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Moored Current Meter Data from the
Atlantic North Equatorial Countercurrent
Near 6°N 28°W (September, 1983 - March, 1984)
Vol. XXXVI

by

Ellen Levy and Philip L. Richardson

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Technical Report

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Nick P. Fofonoff, Chairman
Department of Physical Oceanography

ABSTRACT

This report presents current and wind data from the second of three surface mooring deployments in the Atlantic North Equatorial Countercurrent near 6° N and 28° W. A Vector Averaging Wind Recorder (VAWR) measured wind velocity, sea surface temperature, air temperature, barometric pressure and solar insolation. Four Vector Measuring Current Meters (VMCM) measured current velocity and temperature at depths of 20, 50, 75 and 150 m. The mooring was deployed on September 12, 1983 and recovered (and replaced) on March 24, 1984.

PREFACE

This volume is the thirty-sixth in a series of data reports presenting moored current meter and associated data collected by the WHOI Buoy Group.

Volumes I-XVII present data prior to 1977 and are not listed below.

Volumes XVIII through XXXV present data obtained during the years 1972-1984, either by year or experiment (see notes).

A data directory and bibliography for the years 1963-1978 has been published, as WHOI Technical Report 79-88.

Volume XXXVI presents data from one mooring of the SEQUAL experiment, second setting 1983 and 1984.

Volume No.	WHOI Ref. No.		Notes Year Experiment
XVIII	79-65	Tarbell, S., M. G. Briscoe and R. A. Weller	1978 JASIN
XIX	79-34	Spencer, A., C. Mills and R. Payne	1974-1975 POLYMODE Array I
XX	79-56	Spencer, A.	1974 Rise Array
XXI	79-85	Mills, C. and P. Rhines.	1978 W.B.U.C.
XXII	79-87	Tarbell, S. and R. Payne.	1973 measurements
XXIII	80-40	Tarbell, S. and R. Payne.	1978 POLYMODE Array III
XXIV	80-41	Spencer, A., K. O'Neill and J. R. Luyten	1976 INDEX
XXV	81-12	Spencer, A., E. D'Asaro and L. Armi	1977 B.B.L. Expt.
XXVI	81-45	Chausse, D. and R. Payne	1972 measurements
XXVII	81-68	McKee, T., E. Francis and N. Hogg	1975,78 topographic expts.
XXVIII	81-73	Mills, C., S. Tarbell, W. B. Owens and R. Payne	1978 L.D.E.
XXIX	82-16	Levy, E., A. Spencer, G. Needell, G. Hund and J. R. Luyten	1979 INDEX
XXX	82-43	Levy, E., S. A. Tarbell and N. P. Fofonoff	1979-1980 GSE/NSOI
XXXI	83-30	Levy, E. and S. A. Tarbell	1980-1982 WesPac
XXXII	83-46	Levy, E.	1979-1981 Vema Channel
XXXIII	84-6	Spencer, A. and D. Chausse and W. B. Owens	1981 NPBC
XXXIV	84-16	Levy, E. and P. L. Richardson	1983 SEQUAL I
XXXV	84-36	Tarbell, S. A., N. J. Pennington and M. G. Briscoe	1982-1984 LOTUS

Table of Contents

Abstract	i
Pre face	ii
Table of Contents	iii
SECTION 1: TEXT	
Introduction	1-1
Instrumentation	1-3
Data Processing	1-5
Programs	1-5
Acknowledgments	1-9
References	1-10
SECTION 2: SUMMARY PLOTS OF THE DATA	
	2-1
SECTION 3: INDIVIDUAL PLOTS	
	3-1

INTRODUCTION

In February 1983 an array of six current meter moorings was launched in the equatorial Atlantic as part of the SEQUAL experiment (Seasonal Equatorial Atlantic, see Anon., 1983). The moorings were kept in place for six months and reset two times for a total of one and a half years of continuous data. This data report presents current and temperature data from the second setting of one of these moorings, SB4, located near the center of the North Equatorial Countercurrent at 6°N 28°W. The location of the mooring is shown in Figure 1. The data from the first setting were presented in Report XXXIV (SEQUAL I, February - September, 1983).

