CCGS Amundsen 2009 Field Program

ArcticNet / IORVL Partnership

MetOcean Data Report

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December 4, 2009

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Executive Summary

This document represents the data report for datasets collected by researchers based at the Centre for Earth Observation Science (CEOS), University of Manitoba, under the Sea Ice and MetOcean components of the ArcticNet Network for 2009. Our group is actively involved in research that revolves around improving our understanding of ocean-sea ice-atmosphere dynamic and thermodynamic coupling, as well as how this coupling impacts the ecology of the sea ice, and the waters immediately beneath. We employ a large ensemble of ship-based sensors, and physical sampling equipment that collect sensor-based atmospheric, oceanic and sea ice data. Our data collection efforts are driven by many interlinked objectives. Objectives relevant to our partnership with Imperial Oil Research Ventures Limited (IORVL), and corresponding data collection during 2009 are as follows:

1) **Ocean:** Describe the nature of currents, salinity, temperature, and associated physical variables in the southern Beaufort Sea, and over the IORVL/Exxon exploration block (Ajurak).
2) **Sea Ice:** Describe the aerial concentration, type, growth history, strength and periodicity of sea ice in the southern Beaufort Sea, and over Ajurak.
3) **Atmosphere:** Describe the magnitude and variability of key meteorological variables over the ocean and relative to adjacent land stations.
4) **Coupling:** Provide data on the key coupling mechanisms across the OSA (has this been defined yet?) interface with a particular emphasis on fluxes of mass, energy and momentum.

Field research and data collection activities relevant to these objectives were conducted from the Canadian Coast Guard Ship *Amundsen* (hereafter referred to as "CCGS *Amundsen"*), a research icebreaker, From 15 July to 15 October 2009, our group conducted a variety of sampling activities in the Southern Beaufort Sea, and within the Ajurak Block including, but not limited to: aerial ice thickness surveys passive and active microwave scanning of sea ice, buoy deployment (three surface buoys, two ice mass balance buoys, 14 position-only drift buoys), synoptic meteorology (41 weather balloons, atmospheric profiling, cloud type and coverage), and micrometeorology (radiation, *in situ* meteorology), and ocean sampling (roughness, currents, conductivity-tempearture-density profiling).

Our comprehenisve research program also included *in situ* observations of interesting scientific phenomenom representative of the changing Arctic sea ice regime. The most prominent was the discovery of a discrepency between ice charts (classified using Radarsat SAR imagery), and *in situ* ice observations. Heavily decayed rotten first-year (FY) sea ice, interspersed with thin new ice, and open water was found to have a very similar microwave signature to that of multi-year (MY) ice during late summer (August / September) when ocean, sea ice and atmospheric temperatures are similar. This resulted in the rotten ice being incorrectly classified as old, thick MY ice (Barber et al., 2009 *in press*). MY floes that were present were weak, and susceptible to large-scale break-up from intruding long-wave storm swells. On 6 September 2009, we observed large MY floes break-up in this manner *in situ*, and attributed it to a large stationary cyclone generating large long-wave swells over an anomolously large region of open water in the Canada Basin (Asplin et al., 2010, *in prep*).

ArcticNet 2009 Data Use Policy

All data described in the document hereafter was collected during the 2009 ArcticNet / IORVL partnership field season. The Centre for Earth Observation Science shall make all datasets available upon request to IORVL, pending resolution of quality-assurance related issues. Telemetry from ice beacons deployed during the 2009 field season is expected to continue into 2010, and updates to these datasets will be made available to IORVL at a later date.

All other data access requests shall be addressed to Dr. David Barber at the Centre for Earth Observation Science, University of Manitoba (dbarber@cc.umanitoba.ca). CEOS retains exclusive rights to all data collected during the field season. Field members have first rights to the data for a period of 2 years, followed by non-field participants. Please reference use of any material in this report as follows:

Section 5.3. Temperature and Water Vapour Profiling Radiometer, *in* Asplin M.G., and Candlish, L.M. T. (Eds.) *CEOS-TEC-2009-12-04. pp. 162-171.*

Acknowledgements

First and foremost, we would like to acknowledge the support and expertise of the hardworking crews of the Research Icebreaker CCGS *Amundsen*. Our sincere gratitude is extended to Captains Stéphane Julien, and Marc Thibault. Their patience and expertise was paramount to the success of the 2009 partnership field season.

We also would like acknowledge IORVL for providing funding for the 2009 ArcticNet Cruise, and for the MetOcean team's operations and equipment. This represents a major Arctic science research and discovery partnership between industry and ArcticNet.

We are indebted to Keith Levesque, ArcticNet's Shipbased Research Coordinator, for his tireless efforts, dedication and investment in the preparation of this very challenging 2009 expedition. From community consultations, to research licensing, to planning workshops, to ship mobilization, crew changes, security clearances and the numerous needs of dozens of demanding research groups rotating onboard the ship, a colossal amount of work is involved in the preparation of such an expedition. Thanks to Keith and all who helped him with the preparation of this 2009 expedition.

We would also like to thank Martin Fortier, Executive Director of ArcticNet, for his dedication to ArcticNet, and in particular for the support and energy that he extended toward the planning and implementation of the 2009 field season. Last but not least, we would also to acknowledge his contributions to the field season overview in this data report (section 1.1).

Several government agencies contributed to the success of the 2009 ArcticNet / IORVL partnership field season in the Southern Beaufort Sea. These include the Natural Sciences and Engineering Council (NSERC), the Canada Research Chairs Program (CRC), the Networks of Centres of Excellence Program (NCE), Northern Scientific Training Program (NSTP), Department of Indian and Northern Affairs Canada (INAC), the Canadian Ice Service (CIS), the Canadian Space Agency (RADARSAT-1, RADARSAT-2), the European Space Agency (ESA), the National Aeronautics and Space Administration (NASA), Environment Canada (EC), the Meteorological Service of Canada (MSC), the Department of Fisheries and Oceans (DFO), and the Canadian Coast Guard (CCG).

Title page credit: Doug Barber

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SECTION ONE: INTRODUCTION

1.1 Preface

The Beaufort Sea/Mackenzie Shelf region of the Arctic Ocean has witnessed major changes in recent years, with decreasing sea ice cover and major shifts in sea-ice dynamics. Although major inshore research activities were conducted in the 70's and 80's in large part due to the Oil & Gas interest in the regions, much less is known about the offshore region of the Mackenzie Shelf, shelf slope and Beaufort Sea.

Since 2002, ArcticNet has been conducting extensive multidisciplinary research programs in the area. In addition to an annual fall sampling program, ArcticNet researchers have led two major international overwintering research programs conducted onboard the CGGS *Amundsen* in 2003-2004 (CASES program) and in 2007-2008 (CFL program). A marine observatory of a minimum of 5 oceanographic annual moorings (from 5 to 17 moorings) has been deployed and retrieved annually in the area by ArcticNet researchers since 2002.
Recent interest in the Beaufort Sea has resulted in major bids from industry on offshore exploration licenses (EL) located in the 50 – 1500 m depth range of the shelf and shelf break. Of particular relevance to the 2009 expedition is EL446 (called Ajurak) awarded to Imperial Oil in 2007 (see Figure 1).

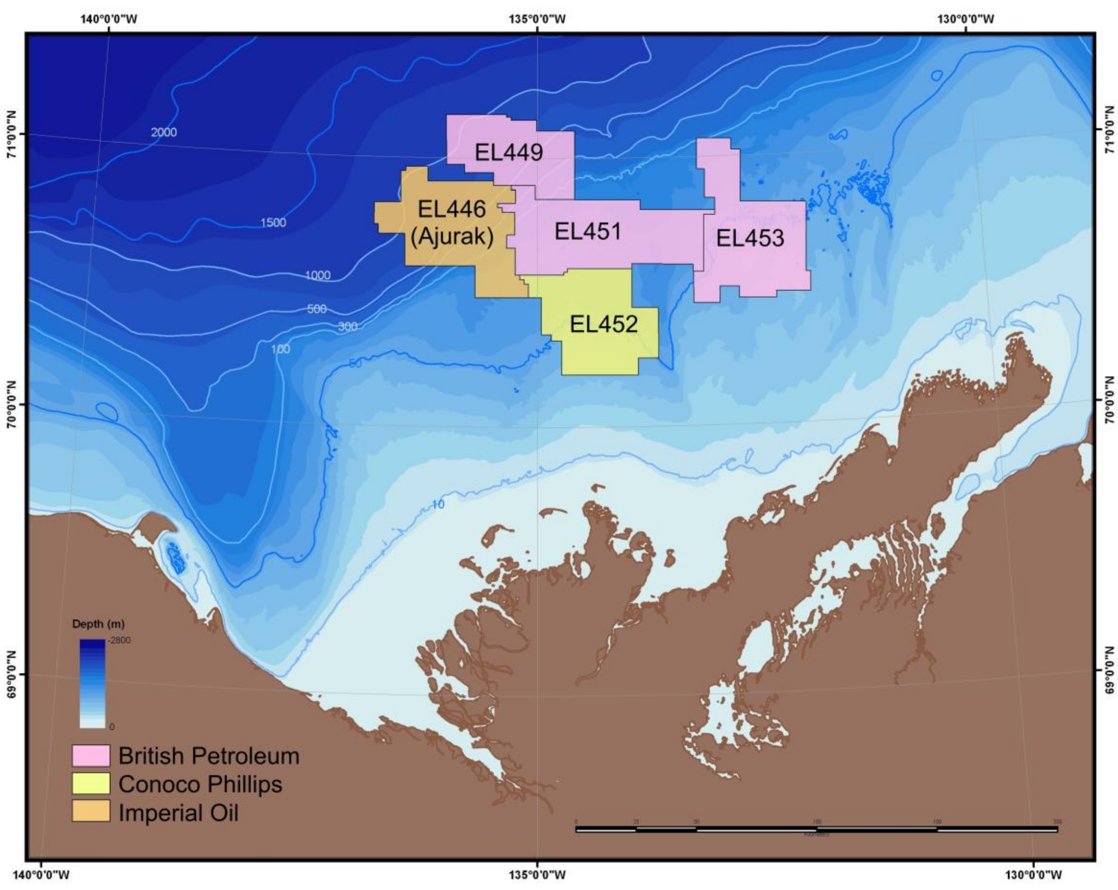

Figure 1: *Map of offshore Exploration Licenses (EL) awarded by the Department of Indian and Northern Affairs in 2007 and 2008 (modified from image courtesy of GSC).*

During the summer of 2009, the CCGS *Amundsen* provided the platform for research conducted under ArcticNet, MALINA (Laboratoire d'Océanographie de Villefranche), GEOTRACES (a Canadian-led IPY project), and the newly formed partnership between ArcticNet and Imperial Oil Resource Ventures Ltd (IORVL) (herein the "Partnership"). This partnership not only forms an important link between industrial and scientific initiatives, but also has extended the duration of valuable data collection and sampling activities in the Western Arctic from two months to five months.

The Partnership has been established as the result of the concurrent need for resources and research within the offshore Northern Oil and Gas lease regions. Under the agreement, IORVL will provide operating and logistic financial support for the CCGS *Amundsen,* and will allow for the consolidation of environmental and risk-assessment research efforts. Active ArcticNet sampling programs, such as ice geophysics and dynamics, ice distribution and thickness and bottom mapping, are of particular interest to IORVL for the reasoning and development of potential future offshore drilling platforms in the Southern Beaufort Sea. The CCGS *Amundsen* cruise sampling timeline for 2009 is organized into segments, referred to as 'legs.' A summary of the legs is provided in Table 1.

Table 1: *Summary of CCGS Amundsen 2009 Legs.*

LEG	Start	Finish	Program	Sampling Area
Leg 1a	04 June	30 June	ArcticNet / IORVL Partnership	*TRANSIT – from Quebec City to Victoria, BC*
Leg 1b	04 July	16 July	ArcticNet / IORVL Partnership	*TRANSIT* – from Victoria, BC to Sachs Harbour, NT
Leg 2a	16 July	30 July	ArcticNet / IORVL Partnership	Southern Beaufort Sea (Ajurak Block)
Leg 2b	30 July	27 Aug	MALINA / ArcticNet	Southern Beaufort Sea (open water transects)
Leg 3a	27 Aug	12 Sept	IPY-GEOTRACES / ArcticNet	Beaufort Sea (transect into the pack ice)
Leg 3b	12 Sept	08 Oct	ArcticNet / IORVL Partnership	Southern Beaufort Sea (Ajurak Block)
Leg 4a	08 Oct	06 Nov	ArcticNet	NW Passage, Baffin Bay, Iqaluit
Leg 4b	06 Nov	18 Nov	ArcticNet	Hudson Strait, Labrador Fjords

As part of a collaborative agreement between ArcticNet and IORVL one of the major goals of the 2009 ArcticNet expedition to the western Arctic was to increase the level and spatial coverage of sea-ice, geological and environmental data collected by the ArcticNet network in the Beaufort Sea/Mackenzie Shelf/Amundsen Gulf region (regional context) with a special focus placed in and around Ajurak.

As designed jointly by ArcticNet and IORVL, the research elements of the collaborative work are divided into 3 major research components:

1) Met/Ocean & Sea Ice Component: The overarching goal of this component is to provide data that describe the variability of met/ocean and sea ice variables within the Ajurak exploration block relative to the larger area of the southern Beaufort Sea continental shelf. The objective is to provide data on the ocean-sea ice-atmosphere (OSA) interface over a range of time and space scales, focusing on spatial and temporal variability over diurnal, seasonal and interannual time scales.

2) Environment & Marine Resources Component: The general goal of this component is to quantify and map the summer-fall distribution and contamination of the main compartments of the pelagic and benthic food webs along the slope of the Mackenzie Shelf, from the inner shelf (50 m) to the margin of the deep basin (approx. 1200 m), and from the Mackenzie Trough to the west to Cape Bathurst to the east with special focus on specific areas in Ajurak.

3) Geology/ Bathymetry Component: This component will conduct an investigation of seabed stability conditions to meet engineering design and regulatory requirements for exploration drilling. Seabed mapping and bottom sediment characterization research is required to investigate seafloor stability conditions at the outer shelf/upper slope area of the central Beaufort Sea with special focus on specific areas in Ajurak. Foundation conditions, slope stability, seabed features and ice scouring are also key issues to be addressed.

This data report is intended to describe and summarize datasets collected by the scientific team based at the Centre for Earth Observation Science, University of Manitoba (herein the “MetOcean Team”) for field activities conducted between 15 July and 15 October 2009. The MetOcean team was primarily dedicated to the Met/Ocean & Sea Ice Component of the 2009 CCGS *Amundsen* field program.

1.2 The MetOcean Team

The Principle Investigators of the MetOcean team are:

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The MetOcean team is comprised of multi-disciplinary research associates, technicians, and graduate students who are based at CEOS, University of Manitoba. These individuals were dedicated to one (or more) of the eight disciplinary MetOcean teams: Surface Buoys, Ocean and Sea Ice Optics, Surface Roughness, Helicopter Electromagnetic Induction Surveys (HEMI), Remote Sensing, Sea Ice Physics, Micrometeorology, and Synoptic Meteorology. Team members were tasked with sampling activities, based upon sampling priorities established for each leg of the cruise. Table 2 provides a summary of the sampling priority for each of the disciplines for the cruise schedule, as some legs will favor some groups over others depending on data collection priorities and sea ice conditions.

Table 2: *MetOcean science priorities by leg*

Leg	GROUPS
2A	HEMI Ice Surveys, Surface Buoys, Micrometeorology, Meteorology, Optics*
2B	Micrometeorology, Meteorology
3A	HEMI Ice Surveys, Micrometeorology, Meteorology, Remote Sensing, Sea Ice Physical Sampling, Surface Roughness, Ice Mass Balance Buoy deployment, Optics*
3B	HEMI Ice Surveys, Surface Buoys, Micrometeorology, Meteorology, Remote Sensing, Sea Ice P&M, Surface Roughness,
4A	HEMI Ice Surveys, Meteorology, Micrometeorology, Remote Sensing, Ice Mass Balance Buoy deployment

*****Optics program data is not included in this report.

1.3 Data Report Outline

Section 1 provides a brief introduction to the partnership between CEOS and IORVL, and sets the context for the report.

Section 2 summarizes the mobilization, crew changes, transit, and science activities of the CCGS *Amundsen*'s 2009 field season as conducted.

Sections 3, 4 and 5 present a detailed summary of ocean, sea ice, and meteorology datasets respectively. Datasets are organized into instrument-specific sub-sections and include descriptions of instrumentation, data collection methodology, and data files. Datasets that involved continuous sampling (e.g. basic meteorological data) are inventoried by date range, and site-specific datasets are inventoried in tabular format.

Section 6 provides information on other available datasets, such as navigation and science logs. A summary of available Radarsat-1 and Radarsar-2 Side Aperture Radar (SAR) products is also provided as guidance for ordering of imagery.

Appendix A contains copies of all MetOcean science update e-mails, as per the IORVL / MetOcean Field Communication Plan.

Appendix B contains the science activities log, including information on stations, positions, sampling activities, and observed weather and ice conditions (as monitored by the watch officer). Since time at a particular station can vary from hours to days, we refer the reader to Appendix B for station-specific information.

Appendix C summarizes the temporal coverage of all MetOcean datasets in chart-form in**.**

Dates are presented in international format (07 July 2009).

Times are presented are UTC (HH:MM:SS) unless otherwise noted as local standard time (LST).

Geographic positions within the dataset may be record in either degrees, decimal-minutes (DD°MM.MMM'), or decimal-degrees (DD.DDDDD°). Although decimal-degree format is highly preferred (mapping, analysis, etc), geographic positions in this report will appear as recorded.

SECTION TWO: CRUISE SUMMARY

2.1 Mobilization

Mobilization of the ship commenced on 21 May 2009. The majority of instrumentation and supplies were placed and secured on the ship prior to launch from Quebec City, QC on 04 June 2009. There were some notable exceptions: The positioners for the C-Band scatterometer and Ship-Based Radiometers required extensive diagnostics and servicing, and thus these instruments were loaded on the ship during the secondary mobilization in Victoria B.C. Two AXYS 3m discus buoys, and two accompanying surface buoys were also shipped to Victoria. Three ice mass balance buoy systems were shipped to Victoria B.C. with the fourth system being transported to the ship as cargo during the full crew change on 27 August 2009. 24 Oceanetics ice drift beacons were shipped directly to the ship from the supplier.

During mobilization activities in Victoria, it became apparent that only one of the AXYS Discus Buoys could be safely stowed and handled (the aft cranes were not tall and long enough to reach the buoys when located on the helideck behind the stacked containers. For the same reason, and also because the roof tops of the containers were not reinforced, the buoys could not be put on top of these containers). Finally one buoy was secured on top of the cargo hatch in front of the ship. The MetOcean team's air-ice boat (damaged from storm spray from Hurricane Andres during Leg 1a) was also removed due to ship storage constraints.

2.2 Ship Berths and Personnel

MetOcean data collection activities were staffed by CEOS personnel appropriate to the eight discipline-specific MetOcean sub-teams (Table 3).

Table 3: *MetOcean Berth Allocations by Sub-Discipline*

PRIORITY →	LEG 1A TRANSIT	LEG 1B TRANSIT	LEG 2A AJURAK	LEG 2B MALINA	LEG 3A GEOTRACES	LEG 3B AJURAK	LEG 4a NWP
Chief Scientist	N/A	Jean-Eric Tremblay	Martin Fortier	Marcel Babin	David Barber*	Tim* Papakyriakou	Keith Levesque
SEA ICE	x	x	John Iacozza	x	Kerri Warner	Mukesh Gupta	Ryan Galley
	x	x		x	Monika Pucko		
	x	x		x	Ryan Galley		
SYN. MET	x	Lauren Candlish	Matt Asplin	Meredith Pind	Matt Asplin	Lauren Candlish	Kerri Warner
	x	D. Babb	Chris Stammers				
	x						
SFC RGH	x	Klaus Hochheim	Tao Li	x	Mukesh Gupta	Mukesh Gupta	X
	x			x	x		X
	x			x	x		X
OPTICS**	x	x	Tao Li	x	x	Tao Li	X
	x	x	Chris Stammers	x	x	Klaus Hochheim	X
	x	x		x	x		X
REM. SENS.	x	Klaus Hochheim	x	x	Mukesh Gupta	Klaus Hochheim	Ryan Galley
	x	Kerri Warner	x	x	Kerri Warner		Kerri Warner
	x		x	x			
HEMI	x	John Iacozza	John Iacozza	x	Ryan Galley	Klaus Hochheim	Ryan Galley
	x	Klaus Hochheim	Chris Stammers	x	Simon Prinsenberg		
	x						
Micromet. Tower	x	Brent Else	Brent Else	Meredith Pind	Kyle Swystun	Emmelia Stainton	Emmelia Stainton
	x	Meredith Pind	Tim Papakyriakou				
		Emmelia Stainton	Vlad Petrusevich				
AXYS Buoys	x	x	Tim Papakyriakou	x	x	Emmelia Stainton	x
	x	x	Brent Else	x	x		x
			Vlad Petrusevich	x	x		x
Total berths allocated for MetOcean Team	0	8	7	1	8	6	3

*Note: David Barber was chief scientist on Leg 3a, and Tim Papakyriakou was chief scientist on Leg 3b. They are included in the total MetOcean berth count for those legs, and participated in science activities when their schedules permitted.
**Optics data is not included in this report.

2.3 Crew Changes

Full crew changes occurred at the end of each 6-week period, and involved full rotation of the Canadian Coast Guard Crew and a number of science personnel. A mid-leg crew change occurred once in each leg, and were for science personnel only. During full crew changes, a Boeing 737 was chartered from Quebec City, to Inuvik for Canadian Coast Guard crew and researchers. For mid-leg crew changes, researchers traveled commercially to Inuvik or Iqaluit. Arrangements were made by ArcticNet for smaller aircraft charters to get people from Inuvik to Paulatuk for all crew changes (Table 4). Personnel were then shuttled to and from the ship via helicopter or by launch vessel.

Table 4: *Summary of science rotation travel:*

Date	Transport to and from the CCGS *Amundsen*
30 June, 2009	Fly commercially to Victoria to board ship
16 July, 2009	ArcticNet charter between Quebec City and Inuvik, small aircraft charters between Inuvik and Sachs Harbour
30 July, 2009	Fly commercially to/from Inuvik day prior/after crew change, small aircraft charters between Inuvik and Sachs Harbour
27 August, 2009	ArcticNet charter between Quebec City and Inuvik, small aircraft charters between Inuvik and Paulatuk
12 September, 2009	Fly commercially to/from Inuvik day prior/after crew change, small aircraft charters between Inuvik and Paulatuk
08 October, 2009	ArcticNet charter between Quebec City and Inuvik, small aircraft charters between Inuvik and Paulatuk
06 November, 2009	Fly commercially to/from Iqaluit day prior/after crew change
18 November, 2009	Return commercially from Quebec City

2.4 Cruise Summary by Leg

Each Leg was comprised of a series of science sampling station (hereafter referred to as 'stations'). The duration of each station depended on the sampling regime. A set number of anticipated stations were outlined for each leg and form the basis of the sampling strategy for the 2009 cruise. Sampling operations at a given station vary by leg, research program, and environmental conditions (i.e. sea ice cover, sea state) but a general description can be found below:

- "CTD" **(C)** stations, the shortest in duration, traditionally involve one CTD (profile with the ship-mounted Rosette). The duration will depend on the depth, and by the inclusion of nutrient sampling, where bottles on the Rosette are closed at specific depths to obtain water for analysis.
- "Basic" **(B)** stations include a CTD profile plus nutrient sampling, box coring, plankton net tows, and vertical turbulence profiles, and typically require eight hours of sampling. On-ice sampling activities can be conducted if ice is present.
- "Full" **(F)** stations require anywhere between 18-24 hours and builds onto the Basic sampling activities. On-ice sampling activities can be conducted if ice is present.
- "Mooring" **(M)** stations entails a Full station plus the recovery and deployment of a mooring and possibly the Remotely Operated Vehicle (ROV).

2.4.1 Leg 1a – Transit: Quebec City to Victoria (04 June - 30 June, 2009)

Leg 1a saw the CCGS *Amundsen* leave port in Quebec City on 04 June, and sail south along the eastern seaboard, crossing the Caribbean Sea and through the Panama Canal to the Pacific, and northward along the coast to Victoria, BC (Figure 2). Due to numerous encounters with bad weather (e.g. Category 1 Hurricane Andres), the ship arrived in Victoria on 01 July, two days behind schedule.

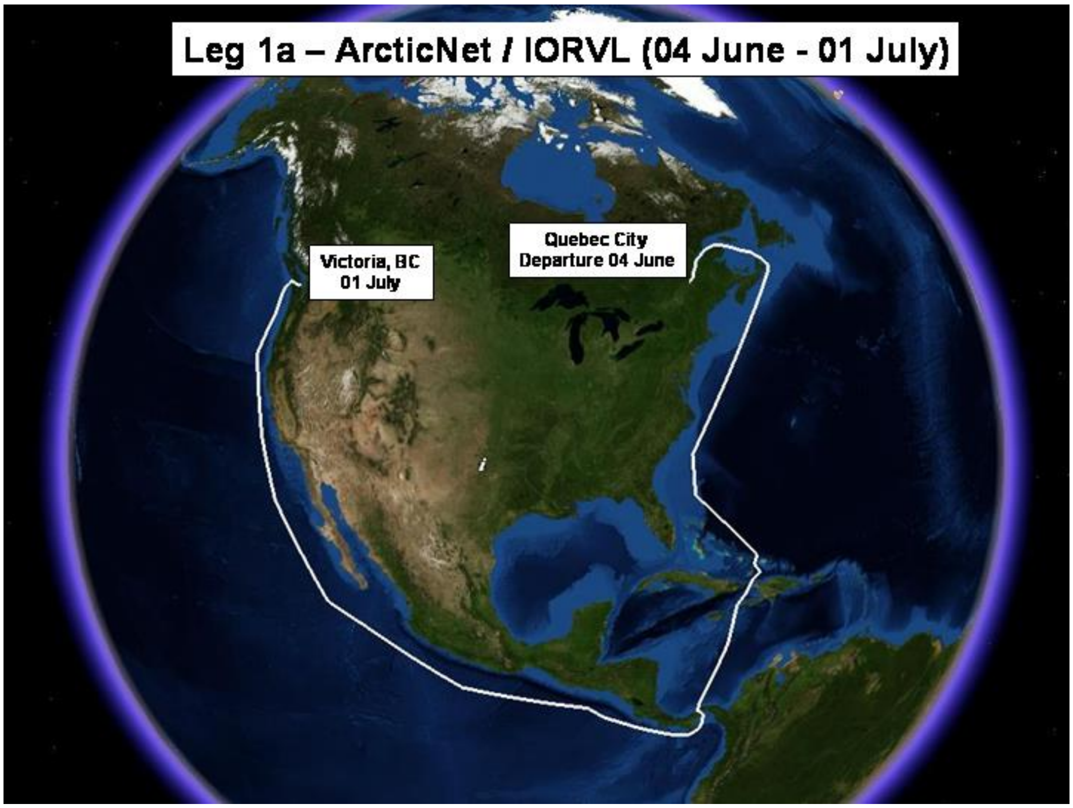


Figure 2: *Cruise Path for Leg 1a: 04 June – 01 July 2009.*

No members of the MetOcean team were on board the ship during leg 1a.

2.4.2 Leg 1b – Victoria to Beaufort Sea (04 July – July 16, 2009)

The ship departed Victoria on 04 July 2009 at 20:00 LST, and transited at 16 knots to compensate for the dealys in Victoria, and the delay caused by hurricane Andrès in the Pacific. The Amundsen was dispatched briefly for Search and Research at around 21:00 LST in the evening of 04 July, but this did not significantly alter the ship's course. The Amundsen was released from SAR the following afternoon, and continued it's transit to the western Beaufort Sea (Figure 3).

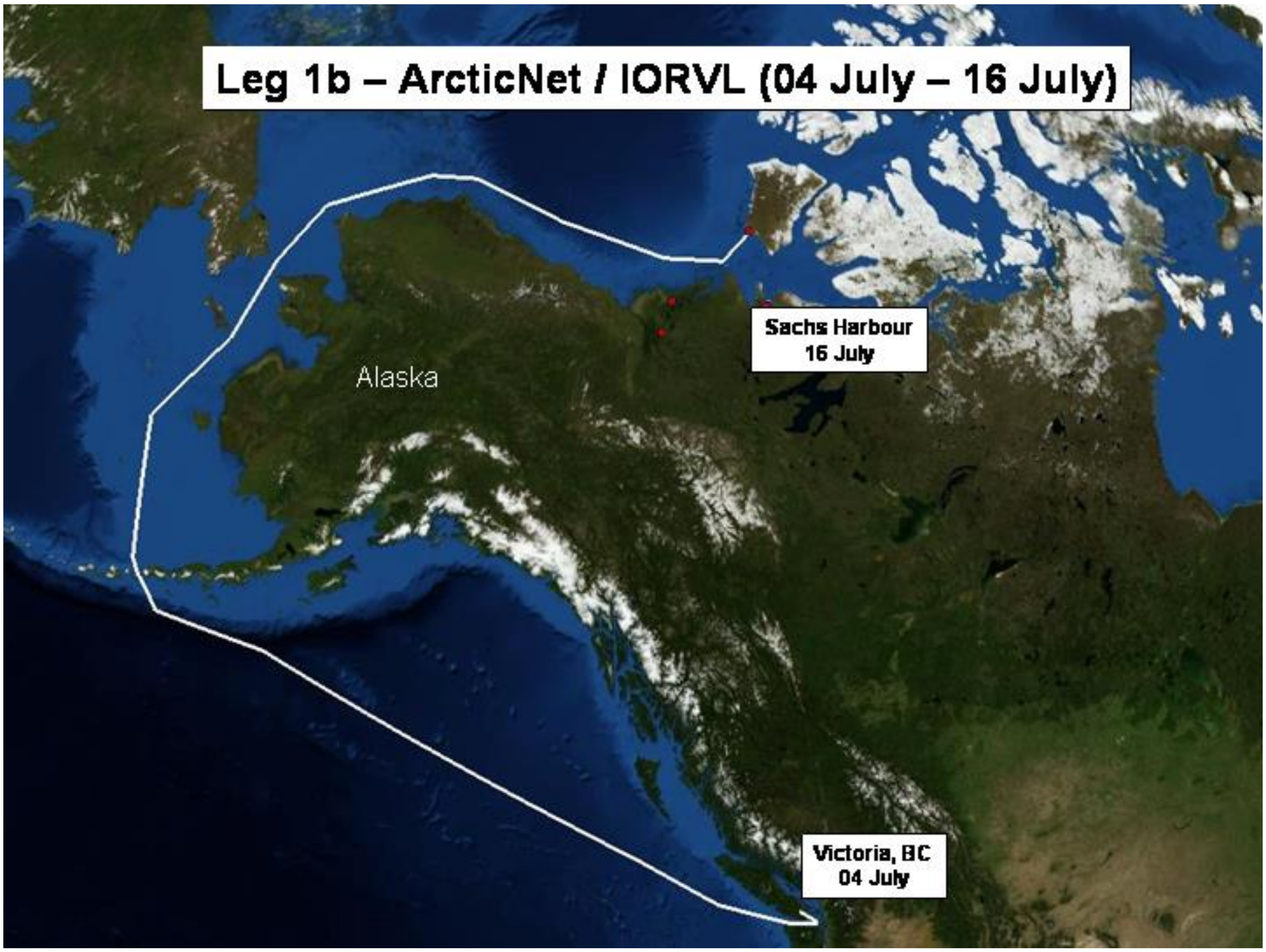


Figure 3: *Cruise Path for Leg 1b: 04 July – 16 July, 2009.*

Science activities were mainly limited to underway sampling during transit. Underway sampling operations included (1) water collection from the ship's clean intake (using the outlet in the benthos lab) three times day (09:00, 13:00, 18:00 LST), (2) radiometer measurements from the top bridge tower after 11 July, (3) measurements from the met tower on the foredeck after 13 July, (4) sampling for air contaminants from the top of the bridge after 10 July. At the request of scientists on board, Keith Levesque applied for a revised permit that would allow us to launch weather balloons and deploy the helicopter for EM scans in American waters, but the reply did not come in time for these activities to be performed. Very large numbers of walruses, densely aggregated on ice floes, were noted on 13 July.

During transit, several requests were made to the ship's crew to install, fix or modify scientific equipment. Several of those requests covered installations that had already been built during previous years, but were no longer on the ship, presumably due to their removal for dry dock operations. These requests included a bracket to hold the Met. tower on the foredeck, a rail to slide the EM scanner off the port bow, brackets to hold gas cylinders and various equipments on containers. The pump for the on-track $p\mathrm{CO_2}$ system was repaired and started, leading to a sizable flooding of the ship's bilge. The situation was corrected and the piping of the system was modified to include a temperature sensor.

The MetOcean meteorology program was impacted by the outage of the liquid nitrogen (LN_2) plant during Leg 1b. Ship technicians attempted to start the LN_2 plant during transit, but realized there was a helium leak in the system. The helium cylinder was empty and, since there was no more high-purity helium available on board, the plant could not be fixed during Leg 1b. A request was put in to bring a new cylinder on board at the next crew change.

2.4.3 Leg 2a – ArcticNet/IORVL Partnership (16 July – 30 July, 2009)

Leg 2a started on 16 July in Sachs Harbour with a full crew change. The CCGS *Amundsen* departed Sachs Harbour around 00:00 LST on 17 July, and reached the first sampling station (Station 1) at 02:00 on 18 July following a 26-hour, 230nm transit in heavy fog and often heavy ice conditions. For the next 11 days, the scientists and crew members of the CCGS *Amundsen* worked 24 hours a day to complete the ambitious cruise plan (Figure 4).

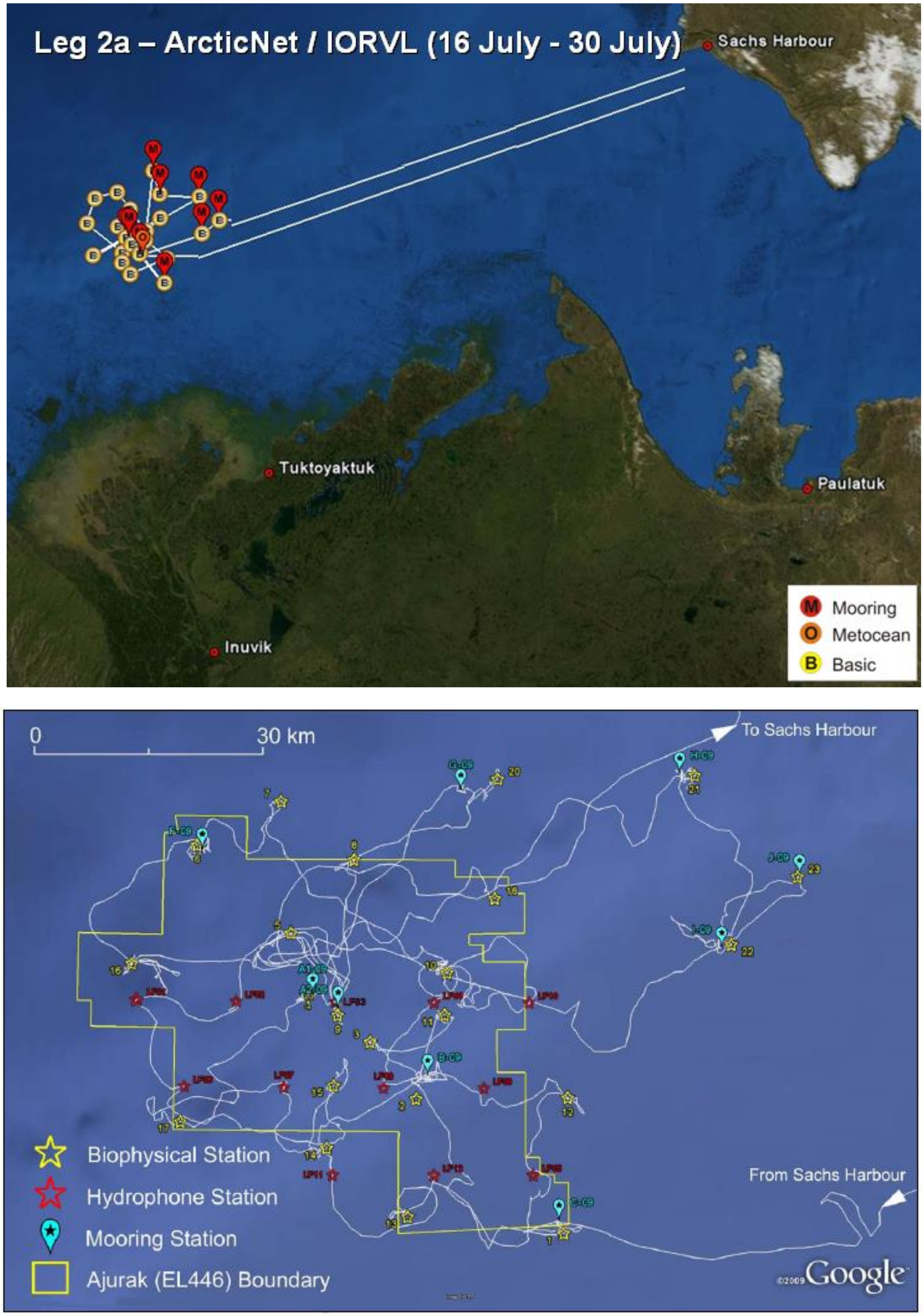


Figure 4: *(Top) Leg 2a cruise plan; (bottom) Ajurak Block cruise path during Leg 2a.*

During Leg 2a, nine sub-surface oceanographic moorings and 12 moored hydrophones were deployed. Sampling at 21 biophysical stations involved 24 CTD-Rosette casts, 21 vertical plankton net tows, 20 horizontal plankton net tows, 25 box-cores, 18 Agassiz trawl tows and one ROV deployment. Surface water sampling was conducted from the 7.33m Zodiac launch at basic and full stations. 14 radiosondes (meteorological balloons) were launched, three ice motion beacons were deployed (triangular configuration) and over 300 transects were sampled for sea ice thickness and surface roughness using the HEMI system. A multitude of oceanic and atmospheric parameters were measured continuously during the entire leg using the CCGS *Amundsen*'s extensive array of continuous samplers (SM-ADCP, EK-60 scientific echosounder, water surface pCO_2 and CTD on track system, foredeck and ship-mast Met. towers, ceilometer, microwave radiometers (atmospheric and downward-looking), all-sky camera, profiling radiometers). Sampling for Leg 2a ended on the evening of 28 July when the Amundsen began its transit back to Sachs Harbour for a scientific crew change on the morning of 30 July.

Seas were initially ice-free in waters surrounding Sachs Harbour, but it did not take long for the Amundsen to encounter large, first-year (FY) and multi-year (MY) ice floes of varying concentrations during transit to the Ajurak block (Figure 5). Ice floe sizes ranged from a few hundred meters, to several nautical miles in diameter. The presence of high ice concentrations is attributed to atmospheric and oceanic conditions during and prior to the Leg 2a cruise. A strong Beaufort High, centered west of the entrance to McClure Strait, produced weak (sometimes moderate) northerly winds throughout much of the month of July, and promoted normal anticyclonic rotation of the Beaufort gyre. This resulted in slow, steady southward and southwestward advection of sea ice, and yielded ice concentrations ranging from 5/10 to 9+/10 over much of the Ajurak block.

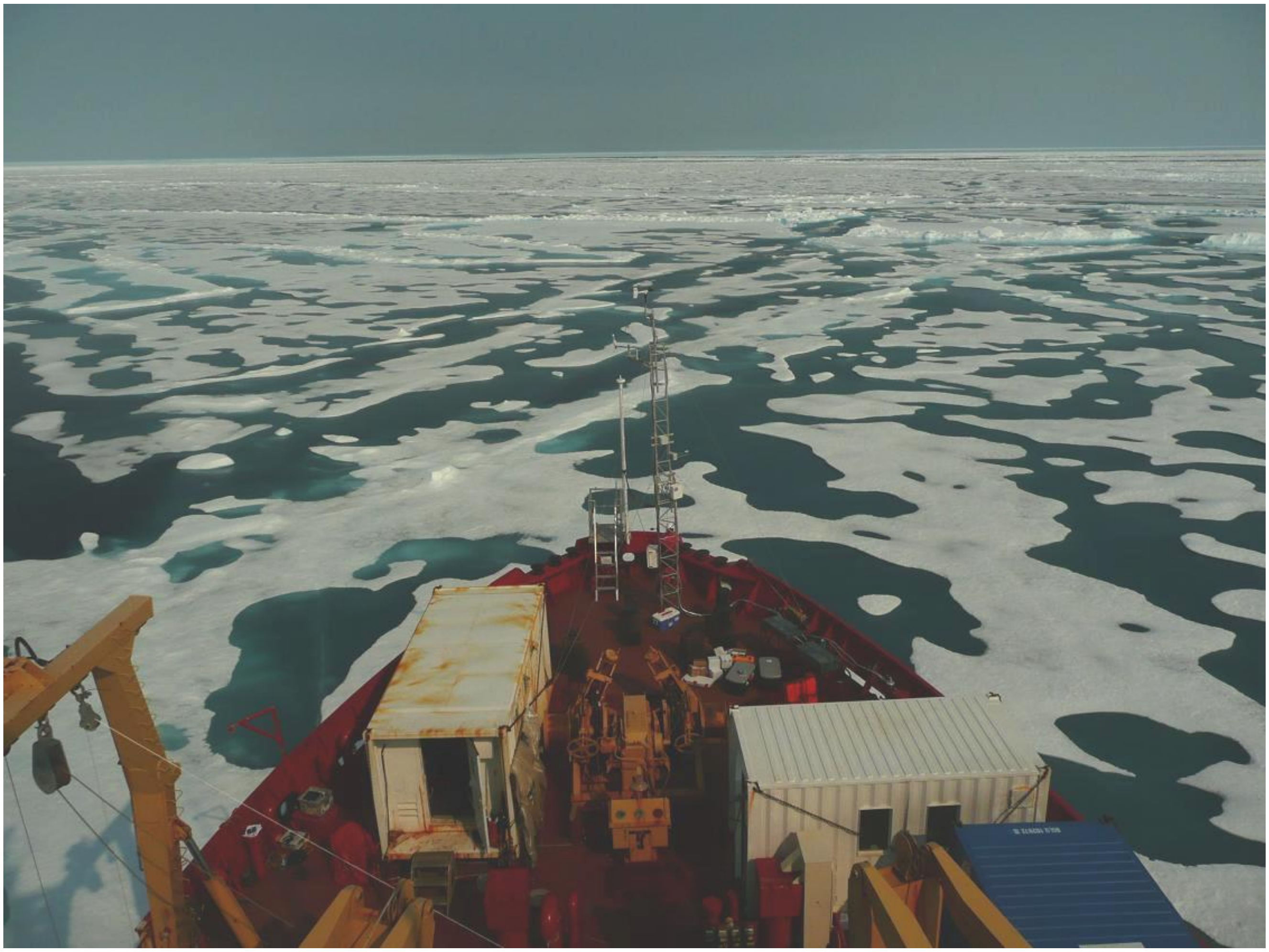


Figure 5: *Typical condition of large ice floes encountered: thick, first-year, or second-year ice, with ridging and melts ponds. (Photo by M.G. Asplin)*

Many of these ice floes showed evidence of a progressing melt season, with many melt ponds, some of which had melted straight through the floe (Figure 5). Ice thickness and roughness were assessed on EMI helicopter for Stations F-09, 05, 07, 12, 02, 20, and where the Cornell University hydrophones (Station HP) were deployed. In total, over 300 transects were sampled for sea ice thickness and surface roughness. All MetOcean underway meteorological sampling activities were operated continuously throughout Leg 2a.

2.4.4 Leg 2b – MALINA / ArcticNet (30 July – 27 August, 2009)

This 28-day leg of the expedition started in Sachs Harbour on July 30 and was mainly dedicated to the French-led MALINA program. MALINA sampling covered much of the Southern Beaufort Sea and Amundsen Gulf (Figure 6).

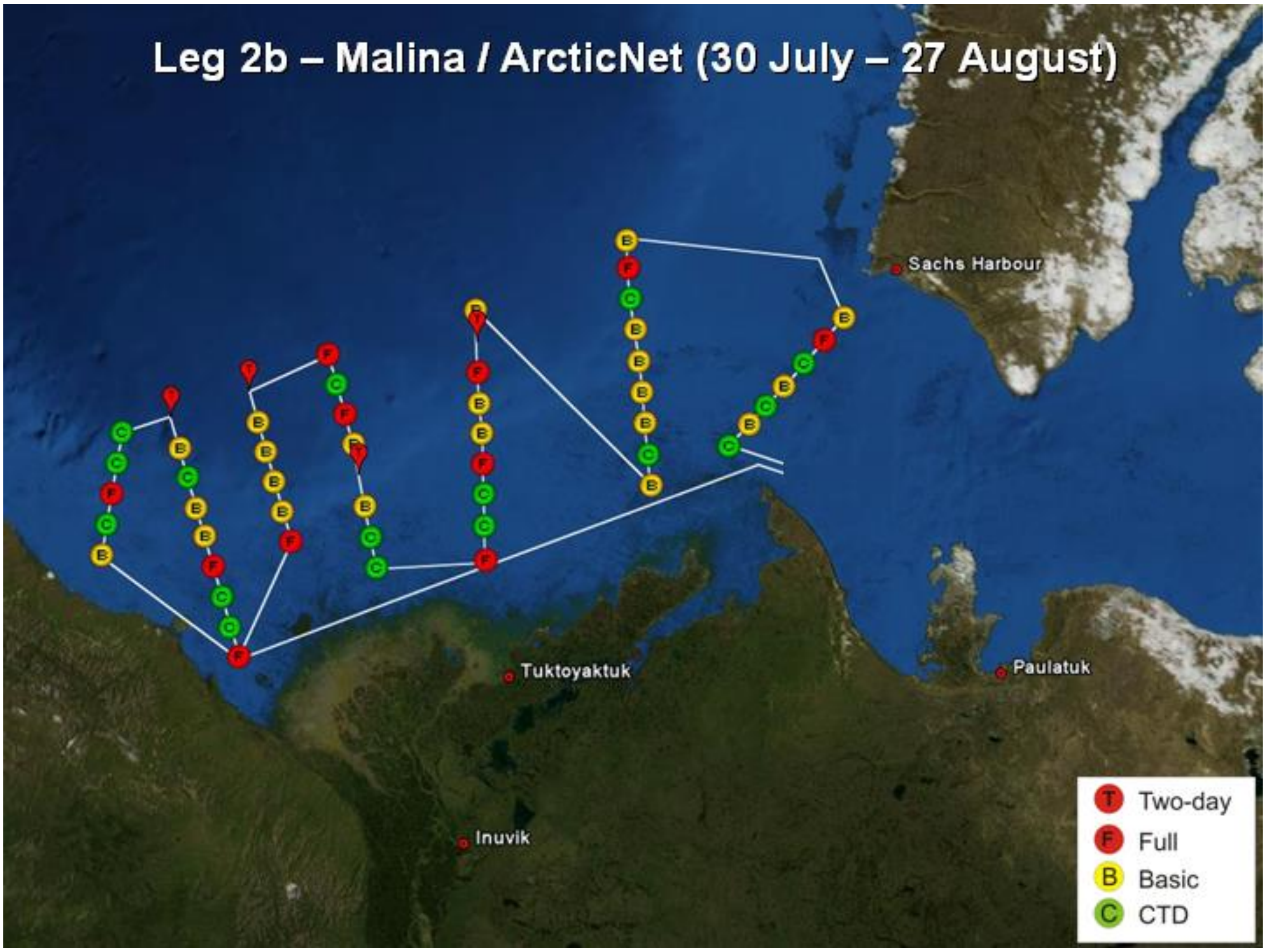


Figure 6: *MALINA Cruise Plan for Leg 2b; 30 July – 27 August (MALINA / ArcticNet).*

Due to the MALINA program having priority on leg 2b, the MetOcean team was assigned only one scientific berth for this leg. We were therefore able to maintain only our meteorology and micrometeorology (Met. tower) programs during this leg.

2.4.5 Leg 3a – IPY-GEOTRACES / ArcticNet (27 August – 12 September, 2009)

Leg 3a commenced on 27 August 2009 with a full crew change conducted at Paulatuk NT. The science contingent for this leg involved researchers from the IPY-GEOTRACES project, and ArcticNet. GEOTRACES is a Canadian IPY project which proposes to determine the global ocean distributions of trace elements and isotopes (TEIs), evaluate the oceanic sources, sinks and internal cycling of these TEIs, and provide a baseline for distribution as reference for assessing past and future changes in the polar basins (see the IPY-GEOTRACES proposal for more information). Leg 3a is an important leg with respect to sea ice as the time period coincides approximately with the occurrence of the summer minimum sea ice extent. Figure 7A shows the sea ice extent for 04 September 2009, and is considered representative of the general sea ice extent during Leg 3a. The 30-year mean ice edge for September is provided for comparison (orange line). Figure 7B shows sea ice conditions in the southern Beaufort Sea with a simplified version of the cruise path superimposed.

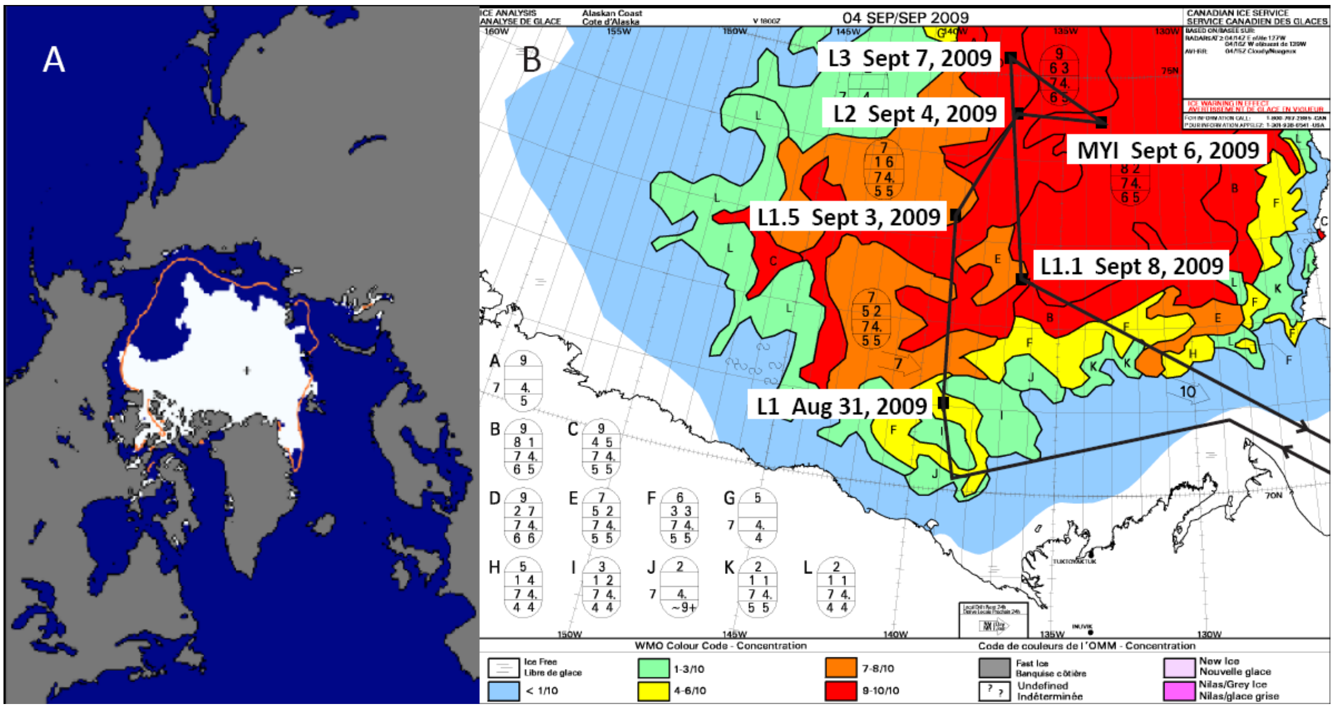


Figure 7: *A) 04 September 2009 Ice Extent (www.NSIDC.org) B) Cruise Path for Leg 3a; 27 August to 12 September superimposed over 04 September ice type chart (Canadian Ice Service).*

There were 5 long stations (48 hours), 3 short stations (24 hours), and one brief stop within the remnants of the MY ice pack (Figure 7B). Ice conditions at each of these stations varied from open water to 9/10+ ice coverage. Seas were initially ice free at our crew change location of Paulatuk, NT. After completing a short rosette station in open water, we turned northward. En route, we started to encounter large, thick, and rotted FY ice floes, and some multi-year floes. We moored the ship to a small, but sizeable MY ice floe, and remained there (Station L1) for two days (Figure 8). Ice floe sizes ranged from a few hundred meters to several nautical miles in diameter at this time. Our northward transect into the old pack ice revealed that ice that had been classified as 9/10+ old and MY ice, was in fact, no more than 6/10 concentration, and consisted of rotted, wet FY sea ice. We were unable to find any MY ice to moor the ship to for station L2.

Figure 8: *CCGS* Amundsen *moored to a MY ice floe at station L1. (Photo by M.G. Asplin)*

Given the unexpected lack of MY ice, we devised a plan to travel eastward, and transit through McClure Strait, and down the Prince of Wales Strait, expecting to sample MY ice along the way. We turned eastward, with an intended station near large MY ice floes at (73.908177°N, 133.815727°W). We positioned the ship by a MY floe and began preparations to deploy on ice science and mooring teams. During this period we noted the beginning of a swell propagating into the ice. Over the course of a few hours the MY ice completely broke up into small pieces (50 - 100 m in size). We noted large long-wave swells propagating under the sea ice. We tied up to a smaller remant MY floe with the idea of continuing our work but the lack of open water precluded Rosette and Trace metal Rosette work.

After some discussion we decided to return out of the old MY pack ice towards the west where we then travelled north to 73.50°N latitude to conduct station L2. The swell which broke up the MY pack ice was clearly evident the next day when we got out of the MY pack ice to an area more towards the edge of the ice. The swells here had caused significant damage to the pack; breaking it up into small pieces. The strong westerly winds and large swells were attributed to a large, deep cyclone that was situated northwest of our location, producing high seas in open water in the Canada Basin, and Western Beaufort Sea. Station L3 was conducted at ~75.000°N, 139.700°W, and involved primarily Rosette casts and onboard sampling. Helicopter surveys were limited due to very poor visibility at L3, but were conducted on our transit to Station L1.1 (72.500°N, 137.200°W). Our transit southward to Station L1.1 took us through wide areas of FY ice that had been broken up by the large swells from the cyclone.

MetOcean sampling activities for this leg included HEMI ice survey flights, deployment of 11 ice motion drift buoys, one ice mass balance buoy, on-ice measurements of surface roughness in melt ponds, sea ice physical structure in ice coring, CTD and optical profiles, as well as SBR, and scatterometer scans of the surface. The meteorological program continued to operate as per normal, including 13 radiosonde launches.

2.4.6 Leg 3b – ArcticNet / IORVL Partnership (12 September – 08 October, 2009)

The main focus of leg 3b was to complete the Geology & Bathymetry Component of the program, and to continue facets of the both the Environment & Marine Resources and Met/Ocean & Sea Components that were initiated during leg 2a.

The major objectives of leg 3b were:

1) Deploy a moored Met/Ocean surface buoy and two Mixed-Layer buoys for the duration of the leg.
2) Turn-over 2 subsurface oceanographic moorings, and to retrieve a third in Ajurak block. Moorings were deployed during 2a.
3) Complete systematic bottom-mapping coverage of the Ajurak block, and at strategic locations outside of the block in support of a regional geophysical survey.
4) Undertake systematic piston and box core operations at 50 locations in the Ajurak block in support of a regional geotechnical survey.
5) Retrieve 12 bottom anchored hydrophones in the Ajurak block that were deployed in Leg 2a.
6) Deploy the Remotely Operated Vehicle (ROV) for a visual survey of the ocean floor at strategic sites in support of the geophysical and geotechnical programs.
7) deploy a moored Met/Ocean surface buoy for the duration of the leg.
8) Conduct ice thickness and roughness surveys using the helicopter mounted EM Induction system and deploy ice drift satellite beacons on large ice floes around Ajurak.

Leg 3b started on 12 September in Paulatuk with an full Coast Guard and scientific contingent crew change. Leaving Paulatuk during the evening of the 12 September, the ship reached the Ajurak block around 03:00 (LST) on 14 September and commenced the leg 3b science program with bottom-mapping operations. For the next 22 days, the scientists and crew members of the CCGS *Amundsen* worked to complete the ambitious cruise plan (figure 9).

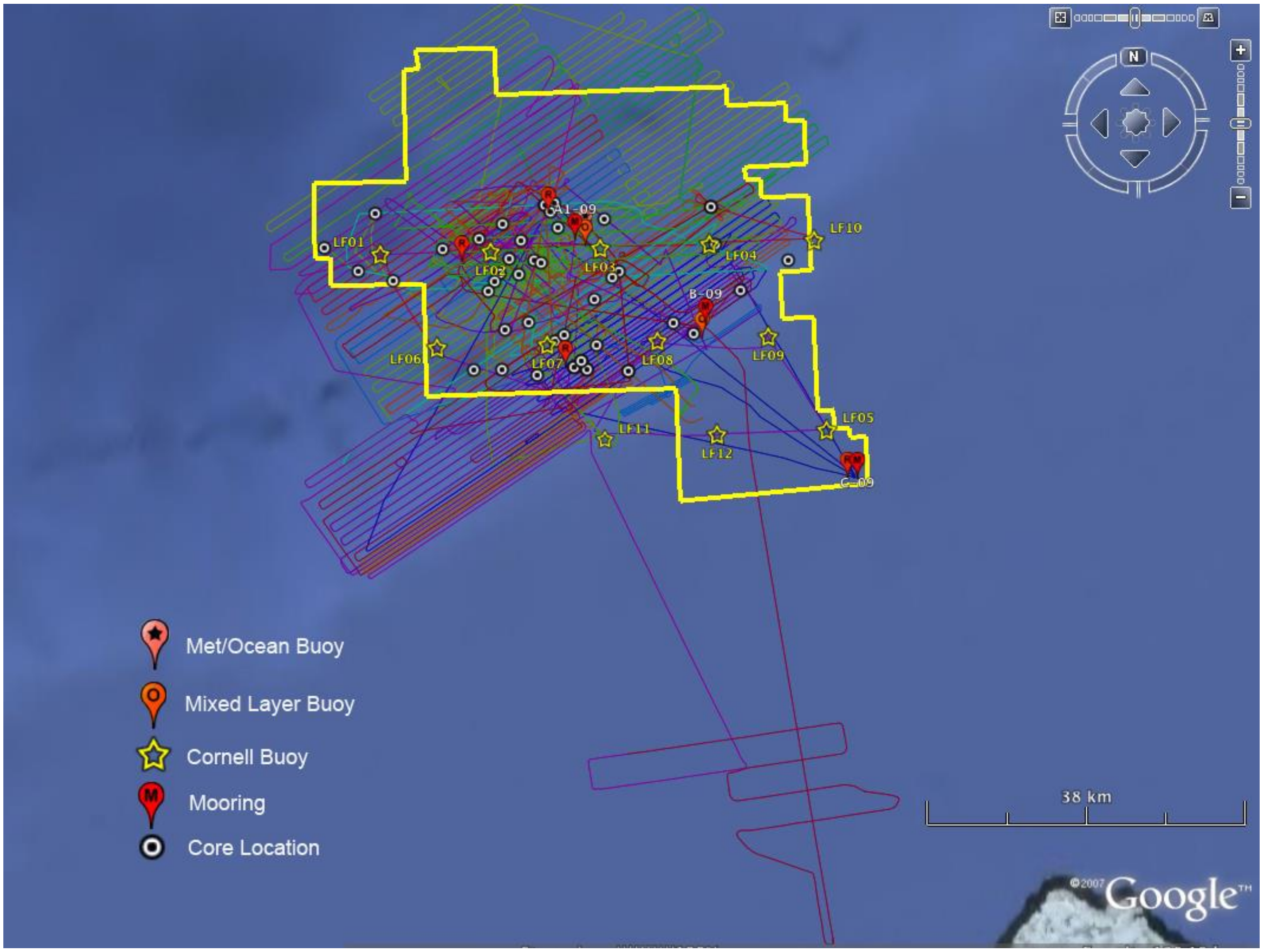


Figure 9: *Cruise track, mapping lines, and sampling stations visiting during leg 3b.*

During that period, 3 surface moored buoys were deployed and retrieved, 50 piston cores and 8 box cores were extracted from locations across the block, 3 sub-surface oceanographic moorings were retrieved, 2 of which were subsequently re-deployed, 11 moored hydrophones were retrieved, 4 ROV operations were undertaken, and over 6,600 km of high resolution bathymetry and sub-bottom data were collected, using the EM302 multibeam sonar and the Knudsen sub-bottom profiler. Other sampling activities proceeded simultaneously with the operations listed above. They include the launch of 13 radiosondes (meteorological balloons), 4 deployments of the ship's 7.33m Zodiac launch for off-ship sampling, and 5 transects were sampled for sea ice thickness and surface roughness using the helicopter-mounted electromagnetic induction system (or IcePic). The relatively low number of ice-thickness transects is due to the combination of low ice concentrations and poor/highly variable weather conditions. The CCGS *Amundsen's* extensive array of oceanographic and atmospheric underway systems associated with the Met/Ocean program were operational throughout the cruise. These include water surface pCO_2 and CTD on track system, foredeck and top bridge met towers, ceilometers, radiometer, all-sky camera). Details appear in the various sub-sections of this report. On the bridge, Marine Wildlife Observers spotted and identified marine mammals and seabirds. Sampling for leg 3b ended on the evening of 06 October, when we started our transit back to Paulatuk for a scientific crew change in the morning of 08 October.

The main sea ice pack remained between 20 nm to 60 nm north of the Ajurak block for much of the cruise. In early October a low concentration ice tongue from the main ice pack extended into the block, and during this same period atmospheric conditions (low wind and cool temperature) prompted the growth of nilas, frazil and pancake sea ice (figure 10). In contrast to Leg 2a, the weather was quite variable, and often presented an obstacle around which science operations were scheduled. Wind speed often exceeded a threshold (approximately 25 kts, or 12.8 m/s) for safe piston core operations (the main deck operation of Leg 3b). Responding to wind speed, maximum wave height ranged from a few centimetres to over 6 m. The latter occurred during the leg's premier storm which occurred on 19 September.

Figure 10: *Ice within the northern portion of the Ajurak Block (02 October, top) ice streamer from the pack ice (SIC <30%), bottom) pancake ice formation (dark grey) and isolated second year ice (white).*

The AXYS Met/Ocean Buoy system was deployed on 16 September, 17:10, and was moored and operational until recovery on 30 September, 00:34, covering a period of ~14.5 days. Two mixed Layer buoys were deployed at a deep water station (546 m) within the Ajurak Block (70°43.918'N, 136°01.036W). A second surface float suspending a 50 m string of sensors was deployed at shallow water (132 m) site (70°39.279'N, 135°38.049'W). The distant proximity to the remaining summer pack ice permitted only two HEMI flights, containing 5 transects in total. Other MetOcean activities during this leg included one deployment of the MOBS roughness buoy, SBR and scatterometer scans of newly forming sea ice, and the ongoing meteorology program, including 11 radiosonde launches.

2.4.7 Leg 4a - ArcticNet (08 October – 06 November, 2009)

Following a full crew change in Paulatuk, the CCGS *Amundsen* retrieved and re-deployed several moorings in the Mackenzie Shelf / Amundsen Gulf region. Following this, the ship transited east through the NW passage en route the eastern arctic, through the Prince of Wales Strait between Banks and Victoria Islands (figure 11). The ship then made it's way to the south of the Queen Elizabeth Islands at Parry Channel. The ship conducted sampling operations in Queen Maud Gulf, Peel Sound, Viscount Melville Sound, Barrow Strait and Lancaster Sound (figure 12). The last segment of Leg 4a was dedicated to ArcticNet operations in northern Baffin Bay (figure 13) and the east coast of Baffin Island (figure 14).

