Marine Field Group
Florida State University

Physical Observations from the Florida State University Northern Gulf Institute Program and the Gulf of Mexico Ocean Observing System November 2007 – April 2013

by
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Marine Field Group, FSU, FL 32306
April 2014

Technical Report

Funding was provided by NOAA, through NGI and a Subcontract from TAMU, to support the Gulf Coastal Ocean Observing System (GCOOS)

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Approved for Distribution:

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Abstract

This data report describes oceanographic data from sites near the coast in the Big Bend region of the Gulf of Mexico, collected by Florida State University during the periods of the Northern Gulf Institute (NGI) and the ongoing Gulf of Mexico Ocean Observing System (GCOOS) program. Monitoring instruments were deployed at four sites (A, B, N7 and Spring Creek), as well as hydrographic data from Transects 1 and 2. Variables include ocean stratification (temperature and conductivity), dissolved oxygen, pH, chlorophyll, photosynthetic active radiation, turbidity, colored dissolved organic matter, pressure, currents and wave parameters.

Front Cover Figure Caption: Picture of a diver replacing a CTD at observing site USAF Tower N7, formerly known as K-tower.

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1. NGI & GCOOS Project Summary and Purpose

The purpose of the Florida State University (FSU) component of Northern Gulf Institute (NGI hereafter) and Gulf of Mexico Ocean Observing System (GCOOS hereafter) is to provide observational support for an integrated ocean research program for the Northeast Gulf of Mexico (GoM hereafter). NOAA, via NGI, funded the initial installation and operation of the system during the preceding 4 years. Since June 2011, GCOOS has been funded by NOAA via a subcontract from Texas A&M University (TAMU).

The Big Bend region (BBR hereafter, see Figure 1.1) is characterized by the wide shallow shelf, bays, shallow sea grass beds, and deeper (10-50 m) sandy bottoms. Coastal runoff and ocean waters are linked both vertically and horizontally through physical transport processes. The intellectual merit objectives are to clarify (1) the basic onshore/offshore transport mechanisms of the BBR, and (2) the impact of these mechanisms on ecological parameters. This is accomplished through monitoring of meteorological variables, such as winds, air temperature, relative humidity and barometric pressure, as well as ocean variables, such as currents, wave parameters and temperature/salinity stratification. These data records serve to constrain coupled ocean-atmosphere models and provide a broader view of the regional transport dynamics.

Figure 1.1: Map showing the location of Florida's Big Bend Region.

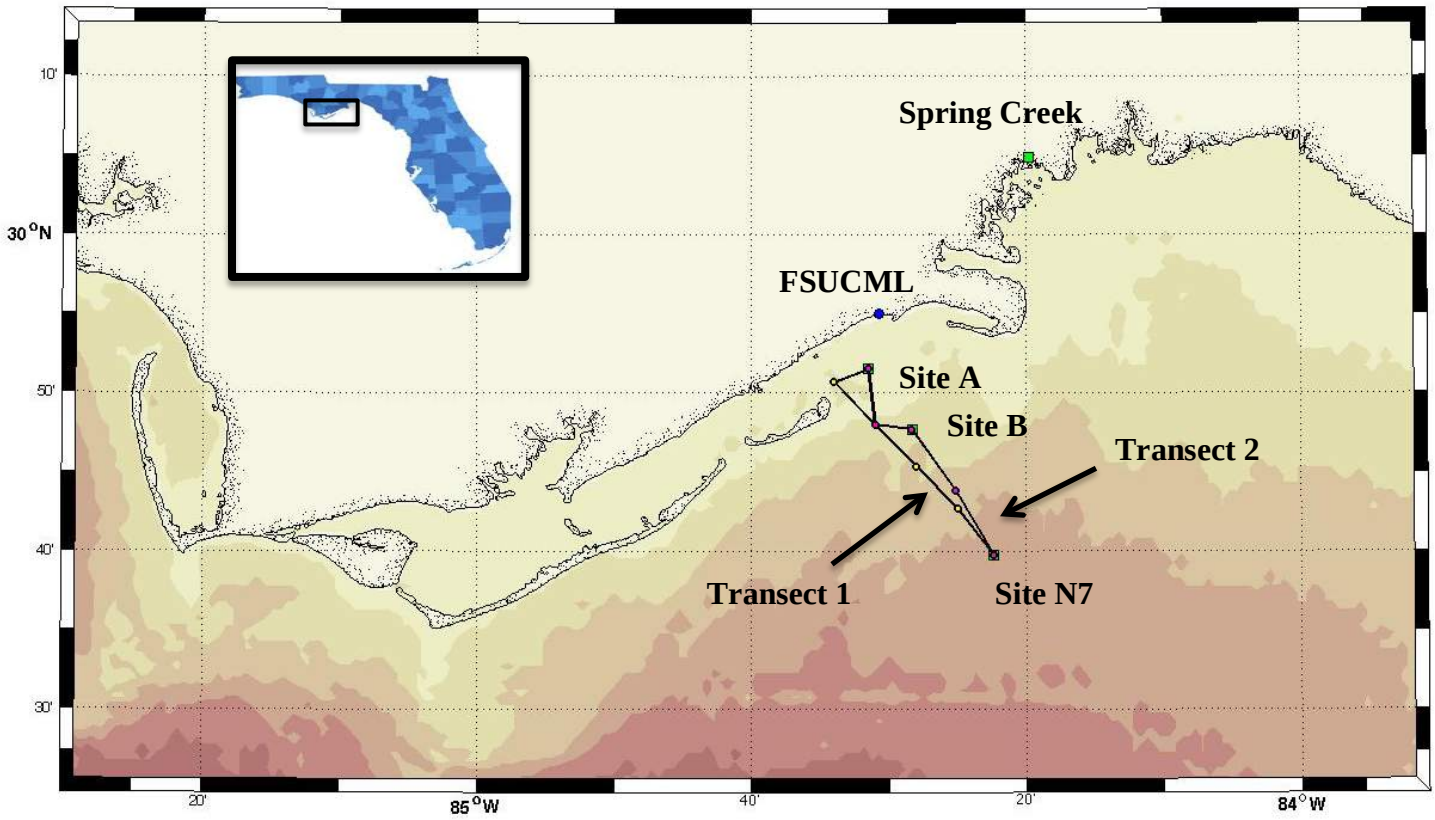
Two main factors are expected to influence the regional ecosystem in the years to come. The first is the natural variability of storms and surges, runoff, and sediment transport (e.g. sand bar evolution). The second is anthropogenic effects such as pollution (the BBR

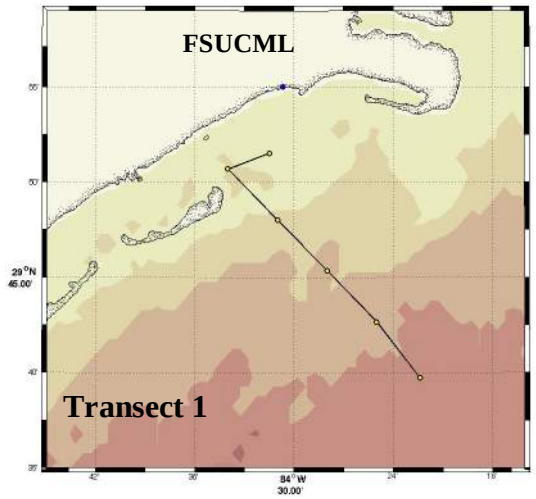
is home to Florida's only industrial-use river, the Fen Holloway), the Deep Horizon oil spill, and continuing coastal development. The details of the effects of the oil spill are not yet well known, beyond the initial toxic effect of the oil in marine coastal environments and sediment. Continued effects from subsurface oil plumes may impact the zone. Our project will probably have value in terms of the calibration of models of the larger scale circulation and dispersion of surface and shallow components in the near-coastal zone, and the inclusion of physical components such as waves that are at present not well represented in larger-scale models. Accelerated coastal development in this region is expected to lead to increases in nutrient concentrations in the coastal zone, promoting blooms and oxygen consumption.

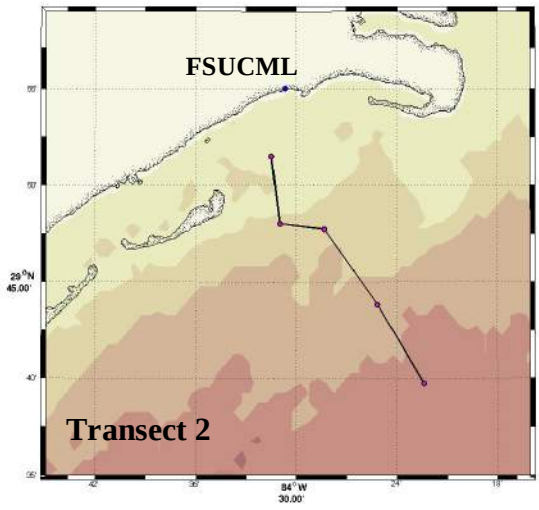
In the Northeastern GoM, shelf currents undergo seasonal changes as the net surface heat flux changes between cooling to warming (Morey, 1999). Wintertime horizontal stratification changes to summertime vertical stratification. While heat flux controls the seasonal transition, wind-driven ocean circulation largely controls the synoptic scale variability. The two processes are closely linked, as bottom topography and coastline geometry generate regions of convergence and divergence. Thus the large-scale current patterns, driven by the GoM loop current, temperature gradients and seasonal wind direction changes, combine with the local transport, caused by local winds, waves and tides. Shelf circulation and sea level variations are highly correlated with wind stress variations (Mitchum and Clarke 1986; Mitchum and Sturges 1982; Ohlmann and Niiler, 2005). Diurnal tidal energy is relatively uniform across the shelf, whereas semidiurnal tidal energy decreases in offshore direction. In our near-shore study region semidiurnal tides (M2 and S2) are therefore important, despite the fact that diurnal tidal constituents (K1 and O1) dominate transport in most of the GoM (Reid and Whitaker 1981). Internal tidal-induced bores exist and may lead to sediment re-suspension in particular areas (Johnson and Weidemann, 1998). Transport by Lagrangian drift is usually small compared to winds, but may play a significant role in certain times and places due to waves and tidal motions. Rivers contribute substantially to the local hydrography and influence biological and geochemical process in the NE GoM shelf.

2. Instruments, Sampling and Units

Within the scope of NGI and GCOOS, four mooring sites (A, B, N7 and Spring Creek; see Figure 2.1) were outfitted with various instruments (see Table 2.1 and Figure 2.2). In addition, hydrographic sections associated with three of the five sites (A, B and N7) were performed multiple times in the years spanning 2007-2011 (see Figure 2.1, Figure 2.2, and Table 2.2). Below is an overview of each instrument, including time step, units, time conventions used and factory calibration dates. The expected typical sensor accuracy is indicated for the ADCP's (RDI Workhorse and Nortek AWAC). Additionally, the RDI Workhorse and Nortek AWAC were deployed in unison for one month at Site N7, to estimate errors (Figure 2.3). In order to estimate errors associated with the YSI 6600 temperature and salinity data, a SBE SeaCAT 19 was used in unison on approximately half of the hydrographic sections (Figure 2.4 and 2.5).







