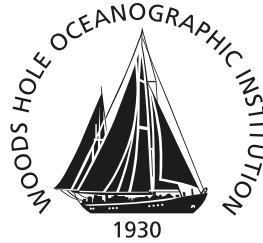


WHOI-2018-01

Woods Hole Oceanographic Institution



Pathways for the Export of Arctic Change into the North Atlantic

August 2008 - September 2009 Data Report

by

Andrée L. Ramsey and Fiamma Straneo

January 2018

Technical Report

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Abstract

The goal of the **Pathways for the Export of Arctic Change into the North Atlantic** project was to measure the exchange between the Hudson Bay System and the Labrador Sea, which occurs in the Hudson Strait. This exchange is of climactic relevance since a large amount of fresh water flows through the Hudson Strait into the Labrador Sea, where it can modulate the exchange of heat with the atmosphere. It is also of regional importance since the exchange influences the climate of Hudson Bay, which is home to a large indigenous population. The project consisted of deploying four subsurface moorings, over a one-year period, beginning August 2008 and ending September 2009. The moorings were positioned across the strait with Mooring A located on the south side and Moorings E, F, and G on the north side. The moorings were equipped with instruments to measure conductivity, temperature, pressure, ice draft and velocity. The National Science Foundation Grant Number OCE-0751554 provided funding for the project.

I. Introduction

This report describes the data collected for the **Pathways for the Export of Arctic Change into the North Atlantic** project. The Principal Investigators were Fiamma Straneo (Woods Hole Oceanographic Institution) and François J. Saucier (Fisheries and Oceans Canada). A brief synopsis of the cruise, mooring deployment, and instrumentation is provided below.

II. Mooring Deployment and Overview

Four subsurface moorings, A, E, F, and G, were deployed for a one-year period starting August 2008 and ending September 2009 in the Hudson Strait (Figure 1). The goal of the project was to measure the exchange between the Hudson Bay System and the Labrador Sea. The moorings were positioned across the strait with Mooring A located on the south side and Moorings E, F, and G on the north side. Mooring E was located near the center of the Strait, Mooring G was near the north shore, and Mooring F was in between the two locations.

The moorings were configured to measure conductivity, temperature, pressure, velocity, and ice draft. Below is a list of the type and total number of instruments deployed:

- (2) ASL Ice Profiler Systems ice draft
- (2) Nortek Aquadopps single-point current meter
- (2) Nortek Continentals profiling current meter
- (10) Onset HOBO TidbiTs temperature recorder
- (2) RBR XR-420s conductivity, temperature, pressure
- (3) RDI Acoustic Doppler Current Profilers profiling current meter
- (12) SBE MicroCATs conductivity, temperature, pressure

Detailed information regarding location, depth, dates, and instrumentation placement for each of the four moorings is listed in Tables 1 - 4. Schematic drawings for each mooring can be found in Appendix A.

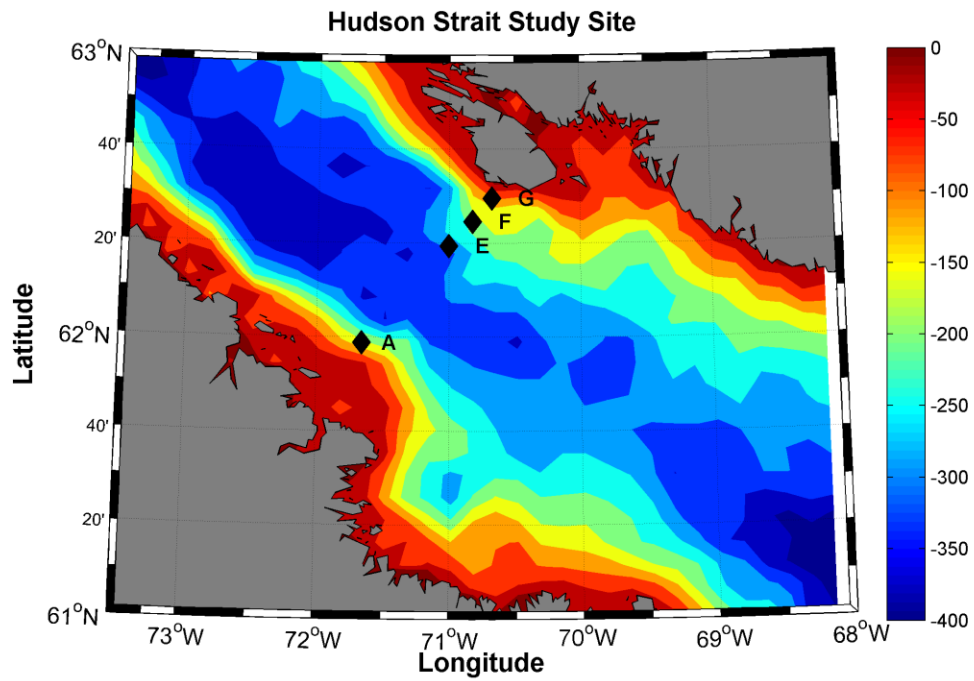
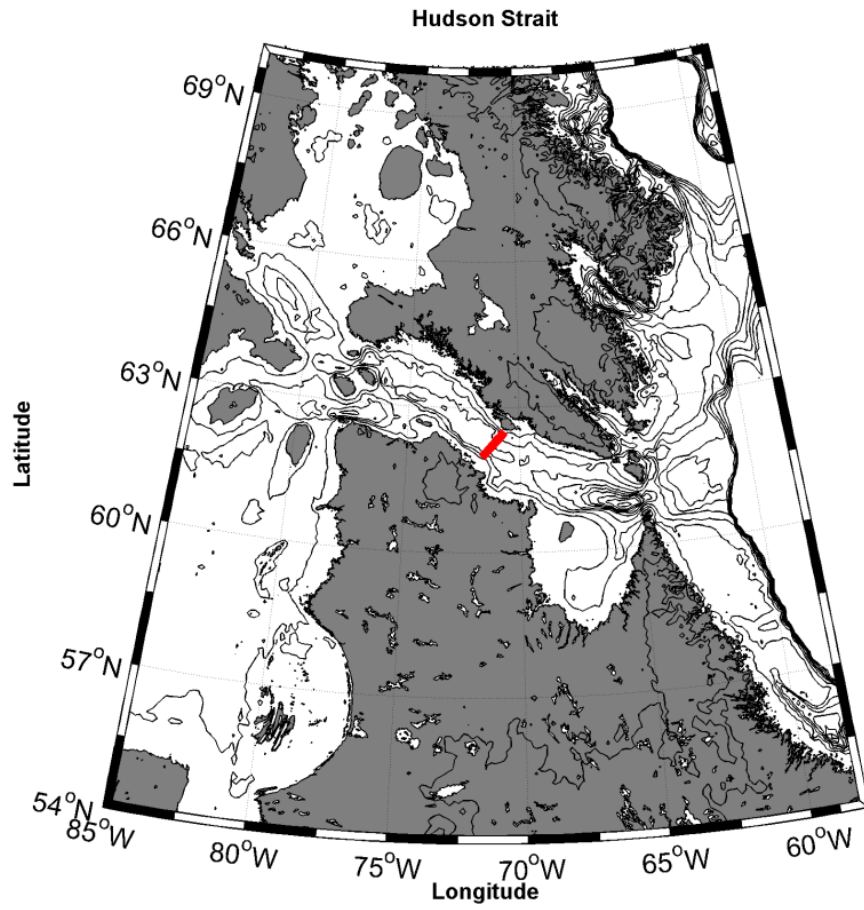


Figure 1: Hudson Strait with moorings in red (top) and close-up in black (bottom).

Mooring ID	Water Depth	Date Deployed	Date Recovered	Latitude	Longitude
Mooring A	186 m	Aug 26, 2008 11:55 UTC	Sep 24, 2009 18:29 UTC	61° 58.75 N 61.9792° N	71° 39.42 W 71.6570° W
<i>Instrument Type</i>	<i>Target Depth</i>	<i>Serial Number</i>	<i>Parameters</i>	<i>File</i>	
SBE-37 w/ press	25 m	5928	t, c, p, s	mcA-25.mat	
ASL Ice Profiler System	45 m	1023	ice draft	N/A	
SBE-37 w/press	45 m	5908	t, c, p, s	mcA-45.mat	
HOBO TidBit	75 m	2224699	t	hoboA-75.mat	
SBE-37	100 m	1648	t, c, s	mcA-100.mat	
HOBO TidBit	135 m	2038426	t	hoboA-135.mat	
RDI ADCP	160 m	10791	u, v, w	adcpA-160.mat	
SBE-37 w/press	160 m	5938	t, c, p, s	mcA-160.mat	

Table 1: Detailed description of Mooring A.

Mooring ID	Water Depth	Date Deployed	Date Recovered	Latitude	Longitude
Mooring E	345 m	Aug 26, 2008 1:36 UTC	Sep 24, 2009 15:10 UTC	62° 19.419 N 62.3236° N	70° 59.994 W 70.9999° W
<i>Instrument Type</i>	<i>Target Depth</i>	<i>Serial Number</i>	<i>Parameters</i>	<i>File</i>	
SBE-37 w/ press	40 m	5904	t, c, p, s	mcE-40.mat	
HOBO TidBit	80 m	2224705	t	hoboE-80.mat	
SBE-37	120 m	2047	t, c, s	mcE-120.mat	
HOBO TidBit	150 m	2038433	t	hoboE-150.mat	
Nortek ADCP	190 m	P20881-2	u, v, w	aqdpE-190.mat	
RBR XR-420	190 m	13214	t, c, p	No Data	
Nortek Aquadopp	300 m	2756	u, v, w	aqdE-300.mat	

Table 2: Detailed description of Mooring E.

Mooring ID	Water Depth	Date Deployed	Date Recovered	Latitude	Longitude
Mooring F	357 m	Aug 27, 2008 1:55 UTC	Sep 24, 2009 12:46 UTC	62° 24.5234 N 62.4087° N	70° 49.300 W 70.8217° W
<i>Instrument Type</i>	<i>Target Depth</i>	<i>Serial Number</i>	<i>Parameters</i>	<i>File</i>	
SBE-37 w/ press	25 m	5906	t, c, p, s	mcF-25.mat	
ASL Ice Profiler System	45 m	1024	ice draft	N/A	
SBE-37 w/press	45 m	5907	t, c, p, s	mcF-45.mat	
RDI ADCP	80 m	335269	u, v, w	adcpF-80.mat	
SBE-37	80 m	2045	t, c, s	mcF-80.mat	
HOBO TidBit	150 m	2038434	t	hoboF-150.mat	
HOBO TidBit	180 m	2038427	t	hoboF-180.mat	
HOBO TidBit	230 m	2038432	t	hoboF-230.mat	
HOBO TidBit	270 m	2038431	t	hoboF-270.mat	
RDI ADCP	320 m	1594	No Data	Flooded	
SBE-37 w/press	320 m	5926	t, c, p, s	mcF-320.mat	

Table 3: Detailed description of Mooring F.

Mooring ID	Water Depth	Date Deployed	Date Recovered	Latitude	Longitude
Mooring G	345 m	Aug 25, 2008 20:15 UTC	Sep 24, 2009 11:05 UTC	62° 29.476 N 62.4913° N	70° 40.262 W 70.6710° W
<i>Instrument Type</i>	<i>Target Depth</i>	<i>Serial Number</i>	<i>Parameters</i>	<i>File</i>	
SBE-37 w/ press	40 m	5905	t, c, p, s	mcG-40.mat	
HOBO TidBit	80 m	2224696	No Data	No Data	
SBE-37	120 m	3407	t, c, s	mcG-120.mat	
HOBO TidBit	150 m	2038425	No Data	No Data	
Nortek ADCP	190 m	P20870-12	u, v, w	aqdpG-190.mat	
RBR XR-420	190 m	13199	t, c, p	rbrG-190.mat	
Nortek Aquadopp	300 m	2771	u, v, w	aqdG-300.mat	

Table 4: Detailed description of Mooring G.

III. Mooring Configuration and Data Recovery

Deployment and recovery of the moorings for the Hudson Strait experiment were conducted from the *R/V Knorr*, cruise numbers KN 194-01 and KN 196-01. The moorings were positioned across the strait with Mooring A located on the south side and Moorings E, F, and G on the north side. Mooring E was located near the center of the Strait, Mooring G was near the north shore, and Mooring F was in between the two locations. Mooring A was the shallowest at 186 meters. Moorings E, F, and G were all similar in depth at 345 meters, 357 meters, and 345 meters, respectively. The distances between the moorings are listed in Table 5.

<i>Moorings</i>	<i>Distance</i>
A to E	51 km
E to F	13 km
F to G	12 km
A to G	76 km

Table 5: Distance between the Moorings.

A. Mooring A

Mooring A was deployed on August 26, 2008 at a depth of 186 meters. It was recovered on September 24, 2009. The instrumentation included two Onset HOBO TidbiTs, one RDI ADCP, four SBE MicroCATs and one ALS Ice Profiler System.

SBE MicroCAT w/pressure The SBE MicroCAT S/N 5928 was attached to an aluminum pole at a depth of 25 meters. The SBE MicroCAT measured conductivity (c), temperature (t), and pressure (p). It recorded data from August 15, 2008 to September 25, 2009 with a sample interval of 15 minutes. Upon recovery, the clock was fast by 1 minute and 43 seconds. The data record for this instrument is extremely noisy, which is most likely due to blow down events when the aluminum pole might be ‘swimming’ in the current. These data were not corrected. The data return was 100%.

ALS Ice Profiler System The IPS S/N 1023 positioned in sphere alongside SBE MicroCAT S/N 5908. The unit was programmed to send a ping every two seconds and record pressure every 20 seconds. During the pre-deployment tests, this unit failed some of the tests but was deployed anyway. The data have not been processed.

SBE MicroCAT w/pressure The SBE MicroCAT S/N 5908 was located at a depth of 45 meters and attached to a sphere that contained the ULS. The instrument was programmed to record samples at 15-minute intervals beginning on August 15, 2008 and ending on September 25, 2009. The first attempt to upload the data indicated errors and only

returned 92% of the data. The second attempt to upload the data was successful, with no errors and 100% of the data recovered. The internal clock was 9 minutes and 6 seconds slow. The SBE MicroCat measured conductivity (c), temperature (t), and pressure (p).

HOBO TidbiT The HOBO TidbiT S/N 2224699 was located at a depth of 75 meters and was programmed to record samples at 15-minute intervals. The TidbiT started recording on August 21, 2008 and ended on September 26, 2009. Upon recovery, the TidbiT was 1 minute and 10 seconds fast and the data return was 100%.

SBE MicroCAT The SBE MicroCAT S/N 1648 was located at a depth of 100 meters. The instrument was programmed to record samples at 15-minute intervals starting on August 19, 2008 and ending on September 26, 2009. Upon recovery, the internal clock was 2 minutes and 7 seconds fast. This SBE MicroCAT measured conductivity (c) and temperature (t). The data return was 100%.

HOBO TidbiT The HOBO TidbiT S/N 2038426 was located at a depth of 135 meters and was programmed to record samples every 15 minutes. The first sample was on August 21, 2008 and the last sample was on September 26, 2009. The TidbiT was clock 39 seconds faster than the ship's clock and the data return was 100%.

RDI ADCP The 75 kHz Long Ranger RDI ADCP S/N 10791 was positioned at a depth of 160 meters. The bin size was programmed to be 10 meters with the first bin 18.89 meters above the transducer. The instrument was programmed to record data at 60-minute intervals, with 30 pings per ensemble. The average ensemble interval was 00:23:04.62 with a time per ping of 00:04.51. The velocity was recorded in ENU coordinates. The first ensemble was recorded on August 10, 2008 and the last ensemble was on September 27, 2009. Upon recovery, the internal clock was 5 minutes 23 seconds slower than the ship's clock. The data show a layer of banding in the water column at a depth of approximately 45 meters. This is most likely due to signal interference with the sphere that was positioned above the RDI ADCP on the mooring. The data return was 100%.

SBE MicroCAT The SBE MicroCAT S/N 5938 was positioned at a depth of 160 meters and was located along side the RDI ADCP (S/N 10791). The instrument was equipped to measure conductivity (c), temperature (t), and pressure (p). The sample interval was set to 15-minutes beginning on August 15, 2008 and ending on September 25, 2009. Upon recovery, the internal clock was 5 minutes and 23 seconds slow. The data return was 100%.

B. Mooring E

Mooring E was deployed on August 26, 2008 in 345 meters of water. The mooring was recovered on September 24, 2009. The mooring included two SBE MicroCats, two Onset HOBO

TidbiTs, one Nortek Continental current profiler, one Nortek Aquadopp, and one RBR XR-420 CTD.

SBE MicroCAT w/pressure The SBE MicroCAT S/N 5904 was positioned below the sphere at a depth of 40 meters. The instrument was programmed to record samples every 15 minutes, starting on August 15, 2008 and ending on September 26, 2009. Upon recovery, the internal clock was 4 minutes and 51 seconds fast. The instrument was equipped to measure conductivity (c), temperature (t), and pressure (p). The data return was 100%.

