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NOS MEMD 8

CURRENT VELOCITY MEASUREMENTS AT GRAY'S REEF NATIONAL MARINE SANCTUARY

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NATIONAL OCEANIC AND ATMOSPHERIC ADMINISTRATION
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OFFICE OF OCEAN AND COASTAL RESOURCE MANAGEMENT
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ABSTRACT

A study was performed to observe the currents at Gray' Reef and a nearby coastal station for a period from June, 1984 to December, 1985. Current meters were deployed by General Oceanics at Gray's Reef (31.4 deg N,80.9 deg W) and "F" Reef (31.1 deg N,81.2 deg W) off the Georgia coast at depths near the middle and near the bottom of the water column. The purpose of the effort was to describe the reef energetics and nutrient dynamics representative of live bottom areas common to the South Atlantic Bight.

The results of the study consisted of records of current velocity and wind velocity spanning the deployment period. Some gaps in the data occurred due to problems with instrumentation and damage from vessels in the area. Overall the data return was very good.

Analyses of the data were done using time series techniques. Means of winds and currents were compared on a seasonal basis. Correlations were computed between the records at each station and between each station and the winds at Savannah Navigational Light Tower.

Fluctuations in winds and currents occurred predominantly at 2-10 day periods. The most energetic fluctuations in ocean currents were generated by the astronomical tide at 0.5 day periods.

Comparisons were made of winds and currents for the spring, summer and autumn season for 1985. The seasonal mean current velocities at the top and bottom of each mooring were consistent with the mean wind speeds. Surface currents were predominately northward driven by the northward directed winds. A component of the flow was usually to the right of the wind at the upper instrument and to the left of the wind near bottom. This finding is consistent with other studies of currents on the continental shelf of the South Atlantic Bight.

There was usually good visual correlation in the data plots. However, there were episodes of southward currents during spring and summer when the wind stress is generally northward. These events result in correlation coefficients between wind and current that are lower than would occur under direct wind generation of shallow-water currents. Pressure gradient forces are likely responsible for a significant portion of the variance in ocean currents in the vicinity of Gray's Reef.

Gray's Reef is in an area which receives seasonal fluctuations of fresh water coastal runoff. The resulting pressure gradients can modify the response of the current to direct wind forcing. Seasonal fluctuations of freshwater runoff and changing sea level gradients have an important influence on coastal currents surrounding Gray's Reef. A key findings of this study, namely the rather low correlation between winds and currents, is evidence of forces other than wind that help force the observed currents at Gray's Reef. We recommend future studies designed to measure the cross-shelf and along shelf pressure gradient in the vicinity of Gray's Reef.

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PREFACE

The field portion of the study was performed by General Oceanics, Inc. of Miami, Florida. The field operations were conducted by Mr. Robert Calvert of General Oceanics including all the mooring and current meter preparation, field servicing and initial translation of the data.

The data processing was performed by Dr. Gregory Han of General Oceanics using the General Oceanics FESTSA processing system on an IBM AT computer. The data interpretation and synthesis was performed by Dr. Jackson Blanton of Skidaway Institute acting as a consultant and by Dr. Han.

The authors thank the University of Georgia, Sapelo Island Marine Institute and the Georgia Department of Natural Resources, Costal Resources Division who provided the vessels and divers to assist General Oceanics in performing the field portion of the program.

1 INTRODUCTION

Current meters were deployed by General Oceanics at Gray's Reef (31.4 deg N,80.9 deg W) and "F" Reef (31.1 deg N,81.2 deg W) off the Georgia coast (Figure 1) under subcontract to the University of Georgia, Sapelo Island Marine Institute. The current meters were deployed on fixed moorings in support of a research effort funded by the Sanctuary Programs Division (SPD) of the National Oceanic and Atmospheric Administration (NOAA). The purpose of the effort is to describe the reef energetics and nutrient dynamics representative of live bottom areas common to the South Atlantic Bight. The moorings were deployed from June, 1984 to December, 1985.

Gray's Reef is located about 35 kilometers west of Sapelo Island off the coast of Georgia at water depths of about 20 m. "F" Reef is located closer to shore in water depths of about 15 m. This portion of the continental shelf receives many localized sources of freshwater discharge which form a frontal zone of low salinity water (Atkinson, Blanton and Haines, 1978; Blanton, 1981; Blanton and Atkinson, 1983). Currents in the frontal zone respond within 6-12 hours of the wind, but the magnitude of the current generated by a given wind strength is dependent upon direction of the wind, the depth under the sea surface, and pressure gradients generated by sea level slopes and by storage of low salinity water within the frontal zone. The frontal zone exerts an important modifying influence on coastal circulation off the Georgia coast.

It is difficult to document the presence or absence of the frontal zone at Gray's Reef because no measurements of salinity or water mass structure were conducted simultaneously with the acquisition of current meter data. While Gray's Reef is thought to be outside the direct influence of the frontal zone, it will be shown that knowledge of its strength and position is necessary for properly interpreting currents measurements based on studies farther north along the Georgia coast (Blanton, 1983; Blanton, in press). "F" Reef is more often under the influence of the fresh water zone because the station is closer to shore.

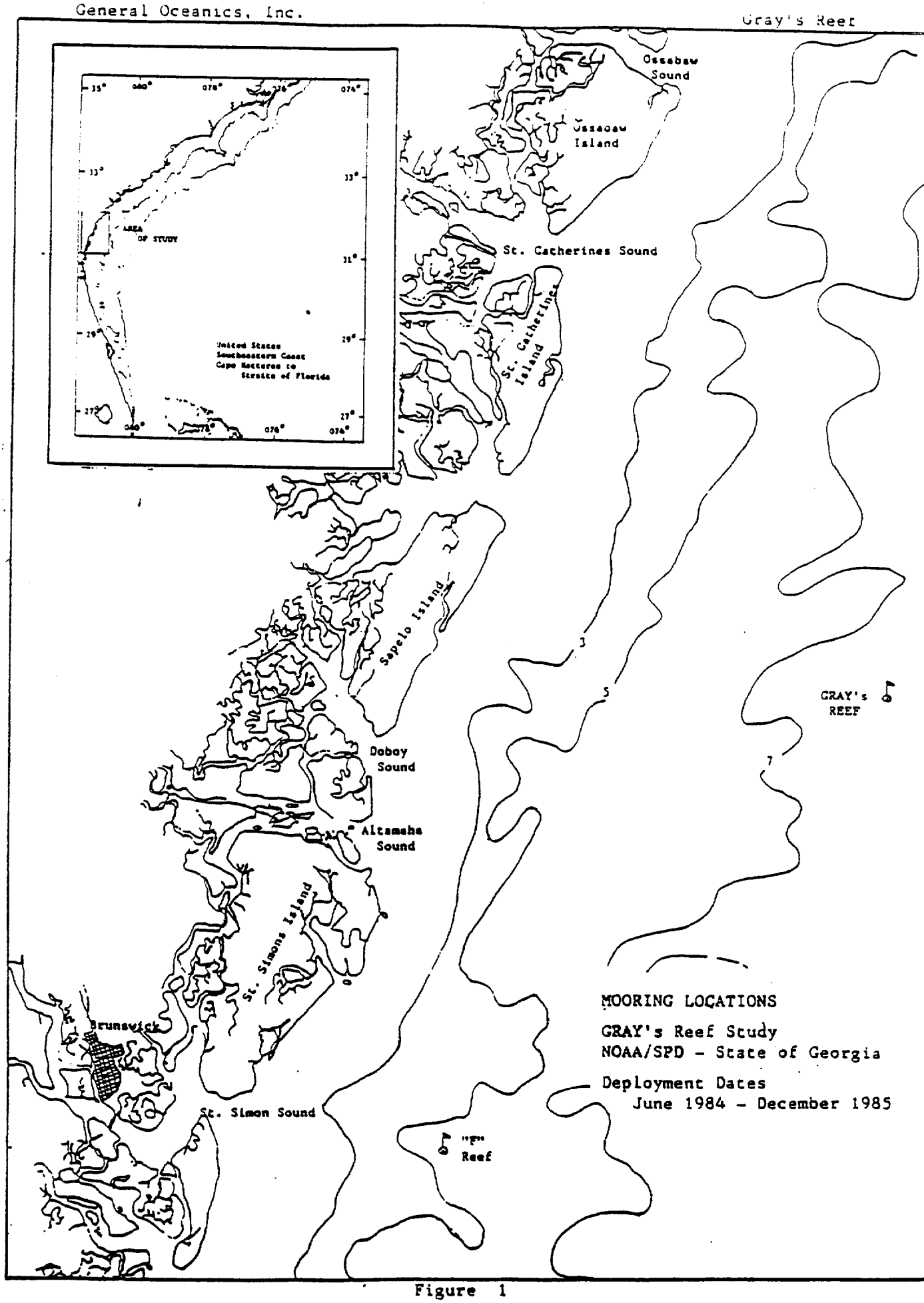
2 METHODS

2.1 Mooring Configuration

Each mooring supported two General Oceanics model 6011 MK I winged current meters. A chartlet of Mooring locations in relation to coastal features is in Figure 1. The Gray's Reef mooring was deployed in 70 feet of water , 16 nautical miles (nm) ENE of Doboy Sound at 31 deg 2 min N and 080 deg 52 min W with current meters at 20 and 50 feet below the surface. The "F" reef mooring was deployed in 45 feet of water, 6.5 nm NW of the entrance buoy of St. Simon's Sound at 31 deg 06 min N and 081 deg 13.3 min W with current meters at the 25 and 35 foot levels. The Gray's Reef mooring was located 50 feet offshore from the reef break. The "F" reef mooring was located 150 ft. from the Reef marker buoy. These locations were considered the most secure sites available.

2.2 Mooring Design

The mooring design was based upon past designs used by General Oceanics on similar programs. The sectional flotation is distributed throughout the mooring rather than at a single sphere to reduce the pendulum effect common to coastal moorings. A total of six trawl floats with 18 pounds of upthrust each were used to support the instrumentation. A representative drawing of the mooring is included in figure 2. The moorings are subject to design analysis prior to assembly. The design is exposed to current profiles judged to be representative of conditions at the deployment site. Low, Mean, and high velocity profiles are run and instrument and mooring excursions are noted. Performance of the mooring is verified during the deployment period from velocity profiles constructed from actual data. The moorings were deployed as designed and no modifications were made during the deployment period.


Ossabaw Sound
Ossabaw Island
St. Catherines Sound
St. Catherines Island
Sapelo Island
Doboy Sound
Altamaha Sound
St. Simons Island
Brunswick
St. Simon Sound
"F" Reef
GRAY's REEF
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AREA OF STUDY
United States Southeastern Coast Cape Hatteras to Straits of Florida
MOORING LOCATIONS
GRAY's Reef Study
NOAA/SPD - State of Georgia
Deployment Dates
June 1984 - December 1985

Figure 1

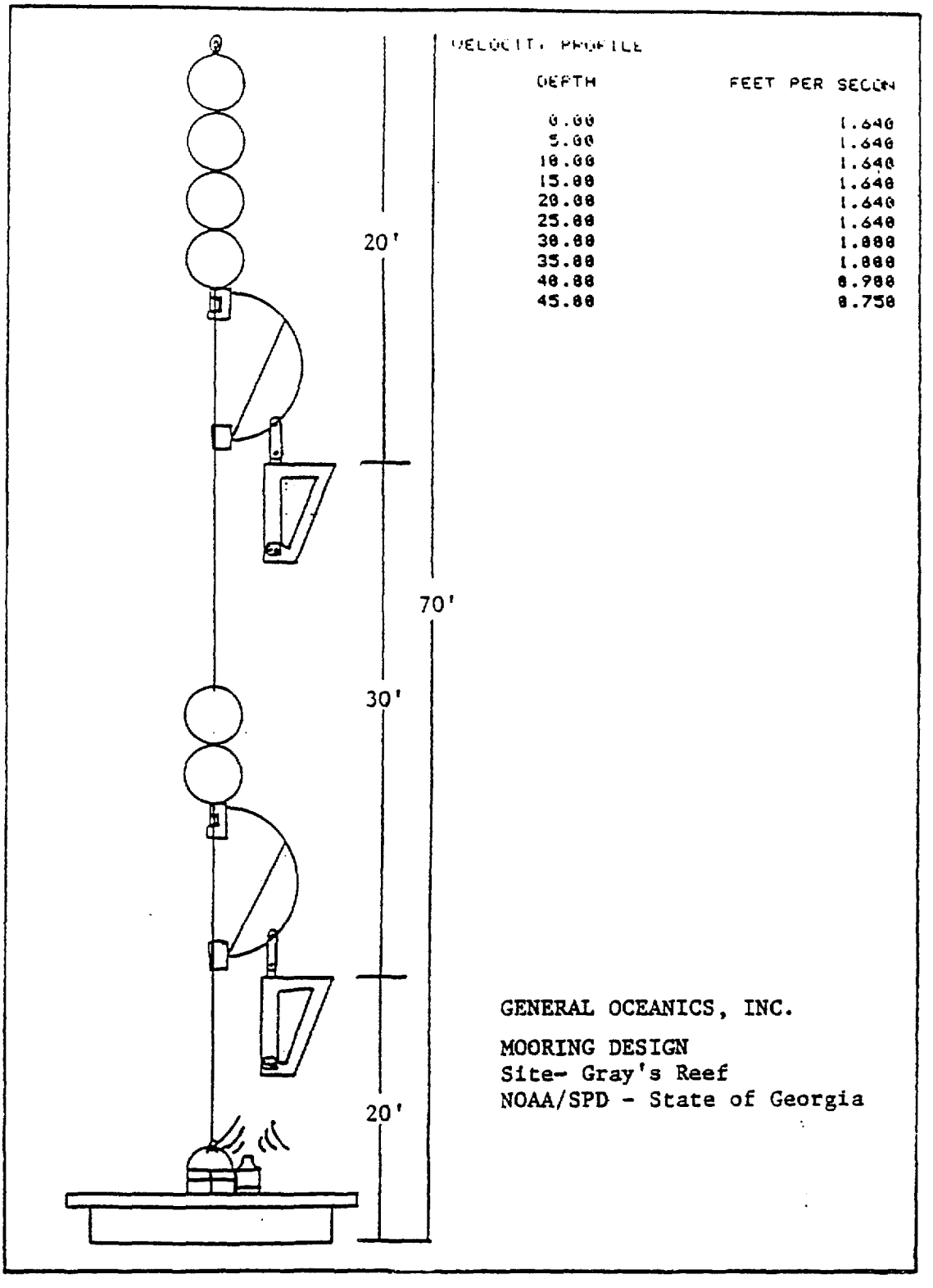

Figure 2. Mooring Design

2.3 Meteorological Station

Meteorological data are recorded continuously by Skidaway Institute of Oceanography, Savannah, GA, from the Savannah Navigational Light Tower (SNLT) located 20 kilometers southeast of Savannah River Inlet. Skidaway Institute furnished hourly values of wind speed and direction to General Oceanics which incorporated them into the data record.

The wind data from SNLT are thought to be representative of the Gray's Reef area because correlation scales between wind stations over oceanic areas are hundreds of kilometers (Weisberg and Pietrafesa, 1983).

2.4 Instrumentation

The NOAA owned General Oceanics Model 6011 MK I current meter was used exclusively in the program. The 6011 MK I is a self-contained inclinometer type winged current meter. The meter is negatively buoyant so that when suspended in still water it hangs vertically downward from the mounting swivel. Any current causes the meter to incline from the vertical in a down current direction.

The magnitude and direction of this tilt is measured within the instrument by four sensors; an inclinometer and three orthogonally mounted flux gate devices. Each flux gate sensor generates a voltage proportional to the , component of the earth's magnetic field along its sensitive axis. A fifth sensor is also installed to record temperature.

Readings from all five sensors are recorded at each sampling interval. Then, during the data reduction process after recovery of the instrument, the inclinometer and flux gate sensor readings are combined and the magnitude and direction of the current computed. The direction must, of course, be corrected for the local variation in the earth's magnetic field to obtain geographic direction.

The complete instrument operates under the control of a quartz crystal timing circuit. This circuit supplies a trigger pulse at each sampling interval. The instrument then cycles through the sequence "power on - measure - record - power off". The "power on" refers to those portions of the circuit having high current drains. These are switched off between readings to conserve power.

During the "measure" part of the sequence, signals from the sensors are digitized and then placed in a 64-bit parallel in/serial out, shift register together with the time code and the instrument serial number. The information is then shifted serially during the "record" period, into the tape head drive circuitry.

The 6011 is available with three wing configurations, low (0-70 cm/s), standard (0-225 cm/s), and high (0-300 cm/s) velocity. The standard wing was used throughout the program. The instruments were set to record a burst of 4 samples, with an interval between bursts of 10.5 seconds every

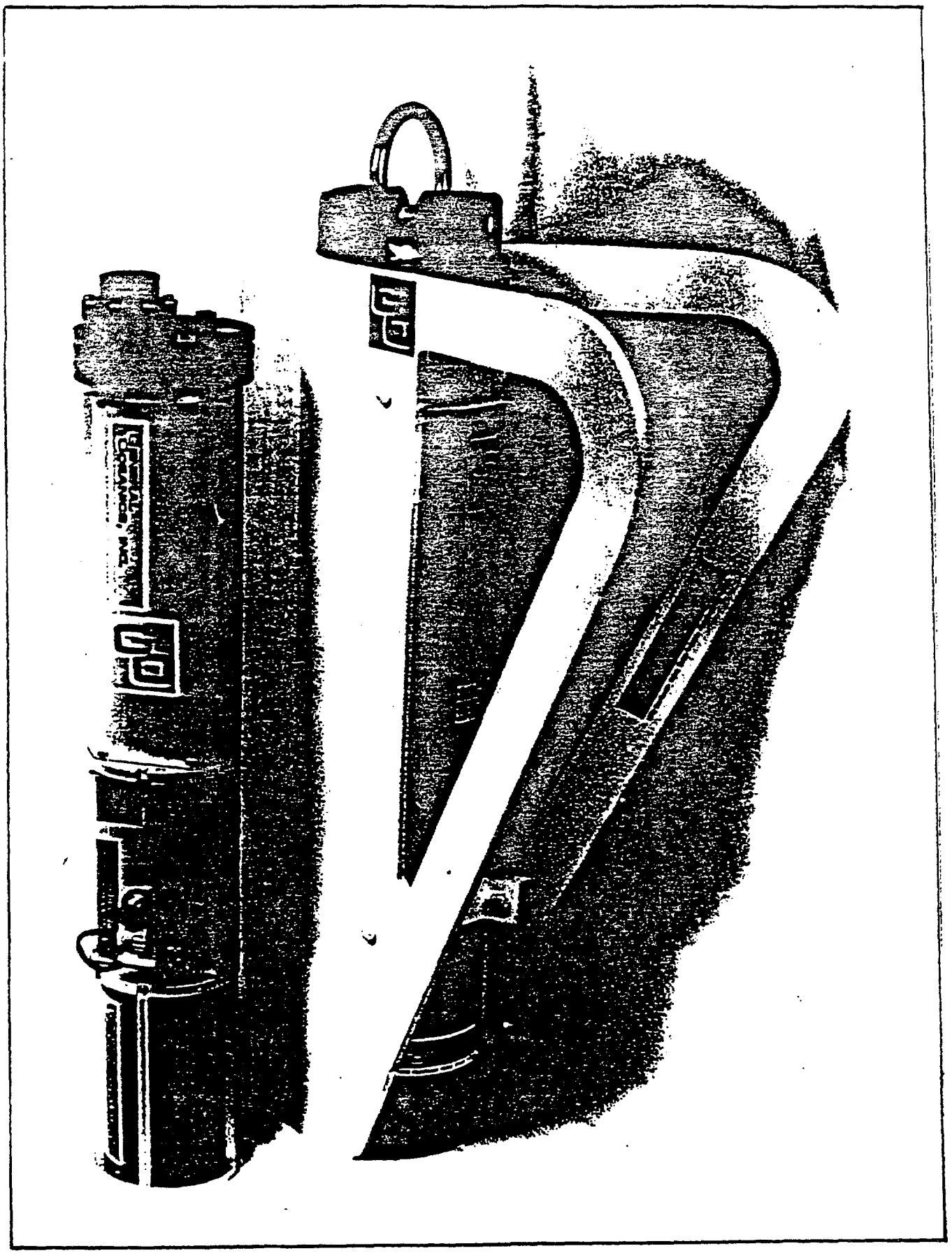

Figure 3. 6011 MKI

thirty minutes. The moorings were serviced quarterly and new tapes and batteries installed. Figure 3 illustrates the General Oceanics 6011 MK I current meter with standard wing.

2.5 Logistics

The moorings and instrumentation were shipped to the State of Georgia, Department of Natural Resources, Coastal Resource Division in Brunswick Georgia. The DNR transferred the equipment to the Darien docks for loading aboard the R/V Spartina chartered from the University of Georgia, Sapelo Island Marine Institute and under charter by NOAA for deployment of the moorings. General Oceanics personnel performed the instrumentation checkout and deployment of the moorings. The DNR supervised the navigation of the vessel to insure proper location using Loran C. The Loran time delays were considered the primary positioning record. The moorings were also equipped with acoustic beacons operating at 27 and 37 KHz to allow the divers to located the moorings in the reduced visibility that was usually present at the site.

The vessel support for the quarterly service of the moorings was divided between the Sapelo Island Marine Institute's R/V Spartina, and Zapala, and the Georgia DNR vessel R/V George T. Bagby. General Oceanics supplied a diver/technician for service of the moorings and the current meters. DNR supplied a diver/scientist for support. The final recovery was made in December 1985 and all equipment was returned to General Oceanics for post calibration, cleaning and storage.

2.6 Mooring Operations

June 1, 1984

General Oceanics personnel deployed the following moorings and instrumentation at the sites listed below aboard the R/V Spartina under charter to NOAA by the University of Georgia, Sapelo Island Marine Institute.

Gray's Reef (mooring located 300 m NE of the Marker Buoy)
Water Depth= 70 ft.

Component	Depth	SN #	Duty Cycle
6011-T MKI	20	109	3 Mo.
6011-T MKI	50	118	3 Mo.
37 KHz Beacon	70	-	5 Yr.

"F" Reef (mooring located 100 ft. South of the Marker Buoy)
Water Depth= 45 feet

Component	Depth	SN #	Duty Cycle
6011-T MKI	25	031	3 Mo.
6011-T MKI	35	091	3 Mo.
27 KHz Beacon	45	-	5 Yr.

Aug 27, 1984

The Gray's Reef mooring was serviced. CM 109 was found to be damaged and was not redeployed because there was no spare standoff available. CM 118 was redeployed at the 50 ft. level. CM 109 recorded 16963 samples and CM 118 recorded 16983 samples. The "F" Reef mooring could not be located. The locating beacon signal was strong but the mooring could not be located by search line. Despite numerous attempts to re-schedule a servicing cruise, the retrieval of the "F" Reef mooring was delayed until October. One cause of the difficulties was periods of severe weather, including a major hurricane passage and persistent ship scheduling difficulties.

Oct 14-17, 1984

General Oceanics shipped a replacement stand-off to Georgia Department of Natural Resources on Aug 28, 1984. The meter left with DNR and was ready to re-deploy on the Gray's Reef top position. On 16 Oct 1984 Georgia DNR notified General Oceanics that they had located the "F" Reef Mooring and had tagged it with a surface float. The beacon had been attached to the mooring by Georgia DNR with a 1/4 inch line. The beacon had been separated form the mooring and it was found about 100 feet from the mooring, buried in the silt. On 17 Oct 1984 Georgia DNR replaced the upper level Gray's Reef Mooring, the resulting data gap was 1.5 months.

Nov 9, 1984

Due to weather delays and ship scheduling problems General Oceanics and Georgia DNR were not able to service the "F" Reef mooring until 9 Nov 1984 aboard the R/V Bagby. Both CM's were recovered and re-deployed. Both current meters showed full tape transport at the time of recovery. The battery on CM 91 had failed the pre-deployment checkout and it was replaced.

The data tapes underwent translation and preliminary analysis of the record for data quality. The analysis of the CM 091 tape revealed that the unit failed early in the deployment. CM 031 recorded 18853 samples, however due to delays in recovery of the meters the unit ran out of tape creating a gap of 2.5 Mo.

Dec 11, 1984

On 11 Dec 1984 General Oceanics and Georgia DNR attempted a routine turnaround of the mooring network aboard the R/V Spartina. The Gray's Reef Mooring was recovered, serviced and re-deployed. Attempts were made to reach the "F" Reef Mooring but heavy fog reduced the lateral visibility and diving operations were considered not possible under those conditions. The next turnaround was scheduled to take place at interval of 3 months from the last "F" Reef service. Analysis of the Gray's Reef tapes showed good data records during the deployments.

Mar 11, 1985

General Oceanics and Georgia DNR attempted routine service of the mooring network aboard the R/V Zapala under charter to NOAA by the University of Georgia, Sapelo Island Marine Institute. The ship experienced considerable difficulties with its main engine and power generating systems which caused the radar and the LORAN to function intermittently. This and the ship's slow cruising speed resulted in sufficient delay so that arrival at F Reef was at twilight and the surface marker was not visible. Only the Gray's Reef mooring was serviced on schedule. Both current meter tapes showed full transport.

Analysis of the current meter data tapes showed that the Gray's Reef top meter did not perform properly. Arrangements were made to ship a replacement meter to Georgia DNR to replace the faulty meter.

Mar 14, 1985

Georgia DNR recovered and re-deployed the "F" Reef mooring aboard the R/V Bagby. The originally scheduled servicing in early March could not be accomplished due to weather and scheduling difficulties. The tapes ran out on March 4, 1985, 10 days before recovery. The data from meter 91 was good even though the previous deployment had bad data return. The previous failure was probably due to a premature battery failure on the previous deployment.

Apr 22, 1985

Current Meter 091 received a full factory checkout and was shipped to Georgia DNR on April 22 to be swapped out for meter 83 which is now on Grays Reef Top position. Meter 83 was bad on the last deployment and may not be working properly. The next scheduled turn around is early June, 1985.

May 3, 1985

Current meter 091 was deployed in place of 083 on the top position of the Gray's mooring. As noted the 083 current meter showed a failure during the last deployment. Sapelo Island Marine Institute made the exchange while performing associated studies a the Gray's reef site.

May 29, 1985

General Oceanics and Georgia DNR performed routine service of the mooring network aboard the R/V/ Bagby under charter to NOAA by the State of Georgia. Two additional meters were supplied to eliminate a dive at each site thus shortening the time required for service. Current meters 083 and 222 were placed on the Gray's mooring and current meters 091 and 118 were removed and serviced in route to the "F" Reef mooring. These meters were installed on the "F" reef mooring and current meters 031 and 109 were removed and returned to General Oceanics for factory checkout. All tapes showed tape transport appropriate to the deployment period.

Aug. 29, 1985

General Oceanics and Georgia DNR performed routine service of the mooring network aboard the R/V/ Bagby under charter to NOAA by the State of Georgia. The turnaround was done as described in the May 29 summary. Two additional meters were supplied to reduce the dive time required to service the moorings. Meters 031 and 109 were deployed on the "F" reef mooring in place of 091 and 118. These meters were serviced in route to the Gray's Reef mooring and were deployed in place of 083 and 222 which were removed and returned to General Oceanics for service. All meters showed tape transport appropriate to the deployment period. The mooring service was originally scheduled for Aug 28 however, weather would not permit diving operations and the service was delayed one day.

Dec. 9, 1985

Georgia DNR recovered all current meters and mooring hardware from both "F" Reef and Gray's Reef aboard the R/V/ Bagby under charter to NOAA by the State of Georgia. The current meters were cleaned and service by General Oceanics at the DNR facility in Brunswick, GA on Dec 23. All meters showed tape transport appropriate to the deployment period. All instrumentation was returned to General Oceanics for post calibration and checkout.

3 RESULTS

3.1 Data Processing

The raw data were processed using the General Oceanics FESTSA timese series processing system. The data were first edited and the timing of the series were adjusted to agree with the deployment and recovery logs. The data were then digitally filtered to smooth the data and to separate the tidal frequency informationin the signals from the low frequency information. First, the x and y components were smoothed with a low pass filter which has a 1/2 power point of 3 hours. This resulted in a data set with a time interval of 1 hour between observation which preserves fluctuations with more than a 3 hour period. The most energetic fluctuations in ocean currents off Georgia occurs at a period of 12.48 hours, the semi-diurnal tidal period. This fluctuation is the dominate signal remaining in the 3-hour low passed (3HLP) data of ocean currents.

A second low passed filter was used to remove the tidal and inertial oscillations in the data set. The resulting data set was analyzed for wind-generated current fluctuations which occur at periods of about 2 days are longer. This low passed filter has a 1/2 power point of 40 hours, and the resulting data set was decimated so that the data interval between observations was 6 hours. This data set will hereafter be designated the 40 hour low passed (40HLP) data set.

The wind and current meter vectors were converted to an x,y coordinate system that was oriented along the local isobaths in the vicinity of Gray's Reef. The isobaths at Gray's Reef and at "F" Reef trend in a direction approximately 20 degrees east of north. Thus positive y-direction is designated alongshore in this direction; positive x-direction is 90 degrees clockwise, or 20 degrees south of due east.

3.2 Data Return

The data returned from the Gray's Reef and "F" Reef locations were sufficient to examine the seasonal fluctuations in the currents. A Time Bar of the good data returned from the experiment are shown in Figure 4. The current and wind velocities for each of the six seasons from Summer 1984 through Fall 1985 are shown in Figure 5.

The mean vector values and their standard deviations (placed in parentheses) are summarized in Table 2. A question mark (?) between the mean and standard deviation indicates that the mean was calculated from fewer observations than were representative of the length of the season. (See appendix A and B for the complete statistical analyses of the 3HLP and 40HLP files.)