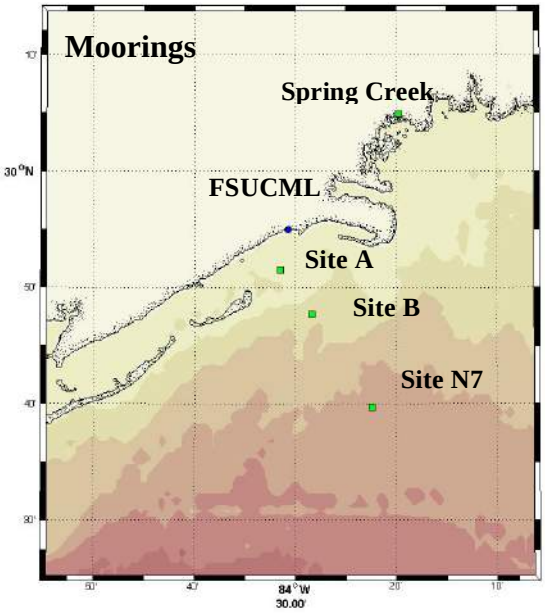


Figure 2.1: Map showing mooring locations, hydrographic sections and FSU Coastal Marine Lab (top), mooring locations (bottom right), transect 1 (middle left) and transect 2 (bottom left). Moorings are denoted by green squares, FSU Coastal Marine Lab by a blue circle, transect 1 by yellow circles, and transect 2 by magenta circles. Bathymetric contours are given every 5 meters.

Typical errors in temperature, salinity and dissolved oxygen from the SBE SeaCAT's (16, 16plus and 19) are estimated to be 0.01˚C, 0.01psu and 0.03ml/L respectively. These are conservative estimates, based on factory calibration data and bio-fouling. In this region, bio-fouling is rapid and difficult to control over long deployment periods. Investigators need to analyze the portions of the dataset they are using carefully, paying special attention to instrument location, to asses errors during that period. A qualitative estimate of bio-fouling conditions is stated for each site in section 3. For further information regarding specific deployments the investigator is referred to the following reports: White et al. (2009) and (2011), and Hancock & Speer (2013).

2.1 Nortek Acoustic Wave and Current Meter (AWAC)

The AWAC is designed as a coastal monitoring system, and measures current speed and direction in 1m thick layers from bottom to surface. Three transducers are used to measure currents (U, V and W) every 15 minutes. A fourth transducer, vertically oriented to track the surface acoustically, records vertical distance (Z) at 1Hz/2Hz for 10/15 minutes of every hour. This allows for an accurate measure of both long and short waves. The vertical distance along with pressure and orbital velocities are then analyzed to give: significant wave height, maximum wave height, peak period and peak direction. Water velocity accuracy is ±0.5cm/s, current profile Doppler uncertainty is 0.5-1cm/s, and wave Doppler uncertainty is 2.7cm/s at 1 Hz for 1m cells. The AWAC was calibrated April 2008. Velocities are given in m/s, vertical distance in meters, significant and maximum wave height in meters, peak period in seconds, peak direction in degrees from north and pressure in dBars. Time is recorded as Greenwich Mean Time.

2.2 Teledyne RD Instruments Workhorse Sentinel

The RDI Workhorse Sentinel is a high-frequency Acoustic Doppler Current Profiler (ADCP), able to measure current speed and direction in 1m thick layers from bottom to surface. Four transducers are used to measure currents (U, V and W) every 15/20 minutes. Due to poor vertical resolution in shallow water, all 1m bins were averaged into three bins spanning the entire water column: surface, middle and bottom. Each of the new bins has a thickness of approximately 4-5m. Hourly averaged wave data is calculated from recorded U and V. In addition, the Workhorse Sentinel has a pressure gauge, recording hourly bottom pressures. Water velocity accuracy is ±0.5cm/s. To estimate wave statistic errors, an RDI Workhorse and Nortek AWAC were deployed in unison for 1 month at site N7. Figure 2.3 shows the offset at each time step, as well as the mean offset. For average wave statistics, the Workhorse and AWAC show good agreement. Velocities are given in m/s, significant wave height in meters, peak period in seconds, peak direction in degrees from north, and pressure in dBars. Time is recorded as Greenwich Mean Time.

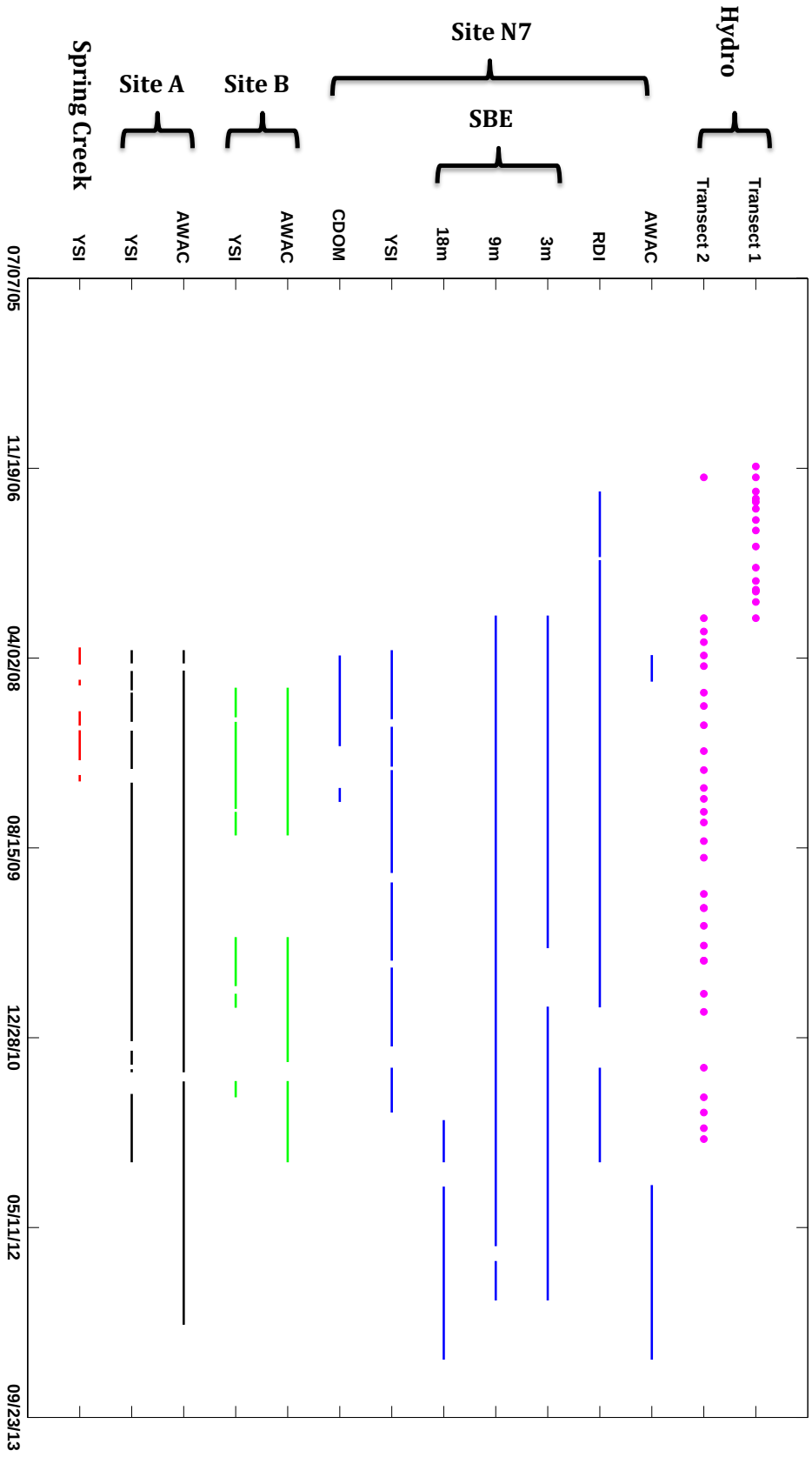


Figure 2.2: Overview of moored instruments at Site N7, A, B and Spring Creek, as well as hydrographic transects, from November 2007 – April 2013, associated with NGI and GCOOS. See Sections 2.1 – 2.8 for details on each instrument and Section 8 for details on hydrographic transects.

2.3 Sea-Bird Electronics (SBE) 16 SeaCAT

The SBE 16 measures temperature and conductivity every 15 minutes at predetermined levels, 3m and 9m. Each is outfitted with an expendable anti-foulant device. Factory calibration dates for each of the SBE 16's can be found in Table 2.3. Typical errors in temperature and salinity are 0.01˚C and 0.01 psu respectively. Temperature is given in degrees Celcius and conductivity in mS/cm. Time is recorded as Greenwich Mean Time.

2.4 Sea-Bird Electronics (SBE) 16plus SeaCAT, outfitted with a Sea-Bird (SBE) 43 Dissolved Oxygen Sensor

The SBE 16plus, outfitted with a SBE 43, measures temperature, conductivity, pressure, and dissolved oxygen every 15 minutes. For maximum bio-fouling protection, the SBE 16plus has both an expendable anti-foulant device as well as a pump. SBE 16plus was factory calibrated 15th of May 2010. Typical errors in temperature, salinity and dissolved oxygen are 0.01˚C, 0.01 psu and 0.03 ml/L respectively. Temperature is given in degrees Celcius, conductivity in mS/cm, pressure in dBars and dissolved oxygen in ml/L. Time is recorded as Greenwich Mean Time.

Table 2.1: Mooring Locations

Mooring	Latitude	Longitude	Depth (m)
Site A	29.85833	-84.525	5
Site B	29.795	-84.47167	10
Site N7	29.6619	-84.3731	18
Spring Creek	30.08169	-84.32942	0.5

Table 2.2: Hydrographic Station Locations

Hydrographic Stations	Latitude	Longitude	Depth
Transect 1			
0	29.85833	-84.525	5
1	29.8445	-84.56667	5
2	29.8	-84.51667	5
3	29.75567	-84.46667	10
4	29.71117	-84.41667	15
5	29.66667	-84.36667	18
Transect 2			
1	29.85833	-84.525	5
2	29.8	-84.51667	5
3	29.7945	-84.47217	10
4	29.73	-84.41917	15
5	29.665	-84.3715	18

