School of OCEANOGRAPHY

O S U

OREGON STATE UNIVERSITY

OBSERVATIONS OF SEA LEVEL, WIND AND ATMOSPHERIC PRESSURE AT NEWPORT, OREGON 1967-1980

by

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William E. Gilbert
Adriana Huyer
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Data Report 98
Reference 82-12
December 1982

National Science Foundation
OCE-7925019

School of Oceanography
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ABSTRACT

Coastal sea level, atmospheric pressure and wind speed and direction are measured routinely at Newport, Oregon. The tide gage is situated just inside Yaquina Bay and has been operating continuously since February 1967. Atmospheric pressure is measured at the Oregon State University Marine Science Center, very near the tide gage; pressure has been recorded since November 1970. The anemometer, in operation on the south jetty since March 1969, has good exposure in all directions except perhaps northeast and southeast. Each variable is digitized at hourly intervals. The wind data are used to calculate wind stress, and sea level and atmospheric pressure are combined to yield adjusted sea level. The hourly data of all five variables are filtered numerically to provide low-passed data and very-low-frequency data, which suppress fluctuations shorter than 46 hours and 51 days, respectively. For each variable, the data are summarized in tables of monthly and annual means, tables of annual standard deviations, and time series plots of the hourly data and each form of the filtered data. In addition, the wind data are displayed in the form of progressive vector diagrams, scatter diagrams of the vector components, and time series of cumulative Ekman transport.

Table of Contents

	Page
Abstract	
List of Figures	
List of Tables	
Introduction	1
Sea Level Observations	3
Atmospheric Pressure Observations	8
Wind Observations	10
Data Processing	15
Summary of Data Presented	19
Statistics	19
Time Series Plots	28
Wind PVD's and Scatter Diagrams	34
Cumulative Ekman Transports	39
Acknowledgments	41
References	41
Appendix A. Statistics	43
Appendix B. Time Series Plots	53
Hourly Time Series	55
Low-passed Time Series	83
Very-low-frequency Time Series	109
Intermediate-low-frequency Time Series	123
Appendix C. Wind PVD's and Scatter Diagrams	143
Appendix D. Cumulative Ekman Transports	155

LIST OF FIGURES

		Page
Figure 1.	Location of measurement sites for sea level, atmospheric pressure and wind.	4
Figure 2.	Schematic of the anemometer on the south jetty.	11
Figure 3.	The amplitude response functions for the low-pass and very-low-frequency filters.	17
Figure 4.	Summary of the monthly means of sea level, atmospheric pressure, adjusted sea level, wind, and wind stress.	21
Figure 5.	Ten-year monthly means of sea level, atmospheric pressure, adjusted sea level, wind, and wind stress.	23
Figure 6.	Monthly mean anomalies of sea level, atmospheric pressure, adjusted sea level, wind, and wind stress.	25
Figure 7.	Annual means and standard deviations of low-passed sea level, atmospheric pressure, adjusted sea level, wind and wind stress.	27
Figure 8.	Continuous time series of the very-low-frequency data, which has been filtered to suppress signals with periods shorter than about 51 days.	30
Figure 9.	Average daily values of the very-low-frequency adjusted sea level, wind and wind stress for the ten-year period 1971-1980.	32
Figure 10.	Composite scatter diagrams of daily low-passed (LLP) wind vectors for two different seasons, 1969-1980.	36
Figure 11.	Composite scatter diagrams of daily low-passed (LLP) wind stress vectors for two different seasons, 1969-1980.	38

LIST OF TABLES

		Page
Table 1.	Time and duration of gaps in the observations of sea level at the Marine Science Center, Newport.	7
Table 2.	Time and duration of gaps in the atmospheric pressure observations.	9
Table 3.	Time and duration of gaps in the wind speed and direction data from the anemometer on the south jetty.	13
Table 4.	Ten-year monthly means (1971 - 1980).	22
Table 5.	The overall record length, overall mean, and the ten-year mean for each variable.	24
Table 6.	Annual means and standard deviations of low-passed sea level, atmospheric pressure, adjusted sea level, northward wind and northward wind stress, 1971 - 1980.	26
Table 7.	Extreme and mean values of the ten-year average very low-frequency adjusted sea level, wind and wind stress, and the dates of their occurrence.	33
Table 8.	Seasonal means and standard deviations of daily values of eastward (u) and northward (v) components of the low-passed wind.	37

INTRODUCTION

Previous studies of the physical oceanography of the Oregon continental shelf have shown that changes in the currents and hydrography are largely driven by the local wind (e.g. Smith, 1974). However, the effect of intermittent winds is sometimes rectified, so that the mean currents and the mean hydrography for a given period cannot be determined solely from the mean wind. In spring, for example, the mean wind stress is zero, but the mean currents are strongly southward--this strong mean current seems to be the result of the first major upwelling event of the season (Huyer, Sobey and Smith, 1979).

For periods longer than a day, the coastal sea level (adjusted for the effect of local atmospheric pressure variations) is extremely well correlated with the currents over the shelf (e.g. Cutchin and Smith, 1973; Marthaler, 1977). The currents at all depths are better correlated with the adjusted sea level than with the wind stress (Huyer, Sobey and Smith, 1979). Bottom temperature are also better correlated with coastal sea level than the wind stress (Kruse and Huyer, 1982). Thus sea level is better than wind stress as an estimator of other oceanographic variables. While wind stress is the force that drives the ocean, sea level is just one aspect of the response of shelf waters to the wind.

Sea level has been measured at the OSU Marine Science Center continuously since February 1967, wind has been measured on the South Jetty since March 1969 and atmospheric pressure has been measured at the Marine Science Center since November 1970. The processing and some analysis of these data have been carried out under a sequence of individual projects to study the circulation over the continental shelf. This report includes data through 1980, by which time we had continuous time series of corrected sea level for a full thirteen-year period, wind for eleven years and atmospheric pressure for ten years. These observations are presented in this technical report in the form of time series plots of the hourly data and low-frequency and very-low-frequency filtered data, and tables of monthly and annual statistics. Our aims are to present the statistics that can be used in modeling the oceanographic environment, and to present the data visually in such a way that the reader will gain a qualitative understanding of the variability of each parameter.

SEA LEVEL OBSERVATIONS

The tide gage is located at 44°37.5'N, 124°02.6'W on the OSU Marine Science Center pier in Southbeach, just south of Newport (Figure 1). The fiberglass stilling well for the 9 inch diameter float is 12 inches in diameter with a 1 1/2 inch diameter intake hole in the cone-shaped bottom. This provides a 64:1 ratio in area in damping wave action.

The sea level is measured by means of a Fischer and Porter model 1551 recorder. This is a float-operated, negator-spring counterpoised instrument that mechanically converts the motion of the rotating float-wheel shaft into a coded digital output. The water level, to the nearest 0.01 foot, is punched in paper tape, at 6 minute intervals, using 16-channel binary-coded decimal format. The paper tape is replaced once a month. The recorder has been replaced twice since its first installation: the original gage (No. 6511 A 4632 M22) installed on 28 January 1967 had an electro-mechanical clock; the second gage (No. 6804 A 4960 M4) installed on 17 April 1978 had a quartz clock; and the present gage (No. 7403 A 3402 M12) installed on 7 November 1978 also has a quartz clock.

A graduated (-3.5 to 16.5 feet) tide staff was installed 28 January 1967. This was superseded by an electric tape gage installed 9 February 1968. The tape gage was moved 7 October 1974. Leveling between the tide staff or tape gage and bench marks has been done annually by the National Ocean Survey.

An observer makes regular comparisons (an average of 10-12 per month) of the tide gage time and height, and the correct time of day and water level indicated on the tide staff or tape gage. The readings of correct time, gage time, staff height, and gage height are tabulated and used

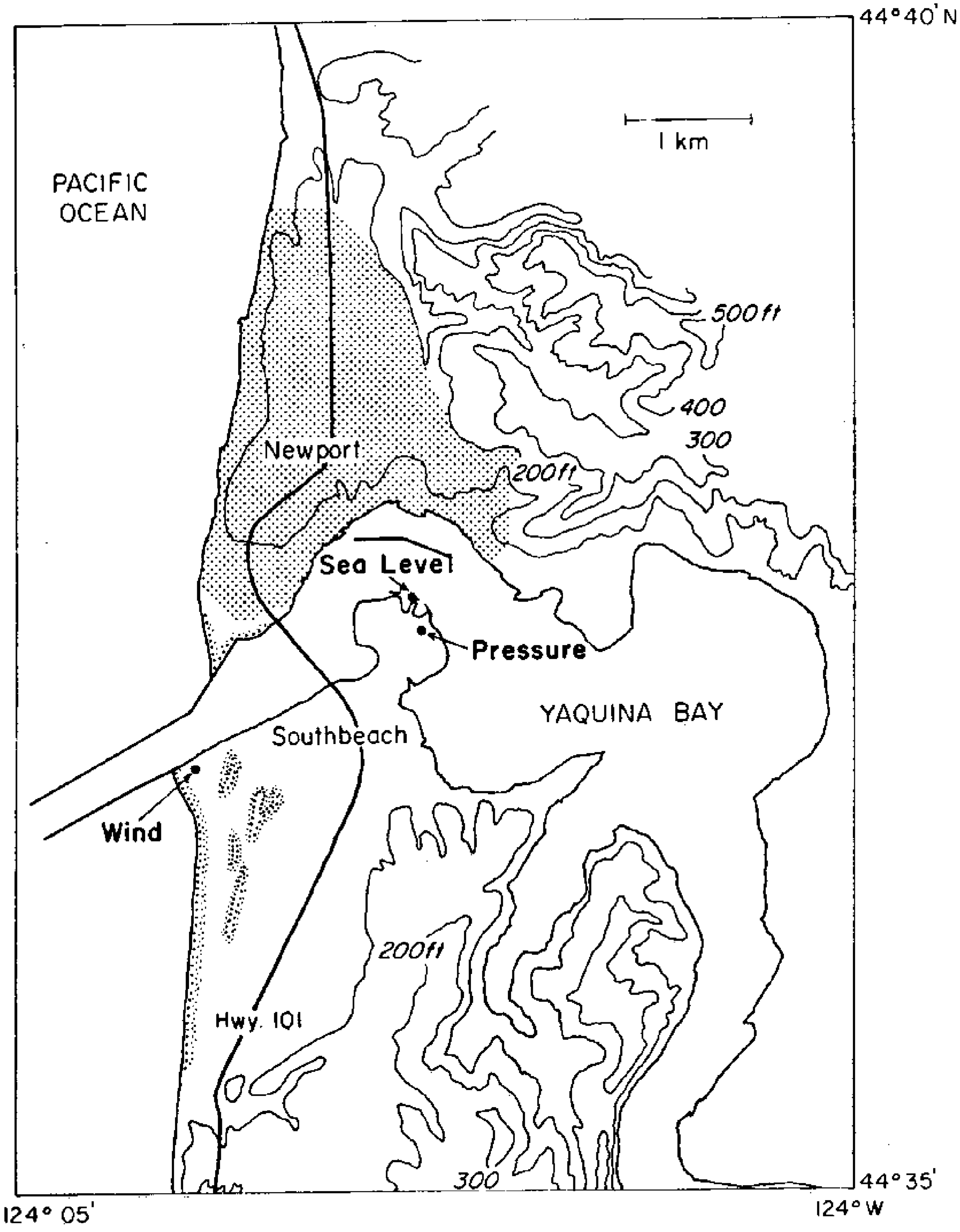

Figure 1. Location of measurement sites for sea level, atmospheric pressure and wind. Elevation is contoured in intervals of 100 ft.

to calculate time and height corrections. The tabulations are examined monthly and used to correct for any changes in the gage timing or height settings.

Data from 28 January 1967 through 31 August 1973 were processed by the National Ocean Survey and supplied to OSU. Beginning 1 September 1973 the data has been processed at OSU. Timing errors were corrected before the hourly heights were tabulated. Pacific Standard Time was used throughout. Height corrections are applied after final values are obtained from the National Ocean Survey, usually 6-12 months after the observations are made. National Ocean Survey obtains the monthly height correction ("mean difference") from the mean of the differences determined by the tide gage observer; individual large differences may be excluded from the computation of the mean difference. Changes in tide staff or tape gage elevations determined by leveling are incorporated in a "constant for fixed datum" to maintain the original tabulation datum. The constant for fixed datum is added to the mean difference to determine the "setting for fixed datum". The setting for fixed datum is subtracted from the original hourly heights during the tabulation process. Updated leveling or a revision in the monthly settings may result in an additional "correction to summary datum". The settings for fixed datum and corrections to summary datum are additive and are supplied by the National Ocean Survey (J. R. Hubbard, personal communication).

Gaps in the sea level record (Table 1) are filled by interpolation on the basis of comparison with the predicted sea level at Newport and, beginning 17 May 1972, with the observed sea level at Depoe Bay located 20 km to the north (44°48.5'N, 124°03.5'W). Gaps of more than a few hours are filled by first estimating the missing high and low water levels, from the comparison of neighboring observed highs and lows at Newport with the predicted and the Depoe Bay values. A graphical method, using a curve which is well rounded near the high and low waters, is then used to infer the missing hourly values.

All sea level data has been referred to summary datum ("0" of the 1967 tide staff). The National Ocean Survey has determined the following elevations and ranges, based on 11 years (1968-1978) of simultaneous comparisons with Crescent City, referred to the 1960-1978 tidal epoch (National Ocean Survey, 1981):

	feet	cm
Mean higher high water (MHHW)	12.90	393.2
Mean high water (MHW)	12.21	372.2
Mean lower high water (MLHW)	11.52	351.1
Mean tide level (MTL)	9.08	276.8
Mean sea level (MSL)	9.01	274.6
National Geodetic Vertical Datum (NGVD)	8.60	262.1
Mean higher low water (MHLW)	7.31	222.8
Mean low water (MLW)	5.94	181.1
Mean lower low water (MLLW)	4.57	139.3
Diurnal range (Gt)	8.33	253.9
Mean range (Mn)	6.27	191.1
Diurnal high water inequality (DHQ)	0.69	21.0
Diurnal low water inequality (DLQ)	1.37	41.8

Table 1. Time and duration of gaps in the observations of sea level at the Marine Science Center, Newport. All times shown are Pacific Standard Time.

1967	1100 23 July
	1600-2200 23 July
	0400-0600 24 July
	1700 28 Nov. - 2300 30 Nov.
1968	2100 6 Feb. - 1500 7 Feb.
	0500 22 Feb. - 1800 23 Feb.
1969	1800 16 Jan. - 0100 17 Jan.
	2000 18 Jan. - 0300 19 Jan.
	2100-2200 19 Jan.
	2100 20 Jan. - 0300 21 Jan.
	2300 23 Jan. - 0400 24 Jan.
1970	0600-1100 22 Jan.
	0500-0600 23 June
	1100 1 Aug. - 1000 3 Aug.
1971	0000-0300 6 Jan.
	0000-0100 5 Feb.
1972	1700 8 Feb. - 1600 10 Feb.
	1100 30 July
	2300 5 Aug. - 0500 6 Aug.
	1300-1600 6 Aug.
	0000-0500, 1500-1700 7 Aug.
	0100-0900, 1400-2000 8 Aug.
	0100-1000, 1400-2100 9 Aug.
	0200-1100, 1500-2000 10 Aug.
	0200-0800 11 Aug.
	0500-0600 3 Dec.
	0100-0200 15 Dec.
1973	1200-1300 8 Feb.
1974	0700 12 July
	2000-2200 14 July
	0100-0700 20 July
	0200-0800 21 July
	1600-2000 22 July
	1600-2200 23 July
	0500-1100 24 July
	1700 24 July - 0000 25 July
	0600-1200 25 July
	1800 25 July - 1600 29 July
1975	1000-1100 2 Oct.
1976	1400 18 Feb.
	1600 2 Aug.
	1400-1700 9 Oct.
	0500 13 Oct.
	0500 3 Nov.
1977	1400 27 Feb. - 0200 28 Feb.
	1300-1600 3 July
	1100 6 July - 1000 7 July
	1100-1200 24 Oct.
	0100-1400 27 Oct.
	0000-0300, 1500-1600 4 Nov.
1978	2100 28 Dec. - 1300 29 Dec.
1980	1100 3 Feb.
	1000-1400 14 May
	0100 12 June - 0700 16 June
	0200-0300 1 July
	0100 5 Sept.
	2200 5 Sept. - 0600 6 Sept.
	1300-1700 6 Sept.
	0000-0500, 1500-1700 7 Sept.
	0100-0500, 1500-1800 8 Sept.
	0200-0600 9 Sept.
	1800-1900 16 Sept.
	2000 18 Sept.
	0300-0400, 1300-1700 23 Sept.
	0300-0400, 0800 24 Sept.
	1500 25 Sept.
	0300-0700 27 Sept.
	1800 30 Sept.
	0900-1400, 1900, 2200-2300 1 Oct.
	0100-0200, 1000-1300, 2200 3 Oct.
	0000-0100, 1100-1900 4 Oct.
	2300 4 Oct. - 0500 5 Oct.
	1100, 1800 5 Oct.
	1300-1400 7 Oct.
	0000-0100, 0300-0400 8 Oct.
	1200 29 Oct.

ATMOSPHERIC PRESSURE OBSERVATIONS

Atmospheric pressure is measured at the Marine Science Center in Southbeach, at 44°37.4'N, 124°02.6'W (Figure 1) with a Belfort Model 5-800 Microbarograph. The instrument makes a continuous inked trace of the pressure on a drum. The chart paper on the drum allows for recording continuously for four days; it is changed once every 3-4 days. Hourly values of pressure are read from the trace. The time base for recording the data is Pacific Standard Time.

Observations began in 1968, but there were a number of major gaps in the first few years: 22-28 October 1968, 18 December 1968 - 5 January 1969, 2 June - 10 September 1970, and 5-22 November 1970. In this report, we present the nearly continuous pressure record beginning in 1971, using enough data from December 1970 to enable the filtered time series to begin 1 January 1971. Until 1000 PST, 28 July 1972, the hourly values were read in inches of mercury to the nearest hundredth. From 1100 PST, 28 July 1972 through 1000 PST, 29 September 1972, values were read in millibars to the nearest 0.5 mb. Since that time, hourly values of pressure are read to the nearest tenth of a millibar.

Minor gaps in the pressure record (Table 2) have been filled by linear interpolation if they were shorter than twelve hours. Longer gaps were filled by graphical interpolation using a curve, by obtaining six-hourly values from synoptic pressure charts and interpolating linearly from these to hourly values, or by use of a computer "bridging" program which uses the spectral characteristics on the data on either side of the gap to extrapolate into the gap.

Table 2. Time and duration of gaps in the atmospheric pressure observations at the OSU Marine Science Center, Newport, and the method used to fill each gap. All times shown are Pacific Standard Time.

1971 1000 7 July - 1500 12 July: bridging
0200 24 July - 0700 26 July: bridging

1972-1973 There may have been some linear interpolation of data but they were not noted.

1974 1600 25 Aug. - 0900 26 Aug.: linear interpolation
0800 29 Oct. - 0800 30 Oct.: linear interpolation
2100 20 Nov. - 1200 21 Nov.: linear interpolation
0200 3 Dec. - 0100 4 Dec.: curve interpolation
1700 26 Dec. - 0300 27 Dec.: curve interpolation

1975 0400-1300 23 Jan.: linear interpolation
2000 21 July - 1000 22 July: linear interpolation
1900 26 July - 0900 28 July: linear interpolation
1900 16 Aug. - 0900 18 Aug.: linear interpolation
1800 1 Sept. - 1000 2 Sept.: linear interpolation
1400 5 Oct. - 0200 6 Oct.: linear interpolation
0100-1100 15 Oct.: linear interpolation
0600 17 Oct. - 1100 21 Oct.: 6-hourly surface pressure maps; linear interpolation between these 6-hourly points
2100 15 Dec. - 1600 19 Dec.: 6-hourly surface pressure maps; linear interpolation between these 6-hourly points

1976 2000 13 Mar. - 0800 14 Mar.: linear interpolation
0900-1700 27 Apr.: linear interpolation
1700 19 Sept. - 0900 20 Sept.: bridging

1977 1300 14 Sept. - 0700 16 Sept.: linear interpolation

1978 1400 8 Sept. - 1800 9 Sept.: linear interpolation

1979 1300 1 Sept. - 0700 4 Sept.: bridging
1800 15 Sept. - 0900 17 Sept.: bridging

1980 1800 15 Apr. - 0700 16 Apr.: bridging
1900 20 May - 1300 21 May: bridging
2300 19 June - 0800 20 June: bridging
0400 27 June - 0700 30 June: bridging
1900 7 July - 0800 8 July: bridging
0800 20 July - 0700 21 July: bridging
1900 6 Sept. - 0700 8 Sept.: bridging

WIND OBSERVATIONS

The anemometer is located at 44°36.8'N, 124°04.0'W, just south of Newport, Oregon (Figure 1) on the south jetty of the Yaquina River. The anemometer is 9 m above the jetty and 14 m above MLLW (Figure 2). Vegetation in the immediate area is beach grass and small shrubs. There are two sectors which contain possible obstructions to the wind pattern. The first, between 6° and 32°, includes Newport. The second, between 76° and 183°, includes some densely wooded hummocks about 1800 feet from the wind gage.

Three different systems have been used to measure wind speed and direction since routine sampling began in 1969. The first system began operating on 3 March 1969. Wind speed was measured with a National Weather Service F102 3-cup S-type anemometer with 1 minute and 1 mile contacts. Wind direction was measured with a wind direction transmitter with 4 contact points. Both speed and direction were recorded by an Esterline Angus Model AW Operation Recorder onto a strip chart. Four pens were used for direction and one pen for speed. The direction was sensed each minute by at least one direction pen. Speed was recorded at the minute when a statute mile of wind has passed the instrument.

Hourly wind values of speed and direction were obtained from the strip chart by counting the miles passed each hour; and by averaging the four compass points of direction recorded once per minute. The interval preceding the nominal hour was used to obtain the value at the nominal hour--e.g. the interval from 2400-0100 was used to obtain the reading at 0100 Pacific Standard Time. Direction data was converted from "direction from" to "direction toward" by adding 180°.

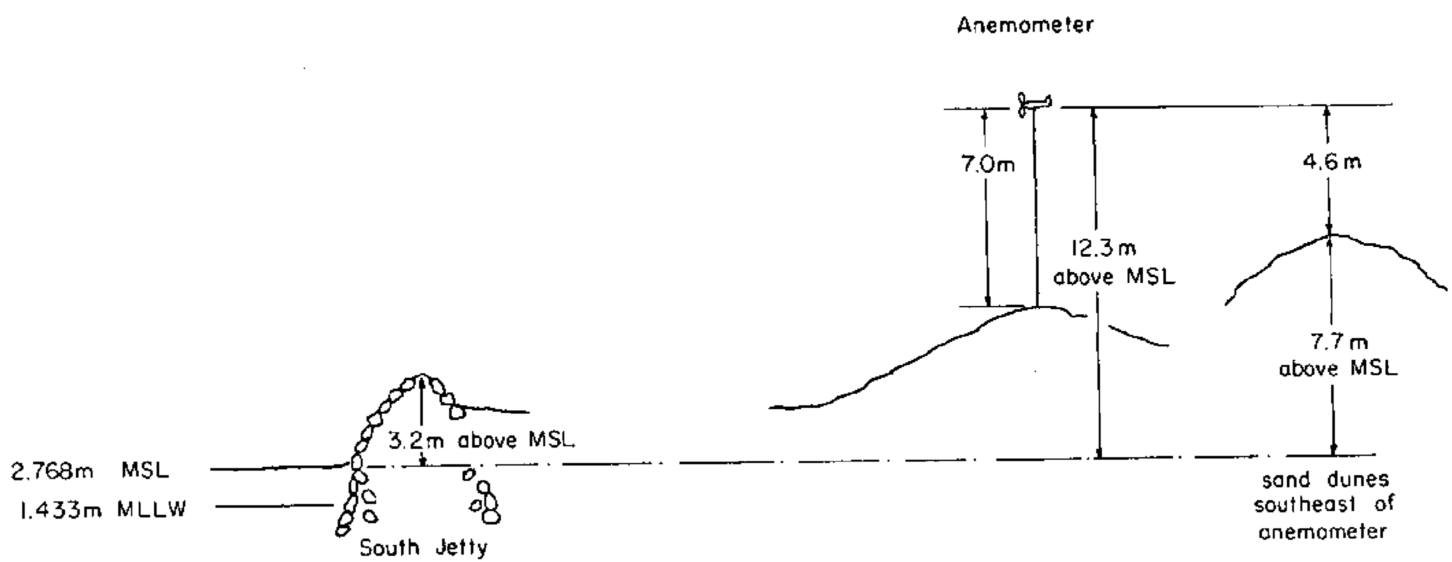

Figure 2. Schematic of the anemometer on the south jetty, showing height above mean sea level (MSL) and mean lower low water (MLLW).

On 11 December 1970, the direction transmitter was changed to one with eight contact points. There was no other change in the measuring-recording system. The increased resolution in direction is apparently reflected in the processed and averaged data: in each summer from 1971 on, there was a net eastward component during July and August; no net eastward wind was detected during the summers of 1969 and 1970, when the direction transmitter had only four contact points.

On 22 April 1972, a Bendix Aerovane was installed as the primary wind speed and direction recorder. The contacting anemometer has been retained as backup. The Aerovane records wind speed in knots and direction in degrees on a strip chart recorder. Values are read from the strip chart on each hour--speed to the nearest knot, and direction to the nearest five degrees. Speed is converted to m/sec, and "direction from" is converted to "direction toward" by adding 180°. When there are gaps in the Bendix Aerovane record, they are filled by using data from the backup contacting anemometer. Data from the contacting anemometer are processed as before 1972, except that the interval is centered on the nominal hour--e.g. the interval from 0030 to 0130 is used to obtain the 0100 reading.

Gaps in the wind record (Table 3) are filled by linear interpolation, data from the backup anemometer, or by the computer "bridging" program. Linear interpolation is used when the data is missing for several hours or less. Gaps longer than several hours are replaced with data from the backup contacting anemometer; if only the speed or direction is missing, only one parameter is replaced. When backup data are not available, the "bridging" program is used to compute eastward and northward components of the wind.

Table 3. Time and duration of gaps in the wind speed and direction data from the anemometer on the south jetty at Newport, and the method used to fill each gap. All times shown are Pacific Standard Time.

1969	1500-2400 16 March: linear interpolate speed
	0700 23 March - 1600 24 March: bridge u and v to get direction
	1400 28 March - 2400 1 April: bridge u and v to get speed
	0100 4 April - 1500 15 April: bridge speed
	2300 14 July - 1000 15 July: bridge speed
	0100-0900 19 July: linear interpolate speed
	1700 26 July - 1400 28 July: bridge speed
	0400-1200 11 Sept.: linear interpolate speed
	1300-2400 2 Oct.: linear interpolate speed and direction
1970	1400 8 May - 1200 21 May: bridge u and v for speed and direction
	1000 6 Oct. - 1300 14 Oct.: bridge u and v for speed and direction
	0600 4 Nov. - 1200 13 Nov.: bridge u and v for speed and direction
	1100 8 Dec. - 1500 10 Dec.: bridge u and v for speed and direction
	1400-2400 28 Dec.: bridge u and v for direction
	0100 29 Dec. - 2400 31 Dec.: bridge u and v for speed and direction
1971	0100 1 Jan. - 2400 3 Jan.: bridge u and v for direction
	2400 24 Feb. - 1100 25 Feb.: linear interpolate speed and direction
	0400-2000 25 Nov.: linear interpolate speed and direction
1973	1700 12 Oct. - 1100 31 Oct.: used backup gauge
1975	0800 8 Feb. - 1200 14 Feb.: used backup gauge
	0200 24 Sept. - 1400 6 Oct.: used backup gauge
1976	0500 18 Jan. - 1200 23 Jan.: used backup gauge
	0500 18 Mar. - 1500 19 Mar.: used backup gauge
	0100 15 April - 1600 16 April: direction from backup gauge
	1500 19 May - 1200 28 May: used backup gauge
	2400 11 Aug. - 0900 12 Aug.: used backup gauge
	2200 15 Sept. - 1500 24 Sept.: used backup gauge
1977	0800 15 Feb. - 1700 18 Feb.: direction from backup gauge
	1300 17 May - 1100 21 May: direction from backup gauge
	0100-1600 5 Aug.: used backup gauge
	1800 29 Sept. - 0900 10 Oct.: used backup gauge
	1100 15 Dec. - 1000 16 Dec.: used backup gauge
1978	1400 30 March - 2400 5 May: used backup gauge with 0100 2 April - 1800 3 April bridge u and v for speed and direction
	1100 3 March - 1300 10 March: direction from backup gauge

Table 3. Continued.

1979	0700-1700	11 May:	used backup gage
	1800	11 May - 1100 16 May:	bridge u and v for speed and direction
	1200	16 May - 1000 29 May:	used backup gage although E contact not working
	1300	29 May - 1000 30 May:	direction corrected by -77 degrees
	1000	1 June - 0800 8 June:	speed from Rustrak recorder
1980	2400	5 Jan. - 1700 7 Jan.:	bridge u and v for direction
	1800	7 Jan. - 1700 10 Jan.:	used backup gauge
	1800	10 Jan. - 1000 11 Jan.:	bridge u and v for direction
	2200	15 June - 0700 20 June:	direction from backup gauge
	2200	21 July - 0700 22 July:	used backup gauge
	0600	18 Oct. - 1300 23 Oct.:	used backup gauge
	1600	29 Nov. - 1300 1 Dec.:	used backup gauge

DATA PROCESSING

For all variables, the processed data files use Greenwich Mean Time (Universal Time) as the time base, although the data were originally recorded in Pacific Standard Time.

The basic measured variables are sea level, atmospheric pressure, wind speed and wind direction. Two other variables, wind stress and "adjusted sea level", that are of oceanographic interest are routinely computed from these measured variables.

Wind stress is the force per unit area that the wind exerts on the water underneath. It has the same direction as the wind, and its magnitude is proportional to the square of the wind speed. The eastward (τ_x) and northward (τ_y) components of the wind stress are computed from the eastward (u) and northward (v) components of the wind velocity:

$$\tau_x = \rho\ C_D(u^2 + v^2)^{\frac{1}{2}}u$$

$$\tau_y = \rho\ C_D(u^2 + v^2)^{\frac{1}{2}}v$$

where ρ is the density of air, taken to be 0.0125 gm cm^{-3}, and C_D is the drag coefficient, taken to be 0.0015.

Sea level varies both as a direct response to changes in atmospheric pressure and in association with changes in surface currents. If sea level is to be used as an indicator of currents or other oceanographic variables, it is desirable to remove the direct effect of atmospheric pressure variations. This effect is frequently described as the "inverted barometer" effect, by which sea level falls one centimeter when atmospheric pressure increases by one millibar. To adjust for this effect, variations in atmospheric pressure are added to the variations in sea level. Thus, the adjusted sea level, η, is obtained from the observed sea level, h, and deviations in atmospheric pressure, p_a, from the standard pressure of 1000 mb:

$$\eta = h + p_a - 1000.$$

Adjusted sea level is sometimes also referred to as "synthetic subsurface pressure".

For each variable, the basic data consist of hourly time series. These hourly data are used to compute monthly and annual statistics and three kinds of filtered time series: low-passed (LLP); very-low-frequency (VLF); and intermediate-low-frequency (ILF). The beginning of the hourly time series depends on the actual measurements, and is different for each variable. The hourly time series were processed through 21 January 1981, so that all filtered time series could end 31 December 1980.

The hourly time series were low-pass filtered to remove fluctuations with periods shorter than a day to produce low-passed (LLP) time series. The filter response function (Figure 3) shows that it passes signals with 95% amplitude of 0.37 cpd (64 hr), 50% amplitude at 0.6 cpd (40 hr) and 5% amplitude at 0.84 cpd (28 hr); its half-power point is at 0.52 cpd (46 hr). Thus the low-passed time series do not contain the diurnal sea breeze or the diurnal and semi-diurnal tides, but they do contain the day-to-day variations associated with the weather, and longer period (e.g. seasonal) variations. The low-passed time series are decimated to six-hourly data. The low-passed time series are 24 hours shorter at each end than the hourly data.

The low-passed time series were further filtered to remove fluctuations with periods shorter than about 25 days, to produce the very-low-frequency

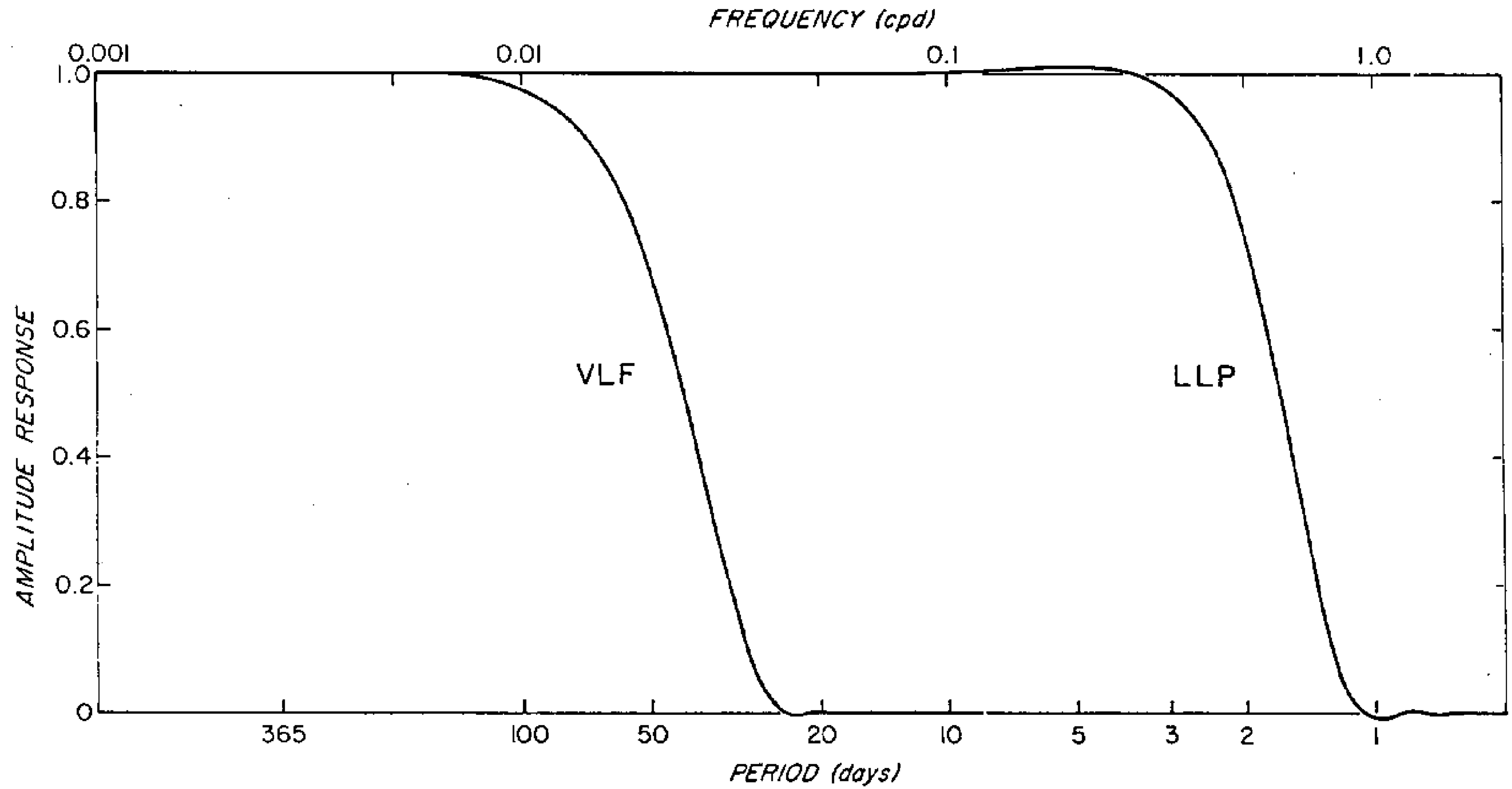

Figure 3. The amplitude response functions for the low-pass (LLP) and very-low-frequency (VLF) filters. Signals passed by the LLP filter and suppressed by the VLF filter are referred to as intermediate-low-frequency (ILF) signals.

(VLF) time series. This filter (Figure 3) passes signals with 95% amplitude at 0.012 cpd (83 days), 50% amplitude at 0.024 cpd (42 days), 5% amplitude at 0.036 cpd (28 days); the half-power point is at 0.0196 cpd (51 days). Thus the VLF time series do not contain the shorter period weather fluctuations or events, but still contain the seasonal variations. The VLF time series are 20 days shorter at each end than the LLP data.

Intermediate-low-frequency (ILF) time series were obtained by subtracting the very-low-frequency (VLF) time series from the low-passed (LLP) time series. Thus the ILF data are a residual time series, with no energy at either very low frequencies or very high frequencies. The half-power points are 51 days at the low frequency end and 46 hours at the high frequency end; all of the energy with periods between 3 and 25 days is retained in the ILF time series. Thus the ILF time series contains those fluctuations usually associated with the weather; this is sometimes referred to as the "event" time scale. The ILF time series are the same length as the VLF series.

SUMMARY OF DATA PRESENTED

Statistics (Appendix A)

For each parameter, tables of the monthly means are presented in Appendix A for each month in each year, beginning with the first full month of data, and ending with December 1980. These tables have marginal entries showing the mean annual values for each full year, and also the mean value for each month. For sea level, the means are given in units of both feet (the recording unit) and centimeters. For the wind and wind stress vectors, we present the monthly mean vectors both as eastward and northward components, and as speed and direction of the vector mean. These monthly means are summarized in Figure 4.

The ten-year monthly and annual means for the period 1971-1980 when all parameters were measured are summarized in Table 4, and graphically in Figure 5. The overall means for the entire record lengths are compared to the ten-year means in Table 5. The ten-year monthly means of adjusted sea level, wind, and wind stress (Table 4 and Figure 5) show a difference between summer and winter regimes. Adjusted sea level is higher than the mean from November through March and lower from April through October. Winds and wind stresses are from the south and southwest from November through March and from the northwest from May through August. The ten-year mean wind and wind stress roses (Figure 5) suggest the following seasonal groupings:

Season	Months	Mean Wind Speed m/sec	Mean Wind Direction °T	Mean Wind Stress Magnitude dynes/cm^2	Mean Wind Stress Direction °T
Winter	Nov-Feb	2.2	4	0.49	21
Spring	Mar-May	1.5	variable	0.27	variable
Summer	Jun-Aug	1.7	152	0.21	155
Fall	Sep-Oct	0.4	variable	0.09	variable

Both the wind and wind stresses are characterized by small directional variability in both winter and summer, separated by transitional spring and fall seasons. The variability in the magnitude of the wind stress between winter and summer is much greater than that of the wind velocity. The fall season has much lower wind and wind stresses than the other seasons.

Subtracting the ten-year means for each month from the monthly means yields monthly anomalies. The monthly anomalies are presented in tabular form for each variable in Appendix A. They are summarized in Figure 6.

Annual standard deviations computed from the hourly data, and for each of the filtered time series, namely the low-passed (LLP), very-low-frequency (VLF) and intermediate-low-frequency (ILF) time series are also tabulated in Appendix A. The annual means and standard deviations of the low-passed (LLP) data are summarized in Table 6 and Figure 7. The inter-annual variation in sea level and adjusted sea level is only a few centimeters and for atmospheric pressure only a fraction of that (Figure 7 and Table 6). At this time scale atmospheric pressure does not have the same moderating effect on sea level as it does at higher frequencies. The standard deviation of the noisiest year (1973) in both sea level and adjusted sea level is about 70% higher than that for the quietest year (1976); for atmospheric pressure it is about 40% (1978 and 1976). The effect of atmospheric pressure results in adjusted sea level having about 20% smaller annual standard deviations than unadjusted sea level.

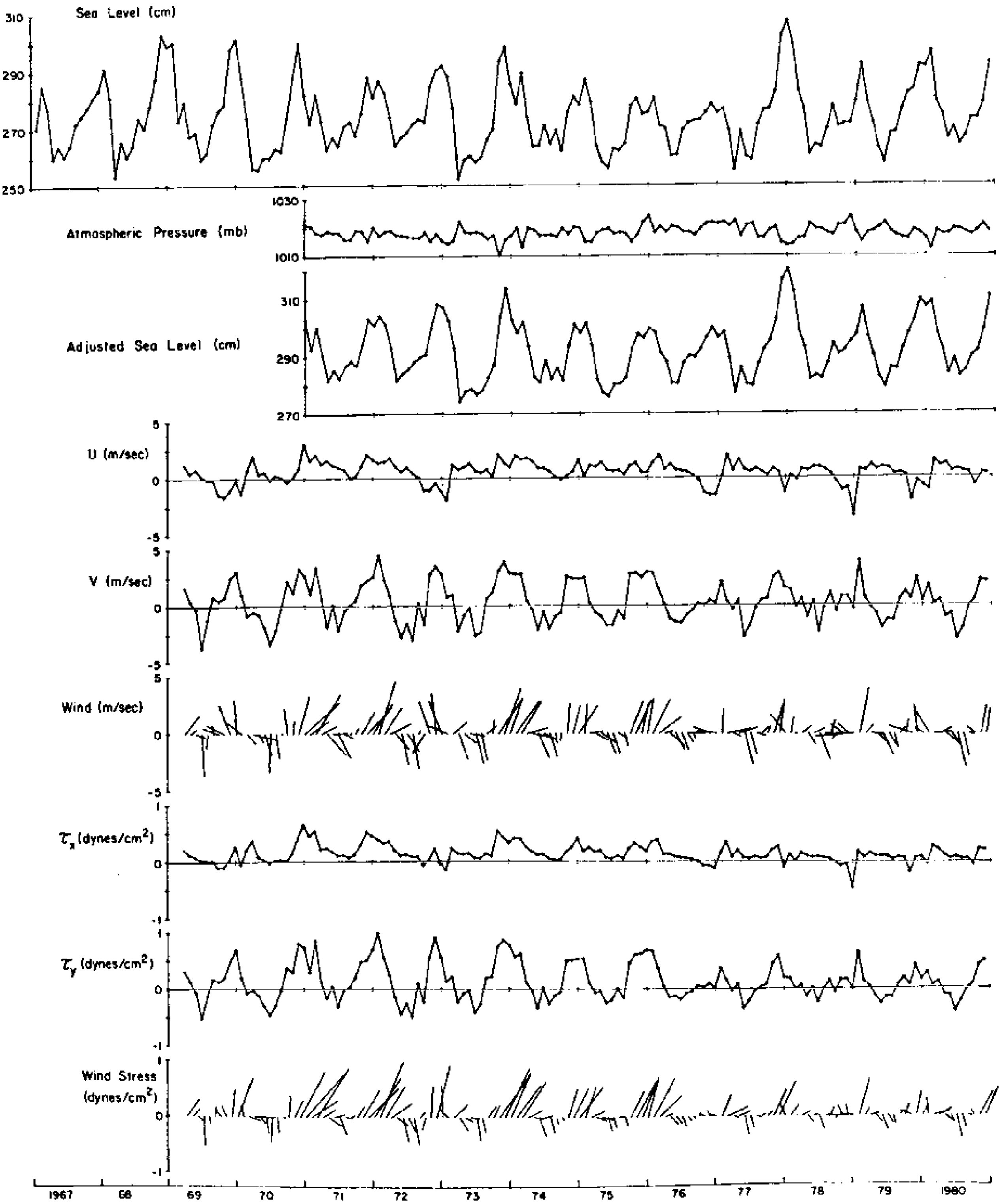

Figure 4. Summary of the monthly means of sea level; atmospheric pressure; adjusted sea level; eastward (U) and northward (V) components of the wind; wind shown as vectors; eastward (τ_x) and northward (τ_y) components of the wind stress; and wind stress shown as vectors. The vectors point in the direction toward which the wind is blowing.

Table 4. Ten-year monthly means (1971-1980).

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Mean
Sea level (cm)	284.6	285.6	279.1	268.4	262.7	262.7	264.8	267.7	272.1	272.4	280.0	286.7	273.8
Atmospheric pressure (mb)	1018.8	1016.9	1017.5	1019.1	1019.0	1019.2	1018.6	1017.5	1016.8	1018.4	1018.2	1018.8	1018.2
Adjusted sea level (cm)	303.4	302.5	296.5	287.5	281.7	281.9	283.4	285.2	288.9	290.8	298.2	305.4	292.1
Eastward wind (m/sec)	-0.0	0.5	1.3	1.1	1.2	0.8	0.8	0.6	0.3	-0.1	-0.0	0.2	0.57
Northward wind (m/sec)	1.8	2.4	1.2	0.0	-0.8	-1.3	-1.8	-1.2	0.1	0.4	1.9	2.3	0.41
Wind speed (m/sec)	1.9	2.4	1.8	1.1	1.5	1.6	2.0	1.4	0.3	0.4	1.9	2.4	0.70
Direction (°T)	359	11	47	88	126	146	157	153	79	352	1	5	54
Eastward wind stress (dynes/cm^2)	0.14	0.21	0.28	0.19	0.16	0.10	0.09	0.07	0.07	0.05	0.15	0.21	0.14
Northward wind stress (dynes/cm^2)	0.44	0.47	0.31	0.05	-0.08	-0.18	-0.23	-0.15	0.03	0.09	0.40	0.52	0.14
Magnitude of wind stress (dynes/cm^2)	0.46	0.51	0.42	0.20	0.18	0.21	0.25	0.17	0.08	0.10	0.43	0.56	0.20
Direction (°T)	18	24	42	75	117	151	159	155	67	29	21	22	45

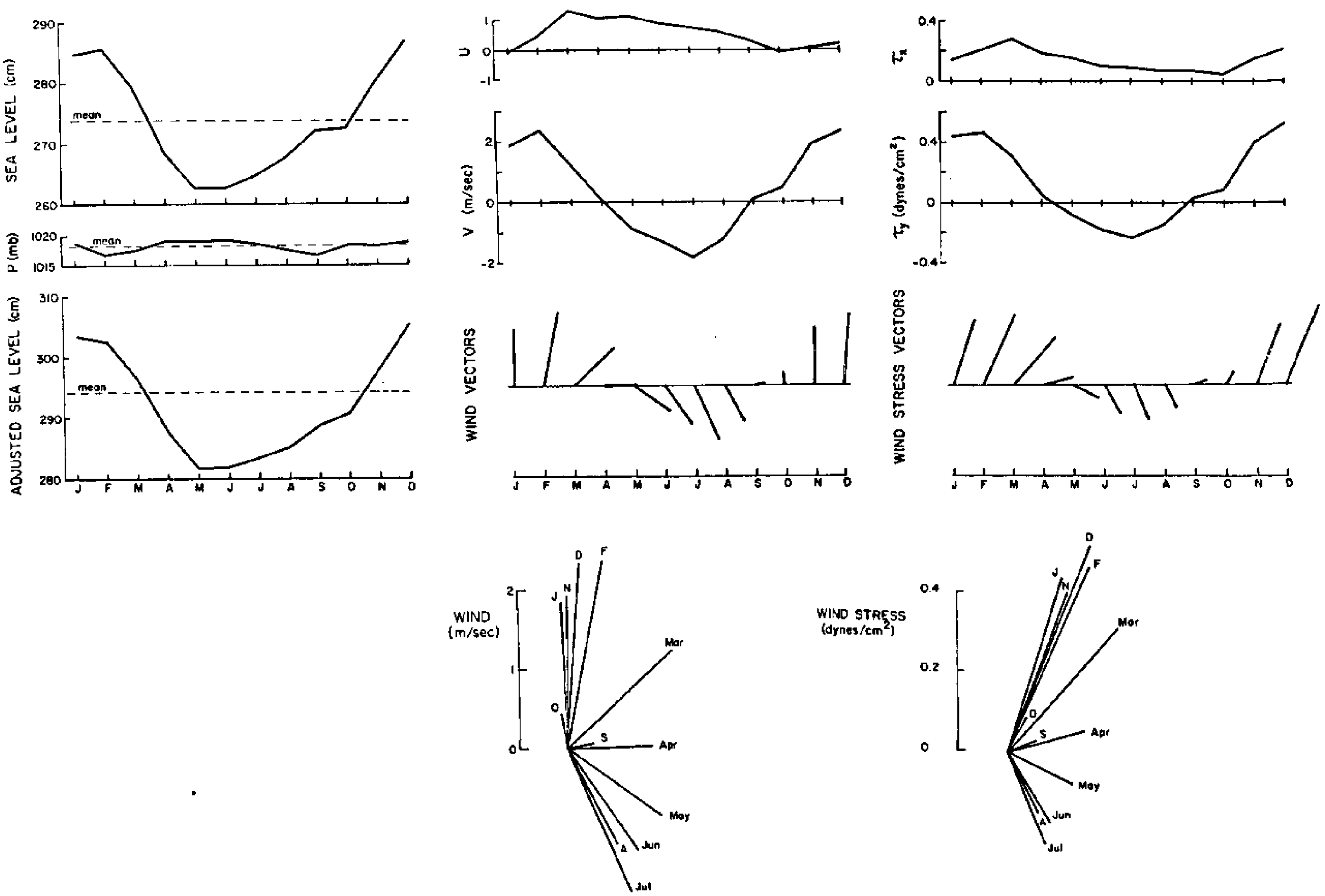

Figure 5. Ten-year monthly means of sea level; atmospheric pressure; adjusted sea level; eastward (U) and northward (V) components of the wind; wind shown as vectors; eastward (τ_X) and northward (τ_Y) components of the wind stress; and wind stress shown as vectors. Ten-year average wind and wind stress roses are also shown.

Table 5. The overall record length, overall mean, and the ten-year (1971-1980) mean for each variable.

	Record Length	Overall Mean	Ten-Year Mean (1971-1980)
Sea Level, h(cm)	1 Feb. 1967-31 Dec. 1980	274.11	273.83
Atmospheric Pressure, p_a(mb)	9 Dec. 1970-31 Dec. 1980	1018.20	1018.23
Adjusted Sea Level, η(cm)	9 Dec. 1970-31 Dec. 1980	292.18	292.06
Eastward Wind, U(m/sec)	3 Mar. 1969-31 Dec. 1980	0.49	0.57
Northward Wind, V(m/sec)		0.37	0.41
Eastward Wind Stress, τ_x(dynes/cm^2)	3 Mar. 1969-31 Dec. 1980	0.14	0.14
Northward Wind Stress, τ_y(dynes/cm^2)		0.13	0.14

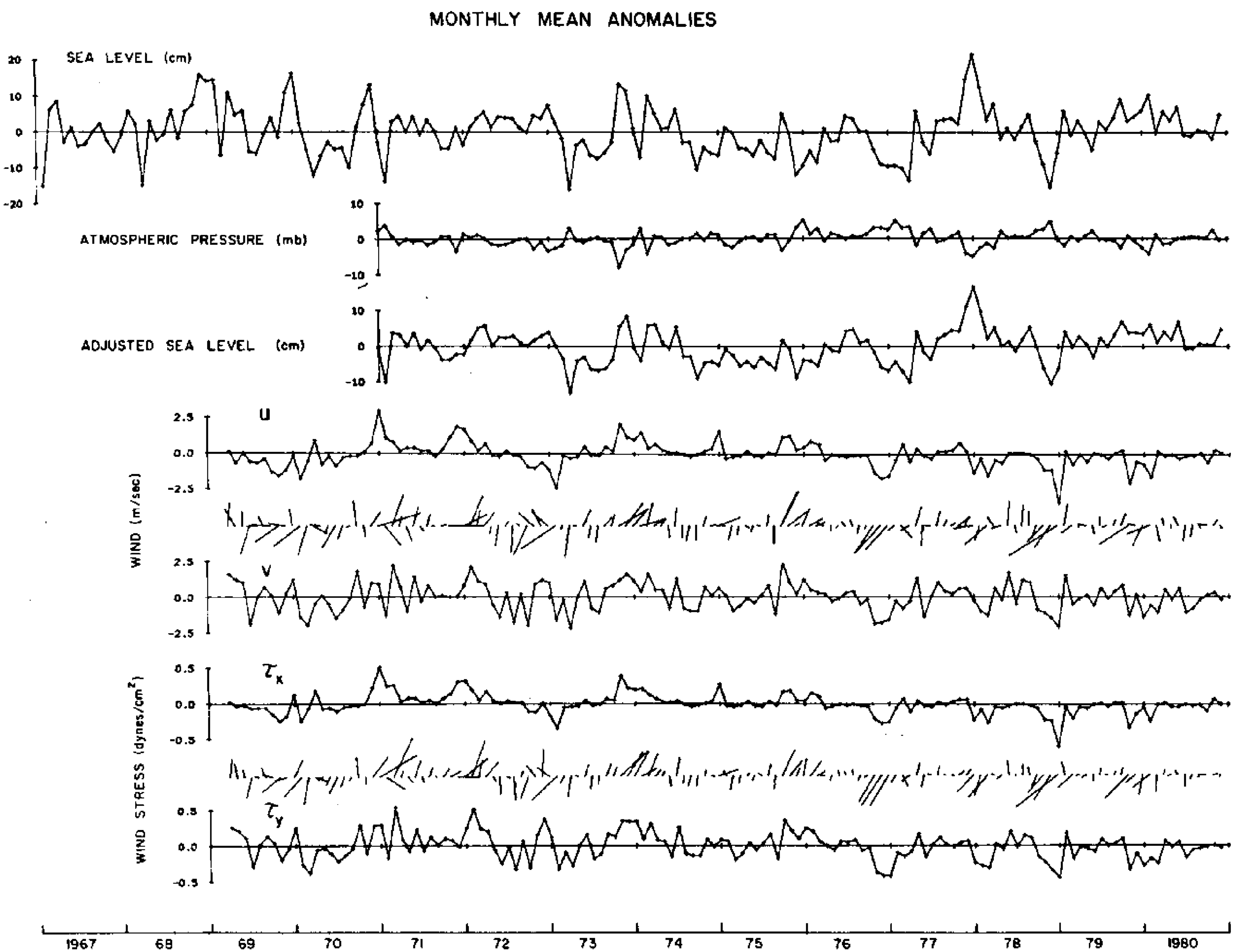

Figure 6. Monthly mean anomalies of sea level; atmospheric pressure; adjusted sea level; wind shown with eastward (U) and northward (V) components and as vectors; wind stress shown as eastward (τ_x) and northward (τ_y) components and as vectors.

Table 6. Annual means and standard deviations of low-passed sea level, atmospheric pressure, adjusted sea level, northward wind and northward wind stress, 1971-1980.

	Sea Level (cm)		Atmospheric Pressure (mb)		Adjusted Sea Level (cm)		Northward Wind (m/sec)		Northward Wind Stress (dynes cm^{-2})	
	$\overline{h}$	σ	$\overline{p_a}$	σ	$\overline{\eta}$	σ	$\overline{v}$	σ	$\overline{\tau_y}$	σ
1971	273.1	15.7	1018.3	6.8	291.4	12.1	0.7	4.7	0.24	0.97
1972	276.4	13.6	1017.8	6.0	294.1	11.1	0.5	5.2	0.20	1.07
1973	273.0	19.1	1016.8	6.4	289.8	15.2	0.4	4.3	0.16	0.81
1974	273.3	15.0	1018.1	6.6	291.4	11.4	0.6	4.3	0.20	0.86
1975	270.3	15.3	1018.0	6.6	288.3	11.7	0.6	4.4	0.18	0.87
1976	271.4	10.9	1019.9	5.0	291.2	9.0	0.2	3.6	0.12	0.68
1977	272.6	15.8	1019.2	5.8	291.9	12.9	0.4	3.5	0.10	0.59
1978	275.8	17.5	1018.4	6.9	294.2	13.2	0.2	3.1	0.04	0.42
1979	275.6	14.9	1018.0	6.2	293.7	11.6	0.3	3.5	0.07	0.55
1980	276.8	15.8	1017.8	6.8	294.6	12.1	0.1	3.5	0.06	0.62

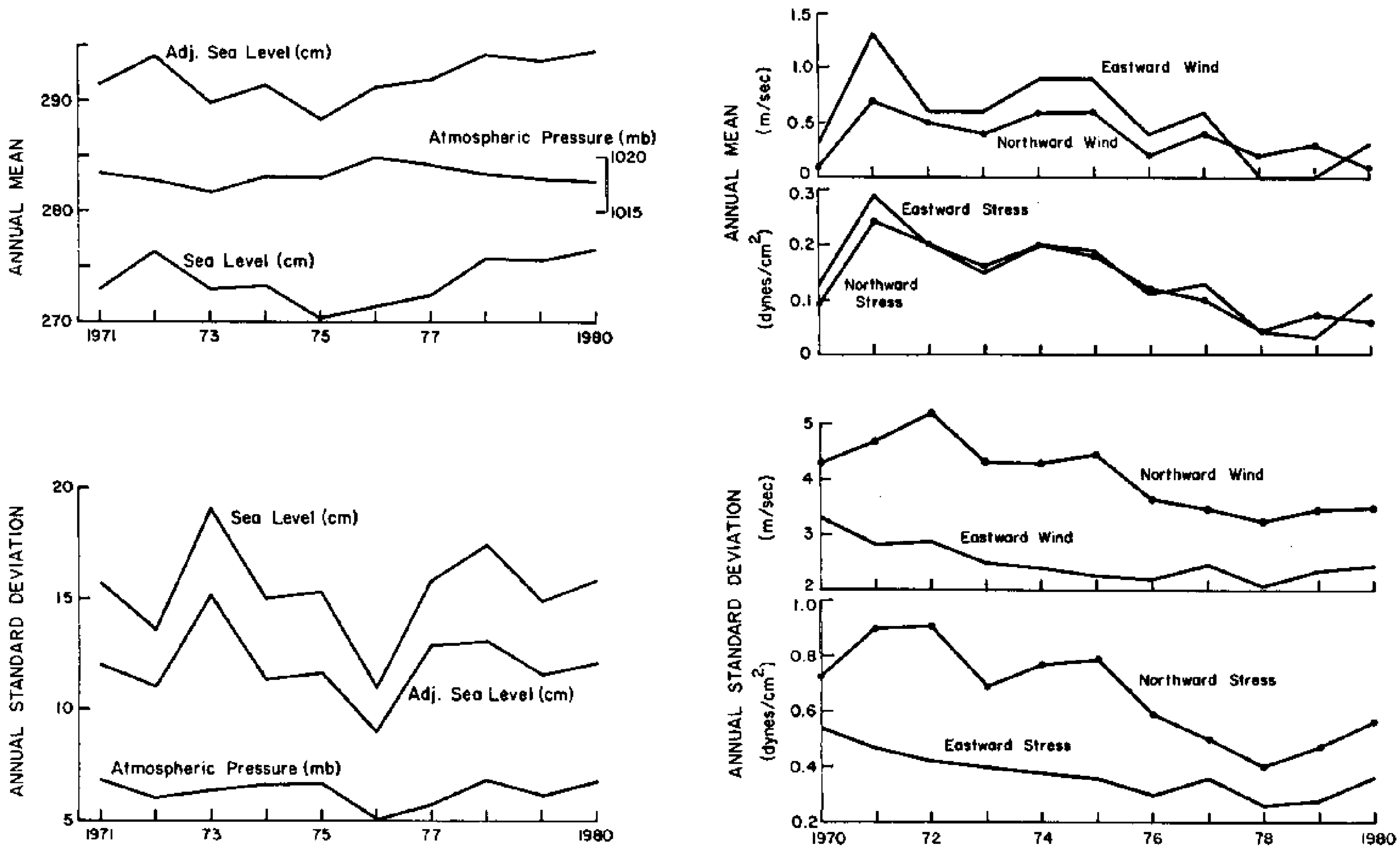

Figure 7. Annual means and standard deviations of low-passed sea level, atmospheric pressure, adjusted sea level, wind and wind stress.

Time Series Plots (Appendix B)

Time series plots of each variable are shown in Appendix B. For each variable, we show plots of the hourly time series, and of each filtered time series.

Hourly Data. Hourly time series are presented on an annual basis for sea level, atmospheric pressure and wind stress, and on a four-monthly basis for wind.

The hourly sea level data are strongly dominated by the semidiurnal tides with amplitudes of a few feet. The envelope of the hourly data clearly shows the occurrence of neap and spring tides. In marked contrast to sea level, the hourly atmospheric pressure data shows almost no diurnal variability. The several-day (event) scale variations are strongest in winter and weakest in summer.

The hourly wind data shows a clear diurnal signal during summer that is generally absent in winter. In winter, the eastward and northward components have roughly the same amplitude, and both show strong variability with periods of several days associated with the passage of weather fronts. In summer, the northward (alongshore) component has strong variability on both the event and the diurnal time scale, but the eastward (onshore) component variability is predominantly diurnal.

The hourly wind stress data shows variability with diurnal, event, and annual periods. Events dominate both eastward and northward components in winter, but only the northward component in summer.

Low-Passed (LLP) Data. To facilitate comparison among variables, all of the low-passed time series presented in Appendix B are plotted with the same time scale. Time series are presented for sea level, atmospheric pressure, adjusted sea level, eastward and northward components of wind, and eastward and northward components of wind stress. In addition, wind and wind stress are displayed as time series of vectors, whose magnitude is indicated by the vertical scale on the left, with north toward the top and east toward the right of the page.

On the plots of atmospheric pressure and sea level, the vertical scales have the same ratio of centimeters or millibars to the inch. This choice of scale demonstrates that sea level and atmospheric pressure are inversely correlated, and that the effect of local atmospheric pressure on sea level (believed to be 1 cm for 1 mb) is smaller than the variations in sea level or adjusted sea level.

Very-Low-Frequency (VLF) Data. All VLF time series presented in Appendix B are plotted to the same time scale as the low-passed time series. The sea level, atmospheric pressure and adjusted sea level are plotted with equivalent vertical scales (1 mb = 1 cm). Wind and wind stress are presented as time series of components and of daily vectors. Seasonal cycles are obvious in the sea level, adjusted sea level, northward wind and northward wind stress, but not in the atmospheric pressure or in the eastward component of wind and wind stress. The continuous time series of the VLF data are shown in Figure 8.

