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NOAA Technical Memorandum NWS WR-160

EASTERN NORTH PACIFIC TROPICAL CYCLONE OCCURRENCES DURING INTRASEASONAL PERIODS

Salt Lake City, Utah
February 1981

U.S. DEPARTMENT OF COMMERCE / National Oceanic and Atmospheric Administration / National Weather Service

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99 A Study of Flash Flood Susceptibility--A Basin in Southern Arizona. Gerald Williams, August 1975. (COM-75-11360/AS)

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EASTERN NORTH PACIFIC TROPICAL CYCLONE OCCURRENCES DURING INTRASEASONAL PERIODS

Preston W. Leftwich and Gail M. Brown

National Hurricane Center
Miami, Florida
February 1981

UNITED STATES DEPARTMENT OF COMMERCE / NATIONAL OCEANIC AND ATMOSPHERIC ADMINISTRATION / National Weather Service
Richard E. Hallgren, Director

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This Technical Memorandum has been reviewed and is approved for publication by Scientific Services Division, Western Region.

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Scientific Services Division
Western Region Headquarters
Salt Lake City, Utah

CONTENTS

Abstract 1

1. Introduction 1

2. Data sources 2

3. Tracks and frequencies 3

4. Storm tracks 7

Acknowledgements 7

References 7

Appendix I. Tropical cyclone tracks by monthly periods,

May - November 9

Appendix II. Tropical cyclone tracks by 15-day periods,

May 16 - November 30 13

Appendix III. Tropical cyclone tracks by 10-day periods,

May 11 - November 30 20

EASTERN NORTH PACIFIC TROPICAL CYCLONE OCCURRENCES DURING INTRASEASONAL PERIODS

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ABSTRACT. In conjunction with development of statistical models for prediction of tropical cyclone motion in the Eastern North Pacific Ocean, the National Hurricane Center (NHC) has compiled tracks of tropical cyclones occurring during the period 1949-1979. This study presents computer plots of these storm tracks for intraseasonal periods ranging from ten days to one month. Basic statistics concerning storm frequencies are also included.

1. INTRODUCTION

Tropical cyclones in the Eastern North Pacific basin, as elsewhere, are categorized by their maximum sustained surface winds. Tropical depressions have winds less than 34 knots (63 km/h), tropical storms have winds from 34 to 63 knots (63-117 km/h), and hurricanes have winds greater than 63 knots (119 km/h). For the purposes of this study, the Eastern North Pacific basin extends from the coasts of the United States, Mexico, and Central America westward to 140° west longitude and from approximately 5° to 35° north latitude. During the period 1949-1979, 337 tropical cyclones reaching at least tropical storm strength have been documented.

Previous studies have been made concerning the climatology of Eastern North Pacific tropical cyclones for specific interests. Eidemiller (1978) presented frequencies of tropical cyclones affecting the southwestern United States and northwestern Mexico. Court (1980) discussed tropical cyclones which affected coastal areas during the first half of this century. Renard and Bowman (1976) described the climatology and forecasting of storms in this basin using data for the period 1965-1972. Hansen (1972) presented climatologies of frequency, duration, intensity, and areas of formation and dissipation. More general discussions of the origin and development of tropical cyclones in this region were offered by Gray (1968, 1975). Statistics concerning motion and frequencies of Eastern North Pacific tropical cyclones are contained in Crutcher and Quayle (1974).

Development of a statistical model, EPCLPR, based on climatology and persistence (Neumann and Leftwich 1977), was the initial motivation for compilation of these storm tracks. These tracks were also used in development of another statistical model, EPHC77 (Leftwich and Neumann 1977), which includes 500-mb geopotential heights as predictors. Recent work has led to additions of wind and central sea-level pressure data to corresponding storm positions. Compiled

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[1] *Current affiliation: Student, Pennsylvania State University.*

[2] *Study partially supported by NOAA/ERL-AOML-National Hurricane Research Laboratory (NHRL).*

data have been stored on a computer card deck and a magnetic tape in a format described by Jarvinen and Caso (1978) for Atlantic tropical cyclones. These data will be available through the National Climatic Center, which is located in Asheville, North Carolina.

2. DATA SOURCES

Information used in preparation of charts and figures was extracted from the recently compiled data set. Basic storm tracks for the period 1949-1975 were acquired from the United States Navy in Monterey, California. Initially, storm positions were given at 12-h intervals. Interpolations of positions to 6-h intervals were made by use of a scheme devised by Akima (1970), with some subjective modifications. From 1976-1979, storm tracks were prepared by the Eastern Pacific Hurricane Center (EPHC) located in Redwood City, California. All tracks are smoothed so that they represent the large-scale motion of the storm's circulation. A thorough review of these storm tracks was made by Arnold Court under contract[3] from the National Weather Service. His work concentrated on extensions of tracks inland and resulted in additions and/or modifications to 81 storm tracks included in our original data set. A final review, including checks for consistency as well as errors, was made once the data had been placed in our card deck.

Before the advent of operational meteorological satellites, land stations, ships at sea, and aerial reconnaissance reports provided information on tropical cyclones in the Eastern North Pacific basin. The greatest number of reports was received from ships at sea. Generally, these ships were traveling in the periphery of a storm's circulation, and the distance to the storm's center was unknown. As warnings became better, even fewer ships encountered the central regions of storms. Aerial reconnaissance was infrequent and concentrated into periods when a storm was threatening land areas. Passage of a storm directly over a land station was also infrequent. Undoubtedly, some weaker and short-lived storms in remote oceanic areas were not detected. Prior to 1965, tracks were only documented for tropical storms and hurricanes. From 1965-1979, depression stages have been included for both formative and dissipative stages. Tracks of all tropical depressions that did not reach at least tropical storm intensity have been excluded.

The first location of a tropical cyclone in the Eastern North Pacific Ocean by satellite was made by TIROS III on July 19, 1961 (Mull 1962). As in other tropical cyclone basins, advent of operational satellite coverage greatly increased the capability for detecting and tracking of storms. This is supported by the increase in the mean number of observed tropical cyclones per year from 8.6 for 1949-1964 to 14.6 for 1965-1979.

Classification of maximum intensity as hurricane versus tropical storm was not made prior to 1954. Intensity at various stages of the tracks was not documented until 1965, but development of techniques to estimate winds from satellite pictures has greatly enhanced availability of wind data in recent

[3] *Contract NA-79-WD-C-00006.*

years. Most wind speeds appearing in our data set were either taken from official advisories issued by the EPHC or estimated from information published in annual summaries appearing in the Monthly Weather Review or Mariners Weather Log.

3. TRACKS AND FREQUENCIES

Figure 1 is a computer plot of all tropical cyclone tracks in the recently compiled data set. Although little detail for individual storms is shown, such presentation depicts both the concentration and range of storm tracks in the Eastern North Pacific basin. Tracks of storms which developed in the Eastern North Pacific basin and moved west of 140°W are truncated at 140°W.

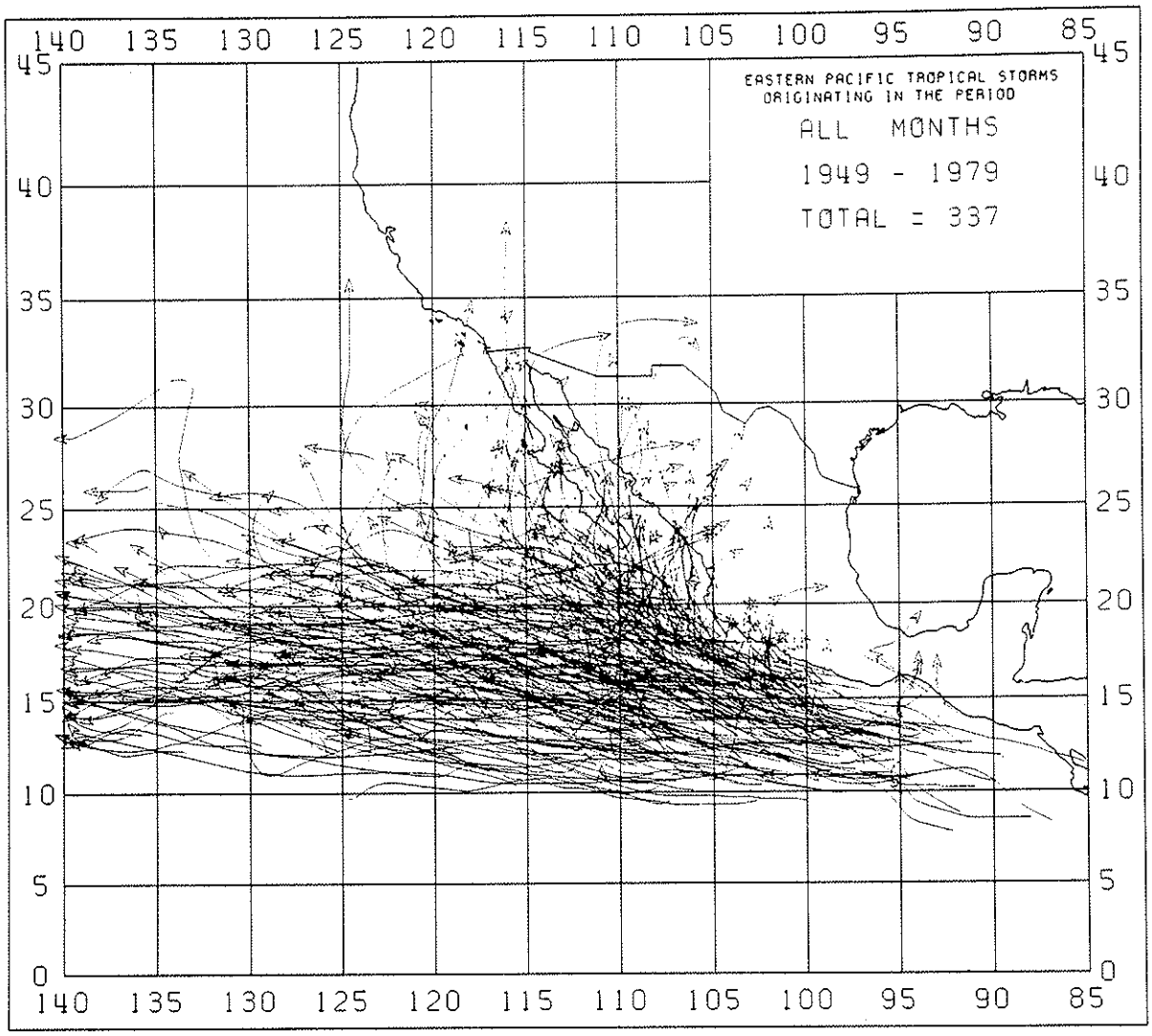

Figure 1. Computer plot of tracks of 337 Eastern North Pacific tropical cyclones during the 31-year period 1949 through 1979.

Figure 2 presents frequencies of storm occurrence for each year from 1949 to 1979. Prior to 1954, no distinctions were made between hurricanes and tropical storms. Storms reaching hurricane intensity are counted as tropical storms as well. For example, during 1974, 18 storms reached tropical storm strength and 11 of these also reached hurricane strength. The increase in number of storms observed after 1964 is evident in the graph. Peak tropical storm occurrence was 19 in both 1970 and 1978, and the peak hurricane occurrence was 13 in 1978. Only four tropical storms were recorded in 1953 and one hurricane was recorded in 1955, 1964 and 1965.

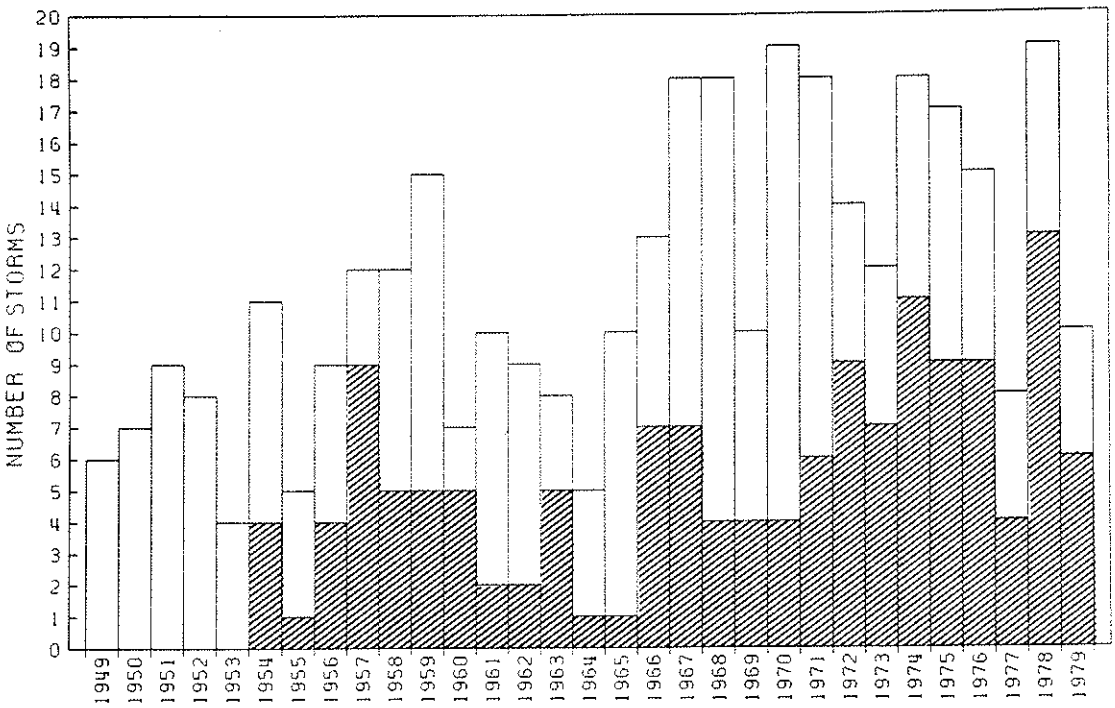

Figure 2. Annual distribution of 337 recorded tropical cyclones reaching at least tropical storm strength (open bar) and hurricane strength (shaded bar), 1949-1979.

Figures 3 and 4 depict the daily incidence of tropical cyclones in the Eastern North Pacific for the eight-month period May-December. If two storms existed on a given day, two storm occurrences were counted for that day. Frequencies have been smoothed (Figure 4) using a 15-day moving average in order to remove much of the "noise" inherent in the original data, but still retain larger-scale cycles. These smoothed frequencies indicate a general increase from mid-May to mid-July, with a slight drop in frequencies during the last half of June. A sharper drop in frequencies occurs during late July before an increase to the seasonal maximum near the end of August. This peak in daily frequencies occurs when both the number of storms and the lengths of

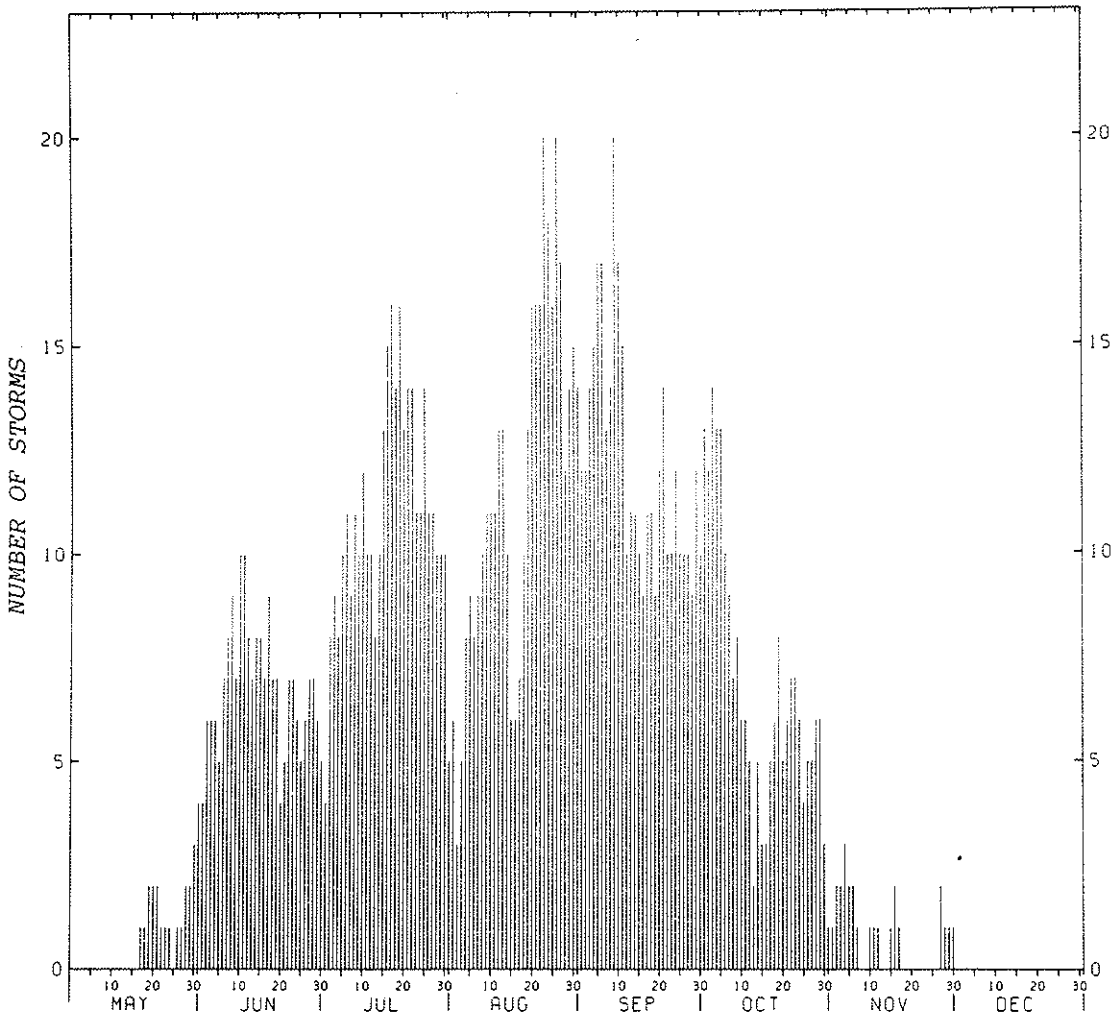

Figure 3. Number of tropical cyclones of at least tropical storm strength observed on each day, May 1 - December 31, 1949-1979.

their tracks are near maxima. Frequencies then show a general decline for the remainder of the season. These data may be compared to similar computations presented by Neumann et al. (1978) for the Atlantic basin.