Figure 4. Time Bar of Current and Wind Data. The numbers in the mooring desination are the deployment period.

```
                                  84                  85                          85
                                  JunJul Sep Nov  Jan Mar May  Jul Sep NovDec
                                  1  1   1   1    1   1   1    1   1   1  1

SAVANNAH LIGHT TOWER WINDS 1      =================   .   .    .   .   .  .
SAVANNAH LIGHT TOWER WINDS 2         .   . 1-Feb-85 ========================
GRAY'S TOP 1                      ========   .    .   .   .    .   .   .  .
GRAY'S TOP 2                         .   .  ===== .   .   .    .   .   .  .
GRAY'S TOP 5-6                       .   .   .   3-May-85 =================
GRAY'S BOTTOM 1-2                 =============== .   .   .    .   .   .  .
GRAY'S BOTTOM 3-6                    .12-Dec-84 ======================  .
FREEF TOP 1                       ========   .    .   .   .    .   .   .  .
FREEF TOP 3                          9-Nov-84.========.   .    .   .   .  .
FREEF TOP 4-6                        .   .   .   1-May-85 =================
FREEF BOTTOM 3                       9-Nov-84.=========   .    .   .   .  .
FREEF BOTTOM 4-6                     .   .   14-Mar-85.===================
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Table 1. Listing of Deployed Current Meters

**********GENERAL OCEANICS**********
CURRENT METER DEPLOYMENT AND RECOVERY DATABASE

SERIAL NUMBER	MOOR NAME	DEPTH INST	DEPTH SITE (M)	DATE START (M)	DATE END	LAT	LONG	RCRD GOOD
91	FREEF	11	14	05/31/84	11/09/84	31 05.9	81 12.5	BAD
31	FREEF	8	14	05/31/84	11/09/84	31 05.9	81 12.5	GOOD
31	FREEF	8	14	11/09/84	03/14/85	31 05.9	81 13.5	GOOD
91	FREEF	11	14	11/09/84	03/14/85	31 05.9	81 13.5	GOOD
31	FREEF	8	14	03/14/85	05/29/85	31 05.9	81 13.5	GOOD
109	FREEF	11	14	03/14/85	05/29/85	31 05.9	81 13.5	GOOD
91	FREEF	8	15	05/29/85	08/29/85	31 05.8	81 13.3	GOOD
118	FREEF	13	15	05/29/85	08/29/85	31 05.8	81 13.3	GOOD
31	FREEF	8	14	08/29/85	12/09/85	31 05.9	81 12.5	GOOD
109	FREEF	13	14	08/28/85	12/09/85	31 05.9	81 12.5	GOOD
118	GRAY'S	15	21	05/31/84	08/27/84	31 24.0	80 52.1	GOOD
109	GRAY'S	6	21	05/31/84	08/27/84	31 24.0	80 52.1	PGOOD
118	GRAY'S	15	21	08/27/84	12/11/84	31 24.0	80 52.1	GOOD
83	GRAY'S	6	21	10/16/84	12/11/84	31 24.0	80 52.1	GOOD
118	GRAY'S	15	21	12/11/84	03/11/85	31 24.0	80 52.1	PGOOD
83	GRAY'S	6	21	12/11/84	03/11/85	31 24.0	80 52.1	BAD
118	GRAY'S	15	21	03/11/85	05/29/85	31 24.0	80 52.1	GOOD
83	GRAY'S	6	21	03/11/85	05/03/85	31 24.0	80 52.1	BAD
91	GRAY'S	6	21	05/03/85	05/29/85	31 24.0	80 52.1	GOOD
83	GRAY'S	6	21	05/29/85	08/29/85	31 24.0	80 52.1	GOOD
222	GRAY'S	18	21	05/29/85	08/29/85	31 24.0	80 52.1	GOOD
91	GRAY'S	6	21	08/29/85	12/09/85	31 24.0	80 52.0	GOOD
118	GRAY'S	18	21	08/29/85	12/09/85	31 24.0	80 52.0	PGOOD

CODE WORDS (RCRD GOOD) HAVE THE FOLLOWING MEANING:

<GOOD>=ALL GOOD; <PGOOD>=PARTIALLY GOOD; <BAD>=DATA BAD

SUMMARY OF RECORD QUALITY
GOOD= 17; PARTIALLY GOOD= 3; BAD = 3.

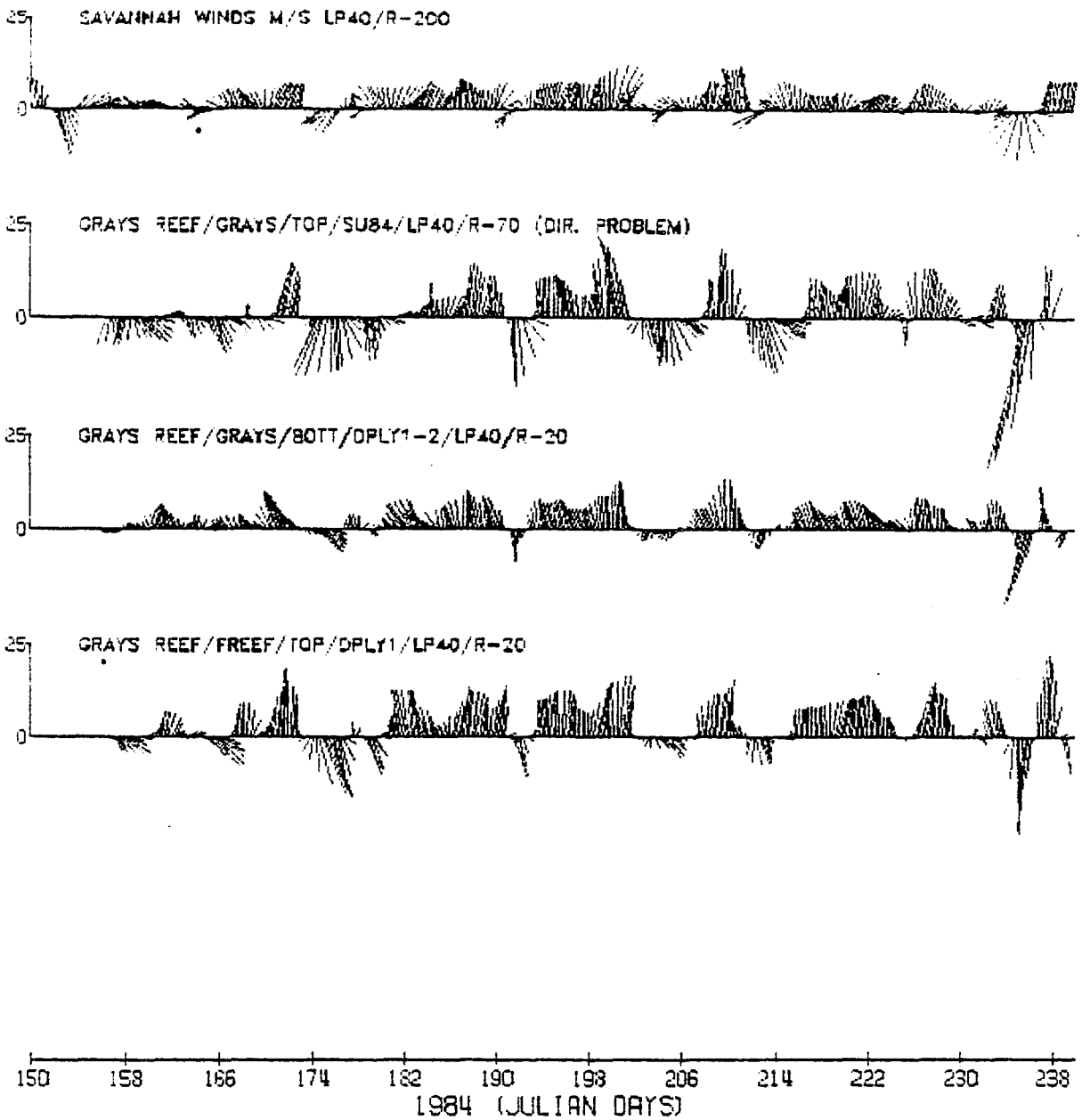

Figure 5a Vector Plot of wind and currents for each season. A vertical vector is directed along a direction of 20 degrees east of north (the y-axis). (a) Summer 1984.

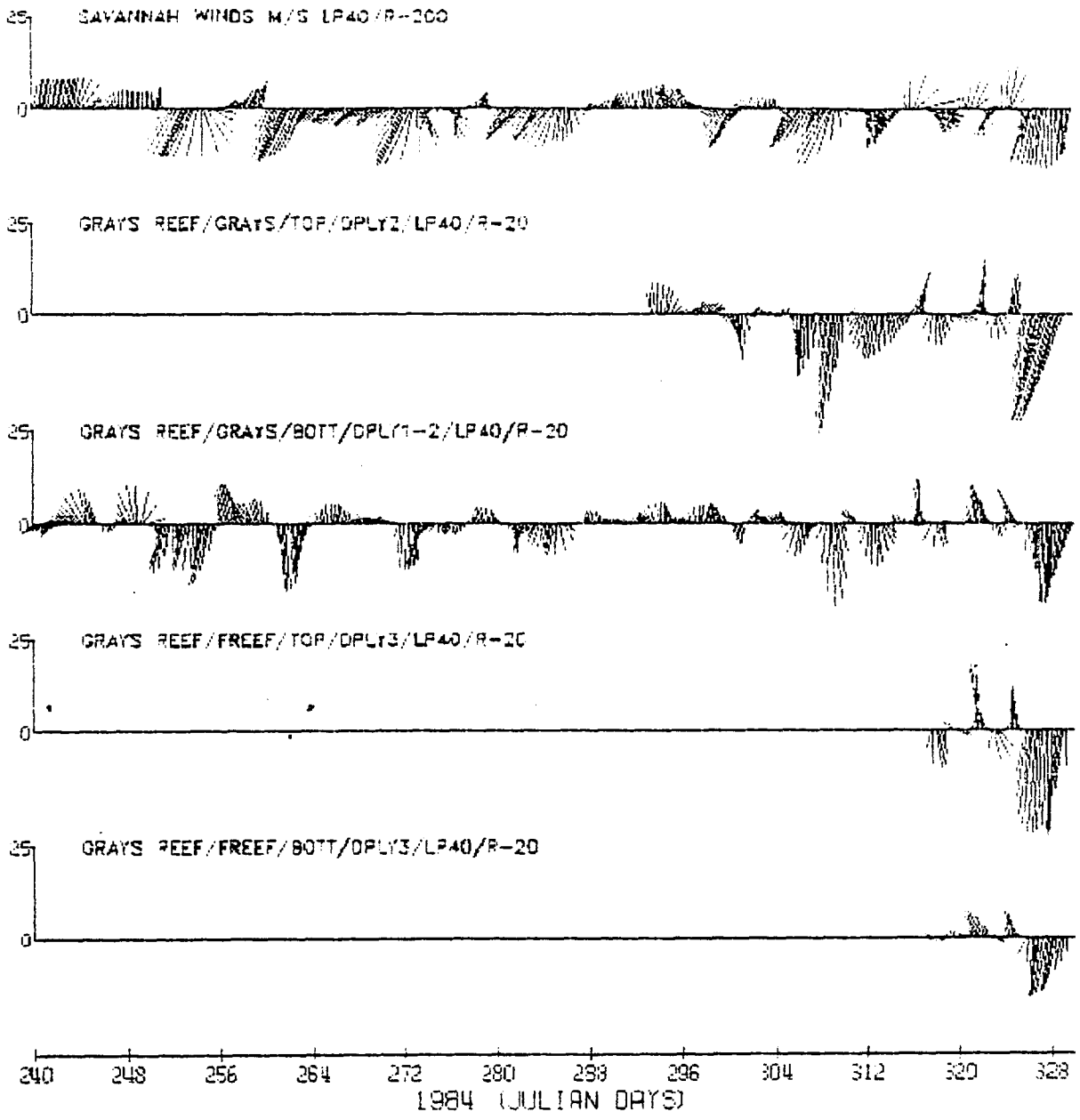

Figure 5b Vector Plot of wind and currents for each season. A vertical vector is directed along a direction of 20 degrees east of north (the y-axis). (b) Autumn 1984.

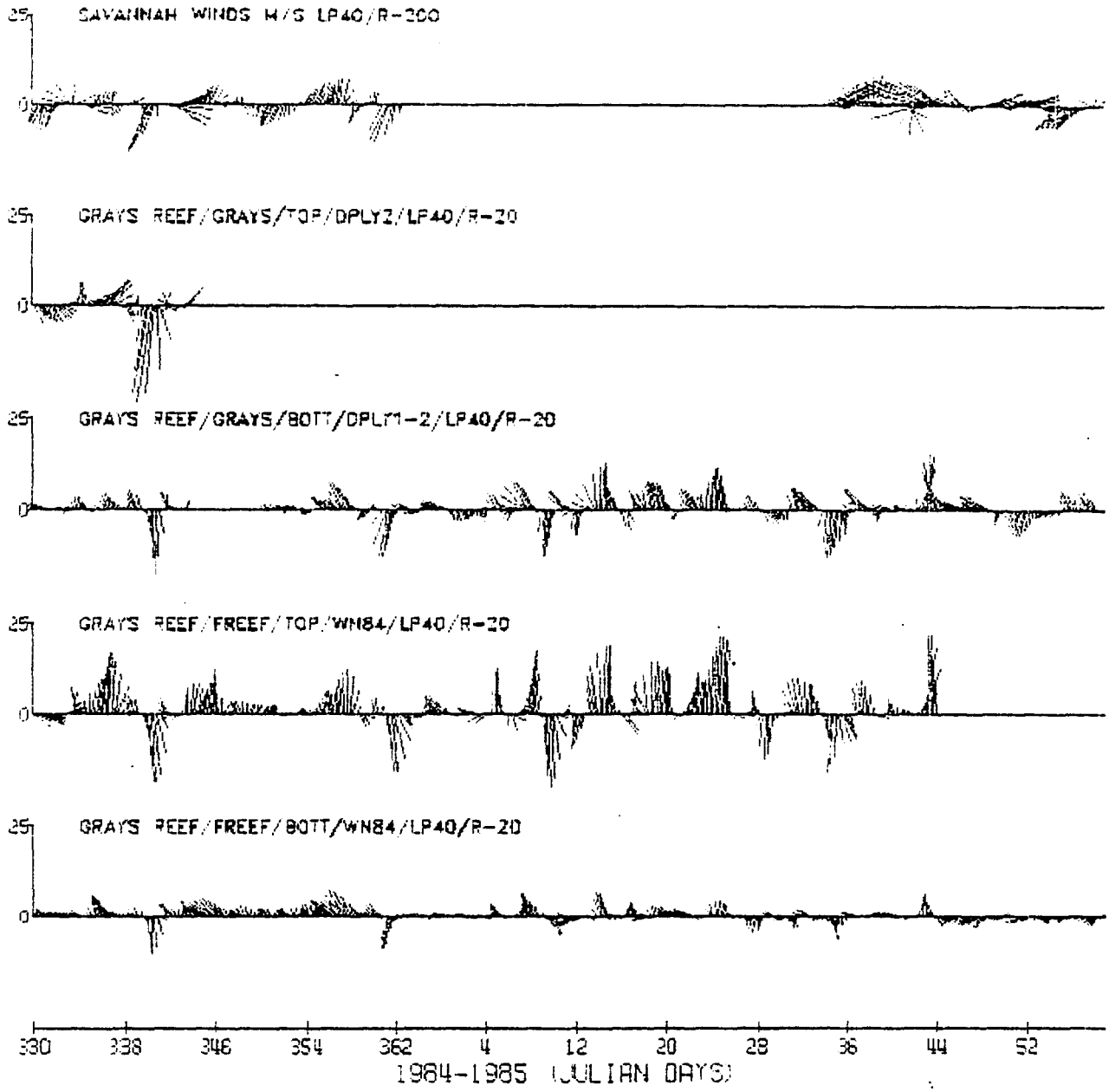

Figure 5c Vector Plot of wind and currents for each season. A vertical vector is directed along a direction of 20 degrees east of north (the y-axis). (c) Winter 1984-85.

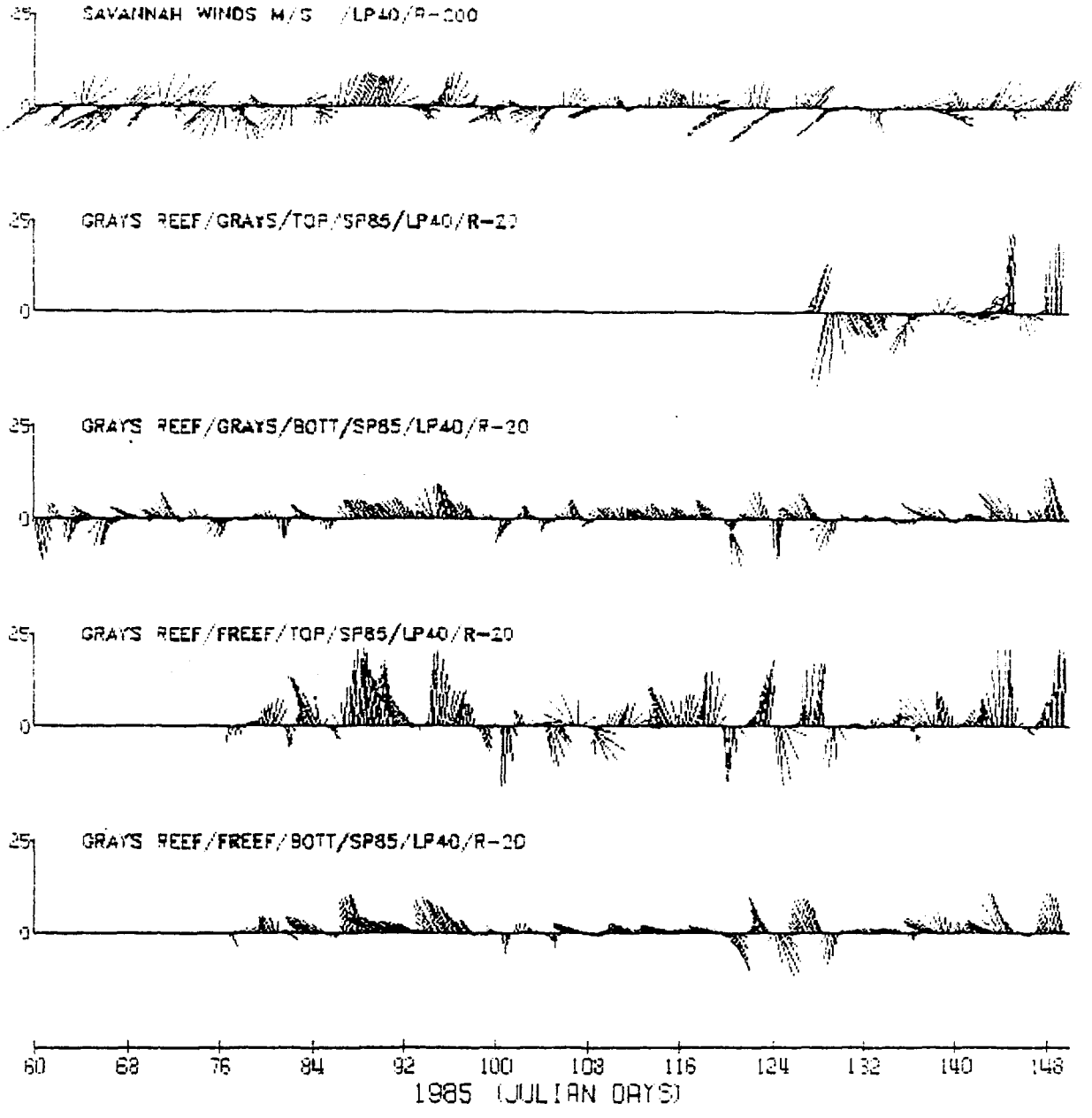

Figure 5d Vector Plot of wind and currents for each season. A vertical vector is directed along a direction of 20 degrees east of north (the y-axis). (d) Spring 1985.

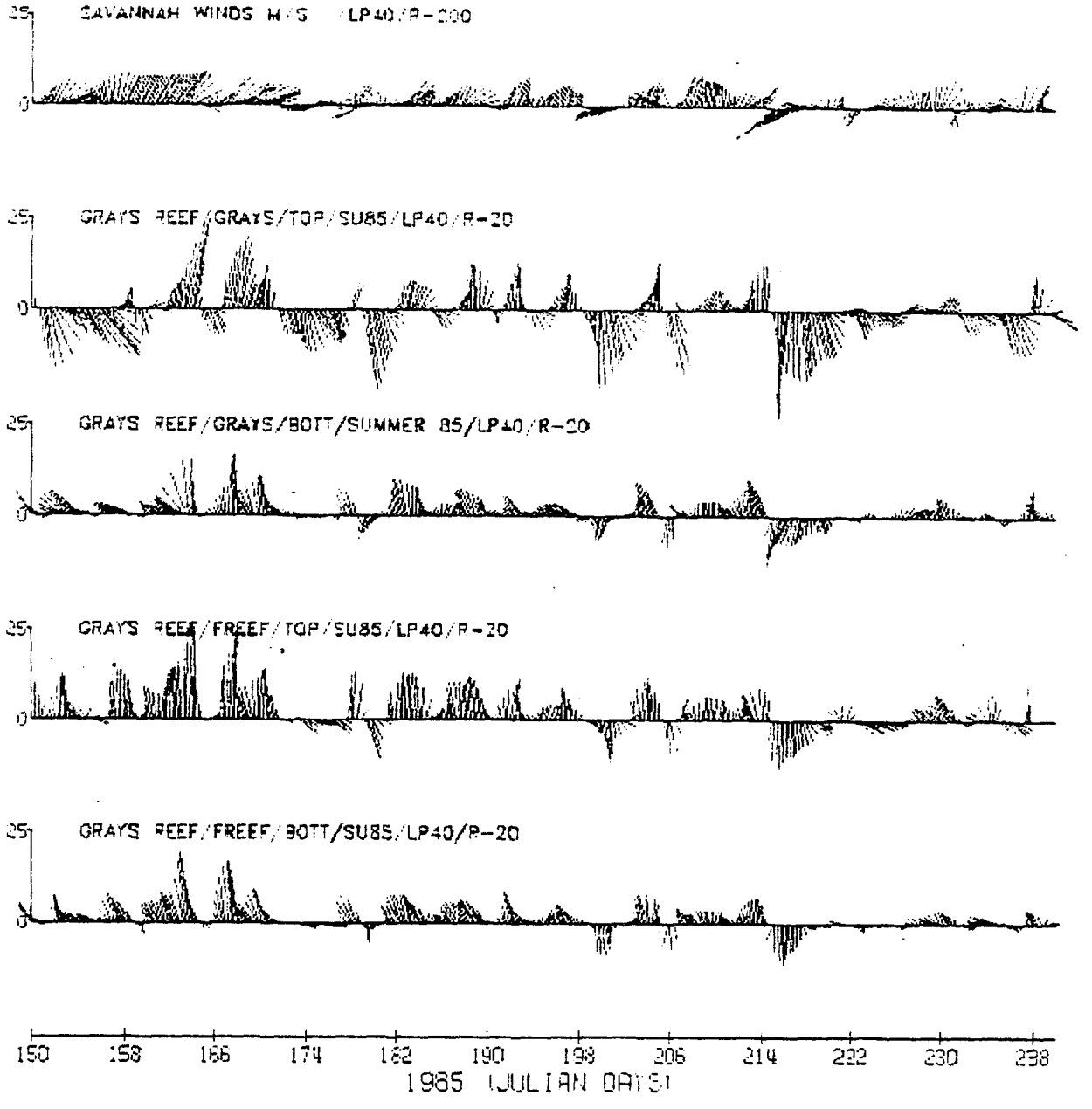

Figure 5e Vector Plot of wind and currents for each season. A vertical vector is directed along a direction of 20 degrees east of north (the y-axis). (e) Summer 1985.

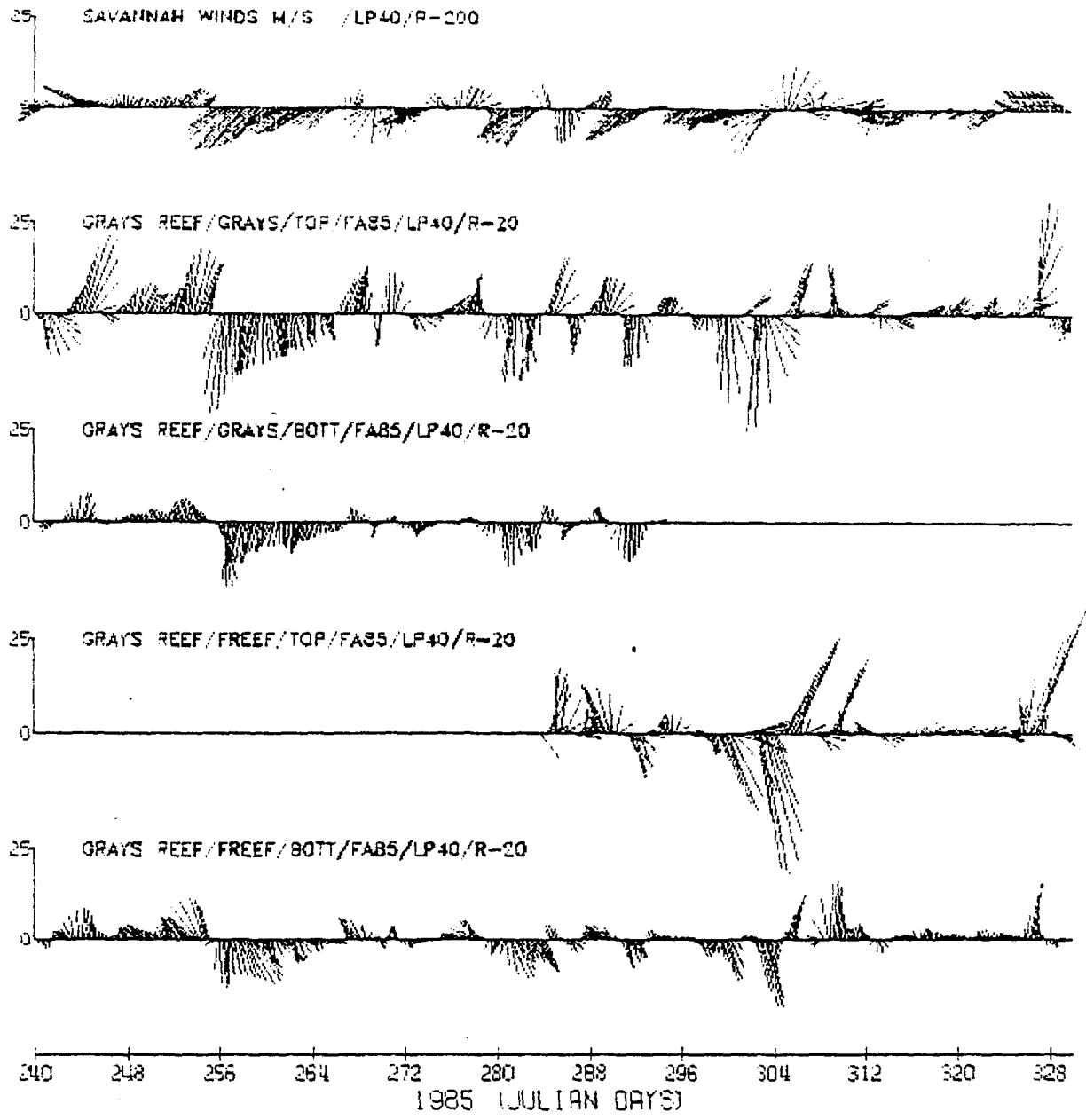

Figure 5f Vector Plot of wind and currents for each season. A vertical vector is directed along a direction of 20 degrees east of north (the y-axis). (f) Autumn 1985.

Table 2a. Statistics of wind and current meter data by season for 3-hour low pass data. GRT = Gray's Reef TOP; GRB = Gray's Reef BOTTOM; FRT = "F" Reef TOP; FRB = "F" Reef BOTTOM

	Wind	GRT	GRB	FRT	FRB
Summer '84					
X(cm/s)	-0.1 (3.7)	1.2 (24.6)	-1.5 (12.6)	1.0 (18.9)	
Y(cm/s)	3.4 (5.0)	1.0 (13.8)	3.1 (6.8)	4.0 (9.8)	
Autumn '84					
X(cm/s)	-1.3 (4.2)	0.1?(20.6)	-1.0 (12.6)	0.4?(20.9)	-1.1?(11.8)
Y(cm/s)	-2.8 (7.0)	-4.2?(13.4)	-1.7 (9.1)	-3.6?(14.5)	-1.1?(8.0)
Winter '85					
X(cm/s)	0.6?(3.8)	2.1 (20.0)	-1.6 (10.7)	0.3 (17.8)	-1.1 (7.1)
Y(cm/s)	-0.6?(4.9)	-0.6 (10.8)	0.8 (6.4)	3.1 (9.6)	0.4 (4.8)
Spring '85					
X(cm/s)	-0.1 (5.4)	1.8 (23.6)	-2.2 (10.6)	0.6 (18.4)	-1.7 (10.0)
Y(cm/s)	0.6 (5.4)	0.1 (13.8)	1.1 (6.1)	4.1 (11.2)	1.6 (5.1)
Summer '85					
X(cm/s)	0.9 (5.0)	2.6 (27.5)	-1.6 (12.4)	0.5 (15.8)	-1.1 (10.6)
Y(cm/s)	3.0 (4.4)	-1.0 (13.0)	2.2 (6.4)	3.9 (9.0)	2.1 (5.6)
Autumn '85					
X(cm/s)	-3.1 (5.6)	2.2 (21.2)	-0.5 (9.9)	4.0 (19.8)	0.1 (10.5)
Y(cm/s)	-1.5 (5.4)	-0.0 (13.7)	-1.8 (6.8)	1.3 (13.3)	-0.1 (6.6)

Table 2b. Statistics of wind and current meter data by season for 40-hour low pass data. GRT = Gray's Reef TOP; GRB = Gray's Reef BOTTOM; FRT = "F" Reef TOP; FRB = "F" Reef BOTTOM

	Wind	GRT	GRB	FRT	FRB
Summer '84					
X(cm/s)	-0.1 (3.0)	1.4 (2.5)	-1.4 (1.6)	1.1 (2.0)	
Y(cm/s)	3.4 (4.4)	1.4 (9.4)	3.2 (4.9)	4.1 (8.0)	
Autumn '84					
X(cm/s)	-1.2 (3.8)	0.0?(2.9)	-1.0 (1.8)	-0.1?(2.2)	-1.2?(1.5)
Y(cm/s)	-2.6 (6.7)	-4.5?(10.3)	-1.7 (7.1)	-5.9?(13.0)	-2.2?(6.8)
Winter '85					
X(cm/s)	0.6 (3.4)		-1.8 (1.7)	0.4 (1.9)	-1.0 (1.6)
Y(cm/s)	-0.6 (4.5)		0.9 (4.9)	3.0 (7.7)	0.4 (2.6)
Spring '85					
X(cm/s)	-0.1 (4.7)	2.2 (3.4)	-2.2 (1.8)	0.7 (2.7)	-1.8 (2.6)
Y(cm/s)	0.6 (4.6)	0.9 (6.5)	1.1 (3.9)	4.6 (8.0)	1.7 (3.8)
Summer '85					
X(cm/s)	0.9 (4.5)	2.6 (2.0)	-1.6 (1.8)	0.5 (1.9)	-1.1 (1.8)
Y(cm/s)	3.0 (3.6)	-1.0 (8.9)	2.2 (4.4)	3.9 (6.8)	2.1 (4.3)
Autumn '85					
X(cm/s)	-3.1 (5.3)	2.2 (2.5)	-0.5 (1.3)	3.9 (3.9)	0.1 (2.5)
Y(cm/s)	-1.5 (4.9)	-0.0 (9.6)	-1.9 (4.9)	1.7 (10.3)	-0.1 (5.2)

3.3 Current & Wind Velocity Results

3.3.1 Tidal Frequency Results

The discussion of the 3 HLP data set (Table 2a) is confined to the standard deviations which represents the total energy present in the flow. The standard deviations of the current meter components are always greater than the mean. If one looks only at the X-component of the currents, the standard deviation is usually 10 or more times the mean X-component. This is because the tidal currents are strongest in the direction perpendicular to the trend of the isobaths. There is no seasonal pattern to the fluctuations because the important tidal fluctuations at periods longer than 12.5 hours are at well defined periods of about 24 hours and 14 days (the spring-neap cycle).

3.3.2 Seasonal Mean Results

The mean currents in the 40 HLP data (Table 2b) are correlated with the seasonal changes in the average wind. The mean wind direction changes with season (Weber and Blanton, 1980). Note that the standard deviation of the 40HLP data is several times larger than the mean and is strongest in the alongshore (Y) component. The standrd deviation represents mainly the energy in the fluctuating currents due to fluctuating winds. Wind-generated currents are primarily directed along the isobaths which accounts for the high standard deviation in the Y-components. These fluctuations will be examined later in the report.

In summer 1984 the wind was primarily directed northward (out of the south). At Gray's Reef TOP (GRT), which was 6 m under the surface, the mean current was directed to the right of the wind with a speed of 2 cm/s. The mean current 6 m above bottom (GRB) directed counterclockwise to the current above. The mean speed was stronger for GRB than for GRT. The current at "F" Reef was stronger than at GRF but directed clockwise to the wind.

In autumn, 1984, the wind changed to southwestward representing typical mean wind conditions for autumn. The data set for GRT was short but indicated near-surface currents directed along the isobath as one would expect for wind-generated currents. Near bottom at Gray's Reef, the current was approximately downwind. The data set at "F" Reef was too short for a confident comparison, but the mean current velocity is consistent with the autumn mean wind.

In winter 1984-85 the wind data set was shorter than the winter analysis period. Nevertheless, the mean wind was representative of average winter conditions (Weber and Blanton, 1980) when the wind typically blows in the offshore direction. Near bottom at Gray's Reef (GRB) the mean current was directed northward and onshore. This is consistent with the bottom current direction at "F" Reef. The current near the surface (FRT), was northward and slightly offshore. The mean currents during this season were similar in direction to those occurring during the previous summer.

During spring 1985 the mean wind was northward, typical for that season. The mean surface current at Gray's Reef was downwind. The offshore component was relatively large compared to the previous summer. Near the bottom at Gray's Reef, the current was directed onshore and slightly northward. This agrees with the bottom current at "F" Reef. Near the surface at "F" Reef, the current was relatively strong in the northward alongshore direction with a slight offshore component.

For summer 1985 the mean wind strengthened and was northward, typical for the summer season. The surface current at Gray's Reef was directed offshore and slightly southward. Its correlation with the mean wind was poor. Near the bottom, the direction was similar to that of the other seasons with the exception of autumn. The surface and bottom currents at "F" Reef were essentially the same as for spring, 1985.

During the second autumn (1986), the mean wind was slightly stronger that autumn, 1984, with a stronger onshore component. The current at Gray's Reef near the surface was strong and offshore while the current near the bottom was directed similarly to that of autumn, 1984. At "F" Reef, the current was also directed offshore near the surface and weakly offshore near the bottom. The speed and direction of the currents during autumn of 1985 were significantly different from those of the previous autumn (with the exception of GRB.

3.3.3 Summer 1985 Currents

The group at Sapelo Island had a special interest in the tidal currents during a transport experiment conducted in July, 1985. The data from that period was plotted especially to assist Dr. Hopkinson and Dr. Fallon in their analyses. Figure 6 a-f show the currents at each station and the winds at Savannah Light during the 15 day period beginning July 1, 1985.

During the interval the low frequency winds and currents were upcoast to the north with average speeds of less than 10 cm/s. The tidal currents were oriented mainly in the cross shore direction with speeds of approxiately 50 cm/s. No unusual events such as storms or storm currents were present during the interval. General Oceanics also provided the group at Sapleo Island with averaged currents over daily intervals for calculation of transports during this period. The transport data is not shown in this report.

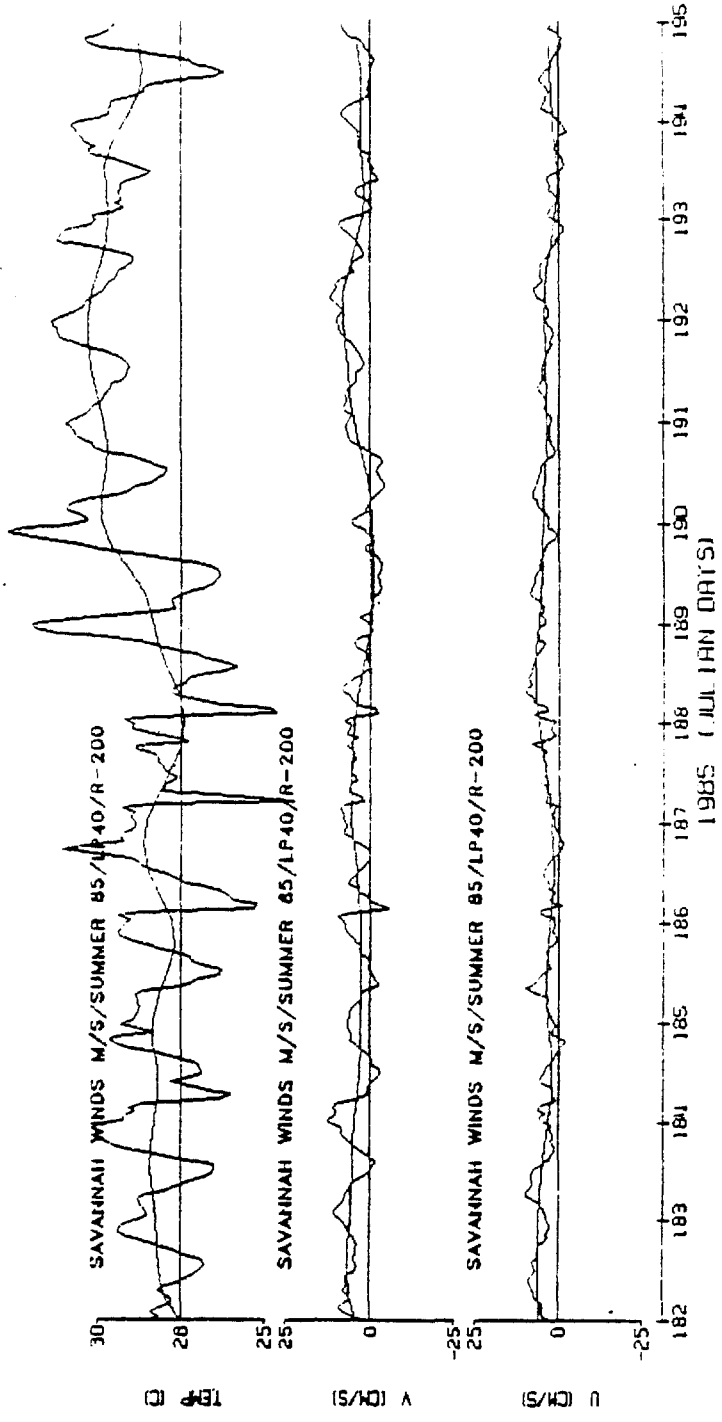

Figure 6a Plots of wind and current meter data for 3-hour low pass data in July 1985. a) Savannah Winds.

