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Woods Hole Oceanographic Institution

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

by

Ellen Levy and Philip L. Richardson

February 1985

Technical Report

*Funding was provided by the National Science Foundation
under grants OCE 82-17112 and OCE 82-11108.*

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Approved for Distribution:

Robert C. Beardsley

Robert C. Beardsley, Acting Chairman
Department of Physical Oceanography

ABSTRACT

This third and final report presents current and wind data from a three part mooring deployment 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, 75, 150, and 300m. The mooring was deployed on March 26, 1984 and recovered on October 12, 1984.

PREFACE

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

Volumes I-XVIII present data prior to 1978 and are not listed below.

Volumes XIX through XXXVI 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 XXXVII presents data from one mooring of the SEQUAL experiment, third setting 1984.

Volume No.	WHOI Ref. No.		Notes	
			Year	Experiment
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
XXXVI	84-37	Levy, E. and P. L. Richardson	1983-1984	SEQUAL II

Table of Contents

Abstract	i
Preface	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 third setting of one of these moorings, SC4, 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) and from the second setting in Report XXXVI (SEQUAL II, September, 1983 - October, 1984).

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 to III. These composite displays include a plot of transport between the surface and 150 m, velocity components and temperatures (Figures 2-14). The third section displays the data from each individual instrument (Figures 15-36). Included are tables of statistics, time series plots, histograms, progressive vector diagrams, scatter plots and spectral plots.

Figure 1: Location of mooring S4 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 meters</u>	<u>Instrument #</u>	<u>Data #</u>
VAWR on surface toroid buoy	<u>-3</u>	V0141	SC40
1/2 inch chain	12		
Test Case			
Test Case			
VMCM	<u>20</u>	VM014	SC41
7/16 inch wire rope with fairing	27.6		
1/2 inch chain	2		
7/16 inch wire rope with fairing	22.6		
VMCM	<u>75</u>	VM012	SC43
7/16 inch wire rope with fairing	72.6		
VMCM	<u>150</u>	VM003	SC45
7/16 inch wire rope with fairing	149.6		
VMCM	<u>300</u>	VM009	SC47
3/8 inch jacketed wire rope	700		
3/4 inch nylon	3218		
17 inch glass spheres on 24 m of 1/2 inch chain	50		
1/2 inch chain	4		
Acoustic Release	1	340	
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>4353</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. SC4 is the mooring designation), a sequential instrument position number (e.g., SC41 is the first instrument down on mooring SC4), a letter to indicate the data version (e.g., SC41A is the first editing of SC41), and an indication of the time sampling interval for that data record (e.g., SC41A1H is the one hour averaged version). After SEQUAL I, the instruments were numbered relative to depth rather than sequence (e.g., SC43 was at 75m and there was no SC42 at 50m).

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 for the entire series in Figures 2 through 4 and for the third setting in Figures 15 and 20 through 23.

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 10 and individually in Figures 16, and 24 through 27, 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 8,9 and 11.

Histograms

The variables temperature, velocity components, speed and direction are shown as frequency of occurrence versus amplitude plots. They are shown in Figures 17 and 28 through 31.

Progressive Vector and Scatter Plots

Progressive vector plots are based on the filtered time series in Figure 6 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 18, 32 and 33.

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) for the entire series are displayed in Figures 12 through 14 and for the third setting in Figures 19 and 34 through 36.

Table 2

DATA QUALITY

(6° N and 28° W)

<u>File</u>	<u>Start Date</u>	<u>End Date</u>	<u>Comments</u>
SC40	84-III-26	84-V-12	The rotor stopped after two months and some water leakage was discovered in the case.
SC41	84-III-26	84-X-14	Good data
SC43	84-III-26	84-X-14	Good temperature data only.
SC45	84-III-26	84-X-14	Good data
SC47	84-III-26	84-X-14	Good data

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 R/V GYRE, 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.

This experiment was funded by National Science Foundation grants OCE82-17112 and OCE82-11108.