Figure 5 shows cumulative frequencies of beginning and ending dates of the Eastern North Pacific tropical storm seasons for the period 1949-1979. Data are the first and last days of each year on which at least one tropical storm or hurricane existed. Mean season length is 134 days. A summary of these statistics is given in Table 1.

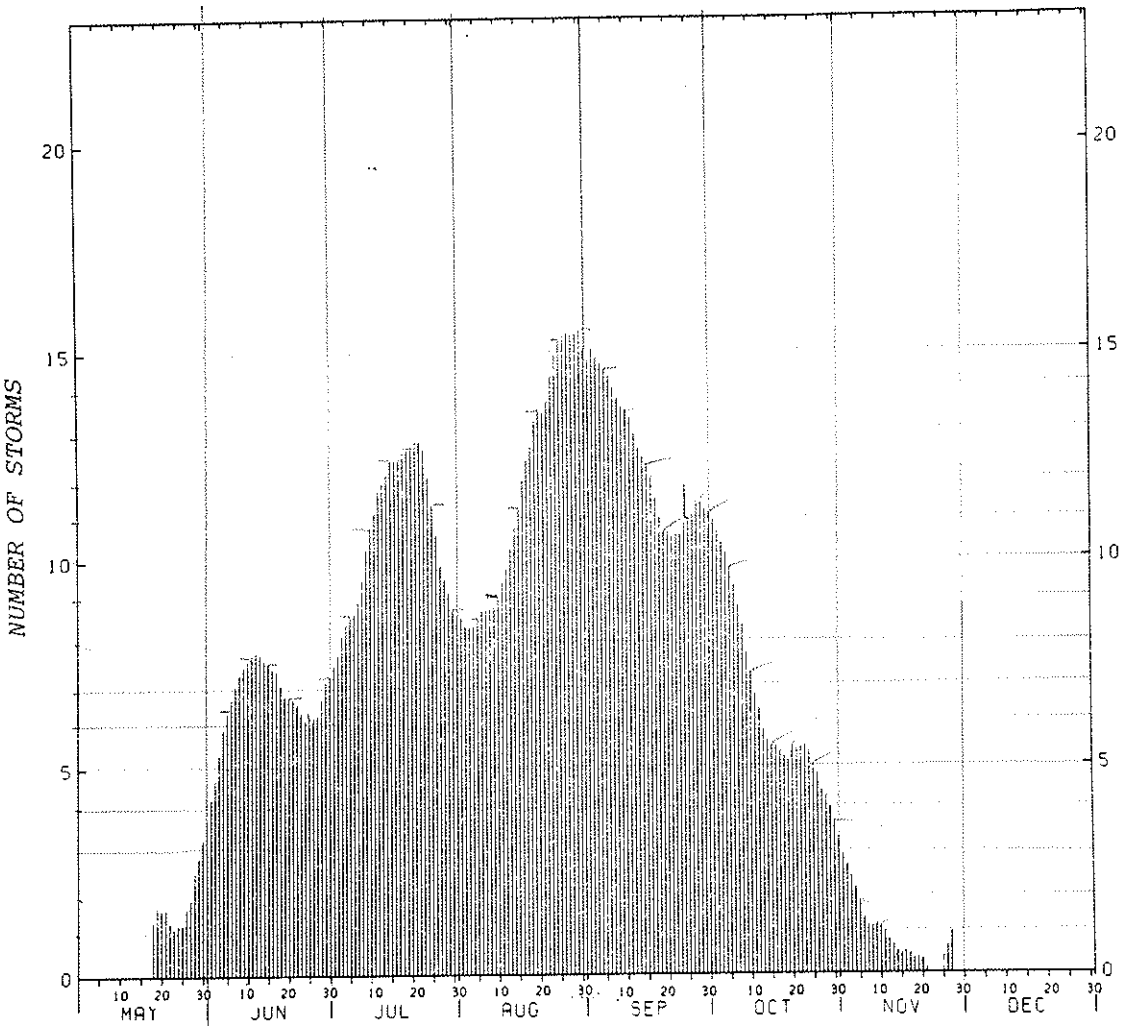

Figure 4. Same as Figure 3, but data smoothed by a 15-day moving average.

Table 1. Statistics concerning beginning and ending dates of Eastern North Pacific tropical cyclone seasons, 1949-1979.

	Beginning Date	Ending Date
Earliest	May 17	September 5
Latest	August 25	November 30
Mean	June 12	October 22
Median	June 7	October 19
Standard Deviation	20 days	18 days

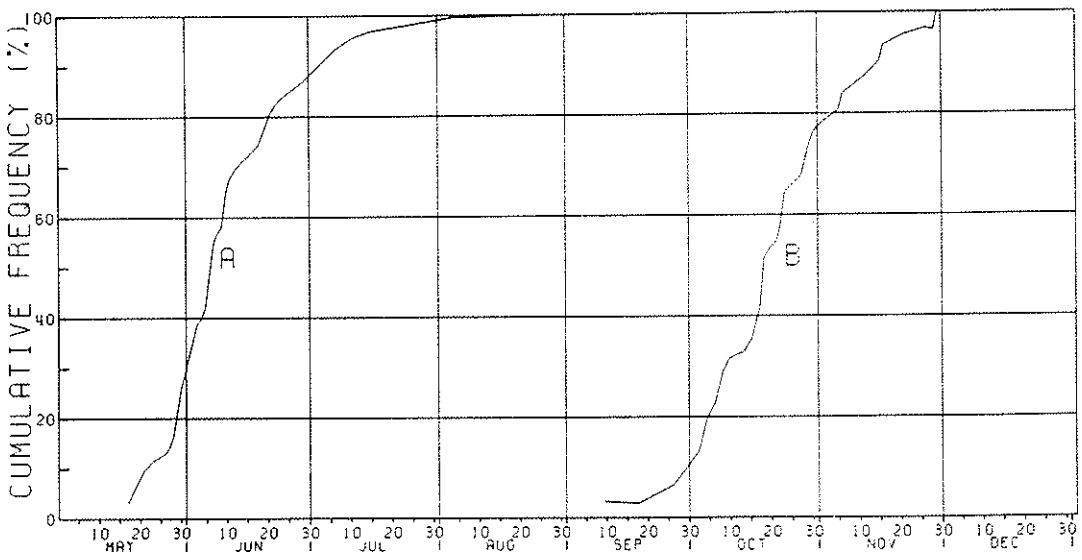

Figure 5. Cumulative frequency distribution of beginning (A) *and ending* (B) *dates of Eastern North Pacific tropical cyclone seasons, 1949-1979.*

4. STORM TRACKS

The various charts on the following pages present tropical cyclone tracks for several intraseasonal periods. These charts were produced on the NOAA FR-80 computer graphics system. Their purpose is graphical depiction of seasonal variations of characteristics of tropical cyclone tracks in the Eastern North Pacific basin. Storms are in the respective periods according to their first day of existence as documented in our compiled data set. No other identification is assigned to individual tracks. Appendix I presents storm tracks for monthly periods from May through November. Similar charts follow for 15-day (Appendix II) and 10-day (Appendix III) periods.

ACKNOWLEDGMENTS

The authors thank Sherri Morris and Brian Jarvinen for help in producing computer plots of storm tracks. Judy Kraus provided technical assistance in production of this report. Charles J. Neumann, Chief of the NHC Research and Development Unit, offered helpful comments.

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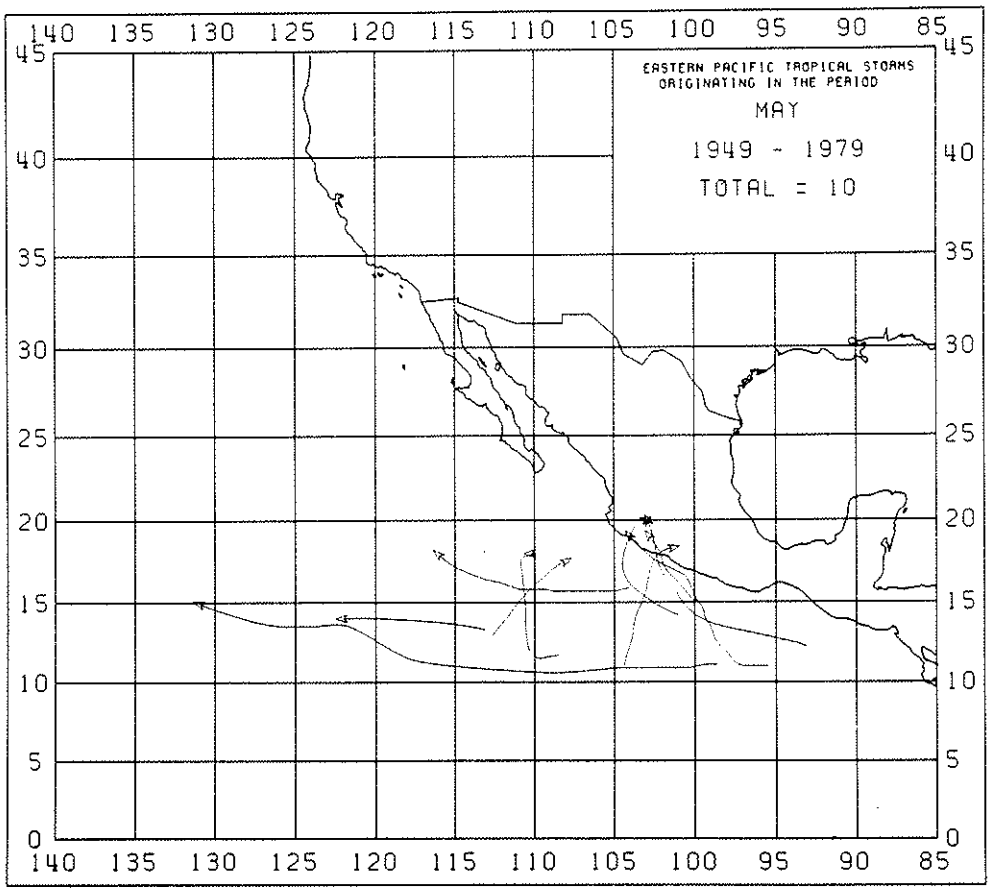
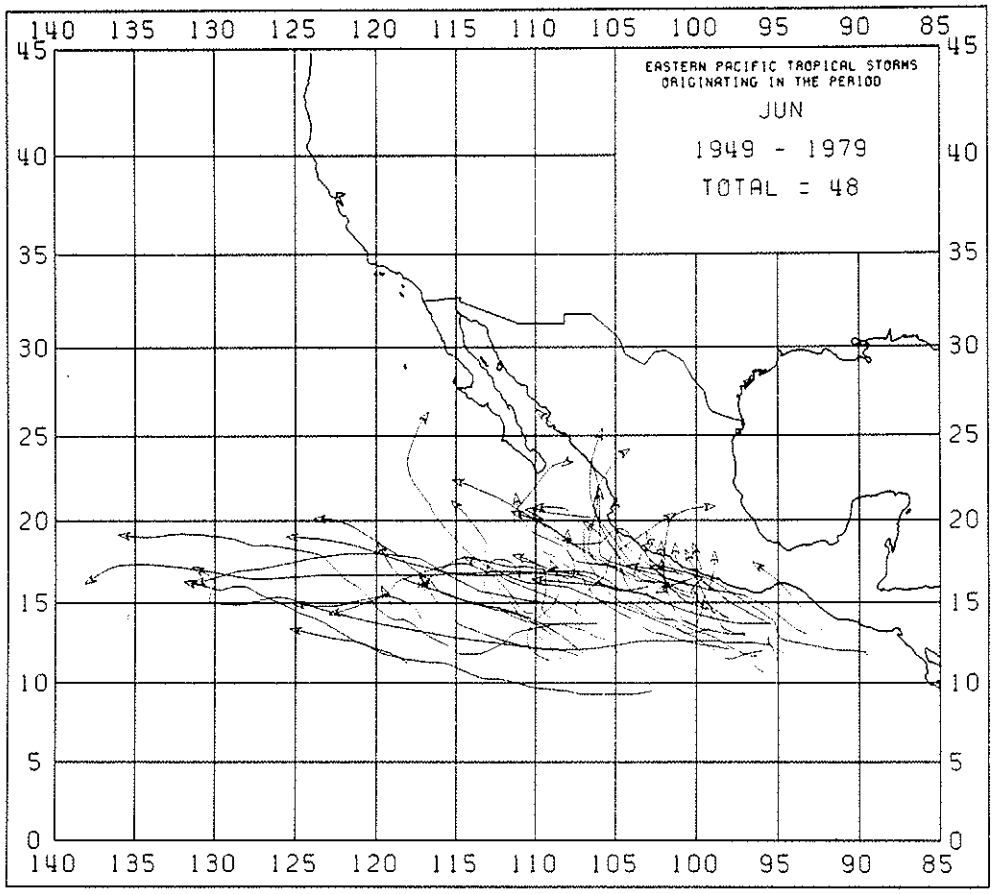
APPENDIX I