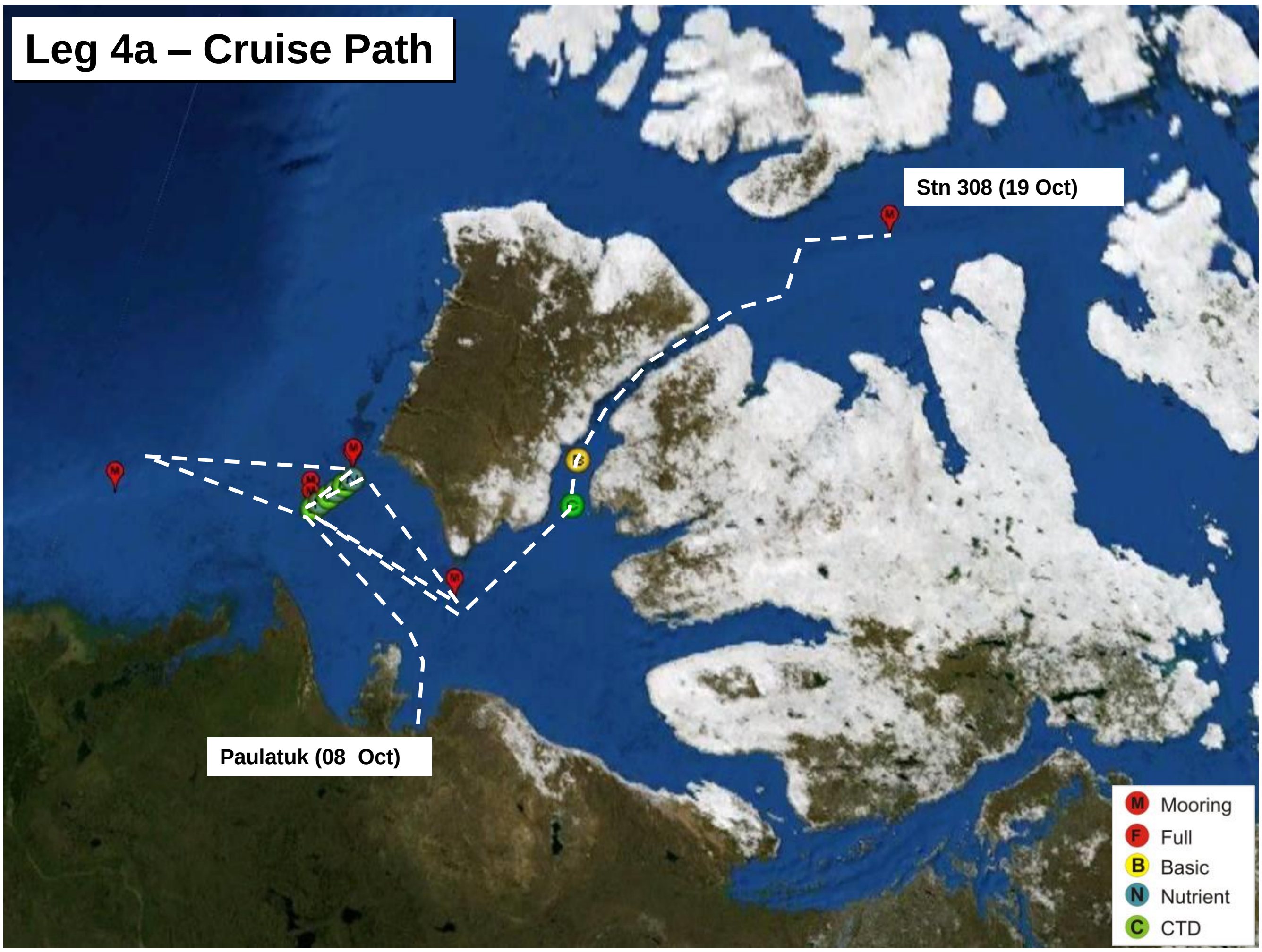


Figure 11: *Cruise plan during the first part of Leg 4a.*

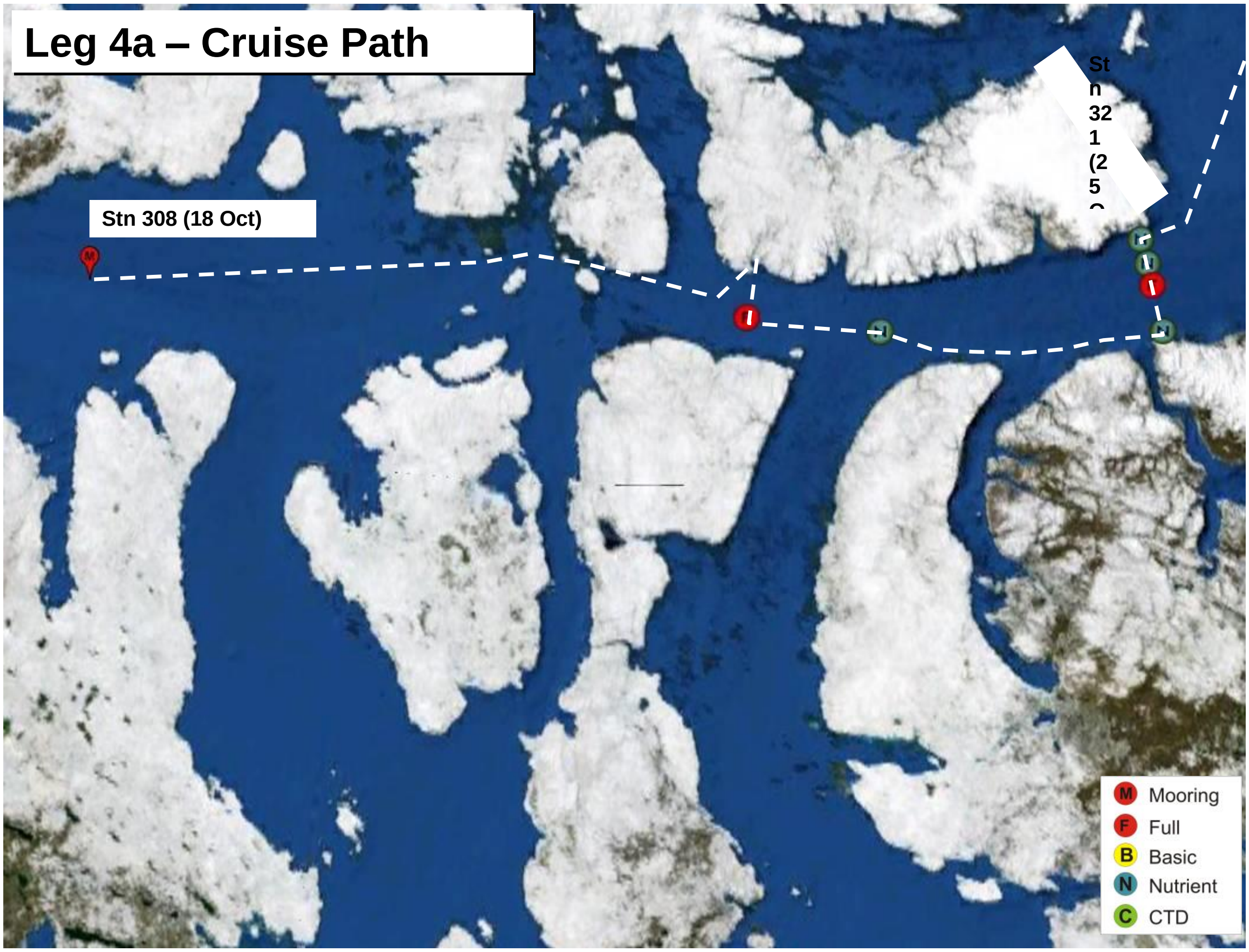


Figure 12: *Cruise plan during the NW passage and Baffin Bay portion of Leg 4a.*

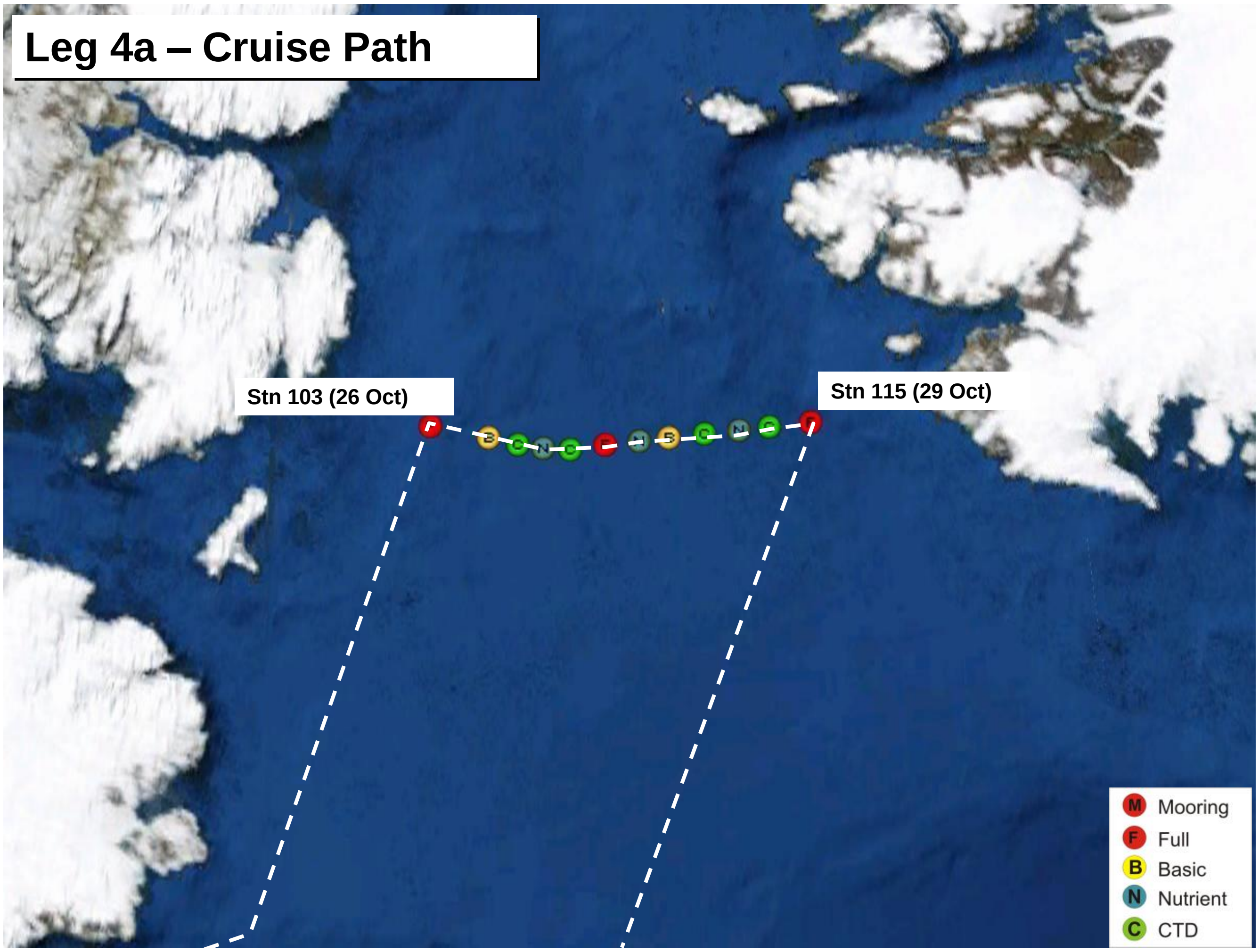


Figure 13: *Cruise plan during the Baffin Bay portion of Leg 4a.*

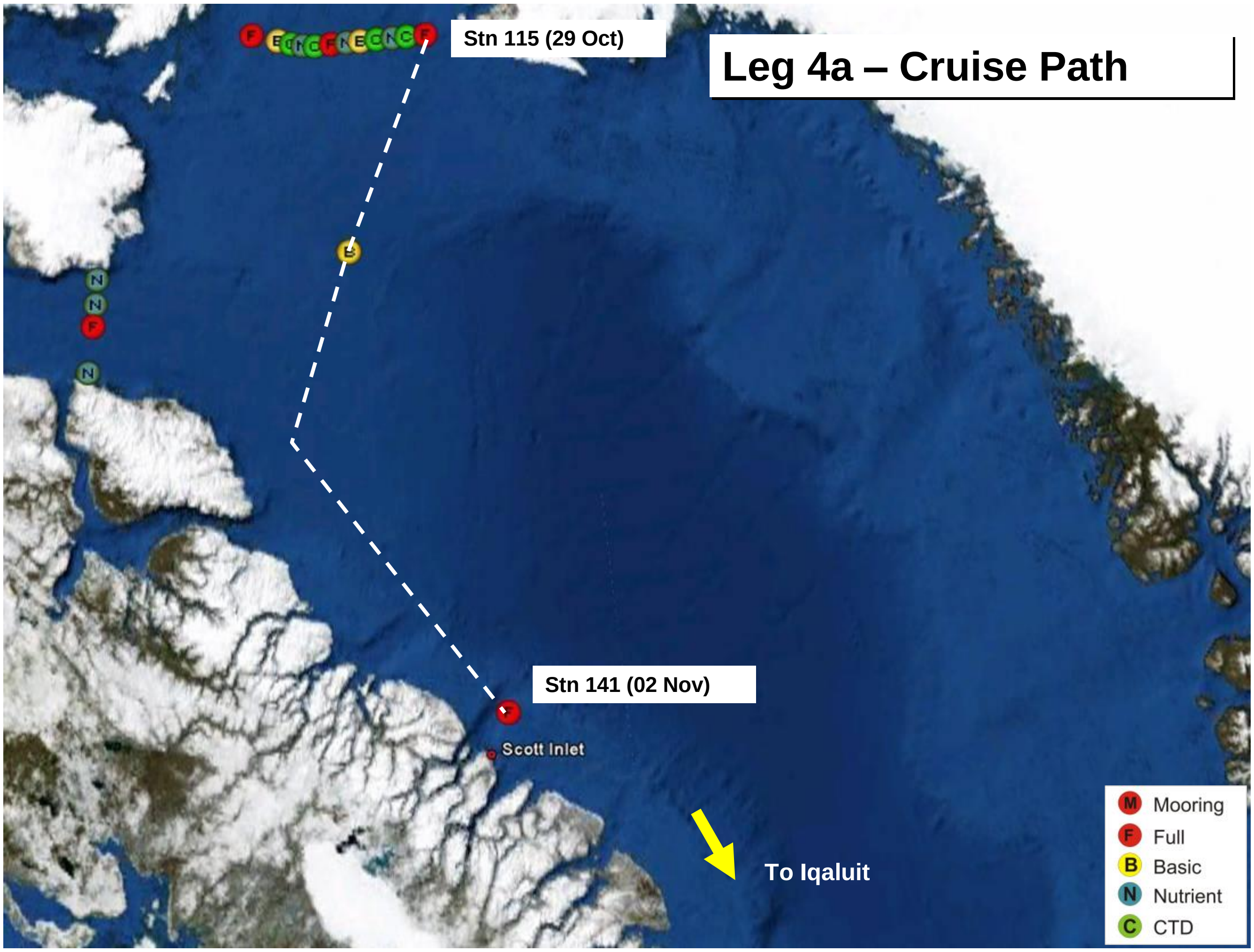


Figure 14: *Cruise plan at the end of Leg 4a.*

MetOcean ice mass balance buoy CEOS_IMB02 was installed in the southeast end of McClure Strait via BO-105 helicopter on 17 October 2009 at 73˚ 34.323'N and 115˚ 11.465'W. A total of 10 different sites were scanned using the C-Band scatterometer and SBR on 10, 21, 22, 23, and 27 October 2009. Out of the 10 floes that were scanned, physical measurements were conducted on six of the floes. Physical sampling of snow and sea ice salinity, temperature coupled with C-band scatterometer and ship-based radiometer measurements were performed in Leg 4a. The MetOcean Meteorological program continued to run as per normal, including 11 radiosonde launches. All MetOcean sampling activities ceased at the end of Leg 4a, and underway equipment was decommissioned and stowed for the return voyage to Quebec City (Leg 4b). The MetOcean team disembarked the CCGS *Amundsen* at Iqaluit, NU during a science crew change on 6 November 2009.

2.4.8 Leg 4b - ArcticNet (6 November - 18 November, 2009)

From Iqaluit, the ship sampled across the Hudson Strait on its way to the Torngat Mountain Fjords (Figure 15). Sampling occurred in four Nunatsiavut Fjords (Figure 16) as part of the annual ArcticNet sampling operations. This segment of the expedition will also support the 2009 Schools on Board field program. The CCGS *Amundsen* returned to its homeport of Quebec City on 18 November 2009 (Figure 17).

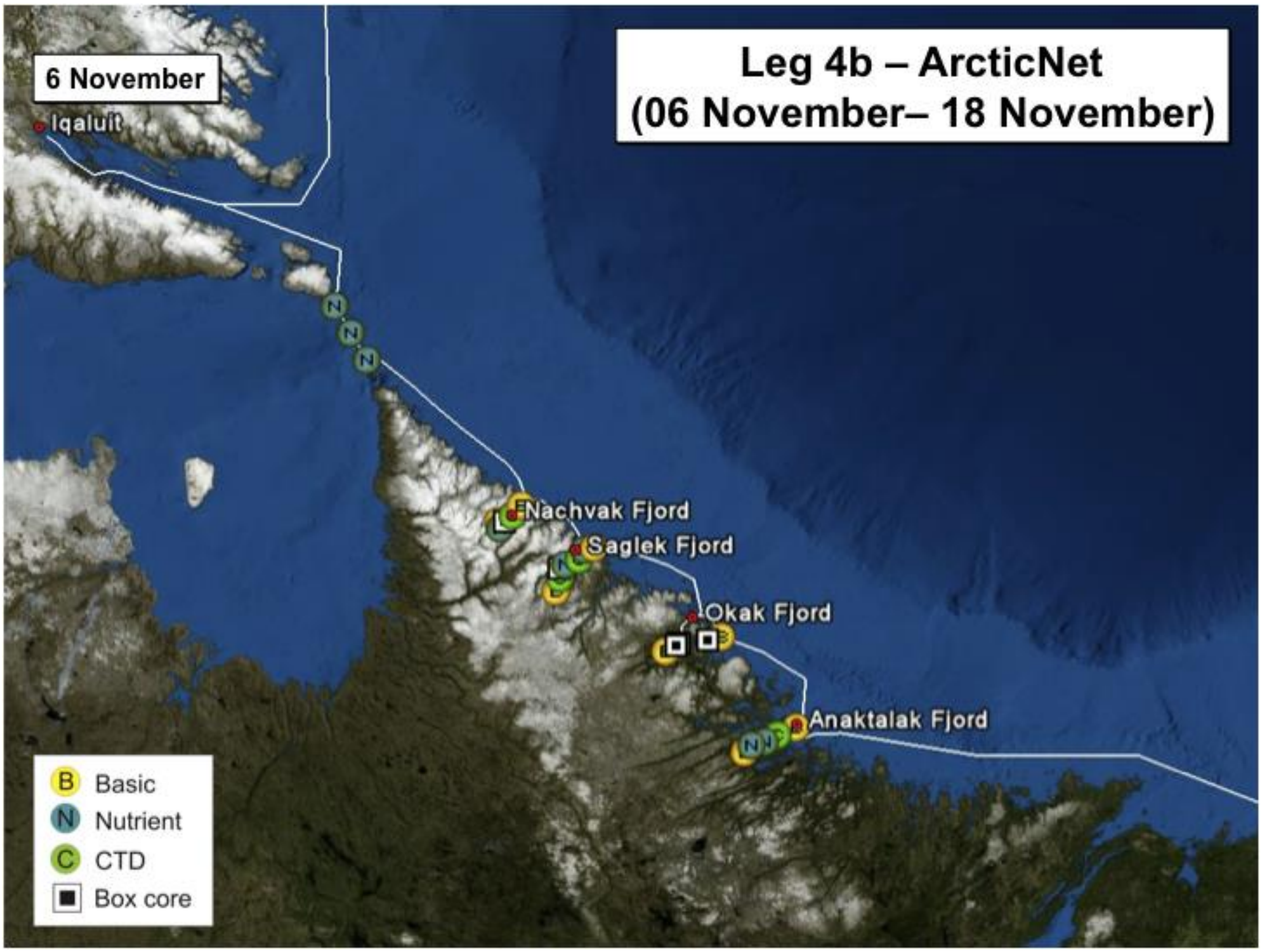


Figure 15: *Cruise path in the Torngat Mountain Fjords region for Leg 4b.*

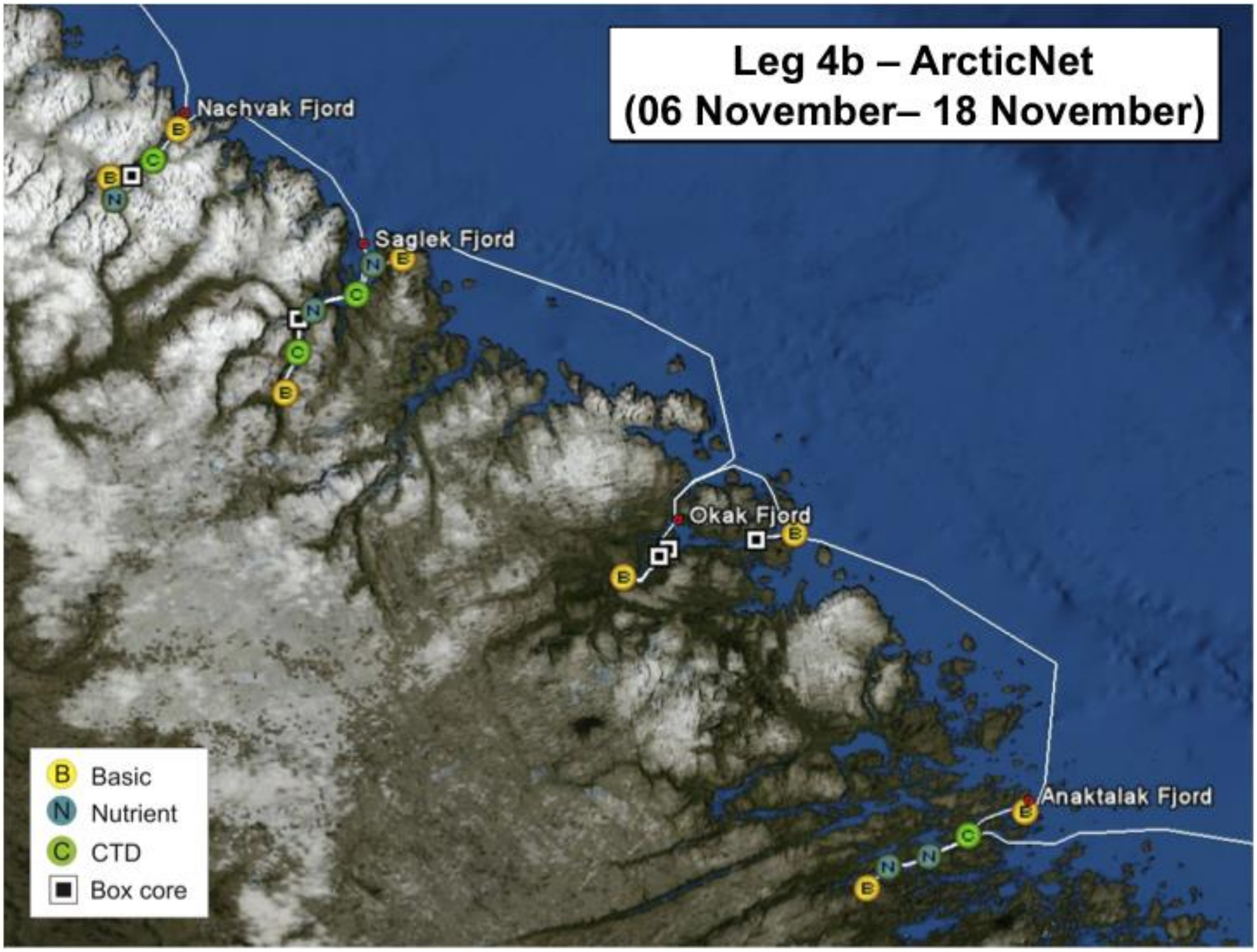


Figure 16: *Cruise path in the Nunatsiavut region for Leg 4b.*

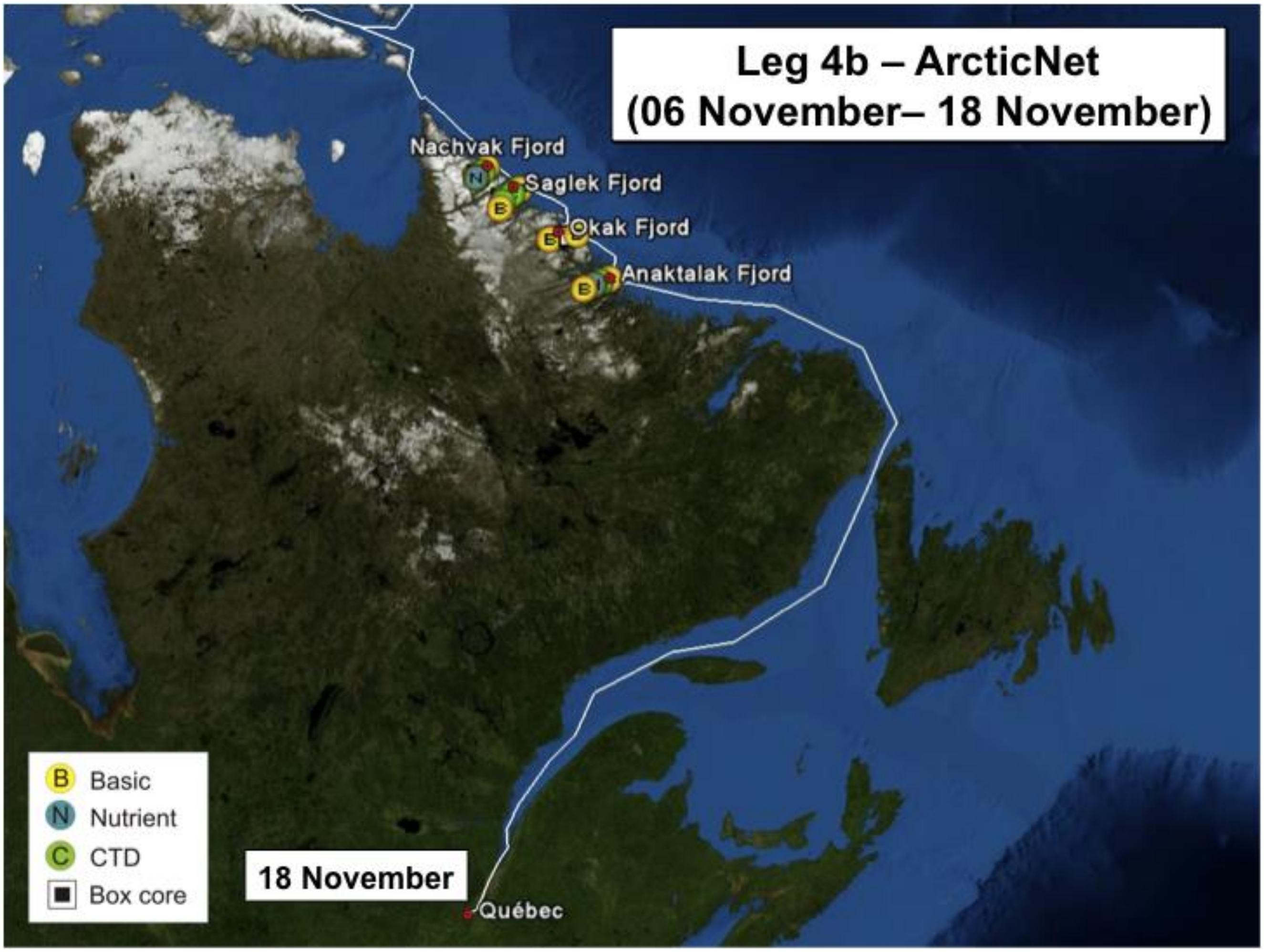


Figure 17: *Cruise path for end of Leg 4b.*

No MetOcean personnel were on board the CCGS *Amundsen* during Leg 4b. A group of MetOcean science personnel was dispatched to Quebec City for CCGS *Amundsen* demobilization. All equipment was packed and shipped back to Winnipeg between 21 – 25 November, with the exception of the buoy system, which will be stored in Quebec City for future deployments from the CCGS *Amundsen*. The MetOcean equipment arrived back at the University on 01 December.

SECTION THREE: OCEAN DATA

3.1 Surface Met/Ocean Buoy Program

3.1.1 Instrumentation

Three buoys were deployed during Leg 3b to obtain data on the surface meteorology, fluxes, and characteristics of the water column's upper 50 m. Two buoys, one 3 m discus buoy (hereafter termed, Met/Ocean buoy) (Figure 18 & 19) and the other a surface float (Figure 20) that suspended a 50 m string of sensors within the upper mixed layer of the water column (figure 20), (hereafter termed Mixed Layer buoy, or MLB) were deployed at a deep water station (546 m) within the Ajurak Block (70°43.918'N, 136°01.036W). A second surface float suspending a 50 m string of sensors was deployed at shallow water (132 m) site (70°39.279'N, 135°38.049'W). The secondary buoy associated with the 3 m discuss buoy at the deeper water location is referred to as secondary buoy A, while the other is called secondary buoy B. Details on the instrumentation and variables collected are provided in Table 5.

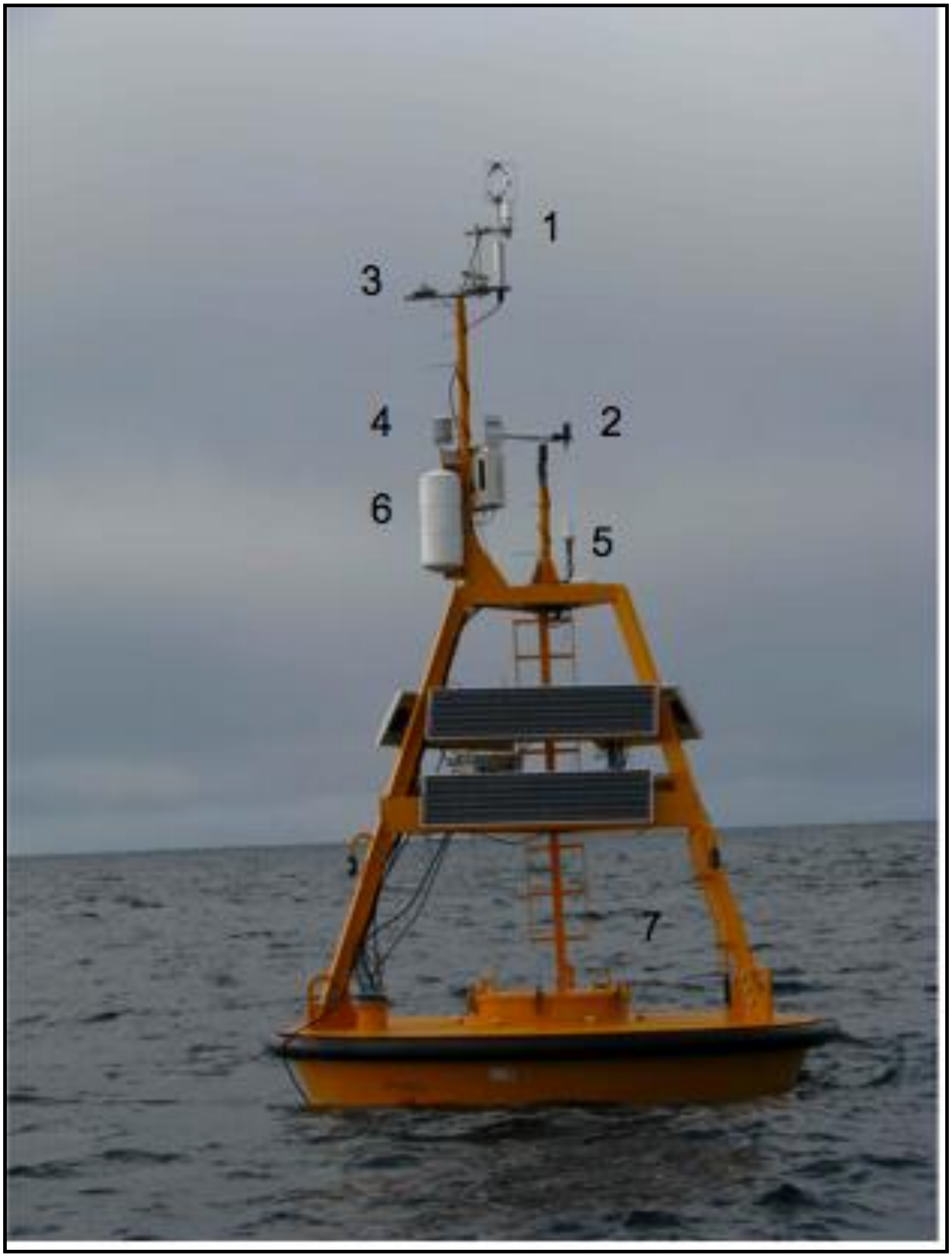


Figure 18: *Above-water instrumentation associated with the Met/Ocean buoy. 1) Eddy covariance sensors: sonic Anemometer, gas analyzer, compass; 2) wind monitor; 3) PAR sensor; 4) temperature-relative humidity probe; 5) GPS antennae and Iridium transmitter; 6) RADAR reflector; 7) in the hold: directional wave sensor, logger, iridium modem, multi-axis accelerometer, battery banks. Sensor specifics appear in Table 4. (Photo by T. Papakyriakou).*

Figure 19: *Underwater instrumentation associated with the Met/Ocean buoy. Upper panel, left to right: Nortek® Aquadopp surface current meter, RBR® multi-probe, and Pro-Oceanus® pCO_2-pro. Lower Panel: installation on anchor yoke. Sensor specifics appear in Table 5. (Photos by E. Stainton and IOL consultant).*

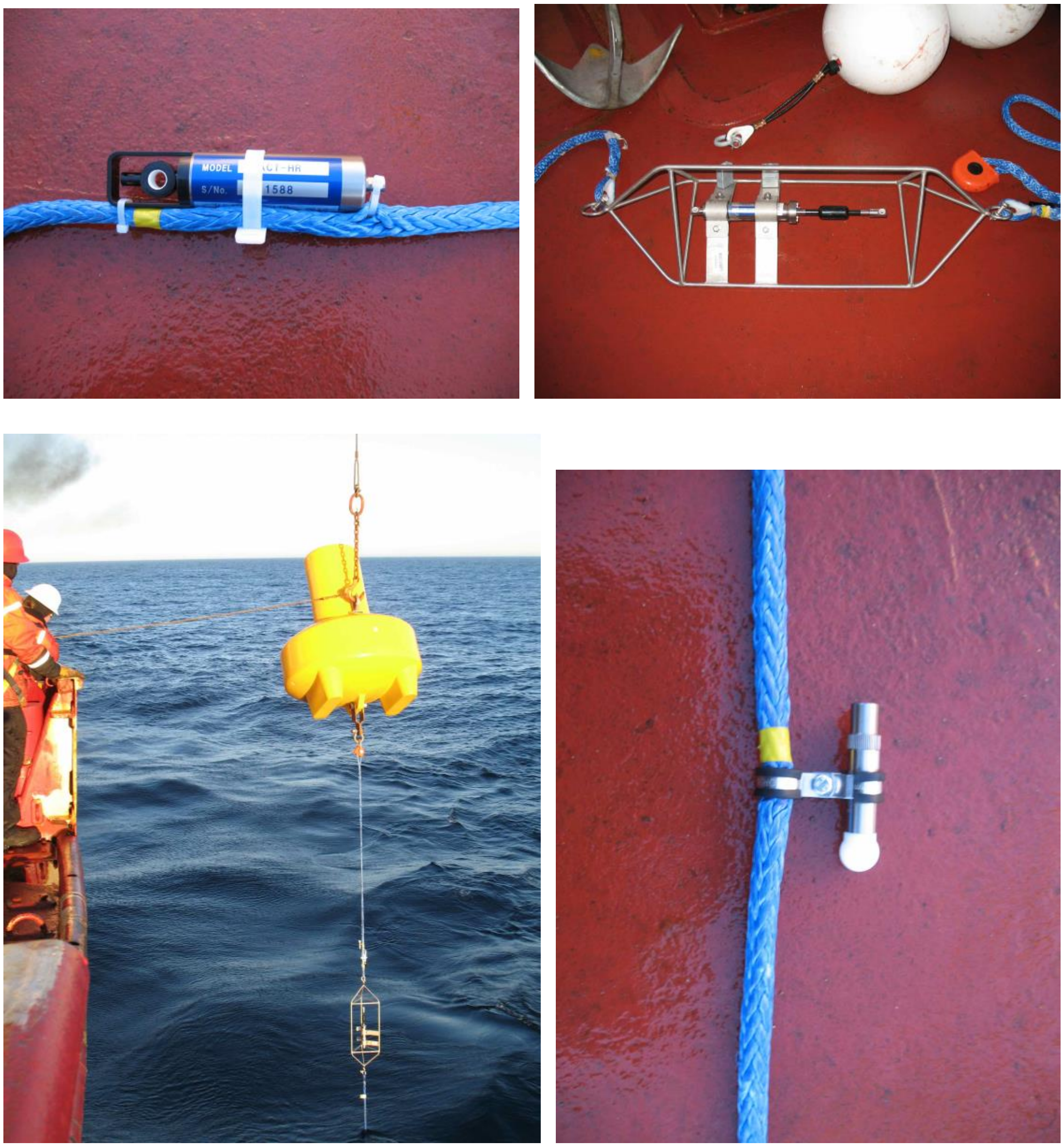


Figure 20: *Mixed-Layer buoy deployment with subsurface string of sensors. Clockwise from top left: Alec CT sensor, Alec EM current meter, Alec PAR sensor, surface float deployment. Not shown is the RBR Multi-probe (see Fig. 19). (Photos by E. Stainton).*

Table 5: *Variables and equipment associated with the Mixed-Layer and Met/Ocean Buoys.*

Variable	Buoy	Sensor, Mode	Ht. to Water	Units	Specifications
near-surface curren (u,v)	MLB	JFE ALEC©, model AEM-USB	-4.4, -21.4 (-4.4, -21.4)	cm/s velocity, direction	± 01 cm/s or 2% veloc ±2º direction
conductivity, temperature (CT)	MLB	JFE ALEC©, model ACT-HR Compact (	-3.4,-6.4,-9.4,-12.4,-15.4,-20 30.4,-45.4 (-3.4,-6.4,-9.4,-12 15.4,-20.4,-30.4,-45.4)	mS/cm, ºC	±0.05ºC, ±0.05 mS/cm
light intensity (PAR)	MLB	JFE ALEC©, model MDS MkV-L	-3.4,-6.4,-9.4,-12.4,-15.4,-20 30.4,-45.4 (-3.4,-6.4,-9.4,-12 15.4,-20.4,-30.4,-45.4)	μmol/m^2/s^1	±4% full scale
surface sea water properties: DO, pH, CTD, FL	MLB	RBR®, model XR-420CTD+DO+pH+F	(-5.5)	% sat.,pH,mS/c ºC, dBar, μg/L	±2% DO, ±0.1 pH, ±0.003 mS/cm, ±0.002ºC, ±0.05% fu scale, ±2%
air temperature (Ta)	Met/Ocean	Vaisala®, model HMP45C212	3.9	ºC	± 0.1 ºC
relative humidity (RH	Met/Ocean	Vaisala®, model HMP45C212	3.9	%	±2% 0-90% @ 20ºC ±3% 90-100% @ 20ºC 0.05% RH/ºC
wind speed (ws-u,v)	Met/Ocean	RM-Young®, model 05106-10	3.9	m/s	±0.6 m/s
wind direction (wd-polar)	Met/Ocean	RM-Young®, model 05106-10	3.9	º	±3º deg
Logger (met. and wa package)	Met/Ocean	AXYS®, Watchman 500	0	-	-
barometric pressure (Patm)	Met/Ocean	RM-Young®, model 61205V	0	kPa	±0.05 kPa
photosynthetically active radiation (PAI	Met/Ocean	quantum sensor (Kipp & Zonen, PARLite	4.7	μmol/m^2/s^1	~±5%
wind speed 3D (u, v, w, Ts)	Met/Ocean	3D wind velocity (Gill Windmaster Pr ultra-sonic anemometer)	5.4	m/s	RMS noise <1% offset <0.01 m/s SOS < 0.5% accuracy
atm. water vapour concentration (ρ_v)	Met/Ocean	LI7500 open path g analyzer	5.4	mmol/mol	RMS noise ±0.1 μmol/mol zero drift 0.1 μmol/mol gain drift 0.1%/ºC
atm. concentration o CO_2 (ρ_c)	Met/Ocean	LI7500 open path g analyzer	5.4	μmol/mol	RMS noise ±0.1 μmol/mol zero drift 0.1 μmol/mol gain drift 0.1%/ºC
rotational motion (ac accy, accz, r x, r_y, r_z)	Met/Ocean	multi-axis inertial sensor (MotionPak, Systro Donner)	0	º/s; g	rate <0.004º/s acc <10 μg
wave parameters: max. ht. (m), sig. ht. (m), peak period (s) mean wave directio (deg), mean spread (deg)	Met/Ocean	AXYS®, TriAXYS O motion sensor	0	max. ht. (m), sig. (m), peak perio (s), mean wav direction (deg) mean spread (de	±0.01 m, ±0.01 m, ±0. ±3º, ±3º
surface sea water properties: DO, pH, CTD, FL	Met/Ocean	RBR®, model XR-420CTD+DO+pH+F	-1.5	% sat.,pH,mS/c ºC, dBar, μg/L	±2% DO, ±0.1 pH, ±0.003 mS/cm, ±0.002ºC, ±0.05% fu scale, ±2%
near-surface curren (u,v,w in upper 50m 2 m bins)	Met/Ocean	Nortek® Aquadopp 600 kHz Profiling Current Meter	-1.5	cm/s	±2.2 cm/S for u,v 0.7 cm/S for w

3.1.2 Buoy Deployment

The Met/Ocean buoy was recovered 30 September (00:34). Meteorological and wave movement data were transmitted hourly from the Met/Ocean buoy via Iridium satellite modem. Data were also stored on datalogger memory and flash card. All sub-surface instruments had internal loggers, which were downloaded upon recovery. All sensors associated with the meteorology and wave package functioned properly. A malfunction in the charge regulator associated with the flux package prevented the charging of those batteries dedicated to the flux sensors, and as a result the batteries were lowered below a critical voltage after one-day of deployment. Of the underwater sensors, only the pCO2 sensor failed to work up to expectations. This sensor did not power-up on deployment, despite passing pre-deployment checks.

The MLB at Site B was recovered on 30 September (14:45), while the MLB at Site A was recovered on 01 October (20:50). Note that sea ice entered the Ajurak Block on 30 September and effectively dragged secondary buoy A approximately 5.5 nm to the south of its original location. The buoy (A) was retrieved at 70° 39.956'N, 136° 13.725'W. At this point we do not know exactly when between 30 September 30 and 01 October the buoy was moved off-station.

Data from the MLBs were downloaded upon recovery. Unfortunately, two conductivity /temperature (CT) sensors were not recovered from the two bottom depths of site MLB “B” (serial numbers 1580 and 1581). It is likely that they were sheared from the mooring line during deployment. All other CT sensors at site B functioned properly throughout deployment. All PAR sensors were recovered from the MLB “B” surface float, however the uppermost sensor (serial number 201281) did not record data properly.

All sensors were recovered from MLB “A”, however one CT sensor (serial number 1517) and one PAR sensor (serial number 201293) did not record data properly. All instruments that did not function properly will be examined to determine the cause of the malfunction, and if necessary returned to the manufacturers.

EM current sensors were located at two depths on each of the secondary buoys, at 3.5 and 20.5m. Data was downloaded upon recovery and all instruments functioned properly throughout the sampling period.

3.1.3 Data Summary

The MetOcean buoy system data is stored at the following location in the database:

\OCEAN\BUOY

The 3 m discus AXYS buoy data is organized by instrument at:

\OCEAN\BUOY\AXYS_3m_Buoy

The surface float data is organized by instrument and by deployment site (two sites) at:

\OCEAN\BUOY\Secondary Buoys\Sitex

Instrument specific data on the buoys are organized into sub-folders:

…\RBR CTD
…\CT
…\PAR

Within each instrument subfolder, the raw and converted (sorted) data files are stored in the aptly named subfolders:

…\CT\Converted
…\CT\Raw

…\PAR\Raw
…\PAR\Sorted

Wave data is specific to the AXYS 3 m discus buoy:

…\Waves

Header information is provided in the *.xls data files for each instrument in this report ? if so, it should be referred to (i.e. See Table X).

3.1.4 Data Visualizations

Time series of select meteorological and oceanographic variables from the Met/Ocean buoy are shown in figures 21 – 28 :

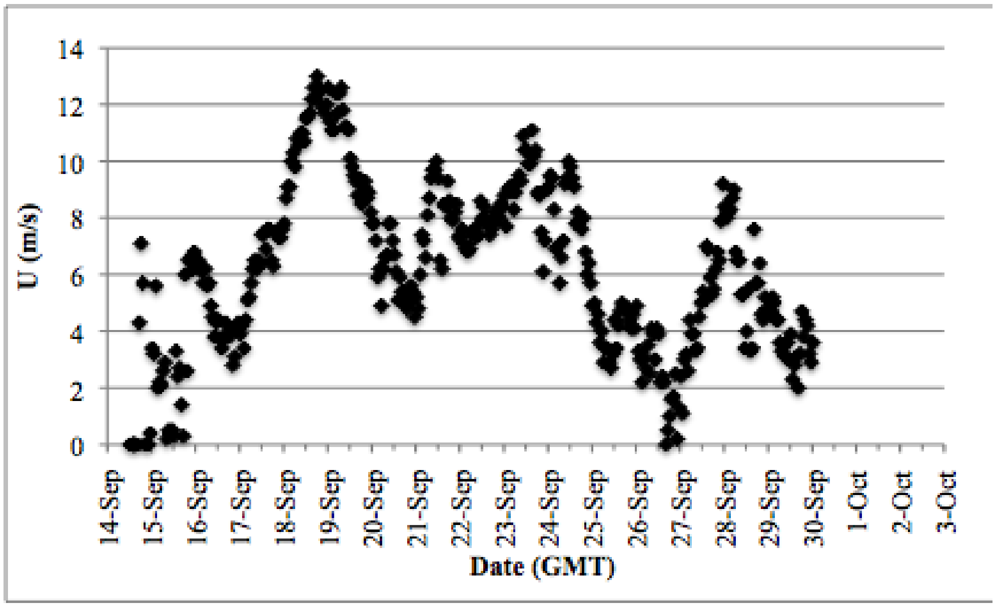


Figure 21: *Hourly average wind speed as measured from the Met/Ocean Buoy.*

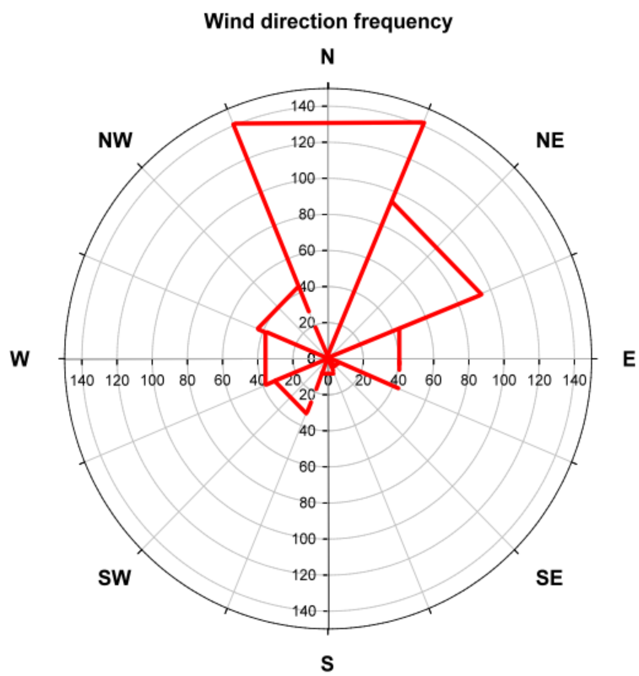


Figure 22: *Hourly average wind direction as measured from the Met/Ocean Buoy.*

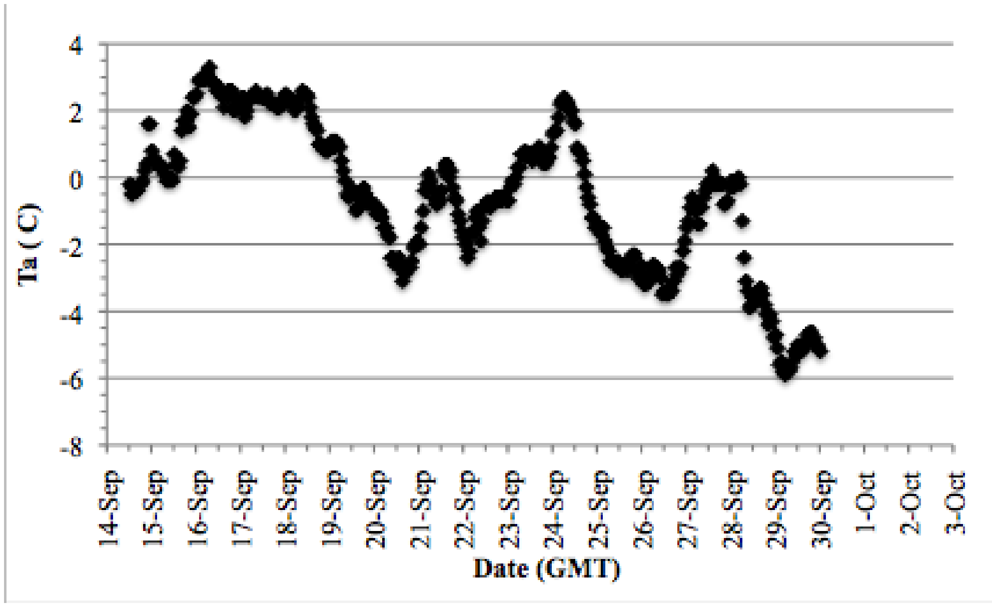


Figure 23: *Hourly average air temperature measured from the Met/Ocean buoy.*

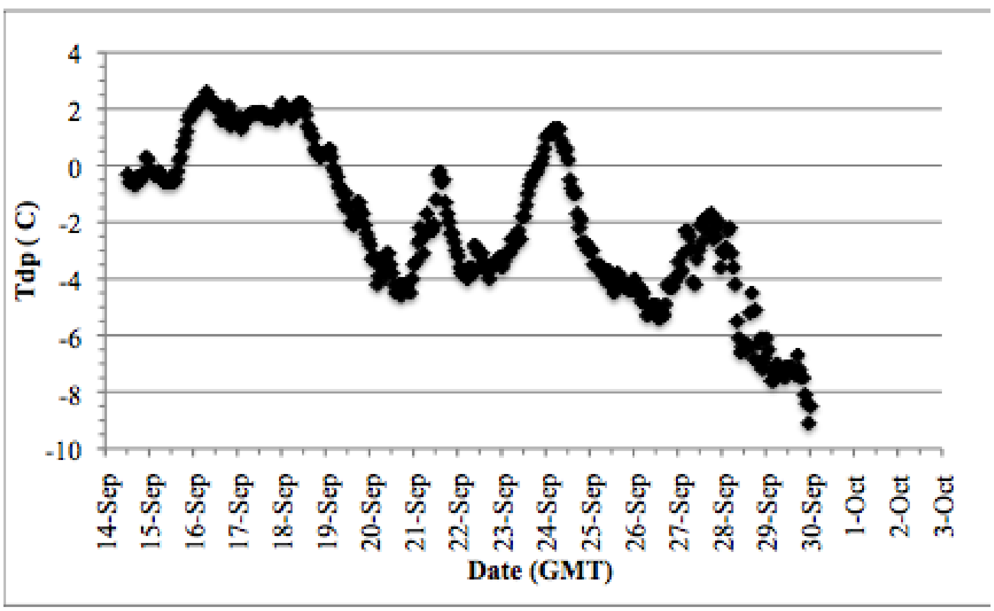


Figure 24: *Hourly average dew point temperature measured from the Met/Ocean buoy.*

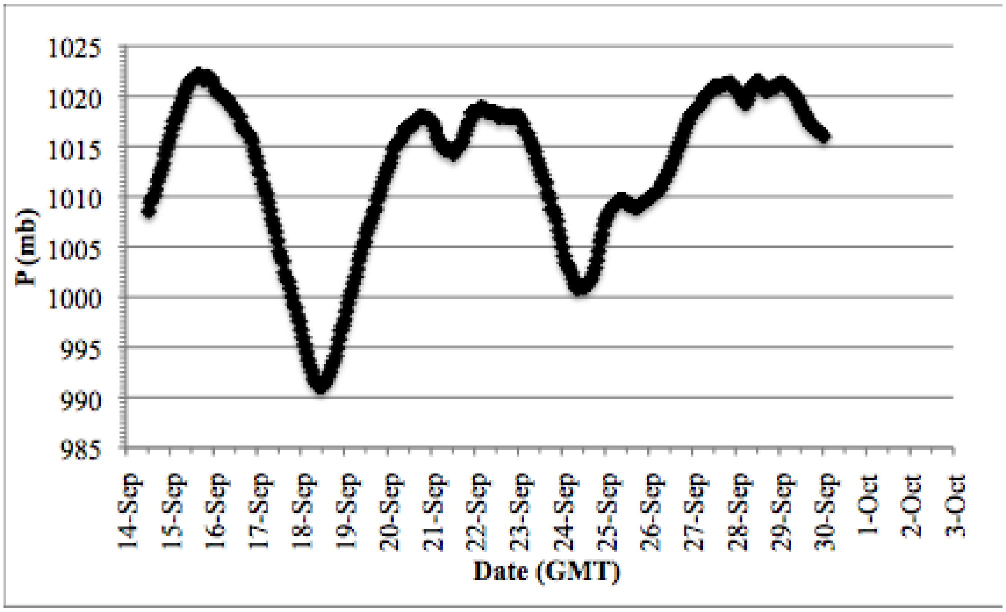


Figure 25: *Hourly average atmospheric pressure measured from the Met/Ocean buoy.*

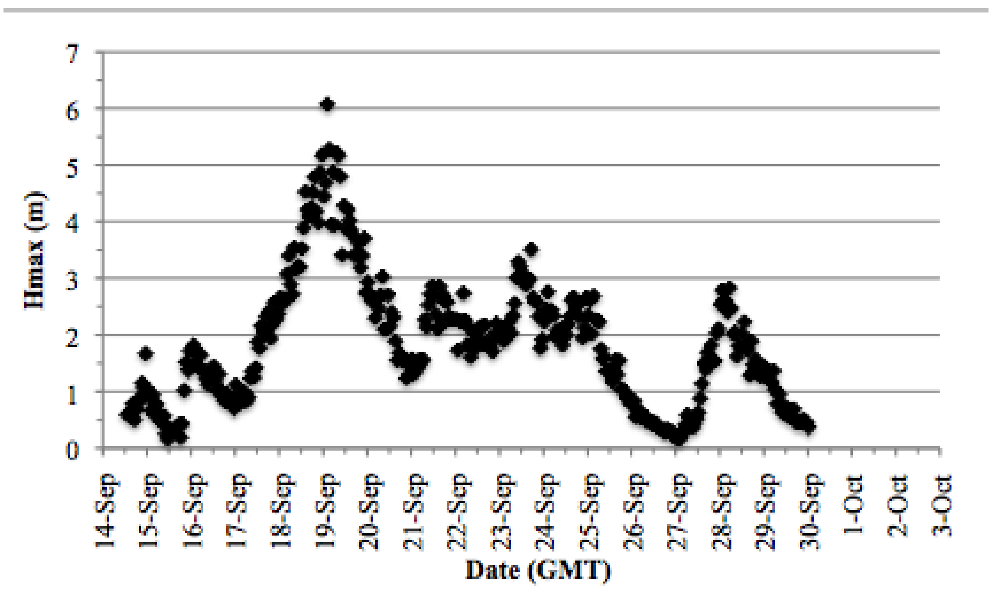


Figure 26: *Hourly maximum wave height measured from the Met/Ocean buoy.*

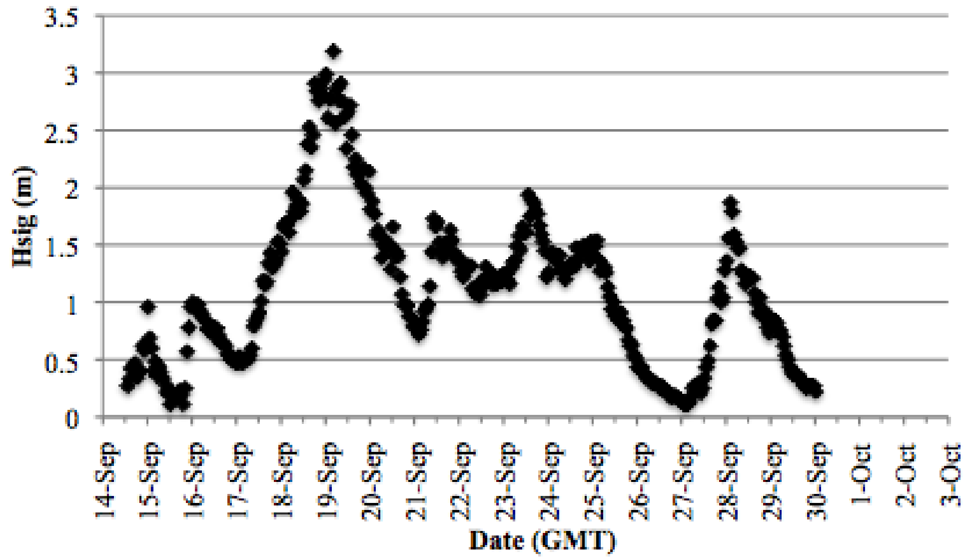


Figure 27: *Hourly significant wave height measured from the Met/Ocean buoy.*

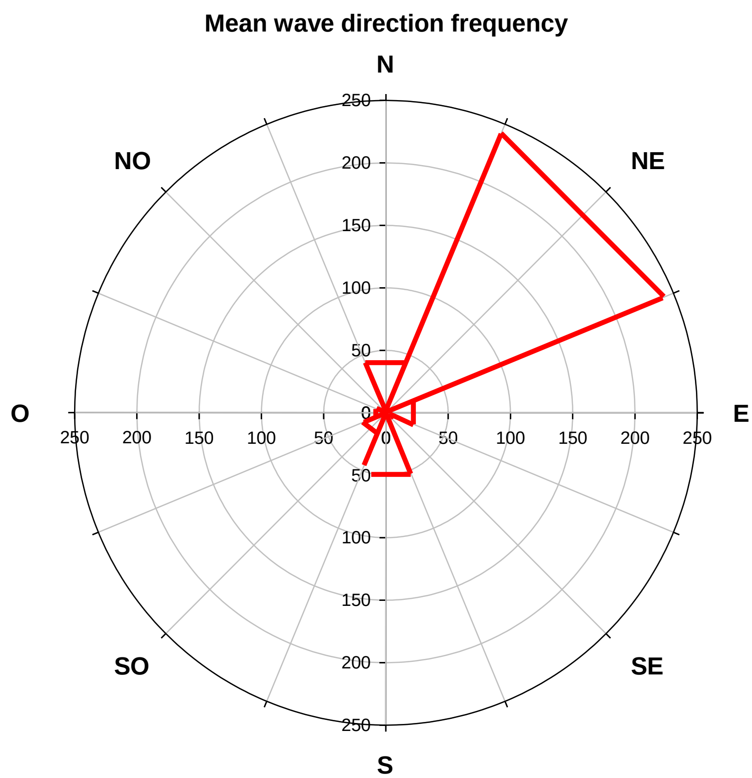


Figure 28: *Frequency of mean hourly wave direction as measured from the Met/Ocean buoy.*

3.2 Ocean Conductivity-Temperature-Density (CTD) Profiles

3.2.1 Instrumentation

Instrument: Idronaut Ocean Seven 304 CTD-T multi-parameter probe with temperature, conductivity and turbidity sensors (Figure 29).

Figure 29: *An Irdonaut Ocean Seven 304 CTD-T probe about to be deployed.*

Pressure/depth
Range: 0-1000 db
Accuracy: 0.05% F.S.
Resolution: 0.0015 % F.S.

The Idronaut was set to start recording at 6 Hz when conductivity exceeded 0.001 mS cm^{-1} and to cease recording 10 sec after conductivity fell below this threshold, ensuring that the last observations would include atmospheric pressure. Water pressure was derived from raw pressure by subtracting the mean of the last six observations from each observation. Atmospheric pressure by this method ranged from 1.85 - 2.14 db. Standard deviations associated with cast means ranged from 0.00 - 0.06 db, indicating that 95% confidence in water pressure by this method was at most ±0.12 db. Observation depths reported in the accompanying data files are calculated from water pressure (i.e. observed pressure - minimum pressure) as:

Depth(m)=water pressure (db)*1.01724

Temperature
Range: -5 to +35°C.
Accuracy: 0.005°C
Resolution: 0.000°C

Conductivity
Range: 0-64 mS cm^{-1}

Accuracy: 0.005 mS cm^{-1}
Resolution: 0.001 mS cm^{-1}

Turbidity:
The Idronaut Ocean Seven 304 CTD-T is equipped with a Seapoint turbidity sensor which measures side-scattered light. Light source is a pair of 880 nm light emitting diodes; detectors are side-by-side silicon photo diodes. Detectors sense light scattered between 15 and 150° to the side of the emission path, and from a volume within 5 m of the sensor window. It is considered insensitive to ambient light when immersed in water. The sensor was factory-calibrated in formazin turbidity units (FTU). Specifications for the Seapoint turbidity meter are given in Table 6.

Table 6: *Seapoint turbidity meter sensor specifications:*

Gain	**Sensitivity (mV/FTU)**	**Range (FTU)**	**Accuracy (FTU)**	**Resolution (FTU)**
200X	200	25	0.05	0.005
20X	40	125	0.25	0.025
5X	10	500	1	0.1
1X	2	>750	5	0.5

3.2.2 Data Summary

CTD datafiles are organized by deployment date in the following folders:

\OCEAN\CTD\2009_07
\OCEAN\CTD\2009_09

A summary of all CTD casts is presented in Table 7:

***Table 7**: Irdonaut Ocean Seven 304 Casts conducted in 2009*

Station	Date(UTC)	Time(UTC)	Latitude(N)	Longitude(W)	Data files
01	07-18	16 :30	70°29.030'	135°11.214'	2009_leg2a_st01_CTD.txt
14	07-19	00 :00	70°34.825'	135°57.278'	2009_leg2a_st14_CTD.txt
17	07-20	14 :00	70°37.170'	136°32.390'	2009_leg2a_st17_CTD.txt
10	07-21	14 :30	70°47.310'	135°33.300'	2009_leg2a_st10_CTD.txt
21	07-22	15 :22	71°01.221'	134°37.336'	2009_leg2a_st21_CTD.txt
20	07-23	15 :48	71°00.941'	135°20.775'	2009_leg2a_st20_CTD.txt
16	07-24	15 :30	70°47.246'	136°40.564'	2009_leg2a_st16_CTD.txt
07	07-25	16 :00	70°59.270'	136°08.333'	2009_leg2a_st07_CTD.txt
12	07-27	15 :54	70°38.196'	135°05.173'	2009_leg2a_st12_CTD.txt
L2	09-05	16 :07	74°24.100’	136°25.400’	2009_09_05_1607_1.txt
L2	09-05	16 :07	74°24.100’	136°25.400’	2009_09_05_1607_2.txt
L2	09-05	16 :07	74°24.100’	136°25.400’	2009_09_05_1607_3.txt
L2	09-05	16 :07	74°24.100’	136°25.400’	2009_09_05_1607_4.txt
L2	09-05	16 :07	74°24.100’	136°25.400’	2009_09_05_1607_5.txt
N/A	09-25	15 :00	70°41.000'	136°10.100'	2009_09_25_1500.txt
N/A	09-29	14 :30	70°37.600'	136°00.750'	2009_09_29_1430.txt

All variables denoted in the file header have been defined in section 3.2.1. A sample of ASCII output for a cast conducted 20 July 2009 is presented in Table 8:

Table 8: Sample ASCII CTD data from 20 July 2009

Date	Time	Pres	Temp	Cond	Sal	Turb
20/07/2009	12:35.0	0.13	0.251	22.632	26.4	0.1
20/07/2009	12:35.1	0.13	0.25	22.635	26.404	0.1
20/07/2009	12:35.3	0.13	0.252	22.662	26.437	0.1
20/07/2009	12:35.4	0.13	0.249	22.659	26.435	0.1
20/07/2009	12:35.5	0.13	0.242	22.631	26.406	0.1
20/07/2009	12:35.7	0.13	0.237	22.627	26.405	0.1
20/07/2009	12:35.8	0.13	0.238	22.617	26.391	0.1
20/07/2009	12:36.0	0.12	0.243	22.624	26.396	0.1
20/07/2009	12:36.1	0.12	0.247	22.622	26.39	0.1
20/07/2009	12:36.3	0.13	0.249	22.61	26.373	0.1
20/07/2009	12:36.4	0.14	0.248	22.601	26.361	0.1
20/07/2009	12:36.5	0.13	0.246	22.601	26.364	0.1
20/07/2009	12:36.7	0.12	0.244	22.608	26.375	0.1
20/07/2009	12:36.8	0.12	0.246	22.616	26.383	0.1
20/07/2009	12:37.0	0.13	0.246	22.614	26.38	0
20/07/2009	12:37.1	0.14	0.245	22.604	26.368	0.1
20/07/2009	12:37.3	0.13	0.245	22.602	26.366	0.1
20/07/2009	12:37.4	0.13	0.243	22.606	26.373	0.1
20/07/2009	12:37.6	0.12	0.24	22.613	26.384	0.1

Figure 30 shows temperature and salinity as measured in a marginal ice zone 5 September 2009.

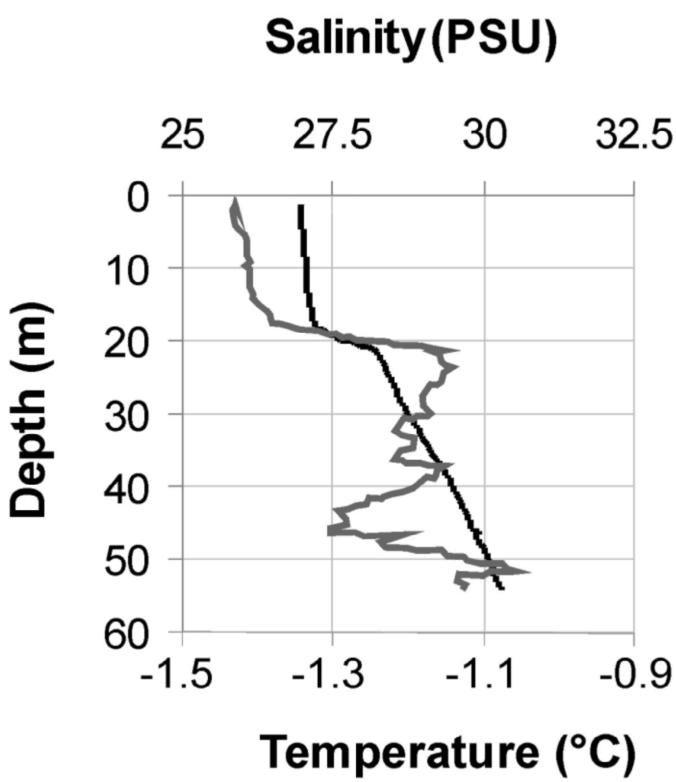


Figure 30: *Ocean profile (bottom) showing salinity (black) and temperature (grey, °C) in the top 50 m of the ocean, 5 September 2009.*

3.3 Ocean Surface Roughness

3.3.1 Instrumentation: Meteorological Ocean Buoy

Instrument : MetOcean Systems Meteorological Ocean Buoy (MOB) System.

The MOB buoy (Figure 31) is used to investigate *in situ* sea surface roughness conditions. Accelerometers are used to generate a 3-dimensional wave-spectrum time series. The MOB also has a Vaisala sonic ultrasonic wind sensor, which measures surface wind speed and direction. There is a GPS receiver on the top of the buoy, and a radio transmitter (160.725 mHz) that transmits a signal that is received by a hand-held directional finder. The buoy weighs approximately 18 kg and has a diameter of 16 inches.

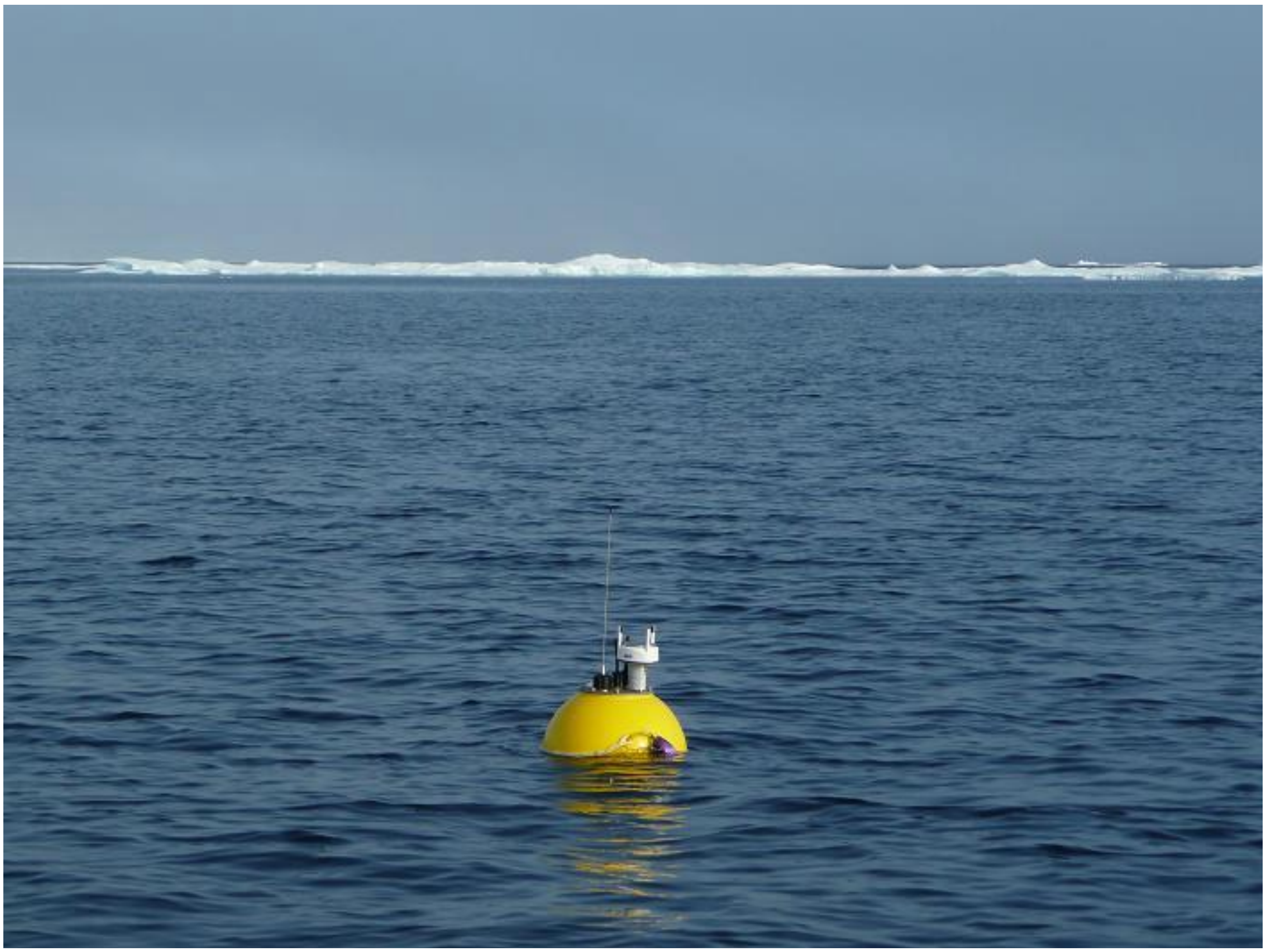


Figure 31: *A MOB during a typical deployment away from the influence of the ship or zodiac.*

The buoy was deployed using the zodiac at least 100 m away from the ship. The buoy is recovered using the zodiac (or the ice cage when the zodiac can't be deployed). The buoy must be on the water for at least 2 hours. This ensures sufficient telemetry to generate various wave parameters including wave spectrum every 15 minutes.

3.3.2 Data Summary

Deployment opportunities were limited to short periods (1.5 to 2 hours), mainly concurrent with the optics sampling (Table 5). The data sets available from these deployments are very limited in temporal coverage, but are representative of relatively small sea surface roughness encountered in and around the Ajurak block arising from high sea ice concentrations, and predominantly light winds.

Table 9: *Summary of MOB buoy deployments during 2009*

Station ID	Date(UTC)	Time(UTC)	Latitude(N)	Longitude(W)	Data Files
21	07-22	15 :22	71°01.221'	134°37.336'	...\MOB\2009-07-22\
20	07-23	15 :48	71°00.941'	135°20.775'	...\MOB\2009-07-23\
16	07-24	15 :30	70°47.246'	136°40.564'	...\MOB\2009-07-24\
12	07-27	15 :54	70°38.196'	135°05.173'	...\MOB\2009-07-27\
L1	08-30	05 :10	69 29.823'	137 58.589'	...\MOB\2009-08-30\
S2	08-31	05 :55	69 58.877'	138 27.500'	...\MOB\2009-08-31\
L2	09-05	17 :06	74 23.994'	136 25.605'	...\MOB\2009-09-05\
L11	09-09	22 :39	72 30.816'	136 44.479'	...\MOB\2009-09-09\
n/a	09-29	22 :05	70°37.359´	136° 01.086´	...\MOB\2009-09-29\

The MOB has two data sets: 1) Wave spectra, and 2) Ocean surface winds using a Vaisala Ultrasonic anemometer. The wave spectra data appears as two Datawell format files having extensions *.RDT and *.SDT. (Note: Datawell BV waverider software, W@ves21 v2.2.14, is required to open the files." This software can be purchased from Datawell BV http://www.datawell.nl/inhoud.php?id=1). The wave data is in proprietary binary format, and is plotted directly by the supplier software and therefore has no header information. The SDT files contain the main wave spectrum information that includes 2D and 3D power spectral density, significant wave height, wave period, latitude and longitude and position plot. The RDT files contain mainly displacement statistics data that includes, heave distribution, horizontal and vertical projection, mean, standard deviation, skewness and kurtosis.

Ocean surface wind data is in comma-delimited ASCII format and can be easily opened with Microsoft Excel. Datafile header information is as follows:

JHOUR: Hour of the year (Counting 1 from January 1st 00:00 hrs)
HDG: Heading
PITCH: Measured pitch (degrees)
ROLL: Measured roll (degrees)
DN: Wind direction (min)
DM: Wind direction (average, m/s)
DX: Wind direction (max, m/s)
SN: Wind speed (min, m/s)
SM: Wind speed (average, m/s)
SX: Wind speed (max, m/s)
VBAT: Battery Voltage (Volts)

MOB datafiles are organized by deployment date in the dataset at:

\OCEAN\MOB\yyyy_mm_dd

3.3.2 Data Visualizations

Data visualizations are presented below in figures 32 and 33.

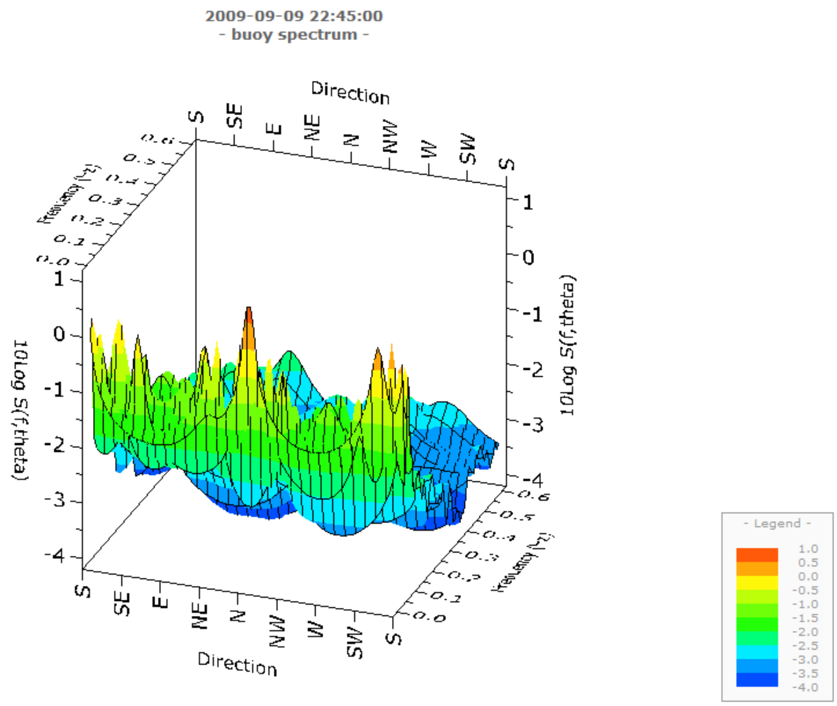


Figure 32: *Three dimensional Meteorological Ocean Buoy spectrum observed on 09 September 2009. The 3D-plot shows spectral density vs. frequency and direction.*

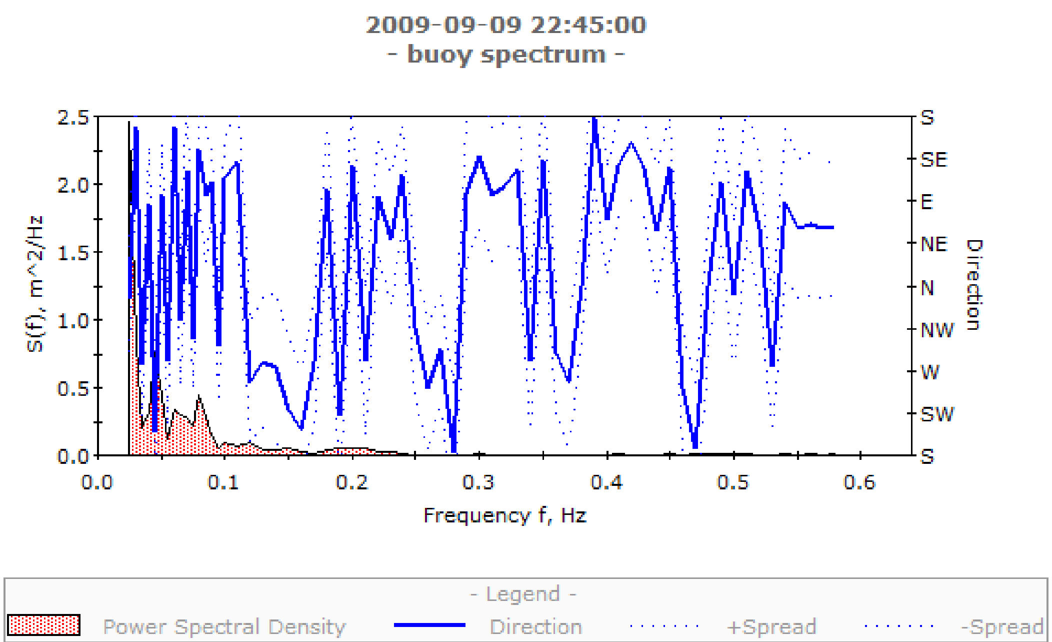


Figure 33: *Two dimensional Meteorological Ocean Buoy spectrum observed on 09 September, 2009. The 2D-plot shows Spectral Density vs. Frequency, spread and direction.*

SECTION FOUR: SEA ICE DATA

4.1 Electromagnetic Induction System Sea Ice Thickness Surveys

4.1.1 Instrumentation

Sea ice thickness and surface ice roughness were measured with a helicopter-borne electromagnetic (HEMI) system, called the "Ice Pic", consisting of a cigar-shaped sensor package fix-mounted on the nose of a BO105 Canadian Coast Guard helicopter. The white and red "POD" fixed to the helicopter skid-gear houses the video and the second laser (Figure 34).

