# MOORED INSTRUMENT OBSERVATIONS FROM BARROW STRAIT, 2010-2011

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Les établissements de l’ancien secteur des Sciences et Levés océaniques dans les régions et à l’administration centrale ont cessé de publier leurs diverses séries de rapports en décembre 1981. Vous trouverez dans l’index des publications du volume 38 du *Journal canadien des sciences halieutiques et aquatiques*, la liste de ces publications ainsi que le dernier numéro paru dans chaque catégorie. La nouvelle série a commencé avec la publication du rapport numéro 1 en janvier 1982.

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by

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## Table of Contents

## List of Figures

## List of Tables

## Abstract

Pettipas, R. and J. Hamilton. 2015. Moored instrument observations from Barrow Strait, 2010-2011. Can. Data Rep. Hydrogr. Ocean Sci. 195: viii + 89 p.

Instrumented moorings deployed in the eastern end of Barrow Strait from August 2010 to August 2011 provide yearlong records of current, temperature, salinity, and ice drift data, extending a data time series to a thirteenth and final year. The observational program, started in 1998, explores the magnitude and variability of freshwater, heat and volume transports through the eastern Northwest Passage. The presented current and ice drift data were collected with acoustic Doppler current profilers (ADCPs) and specialised instrumentation for near-pole direction measurement. Yearlong records of temperature, salinity and density for fixed depths from moored CTDs are also presented. These current and CTD data are reported as filtered and unfiltered time series, spectral and tidal analyses products, and in statistical summaries. Finally, data from a moored, upward-looking sonar that was also a part of the array this year, are presented in a statistical summary and as monthly histograms of ice draft distribution.

## Résumé

Pettipas, R. and J. Hamilton. 2015. Observations des instruments amarrés dans le détroit de Barrow, 2010-2011. Can. Data Rep. Hydrogr. Ocean Sci. 195: viii + 89 p.

Les amarrages équipés installés à l'extrémité est du détroit de Barrows d'août 2010 à août 2011 ont fourni des enregistrements tout au long de l'année de données sur le courant, la température, la salinité et la dérive des glaces, prolongeant ainsi une série chronologique pour une treizième et dernière année. Le programme d'observation, lancé en 1998, examine l'ampleur et la variabilité du transport de l'eau douce, de la chaleur et du volume dans la partie est du passage du Nord-Ouest. Les données présentées sur le courant et la dérive des glaces ont été recueillies à l'aide de profileurs de courant à effet Doppler (ADCP) et d'instruments spécialisés pour la mesure de la direction à proximité des pôles. Les enregistrements tout au long de l'année de la température, de la salinité et

de la densité pour les profondeurs fixes effectués par les sondes CTP amarrées sont également présentés. Ces données sur le courant et les données de CTP sont indiquées sous la forme de séries chronologiques filtrées et non filtrées, de produits d'analyse spectrale et d'analyse de la marée, et de résumés statistiques. Enfin, les données d'un sonar à vision ascendante amarré, qui faisait également partie du dispositif cette année, sont présentées dans un résumé statistique et sous la forme d'histogrammes mensuels de la répartition du tirant d'eau glaciel.

## Introduction

A field program to quantify and examine the inter-annual variability of the exchange through Barrow Strait (a principal pathway between the Arctic and North Atlantic Oceans), was started by BIO investigators in August of 1998. Data from the first 12 years of this study, along with a description of the methods used, have previously been reported [Pettipas and Hamilton, 2013a, 2013b, 2013c, 2014, Pettipas et al., 2010, 2008, 2006, 2005; Hamilton et al., 2008, 2004, 2003, 2002]. Described here are moored instrument data from the thirteenth and final year of the study.

Yearlong records of temperature, salinity and density information derived from moored Microcat CTD data are presented as unfiltered and low-pass filtered time series, and also as power spectra. Current rate and direction (from ADCPs and custom pole compasses) are presented as progressive vector plots, unfiltered and low-pass filtered time-depth plots, and as time series plots for depths corresponding to the moored CTDs. Seasonally averaged statistical summaries for both the CTD and current data are provided as graphs and in tabular form. Results of tidal analyses of the current data give tidal amplitudes, phase, and ellipse orientation as a function of depth for each of the 5 main tidal constituents (K1, M2, O1, S2, P1). As done in previous years, separate tidal analyses were attempted for periods of immobile, solid ice cover and periods of open water. However, as was also the case in 2009-2010, results for the immobile ice condition are not reported since there were no periods of sufficient length to allow for reliable analyses at either of our mooring sites.

Ice drift velocity, obtained from the acoustic Doppler current profilers (ADCPs), are presented as yearlong time series. Ice draft data acquired with a moored ASL ice profiling sonar (IPS) are presented as monthly statistics and monthly histograms of ice draft.

## Mooring Locations and Description

Five instrumented moorings were distributed at two sites (South and South-Central) on the southern side of Barrow Strait (Figure 1) to provide the data required to extend the volume, freshwater and heat transport time series started in 1998. ADCPs manufactured by Teledyne RD Instruments (TRDI) and precision heading references (Watson Industries, Inc.) were mounted in streamlined buoyancy packages to provide current rate and direction information. The technique used to obtain reliable direction measurements here, where conventional compass technology is inadequate due to the proximity of the site to the magnetic pole, is described in detail by Hamilton [2004, 2001]. The upward looking ADCPs logged average speeds from 100 pings over a 5 minute on-period every 2 hours, and also provided a simultaneous ice drift speed throughout the yearlong deployments. Two 307 kHz Workhorse Sentinel ADCPs (WHADCPs) were used at the South site, one moored mid-depth and the other near-bottom to give near-full water column coverage. At the South-Central site, a 150 kHz Quartermaster ADCP (QMADCP) was moored near bottom to provide current data over almost the entire water column (from 25 m to 235 m depth), and a WHADCP was moored at 76 m depth for coverage of the 10 to 70 m depth interval. Concurrent direction measurements were logged separately with the precision heading reference systems, and have been merged with the ADCP speed data for presentation here. The three WHADCP/compass systems were successfully recovered with full data sets, but the QMADCP only provided data for the first five months of the deployment due to a battery problem. Three SeaBird Microcat CTDs were used to measure temperature, conductivity and pressure every 30 minutes at targeted depths of 40, 80 and 150 m at both sites, as well as one near-bottom at the South-Central site. All of these CTDs provided complete data sets.

An Ice Profiling Sonar (IPS) was moored at the South-Central site to provide the ice draft data presented in this report.

An illustration of the five moorings deployed for 2010-2011 is shown in Figure 2. A summary of the 2010-2011 moorings and instrumentation, including mooring positions, instrument depths and acquired data records, is presented in Table 1.

## Data Processing

### Current Speed and Direction Data

The 307 kHz Workhorse ADCPs (WHADCPs) were mounted in streamlined buoyancy packages (A2 "SUBs" manufactured by Open Seas Inc.) and set up to measure current relative to the instrument axes, ignoring their own compass information. These instruments were set up to average over a depth interval of 4 m. Current data above 12 m were rejected based on TRDI's standard echo intensity quality criterion. These ADCPs also record ice drift velocity when there is 100% or near-100% ice cover. Two 307 kHz WHADCPs were moored at the South site (where the water depth is ~149 m), at depths of 77 m and 144 m to give near-full water column current measurement coverage. At the South-Central site where the bottom depth is ~ 268 m, a WHADCP was moored at 76 m depth to provide currents over the upper water column. A 150 kHz Quartermaster ADCP (QMADCP) moored near bottom (244 m) provided near full water column coverage, overlapping the range of the 307 kHz unit in the top 75 m.

Direction was provided using an independent compass package mounted in the buoyancy package tail to give the orientation of the ADCP relative to magnetic north. Initiation of a compass sample cycle was triggered by the commencement of the bihourly ADCP measurement by making use of TRDI's "RDS3 interface" to provide a turn-on pulse to the compass. The compass was programmed to take a 10 s sample in the middle of the 5 minute ADCP sampling interval. This conserved compass battery power, and took advantage of previous experience that current direction does not change significantly over 5 minutes at the study location [Hamilton et al., 2003]. Direction records were then adjusted for the variation in magnetic declination using magnetic observatory data from the NRCAN observatory in Resolute to get direction relative to true north.

Vertical excursions of the WHADCPs caused by current drag forces acting on the mooring were small, with dips exceeding 3 m less than 0.3% of the time at both sites.

## Moored CTD Data

SeaBird Microcat CTDs were set up to measure temperature, conductivity and pressure every 30 minutes for the yearlong deployments. Instrument dips due to current drag forces acting on the moorings were small. Vertical dip of the 40 m CTDs at both sites exceeded 3 m only 0.3% of the time.

## Low-Pass Filtering

Some of the data series presented have been filtered to remove the semidiurnal and diurnal tides using a Cartwright filter. A window length of 130 hours and a high-frequency cutoff of 0.036 cph have been used. In processing of data presented in previous reports, a technique described by Godin [1972] was used where three simple averaging filters were applied in sequence. Although the mean of the resulting filtered data for the Cartwright or Godin methods are nearly identical, the Cartwright filter does a better job at retaining variability on the 1 to 3 day time scale, so has been chosen here.

## Tidal Analysis

Harmonic tidal analyses of current data using Foreman's [1978] method are presented for the summer period of broken or no ice cover. At both the South and South-Central sites this open water period was about 8 weeks; Aug 10 to Oct 6, 2010 and Aug 11 to Oct 9, respectively. The period of consolidated landfast ice was too short at both locations this year to allow for tidal analysis in those contrasting conditions. Tidal ellipse axes amplitudes, orientations and phases for the main tidal constituents (K1, M2, O1, P1 and S2) are plotted as a function of depth.

The periodic vector function describing a particular constituent, traces an ellipse over a tidal cycle with major and minor amplitudes defined by the length of the semi-major and semi-minor axes. The major axis amplitude is always positive. The sign of the minor axis amplitude defines the rotation sense of the current ellipse. When positive the vector traces the ellipse in a counter-clockwise direction; when negative, the rotation sense is clockwise. Ellipse orientation is the angle measured counter-clockwise from east to the semi-major axis. The phase is a measure of the timing of high water referenced to astronomic positions over the Greenwich meridian. Phase is measured counter-clockwise from this chosen reference.

## Data Presentation

Yearlong time series of half-hourly sampled temperature, salinity and density from the moored CTDs are shown in Figures 3- 4. Weak freshening is seen at 40 m in the summer and fall at the South site with the strongest signal being pulses of fresher water from early October to mid-December. Freshening is later (early November to mid-January) and more persistent at the South-Central site, with 40 m salinity values about 1 psu lower than winter-spring values. There, late summer/early fall temperature at 40 m was a half degree lower than in the previous year (Pettipas and Hamilton, 2014), exceeding −1°C for only a week. But water near-bottom in fall and winter at the South-Central site was remarkably warmer than in previous years. The average near-bottom water temperature in the winter of 2011 was +0.30°C compared to -0.05°C the previous year, and ranged between -0.62°C and -0.35°C in the 6 years for which we have these data between 2002 and 2009.

Power spectra of the moored CTD measurements (decimated to 2 hour intervals) are shown in Figures 5 and 6. There is significant energy in the diurnal and semi-diurnal bands in the South site salinity, but only in the diurnal band at the South-Central site. For temperature, the strongest variability is seen in the near-bottom record at the South-Central site.

Yearlong progressive vector diagrams using the bi-hourly data from all ADCP/pole compass systems are shown in Figures 7 - 9. Data from both the mid-water and near-bottom instruments at the South side are combined in Figure 7. QMADCP data from the South-Central site (Figure 8) are only reported until Jan 19 when the instrument stopped working due to a battery issue. The mean flow in the upper water column as measured by the WHADCPs (Figures 7 and 9) is generally alongstrait (105°) at the South site and generally eastward (90°) at the South-Central site. At the South site there are periods in autumn when the alongstrait current is near-zero which in Figure 7 accentuates a cross-strait component in the upper water column as measured by the upper ADCP that is not seen by the lower instrument. However comparison of annual means at 71 m depth where the instrument ranges overlap, demonstrates only a small difference in direction; 9.4 cm/s at 115° and 9.4 cm/s at 105° for the upper and lower South site instruments respectively.

At the South-Central site, the vector plots (Figures 8 and 9) reveal that throughout the water column there is a mean eastward flow for the first few months followed by 3 months of weak westward flow, and then, from late January until recovery (when only measurements in the upper water column are available), flow returns to being predominantly eastward. The extended period of westward flow in fall is unusual, although not unique since similar behavior was measured in the fall of 2007 (Pettipas and Hamilton, 2013b).

Current data are shown as time-depth plots in Figures 10 – 15. Data are presented in along-strait and cross-strait components, where positive values are defined as flow towards 105° and 15° true, respectively. A month of bihourly current data from the South site is presented in Figure 10. Data from the deep and mid-water ADCPs (which were moored 0.34 km apart) have been combined. Bi-hourly data from the South-Central site through most of the water column (QMADCP) and over the top 70 m (WHADCP, moored 1.2 km away) are shown in Figures 11 and 12. These figures reveal the strong tidal nature of the flow. Yearlong records of low-pass filtered data (tides removed) for the 4 instruments are shown in Figures 13-15. As mentioned above, the periods of observed westward and near-zero flow in fall and early winter are unusual. Predominantly eastward currents at this time of year are more typical. The northward current component in deeper water at the South-Central site (Figure 14) is a feature seen in previous years. In these mean flow plots, missing data near the surface in winter are caused by a decrease in the effective range of the ADCPs due to a minimum of acoustic reflectors in the water. The smoothing filter used has smeared the impact of missing data over the filter length.

Smoothed temperature, salinity and current data (where available) are shown for each moored CTD level in Figures 16-22. Tables 2 through 13 provide a summary of the CTD and ADCP data at the CTD depths, with statistics computed over each season, and for the entire year. For the South-Central site, WHADCP data are reported in the tables for the 38 and 56 m levels, while QMADCP data are reported for the deeper levels (154 and 264 m). Density has been included in these statistical summaries.

Annual and seasonal mean flows are summarised in Figures 23-28, where 4 m binned values for the WHADCPs and 8 m bins for the QMADCP are shown. Data from the 39 and 43 m levels at the South site are not shown in these figures because of contamination caused by acoustic interference from the top buoyancy package of the mooring. Late summer and fall along-strait mean currents at both the South and South-Central sites rival those in 2007 as being the lowest over the 13 year monitoring program. Significant cross-strait (northward) currents in deeper water at the South-Central site are evident as usual, appearing in all seasons for which the deep measurements are available. The variance in the bi-hourly, and low-pass filtered current data for the yearlong ADCP records are shown in Figure 29.

Tidal analysis results for each of the 4 ADCP data sets are presented as profiles for the 5 largest tidal constituents in Figures 30 – 44. Analyses have been done for the period of open water only since the immobile ice-cover period was too short to allow for this type of analysis at either site under that ice condition. Ellipse orientations are along-strait as expected. Tidal constants are summarised in Tables 14 – 18.

Ice velocities through the year at both sites were derived from the WHADCPs (Figures 45 and 46). Sections in the record when there are no data indicate periods of open water, or partial ice cover as determined by applying the manufacturer's suggested data quality standards to the ice velocity data. In addition, the ice drift velocity estimate and the adjacent estimates were rejected when the magnitude of the "error velocity" for a particular ensemble was greater than 1 cm/s. Although there was full ice cover for 7 months at both sites, the longest period of immobile ice was less than 4 weeks at the South site, and the ice never stopped moving at the South-Central site. This is similar to what was observed in 2009-2010; more than 8 months of full ice cover at both sites with only a few weeks when the ice became immobile.

Ice draft was measured at the South-Central site for the fifth time in this program, the previous measurement years being 2003-2004, 2005-2006, 2006-2007 and 2009-2010. Monthly mean, standard deviation, and maximum ice draft for 2010-2011 are shown in Figure 47 and Table 19, while histograms of draft distribution by month (based on the data presented in Table 20), are shown in Figure 48. Mean ice draft exceeded 1 m by November, peaked at 2.5 m in January, then dropped back to about 1 meter for April and May. These mean thicknesses were not as large as observed in the previous year but observed monthly maximum ice drafts were comparable, being larger than 15 m for 6 months. The ice draft observations are consistent with what we might expect from an ice pack that was mobile for most of the year. More ice motion leads to more rafting of ice, which results in higher maximum drafts, greater ice volume, and larger monthly mean drafts. It also results in broader monthly distributions of ice draft (Figure 48) compared to years like 2005-2006 (see Pettipas, Hamilton, and Prinsenberg, 2010) when the ice was immobile for almost 6 months. Note that the red bars in the October and November histograms of Figure 48 represent the percentage of missing data in those months.

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**Figure 1**: **A map of the work area with the location of the two mooring sites identified by the open boxes.**

**<u>Figure 2</u>:** **Illustration of the instrumented moorings.**

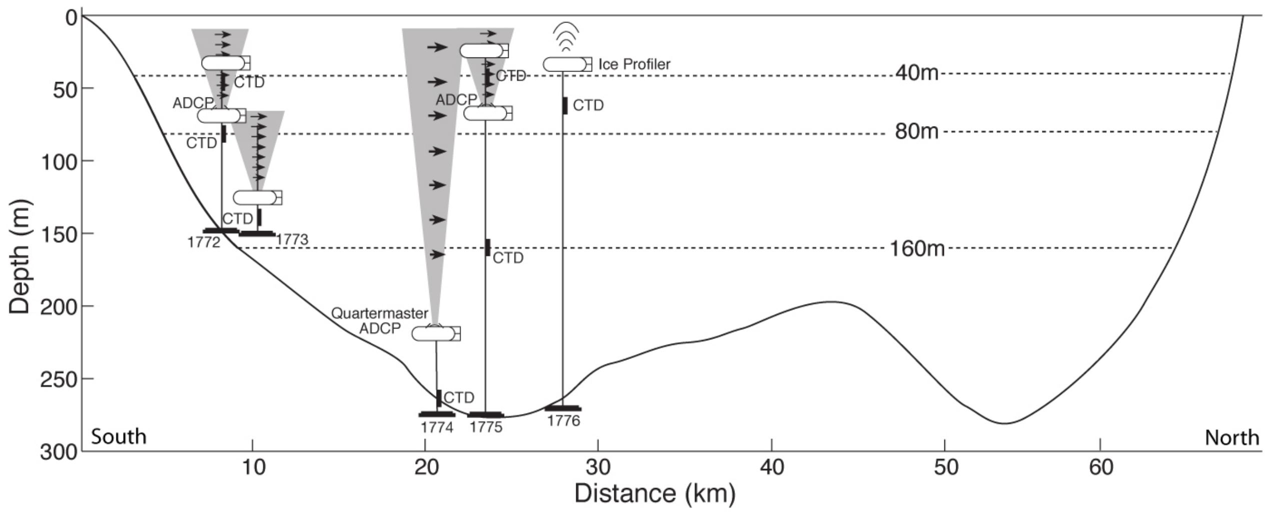


**Figure 3**: **Moored 30 min. CTD data, South Side Barrow Strait.**
**August 2010 – August 2011**

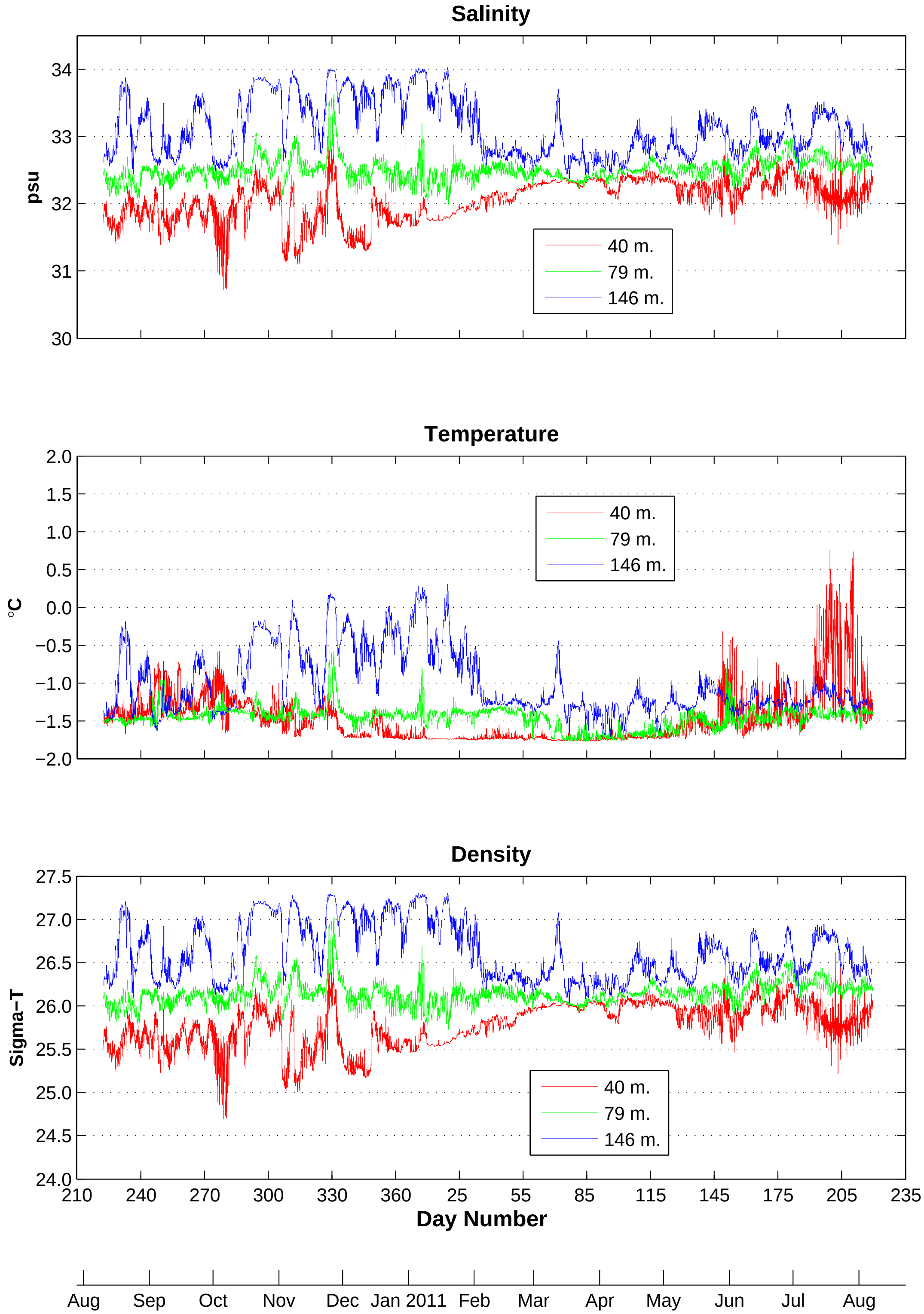


**Figure 4: Moored 30 min. CTD data, South Central Barrow Strait. August 2010 – August 2011**

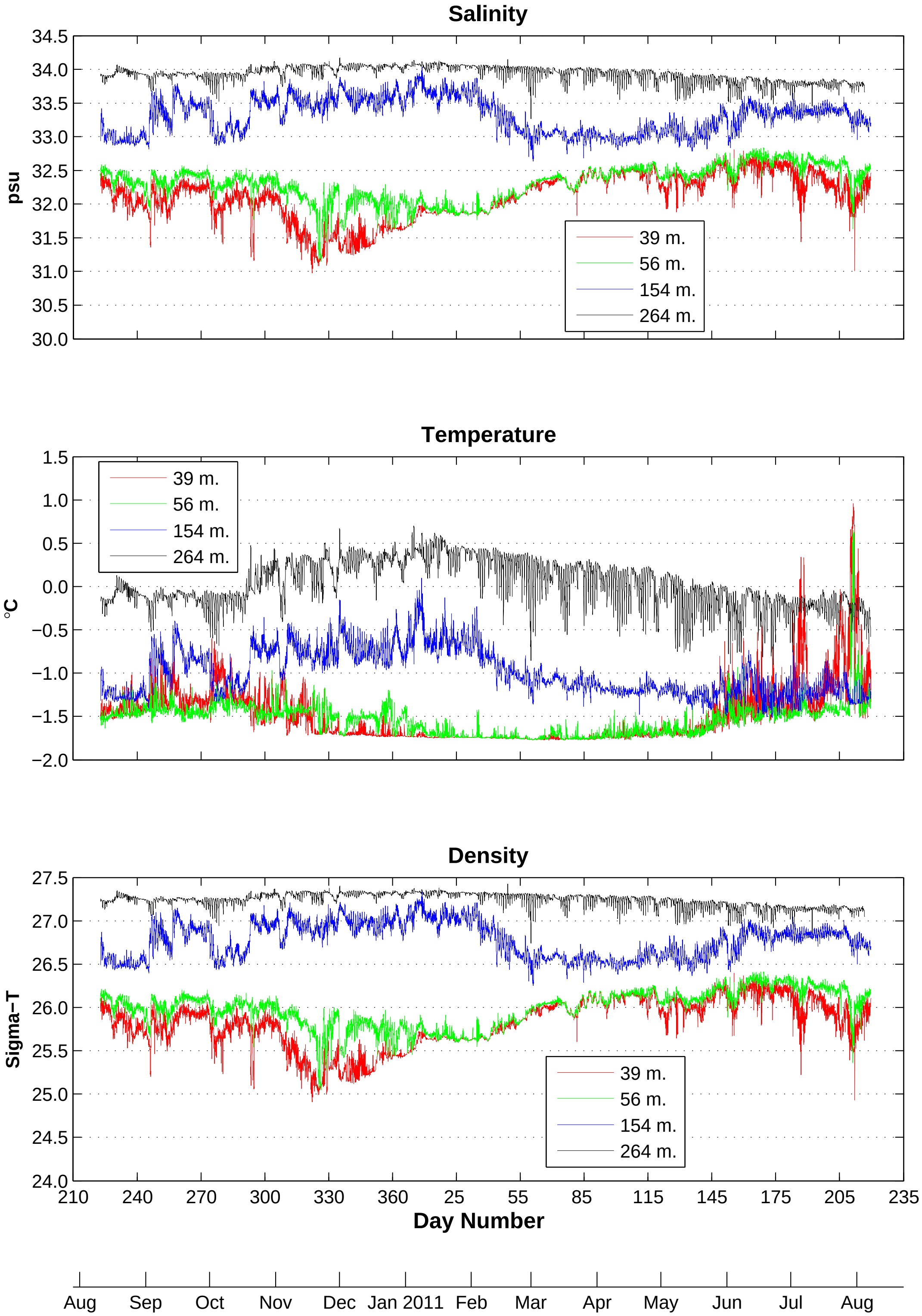


**Figure 5**: **Power Spectra of moored bi-hourly CTD data.**
**South Side Barrow Strait: Aug. 2010 – Aug. 2011.**

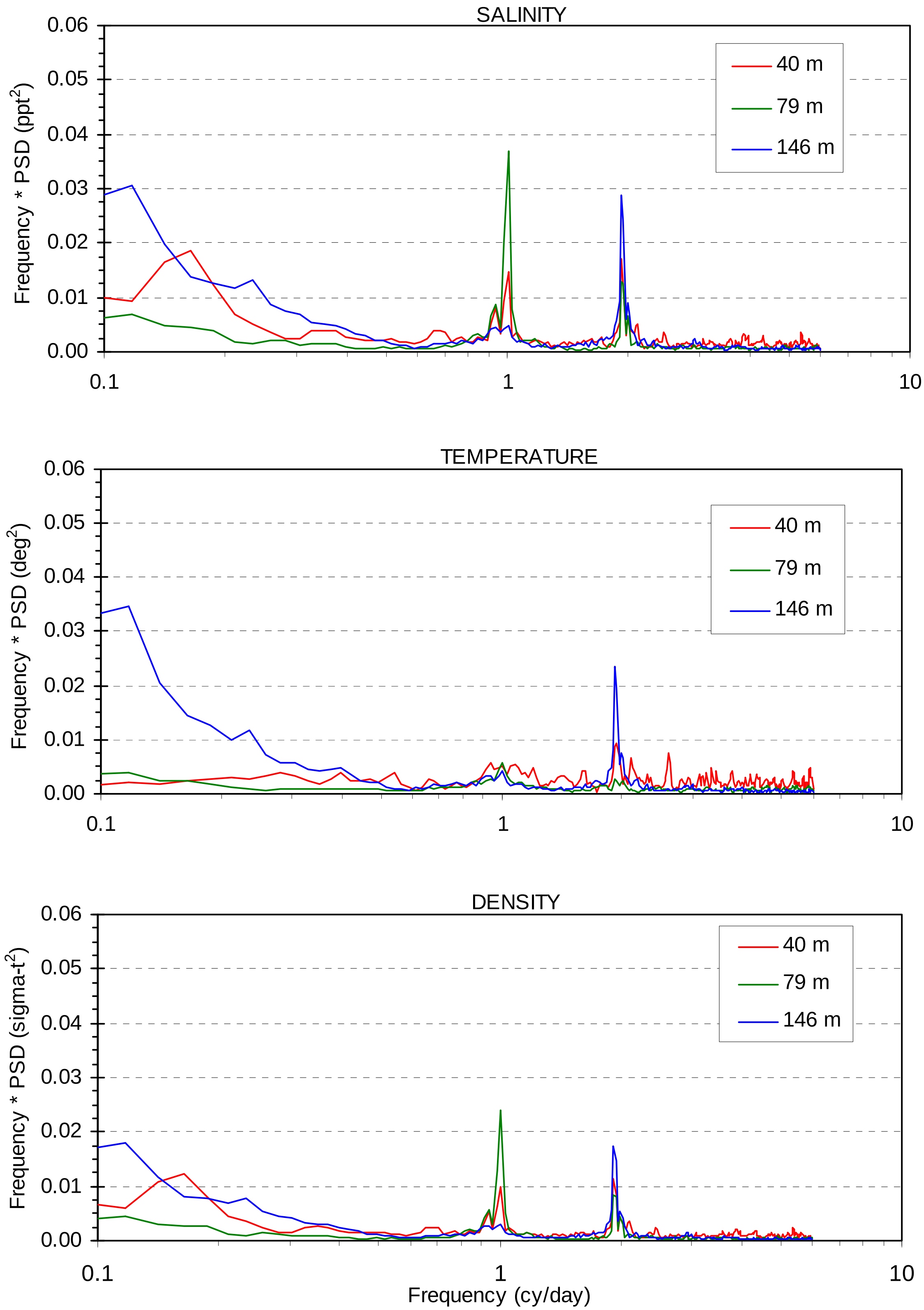
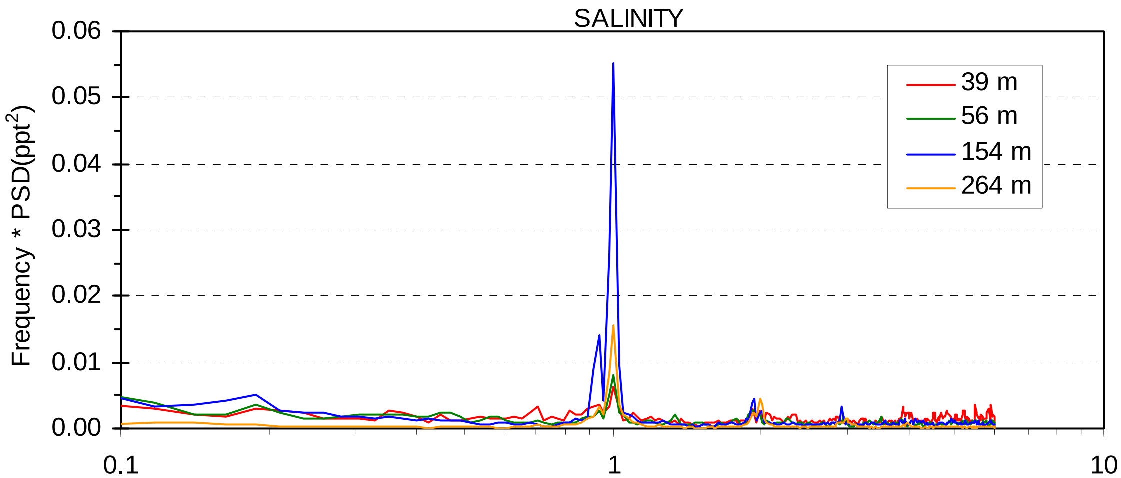
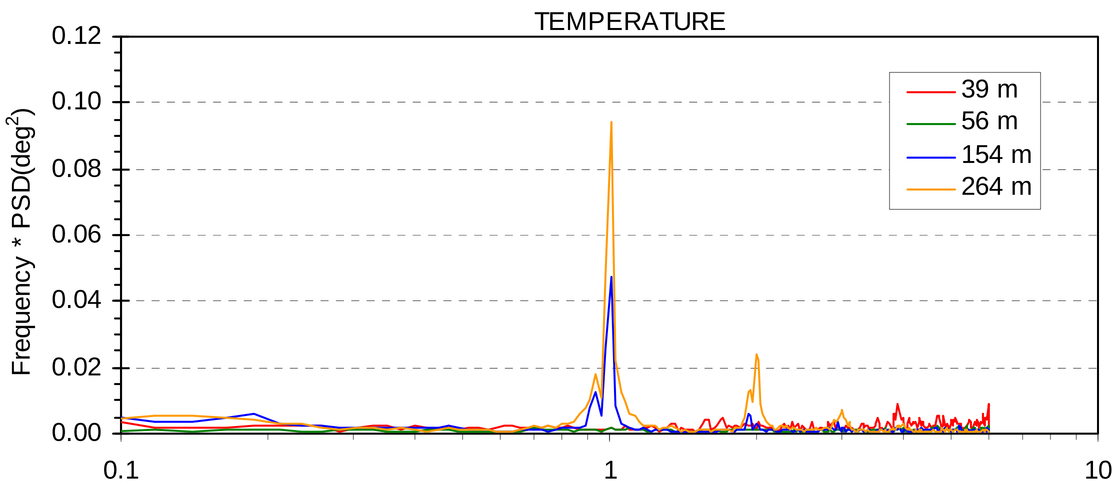


