Marine Field Group Technical Report:

Physical Observations in the Florida State University Northern Gulf Institute Program: Hydrographic Sections and Fixed Sites June 2009-June 2011

by
Stephanie White, Kevin Speer, and Marcus Huettel

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Florida State University
Earth, Ocean, and Atmospheric Science
Marine Field Group
Tallahassee, Florida 32306

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1. Project Summary and Purpose

The purpose of the Florida State University (FSU) component of Northern Gulf Institute (NGI) is to develop an integrated research program for the Northeast Gulf of Mexico, interweaving large scale ecosystem modeling with real time oceanographic, meteorological, and ecological observations. This research is funded by NOAA through the NGI. The overarching component of the effort is based in a hyper-fine resolution ocean model of the Big Bend Region (BBR), including an intra-coastal component, coupled with ecosystem-level biological interactions. This model will serve several local purposes, including the synthesis of the various regional Cooperative Institute research programs within a common framework while providing the scientific context for ecosystem-based management.

FSU's contribution to NGI is organized under three broad themes: Transport, Ecosystems, and Modeling and covers a diverse set of environments which are characteristic of the BBR. These environments (which include shallow seagrass beds, and deeper (20 m) sandy bottoms, from coastal runoff dominated brackish waters to coastal clear waters) are linked both vertically and horizontally through physical and trophic features. The sampling strategies integrate physical oceanographic, physical meteorological, biological, and chemical components. The unique approach is the coupling of physical and biological models to address some of the more pressing environmental issues of the region, ranging from hurricane prediction to natural resource management.

The Transport objectives are to clarify the basic onshore/offshore transport mechanisms of the BBR and the impact of these mechanisms on primary production by monitoring the physical structure of ocean currents and wave parameters, temperature/salinity stratification and biogeochemical parameters (dissolved oxygen, chlorophyll, pH, Dissolved Organic Carbon and Nitrogen). These data records serve to constrain our coupled physical/biogeochemical models and provide a broader view of the regional transport dynamics. The time-series of biogeochemical data will examine the role of benthic primary productivity in sustaining the regional ecosystems and help quantifying biogeochemical cycles in the coastal environment of the BBR. Primary production, coupling between sediment and water column, and oxygen availability together control secondary production, hence fish, mollusk and shrimp yields. However, the productivity of the pelagic and benthic components in this region is not known, and the role of physical transport of chemical and particulate matter on the production process presently is not well understood. This project will

produce the base data that are essential for ecosystem studies, fish yield estimates and regional models linking transport and productivity in the Northeastern Gulf of Mexico.

The Ecosystems group hypothesizes that the BBR fisheries in general respond to regional climatic fluctuations in precipitation and the hydrological cycle, as well as to interactions with the off-shore coastal zone. Gag grouper are being used as a model species for the Ecosystems objectives because of its regional economic significance. FSU will examine the impact of terrestrial and shallow-water climatological conditions on grouper growth rate and diet in BBR seagrass beds. An overarching component of ecosystem-based management for biological systems relates to studies of trophic interactions. Photosynthetic organisms form the base of the food web and, thus, are critical to all biological and geochemical processes, including fish production and development of toxic anoxic environments.

The Transport and Meteorology groups are utilizing the same platform, The United States Air Force (USAF) tower N7, for instrumentation to answer questions regarding air/sea interactions. Topics such as: the influences of swell on surface fluxes, the influences of shoaling waves, and fluxes at high wind speeds (U_{10} > 20 m/s) will be examined. The analysis of these data can be used to improve oceanic and atmospheric model parameterizations of fluxes, and thereby improve the accuracy of forcing fields for oceanographic studies. These observations can also be used to validate atmospheric models, particularly the diurnal variability associated with the land/sea breezes. Heat and freshwater fluxes of atmospheric origin will emerge as of primary significance in defining the environment characteristics of the BBR.

2. Hydrographic Sections

The BBR of Florida extends along 150 miles in the Northeast coast of the Gulf of Mexico. The FSU Coastal and Marine Laboratory (FSUCML) is located, within the BBR, in St. Teresa, Fl 50 miles Southwest of Tallahassee. The FSU Department of Earth, Ocean, and Atmospheric Science Marine Field Group (MFG) utilize the FSUCML for support of the NGI Transport research. The MFG has laboratory space at the facility and stages research cruises from this location. Both the NGI Transport Hydrographic Section and Fixed Sites are located offshore from the FSUCML.

The Hydrographic Section cruises occur approximately monthly aboard a FSUCML vessel. Water column profile data and water samples are collected during these cruises at 5 stations along a transect (Table 1). The Hydrographic Section starts approximately 3nm from the shoreline and extends out 17nm to the offshore USAF tower N7. Along the transect profile data is collected from the down and up casts using a Sea-Bird 19 SEACAT Profiler (SBE19), and a multi-parameter YSI 6600 Sonde (refer to instrument details in section 5) (Table 2). The SBE19 measures conductivity, temperature, and depth (CTD) every 0.5 seconds. The SBE19 was factory calibrated on 27 September 2005, 05 October 2007, and 02 June 2009. The YSI parameters are measured every 1 second and include temperature, conductivity, pH, turbidity, chlorophyll, dissolved oxygen, and depth. The day prior to each cruise, the YSI is calibrated following the procedures outlined in the YSI Operating and Service Manual. Two Niskin water sampling bottles are also lowered for bottom and mid water samples. A surface water sample is collected using a bucket. These water samples were analyzed by Florida Wildlife Research Institute under the FSU Red Tide Monitoring

for nutrients, chlorophyll, and *Karenia brevis* from November 2006 – June 2009, and by McGlynn Laboratories for Nitrate + Nitrite as N and Ortho-Phosphorus as P from September 2010 – present.

The Hydrographic Section sampling began on November 14, 2006. The Transect 1 line was sampled from November 14, 2006 through November 06, 2007. After which Station 1, 3 and 4 locations changed to incorporate NGI Fixed Sites. Transect 2 started December 19, 2007 and is still being sampled. Data included in this report is from June 2009 – June 2011. Refer to the Technical Report CMF-2009-01 for data from November 2006 – June 2009. Transect 1 was sampled 11 times and Transect 2 has been sampled 26 times on a quasi-monthly basis. A summary of the transect casts is created for every cruise with location information.

The Hydrographic Section naming convention is as follows: transect#_station sample. An example is transect2_1a. The data file naming convention is as follows: instrument_transect#_date (yymmdd) _station sample. An example is sbe19_transect2_110603_1a. Refer to Appendix II for monthly transect data plots created using MatLab software.

Table 1. Location details of Hydrographic Sections.

Name	Latitude	Longitude	Depth(m)
transect2_1	29º 51.50	84º 31.50	5
transect2_2	29º 48.00	84º 31.00	5
transect2_3	29º 47.67	84º 28.33	10
transect2_4	29º 43.80	84º 25.15	15
transect2_5	29º 39.90	84º 22.29	18

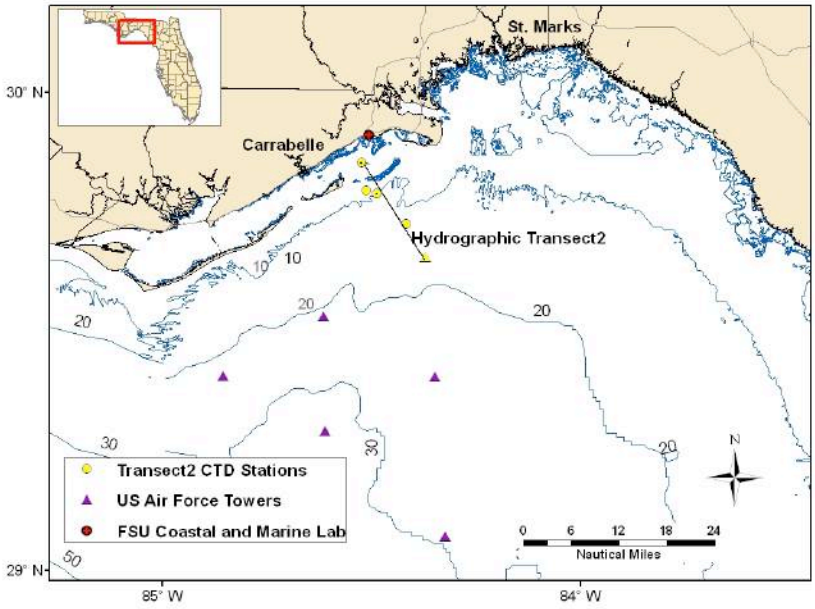


Figure 1. Map of the Big Bend Region, Florida and the FSU NGI Hydrographic Sections.

Table 2. Details of Hydrographic Section Cruises.

Date	**Vessel**	**Transect**	**Instrument(s)**		**Notes**
06/09/2009	R/V Seminole	transect2	ysi	sbe19	last Red Tide sampling cruise
07/28/2009	R/V Seminole	transect2	ysi	sbe19	
09/10/2009	R/V Bellows	transect2	ysi	sbe19	
12/14/2009	R/V Seminole	transect2	ysi	sbe19	
01/20/2010	R/V Seminole	transect2	ysi	sbe19	
03/08/2010	Calcutta	transect2	ysi	sbe19	No station 4 sbe19 data
04/29/2010	Calcutta	transect2	ysi	sbe19	
06/08/2010	R/V Bellows	transect2	ysi	sbe19	CDOM data collected
09/03/2010	Calcutta	transect2	ysi	sbe19	Nutrient samples collected/ CDOM
10/21/2010	Calcutta	transect2	ysi	sbe19	Nutrient samples collected/ CDOM
03/17/2011	Fluid Motion	transect2	ysi	sbe19	Nutrient samples collected/ no station 2 data
06/03/2011	Fluid Motion	transect2	ysi	sbe19	Nutrient samples collected

NOTES:
06/09/2009 last trip for Red Tide water samples.

03/08/2010 no station 4 sbe19 data was collected due to instrument failure.

06/08/2010, 09/03/2010, and 10/21/2010 CDOM instrument was mounted to the profile frame for data collection.

09/03/2010, 10/21/2010, 03/17/2011, and 06/03/2011 water samples were collected for Nitrate + Nitrite and Ortho-Phosphate analysis.

03/17/2011 no station 2 data or water samples were collected.

3. Fixed Sites

Along with the Hydrographic Section the Transport group has instrumentation deployed at three Fixed Sites (Site A, B, and N7) to collect continuous data (Table 3, Figure 2). These three Fixed Sites are also 3 of the 5 Hydrographic Section stations (station 1, 3, and 5). The instrumentation is serviced and downloaded on a monthly basis by the MFG and FSU Academic Dive Program science divers. The Fixed Site naming convention is as follows: instrument_site_date deployment began (yymmdd) _date deployment ended (yymmdd). An example is ysi_siteA_110422_110525. Refer to Appendix III for Site A, B and N7 data plots created using MatLab software. Sediment and water samples are collected for benthic and pelagic productivity measurements. These data can be used to develop a two-dimensional record of flow and solute and particle distributions that will enable estimates of the coupling between the pelagic and benthic components and a determination of fluxes of chlorophyll and oxygen.

Table 3. Location details of Fixed Sites.

Name	Latitude	Longitude	Depth(m)
Site A	29º 51.50	84º 31.50	5
Site B	29º 47.70	84º 28.30	10
Site N7	29º 39.90	84º 22.30	18

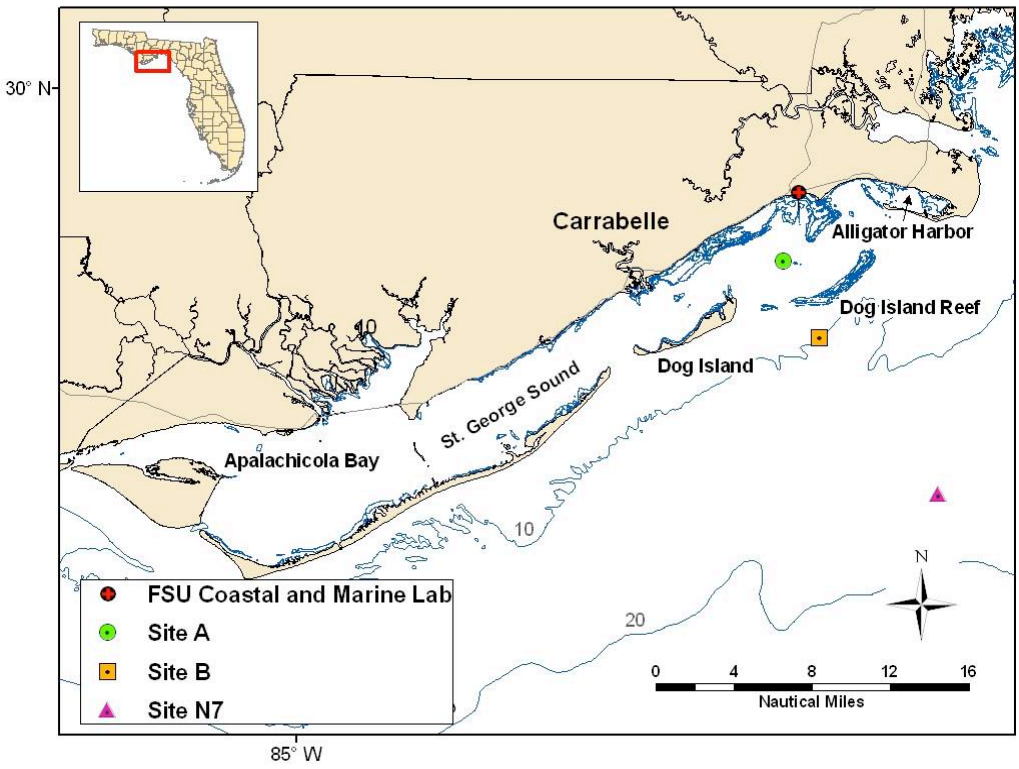


Figure 2. Map of FSU NGI Fixed Sites A, B, and N7.