Figure 34: *The Ice Pic, a fix-mounted helicopter-borne electromagnetic is shown mounted on a BO105 CCG helicopter. The red pod fixed to the helicopter skid-gear houses the video and the second laser.*

The overall weight of the fixed-mount sensor package is 44 kg and consists of the laser, an EM transmitter, and an EM receiver mounted inside a cylindrical tube that is fitted to the nose of the helicopter. The EM induction system uses 4 frequencies: 1.67, 5.02, 11.7, and 35.1 KHz, to measure the distance to the ice-seawater interface. The coil separation is 1.2 m and the footprint is about 2.5 times the sensor altitude above the seawater surface. The sensor altitude above the pack-ice surface is 1.1 m when the helicopter skids are on the ice. The laser measures the distance to the ice surface. The difference between the two measurements gives the snow-plus-ice thickness.

The system can be used to "spot sample" by soft-landing and averaging the incoming 10 Hz data, or it can be used to profile floes by slowly flying at low altitude. The Ice Pic console runs on 28-volt helicopter power, and, in addition to the EM laser data, it logs GPS position and radar altimeter data derived from the helicopter's avionics. The real-time outputs are snow and ice thickness, ice conductivity, and the laser altitude.

VGPS (define) sampling was conducted following HEMI transects, following the same approximate transect line but at an altitude of ~100 m. Video images are collected with a video-laser system, which captures image frames from a downward-looking video camera in a pod mounted on the helicopter skids. Consecutive video frames can form mosaics, which are used to monitor ice conditions such as ridging, ice concentration, and floe size along the flight path. At times they capture pictures of seals along with their seal holes and occasionally polar bear tracks.

(For more detailed information on this system, and to obtain software please visit: http://www.geosensing.com)

4.1.2 Data Summary

HEMI data collection flights conducted between 15 July and 15 October 2009 are summarized by file ID (Table 10). The majority of these flights occurred from 16 July – 30 July (Leg 2a), and 27 August – 12 September (Leg 3a). From 12 September – 15 October (Leg 3b), the ship was positioned far from the ice edge, and only select EMI flights were possible. There were no HEMI operators on board from 30 July – 27 August (Leg 2b).

Table 10: *HEMI data and video lines summary.*

EM/ Video number	Date/ time	Total length/ sections	Pattern flown	N-S and E-W extent
FEM09309	23 Jul	40 km 8 sections	NE to SW Transects	70.96N to 71.71.02N 135.43Wto 135.32W
FEM09310	23 Jul	36 km 8 sections	NE to SW Transects	71.00N to 71.025N 135.56W to 135.5W
FEM09311	23 Jul	68km 8 sections	NW to SE Transects	71.06N to 71.12N 135.35W to 135.15W
FEM09312	23 Jul	25 km 6 sections	NW to SE Transects	71.005N to 71.03N 135.44W to 135.4W
FEM09313	23 Jul	24 km 4 sections	East to West Transects	70.97N to 71.02 135.55W to 135.45W
FEM09315	24 Jul	63 km 8 sections	East -West Transects	70.925 to 70.947 136.48 to 136.40
FEM09316	24 Jul	15 km 4 sections	NW to SE Transects	70.915 to 70.93 136.28 to 136. 36
FEM09326	26Jul	25km 6 sections	East-West Transects	70.81 to 70.85 136 to 136.045
FEM09327	26 Jul	42km 6 sections	NW to SE Transects	70.705 to 70.74 135.90 to 135.75
FEM09328	26 Jul	16 km 5 sections	East -West Transects	70.686 to 70.698 136.08 to 136
FEM09329	26 Jul	16 km 4 section	NW to SE Transects	70.650 to 70.665 136.1to 136 .04
FEM09330	26 Jul	15 km 5 sections	North to South Transects	70.62 to 70.66 136 to 136.04
FEM09331	26 Jul	39 km 6 sections	North to South Transects	70.53 to 70.56 136.12 136.06
FEM09332	26 Jul	26km 4 sections	SW to NE Transects	70.5 to 70.515 136.96 to 135.87
FEM09333	26 Jul	19km 4 sections	East to West Transects	70.525 to 70.535 135.86 to 135.77
FEM0334	26 Jul	55 km 7 sections	NE to SW Transects	70 .55 to 70.585 135.72 to 135.62
FEM0335	26 Jul	19km 6 sections	East to West Transects	70.59 to 70.605 135.78 to 135.70
FEM09336	26 Jul	53 km 6 sections	NW to SE Transects	70.57 to 70.60 136.43 to 136.32
FEM09337	26 Jul	15 km 6 sections	East to West Transects	70.61 to 70.635 136.28 to 136.15

FEM09338	26 Jul	48 km 7 sections	East to West Transects	70.75 to 70.775 136.02 to 135.94
FEM0339	27 Jul	24 km 6 sections	NW to SE Transects	70.59 to 70.625 135 to 134.9
FEM0340	27 Jul	10 km 4 sections	NW to SE Transects	70.64 to 70.655 134.91 to 134.88
FEM09342	27 Jul	36 km 6 sections	NW to SE Transects	70.67 to 70.71 134.9 to 134.8
FEM09343	27 Jul	36 km 6 sections	North to South Transects	70.72 to 70.76 134.88 to 134.81
FEM09344	27 Jul	55 km 6 sections	North to South Transects	70.78 to 70.815 134.95 to 134.82
FEM09345	27 Jul	30 km 6 sections	North to South Transects	70.845 to 70.885 134.62 to 134.53
FEM09346	27 Jul	18 km 5 sections	East to West Transects	70.83 to 70.86 134.55 to 134. 4
FEM09347	27 Jul	85km 7sections	North to South Transects	70.64 to 70.68 134.47 to 134.35
FEM09348	27 Jul	18 km 4sections	North to South Transects	70.67 to 70.70 135.52 to 135.46
FEM09350	27 Jul	35 km 6 sections	NW to SE Transects	70.71 to 70.74 135.38 to 135.31
FEM09351	27 Jul	7.5 km 4sections	NE to SW Transects	70 .734 to 70.744 135.26 to 135.23
FEM09352	27 Jul	24 km 6sections	NE to SW Transects	70.74 to 70.765 135.23 to 135.18
FEM09355	27 Jul	56 km 4sections	NW to SE Transects	70.785 to 70.825 135.48 to 135.38
FEM09356	28 Jul	57 km 6sections	NE to SW Transects	70. 86 to 70.895 135.4 to 135.3
FEM09357	28 Jul	36 km 6sections	North to South Transects	70.91 to 70.95 135.47 to 135.35
FEM09358	28 Jul	57 km 6 sections	NW to SE Transects	70.95 to 70.99 135.65 to 135.55
FEM09359	28 Jul	55 km 6 sections	NW to SE Transects	71. 00 to 71.035 135.74 to 135.62
FEM09360	28 Jul	42 km 6 sections	North to South Transects	70.895 to 70.93 135.72 to 135.67
FEM09361	28 Jul	28 km 6sections	NW to SE Transects	70.825 to 70.86 135.65 to 135.59
FEM09362	29 Jul	14 km 2sections	West to East Transects	71.74 to 71.79 134.65 to 134.4
FEM09363	29 Jul	53km 2 sections	NW to SE Transects	71.6 to 71.8 134.60 to 134.2
FEM09364	29 Jul	1.5km 1section	NW to SE Transects	71.54 to 71.6 134.05 to 133.9
FEM09365	29 Jul	36 km 4sections	NE to SW Transects	71.54 to 71.6 133.87 to 133.3
FEM09409	03 Oct	3500 m 1section	NE to SW Transects	70.71 to 70.75 133.83 to 135.68
FEM09368	31Aug	140 km 9 sections	Large rectangle NW of ship (71.09/138.9)	138.9 to 140.1W 71.09 to 71.46N

FEM09370	31Aug	20 km 4line sections	MYIce floe#1 passes on which ship was anchored (71.105/139.02)	N-S passes 71.095 to 71.115N at 139.0211W
FEM09371	01 Sept	160km 9 sections	Large rectangle NE and NW of ship (71.1/139.2)	138.7 to 140.3W 71.1 to 71.3N
FEM09371	01 Sept	15km 4 sections	2km ice roughness lines at ship (71.1/139.2)	Lines NW 71.12/139.22 to SE 71.1005/139.14
FEM09371	01 Sept	15km 4 sections	2km MY Floe#1 N-S lines at ship (71.1/139.2)	71.114 to 71.12 N at 71.1/139.2)
FEM09372	02Sept	190km 6sections	Large rectangle to North of ship (71.1/139.2)	From ship 71.1 up to 71.85North
FEM09374	02Sept	15km	2km MY Floe#1 N-S lines at ship (71.1/139.2	From ship 71.1 up to 71.85North
F098-F102	02Sept	15km 2 passes	4km MY Floe#1 N-S lines at ship (71.1/139.2)	71.114 to 71.12 N at 71.1/139.2)
F103-F113	02Sept	60km with FEM09372	Video data along large rectangle North of ship	From ship 71.1 up to 71.85North
FEM09375	02Sept	20km 8lines	E-W lines over single flow#1 100 m spacing	Centred at 71.258N, 139.06W
FEM09375	02Sept	20km 8lines	N-S lines over single flow#2 100 m spacing	Centred at 71.36N, 139.04W
FEM09375	02Sept	50km 13ines	E-W lines over single flow#3 100 m spacing	Centred at 71.408N, 139.06W
FEM09375	02Sept	30km 9lines	N-S lines over single flow#4 100m spacing	Centred at 71.505N, 138.82W
FEM09376	02Sept	25km 7lines	N-S lines over single flow#5 100m spacing	Centred at 71.72N, 138.78W
FEM09378	04Sept	36km 3x10km lines	Beacon triangle #1 S, N and West beacon	74.56N to 74 67N 137.15W to 137.40W
F114	04Sept	10km	N to SW beacon	74.66, 137.2 to 74.57, 137.4
F115	04Sept	10km	SW to SE beacon	74.57,137.4 to 71.56, 137.1
F116	04Sept	10km	SE to North beacon	71.56, 137.1 to 74.66, 137.2
F117	04Sept	14km	North beacon to ship	74.68,137.15 to 74.59, 137.02
FEM09381	06Sept	50km to East Video back	Line to east where ship is going (morning)	74.4N and 133.8W to 74.45N and 132.8W
F118-F119	06Sept	30km to west	Line to west to where ship was	74.45N and 132.8W to 74.42N and 133.3W
FEM09382	06Sept	36km 5 lines (4km)	N-S lines near ship Swell was running	Centred at 74.45 and 133.32
FEM09382	06Sept	20km 2 lines (4km)	N-S lines near ship Swell was running	Centred at 74.45 and 133.32
FEM09385	06Sept	10km 1 line (3km)	N-S lines near ship Swell was running	Centred at 74.45 and 133.37
FEM09386	06Sept	25km 4 lines (4km)	N-S lines near ship Swell was running	Centred at 74.45 and 133.32
F120-F121	06Sept	N-S lines morning	Video lines near ship	Centred at 74.45 and 133.32
F122-F249	06Sept	N-S lines afternoon	Short video lines where EM took Ice thicknesses including the MY ice floe #2 ship tried to anchor on	Centred near ship 74.45n and 133.32W
FEM09389	07Sept	Single 3.5km line N Stn.	Line near ship NE-SW	75.36, 137.48 to 75.32, 137.55
FEM09390	07Sept	20km 2 lines (4km)	NE-SW lines near ship Swell was running	Centred at 75.27 and 137.75
FEM09390	07Sept	20km 2 lines (4km)	N-S lines near ship Swell was running	Centred at 75.35 and 137.5
FEM09391	07Sept	20km 2 lines (4km)	NE-SW lines near ship Swell was running	Centred at 75.35 and 137.5
FEM09392	07Sept	1 line (3km)	SNE to NSW line	Centred 75.273 and 137.5
F131-F136	07Sept	Short Video lines N Stn.	Morning Video lines over short EM lines (Thin Ice)	Centred near ship; 75.35 and 137.5

F137-F139	07Sept	Short Video lines N Stn.	Afternoon video lines over short EM lines	Centred near ship; 75.35 and 137.5
FEM09394	08Sept AM	30km EM ice thickness	Beacon triangle#2, 10km side length, N, S and W	Triangle centre at 73.05N and 135.7W
FEM09394	08Sept	30km 3 sections	Beacon triangle, N, S and E	Triangle center at 72.51N and 136.6
F140-F144	08Sept AM	30km Video data	Beacon triangle#2, 10km side length , N, S and W	Triangle centre at 73.05N and 135.7W
FEM0935	08Sept PM	70km EM ice thickness	Beacon triangle#3, 10km side length, N, S and East	Triangle centre at 72.51N and 136.55W
F145-F151	08Sep PM	70km Video data	Beacon triangle#3, 10km side length, N, S and East	Triangle centre at 72.51N and 136.55W
FEM09397	09Sept AM	150km Ice thickness line	From ship due east, video back	From 72.52N and 136.75W to 72.52N and 133.4W
F152-F161	09Sept AM	150km video line	From 150km east of ship to ship	From 72.52N and 133.4W to 72.52N and 136.75W
FEM09400	09Sept PM	130km Ice thickness line	From ship due West, video back	From 72.52N and 136.75W to 72.52N and 140.0W
F162-F167	09Sept PM	130km video line	From 130km West of ship to ship	From 72.52N and 140.0W to 72.52N and 136.75W
FEM09401	09Sept PM	50km Ice thickness line	From ship 50km due North, video back	From 72.52N and 136.75W to 73.00N and 136.75WW
F168-F169	09Sept PM	50km video line	From 50km North of ship to ship	From 73.00N and 136.75W to 72.52N and 136.75W
FEM09403	Sept 16	~10km video, photography	50nm north of ship, FY ice, tightly packed, unconsolidated ice	From 71.41N and 135.677W to 71.40 and 135.676
FEM09404	Sept 16	~10km video, photography	50nm north of ship, FY ice, tightly packed, consolidated ice	From 71.47N and 135.529W to 71.46N and 135.56W
FEM09409	03 Oct	3500km. 7 sections	NE to SW Transects	70.71N and 70.75N to 13.8W and 135.65W

Within each of the flights, the actual locations of the HEMI and VGPS transects were dependent on the surrounding ice and weather conditions at flight time. Many of the flights consisted of a series of transects conducted over a given region (particularly during leg 2a). These transects are summarized in Table 11 (next page).

Table 11: *HEMI transect summary.*

FILENAME	DATE (2009)	FLOE ID	TRAN SECT #	START LAT	START LONG	END LAT	END LONG	MEAN ICE THICKNESS (m)	MEAN ICE ROUGHNESS (m)
FEM09309	23 July	1-20	1	70.98N	135.40W	71.01N	135.36W	2.548	0.118
FEM09309	23 July	1-20	2	71.01N	135.36W	70.97N	135.42W	2.788	0.232
FEM09309	23 July	1-20	3	70.97N	135.41W	71.01N	135.42W	2.754	0.371
FEM09309	23 July	1-20	4	71.01N	135.34W	70.97N	135.42W	2.785	0.370
FEM09309	23 July	1-20	5	70.97N	135.41W	71.005N	135.33W	2.405	0.234
FEM09309	23 July	1-20	6	71.005N	135.33W	70.965N	135.41W	2.698	0.481
FEM09309	23 July	1-20	7	70.97N	135.49W	71.00N	135.33W	2.773	0.282
FEM09309	23 July	1-20	8	71.00N	135.33W	70.97N	135.42W	2.313	0.274
FEM09310	23 July	2-20	1	71.007N	135.53W	71.013N	135.50W	2.179	0.102
FEM09310	23 July	2-20	2	71.014N	135.50W	71.007N	135.54W	1.901	0.231
FEM09310	23 July	2-20	3	71.009N	135.54W	71.015N	135.49W	1.847	0.426
FEM09310	23 July	2-20	4	71.015N	135.51W	71.01N	135.54W	1.884	0.243
FEM09310	23 July	2-20	5	71.012N	135.54W	71.017N	135.49W	1.05	0.174
FEM09310	23 July	2-20	6	71.02N	135.49W	71.013N	135.54W	1.680	0.210
FEM09310	23 July	2-20	7	71.015N	135.54W	71.021N	135.49W	1.773	0.205
FEM09310	23 July	2-20	8	71.02N	135.54W	71.025N	135.51W	2.463	0.371
FEM09311	23 July	3-20	1	71.08N	135.32W	7106N	135.17W	2.222	0.137
FEM09311	23 July	3-20	2	71.062N	135.18W	71.085N	135.32W	2.172	0.205
FEM09311	23 July	3-20	3	71.09N	135.30W	71.07N	135.17W	2.229	0.225
FEM09311	23 July	3-20	4	71.07N	135.17W	71.10N	135.33W	2.191	0.237
FEM09311	23 July	3-20	5	71.11N	135.33W	71.07N	135.15W	2.421	0.266
FEM09311	23 July	3-20	6	71.07N	135.15W	71.12N	135.35W	2.270	0.256
FEM09311	23 July	3-20	7	71.12N	135.35W	71.09N	135.23W	1.806	1.970

FEM09312	23 July	4-20	1	71.015N	135.42W	71.025N	135.414W	2.147	0.147
FEM09312	23 July	4-20	2	71.025N	135.41W	71.015N	135.42W	2.132	0.271
FEM09312	23 July	4-20	3	71.025N	135.41W	71.025N	135.40W	2.052	0.604
FEM09312	23 July	4-20	4	71.025N	135.39W	71.015N	135.41W	1.852	0.214
FEM09312	23 July	4-20	5	71.013N	135.415 W	71.02N	135.40W	1.799	0.186
FEM09312	23 July	4-20	6	71.02N	135.40W	71.012N	135.42W	1.835	0.198
FEM09313	23 July	5-20	1	70.975N	135.50W	70.974N	135.55W	2.331	3.694
FEM09313	23 July	5-20	2	70.974N	135.56W	70.98N	135.50W	2.115	0.224
FEM09313	23 July	5-20	3	70.981N	135.50W	70.981N	135.56W	1.813	5.814
FEM09313	23 July	5-20	4	70.982N	135.55W	70.982N	135.49W	1.471	0.195
FEM09313	23 July	6-20	1	70.997N	135.56W	71.007N	135.57W	1.674	0.763
FEM09313	23 July	6-20	2	71.01N	135.57W	70.993N	135.55W	2.226	5.503
FEM09313	23 July	6-20	3	70.995N	135.55W	71.01N	135.56W	1.654	2.176
FEM09313	23 July	6-20	4	71.01N	135.56W	70.997N	135.55W	1.509	0.206
FEM09315	24 July	1-F09	1	70.939N	136.465 W	70.94N	134.42W	2.171	0.083
FEM09315	24 July	1-F09	2	70.939N	136.415 W	70.938N	136.47 W	1.730	0.249
FEM09315	24 July	1-F09	3	70.936N	136.47 W	70.937N	136.415W	1.864	0.281
FEM09315	24 July	1-F09	4	70.935N	136.415 W	70.934N	136.47W	2.168	0.339
FEM09315	24 July	1-F09	5	70.933N	136.465 W	70.934N	136.415W	3.032	12.745
FEM09315	24 July	1-F09	6	70.931N	136.475 W	70.932N	136.425W	2.111	1.066
FEM09315	24 July	1-F09	7	70.931N	136.43W	70.929N	136.465W	2.084	0.321
FEM09315	24 July	1-F09	8	70.929N	136.43W	70.927N	136.47W	2.032	0.420
FEM09316	24 July	2-F09	1	70.926N	136.32W	70.920N	136.26W	2.719	0.267
FEM09316	24 July	2-F09	2	70.918N	136.27W	70.924N	136.34W	2.956	0.638
FEM09316	24 July	2-F09	3	70.922N	136.34W	70.917N	136.27W	3.525	0.571

FEM09316	24 July	2-F09	4	70.917N	136.28W	70.92N	136.35W	3.680	0.354
FEM09326	26 July	1-HP	1	70.85N	136.00W	70.85N	136.95W	1.919	NA
FEM09326	26 July	1-HP	2	70.85N	135.95W	70.84N	136.02W	1.653	NA
FEM09326	26 July	1-HP	3	70.84N	136.02W	70.84N	135.93W	1.981	NA
FEM09326	26 July	1-HP	4	70.84N	135.94W	70.83N	136.03W	2.346	NA
FEM09326	26 July	1-HP	5	70.83N	136.05W	70.835N	135.90W	2.107	NA
FEM09326	26 July	1-HP	6	70.835N	135.91W	70.81N	136.03W	2.003	NA
FEM09327	26 July	2-HP	1	70.734N	135.83W	70.717N	135.75W	2.986	NA
FEM09327	26 July	2-HP	2	70.717N	135.75W	70.732N	135.84W	2.766	NA
FEM09327	26 July	2-HP	3	70.731N	135.84W	70.715N	135.77W	2.625	NA
FEM09327	26 July	2-HP	4	70.712N	135.77W	70.724N	135.84W	2.853	NA
FEM09327	26 July	2-HP	5	70.724N	135.85W	70.705N	135.77W	2.348	NA
FEM09327	26 July	2-HP	6	70.704N	135.77W	70.716N	135.86W	2.381	NA
FEM09328	26 July	3-HP	1	70.696N	136.028 W	70.693N	136.06W	1.715	NA
FEM09328	26 July	3-HP	2	70.692N	136.055 W	70.693N	136.01W	2.437	NA
FEM09328	26 July	3-HP	3	70.692N	136.055 W	70.69N	136.055W	2.224	NA
FEM09328	26 July	3-HP	4	70.689N	136.055 W	70.689N	136.02W	1.923	NA
FEM09328	26 July	3-HP	5	70.687N	136.025 W	70.687N	136.05W	1.713	NA
FEM09329	26 July	4-HP	1	70.656N	136.06W	70.647N	136.043W	1.975	NA
FEM09329	26 July	4-HP	2	70.646N	136.05W	70.661N	136.08W	2.057	NA
FEM09329	26 July	4-HP	3	70.662N	136.09W	70.644N	136.06W	2.064	NA
FEM09329	26 July	4-HP	4	70.644N	136.067 W	70.657N	136.095W	1.998	NA
FEM09330	26 July	5-HP	1	70.632N	136.105 W	70.621N	136.19W	1.128	NA

FEM09330	26 July	5-HP	2	70.621N	136.095 W	70.636N	136.10W	2.084	NA
FEM09330	26 July	5-HP	3	70.639N	136.095 W	70.624N	136.085W	2.195	NA
FEM09330	26 July	5-HP	4	70.626N	136.08W	70.638N	136.009W	1.824	NA
FEM09330	26 July	5-HP	5	70.64N	136.085 W	70.628N	136.07W	1.424	NA
FEM09331	26 July	6-HP	1	70.559N	136.12W	70.537N	136.13W	1.654	NA
FEM09331	26 July	6-HP	2	70.537N	136.12W	70.559N	136.11W	1.980	NA
FEM09331	26 July	6-HP	3	70.56N	136.10W	70.535N	136.11W	1.944	NA
FEM09331	26 July	6-HP	4	70.535N	136.11W	70.56N	136.08W	1.726	NA
FEM09331	26 July	6-HP	5	70.556N	136.07W	70.533N	136.10W	1.728	NA
FEM09331	26 July	6-HP	6	70.533N	136.10W	70.558N	136.07	1.618	NA
FEM09332	26 July	7-HP	1	70.507N	135.93W	70.513N	135.88	1.830	NA
FEM09332	26 July	7-HP	2	70.512N	135.93W	70.505N	135.94W	1.759	NA
FEM09332	26 July	7-HP	3	70.503N	135.94W	70.503N	135.87W	1.863	NA
FEM09332	26 July	7-HP	4	70.507N	135.88W	70.501N	135.93W	1.339	NA
FEM09333	26 July	8-HP	1	70.532N	135.84W	70.534N	135.76W	1.979	NA
FEM09333	26 July	8-HP	2	70.532N	135.78W	70.529N	135.85W	1.928	NA
FEM09333	26 July	8-HP	3	70.528N	135.85W	70.531N	135.77W	0.879	NA
FEM09333	26 July	8-HP	4	70.529N	135.77W	70.525N	135.85W	0.709	NA
FEM09334	26 July	9-HP	1	70.57N	135.7W	70.584N	135.65W	2.827	NA
FEM09334	26 July	9-HP	2	70.565N	135.7W	70.585N	135.64W	2.774	NA
FEM09334	26 July	9-HP	3	70.564N	135.695 W	70.58N	135.645W	2.572	NA
FEM09334	26 July	9-HP	4	70.577N	135.65W	70.56N	135.695W	2.145	NA
FEM09334	26 July	9-HP	5	70.574N	135.64W	70.555N	135.685W	2.078	NA

FEM09334	26 July	9-HP	6	70.559N	135.69W	70.575N	135.64W	2.107	NA
FEM09334	26 July	9-HP	7	70.555N	135.68W	70.571N	135.63W	1.628	NA
FEM09335	26 July	10-HP	1	70.605N	135.744 W	70.604N	135.770W	1.502	NA
FEM09335	26 July	10-HP	2	70.602N	135.77W	70.604N	135.73W	2.021	NA
FEM09335	26 July	10-HP	3	70.602N	135.73W	70.598N	135.775W	2.101	NA
FEM09335	26 July	10-HP	4	70.597N	135.775 W	70.599N	135.725W	2.362	NA
FEM09335	26 July	10-HP	5	70.599N	135.72W	70.592N	135.78W	2.229	NA
FEM09335	26 July	10-HP	6	70.591N	135.775 W	70.594N	135.725W	2.370	NA
FEM09336	26 July	11-HP	1	70.587N	136.41W	70.57N	136.35W	2.268	NA
FEM09336	26 July	11-HP	2	70.57N	136.35W	70.592N	136.41W	2.203	NA
FEM09336	26 July	11-HP	3	70.595N	136.42W	70.575N	136.33N	2.525	NA
FEM09336	26 July	11-HP	4	70.575N	136.33W	70.598N	136.39W	2.301	NA
FEM09336	26 July	11-HP	5	70.597N	136.39W	70.58N	136.32W	2.064	NA
FEM09336	26 July	11-HP	6	70.58N	136.31W	70.60N	136.38W	2.317	NA
FEM09337	26 July	12-HP	1	70.615N	136.22W	70.617N	136.16W	1.432	NA
FEM09337	26 July	12-HP	2	70.618N	136.16W	70.62N	136.26W	1.387	NA
FEM09337	26 July	12-HP	3	70.622N	136.25W	70.622N	136.16W	1.262	NA
FEM09337	26 July	12-HP	4	70.625N	136.17W	70.625N	136.25W	1.642	NA
FEM09337	26 July	12-HP	5	70.627N	136.26W	70.63N	136.15W	1.538	NA
FEM09337	26 July	12-HP	6	70.632N	136.16W	70.633N	136.26W	1.205	NA
FEM09338	26 July	13-HP	1	70.766N	136.00W	70.774N	135.95W	2.954	NA
FEM09338	26 July	13-HP	2	70.773N	135.95W	70.765N	136.00W	2.928	NA
FEM09338	26 July	13-HP	3	70.763N	136.00W	70.766N	135.945W	2.581	NA

FEM09338	26 July	13-HP	4	70.765N	136.95W	70.761N	136.005W	2.526	NA
FEM09338	26 July	13-HP	5	70.759N	136.00W	70.761N	135.95W	2.727	NA
FEM09338	26 July	13-HP	6	70.76N	135.95W	70.755N	136.01W	2.508	NA
FEM09338	26 July	13-HP	7	70.754N	136.01W	70.754N	135.96W	2.353	NA
FEM09339	27 July	1-12	1	70.608N	135.02W	70.59N	134.95W	1.303	NA
FEM09339	27 July	1-12	2	70.592N	134.94W	70.61N	135.02W	1.115	NA
FEM09339	27July	1-12	3	70.61N	135.01W	70.597N	134.94W	0.893	NA
FEM09339	27 July	1-12	4	70.598N	134.93W	70.613N	135.00W	1.038	NA
FEM09339	27July	1-12	5	70.615N	135.01W	70.615N	135.92W	1.363	NA
FEM09339	27July	1-12	6	70.605N	134.92W	70.622N	135.00W	1.274	NA
FEM09340	27 July	2-12	1	70.651N	134.91W	70.647N	134.9W	4.094	NA
FEM09340	27 July	2-12	2	70.647N	134.893 W	70.651N	134.905W	4.183	NA
FEM09340	27 July	2-12	3	70.648N	134.891 W	70.653N	134.906W	4.321	NA
FEM09340	27 July	2-12	4	70.654N	134.903 W	70.649N	134.89W	3.565	NA
FEM09342	27 July	3-12	1	70.677N	134.83W	70.695N	134.89W	1.451	NA
FEM09342	27 July	3-12	2	70.693N	134.87W	70.675N	134.81W	1.176	NA
FEM09342	27 July	3-12	3	70.678N	134.81W	70.702N	134.89W	1.296	NA
FEM09342	27 July	3-12	4	70.703N	134.89W	70.678N	134.86W	1.122	NA
FEM09342	27 July	3-12	5	70.68N	134.79W	70.707N	134.87W	1.181	NA
FEM09342	27 July	3-12	6	70.707N	134.86W	70.687N	134.79W	1.183	NA
FEM09343	27 July	4-12	1	70.733N	134.89W	70.762N	134.89W	1.561	NA
FEM09343	27 July	4-12	2	70.76N	134.89W	70.724N	134.88W	1.957	NA
FEM09343	27 July	4-12	3	70.726N	134.87W	70.763N	134.87W	1.371	NA

FEM09343	27 July	4-12	4	70.762N	134.86W	70.724N	134.85W	1.207	NA
FEM09343	27 July	4-12	5	70.73N	134.84W	70.76N	134.84W	1.240	NA
FEM09343	27 July	4-12	6	70.76N	134.84W	70.726N	134.83W	1.110	NA
FEM09344	27 July	5-12	1	70.787N	134.90W	70.813N	134.94W	1.805	NA
FEM09344	27 July	5-12	2	70.814N	134.94W	70.785N	134.88W	1.733	NA
FEM09344	27 July	5-12	3	70.785N	134.88W	70.813N	134.91W	1.580	NA
FEM09344	27 July	5-12	4	70.81N	134.89W	70.783N	134.85W	1.178	NA
FEM09344	27 July	5-12	5	70.873N	134.85W	70.815N	134.88W	1.214	NA
FEM09344	27 July	5-12	6	70.815N	134.85W	70.788N	134.83W	1.081	NA
FEM09345	27 July	6-12	1	70.857N	134.59W	70.875N	134.60W	3.280	NA
FEM09345	27 July	6-12	2	70.785N	134.59W	70.856N	134.58W	3.325	NA
FEM09345	27 July	6-12	3	70.857N	134.57W	70.878N	134.57W	3.077	NA
FEM09345	27 July	6-12	4	70.876N	134.565 W	70.856N	134.56W	2.554	NA
FEM09345	27 July	6-12	5	70.86N	134.555 W	70.88N	134.55W	2.457	NA
FEM09345	27 July	6-12	6	70.88N	134.545 W	70.861N	134.54W	1.740	NA
FEM09346	27 July	7-12	1	70.852N	134.46W	70.848N	134.42W	1.109	NA
FEM09346	27 July	7-12	2	70.845N	134.41W	70.84N	134.47W	1.243	NA
FEM09346	27 July	7-12	3	70.847N	134.47W	70.836N	134.40W	1.224	NA
FEM09346	27 July	7-12	4	70.834N	134.41W	70.842N	134.47W	1.101	NA
FEM09346	27 July	7-12	5	70.84N	134.47W	70.831N	134.41W	0.915	NA
FEM09347	27 July	1b-12	1	70.655N	135.42W	70.67N	135.415W	1.962	NA
FEM09347	27 July	1b-12	2	70.67N	135.41W	70.649N	135.41W	1.839	NA
FEM09347	27 July	1b-12	3	70.649N	135.41W	70.673N	135.40W	1.695	NA

FEM09347	27 July	1b-12	4	70.67N	135.39W	70.648N	135.39W	1.717	NA
FEM09347	27 July	1b-12	5	70.646N	135.39W	70.678N	135.38W	1.803	NA
FEM09347	27 July	1b-12	6	70.677N	135.37W	70.64N	135.37W	1.350	NA
FEM09347	27 July	1b-12	7	70.641N	135.36W	70.67N	135.35W	1.047	NA
FEM09348	27 July	2b-12	1	70.684N	135.51W	70.702N	135.515W	3.754	NA
FEM09348	27 July	2b-12	2	70.701N	135.51W	70.683N	135.495W	1.970	NA
FEM09348	27 July	2b-12	3	70.685N	135.49W	70.704N	135.50W	1.880	NA
FEM09348	27 July	2b-12	4	70.703N	135.49W	70.683N	135.48W	1.122	NA
FEM09350	27 July	3b-12	1	70.685N	135.47W	70.705N	135.48W	1.141	NA
FEM09350	27 July	3b-12	2	70.705N	135.48W	70.685N	135.46W	0.906	NA
FEM09350	27 July	3b-12	3	70.719N	135.35W	70.735N	135.38W	1.343	NA
FEM09350	27 July	3b-12	4	70.735N	135.38W	70.716N	135.33W	1.659	NA
FEM09350	27 July	3b-12	5	70.717N	135.32W	70.738N	135.38W	1.331	NA
FEM09350	27 July	3b-12	6	70.737N	135.37	70.72N	135.32W	1.216	NA
FEM09351	27 July	4b-12	1	70.739N	135.25W	70.744N	135.242W	1.423	NA
FEM09351	27 July	4b-12	2	70.743N	135.24W	70.738N	135.25W	1.609	NA
FEM09351	27 July	4b-12	3	70.737N	135.245 W	70.743N	135.233W	2.552	NA
FEM09351	27 July	4b-12	4	70.741N	135.233 W	70.736N	135.243W	1.991	NA
FEM09352	27 July	5b-12	1	70.752N	135.222 W	70.764N	135.205W	1.397	NA
FEM09352	27 July	5b-12	2	70.763N	135.205 W	70.748N	135.217W	1.187	NA
FEM09352	27 July	5b-12	3	70.748N	135.215 W	70.763N	135.195W	1.265	NA
FEM09352	27 July	5b-12	4	70.760N	135.193 W	70.745N	135.212W	1.104	NA
FEM09352	27 July	5b-12	5	70.745N	135.21W	70.762N	135.18W	1.000	NA

FEM09352	27 July	5b-12	6	70.76N	135.18W	70.741N	135.21W	1.074	NA
FEM09355	28 July	1-05	1	70.809N	135.47W	70.791N	135.38W	1.961	NA
FEM09355	28 July	1-05	2	70.809N	135.47W	70.791N	135.38W	1.658	NA
FEM09355	28 July	1-05	3	70.795N	135.40W	70.813N	135.40W	1.685	NA
FEM09355	28 July	1-05	4	70.805N	135.40W	70.816N	135.47W	1.487	NA
FEM09356	28 July	2-05	1	70.866N	135.36W	70.886N	135.30W	1.849	NA
FEM09356	28 July	2-05	2	70.887N	135.30W	70.864N	135.38W	1.593	NA
FEM09356	28 July	2-05	3	70.865N	135.38W	70.889N	135.31W	1.393	NA
FEM09356	28 July	2-05	4	70.893N	135.31W	70.867N	135.38W	1.746	NA
FEM09356	28 July	2-05	5	70.867N	135.39W	70.897N	135.32W	1.861	NA
FEM09356	28 July	2-05	6	70.897N	135.32W	70.872N	135.41W	1.778	NA
FEM09357	28 July	3-05	1	70.92N	135.37W	70.945N	135.35W	1.438	NA
FEM09357	28 July	3-05	2	70.943N	135.36W	70.91N	135.39W	1.517	NA
FEM09357	28 July	3-05	3	70.915N	135.39W	70.945N	135.37W	1.298	NA
FEM09357	28 July	3-05	4	70.944N	135.38W	70.914N	135.41W	1.497	NA
FEM09357	28 July	3-05	5	70.915N	135.41W	70.95N	135.38W	1.260	NA
FEM09357	28 July	3-05	6	70.95N	135.39W	70.914N	135.43W	1.223	NA
FEM09358	28 July	4-05	1	70.956N	135.59W	70.986N	135.65W	2.222	NA
FEM09358	28 July	4-05	2	70.987N	135.65W	70.954N	135.58W	2.265	NA
FEM09358	28 July	4-05	3	70.955N	135.57W	70.985N	135.63W	2.144	NA
FEM09358	28 July	4-05	4	70.985N	135.63W	70.953N	135.56W	1.851	NA
FEM09358	28 July	4-05	5	70.954N	135.56W	70.985N	135.61W	2.132	NA
FEM09358	28 July	4-05	6	70.984N	135.60W	70.97N	135.57W	3.052	NA

FEM09359	28 July	5-05	1	71.006N	135.68W	71.025N	135.73W	2.290	NA
FEM09359	28 July	5-05	2	71.025N	135.72W	71.005N	135.66W	2.657	NA
FEM09359	28 July	5-05	3	71.013N	135.67W	71.031N	135.72W	2.322	NA
FEM09359	28 July	5-05	4	71.031N	135.72W	71.005N	135.65W	2.874	NA
FEM09359	28 July	5-05	5	71.010N	135.65W	71.034N	135.71W	2.809	NA
FEM09359	28 July	5-05	6	71035N	135.71W	71.007N	135.63W	2.305	NA
FEM09360	28 July	6-05	1	70.923N	135.72W	70.899N	135.72W	2.704	NA
FEM09360	28 July	6-05	2	70.915N	135.71W	70.927N	135.71W	2.135	NA
FEM09360	28 July	6-05	3	70.925N	135.705 W	70.895N	135.705W	2.822	NA
FEM09360	28 July	6-05	4	70.90N	135.695 W	70.925N	135.69W	2.545	NA
FEM09360	28 July	6-05	5	70.925N	135.685 W	70.895N	135.685W	2.802	NA
FEM09360	28 July	6-05	6	70.90N	135.68W	70.925N	135.665W	3.254	NA
FEM09361	28 July	7-05	1	70.845N	135.64W	70.83N	135.62W	2.289	NA
FEM09361	28 July	7-05	2	70.833N	135.62W	70.847N	135.635W	2.487	NA
FEM09361	28 July	7-05	3	70.849N	135.63W	70.83N	135.605W	2.005	NA
FEM09361	28 July	7-05	4	70.835N	135.605 W	70.855N	135.62W	2.147	NA
FEM09361	28 July	7-05	5	70.855N	135.61W	70.835N	135.60W	1.753	NA
FEM09361	28 July	7-05	6	70.838N	135.595 W	70.855N	135.60W	1.975	NA
FEM09362	29 July	Site 1	1	71.762N	134.54W	71.774N	134.65W	2.172	NA
FEM09362	29 July	Site 1	2	71.762N	134.62W	71.784N	134.597W	2.021	NA
FEM09363	29 July	Site 2	1	71.77N	134.60W	71.72N	134.45W	2.210	NA
FEM09363	29 July	Site 2	2	71.63N	134.15W	71.60N	134.05W	2.011	NA
FEM09364	29 July	Site 3	1	71.58N	134.02W	71.54N	133.90W	2.777	NA

FEM09365	29 July	Site 4	1	71.55N	133.95W	71.58N	133.58W	3.296	NA
FEM09365	29 July	Site 4	2	71.58N	133.55 W	71.60N	133.35W	2.444	NA
FEM09365	29 July	Site 4	3	71.595N	133.35W	71.56N	133.25W	2.752	NA
FEM09365	29 July	Site 4	4	71.565N	133.30W	71.85N	133.25W	2.570	NA
FEM09403	16 Sep	F1	1	71.410308	135.676580W	71.384393	135.795058W	1.18	NA
FEM09403	16 Sep	F1	2	71.380517	135.770260W	71.400885	135.675898W	1.47	NA
FEM09404	16 Sep	F2	1	71.474797	135.529233W	71.475332	135.683463W	134	NA
FEM09404	16 Sep	F2	2	71.465067	135.676527W	71.464862	135.562555W	1.53	NA
FEM09409	03 Oct	Site 1	1	70.734858N	135.707588W	70.716400N	135.769727W	1.15	NA

HEMI Data is stored in the database at: (summarize flight word doc, file types, images).

\SEA ICE\HEMI

The IcePic™ system generates two data files, stored in the \Survey directory of the console's hard disk drive (C:), whenever it logs data. The base filename is FEMxxxxx.yyy, where xxxxx is a number which increments automatically, and the filename extension yyy is either RAW or TXT. The RAW file is a binary file which captures all data generated by the system during operation as a series of time-stamped data packets. The TXT file is a series of ASCII records, each corresponding to one Sample Run. The Sample Runs are numbered sequentially, starting with the value 1, after every power-up.

Data fields in the TXT file are:

SR #
Mean latitude (N or S, degrees, decimal minutes)
Mean longitude (E or W, degrees, decimal minutes)
Start time (milliseconds since midnight, GPS time)
End time (milliseconds since midnight, GPS time)
Mean ice thickness (m)
Standard deviation ice thickness (m)
Mean ice conductivity (S/m)
Standard deviation ice conductivity (S/m)
Mean sensor altitude (m)
Standard deviation sensor altitude (m)
Final normalised fitting error in sample run
Final # iterations in sample run

The RAW file may be transcribed using program EISXcribV1 to yield an ASCII summary file (FEMxxxxx.IPP) and a binary summary file (FEMxxxxx.DAT) which can be interpreted by the Sensors by Design DAT Viewer program for Matlab.

The IPP file is a column-oriented ASCII data file. IPP data columns are :

1 TimeStmp –System timestamp in milliseconds since 0000 Sunday morning.
2 GPSTime –GPS time of week in seconds since 0000 Sunday morning.
3 Lat –Latitude in degrees and decimal degrees
4 Lon –Longitude in degrees and decimal degrees
5 TimeDelay_lsr –Time delay between laser sample and 0.1 second system “tick”
6 Laser –Laser altimeter output
7 Laser_Return –Strength of laser return, out of about 6500
8 iLaser_Warn –warning character (decimal code for the ascii symbol)
9 Mfid –Manual fiducial (incremented with pushbutton adjacent to user interface)
10 RadAlt –Radar altitude if present and connected to console
11 Pitch –Sensor pitch
12 Roll –Sensor roll
13 SysCurr—Console DC current draw (should be ~5.5-9A if Pic only operating)
14 SysVolt --Console DC supply voltage (normally about 28V)
15 IntTemp –Internal temperature in C of console
16-23 (curr_FDEM_dat_pkt(j),j=1,8)--8 columns of EM data in ppm (parts-per-million)
24-31 (curr_FDEM_Zero_pkt(j),j=1,8)--8 columns of EM baselevel data in ppm
32 NParam –Number of parameters in inversion model, normally 3 for real-time data
33 NIter —Number of iterations during inversion of this sample
34 RMN —Normalized RMS fitting error in ppk during inversion of this sample
35 Sig_{ice} –ice conductivity estimate
36 T_{ice} –ice thickness estimate
37 $Sig_{seawater}$ –seawater conductivity (normally fixed in real time)
(there can be more T and Sig column pairs if additional layers are used for inversion)

4.1.3 EMI Data Visualizations

While there are hundreds of potential examples of EMI data to show in this section, we limited our examples to three: HEMI surveys flown along the sides of a ice drift beacon triangle in FY (Figure 35); N-S transect in MY (Figure 36); E-W long transect survey line in FY ice (Figure 37). The top figure shows the ice thicknesses plotted as they were encountered along the transect. The bottom left figure shows a simple grid showing the coordinates of the data presented (green line). The bottom right figure is a histogram showing ice thickness frequencies. Note that a range of ice thicknesses ranging from 0 – 5 m is present in all cases, however thicker ice is more (less) prevalent in areas of MY (FY) ice (odd sentence).

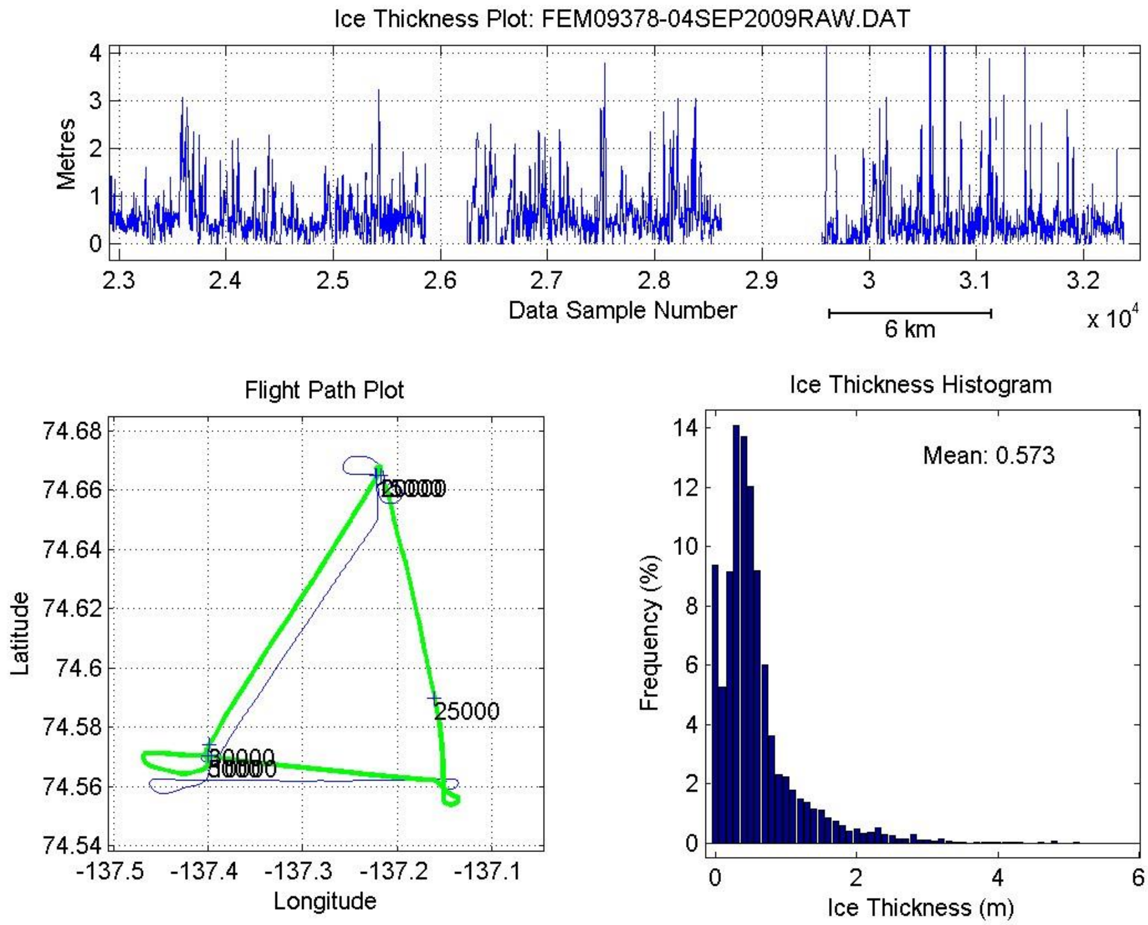


Figure 35: *Triangular beacon deployment in FY ice: 4 Sept 2009. The ice thickness histogram is skewed towards >1m thick ice, chacteristic of FY ice. Values of 0 indicate open water.*

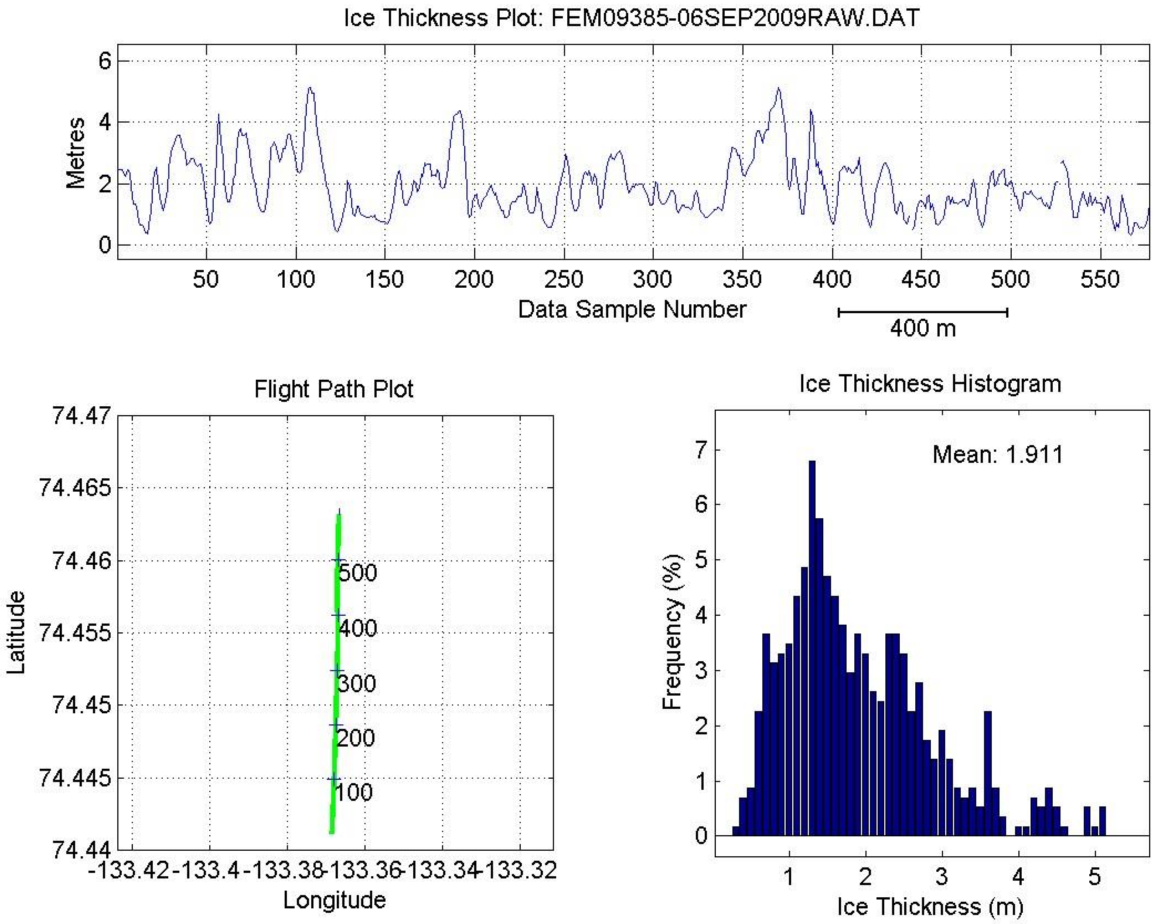


Figure 36: *MY Ice N-S line: Afternoon, 6 Sept 2009. The ice thickness histogram kurtosis shows a wider range of ice thickness frequencies, chacteristic of a region containing MY sea ice. Values of 0 indicate open water (none present).*

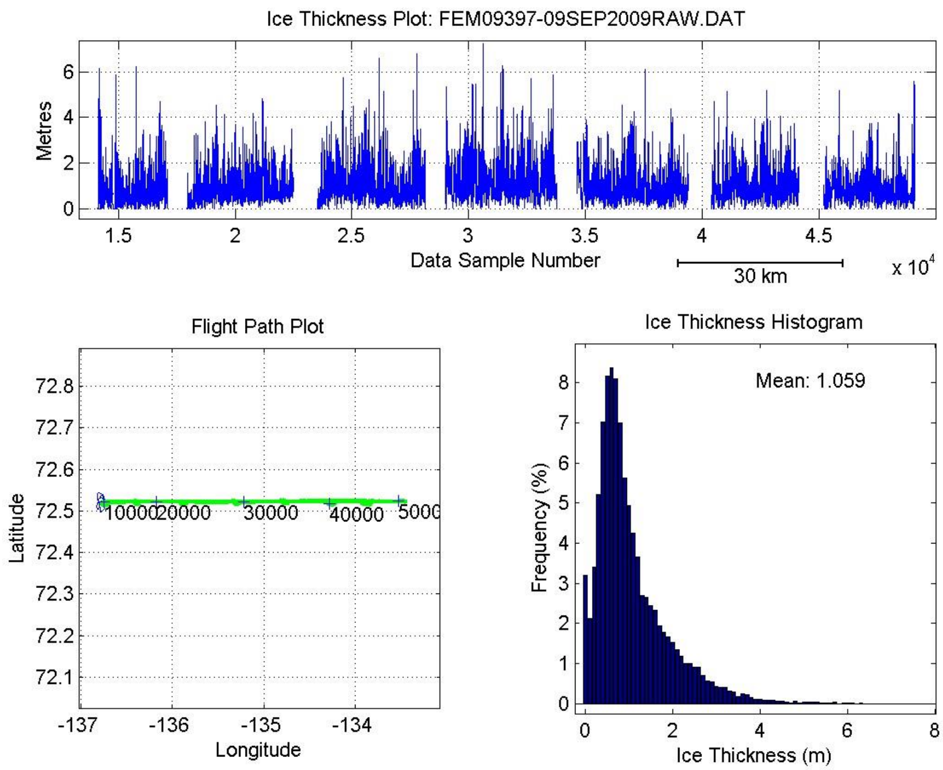


Figure 37: *EMI long flight W-E line, morning flight: 9 Sept 2009. This represents a long-distance survey flight line, and provides insight into the ice thickness distribution over a wide range.*

4.2 Active Microwave Measurements (C-Band Scatterometer)

4.2.1 Instrumentation: C-Band Scatterometer

ProSensing Inc. C-Band Scatterometer

The C-Band scatterometer is a fully polarimetric active radar system developed by ProSensing Inc. The transmit signal is a linear FM modulated pulse, or in other words, a chirp pulse. Its operating frequency is in C-band, with a centre frequency of 5.5 GHz and a bandwidth of 500 MHz. It is capable of measuring the full polarimetric response of the region of interest in terms of the combinations of linear polarizations: VV, HH, HV, and VH. Using proprietary software specific to the device and an internal calibration loop, it calculates the normalized radar cross section (NRCS), defined as !o, which is an averaging of the radar return over the region. From a system perspective, the radar cross section is dependent upon the frequency, polarization, and angle of incidence. From a physical perspective, the radar cross section is also dependent upon the physical makeup of the target area – its electro-physical description.

Figure 38: *C-Band scatterometer*

The scatterometer is used to measure the C-band microwave scattering signatures of a target region. For MY ice, open water, and landfast first year ice a swath at a series of incidence angles will take place. The variation of measurement in the azimuthal direction is neglected as a result of the averaging in this method. Measurements from the ship require a sweep from -30° to 30° in the azimuth, with the 0° reference at a perpendicular line to the ship-side. The variation in elevation is measured with sweeps in the elevation at 5° increments on the range 20° to 60°.

4.2.2 Data Summary

The scatterometer data requires correction before it can be used. Quality assurance revealed a systematic discrepancy was detected in the processed scatterometer data. Specifically, the data is out of phase by +/- 180, indedendent of surface type, time of year, temperature, etc. Processed files included in the dataset are therefore considered “preliminary” and should be used for exploratory purposes only at this point. If corrections should be necessary, a revised dataset will be made available as soon as it is available. Table 12 summarizes the scatterometer scans conducted during the 2009 cruise:

Table 12: *Scatterometer scan summary*

	Coordinates		**Time**				**Scans**	
Date	**Lat (°N)**	**Long (°W)**	**laptop**	**LST**	**UTC**	**CPU**	**#**	**Name of scans**
31-Aug	71.106337	139.024230	7:28	12:28	6:28	10:11	58	*
1-Sep			7:00	0:00	6:00	21:42	1	20090831-214311
1-Sep			11:00	4:03	10:00	1:46	1	20090901-014658
1-Sep			3:00	8:00	2:00	5:43	1	20090901-054314
1-Sep			19:00	12:00	18:00	9:42	1	20090901-094314
1-Sep			23:00	16:00	22:00	13:42	1	20090901-134343
1-Sep			3:00	20:00	2:00	17:42	1	20090901_174239
2-Sep	71.06	139.2	7:00	0:00	6:00	21:42	1	20090902-214324
2-Sep			11:24	4:24	10:24	2:07	1	20090902-020736
2-Sep			3:01	8:01	2:01	5:43	1	20090902-54339
3-Sep	74.39	137.23	12:52	17:51	23:52	15:53	9	20090903-1535 to 20090903-162955
3-Sep			5:38	22:38	4:38	8:38	1	20090903-202156
4-Sep			7:00	0:00	6:00	21:43	1	20090903-214331
4-Sep			11:00	4:00	10:00	1:42	1	20090904-014313
4-Sep			3:01	8:01	2:01	5:43	1	20090904-054352
4-Sep			19:59	12:59	6:59	10:42	1	20090904-104311
4-Sep			11:03	16:03	10:03	13:45	2	20090904-13457 to 20090904-135344
4-Sep			1:38	18:38	12:38	16:21	1	20090905-162201
5-Sep			7:28	12:28	6:28	10:11	2	20090905-101140 to 101928
6-Sep			4:19	9:19	3:19	7:02	7	20090906-070240 to 074925
6-Sep	74 26.277'	133 22.241'	8:43	13:43	7:43	11:26	8	20090906-112631 to 122103
8-Sep	73.12	135.29	17:12	10:12	16:12	7:55	2	20090908-075522 to 080401
8-Sep	72.3	136.34	12:08	17:08	23:08	14:51	2	20090908-145115 to 150713
8-Sep	72.51	136.6	1:24	18:24	12:24	16:06	20	20090908-1606…

10-Sep	72.636	137.335	1:22	18:22	12:22	16:06	3	20090910-160612-161433
10-Sep			1:41	18:41	12:41	16:24	3	20090910-162445-163307
10-Sep			1:59	18:59	12:59	16:43	3	20090910-164314-165136
10-Sep			2:23	19:23	1:23	17:07	3	20090910-170703-171525
10-Sep			2:42	19:42	1:42	17:25	3	20090910-172529-173353
10-Sep			3:05	20:05	2:05	17:48	3	20090910-174838-175702
10-Sep			3:22	20:22	2:22	18:05	5	20090910-180516-181342
10-Oct	71.34	-134.22	17:18	10:18	16:18	8:03	4	20091010_080331 - 081941
10-Oct	71.35	-134.23	18:36	11:36	17:36	9:21	4	20091010_092114-093725
10-Oct	71.37	-134.18	12:05	17:04	23:04	14:50	4	20091010_145010-150619
10-Oct	71.38	-134.19	2:06	19:06	1:06	16:52	4	20091010_165140-170748

It should be noted that there was an ongoing date/time synchronization problem in the scatterometer central processing unit. The operators have taken care to record LST, UTC, time on laptop, and the CPU time. The filename of each scan is linked to the CPU time.

A more detailed version of Table SCAT is available in the database at:

\SEA ICE\SCAT\2009_SCAT_Summary.xls

Raw scatterometer datafiles are organized by date in the database at:

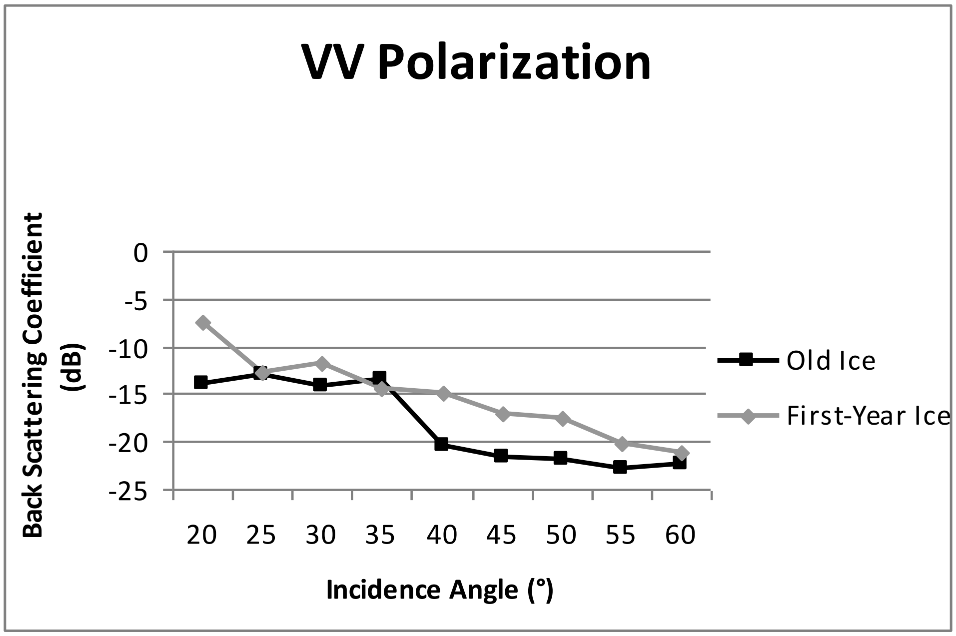
\SEA ICE\SCAT\RAW

The preliminary processed ASCII scatterometer files follow the same naming convention, and are organized into month-day folders as follows:

\SEA ICE\SCAT\MMDD

4.2.3 Data Visualizations

A comparison of scatterometer polarization data for different ice types is presented below :



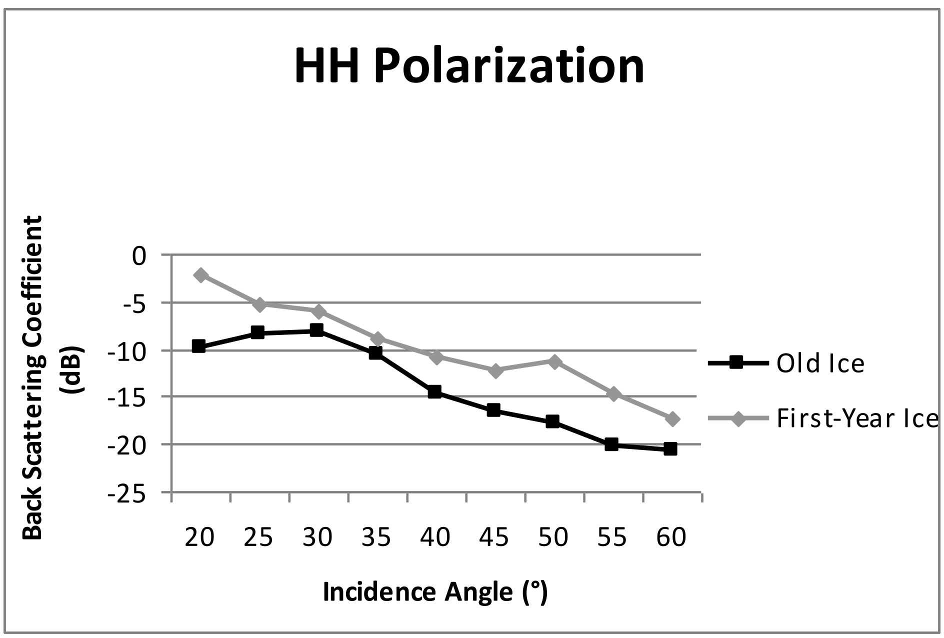


Figure 39: *(Top) VV polarization and (Bottom) HH polarization comparison of FY ice (4 Sept 2009), and old ice (6 Sept 2009) collected during leg 3A*

4.3 Surface-Based Radiometer (SBR) Passive Microwave Measurements

4.3.1 Instrumentation

37 and 89 GHz Passive Radiometers, Radiometrics Corp.

Ship-based ice-EM measurements were conducted to investigate the interactions between microwave signatures (both active and passive) and sea ice thermophysical properties. The observed data will be used to calibrate sea-ice products from the satellite sensors and to evaluate the theoretical microwave emission/scattering models. This result will provide more advanced knowledge of how microwave signature reacts to the evolution of sea ice thermo-physical properties on small scales during the fall freeze-up period.

The radiometers (Dickie type) are dual-polarized at the frequencies of 37 and 89 GHz, with central frequencies of 37.0 GHz (±0.1 GHz) and 89 GHz (±0.1 GHz), respectively. Radiometric resolution is < 0.08K and long-term stability is < 1K / hour. They record the surface emission as voltage readings and convert them into brightness temperature (T_Bs) using an internal calibration procedure. The radiometers are mounted on the port side of the Amundsen, at a height of ~10m above sea level (figure 40).

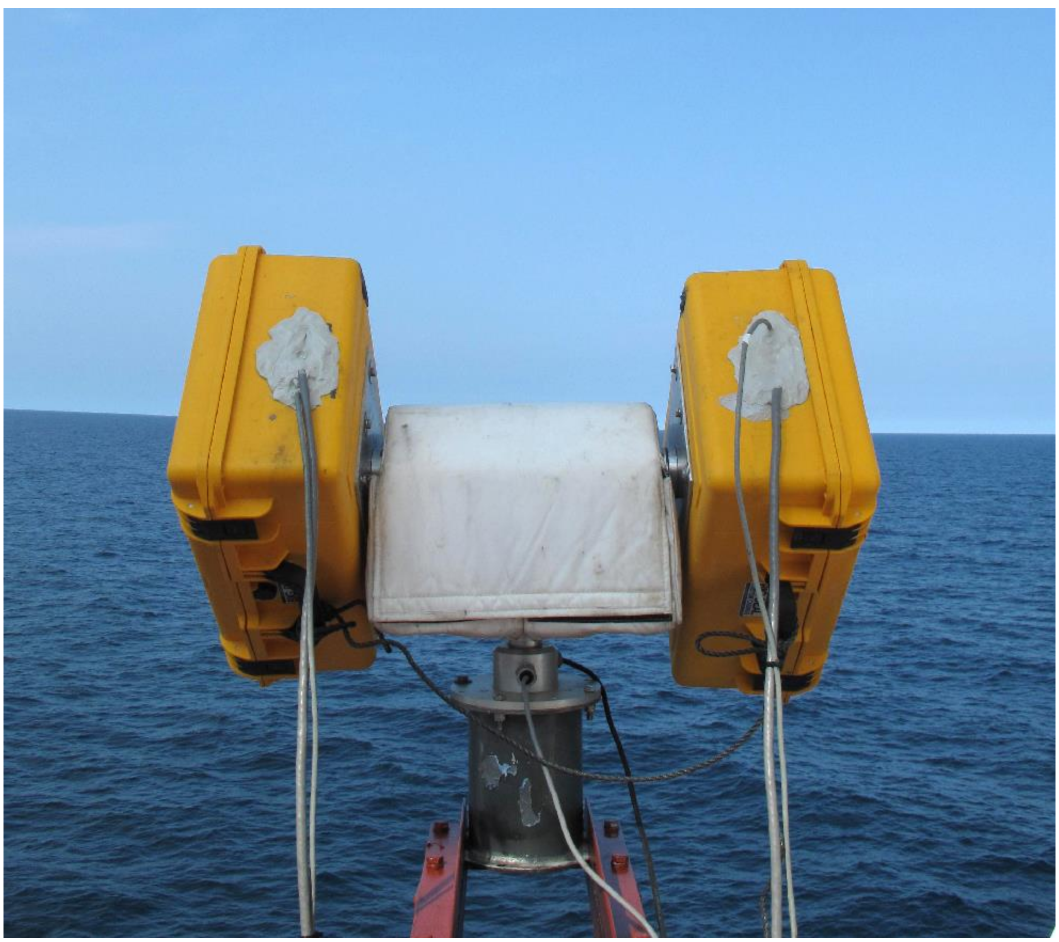


Figure 40: *Surface based radiometer (SBR) (37 and 89 GHz) installed on port side ~10m above sea level.*

4.3.2 Data Summary

Passive microwave data was obtained at 37 and 89 GHz continuously from 30 August to 5 October 2009 while the ship was in transit mode. The scan elevation for transit mode was 53º. Site scans were made at coring / mooring stations (total: 17 scans) representing different sea states and or sea ice types. Scans were made at depression angles of 30°- 70° at 0º azimuth. Sky measurements were made at 125º for calibration purposes. Pictures of the field of view (FOV) of the SBR were also taken at station to record surface conditions. New ice (frazil ice, grease ice, nilas and early pancakes) was scanned in the Ajurak block (Oct 1 & 2) associated with the ice tongue that pushed into the block from the north. Table 13 summarizes the scans made at fixed locations.

Table 13: *Summary of SBR Scans*

Ship date	mode	Latitude/Longitude		File name	Comments
Sep. 19, 2009	Scan (30°-70°)	70° 48.278´ N	136° 03.070´W	RADDAT-2009-09-20-175835	Open water
Sep. 21, 2009	Scan (30°-70°)	70° 43.902´ N	136° 15.276´ W	RADDAT-2009-09-21-174323	Open water, snowing, rough sea
Sep. 21, 2009	Scan (30°-70°)	70° 33.473´ N	135° 57.175´ W	RADDAT-2009-09-21-232245	Open water, snowing, rough sea
Sep. 24, 2009	Scan (30°-125°)	70° 37.127´ N	135° 58.180´ W	RADDAT-2009-09-24-201050	Open water, overcast, very rough sea
Sep. 25, 2009	Scan (30°-125°)	70° 40.279´ N	136° 14.449´ W	RADDAT-2009-09-25-201103	Open water, bit sunny
Sep. 26, 2009	Scan (30°-125°)	70° 44.873´ N	136° 20.645´ W	RADDAT-2009-09-26-175503	Open water, bit snowing, calm
Sep. 27, 2009	Scan (30°-125°)	70° 37.434´ N	135° 45.037´ W	RADDAT-2009-09-27-203949	Open water, overcast, windy, UPS battery exploded and replaced
Sep. 28, 2009	Scan (30°-125°)	70° 43.273´ N	135° 51.832´ W	RADDAT-2009-09-28-182054	Open water, heavily snowing
Sep. 29, 2009	Scan (30°-125°)	70° 37.629´ N	136° 03.122´ W	RADDAT-2009-09-29-193737	Open water, bit sunny and snowing, calm, MOB deployed
Sep. 30, 2009	Scan (30°-125°)	Recording cancelled after one scan		RADDAT-2009-09-30-172322	Ice edge, ship moved- recording cancelled, Only one scan
Oct. 1, 2009	Scan (30°-125°)	70° 45.547´ N	136° 60.730´ W	RADDAT-2009-10-01-173950	New ice, nilas, pancake, water mix
Oct. 1, 2009	Scan (30°-125°)	70° 47.184´ N	136° 06.551´ W	RADDAT-2009-10-01-004025	New ice, nilas, pancake
Oct. 2, 2009	Scan (30°-125°)	70° 45.671´ N	136° 00.786´ W	RADDAT-2009-10-02-173254	Ice edge, open water
Oct. 2, 2009	Scan (30°-125°)	70° 44.528´ N	136° 22.702´ W	RADDAT-2009-10-02-215502	New ice, nilas, pancake, slush
Oct. 3, 2009	Scan (30°-125°)	70° 29.760´ N	135° 07.990´ W	RADDAT-2009-10-03-181547	Open water, 20 knots wind
Oct. 4, 2009	Scan (30°-125°)	70° 48.064´ N	136° 04.143´ W	RADDAT-2009-10-04-181633	Open water, foggy
Oct. 5, 2009	Scan (30°-125°)	70° 46.049´ N	136° 18.965´ W	RADDAT-2009-10-05-172239	Open water, windy

The data file format is an ASCII file with the following naming convention:

'RADDAT-YYYY-MM-DD-hhmmss.DAT'

It contains 24 columns denoted below:

1. Azimuth position
2. Elevation position
3. Record
4. Time
5. 0
6. TECPW
7. TECV
8. T1_load
9. T2_ND
10. T3_ant
11. T4_case
12. GunnV
13. ND_V
14. Vv
15. Vv+ND
16. Vh
17. Vh+ND
18. Vload
19. Vload+ND
20. Tb V
21. Tb H
22. T_P1-_2
23. Channel (0 = 89GHz, 1 = 37GHz)
24. UTC

Of these 24 columns, Column 20 and 21 are 'Brightness Temperatures' for vertical and horizontal polarizations respectively. Column 23 describes which radiometer frequency the record is for. These three frequencies represent the main end output variables that a user would be interested in.

