

Research Paper No.2

to

Office of Naval Research

**Cumulative Paths of Typhoons
by Storm Years
1950 - 1994**

ONR Grant N00014-J-1136

STORM DATA PROJECT

T. Theodore Fujita, PI

**Department of Geophysical Sciences
University of Chicago**

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Section One

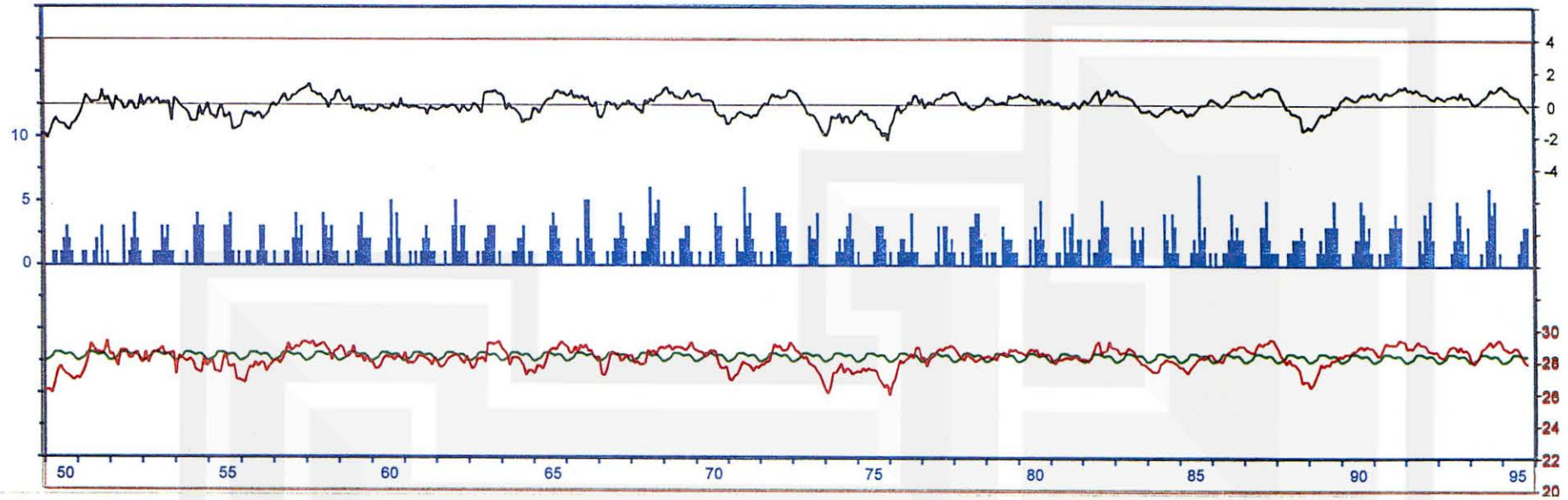
Definition of the Storm Year

Both hurricanes and typhoons do not know when a Calendar year begins and ends. It is because their activities are closely related, not to the equator crossing of the sun, but to the sea-surface temperature in their spawning areas. Daily counts of storm formations reveal that September is the peak activity month of hurricanes while August is the peak month of typhoon activities.

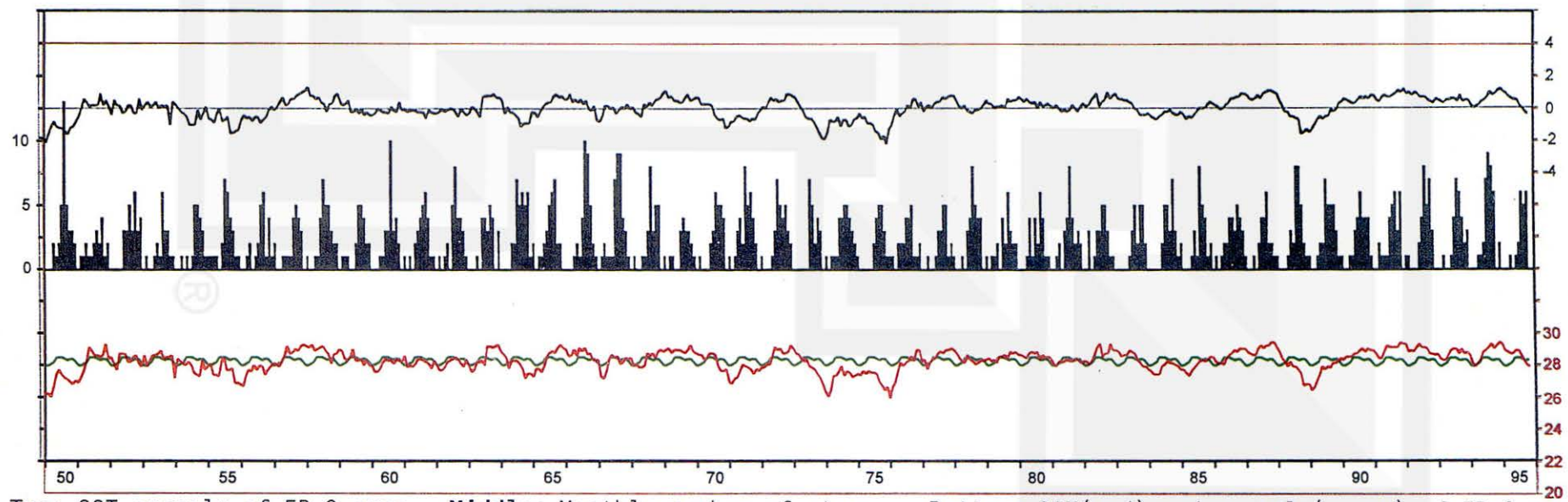
On the other hand, the least activity month of hurricanes is March while that of typhoons is February. In view of the fact that the combined minimum activities of both typhoons and hurricanes are expected to occur during the months of February and March, the **End of February** was chosen to be the changeover date of two consecutive storm years. (Refer to the typhoon frequencies by date presented on page 3).



S+TYPHOONS in 45 years (1950 - Oct.95)



ALL TYPHOONS in 45 years (1950 - Oct.95)



Top: SST anomaly of EP-3 area. Middle: Monthly number of storms. Bottom: SST(red) and anomaly(green) of EP-3 area.

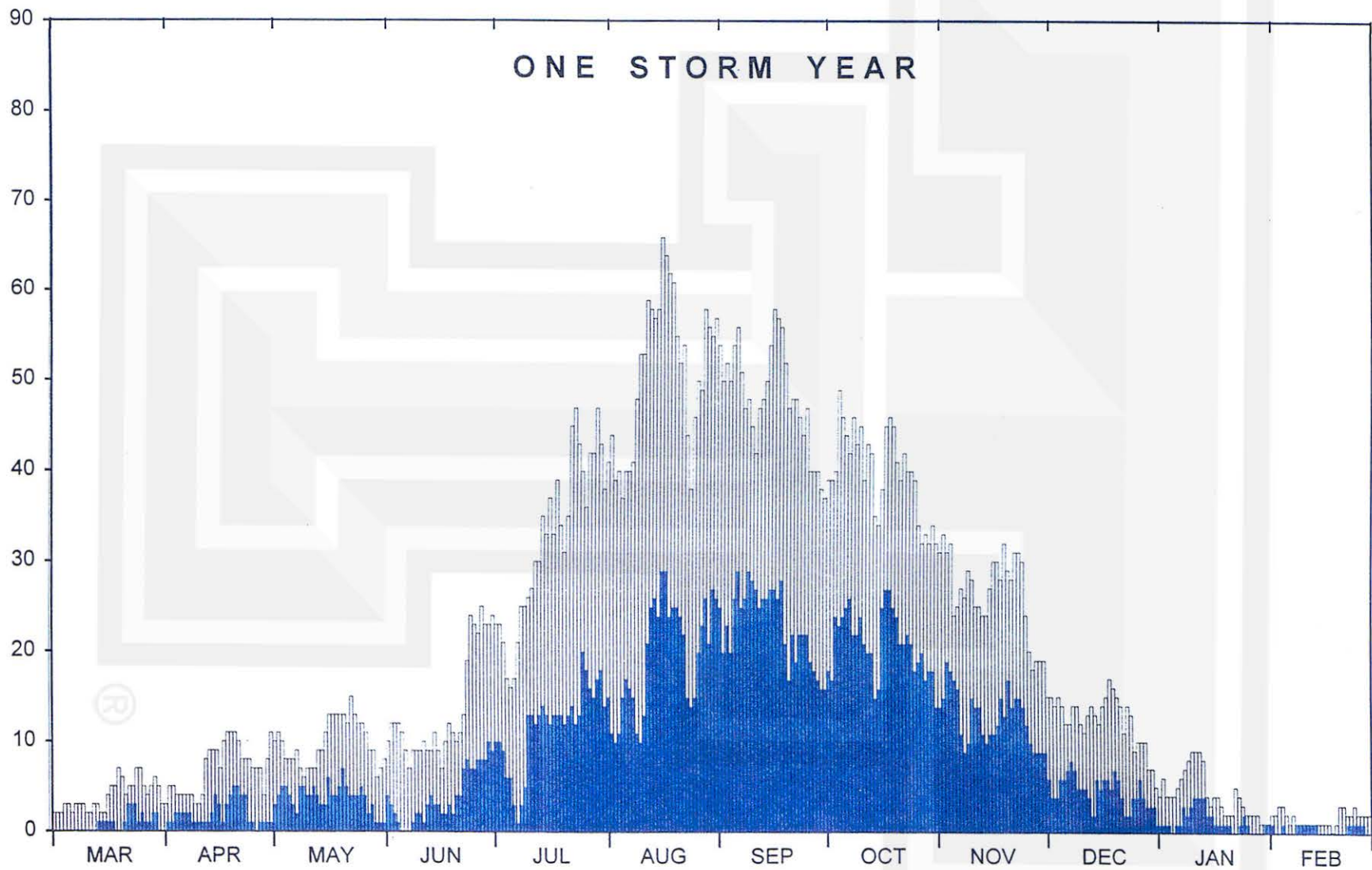
Section Two

Monthly Number of Typhoons vs. EP-3 SST Anomaly

As has been shown in Figure 2 of the **SPECIAL REPORT** dated November 1995, S+typhoon frequencies increase with the SST anomaly in the EP-3 area. However, the time plots of the frequencies of both S+typhoons and all typhoons on page 5 present practically no visible relationship. It is necessary to examine with extreme care the spatial distribution of the composite paths of typhoons in each storm year.

The purpose of this paper is to provide the evidence of the year-to-year variations of typhoon activities recorded accurately by Japan Meteorological Agency during the past 45 years, 1950-1994.





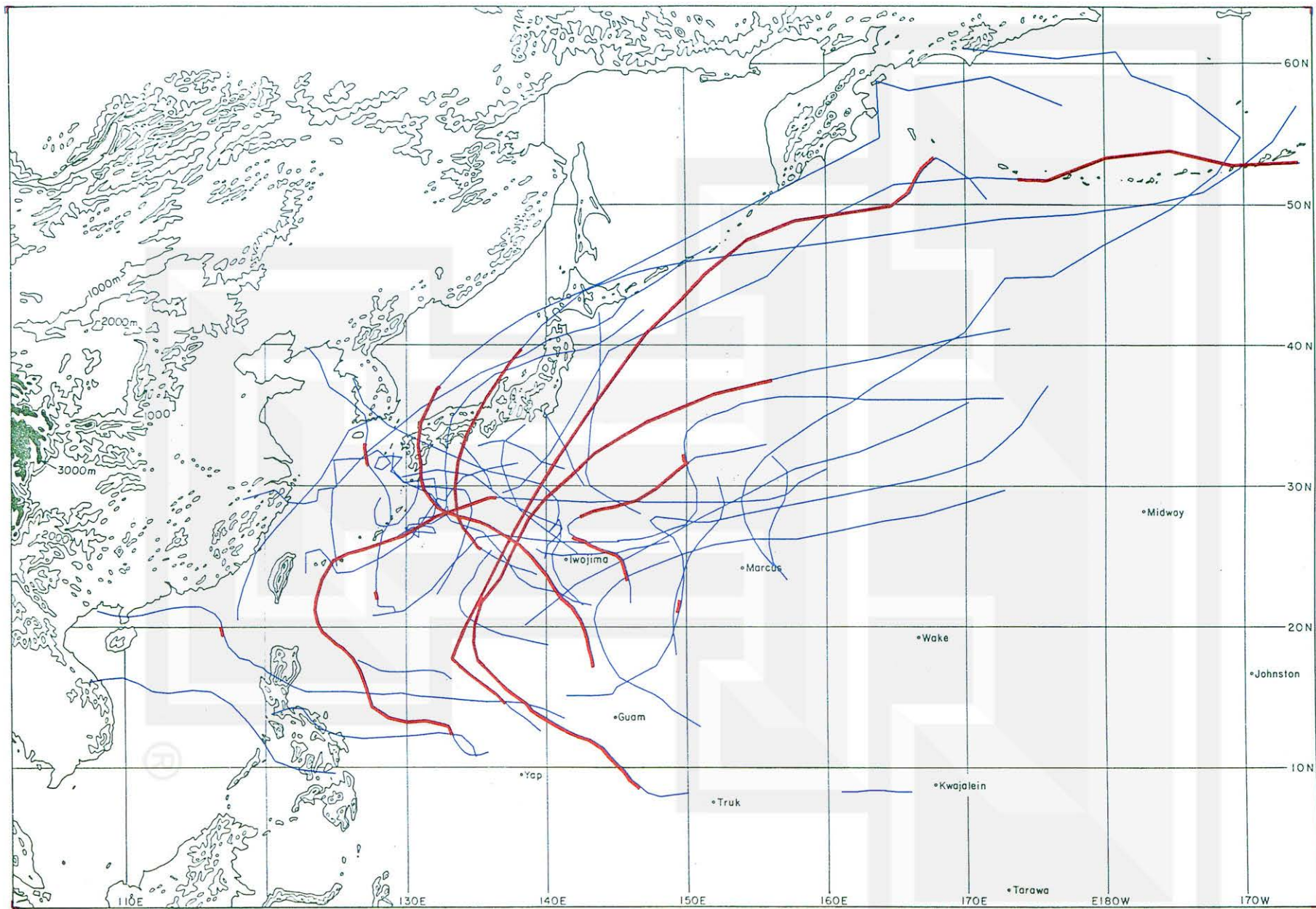
Daily counts of typhoons (black bar), and S+typhoons (blue area) during the 45 years, 1950-1994. The total number of typhoons used was 1231 and that of S+typhoons, 683.

Section Three

Cumulative Paths of Typhoons and S+Typhoons by Storm Year

Presented in the following 45 maps are the paths of all typhoons (blue) and S+typhoons (red) by storm year during the period 1950 through 1994.