Site A:
Site A is located near the Intracoastal Waterway at the end of the FSUCML channel approximately 3nm from the shoreline. It is approximately 5 meters deep. Apalachicola Bay is the adjacent water body to the west and Alligator Harbor is located to the East. It is surrounded by areas of dense seagrass (Lanark Reef, Dog Island Reef, and Turkey Point Shoal). The site location is within the Alligator Harbor Aquatic Preserve. The sediment is a mud/sand mixture. Visibility is on average 1 foot or less. A multi-parameter YSI 6600 EDS and a Nortek Acoustic Wave and Current Meter (AWAC) were deployed March 12, 2008 (refer to instrument details in section 5). The instruments are mounted to a homemade fiberglass bottom mount which is attached to 2 aquors (Figure 4). This site is accessible by a FSUCML pontoon boat for servicing, but also is very accessible to other boaters since it is nearby an Intracoastal Waterway channel marker. Issues with missing buoy markers, fishing lines, vandalism, and the collapse of the piling have been experienced. The instrument servicing schedule is determined by the bio-fouling growth rate. The bio-fouling can be extreme at this site, and mainly consists of barnacles and bryozoans. Measures were taken to

decrease bio-fouling, extend deployment lengths and minimize data loss. The mount and instruments are coated with Interlux Micron Extra anti-fouling paint and the YSI probes are outfitted with copper tape and copper brushes. Prior to each deployment, the YSI 6600 EDS's are calibrated following the procedures outlined in the YSI Operating and Service Manual. The YSI 6600 EDS is set to measure temperature, conductivity, pH, turbidity, chlorophyll, dissolved oxygen, Photosynthetic Active Radiation (PAR), and depth every 15 minutes. The AWAC measures currents every 15 minutes and waves every hour (refer to the deployment configurations in section 4a).

Site B:

Site B is located just offshore of Dog Island Reef along the 10 meter isobath. The sediment is mainly sand with patches of hard bottom reefs. Similar to Site A there is a multi-parameter YSI 6600 EDS and a Nortek AWAC. On June 19, 2008 the instruments were deployed in a MSI rectangular trawl-proof bottom mount (Figure 4). The AWAC is gimble mounted. Over time the mount has been a home to a few octopi. The calibration and deployment procedures are the same as Site A procedures (refer to the deployment configurations in section 4b). Data collection was stopped from July 13, 2009 – April 07, 2010 due to limited accessibility with a FSUCML small boat.

Site N7:

The offshore observing platform is the USAF tower N7, formerly known as K-tower. It is 1 of 6 USAF communication towers in the Northeastern Gulf of Mexico used for navigation training by Tyndall Air Force Base pilots. The tower stands 100 feet tall above the surface and is attached to a submerged barge on the bottom. Essentially the tower is a man-made reef and attracts large schools of fish, goliath groupers, sharks, sea turtles, and many recreational fishermen. Tower N7 is approximately 17nmi offshore from the FSUCML. FSU has obtained approval to utilize the tower as a platform for oceanographic and meteorological instrumentation (Figure 3). The Transport group deployed 2 Sea-Bird 16 SEACAT's on December 12, 2007 (refer to instrument details in section 5). Conductivity and temperature readings are collected every 15 minutes. The instruments are mounted between tower windows at 3m and 9m depth. For safety reasons the surface sensor was mounted at 3m due to the tower docking platform and the underwater supporting structures. The instruments were cabled for real-time telemetry on June 9, 2009. The instruments are serviced approximately every 3-4 months due to bio-fouling. The SBE16's are factory calibrated, which was completed in June 2007, July 2009, and November 2010. These surface and mid water SBE16's along with the bottom mounted YSI show water column stratification.

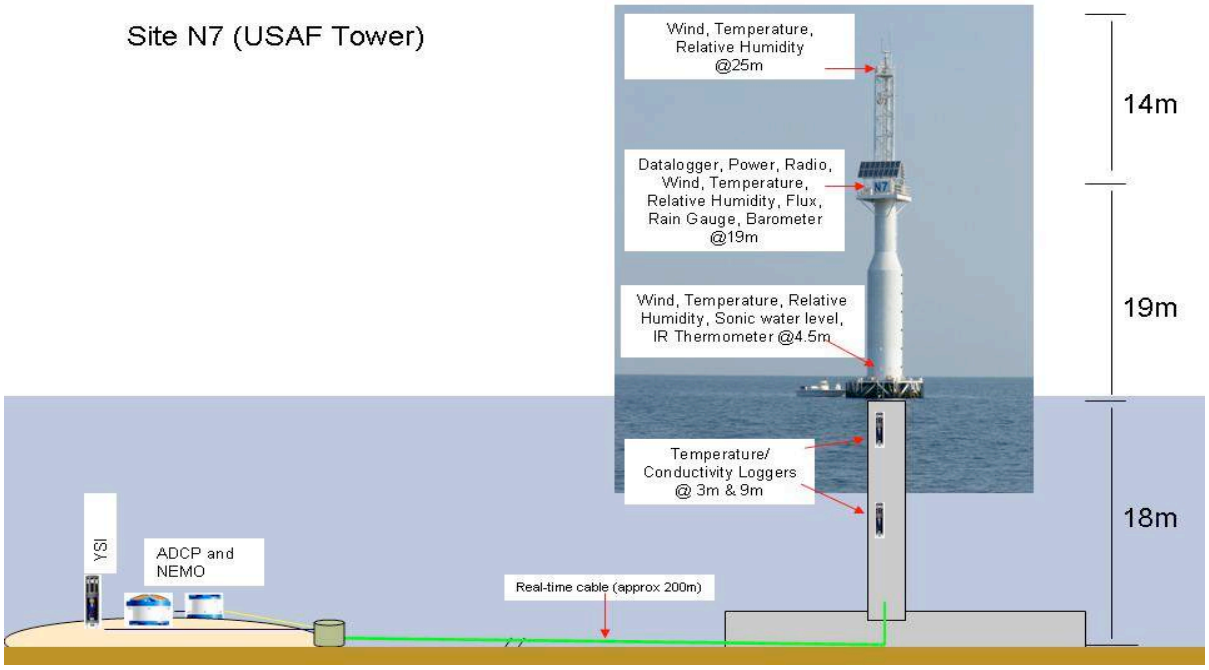


Figure 3. Illustration of Oceanography and Meteorology instrumentation at Site N7.

Additional Transport instruments are deployed approximately 500 feet to the South West of tower N7. These include a Teledyne RDI Acoustic Doppler Current Profiler (ADCP), and a multi-parameter YSI 6600 EDS (refer to instrument details in section 5). The instruments are attached to a MSI trawl-proof saucer bottom mount at a depth of 18m. The RDI ADCP is mounted on a central gimble and the YSI instrument is attached to a basket that is mounted in a side compartment on the frame (Figure 4). The upgraded ADCP with wave measurements was deployed on November 06, 2007. The YSI was deployed on March 12, 2008. The sediment is a sand/shell mixture and is only inches thick to the underlying limestone. Typically there is a moderate current at this site and the visibility is 30+ feet. The YSI calibration and deployment procedures are the same as those for Site A and B. The RDI ADCP measures currents every 15 minutes and waves every hour (refer to the deployment configurations in section 4c). Initial investigation of the current data shows error velocities at times exceed 5 cm/s even in the bins closest to the transducer. The ADCP and YSI are swapped out with identical instruments every month. Bio-fouling is minimal, but copper tape and wipers are used for the YSI and Vaseline is applied to the transducers of the ADCP. In August 2010 a cable was laid to allow for real-time telemetry of the instruments located off the tower. The cable supplies power down to the instruments from solar panels and allows for data to be collected by a Campbell Scientific CR1000 Datalogger located at the upper platform on the tower. The ocean data is then sent to shore with the meteorology data via a radio modem. Issues that are currently being worked out include power voltage drop, instrumentation sampling rates, communication baud rates, implementation of a smart buffer switchbox, and design of instruments in bottom mount.

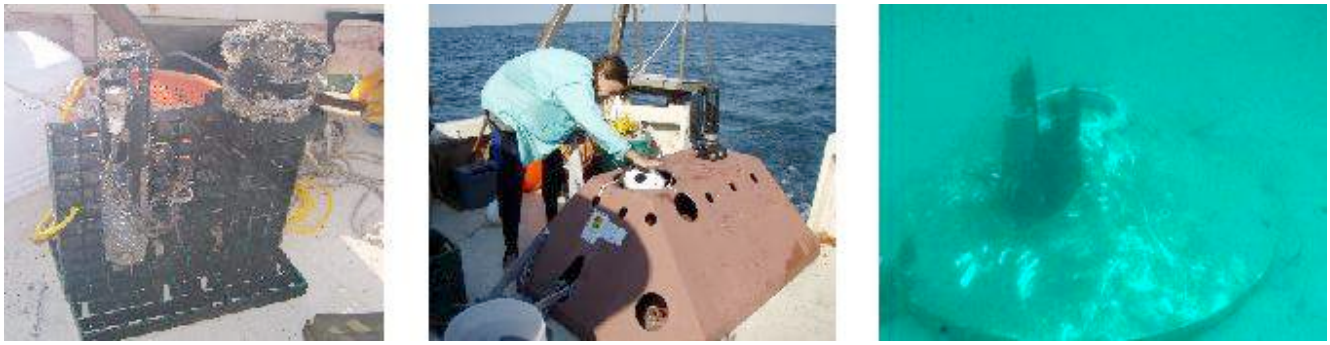


Figure 4. Left to Right: Site A bottom mount with AWAC and YSI after a deployment, Site B MSI bottom mount with a gimbled AWAC and YSI mounted in a custom hole, Site N7 MSI bottom mount with a gimbled ADCP and a custom basket with YSI.

Table 4. Details for Site A Cruises.

Date	**Vessel**	**Site**	**Instrument(s)**		**Notes**
06/01/2009	pontoon	site A	ysi	awac	retrieve instruments
06/03/2009	pontoon	site A	ysi	awac	deploy instruments; awac configuration change
06/30/2009	Polar	site A	ysi	awac	found shopping carts
08/04/2009	pontoon	site A	ysi	awac	retrieve instruments
08/05/2009	pontoon	site A	ysi	awac	deploy instruments
09/03/2009	Polar	site A	ysi	awac	
10/06/2009	Polar	site A	ysi	awac	
10/26/2009	pontoon	site A	ysi	awac	
11/24/2009	pontoon	site A	ysi	awac	
12/16/2009	pontoon	site A	ysi		swap ysi only
01/27/2010	pontoon	site A	ysi	awac	
02/26/2010	pontoon	site A	ysi		swap ysi only
03/24/2010	pontoon	site A	ysi	awac	retrieve instruments
03/25/2010	pontoon	site A	ysi	awac	deploy instruments
04/22/2010	pontoon	site A	ysi		swap ysi only
05/17/2010	pontoon	site A	ysi	awac	
07/15/2010	pontoon	site A	ysi	awac	
08/25/2010	pontoon	site A	ysi		swap ysi only
10/13/2010	pontoon	site A	ysi	awac	
11/08/2010	pontoon	site A	ysi	awac	found shopping carts
01/31/2011	pontoon	site A	ysi	awac	
03/22/2011	Fluid Motion	site A	ysi	awac	piling collapsed
03/29/2011	pontoon	site A	ysi	awac	removal for piling replacement
04/22/2011	Fluid Motion	site A	ysi	awac	new piling deployed by USCG
05/25/2011	pontoon	site A	ysi	awac	ysi failed during deployment

NOTES:

06/01/2009 – 06/03/2009 no site A data due to servicing. The instruments were retrieved on 06/01/2008 for download and service and were redeployed on 06/03/2008.

06/03/2009 awac site A deployment configuration changed from 10 number of cells to 12 (refer to deployment configurations in section 4a).

06/30/2009 found shopping carts scattered nearby the bottom mount, instruments were not damaged. Divers collected the shopping carts for disposal.

08/04/2009 – 08/05/2009 no site A data due to servicing. The instruments were retrieved on 08/04/2009 for download and service and were redeployed on 08/05/2009.

03/24/2010 – 03/25/2010 no site A data due to servicing. The instruments were retrieved on 03/24/2010 for download and service and were redeployed on 03/25/2010.

11/02/2010 – 11/07/2010 no awac data due to battery failure.

11/08/2010 found shopping carts scattered nearby the bottom mount, instruments were not damaged. Divers collected the shopping carts for disposal.

01/06/2011 – 01/31/2011 no ysi data due to battery failure.

03/09/2011 – 03/22/2011 no ysi data due to battery failure.

03/22/2011 the metal piling was found broken off a few feet above the water level and was reported to the USCG. The debris fell to the West, no damage to the instruments.

03/29/2011 the mount and instruments were retrieved due to USCG plans to replace the broken piling. No site A data from 03/29/2011 – 04/22/2011.

04/22/2011 the mount and instruments were redeployed. The USCG replaced the metal piling and removed the fallen debris.

05/25/2011 the ysi failed during deployment. During inspection a problem was found with the electronics board, and the data was not retrieved. No ysi data from 04/22/2011 – 05/25/2011.

Table 5. Details for Site B Cruises.

Date	Vessel	Site	Instrument(s)		Notes
06/16/2009	Polar	site B	ysi	awac	retrieve instruments
06/17/2009	Polar	site B	ysi	awac	deploy instruments
07/13/2009	Cape Horn	site B	ysi	awac	found octopus/ removed instruments
04/07/2010	Calcutta	site B	ysi	awac	redeploy instruments
05/19/2010	Calcutta	site B	ysi		swap ysi only
07/08/2010	Calcutta	site B	ysi	awac	
09/03/2010	Calcutta	site B	ysi		swap ysi only
10/21/2010	Calcutta	site B	ysi	awac	
04/22/2011	Fluid Motion	site B	ysi	awac	
06/03/2011	Fluid Motion	site B	ysi		removed ysi only

NOTES:

06/16/2009 – 06/17/2009 no site B data due to servicing. The instrument was retrieved on 06/16/2009 for download and service and was redeployed on 06/17/2009.