Average daily values of the very-low-frequency adjusted sea level, wind and wind stress were computed for the ten-year period 1971-1980 after elimination of the values for the three occurrences of February 29th (Figure 9). After a winter maximum in sea level and northward winds, adjusted sea level drops rapidly during March and April while the winds are veering clockwise from northward to southeastward. Sea level reaches

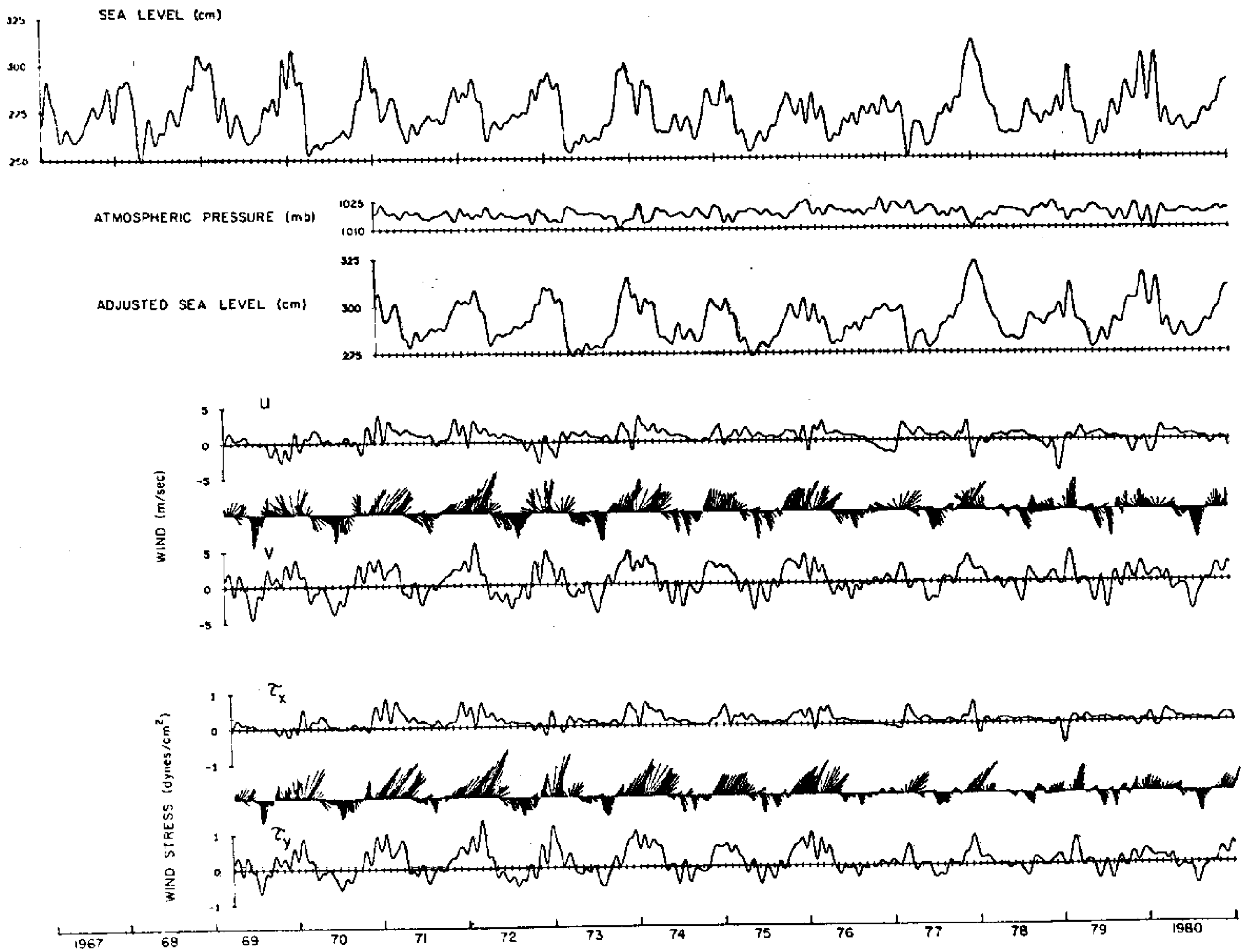

Figure 8. Continuous time series of the very-low-frequency (VLF) data, which has been filtered to suppress signals with periods shorter than about 51 days. Wind and wind stress are shown as vectors and also as eastward and northward components (U and V for wind, τ_x and τ_y for wind stress).

a minimum at the end of May (Table 7) while the winds are settling into their southeastward summer pattern; the strongest southward winds occur in late July (Table 7). The rise in sea level beginning in early June is at a much lower rate than the spring drop. In October, the winds begin blowing from the south again and sea level rises more rapidly to its winter maximum.

Intermediate-Low-Frequency (ILF) Data. Time series of the ILF data are presented on the same time scale as the low-passed data. These time series contain neither the shorter diurnal and semidiurnal variations present in some of the hourly data, nor the seasonal cycle apparent in the low-passed and VLF data, but only those changes that have periods of a few days to a few weeks. This variability is generally assumed to be associated with changes in the weather, the passage of fronts etc., and individual cycles are frequently referred to as events. In most variables, the amplitude of events is larger in winter than summer; this is particularly obvious for the eastward components of the wind and the wind stress. However, events in the northward (alongshore) component of the wind are almost as strong in summer as in winter.

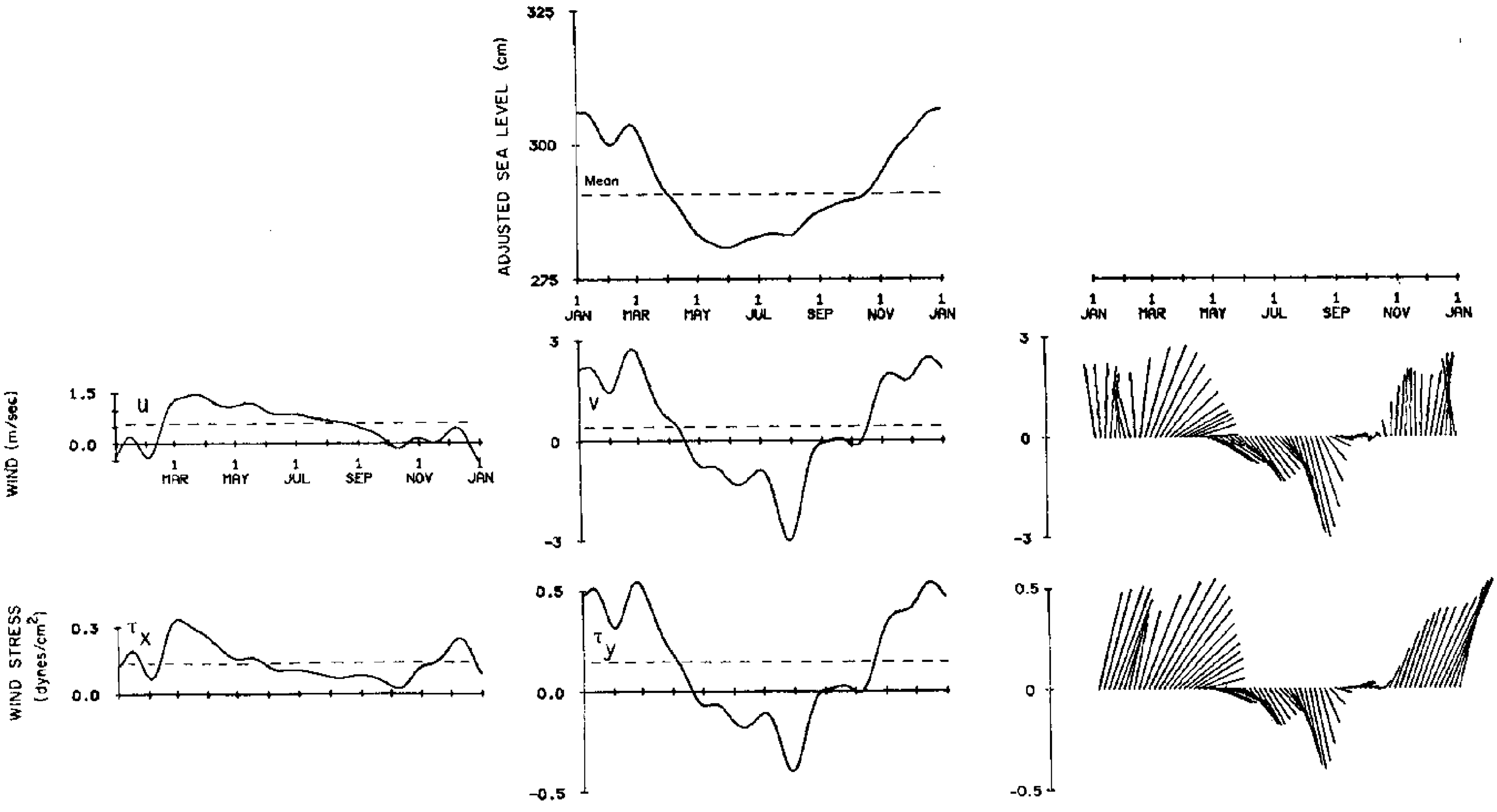

Figure 9. Average daily values of the very-low-frequency (VLF) adjusted sea level, wind and wind stress for the ten-year period 1971 - 1980.

Table 7. Extreme and mean values of the ten-year average VLF adjusted sea level, wind and wind stress, and the dates of their occurrence.

	Maxima		Minimum		Mean		
	Value	Date	Value	Date	Value	Dates Spring	Dates Fall
Adjusted Sea Level (cm)	306.5 306.0 303.6	31 Dec 7 Jan 24 Feb	280.7	30 May	292.1	28 Mar	24 Oct
Northward Wind (m/sec)	2.47 2.19 2.74	18 Dec 10 Jan 24 Feb	-3.00	29 July	0.41	10 Apr	17 Oct
Northward Wind Stress (dynes/cm^2)	0.54 0.51	17 Dec 12 Jan	-0.40	29 July	0.14	8 Apr	19 Oct

Wind PVD's and Scatter Diagrams (Appendix C)

The vector wind data are displayed by two additional methods: progressive vector diagrams (PVD's) and scatter diagrams. A scatter diagram for vectors is one in which the northward (v) component is plotted versus the eastward (u) component: each dot represents the head of a single vector. In a progressive vector diagram, the origin of each succeeding vector is placed at the head of the previous vector: the resulting trace can be interpreted as a pseudo-trajectory; if the velocity field were homogeneous, the curve would represent a true trajectory.

Progressive vector diagrams for the wind were constructed for each year using hourly data; the results are shown in Appendix C. North is toward the top, and east is toward the right of the page. The beginning of each month is indicated by a small square labelled with the initial letter of that month. Some of the PVD's show a period of almost due westward flow in winter, e.g. in January 1970, December 1972 and January 1973. The sustained due westward winds may be a result of poor exposure of the anemometer to winds from the southeast and northeast, combined with the very good exposure to winds from almost due east (Figure 1).

Scatter diagrams for the low-passed wind data are shown in Appendix C for each winter (October through March) and summer (April through September) season. This seasonal division was based partly on the coastal current regime: the summer regime, which prevails from April through September, is characterized by southward surface currents and a persistent vertical shear such that near surface currents are more strongly southward than deeper currents; the winter regime, which prevails from October through March, is characterized by highly variable currents with a northward mean and no persistent vertical shear. This seasonal division is also consistent with the mean seasonal cycle in both wind and sea level data as seen in the monthly mean (Figure 5) and the very-low-frequency data (Figure 9).

Composite scatter diagrams of the eastward and northward components of the low-passed wind (Figure 10) show quite different patterns for the two seasons. In summer, the wind is predominantly alongshore: either almost due southwards, or north-northeastwards. In winter, the direction is much more variable: although the strongest winds are toward the northeast quadrant, weaker winds are frequently directed offshore, with both northward and southward components. The scatter diagrams for individual seasons (Appendix C) resemble the composite diagrams (Figure 10).

Statistics for the summer and winter wind regimes corresponding to the scatter diagrams are presented in Table 8. The long-term mean wind for the summer regime is 1.14 m/sec directed towards 139°T. The mean wind during each summer is also directed towards the southeast quadrant. During each summer the standard deviation of the north-south component is about three times that of the east-west component. The long-term mean winter wind is 1.69 m/sec directed towards 8°T. Half of the winters, however, have a westward component. During each winter the standard deviation of the north-south components is about the same magnitude as the standard deviation of the east-west components.

Composite scatter diagrams of the eastward and northward components of the low-passed wind stress (Figure 11) show the same seasonal pattern as the wind.

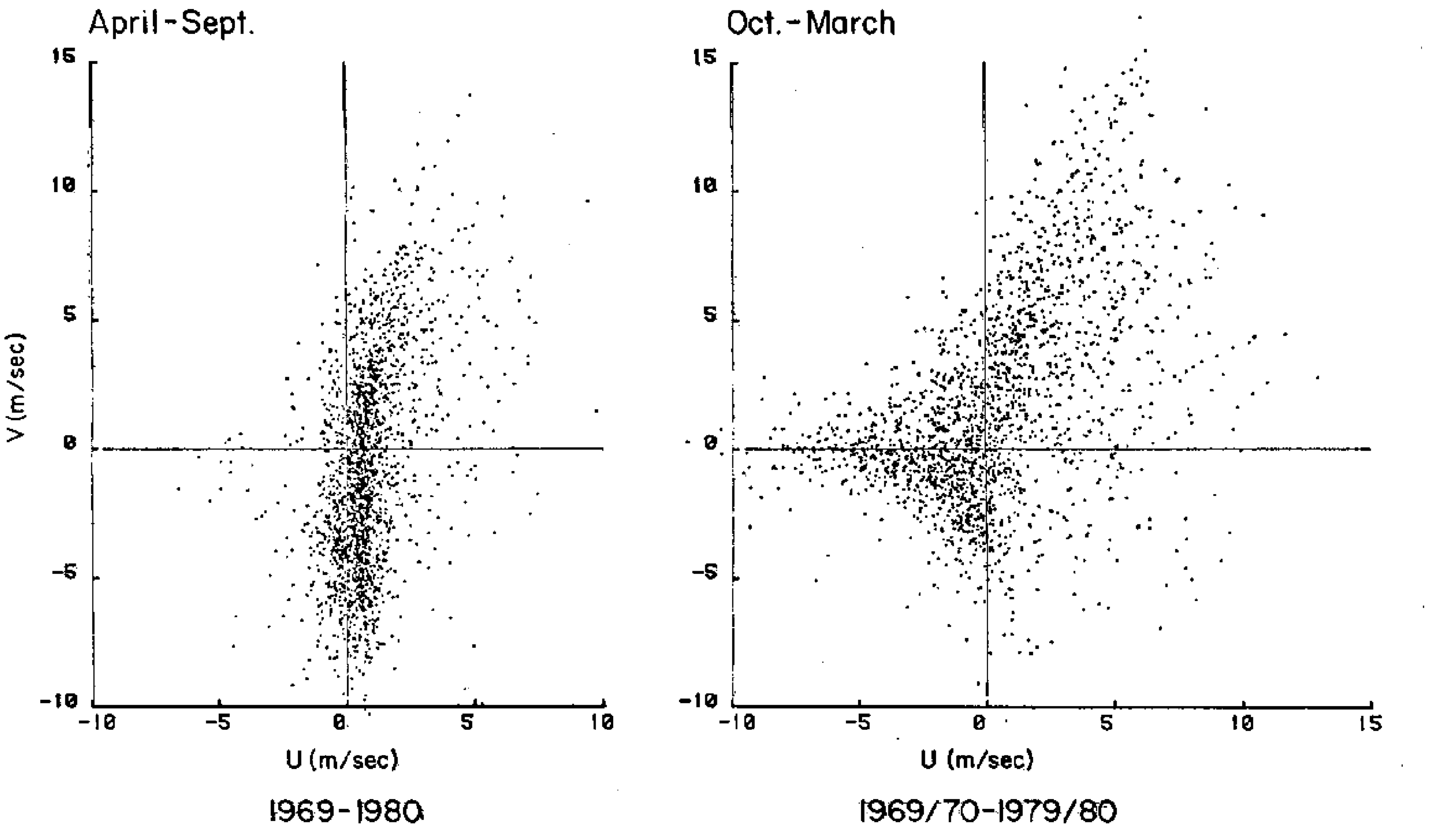

Figure 10. Composite scatter diagrams of daily low-passed (LLP) wind vectors for two different seasons, 1969-1980. Summer includes April - September; winter includes October - March.

Table 8. Seasonal means and standard deviations of daily values of eastward (u) and northward (v) components of the low-passed wind.

	Summer (April through September)					Winter (October through March)			
	$\overline{u}$	$\overline{v}$	σ_u	σ_v		$\overline{u}$	$\overline{v}$	σ_u	σ_v
1969	0.42	-0.44	1.38	4.41	1969-70	-0.77	1.24	3.68	3.78
1970	0.53	-1.41	2.32	3.96	1970-71	1.22	2.31	4.04	4.75
1971	1.00	-0.57	1.60	4.33	1971-72	1.32	2.31	3.39	4.89
1972	0.87	-1.19	1.61	4.89	1972-73	-0.67	1.54	3.30	4.23
1973	0.82	-1.22	1.28	4.07	1973-74	1.37	2.74	3.41	4.28
1974	0.96	-0.83	1.40	3.90	1974-75	0.60	1.57	2.81	4.30
1975	0.79	-1.10	1.13	3.71	1975-76	1.09	2.64	3.11	4.43
1976	0.67	-0.84	0.93	3.31	1976-77	-0.43	0.53	2.45	2.83
1977	0.82	-0.69	1.07	3.21	1977-78	0.00	1.49	3.25	3.06
1978	0.68	-0.18	1.22	3.48	1978-79	-0.80	0.86	2.72	3.18
1979	0.71	-0.78	0.98	3.50	1979-80	-0.38	1.09	3.10	2.89
1980	0.71	-1.03	1.15	3.40					
Mean	0.75	-0.86	1.40	3.89	Mean	0.23	1.67	3.34	4.00

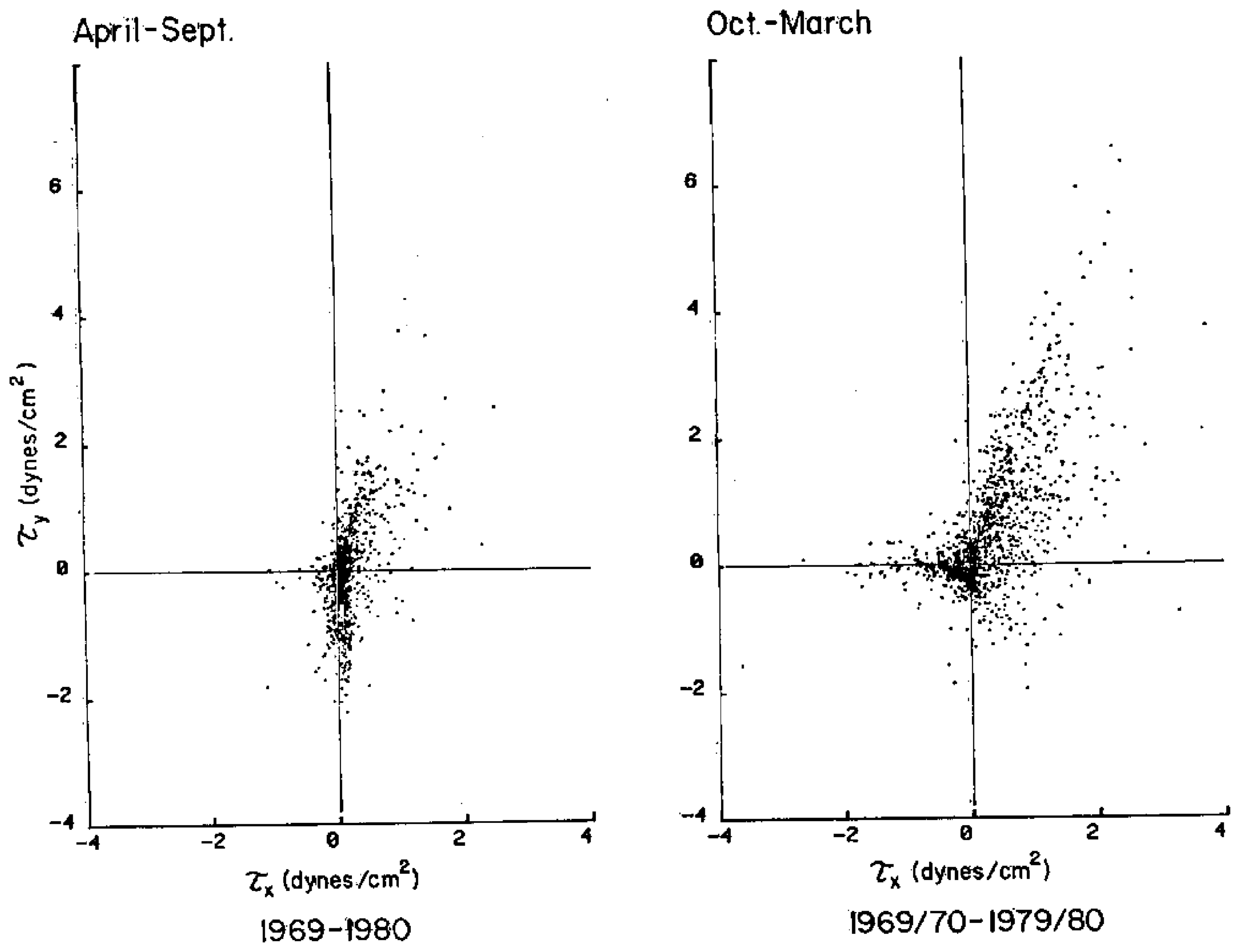

Figure 11. Composite scatter diagrams of daily low-passed (LLP) wind stress vectors for two different seasons, 1969-1980. Summer includes April-September; winter includes October-March.

Cumulative Ekman Transports (Appendix D)

Simple theory indicates that there will be a net onshore or offshore transport of surface water whenever the wind has a net alongshore component. This transport, called the Ekman transport, is directly proportional to the alongshore component of the wind stress, and inversely proportional to the local Coriolis parameter, f. With a north-south coastline orientation, the onshore Ekman transport, M_x, is directed eastward, and it is proportional to the northward wind stress, τ_y:

$$M_x = \frac{\tau_y}{f}$$

The simple theory assumes steady state, but it also appears to work reasonably well for low-passed data. Since the Coriolis parameter for a given location is constant (1.02×10^{-4} sec^{-1} at Newport), time series of the onshore Ekman transport are identical to time series of the northward wind stress presented in Appendix B, except for a change in units: a wind stress of 1 dyne cm^{-2} corresponds to an onshore Ekman transport of 9.8 kg per second per centimeter of coastline, or 98 metric tons per second per hundred meters of coastline. A northward wind stress corresponds to onshore Ekman transport (and downwelling along the coast) and a southward wind stress corresponds to offshore Ekman transport (and upwelling along the coast). With the change of units, and a change in sign, the time series of low-passed northward wind stress in Appendix B are directly comparable to the time series of the upwelling index at 45°N, 125°W (Bakun, 1975) except that the latter is derived from winds calculated from large-scale pressure maps rather than measured winds.

There is some evidence (Huyer et al., 1979) that the response of shelf waters to a given wind stress may depend on its duration as well as on the maximum intensity. To combine both in a single index, Huyer et al. (1979) devised time series of the cumulative Ekman transport, which is a time integration of the low-passed onshore Ekman transport over the duration of a wind event: the integration begins again from zero each time the low-passed alongshore wind stress changes sign. The height of the peaks is a measure of the total Ekman transport resulting from each event; the time series thus readily show which events have greatest effect. Time series of the cumulative Ekman transport are shown in Appendix D for each year from 1969 through 1980.

ACKNOWLEDGMENTS

We wish to thank Gerald Burdwell and especially Clayton Creech for faithfully checking the tide gage, the anemometers and the microbarograph on a regular basis over many years. National Ocean Survey processed the early tide gage data, and continues to provide levelling corrections. Support for collecting and preliminary processing of the data was provided by a series of many different projects funded by the National Science Foundation, the Office of Naval Research, and Sea Grant. Support for the preparation of this data report was provided in part by Sea Grant through Contracts NA 79AA-D-00106 and NA 81AA-D-00086, and in part by the National Science Foundation through Grant OCE-7925019.

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APPENDIX A

STATISTICS

Monthly Means
Monthly Anomalies
Annual Standard Deviations

MONTHLY MEAN SEA LEVEL (FT)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Mean
1967		8.87	9.36	9.09	8.53	8.66	8.56	8.68	8.93	9.02	9.11	9.33	
1968	9.31	9.56	9.23	8.32	8.72	8.55	8.67	8.99	8.97	9.13	9.44	[illegible]	9.06
1969	9.81	9.85	8.95	9.17	8.78	8.82	8.51	8.59	8.91	9.07	9.14	9.77	9.11
1970	9.88	9.45	8.99	8.41	8.40	8.53	8.53	8.64	8.60	8.98	9.44	9.94	8.97
1971	9.24	8.92	9.25	8.95	8.52	8.76	[illegible]	8.89	8.94	8.79	9.04	9.45	8.96
1972	9.22	9.41	9.28	8.99	8.56	8.76	8.81	8.91	8.97	8.94	9.34	9.53	9.07
1973	9.58	9.46	9.10	8.28	8.50	8.55	8.43	8.54	8.74	8.85	9.63	9.79	8.95
1974	9.37	9.14	9.49	8.98	8.55	8.66	8.92	8.63	8.84	8.60	9.05	9.22	8.96
1975	9.13	9.41	9.16	8.66	8.47	8.41	8.64	8.60	8.69	9.11	9.19	9.02	8.87
1976	9.04	9.20	8.88	8.85	8.54	8.55	8.94	8.91	8.94	8.95	9.03	9.12	8.90
1977	9.03	9.07	8.83	8.37	8.82	8.53	8.44	8.89	9.05	9.07	9.27	9.50	8.94
1978	10.06	9.79	9.27	9.07	8.66	8.66	8.63	8.84	9.09	8.86	8.90	8.90	9.05
1979	9.15	9.57	9.14	8.91	8.62	8.46	8.74	8.81	9.06	9.25	9.29	9.56	9.05
1980	9.54	9.72	9.15	9.00	8.73	8.25	8.66	8.75	8.95	8.95	9.33	9.57	9.03
Mean	9.41	9.39	9.15	8.79	8.61	8.63	8.65	8.77	8.90	8.97	9.21	9.49	

MONTHLY MEAN SEA LEVEL (CM)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Mean
1967		270.4	285.3	277.1	260.0	264.0	260.9	264.6	272.2	274.9	277.7	281.3	
1968	283.8	281.4	281.3	253.6	265.8	260.6	264.3	274.0	270.4	278.3	287.7	302.7	276.2
1969	299.0	300.2	272.8	279.5	267.6	268.8	259.4	261.8	271.6	276.5	278.6	297.8	277.6
1970	301.1	288.0	274.0	256.3	256.0	260.0	260.0	263.3	262.1	273.7	287.7	299.9	273.5
1971	281.6	271.9	281.9	272.8	262.7	267.0	264.3	271.0	272.5	267.9	275.5	288.0	273.1
1972	281.0	286.8	282.9	274.0	264.0	267.0	268.8	271.6	273.4	272.5	284.7	290.5	276.4
1973	292.0	288.3	277.4	252.4	259.1	260.0	258.5	260.3	266.4	269.7	293.5	298.4	273.0
1974	285.6	278.6	289.3	273.7	263.7	264.0	271.3	264.9	269.4	262.1	275.8	281.0	273.3
1975	278.3	286.8	279.2	264.0	258.2	256.3	262.7	262.1	264.9	277.7	280.1	274.9	270.3
1976	275.5	280.4	270.7	269.7	260.3	260.6	269.4	271.6	272.5	272.8	275.2	278.0	271.4
1977	275.2	276.5	269.1	255.1	268.8	260.0	258.8	271.0	275.8	276.5	282.5	301.8	272.6
1978	306.6	298.4	282.5	276.5	260.9	264.0	263.0	269.4	277.1	270.1	271.3	271.3	275.8
1979	278.9	291.7	278.6	271.6	262.7	257.9	267.6	268.5	276.1	281.9	283.2	291.4	275.7
1980	290.8	296.3	278.9	274.3	266.1	269.7	264.0	266.7	272.8	272.8	278.3	291.7	276.8
Mean	286.9	286.1	278.9	267.9	262.6	262.9	263.8	267.2	271.2	273.4	280.8	289.2	

MONTHLY MEAN ATMOSPHERIC PRESSURE (MB)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Mean
1971	1021.3	1020.7	1018.4	1017.8	1019.1	1018.5	1018.4	1016.0	1016.1	1019.2	1019.0	1015.4	1018.3
1972	1020.2	1017.4	1018.7	1019.3	1017.7	1017.4	1017.1	1016.7	1016.7	1018.5	1015.4	1018.0	1017.8
1973	1015.4	1014.4	1015.7	1022.2	1018.6	1018.3	1018.6	1018.0	1016.3	1017.5	1010.2	1015.6	1016.7
1974	1017.3	1019.8	1013.2	1020.0	1019.4	1017.4	1017.5	1017.6	1016.8	1019.8	1017.9	1020.2	1018.1
1975	1019.8	1015.1	1015.0	1018.2	1019.3	1019.6	1017.8	1018.5	1017.9	1015.0	1017.5	1021.8	1018.0
1976	1024.0	1018.2	1020.3	1018.4	1020.5	1020.0	1018.4	1018.4	1017.3	1019.7	1021.3	1021.7	1019.9
1977	1021.3	1021.9	1020.4	1022.3	1017.1	1020.6	1021.2	1016.5	1016.4	1019.0	1020.1	1014.7	1019.3
1978	1013.6	1014.1	1016.2	1016.4	1021.1	1019.4	1019.2	1018.0	1017.2	1020.7	1020.9	1023.7	1018.4
1979	1018.4	1015.0	1018.0	1018.6	1019.9	1021.5	1018.4	1017.1	1016.3	1015.9	1019.0	1018.1	1018.0
1980	1016.3	1012.5	1018.7	1017.5	1017.7	1019.2	1019.0	1018.1	1017.2	1018.6	1020.6	1018.4	1017.8
Mean	1018.8	1016.9	1017.5	1019.1	1019.0	1019.2	1018.6	1017.5	1016.8	1018.4	1018.2	1018.8	

MONTHLY MEAN ADJUSTED SEA LEVEL (CM)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Mean
1971	302.8	292.6	300.4	290.7	281.9	285.5	282.6	286.9	288.6	287.0	294.5	303.3	291.4
1972	301.3	304.1	301.5	293.3	281.7	284.5	285.9	288.3	290.0	291.0	300.0	308.4	294.2
1973	307.5	302.7	293.2	274.6	277.8	278.9	277.0	278.4	282.8	287.2	303.8	313.8	289.8
1974	303.0	298.5	302.3	293.8	283.0	281.3	288.9	282.5	286.2	281.9	293.7	301.1	291.3
1975	298.2	301.9	294.1	282.2	277.5	276.1	280.5	280.6	282.7	292.7	297.7	296.6	288.3
1976	299.7	298.5	291.1	288.2	280.7	280.6	287.8	290.1	289.9	292.6	296.6	299.7	291.3
1977	296.6	298.4	289.5	277.5	286.0	280.4	279.9	287.4	292.4	295.4	302.7	316.6	291.9
1978	320.2	312.6	298.7	293.0	282.0	283.3	282.2	287.4	294.3	290.6	292.0	295.0	294.2
1979	297.2	306.8	296.6	290.3	282.6	279.2	285.9	285.5	292.4	297.8	302.2	309.4	293.7
1980	307.0	308.7	297.7	291.8	283.8	288.9	282.8	284.7	289.8	291.4	298.9	310.2	294.6
Mean	303.4	302.5	296.5	287.5	281.7	281.9	283.4	285.2	288.9	290.8	298.2	305.4	

MONTHLY MEAN EASTWARD WIND (M/SEC)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Mean
1969				1.2	0.5	0.8	0.2	-0.1	-0.1	-1.4	-1.6	-1.0	
1970	-0.2	-1.3	0.7	2.0	0.4	0.6	-0.1	0.3	0.1	-0.3	0.1	0.9	0.3
1971	3.0	1.6	2.1	1.3	1.6	1.2	1.0	0.8	0.1	0.2	1.1	2.1	1.3
1972	1.7	1.4	1.5	1.8	1.1	0.6	1.0	0.5	0.1	-1.0	-1.0	-0.4	0.6
1973	-1.1	-1.9	1.2	0.8	1.0	1.3	0.7	0.5	0.8	0.1	2.1	1.4	0.6
1974	1.0	2.0	1.7	1.8	1.5	0.9	0.9	0.6	0.1	-0.1	0.2	0.6	0.9
1975	1.6	0.2	1.1	1.0	1.4	0.7	0.6	0.7	0.3	1.1	1.3	0.5	0.9
1976	0.5	1.4	1.9	0.7	1.2	0.7	0.6	0.5	0.2	-0.2	-1.3	-1.5	0.4
1977	-1.5	0.1	2.0	0.6	1.6	0.7	0.5	0.8	0.5	0.2	0.8	0.4	0.6
1978	-1.3	0.2	-0.2	0.7	0.6	0.9	0.9	0.7	0.3	-0.4	-1.1	-0.9	0.0
1979	-3.4	0.7	0.6	1.1	0.7	0.9	0.8	0.3	0.4	0.2	-2.0	-0.3	0.0
1980	-0.7	-1.1	1.5	1.0	1.2	0.5	0.7	0.5	0.4	-0.7	0.4	0.3	0.3
Mean	-0.0	0.3	1.3	1.2	1.1	0.8	0.7	0.5	0.3	-0.2	-0.1	0.2	

MONTHLY MEAN NORTHWARD WIND (M/SEC)

1969				1.6	0.4	-0.3	-3.7	-1.2	0.8	0.5	0.8	2.5	
1970	3.0	1.0	-0.8	-0.5	-0.7	-1.8	-3.3	-2.1	0.0	2.2	1.2	3.3	0.1
1971	2.7	1.1	3.4	0.7	-1.8	0.1	-2.1	-0.4	0.1	0.5	1.9	2.3	0.7
1972	2.6	4.5	2.3	0.9	-1.3	-2.7	-1.5	-3.0	0.3	-1.6	2.8	3.5	0.5
1973	2.8	0.8	1.0	-2.2	-0.8	-0.2	-2.6	-2.3	0.7	1.2	3.1	3.9	0.4
1974	2.9	2.8	2.8	0.5	-0.3	-2.1	-0.5	-2.0	-0.9	-0.6	2.6	2.4	0.6
1975	2.4	2.5	0.2	-0.6	-0.9	-1.7	-1.7	-0.4	-1.1	2.8	2.9	2.5	0.6
1976	3.0	2.9	1.5	0.2	-1.1	-1.4	-1.5	-0.8	-0.4	0.2	-0.0	0.5	0.2
1977	0.2	2.1	0.4	-0.3	0.5	-2.7	-1.8	-0.2	0.5	0.6	2.5	2.9	0.4
1978	1.6	1.4	-0.1	0.6	-1.0	0.4	-2.3	-0.2	1.1	-0.5	0.8	0.8	0.2
1979	-0.3	3.9	0.7	-0.1	-0.7	-1.9	-1.2	-1.3	0.5	1.2	0.6	2.4	0.3
1980	0.4	1.8	0.1	0.5	-1.0	-0.7	-2.9	-2.0	-0.1	0.5	2.2	2.1	0.1
Mean	1.9	2.3	1.0	0.1	-0.7	-1.3	-2.1	-1.3	0.1	0.6	1.8	2.4	

MONTHLY MEAN WIND SPEED (M/SEC) AND DIRECTION (°T)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Mean
1969				2.0	0.7	0.9	3.7	1.3	0.8	1.5	1.8	2.7	
				37	54	110	177	184	355	291	298	339	
1970	3.0	1.7	1.1	2.1	0.8	1.9	3.3	2.1	0.1	2.2	1.2	3.4	0.3
	357	308	135	105	149	162	182	172	81	353	5	15	67
1971	4.0	1.9	3.9	1.4	2.4	1.2	2.3	0.9	0.2	0.6	2.2	3.1	1.5
	47	56	32	62	137	85	155	116	43	22	31	42	62
1972	3.1	4.7	2.7	2.0	1.7	2.8	1.8	3.0	0.3	1.8	2.9	3.5	0.8
	33	17	33	64	140	167	146	170	28	212	340	354	49
1973	3.0	2.0	1.6	2.3	1.3	1.3	2.7	2.3	1.0	1.2	3.7	4.2	0.7
	339	294	50	159	130	99	166	169	47	7	35	20	53
1974	3.1	3.5	3.3	1.8	1.5	2.3	1.0	2.1	0.9	0.6	2.6	2.5	1.1
	18	35	31	75	102	156	121	163	172	185	4	15	56
1975	2.9	2.5	1.1	1.2	1.7	1.9	1.8	0.8	1.2	3.1	3.2	2.5	1.0
	34	4	78	123	124	157	159	118	165	21	24	11	57
1976	3.0	3.2	2.4	0.7	1.6	1.6	1.6	0.9	0.5	0.3	1.3	1.6	0.5
	9	27	52	76	134	152	157	147	152	304	268	289	57
1977	1.5	2.1	2.0	0.7	1.7	2.8	1.9	0.9	0.7	0.6	2.6	3.0	0.7
	279	4	79	114	74	165	165	106	43	23	17	9	57
1978	2.1	1.4	0.2	0.9	1.1	1.0	2.5	0.8	1.1	0.6	1.4	1.2	0.2
	321	9	239	47	151	66	158	106	14	218	304	310	5
1979	3.4	4.0	0.9	1.1	1.0	2.1	1.4	1.3	0.6	1.2	2.1	2.4	0.3
	265	10	41	95	135	155	146	167	39	9	287	353	358
1980	0.8	2.1	1.5	1.1	1.6	0.9	3.0	2.1	0.4	0.9	2.2	2.1	0.3
	300	329	86	63	130	144	166	166	104	306	10	8	76
Mean	1.9	2.4	1.8	1.1	1.5	1.6	2.0	1.4	0.3	0.4	1.9	2.4	
	359	11	47	88	126	146	157	154	79	352	1	5	

MONTHLY MEAN EASTWARD WIND STRESS (DYNES/CM²)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Mean
1969				.21	.12	.08	.02	.01	.01	-.10	-.10	.04	
1970	.26	-.04	.21	.37	.09	.04	-.02	.02	.04	.02	.15	.43	.13
1971	.65	.46	.54	.22	.24	.18	.11	.12	.07	.13	.29	.52	.29
1972	.46	.40	.33	.36	.20	.11	.13	.09	.09	-.06	.03	.22	.20
1973	-.03	-.14	.23	.15	.13	.15	.07	.06	.14	.10	.54	.43	.15
1974	.34	.42	.41	.26	.18	.12	.13	.06	.03	.03	.16	.25	.20
1975	.41	.18	.24	.17	.19	.07	.05	.10	.05	.22	.33	.25	.19
1976	.18	.36	.38	.13	.13	.09	.07	.06	.04	.01	-.07	-.07	.11
1977	-.12	.15	.35	.08	.20	.07	.05	.09	.06	.08	.21	.27	.13
1978	-.09	.13	.01	.15	.10	.08	.09	.07	.05	-.01	-.07	-.03	.04
1979	-.46	.17	.08	.15	.10	.10	.10	.04	.09	.07	-.18	.07	.03
1980	.09	-.03	.27	.21	.12	.06	.09	.05	.06	-.05	.22	.21	.11
Mean	.15	.19	.28	.21	.15	.10	.07	.06	.06	.04	.13	.22	

MONTHLY MEAN NORTHWARD WIND STRESS (DYNES/CM²)

1969				.31	.13	-.07	-.52	-.13	.17	.13	.20	.48	
1970	.69	.20	-.07	-.01	-.11	-.29	-.45	-.28	-.01	.38	.30	.80	.09
1971	.74	.30	.85	.14	-.16	.05	-.30	-.02	.04	.20	.48	.51	.24
1972	.69	.98	.55	.25	-.14	-.43	-.25	-.48	.10	-.22	.55	.90	.20
1973	.56	.14	.22	-.23	-.07	-.02	-.41	-.26	.20	.22	.75	.86	.16
1974	.78	.57	.62	.13	-.02	-.33	.03	-.26	-.11	-.05	.49	.51	.20
1975	.53	.53	.11	-.06	-.04	-.24	-.19	.01	-.15	.45	.61	.62	.18
1976	.69	.67	.37	.05	-.14	-.12	-.18	-.07	-.04	.06	.03	.10	.12
1977	.02	.37	.16	-.03	.09	-.34	-.21	-.03	.04	.08	.45	.59	.10
1978	.20	.19	-.00	.07	-.13	.02	-.24	-.00	.14	-.06	.16	.17	.04
1979	-.01	.65	.13	.04	-.12	-.26	-.14	-.15	.07	.19	.07	.41	.07
1980	.16	.29	.06	.12	-.10	-.12	-.40	-.21	-.01	.08	.41	.49	.06
Mean	.46	.44	.27	.07	-.07	-.18	-.27	-.16	.04	.12	.38	.54	

MAGNITUDE (DYNES/CM²) AND DIRECTION (°T) OF MONTHLY MEAN WIND STRESS

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Mean
1969				0.4 34	0.2 43	0.1 131	0.5 178	0.1 176	0.2 3	0.2 322	0.2 333	0.5 5	
1970	0.7 21	0.2 349	0.2 108	0.4 92	0.1 141	0.3 172	0.5 183	0.3 176	0.0 104	0.4 3	0.3 27	0.9 28	0.16 54
1971	1.0 41	0.5 57	1.0 32	0.3 58	0.3 124	0.2 74	0.3 160	0.1 99	0.1 60	0.2 33	0.6 31	0.7 46	0.38 51
1972	0.8 34	1.1 22	0.6 31	0.4 55	0.2 125	0.4 166	0.3 153	0.5 169	0.1 42	0.2 195	0.6 3	0.9 14	0.28 44
1973	0.6 357	0.2 315	0.3 46	0.3 147	0.1 118	0.2 98	0.4 170	0.3 167	0.2 35	0.2 24	0.9 36	1.0 27	0.22 43
1974	0.9 24	0.7 36	0.7 33	0.3 63	0.2 96	0.4 160	0.1 77	0.3 167	0.1 165	0.1 149	0.5 18	0.6 26	0.28 45
1975	0.7 38	0.6 19	0.3 65	0.2 109	0.2 102	0.3 164	0.2 165	0.1 84	0.2 162	0.5 26	0.7 28	0.7 22	0.26 46
1976	0.7 15	0.8 28	0.5 46	0.1 69	0.2 137	0.2 143	0.2 159	0.1 139	0.1 135	0.1 9	0.1 293	0.1 325	0.16 43
1977	0.1 279	0.4 22	0.4 65	0.1 111	0.2 66	0.3 168	0.2 167	0.1 108	0.1 56	0.1 45	0.5 25	0.6 25	0.16 52
1978	0.2 336	0.2 34	0.0 90	0.2 65	0.2 142	0.1 76	0.3 159	0.1 90	0.1 20	0.1 189	0.2 336	0.2 350	0.06 43
1979	0.5 269	0.7 15	0.2 32	0.2 75	0.2 140	0.3 159	0.2 144	0.2 165	0.1 52	0.2 20	0.2 291	0.4 10	0.08 21
1980	0.2 29	0.3 354	0.3 77	0.2 60	0.2 130	0.1 153	0.4 167	0.2 167	0.1 99	0.1 328	0.5 28	0.5 23	0.13 60
Mean	0.46 18	0.51 24	0.42 42	0.20 75	0.18 117	0.21 151	0.25 159	0.17 155	0.08 67	0.10 29	0.43 21	0.56 22	

MONTHLY ANOMALIES OF SEA LEVEL (CM)

	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC
1967		-15.2	6.2	8.7	-2.7	1.3	-3.9	-3.1	0.1	2.5	-2.3	-5.4
1968	-0.8	5.8	2.2	-14.8	3.1	-2.1	-0.5	6.3	-1.7	5.9	7.7	16.0
1969	14.4	14.6	-6.3	11.1	4.9	6.1	-5.4	-5.9	-0.5	4.1	-1.4	11.1
1970	16.5	2.4	-3.1	-12.1	-6.7	-2.7	-4.8	-4.4	-10.0	1.3	7.7	13.2
1971	-3.0	-13.7	2.8	4.4	0.0	4.3	-0.5	3.3	0.4	-4.5	-4.5	1.3
1972	-3.6	1.2	3.8	5.6	1.3	4.3	4.0	3.9	1.3	0.1	4.7	3.8
1973	7.4	2.7	-1.7	-16.0	-3.6	-2.1	-6.3	-7.4	-5.7	-2.7	13.5	11.7
1974	1.0	-7.0	10.2	5.3	1.0	1.3	6.5	-2.8	-2.7	-10.3	-4.2	-5.7
1975	-6.3	1.2	0.1	-4.4	-4.5	-6.4	-2.1	-5.6	-7.2	5.3	0.1	-11.8
1976	-9.1	-5.2	-8.4	1.3	-2.4	-2.1	4.6	3.9	0.4	0.4	-4.8	-8.7
1977	-9.4	-9.1	-10.0	-13.3	6.1	-2.7	-6.0	3.3	3.7	4.1	2.5	15.1
1978	22.0	12.8	3.4	8.1	-1.8	1.3	-1.8	1.7	5.0	-2.3	-8.7	-15.4
1979	-5.7	6.1	-0.5	3.2	0.0	-4.8	2.8	0.8	4.0	9.5	3.2	4.7
1980	6.2	10.7	-0.2	5.9	3.4	7.0	-0.8	-1.0	0.7	0.4	-1.7	5.0

MONTHLY ANOMALIES OF ATMOSPHERIC PRESSURE (MB)

1971	2.5	3.8	0.9	-1.3	0.1	-0.7	-0.2	-1.5	-0.7	0.8	0.8	-3.4
1972	1.4	0.5	1.2	0.2	-1.3	-1.8	-1.5	-0.8	-0.1	0.1	-2.8	-0.8
1973	-3.4	-2.5	-1.8	3.1	-0.4	-0.9	0.0	0.5	-0.5	-0.9	-8.0	-3.2
1974	-1.5	2.9	-4.3	0.9	0.4	-1.8	-1.1	0.1	0.0	1.4	-0.3	1.4
1975	1.0	-1.8	-2.5	-0.9	0.3	0.4	-0.8	1.0	1.1	-3.4	-0.7	3.0
1976	5.2	1.3	2.8	-0.7	1.5	0.8	-0.2	0.9	0.5	1.3	3.1	2.9
1977	2.5	5.0	2.9	3.2	-1.9	1.4	2.6	-1.0	-0.4	0.6	1.9	-4.1
1978	-5.2	-2.8	-1.3	-2.7	2.1	0.2	0.6	0.5	0.4	2.3	2.7	4.9
1979	-0.4	-1.9	0.5	-0.5	0.9	2.3	-0.2	-0.4	-0.5	-2.5	0.8	-0.7
1980	-2.5	-4.4	1.2	-1.6	-1.3	0.0	0.4	0.6	0.4	0.2	2.4	-0.4

MONTHLY ANOMALIES OF ADJUSTED SEA LEVEL (CM)

1971	-0.6	-9.9	3.9	3.2	0.2	3.6	-0.8	1.7	-0.3	-3.8	-3.7	-2.1
1972	-2.1	1.6	5.0	5.8	0.0	2.6	2.5	3.1	1.1	0.2	1.8	3.0
1973	4.1	0.2	-3.3	-12.9	-3.9	-3.0	-6.4	-6.8	-6.1	-3.6	5.6	8.4
1974	-0.4	-4.0	5.8	6.3	1.3	-0.6	5.5	-2.7	-2.7	-8.9	-4.5	-4.3
1975	-5.2	-0.6	-2.4	-5.3	-4.2	-5.8	-2.9	-4.6	-6.2	1.9	-0.5	-8.8
1976	-3.7	-4.0	-5.4	0.7	-1.0	-1.3	4.4	4.9	1.0	1.8	-1.6	-5.7
1977	-6.8	-4.1	-7.0	-10.0	4.3	-1.5	-3.5	2.2	3.5	4.6	4.5	11.2
1978	16.8	10.1	2.2	5.5	0.3	1.4	-1.2	2.2	5.4	-0.2	-6.2	-10.4
1979	-6.2	4.3	0.1	2.8	0.9	-2.7	2.5	0.3	3.5	7.0	4.0	4.0
1980	3.6	6.2	1.2	4.3	2.1	7.0	-0.6	-0.5	0.9	0.6	0.7	4.8

MONTHLY ANOMALIES OF EASTWARD WIND (M/SEC)

	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC
1969				0.1	-0.7	0.0	-0.6	-0.7	-0.4	-1.3	-1.7	-1.2
1970	-0.2	-1.8	-0.6	0.9	-0.8	-0.2	-0.9	-0.3	-0.2	-0.2	0.0	0.7
1971	3.0	1.1	0.8	0.2	0.4	0.4	0.2	0.2	-0.2	0.3	1.0	1.9
1972	1.7	0.9	0.2	0.7	-0.1	-0.2	0.2	-0.1	-0.2	-0.9	-1.1	-0.6
1973	-1.1	-2.4	-0.1	-0.3	-0.2	0.5	-0.1	-0.1	0.5	0.2	2.0	1.2
1974	1.0	1.5	0.4	0.7	0.3	0.1	0.1	0.0	-0.2	0.0	0.1	0.4
1975	1.6	-0.3	-0.2	-0.1	0.2	-0.1	-0.2	0.1	0.0	1.2	1.2	0.3
1976	0.5	0.9	0.6	-0.4	0.0	-0.1	-0.2	-0.1	-0.1	-0.1	-1.4	-1.7
1977	-1.5	-0.4	0.7	-0.5	0.4	-0.1	-0.3	0.2	0.2	0.3	0.7	0.2
1978	-1.3	-0.3	-1.5	-0.4	-0.6	0.1	0.1	0.1	0.0	-0.3	-1.2	-1.1
1979	-3.4	0.2	-0.7	0.0	-0.5	0.1	0.0	-0.3	0.1	0.3	-2.1	-0.5
1980	-0.7	-1.6	0.2	-0.1	0.0	-0.3	-0.1	-0.1	0.1	-0.6	0.3	0.1

MONTHLY ANOMALIES OF NORTHWARD WIND (M/SEC)

1969				1.6	1.2	1.0	-1.9	0.1	0.7	0.1	-1.1	0.2
1970	1.2	-1.4	-2.0	-0.5	0.1	-0.5	-1.5	-0.8	-0.1	1.8	-0.7	1.0
1971	0.9	-1.3	2.2	0.7	-1.0	1.4	-0.3	0.9	0.0	0.1	0.0	0.0
1972	0.8	2.1	1.1	0.9	-0.5	-1.4	0.3	-1.7	0.2	-2.0	0.9	1.2
1973	1.0	-1.6	-0.2	-2.2	0.0	1.1	-0.8	-1.0	0.6	0.8	1.2	1.6
1974	1.1	0.4	1.6	0.5	0.5	-0.8	1.3	-0.7	-1.0	-1.0	0.7	0.1
1975	0.6	0.1	-1.0	-0.6	-0.1	-0.4	0.1	0.9	-1.2	2.4	1.0	0.2
1976	1.2	0.5	0.3	0.2	-0.3	-0.1	0.3	0.5	-0.5	-0.2	-1.9	-1.8
1977	-1.6	-0.3	-0.8	-0.3	1.3	-1.4	0.0	1.1	0.4	0.2	0.6	0.6
1978	-0.2	-1.0	-1.3	0.6	-0.2	1.7	-0.5	1.1	1.0	-0.9	-1.1	-1.5
1979	-2.1	1.5	-0.5	-0.1	0.1	-0.6	0.6	0.0	0.4	0.8	-1.3	0.1
1980	-1.4	-0.6	-1.1	0.5	-0.2	0.6	-1.1	-0.7	-0.2	0.1	0.3	-0.2

MONTHLY ANOMALIES OF EASTWARD WIND STRESS ($DYNES/CM^2$)

1969				0.02	-0.04	-0.02	-0.07	-0.06	-0.06	-0.15	-0.25	-0.17
1970	0.12	-0.25	-0.07	0.18	-0.07	-0.06	-0.11	-0.05	-0.03	-0.03	0.00	0.22
1971	0.51	0.25	0.26	0.03	0.08	0.08	0.02	0.05	0.00	0.08	0.14	0.31
1972	0.32	0.19	0.05	0.17	0.04	0.01	0.04	0.02	0.02	-0.11	-0.12	0.01
1973	-0.17	-0.35	-0.05	-0.04	-0.03	0.05	-0.02	-0.01	0.07	0.05	0.39	0.22
1974	0.20	0.21	0.13	0.07	0.02	0.02	0.04	-0.01	-0.04	-0.02	0.01	0.04
1975	0.27	-0.03	-0.04	-0.02	0.03	-0.03	-0.04	0.03	-0.02	0.17	0.18	0.04
1976	0.04	0.15	0.10	-0.06	-0.03	-0.01	-0.02	-0.01	-0.03	-0.04	-0.22	-0.28
1977	-0.26	-0.06	0.07	-0.11	0.04	-0.03	-0.04	0.02	-0.01	0.03	0.06	0.06
1978	-0.23	-0.08	-0.27	-0.04	-0.06	-0.02	0.00	0.00	-0.02	-0.06	-0.22	-0.24
1979	-0.60	-0.04	-0.20	-0.04	-0.06	0.00	0.01	-0.03	0.02	0.02	-0.33	-0.14
1980	-0.05	-0.24	-0.01	0.02	-0.04	-0.04	0.00	-0.02	-0.01	-0.10	0.07	0.00

MONTHLY ANOMALIES OF NORTHWARD WIND STRESS ($DYNES/CM^2$)

1969				0.26	0.21	0.11	-0.29	0.02	0.14	0.04	-0.20	-0.04
1970	0.25	-0.27	-0.38	-0.06	-0.03	-0.11	-0.22	-0.13	-0.04	0.29	-0.10	0.29
1971	0.30	-0.17	0.54	0.09	-0.08	0.23	-0.07	0.13	0.01	0.11	0.08	-0.01
1972	0.25	0.51	0.24	0.20	-0.06	-0.25	-0.02	-0.33	0.07	-0.31	0.15	0.38
1973	0.12	-0.33	-0.09	-0.28	0.01	0.16	-0.18	-0.11	0.17	0.13	0.35	0.34
1974	0.34	0.10	0.31	0.08	0.06	-0.15	0.26	-0.11	-0.14	-0.14	0.09	-0.01
1975	0.09	0.06	-0.20	-0.11	0.04	-0.06	0.04	0.16	-0.18	0.36	0.21	0.10
1976	0.25	0.20	0.06	0.00	-0.06	0.06	0.05	0.08	-0.07	-0.03	-0.37	-0.42
1977	-0.42	-0.10	-0.15	-0.08	0.17	-0.16	0.02	0.12	0.01	-0.01	0.05	0.07
1978	-0.24	-0.28	-0.31	0.02	-0.05	0.20	-0.01	0.15	0.11	-0.15	-0.24	-0.35
1979	-0.45	0.18	-0.18	-0.01	-0.04	-0.08	0.09	0.00	0.04	0.10	-0.33	-0.11
1980	-0.28	-0.18	-0.25	0.07	-0.02	0.06	-0.17	-0.06	-0.04	-0.01	0.01	-0.03

ANNUAL STANDARD DEVIATIONS OF SEA LEVEL (CM)

	Hourly	Low-Passed	VLF	ILF
1967	77.1*	15.0*	9.3*	11.6*
1968	78.4	18.8	14.0	11.9
1969	78.4	18.6	13.7	11.4
1970	79.3	21.6	16.9	12.6
1971	78.1	15.7	7.7	13.3
1972	77.9	13.6	8.7	9.8
1973	78.8	19.1	15.7	10.4
1974	78.2	15.0	9.7	11.1
1975	77.8	15.3	10.1	11.0
1976	76.9	10.9	6.3	8.0
1977	77.5	15.8	12.6	9.2
1978	78.0	17.5	13.7	10.5
1979	77.4	14.9	11.1	8.8
1980	77.7	15.8	11.5	10.0

ANNUAL STANDARD DEVIATIONS OF ATMOSPHERIC PRESSURE (MB)

1971	6.9	6.8	1.8	6.5
1972	6.1	6.0	1.8	5.5
1973	6.5	6.4	2.6	5.7
1974	6.7	6.6	2.4	5.9
1975	6.8	6.6	2.2	6.1
1976	5.1	5.0	2.3	4.3
1977	5.9	5.8	2.6	5.0
1978	7.0	6.9	3.0	6.1
1979	6.3	6.2	3.5	5.5
1980	6.9	6.8	2.6	6.1

ANNUAL STANDARD DEVIATIONS OF ADJUSTED SEA LEVEL (CM)

1971	77.5	12.1	7.6	9.1
1972	77.5	11.1	8.6	6.4
1973	77.9	15.2	13.5	6.6
1974	77.5	11.4	8.8	7.2
1975	77.2	11.7	9.1	6.9
1976	76.7	9.0	6.4	5.7
1977	77.0	12.9	11.1	6.3
1978	77.1	13.2	11.5	6.5
1979	76.9	11.6	9.7	5.6
1980	77.1	12.1	10.0	6.1

* These statistics are based on less than a full year of data.

ANNUAL STANDARD DEVIATIONS OF EASTWARD WIND (M/SEC)

	Hourly	Low-Passed	VLF	ILF
1969	3.04*	2.40*	1.02*	1.97*
1970	3.97	3.32	0.90	3.07
1971	3.48	2.81	0.96	2.50
1972	3.56	2.89	1.25	2.41
1973	3.16	2.51	0.98	2.31
1974	3.01	2.42	0.95	2.12
1975	2.91	2.27	0.55	2.11
1976	2.75	2.20	1.08	1.81
1977	2.94	2.44	1.13	2.07
1978	2.66	2.06	0.97	1.86
1979	2.92	2.38	1.23	1.88
1980	3.00	2.42	0.86	2.22

ANNUAL STANDARD DEVIATIONS OF NORTHWARD WIND (M/SEC)

1969	4.94*	4.19*	1.86*	3.60*
1970	5.03	4.32	2.10	3.71
1971	5.51	4.72	1.68	4.44
1972	5.97	5.20	2.51	4.47
1973	5.07	4.28	2.21	3.63
1974	5.10	4.31	2.05	3.79
1975	5.19	4.45	1.97	3.98
1976	4.34	3.63	1.50	3.20
1977	4.15	3.47	1.69	3.03
1978	3.79	3.12	1.14	2.90
1979	4.18	3.47	1.81	2.89
1980	4.16	3.48	1.60	3.05

ANNUAL STANDARD DEVIATIONS OF EASTWARD WIND STRESS (DYNES/CM^2)

1969	0.46*	0.36*	0.10*	0.29*
1970	0.72	0.59	0.18	0.54
1971	0.67	0.54	0.22	0.47
1972	0.60	0.50	0.20	0.42
1973	0.54	0.43	0.16	0.40
1974	0.54	0.42	0.18	0.38
1975	0.51	0.40	0.12	0.36
1976	0.43	0.35	0.16	0.30
1977	0.51	0.41	0.17	0.36
1978	0.35	0.27	0.11	0.26
1979	0.42	0.34	0.16	0.28
1980	0.49	0.39	0.11	0.36

ANNUAL STANDARD DEVIATIONS OF NORTHWARD WIND STRESS (DYNES/CM^2)

1969	0.91*	0.73*	0.29*	0.62*
1970	1.02	0.83	0.39	0.73
1971	1.22	0.97	0.35	0.90
1972	1.27	1.07	0.52	0.91
1973	1.03	0.81	0.41	0.69
1974	1.09	0.86	0.39	0.77
1975	1.08	0.87	0.35	0.79
1976	0.84	0.68	0.29	0.59
1977	0.74	0.59	0.29	0.50
1978	0.57	0.42	0.14	0.40
1979	0.72	0.55	0.27	0.47
1980	0.79	0.62	0.26	0.56

* These statistics are based on less than a full year of data.

