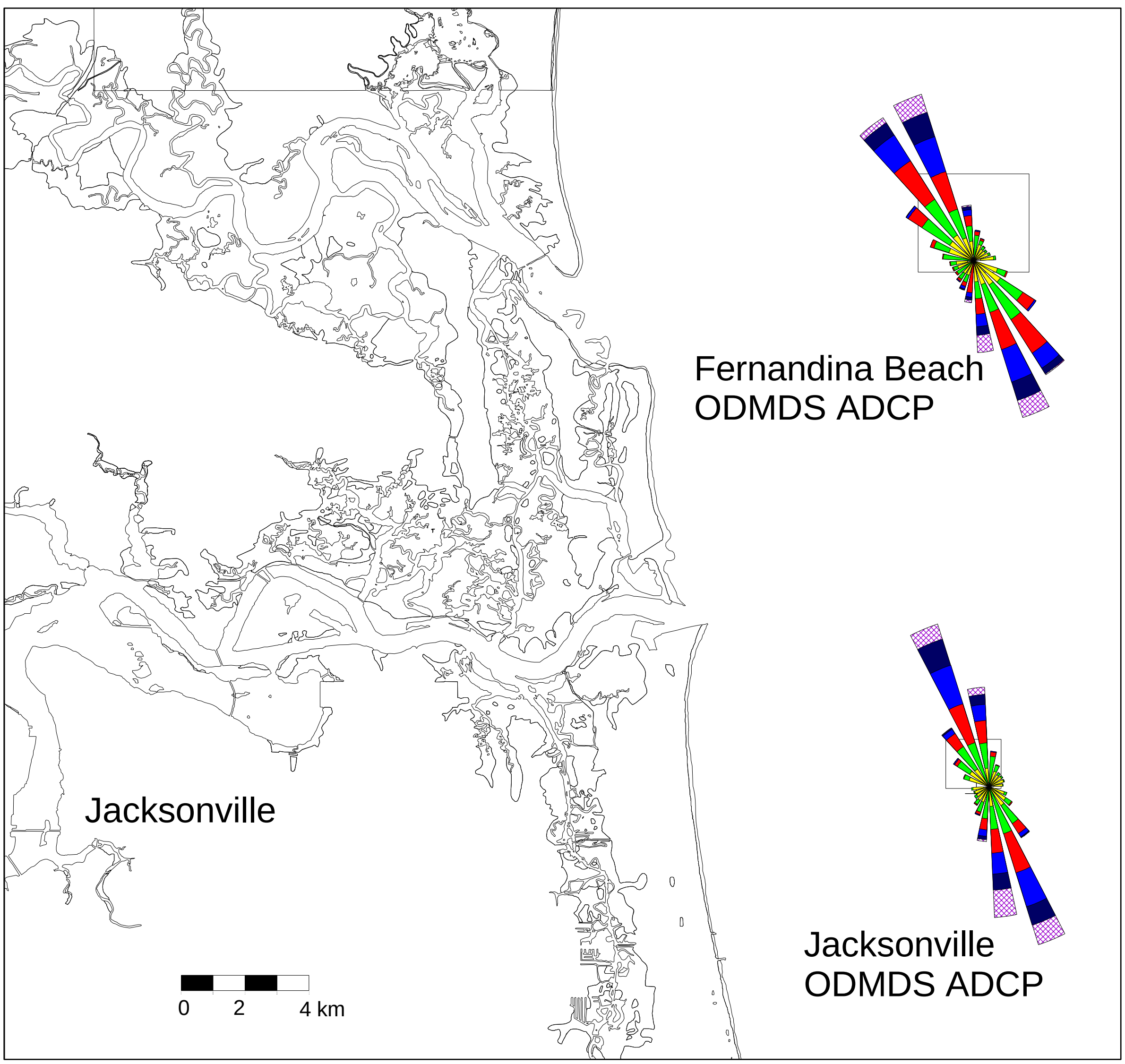
Ocean Current and Wave Measurements at the Jacksonville and Fernandina Beach Ocean Dredged Material Disposal Sites

August 2006 through September 2007



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EPA-904-R-09-001
January 2009

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August 2006 through September 2007

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with funding from:
U.S. Army Corps of Engineers
Jacksonville District
Under Interagency Agreement #RW-96-94593601
MIPR #W32CS561382682 & W32CS572157843

U.S. Environmental Protection Agency Region 4
Atlanta, Georgia

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Ocean Current and Wave Measurements at the Jacksonville and Fernandina Beach Ocean Dredged Material Disposal Sites

1.0 INTRODUCTION

It is the responsibility of the U.S. Environmental Protection Agency (EPA) and the U.S. Army Corps of Engineers (USACE) under the Marine Protection, Research, and Sanctuaries Act (MPRSA) of 1972 to manage and monitor each of the Ocean Dredged Material Disposal Sites (ODMDSs) designated by the EPA pursuant to Section 102 of MPRSA. Additionally, the Memorandum of Understanding (MOU) between EPA Region 4 and the USACE South Atlantic Division specifies that it is in the best interest of the EPA and the USACE to act in partnership concerning the management and monitoring of all ODMDSs.

A Site Management and Monitoring Plan (SMMP) was developed and finalized by the EPA and USACE for the Jacksonville ODMDS in June 1997 and subsequently revised in November 2007. The SMMPs called for the collection of data, including wave conditions and currents at the site, in order to model the capacity of the ODMDS. Current data would also be used for the development of standard water quality model input parameters for dredged material environmental evaluations. A SMMP was developed and finalized for the Fernandina Beach ODMDS in December 1998. This SMMP also called for modeling to determine the capacity of the ODMDS.

In February 2003, EPA Region 4 and the USACE Jacksonville District entered into a joint agreement to jointly manage and monitor ODMDSs within the Jacksonville District. Amendment 2 to the agreement was added in July 2006. This amendment provided funds to EPA to characterize the current and wave climate at the Jacksonville and Fernandina Beach ODMDSs over a period of one year. This report details the results of that study.

2.0 METHODS

2.1 Study Area

The study area consists of the ocean waters within 15 kilometers (8 nautical miles) of the northeast Florida coast. A location approximately 220 meters (725 feet) south of the southwest corner of the Jacksonville ODMDS and 8.7 kilometers (4.7 nautical miles) east of Jacksonville Beach, Florida was selected for the Jacksonville ODMDS instrument deployment. The coordinates of the instrument deployment location are: 30^{o}20.397' N, 81^{o}18.299' W. For the Fernandina Beach ODMDS instrument, a location 426 meters (1,400 feet) inside the southern boundary of the Fernandina Beach ODMDS was selected for instrument deployment. This area is within a buffer area where disposal does not occur and is approximately 14.3 kilometers (7.7 nautical miles) east of Amelia Island, Florida at 30^{o}31.260' N, 81^{o}18.238' W. The Jacksonville ODMDS and Fernandina Beach ODMDS instruments were deployed in water depths of 14.6 meters (48 feet) and 15.5 meters (51 feet), respectively. Instrument locations are shown in figure 1.

2.2 Deployment Periods

A concrete base for the Jacksonville ODMDS instrumentation was designed and built for EPA by the National Oceanic and Atmospheric Administration Atlantic Oceanographic and Meteorological Laboratory in Miami, Florida (figure 2). The base was deployed in May, 2006 from the EPA Ocean Survey Vessel (OSV Bold). A diver deployable fiberglass base manufactured by Ocean Science was utilized at the Fernandina Beach ODMDS (figure 3). The instruments required four deployments each of 3 to 4 months beginning on August 8, 2006. The deployment periods are shown in Table 1.

Table 1: ADCP Deployment Periods

First Ensemble Date-Time (UTC)	Last Ensemble Date-Time (UTC)	Duration
Jacksonville ODMDS		
8/08/2006 23:30hr	10/17/2006 10:45hr	69 days, 11.25 hrs
10/19/2006 16:15hr	02/07/2007 14:15hr	110 days, 22 hrs
02/08/2007 15:15hr	06/05/2007 11:15hr	116 days, 20 hrs
06/06/2007 14:00hr	09/05/2007 11:15hr	90 days, 21.25 hrs
Fernandina Beach ODMDS		
08/09/2006 18:30hr		69 days, 20.25 hrs
10/19/2006 19:45hr	02/08/2007 09:15hr	111 days, 13.5 hrs
02/08/2007 22:00hr	06/06/2007 16:30hr	117 days, 18.5 hrs
06/06/2007 18:45hr	09/05/2007 18:00hr	90 days, 23.25 hrs

2.3 Instrumentation

600 kHz Acoustic Doppler Current Profilers (ADCP) manufactured by RD Instruments were used to measure wave parameters and currents at the Jacksonville ODMDS and currents only at the Fernandina Beach ODMDS. The Coastal Data Information Program (CDIP) maintains a Datawell directional wave buoy 18 kilometers (10 nautical miles) north of the Fernandina ODMDS at 30^{o}43.12' N, 81^{o}17.57' W and at a water depth of 16 meters (53 feet). These buoys use hippy heave-pitch-roll sensors to measure wave direction as well as wave energy (CDIP, 2008). Data from this instrument was used to characterize waves at the Fernandina Beach ODMDS.

ADCPs work by transmitting sound along four separate beams at a fixed frequency and listening to the echoes returned by sound scatterers, such as plankton or small particles, in the water. By calculating the Doppler shift and time of travel of the echoes, the ADCP can calculate velocities for various depths in the water. The calculations performed by the instrument split the water column into equally sized depth cells or bins (in this case the bin size was set at 0.5 m). In each bin, an average velocity vector is calculated. The raw data from the instrument is reported as a velocity magnitude and direction for each bin.

To calculate wave parameters, the wave orbital velocities below the surface are measured by the ADCP. To get a surface height spectrum the velocity spectrum is translated to surface displacement using linear wave kinematics. The ADCP can also measure wave height spectra from its pressure sensor and from echo ranging the surface. For directional spectrum, each depth cell of the ADCP can be considered to be an independent sensor that makes a measurement of one component of the wave field velocity. The ensemble of depth cells along the four beams constitutes an array of sensors from which magnitude and directional information about the wave field can be determined. (Strong, 2000)

In this study the velocity or current profile was sampled every 15 minutes and waves every three hours using the ADCP. Wave data from the CDIP instrument is collected every hour. EPA instrument settings are summarized in table 2.

Table 2: ADCP Settings

ADCP Setup	**Jacksonville ODMDS**	**Fernandina Beach ODMDS**
Number of Bins	35	28-30
Bin Size (m)	0.50 (1.6 ft)	0.50 (1.6 ft)
Pings per Ensemble- Currents	360	150-210
Interval - Currents (h:m:s)		00:15:00
Burst Duration - Waves (minutes)	20	N/A
Burst Interval - Waves (h:m:s)	03:00:00	N/A
Salinity (ppt)	35	35
Magnetic Variation (degrees)	-5.7	-5.7
Temperature (C)	25.5	20
First Bin Range (m)	1.5 (4.9 ft)	1.5 (4.9 ft)
Last Bin Range (m)	19 (62 ft)	15-16 (49-53 ft)
Battery Usage (Wh) / Maximum Deployment Duration (days)	1410 / 130	400/115
Available Storage / Required Storage (MB)	600 / 196	10 / 8
Minimum Observable Wave Period for non-directional (sec)	2.02	N/A

ADCP Setup	**Jacksonville ODMDS**	**Fernandina Beach ODMDS**
Minimum Observable Wave Period for directional (sec)	3.01	N/A
Samples per Wave Burst	2400	N/A
Altitude of Sensor Head above the bottom (m)	0.51 (1.6 ft)	0.46 (1.5 ft)

The ADCPs were mounted in the bases with their face oriented up at approximately 0.5 meters above the bottom. Therefore, the first bin measurement is actually approximately two meters above the bottom.

2.4 Data Analysis

2.4.1 Wave Data

Raw binary data files from the instrument were converted utilizing the RD Instruments software WaveMon® into binary waves data files and binary current data files utilizing the protocols and processing options outlined in the United States Geological Survey (USGS) Wave Data Processing Toolbox Manual (USGS, 2006). The USGS Wave Data Processing Toolbox MATLAB® programs were used to remove out-of-water data collected during instrument deployment and recovery and to convert the statistical wave parameters to EPIC-standard variables (NOAA-PMEL, 2006) and write the data to a NetCDF file (Unidata, 2008) for distribution and archival. The NetCDF format embeds a metadata structure with the data to document pertinent information regarding the deployment and the parameters used to process the data. NetCDF data is portable to any computer platform and is viewable with public-domain freely available software (e.g. ncbrowse).

Wave parameters for the Fernandina Beach ODMDS were extracted from the CDIP website for the months of interest. For both locations, summary and statistical information are presented for significant wave height (average of the 1/3 largest wave), dominant (or peak) wave period, and dominant wave direction

2.4.2 Current Data

Current data was processed using the USGS ADCP Data Processing System (USGS, 2005) and CMGTool (USGS, 2002). The ADCP Data Processing System consists of a series of MATLAB® programs that allows for data editing and quality assessment and converts the data into NetCDF format with embedded metadata and in an EPIC compatible format. The ADCP Data Processing System was used to check the data files for missing ensembles and to remove bad data from the beginning and end of the files. CMGTooL provides a library of MATLAB® programs for analyzing ADCP data. These programs were used to conduct smoothing and lowpass filtering of the data.

Because the ADCP reports current data for bins beyond the surface, the bins beyond the surface need to be removed from the record. The depth and surface bins were determined using the depths reported in the ADCP Data Processing System from the pressure sensor and/or the echo return intensity. For the Jacksonville ODMDS, the depth was determined to vary from 12.5 to 16 meters (41 to 52.5 feet) above the ADCP corresponding to bins 23 to 30. For the Fernandina Beach ODMDS, the depth was determined to vary from 13 to 16 meters (43.7 to 52.5 feet) above the ADCP corresponding to bins 23 to 30. However, due to the instrument setup (see table 2) the surface was sometimes slightly above the range of the Fernandina Beach ODMDS instrument and a consistent depth reading was not discernable for all deployments at high tide.

Additionally, the surface can provide scatterers in the water column that can overwhelm the side lobe suppression of the transducers. Therefore, RD Instruments (1996) cautions that data from the upper 6% of the water column can be contaminated. Echo intensity and percent good values for each bin were examined. Percent good values report percentages of 1) 3-beam transformations, 2) transformations rejected, 3) more than one bad beam and 4) 4-beam transformations for each bin and ensemble. These were examined and it was found that there were consistently a high percentage of 4 beam transformations in bins 1 through 20 for the Jacksonville ODMDS data and bins 1 through 22 for the Fernandina Beach ODMDS. Therefore, it was determined that bins 1 through 20 and 1 through 22 provide reliable current data for the Jacksonville and Fernandina Beach ODMDSs, respectively. This correlates to 1.5 to 11 meters (4.9 to 36 feet) above the instrument face for the Jacksonville ODMDS and 1.5 to 12 meters (4.9 to 39 feet) for Fernandina Beach ODMDS.

Surface, bottom and depth average currents were analyzed. Bin 20 (11 meters or 36 feet) and bin 22 (12 meters or 39.4 feet) were selected to represent surface currents at the Jacksonville and Fernandina Beach ODMDSs, respectively. Bin 1 was used to represent bottom currents at both ODMDSs. To determine average currents, the bins were averaged from bin 1 to the surface bin. To average over the bins, each corresponding magnitude and direction value were used to calculate a north and east component for that bin at the specific time (ensemble). The north and east components were then averaged for each ensemble. These average north and average east components were then used to calculate an average current magnitude and direction for each ensemble. Tidal components were examined after smoothing the data over one hour periods utilizing both a low pass filter (USGS, 2002) and classical tidal harmonic analysis using a set of MATLAB® programs, T_Tide (Pawlowicz et. al., 2002). Harmonic analysis was conducted for a 1 year data record beginning September 1, 2006.

3.0 RESULTS

3.1 Jacksonville ODMDS Waves

A wave rose for the entire deployment period is shown in figures 4 and 5 for wave height and period, respectively. Waves are predominately out of the east and few exceed 2 meters (6.6 feet) in height or 15 seconds in period. Figure 6 shows the wave roses for each quarterly deployment. Figures 7 and 8 show box plots of the monthly significant wave heights and wave periods, respectively. Monthly median significant wave heights ranged from 0.6 meters (2 feet) in February to 1.1 meters (3.6 feet) in May. Wave periods were typically in the 4 to 12 second range. Histograms of significant wave height and wave period are shown in figures 9 and 10. Overall, the median and mean wave heights were 0.80 and 0.90 meters (2.6 and 3.0 feet), respectively. The median and mean wave period was 7.1 and 7.2 seconds, respectively.

3.2 Fernandina Beach ODMDS Waves

A wave rose for the entire deployment period is shown in figures 11 and 12 for wave height and period, respectively. Waves are predominately out of the east and few exceed 2 meters (6.6 feet) in height or 15 seconds in period. Figure 13 shows the wave roses for each quarterly deployment. Figures 14 and 15 show box plots of the monthly significant wave heights and wave periods, respectively. Monthly median significant wave heights ranged from 0.6 meters (2 feet) in February to 1.1 meters (3.6 feet) in May. Wave periods were typically in the 4 to 12 second range. Histograms of significant wave height and wave period are shown in figures 16 and 17. Overall, the median and mean wave height was 0.78 and 0.87 meters (2.6 and 2.9 feet), respectively. The median and mean wave period was 7.7 and 7.9 seconds, respectively. For comparison, historical wave statistics from the CDIP web page for this station are provided in Appendix D.

3.3 Jacksonville ODMDS Currents

A current rose for depth average currents for the entire deployment period is shown in figure 18. Currents flow is predominately in the north-northwest and south-southeast direction and rarely exceeds 30 cm/sec (1.0 ft/sec) in magnitude. Quarterly current roses for depth average currents are shown in figure 19. Seasonal differences due not appear to be significant. However, the summer quarter showed a higher percentage of currents in the northerly direction than the other quarters. Current roses for near surface and near bottom currents are shown in figures 20 to 21. Near surface currents are approximately 1 to 4 meters (3 to 13 feet) below the surface depending on tidal state. Near bottom currents are approximately 2 meters (6.5 feet) above the bottom (1.5 meters above the instrument face). Histograms for the currents are shown in figures 22 and 23. As is typically the case, surface currents are stronger than near bottom currents. The median surface current was 17 cm/sec (0.6 ft/sec) whereas the median bottom currents were 10 cm/sec (0.3 ft/sec). The depth average median current velocity was 13 cm/sec (0.4 ft/sec). For depth averaged currents most current measurements were in the 5 to 10 cm/sec (0.2 to 0.3 ft/sec) range with 90 percent of the measurements below 25 cm/sec (0.9 ft/sec). The net direction of transport as shown by a progressive vector diagram is to the southeast (see figure 24) with surface currents having a stronger southerly component.

A low pass filter was applied to data smoothed over one hour periods to analyze non-tidal variability. Results for the north/south and east/west current components for September are shown in figures 25 and 26, respectively. The east/west component is tidally dominated whereas the north/south component has a significant non-tidal component. Harmonic analysis revealed that the principal tidal constituents are K_1, O_1, M_2, N_2 and S_2 (see table 3). Peak north/south tidal currents were on the order of 10 to 20 cm/sec (0.3 to 0.7 ft/sec) and peak east/west tidal currents were on the order of 5 to 12 cm/sec (0.2 to 0.4 ft/sec). Corresponding tidal excursions are 1 to 2 kilometers (0.5 to 1 nautical miles) in the north/south direction and 1 to 1.3 kilometers (0.5 to 0.7 nautical miles) in the east/west direction. Tables 4 and 5 provide a summary of the tidal constituent parameters for water depth and currents, respectively. Appendix C provides the complete tidal analysis output from T_Tide. Figure 27 shows the tidal cycle as represented by water depth for both the actual data set and a synthesized data set utilizing the calculated tidal constituents. Two distinct high and low tides are seen per day.

Table 3: Principal Tidal Constituents at the Jacksonville and Fernandina ODMDSs

Symbol	**Name**	**Frequency (cycles/hour)**	**Period (hours)**
O_1	Principal lunar diurnal	0.0387	25.84
K_1	Lunisolar diurnal	0.0418	23.92
N_2			12.66
M_2	Principal lunar semidiurnal	0.0805	12.42
S_2	Principal solar semidiurnal	0.0833	12.00

Table 4: Summary of Harmonic Analysis of Water Depth at the Jacksonville ODMDS

Symbol	**Amplitude (meters)**	**Phase (degrees)**
O_1	0.0756	200.95
K_1	0.1036	196.67
N_2	0.1693	353.91
M_2	0.7665	15.75
S_2	0.1295	41.61

Table 5: Summary of Harmonic Analysis of Currents at the Jacksonville ODMDS

Symbol	Major Axis (cm/s)	Minor Axis (cm/s)	Inclination (cc from east-degrees)	Phase (degrees)
Surface Currents				
N_2	3.732	-0.822	118.91	290.15
M_2				308.65
S_2	3.441	-0.997	118.69	333.26
Bottom Currents				
N_2	2.539	-0.113	117.46	276.58
M_2				291.07
S_2	1.916	0.076	115.81	310.84
Depth Averaged Currents				
N_2	3.349	-0.492	119.59	285.13
M_2				303.46
S_2	2.580	-0.249	118.36	325.68

3.4 Fernandina Beach ODMDS Currents

A current rose for depth average currents for the entire deployment period is shown in figure 28. Currents flow predominately in the north-northwest and south-southeast direction and rarely exceed 30 cm/sec (1 ft/sec) in magnitude. Quarterly current roses for depth average currents are shown in figure 29. Seasonal differences due not appear to be significant. However, as was the case at the Jacksonville ODMDS, the summer quarter showed a slightly higher percentage of currents in the northerly direction than the other quarters. Current roses for near surface and near bottom currents are shown in figures 30 to 31. Near surface currents are approximately 1.5 to 3.5 meters (4.9 to 11.5 feet) below the surface depending on tidal state. Near bottom currents are approximately 2 meters (6.5 feet) above the bottom (1.5 meters above the instrument face). Histograms for the currents are shown in figures 32 and 33. As is typically the case, surface currents are stronger than near bottom currents. The median surface current was 16.5 cm/sec (0.5 ft/sec), whereas the median bottom currents were 10 cm/sec (0.3 cm/sec). The depth average median current velocity was 13 cm/sec (0.4 ft/sec). For depth averaged currents most current measurements were in the 5 to 10 cm/sec (0.2 to 03 cm/sec) range with 90 percent of the measurements below 25 cm/sec (0.8 ft/sec). The net direction of transport as shown by a progressive vector diagram was originally to the south followed by a northeasterly trend at the surface and a northwesterly trend near the bottom and throughout the water column average (see figure 34).

A low pass filter was applied to data smoothed over one-hour periods to analyze non-tidal variability. Results for the north/south and east/west current components for September are shown in figures 35 and 36, respectively. The east/west component is tidally dominated whereas the north/south component has a significant non-tidal component. For the period shown, there is almost no east/west non-tidal current component. Harmonic analysis revealed that the principal tidal constituents are K_1, O_1, M_2, N_2 and S_2 (see table 3 above). Peak north/south tidal currents were on the order of 10 to 20 cm/sec (0.3 to 0.7 cm/sec) and peak east/west tidal currents were on the order of 5 to 15 cm/sec (0.2 to 0.5 ft/sec). Corresponding tidal excursions are 1 to 3 kilometers (0.5 to 1.6 nautical miles) in the north/south direction and 1 to 2 kilometers (0.5 to 1 nautical miles) in the east/west direction. Tables 6 and 7 provide a summary of the tidal constituent parameters for water depth and currents, respectively. Appendix C provides the complete tidal analysis output from T_Tide. Figure 37 shows the tidal cycle as represented by water depth for both the actual data set and a synthesized data set utilizing the calculated tidal constituents. Two distinct high and low tides are seen per day.

Table 6: Summary of Harmonic Analysis of Water Depth at the Fernandina Beach ODMDS

Symbol	**Amplitude (meters)**	**Phase (degrees)**
O_1	0.0404	219.64
K_1	0.0757	207.58
N_2	0.1026	350.10
M_2	0.7067	16.16
S_2	0.0695	35.87

Table 7: Summary of Harmonic Analysis of Currents at the Fernandina Beach ODMDS

Symbol	Major Axis (cm/s)	Minor Axis (cm/s)	Inclination (cc from east-degrees)	Phase (degrees)
Surface Currents				
N_2	3.968	-0.445	131.11	284.94
M_2				303.72
S_2	3.419	-0.651	129.06	330.48
Bottom Currents				
N_2	2.532	0.010	126.47	269.14
M_2				283.96
S_2	2.112	0.000	122.95	311.20
Depth Averaged Currents				
N_2	3.518	-0.280	130.16	278.18
M_2				296.36
S_2	2.612	-0.199	126.59	321.28

4.0 SUMMARY AND CONCLUSIONS

Currents in the vicinity of the Jacksonville and Fernandina Beach ODMDSs tend to have a significant tidal component with predominate currents flowing to the north-northwest and south-southeast. There are no strong seasonal trends in the data, however, at both locations the summer quarter showed a slightly higher percentage of currents in the northerly direction than the other quarters. Current magnitudes at both sites were very similar statistically. The median and 90th percentile surface, bottom and depth average currents were the same at both sites. Surface currents exceeded 40 cm/sec (1.3 ft/sec) five percent of the time. The median surface current at both sites was 17 cm/sec (0.6 ft/sec) whereas the median bottom current was 10 cm/sec (0.3 ft/sec). Sandia National Labs (2007) determined that velocities near 60 cm/sec (2 ft/sec) or a shear stress of 1 N/m^2 (0.02 lb/ft^2) are needed to initiate erosion of Mayport Harbor dredged material. Near bottom currents of this magnitude seldom occur and therefore erosion of material would only likely occur prior to consolidation in the absence of major storms or large wave events.

Waves in the vicinity of the Jacksonville and Fernandina Beach ODMDSs are out of the east-southeast. Monthly wave statistics were very similar at both monitoring locations with an overall median wave height of 0.80 meters (2.6 feet) at the Jacksonville ODMDS and 0.78 meters (2.6 feet) at the CDIP location north of the Fernandina Beach ODMDS. The highest measured waves were in excess of 3 meters (9.8 feet) at both sites and occurred in June. Figure 38 compares the measured ocean wave height mean values at the ODMDSs to the Wave

Information Study (WIS) hindcast data from 1980 through 1999 (U.S. Army, 2008). In general, measured wave heights were less than those in the WIS. The most frequent wave period at both sites was 10 seconds. Based on linear wave theory, wave periods in excess of 4 seconds are of sufficient length to influence bottom velocities at the depths of the ODMDSs and therefore waves are likely to affect resuspension and transport of dredged material at the ODMDSs. Using the equations for wave related shear stress presented in U.S. Army (1998), wave conditions are such that the critical shear stress would be exceeded due to waves 84% of the time at the Jacksonville ODMDS and 89% of the time at the Fernandina Beach ODMDS. Waves are therefore the primary factor influencing resuspension of disposed dredged material at these ODMDS, whereas currents probably affect the direction and magnitude of transport.

Current data from this study will be used to update the STFATE model inputs for dredged material evaluations. Using the median values in this report, model input parameters should be revised in accordance with tables 8 and 9:

Table 8: Recommended STFATE ambient velocity parameters for the Jacksonville ODMDS

Existing Velocities (fps)			**Proposed Revised Velocities**		
Depth (ft)	Magnitude	Direction	Depth (ft)	Magnitude	Direction
8.4	0.56	173 ^{o} from North	8.2	0.56	158^{o} from North
39.6	0.33	160 ^{o} from North	40.0	0.33	158^{o} from North

Table 9: Recommended STFATE ambient velocity parameters for the Fernandina Beach ODMDS

Existing Velocities (fps)			**Proposed Revised Velocities**		
Depth (ft)	Magnitude	Direction	Depth (ft)	Magnitude	Direction
Logarithmic Profile	0.33	0 ^{o} from North	8.2	0.54	338^{o} from North
			42.3	0.34	338^{o} from North

Data will also be used to model the long-term fate of dredged material at the Jacksonville and Fernandina Beach ODMDSs utilizing MDFATE and LTFATE. Required MDFATE and LTFATE input parameters include: wave height, wave period and wave direction at three hour intervals and the tidal harmonic constituents and ambient current data. As a result of this data is now available.