TROPICAL CYCLONE TRACKS BY MONTHLY PERIODS, MAY - NOVEMBER




EASTERN PACIFIC TROPICAL STORMS
ORIGINATING IN THE PERIOD
JUN
1949 - 1979
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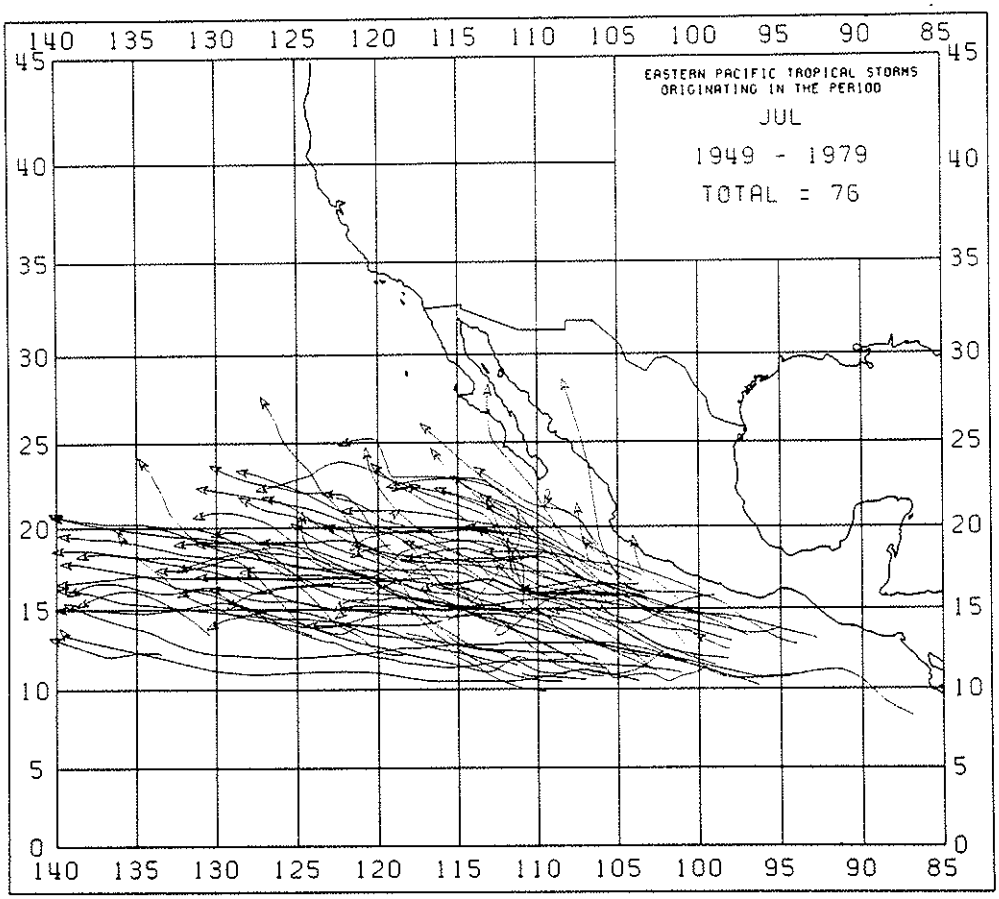
EASTERN PACIFIC TROPICAL STORMS
ORIGINATING IN THE PERIOD
JUL
1949 - 1979
TOTAL = 76
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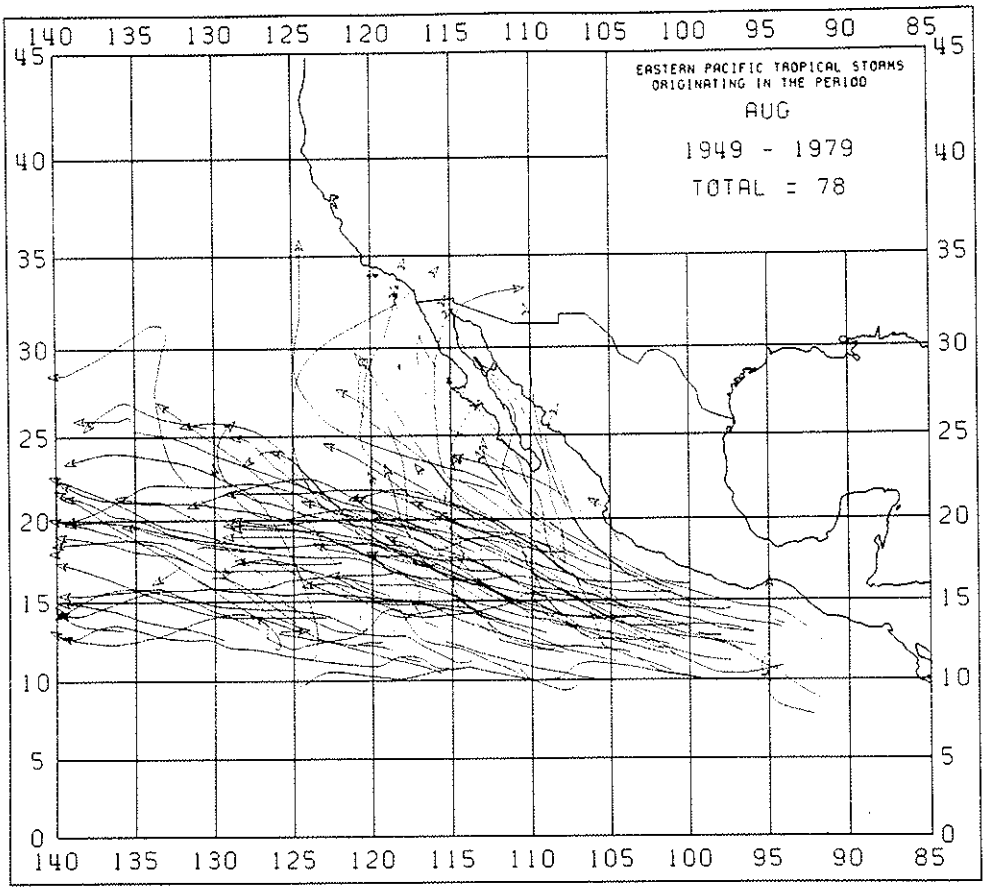
EASTERN PACIFIC TROPICAL STORMS
ORIGINATING IN THE PERIOD
AUG
1949 - 1979
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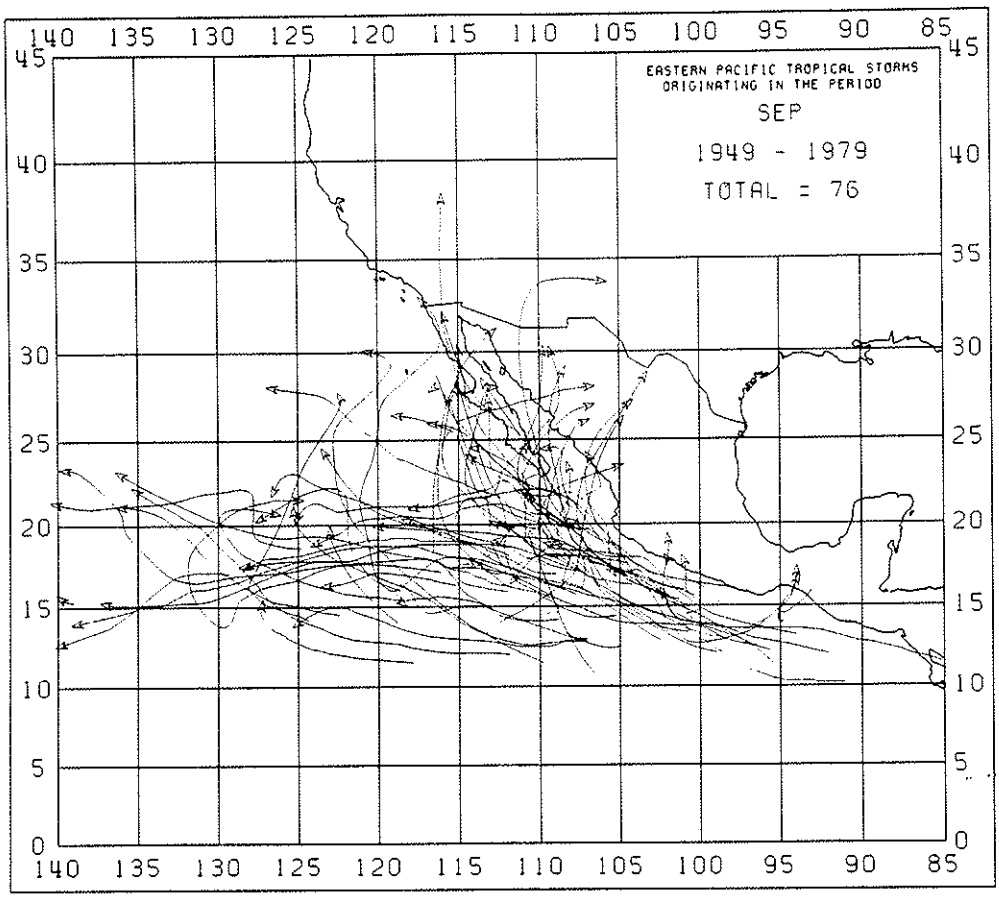
EASTERN PACIFIC TROPICAL STORMS
ORIGINATING IN THE PERIOD
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1949 - 1979
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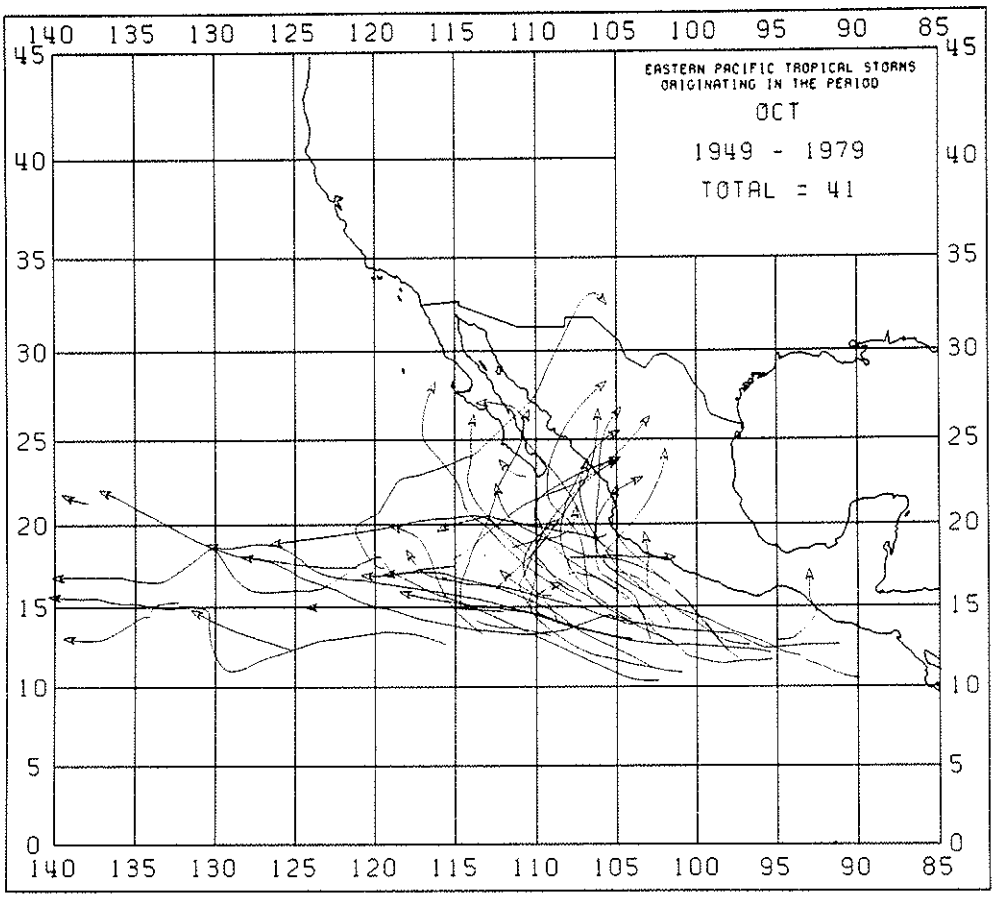
EASTERN PACIFIC TROPICAL STORMS
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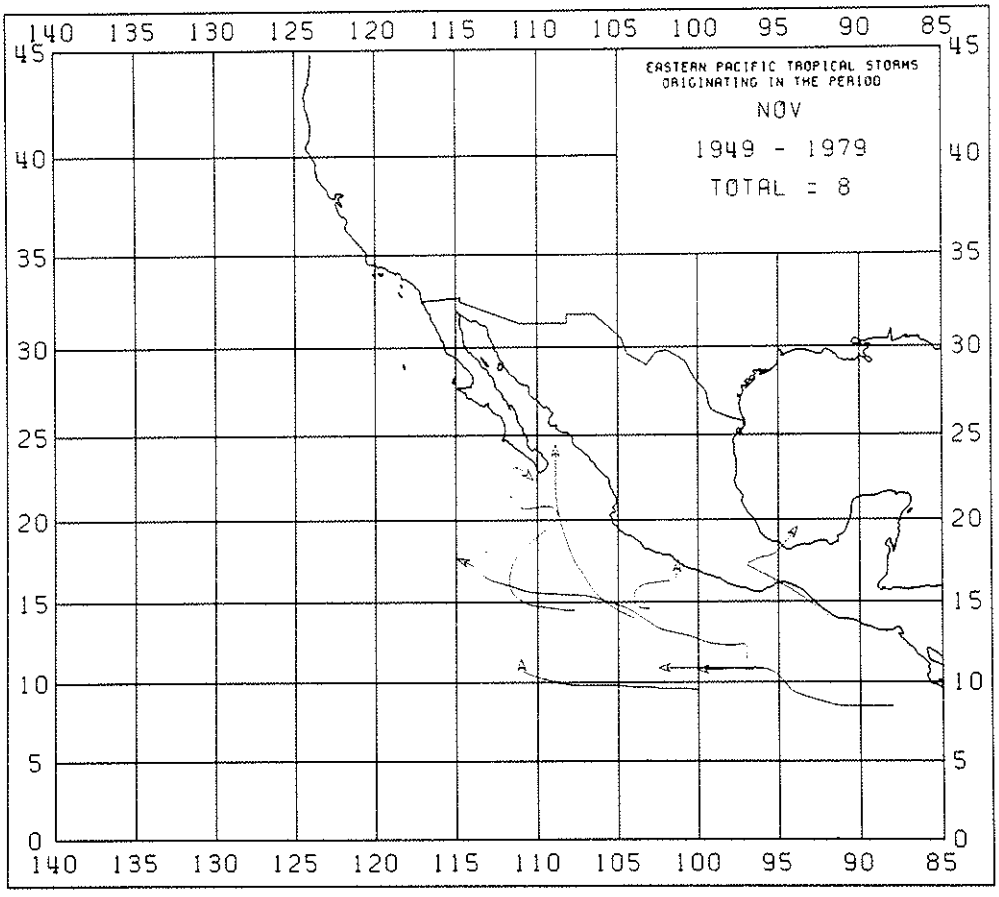
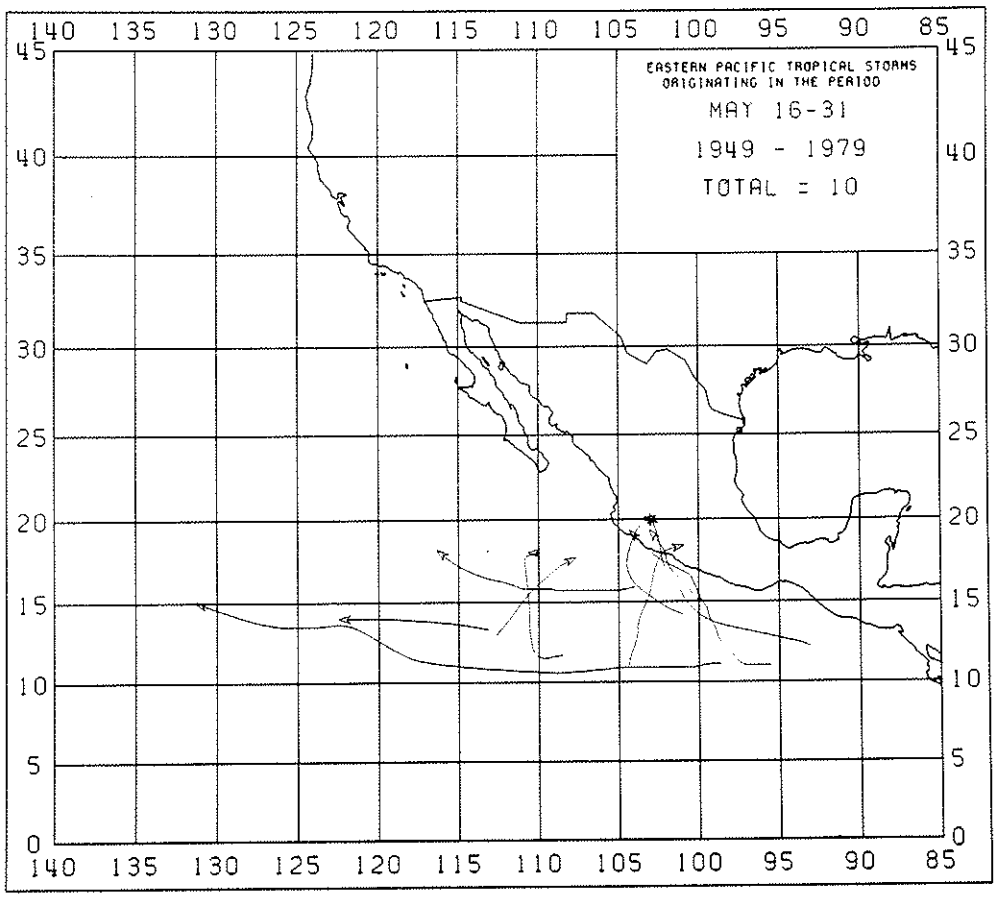
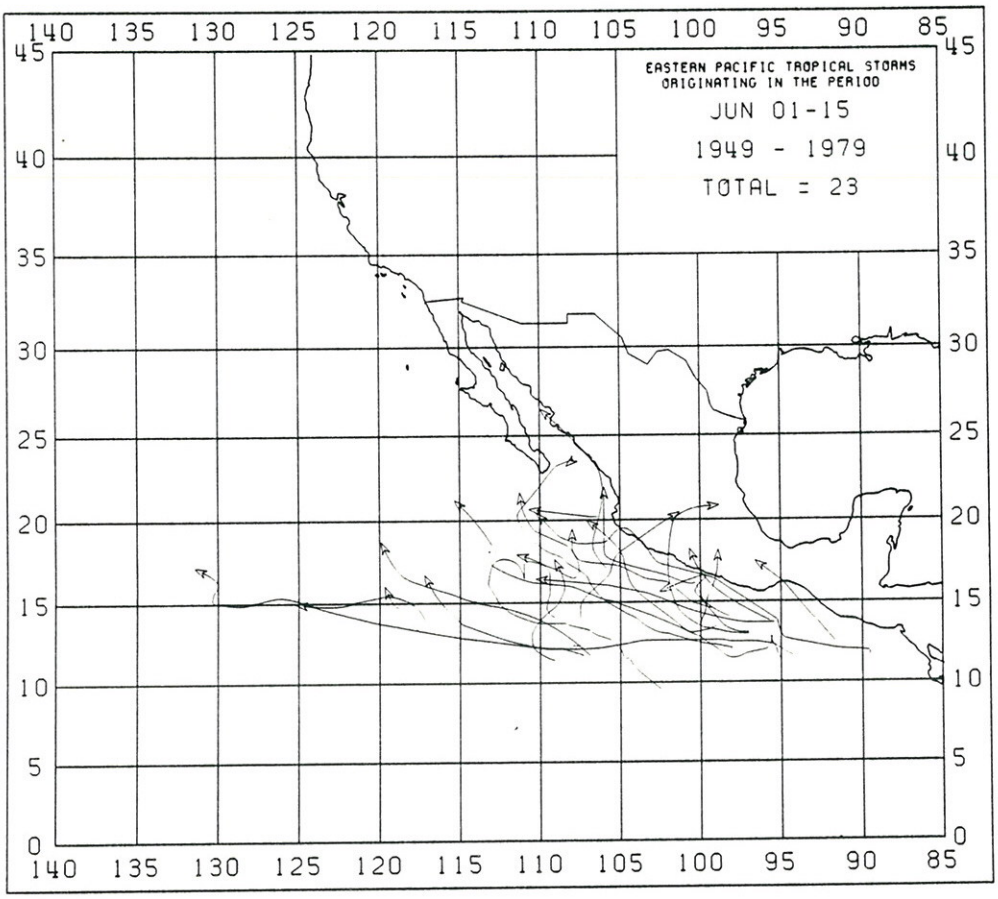

EASTERN PACIFIC TROPICAL STORMS
ORIGINATING IN THE PERIOD
NOV
1949 - 1979
TOTAL = 8
140 135 130 125 120 115 110 105 100 95 90 85
45 40 35 30 25 20 15 10 5 0

