MOORED INSTRUMENT OBSERVATIONS FROM BARROW STRAIT, 2011-2016

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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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ABSTRACT

Nudds, S., Richards, C., and Pittman, M. 2024. Moored Instrument Observations from Barrow Strait, 2011-2016. Can. Data Rep. Hydrogr. Ocean Sci. 218: viii + 75 p.

Instrumented moorings deployed August 2011 to August 2016 on the north side of Barrow Strait (near Gascoyne Inlet, NU, Canada) provided time series measurements of pressure, temperature, salinity, oxygen (2014-2016 only), current velocity, ice drift, and ice draft (2014-2016 only). The instruments were integrated into the Barrow Strait Real-Time Observatory and extend the existing time series on the north side of the strait that were collected as part of the Barrow Strait Monitoring Program (1998-2006). Current velocity and ice drift data were recorded by an acoustic Doppler current profilers (ADCP) and specialized instrumentation for near-pole direction measurements. Moored conductivity, temperature and depth recorders (CTDs) were used to measure salinity, temperature, pressure and dissolved oxygen at fixed depths. The ADCP and CTD data are presented as filtered and unfiltered time series, spectral and tidal analysis products, and in statistical summaries. An ice profiling sonar (IPS) provides measurements of ice draft that are presented as monthly time series, histograms of ice draft distribution, and as a statistical summary.

RÉSUMÉ

Nudds, S., Richards, C., and Pittman, M. 2024. Moored Instrument Observations from Barrow Strait, 2011-2016. Can. Data Rep. Hydrogr. Ocean Sci. 218: viii + 75 p.

Les mouillages instrumentés déployés entre août 2011 et août 2016 du côté nord du détroit de Barrow (près de l'anse de Gascoyne, NU, Canada) ont fourni des séries temporelles de pression, de température, de salinité, d'oxygène (2014 à 2016 seulement), de vitesse des courants, de dérive des glaces et de tirant d'eau des glaces (2014 à 2016 seulement). Les instruments ont été intégrés à l'observatoire en temps réel du détroit de Barrow, et prolongent les séries temporelles existantes du côté nord du détroit qui ont été recueillies dans le cadre du programme de monitorage du détroit de Barrow (1998-2006). Les données sur la vitesse des courants et sur la dérive des glaces sont enregistrées par un courantomètre à effet Doppler (ADCP) et par des instruments spécialisés pour les mesures de direction près des pôles. Des capteurs de conductivité, de température et de profondeur (CTDs) mouillés ont été utilisés pour mesurer la salinité, la température, la pression et l'oxygène dissous à des profondeurs fixes. Les données provenant de l'ADCP et des CTDs sont présentées sous forme de série temporelles filtrées et non filtrées, de produits d'analyse spectrale et d'analyse tidale ainsi que sous forme de résumés statistiques. Un sonar profileur de glace (IPS) fournit des mesures du tirant d'eau qui sont présentées sous forme de séries temporelles mensuelles, d'histogrammes de distribution du tirant d'eau ainsi que d'un résumé statistique.

1 Introduction

The Barrow Strait Monitoring Program (BSMP) was started by investigators at the Bedford Institute of Oceanography (BIO) in 1998 to quantify the inter-annual variability of water and sea-ice through Barrow Strait - a principal pathway between the Arctic and North Atlantic oceans. Data from the first 13 years of this study and a description of the methods, have previously been reported in Hamilton et al. (2002, 2003, 2004), Pettipas et al. (2005, 2006, 2008, 2010), Hamilton et al. (2008), and Pettipas and Hamilton (2013a,b,c, 2014, 2015).

The correlation between salinity and freeze-up dates found in analysis of the BSMP time series (Hamilton and Pittman, 2015), showed the potential for predictive capability of real-time observations, which led to the development and installation of the Barrow Strait Real-Time Observatory (BSRTO). The BSRTO consists of instrumented moorings, or "nodes", that transmit data accoustically to a central mooring, the "hub". The hub is connected via 8 kilometres of underwater cable to a shore station at the Defence Research and Development Canada (DRDC) camp at Gascoyne Inlet on Devon Island (Inuit: Tatlurutit), NU. Data are sent via Iridium satellite from the shore station to a server at the Bedford Institute of Oceanography nominally every 2 hours. A detailed description of the BSRTO can be found in Hamilton and Pittman (2015) and Richards et al. (2017). The installation of the BSRTO has allowed for continued monitoring of the water properties and ice on the north side of Barrow Strait between 2011 and 2016 when funding for the BSMP did not exist.

While the BSRTO allows for access to the data in near real-time, the instruments also log the data internally, similar to a traditional oceanographic mooring. This report presents the complete processed data set, from 2011 to 2016, downloaded from the instruments after recovery.

Moored conductivity, temperature and depth recorders (hereinafter referred to as "CTDs") provided measurements of salinity, temperature, and pressure. Two of the CTDs had optical dissolved oxygen sensors (2014-2016 only). An acoustic Doppler current profiler (ADCP) was used to measure currents and ice velocity, and an ice profiling sonar (IPS) was used to measure the ice draft.

The data in this report are presented by year. Temperature, salinity, density and dissolved oxygen are presented as unfiltered and low-pass filtered time series, and as power spectra. A statistical summary of the water properties are provided in tabular form. Current speed and direction are presented as unfiltered and low-pass filtered contour plots. Seasonally averaged currents are presented as a function of depth. Tidal analysis of the current data gives amplitude of the major and minor axes, phase, and ellipse orientation as a function of depth for each of the 5 main tidal constituents (M2, S2, K1, O1, P1). Tidal analyses are presented for periods of solid (immobile) ice cover and periods of open water. Ice drift velocity is presented as year-long time series, and ice draft is presented as raw time series, monthly histograms and monthly statistics.

In previous years a hydrographic survey was done as part of the BSMP. All efforts were made to continue these measurements but installation of the observatory was the priority and consumed all allotted ship time. Historical hydrographic survey data were published each year in the governement report series *Canadian Data Report of Hydrogrpahy and Ocean Sciences*, and are publicly available in the Canadian Itegrated Ocean Observing System (CIOOS) data catalogue (https://catalogue.cioosatlantic.ca/dataset/ca-cioos_b8482740-31d9-4dd4-87bc-cee1780dffbb).

2 Mooring Deployment and Field Operations

The initial deployment of the BSRTO in August 2011 included the hub, with one CTD, and a single node mooring, with two CTDs and an ADCP. Only one CTD (at 60 m depth on the ADCP node) was set up to transmit data in real-time. From August 2011 to August 2012, the observatory transmitted data with a ∼98% success rate, but unfortunately, the ADCP failed 6 days after deployment (resulting in successfully transmitted but empty files from the ADCP Node).

A complete recovery and redeployment of the observatory system was done in August/September 2012. Shortly after deployment, the ADCP node was struck by ice. The mooring was dragged to an unknown location but continued to transmit data. The pressure sensor on the CTD recorded a change of approximately 5 m in instrument depth. Unfortunately the ADCP failed again, this time, 9 days after deployment. It was later discovered that the ADCP failures in 2011 and 2012 were due to an error in the setup file which caused the ADCP to stay awake between ensembles which rapidly depleted the battery.

Recovery and redeployment of the moorings in 2013 was not permitted due to lack of ship time, but the moorings continued to transmit data. The success rate of data transmission was ∼87% between August 2012 and November 2013, at which time the CTD stopped transmitting in real-time. Although the ADCP itself was not functioning, log files and empty ADCP files continued to transmit until mid-April 2014, but with only ∼6% success rate. Data transmission was least successful during the winter months (December to March). Starting mid-April 2014, only shore station files were transmitted (twice a day) indicating an issue with communication between the shore station and the hub.

During recovery in 2014, the ADCP node was released but did not surface, presumably due to the ice strike damaging the buoyancy packages. The mooring was found and recovered 3 years later near Bylot Island with all instruments intact and the data was recovered.

In 2014, a second node mooring was added to the system with one CTD and an IPS. As the communication issue between the hub and the shore station was not resolved, the observatory did not report in real-time for 2014-2015. Again, due to lack of ship time, recovery and redeployment of the system was not permitted in 2015 but the instruments continued to record internally. All the moorings were recovered successfully in August 2016. No instruments were deployed in 2016 but a temporary mooring was fixed to the end of the cable for a planned reinstallation of the observatory in 2017.

3 Mooring Locations and Instrumentation

The map in Figure 1 shows the approximate location of the BSRTO moorings, outside Gascoyne Inlet. Typical mooring diagrams for the BSRTO moorings are shown in Figures 2-4. Along with the oceanographic instrumentation, each mooring is equiped with Teledyne Benthos acoustic modems and custom electronics (controllers) that allow for transmission of the data between the nodes and the hub, and from the hub through the cable to shore. A summary of the moorings and instrumentation, including mooring positions, instrument depths and acquired data records, for each year, is presented in Table 1.

The ADCP (a 307 kHz Workhorse Sentinel manufactured by Teledyne RD Instruments) and custom pole compass (with a precision heading reference manufactured by Watson Industries, Inc.) were mounted in a streamlined buoyancy package to provide current speed and direction information. This technique is used to obtain reliable direction measurements where conventional compass technology is inadequate due to the proximity of the site to the north magnetic pole (described in detail by Hamilton (2004) and Hamilton (2001)). The ADCP was mounted upward-looking with bottom tracking turned on to provide measurements of ice drift.

SeaBird Microcat CTDs (SBE37-SM/SMP) were used to measure temperature, conductivity, and pressure at targeted depths of 40, 60, 80 and 150 m (see Table 1 for the moored depth of each CTD). In 2014, two of the CTDs (nominally at 40 and 60 m depths) were equiped with optical dissolved oxygen sensors (SBE37-SMP-ODO).

The IPS, manufactured by ASL Environmental Sciences, measures water pressure (ie. depth) and the distance to bottom of the ice (range) and ice draft is computed using equations 1 and 2. Note that the IPS node mooring was added to the observatory in 2014 so there are no ice draft measurements at the BSRTO location prior to August 2014.

4 Instrument Setup and Data Processing

The ADCP and CTD data were processed using standard methodologies employed by the Bedford Institute of Oceanography. These procedures include spike removal and checks for other quality control issues such as low signal-to-noise ratio. The data are archived in a self-described ASCII file in the Ocean Data Format and NetCDF and are publicly available on CIOOS Atlantic (https://catalogue.cioosatlantic.ca/dataset/ca-cioos_80aa63f1-3b88-44ab-a157-e17292cd4d51).

4.1 Current Speed and Direction, and Ice Drift Data

The ADCP was set to measure currents and ice drift relative to the instrument axes, ignoring its own compass information. The ADCP logged average current velocity and ice drift from 100 pings over a 5 minute ensemble every 2 hours. The instrument was deployed at a nominal 40 m depth (below surface), and set to average over 4 m bins (10 bins total). The upper two bins, between 0 and 8 m below surface, were rejected based on RDI's standard echo intensity quality criterion. With bottom-tracking turned on, the ADCP also measures ice drift velocity when there is 100% or near-100% ice cover.

Current direction is provided using an independent compass mounted in the tail of the buoyancy package to give the orientation of the ADCP relative to magnetic north, as described in Section 3. The compass sampling cycle was initiated by a "trigger pulse" from the ADCP. The compass was programmed to take a 10 second measurment in the middle of the 5 minute ADCP sampling interval. This conserved battery power and took advantage of previous experience that current direction does not change significantly over a 5 minute period at the study location (Hamilton et al., 2003). Magnetic observatory data (from the Natural Resources Canada observatory in Resolute) was used to adjust for the variation in magnetic declination and provide current direction relative to true north.

Vertical excursions of the ADCPs caused by drag forces on the mooring were, on average, 1.4 m, with blowdown exceeding 3 m less than 4% of the time. A maximum blowdown of 12 m was recorded during a strong current event on October 29, 2015.

4.2 Moored CTD Data

The CTDs were set to measure temperature, conductivity (salinity), pressure and dissolved oxygen (2014-2016 only) every 1-2 hours (see Table 1 for the sample interval of each CTD). Vertical blowdown of the near-surface CTDs on each mooring were, on average, between 1.3 and 1.6 m. Blowdown greater than 3 m occurred <1% of the time in 2011-2012, 7% of the time in 2012-2014, and <4% of the time in 2014-2016. The higher than average blowdowns in 2012-2014 were likely due to mooring design. A maximum blowdown of approximately 15 m was recorded on the 35 m CTD (on the IPS node mooring) during the strong current event on October 29, 2015.

4.3 IPS Data

The IPS was set to record continuously with a sampling interval of 3 seconds. Sampling was interrupted for approximately 5 minutes each day to download the data to the controller.

The IPS measures the pressure and the distance to bottom of the ice (range), and ice draft (d) is computed using the following equations:

$$d = \eta - \beta \cdot r \cdot cos\theta \tag{1}$$

$$\eta = \frac{P_{ips} - P_{atm}}{\rho g} - \Delta D \tag{2}$$

where η is the water level, r is the range, θ is the tilt angle of the instrument, and β is a calibration factor (range correction factor) that accounts for the actual speed of sound in seawater relative to the assumed value of 1440 m/s. P_{ips} is the pressure at the depth of the instrument, P_{atm} is atmospheric pressure, ρ is the density of seawater at (or close to) the transducer, g is the local acceleration due to gravity, and ΔD is the distance between the pressure sensor and the acoustic transducer.

The data presented here were processed by ASL. Details on processing can be found in ASL Environmental Sciences Inc. (2017).

4.4 Low-pass filtering

Some of the data series presented have been filtered to remove the semidiurnal and diurnal tides using a simple low-pass butterworth filter with a cut-off frequency of 0.036 cph. Linear interpolation was used to fill missing data before the filter was applied. The interpolated points were removed from the final time series for presentation.

4.5 Tidal Analysis

Harmonic tidal analyses of the currents (2014-2016 only) was done using Foreman's method (Foreman, 1978) and are presented for ice-free and solid-ice periods. According to the ice draft and ice drift data, the ice-free periods spanned August 12 to September 27, 2014 and July 1 to September 27, 2015. There was no solid-ice period during 2014-2015. The solid ice period for 2015-2016 spanned March 1 to June 1, 2016.

5 Data Presentation

Yearlong time series of temperature, salinity, density and oxygen are shown in Figures 5 - 9 (unfiltered) and Figures 10 - 26 (filtered). Annual statistical summaries of the moored CTD data are presented in Tables 2 - 6. Temperature and salinity in the upper water column (as measured by the 40 and 60 m CTDs) varies seasonally. Maximum temperature and minimum salinity are typically observed between August and November and correspond to the melting of the ice. In 2011, 2014 and 2015, the seasonality of these late-summer/early-fall warming and freshening "events" is more prominent than in 2012-2013. There is generally less variability in the water properties below 60 m, but some of the larger events are observed at depth as well.

Power spectra of the CTD measurements are shown in Figures 27 - 31. There is a strong diurnal and semi-diurnal signal at all depths. Generally speaking, there is more energy in the upper water column. This is especially true in high frequency band (3-10 hour period) and the low frequency band (50-100 day period). Notably, there is a slight peak in energy in the deep salinity record around the 10 day period that exceeds that of the near surface records. This is consistent across all years. The source of this variability is unknown.

Water velocity data are shown as contour plots in Figures 32 and 34. Figure 32 displays one month of raw (unfiltered) data showing the strong tidal nature of the flow. Figures 33 and 34 show the low-pass filtered year-long records. Data are presented in along-strait and cross-strait components, where positive values are defined as flow towards 105° and 15° true, respectively. Plots of annual and seasonal mean flows are presented in Figures 35 - 46.

The observed annual mean flow varies from year to year. In 2014-2015, the mean flow was approx. 5 cm/s to the west over the upper 40 m of the water column, and in 2015-2016, the mean flow approached 0 cm/s near the surface. Near-surface currents were strongest in late-summer (August-September) with average along-strait velocities between 8-15 cm/s, westward. The mean flow at the surface weakened in the fall, and by winter, the near-surface currents flowed eastward creating shear in the upper water column.

An interesting feature that appears in the velocity data are the strong pulses that flow with, and opposite to, the background mean flow. In 2014-2015 the mean flow over the upper 40 m is generally westward from May - October with the exception of two strong eastward pulses in mid-July and early-August, and there is a strong westward pulse (approx. 50 cm/s) in early July. Again, in 2015-2016, the mean flow is westward from July to mid-November with the exception of two eastward pulses (approaching 30 cm/s) in September and October. A westward pulse occurs in late-October 2015.

Tidal analysis of the currents is presented in Figures 47 - 61, and summarized in Tables 7 - 10. Amplitude of the major and minor axes, orientation and phase of the tidal ellipse for the main tidal constituents (M2, S2, K1, O1, and P1) are plotted as a function of depth. Generally speaking, the magnitude of the major and minor axes, phase and orientation of each constituent are consistent through the upper water column. M2 and K1 are the most dominant constituents in the area with major axes of 0.14-0.17 m/s and 0.12-0.16 m/s, respectively. As expected, the data show a weakening of the tidal current (a decrease in the amplitude of the major axis) during the solid-ice period as compared to the ice-free period for all constituents, but more so for M2 and K1. This weakening is more prominent at the surface than at depth.

Ice draft measurements are presented as raw time series (Figures 62 and 63), and monthly histograms (Figures 64 and 65). The monthly mean, standard deviation, and maximum ice draft for each year are also presented in Figures 66 and 67. In 2014-2015, mean ice draft peaked at 1.4 m in December with a recorded maximum value of 18 m, and gradually declined between January and July. In 2015-2016, the mean ice draft was between 1.5 and 3 m from November to February, with maximum values between 15 and 25 m. The ice was approximately 1 m thick during the solid-ice (immobile) period (March - June 2016).

Ice velocities for 2014-2016 are presented in Figures 68 and 69. 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. It is clear from the ice veloctiy data that there was more ice present in Barrow Strait in 2015-2016 than 2014-2015. There was near-full ice cover for 7 months during the 2015-2016 season. Over the two years of observations, the longest period of immobile ice was approximately 4 months, from March to June, 2016.

6 Acknowledgements

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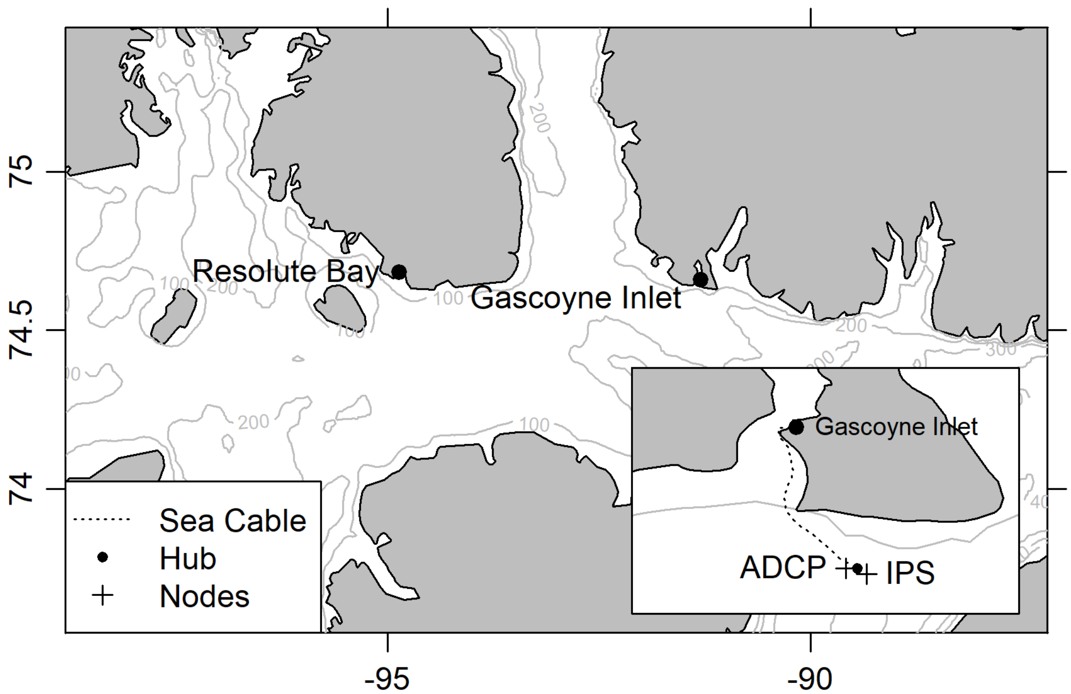

Figure 1: Map of the Barrow Strait field site showing the approximate locations of the BSRTO hub and the two node moorings. Precise position of the moorings over the years are listed in Table 1.

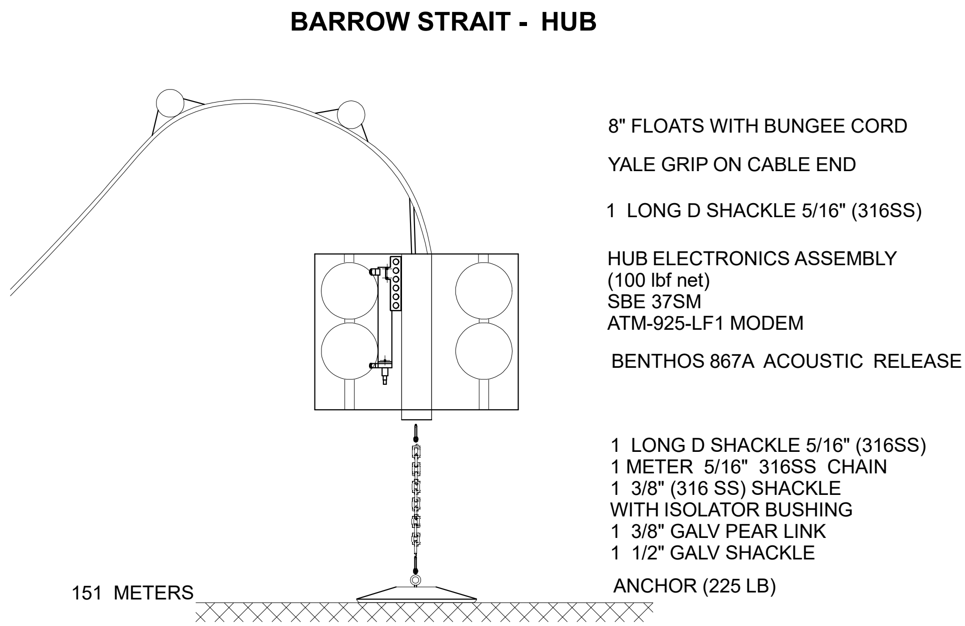

Figure 2: Diagram of the hub mooring.

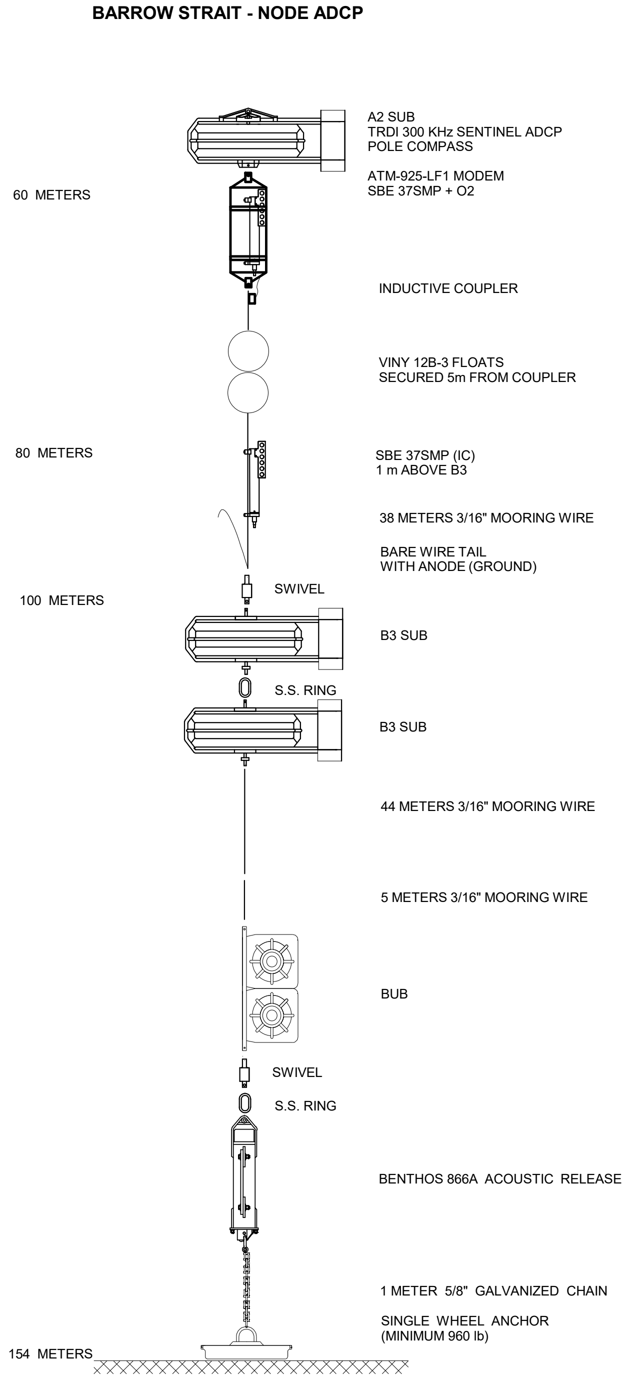

Figure 3: Diagram of the ADCP node mooring.

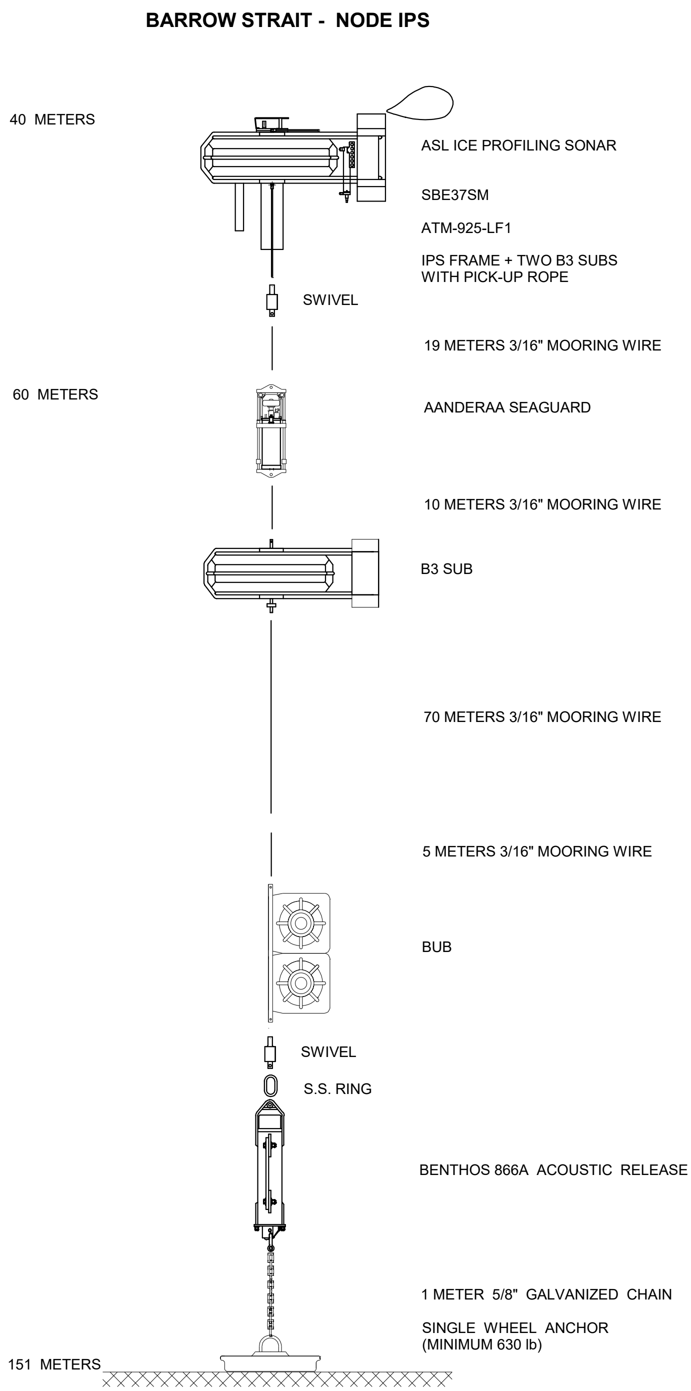

Figure 4: Diagram of the IPS node mooring.

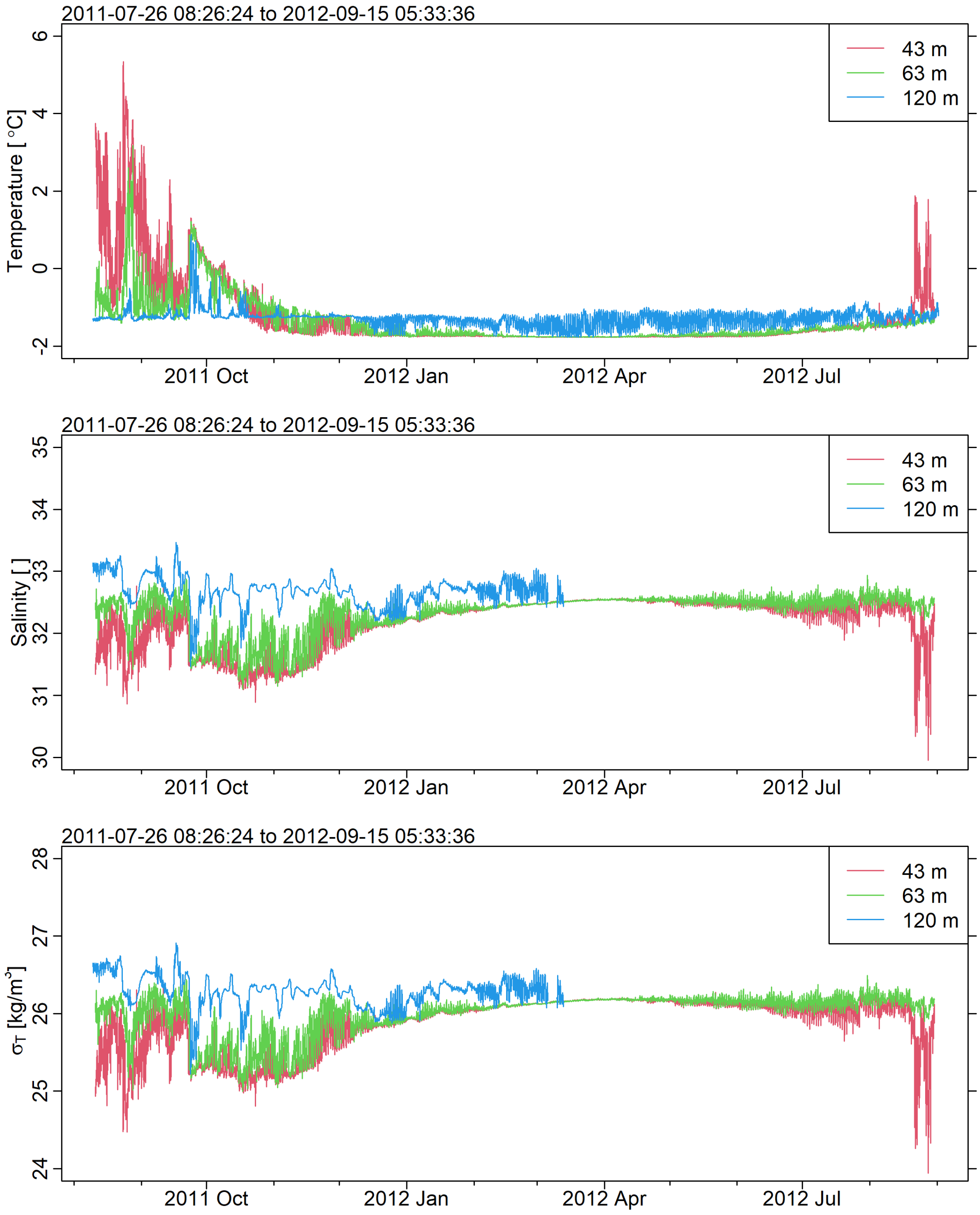

Figure 5: Moored CTD data (unfiltered), August 2011 - August 2012.