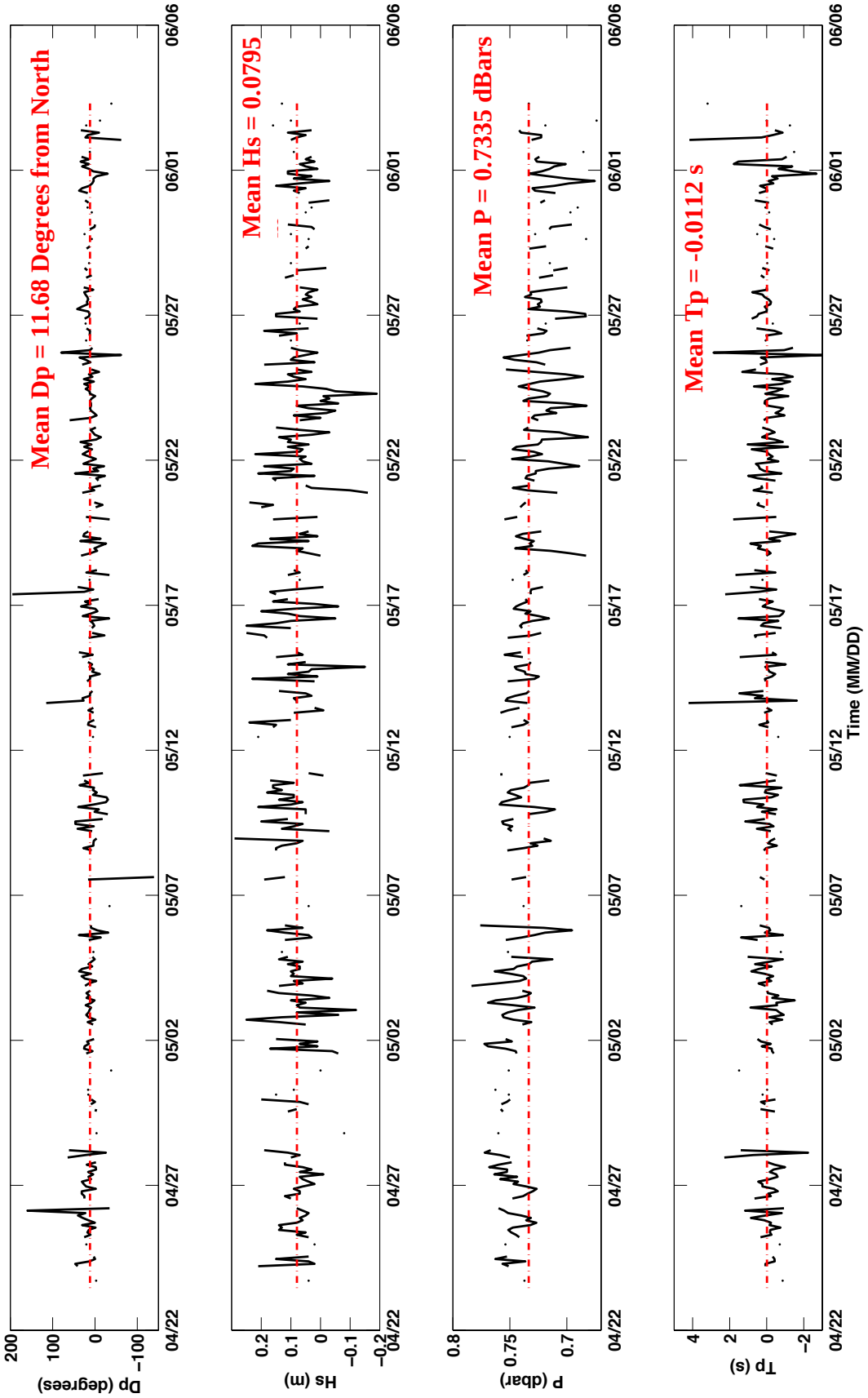


Figure 2.3: Offsets between Nortek AWAC and RDI Workhorse wave statistics, Peak Direction (top), Significant Wave Height (2nd), Pressure (3rd) and Peak Period (bottom).

Table 2.3: Factory calibration dates for the four SBE 16's, given in MM/DD/YYYY.

1980	1982	1984	1986
9/8/1995	9/8/1995	9/8/1995	9/8/1995
11/27/1996	11/27/1996	6/22/2007	6/21/2007
4/26/1997	4/26/1997	7/25/2009	11/19/2013
6/22/2007	6/22/2007	11/30/2010	
7/18/2009	11/30/2010	7/19/2013	

2.5 Sea-Bird Electronics (SBE) 19 SeaCAT

The SBE 19 measures temperature, conductivity and pressure at a frequency of 2 Hz. It is outfitted with a pump-controlled, TC-ducted flow configuration to minimize salinity spiking caused by ship heave. This also allows for slower decent rates and resolved small-scale structure in the water column. SBE 19 was factory calibrated 27th September 2005, 5th October 2007, and 2nd June 2009. Typical errors in temperature and salinity are estimated in the range of 0.01˚C and 0.01 psu, respectively. Temperature is given in degrees Celcius, conductivity in S/m and pressure in dBars. Time is recorded as Eastern Standard Time.

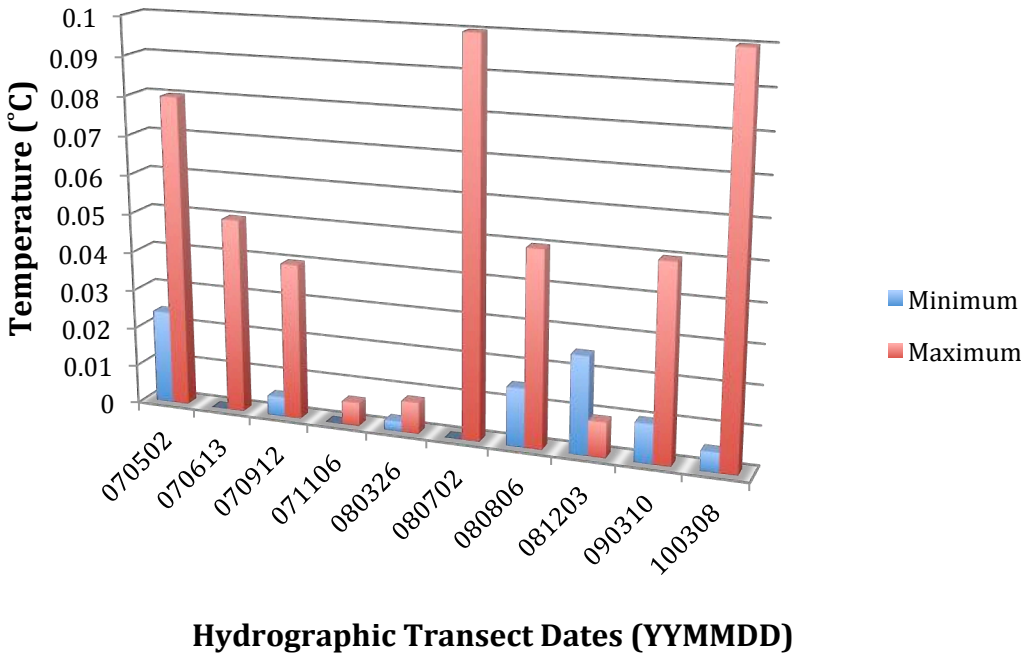


Figure 2.4: Minimum and maximum temperature offsets (˚C) between SBE 19 and YSI 6600 sensors, during hydrographic data collection along transects 1 and 2 (dates given as YYMMDD).

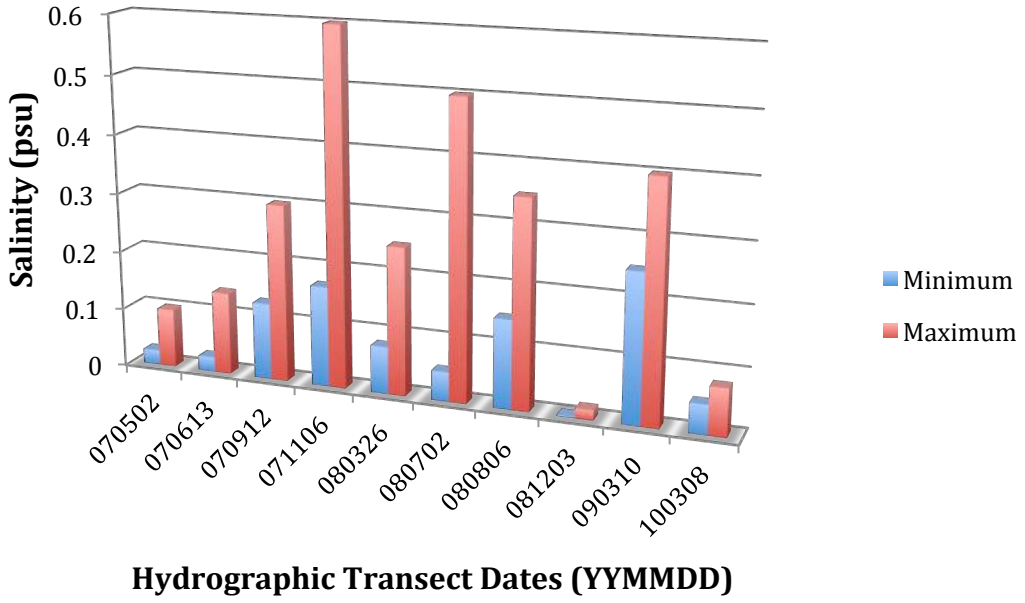


Figure 2.5: Minimum and maximum salinity offsets (psu) between SBE 19 and YSI 6600 sensors, during hydrographic data collection along transects 1 and 2 (dates given as YYMMDD).

2.6 YSI 6600 Multi-parameter Extended Deployment Sonde

The YSI is a comprehensive water quality monitoring device, measuring temperature, conductivity, depth, pH, dissolved oxygen, turbidity, chlorophyll, total dissolved solids and photosynthetic active radiation every 15 minutes. YSI 6600 was calibrated in house before each deployment. To estimate temperature and salinity errors, the YSI and SBE 19 were deployed in unison on some transects. Figure 2.4 and 2.5 display minimum and maximum temperature and salinity offsets in each of these hydrographic transects. It is evident that YSI calibration accuracy greatly influences data errors, which should be kept in mind when using YSI data. Temperature is given in degrees Celcius, conductivity in mS/cm, depth in meters, dissolved oxygen in ml/L, turbidity in Nephelometric Turbidity Units, chlorophyll in ug/L and total dissolved solids in g/L. Time is recorded as Greenwich Mean Time at mooring stations and Eastern Standard Time on hydrographic transects.

2.7 Wet Labs Colored Dissolved Organic Matter (CDOM) Environmental Characterization Optics (ECO) Fluorometer (FL)

The CDOM ECO FL measures CDOM fluorescence ever hour, where measurements are given in part per billion (ppb). Sensor sensitivity is 0.09 ppb. Time is recorded as Greenwich Mean Time.

3. Site A

Site A is located near the Intracoastal Waterway at the end of the FSUCML channel approximately 3nm from the shoreline (Figure 2.1). It is approximately 5 m deep, and is surrounded by areas of dense sea grass (Lanark Reef, Dog Island Reef and Turkey Point Shoal). To the west it is bordered by Apalachicola Bay and to the east by Alligator Harbor. The sediment is a mud/sand mixture, with typical water visibility of 1 foot or less. This site experiences extreme bio-fouling, requiring substantial instrument servicing.

Instruments deployed at this site were a multi-parameter YSI 6600 EDS and a Nortek Acoustic Wave and Current Meter (AWAC). Variables recorded were temperature, salinity, dissolved oxygen, chlorophyll, pressure, pH, turbidity, photosynthetic active radiation, total dissolved solids, currents and wave parameters. Time is recorded as Greenwich Mean Time. See Figures 3.1 and 3.2, and Tables 3.1 and 3.2 for details on data retrieval.

Table 3.1: Wave and current data collected from all AWAC deployments at Site A. Dates are given as yymmdd.

Collected Data
080312-080416
080505-080619
080619-090601
090602-101102
101107-110329
110421-120326
120323-120412
120524-120724

Table 3.2: Variables collected from all YSI deployments at Site A. The variables are as follows: T = Temperature, S = Salinity, Chl = Chlorophyll, TDS = Total Dissolved Solids, PAR = Photosynthetic Active Radiation, pH = Water Acidity, Turb. = Turbidity. Red boxes indicate no data and 'X' indicates data collected. Dates are given as yymmdd.