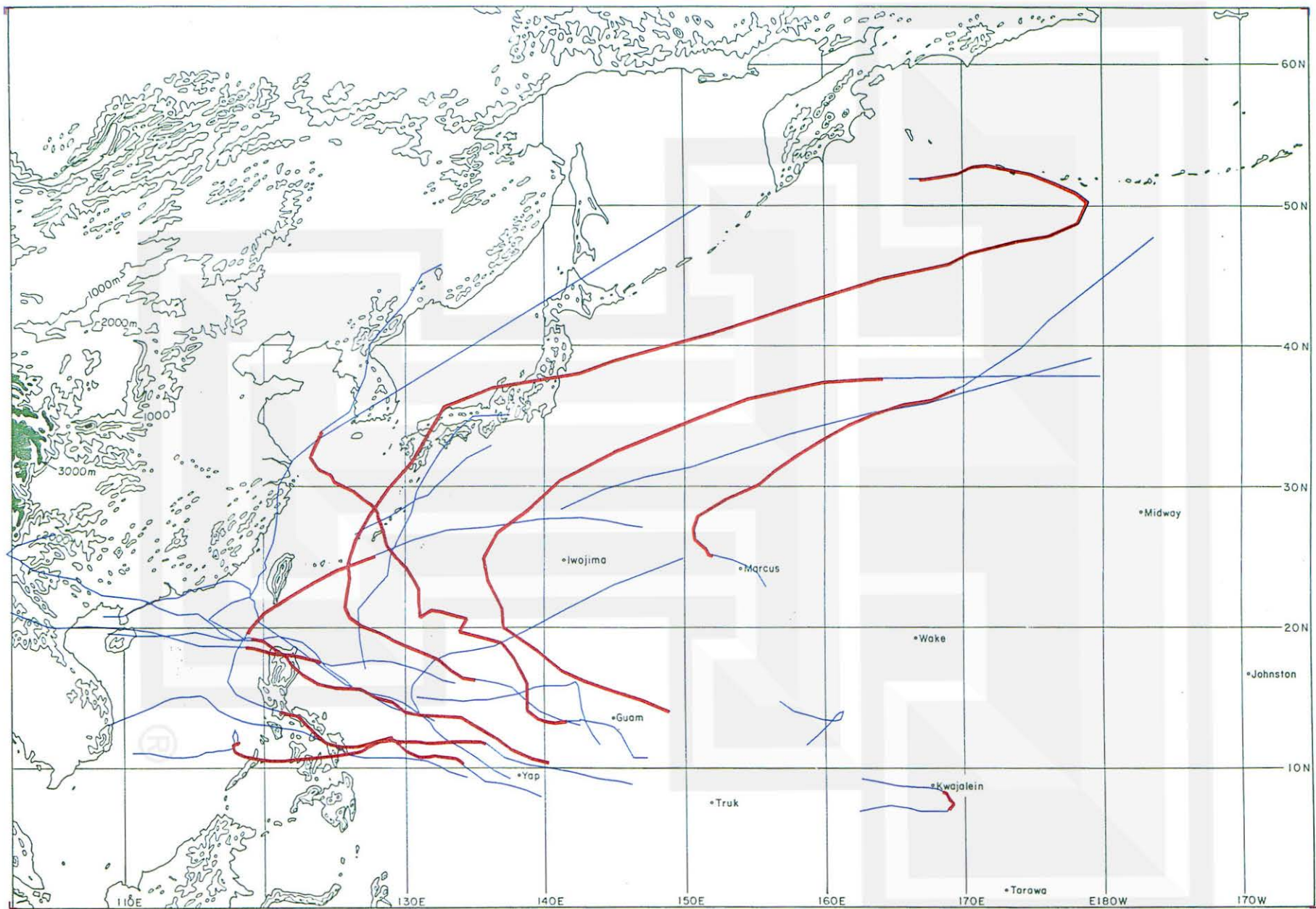


Storm Year: **1950**

EP-3 (Jul-Dec) SST Anomaly: **-1.3°C**

Number of All Typhoons: **37**

S+Typhoons: **11**

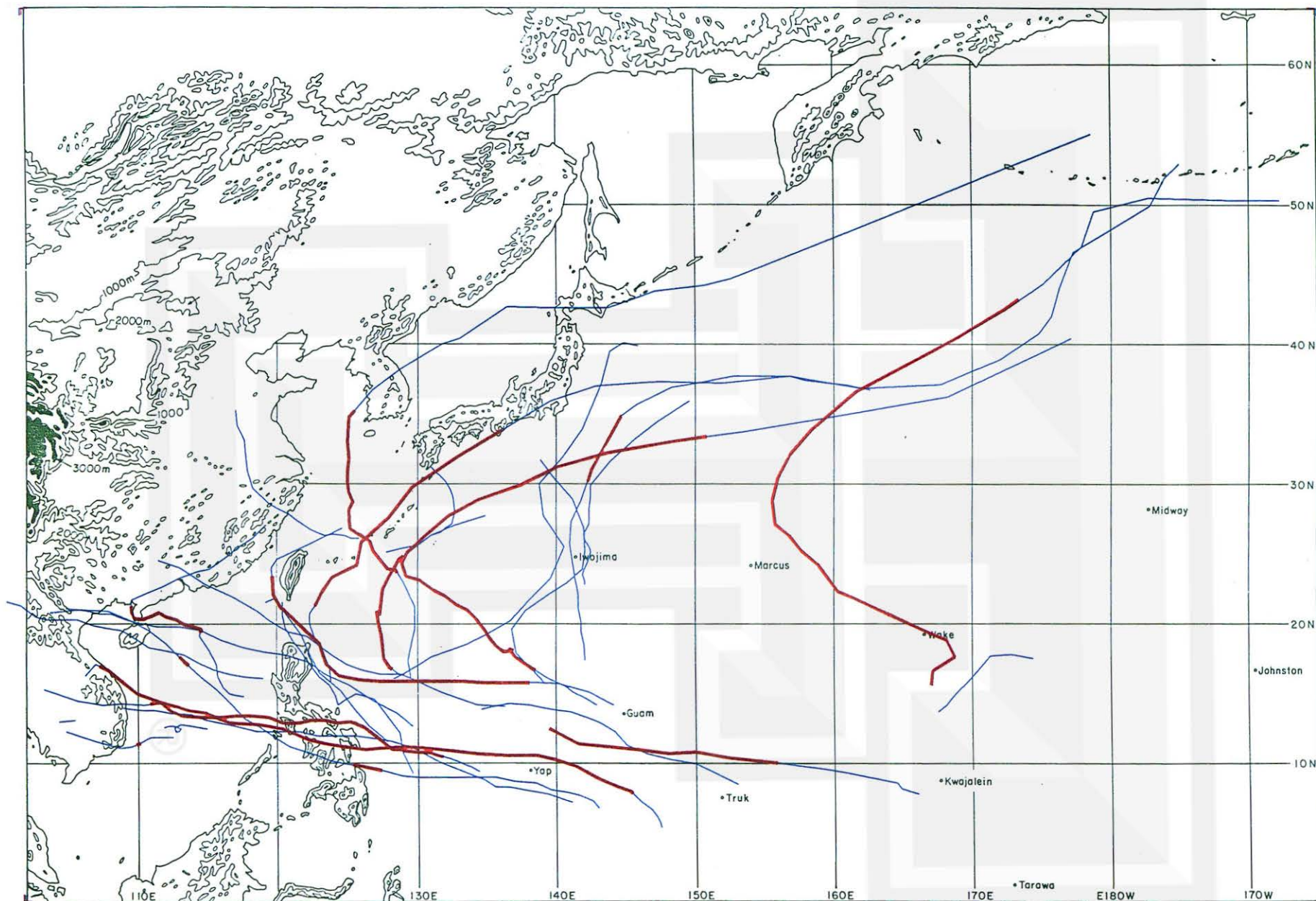


Storm Year: **1951**

EP-3 (Jul-Dec) SST Anomaly: **+0.3°C**

Number of All Typhoons: **19**

S+Typhoons: **9**

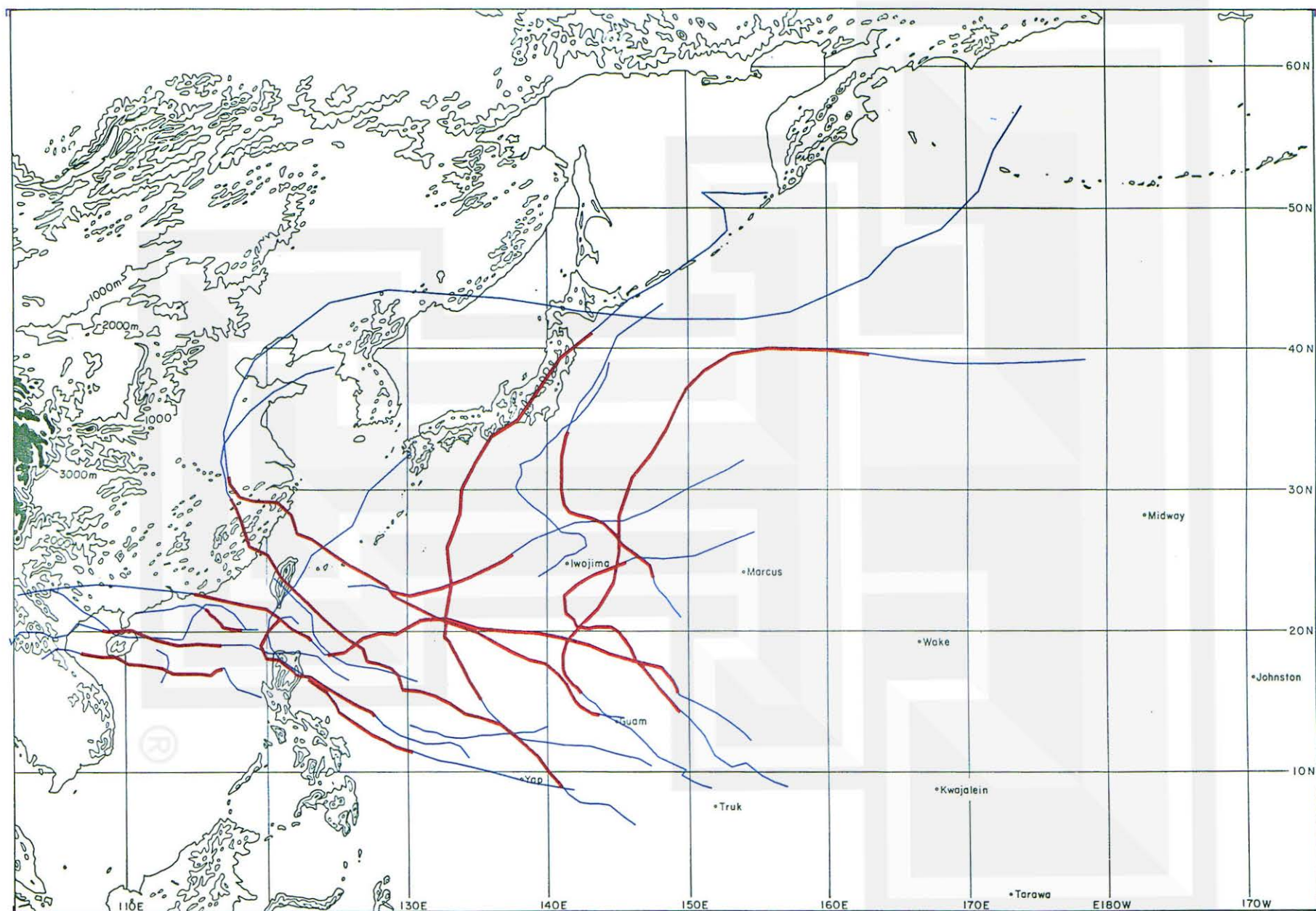


Storm Year: **1952**

EP-3 (Jul-Dec) SST Anomaly: **-0.1°C**

Number of All Typhoons: **28**

S+Typhoons: **13**

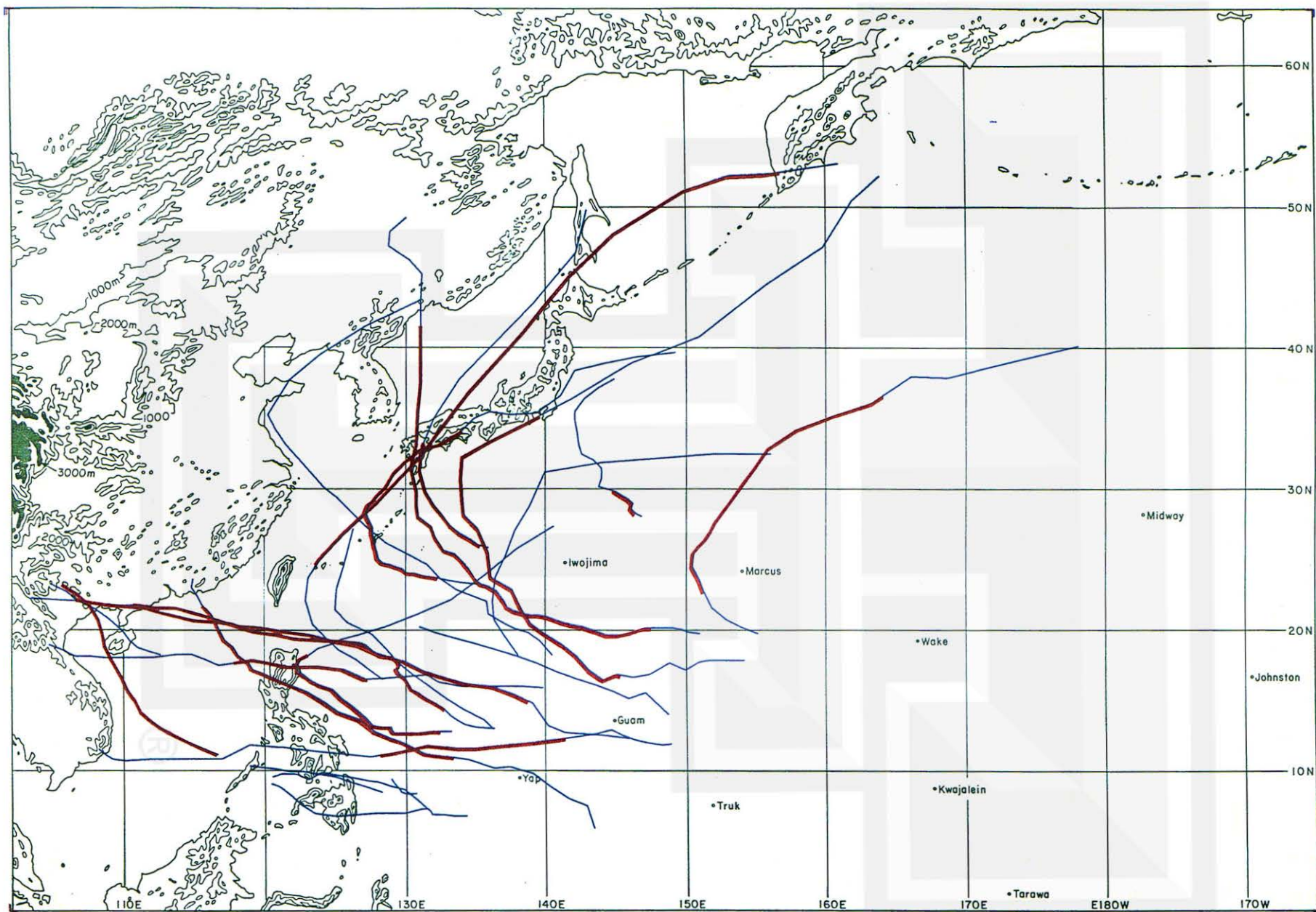


Storm Year: **1953**

EP-3 (Jul-Dec) SST Anomaly: **0.0°C**

Number of All Typhoons: **18**

S+Typhoons: **13**

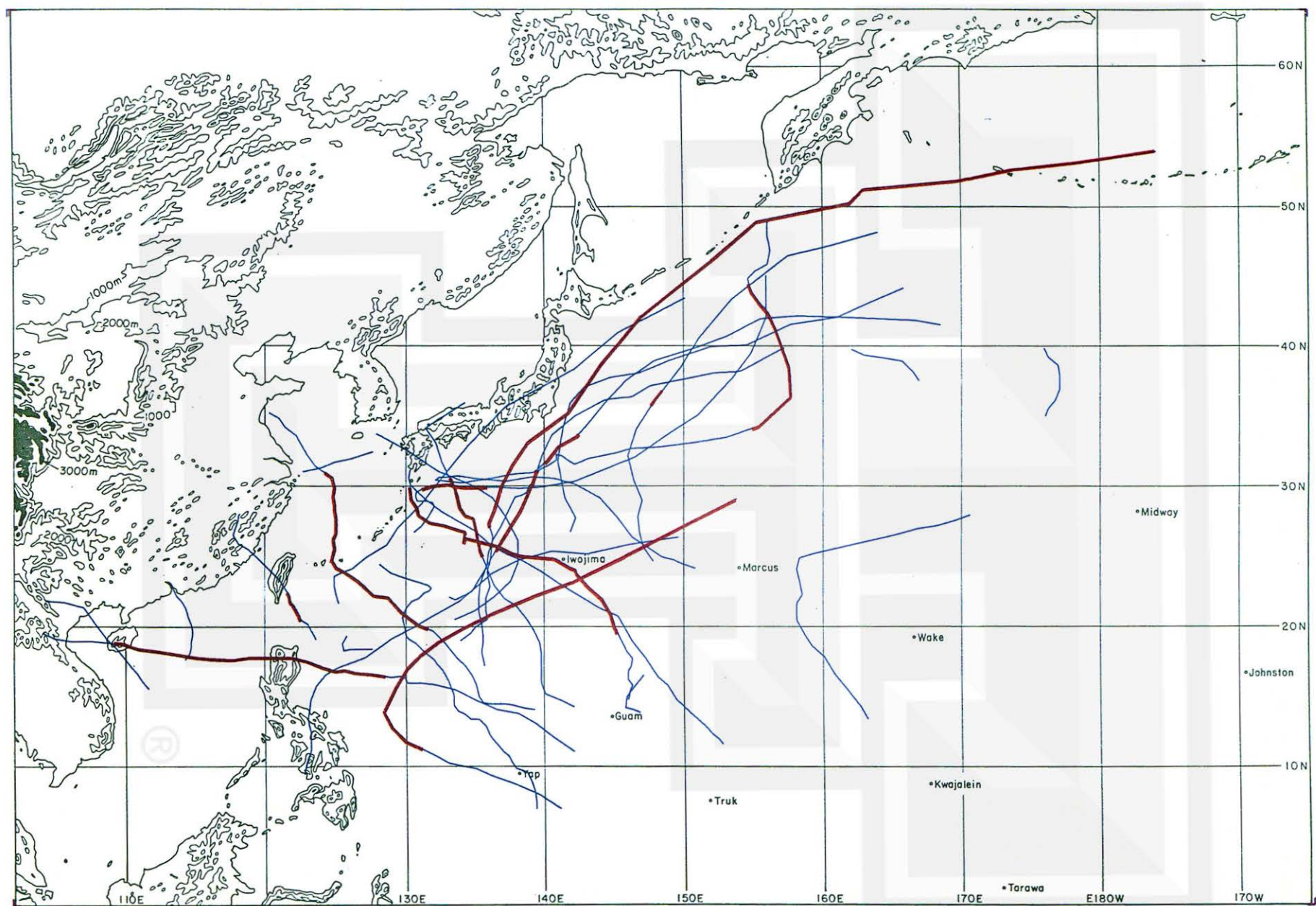


Storm Year: **1954**

EP-3 (Jul-Dec) SST Anomaly: **-0.7°C**

Number of All Typhoons: **23**

S+Typhoons: **14**

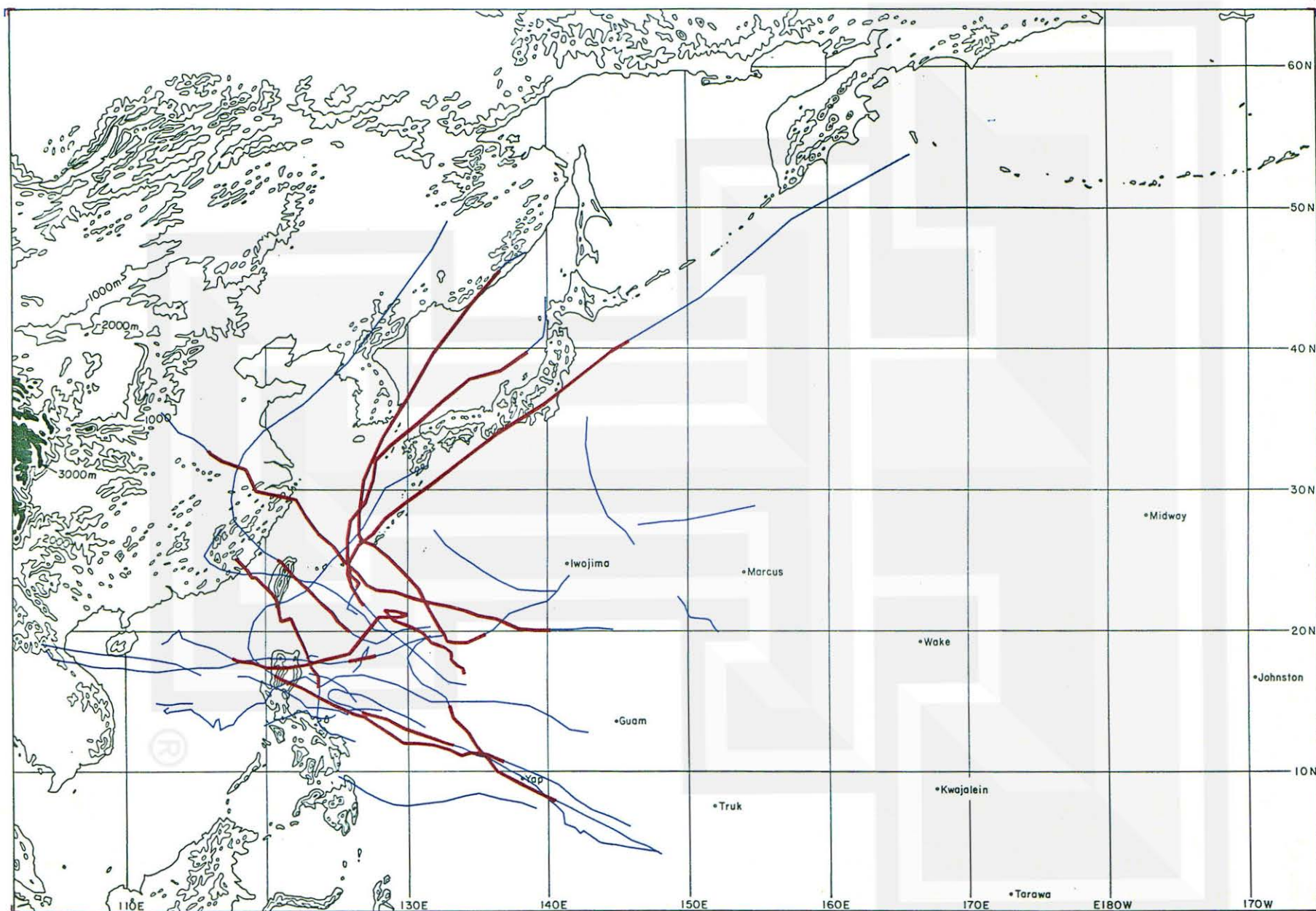


Storm Year: **1955**

EP-3 (Jul-Dec) SST Anomaly: **-1.1°C**

Number of All Typhoons: **26**

S+Typhoons: **12**

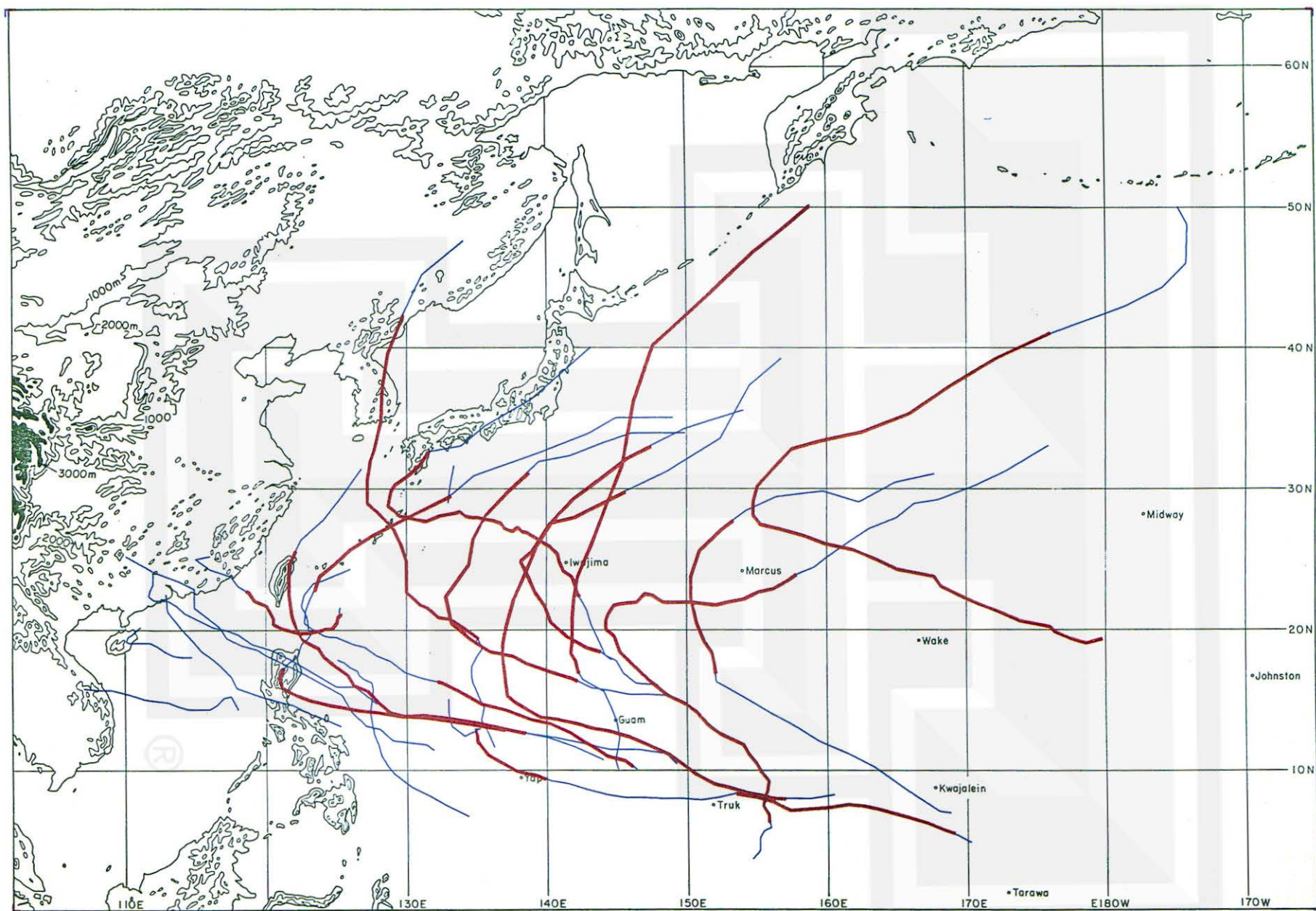


Storm Year: **1956**

