Current Meter Facility Technical Report:

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

by
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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 Oceanography Current Meter Facility (CMF) utilizes the FSUCML for support of the NGI Transport research. The CMF 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 48 foot vessel, the FSUCML R/V Seminole. 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 for conductivity, dissolved oxygen, depth, turbidity and pH 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.

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. This is reflected in the name change from transect 1 to transect 2 (Figure 1). Transect 2 started December 19, 2007 and is still being sampled. Data included in this report is through June 09, 2009. Transect 1 was sampled 11 times and transect 2 was sampled 14 times on a monthly basis with the following exceptions due to weather: July 2007, October 2007, May 2008, June 2008, October 2008, November 2008, and February 2009. A summary of the transect casts is created for every cruise with location information (transect_stations.txt).

The Hydrographic Section naming convention is as follows: transect#_station sample. An example is transect1_1a. The data file naming convention is as follows: instrument_transect#_date (yymmdd) _station sample. An example is sbe19_transect1_061114_1a. Refer to Appendix I for monthly transect data plots created using MatLab software.

Table 1. Location details of Hydrographic Sections.

Name	**Latitude**	**Longitude**	**Depth(m)**
transect1_0	29º 51.40	84º 31.30	5
transect1_1	29º 50.67	84º 34.00	5
transect1_2	29º 48.00	84º 31.00	5
transect1_3	29º 45.34	84º 28.00	10
transect1_4	29º 42.67	84º 25.00	15
transect1_5	29º 40.00	84º 22.00	20
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 40.00	84º 22.00	20

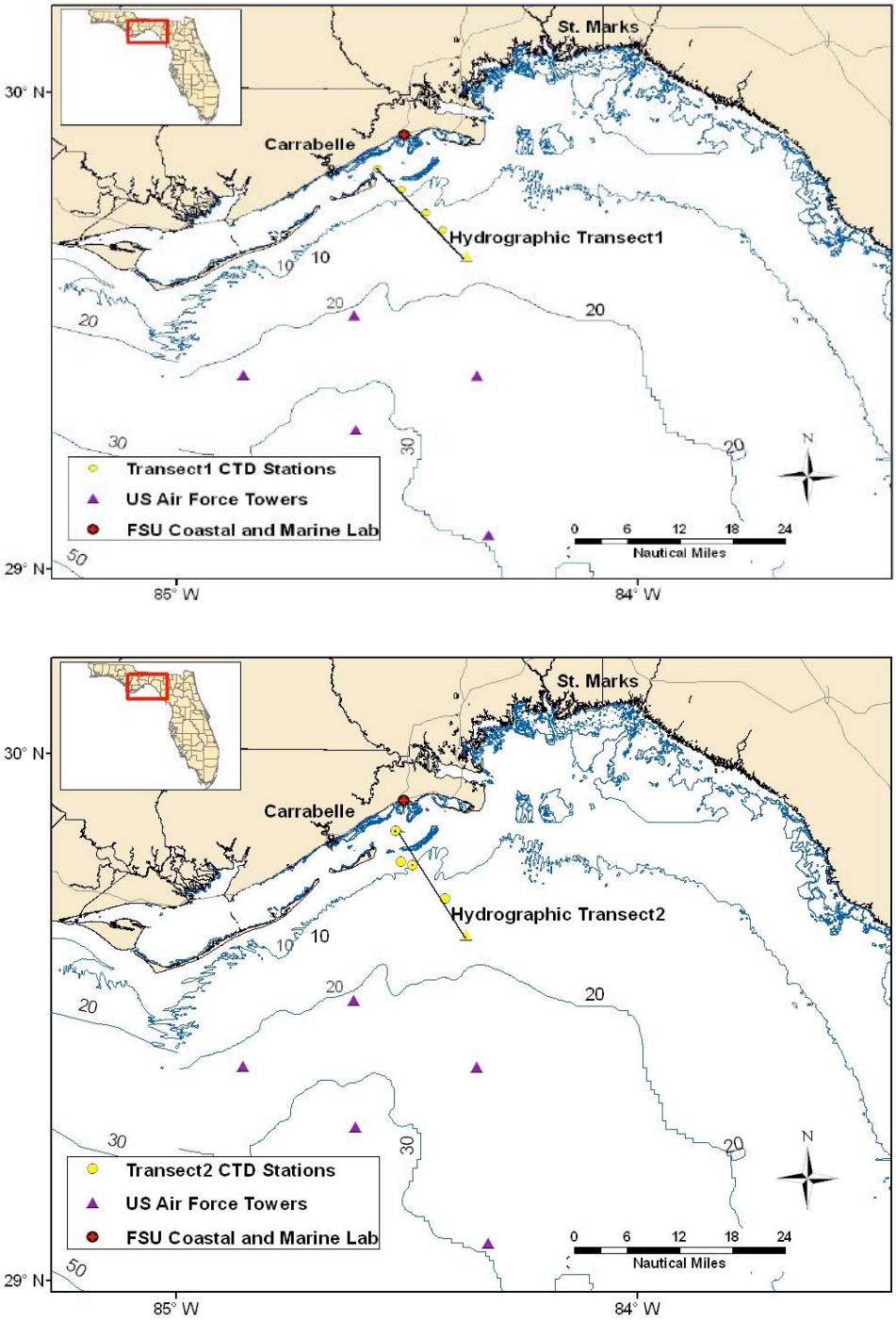

Figure 1. Map of the Big Bend Region, Florida and the FSU NGI Hydrographic Sections.
Top: Hydrographic Transect 1.
Bottom: Hydrographic Transect 2.

Table 2. Details of Hydrographic Section Cruises.

Date	Vessel	Transect	Instrument(s)		Notes
11/14/2006	R/V Seminole	transect1	ysi	sbe19	duplicate profiles (a and b)
12/13/2006	R/V Seminole	transect1	ysi	sbe19	duplicate profiles (a and b)
01/19/2007	R/V Seminole	transect1	ysi	sbe19	duplicate profiles (a and b)
02/07/2007	R/V Seminole	transect1	ysi	sbe19	duplicate profiles (a and b)
03/06/2007	R/V Seminole	transect1	ysi	sbe19	duplicate profiles (a and b)
04/04/2007	R/V Seminole	transect1	ysi	sbe19	
05/02/2007	R/V Seminole	transect1	ysi	sbe19	included station 0; no sbe19 station 4
06/13/2007	R/V Seminole	transect1	ysi	sbe19	included station 0; duplicate profiles (a and b)
08/08/2007	R/V Seminole	transect1	ysi	sbe19	included station 0
09/12/2007	R/V Seminole	transect1	ysi	sbe19	
11/06/2007	R/V Seminole	transect1	ysi	sbe19	
12/19/2007	R/V Seminole	transect2	ysi	sbe19	began sampling new transect
01/23/2008	R/V Seminole	transect2	ysi	sbe19	
02/20/2008	R/V Seminole	transect2	ysi	sbe19	no sbe19 station 2, and no ysi station 5
03/26/2008	R/V Seminole	transect2	ysi	sbe19	
04/23/2008	R/V Seminole	transect2	ysi	sbe19	
07/02/2008	R/V Seminole	transect2	ysi	sbe19	
08/06/2008	R/V Seminole	transect2	ysi	sbe19	
09/26/2008	R/V Bellows	transect2	ysi	sbe19	Oceanography class cruise
12/03/2008	SGI Twin Vee	transect2	ysi	sbe19	no stations 4 or 5
01/22/2009	R/V Seminole	transect2	ysi	sbe19	no sbe19 station 2
03/10/2009	R/V Seminole	transect2	ysi	sbe19	
04/08/2009	R/V Bellows	transect2	ysi	sbe25	Oceanography class cruise; R/V Bellows sbe instrument
05/12/2009	R/V Seminole	transect2	ysi	sbe19	no ysi station 1 and 2
06/09/2009	R/V Seminole	transect2	ysi	sbe19	

NOTES:
2007
NOVEMBER - MARCH
11/14/2006 – 03/06/2007 duplicate profiles were completed at each station. Profile (a) was completed on the 1st cast with the collection of a Niskin water sample from the bottom and profile (b) was collected on the 2nd cast with a water sample from mid depth.

MAY
05/02/2007 station 0 was added to the transect1 line and sbe19 station 4 data was not collected due to a sensor malfunction.

JUNE
06/13/2007 sbe19 station 5a data was not recorded; therefore a second profile sbe19 station 5b was completed, and station 0 was added to the transect1 line.

AUGUST
08/08/2007 station 0 was added to the transect1 line. Station 0 is located at the end of the FSUCML's channel and was compared to station 1. Due to minimal differences and cruise time constraints the station 0 was dropped after 3 months of data collection.

DECEMBER
12/19/2007 began sampling hydrographic transect2 to include NGI Fixed Sites.

2008
FEBRUARY
02/20/2008 sbe19 station 2 data and ysi station 5 data were not collected due to sensor malfunctions.

SEPTEMBER
09/26/2008 no salinity data is available from the sbe19 due to a malfunction; (ysi salinity was recorded). This cruise was completed as part of an Oceanography Field Methods class aboard the R/V Bellows.

DECEMBER
12/03/2008 stations 4 and 5 were not completed due to foul weather.

2009
JANUARY
01/22/2009 sbe19 station 2 data was not collected due to a sensor malfunction.

APRIL
04/08/2009 cruise was completed as part of an Oceanography Field Methods class aboard the R/V Bellows. The R/V Bellows sbe25 instrument was used instead of the sbe19.

MAY
05/12/2009 ysi station 1 and 2 data were not collected due to sensor malfunctions.

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 CMF 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_080312_080416. Refer to Appendix II 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 40.00	84º 22.30	20

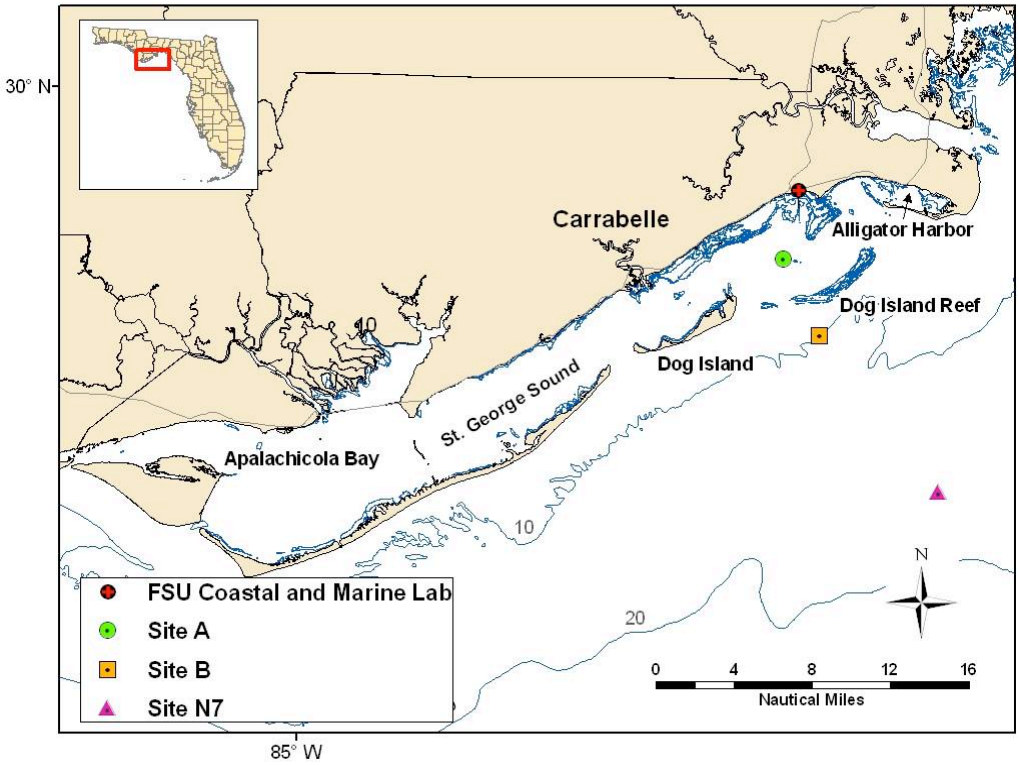

Figure 2. Map of FSU NGI Fixed Sites A, B, and N7.

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, and vandalism have been faced. 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 for conductivity, dissolved oxygen, depth, turbidity and pH following the procedures outlined in the YSI Operating and Service Manual. The YSI 6600 EDS's are 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). This site is less accessible with a small FSUCML 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 on 22 June 2007. These surface and mid water SBE16's along with the bottom mounted YSI will show water column stratification.

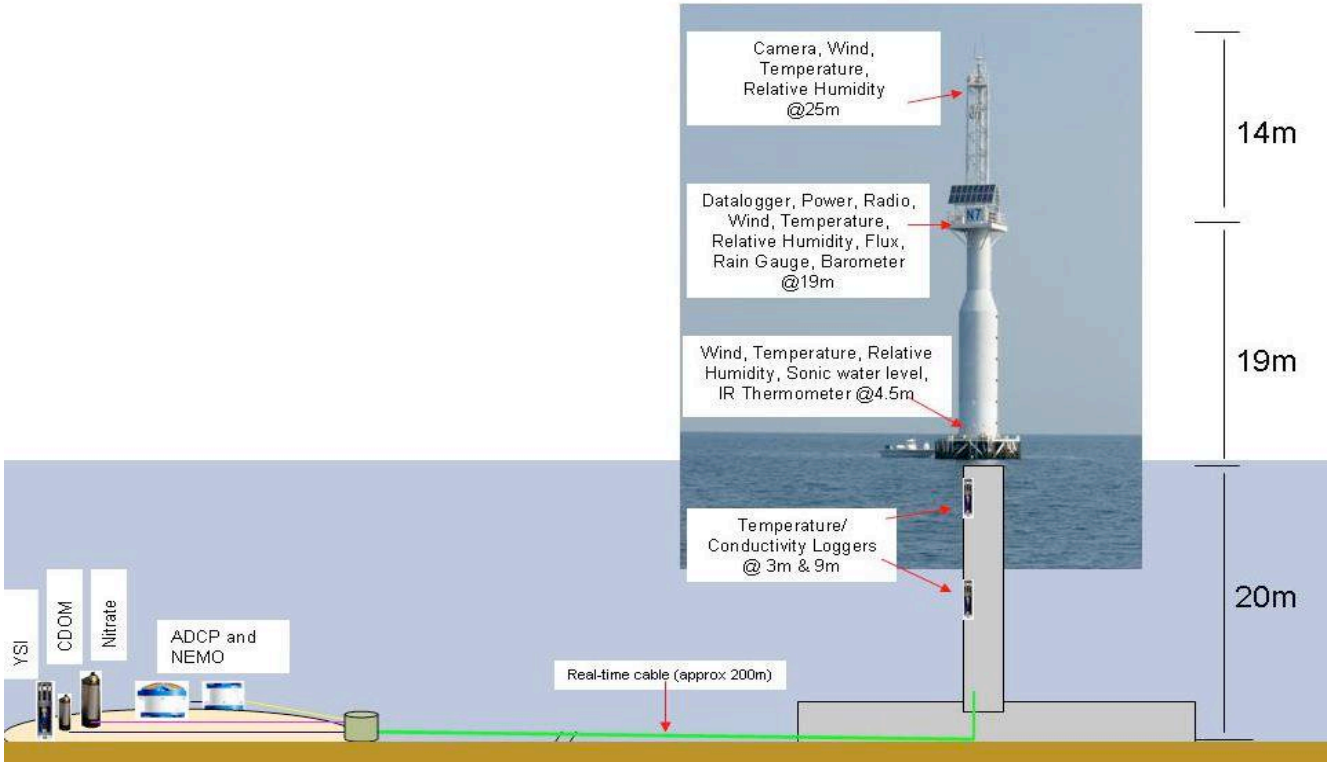

Figure 3. Illustration of Oceanography and Meteorology instrumentation at Site N7.

Additional Transport instruments are deployed approximately 700 feet to the West of tower N7. These include a Teledyne RDI Acoustic Doppler Current Profiler (ADCP), a multi-parameter YSI 6600 EDS, a Wet Labs ECO Fluorometer (CDOM), and a Satlantic MBARI-ISUS V3 (refer to instrument details in section 5). The instruments are attached to a MSI trawl-proof saucer bottom mount at a depth of 20m. The RDI ADCP is mounted on a central gimble and the other instruments are attached to a homemade basket which sits in a side compartment (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 other 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 is swapped out with an identical ADCP every month. The other instruments are turned around on the boat during the monthly Hydrographic Section cruises. 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 the future these instruments will be cabled for real-time telemetry.


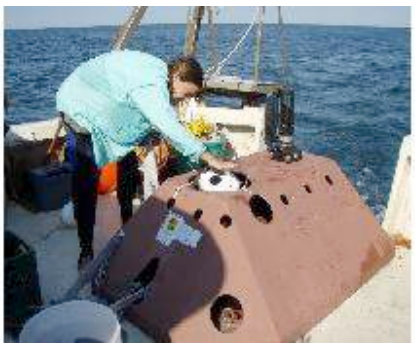


Figure 4. Left to Right: Site A bottom mount with AWAC and YSI after a deployment, Site B MSI bottom mount with a gimbled AWAC and YSI mounted in a custom hole, Site N7 MSI bottom mount with a gimbled ADCP and a custom basket with YSI, CDOM and Nitrate sensors.

Table 4. Details for Site A Cruises.

Date	**Vessel**	**Site**	**Instrument(s)**		**Notes**
02/28/2008	Cape Horn	site A			set mount anchors
03/12/2008	R/V Seminole	site A	ysi	awac	deployment
04/16/2008	pontoon	site A	ysi		
05/06/2008	pontoon	site A	ysi	awac	no data from 080416 – 080506; awac configuration change
05/29/2008	pontoon		ysi	awac	
06/19/2008	pontoon		ysi	awac	awac configuration change
07/02/2008	pontoon		ysi		no ysi data from 080626 - 080702
07/22/2008	R/V Seminole	site A	ysi	awac	
08/26/2008	Cape Horn	site A	ysi	awac	retrieve instruments
08/27/2008	Cape Horn	site A	ysi	awac	deploy instruments
09/17/2008	R/V Seminole	site A	ysi	awac	
10/10/2008	pontoon	site A	ysi	awac	
10/30/2008	pontoon	site A	ysi		
11/19/2008	pontoon	site A	ysi	awac	retrieve instruments
11/21/2008	pontoon	site A	ysi	awac	deploy instruments
12/15/2008	pontoon	site A	ysi	awac	retrieve instruments
12/16/2008	SGI Twin V	site A	ysi	awac	deploy instruments
01/19/2009	pontoon	site A	ysi		no ysi data from 090119 - 090224
02/24/2009	pontoon	site A	ysi	awac	
03/31/2009	pontoon	site A	ysi	awac	
05/05/2009	pontoon	site A	ysi		
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	

NOTES:
2008
MARCH
03/12/2008 awac and ysi were deployed at site A.