APPENDIX II

TROPICAL CYCLONE TRACKS BY 15-DAY PERIODS, MAY 16 - NOVEMBER 30

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ORIGINATING IN THE PERIOD
JUN 01-15
1949 - 1979
TOTAL = 23
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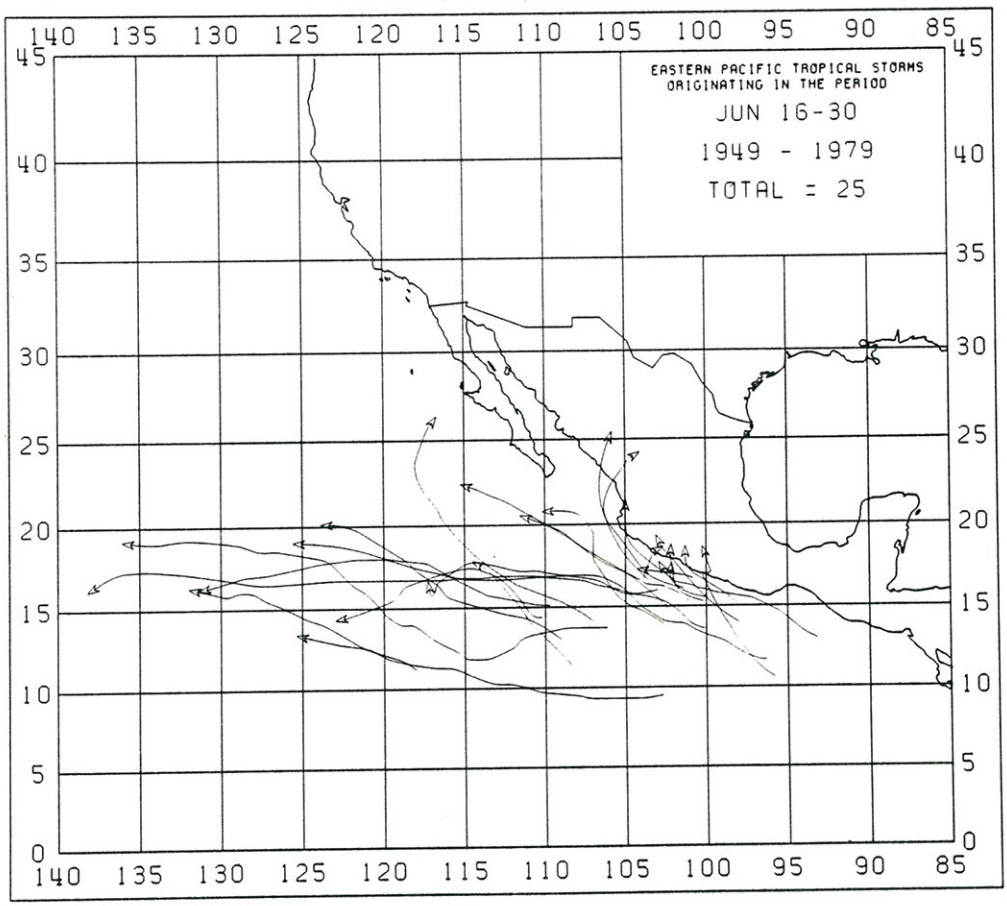
EASTERN PACIFIC TROPICAL STORMS
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JUN 16-30
1949 - 1979
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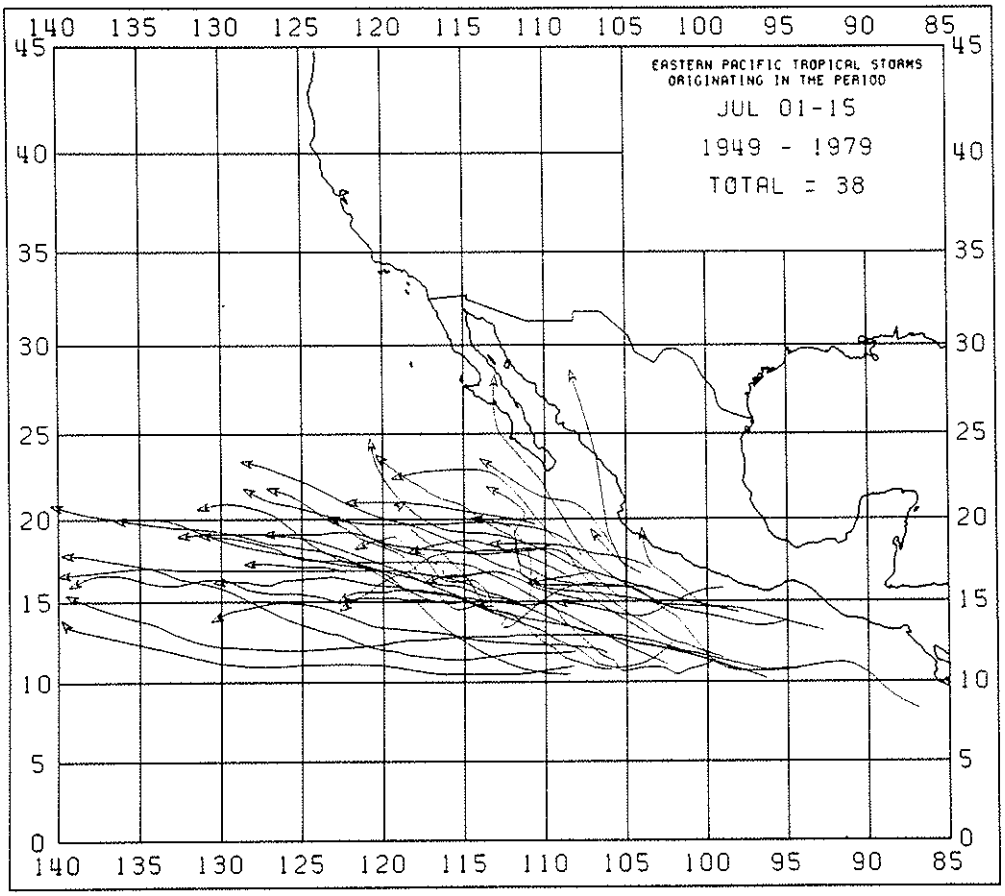
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1949 - 1979
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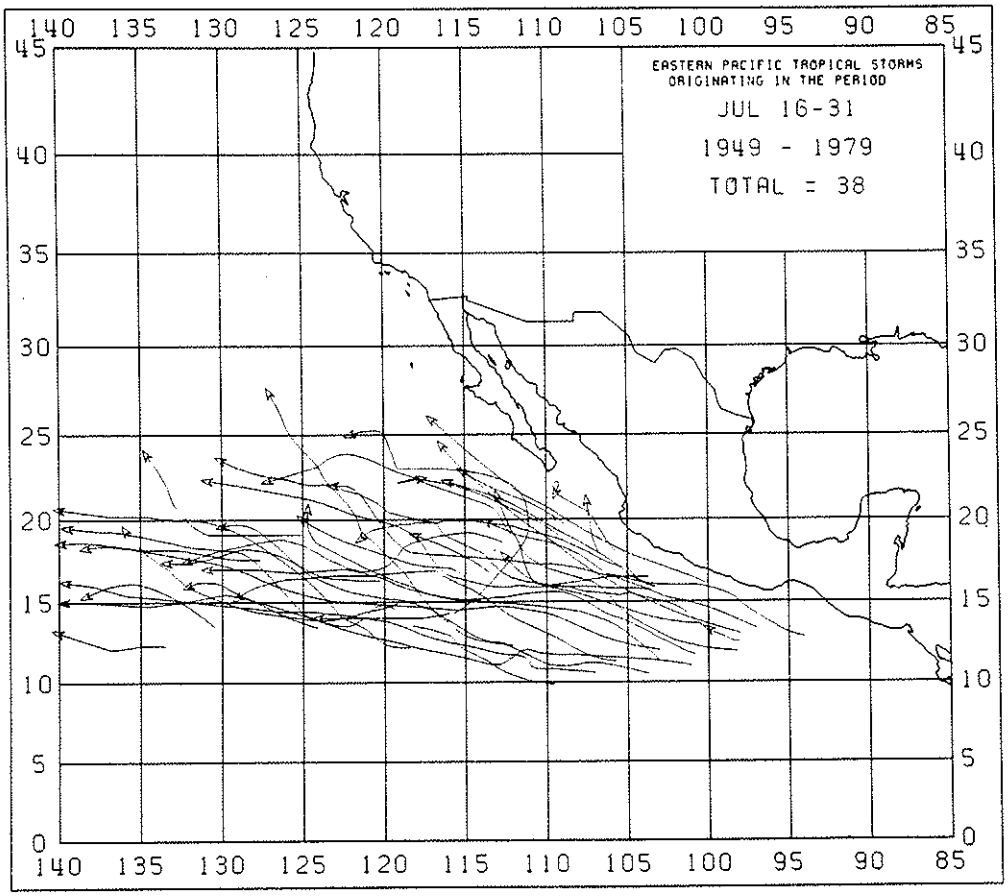
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JUL 16-31
1949 - 1979
TOTAL = 38
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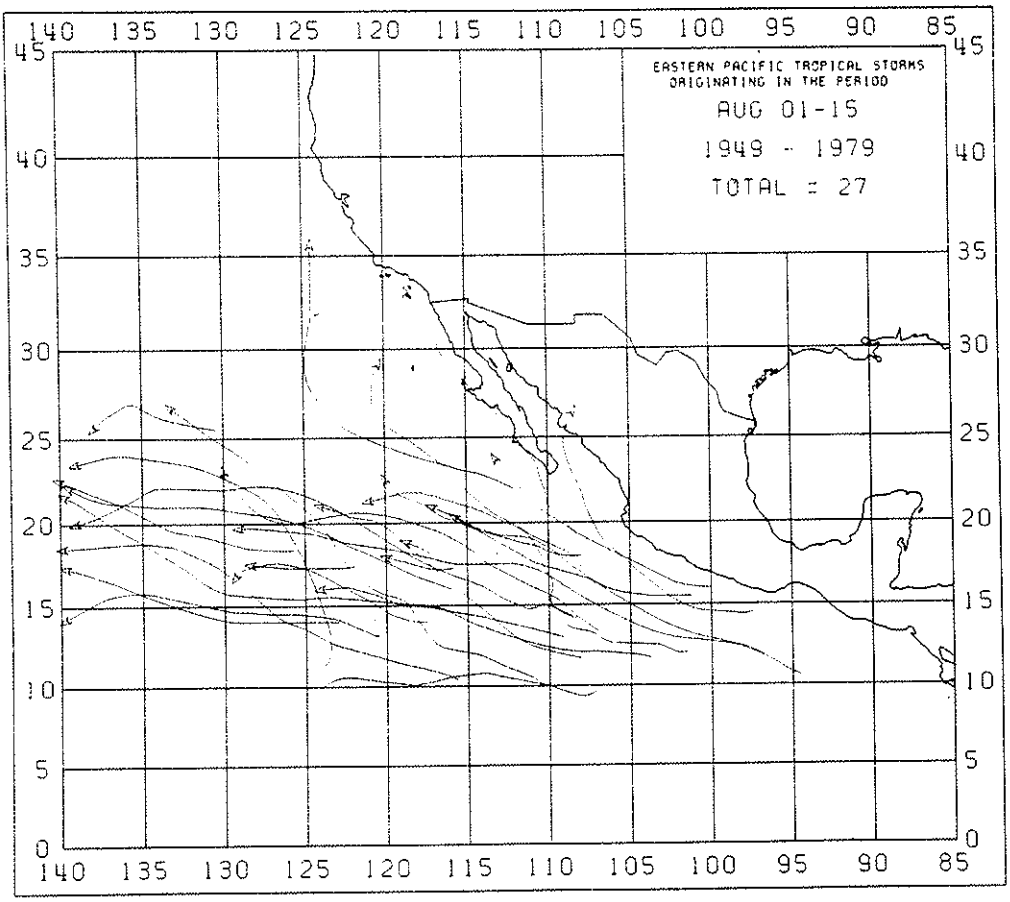
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AUG 01-15
1949 - 1979
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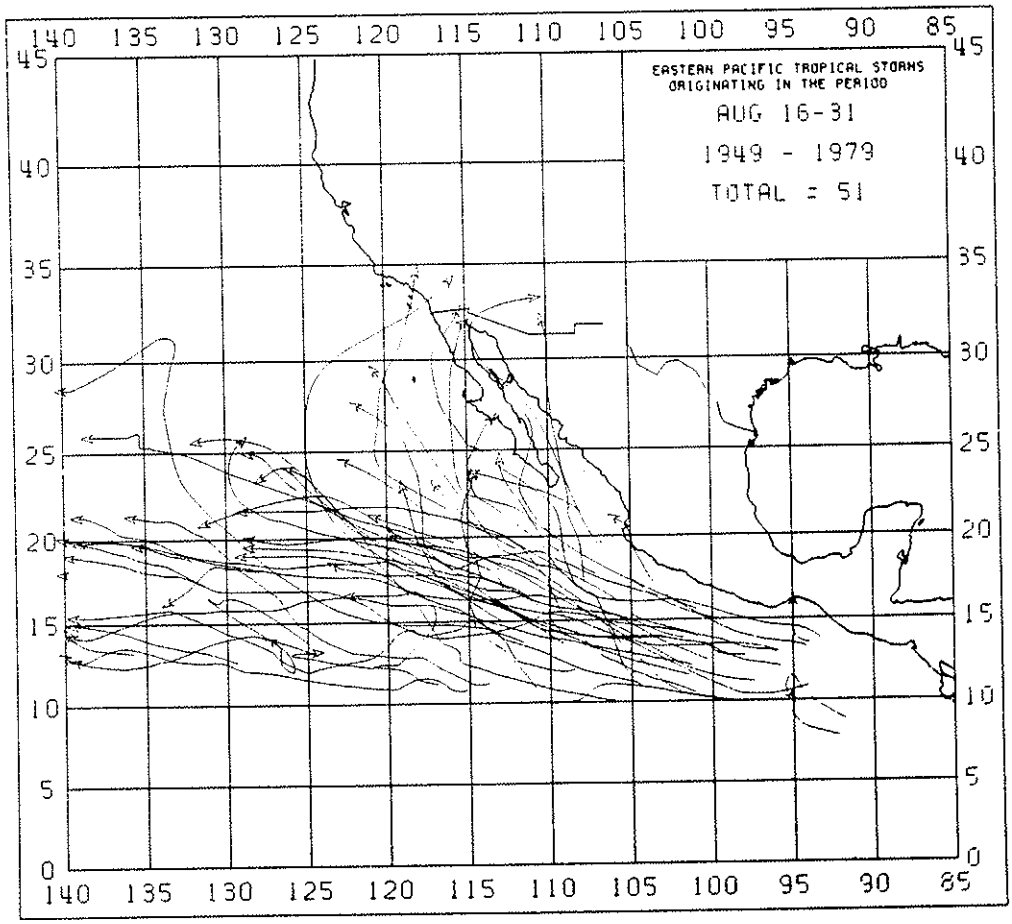
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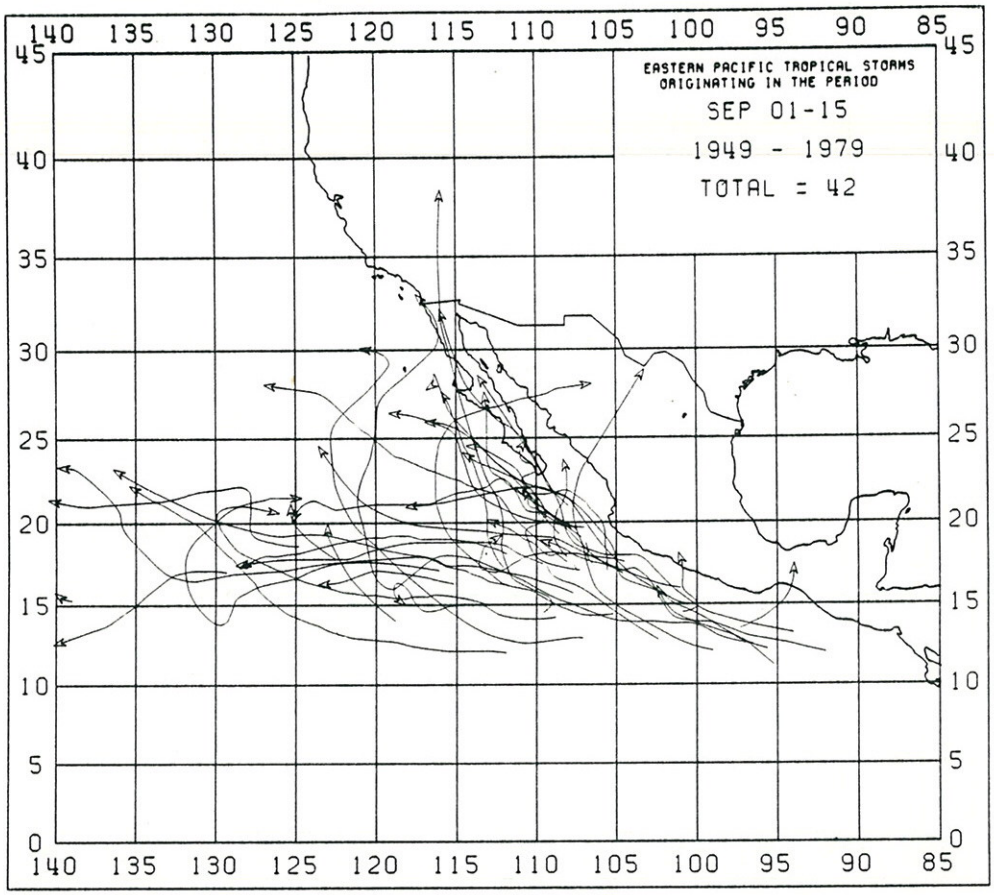