EP-3 (Jul-Dec) SST Anomaly: **-0.5°C**

Number of All Typhoons: **25**

S+Typhoons: **11**

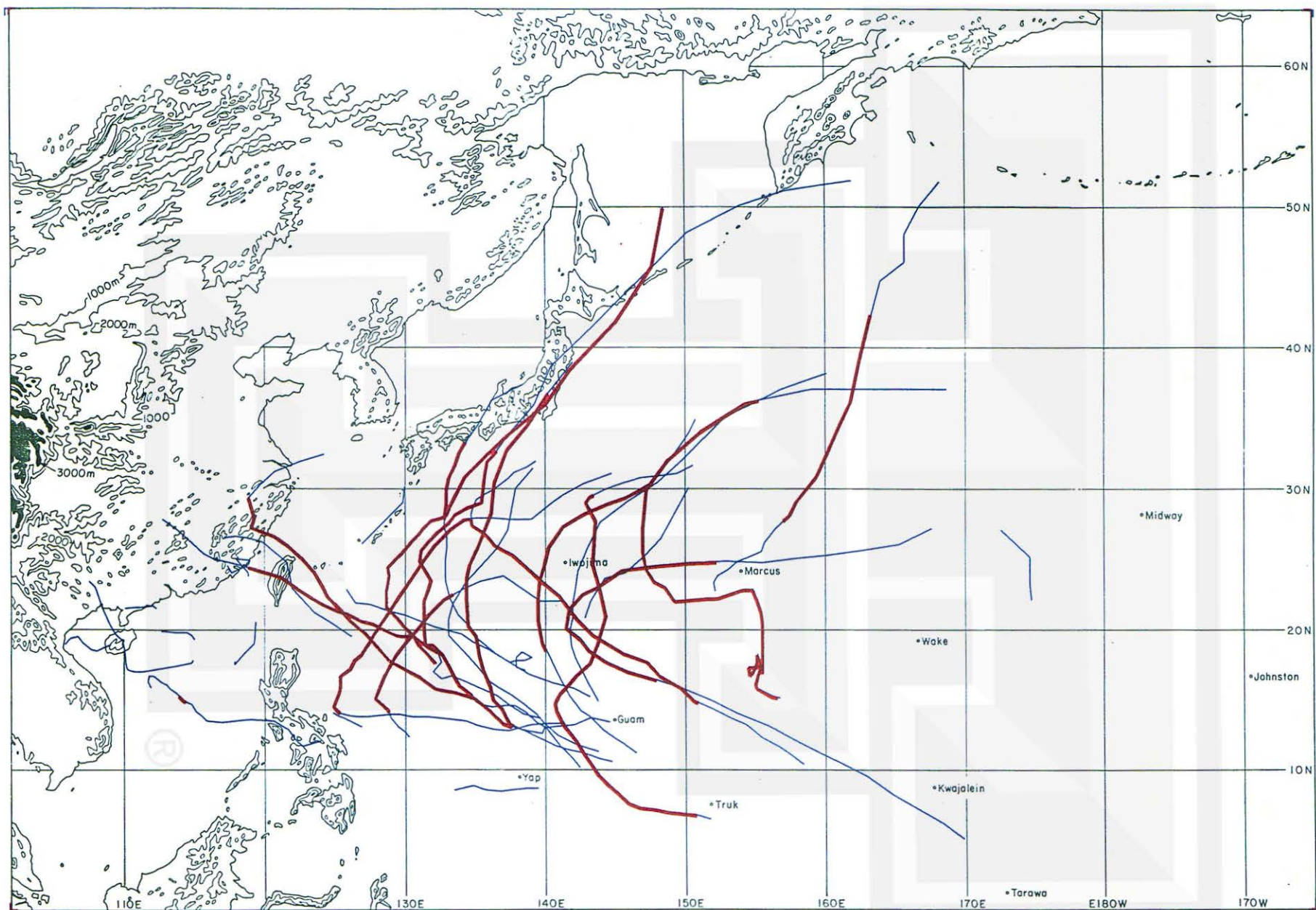


Storm Year: **1957**

EP-3 (Jul-Dec) SST Anomaly: **+0.7°C**

Number of All Typhoons: **21**

S+Typhoons: **14**

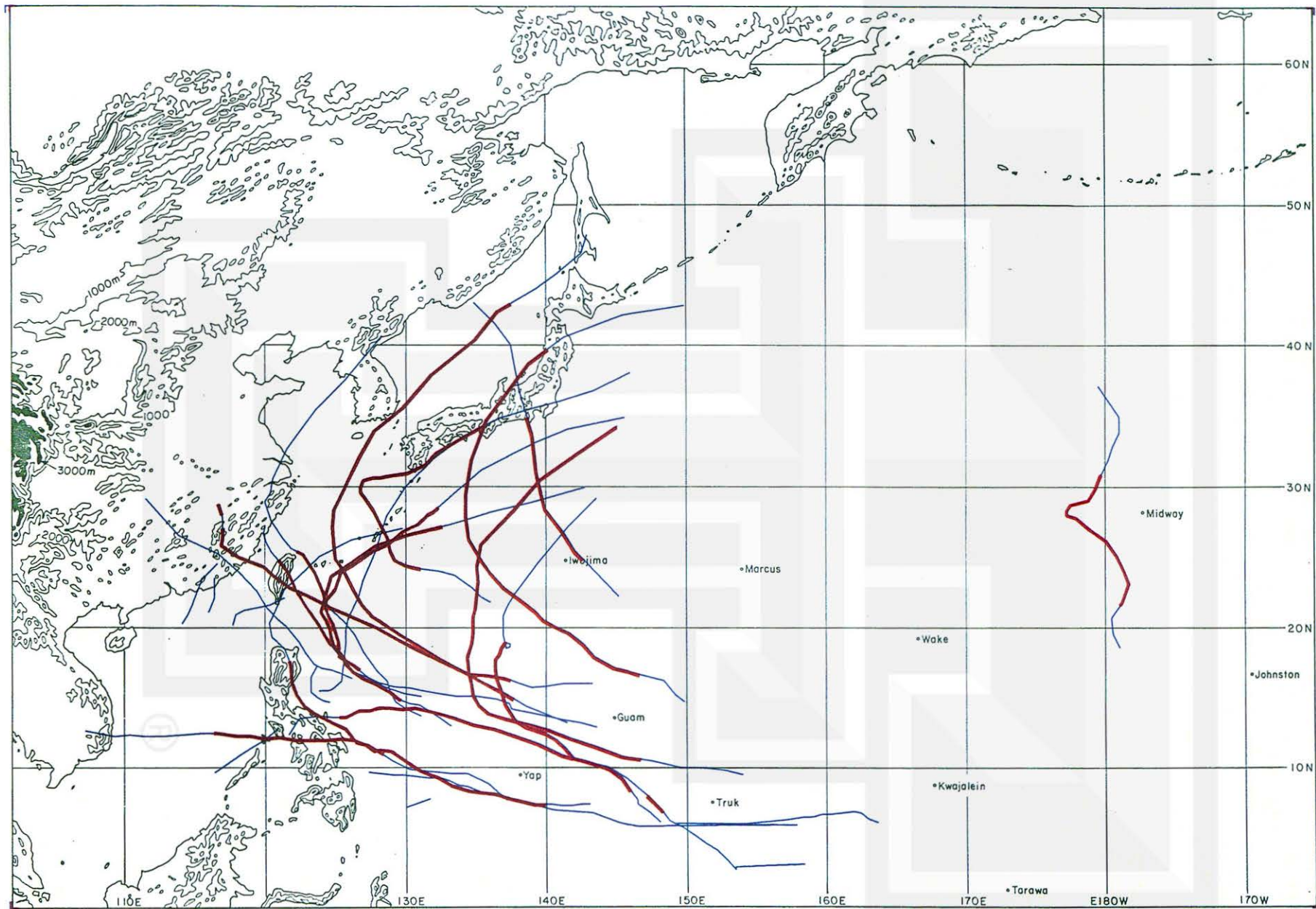


Storm Year: **1958**

EP-3 (Jul-Dec) SST Anomaly: **+0.3°C**

Number of All Typhoons: **31**

S+Typhoons: **15**

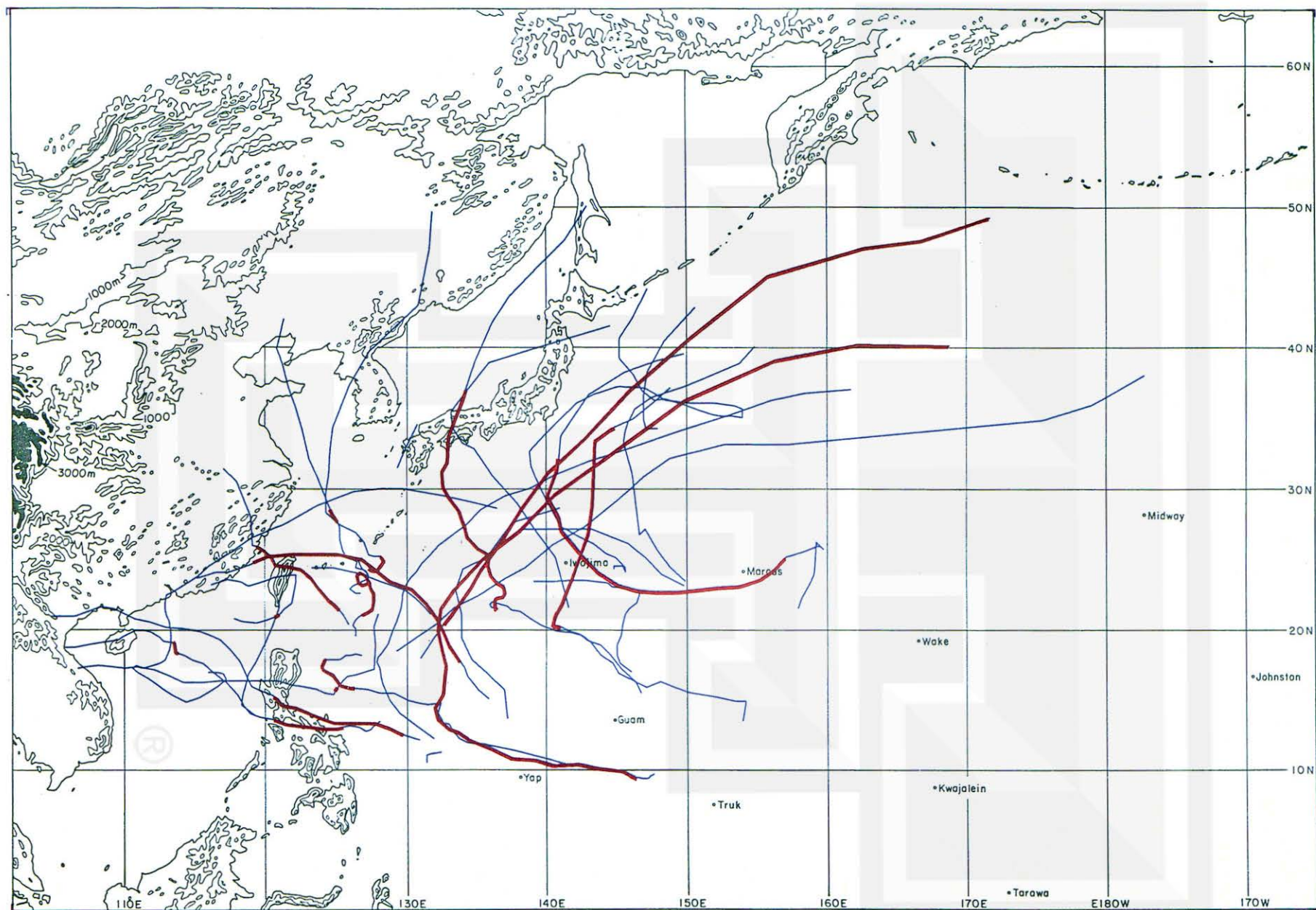


Storm Year: **1959**

EP-3 (Jul-Dec) SST Anomaly: **-0.2°C**

Number of All Typhoons: **22**

S+Typhoons: **15**

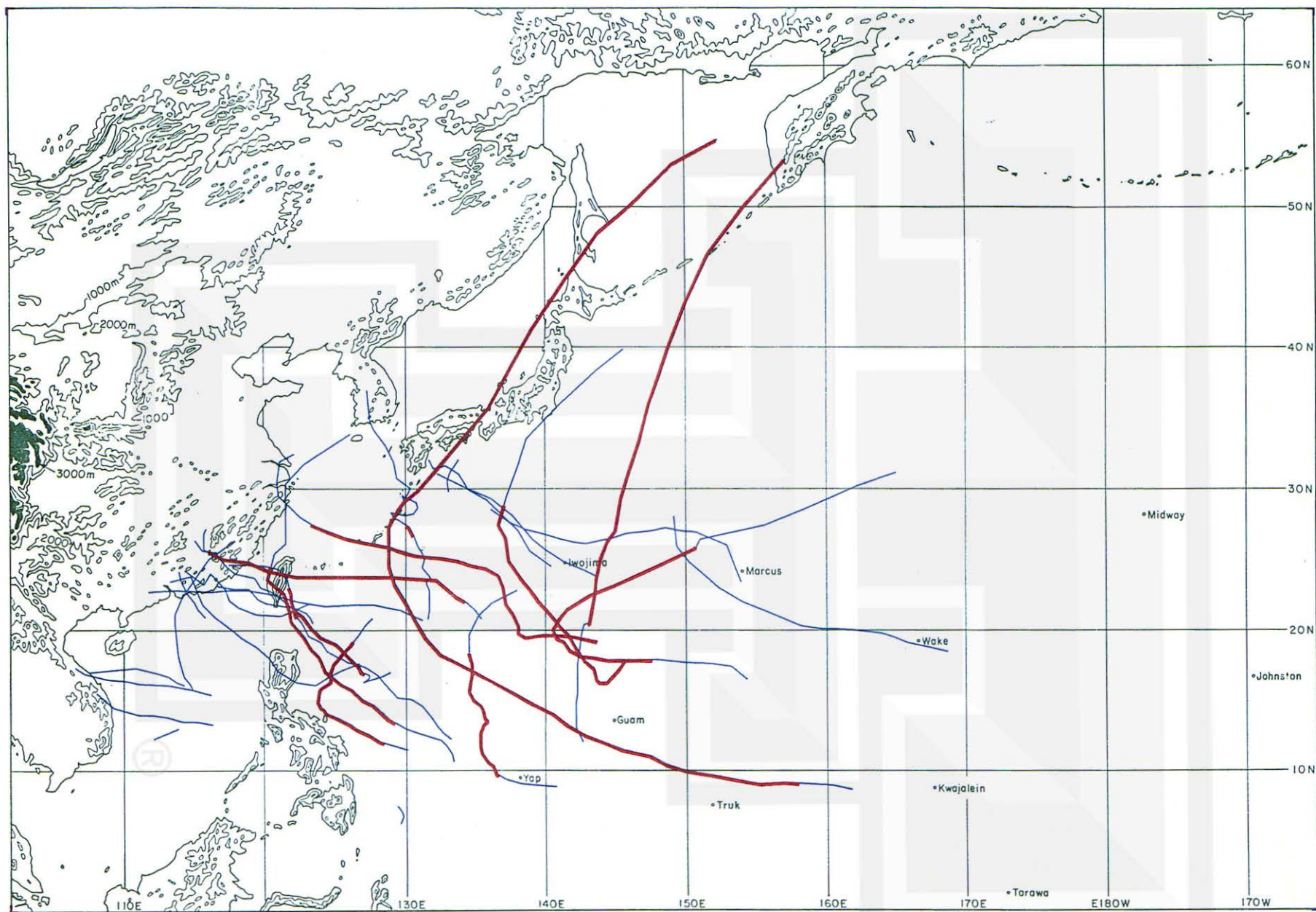


Storm Year: **1960**

EP-3 (Jul-Dec) SST Anomaly: **0.0°C**

Number of All Typhoons: **28**

S+Typhoons: **14**

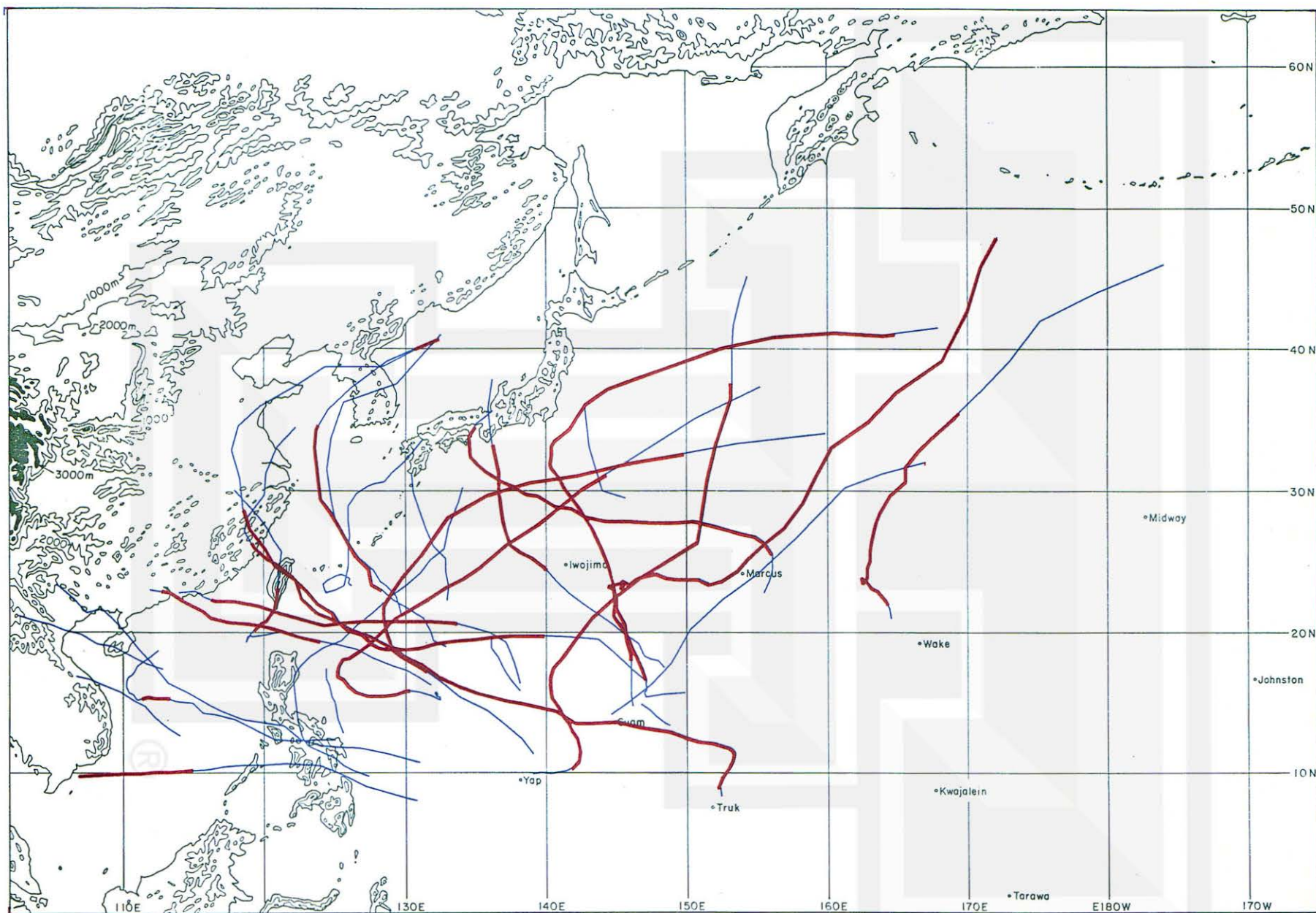


Storm Year: **1961**

EP-3 (Jul-Dec) SST Anomaly: **-0.2°C**

Number of All Typhoons: **28**

S+Typhoons: **12**

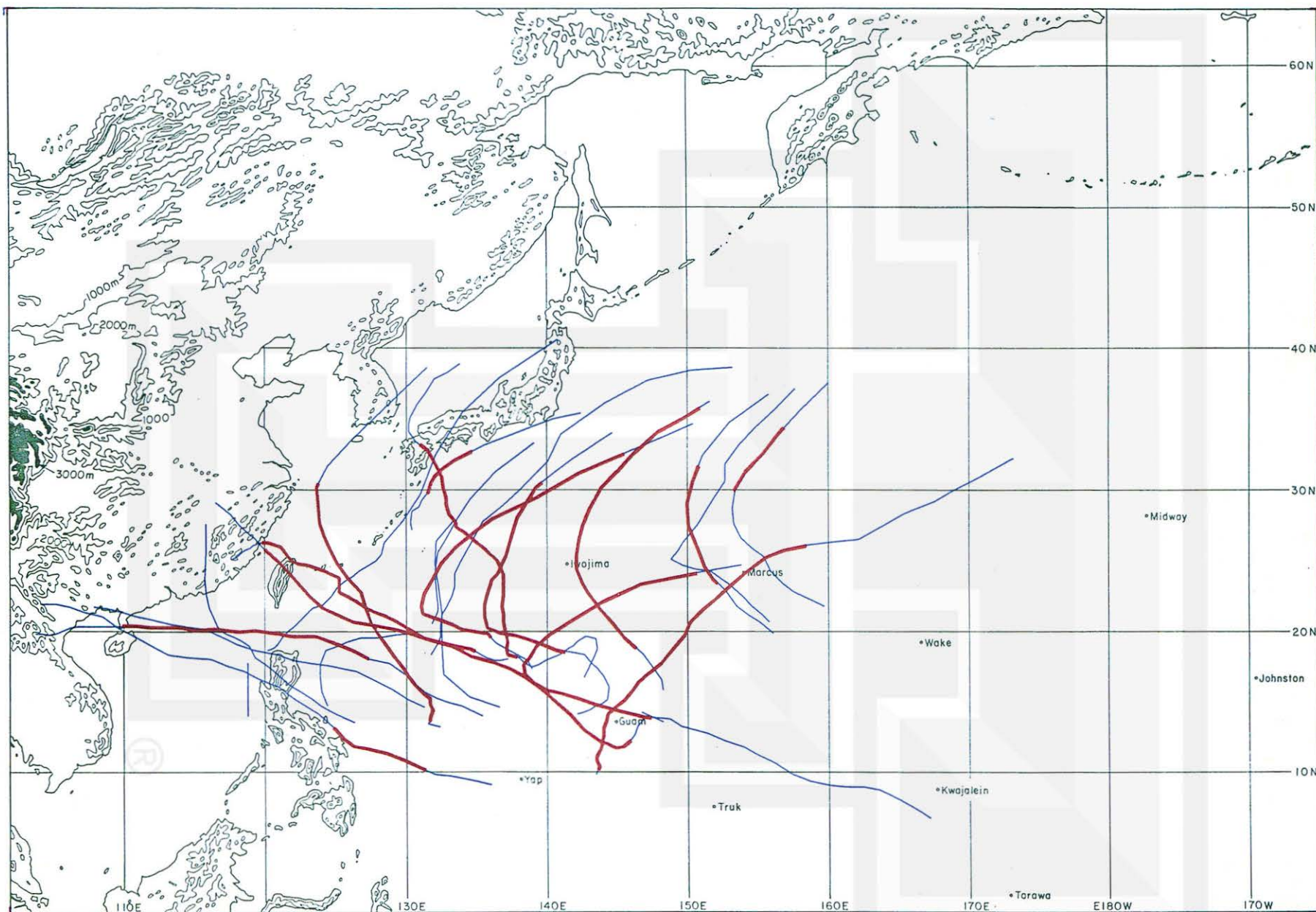


Storm Year: **1962**

EP-3 (Jul-Dec) SST Anomaly: **-0.2°C**

Number of All Typhoons: **28**