03/14/2008 - 03/17/08 awac site A had a pressure sensor malfunction due to an obstruction in the pressure port.

APRIL
04/16/2008 – 05/06/2008 no awac or ysi site A data due to servicing of the instruments. The awac was tested and calibrated due to the pressure sensor malfunction. The ysi was retrieved for servicing due to the extreme bio-fouling.

MAY
05/06/208 awac site A deployment configuration changes include: Current average interval = 300sec and number of wave samples = 1200 (refer to deployment configurations in section 4a).

JUNE
06/19/2008 awac site A deployment configuration changed from 8 number of cells to 10 (refer to deployment configurations in section 4a).

06/26/2008 – 07/02/2008 no ysi site A data is available due to sensor malfunction.

AUGUST
08/26/2008 – 08/27/2008 no awac site A data due to servicing. The instrument was retrieved on 08/26/2008 for download and service and was redeployed on 08/27/2008.

NOVEMBER
11/19/2008 – 11/20/2008 no awac site A data due to servicing. The instrument was retrieved on 11/19/2008 for download and service and was redeployed on 11/20/2008.

DECEMBER
12/15/2008 – 12/16/2008 no awac site A data due to servicing. The instrument was retrieved on 12/15/2008 for download and service and was redeployed on 12/16/2008.

2009
JANUARY – FEBRUARY
01/19/2009 – 02/24/2009 no ysi site A data due to sonde failure.

JUNE
06/01/2009 – 06/03/2009 no awac site A data due to servicing. The instrument was retrieved on 06/01/2008 for download and service and was 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).

Table 5. Details for Site B Cruises.

Date	Vessel	Site	Instrument(s)		Notes
06/19/2008	R/V Seminole	site B	ysi	awac	deployment
07/22/2008	R/V Seminole	site B	ysi	awac	no ysi data from 080905 - 080917
09/17/2008	R/V Seminole	site B	ysi	awac	
10/10/2008	R/V Seminole	site B	ysi	awac	no ysi data from 081013 - 081120
11/20/2008	Cape Horn	site B	ysi		
12/16/2008	SGI Twin V	site B	ysi	awac	Awac data flagged for excessive tilt
01/22/2009	R/V Seminole	site B	ysi	awac	no awac data 090215 - 090310
03/10/2009	R/V Seminole	site B	ysi	awac	awac configuration change
04/16/2009	R/V Seminole	site B	ysi	awac	awac configuration change; no ysi data from 090504 - 090512
05/12/2009	R/V Seminole	site B	ysi		
06/16/2009	Polar	site B	ysi	awac	retrieve instruments
06/17/2008	Polar	site B	ysi	awac	deploy instruments

NOTES:
JUNE
06/19/2008 awac and ysi site B were deployed.

SEPTEMBER
09/05/2008 – 09/17/2008 no ysi site B data due to probe failure.

OCTOBER – NOVEMBER
10/13/2008 – 11/20/2008 no ysi site B data due to probe failure.

2009
FEBRUARY
02/15/2009 – 03/10/2009 no awac site B data due to battery failure.

MARCH
03/10/2009 awac site B deployment configuration change includes: current profile interval = 600sec, current average interval = 60sec, number of wave samples = 1024, cell size = 1m, number of cells = 20, vertical velocity precision = 0.7 cm/s, horizontal velocity precision = 2.2 cm/s (refer to deployment configurations in section 4b).

APRIL
04/16/2009 awac deployment configuration change includes: current profile interval = 900sec, current average interval = 300sec, number of wave samples = 1200, cell size = 0.5m, number of cells = 22, horizontal velocity precision = 2.0 cm/s (refer to deployment configurations in section 4a).

MAY
05/04/2009 – 05/12/2009 no ysi site B data due to probe failure.

JUNE
06/16/2009 – 06/17/2009 no awac 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.

Table 6. Details for Site N7 Cruises.

Date	Vessel	Site	Instrument(s)					Notes
01/19/2007	R/V Seminole	site N7	adcp					
02/07/2007	R/V Seminole	site N7	adcp					
03/06/2007	R/V Seminole	site N7	adcp					
04/04/2007	R/V Seminole	site N7	adcp					
05/02/2007	R/V Seminole	site N7	adcp					
06/13/2007	R/V Seminole	site N7	adcp					
07/19/2007	Privateer/Cape Horn	site N7	adcp					no adcp data from 070711 - 070719
08/08/2007	R/V Seminole	site N7	adcp					
08/29/2007	R/V Seminole	site N7						recon cruise for sites A, B, and N7
09/12/2007	R/V Seminole	site N7	adcp					
11/06/2007	R/V Seminole	site N7	adcp					upgraded adcp with waves
12/12/2007	R/V Seminole	site N7			sbe16			deploy 2 sbe16
12/19/2007	R/V Seminole	site N7	adcp					
01/23/2008	R/V Seminole	site N7	adcp					
02/08/2008	R/V Seminole	site N7			sbe16			recon cruise, sbe16 configuration change
02/20/2008	R/V Seminole	site N7	adcp					adcp configuration change
03/12/2008	R/V Seminole	site N7		ysi				deploy ysi, 2nd MSI mount
03/26/2008	R/V Seminole	site N7	adcp			awac	cdom	adcp configuration change
04/23/2008	R/V Seminole	site N7	adcp	ysi	sbe16		cdom	no adcp waves data from 080326 – 080423; adcp configuration change
06/03/2008	R/V Seminole	site N7	adcp	ysi		awac	cdom	
06/24/2008	R/V Seminole	site N7			sbe16			Meteorology cruise
07/02/2008	R/V Seminole	site N7	adcp	ysi			cdom	
08/06/2008	R/V Seminole	site N7	adcp	ysi			cdom	cdom configuration change; no ysi data from 080910 - 080930
09/30/2008	R/V Seminole	site N7	adcp	ysi	sbe16		cdom	
11/20/2009	Cape Horn	site N7	adcp	ysi			cdom	no ysi data from 081114 - 081120
01/22/2009	R/V Seminole	site N7	adcp	ysi				no ysi data from 090113 - 090122
02/06/2009	R/V Seminole	site N7			sbe16			retrieval of adcp mount
03/10/2009	R/V Seminole	site N7	adcp	ysi			cdom	
04/16/2009	R/V Seminole	site N7	adcp	ysi			cdom	adcp configuration change
05/12/2009	R/V Seminole	site N7	adcp	ysi				
06/01/2009	R/V Seminole	site N7			sbe16			sbe16 real-time telemetry
06/09/2009	R/V Seminole	site N7	adcp	ysi				

NOTES:
2007
JANUARY – SEPTEMBER
01/19/2007 – 09/12/2007 RDI ADCP site N7 current data only.

JULY
07/11/2007 – 07/19/2007 no adcp site N7 data due to battery failure.

NOVEMBER
11/06/2007 adcp site N7 was upgraded to measure currents and waves, and time was changed to EST from GMT.

DECEMBER
12/12/2007 two (2) sbe16 sensors were deployed at site N7 at 3m and 9m.

2008
FEBRUARY
02/08/2008 sbe16 site N7 deployment configuration changed from sampling every 5 minutes to sample every 15 minutes.

02/20/2008 adcp site N7 deployment configuration changes include: number of depth cells = 20, Number of pings in a wave burst = 600, Interval between the start of wave burst = 02:00:00 (refer to deployment configurations in section 4c).

MARCH
03/12/2008 ysi was deployed along with a 2nd MSI trawl-proof bottom mount at site N7.

03/26/2008 awac and cdom were deployed at site N7.

MARCH – APRIL
03/26/2008 – 04/23/2008 no adcp site N7 wave measurements were recorded.

APRIL
04/23/2008 adcp site N7 deployment configuration changes include: number of depth cells = 24, Number of pings in a wave burst = 1200 (refer to deployment configurations in section 4c).

AUGUST
08/06/2008 cdom site N7 deployment configuration changed from sampling every hour to sample every 15 minutes.

SEPTEMBER
09/10/2008 – 09/30/2008 no ysi site N7 data was recorded due to sonde failure.

NOVEMBER
11/14/2008 - 11/20/2008 no ysi site N7 data was recorded due to sonde failure.

2009
JANUARY
01/13/2009 – 01/22/2009 no ysi site N7 data was recorded due to sonde failure.

APRIL
04/16/2009 adcp site N7 deployment configuration changes include: Interval between the start of wave burst = 02:00:00.

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

4. Current and Wave Deployment Configurations

a) Site A Nortek AWAC

03/12/2008 – 04/16/2008
Current profile interval = 900sec
Current average interval = 120sec
Number of wave samples = 1024
Wave sampling interval = 3600sec
Wave sampling rate = 2Hz
Cell size = 0.5m
Blanking distance = 0.4m
Number of cells = 8
Vertical velocity precision = 0.8 cm/s
Horizontal velocity precision = 2.4 cm/s

05/06/2008 – 06/19/2008
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 = 8
Vertical velocity precision = 0.7 cm/s
Horizontal velocity precision = 2.0 cm/s

06/19/2008 – 06/03/2009
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 = 10
Vertical velocity precision = 0.7 cm/s
Horizontal velocity precision = 2.0 cm/s

06/03/2009 – 06/30/2009
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
06/19/2008 – 03/10/2009
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 = 22
Vertical velocity precision = 0.8 cm/s
Horizontal velocity precision = 2.4 cm/s

03/10/2009 – 04/16/2009
Current profile interval = 600sec
Current average interval = 60sec
Number of wave samples = 1024
Wave sampling interval = 3600sec
Wave sampling rate = 2Hz
Cell size = 1m
Blanking distance = 0.4m
Number of cells = 20
Vertical velocity precision = 0.7 cm/s
Horizontal velocity precision = 2.2 cm/s

04/16/2009 – 06/16/2009
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 = 22
Vertical velocity precision = 0.7 cm/s
Horizontal velocity precision = 2.0 cm/s

c) Site N7 RDI ADCP

01/19/2007 – 11/06/2007
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 = 14

11/06/2007 – 02/20/2008
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 = 14
Number of pings in a wave burst = 1800
Interval between wave pings = 00:00:00.05
Interval between the start of wave burst =04:00:00

02/20/2008 – 03/26/2008
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 = 20
Number of pings in a wave burst = 600
Interval between wave pings = 00:00:00.05
Interval between the start of wave burst =02:00:00

03/26/2008 – 04/23/2008
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 = 20

04/23/2008 - 04/16/2009
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

04/16/2009 - 06/10/2009
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

d) Site N7 Nortek AWAC
03/26/2008 – 06/03/2008
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 = 40
Vertical velocity precision = 0.7 cm/s
Horizontal velocity precision = 2.0 cm/s

5. Instrument Specifications

The Transport instrumentation includes: five (5) YSI, two (2) RDI ADCP, 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) 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

c) 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

d) 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

e) 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)

f) Nitrate

Sensor Type: Satlantic MBARI-ISUS V3
Operating Temperature: 0 to 35°C
Depth Rating: 1000m
Sample Rate: 1 Hz
Accuracy: +/- uM or 2%, whichever is larger
Precision: +/- 0.5 uM
Range: up to 2000uM
Wavelength Range: 200-400nm
Optional bio-fouling guard

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. Instrument Comparisons

a) RDI ADCP and Nortek AWAC

The funding for this research allowed for the purchase of two (2) Nortek AWAC's for monitoring currents and waves in the shallower (5m and 10m) sites and for a wave upgrade of the RDI ADCP for the 20m Site N7. To facilitate future comparison of the data from all 3 sites we deployed an RDI ADCP and a Nortek AWAC at Site N7 together for a test period. The instruments were deployed with similar configurations from 03/25/2008 to 06/03/2008. These instruments were mounted in identical MSI trawl proof saucer bottom mounts, approximately 500ft apart.

Results (Figure 5) suggest that the two instruments perform similarly in terms of several standard wave statistics (significant height Hs, peak period Tp, and peak direction Dp). Spectral analysis still underway suggests that the AWAC provides wave information at higher frequency, past the cutoff of the RDI sampling, and in accord with expectations based on the different sampling capabilities of the instruments.

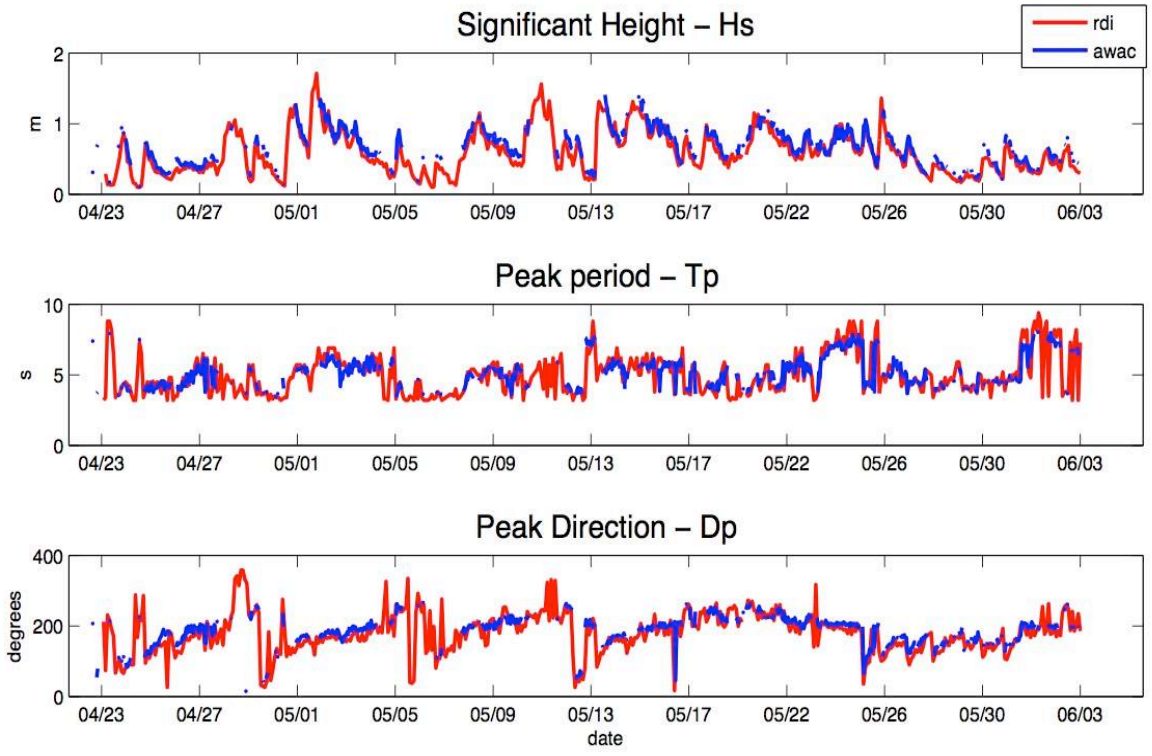

Figure 5. Comparison plot of the RDI ADCP and Nortek AWAC wave results.

b) SBE19 and YSI

Hydrographic profile data is collected with both a SBE19 and a YSI instrument in order to measure an array of water parameters. The instruments are attached to the same cage and lowered at the same rate. The SBE19 records depth (m), temperature (°C) and conductivity (S/m) every 0.5 seconds. The conductivity values are converted to salinity (psu) and the data is binned in 0.5m bins

with the Sea-Bird post processing data software. The YSI collects depth (m), temperature (°C) and conductivity (mS/cm) along with other parameters every 1 second. The salinity (ppt) values are converted on the YSI datasonde. Data is binned in 0.5m bins with MATLAB post processing software. The SBE19 is factory calibrated bi-annually for depth, temperature and conductivity. The YSI is calibrated for depth and specific conductivity (50 mS/cm) prior to every cruise according to YSI standards.

In both the temperature and conductivity values a difference can be seen when comparing the monthly YSI profiles with the SBE19 profiles. The ranges of differences vary from month to month and therefore are most likely due to the accuracy of the YSI calibration. June 09, 2009 profile data was analyzed to show the difference in the 3 parameters (Figure 6). Stations 1, 2, 3, 4 & 5 profile data were binned in 0.5m depth bins and combined together. The SBE19 had a higher average temperature value (0.16375) than the YSI. The YSI had a higher average conductivity (0.12771) and salinity (1.07049) values than the SBE.