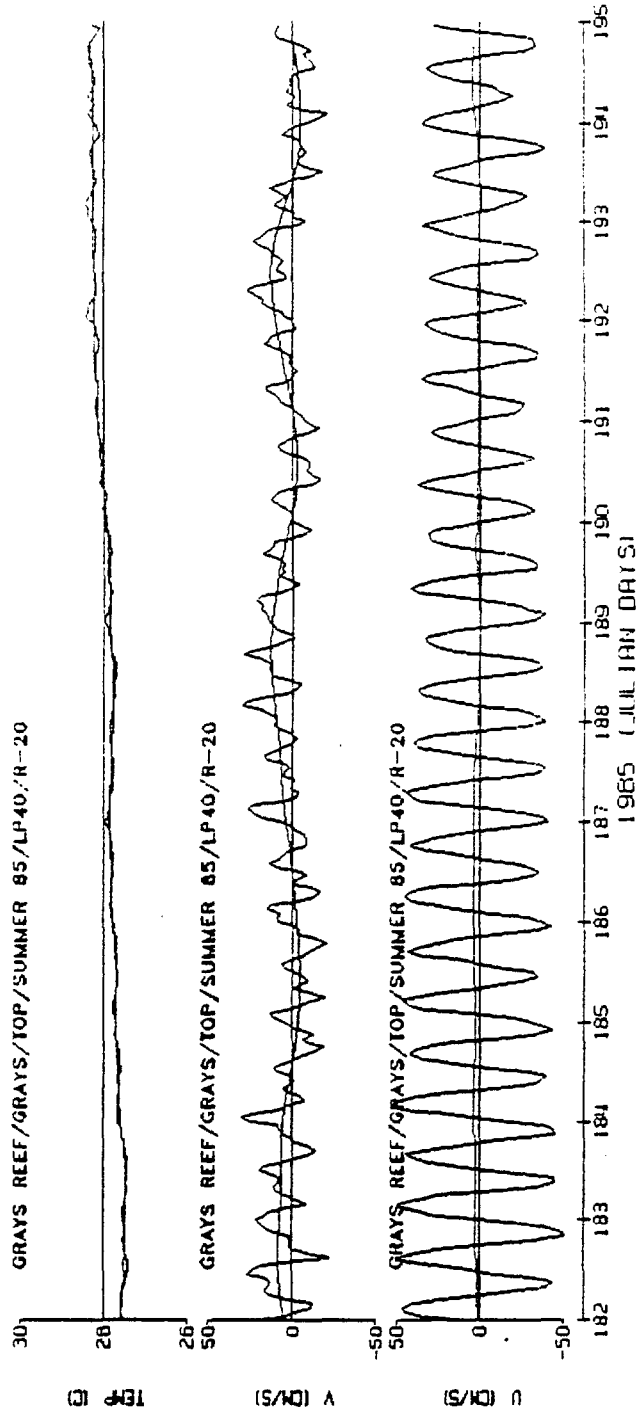

Figure 6b Plots of wind and current meter data for 3-hour low pass data in July 1985. b) Gray's Reef TOP.

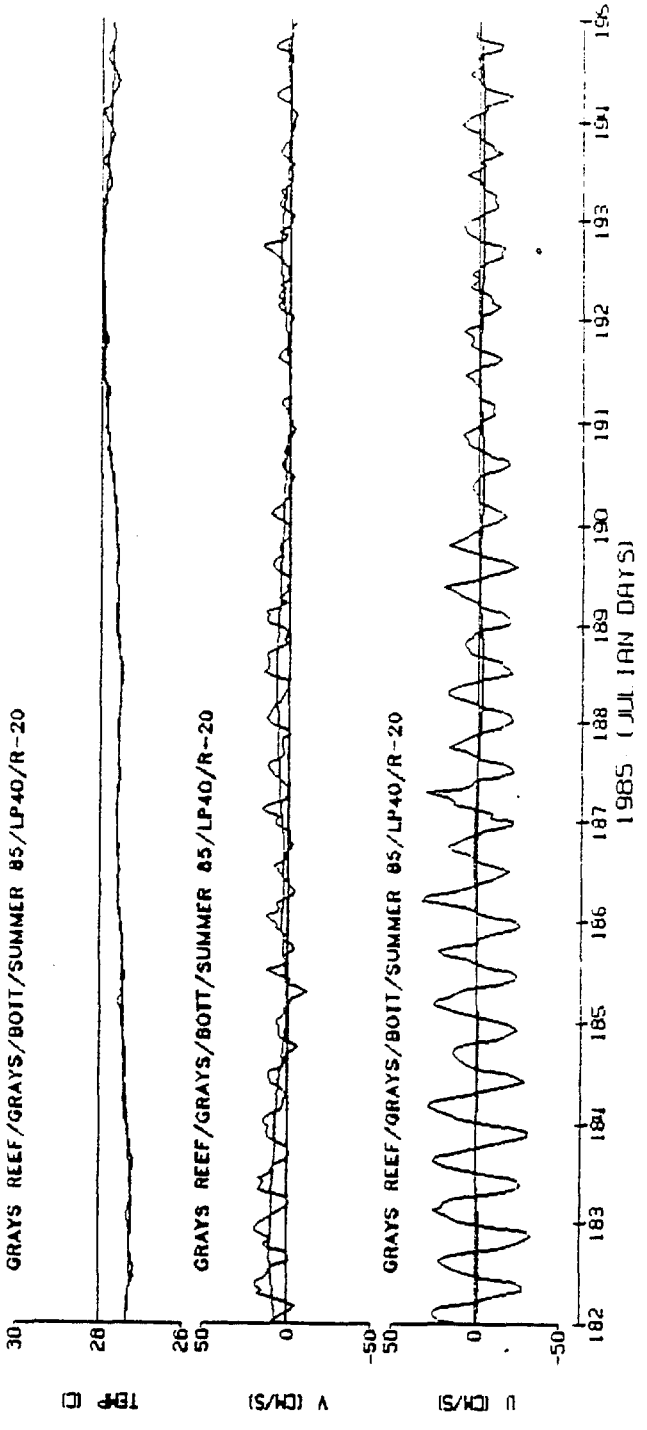

Figure 6c Plots of wind and current meter data for 3-hour low pass data in July 1985. c) Gray's Reef BOTTOM.

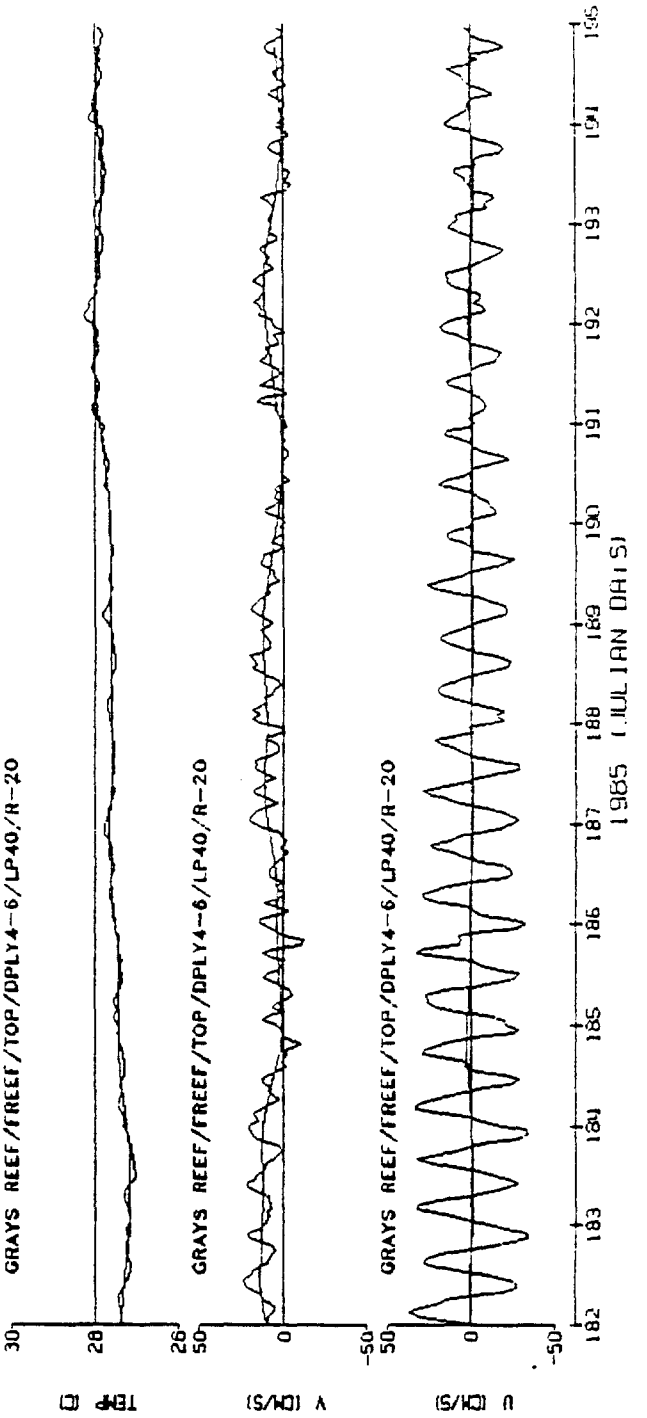

Figure 6d Plots of wind and current meter data for 3-hour low pass data in July 1985. d) "F" Reef TOP.

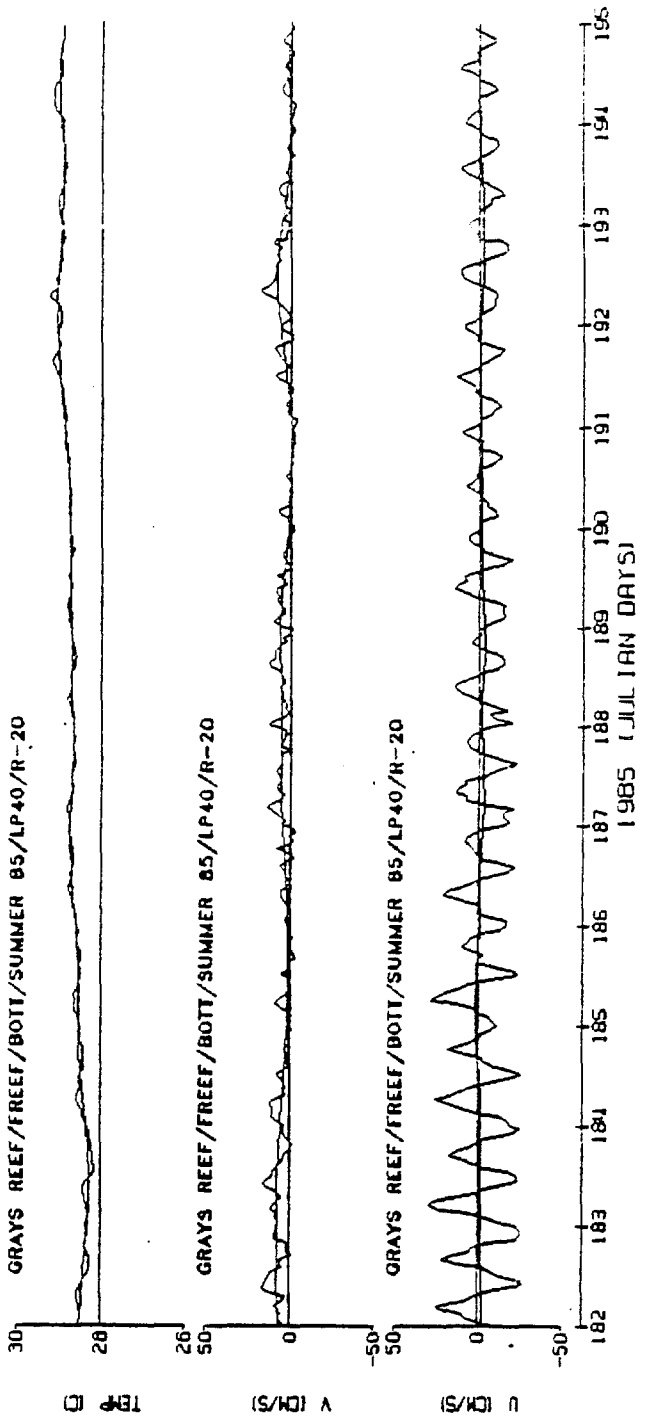

Figure 6e Plots of wind and current meter data for 3-hour low pass data in July 1985. e) "F" Reef BOTTOM.

3.4 Correlation of Currents and Winds

Energy spectra of wind velocity and current velocity reveal that the kinetic energy is roughly divided into fluctuations generated by weather patterns (2 - 10 day periods), and fluctuations generated by the astronomical tide (0.5 to 1 day periods). The results of the spectral analyses are summarized in two tables. Table 3 summarizes the coherence squared (related to the correlations between two series) and the phase lag (the time lag of the second series from the first series) for all current meters for each season. This table is based on analyses of 3HLP data sets. Table 4 summarizes the correlation of the wind at SNLT with the various current meters for the spring, summer and autumn seasons in 1985. Table 4 is based on 40HLP data sets. For both tables, we list the statistics for the dominate periods in the spectra. The detailed analyses can be found in Appendices X and Y.

All current records are usually well correlated (Table 3) at the 0.5 day period. The notable exception occurred during autumn, 1985, at the bottom locations. The effect of friction usually causes the tidal currents near bottom to lead those near the surface by 1-3 hours (Pietrafesa, Blanton, etc., 1985). There are some exceptions to the expected lag. The fluctuations at the 1 day period (Table 3) usually have lower correlation coefficients than those for the 0.5-day period.

The correlation of currents at the "weather" periods (8-day and 3-day periods) are usually high. However, the bottom currents are not statistically correlated during winter and spring.

We compared winds and currents for the spring, summer and autumn season for 1985. There is usually good visual correlation in the data plots (Figure 5 a-f). There are distinct pulses of current (see June and July, 1985) but these pulses are not as distinct in the wind record. At the end of June and first of July, 1985, the alongshore component of wind never reverses in a distinct way, as do the currents. Moreover, if one examines the Gray's Reef currents near the surface, there are clear episodes of southward currents during the June,July period. Thus, in the statistical correlation of winds and currents, the correlation coefficients are somewhat degraded in the dominant wind energy band of 4-day periods (Table 4).

Table 3. Correlation of alongshore components of currents at dominant periods in the spectra (Appendix D). Coherence squared (COH2) <0.3 are not listed because they are not significant at 95% confidence level. Positive phase lags (hrs) mean that the second series lags the first. The first number under each dominant period is COH2; the second is the lag in hours.

	Dominant Periods in Current Spectra							
	8 days		3 days		1 day		0.5 day	
Winter 84-85								
FRT-FRB	0.9	0	0.7	-3	0.7	-1	0.9	0
GRB-FRB	--	-	--	-	--	-	0.8	0
Spring 85								
FRT-FRB	0.9	0	0.8	0	0.8	0	0.8	-2
GRB-FRB	--	-	--	-	--	-	0.6	-5?
Summer 85								
FRT-FRB	>0.9	0	0.9	3	0.6	3	0.8	1
GRB-FRB	0.9	0	0.7	0	--	-	0.8	1
GRT-FRT	>0.9	0	0.8	0	0.6	0	>0.9	-1
GRT-GRB	>0.9	0	0.8	0	0.5	-3	>0.9	-1
Autumn 85								
GRB-FRB	>0.9	8	0.7	0	0.8	1	--	-?
GRT-GRB	>0.9	5	0.7	5	0.7	-2	>0.9	-3

Table 4. Correlation of Wind (W) vs. Current at dominant energy levels in the wind spectra (4-day and 2-day periods). The abbreviations and format are the same as in Table 3.

	Dominant Periods in Wind Spectra			
	4 days		2 days	
Spring 85				
W-FRT	0.3	11	------	
W-FRB	0.3	11	------	
W-GRT	0.3	24	0.9	10
W-GRB	0.5	0	0.3	12
Summer 85				
W-FRT	------		------	
W-FRB	0.6	11	------	
W-GRT	0.6	11	0.3	9
W-GRB	0.7	8	0.4	7
Autumn 85				
W-FRT	0.5	8	------	
W-FRB	0.5	-24?	------	
W-GRT	0.6	8	------	
W-GRB	0.4	8	0.3	8

4 DISCUSSION

The forces responsible for the generation of coastal currents at Gray's Reef are wind stress at the surface, friction at the bottom, and pressure gradients associated with sea level slopes and density gradients. While we did not have the necessary data to examine pressure gradients, we know that they can be important in the overall balance of forces (Lee and Brooks, 1979; Blanton, 1981).

Gray's Reef is in an area which receives seasonal fluctuations of fresh water coastal runoff. The resulting pressure gradients can modify the response of the current to direct wind forcing. For example, during summer, 1985, the cycling of southward and northward currents near the surface is more distinct than the cycles of the wind and which suggests that other forces in addition to the wind are involved. Moreover, the mean currents at Gray's Reef and at "F" Reef do not match the mean values of the wind in summer and autumn, 1985 (Table 2).

Future studies should be designed to measure the cross-shelf and alongshelf pressure gradient in the vicinity of Gray's Reef. The seasonal fluctuations of freshwater runoff and the wind-generated fluctuations of sea level gradients have an important influence on coastal currents surrounding Gray's Reef. The data reported here, namely the rather low correlation between winds and currents, are consistent with that conclusion.

APPENDICES

Appendix A: Statistics of Three Hour Low Passed Data
Appendix B: Statistics of Forty Hour Low Passed Data
Appendix C: Plots of Current and Wind Velocities
Appendix D: Plots of Spectra
Appendix E: Directories of 3 Hour Low Passed Data Files
Appendix F: References

Legend:

The data plots and tables contined in the following appendices are labled according to the same scheme. The data files contain a header which completely describes the file. A typeical header is:

GRAY'S REEF/GRAY'S/TOP/SU85/LP3/R-20

This header is read as follows:

GRAY'S REEF	Project Name
GRAY'S	Mooring designation (Grays or F Reef)
TOP	Depth in water (top or bottom)
SU85	Season or time interval (SP, SU, FA, WN) or Deployment (1, 2, 3, 4, 5, 6, or a range)
LP3	Filtering (LP3= 3 hour low pass and LP40= 40 hour low pass)
R-20	Rotation angle (R-20= 20 degrees clockwise axis rotation) Angle is to bring V component to alongshore alignment. Wind has rotation -200 to compensate for different direction convention.

Appendix A: Statistics of Three Hour Low Passed Data

.....

GRAY'S REEF/GRAY'S/BOTT/WN84/LP3/R-20
Length: 1872 Points Elapsed Time: 77, 23, 0, (DY,HR,MN)
From : 1984 DEC12(347),21 0Z 0 To 1985 FEB28(59),20 0Z 0

	Mean	Stand Dev	Stand Error	Minimum	Maximum
V-Comp (cm/s)	.90	6.28	.32	-24.58	24.03
U-Comp (cm/s)	-1.68	10.72	.55	-29.22	28.98
Temperature (Deg C)	14.43	2.13	.11	11.42	18.22

.....

GRAY'S REEF/FREEF/TOP/WN84/LP3/R-20
Length: 2016 Points Elapsed Time: 83, 23, 0, (DY,HR,MN)
From : 1984 NOV25(330), 0 0Z 0 To 1985 FEB16(47),23 0Z 0

	Mean	Stand Dev	Stand Error	Minimum	Maximum
V-Comp (cm/s)	3.08	9.62	.49	-35.51	39.47
U-Comp (cm/s)	.32	17.91	.91	-42.46	43.44
Temperature (Deg C)	13.95	2.33	.12	9.82	17.59

.....

GRAY'S REEF/FREEF/BOTT/WN84/LP3/R-20
Length: 2304 Points Elapsed Time: 95, 23, 0, (DY,HR,MN)
From : 1984 NOV25(330), 0 0Z 0 To 1985 FEB28(59),23 0Z 0

	Mean	Stand Dev	Stand Error	Minimum	Maximum
V-Comp (cm/s)	.42	4.85	.25	-19.98	21.54
U-Comp (cm/s)	-1.05	7.16	.37	-31.99	33.91
Temperature (Deg C)	13.39	2.39	.12	9.51	17.17

.....

SAVANNAH WINDS M/S /SU85/LP3/R-200
Length: 2160 Points Elapsed Time: 89, 23, 0, (DY,HR,MN)
From : 1985 MAR 1(60), 0 0Z 0 To 1985 MAY29(149),23 0Z 0

	Mean	Stand Dev	Stand Error	Minimum	Maximum
V-Comp (cm/s)	.55	5.43	.29	-14.79	13.59
U-Comp (cm/s)	-.11	5.27	.28	-14.94	14.36
Temperature (Deg C)	20.30	3.92	.21	9.34	29.36

.....

GRAY'S REEF/GRAY'S/TOP/SP85/LP3/R-20
Length: 624 Points Elapsed Time: 25, 23, 0, (DY,HR,MN)
From : 1985 MAY 3(123),21 0Z 0 To 1985 MAY29(149),20 0Z 0

	Mean	Stand Dev	Stand Error	Minimum	Maximum
V-Comp (cm/s)	.06	13.85	.73	-45.57	35.87
U-Comp (cm/s)	1.81	23.61	1.24	-53.06	47.19
Temperature (Deg C)	23.01	1.00	.05	21.23	24.92

GRAY'S REEF/GRAY'S/BOTT/SP85/LP3/R-20
Length: 2160 Points Elapsed Time: 89, 23, 0, (DY,HR,MN)
From : 1985 MAR 1(60), 0 0Z 0 To 1985 MAY29(149),23 0Z 0

	Mean	Stand Dev	Stand Error	Minimum	Maximum
V-Comp (cm/s)	1.11	6.12	.32	-25.61	26.30
U-Comp (cm/s)	-2.21	10.60	.56	-37.19	34.52
Temperature (Deg C)	19.43	3.67	.19	12.97	25.74

GRAY'S REEF/FREEF/TOP/SP85/LP3/R-20
Length: 1800 Points Elapsed Time: 74, 23, 0, (DY,HR,MN)
From : 1985 MAR15(74), 3 0Z 0 To 1985 MAY29(149), 2 0Z 0

	Mean	Stand Dev	Stand Error	Minimum	Maximum
V-Comp (cm/s)	4.11	11.20	.59	-45.46	36.77
U-Comp (cm/s)	.57	18.41	.97	-42.88	48.59
Temperature (Deg C)	20.16	3.21	.17	14.63	25.36

GRAY'S REEF/FREEF/BOTT/SP85/LP3/R-20
Length: 1800 Points Elapsed Time: 74, 23, 0, (DY,HR,MN)
From : 1985 MAR15(74), 4 0Z 0 To 1985 MAY29(149), 3 0Z 0

	Mean	Stand Dev	Stand Error	Minimum	Maximum
V-Comp (cm/s)	1.55	5.13	.27	-24.30	19.01
U-Comp (cm/s)	-1.72	9.98	.53	-34.44	35.82
Temperature (Deg C)	19.76	3.35	.18	14.17	25.19

SAVANNAH WINDS M/S /LP3/R-200
Length: 2160 Points Elapsed Time: 89, 23, 0, (DY,HR,MN)
From : 1985 MAY30(150), 0 0Z 0 To 1985 AUG27(239),23 0Z 0

	Mean	Stand Dev	Stand Error	Minimum	Maximum
V-Comp (cm/s)	2.97	4.40	.23	-10.28	13.66
U-Comp (cm/s)	.91	4.99	.26	-19.88	17.57
Temperature (Deg C)	28.63	1.43	.08	23.13	33.85

GRAY'S REEF/GRAY'S/TOP/SUMMER 85/LP3/R-20
Length: 2160 Points Elapsed Time: 89, 23, 0, (DY,HR,MN)
From : 1985 MAY30(150), 0 0Z 0 To 1985 AUG27(239),23 0Z 0

	Mean	Stand Dev	Stand Error	Minimum	Maximum
V-Comp (cm/s)	-1.05	13.05	.69	-59.09	50.96
U-Comp (cm/s)	2.55	27.50	1.45	-59.27	58.41
Temperature (Deg C)	27.76	1.03	.05	24.89	29.39

GRAY'S REEF/GRAY'S/BOTT/SUMMER 85/LP3/R-20
Length: 2160 Points Elapsed Time: 89, 23, 0, (DY,HR,MN)
From : 1985 MAY30(150), 0 0Z 0 To 1985 AUG27(239),23 0Z 0

	Mean	Stand Dev	Stand Error	Minimum	Maximum
V-Comp (cm/s)	2.20	6.44	.34	-33.46	34.57
U-Comp (cm/s)	-1.59	12.40	.65	-37.95	33.25
Temperature (Deg C)	27.44	1.11	.06	24.58	29.14

GRAY'S REEF/FREEF/TOP/SUMMER 85/LP3/R-20
Length: 2160 Points Elapsed Time: 89, 23, 0, (DY,HR,MN)
From : 1985 MAY30(150), 0 0Z 0 To 1985 AUG27(239),23 0Z 0

	Mean	Stand Dev	Stand Error	Minimum	Maximum
V-Comp (cm/s)	3.92	9.01	.47	-33.80	39.32
U-Comp (cm/s)	.49	15.78	.83	-38.40	38.12
Temperature (Deg C)	27.62	.99	.05	25.21	29.40

GRAY'S REEF/FREEF/BOTT/SUMMER 85/LP3/R-20
Length: 2160 Points Elapsed Time: 89, 23, 0, (DY,HR,MN)
From : 1985 MAY30(150), 0 0Z 0 To 1985 AUG27(239),23 0Z 0

	Mean	Stand Dev	Stand Error	Minimum	Maximum
V-Comp (cm/s)	2.13	5.56	.29	-24.26	30.49
U-Comp (cm/s)	-1.10	10.60	.56	-33.47	29.09
Temperature (Deg C)	28.70	.99	.05	24.24	30.39

SAVANNAH WINDS M/S /FA85/LP3/R-200
Length: 2160 Points Elapsed Time: 89, 23, 0, (DY,HR,MN)
From : 1985 AUG28(240), 0 0Z 0 To 1985 NOV25(329),23 0Z 0

	Mean	Stand Dev	Stand Error	Minimum	Maximum
V-Comp (cm/s)	-1.54	5.37	.28	-15.65	13.39
U-Comp (cm/s)	-3.06	5.58	.29	-14.52	17.42
Temperature (Deg C)	25.27	3.20	.17	11.17	32.80

GRAY'S REEF/GRAY'S/TOP/FA85/LP3/R-20
Length: 2160 Points Elapsed Time: 89, 23, 0, (DY,HR,MN)
From : 1985 AUG28(240), 0 0Z 0 To 1985 NOV25(329),23 0Z 0

	Mean	Stand Dev	Stand Error	Minimum	Maximum