S+Typhoons: **17**

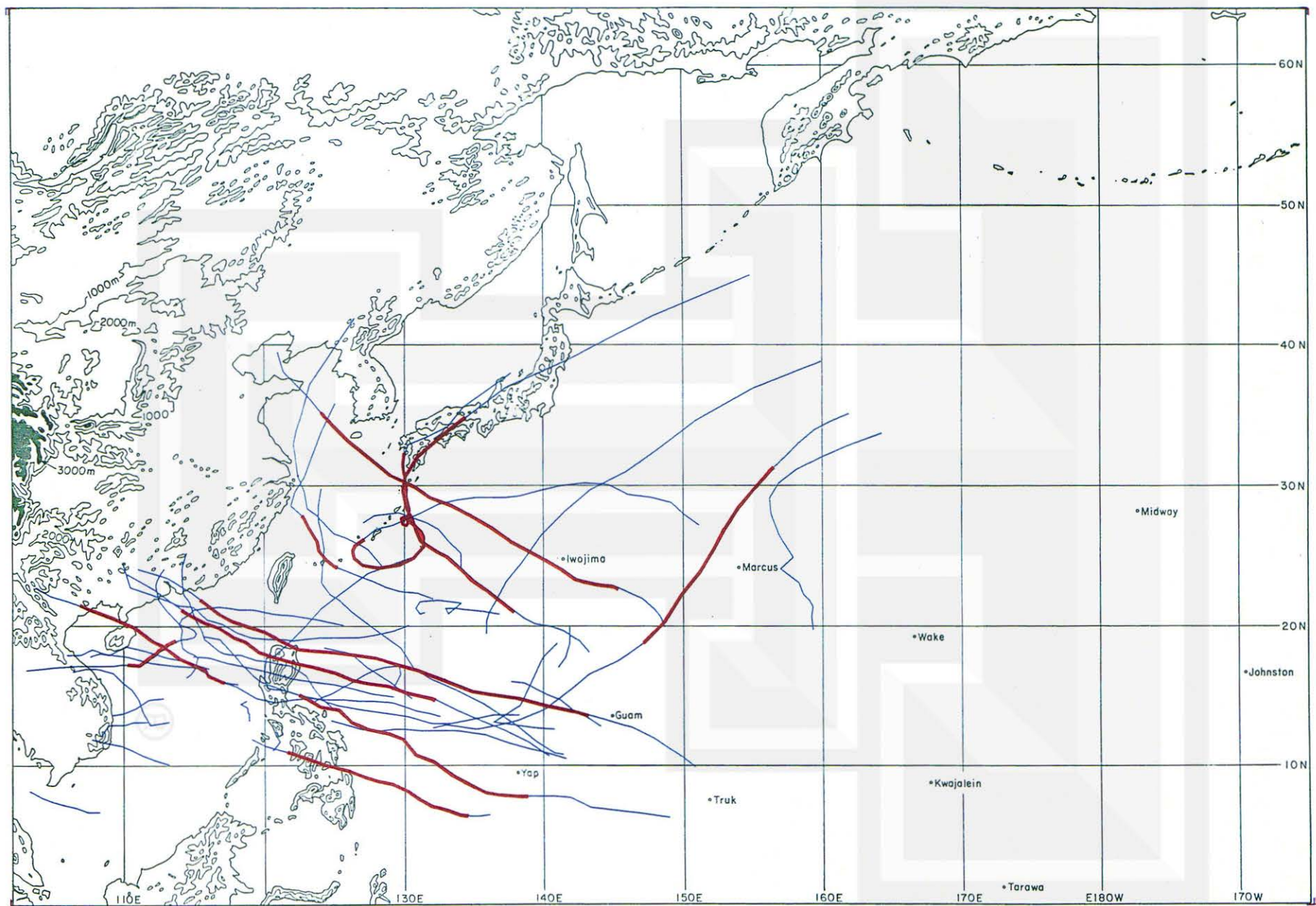


Storm Year: **1963**

EP-3 (Jul-Dec) SST Anomaly: **+0.8°C**

Number of All Typhoons: **24**

S+Typhoons: **14**

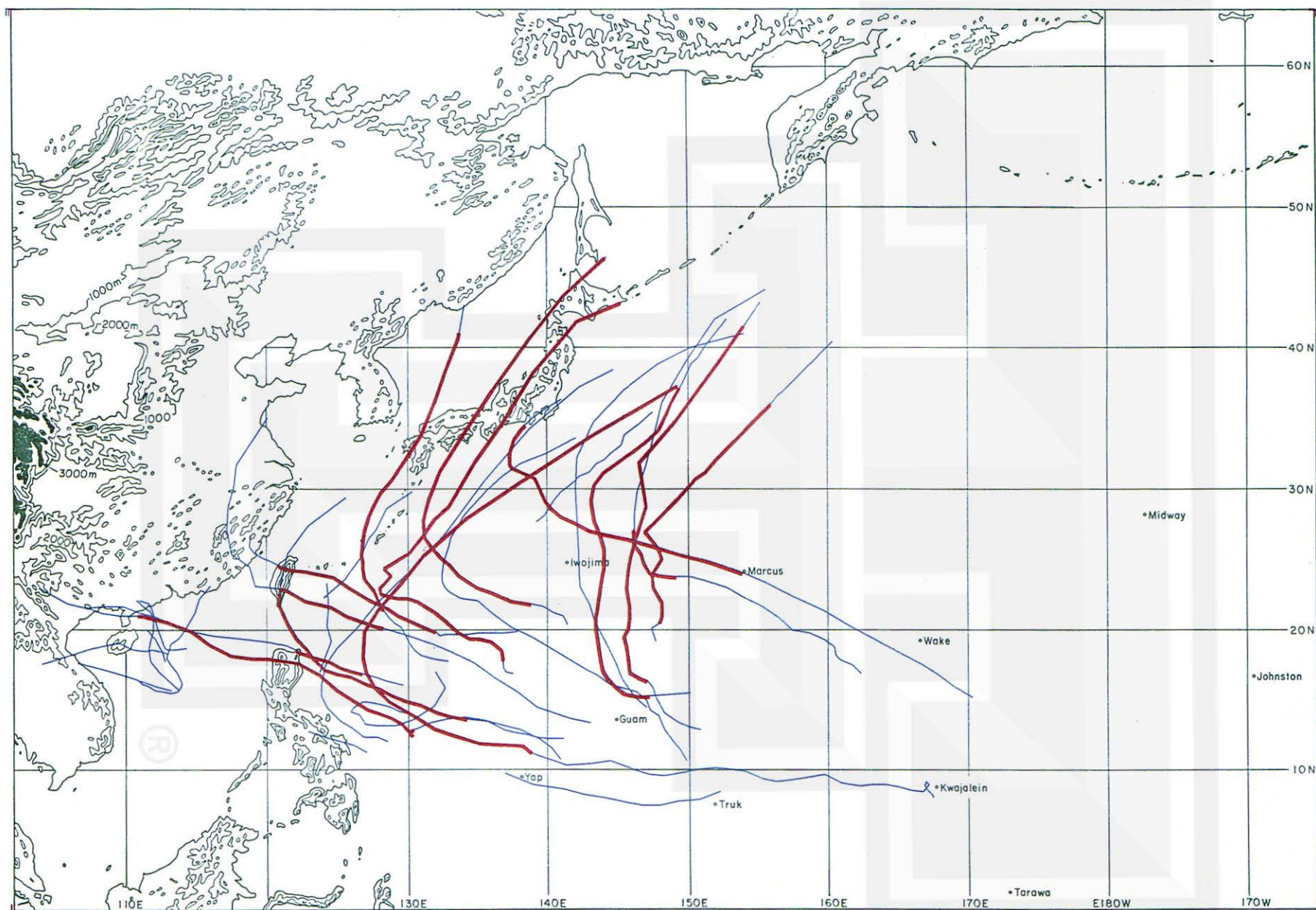


Storm Year: **1964**

EP-3 (Jul-Dec) SST Anomaly: **-0.8°C**

Number of All Typhoons: **36**

S+Typhoons: **11**

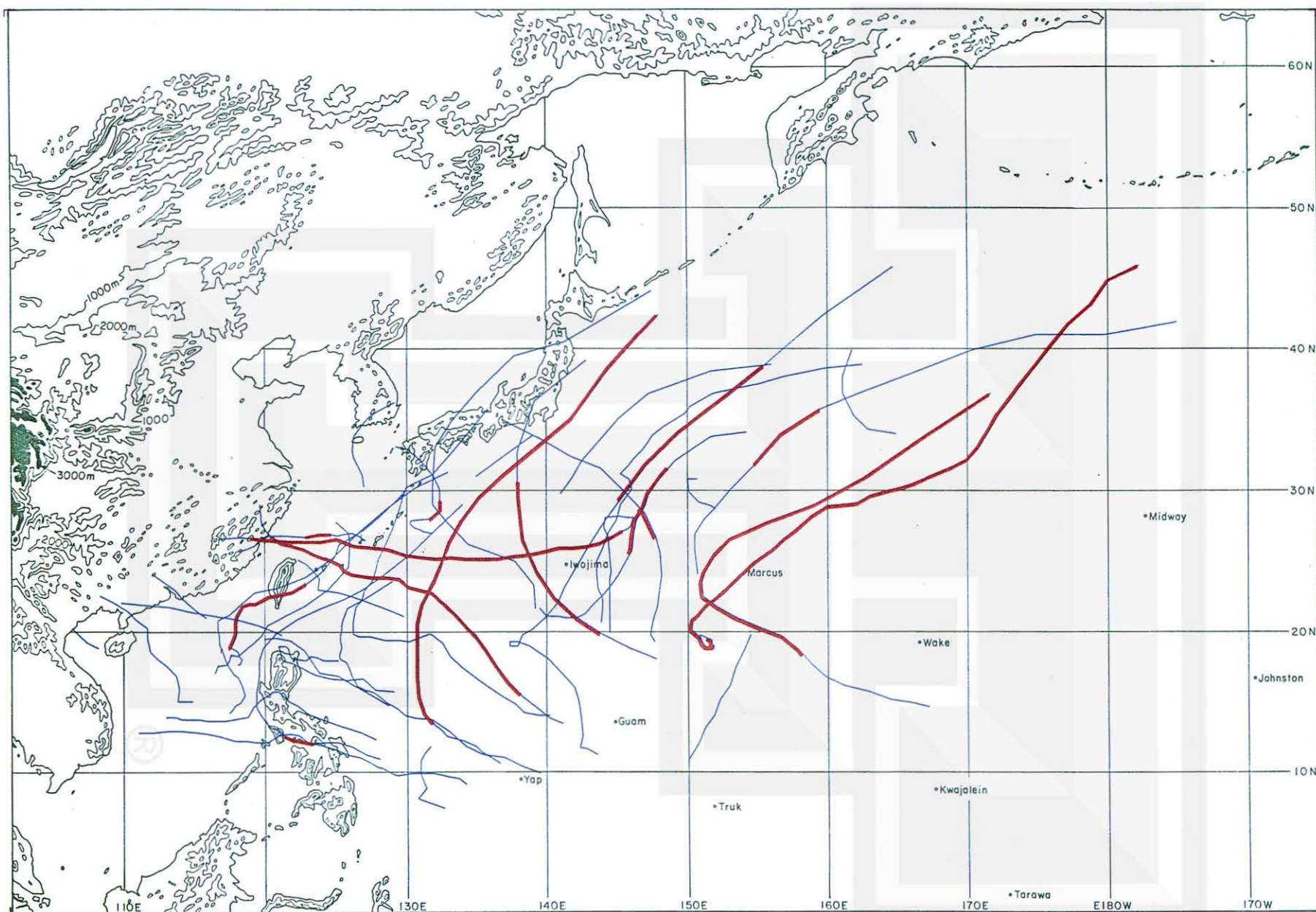


Storm Year: **1965**

EP-3 (Jul-Dec) SST Anomaly: **+0.7°C**

Number of All Typhoons: **29**

S+Typhoons: **14**

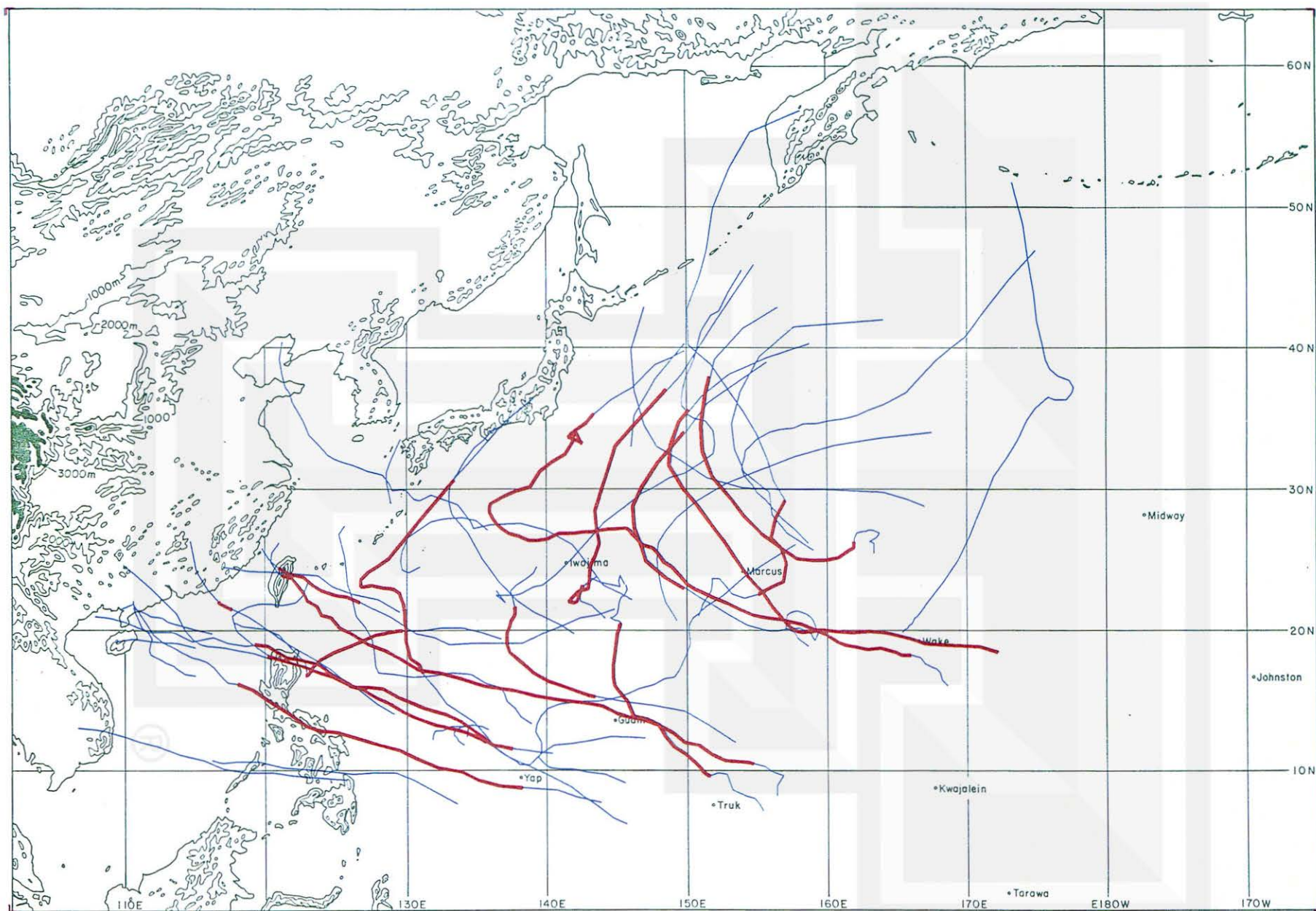


Storm Year: **1966**

EP-3 (Jul-Dec) SST Anomaly: **+0.3°C**

Number of All Typhoons: **36**

S+Typhoons: **16**

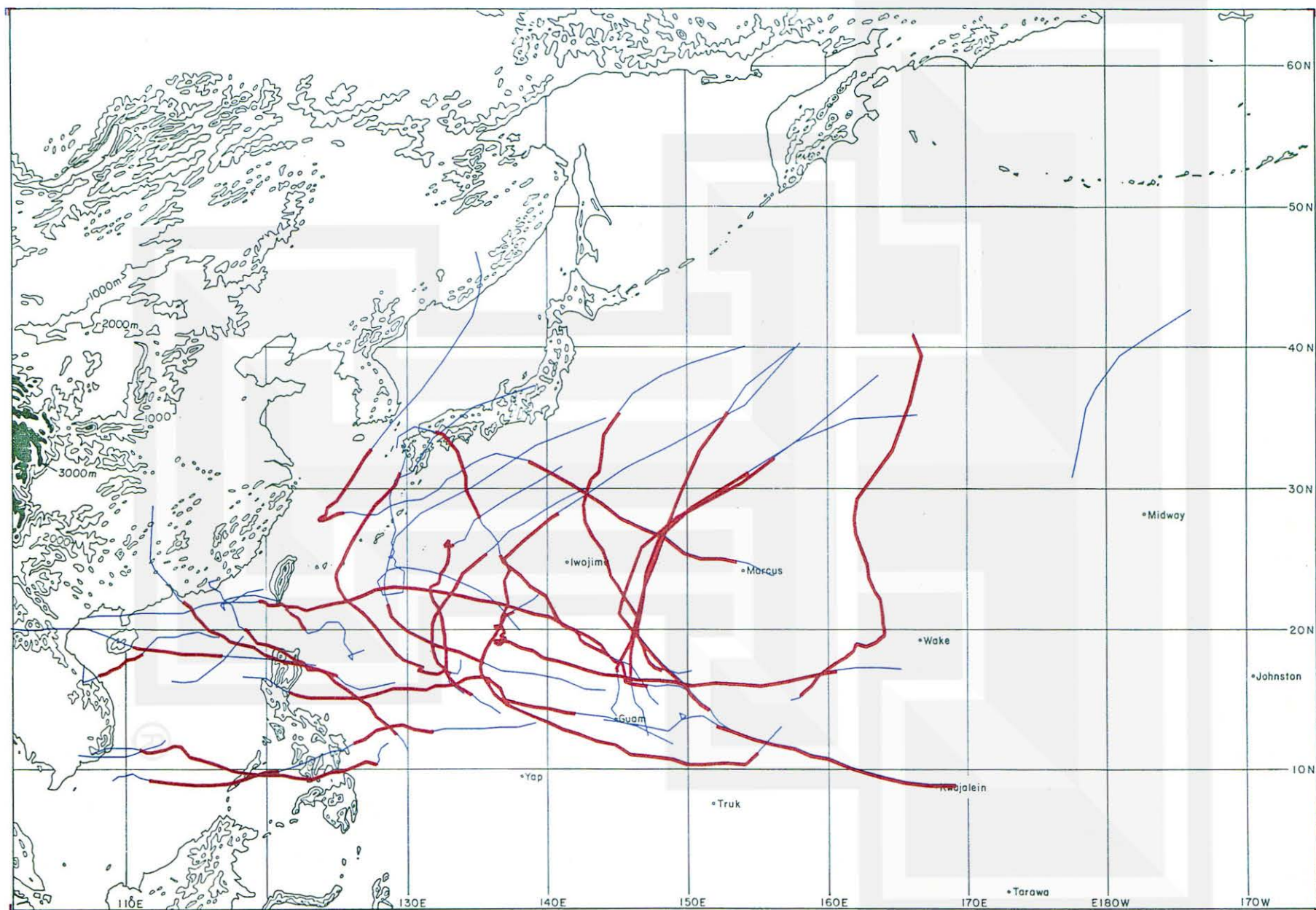


Storm Year: **1967**

EP-3 (Jul-Dec) SST Anomaly: **0.0°C**

Number of All Typhoons: **39**

S+Typhoons: **16**

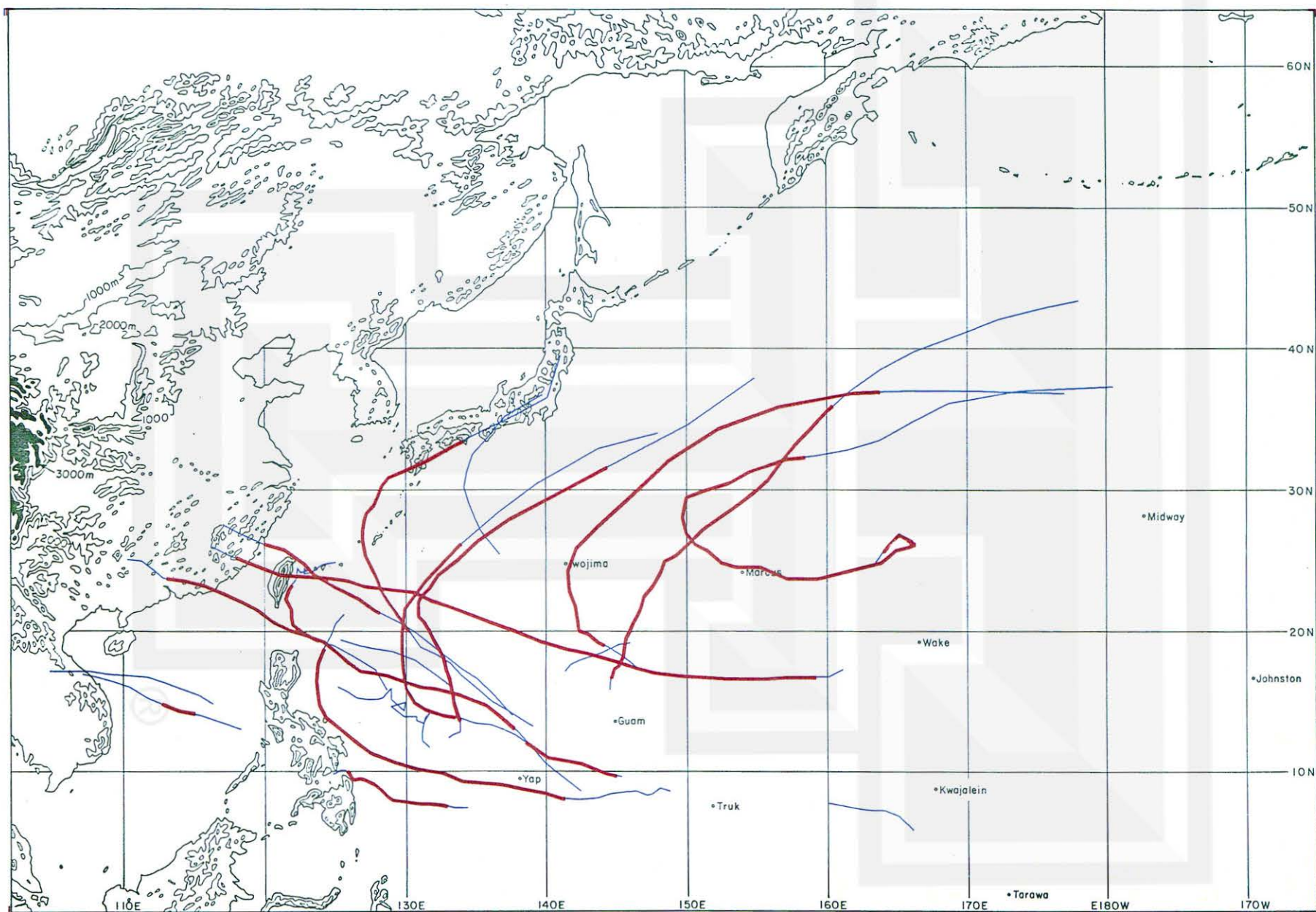


Storm Year: **1968**

EP-3 (Jul-Dec) SST Anomaly: **+0.4°C**

Number of All Typhoons: **27**

S+Typhoons: **23**

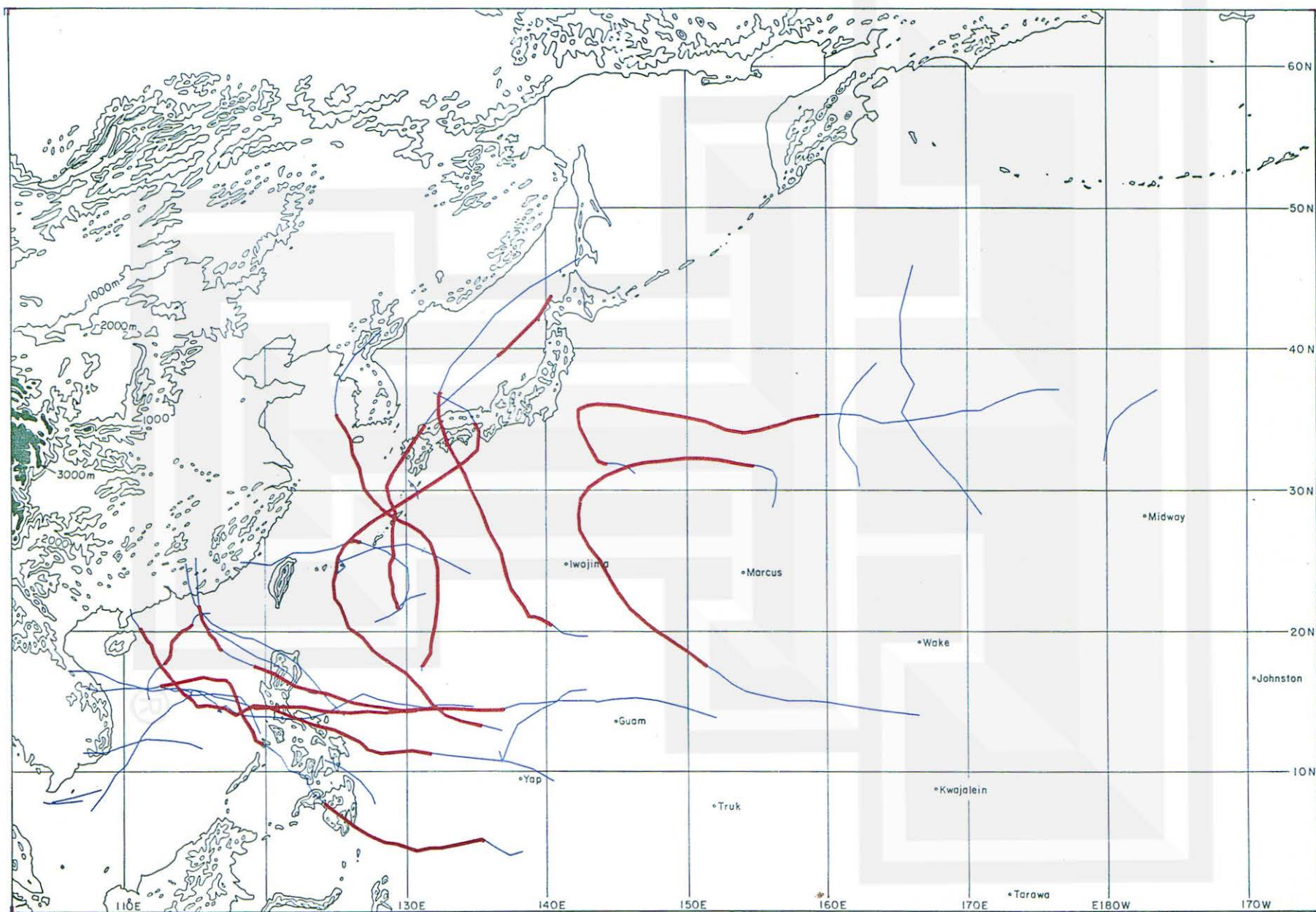