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SEP 01-15
1949 - 1979
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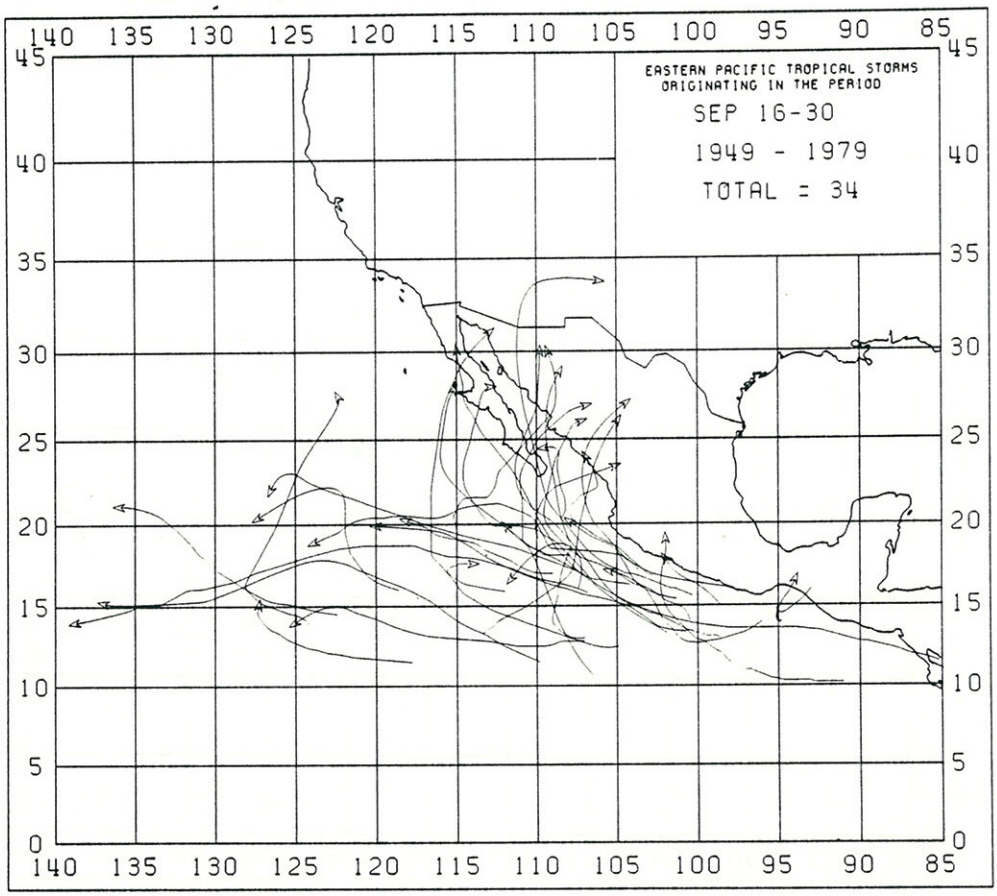
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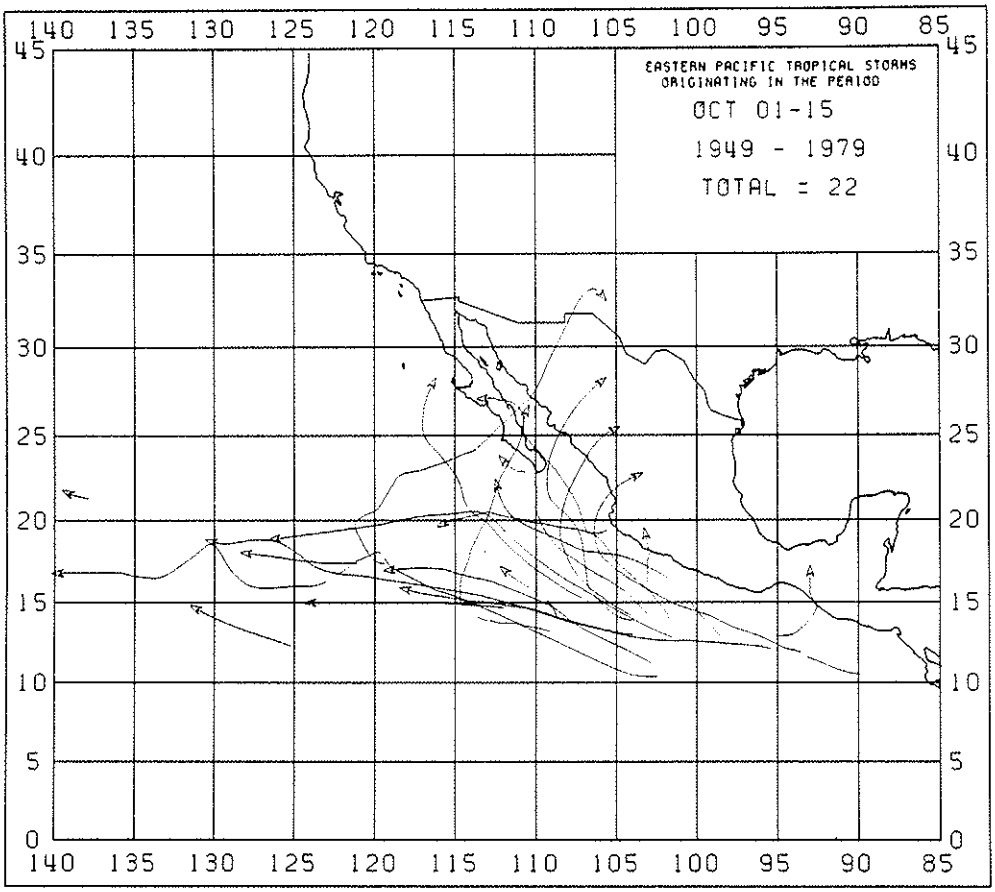
EASTERN PACIFIC TROPICAL STORMS
ORIGINATING IN THE PERIOD
OCT 01-15
1949 - 1979
TOTAL = 22
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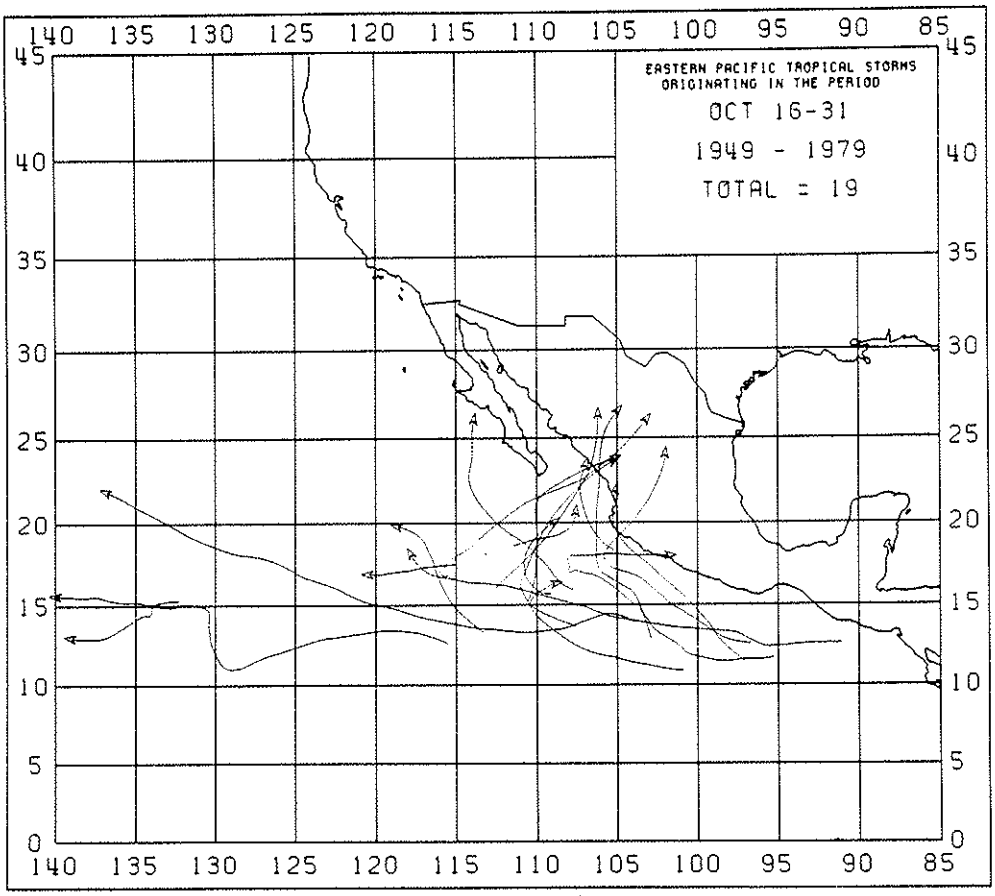
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OCT 16-31
1949 - 1979
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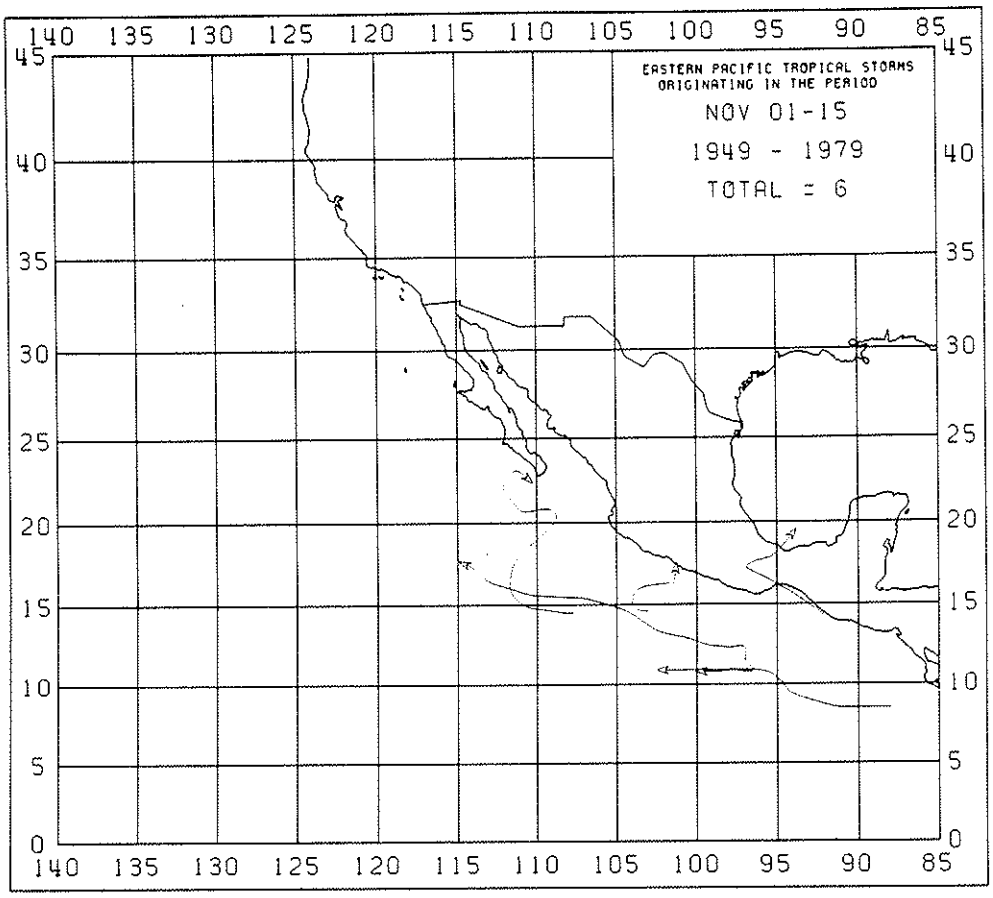
EASTERN PACIFIC TROPICAL STORMS
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NOV 01-15
1949 - 1979
TOTAL = 6
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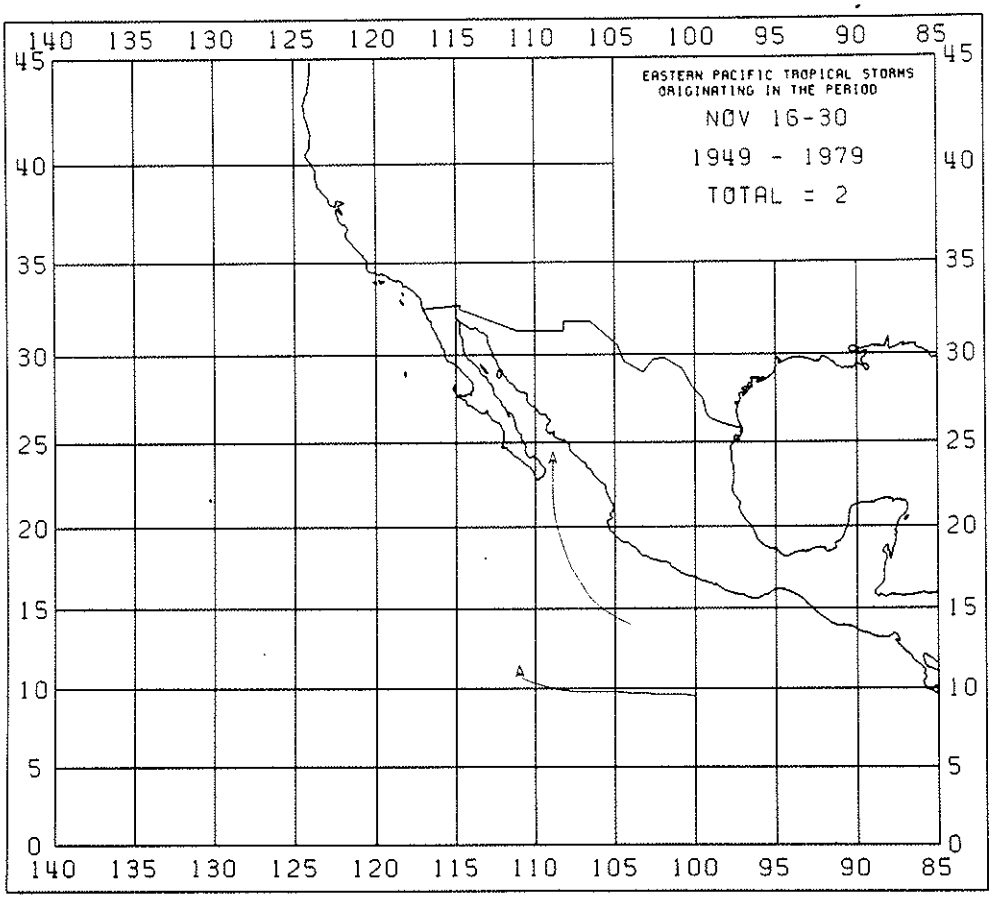
EASTERN PACIFIC TROPICAL STORMS
ORIGINATING IN THE PERIOD
NOV 16-30
1949 - 1979
TOTAL = 2
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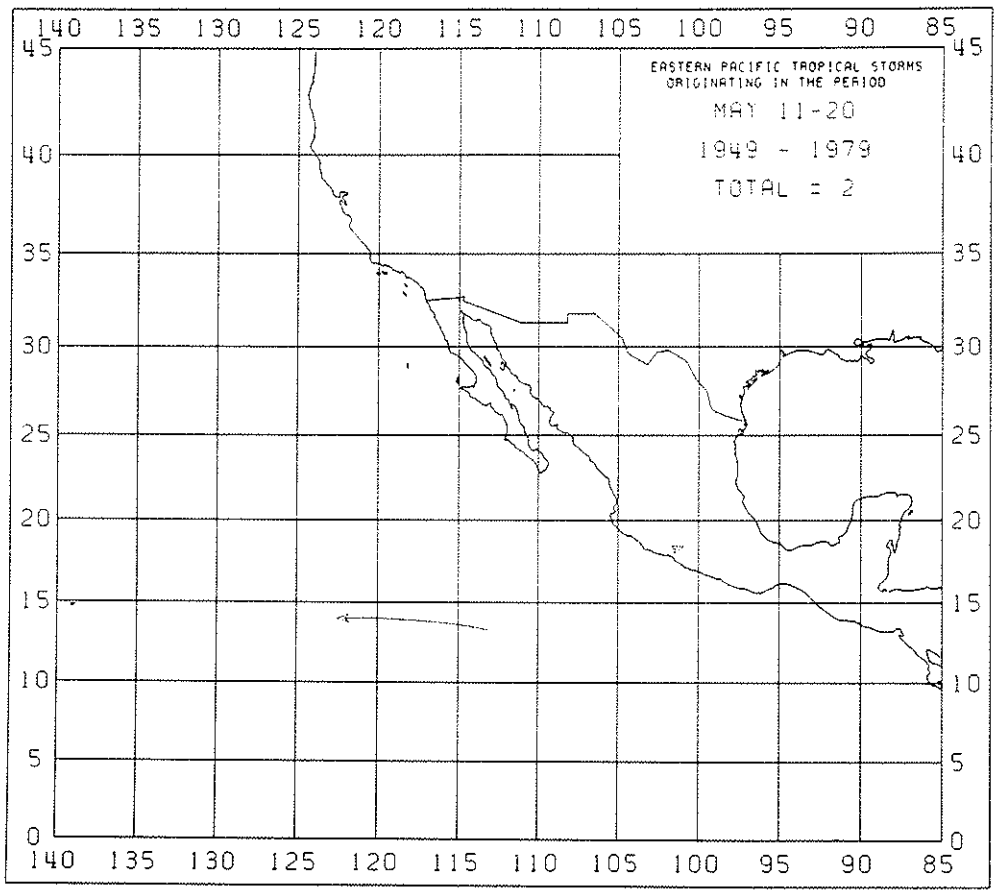
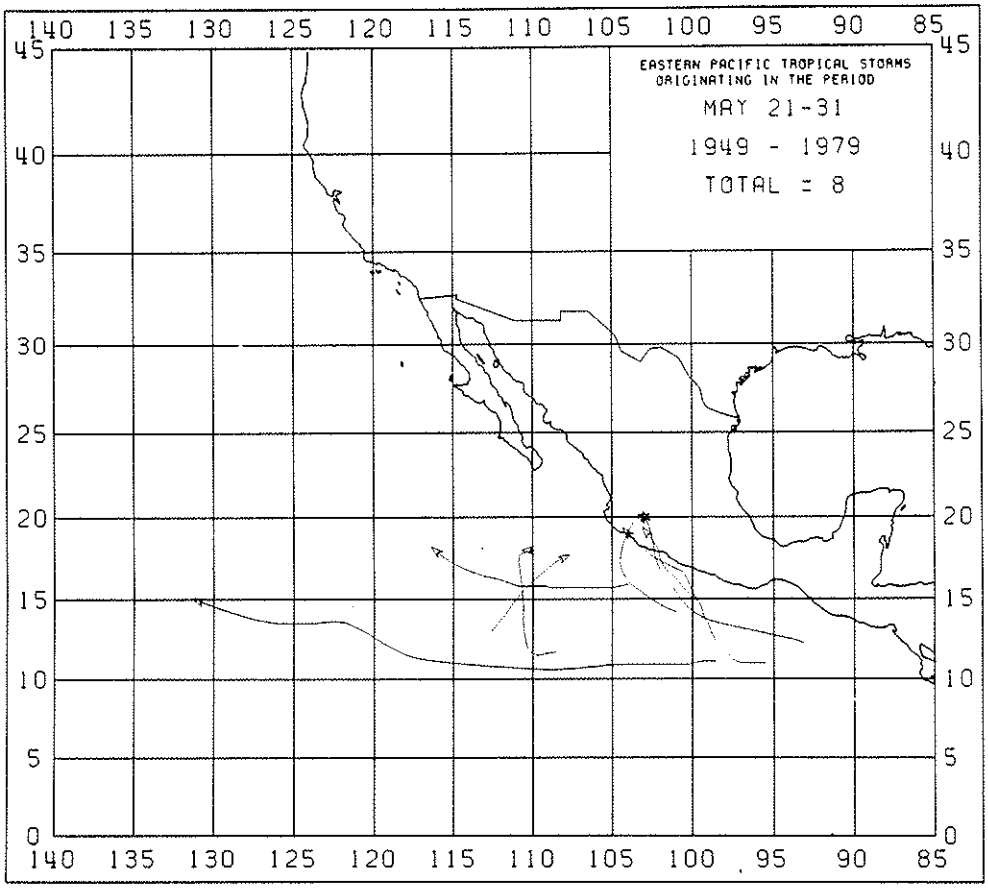
45 40 35 30 25 20 15 10 5 0