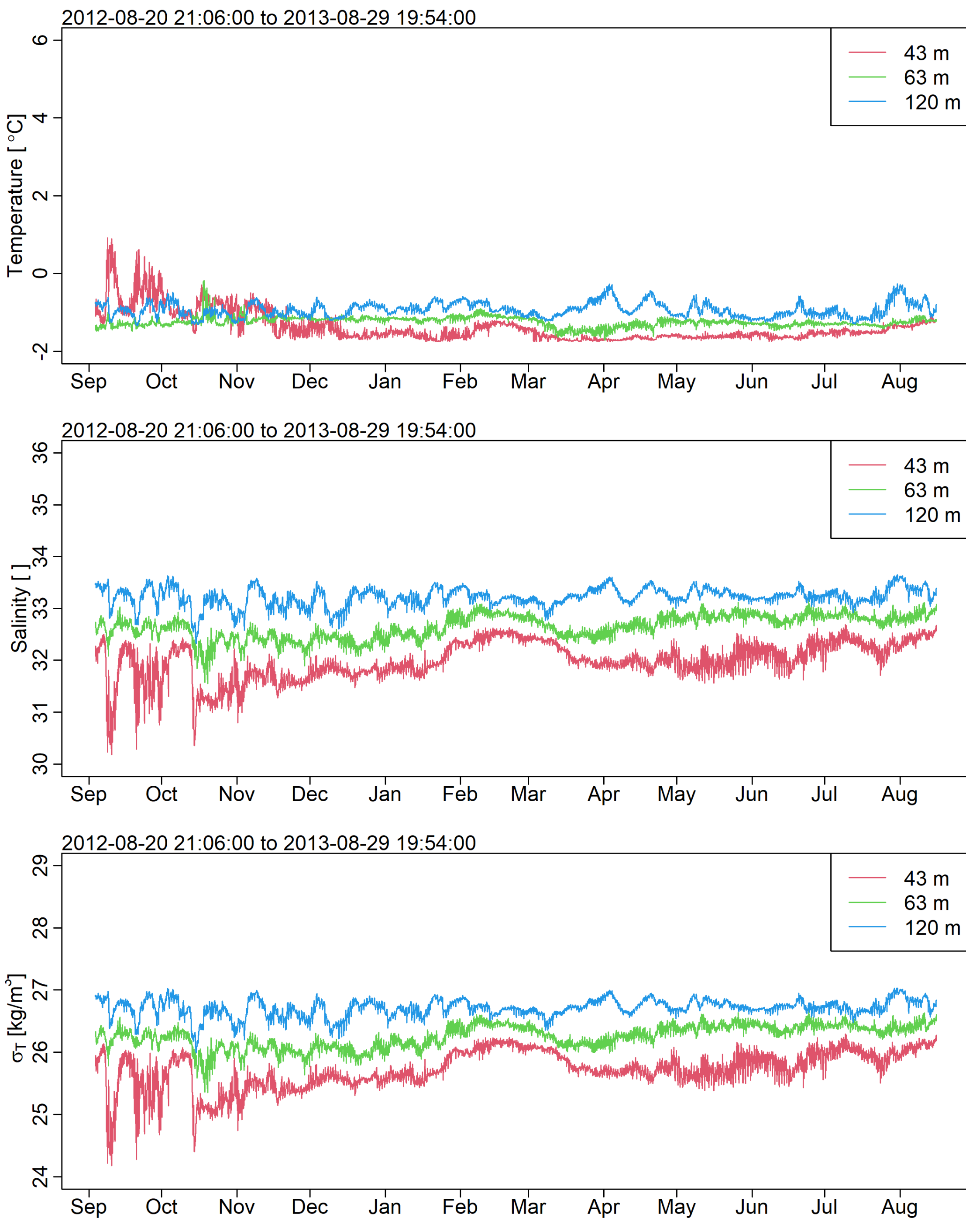

Figure 6: Moored CTD data (unfiltered), August 2012 - August 2013.

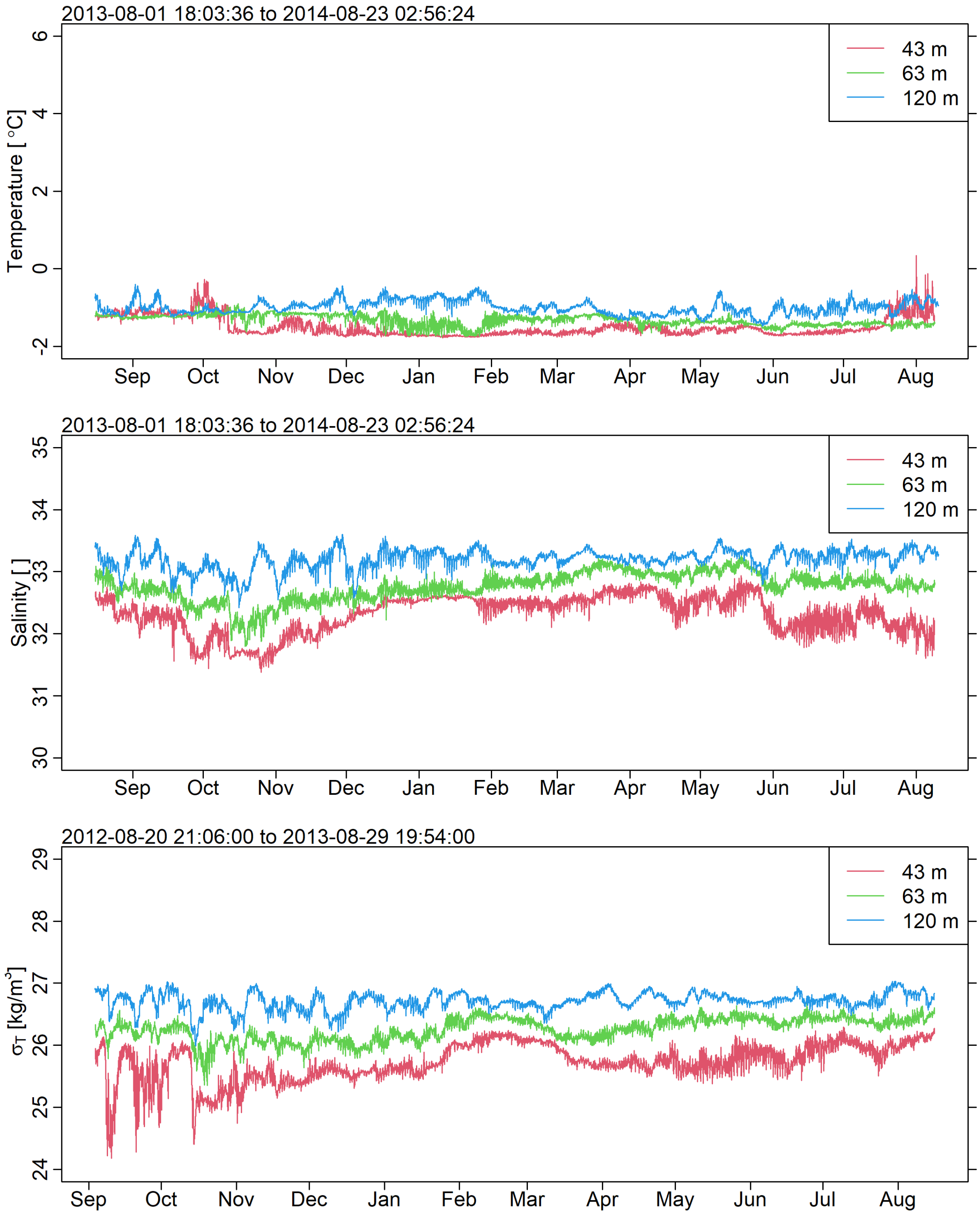

Figure 7: Moored CTD data (unfiltered), August 2013 - August 2014.

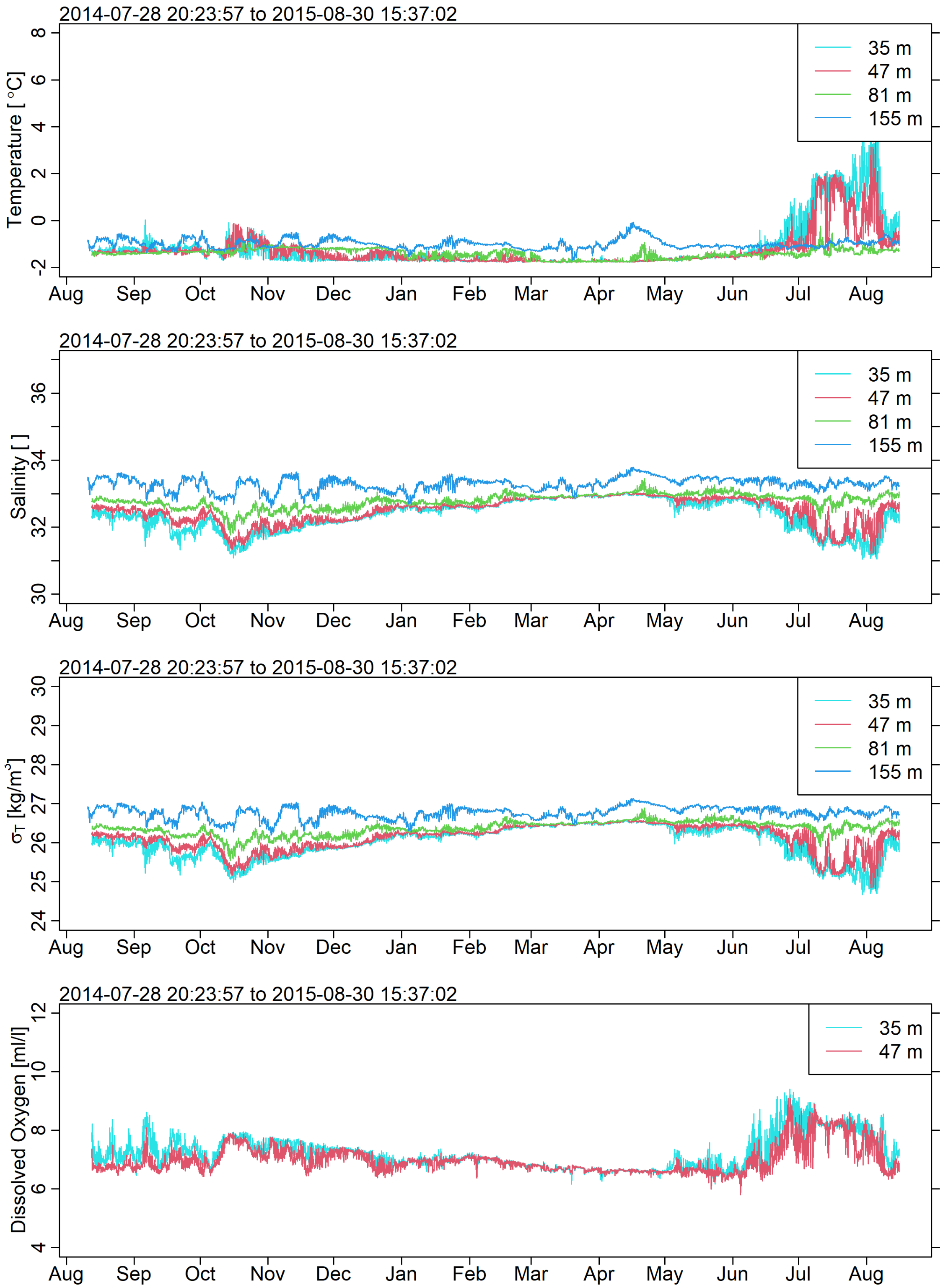

Figure 8: Moored CTD data (unfiltered), August 2014 - August 2015.

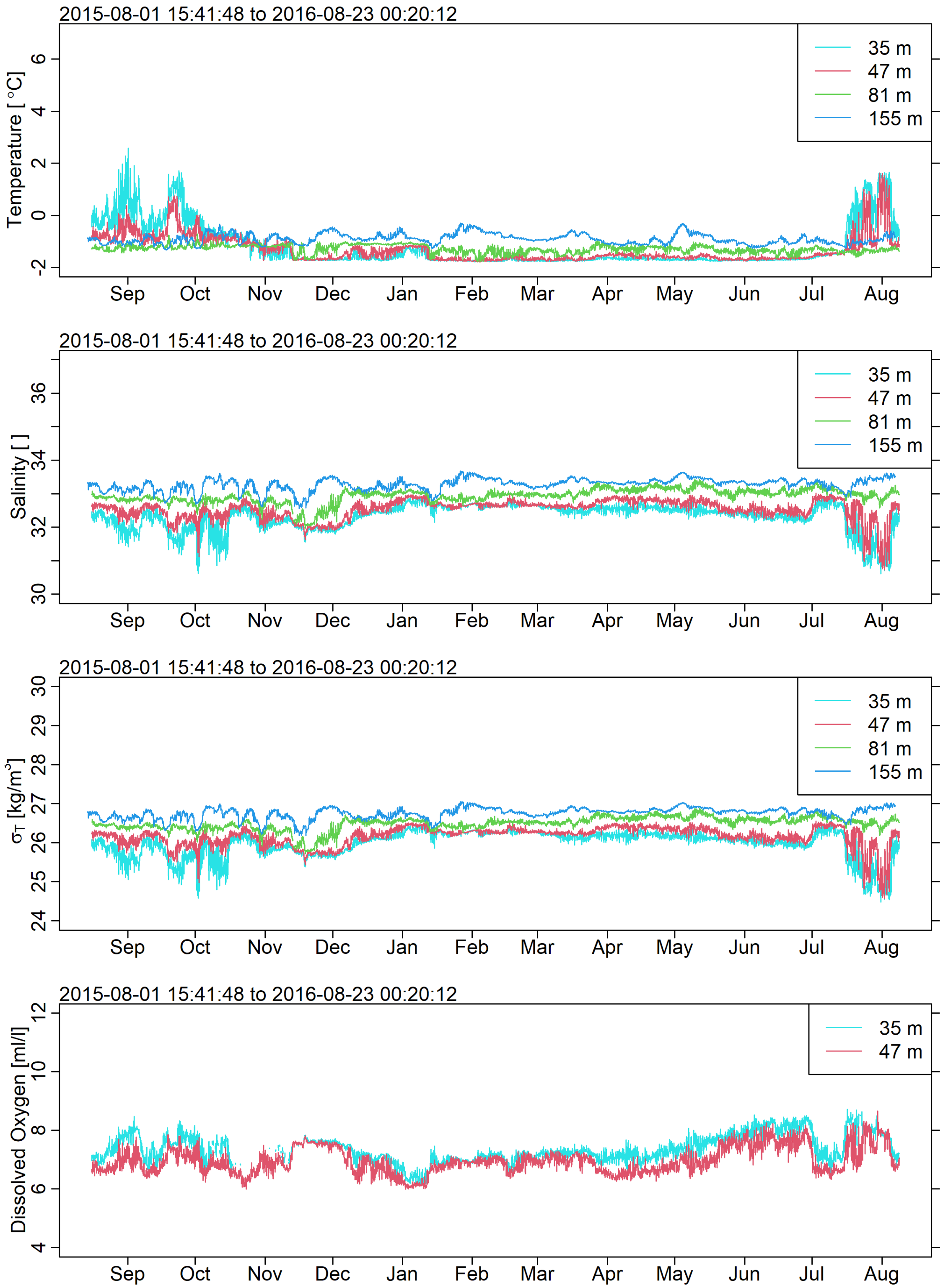

Figure 9: Moored CTD data (unfiltered), August 2015 - August 2016.

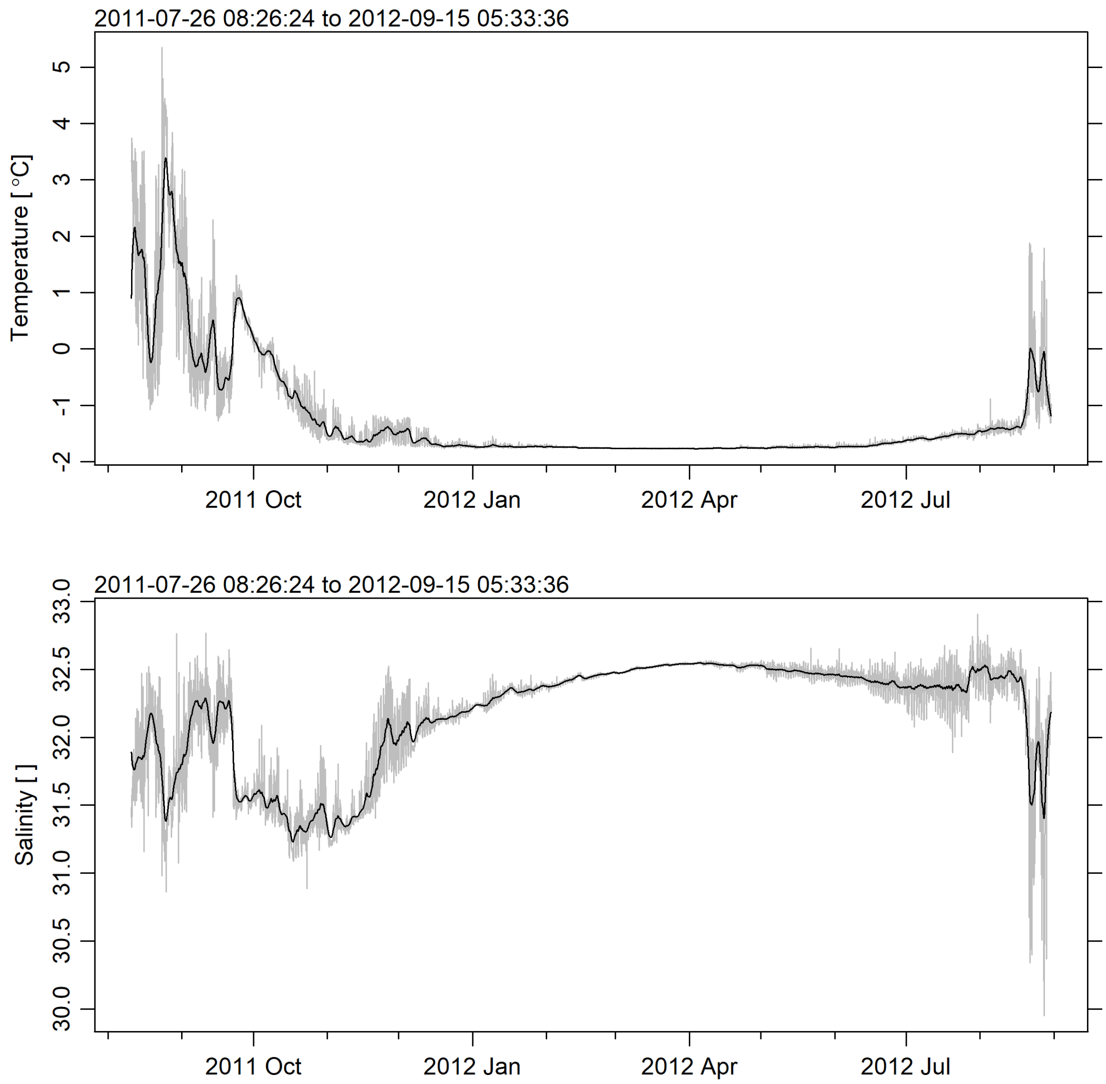

Figure 10: Low-pass filtered T, S (43 m), August 2011 - August 2012.

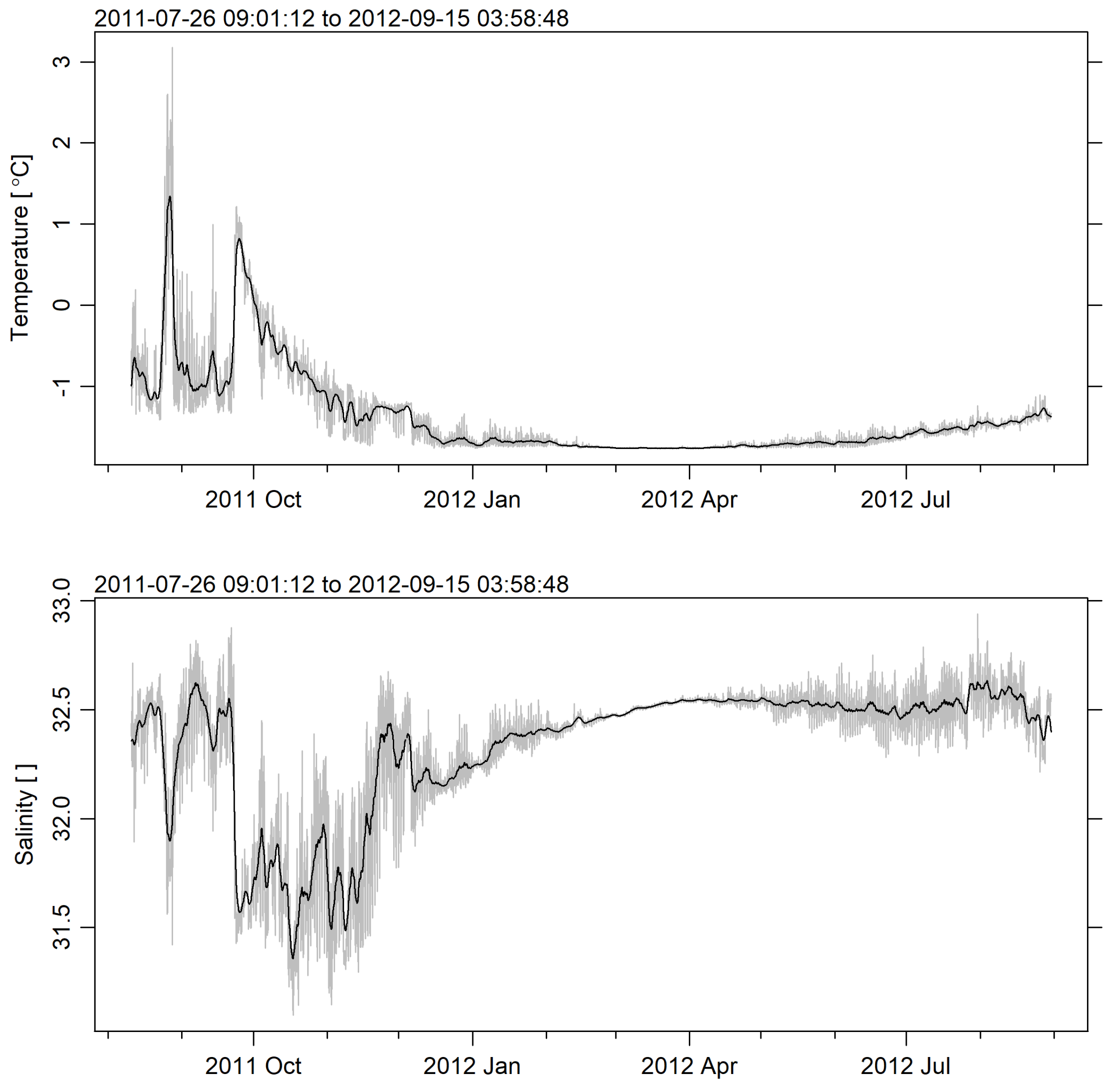

Figure 11: Low-pass filtered T, S (63 m), August 2011 - August 2012.

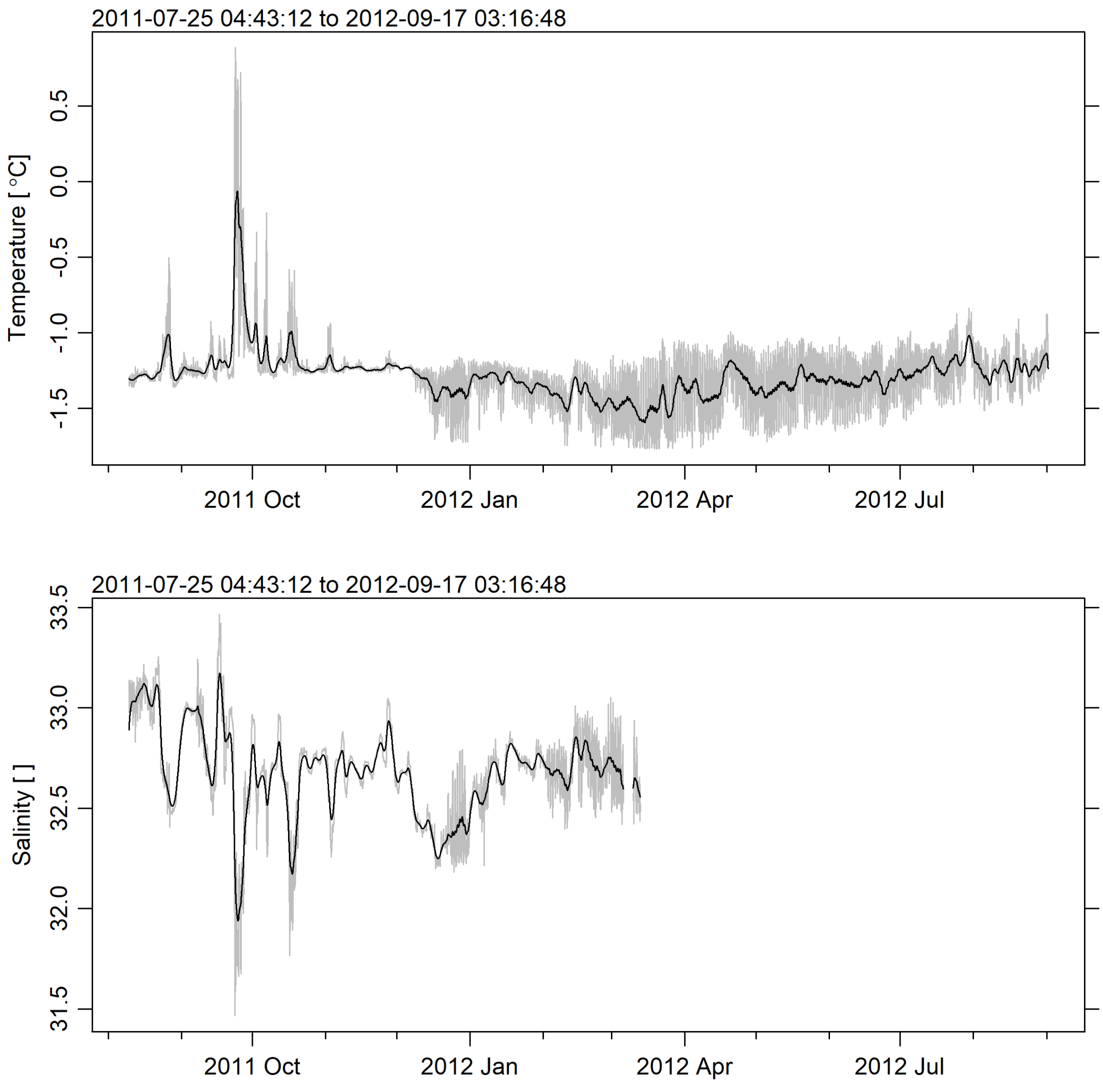

Figure 12: Low-pass filtered T, S (120 m), August 2011 - August 2012.

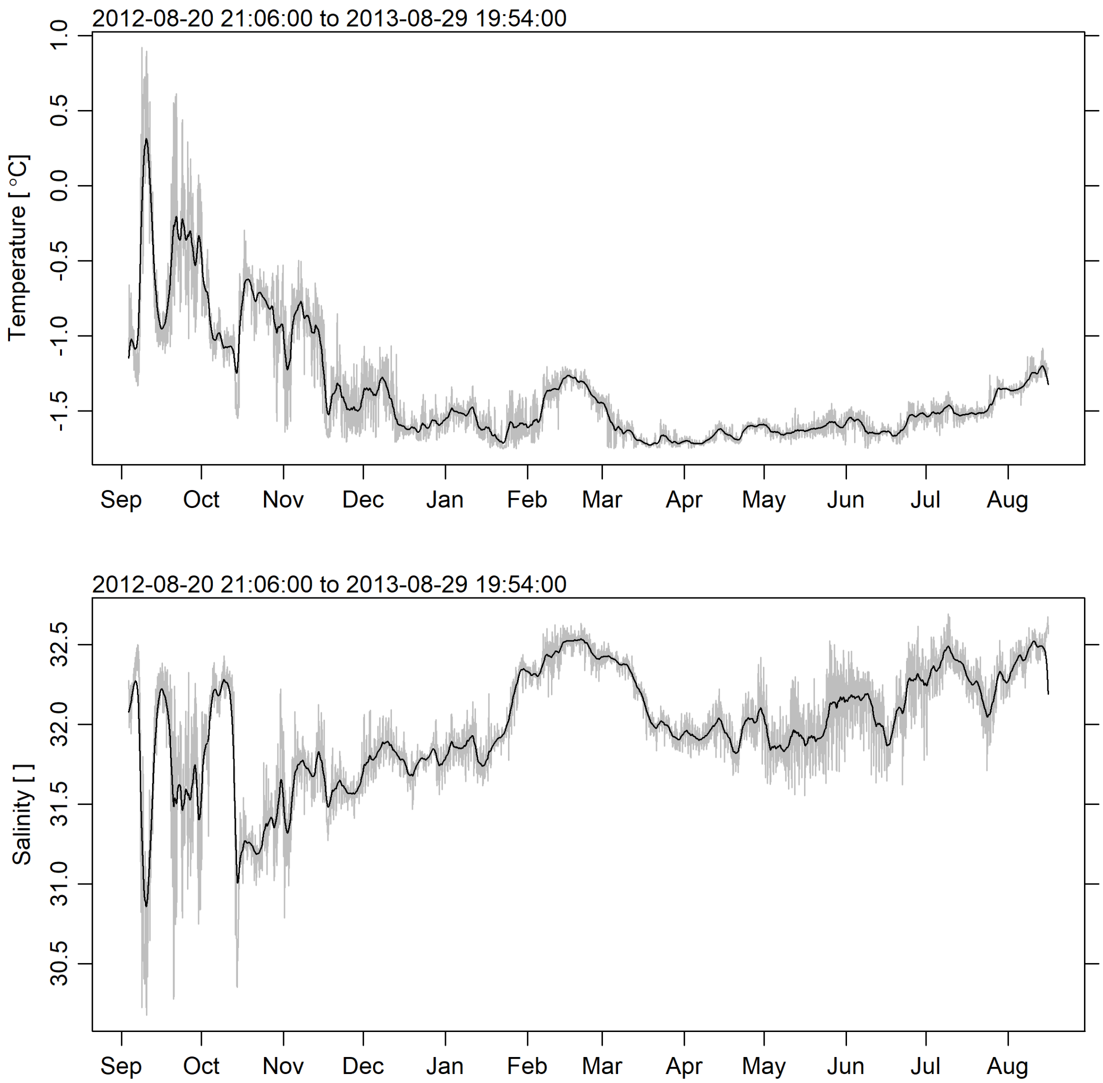

Figure 13: Low-pass filtered T, S (41 m), August 2012 - August 2013.