Variable/Deployment	T	S	Chl	DO	TDS	PAR	pH	Turb.
080312-080416	X	X	X	X	X	X	X	X
080506-080509	X	X	X	X	X	X	X	X
080529-080619	X	X	X	X	X	X	X	X
080619-080628	X	X	X	X	X	X	X	X
080702-080722	X	X	X	X	X	X	X	X
080722-080826	X	X	X	X	X	X	X	X
080826-080917	X	X	X	X	X	X	X	X
081010-081030	X	X	X	X	X	X	X	X
081030-081119	X	X	X	X		X	X	X
081121-081215	X	X	X	X	X		X	X
081216-090119	X	X		X	X	X	X	X
090224-090329	X	X	X	X	X		X	X
090331-090505	X	X	X	X	X		X	X
090505-090601	X	X	X	X	X		X	X
090603-090630	X	X	X	X	X		X	X
090630-090804	X	X	X	X	X		X	X
090804-090903	X	X	X	X		X	X	X
090903-091006	X	X	X	X		X	X	X
091006-091026	X	X	X	X		X	X	X
091026-091124	X	X	X	X		X	X	X
091124-091216	X	X	X	X		X	X	X
091216-100127	X	X	X	X		X	X	X
100127-100226	X	X	X	X		X	X	X
100226-100324	X	X	X	X		X	X	X
100325-100422	X	X	X	X		X	X	X
100422-100517	X	X	X	X		X	X	X
100517-100715	X	X	X	X		X	X	X
100717-100825	X	X	X	X		X	X	X
100825-101013	X	X	X	X		X	X	X
101013-101108	X	X	X	X			X	X
101108-110106	X	X	X	X		X	X	X
110131-110309	X	X		X		X	X	X
110321-110329	X	X	X	X			X	X
110525-110713	X	X	X	X		X	X	X
110713-110812	X	X	X	X		X	X	X
110812-110928	X	X	X	X		X	X	X
110928-111101	X	X	X	X		X	X	X

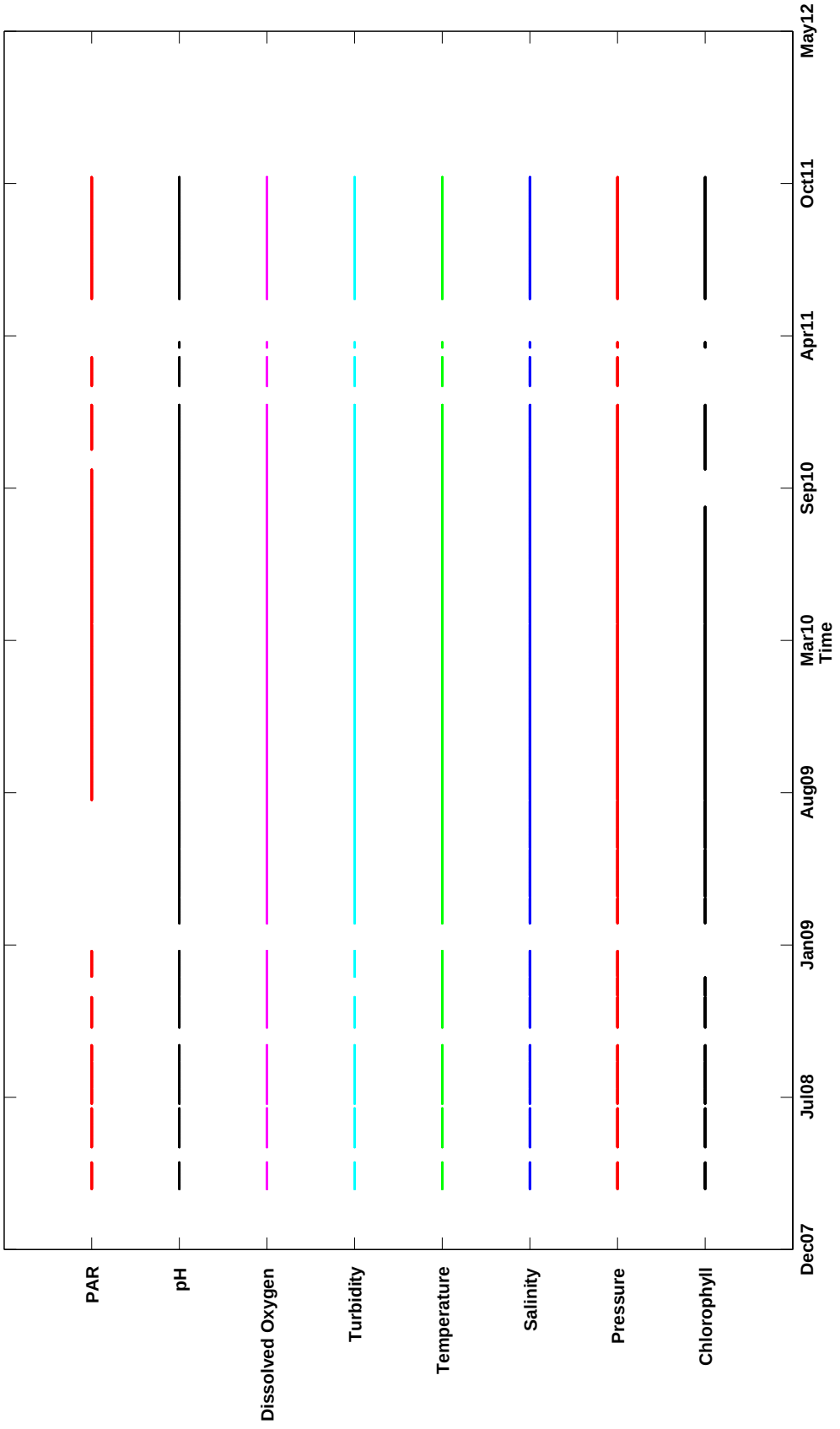


Figure 3.1: Timeline of each variable from YSI 6600 EDS at Site A.

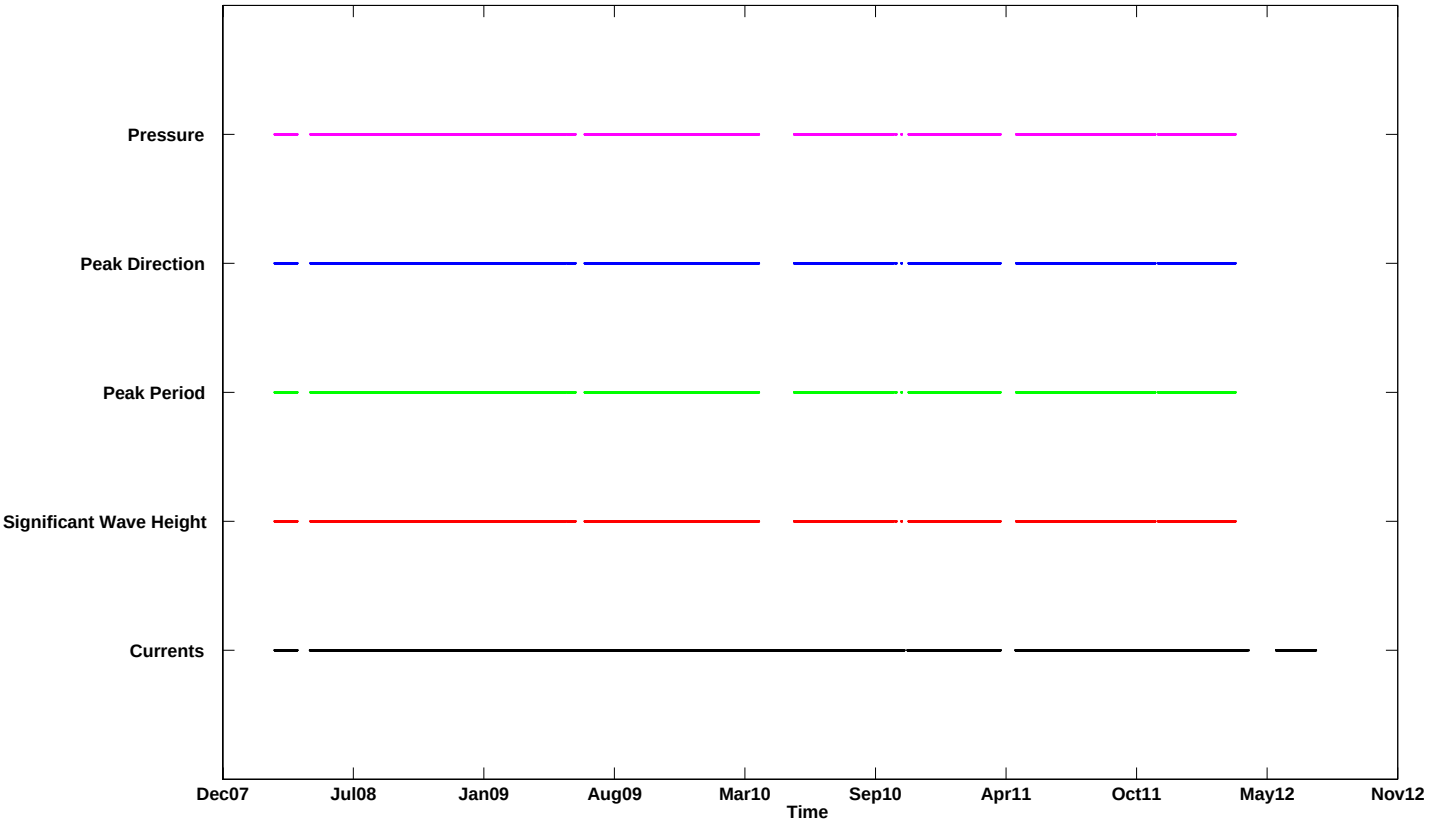


Figure 3.2: Timeline of each variable from AWAC at Site A.

4. Site B

Site B is located just offshore Dog Island Reef, along the 10 m isobaths (Figure 2.1). The sediment is mainly sand with patches of hard bottom reef. This site experiences minimal bio-fouling.

Table 4.1: Wave and current data collected from all AWAC deployments at Site B. Dates are given as yymmdd.

Collected Data
080619-090215
090310-090713
100406-110202
110421-110829
110822-111130

Instruments deployed at this site were a multi-parameter YSI 6600 EDS and a Nortek Acoustic Wave and Current Meter (AWAC). Variables recorded were temperature, salinity, dissolved oxygen, chlorophyll, pressure, pH, turbidity, photosynthetic active

radiation, total dissolved solids, currents and wave parameters. Time is recorded as Greenwich Mean Time. See Figures 4.1 and 4.2, and Tables 4.1 and 4.2 for details on data retrieval.

Table 4.2: Variables collected from all YSI deployments at Site B. The variables are as follows: T = Temperature, S = Salinity, Chl = Chlorophyll, TDS = Total Dissolved Solids, PAR = Photosynthetic Active Radiation, pH = Water Acidity, Turb. = Turbidity. Red boxes indicate no data and 'X' indicates data collected. Dates are given as yymmdd.