Information for columns 5 – 22 is available in the radiometer manual. Unfortunately, the radiometer manual (only in print) was still in the field at the time this report was produced, and therefore this information can be made available upon request.

ProSensing added columns 1,2, 23, 24 to the software, since they dealt with the addition of the positioner. Column 2 has the elevation angle information. This will vary between 30 – 125° in scan files, and will remain fixed at 53° for files acquired in transit mode.

The parameters of interest i.e. Tb (brightness temperature column 20 and 21) are measured in 'degrees Kelvin (°K)'.

Column 24 is UNIX epoch time (seconds), and can be converted to a standard date using an epoch converter (Epoch = 00:00:00, 1 January 1970).

SBR Data files are in ASCII format, and are available at

\SEA ICE\RADDAT\yyyy_mm_dd

SBR Transit files are in ASCII format, and are available at

\SEA ICE\RADDAT\TRANSIT

4.4 Sea Ice Physical Sampling

4.4.1 Methodology

Typical Sea ice physical sampling activities include, but are not limited to:

- Take ice cores from a location with the same snow depth close to were the snow pit is/was done (even at the same spot). Extract one core for temperature, and one for salinity.
- Freeboard (FB): determine FB from a core hole using a ruler.
- Thickness (h_i): determine h_i using an ice thickness gauge.
- Temperature (T_i): Measure at surface or snow/ice interface immediately after removing snow cover. Temperature profiles at intervals in the ice using temperature probe: immediately after extracting core, use drill to make hole to the center of ice core at a known distance from the surface, insert temperature probe to measure temperature. Shade the sensor from direct solar radiation. If T_a is colder than ice temperature, then observe maximum ice temperature. If T_a is warmer than ice temperature, then observe minimum ice temperature. Determine depth interval of temperature measurements depending on ice core thickness. Keep in mind that measuring the profile quickly is better than a high vertical resolution.
- Estimate the length of the ice core thickness (does it match the thickness gauge observation).
- Salinity: Extract an additional core. Cut it in 5 - 10 cm intervals immediately after retrieval and place in whirl-pack bags or buckets. Bring back to ship and allow to melt so that conductivity and salinity can be measured.

Figure 41: *On-ice team taking an ice core for temperature and salinity profiles (top left), and sampling area, depth, temperature and salinity of meltponds (lower right).*

At each station, physical properties of sea ice in the vicinity were observed. The temperature at depth within the visited ice floe(s) was determined by coring the floe and drilling holes in it at 10 cm intervals, starting 5 cm from the ice surface. After each hole was drilled a fast-response digital temperature probe was inserted and the result recorded. The surface temperature of the ice surface was also recorded. A second core was pulled at each station and cut in the field at 10 cm intervals in order to determine the salinity profile within the ice floe (Figure 42).

Figure 42: *An ice core being cut into 10cm segments for eventual salinity analysis*

When it was possible for personnel to work on the ice, a no-walk zone was designated along the port side of the CCGS *Amundsen* (semi-circular area with a radius of 30m) to preserve a natural surface for the passive and active microwave measurements On-ice physical sampling activities were conducted in close proximity to this no-walk zone. For ice thicknesses of 0 cm (e.g. grease or frazil ice) to less than 10 cm, the measurement intervals were modified to whatever was possible.

Ice cores are taken using a Kovacs Enterprises Mark II Coring system, which extracts cores with a 9cm diameter (www.kovacsicedrillingequipment.com). Ice temperature profiles (10cm interval) were measured in the field using a drill and a Hart Scientific Model 1522 temperature probe. Additional Ice cores were brought back to the ship for profile measurements (10cm interval) of salinity, by cutting about 10cm core pieces into (nearly) cubical shapes. The pieces, from which all sides that had been subject to drainage or exposed to the atmosphere were removed, were melted for measurements of conductivity using a Hach Sension5 portable conductivity meter (Hach, Loveland USA), with measurement accuracy of +/- 0.01.

By measuring the temperature and salinity of the sea ice it is possible to calculate the brine volume present in the sea ice and thus get an estimate for the ice porosity. The total thickness and freeboard of the ice floe was also recorded. Pictures were typically taken of the various snow/sea ice/ocean surfaces encountered at each station. Where melt ponds occurred on the sea ice surface, melt pond salinity, temperature and depth was recorded.

4.4.2 Physical Sampling Data Summary

Physical sampling activities were generally conducted in concert with scatterometer and SBR EM scans, and were constrained by the presence / absence of sea ice. There were 10 physical sampling excursions conducted between 15 July and 15 October 2009 (Table 14).

Table 14: *Physical sampling summary of data collected, and type of ice sampled*

Stn	Date (UTC)	Time (UTC)	Lat (N)	Long (W)	Ice Temp. Profile	Ice Salinity Profile	Meltpond (T, S, Area)	Photos	Ice Thickness
L1	31 Aug	2042	71° 05.550’	139° 00.590’	Y	Y	Y	Y	3.9 – 4.1m (MY)
L1	1 Sept	1500	71° 07.400	139° 11.370’	Y	Y	Y	Y	3.9 – 4.1m (MY)
L1	2 Sept	1500	71°06.800	139°19.300	Y	Y	Y	Y	3.9 – 4.1m (MY)
L2	4 Sept	0107	74°38.900	137°21.500	Y	Y	N	Y	2cm, grease ice
L2	4 Sept	1717	74°34.870	137°04.880	Y	Y	N	Y	1.27m, FY
L2	5 Sept	1900	74°24.200	136°26.000	Y	Y	Y	Y	MY
L3	6 Sept	1532	74° 25.420’	133° 54.644’	Y	Y	Y	Y	1.38m FY
L1.1	9 Sept	1700	72° 30.700’	136°46.000’	Y	Y	Y	Y	1.80m (MY floe)
N/a	10 Oct	1829	71°35.327’	134° 23.521’	Y	Y	N	Y	2nd year floe
N/a	10 Oct	2336	71° 37.304	134°18.183’	Y	Y	N	Y	2nd year floe

Physical sampling data is available in the database at:

\SEA ICE\ICEPHY\field_logbook_2009.xls

The information contained in this file is well-described, and organized by date. Ice core profiles are recorded from the top, down (where surface = 0 cm depth).

4.5 Sea Ice Mass Balance System

4.5.1 Instrumentation

The sea ice mass balance systems remotely measure physical properties of the floe in which they are installed as well as some basic meteorological variables and geographic position. The system consists of a temperature dowel containing thermistors positioned at 10 cm intervals from the top of the floe, upward- (from below) and downward- (from above) looking sonic range finders which measure the change in sea ice volume at the installation site, 2m air temperature, barometric pressure at the surface and GPS position. Each of these instruments is logged to a Campbell Scientific data logger and transmitted to a remote logging computer at CEOS in Winnipeg, MB via iridium satellite modem communication. Instrument specifications and associated variables are presented in table 15.

Table 15 : *Summary of sea ice mass balance system sensors.*

Instrument	Variable	Accuracy
YSI 44020 thermistors (n = 45)	sea ice temperature	0.09C
YSI 44020 thermistor	2m air temperature	0.09C
CS 61202V barometer	sea level pressure	1hPa @ -50 to 60C
Benthos PSA-916 sonar altimeter	bottom thickness change	1cm (RS-232 config.)
CS SR50A sonar altimeter	surface thickness change	1cm
Garmin GPS16-HVS	Geographic position	3-5m

4.5.2 Installation procedure

The sea ice temperature dowel (2” O.D.) was installed in the sea ice using a 2” auger. The upward-looking sonic altimeter was mounted to a 2” pipe and installed below the ice on a 5.25m pipe that was installed in the ice using an 8” auger. The downward-looking sonic altimeter, GPS antenna, air temperature sensor, barometer and iridium antenna were installed on an L-shaped mast (1.75m (H) x 0.75m (W)) above the sea ice surface. Each of the three installations was made using a metal tripod base at the sea ice surface. The logging and control system as well as the batteries were housed in a watertight box at the ice surface moored by stainless steel bolts (figure 43).

Figure 43: *Ice Mass Balance Buoy Installation by 09 September 2009 at station L1.1.*

Three mass-balance buoys were deployed in the multi year ice pack within the Beaufort Sea and within the West Central Canadian Archipelago. These buoys will monitor and relay ice thickness at a consistent sampling frequency through satellite telemetry.

CEOS_IMB01 was installed on 9 September during physical sampling activities near station L1.1 at 72°N 30.700’ 136°W 46.000’ (figure 43). As we were immersed in an area of mostly rotten FY ice, a 1.80m thick MY floe was selected as the most suitable piece of ice.

CEOS_IMB02 was installed on 17 October 2009 in the southeast end of McClure Strait via BO-105 helicopter at 73˚ 34.323N and 115˚ 11.465W (figure 44) A large MY ice floe was selected using the helicopter-mounted IcePic system that was 2.20m thick at the installation site. No snow existed on the surface of the floe at the installation site.

Figure 44: *Ice Mass Balance Buoy Installation by helicopter 17 October 2009.*

4.5.3 Data Summary

The sea ice mass balance buoys are presently active and regularly transmitting data. A summary of available data to date is presented in table 16.

Table 16: *Sea ice mass balance buoy data timeline (see appendix 3).*

Variable	CEOS_IMB01	CEOS_IMB02
sea ice temperature	9 Sept - present	17 Oct - present
2m air temperature	9 Sept - present	17 Oct - present
sea level pressure	9 Sept - present	17 Oct - present
bottom thickness change	9 Sept - present	17 Oct - present
surface thickness change	9 Sept - present	17 Oct - present
Geographic position	9 Sept - present	17 Oct - present

Data is received intermittently from the buoys via iridium modem. There may be gaps or incomplete data messages in the data corresponding to periods where the iridium telemetry was not strong enough to establish, or maintain a modem link.

Data is logged into daily files as raw ASCII text:

\SEA ICE\IMB\IMB_MMDDYYYY.txt

A sample complete IMB message is displayed below:


```
RING

CONNECT 9600 V42
--------------------------------------------
CEOS_IMBB01
------------- Parsed GPS Table -------------
"2009-11-29 04:00:00","$GPGGA","040436","7421.6761","N","16247.3826","W","1","10","0.8","-13.1","M","0.1","M","","*7C","","",""
"2009-11-29 03:30:00","$GPGGA","033436","7421.8419","N","16246.5342","W","1","09","0.8","-3.8","M","0.1","M","","*44","","",""
"2009-11-29 03:00:00","$GPGGA","030436","7422.0084","N","16245.6873","W","1","08","0.9","-4.3","M","0.1","M","","*49","","",""
"2009-11-29 02:30:00","$GPGGA","023436","7422.1702","N","16244.8256","W","1","10","0.8","-3.5","M","0.1","M","","*48","","",""
"2009-11-29 02:00:00","$GPGGA","020436","7422.3294","N","16243.9557","W","1","10","0.8","-8.6","M","0.1","M","","*4B","","",""
"2009-11-29 01:30:00","$GPGGA","013436","7422.4845","N","16243.0899","W","1","10","0.8","-12.2","M","0.1","M","","*73","","",""
"2009-11-29 01:00:00","$GPGGA","010436","7422.6377","N","16242.2221","W","1","10","0.9","-16.2","M","0.1","M","","*77","","",""
"2009-11-29 00:30:00","$GPGGA","003436","7422.7859","N","16241.3611","W","2","09","1.0","-10.9","M","0.1","M","","*78","","",""
"2009-11-29 00:00:00","$GPGGA","000436","7422.9272","N","16240.5153","W","1","10","0.9","-11.5","M","0.1","M","","*7E","","",""
"2009-11-28 23:30:00","$GPGGA","233436","7423.0613","N","16239.6929","W","2","11","0.7","-9.9","M","0.1","M","","*46","","",""
"2009-11-28 23:00:00","$GPGGA","230436","7423.1933","N","16238.8899","W","1","10","0.8","-13.2","M","0.1","M","","*71","","",""
"2009-11-28 22:30:00","$GPGGA","223436","7423.3240","N","16238.1049","W","1","09","0.9","-10.1","M","0.1","M","","*7B","","",""
"2009-11-28 22:00:00","$GPGGA","220436","7423.4520","N","16237.3283","W","1","10","0.8","-20.9","M","0.1","M","","*75","","",""
"2009-11-28 21:30:00","$GPGGA","213436","7423.5830","N","16236.5428","W","2","10","0.7","-11.9","M","0.1","M","","*76","","",""
"2009-11-28 21:00:00","$GPGGA","210436","7423.7087","N","16235.7767","W","1","10","0.8","-12.0","M","0.1","M","","*7C","","",""
"2009-11-28 20:30:00","$GPGGA","203436","7423.8309","N","16235.0374","W","1","10","0.9","-13.7","M","0.1","M","","*72","","",""
------------- Output1 Table ----------------
"2009-11-29 04:00:00",2009,11,29,333,4,0,0,-17.3,12.98,-18.82,100.3,"R3.47",3.47,0,0,0
"2009-11-29 03:30:00",2009,11,29,333,3,30,0,-17.35,12.97,-18.72,100.3,"R3.49",3.49,0,0,0
"2009-11-29 03:00:00",2009,11,29,333,3,0,0,-17.46,12.95,-18.61,100.3,"R3.51",3.51,0,0,0
"2009-11-29 02:30:00",2009,11,29,333,2,30,0,-17.59,12.94,-18.61,100.3,"R3.48",3.48,0,0,0
"2009-11-29 02:00:00",2009,11,29,333,2,0,0,-17.83,12.97,-18.81,100.4,"R3.51",3.51,0,0,0
"2009-11-29 01:30:00",2009,11,29,333,1,30,0,-18.02,12.96,-19.05,100.4,"R3.48",3.48,0,0,0
"2009-11-29 01:00:00",2009,11,29,333,1,0,0,-18.21,12.96,-19.05,100.4,"R3.52",3.52,0,0,0
"2009-11-29 00:30:00",2009,11,29,333,0,30,0,-18.45,12.95,-19.39,100.5,"R3.48",3.48,0,0,0
"2009-11-29 00:00:00",2009,11,29,333,0,0,0,-18.7,12.96,-19.63,100.5,"R3.50",3.5,0,0,0
"2009-11-28 23:30:00",2009,11,28,332,23,30,0,-18.94,12.95,-19.92,100.5,"R3.48",3.48,0,0,0
"2009-11-28 23:00:00",2009,11,28,332,23,0,0,-19.16,12.95,-20.12,100.5,"R3.49",3.49,0,0,0
"2009-11-28 22:30:00",2009,11,28,332,22,30,0,-19.47,12.94,-20.26,100.5,"R3.50",3.5,0,0,0
"2009-11-28 22:00:00",2009,11,28,332,22,0,0,-19.83,12.96,-20.6,100.6,"R3.49",3.49,0,0,0
```

"2009-11-28 21:30:00",2009,11,28,332,21,30,0,-20.25,12.95,-20.79,100.6,"R3.50",3.5,0,0,0
"2009-11-28 21:00:00",2009,11,28,332,21,0,0,-20.51,12.94,-21.13,100.5,"R3.52",3.52,0,0,0
"2009-11-28 20:30:00",2009,11,28,332,20,30,0,-20.6,12.94,-21.33,100.6,"R3.47",3.47,0,0,0

------------- Therm Table ------------------
"2009-11-29 04:00:00",12.98,-13.59,-11.26,NAN,-9.7,-8.55,NAN,-7.111,-5.373,NAN,-5.174,-4.571,NAN,-3.373,-2.799,NAN,-1.578,-0.774,NAN,-1.513,-1.497,NAN,-3.297,-1.481,NAN,-1.53,-1.508,NAN,3.015,-1.486,NAN,3.997,-1.497,NAN,-1.486,-57.69,NAN,-17.61,-47.04,NAN,-17.42,-54.78,NAN,-17.17,-81.4,NAN
"2009-11-29 03:30:00",12.97,-13.58,-11.27,NAN,-9.69,-8.55,NAN,-7.11,-5.372,NAN,-5.167,-4.57,NAN,-3.372,-2.797,NAN,-1.577,-0.773,NAN,-1.517,-1.495,NAN,-3.29,-1.473,NAN,-1.528,-1.506,NAN,3.028,-1.484,NAN,4.004,-1.495,NAN,-1.484,-57.69,NAN,-17.61,-47.02,NAN,-17.42,-54.78,NAN,-17.17,-81.4,NAN
"2009-11-29 03:00:00",12.95,-13.63,-11.29,NAN,-9.69,-8.54,NAN,-7.096,-5.369,NAN,-5.164,-4.567,NAN,-3.369,-2.789,NAN,-1.574,-0.758,NAN,-1.508,-1.492,NAN,-3.286,-1.47,NAN,-1.525,-1.497,NAN,3.042,-1.481,NAN,4.008,-1.492,NAN,-1.481,-57.64,NAN,-17.61,-47.02,NAN,-17.42,-54.78,NAN,-17.17,-81.4,NAN
"2009-11-29 02:30:00",12.94,-13.69,-11.32,NAN,-9.69,-8.54,NAN,-7.084,-5.351,NAN,-5.163,-4.566,NAN,-3.357,-2.788,NAN,-1.573,-0.758,NAN,-1.508,-1.491,NAN,-3.286,-1.47,NAN,-1.524,-1.502,NAN,3.032,-1.48,NAN,4.009,-1.491,NAN,-1.48,-57.64,NAN,-17.61,-47.02,NAN,-17.42,-54.78,NAN,-17.17,-81.4,NAN
"2009-11-29 02:00:00",12.97,-13.75,-11.34,NAN,-9.69,-8.54,NAN,-7.084,-5.351,NAN,-5.163,-4.566,NAN,-3.357,-2.788,NAN,-1.567,-0.757,NAN,-1.507,-1.491,NAN,-3.285,-1.474,NAN,-1.523,-1.502,NAN,3.027,-1.48,NAN,4.01,-1.496,NAN,-1.48,-57.64,NAN,-17.61,-47.02,NAN,-17.42,-54.78,NAN,-17.17,-81.4,NAN
"2009-11-29 01:30:00",12.96,-13.82,-11.36,NAN,-9.68,-8.53,NAN,-7.084,-5.351,NAN,-5.163,-4.555,NAN,-3.357,-2.788,NAN,-1.567,-0.768,NAN,-1.507,-1.491,NAN,-3.285,-1.474,NAN,-1.523,-1.502,NAN,3.033,-1.48,NAN,4.004,-1.491,NAN,-1.48,-57.69,NAN,-17.61,-47.02,NAN,-17.42,-54.78,NAN,-17.17,-81.4,NAN
"2009-11-29 01:00:00",12.96,-13.95,-11.4,NAN,-9.67,-8.52,NAN,-7.084,-5.351,NAN,-5.157,-4.555,NAN,-3.357,-2.788,NAN,-1.572,-0.768,NAN,-1.507,-1.491,NAN,-3.285,-1.48,NAN,-1.523,-1.502,NAN,3.033,-1.48,NAN,4.01,-1.491,NAN,-1.48,-57.69,NAN,-17.61,-47.02,NAN,-17.42,-54.78,NAN,-17.17,-81.4,NAN
"2009-11-29 00:30:00",12.95,-14.05,-11.41,NAN,-9.66,-8.52,NAN,-7.078,-5.351,NAN,-5.157,-4.549,NAN,-3.357,-2.788,NAN,-1.572,-0.768,NAN,-1.513,-1.496,NAN,-3.285,-1.474,NAN,-1.523,-1.502,NAN,3.044,-1.48,NAN,4.004,-1.502,NAN,-1.48,-57.69,NAN,-17.61,-47.02,NAN,-17.41,-54.78,NAN,-17.17,-81.6,NAN
"2009-11-29 00:00:00",12.96,-14.15,-11.43,NAN,-9.66,-8.51,NAN,-7.067,-5.345,NAN,-5.151,-4.543,NAN,-3.357,-2.788,NAN,-1.572,-0.768,NAN,-1.513,-1.496,NAN,-3.285,-1.48,NAN,-1.523,-1.502,NAN,3.049,-1.48,NAN,4.01,-1.502,NAN,-1.48,-57.69,NAN,-17.61,-47.02,NAN,-17.42,-54.78,NAN,-17.17,-81.6,NAN
"2009-11-28 23:30:00",12.95,-14.21,-11.46,NAN,-9.64,-8.5,NAN,-7.061,-5.345,NAN,-5.14,-4.543,NAN,-3.357,-2.782,NAN,-1.578,-0.768,NAN,-1.513,-1.496,NAN,-3.285,-1.48,NAN,-1.523,-1.502,NAN,3.055,-1.48,NAN,4.004,-1.502,NAN,-1.48,-57.64,NAN,-17.61,-47.02,NAN,-17.42,-54.78,NAN,-17.17,-81.4,NAN
"2009-11-28 23:00:00",12.95,-14.3,-11.46,NAN,-9.64,-8.5,NAN,-7.061,-5.34,NAN,-5.14,-4.543,NAN,-3.357,-2.782,NAN,-1.578,-0.763,NAN,-1.513,-1.496,NAN,-3.285,-1.485,NAN,-1.523,-1.502,NAN,3.06,-1.485,NAN,4.004,-1.502,NAN,-1.48,-57.69,NAN,-17.61,-47.02,NAN,-17.42,-54.78,NAN,-17.17,-81.6,NAN
"2009-11-28 22:30:00",12.94,-14.45,-11.48,NAN,-9.63,-8.5,NAN,-7.06,-5.339,NAN,-5.139,-4.542,NAN,-3.355,-2.781,NAN,-1.577,-0.767,NAN,-1.511,-1.495,NAN,-3.284,-1.484,NAN,-1.522,-1.5,NAN,3.062,-1.484,NAN,4.006,-1.5,NAN,-1.479,-57.69,NAN,-17.61,-47.04,NAN,-17.42,-54.78,NAN,-17.17,-81.4,NAN
"2009-11-28 22:00:00",12.96,-14.6,-11.48,NAN,-9.61,-8.49,NAN,-7.057,-5.33,NAN,-5.136,-4.539,NAN,-3.352,-2.777,NAN,-1.567,-0.768,NAN,-1.507,-1.491,NAN,-3.28,-1.48,NAN,-1.518,-1.496,NAN,3.088,-1.486,NAN,4.01,-1.496,NAN,-1.48,-57.64,NAN,-17.61,-47.02,NAN,-17.41,-54.78,NAN,-17.16,-81.4,NAN
"2009-11-28 21:30:00",12.95,-14.71,-11.48,NAN,-9.61,-8.49,NAN,-7.056,-5.329,NAN,-5.135,-4.538,NAN,-3.351,-2.777,NAN,-1.561,-0.768,NAN,-1.507,-1.507,NAN,-3.28,-1.48,NAN,-1.518,-1.496,NAN,3.099,-1.48,NAN,4.011,-1.496,NAN,-1.48,-57.68,NAN,-17.6,-47.06,NAN,-17.41,-54.78,NAN,-17.16,-81.4,NAN
"2009-11-28 21:00:00",12.94,-14.73,-11.46,NAN,-9.61,-8.47,NAN,-7.045,-5.329,NAN,-5.135,-4.538,NAN,-3.351,-2.777,NAN,-1.561,-0.762,NAN,-1.507,-1.496,NAN,-3.285,-1.48,NAN,-1.518,-1.496,NAN,3.11,-1.485,NAN,4.011,-1.496,NAN,-1.48,-57.68,NAN,-17.6,-47.02,NAN,-17.41,-54.78,NAN,-17.16,-81.6,NAN
"2009-11-28 20:30:00",12.94,-14.75,-11.44,NAN,-9.61,-8.47,NAN,-7.045,-5.329,NAN,-5.13,-4.527,NAN,-3.351,-2.771,NAN,-1.572,-0.768,NAN,-1.507,-1.496,NAN,-3.28,-1.48,NAN,-1.518,-1.496,NAN,3.137,-1.48,NAN,4.011,-1.496,NAN,-1.48,-57.68,NAN,-17.59,-47.04,NAN,-17.41,-54.81,NAN,-17.16,-81.6,NAN

END TRANSMIT
+++
NO CARRIER

The ‘Parsed GPS table’ contains half-hourly GGA NMEA strings, amd provide information on geographical position. Information on how to decode NMEA strings is readily available on the world-wide web (www.nmea.org).

The ‘Output1’ table provides sea level pressure, air temperature, bottom thickness change, and surface thickness change. A header summary is presented in Table 17.

Table 17: *Header information for the output1*

Header	Description
Year	Year
Month	Month
Domonth	Day-of-month
Doy	Date-of-year (julian day)
Hour	Hour
Minute	Minute
Seconds	Second
CR10_temp (°C)	Data logger temperature
Batt (V)	Data logger battery voltage
Air_Temp (°C)	Air temperature
Air_Press (kPa)	Barometric pressure
Under	String (underwater sonar)
UnderNumber	Underwater sonar
Raw_dist	Snow sounder raw distance (m)
Signal_quality	Snow sounder signal quality
Temp_corr_dist	Snow sounder corrected distance (m)

The 'Therm table' provides half-hourly 10cm resolution sea ice temperature profile data (°C). Values where data is not available are marked with NAN (not a number).

As of the time of this report, there are some unresolved quality assurance issues with some of the 'Them table' data as it appears one or more thermistors may have failed. We are looking into this problem, and will provide corrected data when available. We will also continue to Q/A and correct all IMB data as it is received from the beacons over the coming weeks.

4.5.3 Data Visualizations

A data visualization showing position, temperature and sea level pressure is provided from CEOS_IMB_01 (figure 45).

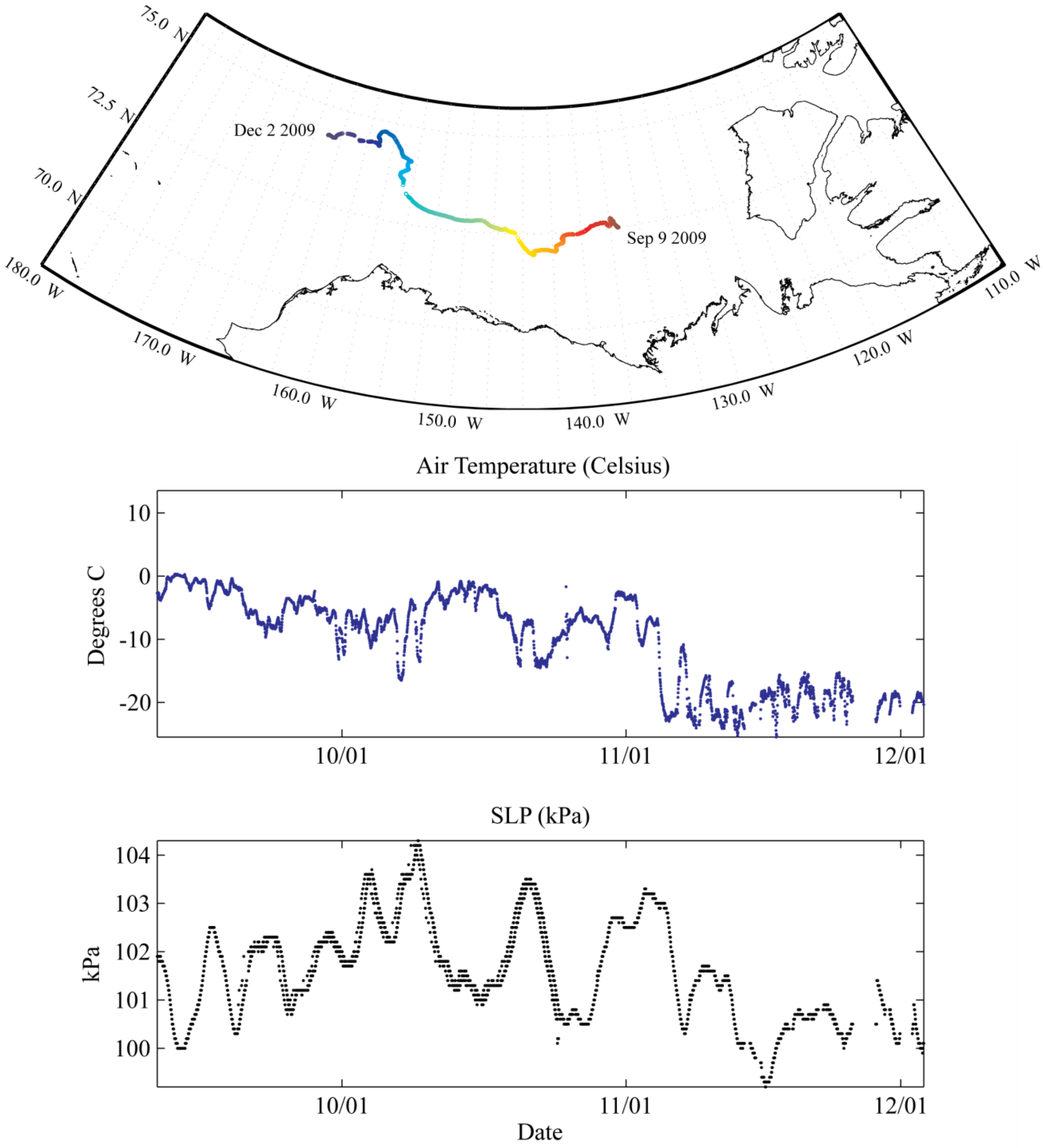


Figure 45: *Ice mass balance buoy CEOS_IMB_01 position (top), air temperature (middle), and barometric pressure (bottom).*

4.6 Ice Motion

4.6.1 Instrumentation

Ice motion data was recorded from the Oceanetic (1989) model 703 Iridium Ice tracking beacons, or ‘ice drift beacons’ (Figure 46), which are 20 cm in diameter and 54 cm in height, with a weight of 11.6 kg.

Figure 46: *An Oceanetics model 703 Iridium Ice tracking buoy. The number on the front corresponds to the last five (sometimes six) digits of the iridum model ID.*

Beacon life expectancy is on the order of 10 months for continuous operation, although the measurement duration is typically less as the beacons will sink if the ice floe they are installed upon melts or breaks up. Ice motion buoys are deployed using an ice auger to drill a hole that is approximately 25cm in depth. GPS positions and time and date stamps are reported and transmitted through a Short Burst Data (SBD) packet to the Iridium modem system by email. Buoys are equipped with Light Emitting Diode (LED) indicators to determine modem status, and each modem is uniquely identified using an International Mobile Equipment Identity. Software called SatTerm is provided so that commands may be sent to the modem, while data is collected via an email account that receives SBD messages from the modem using a “Server for Trackers” application. The resulting data format is user-defined and selected from a variety of formatting options. In this instance, ice motion data is in comma-delimited text format and includes beacon identification, date, time and position, namely latitudinal and longitudinal coordinates.

Ice drift beacons are deployed manually on MY ice (preferred), or thick FY ice floes (figure 47). The Deployment location is usually selected based upon local ice conditions. Anywhere from one to three ice beacons may be deployed at once. The ice beacons are normally taken via helicopter to a suitable ice floe where a 9" auger hole is drilled to a depth of approximately 20cm. The ice beacons are then placed in the hole and packed with snow, and activated by removing a magnet on the side of the buoy. The deployment time, location, ice type, and buoy ID are recorded and monitored. The beacon data is transmitted via Iridium satellite modem every two hours in encoded messages, which are then translated and processed at the University of Manitoba. Ice velocities and trajectories can then be calculated from this data.

Figure 47: *Ice beacon deployment on MY ice on 6 September 2009.*

4.6.2 Data Summary

14 ice drift beacons were deployed on mobile FY or MY ice during the 2009 field season. Where possible, a triangular deployment plan was implemented so that drift beacon tracks could be compared to identify ice shear and local ice vorticity. Of the 14 ice beacons deployed, 12 of these beacons were deployed in 4 such triangular configurations. Ice beacon deployments are summarized in table 18, where the ID and cardinal direction in parenthesis describes the triangle id, and geographical vertices.

Table 18: *Beacons deployment summary :*

Beacon ID	Date	Latitude (N)	Longitude (W)
282100 (1,N)	26 July	71º 46.205’	134 º 37.077’
282060 (1,W)	26 July	71 º 32.954’	133 º 55.681’
282070 (1,E)	26 July	71 º 34.449’	133 º 16.870’
289100	02 Sept	71 º 06.388’	139 º 01.420’
288100 (2,N)	04 Sept	74 º 33.72’	137 º 09.09’
283100 (2,SE)	04 Sept	74 º 33.23’	137 º 24.09’
288060 (2,SW)	04 Sept	74 º 39.09’	137 º 13.228’
20590	06 Sept	74 º 26.266’	133 º 23.141’
281100 (3,N)	08 Sept	73 º 05.68’	135 º 33.25’
284060 (3,S)	08 Sept	72 º 59.61’	135 º 38.92’
286060 (3,W)	08 Sept	73 º 04.15’	135 º 53.36’
287060 (4,S)	08 Sept	72 º 27.53’	136 º 41.33’
280110 (4,E)	08 Sept	72 º 30.76’	136 º 24.05’
282070 (4,N)	08 Sept	72 º 33.77’	136 º 41.88’

Drift buoy data files are currently being downloaded daily, and processed into an ASCII text file. The most recent quality-assured data is included as of 2 December 2009 at:

\SEA ICE\IDB\IDB_2009_12_01.XLS

Data file header description is as follows:

Iridium modem ID
Unit Serial Number
Date: (dd/mm/yyyy)
Internal Variable
Latitude (decimal degrees)
Hemisphere (N/S)
Longitude (decimal degrees)
Hemisphere (E/W)
Altitude* (m)
Speed (m/s).
direction (degrees).

*GPS Altitude from these beacons is unreliable, and beacon altitude should be assumed to be within 2m of mean sea level.

4.6.3 Data Visualizations

Presented in this section, is an example of a triangular beacon deployment with concurrent HEMI ice thickness (figure 48), and a map of the beacon paths from 08-Sept – present (figure 49).

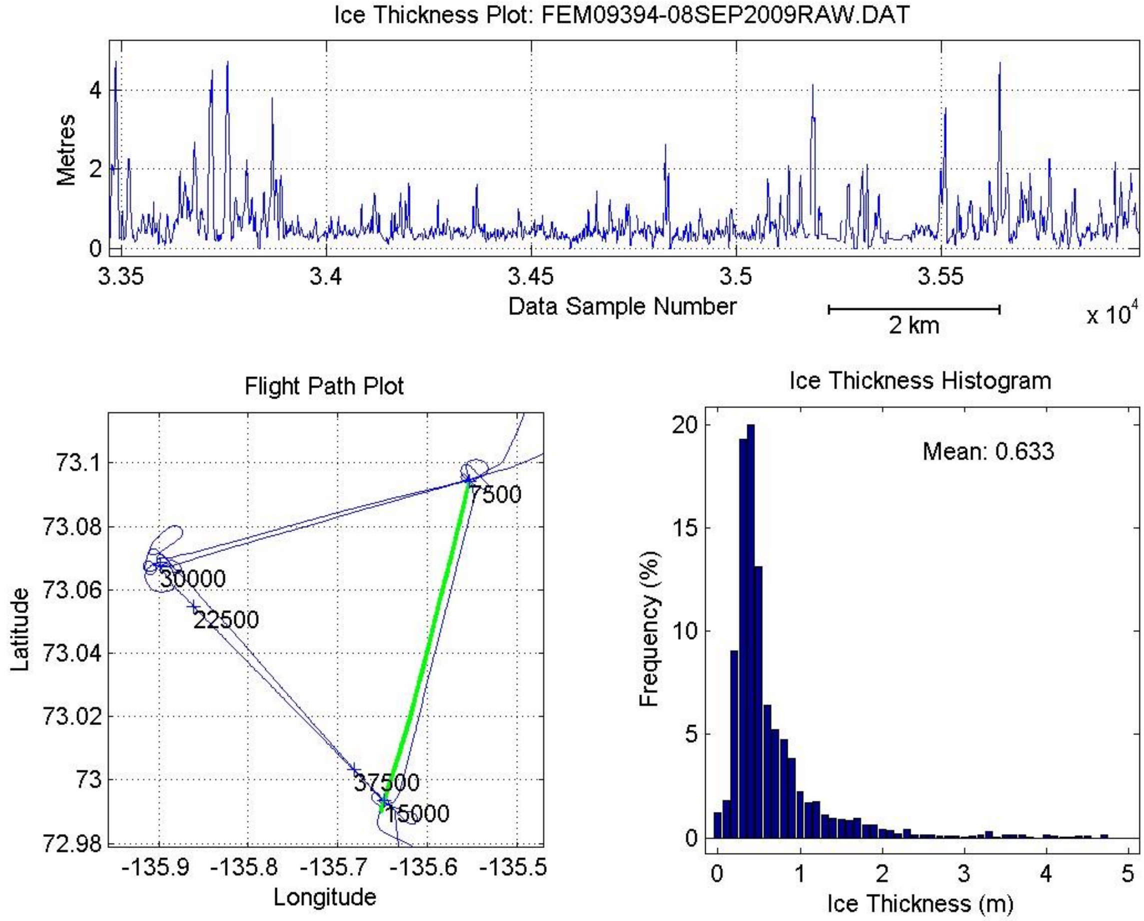


Figure 48: *Triangular ice beacon deployment conducted 08 September 2009. Ice thickness survey data is for the eastern edge of the triangle.*

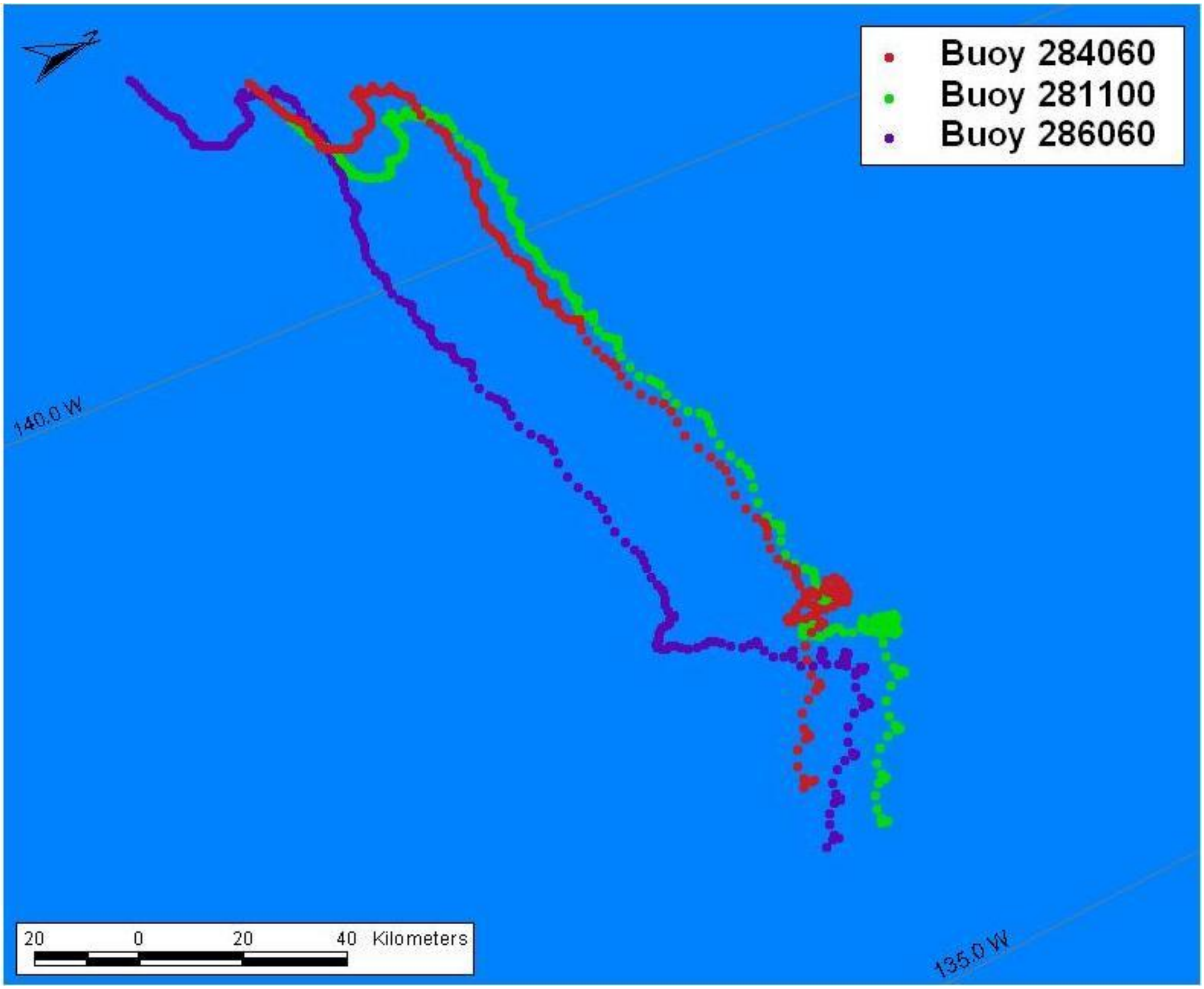


Figure 49: *Beacon drift paths for beacons deployed 08 Sept 2009. Note convergence and then abrupt stretching of the beacon formation.*

4.7 Surface Temperature

4.7.1 Instrumentation: Infrared Transducer

A downward-looking Infrared temperature sensor (Model Everest 4000.4ZL), mounted at 30° from the vertical, took surface temperature measurements at a 15 second sampling interval. The instrument is installed in the scatterometer shed facing the ocean surface (Figure 50). It operates at 8 - 12 microns wavelength of the electromagnetic spectrum. The data collected from this instrument is typically used to characterize the surface temperature during C-Band scatterometer scans.

Figure 50: *Infrared temperature sensor installed on port side of the CCGS Amundsen ~8 m above sea level.*

4.7.2 Data Summary

The infrared transducer was deployed and collected data continuously from 28 August to 15 October 2009 . The files are available in the database at :

\SEA ICE\IRST

The raw logger datafiles are ASCII with extension *.DAT. Table 19 summarizes the temporal range of data within each file.

Table 19: *Everest 4000.4ZL data summary.*

Filename	**Start Date**	**End Date**
IRST_0831-0907.DAT	31 August	07 September
IRST_0907-0907_1.DAT*	07 September	07 September
IRST_0907-0907_2.DAT*	07 September	07 September
IRST_0907-0907_3.DAT	07 September	07 September
IRST_0907-0912.DAT	07 September	12 September
IRST_0912-0929.DAT*	12 September	29 September
IRST_0929-0929.DAT	29 September	29 September
IRST_0929-1007.DAT	29 September	07 October
IRST_1007-1019.DAT	07 October	19 October
IRST_1019-1019.DAT*	19 October	19 October
IRST_1019-1027.DAT	19 October	27 October

*Note: Multiple files for same date indicate difficulties with the datalogger.
**Note: Some values in DATA018.DAT are erratic due to intermittent datalogger failure.

File header information is presented in Table 20:

Table 20: *Header information for IR Transducer data files.*

Column	Description
104	Logger-specific
Year_RTM	Year
DAY_RTM	Day
Hour_Minute_RTM	Hour and Minute
Seconds_RTM	Seconds
BatV	Battery Voltage
PanelT	Panel Tempearture (°C)
IRT	Measured Infrared Temperature (°C)

4.8 EM Scanning Site Camera

An obliquely-mounted camera took pictures off the port side of the ship at a 10-minute interval. These images permit sea ice conditions to be assessed on station (individual pictures), and during transit (streaming images). A network camera (Canon, VB-C10R) was mounted on a rail right beside the wheelhouse (Figure 51). The initial set-up for the camera was pan=0.00°, tilt=-25.00° and zoom=43.40° and was changed to tilt=-40.00° from Nov. 1. The pictures were taken every 10 seconds to 1 minutes depending on surface conditions.

Figure 51: *Obliquely-mounted Canon VB-C10R mounted on the port-side railing, immediately behind the wheelhouse, and above the SBR.*

The images from this camera are stored as *.jpeg images, and are at a resolution of 640 x 480. While somewhat coarse, the images do provide a summary view of the surface immediately in the field-of-view of the C-Band Scatterometer, and SBR systems. Imagery from this camera is organized into folders by day-of-year. Figure 52 shows a sample image from this camera.

Figure 52: *A sample image taken over FY ice at 20:09, 27 July 2009.*

Imagery is available is available for the following periods:

15 July – 06 August
12 – 15 August
19 August
29 August – 15 October

(See Appendix 3 for a visual description of imagery availability).

All images recorded during the 2009 fields season can be found in the database at:

\SEA ICE\SITECAM\yyyy_mm_dd

Image filename convention corresponds to the UTC time taken:

\HHMMSS01.jpg

4.9 Ice Thickness Images

A downward-looking AXYS NETCAM camera monitored ice thickness where ice breaking was necessary: when breaking through ice, some of the broken ice floes will turn on their side. Estimates of ice thickness can be processed from this imagery, and geoencoded using the time stamps.

Preliminary processing and quality assurance of the imagery have revealed that camera operations did not collect as high of a quality of product as in previous field seasons. Efforts are ongoing to identify images that may provide useful information, and these will be made available at a later date.

Ice thickness camera images were collected during the following dates:

16 – 17 July
19 July
21 – 22 July
24 July
26 – 29 July
31 August
03 – 11 September

SECTION 5: METEOROLOGICAL DATA

5.1 Micrometeorology Tower Program

5.1.1 Introduction

The motivation for the work stems from the general poor understanding of the processes that exchange nutrients, heat and momentum between the near ocean surface and atmosphere in the Arctic Ocean and peripheral seas. The group's focus is the exchange of CO_2, heat and momentum, and in particular to achieve a better understanding of the role of sea ice (full and partial ice cover) and surface surfactants on the transport and exchange of the respective entities.

Specific objectives relate to the development of tools (observation, model, and remote sensing) to assist with regional budgeting of (primarily) heat, CO_2, and momentum, and in the longer term, to develop the necessary process-level understanding of the exchange processes, to forecast how the ocean's response to climate change and variability will affect the atmosphere-ocean cycling of CO_2.

The surface meteorology and flux program of the CCGS *Amundsen* is designed to record basic meteorological and surface conditions, and to study exchanges of momentum, heat and mass across the atmosphere-sea ice-ocean interface in support of the objectives described above.

Novel to our air-sea studies is the ship-based application of the eddy covariance technique for the direct measurement of heat, CO_2 and momentum. Eddy covariance represents the lone local scale (100s m to km) direct micrometeorological measurement of the respective fluxes.

Our group's 2009 ArcticNet monitoring and sampling program was expanded to accommodate the monitoring requirement of Imperial Oil within the Ajurak block of the southern Beaufort Sea. The emphasis of the expanded program is on site specific time-series monitoring of near surface meteorology, surface wave parameters and near surface water currents, and upper ocean light, temperature and current profiles using moored buoys.

5.1.2 Methods

The micrometeorological tower located on the front deck of the CCGS *Amundsen* (Figure 53) provides continuous monitoring of meteorological variables and eddy covariance parameters. The tower consists of slow response sensors that record bulk meteorological conditions (air temperature, humidity, wind speed/direction, surface temperature) and fast response sensors that record the eddy covariance parameters (CO_2/H_2O concentration, 3D wind velocity, 3D ship motion, air temperature) (Table 21). In addition, radiation sensors (Figure 51, Table 21) were installed on the roof of the wheelhouse to provide information on incoming long-wave, short-wave, ultraviolet, and photosynthetically active radiation. All data was logged to Campbell Scientific dataloggers; a model CR3000 logger was used for the eddy covariance data, a CR1000 logger for the slow response met data, and a CR23X for the radiation data. All loggers were synchronized to UTC time using the ship's GPS system as a reference. Ship heading and location (lat., lon.) were measured to compensate measured apparent wind information for ship direction and motion.

The eddy covariance system on the tower makes use of two separate gas analyzers and a single 3D sonic anemometer. The dual gas analyzers system allows us to make use of both closed path and open path eddy covariance systems. The open path gas analyzer has the benefit of making measurements concurrently with the sonic anemometer, but the closed path gas analyzer is not as easily disturbed by adverse weather conditions.

In order to make sure that the two systems are comparable, careful calibrations are performed on both instruments. The closed path system is based on a LI-7000 gas analyzer which employs two optical cells, one of which was used to monitor the drift of the instrument by constantly passing a stream of ultra-high purity N_2. In addition, the sample cell of the instrument is calibrated daily using the ultra-high purity N_2 to zero the CO_2 and H_2O measurements, and a reference gas of known CO_2 to span the instrument. Occasionally, a span calibration of the H_2O sensor is performed using a dew point generator (model LI-610). The open path gas analyzer (LI-7500) cannot be calibrated as conveniently, and so it is calibrated approximately every three weeks. In general, we find that this is effective for this particular instrument, which does not drift significantly over time.

The ship motion correction necessary for the application of the eddy covariance technique requires accurate measurement of ship motion (3-axis measurement of angular acceleration and rate), heading and location. Rotational motion is monitored using a multi-axis inertial sensing system. Data related to heading and location is available from the ship's GPS and gyro. Using these data yaw, pitch and roll, in addition to translational motion is calculated, and collectively this information is used to correct our 3D wind measurements.

In addition to the eddy covariance solution to air-sea fluxes, data are collected for the more commonly used bulk approximation. Note however that the bulk approximation is unable to deal with ice in the flux footprint. This last point is a central research theme.

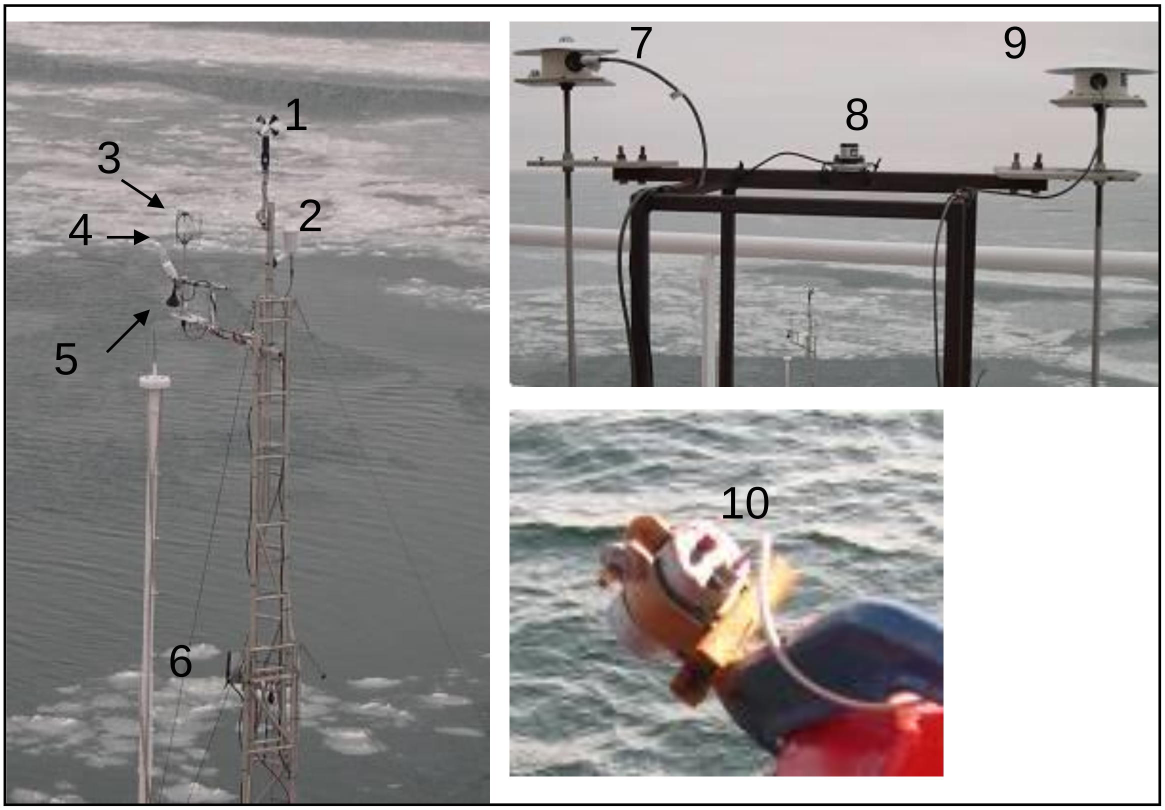


Figure 53: *Meteorology and flux program instrument setup. See Table 21 for description of instruments based on the numbers.*

5.1.3 Dataset Details

Much of the flux tower was fully operational on 16 July 2009. The slow sequence, largely meteorological variables, are scanned at 1s intervals and saved as 1 min averages. Data screening and ship motion correction to wind speed and direction is applied during post-processing. Wind data are screened for times when the apparent wind direction is forward of the ship's wheelhouse. Heavy rime will affect the measurement of wind speed and these periods are also removed from the data set.

The high frequency variables associated with the eddy covariance system are scanned at 0.1 s intervals and are stored as raw data and as 1-minute averages. The raw data are used to compute the fluxes (heat, mass and momentum) over time intervals that can range from 10 min. to 60 min. Frost, rime and aggressive sea spray affect our high frequency measurements of 3D wind and gas concentrations. Periods associated with these events are evident in the data, and need to be removed prior to processing. Fluxes are computed during post processing.

Table 21: *Description of instruments shown in figure 53.*

Figure 1	Sensor	Variables	Units	Ht fron deck (n	Scan (s) / Ave (min)	Specs
1	wind monitor (RMYoung 05103)	ws-2D, wd-polar	m/s; º	8.11	1/1	±0.6 m/s ±3º deg
2	temperature/relative humidity probe (Vasailla HMP45C212)	Ta, RH	ºC; %	7.2	1/1	Humidity ±2% 0-90% @ 20ºC ±3% 90-100% @ 20ºC 0.05% RH/ºC Temperature ± 0.1 ºC
3	3D wind velocity (Gill Windmaster Pro ultra-sonic anemometer)	u,v,w, Ts	m/s; ºC	6.36	10 Hz	RMS noise <1% offset <0.01 m/s SOS < 0.5% accuracy
4	LI7500 open path gas analyzer	ρ_v /ρ_c	μmol/m³ mmol/m³	6.82	10 Hz	RMS noise ±0.1 μmol/mol zero drift 0.1 μmol/mol/ºC gain drift 0.1%/ºC
5 (inlet not shown)	LI7000 closed path gas analyzer	ρ_v /ρ_c	μmol/mo mmol/mo	inlet at 6.49	10 Hz	RMS noise ±0.1 μmol/mol zero drift 0.3 μmol/mol/ºC gain drift 0.2%/ºC
6	multi-axis inertial sensor (MotionPak, Systron Donn	rx,ry,rz accx,accy,accz	º/s; g	4.59	10 Hz	rate <0.004º/s acc <10 μg
7	pyranometer (Eppley, model PSP)	SW_in	W/m²		2/1	~±5%
8	quantum sensor (Kipp & Zonen, PARLite)	PAR	μmol/m²/		2/1	~±5%
9	pyrgeometer (Eppley, model PIR)	LW_in	W/m²		2/1	~±10%
10	surface temperature (Everest infrared transduce model 4000.44ZL)	Tsfc	ºC	1.6 m	1/1	±0.5 ºC accuracy
Not shown	pressure transducer (RM Young, 61205V)	Patm	kPa		2/1	
Not shown	GPS Receiver (Garmin GPS16X-HVS)	lat, lon, SOG, COG	º,kts, º		1	Position: <15m, velocity, 0.1 knots
Not shown	Digital compass (Ocean Server OS5000)	H, pitch, roll	º		1	Precision: 0.5 deg (heading) <1 deg (roll/pitch)

The Micrometeorology datasets are available at:

\ATMOS\TOWER\MET

Where daily files are named using the following convention:

proc_MET_YYYY_JDXXX_MMDD.dat

Radiation datasets are available at:

\ATMOS\TOWER\RAD

Where daily files are named using the following convention:

pRAD_YYYY_JDXXX_MMDD.dat

For both MET and RAD files, the naming convention corresponds to date information:

YYYY = year
JDXXX = julian day of year
YYDD = month, day of year

Header information for the MET files is presented in table 22, and for the RAD files in table 23.

Table 22: *Header information for the MET files.*

Header	Units	Description
Year		
Month		
Day		
Hour		-DATES/TIMES IN UTC
Min		
Sec		
RECORD		-Record stamp from data logger (not used for anything)
batt_volt_Avg	V	-Battery voltage of data logger, Units=volts, useful for identifying poor datalogger performance
panel_temp_Avg	deg C	-Temeprature of data logger, Units=deg C, useful for identifying poor datalogger performance
batt_volt_Std		-Standard Deviation of battery voltage over 1 minute averaging period, useful for identifying poor datalogger performance
panel_temp_Std	V	-Panel temperature standard deviation over 1 minute averaging period, useful for identifying poor datalogger performance
t_hmp_Avg	deg C	-Atmospheric temperature, Units=deg C, measurement height ~14m
rh_hmp_Avg	%	-Atmospheric relative humidty, Units=Percentage, measurement height `14m
Tsrfc_Avg	deg C	-Surface temperature measured from IR transducer, Units=deg C, WARNING: may not be working well
Patm_Avg	kPa	-Atmospheric pressure, Units=kPa
Raw_W_Vel	m/s	-Raw wind velocity, uncorrected for ship motion, Units=m/s
Raw_W_Dir	deg	-Raw wind direction (0/360=wind blowing into front of ship), Units=degrees
Raw_W_Std		-Raw wind standard deviation
t_hmp_Std		-Atmospheric T standard deviation over 1 minute averaging period
rh_hmp_Std		-Relative Humidity standard deviation over 1 minute averaging period
Tsrfc_Std		-Surface temperature standard deviation over 1 minute averaging period
Patm_Std		-Atmospheric pressure standard deviation over 1 minute averaging period
Lat		-Latitude of observation (obtained from Ship GPS system)
Long		-Longitude of observation (obtained from ship GPS system)
SOG	kts	-Speed over ground of ship (obtained from ship GPS system)
COG	deg	-Course over ground of ship (obtained from ship GPS system)
Heading	deg	-Heading of vessel relative to true north (obtained from ship Gyro system)
SOG_std		
COG_std		
True_W_Vel	m/s	-True wind velocity, corrected for ship motion, Units=m/s, measurement height ~14.5m
True_W_Dir	deg	-True wind direction, relative to true north, Units=degrees, measurement height ~14.5m
Diag		-Diagnostic code word for data processing. If 'NaN', data is ok: 1=tower down, 2=faulty conventional anemometer, 3=faulty IR transducer, 4=faulty T/RH probe, 5=faulty P probe
Pitch	deg	-Pitch angle of the tower relative to sea surface (for diagnostic purposes)
Roll	deg	-Roll angle of the tower relative to sea surface (for diagnostic purposes)

Table 23: *Header information for the RAD files.*

Variable	Units	Desc
Year		
Month		
Day		
Hour		
Minute		
Sec		
Batt_avg	V	-Average battery voltage of datalogger (used for some diagnostics)
PanelT_avg	deg C	-Temperature of datalogger
Batt_st	V	-Standard deviation of battery voltage over 1 min averaging period
PanelT_st	deg C	-Standard deviation of datalogger temperature over 1 min averaging period
Kdown_avg	w/m2	-incoming shortwave radiation
Thermopile_avg		-temperature value of long wave radiation sensor (intermediate value for calculating incoming LW)
Tcase_avg		-temperature value of long wave radiation sensor (intermediate value for calculating incoming LW)
Tdome_avg		-temperature value of long wave radiation sensor (intermediate value for calculating incoming LW)
LW_inv	W/m2	-Incoming longwave radiation
PAR_avg	umol/m2/s	-Incoming photosynthetically active radiation
Kdown_st	W/m2	-Standard deviation of incoming sw radiation over 1 min averaging period
Thermopile_st		-Standard devaiation of Thermopile over 1 min averaging period
Tcase_st		-Standard deviation of Tcase over 1 min averaging period
Tdome_st		-Standard deviation of Tdome over 1 min averaging period
LW_in_st		
PAR_st	umol/m2/s	-Standard deviation of incoming PAR over 1 min averaging period
Lat	deg	-Latitude at time of measurement (from ship GPS data)
Long	deg	-Longitude at time of measurement (from ship GPS data)

5.2 Passive Microwave Temperature and Water Vapour Profiles

5.2.1 Microwave Profiling Radiometer

A Radiometrics temperature and water vapour 3000A profiling radiometer (TP/WVP3000A) is used to measure the temperature and water vapour within the atmosphere up to 10km using passive microwave radiometry at 22 – 29GHz, and 51 – 59GHz. The TP/WVP3000A is installed on a mount attached to the white container laboratory (the 'Met Shack') located directly behind the ship's wheelhouse, approximately 19m above sea level (figure 5). The instrument is suspended away from the roof of the shed to ensure that the field-of-view (approximately 15° above the horizon to the left and right to the zenith) is clear of any obstruction (figure 54).

Figure 54: *TP/WVP 3000A mounted on the roof of the CCGS Amundsen 'met shack.'*

The radiometer sequentially views atmospheric radiances from the zenith direction in 12 channels - seven in the oxygen band (51-59 GHz) provide information on the temperature profile, and 5 between 22-30 GHz provide information on the humidity profile. The instrument set-up included sensors for surface pressure, temperature and humidity, and a zenith-pointing infrared radiometer (9.6-11.5 μm), which provides cloud-base altitude. The radiometer system rejected periods when the profiles may be erroneous due to precipitation scattering, and/or due to emissions from moisture on the radome filter.

The instrument generates a vertical profile of upper-level air variables including temperature, water vapour density, relative humidity, and liquid water from the surface to an altitude of 10km (Figure 55). The resolution of the measurements varies with height. The resolution of the instrument is 50 m from the surface to an altitude of 500 m, then increases to 100 m from 500 m to 2 km altitude, and is 250 m for measurements from 2 km to 10 km. Note: the height given for 50 m is actually 69 m as the instrument assumes it's at sea level when it's mounted 19m above sea level. In addition, the instrument also measures concurrent basic surface meteorology variables, including pressure, relative humidity, and ambient temperature. A skyward-looking infrared sensor measures the temperature of the sky. A rain-sensor detects the presence of any precipitation. It should be noted that the fog registered as precipitation during much of the field season. The instrument also calculates integrated column water vapour, and liquid water content. The sampling frequency for all data is approximately one complete profile per minute.

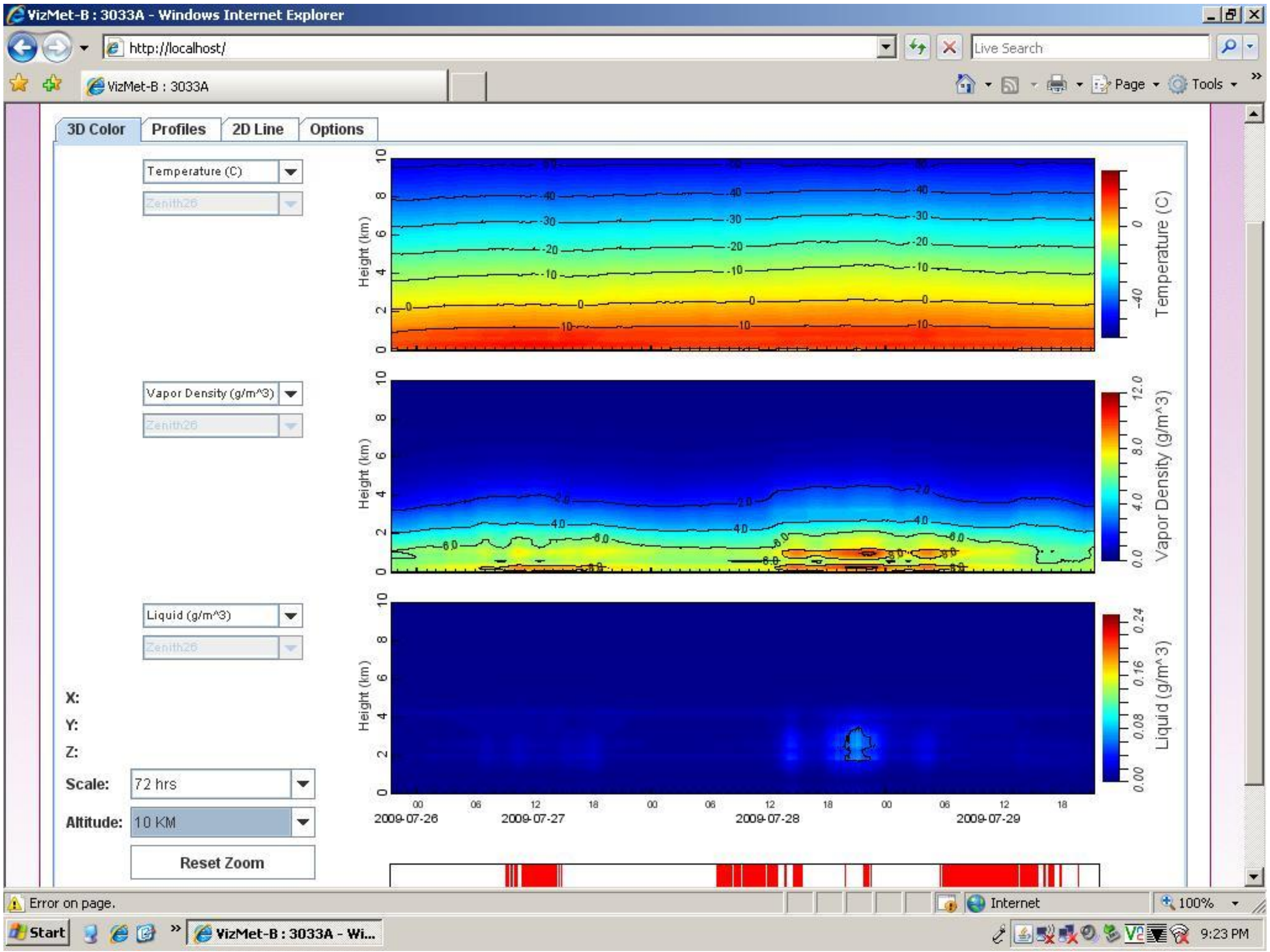


Figure 55: *TP/WVP3000A Data from 26 - 29 July 2009. Temperature (top), water vapour density (middle) and atmospheric liquid content (bottom) are shown. The bar at the bottom shows whether rain was detected or not (red bar).*

The calibration of the water vapour profiling process was continuously maintained by hourly tip curves. An external liquid-nitrogen-cooled blackbody was used to intermittently calibrate the temperature profiling process. All channels also viewed an internal black body target every 5 minutes for relative calibration. Temperature and humidity values (0 to 200 m at 50 meter intervals, 500 to 2000 m at 100 meter intervals, and 2000 to 10,000 m at 250 meter intervals) were derived from microwave brightness temperatures using the manufacturer's neutral network retrievals that had been trained using historical radiosonde measurements, and a radiative transfer model (Solheim et al., 1998). Historical radiosonde data from Inuvik N.W.T. was used to develop neural network coefficients for the Southern Beaufort Sea Region.

5.2.2 Data Summary

The TP/WVP 3000A was fully operational throughout the field season, July 15 to October 15. Due to the untimely breakdown of the ship's liquid nitrogen plant, the liquid nitrogen calibration on the 51 – 59GHz channels was not performed during the setup of the instrument. There was high demand for the ship's technicians during this time, and they were unable to repair the liquid nitrogen plant until August. The liquid nitrogen plant was repaired during leg 2b, and our team was able to perform the calibration on August 28th, along with a radome filter change. Routine maintenance was performed on September 25th with a Radome filter change and a liquid nitrogen calibration on September 30th.

Datafiles are organized by date into folders named by year and month (yyyy_mm), and are found in the database at:

\ATMOS\MWP

Datafiles follow the naming convention:

YYYY-MM-DD_HH-MM-SS_tip.csv
YYYY-MM-DD_HH-MM-SS_lv0.csv
YYYY-MM-DD_HH-MM-SS_lv1.csv
YYYY-MM-DD_HH-MM-SS_lv2.csv

Header information for these files is included in the first 6 lines of each data file.

Files with "*.Lv0, *.Lv1, and *.Lv2" are the raw, first-order processed, and second-order processed datafiles. The "*.tip" files are the daily TIP calibration files used by the radiometer, and are included for reference. The "Lv2" files are the files of interest to the end-user. Records marked 401 – 404 are the key records as they describe the vertical atmospheric profiles of temperature, water vapour density, liquid water, and relative humidity as post-processed by the TP/WVP3000A.

The variable abbreviations are described in table 24.

Table 24: *Microwave Profiling Radiometer "Level 2" file header.*

MWP File	**Units**	
Tamb	K	Surface Ambient air temperature
Rh	%	Surface relative humidity
Pres	Mb	Barometric pressure
Tir	K	Sky temperature (Infrared thermometer)
Rain	n/a	Rain sensor (1 or 0)
Vint	Cm	Vertically integrated water vapour (0 – 10km column total)
Lqint	Mm	Vertically integrated liquid wanter (0 – 10km column total)
Cldb	km	Cloud base height
Record 401	K	Atmospheric profile temperatures for 0 – 10km
Record 402	g/m^3	Atmospheric integrated vapour profile for 0 – 10km
Record 403	g/m^3	Atmospheric liquid water profile for 0 – 10km
Record 404	%	Atmospheric relative humidity profile for 0 – 10km

5.3 Weather Balloon Temperature and Water Vapour Profiles

5.3.1 Vaisala RS-92G Radiosondes

Balloon launches (figure 56) were coordinated to correspond with the overflights of the earth-orbiting satellites CLOUDSAT and CALIPSO (at approximately 1130 and 2100 daily) for an Arctic validation study currently being undertaken by our group. Balloon launches are also used to profile low-pressure systems, cyclones, and periods of significant warm or cold-air advection aloft. If a significant cyclone is affecting the region, the sampling interval will be increased to 3-hourly. Due to a limited supply of radiosondes, we constrained our launches to coincide with passages of the CLOUDSAT and CALIPSO satellites, during periods of warm or cold air advection aloft, or during significant weather events such as cyclones or strong inversions. From 30 July to 27 Aug there were no balloon launches due to being short handed.

Figure 56: *A weather balloon with attached radiosonde, ready to be launched from the helicopter deck.*

Vertical profiles of temperature, pressure, relative humidity, wind speed and wind. direction were obtained using Vaisala RS92G GPS wind-finding radiosondes. The sonde was flown by 300 gm and 200 gm helium-filled balloons at a target ascent rate of 2 to 5 m/s to ensure a good vertical resolution through the boundary layer. An 8-channel uncoded GPS receiver in each sonde automatically detects all satellite signals in visible range. Raw wind vectors are transmitted to the ground station every 0.5 seconds during the flight via digital 1200 baud downlink. All wind computation is done within the ground equipment. Temperature is measured with a THERMOCAP® Capacitive bead, which has a +60.0 C to -90.0 C range, resolution of 0.10C and accuracy of 0.20C up to 50 hPa (most launches terminated before this level). The sensor also has a lag of less than 2.5 seconds in 6 m/s flow at 1000 mb. Pressure is measured with a BAROCAP® Capacitive aneroid. Its measuring range is 1060 mb to 3 mb with a resolution of 0.1 mb and accuracy of 0.5 mb. Humidity s measured with a HUMICAP® thin film capacitor. Its measuring range is from 0 to 100% relative humidity, with a resolution of 1% relative humidity and accuracy of 3%.

More information on the RS-92G radiosondes is available at:
(http://www.vaisala.com/weather/products/rs92.html)

The sensor also has lag of 1 second in 6 m/s flow, 1000 mb pressure and +200C. The temperature, pressure and humidity sensors are collectively sampled at 7 times per 10 seconds. All raw data from the sonde are processed at the ground station through a DigiCORA/MARWIN processor. The DigiCORA is connected to a computer, where data can be viewed in real time throughout the launch and where the data is archived. PILOT and TEMP codes are also produced after the launch terminates. PILOT and TEMP codes, as well as raw and edited measurements were archived for each launch. The edited data is stored in a text file in delimited columns.