V-Comp (cm/s)	-.01	13.69	.72	-64.13	47.84
U-Comp (cm/s)	2.25	21.24	1.12	-50.30	49.70
Temperature (Deg C)	25.18	2.12	.11	21.15	30.54

GRAY'S REEF/GRAY'S/BOTT/FA85/LP3/R-20
Length: 1368 Points Elapsed Time: 56, 23, 0, (DY,HR,MN)
From : 1985 AUG28(240), 0 0Z 0 To 1985 OCT23(296),23 0Z 0

	Mean	Stand Dev	Stand Error	Minimum	Maximum
V-Comp (cm/s)	-1.84	6.82	.36	-33.51	19.22
U-Comp (cm/s)	-.49	9.92	.52	-49.58	28.98
Temperature (Deg C)	27.48	1.34	.07	23.19	32.91

GRAY'S REEF/FREEF/TOP/FA85/LP3/R-20
Length: 1152 Points Elapsed Time: 47, 23, 0, (DY,HR,MN)
From : 1985 OCT 8(281), 5 0Z 0 To 1985 NOV25(329), 4 0Z 0

	Mean	Stand Dev	Stand Error	Minimum	Maximum
V-Comp (cm/s)	1.29	13.27	.70	-53.29	51.92
U-Comp (cm/s)	3.99	19.85	1.05	-49.80	58.33
Temperature (Deg C)	23.21	1.51	.08	20.44	25.47

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GRAY'S REEF/FREEF/BOTT/FA85/LP3/R-20
Length: 2160 Points Elapsed Time: 89, 23, 0, (DY,HR,MN)
From : 1985 AUG28(240), 0 0Z 0 To 1985 NOV25(329),23 0Z 0

	Mean	Stand Dev	Stand Error	Minimum	Maximum
V-Comp (cm/s)	-.09	6.58	.35	-30.94	27.42
U-Comp (cm/s)	.12	10.46	.55	-38.97	37.43
Temperature (Deg C)	24.67	2.16	.11	20.64	29.88

Appendix B: Statistics of Forty Hour Low Passed Data

SAVANNAH WINDS M/S /SU84/LP40/R-200
Length: 360 Points Elapsed Time: 89, 18, 0, (DY,HR,MN)
From : 1984 MAY29(150), 0 0Z 0 To 1984 AUG26(239),18 0Z 0

	Mean	Stand Dev	Stand Error	Minimum	Maximum
V-Comp (cm/s)	3.40	4.38	.73	-12.85	12.34
U-Comp (cm/s)	-.11	2.98	.50	-6.98	7.13

GRAY'S REEF/GRAY'S/TOP/SU84/LP40/R-70 (DIR. PROBLEM)
Length: 327 Points Elapsed Time: 81, 12, 0, (DY,HR,MN)
From : 1984 JUN 4(156),12 0Z 0 To 1984 AUG25(238), 0 0Z 0

	Mean	Stand Dev	Stand Error	Minimum	Maximum
V-Comp (cm/s)	1.37	9.42	1.57	-39.64	21.91
U-Comp (cm/s)	1.35	2.46	.41	-10.08	6.95
Temperature (Deg C)	26.95	1.24	.21	23.12	28.67

GRAY'S REEF/GRAY'S/BOTT/SU84/LP40R/R-20
Length: 332 Points Elapsed Time: 82, 18, 0, (DY,HR,MN)
From : 1984 JUN 4(156),12 0Z 0 To 1984 AUG26(239), 6 0Z 0

	Mean	Stand Dev	Stand Error	Minimum	Maximum
V-Comp (cm/s)	3.20	4.87	.81	-19.98	13.47
U-Comp (cm/s)	-1.44	1.65	.27	-6.83	4.36
Temperature (Deg C)	28.25	1.26	.21	24.41	30.03

GRAY'S REEF/FREEF/TOP/SU84/LP40/R-20
Length: 332 Points Elapsed Time: 82, 18, 0, (DY,HR,MN)
From : 1984 JUN 4(156),12 0Z 0 To 1984 AUG26(239), 6 0Z 0

	Mean	Stand Dev	Stand Error	Minimum	Maximum
V-Comp (cm/s)	4.12	8.03	1.34	-26.90	21.89
U-Comp (cm/s)	1.06	1.96	.33	-3.44	7.84
Temperature (Deg C)	27.60	1.02	.17	24.22	28.82

SAVANNAH WINDS M/S /FA84/LP40/R-200
Length: 360 Points Elapsed Time: 89, 18, 0, (DY,HR,MN)
From : 1984 AUG27(240), 0 0Z 0 To 1984 NOV24(329),18 0Z 0

	Mean	Stand Dev	Stand Error	Minimum	Maximum
V-Comp (cm/s)	-2.62	6.74	1.12	-16.50	11.85
U-Comp (cm/s)	-1.22	3.75	.62	-8.17	11.48

GRAY'S REEF/GRAY'S/BOTT/FA84/SP40/R-20
Length: 360 Points Elapsed Time: 89, 18, 0, (DY,HR,MN)
From : 1984 AUG27(240), 0 0Z 0 To 1984 NOV24(329),18 0Z 0

	Mean	Stand Dev	Stand Error	Minimum	Maximum
V-Comp (cm/s)	-1.71	7.07	1.18	-22.19	11.87
U-Comp (cm/s)	-.99	1.76	.29	-5.77	4.96
Temperature (Deg C)	25.47	2.33	.39	18.70	29.26

GRAY'S REEF/GRAY'S/BOTT/WN84/LP40/R-20
Length: 300 Points Elapsed Time: 74, 18, 0, (DY,HR,MN)
From : 1984 DEC15(350),12 0Z 0 To 1985 FEB28(59), 6 0Z 0

	Mean	Stand Dev	Stand Error	Minimum	Maximum
V-Comp (cm/s)	.93	4.88	.79	-13.47	15.28
U-Comp (cm/s)	-1.75	1.68	.27	-6.36	3.58
Temperature (Deg C)	14.39	2.15	.35	11.49	18.14

GRAY'S REEF/FREEF/TOP/WN84/LP40/R-20
Length: 324 Points Elapsed Time: 80, 18, 0, (DY,HR,MN)
From : 1984 NOV25(330), 0 0Z 0 To 1985 FEB13(44),18 0Z 0

	Mean	Stand Dev	Stand Error	Minimum	Maximum
V-Comp (cm/s)	3.03	7.67	1.24	-20.18	22.15
U-Comp (cm/s)	.36	1.88	.30	-5.92	5.86
Temperature (Deg C)	14.08	2.26	.36	10.25	17.42

GRAY'S REEF/FREEF/BOTT/WN84/LP40/R-20
Length: 384 Points Elapsed Time: 95, 18, 0, (DY,HR,MN)
From : 1984 NOV25(330), 0 0Z 0 To 1985 FEB28(59),18 0Z 0

	Mean	Stand Dev	Stand Error	Minimum	Maximum
V-Comp (cm/s)	.41	2.61	.42	-10.74	7.01
U-Comp (cm/s)	-1.05	1.60	.26	-5.36	3.51
Temperature (Deg C)	13.40	2.38	.38	10.00	17.10

SAVANNAH WINDS M/S /40HLP/R-200
Length: 356 Points Elapsed Time: 88, 18, 0, (DY,HR,MN)
From : 1985 MAR 2(61), 3 0Z 0 To 1985 MAY29(149),21 0Z 0

	Mean	Stand Dev	Stand Error	Minimum	Maximum
V-Comp (cm/s)	.60	4.59	.76	-9.48	9.54
U-Comp (cm/s)	-.06	4.74	.79	-13.27	12.23
Temperature (Deg C)	20.38	3.71	.62	12.26	26.78

GRAY'S REEF/GRAY'S/TOP/SP85/LP40/R-20
Length: 92 Points Elapsed Time: 22, 18, 0, (DY,HR,MN)
From : 1985 MAY 6(126),12 0Z 0 To 1985 MAY29(149), 6 0Z 0

	Mean	Stand Dev	Stand Error	Minimum	Maximum
V-Comp (cm/s)	.86	8.59	1.43	-20.28	23.72
U-Comp (cm/s)	2.20	3.37	.56	-7.64	9.48
Temperature (Deg C)	23.14	.88	.15	21.56	24.54

GRAY'S REEF/GRAY'S/BOTT/SP85/LP40/R-20
Length: 360 Points Elapsed Time: 89, 18, 0, (DY,HR,MN)
From : 1985 MAR 1(60), 0 0Z 0 To 1985 MAY29(149),18 0Z 0

	Mean	Stand Dev	Stand Error	Minimum	Maximum
V-Comp (cm/s)	1.09	3.91	.65	-12.99	11.99
U-Comp (cm/s)	-2.20	1.77	.29	-8.46	4.86
Temperature (Deg C)	19.41	3.67	.61	13.28	25.67

GRAY'S REEF/FREEF/TOP/SP85/LP40/R-20
Length: 292 Points Elapsed Time: 72, 18, 0, (DY,HR,MN)
From : 1985 MAR17(76),18 0Z 0 To 1985 MAY29(149),12 0Z 0

	Mean	Stand Dev	Stand Error	Minimum	Maximum
V-Comp (cm/s)	4.57	7.96	1.32	-16.31	23.02
U-Comp (cm/s)	.67	2.70	.45	-7.85	9.94
Temperature (Deg C)	20.35	3.16	.53	14.81	25.11

GRAY'S REEF/FREEF/BOTT/SP85/LP40/R-20
Length: 292 Points Elapsed Time: 72, 18, 0, (DY,HR,MN)
From : 1985 MAR17(76),18 0Z 0 To 1985 MAY29(149),12 0Z 0

	Mean	Stand Dev	Stand Error	Minimum	Maximum
V-Comp (cm/s)	1.74	3.78	.63	-11.54	10.94
U-Comp (cm/s)	-1.79	2.61	.43	-7.49	5.86
Temperature (Deg C)	19.96	3.30	.55	14.28	25.18

SAVANNAH WINDS M/S/SUMMER 85/LP40/R-200
Length: 360 Points Elapsed Time: 89, 18, 0, (DY,HR,MN)
From : 1985 MAY30(150), 0 0Z 0 To 1985 AUG27(239),18 0Z 0

	Mean	Stand Dev	Stand Error	Minimum	Maximum
V-Comp (cm/s)	2.97	3.60	.60	-8.35	9.60
U-Comp (cm/s)	.91	4.48	.74	-11.22	10.22
Temperature (Deg C)	28.63	1.12	.19	25.06	30.49

GRAY'S REEF/GRAY'S/TOP/SU85/LP40/R-20
Length: 360 Points Elapsed Time: 89, 18, 0, (DY,HR,MN)
From : 1985 MAY30(150), 0 0Z 0 To 1985 AUG27(239),18 0Z 0

	Mean	Stand Dev	Stand Error	Minimum	Maximum
V-Comp (cm/s)	-1.03	8.94	1.49	-28.98	24.70
U-Comp (cm/s)	2.57	1.97	.33	-2.82	10.47
Temperature (Deg C)	27.75	1.03	.17	24.95	29.31

GRAY'S REEF/GRAY'S/BOTT/SUMMER 85/LP40/R-20
Length: 360 Points Elapsed Time: 89, 18, 0, (DY,HR,MN)
From : 1985 MAY30(150), 0 0Z 0 To 1985 AUG27(239),18 0Z 0

	Mean	Stand Dev	Stand Error	Minimum	Maximum
V-Comp (cm/s)	2.19	4.35	.72	-13.68	16.46
U-Comp (cm/s)	-1.58	1.85	.31	-7.20	2.98
Temperature (Deg C)	27.43	1.12	.19	24.61	29.09

GRAY'S REEF/FREEF/TOP/SU85/LP40/R-20
Length: 352 Points Elapsed Time: 87, 18, 0, (DY,HR,MN)
From : 1985 MAY30(150), 0 0Z 0 To 1985 AUG25(237),18 0Z 0

	Mean	Stand Dev	Stand Error	Minimum	Maximum
V-Comp (cm/s)	3.90	6.82	1.14	-13.38	26.77
U-Comp (cm/s)	.50	1.88	.31	-4.26	6.39
Temperature (Deg C)	27.59	.99	.16	25.25	29.22

GRAY'S REEF/FREEF/BOTT/SU85/LP40/R-20
Length: 360 Points Elapsed Time: 89, 18, 0, (DY,HR,MN)
From : 1985 MAY30(150), 0 0Z 0 To 1985 AUG27(239),18 0Z 0

	Mean	Stand Dev	Stand Error	Minimum	Maximum
V-Comp (cm/s)	2.13	4.32	.72	-10.91	19.06
U-Comp (cm/s)	-1.10	1.84	.31	-5.48	3.76
Temperature (Deg C)	28.69	.99	.17	25.99	30.32

SAVANNAH WINDS M/S /FA85/LP40/R-200
Length: 360 Points Elapsed Time: 89, 18, 0, (DY,HR,MN)
From : 1985 AUG28(240), 0 0Z 0 To 1985 NOV25(329),18 0Z 0

	Mean	Stand Dev	Stand Error	Minimum	Maximum
V-Comp (cm/s)	-1.54	4.88	.81	-12.21	11.73
U-Comp (cm/s)	-3.06	5.27	.88	-11.58	15.76
Temperature (Deg C)	25.27	3.05	.51	13.21	30.67

GRAY'S REEF/GRAY'S/TOP/FA85/LP40/R-20
Length: 360 Points Elapsed Time: 89, 18, 0, (DY,HR,MN)
From : 1985 AUG28(240), 0 0Z 0 To 1985 NOV25(329),18 0Z 0

	Mean	Stand Dev	Stand Error	Minimum	Maximum
V-Comp (cm/s)	-.01	9.58	1.59	-32.08	33.05
U-Comp (cm/s)	2.23	2.50	.42	-4.30	10.09
Temperature (Deg C)	25.19	2.12	.35	21.38	29.28

GRAY'S REEF/GRAY'S/BOTT/FA85/LP40/R-20
Length: 220 Points Elapsed Time: 54, 18, 0, (DY,HR,MN)
From : 1985 AUG28(240), 0 0Z 0 To 1985 OCT21(294),18 0Z 0

	Mean	Stand Dev	Stand Error	Minimum	Maximum
V-Comp (cm/s)	-1.86	4.86	.81	-17.70	7.82
U-Comp (cm/s)	-.53	1.34	.22	-3.65	5.05
Temperature (Deg C)	27.52	1.32	.22	25.86	30.12

GRAY'S REEF/FREEF/TOP/FA85/LP40/R-20
Length: 184 Points Elapsed Time: 45, 18, 0, (DY,HR,MN)
From : 1985 OCT10(283),18 0Z 0 To 1985 NOV25(329),12 0Z 0

	Mean	Stand Dev	Stand Error	Minimum	Maximum
V-Comp (cm/s)	1.73	10.27	1.71	-38.36	33.54
U-Comp (cm/s)	3.91	3.88	.65	-5.98	14.62
Temperature (Deg C)	23.14	1.53	.25	20.69	25.38

GRAY'S REEF/FREEF/BOTT/FA85/LP40/R-20
Length: 360 Points Elapsed Time: 89, 18, 0, (DY,HR,MN)
From : 1985 AUG28(240), 0 0Z 0 To 1985 NOV25(329),18 0Z 0

	Mean	Stand Dev	Stand Error	Minimum	Maximum
V-Comp (cm/s)	-.08	5.25	.87	-18.59	16.36
U-Comp (cm/s)	.12	2.48	.41	-7.29	7.69
Temperature (Deg C)	24.68	2.16	.36	20.75	29.82

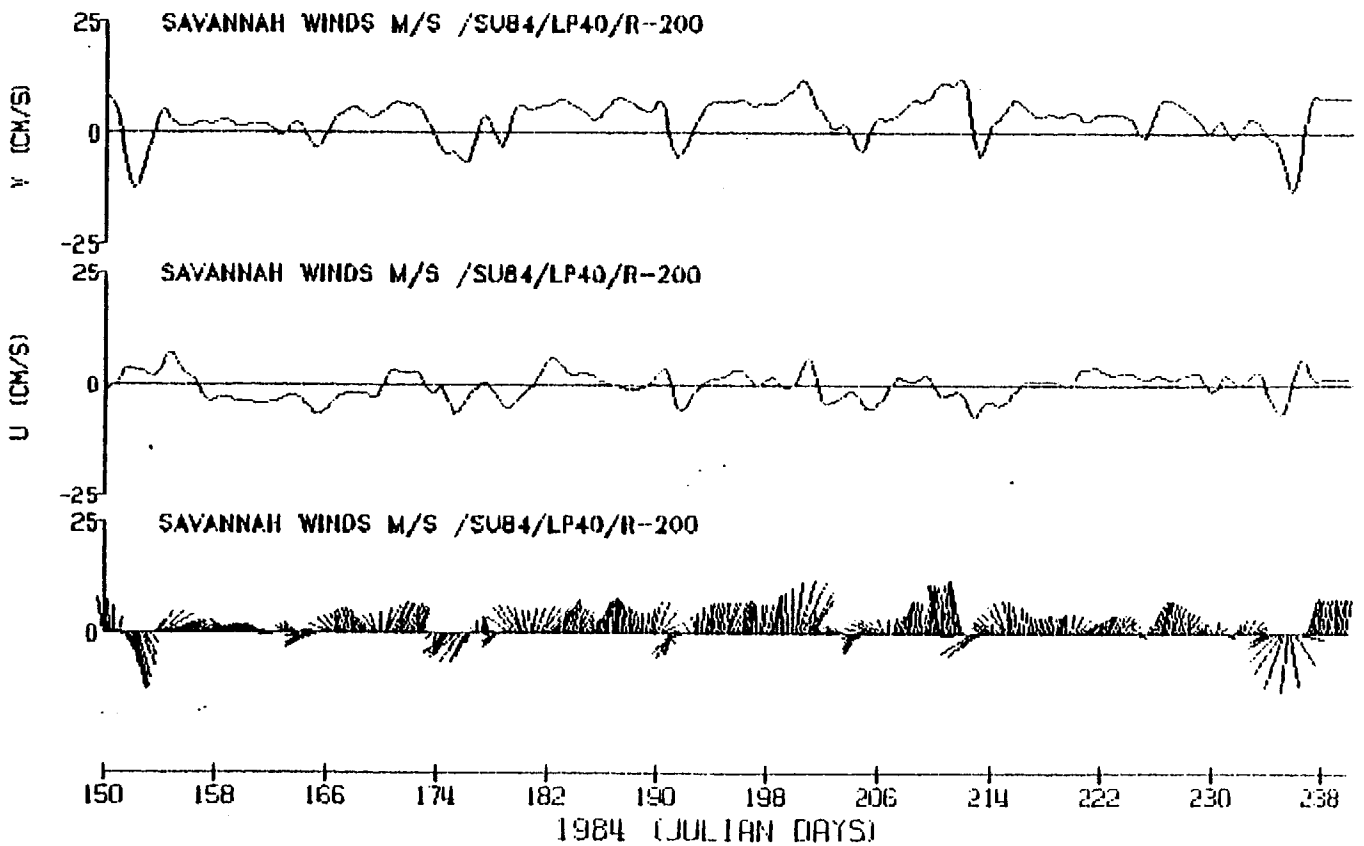
Appendix C: Plots of Current and Wind Velocities

The plots included in the Appendix are organized in various displays. The plots are identified by the Legend at the top of each individual graph. The quantity graphed is identified at the left of the plot. The four graphs on each plot are temperature (T), alongshore velocity (V), cross shore velocity (U) and stick vector plot. The alongshore direction is up coast to 20 degrees True. The alongshore direction is offshore to 110 degrees True. The wind data is in units of m/s and all other velocity data is in cm/s.

The first group of plots are organized seasonally for each station. Each plot represents a 90 day time interval beginning on Julian day 60, 150, 240 and 330 representing the spring, summer, fall and winter. The Savannah Light wind measurements do not include temperature. The stick vector plots are oriented so that vertically upward on the page is up coast to 20 degrees True. One plot is presented for each current meter from which data had been received. They are in order of season from summer 1984 through fall 1985. For each season the plots are in the order Savannah winds, Gray's Top, Gray's Bottom, F Reef Top, F Reef Bottom.

The next group of plots are of the alongshore velocity component only for each season. These plots augment the stick vector plots shown in Figure 5 in the main body of the report. They show the coherence of the alongshore motion in a clear manner.

The next group of plots are the progressive vector representation for each season. Each plot is scaled according to the excursions seen for that data. The progressive line is marked with the number of days from the beginning of the record. The title box on the plot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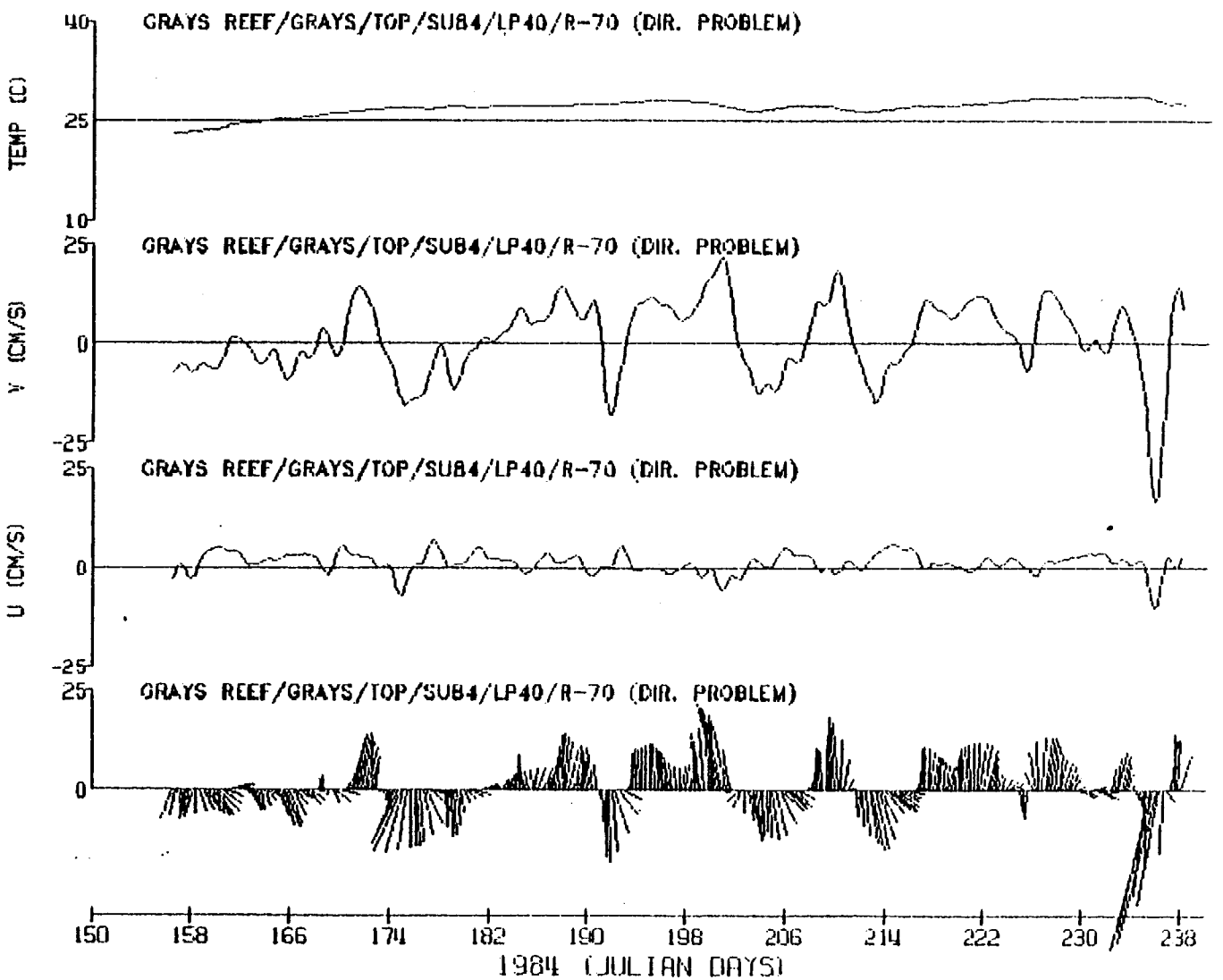
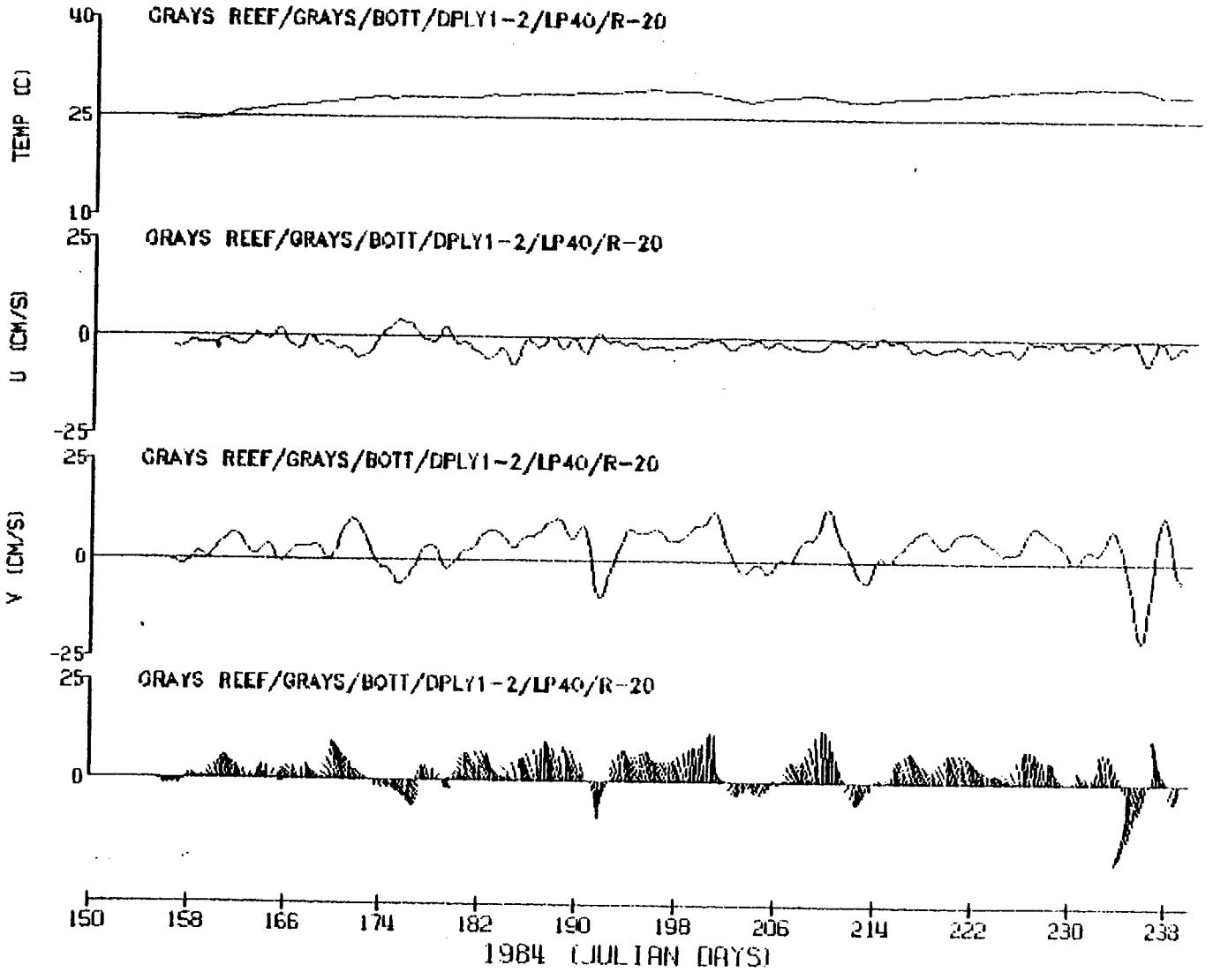
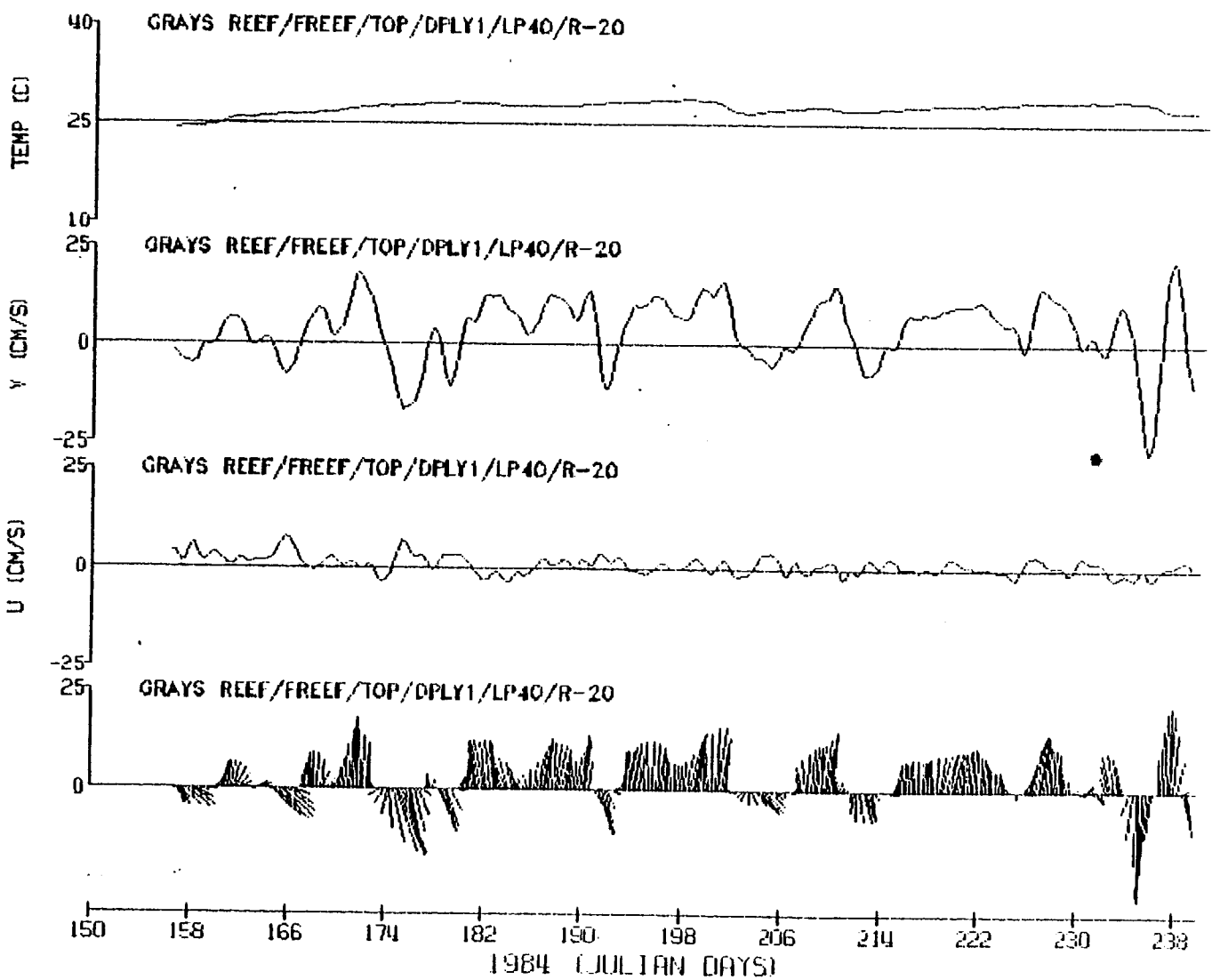
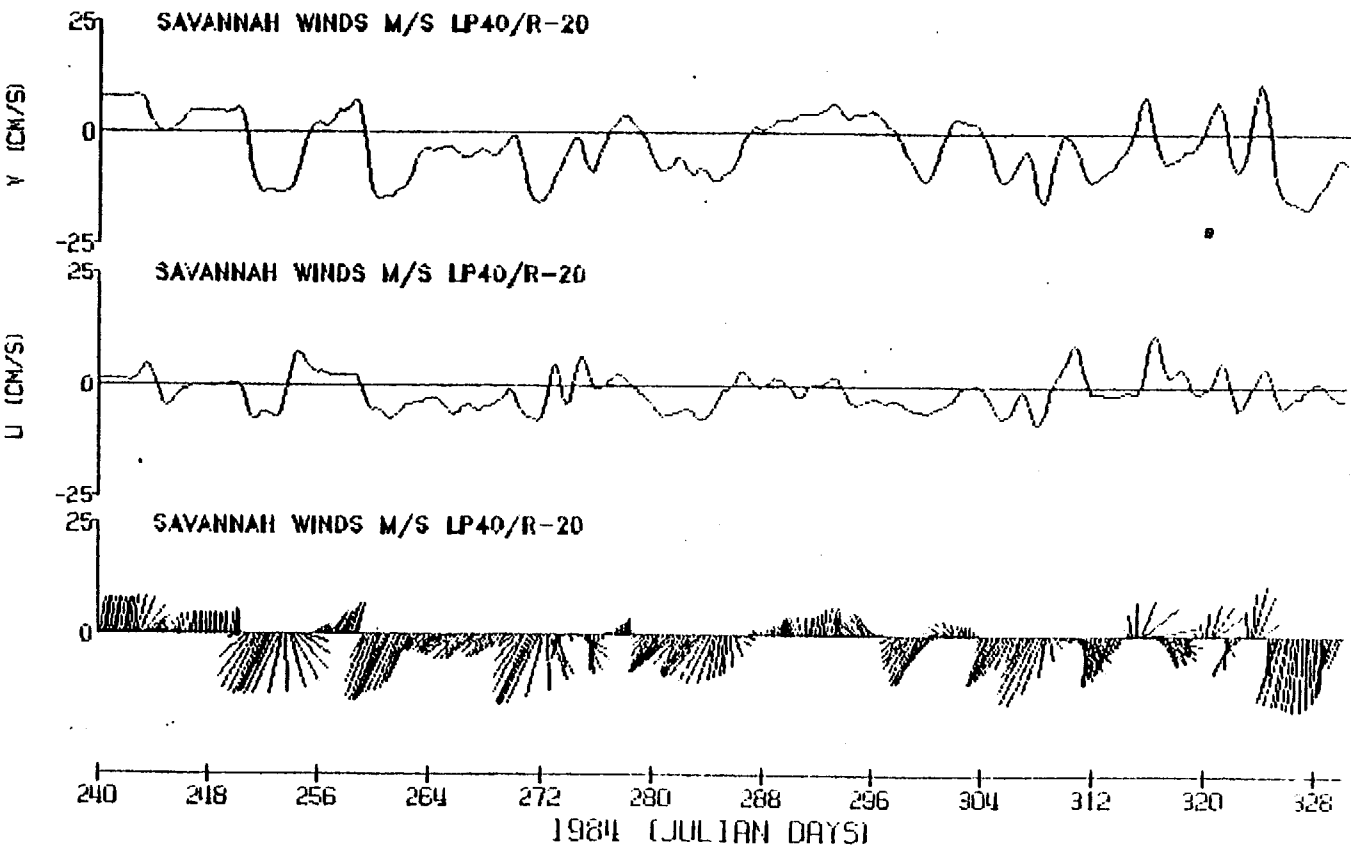
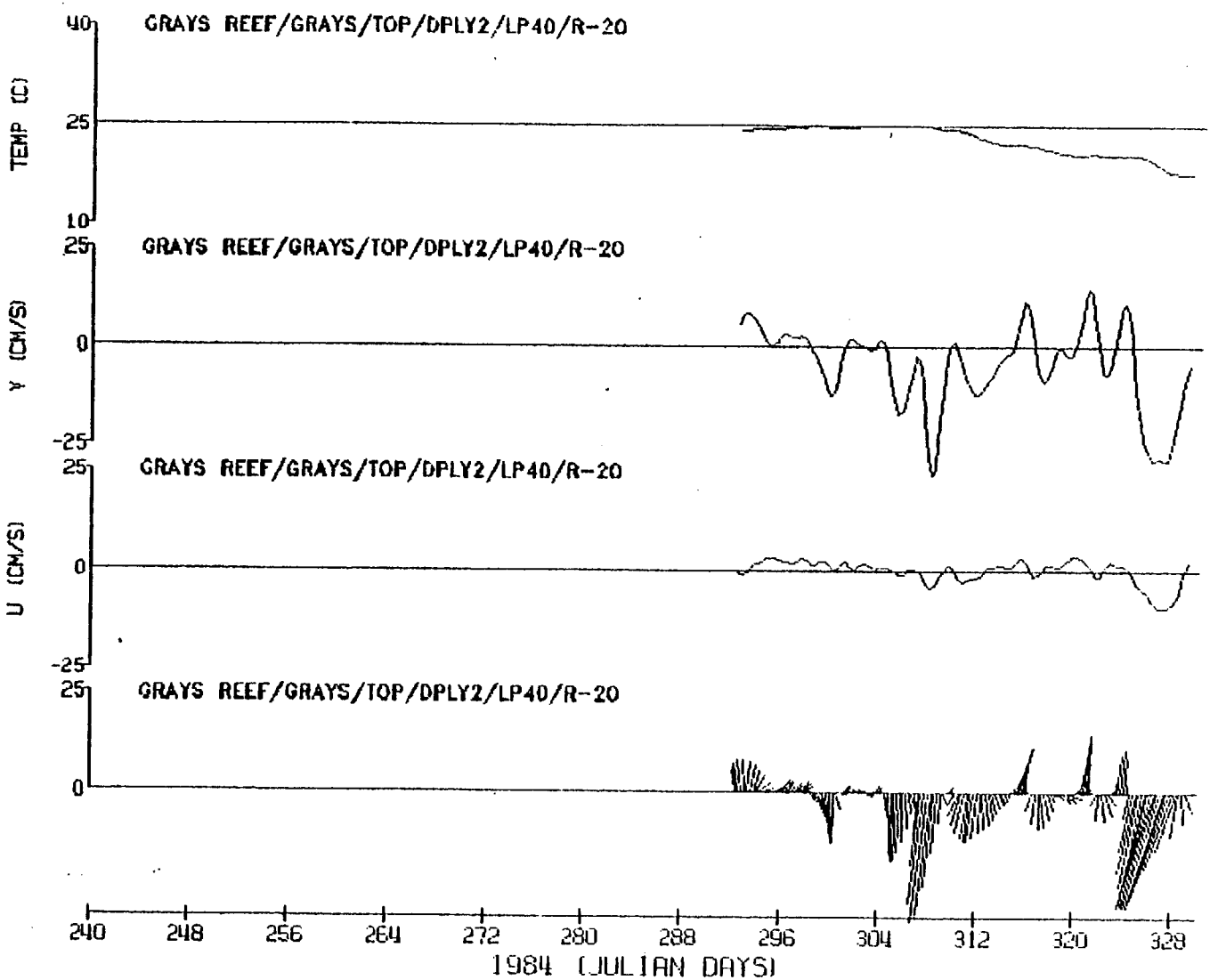
V (CM/S)
25
0
-25
SAVANNAH WINDS M/S /SU84/LP40/R-200
U (CM/S)
25
0
-25
SAVANNAH WINDS M/S /SU84/LP40/R-200
25
0
150
158
166
174
182
190
198
206
214
222
230
238
1984 (JULIAN DAYS)


GRAYS REEF/GRAYS/TOP/SUB4/LP40/R-70 (DIR. PROBLEM)
TEMP (C)
40
25
10
GRAYS REEF/GRAYS/TOP/SUB4/LP40/R-70 (DIR. PROBLEM)
V (CM/S)
25
0
-25
GRAYS REEF/GRAYS/TOP/SUB4/LP40/R-70 (DIR. PROBLEM)
U (CM/S)
25
0
-25
GRAYS REEF/GRAYS/TOP/SUB4/LP40/R-70 (DIR. PROBLEM)
25
0
150
158
166
174
182
190
198
206
214
222
230
238
1984 (JULIAN DAYS)


GRAYS REEF/GRAYS/BOTT/DPLY1-2/LP40/R-20
TEMP (C)
40
25
10
GRAYS REEF/GRAYS/BOTT/DPLY1-2/LP40/R-20