Variable/Deployment	T	S	Chl	DO	TDS	PAR	pH	Turb.
080619-080722	X	X	X	X	X	X	X	X
080722-080905	X	X	X	X	X	X	X	X
080917-081003	X	X	X		X	X	X	X
081010-081016	X	X	X		X	X	X	X
081120-081216	X	X		X	X	X	X	X
081216-090122	X	X	X	X	X		X	
090122-090310	X	X	X	X	X	X	X	
090310-090416	X	X	X	X		X	X	
090416-090503	X	X	X	X			X	
090512-090616	X	X	X	X		X	X	X
090617-090713	X	X	X	X		X	X	X
100407-100519	X	X	X	X		X	X	X
100519-100708	X	X	X	X		X	X	X
100708-100814	X	X	X	X		X	X	X
100903-101010	X	X	X	X		X	X	X
110421-110531	X	X	X	X		X	X	X

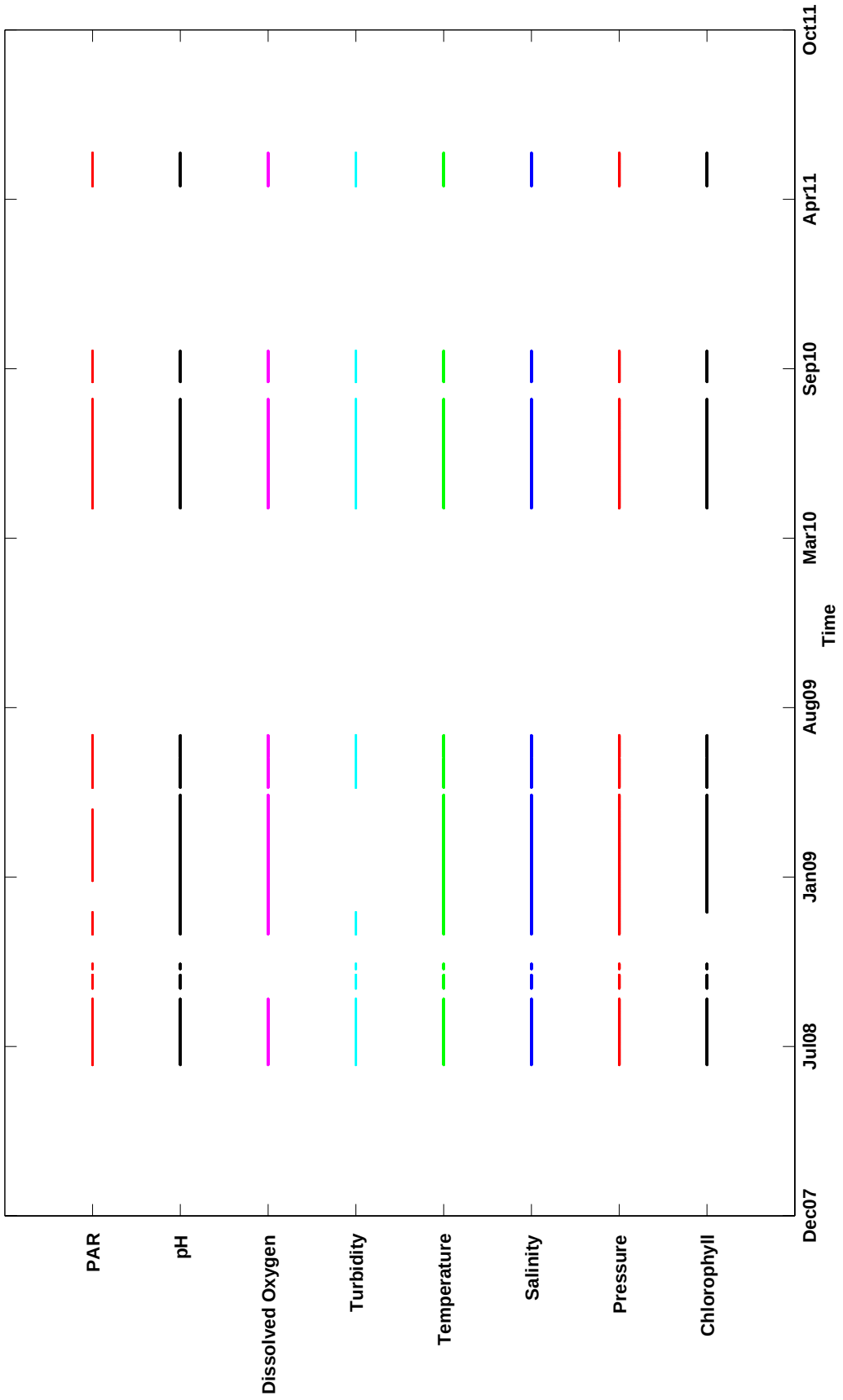


Figure 4.1: Timeline of each variable from YSI 6600 EDS at Site B.

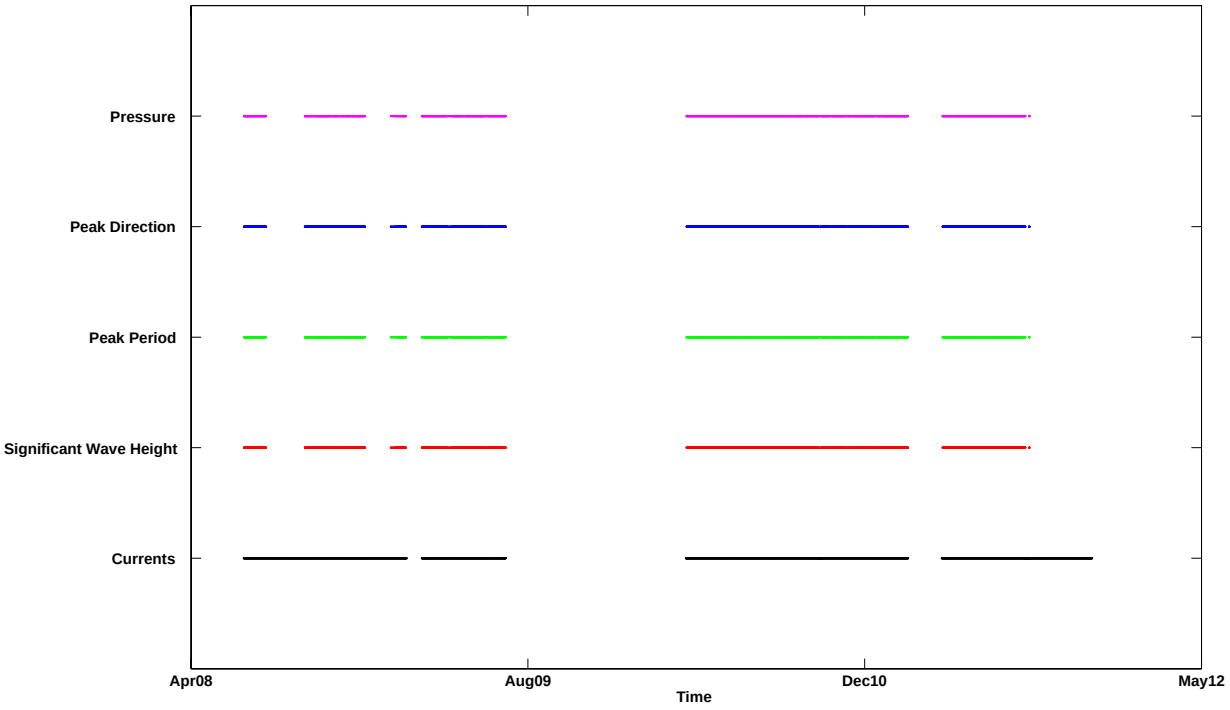


Figure 4.2: Timeline of each variable for AWAC at Site B.

5. Site N7

The offshore observing platform is the USAF tower N7, formerly known as K-tower (Figure 2.1). It is one of six USAF communication towers in the Northeastern Gulf of Mexico used for navigation training by Tyndall Air Force Base pilots. The tower stands approximately 35 m tall above the surface and is attached to a submerged barge on the bottom. Tower N7 is approximately 17 nm offshore from the FSUCML, located in water depth of 19 m. This site experiences minimal bio-fouling.

Instruments deployed during NGI at this site were a multi-parameter YSI 6600 EDS, two Sea-Bird 16 SEACAT's (3m and 9m), a RDI Acoustic Doppler Current Profiler and a Wet Labs CDOM ECO FL. In early 2012 the YSI and RDI were replaced with a Sea-Bird 16plus SEACAT and a Nortek Acoustic Wave and Current Meter (AWAC), respectively. Variables recorded were temperature, salinity, dissolved oxygen, chlorophyll, pressure, pH, turbidity, photosynthetic active radiation, total dissolved solids, colored dissolved organic matter (CDOM), currents and wave parameters. Time is recorded as Greenwich Mean Time. See Figures 5.1 – 5.6, and Tables 5.1 - 5.6 for details on data retrieval.

Table 5.1: Wave and current data collected from all RDI deployments at Site N7. Dates are given as yymmdd.

Collected Data
070119-070711
070719-071106
080326-080423
090122-090418
090512-091108
091114-100903
101008-101109
110317-111121

Table 5.2: Wave and current data collected from all AWAC deployments at Site N7. Dates are given as yymmdd.

Collected Data
120124-130317

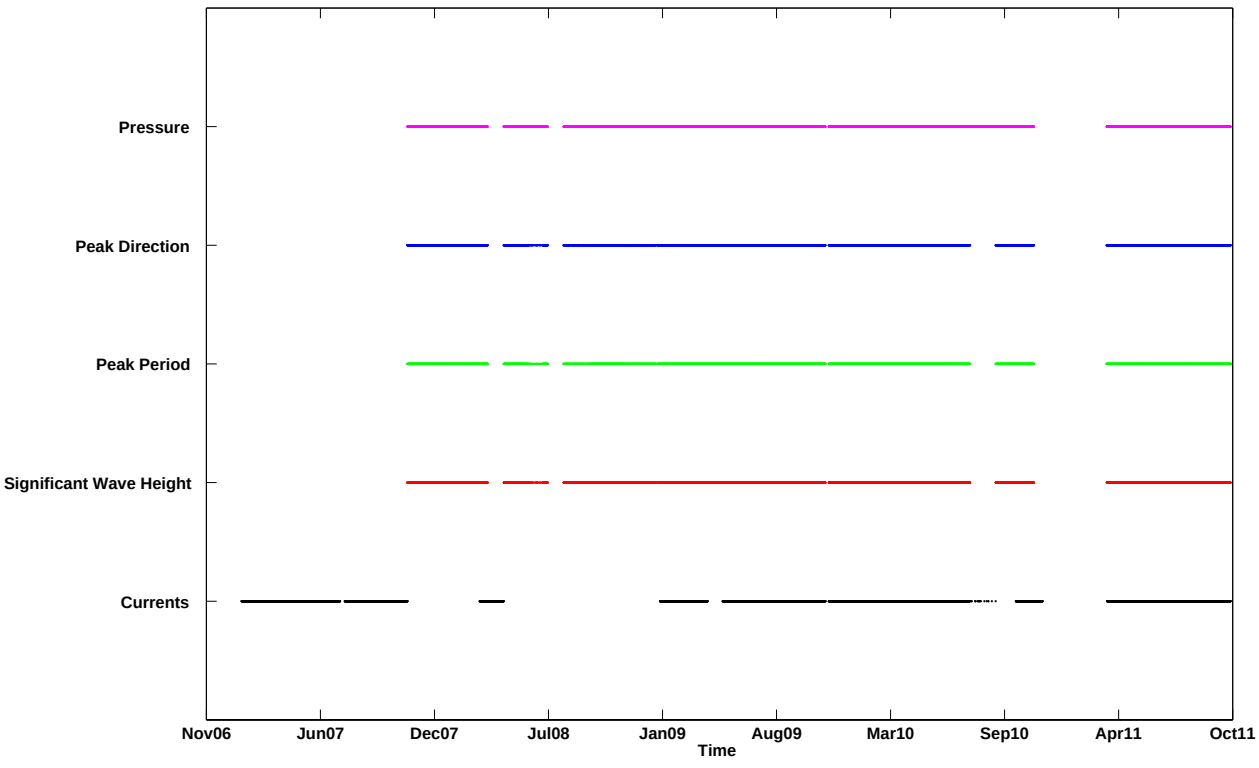


Figure 5.1: Timeline of variables from RDI at Site N7.

Table 5.3: Variables collected from all YSI deployments at Site N7. The variables are as follows: T = Temperature, S = Salinity, Chl = Chlorophyll, TDS = Total Dissolved Solids, PAR = Photosynthetic Active Radiation, pH = Water Acidity, Turb. = Turbidity. Red boxes indicate no data and 'X' indicates data collected. Dates are given as yymmdd.