HOBO TidbiT The HOBO TidbiT S/N 2224705 was located 80 meters below the surface and sampled at a 15-minute interval. The first sample was recorded on August 21, 2008 and the last sample was recorded on September 26, 2009. Upon recovery, the instrument's clock was four minutes slower than the ship's clock. The data return was 100%.

SBE MicroCAT The SBE MicroCAT S/N 2047 was located at a depth of 120 meters. This instrument measured conductivity (c) and temperature (t) only. The sample interval was set to 15 minutes, with the first sample on August 19, 2008 and the last sample on September 26, 2009. Upon recovery, the internal clock was 3 minutes and 39 seconds fast. The data return was 100%.

HOBO TidbiT The HOBO TidbiT S/N 2038433 was located at a depth of 150 meters and was programmed to sample at 15-minute intervals. The first sample was collected on August 21, 2008 and the last sample was collected on September 26, 2009. Upon recovery, the internal clock was 58 seconds slower than the ship's clock. The data return was 100%.

Nortek Continental The Nortek Continental current profiler (S/N P20881-2) was positioned at a depth 190 meters. For unknown reasons, this instrument stopped collecting data one month after being deployed.

RBR XR-420 CTD The RBR XR-420 CTD S/N 13214 was positioned at a depth of 190 meters, adjacent to the Nortek Continental Profiler S/N P20881-2. The pressure sensor on this instrument flooded during the deployment and no data was collected.

Nortek Aquadopp The Nortek Aquadopp S/N 2756 was positioned at a depth of 300 meters and collected velocity data in ENU coordinates. The instrument was programmed to collect data for 60 seconds every 20 minutes. The first sample was recorded on August 16, 2008 and the last measurement was on September 27, 2009. Upon recovery, the logger's internal clock was 4 minutes 32 seconds faster than the ship's clock. The data return was 100%.

C. Mooring F

Mooring F was deployed on August 27, 2008 and recovered on September 4, 2009. The mooring was located in 357 meters of water. Instrumentation included: four SBE MicroCATs, one ASL Ice Profiler System, two RDI ADCPs, and four Onset HOBO TidbiTs temperature loggers.

SBE MicroCAT w/pressure The SBE MicroCAT S/N 5906 was attached to an aluminum pole at a depth of 25 meters and was equipped to measure conductivity (c), temperature (t), and pressure (p). The instrument recorded data from August 15, 2008 to September 25, 2009 with a sample interval of 15 minutes. Upon recovery, the clock was slow by 1 minute and 13 seconds. The data record for this instrument is extremely noisy, which is most likely due to blow down events when the aluminum pole might be 'swimming' in the current. These data were not corrected.

ASL Ice Profiler System The IPS S/N 1024 was positioned in a sphere at a depth of 45 meters. It was located alongside the SBE MicroCAT S/N 5907. The unit was programmed to send a ping every two seconds and record pressure every 20 seconds.

SBE MicroCAT w/pressure The SBE MicroCAT S/N 5907 located at 45 meters depth and was attached to the sphere that contained the Upward Looking Sonar (S/N 1024). The instrument was programmed to record conductivity (c), temperature (t), and pressure (p) data at 15-minute intervals. The first sample was on August 15, 2008 and the last sample was on September 26, 2009. Upon recovery, the internal clock was 5 minutes and 42 seconds fast. The data return was 100%.

RDI ADCP The 300 kHz RDI ADCP S/N 335269 was located at a depth of 80 meters, adjacent to the SBE MicroCAT S/N 2045. The bin size was programmed to be four meters with the first bin 6.20 meters above the transducer. The instrument was programmed to record data at 60-minute intervals, with 120 pings per ensemble. The average ensemble interval was 00:59:60.00 and the time per ping was 00:05.00. The battery died on March 4, 2009 collecting data from August 10, 2008 until March 4, 2009. Upon recovery, the internal clock was 9 minutes 44 seconds slower than the ship's clock. The velocity was recorded in ENU coordinates. The data show a layer of banding in the water column at a depth of approximately 45 meters. This is most likely due to signal interference with the sphere that was positioned at the 45-meter depth position on the mooring.

SBE MicroCAT The SBE MicroCAT S/N 2045 was located adjacent to the RDI ADCP (S/N 335269) at a depth of 80 meters. The instrument was programmed to measure conductivity (c) and temperature (t) at 15-minute intervals. The first sample was on August 19, 2008 and the last sample was on September 25, 2009. Although transmission errors were encountered while downloading the data, the data does not appear to have any issues. The transmission errors were most likely due to erroneous values at the end of the data file, after

the instrument was recovered. Upon recovery, the internal clock was 1 minute and 51 seconds fast. The data return was 100%.

HOBO TidbiT The HOBO TidbiT S/N 2038434 was positioned at a depth of 150 meters and was programmed to record data every 15 minutes. The first sample was recorded on August 21, 2008 and the last sample was recorded on September 26, 2009. Upon recovery, the internal clock was 1 minute 22 seconds slower than the ship's clock. Data return was 100%.

HOBO TidbiT The HOBO TidbiT S/N 2038427 was positioned at a depth of 180 meters and was programmed to record data every 15 minutes. The first sample was collected on August 21, 2008 and the last sample was collected on September 26, 2009. Upon recovery, the internal clock was 2 minutes 53 seconds slower than the ship's clock. The data return was 100%.

HOBO TidbiT The HOBO TidbiT S/N 2038432 was positioned at a depth of 230 meters and was programmed to record samples every 15 minutes. The first sample was recorded on August 21, 2008 and the last sample was collected on September 26, 2009. Upon recovery, the internal clock was 2 minutes and 7 seconds slower than the ship's clock. The data return was 100%.

HOBO TidbiT The HOBO TidbiT S/N 2038431 was positioned at a depth of 275 meters and was programmed to record data at 15-minute intervals. The first sample was recorded on August 21, 2008 and the last sample was recorded on September 26, 2009. Upon recovery, the internal clock was 8 seconds faster than the ship's clock. The data return was 100%.

RDI ADCP The RDI ADCP S/N 1594 was positioned at a depth of 320 meters. No data was collected because of suspect firmware and incompatible software used to program the instrument.

SBE MicroCAT w/pressure The SBE MicroCAT S/N 5926 was positioned at a depth of 320 meters and was located adjacent to the RDI ADCP (S/N 1594). The instrument was programmed to measure conductivity (c), temperature (t) and pressure (p) at 15-minute intervals. The first sample was on August 15, 2008 and the last sample was on September 25, 2009. The first attempt at uploading the data produced gaps in the data most likely caused by corrupt firmware on the computer being used. A second download of the data was completed on another computer. The second download was successful. Upon recovery, the internal clock was 3 minutes and 32 seconds fast. The data return was 100%.

D. Mooring G

Mooring G was deployed on August 25, 2008 in 345 meters of water. It was recovered on September 24, 2009. Instrumentation included two SBE MicroCATs, two Onset HOBO TidbiTs, one Nortek Continental current profiler, one Nortek Aquadopp, and one RBR XR-420 CTD.

SBE MicroCAT w/pressure The SBE MicroCAT S/N 5905 was positioned at a depth of 40 meters. The instrument was programmed to record conductivity (c), temperature (t) and pressure (p) at 15-minute intervals. The instrument started recording data on August 15, 2008 and ended on September 26, 2009. Upon recovery, the internal clock was 5 minutes and 58 seconds slow. The data return was 100%.

HOBO TidbiT The HOBO TidbiT S/N 2224696 was located at a depth of 80 meters. Upon recovery, it was determined that the instrument was not working and therefore, no data was recovered from this instrument.

SBE MicroCAT The SBE MicroCAT S/N 3407 was positioned at a depth of 120 meters. The instrument was programmed to record conductivity (c) and temperature (t) at 15-minute intervals. The instrument started recording data on August 19, 2008 and ended on September 26, 2009. Upon recovery, the internal clock was 1 minute and 8 seconds fast. The data return was 100%.

HOBO TidbiT The HOBO TidbiT S/N 238425 was positioned at a depth of 150 meters. The instrument was missing when the mooring was recovered.

Nortek Continental The Nortek Continental current profiler (S/N P20870-12) was positioned at a depth 190 meters, adjacent to the RBR XR-420 CTD S/N 013199. The instrument was programmed to collect data for 60 seconds every 60 minutes. The depth bins were one-meter with a total of 20 bins. Velocity data was recorded in ENU coordinates. The instrument started collecting data on August 16, 2008 and ended on September 27, 2009. Upon recovery, the internal clock was 4 minutes 33 seconds faster than the ship's clock. The data return was 100%.

RBR XR-420 CTD The RBR XR-420 CTD S/N 013199 was positioned at a depth of 190 meters, adjacent to the Nortek Continental current profiler S/N P20870-12. The CTD was programmed to collect samples at a 15-minute interval, with the first sample collected on August 22, 2008 and the last sample collected on September 26, 2009. Upon recovery, the internal clock was 1 minute 51 seconds faster than the ship's time. The data return was 100%.

Nortek Aquadopp The Nortek Aquadopp (S/N 2771) was positioned at a depth of 300 meters and collected data in ENU coordinates. The instrument was programmed to collect data for 60 seconds every 20 minutes. The first sample was recorded on August 16,

2008 and the last measurement was on September 27, 2009. Upon recovery, the logger's internal clock was 3 minutes 46 seconds faster than the ship's clock. The data return was 100%.

IV. Data Processing

A. Data File Naming Conventions

A standard notation was used to name the processed data files. This naming convention identifies the instrument type, mooring name, and target depth for which the instrument was deployed. As an example, 'mCA-25' is the data file for an SBE-37 MicroCAT located on Mooring A at a target depth of 25 meters.

B. Magnetic Declination

The magnetic declination was applied to the velocity data using the 11th Generation International Geomagnetic Reference Field (IGRF) model, which was released in December 2009. Table 6 summarizes the magnetic declinations at each mooring.

Mooring	Magnetic Variation at Deployment	Magnetic Variation at Recovery
A	28.11 W	27.72 W
E	28.80 W	28.39 W
F	28.98 W	28.57 W
G	29.14 W	28.72 W

Table 6: Magnetic Declination values.

C. Nortek Continental (Nor-AQDP)

The Nortek Continental data output consists of nine files, (eight text files and one binary file). The text files include a header file, a sensor file, three velocity files, one for each beam, and three amplitude files, one for each beam. The three velocity beams are recorded in East-North-Up coordinates, respectively. The text files were first read into MATLAB and combined into a single data file and edited. The editing included eliminating data collected before and after the instrument was in the water and applying the magnetic declination using the IGRF-11 model.

D. Nortek Aquadopp Current Meter

The Nortek Aquadopp output consists of four files, (three text files and one binary file). The three text files include a header file, a data file, and a diagnostics file. The three text files were read into MATLAB and combined into one data file. Data collected pre- and post-deployment were eliminated from the data file. Velocity measurements were recorded in east, north, up

(ENU) coordinates. The magnetic declination was calculated and applied to the velocity data using the IGRF-11 model. Any noise in the data has not been edited at this point.

E. Onset HOBO Tidbit UTBI-001 Temperature Logger

Ten HOBO tidbit temperature sensors were deployed during the 2008-2009 Hudson Strait experiment. Each mooring had two HOBO tidbits with the exception of Mooring F, which had four of the temperature sensors. Of the ten units deployed, eight were recovered with 100% data return. The remaining two units were both located on Mooring G. One temperature sensor was recovered but not working, the other unit was missing.

The data were downloaded and read into Matlab. Data that was collected pre- and post-deployment were eliminated from the file. In general, the data from the HOBO tidbits were very noisy. When a single measurement was collected that was clearly not a valid measurement, the erroneous value was replaced with a NaN. If a group of several measurements appeared to be out of range, these values were left in the record, assumed that they represent a real signal.

Drifts in the data were checked by comparing two loggers located adjacent to each other on the same mooring string. Any drifts in the data were corrected using a low pass filter. Both the raw data and the edited data were saved in the data file.

F. RBR XR-420 CTD

Two RBR XR-420 CTDs were deployed during the 2008-2009 Hudson Strait experiment. The RBR-CTDs were both positioned at a depth of 190 meters. One was located on Mooring E and the other was located on Mooring G. The pressure sensor for the instrument at Mooring E flooded. Although data was recovered from the instrument, it is very poor quality and most likely cannot be used for analysis.

G. RDI Acoustic Doppler Current Profiler (RDI-ADCP)

The recovered raw binary data was read into MATLAB, where basic editing was applied. The first step was to eliminate data collected before and after the actual deployment. The magnetic variation was calculated using the 11th Generation International Geomagnetic Reference Field (IGRF) model and applied to the velocity data.

Next, a depth array was calculated using the corrected transducer depth, where depth is positive meters below the surface. The depth value for each bin corresponds to the center of the depth bin. Values collected beyond the water surface were replaced with NaNs. In addition, measurements collected near the surface were rejected due to side lobe interference. The values contaminated by the side lobe interference were calculated using the following formula and replaced with NaNs:

$$\cos 2\theta = (BS/2) + (tr_depth - (tr_depth * \cos(BA)))$$

Where: BS = bin size
 BA = beam angle

Approximately 8% of the water column velocity data were lost to side lobe interference.

Data from the SBE MicroCAT positioned at approximately the same depth as the ADCP was interpolated onto the RDI-ADCP time-grid and included in the final data file.

H. SeaBird SBE-37 MicroCAT C-T (P optional) Recorder

Twelve SBE Microcats were deployed during the 2008-2009 Hudson Strait experiment, eight of which were equipped with a pressure sensor. Moorings A and F each had four SBE Microcats, while Moorings E and G had two SBE Microcats. Although the recovery notes state that four of the twelve instruments had small data gaps or transmission errors, these were not found in the data files, yielding a data return of 100%.

The raw ASCII data files were first imported into Matlab where they were edited. Editing the data included eliminating any data that were collected while the instrument was out of the water, checking for any erroneous spikes, and correcting for drift in the pressure sensor, if present. If the instrument recorded a single spike in the measurement, the erroneous value was replaced with a NaN. Large groups of data that appeared to be out of the range were left alone as they were assumed to be a real signal. Drifts in the pressure data were corrected using a low pass filter. Both the raw and corrected data are included in the processed files.

V. Mooring Data

Below are tables presenting bulk statistics from each of the mooring instruments. Time series plots for the four moorings can be found in the Appendix.

Instrument	Serial Number	Target Depth	Variable	Minimum	Maximum	Mean	Standard Deviation
SBE-37	5928	25 m	Conductivity (S/m)	2.362	3.045	2.619	0.134
			Temperature (°C)	-1.747	5.136	-0.407	1.491
			Pressure (dB)	20.36	40.99	28.15	4.09
ULS	1023	45 m					
SBE-37	5908	45 m	Conductivity (S/m)	2.369	2.975	2.625	1.100
			Temperature (°C)	-1.746	4.028	-0.651	1.130
			Pressure (dB)	38.64	48.19	43.35	1.98
TidbiT	2224699	75 m	Temperature (°C)	-1.784	3.089	-0.8953	0.8141
SBE-37	1648	100 m	Conductivity (S/m)	2.537	2.926	2.651	0.051
			Temperature (°C)	-1.776	2.406	-0.995	0.643
TidbiT	2038426	135 m	Temperature (°C)	-1.813	0.852	-1.071	0.509
SBE-37	5938	160 m	Conductivity (S/m)	2.575	2.807	2.677	0.041
			Temperature (°C)	-1.748	0.641	-0.946	0.456
			Pressure (dB)	153.37	162.78	158.15	2.15

Table 7: Statistical Data for Mooring A.

Instrument	Serial Number	Target Depth	Variable	Minimum	Maximum	Mean	Standard Deviation
SBE-37	5904	40 m	Conductivity (S/m)	2.568	3.047	2.669	0.085
			Temperature (°C)	-1.796	3.982	-0.849	1.074
			Pressure (dB)	36.51	55.79	42.44	2.73
TidbiT	2224705	80 m	Temperature (°C)	-1.842	1.017	-1.071	0.778
SBE-37	2047	120 m	Conductivity (S/m)	2.591	2.829	2.684	0.066
			Temperature (°C)	-1.786	0.722	-0.941	0.781
TidbiT	2038433	150 m	Temperature (°C)	-1.756	0.742	-0.811	0.767
RBR XR-420	013214	190 m	Conductivity (S/m)	N/A	N/A	N/A	N/A
			Temperature (°C)	N/A	N/A	N/A	N/A
			Pressure (dB)	N/A	N/A	N/A	N/A
Nortek Aquadopp	2756	300 m	U (cm/s)	-76.251	60.262	-3.341	23.610
			V (cm/s)	-76.761	60.758	-1.310	24.675

Table 8: Statistical Data for Mooring E.

