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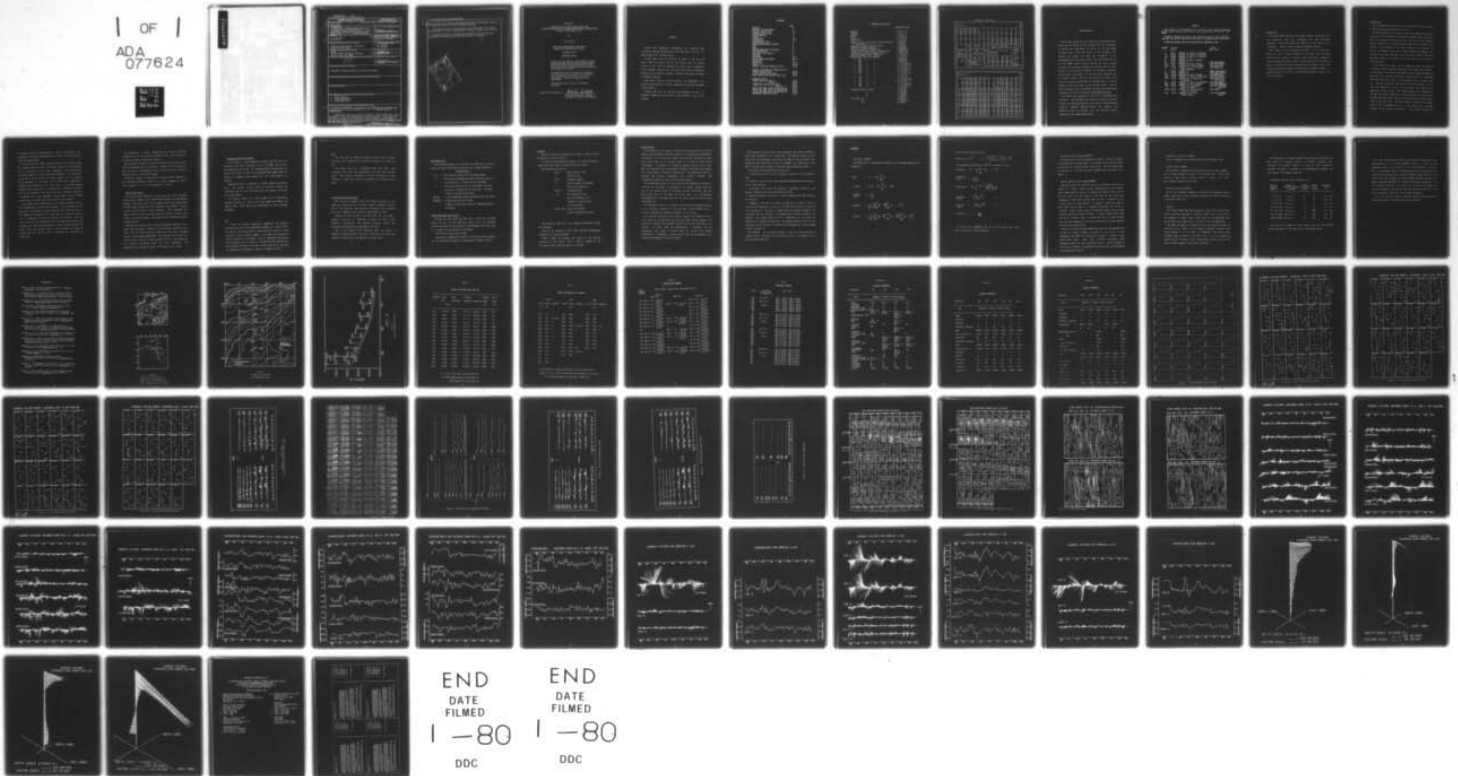
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Selected CTD data are included and displayed as plots of potential temperature and salinity versus pressure, and as T-S diagrams.

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A COMPILATION OF MOORED CURRENT METER DATA,
WHITEHORSE PROFILES AND ASSOCIATED OCEANOGRAPHIC OBSERVATIONS,
VOLUME XX (RISE ARRAY, 1974)

by

Ann Spencer

WOODS HOLE OCEANOGRAPHIC INSTITUTION
Woods Hole, Massachusetts 02543

September 1979

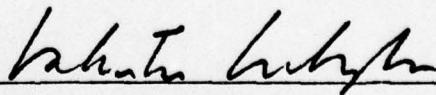
TECHNICAL REPORT

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Department of Physical Oceanography

ABSTRACT

Current and temperature measurements are presented from instruments deployed during 1974 on the continental rise (36 - 40 degrees north, 69 - 70 degrees west).

Current meters were set primarily at depths of 200 and 1000 meters above the bottom, and all the records were of 9 months duration. Basic data are displayed as scatter plots, progressive vector diagrams, spectral plots and time series plots; statistical quantities are displayed in tables. Filtered time series are shown in composite displays.

Data from a vertical current profiler, the 'whitehorse', are shown as basic profiles of current components and filtered, averaged vector profiles.

Selected CTD data are included and displayed as plots of potential temperature and salinity versus pressure, and as T-S diagrams.

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PREFACE

This volume is the twentieth in a series of Data Reports presenting moored current meter and associated data collected by the W.H.O.I. Buoy Group.

Volumes I through XIX present data obtained during the years 1963-1971, and data from special experiments performed in succeeding years (see notes).

Volume XX presents data from the Rise Array Experiment, 1974.

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		1971-1975 MODE Site
		1975-1977 POLYMODE Array II
		1978 JASIN
		1974-7575 POLYMODE Array I

Presentation

The printed pages section of the report contains introductory text and information about the instruments and data processing procedures. Tables and figures give summaries of the location of the instruments. Data are shown in numerous composite displays.

These pages are also reproduced on sheet 1 of the microfiche. Sheets 2,3 and 4 contain displays of the basic data, including spectral plots, tables of statistics, time series plots, progressive vector diagrams and scatter plots. Records from site D are shown on sheet 2, records from along 70 degrees west are shown on sheet 3 and records from along 69 degrees 20 minutes west are shown on sheet 4. A detailed layout of the data on the microfiche sheets is shown in the table of contents.

Introduction

The following brief account of the experiment and some principal results has been adapted from Luyten (1977).

Fifteen moorings were set in April 1974 with 32 VACM current meters and 2 M.I.T. T/P recorders and recovered in December 1974. (See Figs 1 and 2 for mooring locations and Fig.3 and Table 5 for instrument depths.) Mooring 517, an engineering mooring with two VACM current meters is also included in this report because of its location. It was set in December 1973 at Site D and recovered in December 1974. The Rise array data represent the first synoptic view of the field which we recognize to be typical of the deep water in the vicinity of the Gulf Stream.

In the deep water, there are two regimes for both the mean and fluctuation fields, separated nominally by the 4000 meter isobath. In the region to the south of the 4000 m isobath (depth \geq 4000m) the mean flow is principally meridional, characterized by 2 remarkably small, \leq 50 Km zonal scale. The meridional scale is larger, \sim 150 Km. The zonal component of the mean flow over this region is to the east, and appears to be part of an eastward zonal mean flow of appreciable spatial extent. This region appears to be dominated by the deep Gulf Stream variability - meridional bursts of flow of order 40 cm/sec and some 30 days duration, with essentially the same spatial scales as the mean flow. The bursts appear to become less frequent south of 36° N although there is no clear evidence for a southern boundary to this regime of variability. The filtered current data

are shown in Fig. 6 in an approximately correct disposition; for compactness, the data from mooring 525, 45 Km to the west of Site D (524) have been omitted.

To the north of the 4000m isobath the mean flow is directed along the isobaths toward the west. The spatial scales of the flow appear to be controlled by the local topography. The low-frequency variability seems to involve two distinct phenomena. The fluctuation at periods of order 30 days and longer appears to be of a spatial scale comparable to the width of the upper Rise, suggesting a meandering and pulsation of the mean flow. In the band between roughly 5 and 20 days there is a characteristic fluctuation of smaller spatial scale making an acute angle with local topography, associated by Thompson (1971) with topographic Rossby waves. Near the 4000m isobath there is a smooth transition between the two regimes.

The non-geostrophic contributions to the momentum balance for the time averaged mean flow have been estimated. The acceleration of the mean flow by the Reynolds stresses associated with the eddy field or low frequency fluctuations are of the order of 1 cm/sec per day, an order of magnitude less than the Coriolis acceleration. Over the lower rise, the eddy field does work on the mean flow, whereas over the upper rise, the eddy field appears to extract energy from the mean field. While the possible errors in the estimates are large, we believe that the sign and order of magnitude are consistent and significant.

The Whitehorse, a current, temperature and salinity profiling instrument, was put into operation during May 1974. The locations of the drops are shown on Fig.2 and in Table 4.

CTD stations were made at the mooring locations on several cruises while the moorings were in the water. A summary of the stations is given in Table 3. Representative data are shown with the individual instrument data on the microfiche pages.

Scientific analyses of data from this experiment have appeared in the following references: Luyten, J. R. (1977), Thompson, R. (1977, 1978), Schmitz, W. J. Jr. (1977) and Wunsch, C. (1976).

Current Meter Types

The current meters described in this report were Vector Averaging Current Meters (VACMs), built by AMF SeaLink Systems (now EG&G SeaLink Systems). Each time a pair of rotor magnets passes the sensing diode the VACM samples compass and vane information and computes a measure of east and north water current components. These components are summed through the entire recording interval, usually 15 minutes, thus giving a true vector average. One complete rotor revolution initiates 8 compute cycles.

Temperature is derived from a voltage-to-frequency converter (v/f), whose output frequency is related to the thermistor resistance at its input. The v/f output pulses are summed over the entire recording interval thus averaging temperature. All variables are recorded on a cassette tape at the end of each recording interval. The thermistors are routinely calibrated before and after deployment. The temperatures are accurate to about $\pm .01^{\circ}\text{C}$ (Payne et al., 1976).

Temperature/Pressure Recorder

An instrument to record temperature, pressure and time (T/P) was developed in the Draper Laboratory at M.I.T. for MODE-1 and has been used extensively since 1973. The instrument stores a sample every 15 seconds and records the sum of 64 successive data samples every 16 minutes on a magnetic tape cassette (64 x 15 = 960 seconds = 16 minutes).

Temperatures have a resolution of .001°C (Wunsch and Dahlen, 1974). The absolute accuracy cannot be specified because the thermistors have not been calibrated since the original calibration by the manufacturer.

The pressure sensor is a strain gauge with a manufacturer specified accuracy of .03% of the scale range used (Wunsch and Dahlen, 1974). These sensors are recalibrated for each instrument deployment.

CTD

A device to measure conductivity, temperature and pressure, manufactured by Neil Brown Instrument Systems, Inc. (Brown, 1975), was used at the mooring sites to obtain vertical profiles of these quantities. Table 3 gives a summary of the times and locations of profiles presented in the report. Plots of temperature and salinity versus pressure, and T/S plots are included for each mooring site. The data were collected on R/V Knorr cruises 39,40 and 44. The plots are presented on fiche pages 2, 3 and 4, in columns 13 and 14.

Time

Time from T/Ps and VACMs was measured using a quartz crystal oscillator with a manufacturer's specified accuracy of ± 1 second per day.

All stated times are in Greenwich Mean Time (CUT). The instrument clock times were synchronized with CUT before mooring launch. After recovery, differences in the two times were less than 2 minutes. A single worst case was a difference of 45 minutes (record 5252).

Current Meter Data Processing

Data recorded on magnetic tape (1/8" 4-track cassettes) in the VACMs were transcribed on to 9-track computer compatible tape at W.H.O.I. The data were then converted to scientific units (decoded) and stored on magnetic tape in Maltais format (Maltais, 1969)

Editing the data included selecting start and stop times, applying corrections to temperature indicated by post cruise thermistor calibrations, and removing erroneous records and interpolating through the resulting gaps in the data.

Some of the displays show low-passed data. For these, a symmetrical running Gaussian filter with a half-width of 24 hours and a window of width 24 hours was applied to the basic data.

Data Identifiers

The following example will illustrate the scheme that is used to insure that each current meter data series has a unique identifier:

5312Bldg(au)24.

- 531 - The first three digits are the mooring number.
- 2 - The relative instrument position starting at the top of the mooring. 1 denotes the top instrument.
- B - The position of the letter in the alphabet indicates the amount of editing that has been done. The symbol \$ means no editing has been done.
- { 1dg24 - a 1-day subsampled Gaussian filtered series, the filter
1dgau24 having a half width of 24 hours.
a number (e.g.900) would refer to a sampling interval in seconds.

Moored Instrument data quality

Overall, the data return was about 97%. A total of 34 current meters was set. 31 had 100% data return, (i.e. all variables returned good data for the duration of the mooring), and 3 had a loss of 1 variable for the duration of the mooring.

The T/Ps had a data return of 100%.

Data return is summarized in Table 2, and notes of minor problems are in the statistics tables on the microfiche, (columns 3 and 10).

Moorings

Details of mooring configuration are shown in Table 5 and on microfiche, in row G of sheet 1.

The items on each mooring are listed at the left, and depths or lengths are listed under the appropriate mooring number.

Some abbreviations used are:

(2323)	Actual depth of item.
2	Length of item.
V-102	Instrument number.
-4-	Position number of instrument used in data identifier.
Anchors	A Stimson anchor
(2)	and a Danforth if (2). Each are attached to the length(s) of chain denoted in the item above.
chain & sph.	Chain with flotation spheres attached every meter.

See Heinmiller (1976) for a more complete description of Woods Hole moorings.

Data are not presented in this report from the thermographs, tensiometers or corrosion modules.

Table 1 shows the duration and location of the moorings described in this report. Table 2 gives a summary of the instruments, their depths and quality of the data.

The Whitehorse

The Whitehorse is an acoustic dropsonde developed and built by William Schmitz, Richard Koehler and Arthur Voorhis at the Woods Hole Oceanographic Institution. It is a free fall vehicle which records internally the round trip travel time for an acoustic pulse to as many as four moored transponders. It transmits at 11.0 KHZ and receives on 8.5, 9.0, 9.5, 10.5 KHZ. The repetition rate is adjustable, although a 20 second cycle appears to be long enough to eliminate reverberations. The navigation system is a modified AMF acoustic transponder with multiple receivers. AMF transponding releases are used for the acoustic beacons.

The navigational accuracy of the system has been examined for periods of time when the instrument is stationary on the bottom, slightly above the plane of the beacons, before the instrument releases its anchors. The root mean square error in the round trip travel time is 0.5 milliseconds, corresponding to a positional error of less than ± 1 meter, relative to the transponder net.

The horizontal velocity is estimated from differencing smoothed profiles of the horizontal trajectory of the instrument. The estimated error in velocity, averaged over 100 meter increments, is ± 1.5 cm/sec.

The relative positions of the acoustic beacons are determined from a least square fit of some 80-100 sets of travel times from the surface. The Whitehorse transducer was suspended 13 meters from a float drifting on the surface. The water depth was approximately 4 kilometers and the transponders were moored 30 meters above the bottom, with nominal separations of 3 kilometers. It was estimated that the net parameters were consistently determined to within ± 2 meters.

The Whitehorse contains a Neil Brown Instruments Inc. CTD microprofiler. This system is sampled at a 0.5 second rate. The expected accuracy of this system when the appropriate corrections are made for the lag between the temperature and conductivity sensors is: ± 0.003 DEG C in temperature, ± 0.002 0/00 in salinity and ± 3 decibars. (Fofonoff, Hayes and Millard, 1974).

Processing of the Whitehorse Data consists of:

1. Transferring raw data from the instrument cassette to 9-track magnetic tape.
2. Decoding to obtain travel times, conductivity, temperature and pressure at 20 sec. time intervals.
3. Converting travel times and pressure to positions relative to the beacons. Editing occurs before and during this step.
4. Converting changes in position to velocity components at depth intervals of 25 meters.

A summary of the time and location of each drop is given in table 4. East and North components of velocity are shown on microfiche for each drop of the Whitehorse. The depth is computed from the pressure reading of the instrument and the velocities are averaged over 25 meter intervals, the uppermost point shown being at 50 m. Conductivity is not shown and temperature is displayed on CTD plots. The average velocity profile for the instrument at each location is calculated and displayed on a vector diagram viewed in perspective.

The component plots are shown on pages 2, 3 and 4 of the microfiche, in columns 6 and 7. The vector plots are shown on fiche 1 in columns 9 and 10 and on printed pages 56-59.

Programs

Statistics. (STATS)

The quantities are calculated according to the following formulae for a variable X.

$$\text{mean} = \bar{X} = \frac{1}{n} \sum_{i=1}^n X_i$$

$$\text{variance} = (\sigma_x)^2 = \frac{1}{n} \sum_{i=1}^n X_i^2 - (\bar{X})^2$$

$$\text{standard error} = \frac{\sigma_x}{n^{1/2}}$$

$$\text{skewness} = \frac{1}{\sigma_x^3} \left[\frac{1}{n} \sum_{i=1}^n X_i^3 - \frac{3\bar{X}}{n} \sum_{i=1}^n X_i^2 + 2\bar{X}^3 \right]$$

$$\text{kurtosis} = \frac{1}{\sigma_x^4} \left[\frac{1}{n} \sum_{i=1}^n X_i^4 - \frac{4\bar{X}}{n} \sum_{i=1}^n X_i^3 + \frac{6\bar{X}^2}{n} \sum_{i=1}^n X_i^2 - 3\bar{X}^4 \right]$$

With the following definitions:

$$\text{variance of } u = \overline{U'^2}, \quad R = \sqrt{\left(\frac{\overline{U'^2} - \overline{V'^2}}{2}\right)^2 + \overline{U'V'}^2}$$

The quantities calculated for east (U), and north (V) are:

$$\text{covariance} = M = \frac{1}{n} \sum_{i=1}^n U_i V_i - \bar{U} \bar{V}$$

$$\text{correlation coeff.} = \frac{M}{\sigma_u \sigma_v}$$

$$\text{orientation} = \frac{1}{2} \left(\tan^{-1} \frac{2 \overline{U'V'}}{\overline{U'^2} - \overline{V'^2}} \right)$$

$$\text{major axis (mjx)} = \frac{\overline{U'^2} + \overline{V'^2}}{2} + R$$

$$\text{minor axis (mnx)} = \frac{\overline{U'^2} + \overline{V'^2}}{2} - R$$

$$\text{ellipticity} = 1 - \frac{\text{mnx}}{\text{mjx}}$$

See volume XVII (POLYMODE Array II) of this series for a more detailed discussion of these parameters.

Progressive Vector Diagram (PROVEC)

The progressive vector displacements are plotted. These are derived by multiplying the average speed in an interval by the interval length and joining the resulting vectors head-to-tail. The plot begins with an asterisk (*). All following month boundaries are indicated by the symbol + .

Special composite plots (DISPLO,CONTOR)

Additional plots are shown on the first microfiche sheet and on pages 27-41. Figure 4 shows an array representation of the currents, mostly 1000m above the bottom. A running mean Gaussian filter with 10 day half width has been applied to the one day time series and 'snapshots' of plan views are shown every 5th day. In figures 5 and 6, a 1-day filter has been applied. In figure 5, arrays are shown at both levels and in Figure 6 a composite meridional time series is displayed. Figure 7 shows results of objective analysis of the stream function from 10 day filtered currents. A frame is shown every 2 days starting at 28 April, 1974. In Figures 8,9 and 10, 10-day filtered east and north components of velocity are shown as individual component plots and vector stick plots.

Variation of daily averaged temperature about the time-averaged mean is shown as contour diagrams in figure 12, and 10 day filtered temperatures are shown as a time series in figure 11. Figure 13 shows time-latitude plots. These plots illustrate meridional phase propagation toward the south (see Luyten (1977)). Each tick denotes 2 days and the latitude is represented vertically with the northernmost record position at the top.

Variable vs. time plot. (DISPLO)

This is a diagram of any variable plotted as a function of time.

Scatter Plots. (DISPLO)

East and north components are plotted as points on a polar diagram. The line drawn through the points is the principal axis. It has slope theta (θ) (where theta is given by $\tan(2\theta) = (2uv) / (u^2 - v^2)$) and it passes through the point (\bar{u}, \bar{v}) .

Vector Stick plots.(DISPLO)

The 24 hour averaged components are plotted as individual vectors along a time scale. Unless otherwise indicated, the vector orientation is such that north is up.

Spectra.

The program TIMSAN (Time Series Analysis) (Hunt, 1977) uses the Fast Fourier Transform algorithm of Singleton (1969) and is restricted to data segments of length N points, where N must be an even number which has no prime factor larger than 5, and must be less than 8000 points.