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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.

Levy, E. and P. L. Richardson, 1984, Moored current meter data from the Atlantic north equatorial countercurrent near 6° N 28° W (September-March, 1983-1984), Volume XXXVI. Woods Hole Oceanographic Institution Technical Report WHOI-84-37, 15 p. and 29 figures.

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Hunt, M., 1982, A program for spectral analysis of time series "PROSPECT", Woods Hole Oceanographic Institution Internal Document.

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Richardson, P. L. and T. K. McKee, 1984, Average seasonal variation of the Atlantic equatorial currents from historical ship drifts. Journal of Physical Oceanography, 14(7), pp.1226-1238.

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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.

Figures 2-4: Composite statistics for the three settings (filtered and unfiltered data).

Figure 5: Zonal water transport between the surface and 150 meters.

Figure 6: Composite progressive vector plot for the three settings.

Figure 7: Composite contour plot of eastward velocity for the three settings.

Figure 8: Composite eastward velocity time series for the three settings.

Figure 9: Composite northward velocity time series for the three settings.

Figure 10: Composite vector time series for the three settings.

Figure 11: Composite temperature time series for the three settings.

Figures 12-14: Composite rotary and auto spectra at 20m and 150m for the three settings (unfiltered data).

FIGURES (continued)

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 15-19: Wind recorder data series.

Figures 20-36: Current meter data series.

```

*****
** SEQ20B1H      * 14318 POINTS FROM 83- II -25 TO 84- X -14
                  DEPTH 20 M.    BOTTOM DEPTH 4353 M.
    UNITS  =      CM/S          CM/S          CM/S          DEG. C
VARIABLE  ----- EAST ----- NORTH ----- SPEED ----- TEMP
MEAN      =      21.706         -2.807         32.062         27.327
STD.ERR.  =      0.191          0.172          0.166          .468E-2
VARIANCE  =      523.361        422.196        396.533         0.314
KURTOSIS  =      3.057          3.449          3.158          2.000
SKEWNESS  =      0.438          0.345          0.728         -0.230
MINIMUM   =     -38.329        -65.349          0.288         26.151
MAXIMUM   =     117.977         75.632         122.553         28.587
* * * * * * * * * * ----- EAST & NORTH ----- * * * * * * * * * *
COVARIANCE =     -95.068          ***      MAJAX      =      24.092
CORR.COEFF. =     -0.202          ***      MINAX      =      19.107
ORIENTATION =     120.992          ***      ELLIPSE    =      0.207
COMMENTS   =
*****

```

```

*****
** SEQ20B1DG24   * 595 POINTS FROM 83- II -26 TO 84- X -12
                  DEPTH 20 M.    BOTTOM DEPTH 4353 M.
    UNITS  =      CM/S          CM/S          CM/S          DEG. C
VARIABLE  ----- EAST ----- NORTH ----- SPEED ----- TEMP
MEAN      =      21.721         -2.816         30.431         27.328
STD.ERR.  =      0.877          0.768          0.779          .229E-1
VARIANCE  =      457.195        350.705        360.821         0.312
KURTOSIS  =      2.937          3.626          2.951         1.983
SKEWNESS  =      0.409          0.482          0.663         -0.241
MINIMUM   =     -24.248        -47.745          1.021         26.194
MAXIMUM   =      98.491         62.088         104.455         28.510
* * * * * * * * * * ----- EAST & NORTH ----- * * * * * * * * * *
COVARIANCE =     -94.801          ***      MAJAX      =      22.623
CORR.COEFF. =     -0.237          ***      MINAX      =      17.168
ORIENTATION =     120.340          ***      ELLIPSE    =      0.241
COMMENTS   =
*****