Instrument	Serial Number	Target Depth	Variable	Minimum	Maximum	Mean	Standard Deviation
SBE-37	5906	25 m	Conductivity (S/m)	2.534	3.176	2.706	0.141
			Temperature (°C)	-1.801	6.926	-0.208	1.966
			Pressure (dB)	10.10	57.68	23.11	6.94
Uls	1024	45 m					
SBE-37	5907	45 m	Conductivity (S/m)	2.566	3.067	2.671	0.089
			Temperature (°C)	-1.791	5.623	-0.803	1.125
			Pressure (dB)	28.34	61.18	38.33	3.90
SBE-37	2045	80 m	Conductivity (S/m)	2.586	2.852	2.667	0.065
			Temperature (°C)	-1.798	1.212	-1.021	0.785
TidbiT	2038434	150 m	Temperature (°C)	-1.727	0.770	-0.769	0.770
TidbiT	2038427	180 m	Temperature (°C)	-1.756	0.797	-0.669	0.728
TidbiT	2038432	230 m	Temperature (°C)	-1.756	0.880	-0.381	0.641
TidbiT	2038431	270 m	Temperature (°C)	-1.727	1.044	-0.044	0.644
SBE-37	5926	320 m	Conductivity (S/m)	2.659	2.915	2.814	0.060
			Temperature (°C)	-1.551	1.029	0.047	0.614
			Pressure (dB)	322.67	335.29	327.96	2.56

Table 9: Statistical Data for Mooring F.

Instrument	Serial Number	Target Depth	Variable	Minimum	Maximum	Mean	Standard Deviation
SBE-37	5905	40 m	Conductivity (S/m)	2.546	3.122	2.688	0.098
			Temperature (°C)	-1.813	6.049	-0.634	1.270
			Pressure (dB)	32.96	98.38	43.39	7.36
TidbiT	2224696	80 m	Temperature (°C)	N/A	N/A	N/A	N/A
SBE-37	3407	120 m	Conductivity (S/m)	2.541	2.835	2.674	0.065
			Temperature (°C)	-1.813	1.093	-0.955	0.818
TidbiT	2038425	150 m	Temperature (°C)	N/A	N/A	N/A	N/A
RBR XR-420	013199	190 m	Conductivity (S/m)	2.625	2.888	2.737	0.065
			Temperature (°C)	-1.089	0.772	-0.769	0.774
			Pressure (dB)	195.65	244.530	203.42	6.18
Nortek Aquadopp	2771	300 m	U (cm/s)	-92.300	95.604	-1.429	33.660
			V (cm/s)	-66.672	83.144	5.186	20.365

Table 10: Statistical Data for Mooring G.

VI. References

Déry, S.J., M. Stieglitz, E. C. McKenna, E. F. Wood, 2005: Characteristics and trends of river discharge into Hudson, James, and Ungava bays. *Journal of Climate*, **18**, 1,964-2,000.

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VII. Acknowledgments

The investigators would like to thank John Kemp, Jim Ryder and the Mooring Group for designing, building, and deploying the moorings, Dan Torres, Scott Worriow and his group for instrument preparation, and the crew of the R/V Knorr for their expertise and assistance during both the deployment and recovery cruises. The National Science Foundation Grant Number OCE-0751554 provided funding for the project.

Appendix A Mooring Diagrams

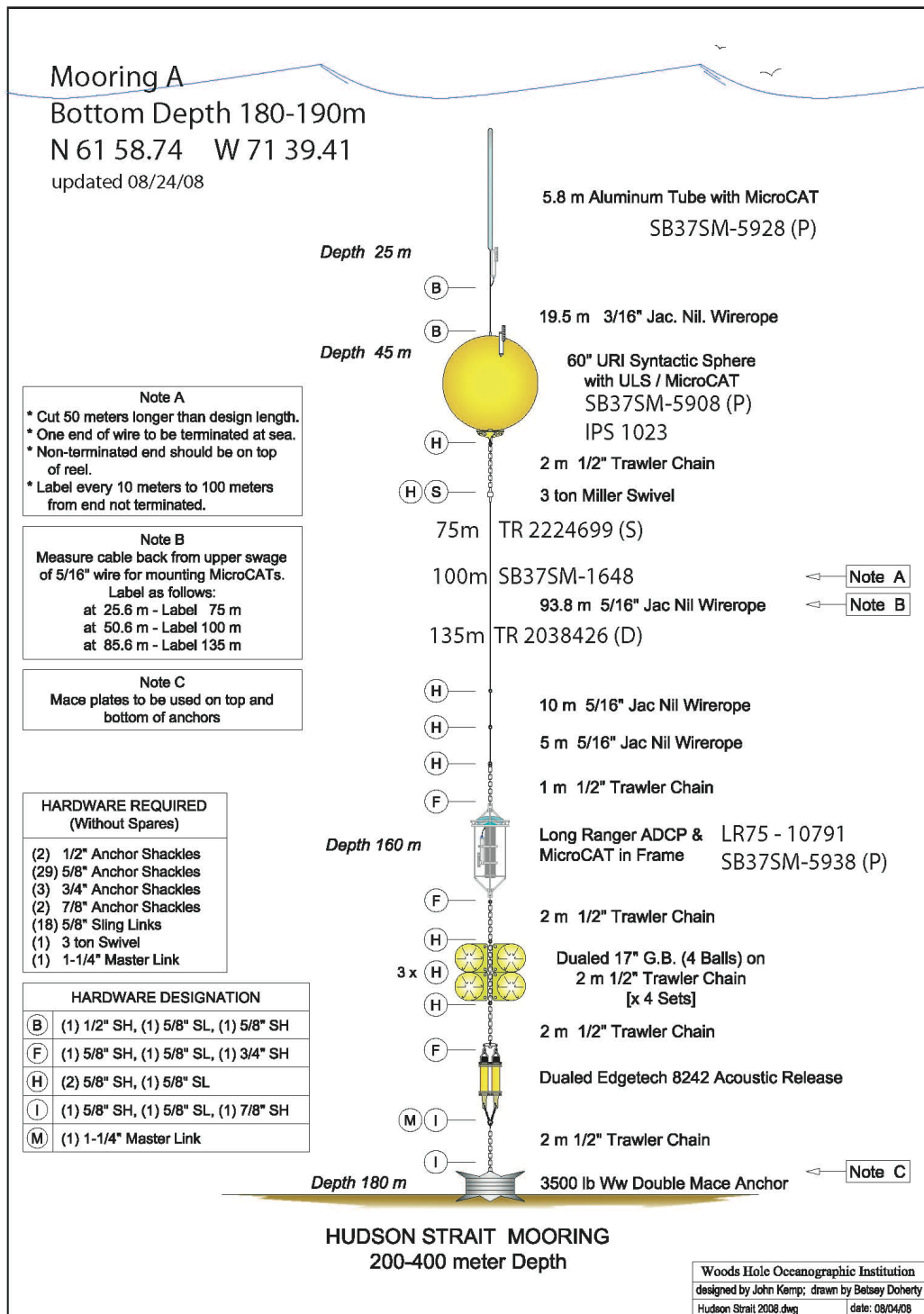


Figure 2: Diagram for Mooring A.

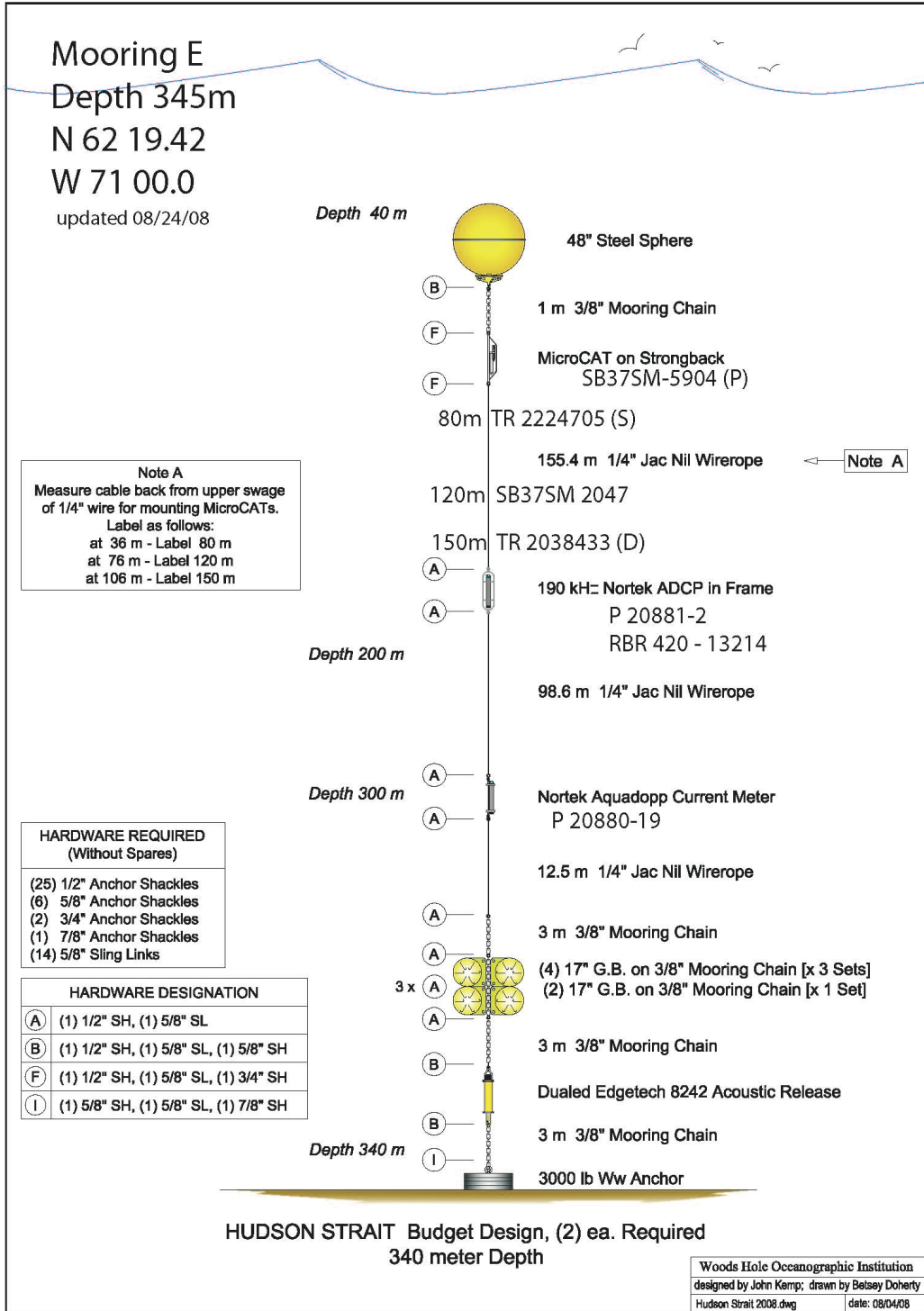
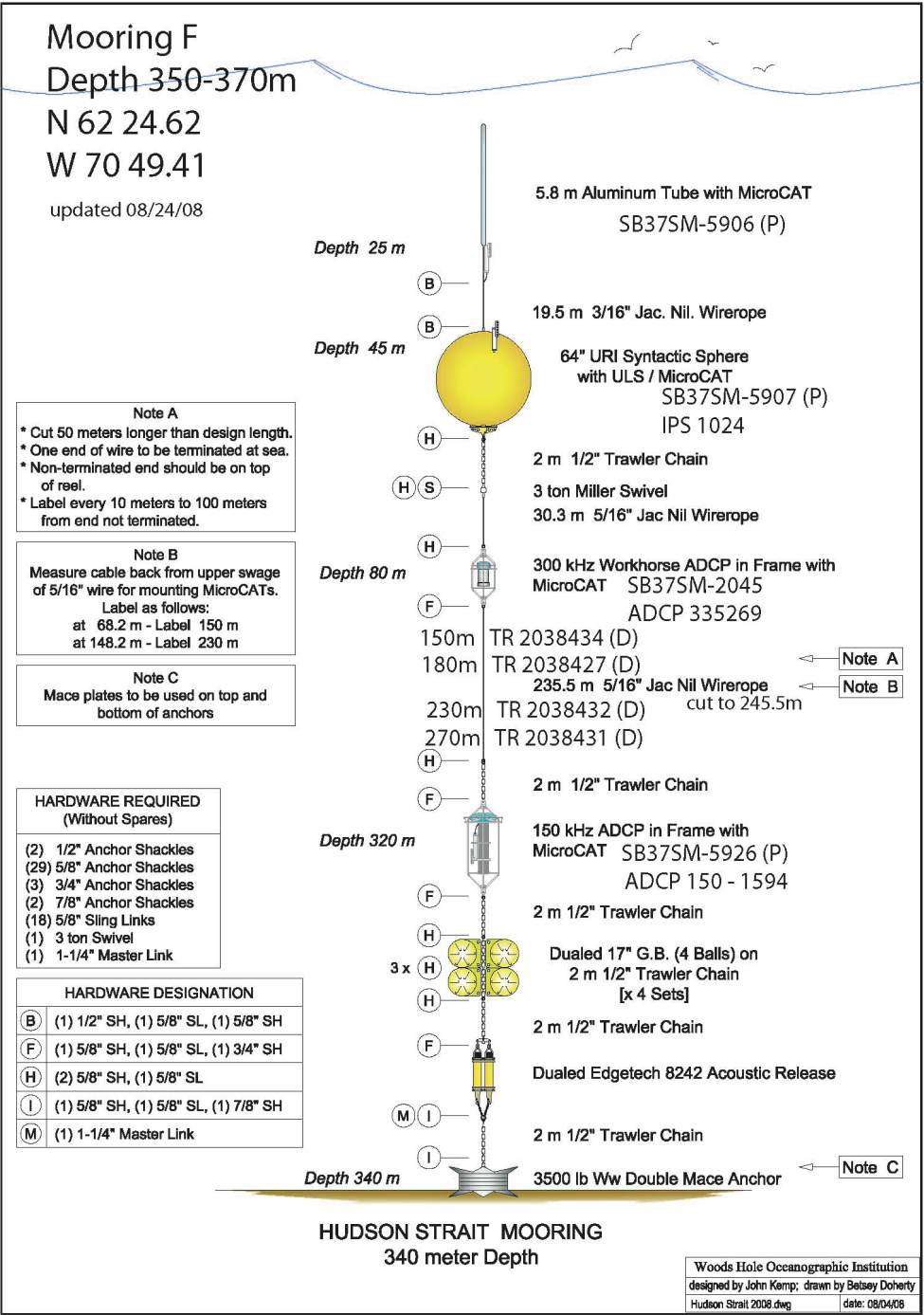


Figure 3: Diagram for Mooring E.



HUDSON STRAIT MOORING
340 meter Depth

Woods Hole Oceanographic Institution
designed by John Kemp; drawn by Betsy Doherty
Hudson Strait 2006.dwg date: 08/04/08

Figure 4: Diagram for Mooring F.

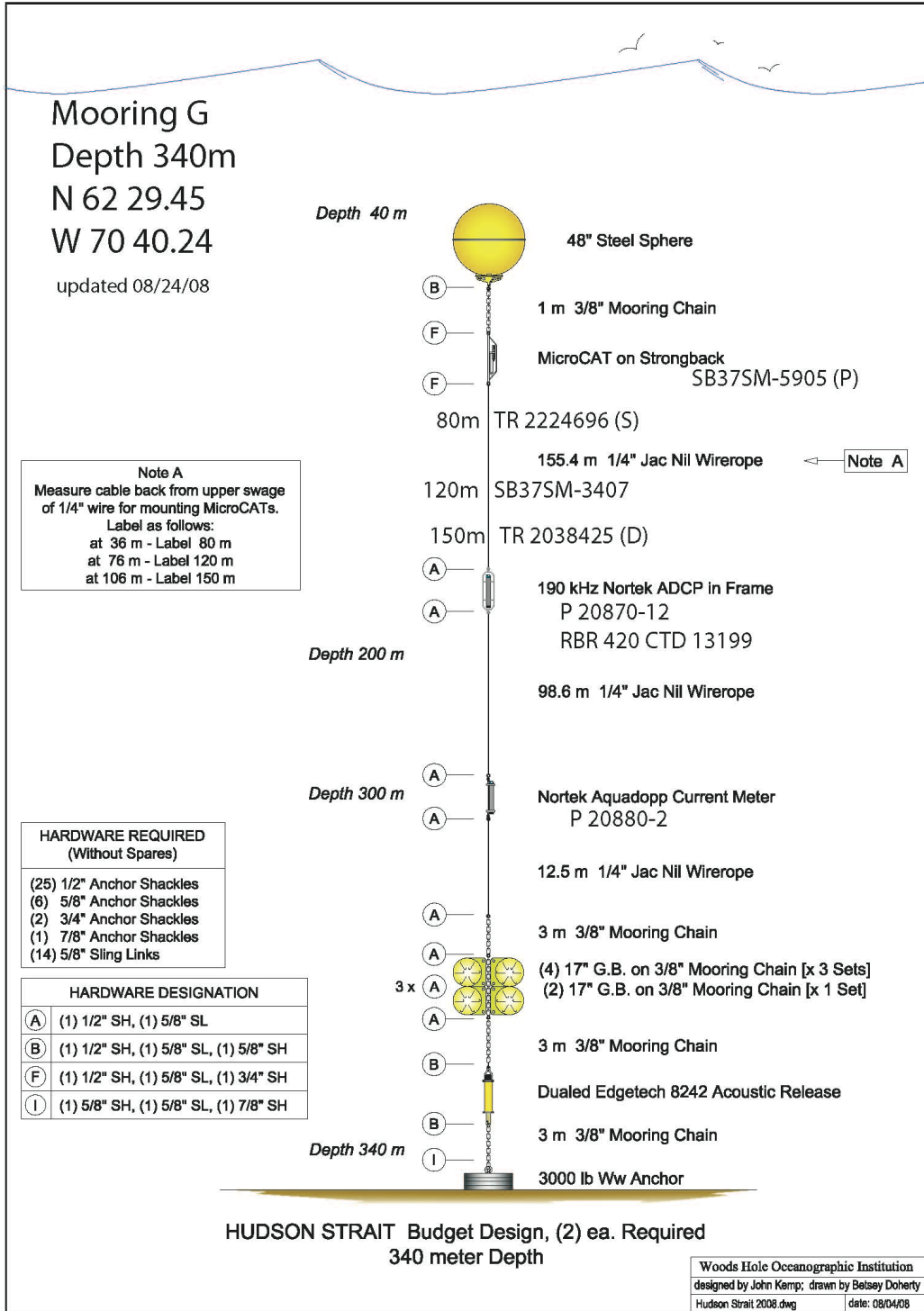


Figure 5: Diagram for Mooring G.