The number of degrees of freedom for the first 40 plotted points is given by $\nu = a m s$ where m is the number of adjacent frequency bands being averaged, s is the number of independent data pieces being averaged, again as stated in the label, and a is 2 for temperature spectra and for Horizontal Kinetic Energy (HKE) spectra for which the EAST and NORTH components seem highly correlated.

The log-log plot is further averaged during plotting so that more and more points are averaged together as frequency increases. This eliminates the bunching together of points at high frequencies, increases the degrees of freedom of the high-frequency estimates, and still permits low-frequency resolution.

Averaging is done as follows (for $m=5$, $s=3$):

Spectral estimate number, K	Number of spectral estimates in average	Number of plotted points	Degrees of freedom	Confidence limits
$1 \leq K \leq 40$	$1 \times m \times s$	40	30	1.57, .56
$41 \leq K \leq 70$	$2 \times m \times s$	15	60	1.39, .67
$71 \leq K \leq 100$	$5 \times m \times s$	6	75	1.34, .71
$101 \leq K \leq 400$	$10 \times m \times s$	30	150	1.24, .79
$401 \leq K \leq 700$	$20 \times m \times s$	15	300	1.17, .85
$701 \leq K \leq 1000$	$50 \times m \times s$	6	750	1.10, .90
$1001 \leq K \leq 4000$	$100 \times m \times s$	30	1500	1.07, .93

For most of the spectra in this report, there are 750 (3750/5) spectral estimates, so that there will be 107 plotted points.

For $\nu \geq 30$, the confidence limits for the spectral estimates are given approximately by $(1 - 2/9\nu \pm z\sqrt{2/9\nu})^3$ where $z = 1.28$ for 80% confidence limits, $z = 1.65$ for 90% , $z = 1.96$ for 95% and $z = 2.58$ for 99%. In the example above, if the HKE spectral plot label had indicated 2 pieces and averaging over 8 adjacent frequency bands then $\nu = 2 \times 2 \times 8 = 32$ for the lowest frequencies (assuming NORTH and EAST components are highly correlated) and $200 \times 32 = 6400$ for the highest frequencies. The 95% confidence intervals (i.e., 95% of the time one would expect the spectral estimates to vary no more than this much) would be (0.57, 1.55) at low frequencies, and (0.97, 1.03) at high frequencies.

For $\nu < 30$, one must obtain confidence intervals from Chi-squared distribution tables in standard statistical references.

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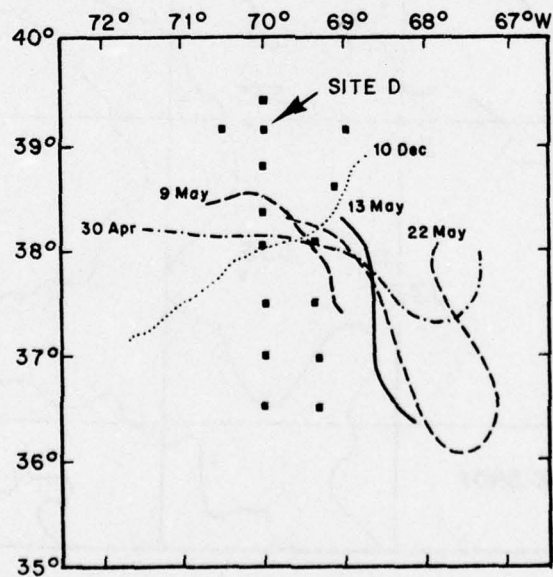
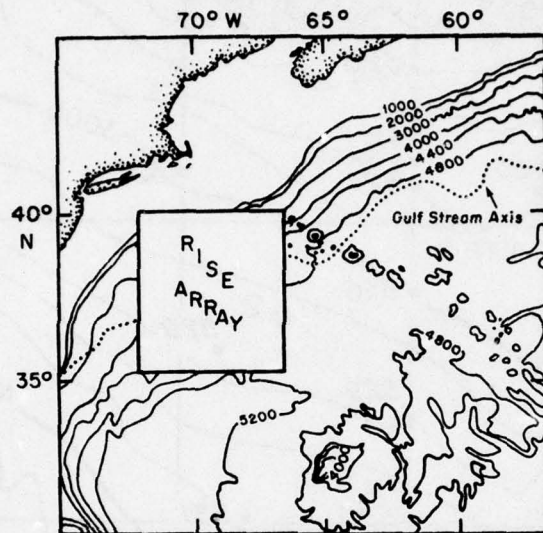


Figure 1.
 Location of Rise Array and
 position of Gulf Stream Axis
 (15° C isotherm at 200 m. depth).

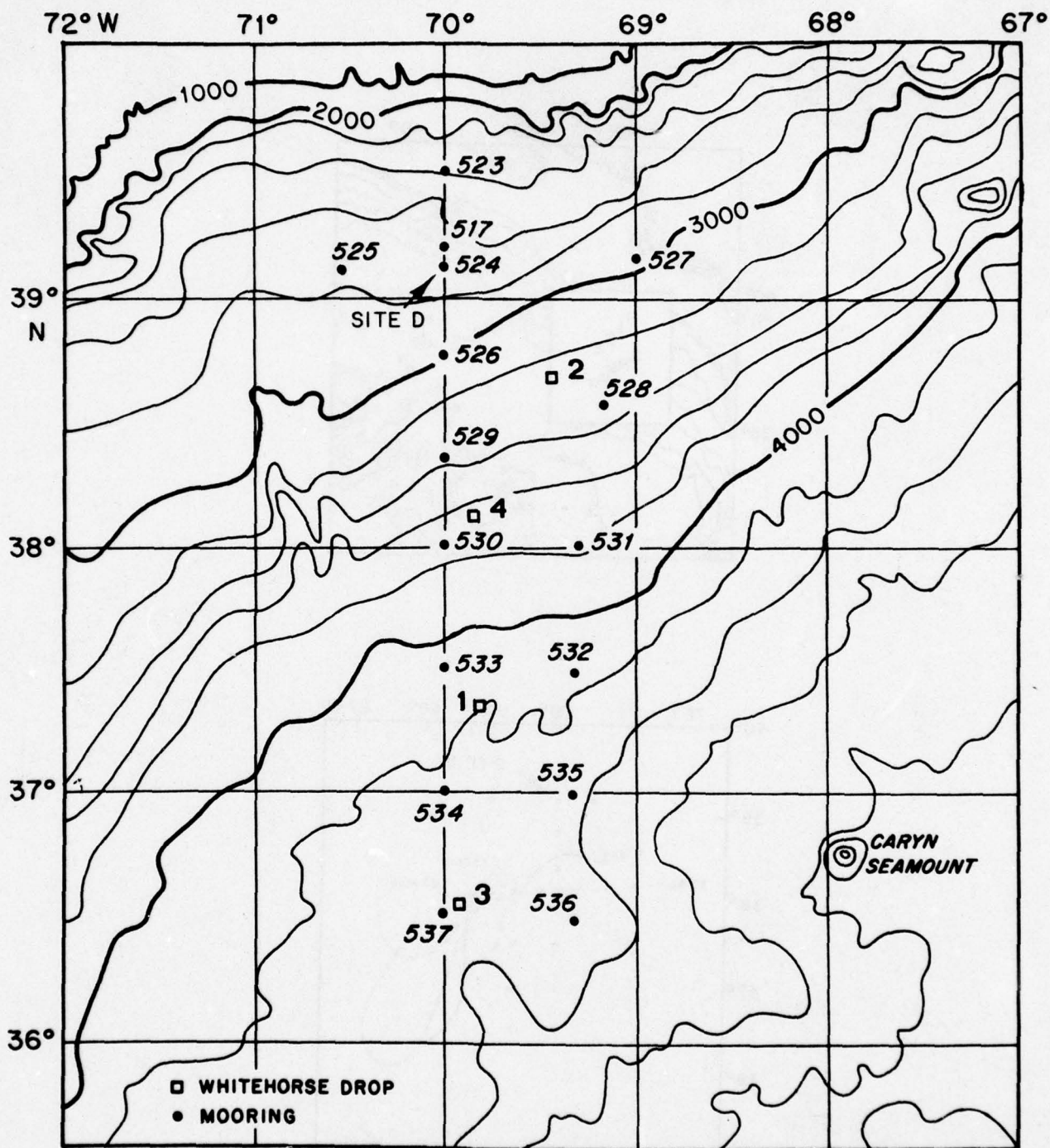


Figure 2.
 Location of Moorings
 and Whitehorse Sites.

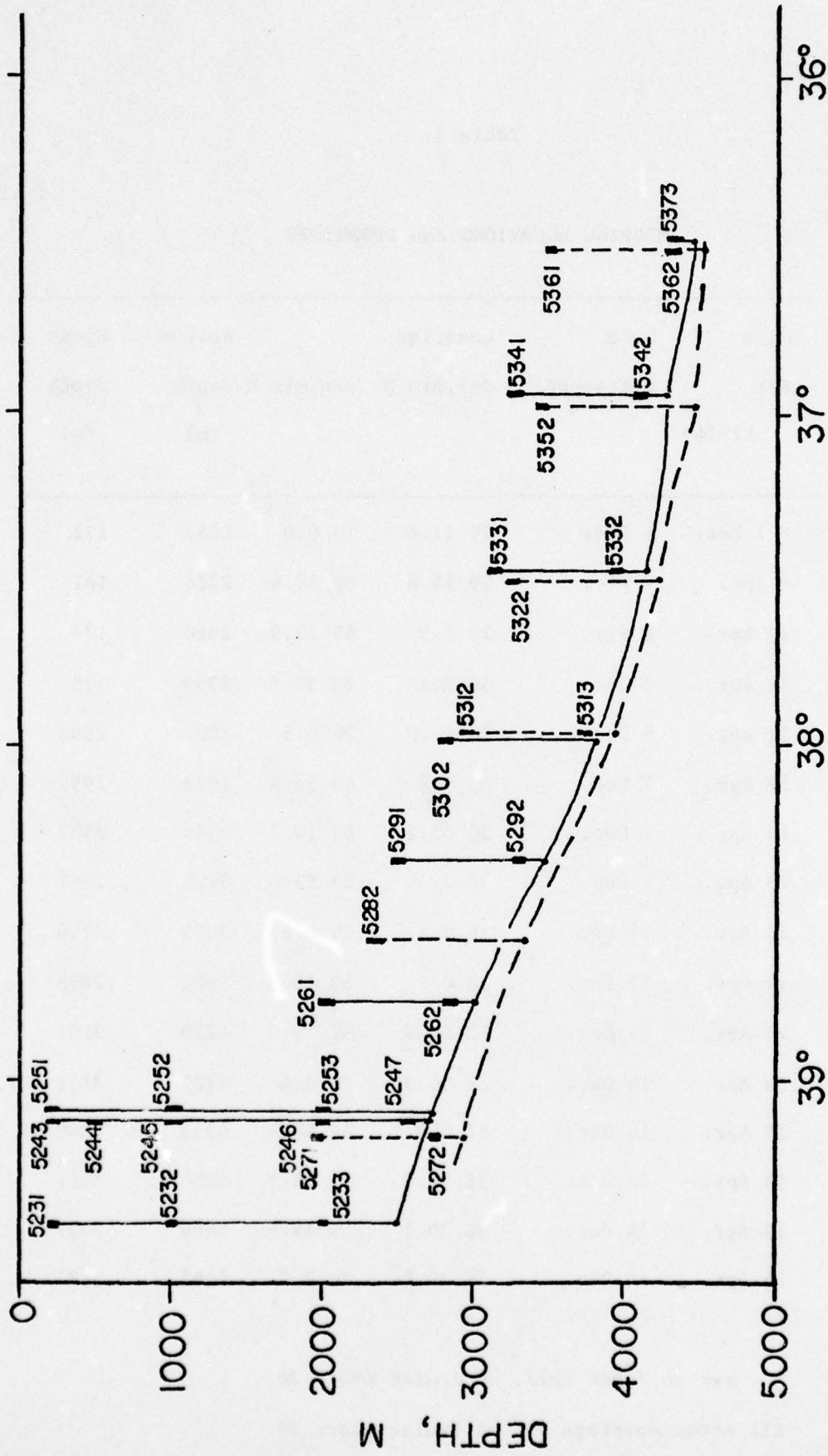


Figure 3.
Moored Instrument Locations.

Table 1.

MOORING LOCATIONS AND DURATIONS

Mooring #	Date Set (1974)	Date Retrieved	Location deg,min N	deg,min W	Bottom depth (m)	Float depth (m)
517	* 7 Dec.	5 Dec.	39 11.8	70 0.0	2647	172
523	9 Apr.	5 Dec.	39 25.6	69 59.6	2504	161
524	10 Apr.	6 Dec.	39 7.5	69 59.9	2664	174
525	11 Apr.	6 Dec.	39 7.1	70 32.6	2759	175
526	12 Apr.	6 Dec.	38 47.0	70 0.5	3007	1988
527	12 Apr.	7 Dec.	39 9.8	68 59.8	2978	1959
528	12 Apr.	7 Dec.	38 35.2	69 10.1	3326	2307
529	13 Apr.	7 Dec.	38 21.4	69 59.6	3480	2467
530	13 Apr.	13 Dec.	38 0.5	70 0.6	3815	2796
531	14 Apr.	13 Dec.	38 0.2	69 18.5	3921	2908
532	14 Apr.	14 Dec.	37 29.8	69 19.9	4210	3191
533	14 Apr.	14 Dec.	37 30.3	70 0.4	4182	3151
534	15 Apr.	16 Dec.	37 0.4	69 59.8	4339	3308
535	15 Apr.	14 Dec.	36 59.3	69 19.7	4450	3411
536	15 Apr.	14 Dec.	36 30.1	69 19.9	4468	3437
537	16 Apr.	16 Dec.	36 29.8	70 0.0	4463	3431

* set on 7 Dec 1973, on cruise Knorr 36.

All other moorings set on cruise Knorr 39
and recovered on cruise Knorr 44.

Table 2.

MOORED INSTRUMENT DATA SUMMARY

site D			70°W			69°W		
record #	depth (m)	comments	record #	depth (m)	comments	record #	depth (m)	comments
5172	193	C	5261	2006		5271	1977	
5173	197	no temp.	5262	2810		5272	2781	
5231	181	C	5291	2483		5282	2329	
5232	983	C	5292	3283	no temp.	5311	2923	T/P
5233	1991	C	5302	2818	C	5312	2925	C
5241	197	C	5331	3182		5313	3724	
5243	202	C	5332	3981		5322	3213	
5244	496	C	5341	3337		5352	3453	
5245	1005		5342	4138		5361	3466	
5246	2013		5371	3461	T/P	5362	4267	
5247	2512		5372	3463	no vane			
5251	195		5373	4262				
5252	997							
5253	2005							

All instruments are VACM current meters (unless denoted T/P).

C means there was a minor problem with the instrument or the data.

(see statistics pages on microfiche, columns 2,9)

Table 3

HYDROSTATION SUMMARY.

# of nearest mooring	Dates (1974), station #'s, locations ($^{\circ}$ N, $^{\circ}$ W)								
	Cruise:		Knorr 39		Knorr 40		Knorr 44		
523	Apr 9	(1)	39 26.4 69 57.5			Dec 5	(1)	39 27.2 70 1.2	
524	Apr 10	(2)	39 8.1 70 0.2	May 22	(26)	39 10.0 70 0.0	Dec 6	(2)	39 6.3 70 1.5
525	Apr 11	(3)	39 5.6 70 33.0			Dec 6	(3)	39 7.1 70 31.0	
526	Apr 12	(4)	38 47.2 69 59.3			Dec 6	(4)	38 45.6 69 58.0	
527	Apr 12	(5)	39 10.0 69 0.0			Dec 6	(5)	39 10.0 69 1.8	
528	Apr 12	(6)	38 35.5 69 11.0	May 11	(15)	38 40.0 69 29.0	Dec 7	(6)	38 34.8 69 7.6
529	Apr 13	(7)	38 20.1 69 59.4	May 12	(19)	38 40.0 69 28.7	Dec 7	(8)	38 22.7 70 01.0
530	Apr 13	(8)	37 59.3 69 59.0			Dec 13	(25)	38 1.0 69 57.1	
531				May 3	(7)	37 20.0 70 0.0	Dec 17	(39)	37 48.0 68 58.0
532	Apr 14	(10)	37 29.1 69 21.0	May 3	(5)	37 19.5 69 20.0	Dec 17	(38)	37 43.4 69 20.2
533	Apr 14	(11)	37 31.0 69 59.6	May 4	(13)	37 36.0 69 59.8	Dec 17	(36)	37 24.0 70 3.5
534	Apr 15	(12)	37 0.3 69 59.4			Dec 16	(32)	37 2.5 69 57.0	
535	Apr 15	(13)	36 58.9 69 19.8			Dec 14	(26)	36 58.8 69 18.3	
536	Apr 15	(14)	36 29.8 69 20.1	May 16	(23)	36 20.5 69 48.6	Dec 14	(27)	36 28.1 69 19.0
537	Apr 16	(15)	36 29.2 70 1.0	May 16	(24)	36 30.8 70 8.6	Dec 16	(30)	36 31.8 70 1.2

Table 4

WHITEHORSE SUMMARY.

Drop	Location (bottom depth) (m)	Time (1974)
101	37° 22' N	May 5 21:05 - May 6 00:03
102		May 6 02:25 - May 6 05:06
103	69° 49' W	May 7 03:20 - May 7 06:11
104		May 7 08:24 - May 7 09:33
105	(4262)	May 7 13:36 - May 7 16:28
106		May 7 23:27 - May 8 02:08
107		May 8 04:38 - May 8 07:30
108		May 8 09:34 - May 8 12:20
201	38° 41' N	May 10 21:02 - May 10 23:29
202		May 11 19:35 - May 11 22:02
203	69° 29' W	May 12 00:40 - May 12 02:55
204		May 12 05:14 - May 12 07:31
205	(3295)	May 12 10:10 - May 12 12:32
206		May 12 14:42 - May 12 17:04
207		May 12 22:40 - May 13 01:14
301	36° 30' N	May 15 17:26 - May 15 22:40
302		May 16 00:14 - May 16 03:16
303	69° 58' W	May 16 04:20 - May 16 07:10
304		May 16 08:41 - May 16 11:40
305	(4457)	May 16 13:18 - May 16 16:16
306		May 16 19:14 - May 16 23:43
307		May 17 01:24 - May 17 05:48
308		May 17 07:28 - May 17 10:52
309		May 17 11:56 - May 17 16:21
310		May 17 17:32 - May 17 20:11
401	38° 08' N	May 19 06:09 - May 19 08:44
402		May 19 10:00 - May 19 12:36
403	69° 54' W	May 19 13:24 - May 19 15:59
404		May 21 16:28 - May 21 19:03
405	(3722)	May 21 20:21 - May 21 22:57
406		May 21 23:37 - May 22 02:11
407		May 22 03:05 - May 22 05:41
408		May 22 06:41 - May 22 09:16
409		May 22 10:13 - May 22 12:50

Table 5a.

MOORING COMPONENTS				
Mooring #	517	523	524	525
Item	(Depth) or length of item in meters			
Float	(172)	(161)	(174)	(175)
1/2"chain	2	2	2	2
3/8"chain	2	2	2	2
3/8"chain & sph.	15	14	19	14
corrosion module "A"	(191) -1-			
VACM	(193) -2-	(181) -1-	(197) -1-	(195) -1-
	#V-177	#V-199	#V-139	#V-205
Depth Recorder (T/P)			(198) -2-	
			DR-1017	
3/8"chain	2		2	
VACM	(197) -3-		(202) -3-	
	#V-112		#V-136	
3/16"wire		792	292	792
1/4"wire	500			
VACM			(496) -4-	
			#V-163	
3/16"wire			500	
3/8"chain & sph.	10	8	7	8
1/4"wire	1300			
VACM		(983) -2-	(1005) -5-	(997) -2-
		#V-164	#DT-107	#V-193
3/16"wire		1000	1000	1000
3/8"chain & sph.		6	6	6
VACM		(1991) -3-	(2013) -6-	(2005) -3-
		#V-135	#V-181	#V-137
tensiometer		#1023 -4-		
3/8"dacron	568	311	474	679
VACM			(2512) -7-	
			#V-204	
3/8"dacron		138	106	
3/8"chain & sph.	15	12	12	13
corrosion module "B"	(2615) -4-			
Release	2	2	2	2
1/2"chain	5	5	5	5
3/4"nylon	20	15	15	15
1/2"chain	3	3	3	3
Anchor	(2647)	(2504)	(2664)	(2759)

Table 5b.