Before launch, the radiosonde's temperature, pressure and humidity sensors are calibrated using the Vaisala ground station calibration unit. Surface meteorological observations are also noted and recorded for each launch. Starting meteorological conditions are input into the sounding including: sea level pressure, air temperature, relative humidity, and wind speed and direction.

5.3.2 Data Summary

There were 41 balloon launches from July 15 to October 15, 2009 (table 25)

Table 25: *Balloon launch summary for 2009.*

Date (GMT)	Time (GMT)	Latitude (DD)	Longitude (DD)	Filename
15-Jul	03 h 00	70.37	-136.08	2009-07-15_0300.csv*
18-Jul	18 h 28	70.5	-135.97	2009-07-18_1828.csv*
19-Jul	18 h 00	70.66	-135.63	2009_07_19_1820.csv
20-Jul	10 h 16	70.65	-135.95	2009_07_20_1036.csv
21-Jul	03 h 00	70.762	-136.026	2009_07_21_0301.csv*
21-Jul	11 h 50	70.805	-135.543	2009_07_21_1152.csv*
21-Jul	21 h 00	70.815	-134.544	2009_07_21_2116.csv*
23-Jul	21 h 00	71	-135.436	2009_07_23_2111.csv*
24-Jul	12 h 00	70.789	-136.572	2009_07_24_1219.csv
25-Jul	03 h 00	70.931	-136.405	2009_07_25_0302.csv*
25-Jul	12 h 00	70.931	-136.272	2009_07_25_1245.csv*
25-Jul	21 h 00	70.96	-136.181	2009_07_25_2107.csv*
26-Jul	12 h 00	70.822	-136.029	2009_07_26_1204.csv
26-Jul	23 h 00	70.621	-136.499	2009_07_26_2304.csv*
27-Jul	12 h 47	70.539	-135.73	2009_07_27_1247.csv
28-Jul	12 h 30	70.777	-135.708	2009_07_28_1230.csv**
29-Aug	02 h 30	70.693	-126.03	2009_08_29_0250.csv*
30-Aug	20 h 30	70.008	-138.503	2009_08_30_2043.csv*
31-Aug	20 h 15	71.093	-139.01	2009_08_31_2014.csv*
02-Sep	21 h 28	71.11	-139.3	2009_09_02_2128.csv**
04-Sep	04 h 00	74.642	-137.32	2009_09_04_0408.csv
04-Sep	06 h 14	74.644	-137.282	2009_09_04_0623.csv
04-Sep	13 h 50	74.593	-137.122	2009_09_04_1404.csv*
05-Sep	18 h 20	74.426	-136.445	2009_09_05_1903.csv*
06-Sep	00 h 00	74.454	-136.328	2009_09_06_0017.csv
07-Sep	06 h 00	74.564	-134.898	2009_09_07_0607.csv
07-Sep	20 h 30	75.29	-137.599	2009_09_07_2030.csv
09-Sep	20 h 00	72.512	-136.84	2009_09_09_2014.csv*
10-Sep	20 h 40	72.605	-137.218	2009_09_10_2042.csv*
20-Sep	20 h 30	70.45	-136.1	2009-09-20_2100.csv*
23-Sep	20 h 32	70.45	-135.34	2009-09-23_2032.csv**
24-Sep	12 h 00	70.44	-135.44	2009-09-24_1212.csv*
25-Sep	18 h 40	70.4	-136.17	2009-09-25_1851.csv
26-Sep	12 h 00	70.48	-135.53	2009-09-26_1219.csv
28-Sep	12 h 00	70.41	-136.42	2009-09-28_1210.csv

30-Sep	20 h 37	70.07	-135.33	2009-09-30_2048.csv
01-Oct	12 h 00	70.54	-136	2009-10-01_1211.csv
02-Oct	20 h 40	70.76	-136.18	2009-10-02_2040.csv
05-Oct	12 h 00	70.56	-136.04	2009-10-05_1207.csv
13-Oct	20 h 30	71.19	-127.33	2009-10-13_2117.csv
14-Oct	11 h 40	71.37	-126.42	2009-10-14_1155.csv

* Datafile has a quality assurance issue, that is unresolved as of the time of this report.
**Datafile is not available.

Data is transmitted at a rate of one message per second via VHF radio (~400.00MHz). Each data message reports a value for pressure, temperature and humidity data (raw PTU data). GPS strings are also transmitted, and are used to calculate upper-level wind speed and direction. All raw PTU and GPS data is used to generate an ensemble of time series data with variables and information information presented in table 26.

Table 26: *Variable denotation header found within radiosonde data files.*

Record Name	Unit	Divisor	Offset	Description
Time	sec	1	0	Time
Pscl(ln)	ln	1	0	(internal)
T(K)	K	10	0	Air Temperature
RH(%)	%	1	0	Relative Humidity
v(m/s)	m/s	-100	0	North-south orthogonal wind component
u(m/s)	m/s	-100	0	East-west orthogonal wind component
Height(m)	m/s	1	30000	Height above ground
P(hPa)	hPa	10	0	Barometric Pressure
TD(K)	K	10	0	Dewpoint temperature
MR(g/kg)	g/kg	100	0	Mixing ratio
DD(dgr)	dgr	1	0	Direction of wind
FF(m/s)	m/s	10	0	Wind speed
AZ(dgr)	dgr	1	0	Bearing to sonde from ground station
Range(m)	m	0.01	0	Range to sonde from ground station
Lon(dgr)	dgr	100	0	Longitude of sonde
Lat(dgr)	dgr	100	0	Latitude of sonde
puKey(bitfield_	bitfield	1	0	Internal
UsrKey(bitfield)	bitfield	1	0	Internal
RadarH(m)	m/s	1	30000	Radar reflector range to sonde (not used).

21 radiosonde profiles were flagged with quality assurance issues. The 20 that passed quality assurance are organized into folders by date, and are available In the database at:

\ATMOS\SONDE\yyyy_mm

5.3.3 Data Summary

A data visualization sample is presented from the radiosonde flight conducted at 10:20, 20 July 2009 (Figure: 57).

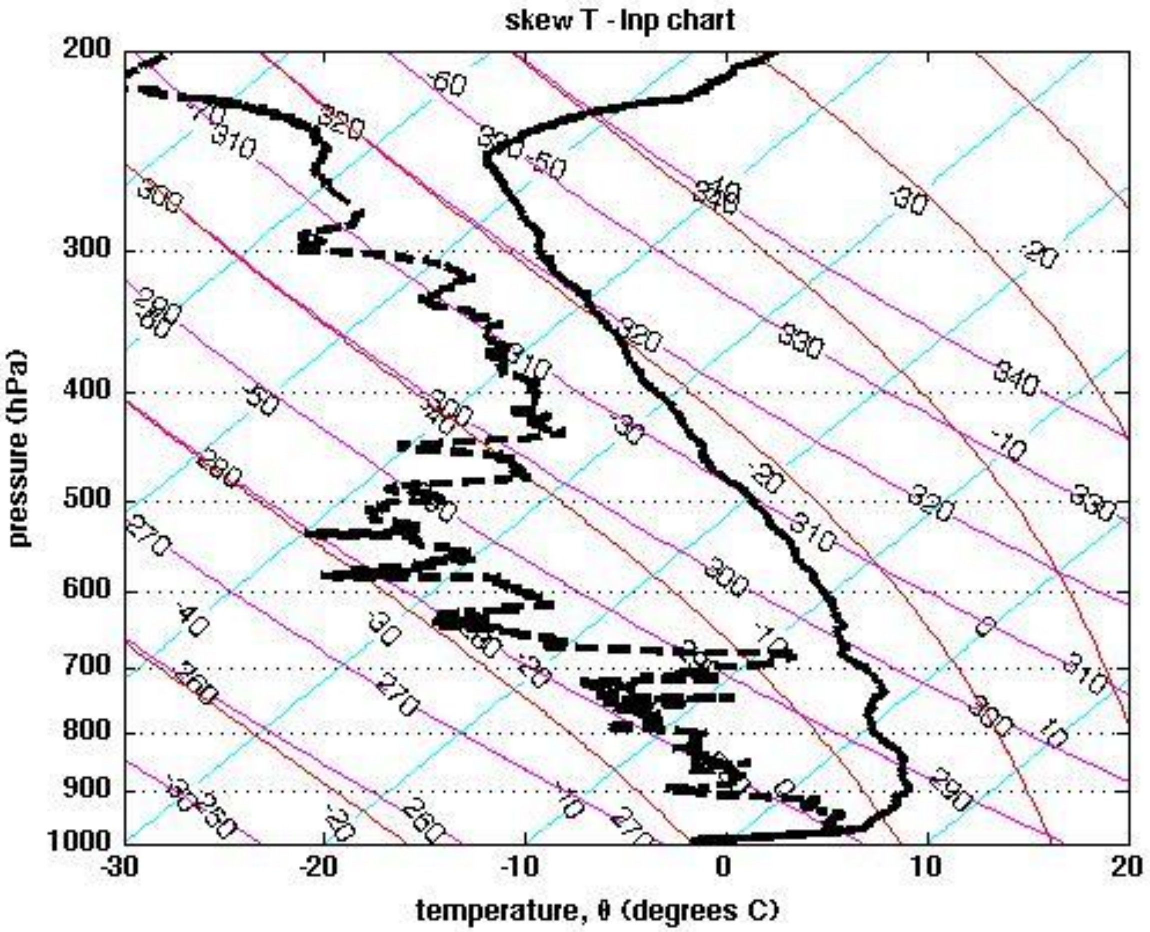


Figure 57: *Air temperature (solid) and dewpoint temperature (dashed) are presented on a SkewT-lnp chart.*

5.4 Cloud Base Height

5.4.1 Vaisala CT25K Ceilometer

The Vaisala CT25K laser ceilometer (figure 58) measures cloud heights and vertical visibilities using pulsed diode laser LIDAR (Light Detection And Ranging) technology, where short powerful laser pulses are sent out in a vertical or near-vertical direction. The laser operates at a centre wavelength of 905 ± 5 nm, a pulse width of 100 ns, beamwidth of ±0.53 mrad edge, ±0.75 mrad diagonal and a peak power of 16 W. The manufacturer suggested measurement range is 0 – 25,000ft (0 – 7.5 km), however, it has been found that high, very visible cirrostratus cloud (~18-20 kft) are consistently undetected by the unit (Hanesiak, 1998). The vertical resolution of the measurements is 50 ft, but decreases to 100 ft after ASCII data file conversion. The reflection of light backscatter caused by haze, fog, mist, virga, precipitation, and clouds is measured as the laser pulses traverse the sky. The resulting backscatter profile (i.e., signal strength versus height) is stored, processed and the cloud bases are detected. Knowing the speed of light, the time delay between the launch of the laser pulse and the backscatter signal indicates the cloud base height. The CT25K is designed to detect three cloud layers simultaneously, given suitable conditions. Besides cloud layers, it detects whether there is precipitation or other obstruction to vision. No adjustments in the field are needed. Output files were created hourly by the system and are in ASCII format. The ceilometer measurements were made in conjunction with all-sky camera measurements throughout the entire observational period. Ceilometer data was collected continuously from 15 July to 15 October 2009.

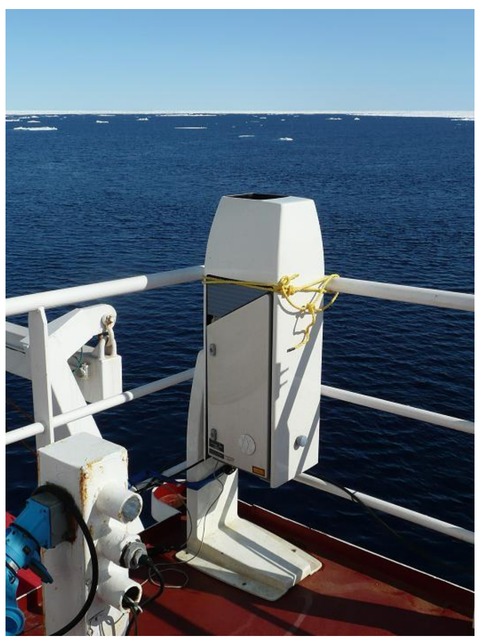


Figure 58: *Vaisala CT25K ceilometer mounted at 90° behind the wheelhouse.*

5.4.2 Data Summary

The ceilometer was running continuously from 15 July – 15 October 2009, and daily data files are available for the entire period.

Ceilometer files are available in two forms: Raw daily logs and processed ASCII daily files.

The Processed files are available at

\ATMOS\CEIL\Processed

Daily filenames follow the naming convention:

CEIL_YYYY_MM_DD.csv

The file header information is defined in table 27:

Table 27: *Ceilometer *.CSV file header*

Header	Description	Units
J_day	Julian day of year	n/a
Year	Year	n/a
Month	Month	n/a
Day	Day	n/a
Hour	Hour	n/a
Min	Minute	n/a
Sec	Seconds	n/a
Lat	Latitude	decimal deg (DD.DDDDD)
Lon	Longitude	decimal deg (DDD.DDDDD)
SOG	Speed over ground	Nm / hr
COG	Course over ground	Degrees (°)
Layer1	Cloud layer base height 1	Ft
Layer2	Cloud layer base height 2	Ft
Layer3	Cloud layer base height 3	Ft

5.4.3 Data Visualization

Ceilometer data for September 2009 is visualized in figure 59.

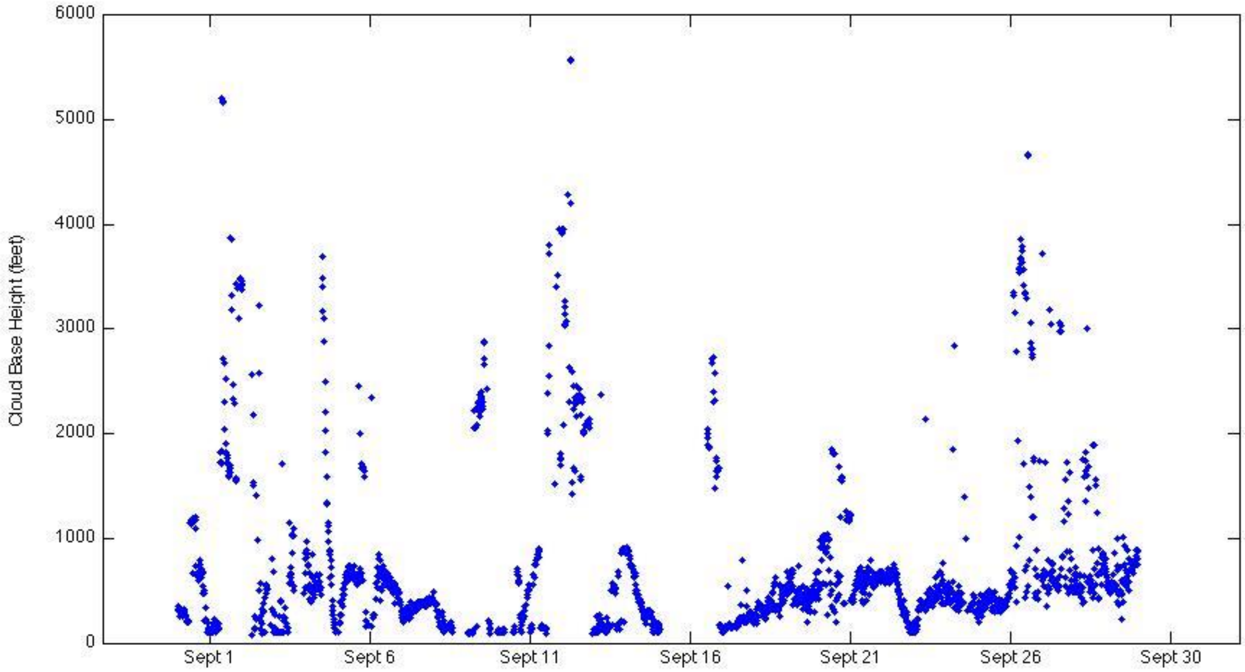


Figure 59: *Detected ceilometer cloud-base heights for September 2009.*

5.5 Precipitation

5.5.1 Theis Clima Laser Precipitation Monitor

A Theis Clima laser precipitation gauge is mounted approximately 3m above the foredeck of the ship on the meteorological tower (figure 60). The instrument analyses precipitation droplets that are intercepted by the laser, and estimates precipitation intensity.

Figure 60: *Laser precipitation gauge mounted on the CEOS Meteorological Tower.*

The laser precipitation monitor measures and detects different types of precipitation such as drizzle, rain, hail, snow, and mixed precipitation. A parallel light-beam (infrared, 780 nm, not visible) is produced by the laser diode and optics. The receiver side contains a photo diode with a lens which measures the optical capacity by transforming it into an electrical signal.

The receiving signal is reduced when a precipitation particle falls through the light beam (measuring area 45.6cm²(7inch²)), this allows the instrument to calculate the diameter of the particle from the amplitude of the reduction. The fall speed of the precipitation particle is calculated from the lenth of time of the reduced signal. The measured values are processed by a signal processor (DSP), and are checked for plausibility (e.g. edge hits). Calculation comprises the intensity, quantity, and type of precipitation (drizzle, rain, snow, soft hail, hail as well as mixed precipitation), and the particle spectrum (distribution of the particles over the class binning). The calculated data are memorized over one minute, and are then output via the serial interface.

The statistic proportion of all particles referring to diameter, and velocity determines the type of precipitation as done in Gunn and Kinzer (1949). In addition, temperature is included in order to improve the identification. Temperature of above 9 °C are automatically accepted as liquid (exception: soft hail, and hail), and temperature of below –4 °C as solid. Between -4 °C and 9 °C all forms of precipitation can occur.

5.5.2 Data Summary

This instrument was fully operational from 16 July – 15 October 2009. All data files are in a proprietary binary format, and required post-processing to ASCII format. At the time of this report, there were unresolved quality assurance concerns with the precipitation data. These are owing to the great difficulties in measuring precipitation from a ship-based platform (wind eddies, ocean spray, etc). A final data product is therefore not ready at this time, but will be made available as soon as possible.

Table 28: *derived from Theis Clima Laser Precipitation Manual.*

Sensors: Laser diode Laser class Modulation frequency Photo diode Measuring area	785nm, max. 0,5mW optical power Laser class 1M (EN 60825-1:1994 A2: 2001) 172.8 KHz with day light filter (< 700nm) 45,6cm² (288 x 20 mm) 7.067inch² (8.98 x 0.787 inch)
Precipitation	
Particle size	0,16 ... >8 mm
Particle speed	0,2 ... 20 m/s
Identification of precipitation types: -drizzle(DZ), freezing drizzle (FZDZ) -rain(RA), freezing rain (FZRA) -hail(GR) -snow (SN) -snow grains (SG), ice needles(IC) -soft hail(GS), ice grains(PL)	Hit rate (compared with synoptic observation), wind speed < 3m/s) >97% (Intensity > 0.01 mm/h) >99% (>= 2 particles/min, no solid precipitation) >95% (>= 2 particles/min) >99% (no mixed precipitation) >60 % t.b.d.
Output Precipitation Type	SYNOP (Tab.4680), METAR (Tab.4678)
Error intensity-/quantity measurement (rain equivalent) compared with reference sensor (wind speed< 3m/s)	≤15% (rain, 0,5... 20mm/h) ≤30% (snow)
Minimum Intensity (depending on precipitation type)	<0,005 mm/h (drizzle)
Maximum Intensity	>250 mm/h

5.6 All-Sky Camera Imagery

5.6.1. Instrumentation

The all-sky camera system takes images of the sky and cloud cover. The system consists of a Nikon D-90 camera outfitted with fish-eye lenses with a viewing angle of 160 degrees, mounted in a heated weather-proof enclosure. The camera is programmed to take pictures using an external intervalometer set at 15-minute intervals, or 96 images per day. The system is mounted in a small 'crow's nest' immediately above the ship's wheelhouse (figure 61).

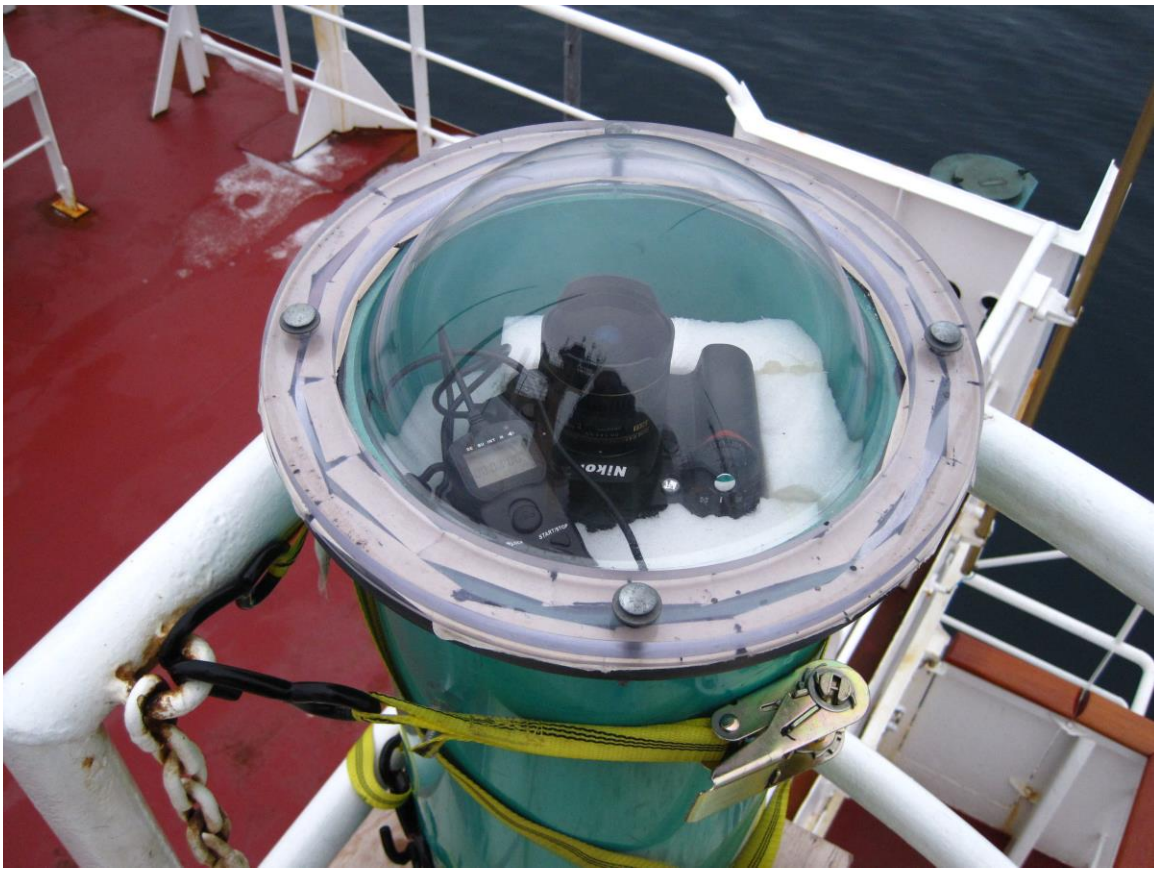


Figure 61: *Nikon D-90 Camera with fisheye lenses attached in a weatherproof enclosure.*

Imagery collection started on 20 July, and was continuous through to 15 October. Gaps in the data are due to routine maintenance and setting adjustments due to the changing light. From 20 July to 16 September the camera was set to automatically adjust aperture with a fixed exposure time. Less light in the season caused this setup to result in poor image quality. The camera was then set to have an aperture of f-12 with a variable exposure time. This allowed for low light or night time images to be taken. Due to problems with the intervalometer, images are missing from the data set; days exist without the full 96 photos.

5.5.2 Data Visualization

A example all-sky image showing 6/8 broken cloud cover is shown in figure 62.

Figure 62: *An All-Sky image taken 2 October 2009 at 01:29 UTC.*

5.7 Manual Meteorological Observations

5.7.1 Instrumentation

Manual meteorological observations were conducted at 3-hour intervals throughout the entire 2009 field season, except for at night when observers were sleeping. There is a gap in observations starting from 30 July till 10 August due to no observers onboard at the time. Observations included current conditions with relation to precipitation type and intensity, visibility, cloud cover (octets), and sea ice coverage (tenths). Basic meteorological values were read and recorded from the onboard weather station, which is owned and operated by the Meteorological Service of Canada. Visibility, cloud octets, sea ice concentration, and precipitation type and intensity observations are subjective based on the observer. If the cloud coverage was not 100% it was not recorded at 8/8, similarly if the coverage has even 1% of clouds the cloud fraction was not recorded as 0/8.

The CCGS *Amundsen* is equipped with an AXYS Automated Voluntary Observation Ship (AVOS), with all sensors located on the roof of the wheelhouse. The AVOS is an interactive environmental reporting system that allows for the hourly transmission of current meteorological conditions to a central land station via Iridium satellite telemetry. Temperatures (air and sea surface), pressure, relative humidity (RH), wind speed, wind direction, and current GPS location are updated every ten minutes and displayed on a computer monitor located in the wheelhouse of the ship. The AVOS deploys a Rotronics MP 101A sensor for temperature and RH, with a resolution of 0.1ºC and an accuracy of ± 0.3ºC, and a 1% ± 1% accuracy for temperature and RH, respectively. Atmospheric pressure was obtained from a Vaisala PTB210 sensor with a 0.01mb resolution and an accuracy of ±0.15 mb. Wind speed and direction is collected from an RM Young 05103 anemometer, accurate to ±3º in direction and ±0.3 m/s.

5.7.2 Data Summary

Table 29: *Parameters recorded by the observer.*

Parameter	Units
Date	UTC
Time	UTC
Latitude	decimal degrees
Longitude	decimal degrees
Temperature	ºC
Relative Humidity	%
Wind Speed	kts
Wind Direction	º
Precipitation Type	snow, rain etc
Precipitation Intensity	Heavy, moderate, light etc.
Visibility	nm
Cloud Fraction	Octets
Sea Ice Concentration	Tenths

Table 30: *Dates when observations were recorded.*

Start Observation	End of Observations
7/8/09 5:06	7/30/09 0:00
10/08/09 21:00	27/08/09 0:00
28/08/09 18:00	8/30/09 0:00
8/30/09 18:00	9/3/09 0:00
9/3/09 15:00	9/11/09 18:00
9/13/09 12:00	08/10/09 3:00
10/9/09 15:00	18/10/09 6:00
10/19/09 15:00	04/11/09 21:00

5.8 Ice Surface Winds

5.8.1 Instrumentation

Instrument : CSAT3 Three Dimensional Sonic Anemometer

The CSAT3 (figure 63) is an ultrasonic anemometer for measuring wind speed in three dimensions. It uses three pairs of non-orthogonally oriented transducers to sense the horizontal wind. Each pair of transducers transmits and receives the ultrasonic signal. The time of flight is directly related to the wind speed along the sonic transducer axis. The speed of sound is directly related of the air density, e.g. temperature and humidity. The CSAT3 can be used to measure average horizontal wind speed and direction or turbulent fluctuations of horizontal and vertical wind.

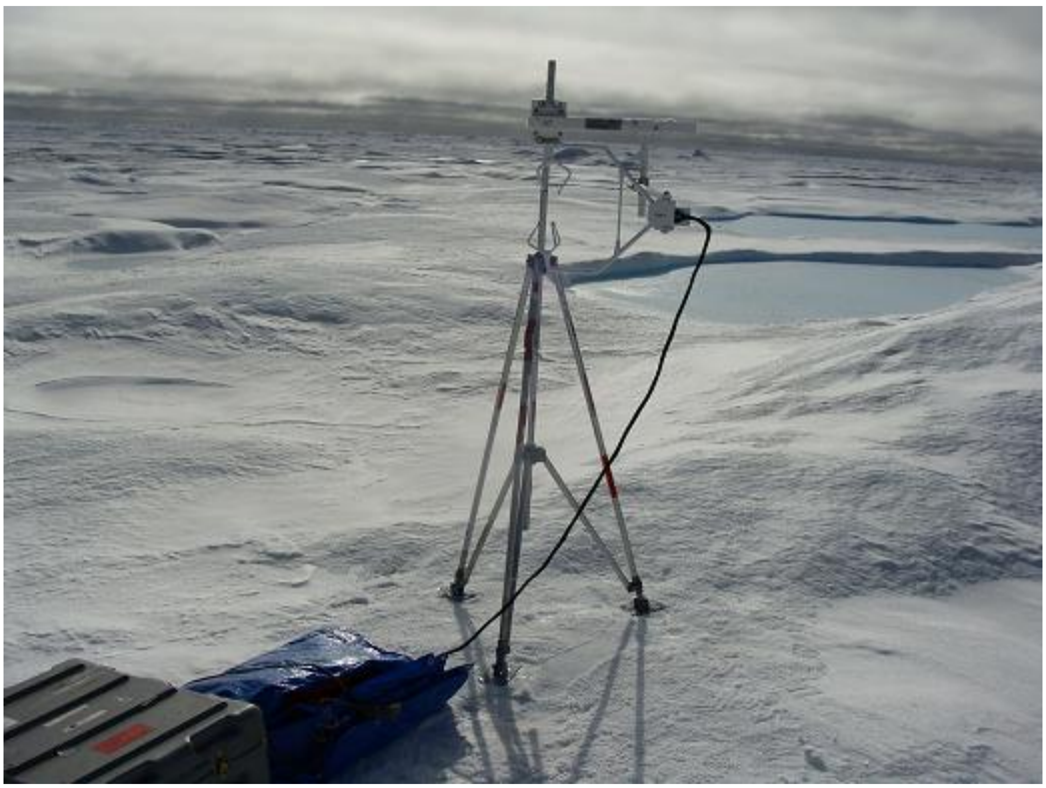


Figure 63: *C-SAT3 Deployed on MY ice on 9 September 2009.*

The CSAT3 measures wind speed and the speed of sound along the three nonorthogonal sonic axes. The wind speeds are then transformed into the orthogonal wind components ux, uy, and uz and are referenced to the anemometer head; the reported speed of sound (c) or sonic virtual temperature (Ts), is the average between the three non-orthogonal sonic axes. The errors caused by wind blowing normal to the sonic path are corrected online before the wind speed is transformed into orthogonal coordinates. The CSAT3 can be configured to make a single measurement per trigger or multiple measurements that are centered around the trigger (oversampled).

OUTPUTS: ux, uy, uz, and c (ux, uy, uz, are orthogonal wind components referenced to the anemometer head; c is the speed of sound)

SPEED OF SOUND: determined from 3 acoustic paths; corrected for crosswind effects

MEASUREMENT RATE: programmable from 1 to 60 Hz, instantaneous measurements; two oversampled modes are block averaged to either 20 Hz or 10 Hz

MEASUREMENT RESOLUTION: ux and uy are 1 mm/s rms; uz is 0.5 mm/s rms; c is 15 mm/s (0.025°C) with embedded code version 4 (standard) [c is 1 mm/s (0.002°C) with embedded code version 3]. Values are the standard deviations of instantaneous measurements made of a constant signal. The noise is unaffected by the sample rate.

OPERATING TEMPERATURE RANGE: -30° to 50°C (standard); -40° to 40°C (cold shifted)

ACCURACY (-30° to 50°C and -40° to 40°C operating range; wind speed < 30 m s-1; azimuth angles between ±170°):

Offset Error:

ux, uy: < ±4 cm/s
uz: < ±2 cm/s

Gain Error:

Wind vector within ±5° of horizontal < ±2 percent of reading
Wind vector within ±10° of horizontal < ±3 percent of reading
Wind vector within ±20° of horizontal < ±6 percent of reading

Physical Description

MEASUREMENT PATH LENGTH: 10.0 cm vertical; 5.8 cm horizontal

TRANSDUCER PATH ANGLE FROM HORIZONTAL: 60 degrees

TRANSDUCER: 0.64 cm (0.25 in) diameter

TRANSDUCER MOUNTING ARMS: 0.84 cm (0.33 in) diameter

SUPPORT ARMS: 1.59 cm (0.63 in) diameter

DIMENSIONS:

Anemometer Head: 47.3 cm (l) x 42.4 cm (h) (18.6 in x 16.7 in)
Electronics Box: 26 cm x 16 cm x 9 cm (10.2 in x 6.3 in x 3.5 in)
Carrying Case: 71.1 cm x 58.4 cm x 33 cm (28 in x 23 in 13 in)

WEIGHT:

Anemometer Head: 1.7 kg (3.7 lb)
Electronics Box: 2.8 kg (6.1 lb)
Shipping: 16.8 kg (37 lb)

Power Requirements

VOLTAGE SUPPLY: 10 to 16 Vdc
2.4 W @ 60 Hz measurement frequency
1.2 W @ 20 Hz measurement frequency

Description of deployment

The tower (an extendable tripod), 2.5 m high, was set up on ice (see site pictures) against the wind and away from ship to avoid tower and ship's obstructions. The height of the anemometer is 2.5 m from the base of the tower. Data is recorded using CR1000 data logger and CFM storage module.

5.8.2 Data Summary

Due to an unexpected lack of MY sea ice during Leg 3a, and unfavourable weather conditions, only two deployments of the C-SAT3 Anemometer were possible (table 31). Site photos are available for both deployments.

Table 31: *CSAT3 deployments in 2009.*

Date	Station	Lat (N)	Long (W)	Site Photos	Filename
31 Aug.	L1 (MY Ice)	71° 05.55'	139° 00.65'	Yes	IWT_2009_08_31.dat
09 Sept.	L11(FY Ice)	72° 30.816'	136° 44.479'	Yes	IWT_2009_09_09.dat

File header information is as follows:

TIMESTAMP (TS) : Record timestamp DD/MM/YYYY HH :MM :SS.S
RECORD (RN) : Serial record number
Ux (m/s) : Orthoganal wind compent (east-west)
Uy (m/s) : Orthoganal wind compent (north-south)
Uz (m/s) : Orthoganal wind compent (vertical)
Ts (°C) : Surface temperature
Diag : Unitless, internal system use variable

The data and site photos are available in the database at:

\ATMOS\IWT\YYYY_MM_DD

SECTION SIX: OTHER CRUISE DATA

6.1 Radarsat Inventory

An inventory of applicable Radarsat-1 and Radarsat-2 SAR imagery has been included in this document (Table 32). The inventory includes all imagery collected from 15 July – 15 October 2009 that provide coverage within the study region (lower-right extent 70°40.000’N 127°30.000’W, upper-left extent of 72°25.000’N 137°00.000’W).

Table 32: *Radarsat-1 and Radarsat-2 Imagery*

Satellite	Image ID	Acq. Date	Acq. Time UTC	Acq End Time	Orbit ID
RADARSAT-2	55992	2009-10-15	2:47:19 PM	2:49:50 PM	9590.28
RADARSAT-2	55878	2009-10-14	3:16:36 PM	3:19:26 PM	9576.28
RADARSAT-2	55765	2009-10-13	3:46:00 PM	3:48:22 PM	9562.28
RADARSAT-2	55707	2009-10-13	2:11:37 AM	2:14:01 AM	9554.2
RADARSAT-2	55659	2009-10-12	4:14:26 PM	4:17:50 PM	9548.27
RADARSAT-2	55512	2009-10-11	3:03:18 PM	3:06:51 PM	9533.27
RADARSAT-2	55398	2009-10-10	3:32:32 PM	3:36:06 PM	9519.27
RADARSAT-2	55272	2009-10-09	4:02:01 PM	4:05:24 PM	9505.27
RADARSAT-2	55272	2009-10-09	4:02:01 PM	4:05:24 PM	9505.27
RADARSAT-2	55138	2009-10-08	2:51:32 PM	2:54:02 PM	9490.28
RADARSAT-2	55015	2009-10-07	3:20:05 PM	3:23:36 PM	9476.27
RADARSAT-2	54894	2009-10-06	3:49:29 PM	3:52:37 PM	9462.27
RADARSAT-2	54830	2009-10-06	2:15:22 AM	2:17:46 AM	9454.19
RADARSAT-2	54702	2009-10-05	2:44:37 AM	2:46:17 AM	9440.19
RADARSAT-2	54634	2009-10-04	3:08:18 PM	3:11:03 PM	9433.28
RADARSAT-2	54569	2009-10-04	1:32:54 AM	1:33:58 AM	9425.19
RADARSAT-2	54515	2009-10-03	3:37:31 PM	3:40:19 PM	9419.28
RADARSAT-2	54403	2009-10-02	4:07:37 PM	4:09:29 PM	9405.29
RADARSAT-2	54403	2009-10-02	4:07:37 PM	4:09:29 PM	9405.29
RADARSAT-2	54226	2009-10-01	1:20:03 AM	1:21:38 AM	9382.19
RADARSAT-2	54173	2009-09-30	3:24:58 PM	3:27:47 PM	9376.28
RADARSAT-2	54064	2009-09-29	3:53:50 PM	3:56:59 PM	9362.28
RADARSAT-2	54064	2009-09-29	3:53:50 PM	3:56:59 PM	9362.28
RADARSAT-2	53991	2009-09-29	2:19:41 AM	2:19:57 AM	9354.2
RADARSAT-2	53946	2009-09-28	4:23:17 PM	4:26:09 PM	9348.28
RADARSAT-2	53935	2009-09-28	2:44:26 PM	2:45:40 PM	9347.3
RADARSAT-2	53879	2009-09-28	2:48:48 AM	2:52:19 AM	9340.19
RADARSAT-2	53812	2009-09-27	3:12:34 PM	3:14:57 PM	9333.28
RADARSAT-2	53733	2009-09-27	1:37:07 AM	1:40:46 AM	9325.19
RADARSAT-2	53733	2009-09-27	1:37:07 AM	1:40:46 AM	9325.19
RADARSAT-2	53685	2009-09-26	3:41:52 PM	3:44:13 PM	9319.28
RADARSAT-2	53629	2009-09-26	2:06:48 AM	2:10:19 AM	9311.19
RADARSAT-2	53582	2009-09-25	4:10:27 PM	4:13:45 PM	9305.27
RADARSAT-2	53582	2009-09-25	4:10:27 PM	4:13:45 PM	9305.27
RADARSAT-2	53520	2009-09-25	2:36:19 AM	2:39:40 AM	9297.19

RADARSAT-2	53395	2009-09-24	1:24:09 AM	1:25:44 AM	9282.19
RADARSAT-2	53342	2009-09-23	3:28:37 PM	3:31:57 PM	9276.28
RADARSAT-2	53342	2009-09-23	3:28:37 PM	3:31:57 PM	9276.28
RADARSAT-2	53256	2009-09-23	1:54:00 AM	1:57:46 AM	9268.19
RADARSAT-2	53195	2009-09-22	3:58:03 PM	4:01:05 PM	9262.28
RADARSAT-2	53195	2009-09-22	3:58:03 PM	4:01:05 PM	9262.28
RADARSAT-2	53067	2009-09-21	2:47:34 PM	2:49:52 PM	9247.29
RADARSAT-2	52948	2009-09-20	3:15:56 PM	3:19:26 PM	9233.28
RADARSAT-2	52830	2009-09-19	3:44:57 PM	3:48:21 PM	9219.27
RADARSAT-2	52769	2009-09-19	2:11:01 AM	2:11:51 AM	9211.19
RADARSAT-2	52719	2009-09-18	4:14:07 PM	4:17:49 PM	9205.27
RADARSAT-2	52568	2009-09-17	3:04:31 PM	3:06:56 PM	9190.29
RADARSAT-2	52568	2009-09-17	3:04:31 PM	3:06:56 PM	9190.29
RADARSAT-2	52455	2009-09-16	3:33:16 PM	3:35:54 PM	9176.28
RADARSAT-2	52338	2009-09-15	4:01:13 PM	4:05:02 PM	9162.27
RADARSAT-2	52208	2009-09-14	2:52:24 PM	2:54:01 PM	9147.29
RADARSAT-2	52086	2009-09-13	3:20:49 PM	3:23:39 PM	9133.28
RADARSAT-2	51978	2009-09-12	3:50:48 PM	3:52:35 PM	9119.29
RADARSAT-2	51978	2009-09-12	3:50:48 PM	3:52:35 PM	9119.29
RADARSAT-2	51926	2009-09-12	2:15:27 AM	2:15:42 AM	9111.2
RADARSAT-2	51863	2009-09-11	4:20:48 PM	4:21:46 PM	9105.29
RADARSAT-2	51785	2009-09-11	2:45:01 AM	2:47:25 AM	9097.2
RADARSAT-2	51715	2009-09-10	3:09:07 PM	3:10:22 PM	9090.29
RADARSAT-2	51593	2009-09-09	3:38:12 PM	3:39:28 PM	9076.29
RADARSAT-2	51483	2009-09-08	4:08:11 PM	4:09:27 PM	9062.29
RADARSAT-2	51412	2009-09-08	2:32:25 AM	2:34:49 AM	9054.2
RADARSAT-2	51342	2009-09-07	2:55:37 PM	2:57:55 PM	9047.28
RADARSAT-2	51226	2009-09-06	3:25:31 PM	3:27:45 PM	9033.29
RADARSAT-2	51226	2009-09-06	3:25:31 PM	3:27:45 PM	9033.29
RADARSAT-2	51117	2009-09-05	3:55:24 PM	3:56:55 PM	9019.29
RADARSAT-2	51002	2009-09-04	4:24:57 PM	4:26:13 PM	9005.29
RADARSAT-2	50990	2009-09-04	2:44:21 PM	2:45:33 PM	9004.3
RADARSAT-2	50852	2009-09-03	3:13:17 PM	3:14:32 PM	8990.29
RADARSAT-2	50722	2009-09-02	3:43:06 PM	3:44:07 PM	8976.3
RADARSAT-2	50622	2009-09-01	4:12:22 PM	4:13:35 PM	8962.29
RADARSAT-2	50480	2009-08-31	3:00:17 PM	3:02:17 PM	8947.29
RADARSAT-2	50422	2009-08-31	1:24:03 AM	1:25:41 AM	8939.19
RADARSAT-2	50373	2009-08-30	3:28:46 PM	3:31:55 PM	8933.28
RADARSAT-2	50373	2009-08-30	3:28:46 PM	3:31:55 PM	8933.28
RADARSAT-2	50230	2009-08-29	3:56:21 PM	4:01:03 PM	8919.26
RADARSAT-2	50178	2009-08-29	2:24:01 AM	2:26:25 AM	8911.2
RADARSAT-2	50112	2009-08-28	2:46:20 PM	2:49:49 PM	8904.27
RADARSAT-2	50055	2009-08-28	1:11:42 AM	1:13:19 AM	8896.19
RADARSAT-2	49993	2009-08-27	3:17:28 PM	3:19:20 PM	8890.29

RADARSAT-2	49993	2009-08-27	3:17:28 PM	3:19:20 PM	8890.29
RADARSAT-2	49764	2009-08-25	4:16:35 PM	4:17:49 PM	8862.29
RADARSAT-2	49615	2009-08-24	3:04:36 PM	3:06:47 PM	8847.29
RADARSAT-2	49615	2009-08-24	3:04:36 PM	3:06:47 PM	8847.29
RADARSAT-2	49545	2009-08-24	1:28:19 AM	1:29:48 AM	8839.19
RADARSAT-2	49493	2009-08-23	3:33:00 PM	3:36:02 PM	8833.28
RADARSAT-2	49493	2009-08-23	3:33:00 PM	3:36:02 PM	8833.28
RADARSAT-2	49429	2009-08-23	1:58:35 AM	2:02:06 AM	8825.2
RADARSAT-2	49375	2009-08-22	4:03:40 PM	4:05:21 PM	8819.29
RADARSAT-2	49251	2009-08-21	2:51:54 PM	2:54:07 PM	8804.29
RADARSAT-2	49127	2009-08-20	3:21:18 PM	3:23:32 PM	8790.29
RADARSAT-2	49127	2009-08-20	3:21:18 PM	3:23:32 PM	8790.29
RADARSAT-2	49018	2009-08-19	3:48:12 PM	3:52:47 PM	8776.26
RADARSAT-2	49018	2009-08-19	3:48:12 PM	3:52:47 PM	8776.26
RADARSAT-2	48897	2009-08-18	4:18:14 PM	4:21:45 PM	8762.27
RADARSAT-2	48826	2009-08-18	2:44:34 AM	2:48:08 AM	8754.19
RADARSAT-2	48741	2009-08-17	3:08:33 PM	3:11:00 PM	8747.29
RADARSAT-2	48673	2009-08-17	1:32:44 AM	1:33:54 AM	8739.19
RADARSAT-2	48617	2009-08-16	3:37:07 PM	3:40:14 PM	8733.28
RADARSAT-2	48617	2009-08-16	3:37:07 PM	3:40:14 PM	8733.28
RADARSAT-2	48556	2009-08-16	2:02:17 AM	2:03:33 AM	8725.19
RADARSAT-2	48511	2009-08-15	4:06:11 PM	4:08:39 PM	8719.27
RADARSAT-2	48389	2009-08-14	2:54:49 PM	2:58:19 PM	8704.27
RADARSAT-2	48342	2009-08-14	1:19:52 AM	1:21:34 AM	8696.19
RADARSAT-2	48298	2009-08-13	3:25:06 PM	3:27:02 PM	8690.28
RADARSAT-2	48200	2009-08-12	3:54:29 PM	3:56:57 PM	8676.28
RADARSAT-2	48092	2009-08-11	4:22:36 PM	4:26:07 PM	8662.27
RADARSAT-2	48085	2009-08-11	2:43:06 PM	2:45:36 PM	8661.28
RADARSAT-2	47980	2009-08-10	3:12:43 PM	3:14:54 PM	8647.29
RADARSAT-2	47918	2009-08-10	1:37:01 AM	1:39:42 AM	8639.19
RADARSAT-2	47918	2009-08-10	1:37:01 AM	1:39:42 AM	8639.19
RADARSAT-2	47874	2009-08-09	3:41:57 PM	3:44:09 PM	8633.28
RADARSAT-2	47818	2009-08-09	2:06:25 AM	2:07:39 AM	8625.19
RADARSAT-2	47764	2009-08-08	4:09:54 PM	4:13:35 PM	8619.27
RADARSAT-2	47628	2009-08-07	3:00:42 PM	3:02:36 PM	8604.29
RADARSAT-2	47628	2009-08-07	3:00:42 PM	3:02:36 PM	8604.29
RADARSAT-2	47521	2009-08-06	3:29:42 PM	3:31:32 PM	8590.29
RADARSAT-2	47393	2009-08-05	3:59:07 PM	4:01:06 PM	8576.29
RADARSAT-2	47393	2009-08-05	3:59:07 PM	4:01:06 PM	8576.29
RADARSAT-2	47282	2009-08-04	2:48:07 PM	2:49:47 PM	8561.29
RADARSAT-2	47175	2009-08-03	3:17:07 PM	3:19:23 PM	8547.29
RADARSAT-2	47175	2009-08-03	3:17:07 PM	3:19:23 PM	8547.29
RADARSAT-2	47108	2009-08-03	1:41:56 AM	1:43:47 AM	8539.2
RADARSAT-2	47055	2009-08-02	3:46:37 PM	3:48:18 PM	8533.29

RADARSAT-2	46946	2009-08-01	4:14:19 PM	4:17:45 PM	8519.27
RADARSAT-2	46822	2009-07-31	3:05:04 PM	3:06:47 PM	8504.29
RADARSAT-2	46751	2009-07-31	1:28:33 AM	1:29:44 AM	8496.19
RADARSAT-2	46702	2009-07-30	3:33:37 PM	3:36:01 PM	8490.29
RADARSAT-2	46583	2009-07-29	4:03:20 PM	4:04:53 PM	8476.29
RADARSAT-2	46528	2009-07-29	2:27:51 AM	2:30:15 AM	8468.19
RADARSAT-2	46454	2009-07-28	2:53:18 PM	2:53:54 PM	8461.3
RADARSAT-2	46382	2009-07-28	1:15:39 AM	1:17:22 AM	8453.19
RADARSAT-2	46324	2009-07-27	3:20:58 PM	3:23:29 PM	8447.28
RADARSAT-2	46218	2009-07-26	3:49:10 PM	3:52:43 PM	8433.27
RADARSAT-2	46115	2009-07-25	4:20:14 PM	4:21:52 PM	8419.29
RADARSAT-2	45991	2009-07-24	3:09:11 PM	3:10:48 PM	8404.29
RADARSAT-2	45883	2009-07-23	3:37:24 PM	3:39:48 PM	8390.28
RADARSAT-2	45784	2009-07-22	4:07:47 PM	4:09:23 PM	8376.29
RADARSAT-2	45709	2009-07-22	2:31:37 AM	2:34:26 AM	8368.19
RADARSAT-2	45649	2009-07-21	2:56:37 PM	2:58:12 PM	8361.29
RADARSAT-2	45593	2009-07-21	1:21:02 AM	1:21:51 AM	8353.2
RADARSAT-2	45534	2009-07-20	3:24:53 PM	3:27:18 PM	8347.28
RADARSAT-2	45428	2009-07-19	3:53:38 PM	3:56:55 PM	8333.28
RADARSAT-2	45428	2009-07-19	3:53:38 PM	3:56:55 PM	8333.28
RADARSAT-2	45305	2009-07-18	4:24:45 PM	4:26:00 PM	8319.29
RADARSAT-2	45236	2009-07-18	2:48:31 AM	2:50:19 AM	8311.19
RADARSAT-2	45172	2009-07-17	3:13:17 PM	3:14:51 PM	8304.29
RADARSAT-2	45107	2009-07-17	1:37:58 AM	1:38:51 AM	8296.2
RADARSAT-2	45106	2009-07-17	1:36:57 AM	1:37:55 AM	8296.19
RADARSAT-2	45000	2009-07-16	2:06:28 AM	2:08:52 AM	8282.19
RADARSAT-2	44941	2009-07-15	4:11:47 PM	4:13:29 PM	8276.29
RADARSAT-2	44868	2009-07-15	2:36:06 AM	2:37:22 AM	8268.19
RADARSAT-1	112890	2009-10-15	3:35:16 PM	3:36:23 PM	72803
RADARSAT-1	112817	2009-10-14	4:04:45 PM	4:06:09 PM	72789
RADARSAT-1	112817	2009-10-14	4:03:37 PM	4:05:10 PM	72789
RADARSAT-1	112731	2009-10-13	2:53:44 PM	2:54:59 PM	72774
RADARSAT-1	112731	2009-10-13	2:52:46 PM	2:54:10 PM	72774
RADARSAT-1	112646	2009-10-12	3:23:07 PM	3:24:25 PM	72760
RADARSAT-1	112646	2009-10-12	3:22:05 PM	3:23:32 PM	72760
RADARSAT-1	112552	2009-10-11	3:52:22 PM	3:53:39 PM	72746
RADARSAT-1	112552	2009-10-11	3:51:21 PM	3:52:45 PM	72746
RADARSAT-1	112453	2009-10-10	2:40:55 PM	2:42:20 PM	72731
RADARSAT-1	112357	2009-10-09	3:10:31 PM	3:11:54 PM	72717
RADARSAT-1	112357	2009-10-09	3:09:19 PM	3:10:48 PM	72717
RADARSAT-1	112279	2009-10-08	3:39:47 PM	3:41:10 PM	72703
RADARSAT-1	112279	2009-10-08	3:38:41 PM	3:40:12 PM	72703
RADARSAT-1	112014	2009-10-05	3:27:13 PM	3:28:39 PM	72660
RADARSAT-1	112014	2009-10-05	3:26:03 PM	3:27:38 PM	72660

RADARSAT-1	111917	2009-10-04	3:56:33 PM	3:57:50 PM	72646
RADARSAT-1	111917	2009-10-04	3:55:27 PM	3:56:52 PM	72646
RADARSAT-1	111825	2009-10-03	4:25:55 PM	4:27:00 PM	72632
RADARSAT-1	111825	2009-10-03	4:25:06 PM	4:26:19 PM	72632
RADARSAT-1	111814	2009-10-03	2:44:52 PM	2:46:29 PM	72631
RADARSAT-1	111735	2009-10-02	3:14:56 PM	3:16:08 PM	72617
RADARSAT-1	111735	2009-10-02	3:13:56 PM	3:15:14 PM	72617
RADARSAT-1	111651	2009-10-01	3:43:56 PM	3:45:20 PM	72603
RADARSAT-1	111651	2009-10-01	3:42:47 PM	3:44:21 PM	72603
RADARSAT-1	110840	2009-09-21	3:36:22 PM	3:36:48 PM	72460
RADARSAT-1	108994	2009-08-28	3:36:21 PM	3:36:48 PM	72117
RADARSAT-1	108865	2009-08-26	2:53:41 PM	2:54:48 PM	72088
RADARSAT-1	108865	2009-08-26	2:52:50 PM	2:54:05 PM	72088
RADARSAT-1	107349	2009-08-04	3:36:19 PM	3:36:45 PM	71774
RADARSAT-1	107157	2009-08-01	3:22:56 PM	3:24:21 PM	71731
RADARSAT-1	106192	2009-07-19	1:25:03 AM	1:26:28 AM	71537
RADARSAT-1	106156	2009-07-18	3:31:19 PM	3:32:39 PM	71531

The tables presented are truncated for brevity, and the complete tables are available in the database at:

\MISC\RADARSAT\rsat_20090715_20091015.xls

A MrSID RADARSAT-2 sample image is presented (0903-1513-banks_R2_LCC_164722) in figure 64.

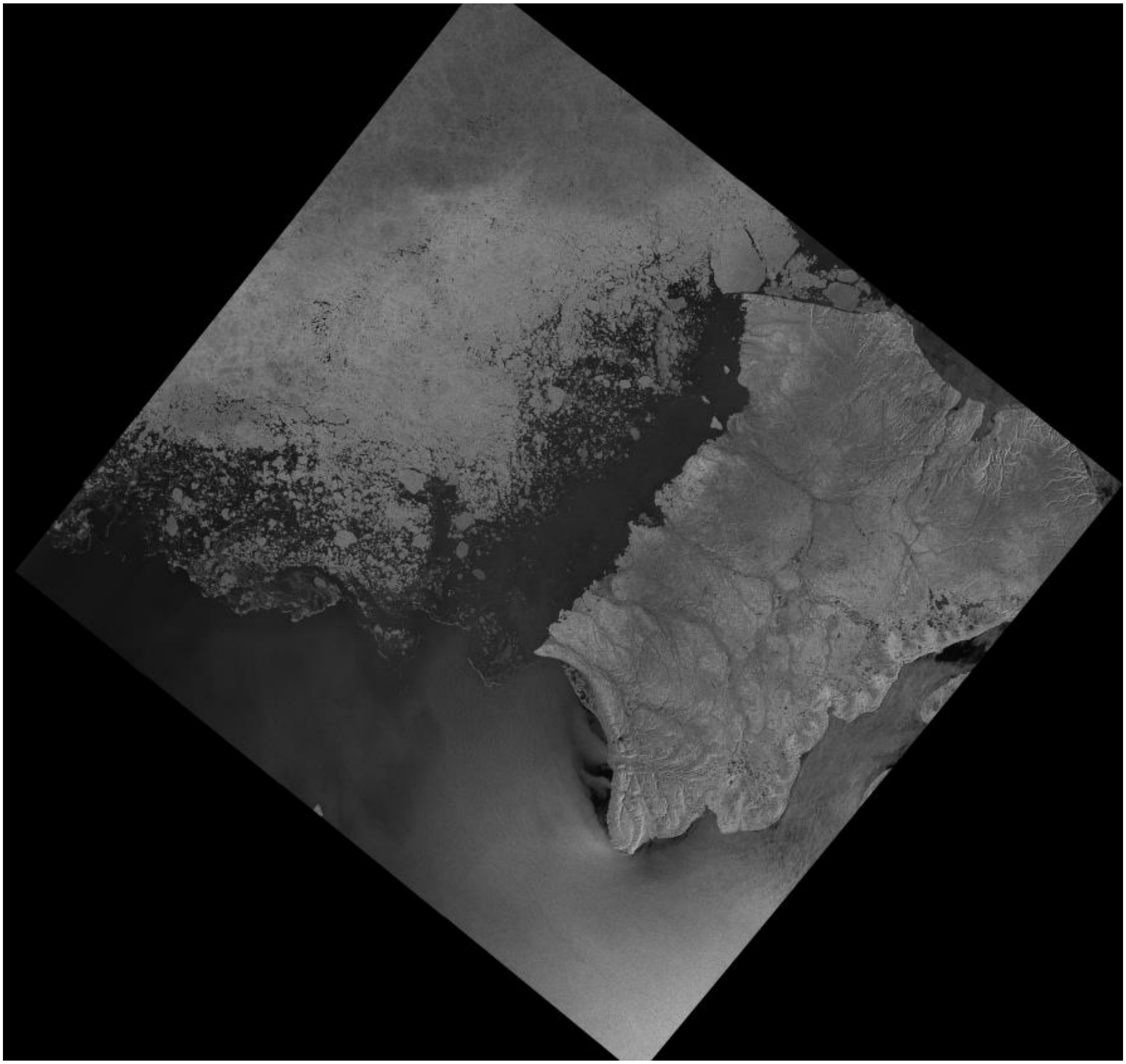


Figure 64: *Banks Island, and perennial pack ice are clearly visibile. Open water in Amundsen Gulf appears brighter due to surface roughness where relatively calmer water (west of Banks Island) appears darker.*

6.2 GPS Position

NMEA RMC Strings collected by the CCGS *Amundsen's* DGPS system for the entire field season are processed into daily files, at minute and second intervals.

ASCII files (*.dat extension) are found in the database for 1 minute resolution at:

\OTHER\NAV\GPS_NMEA_RMC\RMC_DAILY_1min

and for 1 second resolution at:

\OTHER\NAV\GPS_NMEA_RMC\RMC_DAILY_1sec

File naming convention is as follows for 1 minute resolution:

\1min_RMC_2009_JDxxx_MMDD.dat

and for 1 second resolution:

\RMC_2009_JDxxx_MMDD.dat

Where: JDxxx corresponds to the julien day, and MMDD is month and day.

File header:

(Dates and times are in UTC).
Year:
Month:
Day:
Hour:
Min: Minute
Sec: Second
Lat: Latitude (decimal degrees)
Lon: Longitude (decimal degrees)
SOG: Speed over ground (nm / hr)
COG: Course over ground (degrees)
SOG_ST: (standard deviation of speed over ground
COG_ST: (standard deviation of course over ground

6.3 Gyronometer

The CCGS *Amundsen's* Gyronometer provides ship heading.

ASCII files (*.dat extension) are found in the database at 1 minute resolution:

\OTHER\NAV\GYRO\GYRO _DAILY_1min

and at 1 second resolution:

\OTHER\NAV\ GYRO\GYRO _DAILY_1sec

File naming convention is as follows for 1 minute resolution:

\1min_ GYRO _2009_JDxxx_MMDD.dat

and for 1 second resolution:

\GYRO _2009_JDxxx_MMDD.dat

Where: JDxxx corresponds to the julien day, and MMDD is month and day.

File header:

(Dates and times are in UTC).
Year:
Month:
Day:
Hour:
Min: Minute
Sec: Second
Heading: heading (degrees)

6.4 Science Update Communications

The following is a transcript of an email describing the MetOcean science update email communication plan for the 2009 field season:

IORVL-MetOcean group aboard the CCGS Amundsen June – November 2009

Plan is to provide a 3 day summary report of field activities to each member on the communication list for this partnership project. IORVL may, at various intervals, request this report be upgraded to a daily report. Communications will be done via email between the ship and IORVL personnel. In case of emergency you can also contact the Ship via Iridium phone. MSAT (3): 600-700-6216, 600-700-6304, 600-700-6316

Contacts onboard will be:

Leg 1b – Klaus Hochheim hochheim@cc.umanitoba.ca
Leg 2a – Tim Papakyriakou papakyri@cc.umanitoba.ca
Leg 2b – no MetOcean activities
Leg 3a – David Barber dbarber@cc.umanitoba.ca
Leg 3b – Tim Papakyriakou papakyri@cc.umanitoba.ca
Leg 4a – Ryan Galley umgalley@cc.umanitoba.ca
Leg 4b – no MetOcean activities

Email contacts at IORVL will be:

Chris Heuer chris.e.heuer@exxonmobil.com
Dmitri Matskevitch dmitri.g.matskevitch@exxonmobil.com
Mike Curtin michael.j.curtin@esso.ca
David Fissel dfissel@aslenv.com

Report will consist of:

Daily sampling log (station ID, GPS locations, summary of sampling activities.
Daily weather log (air temps, winds, ice).

Report will be sent to all emails listed above. Report will be brief, generally 2-3 pages in length each 3 days.

3-day summary science update emails were dispatched according to the above 22 June 2009 MetOcean communication plan. All Science updates are included in this document in Appendix A. Digital copies of these science updates are also available in the database:

\OTHER\Science Updates

6.5 Science Logs

The bridge staff of the CCGS *Amundsen* kept a written log of all science activities. For each science entry in the log, date (LST and GMT), geographic position (degree, decimal-minutes, and decimal degrees), depth, and basic meteorological variables including air temperature, relative humidity, wind speed and direction, and sea ice concentration are recorded. The science logs are also available in this document in Appendix B.

These science logs are also available as digital files in the database at:

\OTHER\Science Logs

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Gunn, R., and Kinzer, G.D., 1949, The terminal velocity of fall for water droplets in stagnant air, *J. of Meteorology*, Vol . 6, pp. 243–248).

Hanesiak, j., 1998: Ice camp meterological observations. *In:* NOW’98 Sea Ice/Climate Dynamic Subgroup Field Summary. Edited by Papakryriakou, T.N., CJ. Mundy, and D.G. Barber. Centre for Earth Observation Science, Geography Department, University of Manitoba, CEOS Tech 98-8-2, pp. 21-32.

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APPENDIX A: SCIENCE UPDATES

This section contains transcripts of the science updates (sent by email) MetOcean to the IORVL Communication mailing list. To prevent the possibility of discrepancies, no edits have been made to the communications.

Science Activities Summary for July 5-10, 2009

Reporter: Klaus Hochheim
06:35Z, July 11

IOL Update University of Manitoba, CEOS

Mobilization in Victoria took longer than expected. The CCGS *Amundsen* arrived at the Coast Guard Base one Day late (July 1 early AM) due to delays as a result of heavy seas along the west coast of Mexico and the USA. Mobilization activities for the Science teams started on the morning of July 1 and ended on July 4, 12:00pm, the ship left port July 4 at ~12:45.

During leg 1b (July 4-16), the ship will be transiting to the Beaufort Sea, sampling will be restricted to in-transit activities (no station stops). Activities to date have dealt with mainly with setup. Email service resumed shipboard on July 10 after a 4 day absence; we are at the fringe of Telesat F2 satellite coverage.

Position at time of report: **65^{o}18.530N 168^{0}35.993W**

Remote Sensing Activities - (Barber Group)

1. C-band scatterometer is setup and operational for ice activities once they commence.
2. A new radiometer mount was installed July 9; radiometers (37 and 89 GHz) were setup on July 10; tested and considered operational. Data is being recorded in transit at 53^{o} incidence.
3. Photogrammetry setup - mounts installed, synchronized cameras tested, operational. Cameras will be used for 3D modelling of ice surface.

4. Ice Thickness camera tested, to be installed port side adjacent to scatterometer. Camera will be logging when sea ice is encountered.
5. Site Camera for SBR and Scatterometer operational, currently logging in transit for sea state conditions, 60 frames per hour.
6. Sea ice surveying using the ElectroMagnetic Induction (EMI) system has not commenced as of July 10. Sampling will commence once the Amundsen has reached Canadian Arctic waters (approximately July 13).

Meteorological Observations (Barber Group)

1. Manual Weather Observations – recorded every 3 hours (00:00, 03:00, 06:00 etc) UTC
   - GPS location
   - cloud fractional coverage (8/8, 7/8, etc)
   - precipitation type and amount (light, med, heavy)
   - visibility (approx 20 km, 10 km, fog etc)
   - from AVOS record temperature, wind speed and direction and sea ice percent coverage/type

2. Ceilometer is mounted and running. Continuously recording the cloud base height in feet for up to 3 levels.

3. MW Profiler is in the process of being installed. It will not be operational until we are within the Beaufort Sea where the neural network has been trained.

4. The All Sky camera is mounted but requires further attention as it is programmed to take images at intervals of 15 minutes but has currently not been recording them.

Meteorological Observations (Papakyriakou Group)

1.Underway pCO_2 System

-System went operational Jul 7, and has been sampling continuously since (with some minor interruptions for maintenance and system modification).
-Data being returned from the system seems to be of high quality. pCO_2 levels in the North Pacific basin were typically observed to be at or slightly above atmospheric levels. A sharp decrease (with minimum values below 200 ppm) was noticed immediately after ascending the shelf slope into the Bering Sea.

2.Met/Flux Tower

-Erecting the flux tower has been delayed slightly due to high seas immediately after leaving Victoria, and due to delays in getting a mounting bracket fabricated.
-We expect the tower to be operational (minus the closed path eddy covariance system) by the end of the day on July 11. Barring unforeseen delays, the goal of having the system online prior to crossing the Bering Strait will be met.

3.Radiation Array

-The radiation array was mounted on the top of the wheelhouse on July 9. The system is ready to run, but needs a power supply. The system should be operational by the end of the day on July 11.

4.Met-Ocean (3m Discus) Buoy

-Training for U of M students and technicians was conducted June 29-30.
-The AXYS system (met/wave instruments) are integrated, and ready for deployment.
-Some work remains to be done to integrate the U of M flux equipment, but this will be done while the ship is in transit to the Beaufort Sea.
-All equipment necessary for one buoy was loaded onto the CCGS *Amundsen*.
-The buoy will be ready for deployment at the beginning of Leg 2a.

5.Surface Buoys

-All equipment for both surface buoys have been loaded.
-Work is being done by U of M students/technicians to get instruments operational.
-These buoys will be ready for deployment at the beginning of Leg 2a.

Science Activities Summary for July 5-10, 2009

Reporter: Klaus Hochheim
04:00Z, July 15

IOL Update University of Manitoba, CEOS

Since the last reported location in the previous update we have continued to transit to our current location at the Ajurak block. We have been at this location for the last 21 hours bottom mapping and will depart in approximately 3 hours (July 14, 24:00 Local) to Sachs Harbour for crew change early Thursday morning. Most activities have still revolved around setup, and some limited in transit data collection listed below.

Position at time of report: **70^{o}38.250N 136^{0}05.07W**

Remote Sensing Activities - (Barber Group)

7. **C-band scatterometer** is operational for ice activities once they commence.
8. **Radiuometer** data continues to be collected on a continuous basis as we transit, sky measurements (for instrument calibration) occurs every three hours coincident with met observations. Passive microwave data during transit is being recorded at 53^{o} incidence.
9. **Photogrammetry** – Some testing the shipboard camera system has occurred during this reporting period, primarily we have been concerned about a strategy to ensure proper exposure of images in a mix sea-ice water environment and have developed a methodology to optimize sea exposures for sea ice and/or water for 3D modelling. Camera calibration has also been

completed. The photogrammetric camera has been fitted to the Helicopter, to ensure easy installation come survey time, trouble shooting complete.

10. **Ice Thickness camera** on the port side adjacent to scatterometer has been logging for the last 4 days (6 frames per minute) on a continuous basis.
11. **Site Camera** for SBR and Scatterometer operational, currently logging in transit for sea state conditions, 60 frames per hour.
12. Sea ice surveying using the **ElectroMagnetic Induction** (EMI) system has not commenced due to a combination of local ice conditions and low unfavorable flying conditions primarily related to fog and low ceilings. EMI surveys will go into full gear after the crew change and science activities gear up for leg 2a and beyond.
13. **IR transducer** still being worked on, should be up and running before crew change.

Meteorological Observations (Barber Group)

1. **Manual Weather Observations** continue to be recorded every 3 hours (00:00, 03:00, 06:00 etc) UTC

   - GPS location
   - cloud fractional coverage (8/8, 7/8, etc)
   - precipitation type and amount (light, med, heavy)
   - visibility (approx 20 km, 10 km, fog etc)
   - from AVOS record temperature, windspeed and direction and sea ice percent coverage/type

2. **Ceilometer** is mounted and running. There is a data gap due the port being set to data rather then maintenance. The ceilometer is now continuously recording the cloud base height in feet for up to 3 levels.
3. **MW Profiler** will not be operational until the liquid nitrogen plant is up and running. The liquid nitrogen is required to calibrate the instrument and without it the data will be unusable.
4. The **All Sky camera** is not running as the intervalometer is broken, a replacement one has been ordered and shall be here for July 16.

5. The **laser precipitation gauge** is mounted and running on the micro-meteorological tower at the front of the ship.

Meteorological Observations (Papakyriakou Group)

1. **Underway pCO_2 System**

-System went operational Jul 7, and has been sampling continuously since (with some minor interruptions on July 7 and 12 for maintenance and system modification).

-Data being returned from the system seems to be of high quality. pCO2 levels in the North Pacific basin were typically observed to be at or slightly above atmospheric levels. A sharp decrease (with minimum values below 200 ppm) was noticed immediately after ascending the shelf slope into the Bering Sea.

-pCO2 levels have been monitored throughout the Adjurak Block on July 14, and range from 280-340 ppm.

2. **Met/Flux Tower**

- The flux tower was mounted on July 12, and was fully operational (minus the closed path eddy covariance system) on July 13.

- The closed path system setup has been delayed due to problems with the intake pump. A spare intake pump will be used in the interim and setup should be completed on July 15.

3. **Radiation Array**

- The radiation array mounted on the top of the wheelhouse has been operational since July 14.

4. **Met-Ocean (3m Discus) Buoy**

-Equipment integration began on July 13, and will be completed on July 15.

-All equipment necessary for one buoy was loaded onto the *Amundsen*.

-The buoy will be ready for deployment at the beginning of Leg 2a.

5. Surface Buoys

-All equipment for both surface buoys have been loaded.

-Work is being done by U of M students/technicians to get instruments operational.

-These buoys will be ready for deployment at the beginning of Leg 2a.

Science Activities Summary for July 18 – 20, 2009

Reporter: Matthew Asplin & Tim Papakyriakou
12:00Z, July 20th, 2009

IOL Update University of Manitoba, CEOS

Position at time of report: 70° 45.920N 136° 01.012W

TAir: 0.8°C

RH: 98% (Fog)

Winds: 9kts @ 068° True

Summary:

Sampling activities and mooring deployments have been occurring regularly, and on a timely schedule. Our group is continuing to monitor sea ice and meteorological conditions. We are starting to see some opportunities open up for helicopter survey flights (i.e. fog lifting). The helicopter pilot has offered us some flexibility for flight times, in case of better conditions. We are encountering FY sea ice concentrations ranging from open water to 8/10ths in the Ajurak block; however the ice is not impacting our ability to perform our activities. It is interesting to note that the fog and low-stratus cloud plaguing our EMI surveys is surface-based cloud only, and is likely due to the variable sea ice concentrations keeping the air moist, cold, and saturated. A deep atmospheric inversion, characteristic of the Beaufort High, is well-established overhead, with temperatures ranging from 4° - 6°C through a layer approximately 1km thick, from an altitude of 250m to ~1300. Winds have been relatively light at all levels, indicative of a strong barotropic high. The forecast is for surface winds to start veering to southeasterlies over the next few days.

Remote Sensing Activities - (Barber Group)

14. C-band scatterometer and SBR have been put into storage until pack ice transect in leg 3A.
15. Ice Thickness camera is being deployed when transiting ice concentrations of 7/10, or greater.
16. Site Camera for SBR and Scatterometer operational, currently logging in transit for sea state conditions, 60 frames per hour.

17. The first EMI sea ice survey was conducted today (July 20th). It was discovered afterward that the video camera component of the system had malfunctioned during flight, and will be corrected for the next flight. The EMI sea ice surveys were unable to fly July 18th and 19th due to dense fog and near-surface stratus clouds. Otherwise, the system is ready to fly, and will be blown as often as the weather conditions permit.