U (CM/S)
25
0
-25
GRAYS REEF/GRAYS/BOTT/DPLY1-2/LP40/R-20
V (CM/S)
25
0
-25
GRAYS REEF/GRAYS/BOTT/DPLY1-2/LP40/R-20
25
0
150
158
166
174
182
190
198
206
214
222
230
238
1984 (JULIAN DAYS)


GRAYS REEF/FREEF/TOP/DPLY1/LP40/R-20
TEMP (C)
40
25
10
GRAYS REEF/FREEF/TOP/DPLY1/LP40/R-20
V (CM/S)
25
0
-25
GRAYS REEF/FREEF/TOP/DPLY1/LP40/R-20
U (CM/S)
25
0
-25
GRAYS REEF/FREEF/TOP/DPLY1/LP40/R-20
25
0
150
158
166
174
182
190
198
206
214
222
230
238
1984 (JULIAN DAYS)


SAVANNAH WINDS M/S LP40/R-20
V (CM/S)
25
0
-25
SAVANNAH WINDS M/S LP40/R-20
U (CM/S)
25
0
-25
SAVANNAH WINDS M/S LP40/R-20
25
0
240
248
256
264
272
280
288
296
304
312
320
328
1984 (JULIAN DAYS)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GRAYS REEF/GRAYS/TOP/DPLY2/LP40/R-20
V (CM/S)
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U (CM/S)
25
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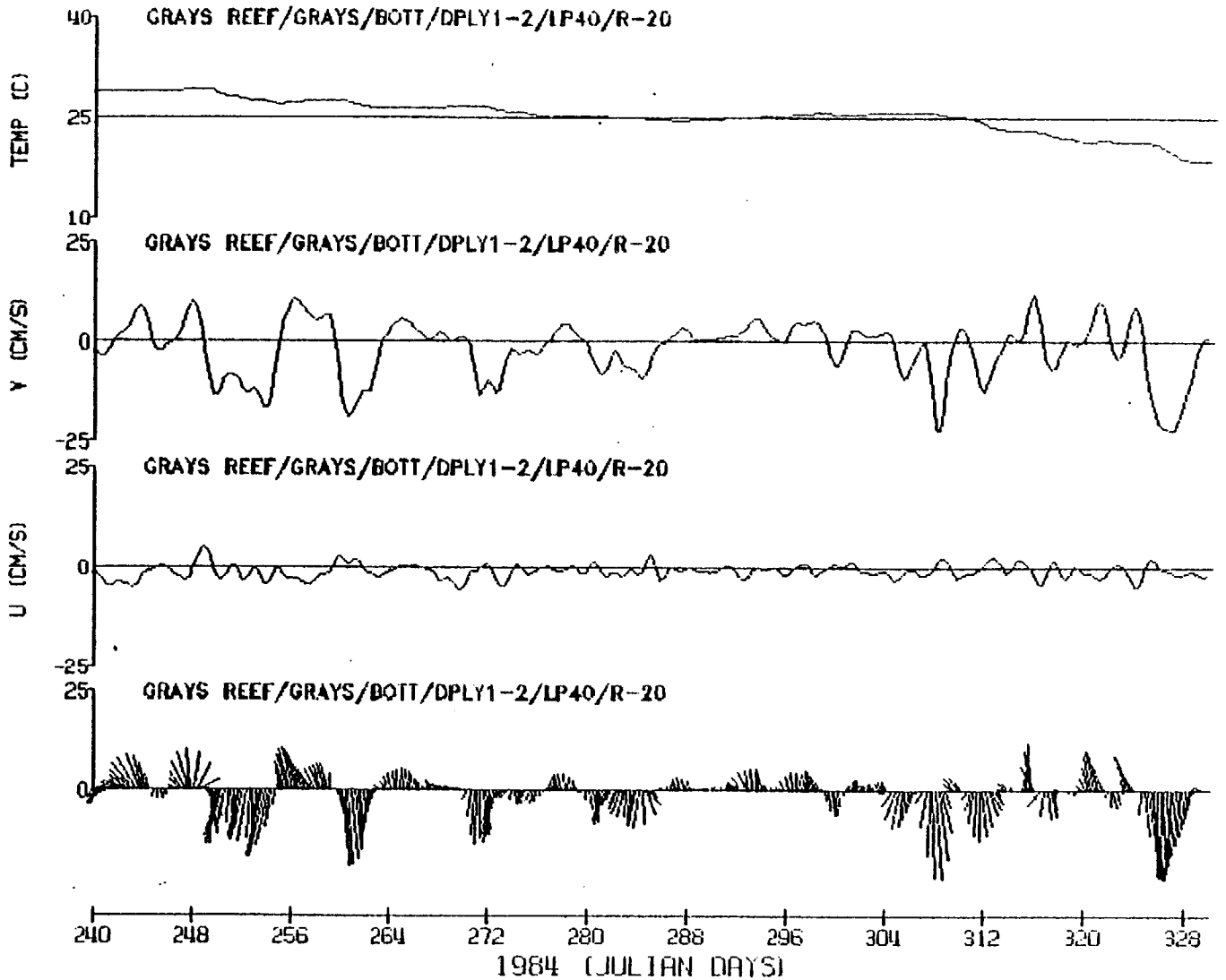
1984 (JULIAN DAYS)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V (CM/S)
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U (CM/S)
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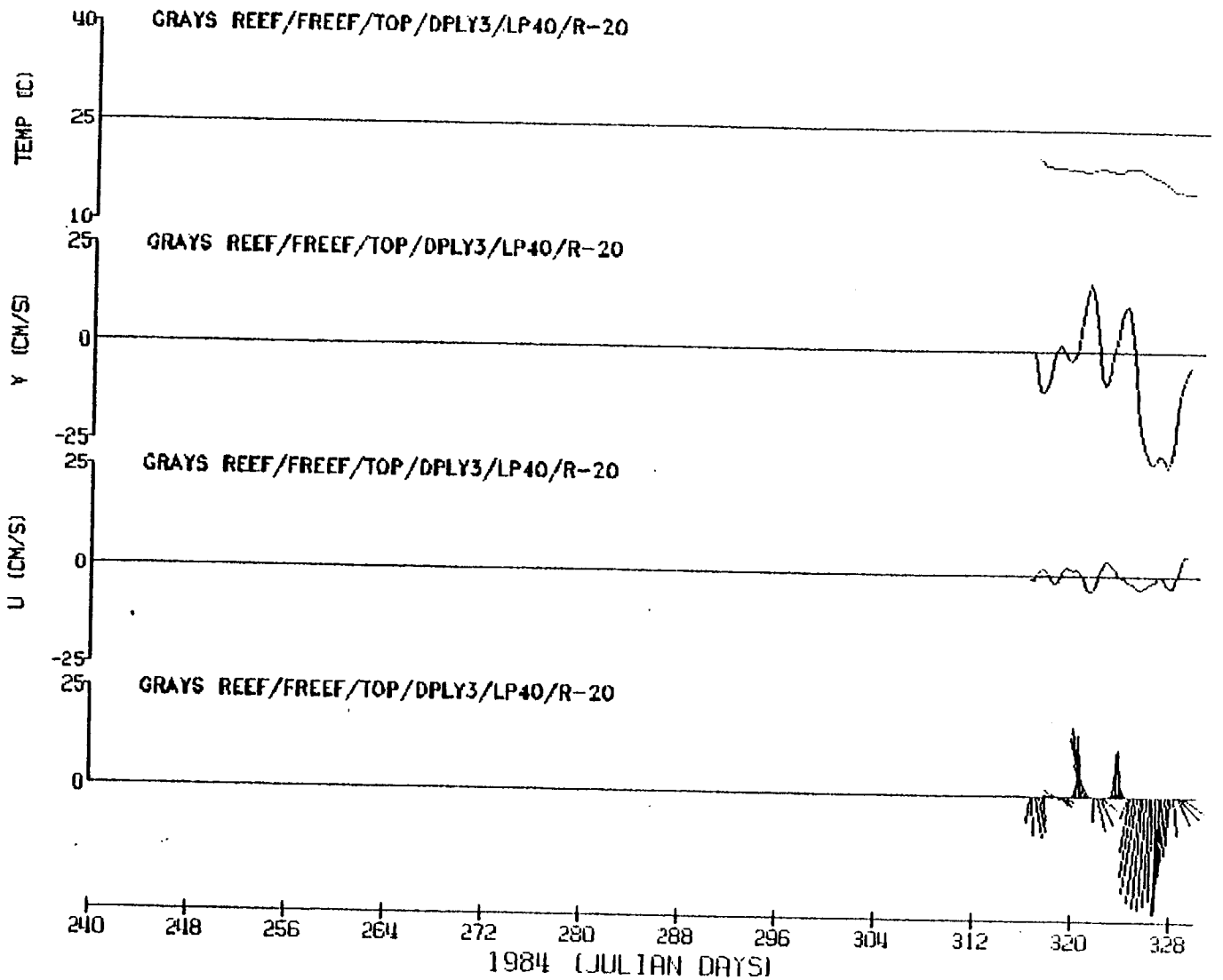
1984 (JULIAN DAYS)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U (CM/S)
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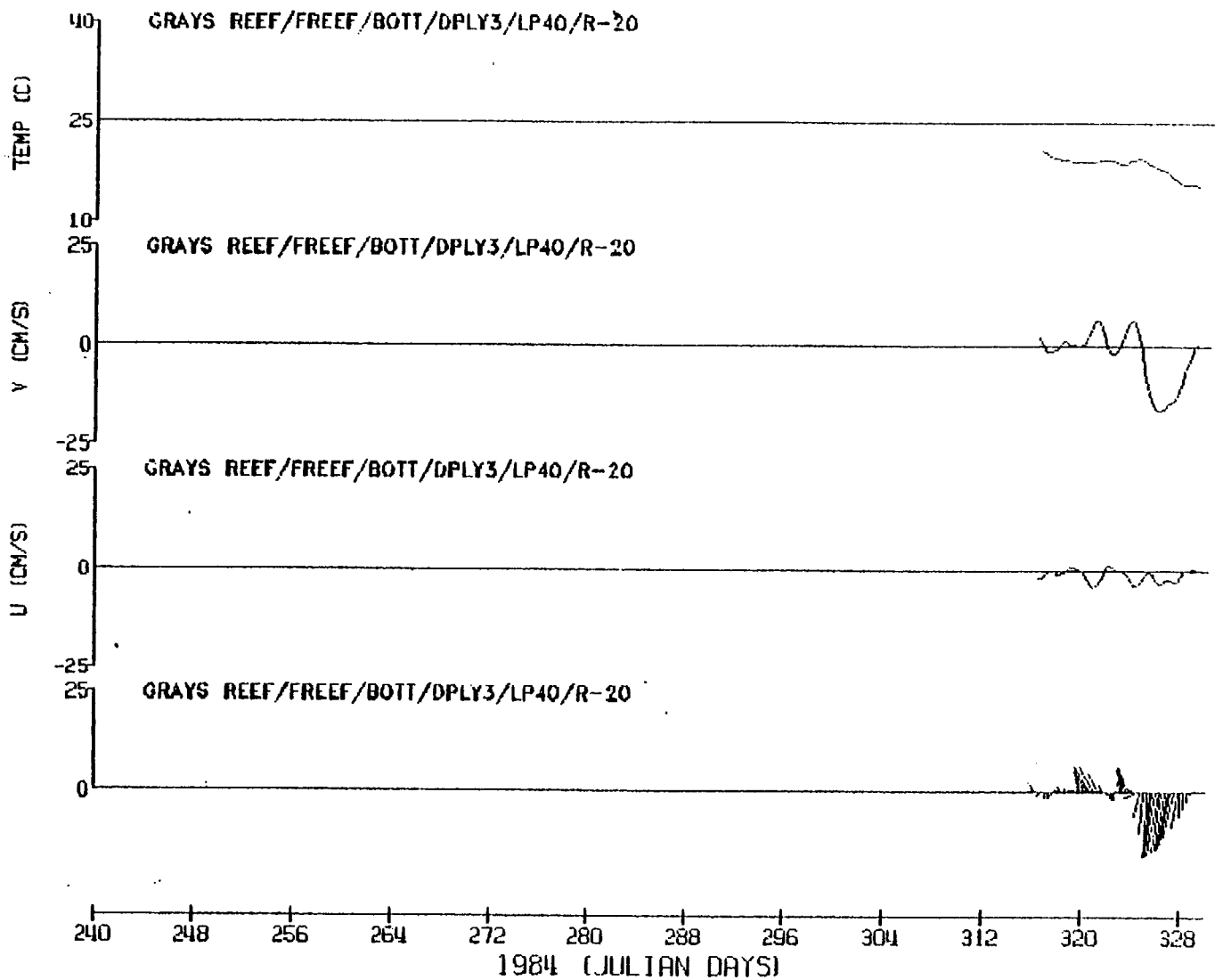
1984 (JULIAN DAYS)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V (CM/S)
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U (CM/S)
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GRAYS REEF/FREEF/BOTT/DPLY3/LP40/R-20
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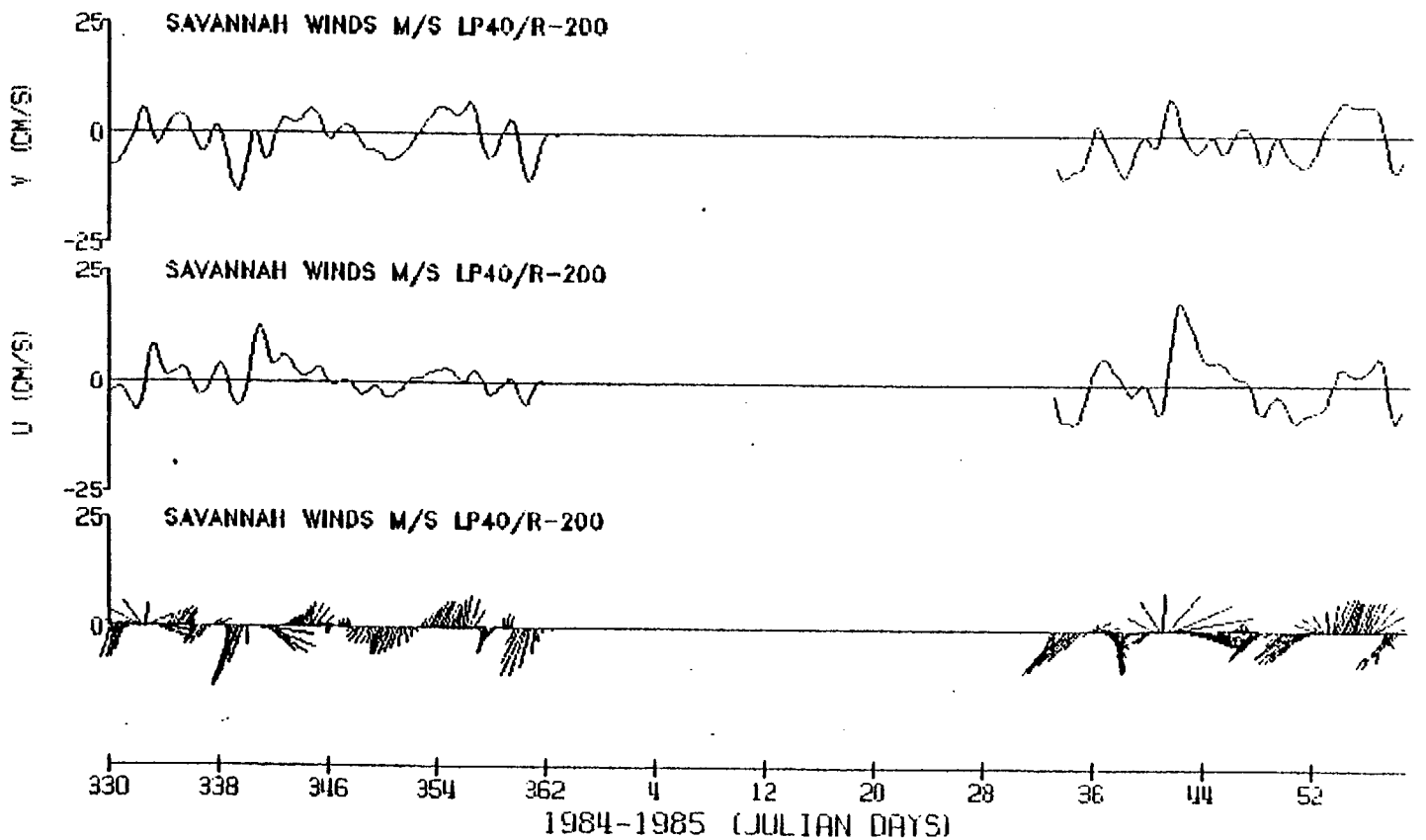
1984 (JULIAN DAYS)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SAVANNAH WINDS M/S LP40/R-200
U (CM/S)
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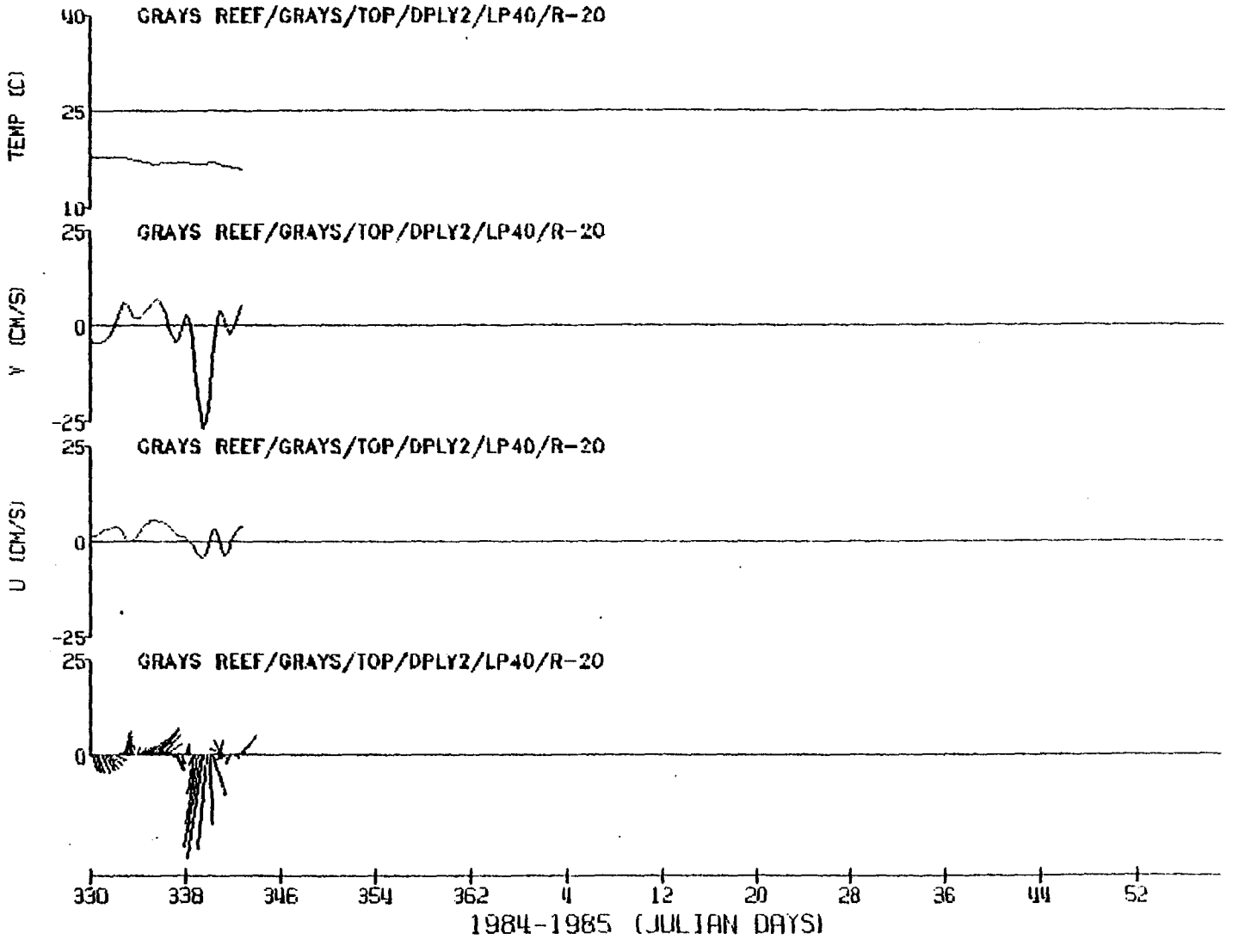
1984-1985 (JULIAN DAYS)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V (CM/S)
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GRAYS REEF/GRAYS/TOP/DPLY2/LP40/R-20
U (CM/S)
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GRAYS REEF/GRAYS/TOP/DPLY2/LP40/R-20
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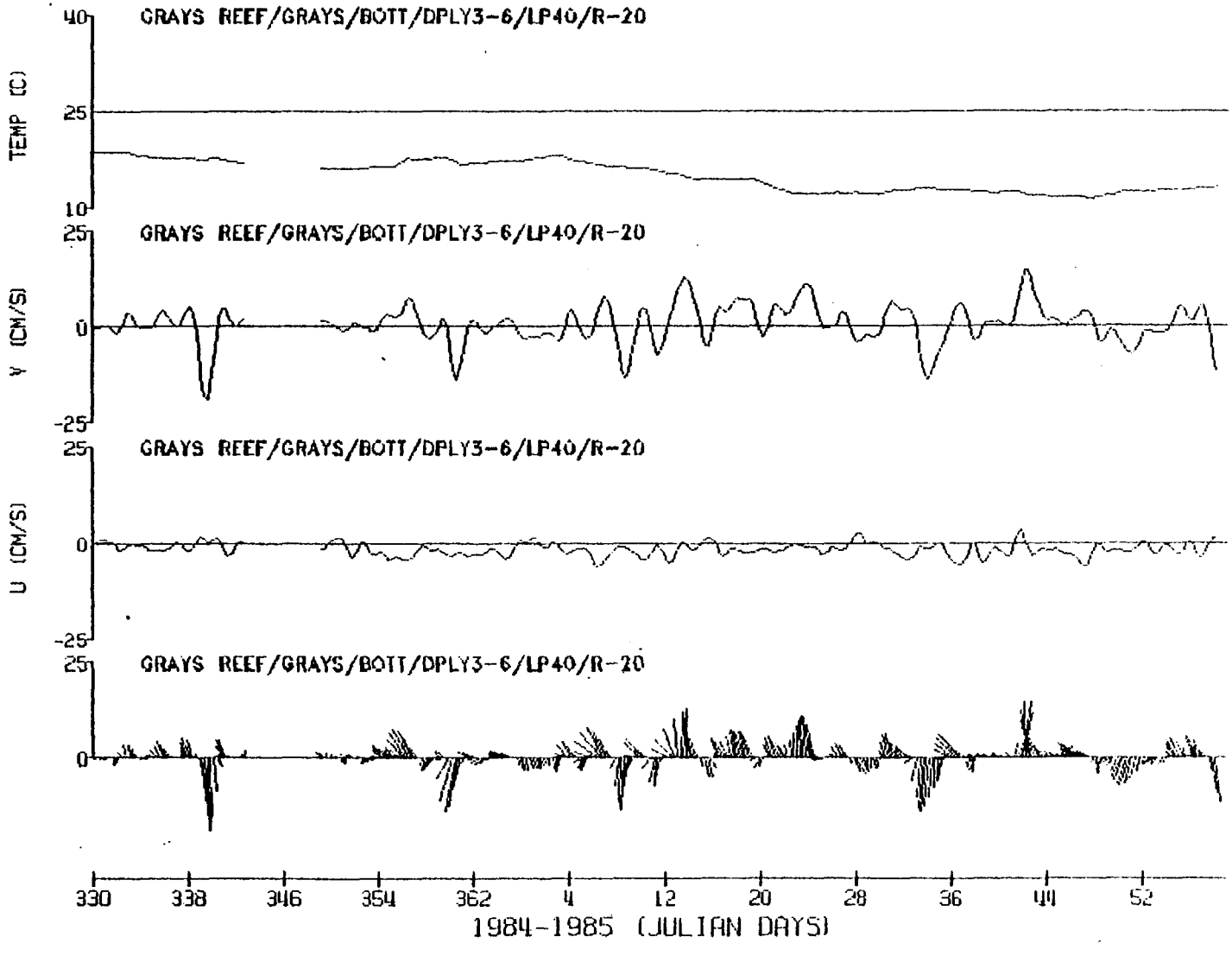
1984-1985 (JULIAN DAYS)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V (CM/S)
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GRAYS REEF/GRAYS/BOTT/DPLY3-6/LP40/R-20
U (CM/S)
25
0
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GRAYS REEF/GRAYS/BOTT/DPLY3-6/LP40/R-20
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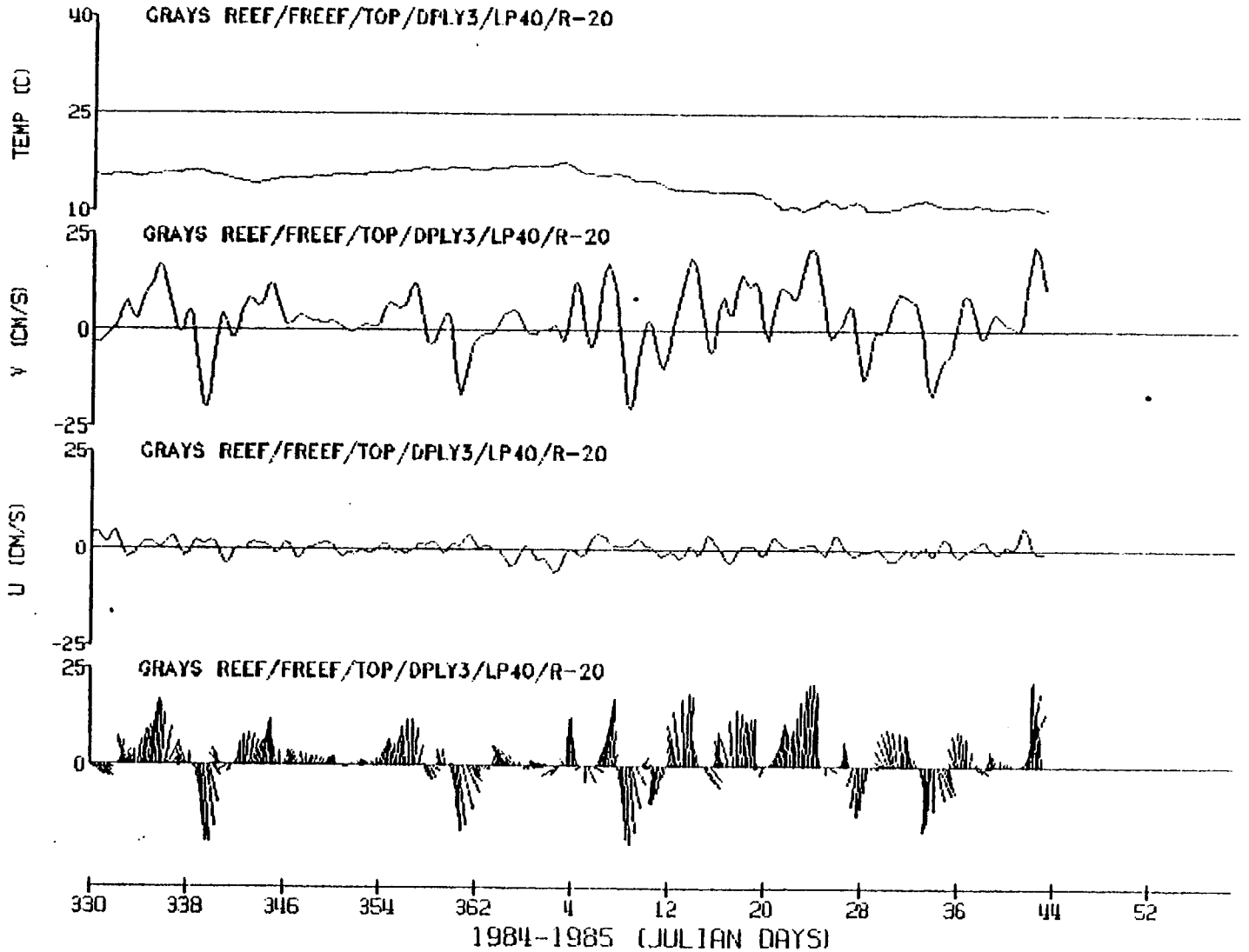
1984-1985 (JULIAN DAYS)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TEMP (C)
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GRAYS REEF/FREEF/TOP/DPLY3/LP40/R-20
V (CM/S)
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GRAYS REEF/FREEF/TOP/DPLY3/LP40/R-20
U (CM/S)
25
0
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GRAYS REEF/FREEF/TOP/DPLY3/LP40/R-20
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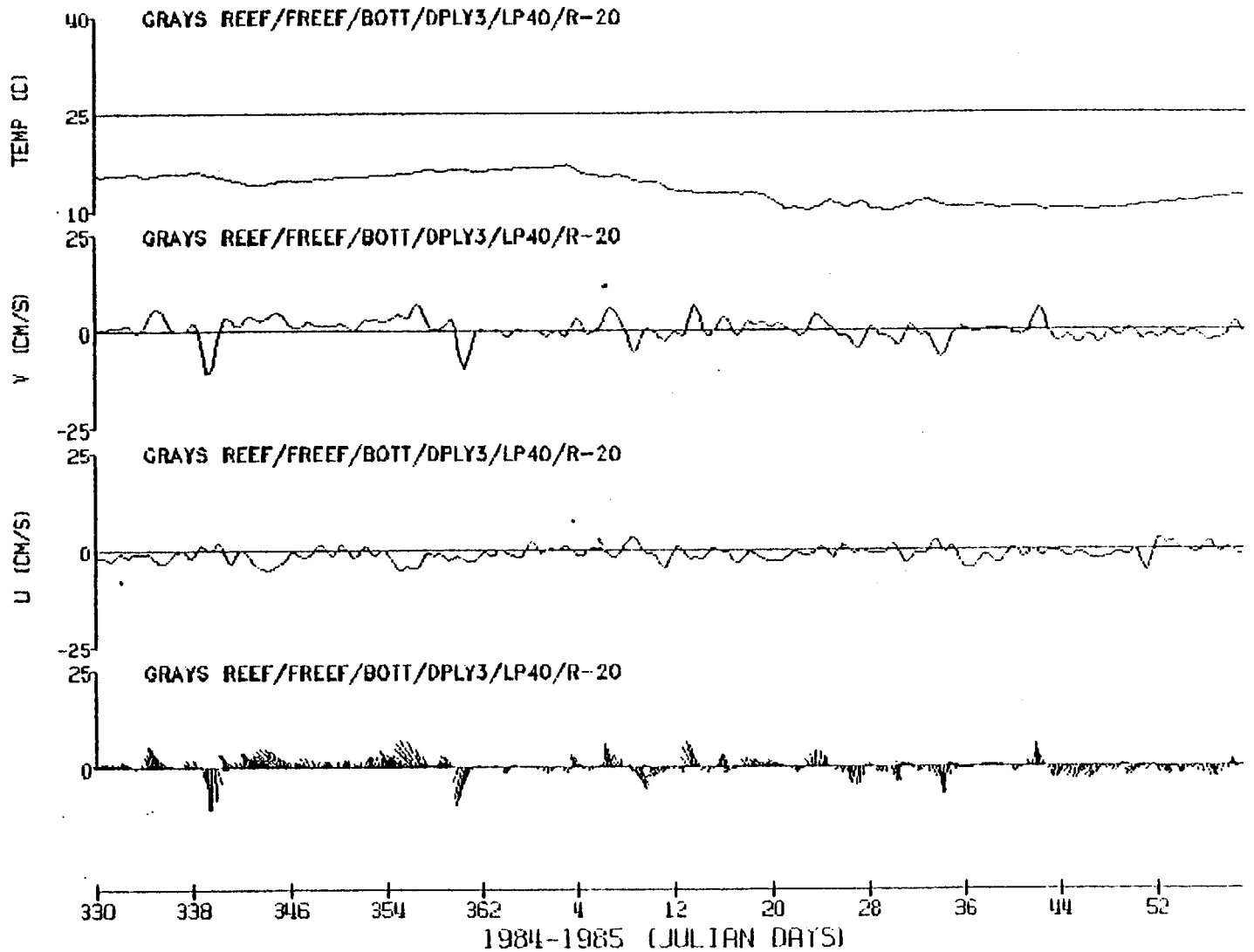
1984-1985 (JULIAN DAYS)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GRAYS REEF/FREEF/BOTT/DPLY3/LP40/R-20
U (CM/S)
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GRAYS REEF/FREEF/BOTT/DPLY3/LP40/R-20
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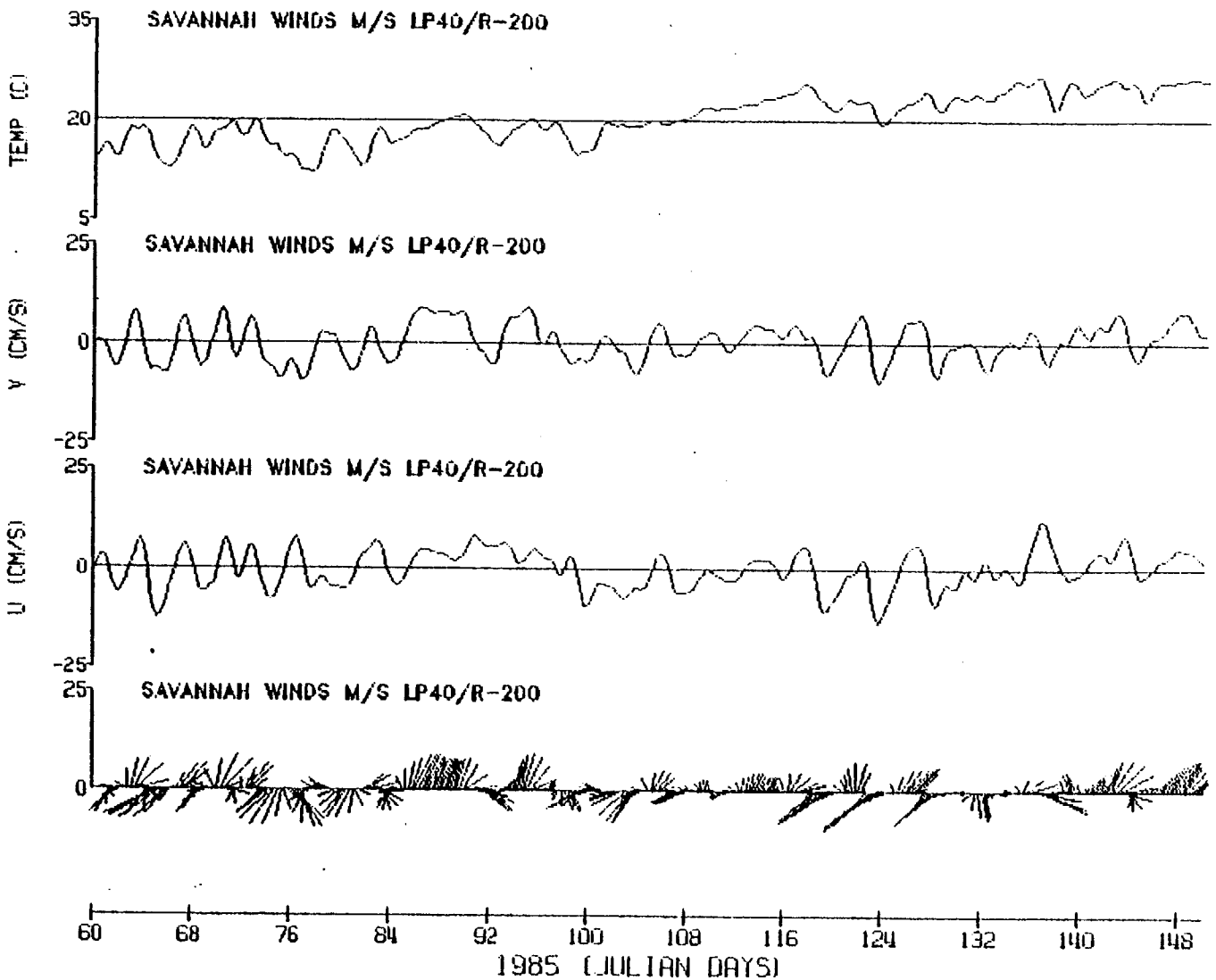
1984-1985 (JULIAN DAYS)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SAVANNAH WINDS M/S LP40/R-200
V (CM/S)
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SAVANNAH WINDS M/S LP40/R-200
U (CM/S)
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SAVANNAH WINDS M/S LP40/R-200
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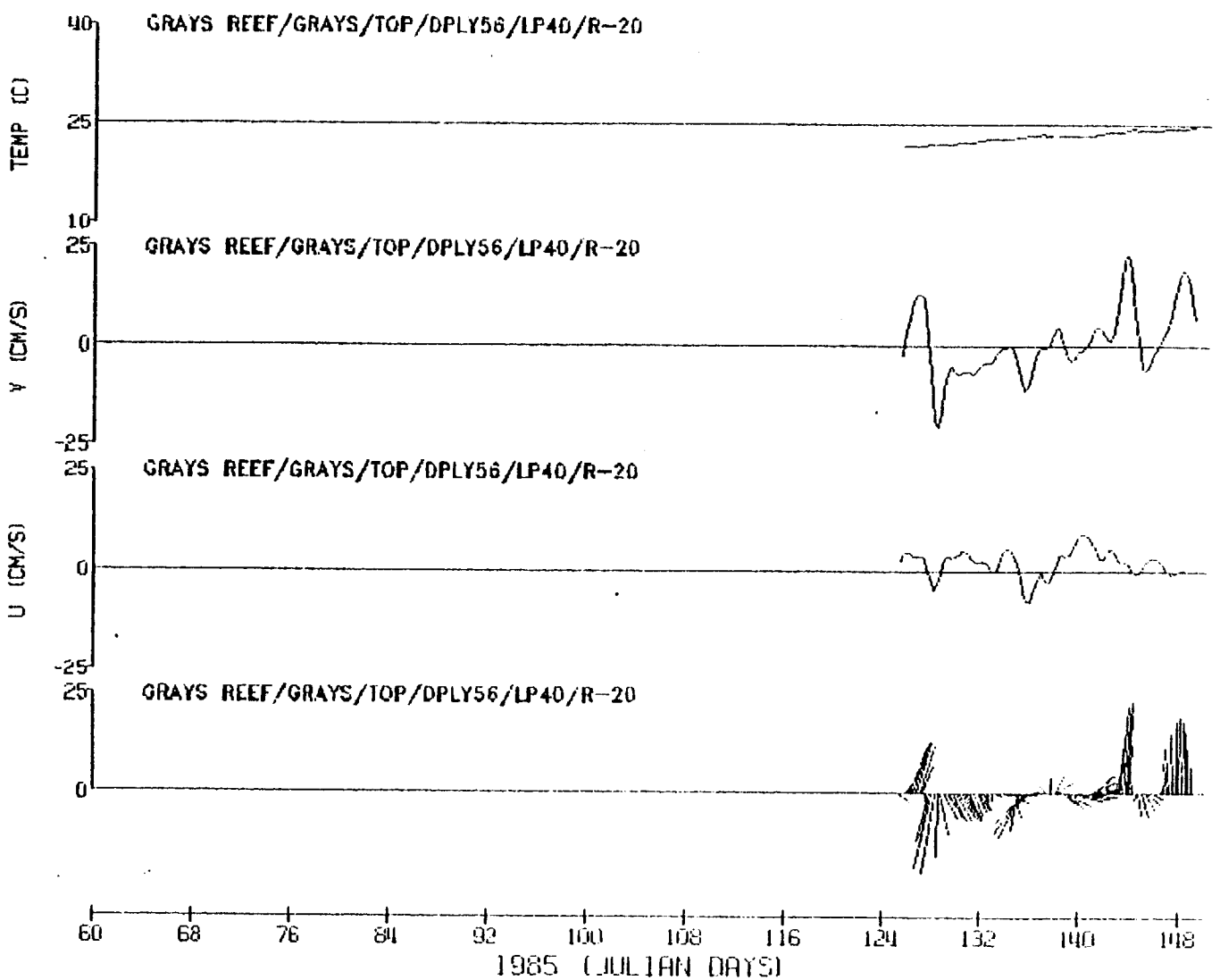
1985 (JULIAN DAYS)


GRAYS REEF/GRAYS/TOP/DPLY56/LP40/R-20
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V (CM/S)
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GRAYS REEF/GRAYS/TOP/DPLY56/LP40/R-20
U (CM/S)
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GRAYS REEF/GRAYS/TOP/DPLY56/LP40/R-20
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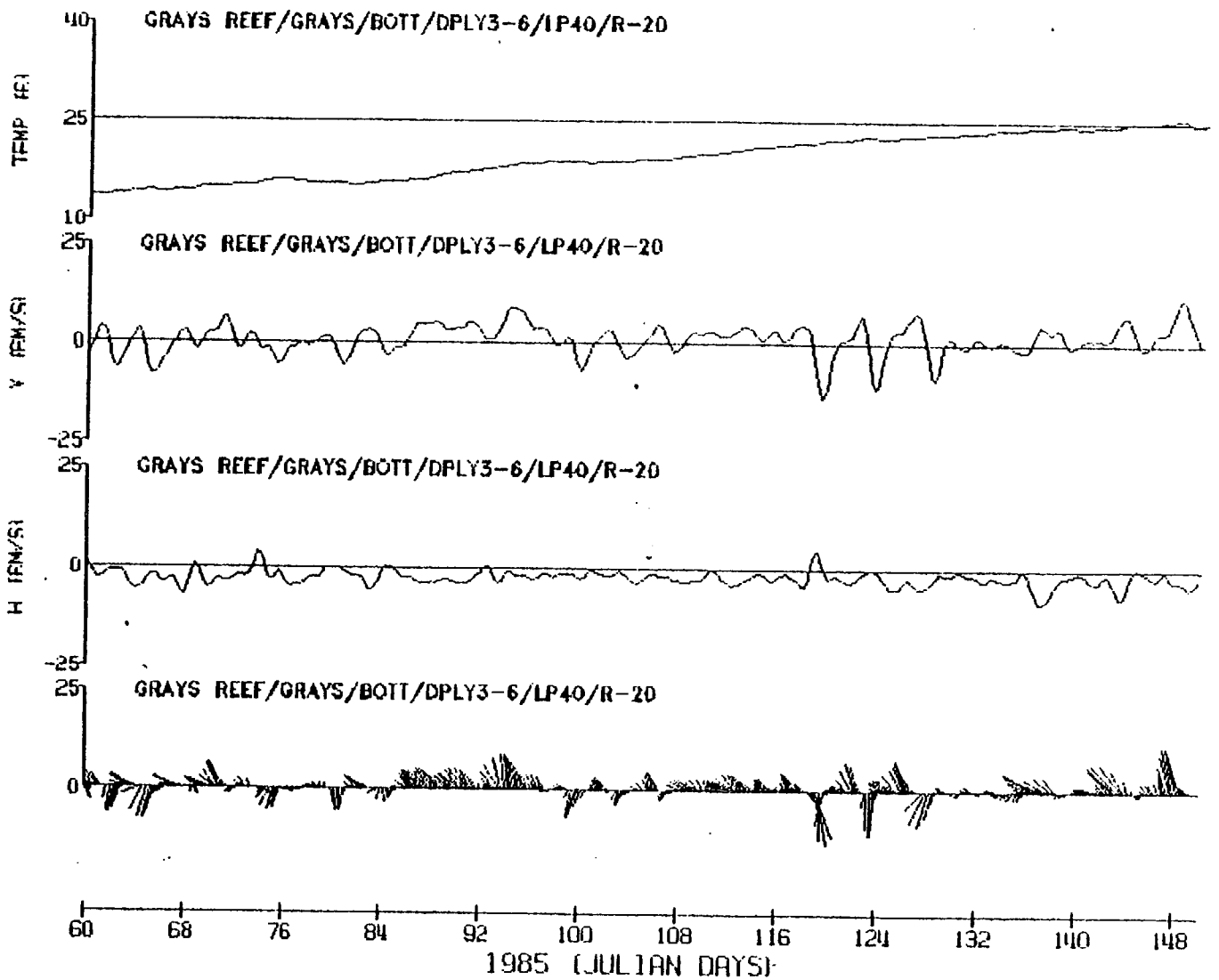
1985 (JULIAN DAYS)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GRAYS REEF/GRAYS/BOTT/DPLY3-6/LP40/R-20
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GRAYS REEF/GRAYS/BOTT/DPLY3-6/LP40/R-20
H (CM/S)
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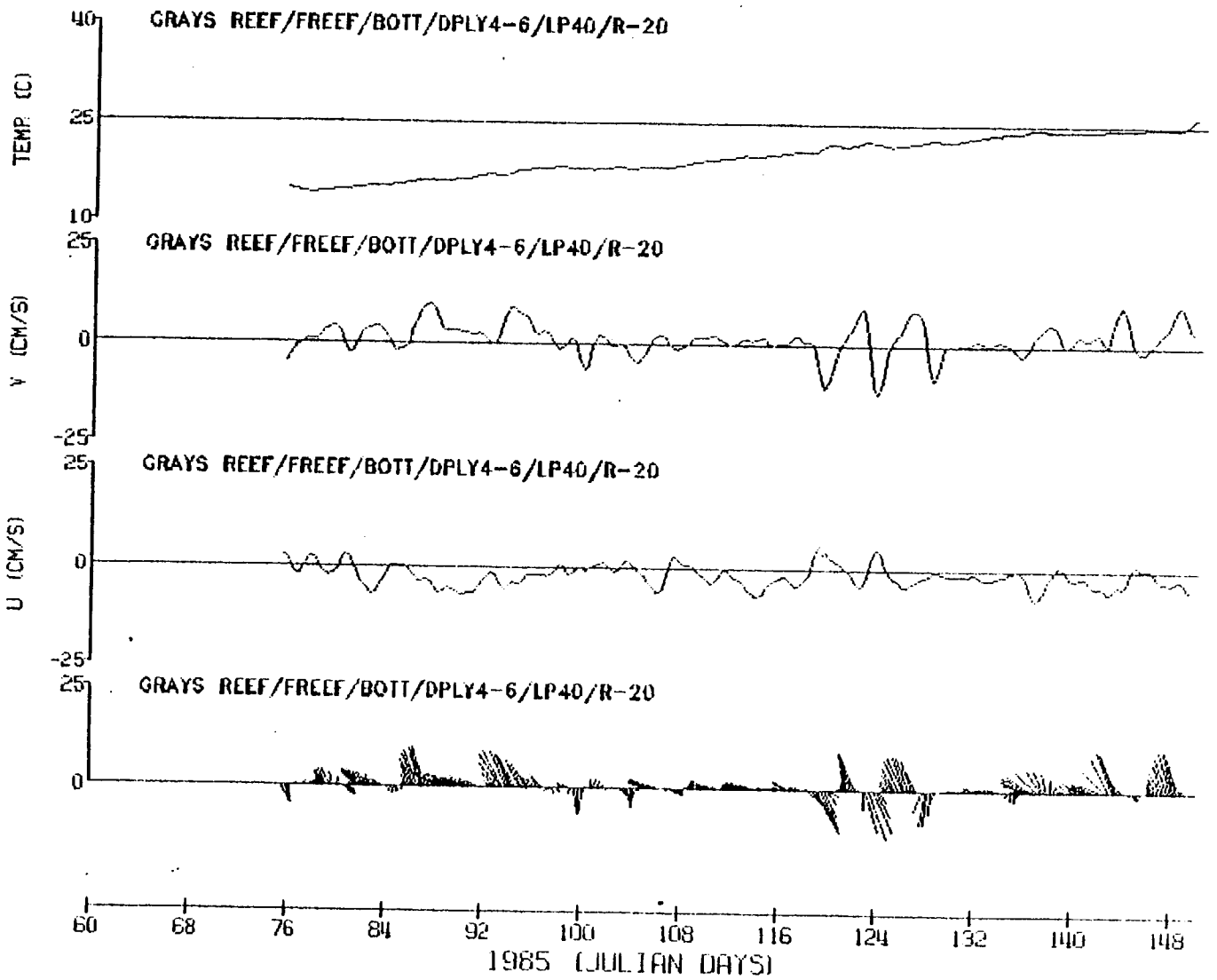
1985 (JULIAN DAYS)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GRAYS REEF/FREEF/BOTT/DPLY4-6/LP40/R-20
V (CM/S)
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GRAYS REEF/FREEF/BOTT/DPLY4-6/LP40/R-20
U (CM/S)
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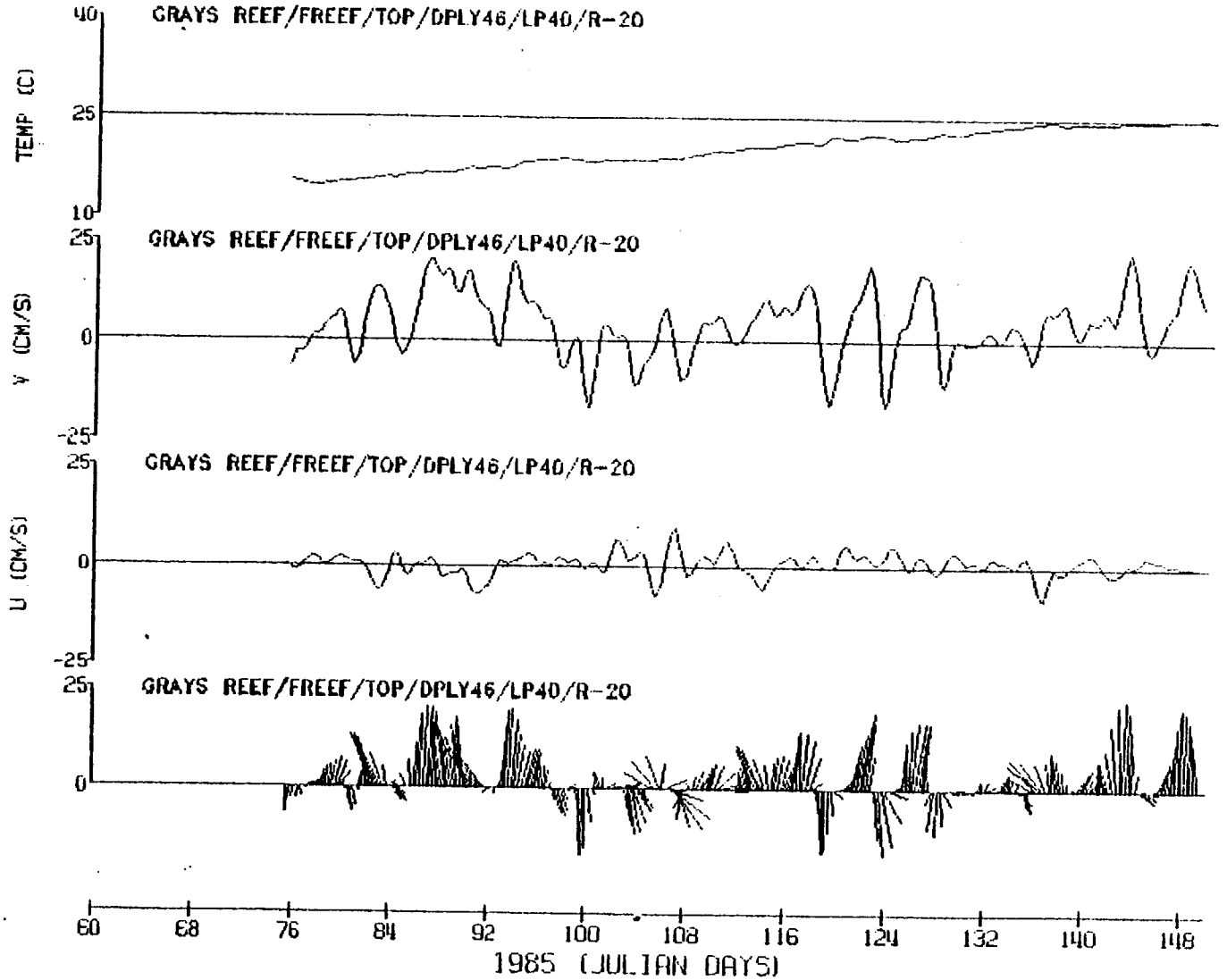
1985 (JULIAN DAYS)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U (CM/S)
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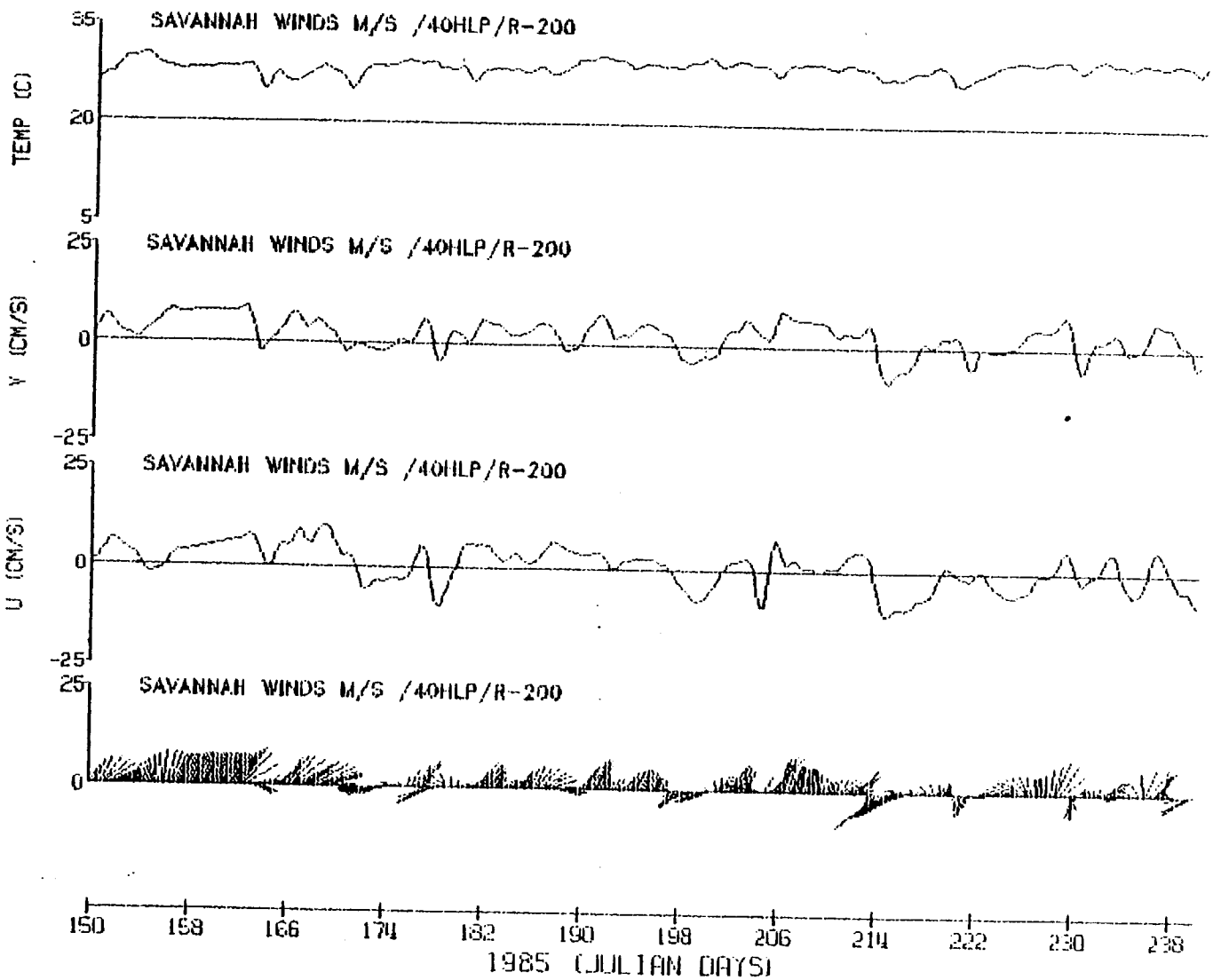
1985 (JULIAN DAYS)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U (CM/S)
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SAVANNAH WINDS M/S /40HLP/R-200
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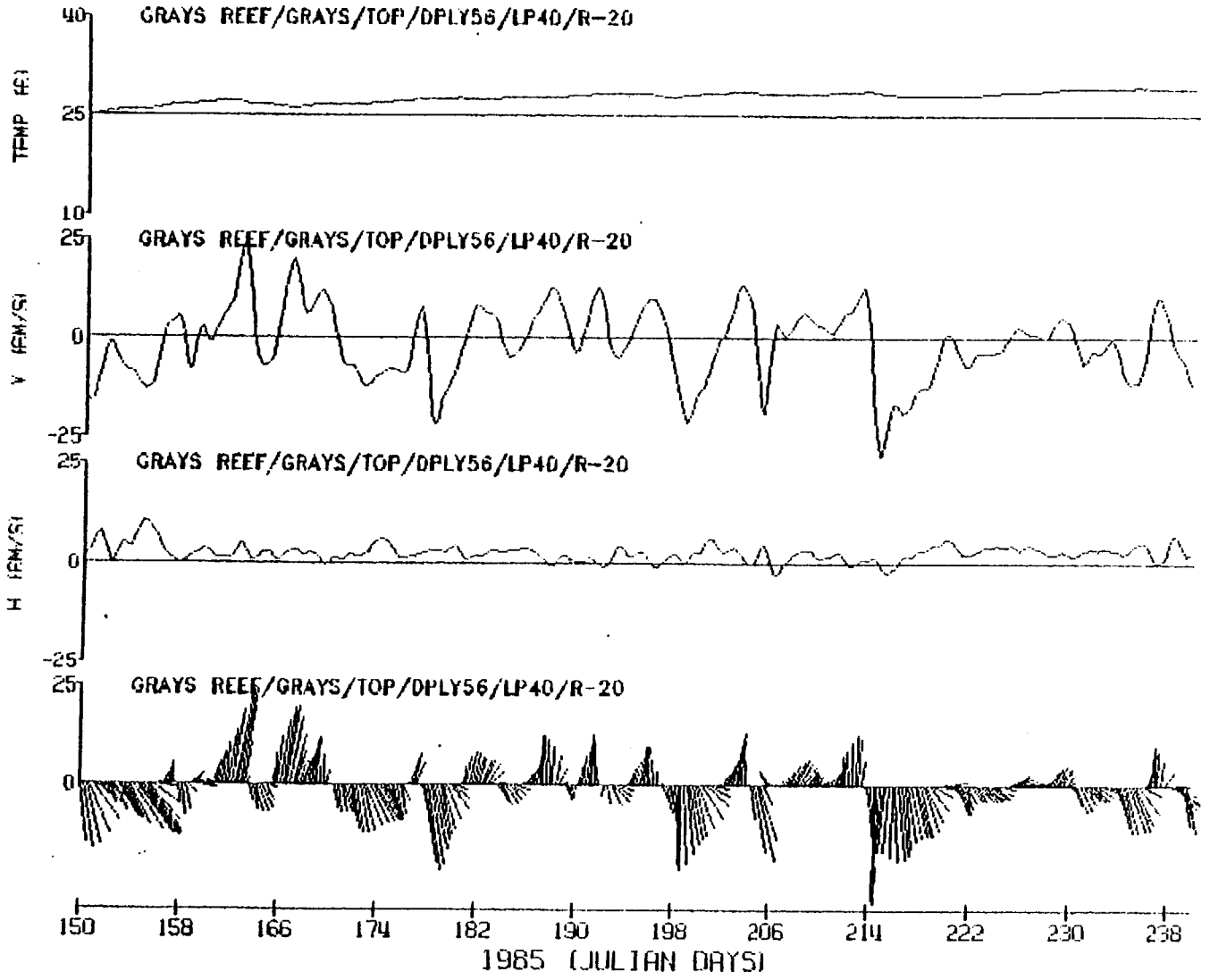
1985 (JULIAN DAYS)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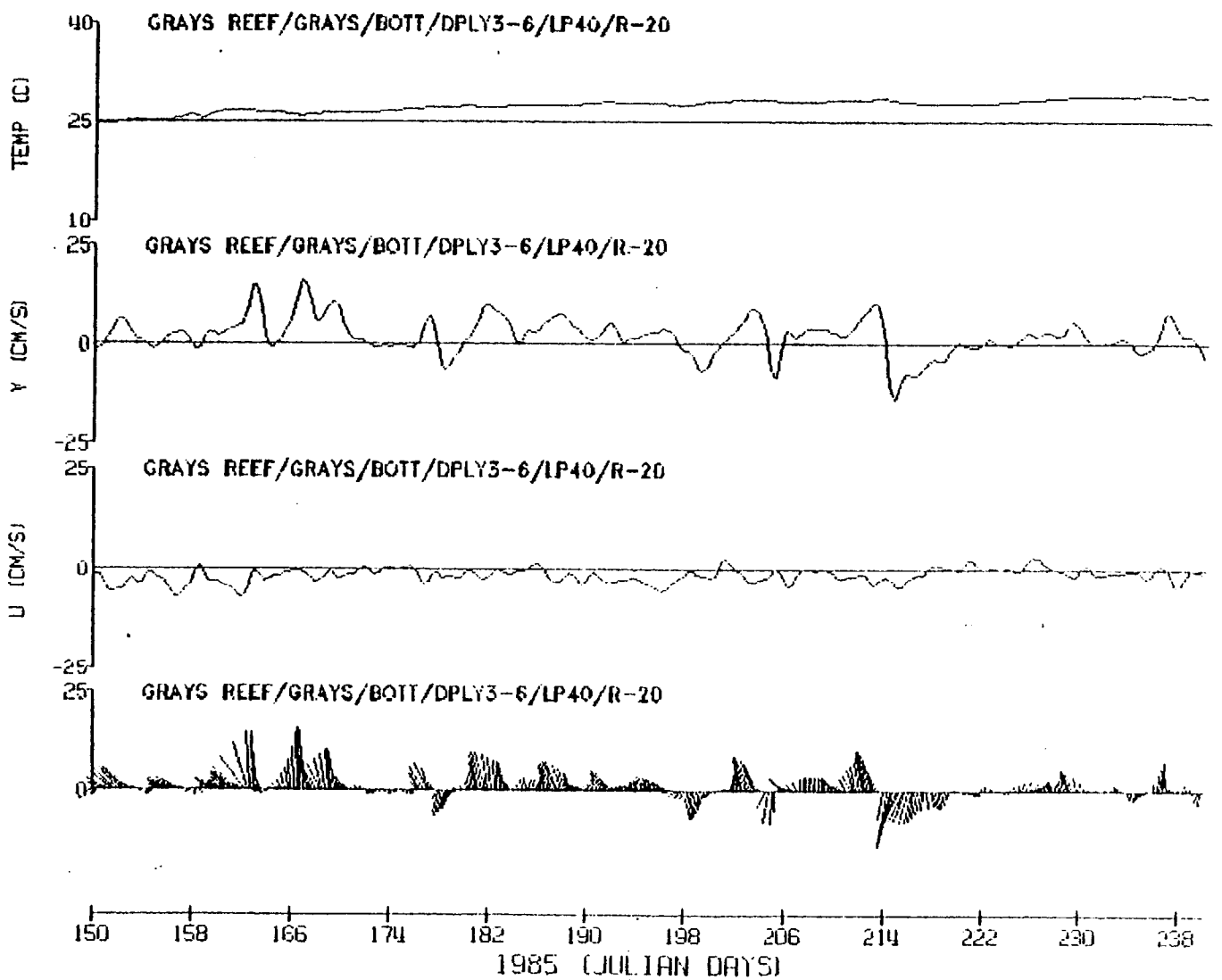
1985 (JULIAN DAYS)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U (CM/S)
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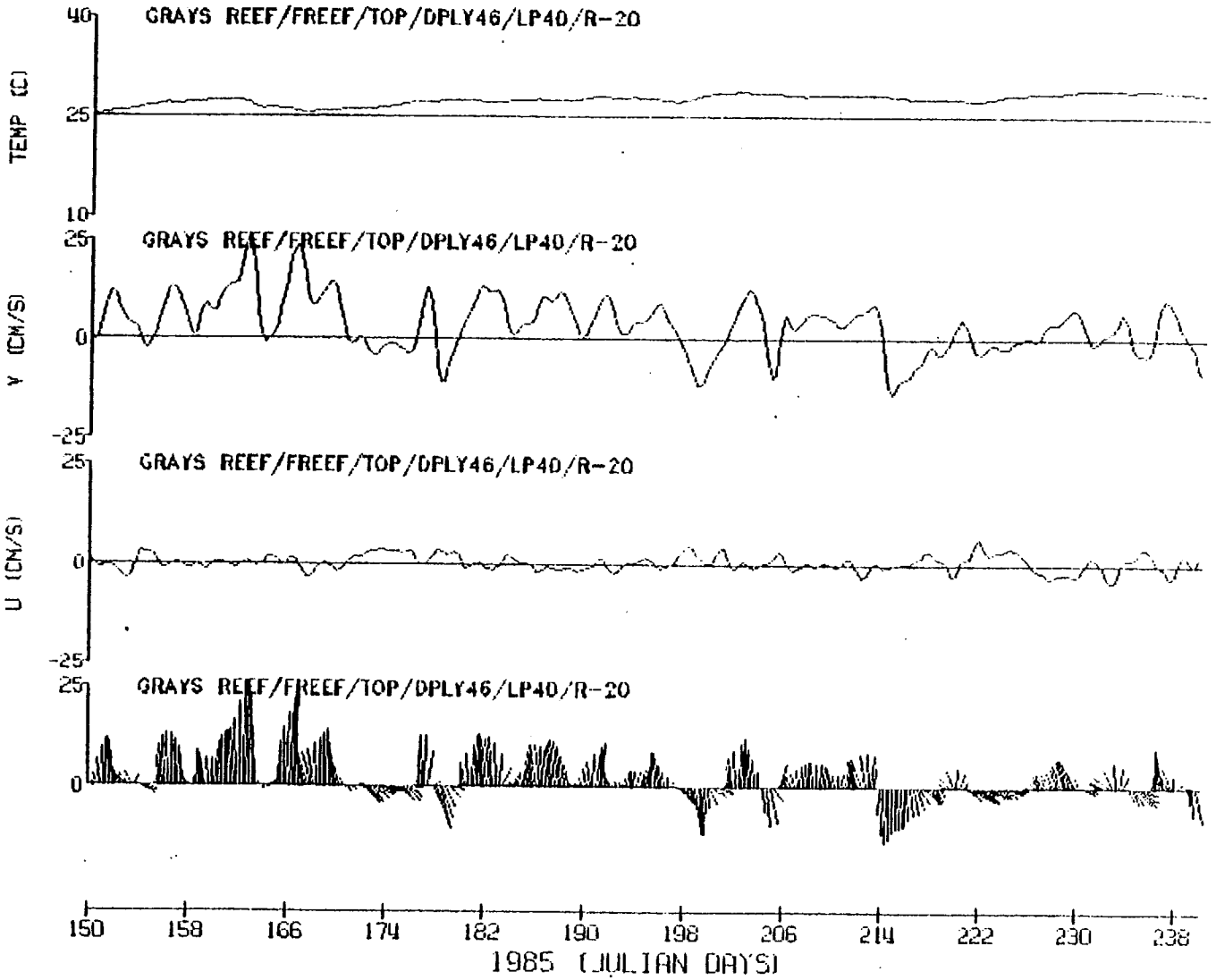
1985 (JULIAN DAYS)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GRAYS REEF/FREEF/TOP/DPLY46/LP40/R-20
U (CM/S)
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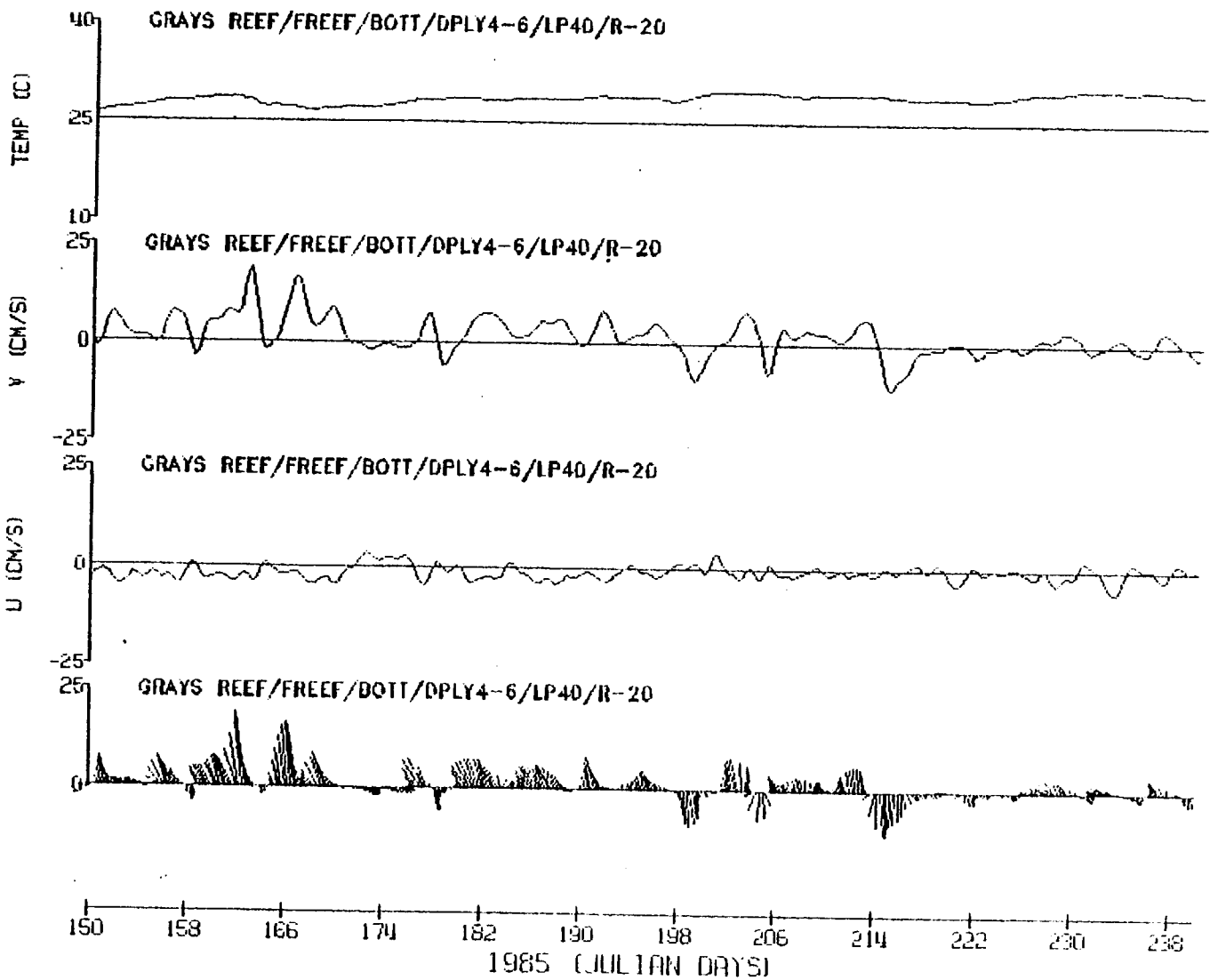
1985 (JULIAN DAYS)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U (CM/S)
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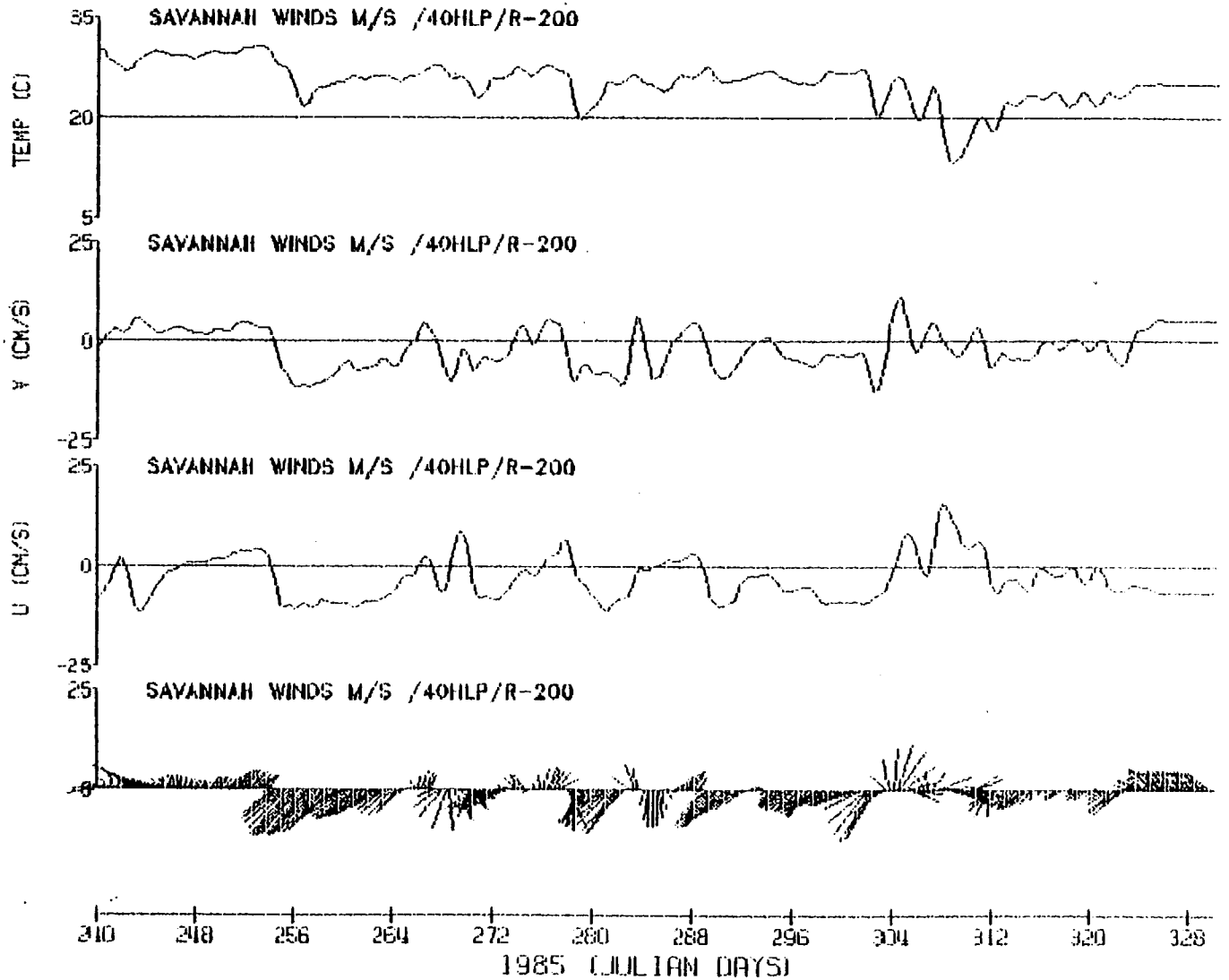
1985 (JULIAN DAYS)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TEMP (C)
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U (CM/S)
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SAVANNAH WINDS M/S /40HLP/R-200
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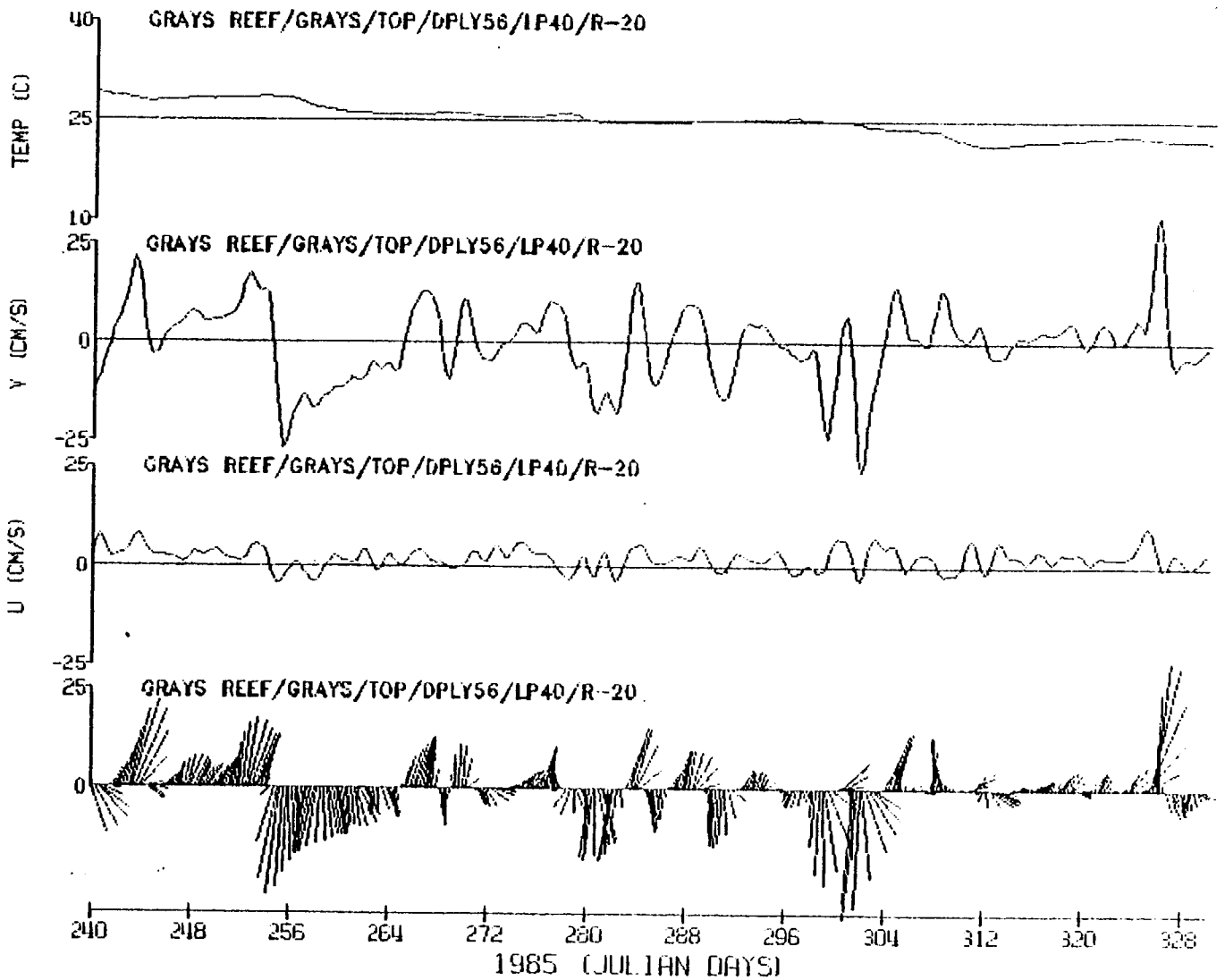
1985 (JULIAN DAYS)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U (CM/S)
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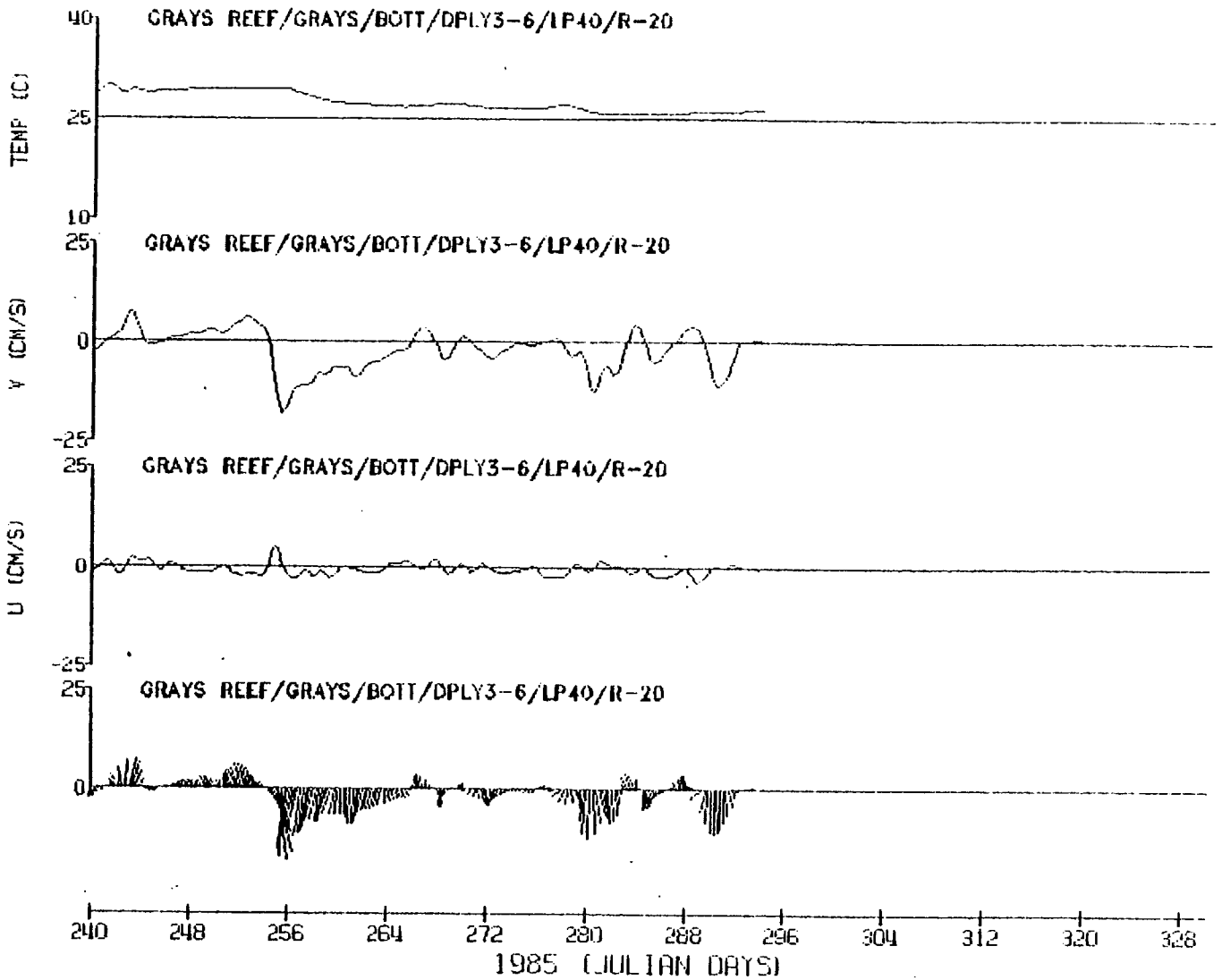
1985 (JULIAN DAYS)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U (CM/S)
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GRAYS REEF/GRAYS/BOTT/DPLY3-6/LP40/R-20
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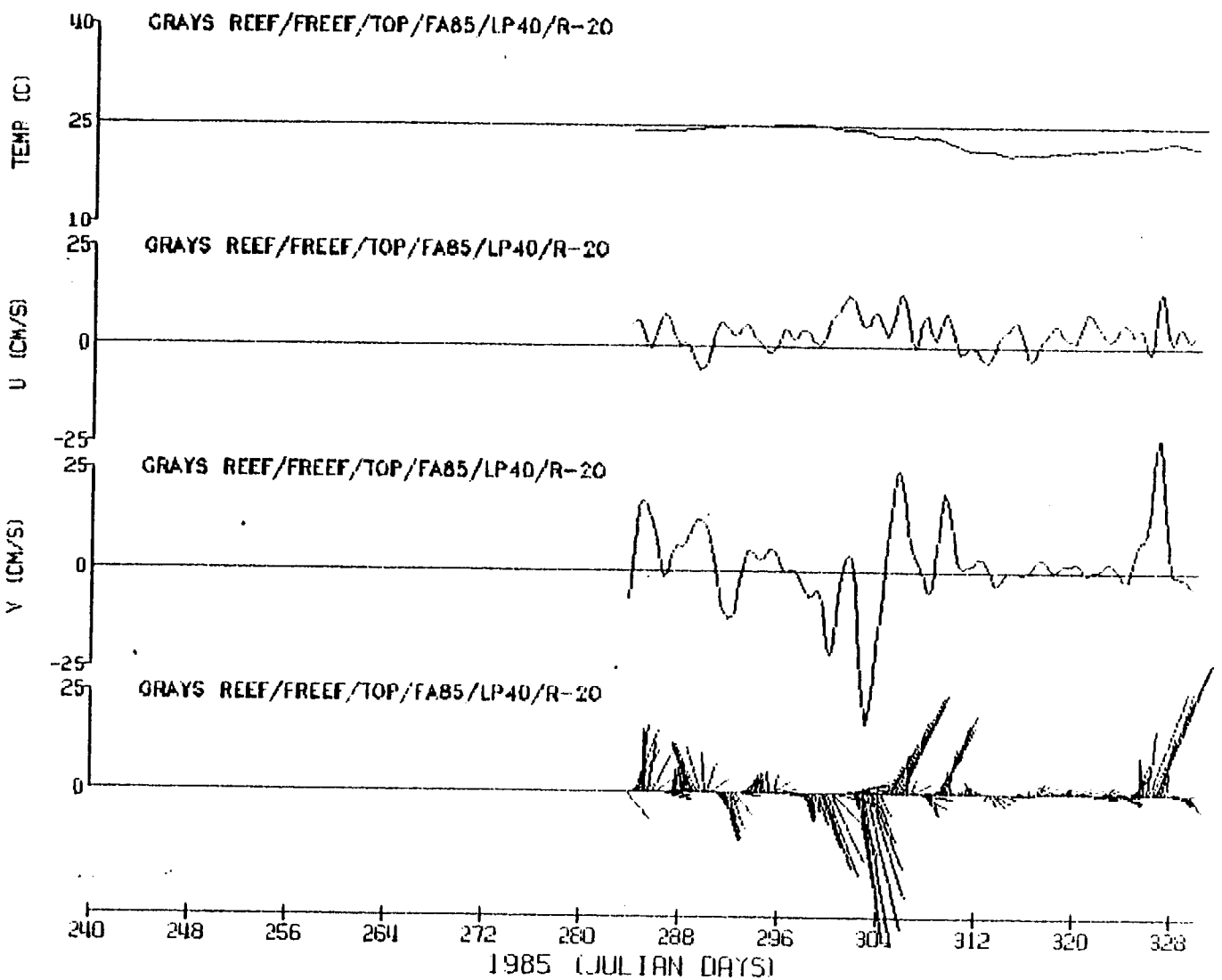
1985 (JULIAN DAYS)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GRAYS REEF/FREEF/TOP/FA85/LP40/R-20
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GRAYS REEF/FREEF/TOP/FA85/LP40/R-20
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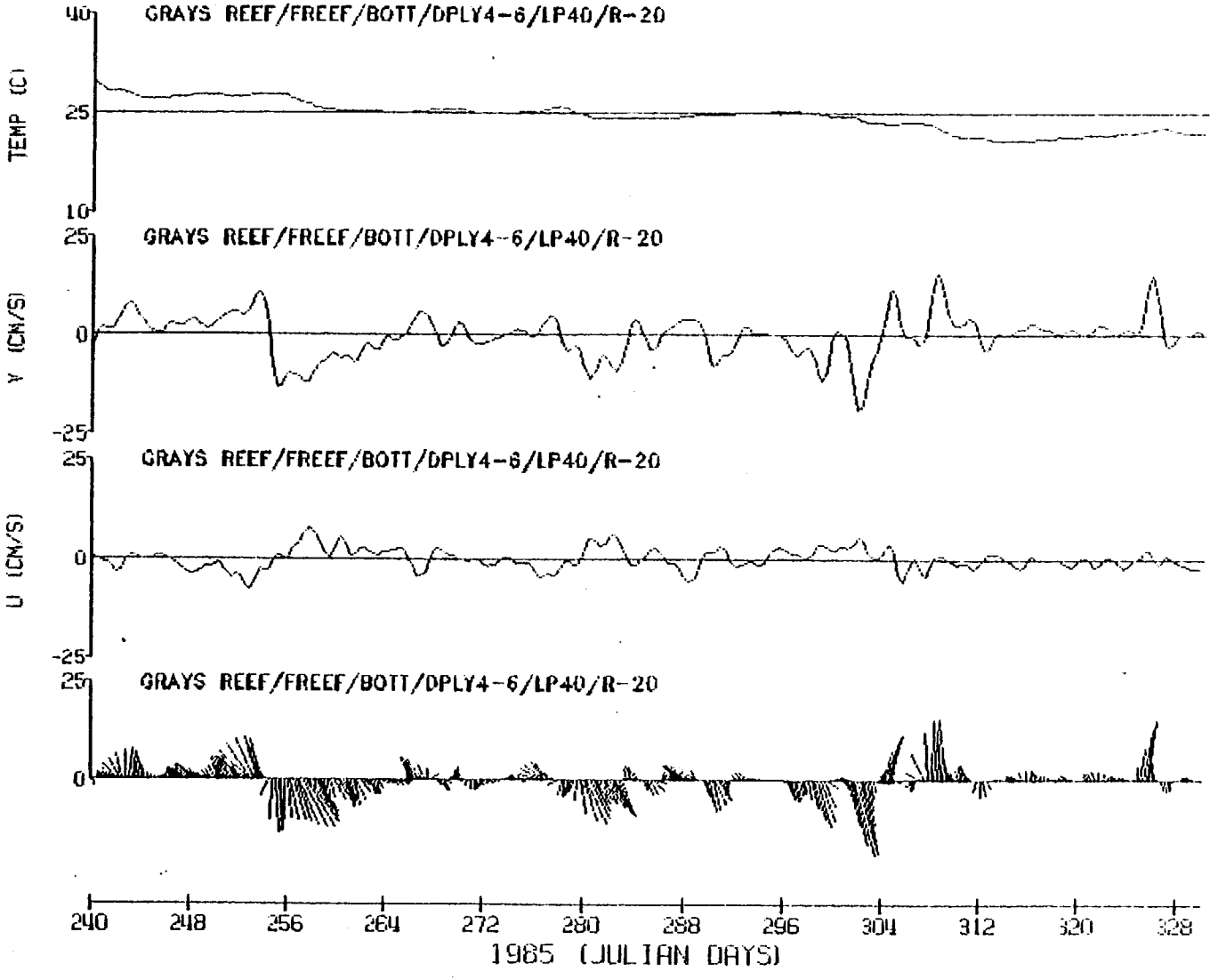
1985 (JULIAN DAYS)


GRAYS REEF/FREEF/BOTT/DPLY4-6/LP40/R-20
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GRAYS REEF/FREEF/BOTT/DPLY4-6/LP40/R-20
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GRAYS REEF/FREEF/BOTT/DPLY4-6/LP40/R-20
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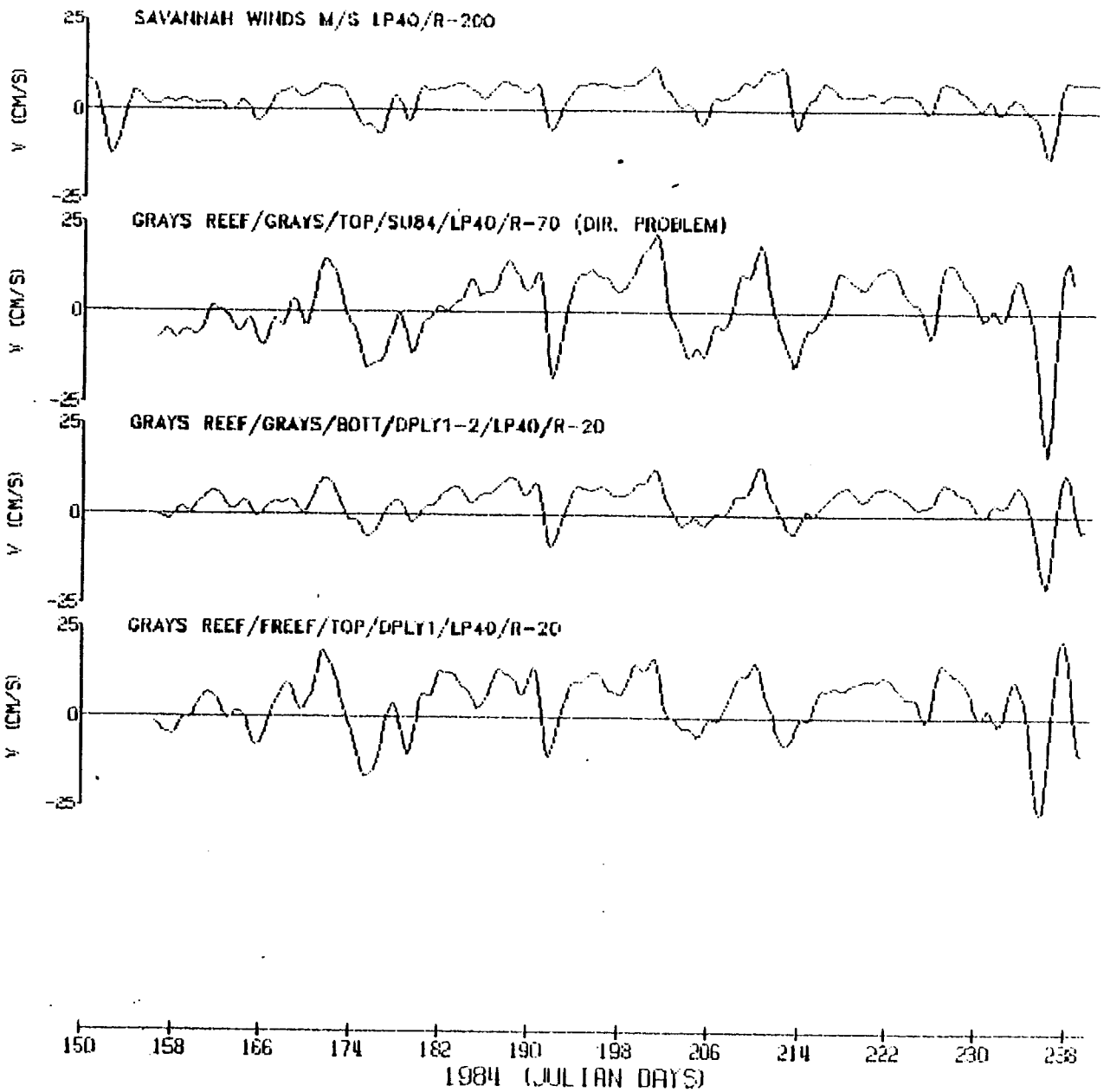
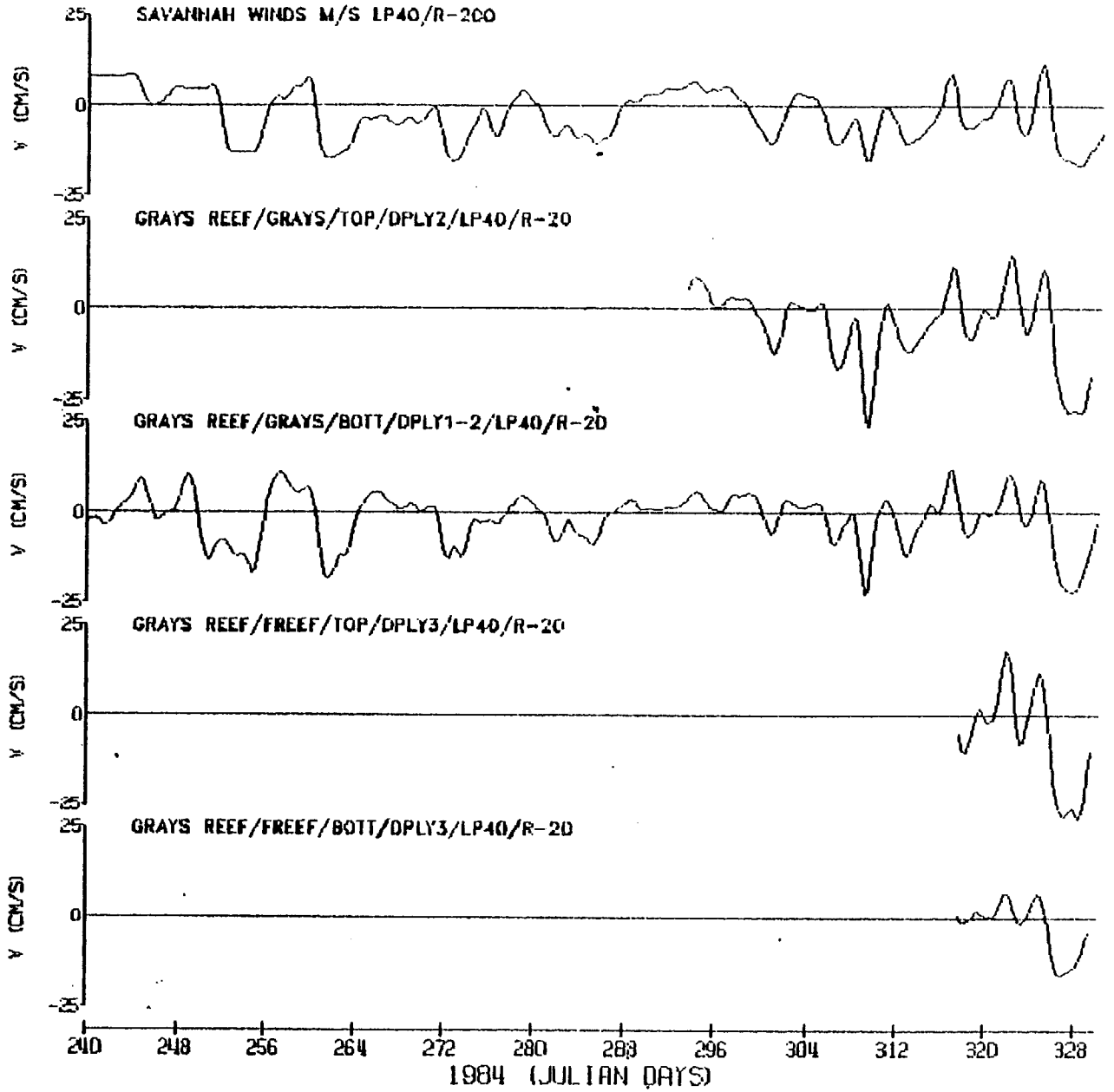
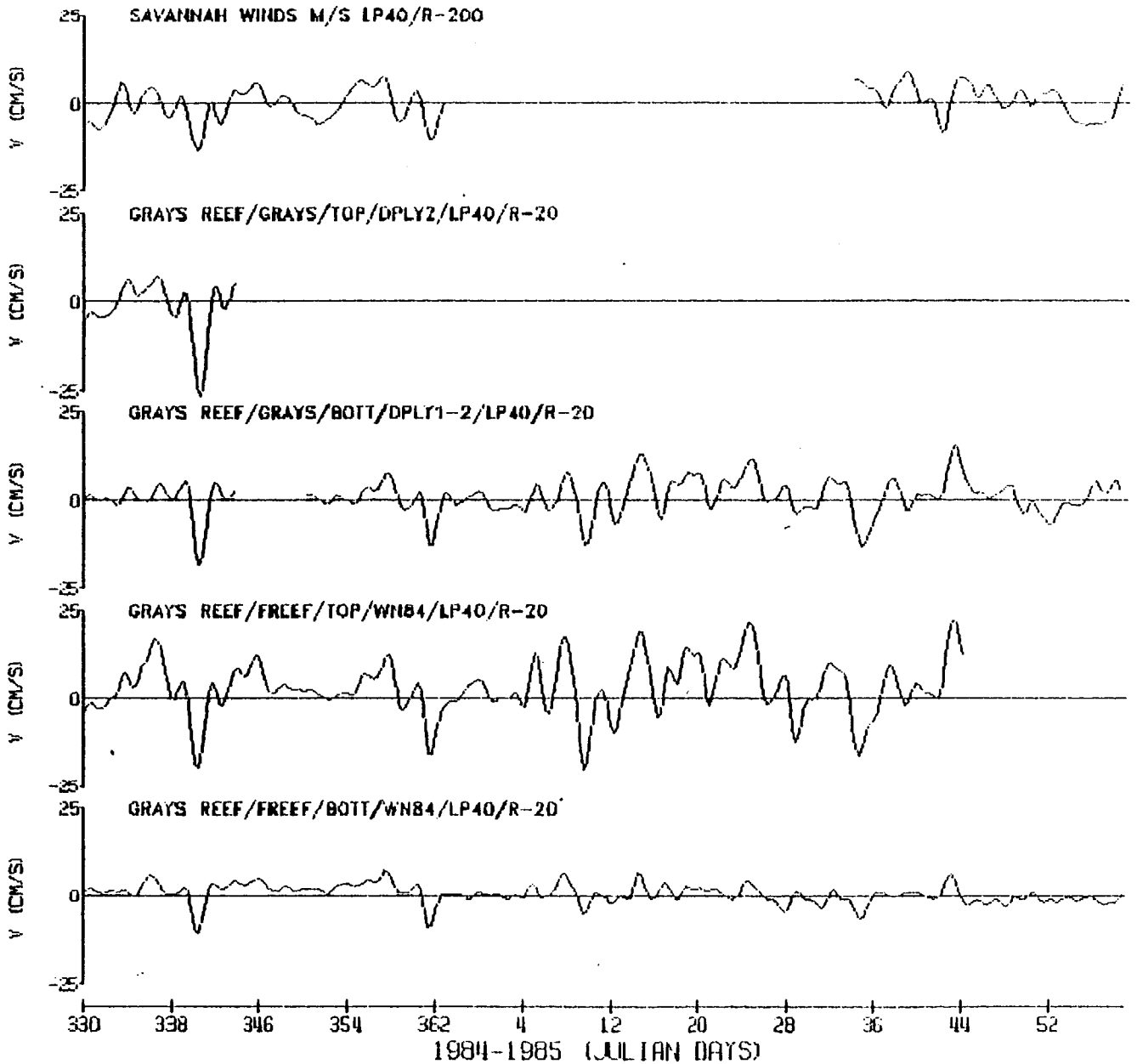
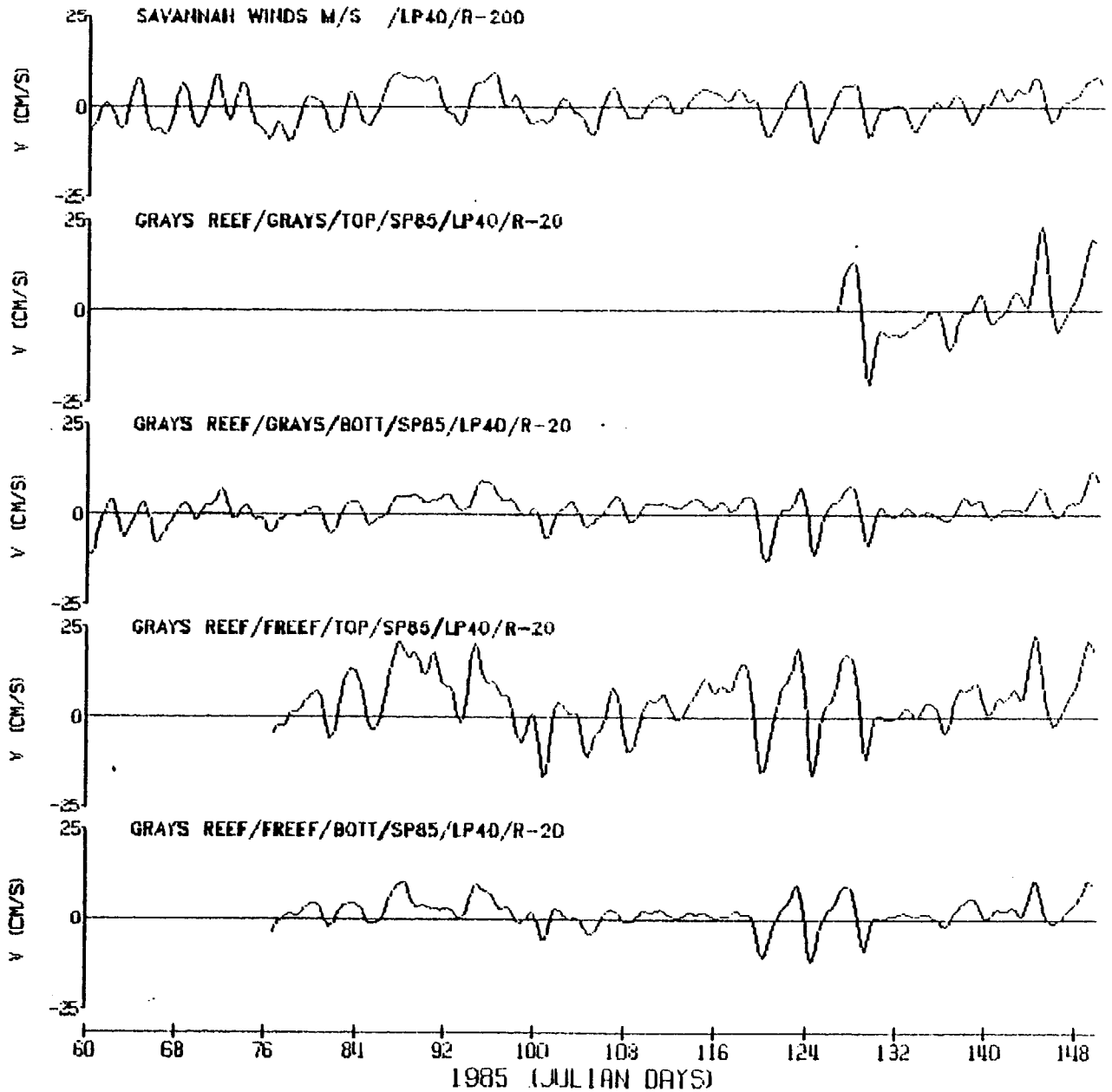
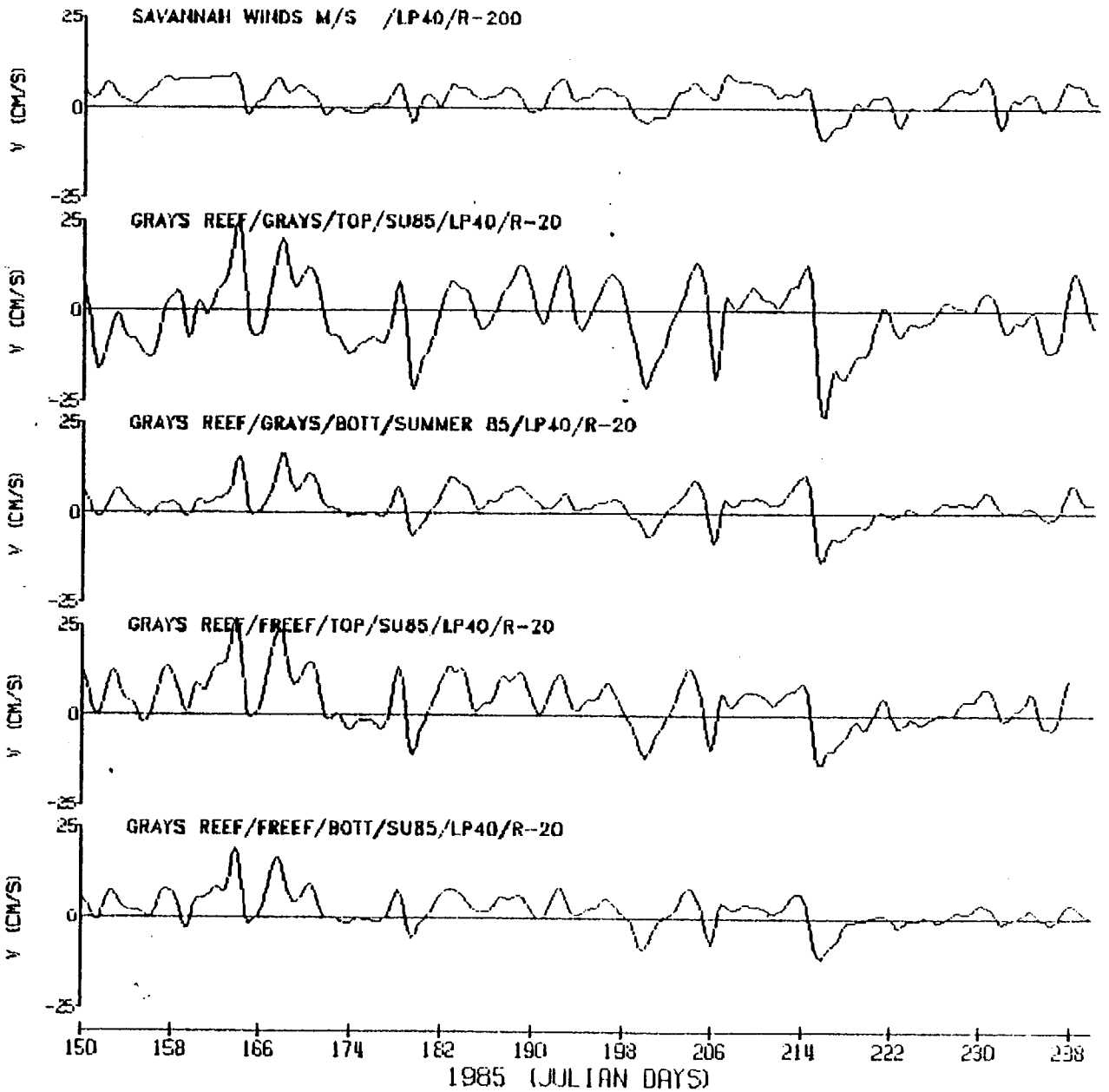
1985 (JULIAN DAYS)

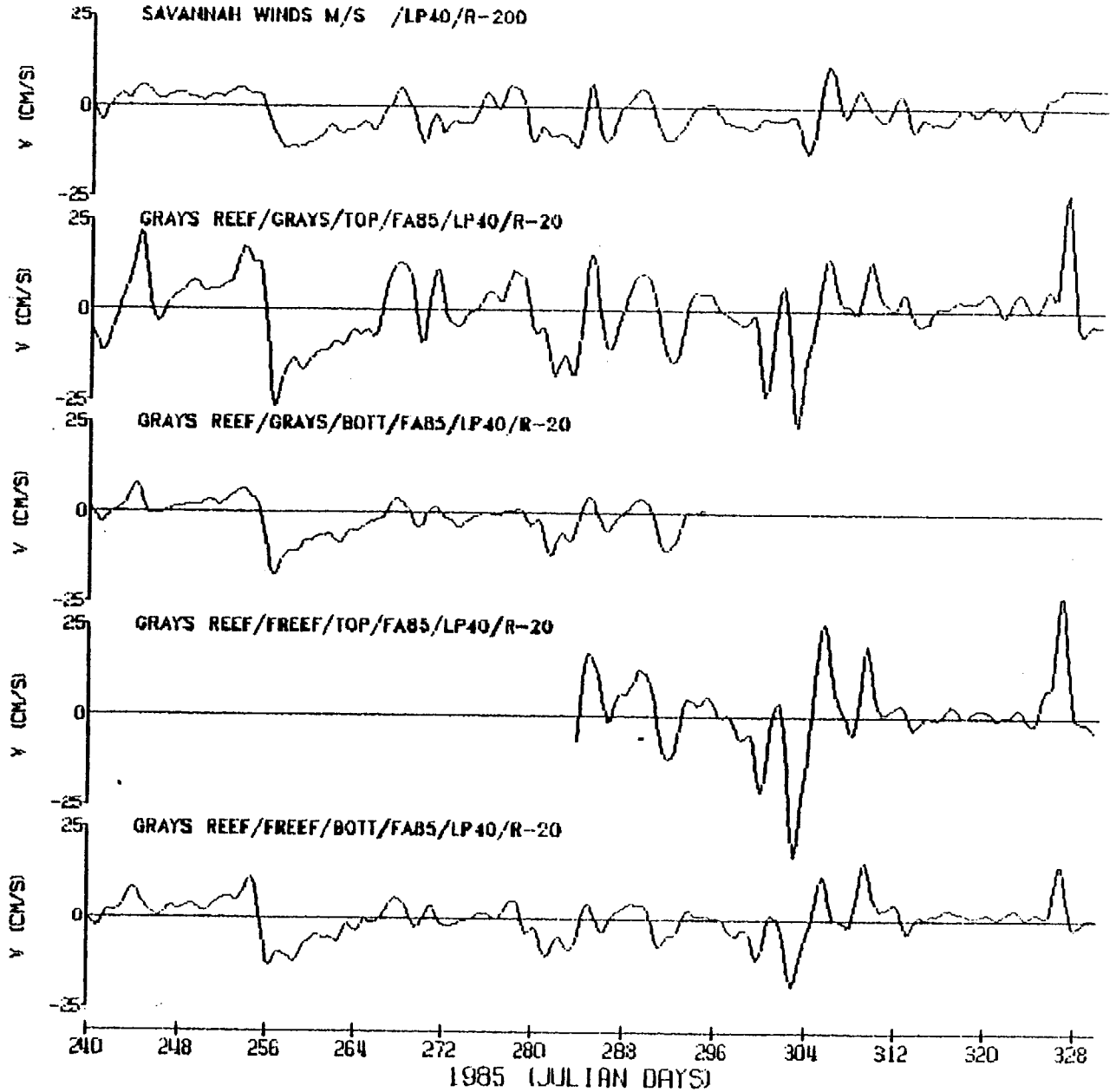

SAVANNAH WINDS M/S LP40/R-200
GRAYS REEF/GRAYS/TOP/SU84/LP40/R-70 (DIR. PROBLEM)
GRAYS REEF/GRAYS/BOTT/DPLY1-2/LP40/R-20
GRAYS REEF/FREEF/TOP/DPLY1/LP40/R-20
V (CM/S)
25
0
-25
150
158
166
174
182
190
198
206
214
222
230
238
1984 (JULIAN DAYS)


SAVANNAH WINDS M/S LP40/R-200
GRAYS REEF/GRAYS/TOP/DPLY2/LP40/R-20
GRAYS REEF/GRAYS/BOTT/DPLY1-2/LP40/R-20
GRAYS REEF/FREEF/TOP/DPLY3/LP40/R-20
GRAYS REEF/FREEF/BOTT/DPLY3/LP40/R-20
V (CM/S)
25
0
-25
240
248
256
264
272
280
288
296
304
312
320
328
1984 (JULIAN DAYS)

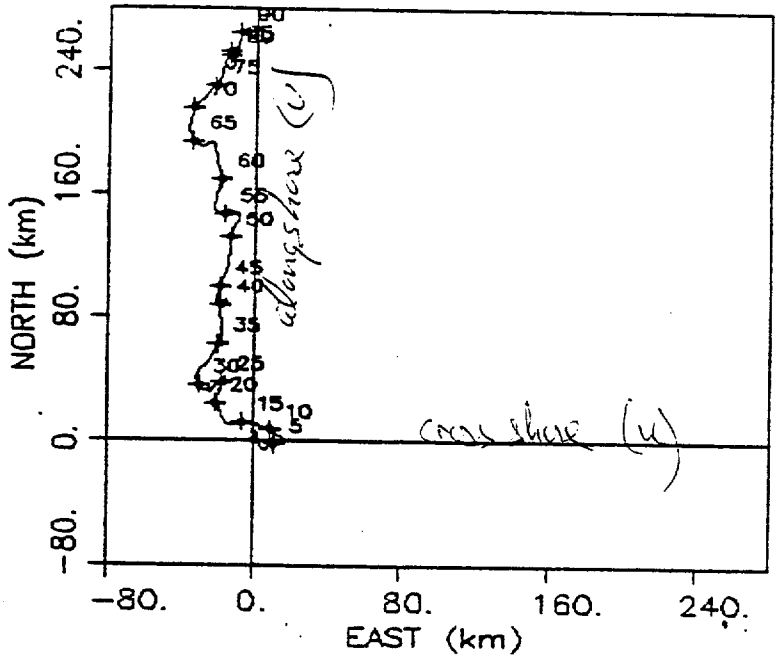

SAVANNAH WINDS M/S LP40/R-200
GRAYS REEF/GRAYS/TOP/DPLY2/LP40/R-20
GRAYS REEF/GRAYS/BOTT/DPLY1-2/LP40/R-20
GRAYS REEF/FREEF/TOP/WN84/LP40/R-20
GRAYS REEF/FREEF/BOTT/WN84/LP40/R-20
V (CM/S)
25
0
-25
330
338
346
354
362
4
12
20
28
36
44
52
1984-1985 (JULIAN DAYS)


SAVANNAH WINDS M/S /LP40/R-200
GRAYS REEF/GRAYS/TOP/SP85/LP40/R-20
GRAYS REEF/GRAYS/BOTT/SP85/LP40/R-20
GRAYS REEF/FREEF/TOP/SP85/LP40/R-20
GRAYS REEF/FREEF/BOTT/SP85/LP40/R-20
V (CM/S)
25
0
-25
60
68
76
84
92
100
108
116
124
132
140
148
1985 (JULIAN DAYS)

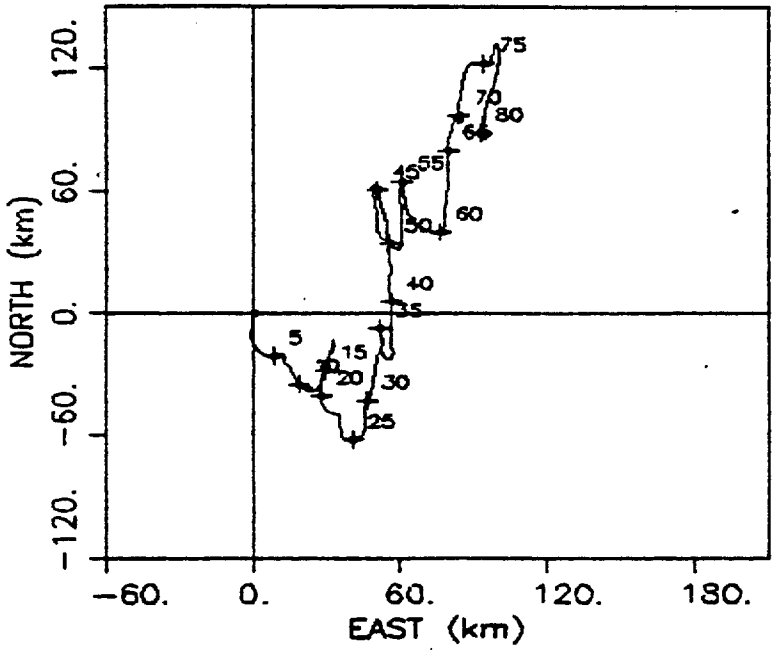

SAVANNAH WINDS M/S /LP40/R-200
GRAYS REEF/GRAYS/TOP/SU85/LP40/R-20
GRAYS REEF/GRAYS/BOTT/SUMMER 85/LP40/R-20
GRAYS REEF/FREEF/TOP/SU85/LP40/R-20
GRAYS REEF/FREEF/BOTT/SU85/LP40/R-20
V (CM/S)
25
0
-25
150
158
166
174
182
190
198
206
214
222
230
238
1985 (JULIAN DAYS)


SAVANNAH WINDS M/S /LP40/R-200
GRAYS REEF/GRAYS/TOP/FA85/LP40/R-20
GRAYS REEF/GRAYS/BOTT/FA85/LP40/R-20
GRAYS REEF/FREEF/TOP/FA85/LP40/R-20
GRAYS REEF/FREEF/BOTT/FA85/LP40/R-20
V (CM/S)
25
0
-25
240
248
256
264
272
280
288
296
304
312
320
328
1985 (JULIAN DAYS)

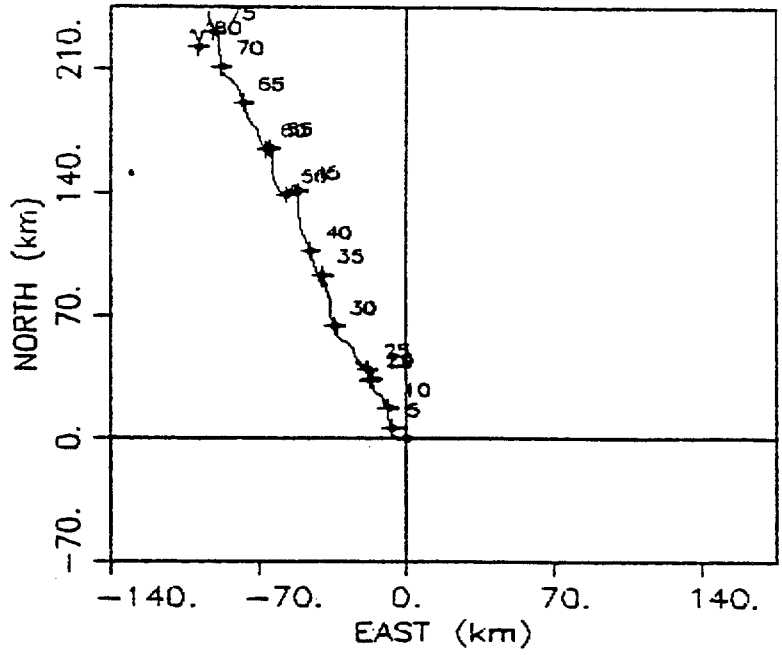
SAVANNAH WINDS M/S /SU84/LP40/R-200
DEPTH .0 M.
LAT= 0 DEG, .00 MIN N
LONG= 0 DEG, .00 MIN W
NO. OF POINTS= 360
DELTA T: 6.00 HOURS
BEGINNING: 1984 MAY29(150), 0 OZ 0. 0
ENDING: 1984 AUG26(239),18 OZ 0. 0



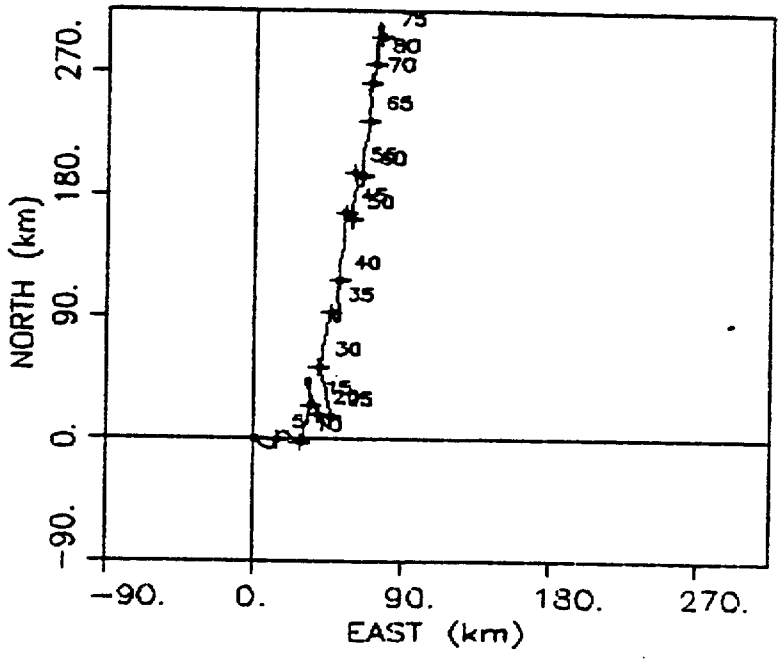
GRAYS REEF/GRAYS/TOP/SU84/LP40/R-70 (DIR. PROBLEM)
DEPTH 6.1 M.
LAT= 31 DEG, 24.00 MIN N
LONG= 80 DEG, 52.10 MIN W
NO. OF POINTS= 327
DELTA T: 6.00 HOURS
BEGINNING: 1984 JUN 4(156),12 OZ 0. 0
ENDING: 1984 AUG25(238), 0 OZ 0. 0



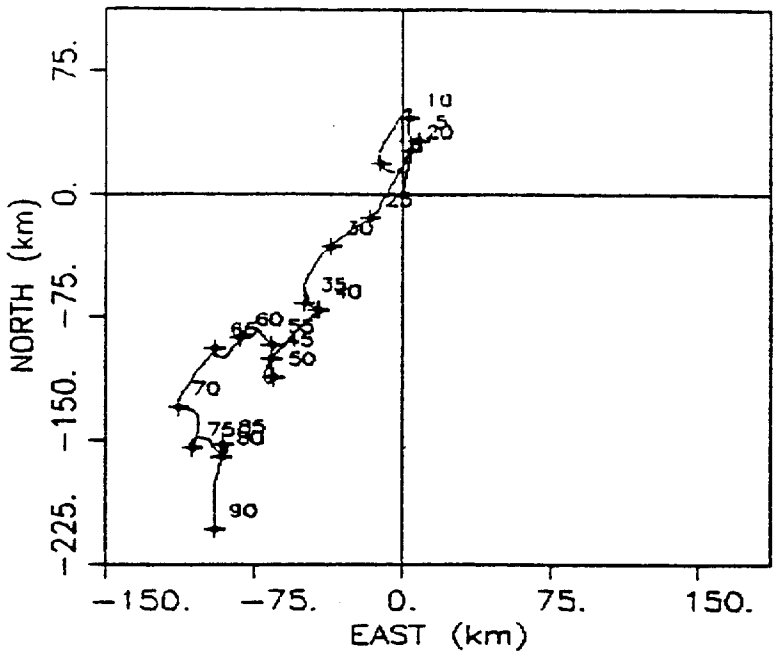
GRAYS REEF/GRAYS/BOTT/SU84/LP40R/R-20
DEPTH 15.2 M.
LAT= 31 DEG, 24.00 MIN N
LONG= 80 DEG, 52.10 MIN W
NO. OF POINTS= 332
DELTA T: 6.00 HOURS
BEGINNING: 1984 JUN 4(156),12 GZ 0. 0
ENDING: 1984 AUG26(239), 6 GZ 0. 0



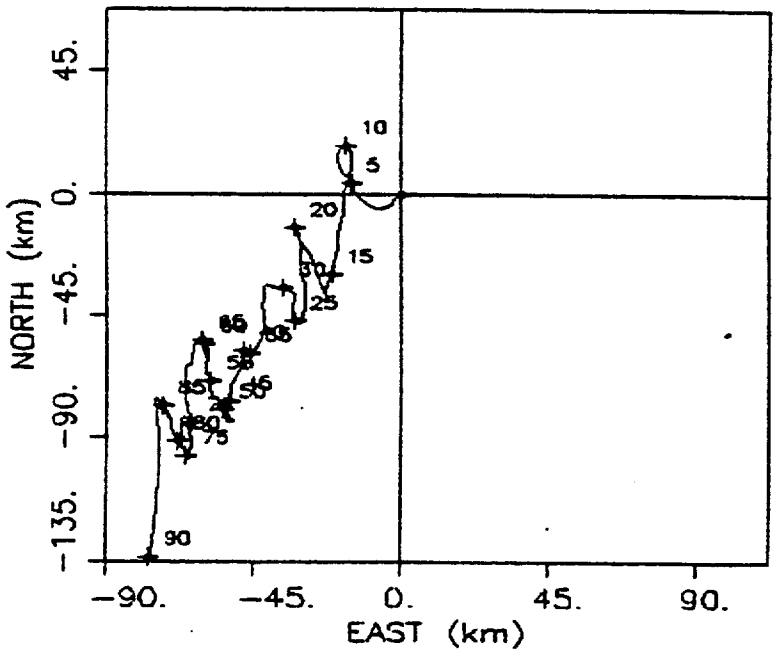
GRAYS REEF/FREEF/TOP/SU84/LP40/R-20
DEPTH 13.7 M.
LAT= 31 DEG, 5.90 MIN N
LONG= 81 DEG, 12.50 MIN W
NO. OF POINTS= 332
DELTA T: 6.00 HOURS
BEGINNING: 1984 JUN 4(156),12 GZ 0. 0
ENDING: 1984 AUG26(239), 6 GZ 0. 0



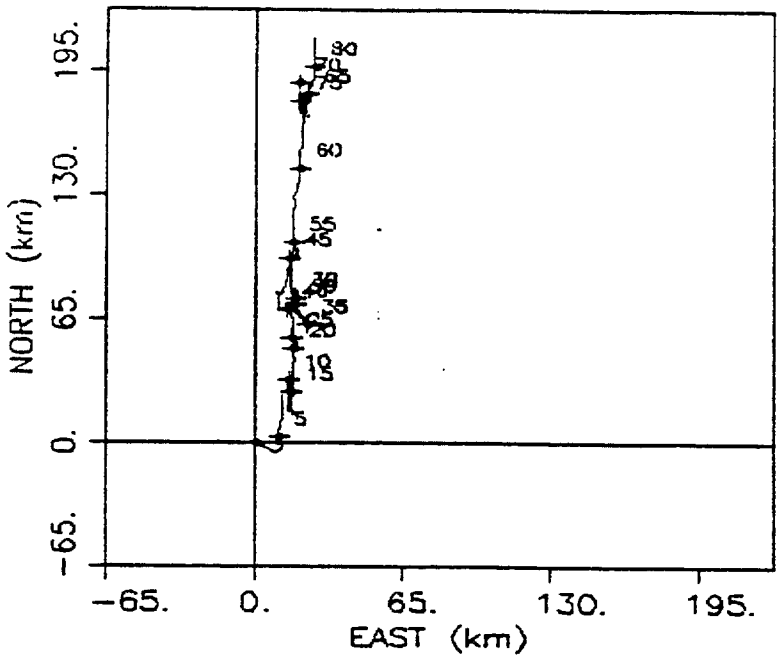
SAVANNAH WINDS M/S /FA84/LP40/R-200
DEPTH .0 M.
LAT= 0 DEG, .00 MIN N
LONG= 0 DEG, .00 MIN W
NO. OF POINTS= 360
DELTA T: 6.00 HOURS
BEGINNING: 1984 AUG27(240), 0 OZ 0. 0
ENDING: 1984 NOV24(329),18 OZ 0. 0



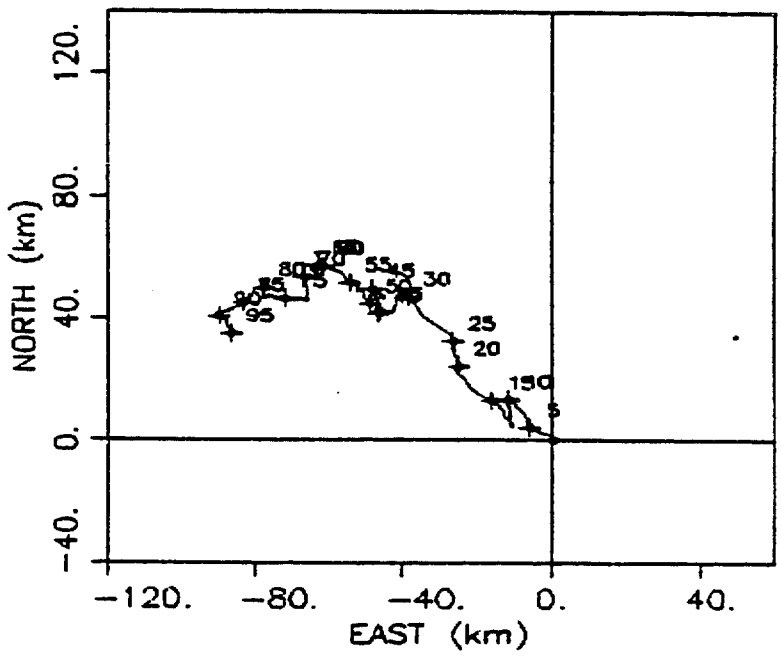
GRAYS REEF/GRAYS/BOTT/FA84/SP40/R-20
DEPTH 15.2 M.
LAT= 31 DEG, 24.00 MIN N
LONG= 80 DEG, 52.10 MIN W
NO. OF POINTS= 360
DELTA T: 6.00 HOURS
BEGINNING: 1984 AUG27(240), 0 OZ 0. 0
ENDING: 1984 NOV24(329),18 OZ 0. 0



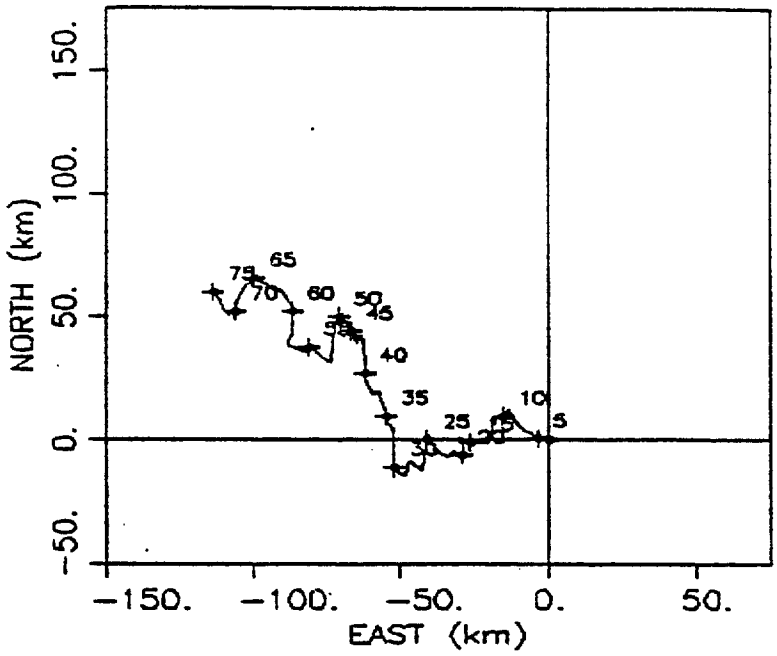
GRAYS REEF/FREEF/TOP/WN84/LP40/R-20
DEPTH 7.6 M.
LAT= 31 DEG, 5.90 MIN N
LONG= 81 DEG, 13.50 MIN W
NO. OF POINTS= 324
DELTA T: 6.00 HOURS
BEGINNING: 1984 NOV25(330), 0 OZ 0. 0
ENDING: 1985 FEB13(44),18 OZ 0. 0



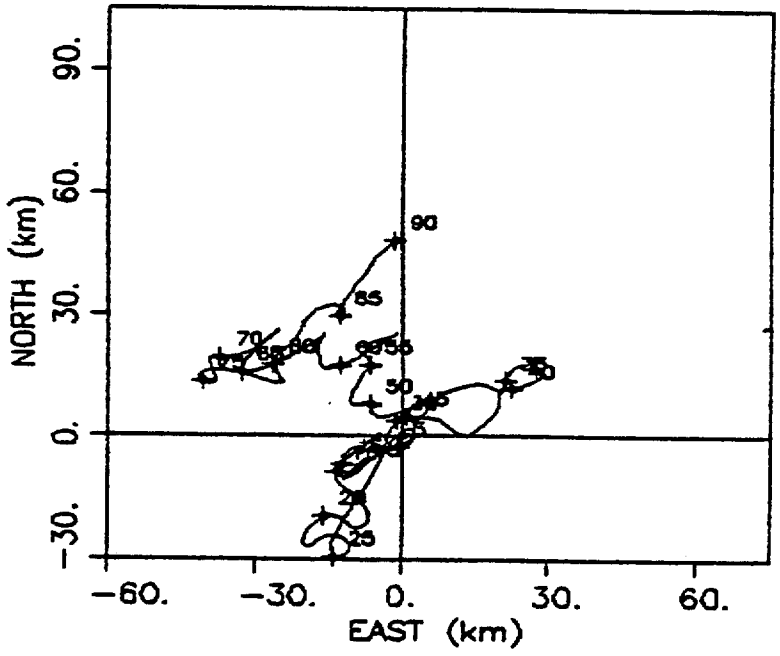
GRAYS REEF/FREEF/BOTT/WN84/LP40/R-20
DEPTH 10.7 M.
LAT= 31 DEG, 5.90 MIN N
LONG= 81 DEG, 13.50 MIN W
NO. OF POINTS= 384
DELTA T: 6.00 HOURS
BEGINNING: 1984 NOV25(330), 0 OZ 0. 0
ENDING: 1985 FEB28(59),18 OZ 0. 0



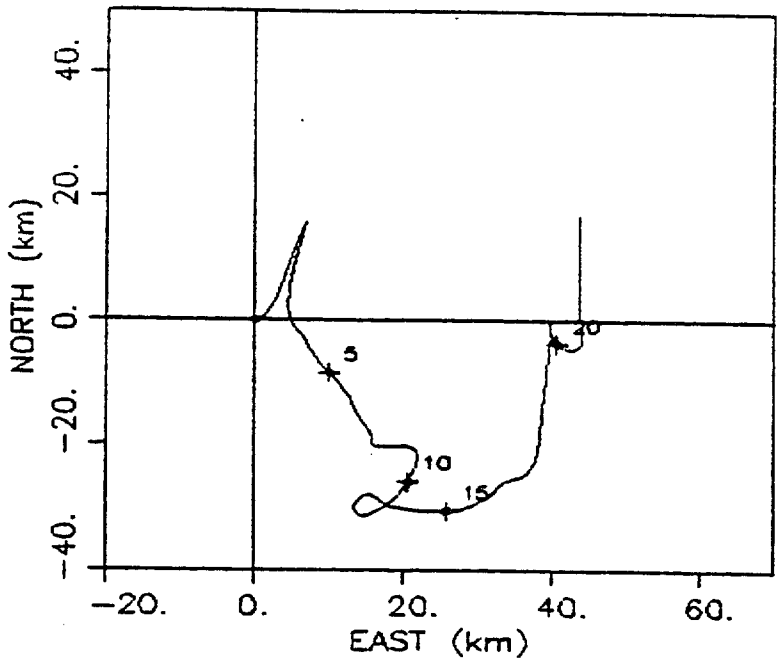
GRAYS REEF/GRAYS/BOTT/WN84/LP40/R-20
DEPTH 15.2 M.
LAT= 31 DEG, 24.00 MIN N
LONG= 80 DEG, 52.10 MIN W
NO. OF POINTS= 300
DELTA T: 6.00 HOURS
BEGINNING: 1984 DEC15(350),12 OZ 0. 0
ENDING: 1985 FEB28(59), 6 OZ 0. 0



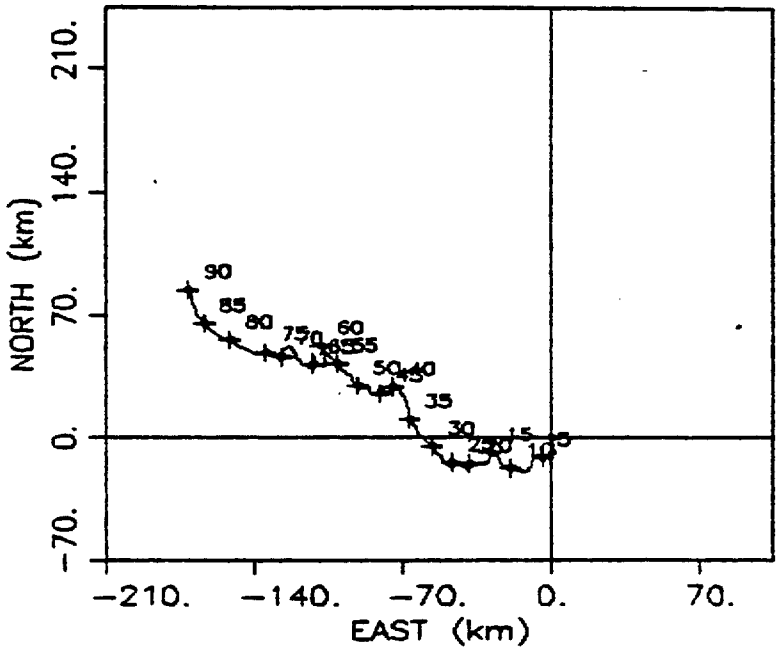
SAVANNAH WINDS M/S /40HLP/R-200