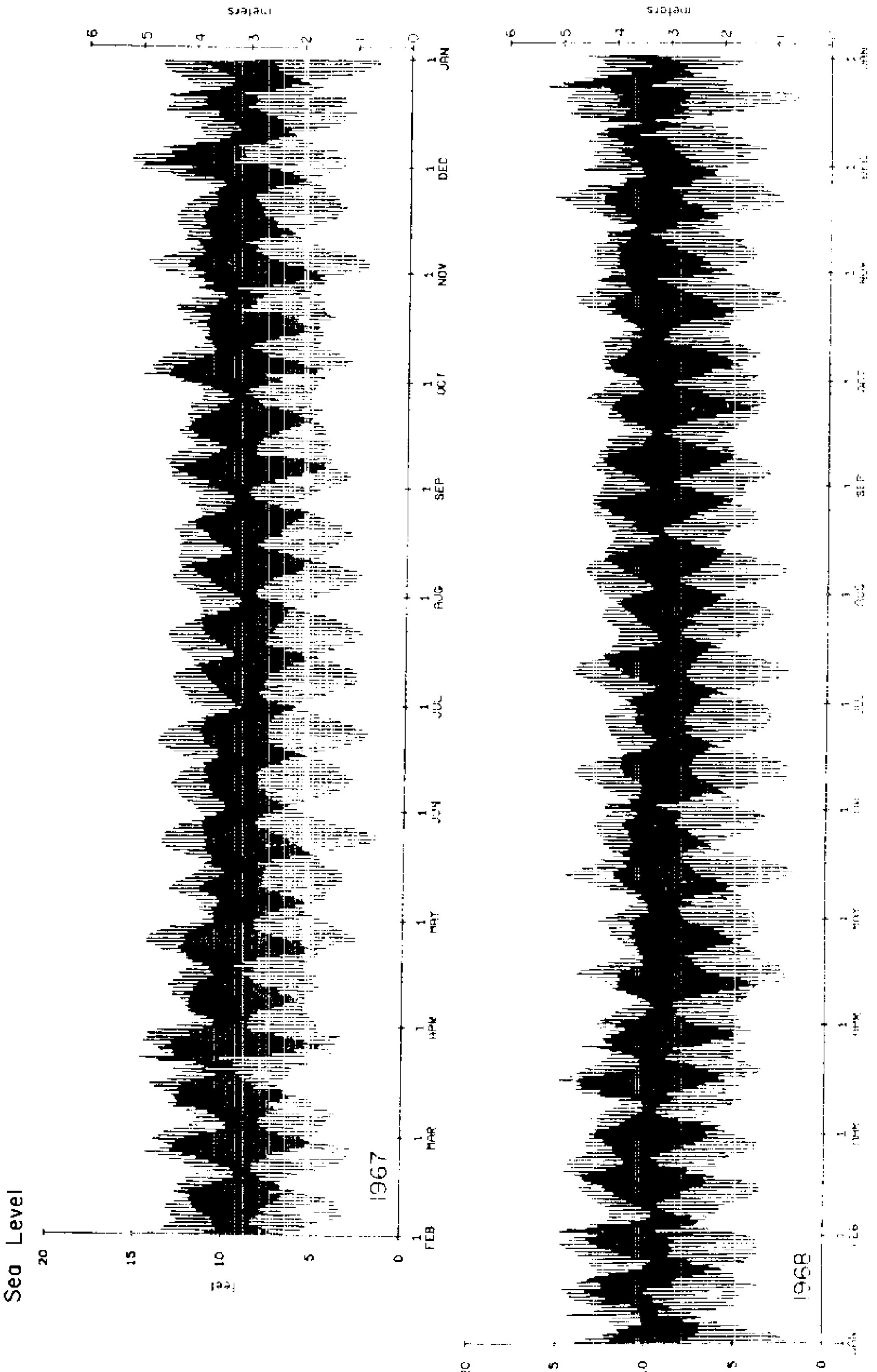
APPENDIX B

TIME SERIES PLOTS

Hourly
Low-Passed
Very-Low-Frequency
Intermediate-Low-Frequency

HOURLY TIME SERIES

Sea Level
Atmospheric Pressure
Adjusted Sea Level
Eastward and Northward Wind
Eastward and Northward Wind Stress


Sea Level
feet
meters
1967
1968
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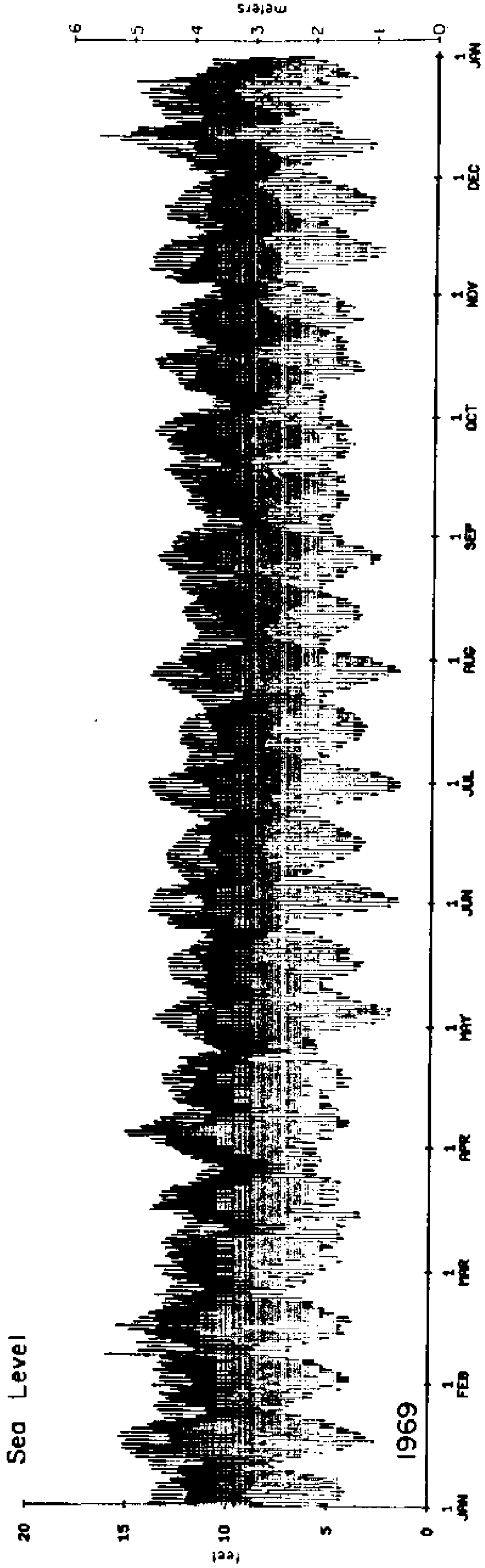
1 MAR
1 APR
1 MAY
1 JUN
1 JUL
1 AUG
1 SEP
1 OCT
1 NOV
1 DEC
1 JAN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1969
feet
meters
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1 MAR
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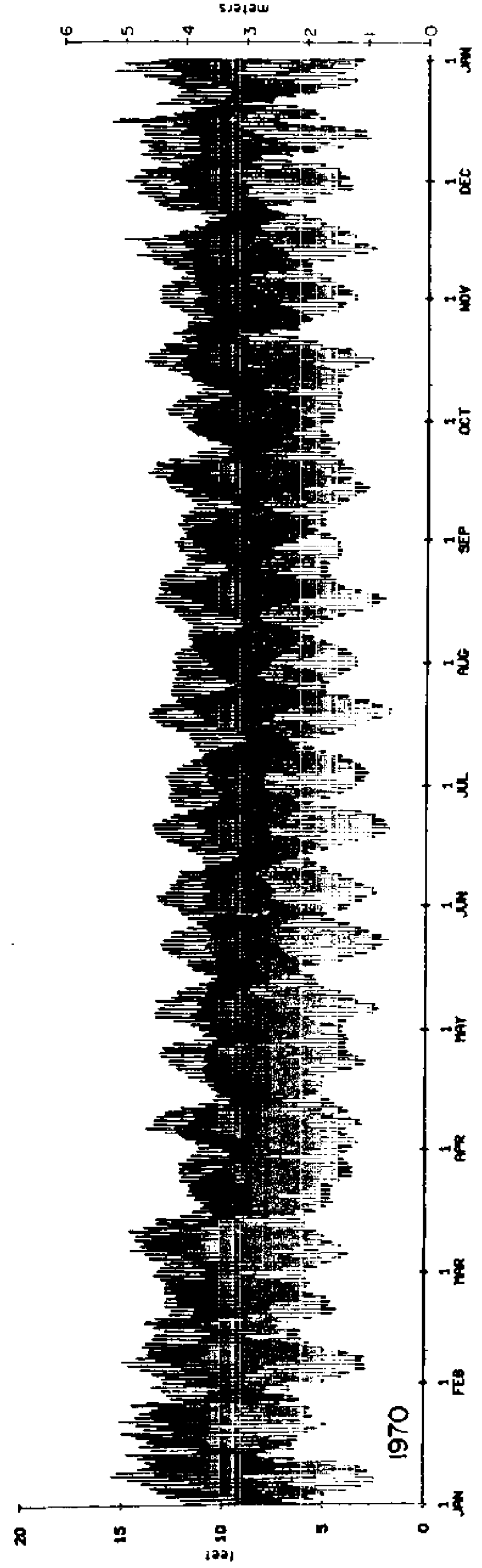
1 NOV
1 DEC
1 JAN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feet
meters
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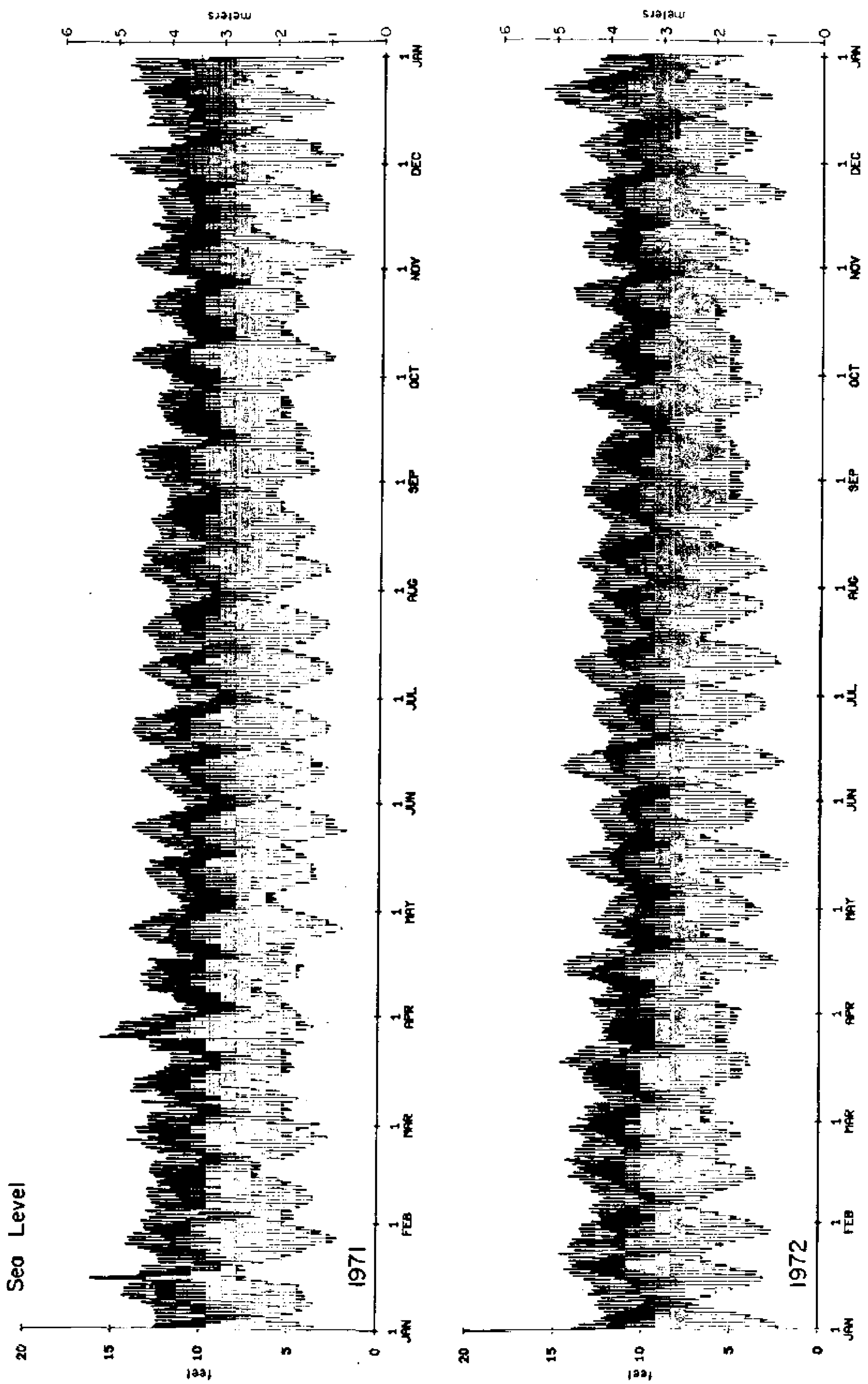
1 FEB
1 MAR
1 APR
1 MAY
1 JUN
1 JUL
1 AUG
1 SEP
1 OCT
1 NOV
1 DEC
1 JAN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1972
feet
meters
20
15
10
5
0
6
5
4
3
2
1
0
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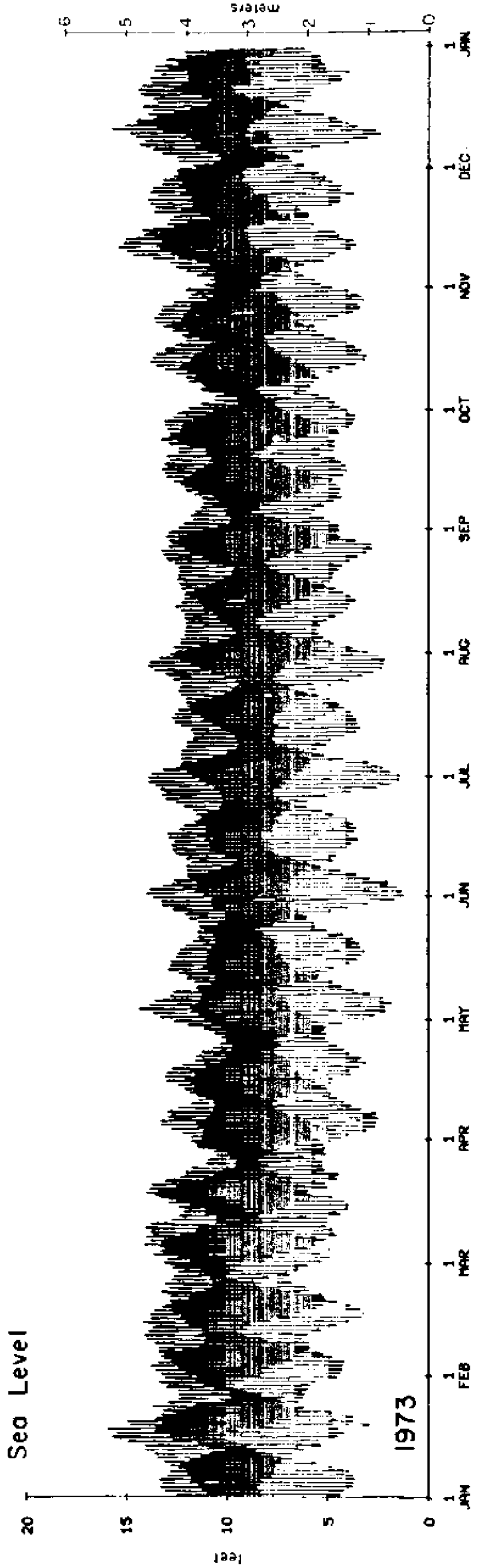
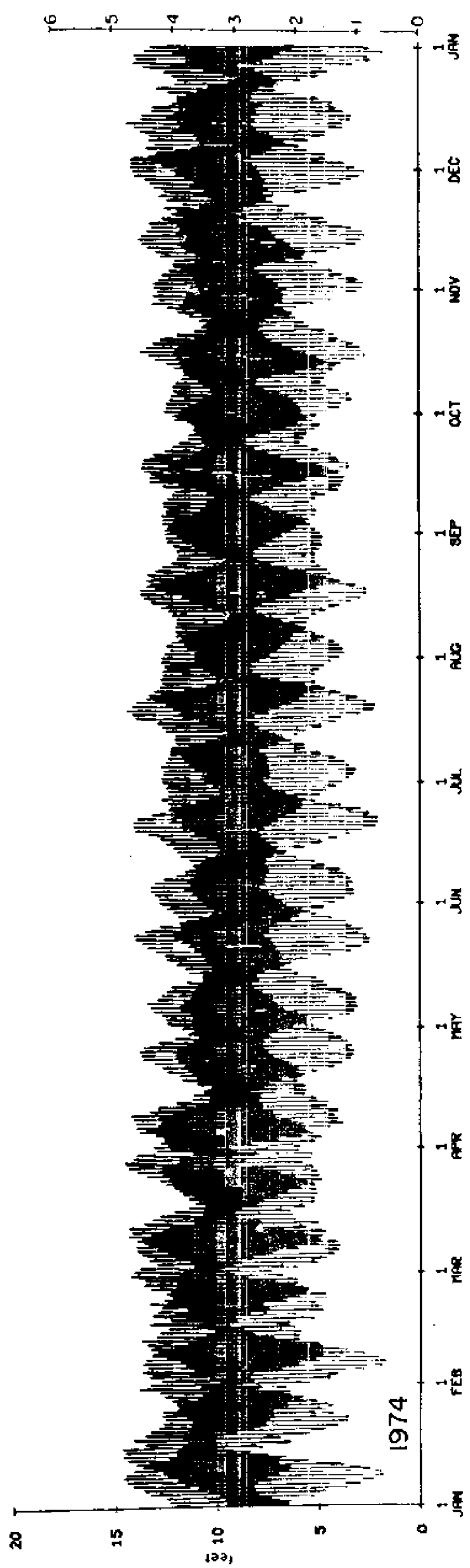
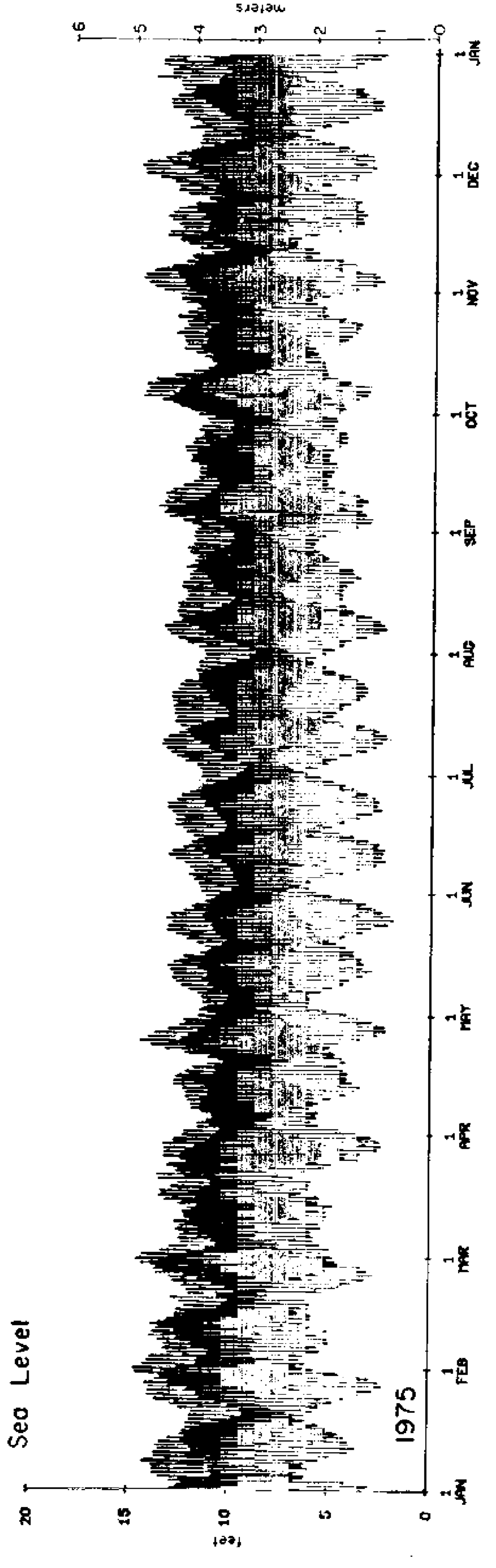
1 MAR
1 APR
1 MAY
1 JUN
1 JUL
1 AUG
1 SEP
1 OCT
1 NOV
1 DEC
1 JAN


Sea Level
1973
feet
meters
JAN
FEB
MAR
APR
MAY
JUN
JUL
AUG
SEP
OCT
NOV
DEC
JAN


1974
feet
meters
JAN
FEB
MAR
APR
MAY
JUN
JUL
AUG
SEP
OCT
NOV
DEC
JAN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1975
feet
meters
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10
15
20
1
2
3
4
5
6
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1 FEB
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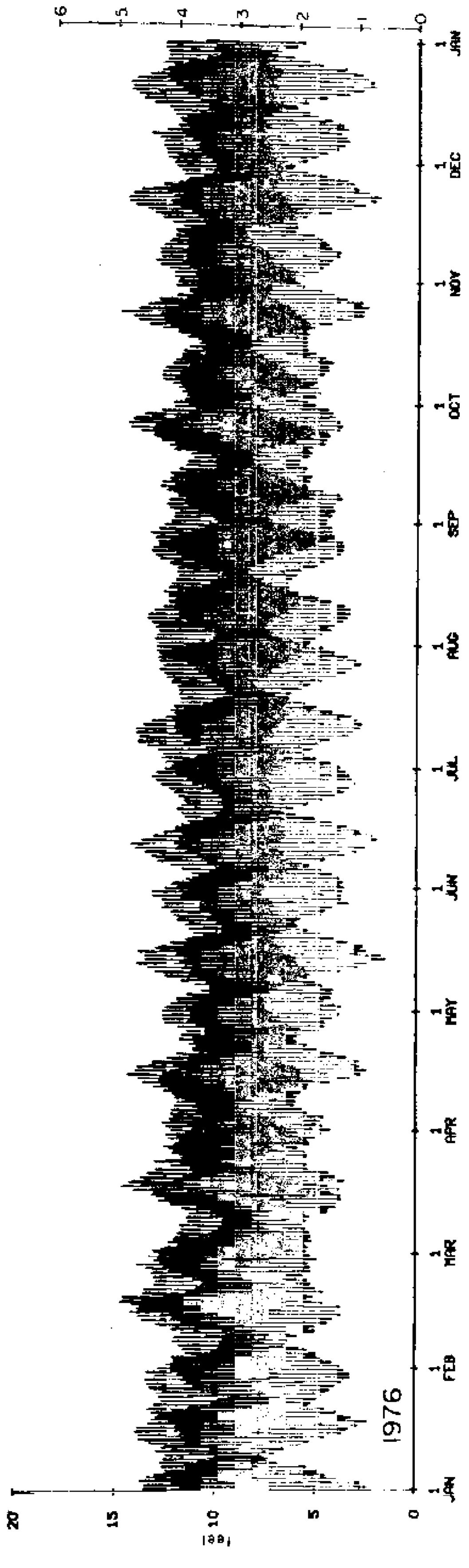
1 APR
1 MAY
1 JUN
1 JUL
1 AUG
1 SEP
1 OCT
1 NOV
1 DEC
1 JAN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feet
meters
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1
2
3
4
5
6
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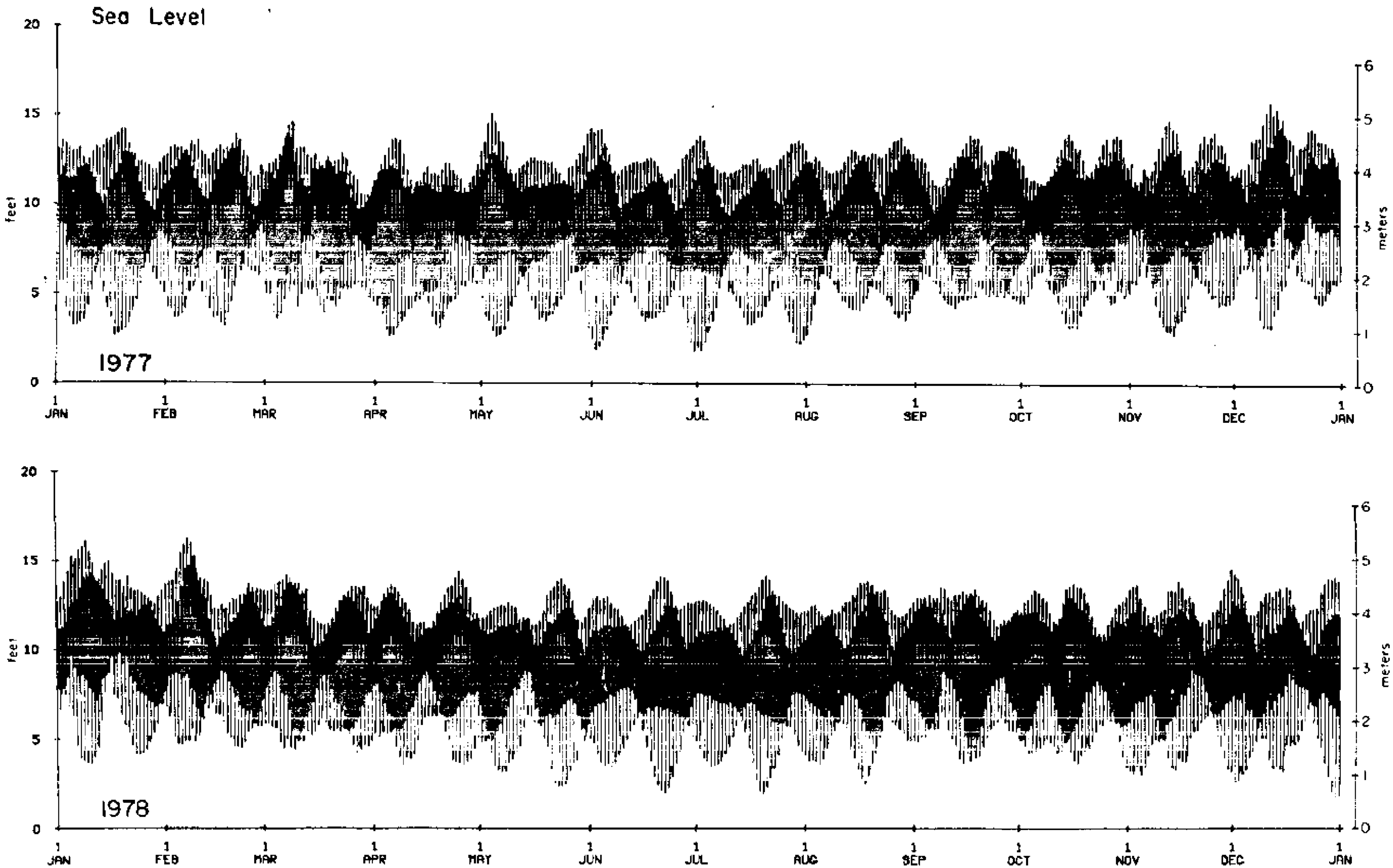
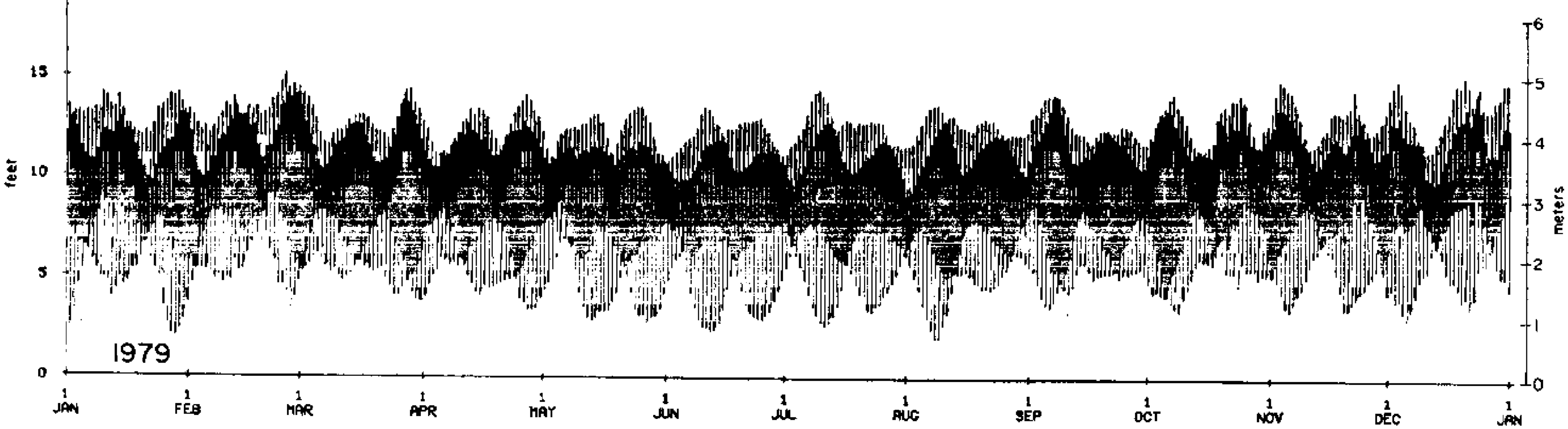
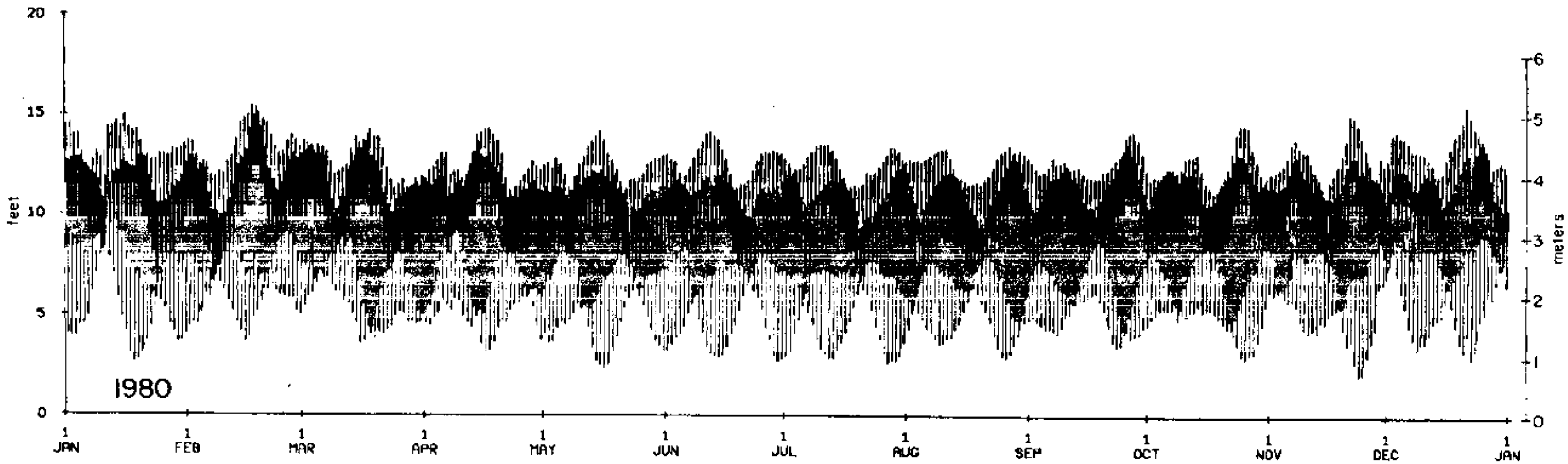
1 OCT
1 NOV
1 DEC
1 JAN


Sea Level
1977
1978
feet
meters
20
15
10
5
0
6
5
4
3
2
1
0
1 JAN
1 FEB
1 MAR
1 APR
1 MAY
1 JUN
1 JUL
1 AUG
1 SEP
1 OCT
1 NOV
1 DEC
1 JAN

Sea Level


1979
feet
meters
1 JAN
1 FEB
1 MAR
1 APR
1 MAY
1 JUN
1 JUL
1 AUG
1 SEP
1 OCT
1 NOV
1 DEC
1 JAN


1980
feet
meters
1 JAN
1 FEB
1 MAR
1 APR
1 MAY
1 JUN
1 JUL
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1 SEP
1 OCT
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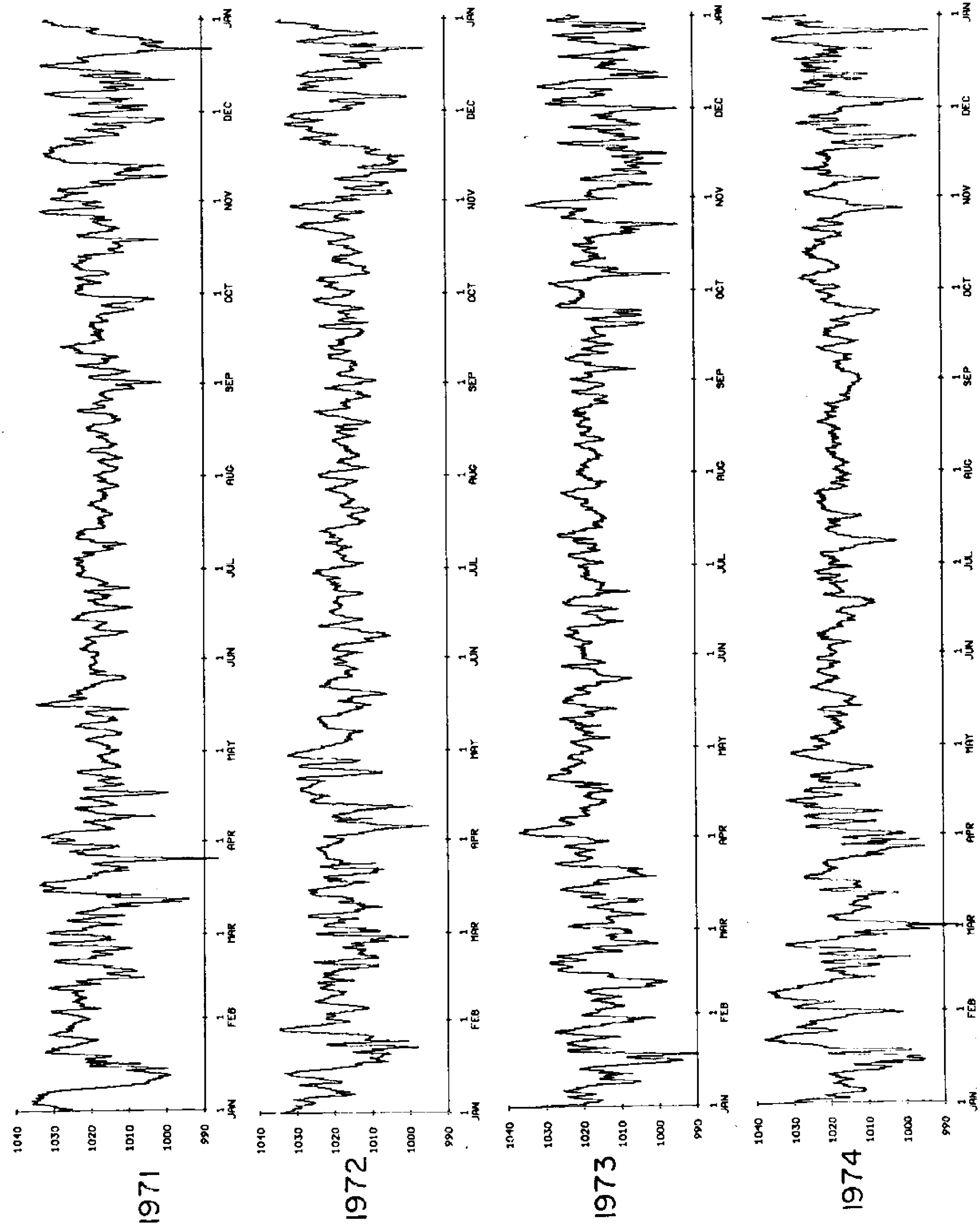
1 DEC
1 JAN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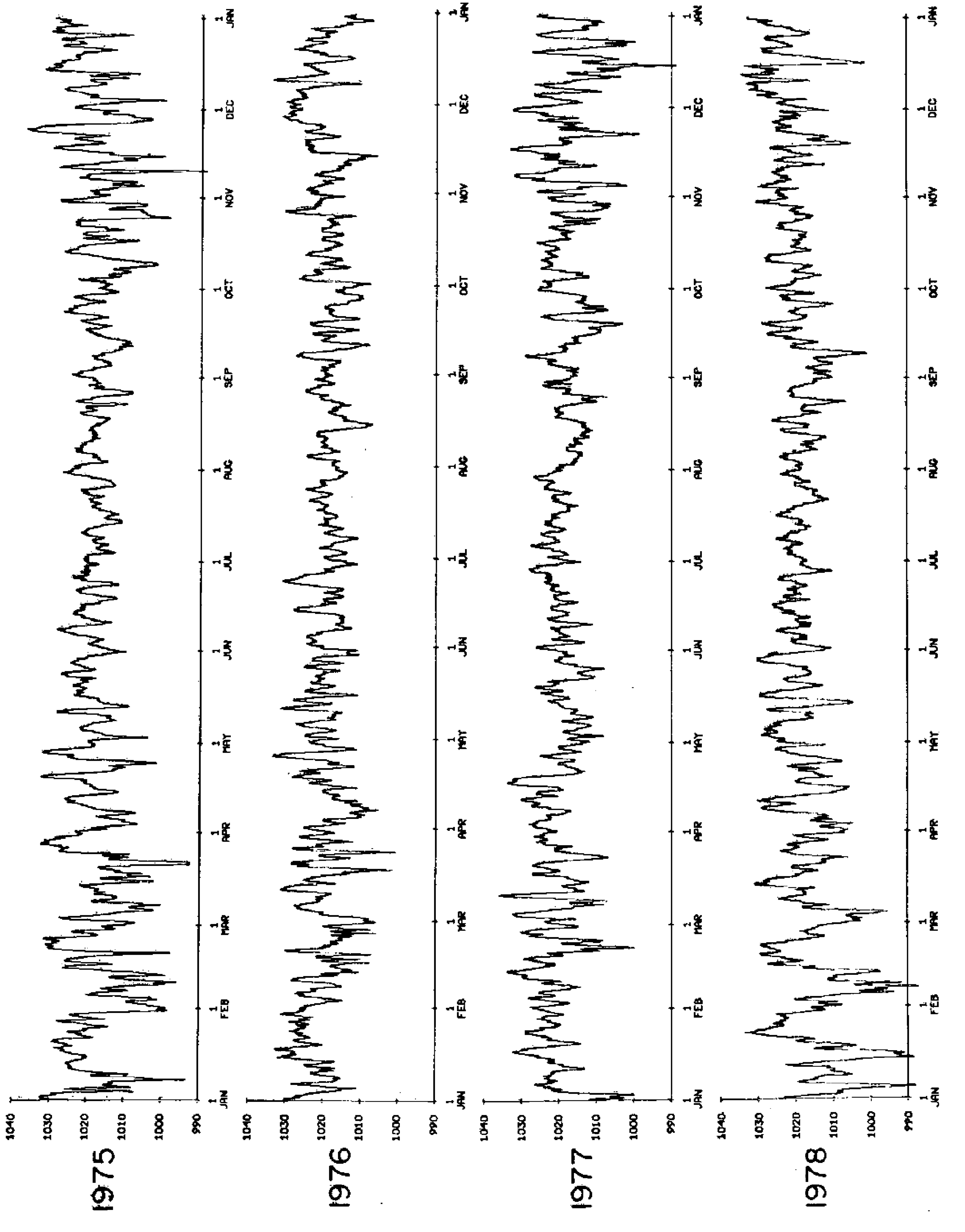
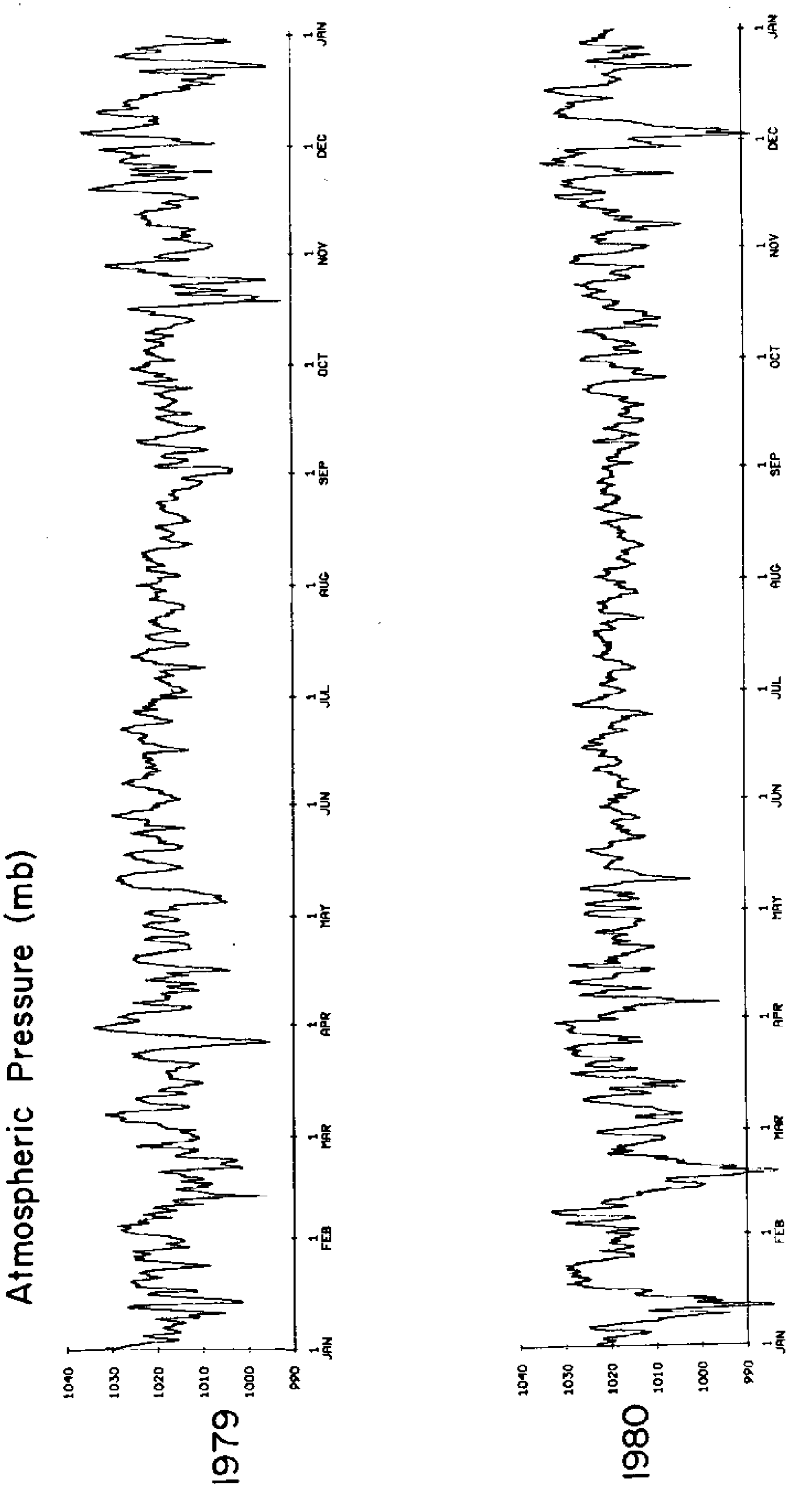
1972
1973
1974
1040
1030
1020
1010
1000
990
1 JAN
1 FEB
1 MAR
1 APR
1 MAY
1 JUN
1 JUL
1 AUG
1 SEP
1 OCT
1 NOV
1 DEC
1 JAN



Atmospheric Pressure (mb)


Atmospheric Pressure (mb)
1979
1980
1040
1030
1020
1010
1000
990
1 JAN
1 FEB
1 MAR
1 APR
1 MAY
1 JUN
1 JUL
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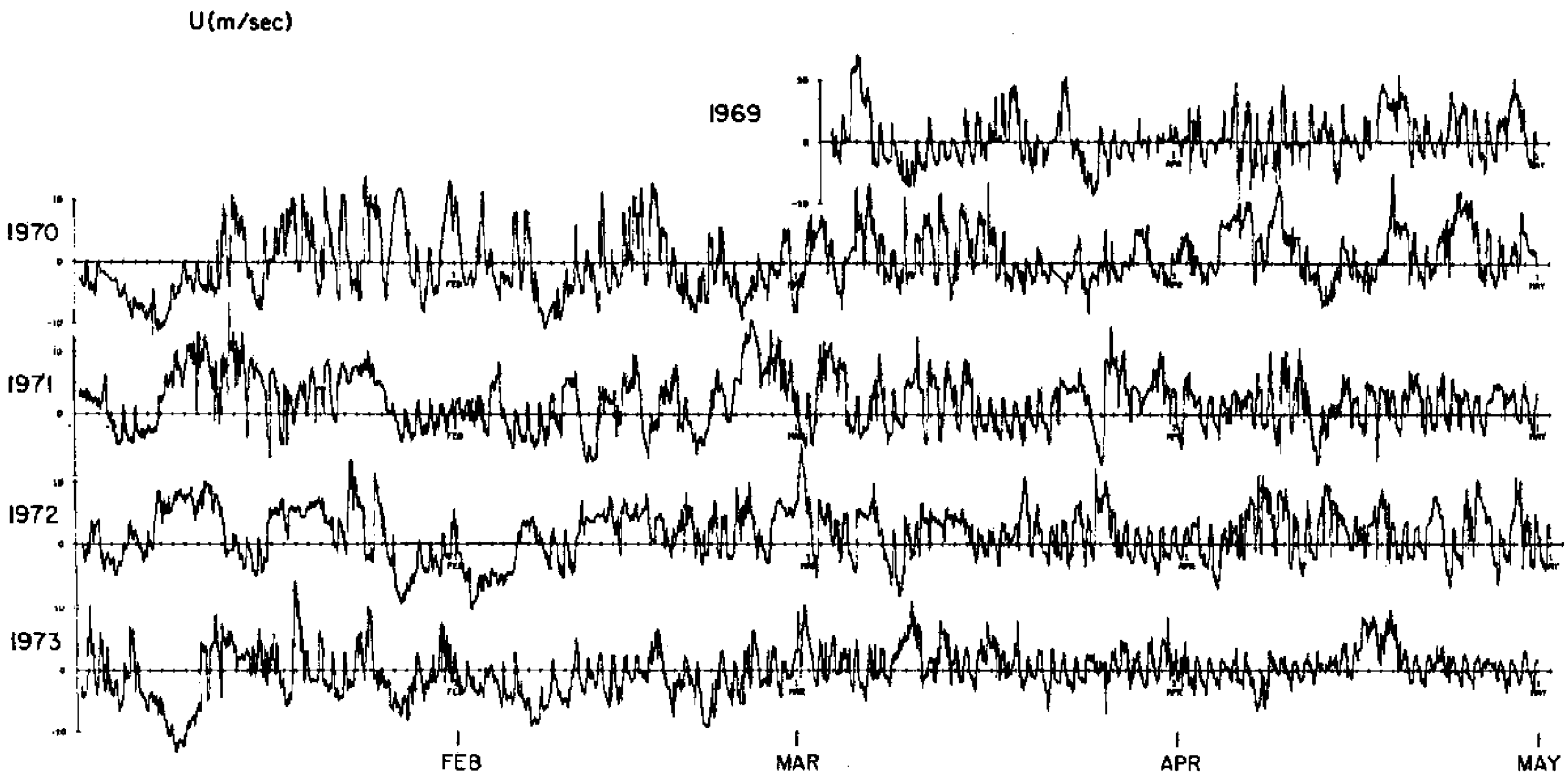
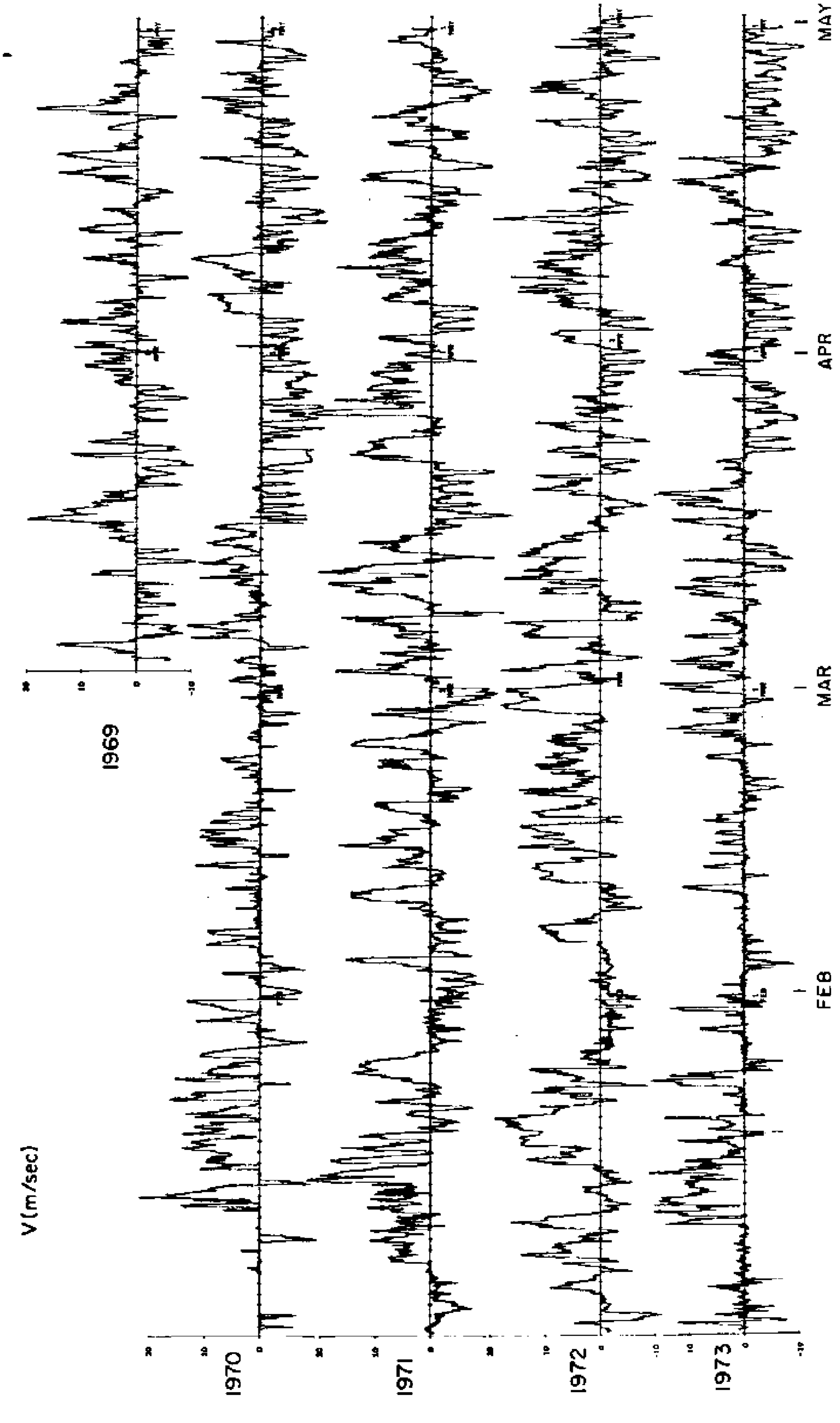
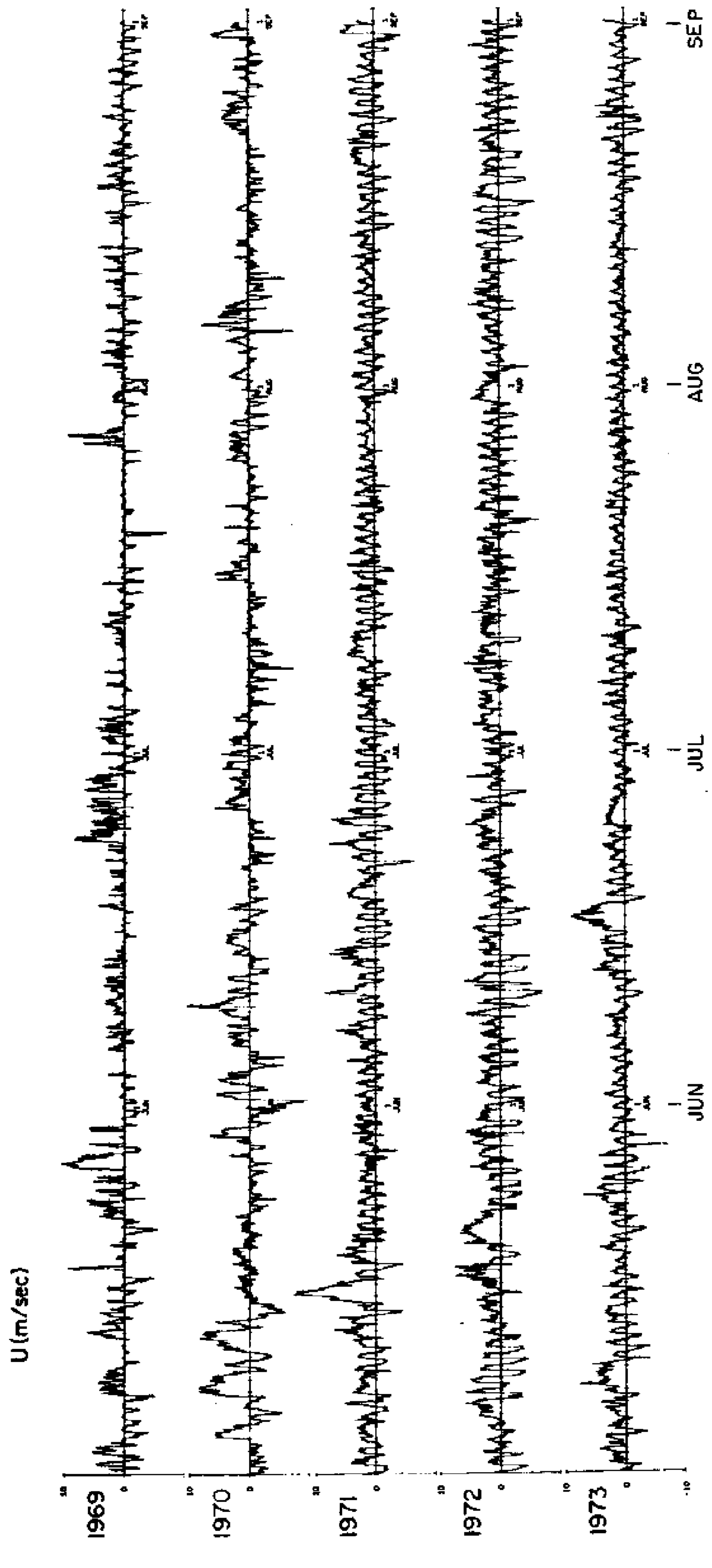
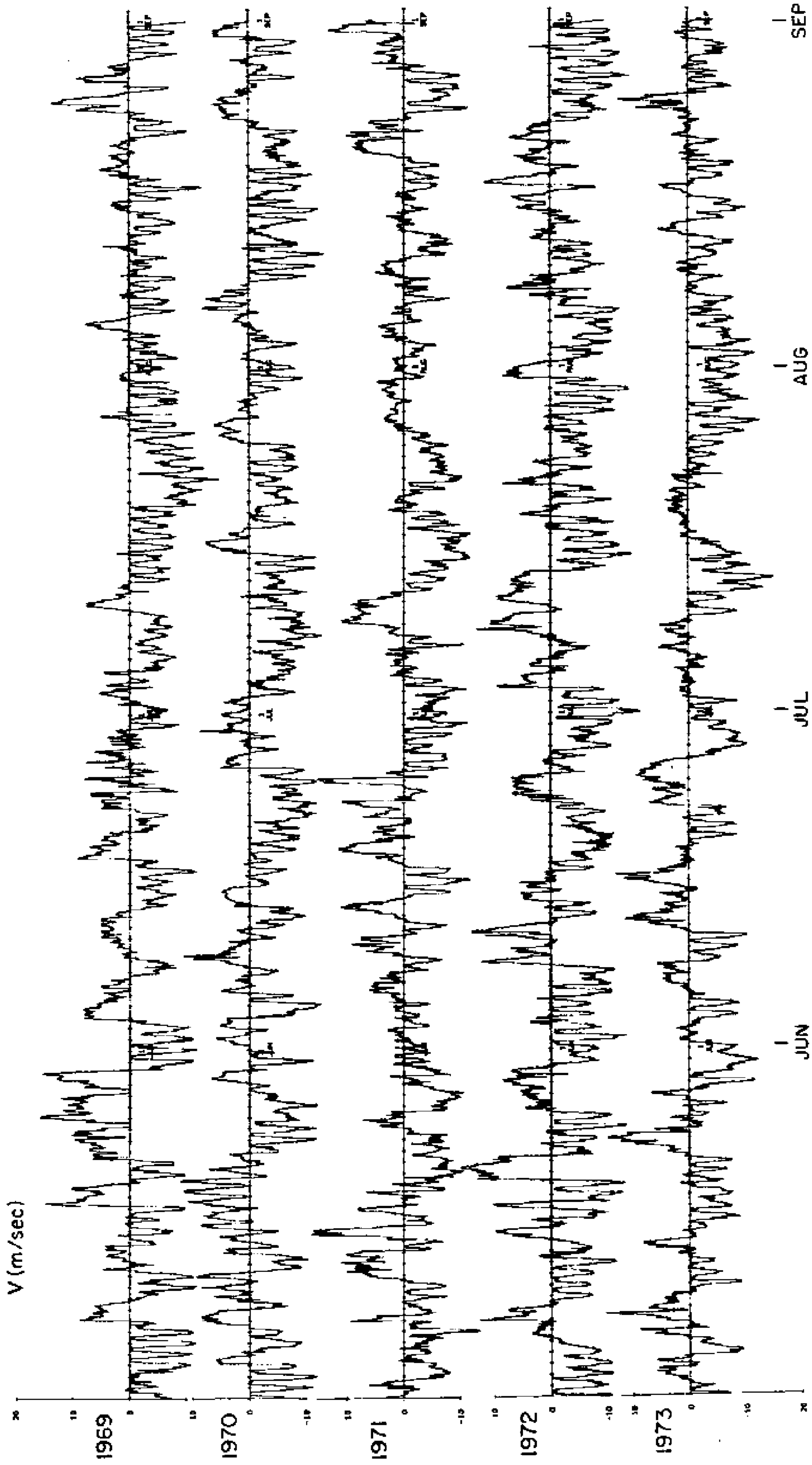
1 OCT
1 NOV
1 DEC
1 JAN

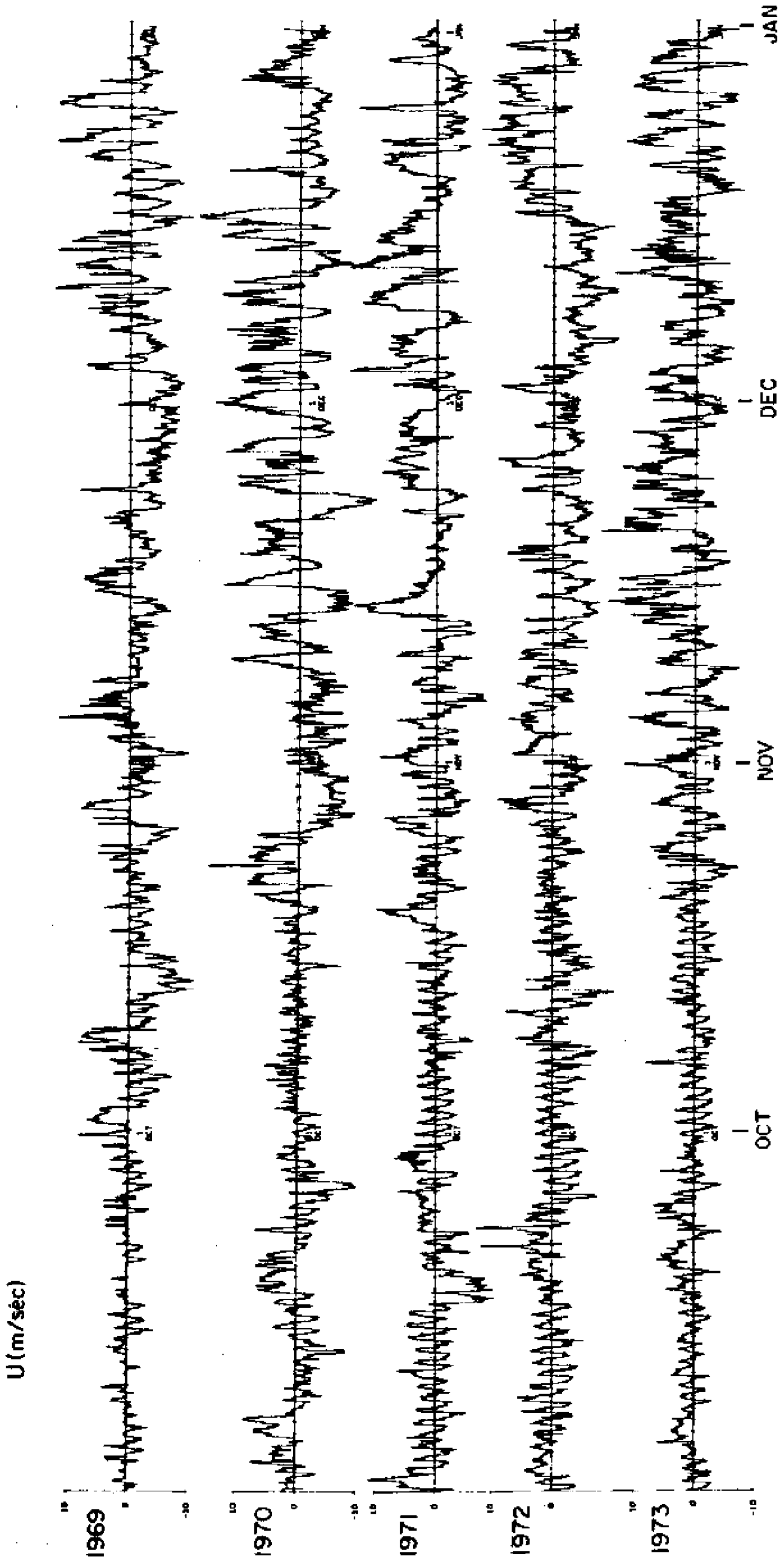

U(m/sec)
1969
1970
1971
1972
1973
FEB
MAR
APR
MAY

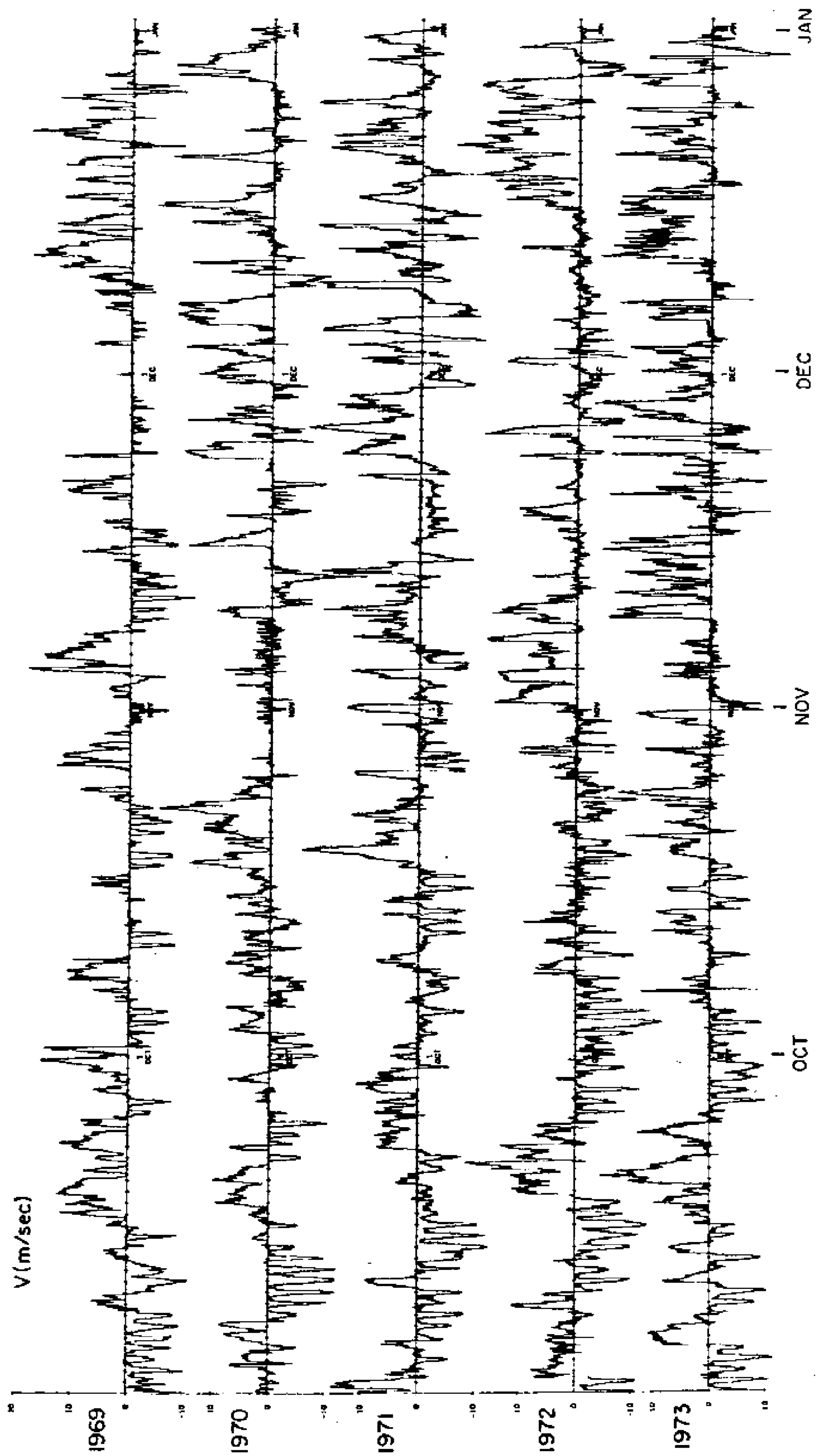


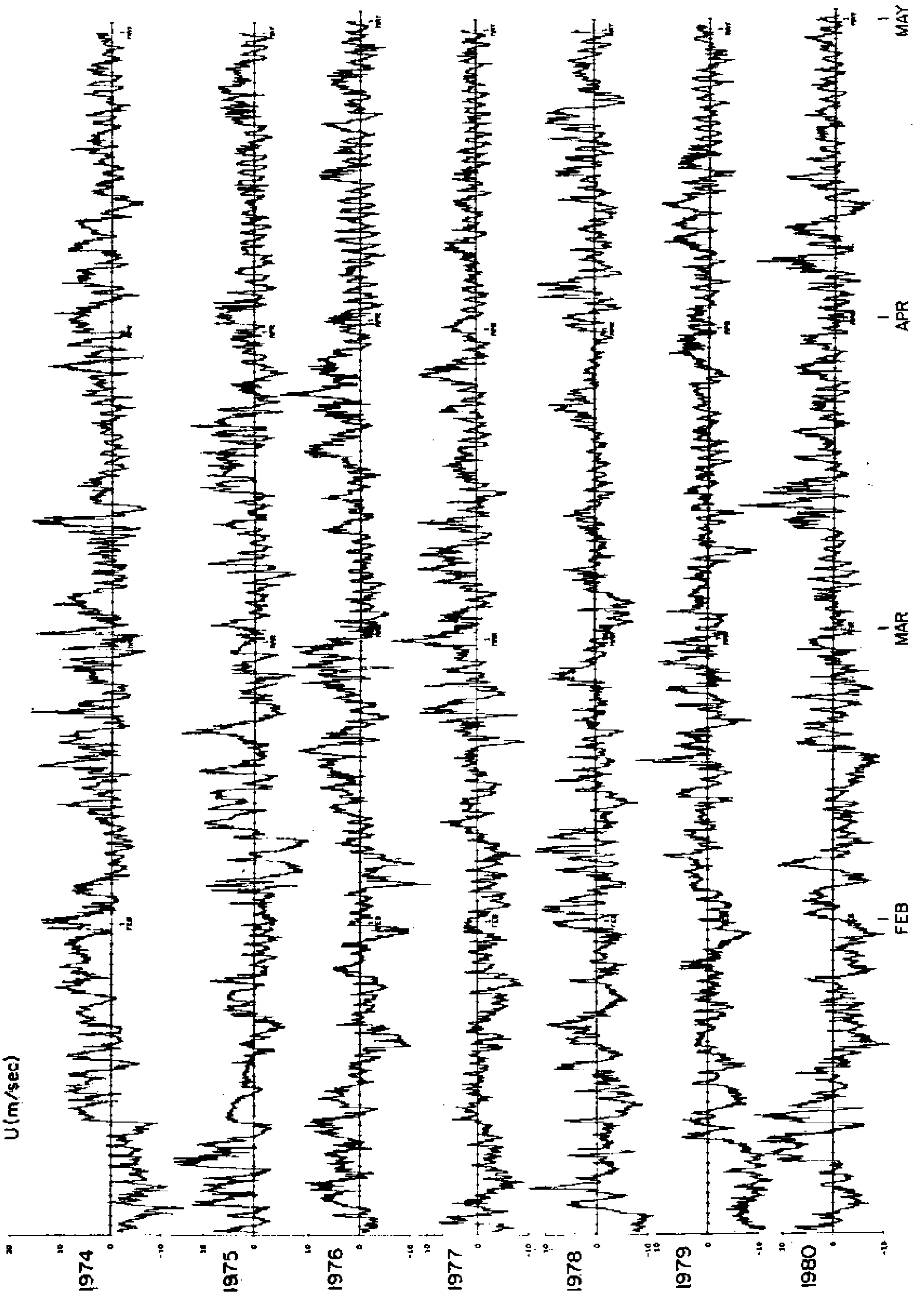
V(m/sec)
1969
1970
1971
1972
1973
FEB
MAR
APR
MAY