07/13/2009 instruments were retrieved. The AWAC battery cable was found unplugged and broken, most likely cause was an octopus. The instruments were removed from site B due to inaccessibility by small boats. No site B data from 07/13/2009 – 04/07/2010.

04/07/2010 instruments were re-deployed at site B.

08/14/2010 – 09/03/2010 no ysi data due to battery failure.

10/10/2010 – 10/21/2010 no ysi data due to battery failure.

10/21/2010 – 04/22/2011 no ysi data due to accessibility problems.

03/02/2011 – 04/22/2011 no awac data due to battery failure.

05/31/2011 – 06/03/2011 no ysi data due to battery failure. 06/03/2011 ysi was removed from site B and will not be redeployed due to inaccessibility by small boats. AWAC remains for data collection.

Table 6. Details for Site N7 Cruises.

Date	Vessel	Site	Instrument(s)				Notes
06/01/2009	R/V Seminole	site N7			sbe16		sbe16 real-time telemetry
06/09/2009	R/V Seminole	site N7	adcp	ysi			
07/28/2009	R/V Seminole	site N7	adcp	ysi			
09/16/2009	R/V Seminole	site N7	adcp	ysi	sbe16		
11/14/2009	R/V Seminole	site N7	adcp	ysi			
12/14/2009	R/V Seminole	site N7		ysi	sbe16		
01/20/2010	R/V Seminole	site N7	adcp	ysi			
03/08/2010	Calcutta	site N7	adcp	ysi			
03/31/2010	Calcutta	site N7					meteorology trip
04/29/2010	Calcutta	site N7	adcp	ysi			
05/06/2010	Calcutta	site N7			sbe16		
06/08/2010	Calcutta	site N7		ysi			
06/26/2010	Calcutta	site N7	adcp	ysi			
08/03/2010	Fluid Motion	site N7					cable deployment
08/04/2010	Fluid Motion	site N7					cable deployment
08/05/2010	Fluid Motion	site N7					cable deployment
08/06/2010	Fluid Motion	site N7					cable deployment
08/18/2010	Fluid Motion	site N7		ysi	sbe16		cable deployment
09/03/2010	Calcutta	site N7	adcp				
09/20/2010	Fluid Motion	site N7					cable/ meteorology trip
10/07/2010	Calcutta	site N7			sbe16		
10/08/2010	Calcutta	site N7	adcp	ysi		nemo	moved bottom mount
10/22/2010	Calcutta	site N7					meteorology trip
11/09/2010	Calcutta	site N7	adcp	ysi		nemo	
03/16/2011	Fluid Motion	site N7			sbe16	nemo	meteorology trip
03/17/2011	Fluid Motion	site N7	adcp	ysi			meteorology trip
05/09/2011	Fluid Motion	site N7	adcp	ysi			meteorology trip
06/02/2011	Fluid Motion	site N7	adcp				moved bottom mount
06/03/2011	Fluid Motion	site N7			sbe16		

NOTES:
06/01/2009 two (2) sbe16 site N7 instruments were cabled for real-time data telemetry.

07/08/2009 – 07/28/2009 no ysi data due to battery failure.

10/20/2009 – 11/14/2009 no ysi data due to battery failure.

03/03/2010 – 03/08/2010 no ysi data due to battery failure.

03/08/2010 – 04/29/2010 no adcp data due to instrument failure.

06/08/2010 – 06/26/2010 no ysi data due to battery failure.

08/03/2010 – 08/06/2010 the telemetry cable was laid from the tower out to the bottom mount for real-time ysi and adcp data.

08/16/2010 – 08/18/2010 no sbe data due to instrument failure.

10/08/2010 the bottom mount was moved (approximately 200 feet) to a location closer to the real-time cable and the RDI nemo waves processor and junction box were deployed.

10/08/2010 – 03/17/2011 no adcp data due to instrument and nemo failures and connector problems.

10/22/2010 uninstalled the meteorology telemetry equipment for the USAF to replace the railings on the upper platform.

01/20/2011 – 03/17/2011 no ysi data due to battery failure and inaccessibility due to weather.

03/16/2011 – 03/17/2011 reinstalled the meteorology telemetry equipment.

05/09/2011 uninstalled the meteorology telemetry equipment for the USAF to replace the railings on the upper platform.

06/02/2011 the bottom mount was relocated (approximately 30 feet) next to the anchored cable. This streamlined the mounts, cables and instruments and provides fewer opportunities for snags from fishermen.

4. Current and Wave Deployment Configurations

a) Site A Nortek AWAC
06/03/2009 – 05/25/2011
Current profile interval = 900sec
Current average interval = 300sec
Number of wave samples = 1200
Wave sampling interval = 3600sec
Wave sampling rate = 2Hz
Cell size = 0.5m
Blanking distance = 0.4m
Number of cells = 12
Vertical velocity precision = 0.7 cm/s
Horizontal velocity precision = 2.0 cm/s

b) Site B Nortek AWAC
06/16/2009 – 07/13/2009
04/07/2010 – 03/02/2011
Current profile interval = 900sec
Current average interval = 300sec
Number of wave samples = 1200
Wave sampling interval = 3600sec
Wave sampling rate = 2Hz
Cell size = 0.5m
Blanking distance = 0.4
Number of cells = 22
Vertical velocity precision = 0.7 cm/s
Horizontal velocity precision = 2.0 cm/s

c) Site N7 RDI ADCP

04/16/2009 – 07/28/2009
09/16/2009 – 11/14/2009
03/17/2011 – 06/02/2011

Interval between ensemble pings = 00:00:03
Interval between full ensemble records =00:15:00
Number of pings averaged per ensemble = 300
Depth cell size = 1m, starting at 3.2 m beyond the transducer
Number of bins in current profile = 24
Number of pings in a wave burst = 1200
Interval between wave pings = 00:00:00.05
Interval between the start of wave burst =01:00:00

07/28/2009 – 09/16/2009
11/14/2009 – 10/08/2010

Interval between ensemble pings = 00:00:03
Interval between full ensemble records =00:15:00
Number of pings averaged per ensemble = 300
Depth cell size = 1m, starting at 3.2 m beyond the transducer
Number of bins in current profile = 24
Number of pings in a wave burst = 1200
Interval between wave pings = 00:00:00.05
Interval between the start of wave burst =02:00:00

10/08/2010 – 03/17/2011

Deployment with NEMO
Interval between ensemble pings = 00:00:05
Interval between full ensemble records =00:10:00
Number of pings averaged per ensemble = 120
Depth cell size = 1m, starting at 3.2 m beyond the transducer
Number of bins in current profile = 24
Number of pings in a wave burst = 2100
Interval between wave pings = 00:00:00.05
Interval between the start of wave burst =01:00:00

5. Instrument Specifications

The Transport instrumentation includes: five (5) YSI, two (2) RDI ADCP, two (2) RDI NEMO, two (2) Nortek AWAC, four (4) SBE16, one (1) SBE19, and one (1) Wet Labs CDOM.

a) RDI ADCP

Sensor Type: Teledyne RD Instruments Workhorse Sentinel with Waves
S/N 7114, S/N 718
Acoustic Frequency: 300 kHz
Acoustic Beams: 4 beams, convex
Beam Angle: 20°
Operating Temperature: -5 to 45°C
Depth Rating: 80m
Depth Cell Size: 0.25-8.0m
Compass Accuracy/Resolution: +/-2°/0.01°
Tilt Accuracy/Resolution: +/-0.5°/0.01°
Pressure Accuracy/Precision: 0.25% / 1/40,000 of full scale
Water Velocity Range: +/- 5m/s
Water Velocity Accuracy: 0.5% of water velocity relative to the ADCP +/- 0.5cm/s

b) RDI NEMO

Sensor Type: Teledyne RD Instruments Wave Processing Module
S/N 0033, S/N 0110
Depth Rating: 200m
Power Requirement: 42Volts
Connection to RDI ADCP: RS-232, baud = 57600, n, 8, 1
Cable Connection: RS-422, baud =9600,n,8,1
Output: NMEA-like string of current data and significant wave parameters for real-time telemetry.

c) SBE 16 (CT)

Sensor Type: SEA-BIRD (SBE) 16 SEACAT
S/N 1612358-1984, S/N 1612358-1982, S/N 1612358-1986, S/N 1612358-1980
Operating Temperature: -5 to 35°C
Depth Rating: 600m
Conductivity Range: 0 to 7S/m
Temperature Accuracy/Resolution: 0.01°C/0.001°C
Conductivity Accuracy/Resolution: 0.001S/m/ 0.0001S/m

d) SBE 19 (CTD)

Sensor Type: SEA-BIRD (SBE) 19 SEACAT Profiler
S/N 196832-1229
Operating Temperature: -5 to 35°C
Conductivity Range: 0 to 7S/m
Temperature Accuracy/Resolution: 0.01°C/0.001°C
Conductivity Accuracy/Resolution: 0.001S/m/ 0.0001S/m
Pressure Accuracy/Resolution: 0.25% of full scale range (100-1500 psia)/0.015% of full scale range (100-15000 psia)

e) Nortek AWAC

Sensor Type: Nortek Acoustic Wave and Current Meter
S/N WAV-5467, S/N WAV-5410
Acoustic Frequency: 1MHz
Acoustic Beams: 4 beams, one vertical, three slanted at 25°
Operating Temperature: -5 to 35°C
Depth Rating: 30m
Depth Cell Size: 0.4 - 2.0m
Compass Accuracy/Resolution: 2°/0.1°
Tilt Accuracy/Resolution: -0.2°/0.1°
Pressure Accuracy/Resolution: 0.25% / Better than 0.005% of F.S. per sample
Water Velocity Range: +/- 10m/s horizontal, +/- 5m/s along beam
Water Velocity Accuracy: 1% of measured value +/- 0.5cm/s
Wave Doppler Uncertainty: 2.7 cm/s at 1Hz for 1m cells
Current Profile Doppler Uncertainty: 0.5-1 cm/s

f) Colored Dissolved Organic Matter (CDOM)

Sensor Type: Wet Labs ECO Fluorometer
Operating Temperature: 0 to 30°C
Depth Rating: 300m
Ex/Em: 370/460 nm
Sensitivity: 0.09 ppb
Linearity: 99%R^2
Range: 0.09-500 ppb
Optional anti-fouling Bio-wiper

g) YSI 6600 Multi-parameter Extended Deployment Sonde

S/N 07H100330, S/N 07H100329, S/N 07H100331, S/N 07G101717

Temperature

Sensor type: Thermistor
Range: -5 to 50°C
Accuracy: +/- 0.15°C
Resolution: 0.01°C
Depth: 200m

Conductivity

Sensor type: 4 electrode cell with autoranging
Range: 0 to 100 mS/cm
Accuracy: +/- 0.5% of reading +0.001 mS/cm
Resolution: 0.001 mS/cm to 0.1mS/cm
Depth: 200m

ROX Optical Dissolved Oxygen

Sensor Type: Optical, Luminescence Lifetime
Range: 0 to 500% air saturation
Accuracy: 0 to 200 % air saturation, +/- 1% of the reading or 1% air saturation, whichever is greater; 200 to 500% air saturation, +/-15% of reading
Resolution: 0.1% air saturation
Depth: 61m

pH

Sensor Type: Glass combination electrode
Range: 0 to 14 units
Accuracy: +/- 0.2 units
Resolution: 0.01 units
Depth: 200m

Turbidity

Sensor Type: Optical, 90° scatter, with mechanical cleaning
Range: 0 to 1000 NTU
Accuracy: +/- 2% of the reading or 0.3 NTU (whichever is greater), in YSI AMCO-AEPA standards
Resolution: 0.1 NTU
Depth: 61m

Chlorophyll

Sensor Type: Optical, fluorescence, with mechanical cleaning
Range: Approximately 0 to 400 ug/L Chl; 0 to 100 Relative Fluorescence Units (RFU)
Linearity: R2>0.9999 for serial dilution of Rhodamine WT solution from 0 to 500 ug/L
Detection Limit: Approximately 0.1 ug/L Chl
Resolution: 0.1 ug/L Chl; 0.1 RFU
Depth: 61m

LiCor Quantum Pyranometer

Model # LI190SB
Stability: <±2% change over 1 yr
Operating Temperature: -40 to 65°C
Sensitivity: typically 5 µA per 1000µmoles s-1 m-2
Light spectrum wavelength: 400 to 700 nm

6. Future Transport Goals (1 June 2011– 31 March 2012)

Continue developing telemetry of the oceanographic instrumentation at Site N7. The RDI ADCP, RDI NEMO, SBE16plus, and junction box will utilize the telemetry hardware that the Meteorology group has deployed at Site N7. A SBE16plus will replace the YSI at Site N7. This pumped instrument will allow for longer deployments. The SBE16plus will measure temperature, conductivity, dissolved oxygen, and pressure every 15 minutes. Data will continue to be transmitted from the tower to a computer housed in the MFG lab at the FSUCML at 9600 baud. All data will be available on the COAPS website, as well as through NOAA channels once a location identifier and data format is identified. A QA/QC procedure will be implemented for oceanography data.

In order to investigate the benthic-pelagic coupling, we propose expanding the monitoring system by adding instruments that record temperature and salinity for surface and mid water column at Site A. This would permit simultaneous recording of water column and benthic processes and estimate stratification. Permission will need to be granted from the US Army Corps/ USCG.