Variable/Deployment	T	S	Chl	DO	TDS	PAR	pH	Turb.
080311-080423	X	X	X	X		X	X	X
080423-080603	X	X	X	X	X	X	X	X
080603-080702	X	X	X	X	X	X	X	X
080702-080806	X	X	X	X	X	X	X	X
080806-080906	X	X	X	X	X	X		X
080930-081114	X	X	X		X	X		X
081120-090113	X	X	X	X		X	X	X
090122-090310	X	X	X		X	X	X	X
090310-090416	X	X	X	X		X	X	X
090416-090512	X	X	X	X		X	X	X
090512-090609	X	X	X	X		X	X	X
090609-090703	X	X	X	X		X	X	X
090728-090916	X	X	X	X		X	X	X
090916-091020	X	X	X	X		X		X
091114-091214	X	X	X	X		X	X	X
091214-100120	X	X	X	X		X	X	X
100120-100303	X	X	X	X		X	X	X
100308-100429	X	X	X	X		X	X	X
100429-100608	X	X	X	X		X	X	X
100626-100818	X	X	X	X		X	X	X
100818-101008	X	X	X	X		X	X	X
101008-101109	X	X	X	X		X	X	X
101109-110120	X	X	X	X		X	X	X
110317-110509	X	X	X	X		X	X	X
110509-110713	X	X	X	X			X	X

Table 5.4: Color Dissolved Organic Matter data collected from deployments at Site N7. Dates are given as yymmdd.

Collected Data
080326 - 081120
090310 - 090416

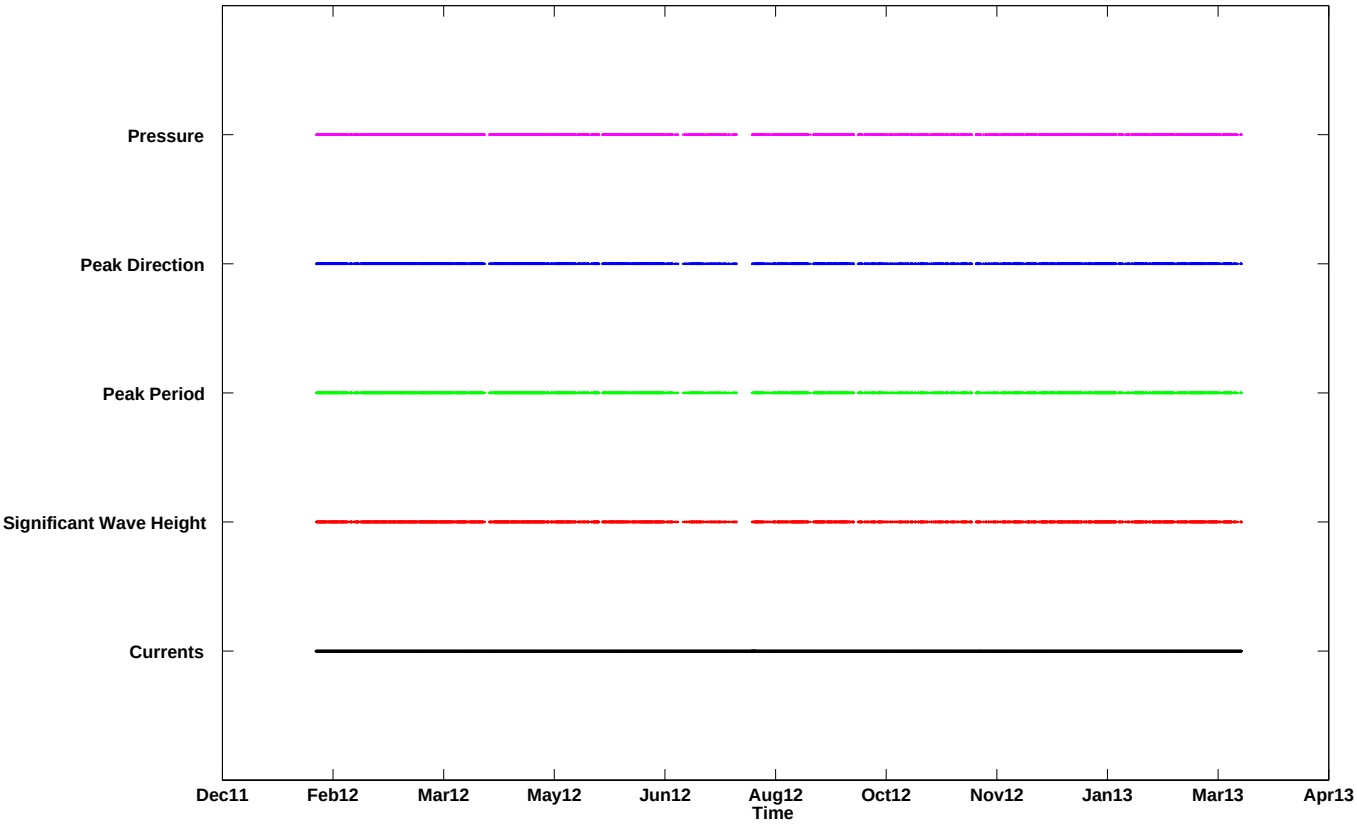


Figure 5.2: Timeline of variables from AWAC at Site N7.

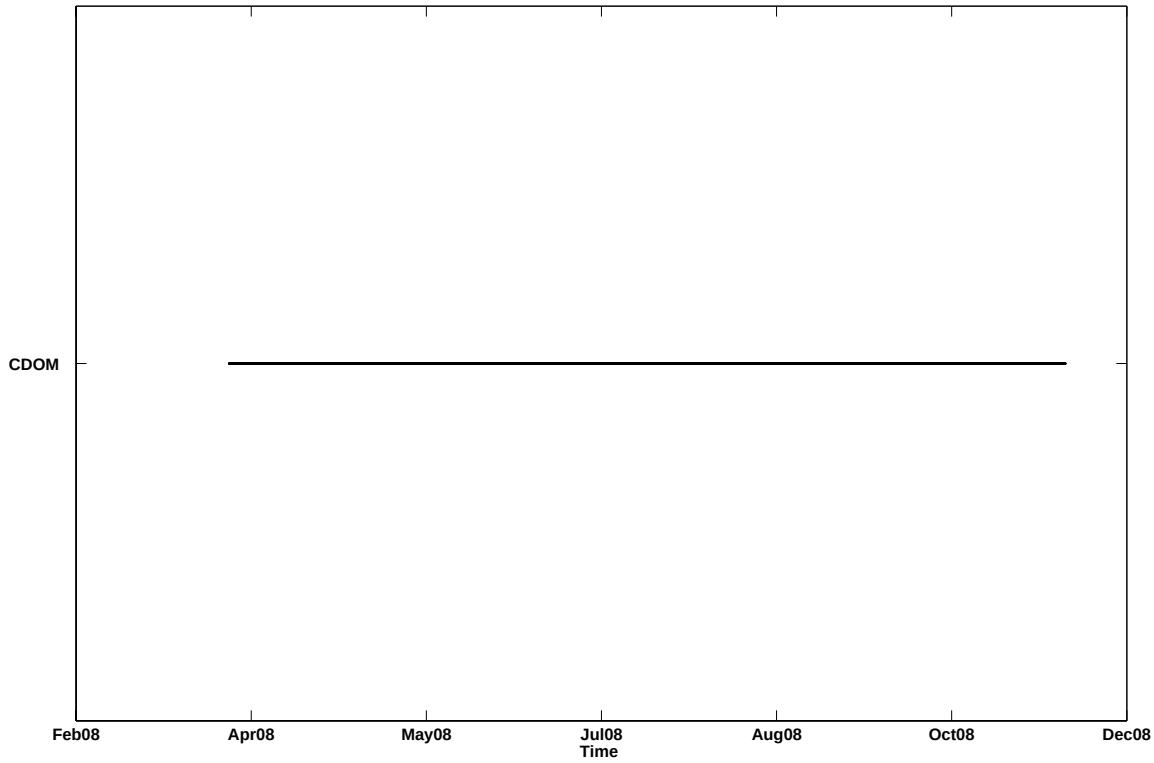


Figure 5.3: Timeline of CDOM at Site N7.

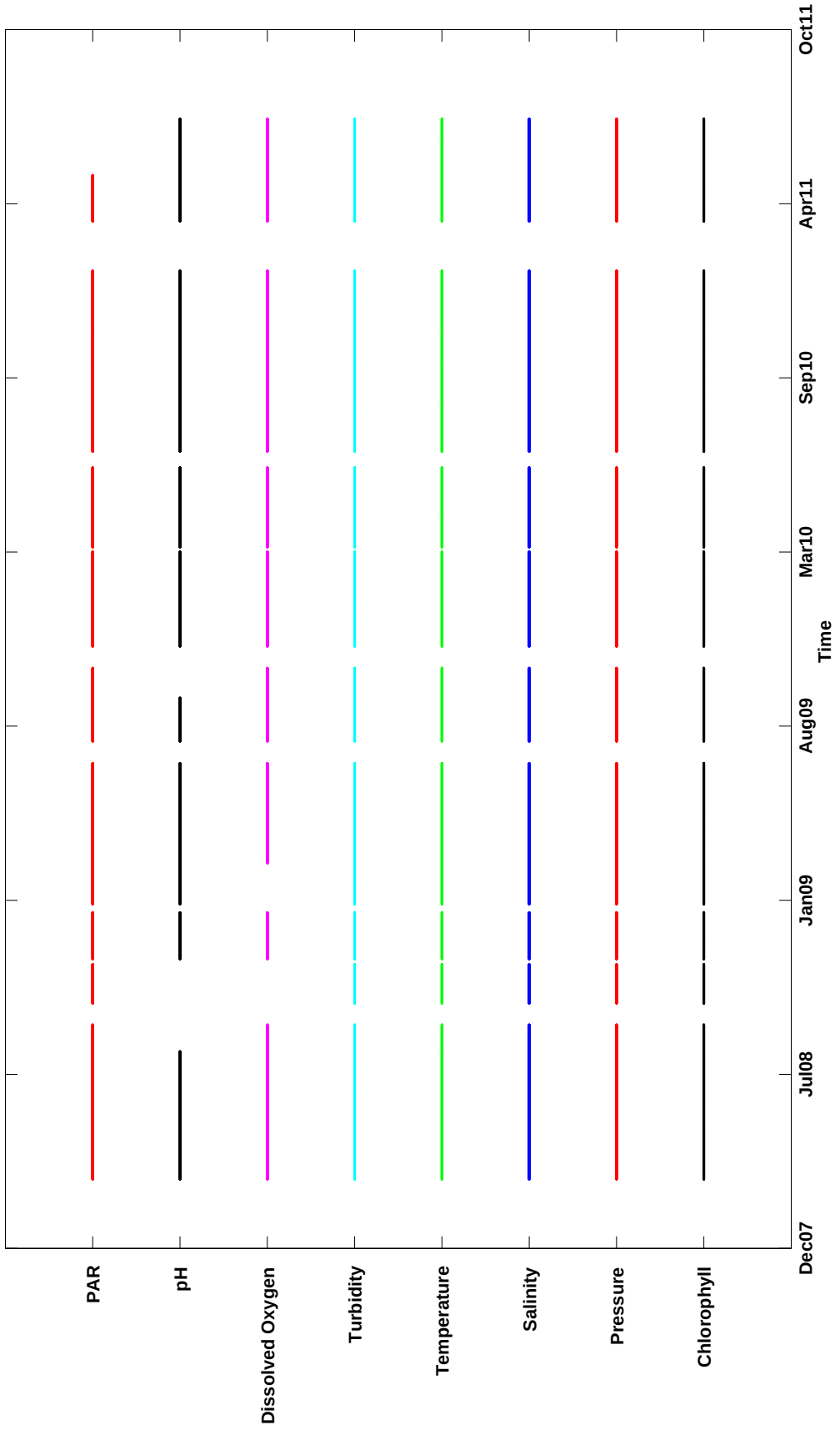


Figure 5.4: Timeline of variables from YSI6600 EDS at Site N7.