**Figure 6: Power Spectra of moored bi-hourly CTD data.**
**South Central Barrow Strait: Aug. 2010 – Aug. 2011.**



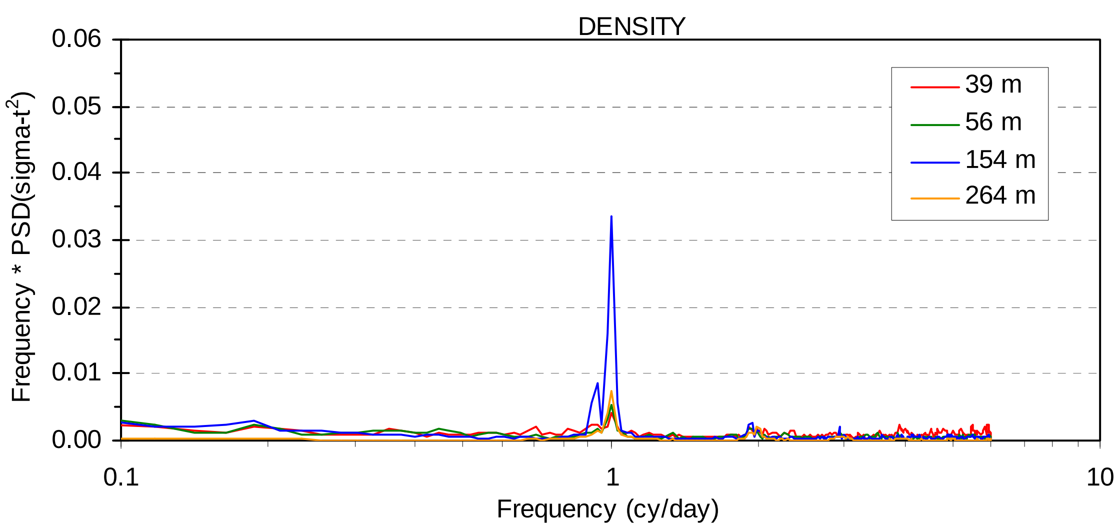
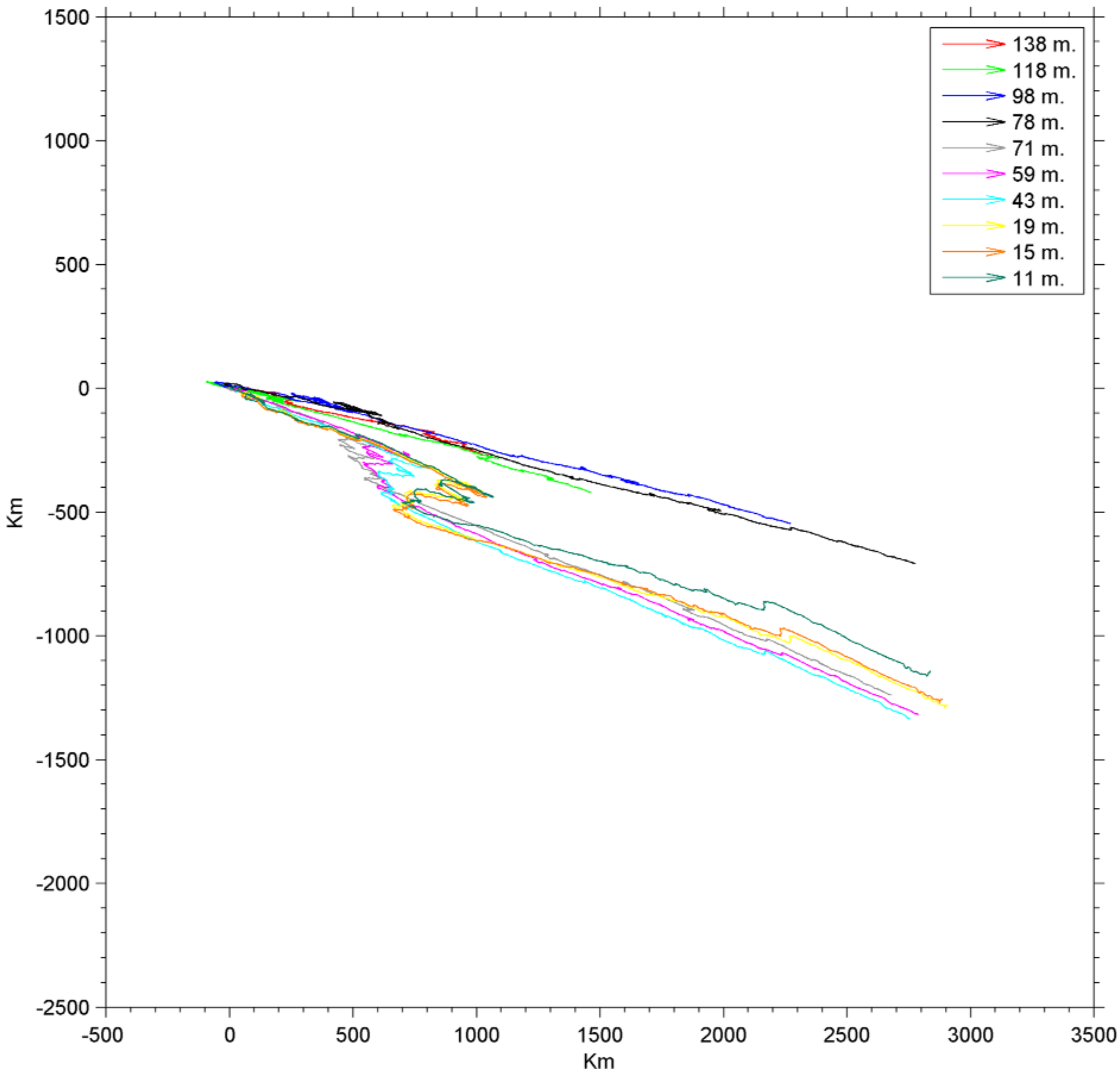
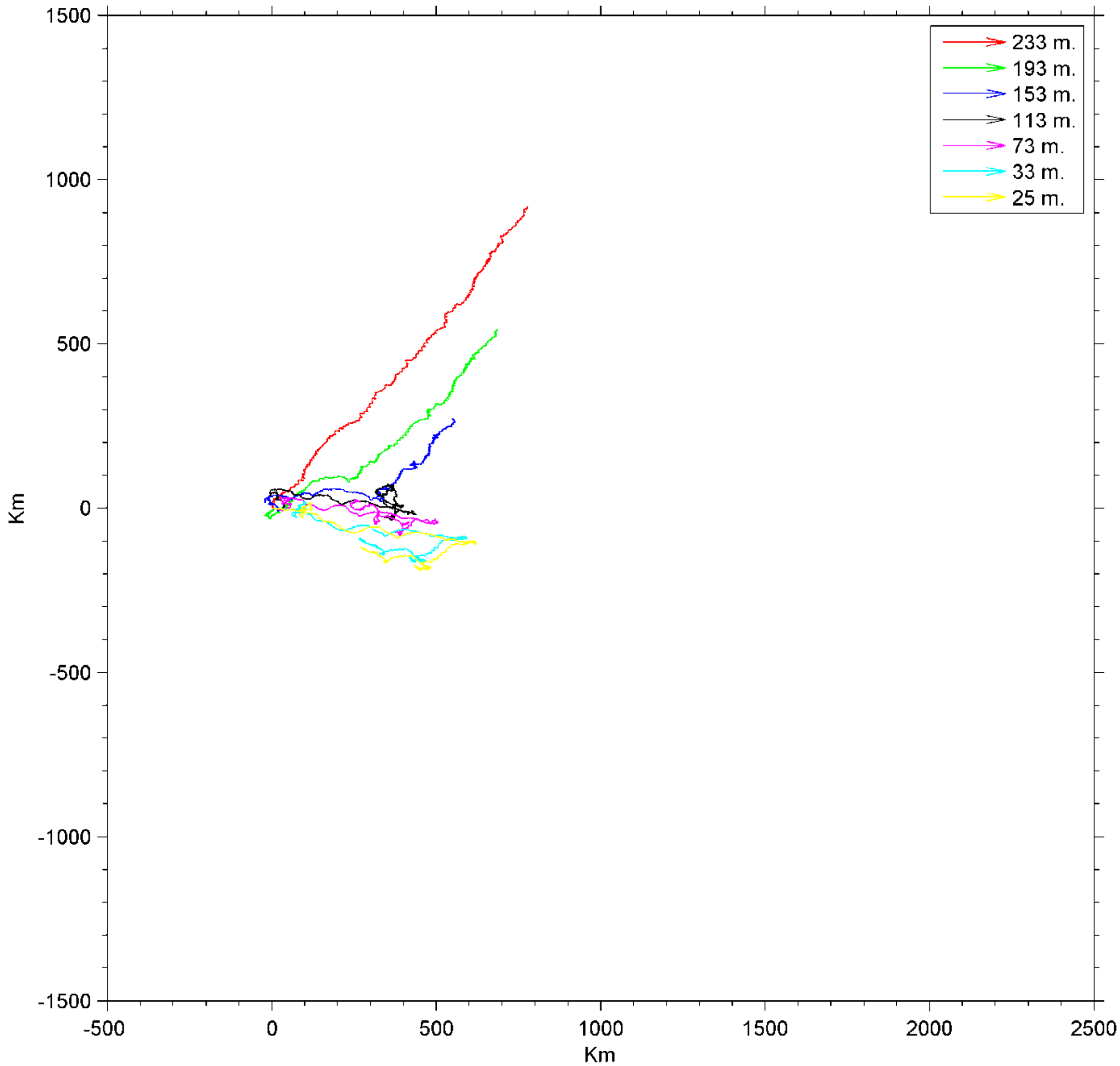



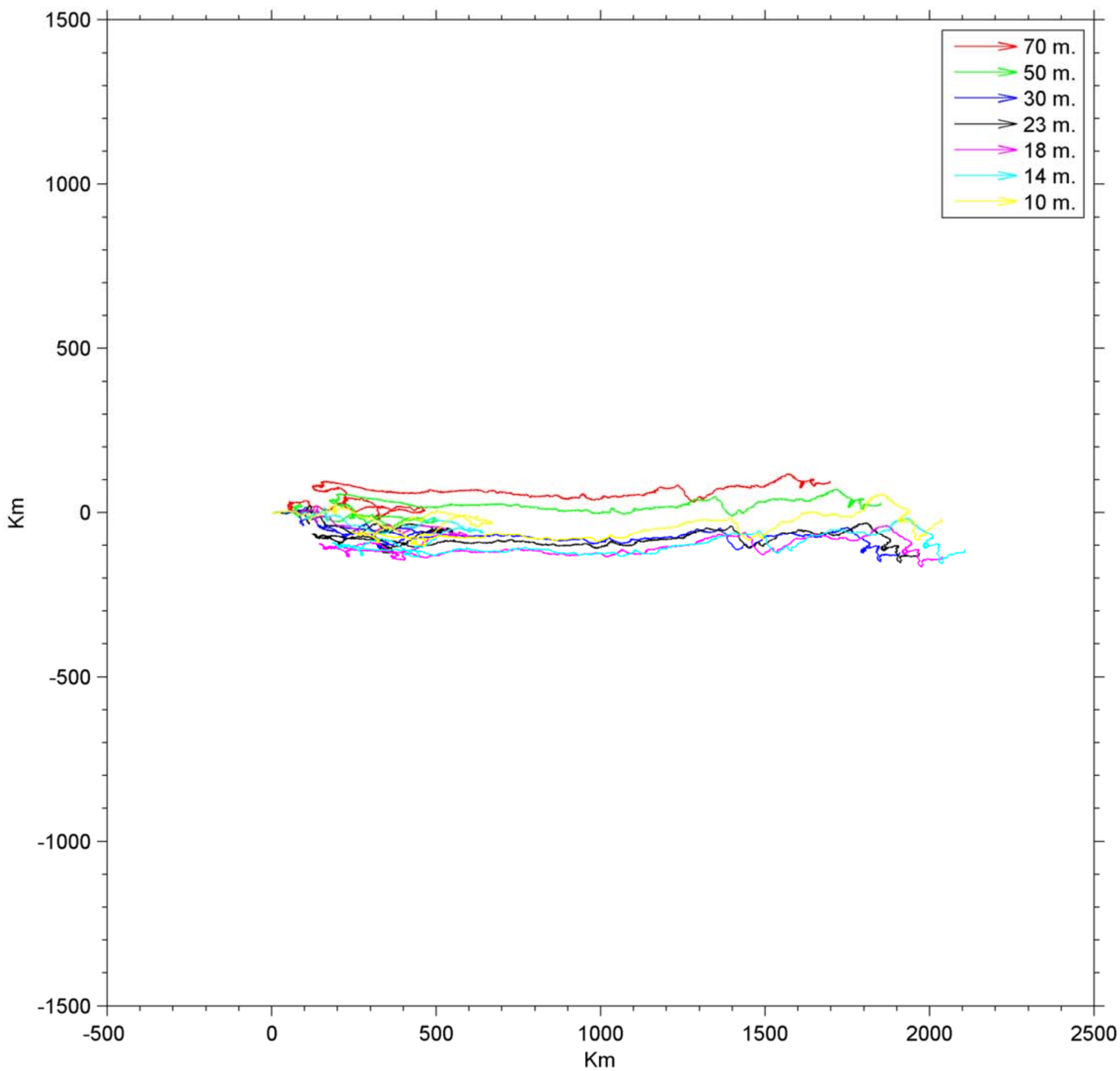
**Figure 7: Progressive Vector Diagram, South Side Barrow Strait.**
**Aug. 10, 2010 – Aug. 7, 2011**



**<u>Figure 8</u>: Progressive Vector Diagram, South Central Barrow Strait. (Quarter Master ADCP) Aug. 11, 2010 – Jan. 19, 2011**



**<u>Figure 9</u>: Progressive Vector Diagram, South Central Barrow Strait. (Workhorse ADCP) Aug. 10, 2010 – Aug. 7, 2011**



**<u>Figure 10</u>: Bi-hourly current data, South Side Barrow Strait.**
**Sep. 1, 2010 – Sep. 30, 2010**

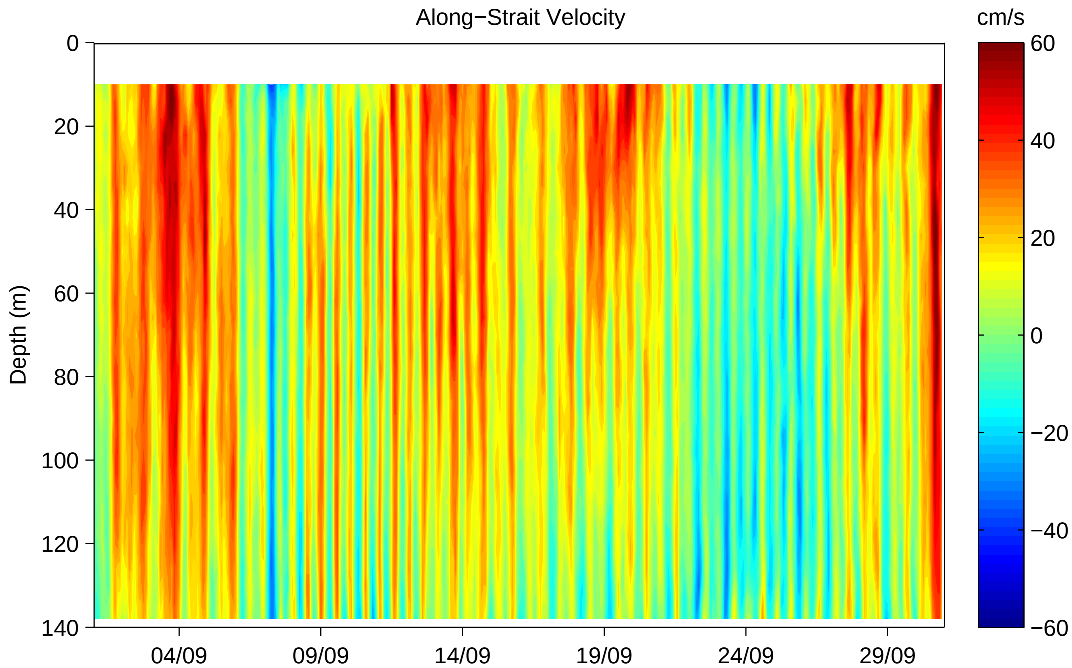
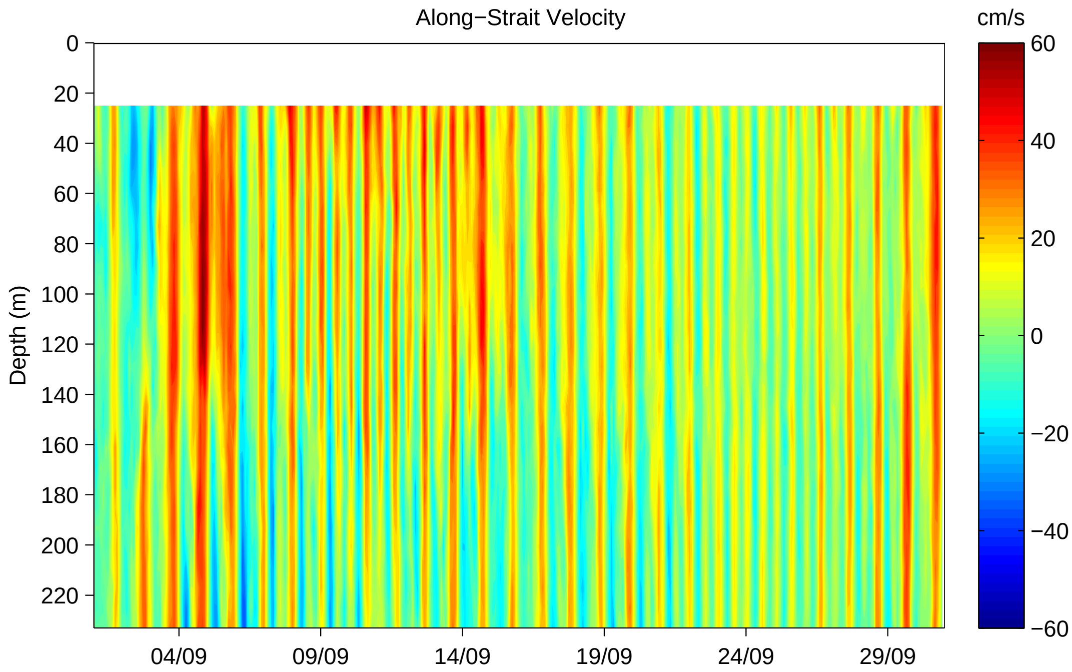
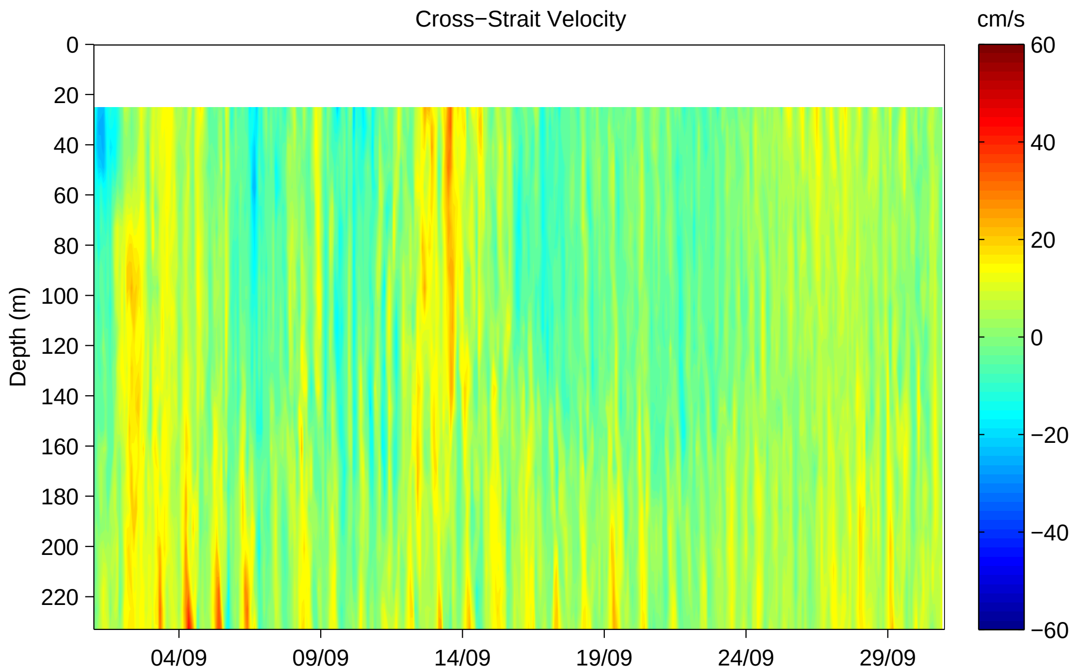
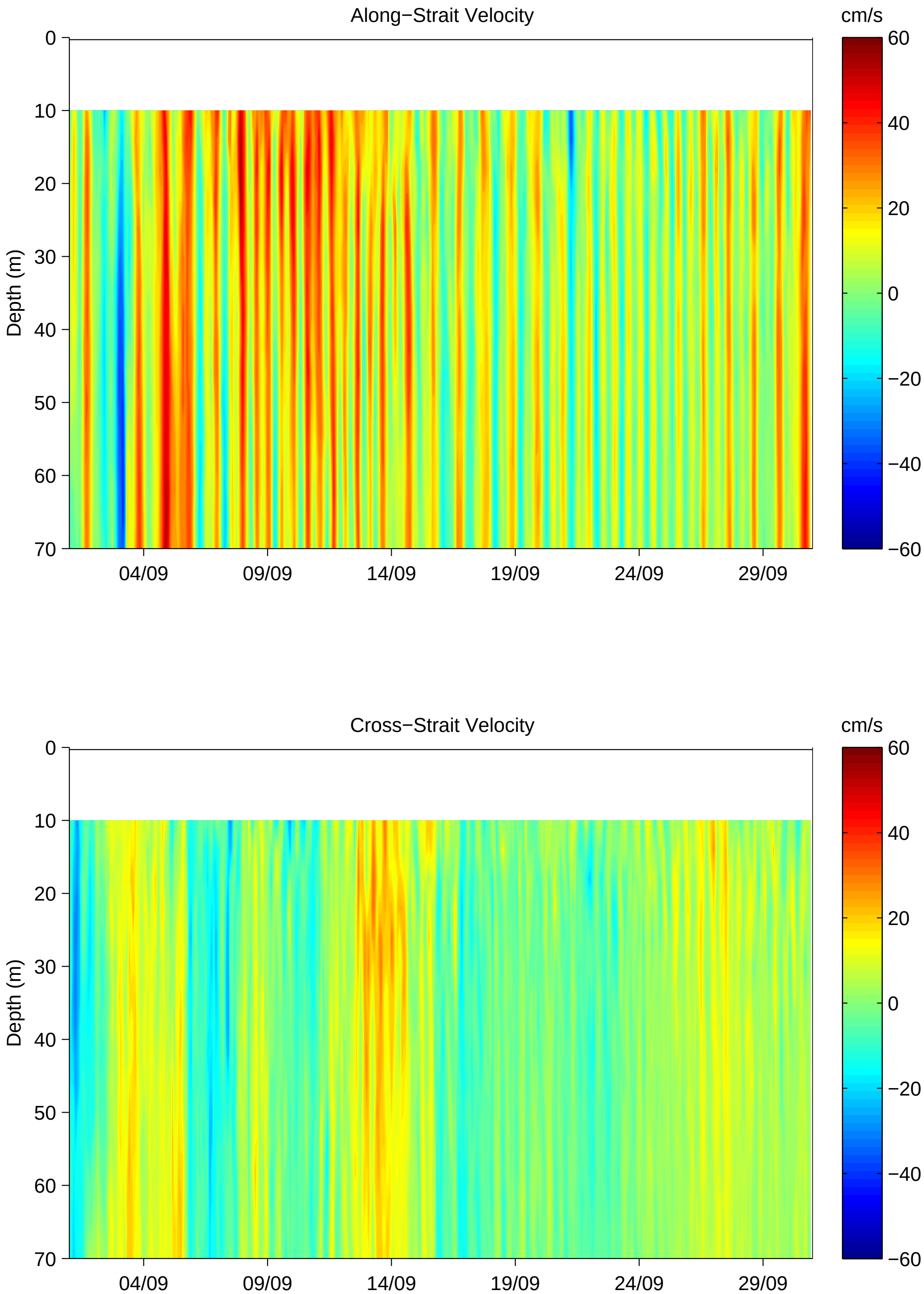



**Figure 11**: Bi-hourly current data, South Central Barrow Strait. (Quarter Master ADCP), Sep. 1, 2010 – Sep. 30, 2010

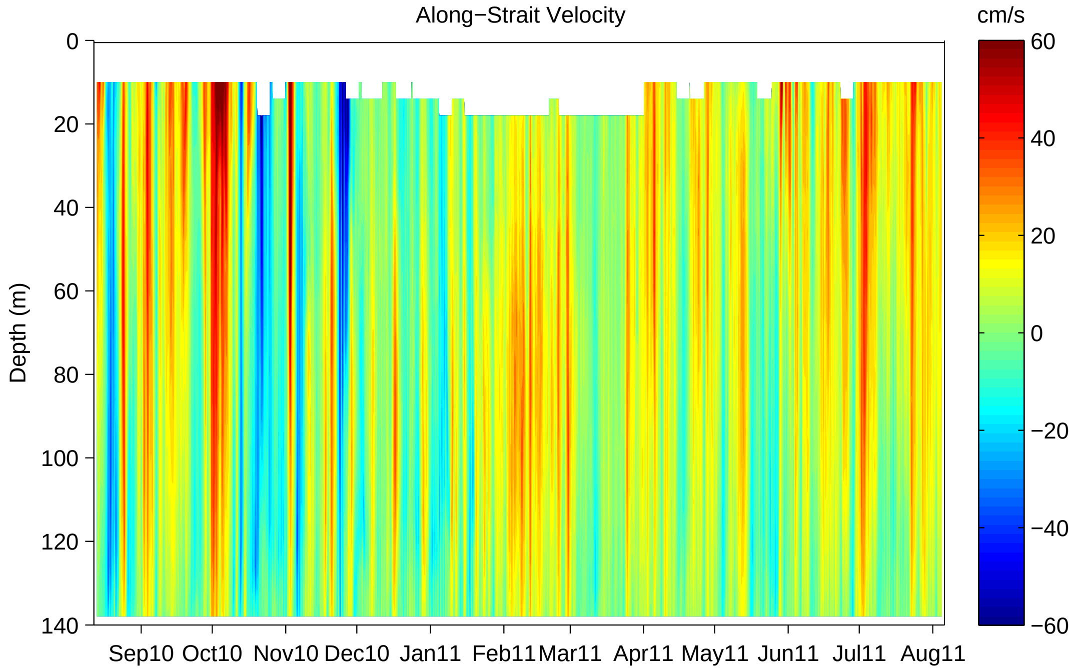


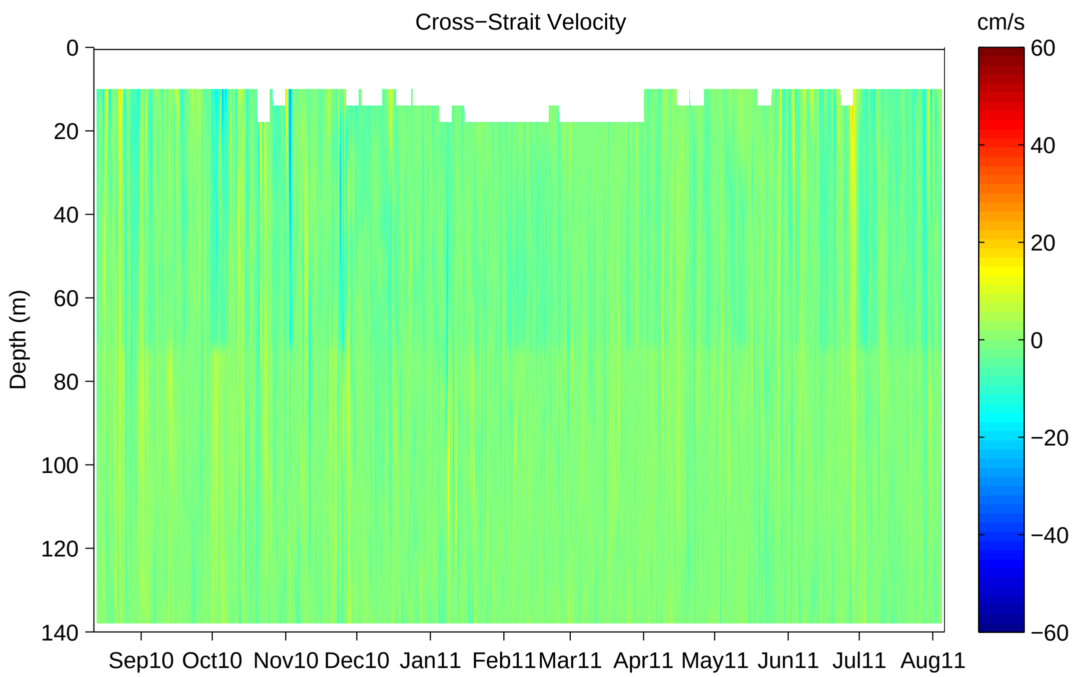



**<u>Figure 12</u>: Bi-hourly current data, South Central Barrow Strait. (Workhorse ADCP) Sep. 1, 2010 – Sep. 30, 2010**

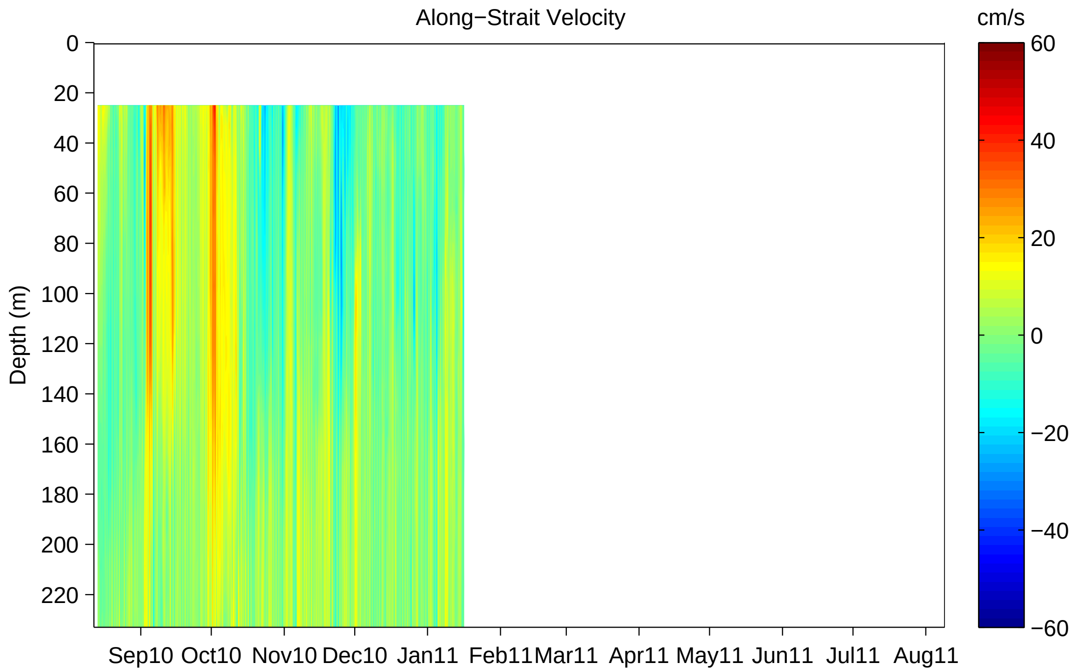


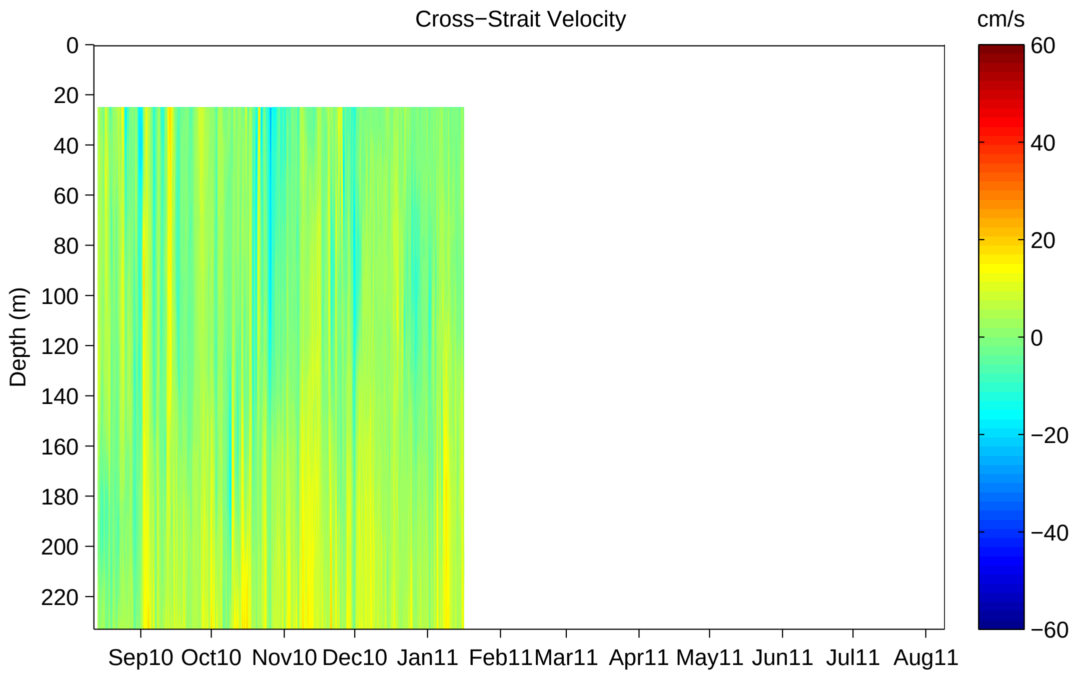
**<u>Figure 13</u>: Low-pass filtered currents, South Side Barrow Strait. August 2010 – August 2011**



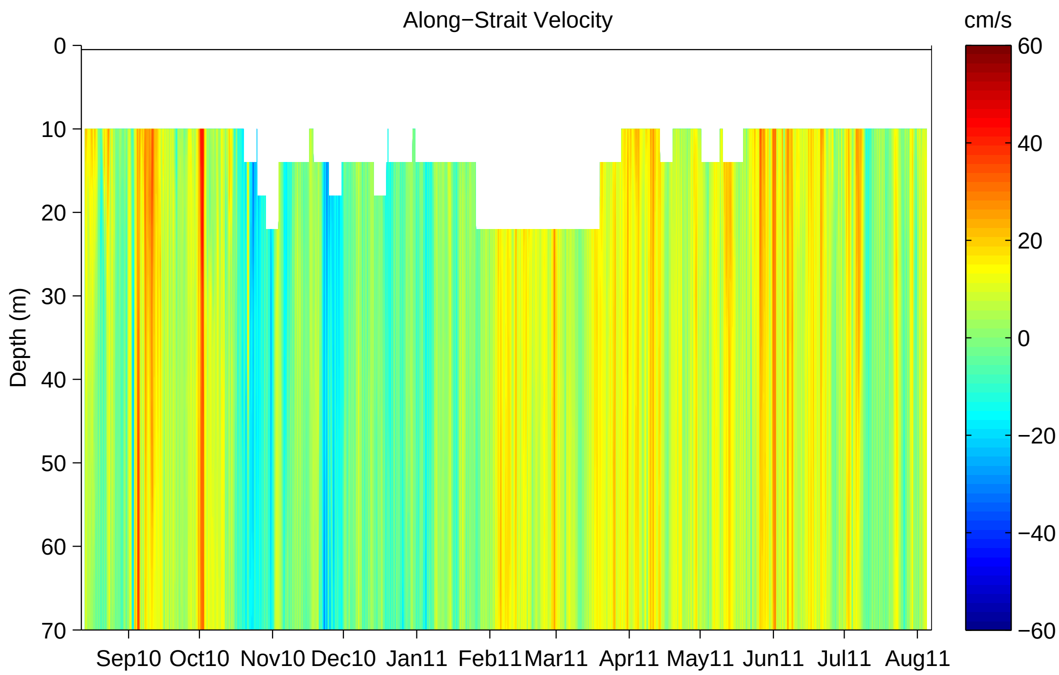



**<u>Figure 14</u>: Low-pass filtered currents, South Central Barrow Strait. (Quarter Master ADCP) August 2010 – January 2011**



**<u>Figure 15</u>: Low-pass filtered currents, South Central Barrow Strait. (Workhorse ADCP) August 2010 – August 2011**