MOORING COMPONENTS

Mooring #	526	527	529	533	534	536
Item	(Depth) or length of item in meters					
Float	(1988)	(1959)	(2467)	(3151)	(3308)	(3437)
1/2"chain	2	2	2	2	2	2
3/8"chain	2	2	2	2	2	2
3/8"chain & spheres	12	12	10	25	25	25
VACM	(2006)	(1977)	(2483)	(3182)	(3337)	(3466)
Inst. position -1-	V-133	V-113	V-106	V-183	V-131	V-111
3/8"dacron	758	758	758	737	737	737
3/8"dacron & spheres	10	10	10	15	15	15
VACM	(2810)	(2781)	(3283)	(3981)	(4138)	(4267)
Inst. position -2-	V-0108	V-110	V-109	DT-106	V-126	V-117
3/8"chain	3	3	3	3	3	3
Release	2	2	2	2	2	2
3/8"dacron	155	155	155	155	155	155
3/4"nylon	20	20	20	20	20	20
1/2"chain	5+3	5+3	5+3	5+3	5+3	5+3
anchors (2)	(3007)	(2978)	(3480)	(4182)	(4339)	(4468)

Table 5c.

MOORING COMPONENTS

Mooring #	528	530	531	532	535	537
Item	(Depth) or length of item in meters					
Float	(2307)	(2796)	(2908)	(3191)	(3411)	(3431)
1/2"chain	2	2	2	2	2	2
3/8"chain	2	2	2	2	2	2
3/8"chain & spheres	15	15	10	15	35	25
Thermograph -1-	(2327)	(2816)	-	(3211)	(3451)	-
	#4	#1	-	#3	#2	-
Temp./depth rcdr.-1-	-	-	(2923)	-	-	(3461)
(T/P)	-	-	#34	-	-	#42
VACM	-	-	(2925)	-	-	(3463)
inst. position -2-	-	-	V-184	-	-	V-179
3/8"dacron	-	-	758	-	-	737
3/8"chain & spheres	-	-	10	-	-	15
VACM	(2329)	(2818)	(3724)	(3213)	(3453)	(4262)
	DT-110	V-115	V-107	DT-111	V-127	V-195
Inst position	-2-	-2-	-3-	-2-	-2-	-3-
3/8"chain	3	3	3	3	3	3
Release	2	2	2	2	2	2
3/8"dacron	916	916	155	916	897	155
2/4"nylon	20	20	20	20	20	20
1/2" chain	5+3	5+3	5+3	5+3	5+3	5+3
Anchors (2)	(3326)	(3815)	(3921)	(4210)	(4450)	(4463)

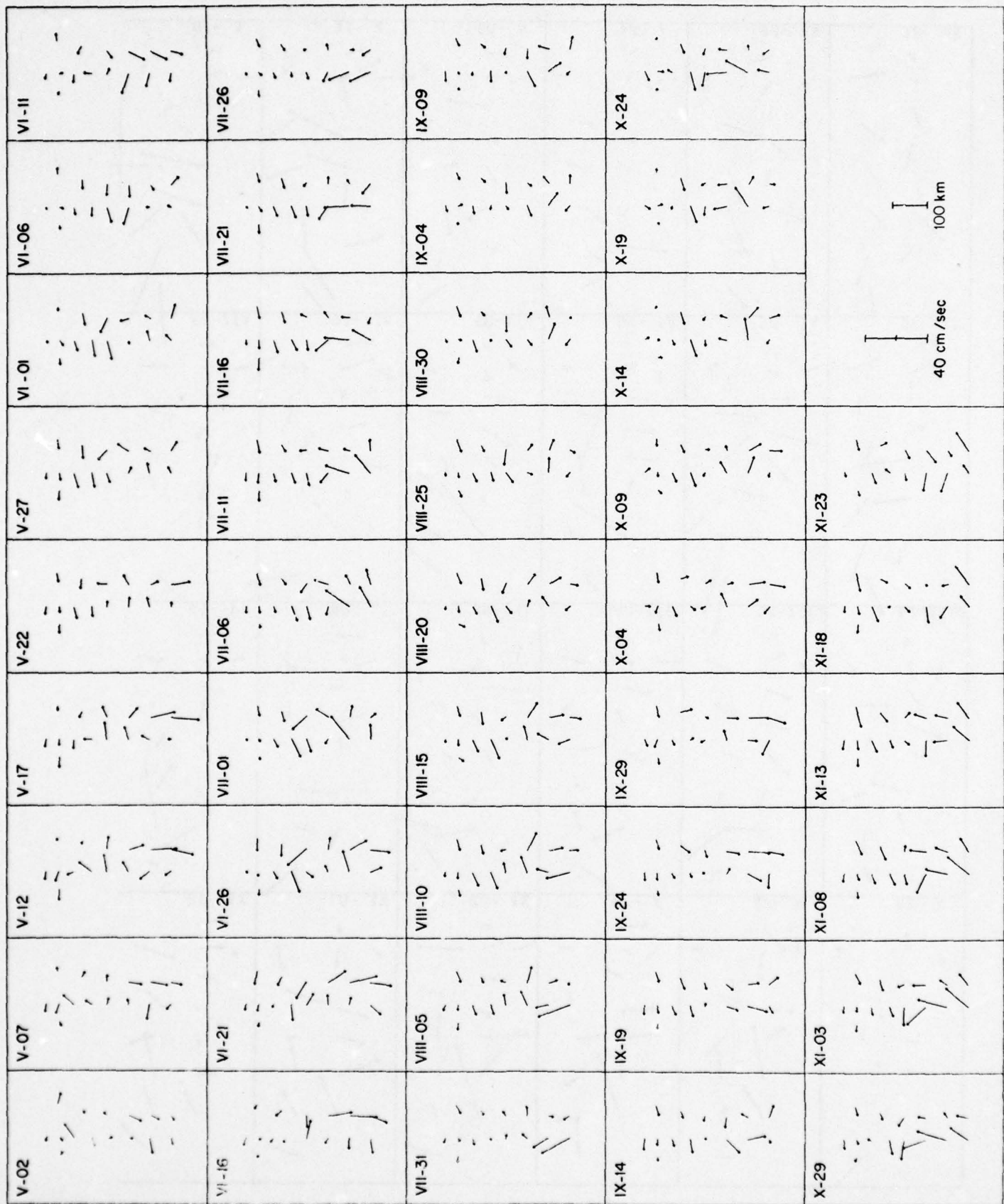
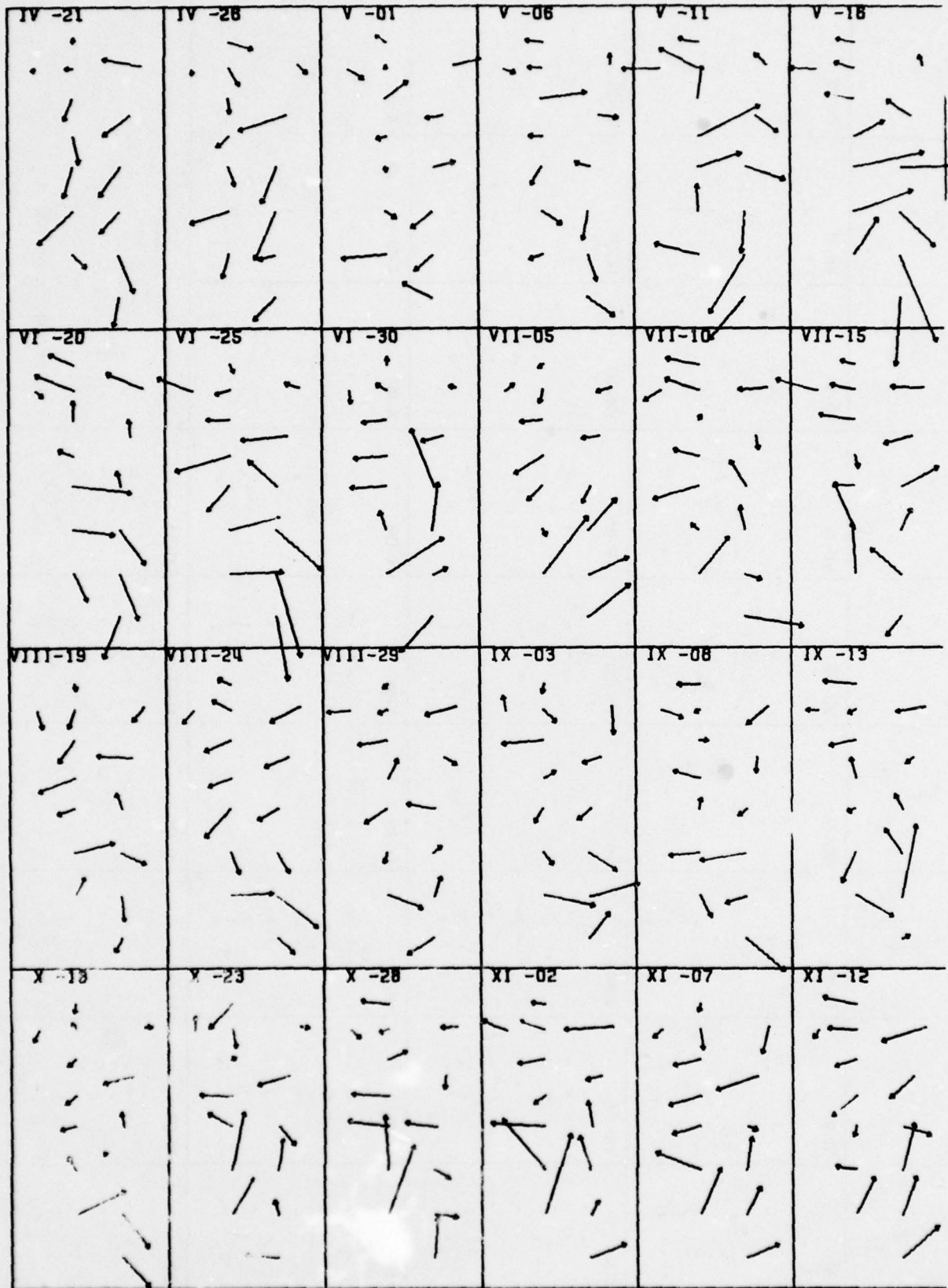


Figure 4. 10-day filtered current vectors

CURRENT VECTOR ARRAY, RECORDS 1000 M OFF BOTTOM



0 45 0 200
KM MM/SEC

Figure 5a. 1-day filtered current vectors

CURRENT VECTOR ARRAY, RECORDS 1000 M OFF BOTTOM

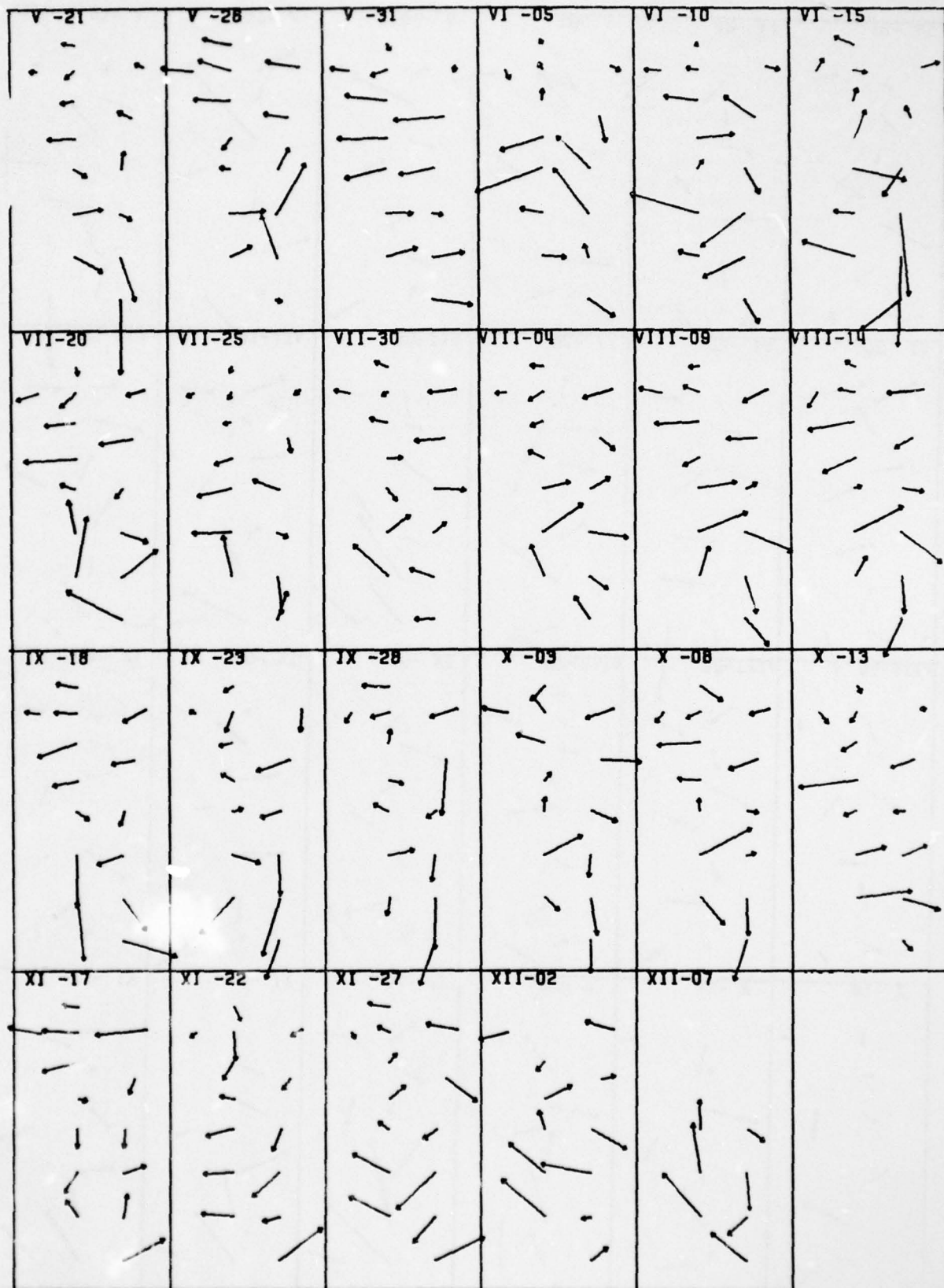
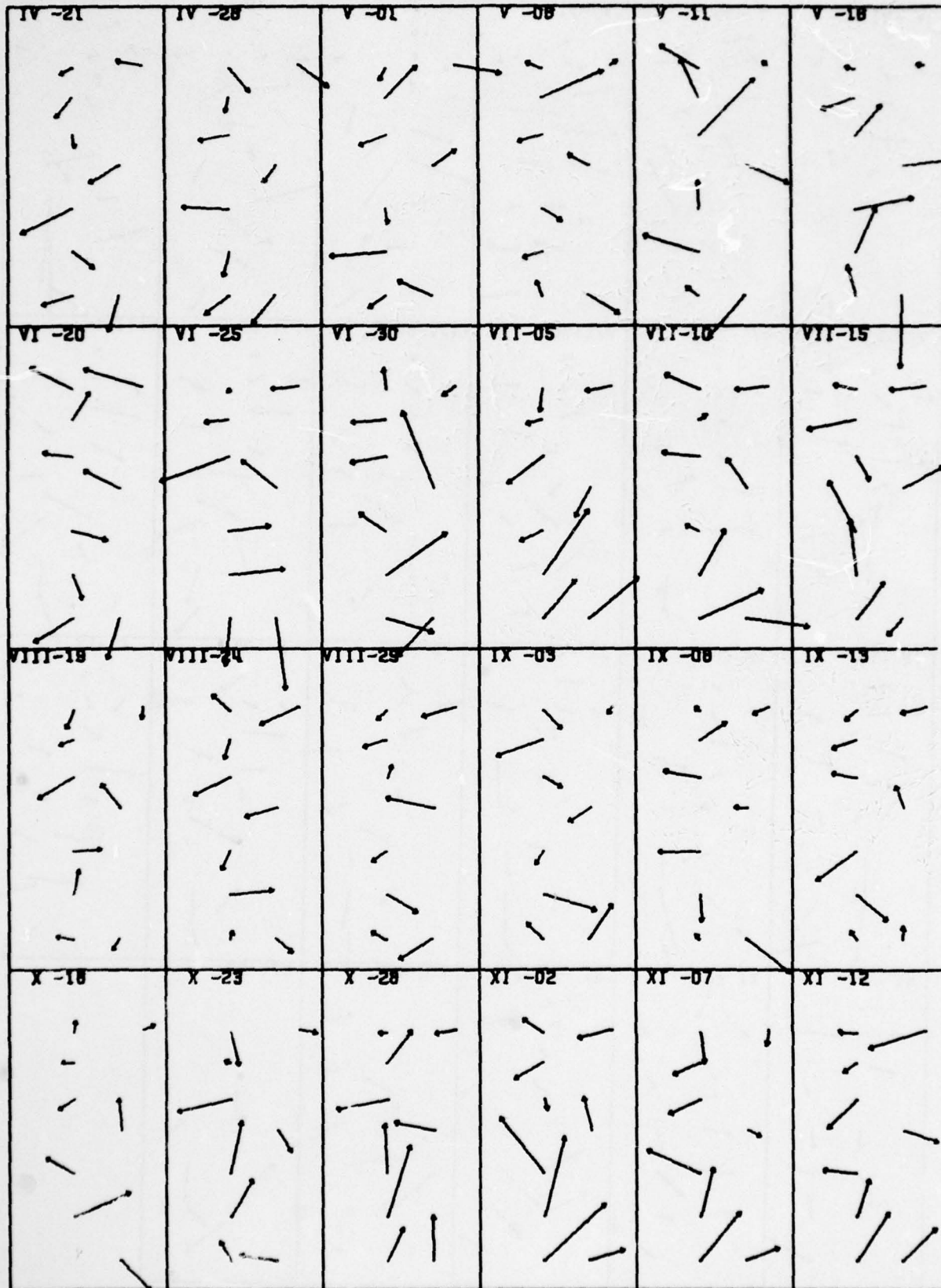