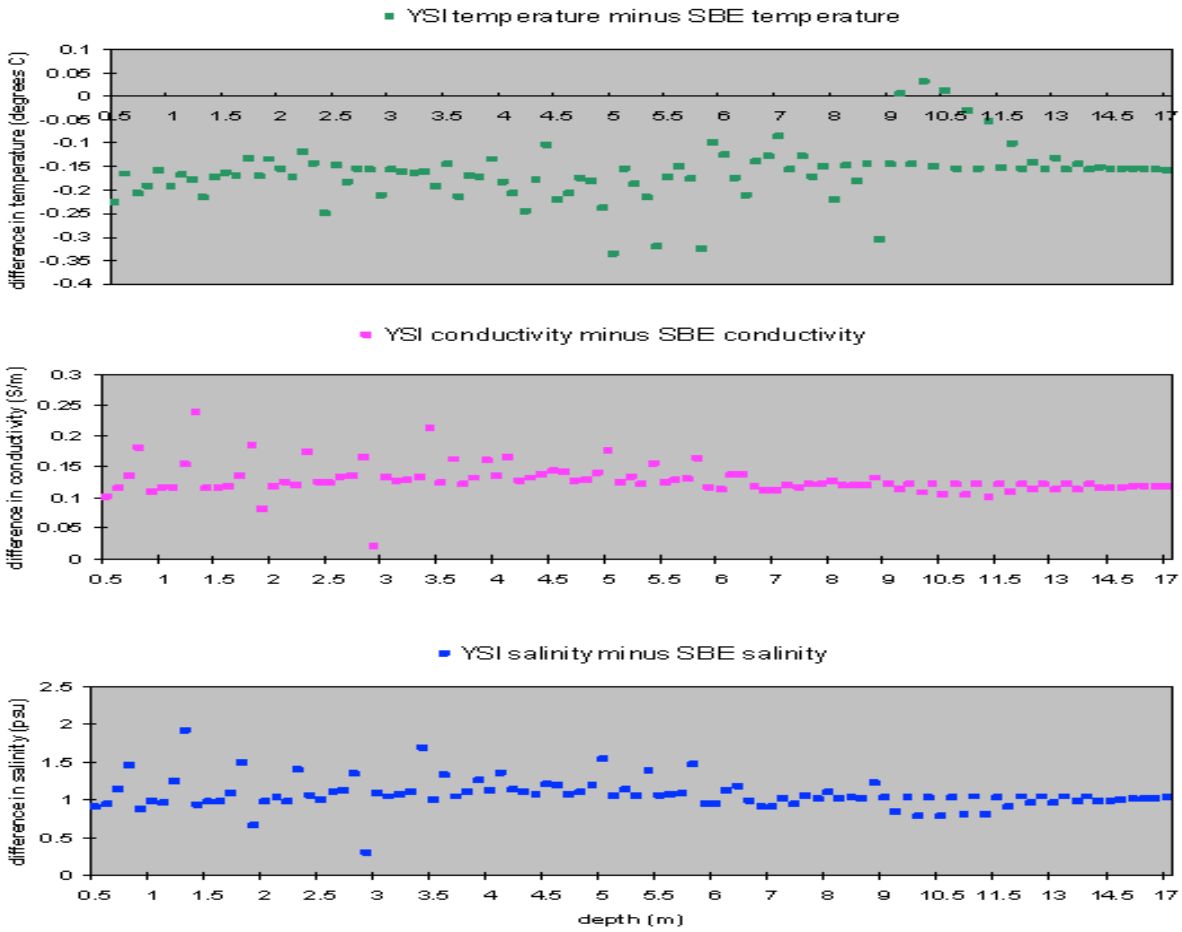

Figure 6. Comparison plot of the YSI and SBE19 average temperature, conductivity, and salinity differences.

7. Future Transport Goals (1 July 2009 – 30 September 2011)

Telemetry of the oceanographic instrumentation at Site N7 is the next priority. The RDI ADCP, YSI, CDOM and Nitrate sensors will utilize the telemetry hardware that the Meteorology group has deployed at Site N7. A RDI NEMO Waves Processing Module will be deployed along with the RDI ADCP for telemetry of the processed wave measurements. The RS232 instruments will be converted to RS422/485 for data transmission over the distance. A cable will be laid between the bottom mount and the tower over the 700 feet distance. A buffered Smart Switch will be deployed in an underwater junction box to allow for the instruments communication. Power issues and voltage drop were taken into account for the purchase of the cable. The cable should be delivered by September 2009. Data is transmitted from the tower to a computer housed in the CMF 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. SBE16 instrumentation will need to be factory calibrated and mounting permission will need to be granted from the US Army Corps.

8. Other Remarks/ Notes

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

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

For more information about the CDOM sensor and data please contact Cedric Magen magen@ocean.fsu.edu

For more information about the Nitrate sensor and data please contact Dr. William Landing wlanding@fsu.edu

The Florida State University Red Tide Monitoring Program collected physical, chemical, and biological oceanographic measurements in the BBR. These data will provide a basis for improved understanding and monitoring of red tide movement into Northwest Florida waters and its intensity at the coast. The program was from 11/14/2006 through 06/09/2009 and 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 14 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. YSI 6600 sondes and similar probes are deployed at 2 locations in the harbor.
http://www.dep.state.fl.us/coastal/sites/alligator/

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

9. 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

Nitrate: http://www.satlantic.com

10. Acknowledgements

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Department of Oceanography Machine Shop: Alan Michels and Dave Oliff

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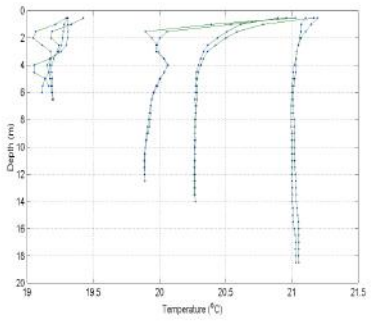
Volunteer Science Divers: Mike Santema, Kelly Kingon, Steve Lambert, Steve Morey, Dmitry Dukhovskoy, Chris Peters, Rick Peterson, Jimmy Nelson, Isaac Santos, Andrew Kowalczk, Anna Strimaitis, Ryan Cantey, and Mike Johnson

Department of Oceanography students and staff: Matt Laschet, Ia Suryaputra, Jiyoung Paeng, Angie Milne, Alex Landing, Mona Behl, Alison Byrd, Ekaterina Maksimova, Tim Mcgann, Nish Krishnamurthy, Fara Ilami, Alex Frahm, Jay Hooper, and Linda Jamison

FSUCML: Felicia Coleman, Chris Koenig, Samantha Bosman, Bobby Henderson, Frank Lindamood, and Mark Daniels

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



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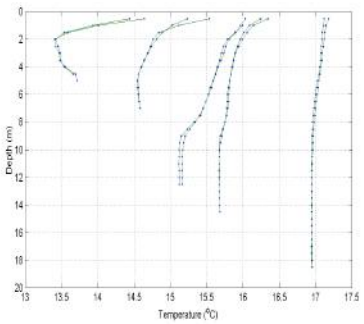
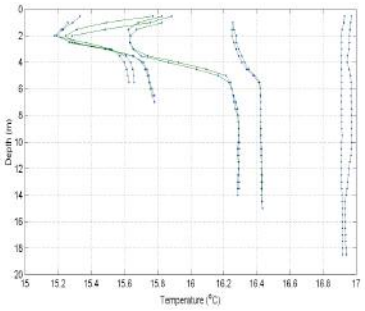
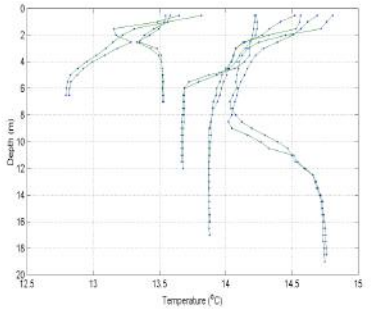


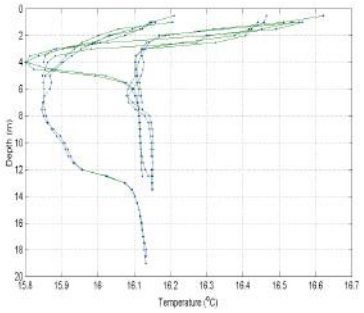
December 2006



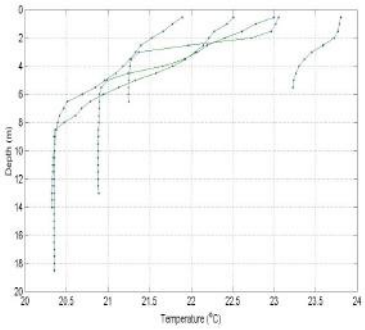
January 2007



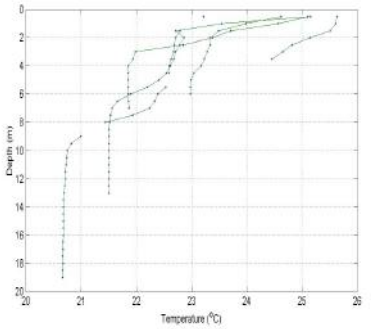
February 2007



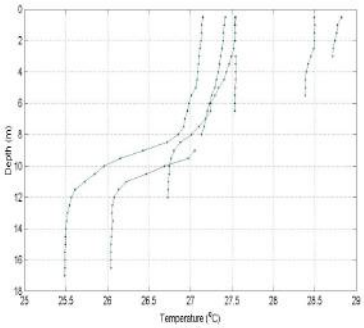
March 2007



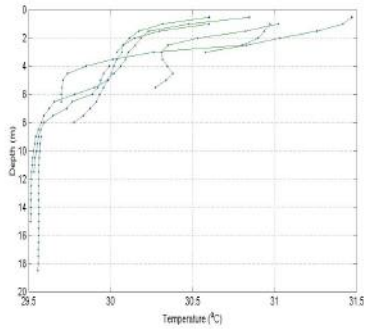
April 2007



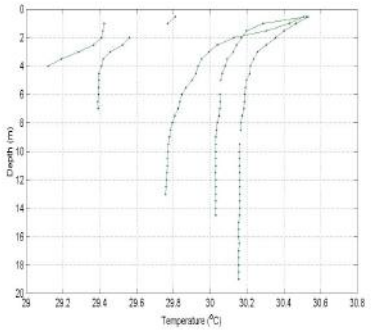
May 2007



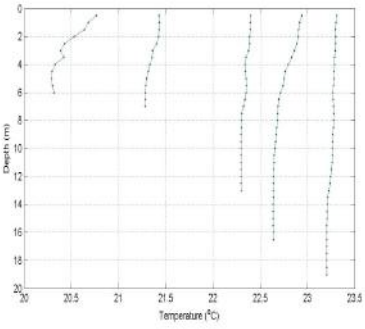
June 2007



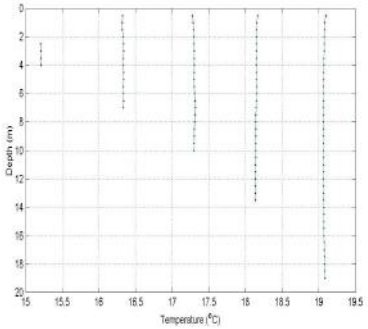
August 2007



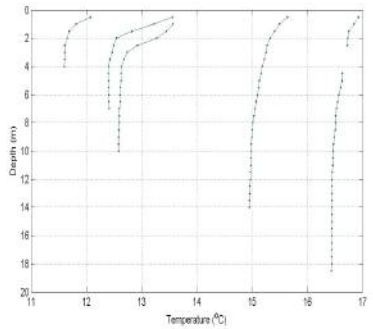
September 2007



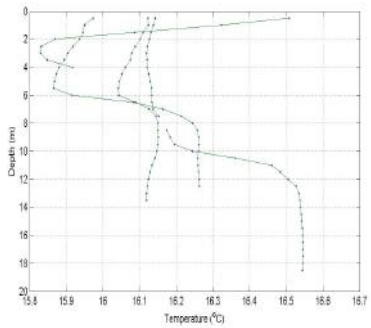
November 2007



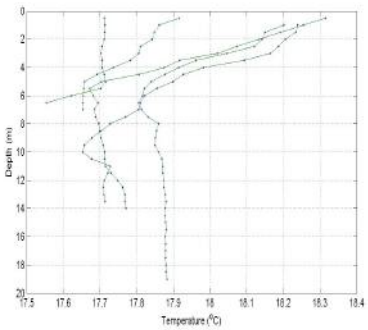
December 2007



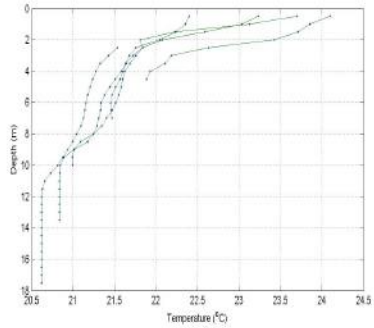
January 2008



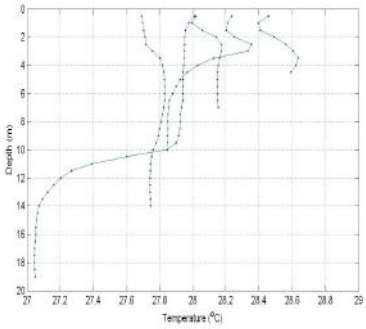
February 2008



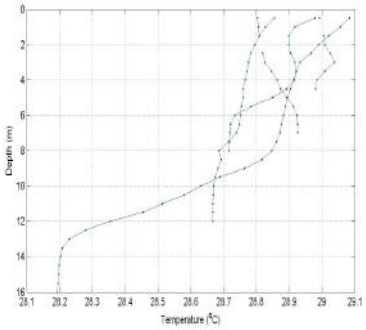
March 2008



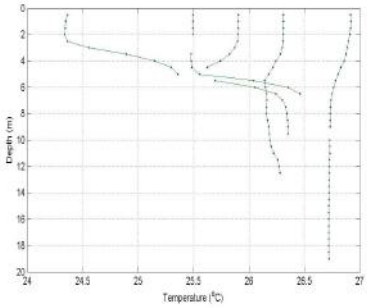
April 2008



July 2008



August 2008



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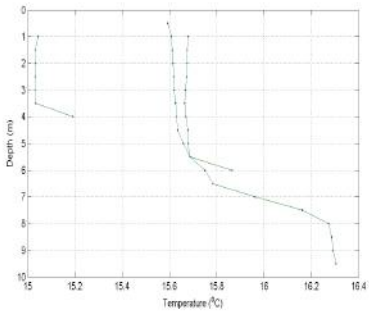

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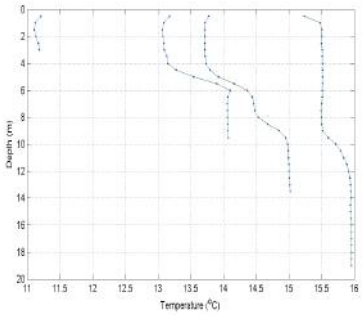
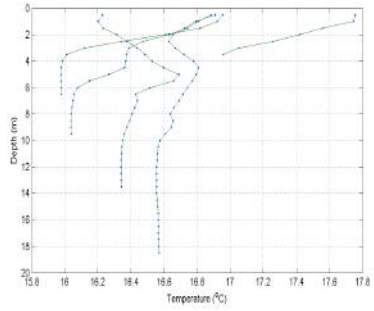
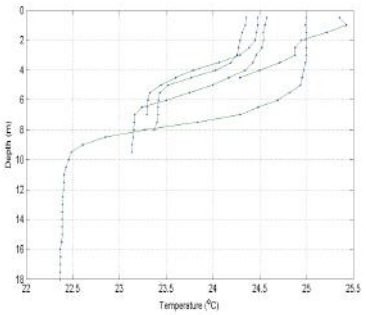


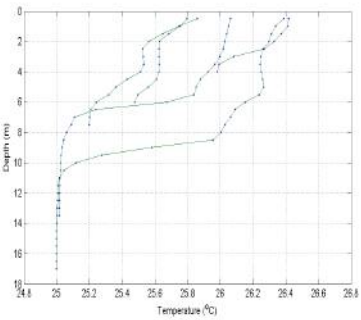
January 2009



March 2009

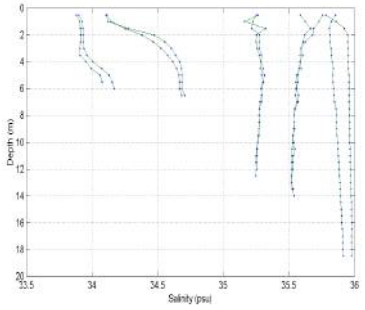


May 2009

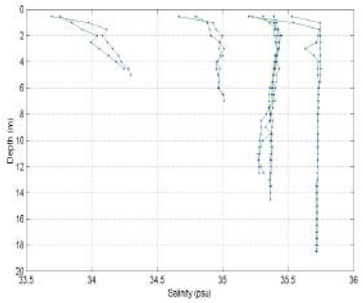


June 2009

b) SBE19 Hydrographic Section Salinity vs. Depth Monthly Plots



November 2006



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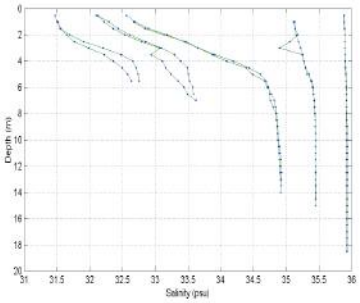

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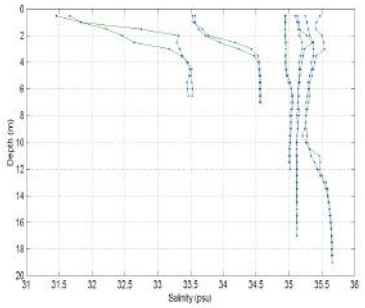
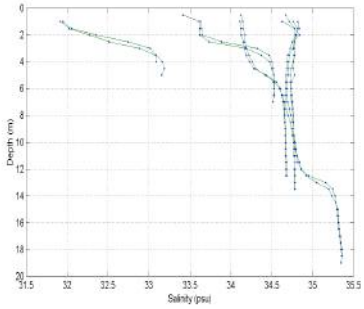


February 2007



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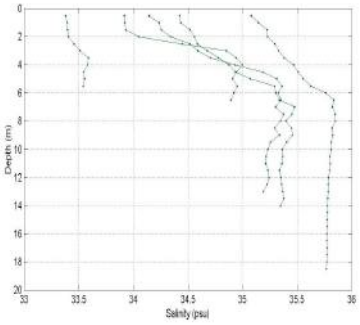
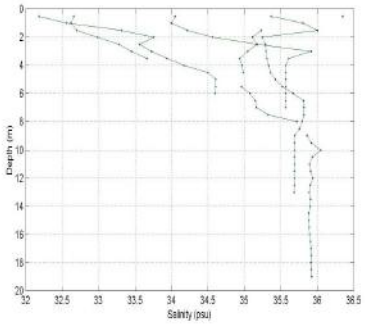
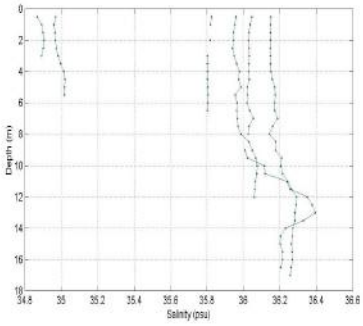