The report is presented in 3 sections. The first section contains introductory text and information about the instruments, data processing procedures, and quality of the data. The second section summarizes the data sets graphically from setting I and II. These composite displays include a plot of transport between the surface and 150 m, velocity components and temperatures (Figures 2-8). The third section displays the data from each individual instrument (Figures 9-31). Included are tables of statistics, time series plots, histograms, progressive vector diagrams, scatter plots and spectral plots.

Figure 1: Location of mooring SB4 at 6°N and 28°W. Vectors are calculated from ship drifts for August through October (from Richardson and McKee, 1984).

INSTRUMENTATION

Vector Averaging Wind Recorder (VAWR)

A modified vector averaging current meter (VACM) (McCullough, 1975) was used to measure and record the wind velocity at three meters height above the sea surface. The Vector Averaging Wind Recorder (VAWR) uses a variation of the Gill 3-cup anemometer and a 17 x 20 cm windvane to provide speed and relative direction inputs to the standard VACM electronics package. The vector calculation is made every count, or 1/2 revolution of the anemometer (corresponding to a wind run of 37.5 cm), and east and north components are summed and stored on tape at the end of fifteen minute intervals.

Other meteorological variables measured were air temperature, sea temperature at one meter depth, incident solar radiation (insolation) and barometric pressure. A thermistor in a sun shield is used to measure air temperature. Insolation is measured with a hot and cold junction thermopile sensor. Barometric pressure is sensed through a two-plate port with a quartz crystal (Digiquartz) transducer. Data are internally recorded on a magnetic tape cassette for later processing.

Vector Measuring Current Meter

The Vector Measuring Current Meters (VMCM) were developed at the Scripps Institution of Oceanography in the 1970's (Weller and Davis, 1980) and were manufactured by EG&G Sea-Link Systems, Inc. Each VMCM has a pair of orthogonally mounted propellers designed with accurate co-sinusoidal response. They measure the two horizontal components of velocity. The instrument uses microprocessor technology and calculates east and north components of velocity every 1/4 second based on both propeller counts and the compass reading. The vector and propeller values are accumulated for fifteen minutes and recorded on a magnetic tape cassette. A record count (clock), instantaneous compass, and temperature are also recorded.

Table 1

MOORING CONFIGURATION

<u>Component</u>	<u>Length in</u> <u>meters</u>	<u>Instrument</u> <u>#</u>	<u>Data</u> <u>#</u>
<u>VAWR</u> on surface toroid buoy	<u>-3</u>	V0121	SB40
1/2 inch chain	6		
7/16 inch wire rope with fairing	10		
<u>VMCM</u>	<u>20</u>	VM029	SB41
7/16 inch wire rope with fairing	27.6		
<u>VMCM</u>	<u>50</u>	VM031	SB42
7/16 inch wire rope with fairing	22.6		
<u>VMCM</u>	<u>75</u>	VM023	SB43
7/16 inch wire rope with fairing	72.6		
<u>VMCM</u>	<u>150</u>	VM027	SB45
7/16 inch wire rope with fairing	149.6		
3/8 inch jacketed wire rope	700		
3/4 inch nylon	3218		
17 inch glass spheres on 24 m of 1/2 inch chain	24		
1/2 inch chain	4		
Acoustic Release	1	109	
1/2 inch chain	1		
1 1/8 inch nylon	20		
7/16 inch jacketed wire rope	15		
1/2 inch chain	6		
<u>Anchor</u> (6400 pound dry weight)	<u>4363</u>		

Note: Numbers underlined represent depths of the instruments
below the sea surface and the bottom depth.

DATA PROCESSING

Data from instrument cassettes (VAWR and VMCM) were transcribed to 9-track magnetic tapes, converted to scientific units, edited to remove launch and retrieval transients and bad points, and linearly interpolated across missing or erroneous data cycles. All directional data has been processed and plotted in degrees true. The VAWR records vector components in the oceanographic convention ("east" means wind blowing toward the east). Data quality was determined, and is noted in Table 2.

Low passed versions of the data series were formed by using a Gaussian filter with either a 5 day half-width (the composite plots shown in section 2), or a 24 hour half-width (individual plots shown for each instrument in section 3), and then subsampling the filtered series once a day.