Figure 5b. 1-day filtered current vectors

CURRENT VECTOR ARRAY, RECORDS 200 M OFF BOTTOM



0 45 0 200
KM MM/SEC

Figure 5c. 1-day filtered current vectors

CURRENT VECTOR ARRAY, RECORDS 200 M OFF BOTTOM

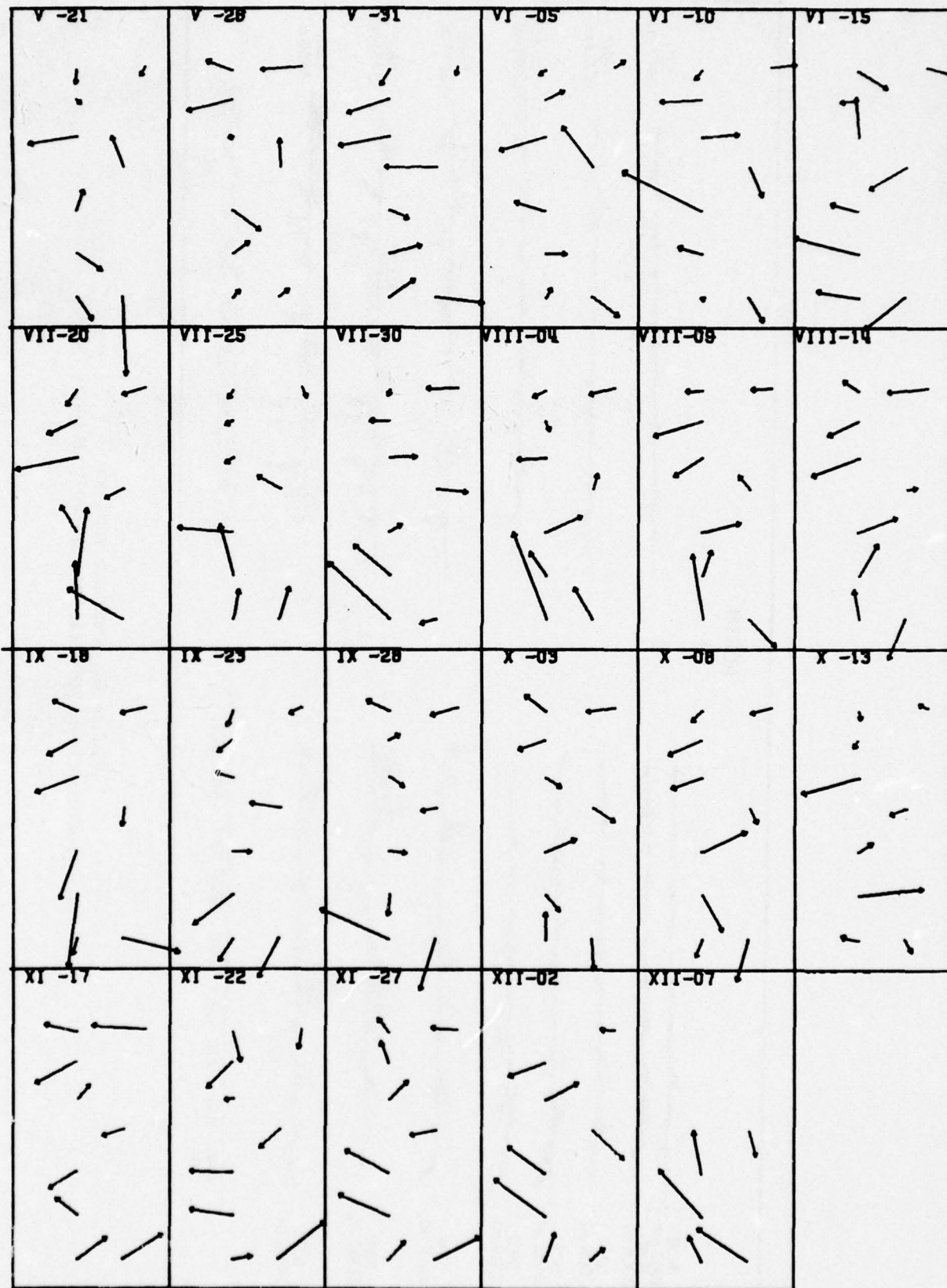


Figure 5d. 1-day filtered current vectors

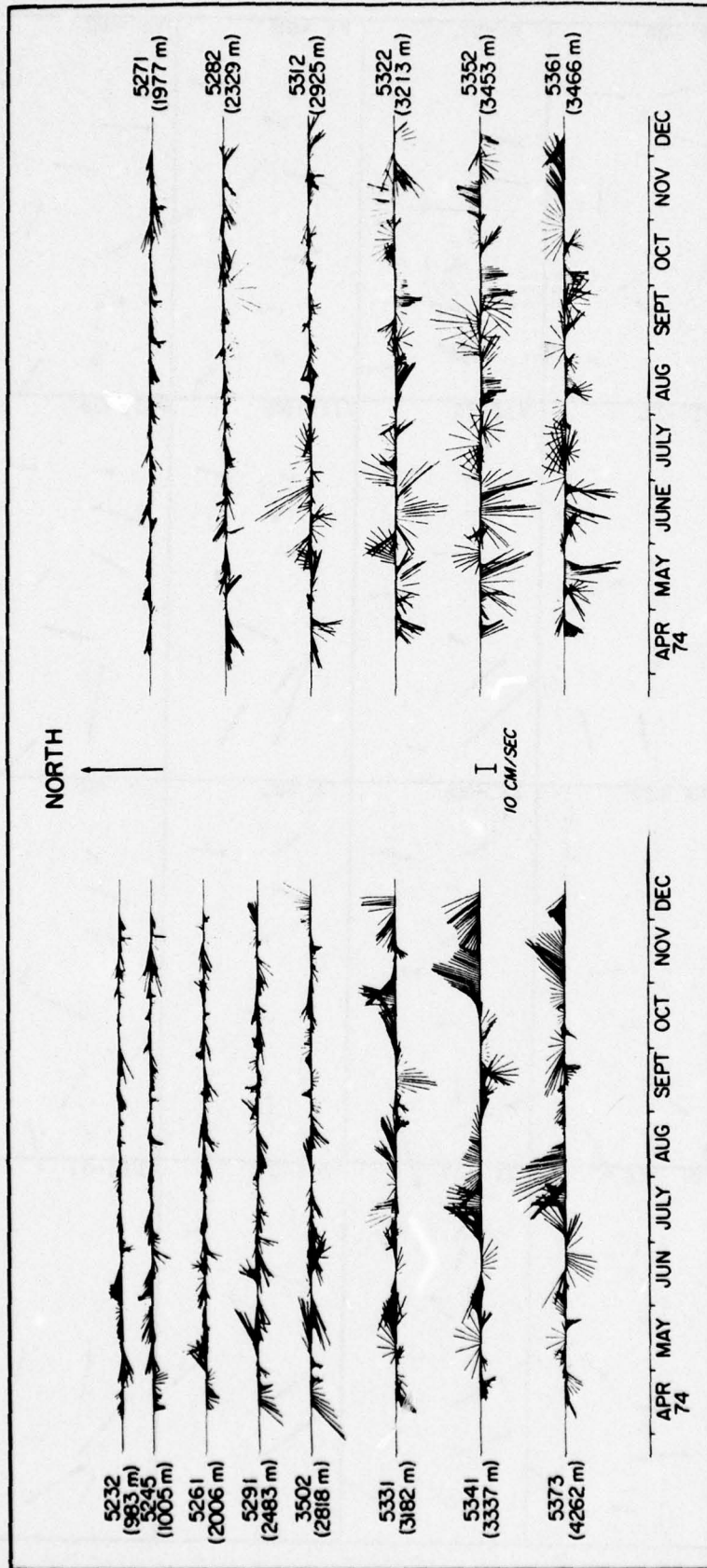


Figure 6. Current vectors
(records from 70°W (left), 69°20'W (right))

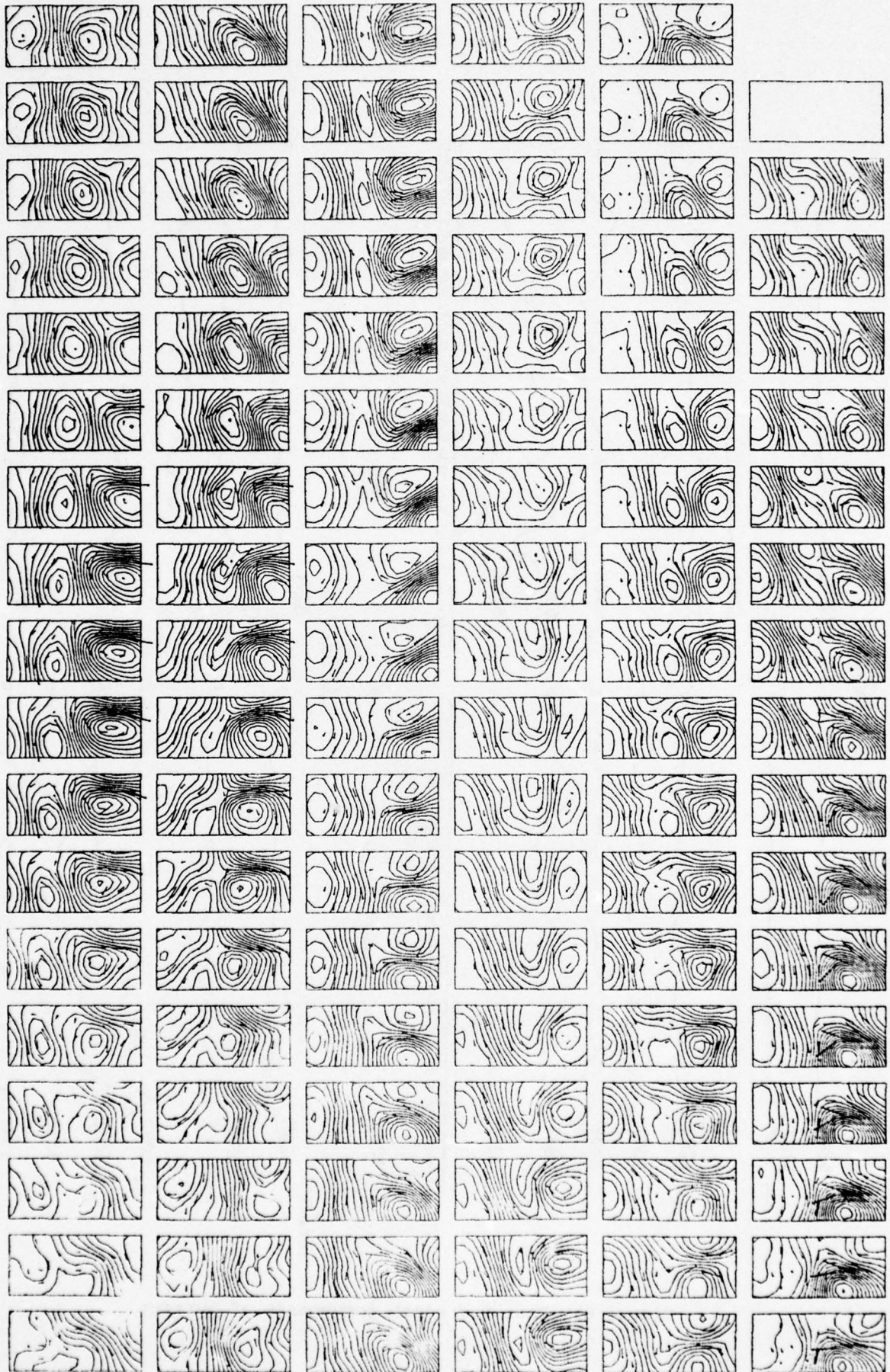


Figure 7. Stream function

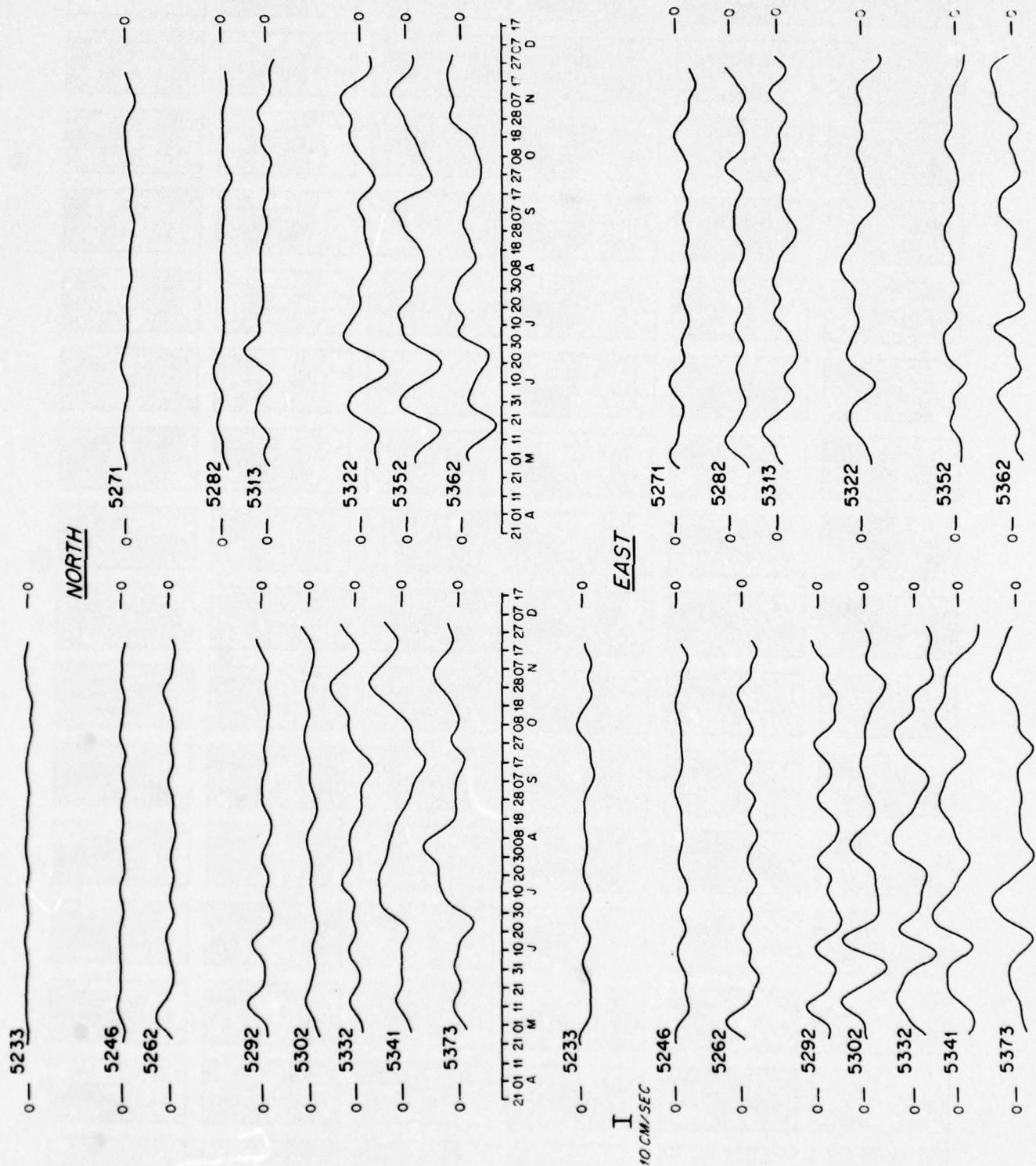


Figure 8. East and north components of current

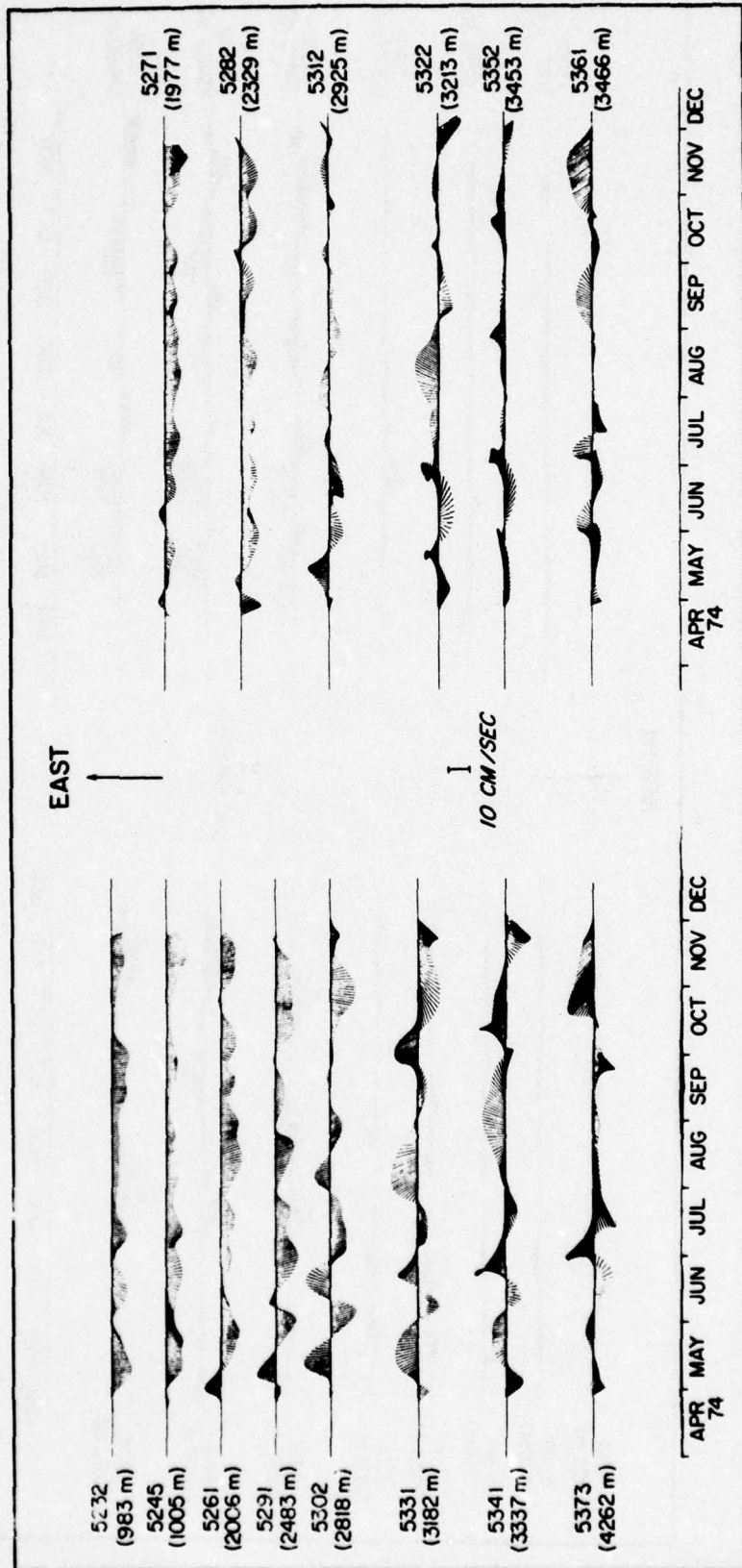


Figure 9. 10-day filtered current vectors

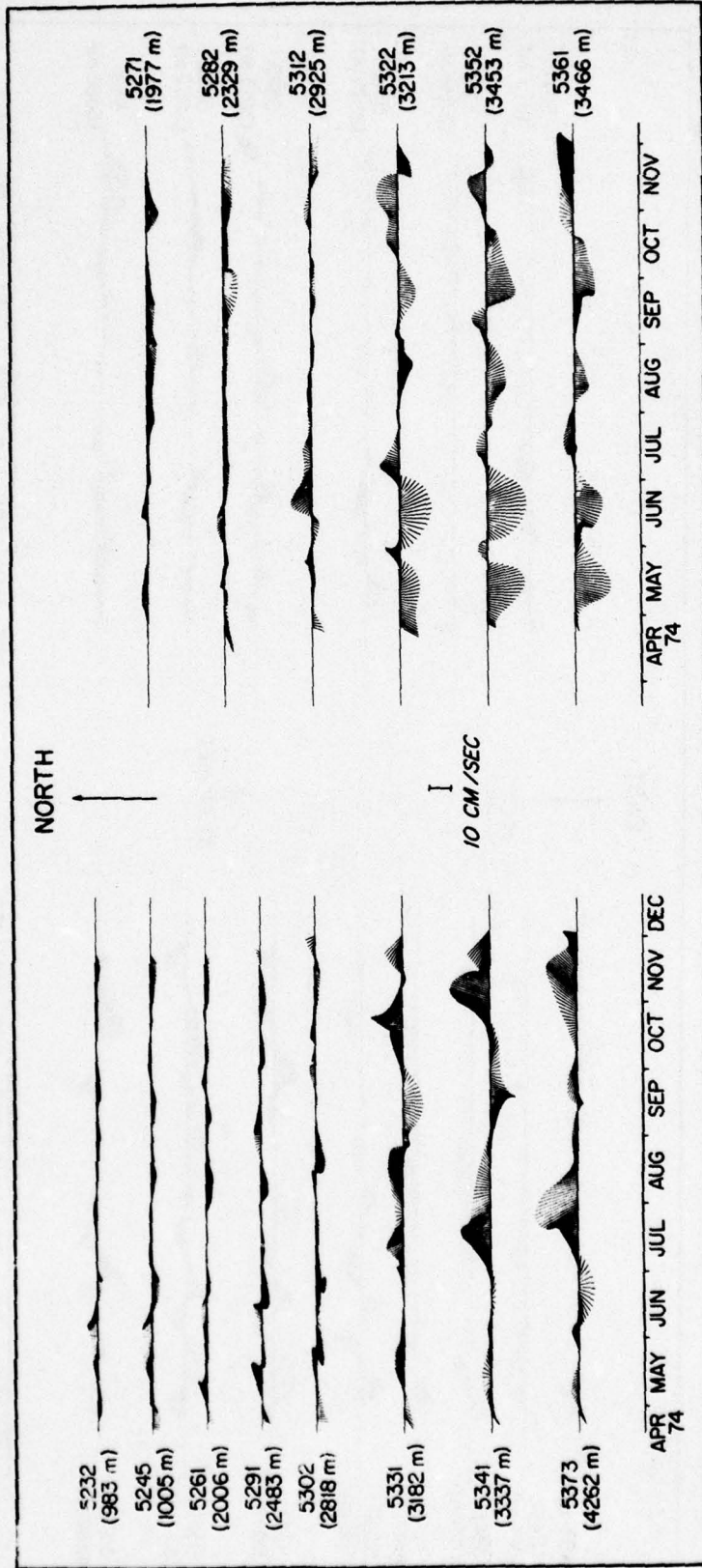


Figure 10. 10-day filtered current vectors

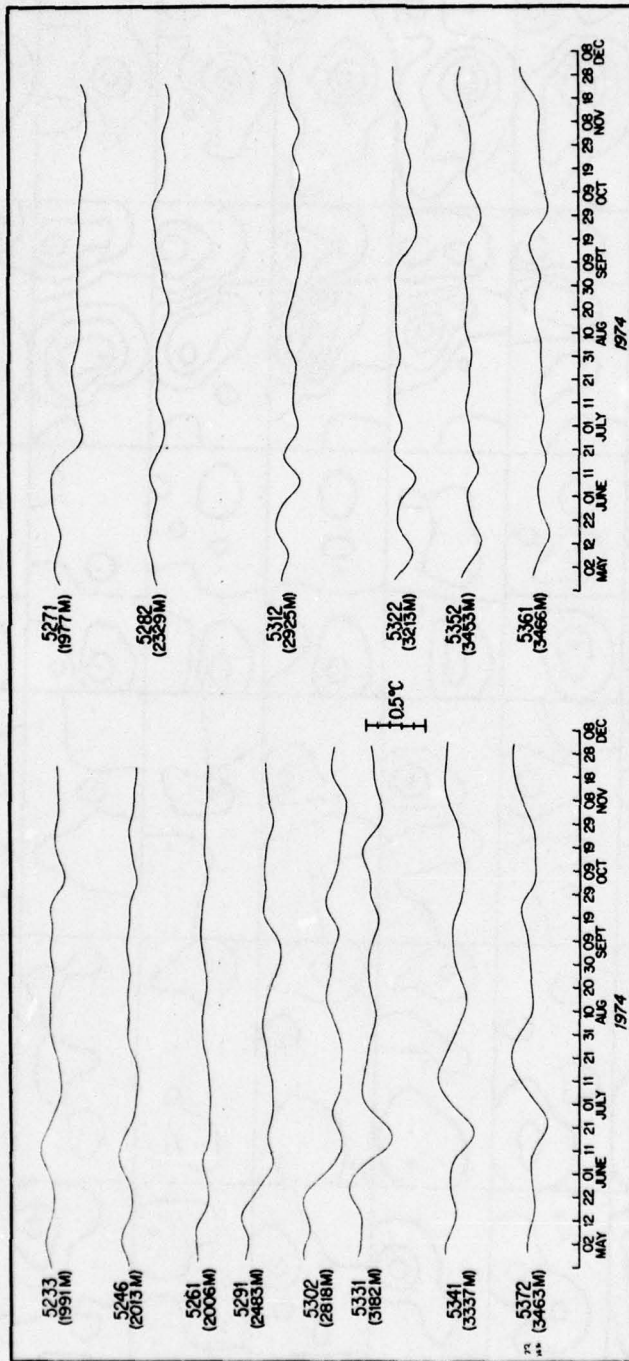


Figure 11. 10-day filtered temperatures

TEMPS. (MEAN SUBTR.) RECORDS 1000 M OFF BOTTOM.