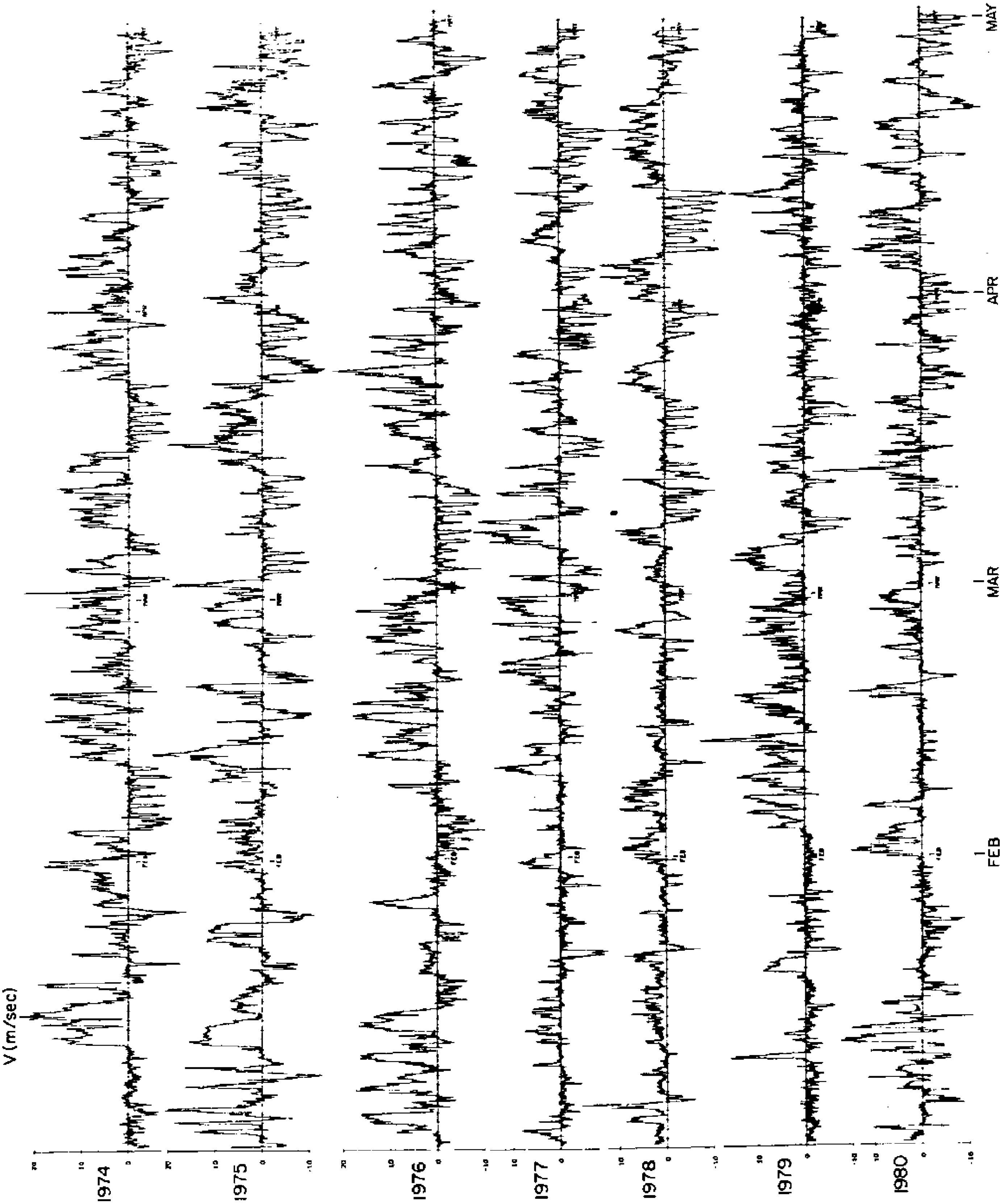

U (m/sec)
1969
1970
1971
1972
1973
JUN
JUL
AUG
SEP

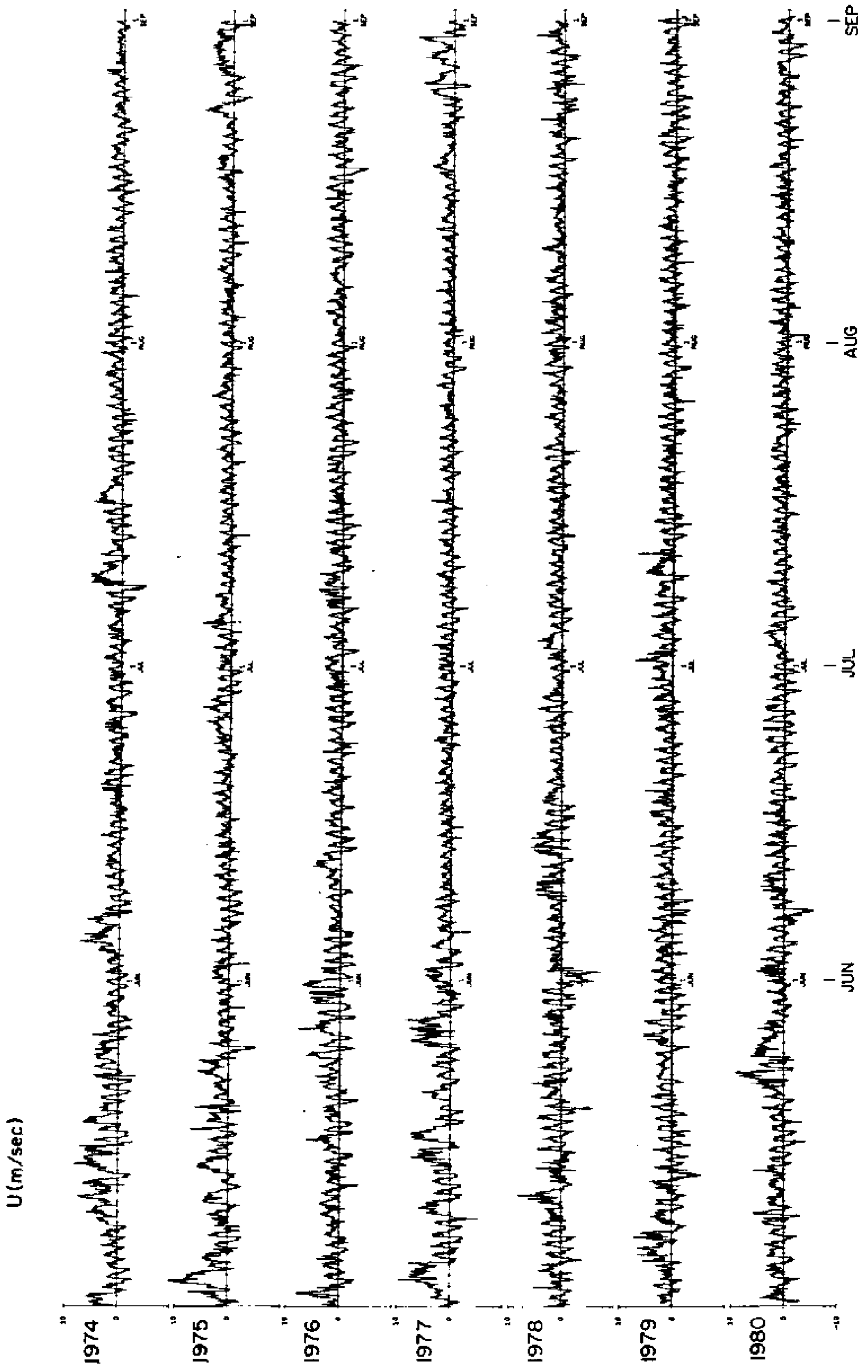

V (m/sec)
1969
1970
1971
1972
1973
JUN
JUL
AUG
SEP

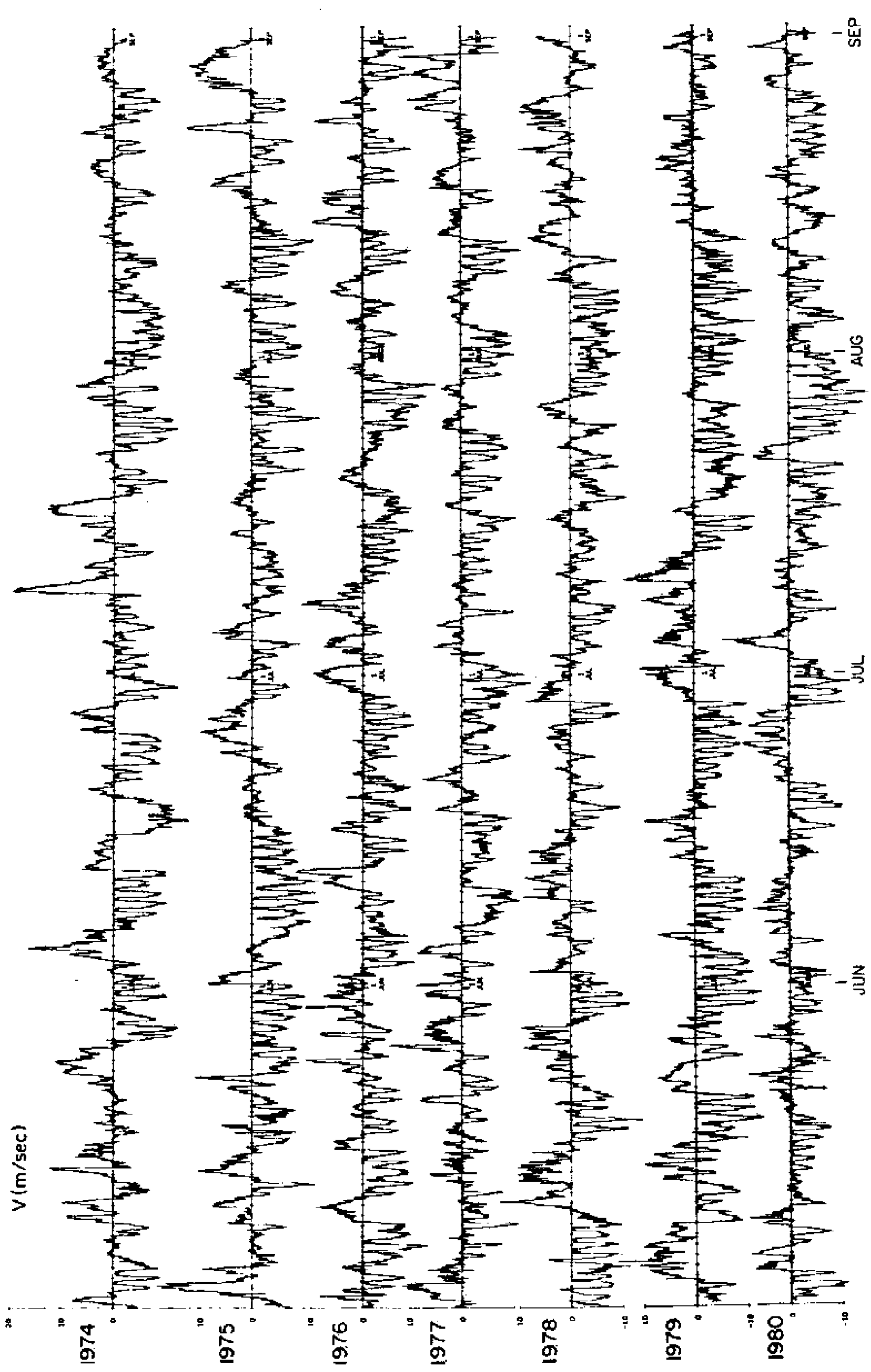

U (m/sec)
1969
1970
1971
1972
1973
OCT
NOV
DEC
JAN

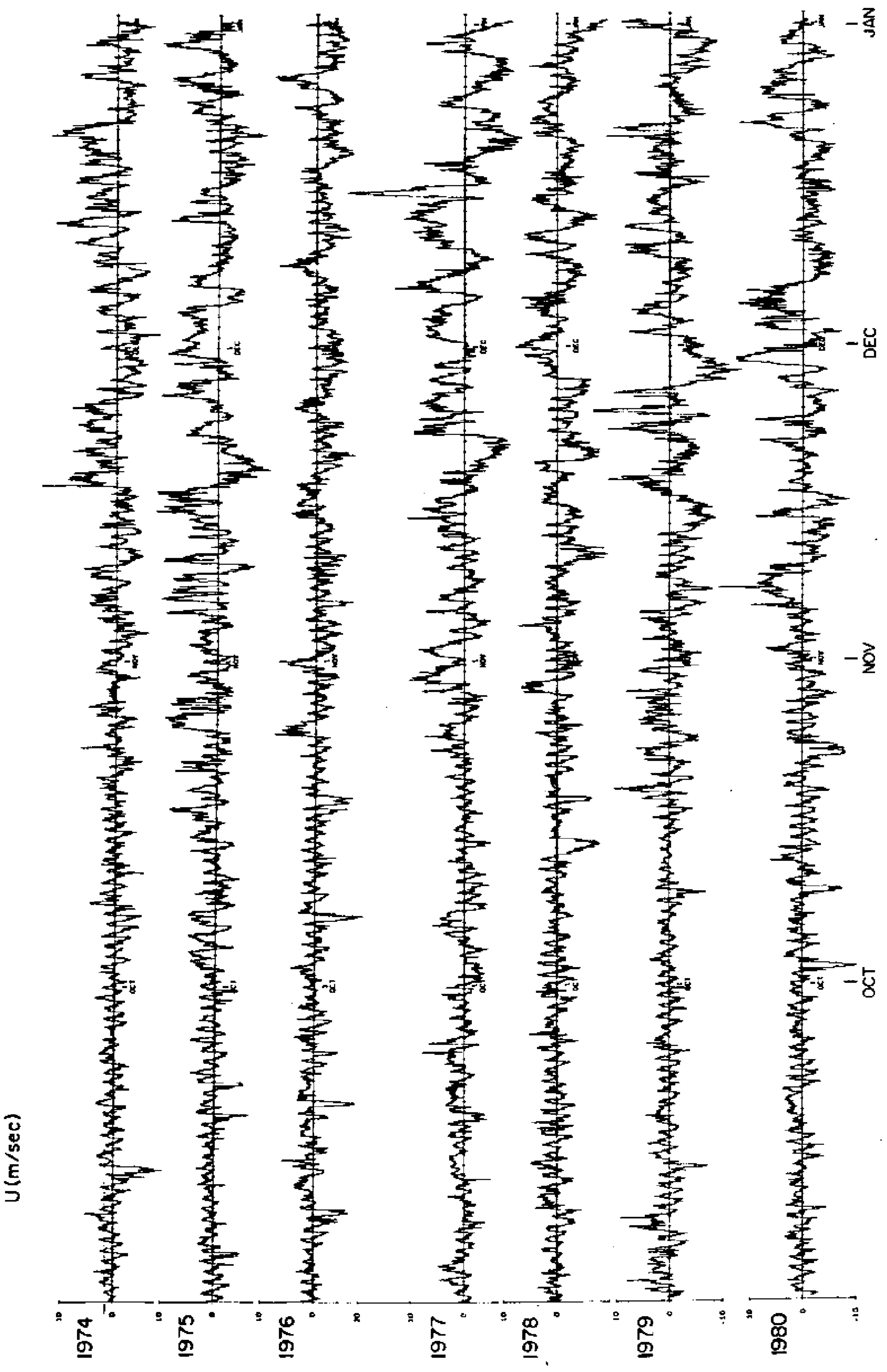

V(m/sec)
1969
1970
1971
1972
1973
OCT
NOV
DEC
JAN

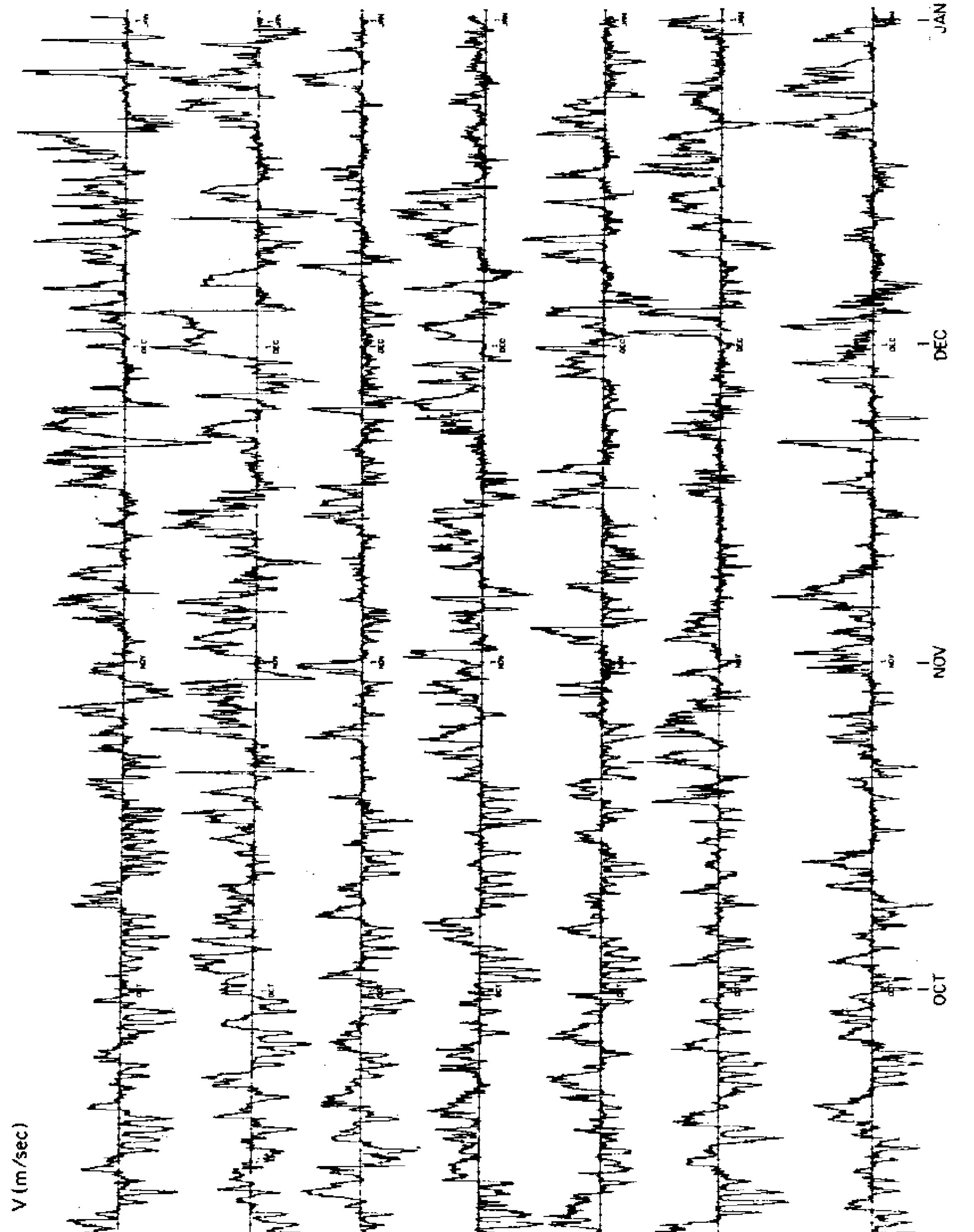

U (m/sec)
1974
1975
1976
1977
1978
1979
1980
FEB
MAR
APR
MAY

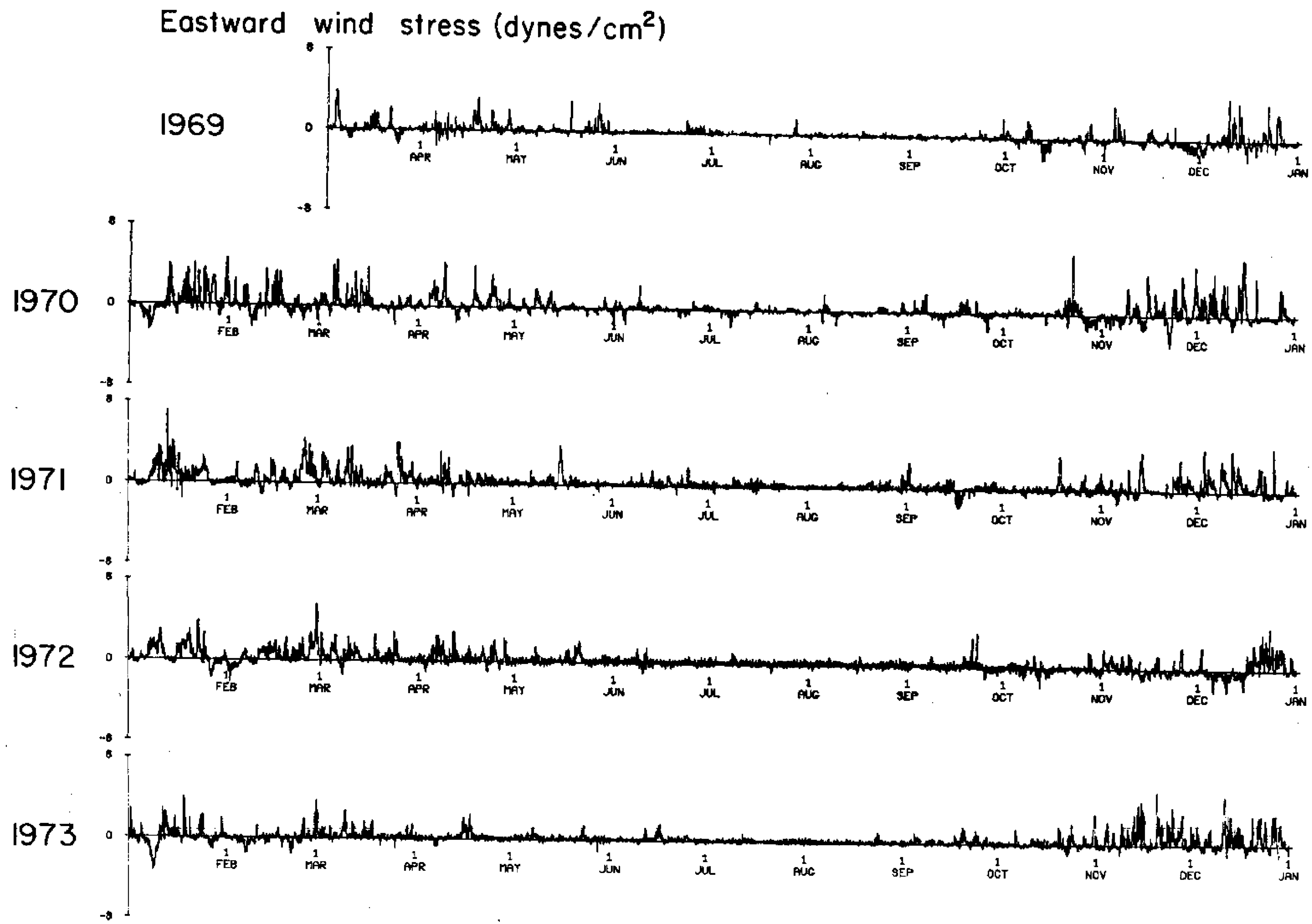

V(m/sec)
1974
1975
1976
1977
1978
1979
1980
FEB
MAR
APR
MAY

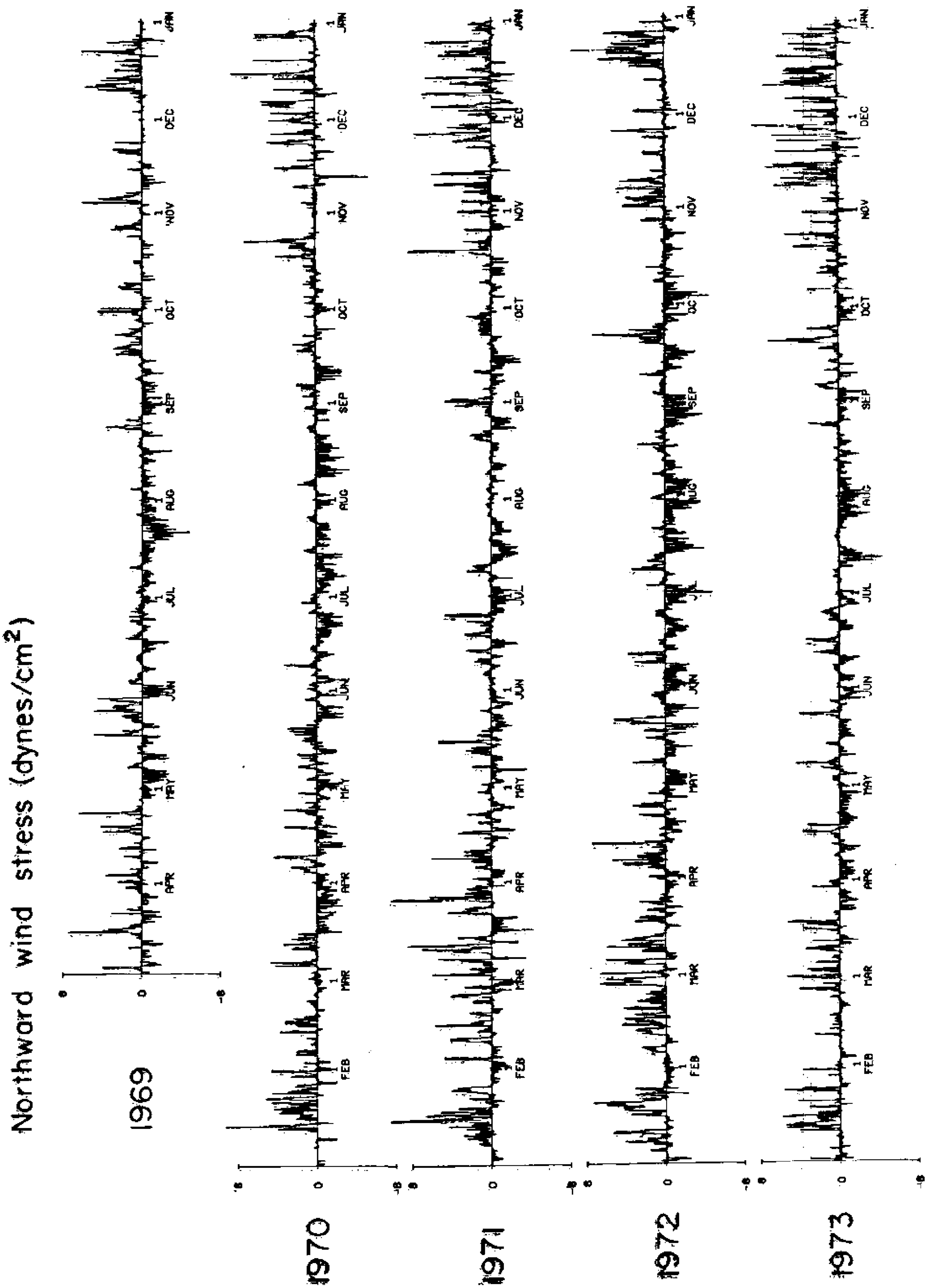

U(m/sec)
1974
1975
1976
1977
1978
1979
1980
JUN
JUL
AUG
SEP


V (m/sec)
1974
1975
1976
1977
1978
1979
1980
1 JUN
1 JUL
1 AUG
1 SEP

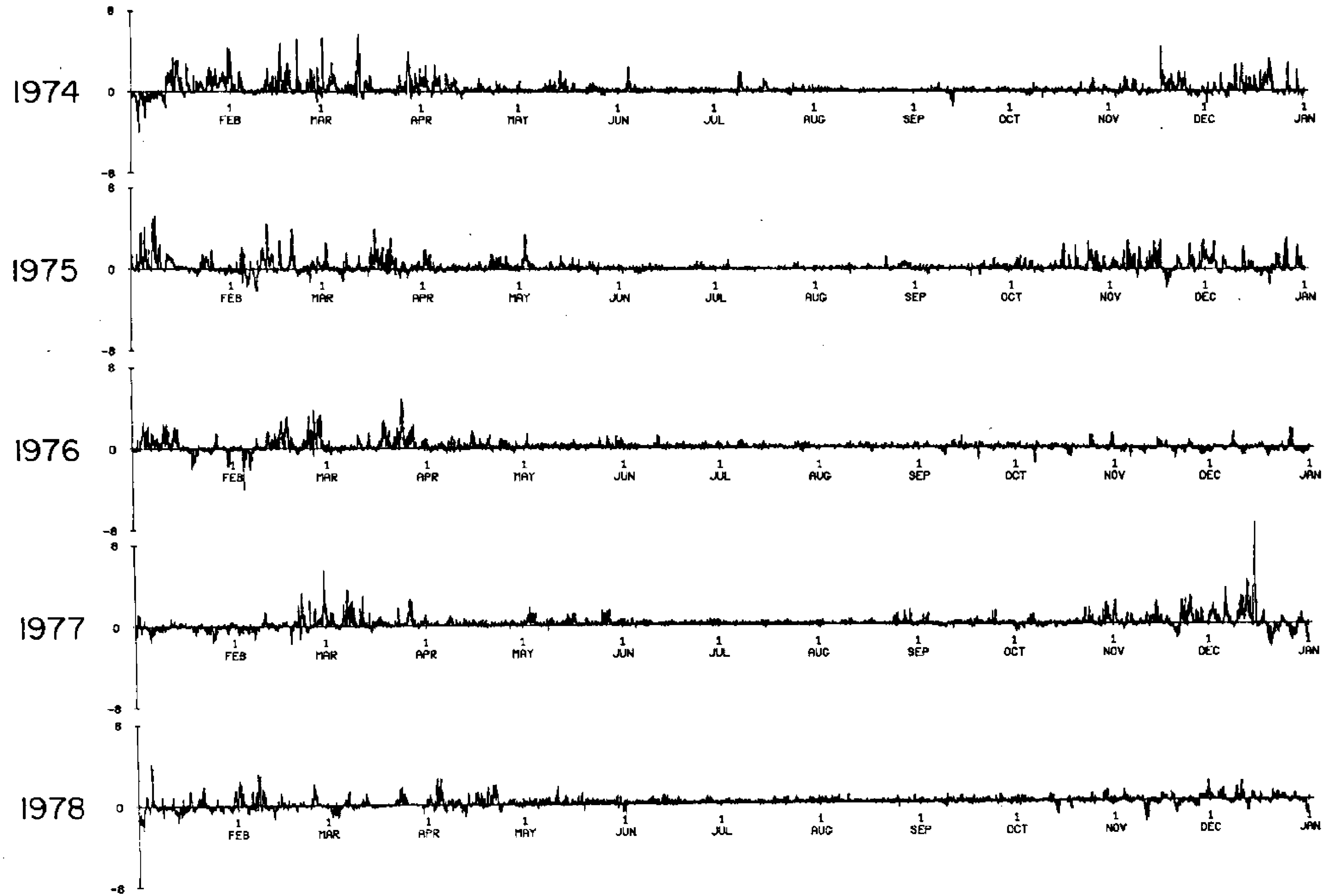

U(m/sec)
1974
1975
1976
1977
1978
1979
1980
OCT
NOV
DEC
JAN

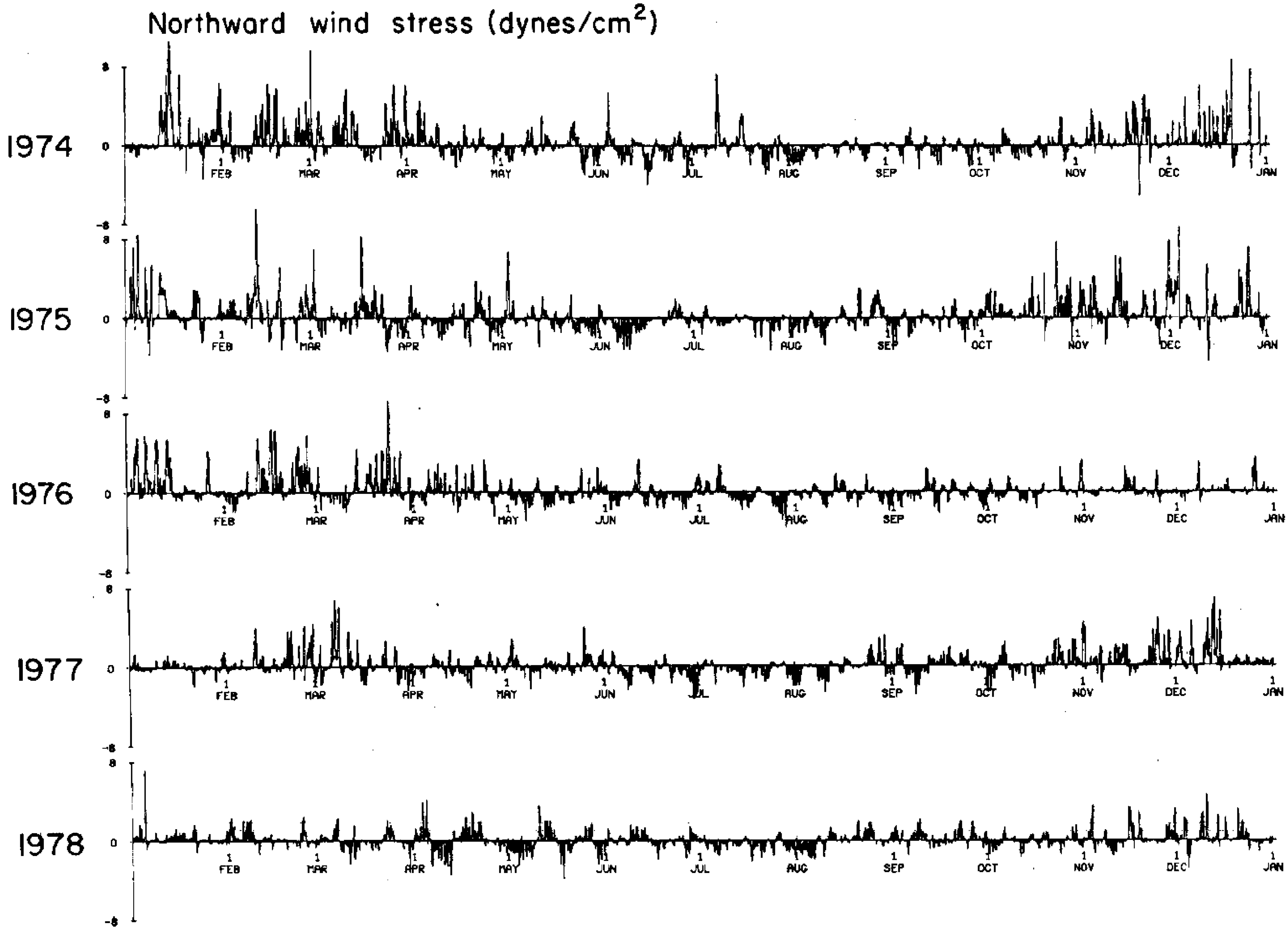

V (m/sec)
1974
1975
1976
1977
1978
1979
1980
OCT
1 NOV
1 DEC
1 JAN

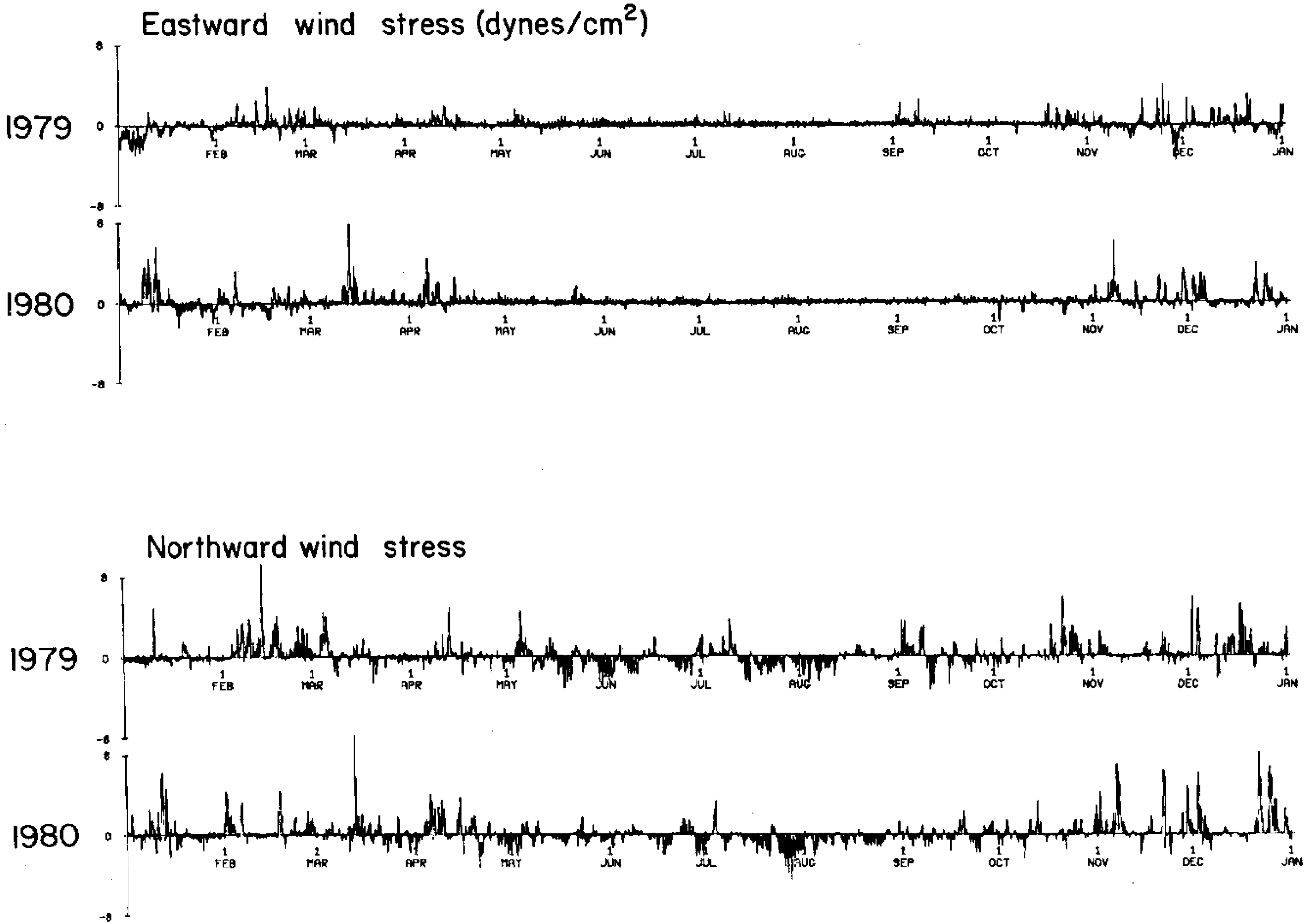

Eastward wind stress (dynes/cm²)
1969
1970
1971
1972
1973
8
0
-8
1 FEB
1 MAR
1 APR
1 MAY
1 JUN
1 JUL
1 AUG
1 SEP
1 OCT
1 NOV
1 DEC
1 JAN


Northward wind stress (dynes/cm²)
1969
1970
1971
1972
1973
8
0
-8
FEB
MAR
APR
MAY
JUN
JUL
AUG
SEP
OCT
NOV
DEC
JAN

Eastward wind stress (dynes/cm^2)

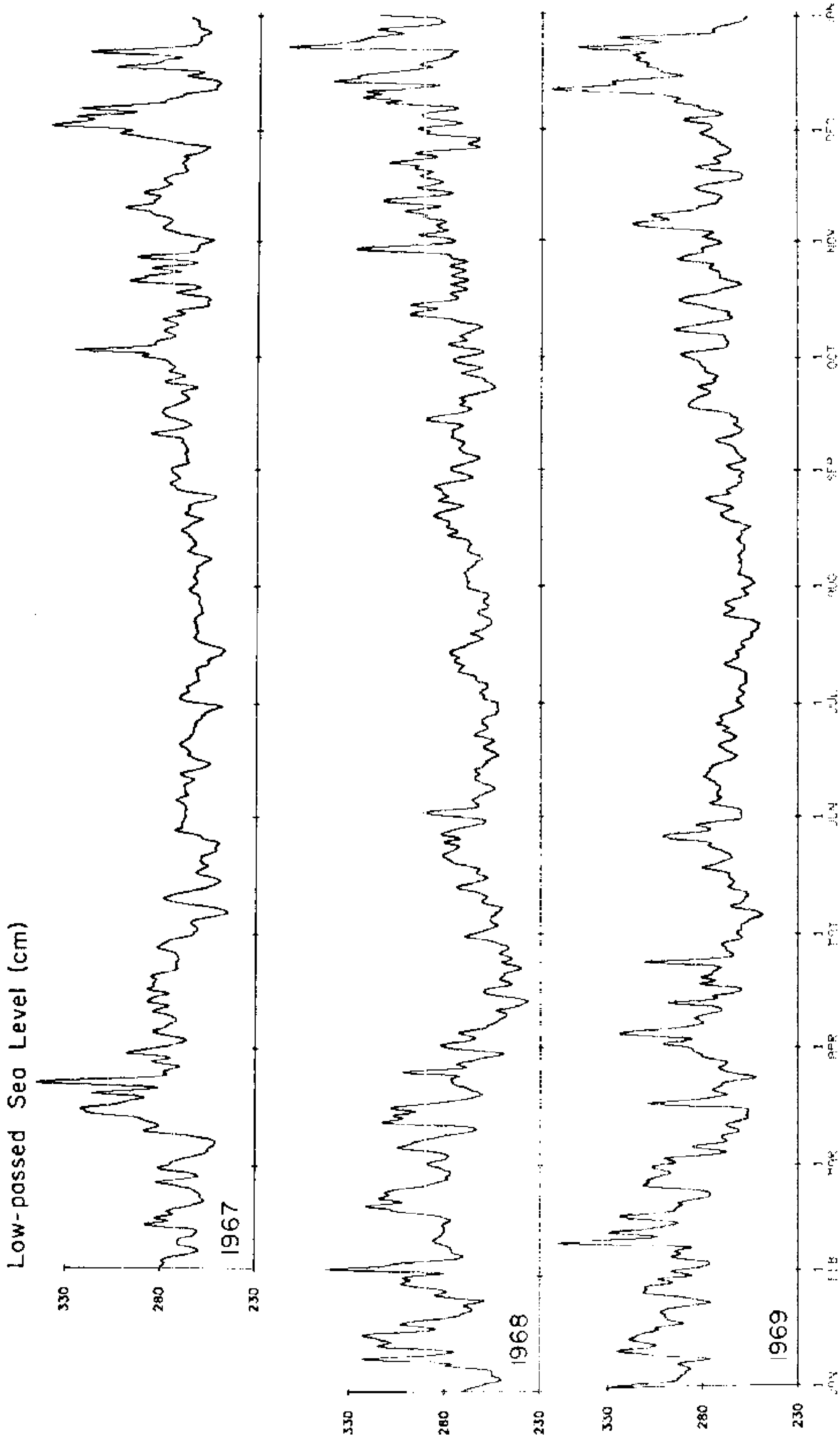


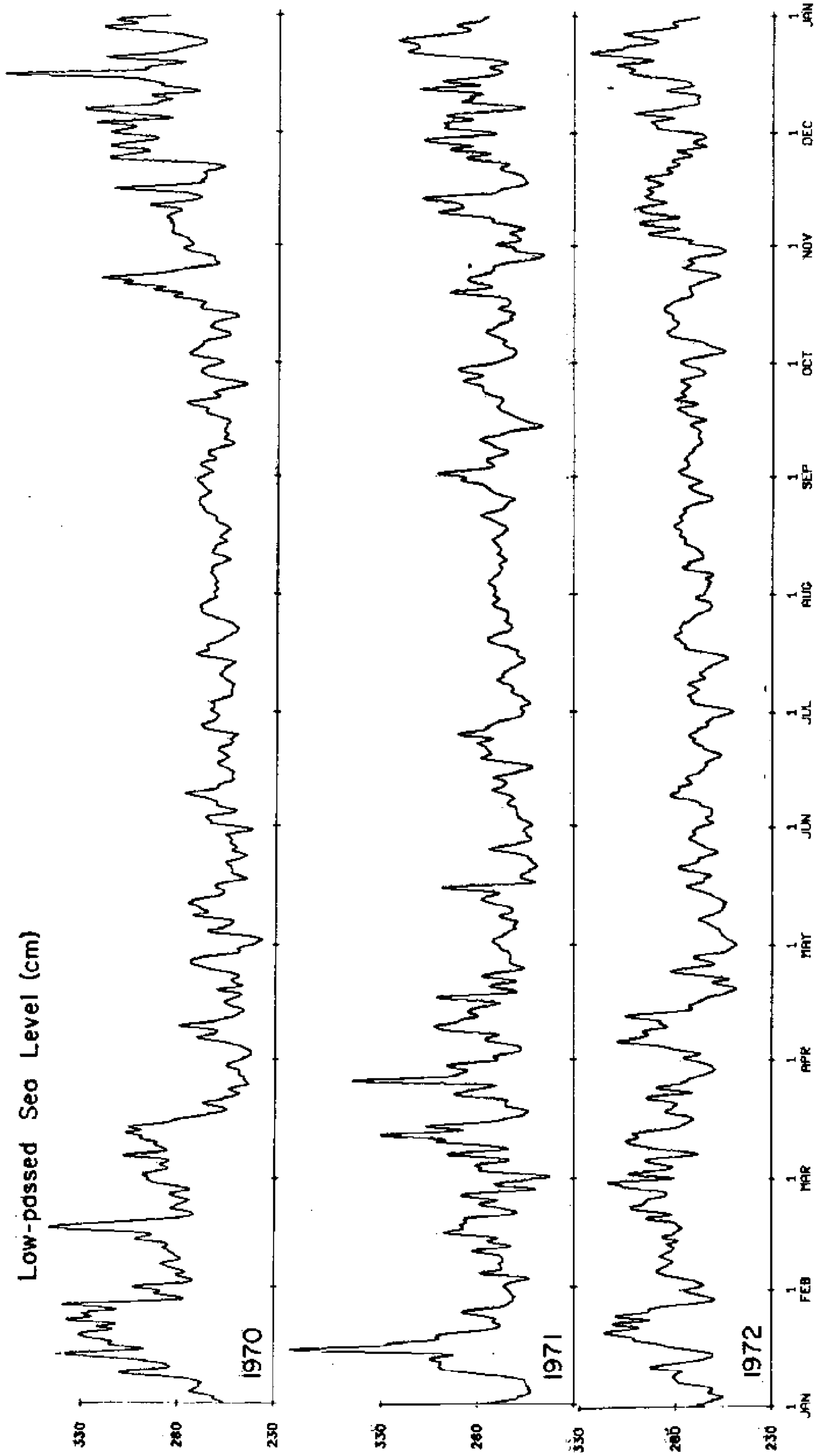

Northward wind stress (dynes/cm2)
1974
1975
1976
1977
1978
8
0
-8
1 FEB
1 MAR
1 APR
1 MAY
1 JUN
1 JUL
1 AUG
1 SEP
1 OCT
1 NOV
1 DEC
1 JAN


Eastward wind stress (dynes/cm²)
1979
1980
8
0
-8
1 FEB
1 MAR
1 APR
1 MAY
1 JUN
1 JUL
1 AUG
1 SEP
1 OCT
1 NOV
1 DEC
1 JAN
Northward wind stress
1979
1980

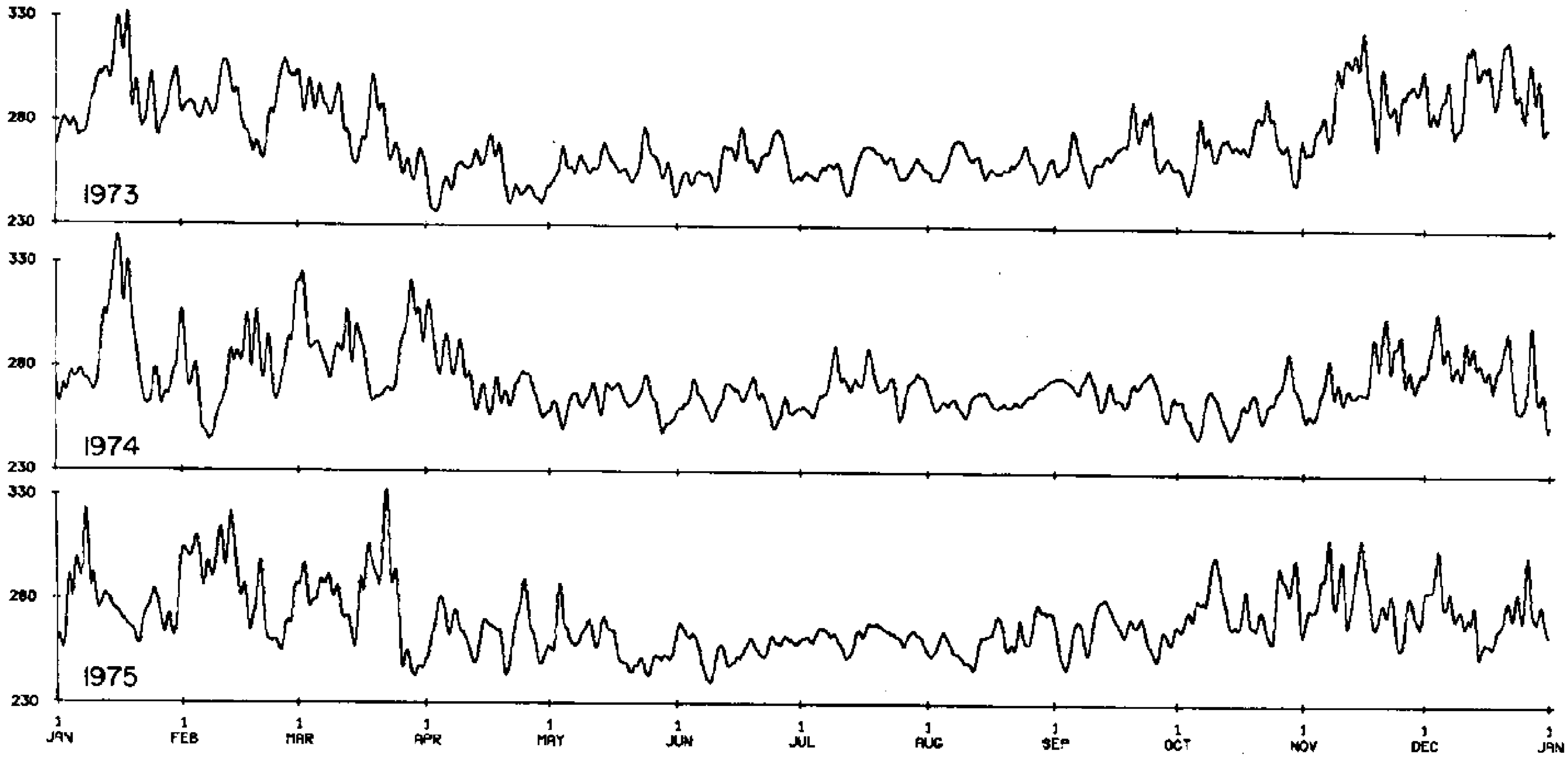
LOW-PASSED TIME SERIES

Sea Level
Atmospheric Pressure
Adjusted Sea Level
Eastward and Northward Wind
Wind Vectors
Eastward and Northward Wind Stress
Wind Stress Vectors

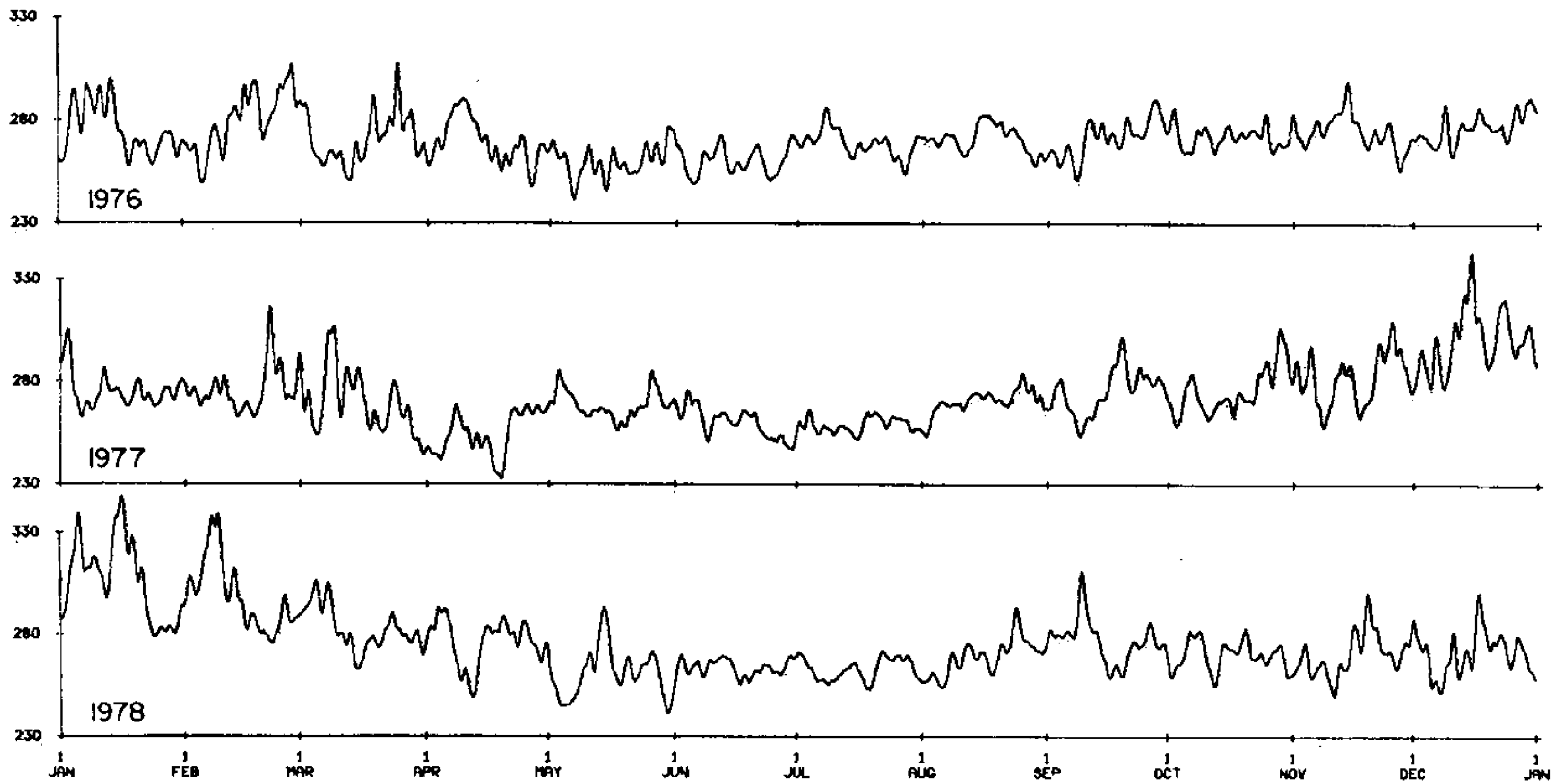

Low-passed Sea Level (cm)
1967
1968
1969
330
280
230


Low-passed Sea Level (cm)
1970
1971
1972
330
280
230
1 JAN
1 FEB
1 MAR
1 APR
1 MAY
1 JUN
1 JUL
1 AUG
1 SEP
1 OCT
1 NOV
1 DEC
1 JAN

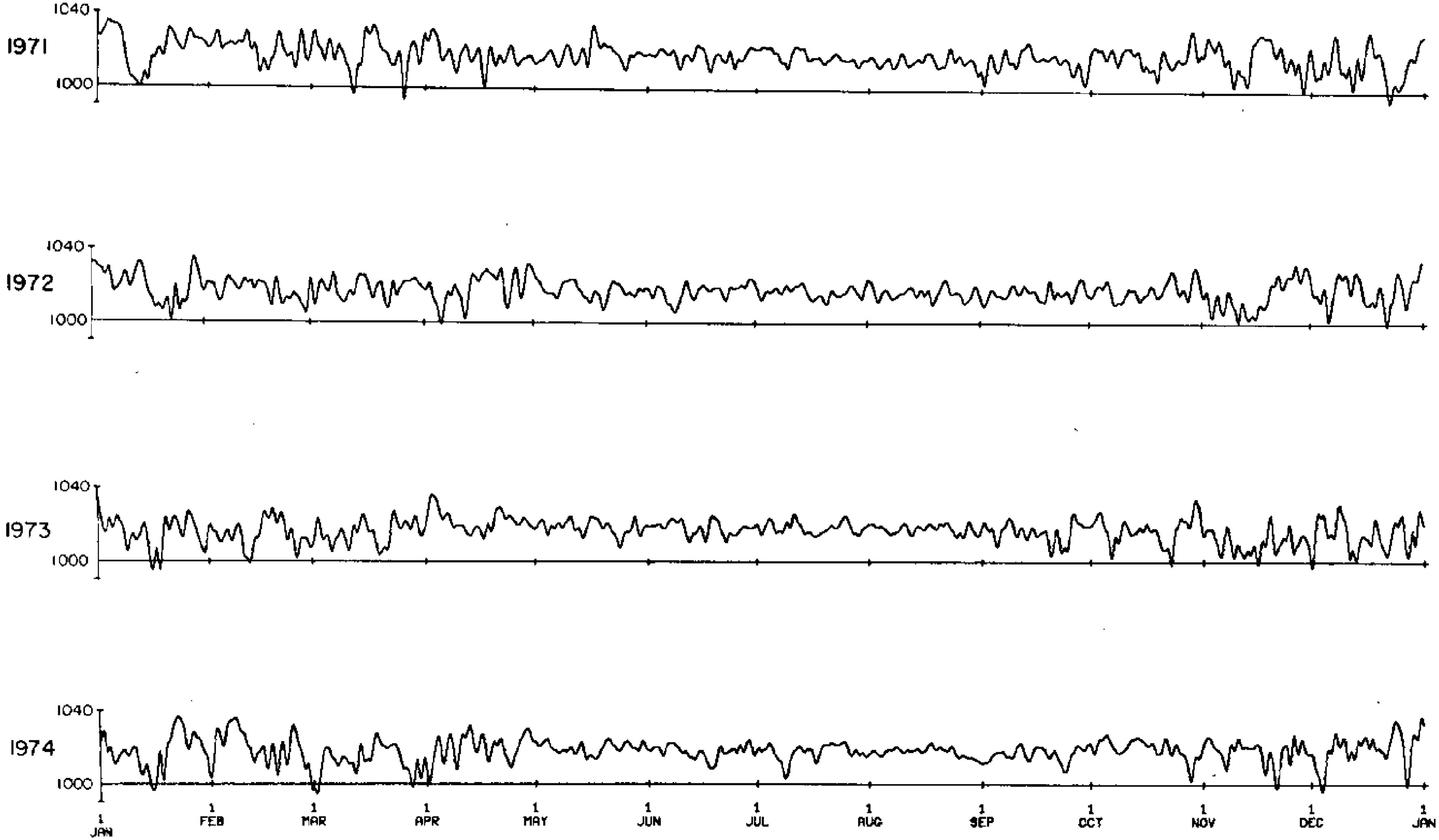
Low-passed Sea Level (cm)