Woods Hole Oceanographic Institution Buoy data are identified by a mooring number (e.g. SB4 is the mooring designation), a sequential instrument position number (e.g., SB41 is the first instrument down on mooring SB4), a letter to indicate the data version (e.g., SB41A is the first editing of SB41), and an indication of the time sampling interval for that data record (e.g., SB41A1H is the one hour averaged version). Due to a change in the numbering convention for setting II, the fourth VMCM was labelled SB45 rather than SB44.

PROGRAMS

Statistics

Mean, standard error, variance, kurtosis, skewness and extrema are computed on the filtered and unfiltered time series. East and north covariance, correlation coefficients, major axis, minor axis and ellipse are computed for the vectors. For reference, note that a Gaussian random variable would have a kurtosis of three and a skewness of zero.

See Volume XVII (POLYMODE Array II) and XX (Rise Array, 1974) of this series for a more detailed discussion of these parameters. The variance, beginning with Volume XXXII (Vema Channel, 1979-1981), is now computed using $(n-1)$ rather than n .

Hourly and one day (filtered) statistics are displayed in Figures 9 and 15 through 18.

Time Series

Velocity vectors plotted from a zero line along a time scale are known as stick plots. The stick plots, displayed as a composite in Figure 7 and individually in Figures 10, and 19 through 22, are plotted such that East is up relative to the time axis. This was done because the average velocity is eastward.

Individual variables and the stick plots are plotted against time from one day Gaussian filtered series. Five day Gaussian filtered composite plots of temperature and speeds are displayed in Figures 5,6 and 8.

Histograms

The variables temperature, velocity components, speed and direction are shown as frequency of occurrence versus amplitude plots. They are shown in Figures 12 and 23 through 26.

Progressive Vector and Scatter Plots

Progressive vector plots are based on the filtered time series in Figure 3 and on unfiltered time series in the other figures. The current vectors are placed tail-to-head so as to show the path that a perfect particle in a perfectly homogeneous flow would have travelled. Flow regimes and low frequency behavior are apparent on these plots. Each plot begins with an asterisk. The first day of each month is marked with a triangle, and every month is annotated.

Every daily averaged point from the series is plotted in a scatter plot, in which east and north components are plotted as points on a polar diagram. The line drawn through the points is the principal axis, which is the line of the major axis of the ellipse of variance. For a more detailed description of the principal axis see Fofonoff (1969). This line denotes the orientation angle but is not a measure of the length of the major axis.

Progressive vectors and scatter plots are shown in Figures 13, 27 and 28.

Spectra

Velocity and temperature data are displayed as auto-spectra using the program "PROSPECT" (Hunt, 1982). Horizontal kinetic energy (HKE) is shown in the auto spectra, where the HKE spectrum is half of the sum of the spectra of the east and north components. It has the advantage of not being tied to a particular coordinate system. The HKE and temperature spectra have units of $(\text{cm}^2/\text{sec}^2)/\text{cph}$ and $^{\circ}\text{C}^2/\text{cph}$, respectively, and are one-sided, i.e., the area under the spectrum is equal to the variance of the original record.

For calculation of these spectra, no data-windowing or prewhitening was done. The plots are log-log rather than "variance preserving", i.e., the contributions of various frequency bands to the total variance are not in proportion to the displayed areas.

The velocity data are also displayed as rotary spectra. "PROSPECT" computes the circular decomposition of a two-dimensional vector series into clockwise and anti-clockwise harmonic components. The clockwise and anti-clockwise spectra actually form one continuous spectrum between $\pm$ the Nyquist frequency, the positive frequencies corresponding to anti-clockwise rotations of the velocity vector, and negative frequencies to the clockwise rotations. No data-averaging, data-windowing or prewhitening was done.

For plotting, "PROSPECT" averages the spectra in increasingly large groups at the high frequencies to reduce superfluous points. The velocity and temperature spectra (plotted from the hourly data series) are displayed in Figures 14 and 29 through 31.

Table 2

DATA QUALITY

(6° N and 28° W)

<u>File</u>	<u>Start Date</u>	<u>End Date</u>	<u>Comments</u>
SB40	83-IX-13 83- X-06	83- X -06 84-III-24	Instrument damaged, possibly hit by ship. Only the air tem- perature was good for for the entire time.
SB41	83-IX-13	84-III-24	Good data
SB42	83-IX-13	84-III-24	Good data
SB43	83-IX-13	84-III-24	Good data
SB45	83-IX-13	84-III-24	Good data 1 blade came off rotor.