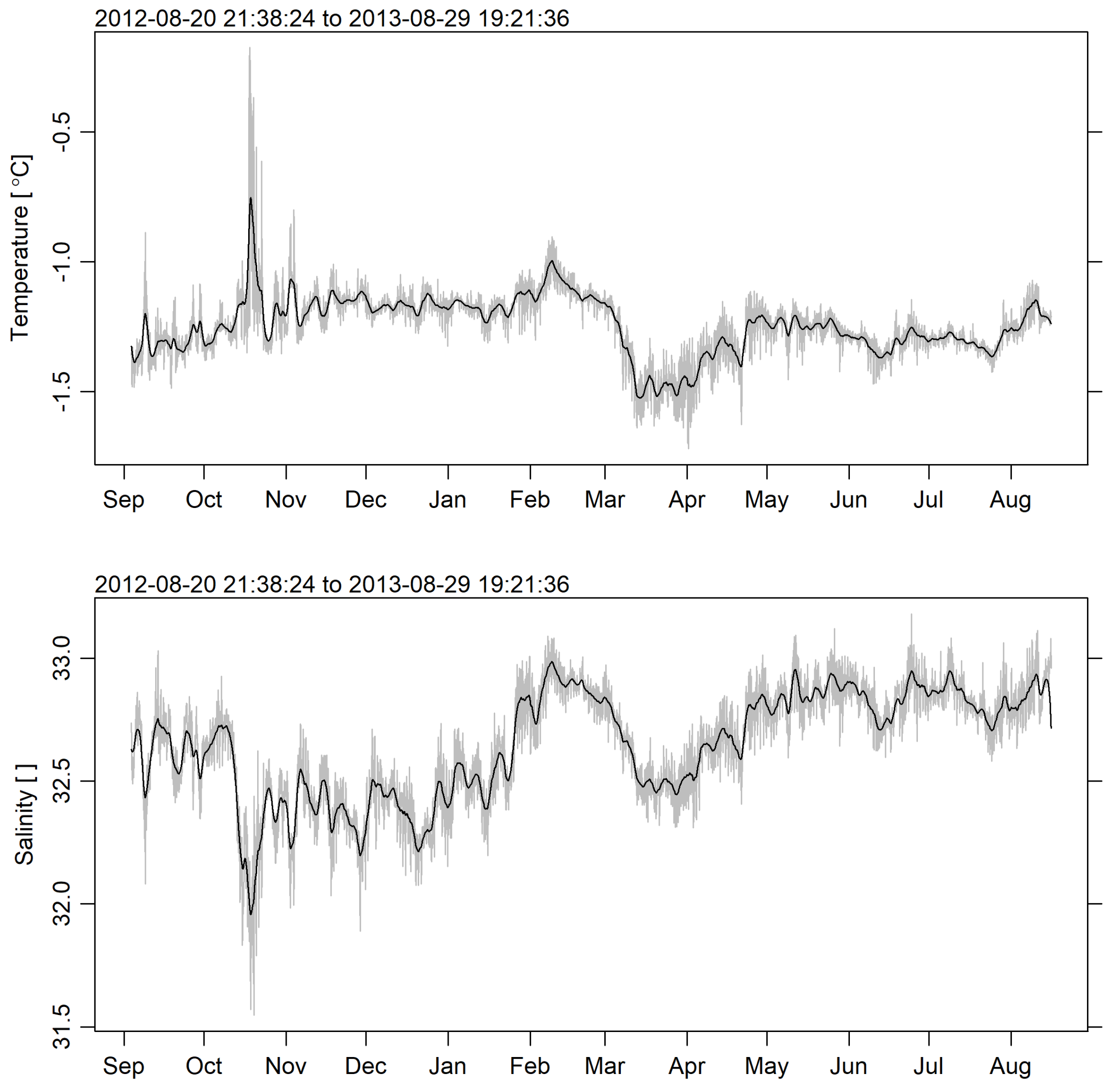

Figure 14: Low-pass filtered T, S (81 m), August 2012 - August 2013.

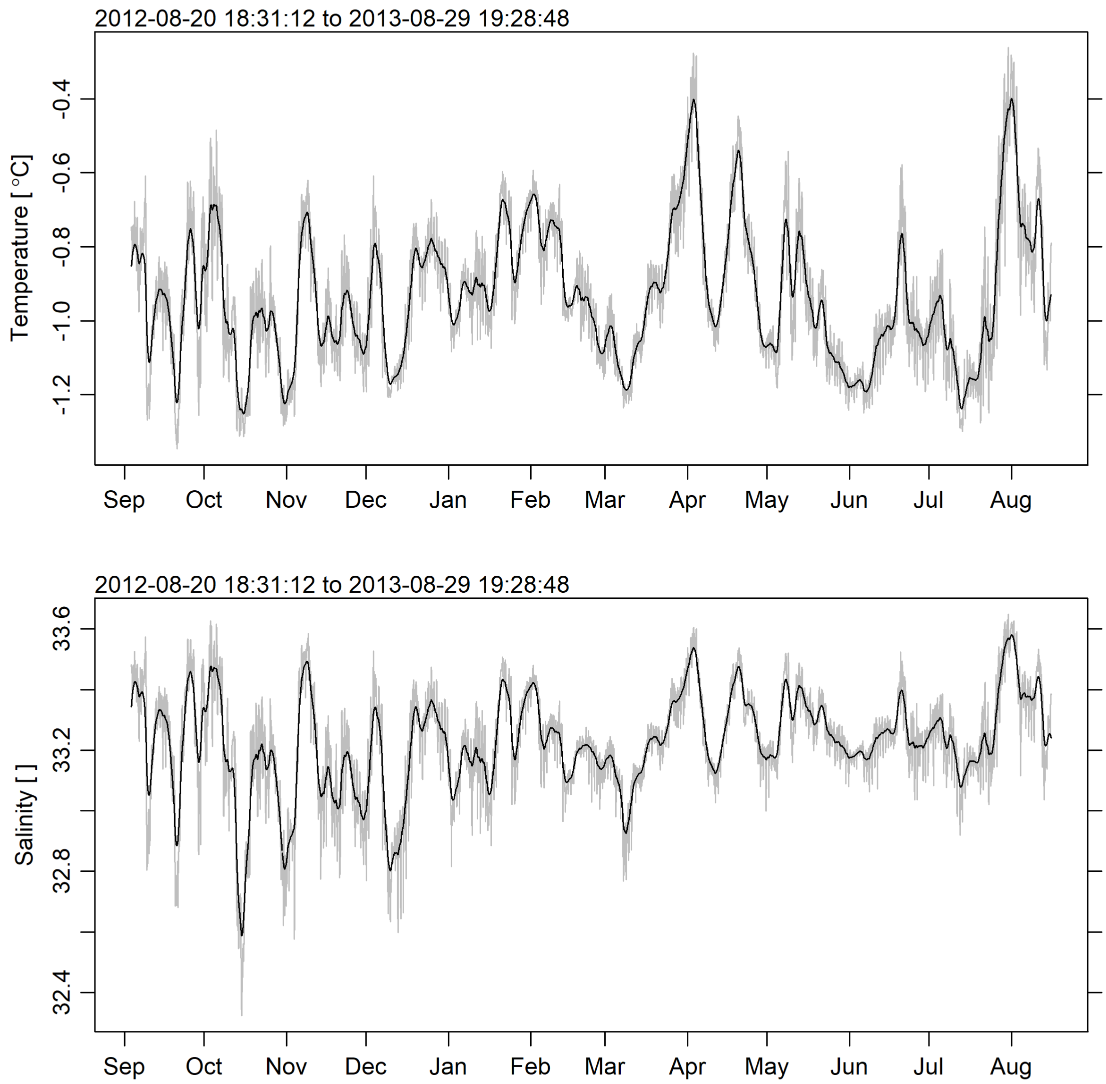

Figure 15: Low-pass filtered T, S (155 m), August 2012 - August 2013.

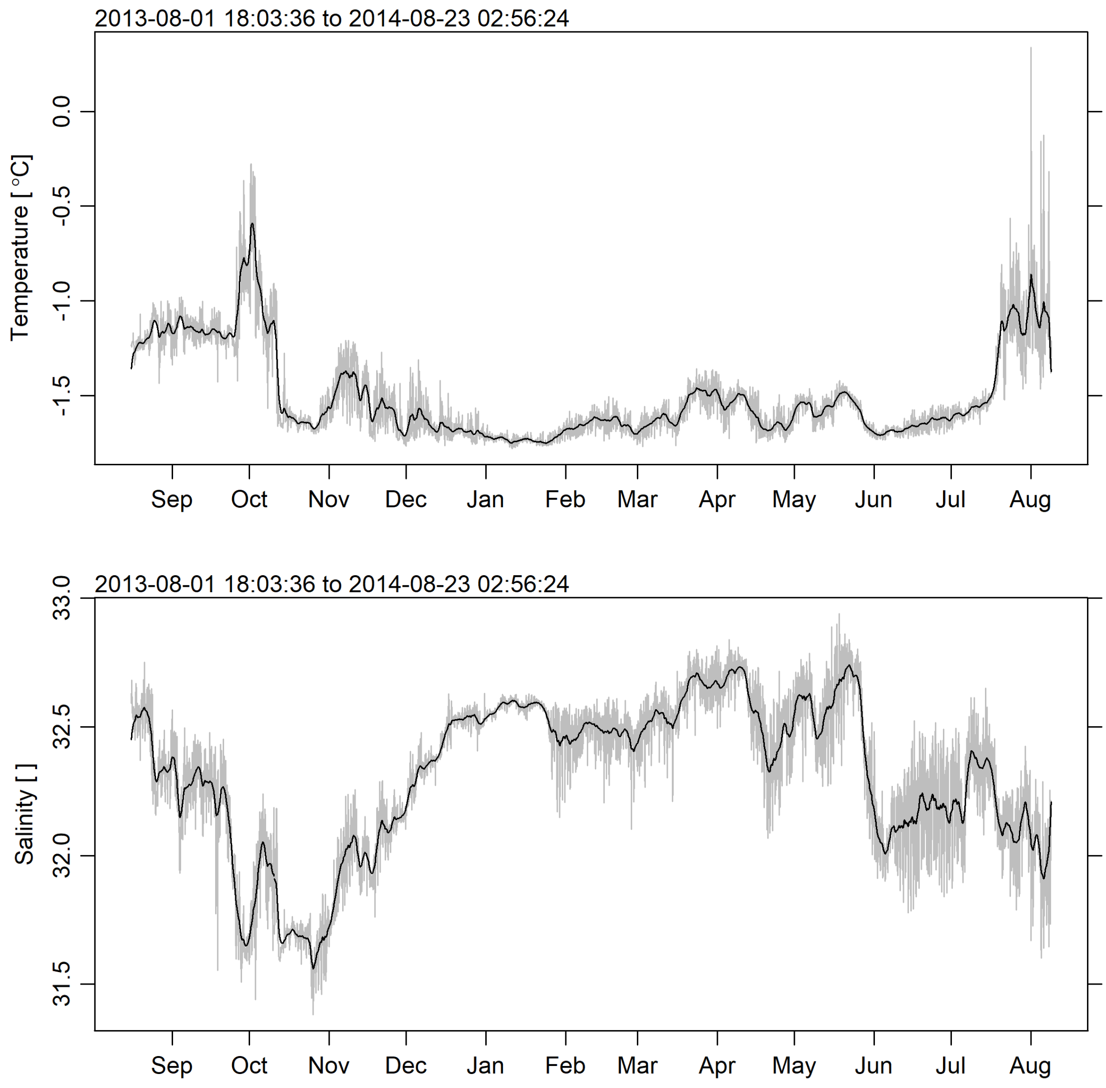

Figure 16: Low-pass filtered T, S (41 m), August 2013 - August 2014.

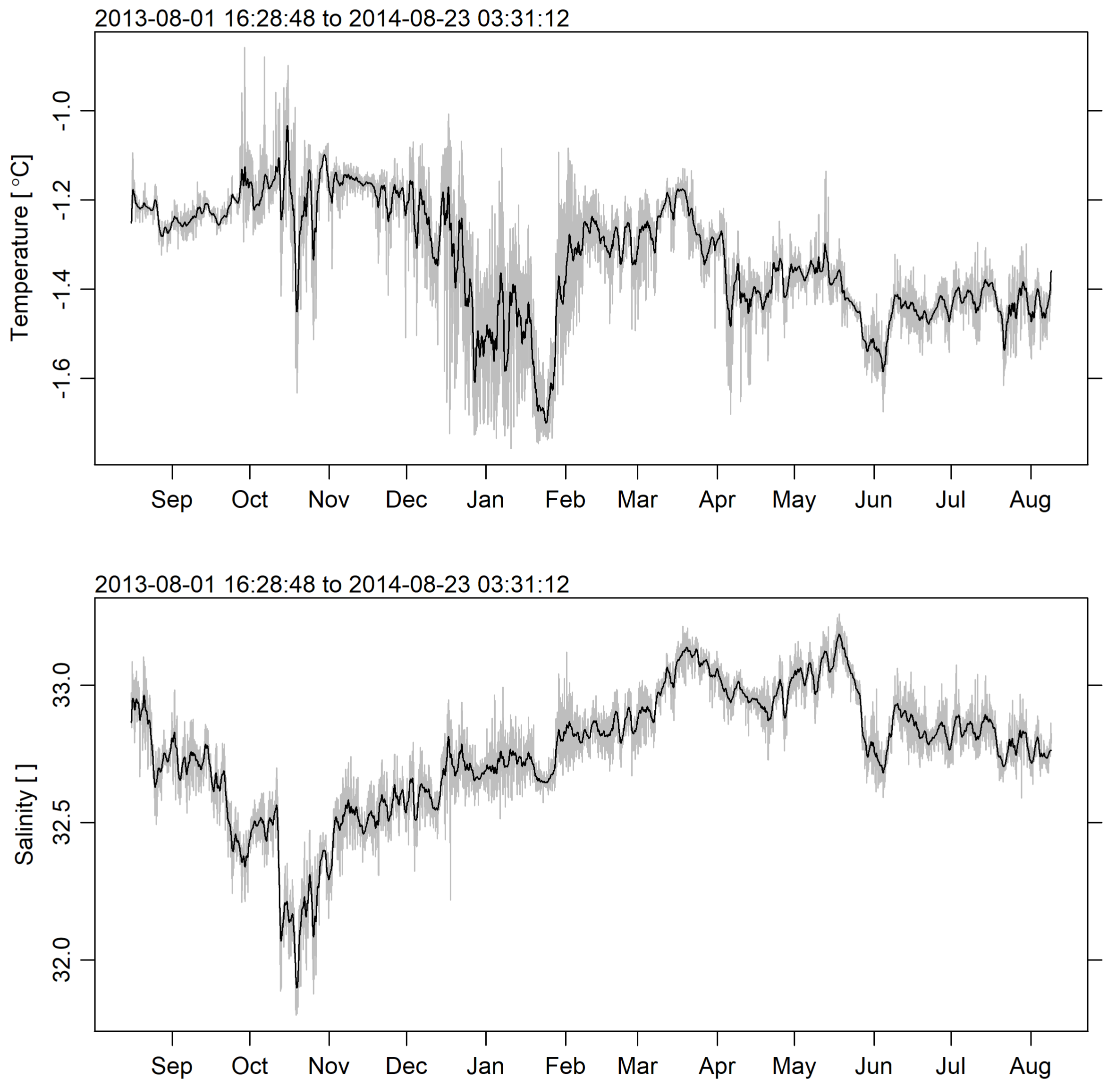

Figure 17: Low-pass filtered T, S (81 m), August 2013 - August 2014.

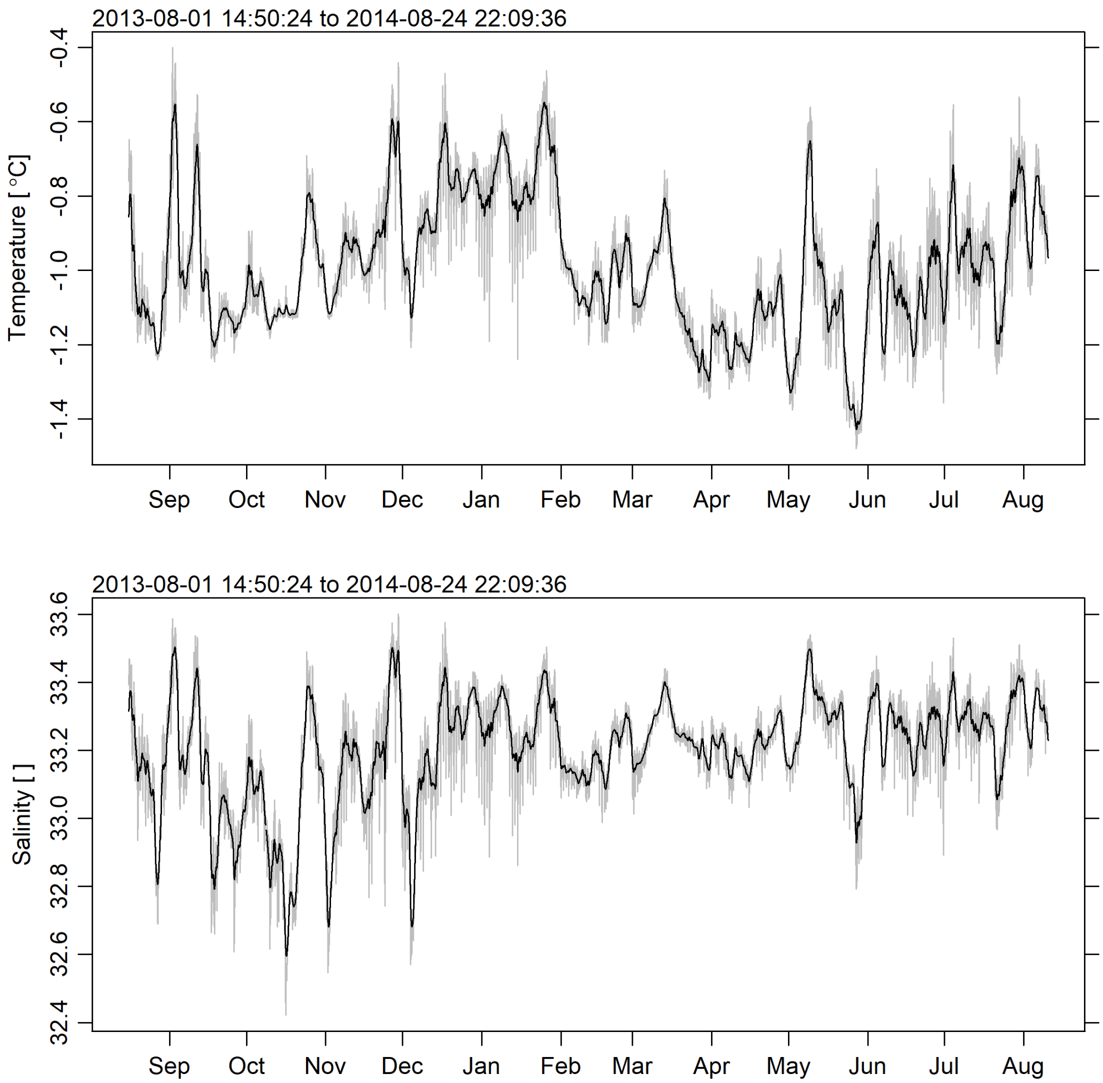

Figure 18: Low-pass filtered T, S (155 m), August 2013 - August 2014.

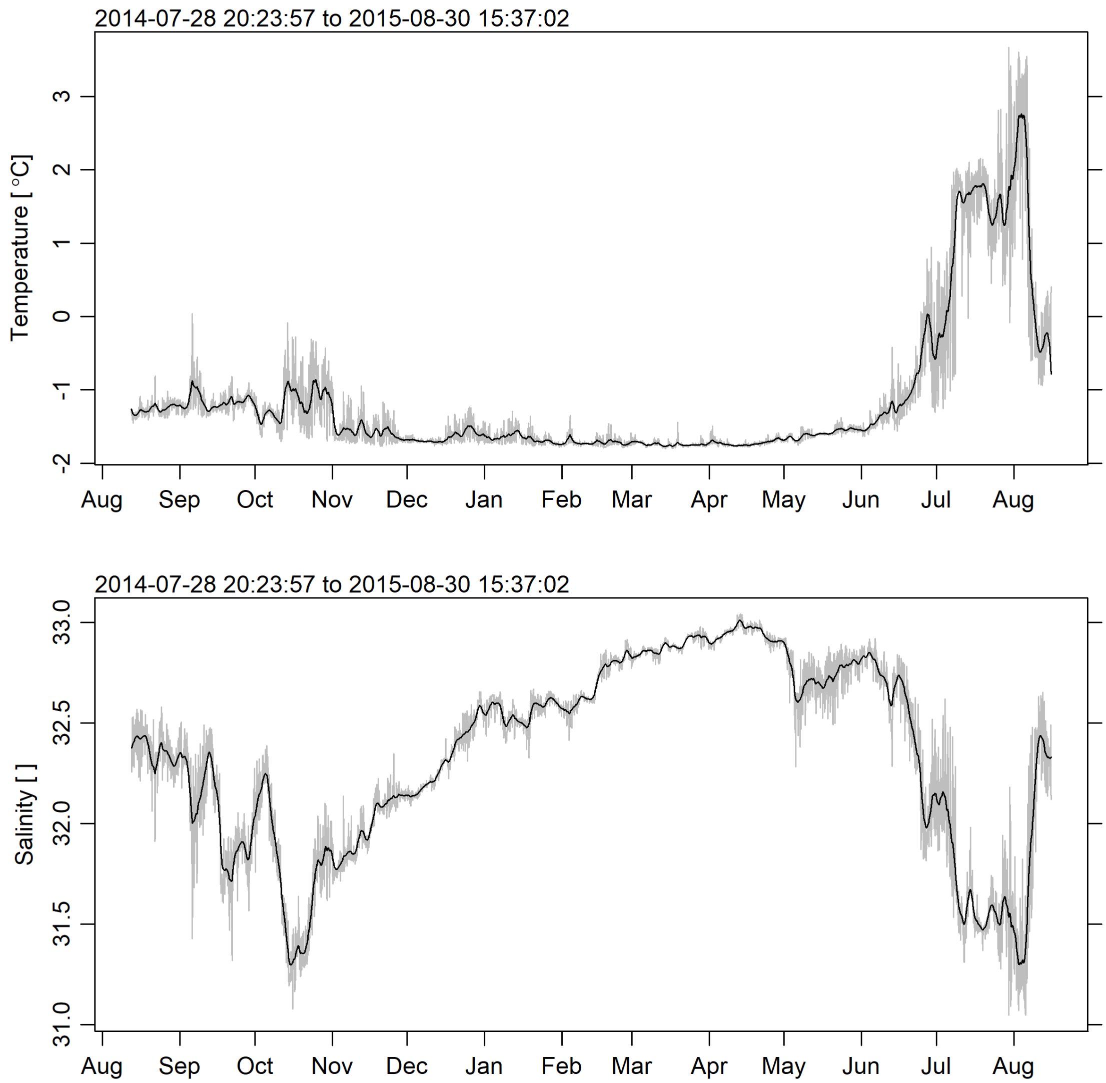

Figure 19: Low-pass filtered T, S (35 m), August 2014 - August 2015.

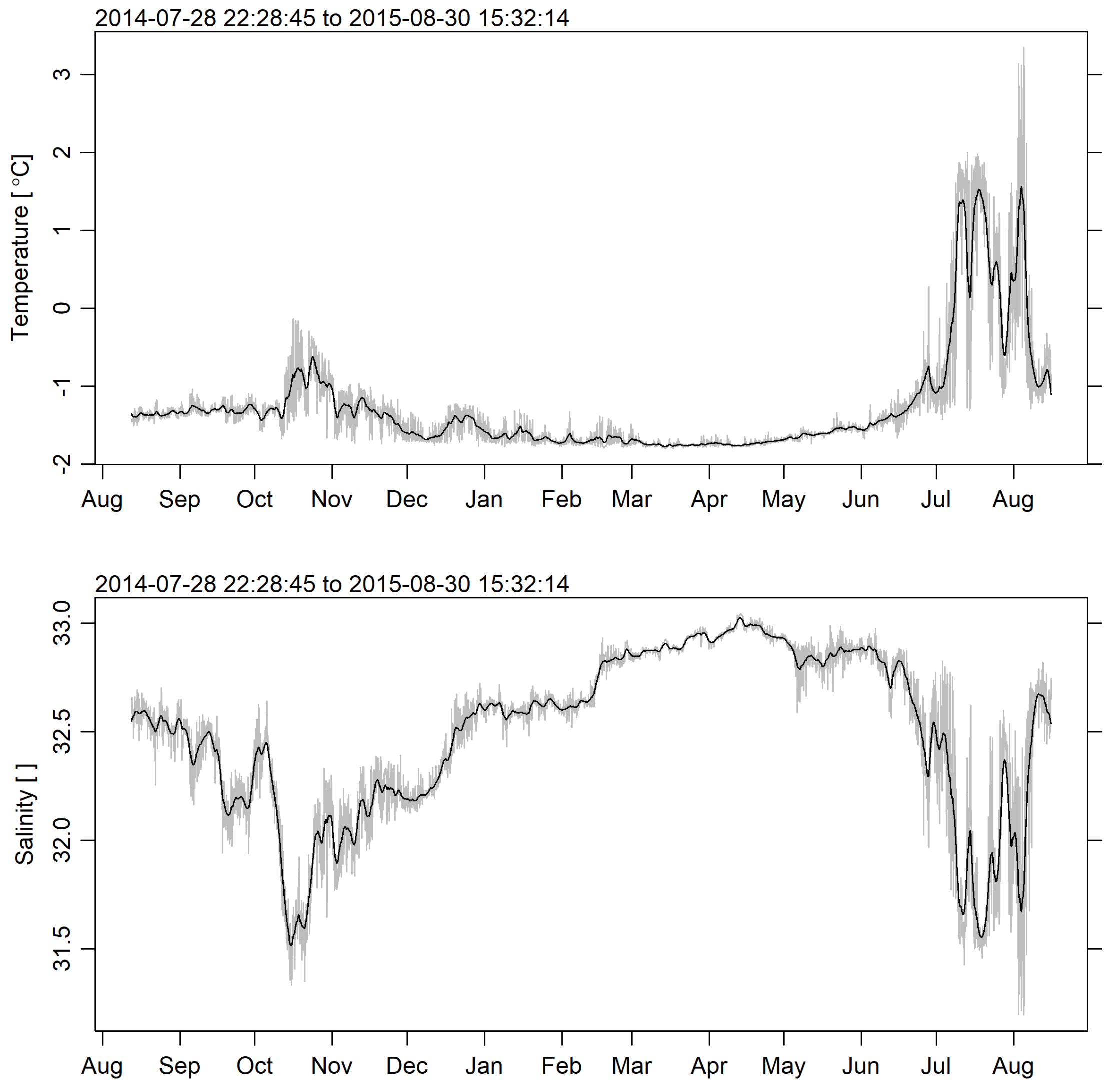

Figure 20: Low-pass filtered T, S (47 m), August 2014 - August 2015.

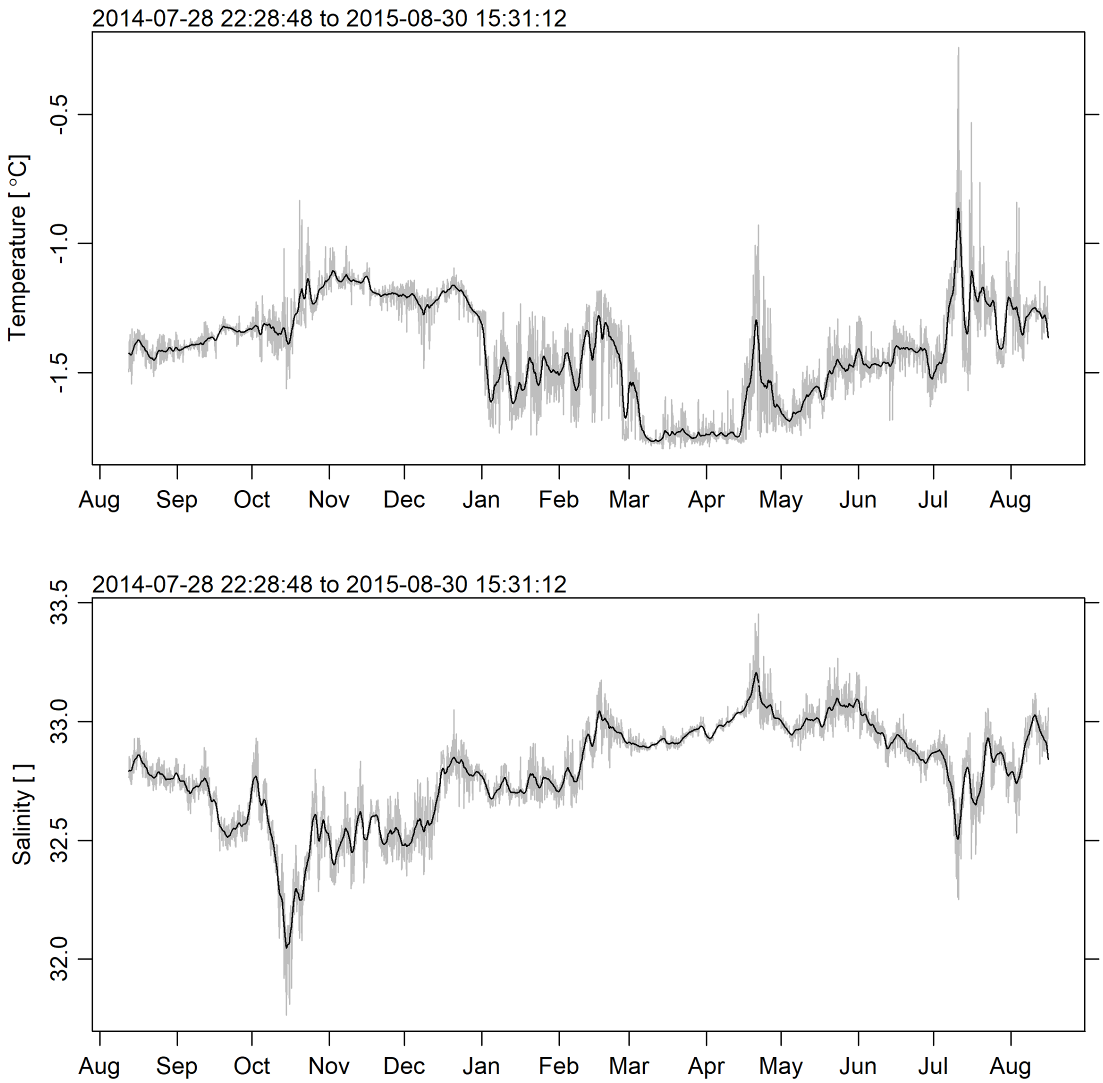

Figure 21: Low-pass filtered T, S (81 m), August 2014 - August 2015.