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APPENDIX A

FIGURES

List of Figures

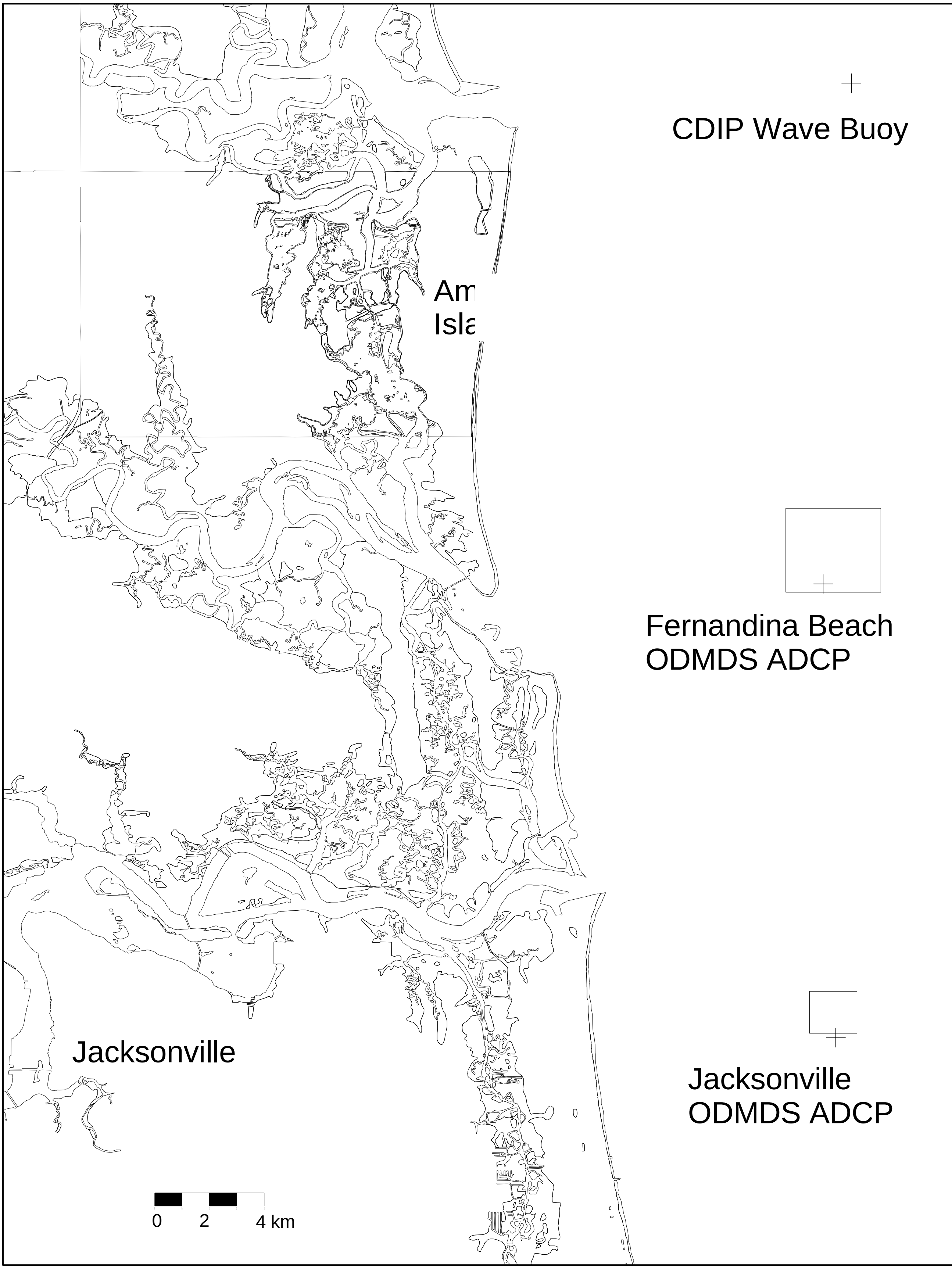


Figure 1: Instrument Location Map

Figure 2: Jacksonville ODMDS Concrete ADCP Base

Figure 3: Fernandina Beach ODMDS ADCP Base

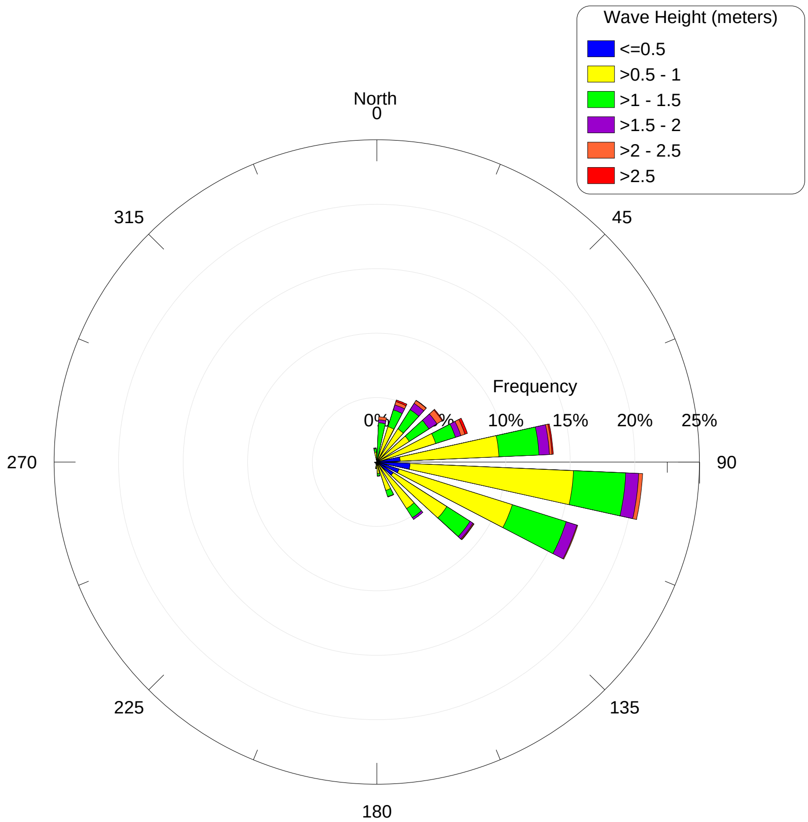


Figure 4: Jacksonville ODMDS Wave Rose for Significant Wave Height

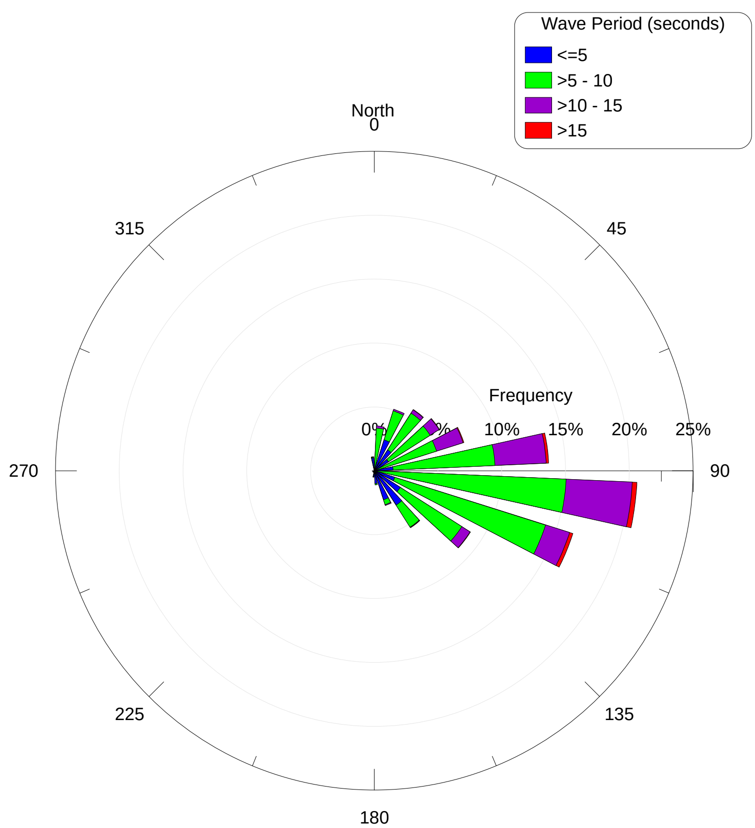


Figure 5: Jacksonville ODMDS Wave Rose for Peak Wave Period

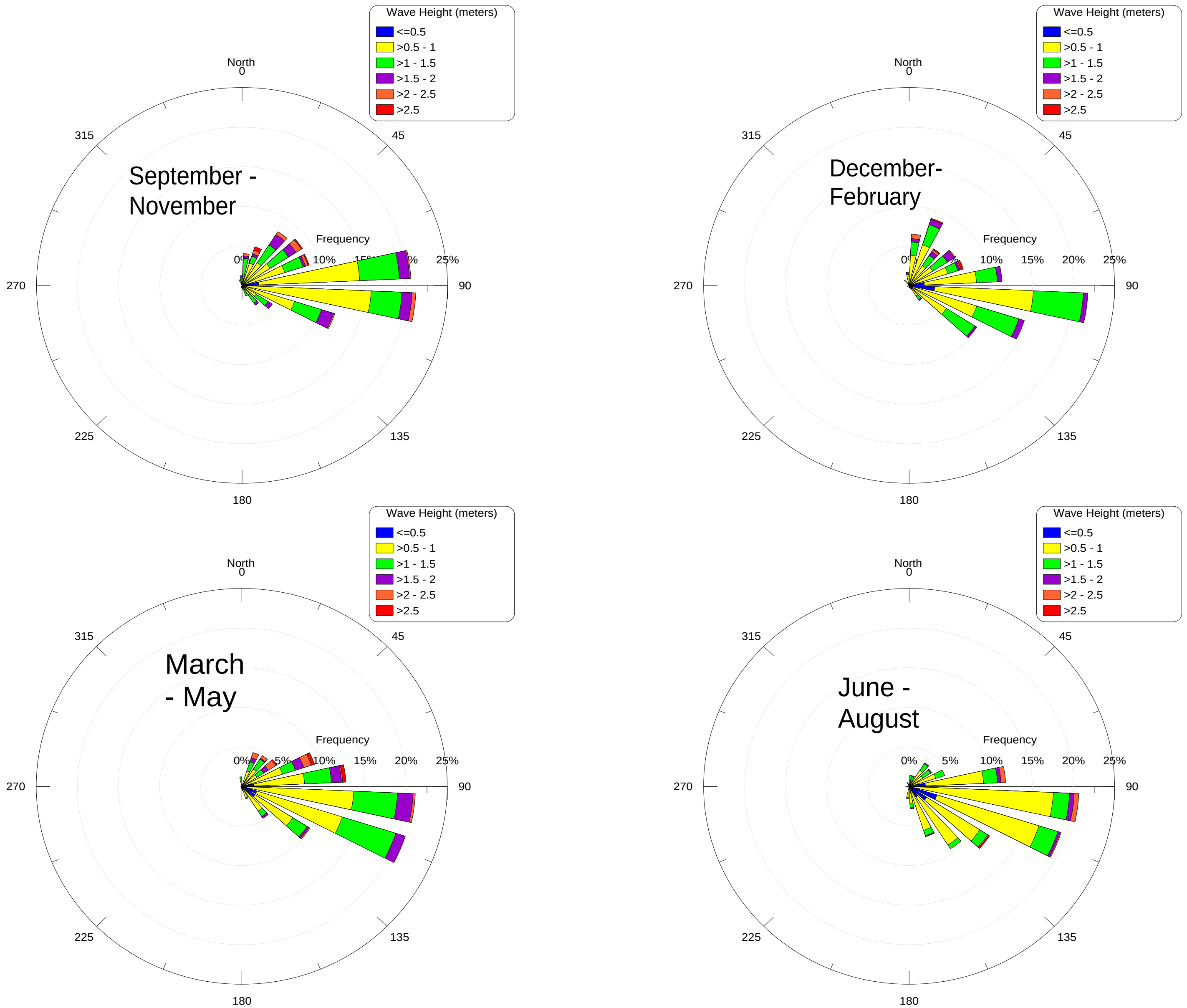


Figure 6: Jacksonville ODMDS Quarterly Wave Rose Diagrams

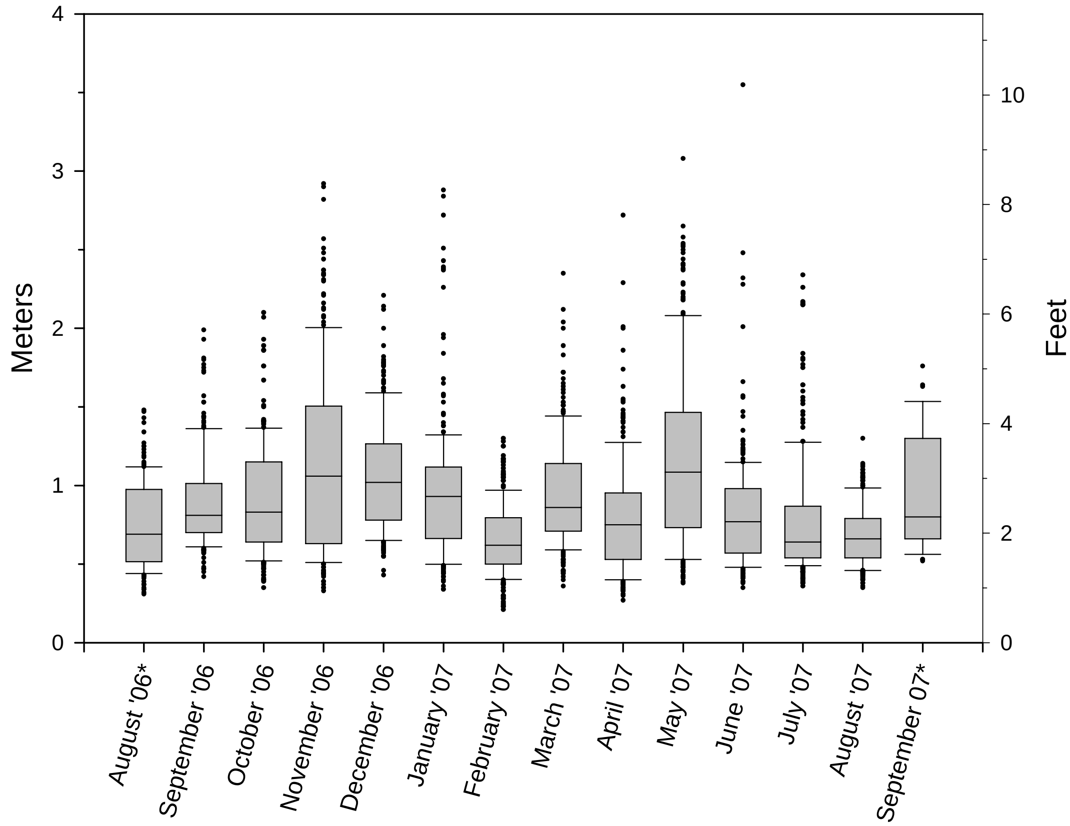


Figure 7: Jacksonville ODMDS Monthly Significant Wave Heights

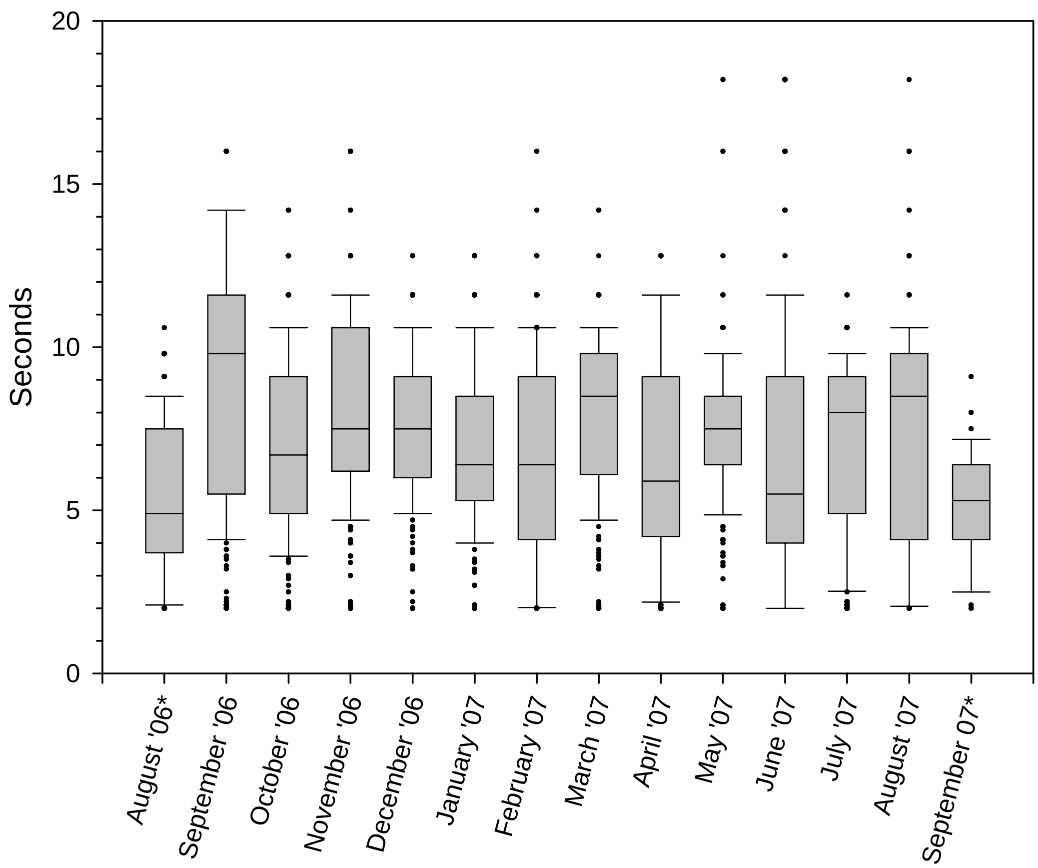


Figure 8: Jacksonville ODMDS Monthly Peak Wave Periods

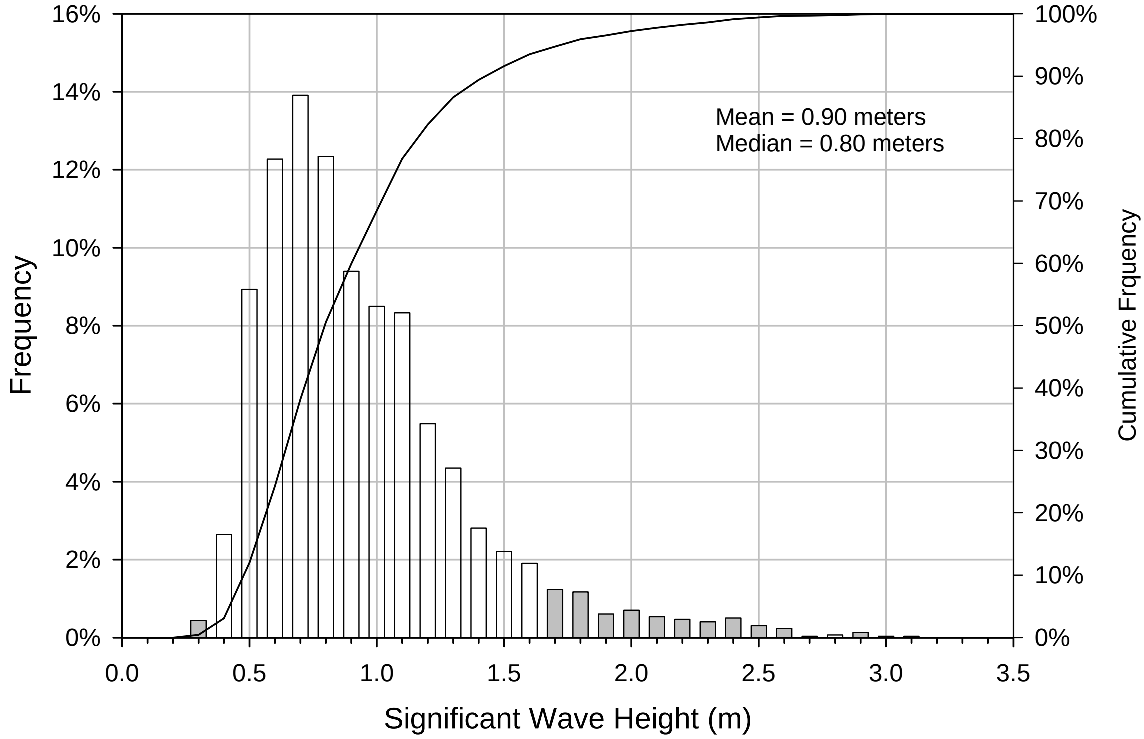


Figure 9: Jacksonville ODMDS Histogram of Significant Wave Height

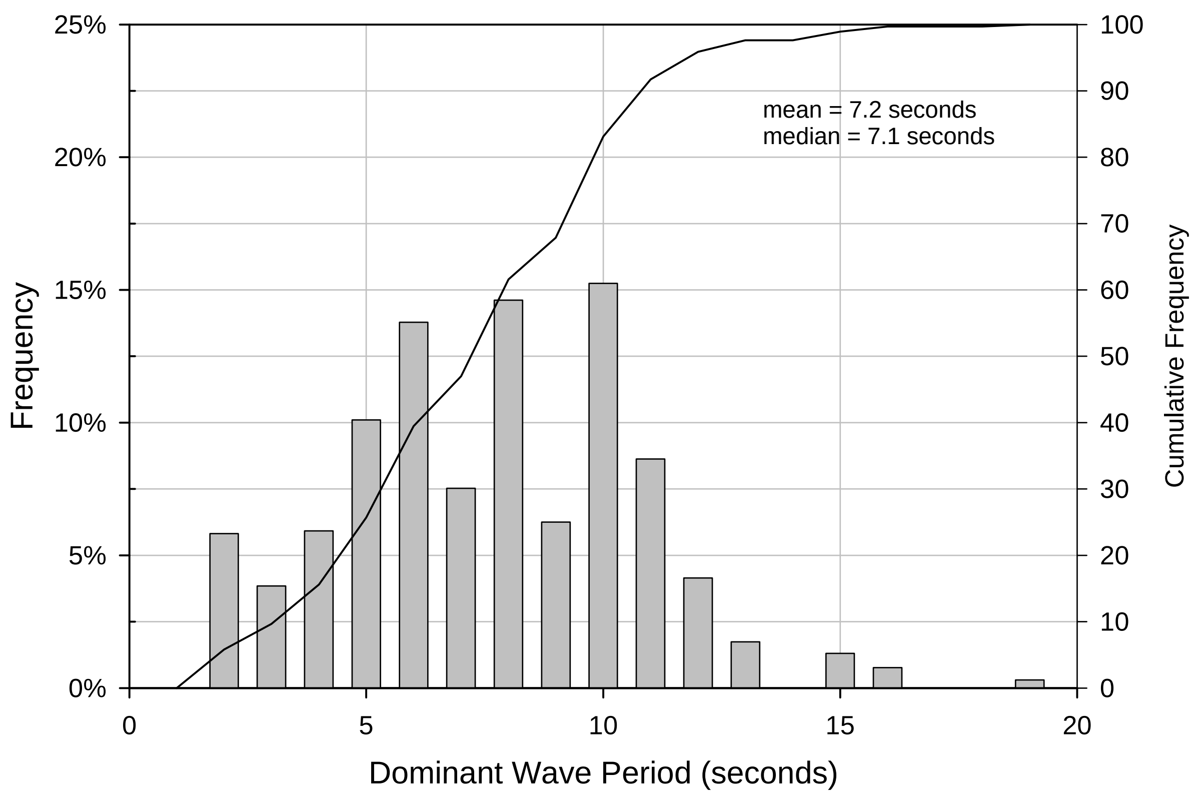


Figure 10: Jacksonville ODMDS Histogram of Peak Wave Period

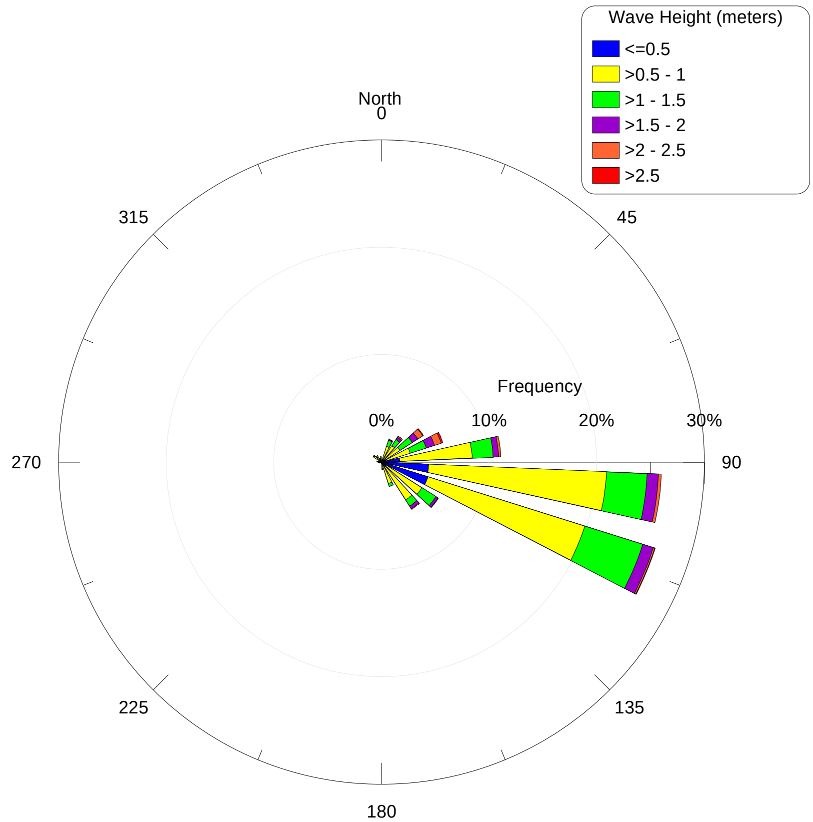


Figure 11: Fernandina Beach ODMDS (CDIP Station 132) Wave Rose for Significant Wave Height

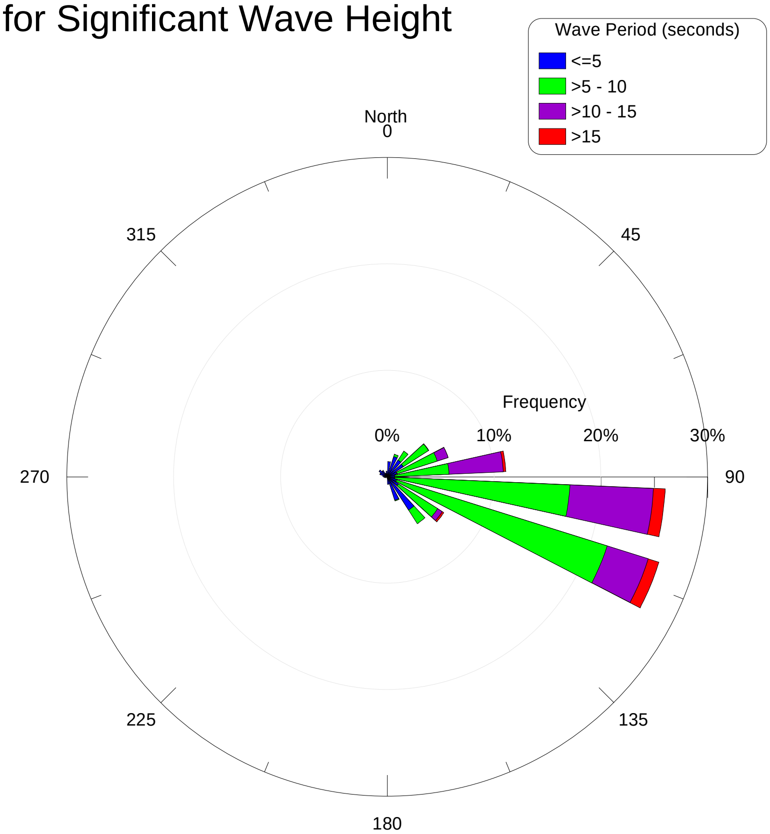


Figure 12: Fernandina Beach ODMDS (CDIP Station 132) Wave Rose for Peak Wave Period

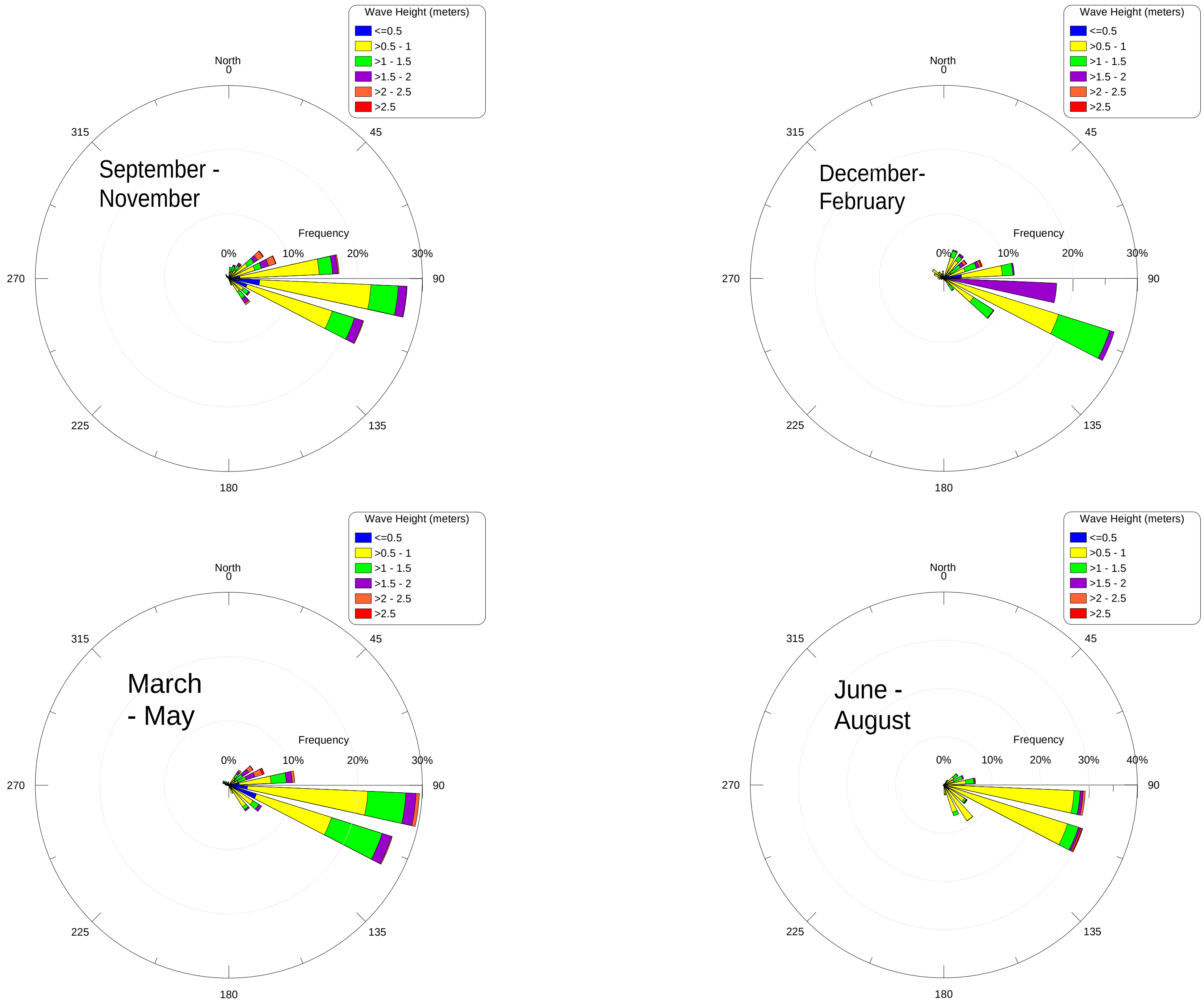


Figure 13: Fernandina Beach ODMDS (CDIP Station 132) Quarterly Wave Rose Diagrams