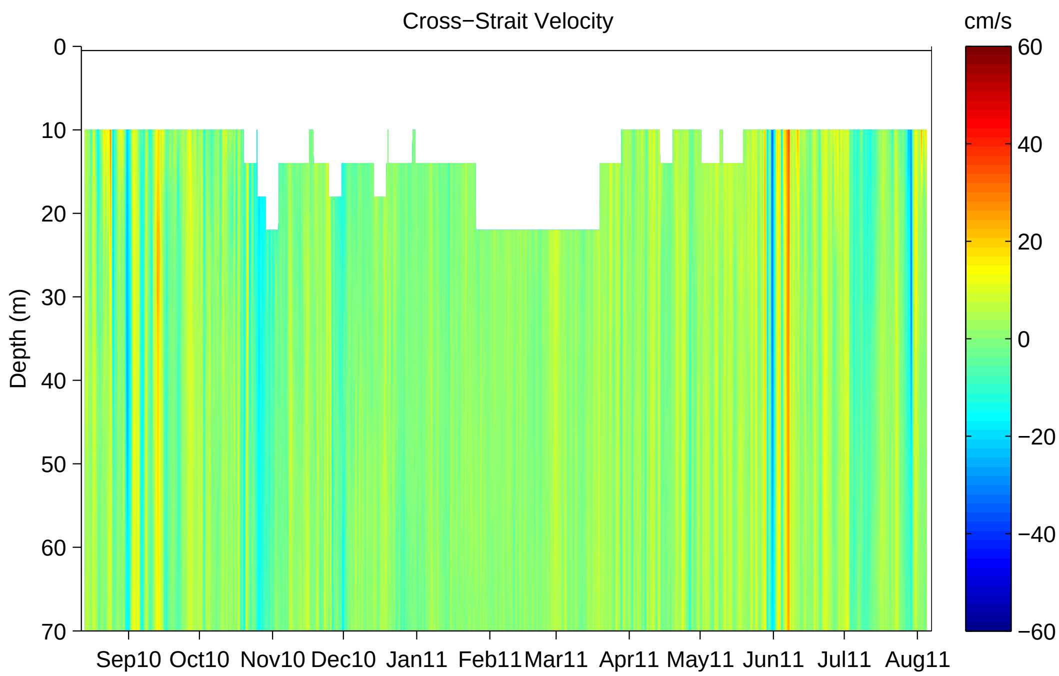
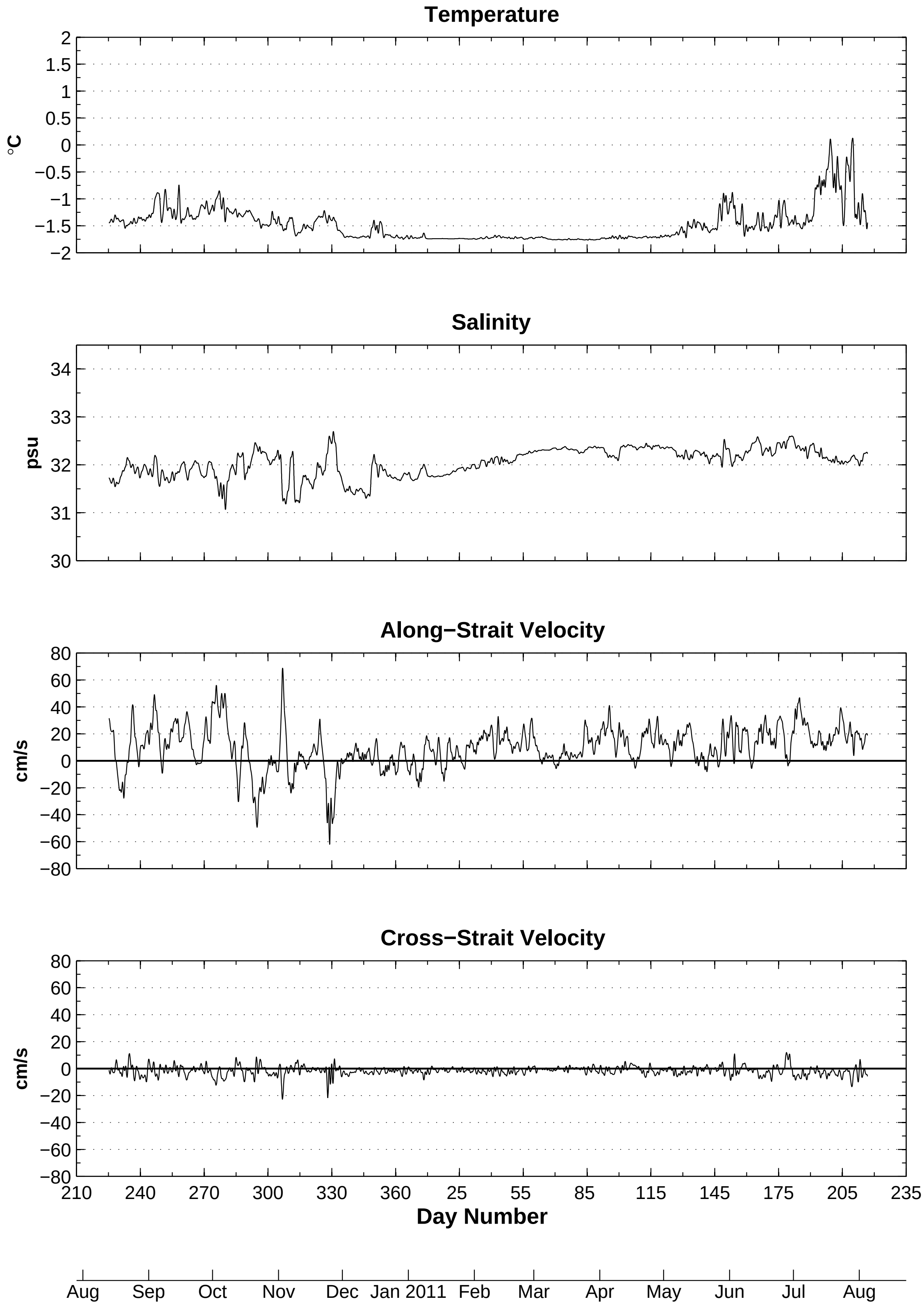
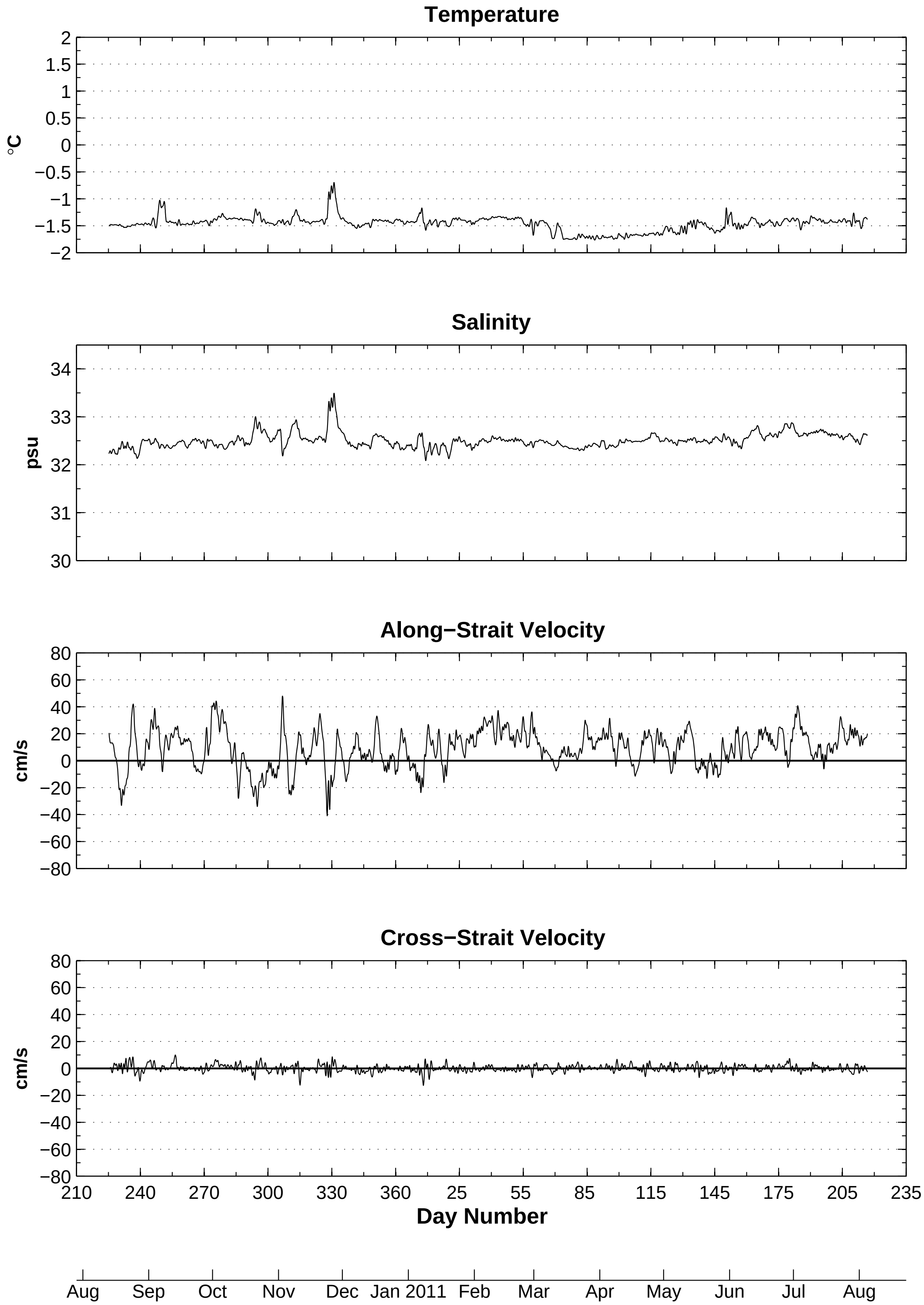



**Figure 16: Low-pass filtered T,S (40 m.) and current data (35 m.). South Side Barrow Strait: August 2010 - August 2011.**



**<u>Figure 17</u>: Low-pass filtered T,S (79 m.) and current data (78 m.). South Side Barrow Strait: August 2010 – August 2011.**



**<u>Figure 18</u>: Low-pass filtered T,S (146 m.) and current data (138 m.). South Side Barrow Strait: August 2010 – August 2011.**

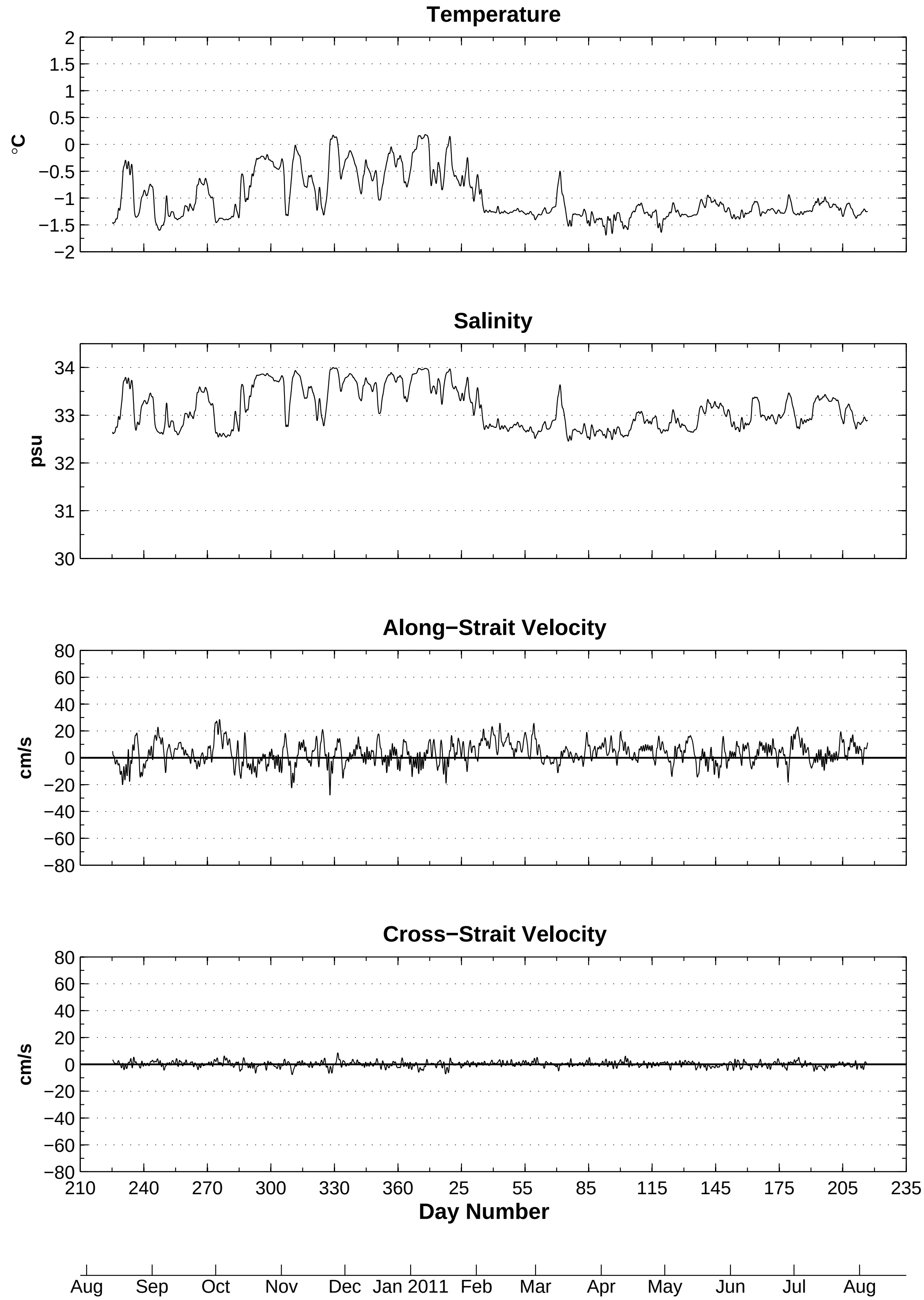


**Figure 19: Low-pass filtered T,S data (39 m.) and current data (38 m.) South Central Barrow Strait: August 2010 – August 2011.**

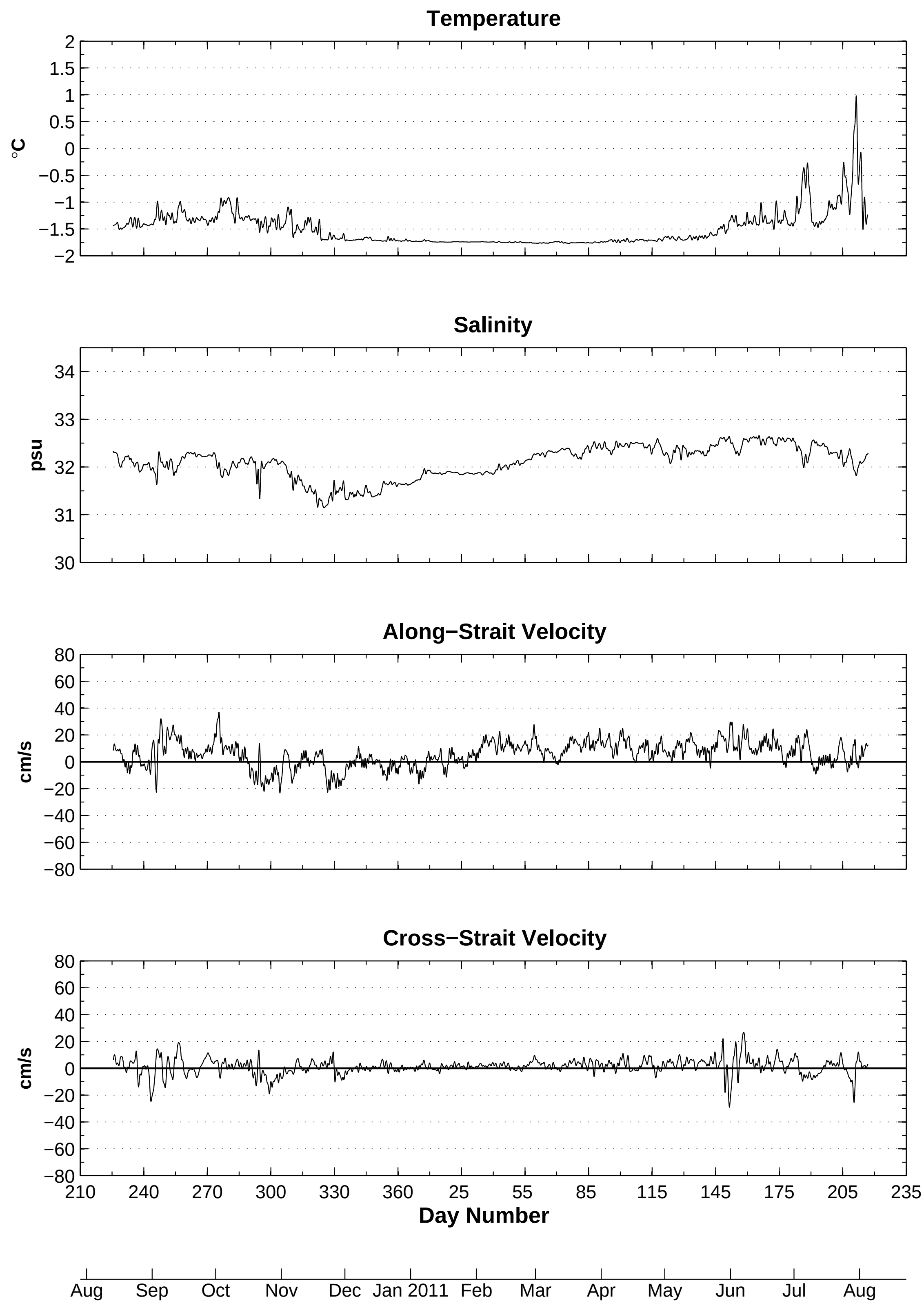


**Figure 20: Low-pass filtered T,S data (56 m.) and current data (54 m.) South Central Barrow Strait: August 2010 – August 2011.**

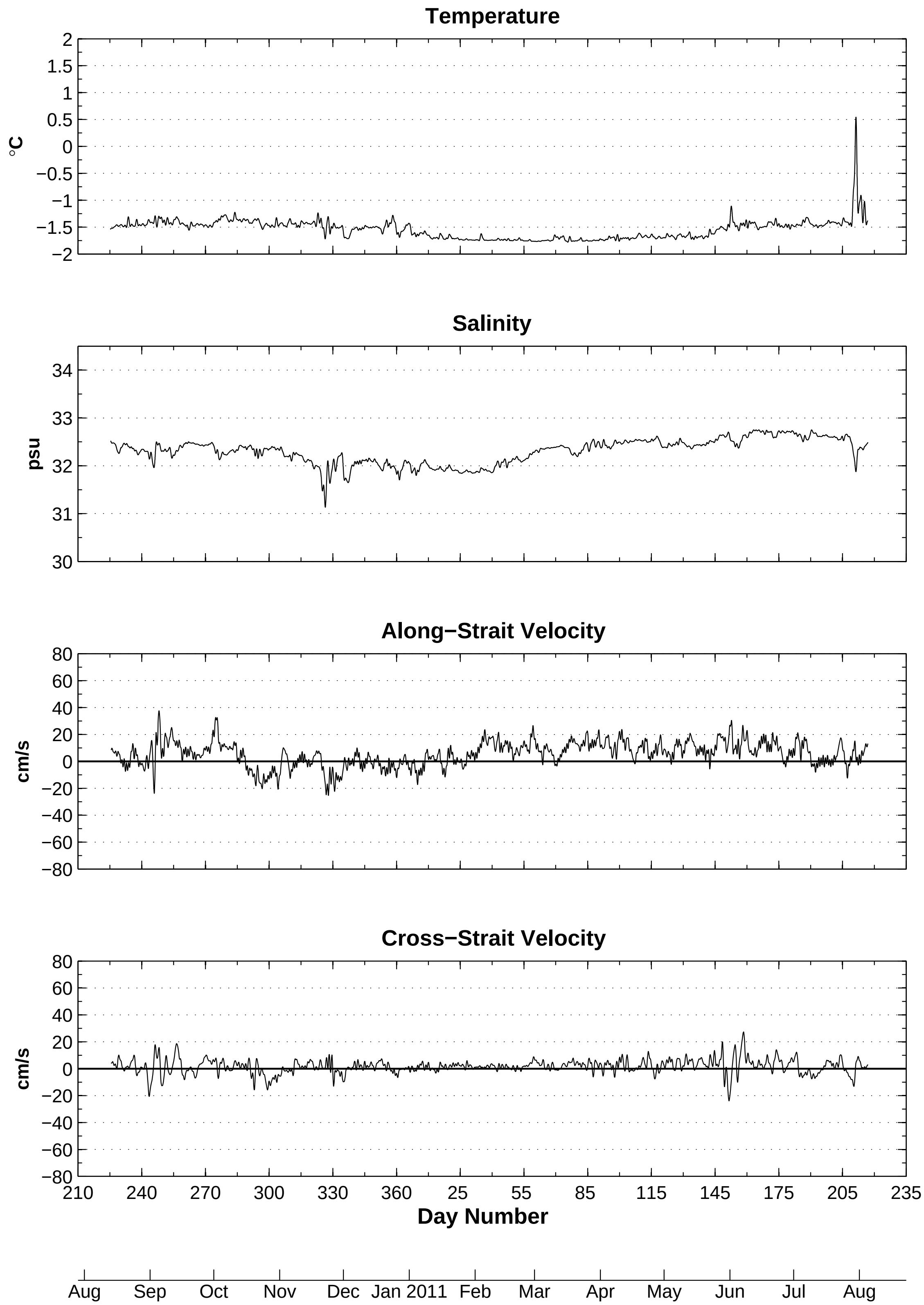


**Figure 21: Low-pass filtered T,S (154 m.) and current data (153 m.). South Central Barrow Strait: August 2010 - August 2011.**

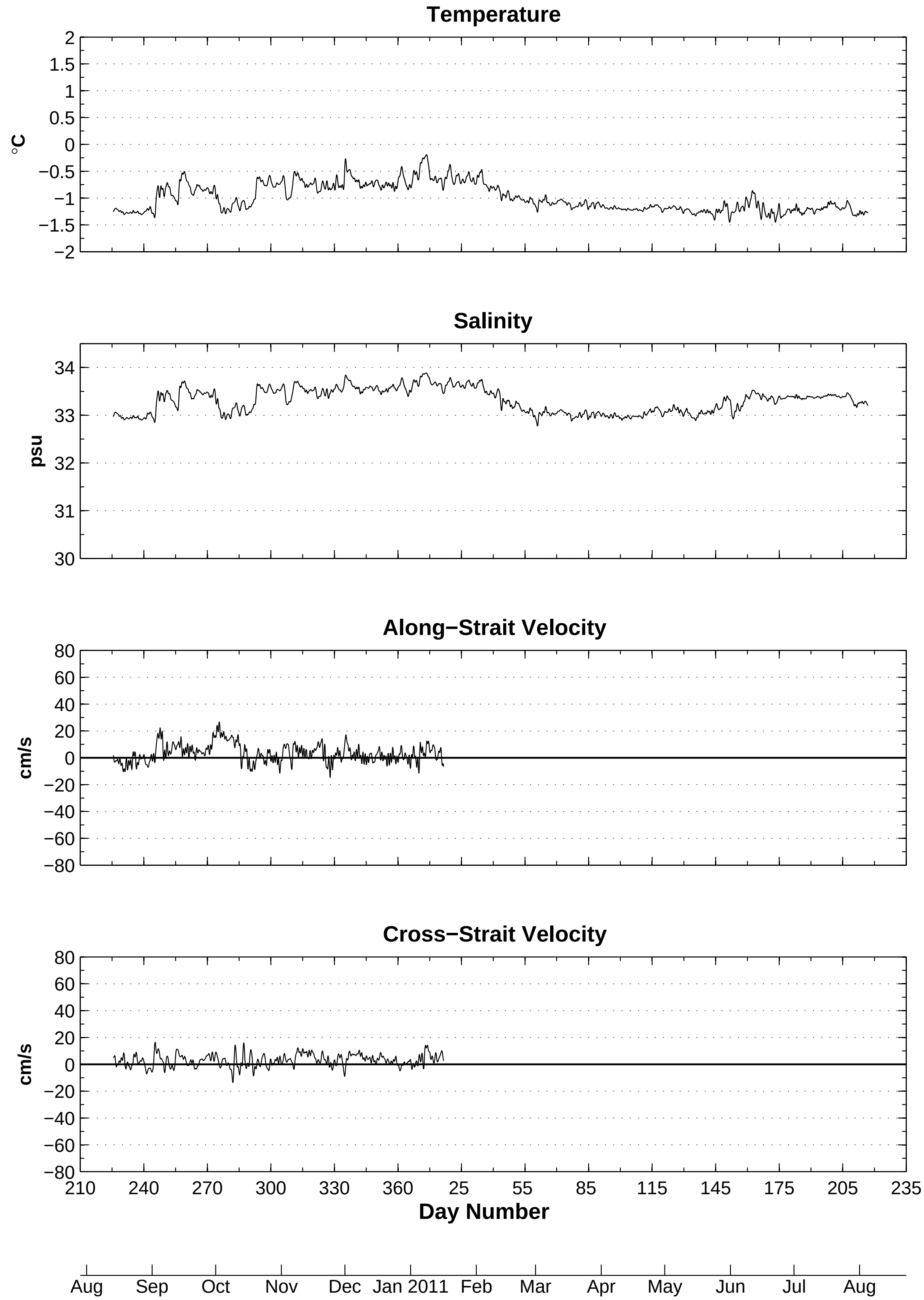
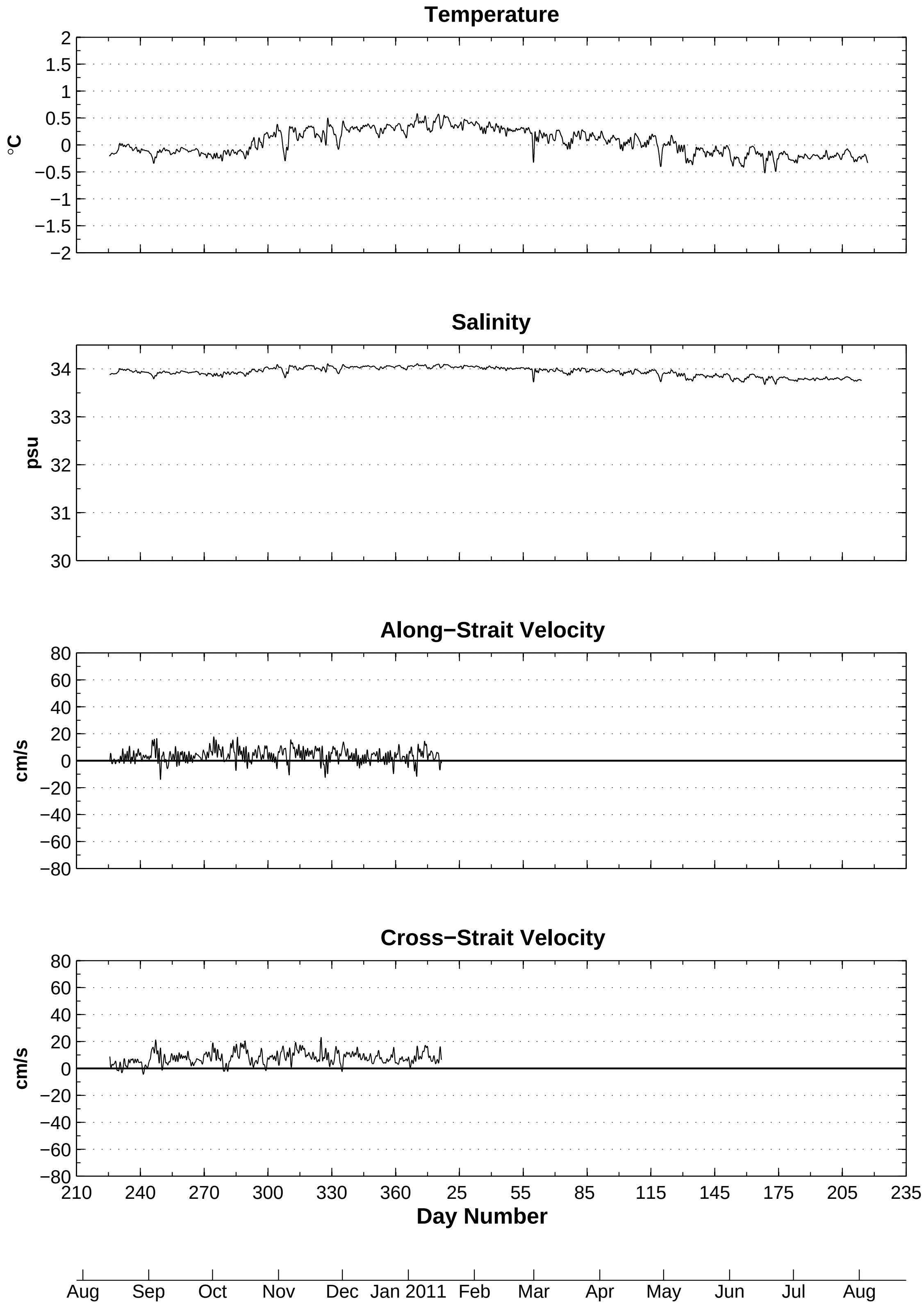
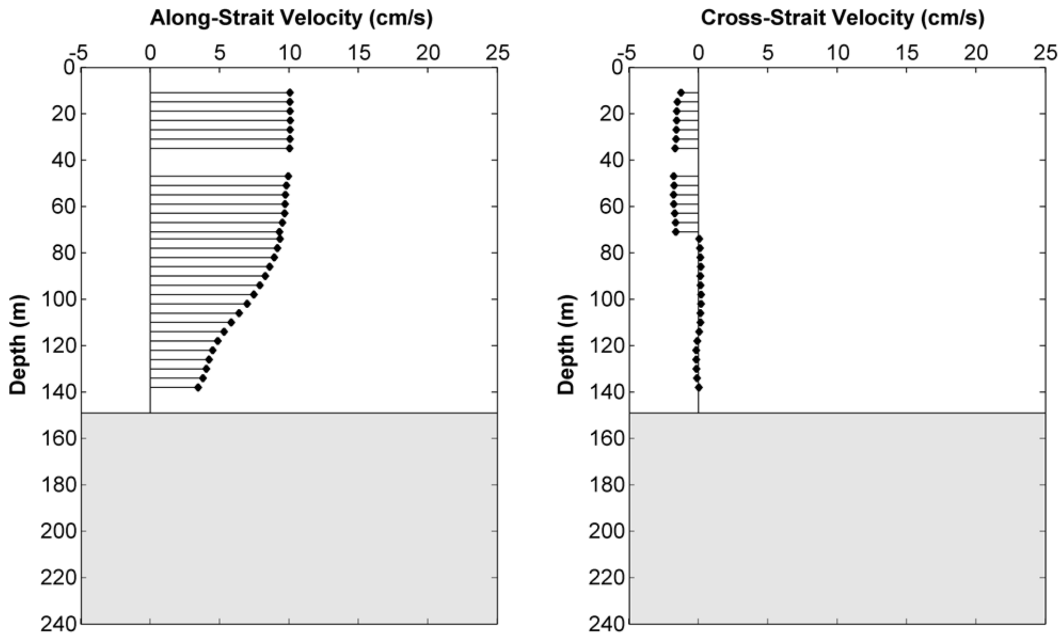


**Figure 22: Low-pass filtered T,S (264 m) and current data (233 m.). South Central Barrow Strait: August 2010 - August 2011.**

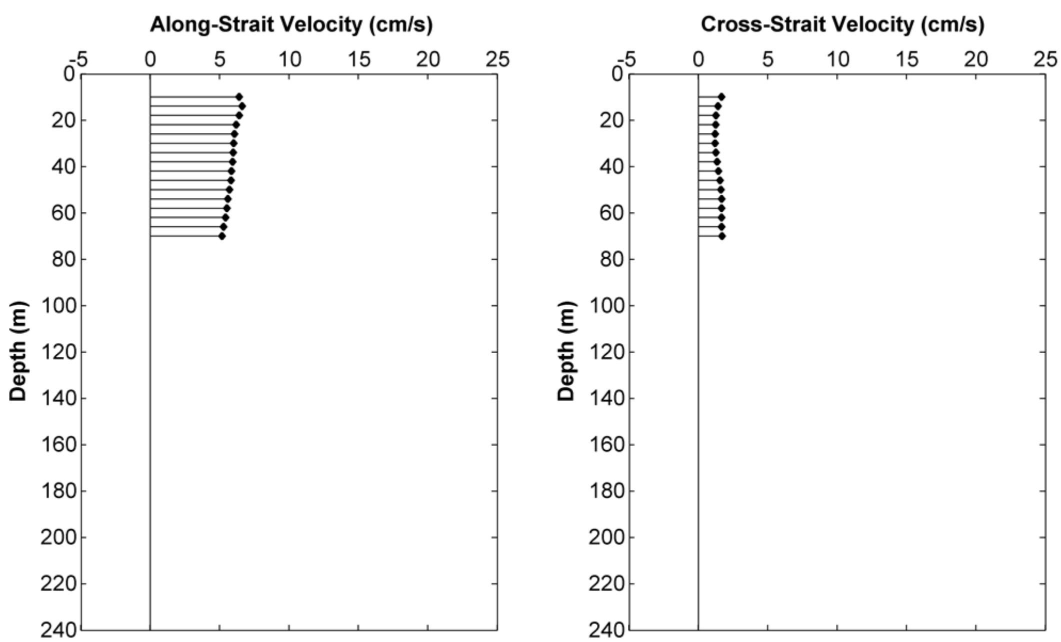


## Figure 23: Mean Flows, August 2010 to August 2011.

**South side of Barrow Strait**

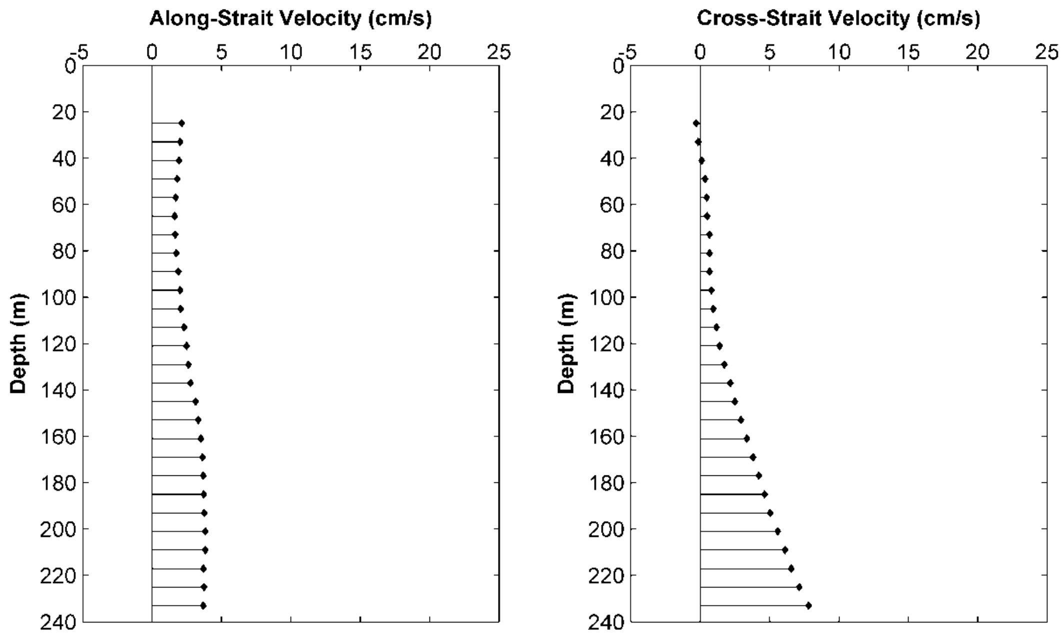



**South Central Barrow Strait (WHADCP)**



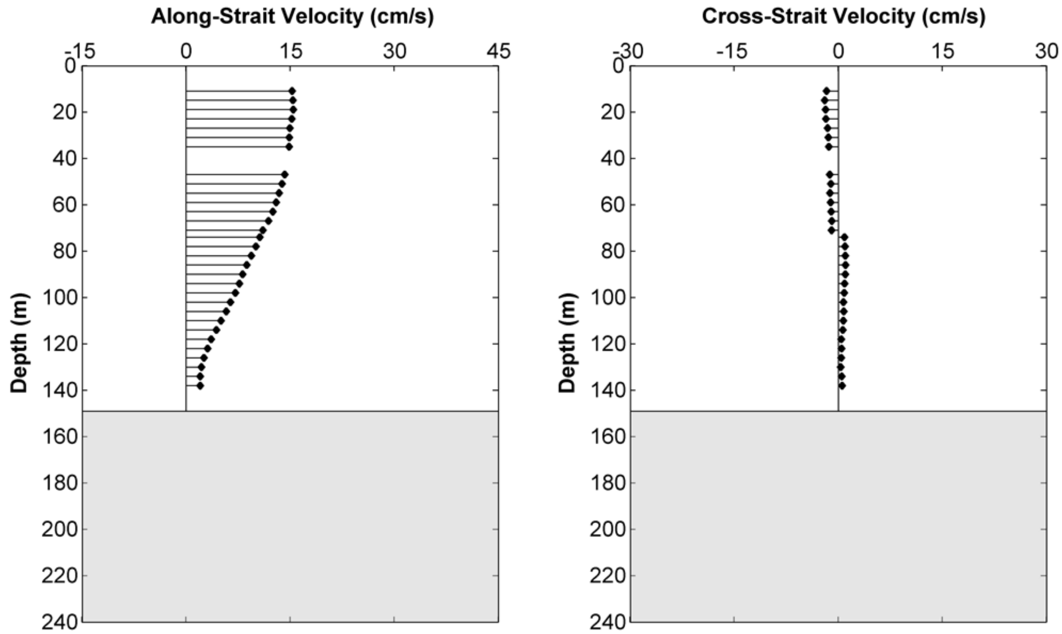
## **Figure 23**: Mean Flows, August 2010 to January 2011. (continued)