ACKNOWLEDGMENTS

Many people share credit for the quality of data returned from this mooring. They include the officers and crews of the R/V KNORR, and the scientific participants from Woods Hole Oceanographic Institution, North Carolina State University and the University of Rhode Island. Dr. Richard Payne (Woods Hole Oceanographic Institution) was responsible for the vector averaging wind recorder and other meteorological sensors.

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- Fofonoff, N. P., 1969, Spectral characteristics of internal waves in the ocean. Deep Sea Research, Supplement to Vol. 16, pp. 59-71.
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- McCullough, J. R., 1975, Vector averaging current meter speed, calibration and recording technique. Woods Hole Oceanographic Institution Technical Report WHOI-75-44, 35 p.
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- Tarbell, S. A., A. Spencer, and R. E. Payne, 1978, A compilation of moored current meter data and associated oceanographic observations, Vol. XVII (Polymode Array II data). Woods Hole Oceanographic Institution Technical Report WHOI-78-49, 78 p.
- Weller, R. A. and R. E. Davis, 1980, A vector measuring current meter. Deep Sea Research, 27A, pp. 565-582.

FIGURES

SECTION 2: Summary plots of the data. The velocity and temperature data were smoothed with a five day (half-width) Gaussian filter to reduce tidal and inertial fluctuations.

Figure 2: Zonal water transport between the surface and 150 meters.

Figure 3: Composite progressive vector plot for the four depths.

Figure 4: Composite velocity contour for the four depths.

Figure 5: Composite eastward velocity time series for the four depths.

Figure 6: Composite northward velocity time series for the four depths.

Figure 7: Composite vector time series for the four depths.

Figure 8: Composite temperature time series for the four depths.

SECTION 3: Individual Plots. The order of the individual plots is as follows: statistics, variables versus time, histograms, scatter plots, progressive vector diagrams, rotary spectra (east and north components), and auto spectra (east and north components and temperature).

Figures 9-13: Wind recorder data series.

Figures 14-30: Current meter data series.

ZONAL TRANSPORT (m^2/s)

Figure 2: Zonal water transport (m^2/s) between the surface and 150 m.

PROGRESSIVE VECTOR
PLOT
MOORING AT 6N 28W
(1983 - 1984)

Figure 3: Composite progressive vector for the four depths. A combination of the first two settings of the SEQUAL S4 mooring.

EASTWARD VELOCITIES

Figure 4: Composite contour plot of the eastward velocities from the surface to 150 m. A combination of the first two settings of the SEQUAL S4 mooring.

Figure 5: Eastward velocities for the four depths. A combination of the first two settings of the SEQUAL S4 mooring.

Figure 6: Northward velocities for the four depths. A combination of the first two settings of the SEQUAL S4 mooring.

EAST IS UP

Figure 7: Composite vector time series for the four depths. A combination of the first two settings of the SEQUAL S4 mooring. East is up to better show fluctuations about the mean velocity which is eastward.

Figure 8: Composite temperature time series plot for the four depths. A combination of the first two settings of the SEQUAL S4 mooring.

```

*****
** SB40AC1H      *      569 POINTS FROM 83- IX -13 TO 83- X -06
  INST. V-121WR   DEPTH  -3 M.    BOTTOM DEPTH 4363 M.
  UNITS  =        M/S          M/S          M/S          DEG. C
VARIABLE ---- EAST ---- NORTH ---- SPEED ----SEA TEMP --AIR TEMP
MEAN      =   -0.287        3.428        4.404        27.885        26.495
STD.ERR.  =   .963E-1      .100E+0      .772E-1      .142E-1      .418E-1
VARIANCE  =   5.280         5.688         3.391         0.114         0.995
KURTOSIS  =   3.165         3.588         2.582         3.266         4.160
SKEWNESS  =   0.494        -0.579         0.261         0.701        -1.009
MINIMUM   =   -5.883        -6.613         0.276         27.062        22.565
MAXIMUM   =   8.129         8.588         9.228         29.130        28.701
* * * * * * * * * * ----- EAST & NORTH ----- * * * * *
COVARIANCE =   -1.069          ***      MAJAX      =   2.561
CORR.COEFF. =   -0.195          ***      MINAX      =   2.095
ORIENTATION =   140.409          ***      ELLIPSE    =   0.182
COMMENTS   =
*****