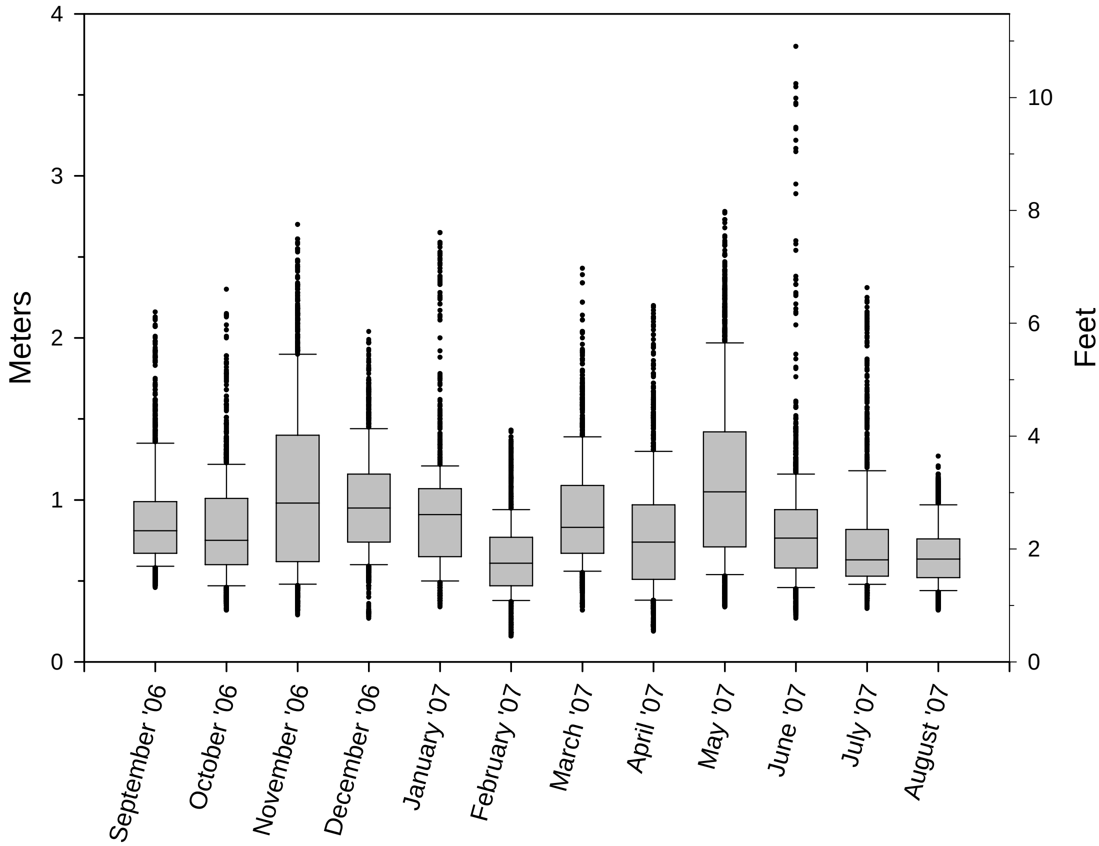


Figure 14: Fernandina Beach ODMDS (CDIP Station 132) Monthly Significant Wave Heights

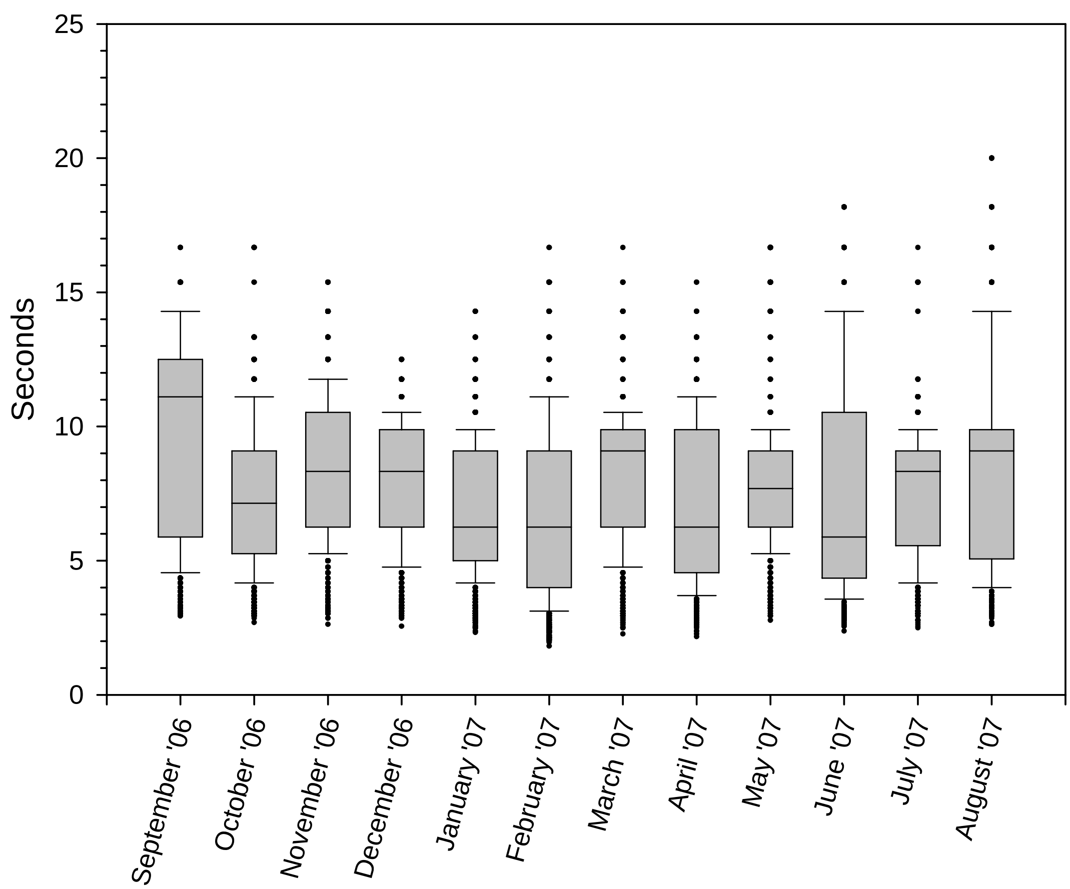


Figure 15: Fernandina Beach ODMDS (CDIP Station 132) Monthly Peak Wave Periods

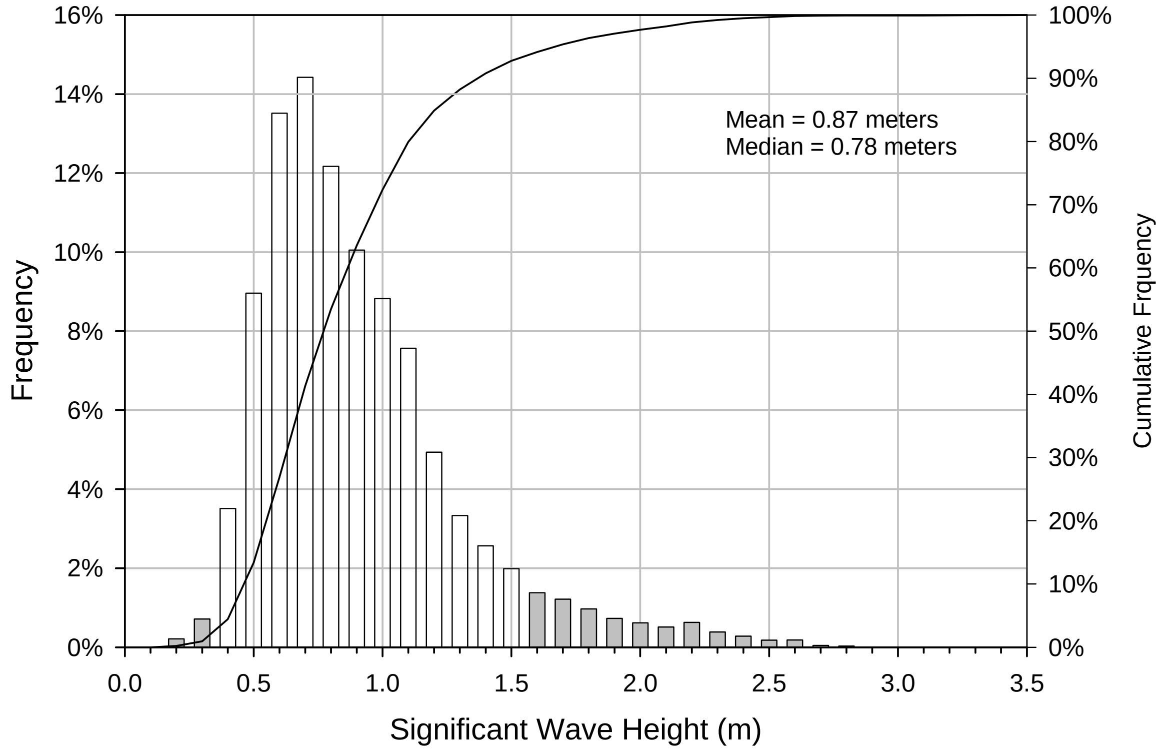


Figure 16: Fernandina Beach ODMDS (CDIP Station 132)
Histogram of Significant Wave Height

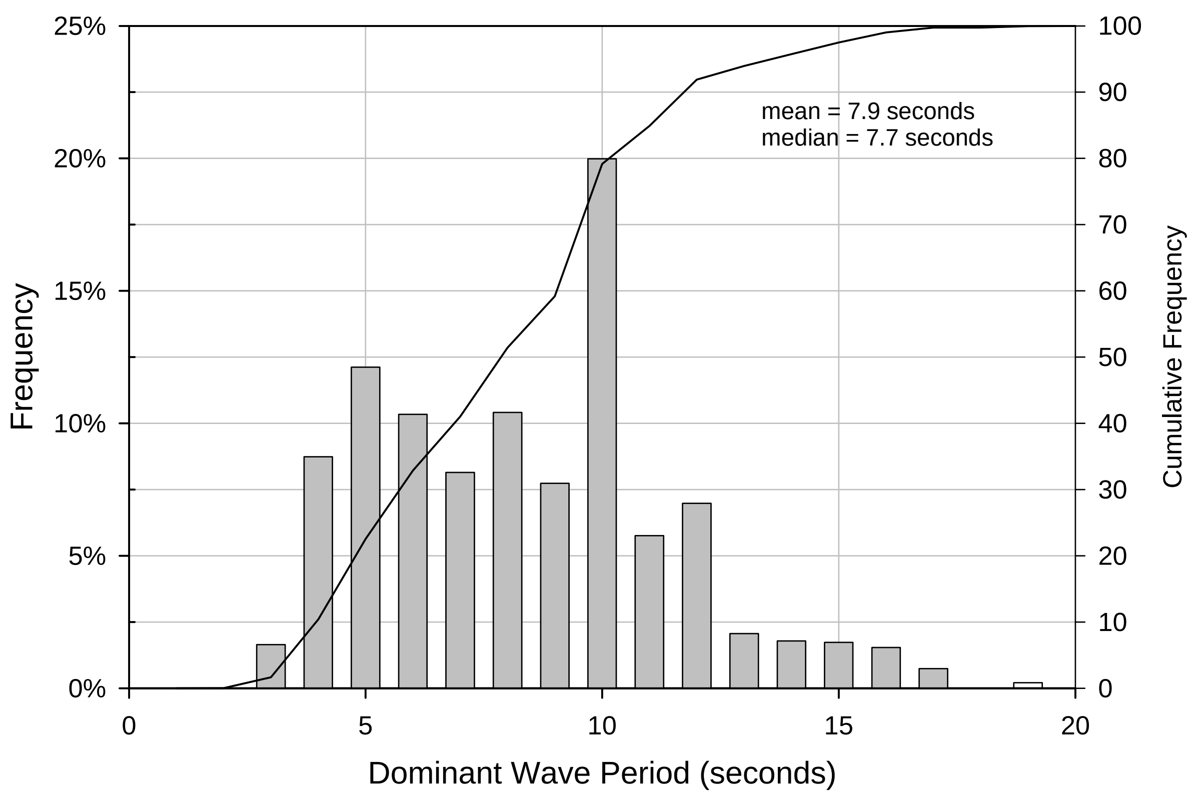


Figure 17: Fernandina Beach ODMDS (CDIP Station 132)
Histogram of Peak Wave Period

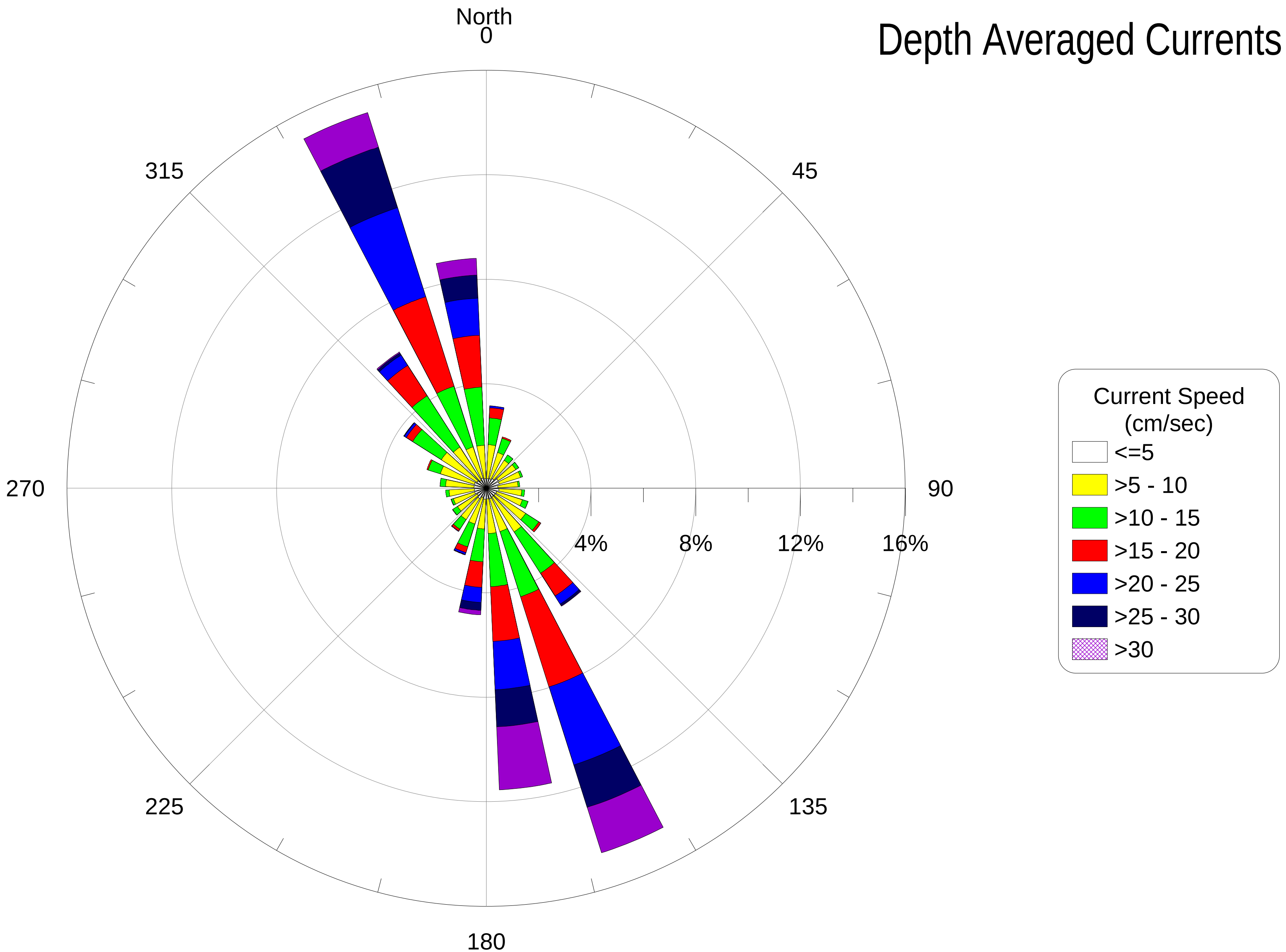


Figure 18: Jacksonville ODMDS Depth Averaged Current Rose Diagram

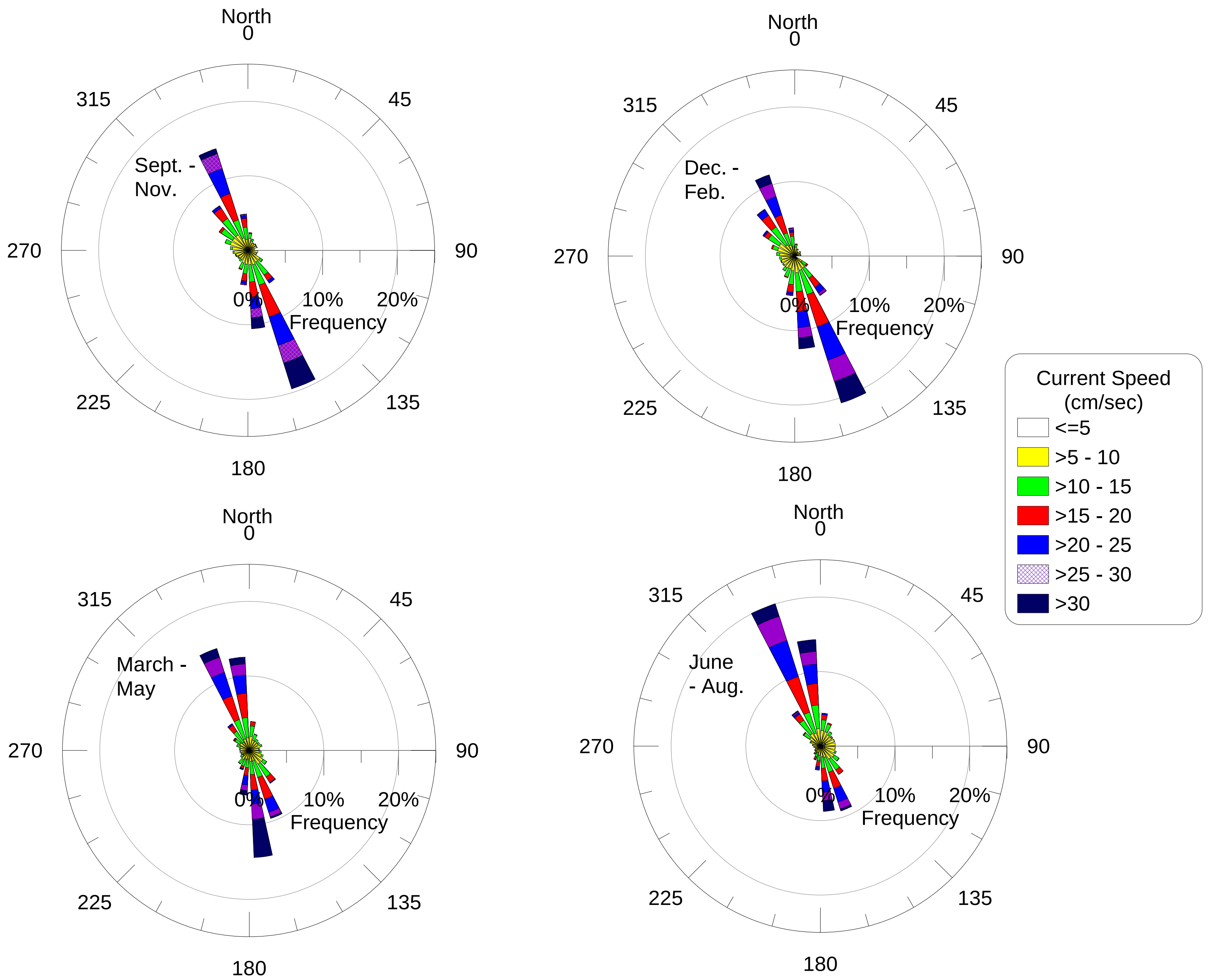


Figure 19: Jacksonville ODMDS Quarterly Current Rose Diagrams for Depth Averaged Currents