**South Central Barrow Strait (QMADCP)**



**<u>Figure 24</u>: Mean Flows, Late Summer: Aug. 2010 to Sep. 2010.**

**South side of Barrow Strait**




**South Central Barrow Strait (WHADCP)**

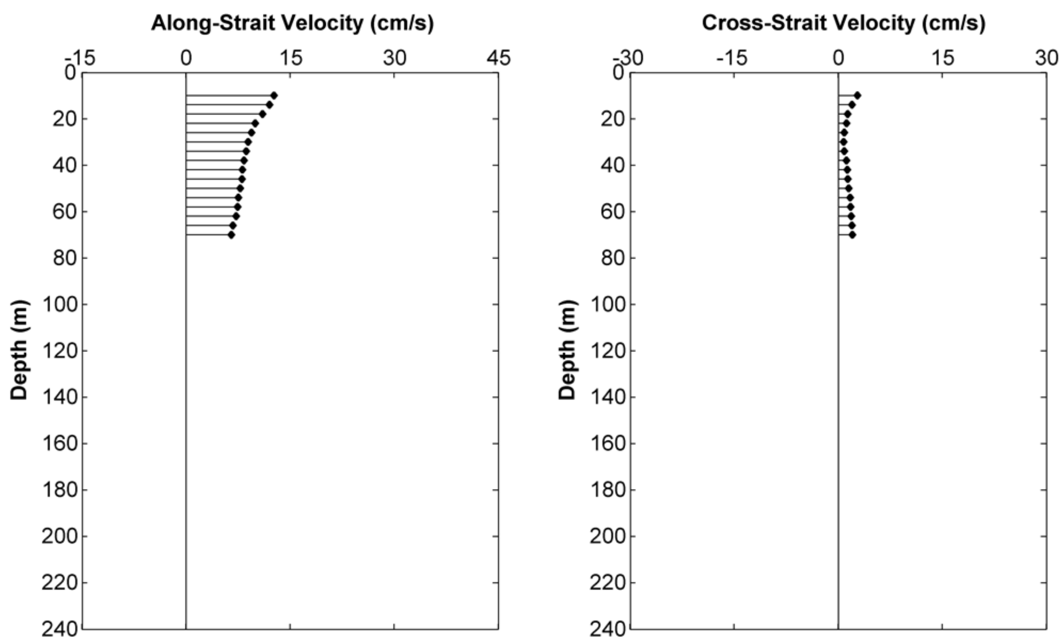
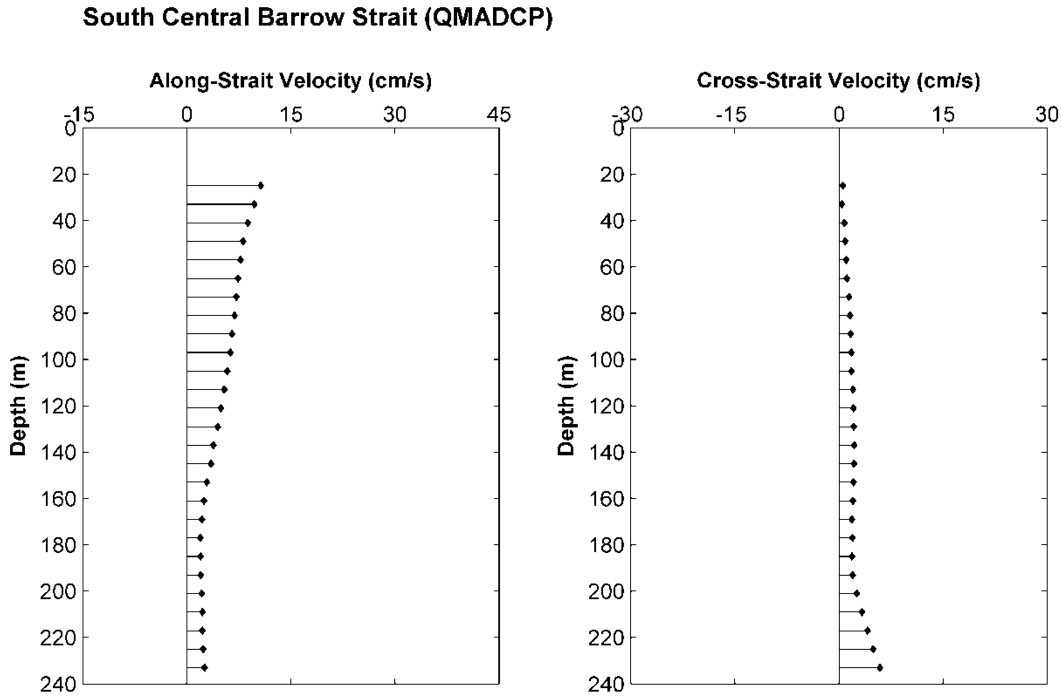
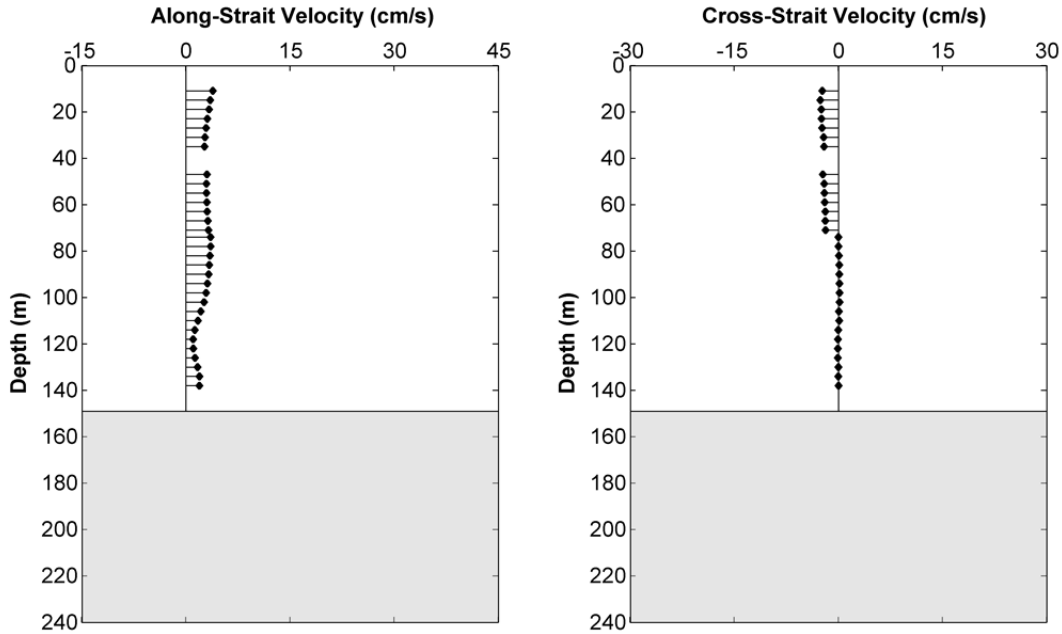


**Figure 24: Mean Flows, Late Summer: Aug. 2010 to Sep. 2010 (continued)**



**<u>Figure 25</u>: Mean Flows, Fall: Sep. 2010 to Dec. 2010.**

**South side of Barrow Strait**




**South Central Barrow Strait (WHADCP)**

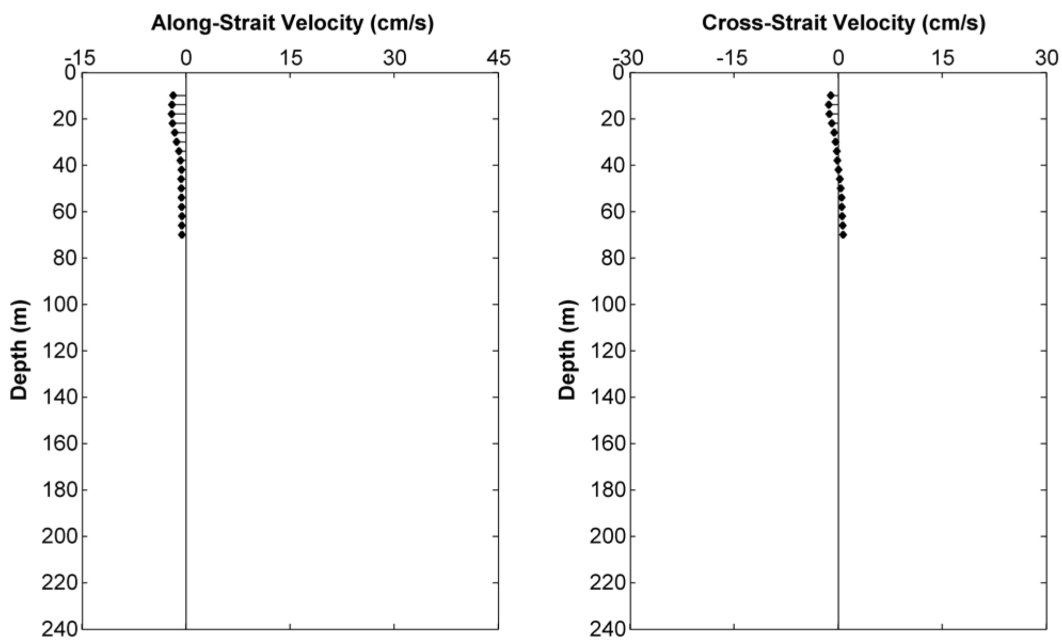


**Figure 25: Mean Flows, Fall: Sep. 2010 to Dec. 2010 (continued).**

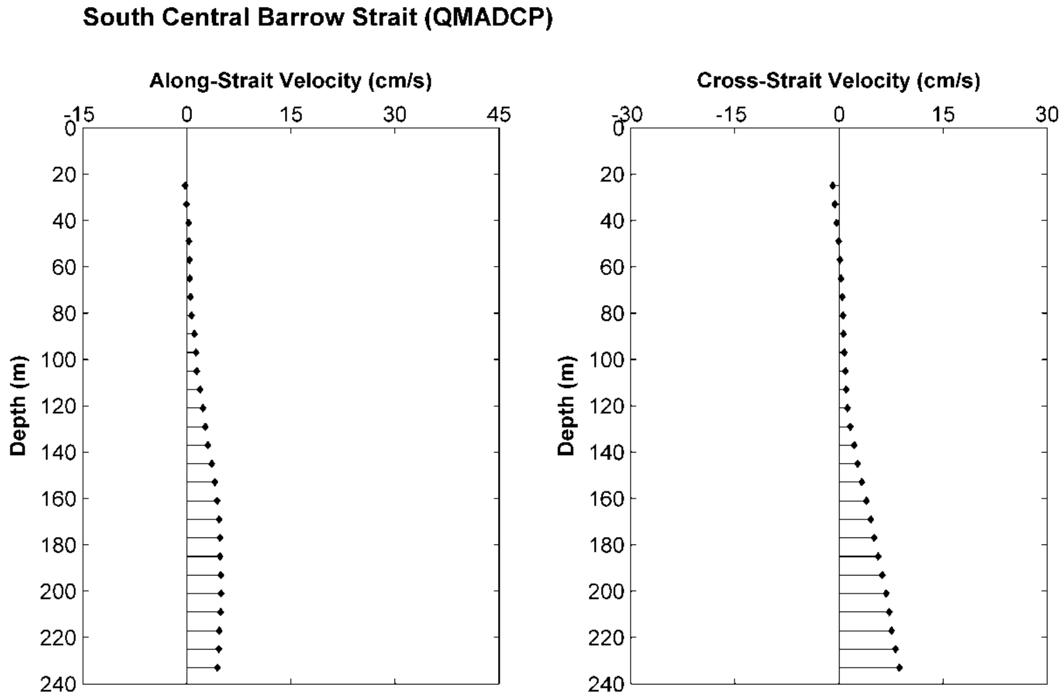
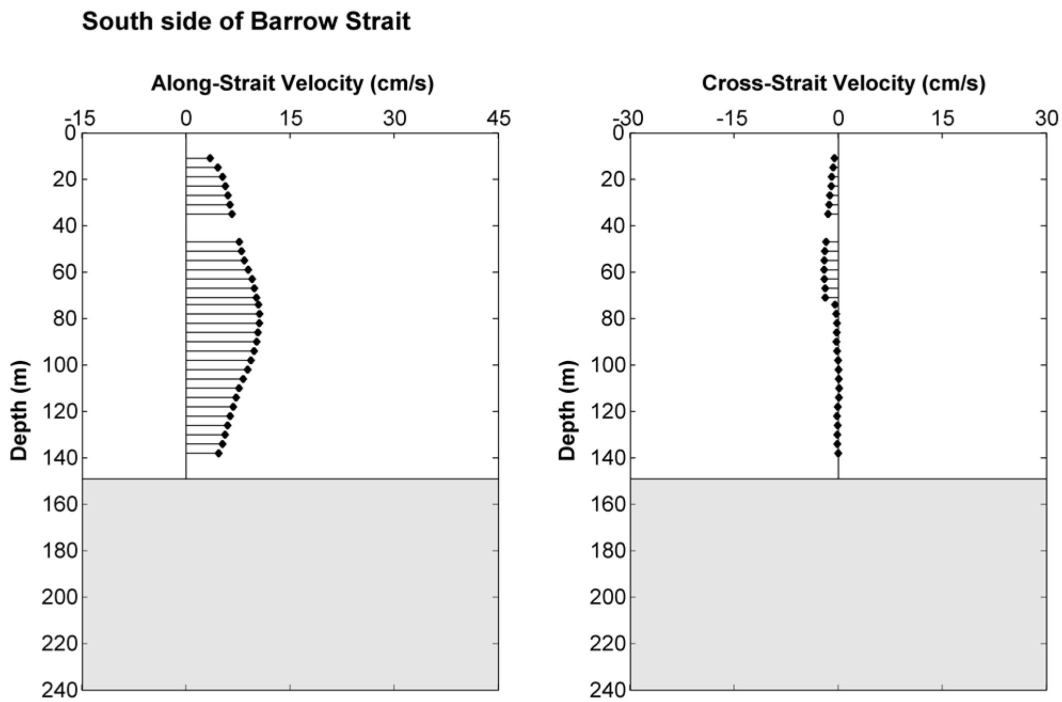


**Figure 26: Mean Flows, Winter: Dec. 2010 to Mar. 2011.**



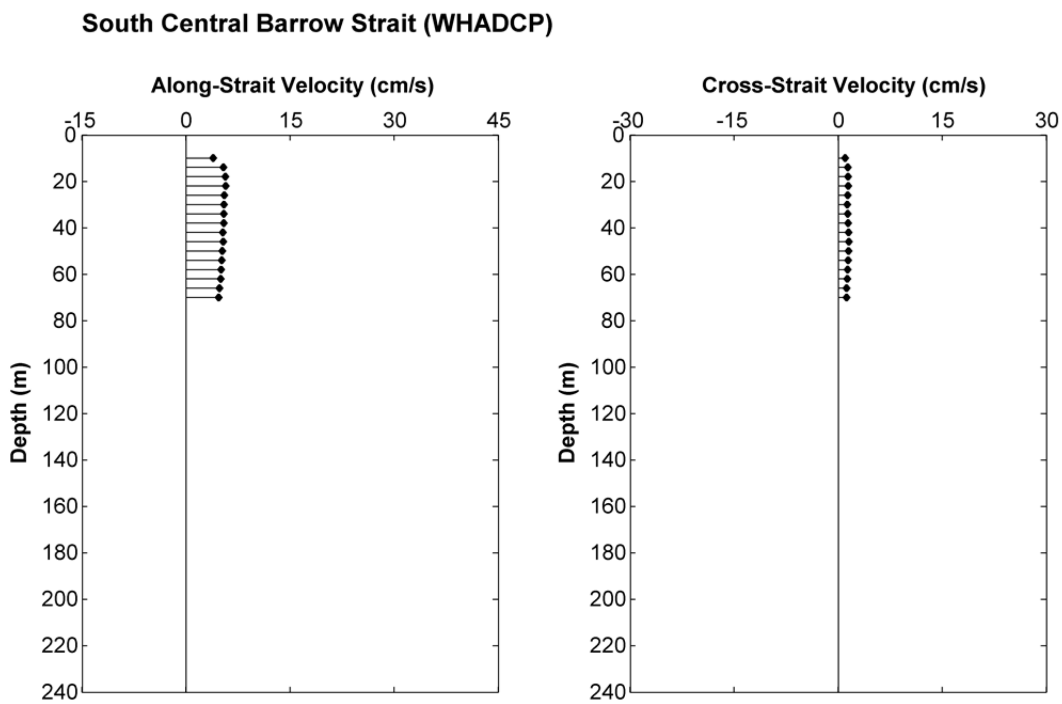



**Figure 26: Mean Flows, Winter: Dec. 2010 to Jan. 2011 (continued).**

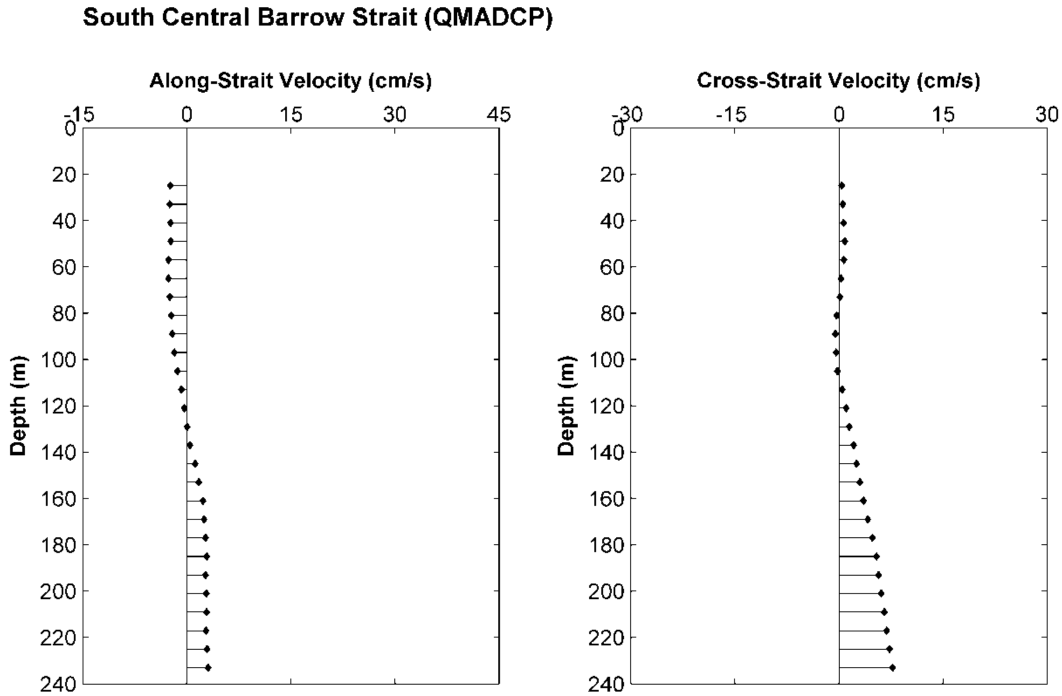
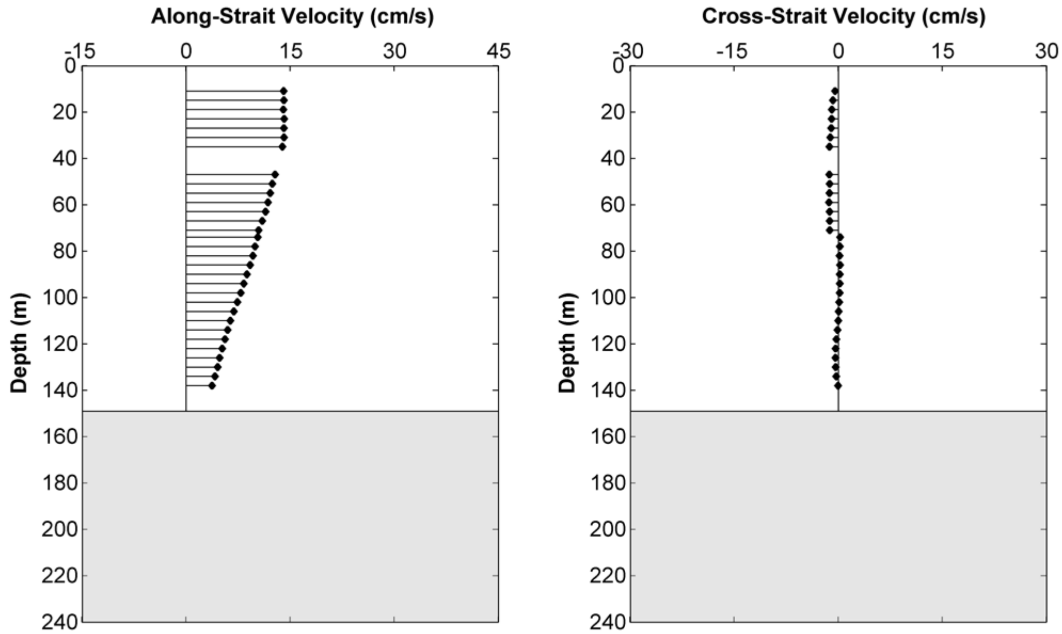
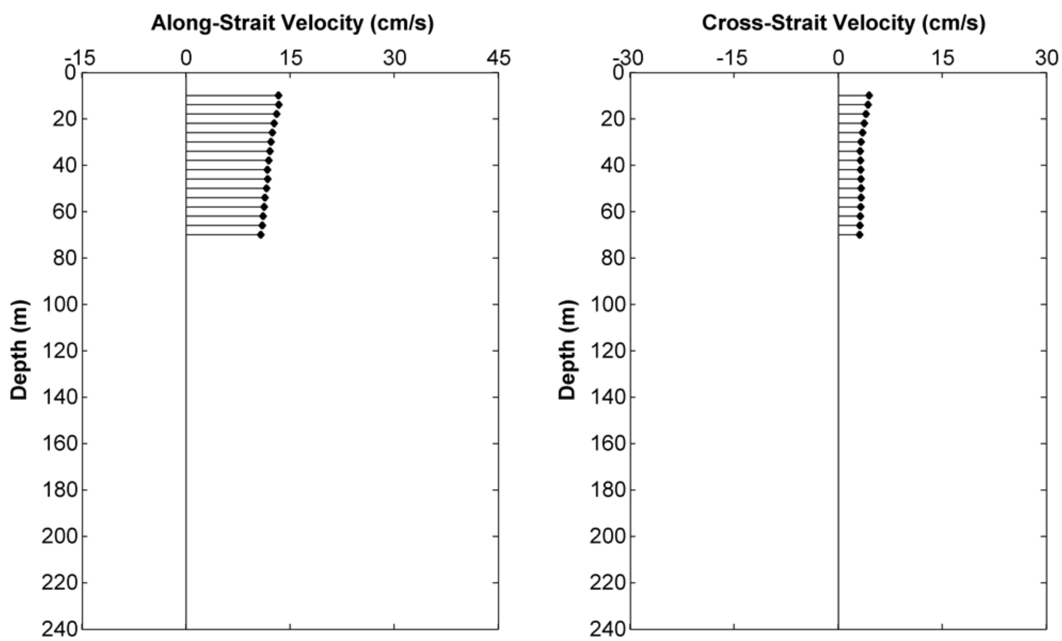


**Figure 27: Mean Flows, Spring: Mar. 2011 to Jun. 2011.**

**South side of Barrow Strait**




**South Central Barrow Strait (WHADCP)**



**<u>Figure 27</u>: Mean Flows, Spring: Mar. 2011 to Jun. 2011 (continued).**

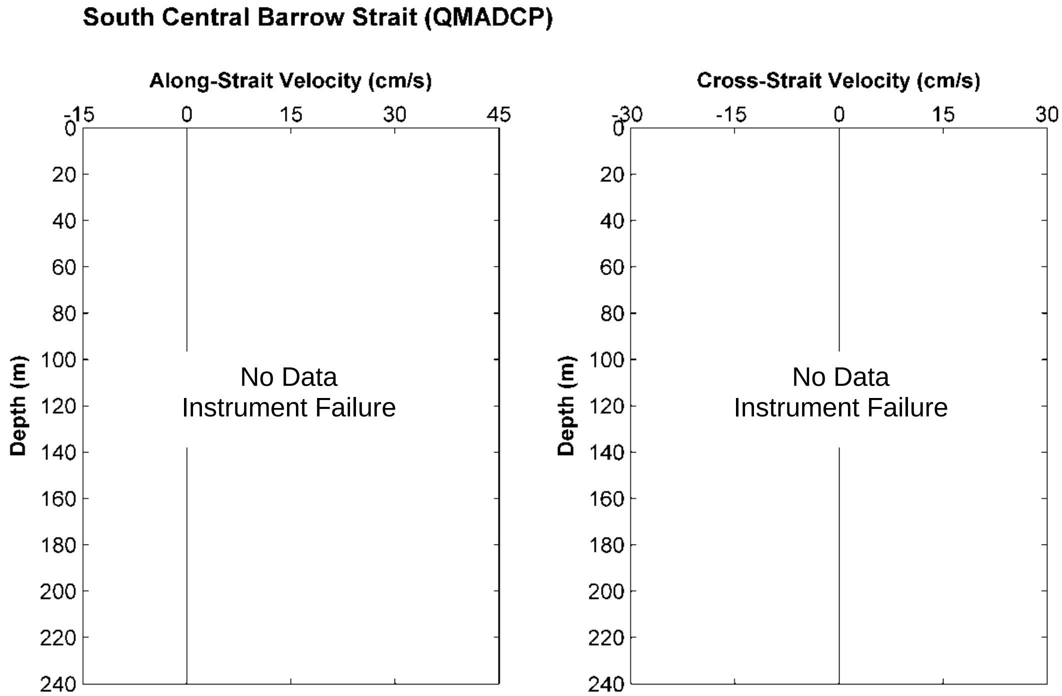
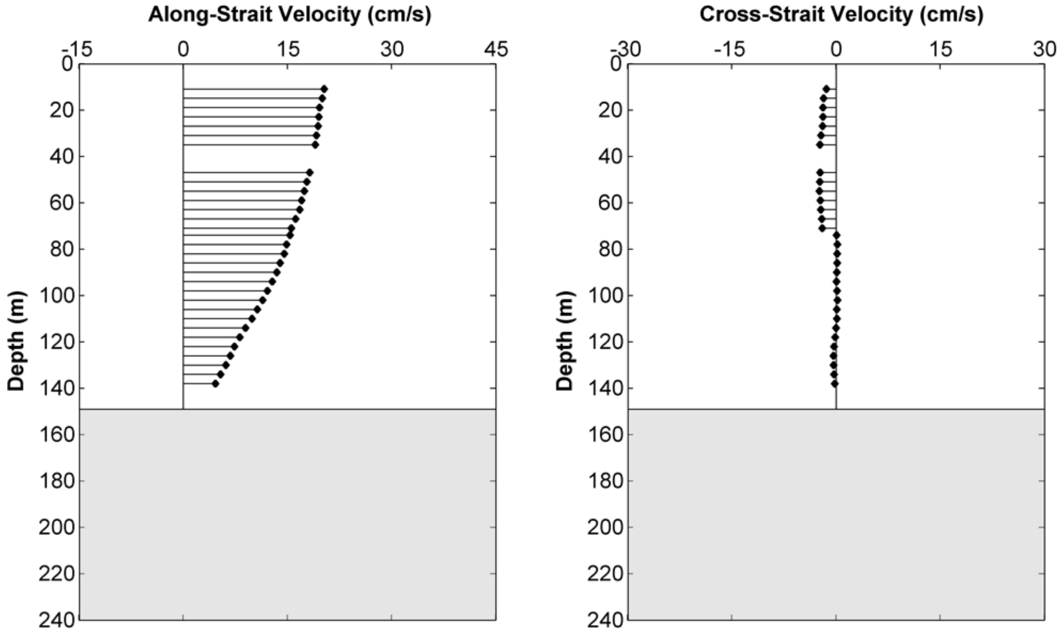
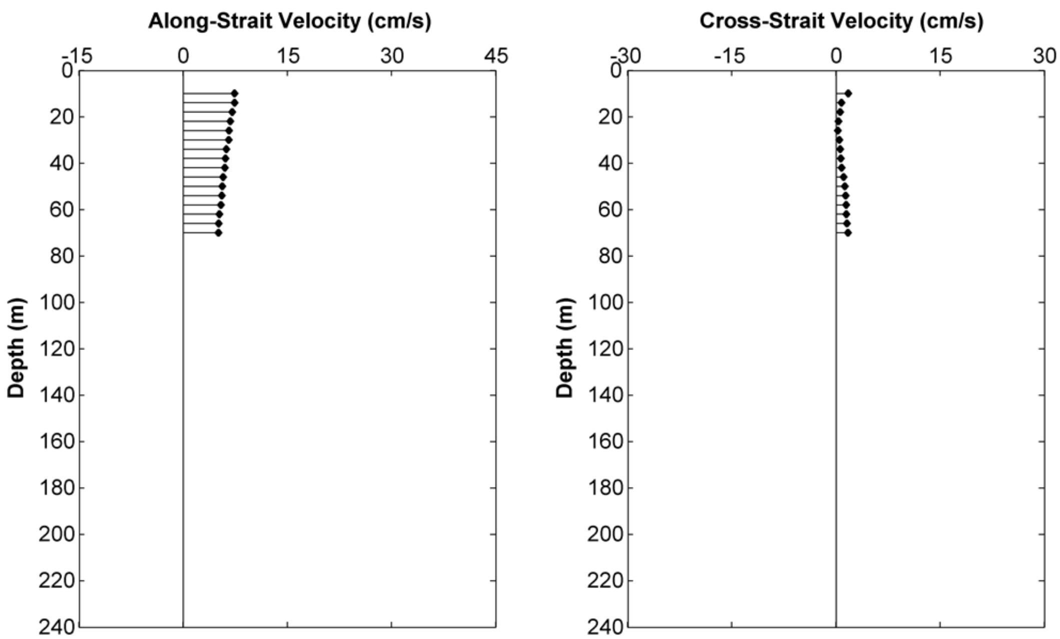


**Figure 28: Mean Flows, Early Summer: Jun. 2011 to Aug. 2011.**

**South side of Barrow Strait**




**South Central Barrow Strait (WHADCP)**



**<u>Figure 28</u>: Mean Flows, Early Summer: Jun. 2011 to Aug. 2011 (continued).**

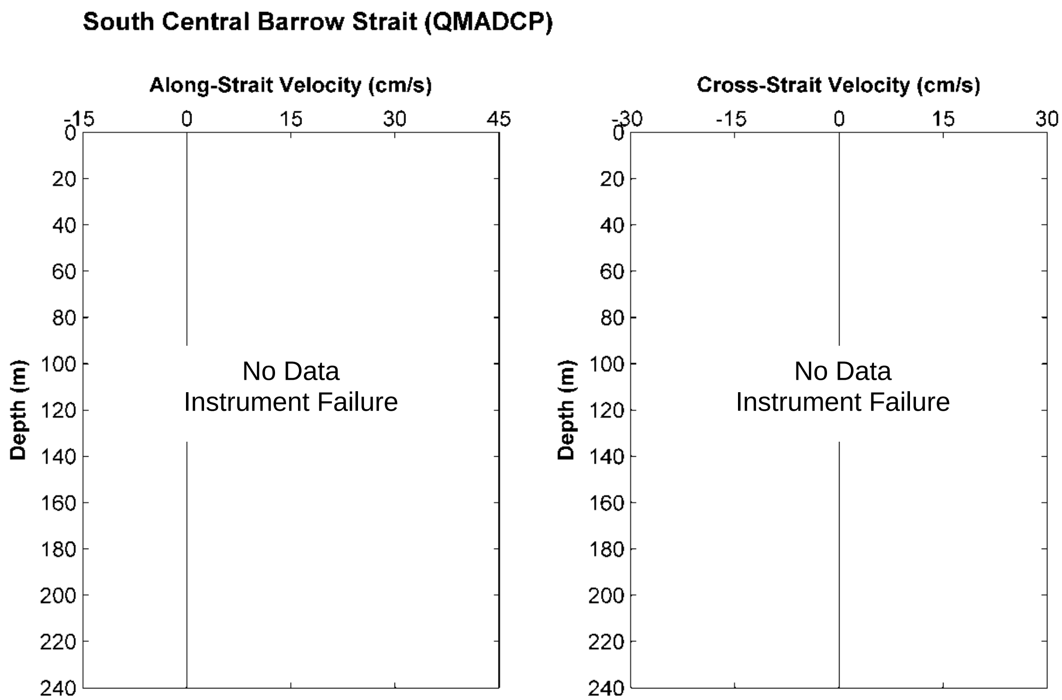
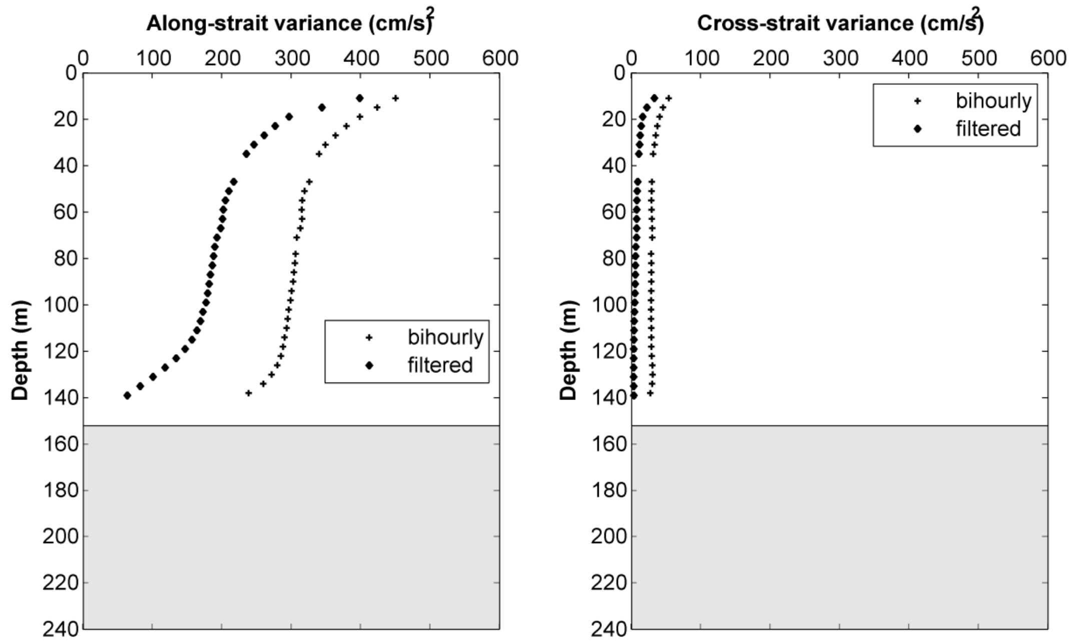