April 2007



May 2007



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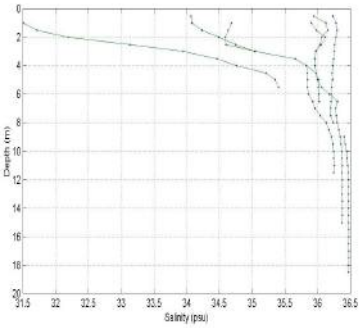
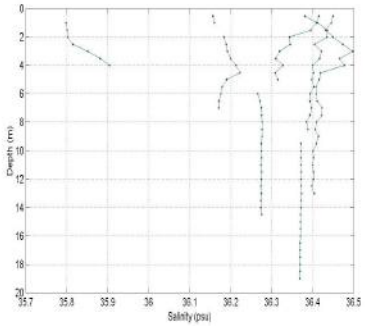
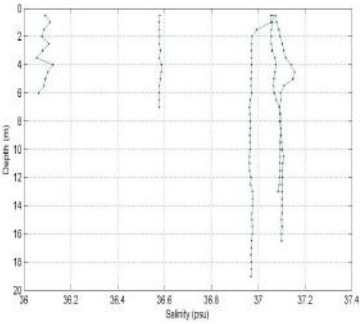


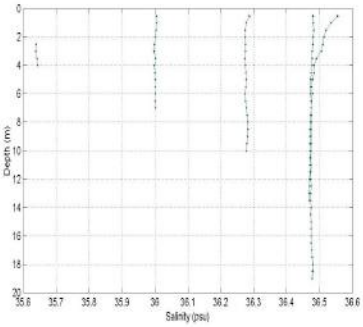
August 2007



September 2007



November 2007



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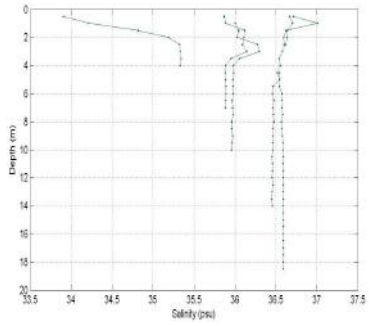
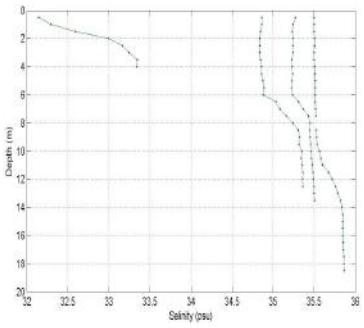
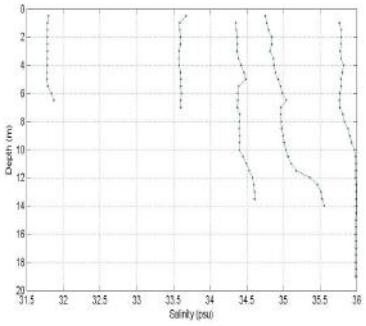


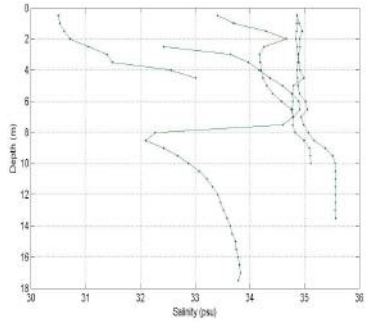
January 2008



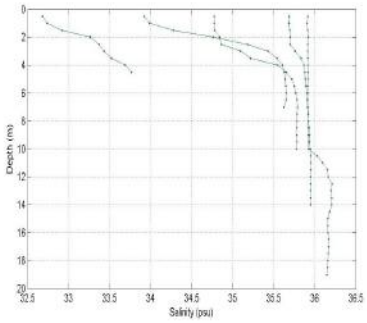
February 2008



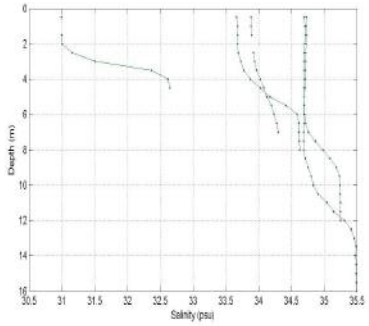
March 2008



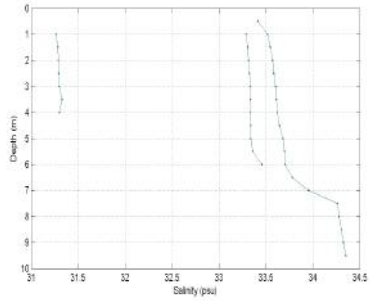
April 2008



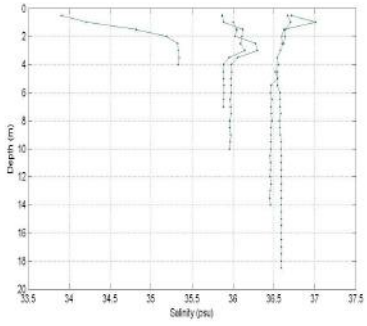
July 2008



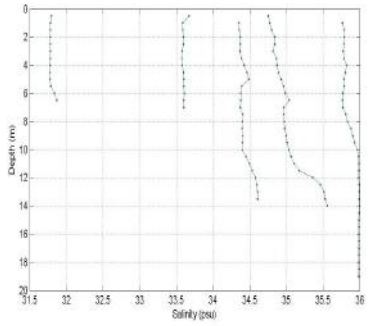
August 2008



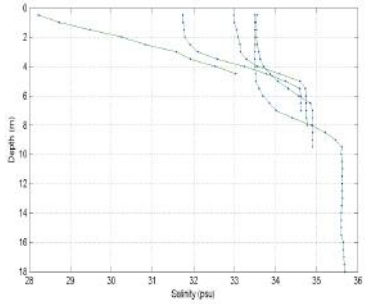
December 2008



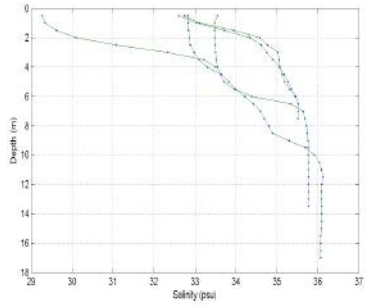
January 2009



March 2009

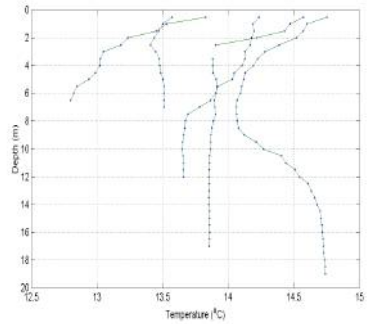


May 2009

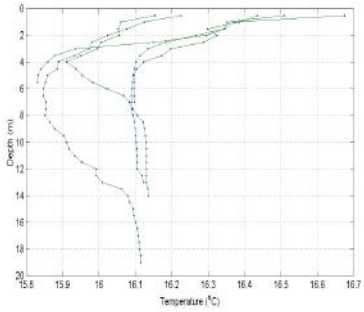


June 2009

c) YSI Hydrographic Section Temperature vs. Depth Monthly Plots



February 2007



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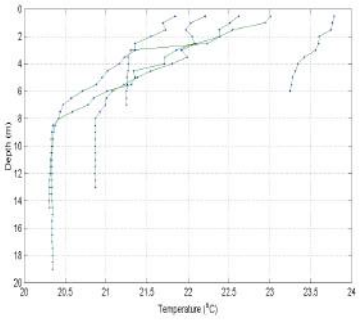
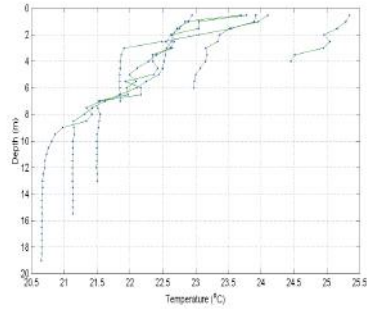
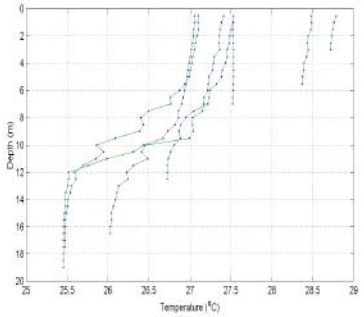


April 2007



May 2007



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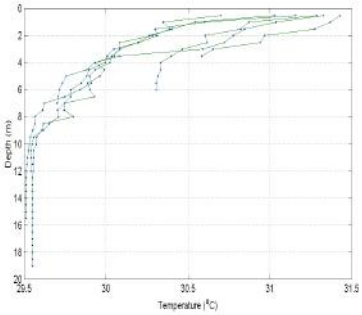
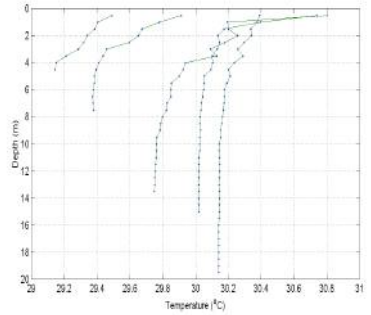
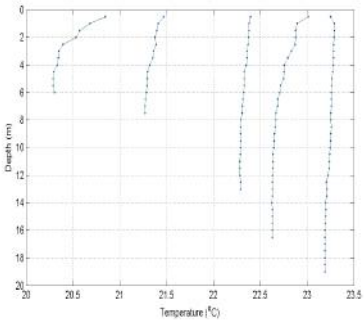


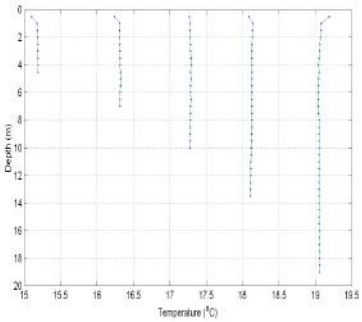
August 2007



September 2007



November 2007



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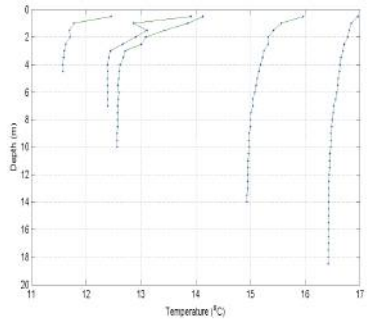
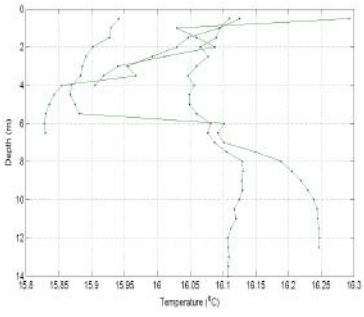
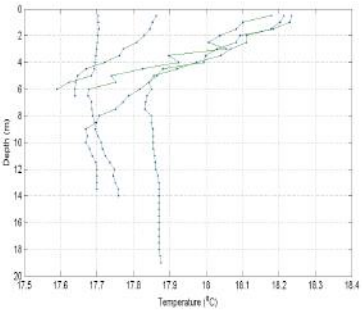


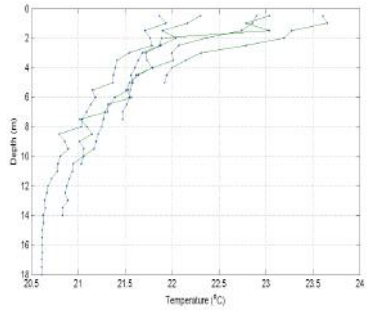
January 2008



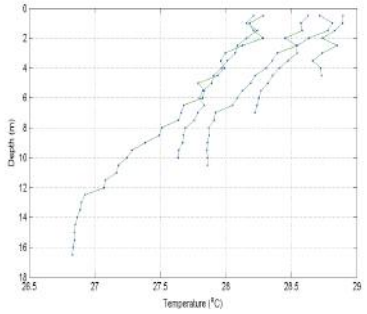
February 2008



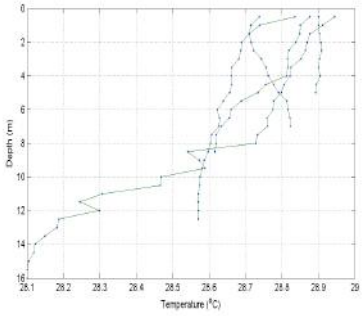
March 2008



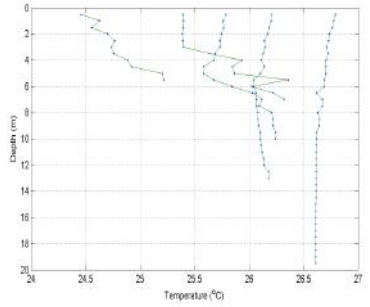
April 2008



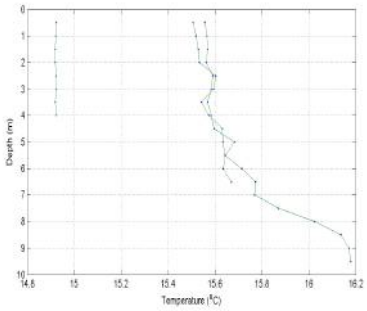
July 2008



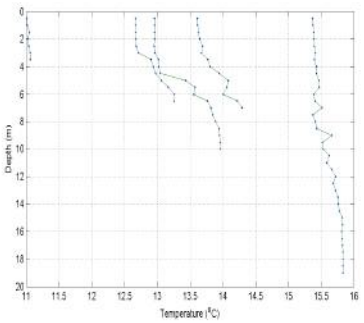
August 2008



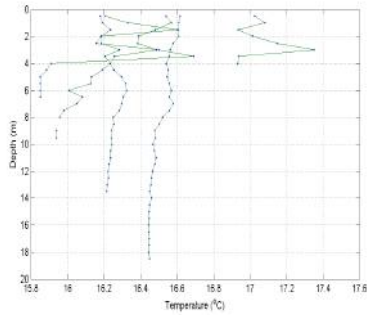
September 2008



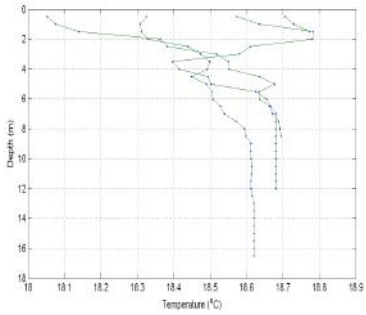
December 2008



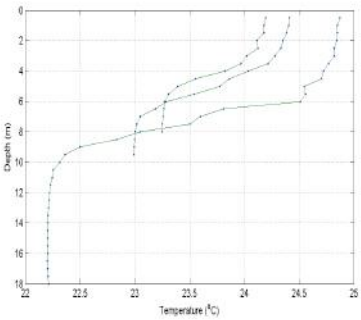
January 2009



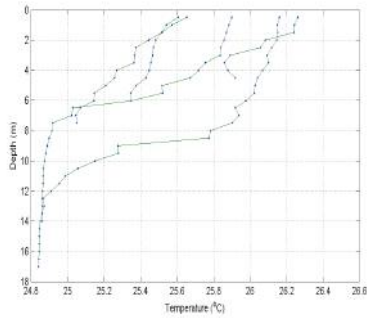
March 2009



April 2009

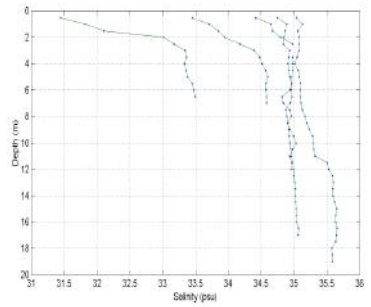


May 2009

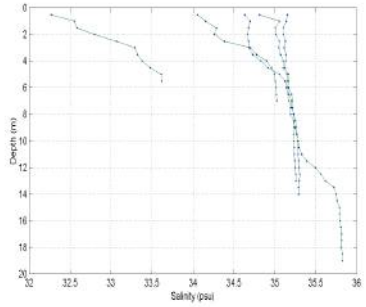


June 2009

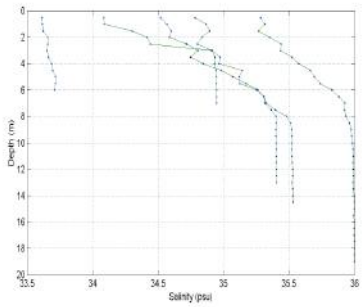
d) YSI Hydrographic Section Salinity vs. Depth Monthly Plots