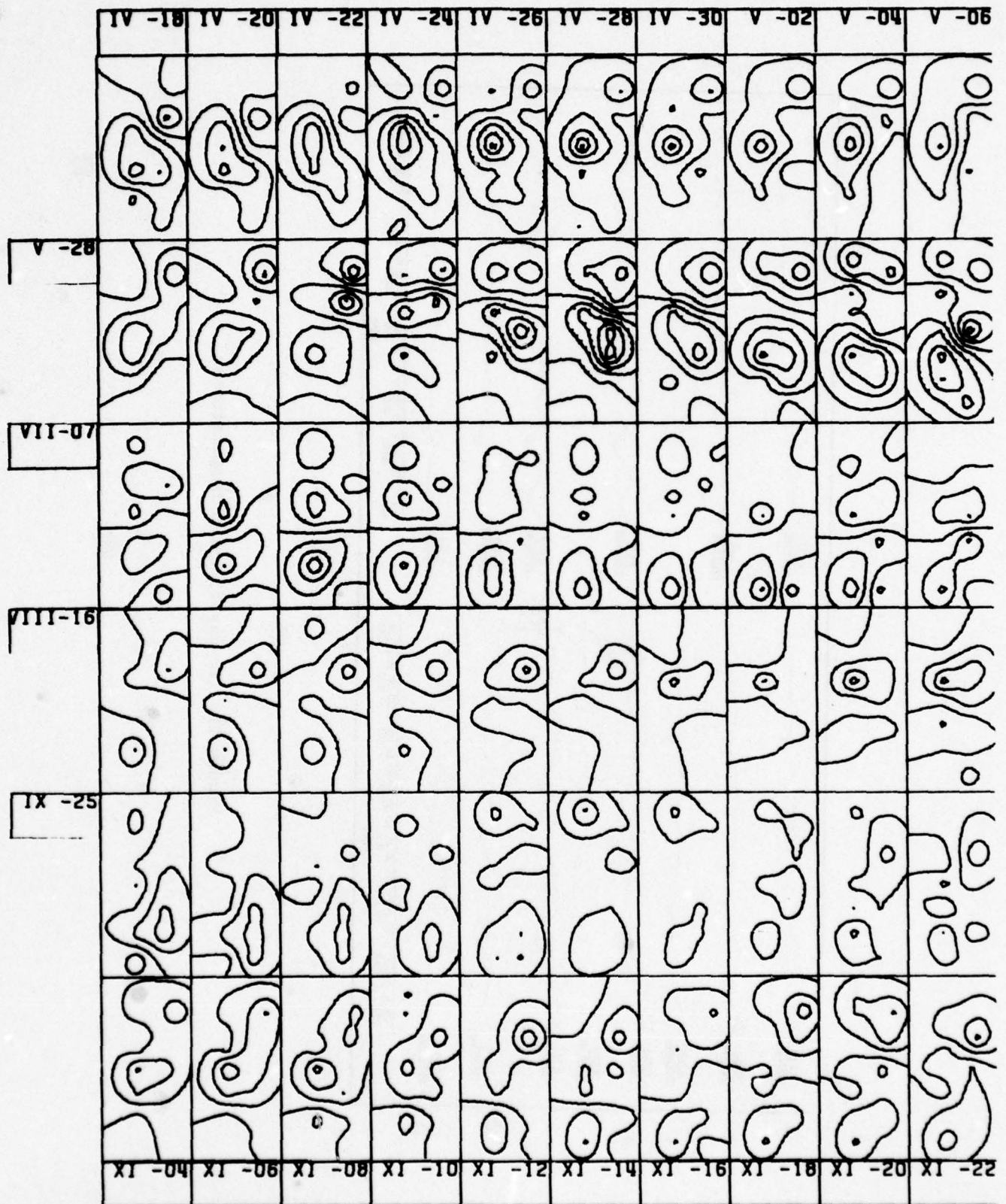


Figure 12a. Contours of temperature variation

TEMPS. (MEAN SUBTR.) RECORDS 1000 M OFF BOTTOM.

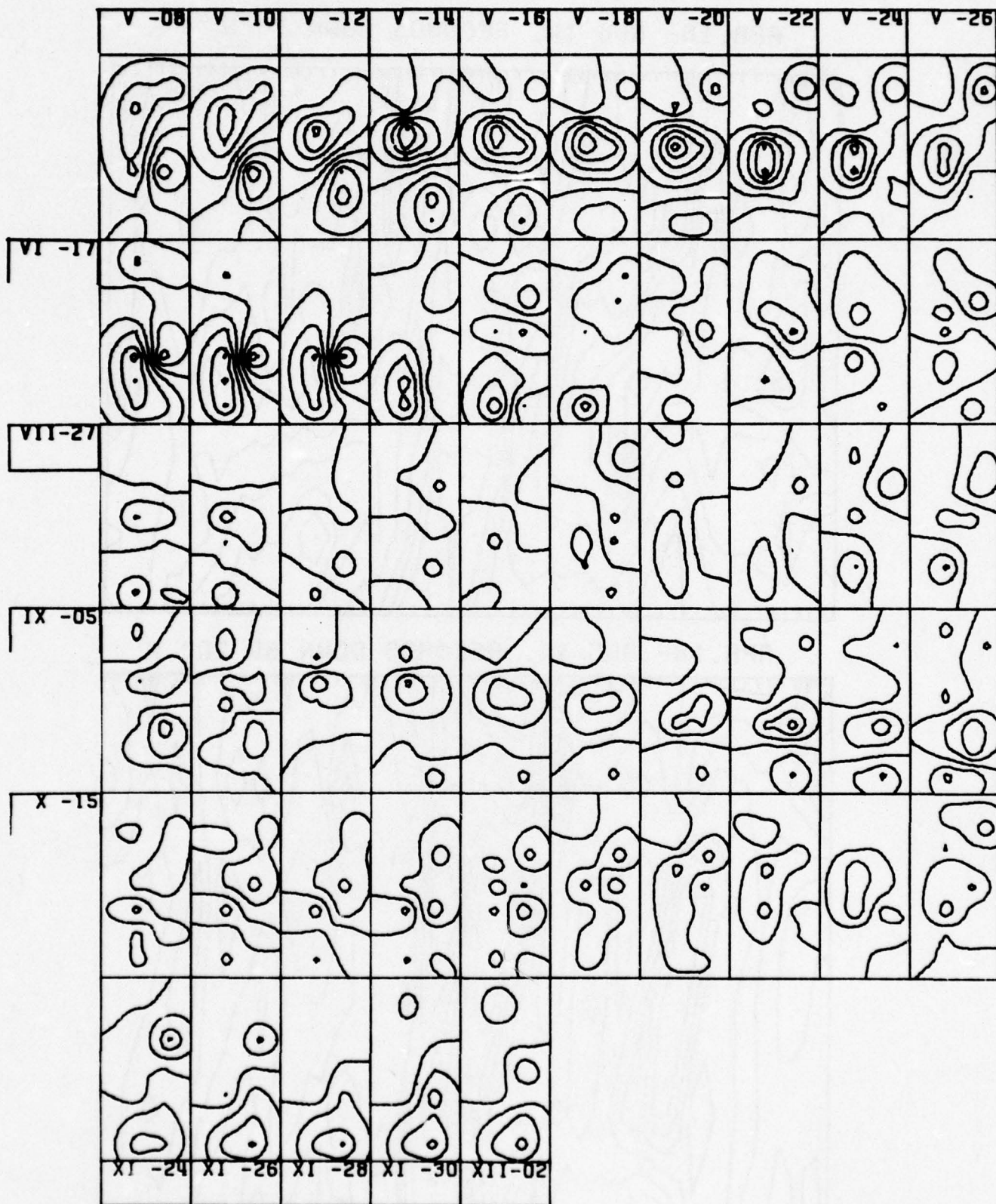
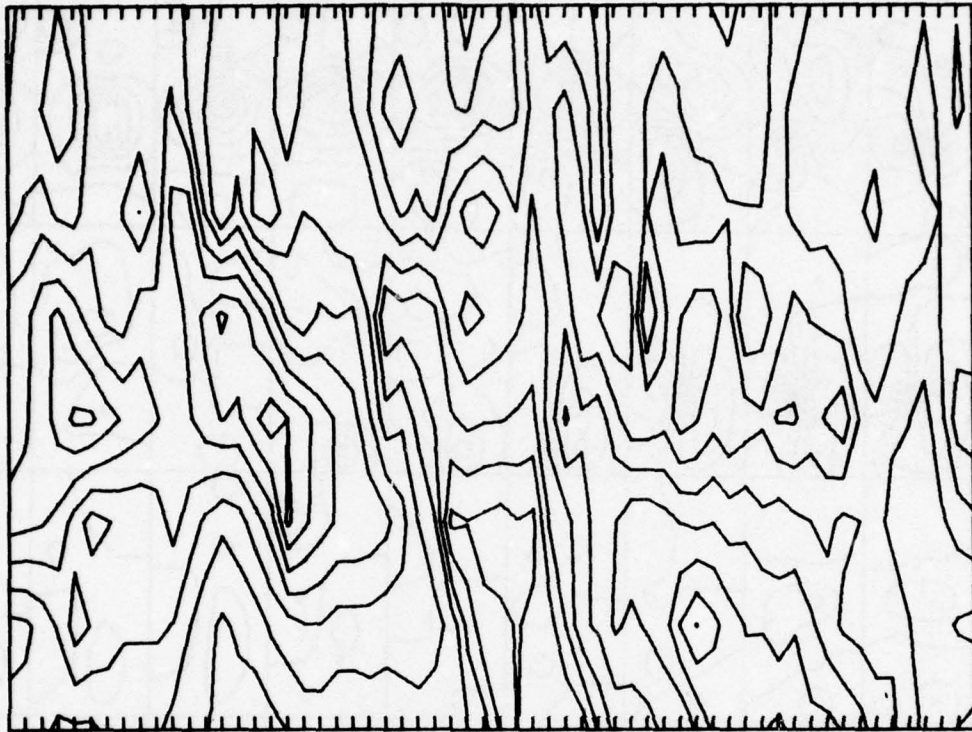


Figure 12b. Contours of temperature variation

TIME PHASE PLOT OF TEMPERATURE VARIATION,
APR. 18- AUG 14, RECORDS DOWN 70 W



APR. 18- AUG 14, RECORDS DOWN 69 20' W

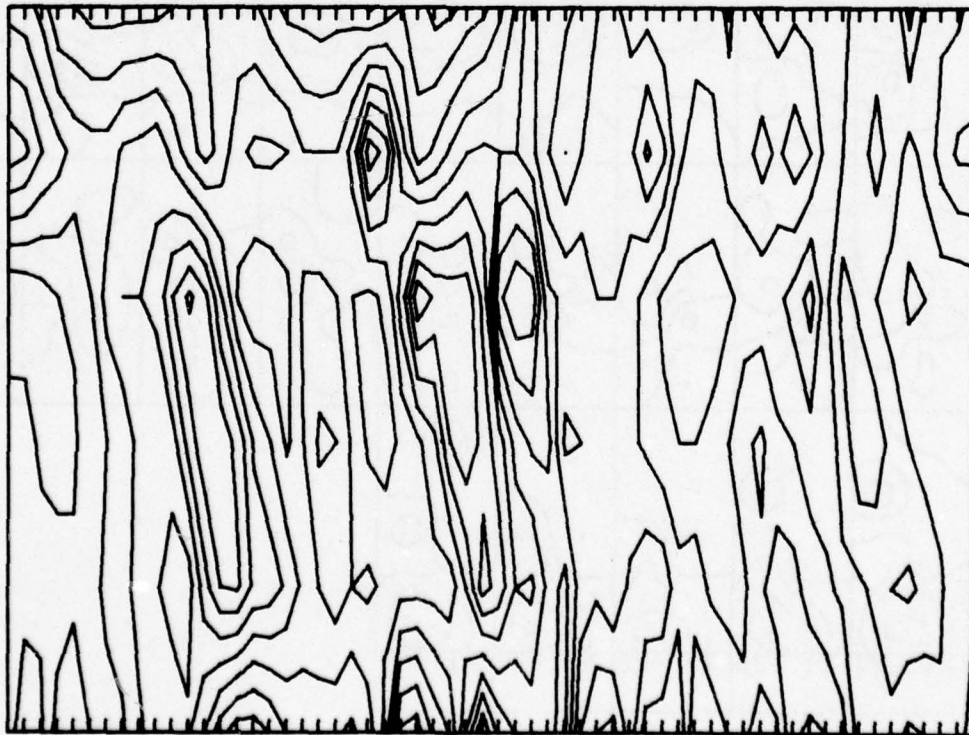
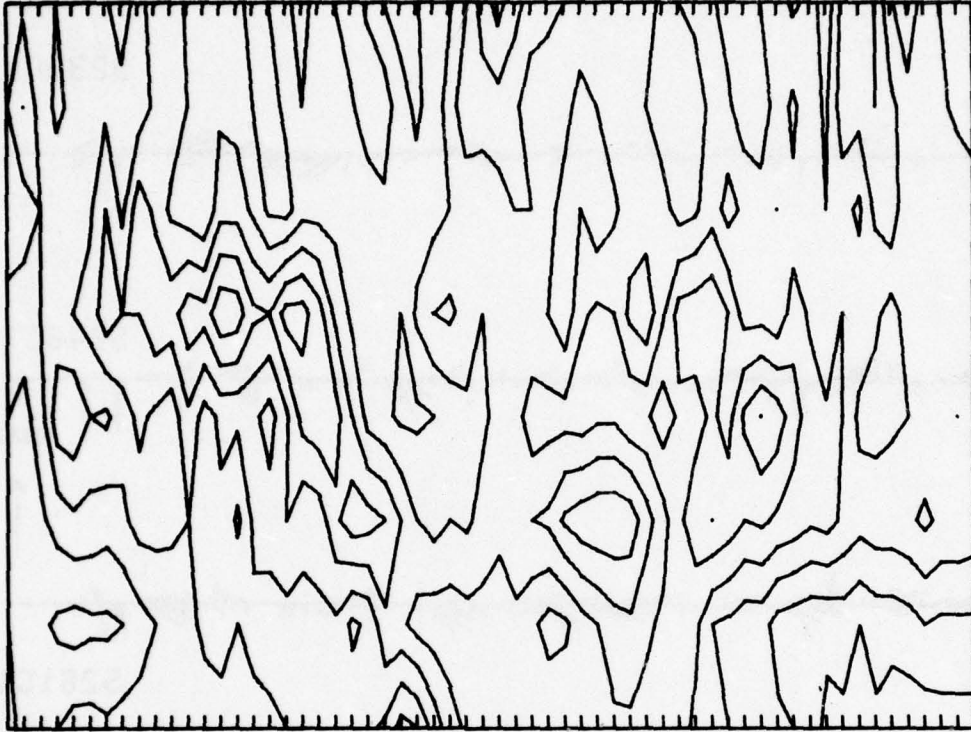
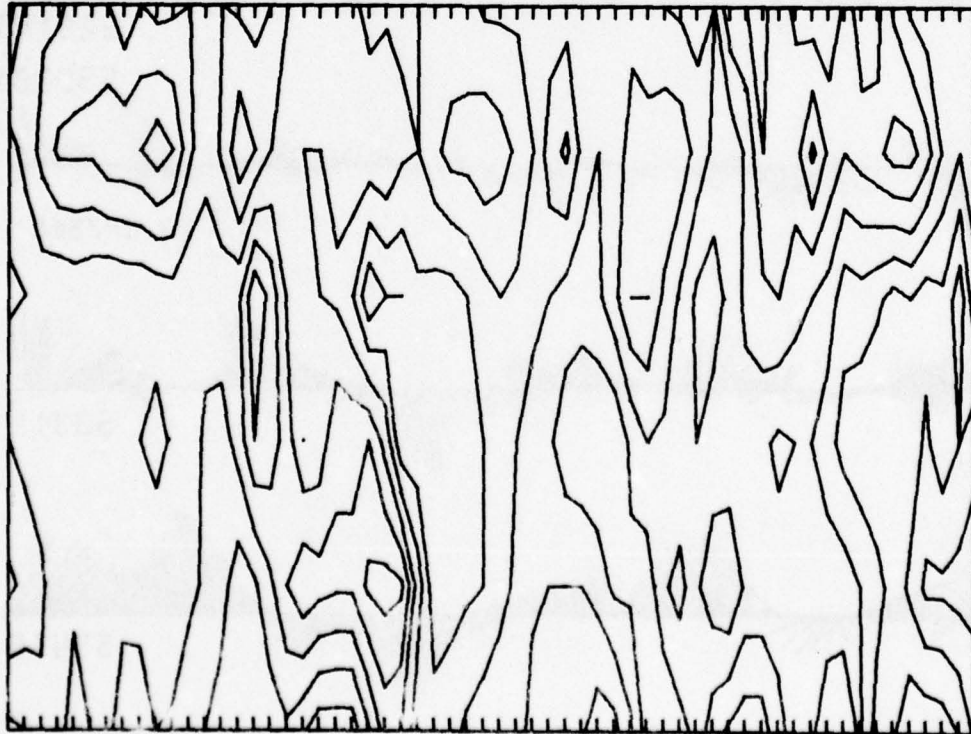


Figure 13a. Time/latitude diagram

TIME PHASE PLOT OF TEMPERATURE VARIATION,
AUG 06- DEC. 02, RECORDS DOWN 70 W



AUG.06- DEC. 02, RECORDS DOWN 69 20' W



CURRENT VECTORS (RECORDS DOWN 70 W, 1000 M OFF BOTTOM)

APR MAY JUN JUL AUG SEP OCT NOV DEC

5233A10G24



5246C10G24



NORTH



5261C10G24



5291B10G24



5302B10G24

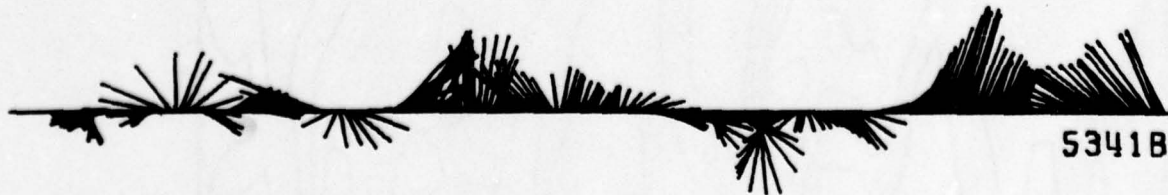


10 CM/SEC

5331A10G24



5341B10G24



APR MAY JUN JUL AUG SEP OCT NOV DEC

CURRENT VECTORS (RECORDS DOWN 70 W, 200 M OFF BOTTOM)