```

Figure 2


```

*****
** SEQ75T1H      * 14318 POINTS FROM 83- II -25 TO 84- X -14
                   DEPTH 75 M.    BOTTOM DEPTH 4353 M.
    UNITS  =      DEG. C
    VARIABLE ----- TEMP
    MEAN    =      22.947
    STD.ERR. =      .207E-1
    VARIANCE =      6.150
    KURTOSIS =      2.125
    SKEWNESS =      0.275
    MINIMUM  =      16.852
    MAXIMUM  =      28.022
*****

```

```

*****
** SEQ75T1DG24   * 595 POINTS FROM 83- II -26 TO 84- X -12
                   DEPTH 75 M.    BOTTOM DEPTH 4353 M.
    UNITS  =      DEG. C
    VARIABLE ----- TEMP
    MEAN    =      22.941
    STD.ERR. =      .960E-1
    VARIANCE =      5.481
    KURTOSIS =      2.144
    SKEWNESS =      0.453
    MINIMUM  =      18.873
    MAXIMUM  =      27.853
*****

```

Figure 3

```

*****
** SEQ150B1H      * 14317 POINTS FROM 83- II -25 TO 84- X -14
                   DEPTH 150 M.   BOTTOM DEPTH 4353 M.
  UNITS  =          CM/S          CM/S          CM/S          DEG. C
VARIABLE ----- EAST ----- NORTH ----- SPEED ----- TEMP
MEAN    =          8.135          -0.698          14.403          13.183
STD.ERR. =          0.119          .761E-1          0.101          .979E-2
VARIANCE =        203.145          82.834          145.189          1.373
KURTOSIS =          3.823          4.405          4.795          4.302
SKEWNESS =          1.110          -0.582          1.525          1.162
MINIMUM  =        -39.005          -46.456          0.156          11.068
MAXIMUM  =          60.230          45.595          72.520          19.417
* * * * * * * * * * ----- EAST & NORTH ----- * * * * * * * * * *
COVARIANCE =        -39.788          ***          MAJAX =          14.666
CORR.COEFF. =         -0.307          ***          MINAX =          8.418
ORIENTATION =        106.741          ***          ELLIPSE =          0.426
COMMENTS  =
*****

```

```

*****
** SEQ150B1DG24   * 595 POINTS FROM 83- II -26 TO 84- X -12
                   DEPTH 150 M.   BOTTOM DEPTH 4353 M.
  UNITS  =          CM/S          CM/S          CM/S          DEG. C
VARIABLE ----- EAST ----- NORTH ----- SPEED ----- TEMP
MEAN    =          8.125          -0.710          13.442          13.181
STD.ERR. =          0.565          0.333          0.487          .461E-1
VARIANCE =        189.614          65.861          141.111          1.263
KURTOSIS =          3.917          4.889          4.984          3.690
SKEWNESS =          1.210          -0.758          1.638          1.071
MINIMUM  =        -15.685          -40.027          0.726          11.592
MAXIMUM  =          53.961          17.408          55.511          17.123
* * * * * * * * * * ----- EAST & NORTH ----- * * * * * * * * * *
COVARIANCE =        -41.167          ***          MAJAX =          14.203
CORR.COEFF. =         -0.368          ***          MINAX =          7.303
ORIENTATION =        106.818          ***          ELLIPSE =          0.486
COMMENTS  =
*****

```

Figure 4

Figure 5: Zonal water transport (m^2/s) between the surface and 150 m based on current meter records at 20 m and 150 m.

Figure 6: Composite progressive vectors for the five depths from 20 to 300 meters. The upper plot shows data from the third setting only.

Figure 7: Composite contour plot of the eastward velocities from the surface to 150 m in the first two settings and from the surface to 300 m in the third setting.

Figure 8: Eastward velocities for the five depths. This plot is a combination of the three settings of the SEQUAL S4 mooring.

Figure 9: Northward velocities for the five depths. This plot is a combination of the three settings of the SEQUAL S4 mooring.

Figure 10: Composite vector time series for the five depths. A combination of the three settings of the SEQUAL S4 mooring. East is up to better show fluctuations about the mean velocity which is eastward.