Storm Year: **1969**

EP-3 (Jul-Dec) SST Anomaly: **+0.6°C**

Number of All Typhoons: **19**

S+Typhoons: **13**

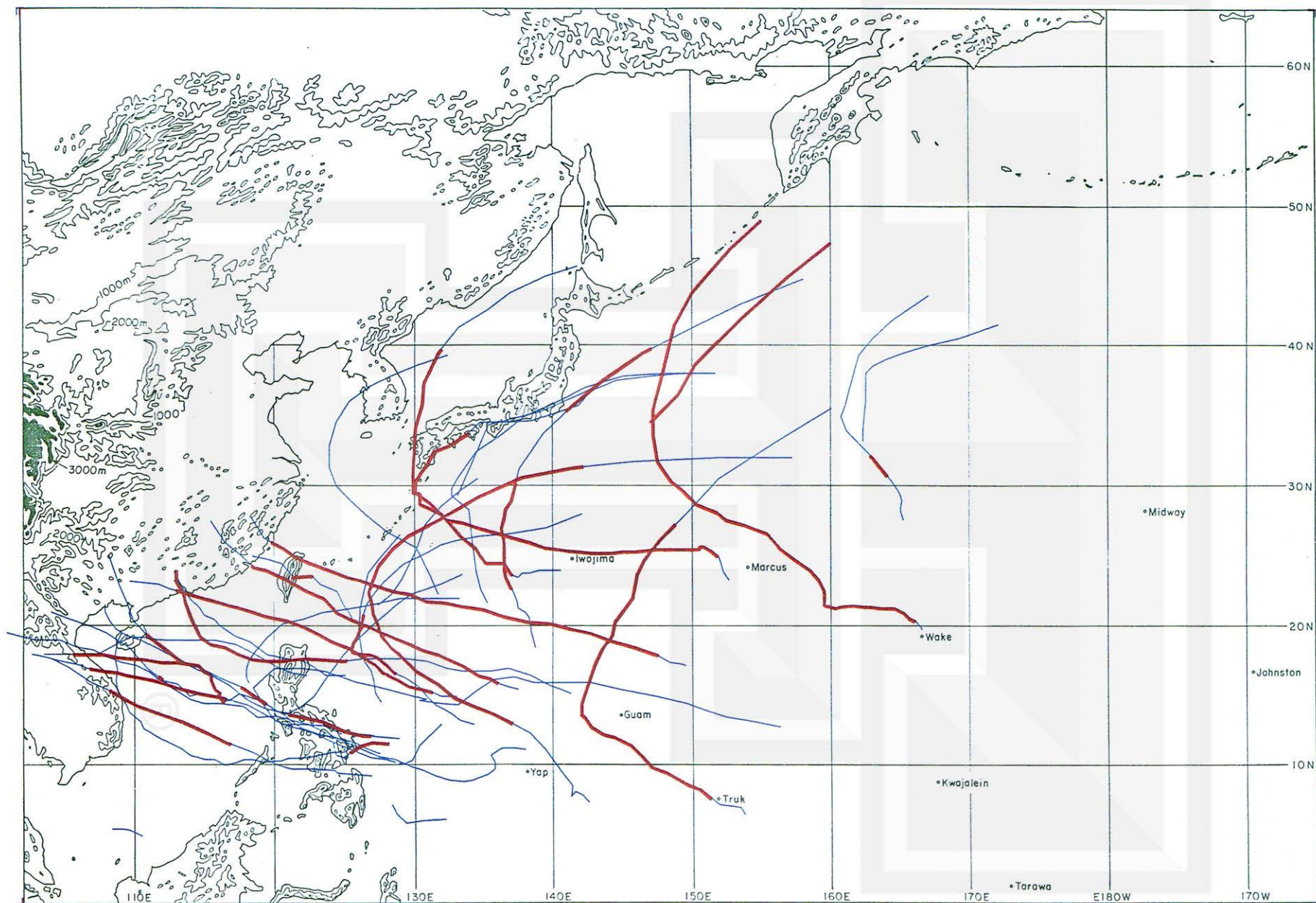


Storm Year: **1970**

EP-3 (Jul-Dec) SST Anomaly: **-0.6°C**

Number of All Typhoons: **26**

S+Typhoons: **12**

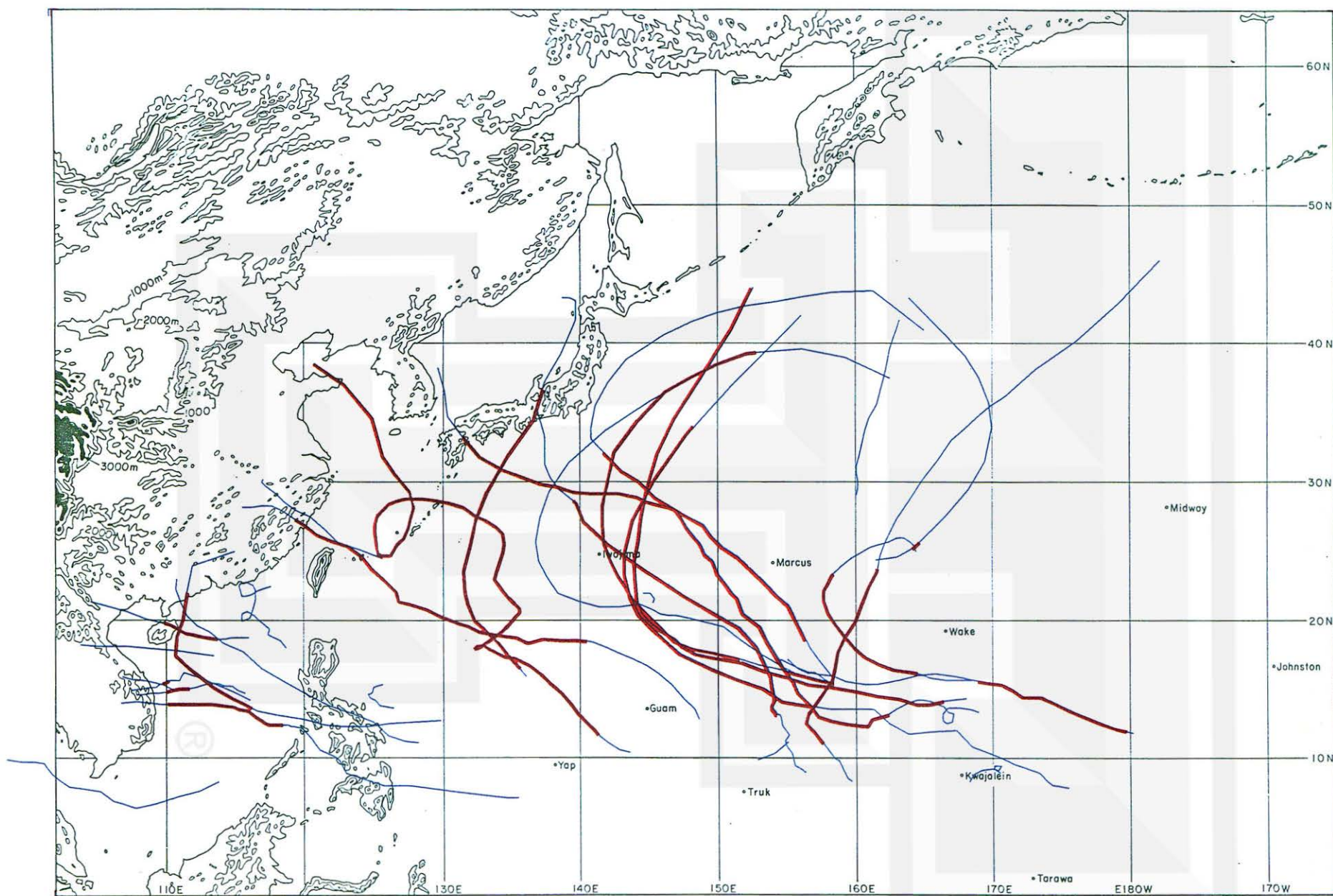


Storm Year: **1971**

EP-3 (Jul-Dec) SST Anomaly: **-0.6°C**

Number of All Typhoons: **36**

S+Typhoons: **21**

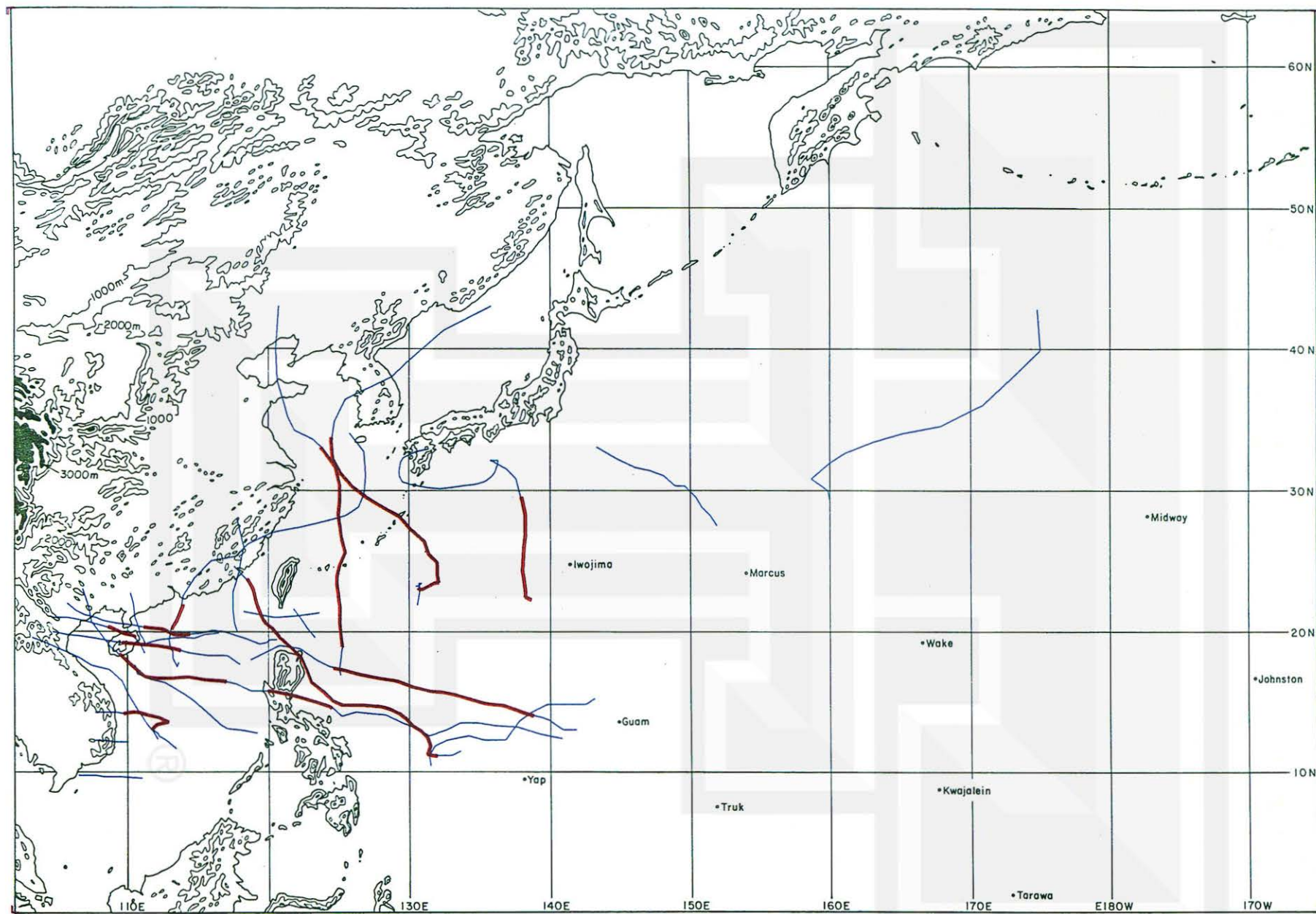


Storm Year: **1972**

EP-3 (Jul-Dec) SST Anomaly: **+0.6°C**

Number of All Typhoons: **30**

S+Typhoons: **18**

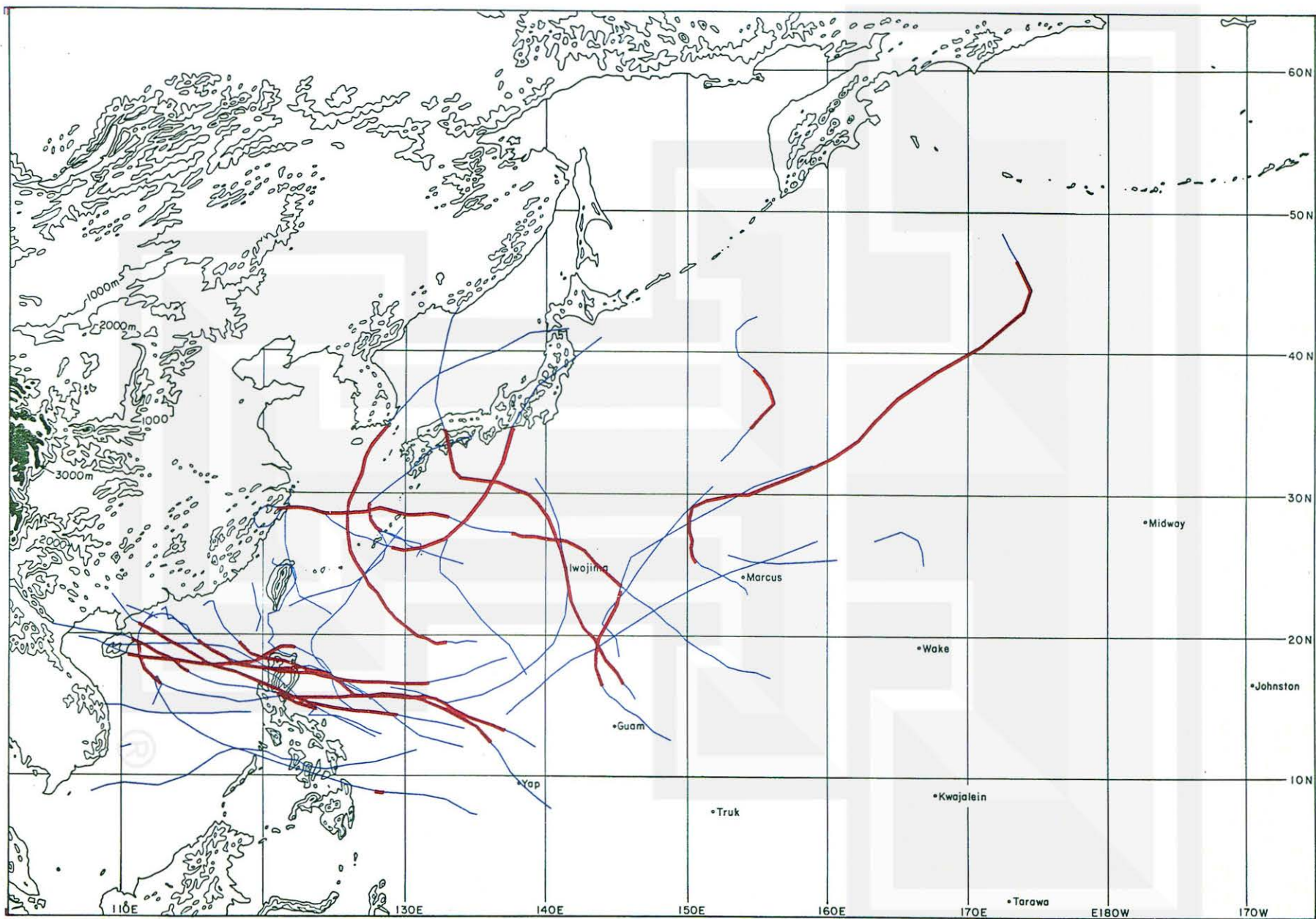


Storm Year: **1973**

EP-3 (Jul-Dec) SST Anomaly: **-1.1°C**

Number of All Typhoons: **22**

S+Typhoons: **11**

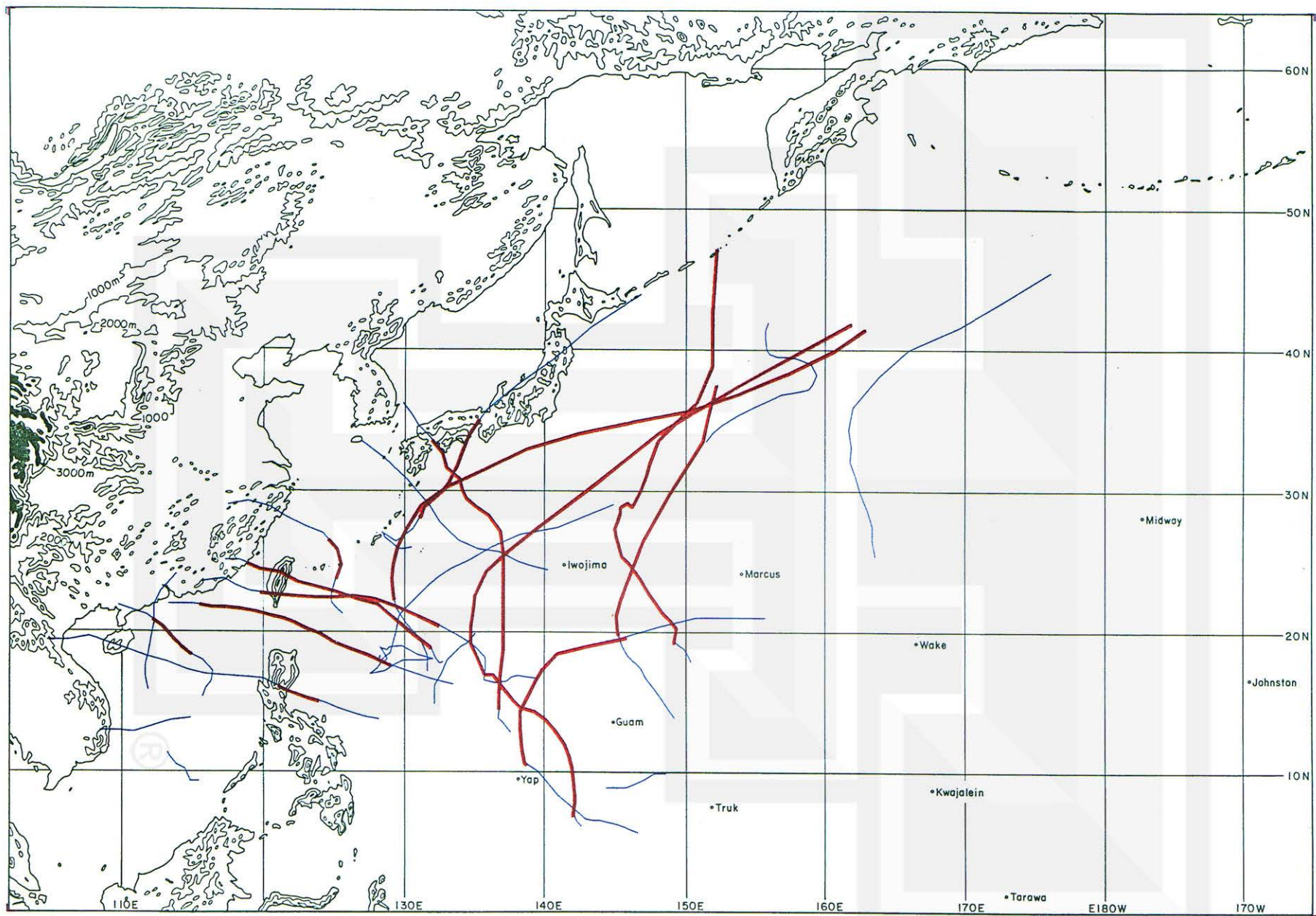


Storm Year: **1974**

EP-3 (Jul-Dec) SST Anomaly: **-0.9°C**

Number of All Typhoons: **31**

S+Typhoons: **16**

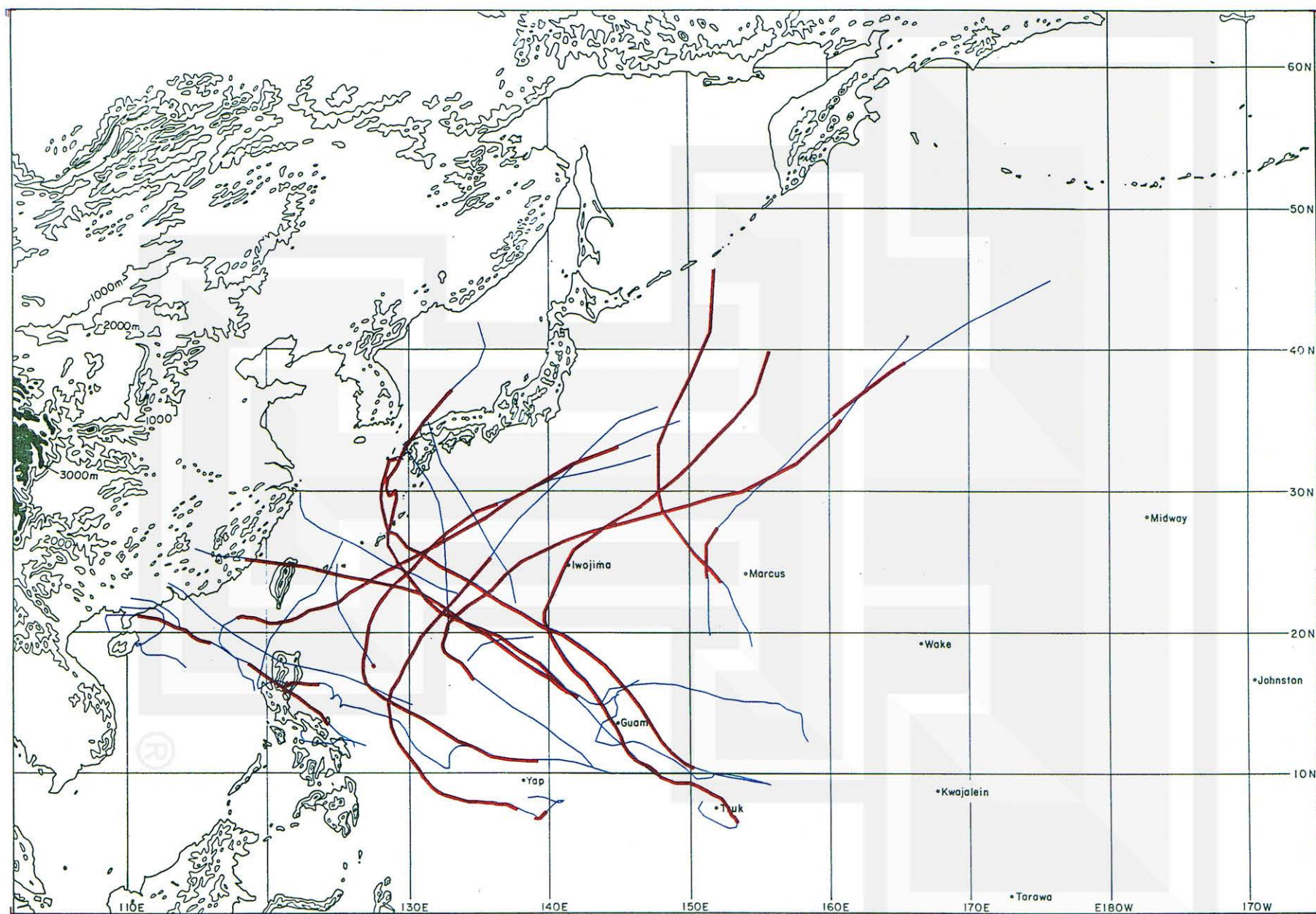


Storm Year: **1975**

EP-3 (Jul-Dec) SST Anomaly: **-1.6°C**