**Figure 29: Variance in bi-hourly and low-pass filtered currents. Aug. 2010 to Aug. 2011.**

**South Side of Barrow Strait**




**South Central Barrow Strait (WHADCP)**

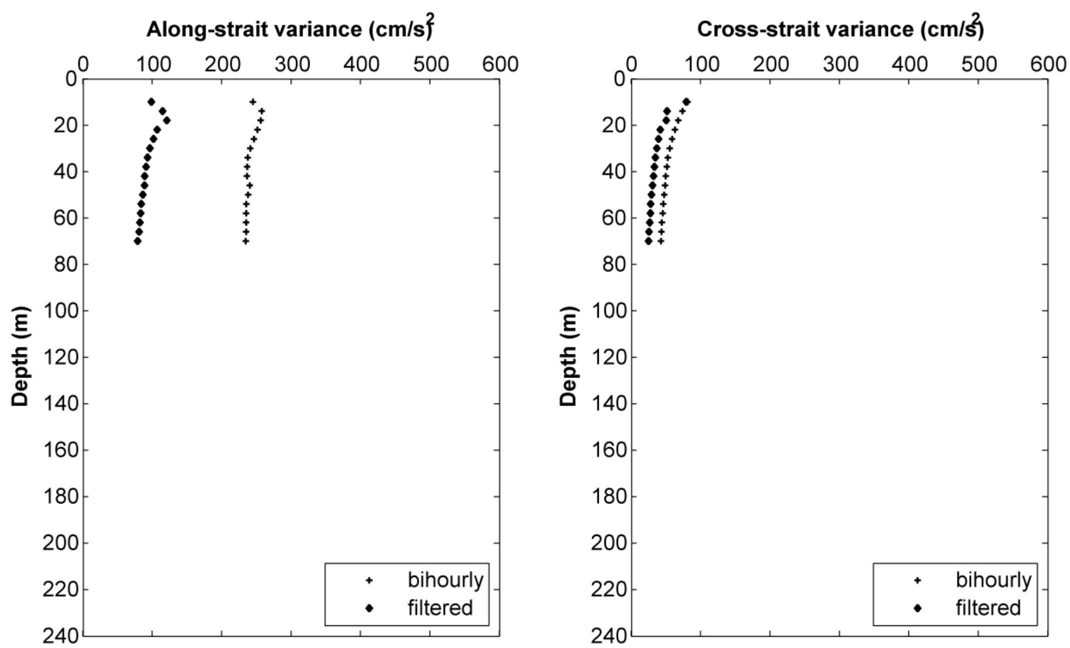
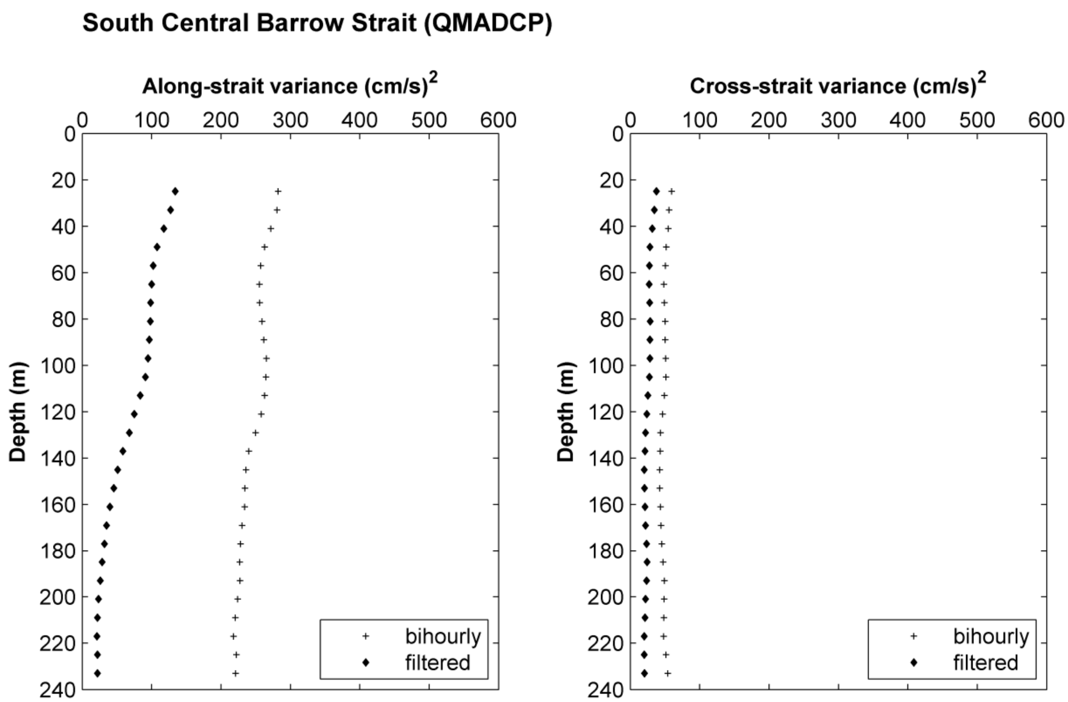
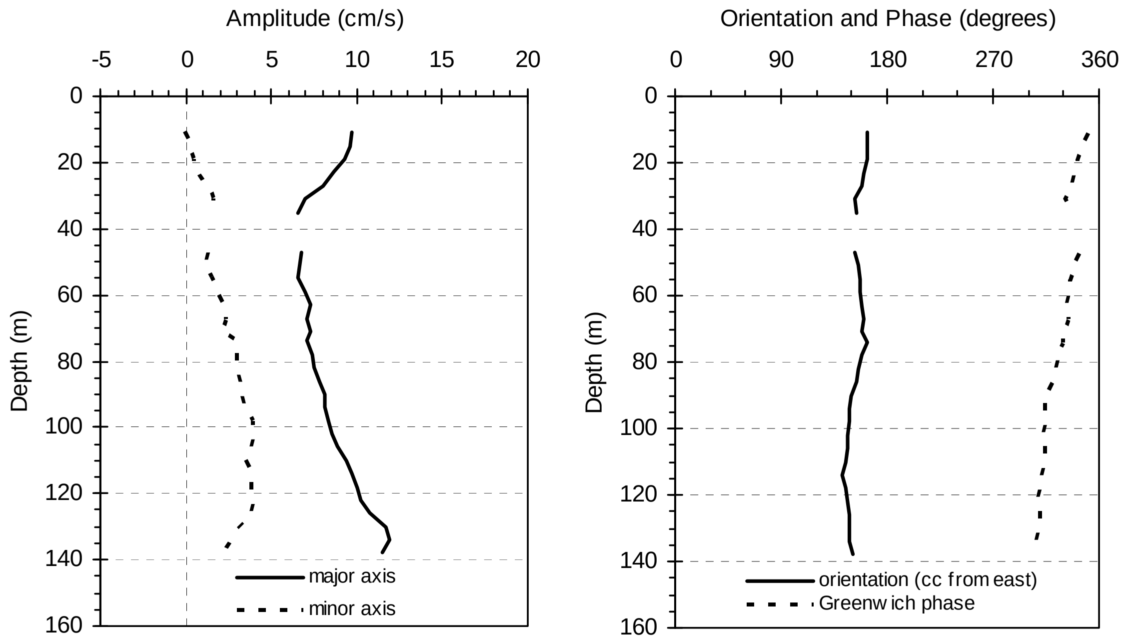


**Figure 29: Variance in bi-hourly and low-pass filtered currents Aug. 2010 to Jan. 2011 (continued).**

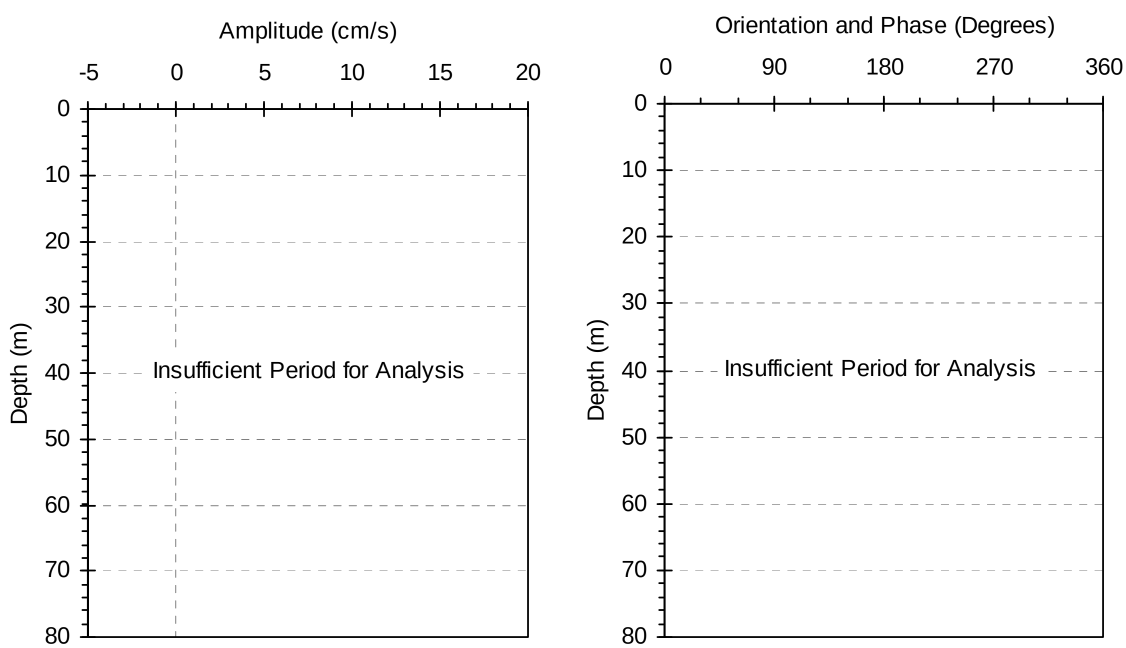


## Figure 30: K1 Tidal Constituent, South Side of Barrow Strait

### For Ice Free Period (Aug. 10, 2010 to Oct. 6, 2010):

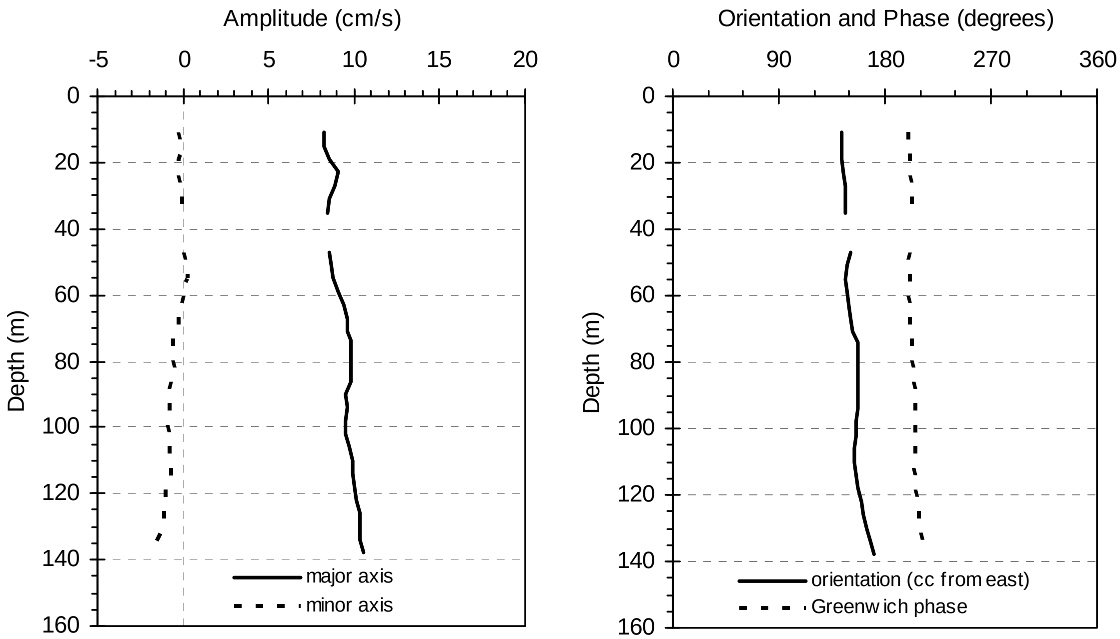



### For Solid Ice Period

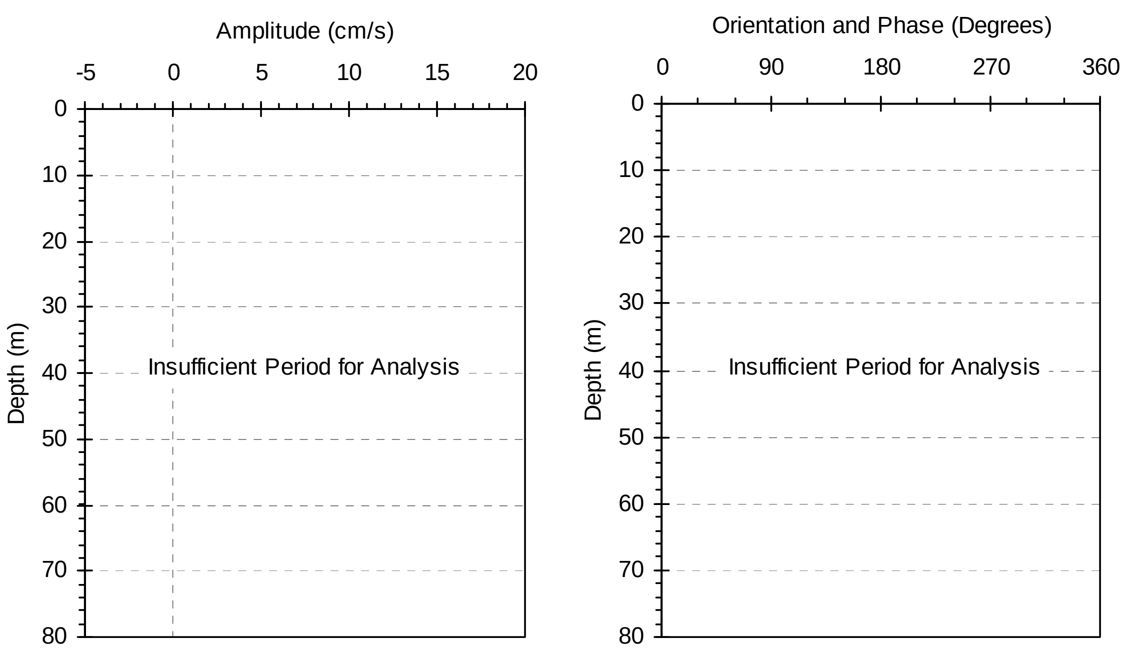


## Figure 31: M2 Tidal Constituent, South Side of Barrow Strait

### For Ice Free Period (Aug. 10, 2010 to Oct. 6, 2010):

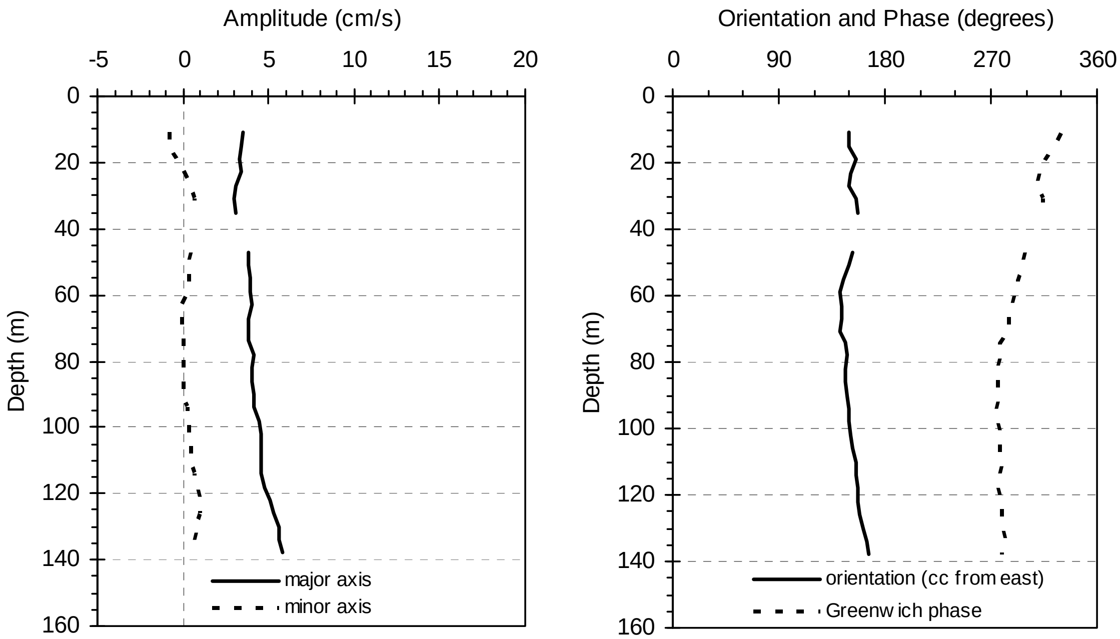



### For Solid Ice Period

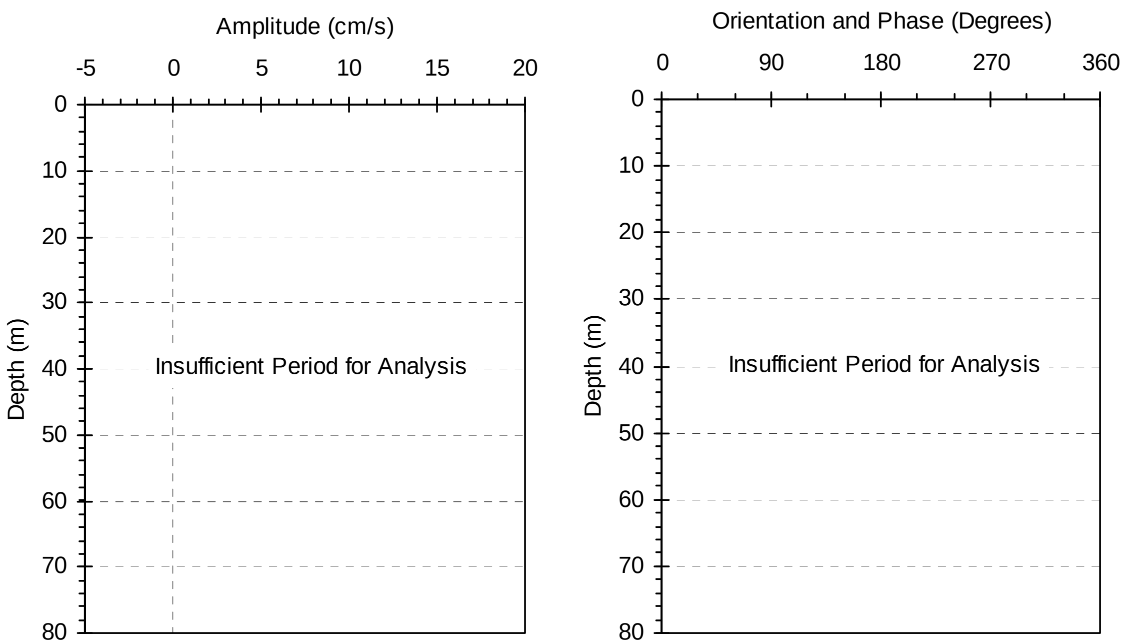


## Figure 32: O1 Tidal Constituent, South Side of Barrow Strait

### For Ice Free Period (Aug. 10, 2010 to Oct. 6, 2010):

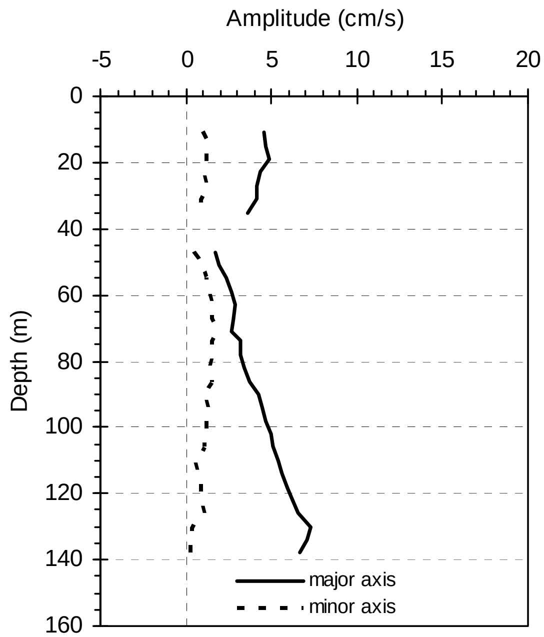


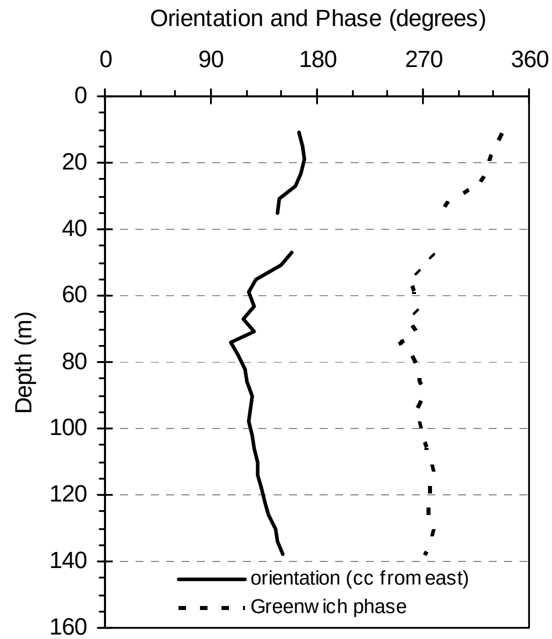

### For Solid Ice Period



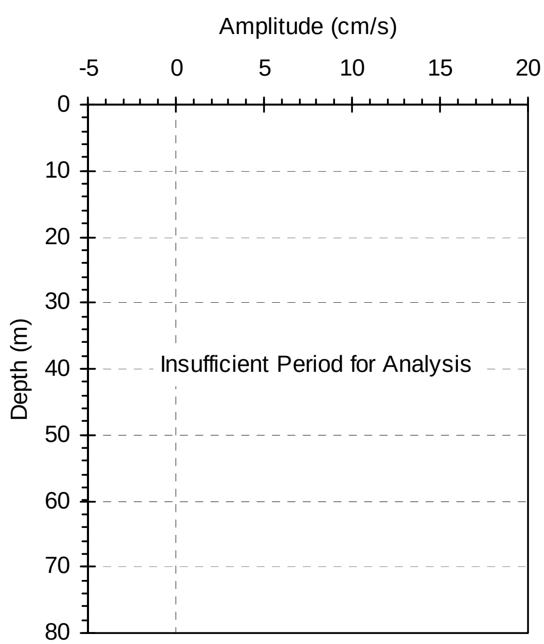
## Figure 33: P1 Tidal Constituent, South Side of Barrow Strait

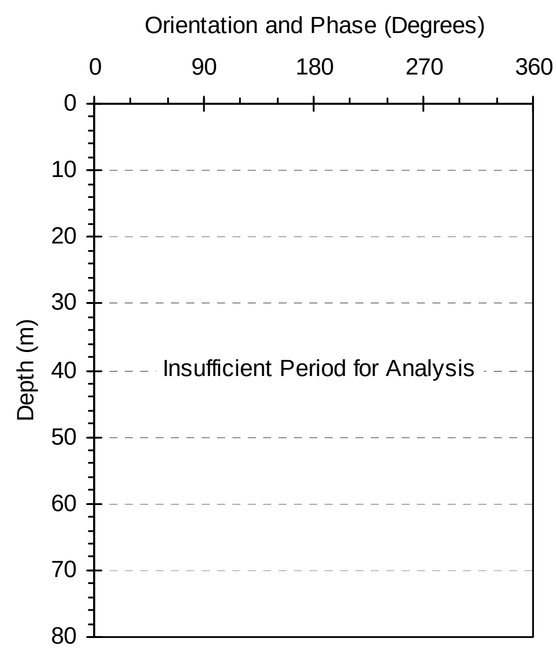
### For Ice Free Period (Aug. 10, 2010 to Oct. 6, 2010):



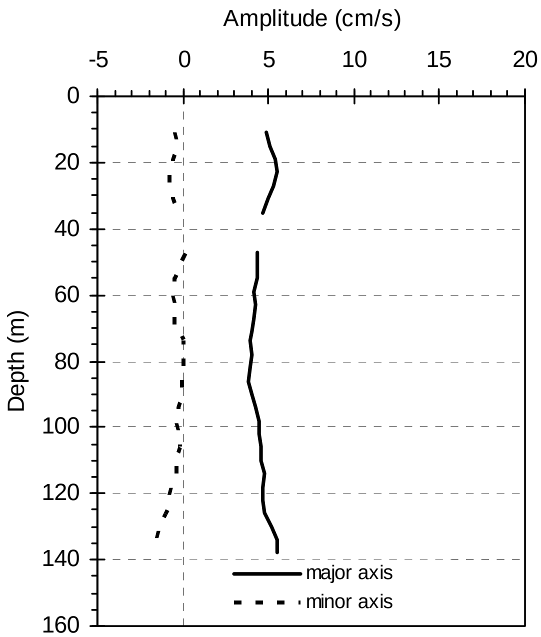

### For Solid Ice Period

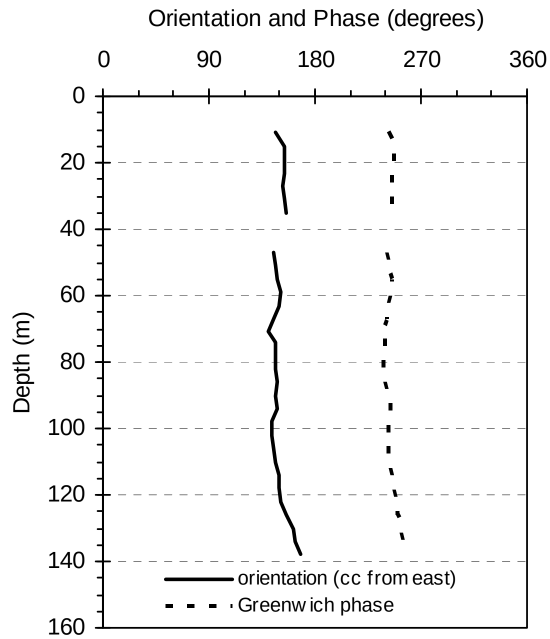


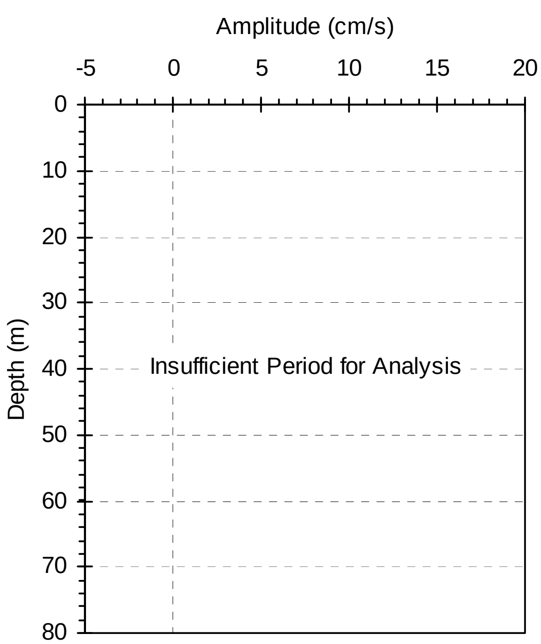
**<u>Figure 34</u>: S2 Tidal Constituent, South Side of Barrow Strait**

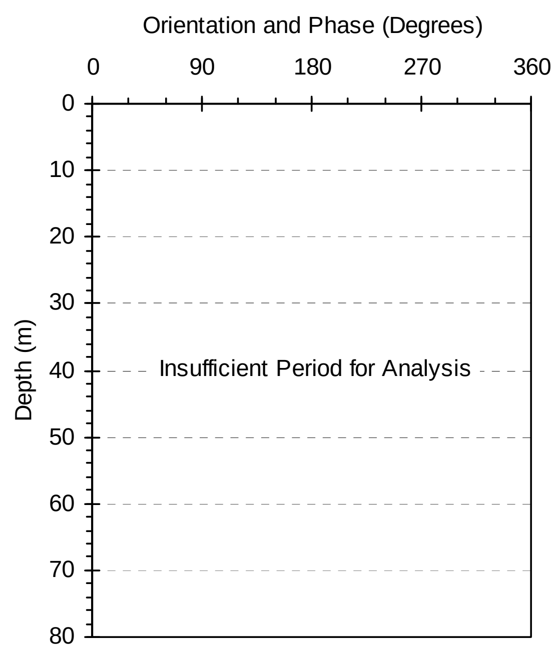
**For Ice Free Period (Aug. 10, 2010 to Oct. 6, 2010):**



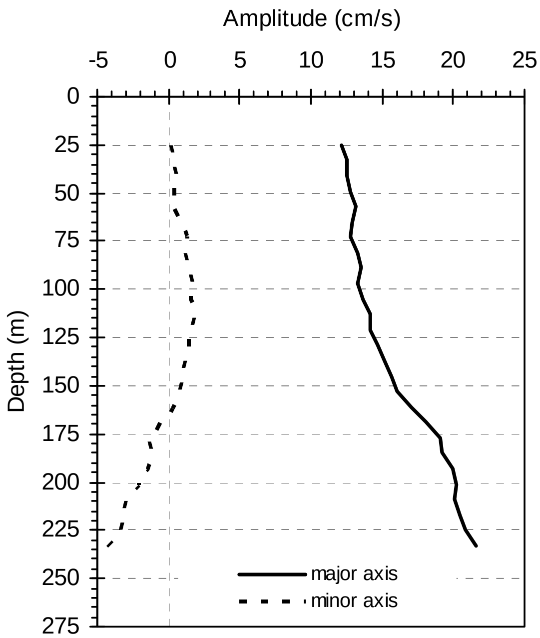

**For Solid Ice Period**

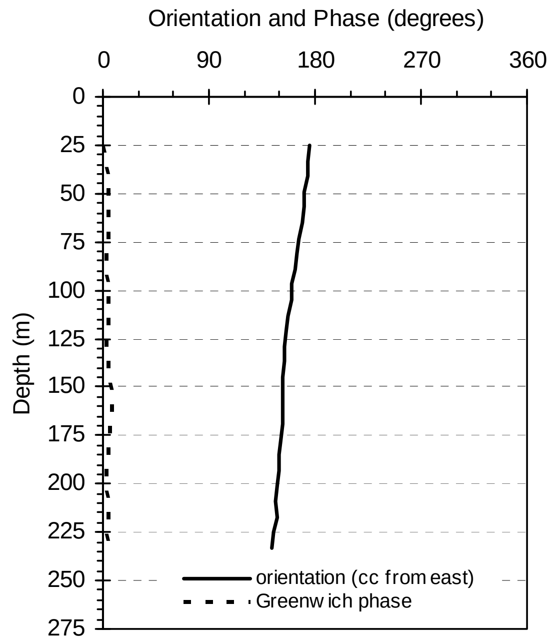


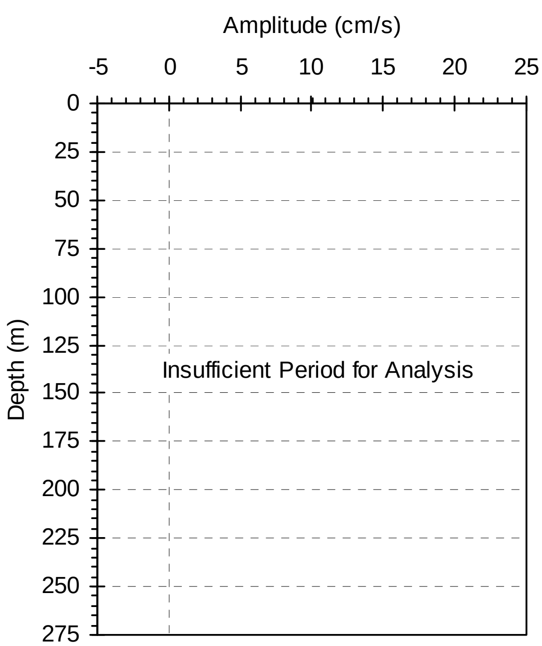
## Figure 35: K1 Tidal Constituent, South Central Barrow Strait (Quarter Master ADCP)

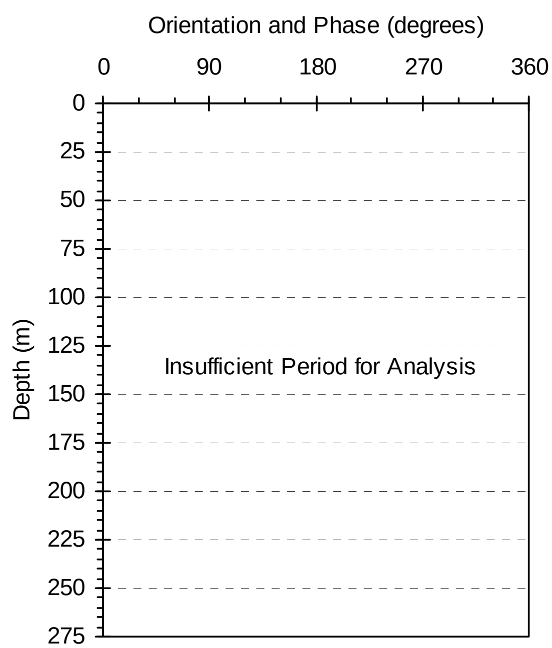
### For Ice Free Period (Aug. 11, 2010 to Oct. 9, 2010):



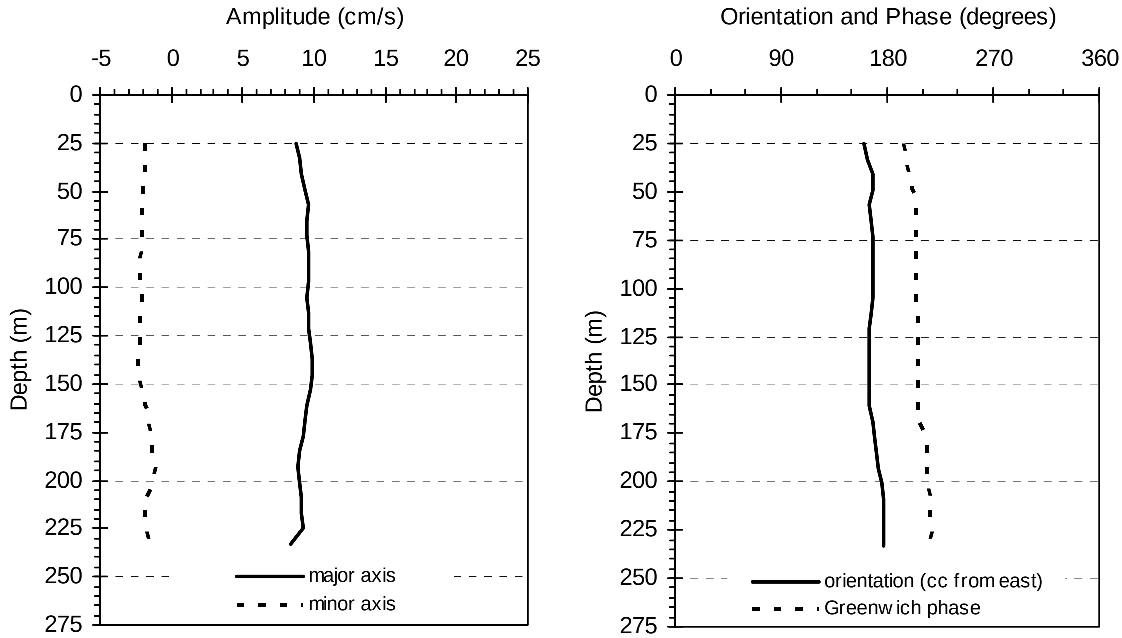

### For Solid Ice Period



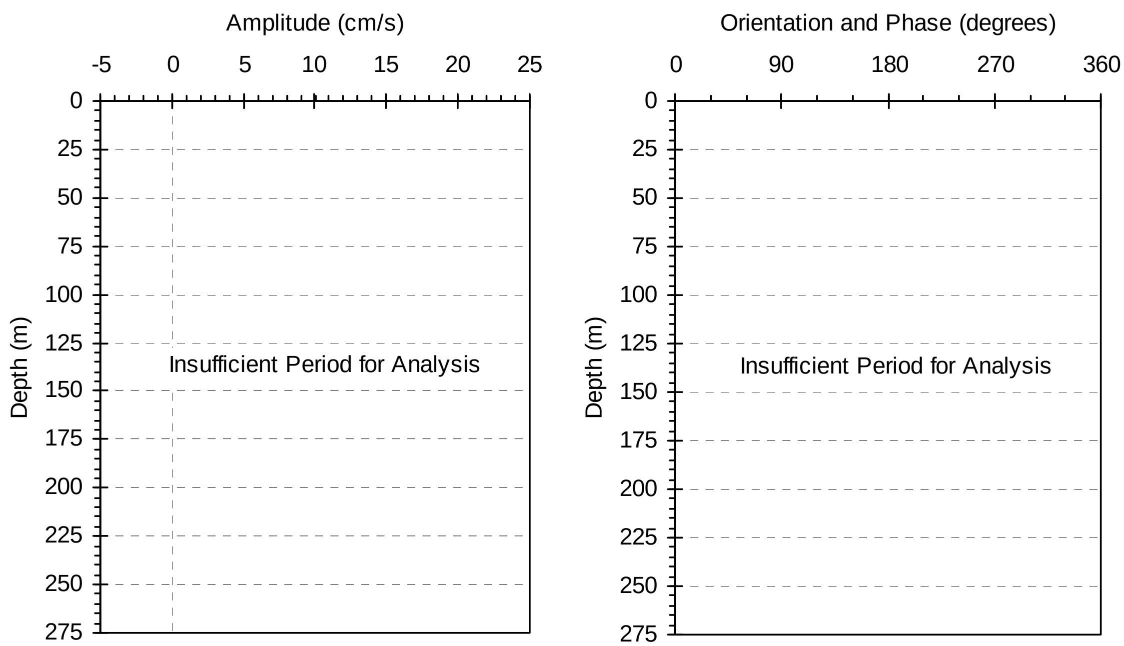



## Figure 36: M2 Tidal Constituent, South Central Barrow Strait (Quarter Master ADCP)

### For Ice Free Period (Aug. 11, 2010 to Oct. 9, 2010):

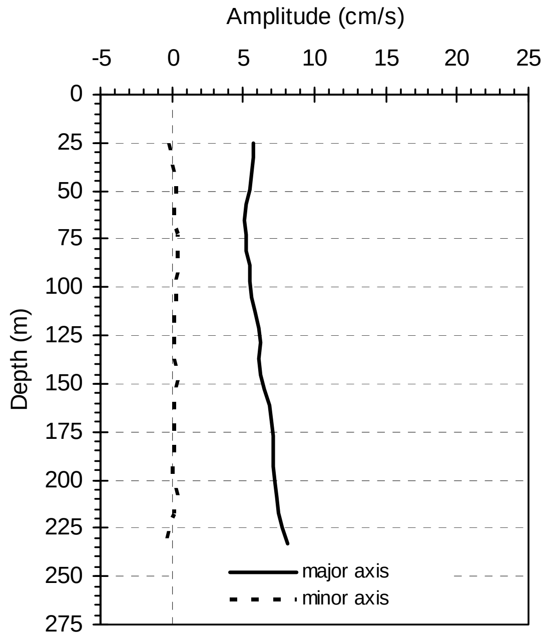


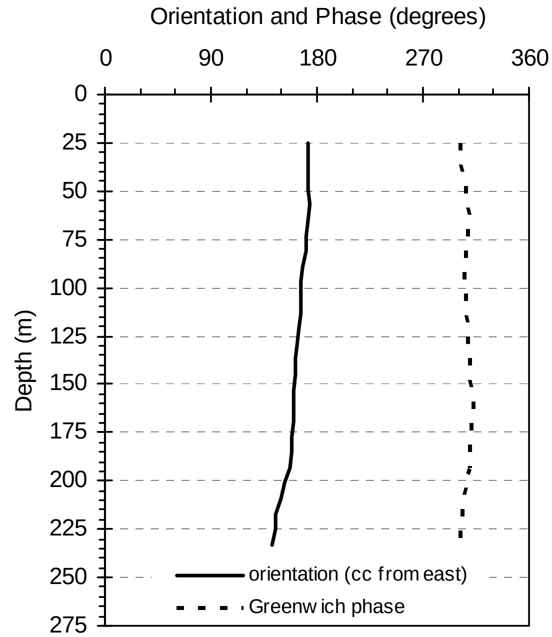

### For Solid Ice Period



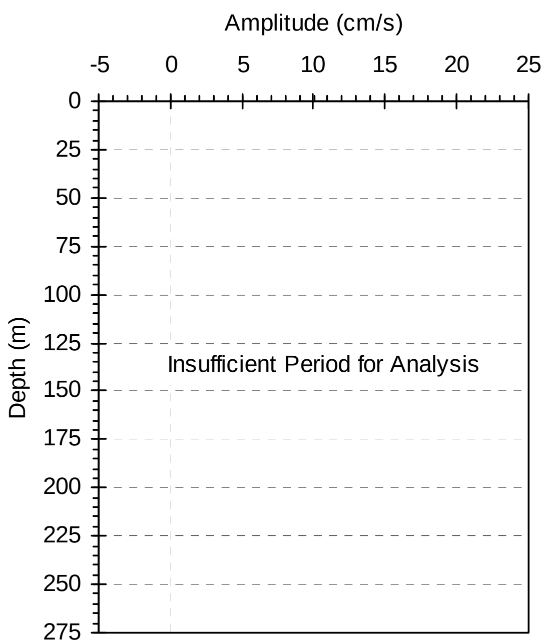
## Figure 37: O1 Tidal Constituent, South Central Barrow Strait (Quarter Master ADCP)