Appendix B Mooring Instrumentation (top to bottom)

Mooring A (WHOI)

25 meters (below aluminum pole)	SB37M (P)	5928	15 min
45 meters (in sphere)	Upward Looking Sonar	1023	2 sec
45 meters (on sphere)	SB37M (P)	5908	15 min
75 meters	HOBO Tidbit	2224699(S)	15 min
100 meters	SB37M	1648	15 min
135 meters	HOBO Tidbit	2038426(D)	15 min
160 meters	RDI ADCP (LR)	10791	60 min
160 meters	SB37M (P)	5938	15 min

Mooring E

40 meters (below sphere)	SBE37 (P)	5904	15 min
80 meters	HOBO Tidbit	2224705	15 min
120 meters	SBE37	2047	15 min
150 meters	HOBO Tidbit	2038433	15 min
190 meters	Nortek ADCP	P20881-2	30 min
190 meters	RBR	13214	15 min
300 meters	Nortek Aquadopp	2756	20 min

Mooring F (WHOI)

25 meters (below aluminum pole)	SB37M (P)	5906	15 min
45 meters (in sphere)	Upward Looking Sonar	1024	
45 meters (on sphere)	SB37M (P)	5907	15 min
80 meters	RDI ADCP (WH)	335269	60 min
80 meters	SB37SM	2045	15 min
150 meters	HOBO Tidbit	2038434	15 min
180 meters	HOBO Tidbit	2038427	15 min
230 meters	HOBO Tidbit	2038432	15 min
270 meters	HOBO Tidbit	2038431	15 min
320 meters	RDI ADCP (WH)	1594	60 min
320 meters	SBE37M (P)	5926	15 min

Mooring G

40 m	SBE37 (P)	5905	15 min
80 m	HOBO Tidbit	2224696(S)	15 min
120 m	SBE37	3407	15 min
150 m	HOBO Tidbit	2038425(D)	15 min
190 m	Nortek ADCP	P20870-12	30 min
190 m	RBR XR-420	420-13199	15 min
300 m	Nortek Aquadopp	2771	20 min

Appendix C Data Recovery Summary

RDI Acoustic Doppler Current Profiler Data

adcpA-160.mat	9914 ensembles	Mooring A	Depth 160m
adcpF-80.mat	4957 ensembles	Mooring F	Depth 80m

Note: Battery died on March 3, 2009

Nortek Continental Current Profiler

aqdcE-190.mat	851 measurements	Mooring E	Depth 190m
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Note: Instrument stopped collecting data on September 21, 2008

aqdG-190.mat	9779 measurements	Mooring G	Depth 190m
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Nortek Aquadopp Current Meter

aqdE-300.mat	29,272 measurements	Mooring E	Depth 300m
aqdG-300.mat	29,269 measurements	Mooring G	Depth 300m

Onset HOBO Tidbit UTBI-001 Temperature Logger

hoboA-75.mat	38,531 measurements	Mooring A	Depth 75m
hoboA-135.mat	38,535 measurements	Mooring A	Depth 135m
hoboE-80.mat	38,522 measurements	Mooring E	Depth 80m
hoboE-150.mat	38,536 measurements	Mooring E	Depth 150m
hoboF-150.mat	38,538 measurements	Mooring F	Depth 150m
hoboF-180.mat	38,536 measurements	Mooring F	Depth 180m
hoboF-230.mat	38,536 measurements	Mooring F	Depth 230m
hoboF-270.mat	38535 measurements	Mooring F	Depth 270m

RBR XR-420 CTD

rbrG-190.mat	38,461 samples	Mooring G	Depth 190m
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SeaBird MicroCAT C-T (P optional) Recorder

mcA-25.mat	39,042 samples	Mooring A	Depth 25m
mcA-45.mat	39,044 samples	Mooring A	Depth 45m
mcA-100.mat	38,611 samples	Mooring A	Depth 100m
mcA-160.mat	39,050 samples	Mooring A	Depth 160m
mcE-40.mat	39,093 samples	Mooring E	Depth 40m
mcE-120.mat	38,624 samples	Mooring E	Depth 120m
mcF-25.mat	39,028 samples	Mooring F	Depth 25m
mcF-45.mat	39,086 samples	Mooring F	Depth 45m
mcF-80.mat	38,580 samples	Mooring F	Depth 80m
mcF-320.mat	39,060 samples	Mooring F	Depth 320m
mcG-40.mat	39,122 samples	Mooring G	Depth 40m

Appendix D Mooring A Time Series Plots

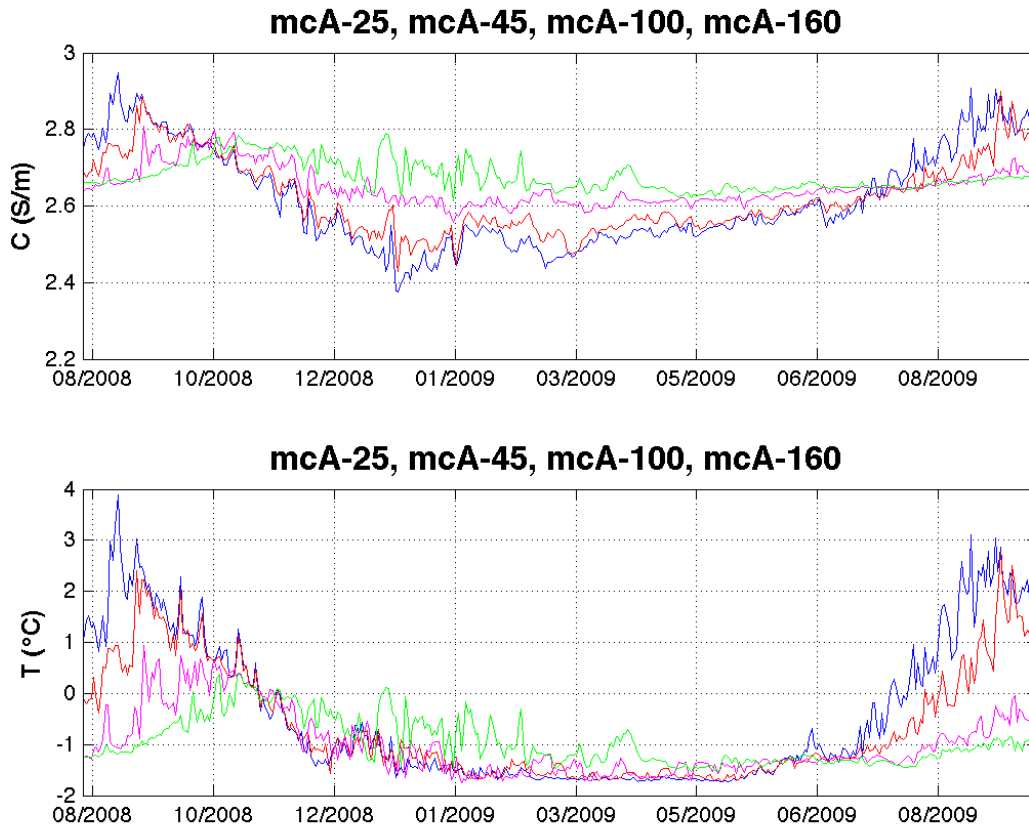


Figure 6: SBE MicroCAT data. Top is conductivity (S/m), bottom is temperature (degrees C), Blue line is 25 meters, Red line is 45 meters, Magenta line is 100 meters, and Green line is 160 meters.

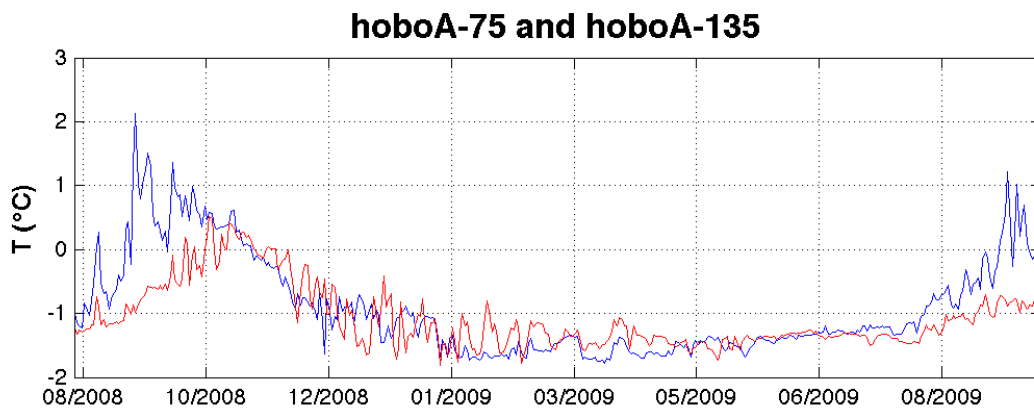


Figure 7: Onset HOBO TidbiT data temperature (degrees C), Blue line is at 75 meters and Red line is 135 meters.

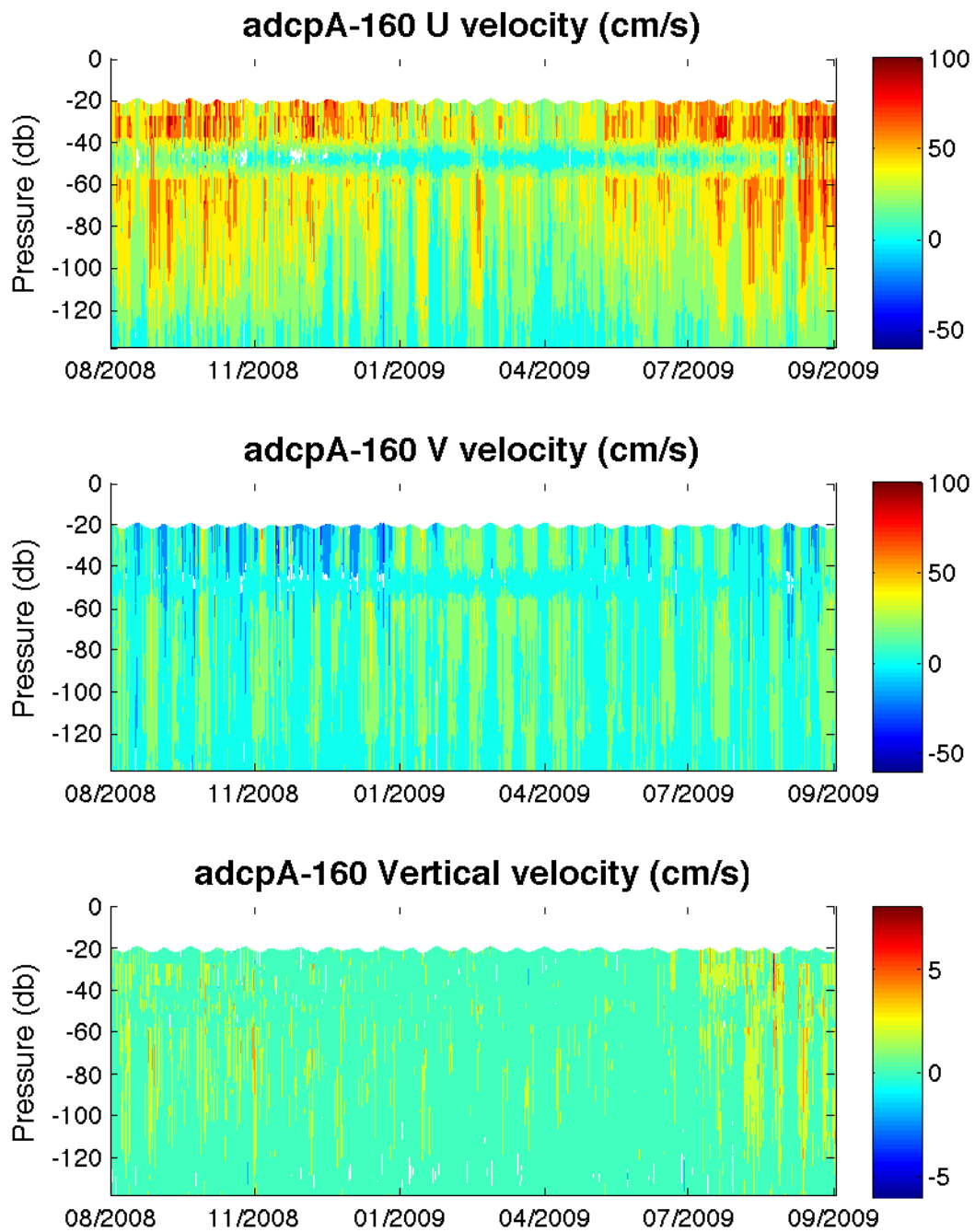


Figure 8: RDI ADCP velocity data 160 meters with pressure data superimposed on the uppermost bin. The banding around 45 meters is most likely due to interference from the sphere.

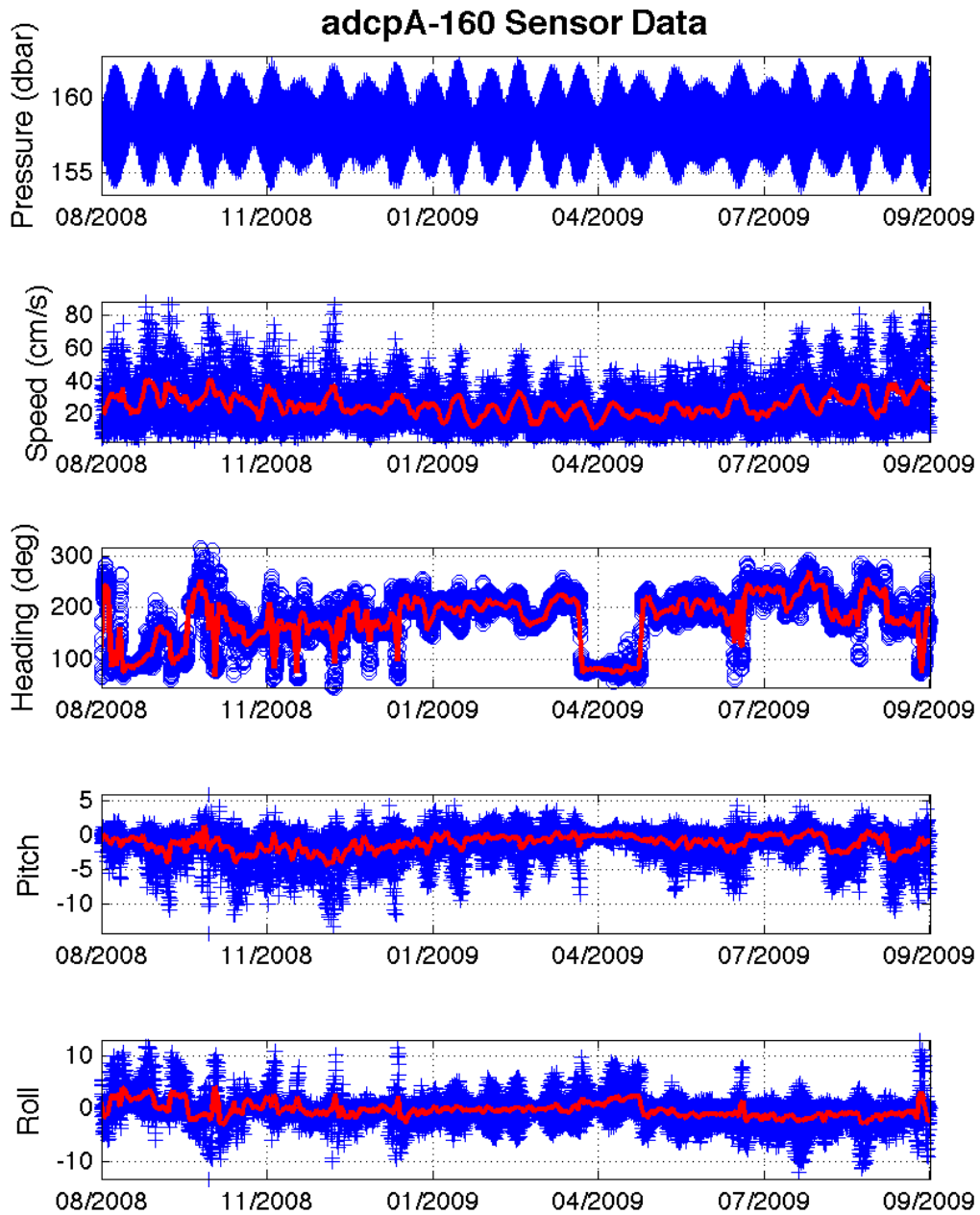


Figure 9: RDI ADCP sensor data at 160 meters. Top panel is pressure (dbar), second panel is speed (cm/s), third panel is heading, fourth panel is pitch, and bottom panel is roll. For the second to bottom plot, the blue line represents every one-hour sample and the red line represents a daily average.