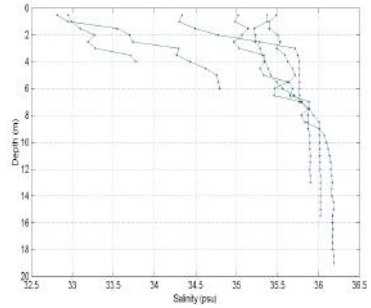
February 2007



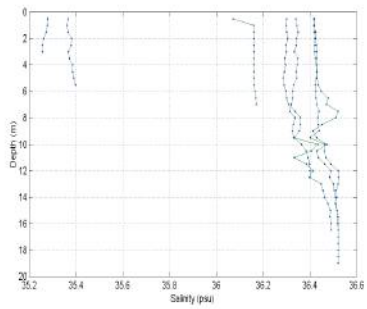
March 2007



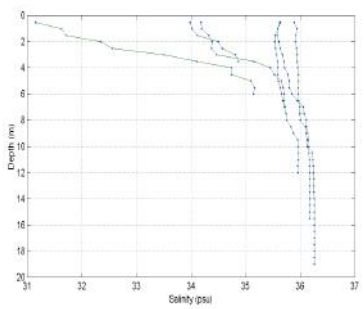
April 2007



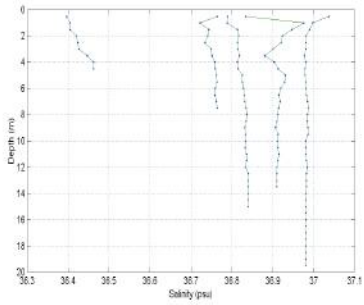
May 2007



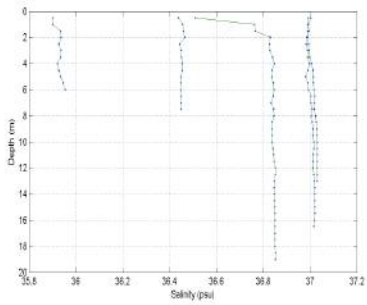
June 2007



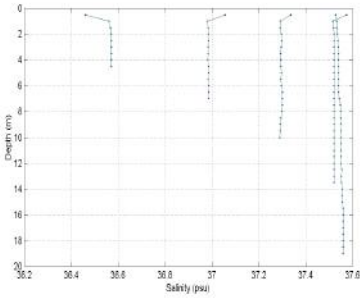
August 2007



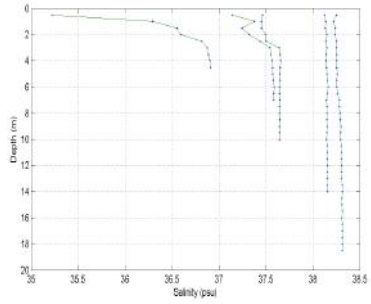
September 2007



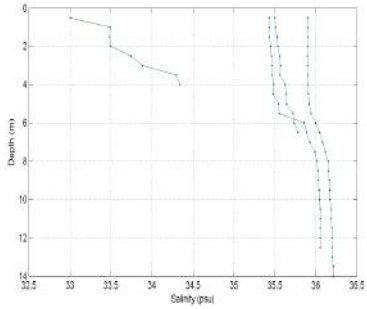
November 2007



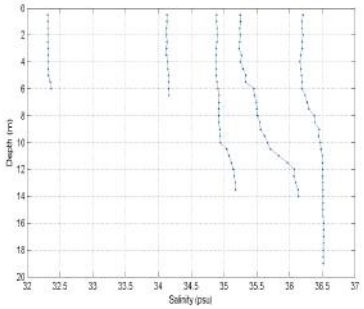
December 2007



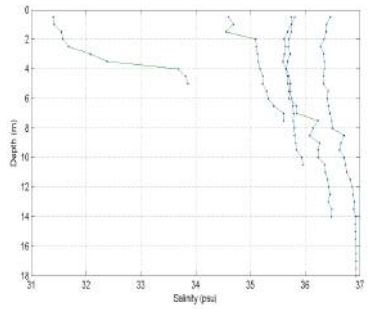
January 2008



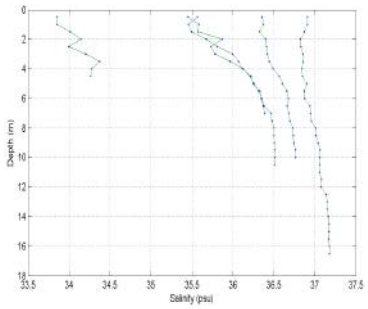
February 2008



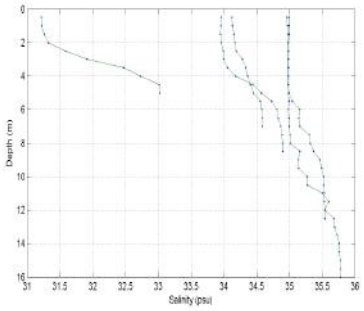
March 2008



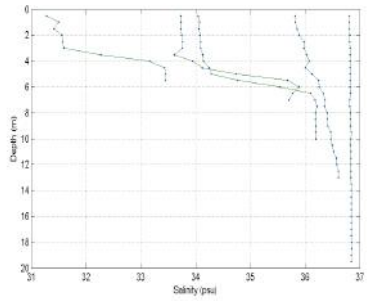
April 2008



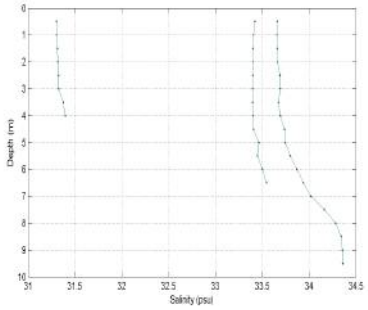
July 2008



August 2008



September 2008



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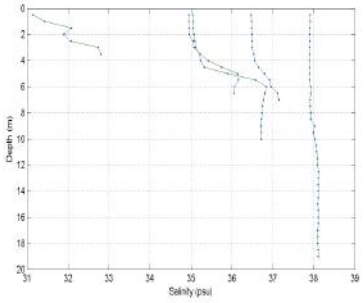
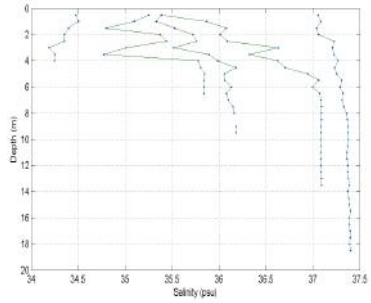
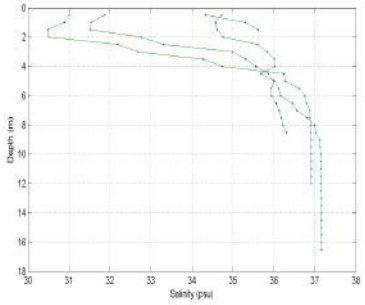


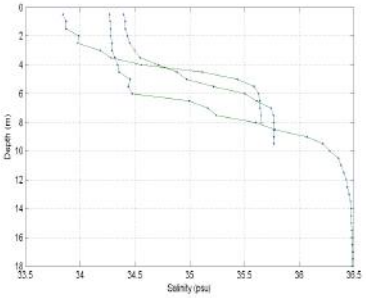
January 2009



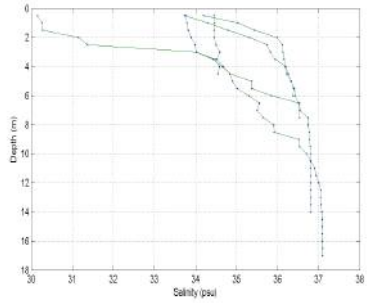
March 2009



April 2009

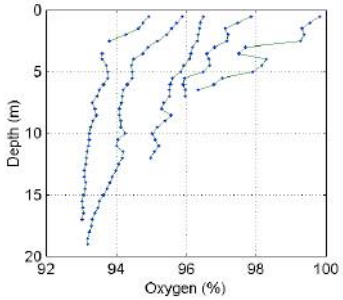


May 2009

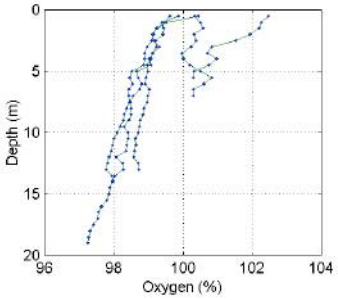


June 2009

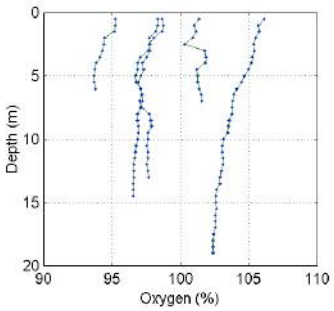
e) YSI Hydrographic Section Dissolved Oxygen vs. Depth Monthly Plots



February 2007



March 2007



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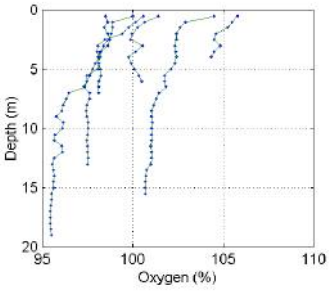

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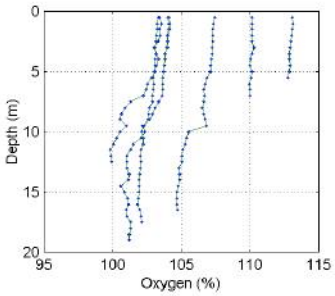

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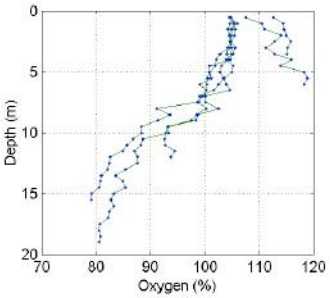
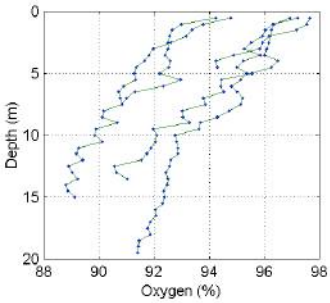


August 2007



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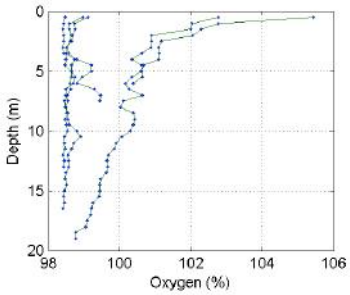
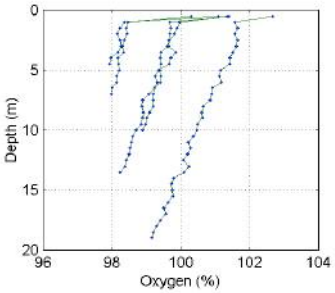


November 2007



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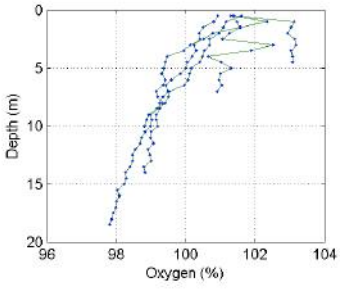
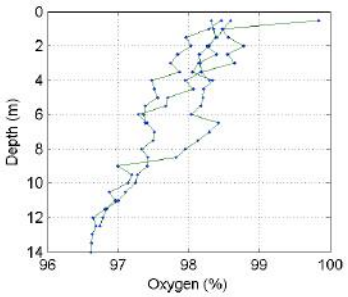
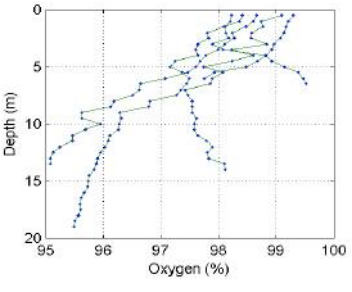


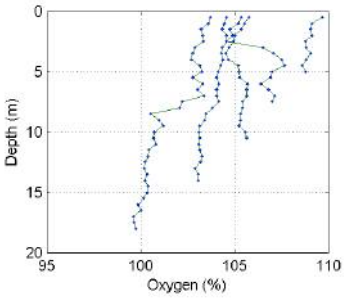
January 2008



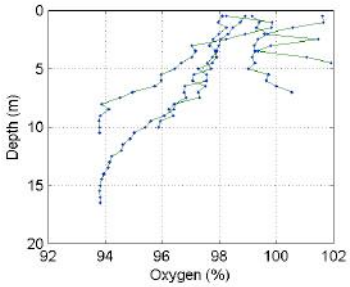
February 2008



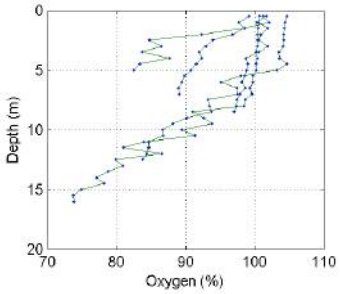
March 2008



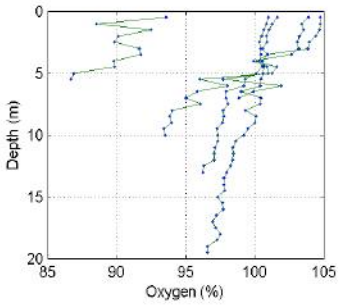
April 2008



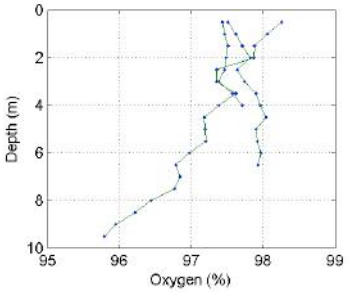
July 2008



August 2008



September 2008



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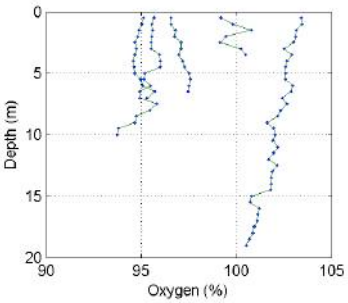
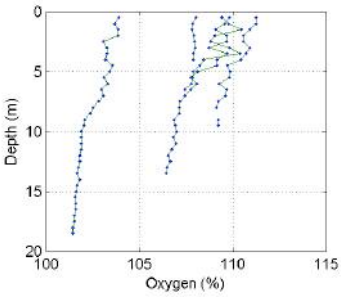
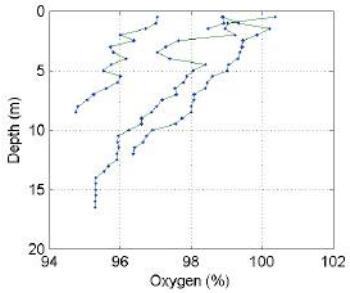