APPENDIX III

TROPICAL CYCLONE TRACKS BY 10-DAY PERIODS, MAY 11 - NOVEMBER 30




EASTERN PACIFIC TROPICAL STORMS
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MAY 21-31
1949 - 1979
TOTAL = 8
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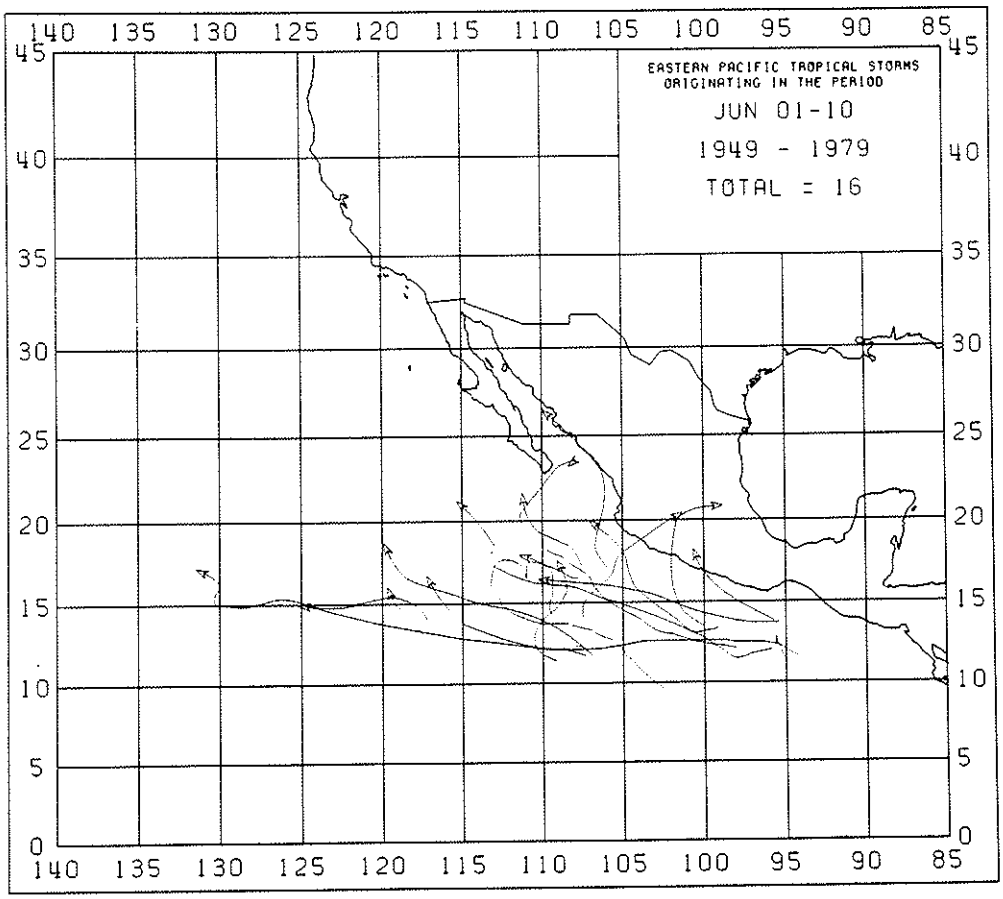
EASTERN PACIFIC TROPICAL STORMS
ORIGINATING IN THE PERIOD
JUN 01-10
1949 - 1979
TOTAL = 16
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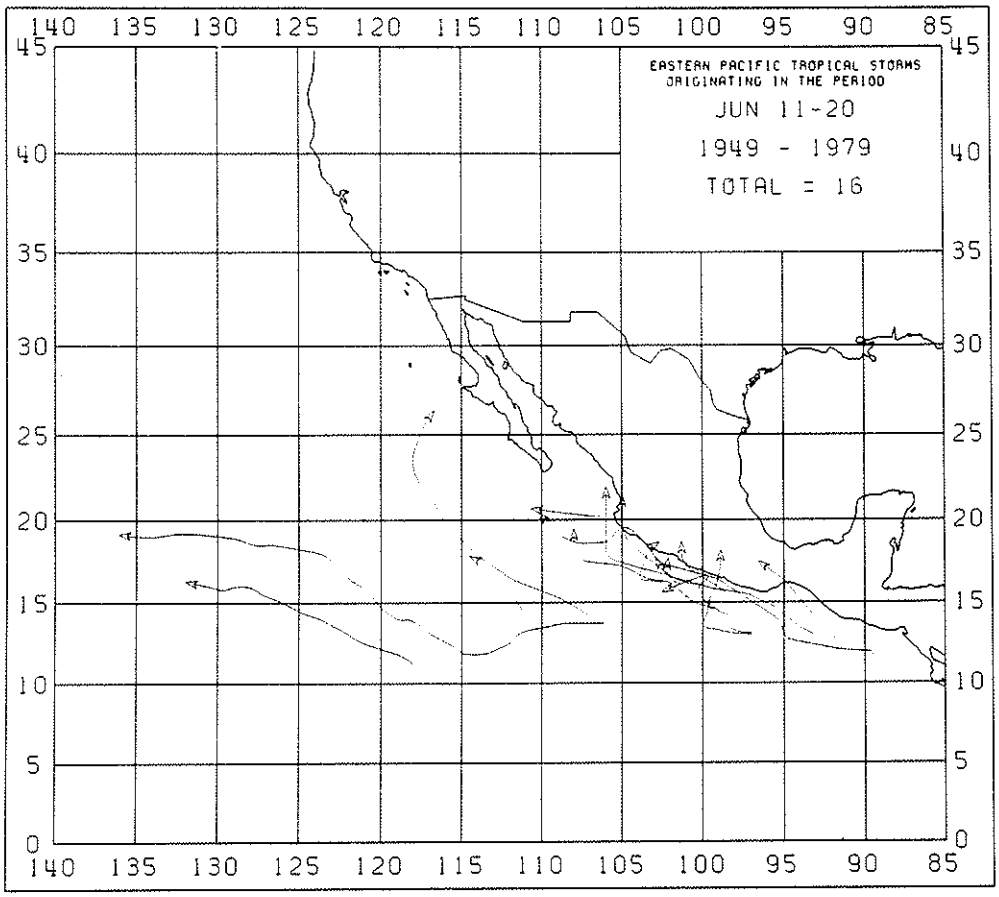
45 40 35 30 25 20 15 10 5 0


EASTERN PACIFIC TROPICAL STORMS
ORIGINATING IN THE PERIOD
JUN 11-20
1949 - 1979
TOTAL = 16
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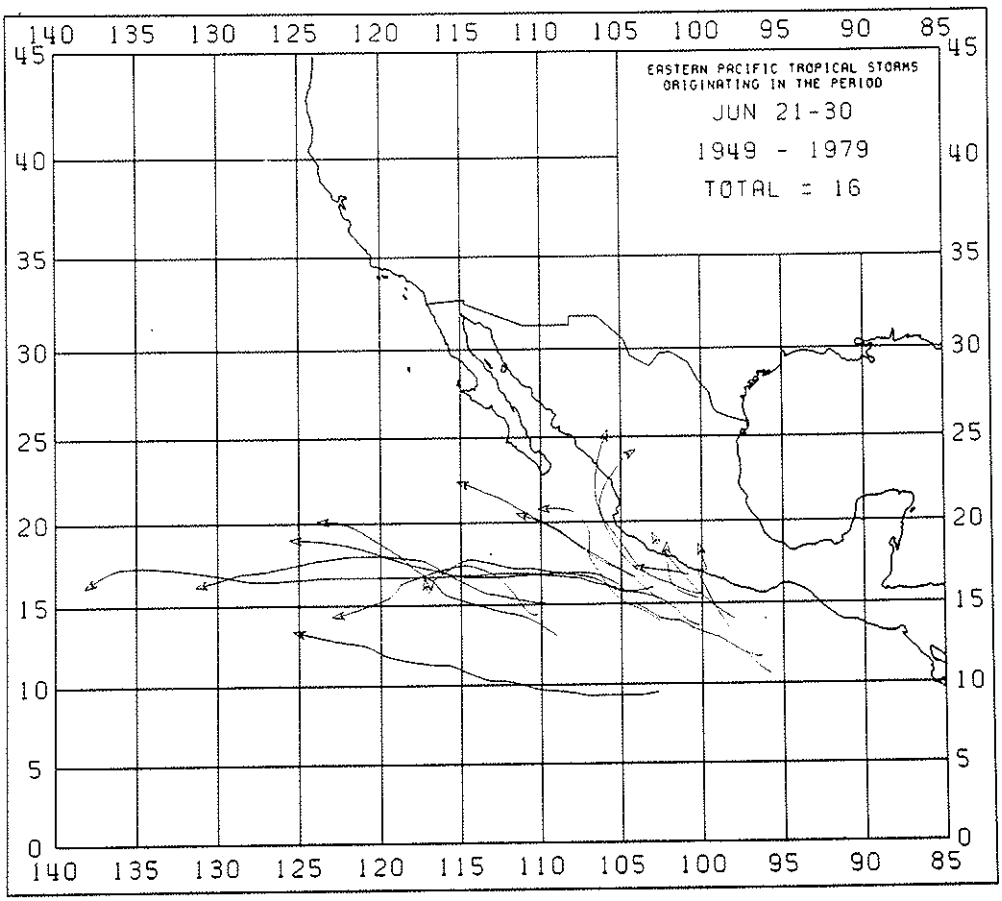
EASTERN PACIFIC TROPICAL STORMS
ORIGINATING IN THE PERIOD
JUN 21-30
1949 - 1979
TOTAL = 16
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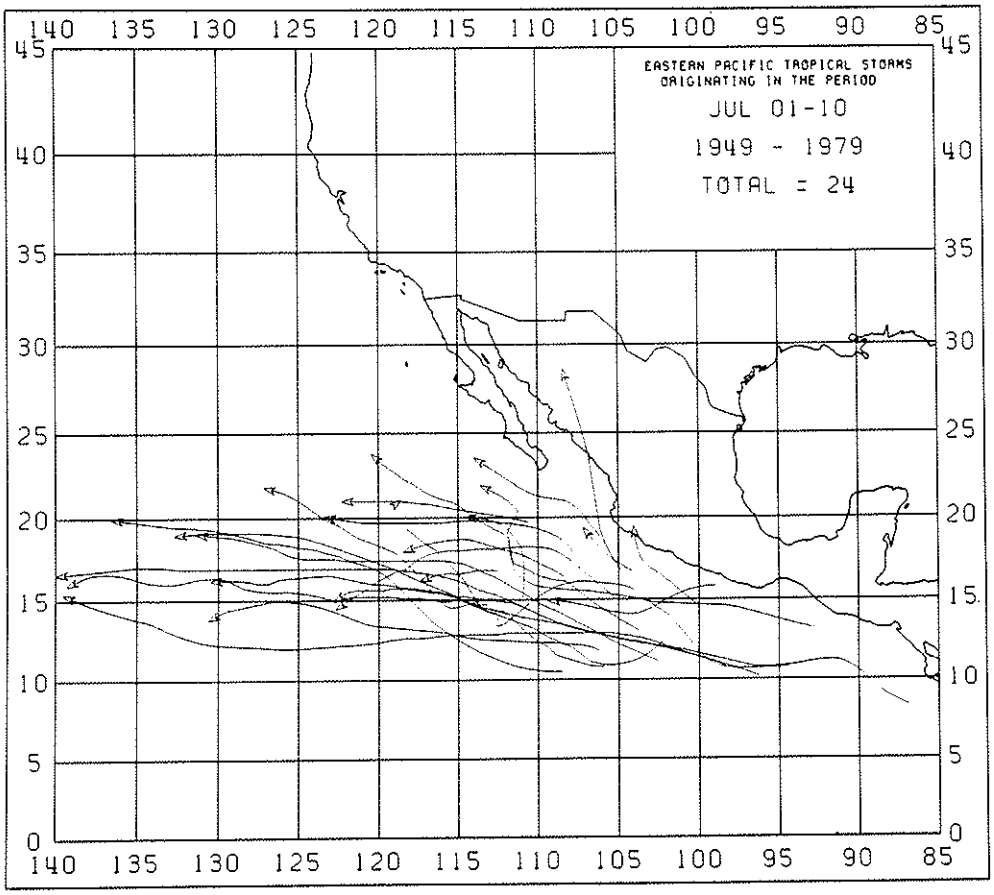
45 40 35 30 25 20 15 10 5 0