```

```

*****
** SB40AC1H      (continued)
  UNITS  =   Decibars Watts/M2
VARIABLE ----Bar.Press.---Insol.
MEAN      =   -0.287        3.428
STD.ERR.  =   .963E-1      .100E+0
VARIANCE  =   5.280         5.688
KURTOSIS  =   3.165         3.588
SKEWNESS  =   0.494        -0.579
MINIMUM   =   -5.883        -6.613
MAXIMUM   =   8.129         8.588
*****

```

```

*****
** SB40BC1H From 83-X-06
  To 84-III-24
  UNITS  =   Deg.C
  Air Temperature
26.167
.129E-1
0.683
3.501
-0.220
22.159
28.716
*****

```

```

*****
** SB40AC1DG24 *      22 POINTS FROM 83- IX -14 TO 83- X -05
  INST. V-121WR   DEPTH  -3 M.    BOTTOM DEPTH 4363 M.
  UNITS  =        M/S          M/S          M/S          DEG. C
VARIABLE --- EAST ---- NORTH ---- SPEED ----SEA TEMP---AIR TEMP
MEAN      =   -0.372        3.332        3.770        27.884        26.506
STD.ERR.  =   .381         .331         .337         .527E-1      .990E-1
VARIANCE  =   3.191         2.415         2.493         0.611E-1      0.216
KURTOSIS  =   2.656         2.775         3.173         2.274         2.173
SKEWNESS  =   0.356         0.259         0.617         0.630        -0.620
MINIMUM   =   -3.408         0.159         1.019         27.528        25.525
MAXIMUM   =   3.524         6.528         7.361         28.437        27.200
* * * * * * * * * * ----- EAST & NORTH ----- * * * * *
COVARIANCE =   -0.960          ***      MAJAX      =   1.914
CORR.COEFF. =   -0.346          ***      MINAX      =   1.299
ORIENTATION =   124.009          ***      ELLIPSE    =   0.321
COMMENTS   =
*****

```

Figure 9

Figure 10

Figure 11

Data File SB40AC1H : Depth = -2m

Figure 12

3-5

SB40AC1DG24

SB40AC1H

-3 #M

83- IX -13 TO 83- X -06

Figure 13

AUTO-SPECTRUM

east = solid line
north = dotted line

AUTO-SPECTRUM

TEMP

ROTARY SPECTRUM CLOCKWISE IS SOLID LINE

Figure 14


```

*****
** SB41A1H      * 4650 POINTS FROM 83- IX -13 TO 84- III-24
  INST. VM-29    DEPTH 20 M.    BOTTOM DEPTH 4363 M.
  UNITS =        CM/S          CM/S          CM/S          DEG. C
VARIABLE ----- EAST ----- NORTH ----- SPEED ----- TEMP
MEAN      =      18.046         -2.999         29.671         27.294
STD.ERR.  =      0.245          0.353          0.260          .974E-2
VARIANCE  =     279.308         580.225         313.711          0.441
KURTOSIS  =      2.259          3.446          2.113          1.688
SKEWNESS  =      0.136          0.713          0.308          .610E-1
MINIMUM   =     -33.516         -61.266          0.288          26.286
MAXIMUM   =      65.141          75.632          87.820          28.587
* * * * * ----- EAST & NORTH ----- * * * * *
COVARIANCE =    -110.186         ***      MAJAX      =      24.822
CORR.COEFF. =     -0.274         ***      MINAX      =      15.596
ORIENTATION =     161.892         ***      ELLIPSE     =      0.372
COMMENTS   =
*****