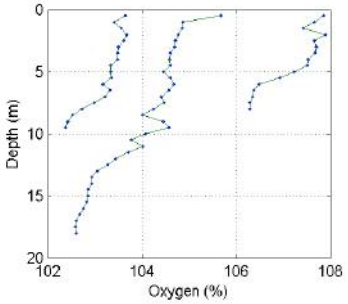
January 2009



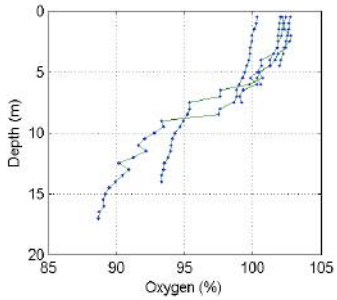
March 2009



April 2009

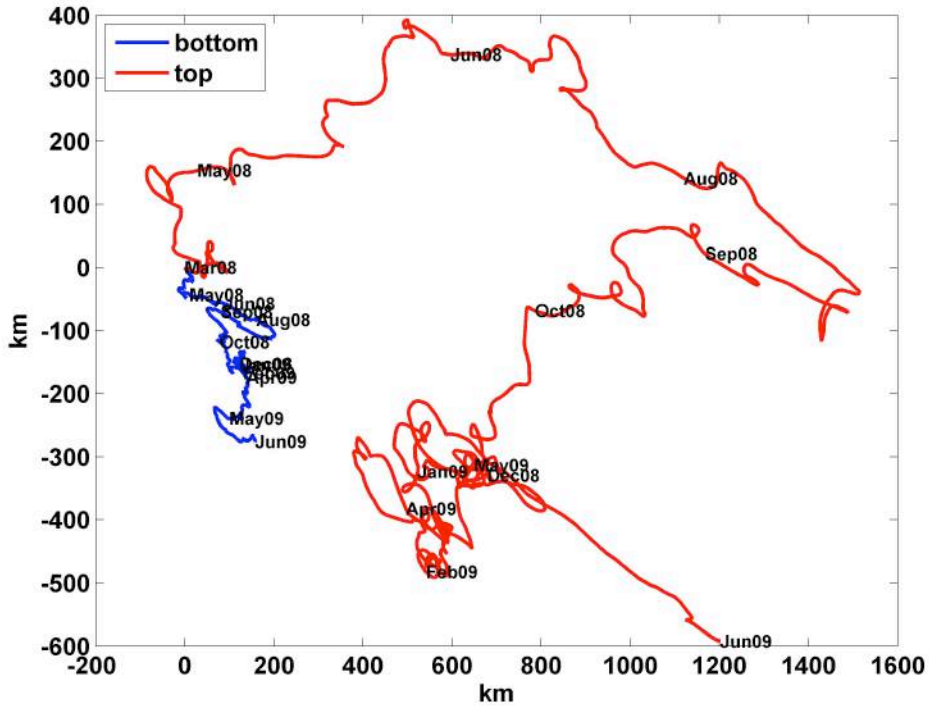


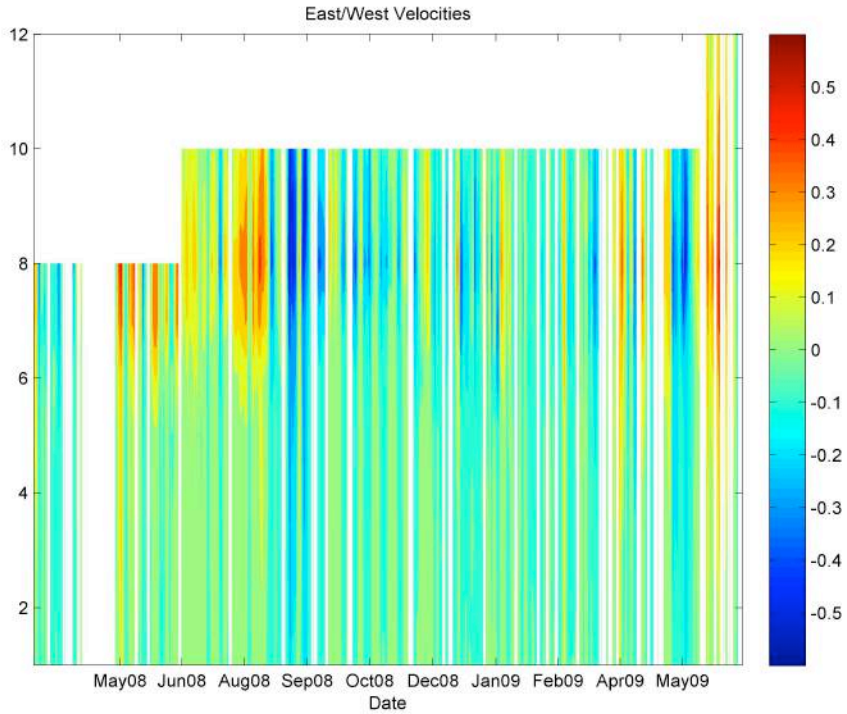
May 2009



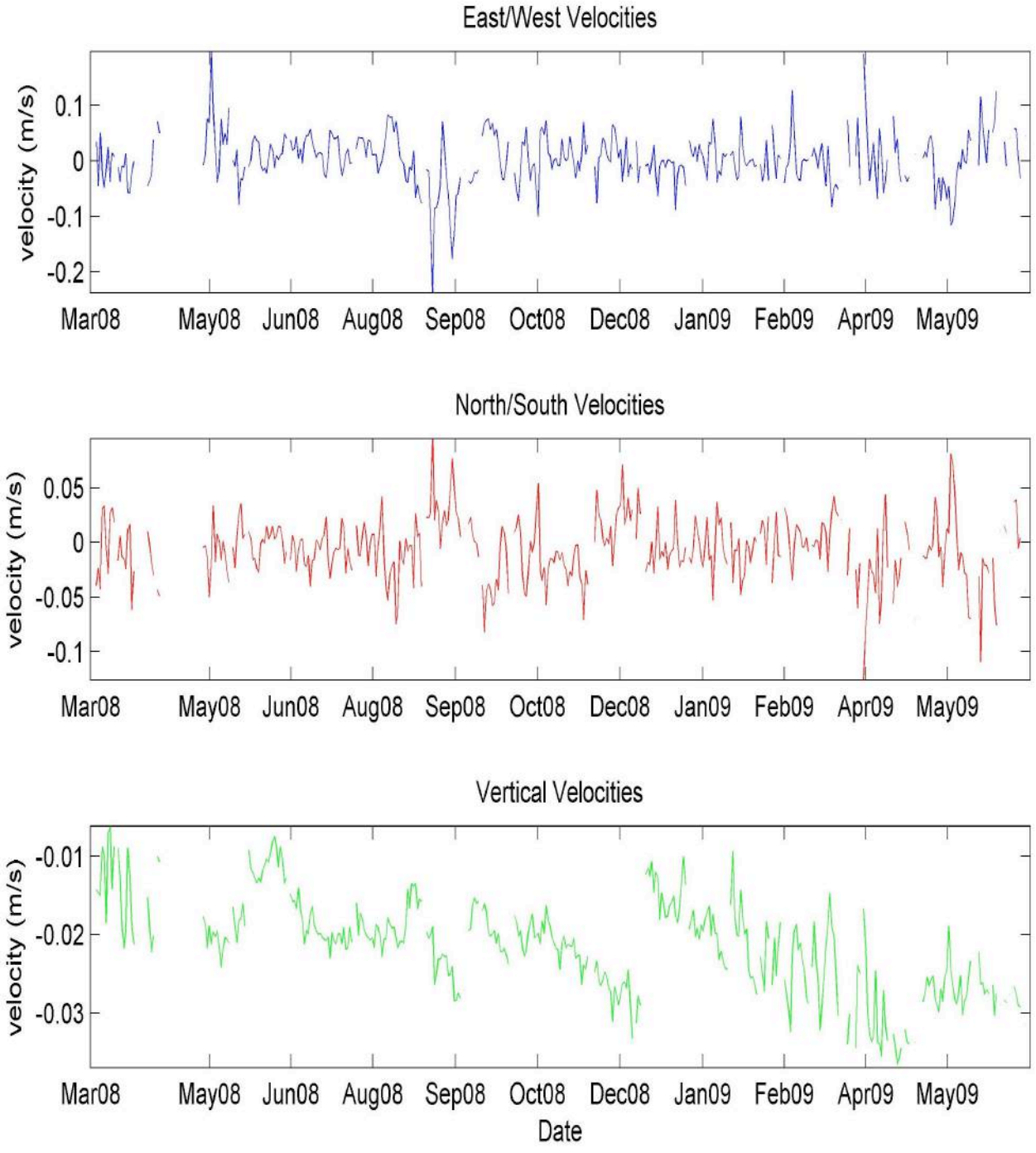
June 2009

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

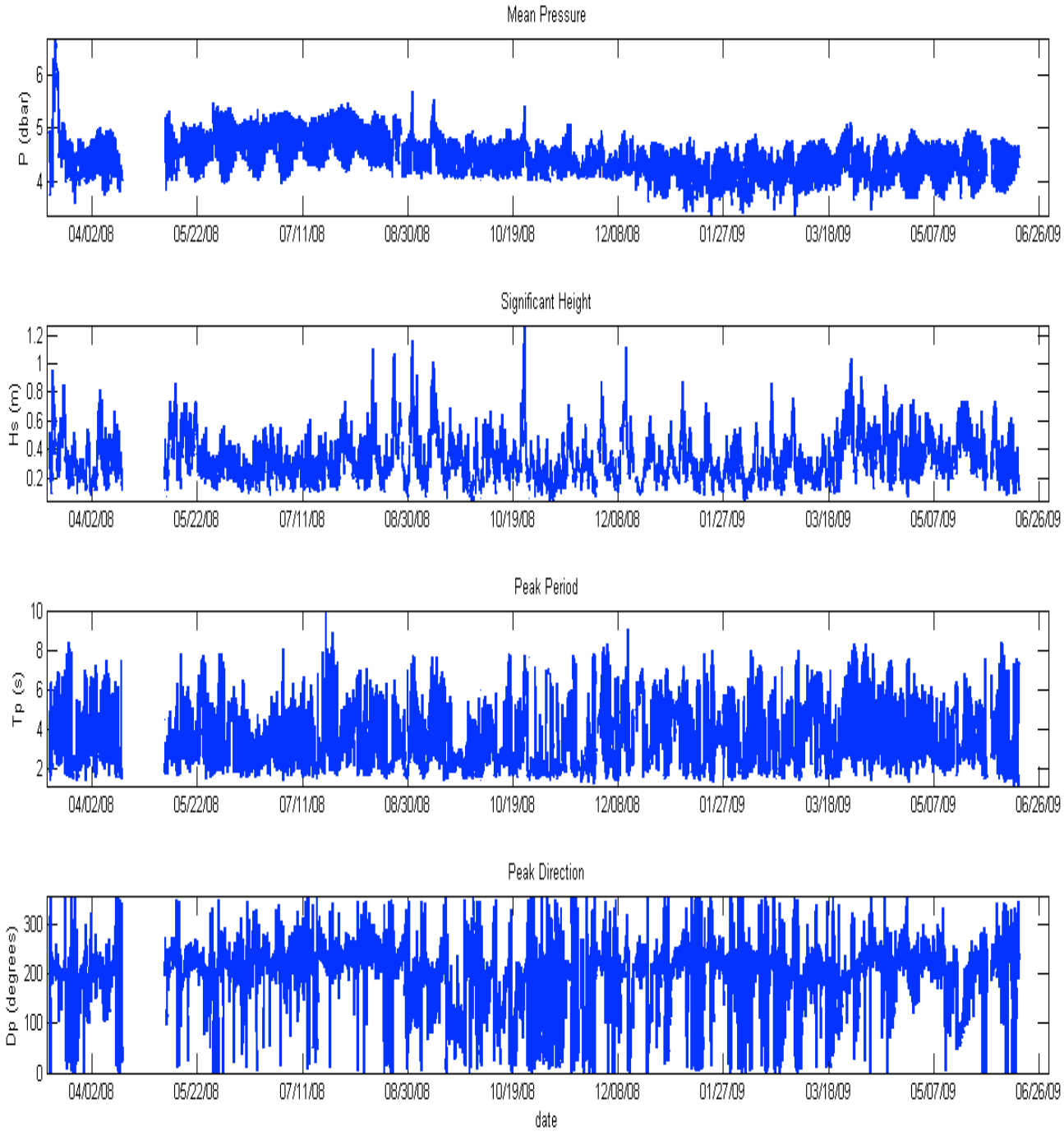




Top: Site A Nortek AWAC progressive vector diagram of Top and Bottom Currents March 2008 – June 2009.
Bottom: Site A Nortek AWAC East/West Current Velocities March 2008 - June 2009.

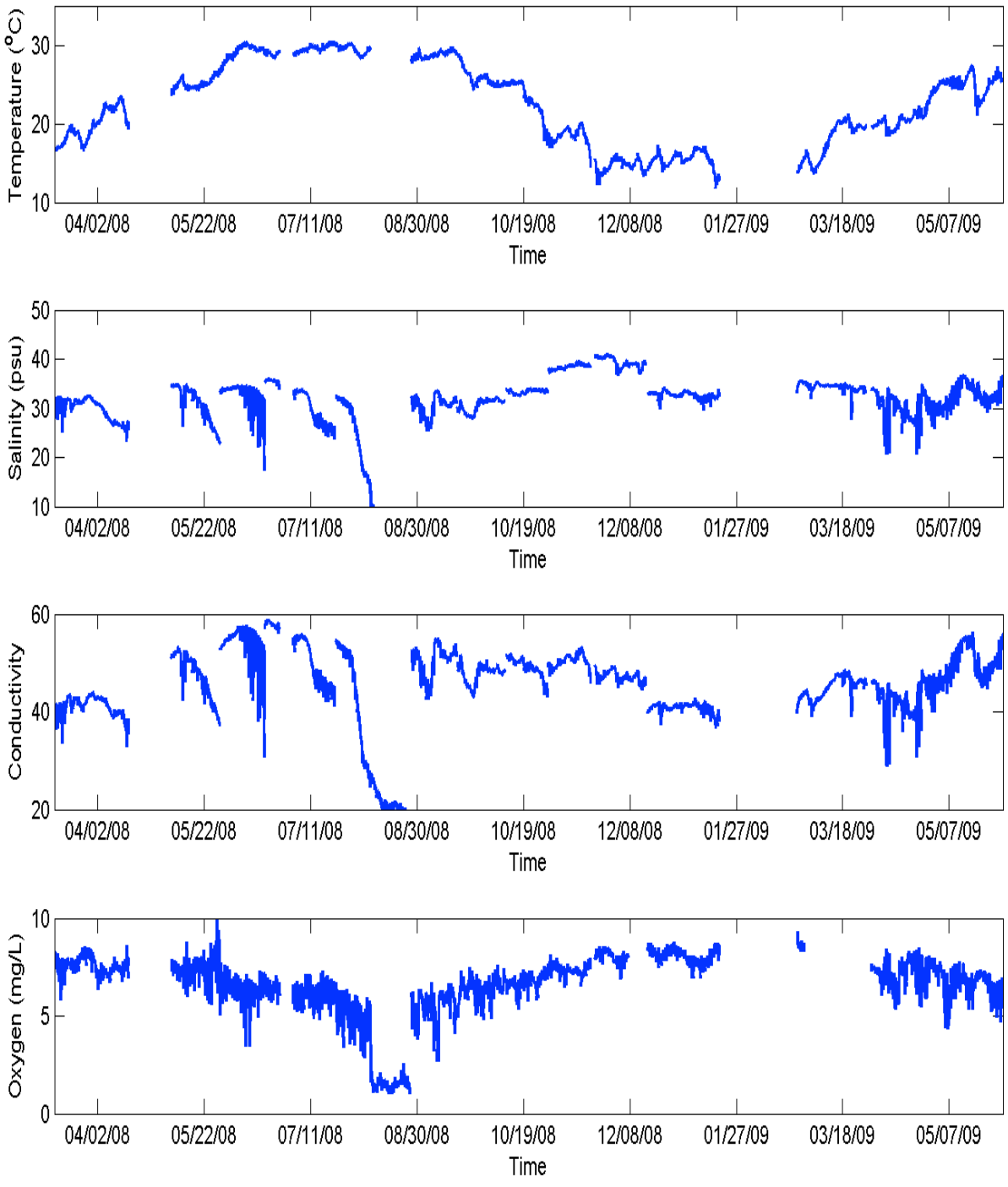


Site A Nortek AWAC East/West, North/South and Vertical Velocities March 2008 – June 2009.

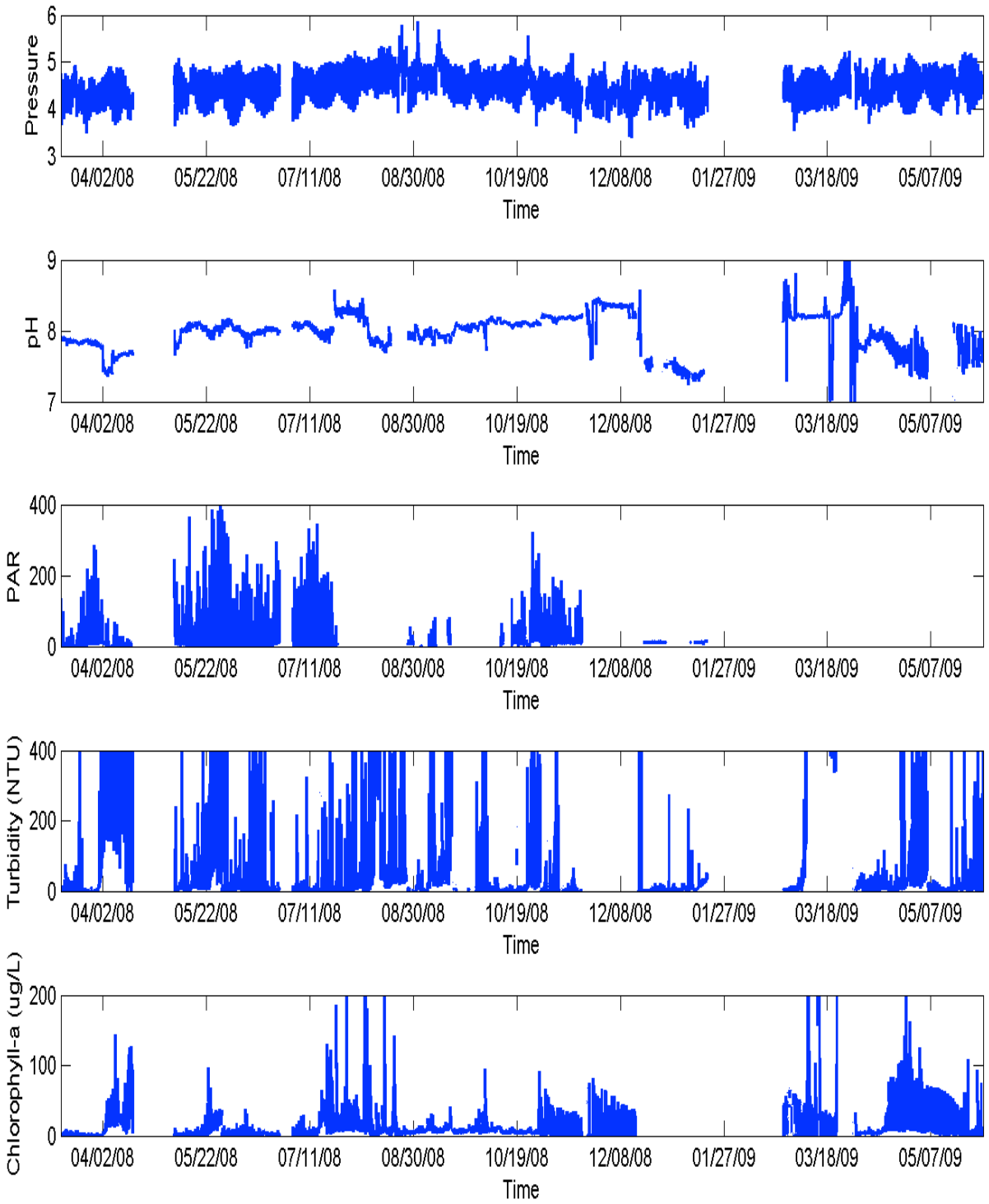


Site A Nortek AWAC wave results March 2007 – June 2009: Mean Pressure, Significant Wave Height, Peak Period, and Peak Direction.

b) Fixed Site A YSI Data Plots.

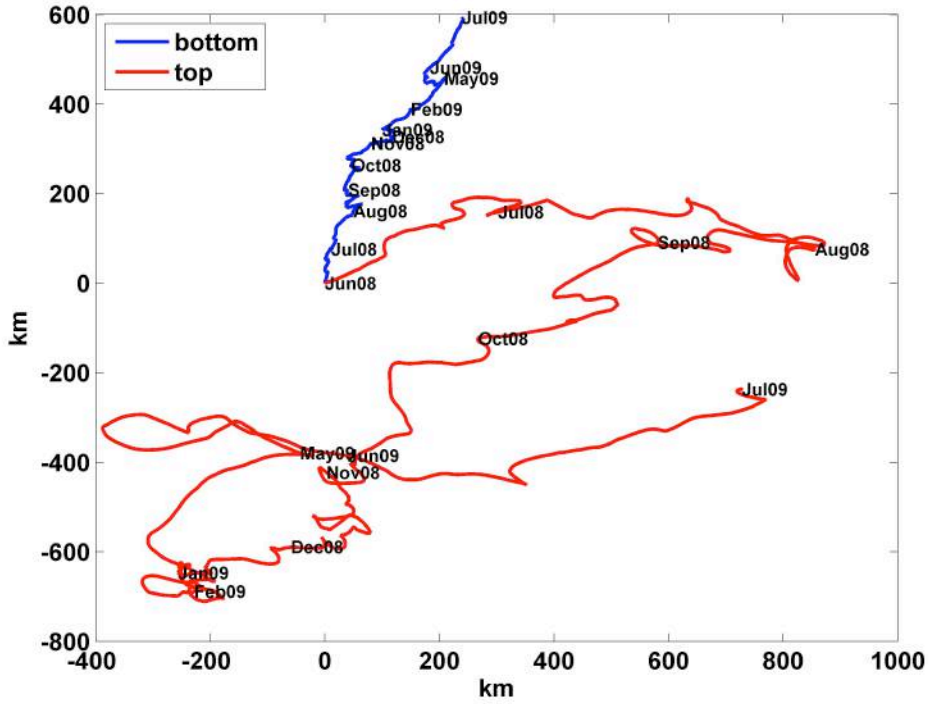


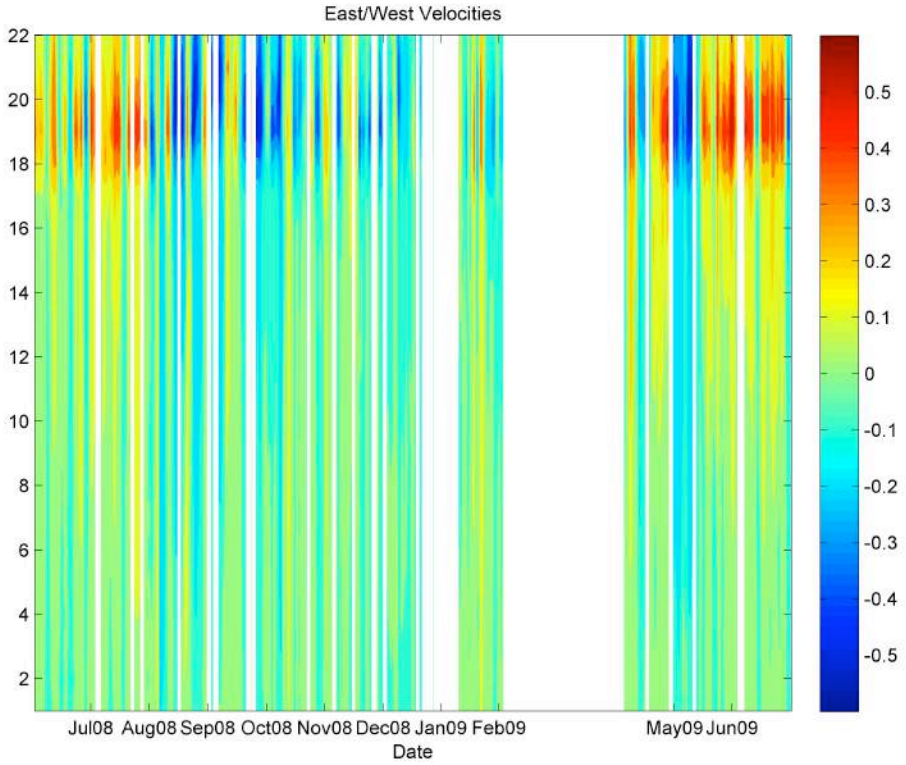
Site A YSI water quality parameters March 2008 – June 2009: Temperature, Salinity, Conductivity, and Oxygen.