EASTERN PACIFIC TROPICAL STORMS
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JUL 01-10
1949 - 1979
TOTAL = 24
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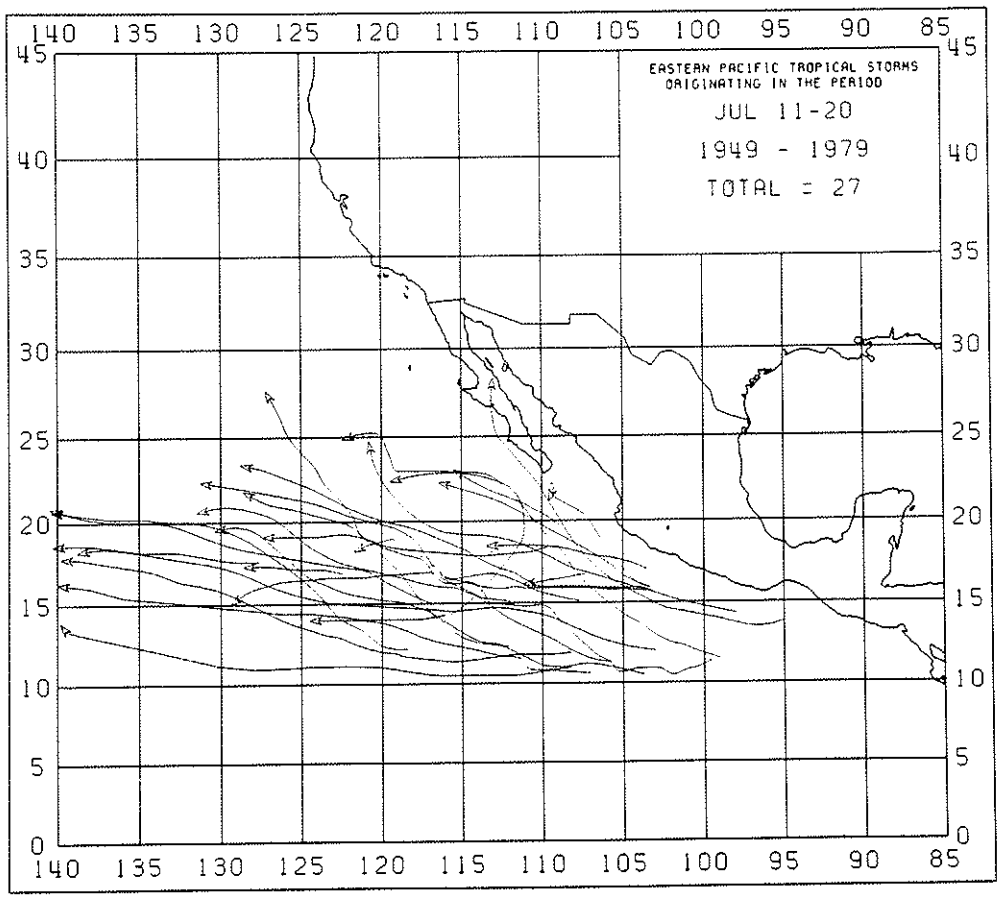
EASTERN PACIFIC TROPICAL STORMS
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JUL 11-20
1949 - 1979
TOTAL = 27
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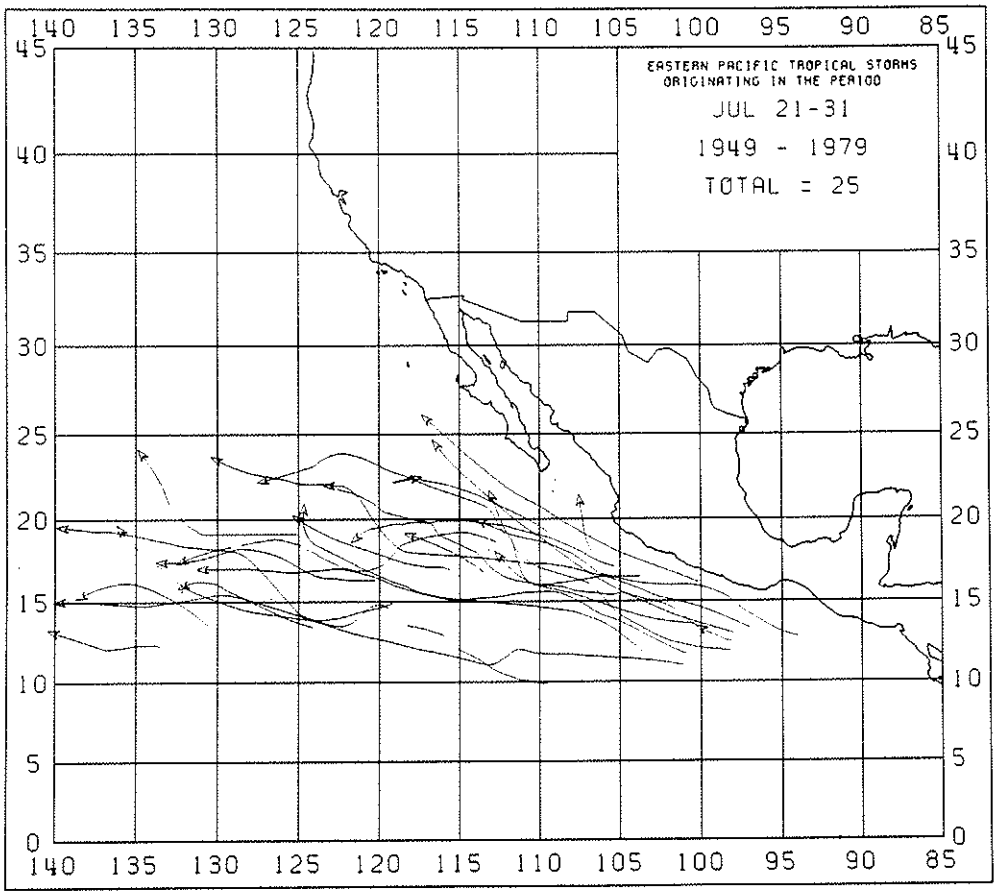
EASTERN PACIFIC TROPICAL STORMS
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JUL 21-31
1949 - 1979
TOTAL = 25
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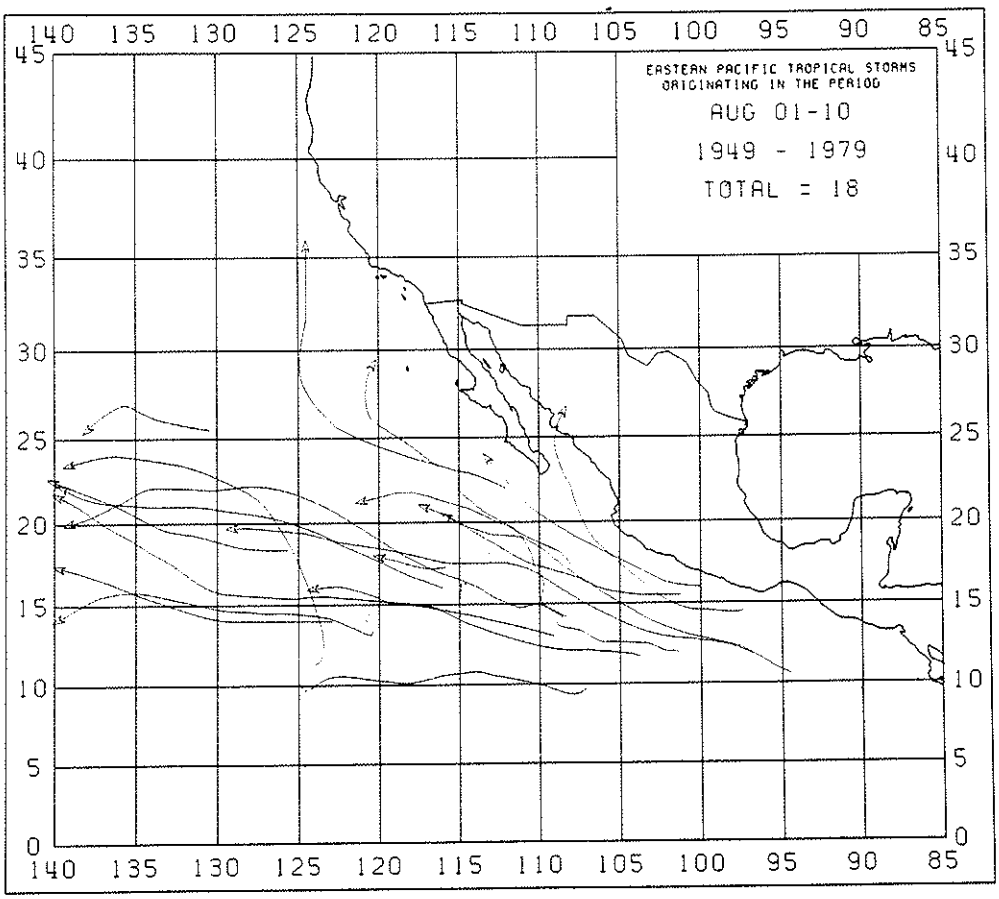
EASTERN PACIFIC TROPICAL STORMS
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AUG 01-10
1949 - 1979
TOTAL = 18
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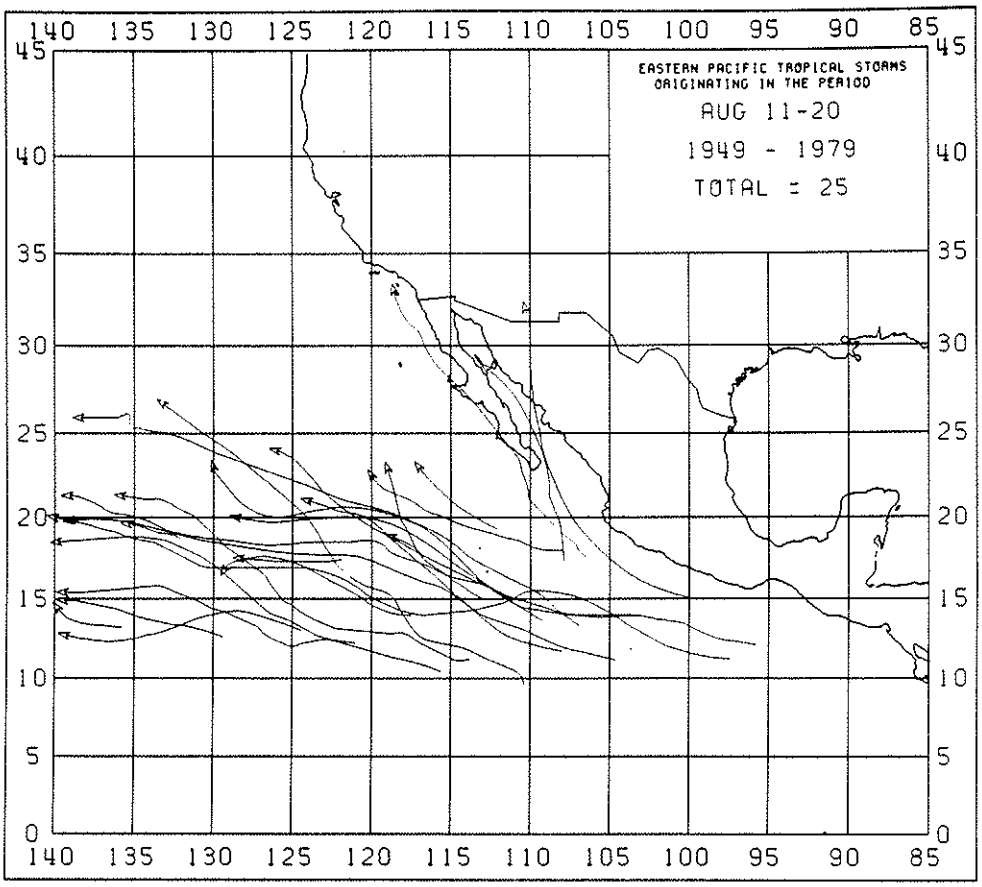
EASTERN PACIFIC TROPICAL STORMS
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AUG 11-20
1949 - 1979
TOTAL = 25
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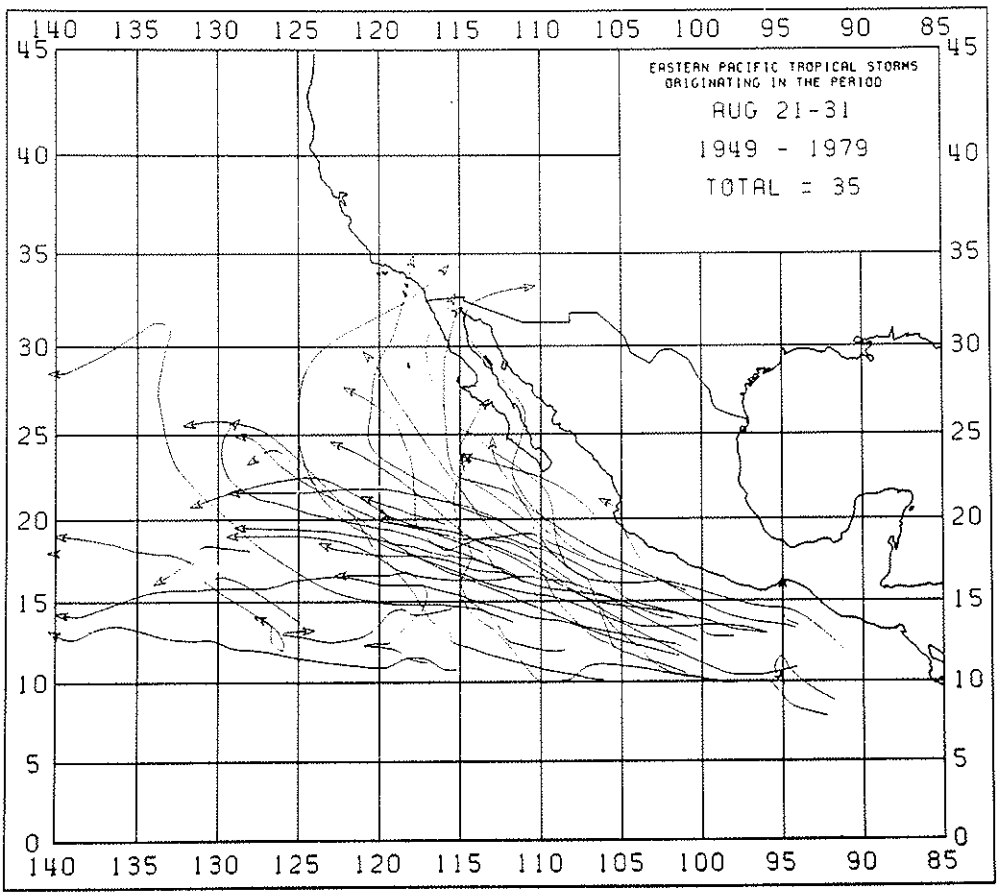
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1949 - 1979
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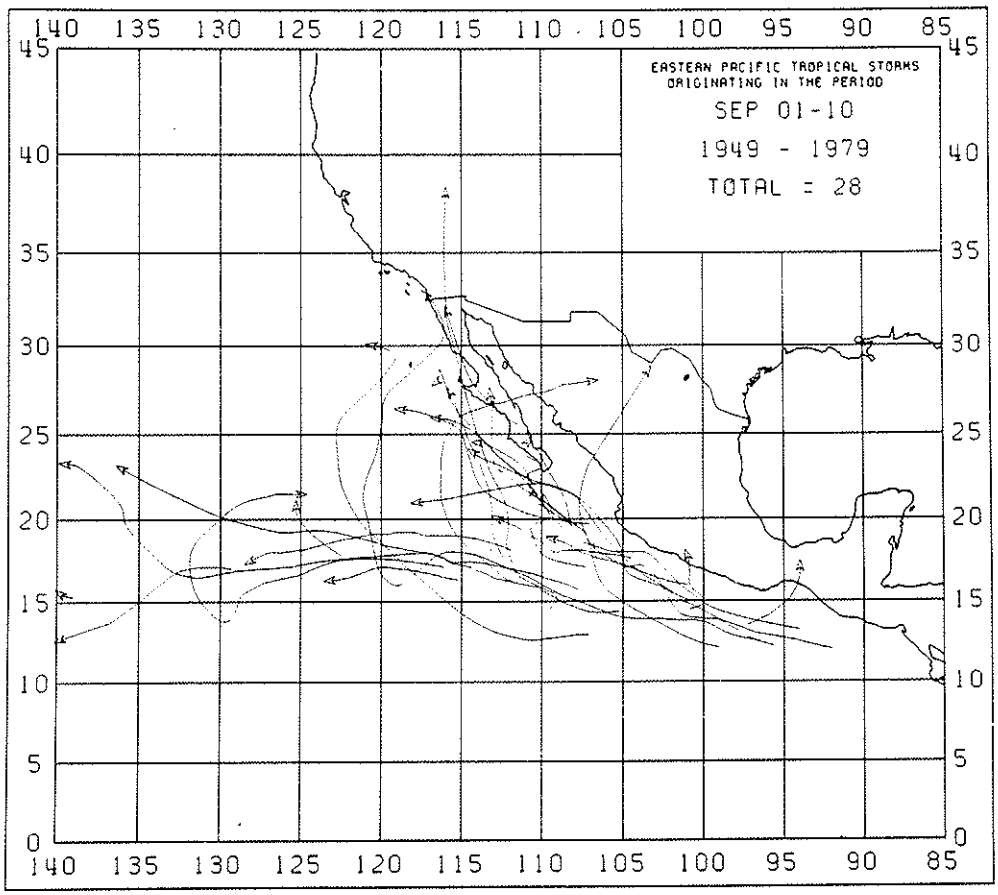
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SEP 01-10
1949 - 1979
TOTAL = 28
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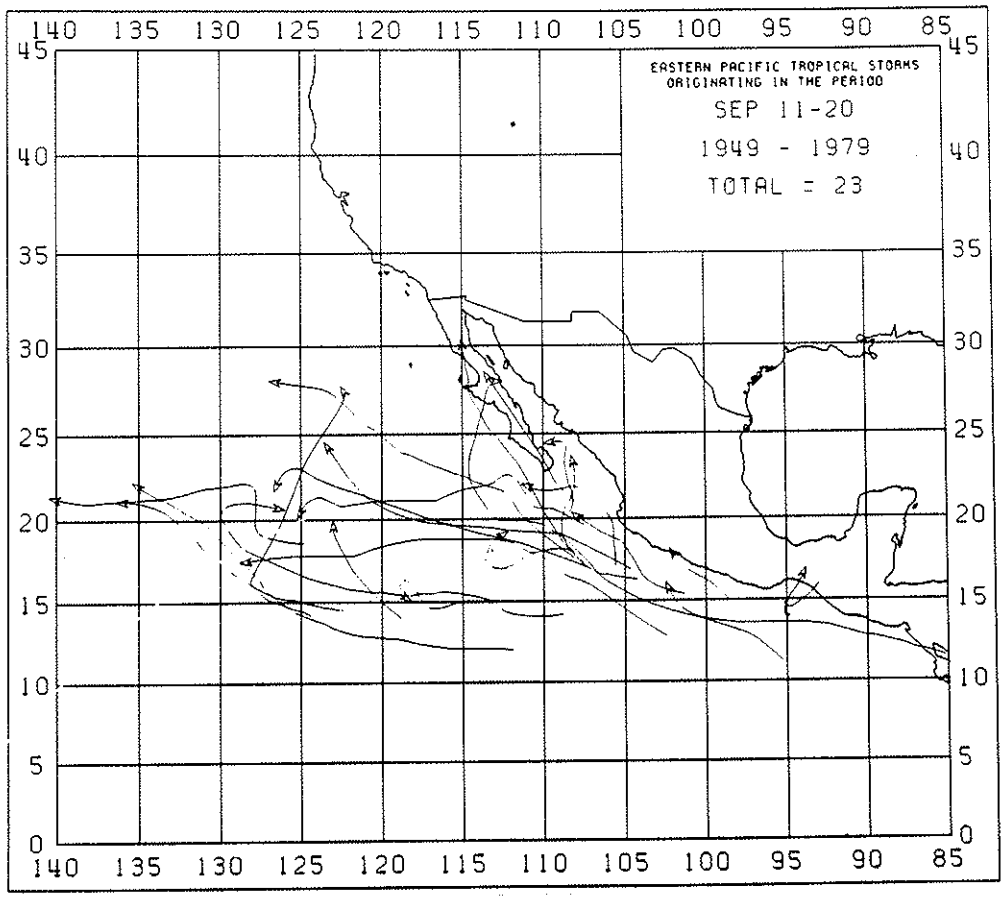
EASTERN PACIFIC TROPICAL STORMS
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SEP 11-20
1949 - 1979
TOTAL = 23
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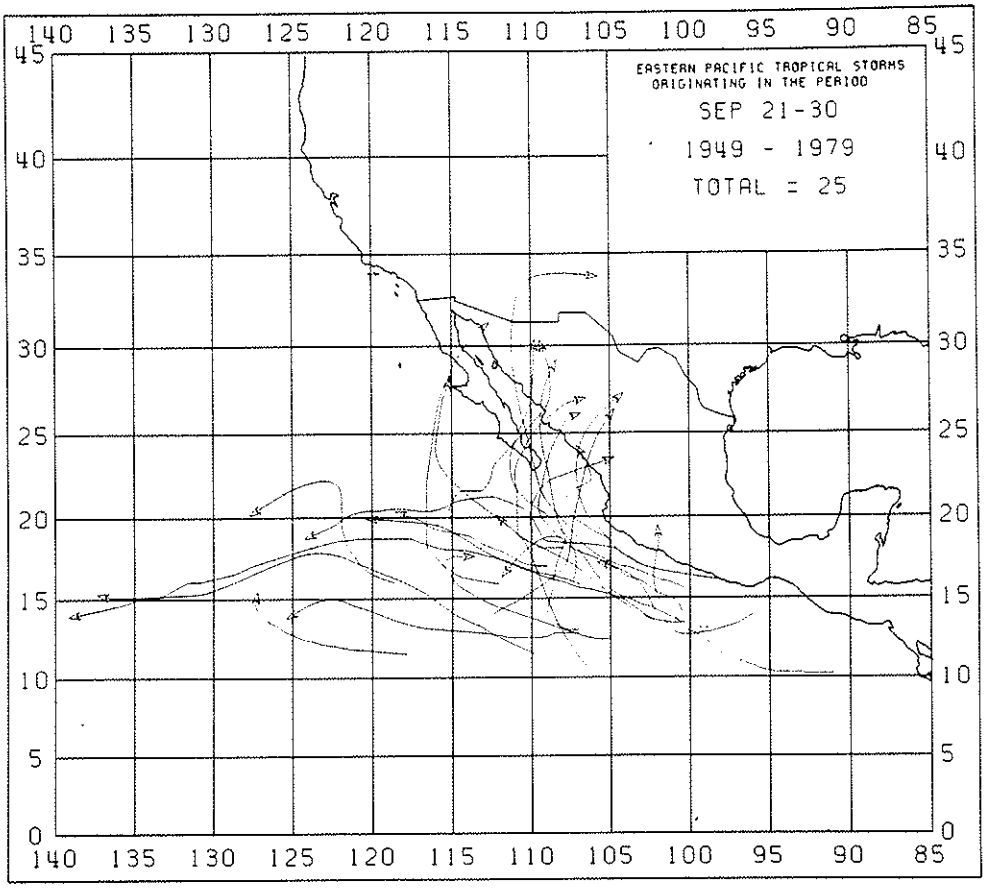
EASTERN PACIFIC TROPICAL STORMS
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SEP 21-30
1949 - 1979
TOTAL = 25
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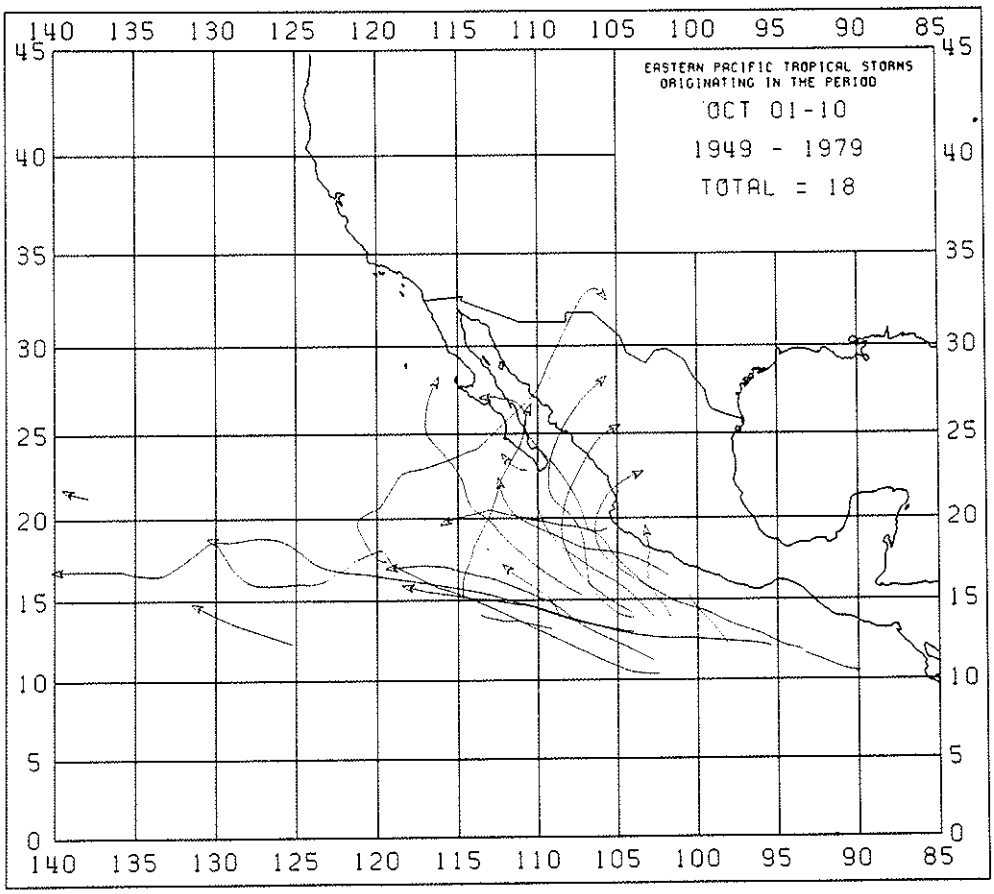
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OCT 01-10
1949 - 1979
TOTAL = 18
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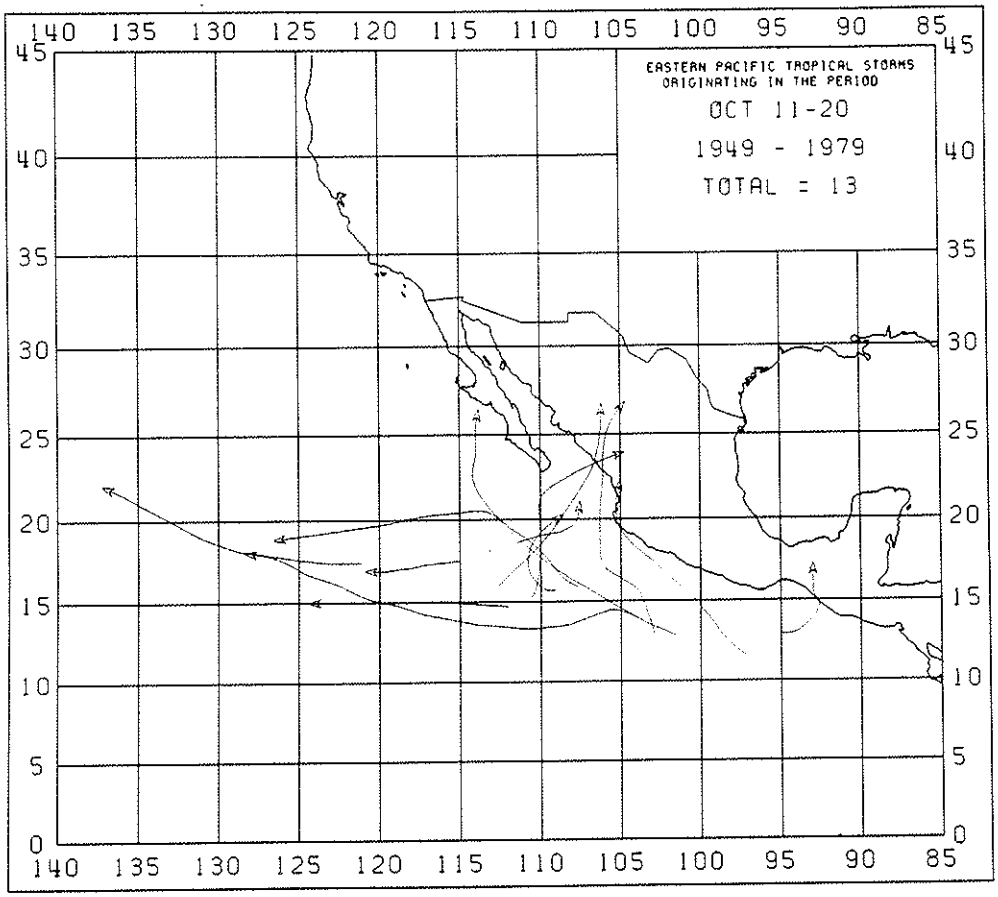
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1949 - 1979