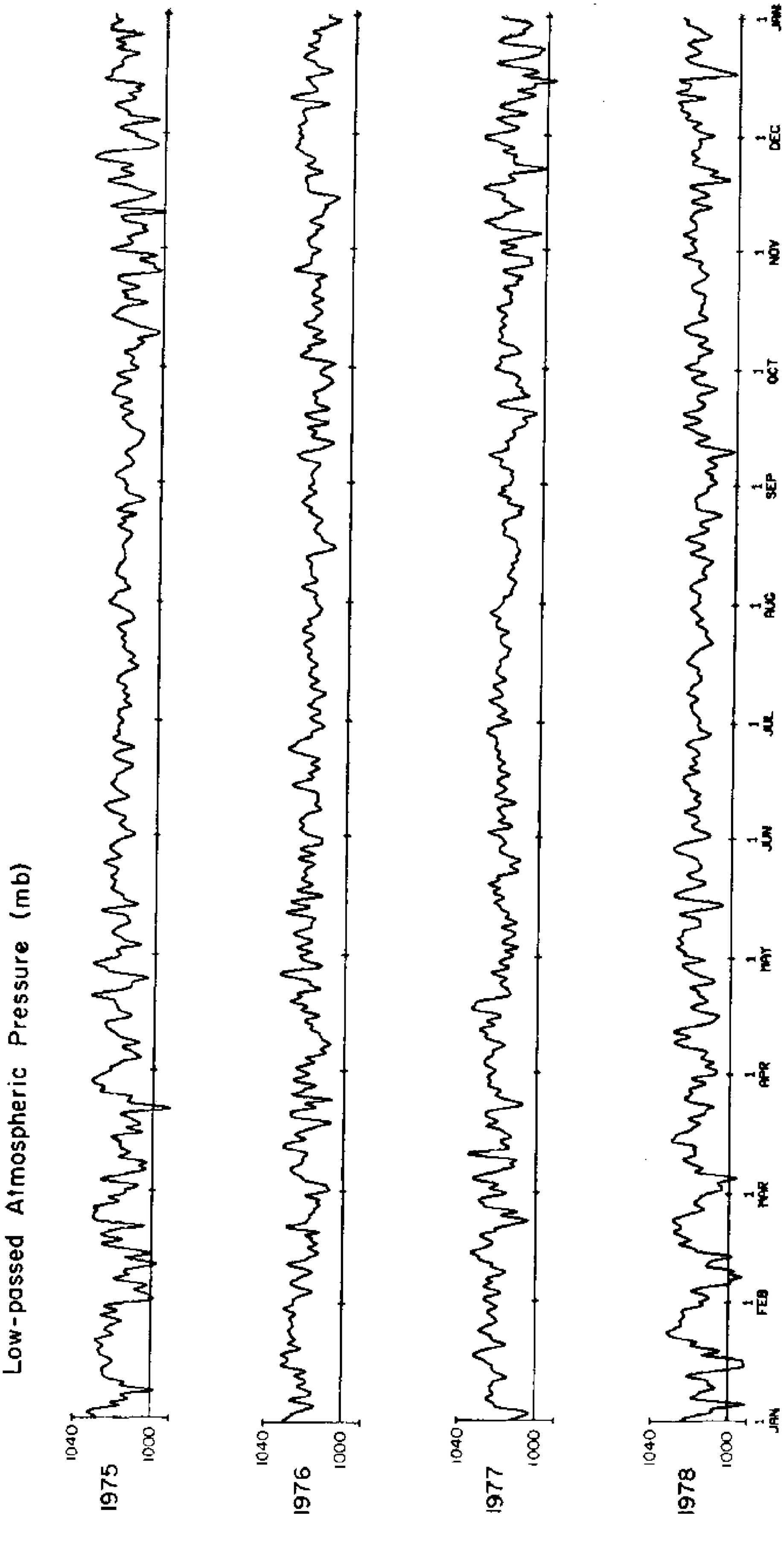


Low-passed Sea Level (cm)

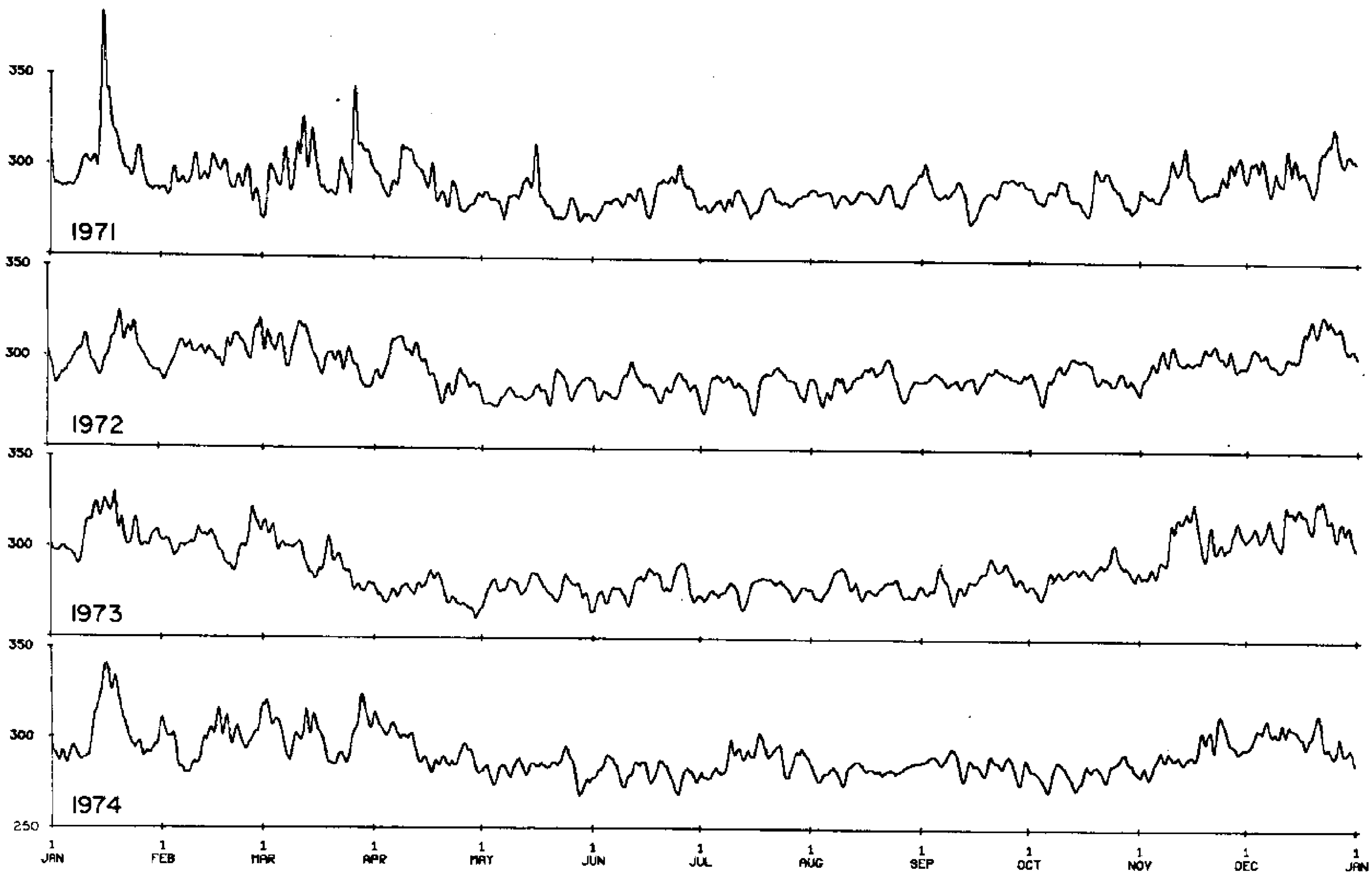


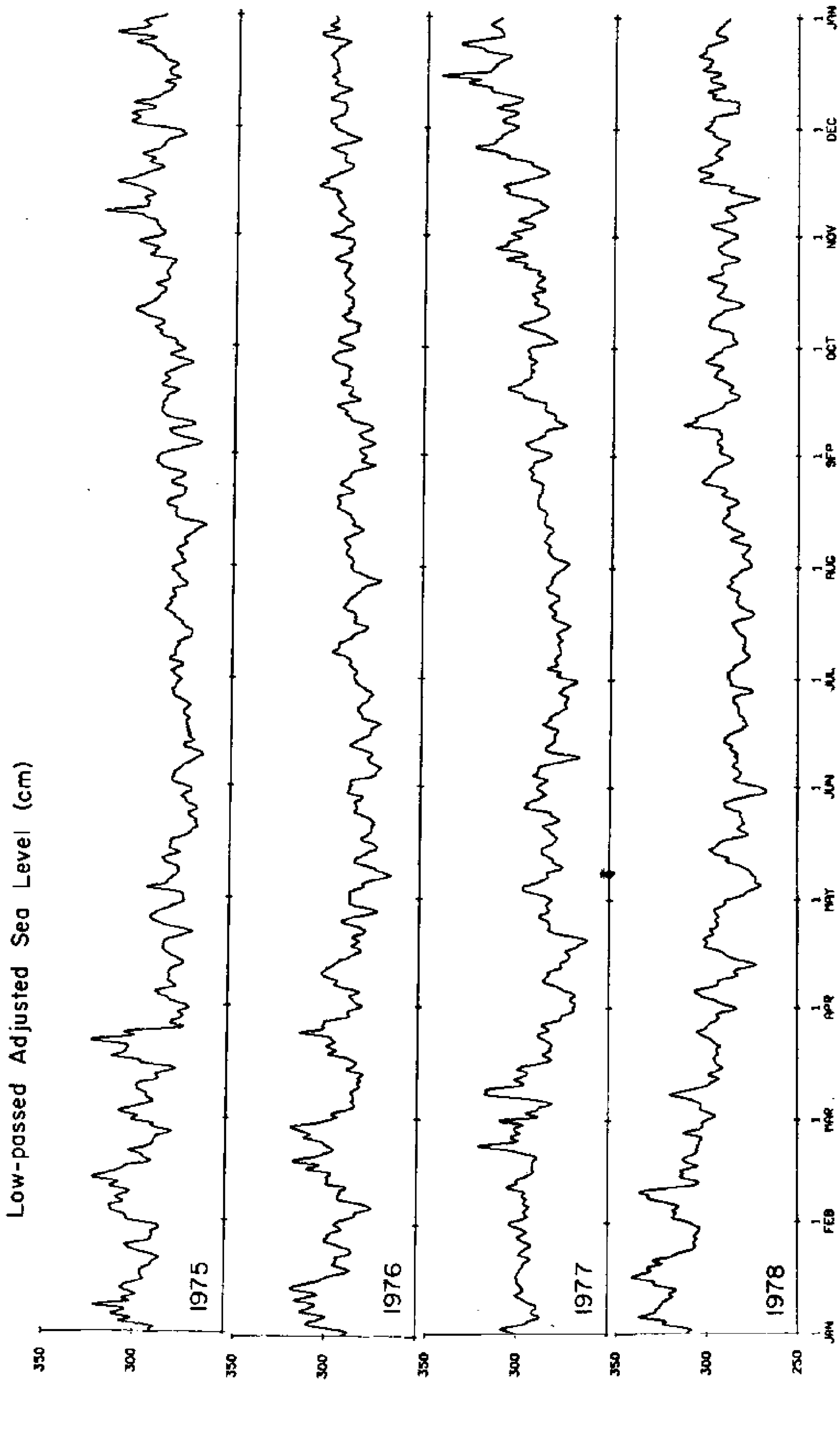
Low-passed Atmospheric Pressure (mb)

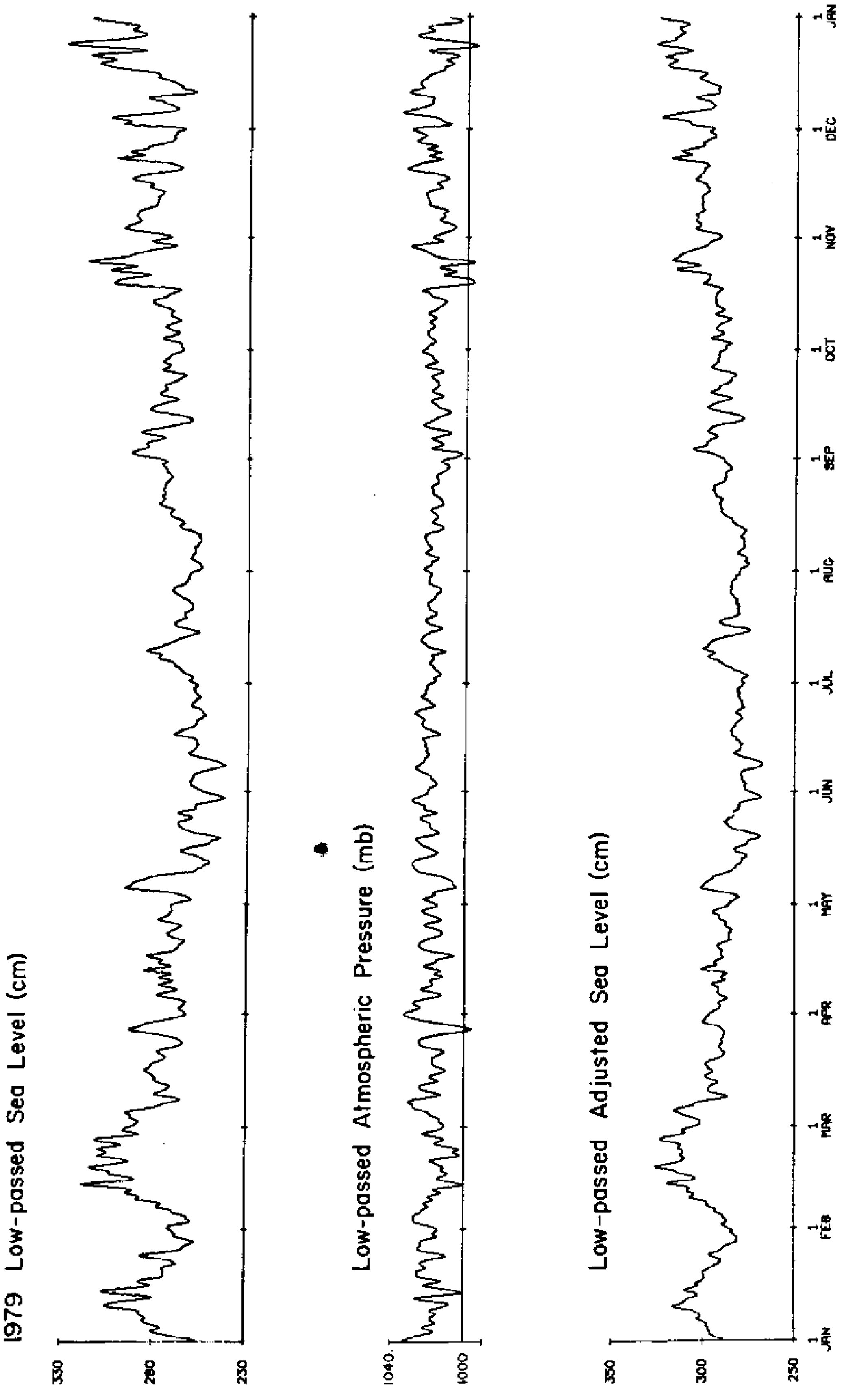


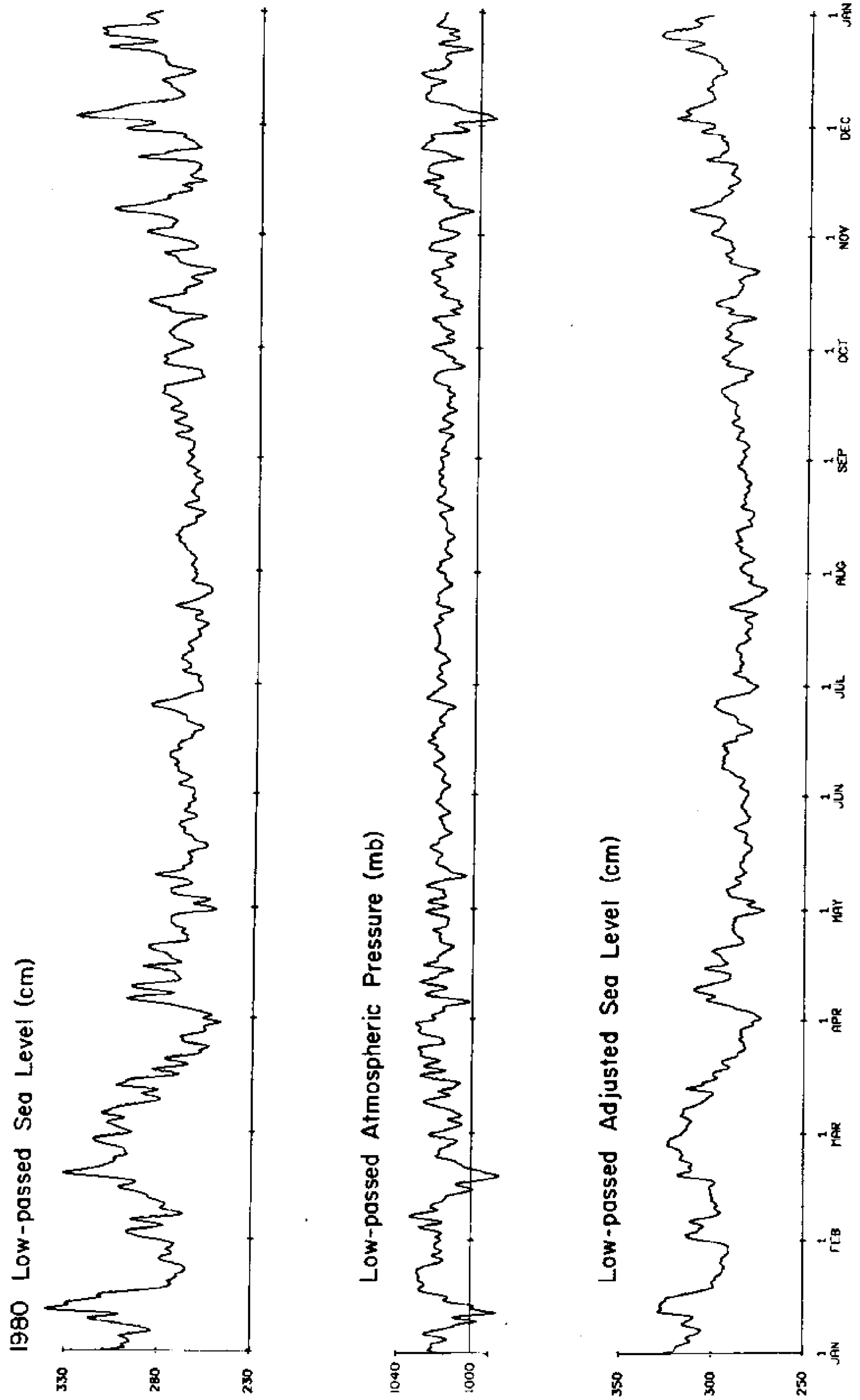

Low-passed Atmospheric Pressure (mb)
1975
1976
1977
1978
1040
1000
1 JAN
1 FEB
1 MAR
1 APR
1 MAY
1 JUN
1 JUL
1 AUG
1 SEP
1 OCT
1 NOV
1 DEC
1 JAN

Low-passed Adjusted Sea Level (cm)

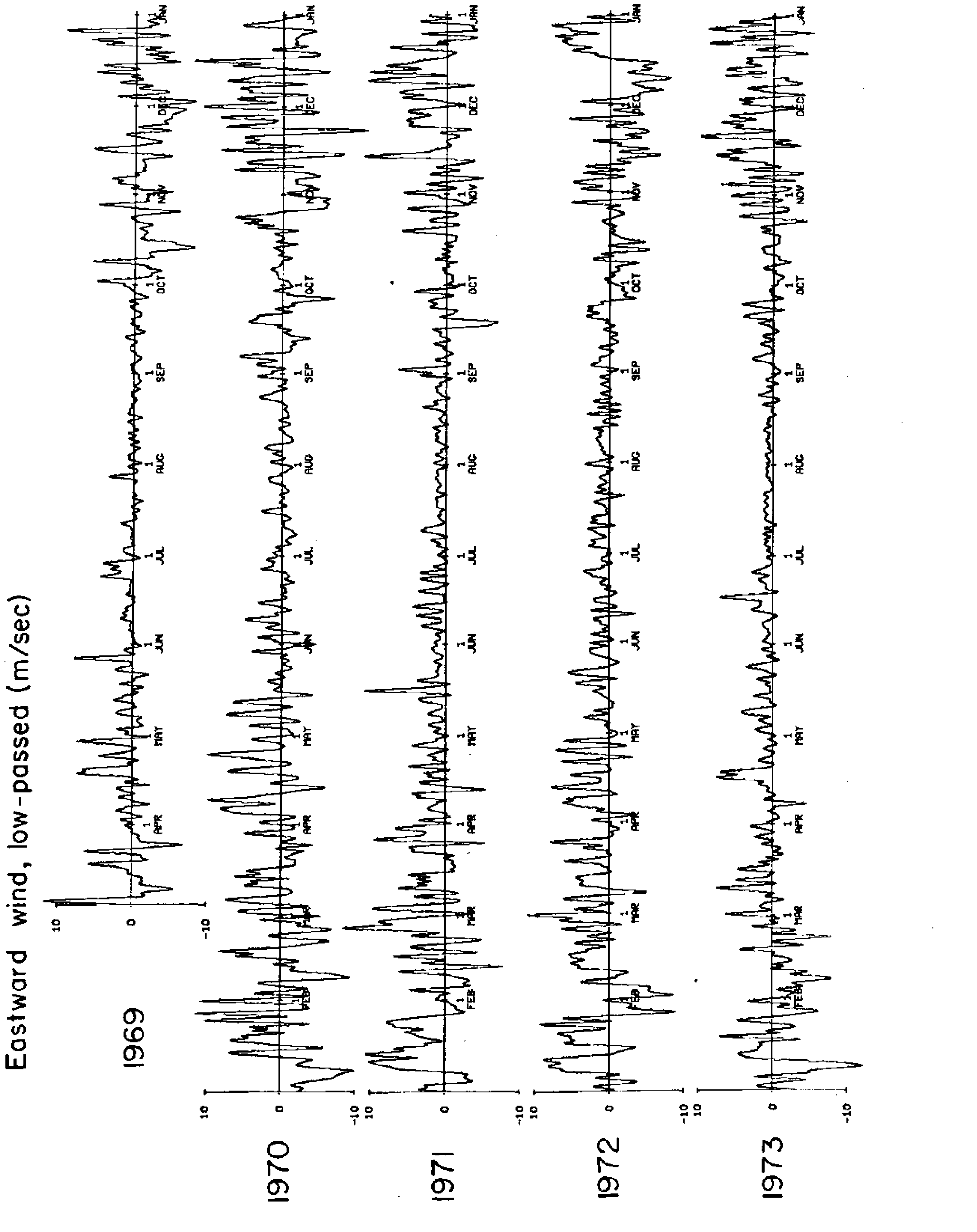



Low-passed Adjusted Sea Level (cm)
1975
1976
1977
1978
350
300
250
JAN
1 FEB
1 MAR
1 APR
1 MAY
1 JUN
1 JUL
1 AUG
1 SEP
1 OCT
1 NOV
1 DEC
1 JAN

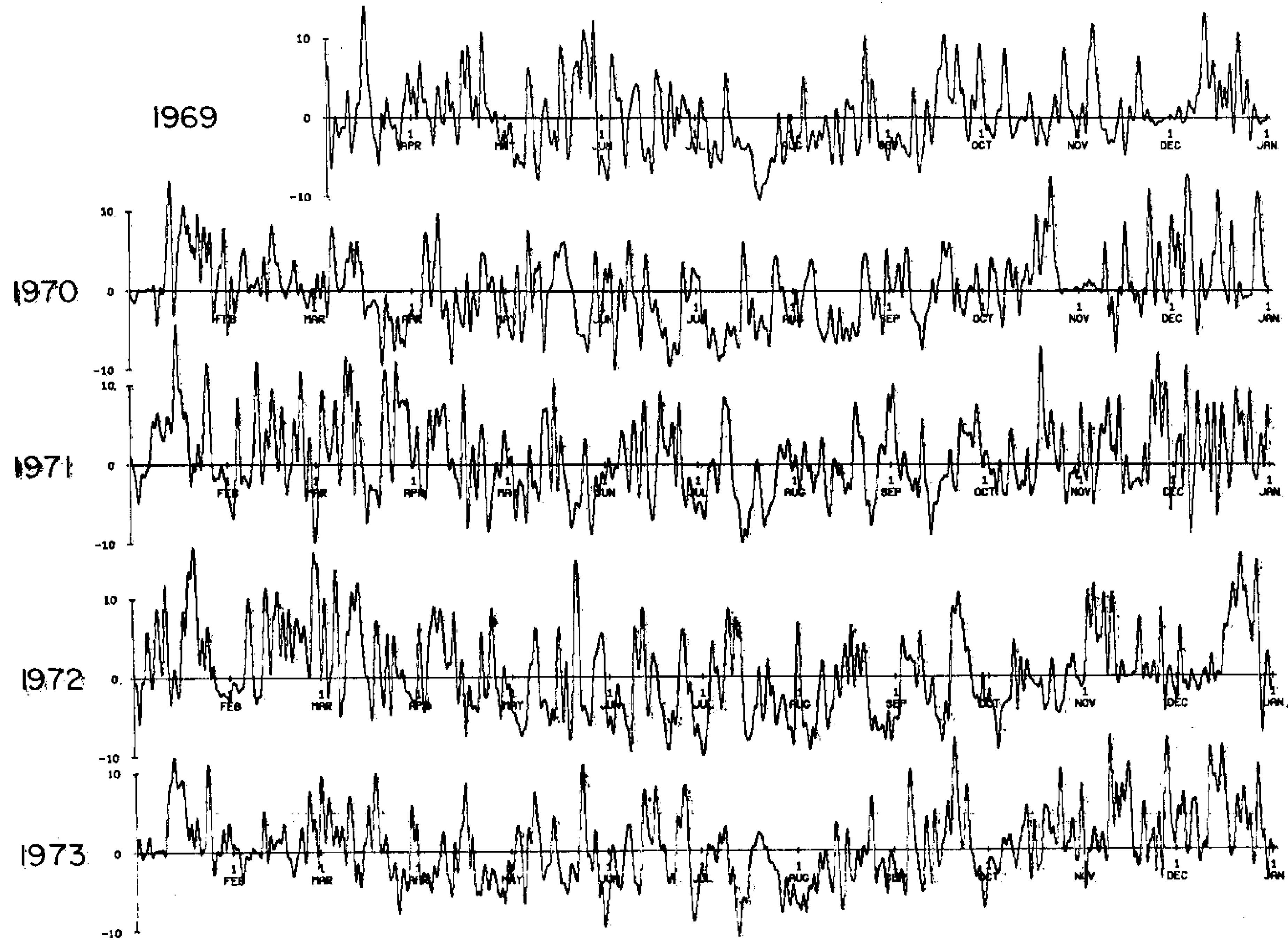

1979 Low-passed Sea Level (cm)
330
280
230
Low-passed Atmospheric Pressure (mb)
1040
1000
Low-passed Adjusted Sea Level (cm)
350
300
250
1 JAN
1 FEB
1 MAR
1 APR
1 MAY
1 JUN
1 JUL
1 AUG
1 SEP
1 OCT
1 NOV
1 DEC
1 JAN



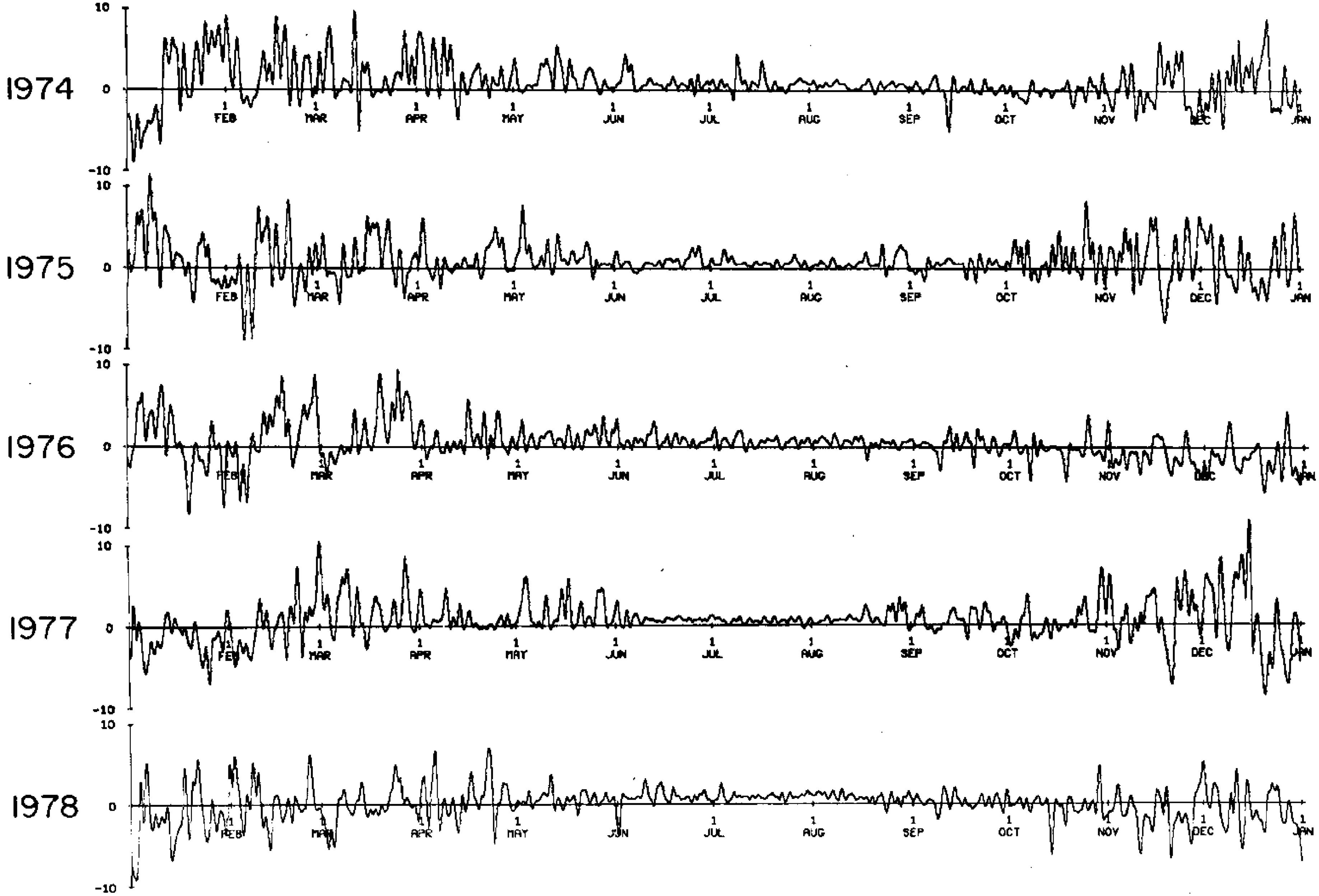
1980 Low-passed Sea Level (cm)
330
280
230
Low-passed Atmospheric Pressure (mb)
1040
1000
Low-passed Adjusted Sea Level (cm)
350
300
250
1 JAN
1 FEB
1 MAR
1 APR
1 MAY
1 JUN
1 JUL
1 AUG
1 SEP
1 OCT
1 NOV
1 DEC
1 JAN


Eastward wind, low-passed (m/sec)
1969
1970
1971
1972
1973
10
0
-10
1 FEB
1 MAR
1 APR
1 MAY
1 JUN
1 JUL
1 AUG
1 SEP
1 OCT
1 NOV
1 DEC
1 JAN

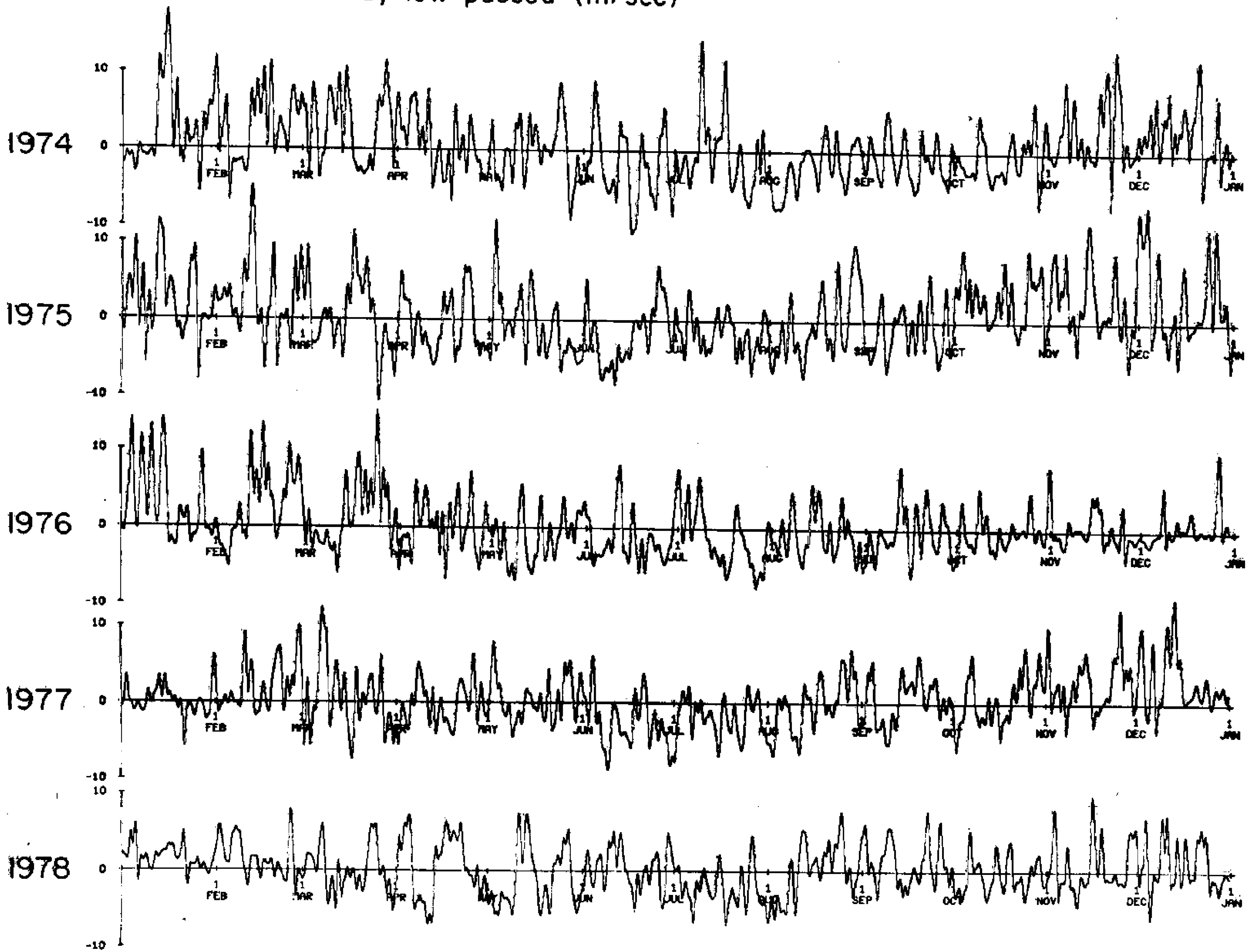
Northward wind, low-passed (m/sec)

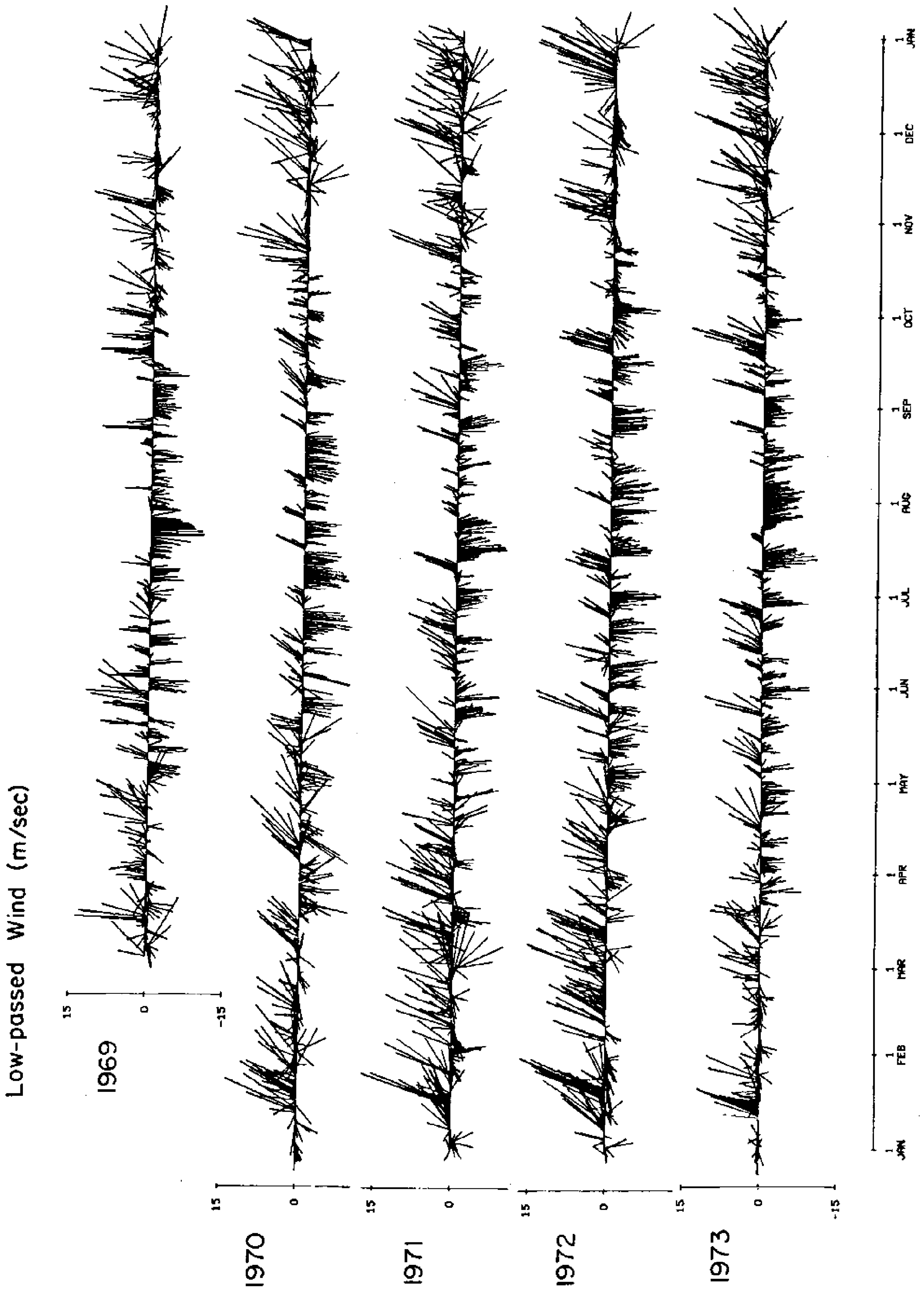


Eastward wind, low-passed (m/sec)

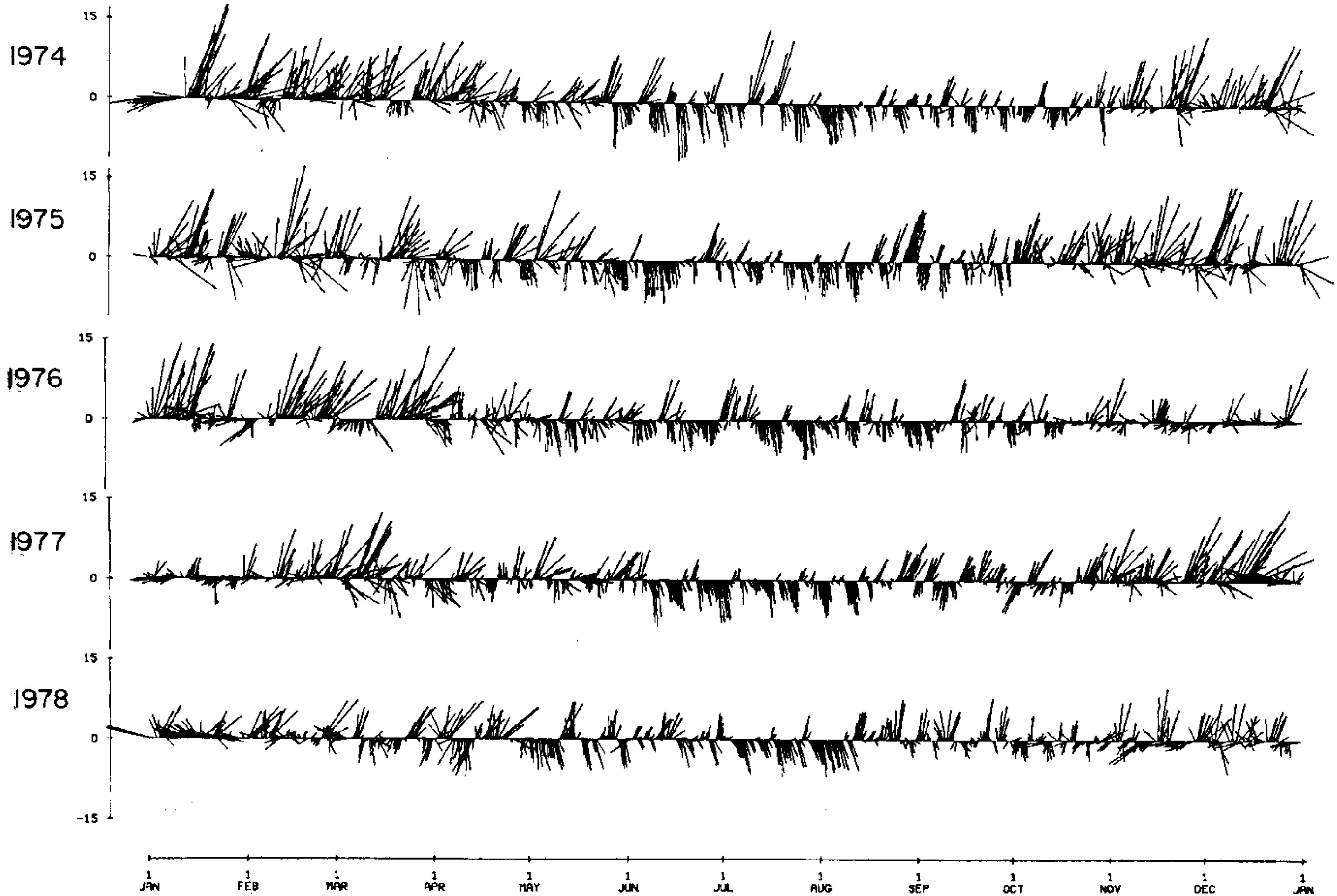


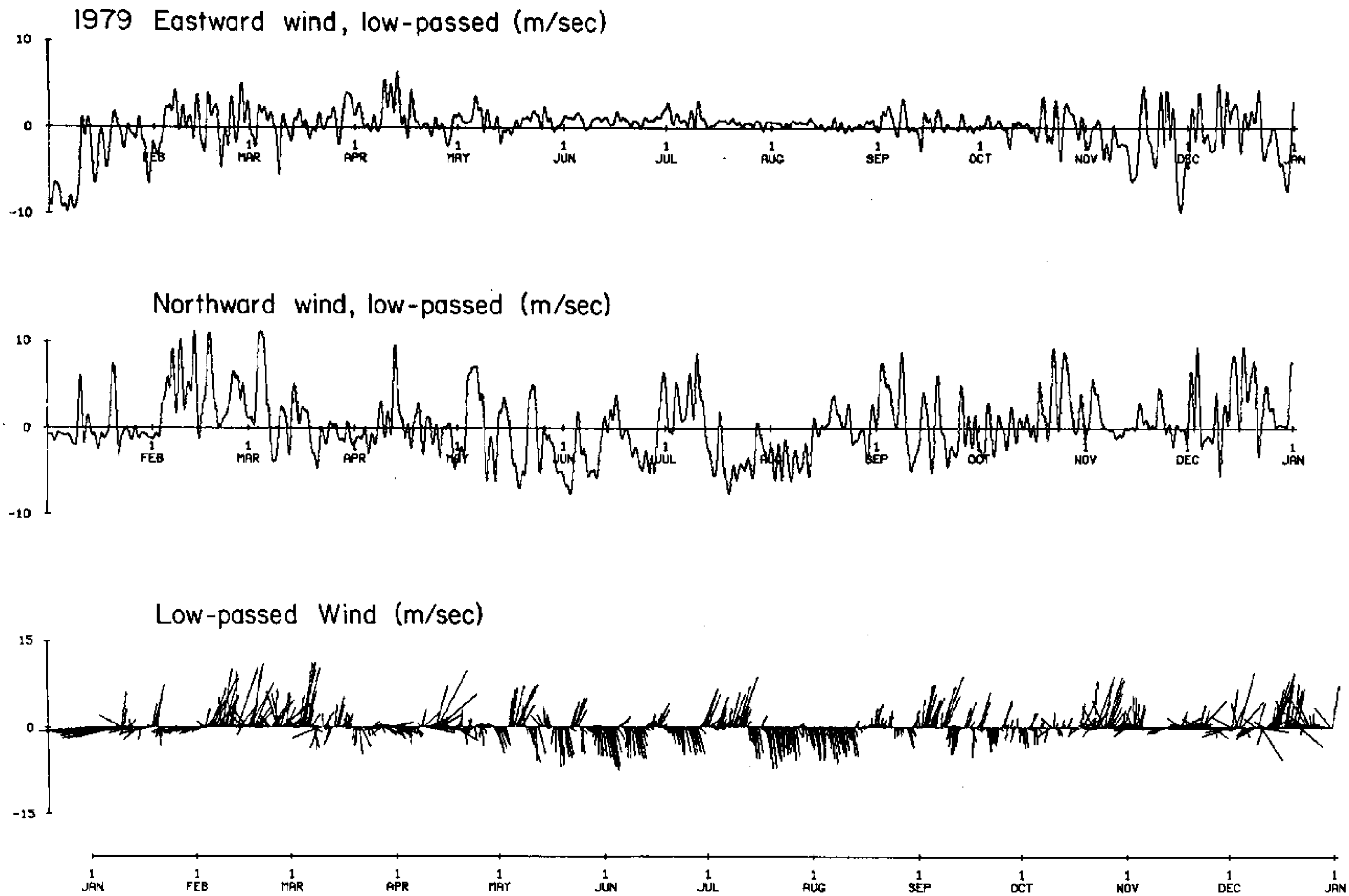
Northward wind, low-passed (m/sec)

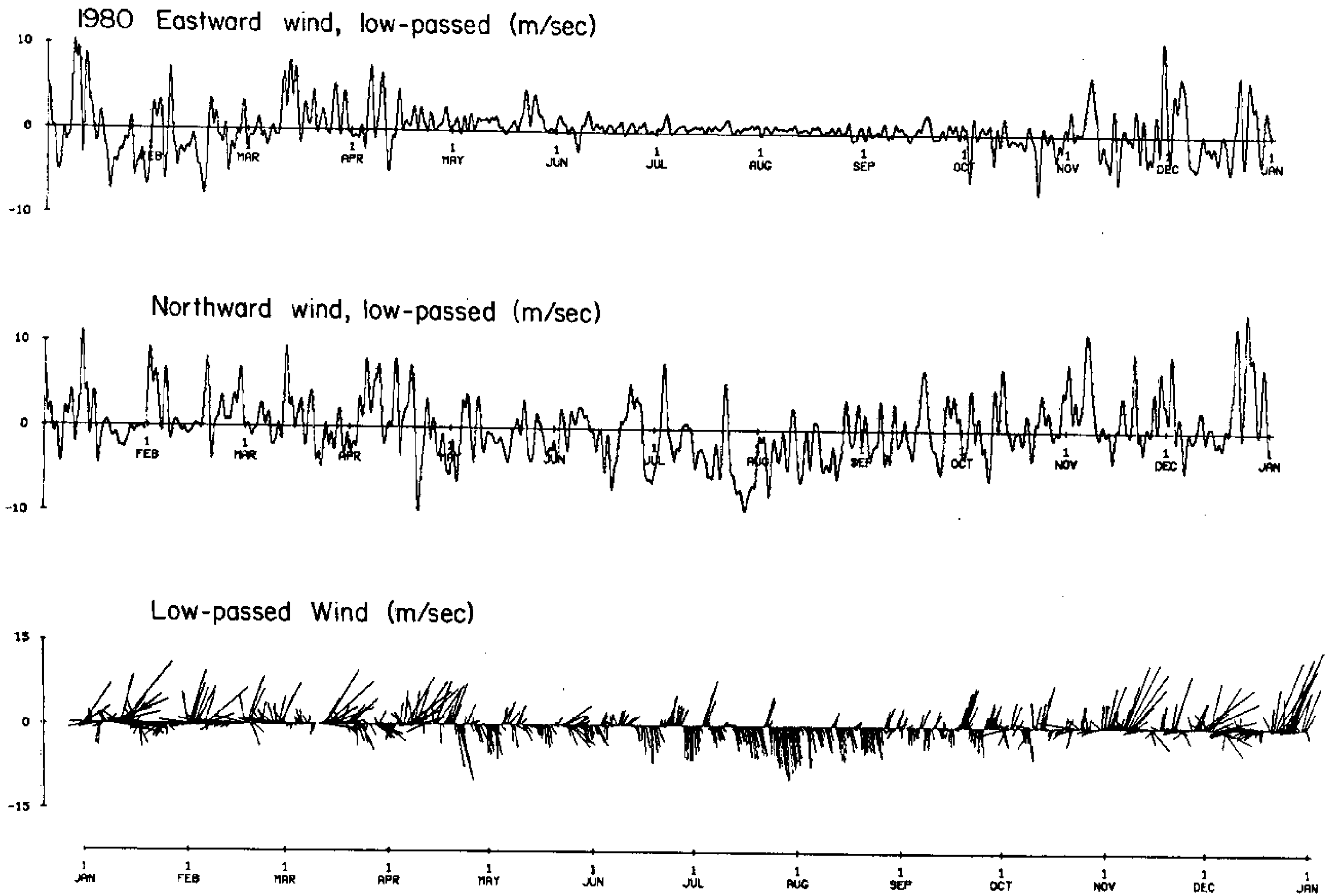


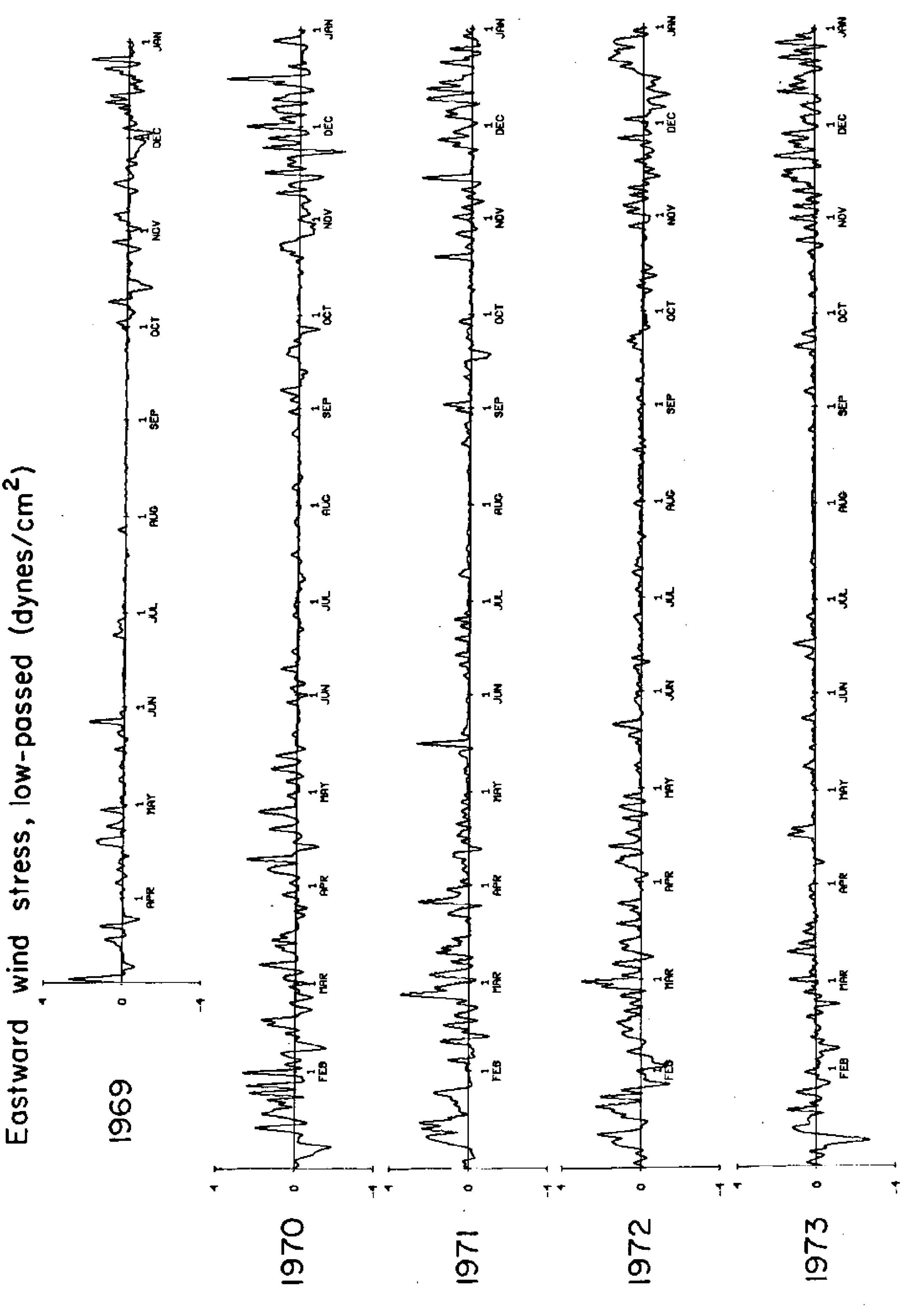

Low-passed Wind (m/sec)
1969
1970
1971
1972
1973
15
0
-15
1 JAN
1 FEB
1 MAR
1 APR
1 MAY
1 JUN
1 JUL
1 AUG
1 SEP
1 OCT
1 NOV
1 DEC
1 JAN

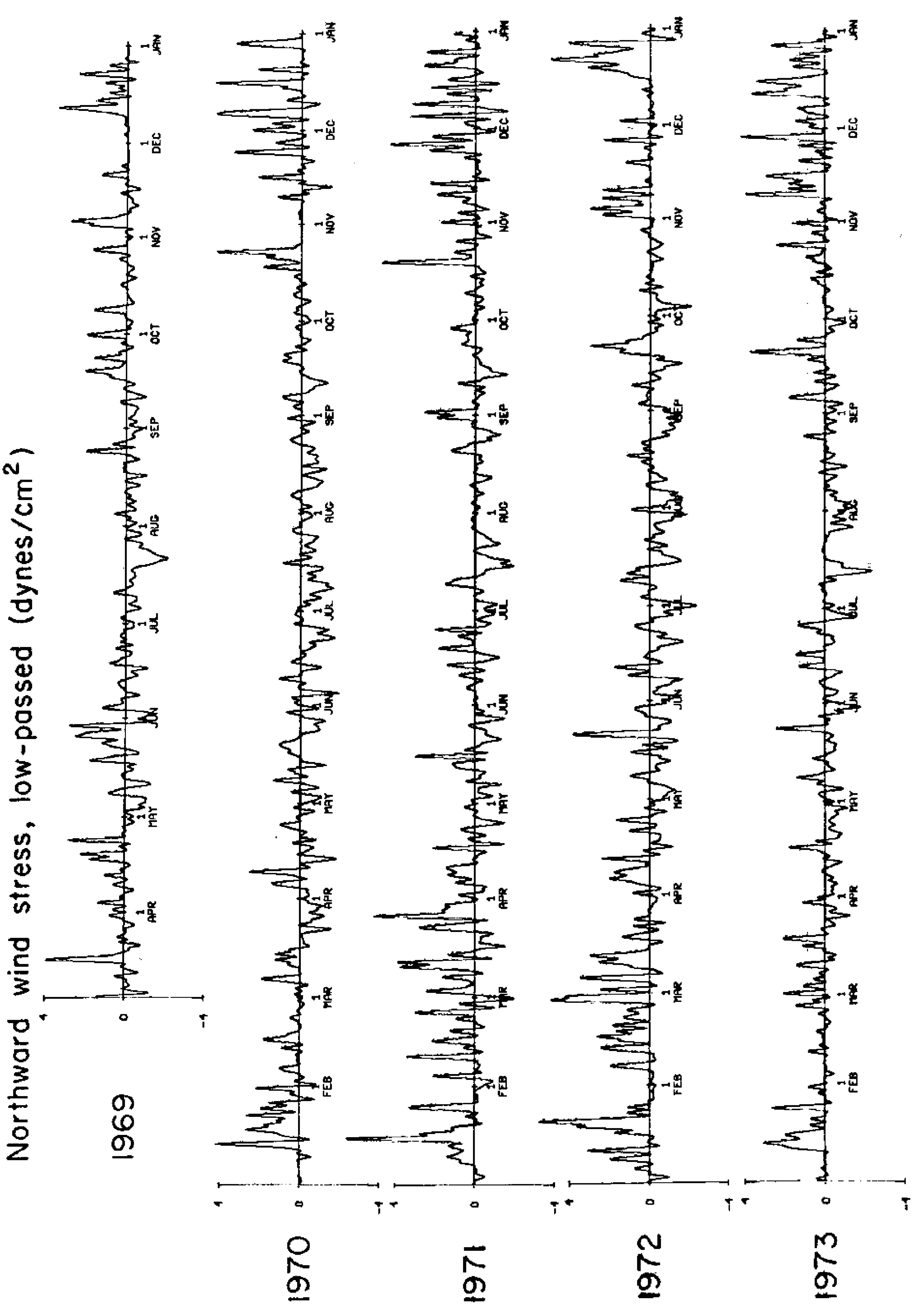
Low-passed Wind (m/sec)



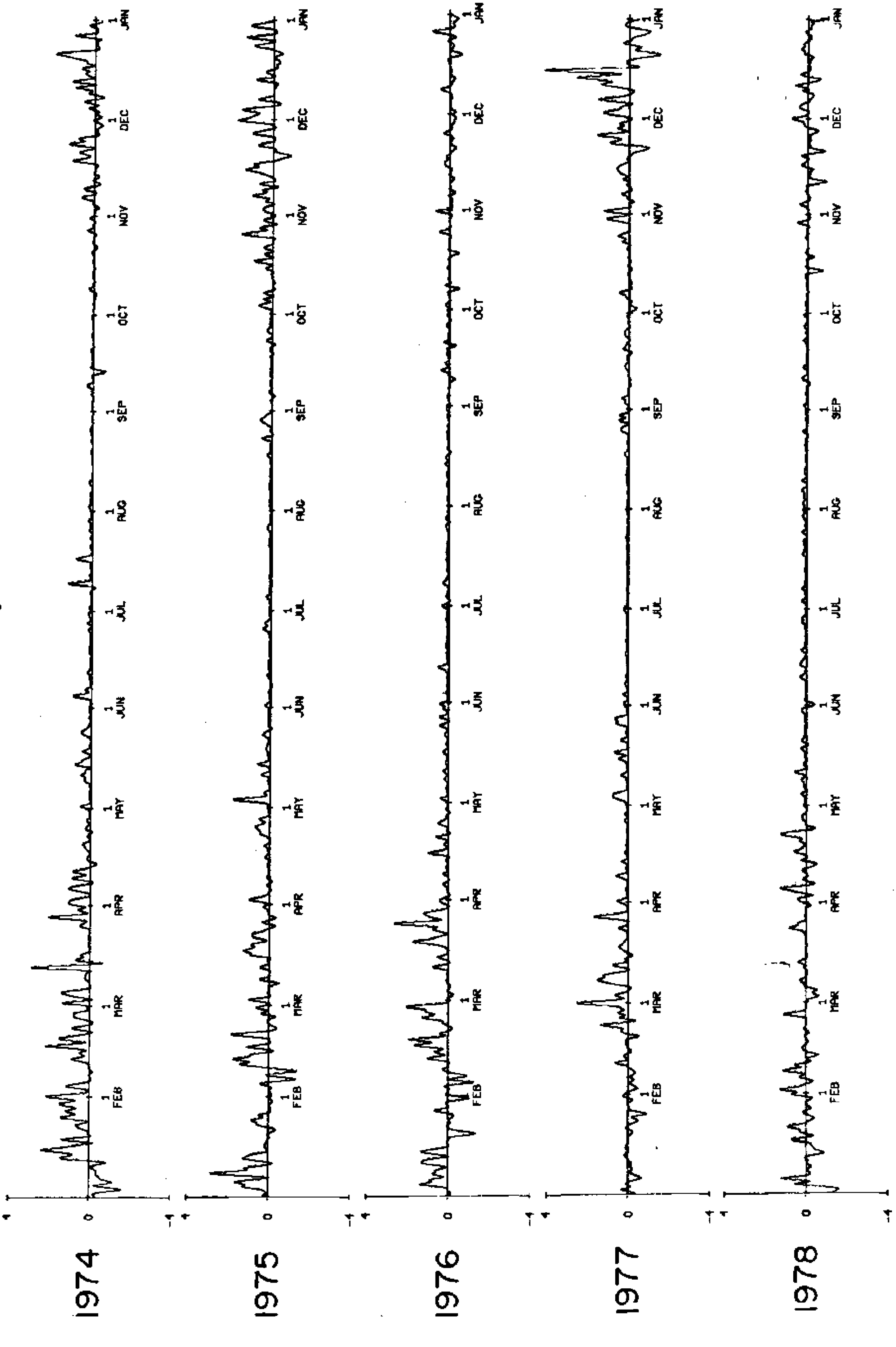

1979 Eastward wind, low-passed (m/sec)
Northward wind, low-passed (m/sec)
Low-passed Wind (m/sec)
10
0
-10
15
-15
1 JAN
1 FEB
1 MAR
1 APR
1 MAY
1 JUN
1 JUL
1 AUG
1 SEP
1 OCT
1 NOV
1 DEC
1 JAN