Meteorological Observations (Barber Group)

1. Manual Weather Observations – recorded every 3 hours (00:00, 03:00, 06:00 etc) UTC
   - GPS location
   - cloud fractional coverage (8/8, 7/8, etc)
   - precipitation type and amount (light, med, heavy)
   - visibility (approx 20 km, 10 km, fog etc)
   - from AVOS record temperature, wind speed and direction and sea ice percent coverage/type

2. Ceilometer is mounted and running. Continuously recording the cloud base height in feet for up to 3 levels.
3. The temperature and water vapour microwave profiler (TP/WVP 3000A) was installed and activated on July 18th, and has been running well. We are still awaiting repair of the liquid nitrogen plant.
4. The All-sky camera's exposure rate was found to be set too high, and has been corrected to avoid 'white' sky images. The camera is operating well, and collecting data.
5. Three balloon launches have occurred in the past three days. Balloon launches are to continue regularly (once or twice per day), and will coincide with the passage of the A-train satellites (~4:30am and 2:30pm LST). The 2:30pm balloon launches cannot be done if the helicopter is in the air. 3-hourly sampling will occur if a low-pressure system is encountered.
6. Zodiac operations have permitted us to deploy a small meteorological-surface roughness buoy for the first time this leg. The data collected is limited to the time the zodiac is in the water, but we will continue to deploy it as opportunities arise.

Meteorological Observations (Papakyriakou Group)

1. Underway pCO2 System

-pCO2 system has continued to operate adequately. We have noticed some recent decreases in flow volume through the system and are working on fixing the issue.

2. Met/Flux Tower

-The flux tower is now fully operational, minus a surface temperature sensor (IR transducer).
-On July 16, the wind monitor was replaced because the previous one was not properly outputting wind direction. The instrument was operational before leaving Sachs Harbour for the IOL study area.
-The closed path eddy covariance system went operational on July 17, and seems to be operating properly.

3. Radiation Array

-The radiation array is continuing to run normally

Met-Ocean (3m Discus) Buoy

-The AXYS 3m buoy is nearly ready for deployment. The only remaining issue is an instrument within the U of M flux system that is not operating properly. Troubleshooting will take place on July 18th, and a spare instrument is available if we are unsuccessful.

4. Surface Buoys

-Surface buoys are nearly ready for deployment. We are currently working on configuring the conductivity/temperature sensors.

Science Activities Summary for July 21 – 23, 2009

Reporters: Matthew Asplin & Tim Papakyriakou
12:00Z, July 23rd, 2009

IORVL Update University of Manitoba, Centre for Earth Observation Science

Position at time of report: 71° 00.128N 135° 28.82W

TAir: 3.0°C

RH: 90% (Clear)

Winds: 11kts @ 045° True

Summary:

Sampling activities and mooring deployments have been occurring as per the plan. The visibility conditions have vastly improved as of today (July 23rd), and presented us with an opportunity for a helicopter EMI survey flight. Sea ice concentration remains high. The forecast is for surface winds to remain light for the next three days.

Remote Sensing Activities - (Barber Group)

18. Ice Thickness camera is being deployed when transiting ice concentrations of 7/10, or greater.
19. Site Camera for SBR and Scatterometer operational, currently logging in transit for sea state conditions, 60 frames per hour, and has been backed up.
20. The EMI sea ice surveys were unable to fly July 21st and 22nd due to dense fog and near-surface stratus clouds. The weather improved on July 23rd, and permitted a survey to be flown. Six sites were surveyed near Station #20, and were followed up with a survey of ice roughness.

Meteorological Observations (Barber Group)

7. Manual Weather Observations – recorded every 3 hours (00:00, 03:00, 06:00 etc) UTC
   - GPS location
   - cloud fractional coverage (8/8, 7/8, etc)
   - precipitation type and amount (light, med, heavy, or fog)
   - visibility
   - from AVOS record temperature, wind speed and direction
   - Sea ice percent coverage

8. The Vasaila CT25K Ceilometer is functional, and operating well.
9. The temperature and water vapour microwave profiler (TP/WVP 3000A) continues to run well. We are still awaiting repair of the liquid nitrogen plant so that we can calibrate the 51 to 59 GHz channels, and are hopeful that this can be accomplished during leg 2A.
10. The all-sky camera is recording pictures of the sky at 15-minute intervals.

11. The radiosonde system was down for the day on July 22nd, but has been repaired. Balloon launches will continue to coincide with the passage of the A-train satellites (~4:30am and 2:30pm LST). The 2:30pm balloon launches cannot be done if the helicopter is in the air. 3-hourly sampling will occur if a low-pressure system is encountered.
12. Zodiac operations continue to permit us to deploy a small meteorological-surface roughness buoy for short periods of time.
13. The laser precipitation gauge is fully operational.

Meteorological Observations (Papakyriakou Group)

1. Underway pCO2 System

-pCO2 system continues to operate well.

2. Met/Flux Tower

-All met, flux and radiation sensors are working.

3. Met-Ocean (3m Discus) Buoy

-Deployment is delayed because of the high sea ice concentration.

4. Surface Buoys

-Deployment is delayed because of the high sea ice concentration.

Science Activities Summary for July 24 – 26, 2009

Reporters: Matthew Asplin & Tim Papakyriakou
0210Z, July 27th, 2009

IORVL Update University of Manitoba, Centre for Earth Observation Science

Position at time of report: 70° 31.804N 135° 43.511W

TAir: 6.1°C

RH: 86% (Clear)

Winds: 17kts @ 094° True

Summary:

Visibility over this period has been excellent. We are encountering high concentration of multi-year and conglomerate sea ice. Moderate easterly winds have picked up, and are expected to move ice westward; however, it will probably not significantly change the ice concentrations in the Ajurak block before the end of Leg 2A.

Remote Sensing Activities - (Barber Group)

21. C-band scatterometer and the ship-based radiometers have been put into storage until the pack ice transect in leg 3A.
22. Ice Thickness camera is being deployed when transiting ice concentrations of 7/10, or greater. The ship was forced to break through some significantly large ice floes on July 26th, and the ice thickness camera was running during these operations.
23. Site Camera for SBR and Scatterometer operational, currently logging in transit for sea state conditions, 60 frames per hour, and has been backed up.
24. Weather has permitted helicopter-based EMI surveys. Details appear below. The synoptic-scale outlook for weather indicates that flights should continue over the next several days, barring fog.

EMI Sea Ice Surveys

<u>EMI SAMPLING – JULY 24, 2009</u>

Start Time – approximately 4:20 pm, End time – approximately 5:00 pm
(short flight due to increased fog conditions)

Two floes sampled around Mooring Station F09, with a total of 12 separate sampling transects.

(note: location, ice roughness and thickness values are quick approximations based on the data collected).

Photos along each transect were taken during surveying. These photos will be used to characterize the ice conditions along each transect during the post-processing phase.

Floe 1-F09 – eight separate transects sampled at this floe

Transect #	Start Location	End Location	Mean Ice Thickness (m)	Mean Ice Roughness (m)
1	70.939 N 136.465 W	70.94 N 136.42 W	2.171	**0.083**
2	70.939 N 136.415 W	70.938 N 136.47 W	1.730	**0.249**
3	70.936 N 136.47 W	70.937 N 136.415 W	1.864	**0.281**
4	70.935 N 136.415 W	70.934 N 136.47 W	2.168	**0.339**
5	70.933 N 136.465 W	70.934 N 136.415 W	3.032	**12.745**
6	70.931 N 136.475 W	70.932 N 136.425 W	2.111	**1.066**
7	70.931 N 136.43 W	70.929 N 136.465 W	2.084	**0.321**
8	**70.929 N 136.43 W**	**70.927 N 136.47 W**	**2.032**	**0.420**

Below is an output showing the transect lines for floe 1-F09, as well as the ice thickness.

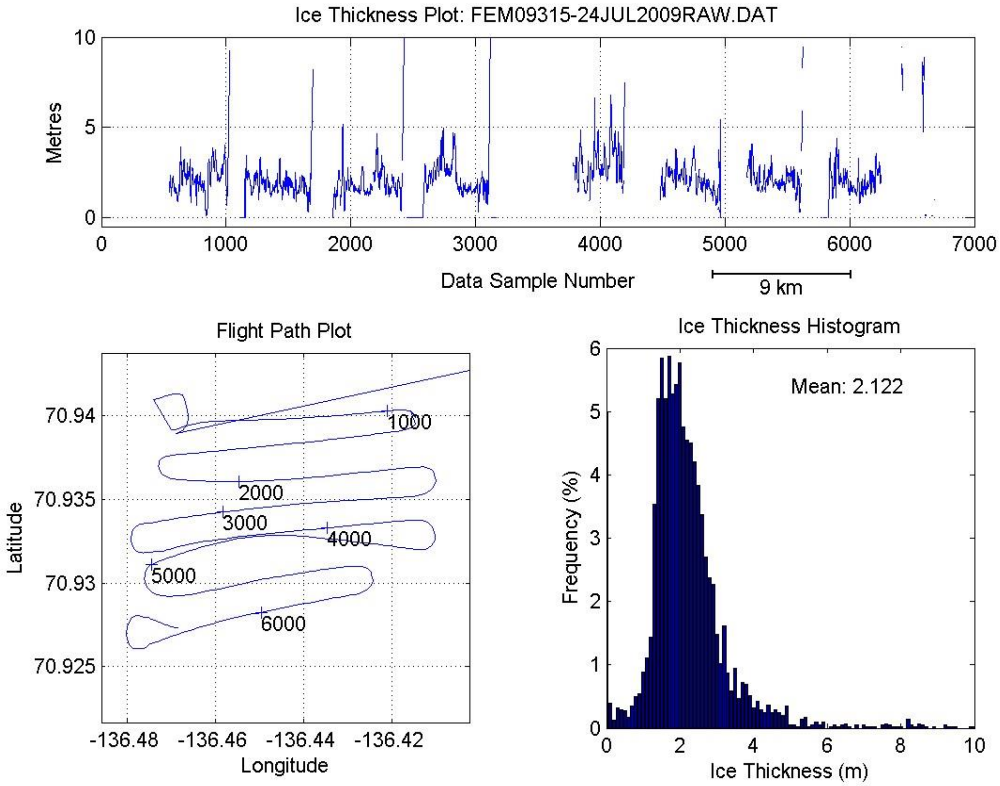
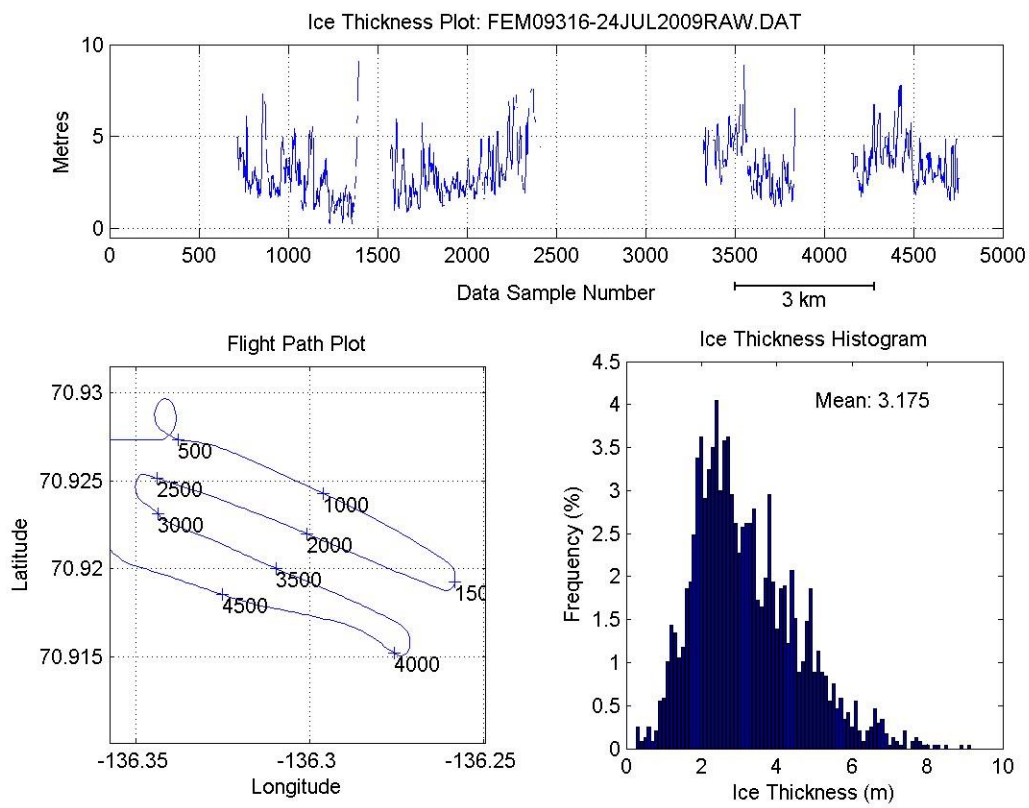

Ice Thickness Plot: FEM09315-24JUL2009RAW.DAT
Metres
Data Sample Number
9 km
Flight Path Plot
Latitude
Longitude
1000
2000
3000
4000
5000
6000
Ice Thickness Histogram
Mean: 2.122
Frequency (%)
Ice Thickness (m)

Photo of Site 1-F09:

Floe 2-F09 – four separate transects sampled at this floe

Transect #	Start Location	End Location	Mean Ice Thickness (m)	Mean Ice Roughness (m)
1	70.926 N 136.32 W	70.920 N 136.26 W	2.719	**0.267**
2	70.918 N 136.27 W	70.924 N 136.34 W	2.956	**0.638**
3	70.922 N 136.34 W	70.917 N 136.27 W	3.525	**0.571**
4	**70.917 N 136.28 W**	**70.92 N 136.35 W**	**3.680**	**0.354**

Below is an output showing the transect lines for floe 2-F09, as well as the ice thickness.



Meteorological Observations (Barber Group)

14. Manual Weather Observations – recorded every 3 hours (00:00, 03:00, 06:00 etc) UTC
    - GPS location
    - cloud fractional coverage (8/8, 7/8, etc)

- precipitation type and amount (light, med, heavy, or fog)
- visibility
- from AVOS record temperature, wind speed and direction
- Sea ice percent coverage

15. The Vasaila CT25K Ceilometer is functional, and operating well.
16. The temperature and water vapour microwave profiler (TP/WVP 3000A) continues to run well. We are still awaiting repair of the liquid nitrogen plant so that we can calibrate the 51 to 59 GHz channels, and are hopeful that this can be accomplished before July 30th.
17. The all-sky camera is recording pictures of the sky at 15-minute intervals.
18. The radiosonde system was down for the day on July 22nd, but has been repaired. Balloon launches will continue to coincide with the passage of the A-train satellites (~4:30am and 2:30pm LST). The 2:30pm balloon launches cannot be done if the helicopter is inthe air. 3-hourly sampling will occur if a low-pressure system is encountered. A strong temperature inversion was detected on July 26th, with surface temperature around 5 – 6C, and temperatures at ~1000m at >=15C. This is consistent with warm air advection aloft, building a ridge of high pressure over the region.
19. Zodiac operations continue to permit us to deploy a small meteorological-surface roughness buoy for short periods of time, however, we do not anticipate any more zodiac time on this leg for this operation.
20. The laser precipitation gauge is fully operational.

Meteorological Observations (Papakyriakou Group)

Underway pCO2 System

It continues to operate well, continuously recording along the ship track: surface water pCO2, temperature, salinity, O_2, pH.

Met/Flux Tower

It continues to operate well, continuously recording air temperature, humidity, barometric pressure, wind speed and direction, precipitation, and variables necessary to compute surface shearing stress, and the air-surface flux of sensible heat, latent heat and CO_2.

Radiation Array

Our UV sensor has malfunctioned. Currently we are recording incident solar radiation, long-wave radiation and photosynthetically active radiation.

Met-Ocean (3m Discus) Buoy

The buoy will not see deployment in 2a given the high concentration of ice. We prepared the buoy for storage until leg 3b. All sensors were functioning at the time of decommissioning.

Surface Buoys

Sensors have been prepared, but as is the case with the 3 m buoy, this installation will not be deployed until 3b.

Science Activities Summary for July 27 – 29, 2009

Reporters: Matthew Asplin & Tim Papakyriakou

0210Z, July 27th, 2009

IORVL Update University of Manitoba, Centre for Earth Observation Science

Position at time of report: 70° 31.804N 135° 43.511W

TAir: 6.1°C

RH: 86% (Clear)

Winds: 17kts @ 094° True

Summary:

Visibility has been excellent. Ice concentration continues to be heavy, largely multi-year and conglomerate. Winds have been moderate and easterly.

Remote Sensing Activities - (Barber Group)

25. C-band scatterometer and the ship-based radiometers have been put into storage until the pack ice transect in leg 3A.
26. Ice Thickness camera is being deployed when transiting ice concentrations of 7/10, or greater. The ship was forced to break through some significantly large ice floes on July 26th.
27. Site Camera for SBR and Scatterometer operational, currently logging in transit for sea state conditions, 60 frames per hour, and has been backed up.
28. Weather has allowed for EMI surveys.

Ice Motion Beacons

Three ice motion beacons were deployed on July 29, 2009 on the sea ice northwest of the AJURAK block.

Location of ice beacon deployment.

Beacon ID	Deployment Location
282100	71º 46.205'N, 134 º 37.077'W
282060	71 º 32.954'N, 133 º 55.681'W
282070	71 º 34.449'N, 133 º 16.870'W

EMI Sea Ice Surveys

Details follow.

Preliminary results are provided below.

Summary of EMI Transect Surveys for Leg 2A.

Station ID	Date	Number of Sites	Number of Transects
20	July 23, 2009	20	37
Mooring Site F09	July 24, 2009	2	12
07	July 25, 2009	9	53
Hydrophones	July 26, 2009	13	78
12	July 27, 2009	24	68
5	July 28, 2009	7	40
Beacon deployment	July 29, 2009	5	8 (long)

EMI SAMPLING – JULY 26, 2009

One survey was conducted in the morning: Start Time – 11:22 am local time (17:22 UTC), End Time – 4:05 pm local time (23:05 UTC)

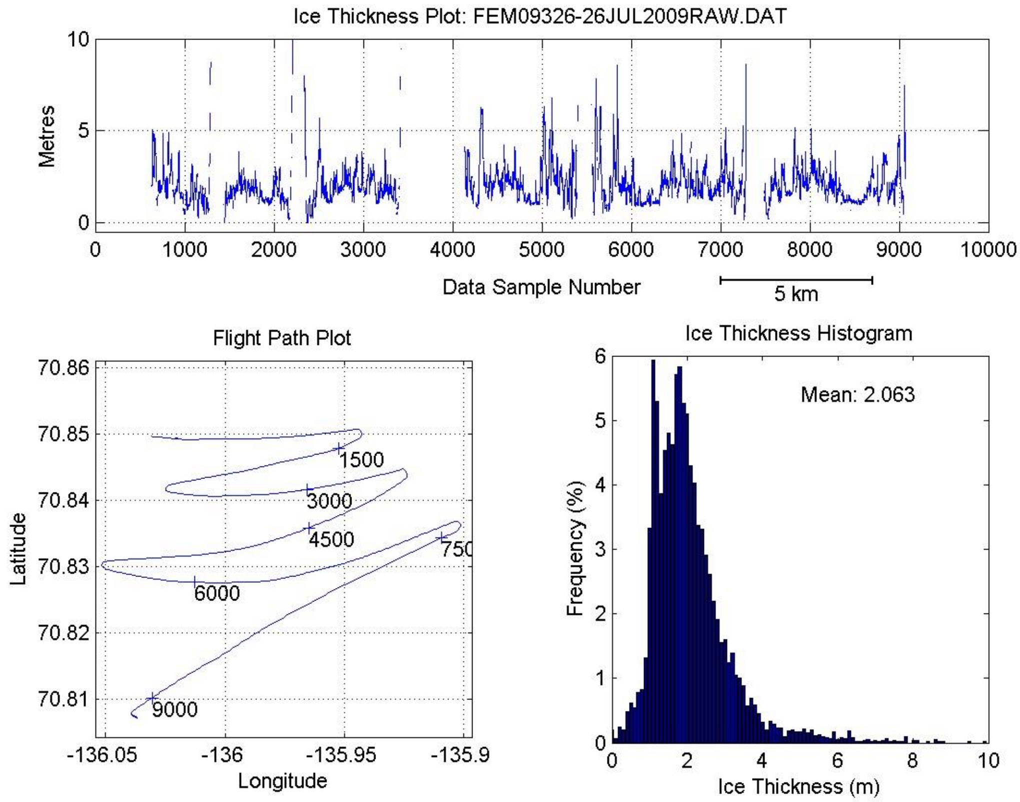
In the morning, thirteen floes sampled around the deployment of the hydrophones, with a total of 78 separate sampling transects. A seal was spotted in the water at 70°34.8' N and 135°37.9'W

Photos along each transect were taken during surveying, except for the thirteenth floe (malfunction with camera). These photos will be used to characterize the ice conditions along each transect.

Floe 1-HP – six separate transects were sampled at this floe.

Transect #	Start Location	End Location	Mean Ice Thickness (m)
1	70.85 N 136.00 W	70.85 N 135.95 W	**1.919**
2	70.85 N 135.95 W	70.84 N 136.02 W	**1.653**
3	70.84 N 136.02 W	70.84 N 135.93 W	**1.981**
4	70.84 N 135.94 W	70.83 N 136.03 W	**2.346**
5	70.83 N 136.05 W	70.835 N 135.90 W	**2.107**
6	**70.835 N 135.91 W**	**70.81 N 136.03 W**	**2.003**

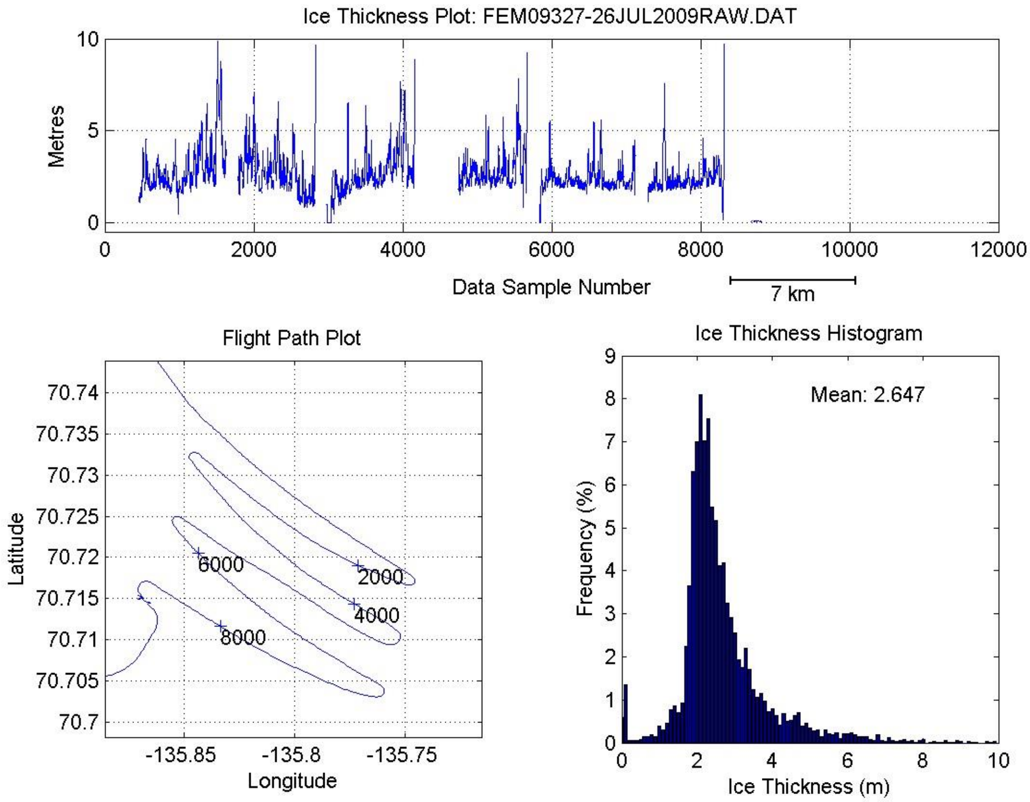
Floe 1-HP Output.



Floe 2-HP – Six separate transects sampled at this floe.

Transect #	Start Location	End Location	Mean Ice Thickness (m)
1	70.734 N 135.83 W	70.717 N 135.75 W	**2.986**
2	70.717 N 135.75 W	70.732 N 135.84 W	**2.766**
3	70.731 N 135.84 W	70.715 N 135.77 W	**2.625**
4	70.712 N 135.77 W	70.724 N 135.84 W	**2.853**
5	70.724 N 135.85 W	70.705 N 135.77 W	**2.348**
6	**70.704 N 135.77 W**	**70.716 N 135.86 W**	**2.381**

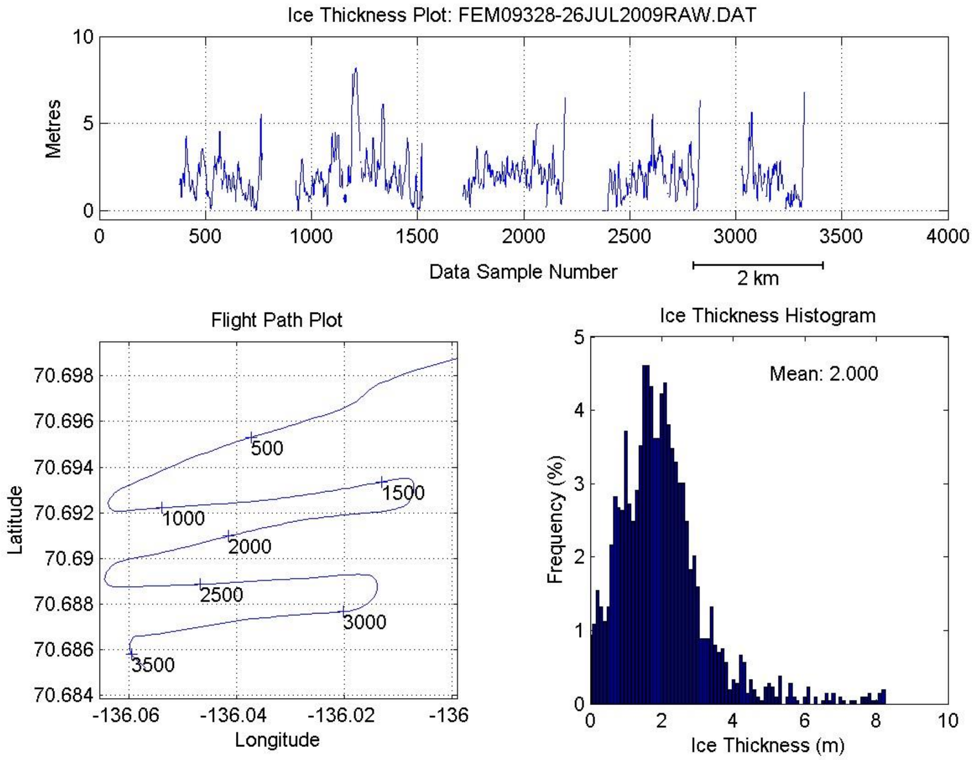
Floe 2-HP Output.



Floe 3-HP – Five separate transects were sampled at this floe.

Transect #	Start Location	End Location	Mean Ice Thickness (m)
1	70.696 N 136.028 W	70.693 N 136.06 W	**1.715**
2	70.692 N 136.055 W	70.693 N 136.01 W	**2.437**
3	70.692 N 136.015 W	70.69 N 136.055 W	**2.224**
4	70.689 N 136.055 W	70.689 N 136.02 W	**1.923**
5	**70.687 N 136.025 W**	**70.687 N 136.05 W**	**1.713**

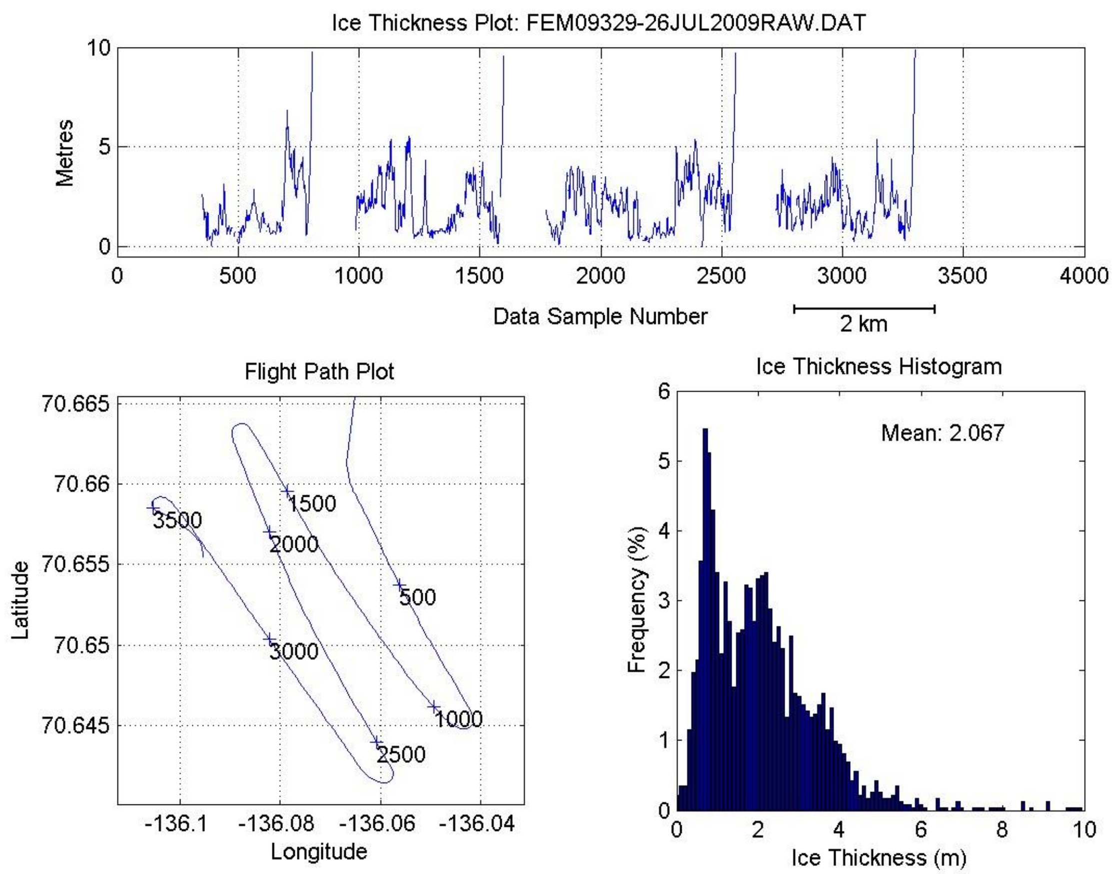
Floe 3 -HP Output.



Floe 4-HP – Four separate transects were sampled at this floe.

Transect #	Start Location	End Location	Mean Ice Thickness (m)
1	70.656 N 136.06 W	70.647 N 136.043 W	**1.975**
2	70.646 N 136.05 W	70.661 N 136.08 W	**2.057**
3	70.662 N 136.09 W	70.644 N 136.06 W	**2.064**
4	**70.644 N 136.067 W**	**70.657 N 136.095 W**	**1.998**

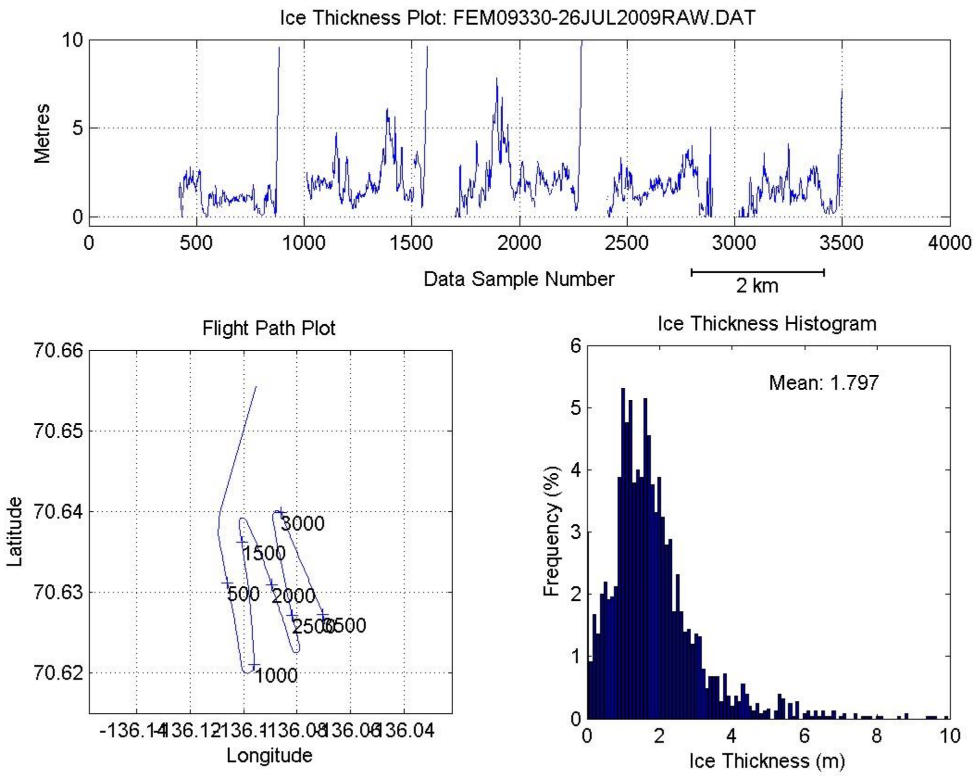
Floe 4 -HP Output.



Floe 5-HP – five separate transects sampled at this floe.

Transect #	Start Location	End Location	Mean Ice Thickness (m)
1	70.632 N 136.105 W	70.621 N 136.10 W	**1.128**
2	70.621 N 136.095 W	70.636 N 136.10 W	**2.084**
3	70.639 N 136.095 W	70.624 N 136.085 W	**2.195**
4	70.626 N 136.08 W	70.638 N 136.09 N	**1.824**
5	**70.64 N 136.085 W**	**70.628 N 136.07 W**	**1.424**

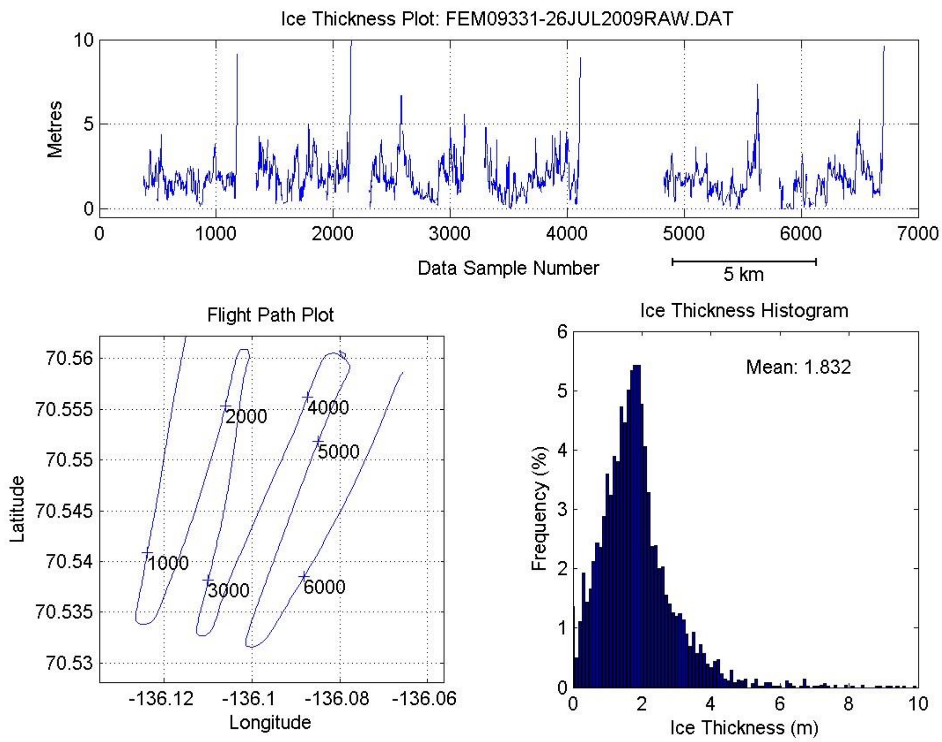
Floe 5 -HP Output.



Floe 6-HP – six separate transects sampled at this floe.

Transect #	Start Location	End Location	Mean Ice Thickness (m)
1	70.559 N 136.12 W	70.537 N 136.13 W	**1.654**
2	70.537 N 136.12 W	70.559 N 136.11 W	**1.980**
3	70.56 N 136.10 W	70.535 N 136.11 W	**1.944**
4	70.535 N 136.11 W	70.56 N 136.08 W	**1.726**
5	70.556 N 136.07 W	70.533 N 136.10 W	**1.728**
6	**70.533 N 136.10 W**	**70.558 N 136.07 W**	**1.618**

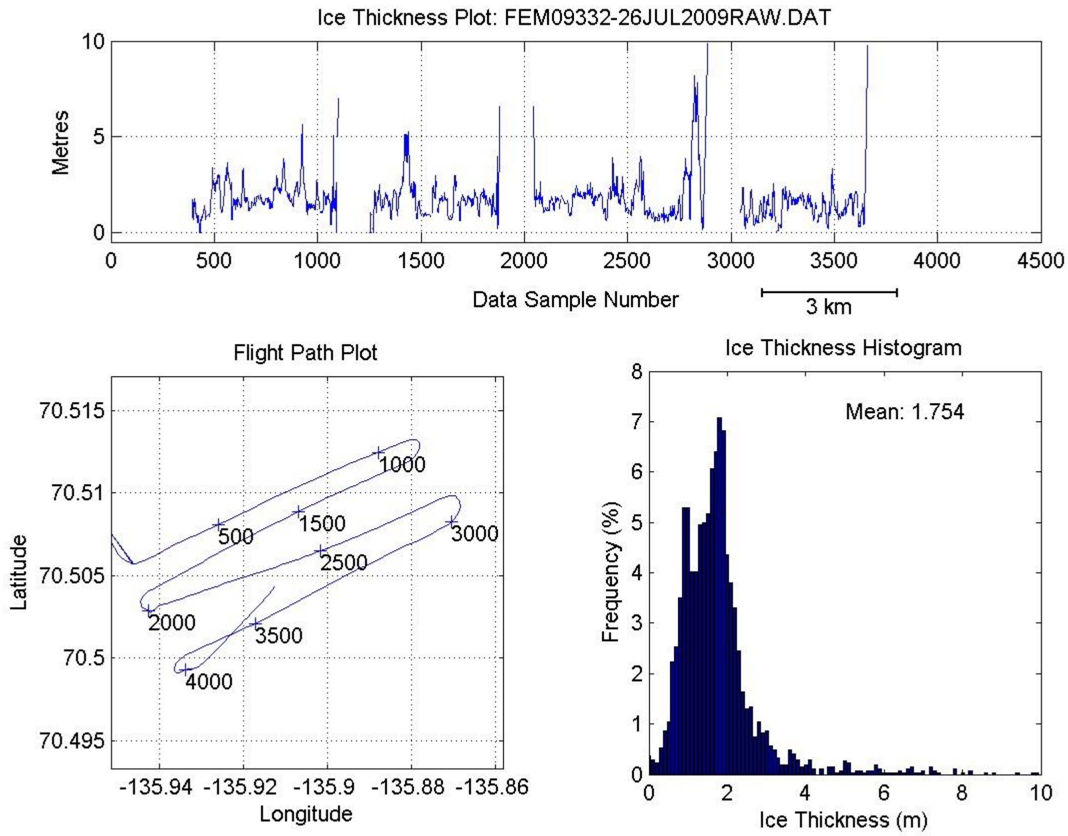
Floe 6-HP – Output



Floe 7-HP – four separate transects sampled at this floe.

Transect #	Start Location	End Location	Mean Ice Thickness (m)
1	70.507 N 135.93 W	70.513 N 135.88 W	**1.830**
2	70.512 N 135.89 W	70.505 N 135.94 W	**1.759**
3	70.503 N 135.94 W	70.51 N 135.87 W	**1.863**
4	**70.507 N 135.88 W**	**70.501 N 135.93 W**	**1.339**

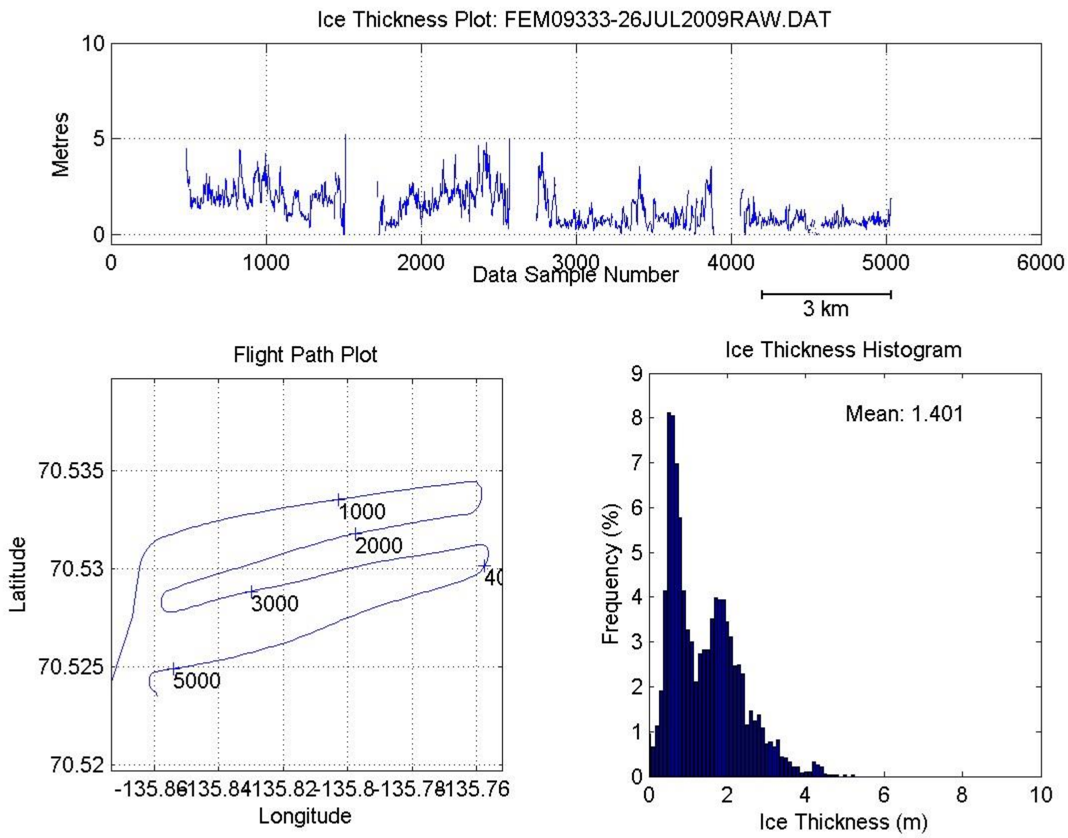
Floe 7-HP Output.



Floe 8-HP – Four separate transects sampled at this floe .

Transect #	Start Location	End Location	Mean Ice Thickness (m)
1	70.532 N 135.84 W	70.534 N 135.76 W	**1.979**
2	70.532 N 135.78 W	70.529 N 135.85 W	**1.928**
3	70.528 N 135.85 W	70.531 N 135.77 W	**0.879**
4	**70.529 N 135.77 W**	**70.525 N 135.85 W**	**0.709**

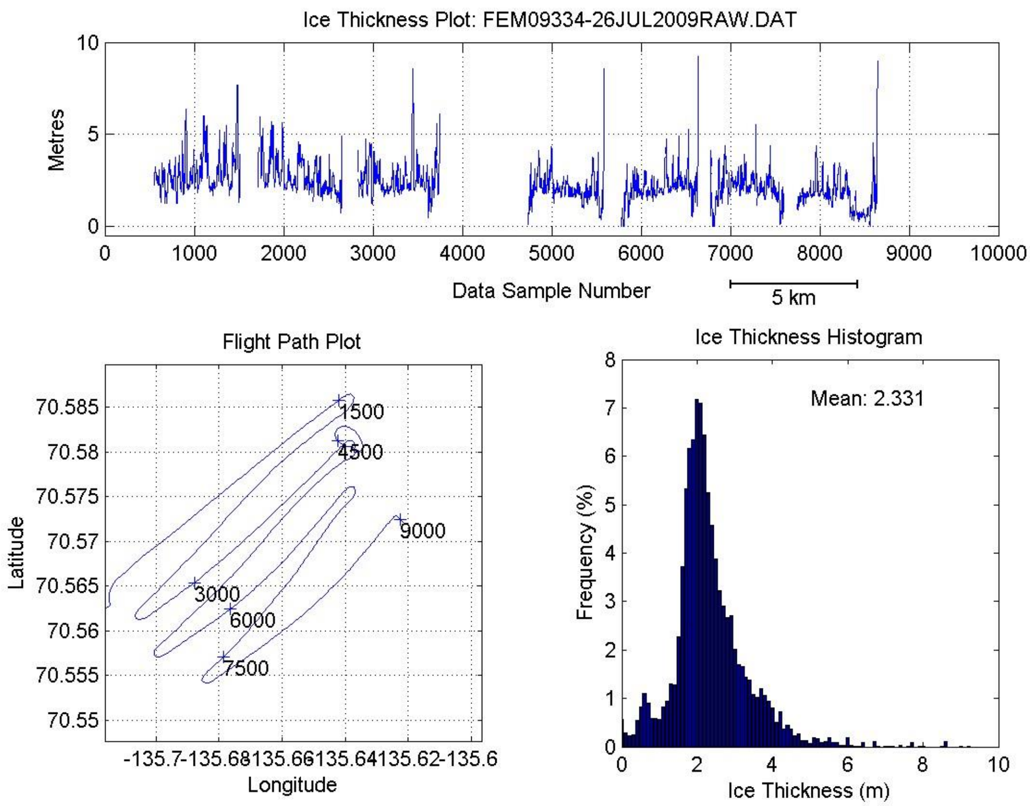
Floe 8-HP Output.



Floe 9-HP – Seven separate transects sampled at this floe

Transect #	Start Location	End Location	Mean Ice Thickness (m)
1	70.57 N 135.7 W	70.584 N 135.65 W	**2.827**
2	70.565 N 135.7 W	70.585 N 135.64 W	**2.774**
3	70.564 N 135.695 W	70.58 N 135.645 W	**2.572**
4	70.577 N 135.65 W	70.56 N 135.695 W	**2.145**
5	70.574 N 135.64 W	70.555 N 135.685 W	**2.078**
6	70.559 N 135.69 W	70.575 N 135.64 W	**2.107**
7	**70.555 N 135.68 W**	**70.571 N 135.63 W**	**1.628**

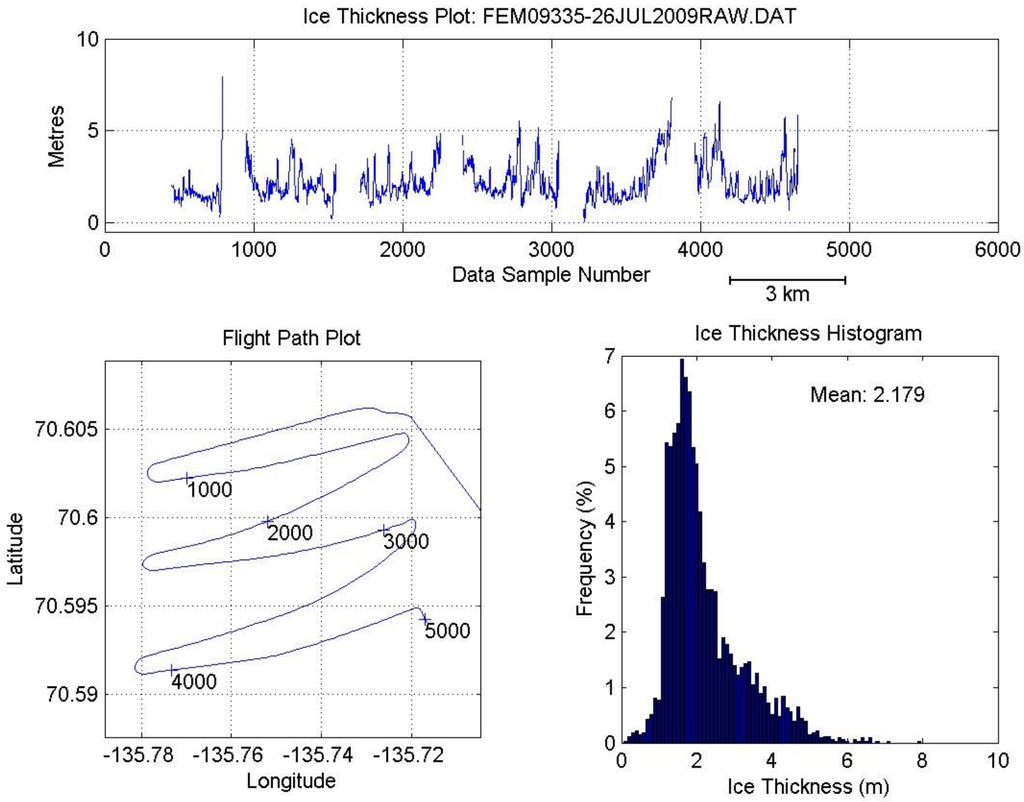
Floe 9-HP Output.



Floe 10-HP – six separate transects sampled at this floe

Transect #	Start Location	End Location	Mean Ice Thickness (m)
1	70.605 N 135.744 W	70.604 N 135.770 W	**1.502**
2	70.602 N 135.77 N	70.604 N 135.73 W	**2.021**
3	70.602 N 135.73 W	70.598 N 135.775 W	**2.101**
4	70.597 N 135.775 W	70.599 N 135.725 W	**2.362**
5	70.599 N 135.72 W	70.592 N 135.78 W	**2.229**
6	**70.591 N 135.775 W**	**70.594 N 135.725 W**	**2.370**

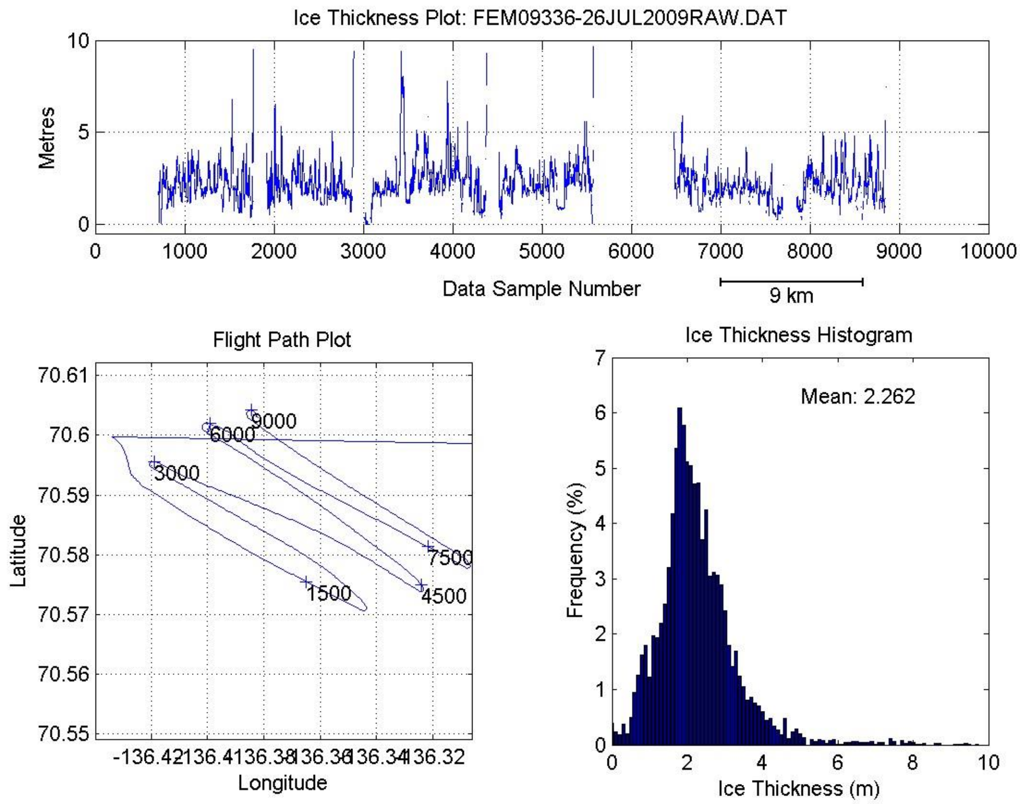
Floe 10-HP Output.



Floe 11-HP – Six separate transects were sampled at this floe.

Transect #	Start Location	End Location	Mean Ice Thickness (m)
1	70.587 N 136.41 W	70.57 N 136.35 W	**2.268**
2	70.57 N 136.35 W	70592 N 136.41 W	**2.203**
3	70.595 N 136.42 W	70.575 N 136.33 W	**2.525**
4	70.575 N 136.33 W	70.598 N 136.39 W	**2.301**
5	70.597 N 136.39 W	70.58 N 136.32 W	**2.064**
6	**70.58 N 136.31 W**	**70.60 N 136.38 W**	**2.317**

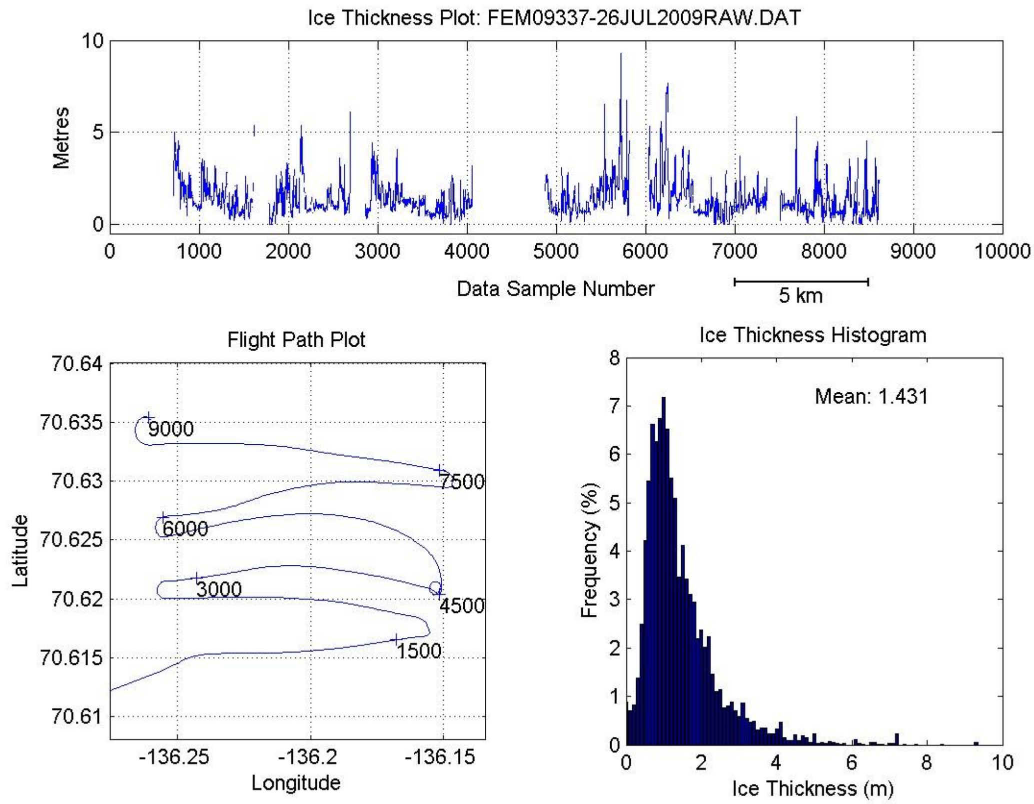
Floe 11-HP Output.



Floe 12-HP – six separate transects sampled at this floe

Transect #	Start Location	End Location	Mean Ice Thickness (m)
1	70.615 N 136.22 W	70.617 N 136.16 W	**1.432**
2	70.618 N 136.16 W	70.62 N 136.26 W	**1.387**
3	70.622 N 136.25 W	70.622 N 136.16 W	**1.262**
4	70.625 N 136.17 W	70.625 N 136.25 W	**1.642**
5	70.627 N 136.26 W	70.63 N 136.15 W	**1.538**
6	**70.632 N 136.16 W**	**70.633 N 136.26 W**	**1.205**

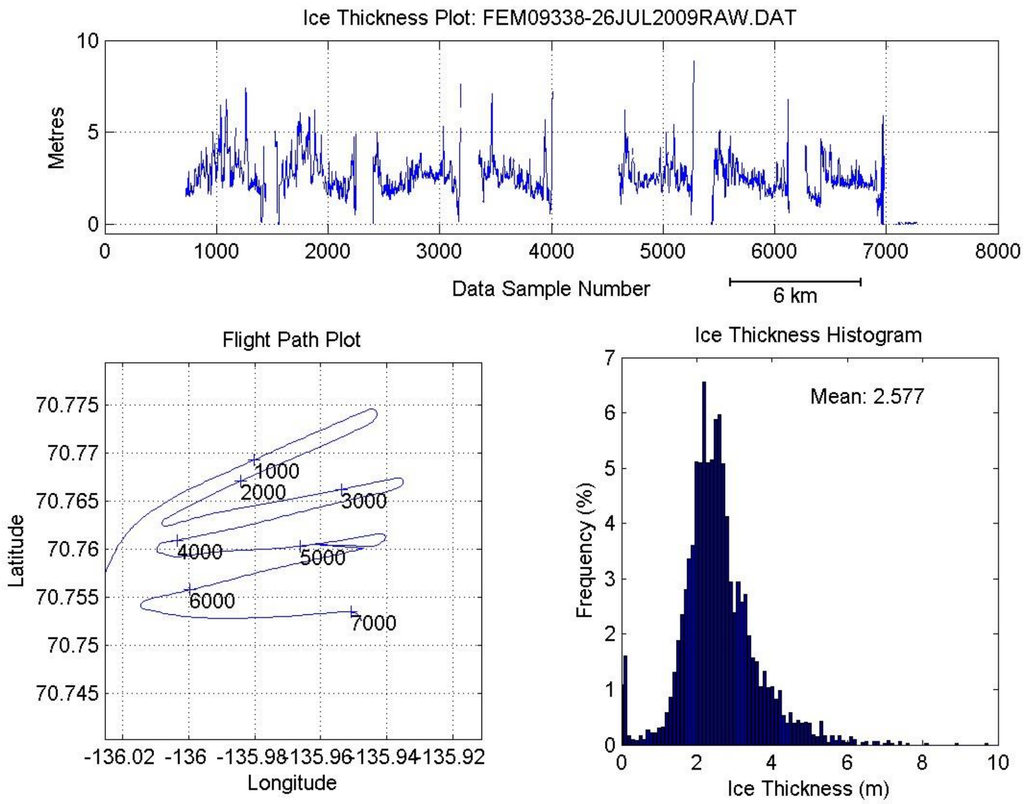
Floe 12-HP Output.



Floe 13-HP – Seven separate transects sampled at this floe.

Transect #	Start Location	End Location	Mean Ice Thickness (m)
1	70.766 N 136.00 W	70.774 N 135.95 W	**2.954**
2	70.773 N 135.95 W	70.765 N 136.00 W	**2.928**
3	70.763 N 136.00 W	70.766 N 135.945 W	**2.581**
4	70.765 N 135.95 W	70.761 N 136.005 W	**2.526**
5	70.759 N 136.00 W	70.761 N 135.95 N	**2.727**
6	70.76 N 135.95 W	70.755 N 136.01 W	**2.508**
7	**70.754 N 136.01 W**	**70.754 N 135.96 W**	**2.353**

Floe 13HP Output.



EMI SAMPLING – JULY 27, 2009

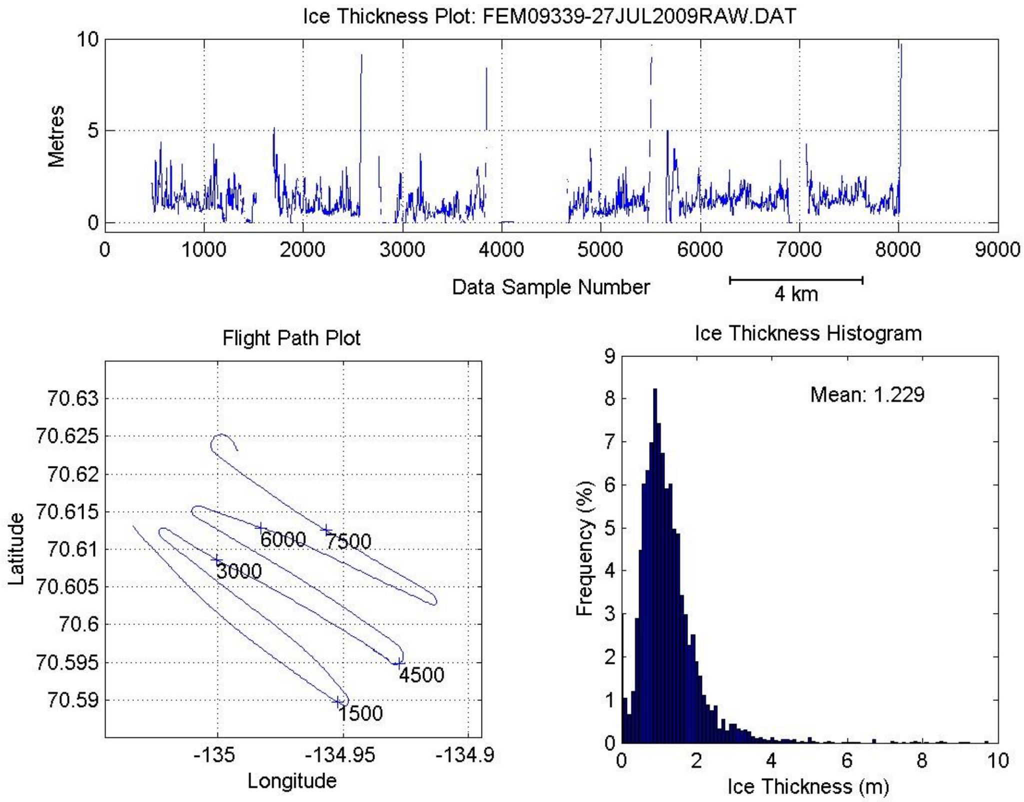
Two surveys conducted, one in the morning and the other (shorter) in the afternoon
Morning flight: Start Time – 8:57 am local time (14:57 UTC), End Time – 11:02 am local time (17:02 UTC)
Afternoon flight: Start Time – 4:00 pm local time (22:00 UTC), End Time – 5:09 pm local time (23:09 UTC)

In the morning, seven floes sampled around Station 12, with a total of 41 separate sampling transects. A polar bear was seen at approximately 70º42.0'N, 134º53.9'W

Photos along each transect were taken during surveying. These photos will be used to characterize the ice conditions along each transect.
Floe 1-12 – Six separate transects sampled at this floe .

Transect #	Start Location	End Location	Mean Ice Thickness (m)
1	70.608 N 135.02 W	70.59 N 134.95 W	**1.303**
2	10.592 N 134.94 W	70.61 N 135.02 W	**1.115**
3	70.61 N 135.01 W	70.597 N 134.94 W	**0.893**
4	70.598 N 134.93 W	70.613 N 135.00 W	**1.038**
5	70.615 N 135.01 W	70.603 N 134.92 W	**1.363**
6	**70.605 N 134.92 W**	**70.622 N 135.00 W**	**1.274**

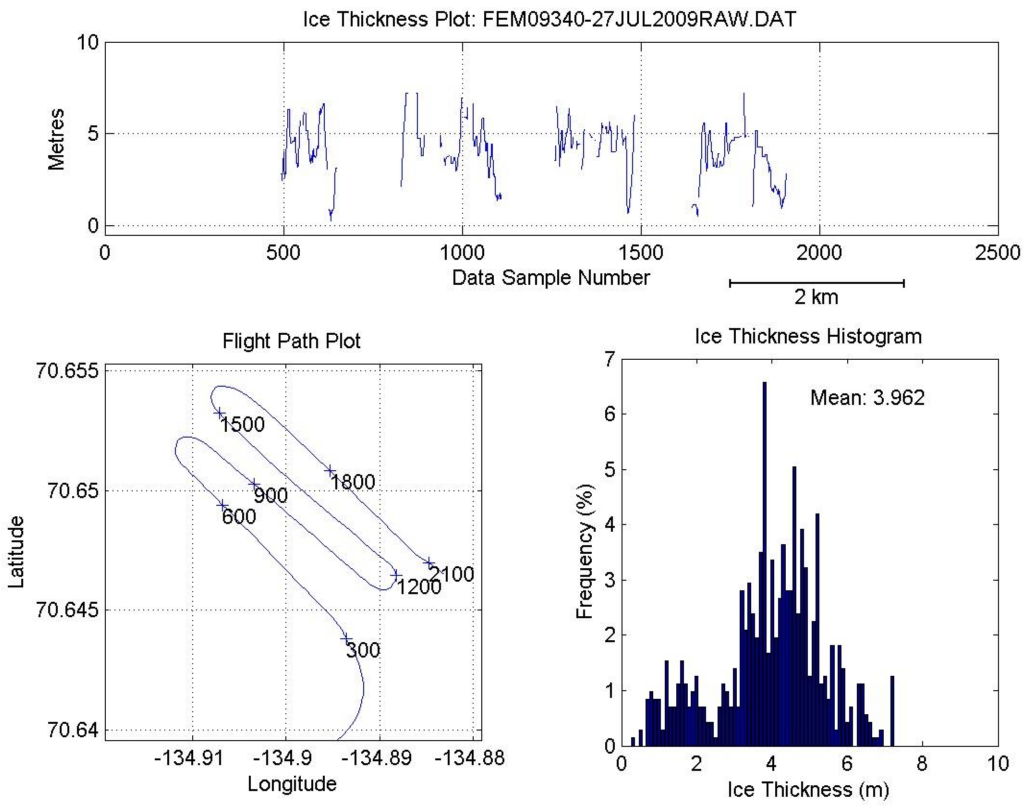
Floe 1-12 Output.



Floe 2-12 – Four separate transects sampled at this floe.

Transect #	Start Location	End Location	Mean Ice Thickness (m)
1	70.651 N 134.91 W	70.647 N 134.9 W	**4.094**
2	70.647 N 134.893 W	70.651 N 134.905 W	**4.183**
3	70.648 N 134.891 W	70.653 N 134.906 W	**4.321**
4	**70.654 N 134.903 W**	**70.649 N 134.89 W**	**3.565**

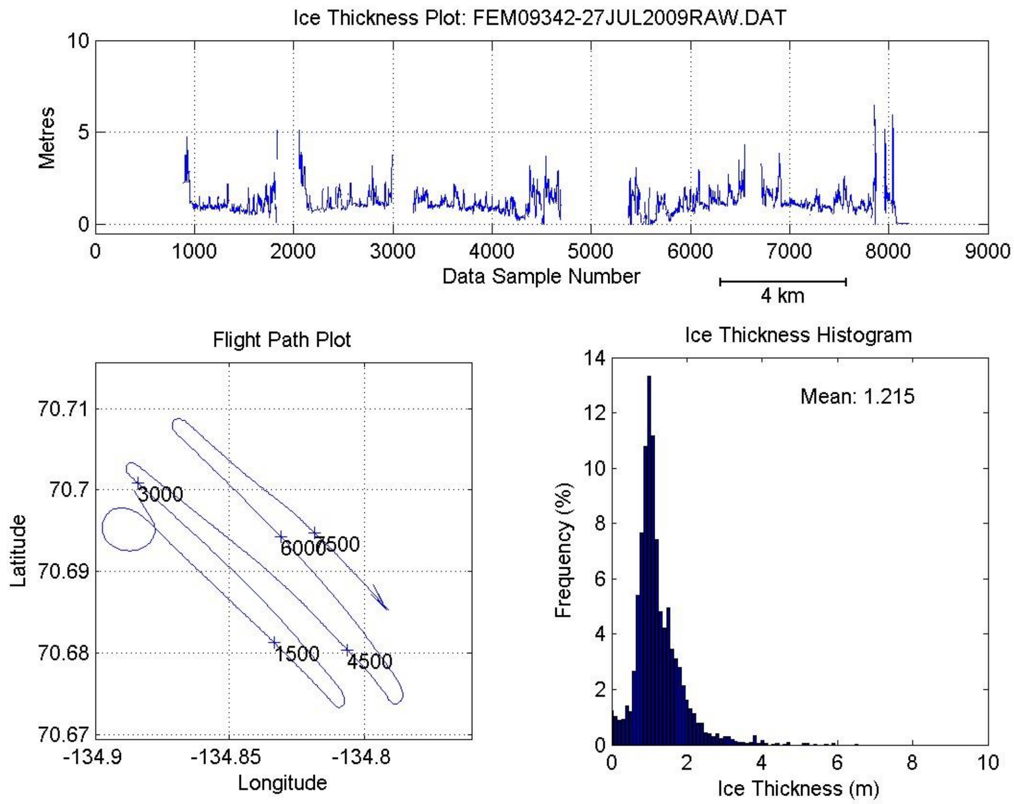
Floe 2-12 Output.



Floe 3-12 – six separate transects sampled at this floe.

Transect #	Start Location	End Location	Mean Ice Thickness (m)
1	70.677 N 134.83 W	70.695 N 134.89 W	**1.451**
2	70.693 N 134.87 W	70.675 N 134.81 W	**1.176**
3	70.678 N 134.81 W	70.702 N 134.89 W	**1.296**
4	70.703 N 134.89 W	70.678 N 134.86 W	**1.122**
5	70.68 N 134.79 W	70.707 N 134.87 W	**1.181**
6	**70.707 N 134.86 W**	**70.687 N 134.79 W**	**1.183**

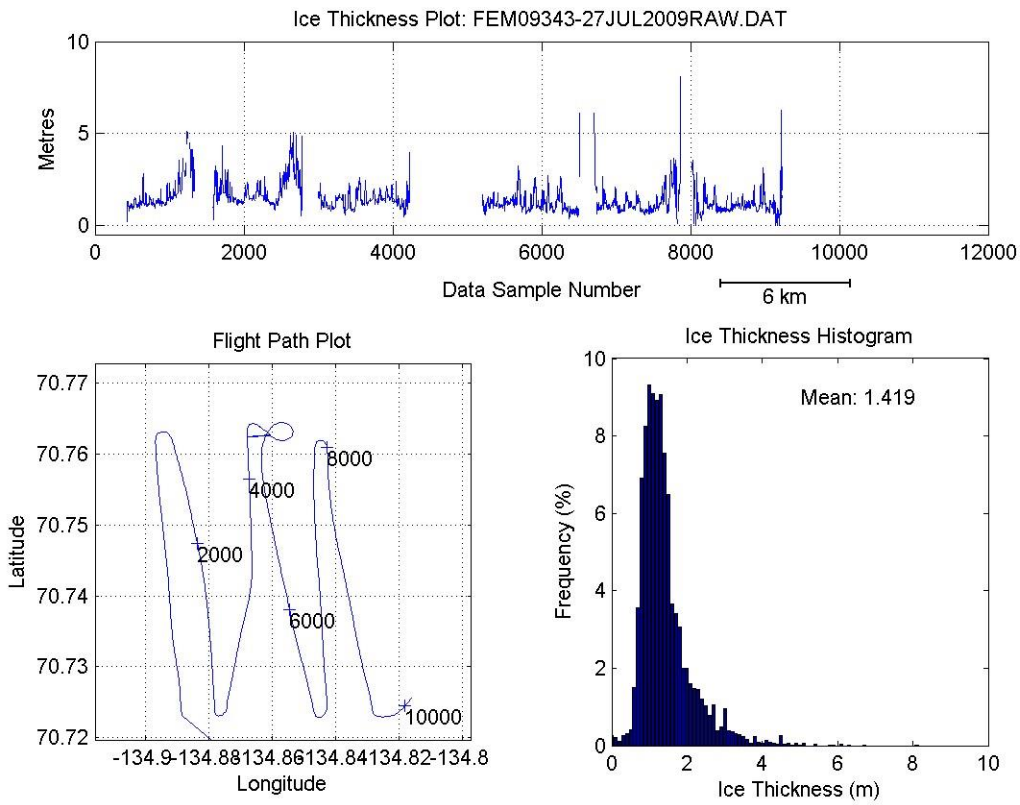
Floe 3-12 Output.