APR MAY JUN JUL AUG SEP OCT NOV DEC



5247B10G24

NORTH



5262A10G24



5292B10G24



5332A10G24

10 CM/SEC



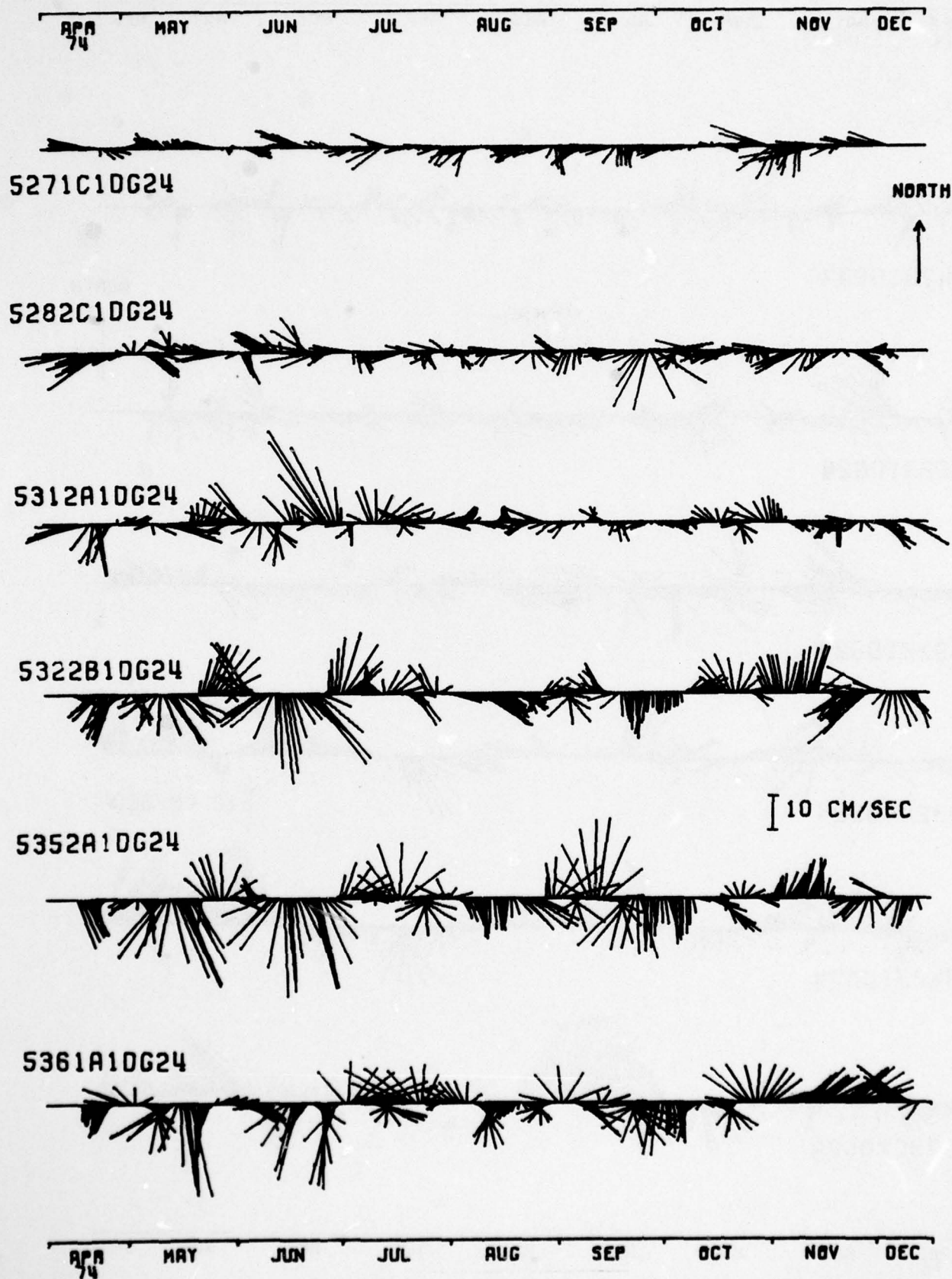
5342J10G24



5373C10G24

APR MAY JUN JUL AUG SEP OCT NOV DEC

CURRENT VECTORS (RECORDS DOWN 69.3 W, 1000M OFF BOTTOM)



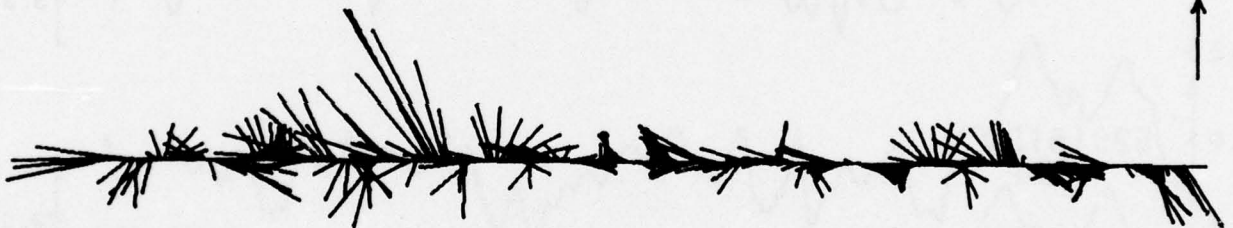
CURRENT VECTORS (RECORDS DOWN 69.3 W, 200M OFF BOTTOM)

APR 74 MAY JUN JUL AUG SEP OCT NOV DEC



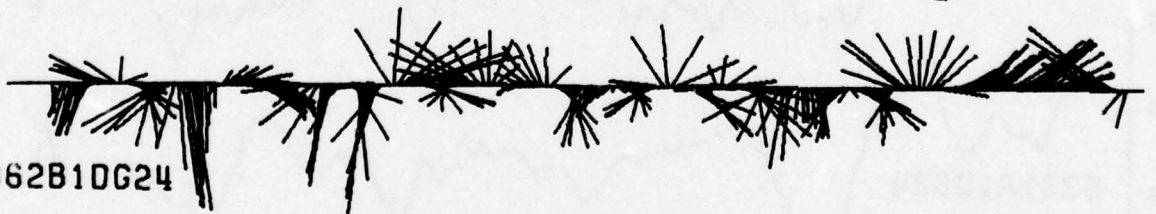
5272G1DG24

NORTH



5313C1DG24

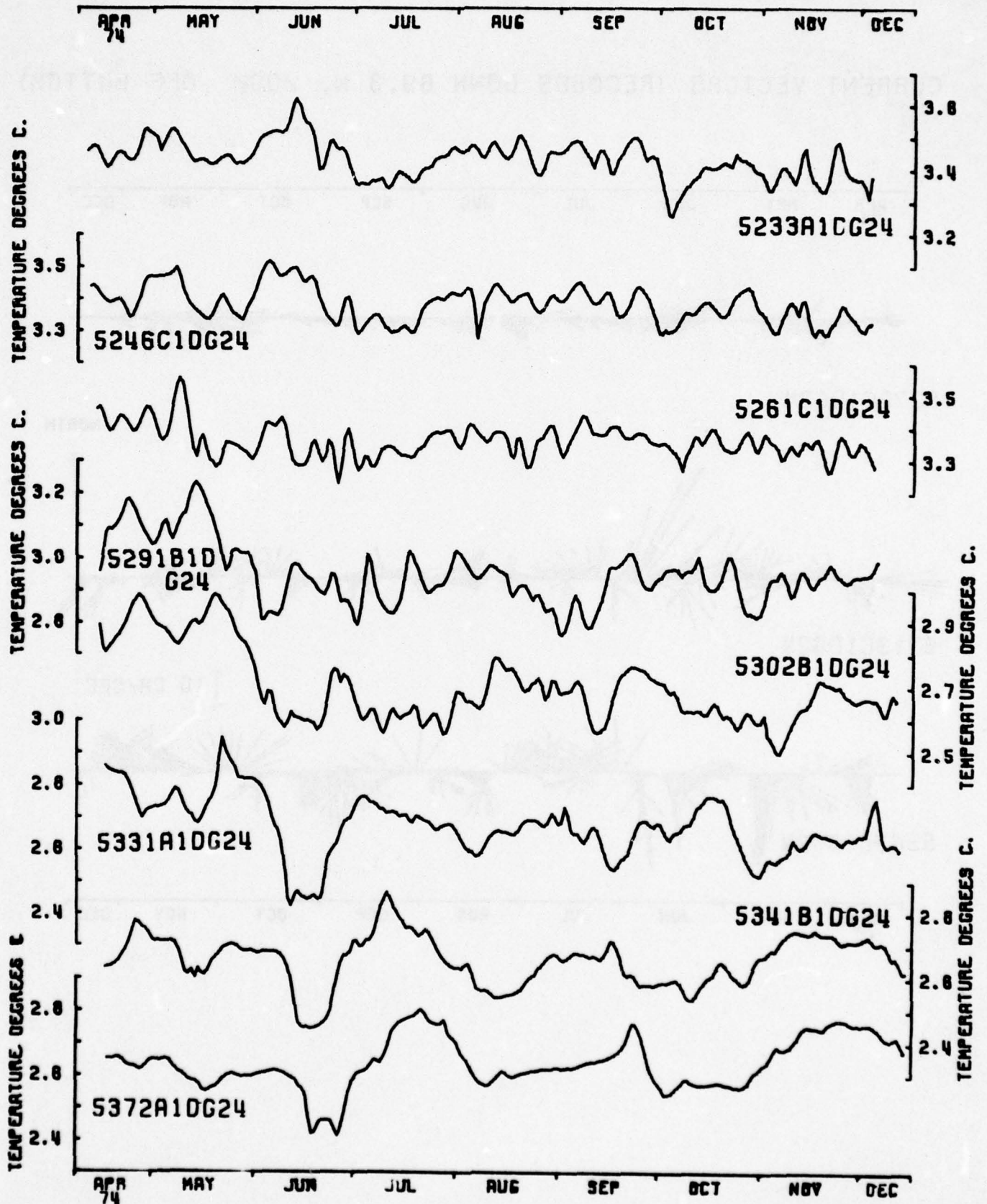
10 CM/SEC



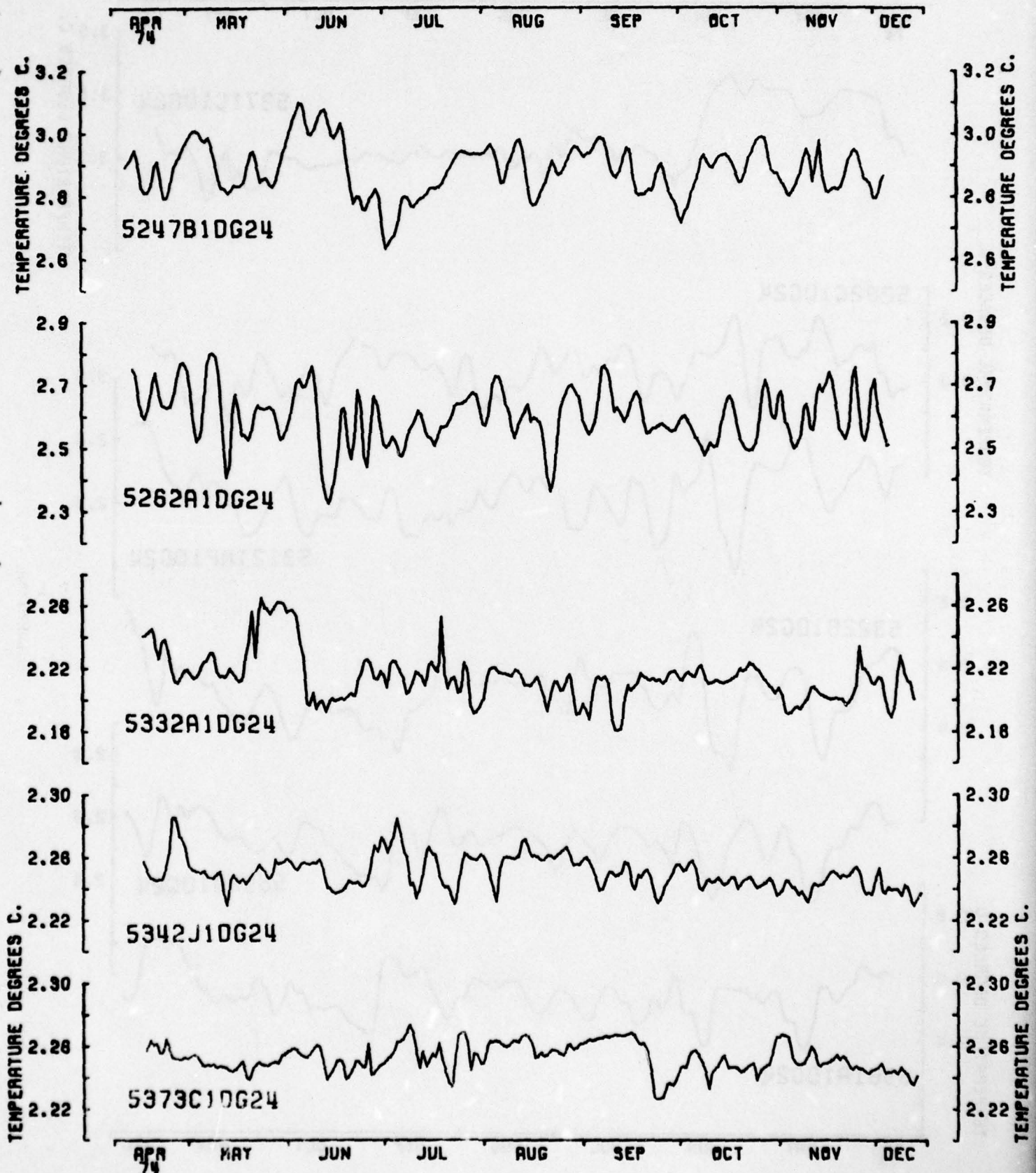
5362B1DG24

APR 74 MAY JUN JUL AUG SEP OCT NOV DEC

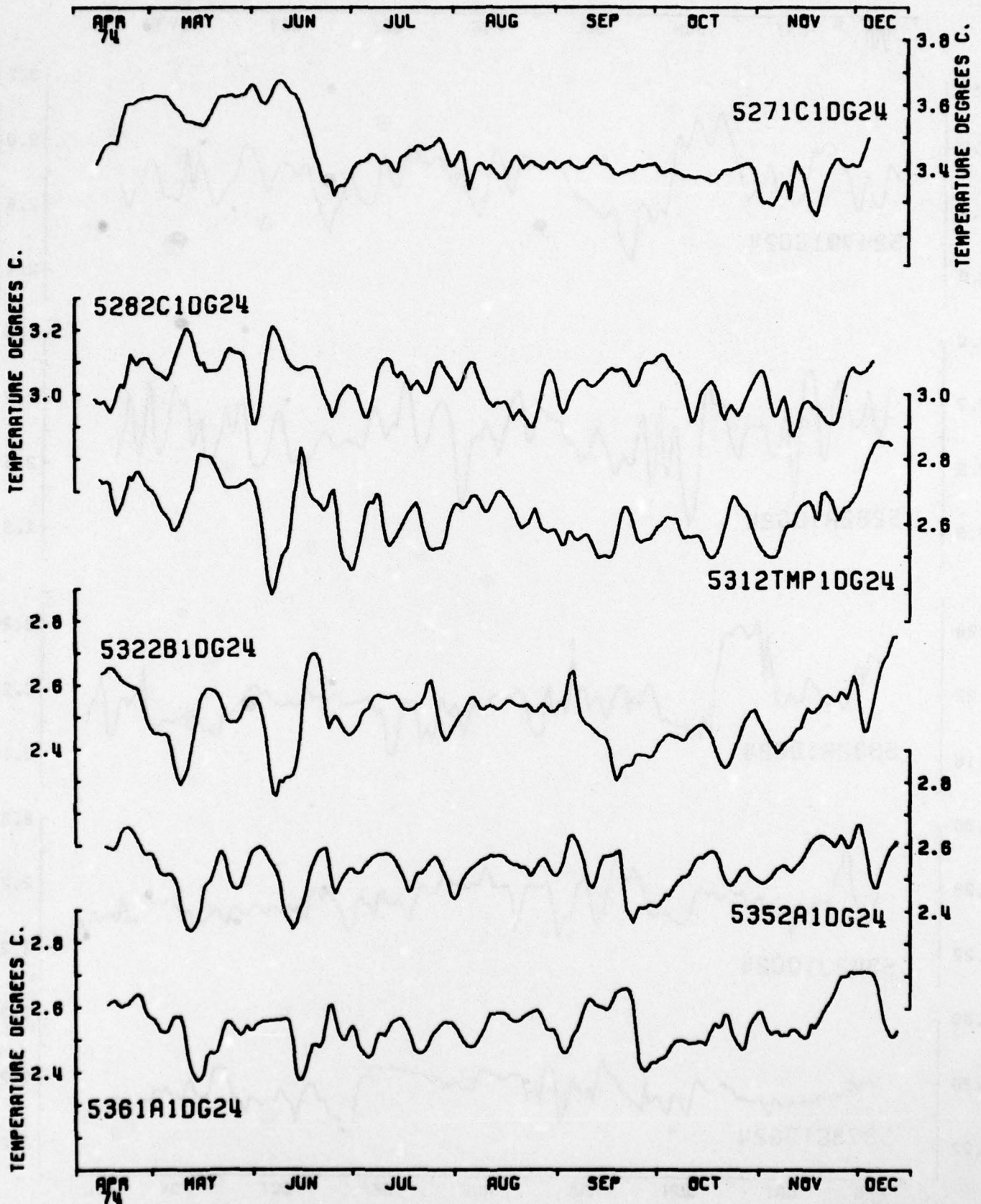
TEMPERATURES FOR RECORDS DOWN 70 W, 1000 M OFF BOTTOM



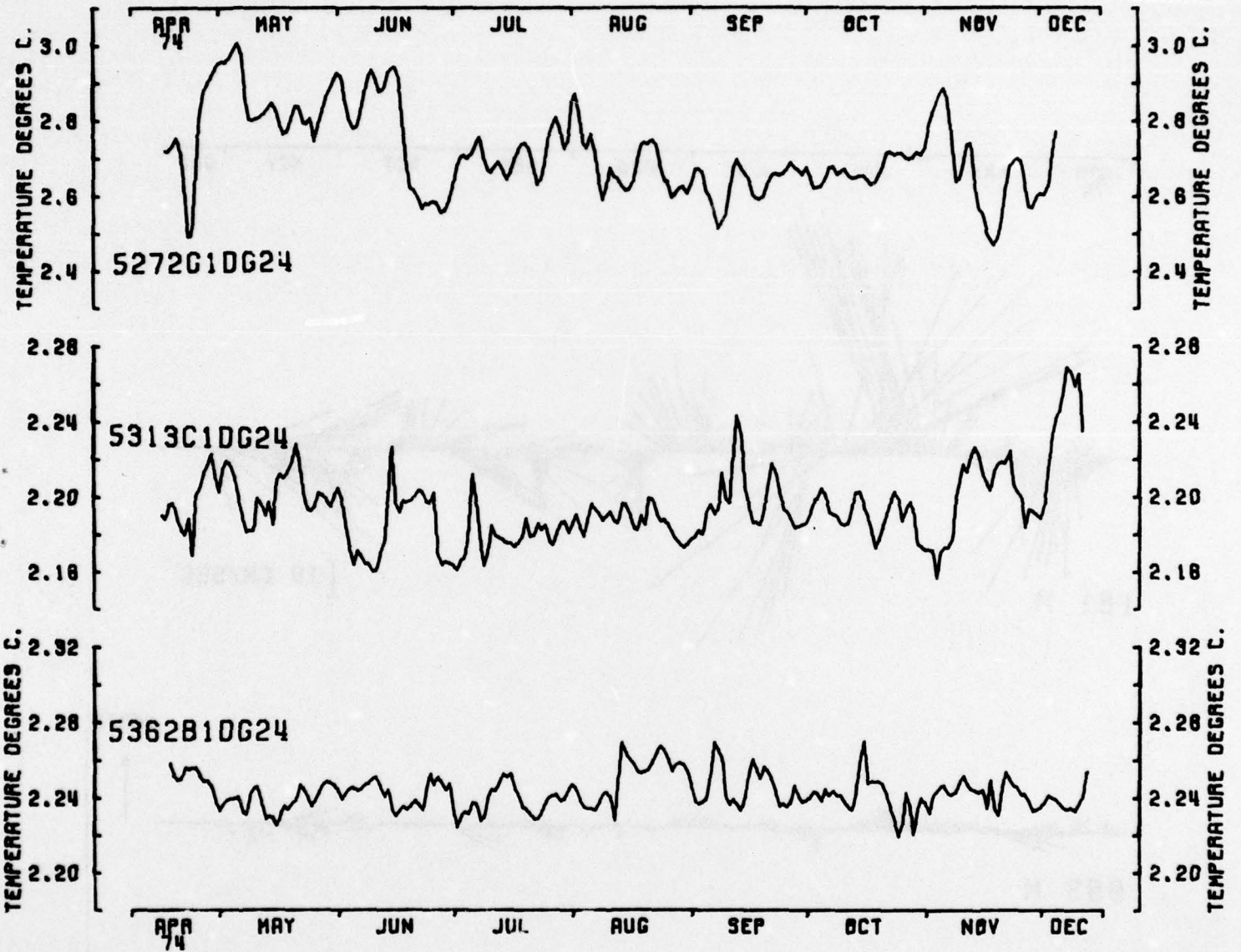
TEMPERATURES (RECORDS DOWN 70 W, 200 M OFF BOTTOM)