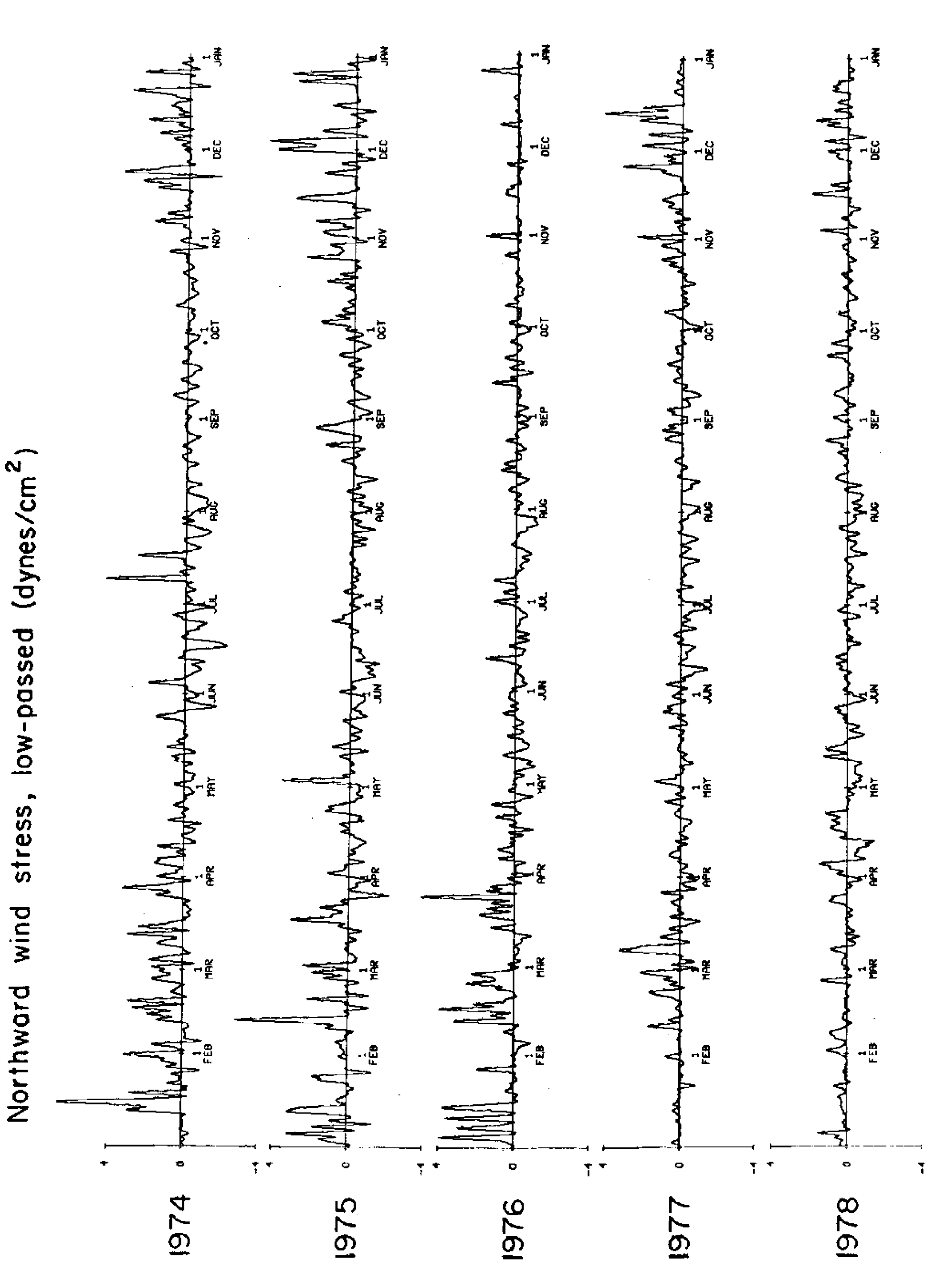

1980 Eastward wind, low-passed (m/sec)
Northward wind, low-passed (m/sec)
Low-passed Wind (m/sec)
10
0
-10
15
-15
1 JAN
1 FEB
1 MAR
1 APR
1 MAY
1 JUN
1 JUL
1 AUG
1 SEP
1 OCT
1 NOV
1 DEC
1 JAN


Eastward wind stress, low-passed (dynes/cm²)
1969
1970
1971
1972
1973
4
0
-4
1 FEB
1 MAR
1 APR
1 MAY
1 JUN
1 JUL
1 AUG
1 SEP
1 OCT
1 NOV
1 DEC
1 JAN

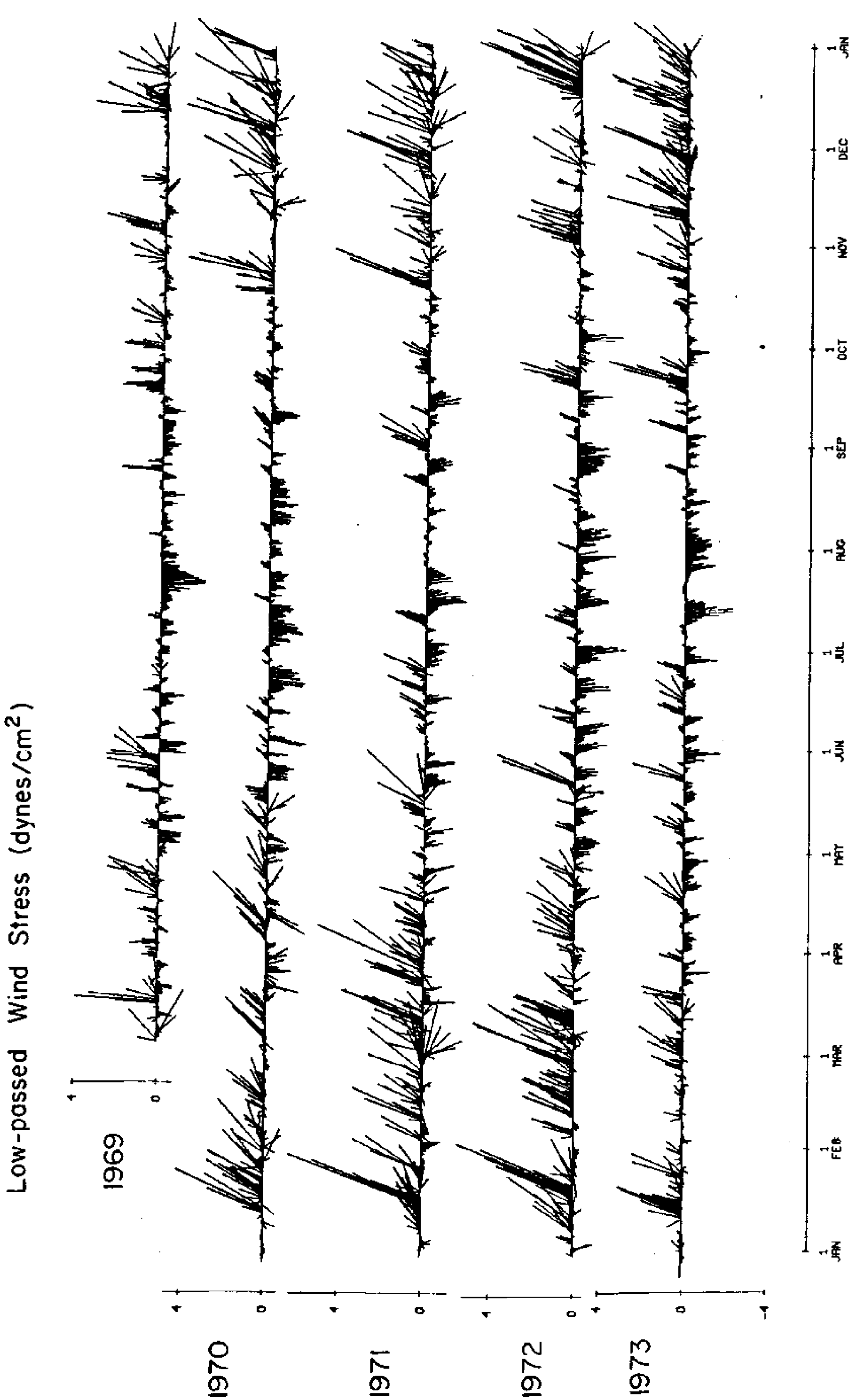

Northward wind stress, low-passed (dynes/cm²)
1969
1970
1971
1972
1973
4
0
-4
1 FEB
1 MAR
1 APR
1 MAY
1 JUN
1 JUL
1 AUG
1 SEP
1 OCT
1 NOV
1 DEC
1 JAN

Eastward wind stress, low-passed (dynes/cm^2)

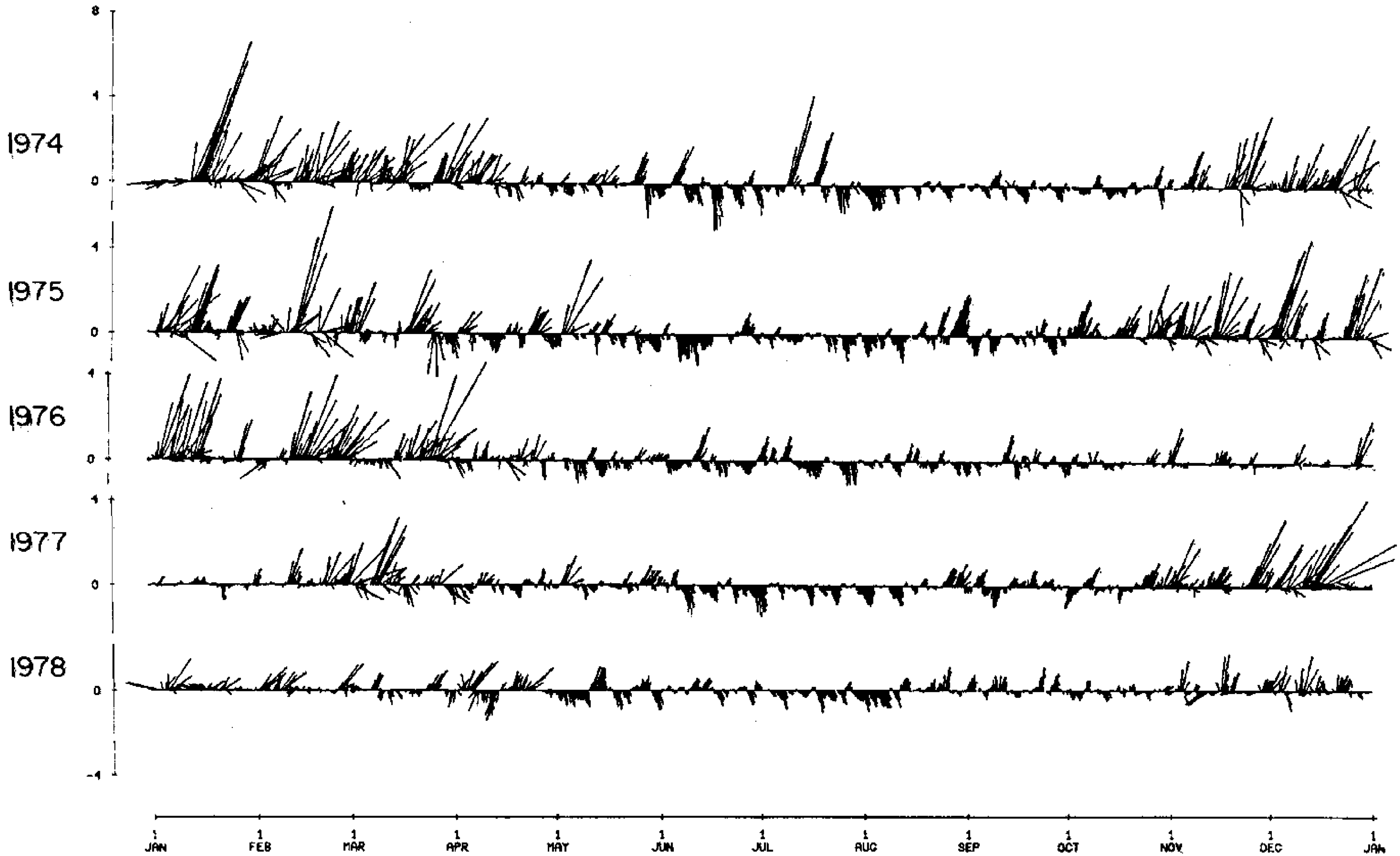


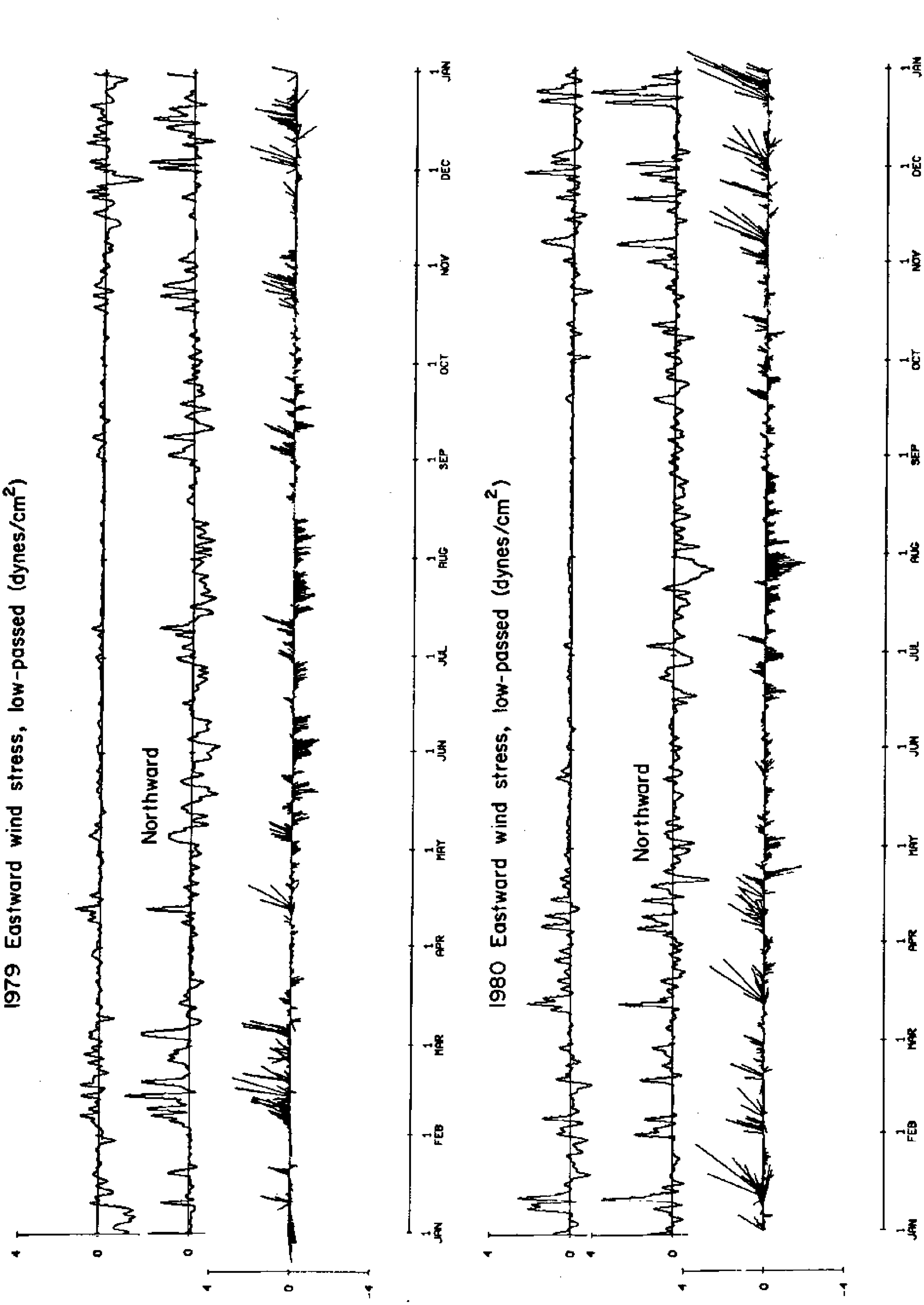


Northward wind stress, low-passed (dynes/cm²)
1974
1975
1976
1977
1978
4
0
-4
1 FEB
1 MAR
1 APR
1 MAY
1 JUN
1 JUL
1 AUG
1 SEP
1 OCT
1 NOV
1 DEC
1 JAN


Low-passed Wind Stress (dynes/cm²)
1969
1970
1971
1972
1973
4
0
-4
1 JAN
1 FEB
1 MAR
1 APR
1 MAY
1 JUN
1 JUL
1 AUG
1 SEP
1 OCT
1 NOV
1 DEC
1 JAN

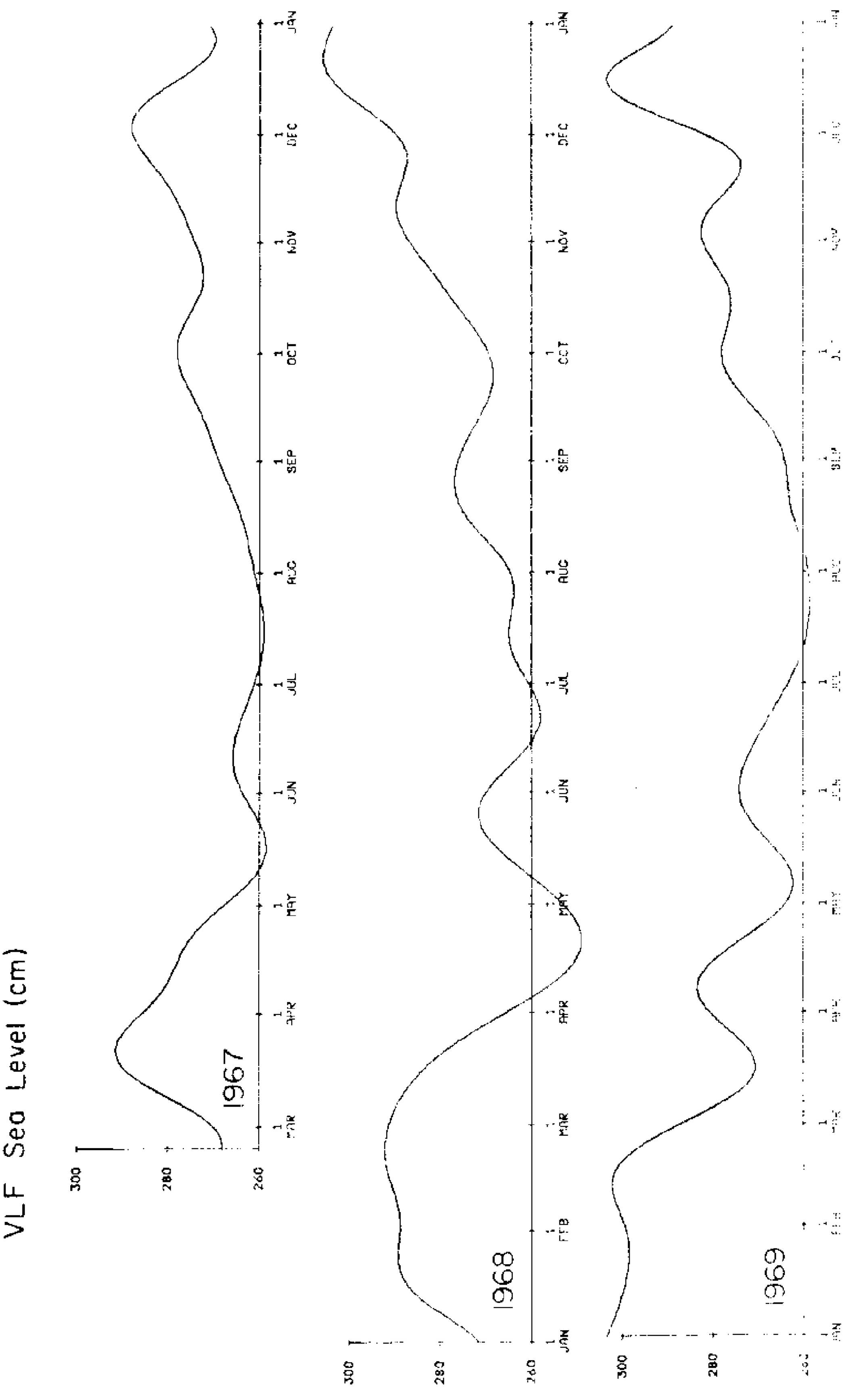
Low-passed Wind Stress (dynes/cm²)

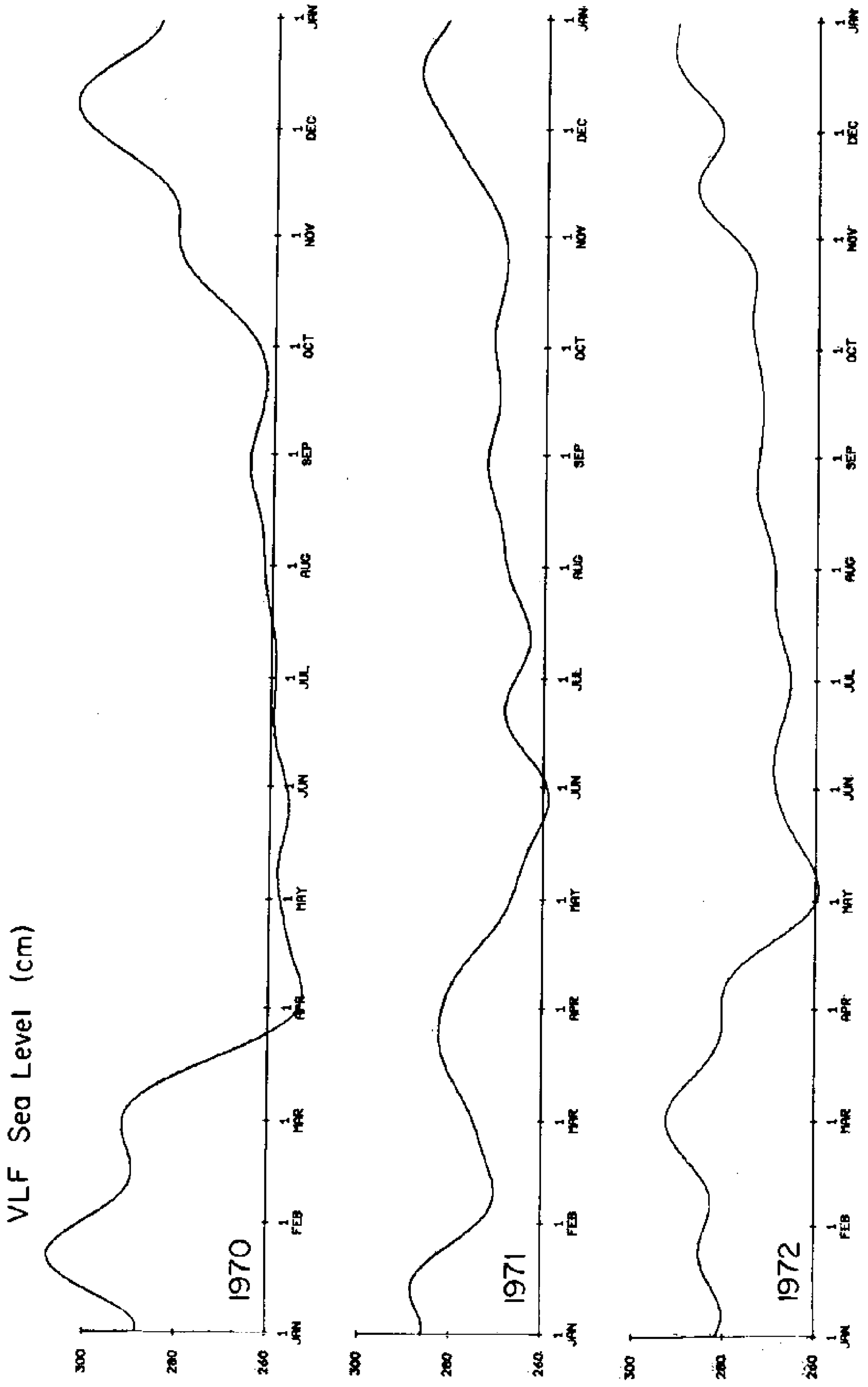


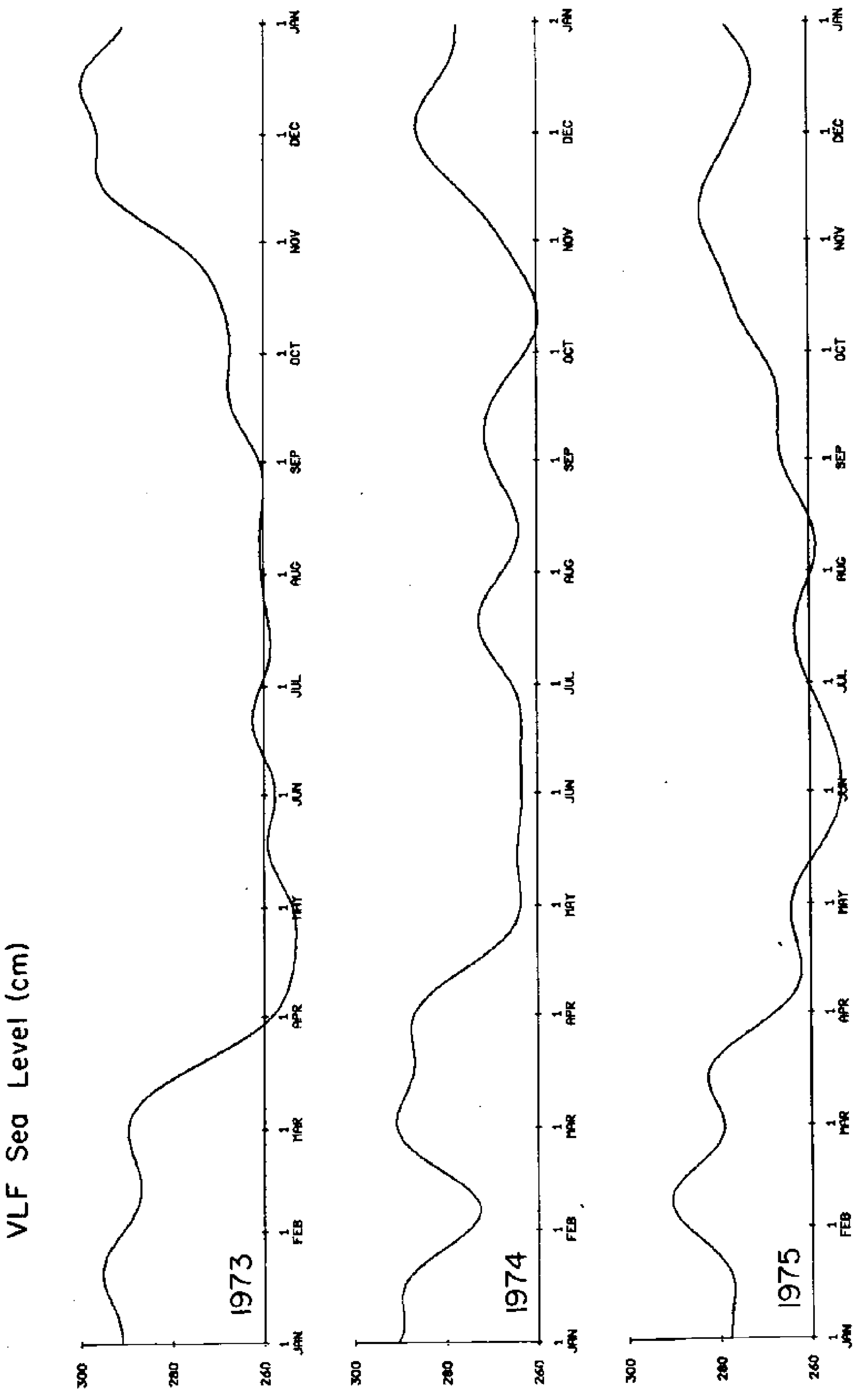

1979 Eastward wind stress, low-passed (dynes/cm²)
Northward
1980 Eastward wind stress, low-passed (dynes/cm²)
Northward
4
0
-4
1 JAN
1 FEB
1 MAR
1 APR
1 MAY
1 JUN
1 JUL
1 AUG
1 SEP
1 OCT
1 NOV
1 DEC

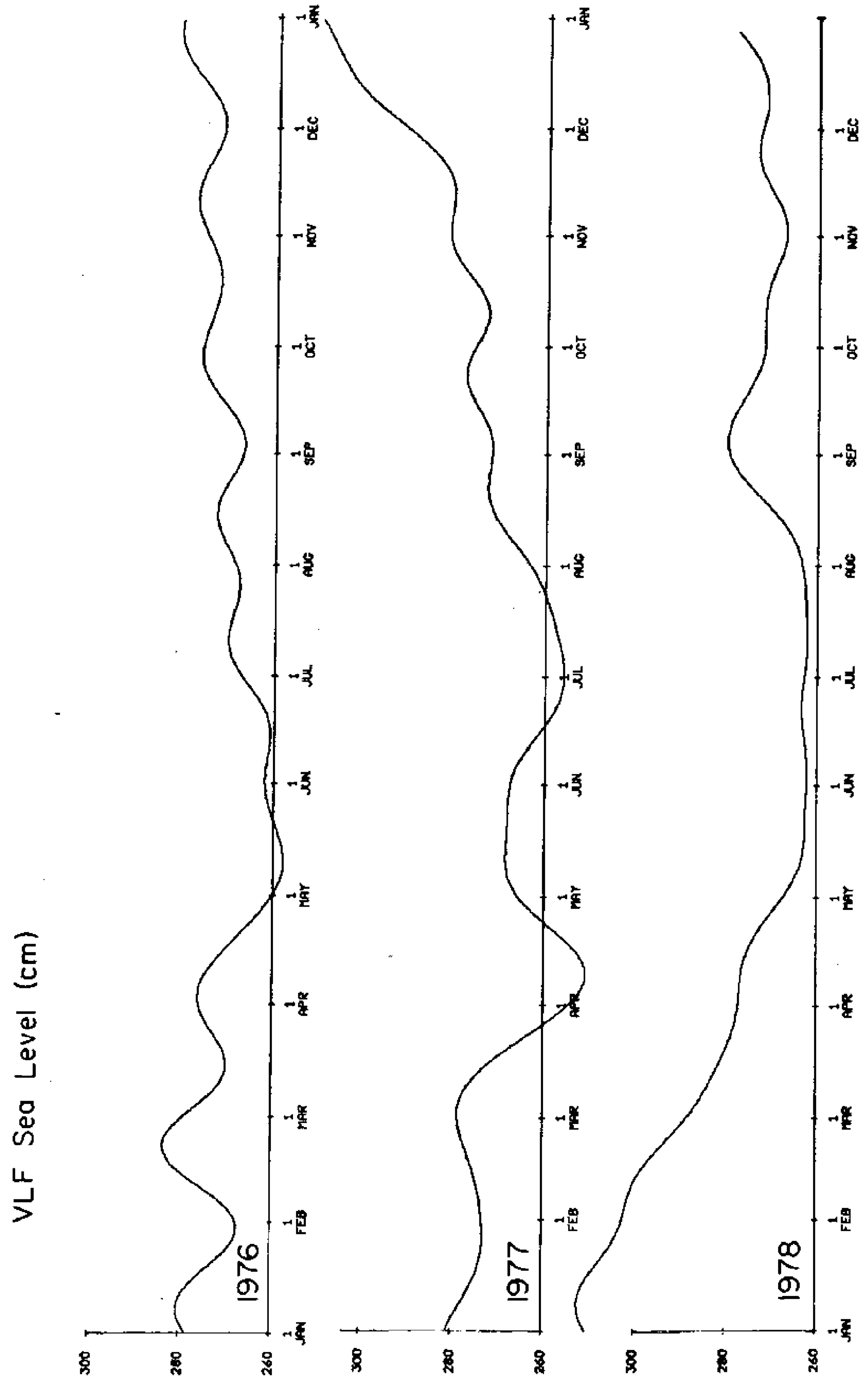
VERY-LOW-FREQUENCY TIME SERIES

Sea Level
Atmospheric Pressure
Adjusted Sea Level
Wind Vectors
Wind Stress Vectors

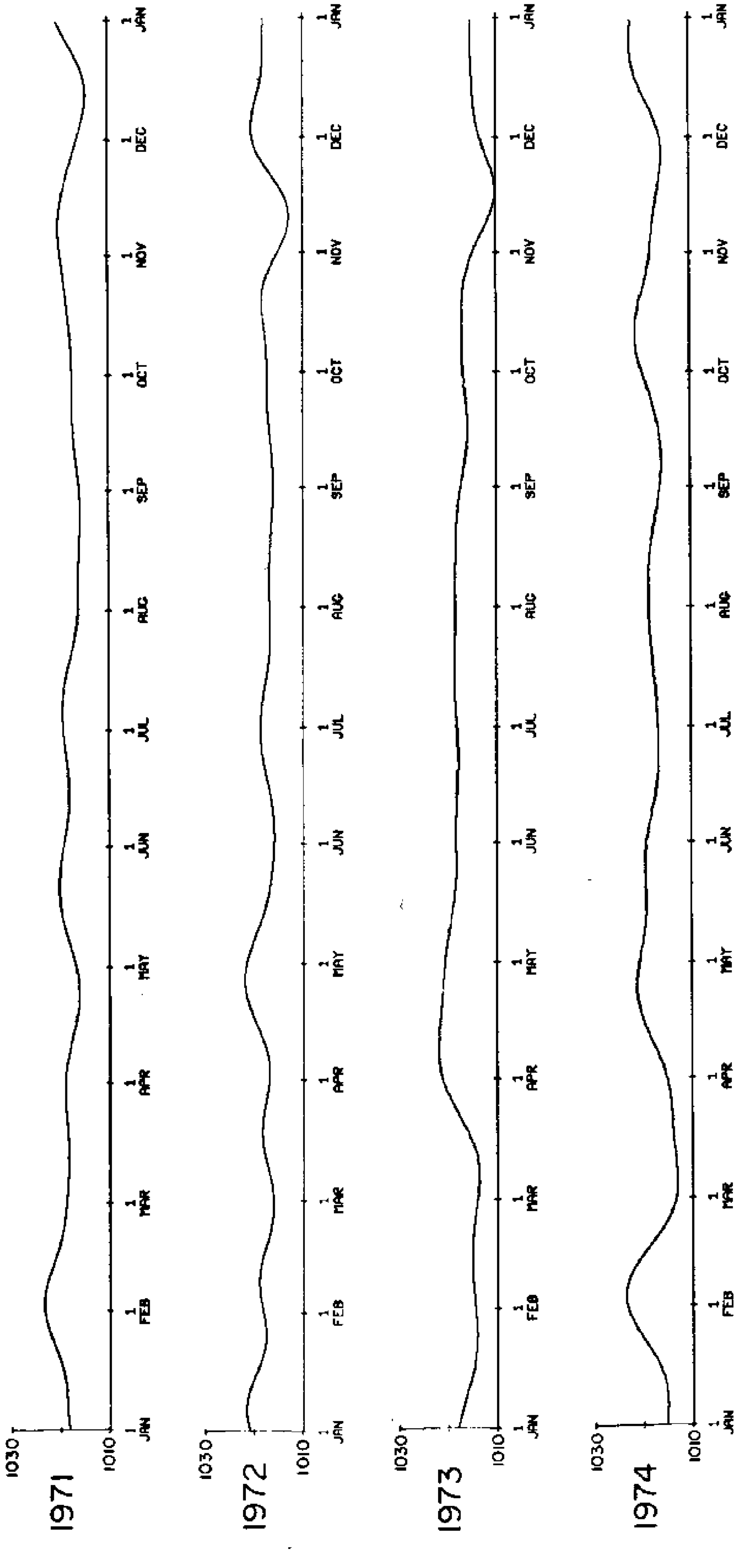

VLF Sea Level (cm)
1967
1968
1969
300
280
260
1 MAR
1 APR
1 MAY
1 JUN
1 JUL
1 AUG
1 SEP
1 OCT
1 NOV
1 DEC
1 JAN
1 FEB


VLF Sea Level (cm)
1970
1971
1972
300
280
260
1 JAN
1 FEB
1 MAR
1 APR
1 MAY
1 JUN
1 JUL
1 AUG
1 SEP
1 OCT
1 NOV
1 DEC
1 JAN

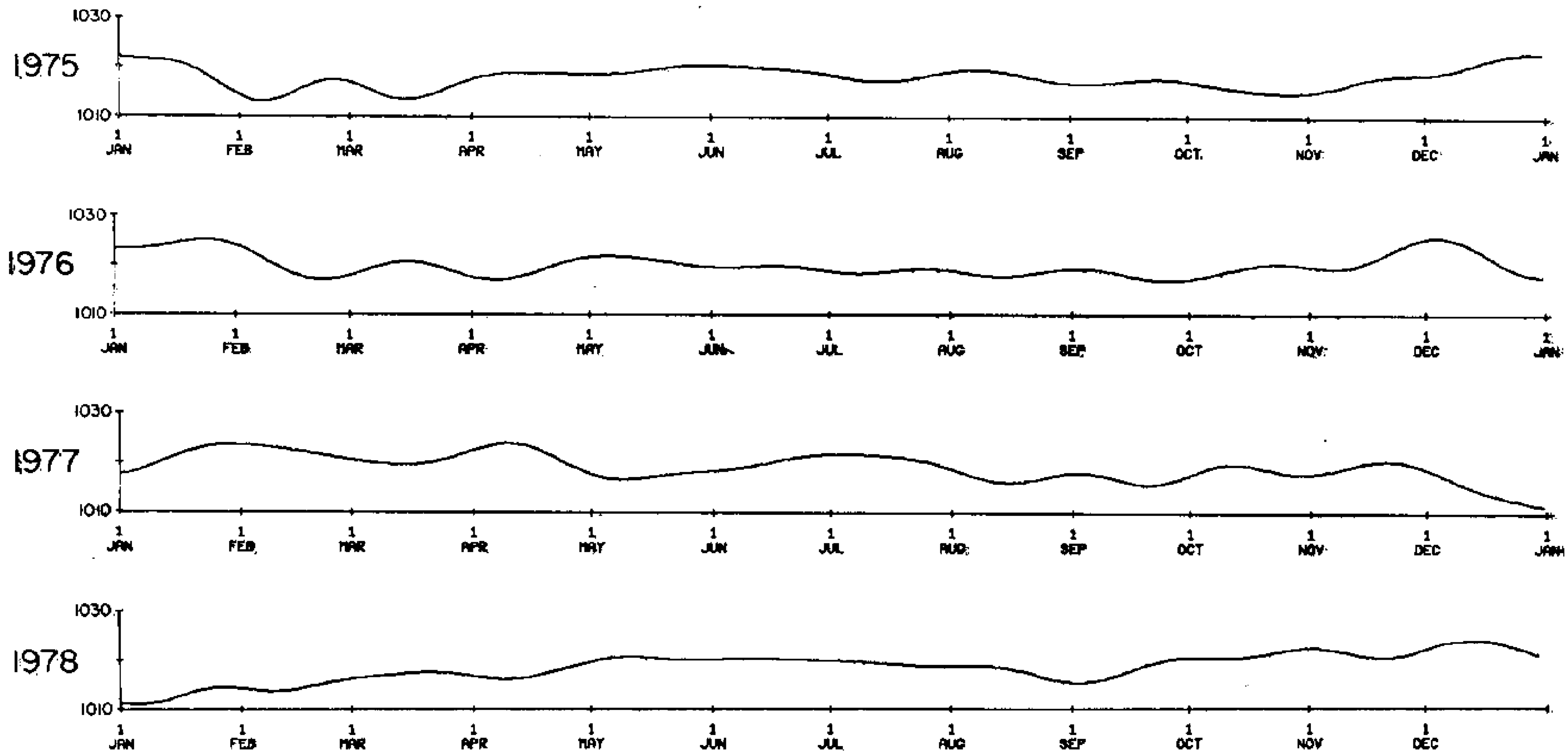

VLF Sea Level (cm)
1973
1974
1975
300
280
260
1 JAN
1 FEB
1 MAR
1 APR
1 MAY
1 JUN
1 JUL
1 AUG
1 SEP
1 OCT
1 NOV
1 DEC
1 JAN

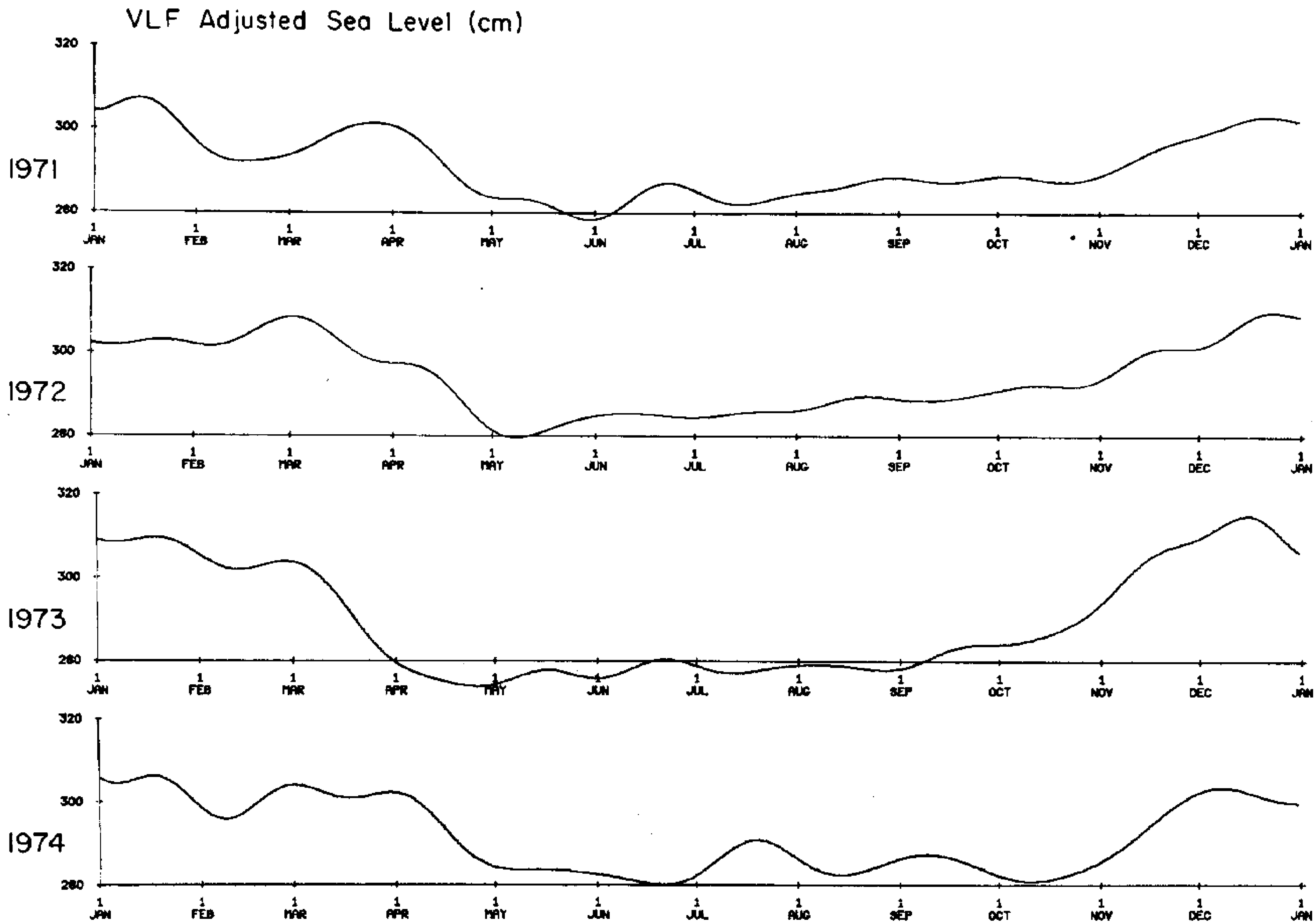

VLF Sea Level (cm)
1976
1977
1978
300
280
260
1 JAN
1 FEB
1 MAR
1 APR
1 MAY
1 JUN
1 JUL
1 AUG
1 SEP
1 OCT
1 NOV
1 DEC

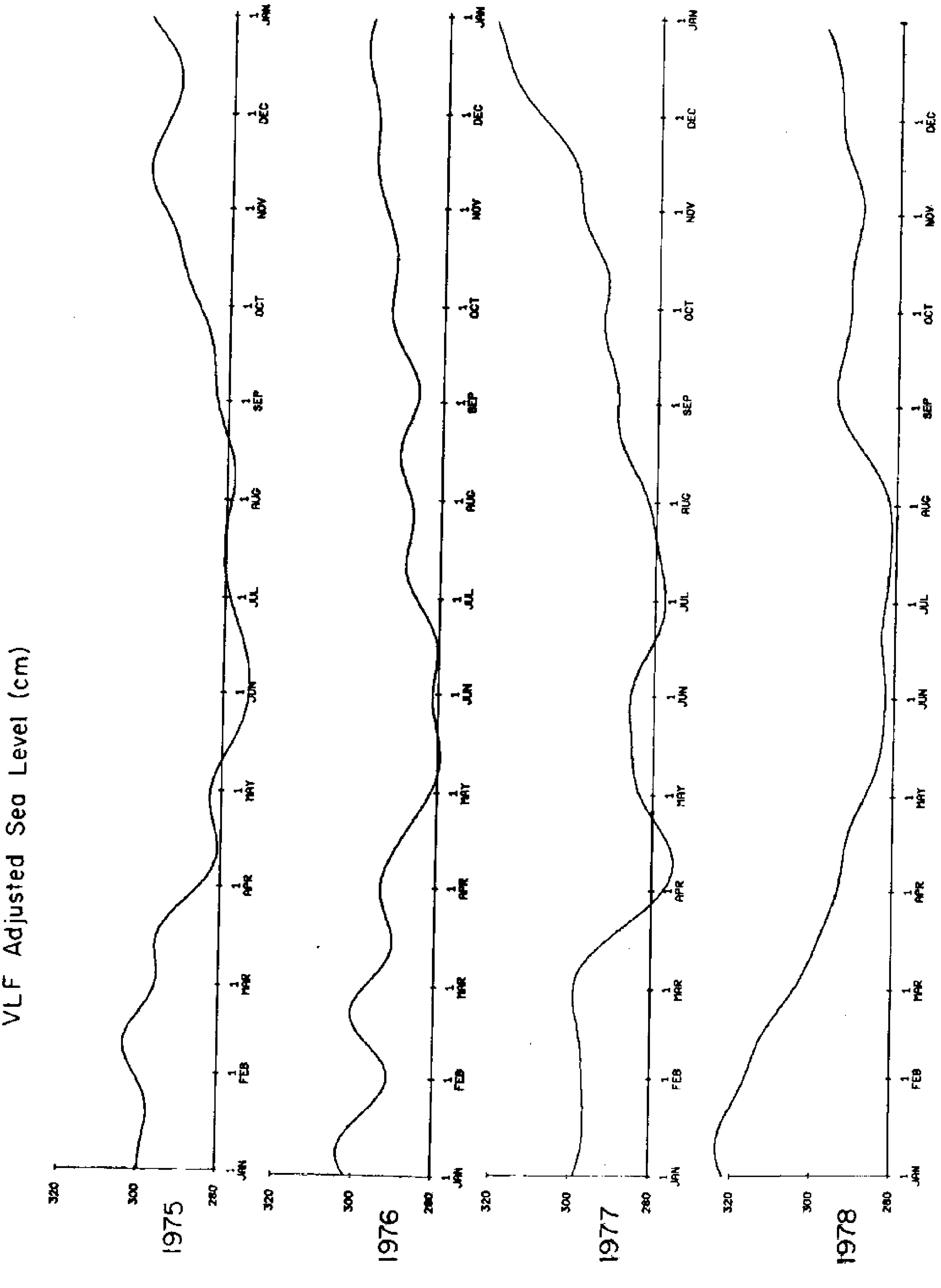
VLF Atmospheric Pressure (mb)

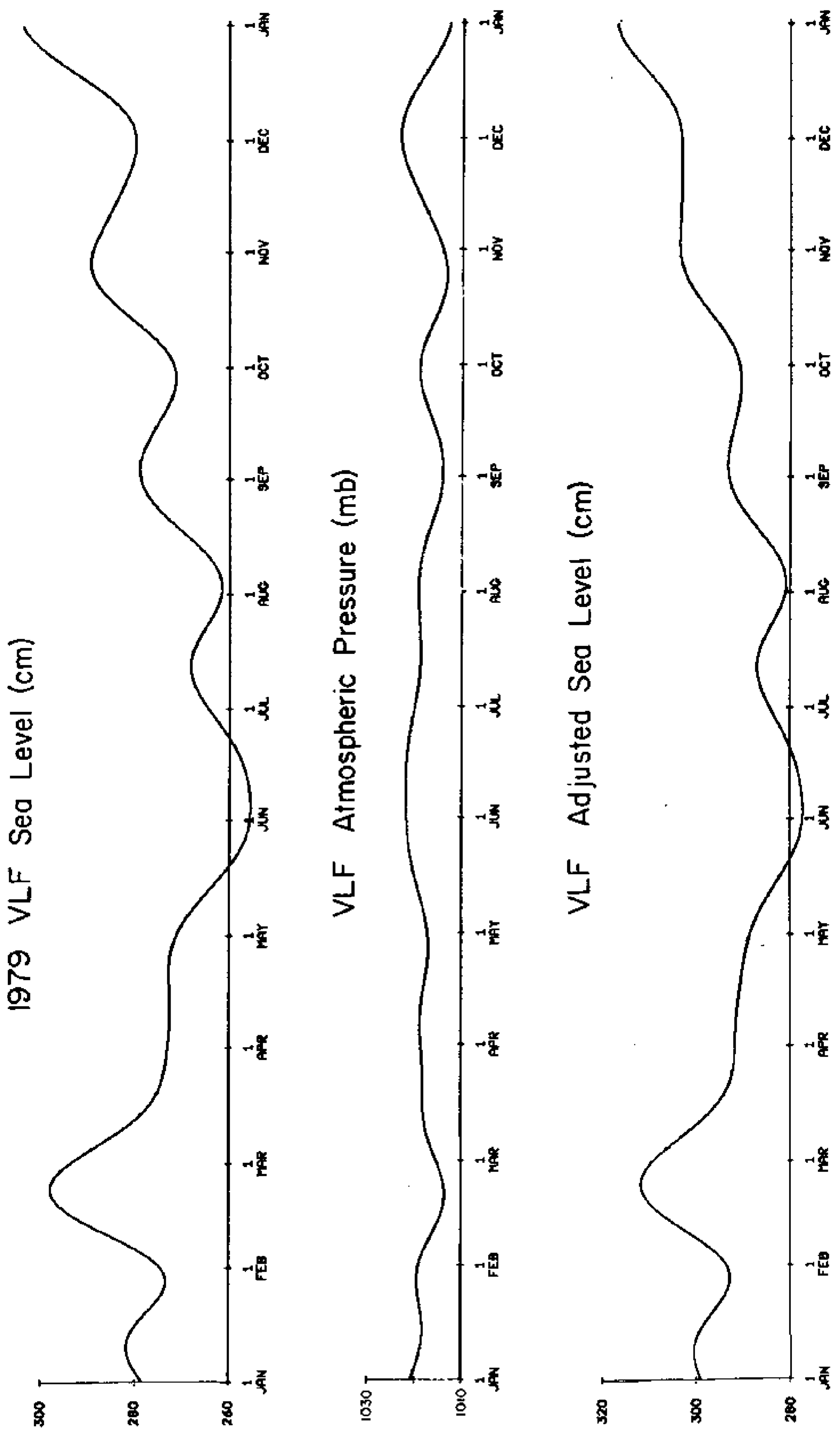


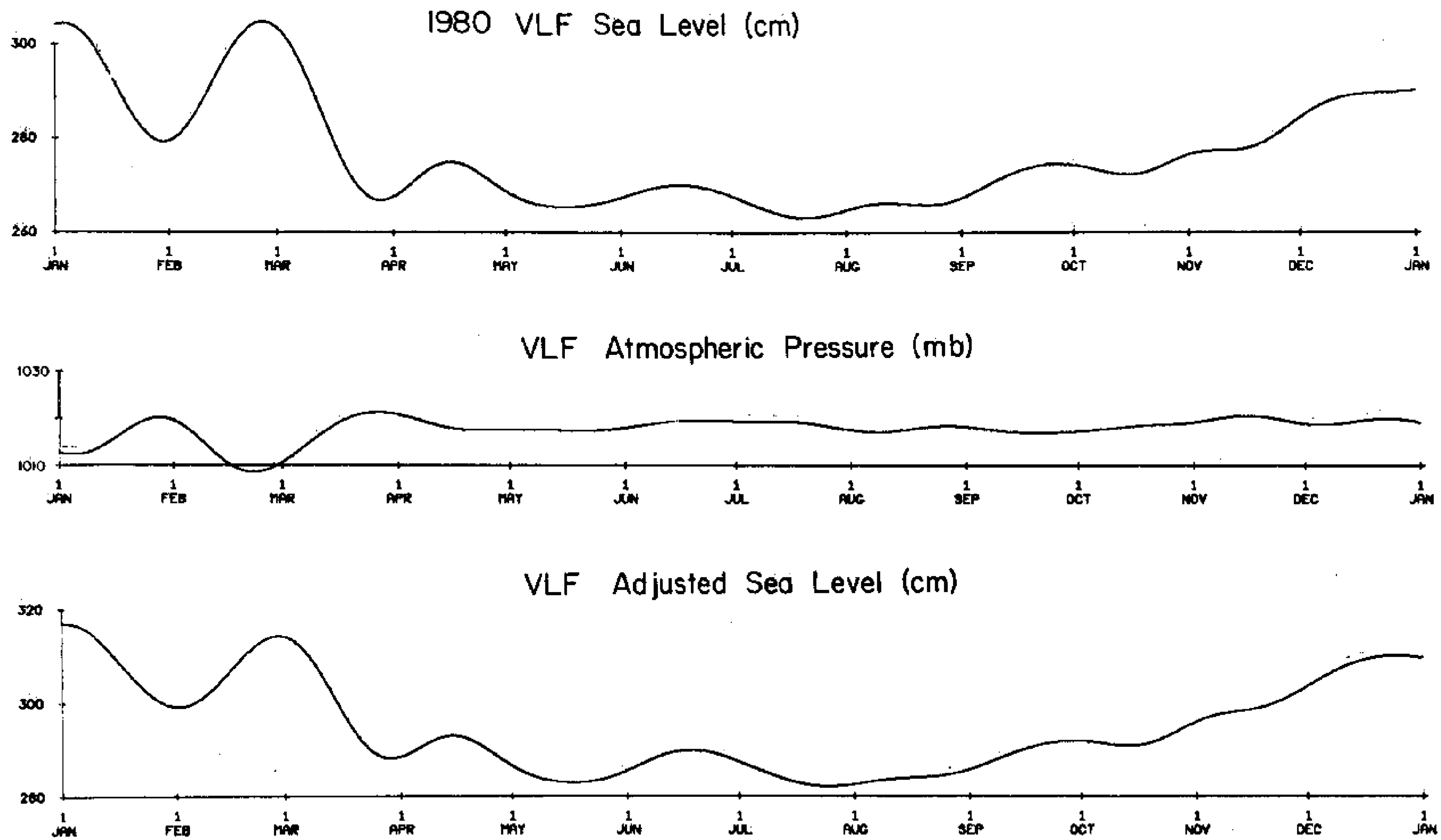
VLF Atmospheric Pressure (mb)

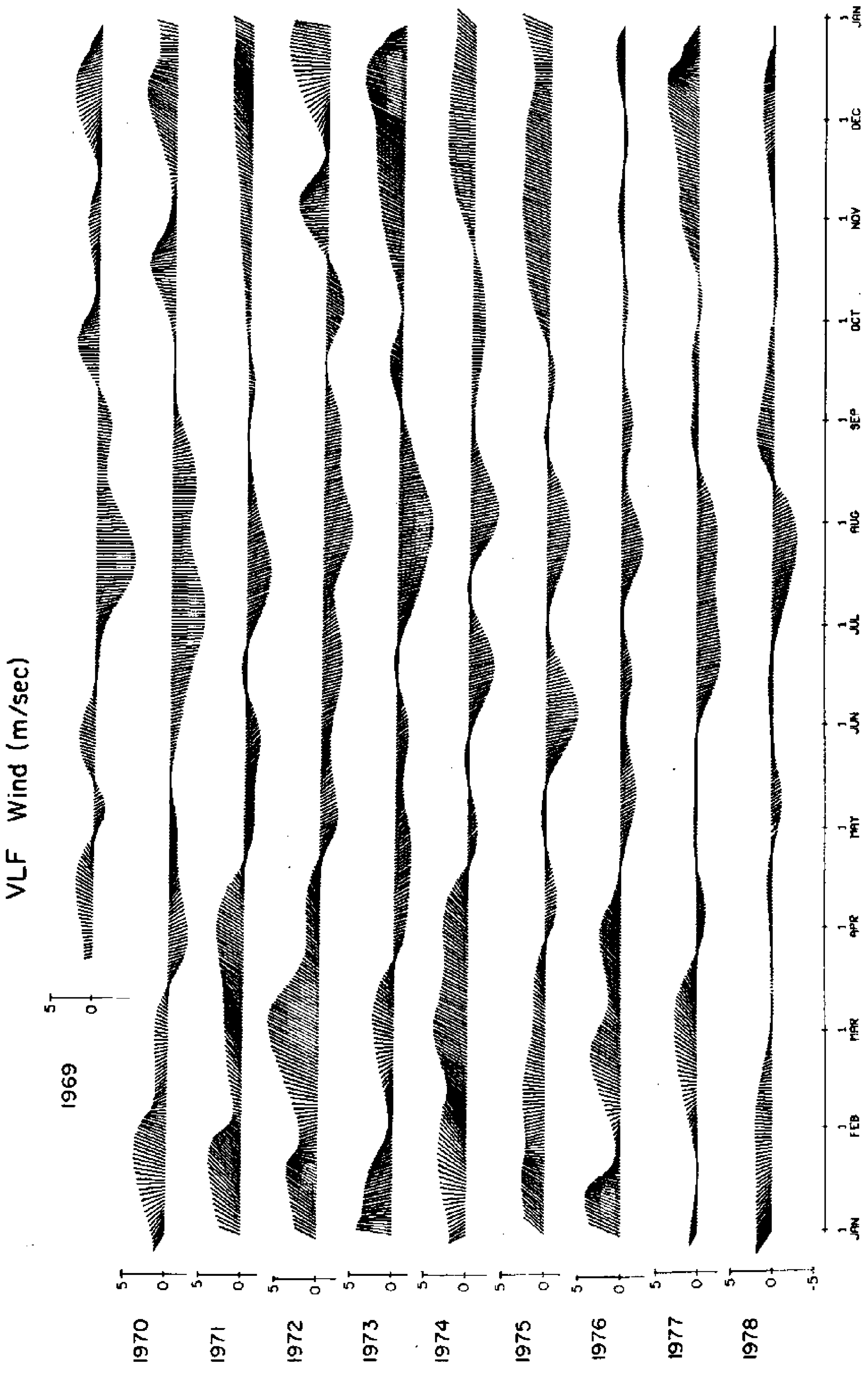



VLF Adjusted Sea Level (cm)
1971
1972
1973
1974
320
300
280
1 JAN
1 FEB
1 MAR
1 APR
1 MAY
1 JUN
1 JUL
1 AUG
1 SEP
1 OCT
1 NOV
1 DEC
1 JAN

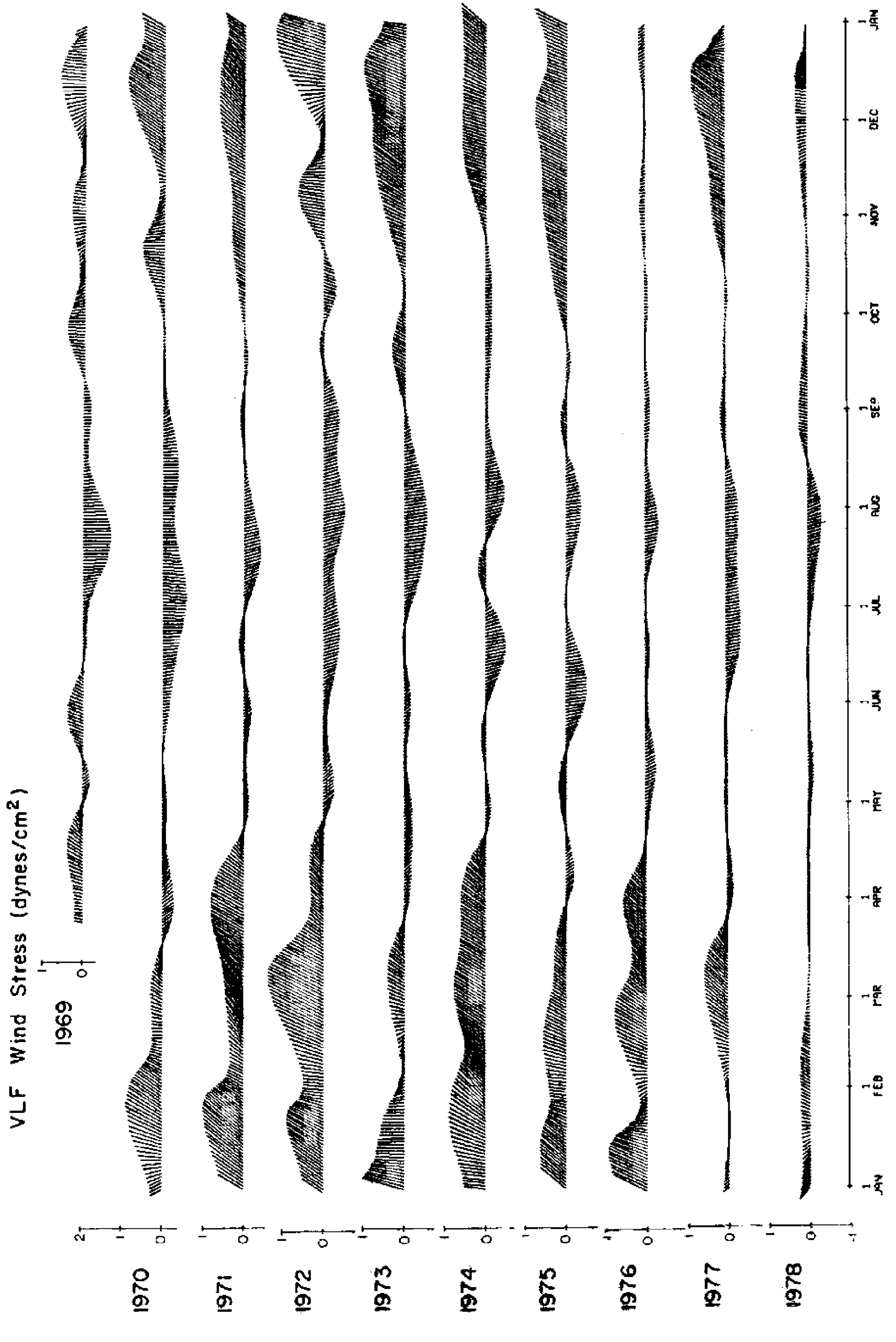

VLF Adjusted Sea Level (cm)
1975
1976
1977
1978
320
300
280
1 JAN
1 FEB
1 MAR
1 APR
1 MAY
1 JUN
1 JUL
1 AUG
1 SEP
1 OCT
1 NOV
1 DEC