Table 5.5: Temperature and Salinity data collected from 3m and 9m SBE deployments at Site N7. Red boxes indicate no data and 'X' indicates data collected. Dates are given as yymmdd.

3 meter	9 meter
071212-080208	071212-080208
080208-080423	080208-080423
080423-080624	080423-080624
080624-080930	080624-080930
080930-090206	080930-090206
090206-090601	090206-090601
090601-090916	090609-090916
090916-091016	090916-091214
091214-100506	091214-100506
	100506-100816
	100818-101007
101007-110316	101007-110316
110316-110603	110316-110603
110603-110823	110603-110823
110824-111010	110824-120125
120125-120329	120125-120531
120531-120611	120531-120808
120629-120808	
120808-121118	120808-121118
121126-121226	121119-130424

Table 5.6: Variables collected from 18m SBE deployments at Site N7. The variables are as follows: CTD = Conductivity, Temperature and Depth, and DO = Dissolved Oxygen. Red boxes indicate no data and 'X' indicates data collected. Dates are given as yymmdd.

Deployments	CTD	DO
110810-110917	X	X
110917-111117	X	X
120217-120531	X	X
120531-120808	X	
120817-121118	X	

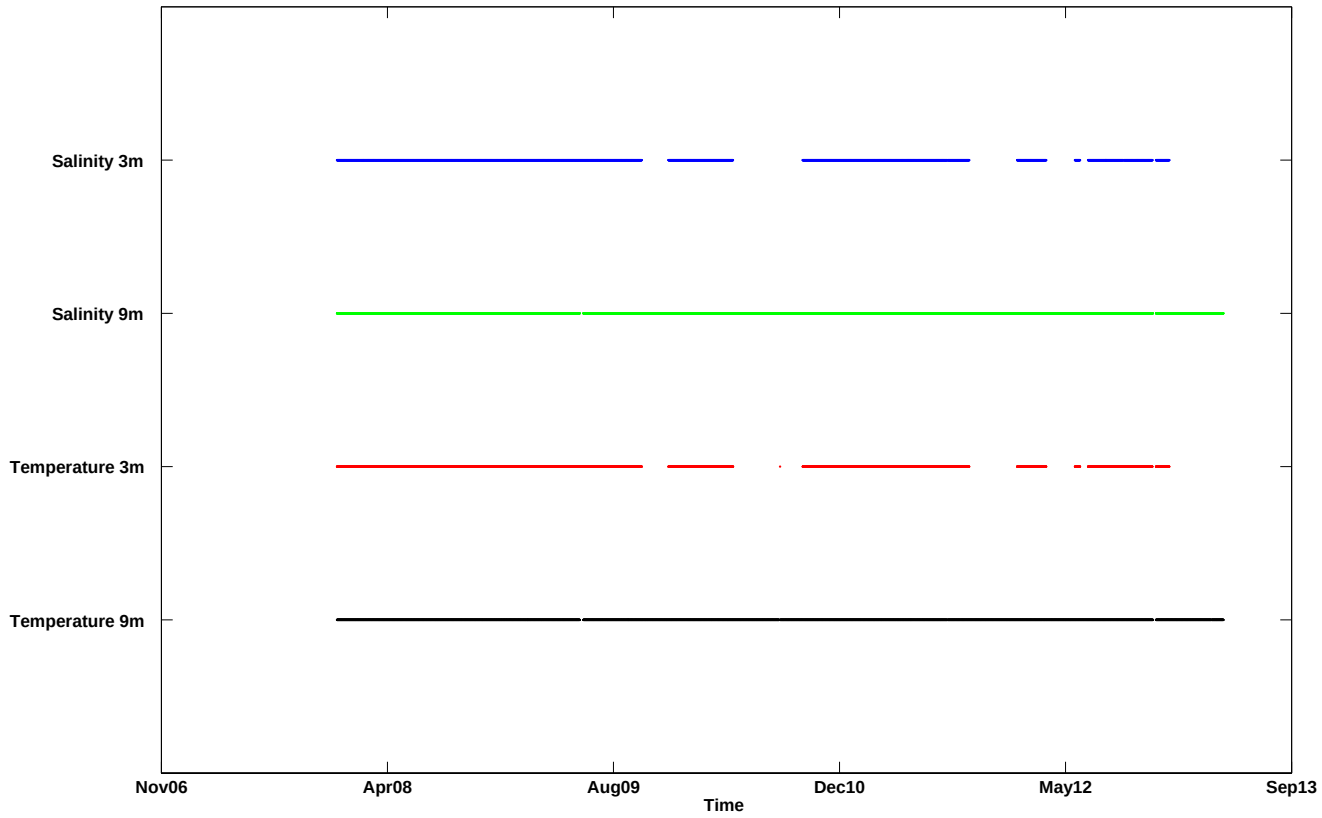


Figure 5.5: Timeline of variables from SBE 16's, located at 3m and 9m, at Site N7.

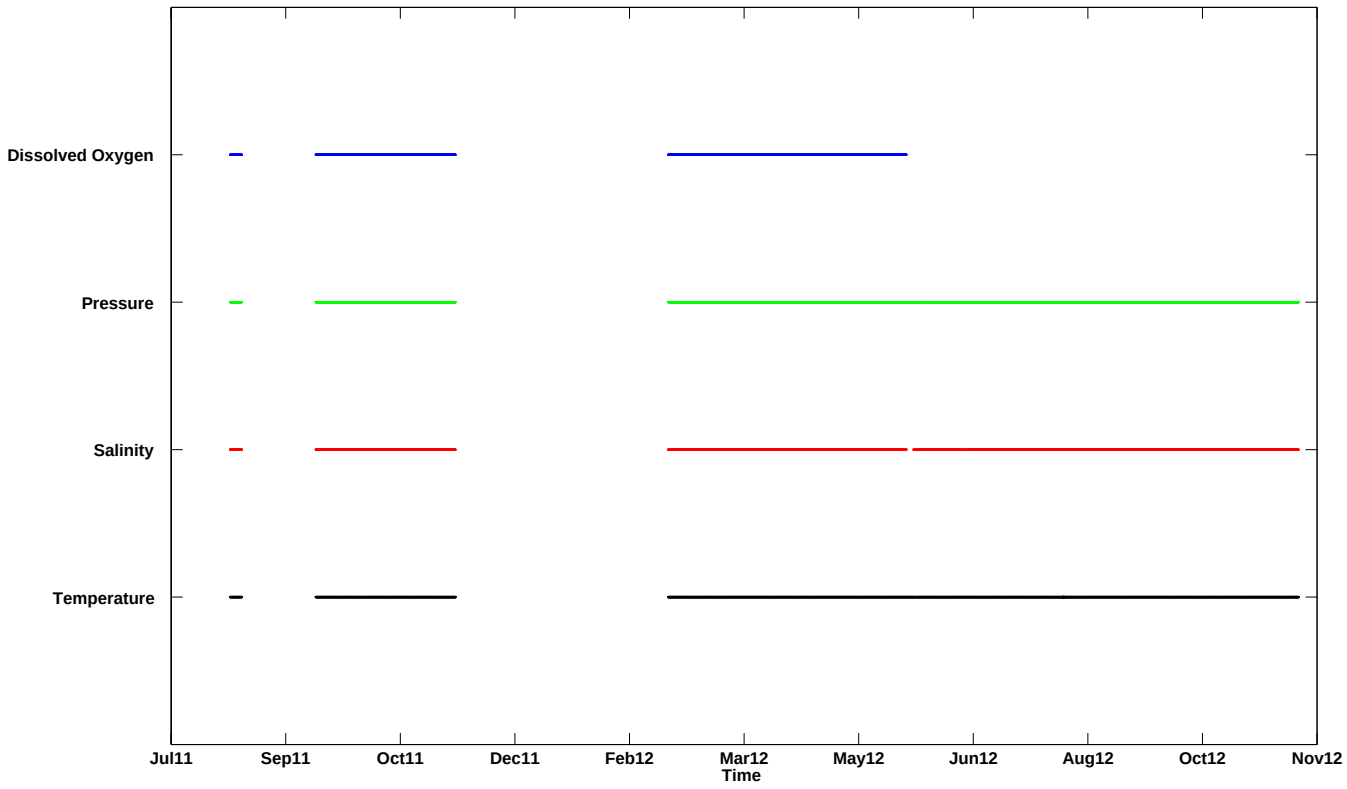


Figure 5.6: Timeline of variables from SBE 16*plus* at Site N7.

6. Spring Creek

Spring Creek is approximately 11 km southeast of Crawfordville and can be accessed from Apalachee Bay via boat (Figure 2.1). It is in a tidal marsh typical of the northeastern GoM. There are fourteen known springs in the Spring Creek Springs Group, where most discharge into the widened mouth of Spring Creek as it reaches the GoM (Schmidt, 2004). The surrounding land is brackish marsh and coastal hardwood-palm hammock.

Table 6.1: Variables collected from all YSI deployments at Spring Creek. The variables are as follows: T = Temperature, S = Salinity, Chl = Chlorophyll, P = Pressure, and Turb. = Turbidity. Red boxes indicate no data and 'X' indicates data collected. Dates are given as yymmdd.

Variable/Deployment	T	S	Chl	P	Turb.
080305-080425	X	X	X	X	X
080529-080714	X	X		X	X
080818-080927	X	X		X	X
081009-081209	X	X		X	X
081209-081227	X	X		X	X
090204-090221	X	X		X	X

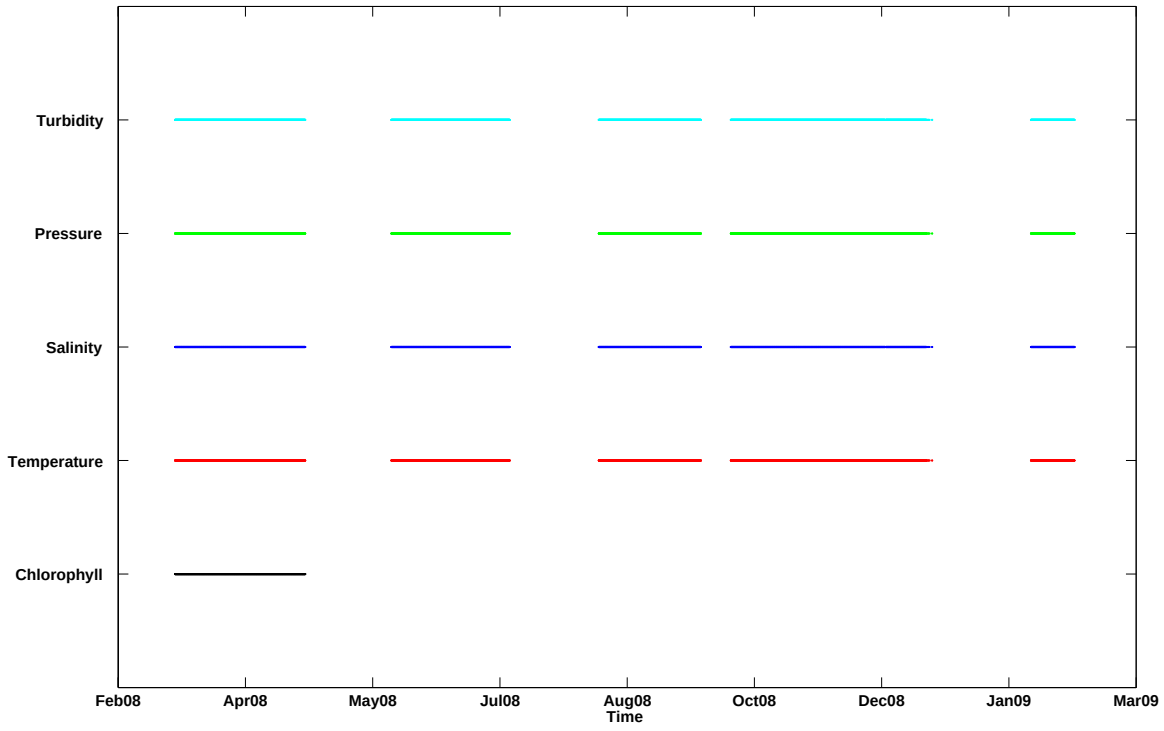


Figure 6.1: Timeline of variables from YSI6600 EDS at Spring Creek.