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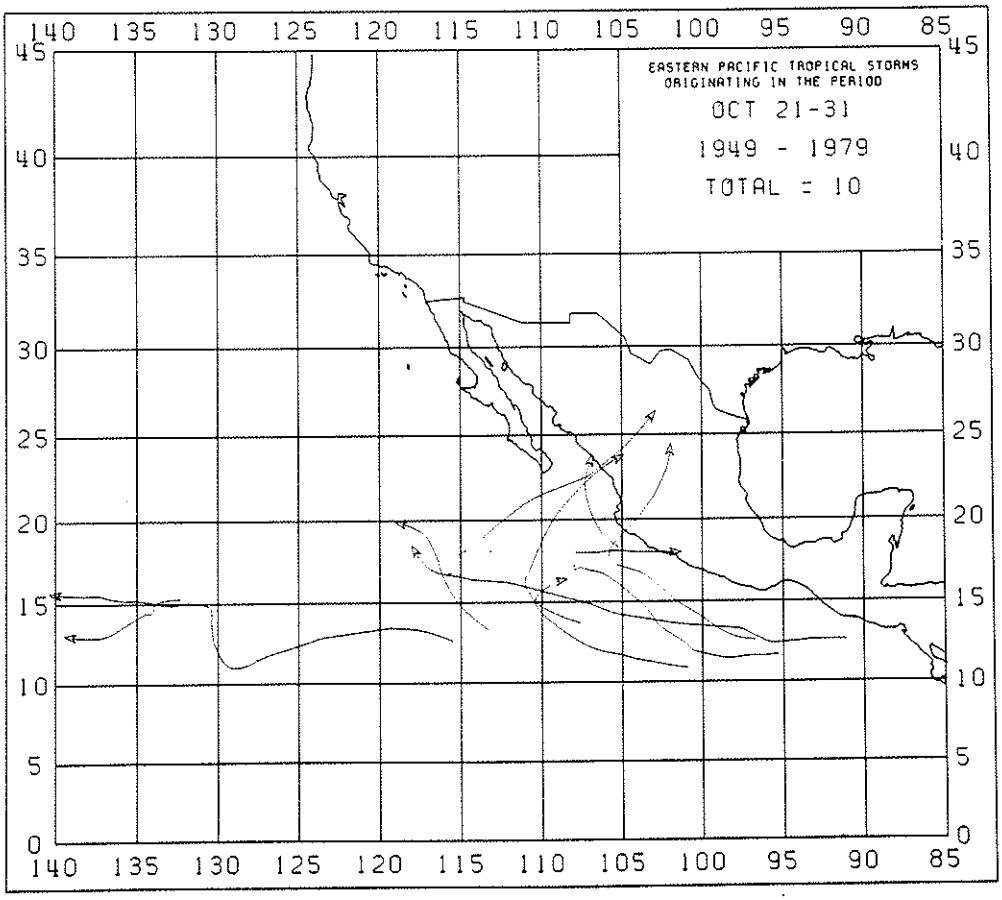
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1949 - 1979
TOTAL = 10
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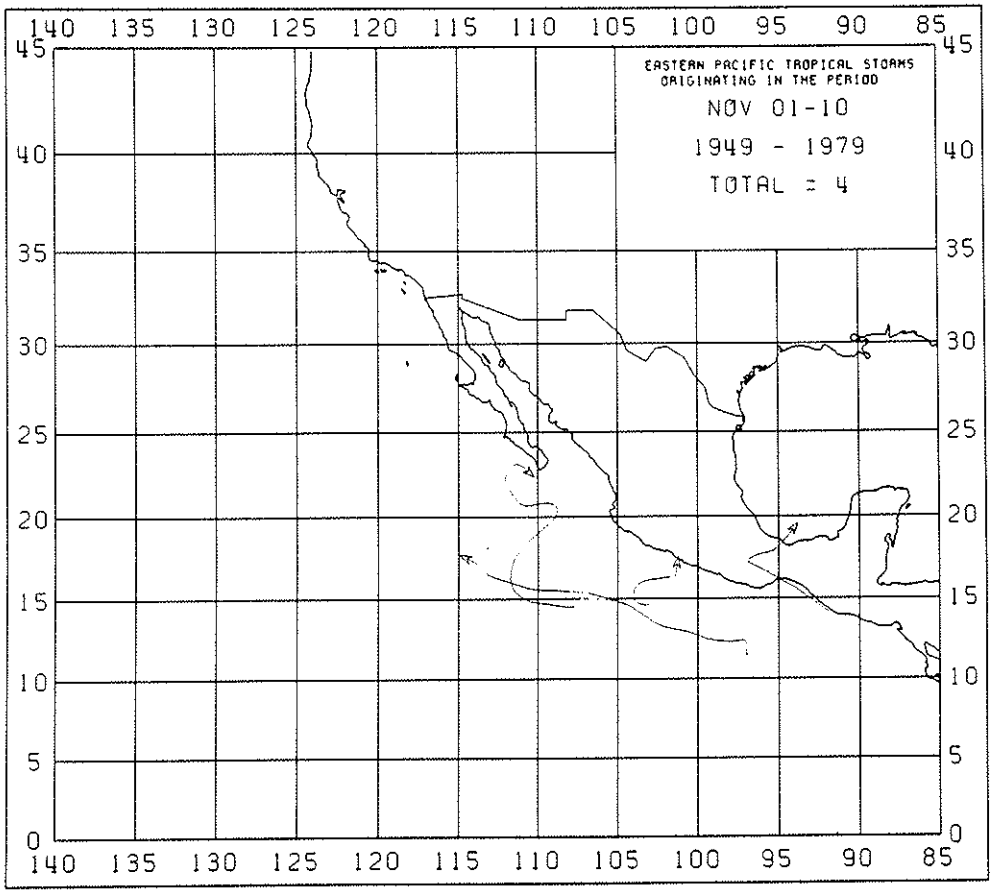
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NOV 01-10
1949 - 1979
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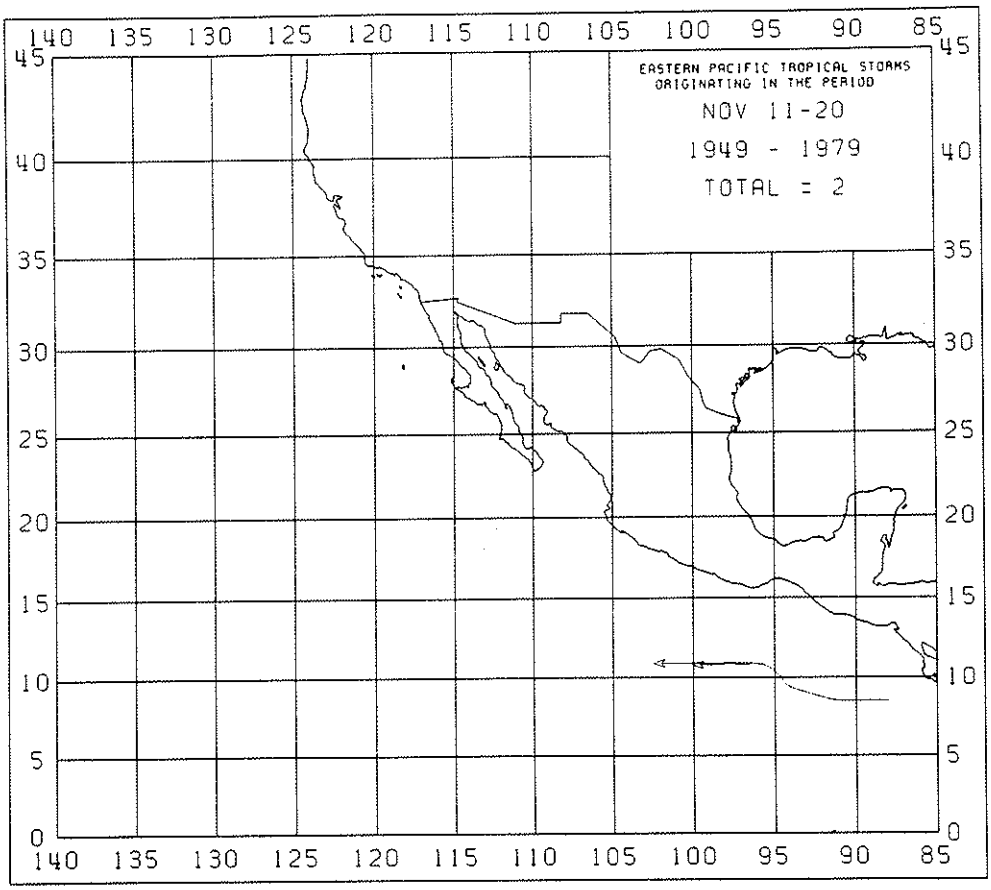
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1949 - 1979
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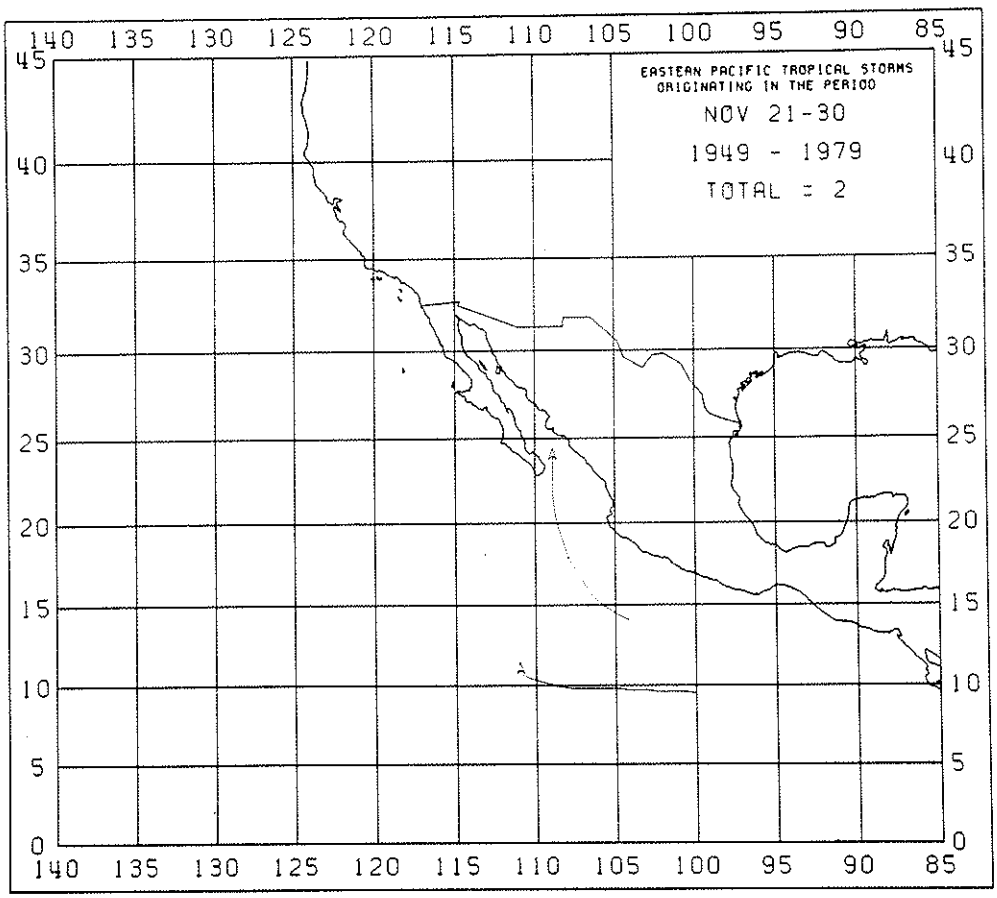
EASTERN PACIFIC TROPICAL STORMS
ORIGINATING IN THE PERIOD
NOV 21-30
1949 - 1979
TOTAL = 2
140 135 130 125 120 115 110 105 100 95 90 85
45 40 35 30 25 20 15 10 5 0

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154 Regression Equation for the Peak Wind Gust 6 to 12 Hours in Advance at Great Falls During Strong Downslope Wind Storms. Michael J. Oard, July 1980. (PB81108367)
155 A Raininess Index for the Arizona Monsoon, John H. TenHarkel, July 1980. (PB81106494) (PB81102501)
156 The Effects of Terrain Distribution on Summer Thunderstorm Activity at Reno, Nevada. Christopher Dean Hill, July 1980.
157 An Operational Evaluation of the Scofield/Oliver Technique for Estimating Precipitation Rates from Satellite Imagery. Richard Ochoa, August 1980. (PB81108227)
158 Hydrology Practicum. Thomas Dietrich, September 1980. (PB81134033)
159 Tropical Cyclone Effects on California. Arnold Court, October 1980. (PB81133779)

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NOAA SCIENTIFIC AND TECHNICAL PUBLICATIONS

The National Oceanic and Atmospheric Administration was established as part of the Department of Commerce on October 3, 1970. The mission responsibilities of NOAA are to assess the socioeconomic impact of natural and technological changes in the environment and to monitor and predict the state of the solid Earth, the oceans and their living resources, the atmosphere, and the space environment of the Earth.

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