Appendix E Mooring E Time Series Plots

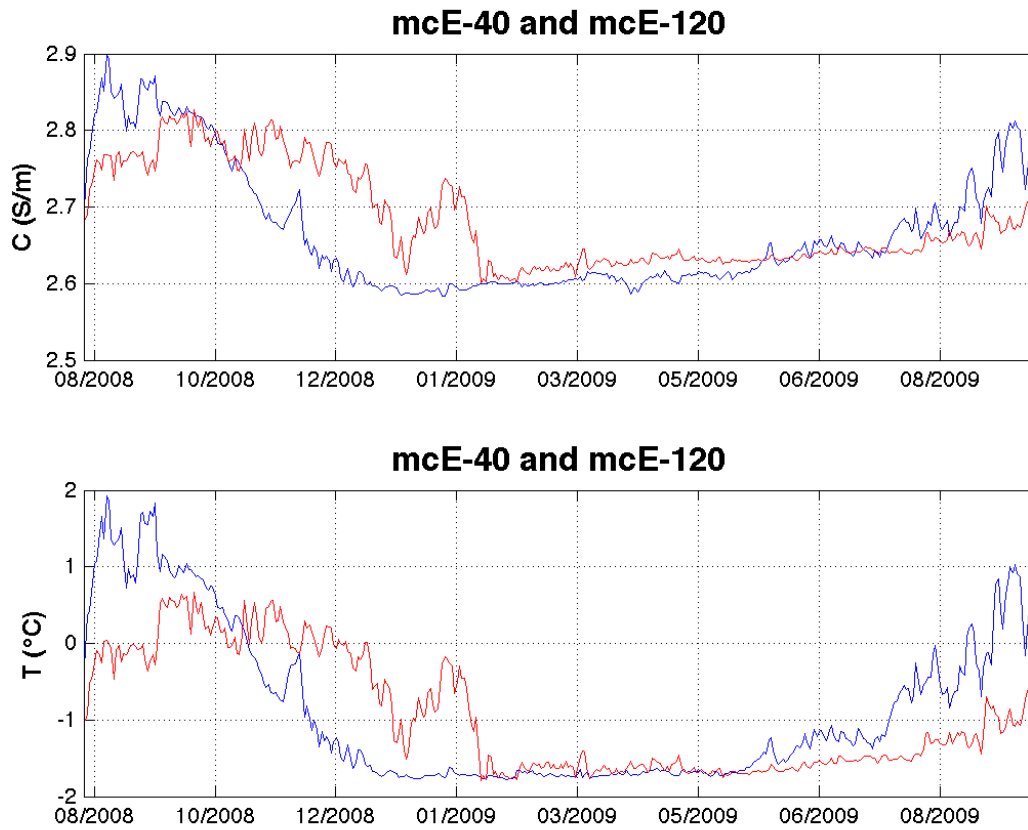


Figure 10: SBE-37 MicroCAT data. Top panel is conductivity (S/M), bottom panel is temperature (degrees C). Blue line represents 40 meters and red line represents 120 meters.

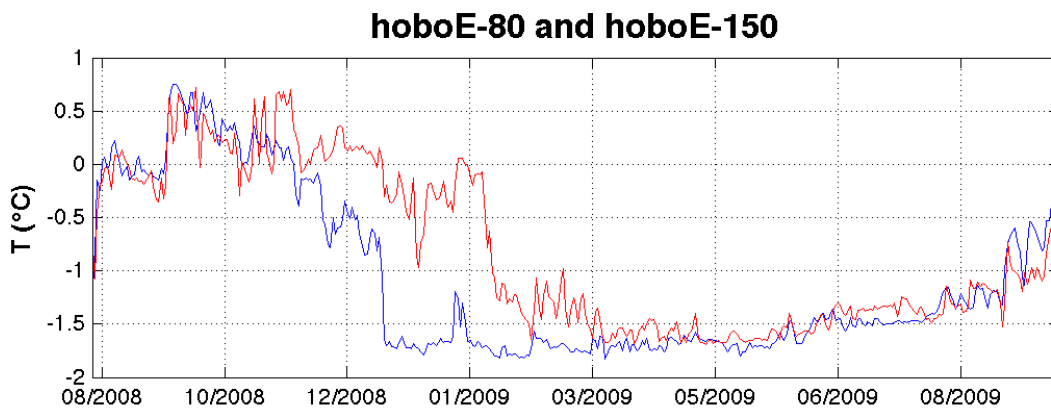


Figure 11: Onset HOBOTidbit temperature (degrees C) data. Blue line represents 80 meters and red line represents 150 meters.

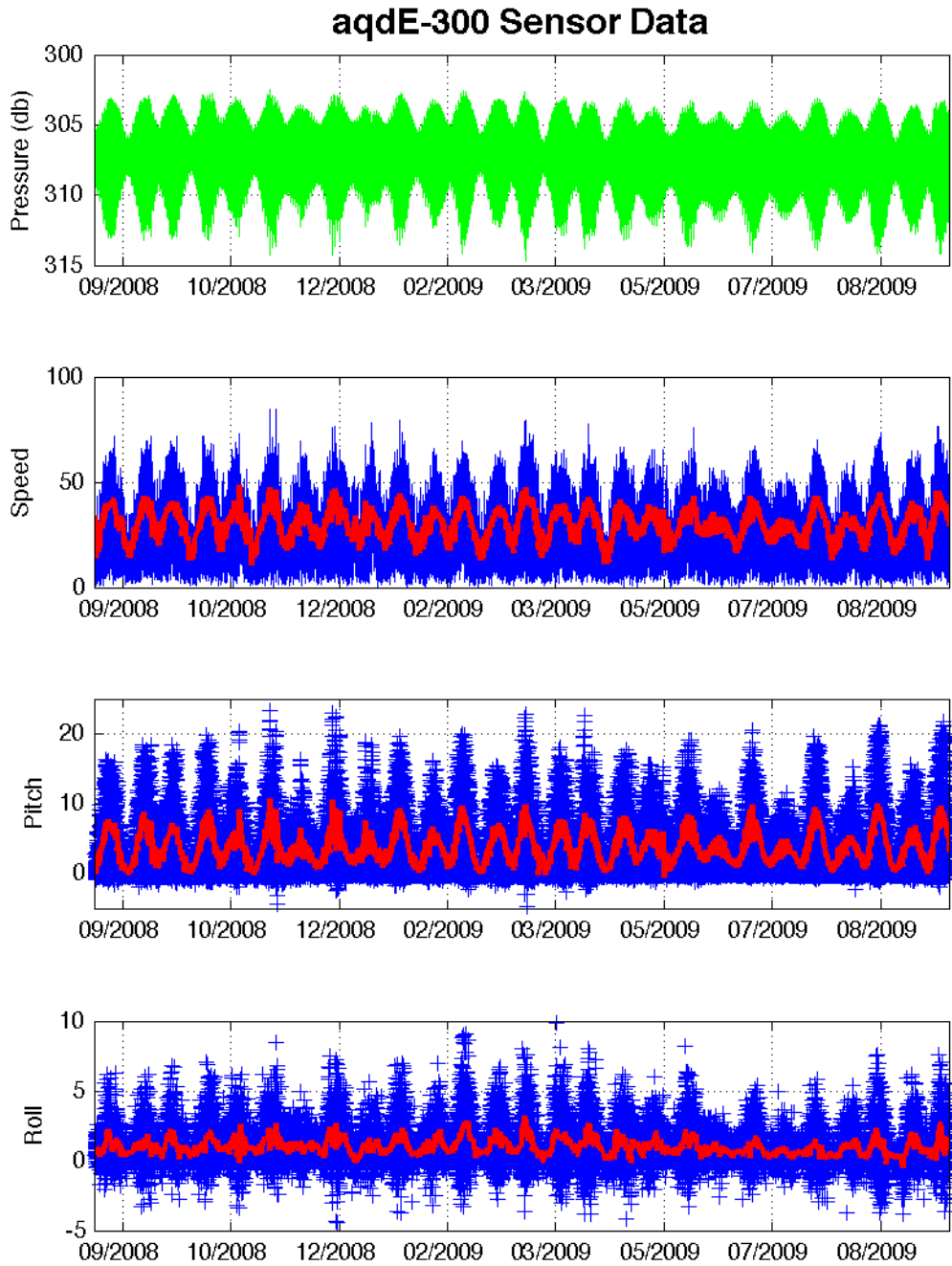


Figure 12: Nortek Aquadopp sensor data at 300 meters. Top panel is pressure (dbar), second panel is speed (cm/s), third panel is pitch, and bottom panel is roll. For the bottom three panels, the blue represents each 20-minute measurement and the red line represents measurements at a six-hour interval.

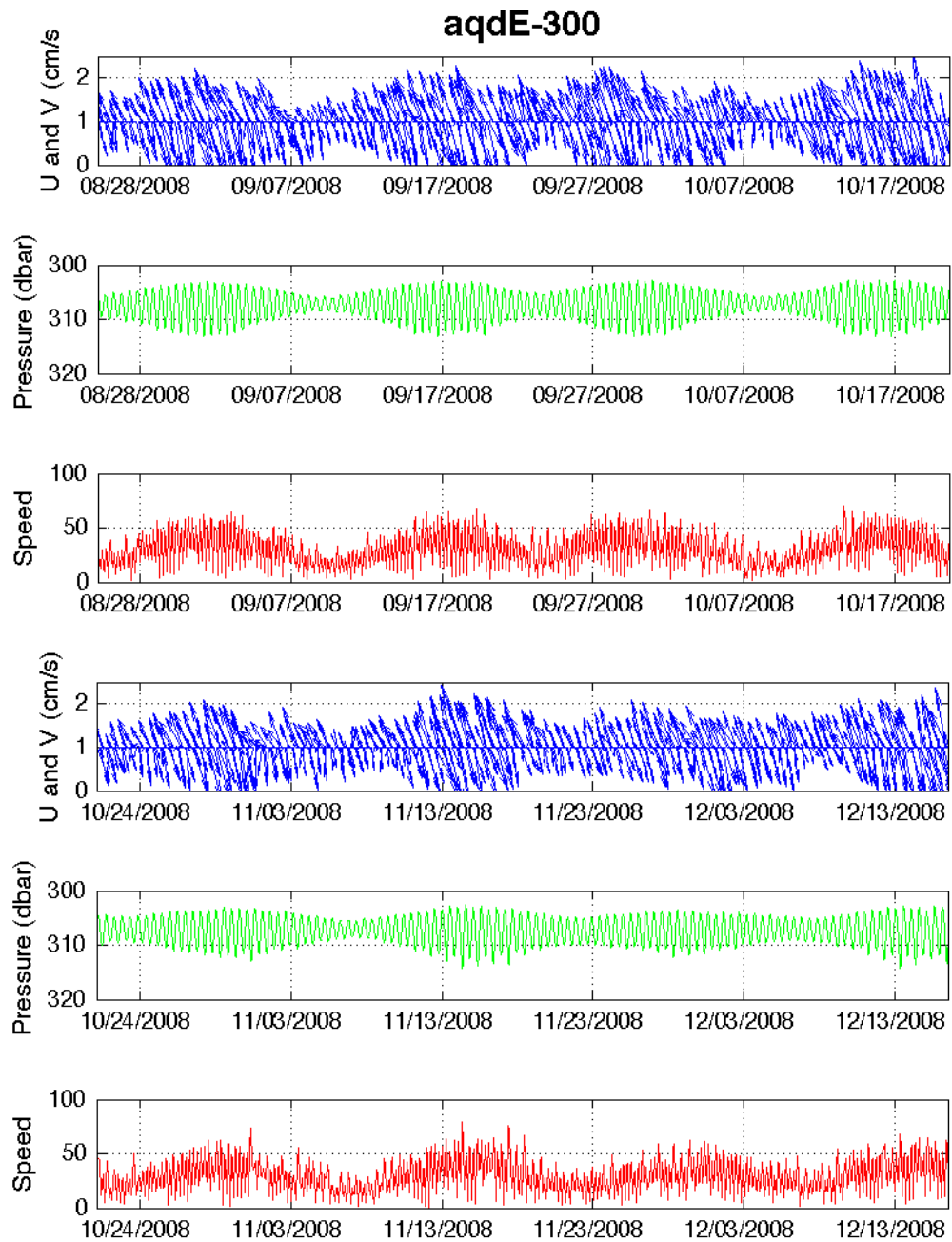


Figure 13: Nortek Aquadopp velocity (cm/s), pressure (dbar), and speed (cm/s) data at 300 meters at one-hour intervals. Top three plots are from August 28, 2008 to Oct 20, 2008. Bottom three plots are from October 20, 2008 to December 16, 2008.

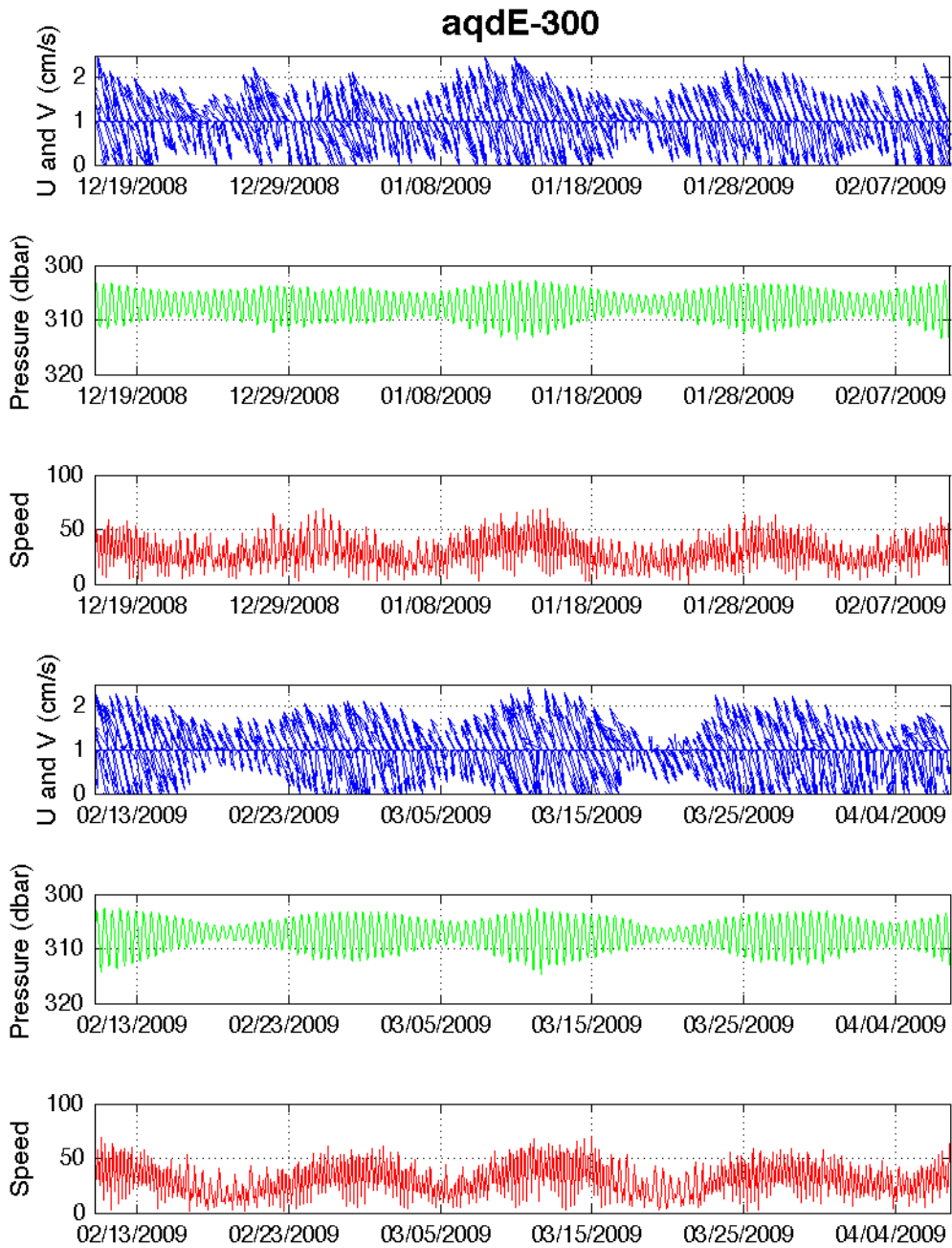


Figure 14: Nortek Aquadopp velocity (cm/s), pressure (dbar), and speed (cm/s) data at 300 meters at one-hour intervals. Top three plots are from December 16, 2008 to February 10, 2009. Bottom three plots are from February 10, 2009 to April 7, 2009.