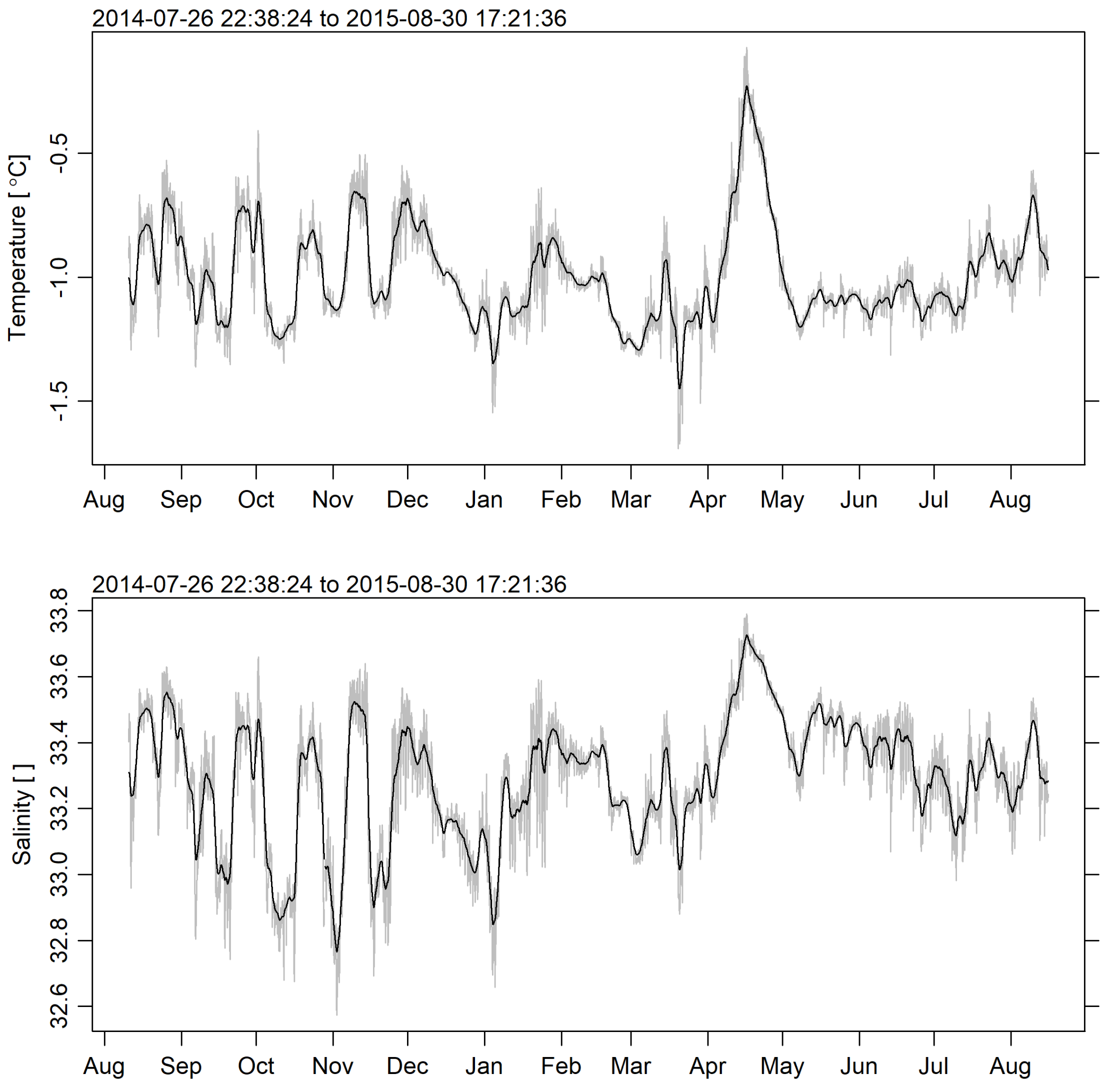

Figure 22: Low-pass filtered T, S (155 m), August 2014 - August 2015.

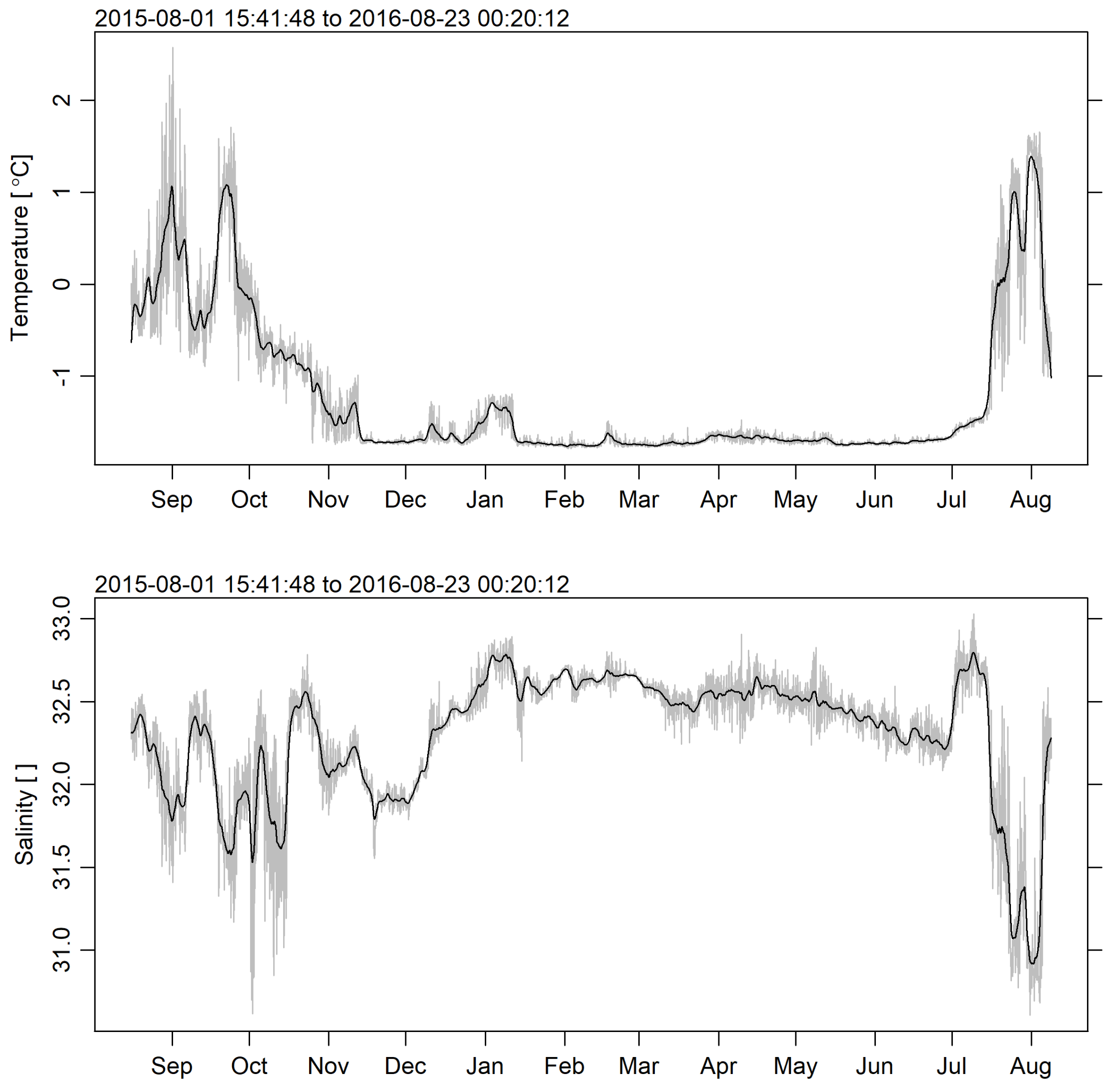

Figure 23: Low-pass filtered T, S (35 m), August 2015 - August 2016.

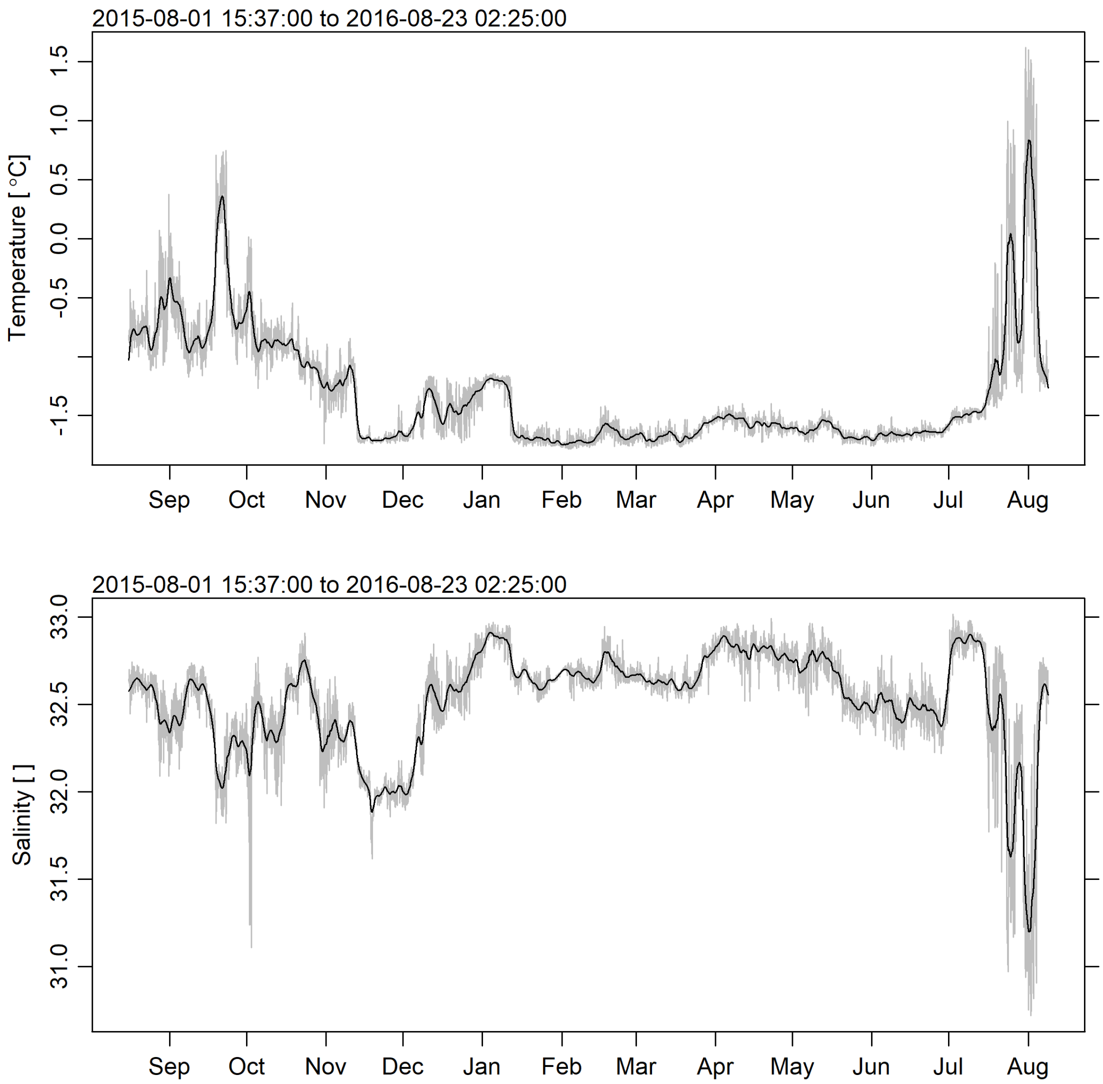

Figure 24: Low-pass filtered T, S (47 m), August 2015 - August 2016.

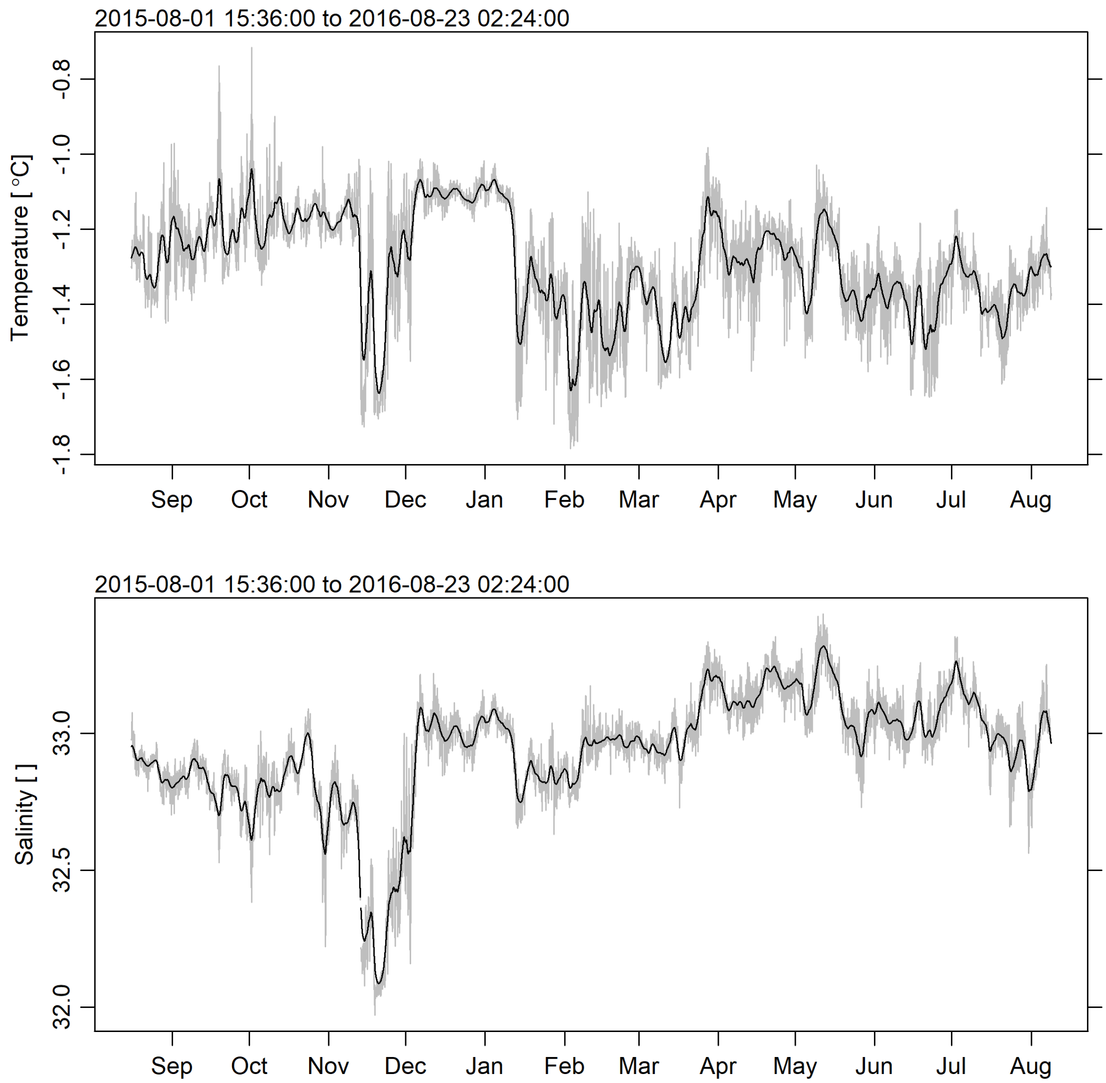

Figure 25: Low-pass filtered T, S (81 m), August 2015 - August 2016.

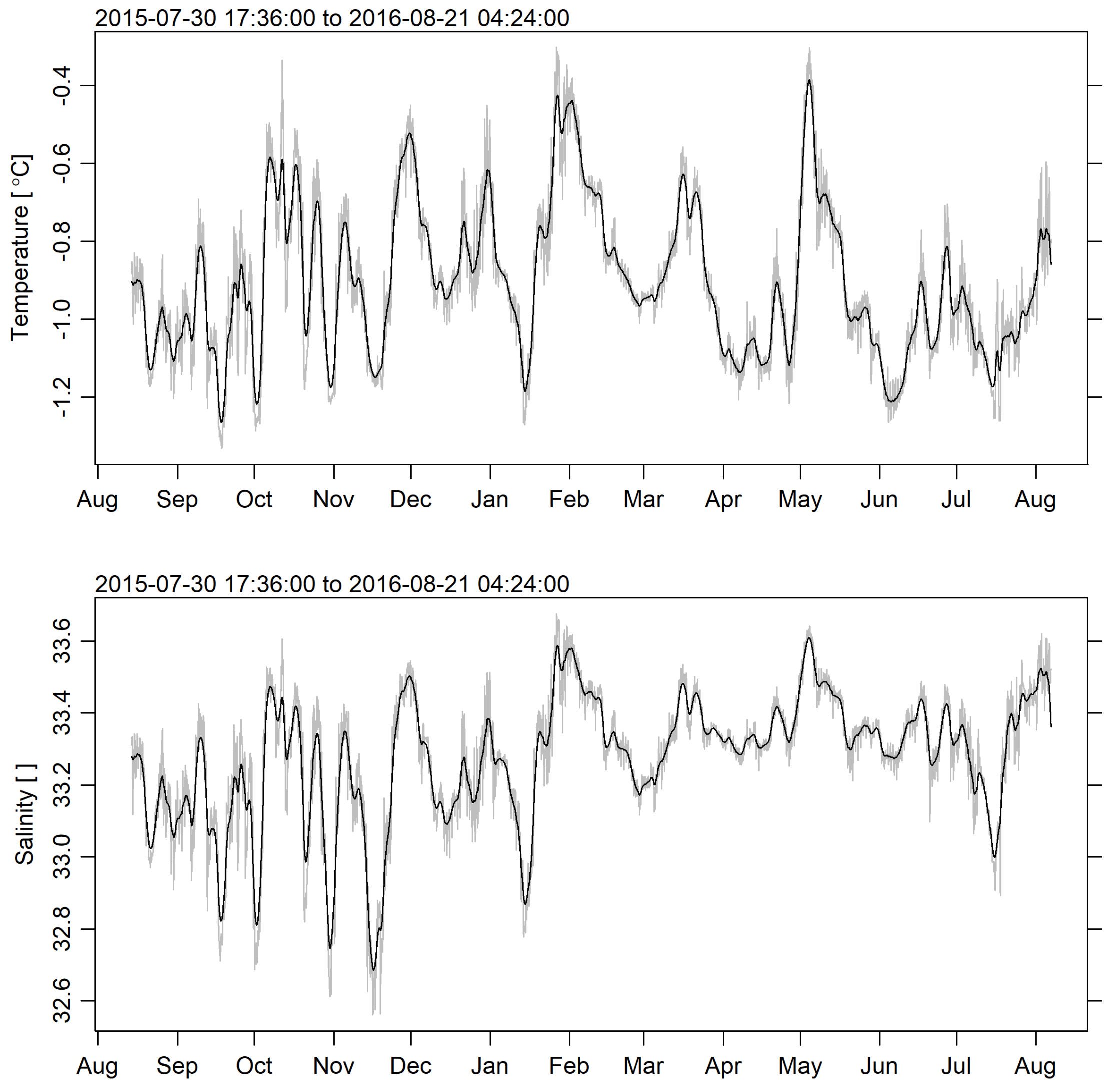

Figure 26: Low-pass filtered T, S (155 m), August 2015 - August 2016.

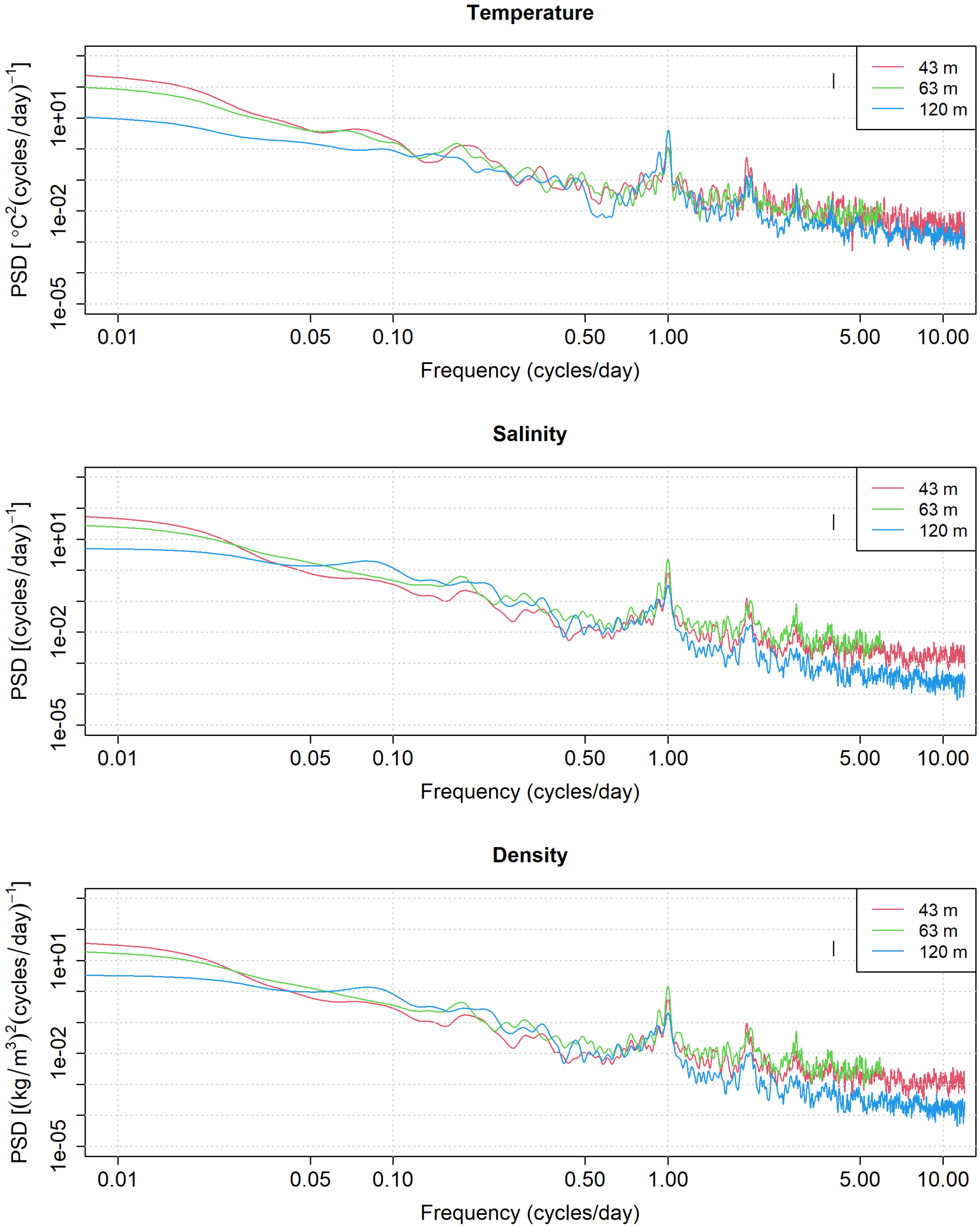

Figure 27: Power spectra of moored CTD data, August 2011 - August 2012. The black vertical line is representative of the 95% confidence interval for all records.

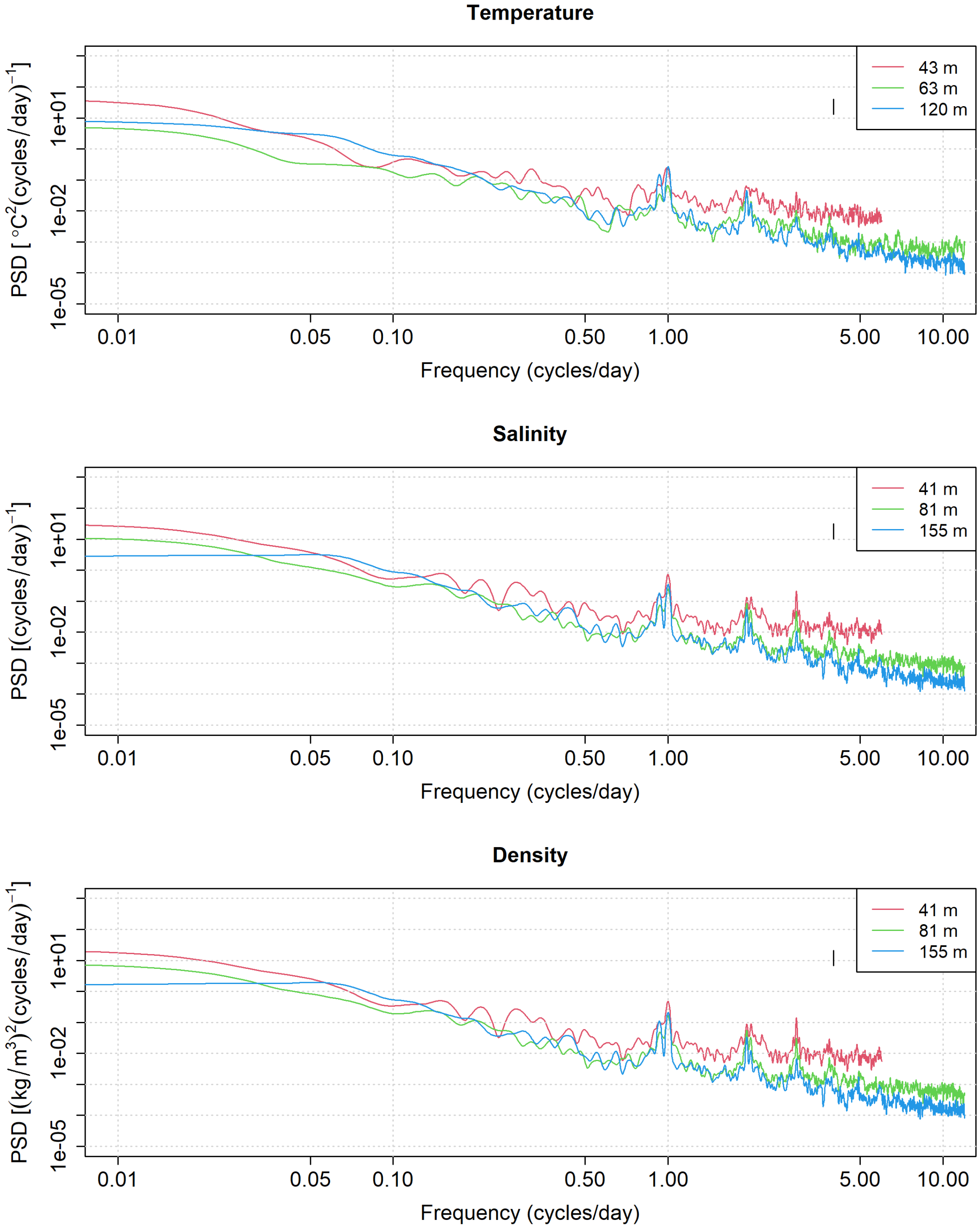

Figure 28: Power spectra of moored CTD data, August 2012 - August 2013. The black vertical line is representative of the 95% confidence interval for all records.