Floe 4-12 – Six separate transects sampled at this floe.

Transect #	Start Location	End Location	Mean Ice Thickness (m)
1	70.733 N 134.89 W	70.762 N 134.89 W	**1.561**
2	70.76 N 134.89 W	70.724 N 134.88 W	**1.957**
3	70.726 N 134.87 W	70.763 N 134.87 W	**1.371**
4	70.762 N 134.86 W	70.724 N 134.85 W	**1.207**
5	70.73 N 134.84 W	70.76 N 134.84 W	**1.240**
6	**70.76 N** **134.84 W**	**70.726 N** **134.83 W**	**1.110**

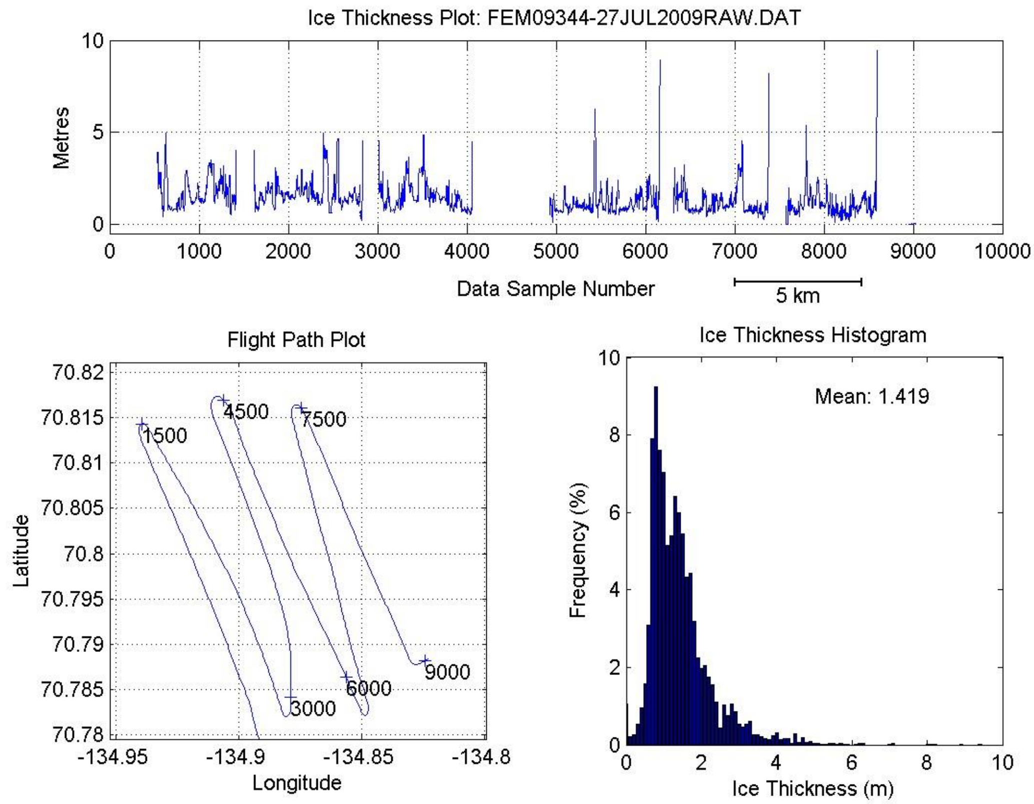
Floe 4-12 Output.



Floe 5-12 – six separate transects sampled at this floe

Transect #	Start Location	End Location	Mean Ice Thickness (m)
1	70.787 N 134.90 W	70.813 N 134.94 W	**1.805**
2	70.814 N 134.94 W	70.785 N 134.88 W	**1.733**
3	70.785 N 134.88 W	70.813 N 134.91 W	**1.580**
4	70.81 N 134.89 W	70.783 N 134.85 W	**1.178**
5	70.783 N 134.85 W	70.815 N 134.88 W	**1.214**
6	**70.815 N 134.85 W**	**70.788 N 134.83 W**	**1.081**

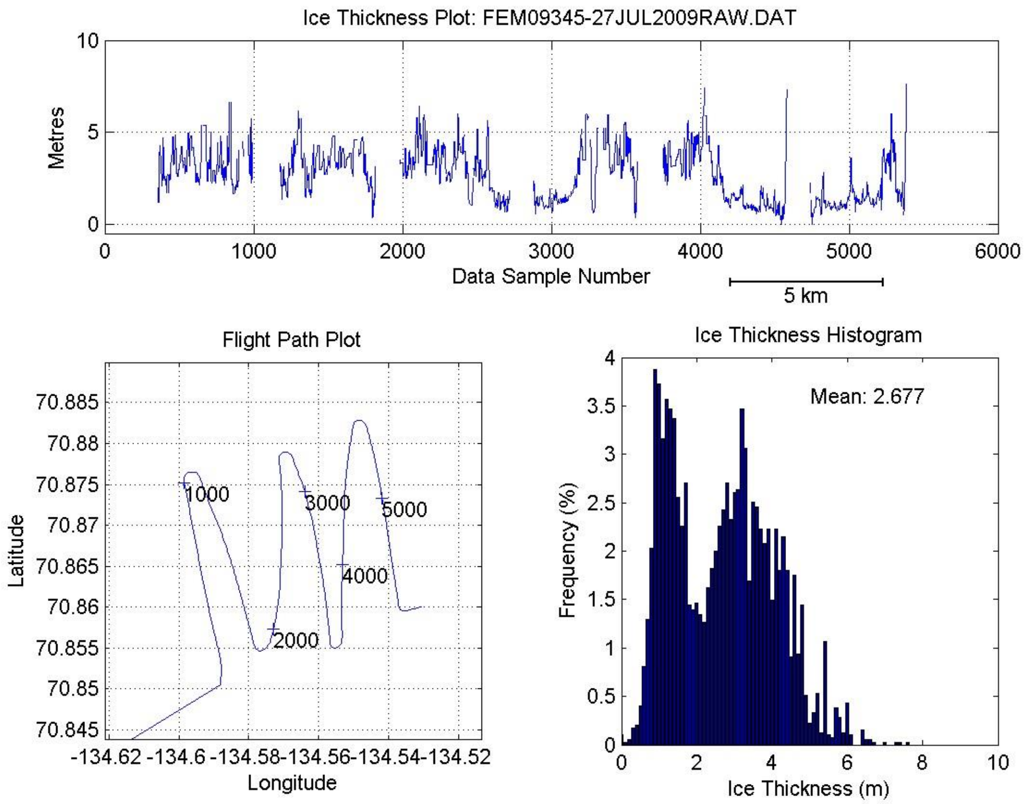
Floe 5-12 Output



Floe 6-12 – six separate transects sampled at this floe

Transect #	Start Location	End Location	Mean Ice Thickness (m)
1	70.857 N 134.59 W	70.875 N 134.60 W	**3.280**
2	70.875 N 134.59 W	70.856 N 134.58 W	**3.325**
3	70.857 N 134.57 W	70.878 N 134.57 W	**3.077**
4	70.876 N 134.565 W	70.856 N 134.56 W	**2.554**
5	70.86 N 134.555 W	70.88 N 134.55 W	**2.457**
6	**70.88 N 134.545 W**	**70.861 N 134.54 W**	**1.740**

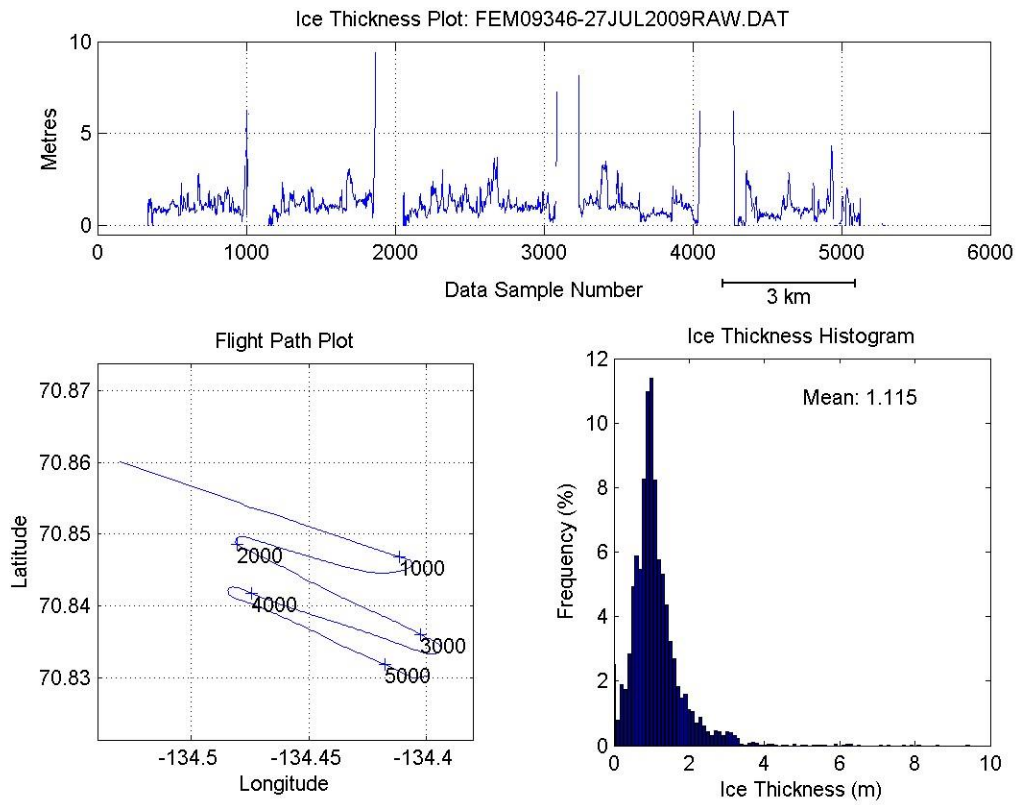
Floe 6-12 Output.



Floe 7-12 – Five separate transects sampled at this floe.

Transect #	Start Location	End Location	Mean Ice Thickness (m)
1	70.852 N 134.46 W	70.848 N 134.42 W	**1.109**
2	70.845 N 134.41 W	70.84 N 134.47 W	**1.243**
3	70.847 N 134.47 W	70.836 N 134.40 W	**1.224**
4	70.834 N 134.41 W	70.842 N 134.47 W	**1.101**
5	**70.84 N 134.47 W**	**70.831 N 134.41 W**	**0.915**

Floe 7-12 Output.

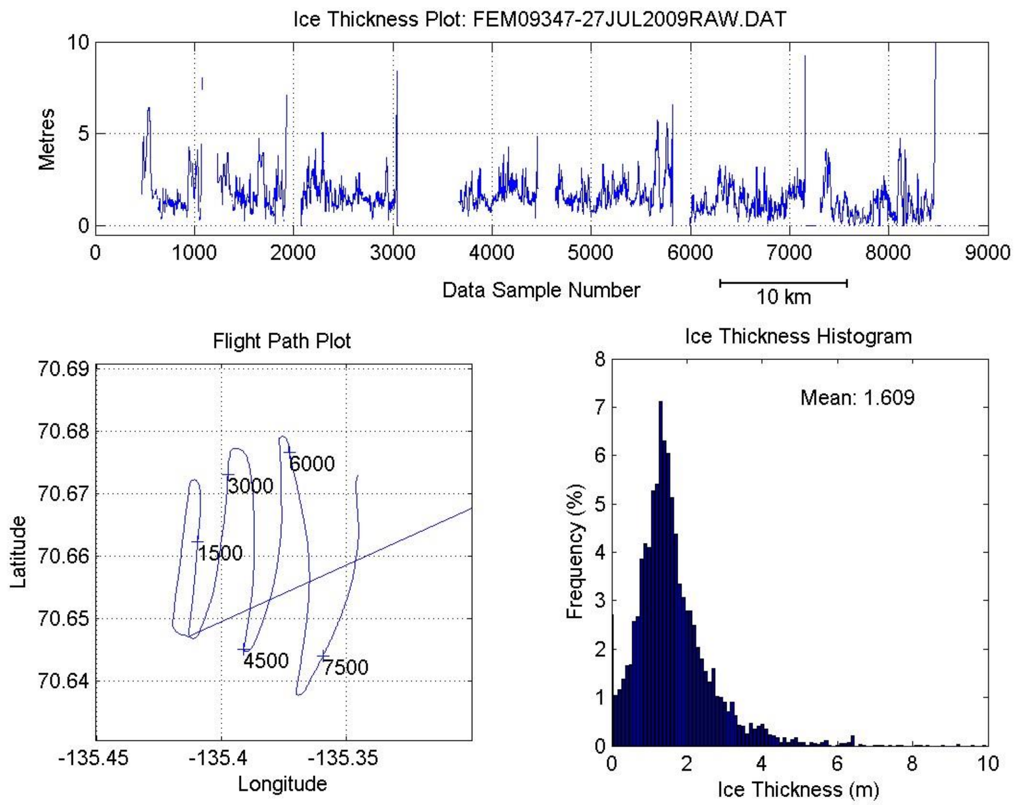


In the afternoon, five floes sampled around Station 12, with a total of 27 separate sampling transects. A female polar bear with a cub was seen at approximately 70º40.9'N, 135º28.5'W

Floe 1b-12 – seven separate transects sampled at this floe

Transect #	Start Location	End Location	Mean Ice Thickness (m)
1	70.655 N 135.42 W	70.67 N 135.415 W	**1.962**
2	70.67 N 135.41 W	70.649 N 135.41 W	**1.839**
3	70.649 N 135.41 W	70.673 N 135.40 W	**1.695**
4	70.67 N 135.39 W	70.648 N 135.39 W	**1.717**
5	70.646 N 135.39 W	70.678 N 135.38 W	**1.803**
6	70.677 N 135.37 W	70.64 N 135.37 W	**1.350**
7	**70.641 N 135.36 W**	**70.67 N 135.35 W**	**1.047**

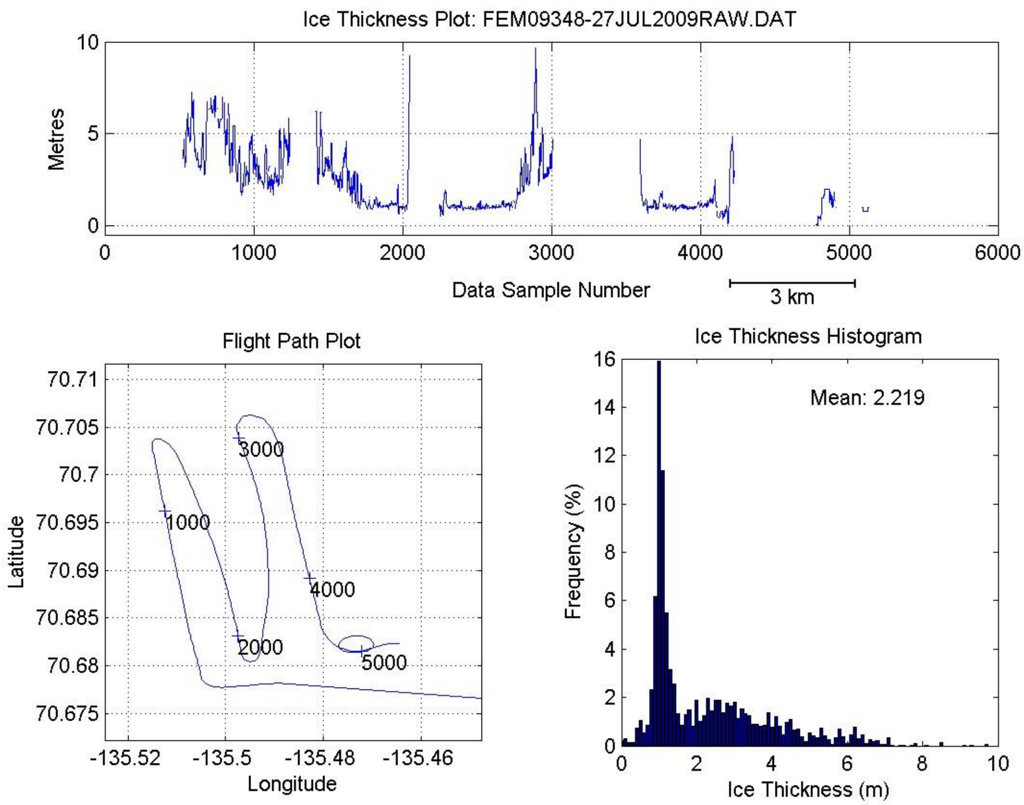
Floe 1b-12 Output.



Floe 2b-12 – four separate transects sampled at this floe

Transect #	Start Location	End Location	Mean Ice Thickness (m)
1	70.684 N 135.51 W	70.702 N 135.515 W	**3.754**
2	70.701 N 135.51 W	70.683 N 135.495 W	**1.970**
3	70.685 N 135.49 W	70.704 N 135.50 W	**1.880**
4	**70.703 N 135.49 W**	**70.683 N 135.48 W**	**1.122**

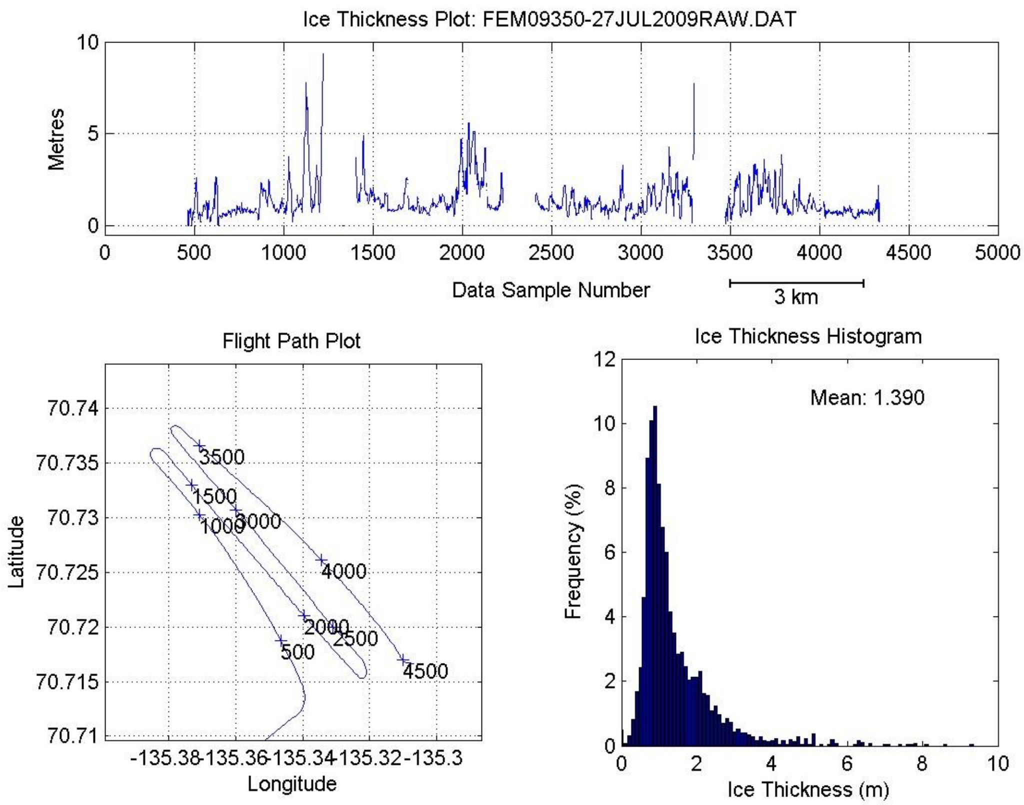
Floe 2b-12 Output.



Floe 3b-12 – Six separate transects sampled at this floe.

Transect #	Start Location	End Location	Mean Ice Thickness (m)
1	70.685 N 135.47 W	70.705 N 135.48 W	**1.141**
2	70.705 N 135.48 W	70.685 N 135.46 W	**0.906**
3	70.719 N 135.35 W	70.735 N 135.38 W	**1.343**
4	70.735 N 135.38 W	70.716 N 135.33 W	**1.659**
5	70.717 N 135.32 W	70.738 N 135.38 W	**1.331**
6	**70.737 N** **135.37 W**	**70.72 N** **135.32 W**	**1.216**

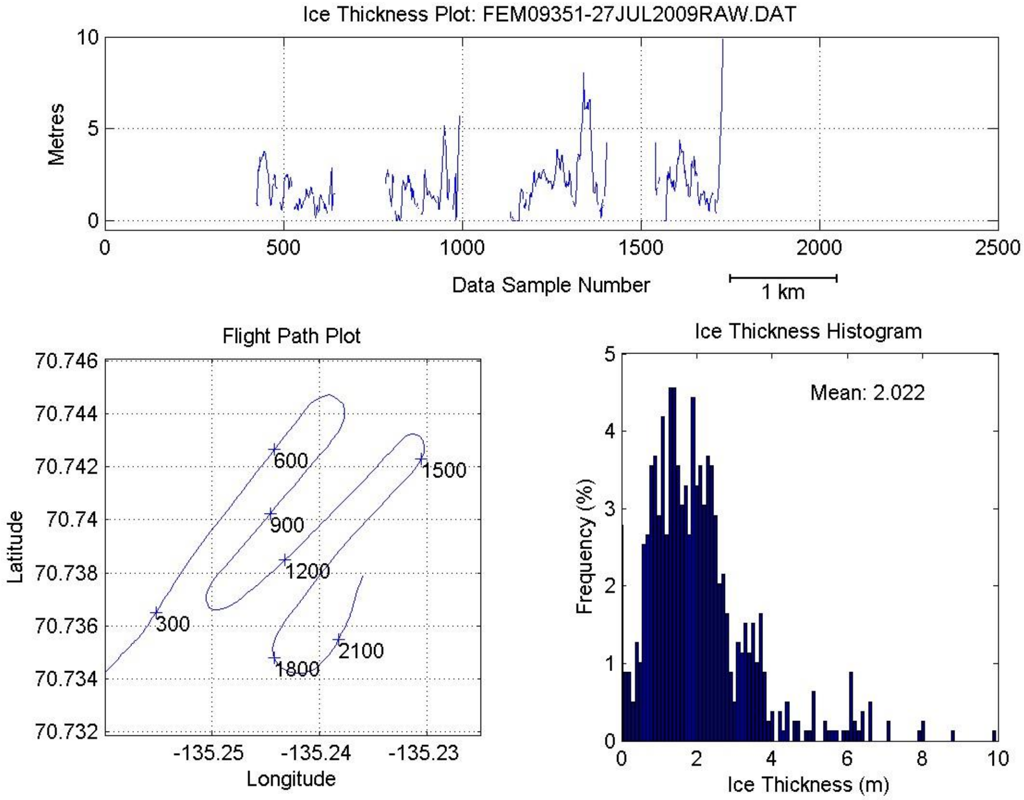
Floe 3b-12 Output.



Floe 4b-12 – Four separate transects sampled at this floe.

Transect #	Start Location	End Location	Mean Ice Thickness (m)
1	70.739 N 135.25 W	70.744 N 135.242 W	**1.423**
2	70.743 N 135.24 W	70.738 N 135.25 W	**1.609**
3	70.737 N 135.245 W	70.743 N 135.233 W	**2.552**
4	**70.741 N 135.233 W**	**70.736 N 135.243 W**	**1.991**

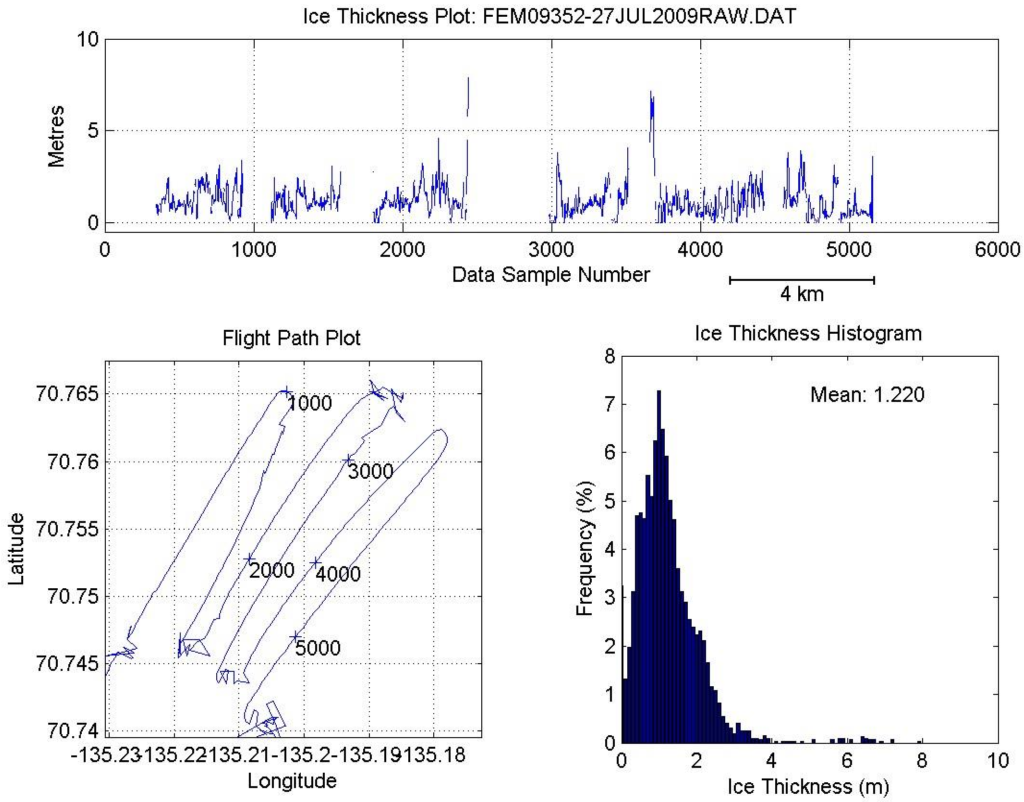
Floe 4b-12 Output.



Floe 5b-12 – Six separate transects sampled at this floe.

Transect #	Start Location	End Location	Mean Ice Thickness (m)
1	70.752 N 135.222 W	70.764 N 135.205 W	**1.397**
2	70.763 N 135.205 W	70.748 N 135.217 W	**1.187**
3	70.748 N 135.215 W	70.763 N 135.195 W	**1.265**
4	70.760 N 135.193 W	70.745 N 135.212 W	**1.104**
5	70.745 N 135.21 W	70.762 N 135.18 W	**1.000**
6	**70.76 N** **135.18 W**	**70.741 N** **135.21 W**	**1.074**

Floe 5b-12 Output.



EMI SAMPLING – JULY 28, 2009

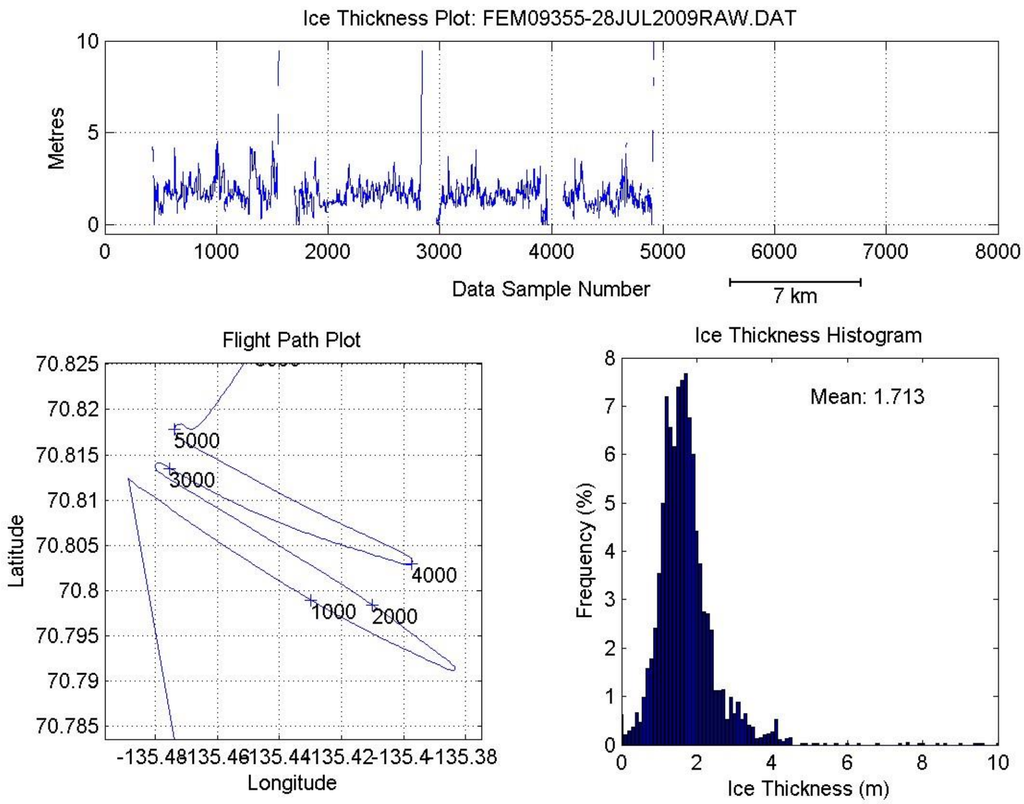
One survey was conducted in the morning: Start Time – 8:46 am local time (14:46 UTC), End Time – 10:48 am local time (16:48 UTC)

In the morning, seven floes were sampled at station 5, with a total of 40 separate sampling transects. Photos along each transect were taken during surveying. These photos will be used to characterize the ice conditions along each transect.

Floe 1-05 – four separate transects sampled at this floe

Transect #	Start Location	End Location	Mean Ice Thickness (m)
1	70.809 N 135.47 W	70.791 N 135.38 W	**1.961**
2	70.795 N 135.40 W	70.812 N 135.48 W	**1.658**
3	70.813 N 135.47 W	70.803 N 135.40 W	**1.685**
4	**70.805 N 135.40 W**	**70.816 N 135.47 W**	**1.487**

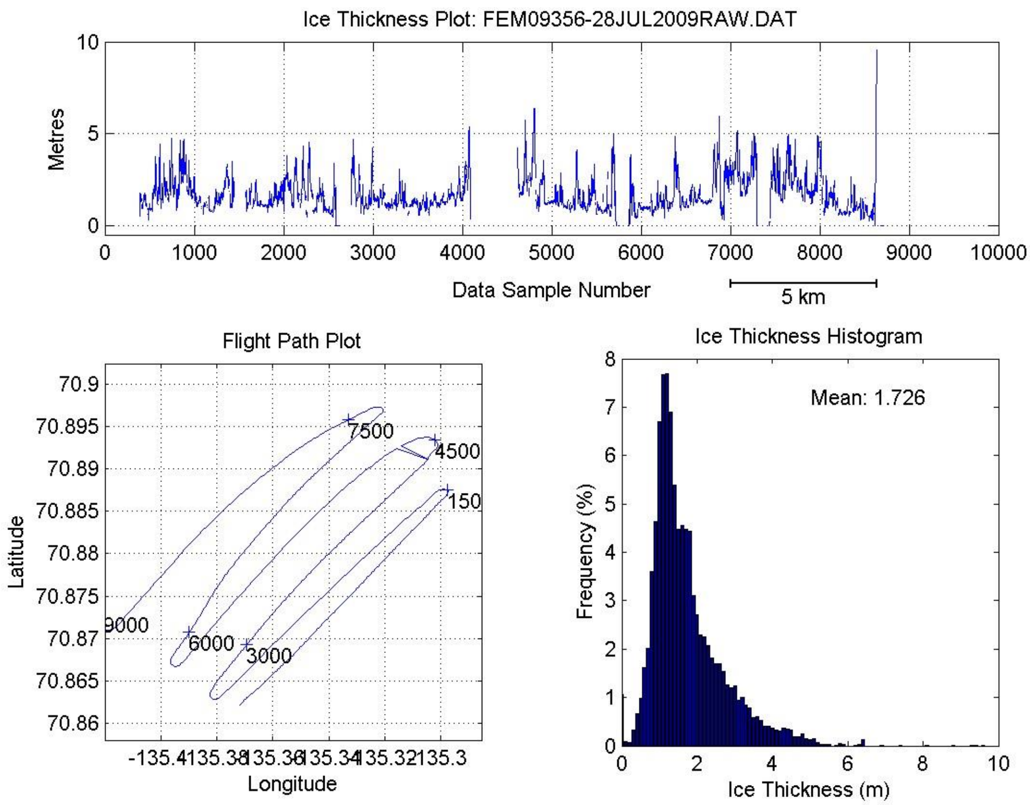
Floe 1-05 Output.



Floe 2-05 – Six separate transects sampled at this floe.

Transect #	Start Location	End Location	Mean Ice Thickness (m)
1	70.866 N 135.36 W	70.886 N 135.30 W	**1.849**
2	70.887 N 135.30 W	70.864 N 135.38 W	**1.593**
3	70.865 N 135.38 W	70.889 N 135.31 W	**1.396**
4	70.893 N 135.31 W	70.867 N 135.39 W	**1.746**
5	70.867 N 135.39 W	70.897 N 135.32 W	**1.861**
6	**70.897 N 135.32 W**	**70.872 N 135.41 W**	**1.778**

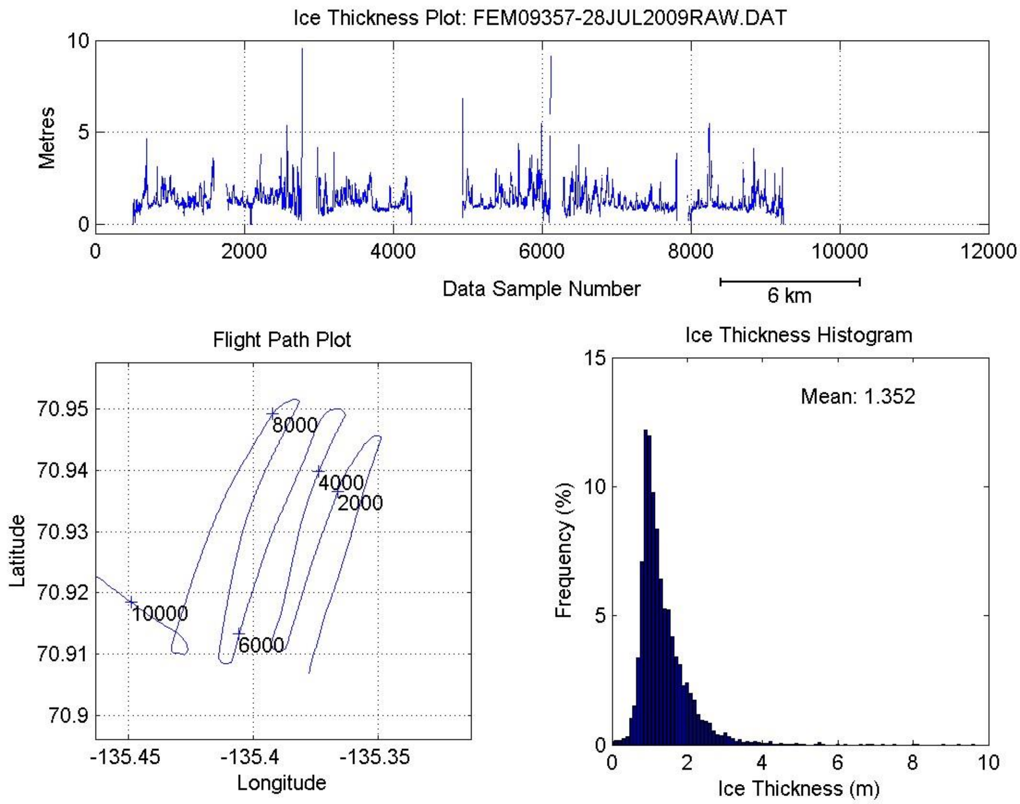
Floe 2-05 – Output.



Floe 3-05 – six separate transects sampled at this floe

Transect #	Start Location	End Location	Mean Ice Thickness (m)
1	70.92 N 135.37 W	70.945 N 135.35 W	**1.438**
2	70.943 N 135.36 W	70.91 N 135.39 W	**1.517**
3	70.915 N 135.39 W	70.945 N 135.37 W	**1.298**
4	70.944 N 135.38 W	70.914 N 135.41 W	**1.497**
5	70.915 N 135.41 W	70.95 N 135.38 W	**1.260**
6	**70.95 N 135.39 W**	**70.914 N 135.43 W**	**1.223**

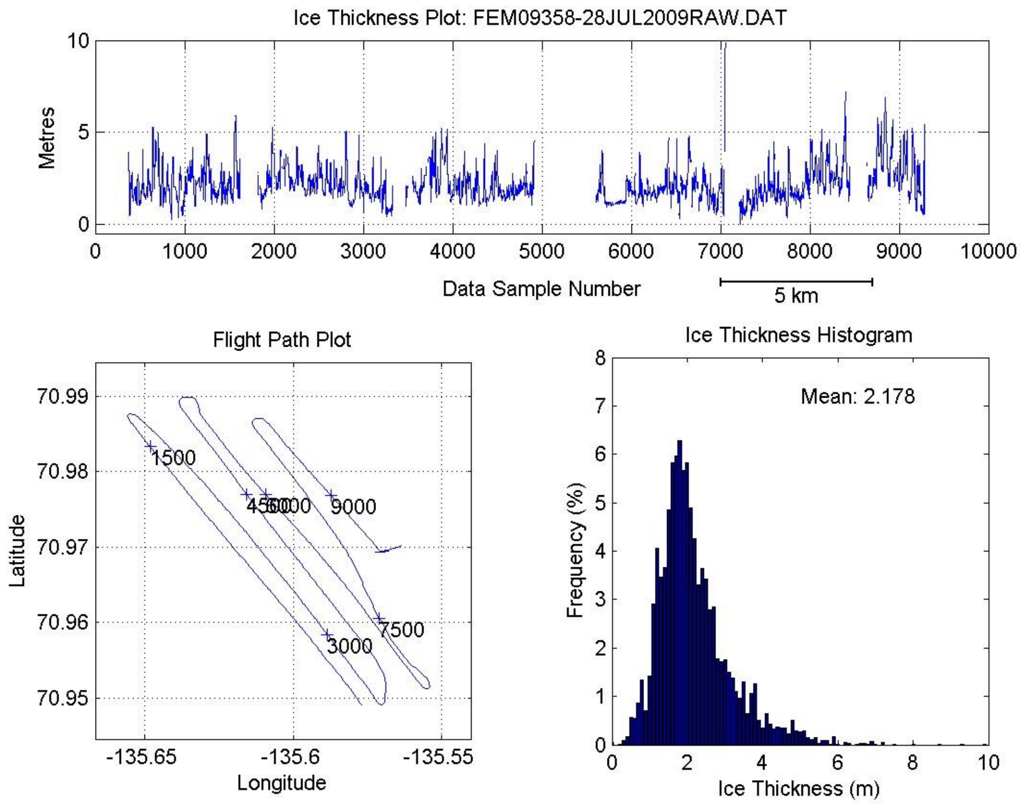
Floe 3-05 Output.



Floe 4-05 – Six separate transects sampled at this floe.

Transect #	Start Location	End Location	Mean Ice Thickness (m)
1	70.956 N 135.59 W	70.986 N 135.65 W	**2.222**
2	70.987 N 135.65 W	70.954 N 135.58 W	**2.265**
3	70.955 N 135.57 W	70.985 N 135.63 W	**2.144**
4	70.985 N 135.63 W	70.953 N 135.56 W	**1.851**
5	70.954 N 135.56 W	70.985 N 135.61 W	**2.132**
6	**70.984 N 135.60 W**	**70.97 N 135.57 W**	**3.052**

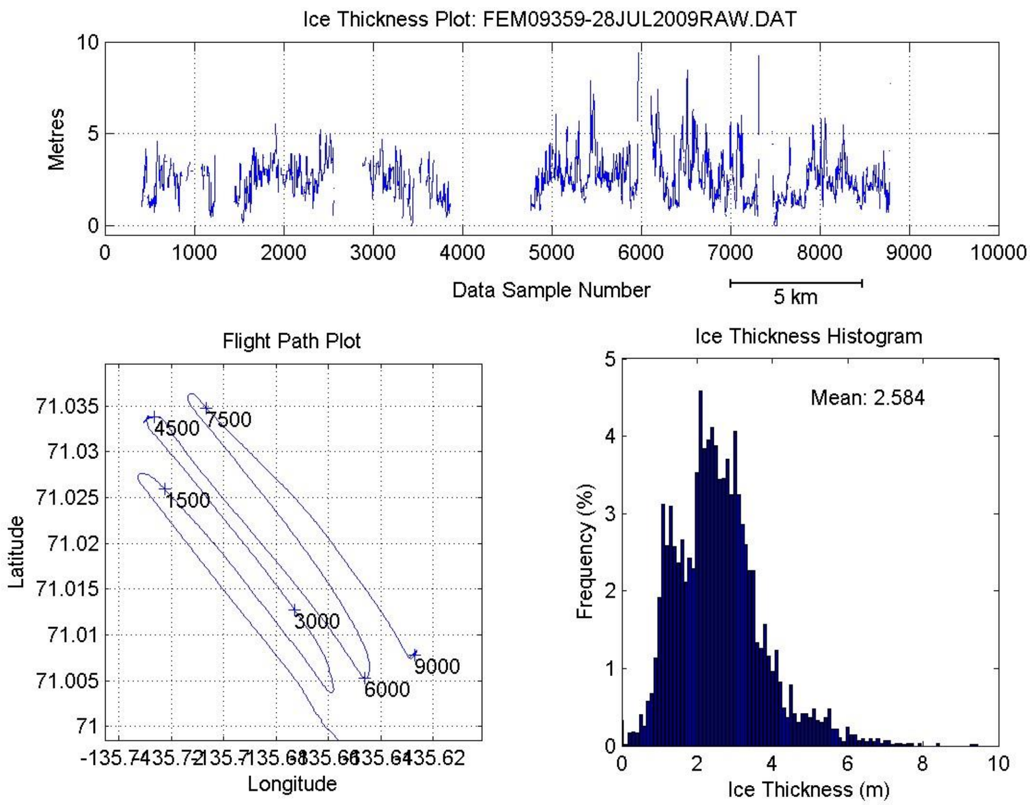
Floe 4-05 Output.



Floe 5-05 – six separate transects sampled at this floe.

Transect #	Start Location	End Location	Mean Ice Thickness (m)
1	71.006 N 135.68 W	71.025 N 135.73 W	**2.290**
2	71.025 N 135.72 W	71.005 N 135.66 W	**2.657**
3	71.013 N 135.67 W	71.031 N 135.72 W	**2.322**
4	71.031 N 135.72 W	71.005 N 135.65 W	**2.874**
5	71.010 N 135.65 W	71.034 N 135.71 W	**2.809**
6	**71.035 N 135.71 W**	**71.007 N 135.63 W**	**2.305**

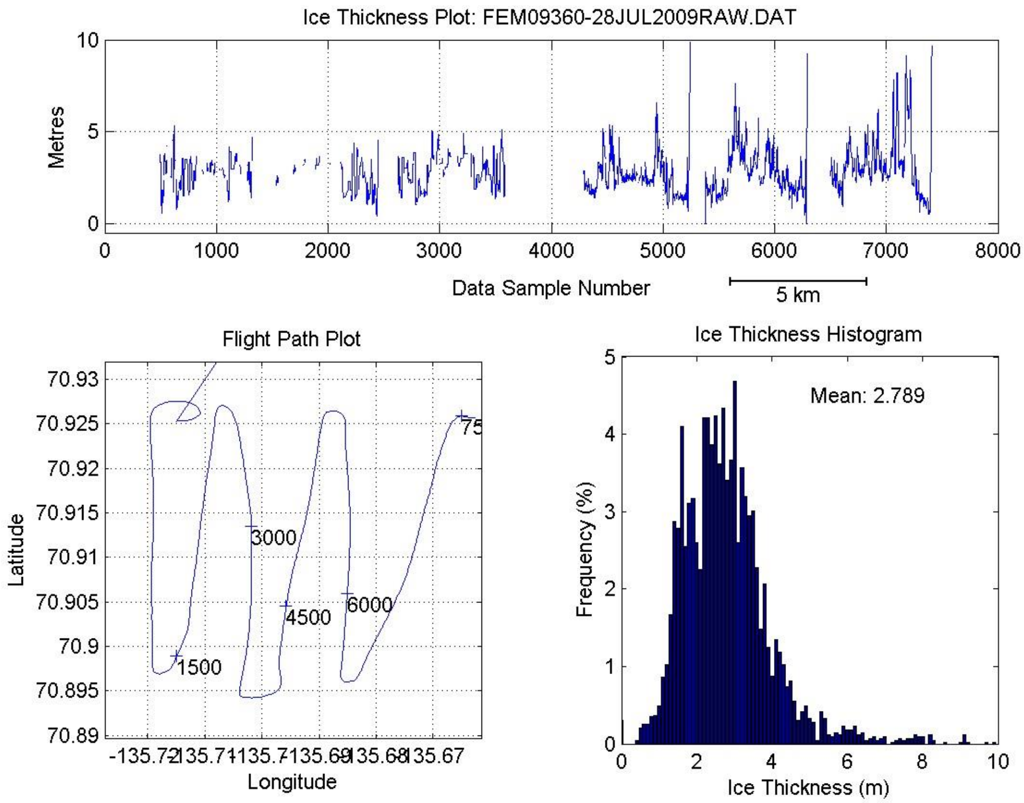
Floe 5-05 Output.



Floe 6-05 – six separate transects sampled at this floe

Transect #	Start Location	End Location	Mean Ice Thickness (m)
1	70.923 N 135.72 W	70.899 N 135.72 W	**2.704**
2	70.915 N 135.71 W	70.927 N 135.71 W	**2.135**
3	70.925 N 135.705 W	70.895 N 135.705 W	**2.822**
4	70.90 N 135.695 W	70.925 N 135.69 W	**2.545**
5	70.925 N 135.685 W	70.895 N 135.685 W	**2.802**
6	**70.90 N 135.68 W**	**70.925 N 135.665 W**	**3.254**

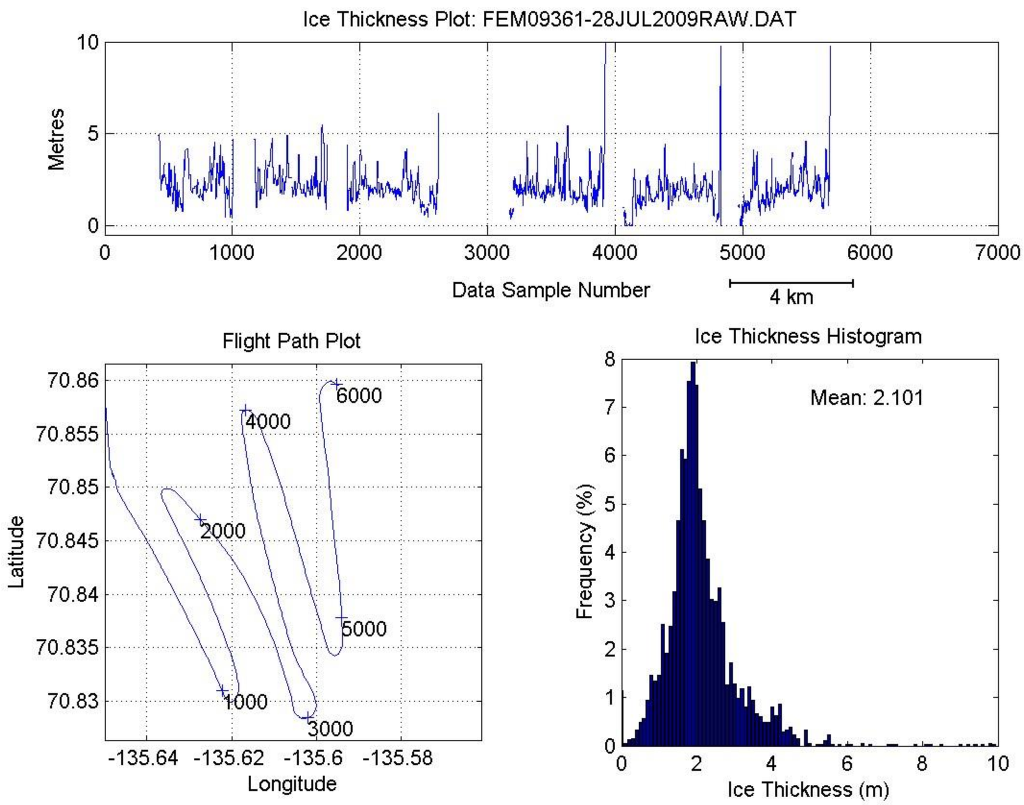
Floe 6-05 Output.



Floe 7-05 – Six separate transects sampled at this floe.

Transect #	Start Location	End Location	Mean Ice Thickness (m)
1	70.845 N 135.64 W	70.83 N 135.62 W	**2.289**
2	70.833 N 135.62 W	70.847 N 135.635 W	**2.487**
3	70.849 N 135.63 W	70.83 N 135.605 W	**2.005**
4	70.835 N 135.605 W	70.855 N 135.62 W	**2.147**
5	70.855 N 135.61 W	70.835 N 135.60 W	**1.753**
6	**70.838 N 135.595 W**	**70.855 N 135.60 W**	**1.975**

Floe 7-05 Output.



EMI SAMPLING – JULY 29, 2009

Three ice motion beacons were deployed on July 29, 2009 at the following locations:

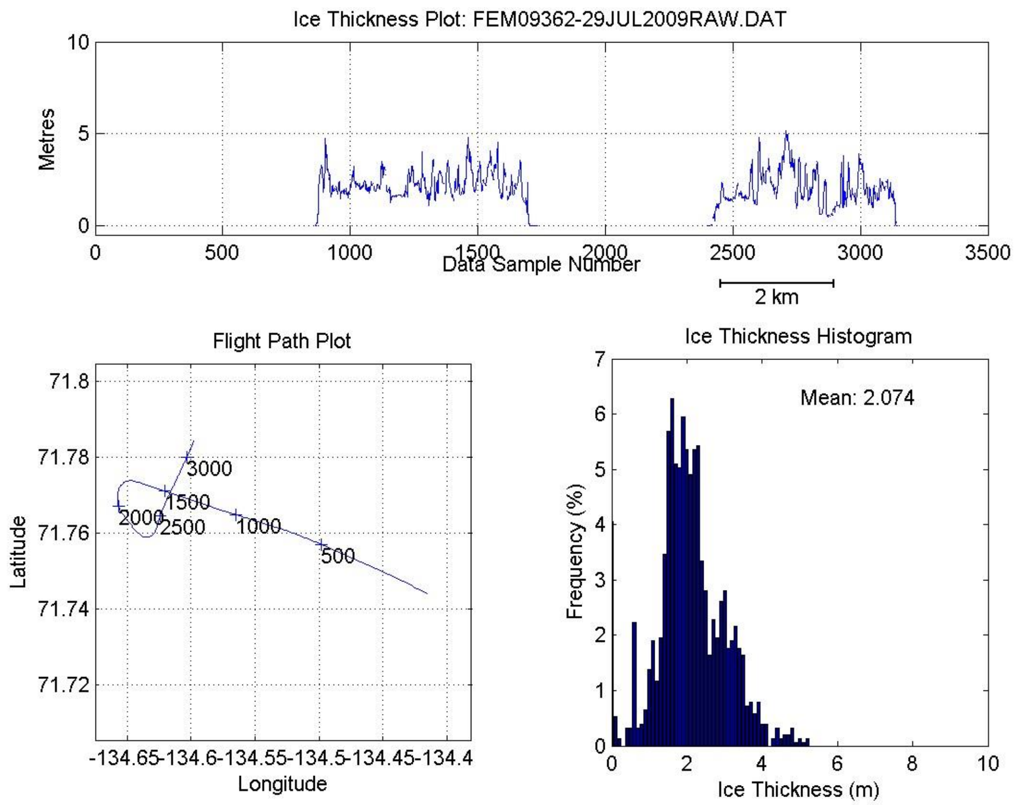
Beacon 282100	71°46.205'N, 134o37.007'W
Beacon 282060	71°32.954'N, 133o55.681'W
Beacon 281070	71°34.449'N, 133°16.870'W

During the deployment of the beacons, 9 transects were flown over the ice the beacons were deployed. The location and mean ice thickness of these transects are provided in the following tables, as well as graphical output of the transects.

Site 1 – two separate transects sampled at this site. This site represented the floe in which the beacon was placed on.

Transect #	Start Location	End Location	Mean Ice Thickness (m)
1	71.762 N 134.54 W	71.774 N 134.65 W	**2.172**
2	**71.762 N 134.62 W**	**71.784 N 134.597 W**	**2.021**

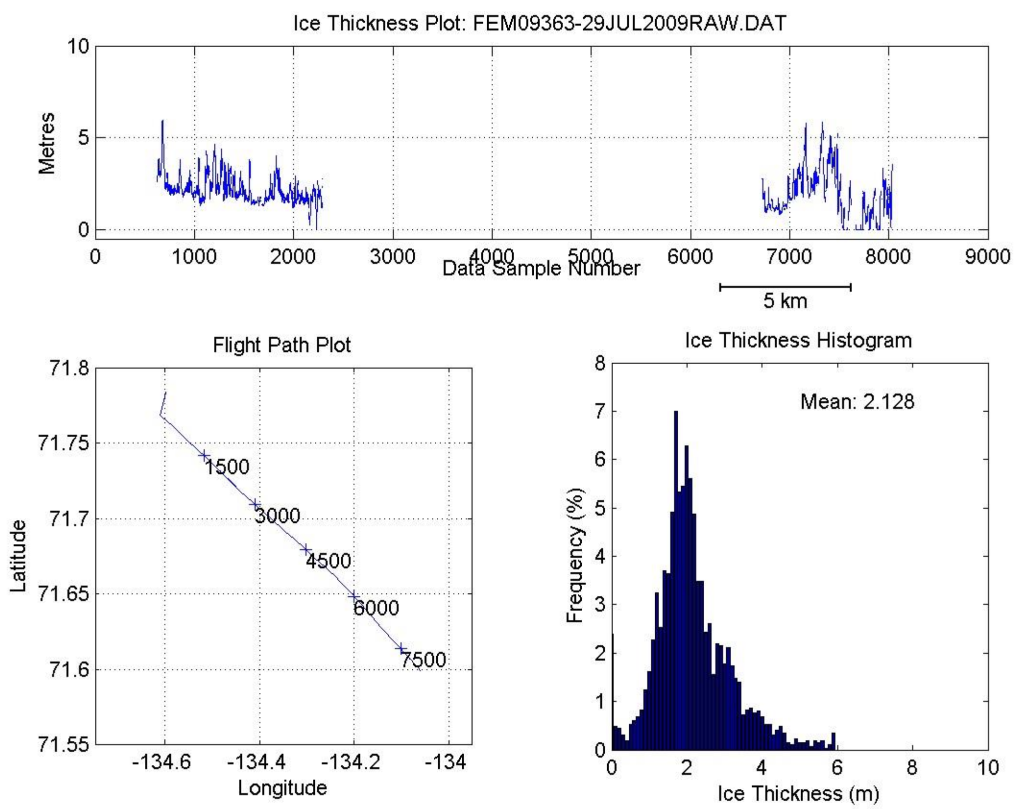
Site 1 Output.



Site 2 – two separate transects sampled at this site. These transects were flown in transit from the location of beacon 1 to the location in which beacon 2 was placed.

Transect #	Start Location	End Location	Mean Ice Thickness (m)
1	71.77 N 134.60 W	71.72 N 134.45 W	**2.210**
2	**71.63 N 134.15 W**	**71.60 N 134.05 W**	**2.011**

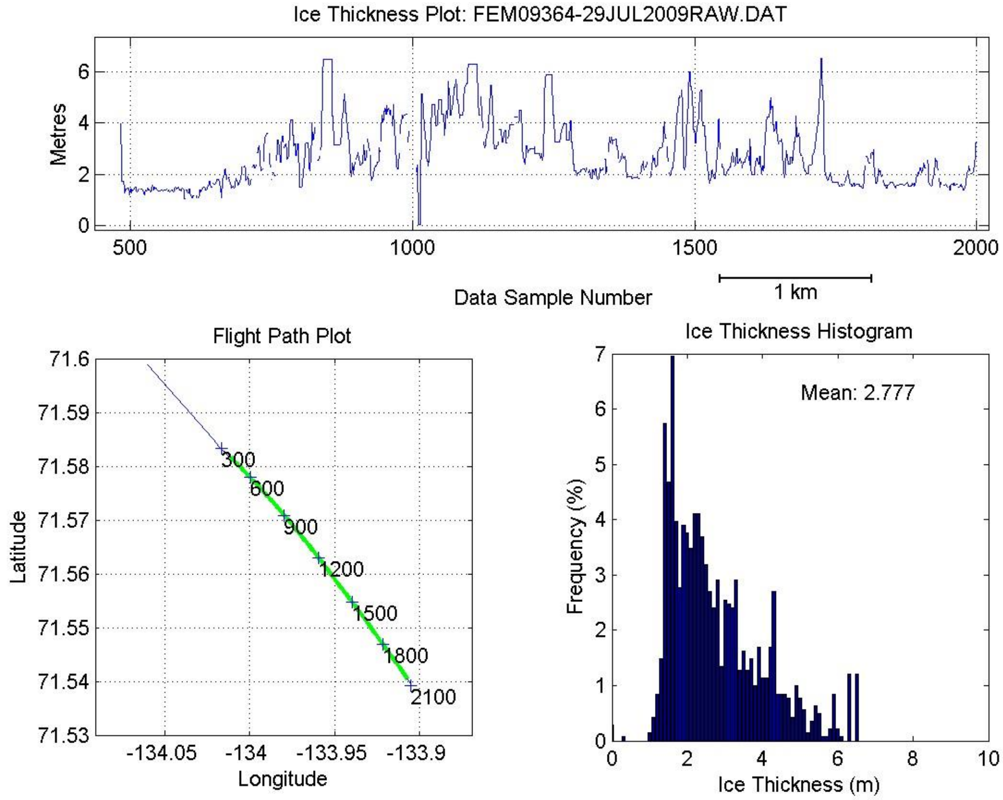
Site 2 Output.



Site 3 – one transect was sampled at this site. This transect was sampled from the location of beacon 2 to the location beacon 3 was placed.

Transect #	Start Location	End Location	Mean Ice Thickness (m)
1	**71.58 N 134.02 W**	**71.54 N 133.90 W**	**2.777**

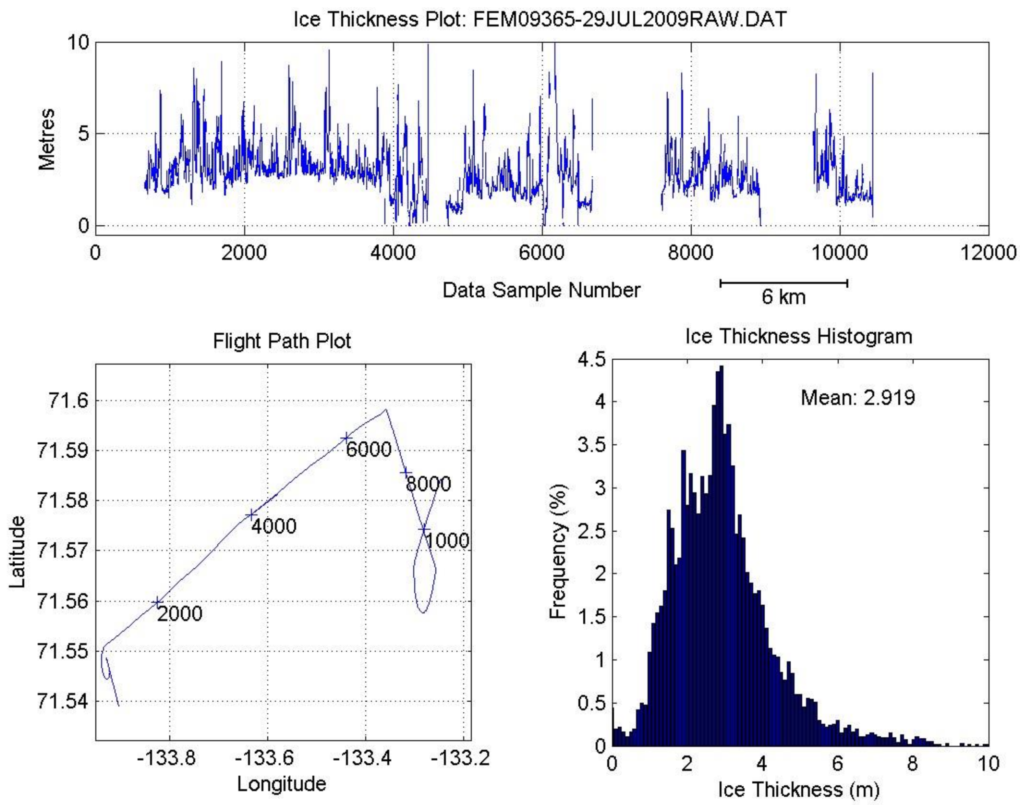
Site 3 Output.



Site 4 – four transects were sampled at this site, one across the floe in which beacon 3 was placed, and the other perpendicular to the first transect. Two additional transects were flown enroute to the placement of beacon 3.

Transect #	Start Location	End Location	Mean Ice Thickness (m)
1	71.55 N 133.95 W	71.58 N 133.58 W	**3.296**
2	71.58 N 133.55 W	71.60 N 133.35 W	**2.444**
3	71.595 N 133.35 W	71.56 N 133.25 W	**2.752**
4	**71.565 N 133.30 W**	**71.85 N 133.25 W**	**2.570**

Site 4 Output.



Meteorological Observations (Barber Group)

5. Manual Weather Observations – recorded every 3 hours (00:00, 03:00, 06:00 etc) UTC
   - GPS location
   - cloud fractional coverage (8/8, 7/8, etc)
   - precipitation type and amount (light, med, heavy, or fog)
   - visibility
   - from AVOS record temperature, wind speed and direction
   - Sea ice percent coverage

6. The Vasaila CT25K Ceilometer is functional, and operating well.
7. The temperature and water vapour microwave profiler (TP/WVP 3000A) continues to run well. We are still awaiting repair of the liquid nitrogen plant so that we can calibrate the 51 to 59 GHz channels, and are hopeful that this can be accomplished before July 30th.
8. The all-sky camera is recording pictures of the sky at 15-minute intervals.
9. The radiosonde system was down for the day on July 22nd, but has been repaired. Balloon launches will continue to coincide with the passage of the A-train satellites (~4:30am and 2:30pm LST). The 2:30pm balloon launches cannot be done if the helicopter is inthe air. 3-hourly sampling will occur if a low-pressure system is encountered. A strong temperature inversion was detected on July 26th, with surface temperature around 5 – 6C, and temperatures at ~1000m at >=15C. This is consistent with warm air advection aloft, building a ridge of high pressure over the region.
10. Zodiac operations continue to permit us to deploy a small meteorological-surface roughness buoy for short periods of time, however, we do not anticipate any more zodiac time on this leg for this operation.
11. The laser precipitation gauge is fully operational.

Meteorological Observations (Papakyriakou Group)

1. **Underway pCO2 System**

-pCO2 system continues to operate well.

2. Met/Flux Tower

-All met, flux and radiation sensors are working.

3. Met-Ocean (3m Discus) Buoy

-Deployment postponed until 3b.

4. Surface Buoys

-Deployment postponed until 3b.

Science Activities Summary for July 27 – 29, 2009

Reporters: Matthew Asplin & Tim Papakyriakou
2100Z, July 29th, 2009

IORVL Update University of Manitoba, Centre for Earth Observation Science

Position at time of report: 71° 30.846N 130° 25.081W

TAir: 5.9°C

RH: 90%

Winds: 16kts @ 105° True

Summary:

We are now at the end of Leg 2A, and are en route to Sachs Harbour for the mid-leg crew change. Major station-based sampling activities, and mooring deployments were completed on July 27th, but our group is continuing to monitor sea ice and meteorological conditions until 0000Z July 30th. The visibility conditions have continued to be excellent and have permitted us to fly four more helicopter

EMI survey flights. Three ice drift buoys (ice beacons) were deployed today along with the EMI survey flight. A minimum ensemble of meteorological instruments will continue to operate during leg 2B, along with the oblique webcam (SBR webcam). These instruments will be maintained by a member of the MALINA project during leg 2B.

EMI Helicopter Surveys (Barber Group)

John is processing this…

Remote Sensing Activities - (Barber Group)

29. C-band scatterometer and the ship-based radiometers have been put into storage until the pack ice transect in leg 3A.
30. Ice Thickness camera is being deployed when transiting ice concentrations of 7/10, or greater.
31. Site Camera for SBR and Scatterometer operational, currently logging in transit for sea state conditions, 60 frames per hour, and has been backed up.

Meteorological Observations (Barber Group)

21. Manual Weather Observations – recorded every 3 hours (00:00, 03:00, 06:00 etc) UTC
    - GPS location
    - cloud fractional coverage (8/8, 7/8, etc)
    - precipitation type and amount (light, med, heavy, or fog)
    - visibility
    - from AVOS record temperature, wind speed and direction
    - Sea ice percent coverage

22. The Vasaila CT25K Ceilometer is functional, and operating well.
23. The temperature and water vapour microwave profiler (TP/WVP 3000A) continues to run well. We are still awaiting repair of the liquid nitrogen plant so that we can calibrate the 51 to 59 GHz channels, and are hopeful that this can be accomplished during leg 2A.

24. The all-sky camera is recording pictures of the sky at 15-minute intervals.
25. Balloon launches ceased on July 28th, and they will resume at the start of leg 3A, (August 27th).
26. Zodiac operations permitted us to deploy the MOBS roughness buoy one more time at our last station (station 16).
27. The laser precipitation gauge is fully operational.
28. Data backups for all data collected by our group are ongoing today, and will encompass all data collected up to 0000Z July 30th, 2009.

Meteorological Observations (Papakyriakou Group)

1. Underway pCO2 System

-pCO2 system has continued to operate adequately. We have noticed some recent decreases in flow volume through the system and are working on fixing the issue.

2. Met/Flux Tower

-The flux tower is now fully operational, minus a surface temperature sensor (IR transducer).
-On July 16, the wind monitor was replaced because the previous one was not properly outputting wind direction. The instrument was operational before leaving Sachs Harbour for the IOL study area.
-The closed path eddy covariance system went operational on July 17, and seems to be operating properly.

3. Radiation Array

-The radiation array is continuing to run normally

4. Met-Ocean (3m Discus) Buoy

-The AXYS 3m buoy is nearly ready for deployment. The only remaining issue is an instrument within the U of M flux system that is not operating properly. Troubleshooting will take place on July 18th, and a spare instrument is available if we are unsuccessful.

5. Surface Buoys

-Surface buoys are nearly ready for deployment. We are currently working on configuring the conductivity/temperature sensors.

MetOcean Science Activities Summary for Aug. 27 – 29th, 2009

Reporters: Matthew Asplin and David Barber
2100Z, Aug 29th, 2009

IOL Update University of Manitoba, CEOS

Position at time of report: 69 ºN 45.485’ 123 ºW 29.934’

TAir: 8.8 ºC

RH: 88%

Winds: 23kt at ENE

Summary:

The full crew change was conducted out of Paulatuk, NWT on August 27th, and the ship is now underway to the first station of leg 3A. Our group is presently monitoring meteorological conditions en route, and is preparing for sea ice physical sampling, ship-based sensor scans, EMI helicopter flights, and ice tracking beacon deployments. The ice mass balance buoys are on board, and are being prepared for deployment at the north end of the leg 3A pack ice transect. We are presently transiting through open water, and will be influenced by a weak low-pressure system. This weather system is producing light rain, and low cloud and fog, and helicopter survey flights cannot be conducted during these weather conditions. The forecast shows improving weather conditions within 2-3 days, and survey flights will commence as soon as the weather permits.

Remote Sensing Activities - (Barber Group)

32. The C-band scatterometer and ship-based radiometers (SBR) have been set up and are ready for station-based scanning. The SBR is currently running in transit mode.
33. The Ice Thickness camera is ready for deployment when significant ice concentrations are encountered.

34. The Site Camera for SBR and Scatterometer was down Aug 14 – Aug 28, but is now fully operational, and currently logging in transit for sea state conditions, at a rate of 60 frames per hour.
35. The EMI system is being re-installed on the helicopter, and is expected to be ready for use shortly.

Sea Ice Physical Sampling Activies (Barber Group)

Our group is prepared to conduct extensive on-ice physical sampling activities, in parallel with our remote sensing program. At each station, a particular site will be scanned using the scatterometer and SBR. A team of scientists will then be deployed on the ice floe for upwards of 6 hours to collect the following data:

- Ice thickness and freeboard
- Ice temperature profile
- Ice salinity
- Snow temperature, salinity, and density samples (where snow exists)
- Snow grain size
- Melt ponds (area, long-axis dimensions, roughness, fetch, depth)
- On-ice winds
- Site photography

Meteorological Observations (Barber Group)

29. Manual Weather Observations – recorded every 3 hours (00:00, 03:00, 06:00 etc) UTC
    - GPS location
    - Air temperature, wind speed and direction and sea ice percent coverage/type
    - cloud fractional coverage (8/8, 7/8, etc)
    - precipitation type and amount (light, med, heavy)
    - visibility (approx 20 km, 10 km, fog etc)
30. The ceilometer is continuously recording the cloud base height in feet for up to 3 levels.

31. The temperature and water vapour microwave profiler (TP/WVP 3000A) is running well. The liquid nitrogen calibration procedure was conducted today, and the instrument is operating normally.
32. The all-sky camera is operating well, and collecting data.
33. Balloon launches will occur August 29th to sample the low-pressure system, with one corresponding with the 3:00pm (LST) Passover of the A-train.

Micro-Meteorological Observations (Papakyriakou Group)

1. Underway pCO2 System

-pCO2 system has continued to operate adequately.

2. Met/Flux Tower

-The flux tower is now fully operational, minus a surface temperature sensor (IR transducer) which failed during leg 2b.
-The closed path eddy covariance system went operational on July 17, and seems to be operating properly.

3. Radiation Array

-The radiation array is continuing to run normally

4. Met-Ocean (3m Discus) Buoy

-The AXYS 3m buoy is ready to be deployed during leg 3B.

5. Surface Buoys

-Surface buoys are ready for deployment during leg 3B.

MetOcean Science Activities Summary Sept 1 – Sept 3rd, 2009
University of Manitoba, CEOS

Reporters: Matthew Asplin and David Barber
2100Z, Sept 3rd, 2009

Position at time of report: 74 ºN 38.612’ 137 ºW 20.235’ (stationary).

TAir: 0.1 ºC

RH: 99%

Winds: 14kt at 224º

Summary:

Sept 1st and the morning of Sept 2nd were spent collecting data at station L1. Work included physical sampling and EM scanning of the ice floe, weather balloon launches, and three helicopter EMI survey flights. We completed our sampling activities at station L1 and departed at approximately 2100Z, Sept 2nd to continue our northward trek into the pack ice. We arrived at our current position at 00Z Sept 4th, but were unable to find a multi-year ice floe to moor the ship to. The entire region appears to be covered with weak, rotten, old ice and can be sampled by the ice cage only. We are expecting a storm to move over us tonight, and into tomorrow morning, with sustained winds reaching 30kts. Our group’s automated sampling activities should not be affecting, but helicopter, and ice cage activities may be suspended if weather conditions become severe.

Remote Sensing Activities - (Barber Group)

36. The C-band scatterometer and ship-based radiometers (SBR) performed many replicate scans at station L1.
37. The Ice Thickness camera has been collecting ice thickness images for the past day.
38. The Site Camera is now fully operational, and currently logging in transit for sea state conditions, at a rate of 60 frames per hour.
39. The EMI system was deployed on Sept 1, and twice on Sept. 2nd.