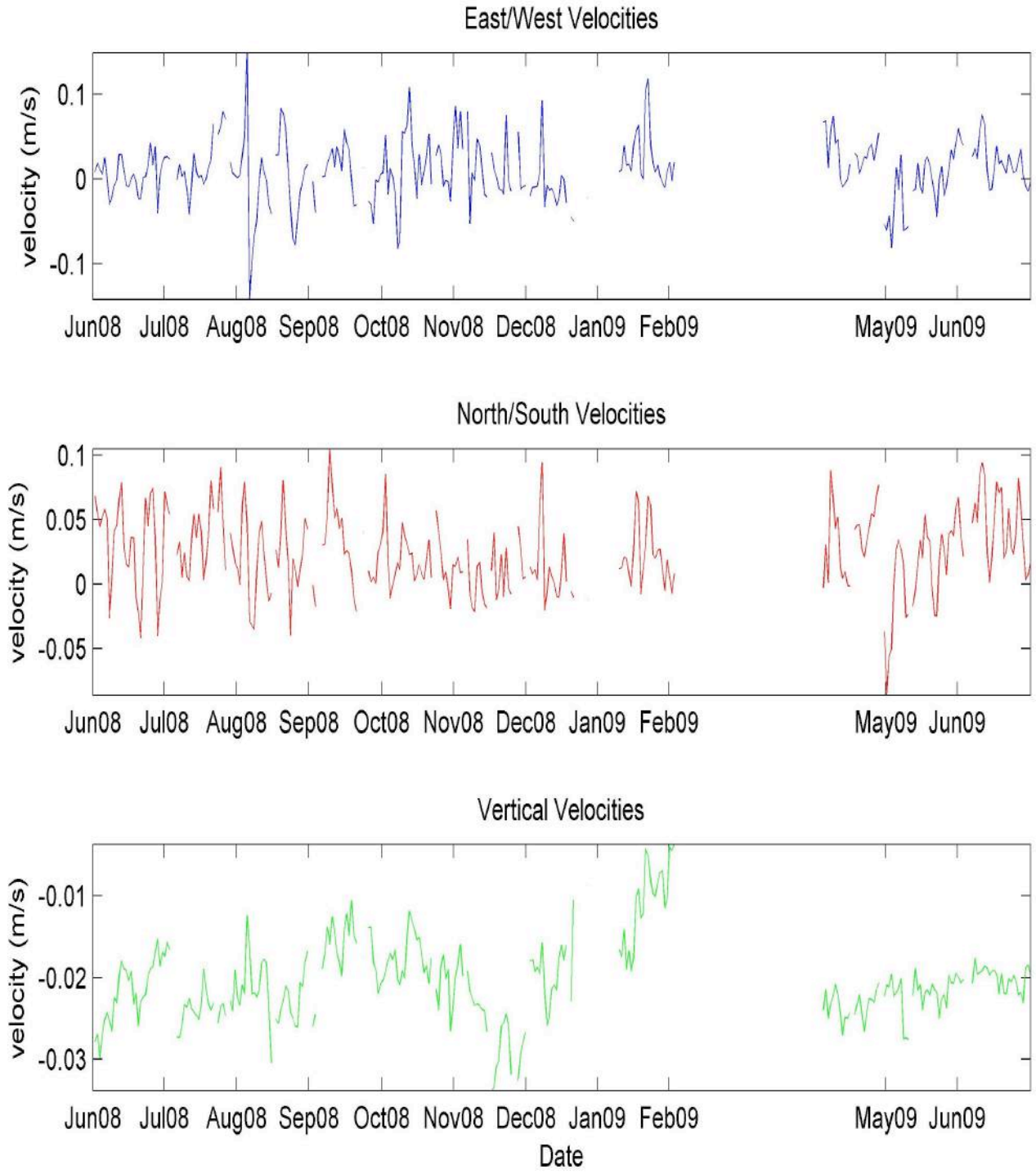
Site A YSI water quality parameters March 2008 – June 2009: Pressure, pH, PAR, Turbidity, and Chlorophyll.

c) Fixed Site B Nortek AWAC Data Plots.

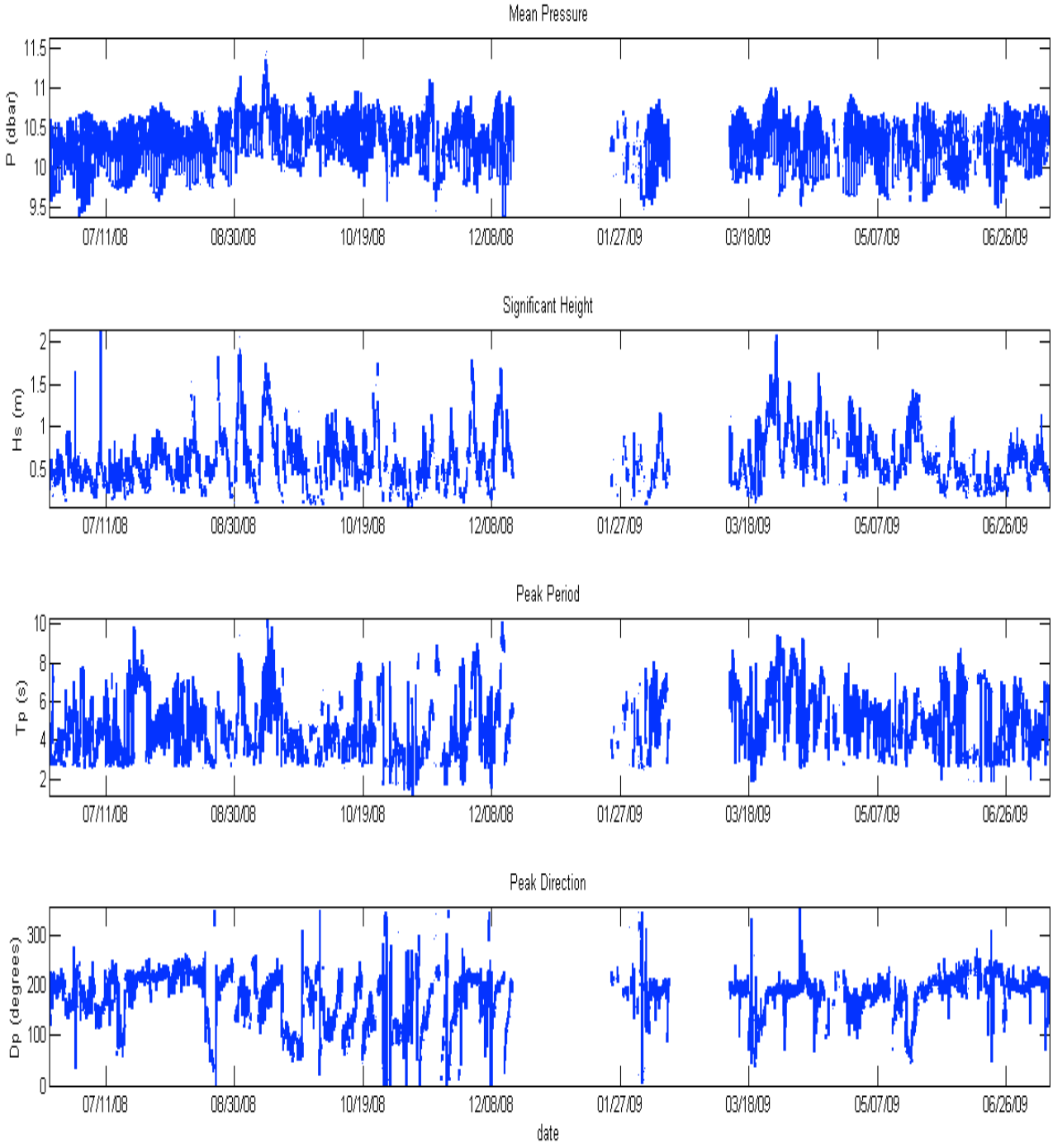




Top: Site B Nortek AWAC progressive vector diagram of Top and Bottom Currents June 2008 – July 2009.
Bottom: Site B Nortek AWAC East/West Current Velocities June 2008 - July 2009.

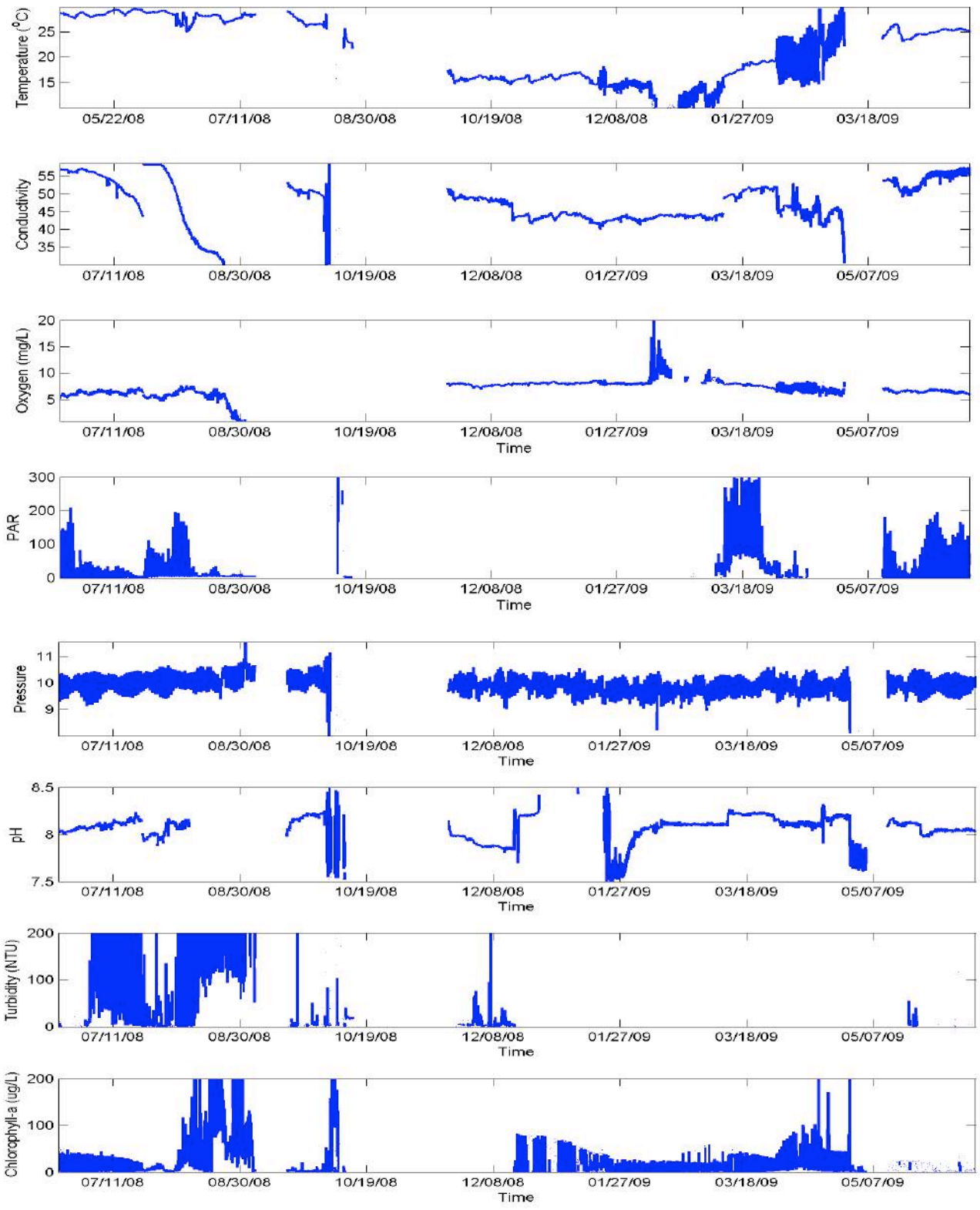


Site B Nortek AWAC East/West, North/South and Vertical Velocities June 2008 – July 2009.



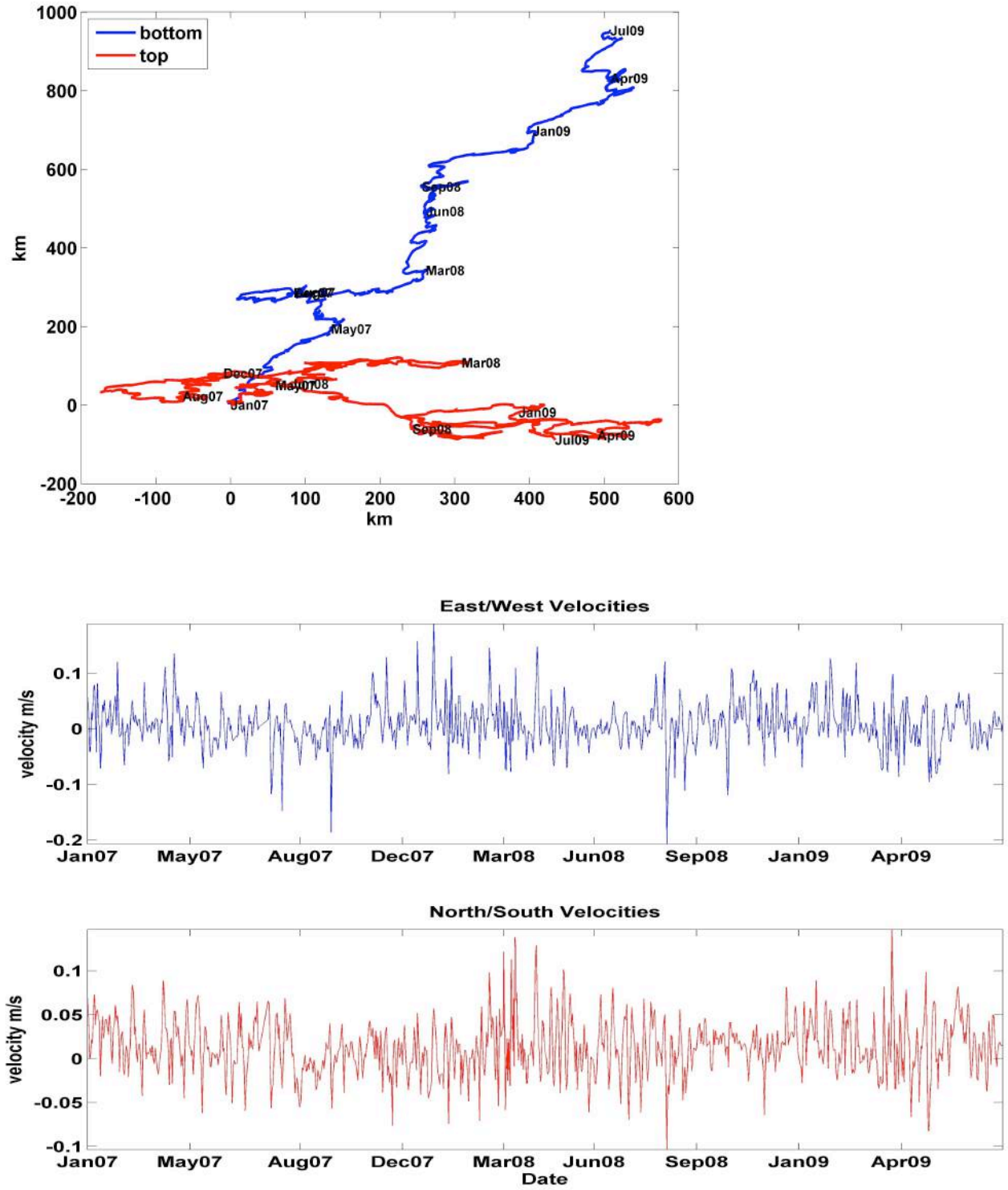
Site B Nortek AWAC wave results June 2008 – July 2009: Mean Pressure, Significant Wave Height, Peak Period, and Peak Direction.

d) Fixed Site B YSI Data Plots.