7. Other Remarks/ Notes

For access to the Transport data please contact Stephanie White white@ocean.fsu.edu

For more information on the Meteorology instrumentation and data please contact Dr. Paul Ruscher pruscher@fsu.edu

The Florida State University Red Tide Monitoring Program collected physical, chemical, and biological oceanographic measurements in the BBR from 11/14/2006 through 06/09/2009. Samples were collected along the Hydrographic Transect 1 and Transect 2. For more information please contact Dr. Allan Clarke aclarke@ocean.fsu.edu

The Apalachicola National Estuarine Research Reserve (ANERR) is one of 25 sites designated by NOAA as a Research Reserve and is located to the West of the FSUCML. The ANERR research and monitoring program promotes research within the Apalachicola Reserve utilizing a variety of methods. The National Estuarine Research Reserve System-wide Monitoring Program which tracks short-term variability and long-term changes in estuarine waters to understand how human activities and natural events can change ecosystems. It provides valuable long-term data on water quality and weather. ANERR currently measures physical and chemical water quality indicators, nutrients and the impacts of weather on estuaries. The reserve uses YSI 6600 sondes and similar probes for measuring water quality. ANERR has a 15 year water quality database. http://nerrs.noaa.gov/Apalachicola/welcome.html

Alligator Harbor lies just east of the FSUCML. Alligator Harbor, enclosed by the Alligator Point sand spit, has been described as a neutral estuary and a barrier spit lagoon. Alligator Harbor is designated as an Aquatic Preserve by the Florida Department of Environmental Protection (DEP). Clam aquaculture leases were established in 2002 within the harbor. Water quality surrounding these lease sites is monitored by the Alligator Harbor Aquatic Preserve Florida DEP and Florida

Department of Agriculture and Consumer Services Division of Aquaculture. A YSI 6600 sonde and similar probes is deployed in the harbor.

http://www.dep.state.fl.us/coastal/sites/alligator/

http://floridaaquaculture.com/SEAS_maplinks/18.htm

8. Related Links

Current Meter Facility: http://cmf.ocean.fsu.edu

Center for Ocean-Atmospheric Prediction Studies: http://coaps.fsu.edu/gulf_inst.shtml

Northern Gulf Institute: www.northerngulfinstitute.org

FSU Coastal and Marine Laboratory: http://www.marinelab.fsu.edu

RDI ADCP: http://www.rdinstruments.com/sen.html

Nortek AWAC: http://www.nortekusa.com/hardware/AWAC.html

SBE: http://www.seabird.com

YSI: http://www.ysi.com

CDOM: www.wetlabs.com

9. Acknowledgements

Technical support and assistance for this project was provided by:
MFG: Eric Howarth, Nicolas Wienders, and Peter Lazarevich

Department of EOAS Machine Shop: Alan Michels and Dave Oliff

FSUCML Captain: Roseanne Weglinski

Academic Dive Program: Sonja Bridges

Volunteer Science Divers: Mike Santema, Kelly Kingon, Steve Morey, Dmitry Dukhovskoy, Chris Peters, Jennifer Schellinger, Robert Ellis, Donnie McClain, Justin Lewis, Austin Todd, Eric Mortenson, and Ale Mickle.

FSUCML: Felicia Coleman, Bobby Henderson, Frank Lindamood, and Mark Daniels

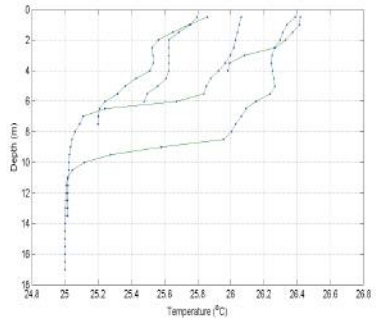
Appendix I. Timeline for NGI Data Collection for Transect and Sites N7, B, and A from January 2007 – June 2011.

Transect																								
	YSI	X	X	X	X	X	X		X	X		X	X	X	X	X	X			X	X	X			X
	SBE19	X	X	X	X	X	X		X	X		X	X	X	X	X	X			X	X	X			X
Site N7																									
	ADCP	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X
	YSI															X	X	X	X	X	X		X	X	X
	CDOM															X	X	X	X	X	X	X	X	X	
	SBE16												X	X	X	X	X	X	X	X	X	X	X	X	X
Site B																									
	AWAC																		X	X	X	X	X	X	X
	YSI																		X	X	X			X	X
Site A																									
	AWAC															X		X	X	X	X	X	X	X	X
	YSI															X		X	X	X	X	X	X	X	X
		Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sept	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sept	Oct	Nov	Dec
		2007												2008											

Transect																								
	YSI	X		X	X	X	X	X		X			X	X		X	X		X			X	X		
	SBE19	X		X	X	X	X	X		X			X	X		X	X		X			X	X		
Site N7																									
	ADCP	X	X	X	X	X	X	X	X	X	X	X	X	X	X			X	X	X	X	X			
	YSI	X	X	X	X	X	X		X	X	X		X	X	X	X	X	X		X	X	X	X	X	X
	CDOM			X	X																				
	SBE16	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X
Site B																									
	AWAC	X		X	X	X	X	X									X	X	X	X	X	X	X	X	X
	YSI	X	X	X	X		X	X									X	X	X	X		X			
Site A																									
	AWAC																								
	YSI	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X
		X		X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X
		Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sept	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sept	Oct	Nov	Dec
		2009												2010											

Transect							
	YSI			X			X
	SBE19			X			X
Site N7					X	X	X
	ADCP	X			X	X	X
	YSI						
	CDOM	X	X	X	X	X	X
	SBE16						
Site B							
	AWAC	X	X			X	X
	YSI					X	
Site A							
	AWAC	X	X	X		X	X
	YSI		X				X
		Jan	Feb	Mar	Apr	May	Jun
		2011					

Appendix II. Hydrographic Sections SBE19 and YSI Profile Plots
a) SBE19 Hydrographic Section Temperature vs. Depth Monthly Plots



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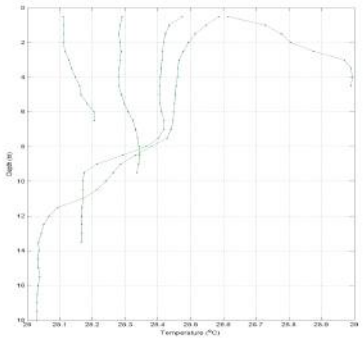

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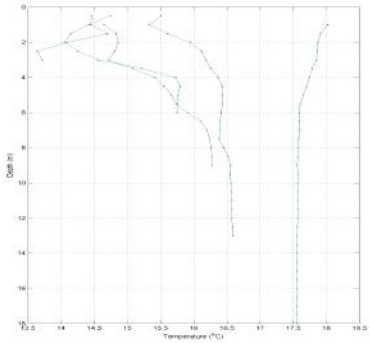

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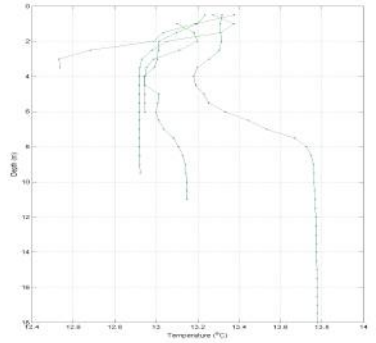

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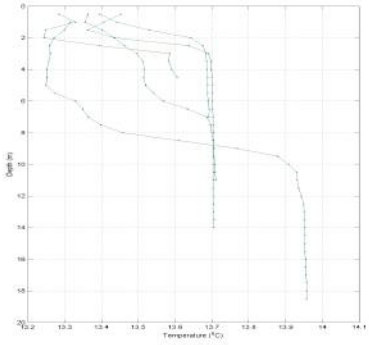

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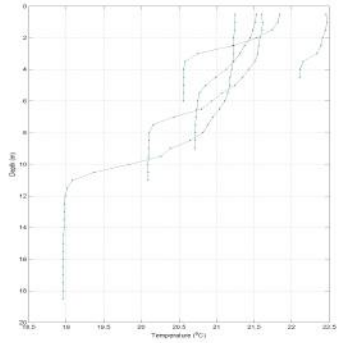

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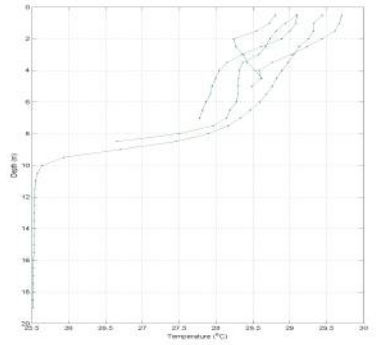

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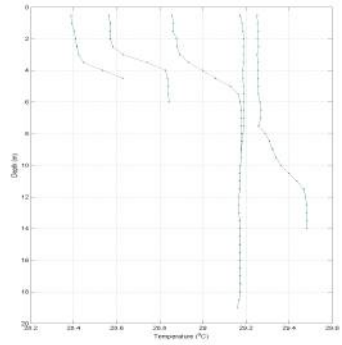

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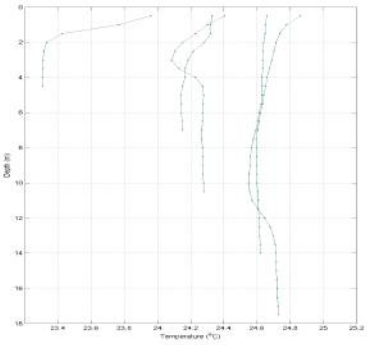

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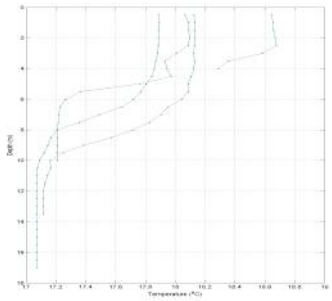

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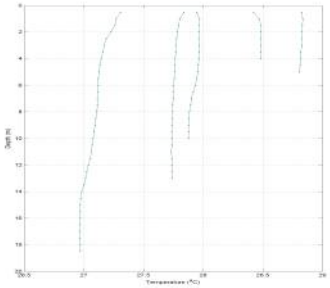
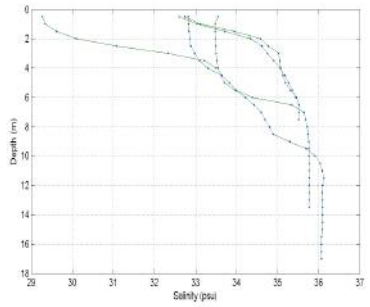


June 2011

b) SBE19 Hydrographic Section Salinity vs. Depth Monthly Plots



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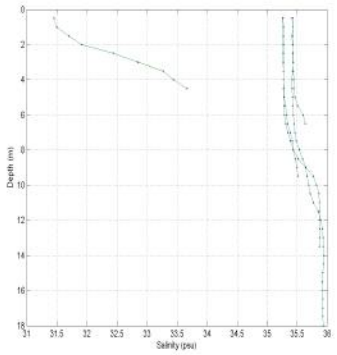

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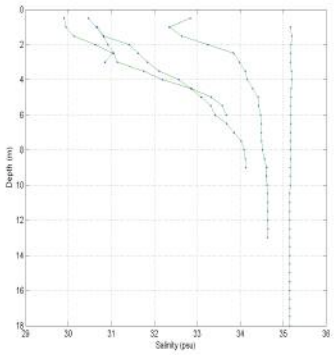

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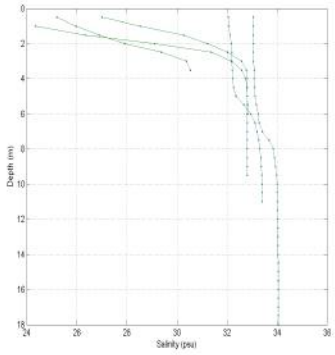

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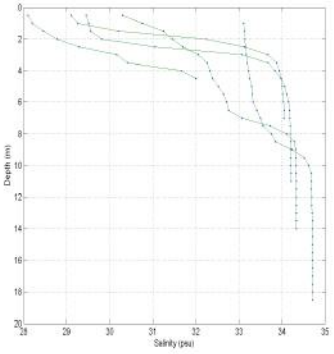

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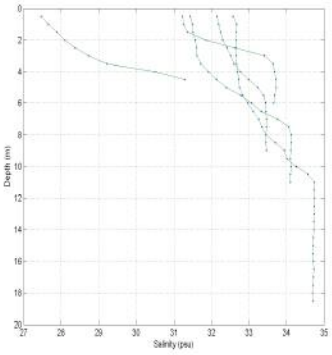

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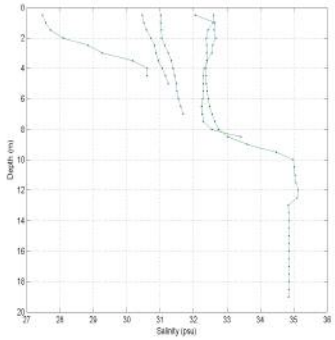

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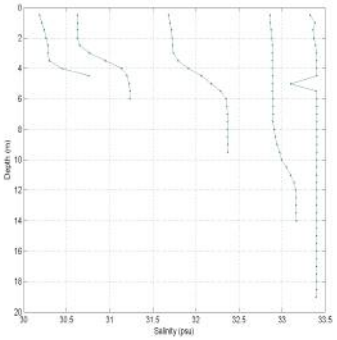

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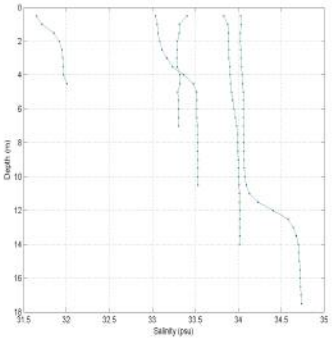
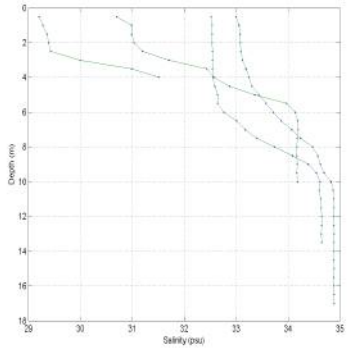
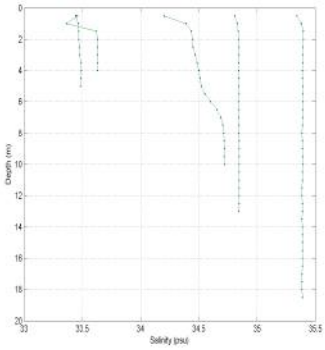