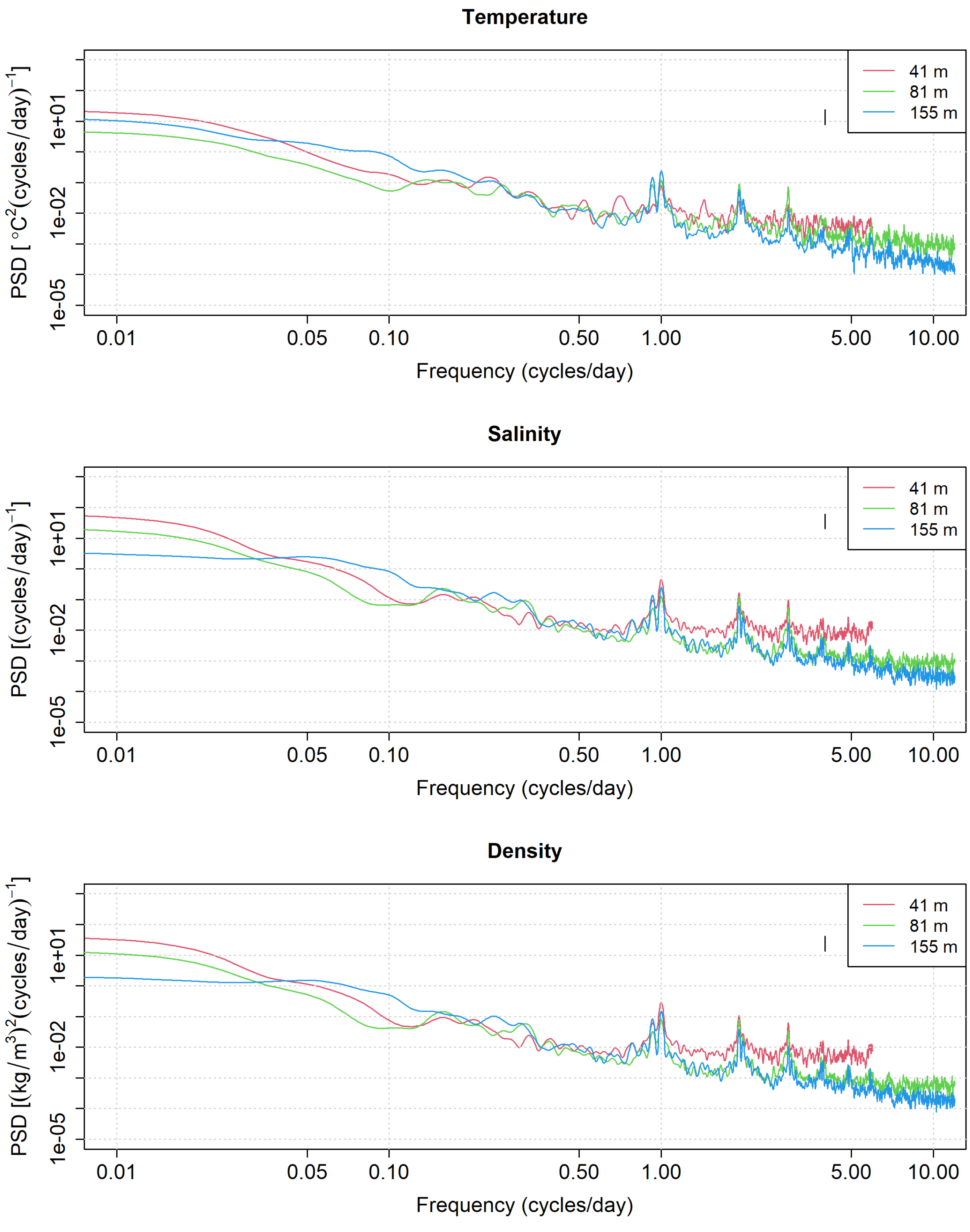

Figure 29: Power spectra of moored CTD data, August 2013 - August 2014. The black vertical line is representative of the 95% confidence interval for all records.

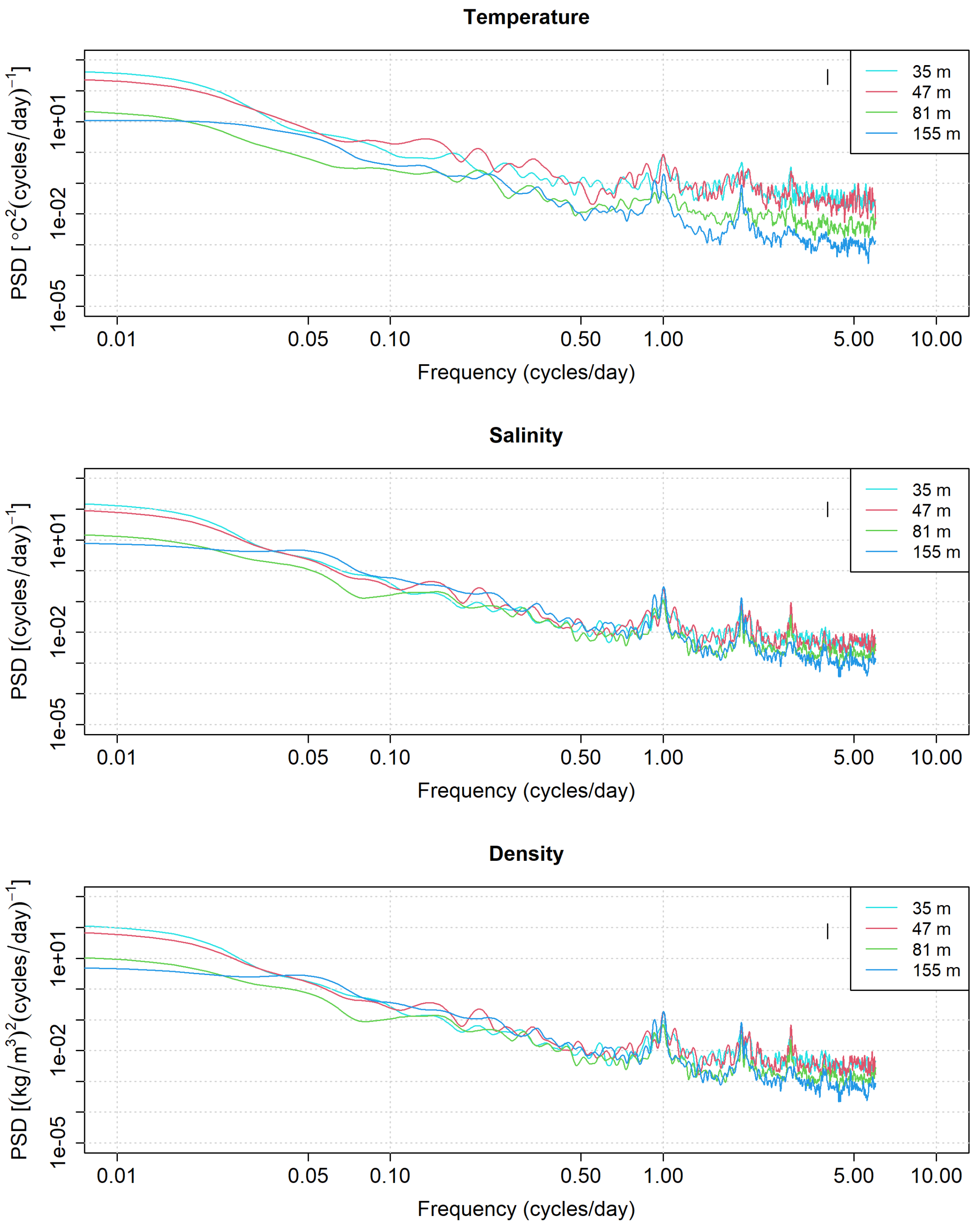

Figure 30: Power spectra of moored CTD data, August 2014 - August 2015. The black vertical line is representative of the 95% confidence interval for all records.

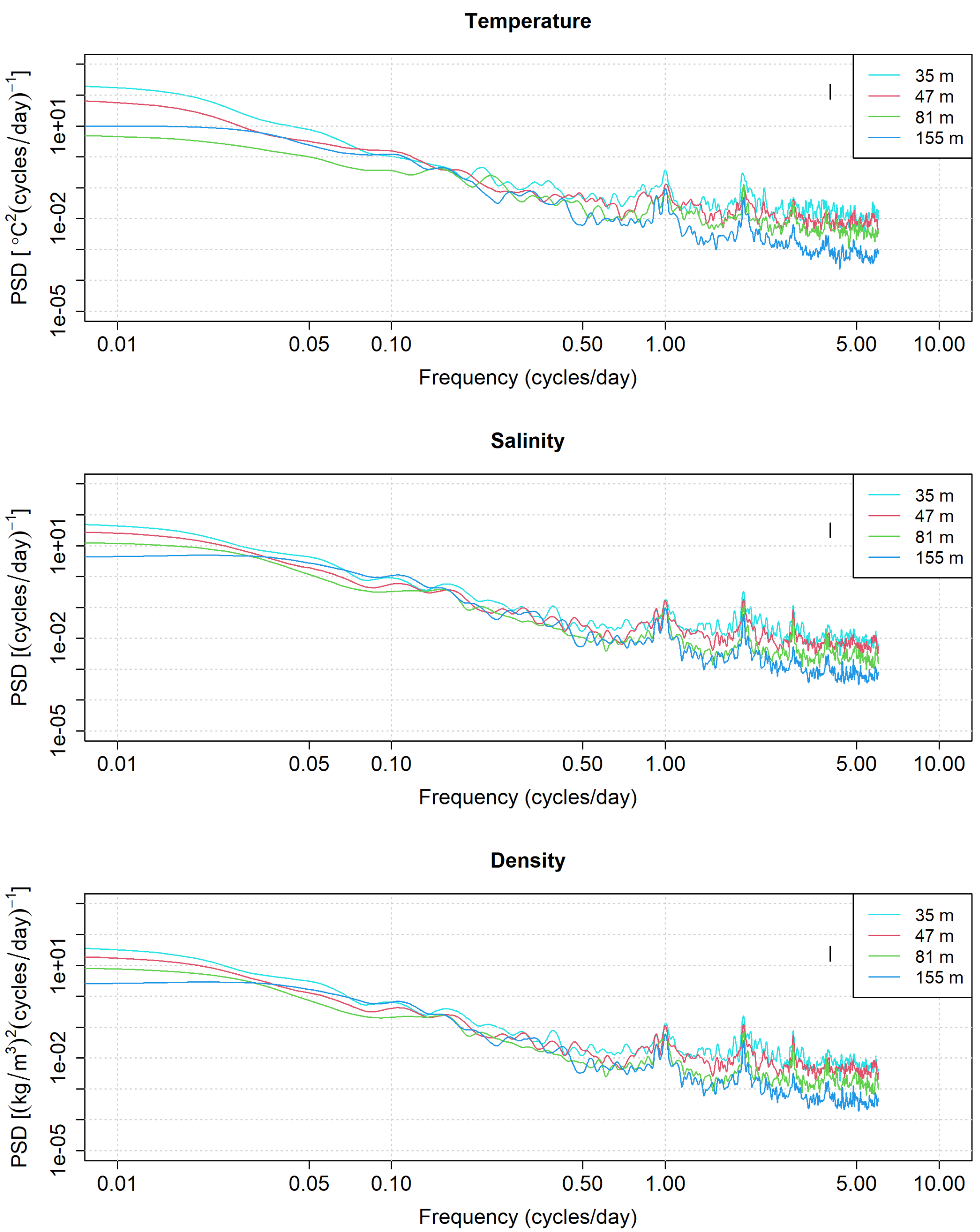

Figure 31: Power spectra of moored CTD data, August 2015 - August 2016. The black vertical line is representative of the 95% confidence interval for all records.

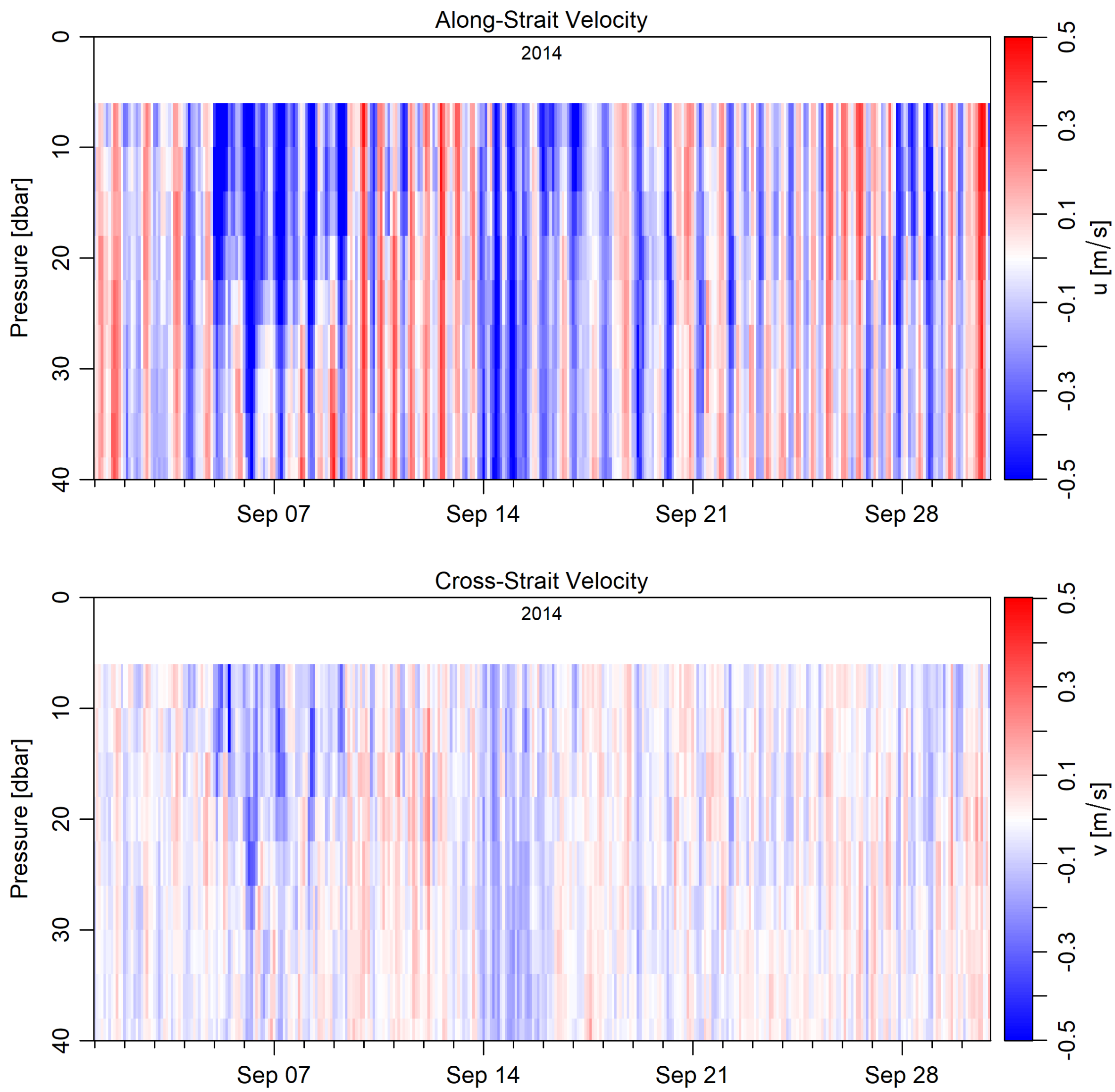

Figure 32: Bi-hourly moored ADCP data, September 1 2014 - September 30 2014.

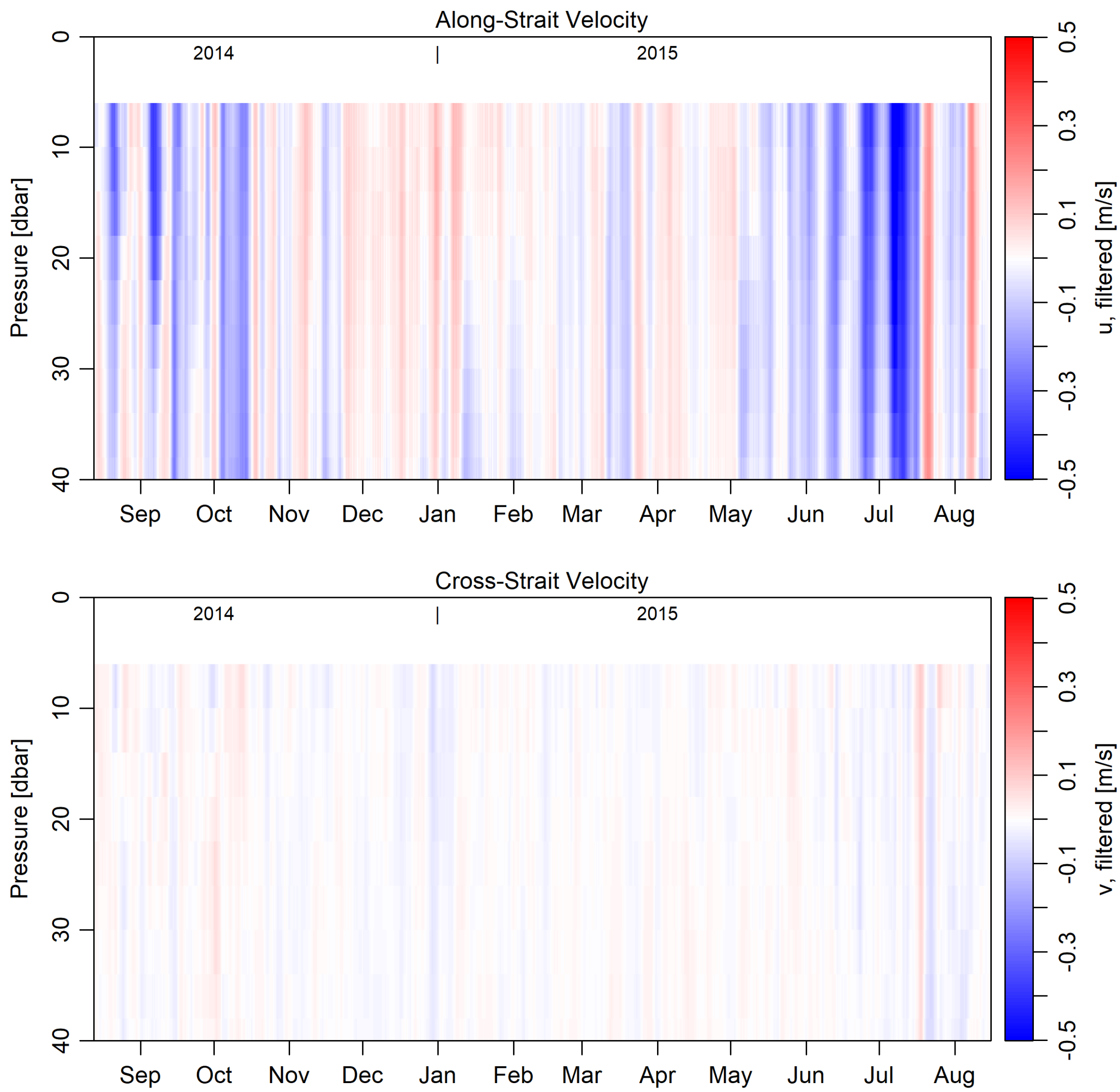

Figure 33: Low-pass filtered ADCP data, August 2014 - August 2015.

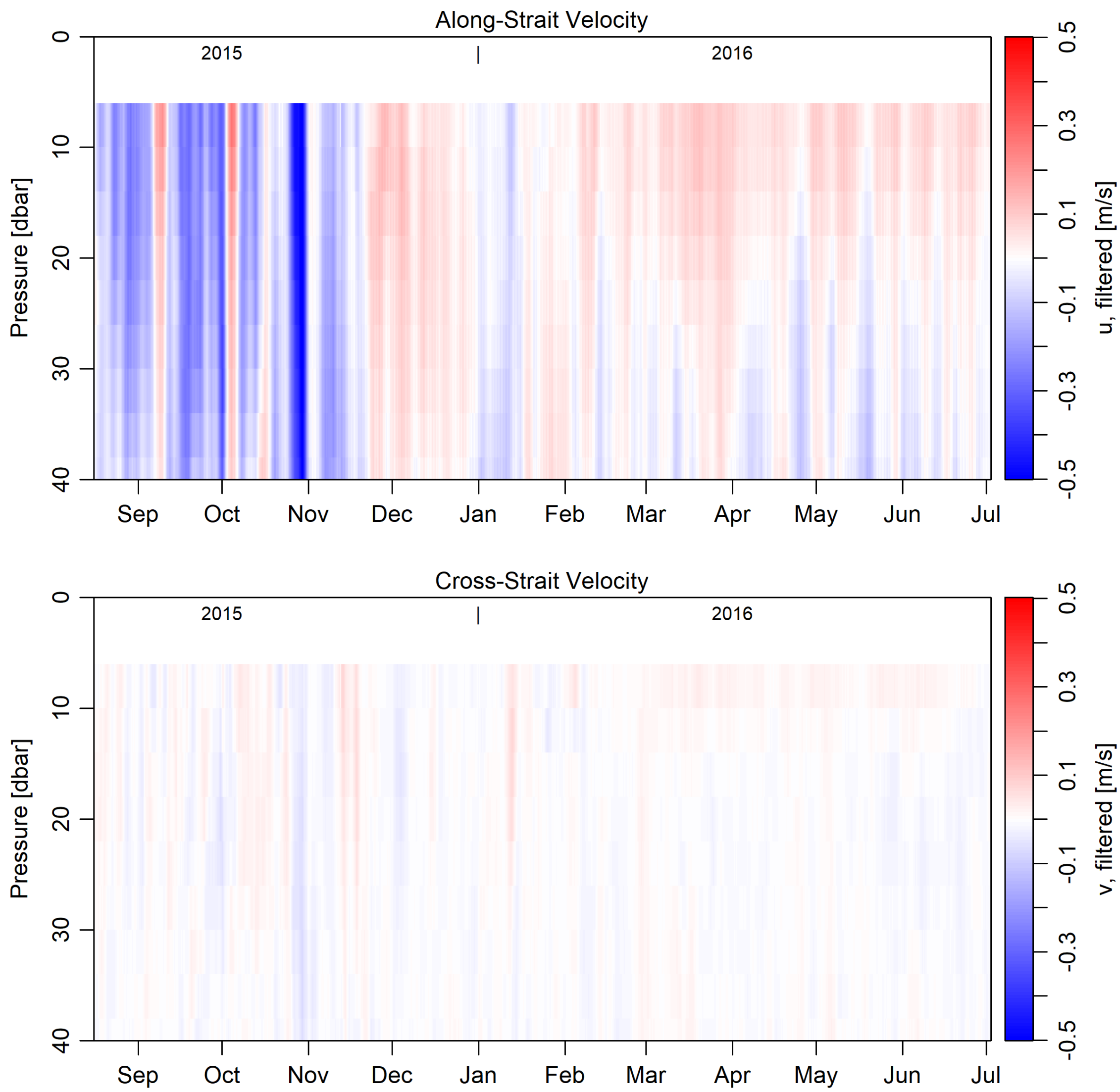

Figure 34: Low-pass filtered ADCP data, August 2015 - August 2016.

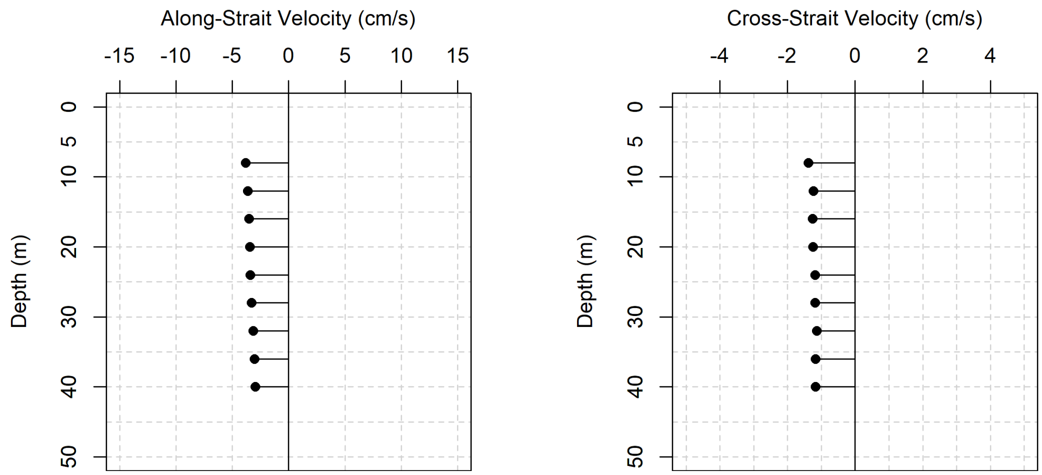

Figure 35: Annual Mean flow, August 2014 - August 2015.

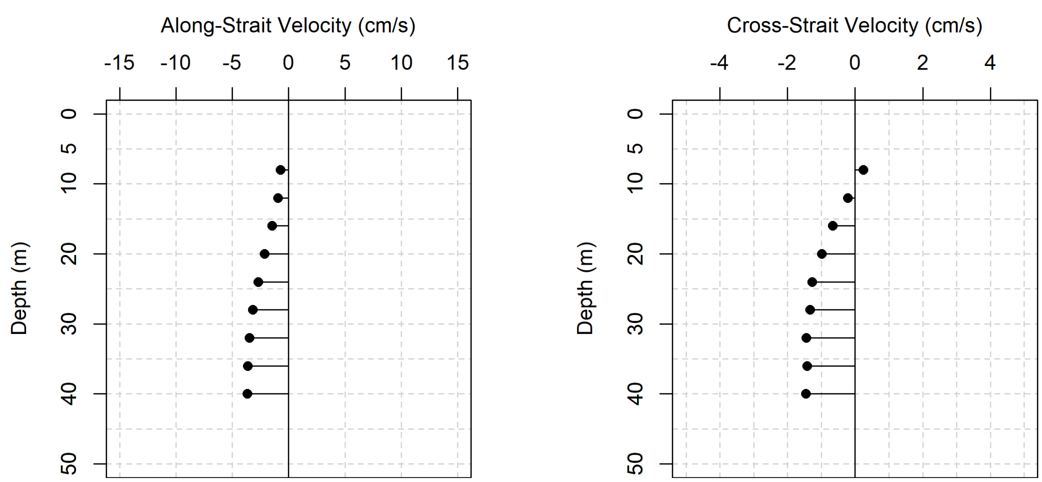

Figure 36: Annual Mean flow, August 2015 - August 2016.

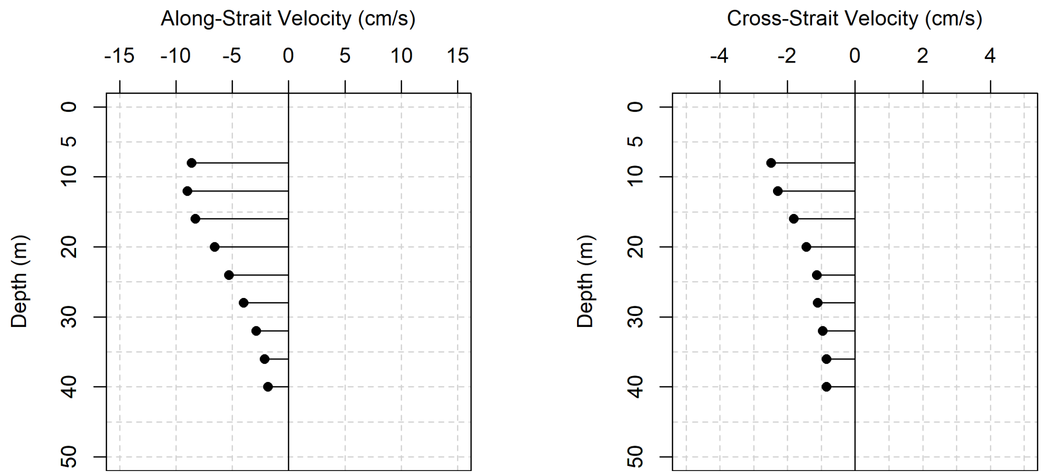

Figure 37: Mean flow, Late Summer: August 2014 to September 2014.

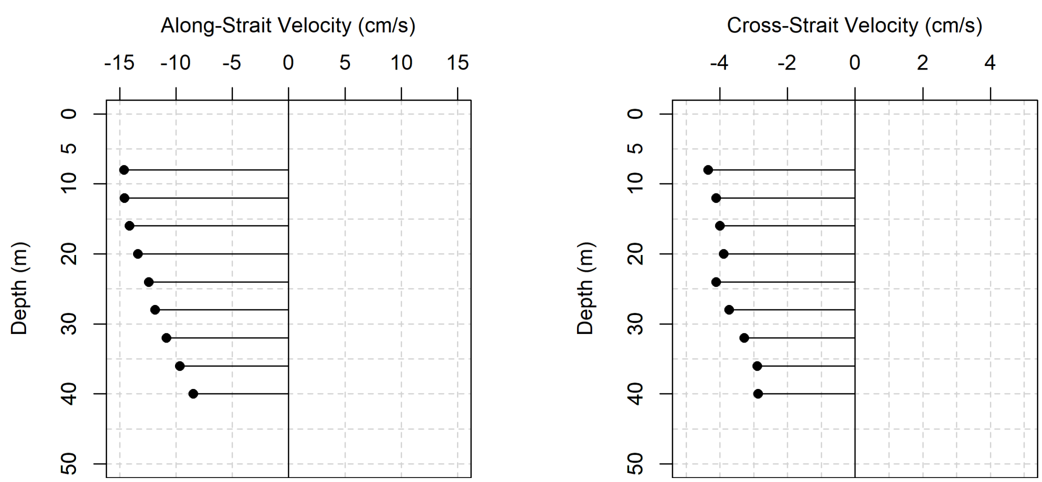

Figure 38: Mean flow, Late Summer: August 2015 to September 2015.

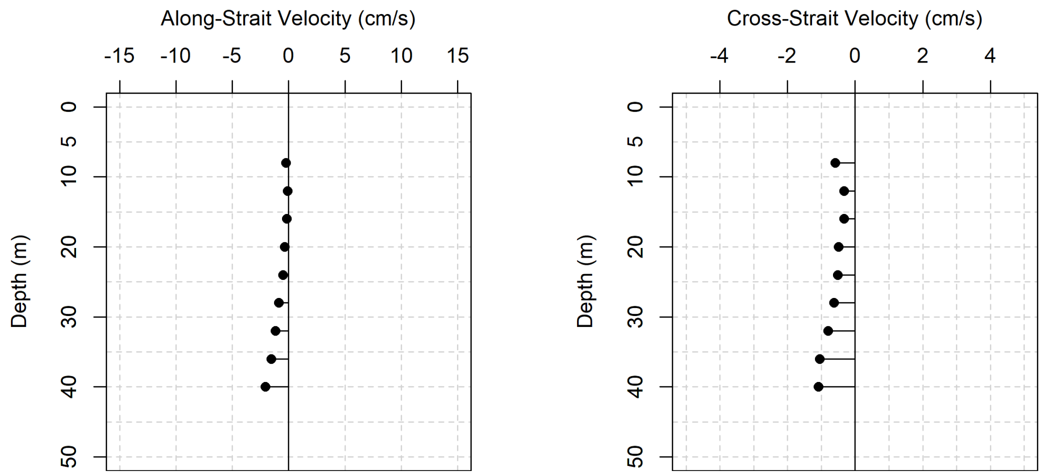

Figure 39: Mean flow, Fall: October 2014 - December 2014.

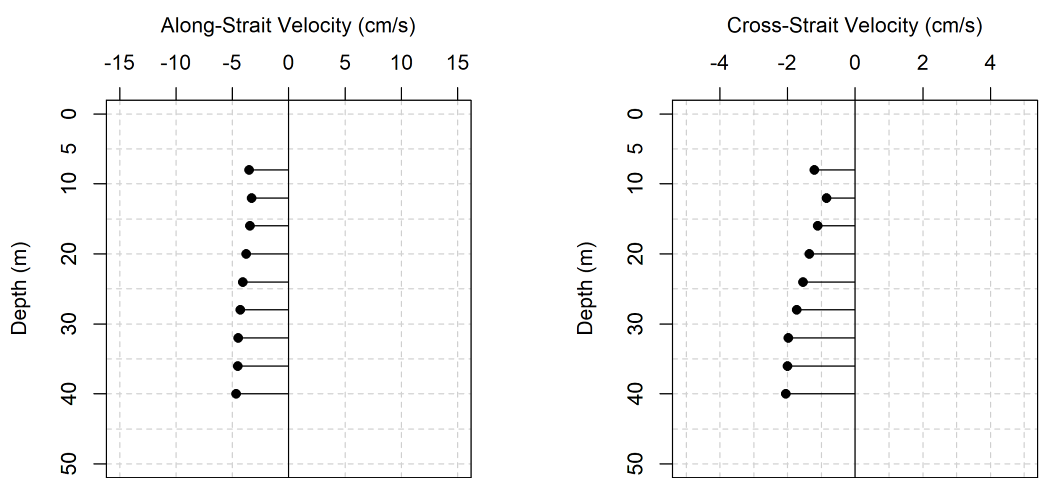

Figure 40: Mean flow, Fall: October 2015 - December 2015.