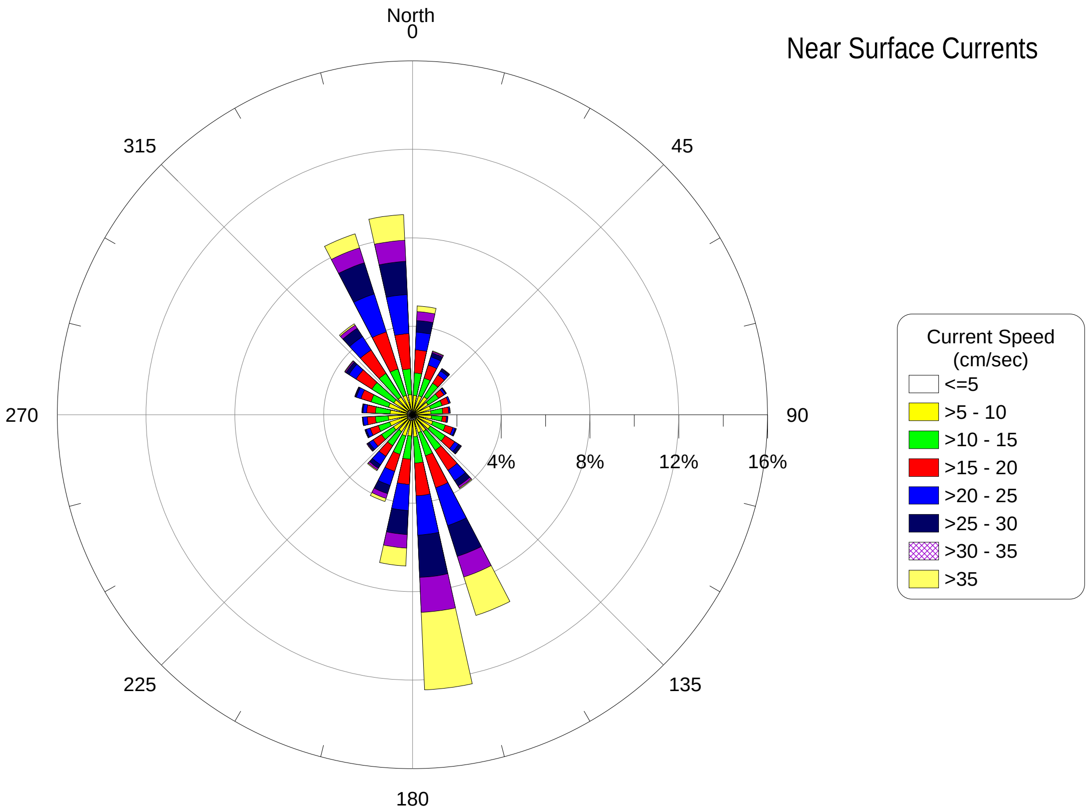


Figure 20: Jacksonville ODMDS Current Rose for Near Surface Currents

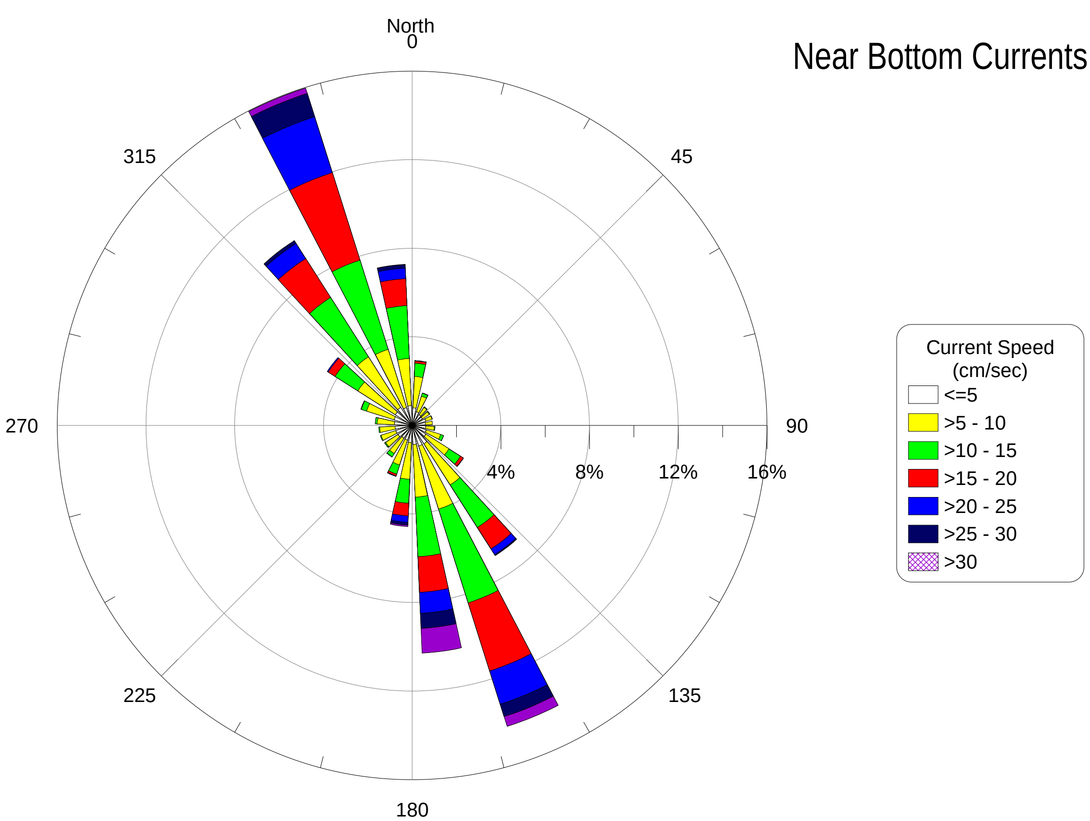


Figure 21: Jacksonville ODMDS Current Rose for Near Bottom Currents

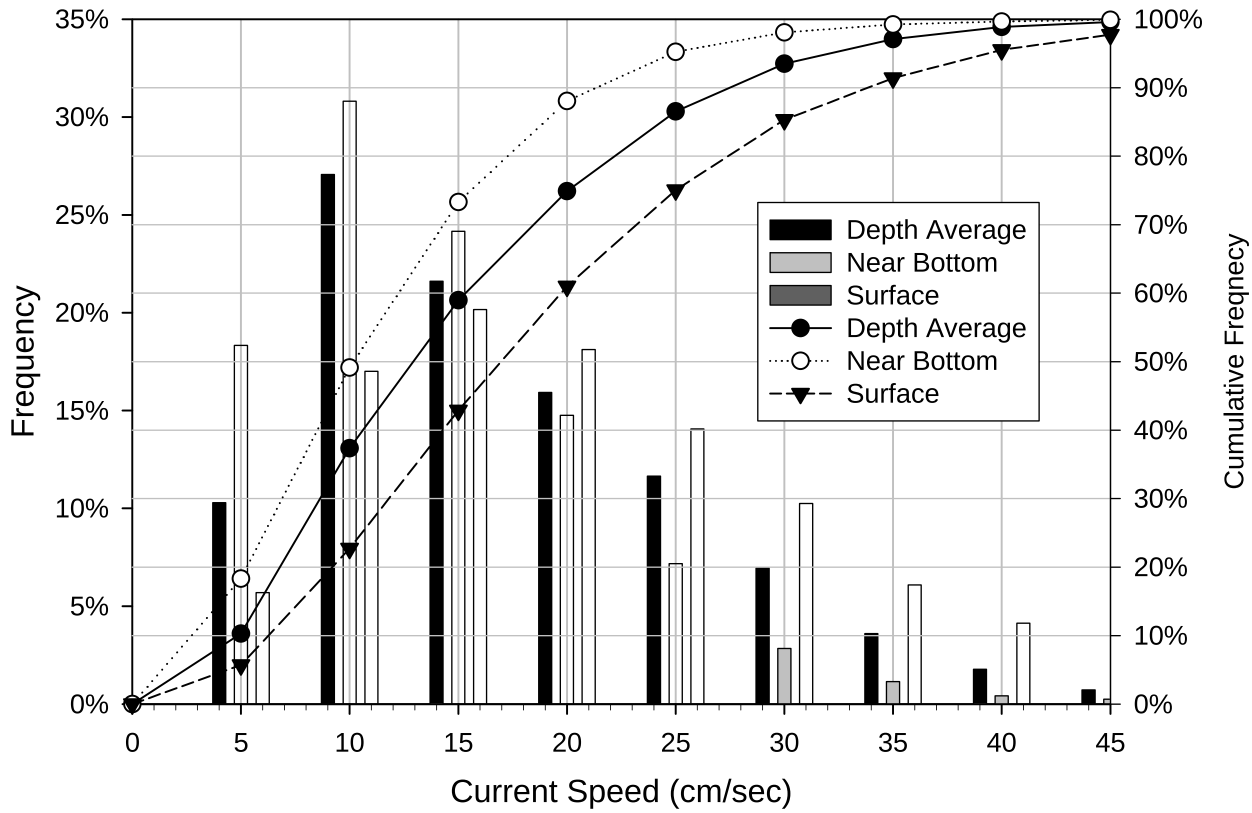


Figure 22: Jacksonville ODMDS Current Magnitude Histogram

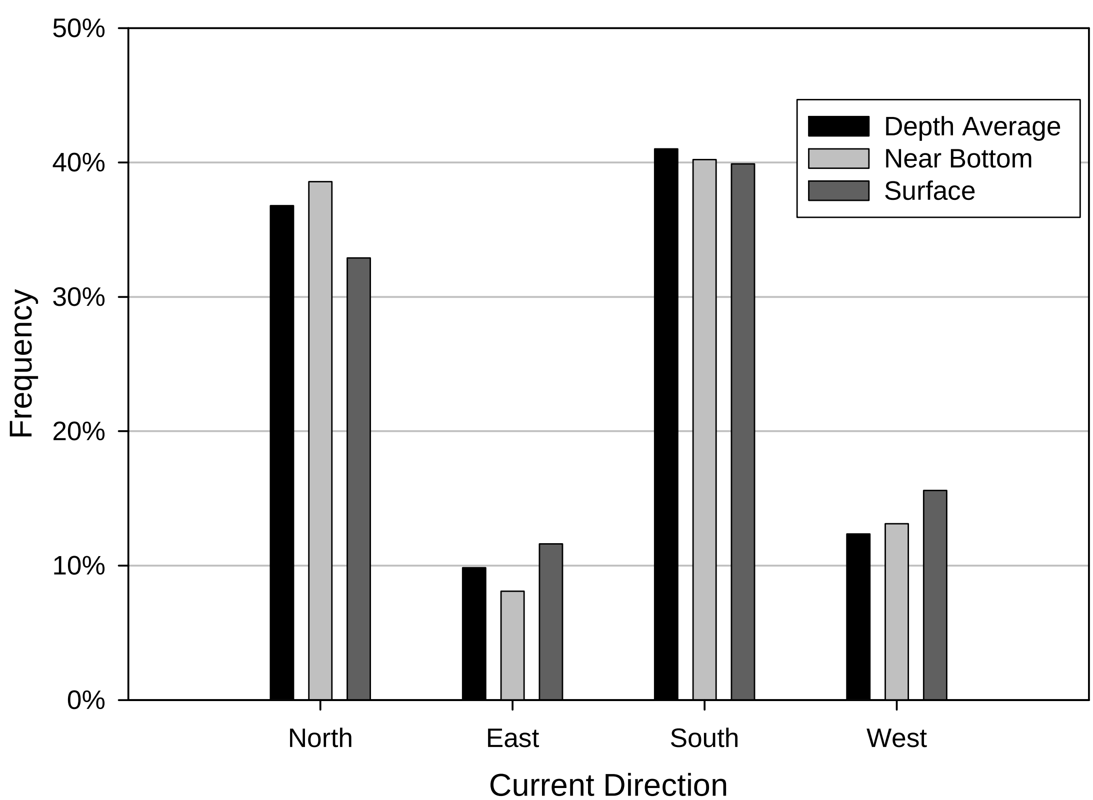


Figure 23: Jacksonville ODMDS Current Direction Histogram

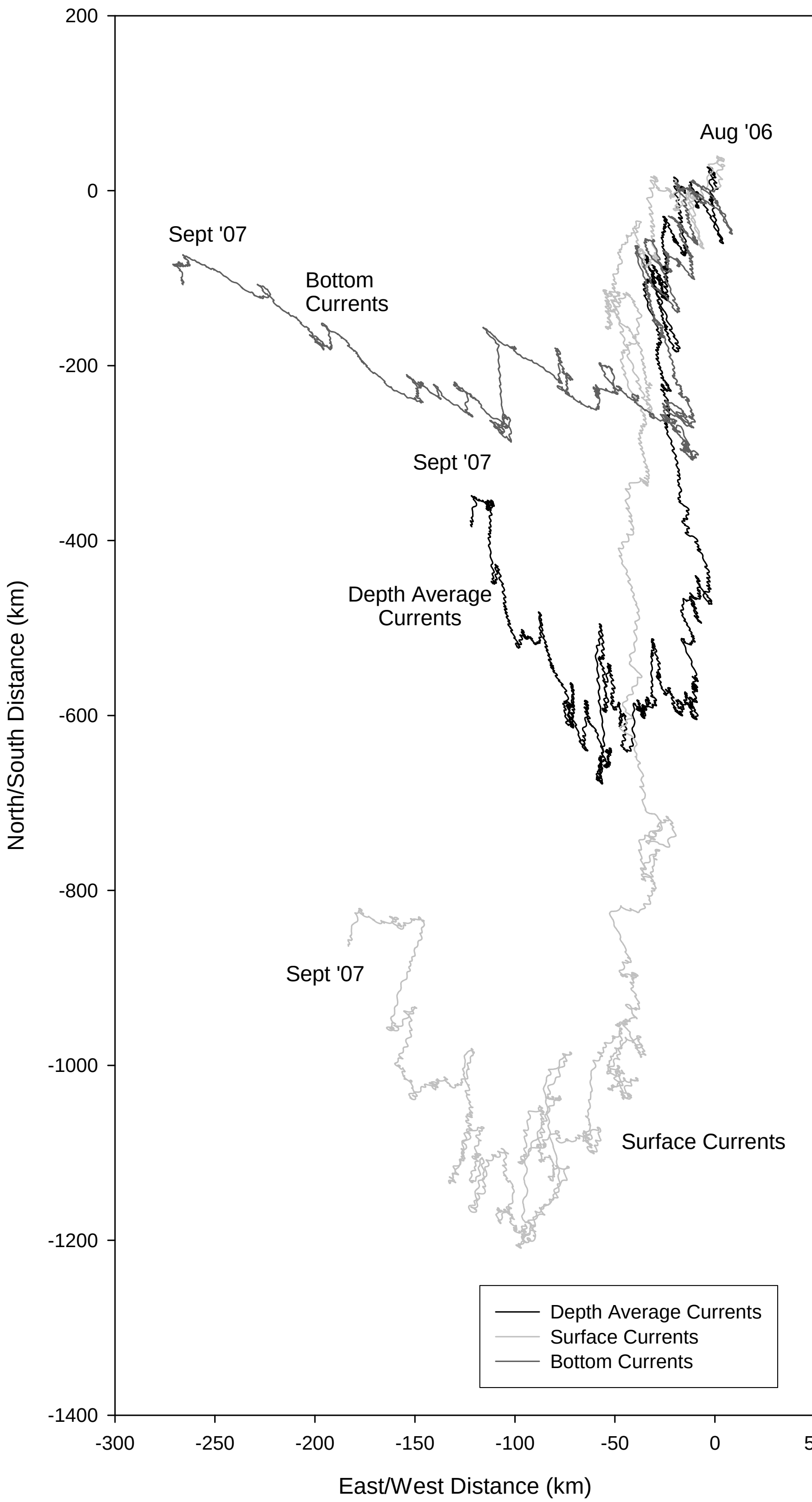


Figure 24: Jacksonville ODMDS Progressive Vector Diagram

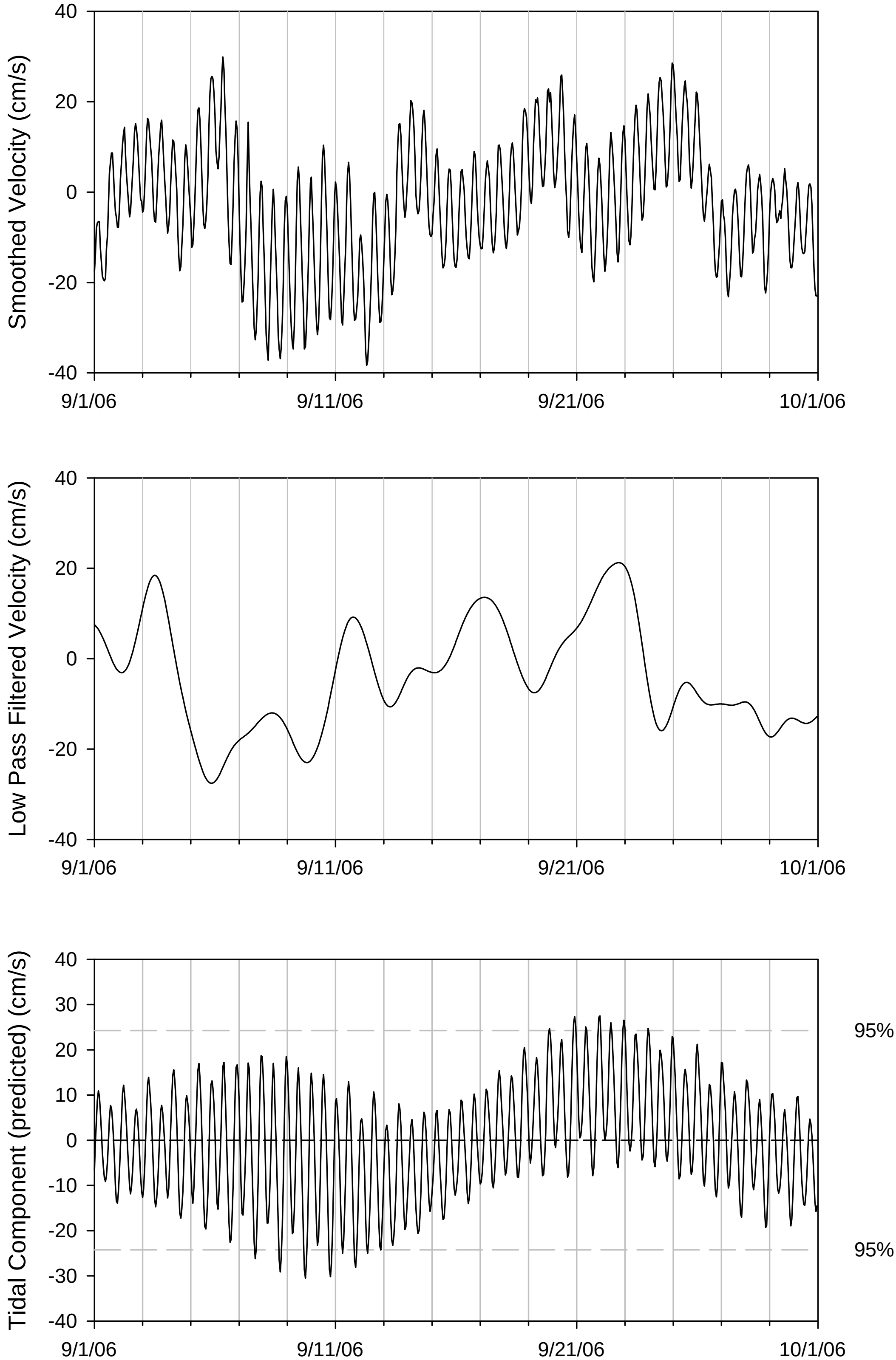


Figure 25: Jacksonville ODMDS Filtered and Tidal Currents (north/south component) for September 2006

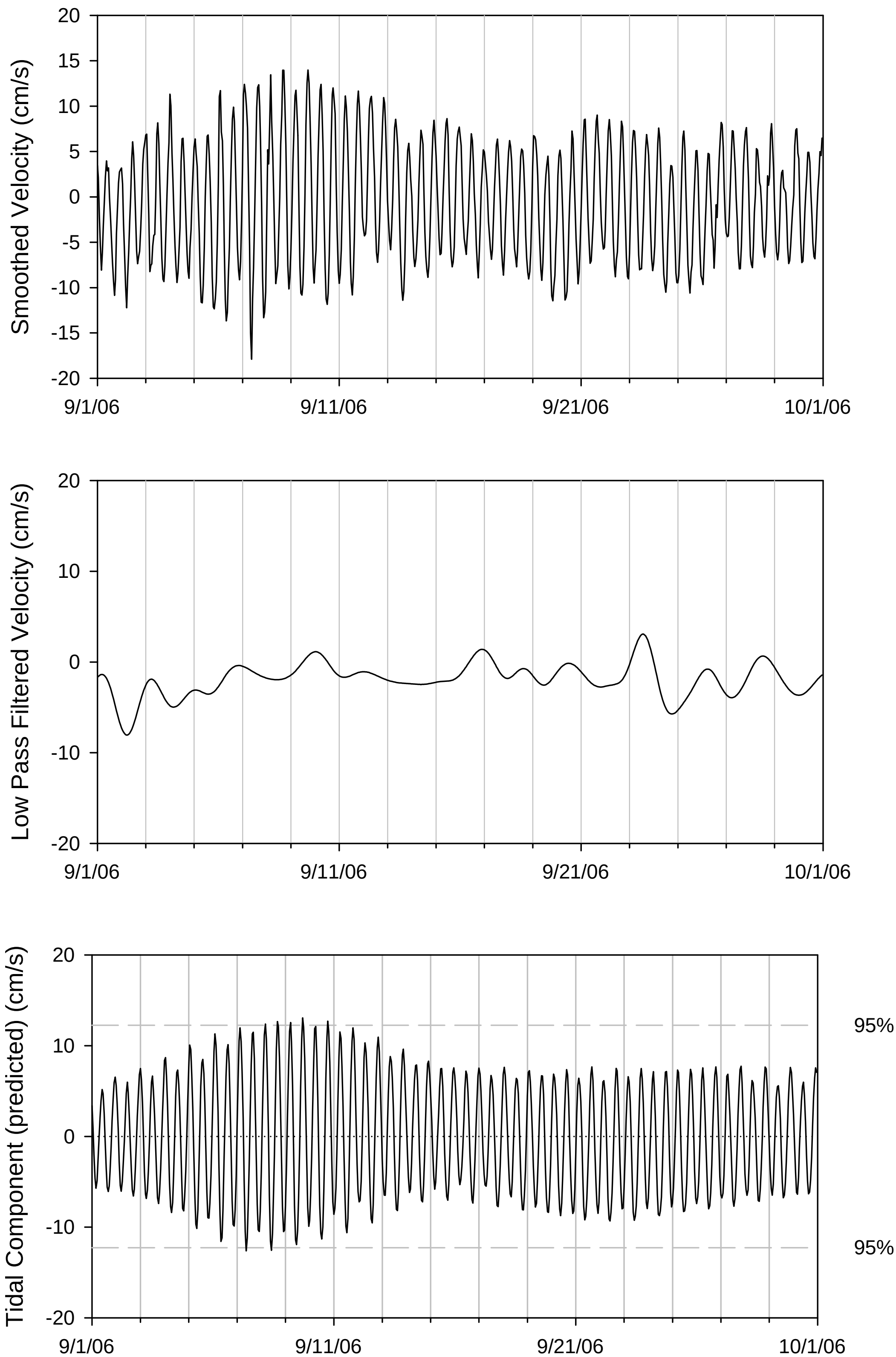
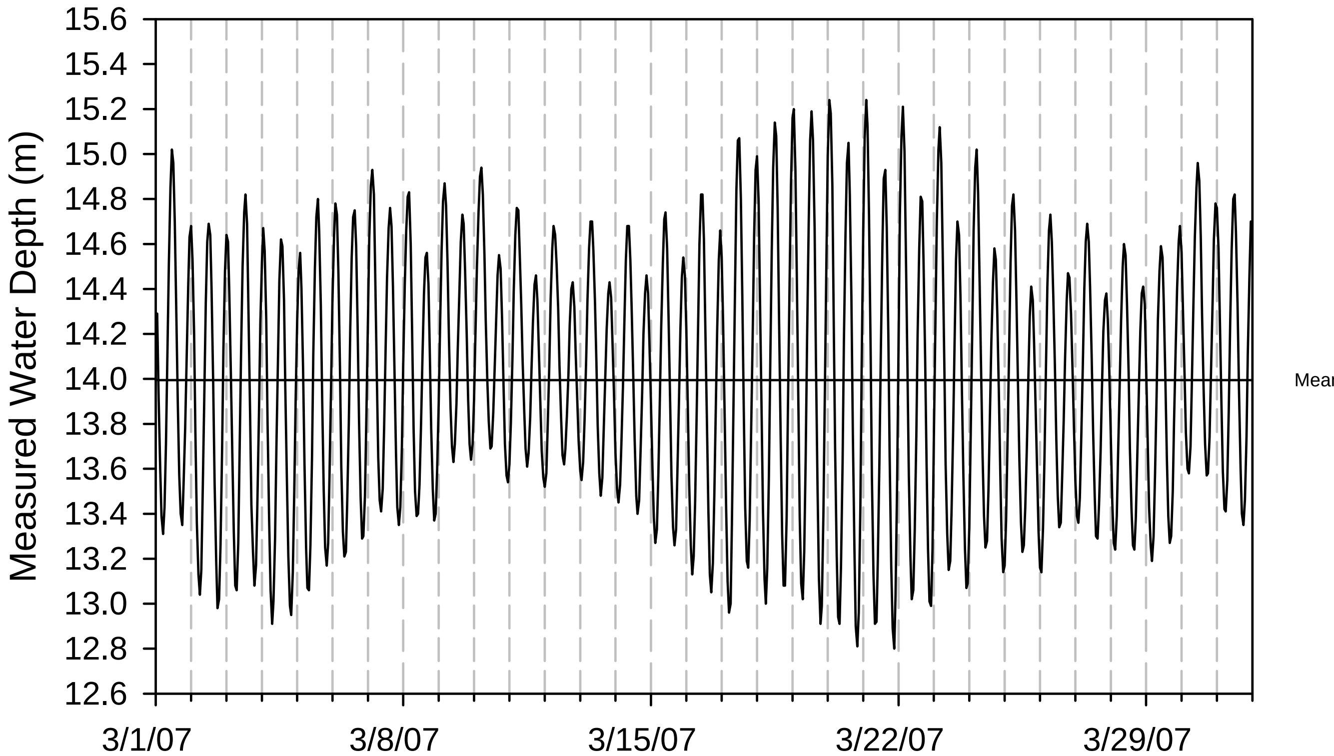


Figure 26: Jacksonville ODMDS Filtered and Tidal Currents (east/west component) for September 2006



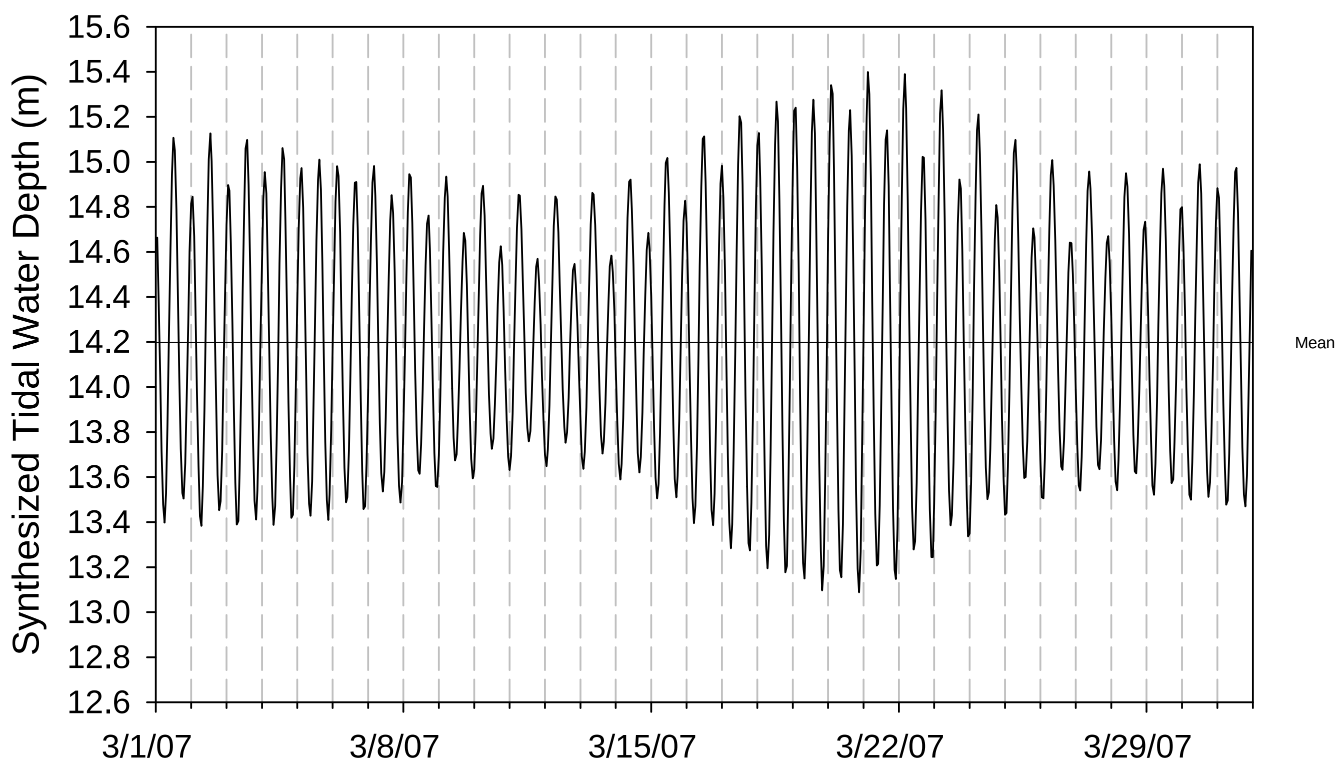


Figure 27: Jacksonville ODMDS Tides for March 2007.

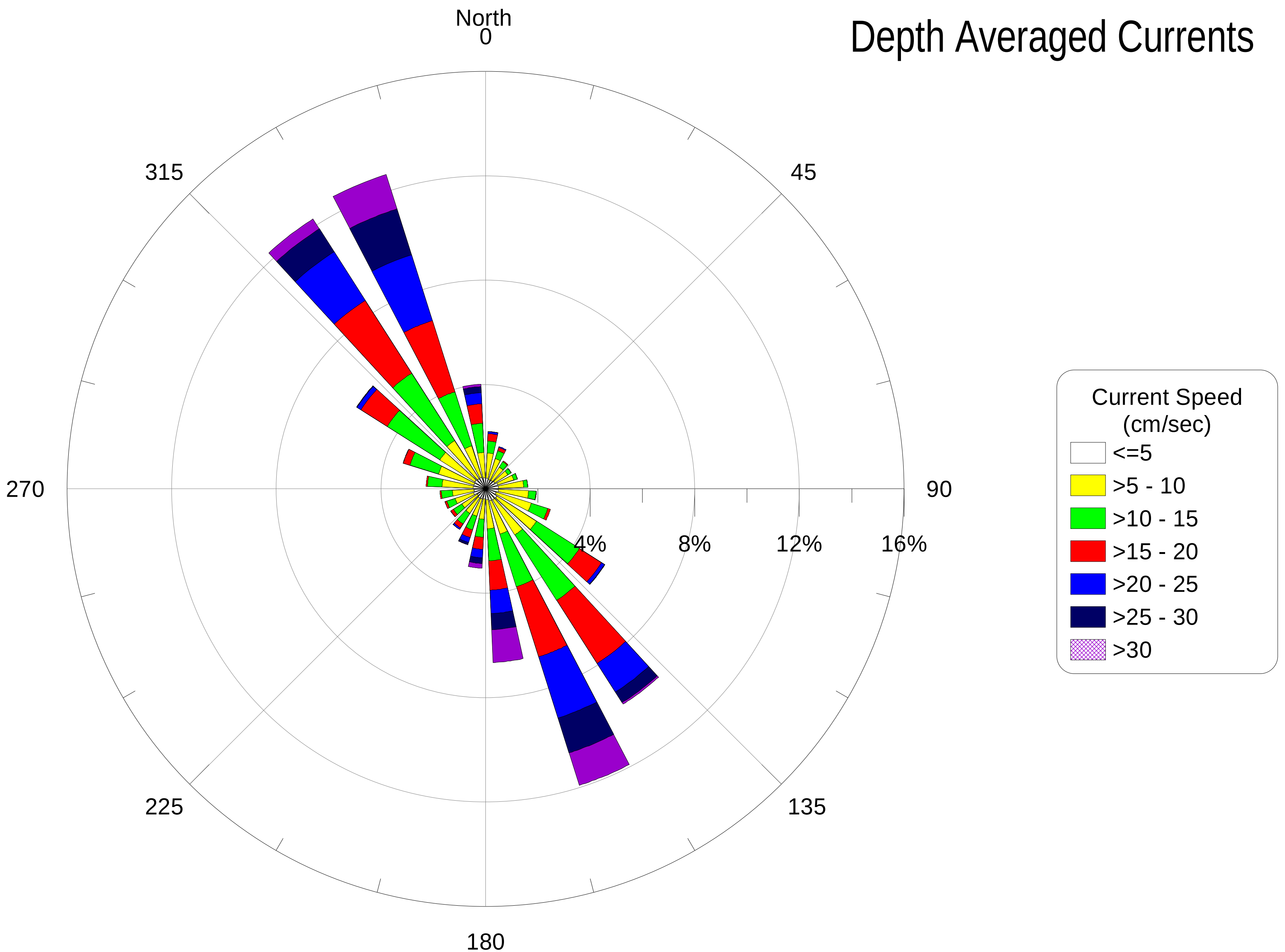


Figure 28: Fernandina Beach ODMDS Depth Averaged Current Rose Diagram

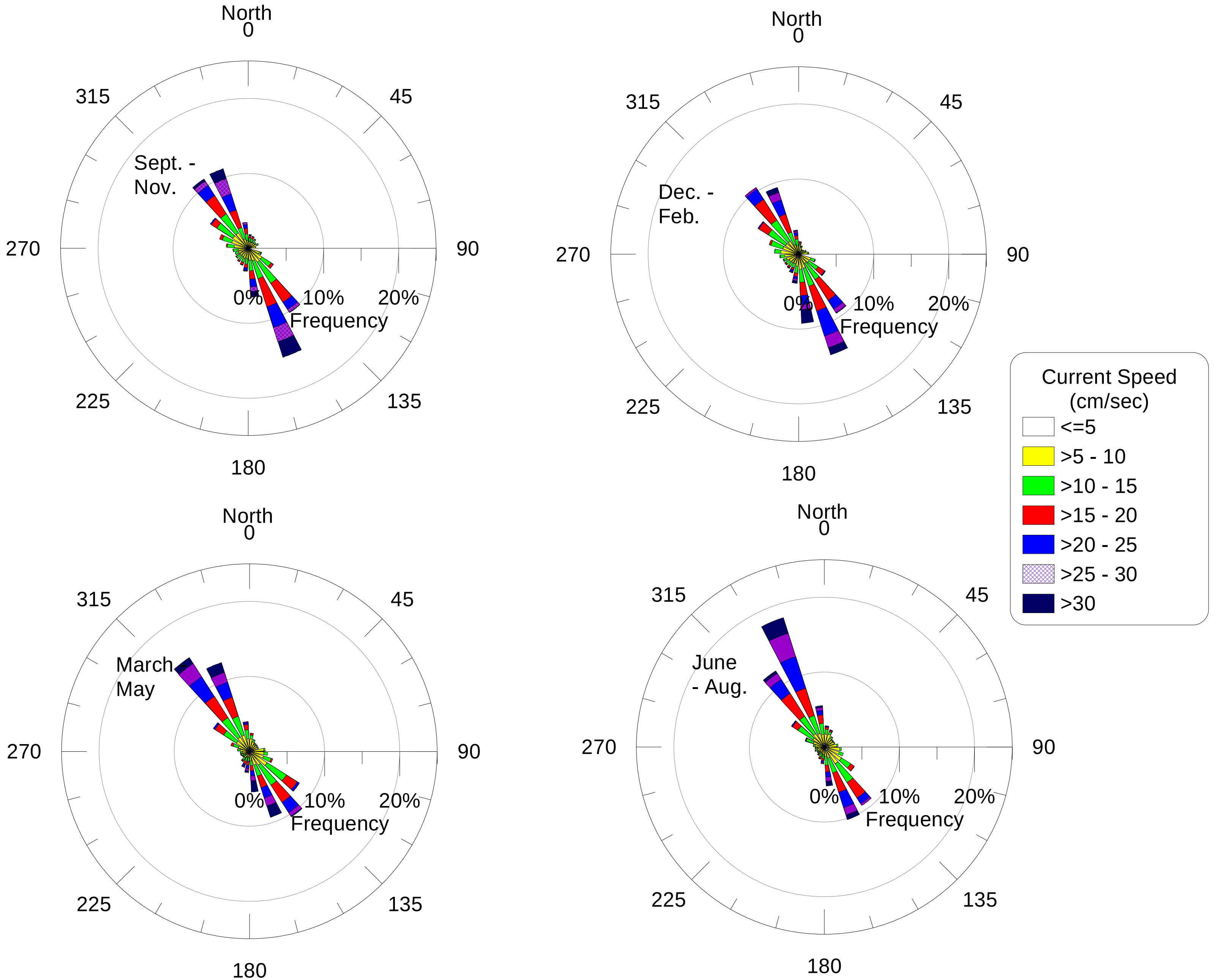


Figure 29: Fernandina Beach ODMDS Quarterly Current Rose Diagrams for Depth Averaged Currents