October 2010

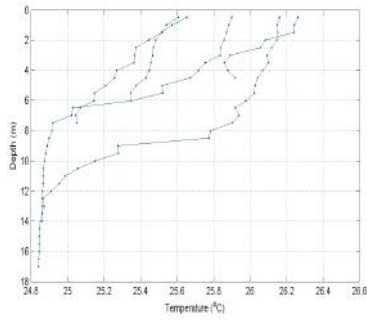


March 2011



June 2011

c) YSI Hydrographic Section Temperature vs. Depth Monthly Plots



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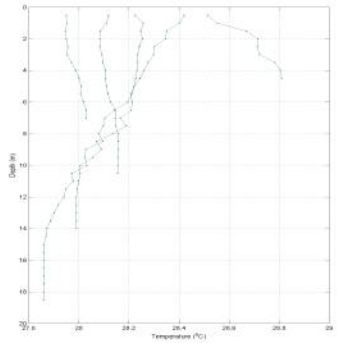
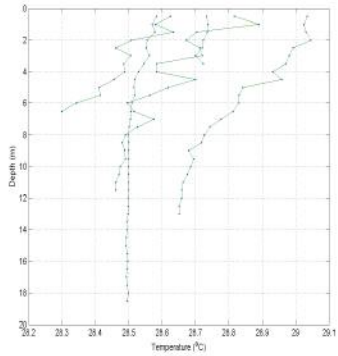


July 2009



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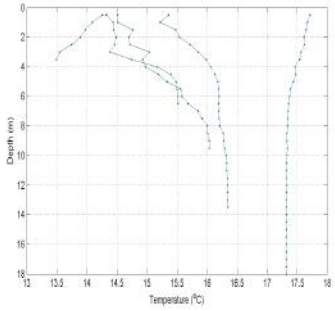

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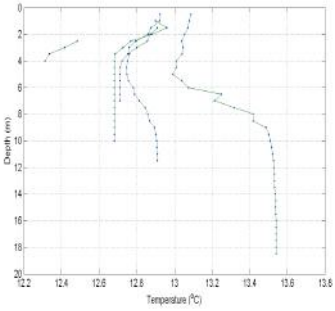
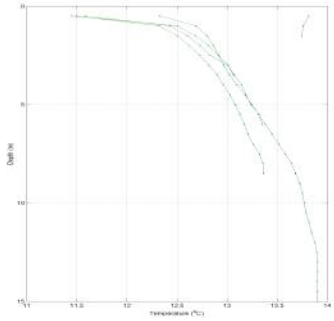


January 2010



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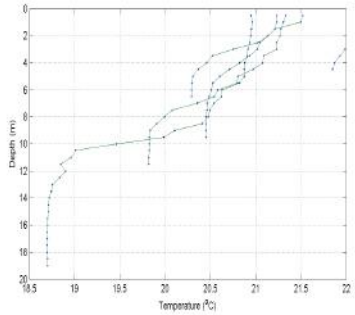

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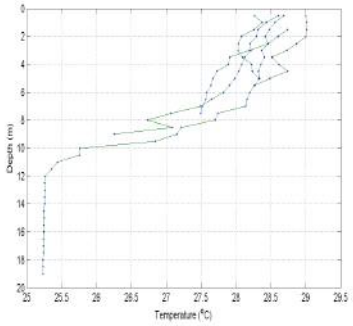

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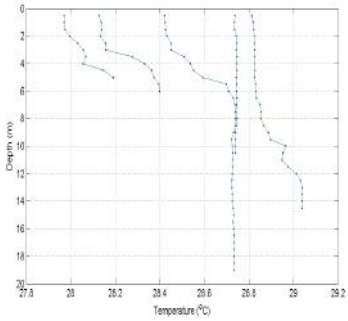

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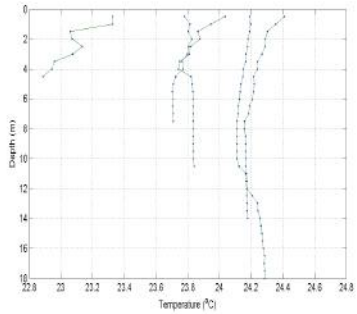
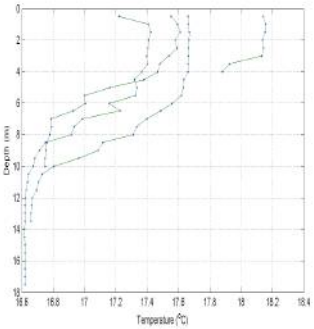
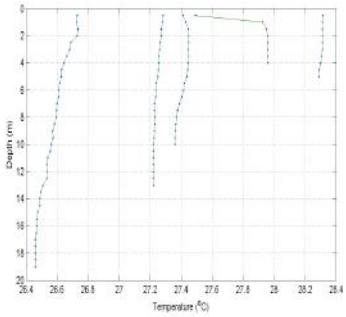


October 2010

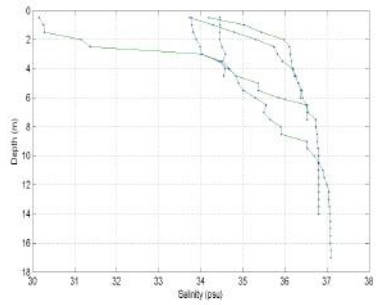


March 2011

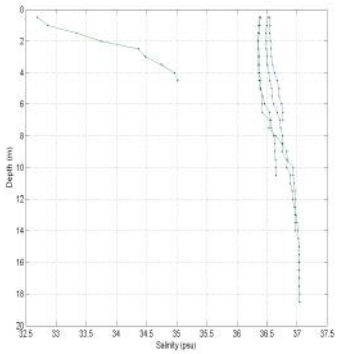


June 2011

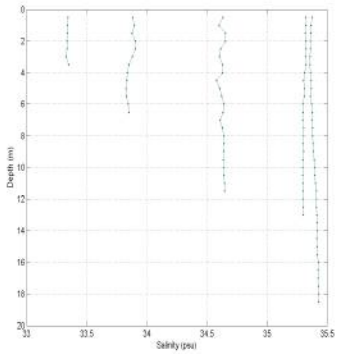
d) YSI Hydrographic Section Salinity vs. Depth Monthly Plots



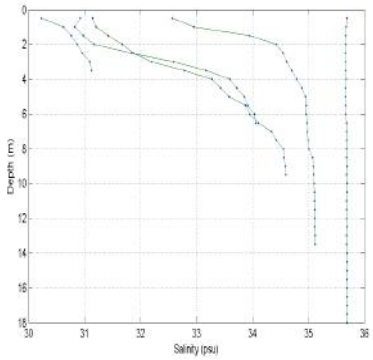
June 2009



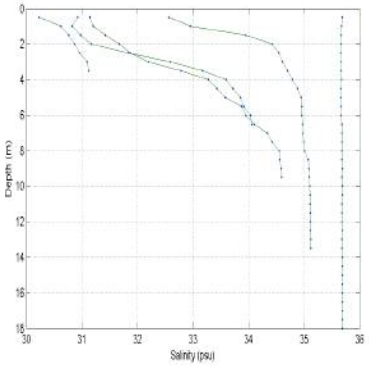
July 2009



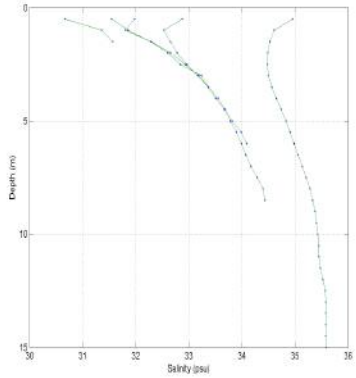
September 2009



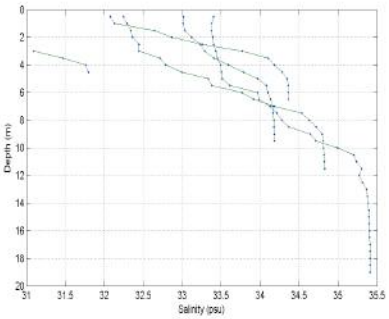
December 2009



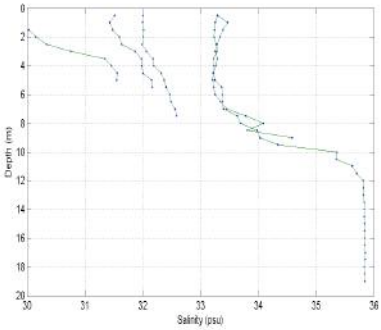
January 2010



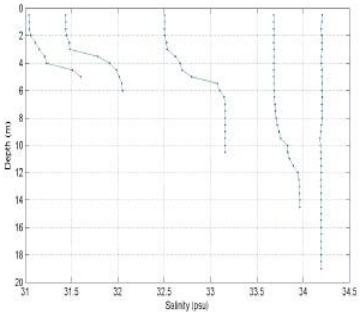
March 2010



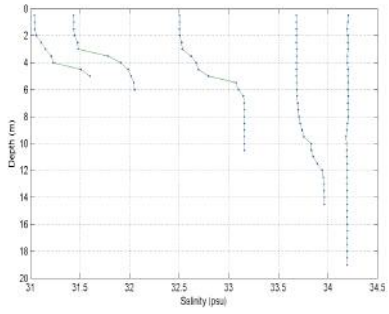
April 2010



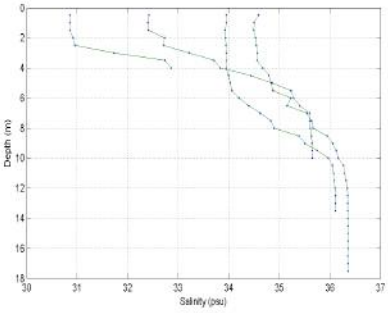
June 2010



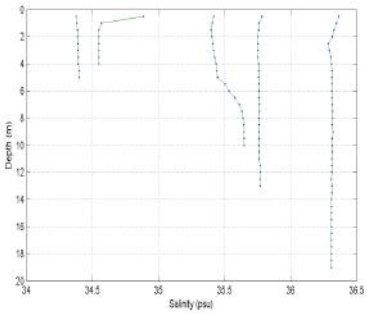
September 2010



October 2010

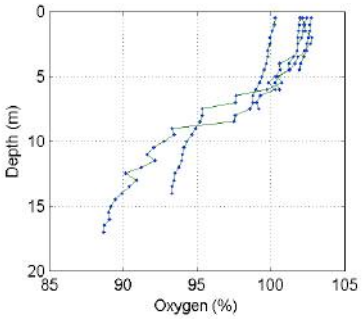


March 2011

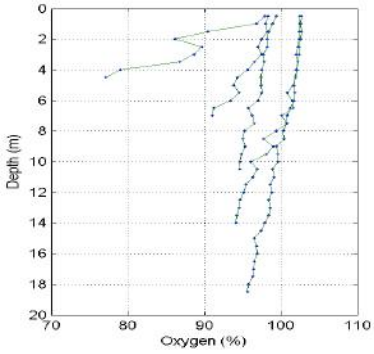


June 2011

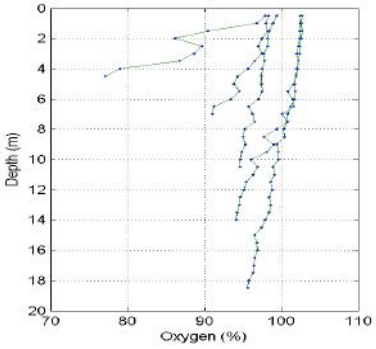
e) YSI Hydrographic Section Dissolved Oxygen vs. Depth Monthly Plots