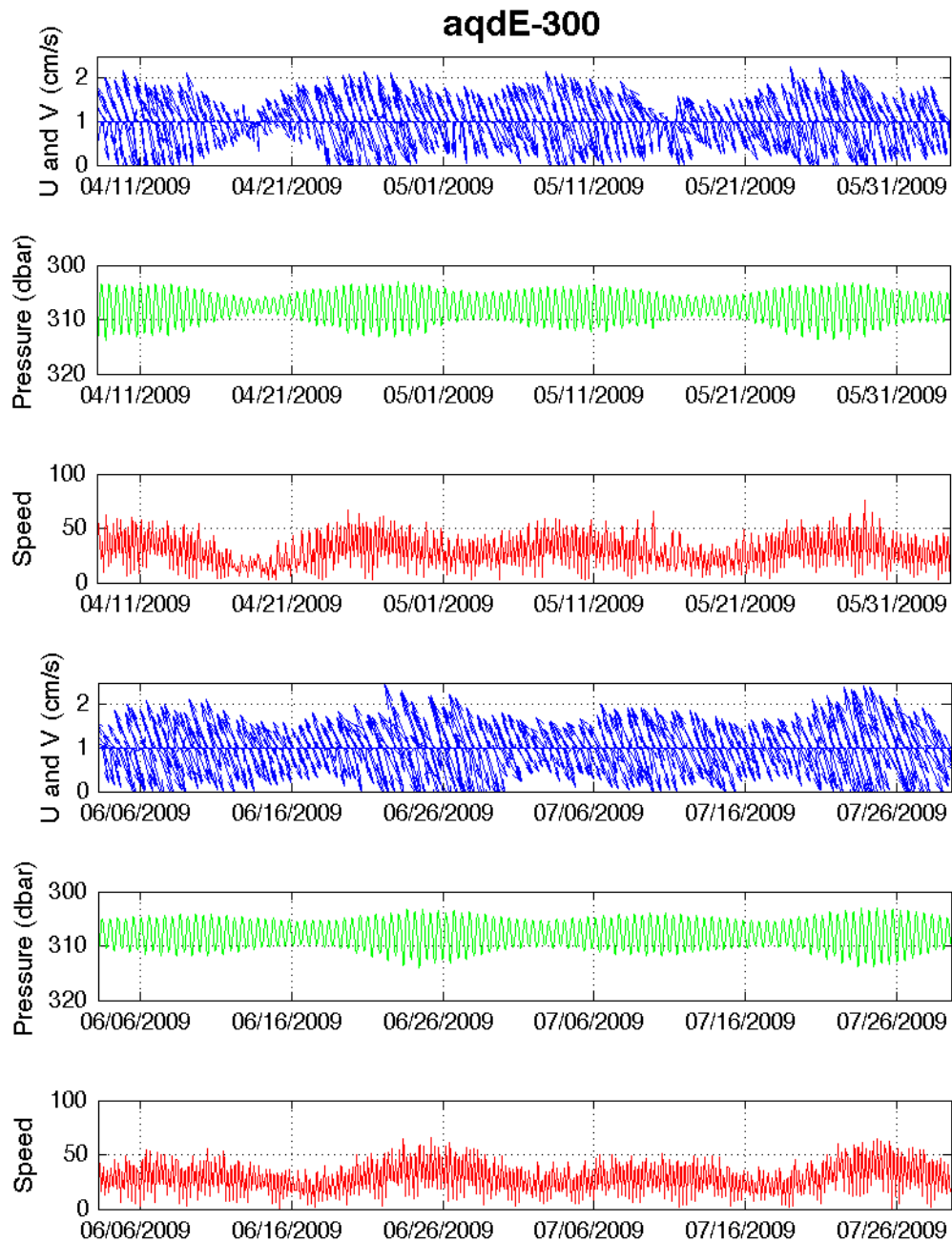


Figure 15: Nortek Aquadopp velocity (cm/s), pressure (dbar), and speed (cm/s) data at 300 meters at one-hour intervals. Top three plots are from April 7, 2009 to June 3, 2009. Bottom three plots are from June 3, 2009 to July 29, 2009.

Appendix F Mooring F Times Series Plots

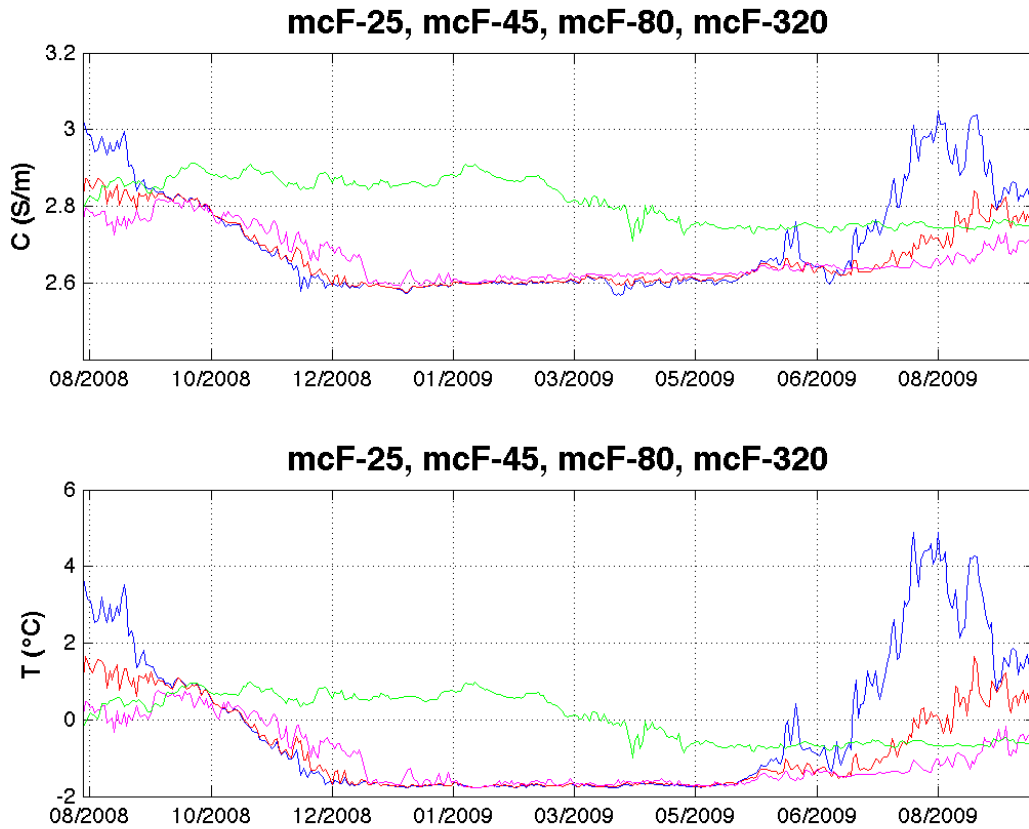


Figure 16: SBE MicroCAT data. Top is conductivity (S/m), bottom is temperature (degrees C), Blue line is 25 meters, Red line is 45 meters, Magenta line is 80 meters, and Green line is 320 meters.

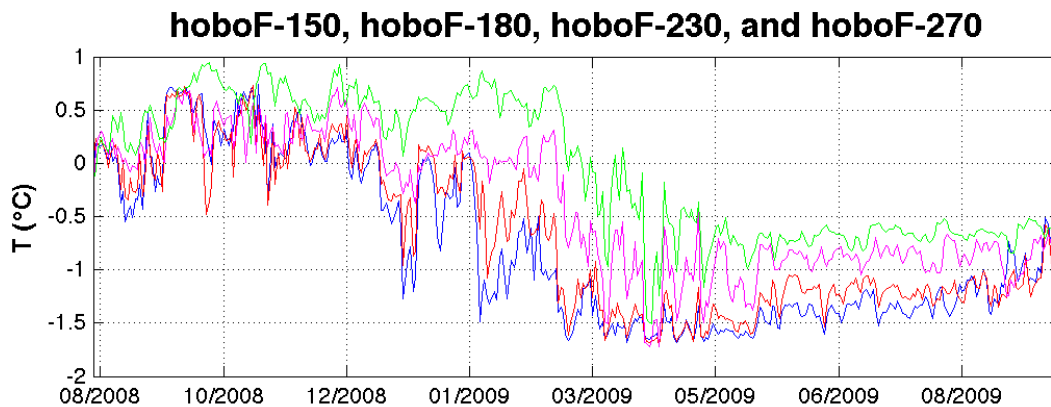


Figure 17: Onset HOBOTidbit temperature (degrees C) data, Blue line is at 150 meters, Red line is at 180 meters, Magenta line is at 230 meters, and Green line is 270 meters.

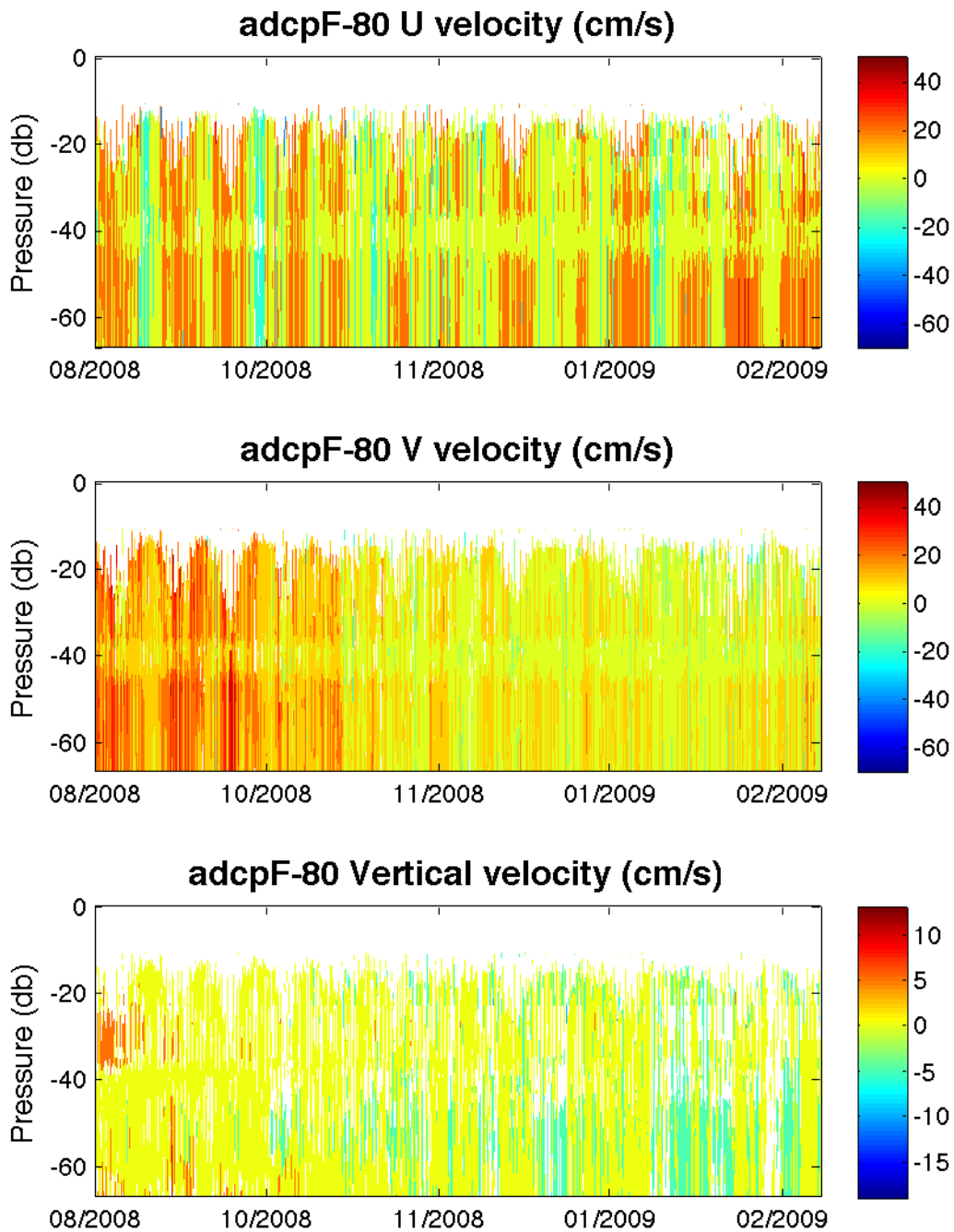


Figure 18: RDI ADCP velocity data at 80 meters with pressure data superimposed on the uppermost bin. The banding around 40 meters is most likely due to interference from the sphere.

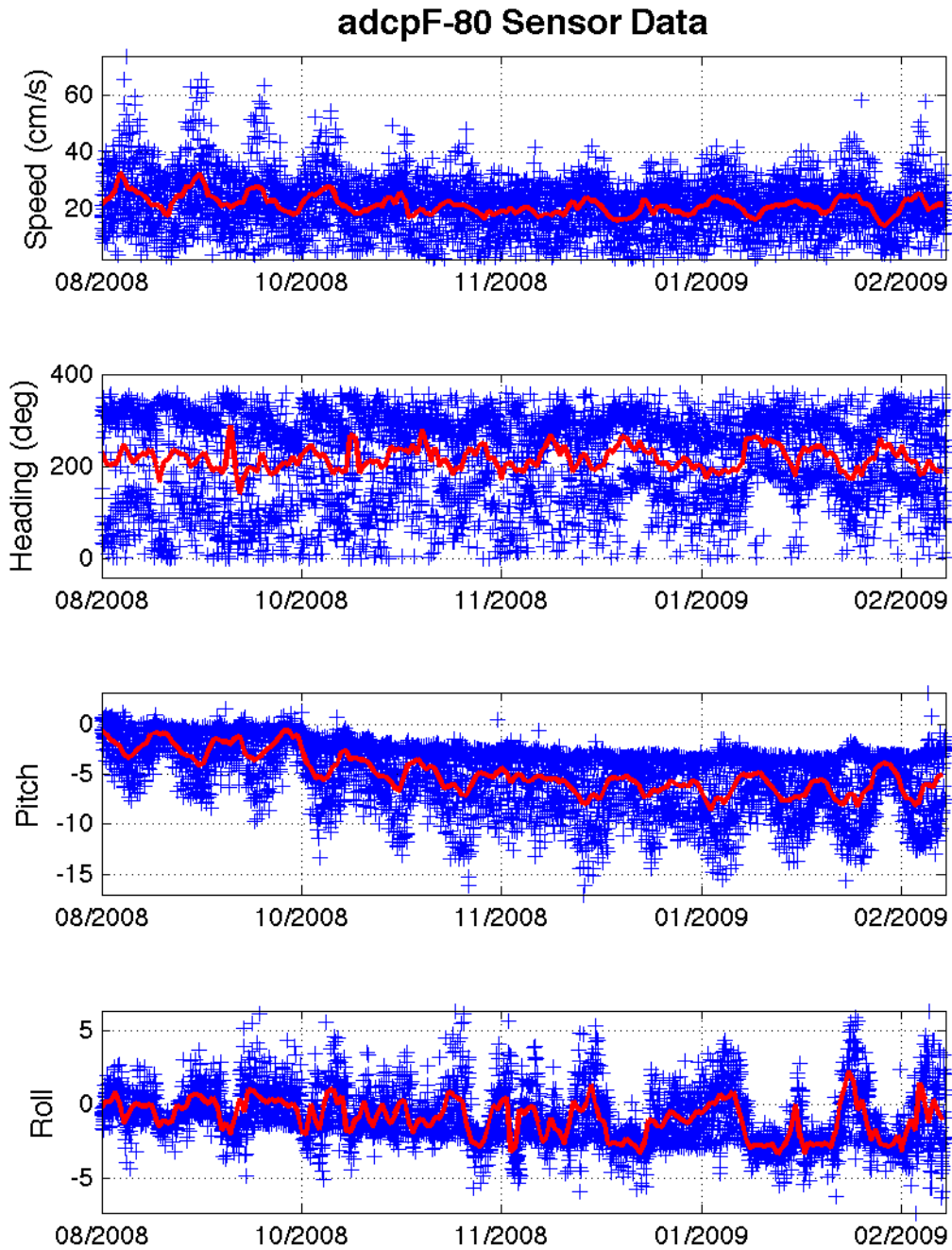


Figure 19: RDI ADCP sensor data at 80 meters. Top panel is pressure (dbar), second panel is speed (cm/s), third panel is heading, fourth panel is pitch, and bottom panel is roll. For the second to bottom panels, the blue line represents every one-hour sample and the red line represents a daily average.