Figure 11: Composite temperature time series plot for the five depths. This shows a combination of the three settings of the SEQUAL S4 mooring.

AUTO-SPECTRUM

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

SEQ20B1H

SEQ150B1H

Figure 12

ROTARY SPECTRUM
 CLOCKWISE IS SOLID LINE
 SEQ20B1H

ROTARY SPECTRUM
 CLOCKWISE IS SOLID LINE
 SEQ150B1H

Figure 13

SEQ20B1H

AUTO-SPECTRUM

TEMP

SEQ75T1H

SEQ150B1H

Figure 14


```

*****
** SC40B1H      * 1123 POINTS FROM 84- III -26 TO 84- V -12
  INST. V-141WR  DEPTH 0 M.  BOTTOM DEPTH 4353 M.
  UNITS = M/S M/S M/S DEG. C DEG. C
  VARIABLE ---- EAST ---- NORTH ---- SPEED --AIR TEMP - SEA TEMP
  MEAN = -3.766 -5.209 6.538 26.010 27.135
  STD.ERR. = .356E-1 .328E-1 .327E-1 .111E-1 .135E-1
  VARIANCE = 1.426 1.207 1.197 0.138 0.206
  KURTOSIS = 2.805 3.123 3.257 2.977 1.735
  SKEWNESS = 0.378 -.521E-1 -0.176 -0.241 0.194
  MINIMUM = -6.334 -9.293 2.744 24.994 26.407
  MAXIMUM = 0.486 -1.815 10.657 27.120 28.017
  * * * * * ---- EAST & NORTH ---- * * * * *
  COVARIANCE = -.173E-1 *** MAJAX = 1.194
  CORR.COEFF. = -.132E-1 *** MINAX = 1.097
  ORIENTATION = 94.492 *** ELLIPSE = .809E-1
  COMMENTS =
*****

```

```

*****
** SC40B1DG24   * 45 POINTS FROM 84- III -27 TO 84- V -10
  INST. V-141WR  DEPTH 0 M.  BOTTOM DEPTH 4353 M.
  UNITS = M/S M/S M/S DEG. C DEG. C
  VARIABLE ---- EAST ---- NORTH ---- SPEED --AIR TEMP - SEA TEMP
  MEAN = -3.767 -5.232 6.496 26.000 27.120
  STD.ERR. = 0.140 0.106 0.128 .451E-1 .652E-1
  VARIANCE = 0.877 0.510 0.733 .915E-1 0.191
  KURTOSIS = 2.652 2.519 2.752 2.306 1.627
  SKEWNESS = 0.432 -0.518 -0.270 -0.317 0.227
  MINIMUM = -5.514 -6.981 4.425 25.334 26.528
  MAXIMUM = -1.206 -4.079 8.289 26.603 27.894
  * * * * * ---- EAST & NORTH ---- * * * * *
  COVARIANCE = 0.128 *** MAJAX = 0.947
  CORR.COEFF. = 0.192 *** MINAX = 0.678
  ORIENTATION = 72.516 *** ELLIPSE = 0.284
  COMMENTS =
*****

```

Figure 15

Figure 16

Data File SC40B1H : Depth = 0m

Figure 17

SC40B1DG24

Figure 18

AUTO-SPECTRUM

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

AUTO-SPECTRUM
SEA TEMP

ROTARY SPECTRUM
CLOCKWISE IS SOLID LINE
SC40B1H

CW SOLID CCW DASH

Figure 19

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```

*****
** SC41B1H * 4837 POINTS FROM 84- III -26 TO 84- X -14
INST. VM-014 DEPTH 20 M. BOTTOM DEPTH 4353 M.
UNITS = CM/S CM/S CM/S DEG. C
VARIABLE ----- EAST ----- NORTH ----- SPEED ----- TEMP
MEAN = 30.029 -2.620 37.445 26.955
STD.ERR. = 0.350 0.295 0.327 .519E-2
VARIANCE = 591.386 420.676 518.416 0.130
KURTOSIS = 2.858 2.602 2.830 2.557
SKEWNESS = 0.548 -0.244 0.713 -0.244
MINIMUM = -23.621 -64.681 0.669 26.151
MAXIMUM = 117.296 54.707 122.307 27.770
* * * * * ----- EAST & NORTH ----- * * * * *
COVARIANCE = -170.395 *** MAJAX = 26.391
CORR.COEFF. = -0.342 *** MINAX = 17.759
ORIENTATION = 121.696 *** ELLIPSE = 0.327
COMMENTS =
*****

```