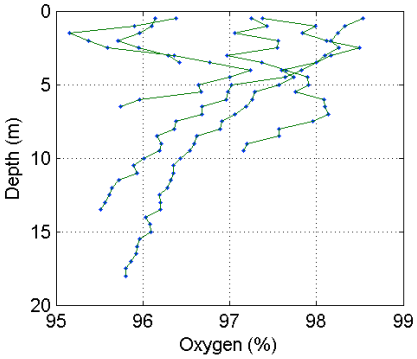
June 2009



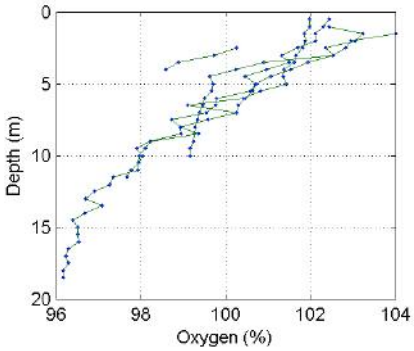
July 2009



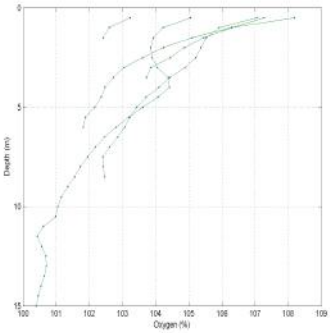
September 2009



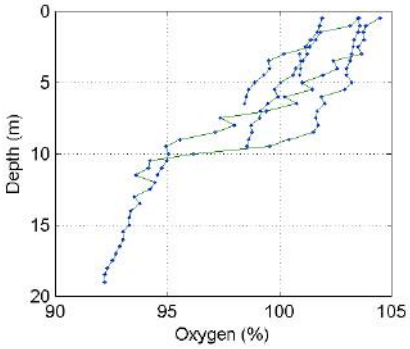
December 2009



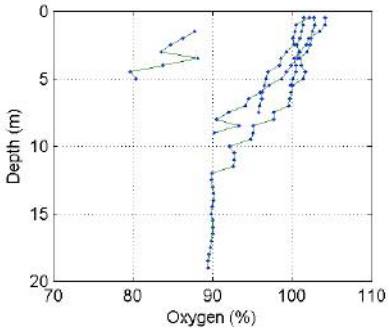
January 2010



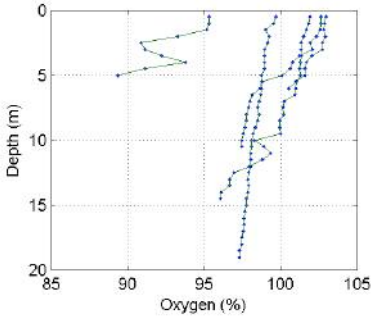
March 2010



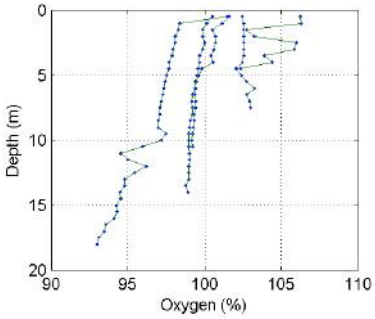
April 2010



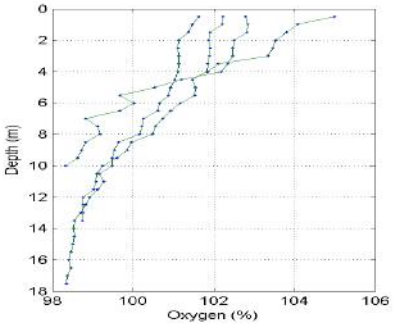
June 2010



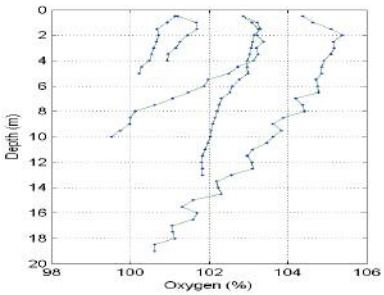
September 2010



October 2010

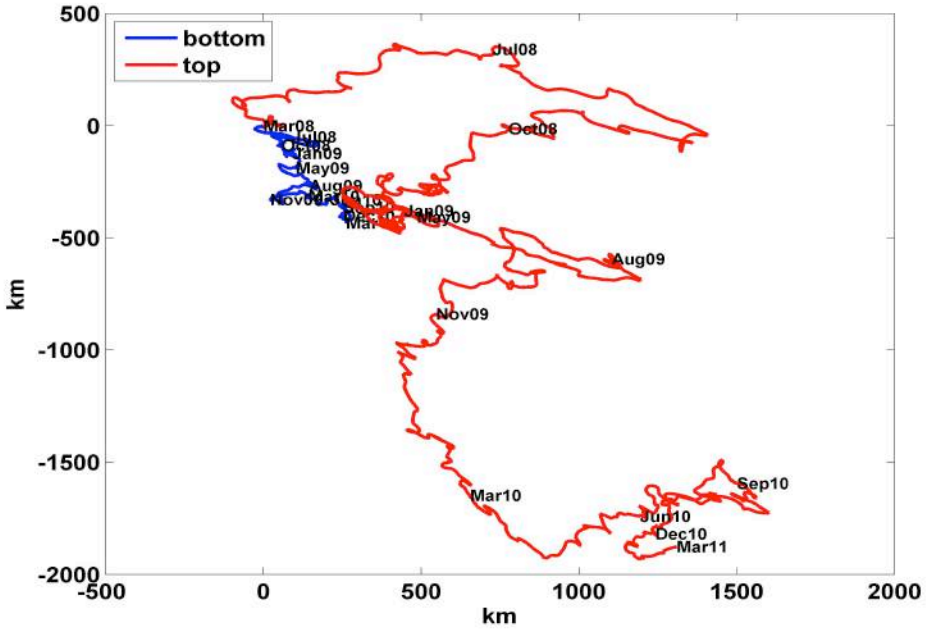


March 2011

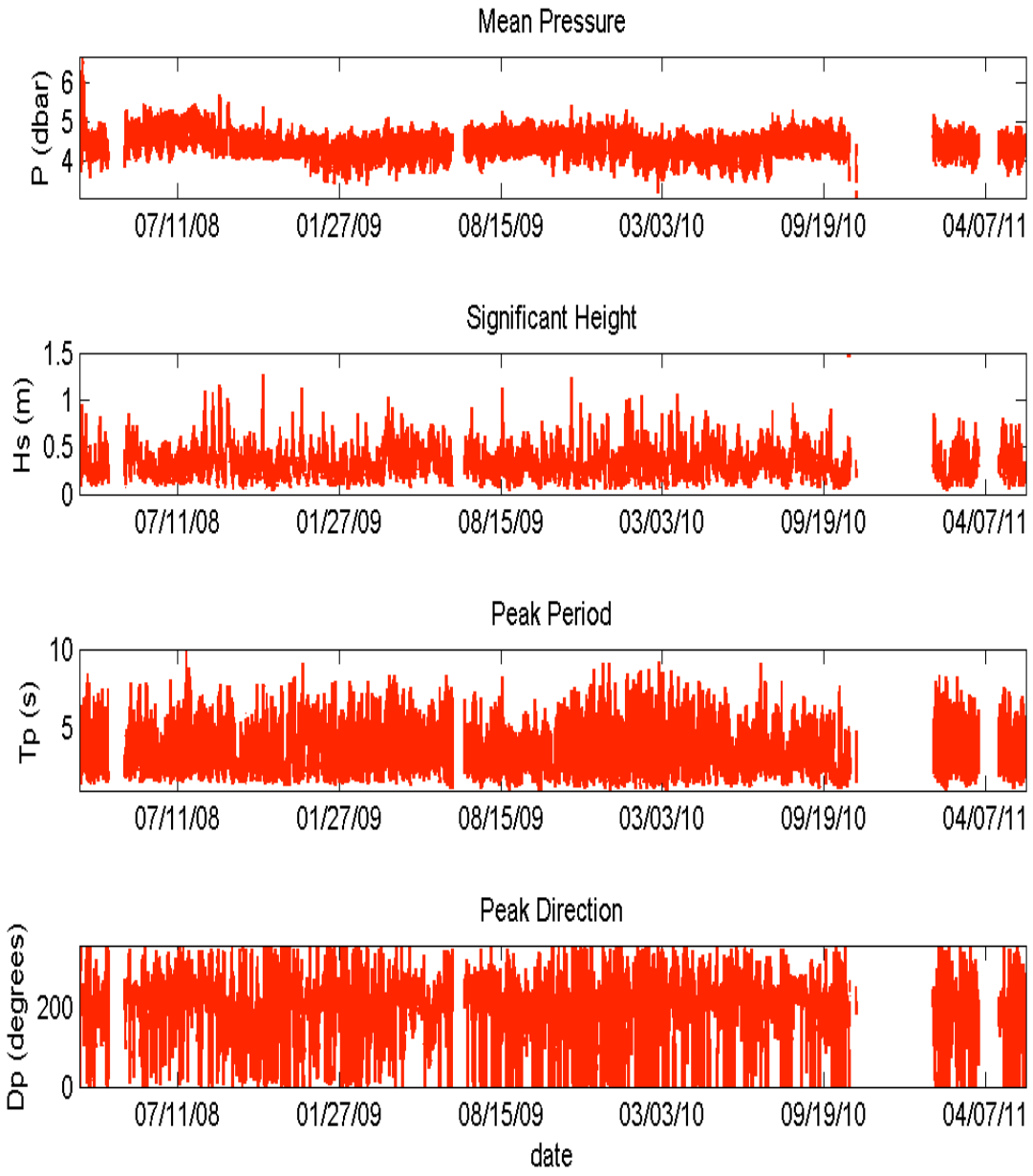


June 2011

Appendix III. Fixed Sites ADCP, AWAC, YSI, and SBE16 Data Plots.
a) Fixed Site A Nortek AWAC Data Plots.

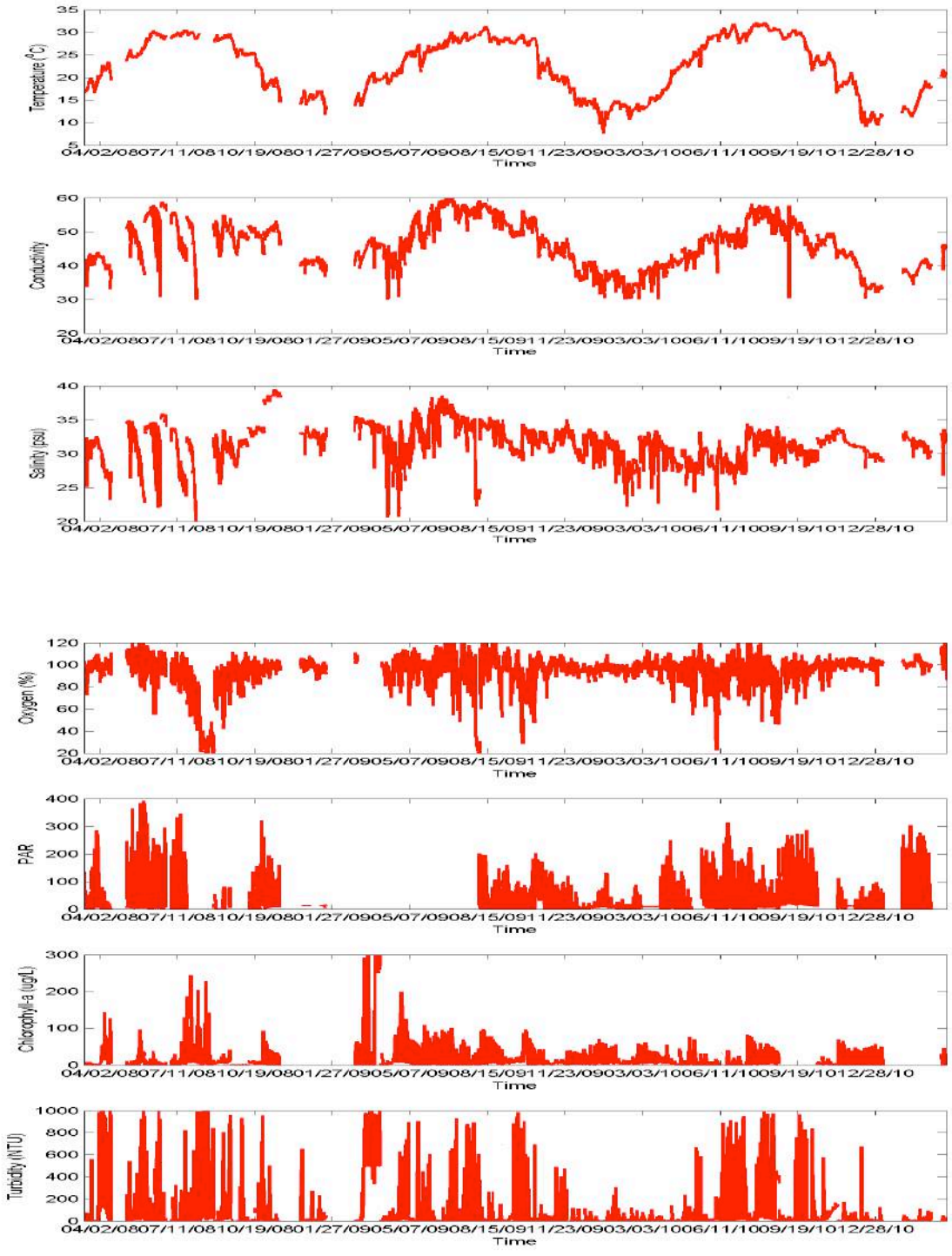


Site A Nortek AWAC progressive vector diagram of Top and Bottom Currents March 2008 – March 2011.



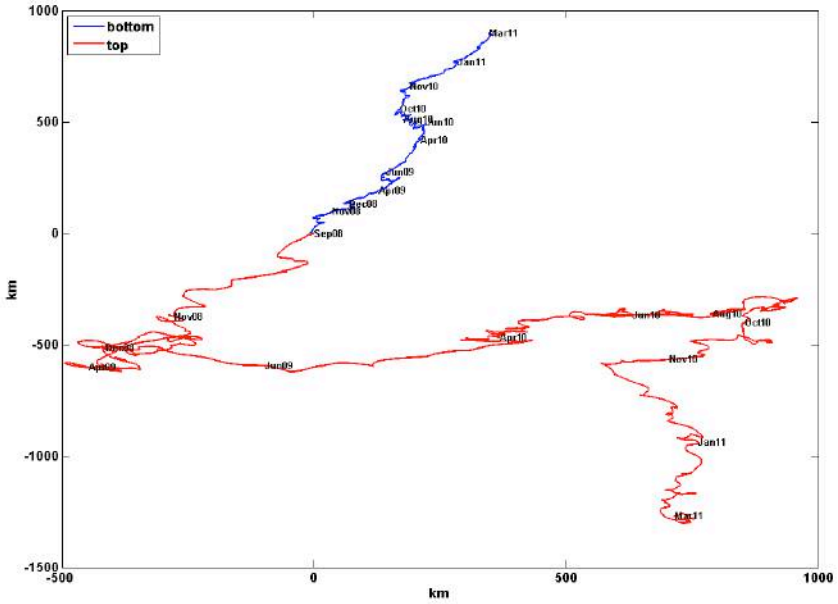
Site A Nortek AWAC wave results March 2007 – May 2011: Mean Pressure, Significant Wave Height, Peak Period, and Peak Direction.

b) Fixed Site A YSI Data Plots.