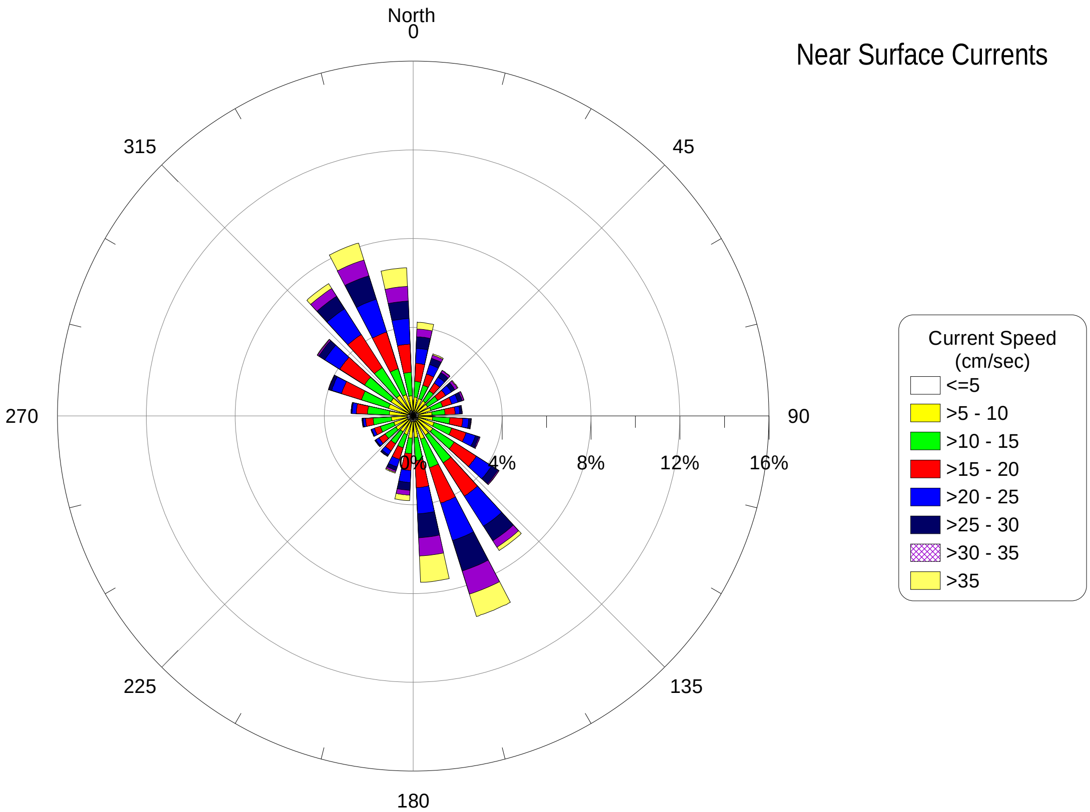


Figure 30: Fernandina Beach ODMDS Current Rose for Near Surface Currents

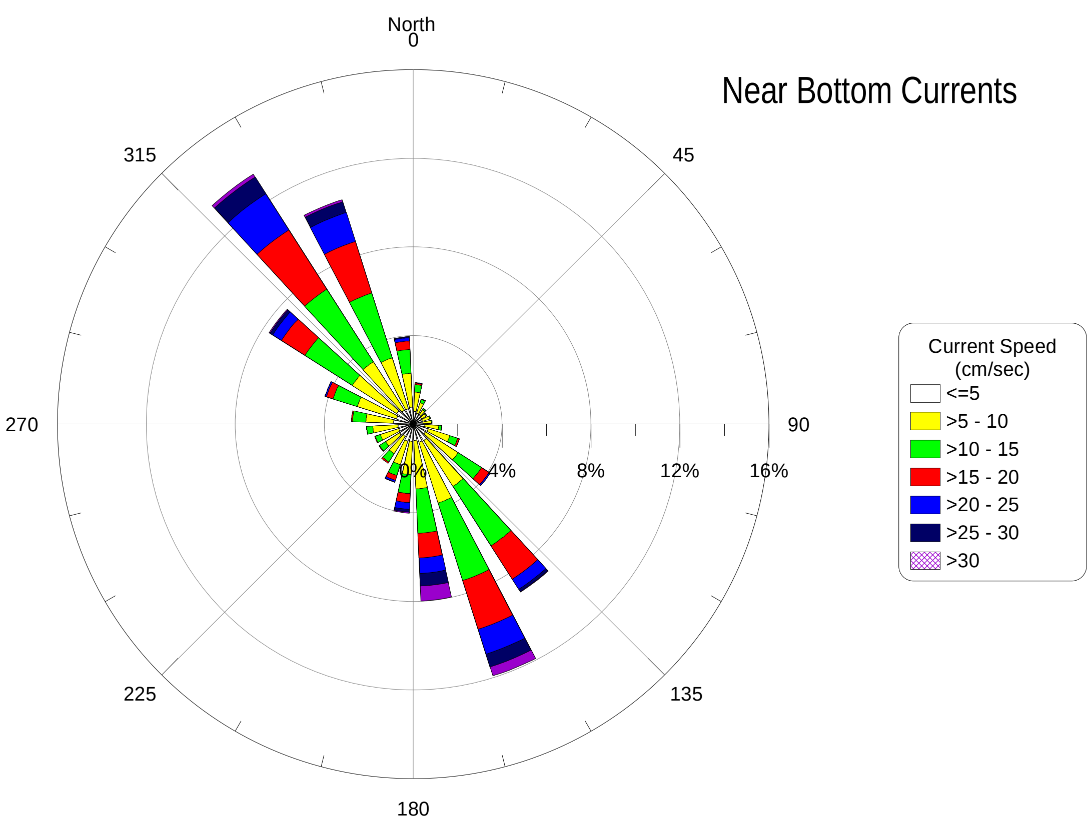


Figure 31: Fernandina Beach ODMDS Current Rose for Near Bottom Currents

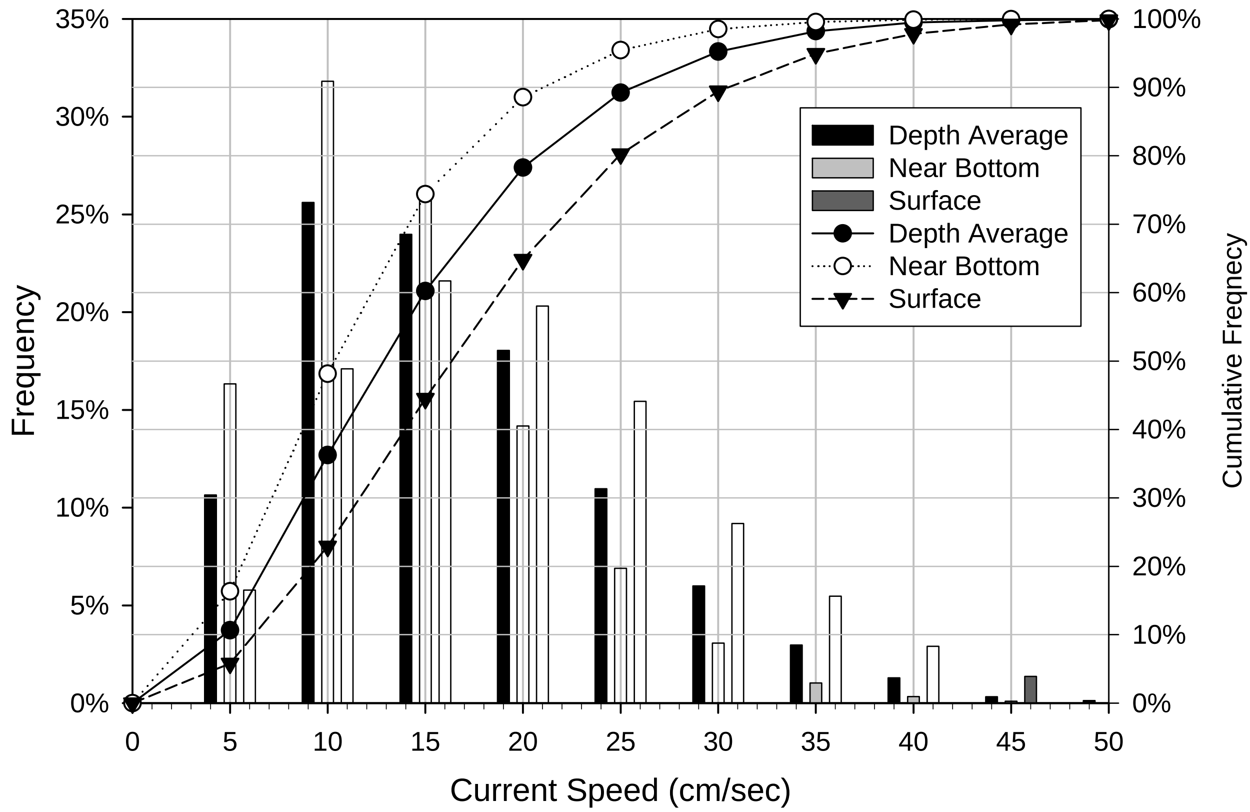


Figure 32: Fernandina Beach ODMDS Current Magnitude Histogram

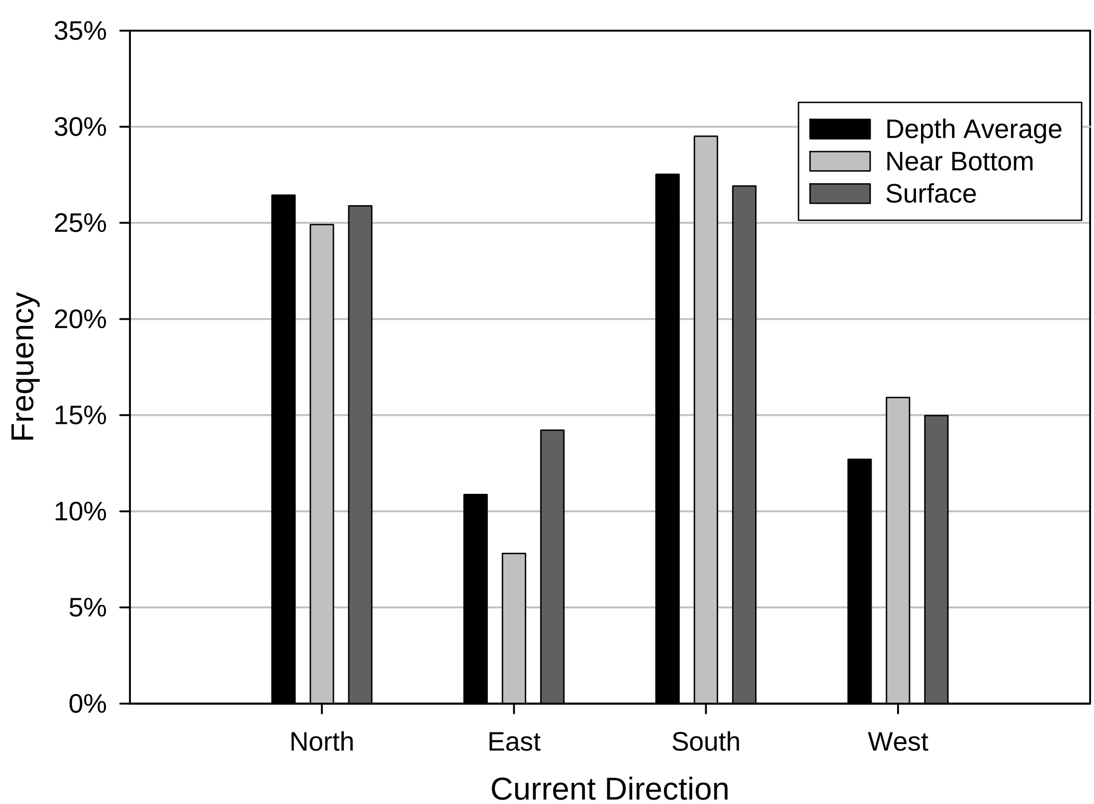


Figure 33: Fernandina Beach ODMDS Current Direction Histogram

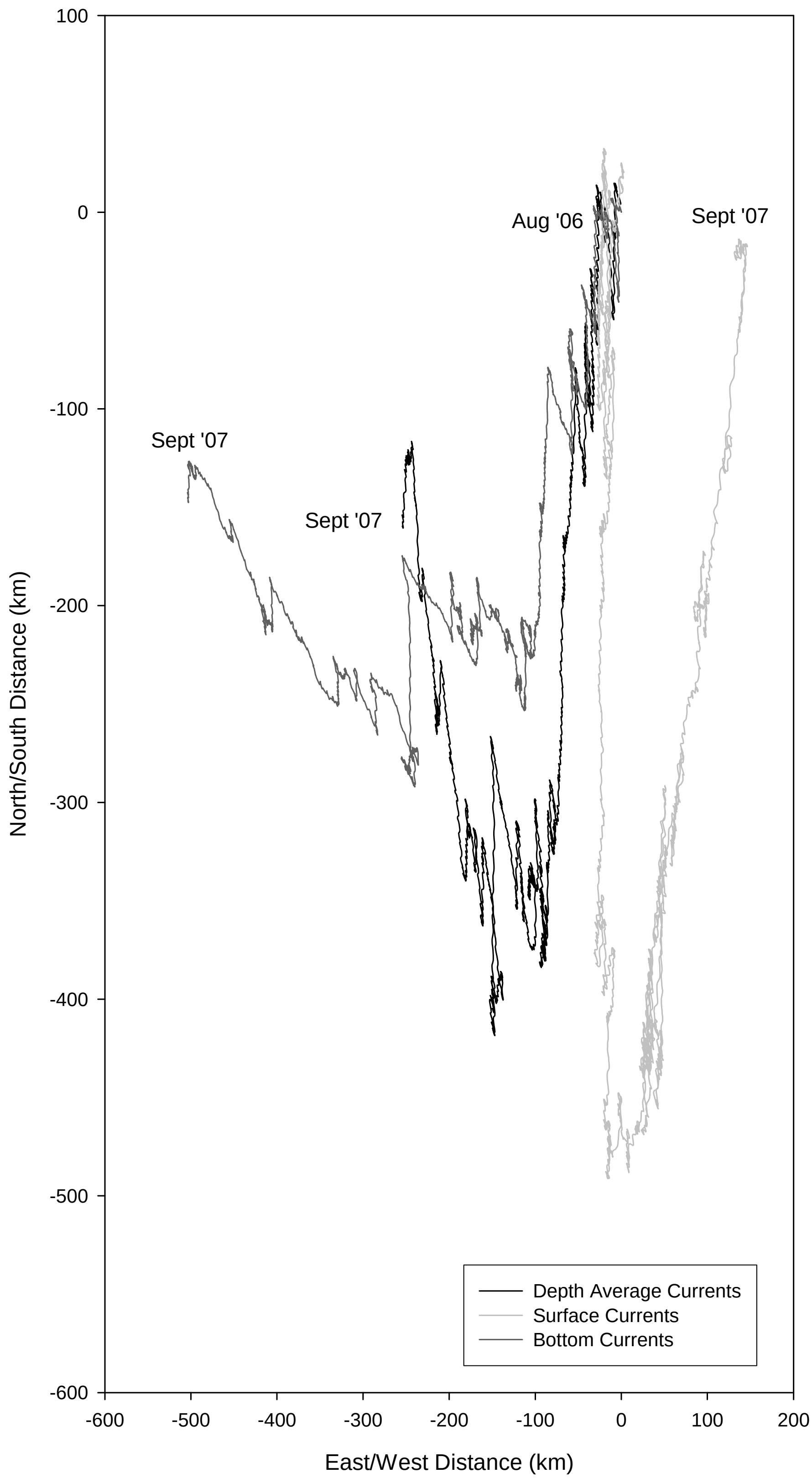


Figure 34: Fernandina Beach ODMDS Progressive Vector Diagram

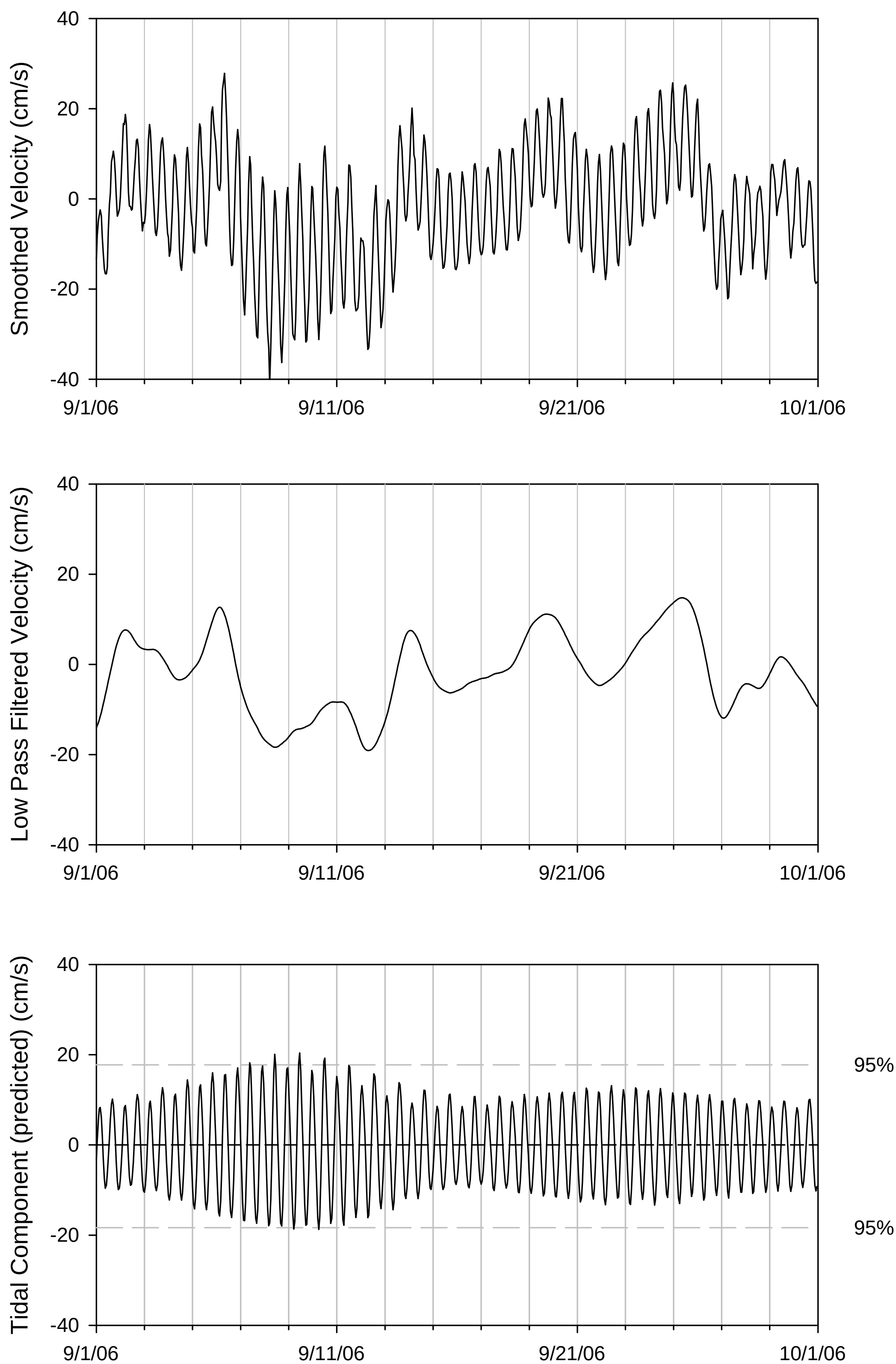


Figure 35: Fernandina Beach ODMDS Filtered and Tidal Currents (north/south component) for September 2006

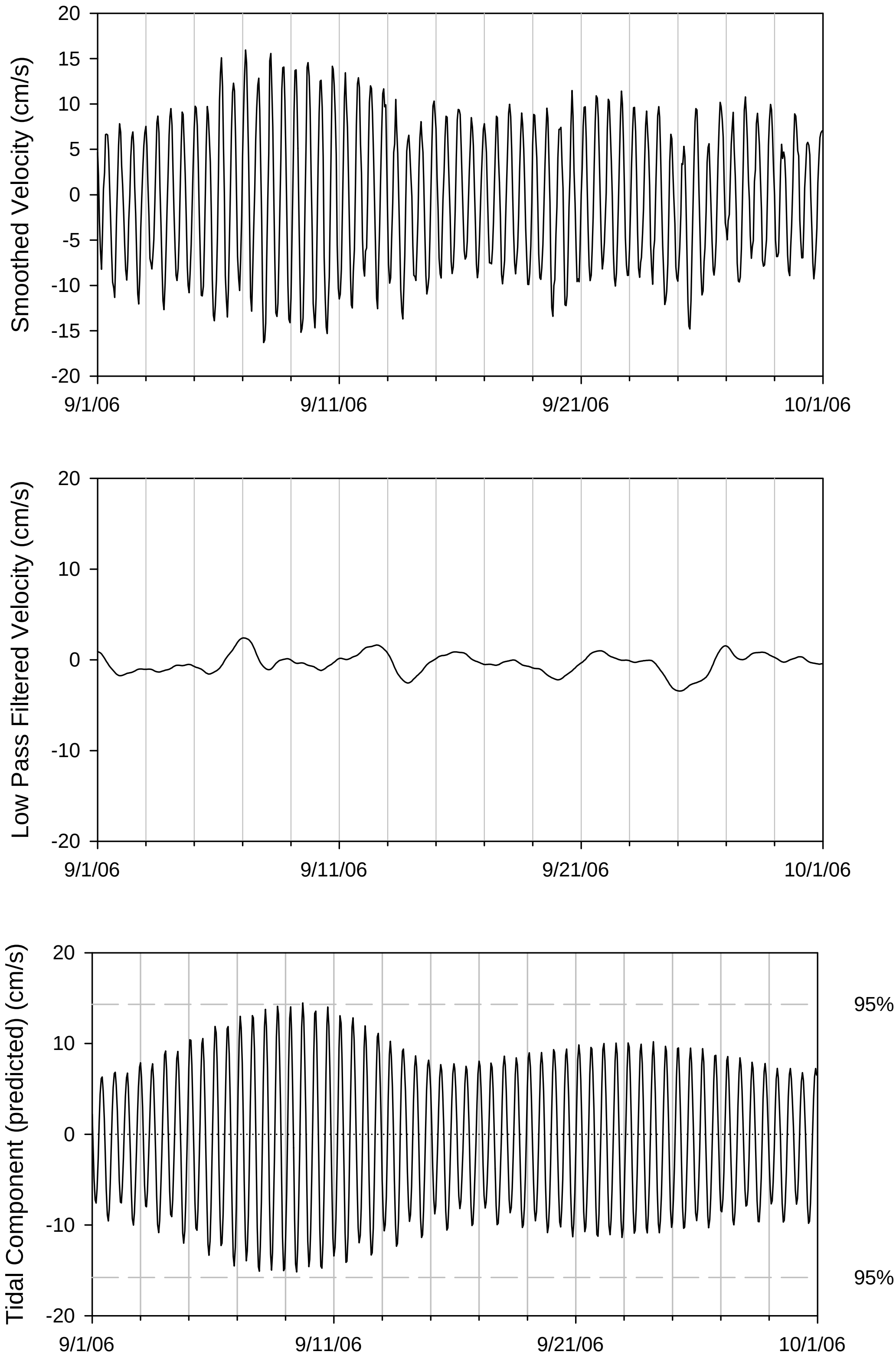
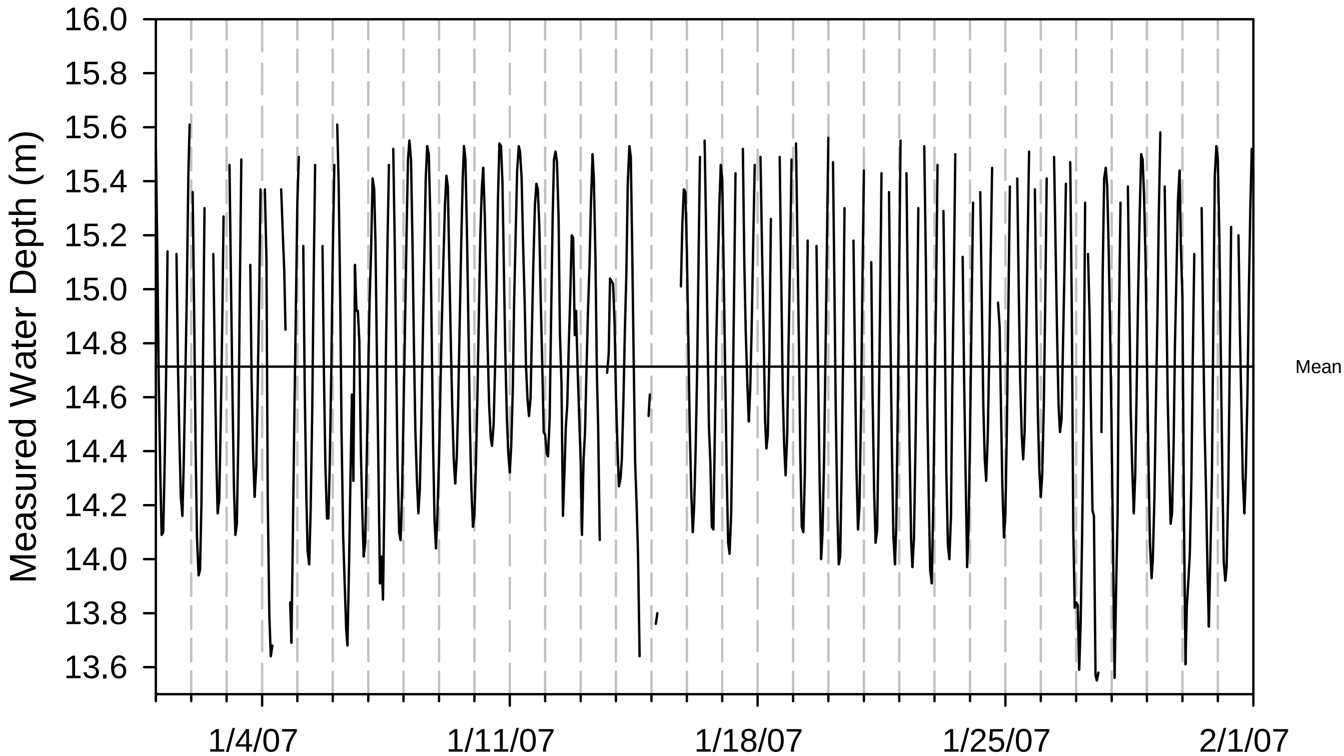


Figure 36: Fernandina Beach ODMDS Filtered and Tidal Currents (east/west component) for August 2006



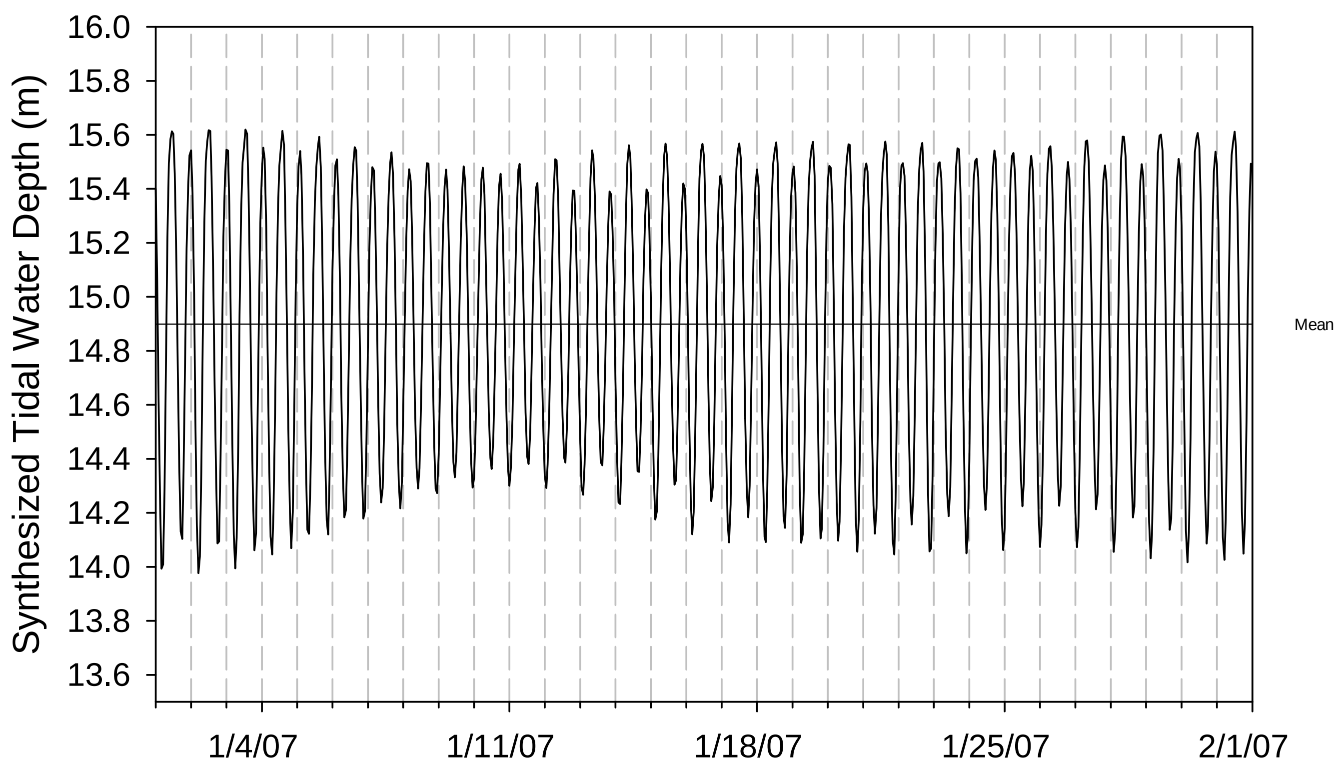


Figure 37: Fernandina Beach ODMDS Tides for March 2007.

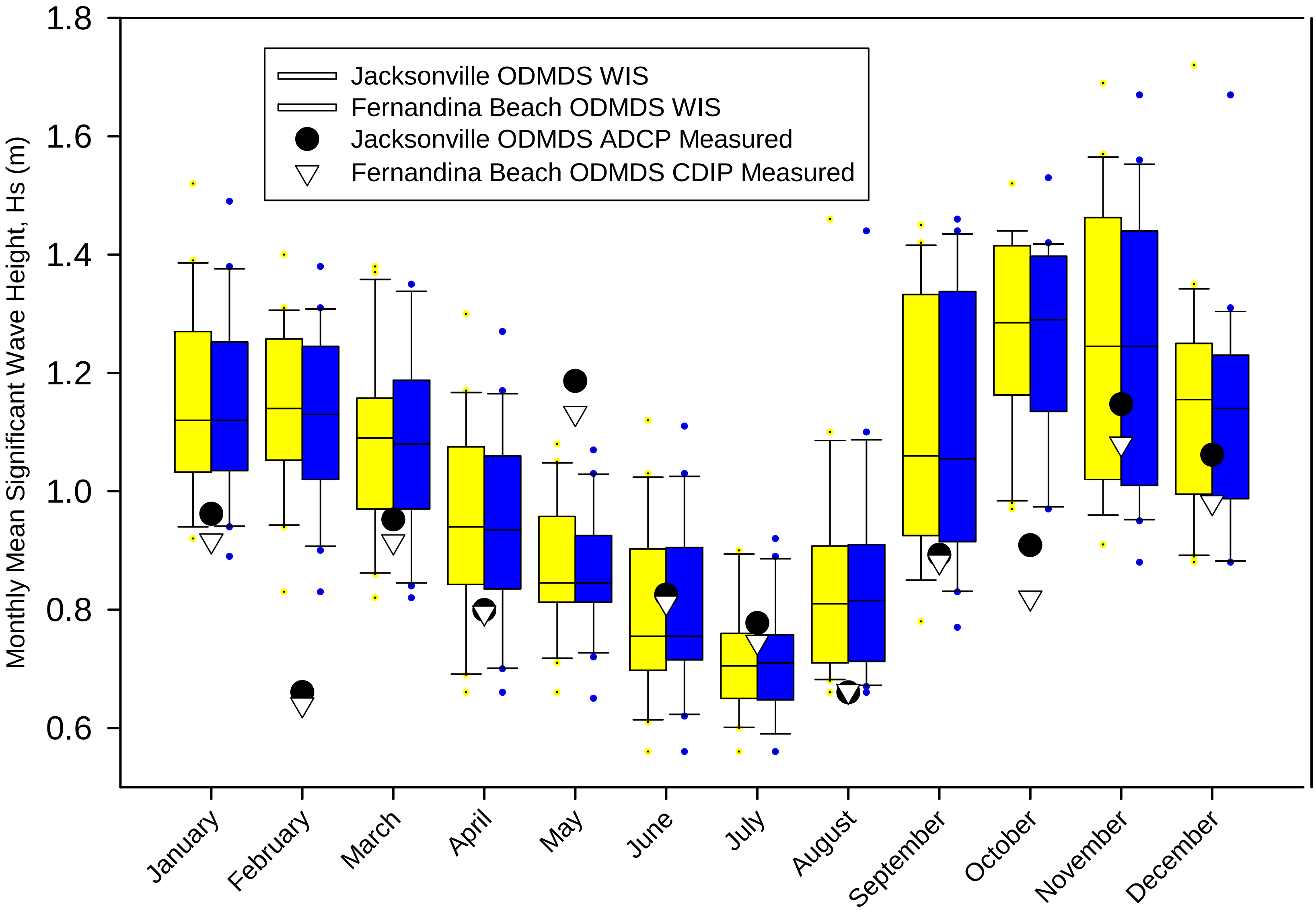


Figure 38: Comparison of Measured Mean Wave Height to Wave Information Study (WIS) Hindcast Mean Wave Heights.