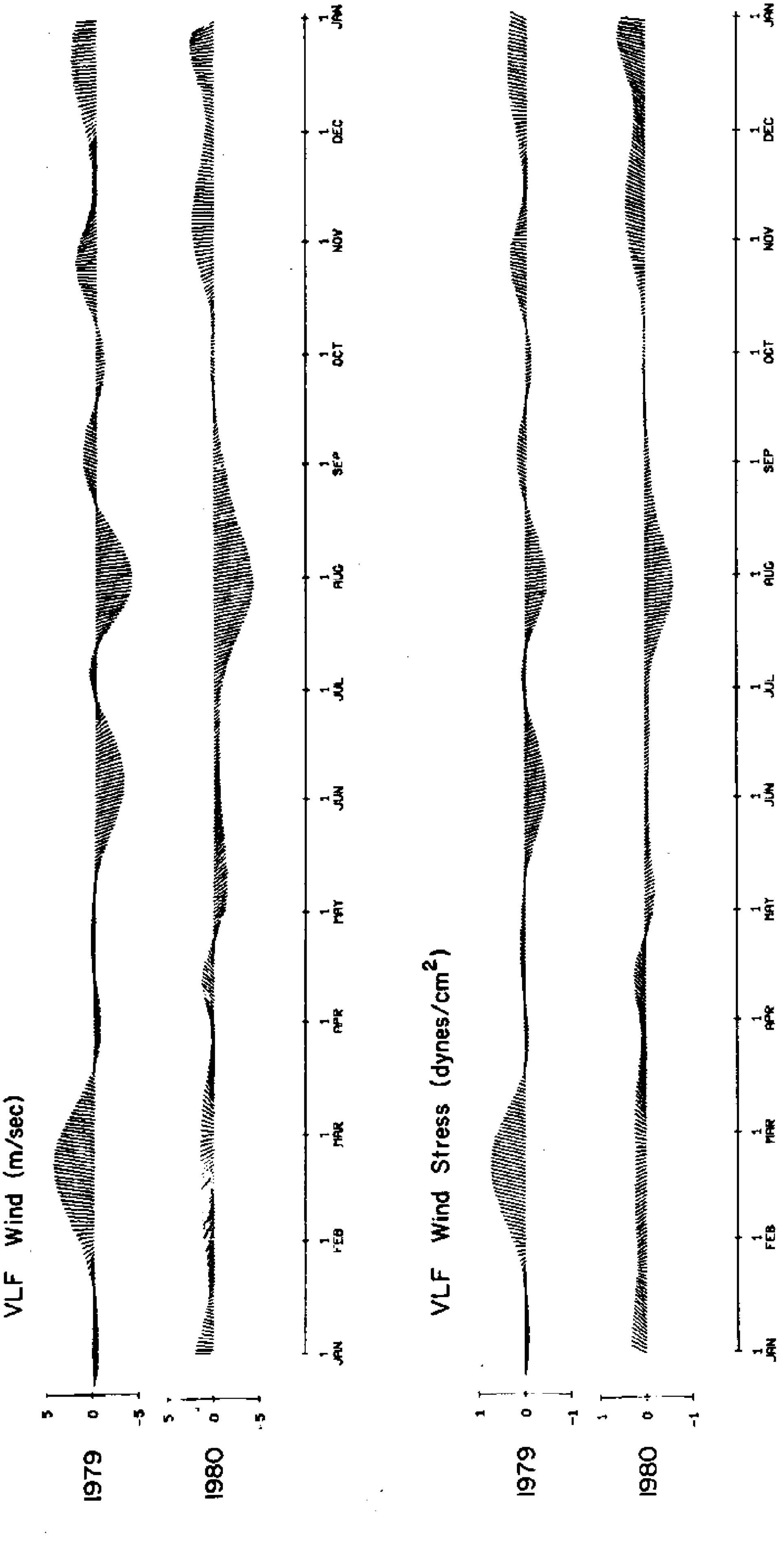

1979 VLF Sea Level (cm)
300
280
260
VLF Atmospheric Pressure (mb)
1030
1010
VLF Adjusted Sea Level (cm)
320
300
280
1 JAN
1 FEB
1 MAR
1 APR
1 MAY
1 JUN
1 JUL
1 AUG
1 SEP
1 OCT
1 NOV
1 DEC
1 JAN


1980 VLF Sea Level (cm)
300
280
260
1 JAN
1 FEB
1 MAR
1 APR
1 MAY
1 JUN
1 JUL
1 AUG
1 SEP
1 OCT
1 NOV
1 DEC
1 JAN
VLF Atmospheric Pressure (mb)
1030
1010
VLF Adjusted Sea Level (cm)
320
300
280



VLF Wind (m/sec)
1969
1970
1971
1972
1973
1974
1975
1976
1977
1978
5
0
-5
1 JAN
1 FEB
1 MAR
1 APR
1 MAY
1 JUN
1 JUL
1 AUG
1 SEP
1 OCT
1 NOV
1 DEC
1 JAN


VLF Wind Stress (dynes/cm^2)
1969
1970
1971
1972
1973
1974
1975
1976
1977
1978
JAN
FEB
MAR
APR
MAY
JUN
JUL
AUG
SEP
OCT
NOV
DEC
JAN

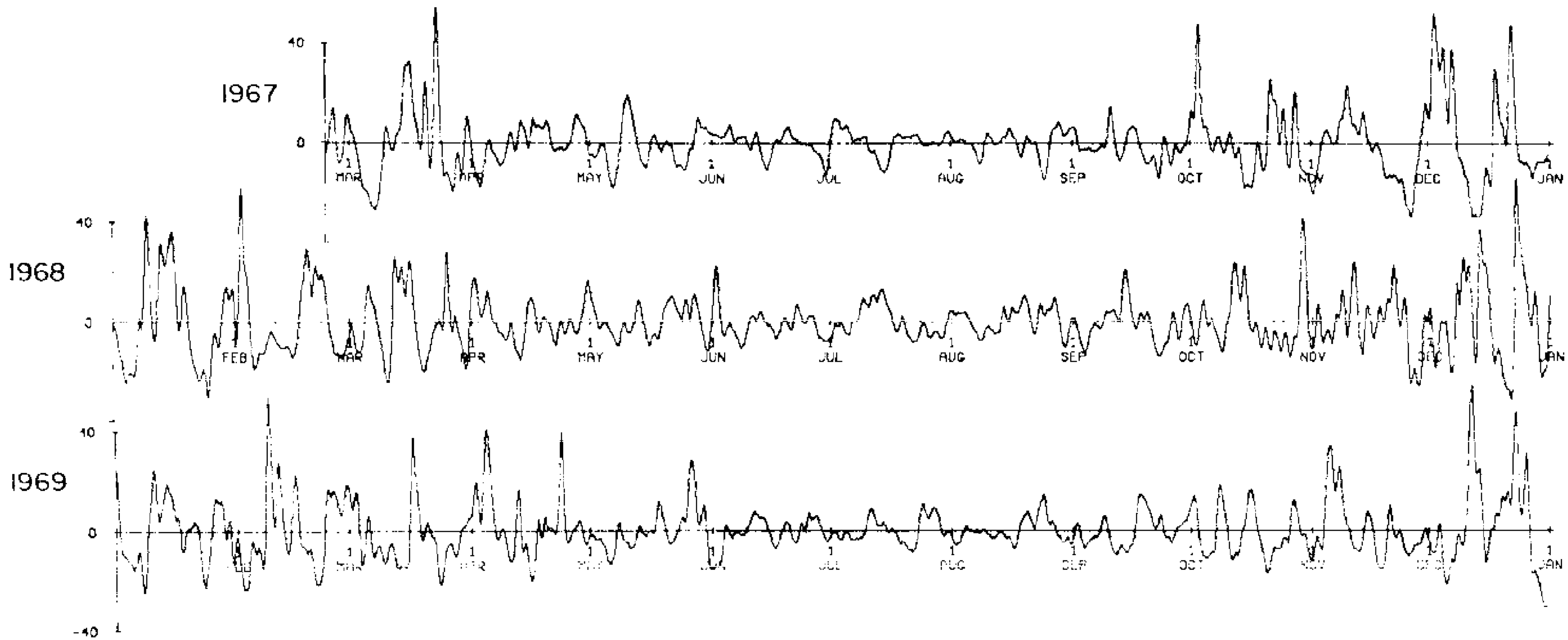


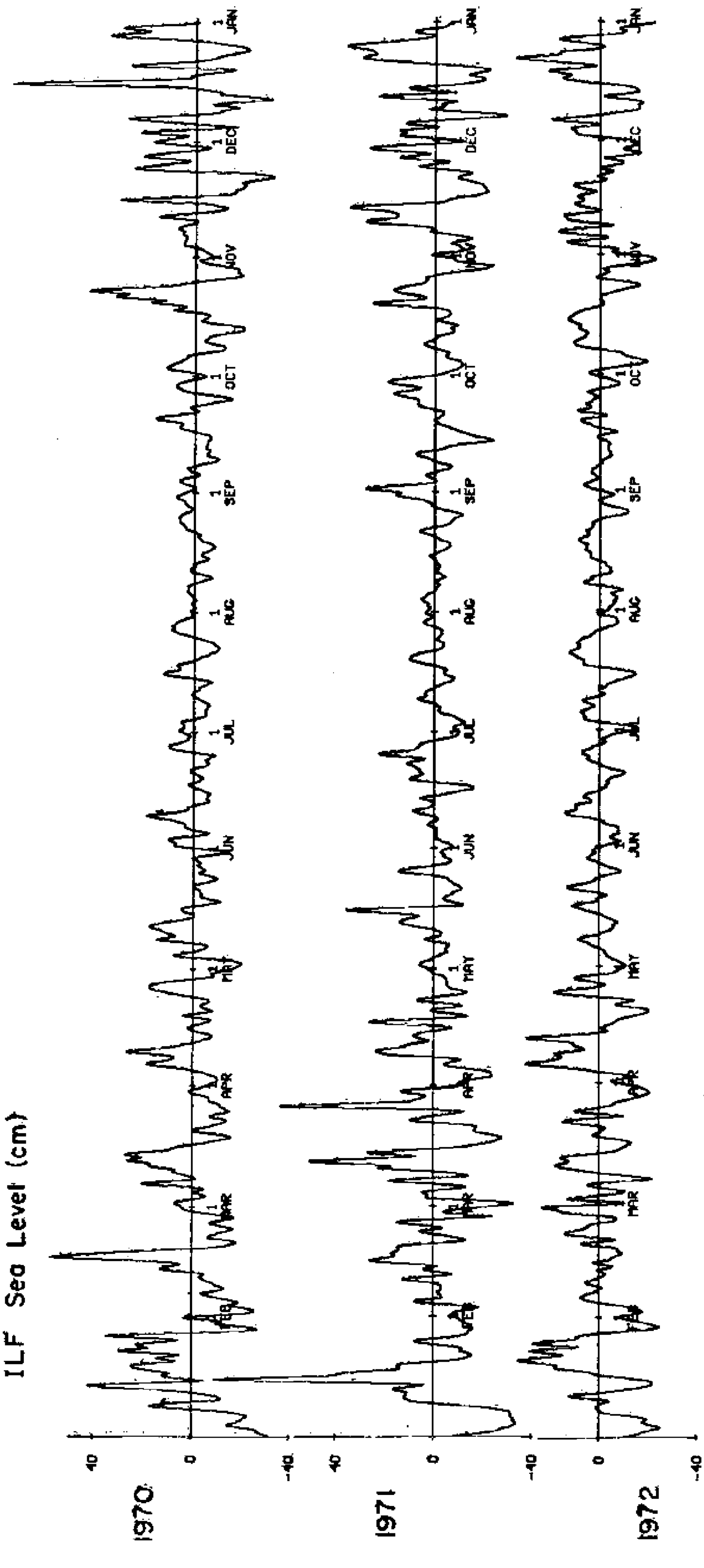
VLF Wind (m/sec)
1979
1980
5
0
-5
VLF Wind Stress (dynes/cm2)
1979
1980
1
0
-1
1 JAN
1 FEB
1 MAR
1 APR
1 MAY
1 JUN
1 JUL
1 AUG
1 SEP
1 OCT
1 NOV
1 DEC
1 JAN

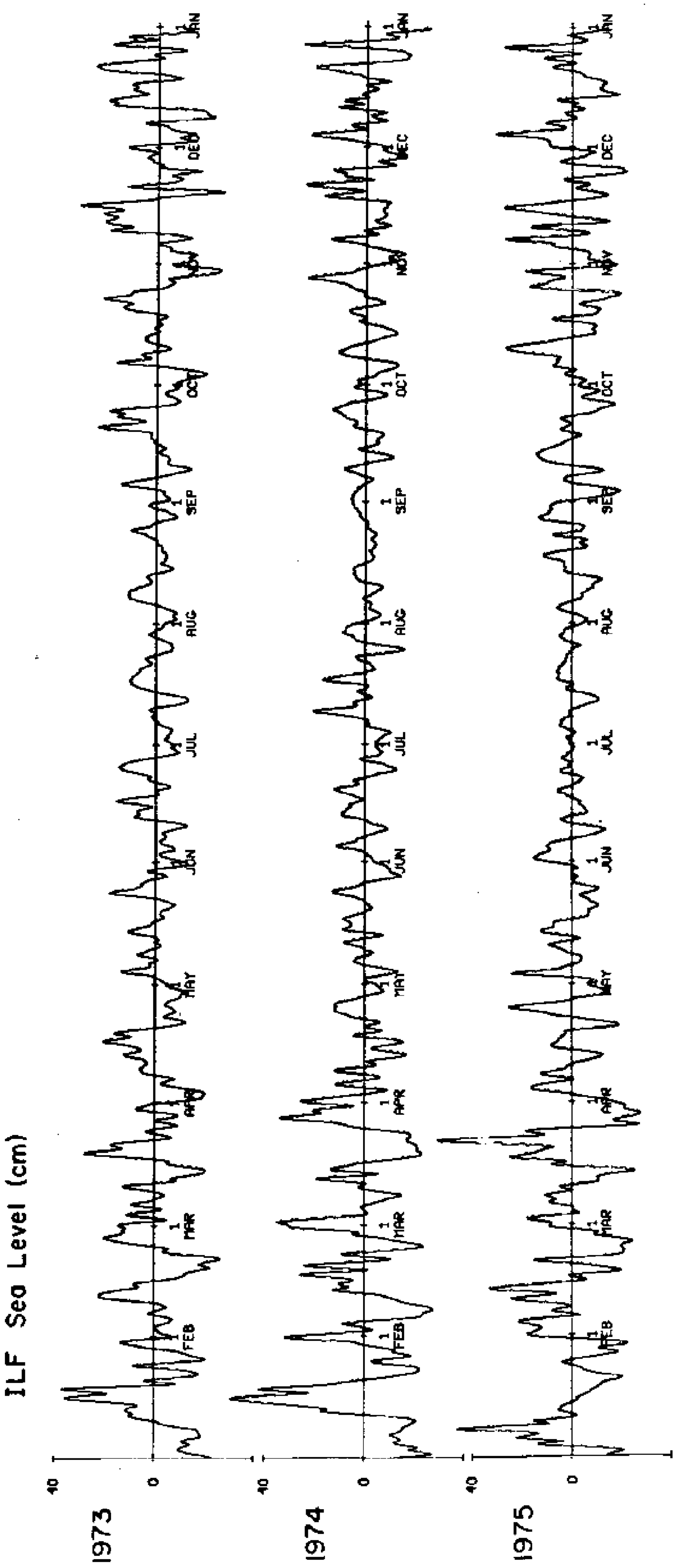
INTERMEDIATE-LOW-FREQUENCY TIME SERIES

Sea Level
Atmospheric Pressure
Adjusted Sea Level
Eastward and Northward Wind
Eastward and Northward Wind Stress

ILF Sea Level (cm)

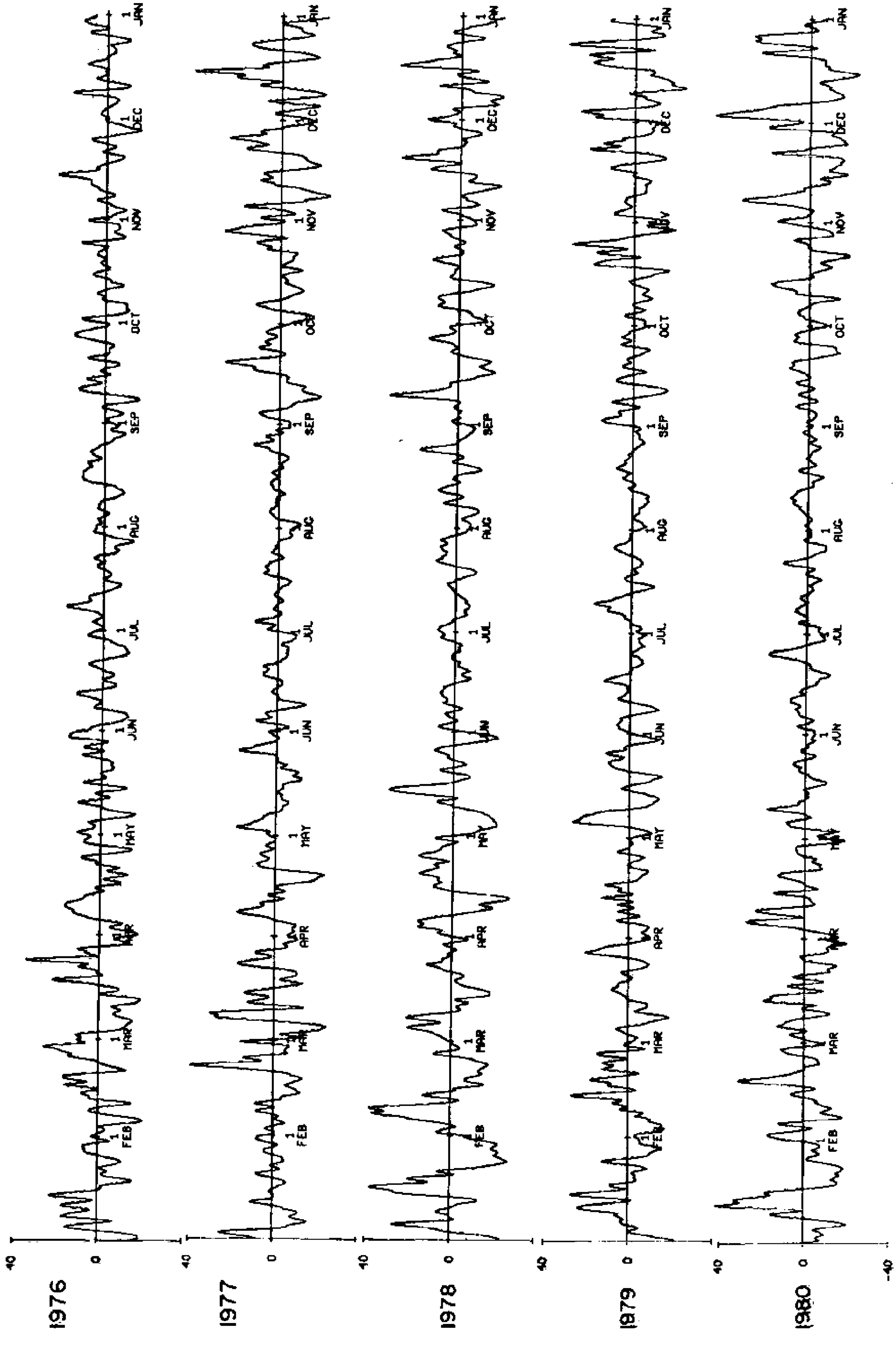



ILF Sea Level (cm)
1970
1971
1972
40
0
-40
1 JAN
1 FEB
1 MAR
1 APR
1 MAY
1 JUN
1 JUL
1 AUG
1 SEP
1 OCT
1 NOV
1 DEC

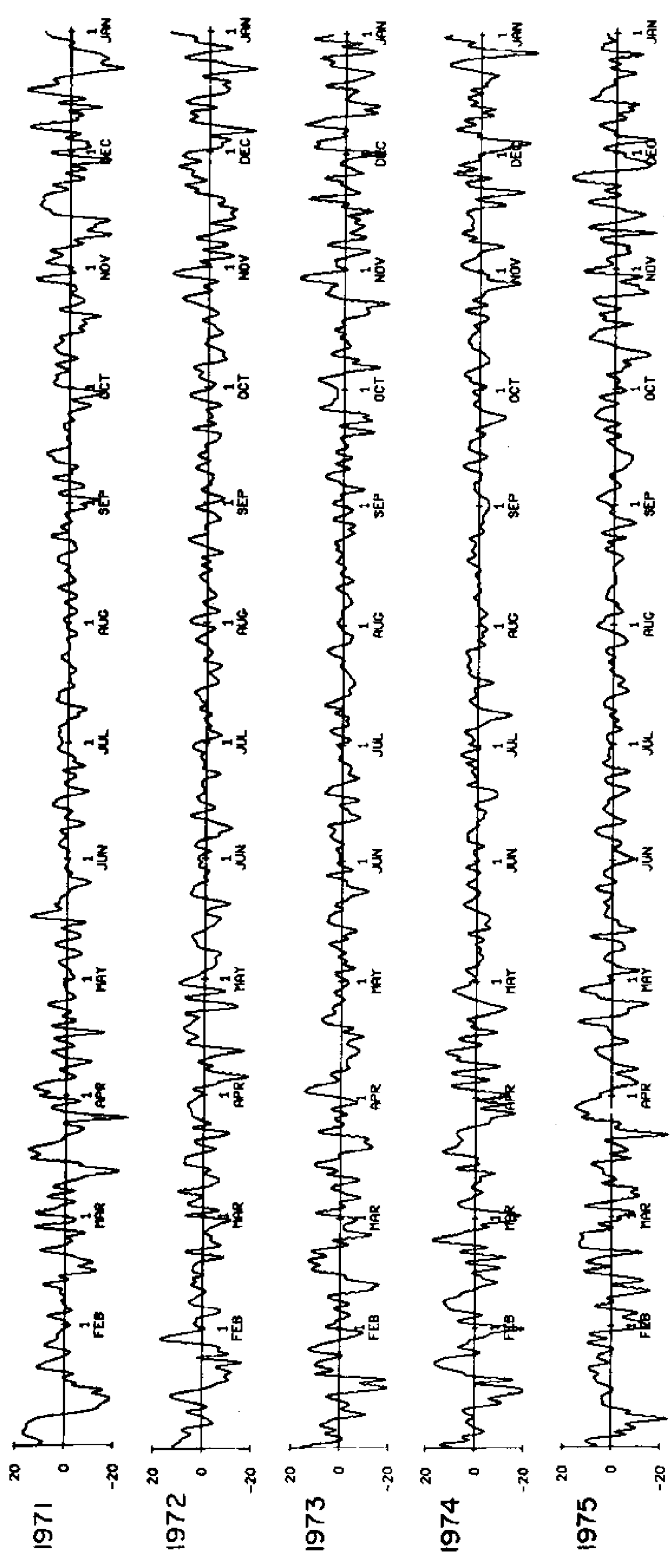


ILF Sea Level (cm)
1973
1974
1975
40
0
1 FEB
1 MAR
1 APR
1 MAY
1 JUN
1 JUL
1 AUG
1 SEP
1 OCT
1 NOV
1 DEC
1 JAN

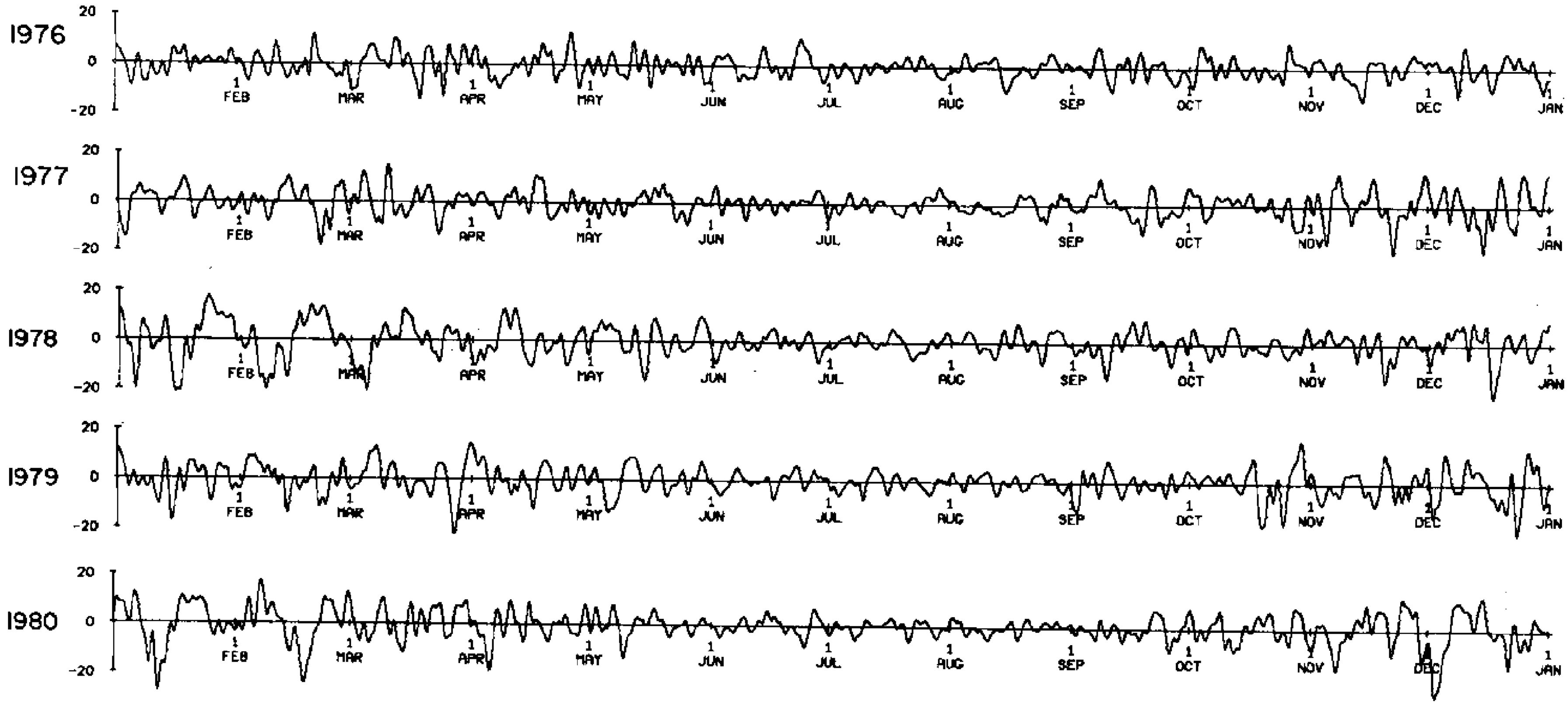
ILF Sea Level (cm)

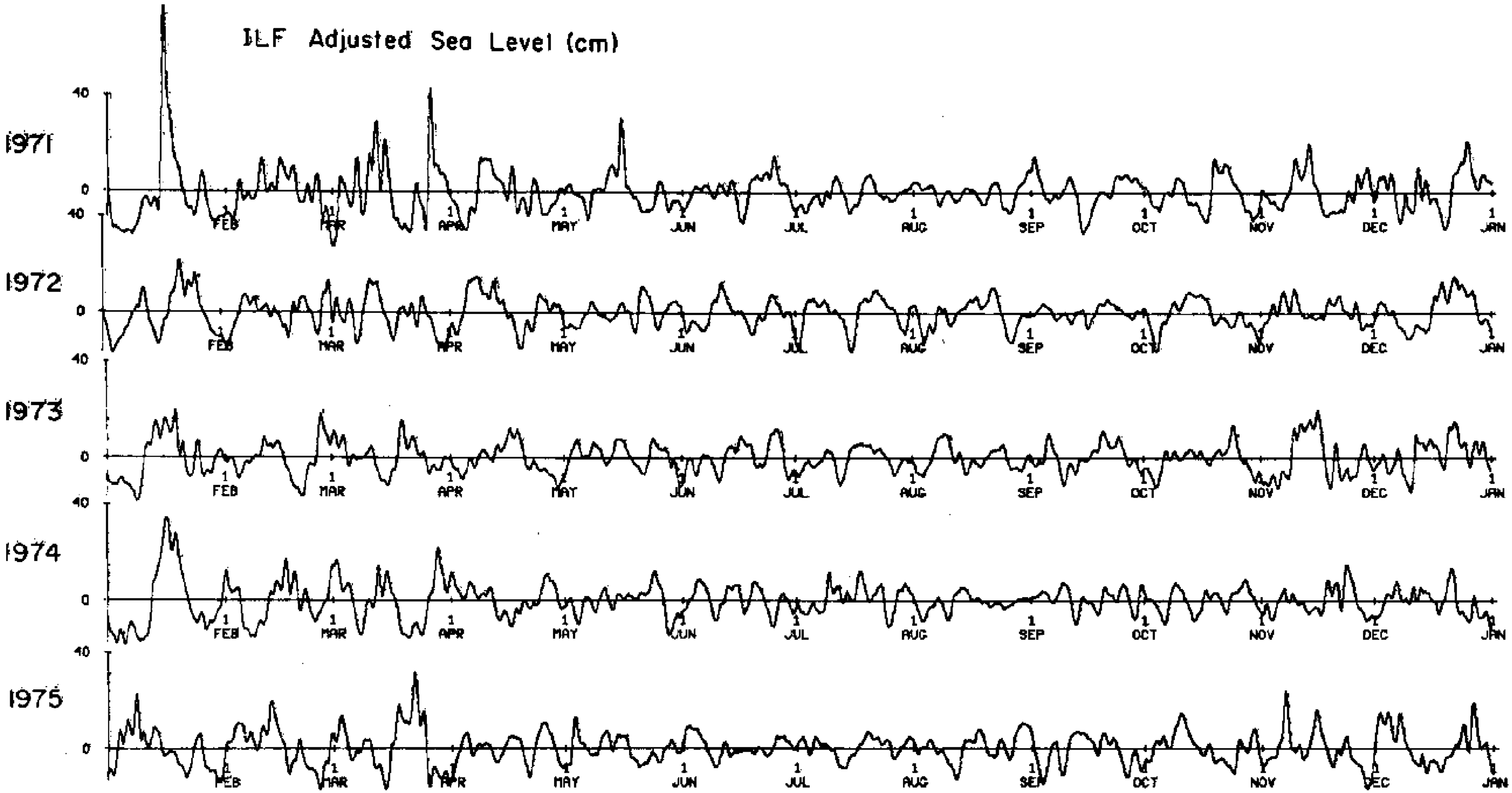


1LF Atmospheric Pressure (mb)

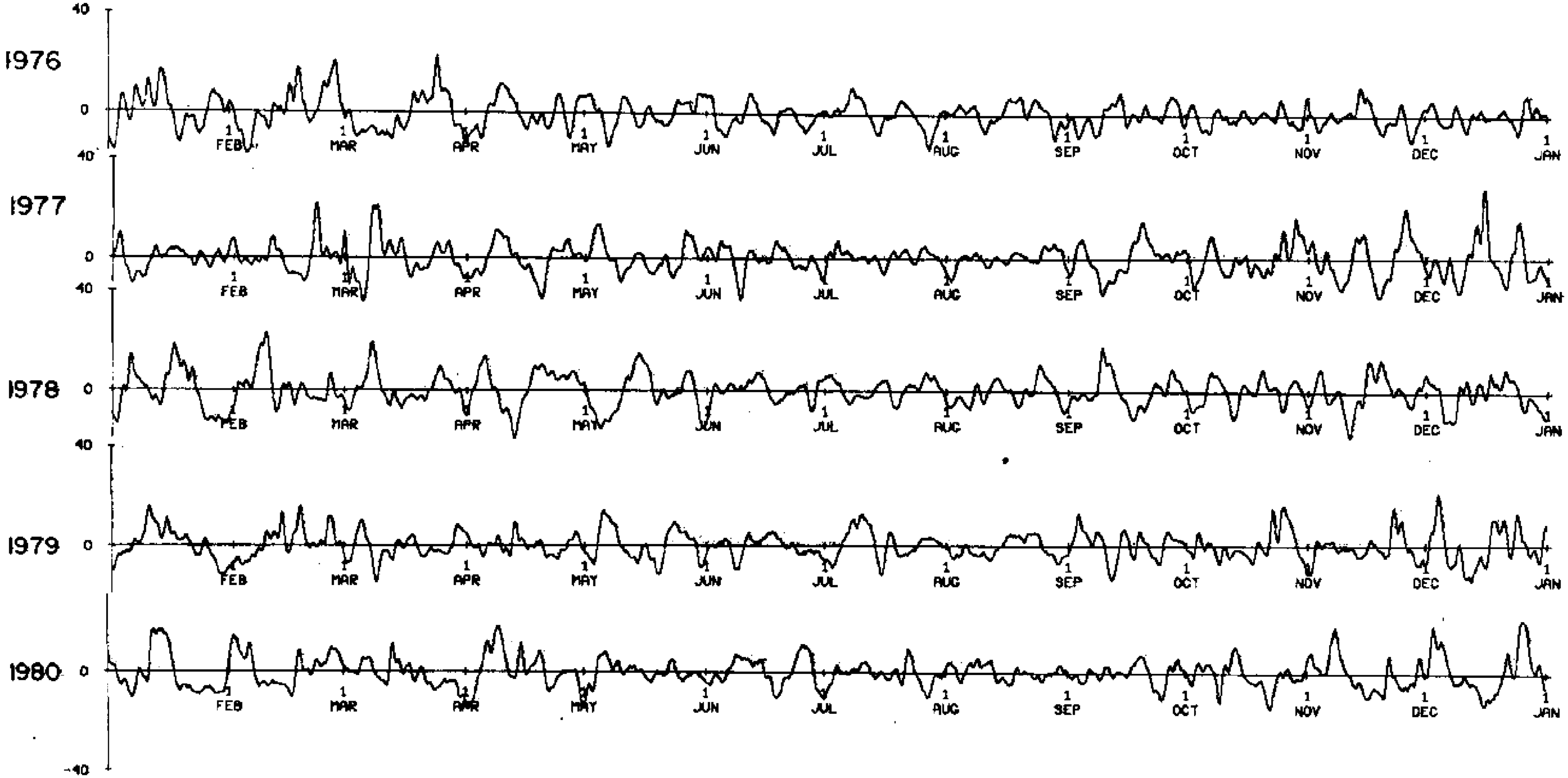


ILF Atmospheric Pressure (mb)

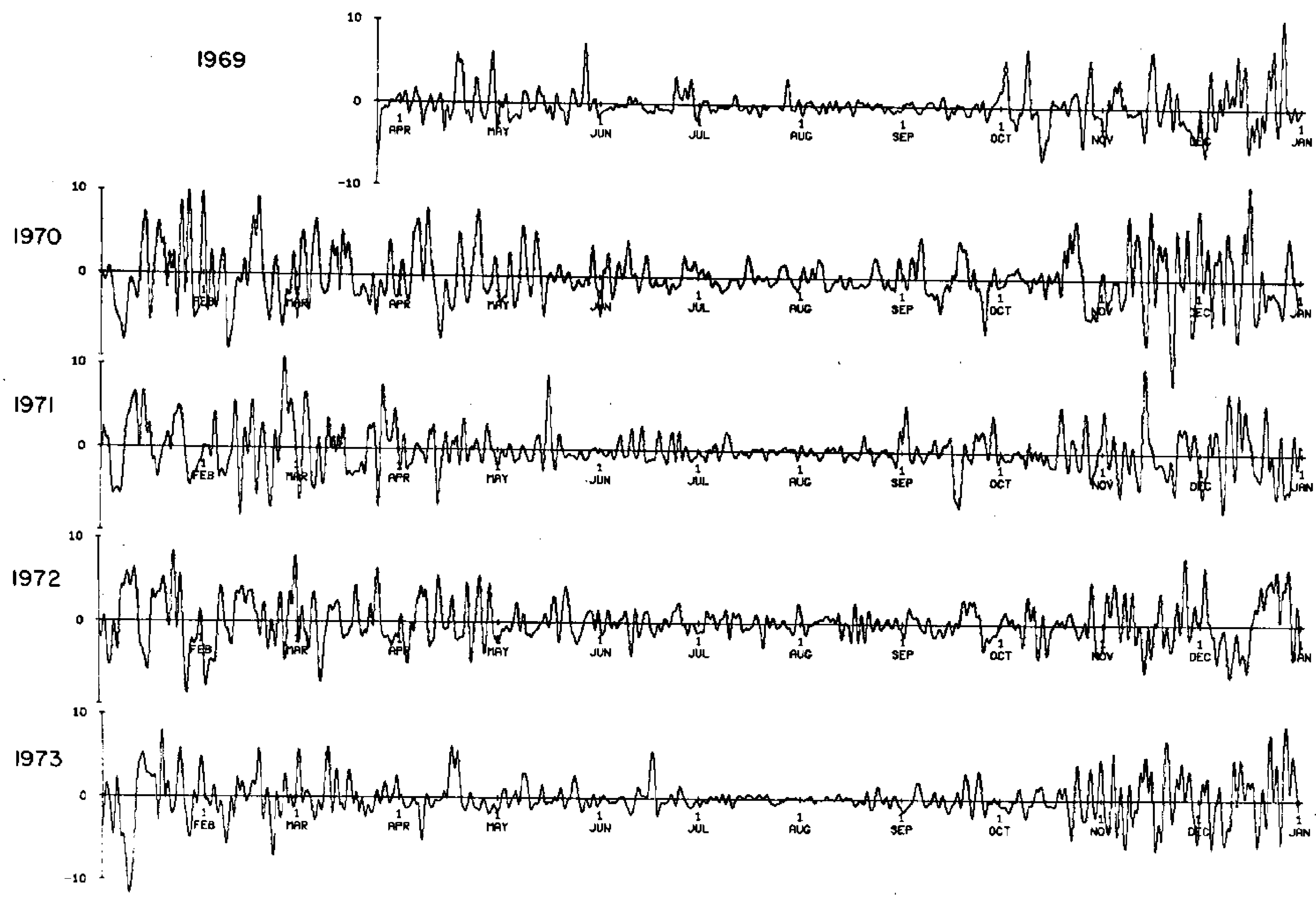



ILF Adjusted Sea Level (cm)
1971
1972
1973
1974
1975
40
0
40
1 FEB
1 MAR
1 APR
1 MAY
1 JUN
1 JUL
1 AUG
1 SEP
1 OCT
1 NOV
1 DEC
1 JAN

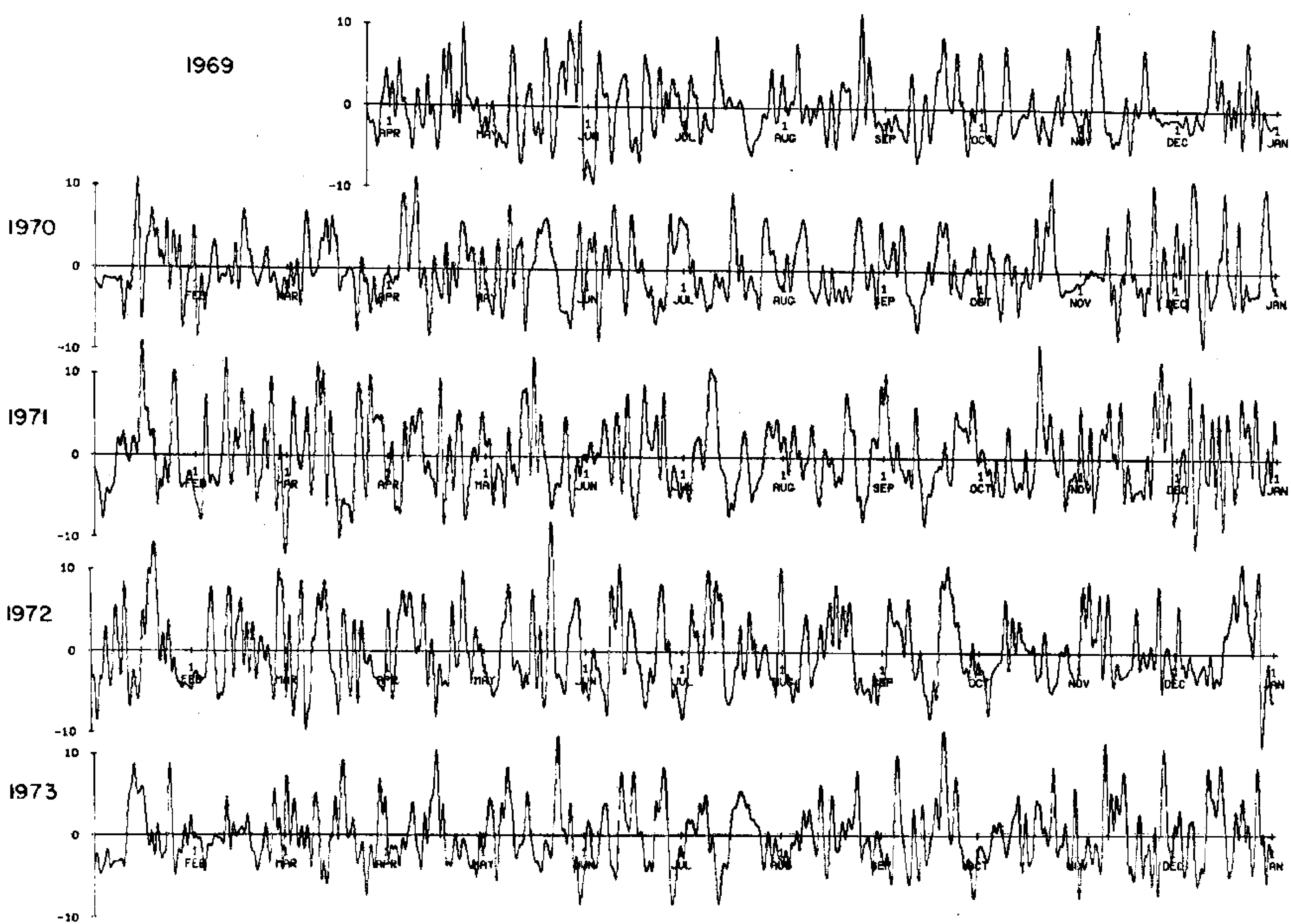
ILF Adjusted Sea Level (cm)



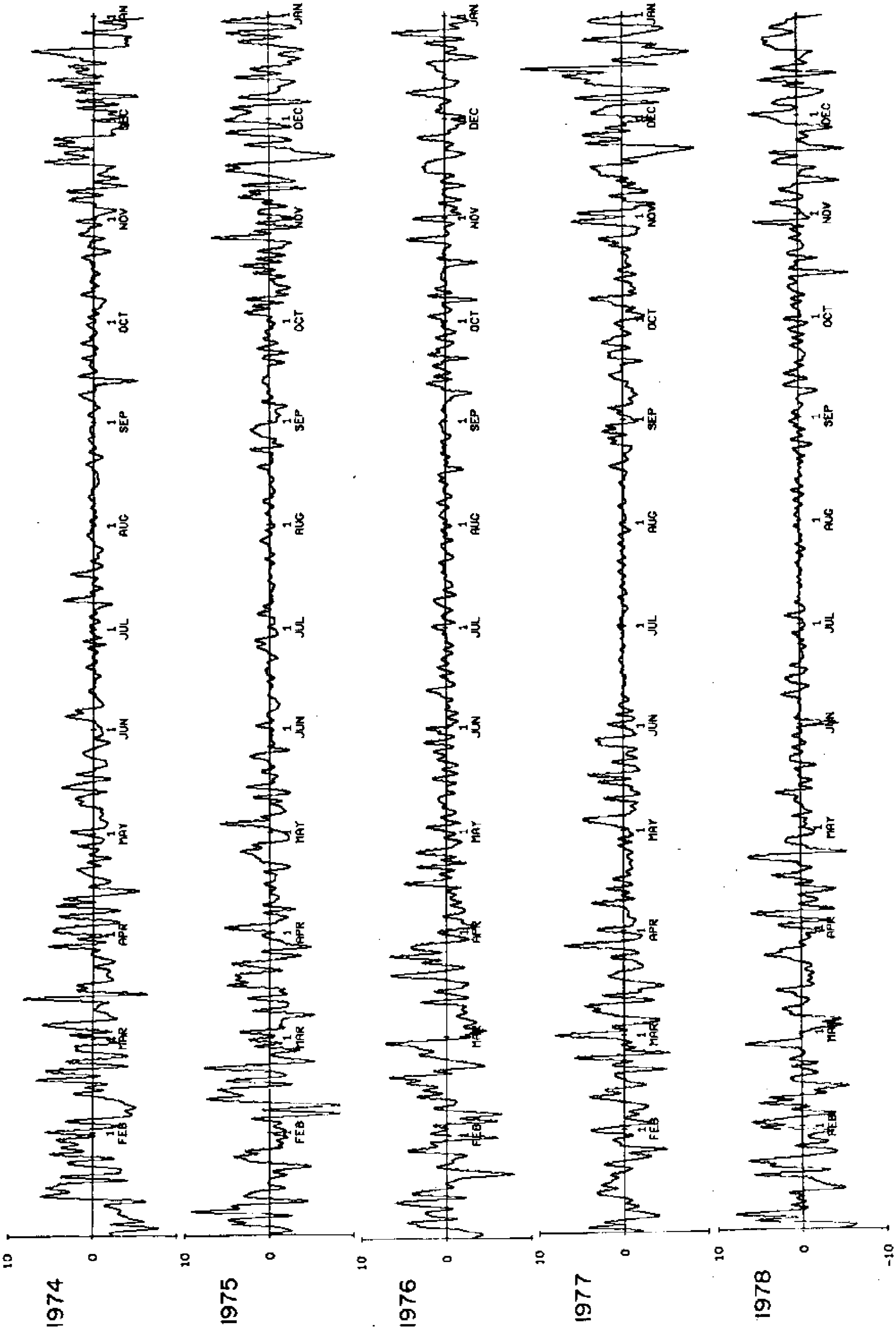
ILF Eastward Wind (m/sec)

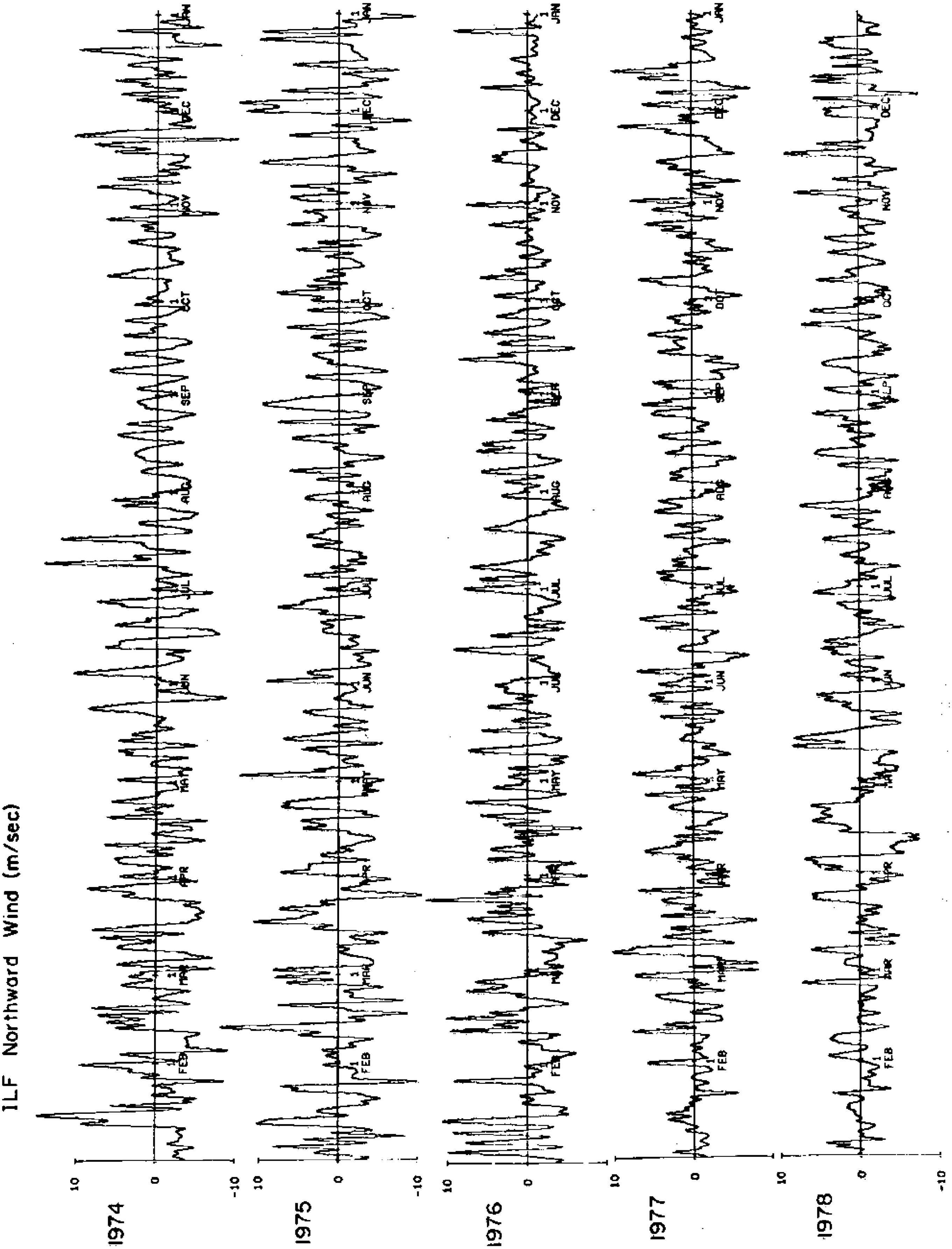


ILF Northward Wind (m/sec)

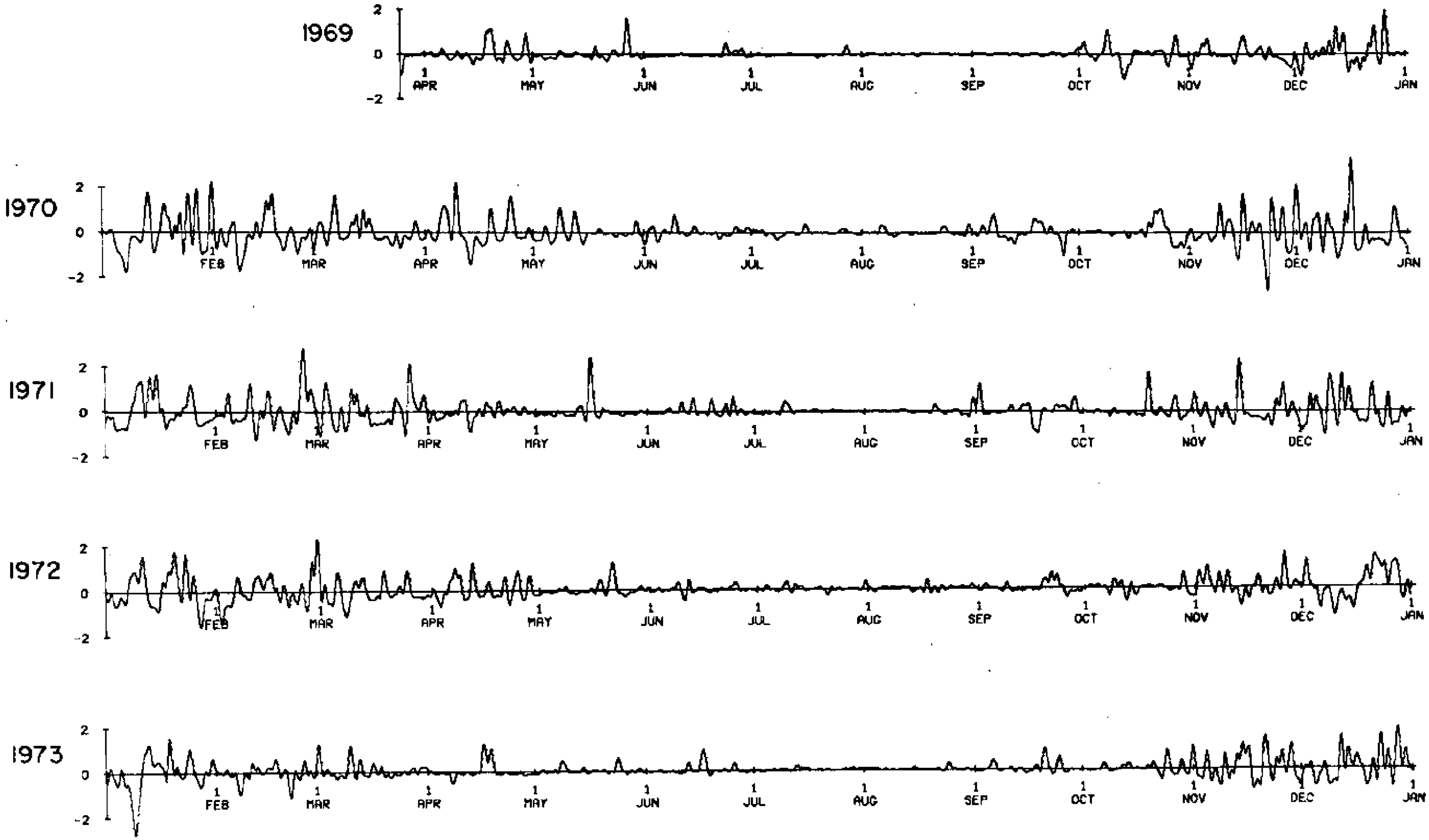


ILF Eastward Wind (m/sec)

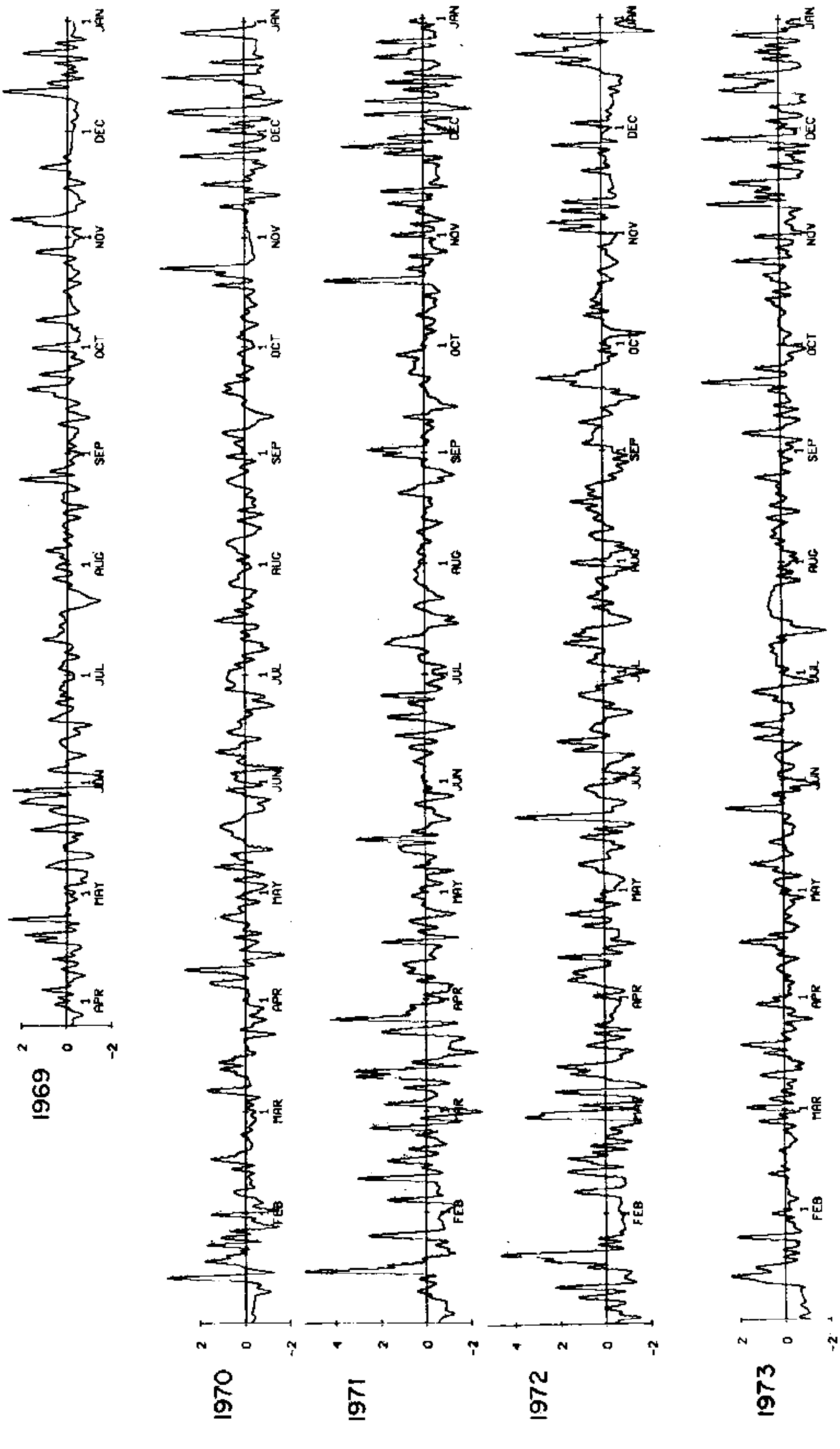



ILF Northward Wind (m/sec)
1974
1975
1976
1977
1978
10
0
-10
1 FEB
1 MAR
1 APR
1 MAY
1 JUN
1 JUL
1 AUG
1 SEP
1 OCT
1 NOV
1 DEC
1 JAN

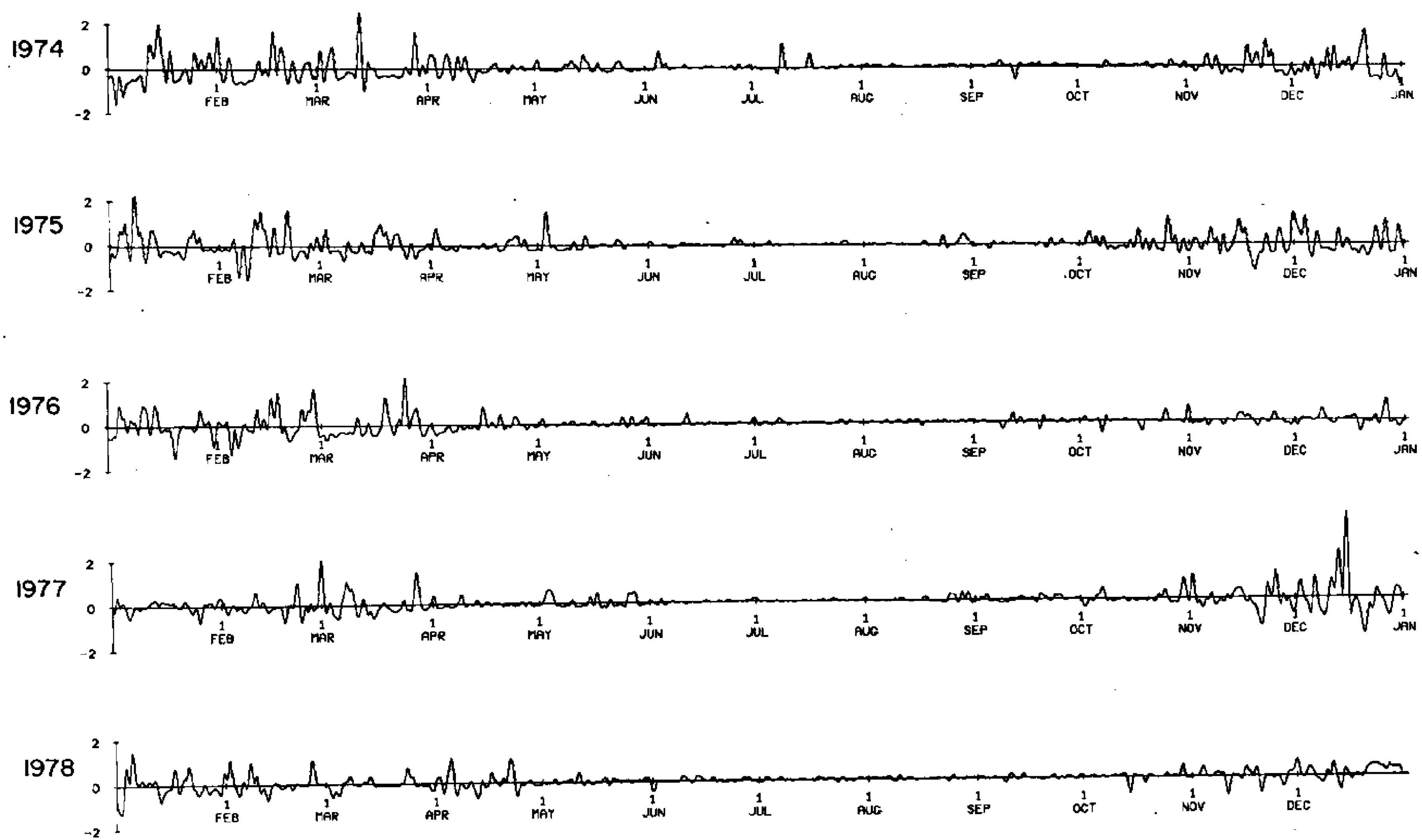
ILF Eastward Wind Stress (dynes/cm^2)