DEPTH .0 M.
LAT= 0 DEG, .00 MIN N
LONG= 0 DEG, .00 MIN W
NO. OF POINTS= 360
DELTA T: 6.00 HOURS
BEGINNING: 1985 MAR 2(61), 3 OZ 0. 0
ENDING: 1985 MAY30(150),21 OZ 0. 0



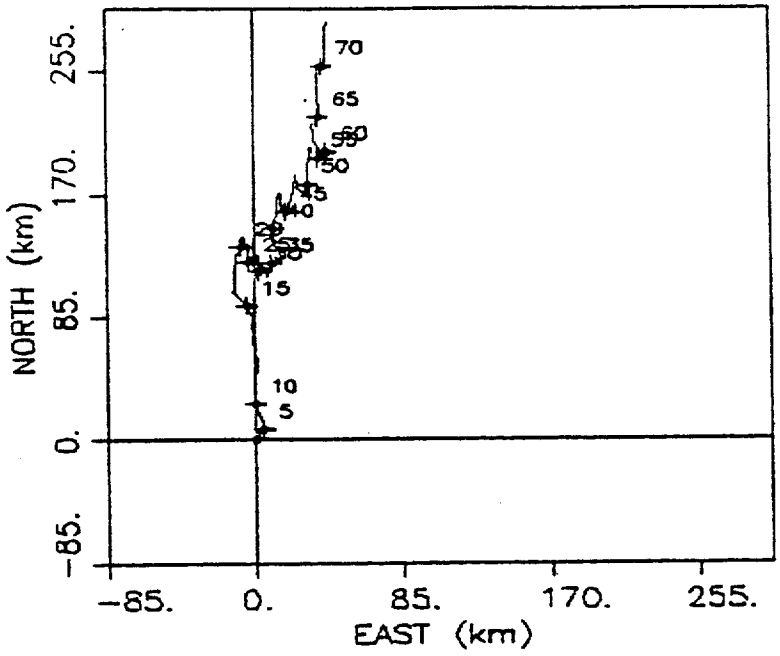
GRAYS REEF/GRAYS/TOP/SP85/LP40/R-20
DEPTH 6.1 M.
LAT= 31 DEG. 24.00 MIN N
LONG= 80 DEG. 52.10 MIN W
NO. OF POINTS= 92
DELTA T: 6.00 HOURS
BEGINNING: 1985 MAY 6(126),12 OZ 0. 0
ENDING: 1985 MAY29(149), 6 OZ 0. 0



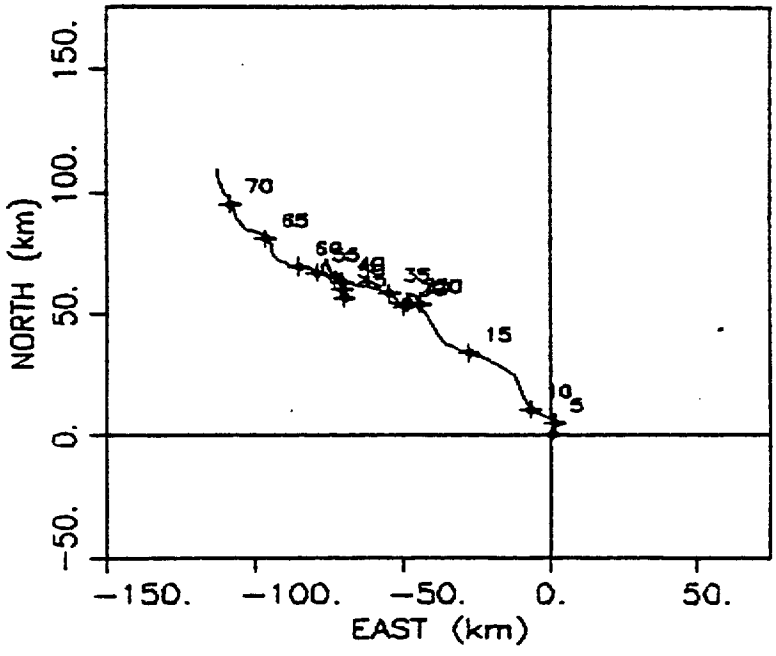
GRAYS REEF/GRAYS/BOTT/SP85/LP40/R-20
DEPTH 15.2 M.
LAT= 31 DEG. 24.00 MIN N
LONG= 80 DEG. 52.10 MIN W
NO. OF POINTS= 360
DELTA T: 6.00 HOURS
BEGINNING: 1985 MAR 1(60), 0 OZ 0. 0
ENDING: 1985 MAY29(149),18 OZ 0. 0



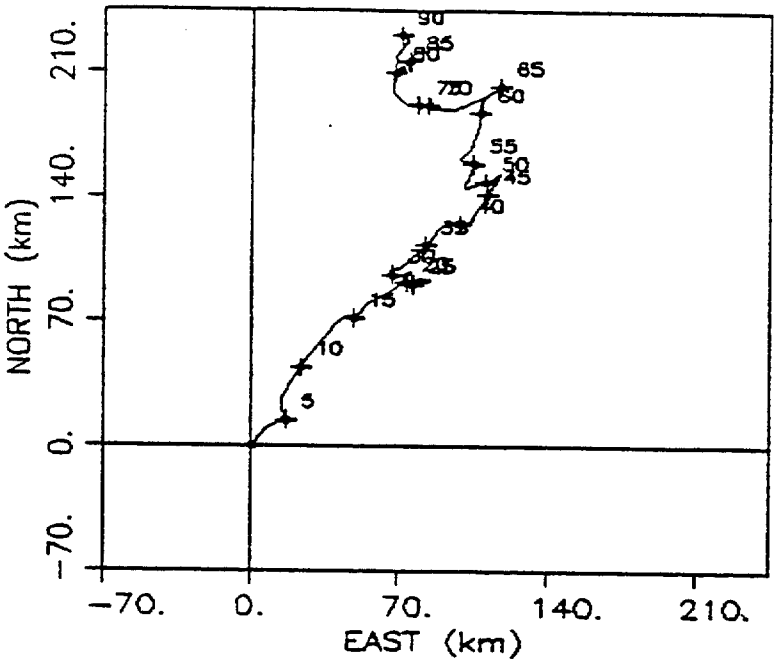
GRAYS REEF/FREEF/TOP/SP85/LP40/R-20
DEPTH 7.6 M.
LAT= 31 DEG, 5.00 MIN N
LONG= 81 DEG, 13.50 MIN W
NO. OF POINTS= 292
DELTA T: 6.00 HOURS
BEGINNING: 1985 MAR17(76),18 OZ 0. 0
ENDING: 1985 MAY29(149),12 OZ 0. 0



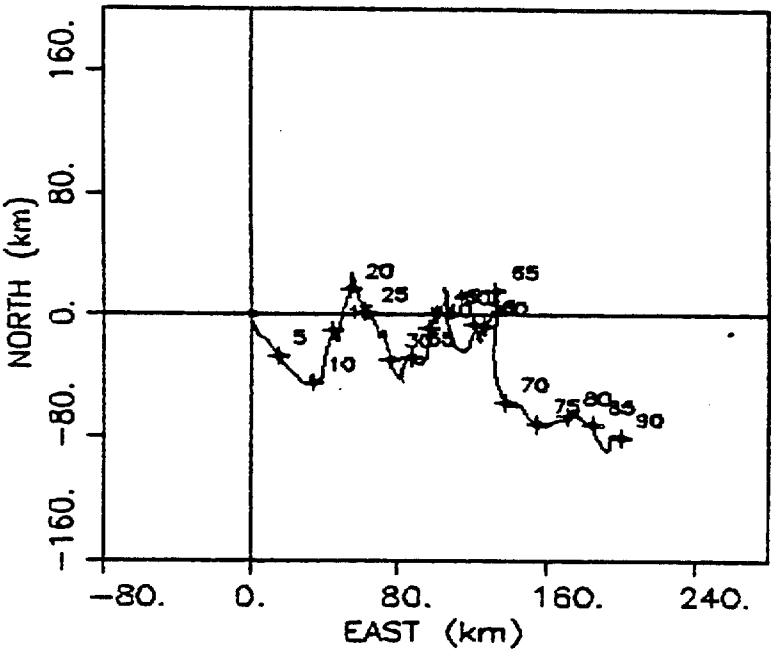
GRAYS REEF/FREEF/BOTT/SP85/LP40/R-20
DEPTH 10.7 M.
LAT= 31 DEG, 5.90 MIN N
LONG= 81 DEG, 13.50 MIN W
NO. OF POINTS= 292
DELTA T: 6.00 HOURS
BEGINNING: 1985 MAR17(76),18 OZ 0. 0
ENDING: 1985 MAY29(149),12 OZ 0. 0



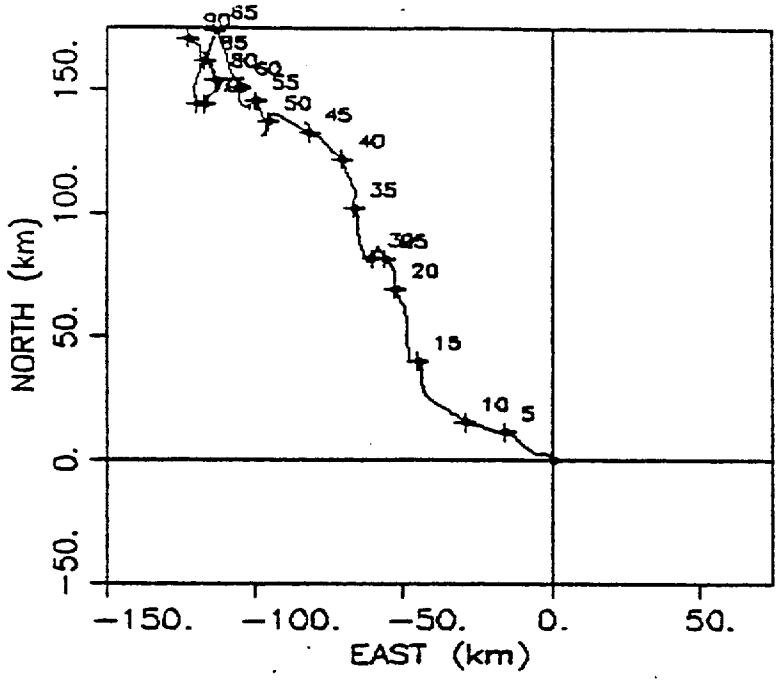
SAVANNAH WINDS M/S/SUMMER 85/LP40/R-200
DEPTH .0 M.
LAT= 0 DEG, .00 MIN N
LONG= 0 DEG, .00 MIN W
NO. OF POINTS= 360
DELTA T: 6.00 HOURS
BEGINNING: 1985 MAY30(150), 0 OZ 0. 0
ENDING: 1985 AUG27(239),18 OZ 0. 0



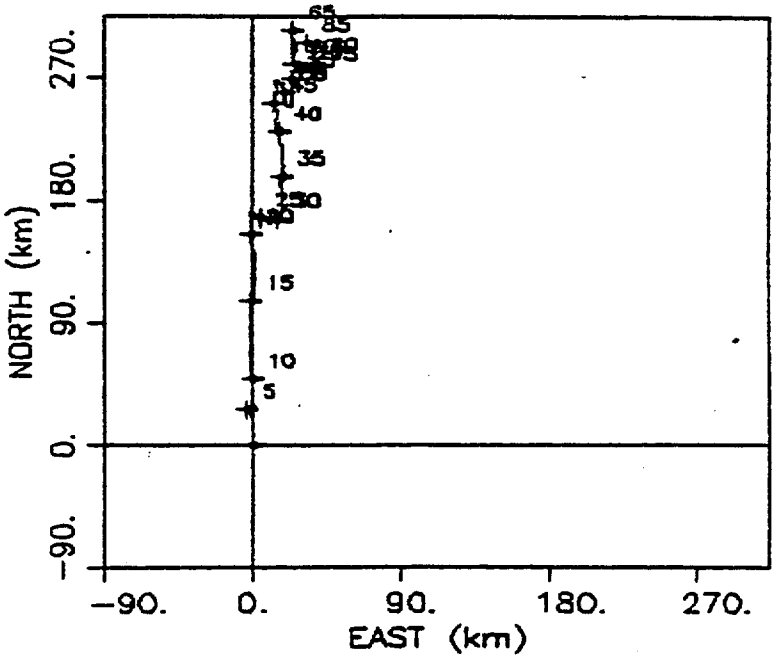
GRAYS REEF/GRAYS/TOP/SU85/LP40/R-20
DEPTH 6.1 M.
LAT= 31 DEG, 24.00 MIN N
LONG= 80 DEG, 52.10 MIN W
NO. OF POINTS= 360
DELTA T: 6.00 HOURS
BEGINNING: 1985 MAY30(150), 0 OZ 0. 0
ENDING: 1985 AUG27(239),18 OZ 0. 0



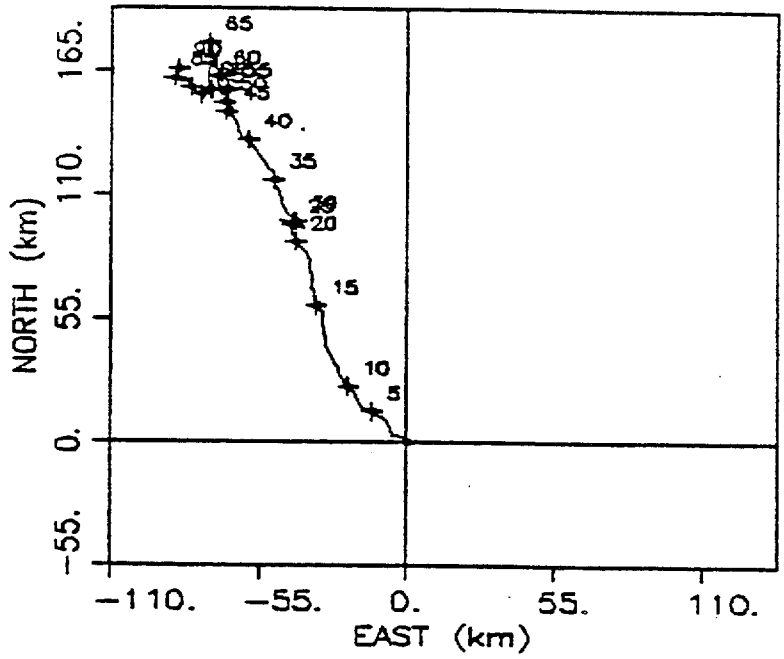
GRAYS REEF/GRAYS/BOTT/SUMMER 85/LP40/R-20
DEPTH 15.2 M.
LAT= 31 DEG, 24.00 MIN N
LONG= 80 DEG, 52.10 MIN W
NO. OF POINTS= 360
DELTA T: 6.00 HOURS
BEGINNING: 1985 MAY30(150), 0 GZ 0. 0
ENDING: 1985 AUG27(239),18 GZ 0. 0



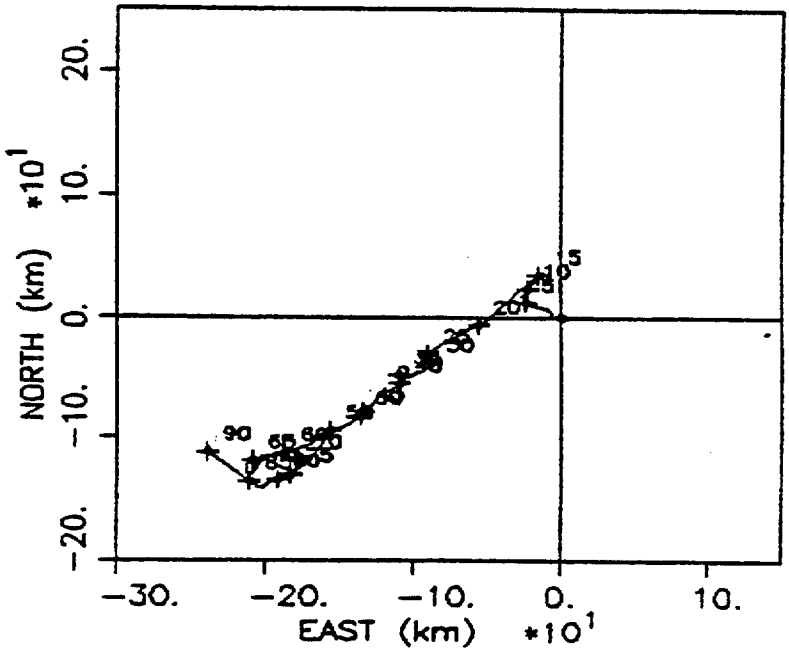
GRAYS REEF/FREEF/TOP/SU85/LP40/R-20
DEPTH 7.6 M.
LAT= 31 DEG, 5.00 MIN N
LONG= 81 DEG, 13.50 MIN W
NO. OF POINTS= 352
DELTA T: 6.00 HOURS
BEGINNING: 1985 MAY30(150), 0 GZ 0. 0
ENDING: 1985 AUG25(237),18 GZ 0. 0



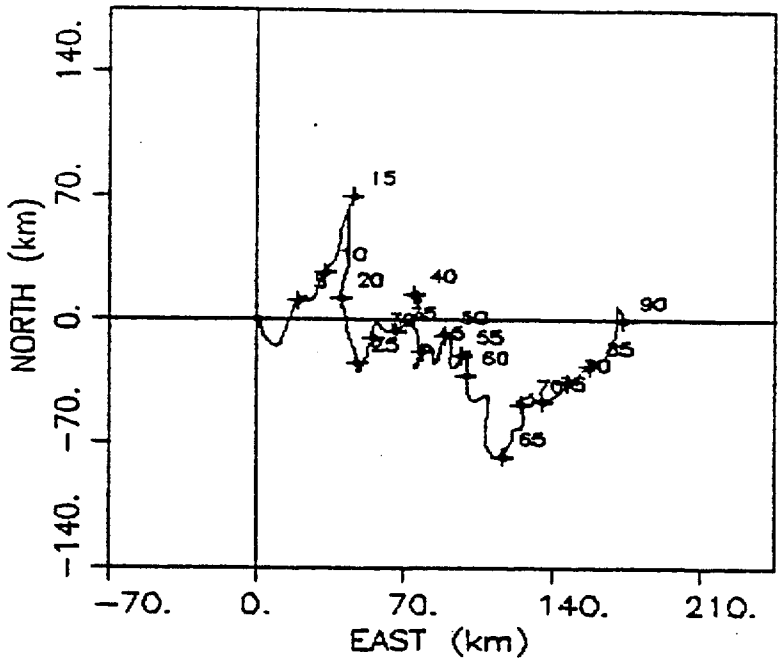
GRAYS REEF/FREEF/BOTT/SU85/LP40/R-20
DEPTH 10.7 M.
LAT= 31 DEG. 5.90 MIN N
LONG= 81 DEG. 13.50 MIN W
NO. OF POINTS= 360
DELTA T: 6.00 HOURS
BEGINNING: 1985 MAY30(150), 0 OZ 0. 0
ENDING: 1985 AUG27(239),18 OZ 0. 0



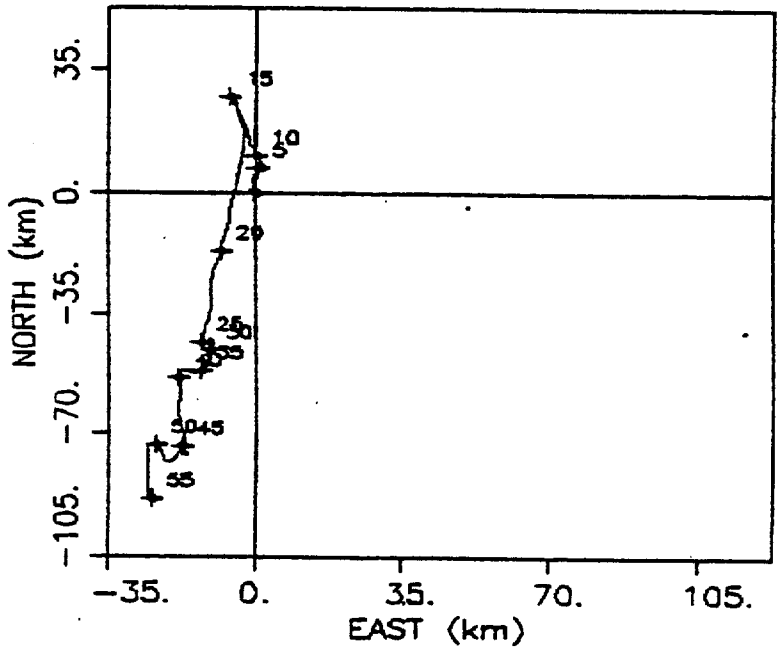
SAVANNAH WINDS M/S /40HLP/R-200
DEPTH .0 M.
LAT= 0 DEG. .00 MIN N
LONG= 0 DEG. .00 MIN W
NO. OF POINTS= 360
DELTA T: 6.00 HOURS
BEGINNING: 1985 AUG29(241), 3 OZ 0. 0
ENDING: 1985 NOV26(330),21 OZ 0. 0



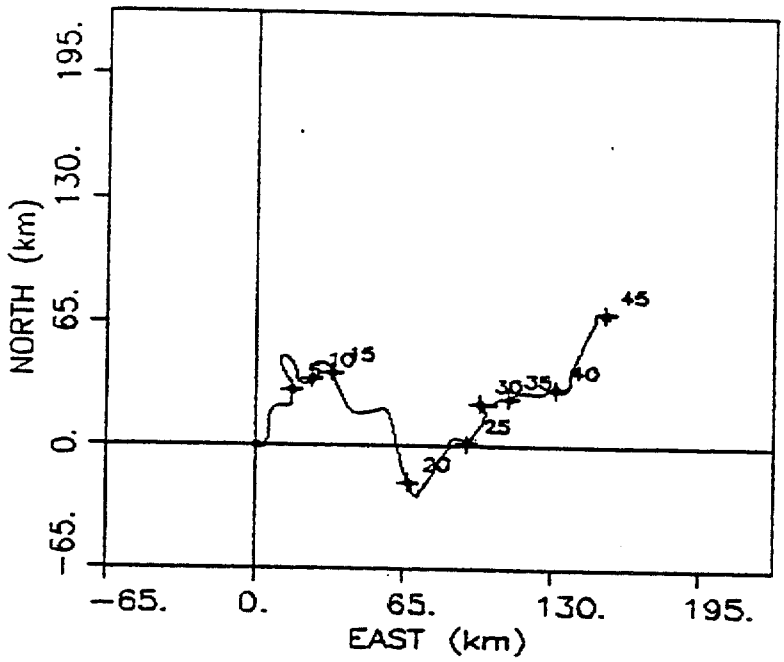
GRAYS REEF/GRAYS/TOP/FA85/LP40/R-20
DEPTH 6.1 M.
LAT= 31 DEG. 24.00 MIN N
LONG= 80 DEG. 52.10 MIN W
NO. OF POINTS= 360
DELTA T: 6.00 HOURS
BEGINNING: 1985 AUG28(240), 0 OZ 0. 0
ENDING: 1985 NOV25(329),18 OZ 0. 0



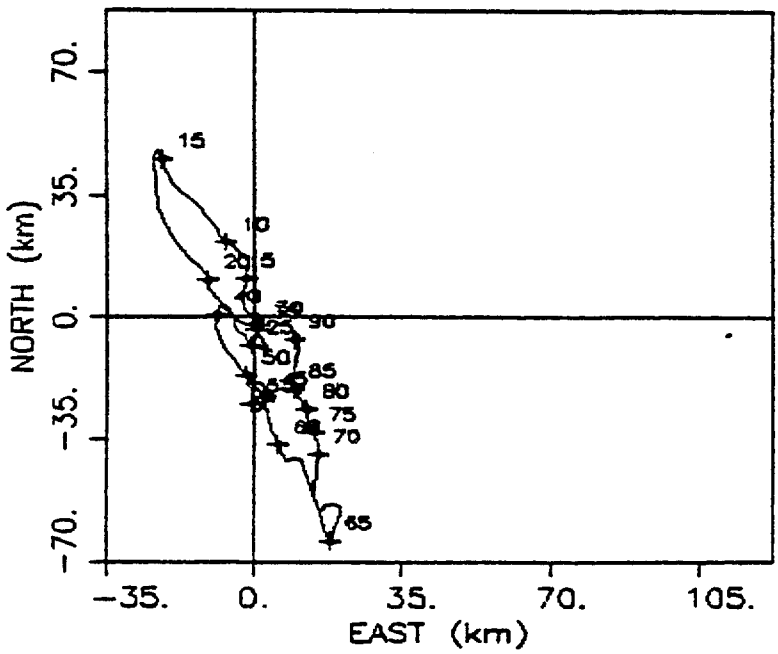
GRAYS REEF/GRAYS/BOTT/FA85/LP40/R-20
DEPTH 15.2 M.
LAT= 31 DEG. 24.00 MIN N
LONG= 80 DEG. 52.10 MIN W
NO. OF POINTS= 220
DELTA T: 6.00 HOURS
BEGINNING: 1985 AUG28(240), 0 OZ 0. 0
ENDING: 1985 OCT21(294),18 OZ 0. 0



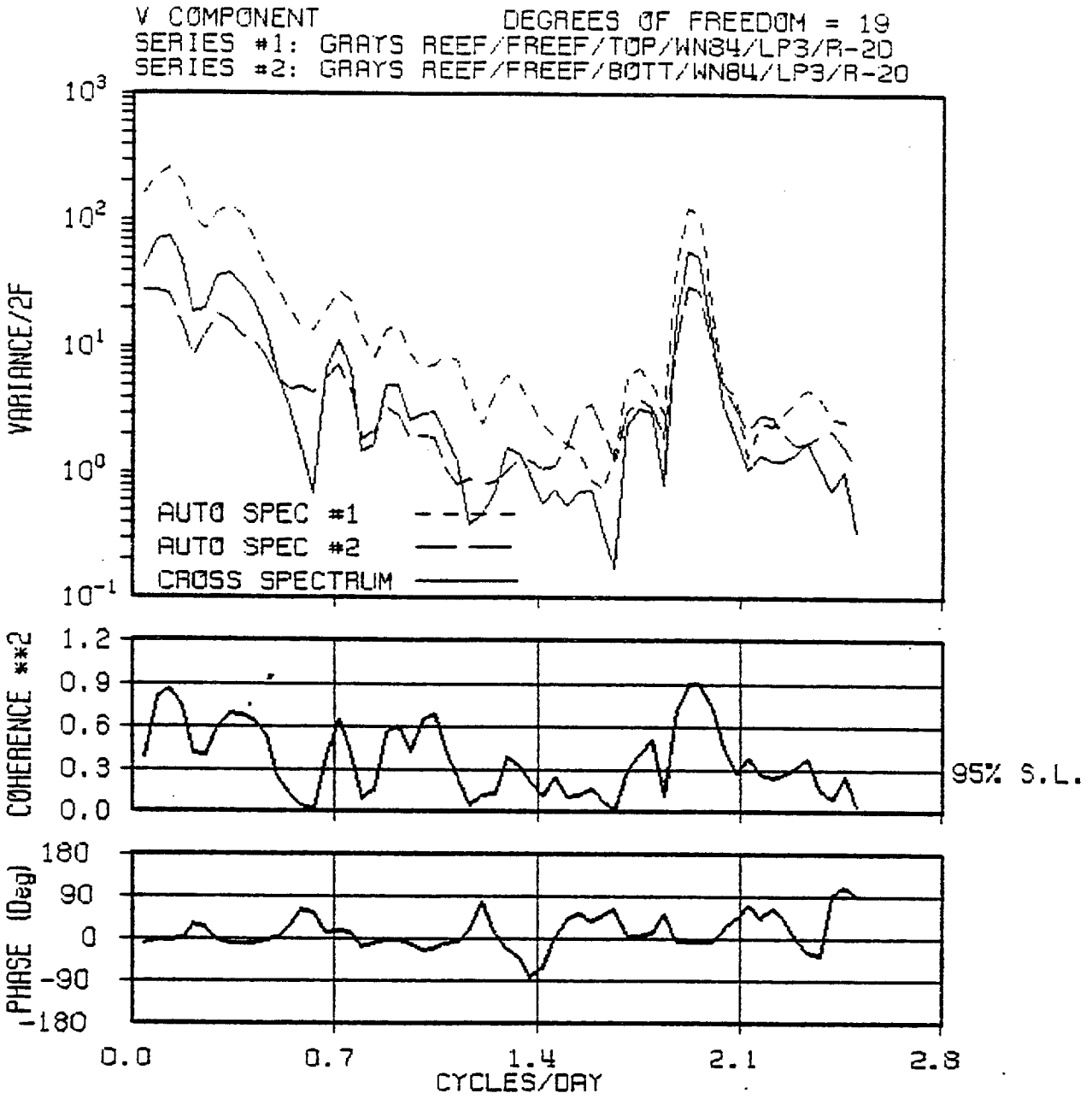
GRAYS REEF/FREEF/TOP/FA85/LP40/R-20
DEPTH 7.6 M.
LAT= 31 DEG, 5.00 MIN N
LONG= 81 DEG, 13.50 MIN W
NO. OF POINTS= 184
DELTA T: 6.00 HOURS
BEGINNING: 1985 OCT10(283),18 OZ 0. 0
ENDING: 1985 NOV25(329),12 OZ 0. 0

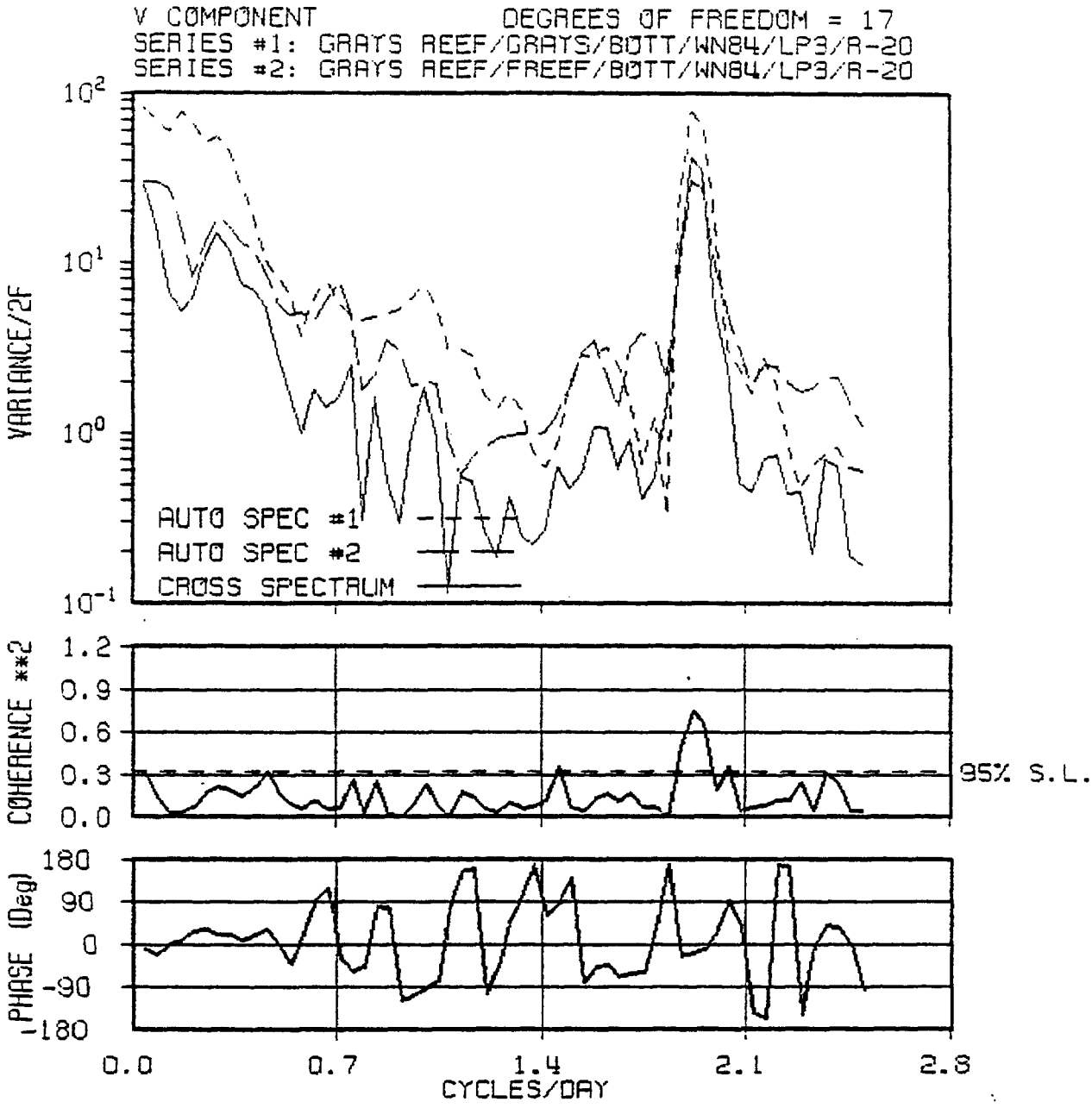


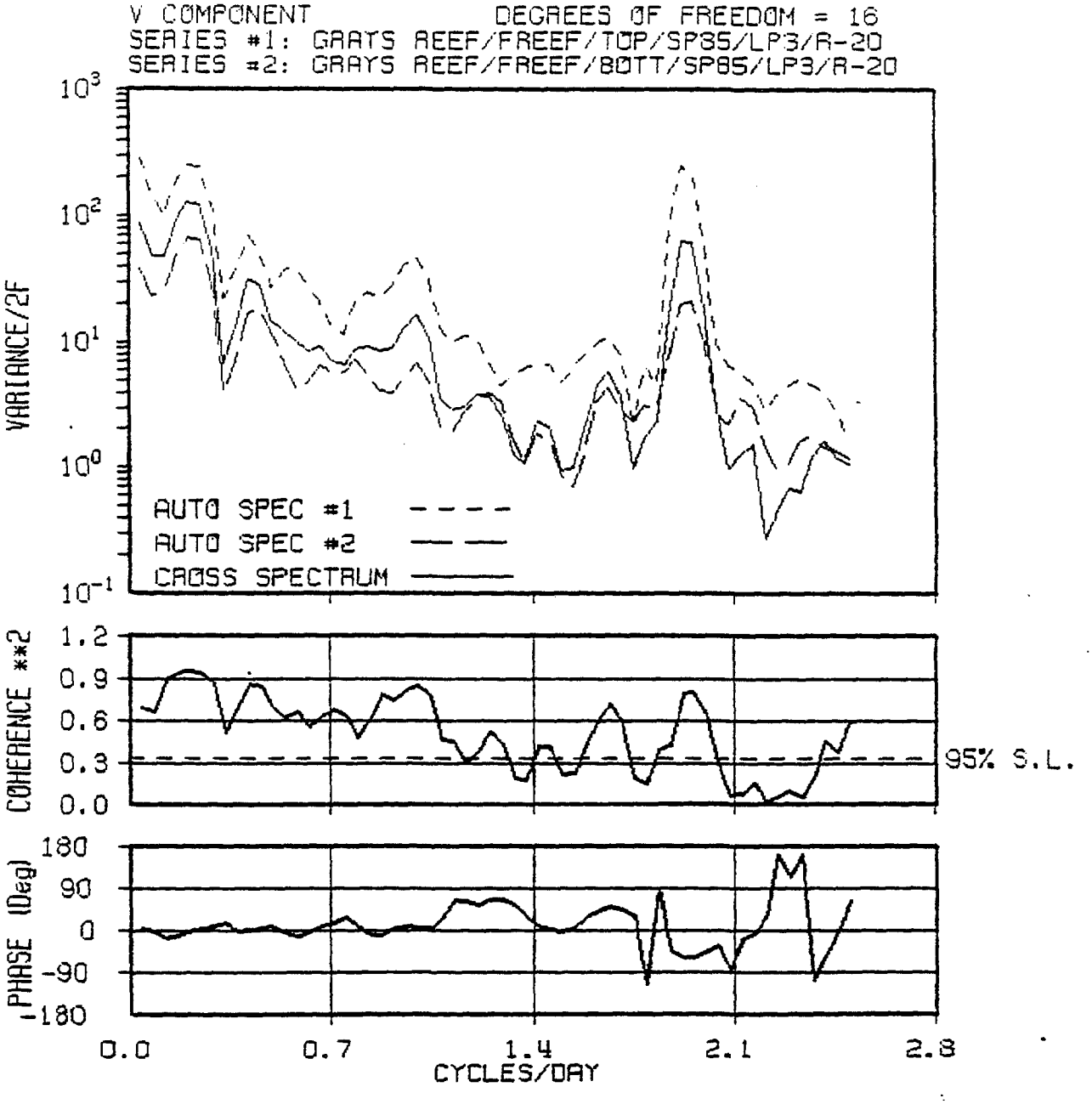
GRAYS REEF/FREEF/BOTT/FA85/LP40/R-20
DEPTH 10.7 M.
LAT= 31 DEG, 5.90 MIN N
LONG= 81 DEG, 13.50 MIN W
NO. OF POINTS= 360
DELTA T: 6.00 HOURS
BEGINNING: 1985 AUG28(240), 0 OZ 0. 0
ENDING: 1985 NOV25(329),18 OZ 0. 0

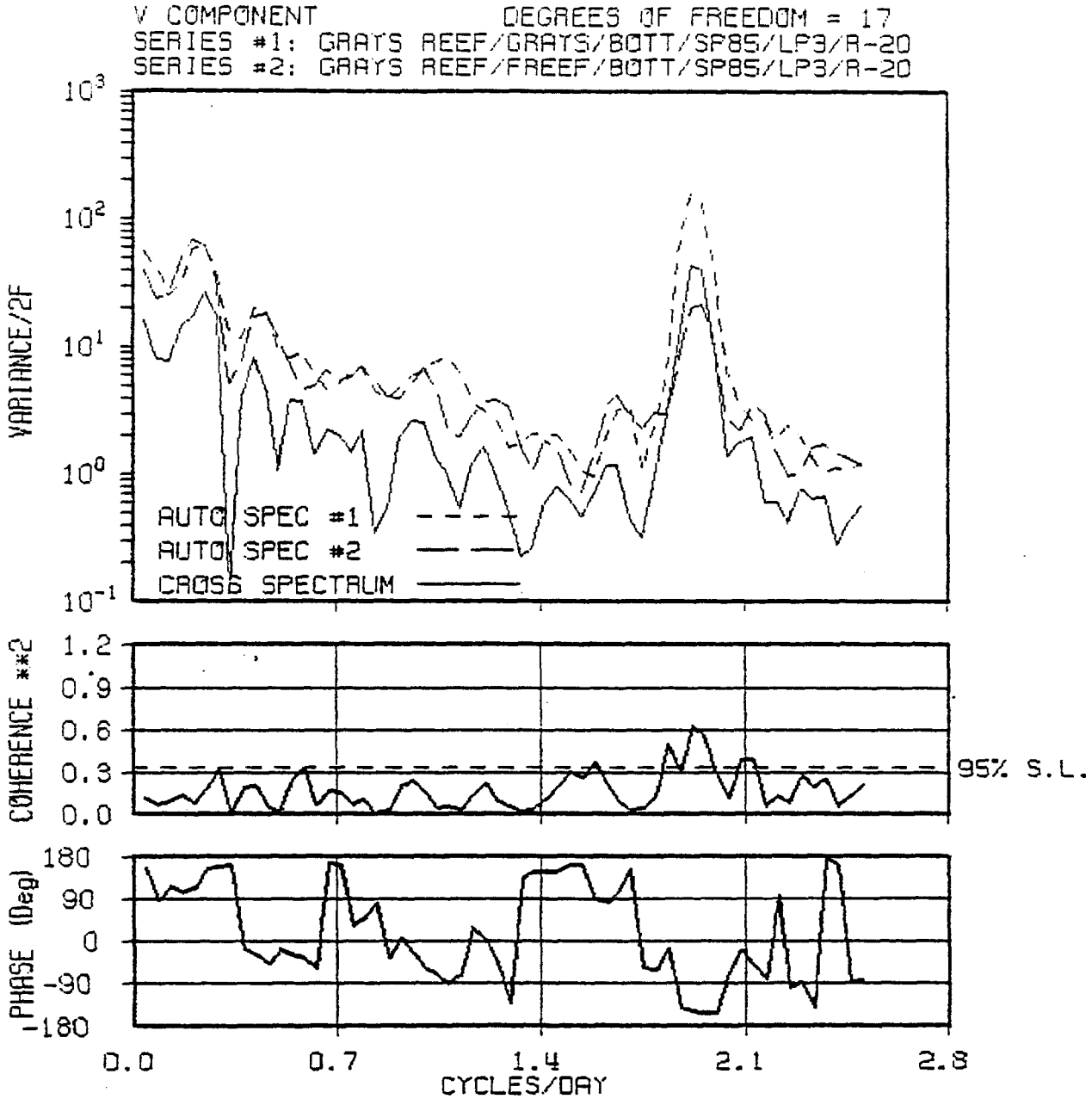


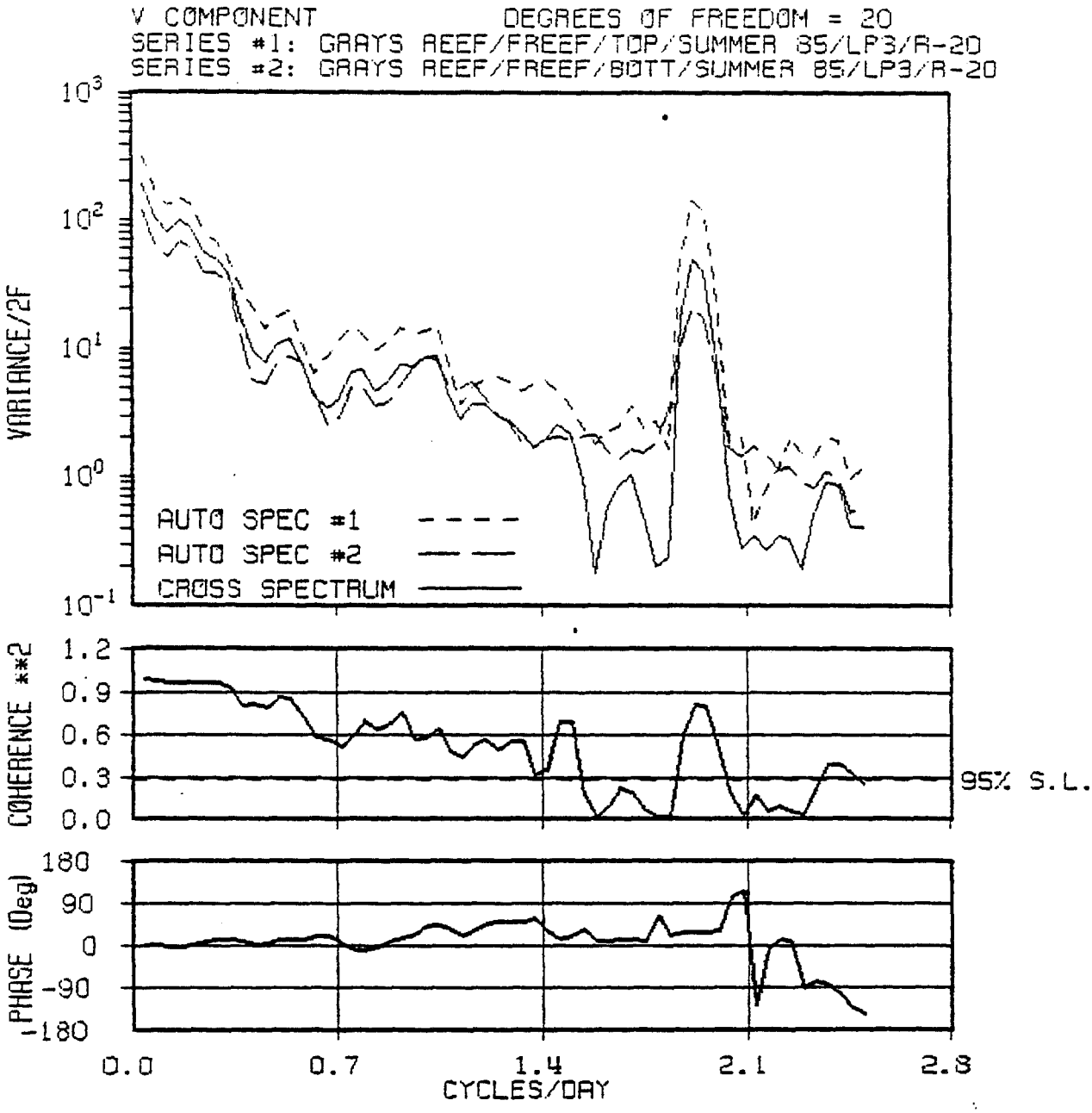
Appendix D: Plots of Spectra

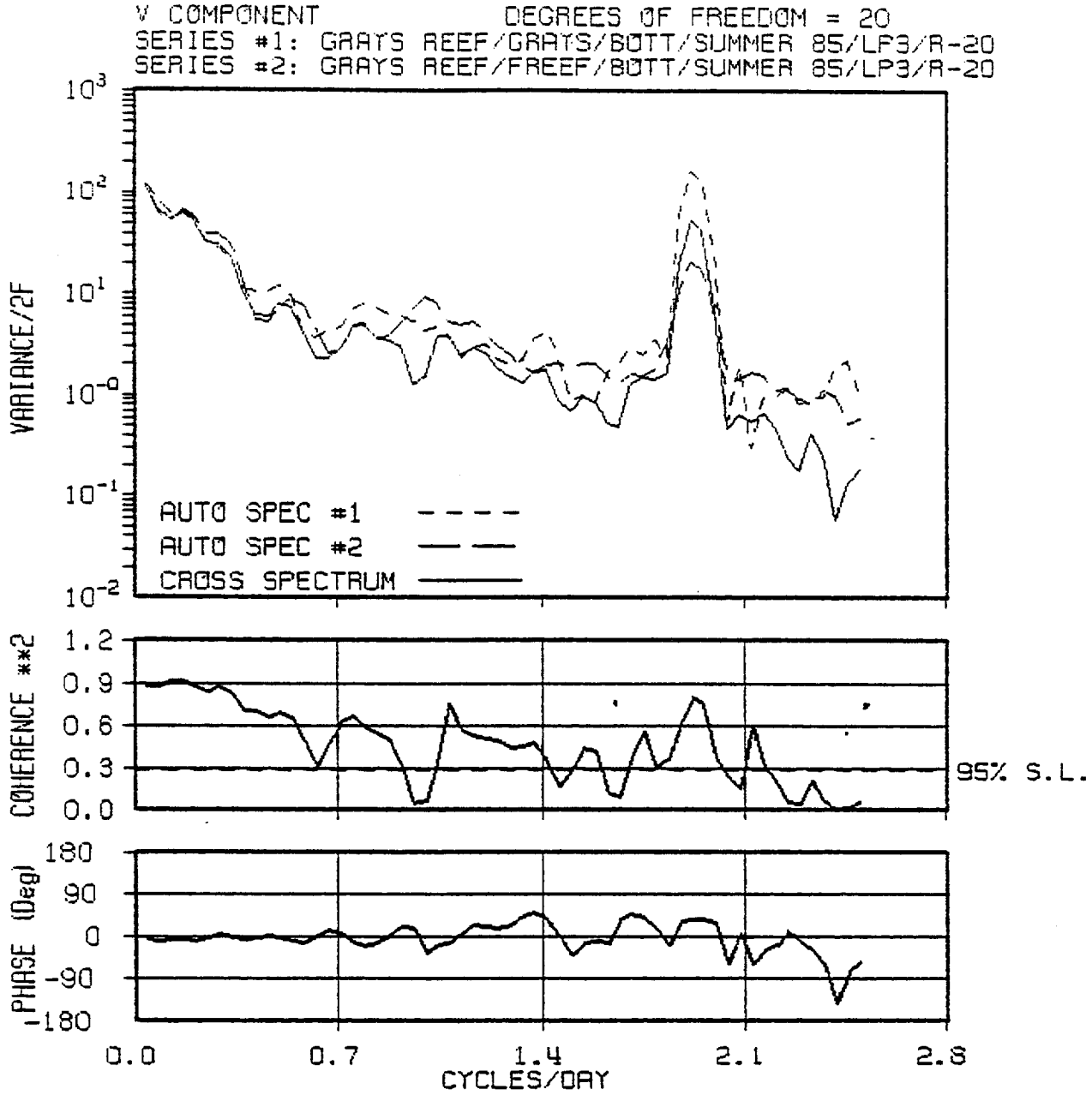

V COMPONENT
DEGREES OF FREEDOM = 19
SERIES #1: GRAYS REEF/FREEF/TOP/WN84/LP3/R-20
SERIES #2: GRAYS REEF/FREEF/BOTT/WN84/LP3/R-20
VARIANCE/2F
AUTO SPEC #1
AUTO SPEC #2
CROSS SPECTRUM
COHERENCE **2
95% S.L.
PHASE (Deg)
CYCLES/DAY

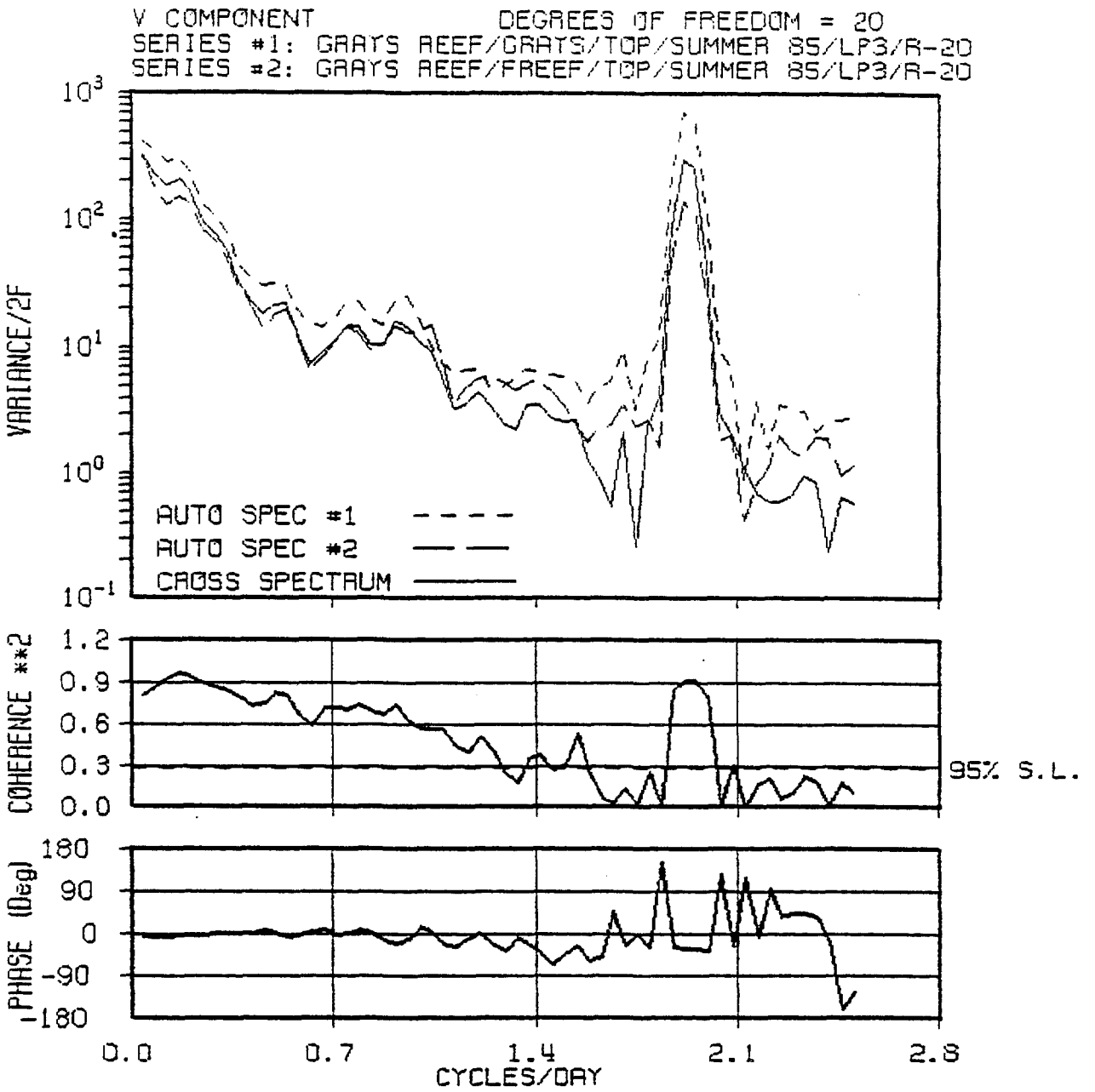

V COMPONENT
DEGREES OF FREEDOM = 17
SERIES #1: GRAYS REEF/GRAYS/BOTT/WN84/LP3/R-20
SERIES #2: GRAYS REEF/FREEF/BOTT/WN84/LP3/R-20
VARIANCE/2F
AUTO SPEC #1
AUTO SPEC #2
CROSS SPECTRUM
COHERENCE **2
95% S.L.
PHASE (Deg)
CYCLES/DAY

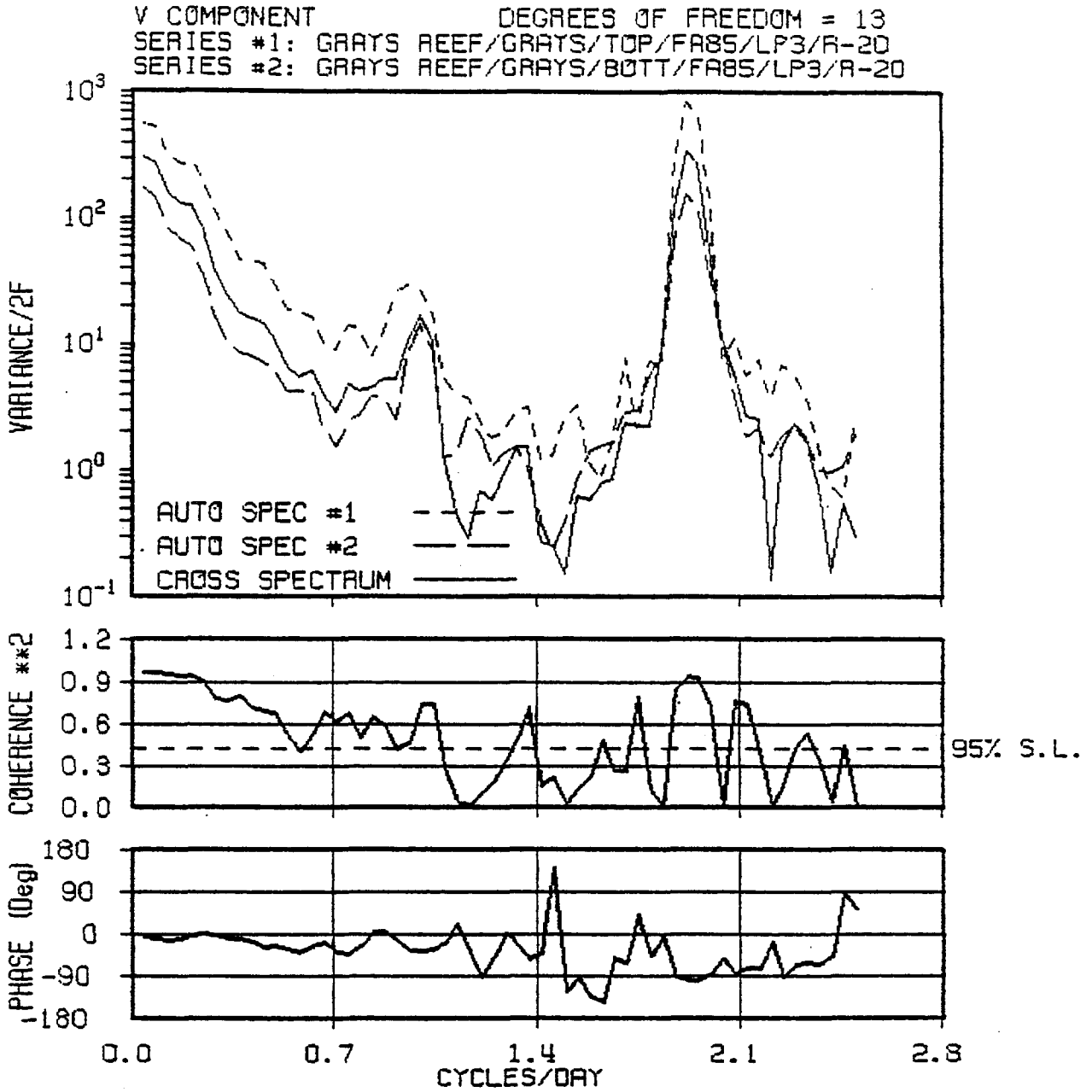

V COMPONENT
DEGREES OF FREEDOM = 16
SERIES #1: GRATS REEF/FREEF/TOP/SP85/LP3/R-20
SERIES #2: GRAYS REEF/FREEF/BOTT/SP85/LP3/R-20
VARIANCE/2F
AUTO SPEC #1
AUTO SPEC #2
CROSS SPECTRUM
COHERENCE **2
95% S.L.
PHASE (Deg)
CYCLES/DAY


V COMPONENT
DEGREES OF FREEDOM = 17
SERIES #1: GRATS REEF/GRATS/BOTT/SP85/LP3/R-20
SERIES #2: GRATS REEF/FREEF/BOTT/SP85/LP3/R-20
VARIANCE/2F
AUTO SPEC #1
AUTO SPEC #2
CROSS SPECTRUM
COHERENCE **2
95% S.L.
PHASE (Deg)
CYCLES/DAY


V COMPONENT
DEGREES OF FREEDOM = 20
SERIES #1: GRAYS REEF/FREEF/TOP/SUMMER 85/LP3/R-20
SERIES #2: GRAYS REEF/FREEF/BOTT/SUMMER 85/LP3/R-20
VARIANCE/2F
AUTO SPEC #1
AUTO SPEC #2
CROSS SPECTRUM
COHERENCE **2
95% S.L.
PHASE (Deg)
CYCLES/DAY


V COMPONENT
DEGREES OF FREEDOM = 20
SERIES #1: GRAYS REEF/GRAYS/BOTT/SUMMER 85/LP3/R-20
SERIES #2: GRAYS REEF/FREEF/BOTT/SUMMER 85/LP3/R-20
VARIANCE/2F
AUTO SPEC #1
AUTO SPEC #2
CROSS SPECTRUM
COHERENCE **2
95% S.L.
PHASE (Deg)
CYCLES/DAY


V COMPONENT
DEGREES OF FREEDOM = 20
SERIES #1: GRAYS REEF/GRATS/TOP/SUMMER 85/LP3/R-20
SERIES #2: GRAYS REEF/FREEF/TOP/SUMMER 85/LP3/R-20
VARIANCE/2F
AUTO SPEC #1
AUTO SPEC #2
CROSS SPECTRUM
COHERENCE **2
95% S.L.
PHASE (Deg)
CYCLES/DAY

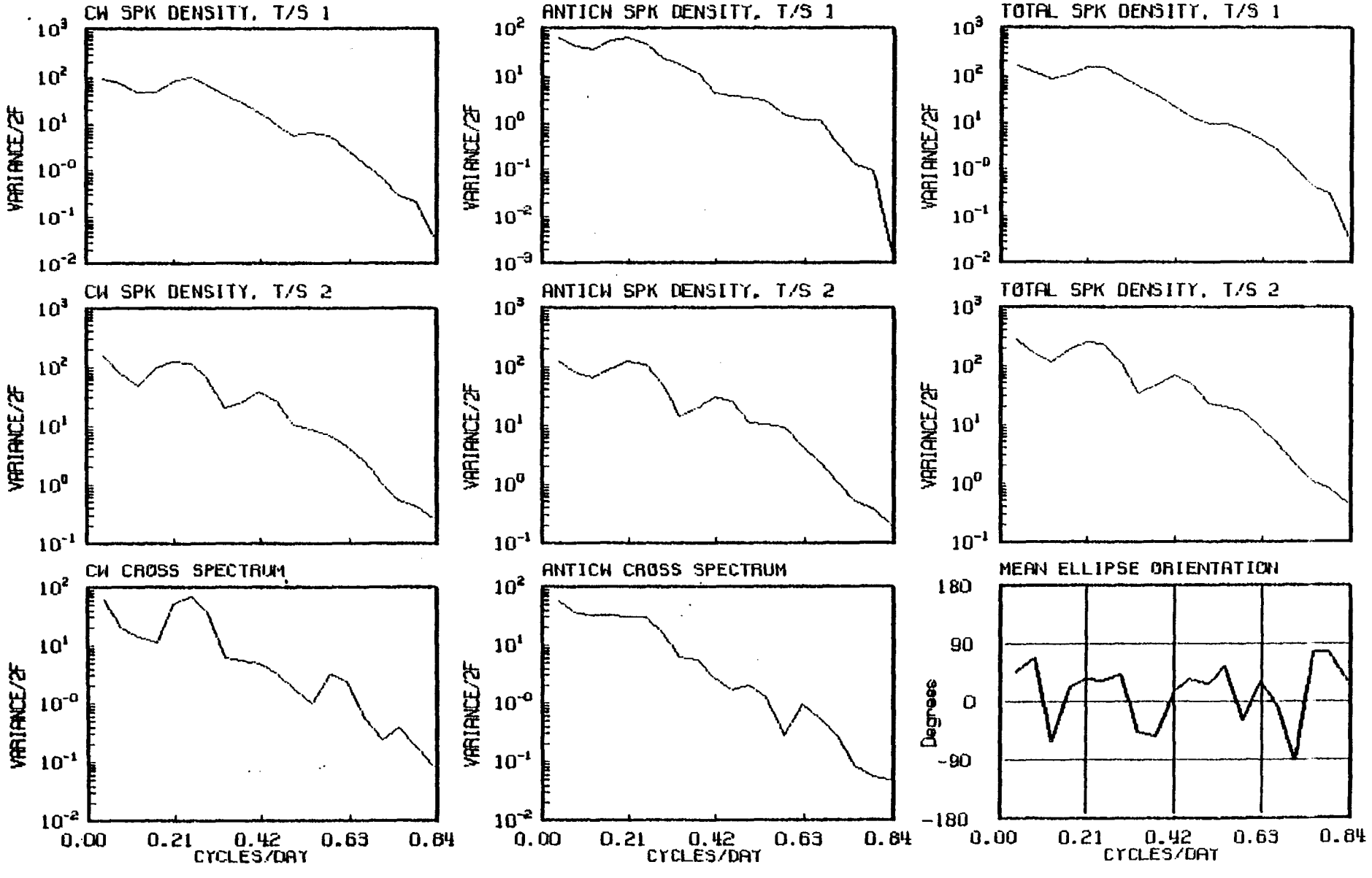

V COMPONENT
DEGREES OF FREEDOM = 13
SERIES #1: GRAYS REEF/GRAYS/TOP/FA85/LP3/R-20
SERIES #2: GRAYS REEF/GRAYS/BOTT/FA85/LP3/R-20
VARIANCE/2F
AUTO SPEC #1
AUTO SPEC #2
CROSS SPECTRUM
COHERENCE **2
95% S.L.
PHASE (Deg)
CYCLES/DAY

ROTARY SPECTRAL QUANTITIES

FILE: SNFTSP85.R40

SERIES #1: SAVANNAH WINDS M/S /40HLP/A-200

SERIES #2: GRAYS REEF/FREEF/TOP/SP85/LP40/A-20

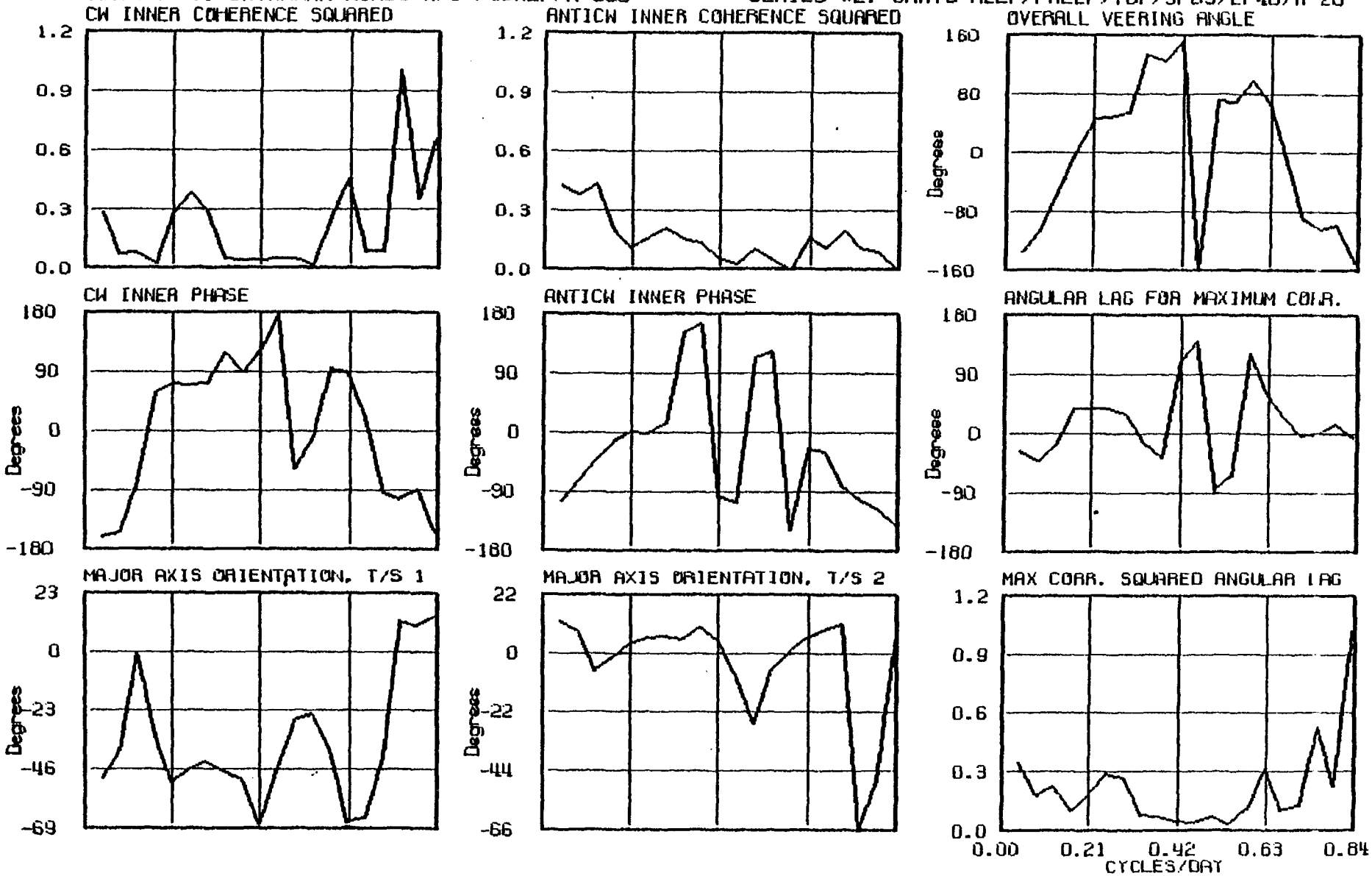


ROTARY SPECTRAL QUANTITIES

FILE: SNFTSP85.R40

SERIES #1: SAVANNAH WINDS M/S /40HLP/R-200

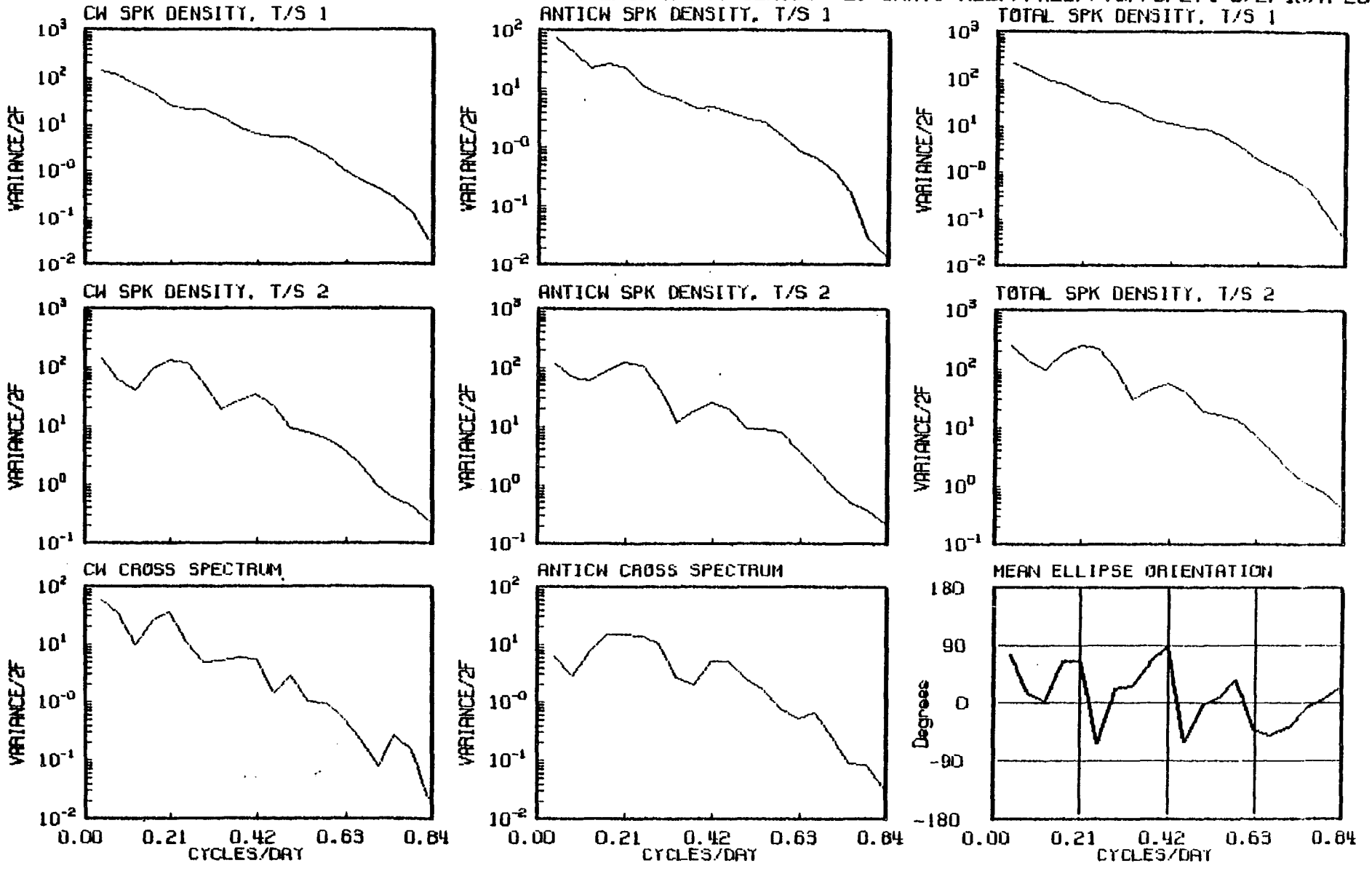
SERIES #2: GRAYS REEF/FREEF/TOP/SP85/LP40/R-20



ROTARY SPECTRAL QUANTITIES

FILE: SNFTSU85.R40

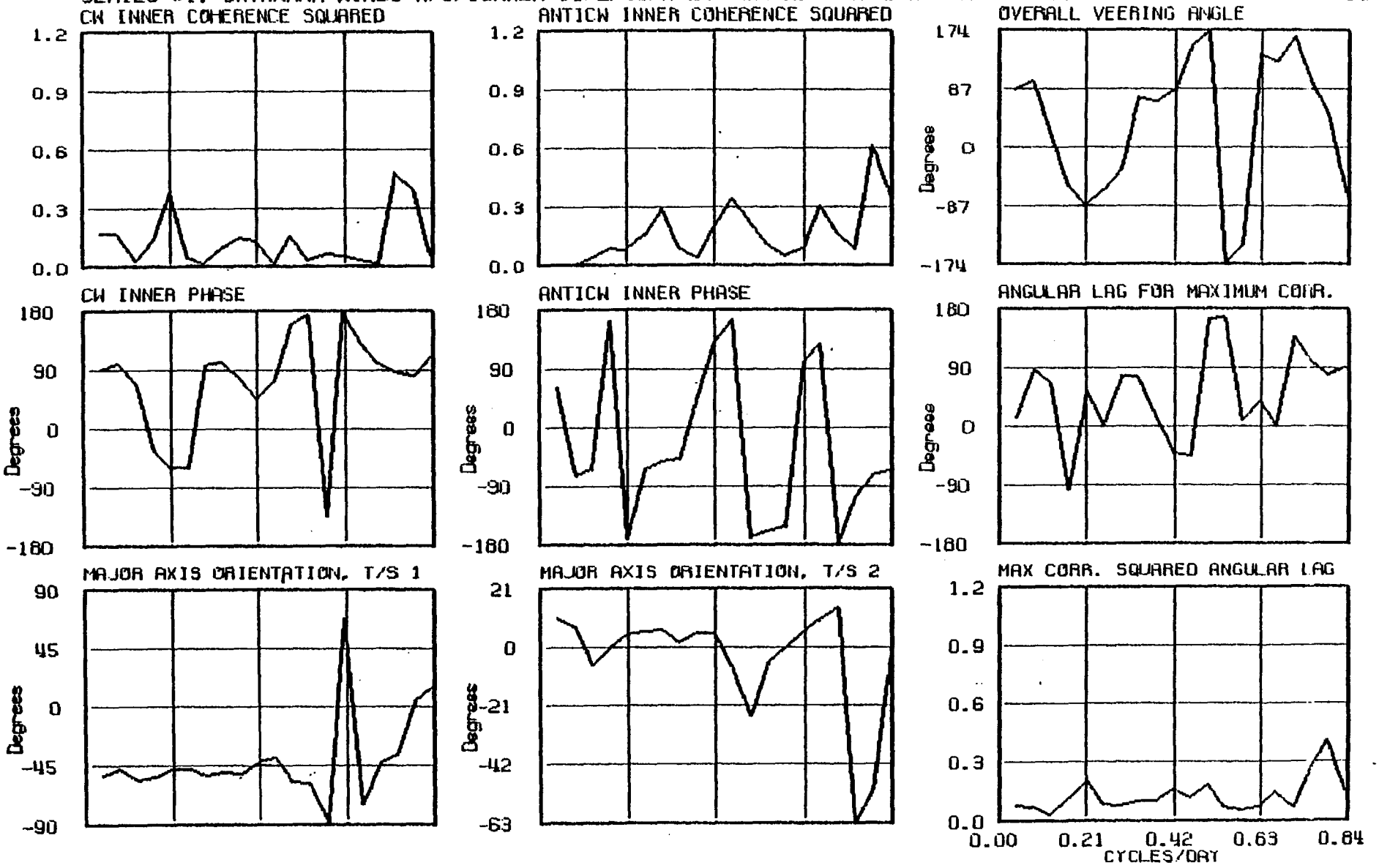
SERIES #1: SAVANNAH WINDS M/S/SUMMER 85/LP40/A-200 SERIES #2: GRATS REEF/FREEF/TOP/DPLY4-6/LP40/A-20



ROTARY SPECTRAL QUANTITIES

FILE: SNFTSU85.R40

SERIES #1: SAVANNAH WINDS M/S/SUMNER 85/LP40/R-200 SERIES #2: GRAYS REEF/FREEF/TOP/DPLY4-6/LP40/R-20

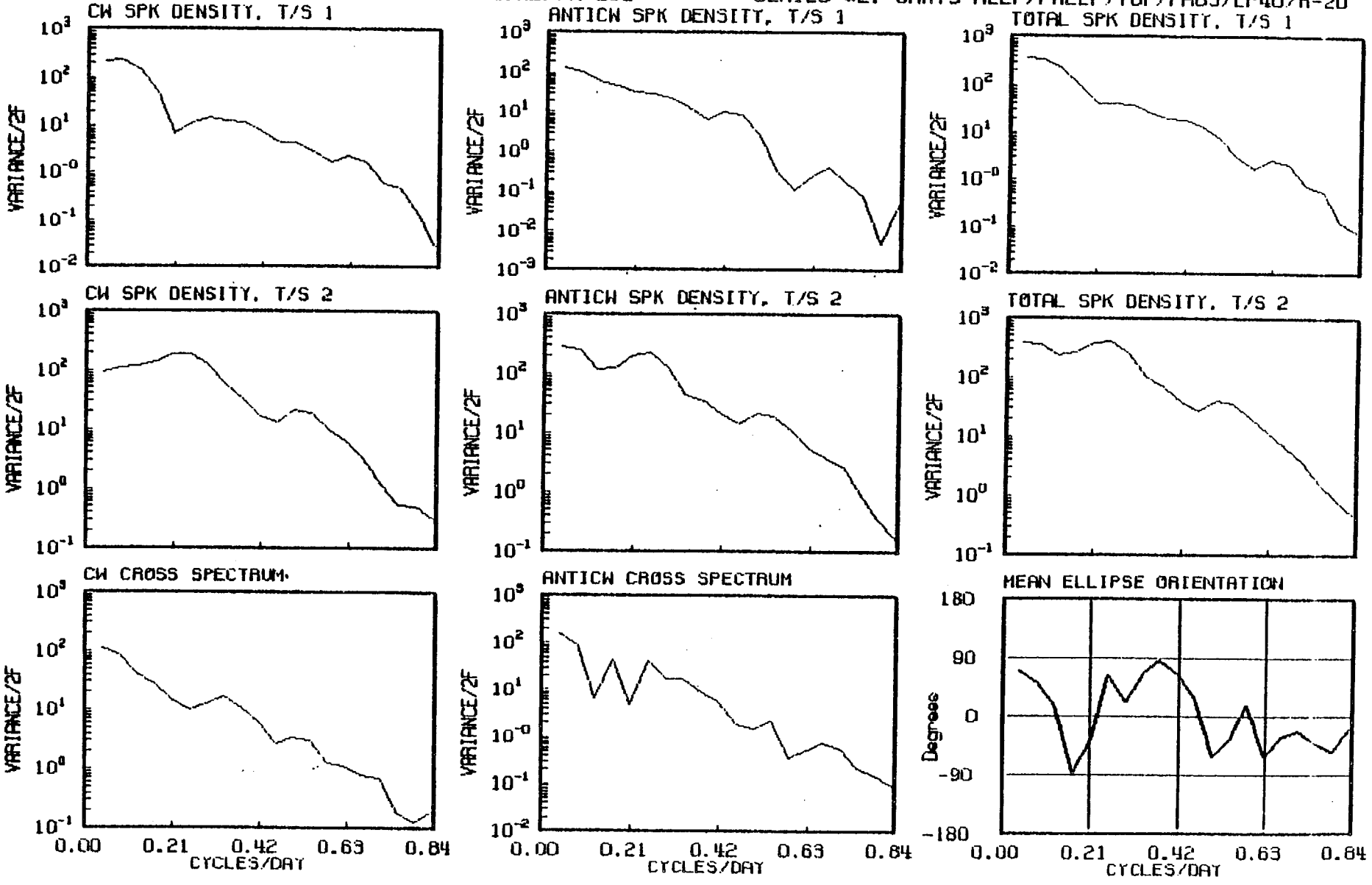


ROTARY SPECTRAL QUANTITIES

FILE: SNFTFA85.R40

SERIES #1: SAVANNAH WINDS M/S /40HLP/R-200

SERIES #2: GRAYS REEF/FREEF/TOP/FA85/LP40/R-20

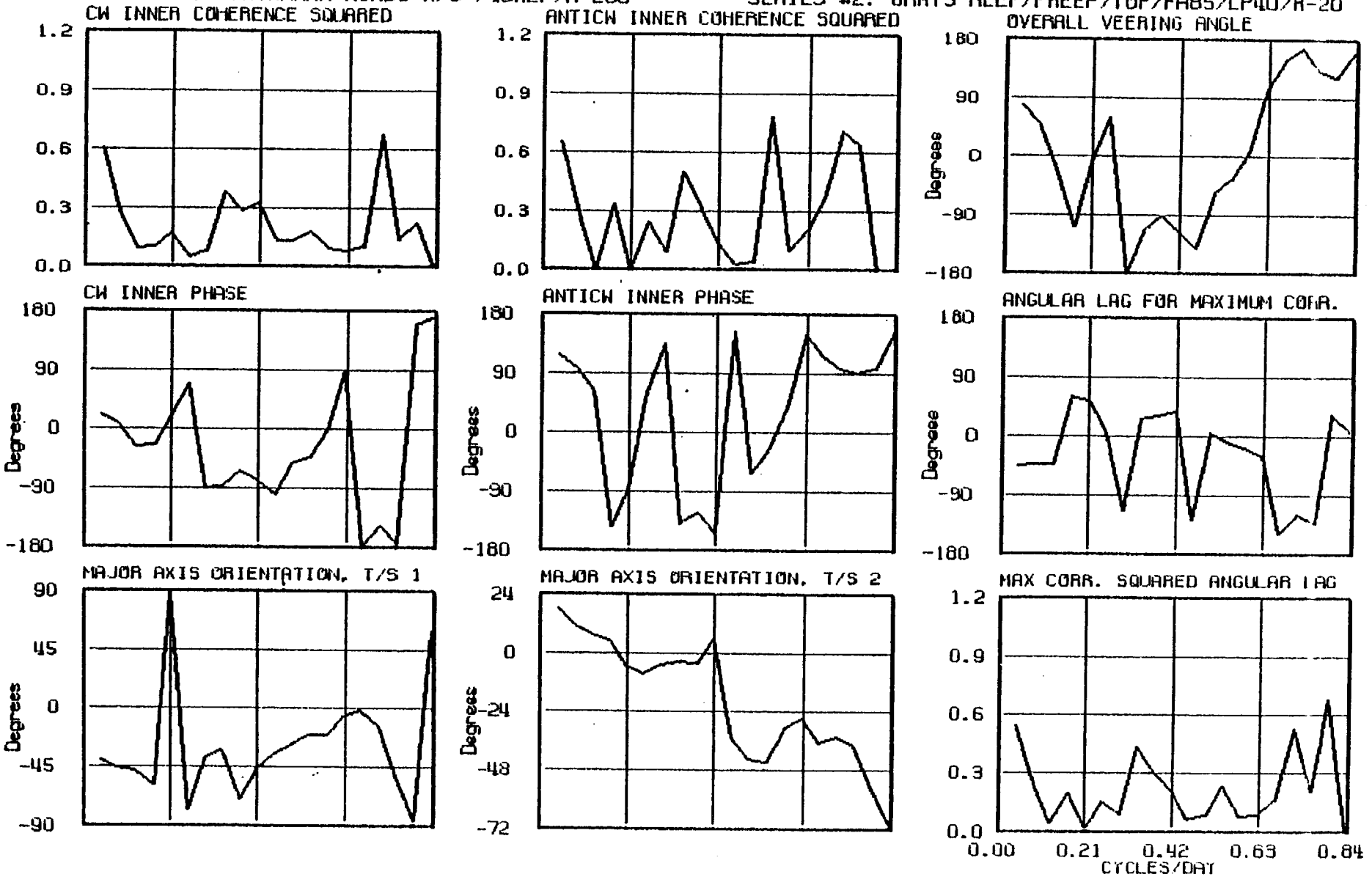


ROTARY SPECTRAL QUANTITIES

FILE: SNFTFA85.R40

SERIES #1: SAVANNAH WINDS M/S /40HLP/R-200

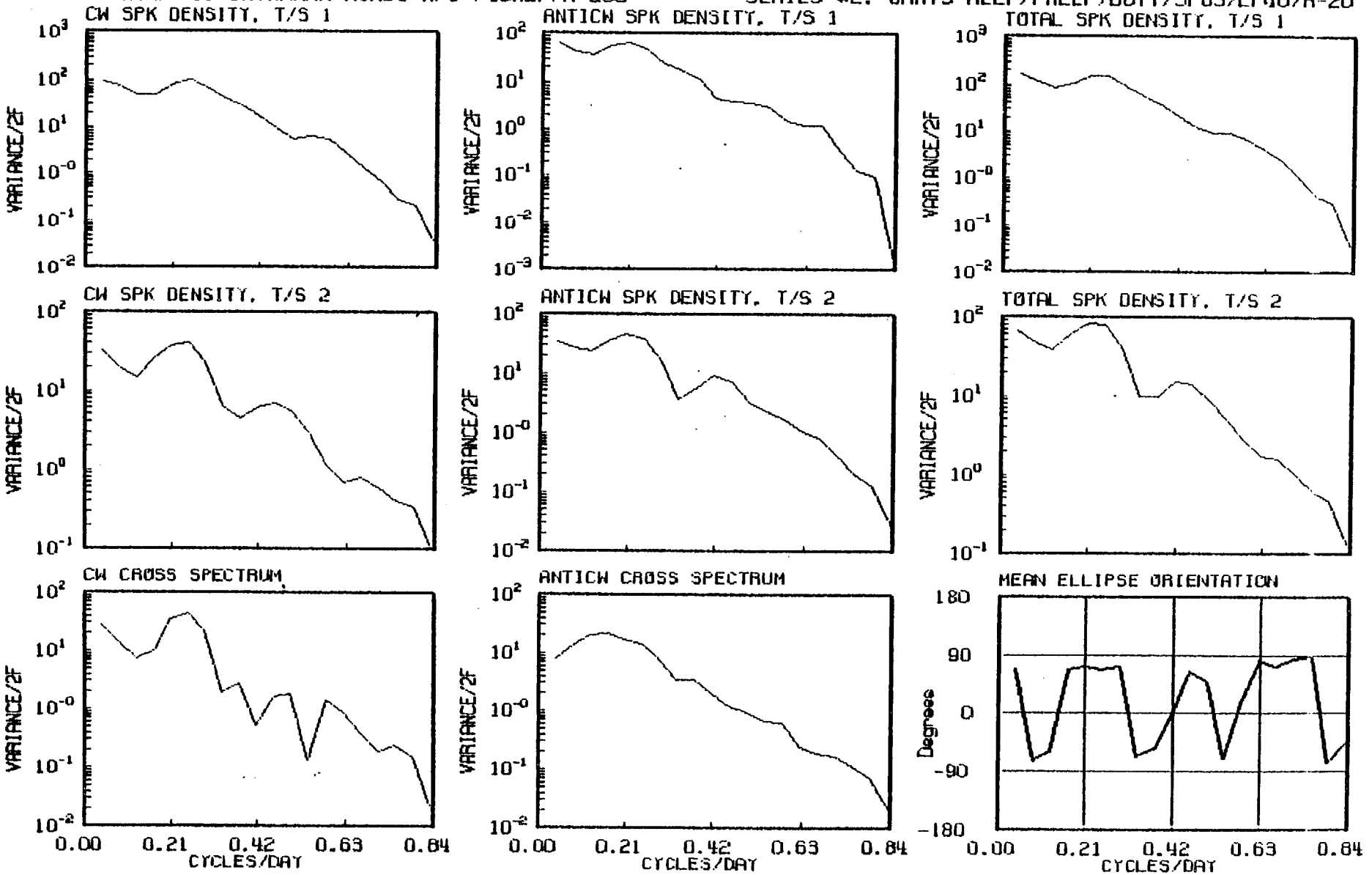
SERIES #2: GRAYS REEF/FREEF/TOP/FA85/LP40/R-20



ROTARY SPECTRAL QUANTITIES

FILE: SNFBSP85.R40

SERIES #1: SAVANNAH WINDS M/S /40HLP/R-200 SERIES #2: GRAYS REEF/FREEF/BOTT/SP85/LP40/R-20

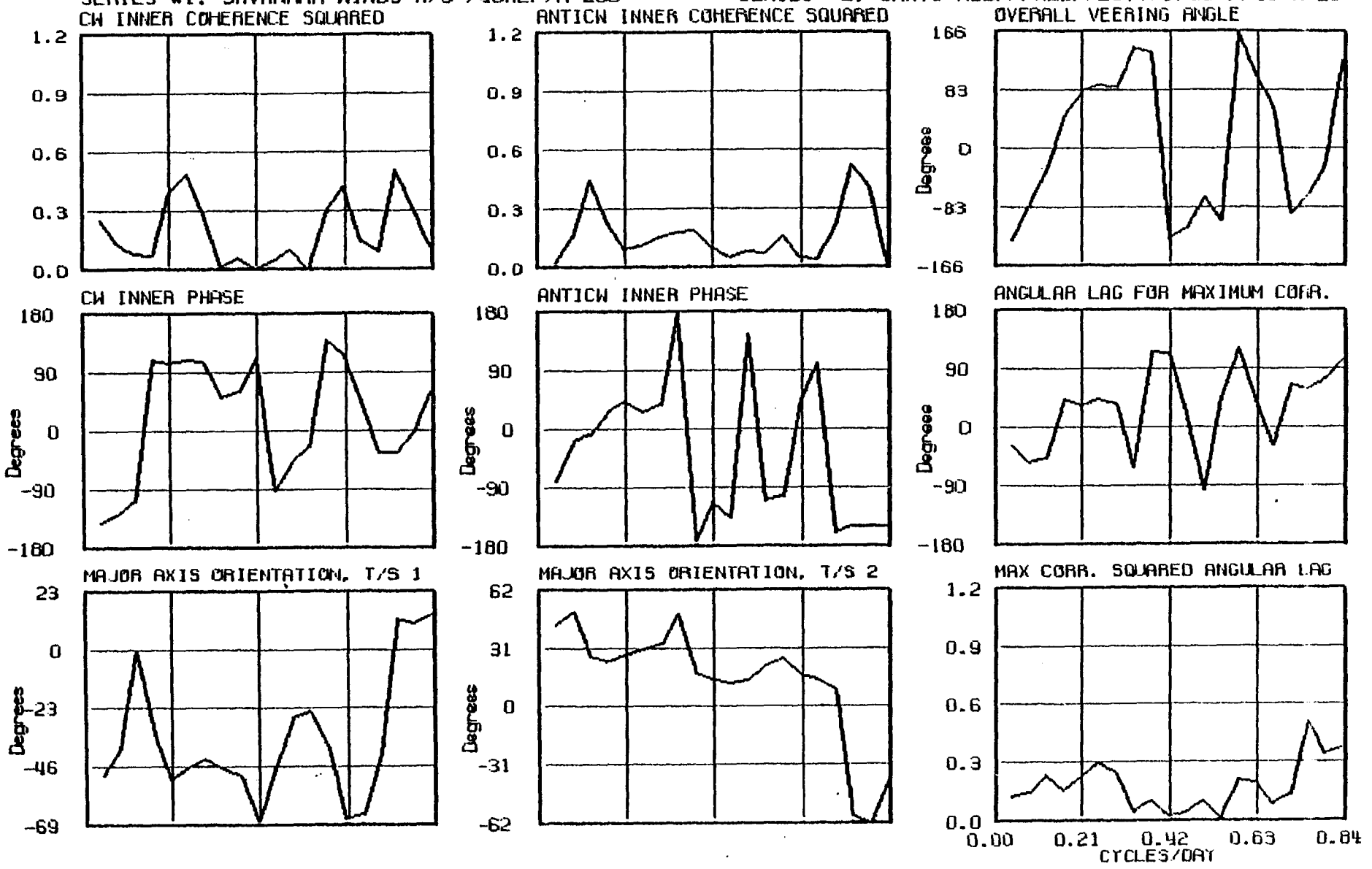


ROTARY SPECTRAL QUANTITIES

FILE: SNFBSP85.R40

SERIES #1: SAVANNAH WINDS M/S /40HLP/R-200

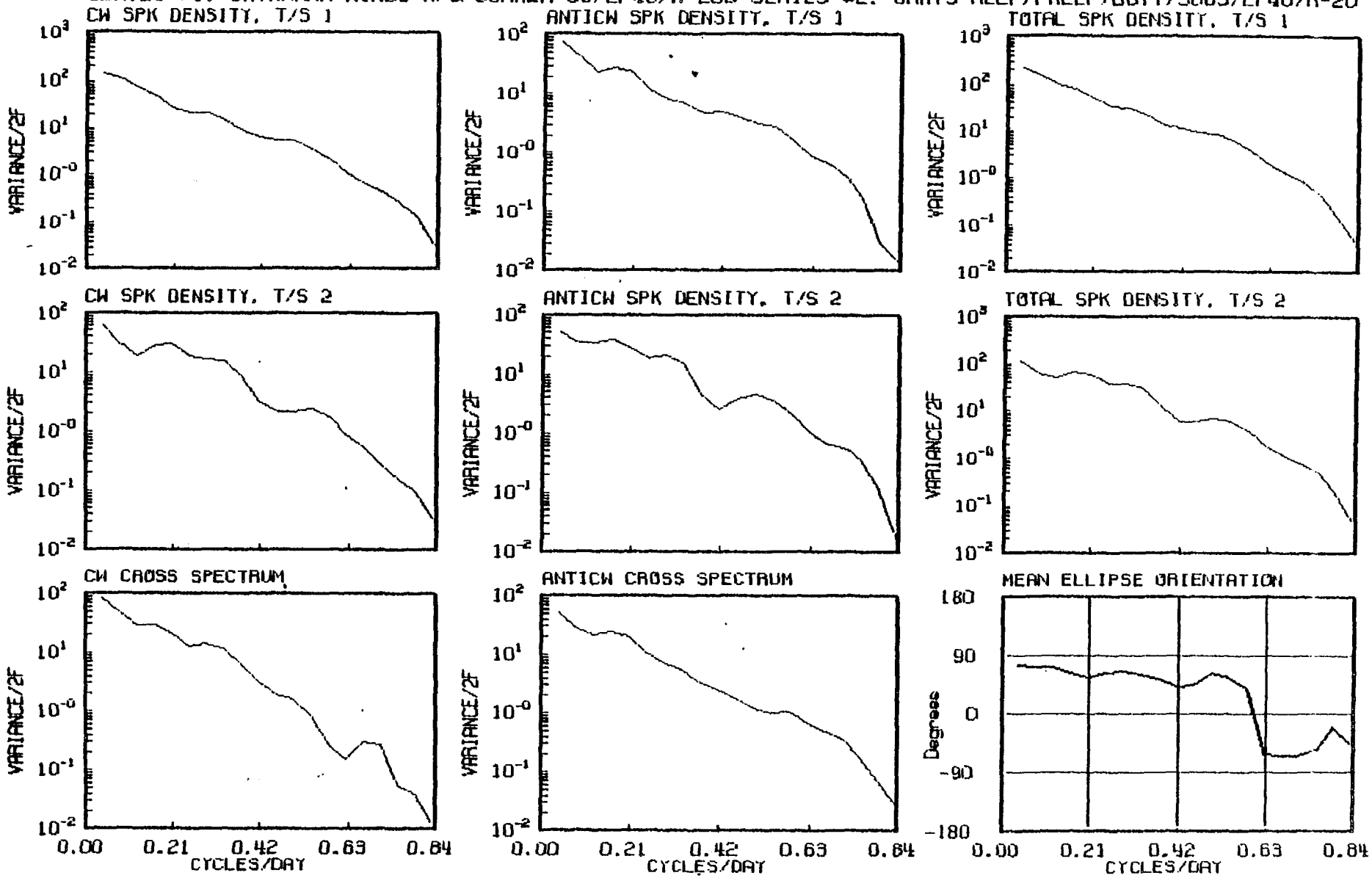
SERIES #2: GRAYS REEF/FREEF/BOTT/SP85/LP40/R-20



ROTARY SPECTRAL QUANTITIES

FILE: SNFBSU85.R40

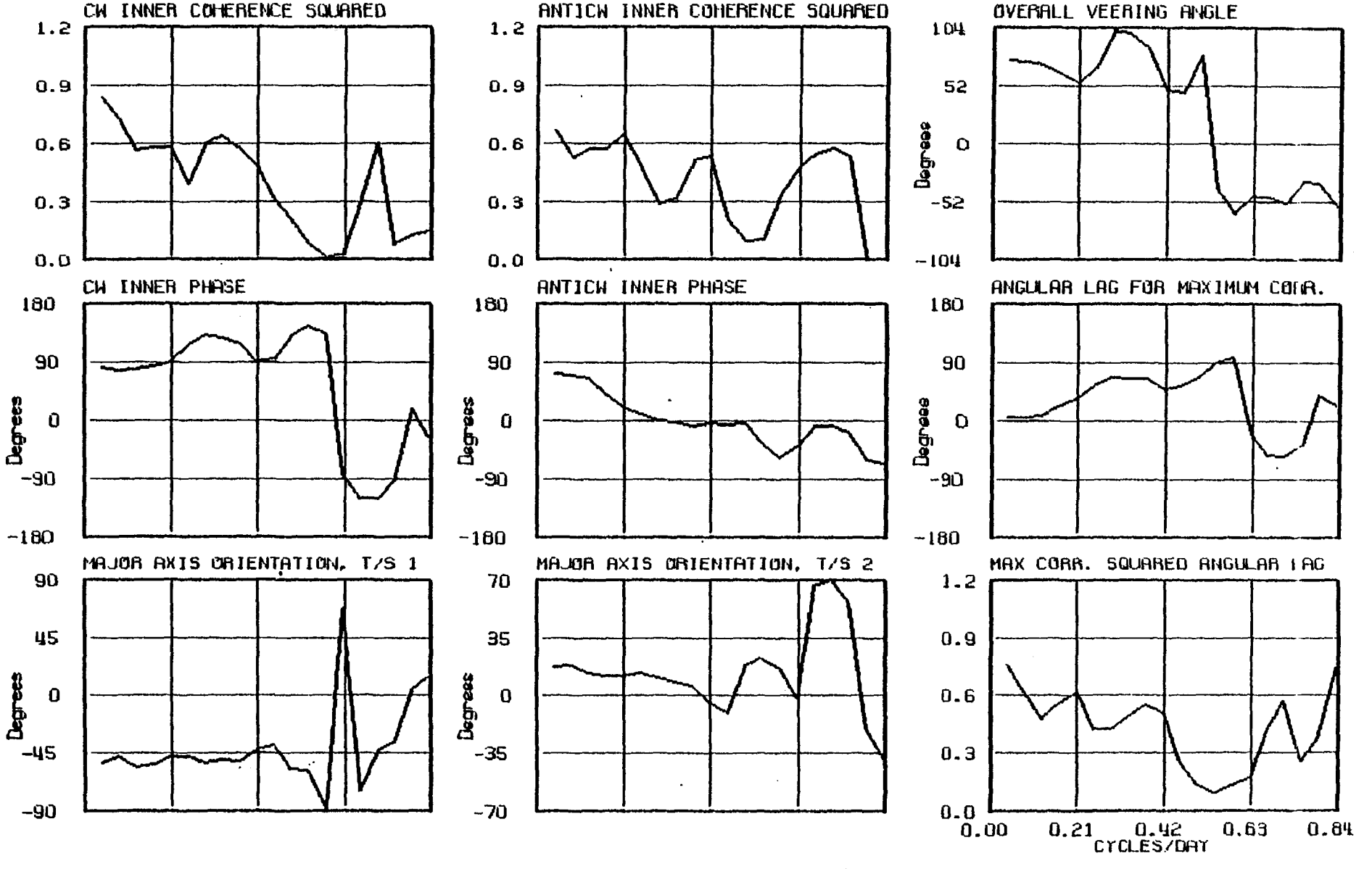
SERIES #1: SAVANNAH WINDS M/S/SUMMER 85/LP40/R-200 SERIES #2: GRAYS REEF/FREEF/BOTT/SU85/LP40/R-20



ROTARY SPECTRAL QUANTITIES

FILE: SNFBSU85.R40

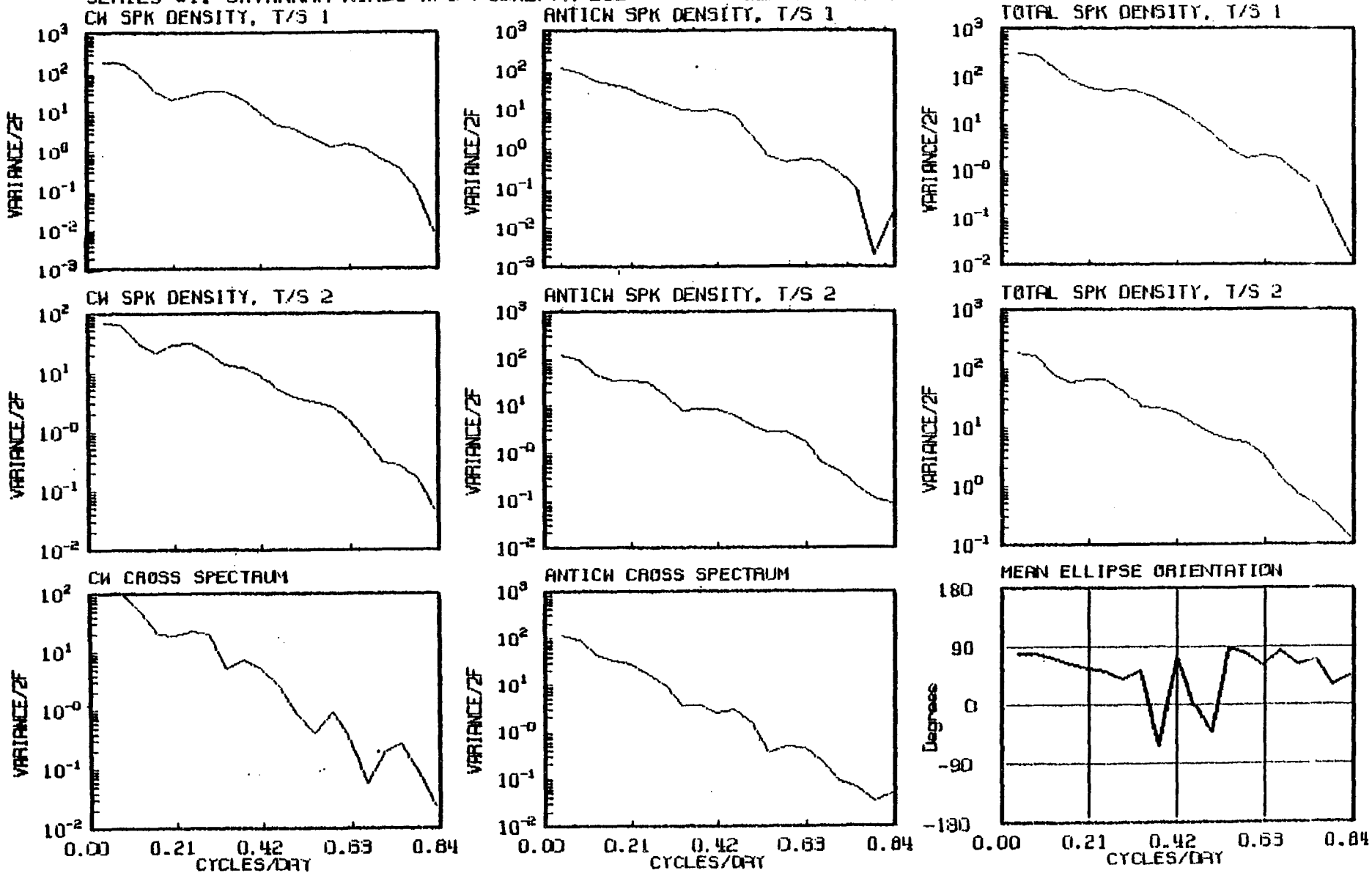
SERIES #1: SAVANNAH WINDS M/S/SUMNER 85/LP40/R-200 SERIES #2: GRAYS REEF/FREEF/BOTT/SU85/LP40/R-20



ROTARY SPECTRAL QUANTITIES

FILE: SNFBFAB5.A40

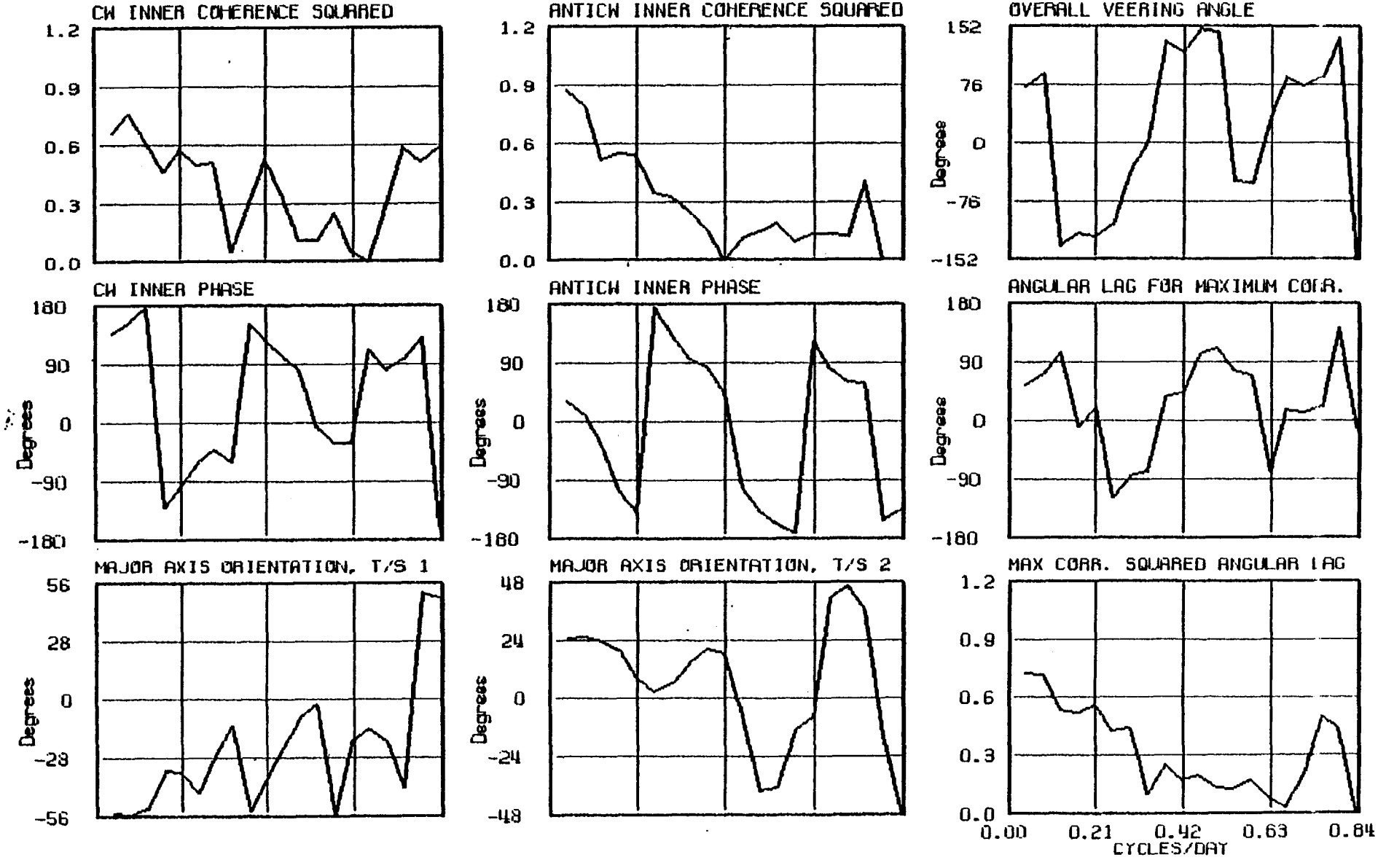
SERIES #1: SAVANNAH WINDS N/S /40HLP/A-200 SERIES #2: GRAYS REEF/FREEF/BOTT/DPLY4-6/LP40/A-20



ROTARY SPECTRAL QUANTITIES

FILE: SNFBFA85.R40

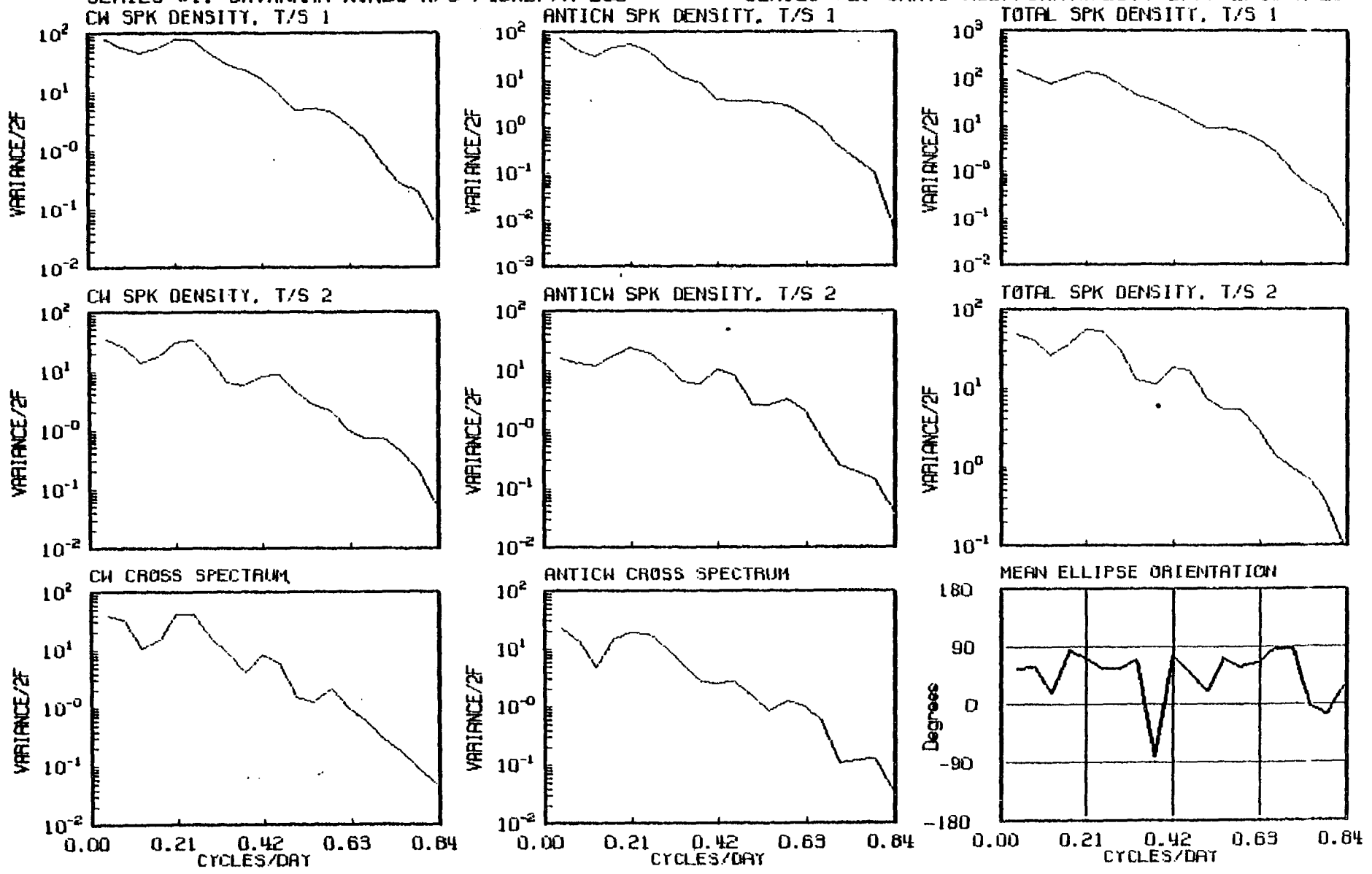
SERIES #1: SAVANNAH WINDS M/S /40HLP/R-200 SERIES #2: GRAYS REEF/FREEF/BOTT/FA85/LP40/R-20



ROTARY SPECTRAL QUANTITIES

FILE: SNGBSP85.R40

SERIES #1: SAVANNAH WINDS M/S /40HLP/R-200 SERIES #2: GRATS REEF/GRATS/BOTT/SP85/LP40/R-20

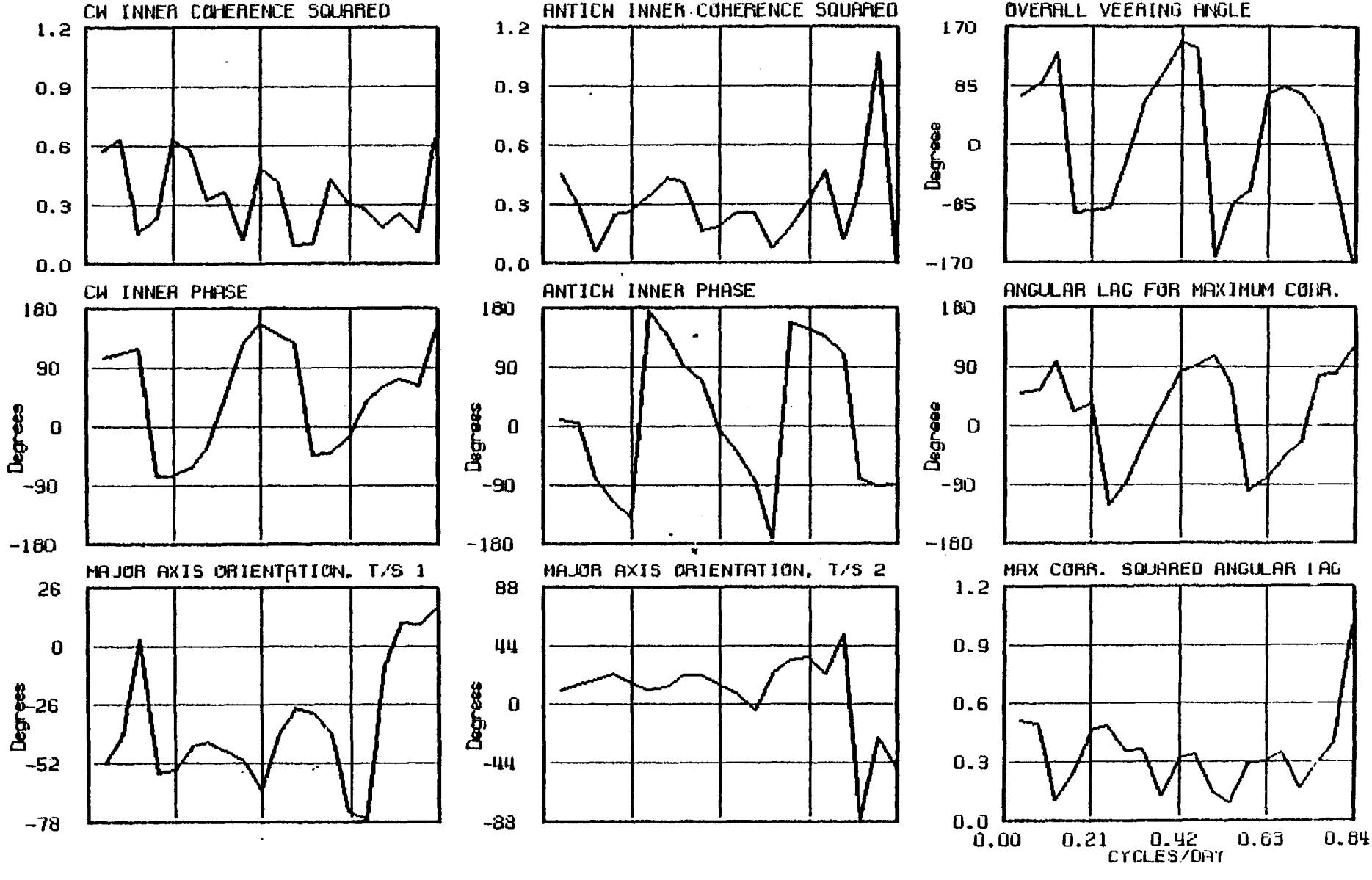


ROTARY SPECTRAL QUANTITIES

FILE: SNGBSP85.R40

SERIES #1: SAVANNAH WINDS M/S /40HLP/R-200

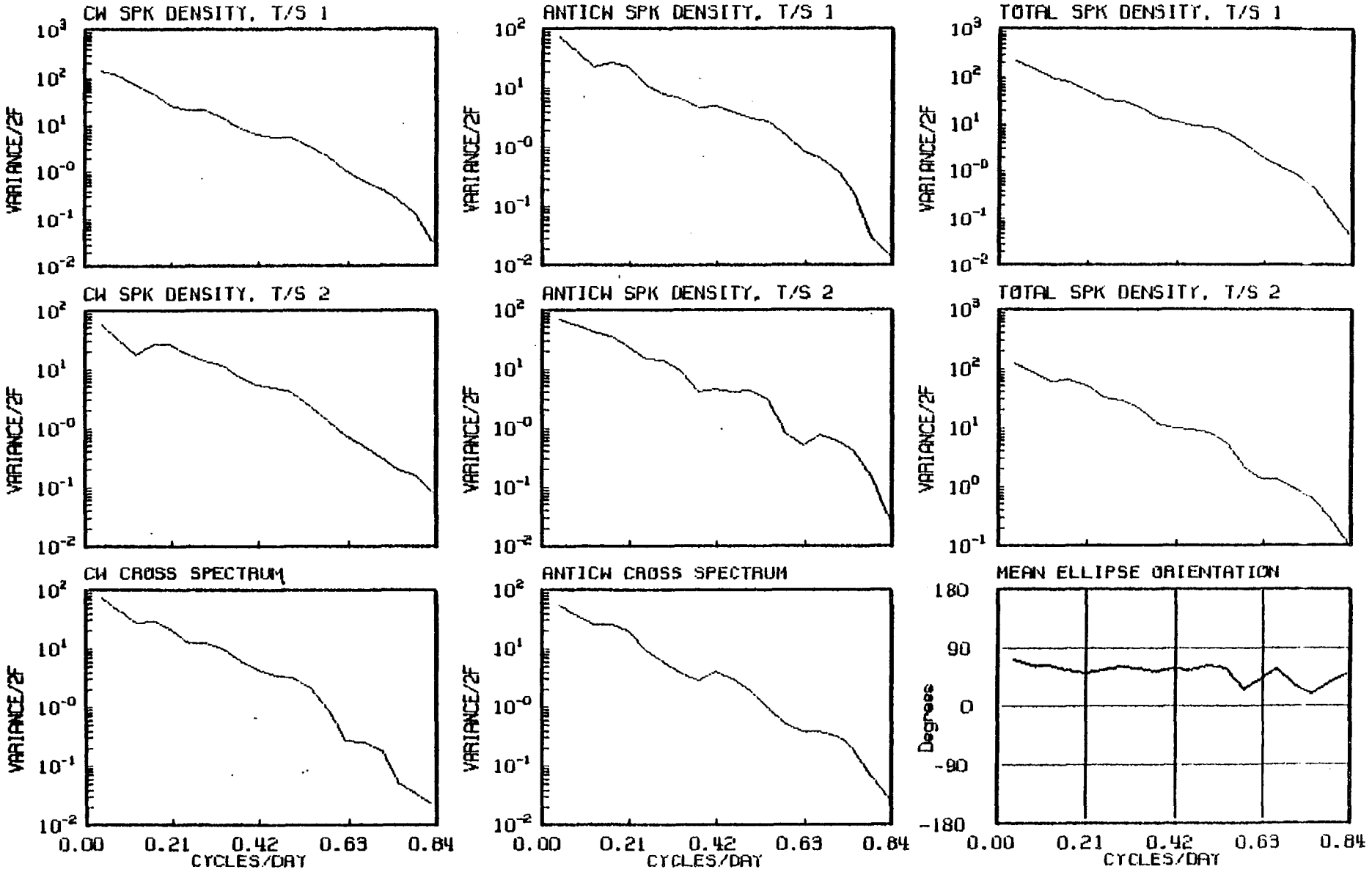
SERIES #2: GRAYS REEF/GRAYS/BOTT/SP85/LP40/R-20



ROTARY SPECTRAL QUANTITIES

FILE: SNGBSU85.R40

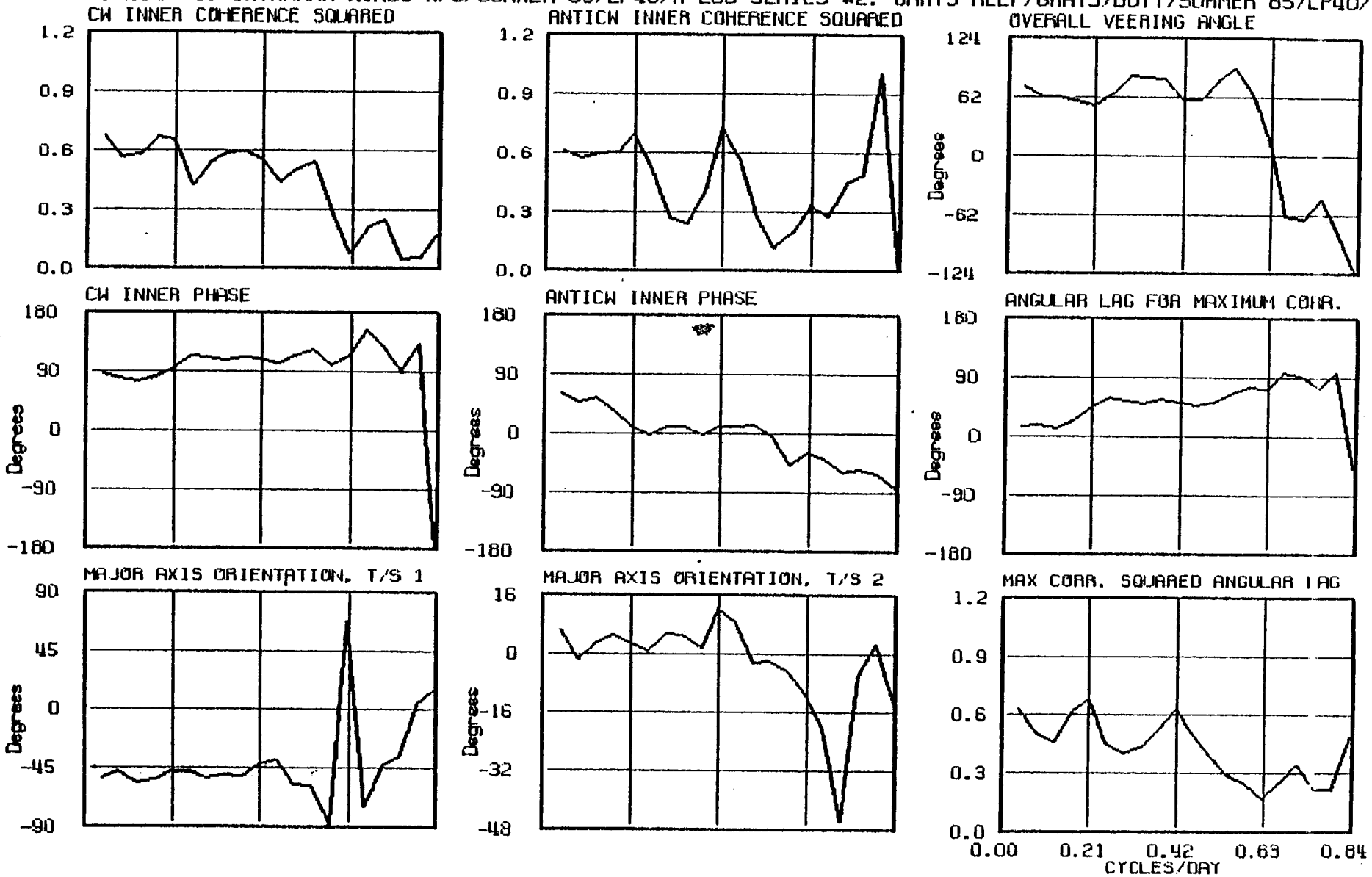
SERIES #1: SAVANNAH WINDS M/S/SUMMER 85/LP40/R-200 SERIES #2: GRATS REEF/GRATS/BOTT/SUMMER 85/LP40/R-20



ROTARY SPECTRAL QUANTITIES

FILE: SNGBSU85.R40

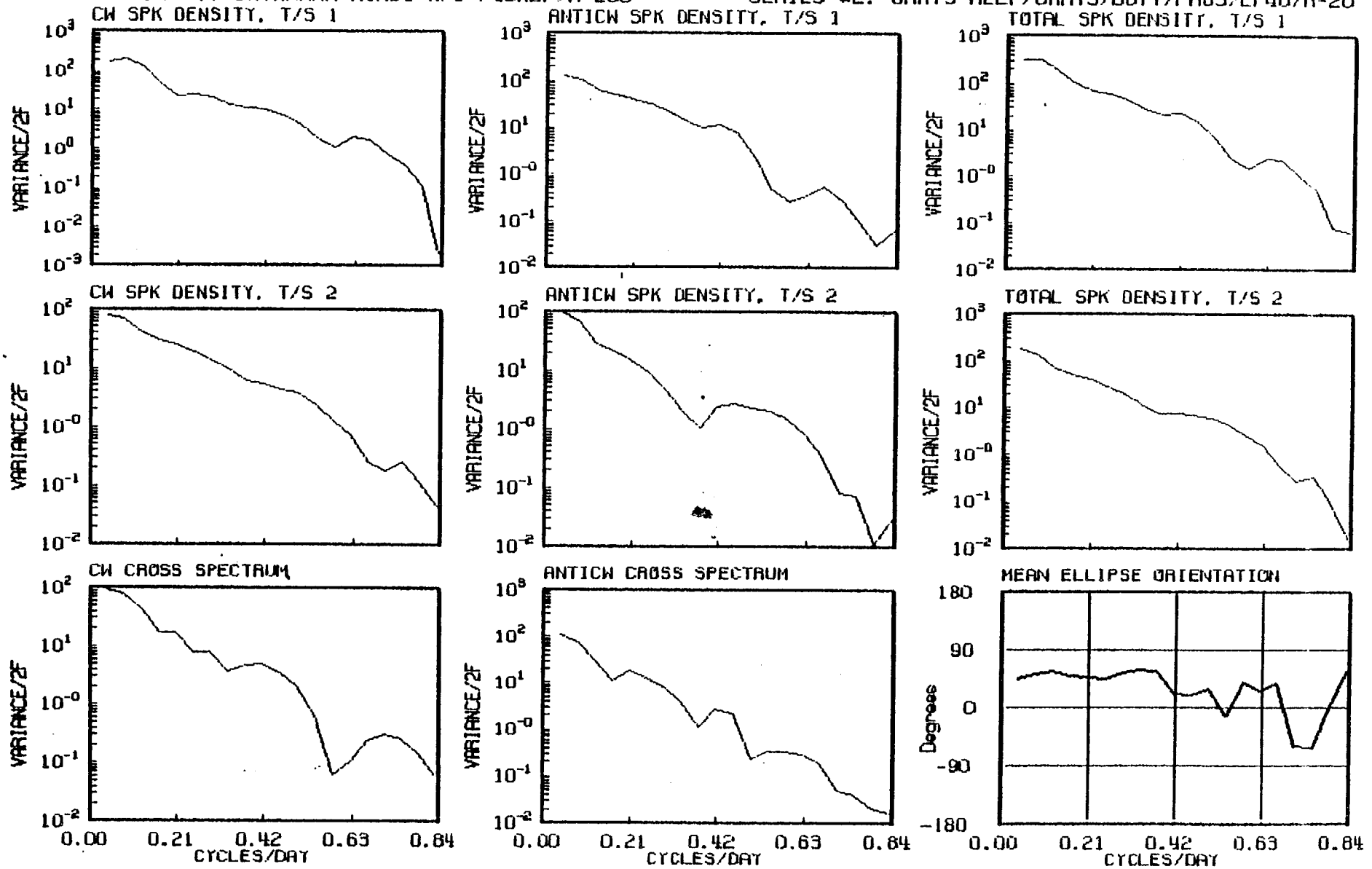
SERIES #1: SAVANNAH WINDS M/S/SUMMER 85/LP40/R-200 SERIES #2: GRAYS REEF/GRAYS/BOTT/SUMMER 85/LP40/R-20



ROTARY SPECTRAL QUANTITIES

FILE: SNGBFA85.R40

SERIES #1: SAVANNAH WINDS M/S /40HLP/R-200 SERIES #2: GRAYS REEF/GRAYS/BOTT/FA85/LP40/R-20

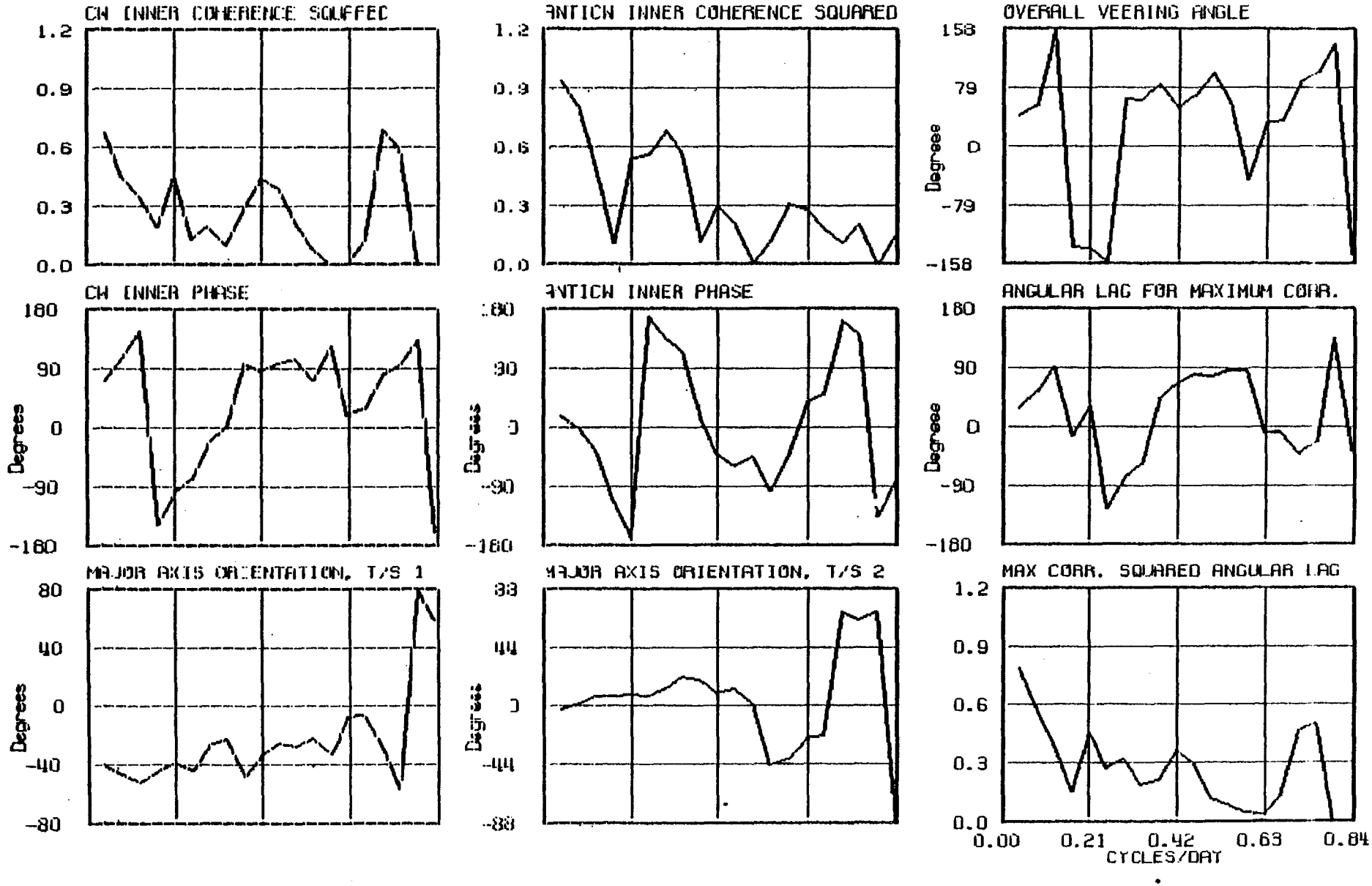


ROTARY SPECTRAL QUANTITIES

FILE: SNGBFA85.R40

SERIES #1: SAVANNAH WINDS M/S /4CFLP/R-200

SERIES #2: GRAYS REEF/GRAYS/BOTT/FA85/LP40/R-20

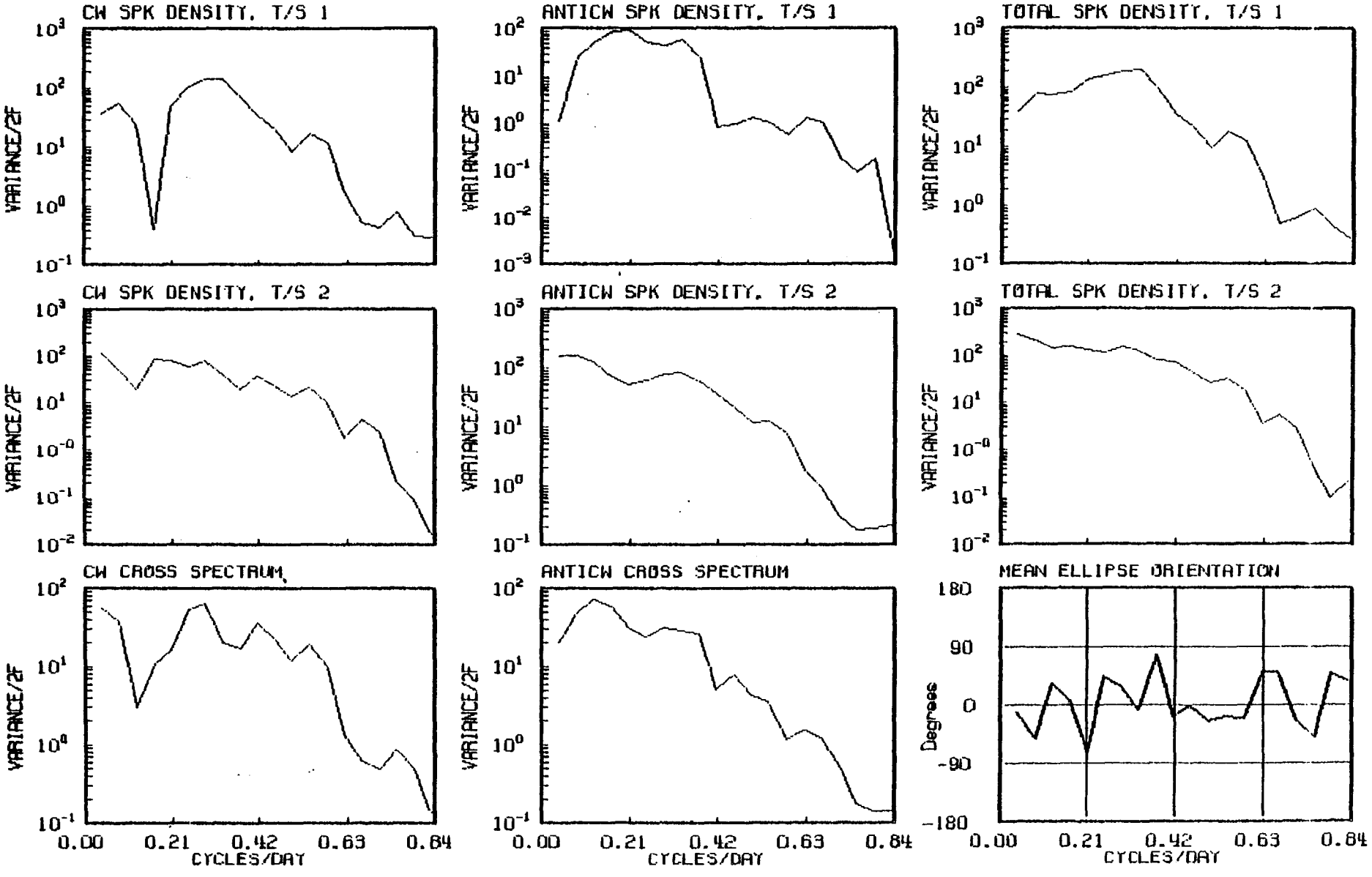


ROTARY SPECTRAL QUANTITIES

FILE: SNGTSP85.R40

SERIES #1: SAVANNAH WINDS N/S /40HLP/R-200

SERIES #2: GRAYS REEF/GRAYS/TOP/SP85/LP40/R-20

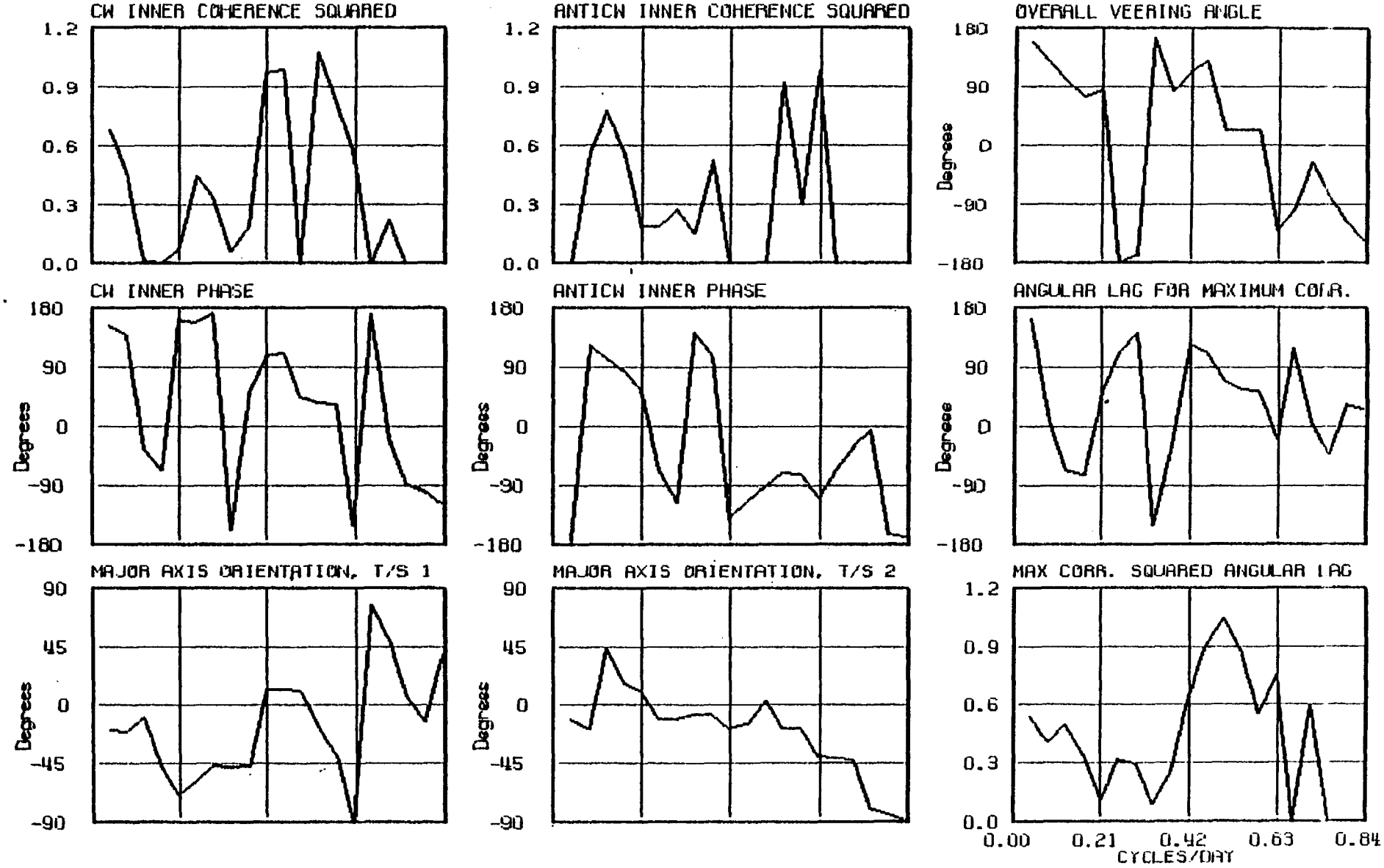


ROTARY SPECTRAL QUANTITIES

FILE: SNCTSP85.R40

SERIES #1: SAVANNAH WINDS M/S /40HLP/R-200

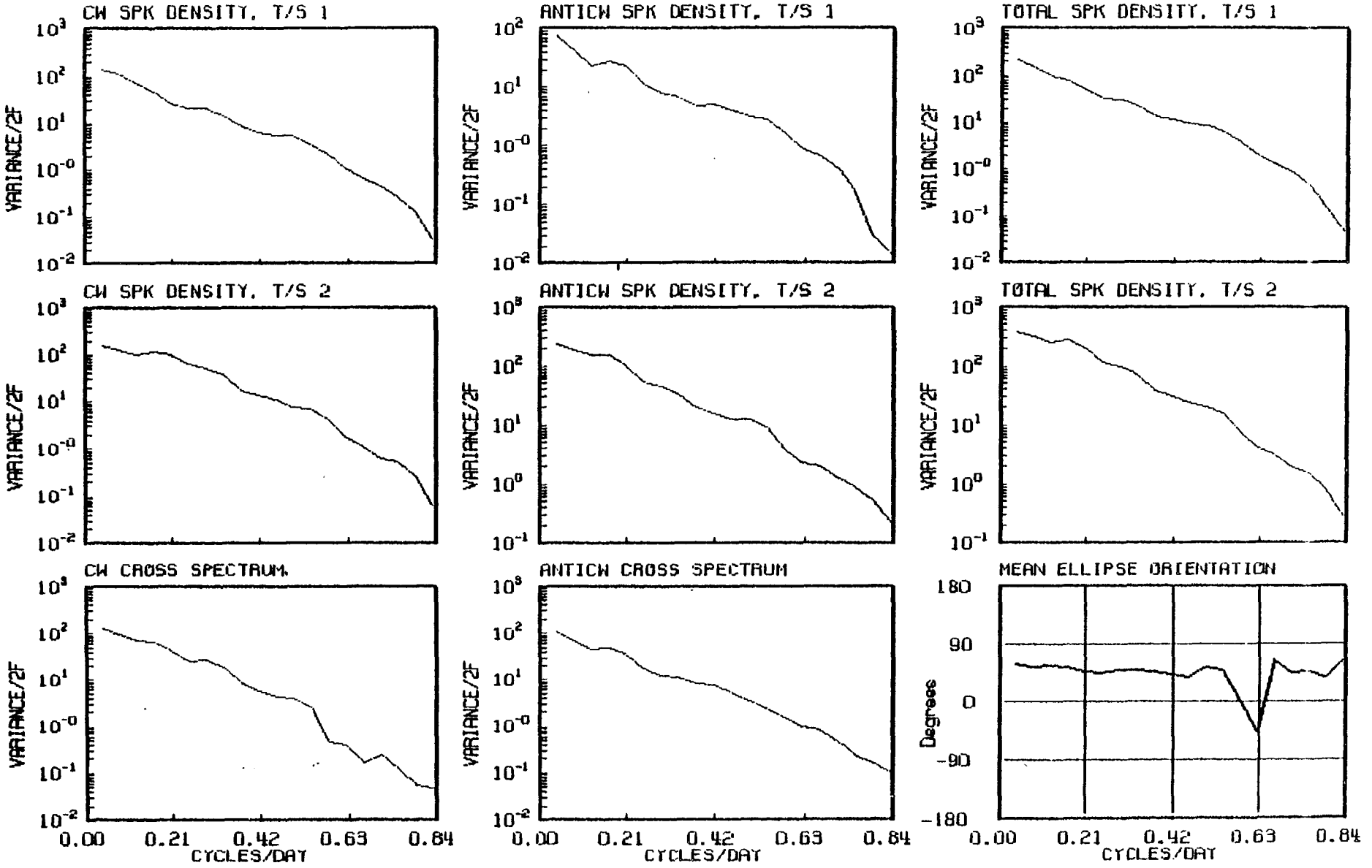
SERIES #2: GRAYS REEF/GRAYS/TOP/SP85/LP40/R-20



ROTARY SPECTRAL QUANTITIES

FILE: SNGTSU85.R40

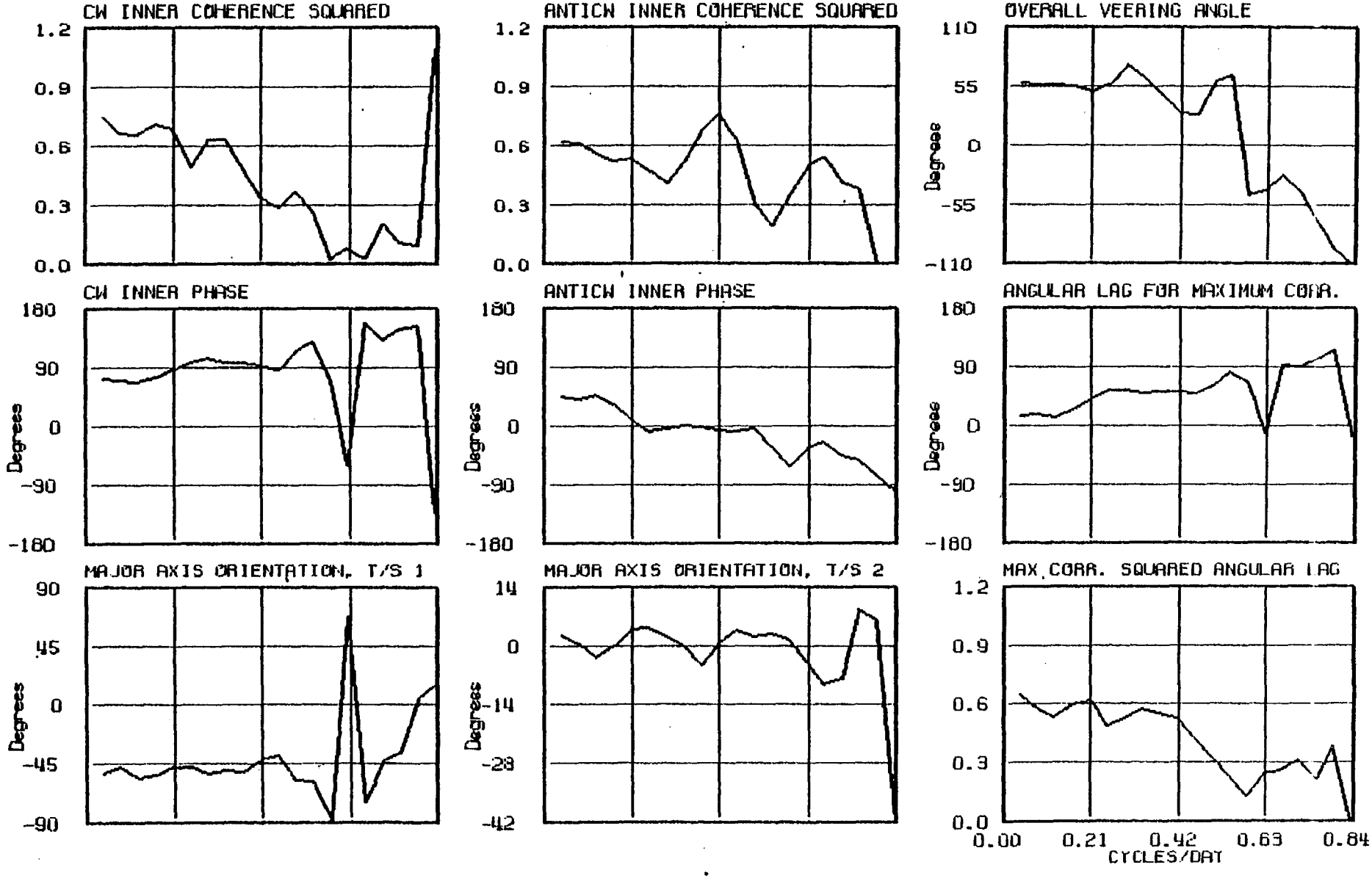
SERIES #1: SAVANNAH WINDS M/S/SUMNER 85/LP40/R-200 SERIES #2: GRATS REEF/GRATS/TOP/SU85/LP40/R-20



ROTARY SPECTRAL QUANTITIES

FILE: SNGTSU85.R40

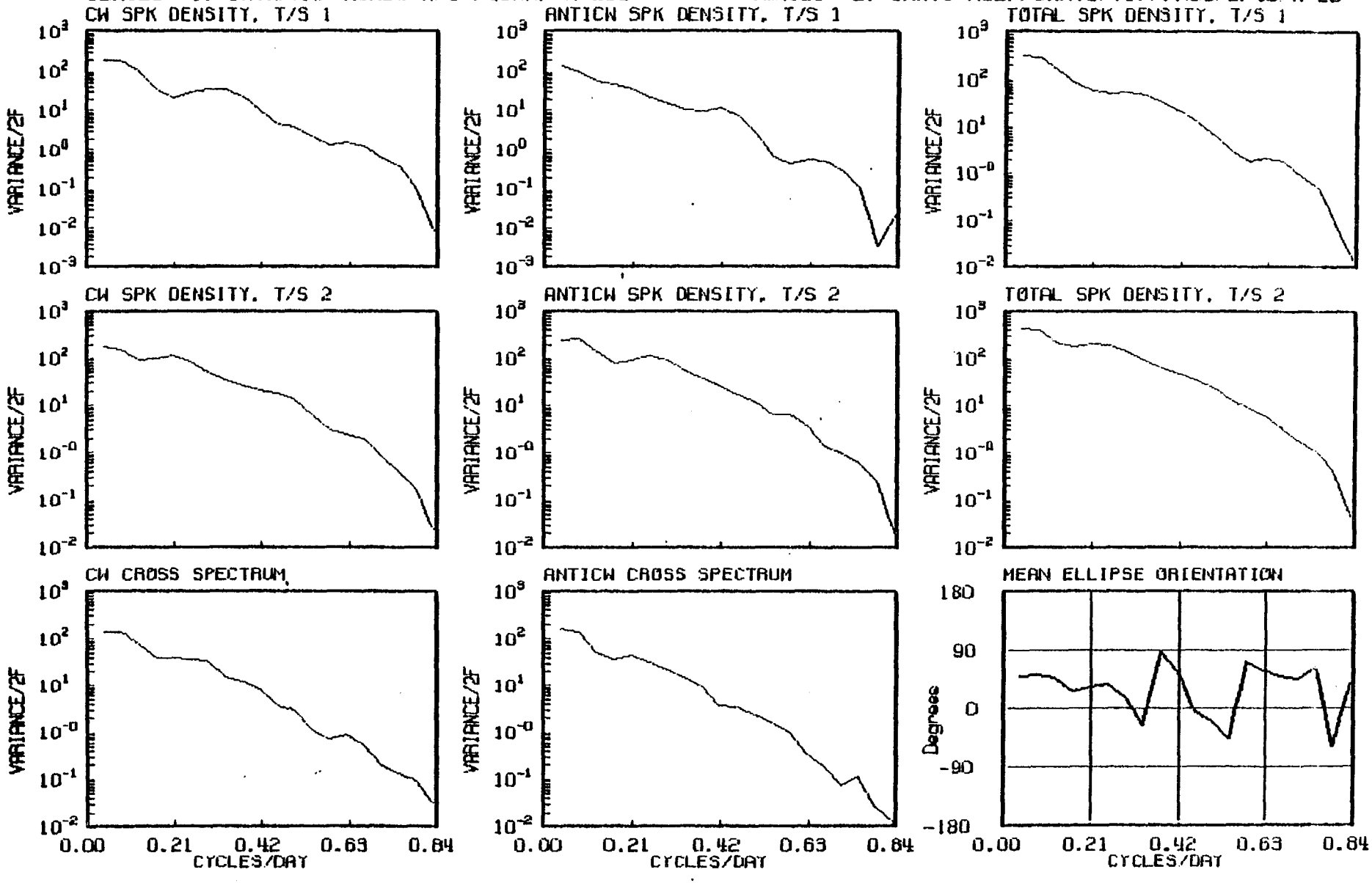
SERIES #1: SAVANNAH WINDS M/S/SUMMER 85/LP40/R-200 SERIES #2: GRAYS REEF/GRAYS/TOP/SU85/LP40/R-20



ROTARY SPECTRAL QUANTITIES

FILE: SNGTFA85.R40

SERIES #1: SAVANNAH WINDS M/S /40HLP/R-200 SERIES #2: GRAYS REEF/GRAYS/TOP/FA85/LP40/R-20

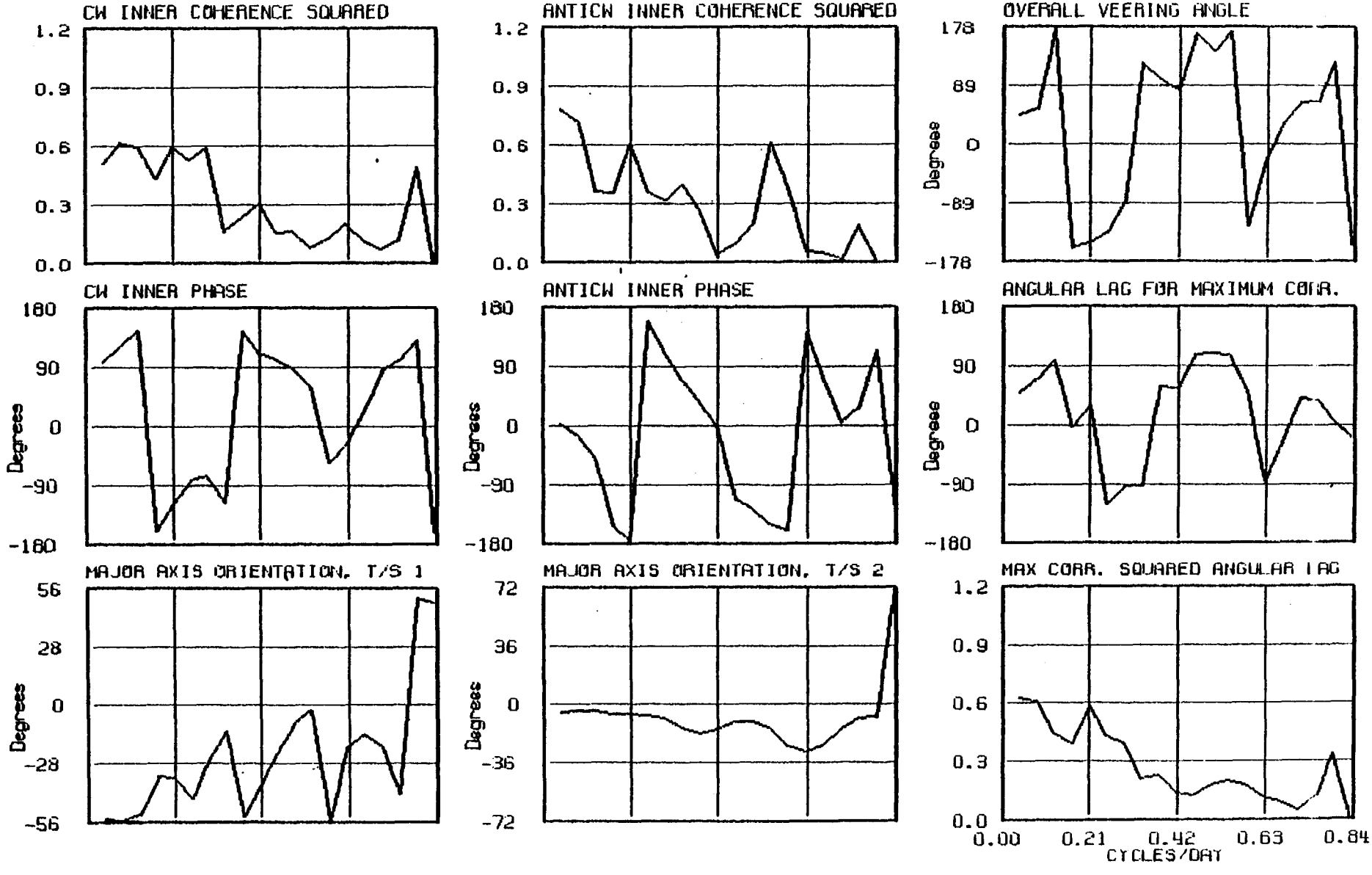


ROTARY SPECTRAL QUANTITIES

FILE: SNGTFA85.R40

SERIES #1: SAVANNAH WINDS M/S /40HLP/R-200

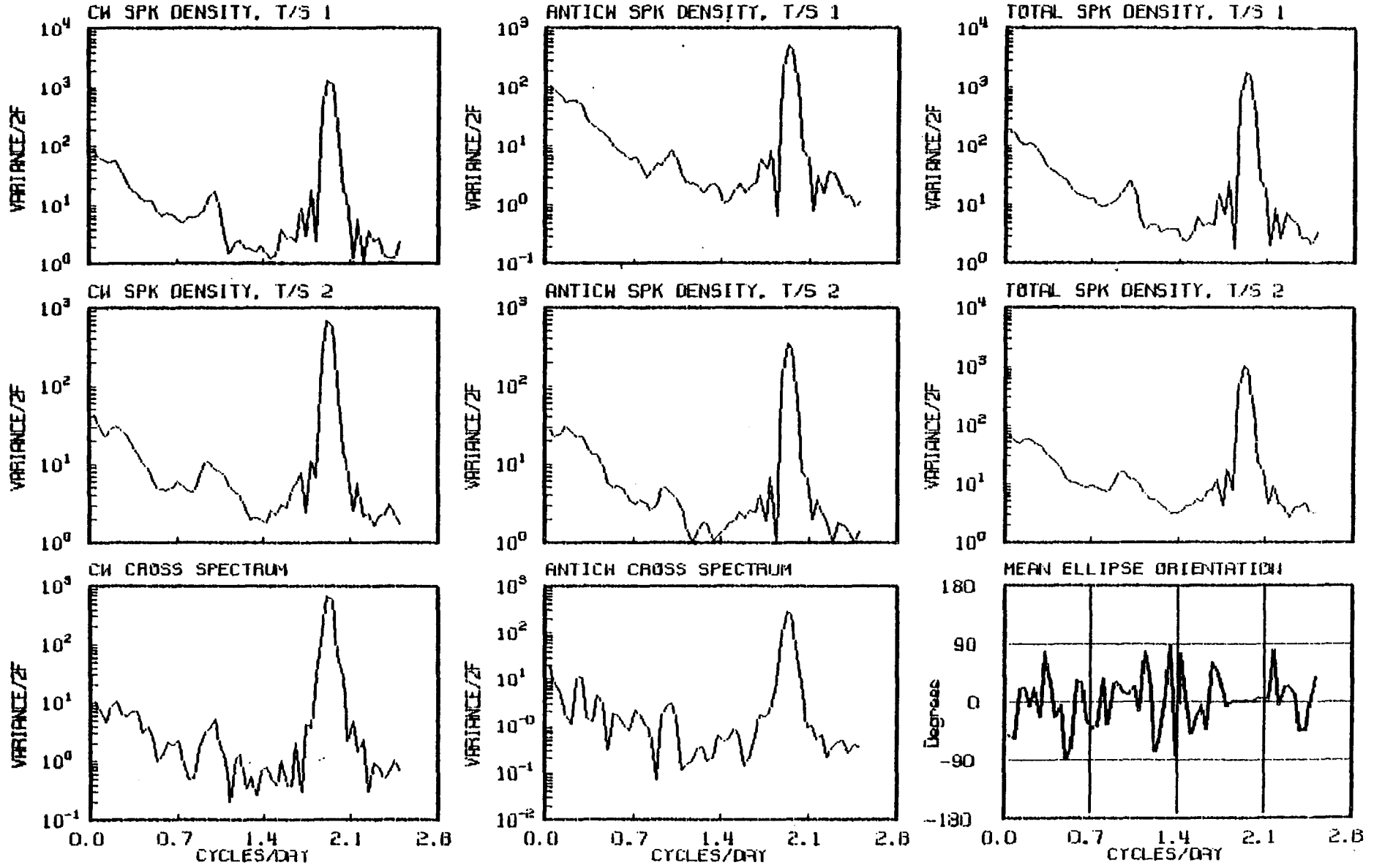
SERIES #2: GRATS REEF/GRATS/TOP/FA85/LP40/R-20



ROTARY SPECTRAL QUANTITIES

FILE: GTGB.A3

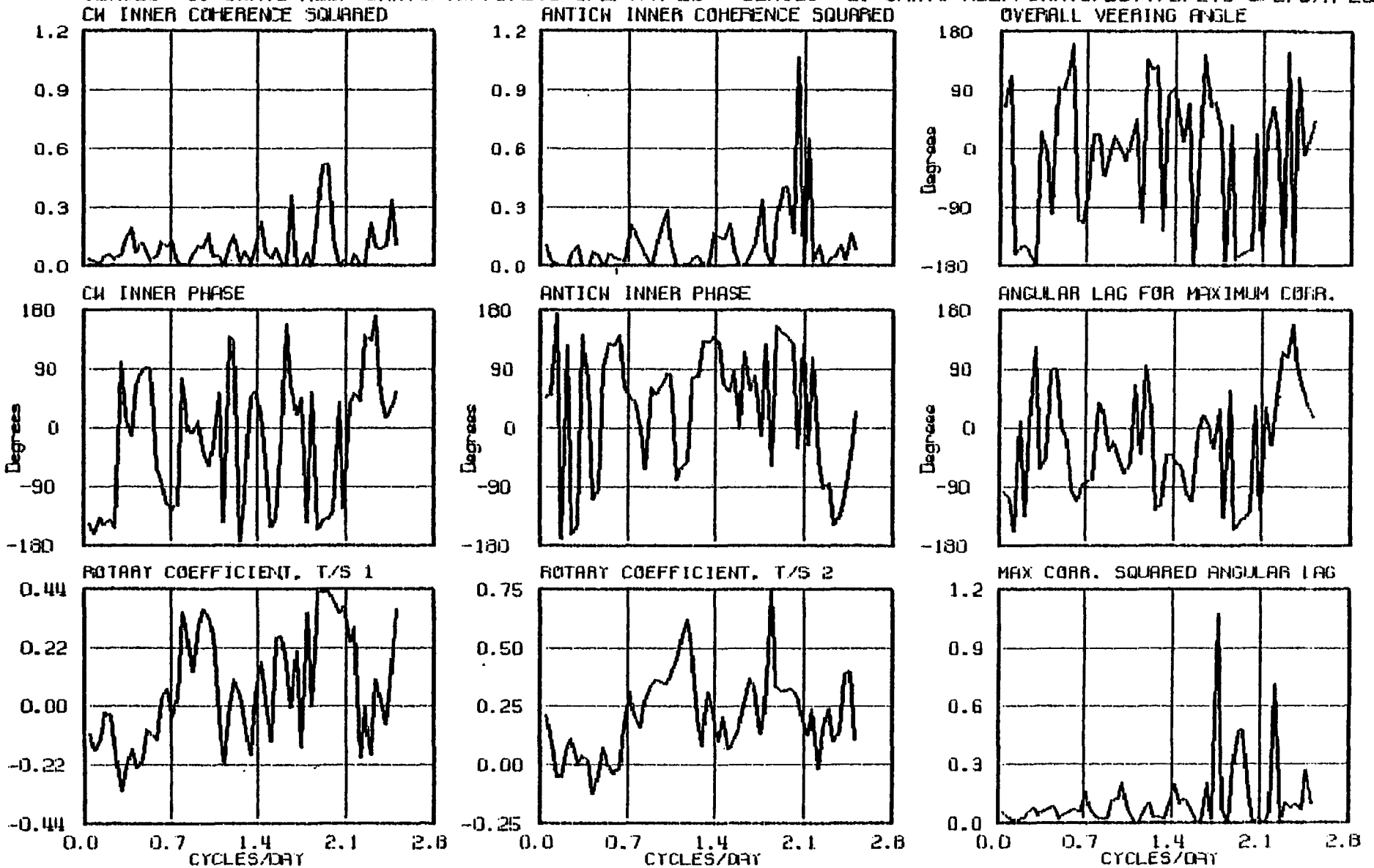
SERIES #1: GRATS REEF/GRATS/TOP/DPLTS-6/LP3/R-20 SERIES #2: GRATS REEF/GRATS/BOTT/DPLTS-6/LP3/R-20



ROTARY SPECTRAL QUANTITIES

FILE: GTGB.A3

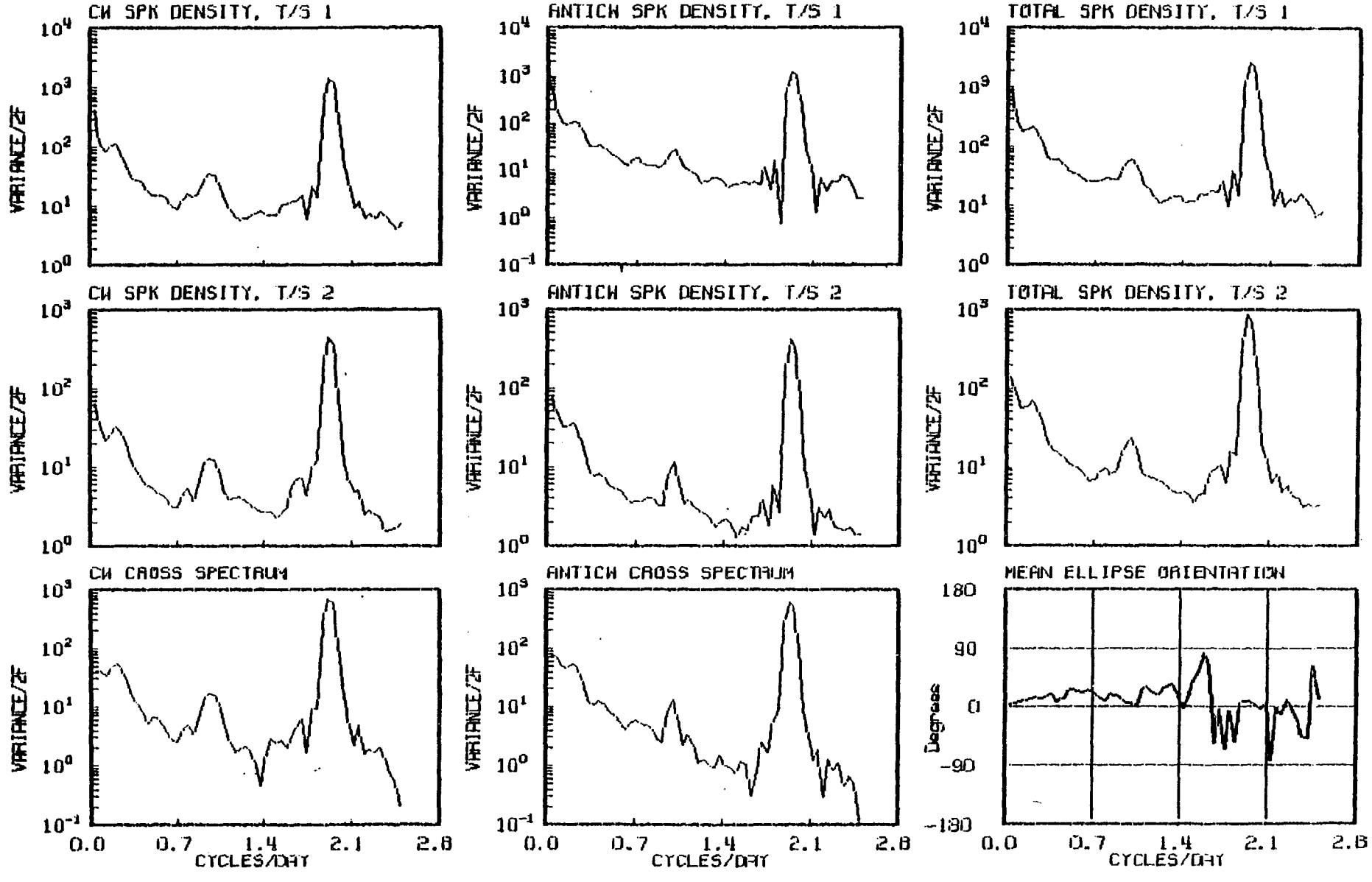
SERIES #1: GRAYS REEF/GRAYS/TOP/DPLY5-6/LP3/R-20 SERIES #2: GRAYS REEF/GRAYS/BOTT/DPLY3-6/LP3/R-20



ROTARY SPECTRAL QUANTITIES

FILE: FTFB.A3

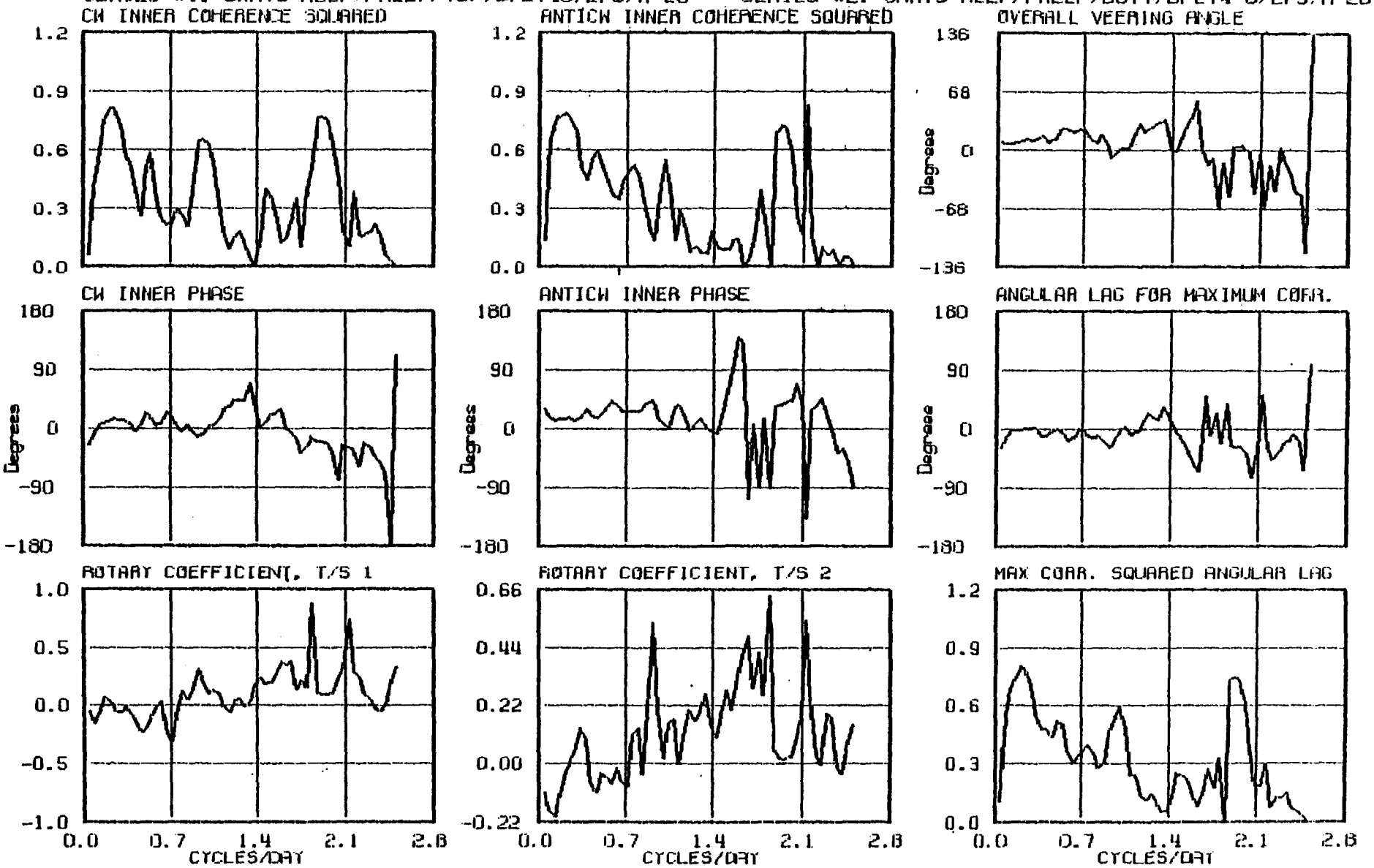
SERIES #1: GRATS REEF/FREEF/TOP/DPLY46/LPS/R-20 SERIES #2: GRATS REEF/FREEF/BOTT/DPLY4-6/LPS/R-20



ROTARY SPECTRAL QUANTITIES

FILE: FTFB.A3

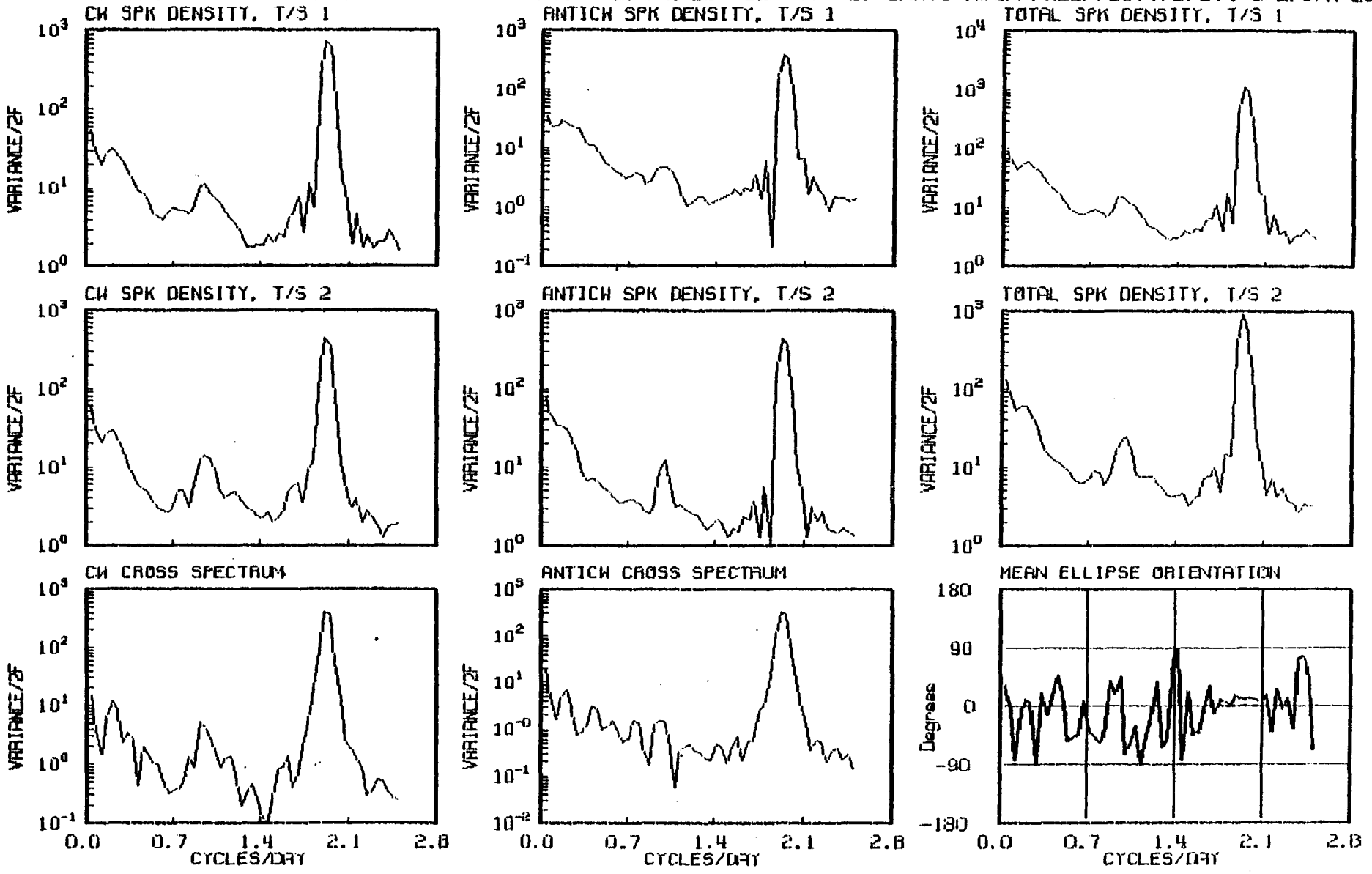
SERIES #1: GRATS REEF/FREEF/TOP/DPLY48/LP3/R-20 SERIES #2: GRATS REEF/FREEF/BOTT/DPLY4-6/LP3/R-20



ROTARY SPECTRAL QUANTITIES

FILE: GBFB.R3

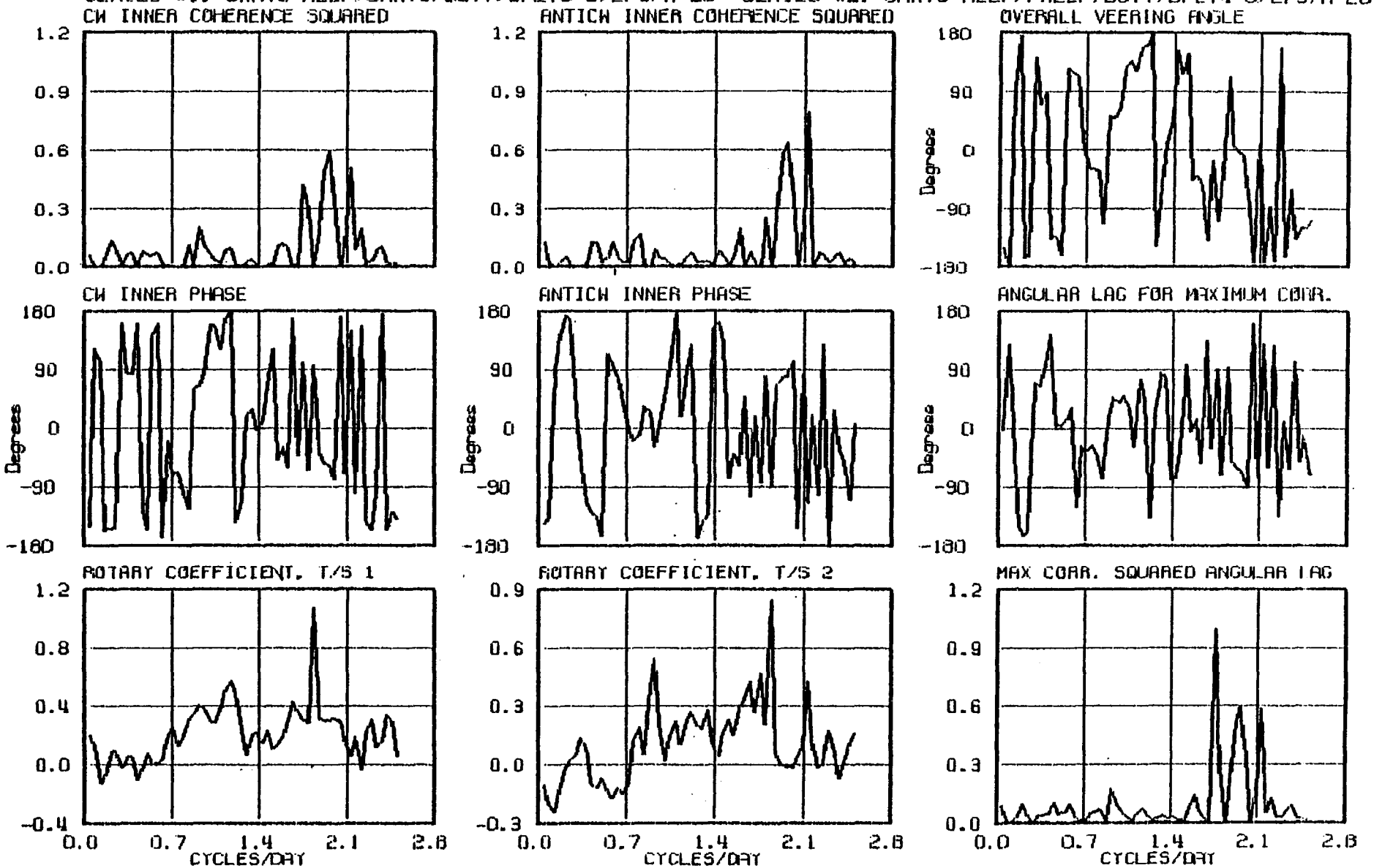
SERIES #1: GRAYS REEF/GRAYS/BOTT/DPLY3-6/LP3/R-20 SERIES #2: GRAYS REEF/FREEF/BOTT/DPLY4-6/LP3/R-20



ROTARY SPECTRAL QUANTITIES

FILE: GBFB.A3

SERIES #1: GRAYS REEF/GRAYS/BOTT/DPLY3-6/LP3/A-20 SERIES #2: GRAYS REEF/FREEF/BOTT/DPLY4-6/LP3/A-20



Appendix E: Directories of 3 Hour Low Passed Data Files