APPENDIX B

DATA FILES

DATA FILES

Jacksonville&FernandinaBeach_ODMDS_Current_Wave_Study.pdf .... Study Report

Jacksonville ODMDS Processed Data CSV Files

JacksonvilleODMDSWaves.csv	......	Wave Statistics Output
JAX Currents_all.csv	......	Depth averaged and individual bin u.v currents and surface, bottom and depth averaged current magnitude and direction
JAX_Currents_all_hravg.csv	......	Depth averaged and individual bin u.v currents and surface, bottom and depth averaged current magnitude and direction averaged over 1 hour period.
JAX_Depth_all.csv	......	15 minute water depth measurements
JAX_depth_hravg_all.csv	......	Hourly averaged water depth

Fernandina Beach ODMDS Processed Data CSV Files

FBODMDS_Waves_1yr.csv	......	Wave Statistics Output from CDIP
FB_Currents_all.csv	......	Depth averaged and individual bin u.v currents and surface, bottom and depth averaged current magnitude and direction
FB_Currents_all_hravg.csv	......	Depth averaged and individual bin u.v currents and surface, bottom and depth averaged current magnitude and direction averaged over 1 hour period.

NCBrowse

ncBrowse_install_rel1_6_3.exe

This software can be used to view the NetCDF files (*.nc). This software was developed at the Joint Institute for the Study of the Atmosphere and Ocean (JISAO), a joint institute of the University of Washington (UW) and the National Oceanic and Atmospheric Administration's (NOAA) Pacific Marine Environmental Laboratory (PMEL), and funded by NOAA/ESDIM, NOAA/HPCC, NSF, and NOAA/PMEL. Help, updates and a users guide can be found at: http://www.epic.noaa.gov/java/ncBrowse/

Jacksonville ODMDS Processed NetCDF Wave Data Files

JAX01p-cal.nc	......	Deployment 1 Time series of pressure & velocities
JAX02p-cal.nc	......	Deployment 2 Time series of pressure & velocities
JAX03p-cal.nc	......	Deployment 3 Time series of pressure & velocities
JAX04p-cal.nc	......	Deployment 4 Time series of pressure & velocities

JAX01r-cal.nc	......	Deployment 1 Time series of statistical wave parameters
JAX02r-cal.nc	......	Deployment 2 Time series of statistical wave parameters
JAX03r-cal.nc	......	Deployment 3 Time series of statistical wave parameters
JAX04r-cal.nc	......	Deployment 4 Time series of statistical wave parameters

Jacksonville ODMDS Processed NetCDF Current Data Files

JAX01_CurrentsDat.nc .... Deployment 1 EPIC NetCDF Best Basic Version (BBV)
JAX02_CurrentsDat.nc .... Deployment 2 EPIC NetCDF Best Basic Version (BBV)
JAX03_CurrentsDat.nc .... Deployment 3 EPIC NetCDF Best Basic Version (BBV)
JAX04_CurrentsDat.nc .... Deployment 4 EPIC NetCDF Best Basic Version (BBV)

Fernandina Beach ODMDS Processed NetCDF Current Data Files
FB01wh.nc .... Deployment 1 EPIC NetCDF Best Basic Version (BBV)
FB02wh.nc .... Deployment 2 EPIC NetCDF Best Basic Version (BBV)
FB03wh.nc .... Deployment 3 EPIC NetCDF Best Basic Version (BBV)
FB04wh.nc .... Deployment 4 EPIC NetCDF Best Basic Version (BBV)

Jacksonville ODMDS RD Instruments Raw Binary Data
JAX01_RawData.000 .... Deployment 1 binary ADCP Data
JAX02_RawData.000 .... Deployment 2 binary ADCP Data
JAX03_RawData.000 .... Deployment 3 binary ADCP Data
JAX04_RawData.000 .... Deployment 4 binary ADCP Data

Jacksonville ODMDS RD Instruments Binary Current Data
JAX01_CurrentsData.000 .... Deployment 1 binary ADCP current data
JAX02_CurrentsData.000 .... Deployment 2 binary ADCP current data
JAX03_CurrentsData.001 .... Deployment 3 binary ADCP current data
JAX04_CurrentsData.000 .... Deployment 4 binary ADCP current data

Jacksonville ODMDS RD Instruments Binary Wave Data
JAX01_ProcWvsData_000.wvs
JAX01_ProcWvsData_001.wvs
JAX01_ProcWvsData_002.wvs
JAX01_ProcWvsData_003.wvs.. Deployment 1 binary wave data

JAX02_ProcWvsData_000.wvs
JAX02_ProcWvsData_001.wvs
JAX02_ProcWvsData_002.wvs
JAX02_ProcWvsData_003.wvs
JAX02_ProcWvsData_004.wvs
JAX02_ProcWvsData_005.wvs.. Deployment 2 binary wave data

JAX03_ProcWvsData_000.wvs
JAX03_ProcWvsData_001.wvs
JAX03_ProcWvsData_002.wvs
JAX03_ProcWvsData_003.wvs
JAX03_ProcWvsData_004.wvs
JAX03_ProcWvsData_005.wvs
JAX03_ProcWvsData_006.wvs.. Deployment 3 binary wave data

JAX04_ProcWvsData_000.wvs
JAX04_ProcWvsData_001.wvs
JAX04_ProcWvsData_002.wvs
JAX04_ProcWvsData_003.wvs
JAX04_ProcWvsData_004.wvs.. Deployment 4 binary wave data

Fernandina Beach ODMDS RD Instruments Binary Current Data

FERN1002.000 ....Deployment 1 binary ADCP current data
FERN2000.000 ....Deployment 2 binary ADCP current data
FB003000.000 ....Deployment 3 binary ADCP current data
FERN4000.000 ....Deployment 4 binary ADCP current data

APPENDIX C

COMPLETE TIDAL ANALYSIS OUTPUT FROM T_TIDE

T_TIDE output includes the following columns:

- tide: tidal constituent
- freq: frequency (cycles/hour)

Currents

- major: major axis of tidal ellipse (cm/sec)
- emaj: error estimate (95% confidence limit) for major axis (cm/sec)
- minor: minor axis of tidal ellipse (cm/sec)
- emin: error estimate (95% confidence limit) for minor axis (cm/sec)
- inc: inclination of major axis (counter clockwise from east in degrees)
- einc: error estimate (95% confidence limit) for inclination (degrees)

Water Depth

- amp: amplitude (meters)
- amp_err: error estimate (95% confidence limit) for amplitude (meters)

- phase: constituent phases (degrees relative to Greenwich)
- epha: error estimate (95% confidence limit) of phase (degrees)
- snr: signal to noise ratio

Jacksonville ODMDS Bottom Currents

file name: Bin1.out
date: 25-Jan-2008
nobs = 8760, ngood = 8648, record length (days) = 365.00
start time: 01-Sep-2006
rayleigh criterion = 1.0
Greenwich phase computed with nodal corrections applied to amplitude \n and phase relative to center time

x0= -0.844, x trend= 0

var(x)= 28.5445 var(xp)= 13.5995 var(xres)= 14.9491
percent var predicted/var original= 47.6 %

y0= -0.152, x trend= 0

var(y)= 142.4569 var(yp)= 59.3347 var(yres)= 83.147
percent var predicted/var original= 41.7 %

ellipse parameters with 95%% CI estimates

tide	freq	major	emaj	minor	emin	inc	einc	pha	epha	snr
SSA	0.0002282	1.925	2.360	0.021	0.98	106.50	24.58	285.32	62.53	0.67
MSM	0.0013098	1.346	2.172	0.130	0.91	103.65	23.67	167.30	101.02	0.38
MM	0.0015122	2.475	2.359	0.026	0.99	105.60	20.41	130.91	54.07	1.1
MSF	0.0028219	1.028	2.022	-0.274	0.85	99.59	34.54	213.23	144.68	0.26
MF	0.0030501	1.329	1.994	-0.104	0.93	107.98	34.20	323.25	102.04	0.44
ALP1	0.0343966	0.126	0.260	0.002	0.25	171.39	120.43	125.43	160.52	0.24
2Q1	0.0357064	0.088	0.233	-0.011	0.23	17.96	137.46	230.31	158.16	0.14
SIG1	0.0359087	0.253	0.281	-0.005	0.25	129.13	77.62	245.68	75.43	0.81
Q1	0.0372185	0.372	0.328	-0.056	0.22	104.82	53.45	150.67	62.20	1.3
RHO1	0.0374209	0.211	0.296	-0.011	0.24	103.52	67.27	219.65	110.48	0.51
O1	0.0387307	0.189	0.254	0.002	0.25	127.58	81.05	149.52	121.38	0.55
TAU1	0.0389588	0.146	0.398	0.048	0.33	35.48	121.99	137.02	184.91	0.13
BET1	0.0400404	0.201	0.276	-0.015	0.24	109.93	67.56	93.94	127.49	0.53
NO1	0.0402686	0.152	0.224	-0.022	0.21	116.44	88.39	110.94	115.84	0.46
CHI1	0.0404710	0.113	0.221	-0.047	0.22	107.74	100.90	122.47	192.26	0.26
*P1	0.0415526	0.609	0.367	-0.222	0.31	93.28	42.56	41.11	57.19	2.8
K1	0.0417807	0.403	0.345	0.140	0.28	80.23	57.73	82.89	69.78	1.4
PHI1	0.0420089	0.172	0.313	-0.056	0.28	106.24	91.51	333.00	146.37	0.3
THE1	0.0430905	0.212	0.234	-0.159	0.26	51.25	111.67	184.87	148.03	0.82
J1	0.0432929	0.271	0.308	-0.100	0.27	59.28	79.32	162.20	104.16	0.77
SO1	0.0446027	0.177	0.276	0.002	0.23	118.38	73.19	229.98	111.42	0.41
OO1	0.0448308	0.165	0.168	-0.114	0.16	125.41	105.23	32.15	109.71	0.97
UPS1	0.0463430	0.088	0.165	-0.033	0.16	148.41	118.29	162.17	132.62	0.28
OQ2	0.0759749	0.139	0.223	-0.013	0.18	97.66	56.83	299.44	143.18	0.39
EPS2	0.0761773	0.318	0.284	-0.168	0.19	113.08	62.89	303.77	83.70	1.3
2N2	0.0774871	0.242	0.256	0.019	0.21	118.71	50.42	249.71	87.54	0.89
MU2	0.0776895	0.321	0.259	-0.044	0.23	120.04	42.97	316.67	65.14	1.5
*N2	0.0789992	2.539	0.361	-0.113	0.26	117.46	6.37	276.58	7.03	49
*NU2	0.0792016	0.472	0.293	0.054	0.25	122.25	34.94	270.65	39.97	2.6
*M2	0.0805114	11.964	0.336	-0.011	0.26	115.51	1.27	291.07	1.51	1.3e+003
*MKS2	0.0807396	0.407	0.272	-0.064	0.18	100.76	22.77	105.34	43.91	2.2
LDA2	0.0818212	0.355	0.329	-0.043	0.19	102.48	34.25	260.59	55.18	1.2
L2	0.0820236	0.182	0.317	-0.019	0.27	27.95	97.95	174.15	140.17	0.33
*S2	0.0833333	1.916	0.315	0.076	0.28	115.81	6.59	310.84	10.38	37
*K2	0.0835615	0.486	0.225	-0.045	0.19	119.96	22.47	299.82	26.52	4.7
MSN2	0.0848455	0.420	0.298	-0.090	0.21	110.78	32.99	78.51	50.31	2
ETA2	0.0850736	0.058	0.132	-0.038	0.12	66.52	75.18	234.05	163.03	0.2
MO3	0.1192421	0.119	0.137	0.004	0.09	95.31	45.16	52.35	72.93	0.76
*M3	0.1207671	0.373	0.161	0.021	0.12	96.11	17.68	55.89	27.16	5.3
SO3	0.1220640	0.068	0.089	0.013	0.09	127.91	80.87	109.45	118.98	0.58
MK3	0.1222921	0.165	0.145	-0.021	0.10	110.62	42.31	331.09	53.28	1.3
SK3	0.1251141	0.174	0.132	-0.002	0.10	108.75	39.62	5.69	52.51	1.7
*MN4	0.1595106	0.234	0.129	0.047	0.09	95.77	25.85	195.80	36.91	3.3

*M4	0.1610228	0.300	0.133	-0.065	0.10	83.84	22.11	192.67	28.21	5.1
SN4	0.1623326	0.101	0.100	-0.063	0.08	74.94	69.33	192.64	103.82	1
*MS4	0.1638447	0.328	0.127	-0.096	0.09	95.07	21.96	167.01	26.91	6.7
MK4	0.1640729	0.110	0.083	-0.062	0.07	124.51	73.56	88.54	82.35	1.8
*S4	0.1666667	0.189	0.112	-0.093	0.09	112.86	42.70	253.25	54.30	2.9
SK4	0.1668948	0.066	0.072	-0.023	0.07	144.11	92.27	157.35	93.34	0.84
2MK5	0.2028035	0.048	0.064	0.010	0.05	66.36	63.37	350.40	119.14	0.55
*2SK5	0.2084474	0.093	0.061	-0.045	0.06	128.69	60.18	251.27	63.10	2.3
2MN6	0.2400221	0.111	0.095	-0.048	0.07	84.57	47.40	74.74	69.44	1.4
*M6	0.2415342	0.140	0.088	-0.074	0.07	85.60	44.29	108.31	64.87	2.5
2MS6	0.2443561	0.143	0.109	-0.006	0.07	63.40	30.64	179.05	37.41	1.7
2MK6	0.2445843	0.057	0.059	-0.022	0.05	103.29	61.87	205.45	83.95	0.94
2SM6	0.2471781	0.112	0.082	-0.019	0.05	106.67	34.78	289.08	54.30	1.9
MSK6	0.2474062	0.054	0.048	-0.035	0.05	28.93	99.95	321.72	88.57	1.3
3MK7	0.2833149	0.057	0.053	0.008	0.04	72.53	47.81	107.99	67.28	1.2
*M8	0.3220456	0.056	0.038	-0.021	0.05	5.10	78.20	45.10	68.44	2.2

total var= 171.0013   pred var= 72.9342
percent total var predicted/var original= 42.7 %

Jacksonville ODMDS Surface Currents

file name: Bin20.out
date: 25-Jan-2008
nobs = 8760, ngood = 8648, record length (days) = 365.00
start time: 01-Sep-2006
rayleigh criterion = 1.0
Greenwich phase computed with nodal corrections applied to amplitude \n and phase relative to center time

x0= -0.485, x trend= 0

var(x)= 72.9475   var(xp)= 44.0463   var(xres)= 28.8921
percent var predicted/var original= 60.4 %

y0= -2.43, x trend= 0

var(y)= 368.0116   var(yp)= 126.8075 var(yres)= 241.4954
percent var predicted/var original= 34.5 %

ellipse parameters with 95%% CI estimates

tide	freq	major	emaj	minor	emin	inc	einc	pha	epha	snr
SSA	0.0002282	3.052	4.334	-0.099	0.91	98.10	15.28	316.08	96.13	0.5
MSM	0.0013098	2.066	3.721	-0.105	0.97	82.07	19.83	171.82	153.95	0.31
MM	0.0015122	3.845	4.725	-0.157	1.14	82.97	14.83	131.12	85.50	0.66
MSF	0.0028219	1.967	4.295	0.332	1.15	104.03	20.19	200.21	133.87	0.21
MF	0.0030501	2.059	4.231	0.342	0.95	83.12	16.48	334.14	133.45	0.24
ALP1	0.0343966	0.434	0.528	-0.138	0.40	86.26	63.88	69.14	120.04	0.68
2Q1	0.0357064	0.255	0.446	-0.046	0.41	106.68	73.94	187.00	162.90	0.33
SIG1	0.0359087	0.477	0.494	-0.033	0.58	19.97	101.64	243.76	67.74	0.93
Q1	0.0372185	0.401	0.606	-0.015	0.44	111.20	68.14	134.46	101.15	0.44
RHO1	0.0374209	0.310	0.546	-0.142	0.47	69.80	82.30	229.57	141.61	0.32
O1	0.0387307	0.760	0.546	-0.608	0.49	118.48	92.01	175.13	116.48	1.9
TAU1	0.0389588	0.712	0.744	-0.038	0.77	36.92	74.29	285.05	73.07	0.92
BET1	0.0400404	0.298	0.455	-0.176	0.45	37.61	113.94	71.49	144.96	0.43
NO1	0.0402686	0.287	0.394	0.073	0.40	124.53	79.59	164.88	111.58	0.53
CHI1	0.0404710	0.331	0.442	0.152	0.40	111.80	78.85	354.95	143.63	0.56
P1	0.0415526	0.735	0.620	-0.451	0.61	139.47	86.84	185.37	88.42	1.4
*K1	0.0417807	1.816	0.712	-1.126	0.50	115.18	35.96	149.20	39.55	6.5
PHI1	0.0420089	0.462	0.687	-0.085	0.52	98.30	62.23	70.35	113.22	0.45
THE1	0.0430905	0.459	0.491	-0.125	0.47	49.55	66.43	18.76	97.18	0.88
J1	0.0432929	0.372	0.526	-0.240	0.49	159.41	139.90	203.11	112.64	0.5
SO1	0.0446027	0.154	0.428	0.031	0.38	26.97	114.42	252.09	181.45	0.13
OO1	0.0448308	0.160	0.314	-0.144	0.29	29.89	104.38	316.10	158.70	0.26
UPS1	0.0463430	0.343	0.372	-0.106	0.29	78.52	52.42	81.80	91.10	0.85

OQ2	0.0759749	0.113	0.264	-0.026	0.26	137.03	103.35	138.54	159.89	0.18
EPS2	0.0761773	0.197	0.337	0.109	0.30	95.04	96.09	251.06	153.39	0.34
2N2	0.0774871	0.420	0.376	-0.116	0.32	113.06	54.48	256.98	69.95	1.2
MU2	0.0776895	0.472	0.363	-0.116	0.37	122.96	50.63	321.44	63.90	1.7
*N2	0.0789992	3.732	0.413	-0.822	0.41	118.91	6.20	290.15	7.45	82
*NU2	0.0792016	0.921	0.406	-0.262	0.29	97.01	27.15	293.57	32.65	5.1
*M2	0.0805114	17.897	0.406	-2.329	0.37	119.84	1.23	308.65	1.56	1.9e+003
*MKS2	0.0807396	0.560	0.308	-0.141	0.27	116.14	36.56	159.82	37.53	3.3
LDA2	0.0818212	0.349	0.348	0.054	0.32	127.02	66.75	335.25	83.53	1
L2	0.0820236	0.653	0.483	0.012	0.46	89.51	42.53	283.84	60.51	1.8
*S2	0.0833333	3.441	0.423	-0.997	0.38	118.69	7.18	333.26	9.49	66
*K2	0.0835615	0.700	0.323	-0.129	0.29	128.58	27.06	315.14	28.09	4.7
MSN2	0.0848455	0.114	0.243	0.044	0.28	107.59	100.16	163.73	196.40	0.22
ETA2	0.0850736	0.201	0.225	0.034	0.24	141.72	77.55	209.91	89.21	0.8
MO3	0.1192421	0.197	0.209	-0.005	0.17	122.81	62.31	50.60	70.90	0.89
*M3	0.1207671	0.555	0.254	-0.077	0.24	116.98	22.43	84.21	28.59	4.8
*SO3	0.1220640	0.309	0.192	-0.084	0.16	110.83	39.25	22.73	41.67	2.6
MK3	0.1222921	0.240	0.197	-0.002	0.17	128.53	49.05	317.79	53.02	1.5
SK3	0.1251141	0.195	0.199	-0.055	0.14	84.83	61.66	359.96	75.87	0.96
*MN4	0.1595106	0.283	0.170	-0.006	0.15	71.65	34.67	149.00	36.49	2.8
*M4	0.1610228	0.344	0.162	-0.096	0.16	41.94	32.16	178.27	31.06	4.5
SN4	0.1623326	0.045	0.099	-0.008	0.09	24.24	141.14	210.78	180.41	0.21
*MS4	0.1638447	0.436	0.157	-0.174	0.15	89.47	24.32	146.48	27.97	7.8
MK4	0.1640729	0.081	0.104	-0.048	0.10	144.99	112.42	174.53	115.78	0.61
*S4	0.1666667	0.338	0.127	-0.262	0.13	16.48	73.91	357.81	65.14	7.1
SK4	0.1668948	0.115	0.109	-0.036	0.10	68.05	63.56	212.49	72.13	1.1
2MK5	0.2028035	0.038	0.091	0.021	0.07	77.22	90.97	298.44	175.93	0.17
*2SK5	0.2084474	0.132	0.089	-0.079	0.09	159.94	80.62	186.96	96.39	2.2
*2MN6	0.2400221	0.212	0.133	0.036	0.08	71.00	27.16	108.52	41.53	2.6
*M6	0.2415342	0.361	0.130	0.053	0.09	89.88	15.45	151.23	22.50	7.7
*2MS6	0.2443561	0.277	0.112	-0.026	0.09	95.61	15.96	179.12	24.90	6.2
2MK6	0.2445843	0.071	0.064	0.027	0.06	38.62	83.40	199.11	81.33	1.3
2SM6	0.2471781	0.065	0.087	0.005	0.07	77.04	74.42	289.86	136.05	0.56
MSK6	0.2474062	0.046	0.060	-0.001	0.07	160.87	113.67	238.55	111.82	0.58
3MK7	0.2833149	0.049	0.064	0.005	0.06	111.99	74.35	186.41	105.85	0.59
*M8	0.3220456	0.090	0.059	-0.034	0.06	3.54	57.05	23.69	47.25	2.4

total var= 440.9591   pred var= 170.8538
percent total var predicted/var original= 38.7 %

Jacksonville ODMDS Depth Averaged Currents

file name: Avg1yr.out
date: 25-Jan-2008
nobs = 8760, ngood = 8648, record length (days) = 365.00
start time: 01-Sep-2006
rayleigh criterion = 1.0
Greenwich phase computed with nodal corrections applied to amplitude \n and phase relative to center time

x0= -0.344, x trend= 0

var(x)= 39.1302 var(xp)= 33.2203 var(xres)= 5.8762
percent var predicted/var original= 84.9 %

y0= -0.935, x trend= 0

var(y)= 244.1324 var(yp)= 96.8425 var(yres)= 147.2083
percent var predicted/var original= 39.7 %

ellipse parameters with 95%% CI estimates

tide	freq	major	emaj	minor	emin	inc	einc	pha	epha	snr
SSA	0.0002282	2.571	3.032	0.034	0.64	99.05	8.38	301.58	85.88	0.72
MSM	0.0013098	1.684	2.993	0.141	0.56	96.65	10.27	165.76	127.23	0.32
MM	0.0015122	3.261	3.698	-0.074	0.43	91.93	6.02	131.45	73.40	0.78
MSF	0.0028219	1.561	3.230	-0.116	0.46	97.61	9.45	208.78	125.51	0.23
MF	0.0030501	1.709	3.335	-0.110	0.47	96.43	9.86	330.99	115.36	0.26
ALP1	0.0343966	0.248	0.376	-0.012	0.16	87.93	35.28	46.74	90.26	0.44
2Q1	0.0357064	0.113	0.263	0.000	0.18	40.97	60.27	184.98	150.96	0.18
SIG1	0.0359087	0.269	0.371	-0.100	0.22	115.39	47.72	285.21	103.47	0.52
Q1	0.0372185	0.494	0.386	-0.069	0.23	110.92	22.85	143.20	49.93	1.6
RHO1	0.0374209	0.359	0.427	-0.041	0.16	91.51	32.71	207.73	78.83	0.71
*O1	0.0387307	0.557	0.298	-0.371	0.21	122.87	59.18	167.48	73.05	3.5
TAU1	0.0389588	0.228	0.472	-0.007	0.27	101.58	41.15	316.49	147.94	0.23
BET1	0.0400404	0.188	0.286	-0.009	0.22	127.90	52.44	68.11	105.83	0.43
NO1	0.0402686	0.210	0.271	-0.011	0.15	112.04	35.20	135.30	89.60	0.6
CHI1	0.0404710	0.180	0.251	0.019	0.25	161.80	84.72	65.48	124.81	0.52
P1	0.0415526	0.217	0.320	-0.030	0.28	138.32	57.33	78.42	142.58	0.46
*K1	0.0417807	0.831	0.410	-0.184	0.28	121.99	23.00	146.13	29.81	4.1
PHI1	0.0420089	0.239	0.419	-0.042	0.21	89.31	40.92	8.48	130.75	0.33
THE1	0.0430905	0.172	0.323	-0.008	0.16	108.22	44.00	46.56	125.48	0.28
J1	0.0432929	0.224	0.376	-0.030	0.17	92.53	33.70	162.80	101.17	0.35
SO1	0.0446027	0.143	0.276	-0.053	0.21	61.45	46.99	199.56	146.98	0.27
OO1	0.0448308	0.090	0.144	-0.023	0.14	148.25	72.81	18.23	135.15	0.39
UPS1	0.0463430	0.089	0.208	0.030	0.10	92.75	48.99	111.66	173.10	0.18
OQ2	0.0759749	0.044	0.152	-0.000	0.14	155.77	98.18	94.27	222.72	0.083
EPS2	0.0761773	0.268	0.233	0.012	0.17	110.36	40.37	282.10	60.37	1.3
*2N2	0.0774871	0.367	0.258	-0.070	0.20	119.28	34.51	254.34	43.69	2
MU2	0.0776895	0.345	0.266	-0.075	0.20	121.99	34.48	319.77	48.57	1.7
*N2	0.0789992	3.349	0.245	-0.492	0.23	119.59	3.66	285.13	4.65	1.9e+002
*NU2	0.0792016	0.750	0.265	-0.078	0.21	110.14	16.00	282.91	22.66	8
*M2	0.0805114	15.911	0.239	-1.093	0.22	120.29	0.82	303.46	0.97	4.4e+003
*MKS2	0.0807396	0.440	0.199	0.028	0.15	110.64	21.36	141.84	25.36	4.9
*LDA2	0.0818212	0.313	0.217	0.074	0.17	102.80	40.90	277.71	54.75	2.1
L2	0.0820236	0.350	0.309	0.027	0.31	143.03	50.38	336.33	52.99	1.3
*S2	0.0833333	2.580	0.269	-0.249	0.18	118.36	4.77	325.68	5.81	92
*K2	0.0835615	0.588	0.196	0.009	0.16	121.87	16.21	306.81	18.63	9
MSN2	0.0848455	0.230	0.232	0.077	0.17	90.50	56.17	96.02	89.35	0.98
ETA2	0.0850736	0.076	0.126	-0.006	0.10	110.67	78.71	197.36	142.32	0.37
MO3	0.1192421	0.129	0.106	-0.005	0.09	122.21	47.80	49.58	57.34	1.5
*M3	0.1207671	0.478	0.149	-0.029	0.12	111.78	12.58	72.16	19.08	10
SO3	0.1220640	0.141	0.119	-0.038	0.08	100.00	42.10	30.46	71.39	1.4
*MK3	0.1222921	0.222	0.144	-0.001	0.11	118.11	27.22	323.37	38.75	2.4
SK3	0.1251141	0.160	0.151	-0.008	0.08	89.19	32.53	357.81	54.76	1.1
*MN4	0.1595106	0.238	0.104	-0.026	0.07	89.35	18.99	182.99	24.22	5.2

*M4	0.1610228	0.391	0.105	-0.161	0.08	80.19	14.23	200.13	17.70	14
SN4	0.1623326	0.096	0.076	-0.074	0.07	60.41	90.38	208.52	110.34	1.6
*MS4	0.1638447	0.365	0.108	-0.123	0.07	101.34	13.24	160.44	17.21	11
*MK4	0.1640729	0.107	0.064	-0.013	0.06	102.63	31.27	119.60	41.49	2.7
*S4	0.1666667	0.222	0.082	-0.157	0.06	114.94	50.07	258.09	59.09	7.4
*SK4	0.1668948	0.094	0.065	-0.023	0.05	98.51	38.67	209.41	54.64	2.1
2MK5	0.2028035	0.042	0.059	0.005	0.05	92.63	62.67	331.96	108.67	0.5
*2SK5	0.2084474	0.096	0.062	-0.064	0.06	151.37	83.72	205.29	81.10	2.4
*2MN6	0.2400221	0.191	0.087	-0.033	0.06	82.29	18.52	97.13	32.89	4.8
*M6	0.2415342	0.305	0.087	-0.059	0.05	89.11	10.69	136.94	17.70	12
*2MS6	0.2443561	0.220	0.077	-0.065	0.05	83.78	16.60	179.55	27.29	8.1
2MK6	0.2445843	0.054	0.048	0.001	0.05	50.67	47.01	211.44	60.19	1.3
2SM6	0.2471781	0.106	0.077	-0.015	0.05	88.75	23.56	291.43	46.60	1.9
MSK6	0.2474062	0.053	0.051	-0.020	0.04	96.51	51.92	257.62	75.10	1.1
*3MK7	0.2833149	0.058	0.038	-0.002	0.03	98.25	28.49	156.48	43.97	2.3
*M8	0.3220456	0.055	0.030	-0.030	0.03	17.00	63.24	37.99	51.45	3.4

total var= 283.2626   pred var= 130.0629
percent total var predicted/var original= 45.9 %