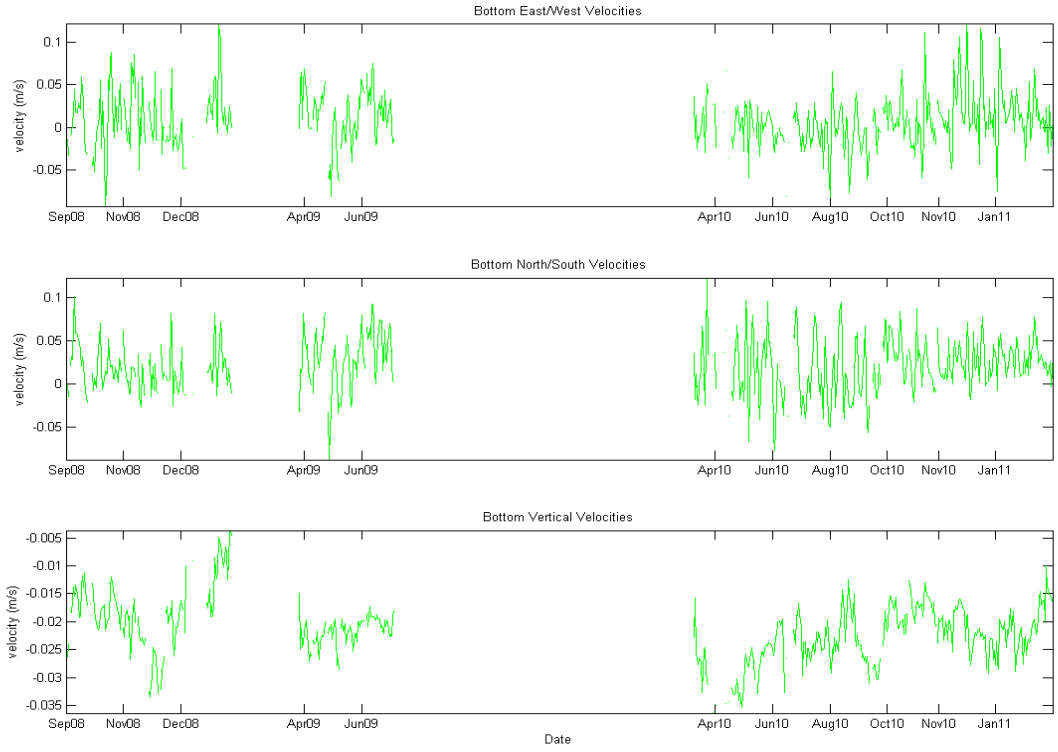


Site A YSI water quality parameters March 2008 – March 2011: Temperature, Conductivity, Salinity, Oxygen, PAR, Chlorophyll, and Turbidity.

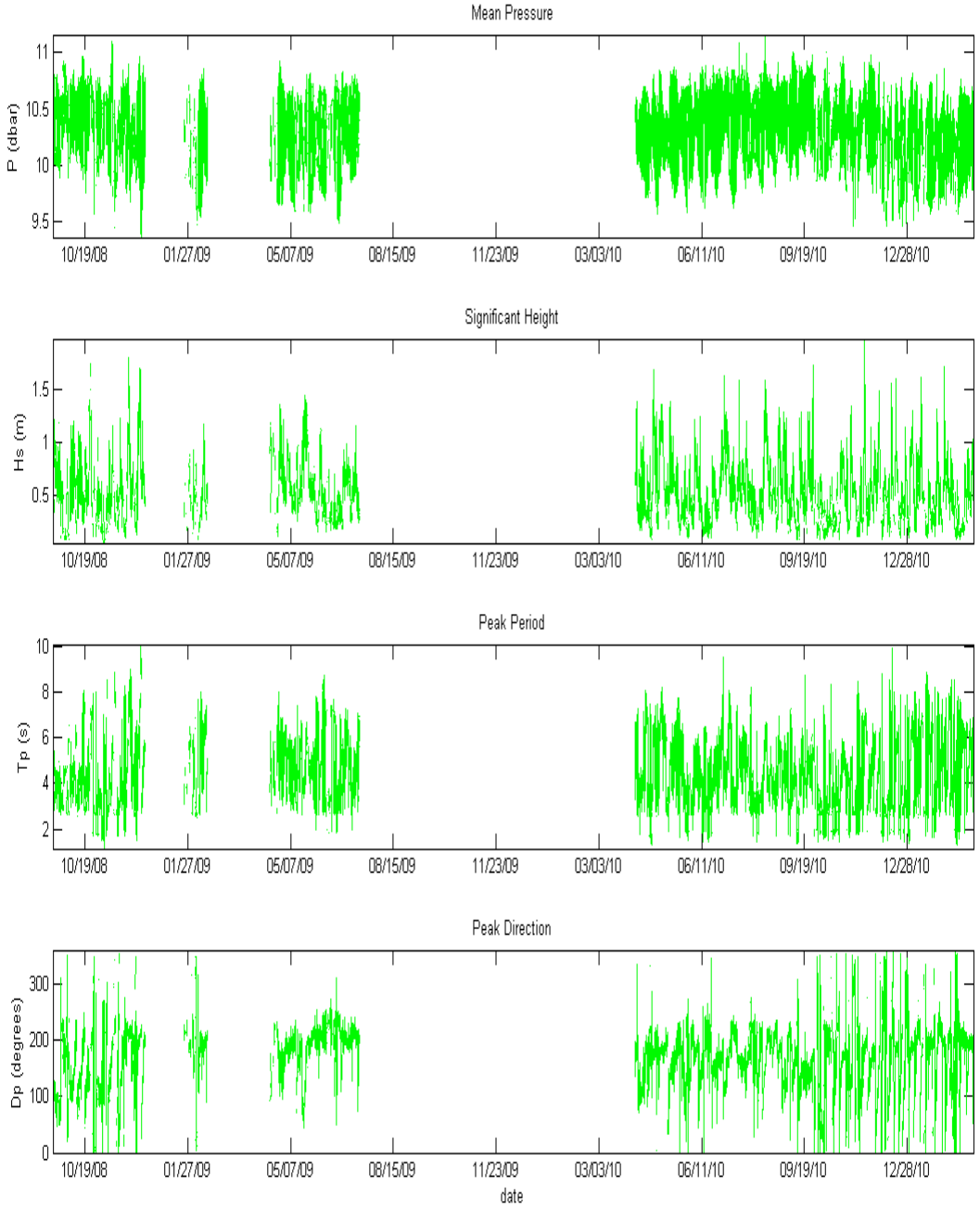
c) Fixed Site B Nortek AWAC Data Plots.



Site B Nortek AWAC data June 2008 – March 2011 Progressive Vector Diagram of Top and Bottom Currents.

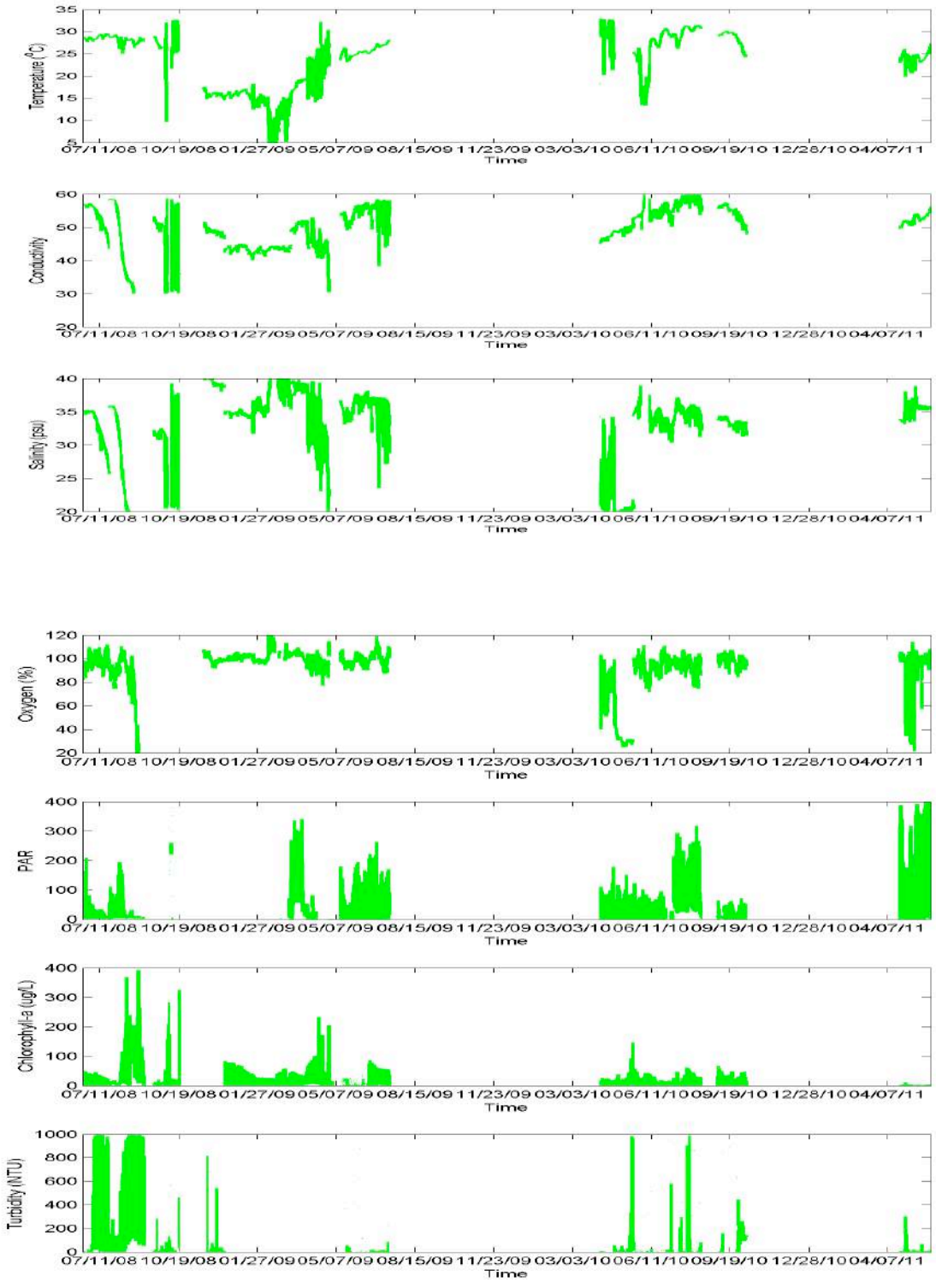


Site B Nortek AWAC data June 2008 – March 2011 East/West, North/South and Vertical Velocities.



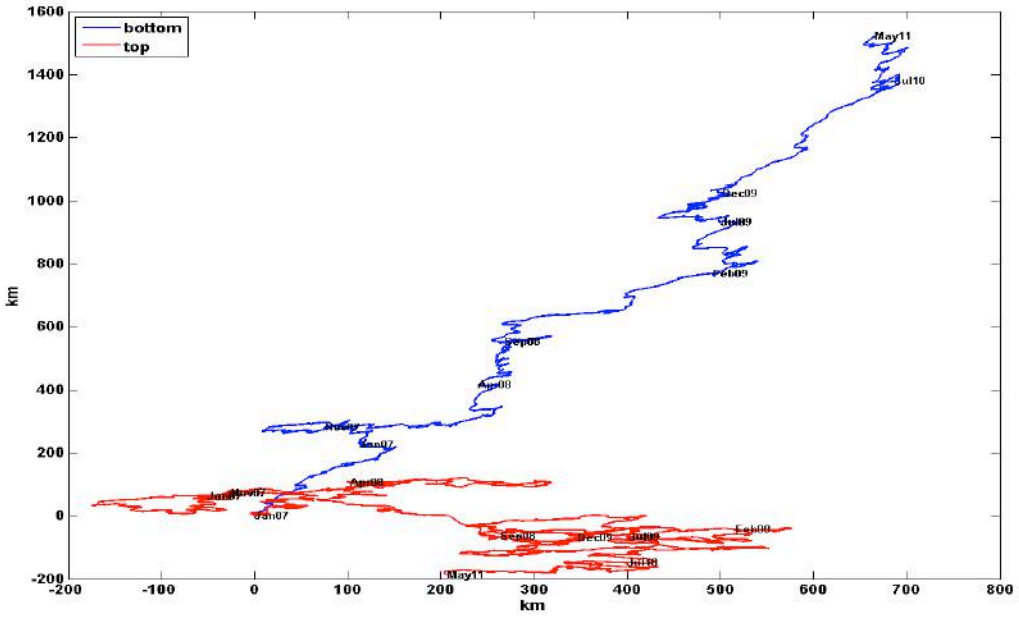
Site B Nortek AWAC wave results June 2008 – March 2011: Mean Pressure, Significant Wave Height, Peak Period, and Peak Direction.

d) Fixed Site B YSI Data Plots.