```

```

*****
** SB41A1DG24   * 192 POINTS FROM 83- IX -14 TO 84- III-23
  INST. VM-29    DEPTH 20 M.    BOTTOM DEPTH 4363 M.
  UNITS =        CM/S          CM/S          CM/S          DEG. C
VARIABLE ----- EAST ----- NORTH ----- SPEED ----- TEMP
MEAN      =      18.005         -3.183         27.992         27.294
STD.ERR.  =      1.102          1.649          1.258          .479E-1
VARIANCE  =     233.263         522.100         303.738          0.441
KURTOSIS  =      1.895          3.494          1.799          1.659
SKEWNESS  =     .836E-1          0.858          0.144          .543E-1
MINIMUM   =     -13.799         -45.502          1.021          26.323
MAXIMUM   =      48.726          62.088          66.523          28.510
* * * * * ----- EAST & NORTH ----- * * * * *
COVARIANCE =    -108.270         ***      MAJAX      =      23.564
CORR.COEFF. =     -0.310         ***      MINAX      =      14.006
ORIENTATION =     161.571         ***      ELLIPSE     =      0.406
COMMENTS   =
*****

```

Figure 15

```

*****
** SB42A1H      * 4650 POINTS FROM 83- IX -13 TO 84- III-24
  INST. VM-31    DEPTH 50 M.    BOTTOM DEPTH 4363 M.
  UNITS =        CM/S          CM/S          CM/S          DEG. C
VARIABLE ----- EAST ----- NORTH ----- SPEED ----- TEMP
MEAN      =      18.300        -2.536        28.369        26.509
STD.ERR.  =      0.207         0.333         0.232         .130E-1
VARIANCE  =     199.171        514.409        250.000         0.790
KURTOSIS  =      2.461         3.710         2.239         4.116
SKEWESS   =      0.256         0.995         0.260        -0.758
MINIMUM   =     -17.191        -52.680         0.114        21.496
MAXIMUM   =      61.831         76.044        77.519        28.380
* * * * * * * * * * ----- EAST & NORTH ----- * * * * * * * * * *
COVARIANCE =     -92.913         ***      MAJAX      =      23.230
CORR.COEFF. =     -0.290         ***      MINAX      =      13.183
ORIENTATION =     164.741         ***      ELLIPSE     =      0.433
COMMENTS   =
*****

```

```

*****
** SB42A1DG24   * 192 POINTS FROM 83- IX -14 TO 84- III-23
  INST. VM-31    DEPTH 50 M.    BOTTOM DEPTH 4363 M.
  UNITS =        CM/S          CM/S          CM/S          DEG. C
VARIABLE ----- EAST ----- NORTH ----- SPEED ----- TEMP
MEAN      =     18.270         -2.817         26.688         26.504
STD.ERR.  =      0.901         1.544         1.120         .570E-1
VARIANCE  =     155.911        457.447        240.927         0.624
KURTOSIS  =      2.021         3.874         1.921         2.167
SKEWESS   =      0.289         1.156         0.913E-1        -0.139
MINIMUM   =     -2.806        -34.985         0.743         24.687
MAXIMUM   =     48.861         63.639         64.821         28.006
* * * * * * * * * * ----- EAST & NORTH ----- * * * * * * * * * *
COVARIANCE =     -93.341         ***      MAJAX      =      21.943
CORR.COEFF. =     -0.350         ***      MINAX      =      11.344
ORIENTATION =     164.119         ***      ELLIPSE     =      0.483
COMMENTS   =
*****

```

Figure 16


```

*****
** SB43A1H * 4650 POINTS FROM 83- IX -13 TO 84- III-24
  INST. VM-23 DEPTH 75 M. BOTTOM DEPTH 4363 M.
  UNITS = CM/S CM/S CM/S DEG. C
  VARIABLE ----- EAST ----- NORTH ----- SPEED ----- TEMP
  MEAN = 12.651 2.040 21.676 22.362
  STD.ERR. = 0.180 0.260 0.185 .339E-1
  VARIANCE = 151.126 314.425 159.843 5.356
  KURTOSIS = 2.540 4.442 3.338 2.623
  SKEWNESS = -.862E-2 1.257 0.772 0.463
  MINIMUM = -22.320 -39.348 0.214 16.852
  MAXIMUM = 59.278 70.067 71.276 27.622
  * * * * * * * * * * ----- EAST & NORTH ----- * * * * *
  COVARIANCE = -8.708 *** MAJAX = 17.743
  CORR.COEFF. = -.399E-1 *** MINAX = 12.273
  ORIENTATION = 176.956 *** ELLIPSE = 0.308
  COMMENTS =
*****