### For Ice Free Period (Aug. 11, 2010 to Oct. 9, 2010):




### For Solid Ice Period



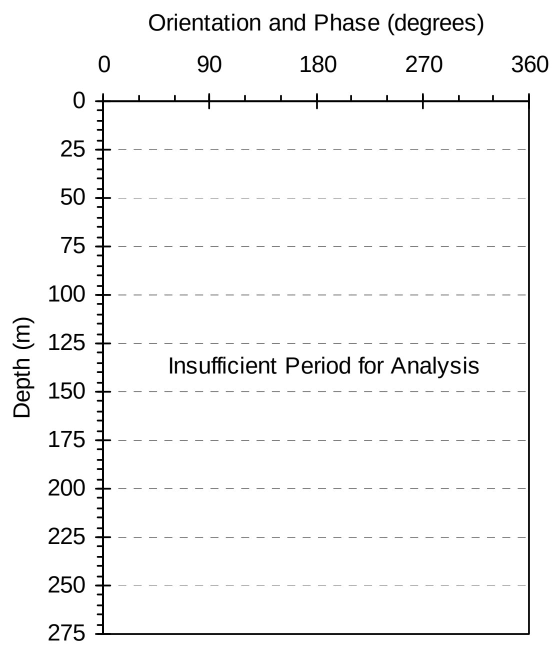
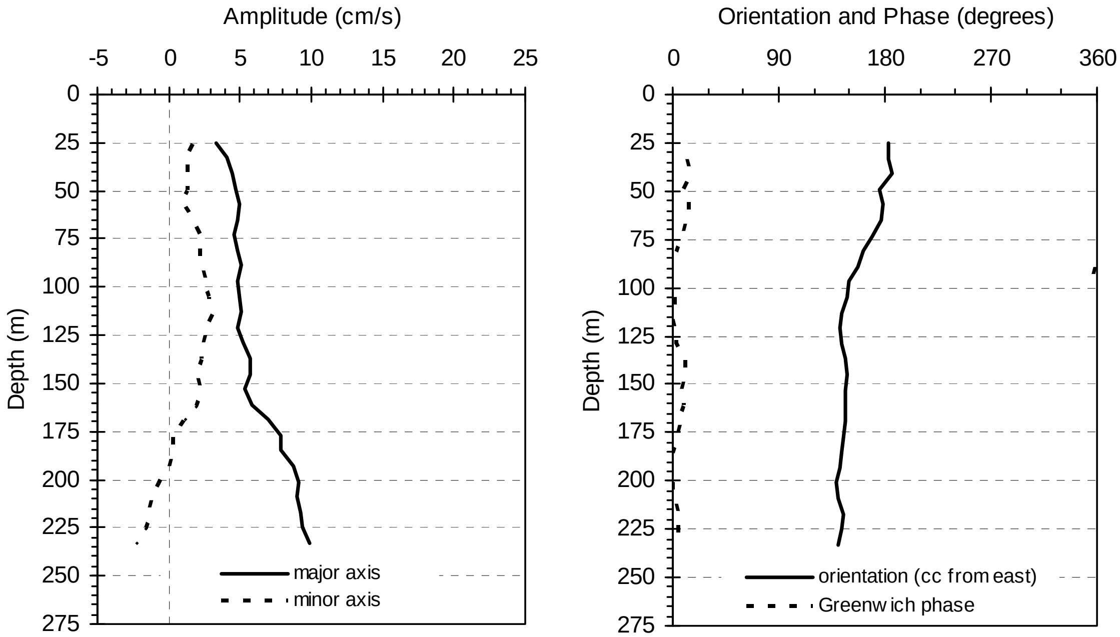
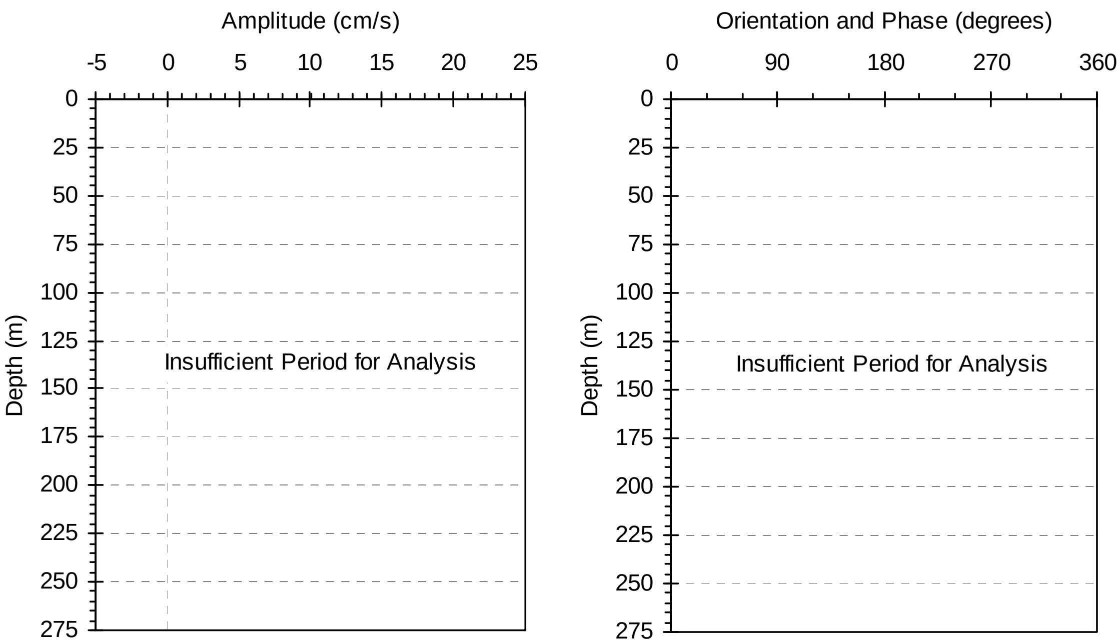



**Figure 38**: P1 Tidal Constituent, South Central Barrow Strait (Quarter Master ADCP)

**For Ice Free Period (Aug. 11, 2010 to Oct. 9, 2010):**

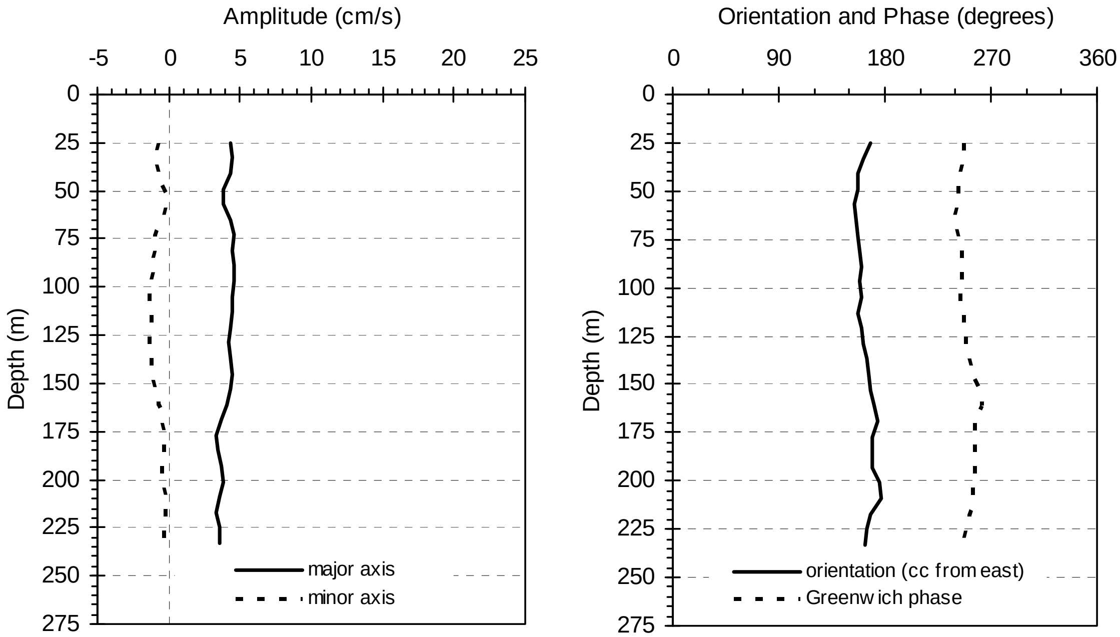



**For Solid Ice Period**



## Figure 39: S2 Tidal Constituent, South Central Barrow Strait (Quarter Master ADCP)

### For Ice Free Period (Aug. 11, 2010 to Oct. 9, 2010):




### For Solid Ice Period

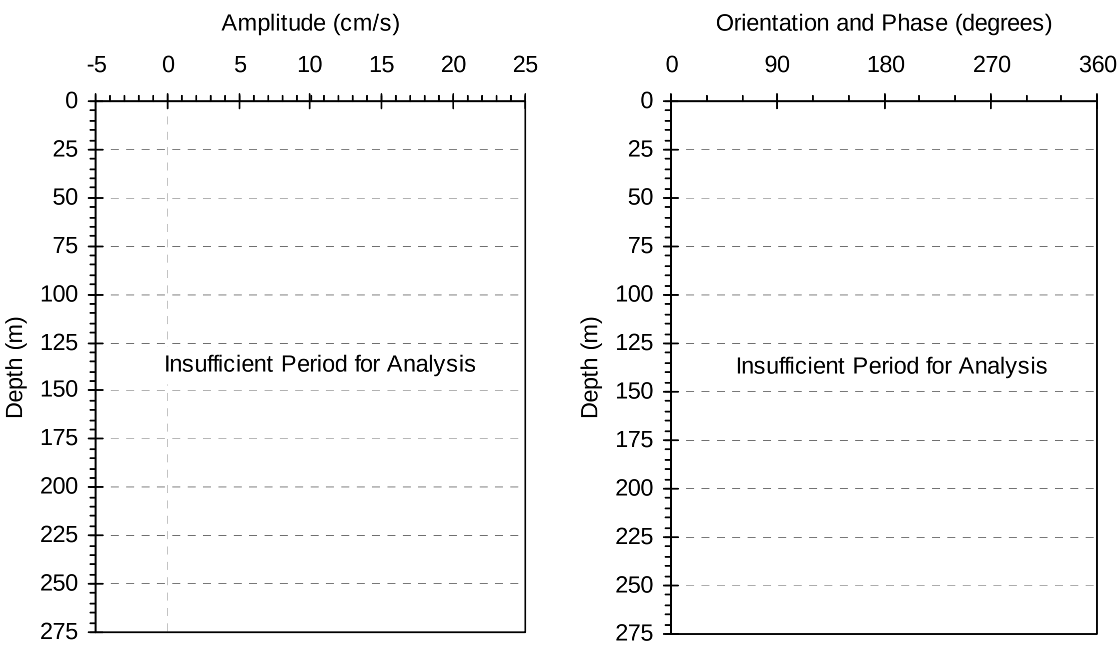
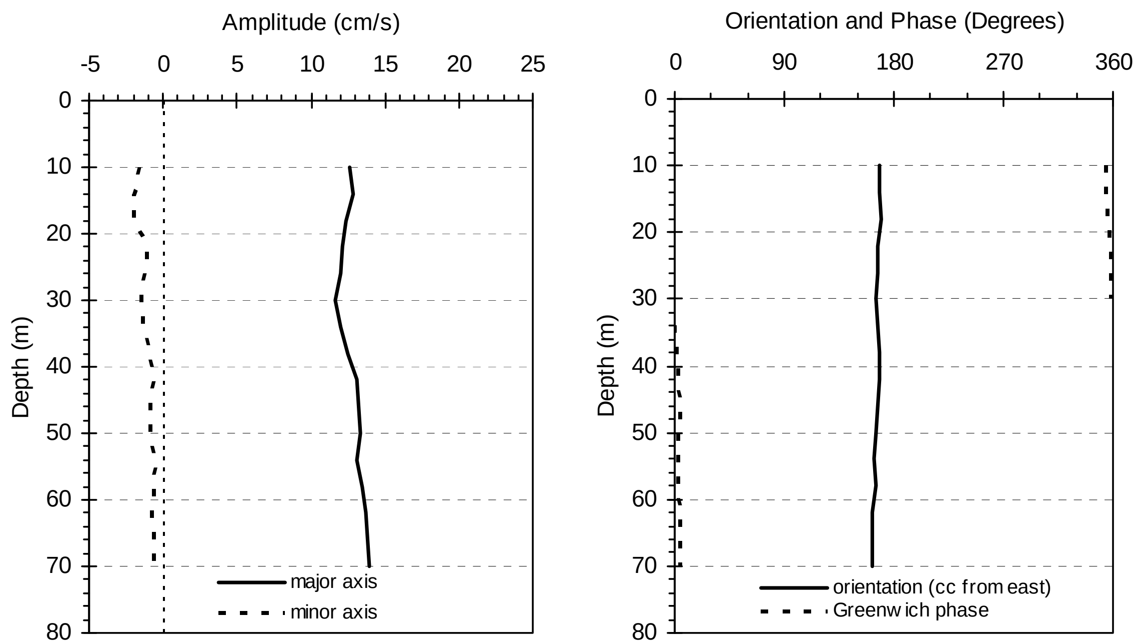
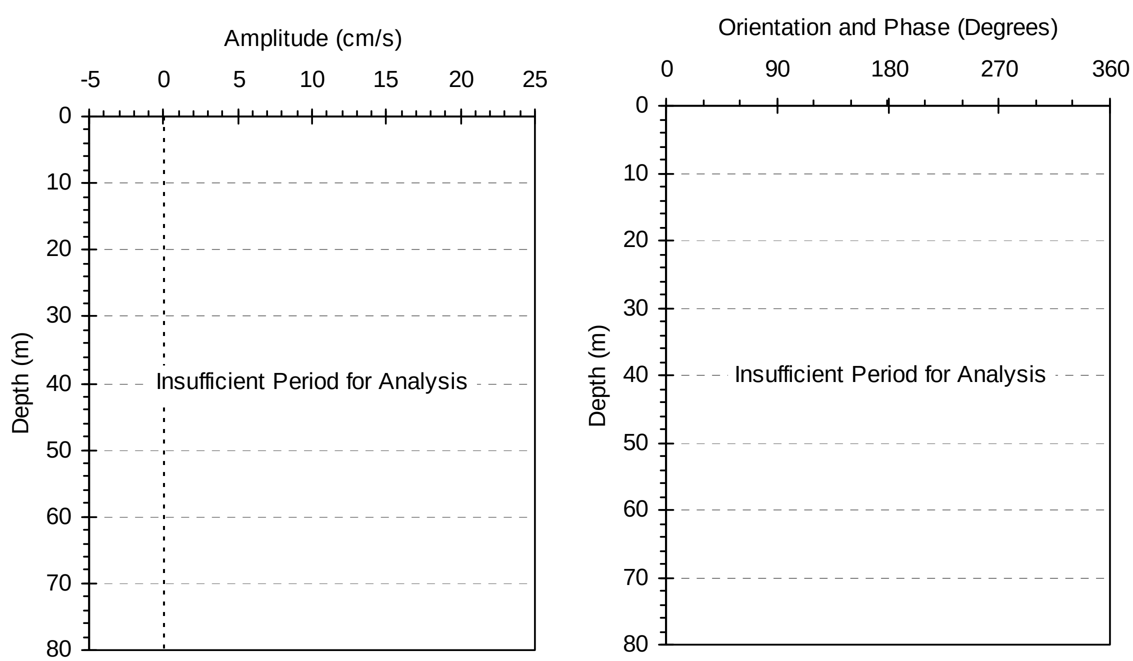


**Figure 40: K1 Tidal Constituent, South Central Barrow Strait (Workhorse ADCP)**

**For Ice Free Period (Aug. 10, 2010 to Oct. 9, 2010):**

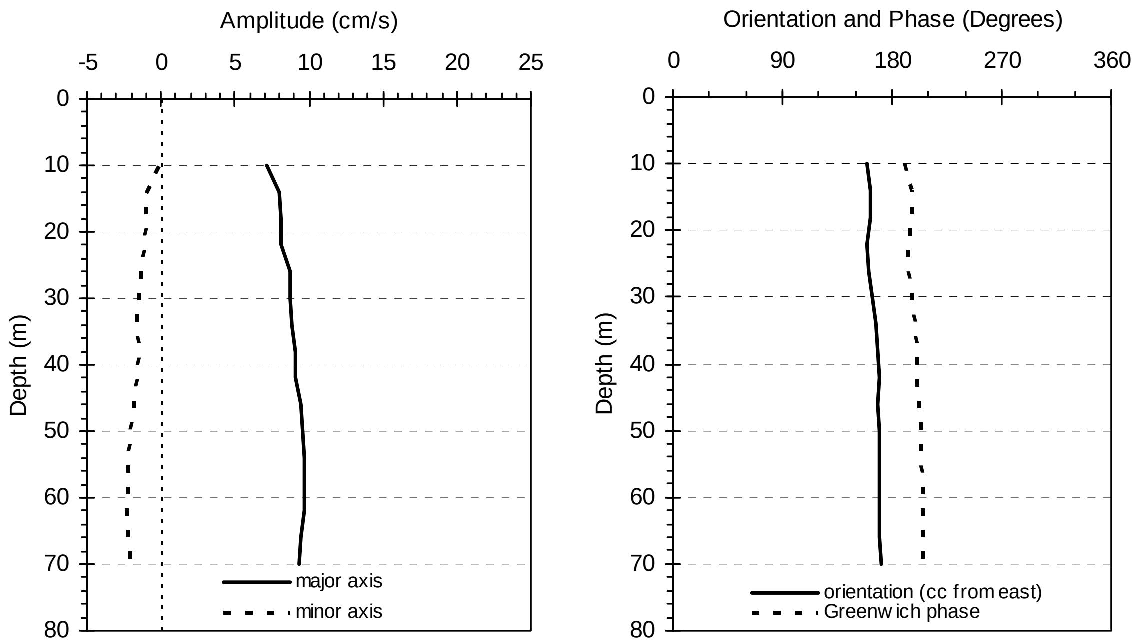



**For Solid Ice Period**

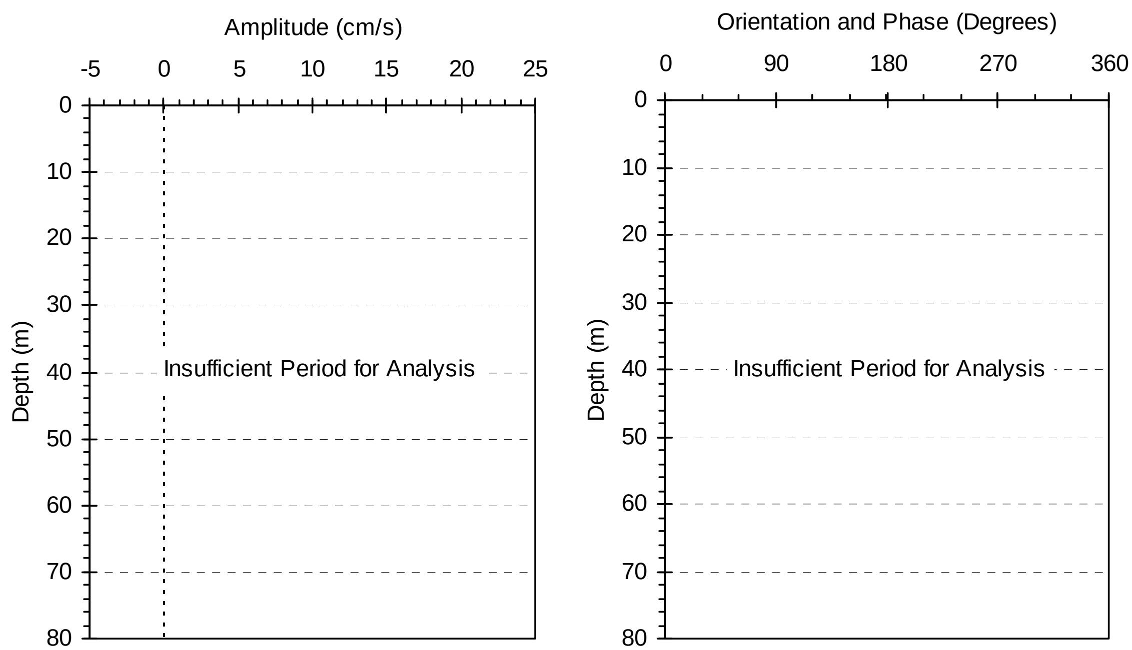


# <u>Figure 41</u>: M2 Tidal Constituent, South Central Barrow Strait (Workhorse ADCP)

**For Ice Free Period (Aug. 10, 2010 to Oct. 9, 2010):**

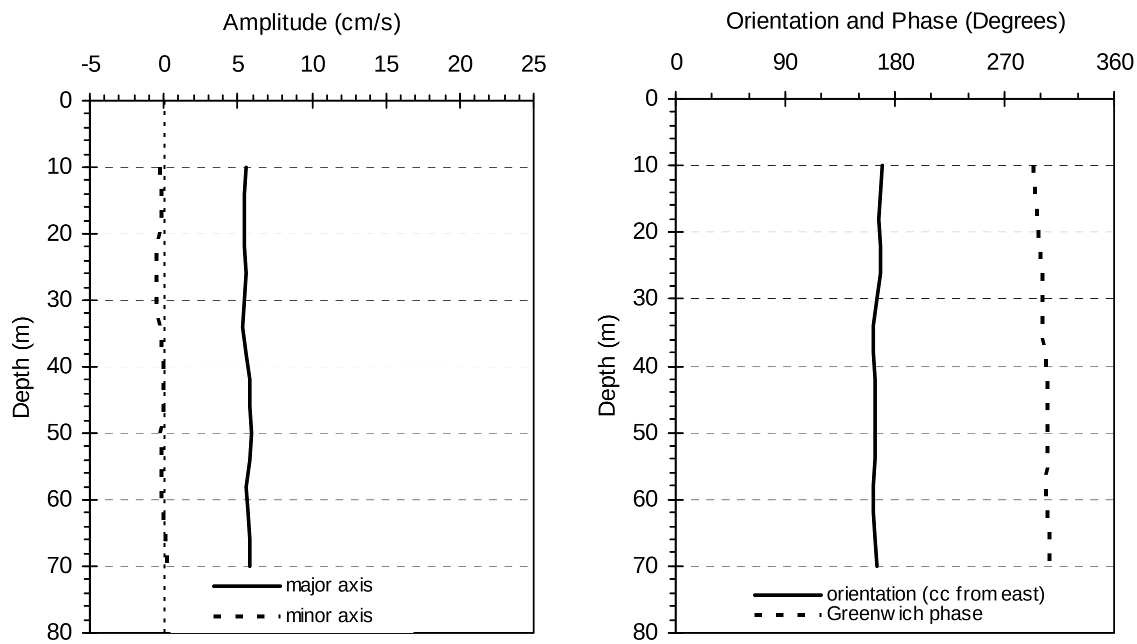



**For Solid Ice Period**

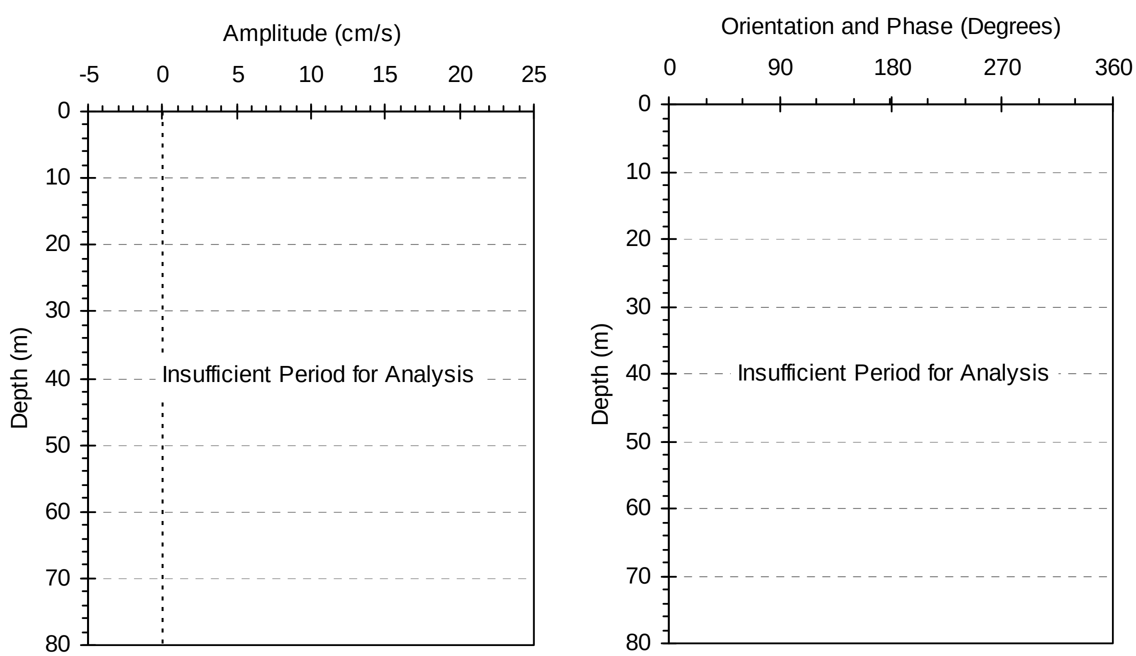


## Figure 42: O1 Tidal Constituent, South Central Barrow Strait (Workhorse ADCP)

### For Ice Free Period (Aug. 10, 2010 to Oct. 9, 2010):

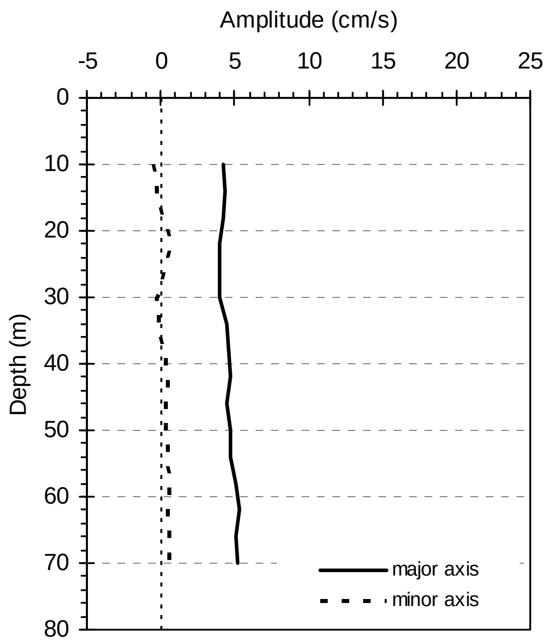


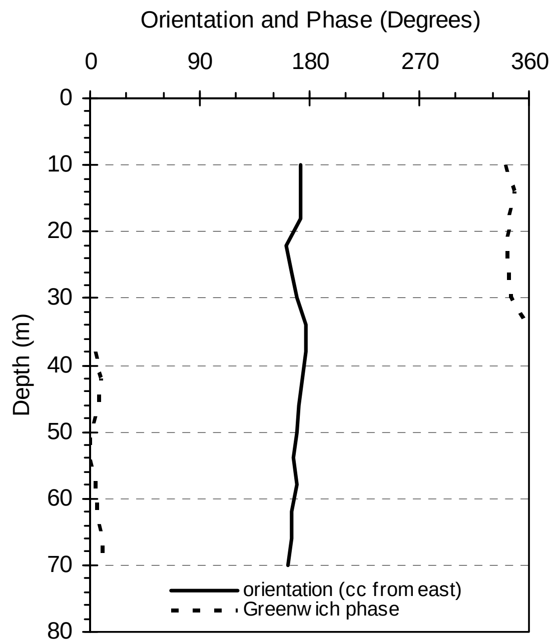

### For Solid Ice Period



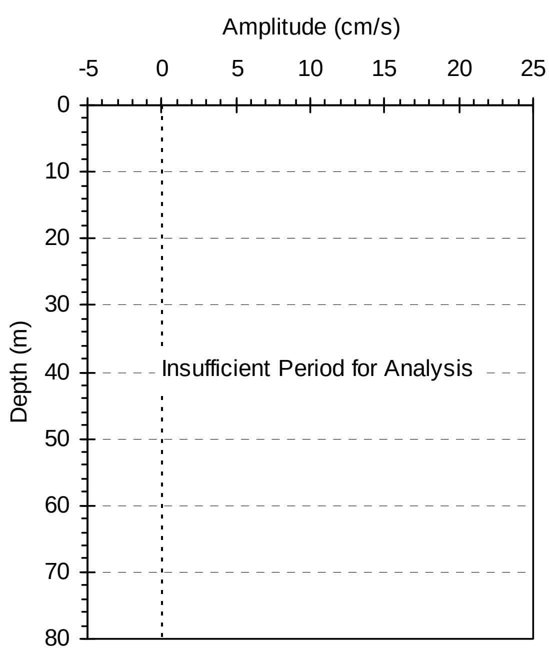
## Figure 43: P1 Tidal Constituent, South Central Barrow Strait (Workhorse ADCP)

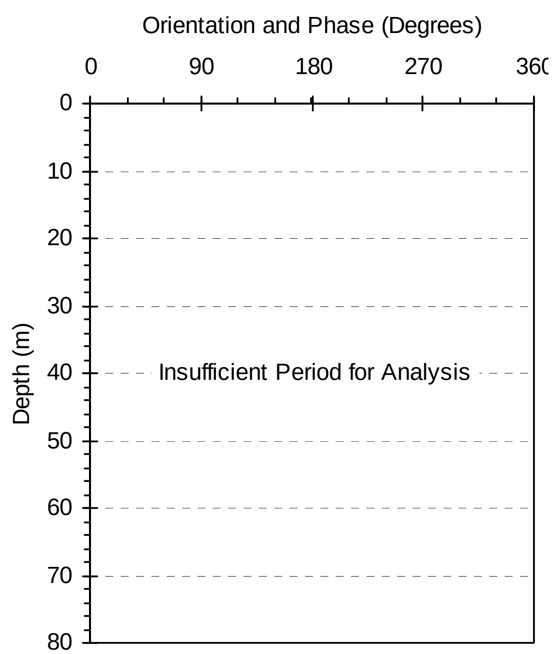
### For Ice Free Period (Aug. 10, 2010 to Oct. 9, 2010):



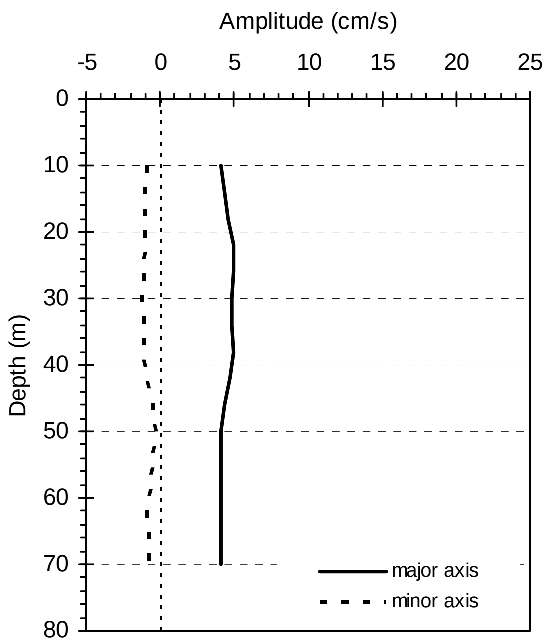

### For Solid Ice Period

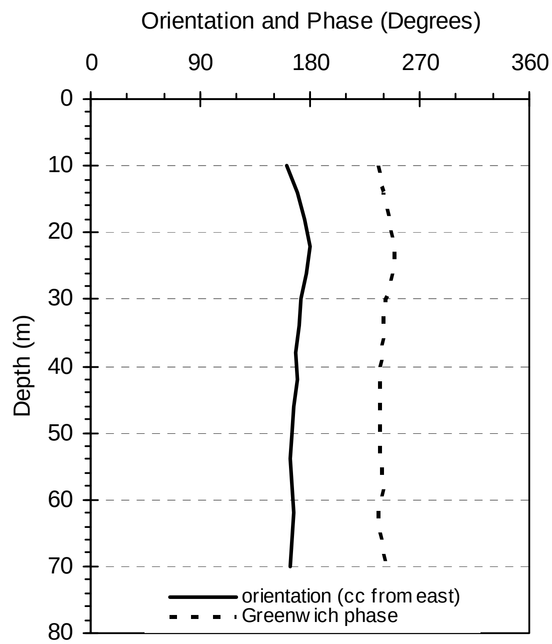


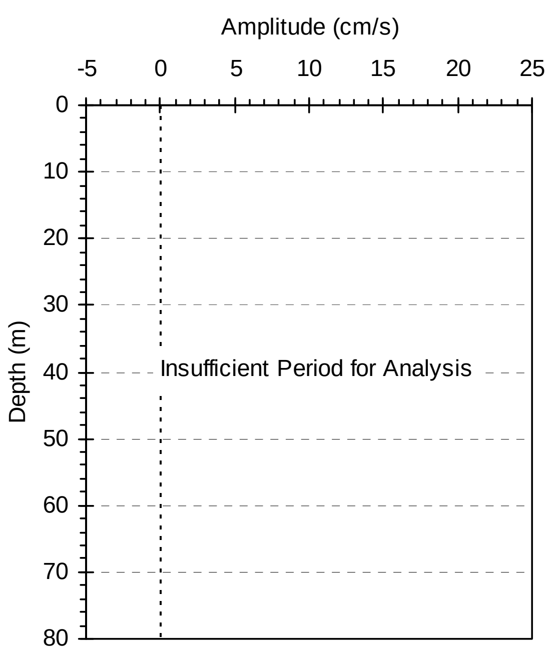
## Figure 44: S2 Tidal Constituent, South Central Barrow Strait (Workhorse ADCP)