```

*****
** SC41B1DG24 * 199 POINTS FROM 84- III -28 TO 84- X -12
INST. VM-014 DEPTH 20 M. BOTTOM DEPTH 4353 M.
UNITS = CM/S CM/S CM/S DEG. C
VARIABLE ----- EAST ----- NORTH ----- SPEED ----- TEMP
MEAN = 30.257 -2.694 36.139 26.958
STD.ERR. = 1.596 1.289 1.508 .252E-1
VARIANCE = 506.780 330.787 452.390 0.126
KURTOSIS = 2.715 2.398 2.709 2.567
SKEWNESS = 0.511 -0.245 0.710 -0.268
MINIMUM = -14.522 -47.745 3.674 26.194
MAXIMUM = 98.491 36.257 104.455 27.667
* * * * * ----- EAST & NORTH ----- * * * * *
COVARIANCE = -169.880 *** MAJAX = 24.638
CORR.COEFF. = -0.415 *** MINAX = 15.044
ORIENTATION = 121.308 *** ELLIPSE = 0.389
COMMENTS =
*****

```

Figure 20

```

*****
** SC43A1H      * 4837 POINTS FROM 84- III -26 TO 84- X -14
  INST. T-765    DEPTH 75 M.    BOTTOM DEPTH 4353 M.
  UNITS =        DEG. C
  VARIABLE ----- TEMP
  MEAN =         22.717
  STD.ERR. =     .361E-1
  VARIANCE =     6.319
  KURTOSIS =     1.855
  SKEWNESS =     0.177
  MINIMUM =     16.984
  MAXIMUM =     27.719
*****

```

```

*****
** SC43A1DG24   * 199 POINTS FROM 84- III -28 TO 84- X -12
  INST. T-765    DEPTH 75 M.    BOTTOM DEPTH 4353 M.
  UNITS =        DEG. C
  VARIABLE ----- TEMP
  MEAN =         22.711
  STD.ERR. =     0.168
  VARIANCE =     5.636
  KURTOSIS =     1.708
  SKEWNESS =     0.318
  MINIMUM =     19.079
  MAXIMUM =     26.814
*****

```

Figure 21


```

*****
** SC45A1H * 4833 POINTS FROM 84- III -26 TO 84- X -14
INST. VM-003 DEPTH 150 M. BOTTOM DEPTH 4353 M.
UNITS = CM/S CM/S CM/S DEG. C
VARIABLE ----- EAST ----- NORTH ----- SPEED ----- TEMP
MEAN = 11.342 -3.099 18.580 13.351
STD.ERR. = 0.270 0.117 0.209 .129E-1
VARIANCE = 352.078 65.660 210.718 0.804
KURTOSIS = 2.264 3.389 2.554 3.006
SKEWNESS = 0.627 -0.256 0.912 0.174
MINIMUM = -22.060 -36.818 0.191 11.070
MAXIMUM = 59.790 22.181 59.887 17.053
* * * * * ----- EAST & NORTH ----- * * * * *
COVARIANCE = -46.008 *** MAJAX = 18.953
CORR.COEFF. = -0.303 *** MINAX = 7.645
ORIENTATION = 98.905 *** ELLIPSE = 0.597
COMMENTS =
*****

```