Appendix G Mooring G Time Series Plots

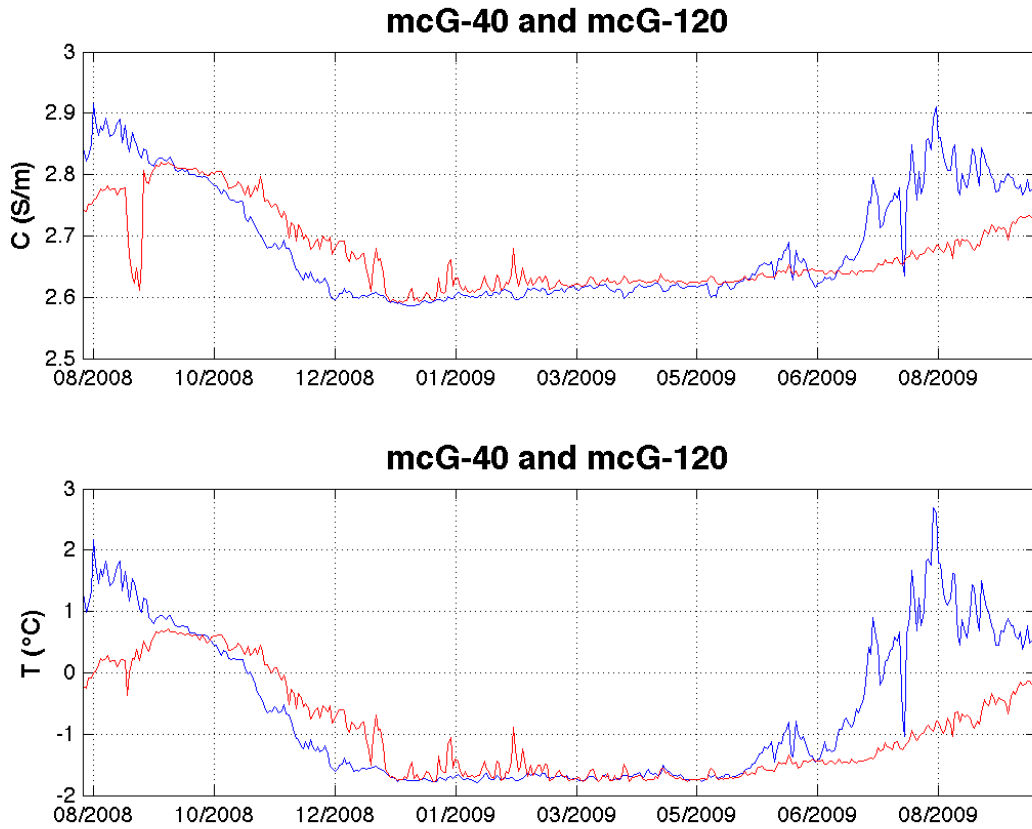


Figure 20: SBE-37 MicroCAT data. Top panel is conductivity (S/M) and bottom panel is temperature (degrees C). Blue line represents 40 meters and red line represents 120 meters.

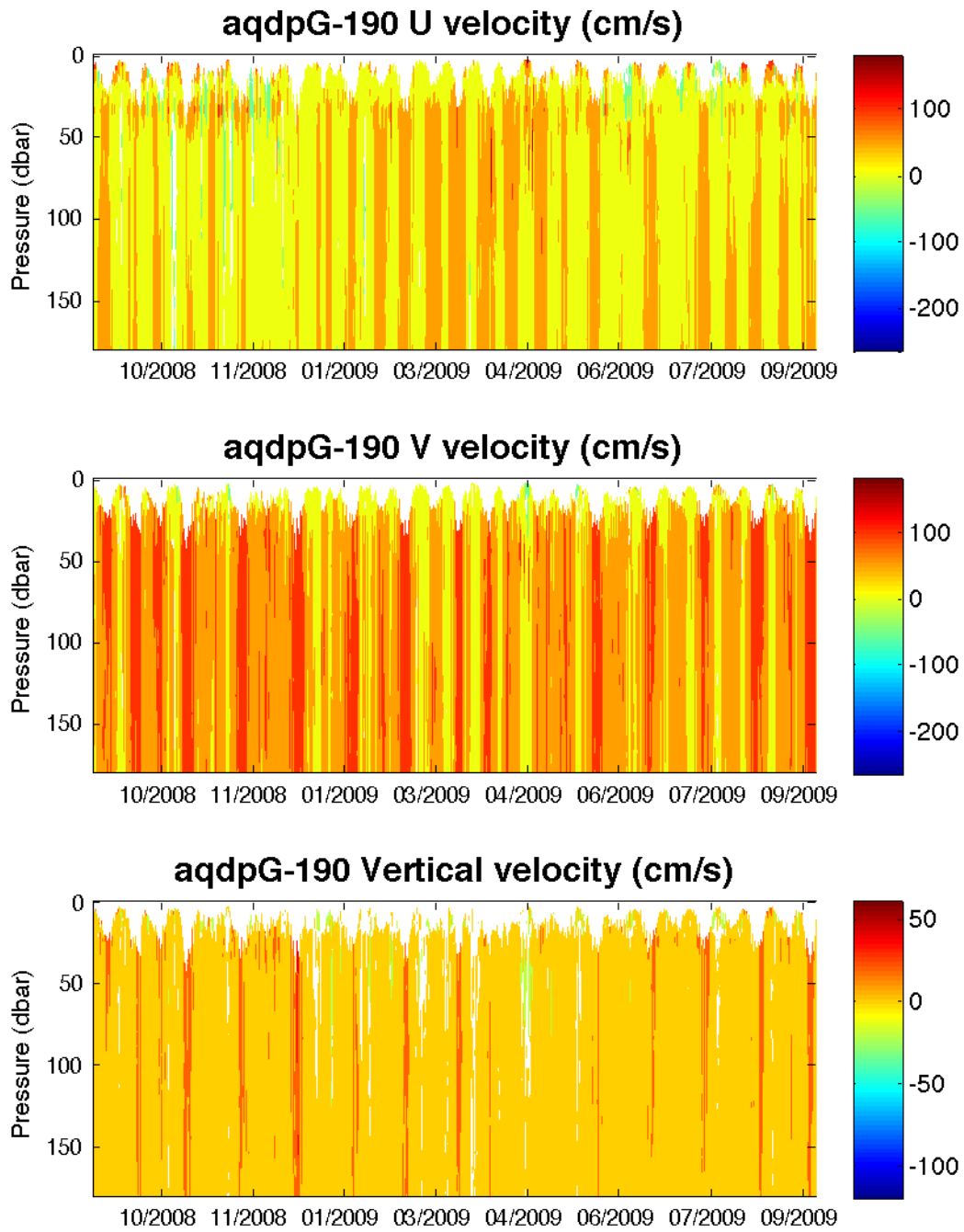


Figure 21: Nortek Continental velocity profile data at 190 meters with pressure data superimposed on the uppermost bin.

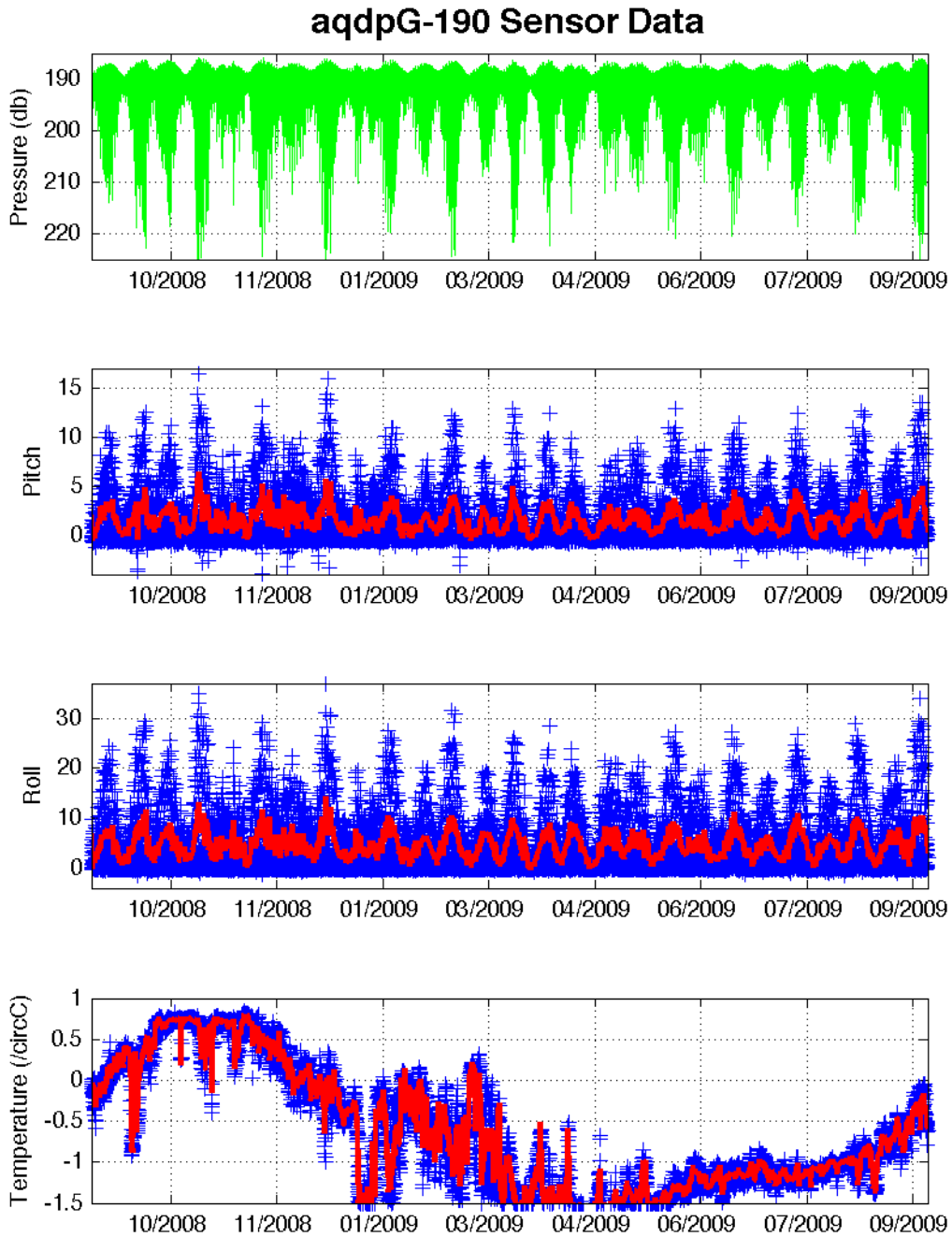


Figure 22: Nortek Continental sensor data at 190 meters. Top panel is pressure (dbar), second panel is pitch, third panel is roll, and bottom panel is temperature (degrees C). For the second to bottom panels, the blue line represents every one-hour sample and the red line represents a six-hour average.

rbrG-190

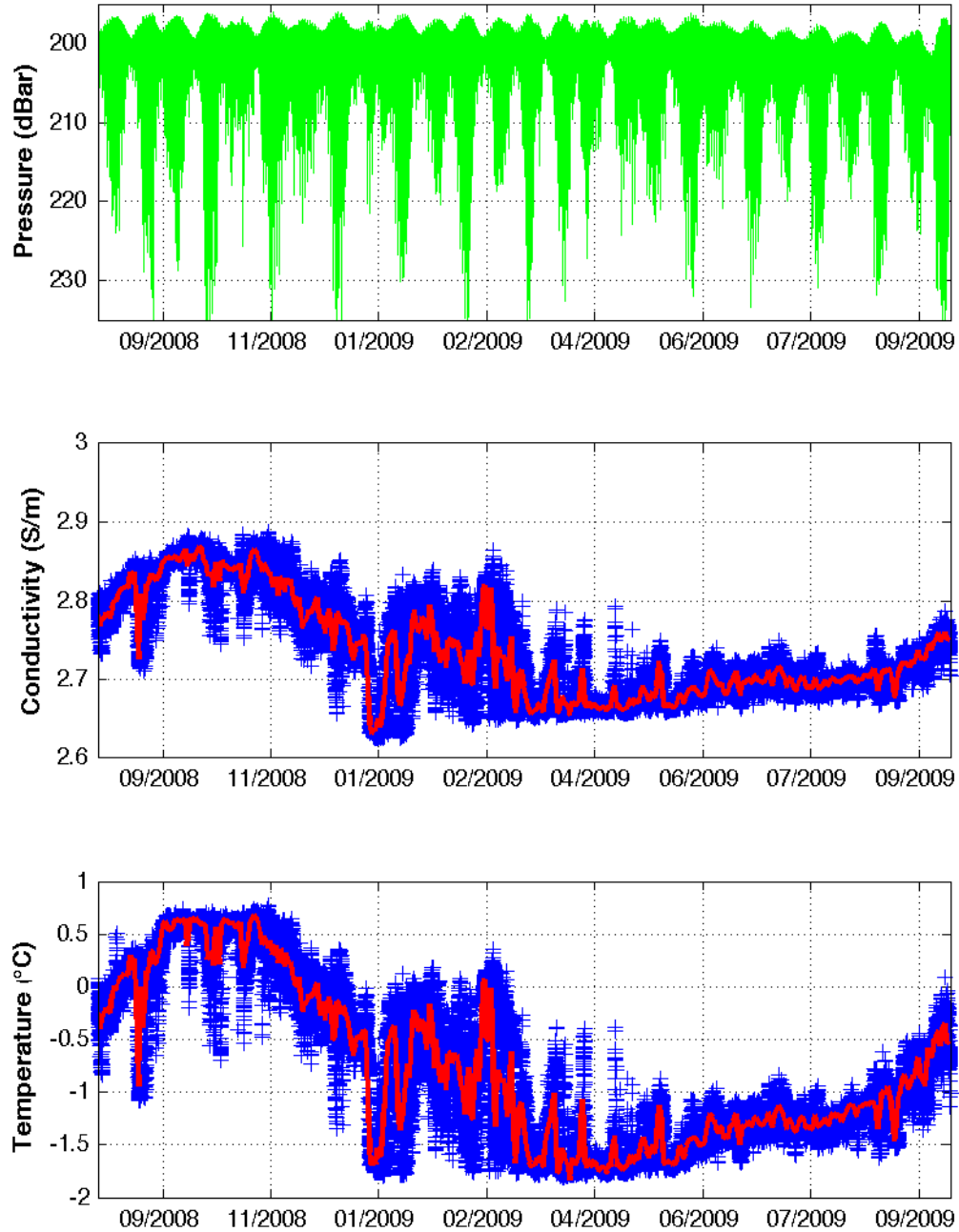


Figure 23: RBR XR-420 CTD data at 190 meters. Top panel is pressure (dBar), middle panel is conductivity (S/m), and bottom panel is temperature (degrees C). For the bottom two panels, the blue represents each 15-minute measurement and the red line represents a daily average.