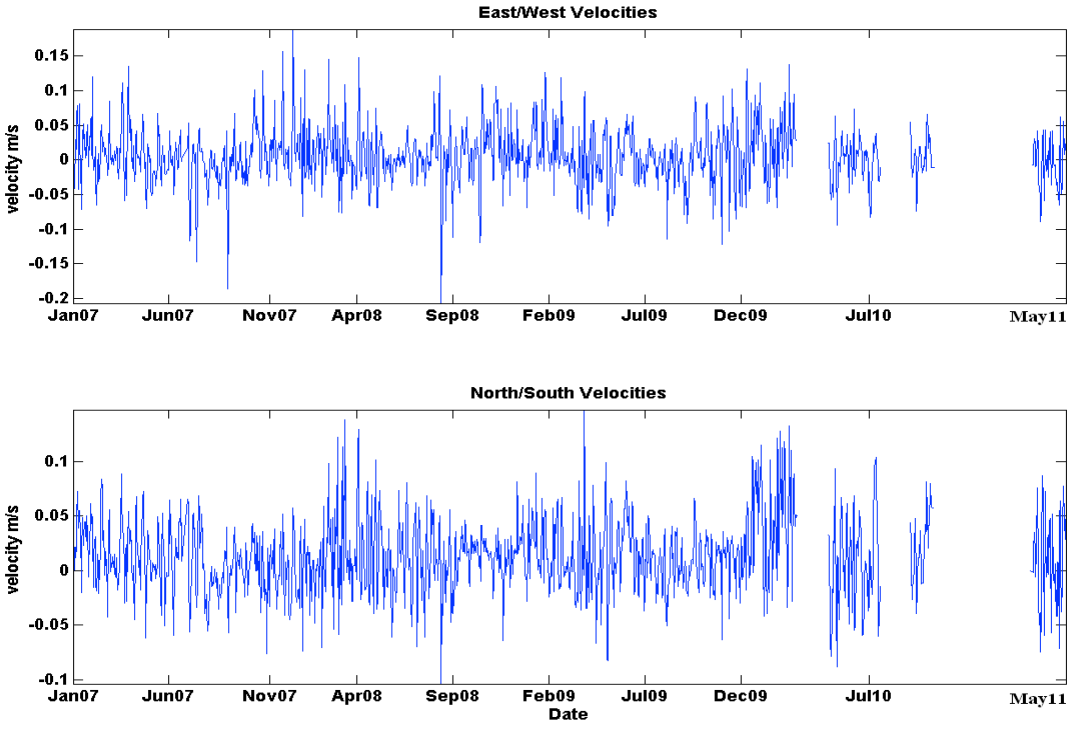


Site B YSI water quality parameters June 2008 – May 2011:Temperature, Conductivity, Salinity, Oxygen, PAR, Chlorophyll and Turbidity.

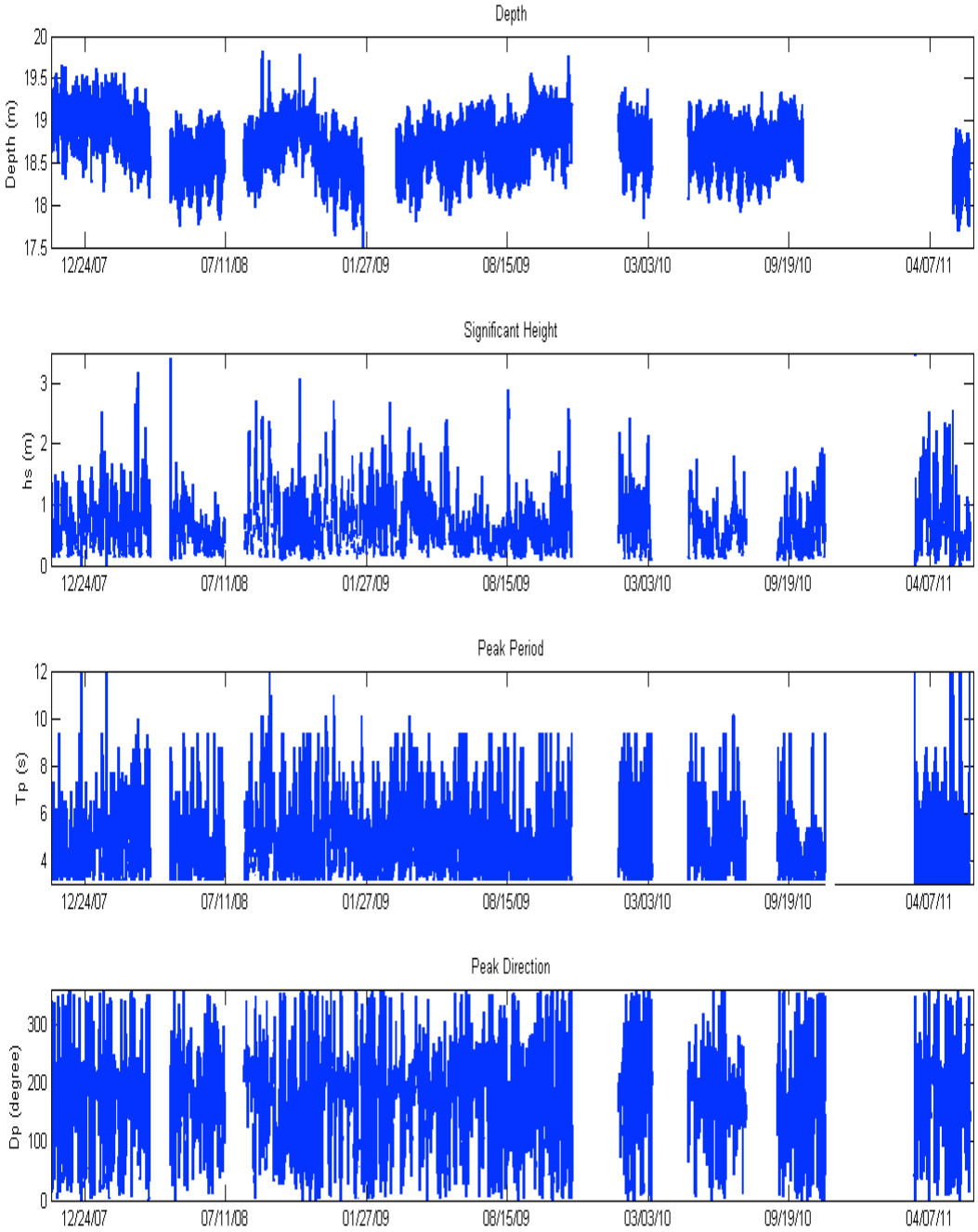
e) Fixed Site N7 RDI ADCP Data Plots.



Site N7 RDI ADCP Progressive vector diagram of Top and Bottom Currents January 2007 – May 2011.

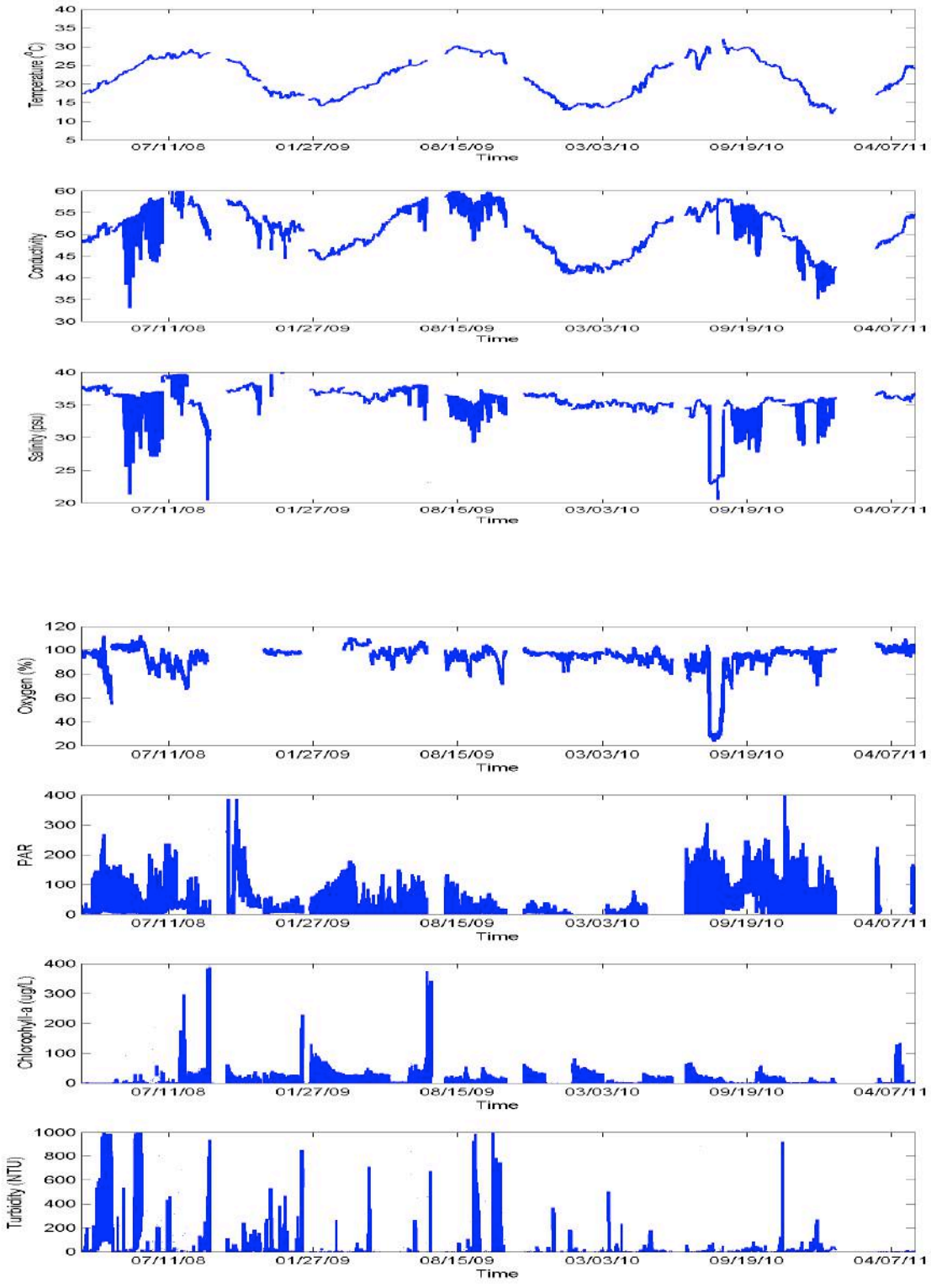


Site N7 RDI ADCP East/West and North/South Current Velocities January 2007 – May 2011.



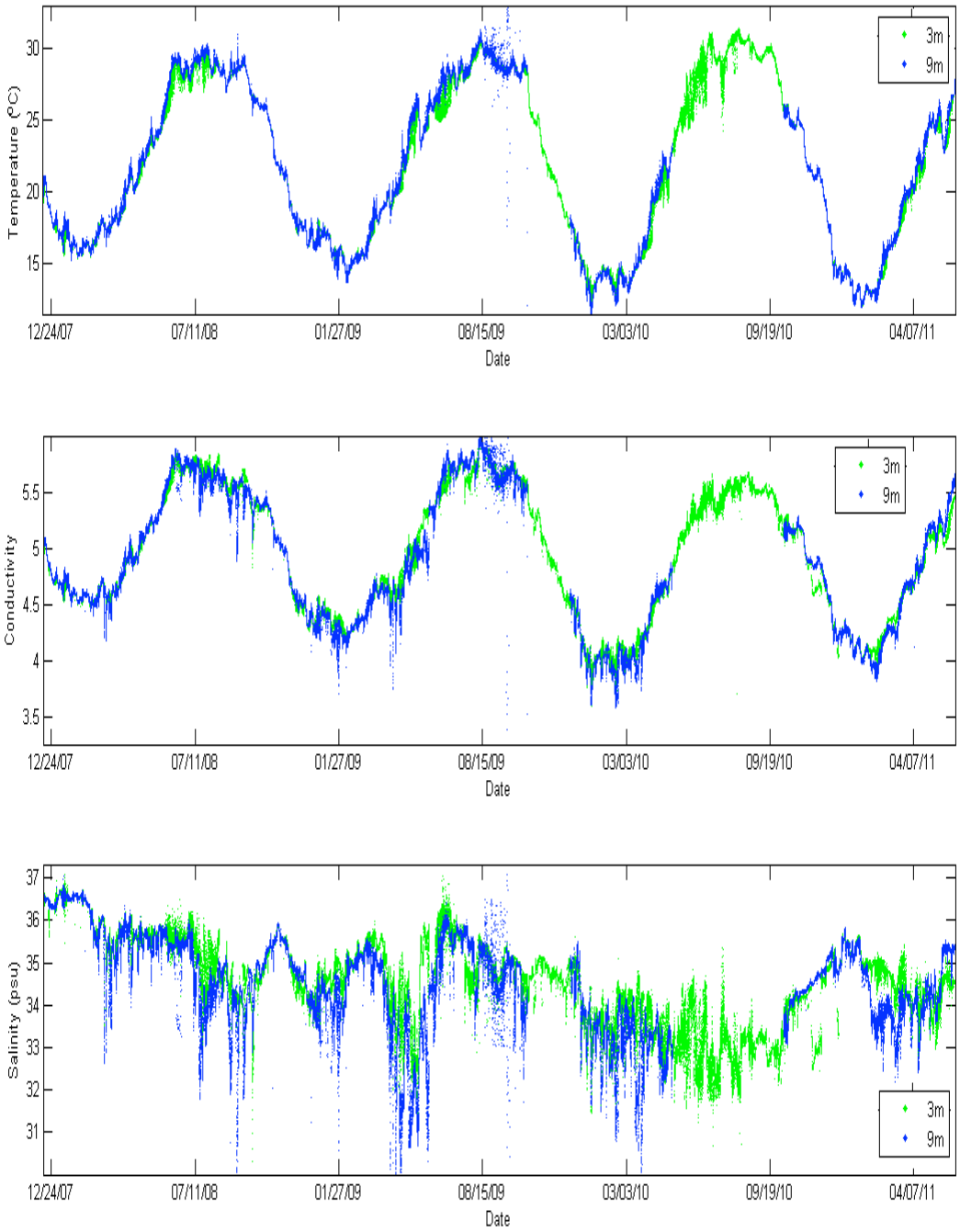
Site N7 RDI ADCP wave results November 2007 – May 2011: Depth, Significant Wave Height, Peak Period, and Peak Direction

f) Fixed Site N7 YSI Data Plots.



Site N7 YSI water quality parameters March 2008 – May 2011:Temperature, Conductivity, Salinity, Oxygen, PAR, Chlorophyll and Turbidity.

g) Fixed Site N7 SBE16 Data Plots.



Site N7 SBE16 Temperature, Conductivity, and Salinity at 3m and 9m depths from December 2007 – May 2011.