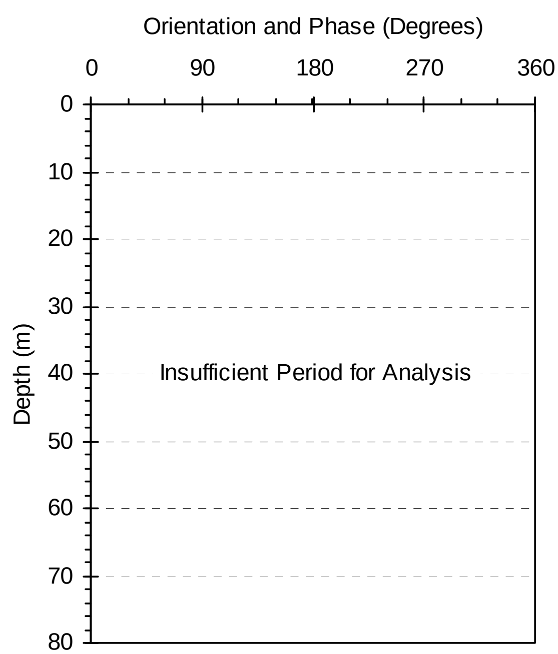
### For Ice Free Period (Aug. 10, 2010 to Oct. 9, 2010):



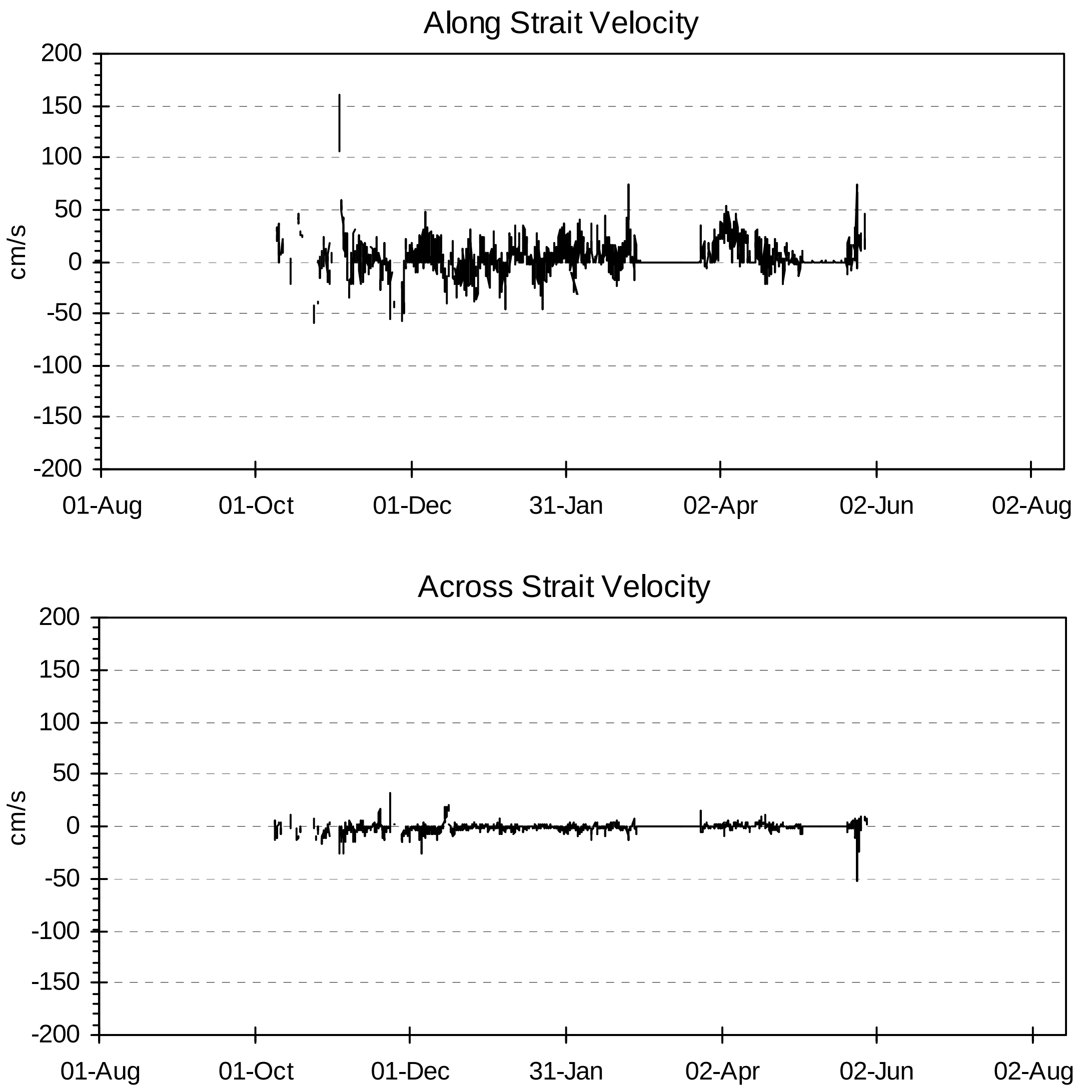




### For Solid Ice Period

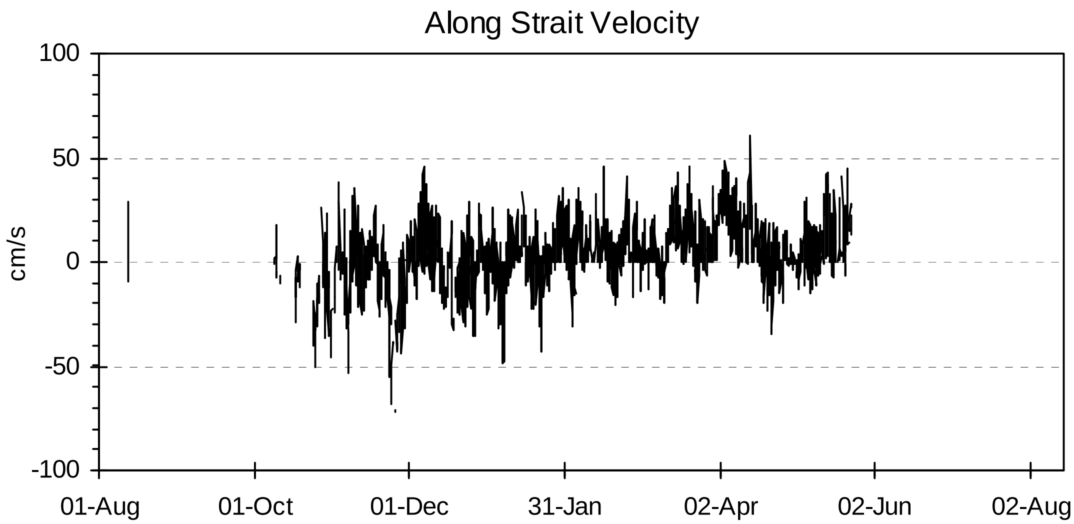


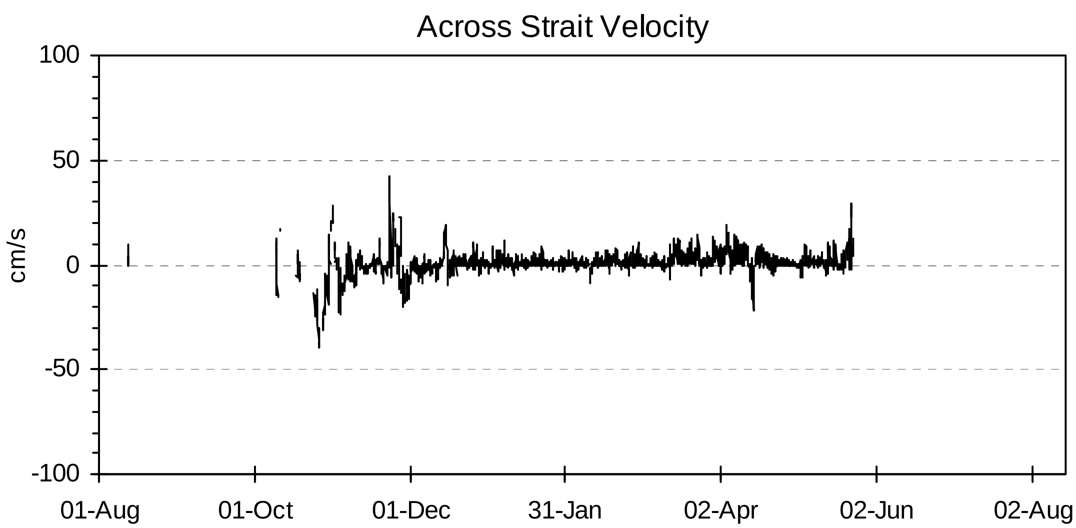



**<u>Figure 45</u>: Ice velocity data, South side of Barrow Strait August 2010 – August 2011**



**<u>Figure 46</u>: Ice velocity data, South Central Barrow Strait (Workhorse ADCP) August 2010 – August 2011**



**<u>Figure 47</u>: Ice Draft Statistics from Ice Profiling Sonar South-Central Barrow Strait, August 2010 – July 2011**

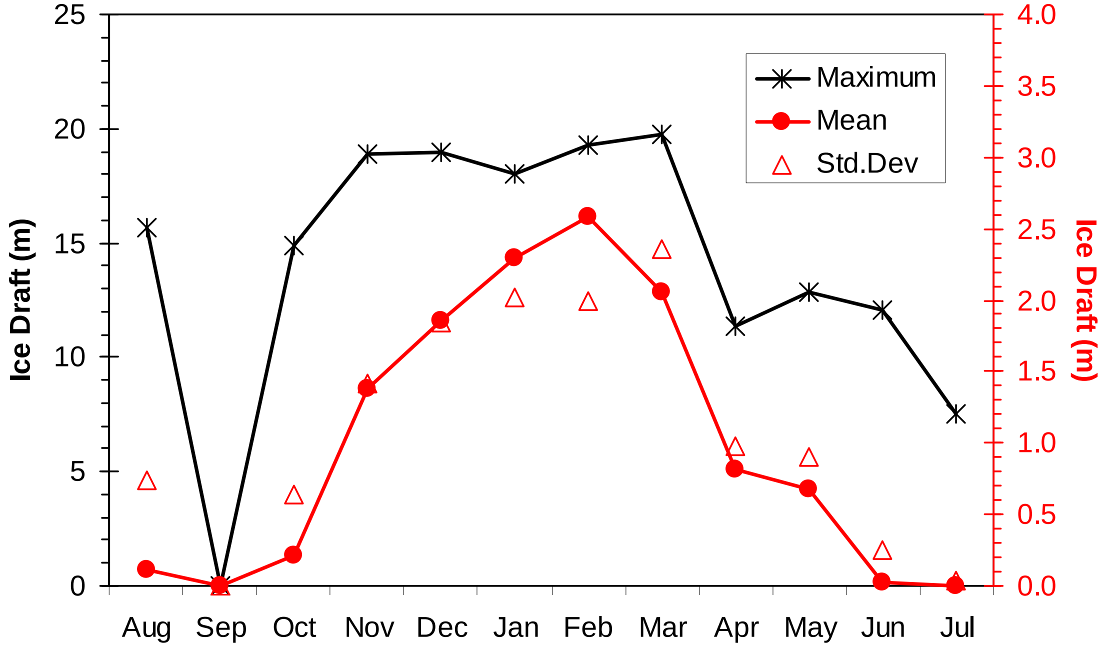
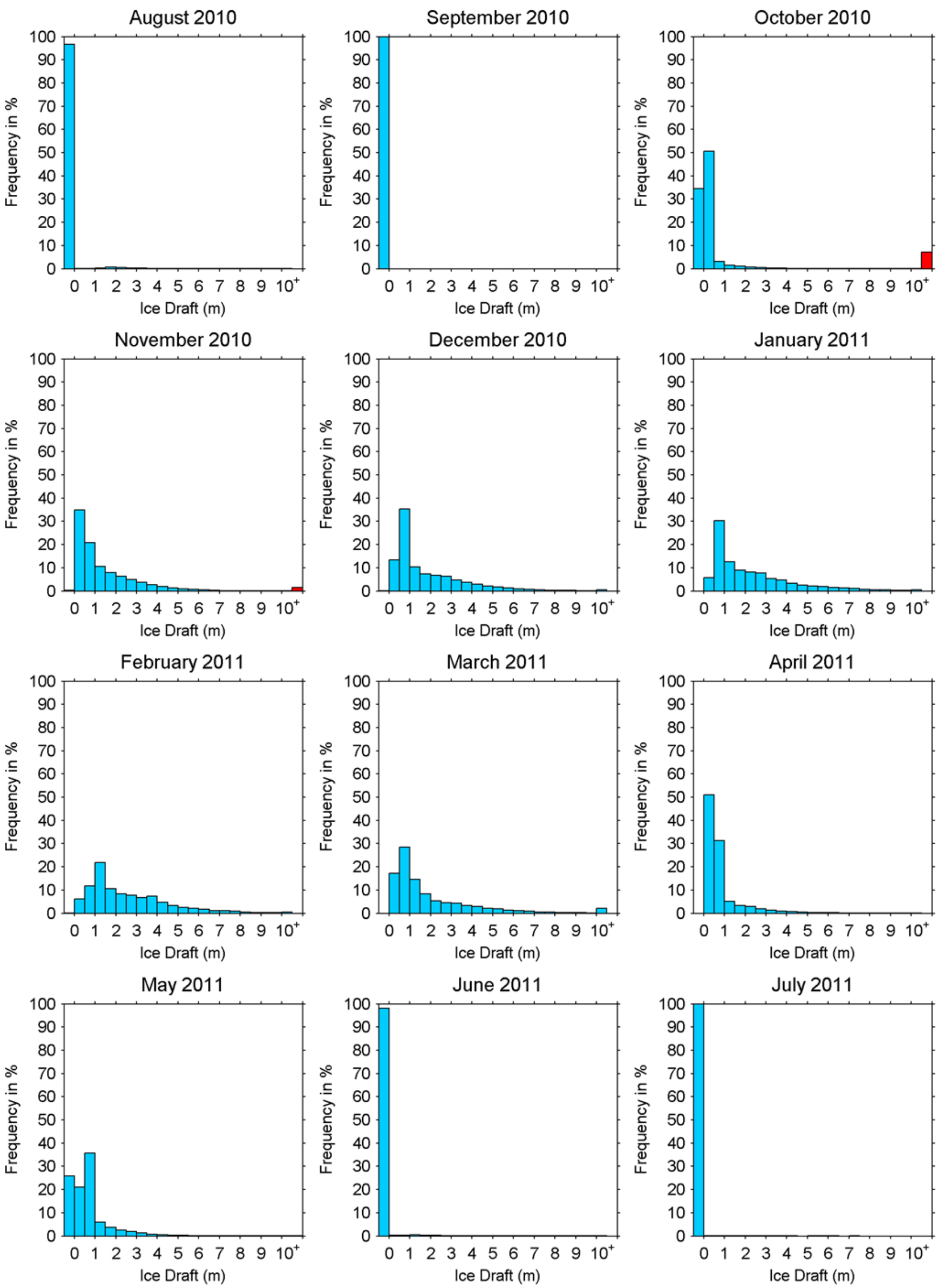


**Figure 48: Frequency of Occurrence vs. Ice Draft in meters**
**South-Central Barrow Strait, August 2010 – July 2011**



## Table 1: Mooring Summary, 2010-2011

### South Barrow Strait

| BIO Consecutive Mooring Number | Instrument Type | Moored Depth (m) | Sounding (m) | Latitude (°N) | Longitude (°W) | Start Date-Time (UTC) | End Date-Time (UTC) | Sampling Interval (Seconds) |
|---|---|---|---|---|---|---|---|---|
| 1772 | MCTD | 40 | 149 | 74.08308 | -91.04250 | 10-Aug-2010 13:30 | 07-Aug-2011 13:30 | 1800 |
| 1772 | WHADCP | 77 | 149 | 74.08308 | -91.04250 | 10-Aug-2010 14:00 | 07-Aug-2011 12:00 | 7200 |
| 1772 | MCTD | 79 | 149 | 74.08308 | -91.04250 | 10-Aug-2010 13:30 | 07-Aug-2011 13:30 | 1800 |
| 1773 | WHADCP | 144 | 148 | 74.08165 | -91.03272 | 10-Aug-2010 16:00 | 07-Aug-2011 12:00 | 7200 |
| 1773 | MCTD | 146 | 148 | 74.08165 | -91.03272 | 10-Aug-2010 14:30 | 07-Aug-2011 12:30 | 1800 |

### South Central Barrow Strait

| BIO Consecutive Mooring Number | Instrument Type | Moored Depth (m) | Sounding (m) | Latitude (°N) | Longitude (°W) | Start Date-Time (UTC) | End Date-Time (UTC) | Sampling Interval (Seconds) |
|---|---|---|---|---|---|---|---|---|
| †1774 | QMADCP | 244 | 268 | 74.19578 | -90.85275 | 11-Aug-2010 00:00 | 19-Jan-2011 06:00 | 7200 |
| 1774 | MCTD | 264 | 268 | 74.19578 | -90.85275 | 10-Aug-2010 22:30 | 07-Aug-2011 14:30 | 1800 |
| 1775 | MCTD | 39 | 264 | 74.20423 | -90.82792 | 10-Aug-2010 21:00 | 07-Aug-2011 17:00 | 1800 |
| 1775 | WHADCP | 76 | 264 | 74.20423 | -90.82792 | 10-Aug-2010 22:00 | 07-Aug-2011 16:00 | 7200 |
| 1775 | MCTD | 154 | 264 | 74.20423 | -90.82792 | 10-Aug-2010 21:00 | 07-Aug-2011 17:00 | 1800 |
| 1776 | IPS | 29 | 262 | 74.19623 | -90.83650 | 10-Aug-2010 17:25 | 07-Aug-2011 16:20 | 3 |
| 1776 | MCTD | 56 | 262 | 74.19623 | -90.83650 | 10-Aug-2010 16:00 | 07-Aug-2011 16:30 | 1800 |

† Data terminated early due to instrument failure.

## Table 2: South Barrow Strait, Microcat/ADCP statistical summary
## Late summer: August 10, 2010 - September 20, 2010

| Depth (m) | | Temperature (°C) | | | | Salinity (ppt) | | | | Density (Sigma-T) | | | | Along-Strait Velocity (cm/s) | | | | Cross-Strait Velocity (cm/s) | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Micro Cat | ADCP | Avg | SD | Min | Max | Avg | SD | Min | Max | Avg | SD | Min | Max | Avg | SD | Min | Max | Avg | SD | Min | Max |
| 40 | 35 | -1.31 | 0.19 | -1.68 | -0.72 | 31.84 | 0.16 | 31.39 | 32.29 | 25.60 | 0.13 | 25.23 | 25.96 | 14.84 | 18.80 | -56.12 | 55.14 | -1.36 | 6.29 | -15.53 | 24.82 |
| 79 | 78 | -1.44 | 0.11 | -1.62 | -0.95 | 32.39 | 0.11 | 32.07 | 32.69 | 26.05 | 0.09 | 25.79 | 26.30 | 10.06 | 18.22 | -48.94 | 51.75 | 0.96 | 5.95 | -20.60 | 22.98 |
| 146 | 138 | -1.14 | 0.35 | -1.63 | -0.19 | 33.00 | 0.35 | 32.45 | 33.88 | 26.54 | 0.27 | 26.10 | 27.21 | 2.04 | 16.15 | -50.75 | 37.26 | 0.55 | 5.39 | -24.39 | 14.48 |

## Table 3: South Central Barrow Strait, Microcat/ADCP statistical summary
## Late summer: August 10, 2010 - September 20, 2010

| Depth (m) | | Temperature (°C) | | | | Salinity (ppt) | | | | Density (Sigma-T) | | | | Along-Strait Velocity (cm/s) | | | | Cross-Strait Velocity (cm/s) | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Micro Cat | ADCP | Avg | SD | Min | Max | Avg | SD | Min | Max | Avg | SD | Min | Max | Avg | SD | Min | Max | Avg | SD | Min | Max |
| 39 | 38 | -1.35 | 0.14 | -1.54 | -0.77 | 32.11 | 0.17 | 31.36 | 32.47 | 25.82 | 0.14 | 25.20 | 26.12 | 8.35 | 15.55 | -34.63 | 50.99 | 1.17 | 9.69 | -29.48 | 26.60 |
| 56 | 58 | -1.44 | 0.08 | -1.64 | -1.03 | 32.36 | 0.12 | 31.91 | 32.58 | 26.03 | 0.10 | 25.65 | 26.21 | 7.43 | 15.37 | -40.72 | 49.81 | 1.77 | 8.59 | -23.92 | 24.80 |
| 154 | 153 | -1.06 | 0.25 | -1.42 | -0.40 | 33.18 | 0.26 | 32.82 | 33.79 | 26.68 | 0.20 | 26.40 | 27.15 | 2.88 | 15.22 | -31.76 | 43.50 | 2.06 | 6.99 | -14.76 | 21.28 |
| 264 | 233 | -0.11 | 0.08 | -0.52 | 0.13 | 33.93 | 0.05 | 33.67 | 34.07 | 27.24 | 0.03 | 27.06 | 27.35 | 2.54 | 14.89 | -44.90 | 41.20 | 5.88 | 8.50 | -17.13 | 43.82 |

## Table 4: South Barrow Strait, Microcat/ADCP statistical summary
## Fall: September 21, 2010 - December 20, 2010

| Depth (m) | | Temperature (°C) | | | | Salinity (ppt) | | | | Density (Sigma-T) | | | | Along-Strait Velocity (cm/s) | | | | Cross-Strait Velocity (cm/s) | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Micro Cat | ADCP | Avg | SD | Min | Max | Avg | SD | Min | Max | Avg | SD | Min | Max | Avg | SD | Min | Max | Avg | SD | Min | Max |
| 40 | 35 | -1.42 | 0.21 | -1.73 | -0.58 | 31.84 | 0.36 | 30.72 | 33.03 | 25.61 | 0.29 | 24.69 | 26.56 | 2.68 | 23.72 | -107.2 | 86.92 | -2.08 | 6.77 | -41.18 | 46.57 |
| 79 | 78 | -1.38 | 0.14 | -1.69 | -0.59 | 32.57 | 0.22 | 32.12 | 33.63 | 26.20 | 0.17 | 25.83 | 27.03 | 3.56 | 20.55 | -64.91 | 59.30 | 0.00 | 5.74 | -20.10 | 25.32 |
| 146 | 138 | -0.68 | 0.42 | -1.48 | 0.18 | 33.43 | 0.41 | 32.48 | 34.00 | 26.87 | 0.32 | 26.12 | 27.29 | 1.94 | 16.56 | -47.01 | 41.54 | 0.02 | 5.43 | -19.60 | 15.76 |

## Table 5: South Central Barrow Strait, Microcat/ADCP statistical summary
## Fall: September 21, 2010 - December 20, 2010

| Depth (m) | | Temperature (°C) | | | | Salinity (ppt) | | | | Density (Sigma-T) | | | | Along-Strait Velocity (cm/s) | | | | Cross-Strait Velocity (cm/s) | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Micro Cat | ADCP | Avg | SD | Min | Max | Avg | SD | Min | Max | Avg | SD | Min | Max | Avg | SD | Min | Max | Avg | SD | Min | Max |
| 39 | 38 | -1.45 | 0.23 | -1.74 | -0.60 | 31.77 | 0.34 | 30.98 | 32.40 | 25.55 | 0.28 | 24.91 | 26.06 | -0.80 | 15.96 | -46.89 | 55.13 | -0.14 | 6.99 | -30.83 | 29.17 |
| 56 | 58 | -1.46 | 0.10 | -1.73 | -0.97 | 32.18 | 0.24 | 31.15 | 32.57 | 25.88 | 0.19 | 25.05 | 26.20 | -0.62 | 15.64 | -49.26 | 57.43 | 0.49 | 6.72 | -23.43 | 25.92 |
| 154 | 153 | -0.82 | 0.21 | -1.33 | -0.16 | 33.44 | 0.21 | 32.87 | 33.88 | 26.88 | 0.17 | 26.44 | 27.21 | 4.03 | 15.19 | -37.87 | 43.46 | 3.28 | 6.33 | -16.45 | 24.00 |
| 264 | 233 | 0.10 | 0.22 | -0.68 | 0.67 | 33.98 | 0.08 | 33.52 | 34.17 | 27.28 | 0.05 | 26.94 | 27.41 | 4.40 | 14.92 | -45.45 | 43.97 | 8.70 | 7.06 | -9.69 | 35.43 |

## Table 6: South Barrow Strait, Microcat/ADCP statistical summary
## Winter: December 21, 2010 - March 20, 2011

| **Depth (m)** | | **Temperature (°C)** | | | | **Salinity (ppt)** | | | | **Density (Sigma-T)** | | | | **Along-Strait Velocity (cm/s)** | | | | **Cross-Strait Velocity (cm/s)** | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Micro Cat | ADCP | Avg | SD | Min | Max | Avg | SD | Min | Max | Avg | SD | Min | Max | Avg | SD | Min | Max | Avg | SD | Min | Max |
| 40 | 35 | -1.73 | 0.03 | -1.77 | -1.53 | 32.02 | 0.22 | 31.65 | 32.39 | 25.76 | 0.18 | 25.45 | 26.06 | 6.62 | 13.59 | -42.10 | 46.38 | -1.47 | 3.55 | -17.90 | 8.62 |
| 79 | 78 | -1.45 | 0.12 | -1.76 | -0.79 | 32.43 | 0.12 | 31.99 | 33.20 | 26.09 | 0.10 | 25.73 | 26.70 | 10.58 | 16.26 | -64.29 | 49.61 | -0.30 | 5.14 | -27.98 | 17.16 |
| 146 | 138 | -0.82 | 0.49 | -1.69 | 0.31 | 33.21 | 0.49 | 32.36 | 34.02 | 26.69 | 0.38 | 26.03 | 27.30 | 4.70 | 15.63 | -44.38 | 39.76 | -0.01 | 4.90 | -21.47 | 14.46 |

## Table 7: South Central Barrow Strait, Microcat/ADCP statistical summary
## Winter: December 21, 2010 - March 20, 2011

| **Depth (m)** | | **Temperature (°C)** | | | | **Salinity (ppt)** | | | | **Density (Sigma-T)** | | | | **Along-Strait Velocity (cm/s)** | | | | **Cross-Strait Velocity (cm/s)** | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Micro Cat | ADCP | Avg | SD | Min | Max | Avg | SD | Min | Max | Avg | SD | Min | Max | Avg | SD | Min | Max | Avg | SD | Min | Max |
| 39 | 38 | -1.74 | 0.02 | -1.77 | -1.46 | 31.97 | 0.23 | 31.50 | 32.40 | 25.72 | 0.18 | 25.33 | 26.07 | 5.43 | 13.63 | -40.25 | 42.44 | 1.41 | 3.65 | -12.45 | 17.11 |
| 56 | 58 | -1.69 | 0.10 | -1.77 | -1.20 | 32.06 | 0.19 | 31.62 | 32.49 | 25.79 | 0.15 | 25.43 | 26.13 | 5.05 | 14.21 | -43.67 | 45.57 | 1.34 | 4.25 | -14.91 | 16.20 |
| 154 | 153 | -0.81 | 0.25 | -1.36 | 0.10 | 33.40 | 0.30 | 32.64 | 34.03 | 26.85 | 0.23 | 26.25 | 27.34 | Instrument Failed, January 19, 2011 | | | | | | | |
| 264 | 233 | 0.30 | 0.17 | -0.85 | 0.70 | 34.02 | 0.07 | 33.27 | 34.14 | 27.30 | 0.04 | 26.74 | 27.42 | | | | | | | | |

## Table 8: South Barrow Strait, Microcat/ADCP statistical summary
## Spring: March 21, 2011 - June 20, 2011

| Depth (m) | | Temperature (°C) | | | | Salinity (ppt) | | | | Density (Sigma-T) | | | | Along-Strait Velocity (cm/s) | | | | Cross-Strait Velocity (cm/s) | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Micro Cat | ADCP | Avg | SD | Min | Max | Avg | SD | Min | Max | Avg | SD | Min | Max | Avg | SD | Min | Max | Avg | SD | Min | Max |
| 40 | 35 | -1.58 | 0.22 | -1.77 | -0.32 | 32.28 | 0.13 | 31.69 | 32.75 | 25.97 | 0.10 | 25.46 | 26.35 | 13.87 | 14.12 | -34.96 | 49.47 | -1.28 | 5.11 | -15.61 | 24.55 |
| 79 | 78 | -1.58 | 0.13 | -1.77 | -0.79 | 32.50 | 0.10 | 32.22 | 32.94 | 26.14 | 0.08 | 25.90 | 26.50 | 9.93 | 14.82 | -44.57 | 50.20 | 0.22 | 5.14 | -18.13 | 18.63 |
| 146 | 138 | -1.29 | 0.15 | -1.72 | -0.84 | 32.86 | 0.23 | 32.42 | 33.45 | 26.43 | 0.18 | 26.08 | 26.90 | 3.74 | 13.57 | -38.48 | 39.62 | -0.03 | 5.07 | -17.37 | 15.63 |

## Table 9: South Central Barrow Strait, Microcat/ADCP statistical summary
## Spring: March 21, 2011 - June 20, 2011

| Depth (m) | | Temperature (°C) | | | | Salinity (ppt) | | | | Density (Sigma-T) | | | | Along-Strait Velocity (cm/s) | | | | Cross-Strait Velocity (cm/s) | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Micro Cat | ADCP | Avg | SD | Min | Max | Avg | SD | Min | Max | Avg | SD | Min | Max | Avg | SD | Min | Max | Avg | SD | Min | Max |
| 39 | 38 | -1.61 | 0.18 | -1.77 | -0.45 | 32.42 | 0.14 | 31.83 | 32.81 | 26.08 | 0.11 | 25.60 | 26.40 | 11.91 | 13.55 | -30.15 | 51.19 | 3.19 | 7.78 | -32.04 | 42.18 |
| 56 | 58 | -1.63 | 0.13 | -1.77 | -0.91 | 32.51 | 0.12 | 32.16 | 32.83 | 26.15 | 0.09 | 25.87 | 26.41 | 11.25 | 13.86 | -26.51 | 53.93 | 3.23 | 7.41 | -25.53 | 37.50 |
| 154 | 153 | -1.19 | 0.10 | -1.51 | -0.74 | 33.11 | 0.17 | 32.68 | 33.60 | 26.63 | 0.14 | 26.29 | 27.02 | Instrument Failed, January 19, 2011 | | | | | | | |
| 264 | 233 | -0.04 | 0.21 | -0.89 | 0.31 | 33.89 | 0.09 | 33.51 | 34.03 | 27.21 | 0.06 | 26.94 | 27.31 | | | | | | | | |

## Table 10: South Barrow Strait, Microcat/ADCP statistical summary
## Early Summer: June 21, 2011 - August 7, 2011

| Depth (m) | | Temperature (°C) | | | | Salinity (ppt) | | | | Density (Sigma-T) | | | | Along-Strait Velocity (cm/s) | | | | Cross-Strait Velocity (cm/s) | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Micro Cat | ADCP | Avg | SD | Min | Max | Avg | SD | Min | Max | Avg | SD | Min | Max | Avg | SD | Min | Max | Avg | SD | Min | Max |
| 40 | 35 | -1.04 | 0.51 | -1.65 | 0.76 | 32.25 | 0.18 | 31.39 | 33.09 | 25.92 | 0.16 | 25.21 | 26.62 | 19.00 | 14.64 | -26.61 | 67.39 | -2.32 | 6.56 | -20.36 | 22.26 |
| 79 | 78 | -1.42 | 0.06 | -1.69 | -1.10 | 32.64 | 0.10 | 32.32 | 32.98 | 26.26 | 0.08 | 26.00 | 26.53 | 14.87 | 14.58 | -32.56 | 63.05 | 0.18 | 4.85 | -14.25 | 24.08 |
| 146 | 138 | -1.21 | 0.10 | -1.41 | -0.83 | 33.06 | 0.23 | 32.52 | 33.52 | 26.59 | 0.18 | 26.15 | 26.95 | 4.64 | 15.42 | -41.35 | 34.70 | -0.19 | 5.65 | -22.43 | 16.55 |

## Table 11: South Central Barrow Strait, Microcat/ADCP statistical summary
## Early Summer: June 21, 2011 - August 7, 2011

| Depth (m) | | Temperature (°C) | | | | Salinity (ppt) | | | | Density (Sigma-T) | | | | Along-Strait Velocity (cm/s) | | | | Cross-Strait Velocity (cm/s) | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Micro Cat | ADCP | Avg | SD | Min | Max | Avg | SD | Min | Max | Avg | SD | Min | Max | Avg | SD | Min | Max | Avg | SD | Min | Max |
| 39 | 38 | -1.00 | 0.50 | -1.58 | 0.96 | 32.33 | 0.21 | 31.01 | 32.71 | 25.99 | 0.18 | 24.93 | 26.31 | 6.08 | 15.40 | -28.98 | 53.27 | 0.68 | 7.93 | -27.90 | 20.53 |
| 56 | 58 | -1.35 | 0.30 | -1.58 | 0.65 | 32.57 | 0.15 | 31.63 | 32.80 | 26.20 | 0.13 | 25.36 | 26.38 | 5.43 | 14.96 | -29.89 | 50.66 | 1.44 | 6.97 | -17.07 | 20.91 |
| 154 | 153 | -1.23 | 0.11 | -1.51 | -0.74 | 33.35 | 0.09 | 32.95 | 33.65 | 26.82 | 0.07 | 26.50 | 27.05 | Instrument Failed, January 19, 2011 | | | | | | | |
| 264 | 233 | -0.23 | 0.11 | -0.90 | -0.04 | 33.79 | 0.04 | 33.45 | 33.86 | 27.14 | 0.03 | 26.87 | 27.19 | | | | | | | | |

**Table 12: South Barrow Strait, Microcat/ADCP statistical summary**
**Complete Record: August 10, 2010 - August 7, 2011**

| Depth (m) | | Temperature (°C) | | | | Salinity (ppt) | | | | Density (Sigma-T) | | | | Along-Strait Velocity (cm/s) | | | | Cross-Strait Velocity (cm/s) | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Micro Cat | ADCP | Avg | SD | Min | Max | Avg | SD | Min | Max | Avg | SD | Min | Max | Avg | SD | Min | Max | Avg | SD | Min | Max |
| 40 | 35 | -1.48 | 0.33 | -1.77 | 0.76 | 32.05 | 0.30 | 30.72 | 33.09 | 25.78 | 0.25 | 24.69 | 26.62 | 10.03 | 18.44 | -107.2 | 86.92 | -1.67 | 5.62 | -41.18 | 46.57 |
| 79 | 78 | -1.46 | 0.14 | -1.77 | -0.59 | 32.51 | 0.17 | 31.99 | 33.63 | 26.15 | 0.13 | 25.73 | 27.03 | 9.16 | 17.50 | -64.91 | 63.05 | 0.11 | 5.37 | -27.98 | 25.32 |
| 146 | 138 | -0.99 | 0.43 | -1.72 | 0.31 | 33.13 | 0.43 | 32.36 | 34.02 | 26.64 | 0.33 | 26.03 | 27.30 | 3.45 | 15.45 | -50.75 | 41.54 | 0.03 | 5.24 | -24.39 | 16.55 |

**Table 13: South Central Barrow Strait, Microcat/ADCP statistical summary**
**Complete Record: August 10, 2010 - August 7, 2011**

| Depth (m) | | Temperature (°C) | | | | Salinity (ppt) | | | | Density (Sigma-T) | | | | Along-Strait Velocity (cm/s) | | | | Cross-Strait Velocity (cm/s) | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Micro Cat | ADCP | Avg | SD | Min | Max | Avg | SD | Min | Max | Avg | SD | Min | Max | Avg | SD | Min | Max | Avg | SD | Min | Max |
| 39 | 38 | -1.49 | 0.33 | -1.77 | 0.96 | 32.10 | 0.35 | 30.98 | 32.81 | 25.82 | 0.28 | 24.91 | 26.40 | 5.93 | 15.38 | -46.89 | 55.13 | 1.35 | 7.17 | -32.04 | 42.18 |
| 56 | 58 | -1.54 | 0.19 | -1.77 | 0.65 | 32.31 | 0.26 | 31.15 | 32.83 | 25.98 | 0.21 | 25.05 | 26.41 | 5.52 | 15.33 | -49.26 | 57.43 | 1.67 | 6.75 | -25.53 | 37.50 |
| 154 | 153 | -1.00 | 0.27 | -1.51 | 0.10 | 33.30 | 0.26 | 32.64 | 34.03 | 26.78 | 0.20 | 26.25 | 27.34 | Instrument Failed, January 19, 2011 | | | | | | | |
| 264 | 233 | 0.04 | 0.25 | -0.90 | 0.70 | 33.94 | 0.10 | 33.27 | 34.17 | 27.24 | 0.07 | 26.74 | 27.42 | | | | | | | | |