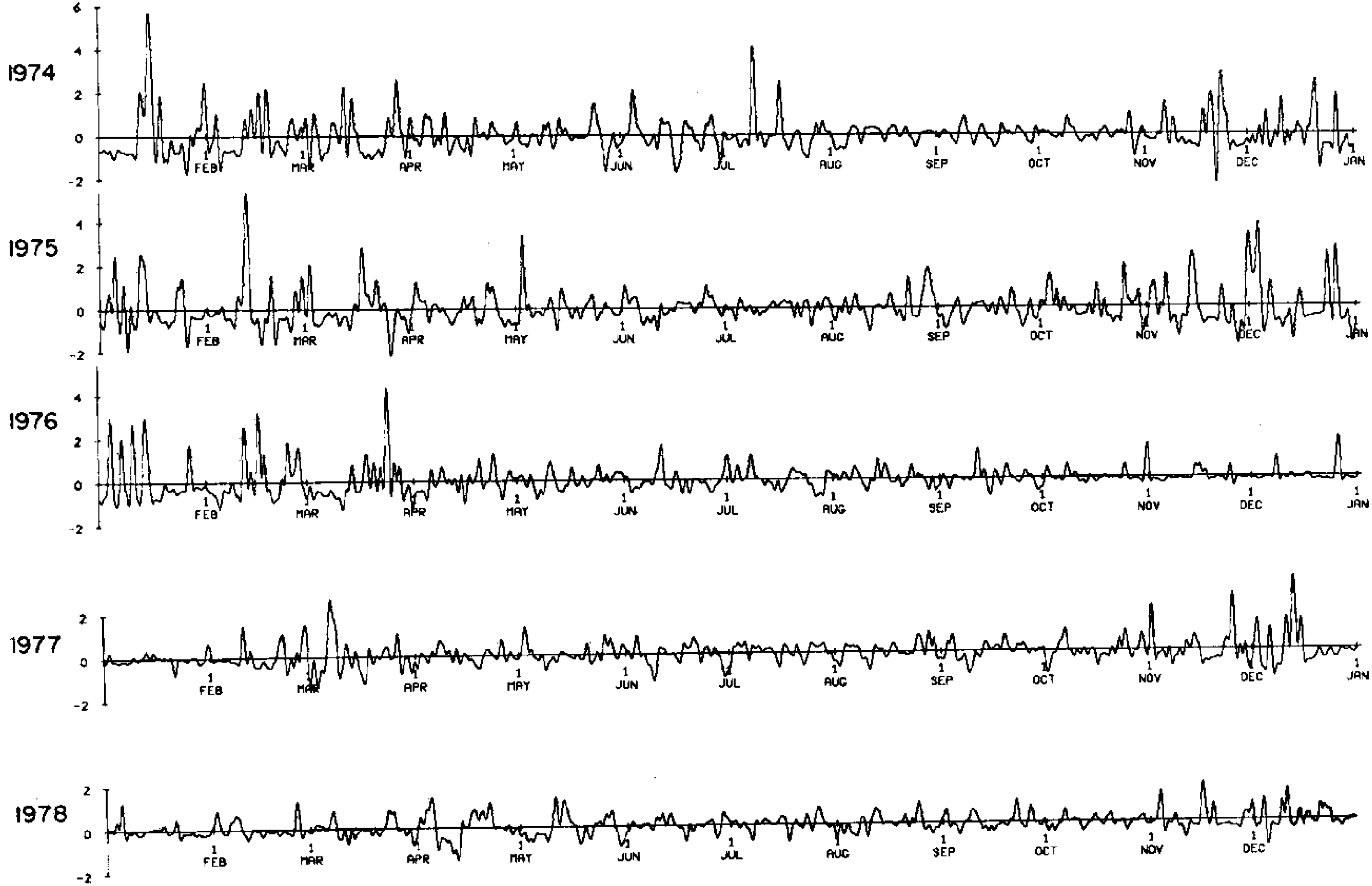
ILF Northward Wind Stress (dynes/cm2)

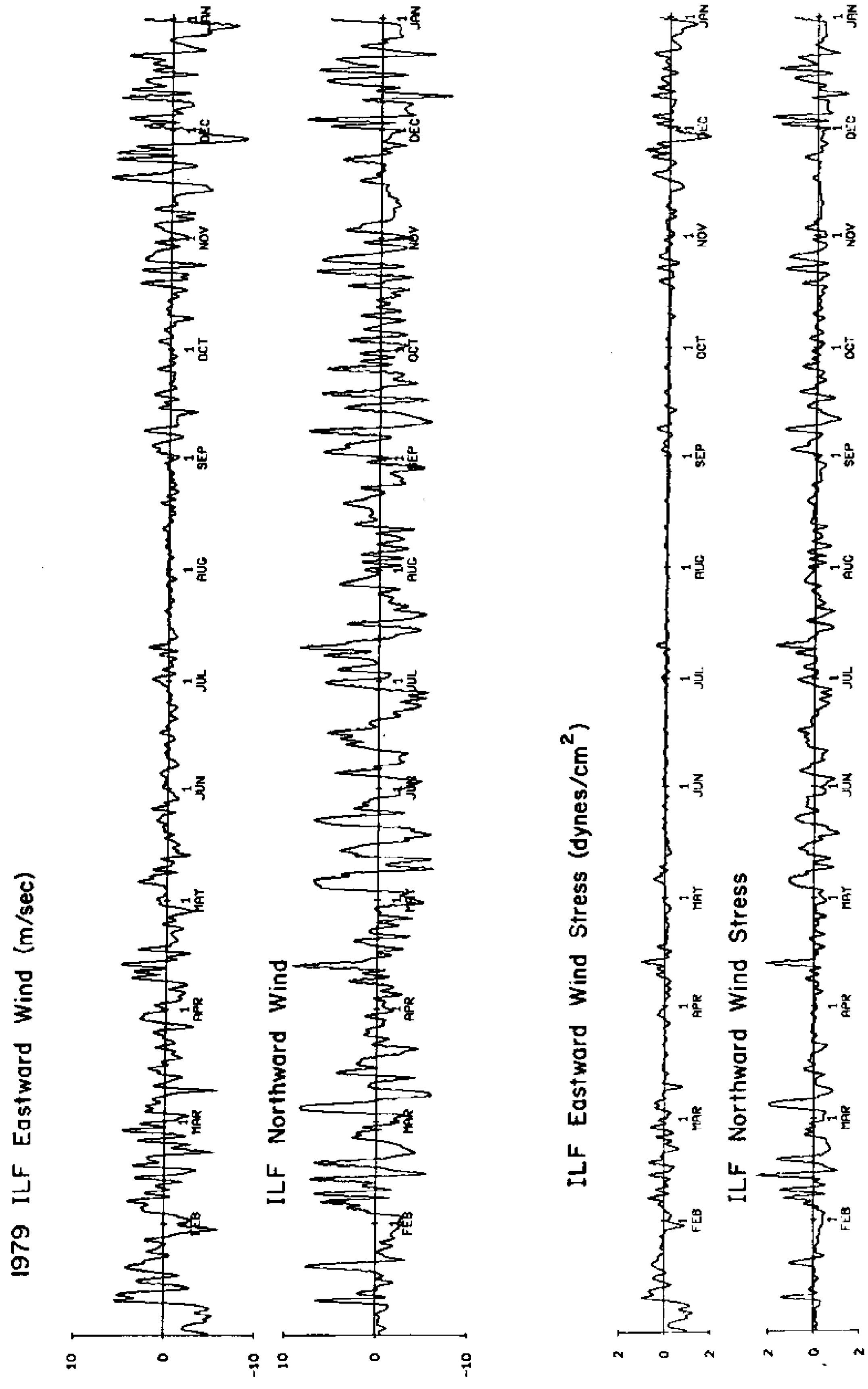


ILF Eastward Wind Stress (dynes/cm^2)

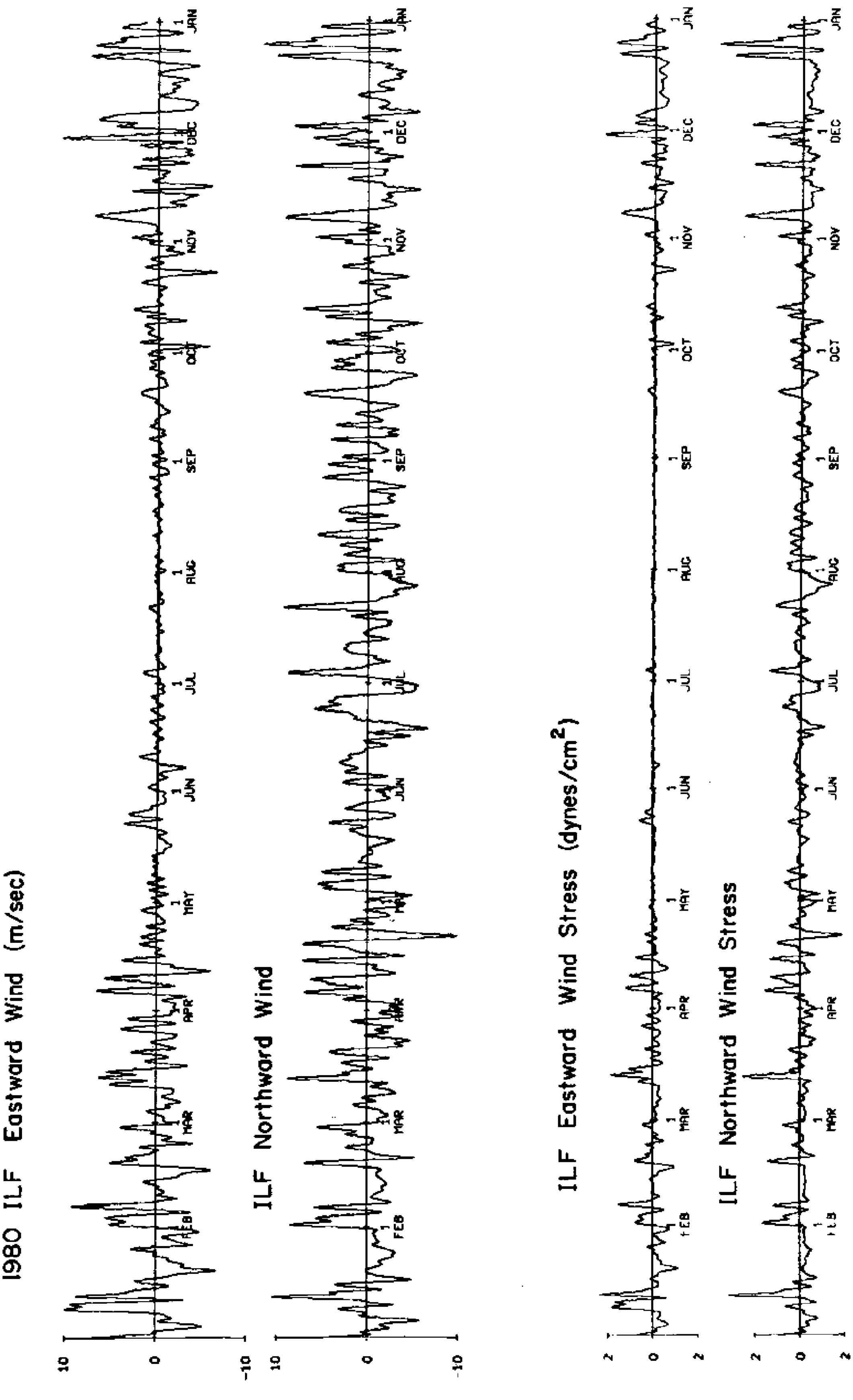


ILF Northward Wind Stress (dynes/cm^2)





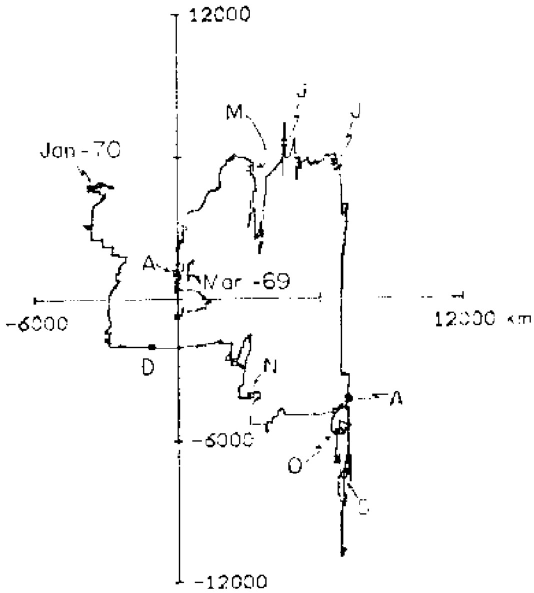
1979 ILF Eastward Wind (m/sec)
ILF Northward Wind
ILF Eastward Wind Stress (dynes/cm^2)
ILF Northward Wind Stress
10
0
-10
2
0
2
1 FEB
1 MAR
1 APR
1 MAY
1 JUN
1 JUL
1 AUG
1 SEP
1 OCT
1 NOV
1 DEC
1 JAN



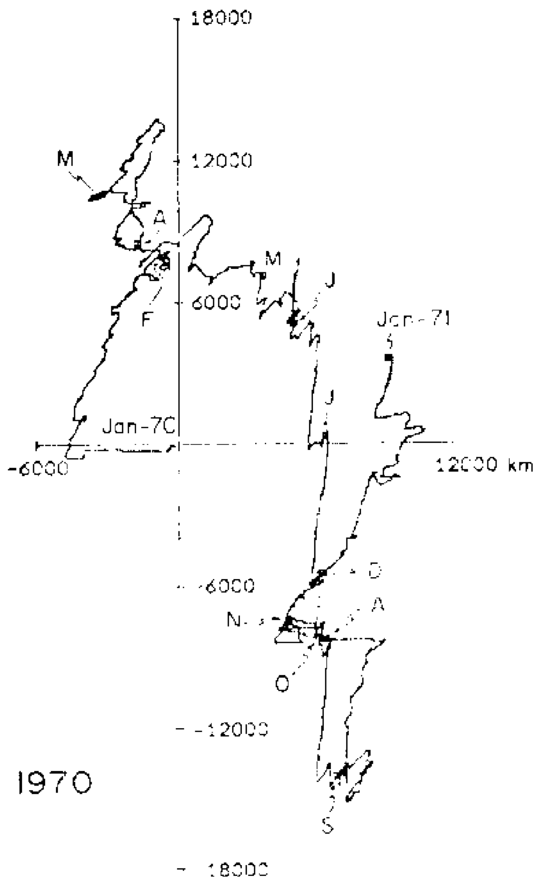
1980 ILF Eastward Wind (m/sec)
ILF Northward Wind
ILF Eastward Wind Stress (dynes/cm^2)
ILF Northward Wind Stress
10
0
-10
2
0
2
1 FEB
1 MAR
1 APR
1 MAY
1 JUN
1 JUL
1 AUG
1 SEP
1 OCT
1 NOV
1 DEC
1 JAN

APPENDIX C

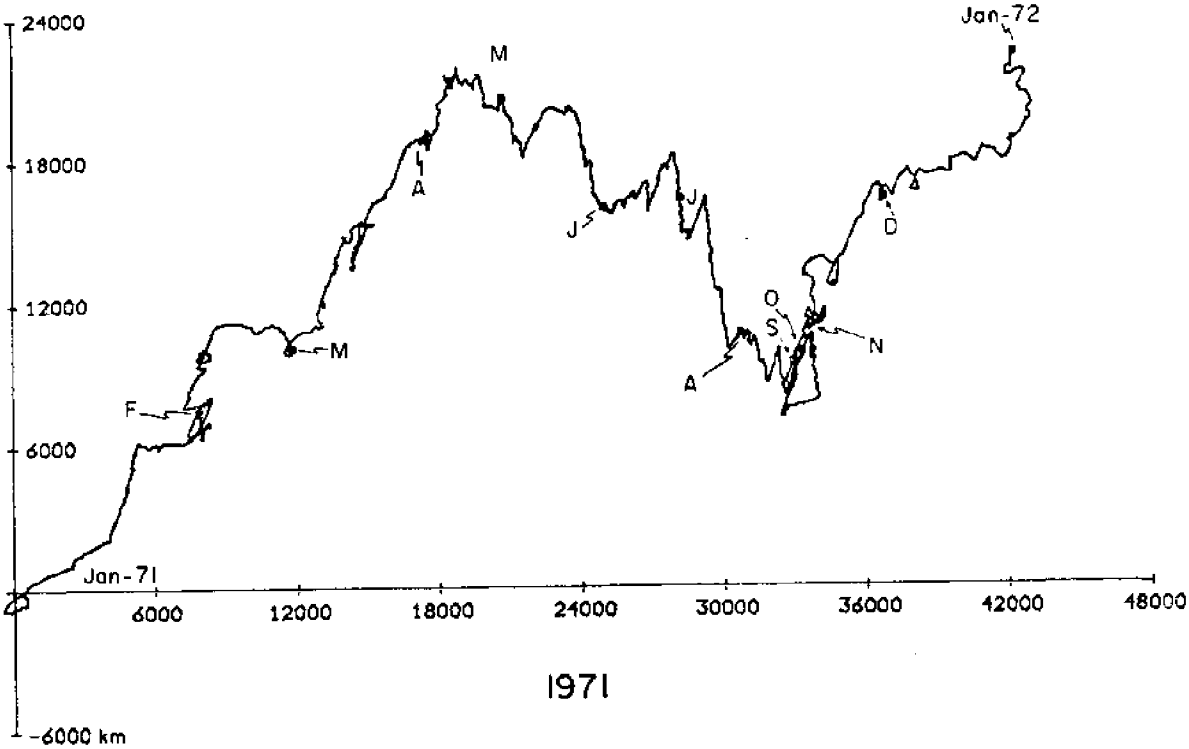
Wind PVD's
Scatter Diagrams


12000
J
M
J
Jan-70
A
Mar -69
-6000
12000 km
D
N
A
-6000
O
S
-12000

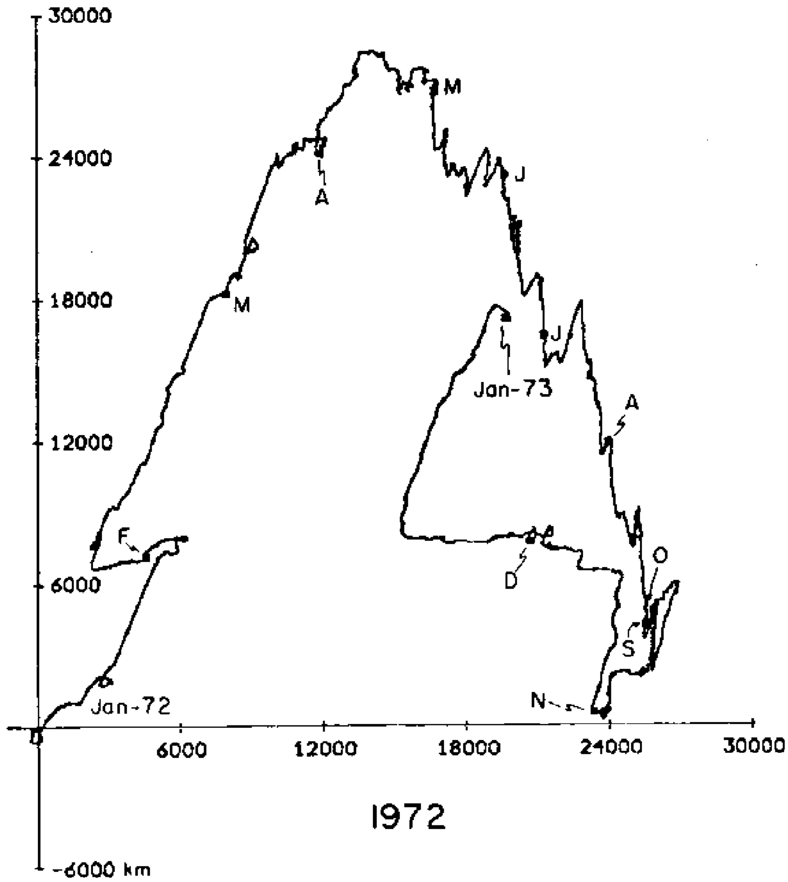
1969


18000
M
12000
A
M
J
6000
F
Jan-71
J
Jan-70
-6000
12000 km
D
-6000
N
A
O
-12000
S
18000

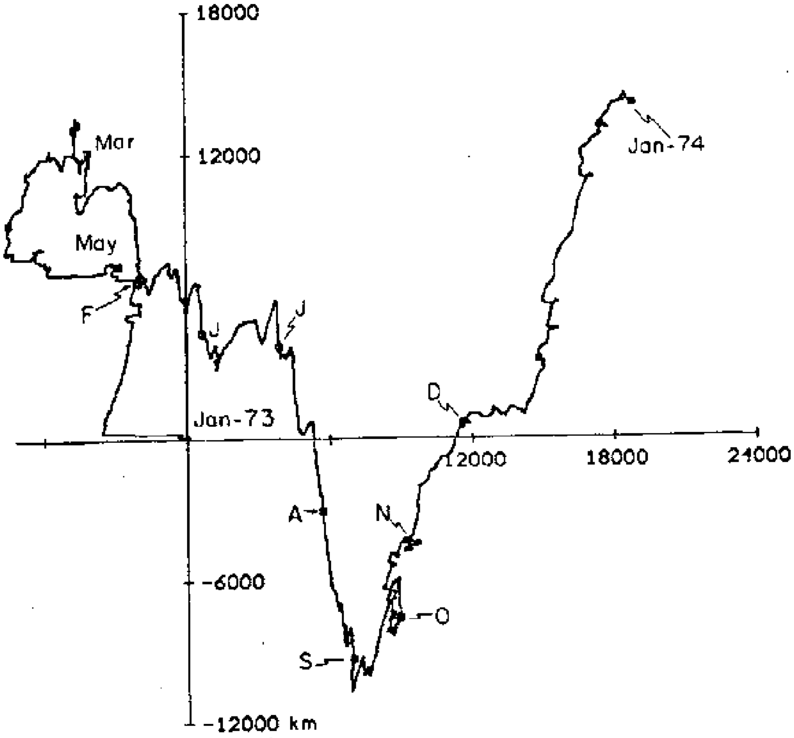
1970


24000
18000
12000
6000
-6000 km
6000
12000
18000
24000
30000
36000
42000
48000
Jan-71
Jan-72
F
M
A
M
J
J
A
S
O
N
D

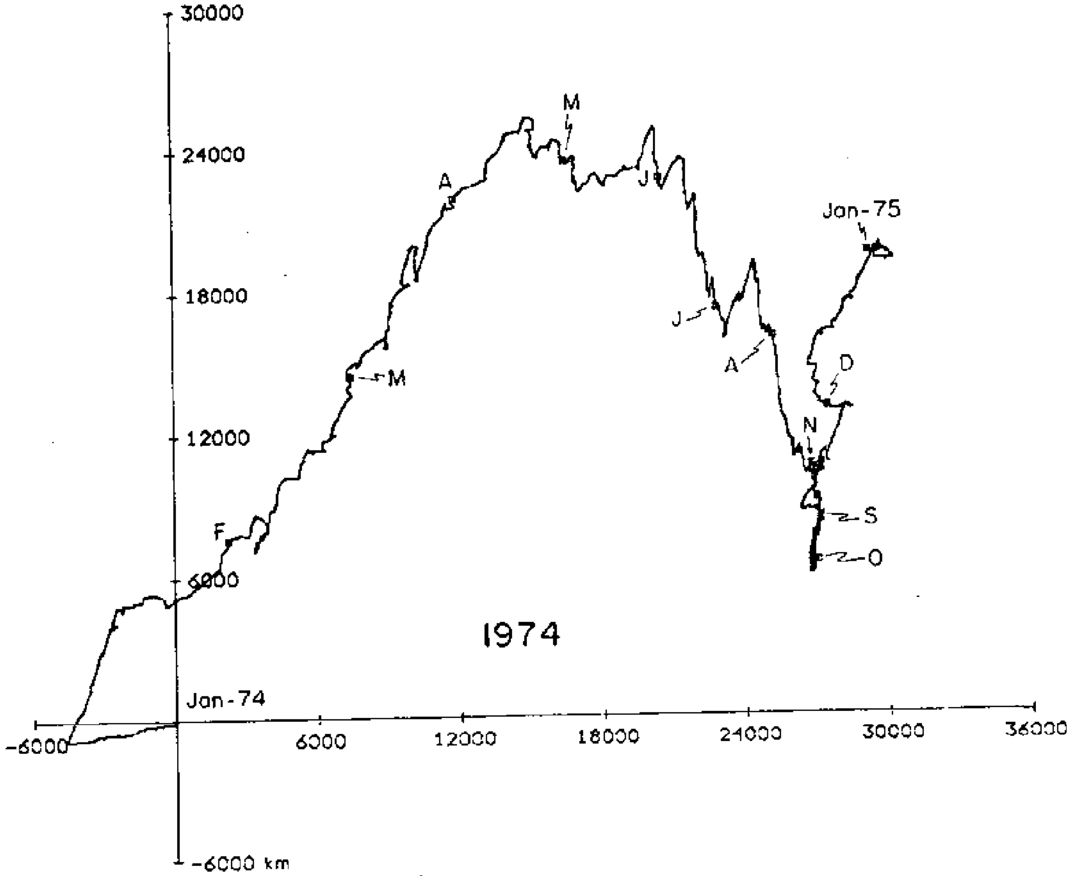
1971


30000
24000
18000
12000
6000
-6000 km
6000
12000
18000
24000
30000
Jan-72
Jan-73
F
M
A
M
J
J
A
S
O
N
D

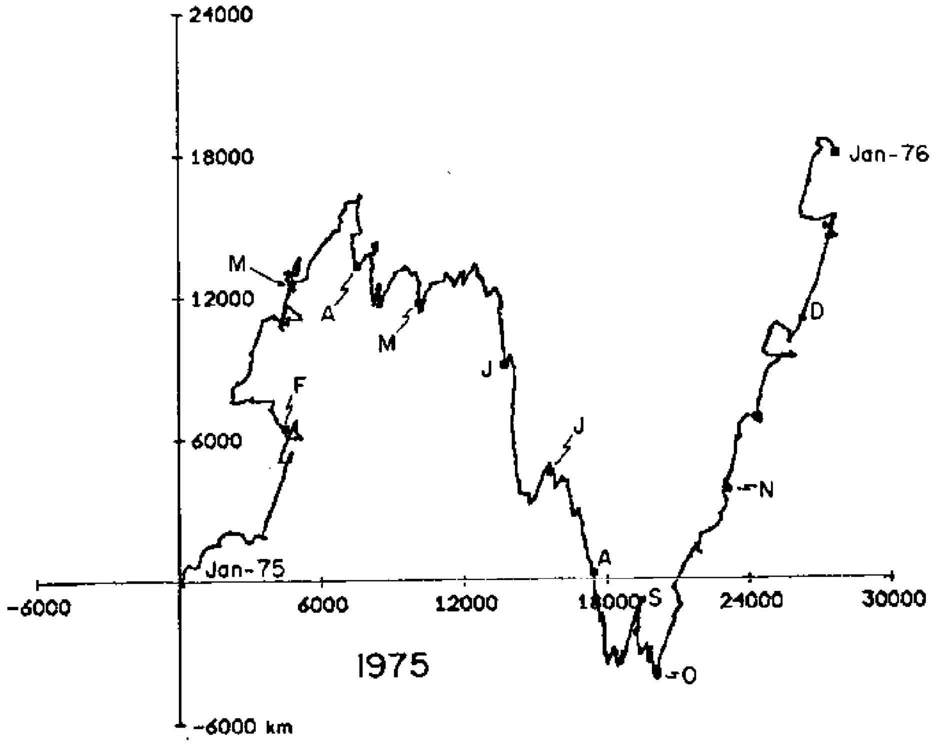
1972


18000
12000
-6000
-12000 km
12000
18000
24000
Jan-73
Jan-74
Mar
May
A
F
J
J
A
S
O
N
D

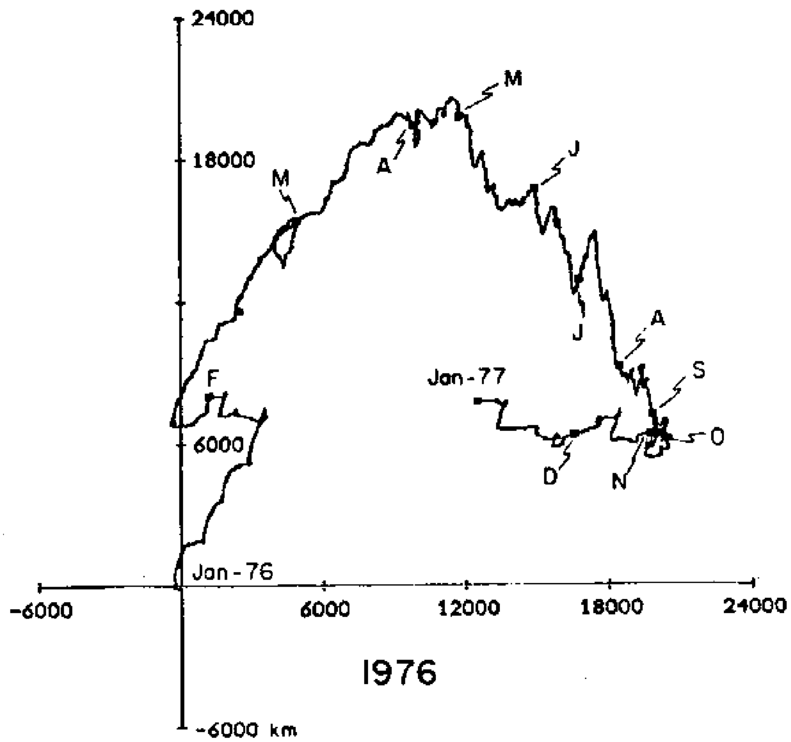
1973


30000
24000
18000
12000
6000
-6000 km
-6000
6000
12000
18000
24000
30000
36000
Jan-74
Jan-75
F
M
A
M
J
J
A
S
O
N
D

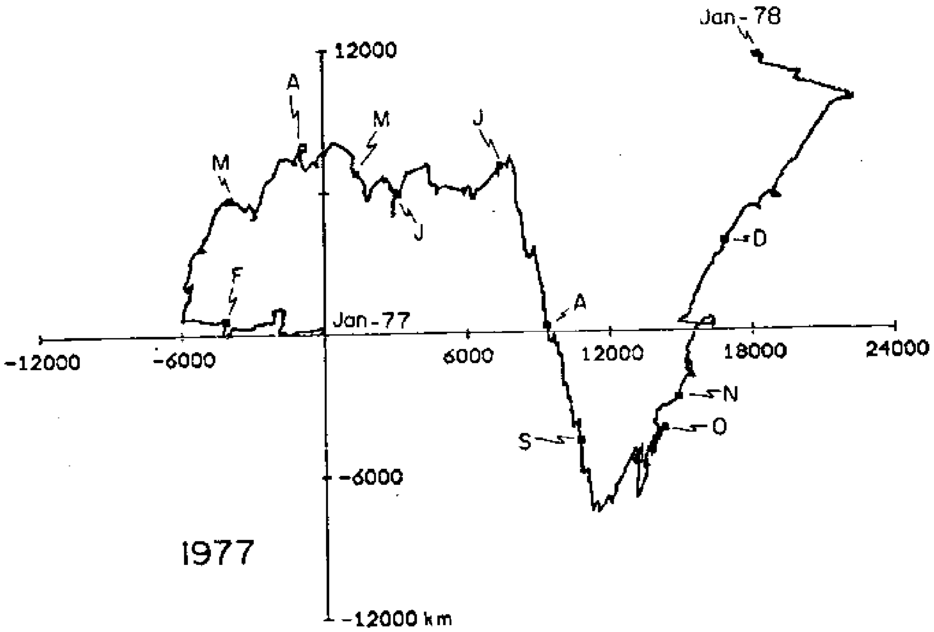
1974



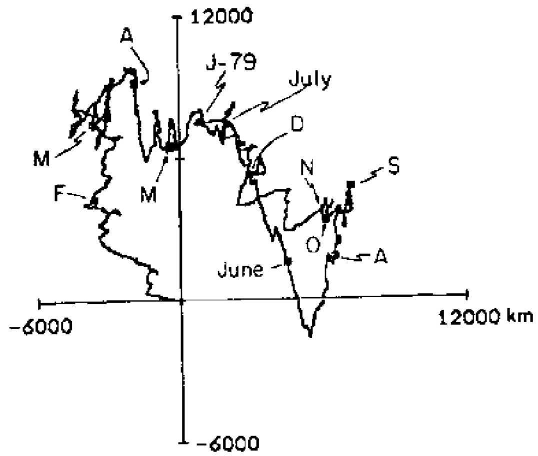
24000
18000
12000
6000
-6000 km
-6000
6000
12000
18000
24000
30000
Jan-75
Jan-76
M
A
M
F
J
J
A
S
O
N
D
1975



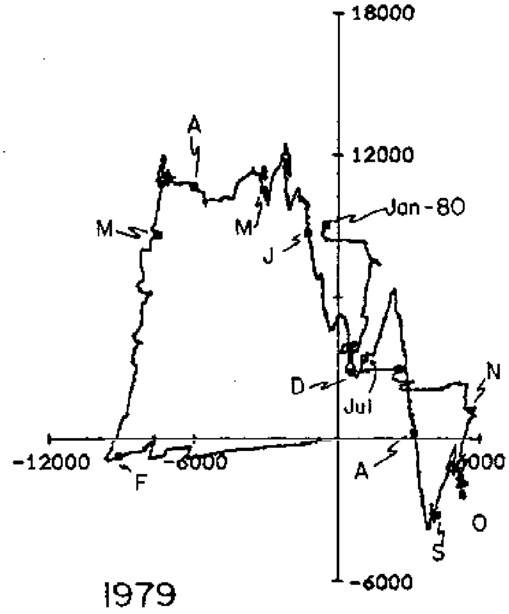
24000
18000
6000
-6000 km
-6000
6000
12000
18000
24000
Jan-76
Jan-77
F
M
A
M
J
J
A
S
O
N
D
1976

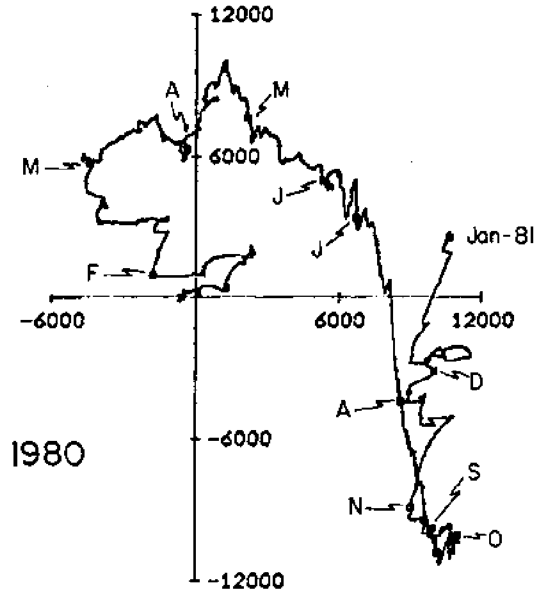

Jan-78
12000
A
M
M
J
J
D
F
A
Jan-77
-12000
-6000
6000
12000
18000
24000
N
O
S
-6000
-12000 km

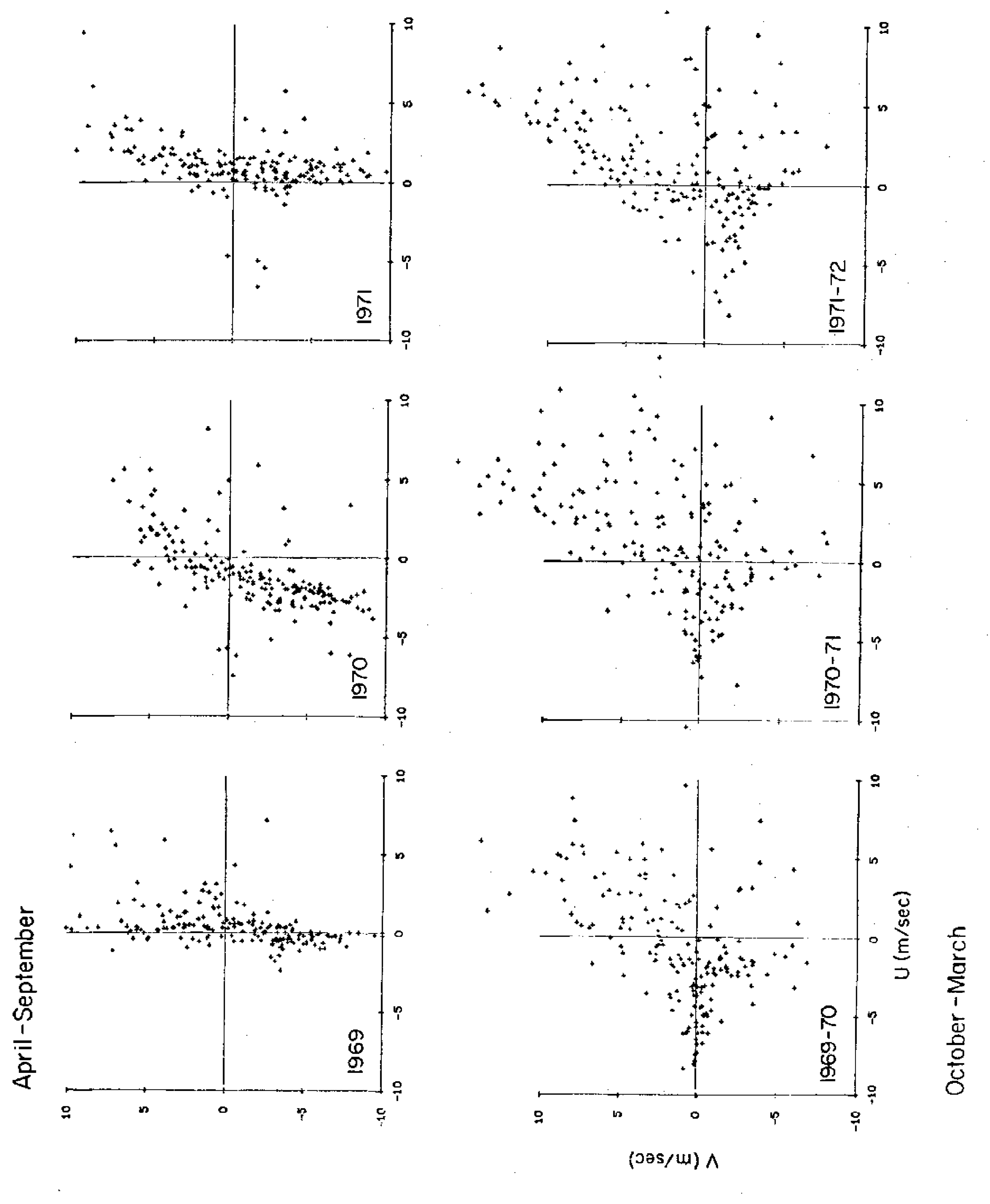
1977


12000
A
J-79
July
D
M
N
S
F
M
O
June
A
-6000
12000 km
-6000

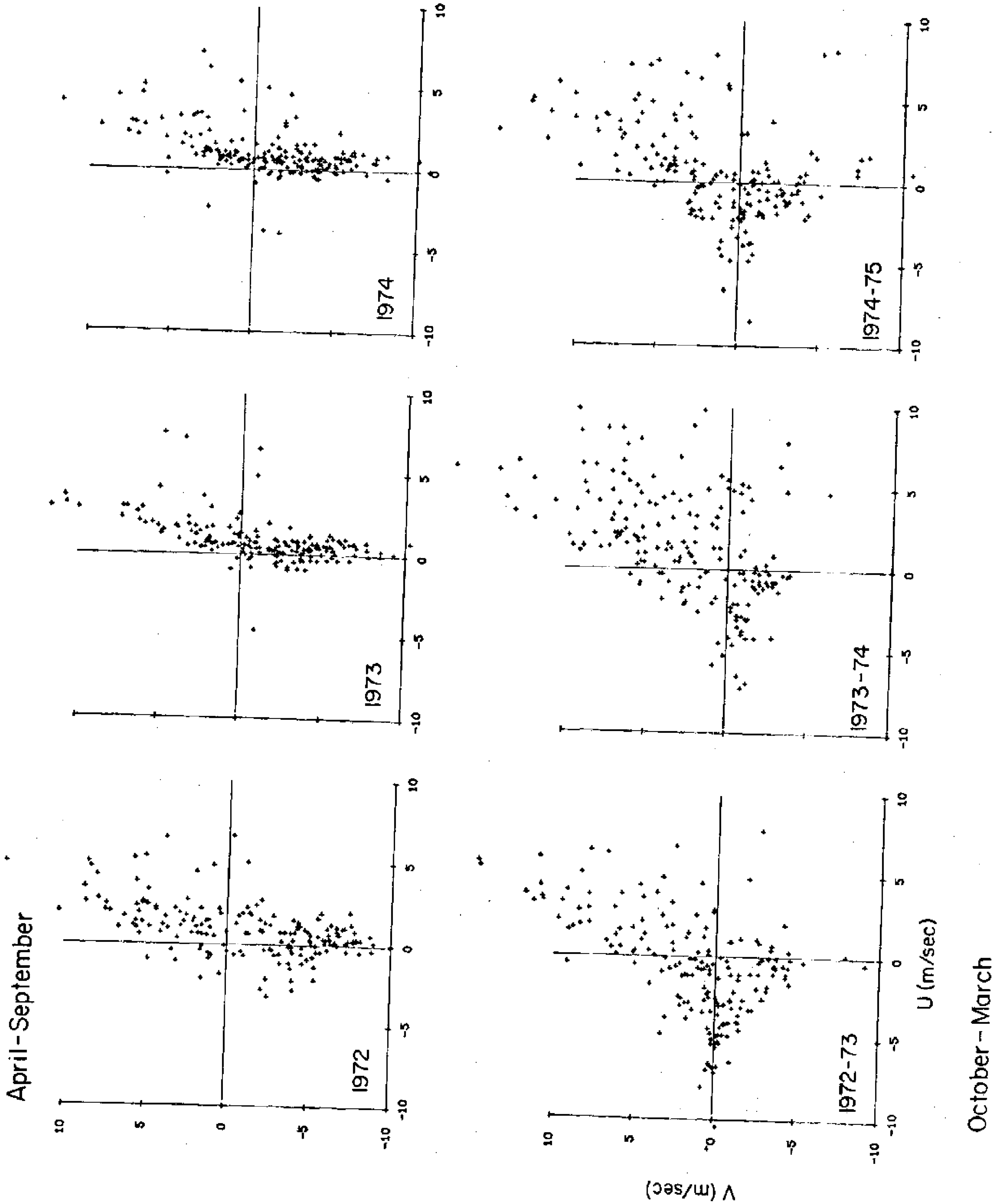
1978

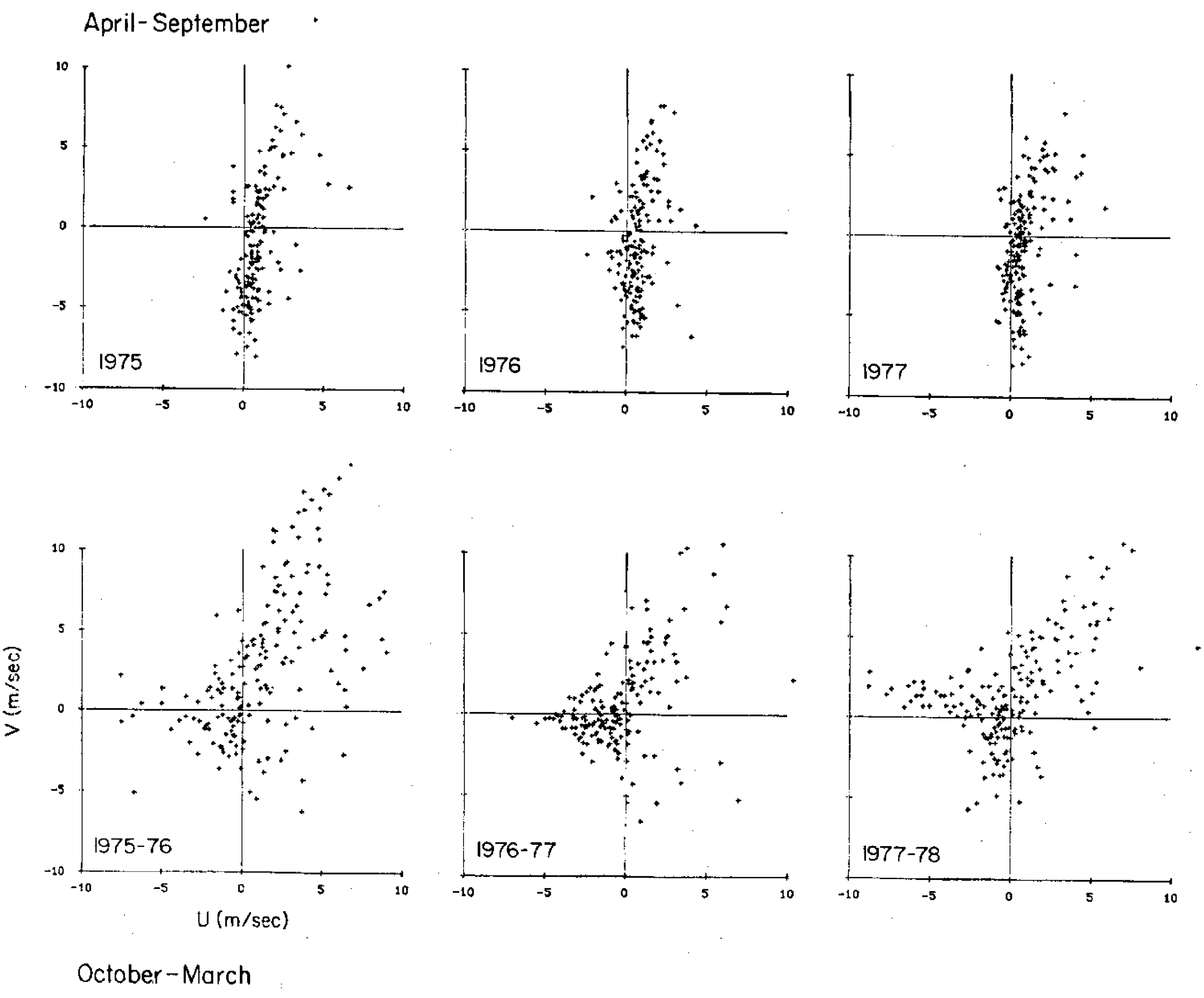

18000
12000
-6000
-12000
-6000
6000
A
M
M
J
Jan-80
D
Jul
N
F
A
S
O
1979

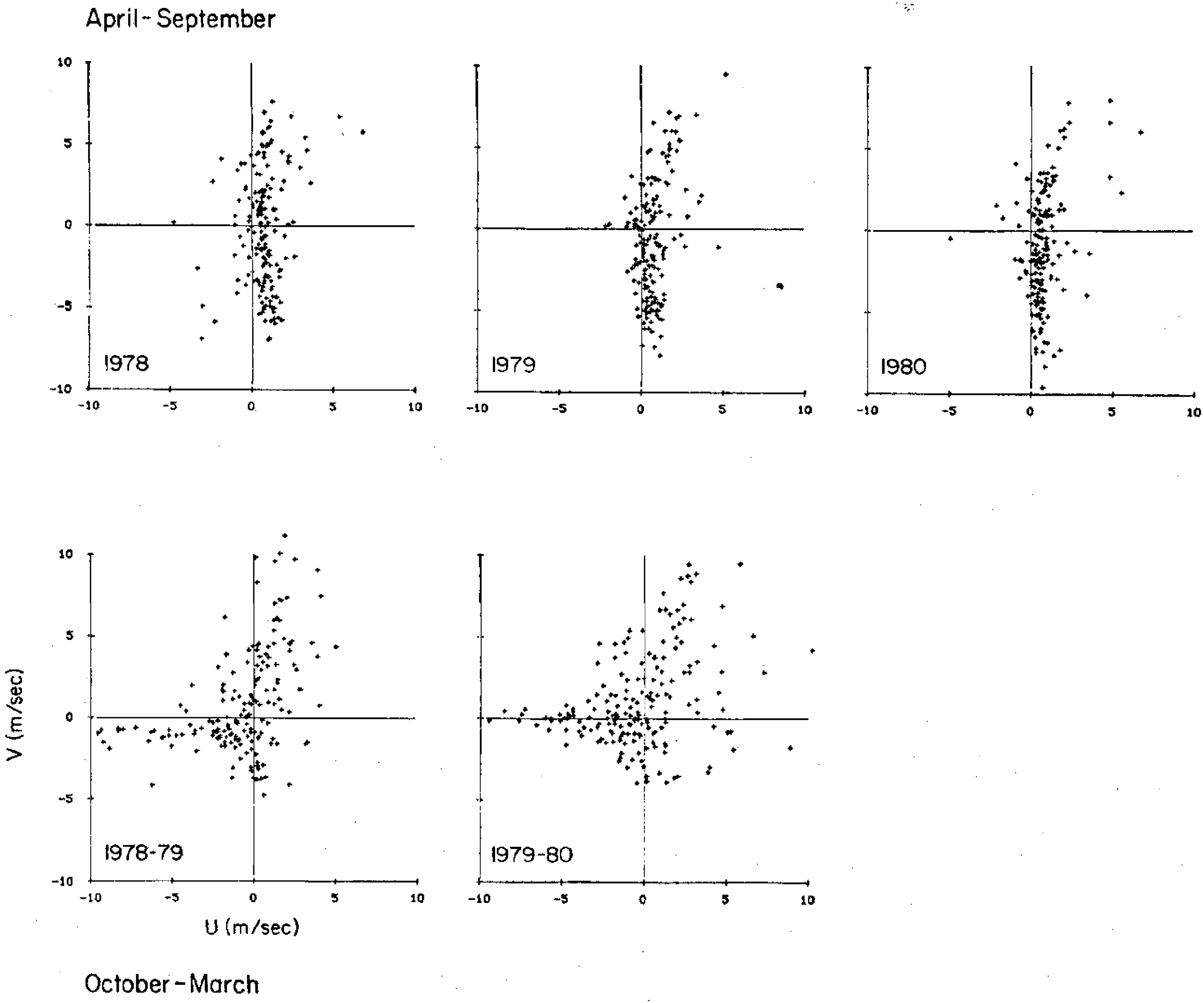

12000
6000
-6000
-12000
-6000
6000
12000
A
M
M
J
J
F
Jan-81
D
A
S
N
O
1980



April-September
1969
1970
1971
1969-70
1970-71
1971-72
October-March
U (m/sec)
V (m/sec)

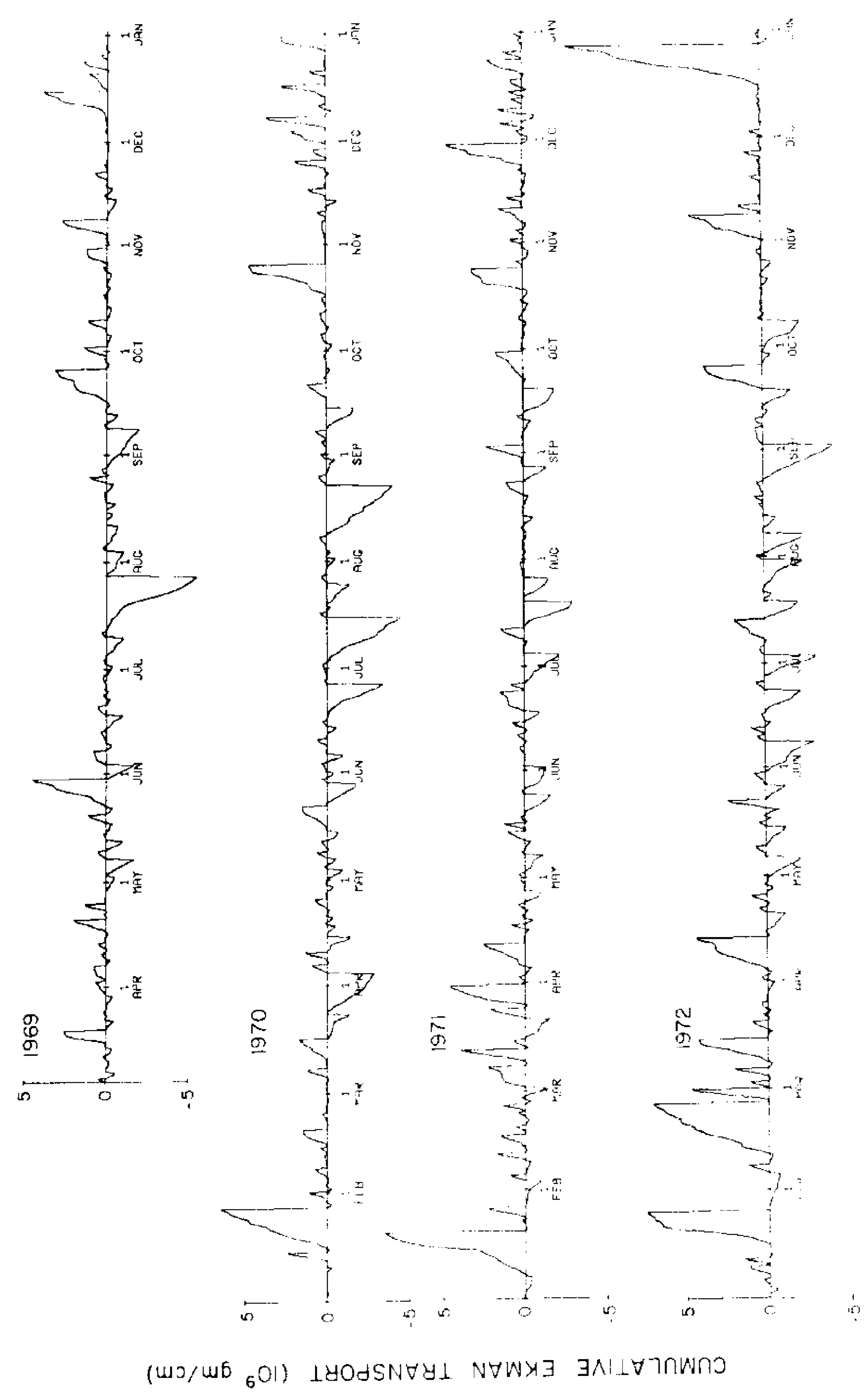

April-September
1972
1973
1974
October-March
1972-73
1973-74
1974-75
U (m/sec)
V (m/sec)


April-September
1975
1976
1977
1975-76
1976-77
1977-78
V (m/sec)
U (m/sec)
October-March

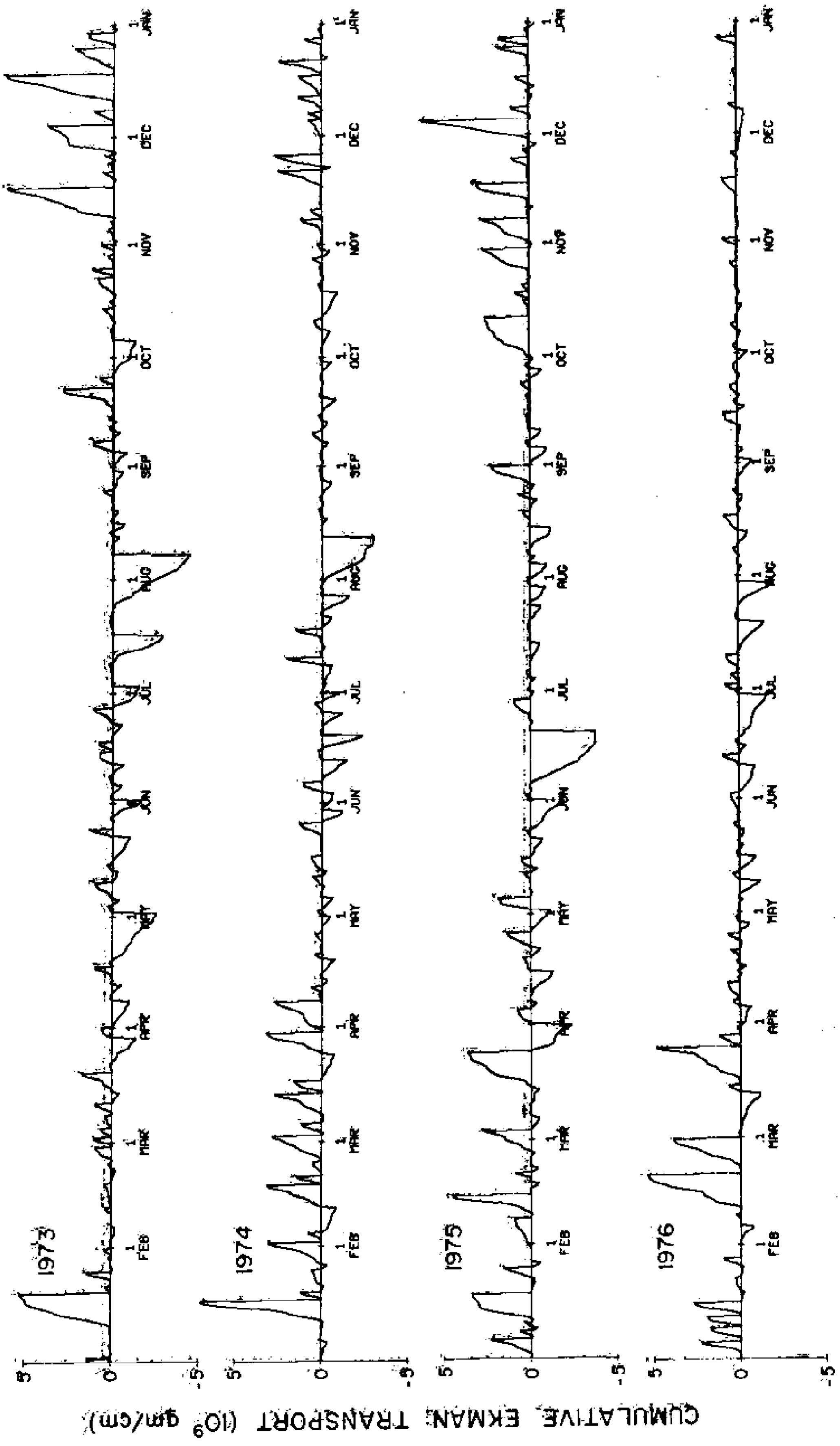

April-September
1978
1979
1980
1978-79
1979-80
V (m/sec)
U (m/sec)
October-March

APPENDIX D

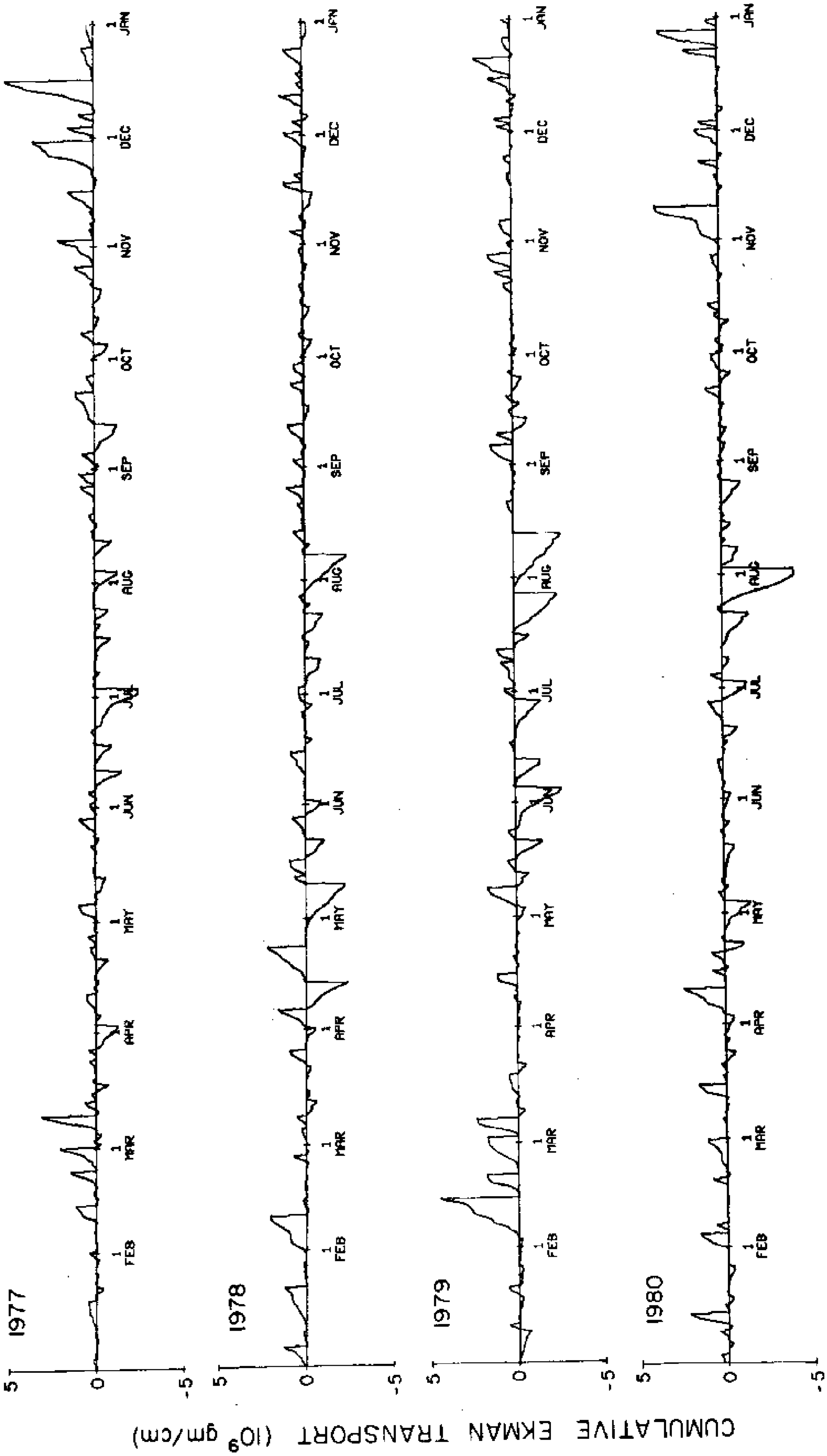
Cumulative Ekman Transport



CUMULATIVE EKMAN TRANSPORT (10^9 gm/cm)
1969
1970
1971
1972
5
0
-5
1 FEB
1 MAR
1 APR
1 MAY
1 JUN
1 JUL
1 AUG
1 SEP
1 OCT
1 NOV
1 DEC
1 JAN



1973
1974
1975
1976
1 FEB
1 MAR
1 APR
1 MAY
1 JUN
1 JUL
1 AUG
1 SEP
1 OCT
1 NOV
1 DEC
1 JAN
5
0
-5
CUMULATIVE EKMAN TRANSPORT (10⁹ gm/cm)


1977
1978
1979
1980
5
0
-5
1 FEB
1 MAR
1 APR
1 MAY
1 JUN
1 JUL
1 AUG
1 SEP
1 OCT
1 NOV
1 DEC
1 JAN
CUMULATIVE EKMAN TRANSPORT (10⁹ gm/cm)