```

*****
** SC45A1DG24 * 199 POINTS FROM 84- III -28 TO 84- X -12
INST. VM-003 DEPTH 150 M. BOTTOM DEPTH 4353 M.
UNITS = CM/S CM/S CM/S DEG. C
VARIABLE ----- EAST ----- NORTH ----- SPEED ----- TEMP
MEAN = 11.466 -3.119 17.883 13.354
STD.ERR. = 1.309 0.492 1.027 .591E-1
VARIANCE = 340.973 48.265 209.736 0.695
KURTOSIS = 2.180 3.039 2.465 2.353
SKEWNESS = 0.646 -0.160 0.948 -.339E-1
MINIMUM = -15.685 -23.970 1.501 11.657
MAXIMUM = 53.961 14.563 54.497 15.128
* * * * * ----- EAST & NORTH ----- * * * * *
COVARIANCE = -47.351 *** MAJAX = 18.620
CORR.COEFF. = -0.369 *** MINAX = 6.371
ORIENTATION = 98.964 *** ELLIPSE = 0.658
COMMENTS =
*****

```

Figure 22

```

*****
** SC47A1H * 4832 POINTS FROM 84- III -26 TO 84- X -14
INST. VM-009 DEPTH 300 M. BOTTOM DEPTH 4353 M.
UNITS = CM/S CM/S CM/S DEG. C
VARIABLE ----- EAST ----- NORTH ----- SPEED ----- TEMP
MEAN = 3.363 -1.182 7.312 10.140
STD.ERR. = .978E-1 .703E-1 .779E-1 .565E-2
VARIANCE = 46.213 23.861 29.301 0.154
KURTOSIS = 3.538 3.780 4.431 2.775
SKEWNESS = 0.923 .785E-1 1.245 0.105
MINIMUM = -12.977 -20.518 .277E-1 9.218
MAXIMUM = 29.470 21.067 34.749 11.606
* * * * * ----- EAST & NORTH ----- * * * * *
COVARIANCE = 4.012 *** MAJAX = 6.848
CORR.COEFF. = 0.121 *** MINAX = 4.812
ORIENTATION = 80.127 *** ELLIPSE = 0.297
COMMENTS =
*****

```

```

*****
** SC47A1DG24 * 199 POINTS FROM 84- III -28 TO 84- X -12
INST. VM-009 DEPTH 300 M. BOTTOM DEPTH 4353 M.
UNITS = CM/S CM/S CM/S DEG. C
VARIABLE ----- EAST ----- NORTH ----- SPEED ----- TEMP
MEAN = 3.398 -1.195 6.373 10.144
STD.ERR. = 0.435 0.264 0.346 .256E-1
VARIANCE = 37.727 13.877 23.823 0.131
KURTOSIS = 3.226 2.963 4.031 2.721
SKEWNESS = 1.067 0.382 1.279 -.448E-3
MINIMUM = -5.331 -10.307 .629E-1 9.418
MAXIMUM = 22.751 9.195 24.238 11.135
* * * * * ----- EAST & NORTH ----- * * * * *
COVARIANCE = 3.300 *** MAJAX = 6.163
CORR.COEFF. = 0.144 *** MINAX = 3.655
ORIENTATION = 82.267 *** ELLIPSE = 0.407
COMMENTS =
*****

```

Figure 23

Figure 24

Figure 25

Figure 26

Figure 27

Data File SC41B1H : Depth = 20m

Figure 28

Data File SC43A1H : Depth = 75m

Figure 29

Data File SC45A1H : Depth = 150m

Figure 30

Data File SC47A1H : Depth = 300m

Figure 31

SC41B1DG24

SC45A1DG24

SC47A1DG24

Figure 32

Figure 33

SC41B1H

SC45A1H

SC47A1H

ROTARY SPECTRUM
CLOCKWISE IS SOLID LINE

Figure 34

SC41B1H

SC45A1H

SC47A1H

AUTO-SPECTRUM

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

Figure 35

SC41B1H

SC45A1H

SC43A1H

AUTO-SPECTRUM
TEMP

SC47A1H

Figure 36

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