## Table 14: Tidal Constants for K1 Constituent

### South Side Barrow Strait

### For Ice Free Period (Aug. 10, 2010 – Oct. 6, 2010):

| Depth (m) | Major Amplitude (cm/s) | Minor Amplitude (cm/s) | Orientation (degrees cc from East) | Greenwich Phase (degrees) |
|---|---|---|---|---|
| 11 | 9.74 | -0.01 | 164 | 351 |
| 15 | 9.65 | 0.24 | 163 | 346 |
| 19 | 9.27 | 0.47 | 163 | 342 |
| 23 | 8.68 | 0.63 | 160 | 339 |
| 27 | 7.99 | 1.23 | 159 | 337 |
| 31 | 7.02 | 1.63 | 153 | 331 |
| 35 | 6.60 | 1.97 | 154 | 336 |
| 39 | Data contaminated by presence of buoyancy package | | | |
| 43 | | | | |
| 47 | 6.76 | 1.33 | 152 | 343 |
| 51 | 6.61 | 1.21 | 155 | 339 |
| 55 | 6.51 | 1.51 | 157 | 336 |
| 59 | 6.93 | 1.88 | 158 | 334 |
| 63 | 7.27 | 2.13 | 159 | 333 |
| 67 | 7.08 | 2.31 | 161 | 334 |
| 71 | 7.28 | 2.06 | 158 | 331 |
| 74 | 7.12 | 2.87 | 163 | 330 |
| 78 | 7.40 | 3.00 | 158 | 327 |
| 82 | 7.53 | 2.86 | 155 | 323 |
| 86 | 7.80 | 3.24 | 153 | 320 |
| 90 | 8.12 | 3.32 | 149 | 316 |
| 94 | 8.16 | 3.55 | 148 | 315 |
| 98 | 8.38 | 3.89 | 147 | 315 |
| 102 | 8.57 | 3.89 | 147 | 313 |
| 106 | 8.91 | 3.78 | 147 | 314 |
| 110 | 9.36 | 3.49 | 145 | 313 |
| 114 | 9.72 | 3.82 | 143 | 311 |
| 118 | 9.99 | 3.86 | 145 | 310 |
| 122 | 10.22 | 3.92 | 146 | 309 |
| 126 | 10.77 | 3.77 | 148 | 309 |
| 130 | 11.68 | 2.97 | 148 | 308 |
| 134 | 11.87 | 2.64 | 149 | 306 |
| 138 | 11.46 | 2.05 | 150 | 302 |

### For Solid Ice Period

**Insufficient Period for Analysis**

## Table 14: Tidal Constants for K1 Constituent (continued)

### South Central Barrow Strait (Workhorse ADCP)

### For Ice Free Period (Aug. 10, 2010 – Oct. 9, 2010):

| Depth (m) | Major Amplitude (cm/s) | Minor Amplitude (cm/s) | Orientation (degrees cc from East) | Greenwich Phase (degrees) |
|---|---|---|---|---|
| 10 | 12.61 | -1.56 | 168 | 354 |
| 14 | 12.90 | -1.94 | 168 | 355 |
| 18 | 12.36 | -1.94 | 170 | 355 |
| 22 | 12.16 | -1.07 | 167 | 359 |
| 26 | 11.98 | -1.29 | 166 | 358 |
| 30 | 11.58 | -1.52 | 165 | 359 |
| 34 | 11.99 | -1.39 | 167 | 0 |
| 38 | 12.52 | -0.85 | 168 | 2 |
| 42 | 13.07 | -0.64 | 168 | 3 |
| 46 | 13.21 | -0.87 | 166 | 4 |
| 50 | 13.39 | -0.92 | 165 | 3 |
| 54 | 13.15 | -0.56 | 164 | 3 |
| 58 | 13.50 | -0.68 | 165 | 3 |
| 62 | 13.72 | -0.71 | 163 | 4 |
| 66 | 13.79 | -0.64 | 163 | 5 |
| 70 | 14.01 | -0.62 | 162 | 5 |

### For Solid Ice Period

**Insufficient Period for Analysis**

## Table 14: Tidal Constants for K1 Constituent (continued)

### South Central Barrow Strait (Quarter Master ADCP)

### For Ice Free Period (Aug. 11, 2010 – Oct. 9, 2010):

| Depth (m) | Major Amplitude (cm/s) | Minor Amplitude (cm/s) | Orientation (degrees cc from East) | Greenwich Phase (degrees) |
|---|---|---|---|---|
| 25 | 12.09 | 0.21 | 176 | 0 |
| 33 | 12.51 | 0.27 | 175 | 3 |
| 41 | 12.48 | 0.59 | 174 | 4 |
| 49 | 12.83 | 0.45 | 171 | 4 |
| 57 | 13.17 | 0.27 | 171 | 5 |
| 65 | 12.93 | 0.83 | 170 | 5 |
| 73 | 12.80 | 1.30 | 166 | 4 |
| 81 | 13.28 | 1.21 | 164 | 4 |
| 89 | 13.49 | 1.37 | 163 | 3 |
| 97 | 13.28 | 1.64 | 161 | 4 |
| 105 | 13.65 | 1.57 | 160 | 4 |
| 113 | 14.14 | 1.89 | 157 | 5 |
| 121 | 14.20 | 1.59 | 156 | 5 |
| 129 | 14.66 | 1.38 | 155 | 4 |
| 137 | 15.23 | 1.20 | 154 | 5 |
| 145 | 15.64 | 0.89 | 153 | 6 |
| 153 | 16.09 | 0.74 | 152 | 7 |
| 161 | 17.09 | 0.26 | 152 | 8 |
| 169 | 18.12 | -0.61 | 152 | 7 |
| 177 | 19.13 | -1.40 | 151 | 6 |
| 185 | 19.25 | -1.22 | 150 | 5 |
| 193 | 19.92 | -1.47 | 150 | 3 |
| 201 | 20.20 | -2.16 | 147 | 4 |
| 209 | 20.14 | -2.94 | 147 | 4 |
| 217 | 20.42 | -3.08 | 147 | 5 |
| 225 | 20.80 | -3.38 | 146 | 4 |
| 233 | 21.62 | -4.41 | 143 | 4 |

### For Solid Ice Period

**Insufficient Period for Analysis**

## <u>Table 15</u>: Tidal Constants for M2 Constituent

### South Side Barrow Strait

### For Ice Free Period (Aug. 10, 2010 – Oct. 6, 2010):

| Depth (m) | Major Amplitude (cm/s) | Minor Amplitude (cm/s) | Orientation (degrees cc from East) | Greenwich Phase (degrees) |
|---|---|---|---|---|
| 11 | 8.22 | -0.27 | 144 | 200 |
| 15 | 8.20 | -0.10 | 143 | 200 |
| 19 | 8.56 | -0.26 | 144 | 201 |
| 23 | 9.08 | -0.31 | 145 | 202 |
| 27 | 8.89 | -0.14 | 146 | 202 |
| 31 | 8.55 | -0.02 | 146 | 202 |
| 35 | 8.44 | -0.09 | 147 | 203 |
| 39 | Data contaminated by presence of buoyancy package | | | |
| 43 | | | | |
| 47 | 8.53 | 0.08 | 150 | 202 |
| 51 | 8.63 | 0.22 | 148 | 201 |
| 55 | 8.74 | 0.20 | 147 | 201 |
| 59 | 9.07 | 0.06 | 148 | 200 |
| 63 | 9.38 | -0.07 | 150 | 201 |
| 67 | 9.56 | -0.27 | 151 | 201 |
| 71 | 9.60 | -0.39 | 152 | 202 |
| 74 | 9.78 | -0.57 | 158 | 202 |
| 78 | 9.78 | -0.66 | 157 | 203 |
| 82 | 9.78 | -0.46 | 156 | 204 |
| 86 | 9.80 | -0.66 | 157 | 205 |
| 90 | 9.54 | -0.90 | 157 | 206 |
| 94 | 9.58 | -0.84 | 157 | 206 |
| 98 | 9.53 | -0.88 | 156 | 206 |
| 102 | 9.50 | -0.79 | 155 | 206 |
| 106 | 9.66 | -0.75 | 155 | 206 |
| 110 | 9.90 | -0.75 | 154 | 205 |
| 114 | 9.92 | -0.72 | 155 | 205 |
| 118 | 10.02 | -0.96 | 157 | 205 |
| 122 | 10.14 | -1.01 | 160 | 207 |
| 126 | 10.34 | -1.11 | 162 | 209 |
| 130 | 10.37 | -1.18 | 165 | 211 |
| 134 | 10.38 | -1.51 | 168 | 213 |
| 138 | 10.56 | -1.35 | 171 | 214 |

### For Solid Ice Period

**Insufficient Period for Analysis**

## Table 15: Tidal Constants for M2 Constituent (continued)

### South Central Barrow Strait (Workhorse ADCP)

### For Ice Free Period (Aug. 10, 2010 – Oct. 9, 2010):

| Depth (m) | Major Amplitude (cm/s) | Minor Amplitude (cm/s) | Orientation (degrees cc from East) | Greenwich Phase (degrees) |
|---|---|---|---|---|
| 10 | 7.18 | -0.17 | 159 | 190 |
| 14 | 8.03 | -1.03 | 163 | 196 |
| 18 | 8.08 | -0.95 | 162 | 196 |
| 22 | 8.13 | -1.15 | 160 | 193 |
| 26 | 8.69 | -1.35 | 160 | 193 |
| 30 | 8.78 | -1.47 | 163 | 196 |
| 34 | 8.87 | -1.55 | 167 | 199 |
| 38 | 9.03 | -1.53 | 168 | 201 |
| 42 | 9.08 | -1.63 | 169 | 201 |
| 46 | 9.41 | -1.85 | 169 | 202 |
| 50 | 9.55 | -2.04 | 169 | 203 |
| 54 | 9.72 | -2.20 | 170 | 204 |
| 58 | 9.68 | -2.25 | 170 | 205 |
| 62 | 9.66 | -2.32 | 169 | 205 |
| 66 | 9.51 | -2.24 | 170 | 205 |
| 70 | 9.36 | -2.07 | 171 | 205 |

### For Solid Ice Period

**Insufficient Period for Analysis**

## Table 15: Tidal Constants for M2 Constituent (continued)

### South Central Barrow Strait (Quarter Master ADCP)

### For Ice Free Period (Aug. 11, 2010 – Oct. 9, 2010):

| Depth (m) | Major Amplitude (cm/s) | Minor Amplitude (cm/s) | Orientation (degrees cc from East) | Greenwich Phase (degrees) |
|---|---|---|---|---|
| 25 | 8.69 | -1.87 | 160 | 194 |
| 33 | 9.01 | -1.86 | 164 | 197 |
| 41 | 9.16 | -1.90 | 168 | 199 |
| 49 | 9.39 | -2.00 | 167 | 201 |
| 57 | 9.58 | -2.09 | 165 | 204 |
| 65 | 9.52 | -2.11 | 166 | 205 |
| 73 | 9.44 | -2.10 | 168 | 205 |
| 81 | 9.59 | -2.08 | 168 | 205 |
| 89 | 9.62 | -2.23 | 168 | 205 |
| 97 | 9.60 | -2.18 | 168 | 205 |
| 105 | 9.53 | -2.12 | 167 | 205 |
| 113 | 9.67 | -2.23 | 166 | 206 |
| 121 | 9.65 | -2.18 | 165 | 206 |
| 129 | 9.69 | -2.18 | 165 | 206 |
| 137 | 9.83 | -2.38 | 165 | 205 |
| 145 | 9.93 | -2.22 | 164 | 206 |
| 153 | 9.77 | -2.08 | 164 | 206 |
| 161 | 9.55 | -1.89 | 165 | 206 |
| 169 | 9.33 | -1.60 | 168 | 208 |
| 177 | 9.21 | -1.42 | 170 | 211 |
| 185 | 8.94 | -1.28 | 171 | 214 |
| 193 | 8.87 | -1.14 | 172 | 214 |
| 201 | 8.96 | -1.33 | 175 | 215 |
| 209 | 9.15 | -1.71 | 176 | 216 |
| 217 | 9.08 | -1.87 | 177 | 217 |
| 225 | 9.21 | -1.85 | 177 | 217 |
| 233 | 8.36 | -1.48 | 177 | 217 |

### For Solid Ice Period

**Insufficient Period for Analysis**

## Table 16: Tidal Constants for O1 Constituent

### South Side Barrow Strait

### For Ice Free Period (Aug. 10, 2010 – Oct. 6, 2010):

| Depth (m) | Major Amplitude (cm/s) | Minor Amplitude (cm/s) | Orientation (degrees cc from East) | Greenwich Phase (degrees) |
|---|---|---|---|---|
| 11 | 3.51 | -0.81 | 149 | 329 |
| 15 | 3.45 | -0.76 | 149 | 324 |
| 19 | 3.32 | -0.43 | 155 | 315 |
| 23 | 3.42 | 0.03 | 151 | 311 |
| 27 | 3.04 | 0.41 | 150 | 310 |
| 31 | 2.94 | 0.63 | 156 | 314 |
| 35 | 3.14 | 0.64 | 158 | 316 |
| 39 | Data contaminated by presence of buoyancy package | | | |
| 43 | | | | |
| 47 | 3.80 | 0.43 | 152 | 299 |
| 51 | 3.79 | 0.29 | 149 | 296 |
| 55 | 3.90 | 0.33 | 144 | 293 |
| 59 | 3.95 | 0.29 | 142 | 292 |
| 63 | 4.04 | -0.05 | 143 | 287 |
| 67 | 3.78 | -0.07 | 143 | 285 |
| 71 | 3.87 | 0.07 | 142 | 283 |
| 74 | 3.87 | 0.09 | 146 | 277 |
| 78 | 4.09 | 0.02 | 147 | 277 |
| 82 | 4.04 | 0.03 | 146 | 276 |
| 86 | 4.05 | 0.08 | 147 | 276 |
| 90 | 4.09 | 0.09 | 148 | 276 |
| 94 | 4.15 | 0.25 | 149 | 274 |
| 98 | 4.41 | 0.32 | 150 | 276 |
| 102 | 4.55 | 0.37 | 151 | 278 |
| 106 | 4.53 | 0.43 | 153 | 278 |
| 110 | 4.51 | 0.49 | 156 | 280 |
| 114 | 4.58 | 0.66 | 156 | 278 |
| 118 | 4.79 | 0.92 | 157 | 276 |
| 122 | 5.10 | 0.98 | 158 | 277 |
| 126 | 5.33 | 0.94 | 159 | 279 |
| 130 | 5.59 | 0.82 | 162 | 281 |
| 134 | 5.63 | 0.71 | 165 | 282 |
| 138 | 5.82 | 0.87 | 166 | 280 |

### For Solid Ice Period

**Insufficient Period for Analysis**

## Table 16: Tidal Constants for O1 Constituent (continued)

### South Central Barrow Strait (Workhorse ADCP)

### For Ice Free Period (Aug. 10, 2010 – Oct. 9, 2010):

| Depth (m) | Major Amplitude (cm/s) | Minor Amplitude (cm/s) | Orientation (degrees cc from East) | Greenwich Phase (degrees) |
|---|---|---|---|---|
| 10 | 5.53 | -0.26 | 169 | 294 |
| 14 | 5.40 | -0.18 | 168 | 295 |
| 18 | 5.45 | -0.09 | 167 | 297 |
| 22 | 5.47 | -0.54 | 168 | 300 |
| 26 | 5.54 | -0.52 | 169 | 302 |
| 30 | 5.42 | -0.49 | 165 | 301 |
| 34 | 5.36 | -0.26 | 162 | 301 |
| 38 | 5.62 | 0.02 | 163 | 303 |
| 42 | 5.81 | 0.02 | 164 | 305 |
| 46 | 5.75 | -0.07 | 164 | 305 |
| 50 | 5.89 | -0.22 | 164 | 305 |
| 54 | 5.78 | -0.11 | 164 | 305 |
| 58 | 5.58 | -0.11 | 162 | 305 |
| 62 | 5.66 | -0.07 | 162 | 306 |
| 66 | 5.81 | 0.16 | 164 | 307 |
| 70 | 5.84 | 0.25 | 165 | 307 |

### For Solid Ice Period

**Insufficient Period for Analysis**

## Table 16: Tidal Constants for O1 Constituent (continued)

### South Central Barrow Strait (Quarter Master ADCP)

### For Ice Free Period (Aug. 11, 2010 – Oct. 9, 2010):

| Depth (m) | Major Amplitude (cm/s) | Minor Amplitude (cm/s) | Orientation (degrees cc from East) | Greenwich Phase (degrees) |
|---|---|---|---|---|
| 25 | 5.73 | -0.27 | 173 | 302 |
| 33 | 5.69 | -0.11 | 173 | 302 |
| 41 | 5.62 | 0.20 | 172 | 303 |
| 49 | 5.43 | 0.32 | 173 | 306 |
| 57 | 5.21 | 0.16 | 175 | 308 |
| 65 | 5.05 | 0.22 | 172 | 309 |
| 73 | 5.17 | 0.46 | 171 | 308 |
| 81 | 5.25 | 0.38 | 170 | 306 |
| 89 | 5.40 | 0.37 | 168 | 305 |
| 97 | 5.47 | 0.32 | 166 | 304 |
| 105 | 5.65 | 0.33 | 167 | 307 |
| 113 | 5.89 | 0.20 | 166 | 307 |
| 121 | 6.16 | 0.16 | 164 | 308 |
| 129 | 6.27 | 0.18 | 163 | 308 |
| 137 | 6.07 | 0.22 | 162 | 310 |
| 145 | 6.16 | 0.51 | 162 | 310 |
| 153 | 6.41 | 0.28 | 161 | 312 |
| 161 | 6.86 | 0.16 | 160 | 312 |
| 169 | 7.01 | 0.23 | 159 | 311 |
| 177 | 7.06 | 0.21 | 158 | 311 |
| 185 | 7.12 | 0.13 | 158 | 310 |
| 193 | 7.11 | 0.06 | 156 | 309 |
| 201 | 7.17 | 0.17 | 153 | 307 |
| 209 | 7.34 | 0.45 | 149 | 305 |
| 217 | 7.52 | 0.23 | 145 | 304 |
| 225 | 7.79 | -0.10 | 144 | 303 |
| 233 | 8.13 | -0.41 | 142 | 302 |

### For Solid Ice Period

**Insufficient Period for Analysis**

## Table 17: Tidal Constants for P1 Constituent

### South Side Barrow Strait

### For Ice Free Period (Aug. 10, 2010 – Oct. 6, 2010):

| Depth (m) | Major Amplitude (cm/s) | Minor Amplitude (cm/s) | Orientation (degrees cc from East) | Greenwich Phase (degrees) |
|---|---|---|---|---|
| 11 | 4.53 | 1.02 | 164 | 337 |
| 15 | 4.70 | 1.26 | 167 | 332 |
| 19 | 4.86 | 1.21 | 170 | 327 |
| 23 | 4.38 | 0.98 | 166 | 323 |
| 27 | 4.16 | 1.26 | 161 | 314 |
| 31 | 4.17 | 0.90 | 149 | 294 |
| 35 | 3.63 | 0.86 | 146 | 286 |
| 39 | Data contaminated by presence of buoyancy package | | | |
| 43 | | | | |
| 47 | 1.72 | 0.49 | 159 | 279 |
| 51 | 1.90 | 0.99 | 150 | 270 |
| 55 | 2.33 | 1.16 | 128 | 258 |
| 59 | 2.68 | 1.37 | 122 | 262 |
| 63 | 2.87 | 1.49 | 127 | 267 |
| 67 | 2.82 | 1.53 | 117 | 256 |
| 71 | 2.67 | 1.71 | 127 | 264 |
| 74 | 3.19 | 1.52 | 107 | 250 |
| 78 | 3.19 | 1.64 | 112 | 259 |
| 82 | 3.44 | 1.45 | 119 | 265 |
| 86 | 3.71 | 1.46 | 121 | 267 |
| 90 | 4.28 | 1.14 | 125 | 270 |
| 94 | 4.50 | 1.27 | 123 | 266 |
| 98 | 4.67 | 1.19 | 122 | 267 |
| 102 | 5.01 | 1.19 | 125 | 268 |
| 106 | 5.09 | 1.09 | 126 | 273 |
| 110 | 5.37 | 0.58 | 130 | 278 |
| 114 | 5.66 | 0.64 | 129 | 279 |
| 118 | 5.88 | 0.92 | 133 | 276 |
| 122 | 6.24 | 1.04 | 136 | 274 |
| 126 | 6.61 | 1.05 | 138 | 275 |
| 130 | 7.25 | 0.39 | 144 | 279 |
| 134 | 7.12 | 0.24 | 147 | 276 |
| 138 | 6.64 | 0.21 | 151 | 271 |

### For Solid Ice Period

**Insufficient Period for Analysis**

## Table 17: Tidal Constants for P1 Constituent (continued)

### South Central Barrow Strait (Workhorse ADCP)

### For Ice Free Period (Aug. 10, 2010 – Oct. 9, 2010):

| Depth (m) | Major Amplitude (cm/s) | Minor Amplitude (cm/s) | Orientation (degrees cc from East) | Greenwich Phase (degrees) |
|---|---|---|---|---|
| 10 | 4.23 | -0.48 | 173 | 342 |
| 14 | 4.37 | -0.29 | 173 | 349 |
| 18 | 4.20 | 0.27 | 173 | 344 |
| 22 | 3.94 | 0.66 | 161 | 342 |
| 26 | 4.02 | 0.21 | 166 | 344 |
| 30 | 4.02 | -0.21 | 170 | 345 |
| 34 | 4.49 | -0.12 | 176 | 357 |
| 38 | 4.61 | 0.24 | 177 | 5 |
| 42 | 4.72 | 0.44 | 175 | 9 |
| 46 | 4.45 | 0.29 | 171 | 7 |
| 50 | 4.72 | 0.32 | 169 | 1 |
| 54 | 4.76 | 0.46 | 166 | 0 |
| 58 | 5.07 | 0.59 | 169 | 4 |
| 62 | 5.27 | 0.47 | 166 | 6 |
| 66 | 5.13 | 0.53 | 165 | 10 |
| 70 | 5.24 | 0.61 | 162 | 10 |

### For Solid Ice Period

**Insufficient Period for Analysis**

## Table 17: Tidal Constants for P1 Constituent (continued)

### South Central Barrow Strait (Quarter Master ADCP)

### For Ice Free Period (Aug. 11, 2010 – Oct. 9, 2010):

| Depth (m) | Major Amplitude (cm/s) | Minor Amplitude (cm/s) | Orientation (degrees cc from East) | Greenwich Phase (degrees) |
|---|---|---|---|---|
| 25 | 3.32 | 1.72 | 183 | 358 |
| 33 | 4.12 | 1.36 | 184 | 12 |
| 41 | 4.43 | 1.32 | 186 | 16 |
| 49 | 4.69 | 1.34 | 176 | 9 |
| 57 | 4.99 | 1.09 | 179 | 13 |
| 65 | 4.84 | 1.70 | 177 | 12 |
| 73 | 4.56 | 2.18 | 169 | 8 |
| 81 | 4.81 | 2.21 | 162 | 4 |
| 89 | 5.09 | 2.34 | 157 | 359 |
| 97 | 4.84 | 2.60 | 149 | 358 |
| 105 | 4.98 | 2.82 | 149 | 2 |
| 113 | 5.06 | 3.04 | 143 | 1 |
| 121 | 4.87 | 2.70 | 142 | 2 |
| 129 | 5.18 | 2.44 | 144 | 3 |
| 137 | 5.66 | 2.26 | 147 | 10 |
| 145 | 5.73 | 2.08 | 148 | 10 |
| 153 | 5.40 | 2.21 | 147 | 8 |
| 161 | 5.85 | 1.89 | 146 | 9 |
| 169 | 6.92 | 1.04 | 146 | 6 |
| 177 | 7.89 | 0.34 | 145 | 5 |
| 185 | 7.84 | 0.28 | 143 | 0 |
| 193 | 8.72 | -0.02 | 143 | 357 |
| 201 | 9.13 | -0.73 | 139 | 0 |
| 209 | 9.05 | -1.17 | 141 | 2 |
| 217 | 9.25 | -1.31 | 144 | 5 |
| 225 | 9.40 | -1.62 | 143 | 4 |
| 233 | 9.81 | -2.40 | 140 | 7 |

### For Solid Ice Period

**Insufficient Period for Analysis**

## Table 18: Tidal Constants for S2 Constituent

### South Side Barrow Strait

### For Ice Free Period (Aug. 10, 2010 – Oct. 6, 2010):

| Depth (m) | Major Amplitude (cm/s) | Minor Amplitude (cm/s) | Orientation (degrees cc from East) | Greenwich Phase (degrees) |
|---|---|---|---|---|
| 11 | 4.92 | -0.53 | 146 | 242 |
| 15 | 5.06 | -0.35 | 153 | 248 |
| 19 | 5.38 | -0.55 | 153 | 247 |
| 23 | 5.49 | -0.78 | 153 | 246 |
| 27 | 5.26 | -0.78 | 153 | 245 |
| 31 | 5.02 | -0.57 | 154 | 246 |
| 35 | 4.65 | -0.35 | 155 | 246 |
| 39 | Data contaminated by presence of buoyancy package | | | |
| 43 | | | | |
| 47 | 4.30 | 0.12 | 145 | 241 |
| 51 | 4.30 | -0.12 | 146 | 243 |
| 55 | 4.31 | -0.45 | 148 | 246 |
| 59 | 4.19 | -0.62 | 151 | 246 |
| 63 | 4.24 | -0.49 | 149 | 241 |
| 67 | 4.13 | -0.50 | 145 | 242 |
| 71 | 4.05 | -0.36 | 141 | 238 |
| 74 | 3.95 | 0.03 | 146 | 240 |
| 78 | 3.98 | 0.08 | 147 | 238 |
| 82 | 3.88 | 0.04 | 147 | 238 |
| 86 | 3.87 | -0.03 | 148 | 239 |
| 90 | 4.07 | -0.10 | 147 | 243 |
| 94 | 4.22 | -0.27 | 147 | 244 |
| 98 | 4.46 | -0.34 | 144 | 243 |
| 102 | 4.45 | -0.19 | 143 | 242 |
| 106 | 4.54 | -0.17 | 145 | 243 |
| 110 | 4.60 | -0.39 | 146 | 243 |
| 114 | 4.72 | -0.42 | 149 | 245 |
| 118 | 4.64 | -0.65 | 149 | 247 |
| 122 | 4.65 | -0.77 | 150 | 249 |
| 126 | 4.75 | -0.98 | 155 | 251 |
| 130 | 5.23 | -1.33 | 162 | 253 |
| 134 | 5.52 | -1.50 | 164 | 254 |
| 138 | 5.54 | -1.38 | 167 | 255 |

### For Solid Ice Period

**Insufficient Period for Analysis**

## Table 18: Tidal Constants for S2 Constituent (continued)

### South Central Barrow Strait (Workhorse ADCP)

### For Ice Free Period (Aug. 10, 2010 – Oct. 9, 2010):

| Depth (m) | Major Amplitude (cm/s) | Minor Amplitude (cm/s) | Orientation (degrees cc from East) | Greenwich Phase (degrees) |
|---|---|---|---|---|
| 10 | 4.15 | -0.90 | 161 | 237 |
| 14 | 4.33 | -1.04 | 169 | 240 |
| 18 | 4.60 | -0.94 | 176 | 245 |
| 22 | 4.91 | -0.96 | 180 | 249 |
| 26 | 4.96 | -1.06 | 177 | 247 |
| 30 | 4.84 | -1.19 | 172 | 242 |
| 34 | 4.89 | -1.14 | 170 | 240 |
| 38 | 5.01 | -1.13 | 168 | 239 |
| 42 | 4.76 | -1.02 | 169 | 237 |
| 46 | 4.33 | -0.47 | 167 | 238 |
| 50 | 4.08 | -0.29 | 165 | 237 |
| 54 | 4.10 | -0.46 | 165 | 237 |
| 58 | 4.05 | -0.67 | 165 | 240 |
| 62 | 4.06 | -0.82 | 166 | 236 |
| 66 | 4.07 | -0.72 | 165 | 239 |
| 70 | 4.12 | -0.78 | 163 | 242 |

### For Solid Ice Period

**Insufficient Period for Analysis**

## Table 18: Tidal Constants for S2 Constituent (continued)

### South Central Barrow Strait (Quarter Master ADCP)

### For Ice Free Period (Aug. 11, 2010 – Oct. 9, 2010):

| Depth (m) | Major Amplitude (cm/s) | Minor Amplitude (cm/s) | Orientation (degrees cc from East) | Greenwich Phase (degrees) |
|---|---|---|---|---|
| 25 | 4.33 | -0.74 | 167 | 247 |
| 33 | 4.47 | -0.81 | 162 | 247 |
| 41 | 4.31 | -0.77 | 157 | 243 |
| 49 | 3.84 | -0.35 | 157 | 243 |
| 57 | 3.77 | -0.08 | 154 | 240 |
| 65 | 4.27 | -0.52 | 155 | 240 |
| 73 | 4.53 | -0.92 | 157 | 243 |
| 81 | 4.45 | -1.00 | 158 | 245 |
| 89 | 4.57 | -1.12 | 160 | 246 |
| 97 | 4.55 | -1.25 | 159 | 246 |
| 105 | 4.49 | -1.36 | 159 | 244 |
| 113 | 4.42 | -1.22 | 158 | 247 |
| 121 | 4.38 | -1.24 | 160 | 248 |
| 129 | 4.26 | -1.31 | 162 | 248 |
| 137 | 4.32 | -1.16 | 164 | 252 |
| 145 | 4.44 | -1.06 | 166 | 255 |
| 153 | 4.28 | -0.92 | 168 | 261 |
| 161 | 4.03 | -0.67 | 171 | 262 |
| 169 | 3.76 | -0.42 | 173 | 257 |
| 177 | 3.36 | -0.37 | 170 | 256 |
| 185 | 3.48 | -0.39 | 170 | 256 |
| 193 | 3.68 | -0.48 | 170 | 256 |
| 201 | 3.78 | -0.36 | 175 | 255 |
| 209 | 3.58 | -0.26 | 176 | 255 |
| 217 | 3.37 | -0.20 | 168 | 252 |
| 225 | 3.60 | -0.39 | 165 | 248 |
| 233 | 3.63 | -0.35 | 163 | 248 |

### For Solid Ice Period

**Insufficient Period for Analysis**

**Table 19: Ice Profiling Sonar, Ice Draft Monthly Statistics South-Central Barrow Strait, August 2010 – July 2011**

| | | Ice Draft (m) | | |
|---|---|---|---|---|
| **Year** | **Month** | **Mean** | **Maximum** | **Std.Dev** |
| 2010 | August | 0.11 | 15.70 | 0.74 |
| | September | 0.00 | 0.00 | 0.00 |
| | October | 0.22 | 14.86 | 0.63 |
| | November | 1.38 | 18.86† | 1.42 |
| | December | 1.85 | 18.99† | 1.84 |
| 2011 | January | 2.29 | 18.03 | 2.02 |
| | February | 2.59 | 19.31† | 1.99 |
| | March | 2.05 | 19.77† | 2.36 |
| | April | 0.82 | 11.37 | 0.97 |
| | May | 0.68 | 12.86 | 0.90 |
| | June | 0.03 | 12.08 | 0.25 |
| | July | 0.00 | 7.50 | 0.03 |

† Maximum limited by moored depth (29 m) and lock out range (10 m)

**Table 20: Ice Profiling Sonar, Ice Draft Percent Frequency by Month**
**South-Central Barrow Strait, August 2010 – July 2011**

| | 2010 | | | | | 2011 | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **Ice Draft (m)** | **August** | **September** | **October** | **November** | **December** | **January** | **February** | **March** | **April** | **May** | **June** | **July** |
| Open Water | 96.59 | 100.00 | 34.48 | 0.37 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 25.77 | 98.10 | 99.99 |
| 0.0-0.5 | 0.11 | 0.00 | 50.63 | 34.99 | 13.46 | 5.72 | 6.17 | 17.19 | 51.08 | 21.04 | 0.33 | 0.00 |
| 0.5-1.0 | 0.11 | 0.00 | 3.17 | 20.85 | 35.25 | 30.25 | 11.87 | 28.37 | 31.34 | 35.72 | 0.32 | 0.00 |
| 1.0-1.5 | 0.34 | 0.00 | 1.48 | 10.66 | 10.29 | 12.50 | 21.81 | 14.49 | 5.09 | 6.01 | 0.50 | 0.00 |
| 1.5-2.0 | 0.74 | 0.00 | 1.01 | 7.93 | 7.35 | 8.94 | 10.52 | 8.28 | 3.24 | 3.65 | 0.31 | 0.00 |
| 2.0-2.5 | 0.56 | 0.00 | 0.68 | 6.25 | 6.69 | 8.13 | 8.33 | 5.24 | 2.84 | 2.52 | 0.21 | 0.00 |
| 2.5-3.0 | 0.40 | 0.00 | 0.44 | 4.92 | 6.42 | 7.78 | 7.65 | 4.50 | 1.96 | 1.81 | 0.09 | 0.00 |
| 3.0-3.5 | 0.26 | 0.00 | 0.31 | 3.66 | 4.78 | 5.38 | 6.77 | 4.37 | 1.27 | 1.25 | 0.05 | 0.00 |
| 3.5-4.0 | 0.16 | 0.00 | 0.22 | 2.72 | 3.77 | 4.64 | 7.31 | 3.39 | 0.86 | 0.77 | 0.03 | 0.00 |
| 4.0-4.5 | 0.12 | 0.00 | 0.13 | 1.94 | 2.91 | 3.34 | 4.81 | 2.98 | 0.66 | 0.51 | 0.02 | 0.00 |
| 4.5-5.0 | 0.09 | 0.00 | 0.08 | 1.34 | 2.11 | 2.59 | 3.41 | 2.05 | 0.49 | 0.32 | 0.02 | 0.00 |
| 5.0-5.5 | 0.07 | 0.00 | 0.06 | 0.93 | 1.65 | 2.11 | 2.47 | 1.81 | 0.34 | 0.22 | 0.01 | 0.00 |
| 5.5-6.0 | 0.06 | 0.00 | 0.04 | 0.63 | 1.37 | 1.93 | 2.12 | 1.28 | 0.27 | 0.15 | 0.01 | 0.00 |
| 6.0-6.5 | 0.05 | 0.00 | 0.03 | 0.43 | 1.00 | 1.59 | 1.63 | 1.08 | 0.21 | 0.09 | 0.00 | 0.00 |
| 6.5-7.0 | 0.04 | 0.00 | 0.03 | 0.31 | 0.64 | 1.31 | 1.09 | 0.83 | 0.17 | 0.06 | 0.00 | 0.00 |
| 7.0-7.5 | 0.03 | 0.00 | 0.03 | 0.18 | 0.54 | 1.04 | 1.09 | 0.59 | 0.06 | 0.04 | 0.00 | 0.00 |
| 7.5-8.0 | 0.03 | 0.00 | 0.02 | 0.13 | 0.36 | 0.73 | 0.94 | 0.46 | 0.04 | 0.02 | 0.00 | 0.00 |
| 8.0-8.5 | 0.03 | 0.00 | 0.02 | 0.08 | 0.31 | 0.52 | 0.52 | 0.37 | 0.03 | 0.01 | 0.00 | 0.00 |
| 8.5-9.0 | 0.03 | 0.00 | 0.01 | 0.05 | 0.22 | 0.44 | 0.40 | 0.27 | 0.03 | 0.00 | 0.00 | 0.00 |
| 9.0-9.5 | 0.02 | 0.00 | 0.01 | 0.04 | 0.15 | 0.33 | 0.29 | 0.23 | 0.01 | 0.00 | 0.00 | 0.00 |
| 9.5-10.0 | 0.03 | 0.00 | 0.01 | 0.03 | 0.08 | 0.22 | 0.20 | 0.17 | 0.01 | 0.00 | 0.00 | 0.00 |
| >=10.0 | 0.12 | 0.00 | 0.03 | 0.08 | 0.56 | 0.53 | 0.57 | 2.03 | 0.01 | 0.01 | 0.00 | 0.00 |
| Missing | 0.01 | 0.00 | 7.07 | 1.49 | 0.09 | 0.00 | 0.04 | 0.00 | 0.00 | 0.01 | 0.00 | 0.00 |