Number of All Typhoons: **22**

S+Typhoons: **13**

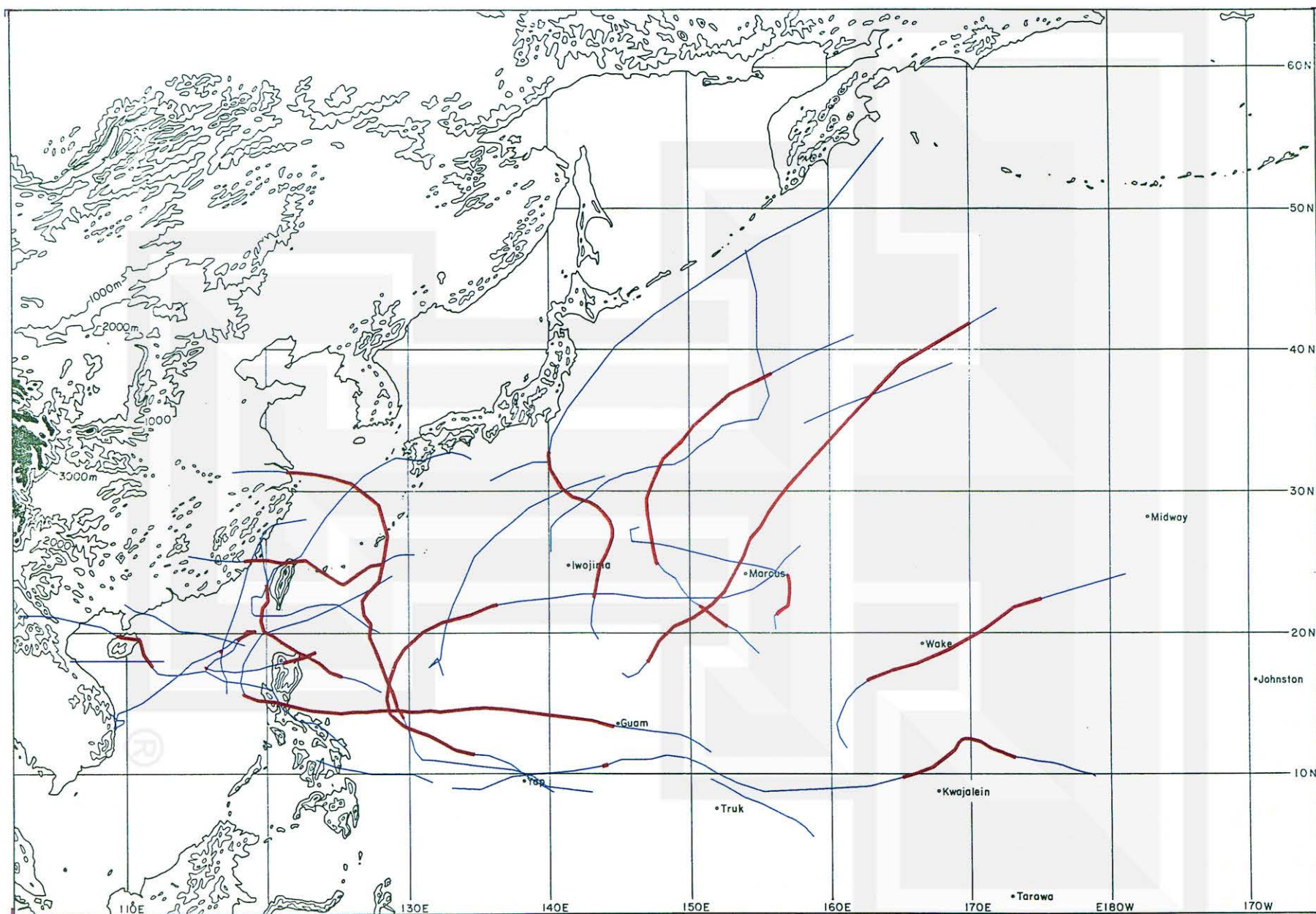


Storm Year: **1976**

EP-3 (Jul-Dec) SST Anomaly: **+0.2°C**

Number of All Typhoons: **23**

S+Typhoons: **13**

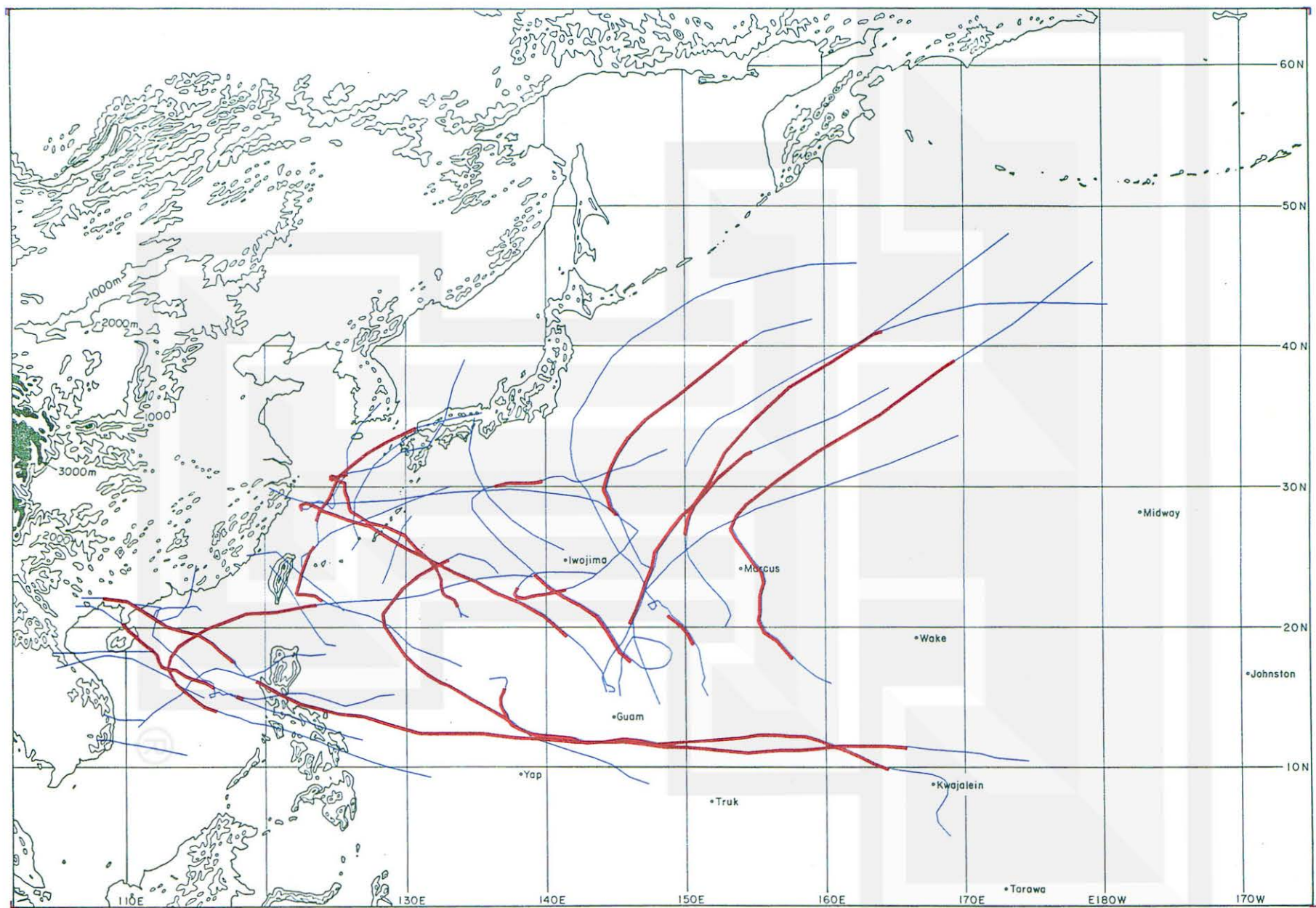


Storm Year: **1977**

EP-3 (Jul-Dec) SST Anomaly: **+0.6°C**

Number of All Typhoons: **22**

S+Typhoons: **14**

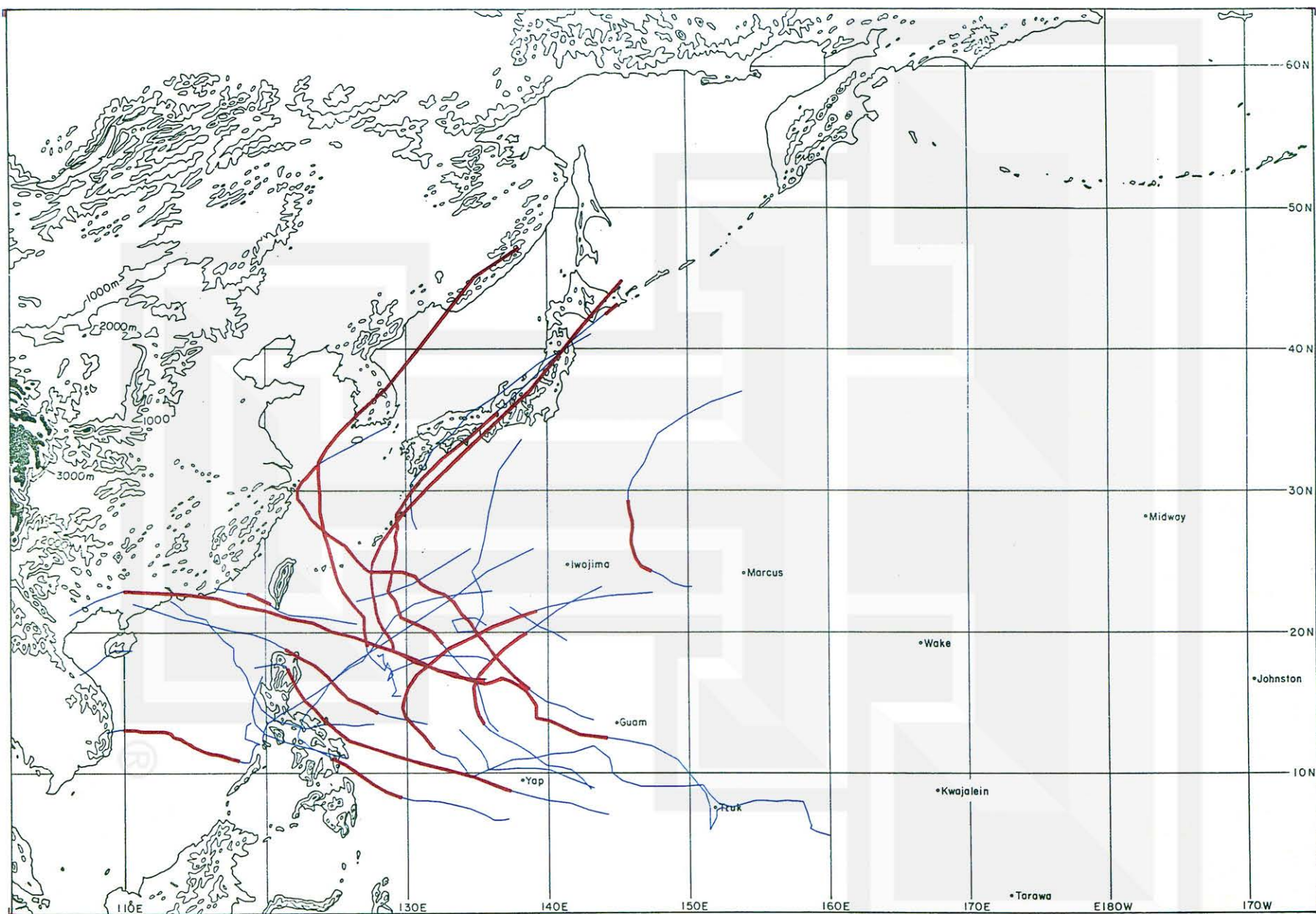


Storm Year: **1978**

EP-3 (Jul-Dec) SST Anomaly: **-0.1°C**

Number of All Typhoons: **30**

S+Typhoons: **18**

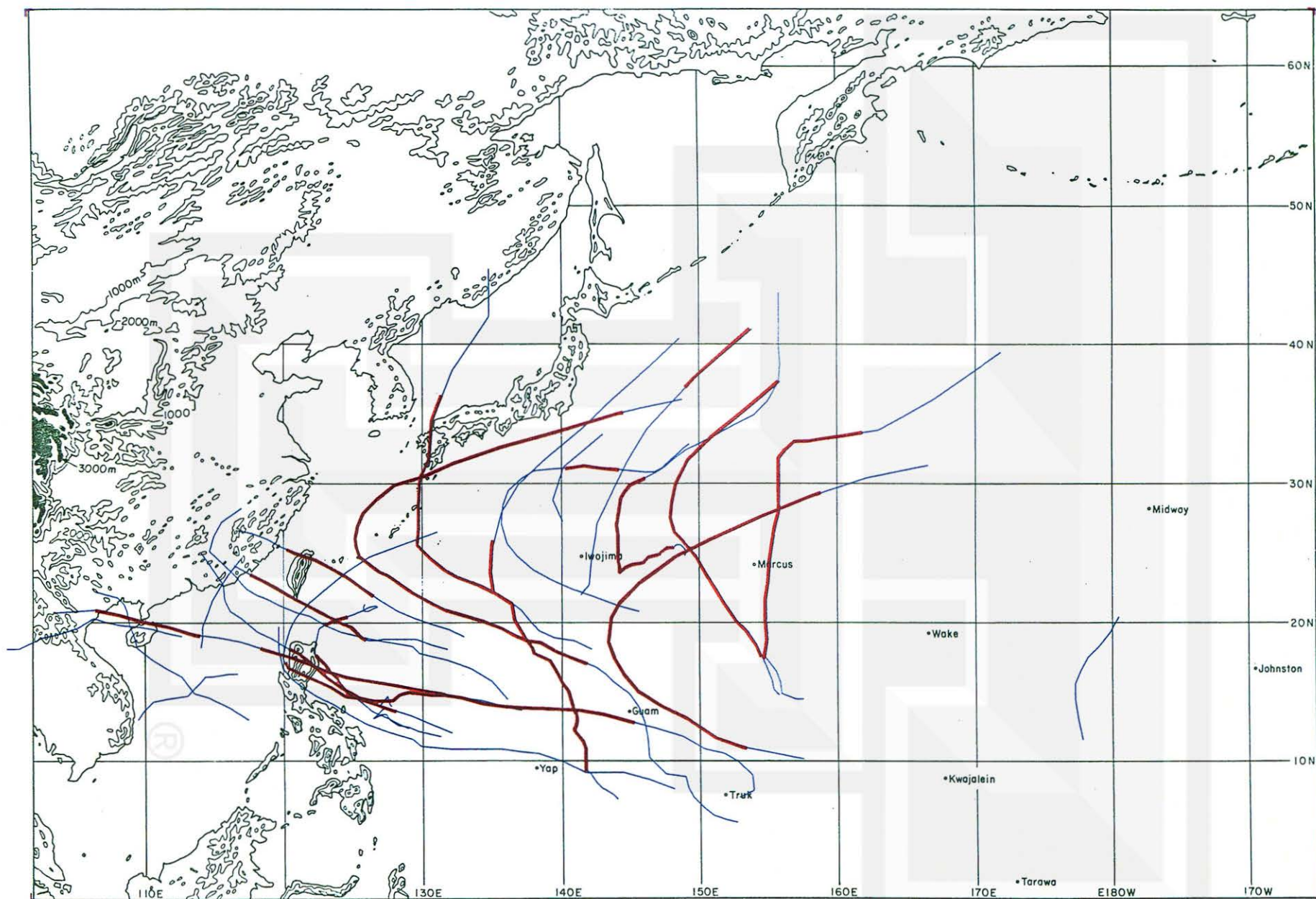


Storm Year: **1979**

EP-3 (Jul-Dec) SST Anomaly: **+0.4°C**

Number of All Typhoons: **23**

S+Typhoons: **13**

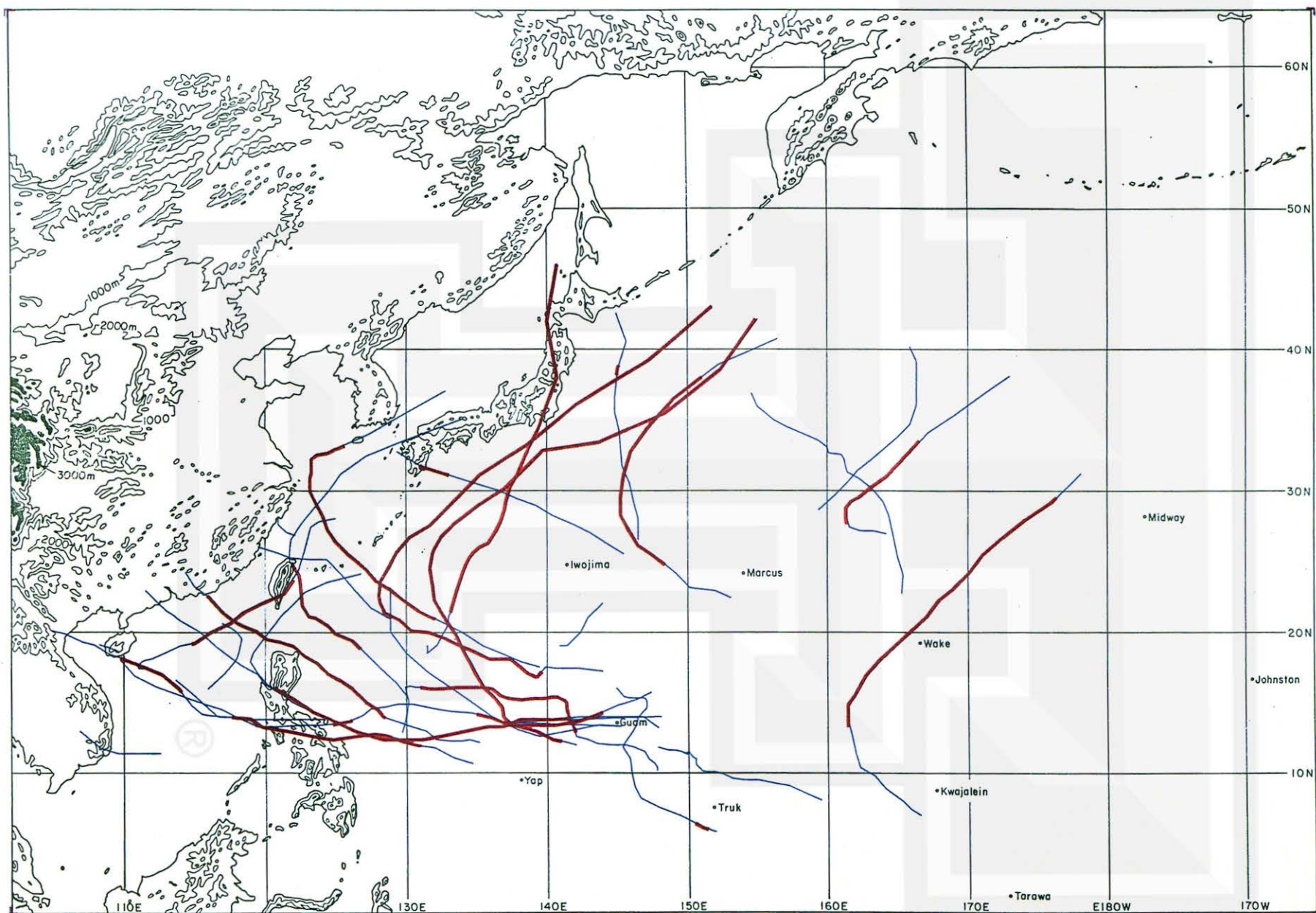


Storm Year: **1980**

EP-3 (Jul-Dec) SST Anomaly: **+0.2°C**

Number of All Typhoons: **24**

S+Typhoons: **15**

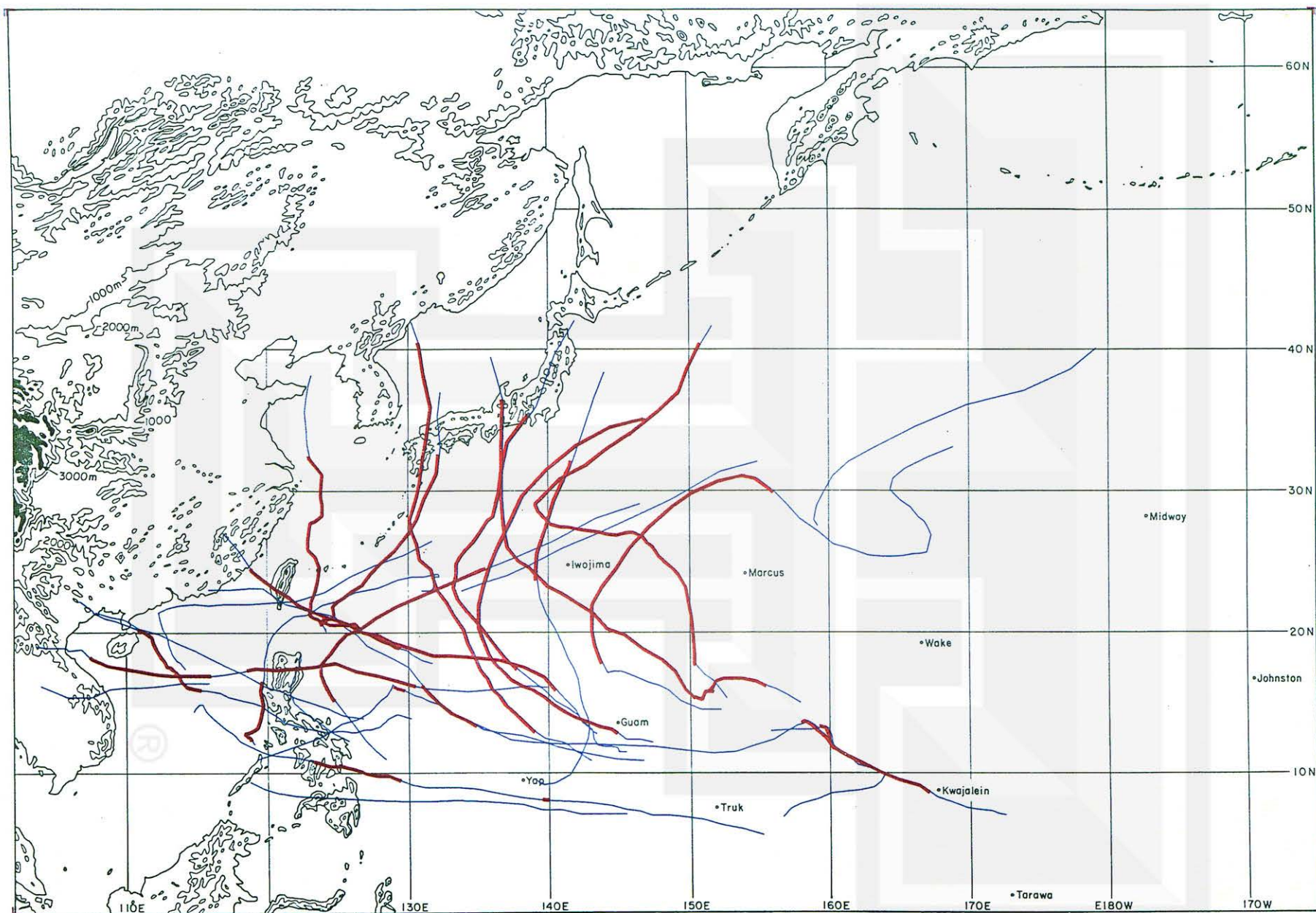


Storm Year: **1981**

EP-3 (Jul-Dec) SST Anomaly: **0.0°C**

Number of All Typhoons: **29**

S+Typhoons: **18**