```
.....................................................................
     SAVANNAH WINDS M/S LP3/R-20
     LENGTH:    5417          LATITUDE :   0 D   .0 M N  WATER DEPTH  :     .0 M
     START :   38428.00 HRS   LONGITUDE:   0 D   .0 M W  ABOVE BOTTOM :     .0 M
     DELTAT:       1.00 HRS                              BELOW SURFACE:     .0 M
     FROM     : 1984 MAY19(140),15 0Z  0.  0 TO 1984 DEC31(366), 7 0Z  0.  0
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     GRAY'S REEF/GRAY'S/TOP/DPLY1/LP3/R-70(DIR. PROBLEM)
     LENGTH:    2076          LATITUDE :  31 D 24.0 M N  WATER DEPTH  :   21.3 M
     START :   38735.50 HRS   LONGITUDE:  80 D 52.1 M W  ABOVE BOTTOM :     .0 M
     DELTAT:       1.00 HRS                              BELOW SURFACE:    6.1 M
     FROM     : 1984 JUN 1(153),1030Z  0.  0 TO 1984 AUG26(239),2130Z  0.  0
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     GRAY'S REEF/GRAY'S/TOP/DPLY2/LP3/R-20
     LENGTH:    1333          LATITUDE :  31 D 24.0 M N  WATER DEPTH  :   21.3 M
     START :   42022.50 HRS   LONGITUDE:  80 D 52.1 M W  ABOVE BOTTOM :     .0 M
     DELTAT:       1.00 HRS                              BELOW SURFACE:    6.1 M
     FROM     : 1984 OCT16(290), 930Z  0.  0 TO 1984 DEC10(345),2130Z  0.  0
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     GRAY'S REEF/GRAY'S/TOP/DPLY5-6/LP3/R-20
     LENGTH:    5271          LATITUDE :  31 D 24.0 M N  WATER DEPTH  :   21.3 M
     START :   46796.50 HRS   LONGITUDE:  80 D 52.1 M W  ABOVE BOTTOM :     .0 M
     DELTAT:       1.00 HRS                              BELOW SURFACE:    6.1 M
     FROM     : 1985 MAY 3(123), 730Z  0.  0 TO 1985 DEC 8(342),2130Z  0.  0
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     GRAY'S REEF/GRAY'S/BOTT/DPLY1-2/LP3/R-20
     LENGTH:    4619          LATITUDE :  31 D 24.0 M N  WATER DEPTH  :   21.3 M
     START :   38735.50 HRS   LONGITUDE:  80 D 52.1 M W  ABOVE BOTTOM :     .0 M
     DELTAT:       1.00 HRS                              BELOW SURFACE:   15.2 M
     FROM     : 1984 JUN 1(153),1030Z  0.  0 TO 1984 DEC10(345),2030Z  0.  0
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     GRAY'S REEF/GRAY'S/BOTT/DPLY3-6/LP3/R-20
     LENGTH:    7586          LATITUDE :  31 D 24.0 M N  WATER DEPTH  :   21.3 M
     START :   43389.00 HRS   LONGITUDE:  80 D 52.1 M W  ABOVE BOTTOM :     .0 M
     DELTAT:       1.00 HRS                              BELOW SURFACE:   15.2 M
     FROM     : 1984 DEC12(347), 8 0Z  0.  0 TO 1985 OCT24(297), 9 0Z  0.  0
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     GRAY'S REEF/FREEF/TOP/DPLY1/LP3/R-20
     LENGTH:    2318          LATITUDE :  31 D  5.9 M N  WATER DEPTH  :    7.6 M
     START :   38731.00 HRS   LONGITUDE:  81 D 12.5 M W  ABOVE BOTTOM :     .0 M
     DELTAT:       1.00 HRS                              BELOW SURFACE:   13.7 M
     FROM     : 1984 JUN 1(153), 6 0Z  0.  0 TO 1984 SEP 5(249),19 0Z  0.  0
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     GRAY'S REEF/FREEF/TOP/DPLY3/LP3/R-20
     LENGTH:    2379          LATITUDE :  31 D  5.9 M N  WATER DEPTH  :   13.7 M
     START :   42597.00 HRS   LONGITUDE:  81 D 13.5 M W  ABOVE BOTTOM :     .0 M
     DELTAT:       1.00 HRS                              BELOW SURFACE:    7.6 M
     FROM     : 1984 NOV 9(314), 8 0Z  0.  0 TO 1985 FEB16( 47),10 0Z  0.  0
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     GRAY'S REEF/FREEF/TOP/DPLY46/LP3/R-20
     LENGTH:     6419          LATITUDE :  31 D  5.0 M N  WATER DEPTH  :   13.7 M
     START :   45602.50 HRS    LONGITUDE:  81 D 13.5 M W  ABOVE BOTTOM :     .0 M
     DELTAT:       1.00 HRS                               BELOW SURFACE:    7.6 M
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     GRAY'S REEF/FREEF/BOTT/DPLY3/LP3/R-20
     LENGTH:     2766          LATITUDE :  31 D  5.9 M N  WATER DEPTH  :   13.7 M
     START :   42597.00 HRS    LONGITUDE:  81 D 13.5 M W  ABOVE BOTTOM :     .0 M
     DELTAT:       1.00 HRS                               BELOW SURFACE:   10.7 M
     FROM     : 1984 NOV 9(314), 8 0Z  0.  0 TO 1985 MAR 4( 63),13 0Z  0.  0
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     GRAY'S REEF/FREEF/BOTT/DPLY4-6/LP3/R-20
     LENGTH:     6467          LATITUDE :  31 D  5.9 M N  WATER DEPTH  :   13.7 M
     START :   45603.50 HRS    LONGITUDE:  81 D 13.5 M W  ABOVE BOTTOM :     .0 M
     DELTAT:       1.00 HRS                               BELOW SURFACE:   10.7 M
     FROM     : 1985 MAR14( 73),1430Z  0.  0 TO 1985 DEC 9(343), 030Z  0.  0
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Appendix F: References