Jacksonville ODMDS Water Depth

file name: depth.out
date: 22-Jan-2008
nobs = 8760, ngood = 8648, record length (days) = 365.00
start time: 01-Sep-2006
rayleigh criterion = 1.0
Greenwich phase computed with nodal corrections applied to amplitude \n and phase relative to center time

x0= 14.2, x trend= 0

var(x)= 0.3389   var(xp)= 0.31147   var(xres)= 0.027347
percent var predicted/var original= 91.9 %

tidal amplitude and phase with 95% CI estimates

tide	freq	amp	amp_err	pha	pha_err	snr
SSA	0.0002282	0.0558	0.053	146.13	63.46	1.1
MSM	0.0013098	0.0175	0.042	19.17	189.81	0.18
MM	0.0015122	0.0383	0.053	347.12	88.99	0.53
MSF	0.0028219	0.0157	0.050	107.86	182.55	0.098
MF	0.0030501	0.0109	0.047	115.58	190.38	0.054
ALP1	0.0343966	0.0014	0.003	136.11	139.35	0.29
2Q1	0.0357064	0.0028	0.003	158.45	92.11	0.65
SIG1	0.0359087	0.0034	0.004	143.62	63.23	0.71
*Q1	0.0372185	0.0146	0.004	194.92	14.57	16
RHO1	0.0374209	0.0037	0.004	184.00	64.69	0.95
*O1	0.0387307	0.0756	0.004	200.95	2.80	3.5e+002
TAU1	0.0389588	0.0019	0.005	317.24	134.00	0.17
BET1	0.0400404	0.0023	0.004	276.99	96.37	0.41
*NO1	0.0402686	0.0066	0.003	202.70	23.78	5.2
CHI1	0.0404710	0.0018	0.003	201.68	131.52	0.49
*P1	0.0415526	0.0341	0.004	192.18	8.17	59
*K1	0.0417807	0.1036	0.004	196.67	2.08	7e+002
PHI1	0.0420089	0.0020	0.003	266.31	137.92	0.33
THE1	0.0430905	0.0012	0.003	164.47	174.75	0.17
J1	0.0432929	0.0046	0.005	215.87	47.67	1
SO1	0.0446027	0.0009	0.003	292.69	190.40	0.093
*OO1	0.0448308	0.0035	0.002	205.68	41.52	2.1
UPS1	0.0463430	0.0015	0.002	218.68	88.76	0.53
OQ2	0.0759749	0.0021	0.004	325.99	126.46	0.31
EPS2	0.0761773	0.0059	0.005	22.15	53.55	1.3
*2N2	0.0774871	0.0171	0.006	338.33	18.33	9.4
*MU2	0.0776895	0.0230	0.005	14.91	15.20	18
*N2	0.0789992	0.1693	0.005	353.91	1.71	1e+003
*NU2	0.0792016	0.0308	0.006	355.46	10.89	31
*M2	0.0805114	0.7665	0.006	15.75	0.43	1.9e+004
*MKS2	0.0807396	0.0144	0.004	245.81	16.63	11
*LDA2	0.0818212	0.0088	0.006	39.68	35.09	2.2
*L2	0.0820236	0.0160	0.008	49.52	27.40	3.9
*S2	0.0833333	0.1295	0.005	41.61	2.93	5.7e+002
*K2	0.0835615	0.0325	0.005	32.84	7.11	49
MSN2	0.0848455	0.0007	0.003	345.40	211.02	0.038
ETA2	0.0850736	0.0021	0.003	312.69	105.41	0.51
*MO3	0.1192421	0.0081	0.002	136.31	16.98	12
*M3	0.1207671	0.0089	0.003	155.48	18.63	9.2
*SO3	0.1220640	0.0031	0.002	140.82	40.47	2
*MK3	0.1222921	0.0045	0.002	100.24	35.65	3.3
SK3	0.1251141	0.0017	0.002	57.78	84.60	0.66
*MN4	0.1595106	0.0044	0.002	339.29	26.74	4.4
*M4	0.1610228	0.0106	0.002	28.95	12.11	26
SN4	0.1623326	0.0006	0.002	130.33	185.11	0.13
*MS4	0.1638447	0.0075	0.002	121.62	16.85	13
*MK4	0.1640729	0.0023	0.001	101.46	45.01	2.4
*S4	0.1666667	0.0059	0.002	275.26	21.51	7.1

SK4	0.1668948	0.0013	0.002	227.04	66.58	0.75
2MK5	0.2028035	0.0004	0.001	219.88	194.59	0.11
*2SK5	0.2084474	0.0029	0.001	273.01	29.25	3.9
*2MN6	0.2400221	0.0038	0.002	45.34	28.71	4.6
*M6	0.2415342	0.0060	0.002	100.65	16.27	15
*2MS6	0.2443561	0.0042	0.001	143.30	22.72	8.3
2MK6	0.2445843	0.0009	0.001	165.27	78.85	0.76
2SM6	0.2471781	0.0014	0.002	278.29	70.17	0.74
MSK6	0.2474062	0.0012	0.001	264.06	52.97	1.2
3MK7	0.2833149	0.0006	0.000	51.20	54.05	1.5
*M8	0.3220456	0.0010	0.000	317.48	22.58	4.9

Fernandina Beach ODMDS Bottom Currents

file name: FB_Bin1.out
date: 25-Feb-2008
nobs = 8760, ngood = 8712, record length (days) = 365.00
start time: 01-Sep-2006
rayleigh criterion = 1.0
Greenwich phase computed with nodal corrections applied to amplitude \n and phase relative to center time

x0= -1.55, x trend= 0

var(x)= 43.9116 var(xp)= 26.5595 var(xres)= 17.356
percent var predicted/var original= 60.5 %

y0= -0.346, x trend= 0

var(y)= 118.7324 var(yp)= 58.2743 var(yres)= 60.5912
percent var predicted/var original= 49.1 %

ellipse parameters with 95%% CI estimates

tide	freq	major	emaj	minor	emin	inc	einc	pha	epha	snr
SSA	0.0002282	1.644	1.718	-0.306	0.91	105.34	34.90	272.28	69.24	0.92
MSM	0.0013098	1.117	1.540	0.314	0.94	106.62	52.01	166.87	111.56	0.53
MM	0.0015122	1.878	1.778	-0.050	1.14	114.17	36.85	131.64	65.85	1.1
MSF	0.0028219	0.775	1.650	-0.090	0.86	90.16	49.39	187.86	153.81	0.22
MF	0.0030501	1.132	1.472	-0.193	0.94	119.69	52.35	322.36	90.23	0.59
ALP1	0.0343966	0.121	0.264	-0.062	0.22	79.87	93.43	117.46	177.70	0.21
2Q1	0.0357064	0.049	0.234	0.027	0.22	153.29	107.18	219.32	261.63	0.045
SIG1	0.0359087	0.179	0.290	-0.108	0.22	103.14	85.10	312.02	134.67	0.38
Q1	0.0372185	0.420	0.356	-0.003	0.29	100.62	40.28	133.48	53.13	1.4
RHO1	0.0374209	0.245	0.314	-0.099	0.27	105.46	73.69	229.10	106.17	0.61
O1	0.0387307	0.274	0.266	-0.005	0.28	146.73	74.04	129.12	89.69	1.1
TAU1	0.0389588	0.300	0.357	0.023	0.35	42.22	102.65	125.42	109.59	0.71
BET1	0.0400404	0.109	0.256	-0.079	0.24	149.83	124.16	60.51	164.56	0.18
NO1	0.0402686	0.170	0.208	0.022	0.17	77.65	69.21	113.75	105.69	0.67
CHI1	0.0404710	0.252	0.292	-0.106	0.26	134.37	82.44	116.43	90.40	0.74
*P1	0.0415526	0.630	0.340	-0.435	0.32	80.07	64.89	51.64	83.43	3.4
*K1	0.0417807	0.689	0.358	0.045	0.33	85.30	24.90	78.47	33.99	3.7
PHI1	0.0420089	0.171	0.325	-0.064	0.29	84.81	82.67	337.05	137.65	0.28
THE1	0.0430905	0.131	0.253	-0.059	0.20	65.59	78.65	176.24	168.80	0.27
J1	0.0432929	0.271	0.285	-0.172	0.28	64.47	89.15	159.56	119.50	0.9
SO1	0.0446027	0.259	0.313	-0.006	0.26	114.63	70.70	215.75	98.31	0.69
OO1	0.0448308	0.058	0.144	-0.041	0.14	51.28	91.15	96.36	173.52	0.16
UPS1	0.0463430	0.082	0.161	0.017	0.14	96.49	92.27	204.68	163.34	0.26
OQ2	0.0759749	0.101	0.224	-0.007	0.19	76.81	79.97	300.95	162.03	0.2
*EPS2	0.0761773	0.584	0.335	-0.191	0.24	113.14	31.88	330.02	41.44	3
2N2	0.0774871	0.223	0.235	0.062	0.25	132.28	70.43	271.39	91.71	0.9
*MU2	0.0776895	0.580	0.282	-0.021	0.33	131.38	27.75	312.76	33.72	4.2
*N2	0.0789992	2.532	0.313	0.010	0.32	126.47	6.54	269.14	7.33	65
*NU2	0.0792016	0.382	0.266	-0.084	0.30	139.52	48.41	286.94	48.24	2.1
*M2	0.0805114	12.880	0.319	0.123	0.29	124.04	1.27	283.96	1.58	1.6e+003

*MKS2	0.0807396	0.519	0.256	-0.159	0.19	80.39	27.71	113.52	37.07	4.1
LDA2	0.0818212	0.244	0.312	-0.054	0.23	107.80	62.48	272.92	96.82	0.61
L2	0.0820236	0.423	0.443	0.012	0.34	77.15	47.55	208.52	63.72	0.91
*S2	0.0833333	2.112	0.341	0.000	0.29	122.95	8.25	311.20	10.19	38
*K2	0.0835615	0.481	0.243	0.077	0.21	133.86	31.75	306.23	28.60	3.9
MSN2	0.0848455	0.372	0.344	-0.130	0.28	116.90	54.11	49.93	67.12	1.2
ETA2	0.0850736	0.142	0.172	0.043	0.15	95.17	66.85	212.20	101.81	0.68
MO3	0.1192421	0.102	0.111	-0.037	0.07	101.48	56.93	51.18	87.74	0.84
*M3	0.1207671	0.432	0.143	-0.019	0.11	112.66	13.70	64.34	19.11	9.2
SO3	0.1220640	0.069	0.086	-0.003	0.07	105.35	66.38	58.93	98.63	0.65
MK3	0.1222921	0.132	0.106	-0.013	0.10	133.75	47.75	315.87	52.03	1.5
SK3	0.1251141	0.149	0.126	-0.041	0.08	101.15	39.60	358.19	54.68	1.4
*MN4	0.1595106	0.163	0.101	-0.028	0.09	82.27	34.21	162.12	42.24	2.6
*M4	0.1610228	0.348	0.116	-0.061	0.10	77.01	17.00	170.24	20.94	9
SN4	0.1623326	0.070	0.079	-0.016	0.09	151.06	100.11	56.16	87.72	0.77
*MS4	0.1638447	0.320	0.112	-0.152	0.08	83.47	24.04	153.33	27.23	8.1
MK4	0.1640729	0.105	0.076	-0.053	0.07	103.55	56.87	128.37	65.64	1.9
*S4	0.1666667	0.232	0.104	-0.140	0.09	116.89	41.40	246.78	44.77	5
SK4	0.1668948	0.027	0.056	-0.012	0.05	90.90	100.70	154.40	165.48	0.23
2MK5	0.2028035	0.034	0.061	-0.002	0.05	106.41	78.54	291.52	139.49	0.32
2SK5	0.2084474	0.043	0.052	-0.036	0.06	140.12	120.70	258.08	145.76	0.69
*2MN6	0.2400221	0.165	0.089	-0.066	0.07	113.32	32.29	43.44	37.58	3.4
*M6	0.2415342	0.138	0.075	-0.114	0.07	69.84	96.76	159.39	97.10	3.5
*2MS6	0.2443561	0.175	0.080	-0.090	0.07	65.04	35.21	206.73	39.53	4.7
2MK6	0.2445843	0.031	0.044	-0.002	0.04	27.45	111.95	307.03	123.96	0.5
2SM6	0.2471781	0.076	0.077	-0.001	0.06	105.37	56.78	297.17	79.95	0.99
MSK6	0.2474062	0.036	0.047	0.002	0.03	66.01	69.27	305.32	108.44	0.59
3MK7	0.2833149	0.046	0.049	0.024	0.05	81.60	86.23	141.95	84.84	0.87
M8	0.3220456	0.031	0.040	-0.005	0.04	50.20	105.71	30.11	109.08	0.58

total var= 162.644   pred var= 84.8339
percent total var predicted/var original= 52.2 %

Fernandina Beach ODMDS Surface Currents

file name: FB_Bin22.out
date: 25-Feb-2008
nobs = 8760, ngood = 8712, record length (days) = 365.00
start time: 01-Sep-2006
rayleigh criterion = 1.0
Greenwich phase computed with nodal corrections applied to amplitude \n and phase relative to center time

x0= 0.636, x trend= 0

var(x)= 106.1522   var(xp)= 78.9585   var(xres)= 27.325
percent var predicted/var original= 74.4 %

y0= 0.0378, x trend= 0

var(y)= 279.806   var(yp)= 106.3606 var(yres)= 173.4795
percent var predicted/var original= 38.0 %

ellipse parameters with 95%% CI estimates

tide	freq	major	emaj	minor	emin	inc	einc	pha	epha	snr
SSA	0.0002282	2.480	3.226	0.379	1.00	76.87	18.83	301.75	92.25	0.59
MSM	0.0013098	2.240	3.322	-0.131	0.75	82.17	16.91	187.06	98.04	0.45
MM	0.0015122	3.609	3.603	0.185	1.04	77.70	15.05	132.65	62.24	1
MSF	0.0028219	1.733	3.047	0.120	0.75	94.72	16.58	210.36	129.39	0.32
MF	0.0030501	1.688	3.374	0.098	0.82	79.66	18.66	327.99	122.44	0.25
ALP1	0.0343966	0.281	0.403	-0.003	0.41	148.45	95.16	83.52	124.85	0.49
2Q1	0.0357064	0.302	0.474	-0.167	0.42	49.95	85.42	207.43	119.91	0.41
SIG1	0.0359087	0.305	0.503	-0.010	0.44	42.37	93.80	245.03	125.28	0.37
Q1	0.0372185	0.387	0.476	-0.157	0.38	83.18	70.37	149.50	116.27	0.66

RHO1	0.0374209	0.403	0.481	-0.100	0.46	82.08	69.48	143.83	118.14	0.7
*O1	0.0387307	0.934	0.458	-0.541	0.45	148.64	65.75	139.64	65.26	4.2
TAU1	0.0389588	0.648	0.739	-0.206	0.69	58.92	77.39	262.39	88.32	0.77
BET1	0.0400404	0.244	0.449	0.004	0.34	70.99	74.44	5.24	138.06	0.3
NO1	0.0402686	0.240	0.331	-0.087	0.33	148.50	97.75	144.09	129.89	0.52
CHI1	0.0404710	0.403	0.457	-0.362	0.49	157.29	145.32	271.42	115.70	0.78
*P1	0.0415526	0.968	0.591	-0.702	0.62	0.20	104.68	319.24	75.67	2.7
*K1	0.0417807	2.221	0.617	-1.103	0.56	133.09	24.19	143.54	24.23	13
PHI1	0.0420089	0.562	0.608	-0.244	0.47	103.13	68.13	94.60	105.36	0.85
THE1	0.0430905	0.266	0.441	-0.062	0.34	53.91	94.87	57.44	118.85	0.36
J1	0.0432929	0.485	0.439	-0.155	0.51	170.87	105.56	206.60	79.48	1.2
SO1	0.0446027	0.196	0.417	-0.136	0.41	122.61	93.57	110.14	190.33	0.22
OO1	0.0448308	0.122	0.246	-0.041	0.23	132.04	94.51	182.19	182.89	0.25
UPS1	0.0463430	0.231	0.301	-0.094	0.29	133.89	90.67	63.29	106.49	0.59
OQ2	0.0759749	0.111	0.231	-0.023	0.27	178.31	136.09	289.90	156.62	0.23
EPS2	0.0761773	0.375	0.320	-0.019	0.29	69.84	61.59	276.44	58.80	1.4
2N2	0.0774871	0.474	0.364	-0.113	0.34	108.67	52.22	263.96	54.15	1.7
MU2	0.0776895	0.536	0.386	-0.113	0.29	103.13	39.84	329.39	43.38	1.9
*N2	0.0789992	3.968	0.374	-0.445	0.39	131.11	5.21	284.94	5.69	1.1e+002
*NU2	0.0792016	0.808	0.363	-0.304	0.35	118.11	33.76	269.69	37.34	4.9
*M2	0.0805114	18.688	0.345	-1.277	0.39	130.63	1.22	303.72	1.20	2.9e+003
*MKS2	0.0807396	0.571	0.279	-0.013	0.25	97.34	32.59	148.48	27.97	4.2
LDA2	0.0818212	0.370	0.315	0.136	0.29	159.19	73.70	341.06	76.80	1.4
*L2	0.0820236	0.832	0.495	0.097	0.50	150.35	31.43	303.01	39.94	2.8
*S2	0.0833333	3.419	0.374	-0.651	0.34	129.06	6.32	330.48	6.07	84
*K2	0.0835615	0.923	0.257	0.045	0.26	138.55	18.99	320.13	18.09	13
MSN2	0.0848455	0.181	0.304	0.088	0.25	169.69	123.20	195.73	125.89	0.36
ETA2	0.0850736	0.102	0.154	0.009	0.17	19.98	119.27	12.59	125.73	0.44
MO3	0.1192421	0.144	0.147	-0.029	0.17	139.77	88.24	25.73	81.05	0.96
*M3	0.1207671	0.536	0.208	0.028	0.21	109.92	21.51	67.16	25.48	6.6
*SO3	0.1220640	0.210	0.145	-0.058	0.15	132.63	59.21	48.99	59.70	2.1
*MK3	0.1222921	0.253	0.173	-0.105	0.18	119.77	54.71	302.75	61.15	2.1
SK3	0.1251141	0.238	0.183	0.082	0.17	104.03	54.84	17.03	67.66	1.7
*MN4	0.1595106	0.290	0.134	0.043	0.15	82.10	35.82	157.99	29.50	4.7
*M4	0.1610228	0.568	0.137	-0.336	0.16	76.41	26.36	166.93	28.31	17
SN4	0.1623326	0.105	0.115	0.022	0.12	144.70	93.05	177.31	90.08	0.84
*MS4	0.1638447	0.522	0.151	-0.285	0.14	101.13	24.61	159.81	23.87	12
*MK4	0.1640729	0.150	0.087	0.009	0.10	88.46	47.44	123.63	46.41	3
*S4	0.1666667	0.345	0.137	-0.172	0.13	121.22	36.63	295.15	36.45	6.3
SK4	0.1668948	0.122	0.096	-0.054	0.09	127.04	72.95	252.59	80.79	1.6
2MK5	0.2028035	0.047	0.101	0.007	0.10	113.73	118.66	15.47	151.84	0.22
2SK5	0.2084474	0.093	0.098	-0.030	0.10	79.42	76.45	272.15	81.83	0.91
*2MN6	0.2400221	0.172	0.120	-0.019	0.10	111.27	39.74	100.24	52.38	2.1
*M6	0.2415342	0.305	0.120	-0.140	0.10	109.71	32.03	141.03	32.10	6.4
*2MS6	0.2443561	0.225	0.102	-0.159	0.10	82.50	66.58	202.41	69.61	4.9
2MK6	0.2445843	0.059	0.069	-0.020	0.07	124.37	73.64	210.19	91.74	0.73
2SM6	0.2471781	0.105	0.082	-0.080	0.09	167.26	120.00	243.35	102.55	1.6
MSK6	0.2474062	0.105	0.075	-0.057	0.07	113.74	68.78	311.46	69.28	2
3MK7	0.2833149	0.041	0.054	0.012	0.07	170.31	121.81	74.72	127.73	0.57
M8	0.3220456	0.120	0.086	0.007	0.08	170.36	47.18	249.25	50.81	1.9

total var= 385.9583   pred var= 185.3191
percent total var predicted/var original= 48.0 %

Fernandina Beach ODMDS Depth Average Currents

file name: FBavg.out
date: 25-Feb-2008
nobs = 8760, ngood = 8712, record length (days) = 365.00
start time: 01-Sep-2006
rayleigh criterion = 1.0
Greenwich phase computed with nodal corrections applied to amplitude \n and phase relative to center time

x0= -0.725, x trend= 0

var(x)= 61.9278   var(xp)= 56.0838   var(xres)= 5.8936
percent var predicted/var original= 90.6 %

y0= -0.31, x trend= 0

var(y)= 194.3195   var(yp)= 88.5166 var(yres)= 105.8547
percent var predicted/var original= 45.6 %

ellipse parameters with 95%% CI estimates

tide	freq	major	emaj	minor	emin	inc	einc	pha	epha	snr
SSA	0.0002282	1.976	2.891	-0.170	0.59	89.82	12.12	288.12	73.94	0.47
MSM	0.0013098	1.585	2.700	0.138	0.68	99.68	13.99	179.54	98.63	0.34
MM	0.0015122	2.685	2.821	0.044	0.55	94.12	9.74	131.61	62.96	0.91
MSF	0.0028219	1.367	2.435	0.027	0.56	84.64	15.16	200.03	136.63	0.32
MF	0.0030501	1.491	2.479	-0.130	0.68	99.85	18.82	328.17	111.96	0.36
ALP1	0.0343966	0.152	0.287	-0.009	0.17	121.58	50.11	76.59	138.72	0.28
2Q1	0.0357064	0.135	0.276	0.012	0.18	55.44	42.41	151.09	140.40	0.24
SIG1	0.0359087	0.205	0.296	-0.102	0.18	103.25	56.27	309.85	132.46	0.48
*Q1	0.0372185	0.477	0.335	-0.088	0.22	110.63	28.03	136.99	46.89	2
RHO1	0.0374209	0.366	0.372	-0.166	0.19	95.10	41.38	193.41	86.11	0.97
*O1	0.0387307	0.631	0.243	-0.239	0.38	151.90	42.61	128.98	30.82	6.7
TAU1	0.0389588	0.168	0.351	0.141	0.30	20.32	88.67	183.06	145.28	0.23
BET1	0.0400404	0.107	0.238	0.049	0.17	140.19	62.39	73.39	172.74	0.2
NO1	0.0402686	0.221	0.286	-0.012	0.15	104.28	32.64	126.61	78.08	0.6
CHI1	0.0404710	0.124	0.234	-0.021	0.19	144.17	63.16	128.40	137.84	0.28
P1	0.0415526	0.312	0.302	-0.079	0.28	122.57	52.27	32.10	86.31	1.1
*K1	0.0417807	0.890	0.374	0.041	0.31	124.61	16.44	127.34	23.95	5.7
PHI1	0.0420089	0.265	0.343	-0.006	0.24	61.45	47.53	16.83	104.22	0.6
THE1	0.0430905	0.065	0.252	0.014	0.16	117.15	51.10	95.22	215.25	0.067
J1	0.0432929	0.264	0.324	-0.118	0.23	67.31	55.42	172.97	113.55	0.66
SO1	0.0446027	0.182	0.295	0.014	0.17	112.98	41.87	189.41	108.44	0.38
OO1	0.0448308	0.029	0.154	-0.004	0.10	89.00	48.87	145.31	232.57	0.036
UPS1	0.0463430	0.017	0.174	-0.012	0.11	8.18	113.82	139.69	238.74	0.0097
OQ2	0.0759749	0.111	0.174	-0.040	0.16	46.22	90.09	42.87	107.26	0.41
EPS2	0.0761773	0.310	0.227	0.063	0.15	91.67	34.15	308.09	55.02	1.9
*2N2	0.0774871	0.360	0.213	-0.044	0.17	114.56	30.64	260.40	41.97	2.9
*MU2	0.0776895	0.572	0.216	-0.114	0.20	118.71	21.32	329.07	26.46	7
*N2	0.0789992	3.518	0.230	-0.280	0.23	130.16	4.05	278.18	3.60	2.3e+002
*NU2	0.0792016	0.631	0.226	-0.132	0.21	122.00	20.65	281.92	22.67	7.8
*M2	0.0805114	16.820	0.233	-0.436	0.24	128.58	0.80	296.36	0.81	5.2e+003
*MKS2	0.0807396	0.544	0.223	-0.039	0.15	86.81	14.07	136.71	19.37	6
LDA2	0.0818212	0.297	0.211	0.099	0.19	120.18	49.93	283.17	55.89	2
*L2	0.0820236	0.534	0.292	0.168	0.34	158.70	43.29	298.71	34.91	3.3
*S2	0.0833333	2.612	0.213	-0.199	0.25	126.59	4.24	321.28	5.42	1.5e+002
*K2	0.0835615	0.661	0.157	0.104	0.16	133.80	14.62	315.34	12.09	18
MSN2	0.0848455	0.233	0.214	-0.015	0.19	84.74	43.18	84.35	66.52	1.2
ETA2	0.0850736	0.036	0.101	0.028	0.10	175.52	142.81	208.61	164.15	0.13
*MO3	0.1192421	0.114	0.074	-0.056	0.08	150.52	85.28	5.56	79.35	2.3
*M3	0.1207671	0.537	0.134	-0.036	0.10	107.79	10.91	67.14	15.26	16
SO3	0.1220640	0.116	0.084	-0.082	0.08	99.33	66.36	56.79	90.61	1.9
*MK3	0.1222921	0.178	0.106	-0.010	0.10	137.10	38.82	316.24	30.73	2.8
*SK3	0.1251141	0.221	0.120	0.002	0.09	89.65	24.16	3.95	35.41	3.4
*MN4	0.1595106	0.209	0.089	-0.007	0.06	93.05	18.90	156.64	25.34	5.5
*M4	0.1610228	0.507	0.085	-0.121	0.06	91.89	8.53	168.76	10.03	36
SN4	0.1623326	0.073	0.067	-0.039	0.06	112.59	73.34	163.36	90.75	1.2
*MS4	0.1638447	0.412	0.078	-0.215	0.07	94.02	15.64	164.16	17.09	28
*MK4	0.1640729	0.133	0.071	-0.007	0.05	92.18	22.82	134.40	29.77	3.5
*S4	0.1666667	0.245	0.080	-0.165	0.06	108.31	35.69	283.21	39.38	9.4
*SK4	0.1668948	0.079	0.051	-0.009	0.05	114.35	38.13	214.41	45.31	2.4
2MK5	0.2028035	0.040	0.051	-0.025	0.05	34.00	103.82	40.31	132.25	0.64
*2SK5	0.2084474	0.101	0.065	-0.046	0.06	85.67	47.23	285.71	56.03	2.4
*2MN6	0.2400221	0.185	0.079	-0.074	0.06	119.67	24.40	67.53	27.06	5.5
*M6	0.2415342	0.304	0.065	-0.147	0.06	120.10	18.48	120.73	20.39	22
*2MS6	0.2443561	0.185	0.076	-0.132	0.06	91.97	50.73	190.02	56.24	5.9

2MK6	0.2445843	0.030	0.047	-0.024	0.04	2.66	137.57	296.61	122.27	0.4
2SM6	0.2471781	0.090	0.064	-0.046	0.05	118.80	51.85	271.88	63.53	2
*MSK6	0.2474062	0.067	0.047	-0.003	0.04	89.48	39.95	327.54	43.22	2.1
3MK7	0.2833149	0.027	0.034	0.010	0.03	100.26	71.13	167.90	95.52	0.61
*M8	0.3220456	0.073	0.040	-0.016	0.04	6.62	36.85	57.60	42.91	3.4

total var= 256.2473   pred var= 144.6004
percent total var predicted/var original= 56.4 %

