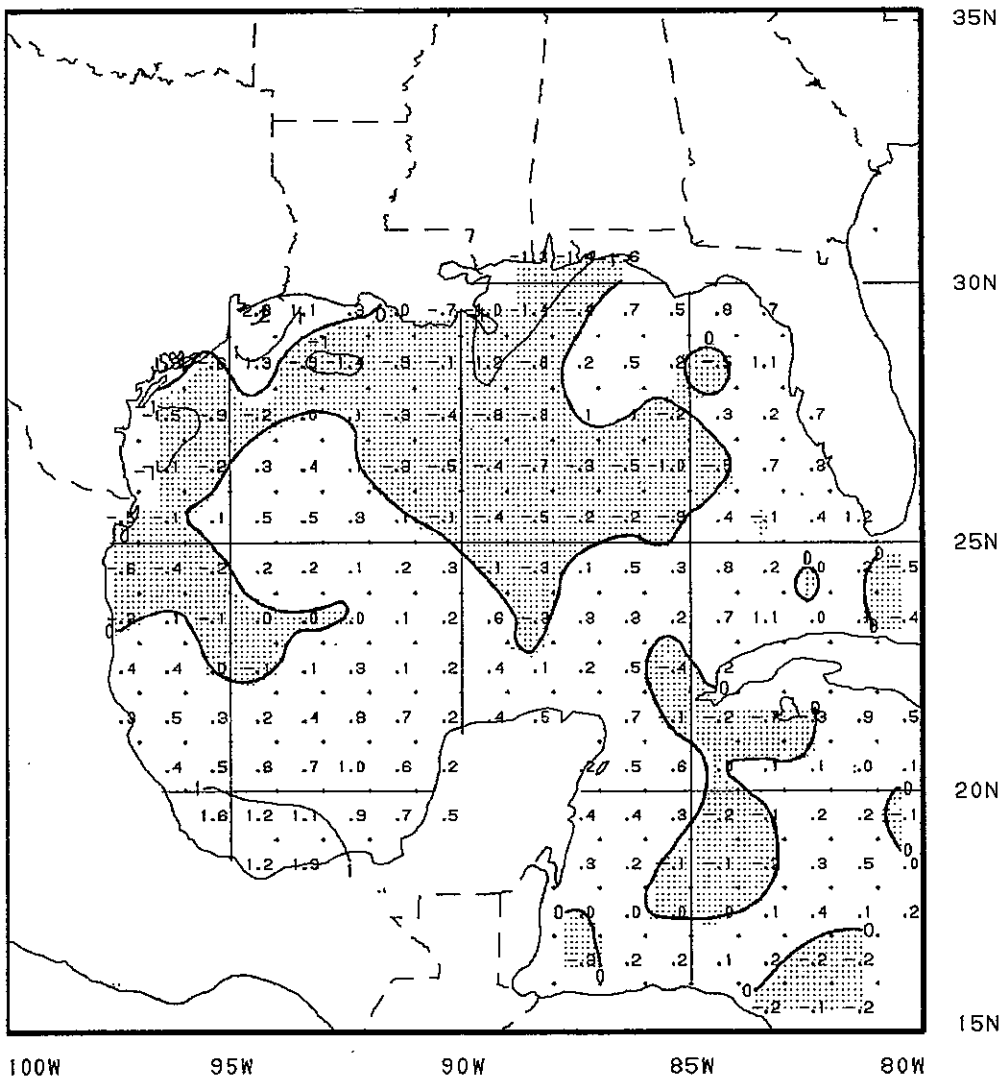
EAST COAST SST-ANOMALY



Gulf of Mexico
SST--MONTHLY ANOMALY (°C)
December 1984

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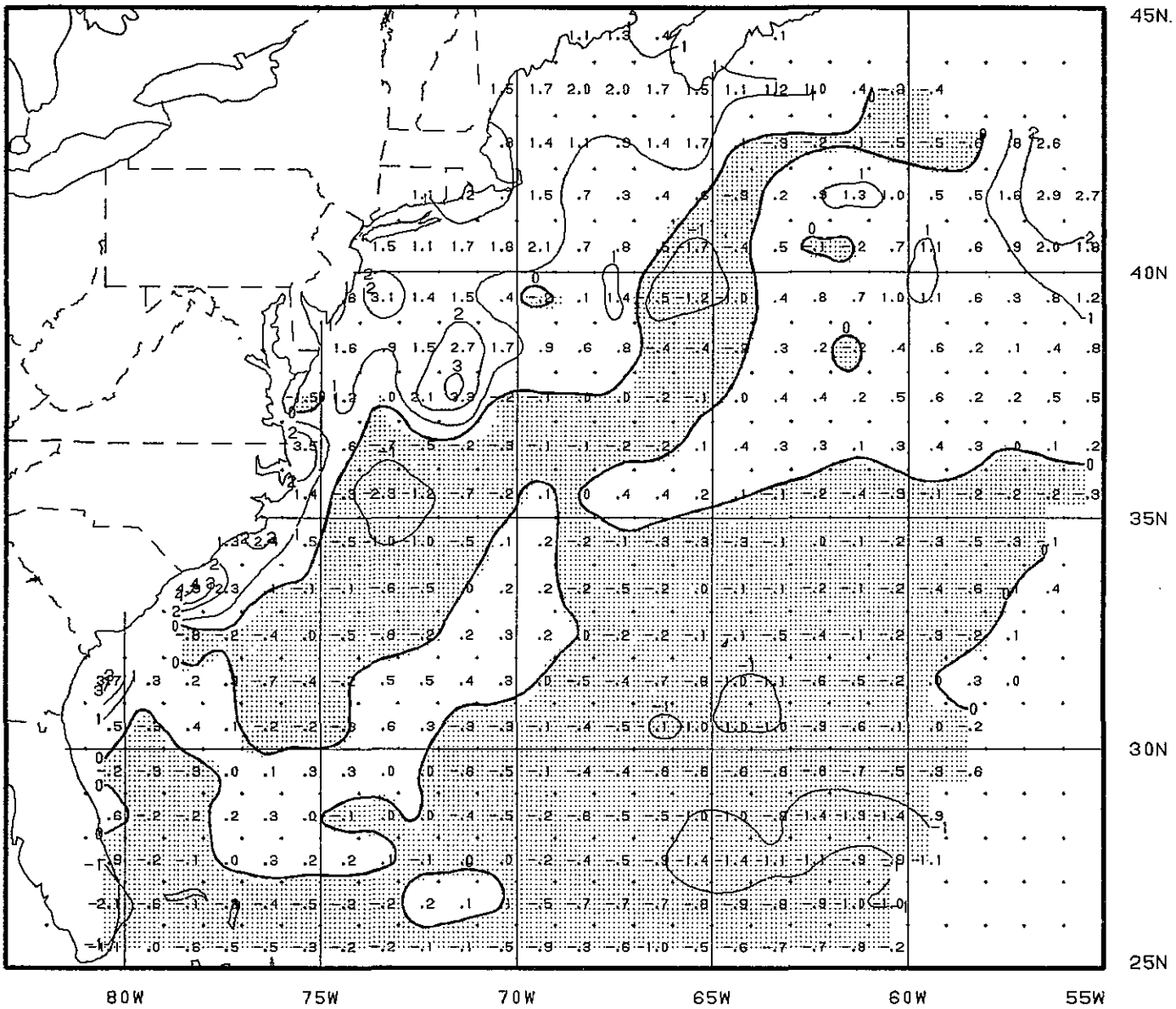

NW Atlantic Ocean
SST--MONTHLY ANOMALY (°C)
December 1984

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