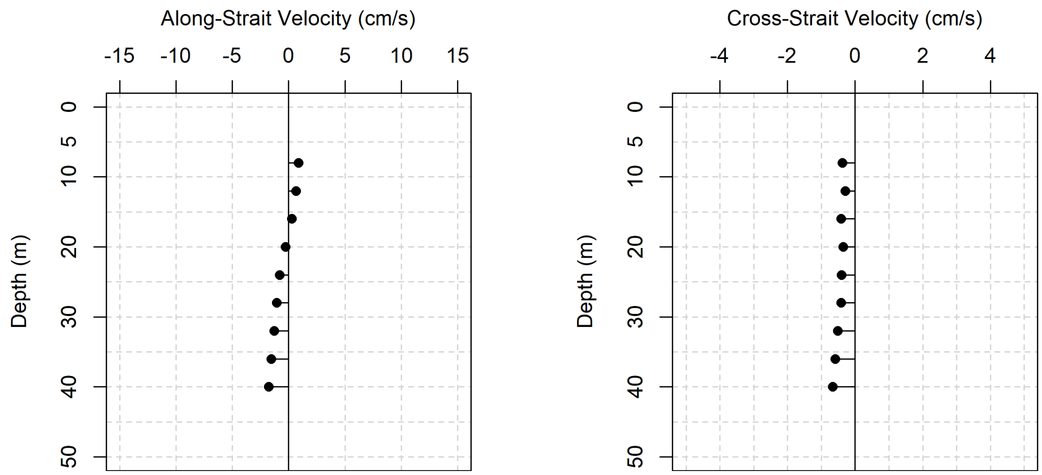

Figure 41: Mean flow, Winter: January 2015 - March 2015.

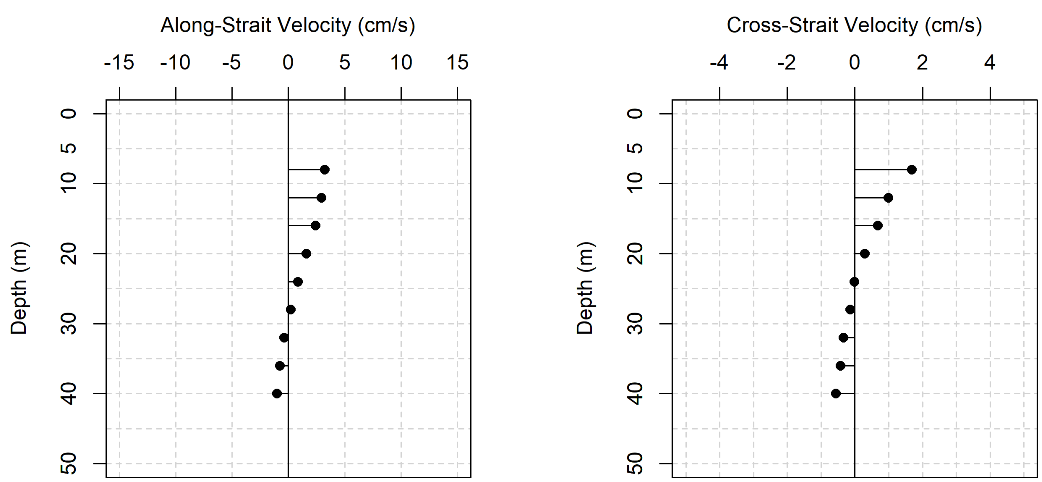

Figure 42: Mean flow, Winter: January 2016 - March 2016.

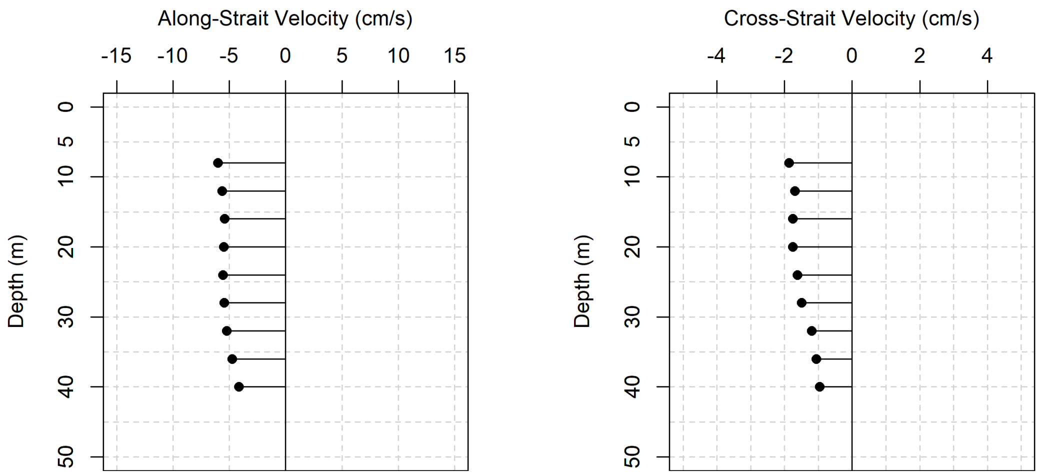

Figure 43: Mean flow, Spring: April 2015 - June 2015.

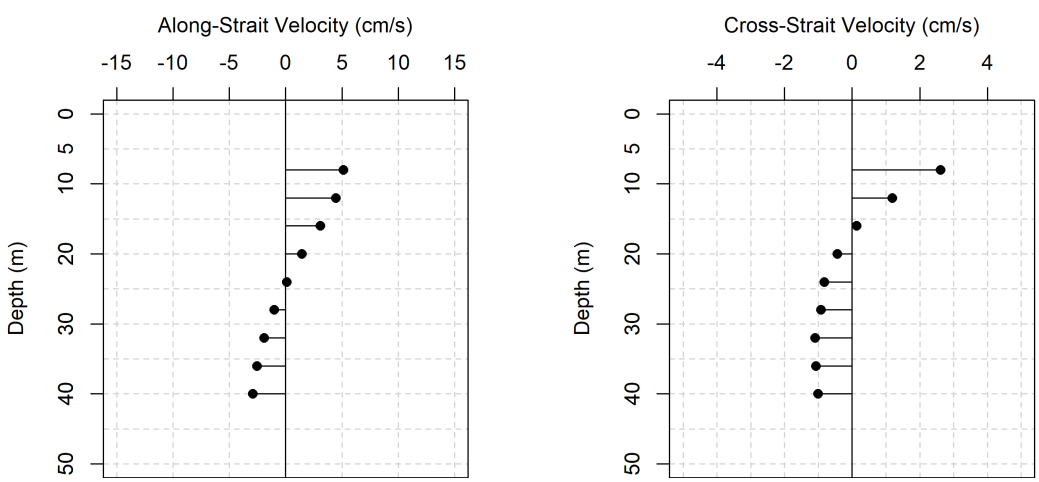

Figure 44: Mean flow, Spring: April 2016 - June 2016.

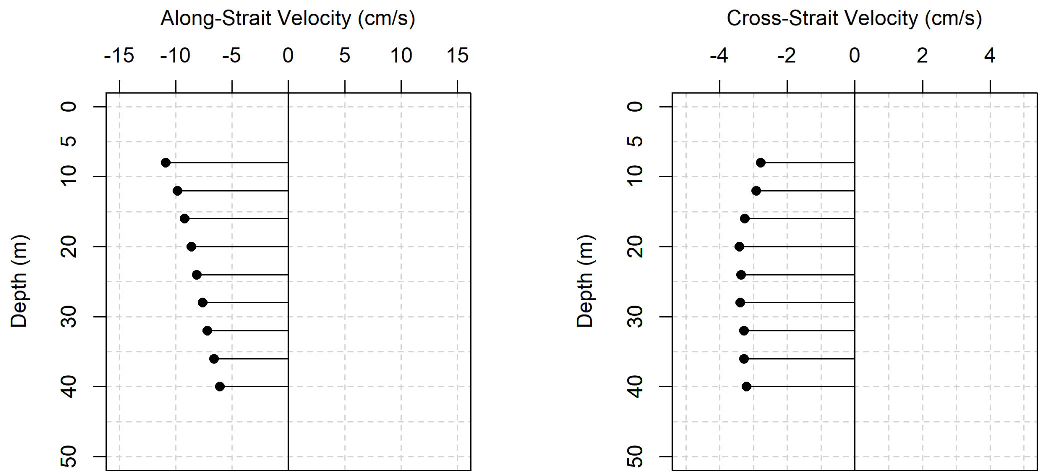

Figure 45: Mean flow, Early Summer: July 2015 - August 2015.

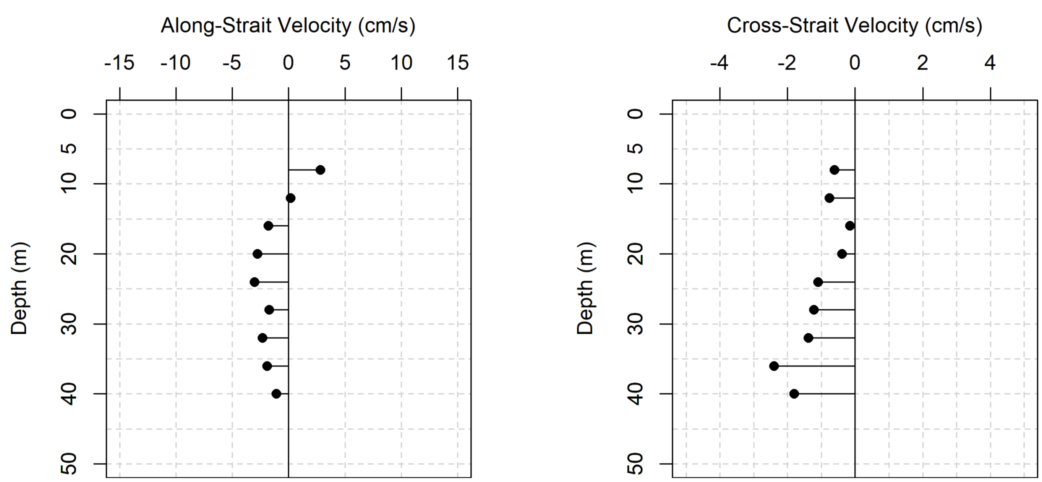

Figure 46: Mean flow, Early Summer: July 2016 - August 2016.

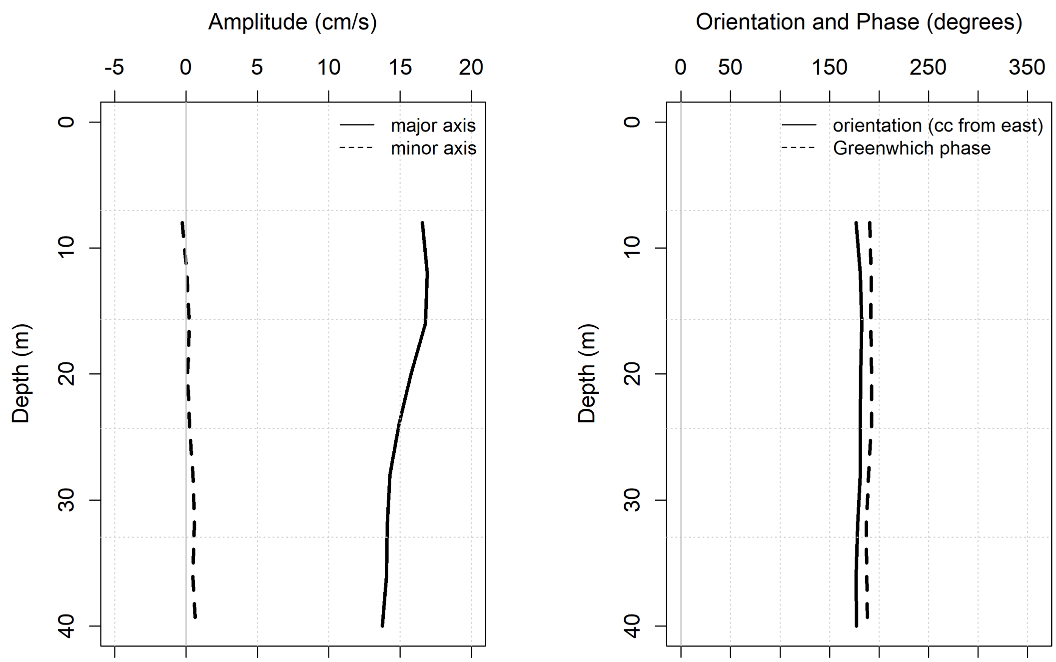

Figure 47: M2 Tidal Constituent, Ice Free Period (August 12 2014 - September 27 2014).

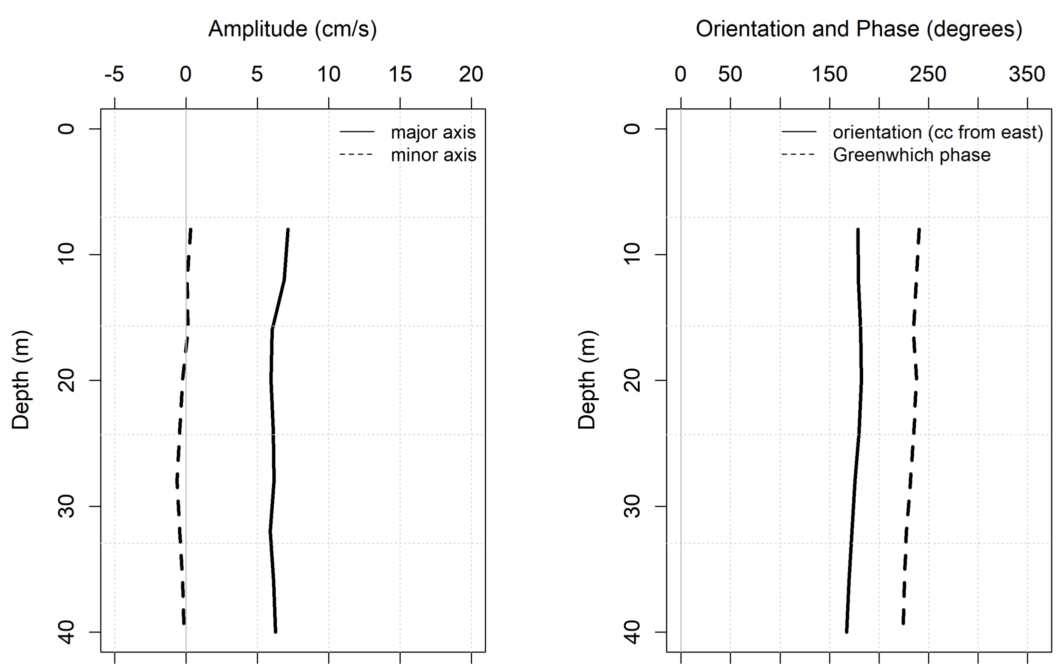

Figure 48: S2 Tidal Constituent, Ice Free Period (August 12 2014 - September 27 2014).

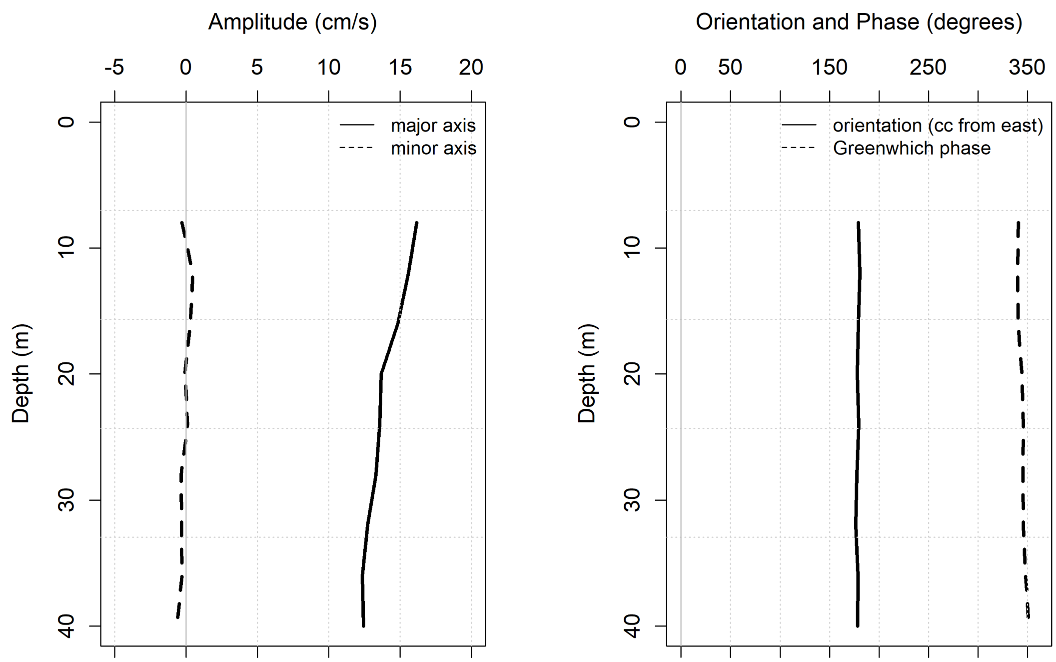

Figure 49: K1 Tidal Constituent, Ice Free Period (August 12 2014 - September 27 2014).

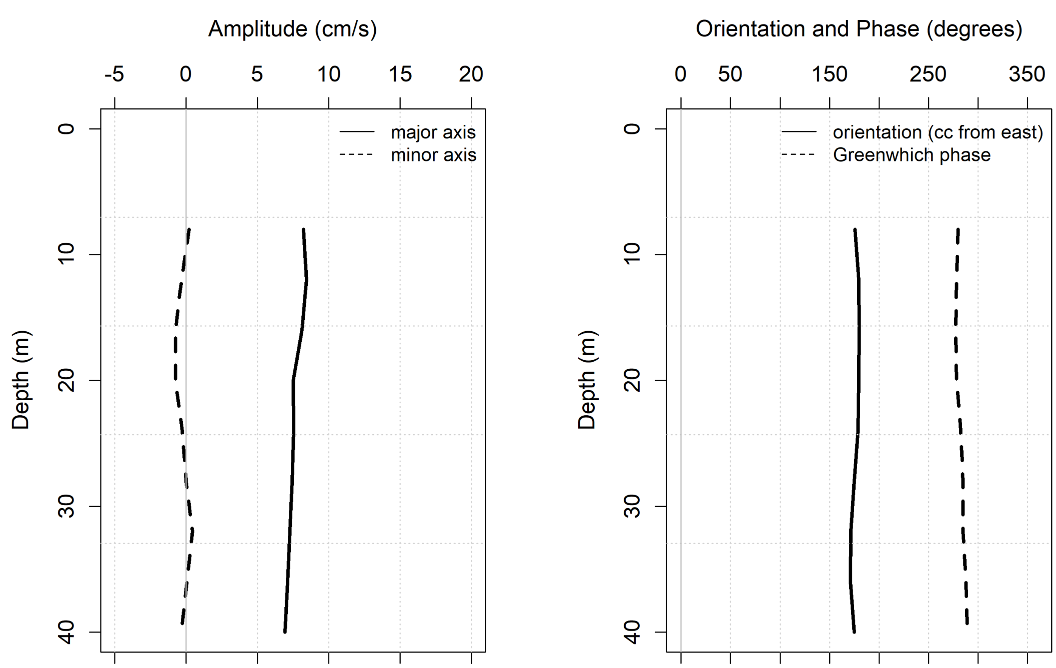

Figure 50: O1 Tidal Constituent, Ice Free Period (August 12 2014 - September 27 2014).

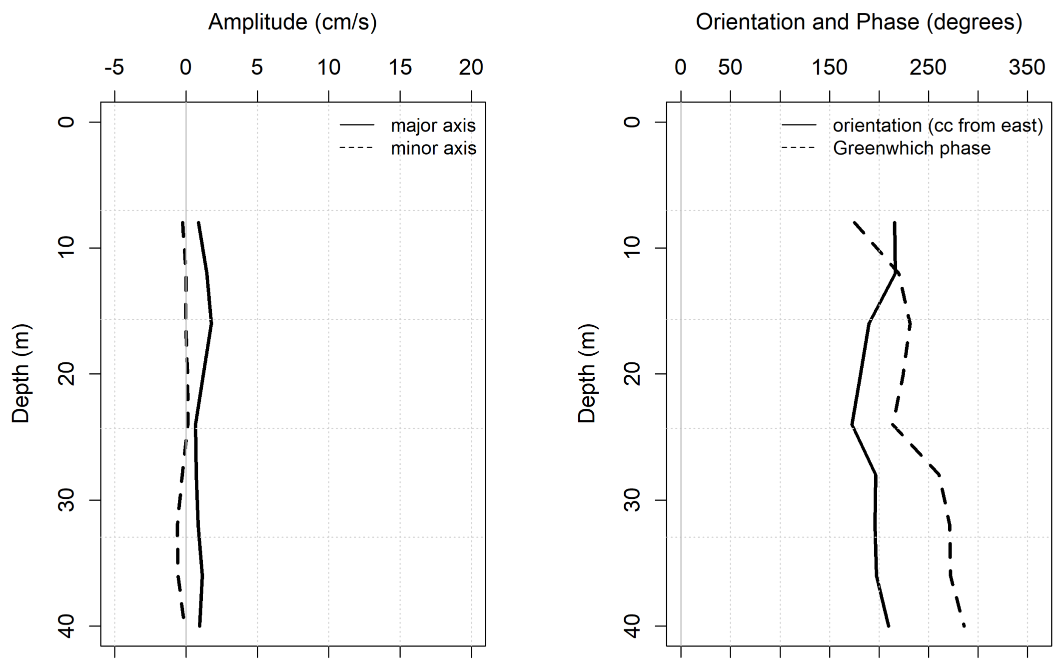

Figure 51: P1 Tidal Constituent, Ice Free Period (August 12 2014 - September 27 2014).

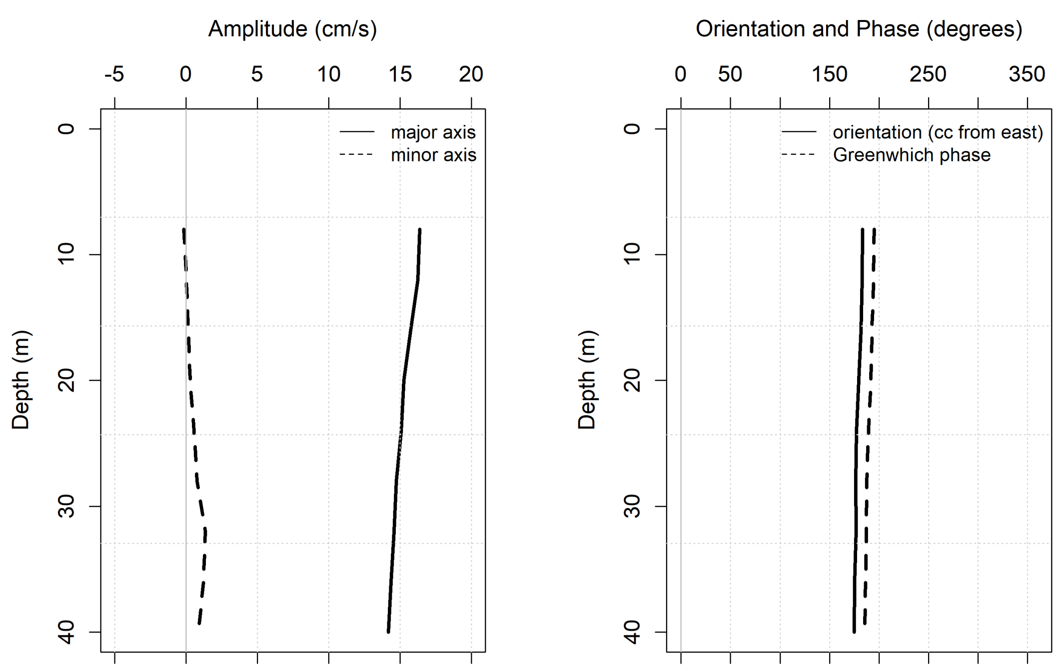

Figure 52: M2 Tidal Constituent, Ice Free Period (July 15 2015 - September 27 2015).

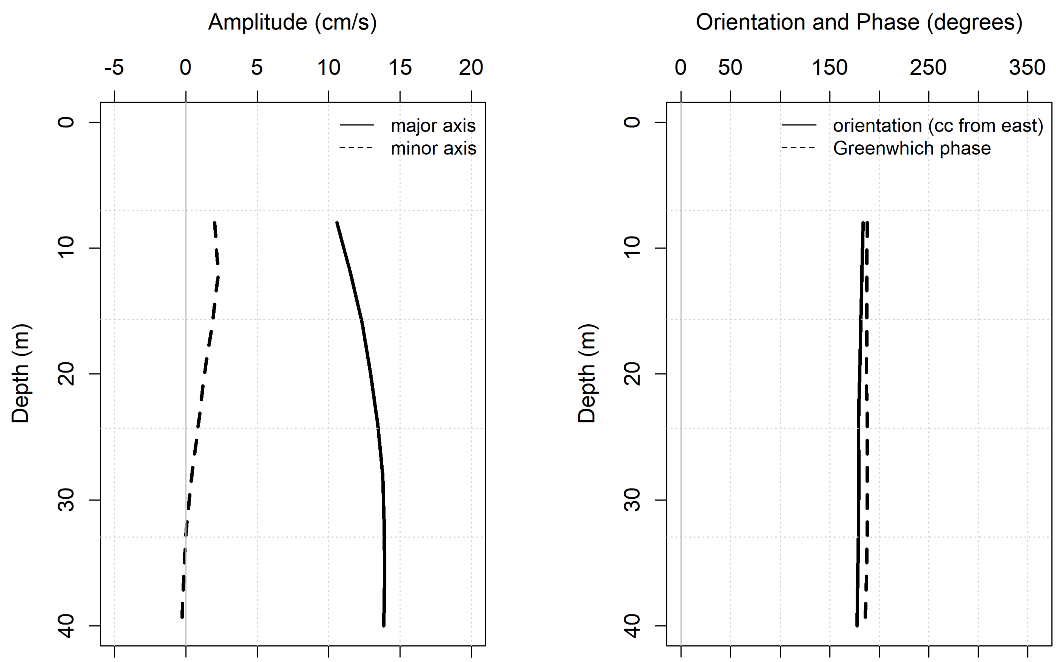

Figure 53: M2 Tidal Constituent, Solid Ice Period (March 1 2016 - June 1 2016).

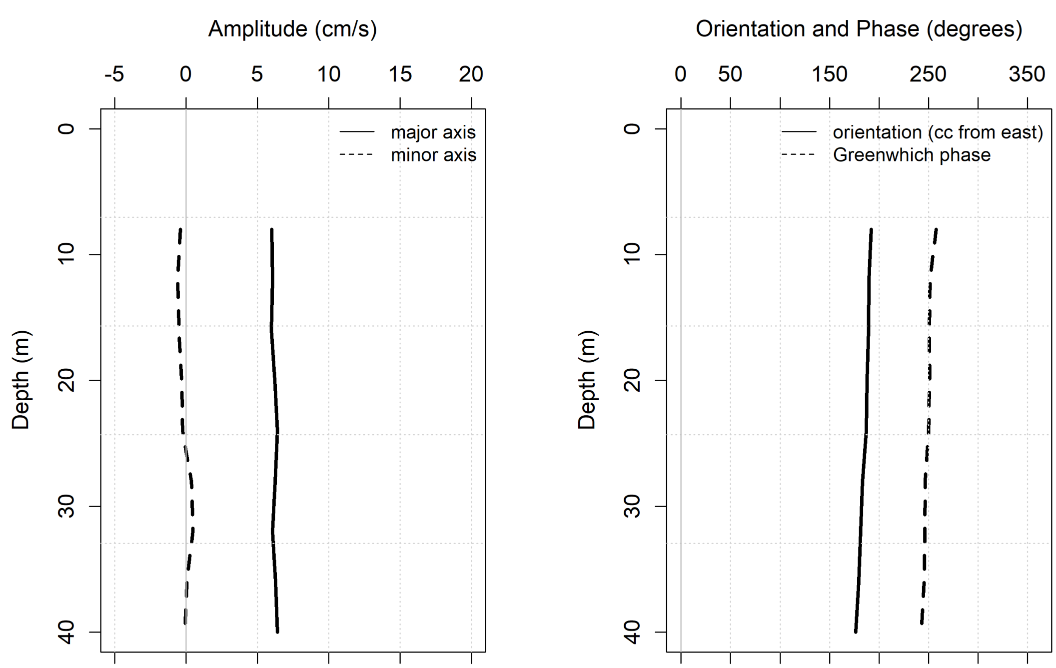

Figure 54: S2 Tidal Constituent, Ice Free Period (July 15 2015 - September 27 2015).

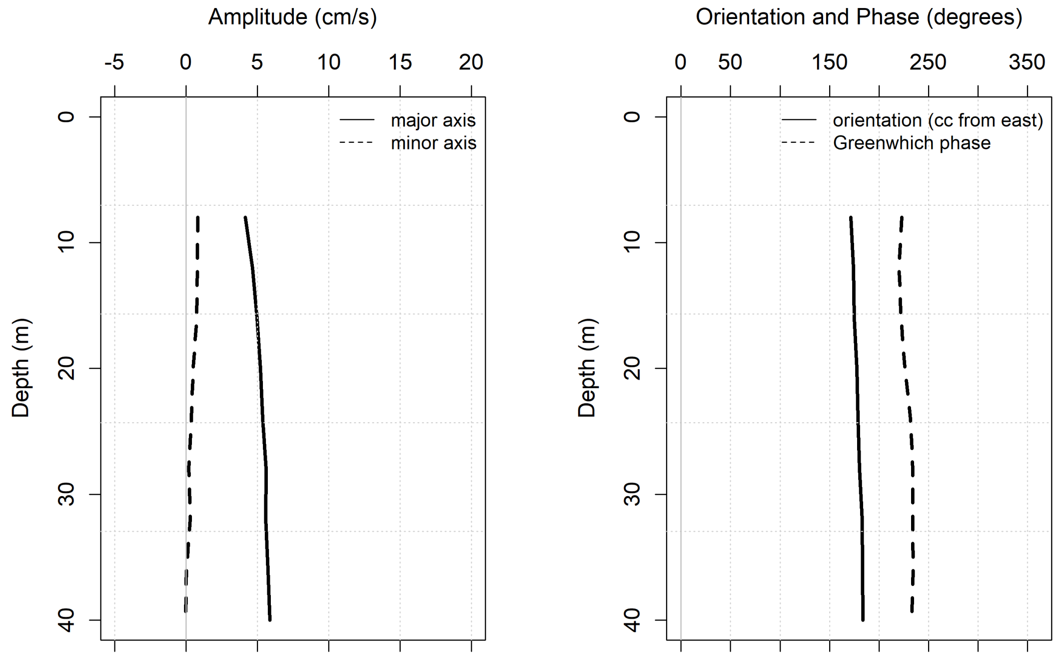

Figure 55: S2 Tidal Constituent, Solid Ice Period (March 1 2016 - June 1 2016).