TEMPERATURES FOR RECORDS DOWN 69.3 W, 1000M OFF BOTTOM

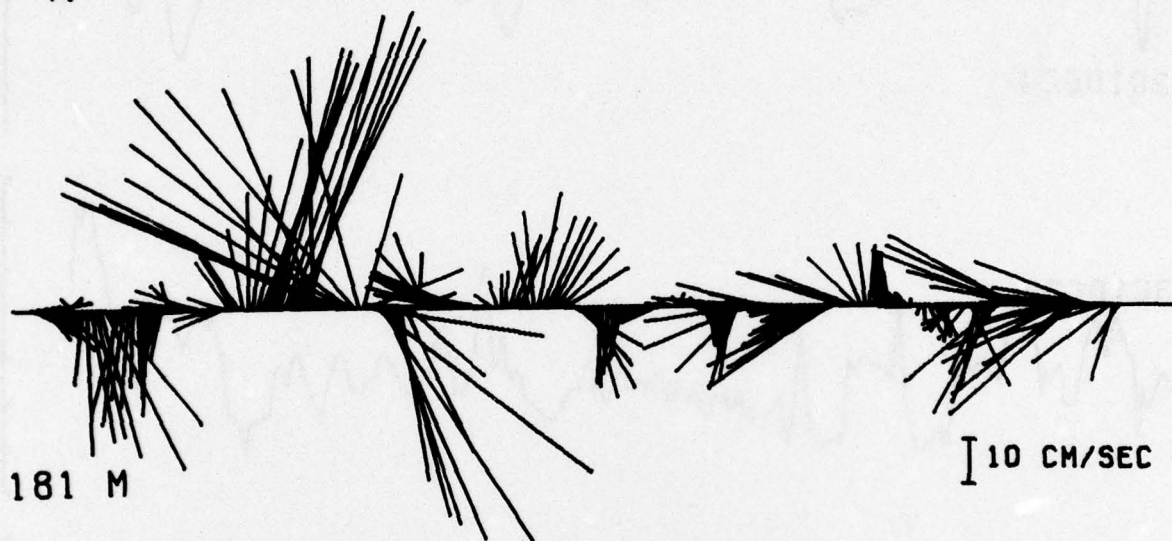


TEMPERATURES (RECORDS DOWN 69.3 W, 200M OFF BOTTOM)