Fernandina Beach ODMDS Water Depth

file name: depth.out
date: 28-Feb-2008
nobs = 2676, ngood = 2179, record length (days) = 111.50
start time: 19-Oct-2006 21:00:00
rayleigh criterion = 1.0
Greenwich phase computed with nodal corrections applied to amplitude \n and phase relative to center time

x0= 14.9, x trend= 0

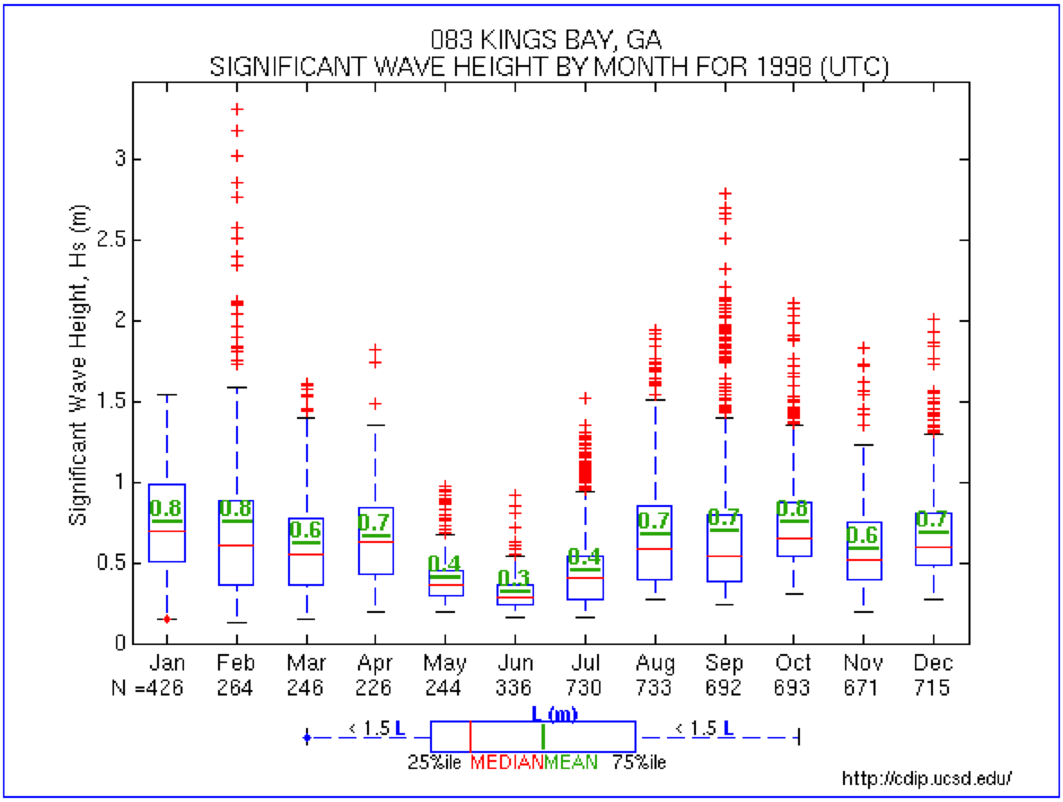
var(x)= 0.25192   var(xp)= 0.21501   var(xres)= 0.041449
percent var predicted/var original= 85.3 %

tidal amplitude and phase with 95% CI estimates

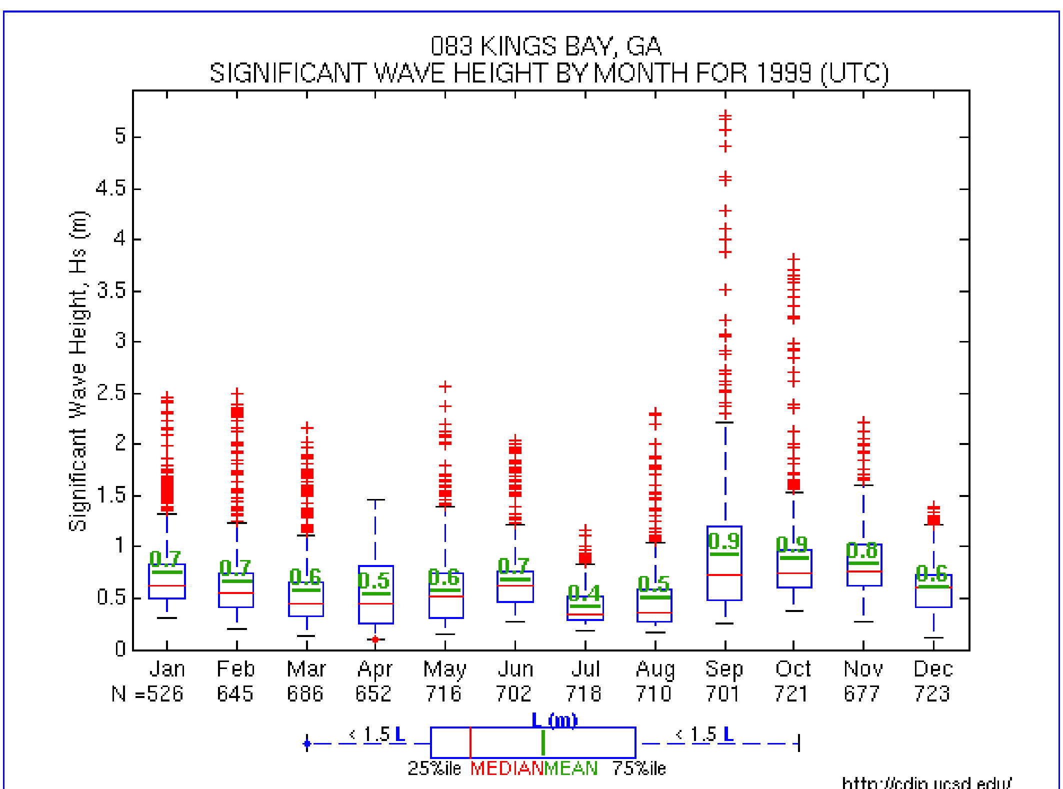
tide	freq	amp	amp_err	pha	pha_err	snr
MM	0.0015122	0.0439	0.069	327.05	110.08	0.4
MSF	0.0028219	0.0551	0.079	66.30	103.95	0.49
ALP1	0.0343966	0.0167	0.020	100.98	78.37	0.69
2Q1	0.0357064	0.0173	0.018	79.93	72.98	0.89
Q1	0.0372185	0.0053	0.015	304.96	159.84	0.12
*O1	0.0387307	0.0404	0.023	219.64	31.67	3
NO1	0.0402686	0.0216	0.018	249.98	45.64	1.5
*K1	0.0417807	0.0757	0.024	207.58	18.99	10
J1	0.0432929	0.0071	0.017	82.21	147.19	0.18
OO1	0.0448308	0.0037	0.009	327.70	151.58	0.17
UPS1	0.0463430	0.0065	0.011	67.44	117.14	0.34
EPS2	0.0761773	0.0160	0.017	178.24	69.32	0.9
*MU2	0.0776895	0.0343	0.019	138.79	32.14	3.2
*N2	0.0789992	0.1026	0.018	350.10	11.85	32
*M2	0.0805114	0.7067	0.019	16.16	1.55	1.5e+003
*L2	0.0820236	0.0479	0.029	31.69	34.66	2.7
*S2	0.0833333	0.0695	0.019	35.87	15.69	13
ETA2	0.0850736	0.0028	0.008	263.96	180.20	0.14
*MO3	0.1192421	0.0238	0.011	30.58	31.15	4.9
*M3	0.1207671	0.0208	0.011	75.92	32.09	3.4
*MK3	0.1222921	0.0372	0.011	34.08	16.52	11
*SK3	0.1251141	0.0189	0.009	49.86	32.96	4.3
*MN4	0.1595106	0.0315	0.011	200.43	20.30	8.4
*M4	0.1610228	0.0554	0.009	205.69	10.58	34
SN4	0.1623326	0.0016	0.006	211.56	224.73	0.06
*MS4	0.1638447	0.0262	0.011	213.61	22.44	5.6
S4	0.1666667	0.0125	0.010	287.69	49.08	1.5
*2MK5	0.2028035	0.0095	0.006	34.09	48.60	2.5
2SK5	0.2084474	0.0027	0.005	205.93	131.33	0.33
*2MN6	0.2400221	0.0087	0.005	168.50	34.68	2.7
*M6	0.2415342	0.0202	0.006	197.72	16.24	11
*2MS6	0.2443561	0.0104	0.006	216.22	30.97	3
2SM6	0.2471781	0.0047	0.004	304.21	71.77	1.1
3MK7	0.2833149	0.0025	0.004	270.43	96.58	0.44
M8	0.3220456	0.0033	0.004	28.70	87.19	0.55

APPENDIX D

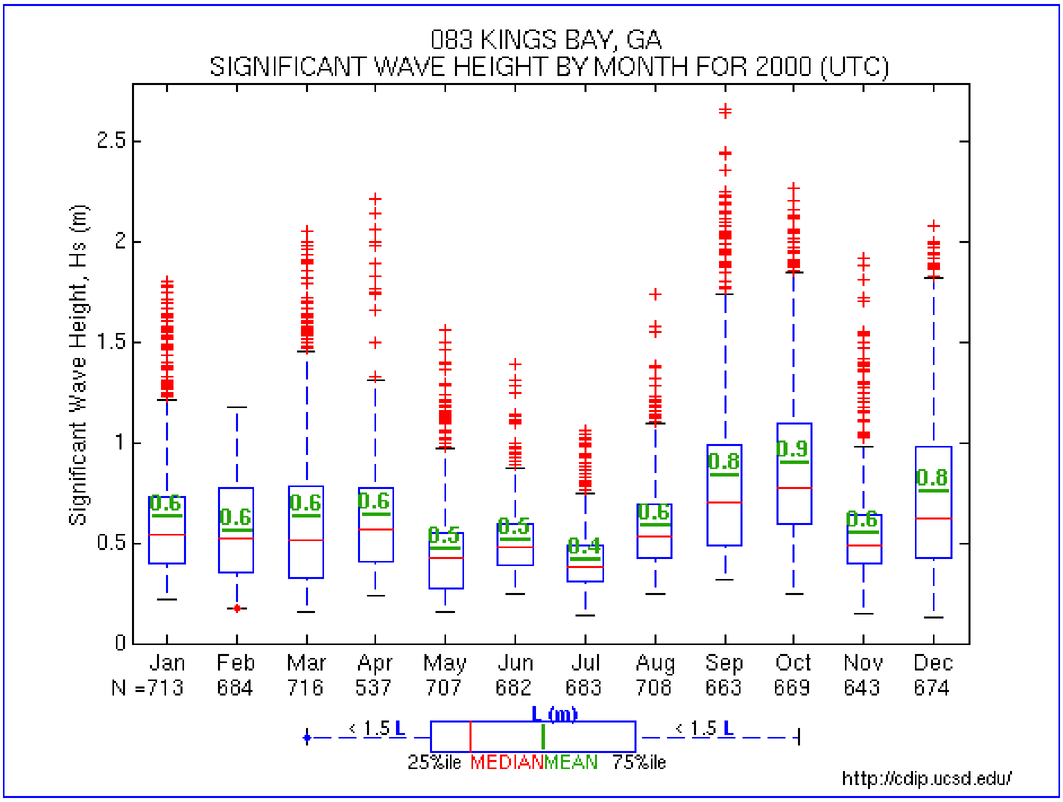
CDIP Station 132 Historical Wave Statistics

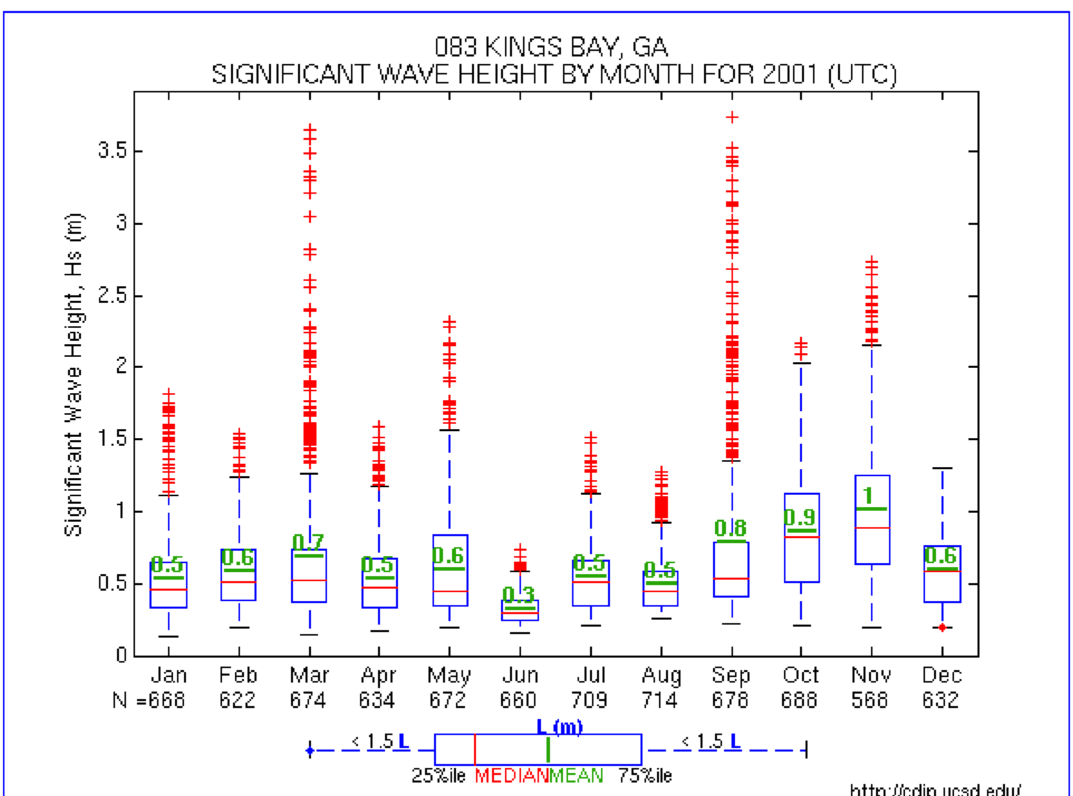


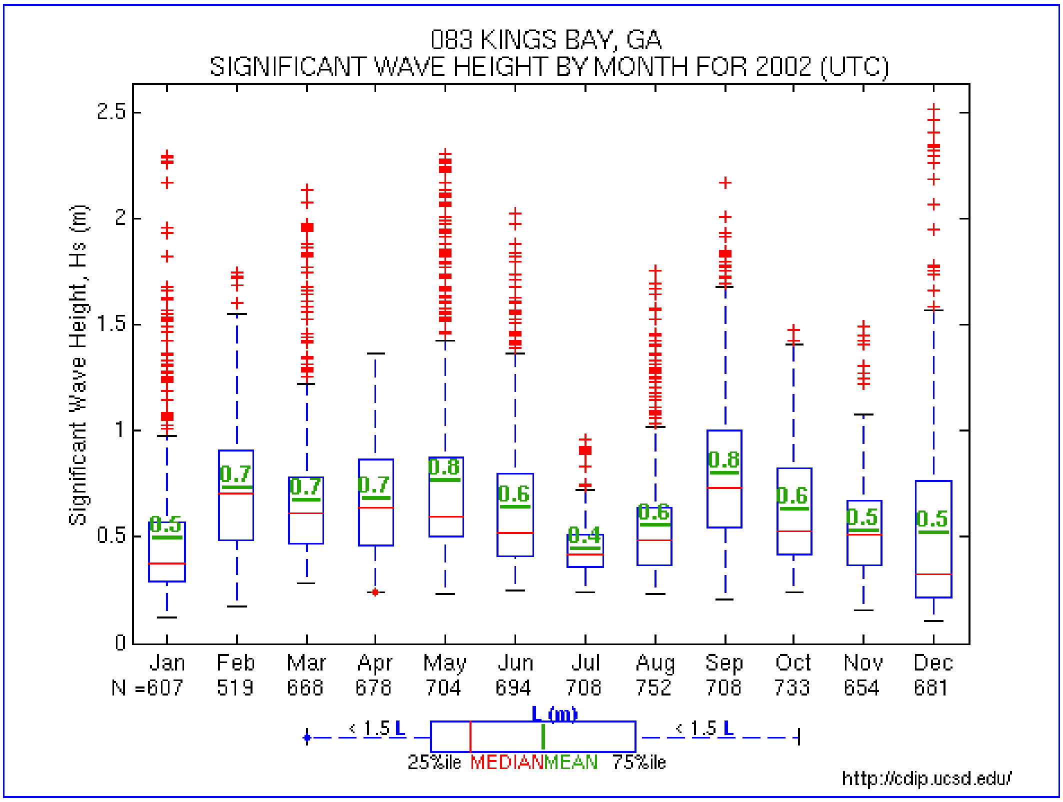
083 KINGS BAY, GA
SIGNIFICANT WAVE HEIGHT BY MONTH FOR 1998 (UTC)
Significant Wave Height, Hs (m)
Jan Feb Mar Apr May Jun Jul Aug Sep Oct Nov Dec
N =426 264 246 226 244 336 730 733 692 693 671 715
0.8 0.8 0.6 0.7 0.4 0.3 0.4 0.7 0.7 0.8 0.6 0.7
L (m)
< 1.5 L
25%ile MEDIAN MEAN 75%ile
http://cdip.ucsd.edu/

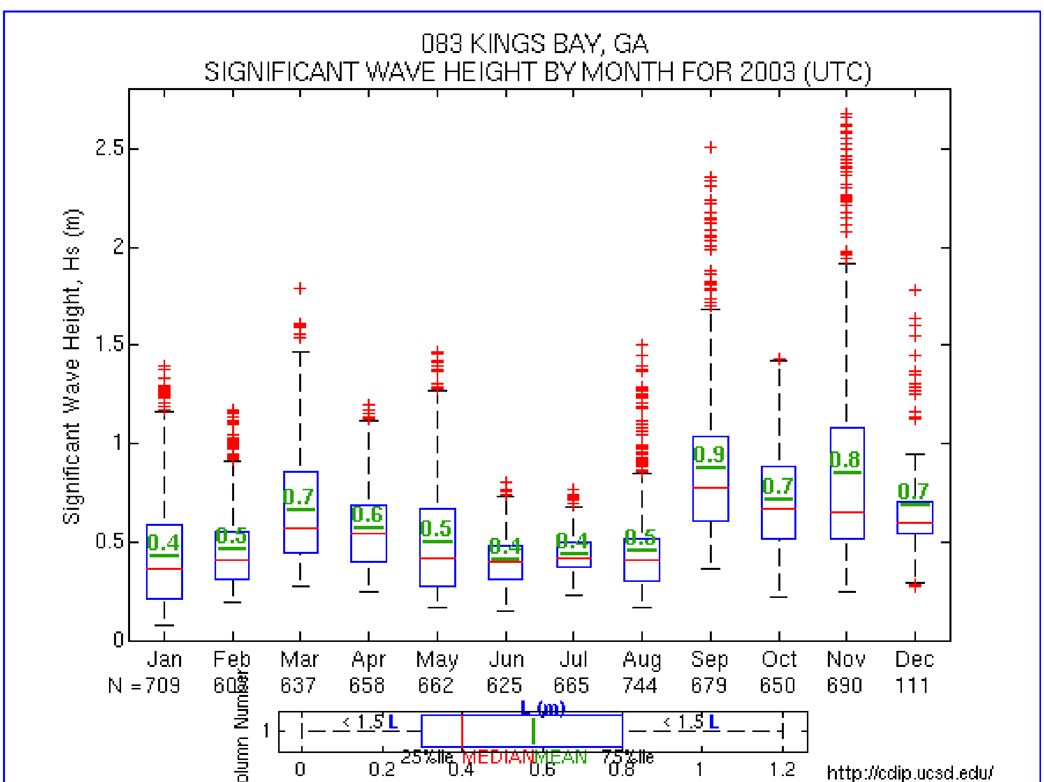


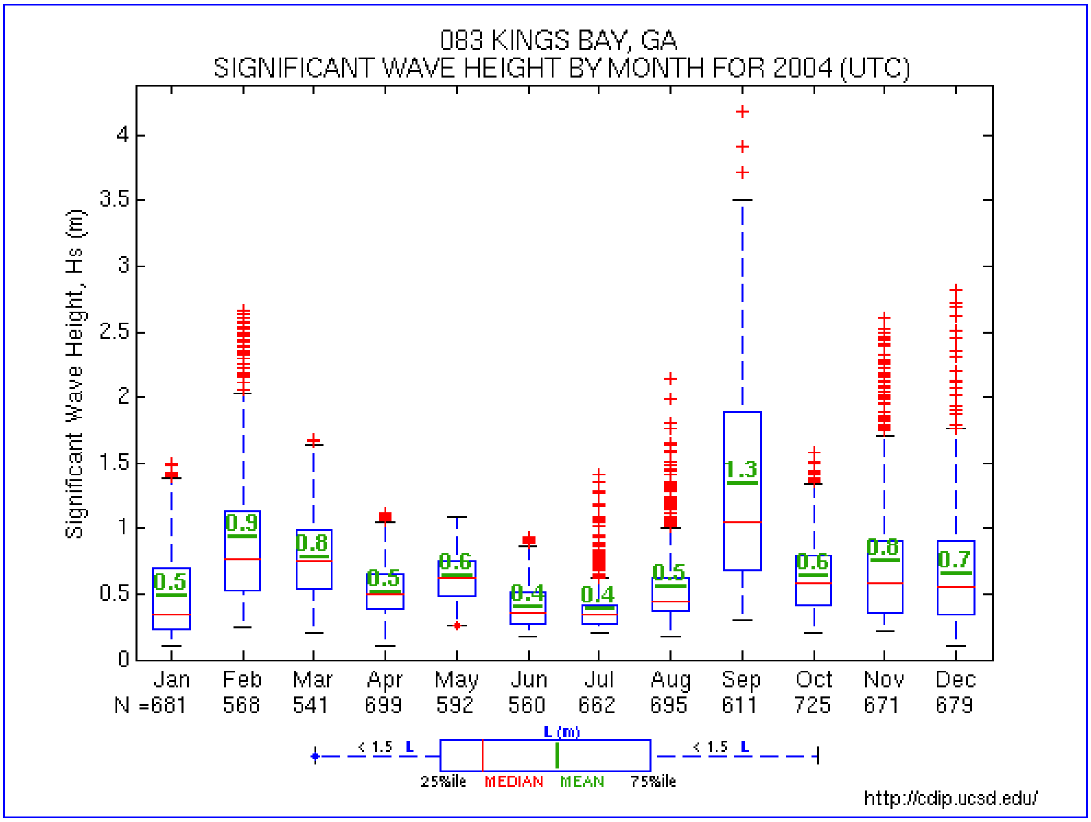
083 KINGS BAY, GA
SIGNIFICANT WAVE HEIGHT BY MONTH FOR 1999 (UTC)
Significant Wave Height, Hs (m)
Jan Feb Mar Apr May Jun Jul Aug Sep Oct Nov Dec
N =526 645 686 652 716 702 718 710 701 721 677 723
0.7 0.7 0.6 0.5 0.6 0.7 0.4 0.5 0.9 0.9 0.8 0.6
L (m)
< 1.5 L
25%ile MEDIAN MEAN 75%ile
http://cdip.ucsd.edu/

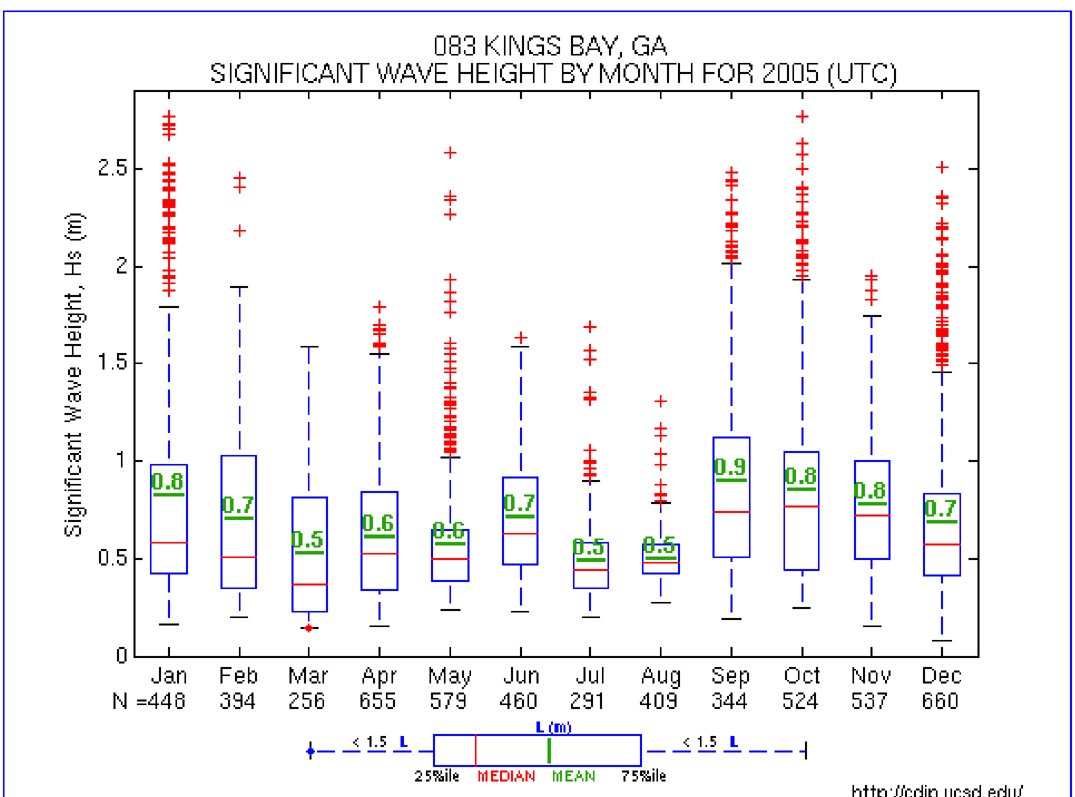

083 KINGS BAY, GA
SIGNIFICANT WAVE HEIGHT BY MONTH FOR 2000 (UTC)
Significant Wave Height, Hs (m)
0
0.5
1
1.5
2
2.5
Jan
Feb
Mar
Apr
May
Jun
Jul
Aug
Sep
Oct
Nov
Dec
N =713
684
716
537
707
682
683
708
663
669
643
674
0.6
0.6
0.6
0.6
0.5
0.5
0.4
0.6
0.8
0.9
0.6
0.8
L (m)
< 1.5 L
< 1.5 L
25%ile
MEDIAN
MEAN
75%ile
http://cdip.ucsd.edu/

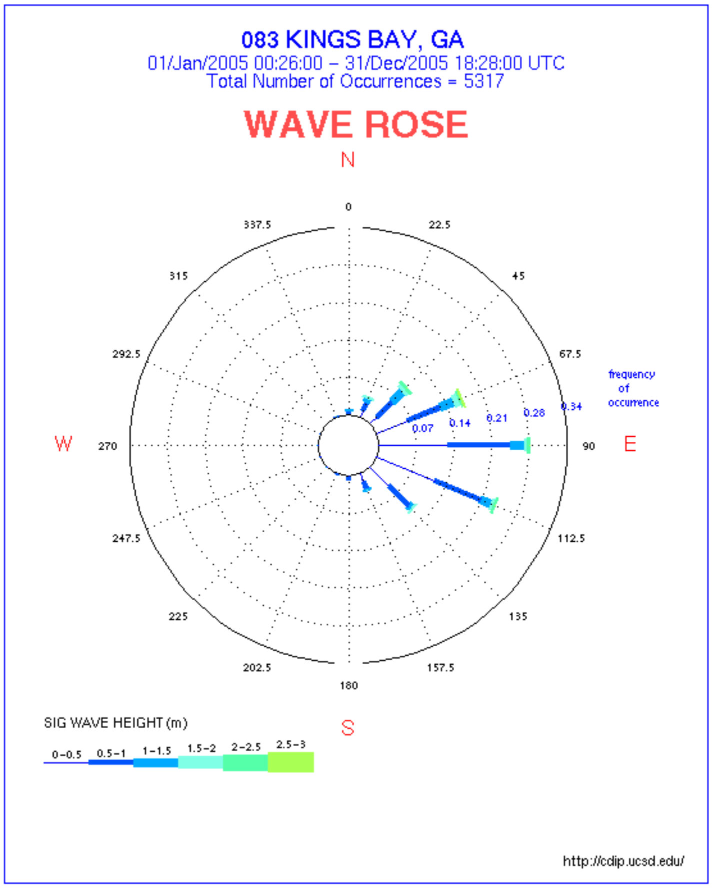

083 KINGS BAY, GA
SIGNIFICANT WAVE HEIGHT BY MONTH FOR 2001 (UTC)
Significant Wave Height, Hs (m)
0
0.5
1
1.5
2
2.5
3
3.5
Jan
Feb
Mar
Apr
May
Jun
Jul
Aug
Sep
Oct
Nov
Dec
N =668
622
674
634
672
660
709
714
678
688
568
632
0.5
0.6
0.7
0.5
0.6
0.3
0.5
0.5
0.8
0.9
1
0.6
L (m)
< 1.5 L
< 1.5 L
25%ile
MEDIAN
MEAN
75%ile
http://cdip.ucsd.edu/


083 KINGS BAY, GA
SIGNIFICANT WAVE HEIGHT BY MONTH FOR 2002 (UTC)
Significant Wave Height, Hs (m)
Jan Feb Mar Apr May Jun Jul Aug Sep Oct Nov Dec
N =607 519 668 678 704 694 708 752 708 733 654 681
0.5 0.7 0.7 0.7 0.8 0.6 0.4 0.6 0.8 0.6 0.5 0.5
< 1.5 L
L (m)
25%ile MEDIAN MEAN 75%ile
http://cdip.ucsd.edu/

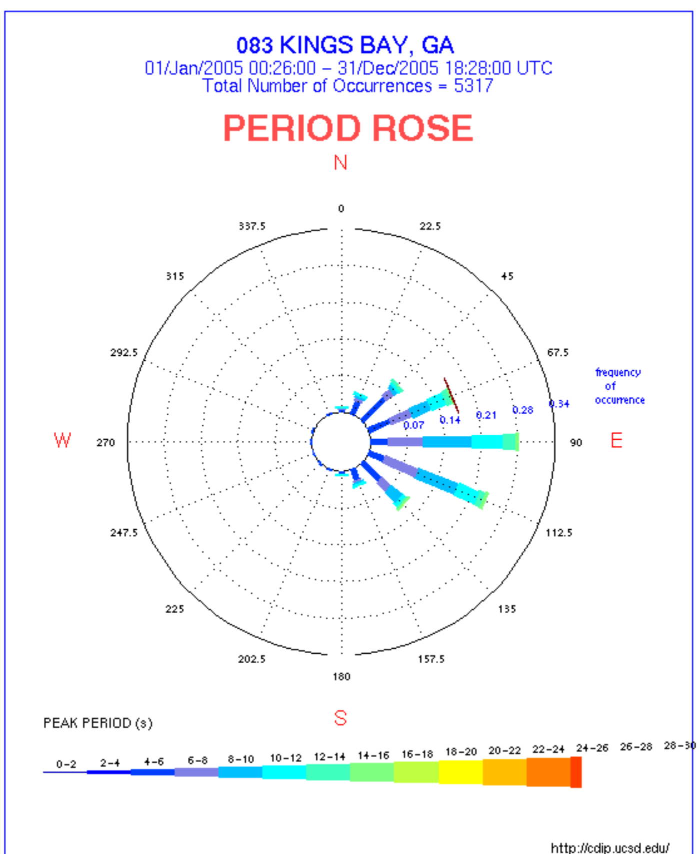

083 KINGS BAY, GA
SIGNIFICANT WAVE HEIGHT BY MONTH FOR 2003 (UTC)
Significant Wave Height, Hs (m)
Jan Feb Mar Apr May Jun Jul Aug Sep Oct Nov Dec
N =709 603 637 658 662 625 665 744 679 650 690 111
0.4 0.5 0.7 0.6 0.5 0.4 0.4 0.5 0.9 0.7 0.8 0.7
< 1.5 L
L (m)
25%ile MEDIAN MEAN 75%ile
Column Number
Values
http://cdip.ucsd.edu/


083 KINGS BAY, GA
SIGNIFICANT WAVE HEIGHT BY MONTH FOR 2004 (UTC)
Significant Wave Height, Hs (m)
Jan Feb Mar Apr May Jun Jul Aug Sep Oct Nov Dec
N =681 568 541 699 592 560 662 695 611 725 671 679
0.5 0.9 0.8 0.5 0.6 0.4 0.4 0.5 1.3 0.6 0.8 0.7
< 1.5 L
L (m)
25%ile MEDIAN MEAN 75%ile
http://cdip.ucsd.edu/


083 KINGS BAY, GA
SIGNIFICANT WAVE HEIGHT BY MONTH FOR 2005 (UTC)
Significant Wave Height, Hs (m)
Jan Feb Mar Apr May Jun Jul Aug Sep Oct Nov Dec
N =448 394 256 655 579 460 291 409 344 524 537 660
0.8 0.7 0.5 0.6 0.6 0.7 0.5 0.5 0.9 0.8 0.8 0.7
< 1.5 L
L (m)
25%ile MEDIAN MEAN 75%ile
http://cdip.ucsd.edu/



083 KINGS BAY, GA
01/Jan/2005 00:26:00 – 31/Dec/2005 18:28:00 UTC
Total Number of Occurrences = 5317
WAVE ROSE
N
E
S
W
frequency of occurrence
0.07
0.14
0.21
0.28
0.34
SIG WAVE HEIGHT (m)
0–0.5
0.5–1
1–1.5
1.5–2
2–2.5
2.5–3
http://cdip.ucsd.edu/



083 KINGS BAY, GA
01/Jan/2005 00:26:00 – 31/Dec/2005 18:28:00 UTC
Total Number of Occurrences = 5317
PERIOD ROSE
N
E
S
W
frequency of occurrence
0.07
0.14
0.21
0.28
0.34
PEAK PERIOD (s)
0–2
2–4
4–6
6–8
8–10
10–12
12–14
14–16
16–18
18–20
20–22
22–24
24–26
26–28
28–30
http://cdip.ucsd.edu/