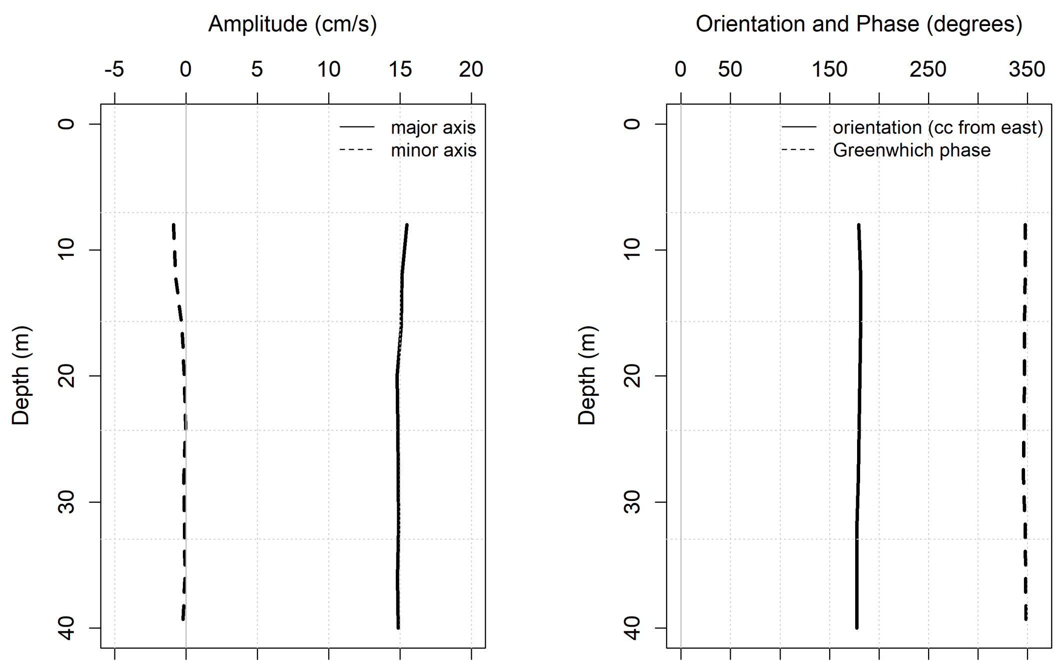

Figure 56: K1 Tidal Constituent, Ice Free Period (July 15 2015 - September 27 2015).

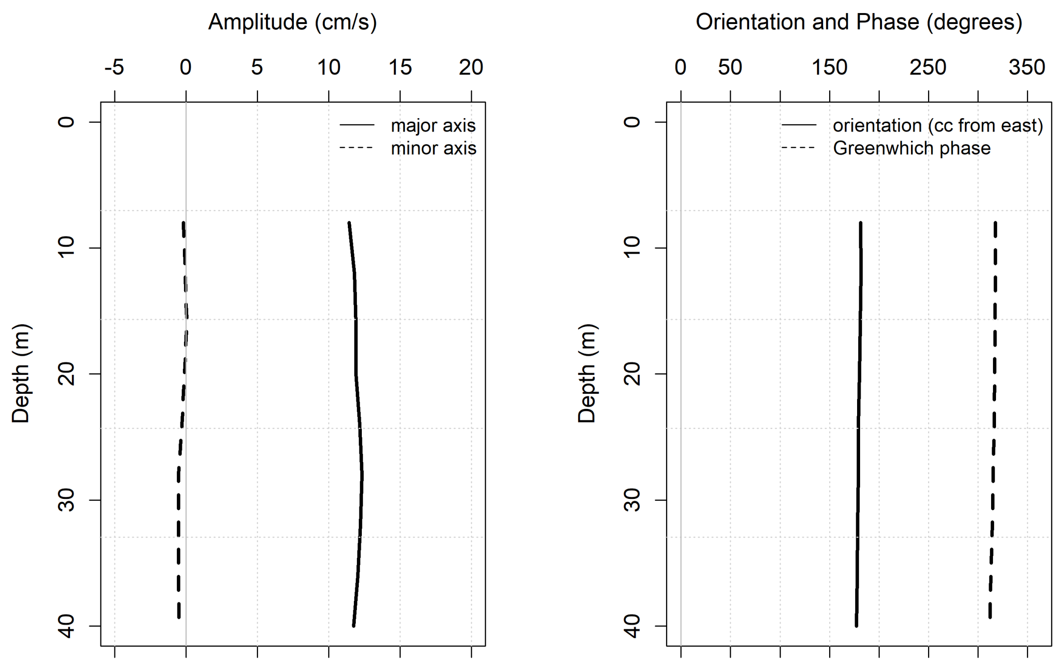

Figure 57: K1 Tidal Constituent, Solid Ice Period (March 1 2016 - June 1 2016).

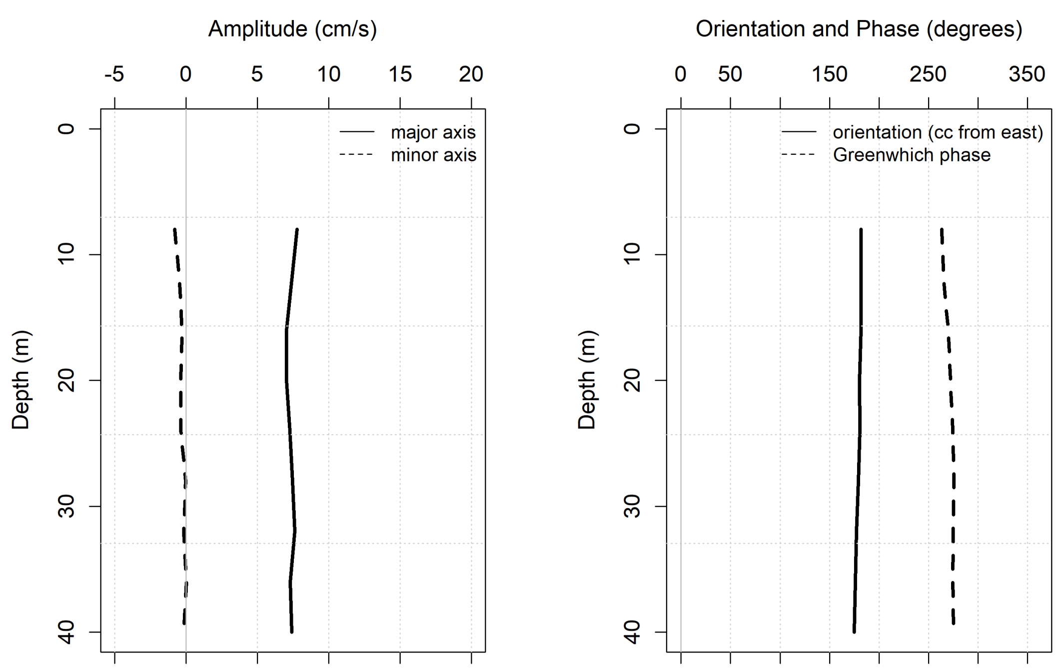

Figure 58: O1 Tidal Constituent, Ice Free Period (July 15 2015 - September 27 2015).

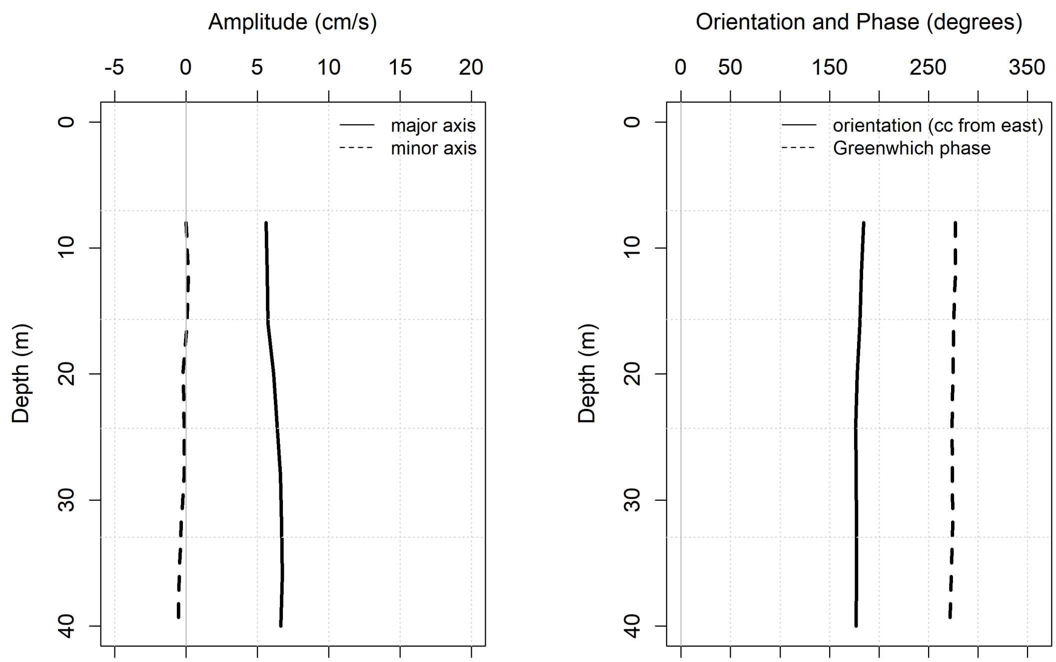

Figure 59: O1 Tidal Constituent, Solid Ice Period (March 1 2016 - June 1 2016).

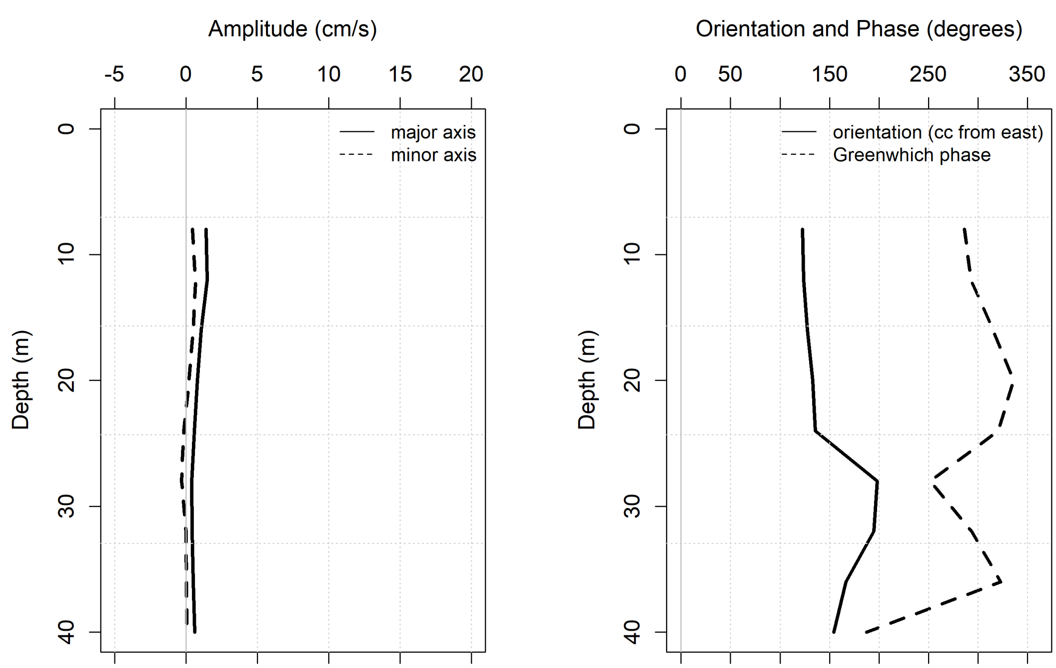

Figure 60: P1 Tidal Constituent, Ice Free Period (July 15 2015 - September 27 2015).

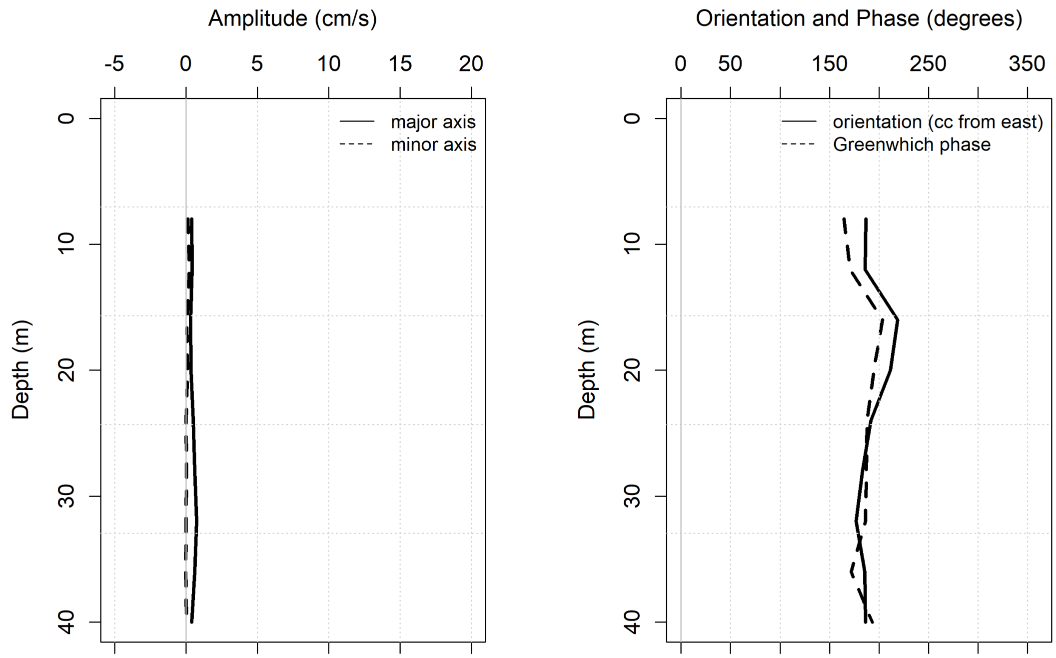

Figure 61: P1 Tidal Constituent, Solid Ice Period (March 1 2016 - June 1 2016).

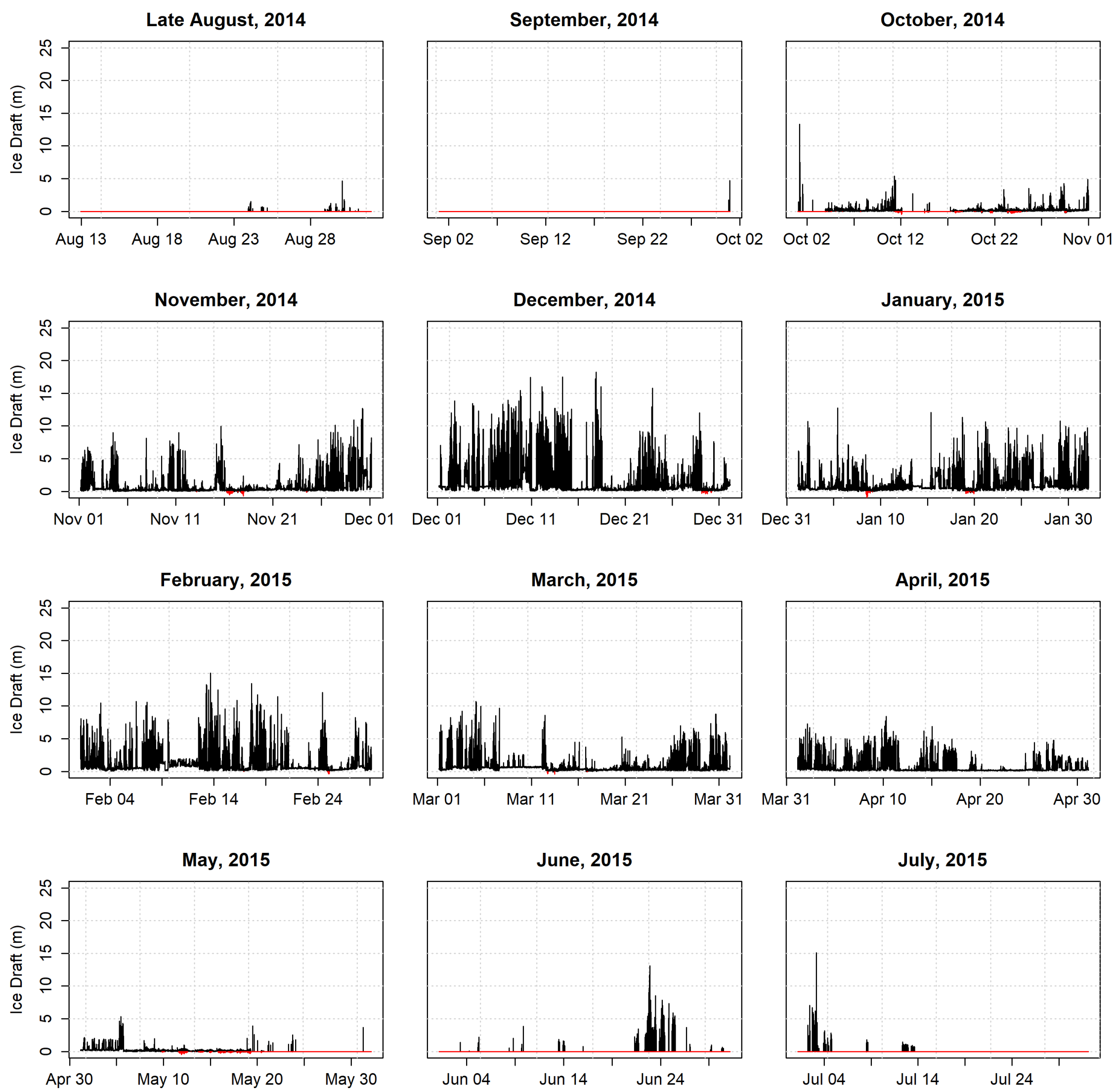

Figure 62: Ice draft, monthly time series, August 2014 - July 2015. Red line indicates period of open water. Negative ice drafts are indicative of open water.

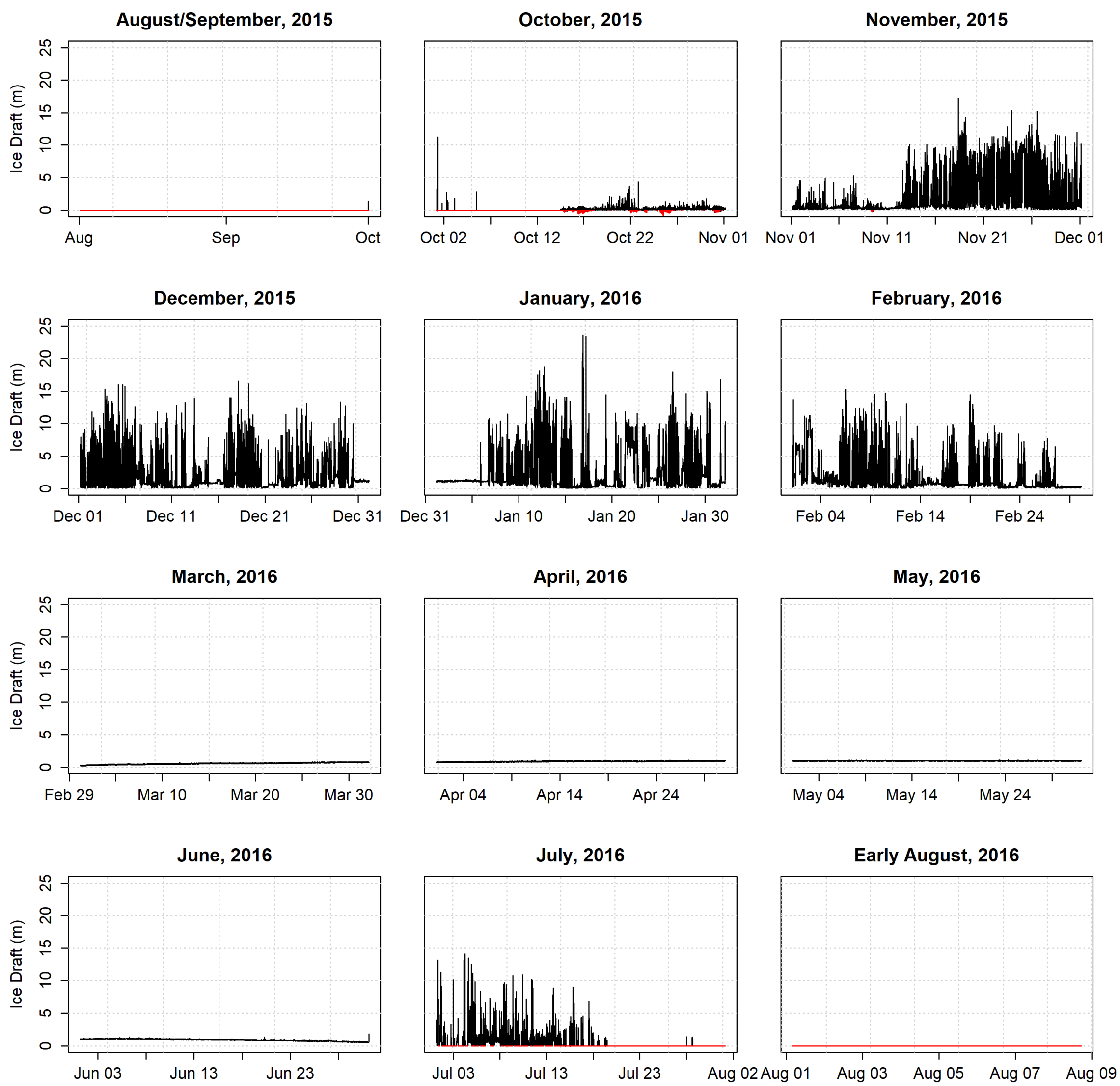

Figure 63: Ice draft, monthly time series, August 2015 - July 2016. Red line indicates period of open water. Negative ice drafts are indicative of open water.

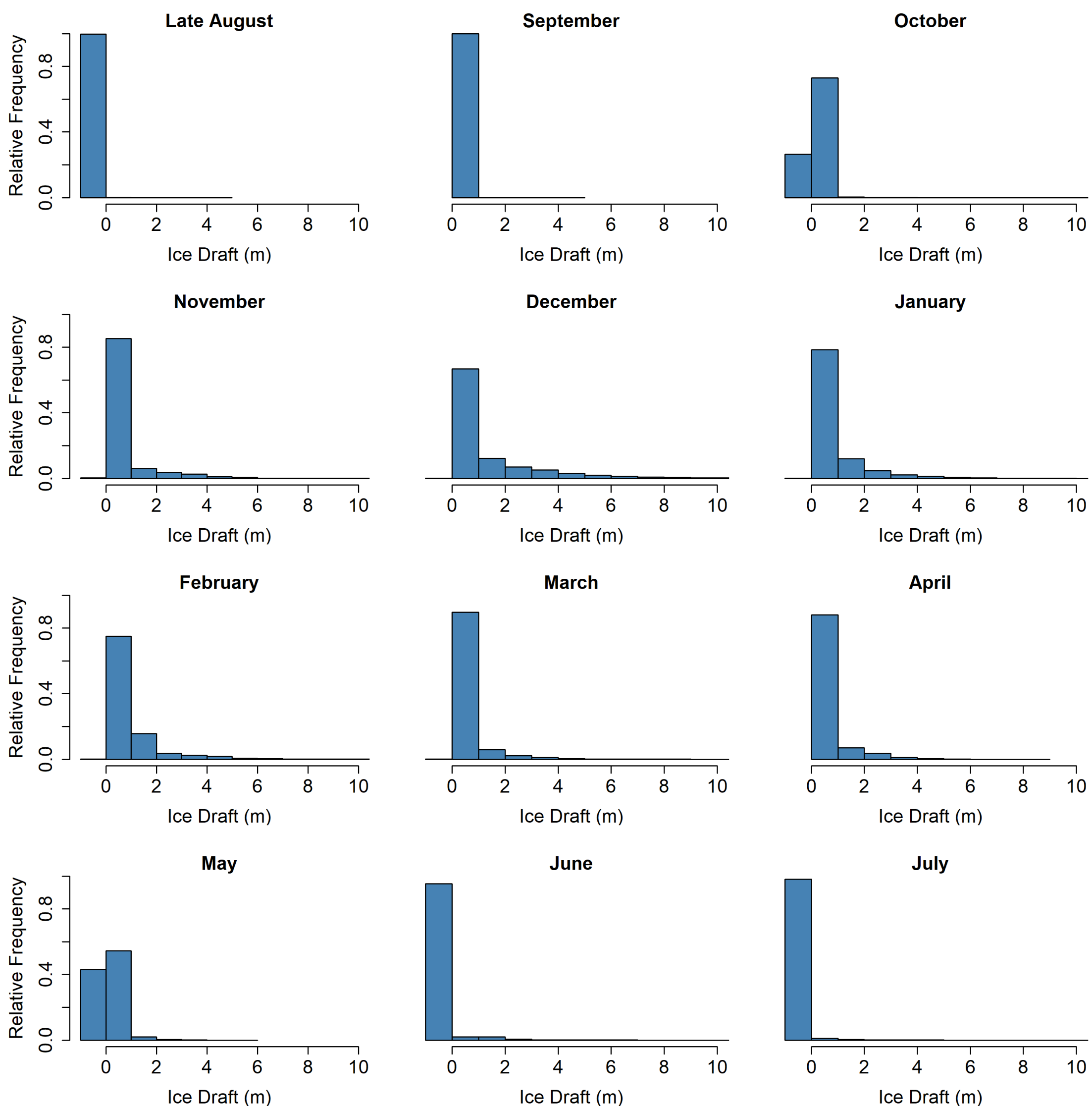

Figure 64: Monthly histograms of ice draft, Late August 2014 - July 2015. Anything left of 0 is indicative of open water.

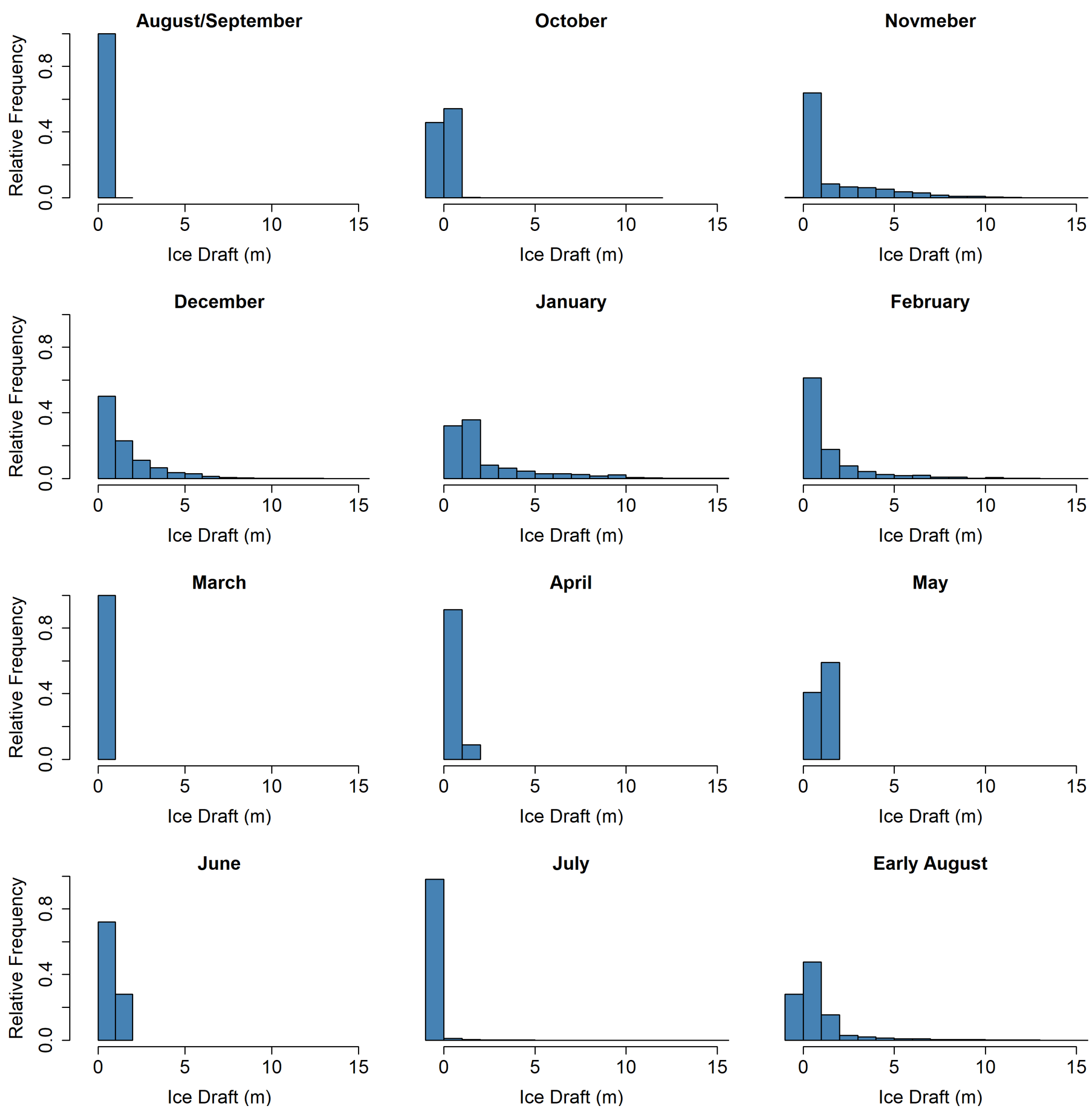

Figure 65: Monthly histograms of ice draft, August 2015 - Early August 2016. Anything left of 0 is indicative of open water.