CURRENT VECTORS FOR MOORING # 523

APR 74 MAY JUN JUL AUG SEP OCT NOV DEC



NORTH



983 M

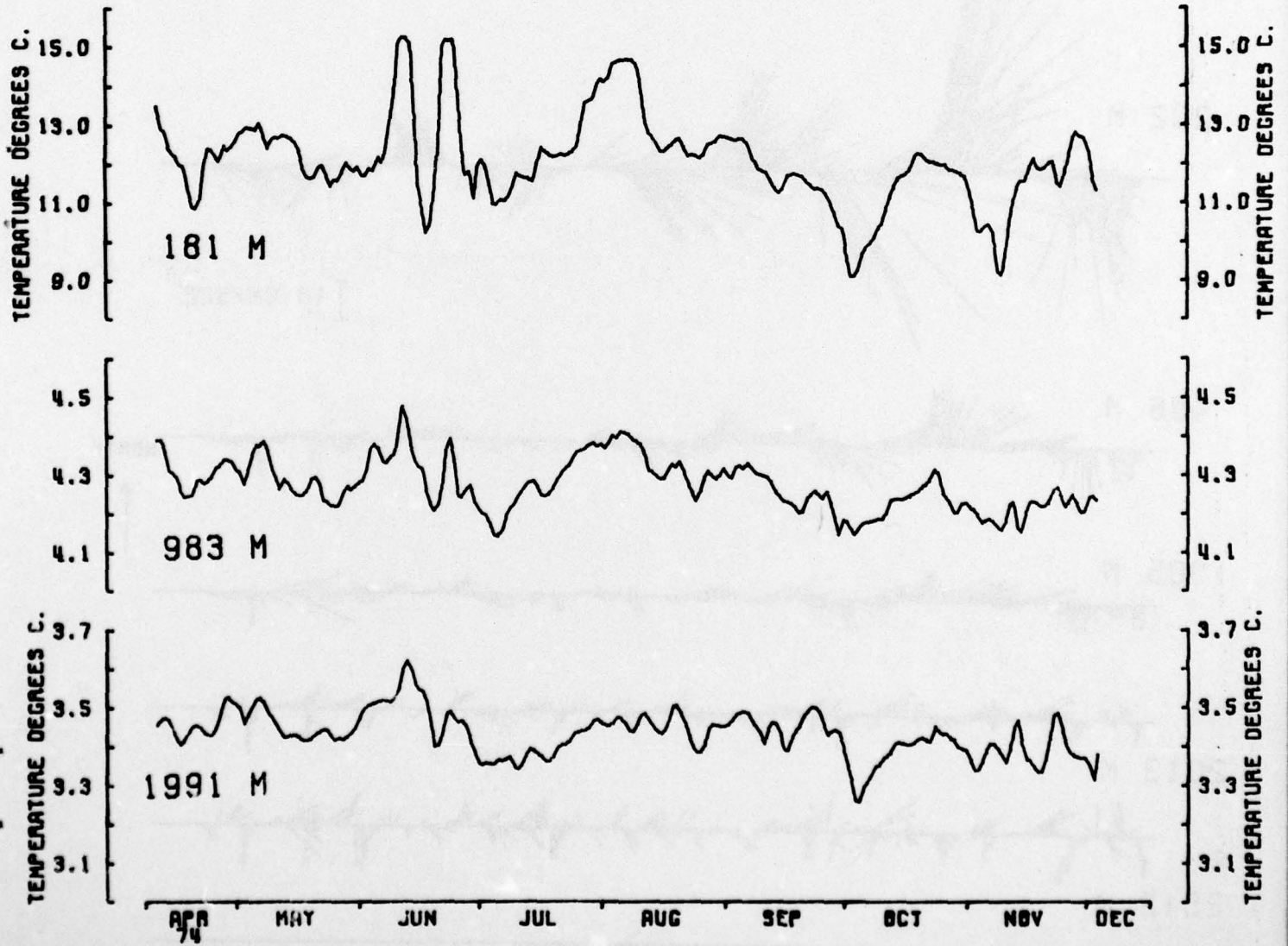


1991 M

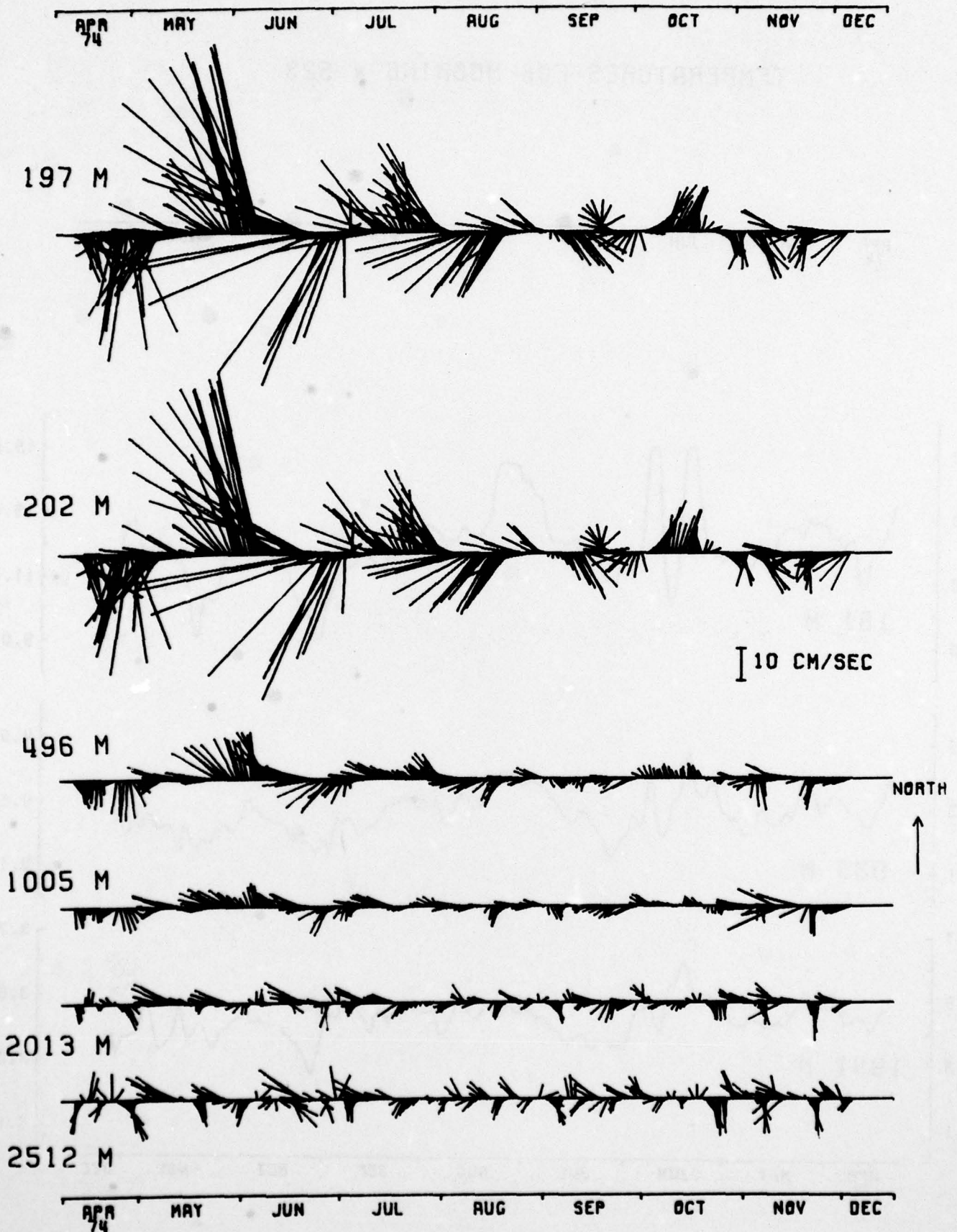
APR 74 MAY JUN JUL AUG SEP OCT NOV DEC

TEMPERATURES FOR MOORING # 523

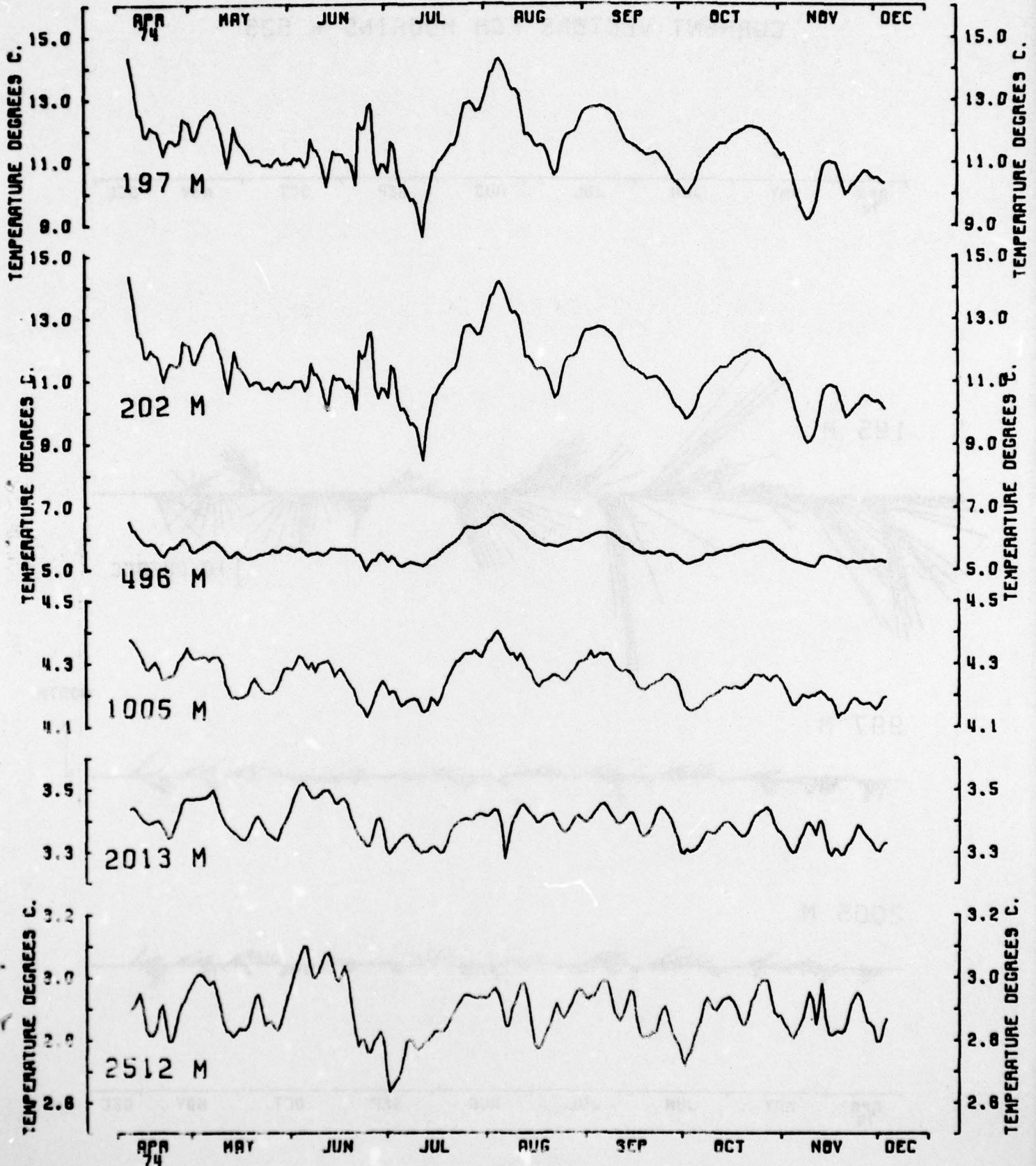
APR 74 MAY JUN JUL AUG SEP OCT NOV DEC



CURRENT VECTORS FOR MOORING # 524

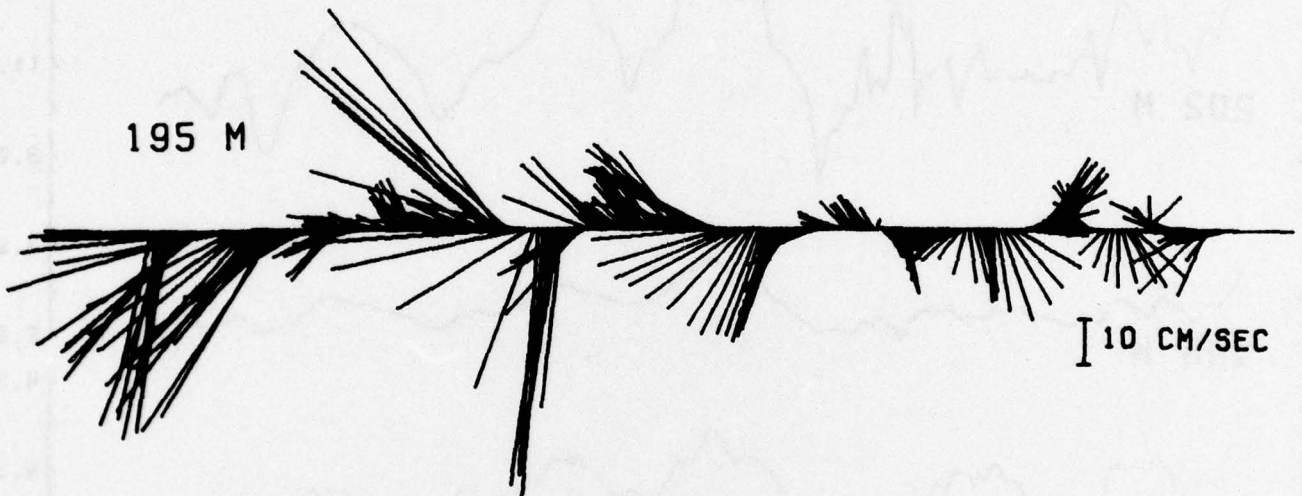


TEMPERATURES FOR MOORING # 524



CURRENT VECTORS FOR MOORING # 525

APR 74 MAY JUN JUL AUG SEP OCT NOV DEC



997 M



NORTH

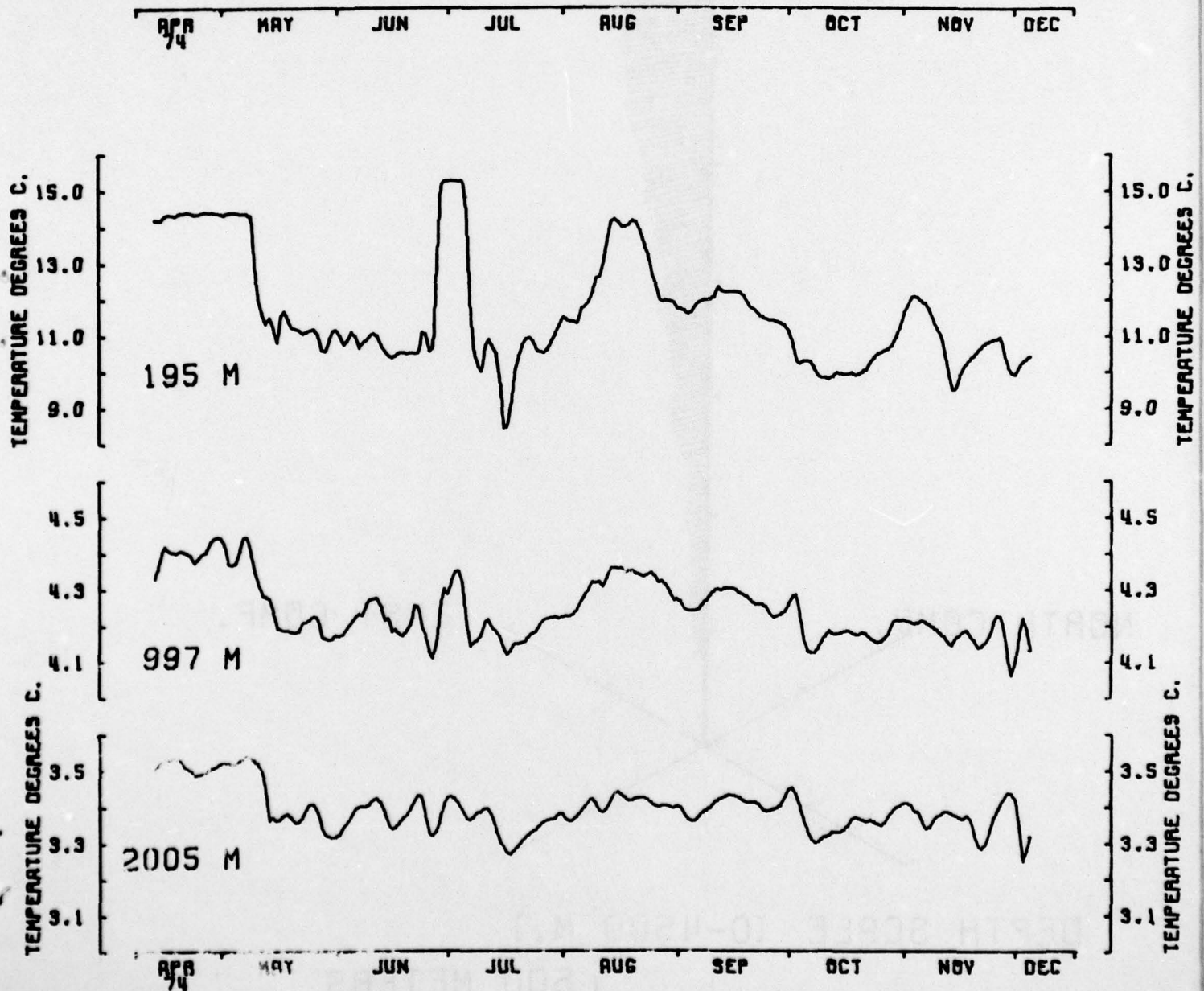


2005 M

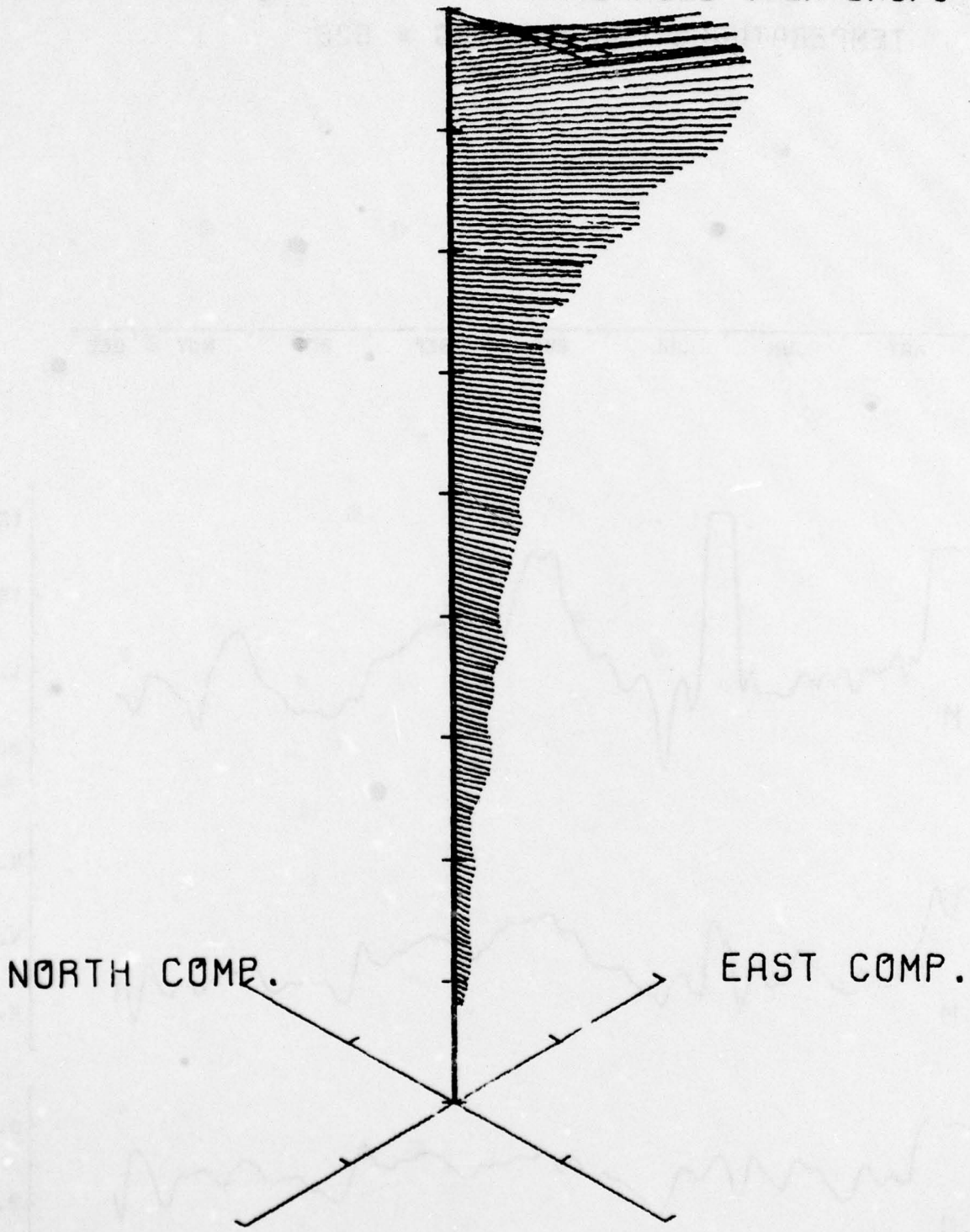


APR 74 MAY JUN JUL AUG SEP OCT NOV DEC

TEMPERATURES FOR MOORING # 525



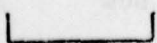
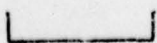
CURRENT VECTORS
AVERAGED OVER DROPS 101-108



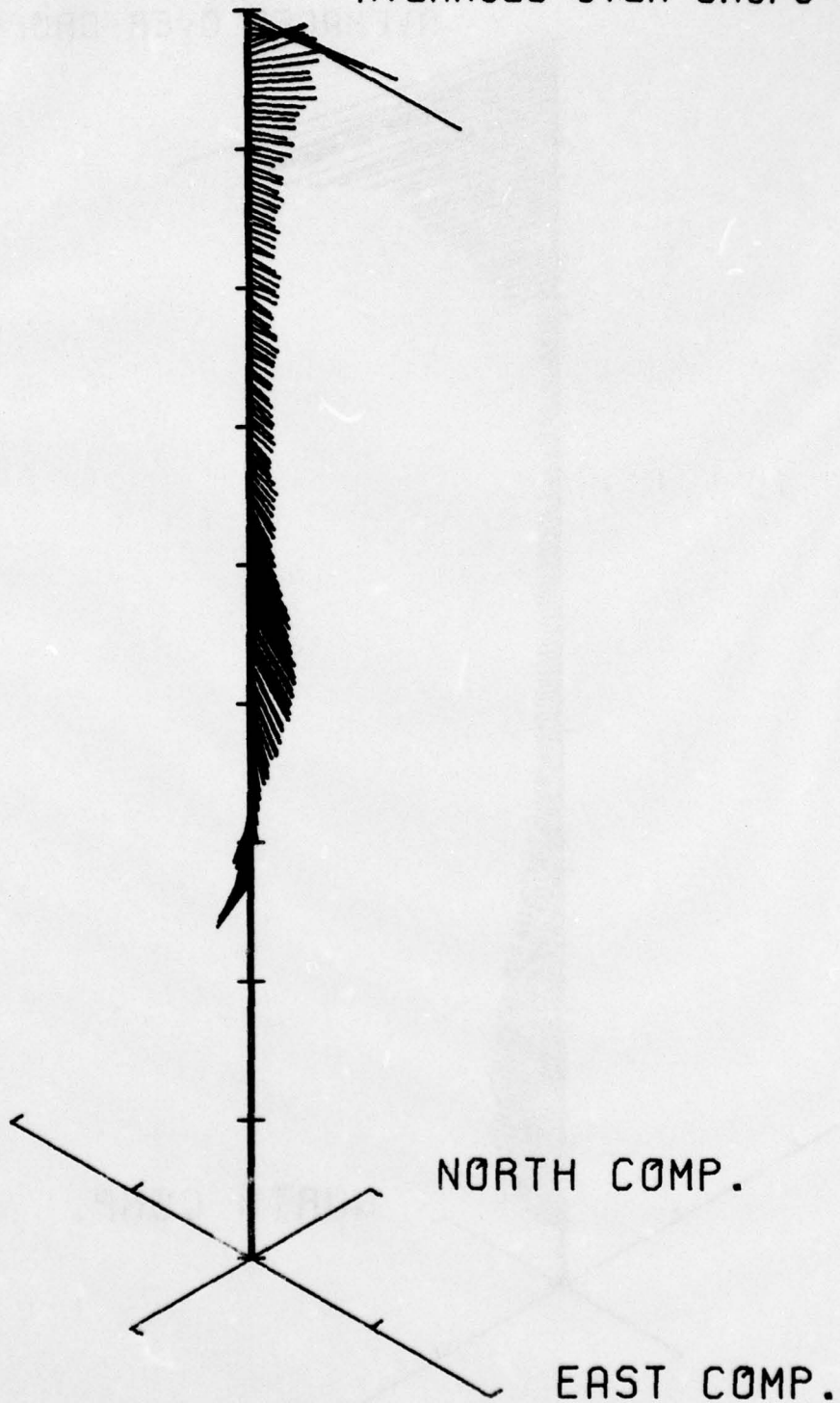
NORTH COMP.

EAST COMP.

DEPTH SCALE (0-4500 M.)

VECTOR SCALE  500 METERS
 20 CM/SEC

CURRENT VECTORS
AVERAGED OVER DROPS 201-207



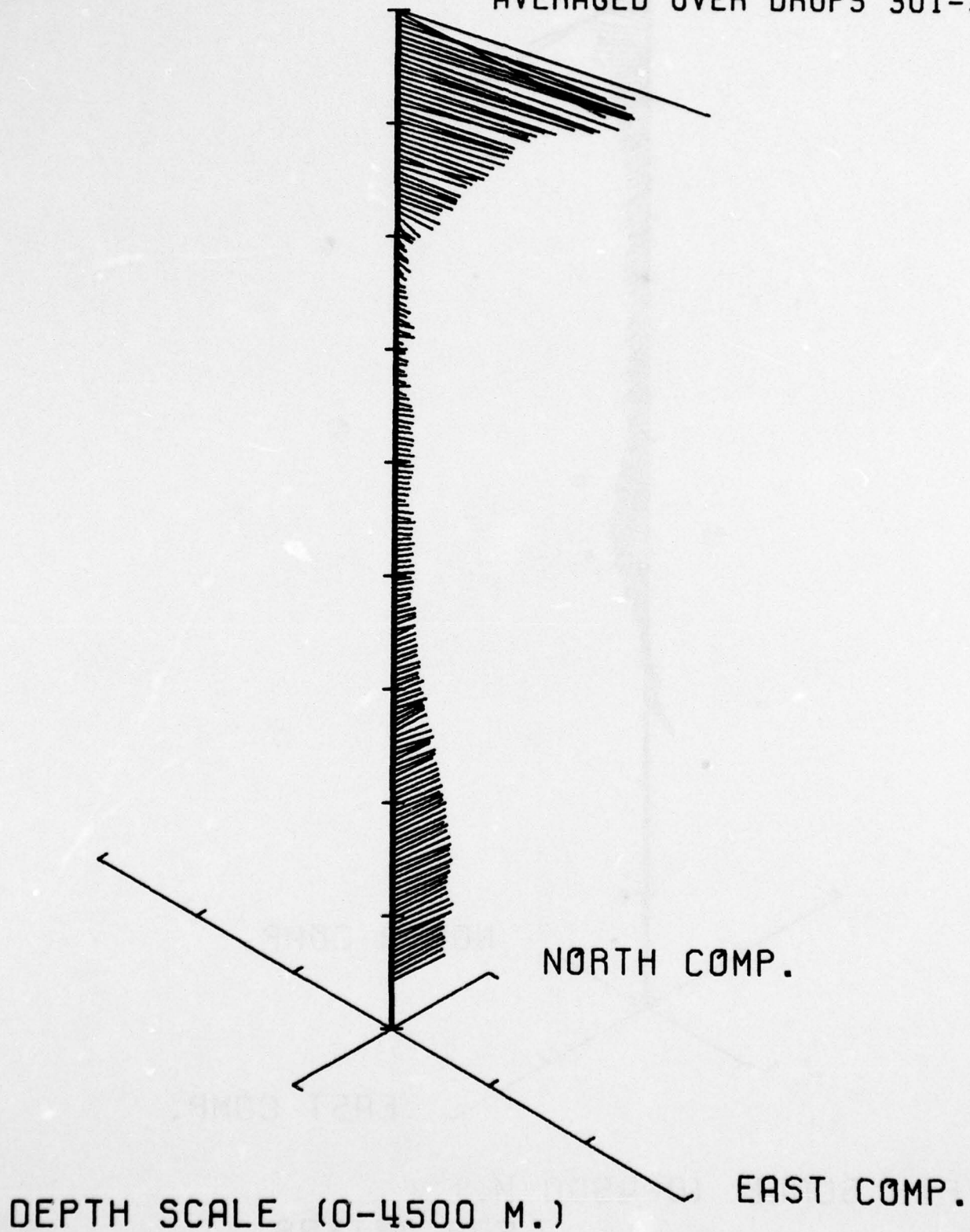
DEPTH SCALE (0-4500 M.)

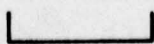
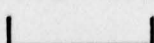
┌───┐ 500 METERS

VECTOR SCALE

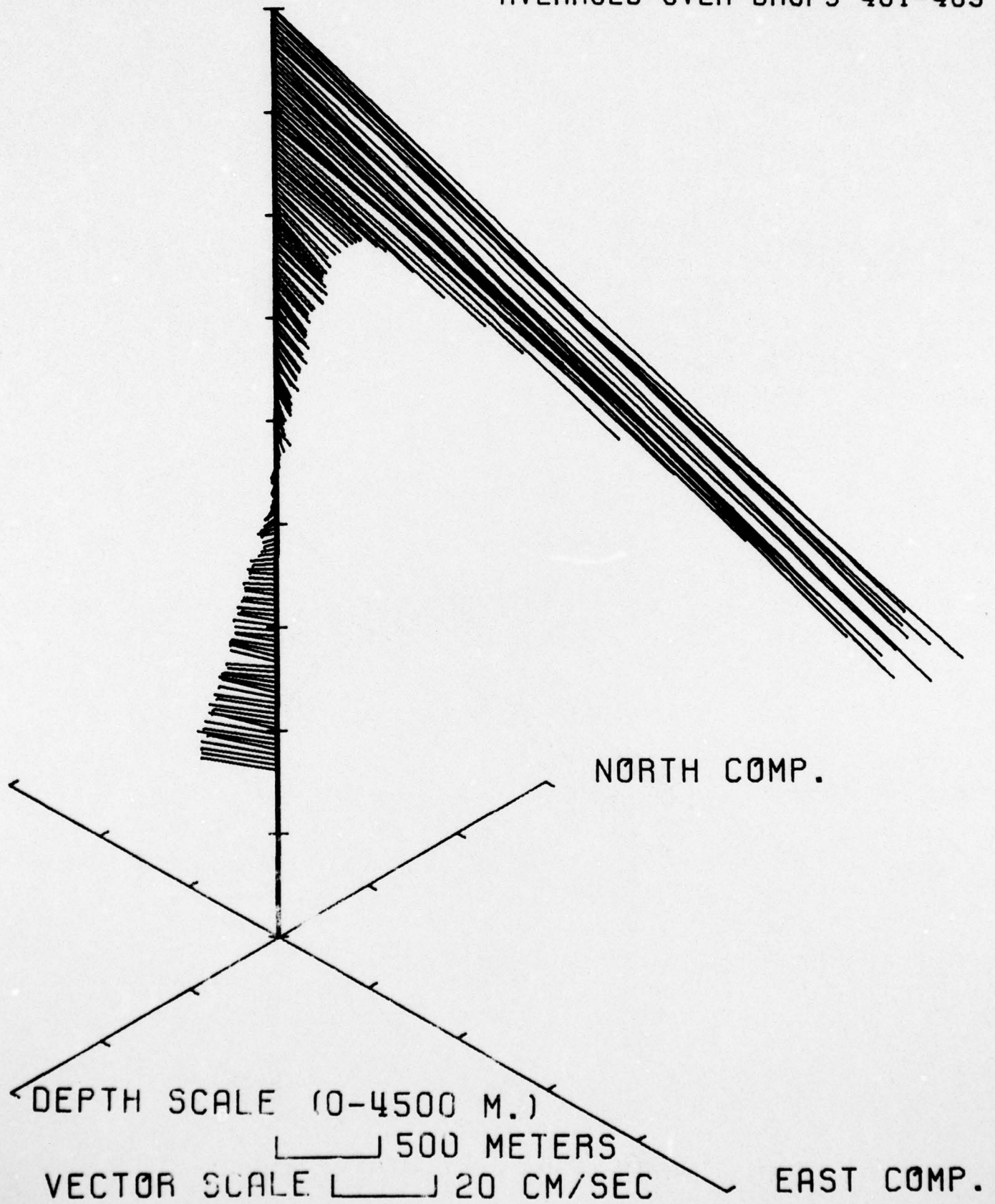
┌───┐ 20 CM/SEC

CURRENT VECTORS
AVERAGED OVER DROPS 301-310



VECTOR SCALE  500 METERS
 20 CM/SEC

CURRENT VECTORS
AVERAGED OVER DROPS 401-409



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<p>Hoods Hole Oceanographic Institution WHOI-79-56</p> <p>A COMPILATION OF MOORED CURRENT METER DATA, WHITEHORSE PROFILES AND ASSOCIATED OCEANOGRAPHIC OBSERVATIONS, VOLUME XI (RISE ARRAY, 1974) by Ann Spencer. 59 pages. September 1979. Prepared for the Office of Naval Research under Contracts N00014-74-C-0262; NR 083-004, N00014-76-C-0197; NR 083-400 and for the National Science Foundation under Grant OCE 74-01282.</p> <p>Current and temperature measurements are presented from instruments deployed during 1974 on the continental rise (36 - 40 degrees north, 69 - 70 degrees west).</p> <p>Current meters were set primarily at depths of 200 and 1000 meters above the bottom, and all the records were of 9 months duration. Basic data are displayed as scatter plots, progressive vector diagrams, spectral plots and time series plots; statistical quantities are displayed in tables. Filtered time series are shown in composite displays.</p> <p>Data from a vertical current profiler, the 'whitehorse', are shown as basic profiles of current components and filtered, averaged vector profiles.</p> <p>Selected CTD data are included and displayed as plots of potential temperature and salinity versus pressure, and as T-S diagrams.</p>	<p>1. Ocean currents 2. Ocean temperatures 3. Continental Rise</p> <p>I. Spencer, Ann II. N00014-74-C-0262; NR 083-004 III. N00014-76-C-0197; NR 083-400 IV. OCE 74-01282</p> <p>This card is UNCLASSIFIED</p>	<p>Hoods Hole Oceanographic Institution WHOI-79-56</p> <p>A COMPILATION OF MOORED CURRENT METER DATA, WHITEHORSE PROFILES AND ASSOCIATED OCEANOGRAPHIC OBSERVATIONS, VOLUME XI (RISE ARRAY, 1974) by Ann Spencer. 59 pages. September 1979. Prepared for the Office of Naval Research under Contracts N00014-74-C-0262; NR 083-004, N00014-76-C-0197; NR 083-400 and for the National Science Foundation under Grant OCE 74-01282.</p> <p>Current and temperature measurements are presented from instruments deployed during 1974 on the continental rise (36 - 40 degrees north, 69 - 70 degrees west).</p> <p>Current meters were set primarily at depths of 200 and 1000 meters above the bottom, and all the records were of 9 months duration. Basic data are displayed as scatter plots, progressive vector diagrams, spectral plots and time series plots; statistical quantities are displayed in tables. Filtered time series are shown in composite displays.</p> <p>Data from a vertical current profiler, the 'whitehorse', are shown as basic profiles of current components and filtered, averaged vector profiles.</p> <p>Selected CTD data are included and displayed as plots of potential temperature and salinity versus pressure, and as T-S diagrams.</p>	<p>1. Ocean currents 2. Ocean temperatures 3. Continental Rise</p> <p>I. Spencer, Ann II. N00014-74-C-0262; NR 083-004 III. N00014-76-C-0197; NR 083-400 IV. OCE 74-01282</p> <p>This card is UNCLASSIFIED</p>	<p>Hoods Hole Oceanographic Institution WHOI-79-56</p> <p>A COMPILATION OF MOORED CURRENT METER DATA, WHITEHORSE PROFILES AND ASSOCIATED OCEANOGRAPHIC OBSERVATIONS, VOLUME XI (RISE ARRAY, 1974) by Ann Spencer. 59 pages. September 1979. Prepared for the Office of Naval Research under Contracts N00014-74-C-0262; NR 083-004, N00014-76-C-0197; NR 083-400 and for the National Science Foundation under Grant OCE 74-01282.</p> <p>Current and temperature measurements are presented from instruments deployed during 1974 on the continental rise (36 - 40 degrees north, 69 - 70 degrees west).</p> <p>Current meters were set primarily at depths of 200 and 1000 meters above the bottom, and all the records were of 9 months duration. Basic data are displayed as scatter plots, progressive vector diagrams, spectral plots and time series plots; statistical quantities are displayed in tables. Filtered time series are shown in composite displays.</p> <p>Data from a vertical current profiler, the 'whitehorse', are shown as basic profiles of current components and filtered, averaged vector profiles.</p> <p>Selected CTD data are included and displayed as plots of potential temperature and salinity versus pressure, and as T-S diagrams.</p>	<p>1. Ocean currents 2. Ocean temperatures 3. Continental Rise</p> <p>I. Spencer, Ann II. N00014-74-C-0262; NR 083-004 III. N00014-76-C-0197; NR 083-400 IV. OCE 74-01282</p> <p>This card is UNCLASSIFIED</p>
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