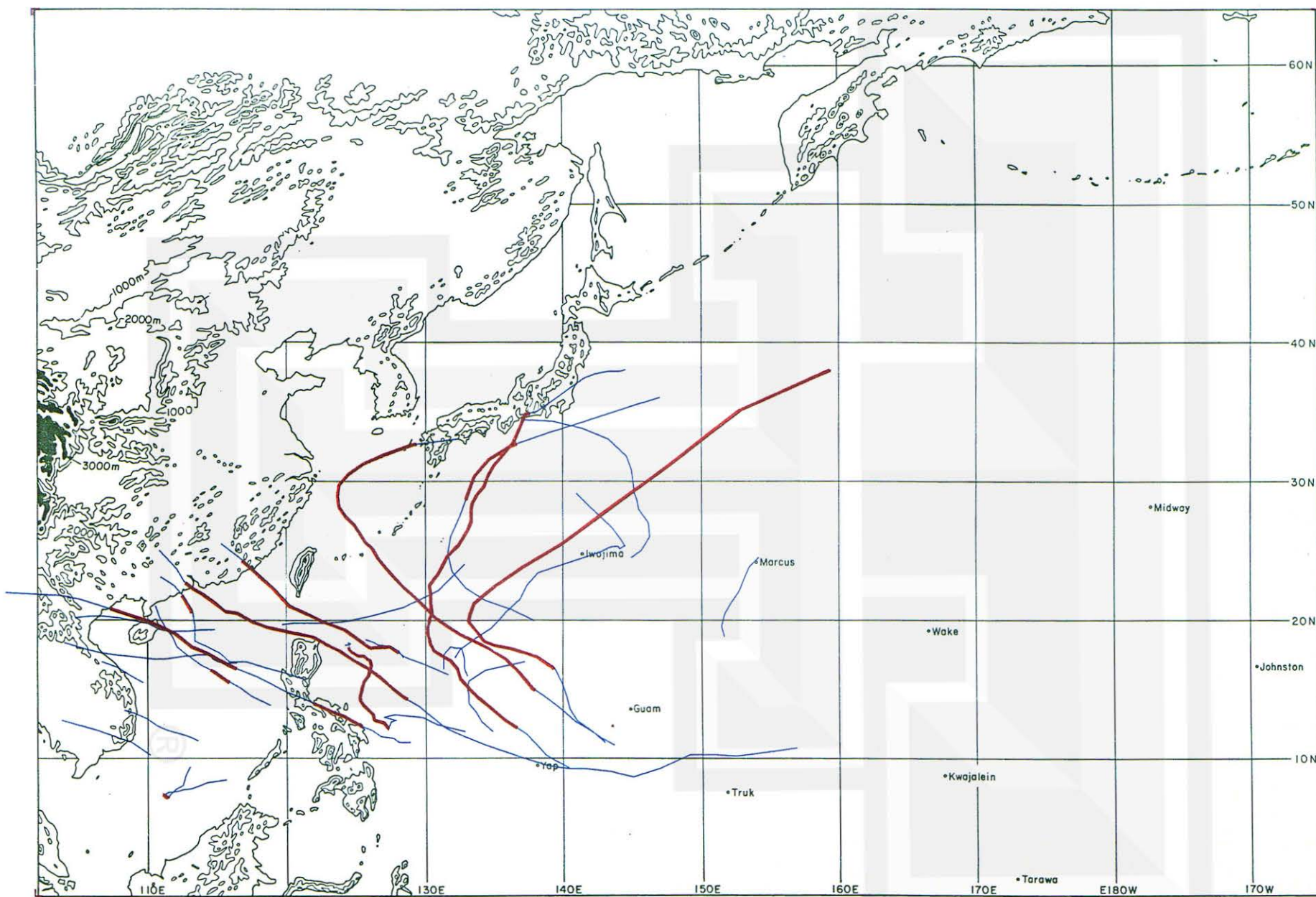


Storm Year: **1982**

EP-3 (Jul-Dec) SST Anomaly: **+0.6°C**

Number of All Typhoons: **25**

S+Typhoons: **18**

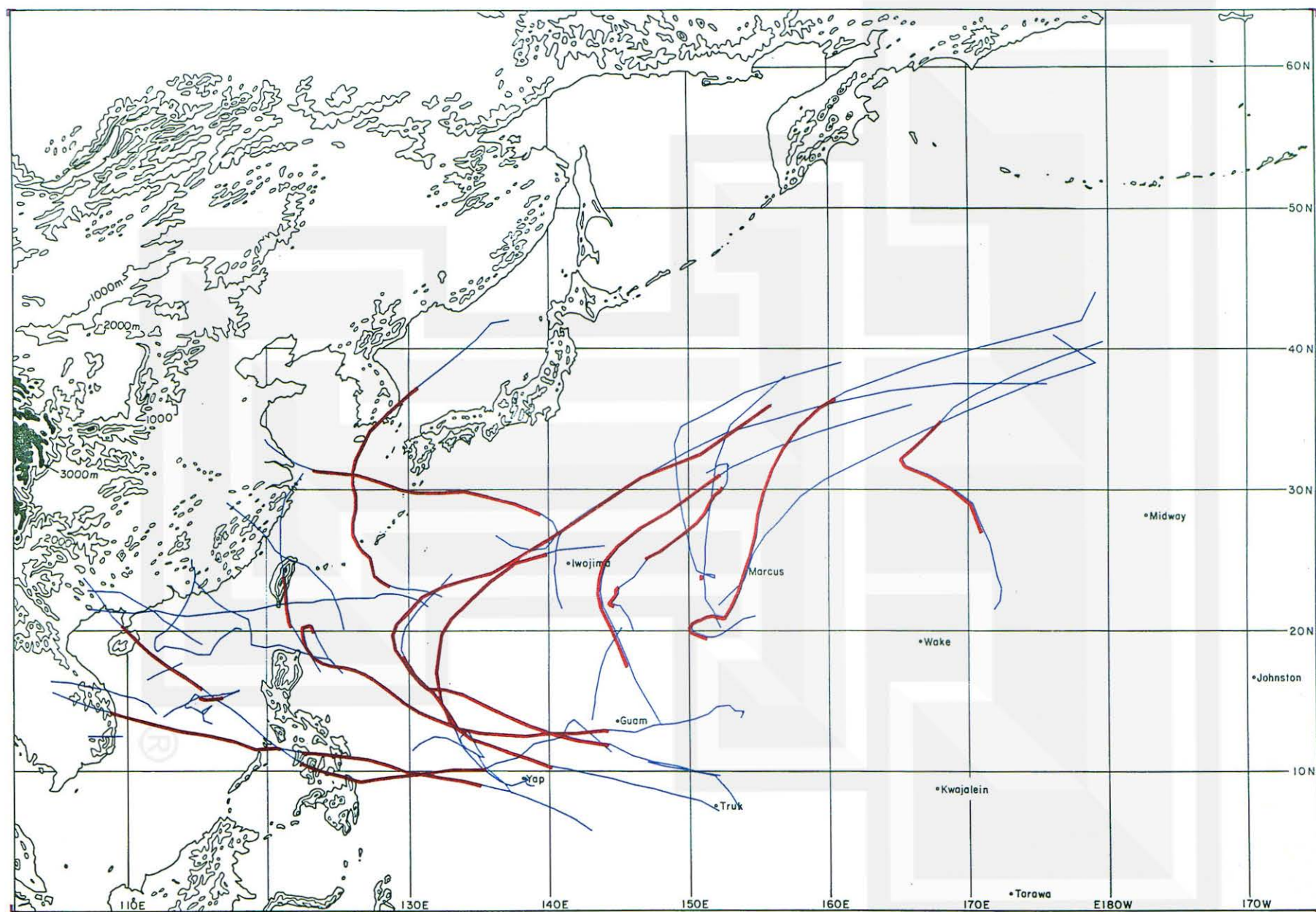


Storm Year: **1983**

EP-3 (Jul-Dec) SST Anomaly: **-0.2°C**

Number of All Typhoons: **23**

S+Typhoons: **11**

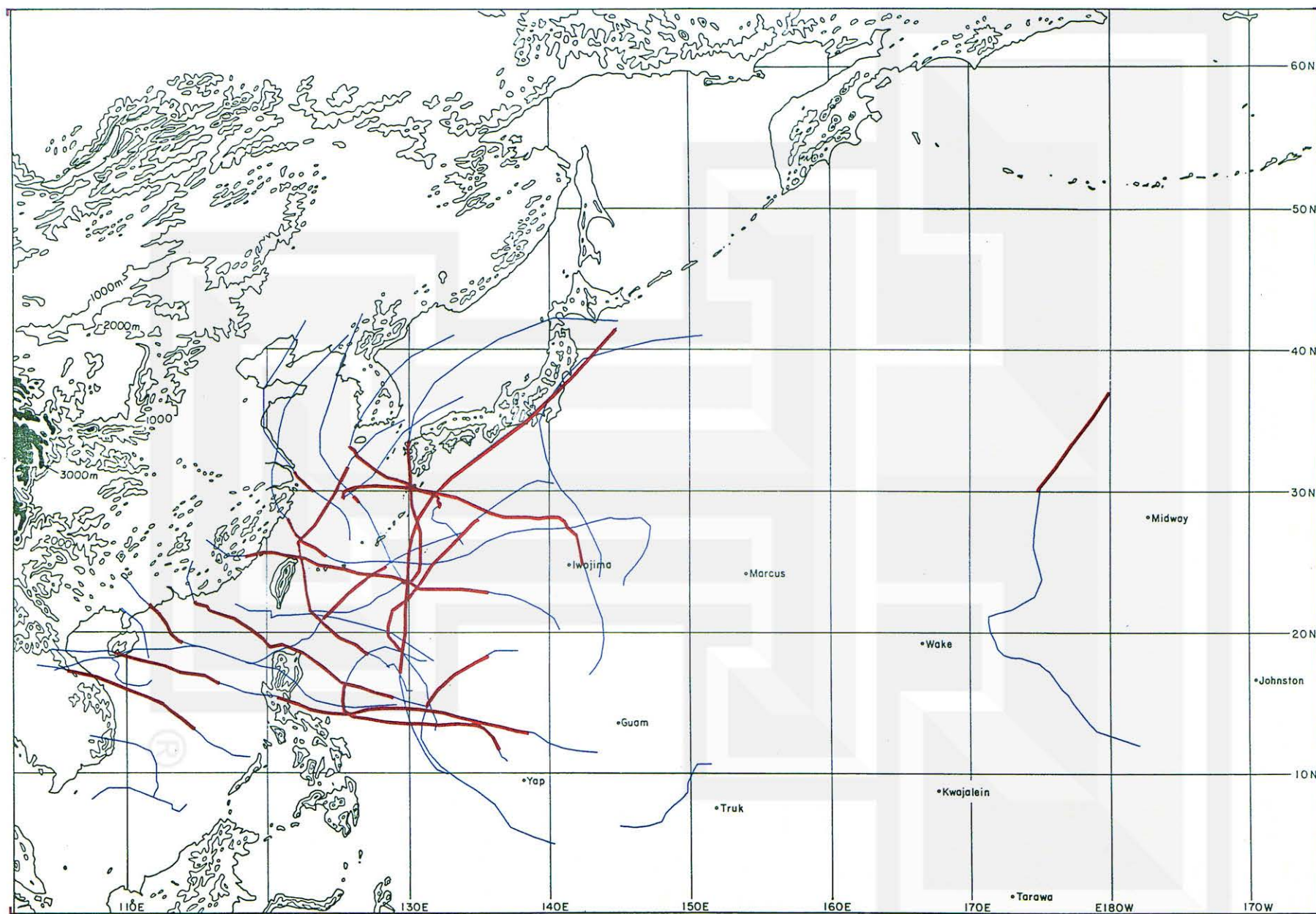


Storm Year: **1984**

EP-3 (Jul-Dec) SST Anomaly: **-0.3°C**

Number of All Typhoons: **28**

S+Typhoons: **15**

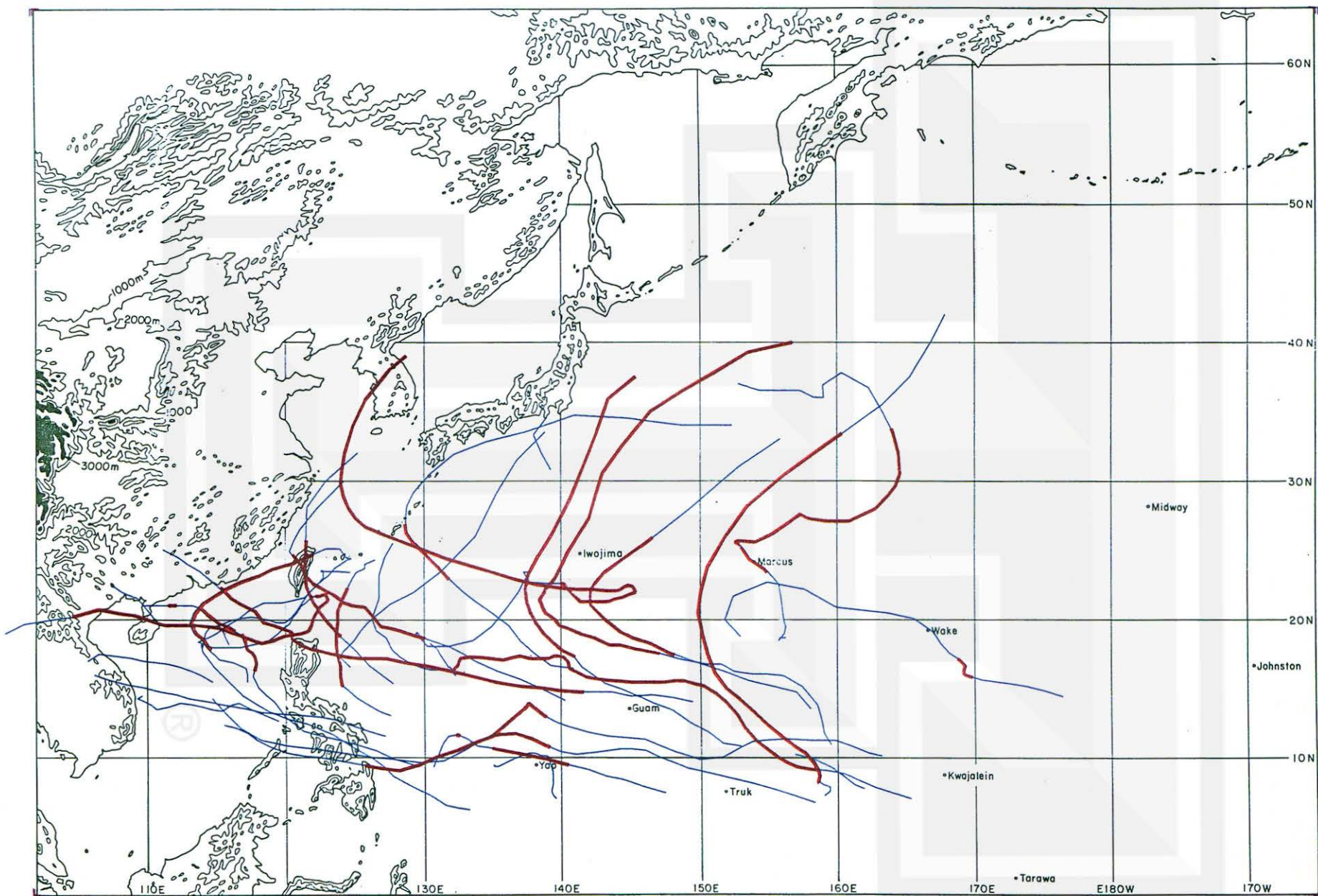


Storm Year: **1985**

EP-3 (Jul-Dec) SST Anomaly: **+0.1°C**

Number of All Typhoons: **26**

S+Typhoons: **18**

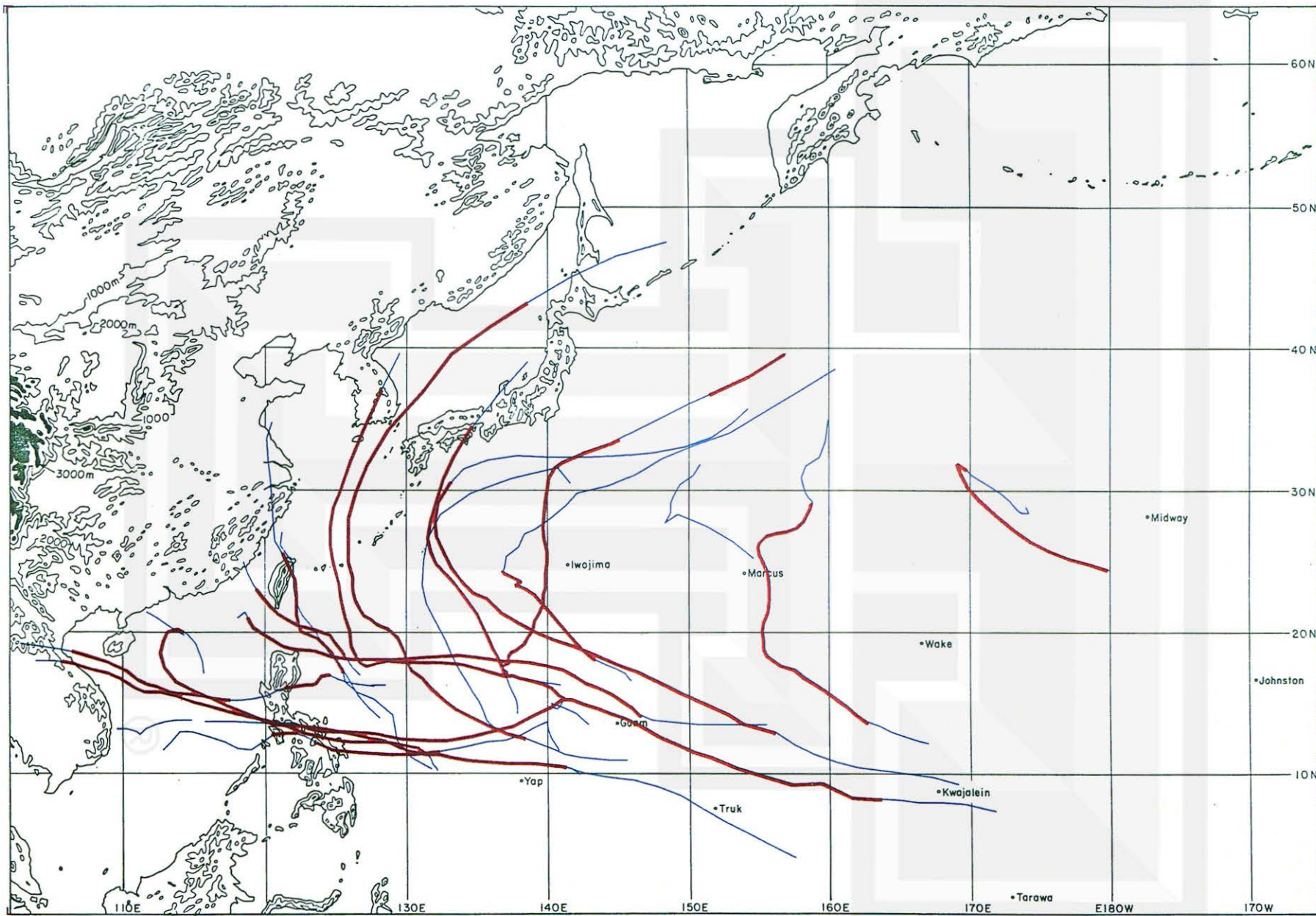


Storm Year: **1986**

EP-3 (Jul-Dec) SST Anomaly: **+0.6°C**

Number of All Typhoons: **29**

S+Typhoons: **18**

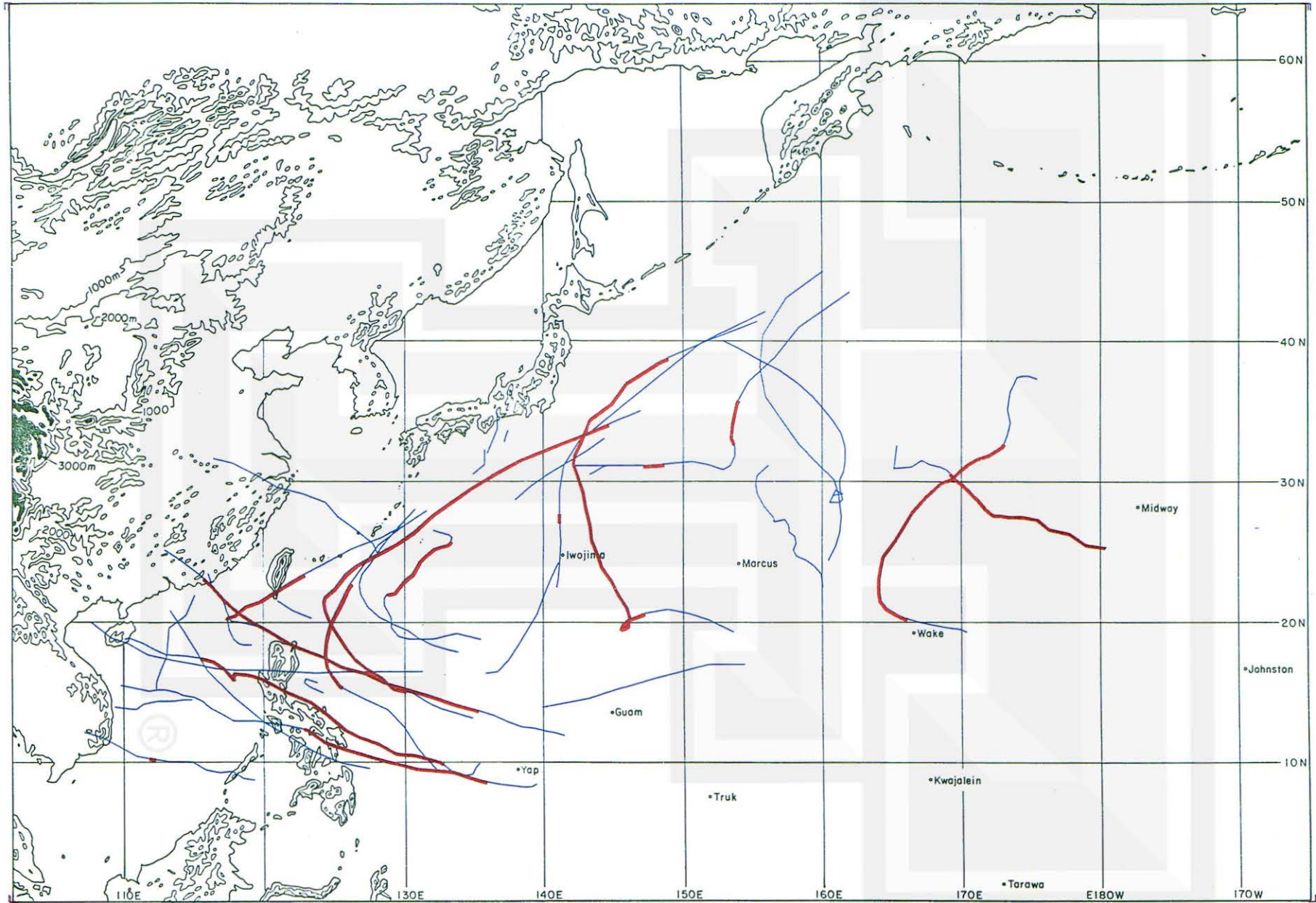


Storm Year: **1987**

EP-3 (Jul-Dec) SST Anomaly: **+1.0°C**

Number of All Typhoons: **23**

S+Typhoons: **16**

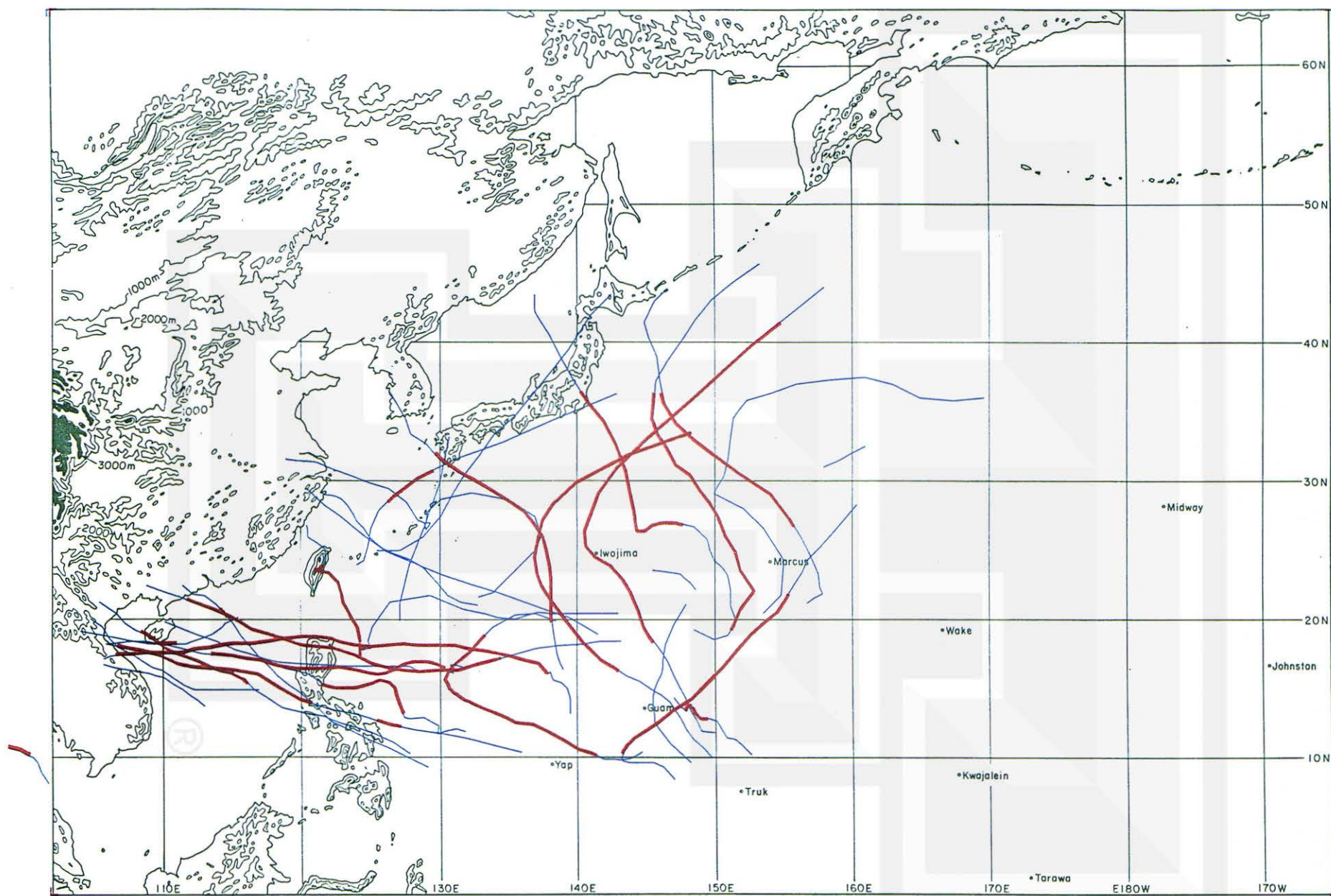