A YSI 6600 EDS was deployed at this site. Variables recorded were temperature, salinity, pressure, chlorophyll and turbidity. Time is recorded as Greenwich Mean Time.

7. Hydrographic Sections

The Hydrographic Section cruises occurred on a monthly basis in 2007, and a quasi-monthly basis from 2008-2010. Water column profile data were collected during these cruises at 5 stations along a transect (Table 2.2 and 7.1 and Figure 2.1, 7.1 and 7.2). The Hydrographic Section starts approximately 3nm from the shoreline and extends out 17nm to the offshore USAF tower, Site N7. Along the transect, profile data is collected from the down and up casts using a SeaBird 19 SEACAT Profiles (SBE19) and a multi-parameter YSI 6600 Sonde (see section 2 for instrument details). The SBE19 and the YSI 6600 measure at frequencies of 2 Hz and 1 Hz, respectively. In addition, water samples were collected and later analyzed by McGlynn Laboratories for Nitrite + Nitrate as N and Ortho-Phosphorus as P. Two transect lines have been sampled, Transect 1 in the period November 2006 – November 2007, and Transect 2 in the period December 2007 – September 2011 (Table 2.2 and Figure 2.1). Unlike the moored instruments, date and time for all transect data are recorded as local with daylight savings.

Table 7.1: Variables collected from all Hydrographic sections along Transects 1 (yellow boxes) and 2 (aquamarine boxes). The instruments/Variables are as follows: YSI = YSI 6600 Multi-parameter Extended Deployment Sonde, SBE = SeaBird 16 SeaCAT CTD, and NUTS = Nutrients. Red boxes indicate no data and 'X' indicates data collected. Dates are given as yymmdd.

Cruise	Transect	YSI	SBE	NUTS
061114	1	X	X	
061213	1	X	X	
071119	1		X	
070207	1	X	X	
070306	1	X	X	
070404	1	X	X	
070502	1	X	X	
070613	1	X	X	
070808	1	X	X	
070912	1	X	X	
071106	1	X	X	
071219	2	X	X	
080123	2	X	X	
080220	2	X	X	
080326	2	X	X	
080423	2	X	X	

Cruise	Transect	YSI	SBE	NUTS
080702	2	X	X	
080806	2	X	X	
080926	2	X	X	
081203	2	X	X	
090122	2	X	X	
090310	2	X	X	
090408	2	X		
090512	2	X	X	
090609	2	X	X	
090728	2	X	X	
090910	2	X	X	
091024	2			
091214	2	X	X	
100120	2	X	X	
100308	2	X	X	
100429	2	X	X	
100608	2	X	X	
100903	2	X	X	X
101021	2	X	X	X
110317	2	X	X	X
110603	2	X	X	X
110713	2	X	X	X
110823	2	X	X	X
110921	2	X	X	

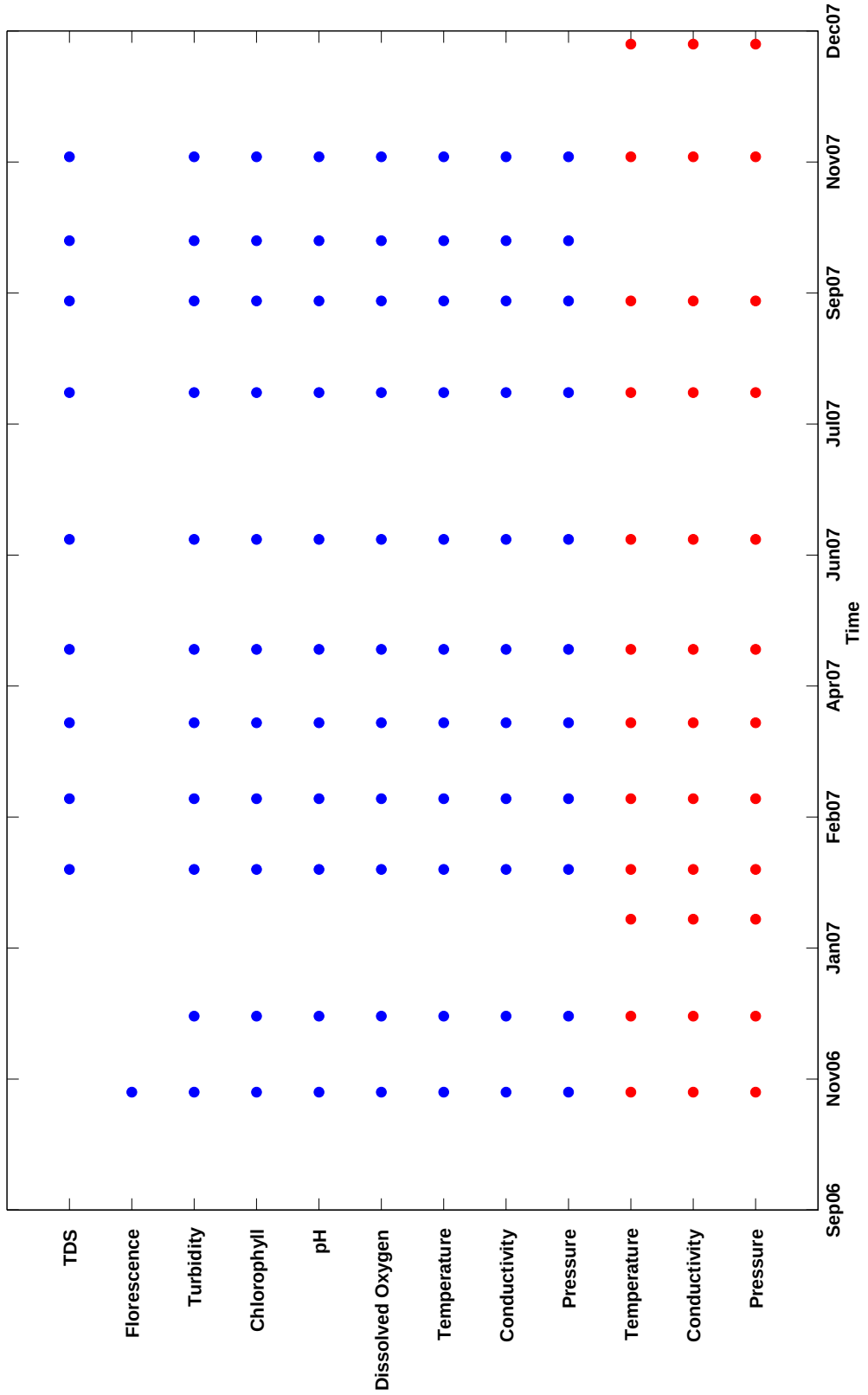


Figure 7.1: Timeline of variables from Transect 1. Data recorded using a SBE 19 (red dots) and a YSI 6600 (blue dots).

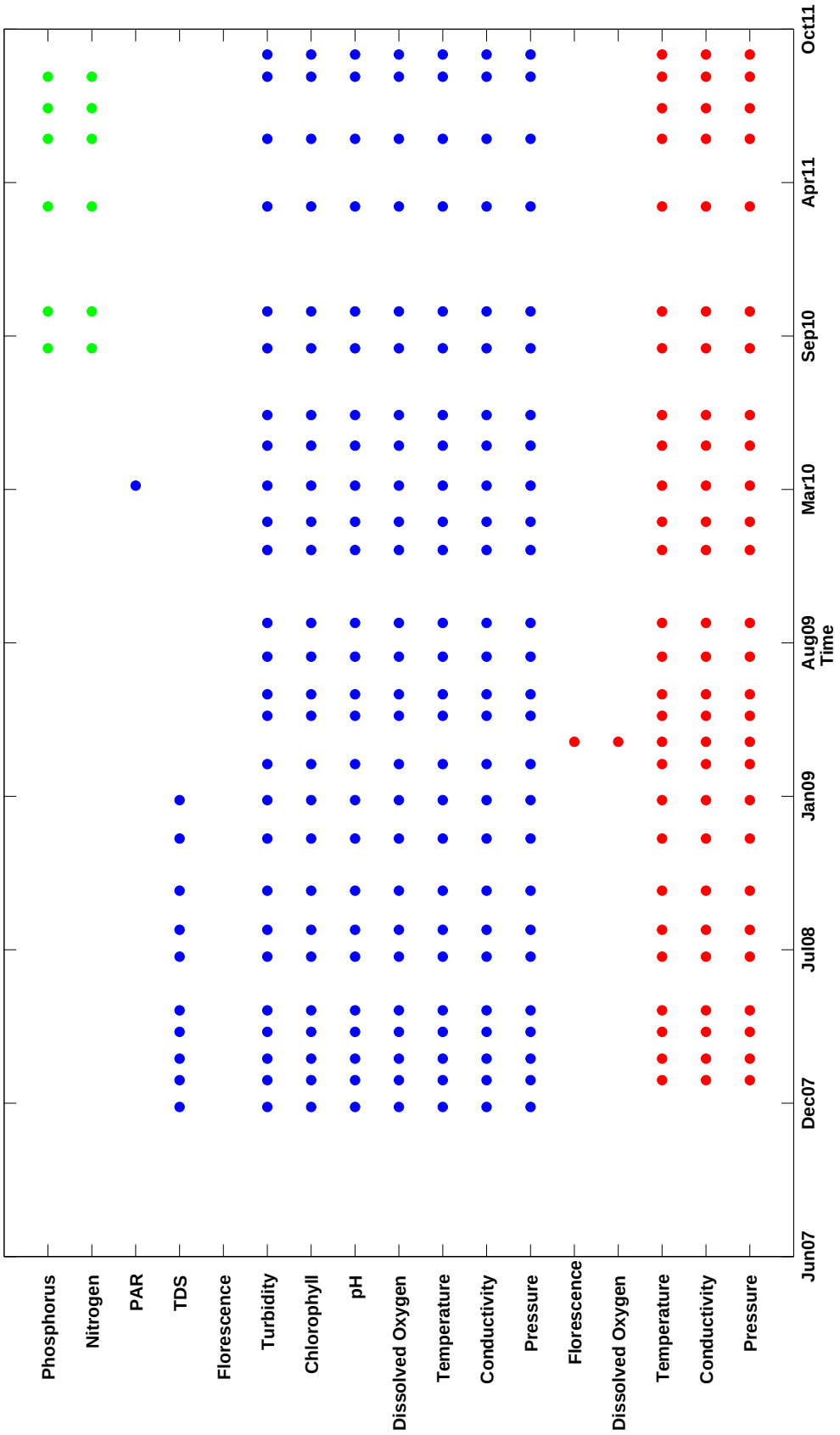


Figure 7.2: Timeline of variables from Transect 2. Data recorded using a SBE 19 (red dots), a YSI 6600 (blue dots), and laboratory analyzed water samples (green dots).

8. References

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