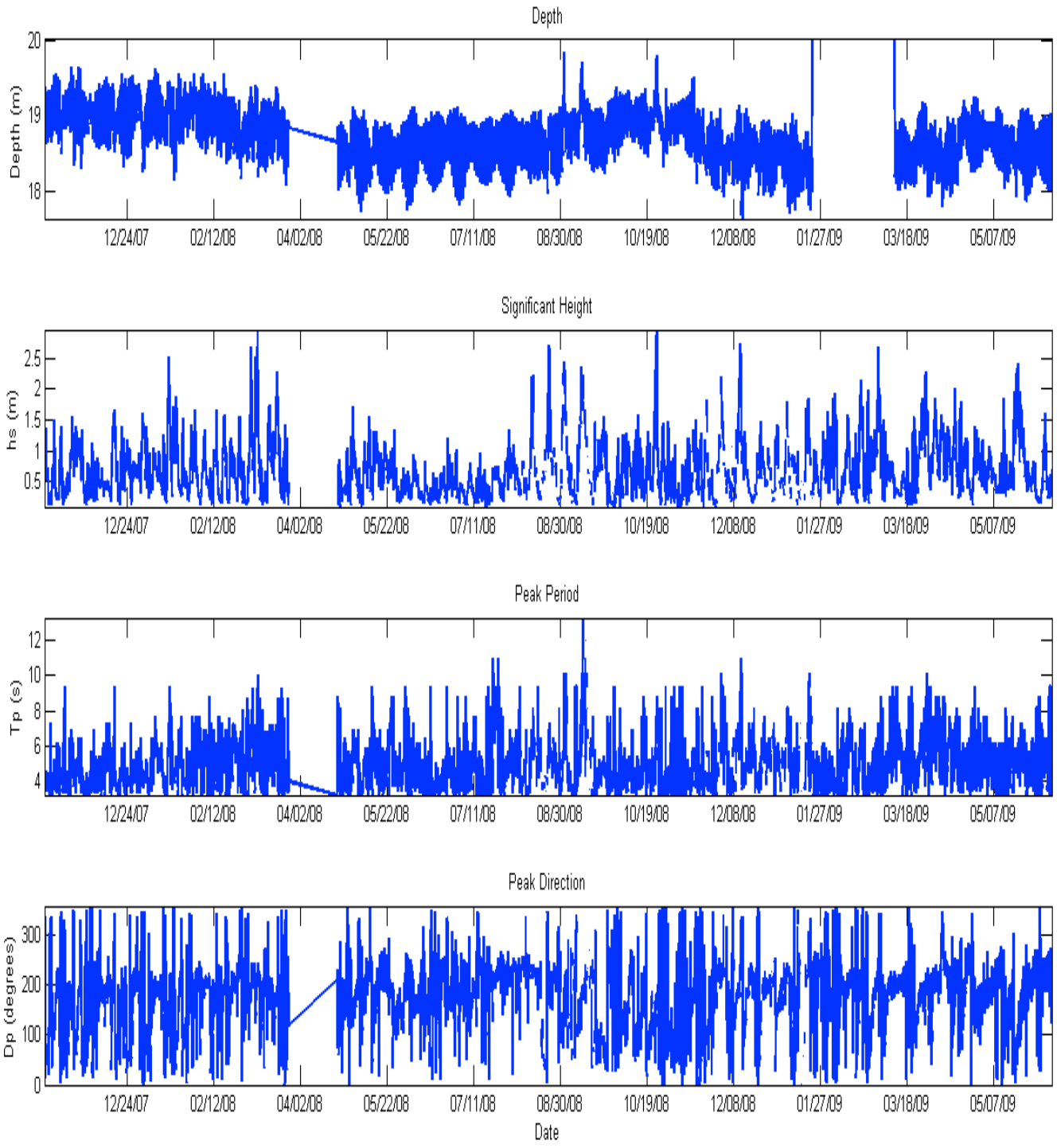


Site B YSI water quality parameters June 2008 – July 2009: Temperature, Conductivity, Oxygen, PAR, Pressure, pH, Turbidity, and Chlorophyll.

e) Fixed Site N7 RDI ADCP Data Plots.

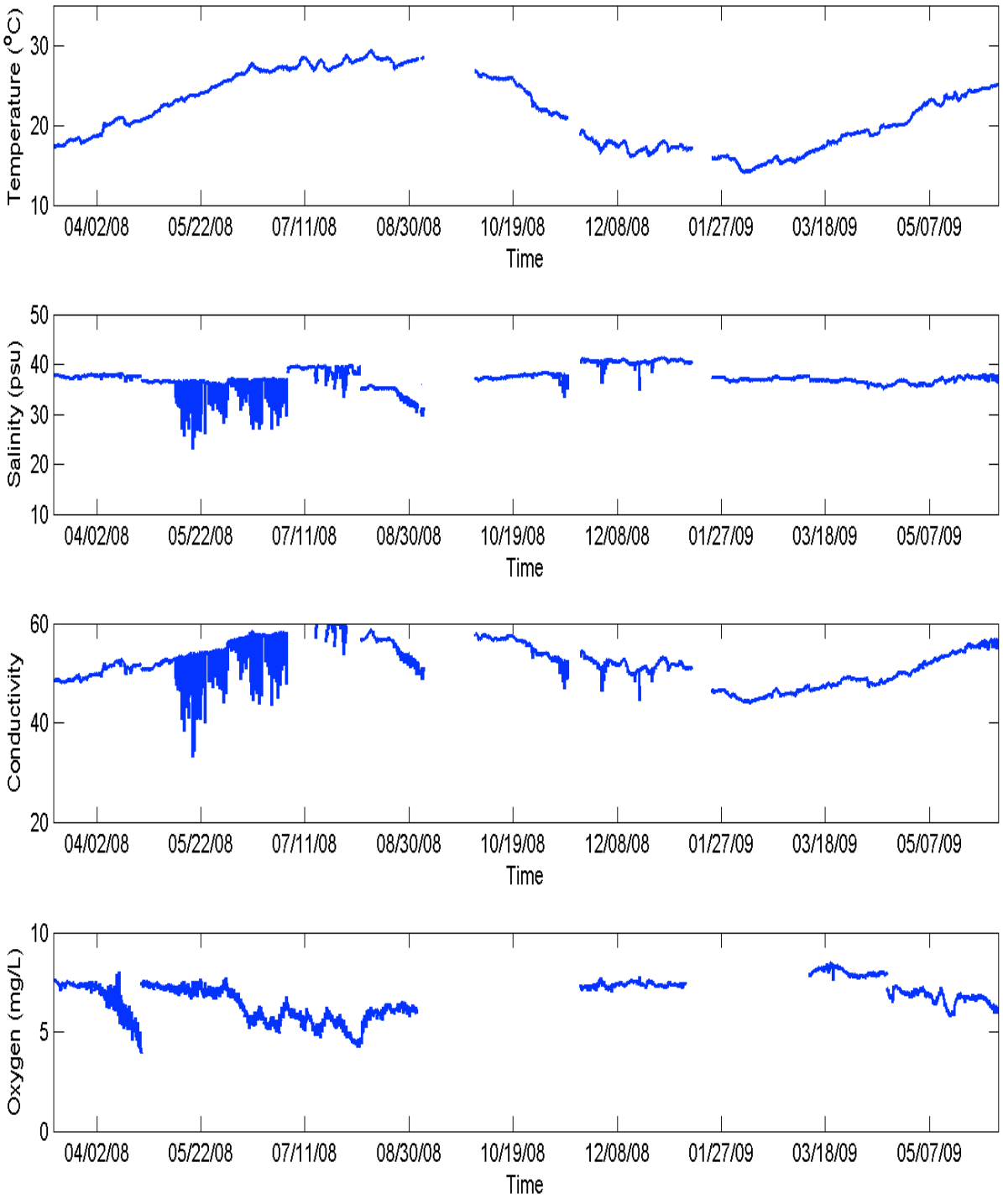


Top: Site N7 RDI ADCP Progressive vector diagram of Top and Bottom Currents January 2007 – July 2009.
Bottom: Site N7 RDI ADCP East/West and North/South Current Velocities January 2007 – June 2009.

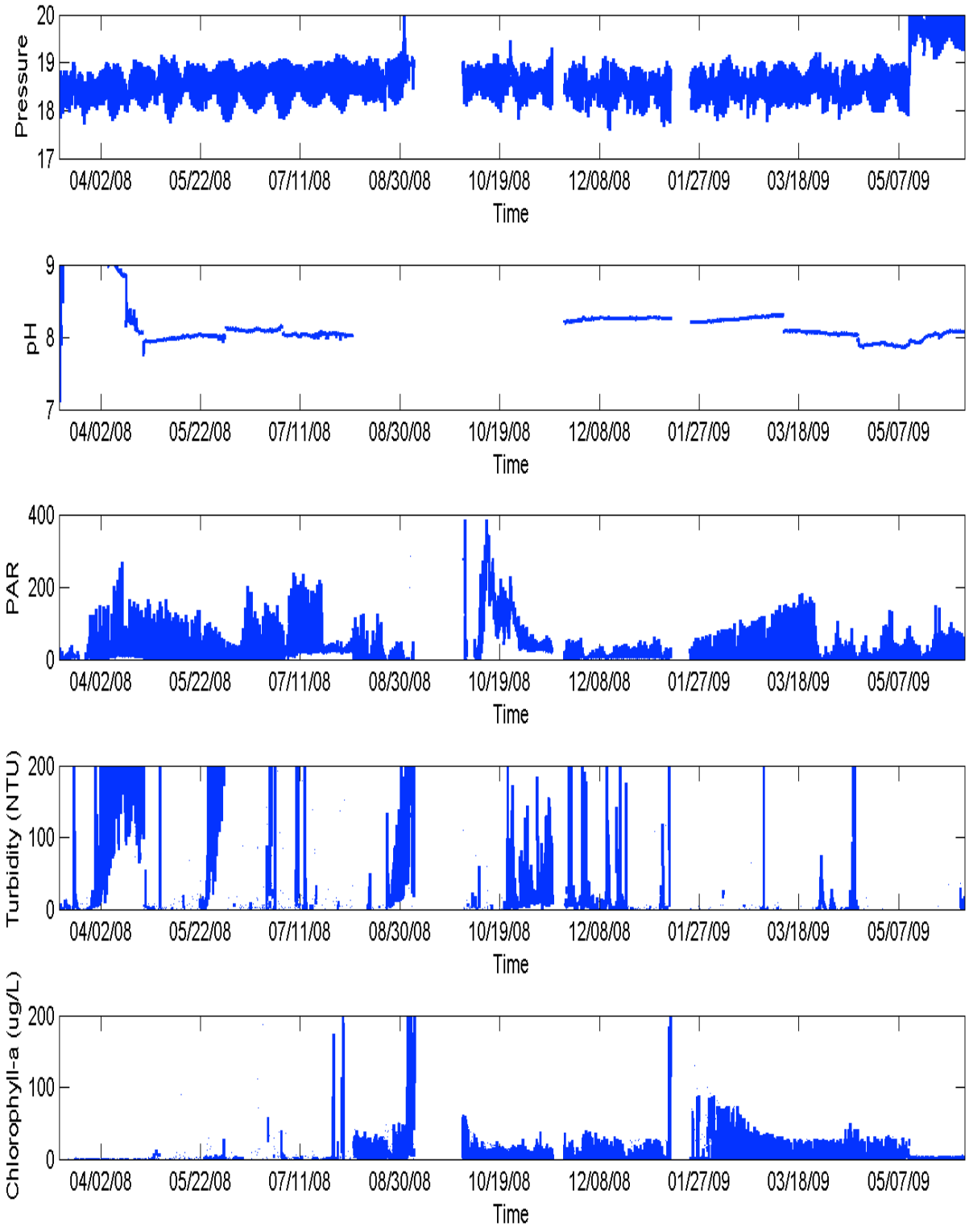


Site N7 RDI ADCP wave results November 2007 – June 2009: Depth, Significant Wave Height, Peak Period, and Peak Direction.

f) Fixed Site N7 YSI Data Plots.

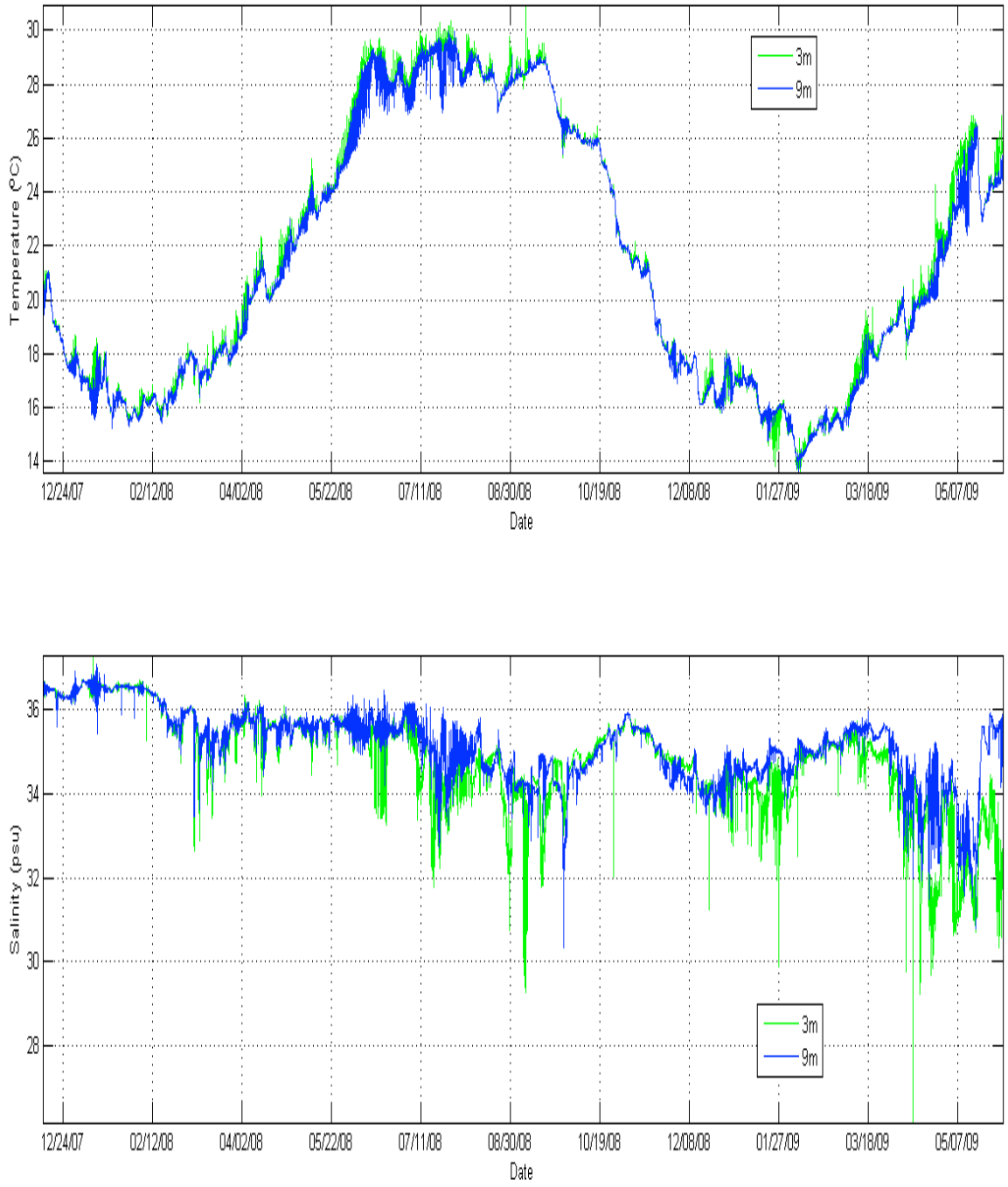


Site N7 YSI water quality parameters March 2008 – June 2009: Temperature, Salinity, Conductivity, and Oxygen.



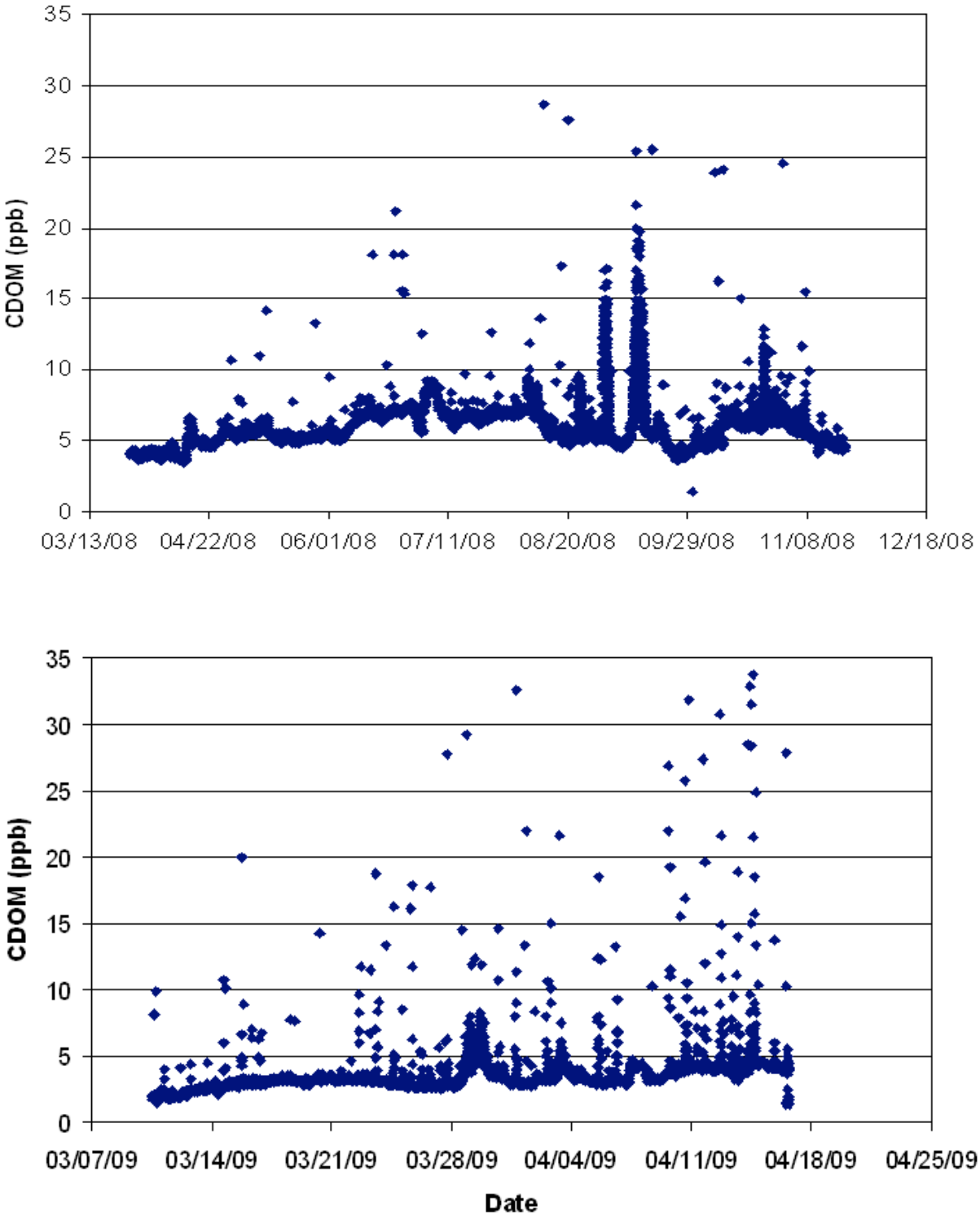
Site N7 YSI water quality parameters March 2008 – June 2009: Pressure, pH, PAR, Turbidity, and Chlorophyll.

g) Fixed Site N7 SBE16 Data Plots.



Site N7 SBE16 Temperature (top) and Salinity (bottom) at 3m and 9m from December 2007 – June 2009.

h) Fixed Site N7 CDOM Data Plots.



Site N7 CDOM results. Top: March 2008 – November 2008.
Bottom: March 2009 – April 2009.