Storm Year: **1988**

EP-3 (Jul-Dec) SST Anomaly: **-1.0°C**

Number of All Typhoons: **31**

S+Typhoons: **13**

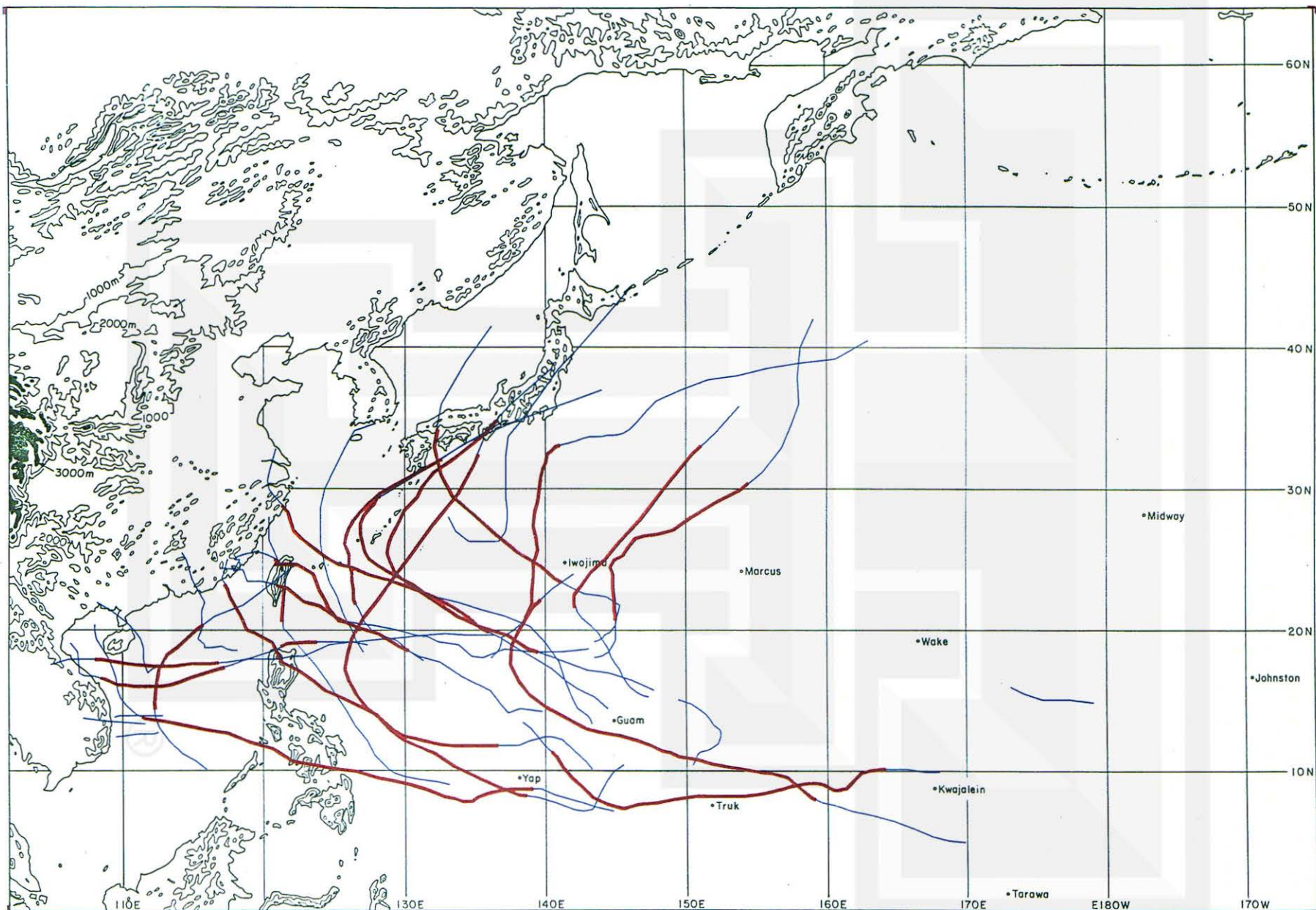


Storm Year: **1989**

EP-3 (Jul-Dec) SST Anomaly: **-0.2°C**

Number of All Typhoons: **32**

S+Typhoons: **22**

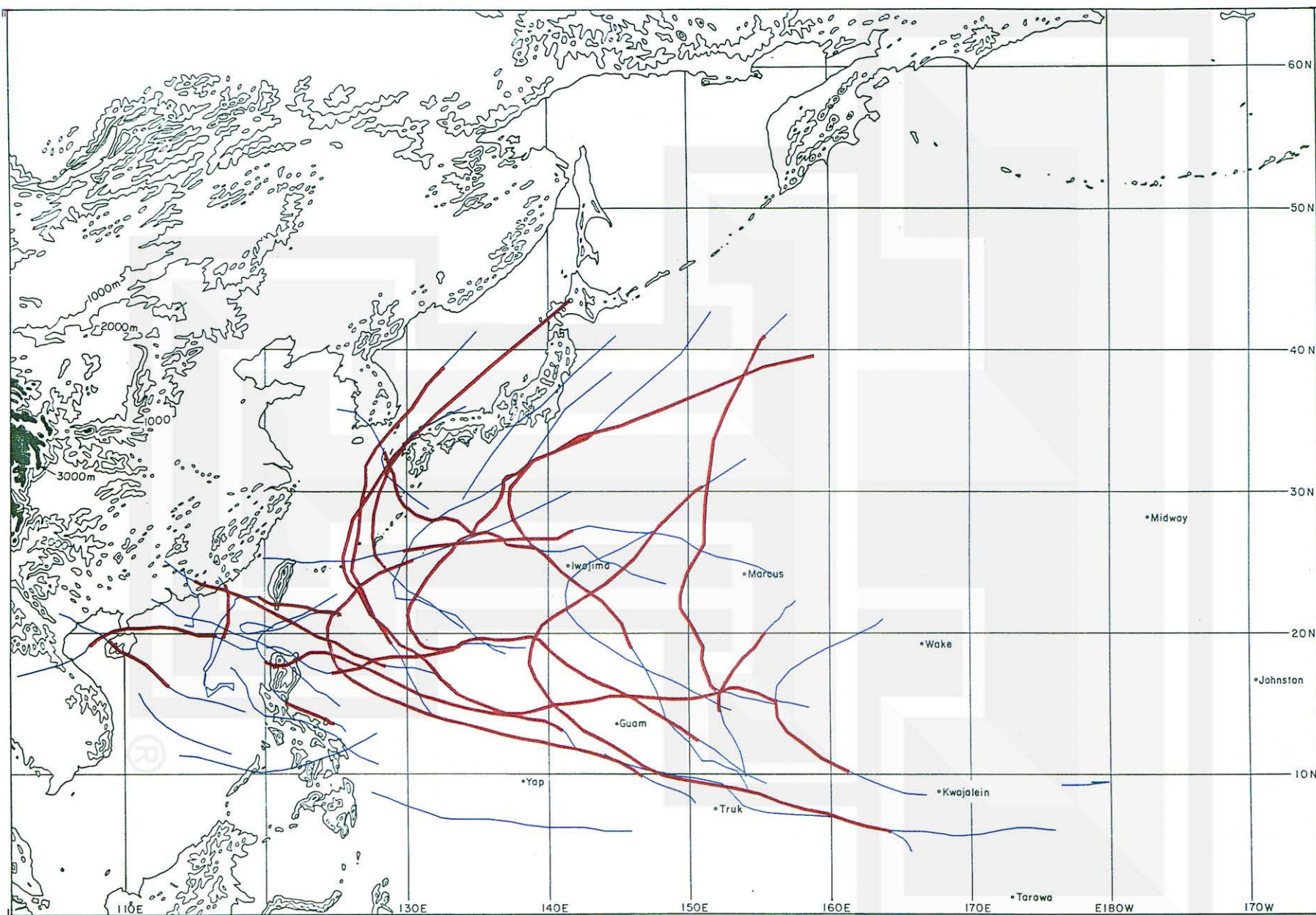


Storm Year: **1990**

EP-3 (Jul-Dec) SST Anomaly: **+0.7°C**

Number of All Typhoons: **28**

S+Typhoons: **20**

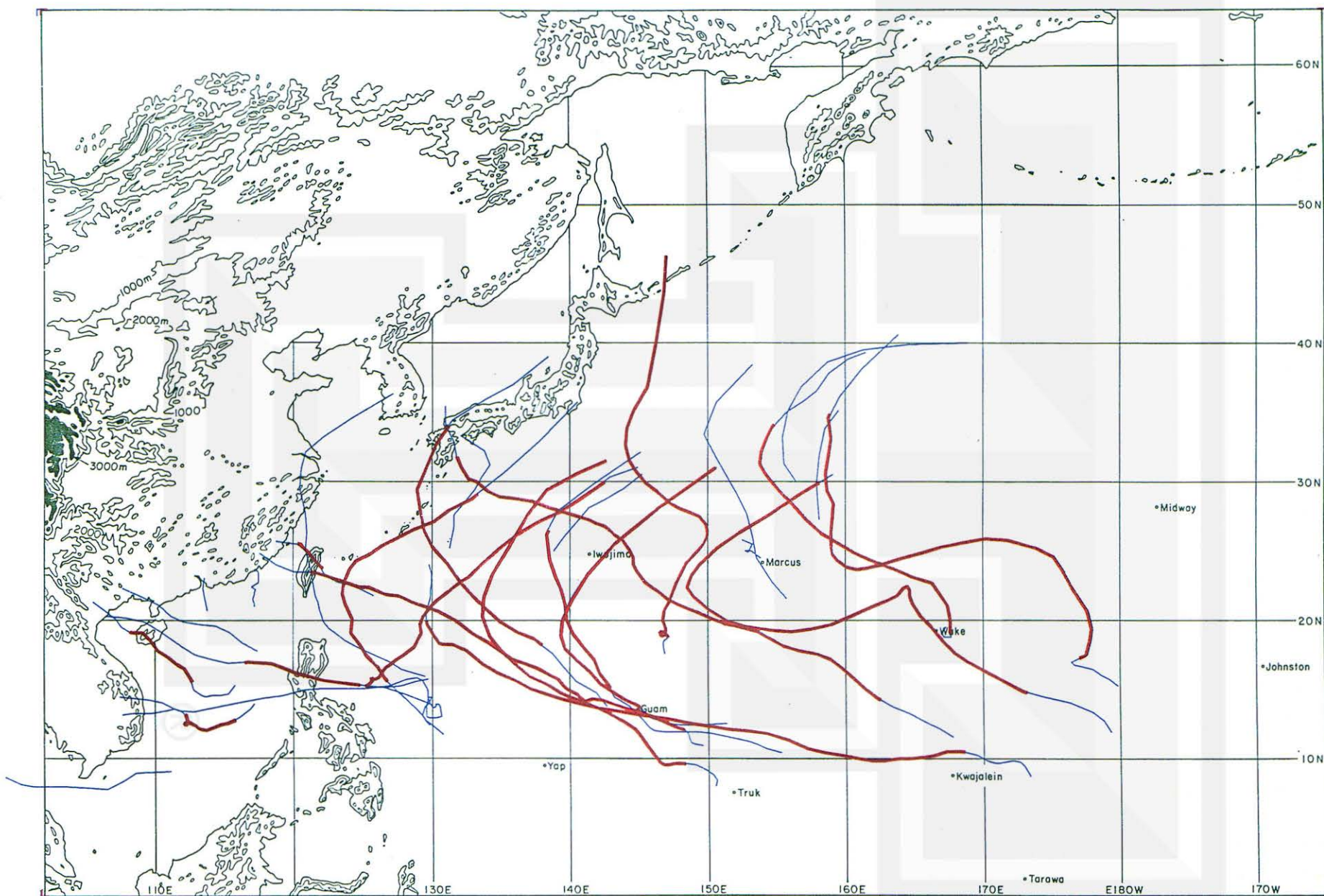


Storm Year: **1991**

EP-3 (Jul-Dec) SST Anomaly: **+1.0°C**

Number of All Typhoons: **31**

S+Typhoons: **19**

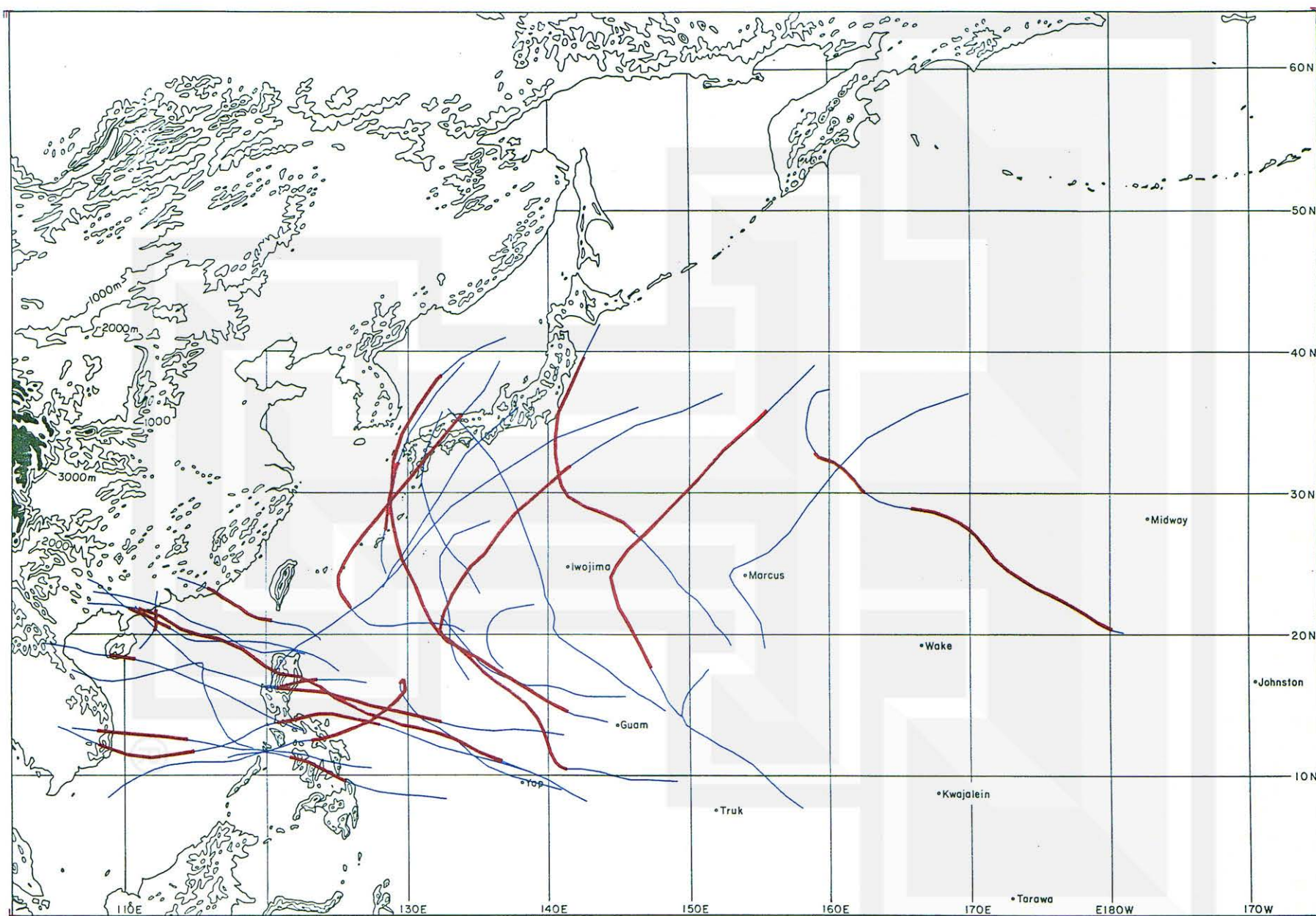


Storm Year: **1992**

EP-3 (Jul-Dec) SST Anomaly: **+0.5°C**

Number of All Typhoons: **29**

S+Typhoons: **17**

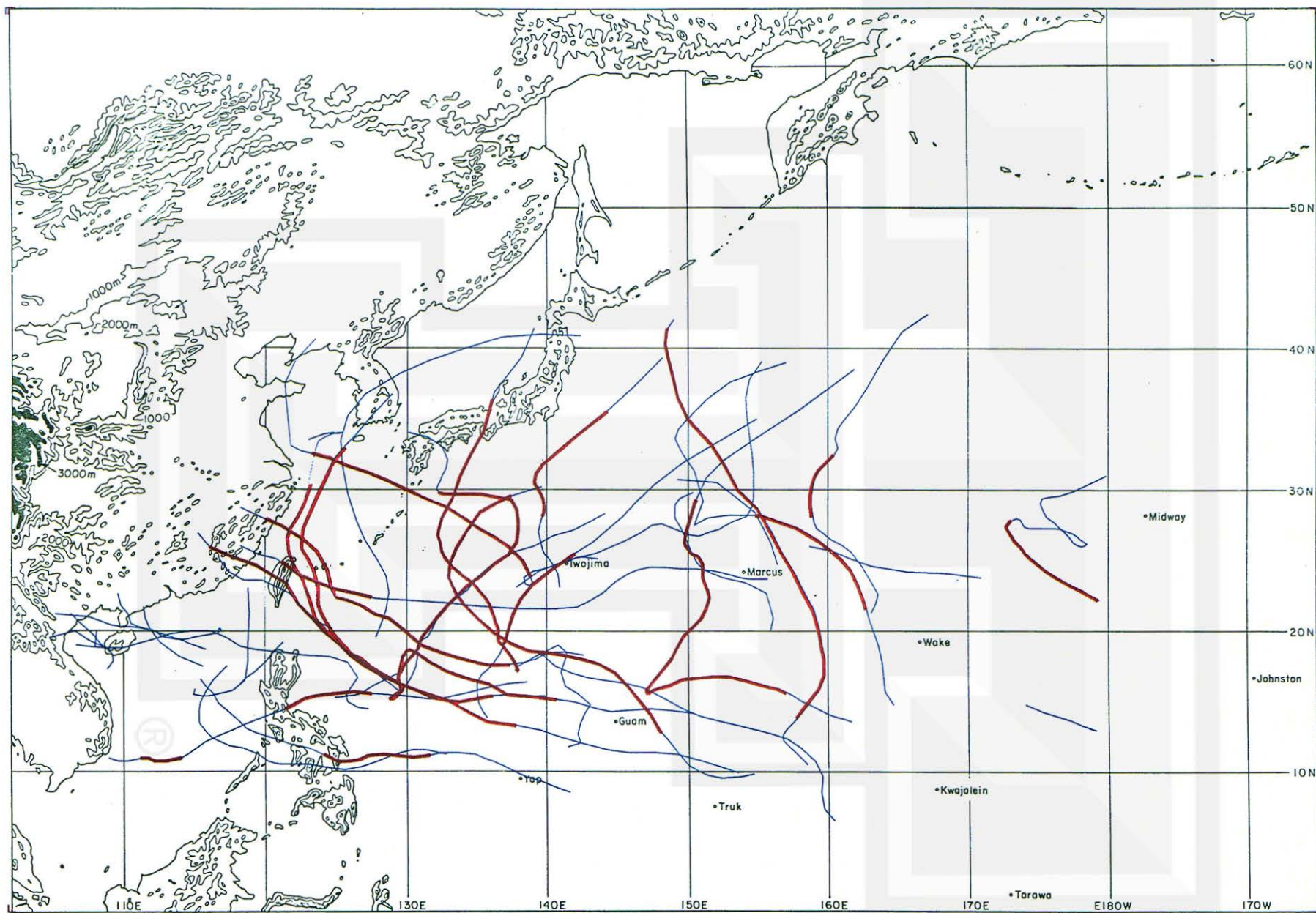


Storm Year: **1993**

EP-3 (Jul-Dec) SST Anomaly: **+0.5°C**

Number of All Typhoons: **28**

S+Typhoons: **18**



Storm Year: **1994**

EP-3 (Jul-Dec) SST Anomaly: **+1.0°C**

Number of All Typhoons: **36**

S+Typhoons: **19**