Atkinson, L.P., J.O. Blanton and E. Haines. 1978. Shelf flushing rates based on the distribution of salinity and freshwater in the Georgia Bight. Estuarine and Coastal Marine Science 7:465-472.

Blanton, J.O. 1981. Ocean currents along a nearshore frontal zone on the continental shelf of the southeastern U.S. Journal of Physical Oceanography 11: 1627-1637.

Blanton, J.O., and L.P. Atkinson. 1983. Transport and fate of river discharge on the continental shelf of the southeastern United States. Journal of Geophysical Research 88:4730-4738.

Blanton, J.O. Coastal frontal zones as barriers to offshore fluxes of contaminants. Rapp. Proc.-verbeaux Reun. Cons.Int.Explor.Mer. In Press.

Lee, T.N. and D.A.Brooks. 1979. Initial observations of current, temperature and coastal sea level response to atmospheric and Gulf Stream forcing on the Georgia shelf. Geophysical Research Letters 2:321-324.

Pietrafesa, L., J.Blanton, J.Wang, V.Kourafalou,T.Lee and K.Bush. 1985. The tidal regime in the south Atlantic Bight. In: Oceanography of the southeastern United States Continental Shelf. Coastal Estuarine Science, vol 2. American Geophysical Union, Wash.D.C. p. 63-76.

Weber, A.H. and J.O. Blanton. 1980. Monthly mean wind fields for the South Atlantic Bight. Journal of Physical Oceanography 10:1256-1263.

Weisberg, R.H. and L.J. Pietrafesa. 1983. Kinematics and correlation of the surface wind field in the South Atlantic Bight. Journal of Geophysical Research 88:4593-4610.