```

```

*****
** SB43A1DG24 * 192 POINTS FROM 83- IX -14 TO 84- III-23
  INST. VM-23 DEPTH 75 M. BOTTOM DEPTH 4363 M.
  UNITS = CM/S CM/S CM/S DEG. C
  VARIABLE ----- EAST ----- NORTH ----- SPEED ----- TEMP
  MEAN = 12.624 1.787 19.344 22.339
  STD.ERR. = 0.750 1.148 0.879 .156
  VARIANCE = 108.075 253.010 148.349 4.653
  KURTOSIS = 2.105 5.139 2.988 2.807
  SKEWNESS = -.658E-3 1.656 0.658 0.665
  MINIMUM = -6.430 -23.434 0.602 18.873
  MAXIMUM = 38.036 53.735 53.997 27.569
  * * * * * * * * * * ----- EAST & NORTH ----- * * * * *
  COVARIANCE = -8.097 *** MAJAX = 15.879
  CORR.COEFF. = -.490E-1 *** MINAX = 10.347
  ORIENTATION = 176.812 *** ELLIPSE = 0.348
  COMMENTS =
*****

```

Figure 17

```

*****
** SB45B1H      * 4649 POINTS FROM 83- IX -13 TO 84- III-24
  INST. VM-27    DEPTH 150 M.    BOTTOM DEPTH 4363 M.
  UNITS  =        CM/S          CM/S          CM/S          DEG. C
VARIABLE ----- EAST ----- NORTH ----- SPEED ----- TEMP
MEAN    =        3.866          2.071          10.042          12.652
STD.ERR. =        0.102          0.116          0.801E-1          .158E-1
VARIANCE =       48.835          62.646          29.857          1.155
KURTOSIS =        3.045          2.498          2.737          5.254
SKEWNESS =        0.506          .164E-1          0.453          1.742
MINIMUM  =       -14.179         -23.101          0.189          11.272
MAXIMUM  =        29.733          26.438          30.970          17.500
* * * * * * * * * * ----- EAST & NORTH ----- * * * * * * * * * *
COVARIANCE =       -3.943          ***          MAJAX    =          7.980
CORR.COEFF. =       - .713E-1          ***          MINAX    =          6.912
ORIENTATION =       165.137          ***          ELLIPSE   =          0.134
COMMENTS   =
*****

```

```

*****
** SB45B1DG24   * 192 POINTS FROM 83- IX -14 TO 84- III-23
  INST. VM-27    DEPTH 150 M.    BOTTOM DEPTH 4363 M.
  UNITS  =        CM/S          CM/S          CM/S          DEG. C
VARIABLE ----- EAST ----- NORTH ----- SPEED ----- TEMP
MEAN    =        3.865          2.071          9.130          12.638
STD.ERR. =        0.444          0.501          0.335          .733E-1
VARIANCE =       37.791          48.223          21.550          1.031
KURTOSIS =        2.767          2.166          2.408          4.571
SKEWNESS =        0.453          - .117E-2          0.300          1.683
MINIMUM  =       -9.214         -11.027          0.818          11.592
MAXIMUM  =       22.396          17.408          23.126          15.738
* * * * * * * * * * ----- EAST & NORTH ----- * * * * * * * * * *
COVARIANCE =       -4.380          ***          MAJAX    =          7.040
CORR.COEFF. =       -0.103          ***          MINAX    =          6.001
ORIENTATION =       159.989          ***          ELLIPSE   =          0.148
COMMENTS   =
*****

```

Figure 18

Figure 19

Figure 20

Figure 21

Figure 22

Data File SB41A1H : Depth = 20m

Figure 23

Data File SB42A1H : Depth = 50m

Figure 24

Data File SB43A1H : Depth - 75m

Figure 25

Data File SB45B1H : Depth - 150m

Figure 26

Figure 27

Figure 28

ROTARY SPECTRUM
CLOCKWISE IS SOLID LINE
SB41A1H

ROTARY SPECTRUM
CLOCKWISE IS SOLID LINE
SB42A1H

ROTARY SPECTRUM
CLOCKWISE IS SOLID LINE
SB43A1H

ROTARY SPECTRUM
CLOCKWISE IS SOLID LINE
SB45B1H

solid line = East auto spectra
dotted line = North auto spectra

Figure 30

TEMP SB41A1H

TEMP SB42A1H

TEMP SB43A1H

TEMP SB45B1H

Figure 31

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