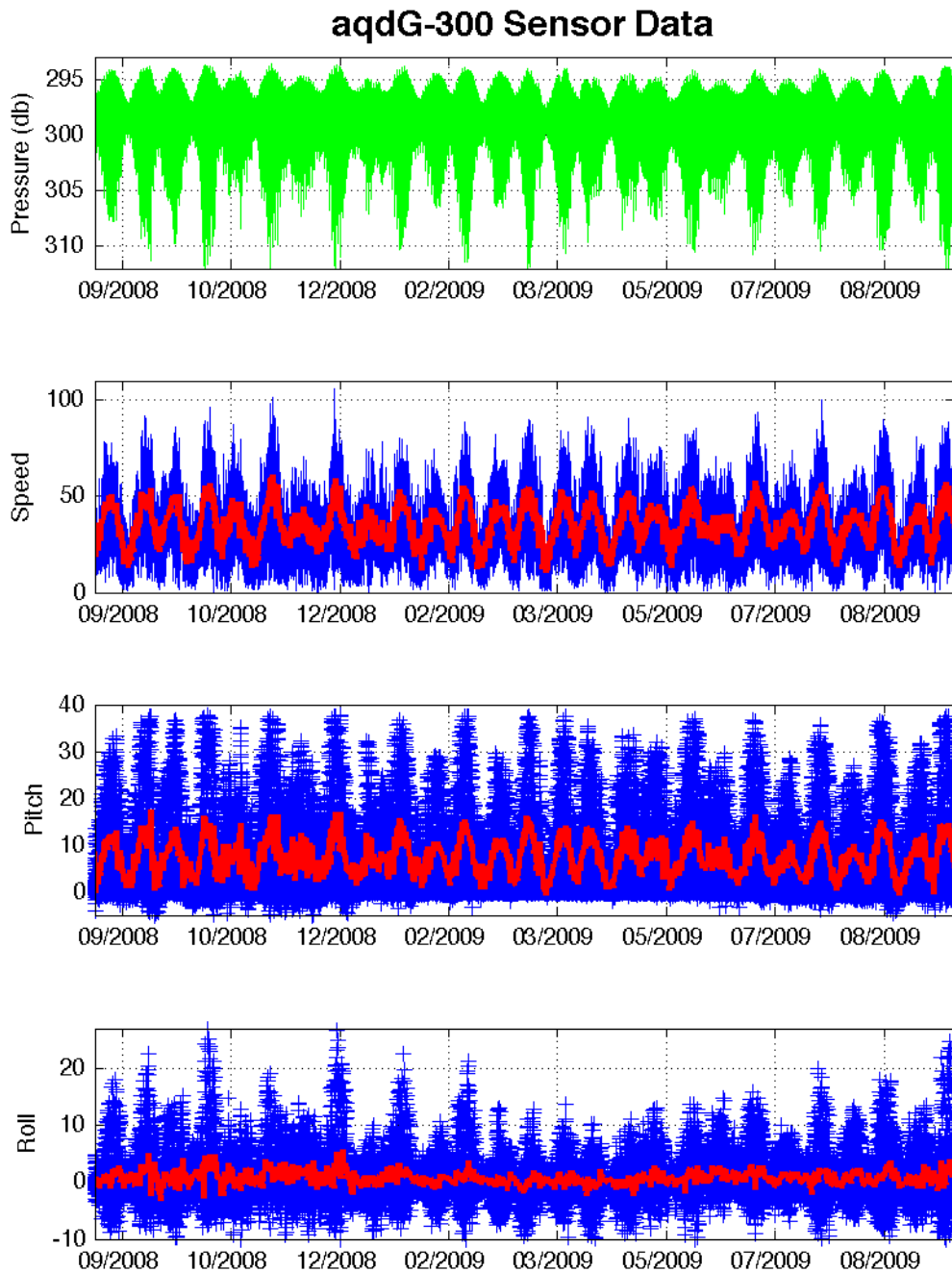


Figure 24: Nortek Aquadopp sensor data at 300 meters. Top panel is pressure (dbar), second panel is speed (cm/s), third panel is pitch, and bottom panel is roll. For the bottom three panels, the blue represents each 20-minute measurement and the red line represents measurements at a six-hour interval.

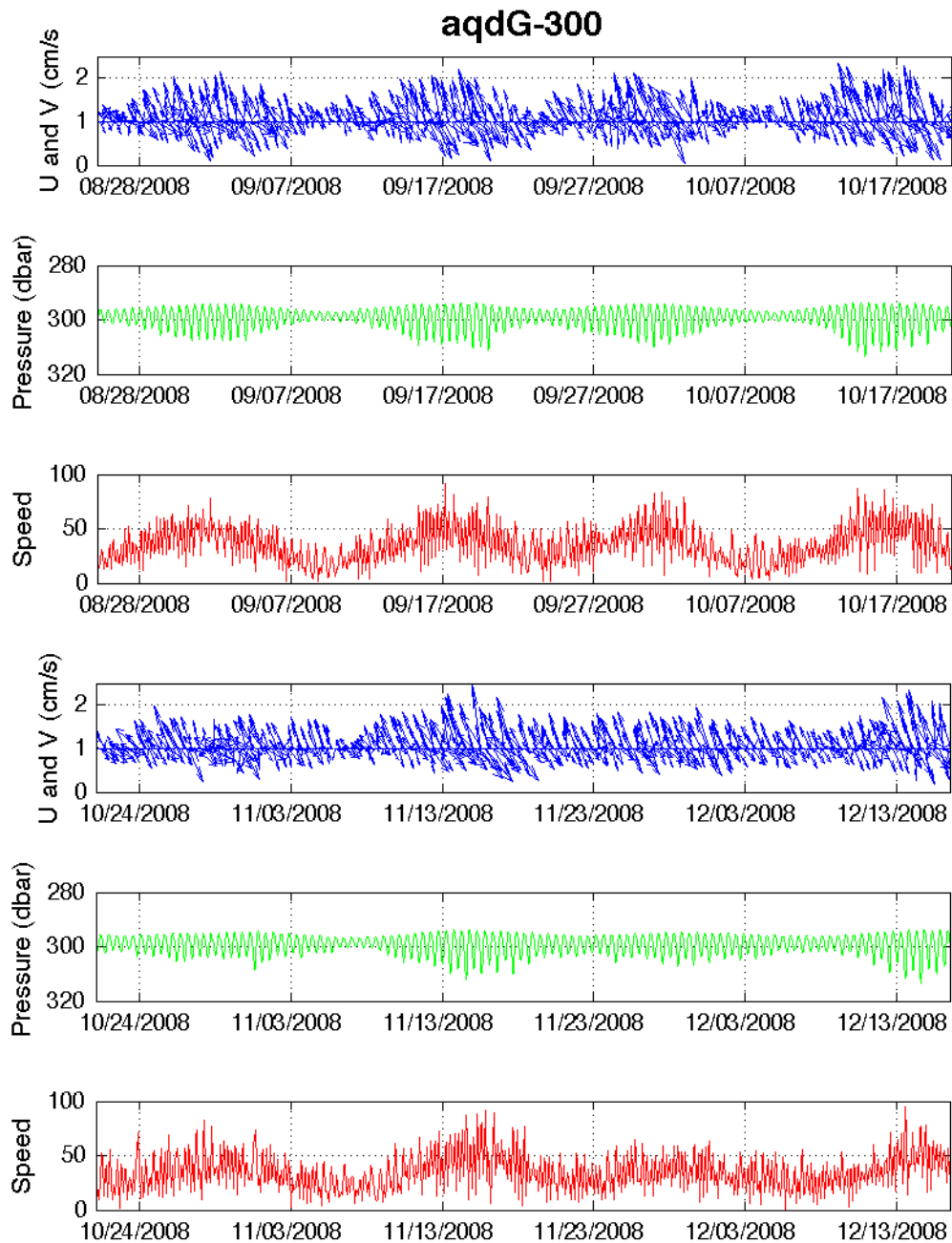


Figure 25: Nortek Aquadopp velocity (cm/s), pressure (dbar), and speed (cm/s) data at 300 meters at one-hour intervals. Top three plots are from August 28, 2008 to Oct 20, 2008. Bottom three plots are from October 20, 2008 to December 16, 2008.

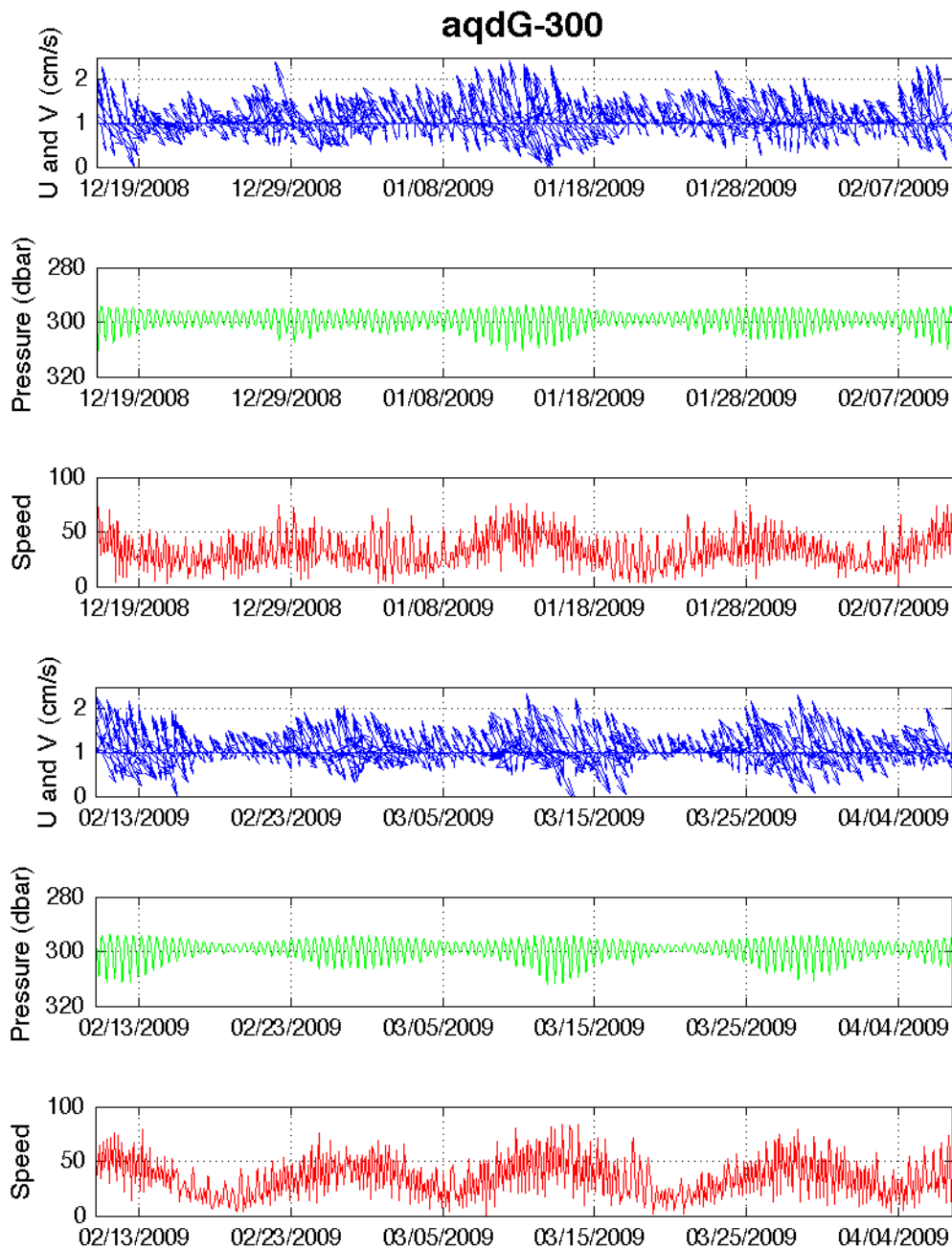


Figure 26: Nortek Aquadopp velocity (cm/s), pressure (dbar), and speed (cm/s) data at 300 meters at one-hour intervals. Top three plots are from December 16, 2008 to February 10, 2009. Bottom three plots are from February 10, 2009 to April 7, 2009.

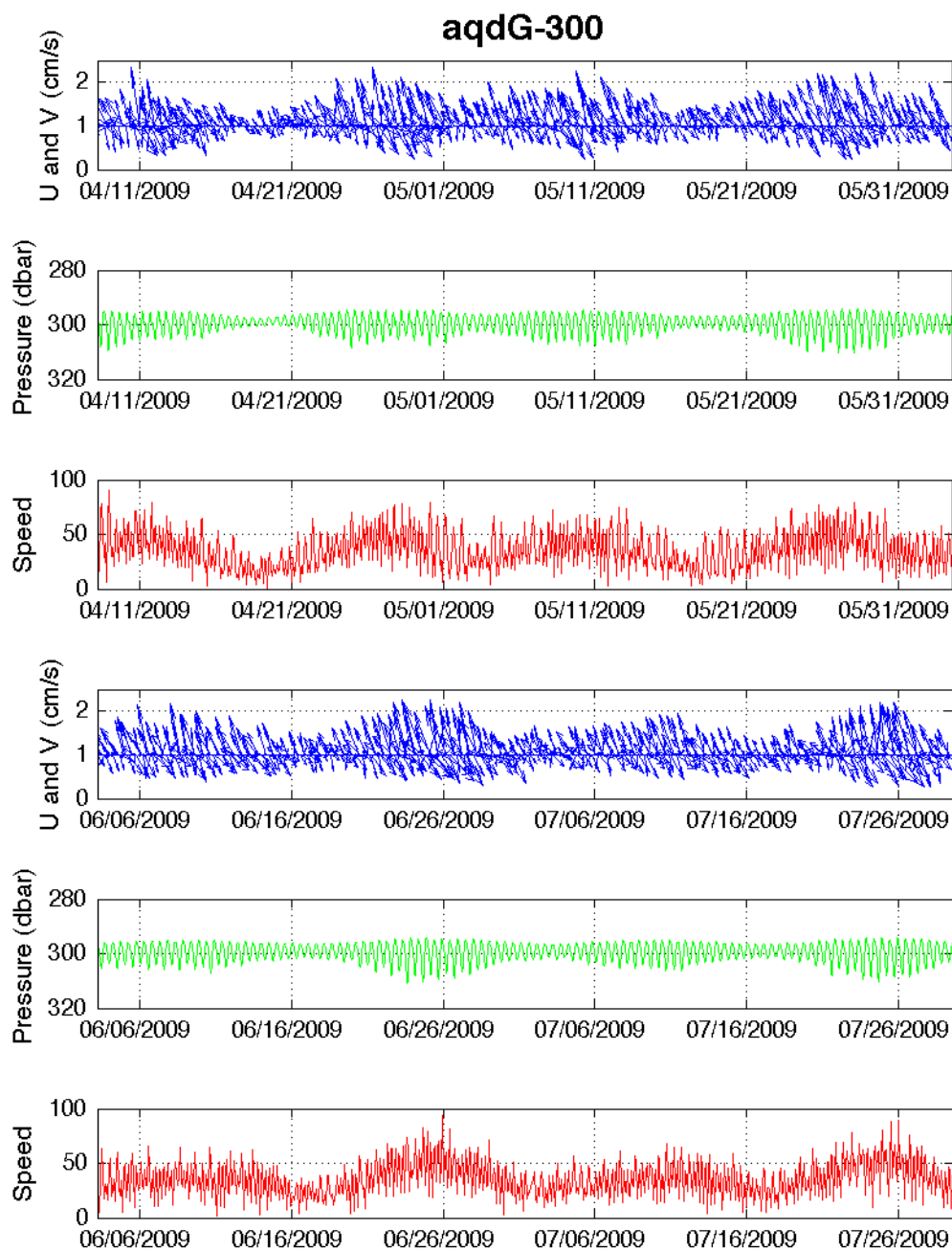


Figure 27: Nortek Aquadopp velocity (cm/s), pressure (dbar), and speed (cm/s) data at 300 meters at one-hour intervals. Top three plots are from April 7, 2009 to June 3, 2009. Bottom three plots are from June 3, 2009 to July 29, 2009.

REPORT DOCUMENTATION PAGE	1. REPORT NO. WHOI-2018-01	2.	3. Recipient's Accession No.
4. Title and Subtitle Pathways for the Export of Arctic Change into the North Atlantic August 2008 - September 2009 Data Report		5. Report Date January 2018	
7. Author(s) Andree L. Ramsey and Fiamma Straneo		6.	
9. Performing Organization Name and Address Woods Hole Oceanographic Institution Woods Hole, Massachusetts 02543		8. Performing Organization Rept. No.	
12. Sponsoring Organization Name and Address		10. Project/Task/Work Unit No.	
		11. Contract(C) or Grant(G) No. (C) (G)	
		13. Type of Report & Period Covered Technical Report	
		14.	
15. Supplementary Notes This report should be cited as: Woods Hole Oceanographic Institution Technical Report, WHOI-2018-01.			
16. Abstract (Limit: 200 words) The goal of the Pathways for the Export of Arctic Change into the North Atlantic project was to measure the exchange between the Hudson Bay System and the Labrador Sea, which occurs in the Hudson Strait. This exchange is of climactic relevance since a large amount of fresh water flows through the Hudson Strait into the Labrador Sea, where it can modulate the exchange of heat with the atmosphere. It is also of regional importance since the exchange influences the climate of Hudson Bay, which is home to a large indigenous population. The project consisted of deploying four subsurface moorings, over a one-year period, beginning August 2008 and ending September 2009. The moorings were positioned across the strait with Mooring A located on the south side and Moorings E, F, and G on the north side. The moorings were equipped with instruments to measure conductivity, temperature, pressure, ice draft and velocity.			
17. Document Analysis a. Descriptors Hudson Strait Hudson Bay Labrador Current b. Identifiers/Open-Ended Terms c. COSATI Field/Group			
18. Availability Statement Approved for public release; distribution unlimited.	19. Security Class (This Report) UNCLASSIFIED	21. No. of Pages 54	
	20. Security Class (This Page)	22. Price	