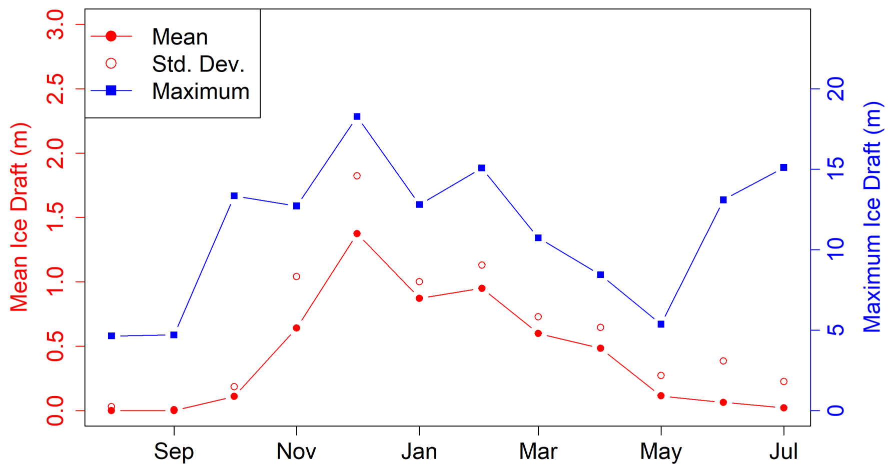

Figure 66: Ice draft statistics from Ice Profiling Sonar, Late August 2014 - July 2015.

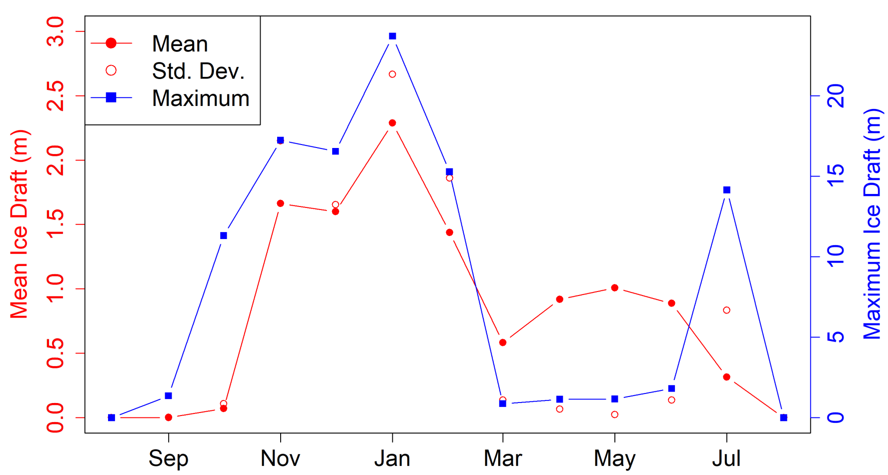

Figure 67: Ice draft statistics from Ice Profiling Sonar, August 2015 - Early August 2016.

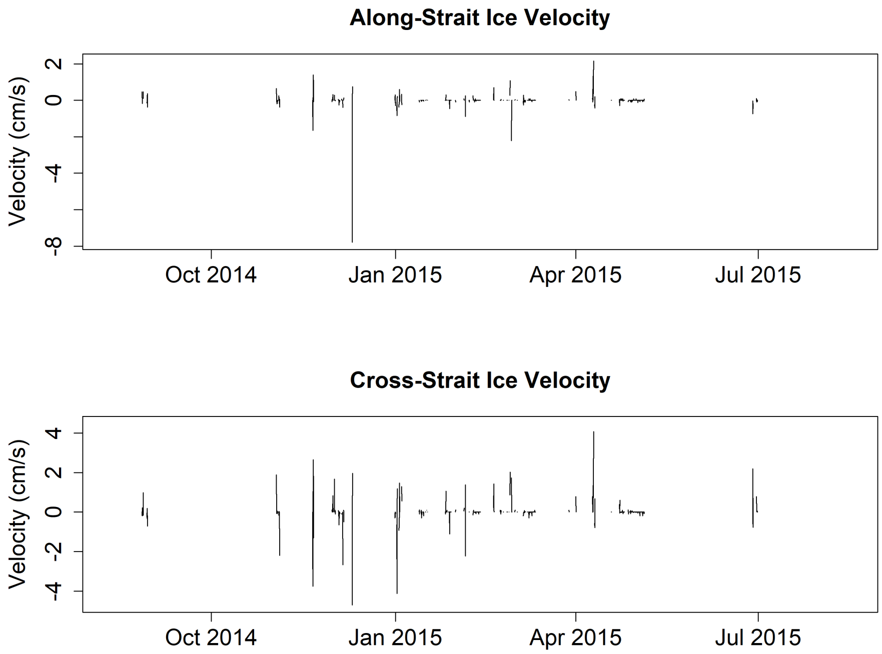

Figure 68: Ice velocity, August 2014 - July 2015.

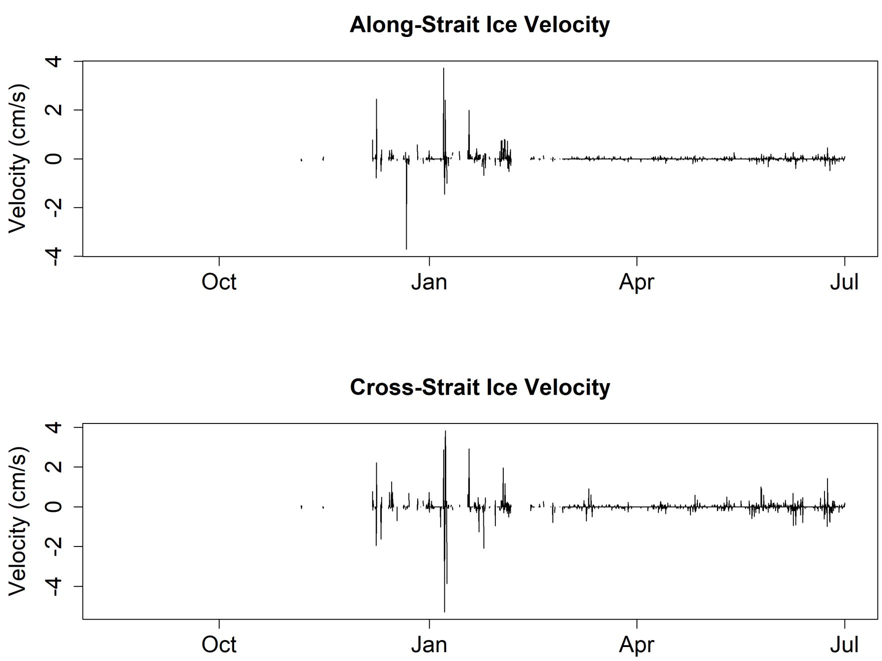

Figure 69: Ice velocity, August 2015 - Early August 2016.

Table 1: Mooring and Instrument Summary, 2011-2016.

Year	Mooring Number	Instrument Type	Serial Number	Moored Depth (m)	Sounding (m)	Latitude (°N)	Longitude (°W)	Start Date	End Date	Sample Int. (sec)
2011	1801	CTD	361	121	122	74.6244	-91.2996	2011-08-09	2012-09-01	3600
2011	1802	CTD	374	63	135	74.623	-91.2976	2011-08-10	2012-08-30	7200
2011	1802	CTD	287	43	135	74.623	-91.2976	2011-08-10	2012-08-30	3600
2011	1802	ADCP	499	61	135	74.623	-91.2976	2011-08-10	2011-08-16	7200
2011	1802	PoCo	144	61	135	74.623	-91.2976	NA	NA	7200
2012	1825	CTD	864	156	151	74.608	-91.2498	2012-09-03	2014-08-10	3600
2012	1826	CTD	861	82	163	74.6061	-91.2436	2012-09-03	2014-08-08	3600
2012	1826	CTD	720	41	163	74.6061	-91.2436	2012-09-03	2014-08-08	7200
2012	1826	ADCP	1266	31	163	74.6061	-91.2436	2012-09-03	2012-09-12	7200
2012	1826	PoCo	146	31	163	74.6061	-91.2436	NA	NA	7200
2014	1877	CTD	7375	156	NA	74.6044	-91.2453	2014-08-10	2016-08-09	7200
2014	1878	CTD	11719	81	154	74.6045	-91.2564	2014-08-12	2016-08-08	7200
2014	1878	CTD-ODO	10513	47	154	74.6045	-91.2564	2014-08-12	2016-08-08	7200
2014	1878	ADCP	2456	40	154	74.6045	-91.2564	2014-08-12	2016-07-02	7200
2014	1878	PoCo	145	40	154	74.6045	-91.2564	NA	NA	7200
2014	1879	CTD-ODO	10514	35	151	74.6022	-91.2367	2014-08-12	2016-08-08	7200
2014	1879	IPS	51061	40	151	74.6022	-91.2367	2014-08-12	2016-08-08	3

Table 2: Microcat CTD statistical summary, 2011-2012.

Depth (m)	**Temperature (°C)**				**Salinity ()**				**Density (kg/m^3)**			
CTD	Avg	SD	Min	Max	Avg	SD	Min	Max	Avg	SD	Min	Max
Annual												
41	-1.23	1.01	-1.78	5.35	32.18	0.41	29.95	32.9	25.87	0.36	23.94	26.47
61	-1.39	0.56	-1.77	3.18	32.34	0.32	31.1	32.94	26.01	0.27	24.99	26.49
155	-1.29	0.21	-1.77	0.89	32.68	0.24	31.47	33.47	26.28	0.2	25.22	26.91
Fall (August - December)												
41	-0.55	1.35	-1.77	5.35	31.79	0.37	30.86	32.77	25.52	0.32	24.47	26.33
61	-0.94	0.7	-1.77	3.18	32.08	0.39	31.1	32.88	25.78	0.33	24.99	26.44
155	-1.21	0.25	-1.73	0.89	32.67	0.28	31.47	33.47	26.27	0.23	25.22	26.91
Winter/Spring (January - June)												
41	-1.74	0.03	-1.78	-1.55	32.45	0.08	32.18	32.66	26.11	0.07	25.89	26.27
61	-1.72	0.05	-1.77	-1.4	32.48	0.08	32.2	32.75	26.13	0.07	25.9	26.35
155	-1.37	0.17	-1.77	-1	32.7	0.12	32.21	33.05	26.3	0.1	25.91	26.58

Table 3: Microcat CTD statistical summary, 2012-2013.

Depth (m)	**Temperature (°C)**				**Salinity ()**				**Density (kg/m^3)**			
CTD	Avg	SD	Min	Max	Avg	SD	Min	Max	Avg	SD	Min	Max
Annual												
41	-1.37	0.4	-1.75	0.92	31.99	0.37	30.18	32.69	25.72	0.31	24.17	26.29
82	-1.24	0.12	-1.72	-0.18	32.65	0.23	31.55	33.18	26.25	0.19	25.35	26.68
156	-0.93	0.19	-1.35	-0.26	33.23	0.18	32.32	33.65	26.71	0.14	25.99	27.03
Fall (August - December)												
41	-1.03	0.5	-1.71	0.92	31.69	0.38	30.18	32.5	25.47	0.32	24.17	26.14
82	-1.2	0.13	-1.49	-0.18	32.45	0.2	31.55	33.03	26.09	0.16	25.35	26.56
156	-0.97	0.17	-1.35	-0.48	33.17	0.23	32.32	33.63	26.67	0.18	25.99	27.0
Winter/Spring (January - June)												
41	-1.59	0.12	-1.75	-1.2	32.1	0.24	31.55	32.63	25.82	0.2	25.38	26.24
82	-1.26	0.13	-1.72	-0.9	32.73	0.17	32.2	33.18	26.32	0.14	25.89	26.68
156	-0.92	0.18	-1.25	-0.28	33.25	0.13	32.77	33.61	26.73	0.1	26.35	26.99

Table 4: Microcat CTD statistical summary, 2013-2014.

Depth (m)	**Temperature (°C)**				**Salinity ()**				**Density (kg/m^3)**			
CTD	Avg	SD	Min	Max	Avg	SD	Min	Max	Avg	SD	Min	Max
Annual												
41	-1.5	0.25	-1.78	0.34	32.31	0.3	31.38	32.94	25.99	0.25	25.24	26.5
82	-1.33	0.14	-1.76	-0.86	32.76	0.23	31.8	33.26	26.35	0.19	25.57	26.75
156	-0.99	0.18	-1.48	-0.4	33.2	0.16	32.42	33.6	26.7	0.13	26.06	27
Fall (August - December)												
41	-1.39	0.29	-1.77	-0.28	32.13	0.31	31.38	32.75	25.84	0.25	25.24	26.34
82	-1.23	0.11	-1.73	-0.86	32.56	0.21	31.8	33.1	26.18	0.17	25.57	26.62
156	-0.96	0.17	-1.25	-0.4	33.13	0.21	32.42	33.6	26.63	0.17	26.06	27
Winter/Spring (January - June)												
41	-1.63	0.09	-1.78	-1.36	32.48	0.21	31.78	32.94	26.13	0.17	25.56	26.5
82	-1.39	0.12	-1.76	-1.08	32.9	0.14	32.51	33.26	26.46	0.11	26.15	26.75
156	-1.03	0.19	-1.48	-0.46	33.24	0.1	32.79	33.54	26.73	0.08	26.38	26.95

Table 5: Microcat CTD statistical summary, 2014-2015.

Depth (m)	**Temperature (°C)**				**Salinity ()**				**Density (kg/m^3)**				**Oxygen (ml/l)**			
CTD	Avg	SD	Min	Max	Avg	SD	Min	Max	Avg	SD	Min	Max	Avg	SD	Min	Max
Annual																
35	-1.16	1	-1.81	3.67	32.35	0.47	31.05	33.04	26.01	0.41	24.67	26.59	7.23	0.56	5.96	9.41
47	-1.28	0.72	-1.8	3.35	32.5	0.39	31.19	33.04	26.13	0.34	24.82	26.59	7	0.47	5.8	9.1
81	-1.41	0.2	-1.8	-0.24	32.79	0.21	31.76	33.45	26.37	0.17	25.54	26.9	-	-	-	-
156	-0.99	0.21	-1.69	-0.07	33.29	0.2	32.57	33.79	26.77	0.15	26.19	27.13	-	-	-	-
Fall (August - December)																
35	-1.37	0.29	-1.77	0.04	32.07	0.32	31.08	32.66	25.79	0.26	24.99	26.27	7.35	0.33	6.46	8.63
47	-1.32	0.26	-1.77	-0.13	32.25	0.28	31.33	32.72	25.94	0.23	25.17	26.32	7.03	0.33	6.38	8.08
81	-1.28	0.11	-1.56	-0.83	32.61	0.18	31.76	33.05	26.22	0.15	25.54	26.58	-	-	-	-
156	-0.96	0.19	-1.36	-0.41	33.23	0.23	32.57	33.66	26.72	0.18	26.19	27.05	-	-	-	-
Winter/Spring (January - June)																
35	-1.58	0.33	-1.81	0.95	32.73	0.21	31.81	33.04	26.33	0.18	25.53	26.59	6.94	0.49	5.96	9.41
47	-1.61	0.2	-1.8	0.28	32.79	0.16	31.97	33.04	26.38	0.13	25.65	26.59	6.81	0.34	5.8	9.1
81	-1.55	0.16	-1.8	-0.93	32.92	0.13	32.63	33.45	26.48	0.1	26.25	26.9	-	-	-	-
156	-1.03	0.23	-1.69	-0.07	33.34	0.17	32.66	33.79	26.81	0.13	26.27	27.13	-	-	-	-

Table 6: Microcat CTD statistical summary, 2015-2016.

Depth (m)	**Temperature (°C)**				**Salinity ()**				**Density (kg/m^3)**				**Oxygen (ml/l)**			
CTD	Avg	SD	Min	Max	Avg	SD	Min	Max	Avg	SD	Min	Max	Avg	SD	Min	Max
Annual																
35	-1.22	0.83	-1.79	2.57	32.3	0.4	30.61	33.03	25.97	0.35	24.48	26.57	7.37	0.47	6.13	8.72
47	-1.33	0.51	-1.78	1.62	32.53	0.31	30.72	33.01	26.16	0.26	24.57	26.56	6.97	0.45	5.99	8.66
81	-1.29	0.15	-1.79	-0.72	32.94	0.22	31.97	33.43	26.49	0.18	25.71	26.89	-	-	-	-
156	-0.9	0.2	-1.33	-0.3	33.28	0.19	32.56	33.68	26.75	0.15	26.18	27.05	-	-	-	-
Fall (August - December)																
35	-0.85	0.88	-1.75	2.57	32.12	0.32	30.62	32.8	25.81	0.27	24.58	26.38	7.37	0.37	6.37	8.48
47	-1.07	0.47	-1.74	0.75	32.39	0.26	31.11	32.91	26.04	0.21	24.97	26.47	6.92	0.4	5.99	7.86
81	-1.21	0.14	-1.73	-0.72	32.78	0.24	31.97	33.22	26.36	0.19	25.71	26.71	-	-	-	-
156	-0.9	0.2	-1.33	-0.34	33.18	0.21	32.56	33.61	26.67	0.16	26.18	27	-	-	-	-
Winter/Spring (January - June)																
35	-1.69	0.1	-1.79	-1.19	32.52	0.15	32.08	32.91	26.16	0.12	25.81	26.47	7.32	0.49	6.13	8.54
47	-1.62	0.13	-1.78	-1.14	32.67	0.15	32.22	32.99	26.28	0.12	25.92	26.54	6.96	0.45	5.99	8.26
81	-1.34	0.15	-1.79	-0.98	33.03	0.14	32.63	33.43	26.57	0.11	26.25	26.89	-	-	-	-
156	-0.89	0.21	-1.27	-0.3	33.35	0.13	32.78	33.68	26.81	0.1	26.36	27.05	-	-	-	-

Table 7: Major axis of each tidal constituent for ice-free and solid ice periods, 2014-2016.

	Depth	M2	S2	K1	O1	P1
2014, ice-free (August 12 2014 - September 27 2014)	8	0.17	0.07	0.16	0.08	0.01
	12	0.17	0.07	0.15	0.09	0.02
	16	0.17	0.06	0.15	0.08	0.02
	20	0.16	0.06	0.14	0.08	0.01
	24	0.15	0.06	0.14	0.08	0.01
	28	0.14	0.06	0.13	0.07	0.01
	32	0.14	0.06	0.13	0.07	0.01
	36	0.14	0.06	0.12	0.07	0.01
	40	0.14	0.06	0.12	0.07	0.01
2015, ice-free (July 15 2015 - September 27 2015)	8	0.16	0.06	0.16	0.08	0.01
	12	0.16	0.06	0.15	0.08	0.01
	16	0.16	0.06	0.15	0.07	0.01
	20	0.15	0.06	0.15	0.07	0.01
	24	0.15	0.06	0.15	0.07	0.01
	28	0.15	0.06	0.15	0.08	0
	32	0.15	0.06	0.15	0.08	0
	36	0.15	0.06	0.15	0.07	0
	40	0.14	0.06	0.15	0.08	0.01
2015, solid ice (March 1 2016 - June 1 2016)	8	0.11	0.04	0.11	0.06	0
	12	0.11	0.05	0.12	0.06	0
	16	0.12	0.05	0.12	0.06	0
	20	0.13	0.05	0.12	0.06	0
	24	0.13	0.05	0.12	0.06	0
	28	0.14	0.06	0.12	0.07	0.01
	32	0.14	0.06	0.12	0.07	0.01
	36	0.14	0.06	0.12	0.07	0.01
	40	0.14	0.06	0.12	0.07	0

Table 8: Minor axis of each tidal constituent for ice-free and solid ice periods, 2014-2016.

	Depth	M2	S2	K1	O1	P1
2014, ice-free (August 12 2014 - September 27 2014)	8	0	0	0	0	0
	12	0	0	0	0	0
	16	0	0	0	-0.01	0
	20	0	0	0	-0.01	0
	24	0	0	0	0	0
	28	0	-0.01	0	0	0
	32	0.01	0	0	0	-0.01
	36	0	0	0	0	-0.01
	40	0.01	0	-0.01	0	0
2015, ice-free (July 15 2015 - September 27 2015)	8	0	0	-0.01	-0.01	0
	12	0	-0.01	-0.01	0	0.01
	16	0	0	0	0	0
	20	0	0	0	0	0
	24	0.01	0	0	0	0
	28	0.01	0	0	0	0
	32	0.01	0	0	0	0
	36	0.01	0	0	0	0
	40	0.01	0	0	0	0
2015, solid ice (March 1 2016 - June 1 2016)	8	0.02	0.01	0	0	0
	12	0.02	0.01	0	0	0
	16	0.02	0.01	0	0	0
	20	0.01	0	0	0	0
	24	0.01	0	0	0	0
	28	0	0	-0.01	0	0
	32	0	0	-0.01	0	0
	36	0	0	-0.01	0	0
	40	0	0	-0.01	-0.01	0

Table 9: Orientation of each tidal constituent for ice-free and solid ice periods, 2014-2016.

	Depth	M2	S2	K1	O1	P1
2014, ice-free (August 12 2014 - September 27 2014)	8	176.81	178.96	179.14	175.38	204.81
	12	180.89	179.2	180.8	178.96	210.32
	16	182.2	181.3	179.41	179.44	187.92
	20	181.26	181.96	177.97	179.41	181.24
	24	181.11	179.65	179.26	178.96	174.96
	28	181.11	175.67	177.33	175.04	196.82
	32	178.42	172.43	176.26	171.69	201.09
	36	176.81	169.39	178.49	171.16	198.71
	40	177.31	167.12	178.27	174.74	209.19
2015, ice-free (July 15 2015 - September 27 2015)	8	183.36	191.95	179.33	181.8	122.08
	12	182.86	189.6	1.35	181.83	123.52
	16	181.5	189.23	1.43	181.6	125.86
	20	179.54	187.92	0.58	180.08	128.16
	24	177.03	186.96	179.84	180.8	131.72
	28	176.49	183.38	178.86	179.26	209.92
	32	176.86	181.15	177.45	177.32	194.95
	36	175.4	179.12	177.41	176.29	164.39
	40	175.07	176.36	177.66	175.14	146.87
2015, solid ice (March 1 2016 - June 1 2016)	8	183.53	171.27	181.39	184.41	184.78
	12	182.4	174.24	181.61	182.26	180.88
	16	181.2	174.92	180.82	180.74	221.14
	20	180.1	177.28	180.16	177.76	211.85
	24	179.16	178.61	179.04	176.23	191.38
	28	179.44	180.28	178.87	176.8	183.46
	32	179.23	182.83	178.18	177.12	176.82
	36	178.2	183.12	178.02	176.87	184.99
	40	177.66	183.71	176.93	176.76	185.68

Table 10: Phase of each tidal constituent for ice-free and solid ice periods, 2014-2016.

	Depth	M2	S2	K1	O1	P1
2014, ice-free (August 12 2014 - September 27 2014)	8	191.06	242.26	340.48	278.19	184.08
	12	192.44	239.1	339.77	277.02	219.06
	16	191.97	235.42	340.23	277	230.05
	20	192.75	238.21	343.98	277.76	224.03
	24	192.42	235.3	345.63	281.99	213.91
	28	189.58	232.28	345.13	284.02	256.39
	32	187.45	228.15	345.53	284.09	262.59
	36	187.62	225.9	347.86	287.13	267.41
	40	188.33	224.36	351.31	288.46	281.95
2015, ice-free (July 15 2015 - September 27 2015)	8	194.83	256.93	347.1	263.2	283.84
	12	194.39	250.84	167.3	265.34	290.61
	16	192.88	250.42	166.43	269.92	311.21
	20	191.64	250.62	166.45	271.8	331.6
	24	189.25	248.99	346.06	274.04	316.65
	28	187.37	245.65	345.29	274.9	231.47
	32	187.09	245	347	274.36	276.16
	36	186.14	244.25	347.7	273.92	310.6
	40	185.71	241.75	348.15	274.75	185.01
2015, solid ice (March 1 2016 - June 1 2016)	8	188.03	223.22	317.76	276.53	157.4
	12	187.43	220.43	317.56	276.85	162.16
	16	187.56	222.45	317.06	274.94	201.03
	20	187.13	225.95	316.92	274.41	194.56
	24	187.82	231.54	316.44	273.35	189.46
	28	187.92	233.53	315.28	273.89	189.41
	32	187.87	233.84	314.21	274.06	188.17
	36	187.03	234.13	313.02	272.65	174.82
	40	185.69	232.29	311.56	271.26	199.59

Table 11: Ice Draft Monthly Statistics: August 12 2014 - August 2016.

		Ice Draft (m)		
Year	**Month**	**Mean**	**Maximum**	**Std. Dev**
2014	Late August (> Aug 12)	0.00	4.64	0.03
	September	0.00	4.70	0.01
	October	0.11	13.34	0.19
	November	0.64	12.72	1.04
	December	1.37	18.27	1.82
2015	January	0.87	12.80	1.00
	February	0.95	15.07	1.13
	March	0.60	10.73	0.73
	April	0.49	8.44	0.65
	May	0.12	5.37	0.27
	June	0.06	13.09	0.38
	July	0.02	15.10	0.23
	August	0.00	0.00	0.00
	September	0.00	1.36	0.00
	October	0.07	11.31	0.11
	November	1.66	17.23	2.15
	December	1.60	16.54	1.65
2016	January	2.29	23.69	2.67
	February	1.44	15.27	1.86
	March	0.58	0.87	0.14
	April	0.92	1.15	0.07
	May	1.01	1.16	0.02
	June	0.89	1.29	0.14
	July	0.02	15.10	0.23
	Early August (< Aug 8)	0.00	0.00	0.00

Table 12: Ice Draft Percent Frequency by Month (August 2014 - July 2015).

	2014					**2015**						
Ice Draft (m)	Late August	September	October	November	December	January	February	March	April	May	June	July
Open Water	99.73	100	25.2	0	0	0	0	0	0	41.16	95.36	98.22
0.0-0.5	0.2	0	71.76	73.9	40.7	41.67	40.28	57.7	80.16	53.62	0.73	0.27
0.5-1.0	0.03	0	1.11	11.48	26.16	36.79	34.73	32.06	7.9	1.1	1.13	0.76
1.0-1.5	0.01	0	0.29	3.56	7.82	7.54	10.46	3.87	4.4	1.06	1.23	0.3
1.5-2.0	0	0	0.15	2.59	4.47	4.52	5.25	2.08	2.52	0.84	0.69	0.14
2.0-2.5	0	0	0.1	1.75	3.41	2.66	1.9	1.38	2.56	0.19	0.33	0.1
2.5-3.0	0	0	0.05	1.7	3.59	2	1.59	0.91	0.99	0.1	0.2	0.08
3.0-3.5	0	0	0.03	1.7	3.09	1.31	1.44	0.56	0.7	0.06	0.12	0.05
3.5-4.0	0	0	0.01	0.86	2	0.86	1.06	0.41	0.39	0.02	0.06	0.02
4.0-4.5	0	0	0	0.6	2.02	0.66	1.26	0.28	0.21	0	0.04	0.01
4.5-5.0	0	0	0	0.46	1.18	0.57	0.45	0.18	0.09	0	0.02	0.01
5.0-5.5	0	0	0	0.3	1.03	0.38	0.34	0.13	0.04	0	0.02	0
5.5-6.0	0	0	0	0.17	0.88	0.28	0.28	0.11	0.02	0	0.01	0.01
6.0-6.5	0	0	0	0.16	0.7	0.15	0.23	0.09	0.01	0	0.01	0
6.5-7.0	0	0	0	0.08	0.6	0.11	0.14	0.07	0.01	0	0.01	0
7.0-7.5	0	0	0	0.05	0.45	0.09	0.12	0.04	0	0	0.01	0
7.5-8.0	0	0	0	0.03	0.39	0.06	0.08	0.03	0	0	0.01	0
8.0-8.5	0	0	0	0.02	0.3	0.05	0.08	0.03	0	0	0	0
8.5-9.0	0	0	0	0.05	0.23	0.03	0.05	0.03	0	0	0	0
9.0-9.5	0	0	0	0.03	0.19	0.02	0.06	0	0	0	0	0
9.5-10.0	0	0	0	0.02	0.18	0.02	0.07	0	0	0	0	0
>10.0	0	0	0	0.12	0.56	0.02	0.11	0	0	0	0.01	0
Missing	0	0	0	0	0	0	0	0	0	0	0	0

Table 13: Ice Draft Percent Frequency by Month (August 2015 - August 2016).

	2015					**2016**							
Ice Draft (m)	August	September	October	November	December	January	February	March	April	May	June	July	Early August
Open Water	100	100	43.2	0	0	0	0	0	0	0	0	98.22	100
0.0-0.5	0	0	53.74	43.43	23.34	20.45	34.36	29.5	0	0	0.01	0.27	0
0.5-1.0	0	0	0.29	20.5	26.87	11.74	27.04	70.5	91.39	40.9	71.89	0.76	0
1.0-1.5	0	0	0.08	4.64	15.7	29.53	11.11	0	8.61	59.1	28.1	0.3	0
1.5-2.0	0	0	0.03	3.71	7.37	6.13	6.65	0	0	0	0	0.14	0
2.0-2.5	0	0	0.01	3.33	6.71	4.63	4.34	0	0	0	0	0.1	0
2.5-3.0	0	0	0	3.2	4.45	3.45	3.33	0	0	0	0	0.08	0
3.0-3.5	0	0	0	2.98	3.2	3.41	2.48	0	0	0	0	0.05	0
3.5-4.0	0	0	0	3.03	3.33	2.79	1.82	0	0	0	0	0.02	0
4.0-4.5	0	0	0	2.79	1.96	2.22	1.35	0	0	0	0	0.01	0
4.5-5.0	0	0	0	2.41	1.58	2.22	1.16	0	0	0	0	0.01	0
5.0-5.5	0	0	0	1.96	1.56	1.43	0.96	0	0	0	0	0	0
5.5-6.0	0	0	0	1.59	1.22	1.54	0.88	0	0	0	0	0.01	0
6.0-6.5	0	0	0	1.38	0.79	1.52	1.23	0	0	0	0	0	0
6.5-7.0	0	0	0	1.49	0.51	1.27	0.72	0	0	0	0	0	0
7.0-7.5	0	0	0	0.86	0.37	1.33	0.32	0	0	0	0	0	0
7.5-8.0	0	0	0	0.62	0.27	0.99	0.44	0	0	0	0	0	0
8.0-8.5	0	0	0	0.43	0.18	0.67	0.55	0	0	0	0	0	0
8.5-9.0	0	0	0	0.46	0.14	0.89	0.28	0	0	0	0	0	0
9.0-9.5	0	0	0	0.54	0.12	1.58	0.1	0	0	0	0	0	0
9.5-10.0	0	0	0	0.29	0.09	0.67	0.08	0	0	0	0	0	0
> 10.0	0	0	0	0.32	0.26	1.54	0.81	0	0	0	0	0	0
Missing	0	0	0	0	0	0	0	0	0	0	0	0	0