EMI Helicopter Surveys

Weather conditions permitted an EMI helicopter survey to be conducted over ice floes in the vicinity of station L1 on Sept 1, 2009 (figure 1), the morning of Sept 2nd, (figure 2), and the afternoon of Sept. 2nd, (figure 3).

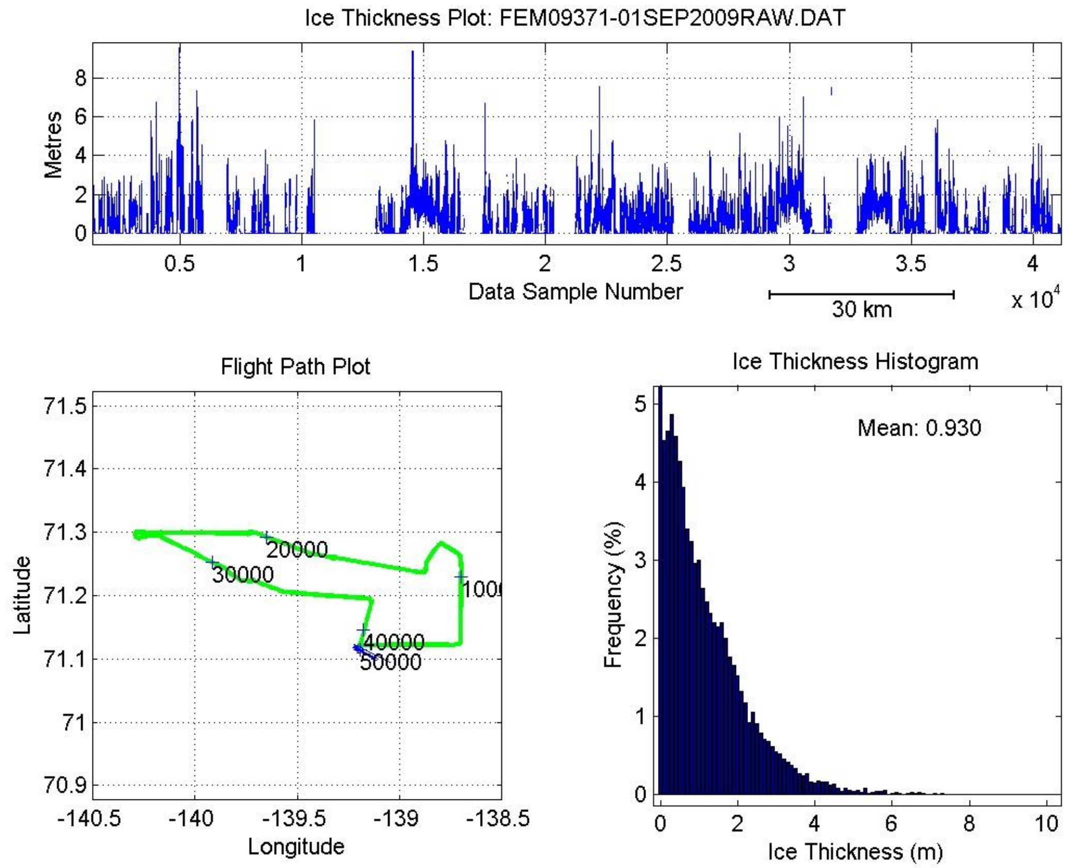


Figure 1: Summary of Sept 1, 2009 Helicopter EMI Survey near station L1. Top: Ice thickness plot, bottom left: transect coordinates, bottom right: histogram of ice thicknesses observed during total flight.

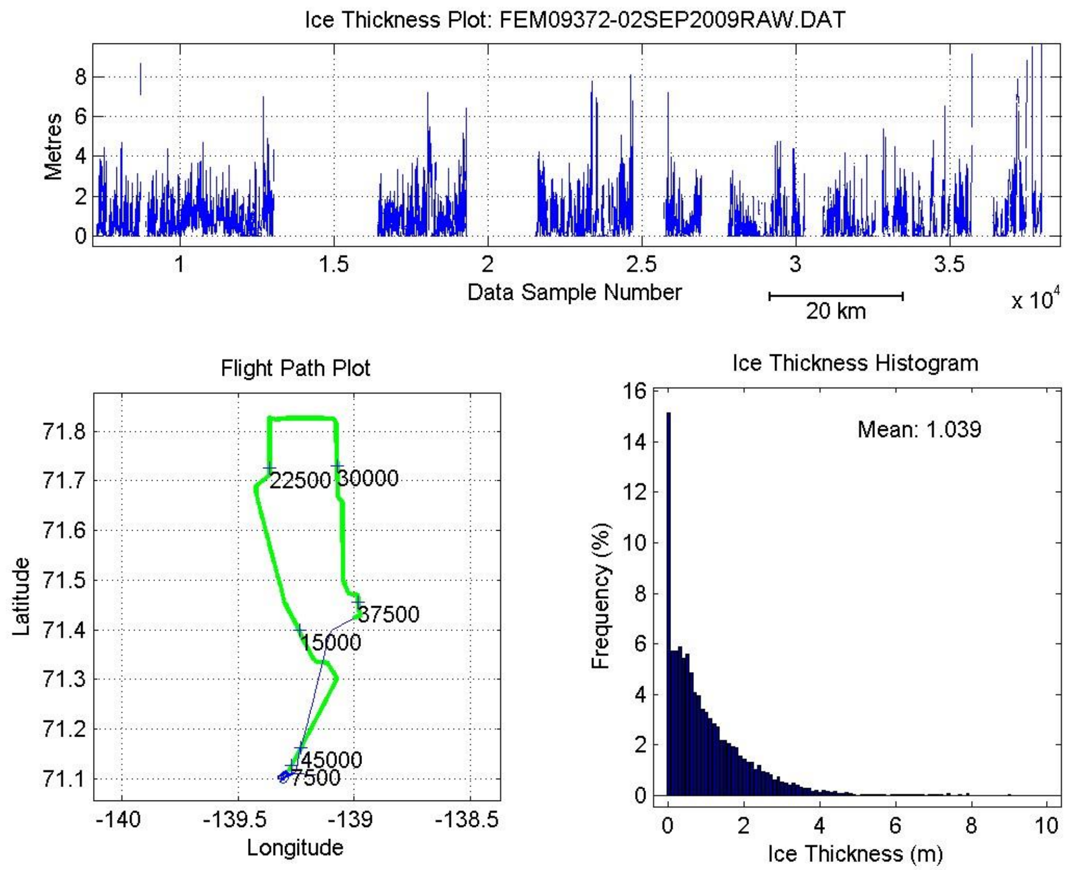


Figure 2: Summary of Sept 2, 2009 (morning) Helicopter EMI Survey near station L1. Top: Ice thickness plot, bottom left: transect coordinates, bottom right: histogram of ice thicknesses observed during total flight.

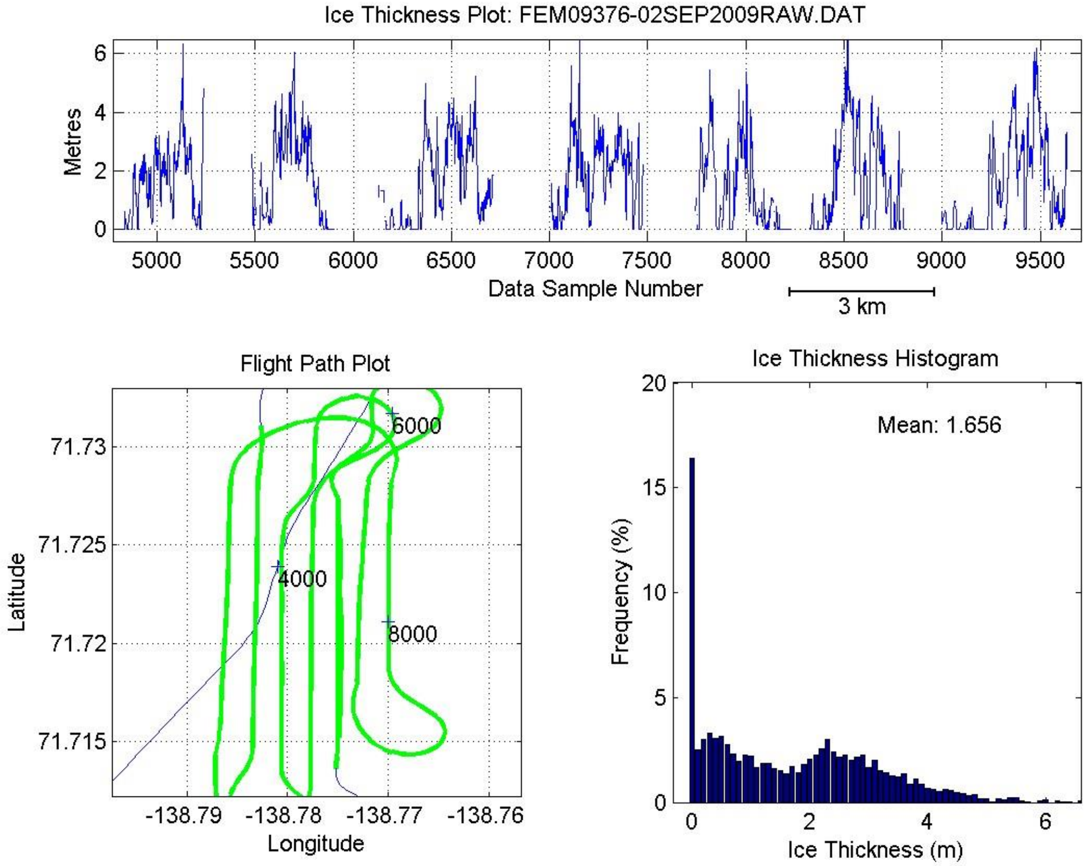


Figure 3: Summary of Sept 2, 2009, (afternoon) Helicopter EMI Survey near station L1. Top: Ice thickness plot, bottom left: transect coordinates, bottom right: histogram of ice thicknesses observed during total flight.

Sea Ice Physical Sampling Activities (Barber Group)

Our group will continue to conduct extensive on-ice physical sampling activities, in parallel with our remote sensing program. At each station, a particular site will be scanned using the scatterometer and SBR. A team of scientists will then be deployed on the ice floe for upwards of 6 hours to collect the following data:

- Ice thickness and freeboard
- Ice temperature profile
- Ice salinity
- Snow temperature, salinity, and density samples (where snow exists)

- Snow grain size
- Melt ponds (area, long-axis dimensions, roughness, fetch, depth)
- On-ice winds
- Site photography

Sampling excursions occurred on Sept 1st, and Sept 2nd, at station L1 and all above-listed parameters were collected.

The Ice tracking beacon deployed at station L1, ID 20590, was replaced with ice beacon ID 289100 as we were unable to confirm that beacon 20590 was functioning correctly. Ice beacon deployment was planned for today (Sept 3rd), but was cancelled due to the occurrence of freezing precipitation. It should be noted that few suitable pieces of ice were observed during the helicopter recon flight for ice motion beacon deployment in this area.

Meteorological Observations (Barber Group)

34. Manual Weather Observations – recorded every 3 hours (00:00, 03:00, 06:00 etc) UTC
    - GPS location
    - Air temperature, wind speed and direction and sea ice percent coverage/type
    - cloud fractional coverage (8/8, 7/8, etc)
    - precipitation type and amount (light, med, heavy)
    - visibility (approx 20 km, 10 km, fog etc)
35. The ceilometer is continuously recording the cloud base height in feet for up to 3 levels.
36. The temperature and water vapour microwave profiler (TP/WVP 3000A) is functional and collecting data. It was down for one hour on Sept 2nd for maintenance.
37. The all-sky camera is functional and collecting data.
38. Balloon launches have continued to capture fly-overs of the A-train satellites. Intensive sampling is planned for tonight (starting 03Z Sept 4th) to profile a moderately intense approaching cyclone.

Micro-Meteorological Observations (Papakyriakou Group)

1. Underway pCO2 System

-pCO2 system has continued to operate adequately.

2. Met/Flux Tower

-The flux tower is now fully operational. The surface temperature sensor (IR transducer) which failed during leg 2b is now repaired and collecting data.
-The closed path eddy covariance system went operational on July 17, and seems to be operating properly.

3. Radiation Array

-The radiation array is continuing to run normally

4. Met-Ocean (3m Discus) Buoy

-The AXYS 3m buoy is ready to be deployed during leg 3B.

5. Surface Buoys

-Surface buoys are ready for deployment during leg 3B.

MetOcean Science Activities Summary Sept 4th – Sept 6th, 2009
University of Manitoba, CEOS

Reporters: Matthew Asplin and David Barber
2100Z, Sept 6th, 2009

Position at time of report: 74 ºN 26.271'   133 º23.178' (stationary).

TAir: +0.2 ºC

RH: 94%

Winds: 14kt at 205º

Summary:

00Z Sept 4th to 06Z Sept 6th were spent collecting data at station L2. Work included physical sampling and EM scanning of the ice floe, weather balloon launches, and a helicopter EMI survey flight that included deployment of three ice motion beacons. We turned eastward and sailed from 0600Z to 1400Z Sept 6th, to an intended station near large multi-year ice floes at 73.908177N, 133.815727W). We arrived at the MYI floe and began preparations to deploy on ice teams. During this period we noted the beginning of a swell propagating into the ice. Over the course of a few hours the MYI completely broke up into small pieces (50 to 100m in size). We noted large long-wave swells propagating under the sea ice. We tied up to a smaller MYI remnant floe with the idea of continuing our work but the lack of open water precluded Rosette and Tracemetal rosette work. After some discussion we decided to return out of the old MYpack towards the west where we then travelled north to 73 30 to conduct station L2. The swell which broke up the MY ice was clearly eviden the next day when we got out of the MY pack to an area more towards the edge of the ice. The swells here had caused significant damage to the pack; breaking it up into small pieces. The strong westerly winds and large swells are attributed to a large, deep cyclone that was situated northwest of our location, producing high seas in open water in the Canada Basin, and Western Beaufort Sea. This storm is moving eastward very slowly, and continues to produce swells at the time of this report. We will complete station L3 around 9pm tonight and sail southeasterly closer to the multiyear ice pack where we will conduct various operations at station L11. The plan for tomorrow is to fly HEMI surveys and install on ice beacons while in transit southwards.

Remote Sensing Activities - (Barber Group)

40. The C-band scatterometer and ship-based radiometers (SBR) are continuing to perform diurnal scans when possible, mainly over multiyear sea ice hummocks, meltponds and newly formed ice.
41. The Ice Thickness camera has been collecting ice thickness images for the 3-day period, including multi-year ice floes. The MY ice was very thick at our MYI station with observations from 8m to 14m in thickness.
42. The Site Camera is logging in transit for sea state conditions, at a rate of 60 frames per hour.
43. The EMI system was deployed on Sept 4^{th}, and Sept 6^{th} (more below).

EMI Helicopter Surveys / Ice Motion Beacons

Weather conditions permitted EMI helicopter surveys to be conducted over old, FY ice floes on Sept 4, 2009 (figure 1). On Sept 4^{th}, three ice beacons were deployed in a triangular configuration on small, but thick (2.3 – 3.3m) first-year and young MY ice floes. EMI surveys were conducted along the beacon deployment configuration. The beacon configuration was modified slightly from an equilateral triangle to account for ice conditions (very few suitable floes for installation). EMI Data from each leg of the triangle is presented in Figures 2 – 4.

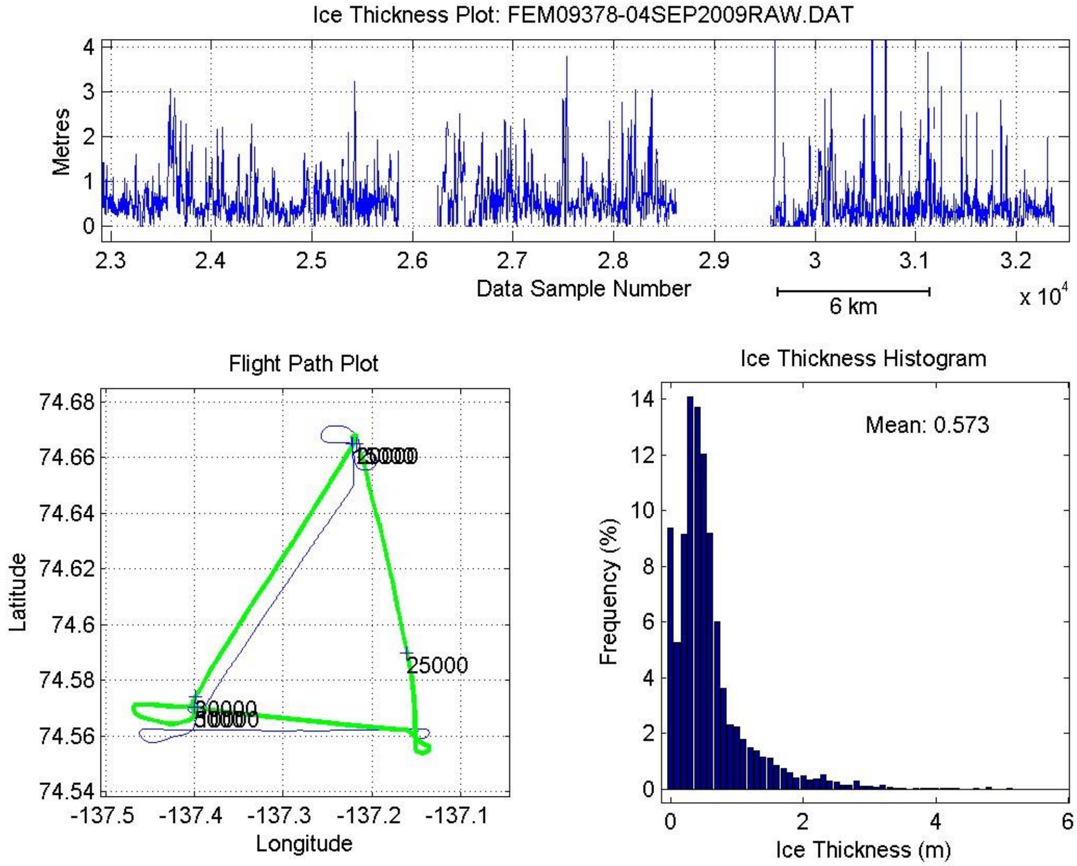


Figure 1: Summary of Sept 4, 2009 Helicopter EMI Survey over old, first-year ice floes with beacon deployment. Top: Ice thickness plot, bottom left: triangular transect coordinates, bottom right: histogram of ice thicknesses observed during total flight.

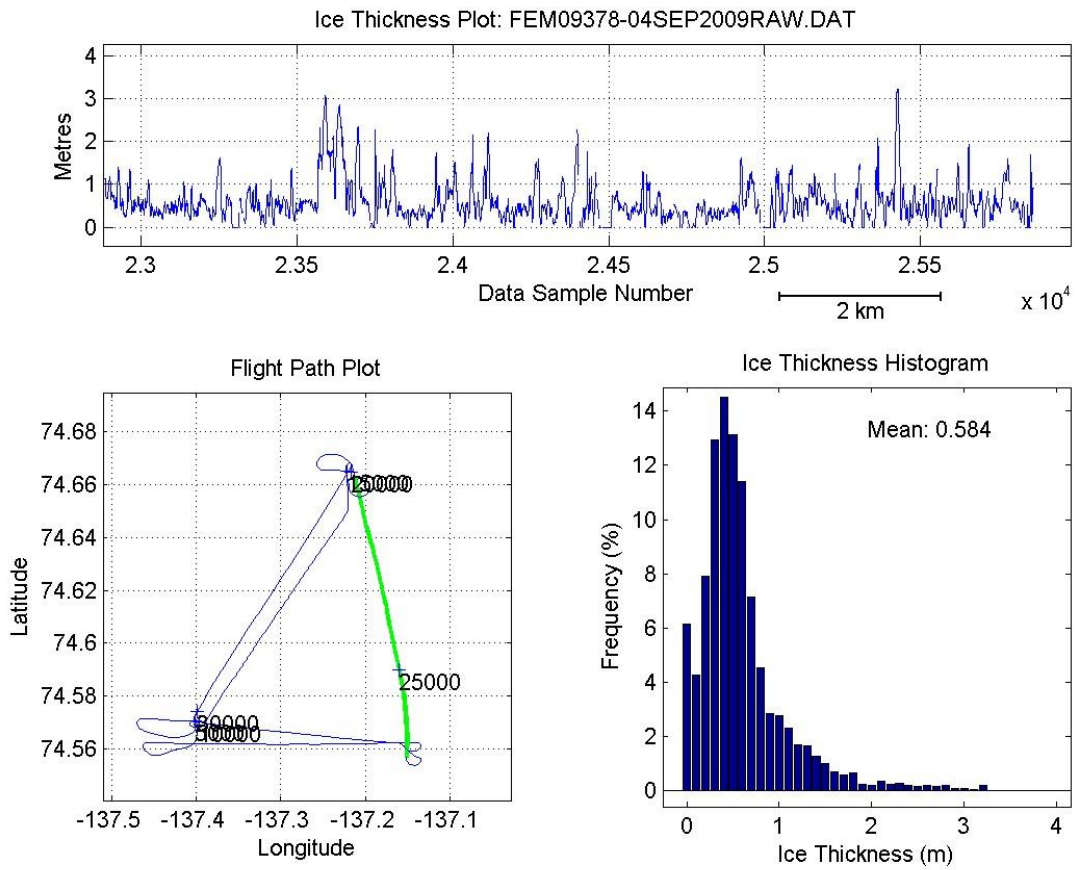


Figure 2: EMI Survey of the northeast leg of triangular beacon deployment Sept 4, 2009. Top: Ice thickness plot, bottom left: transect coordinates, bottom right: histogram of ice thicknesses observed during total flight.

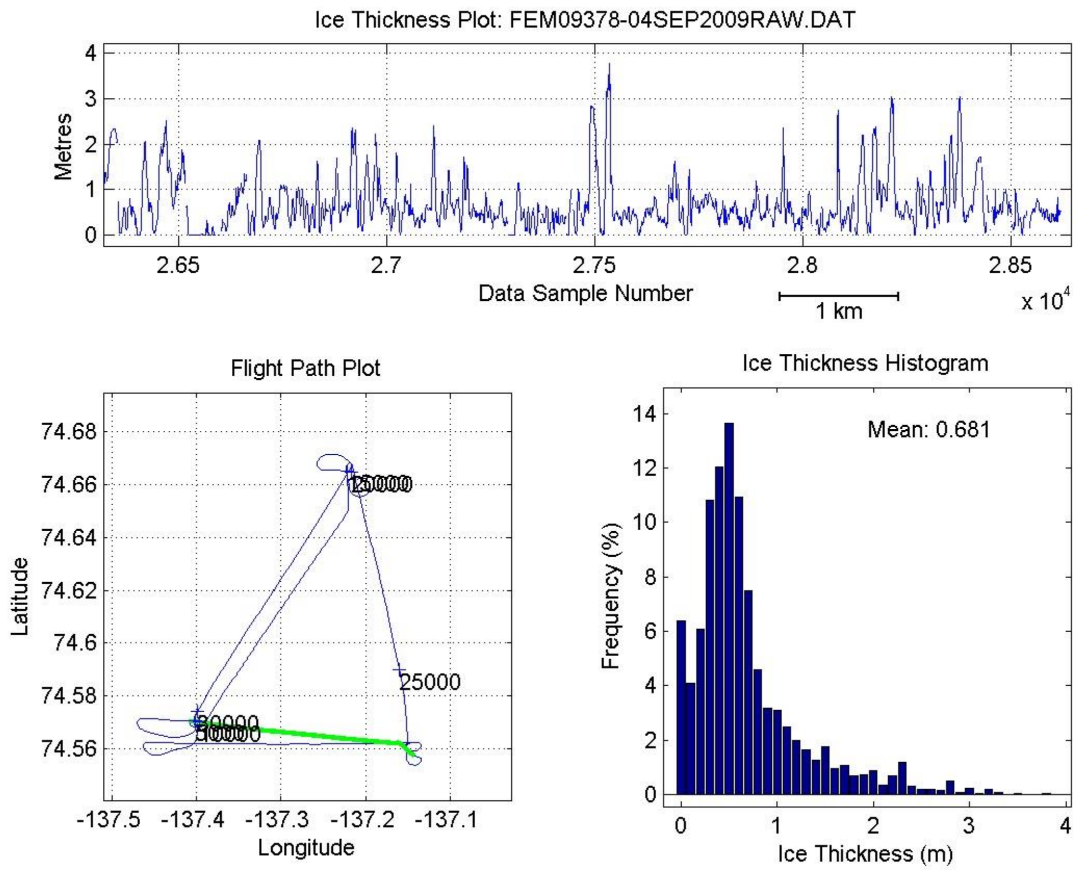


Figure 3: EMI Survey of the south leg of triangular beacon deployment Sept 4, 2009. Top: Ice thickness plot, bottom left: transect coordinates, bottom right: histogram of ice thicknesses observed during total flight.

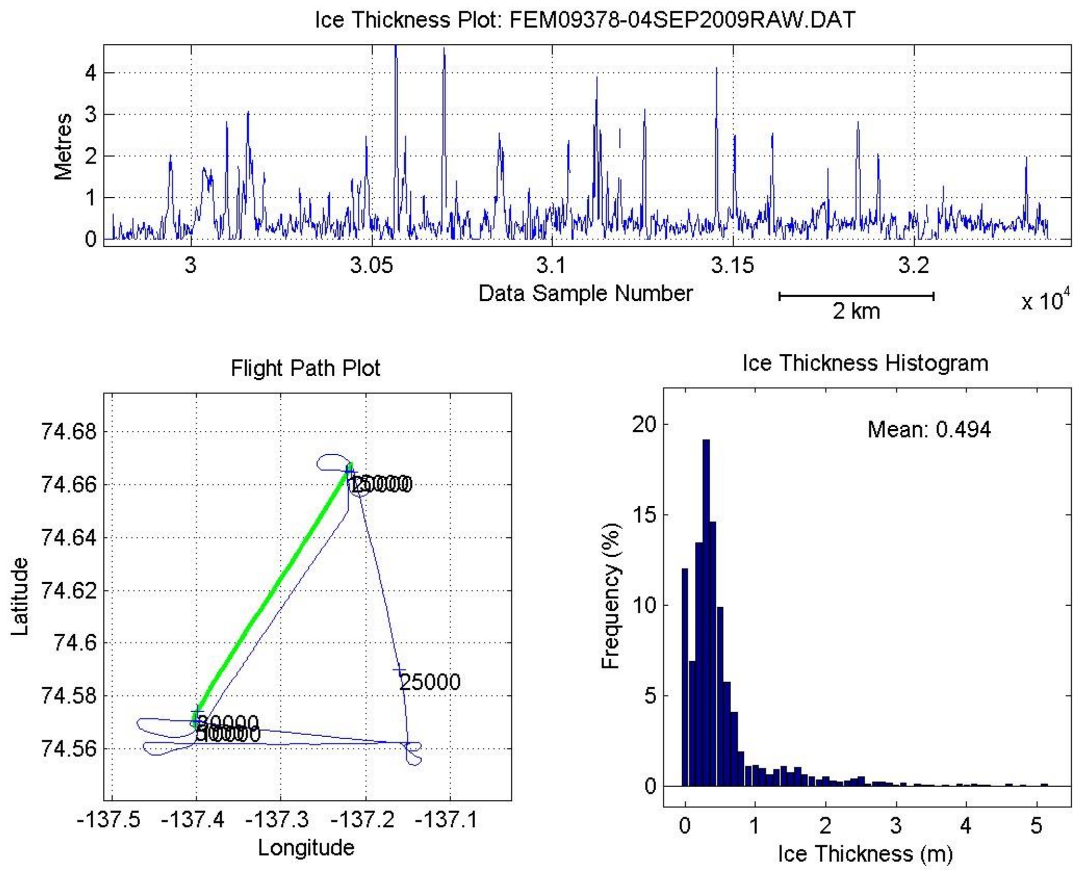


Figure 4: EMI Survey of the northwest leg of triangular beacon deployment Sept 4, 2009. Top: Ice thickness plot, bottom left: transect coordinates, bottom right: histogram of ice thicknesses observed during total flight.

On Sept 6th, the ship arrived in a region of thick multi-year ice floes (73.908177N, 133.815727W). An EMI Helicopter survey was conducted while we attempted to moor the ship to an ice floe. The helicopter was airborne when the swell-driven break-up of the pack ice occurred (Figure 5).

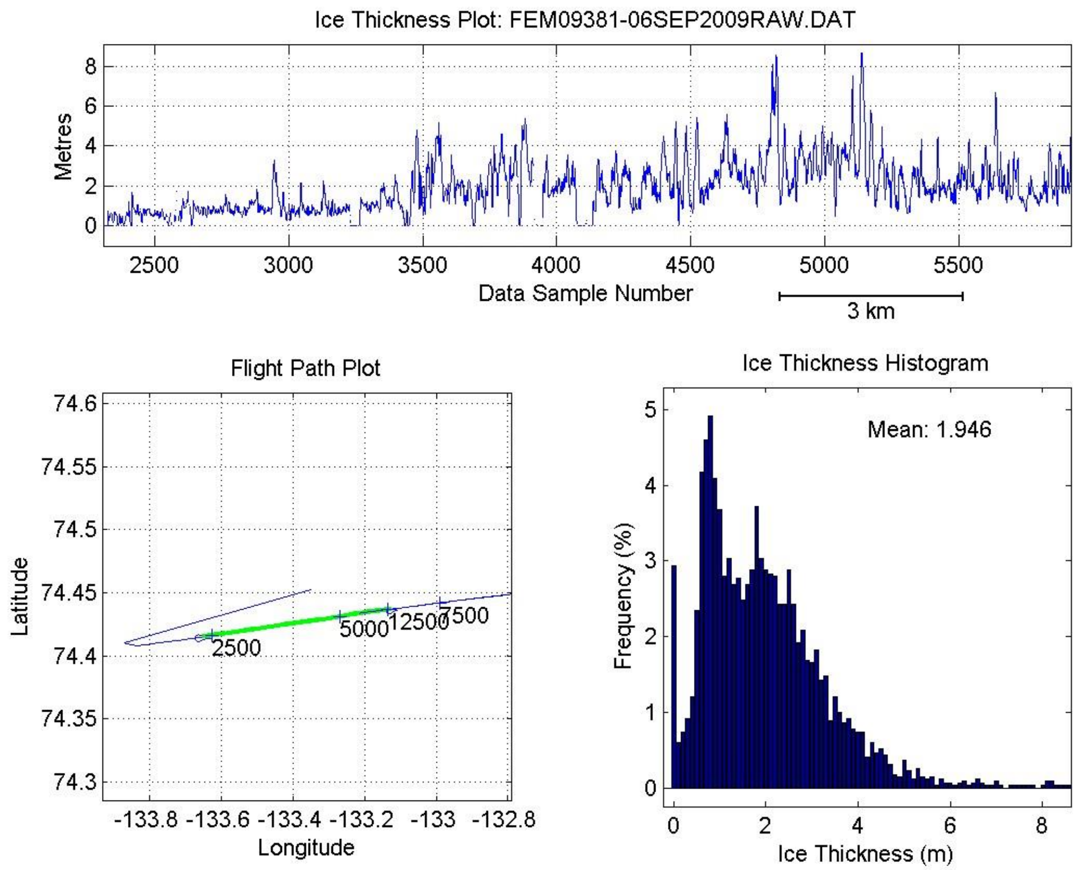


Figure 5: Summary of Sept 6, 2009 Helicopter EMI east-to-west survey flight from relatively thin first-year ice to multi-year ice floes. Top: Ice thickness plot, bottom left: transect coordinates, bottom right: histogram of ice thicknesses observed during the 'green' portion of the flight line above.

An ice motion tracking (beacon Id# 20590) was deployed on a multi-year floe in this area before departure.

Sea Ice Physical Sampling Activities (Barber Group)

Our group will continue to conduct extensive on-ice physical sampling activities, in parallel with our remote sensing program. We will continue to conduct scans with the scatterometer and SBR as opportunity arise. A team of scientists will then be deployed via ice cage, or directly onto the floe to collect the following data:

- Ice thickness and freeboard

- Ice temperature profile
- Ice salinity
- Snow temperature, salinity, and density samples (where snow exists)
- Snow grain size
- Melt ponds (area, long-axis dimensions, roughness, fetch, depth)
- On-ice winds
- Site photography

Sampling excursions occurred Sept 4 – 6th.

Ice Mass-Balance Buoys

We have successfully installed one ice mass balance beacon at station L11. We will be revisiting the buoy tomorrow (Sept 10$^{)}$ to confirm that is it fully functional, and frozen in place.

Meteorological Observations (Barber Group)

39. Manual Weather Observations – recorded every 3 hours (00:00, 03:00, 06:00 etc) UTC
    - GPS location
    - Air temperature, wind speed and direction and sea ice percent coverage/type
    - cloud fractional coverage (8/8, 7/8, etc)
    - precipitation type and amount (light, med, heavy)
    - visibility (approx 20 km, 10 km, fog etc)
40. The ceilometer is continuously recording the cloud base height in feet for up to 3 levels.
41. The temperature and water vapour microwave profiler (TP/WVP 3000A) is functional and collecting data.
42. The all-sky camera is functional and collecting data.
43. Balloon launches have continued to capture fly-overs of the A-train satellites.

Micro-Meteorological Observations (Papakyriakou Group)

1. Underway pCO2 System

-pCO2 system has continued to operate adequately.

2. Met/Flux Tower

-The flux tower is now fully operational. The surface temperature sensor (IR transducer) which failed during leg 2b is now repaired and collecting data.
-The closed path eddy covariance system went operational on July 17, and seems to be operating properly.

3. Radiation Array

-The radiation array is continuing to run normally

4. Met-Ocean (3m Discus) Buoy

-The AXYS 3m buoy is ready to be deployed during leg 3B.

5. Surface Buoys

-Surface buoys are ready for deployment during leg 3B.

MetOcean Science Activities Summary Sept 7th – Sept 9th, 2009
University of Manitoba, CEOS

Reporters: Matthew Asplin and David Barber
2100Z, Sept 9th, 2009

Position at time of report: 72 ºN 29.972’ 136 º45.890’ (stationary at station L11).

TAir: -2.8 ºC

RH: 94%

Winds: 16kt at 080º

Summary:

Sampling activities at station L3 (75.31N, -137.59W) were completed Sept 7th at approximately 9:00pm Sept 7th, as anticipated. Sampling activities were predominantly rosette casts, but we managed to get two short helicopter EMI flights in before weather conditions made flight difficult. We then transited to the southeast, to get us closer to the multiyear pack ice, but also remain in an area of open water for rosette operations. We were en route to station, L11 at 72.51N, -136.79W, until about 5:00pm LST on Sept 8th. We observed considerable fracturing of the pack ice along the entire route, from the previous days large storm-driven swells. Two HEMI flights were flown during transit the morning and afternoon of Sept 8th, and included deployment of two triangular arrays of on ice beacons. These were also flown with the HEMI to get ice thickness, roughness and video along each axis of the 2 triangles. Upon arrival at site L11, we selected a sampling site nearby a suitable floe for deployment of an ice mass balance buoy. Deployment of the ice mass balance buoy occurred on Sept 9th, along with regular physical sampling activities. Weather conditions were excellent on Sept 9th, and allowed long-transect HEMI flights to be conducted. Further HEMI survey work is planned for Sept 10th (weather permitting). We plan to spend a couple hours tomorrow evening (1800 – 2000hrs) conducting some EM scans of ice floes, and then will be en route to Paulatuk for the crew change on Sept 12th. Sept. 10th will be the last day for all sampling activities.

Remote Sensing Activities - (Barber Group)

44. The C-band scatterometer and ship-based radiometers (SBR) are continuing to perform diurnal scans when possible, mainly over multiyear sea ice hummocks, meltponds and newly formed ice. The SBR continues to collect data in transit mode otherwise.
45. The Ice Thickness camera continues to monitor ice thickness.
46. The Site Camera is logging in transit for sea state conditions, at a rate of 60 frames per hour.

EMI Helicopter Surveys / Ice Motion Beacons

EMI helicopter surveys were conducted at numerous opportunities from September 7th – 9th
Two flights occurred on Sept. 7th, with EM and video. Both flights starting at 0940 and 1320 LST were cut short due to weather conditions, and only flights near the ship were done. Two HEMI and video flights were conducted on Sept 8th, commencing at 0915 and 1500 respectively. Each flight consisted of deployment of three ice motion tracking beacons in a triangular configuration, with EMI and video surveys conducted along the triangle afterwards. Long-flight HEMI surveys were conducted on Sept 9th. Data visualizations for this report will focus on HEMI surveys flown for the two triangular ice beacon deployment flights conducted on Sept 8th (Figure 1 and 2). A summary plot for the Sept 9th long survey eastward from station L11 was still being processed at the time of this report.

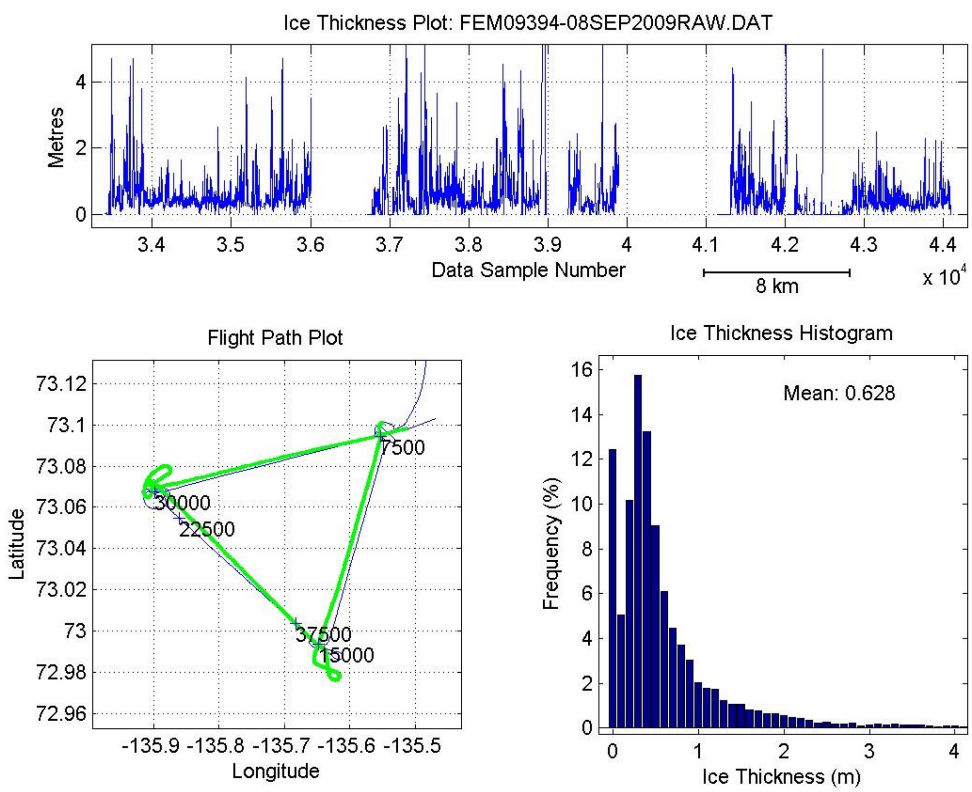


Figure 1: Summary of Sept 8, 2009 morning HEMI Survey over old, first-year ice floes with beacon deployment. Top: Ice thickness plot, bottom left: triangular transect coordinates, bottom right: histogram of ice thicknesses observed during total flight.

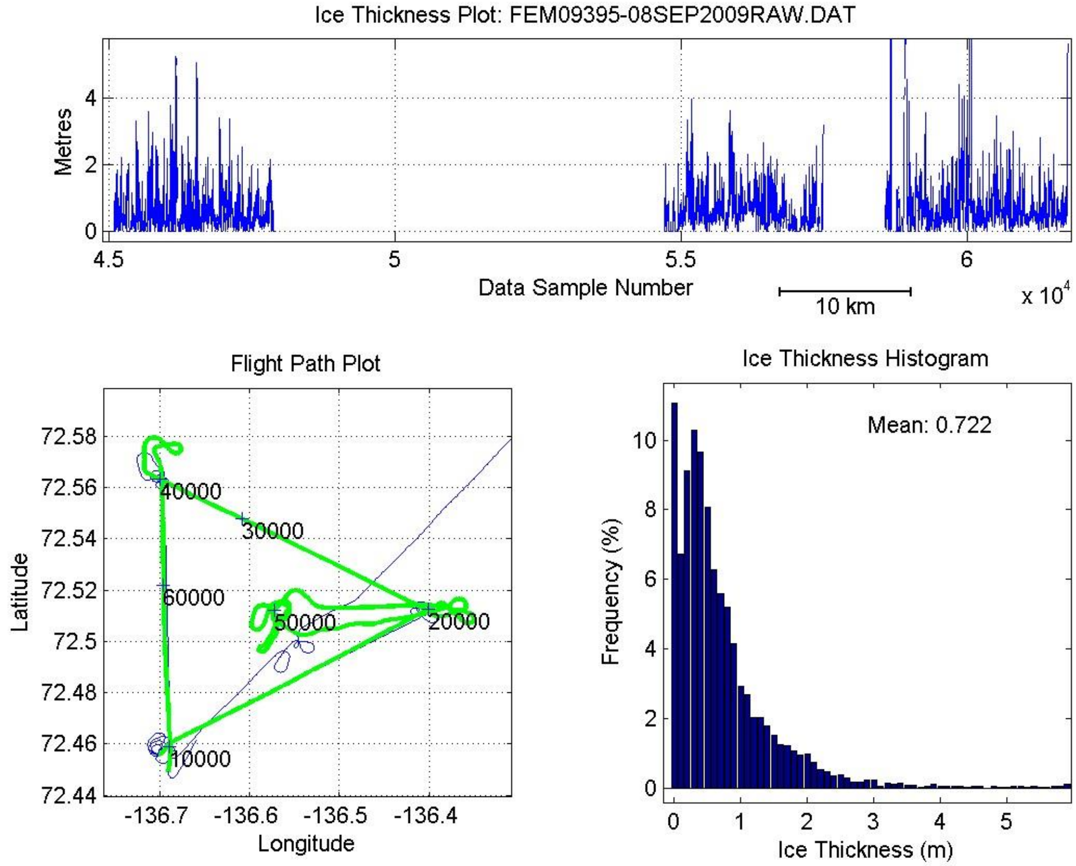


Figure 2: Summary of Sept 8, 2009 afternoon HEMI Survey over old, first-year ice floes with beacon deployment. Top: Ice thickness plot, bottom left: triangular transect coordinates, bottom right: histogram of ice thicknesses observed during total flight. Note that this beacon configuration includes the ice mass balance buoy deployed station L11 (centre of the triangular deployment configuration).

Beacon ID	Date and Time (LST)	Latitude	Longitude
281100	Sept 8, 0941	73 05.68	135 33.25
284060	Sept 8, 1003	72 59.61	135 38.92
286060	Sept 8, 1014	73 04.15	135 53.36
287060	Sept 8, 1524	72 27.53	136 41.33
280110	Sept 8, 1549	72 30.76	136 24.05
282070	Sept 8, 1405	72 33.77	136 41.88

Sea Ice Physical Sampling Activities (Barber Group)

Our group will continue to conduct extensive on-ice physical sampling activities, in parallel with our remote sensing program. We will continue to conduct scans with the scatterometer and SBR as opportunity arise. A team of scientists will then be deployed via ice cage, or directly onto the floe to collect the following data:

- Ice thickness and freeboard
- Ice temperature profile
- Ice salinity
- Snow temperature, salinity, and density samples (where snow exists)
- Snow grain size
- Melt ponds (area, long-axis dimensions, roughness, fetch, depth)
- On-ice winds
- Site photography

Sampling excursions occurred from the ice cage on Sept 7th, and by on-ice deployment on Sept 9th.

Ice Mass-Balance Buoys

We have successfully installed one ice mass balance beacon at station L11. We will be revisiting the buoy tomorrow (Sept 10) to confirm that is it fully functional, and properly installed in place.

Meteorological Observations (Barber Group)

44. Manual Weather Observations – recorded every 3 hours (00:00, 03:00, 06:00 etc) UTC
    - GPS location
    - Air temperature, wind speed and direction and sea ice percent coverage/type
    - cloud fractional coverage (8/8, 7/8, etc)
    - precipitation type and amount (light, med, heavy)
    - visibility (approx 20 km, 10 km, fog etc)
45. The ceilometer is continuously recording the cloud base height.

46. The temperature and water vapour microwave profiler (TP/WVP 3000A) is functional and collecting data.
47. The all-sky camera is functional and collecting data.
48. Balloon launches have continued to capture fly-overs of the A-train satellites.
49. The Surface roughness (MOBS) buoy was deployed Sept 9th, from 1030(LST) to 1600(LST)

Micro-Meteorological Observations (Papakyriakou Group)

1. <u>Underway pCO2 System</u>

-pCO2 system has continued to operate adequately.

2. <u>Met/Flux Tower</u>

-The flux tower is now fully operational. The surface temperature sensor (IR transducer) which failed during leg 2b is now repaired and collecting data.
-The closed path eddy covariance system went operational on July 17, and seems to be operating properly.

3. <u>Radiation Array</u>

-The radiation array is continuing to run normally

4. <u>Met-Ocean (3m Discus) Buoy</u>

-The AXYS 3m buoy is ready to be deployed during leg 3B.

5. <u>Surface Buoys</u>
-Surface buoys are ready for deployment during leg 3B.

MetOcean Science Activities Summary Sept 10th – Sept 12th, 2009
University of Manitoba, CEOS

Reporters: Matthew Asplin and David Barber
2100Z, Sept 11th, 2009

Position at time of report: 71 ºN 05.972' 141 ºW 27.890' (en route to Paulatuk).

TAir: 3.0 ºC

RH: 94%

Winds: 22kt at 080º

Summary:

Prior to our departure from station L11, we were able to use the ship to conduct EM scans of some ice floes in the vicinity; however, due to rapidly deteriorating weather conditions, our activities were limited to on-ship activities only. Scheduled on-ice and helicopter activities were cancelled due to very poor visibility, and strong winds. We are now en route to Paulatuk for the crew change on Sept 12th. All MetOcean science activities will resume after the commencement of leg 3B.

Remote Sensing Activities - (Barber Group)

47. The C-band scatterometer and ship-based radiometers (SBR) are continuing to perform diurnal scans when possible, mainly over multiyear sea ice hummocks, meltponds and newly formed ice. The SBR continues to collect data in transit mode otherwise.
48. The Ice Thickness camera is not in operation during our transit through open water.
49. The Site Camera is logging in transit for sea state conditions, at a rate of 60 frames per hour.

EMI Helicopter Surveys / Ice Motion Beacons

EMI helicopter surveys scheduled for September 10th were cancelled due to poor weather conditions. Surveys will resume during leg 3B at every possible opportunity, and will be conducted by Klaus Hochheim (CEOS).

Sea Ice Physical Sampling Activities (Barber Group)

Our group will continue to conduct extensive on-ice physical sampling activities, in parallel with our remote sensing program. We will continue to conduct scans with the scatterometer and SBR as opportunity arise. A team of scientists will then be deployed via ice cage, or directly onto the floe to collect the following data:

- Ice thickness and freeboard
- Ice temperature profile
- Ice salinity
- Snow temperature, salinity, and density samples (where snow exists)
- Snow grain size
- Melt ponds (area, long-axis dimensions, roughness, fetch, depth)
- On-ice winds
- Site photography

No sampling excursions occurred on September 10th due to bad weather.

Ice Mass-Balance Buoys

We have successfully installed one ice mass balance beacon at station L11.

Meteorological Observations (Barber Group)

50. Manual Weather Observations – recorded every 3 hours (00:00, 03:00, 06:00 etc) UTC
    - GPS location
    - Air temperature, wind speed and direction and sea ice percent coverage/type
    - cloud fractional coverage (8/8, 7/8, etc)
    - precipitation type and amount (light, med, heavy)
    - visibility (approx 20 km, 10 km, fog etc)
51. The ceilometer is continuously recording the cloud base height.
52. The temperature and water vapour microwave profiler (TP/WVP 3000A) is functional and collecting data.
53. The all-sky camera is functional and collecting data.
54. Balloon launches have continued to capture fly-overs of the A-train satellites.
55. The Surface roughness (MOBS) buoy was deployed Sept 9th, from 1030(LST) to 1600(LST)

Micro-Meteorological Observations (Papakyriakou Group)

1. <u>Underway pCO2 System</u>

-pCO2 system has continued to operate adequately.

2. <u>Met/Flux Tower</u>

-The flux tower is now fully operational. The surface temperature sensor (IR transducer) which failed during leg 2b is now repaired and collecting data.
-The closed path eddy covariance system went operational on July 17, and seems to be operating properly.

3. <u>Radiation Array</u>

-The radiation array is continuing to run normally

4. <u>Met-Ocean (3m Discus) Buoy</u>

-The AXYS 3m buoy is ready to be deployed during leg 3B.

5. <u>Surface Buoys</u>
-Surface buoys are ready for deployment during leg 3B.

MetOcean Science Activities Summary Sept 12th – Sept 15th, 2009
University of Manitoba, CEOS

Reporters: Klaus Hochheim and Tim Papakyriakou
2100Z, Sept 15th, 2009

Position at time of report: 70 ºN 44.759’ 136 º22.57’ (Ajurak Block)

TAir: 2.1 ºC

RH: 99%

Fog

Summary:

Crew change was completed late September 12, out of Paulatuk. The Ajurak Block is completely ice free, the pack is approximately 60mn north and west of the survey area. Wind and sea state have been variable, with temperatures hovering around freezing. Sky conditions have largely been overcast, to broken cloud coverage.

Remote Sensing Activities - (Barber Group)

50. The C-band scatterometer is functional, not being used currently due to ice free conditions. Ship-based radiometers (SBR) continue to run in transit mode.
51. The Ice Thickness camera off.
52. The Site Camera is logging in transit for sea state conditions, at a rate of 60 frames per hour.
53. As of yet no near surface hyperspectral ocean profiling work has been conducted, due to mapping activities etc., nor ocean surface roughness measurements (MOBS buoy). These will commence once coring activities begin providing opportunity for the deployment of the zodiac.
54. The EM Induction /video system has been mounted and ground tested. Flight test will be conducted on September 16. The photogrammetric camera has been tested and mounted as well. The system will be deployed once we are in range of pack ice weather permitting.

Meteorological Observations (Barber Group)

56. Manual Weather Observations – recorded every 3 hours (00:00, 03:00, 06:00 etc) UTC
    - GPS location
    - Air temperature, wind speed and direction and sea ice percent coverage/type
    - cloud fractional coverage (8/8, 7/8, etc)
    - precipitation type and amount (light, med, heavy)
    - visibility (approx 20 km, 10 km, fog etc)
57. The ceilometer is continuously recording the cloud base height.
58. The temperature and water vapour microwave profiler (TP/WVP 3000A) is functional and collecting data.
59. The all-sky camera is functional and collecting data.

60. Balloon launches will commence shortly.

61. The Surface roughness (MOBS) buoy was deployed Sept 9th, from 1030(LST) to 1600(LST)

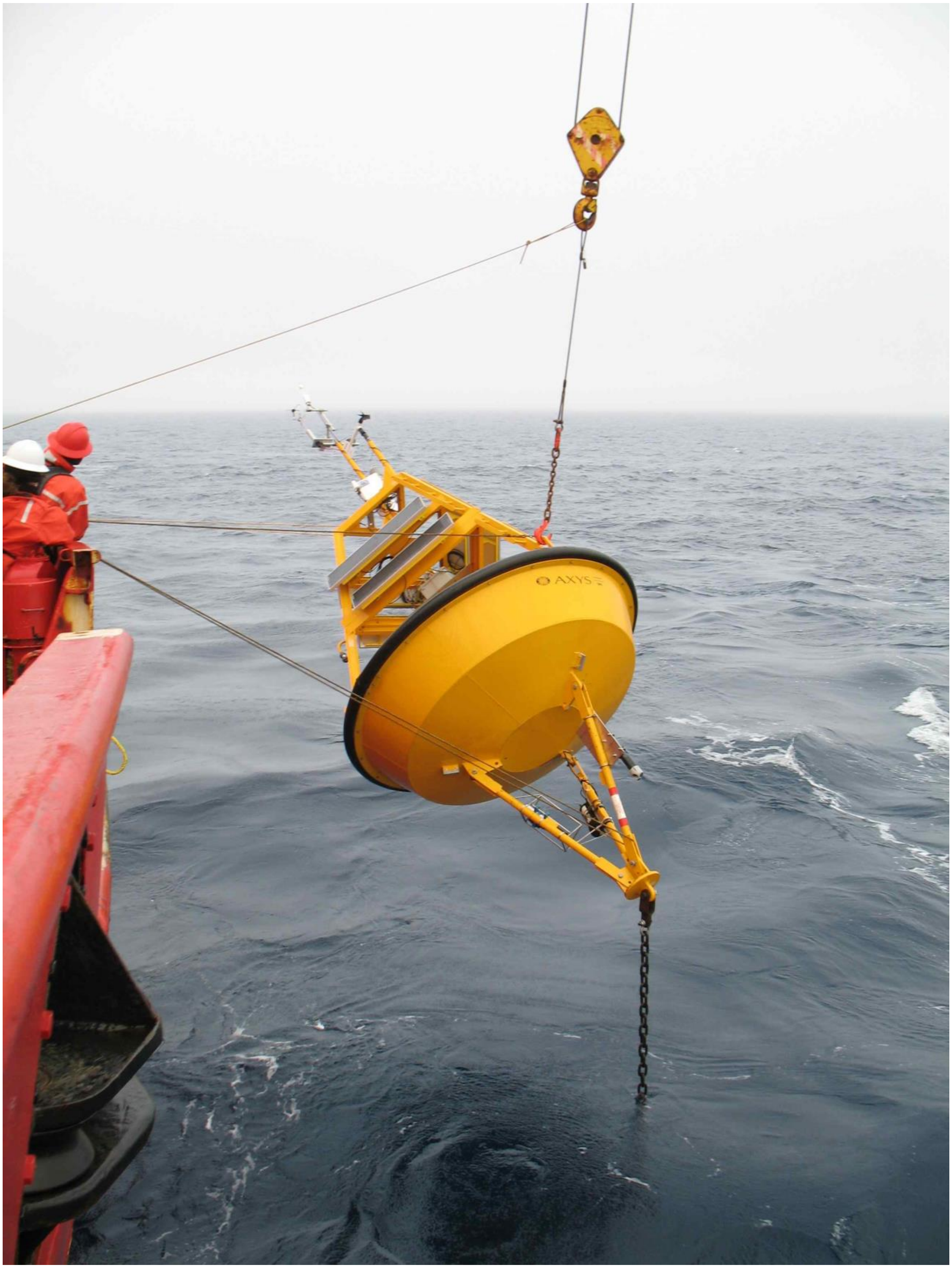
Micro-Meteorological Observations (Papakyriakou Group)

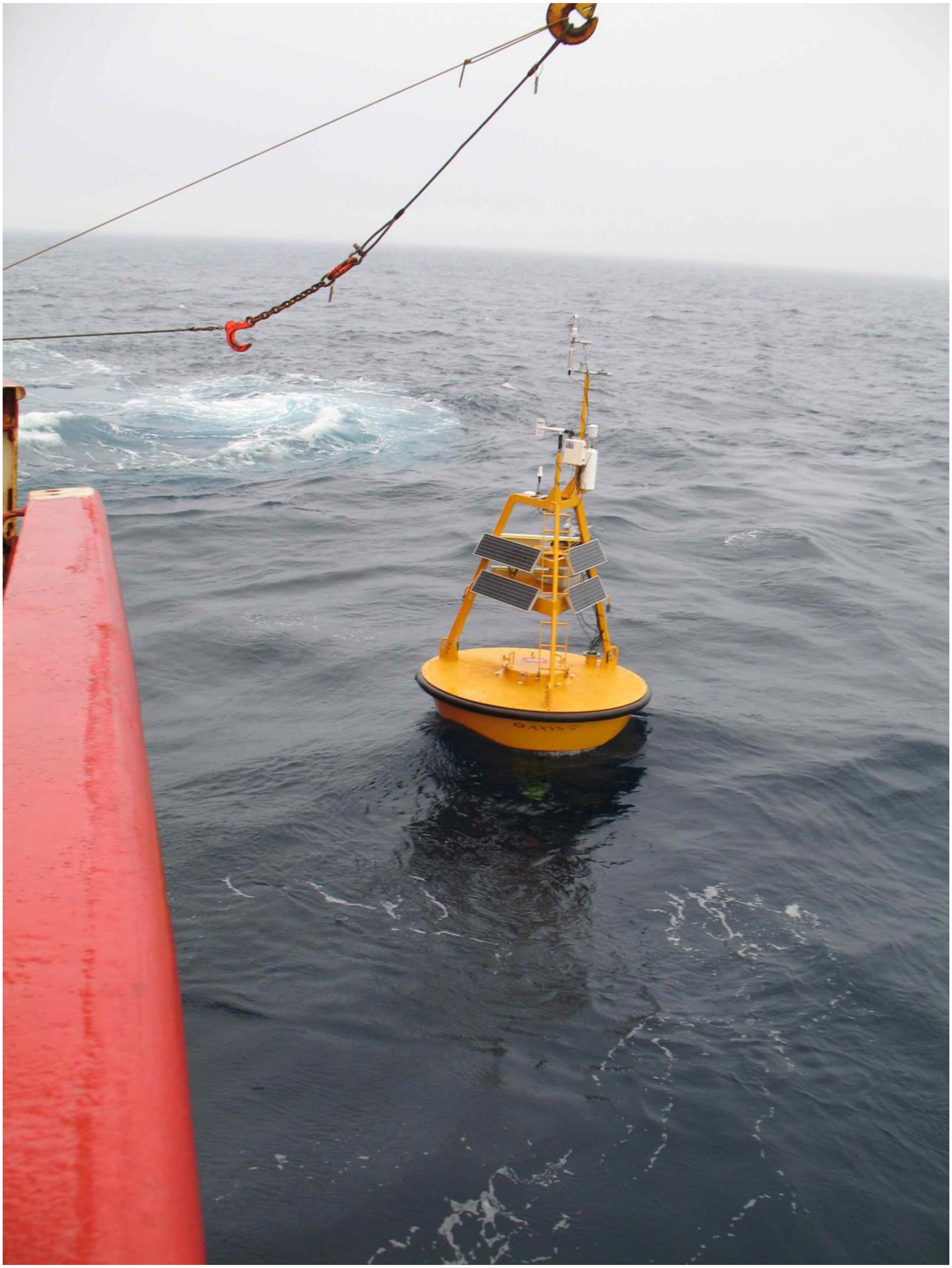
1. Underway pCO2 System
-pCO2 system has continued to operate adequately.

2. Met/Flux Tower
-The flux tower on the foredeck is fully operational.

3. Radiation Array
-The radiation array is continuing to run normally

4. Met-Ocean (3m Discus) Buoy
-The 3m ODAS buoy was deployed today (Sept. 15, 19:43 UTC) at 70° 43.918N, 136 01.036W – approximately 3 km south of mooring A1. A subset of the resulting data are telemetered every hour. Data have been received and appear good. The secondary surface layer buoys are scheduled to be deployed Sept. 16 (AM) – one near to the ODAS buoy and the other by mooring B (~ 70 39.57N; 135 36.30W). Attached is a small sample of raw data output (time in UTC), as is a photo of the buoy.


AXYS



MetOcean Science Activities Summary Sept 19th – Sept 22 nd, 2009

University of Manitoba, CEOS

Reporters: Klaus Hochheim and Tim Papakyriakou
23:00Z, Sept 23th, 2009

Position at time of report: N70 º 48.34 W135 º36.28 (Ajurak Block)

T_{Air} : 1.5 ºC

Winds 20 kts at 88º

Rh 99%, foggy

Overcast

Summary:

Activities during this period as proceeding as normal. Ship activities are mainly revolving around coring, mooring and sea floor mapping. The MetOcean activities are listed below. Winds have been consistently high with high seas.

Remote Sensing Activities - (Barber Group)

55. The C-band scatterometer is functional, not being used currently due to ice free conditions. Ship-based radiometers (SBR) continue to run in transit mode.
56. The Ice Thickness camera off.
57. The Site Camera is logging in transit for sea state conditions, at a rate of 60 frames per hour.
58. As of yet no near surface hyperspectral ocean profiling work has been conducted, due to mapping activities etc., nor ocean surface roughness measurements (MOBS buoy). These will commence once opportunities arise for deployment of the zodiac.
59. The **EM Induction /video system** has not been deployed during this period due to unforvorable flying condition and distance to ice pack (60nm).

Meteorological Observations (Barber Group)

Manual Weather Observations – recorded every 3 hours (00:00, 03:00, 06:00 etc) UTC

- GPS location
- cloud fractional coverage (8/8, 7/8, etc)
- precipitation type and amount (light, med, heavy)
- visibility (approx 20 km, 10 km, fog etc)
- from AVOS record temperature, wind speed and direction and sea ice percent coverage/type

Ceilometer is still running problem free and continuously recording the cloud base height in feet for up to 3 levels. Maintenance is being done to keep the window clear.

The Microwave Profiler is still recording error free. Next scheduled maintenance will be done in a weeks time.

The All Sky camera is running as usual and recording an image every 15 minutes.

The laser precip. gauge is mounted and running on the micro-meteorological tower at the front of the ship.

Micro-Meteorological Observations (Papakyriakou Group)

1. Underway pCO2 System

-pCO2 system is operational.

2. Met/Flux Tower

-The flux and met sensors on the foredeck tower are working, with the exception of our IR transducer for surface temperature and one of our barometers. Data is still being logged from a second barometer as part of the eddy correlation system. Waves from the last storm damaged the IR transducer.

3. Radiation Array

-The radiation array is continuing to run normally

4. Met-Ocean (3m Discus) Buoy

-The AXYS 3m ODAS buoy is holding station and transmitting data hourly.

5. Surface Buoys

-The surface buoys are holding station.

MetOcean Science Activities Summary Sept 23th – Sept 26 th, 2009
University of Manitoba, CEOS

Reporters: Klaus Hochheim and Tim Papakyriakou
17:00Z, Sept 27th, 2009

Position at time of report: N70º 35.428 W135º45.06 (Ajurak Block)

T_{Air} -0.2ºC

Winds 18 kts at 240^{o}

Rh 87%, Isolated flurries

Broken Overcast

Summary:

Activities during this period as proceeding as normal. Ship activities are mainly revolving around coring, mooring, and sea floor mapping. Sea state conditions improved between September 25 – 26 thus permitting off ship activities. The MetOcean activities are listed below.

Remote Sensing Activities - (Barber Group)

60. The C-band scatterometer is functional, not being used currently due to ice free conditions. Ship-based radiometers (SBR) continue to run in transit mode.
61. The Ice Thickness camera off.
62. The Site Camera is logging in transit for sea state conditions, at a rate of 60 frames per hour.
63. Hyperspectral ocean profiling work was conducted on 25th and 26th due to improved sea state conditions and availability of the zodiac. On the 25th two profiles were made in the vicinity of the AXYS 3m ODAS buoy, this trip was more time constrained due to buoy servicing activities during the same trip. The following day was a dedicated hyperspectral profiling trip, another 9

profiles were made near coring station CL-13. More profiles are anticipated depending on sea state and zodiac availability.

64. The **EM Induction /video system** has not been deployed during this period due to unpredictable flying weather conditions (low overcast/snow showers) and distance to ice pack (60nm).

Meteorological Observations (Barber Group)

Manual Weather Observations – recorded every 3 hours (00:00, 03:00, 06:00 etc) UTC

- GPS location
- cloud fractional coverage (8/8, 7/8, etc)
- precipitation type and amount (light, med, heavy)
- visibility (approx 20 km, 10 km, fog etc)
- from AVOS record temperature, wind speed and direction and sea ice percent coverage/type

Ceilometer is still running problem free and continuously recording the cloud base height in feet for up to 3 levels. Maintenance is being done to keep the window clear.

The Microwave Profiler is still recording error free. The radome filter has been changed and the LN2 calibration is scheduled for September 27.

The All Sky camera is running as usual and recording an image every 15 minutes.

The laser precip. gauge is mounted and running on the micro-meteorological tower at the front of the ship.

Micro-Meteorological Observations (Papakyriakou Group)

1. <u>Underway pCO2 System</u>

-pCO2 system is operational.

2. <u>Met/Flux Tower</u>

-The flux and met sensors on the foredeck tower are working, with the exception of our IR transducer for surface temperature. The problematic barometer associated with the met system was replaced on the 26th, and surface pressure is again being logged as part of both our met, and flux systems.

3. Radiation Array

-The radiation array is continuing to run normally

4. Met-Ocean (3m Discus) Buoy

-The AXYS 3m ODAS buoy is holding station and transmitting data hourly.

5. Surface Buoys

-The surface buoys are holding station.

MetOcean Science Activities Summary Sept 27th – Oct 1st, 2009
University of Manitoba, CEOS

Reporters: Klaus Hochheim and Tim Papakyriakou
14:00Z, Oct 2, 2009

Position at time of report: N70º 47 W136º05 (Ajurak Block)

T_{Air} -4.4 ºC

Winds 9 kts at 272º

Rh 75%,

Overcast/occasional flurries

Summary:

Activities during this period as proceeding as normal. Ship activities are mainly revolving around coring, mooring deployment and retrieval, and sea floor mapping. The sea ice has been moving closer to the ship and some isolated streamers are within the Ajurak block(<30% SIC) consisting of small floes, the main pack ice remains approximately 60mn to North. These is some formation of new ice in northern portion of the block (October 1).

The MetOcean activities are listed below.

Remote Sensing Activities - (Barber Group)

65. The C-band scatterometer is functional. Ship-based radiometers (SBR) continue to run in transit mode.
66. The Ice Thickness camera off.
67. The Site Camera is logging in transit for sea state conditions and ice type, at a rate of 60 frames per hour.
68. Hyperspectral ocean profiling work was conducted on 29th, 6 profiles were made within the time available. Ocean surface roughness buoy was successfully deployed and retrieved during this period.
69. The **EM Induction /video system** has not been deployed during this period due to unfavourable flying conditions.

Meteorological Observations (Barber Group)

Manual Weather Observations – recorded every 3 hours (00:00, 03:00, 06:00 etc) UTC

- GPS location
- cloud fractional coverage (8/8, 7/8, etc)
- precipitation type and amount (light, med, heavy)
- visibility (approx 20 km, 10 km, fog etc)
- from AVOS record temperature, wind speed and direction and sea ice percent coverage/type

Ceilometer is still running problem free and continuously recording the cloud base height in feet for up to 3 levels. Maintenance is being done to keep the window clear.

The Microwave Profiler is still recording error free. The LN2 calibration was completed September 30.

The All Sky camera is running as usual and recording an image every 15 minutes.

The laser precip. gauge is mounted and running on the micro-meteorological tower at the front of the ship.

Micro-Meteorological Observations (Papakyriakou Group)

1. Underway pCO2 System

-pCO2 system is operational. Data appear to be of high quality.

2. Met/Flux Tower

-The flux and met sensors on the foredeck tower are working, with the exception of our IR transducer, as noted in previous dispatches. Data appear to be of high quality.

3. Radiation Array

-The radiation array is continuing to run normally, with no problems.

4. Met-Ocean (3m Discus) Buoy

-The AXYS 3m ODAS buoy was retrieved on Sept. 29, without incident. Data have been secured (from sensors above and below the waterline) and the time series covers 14 days showing a wide range in wind and wave conditions.

5. Surface Buoys

- The two surface (secondary buoys) were retrieved this week: Buoy ‘B’ (installed at 70° 39.5’N, 135° 36.4’W) on Sept. 30 and Buoy ‘A’ (installed at 70° 43.7’N, 136° 01.6’W) on Oct. 1. Sea ice entered the block on Sept. 30, and as a result Buoy ‘A’ was dragged approximately 5.5 NM south from its original location (figure below). The buoy and sensors were retrieved without incident and data are being downloaded from Buoy ‘A’. All sensors were retrieved from Buoy ‘A’. On Buoy ‘B’, the two bottom-most CT sensors (30m and 45m) on the 50 m string were lost, presumably during installation. We suspect that the line sheared against itself, or a current meter, during deployment stripping the sensors from the line. The data from the other sensors on Buoy 'B' has been downloaded, and on first inspection appears to be of high quality.

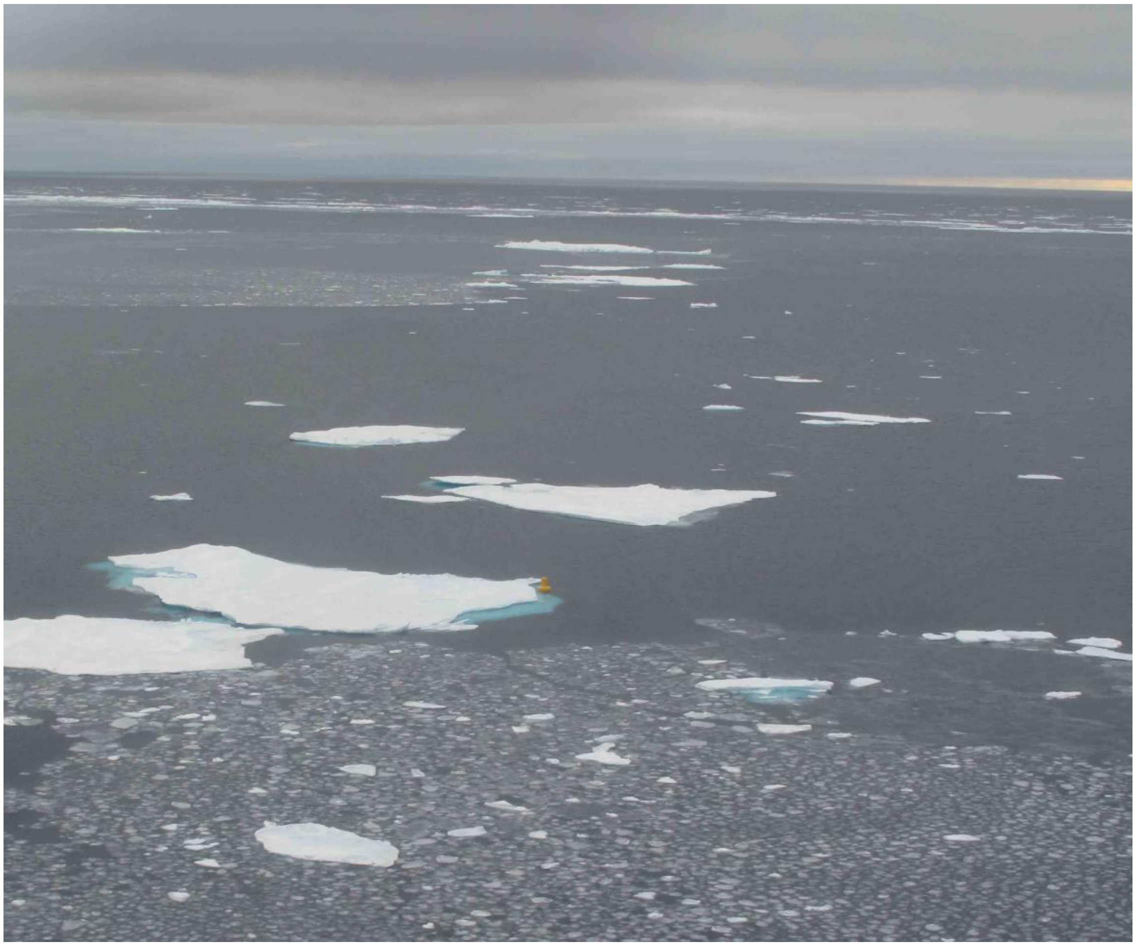
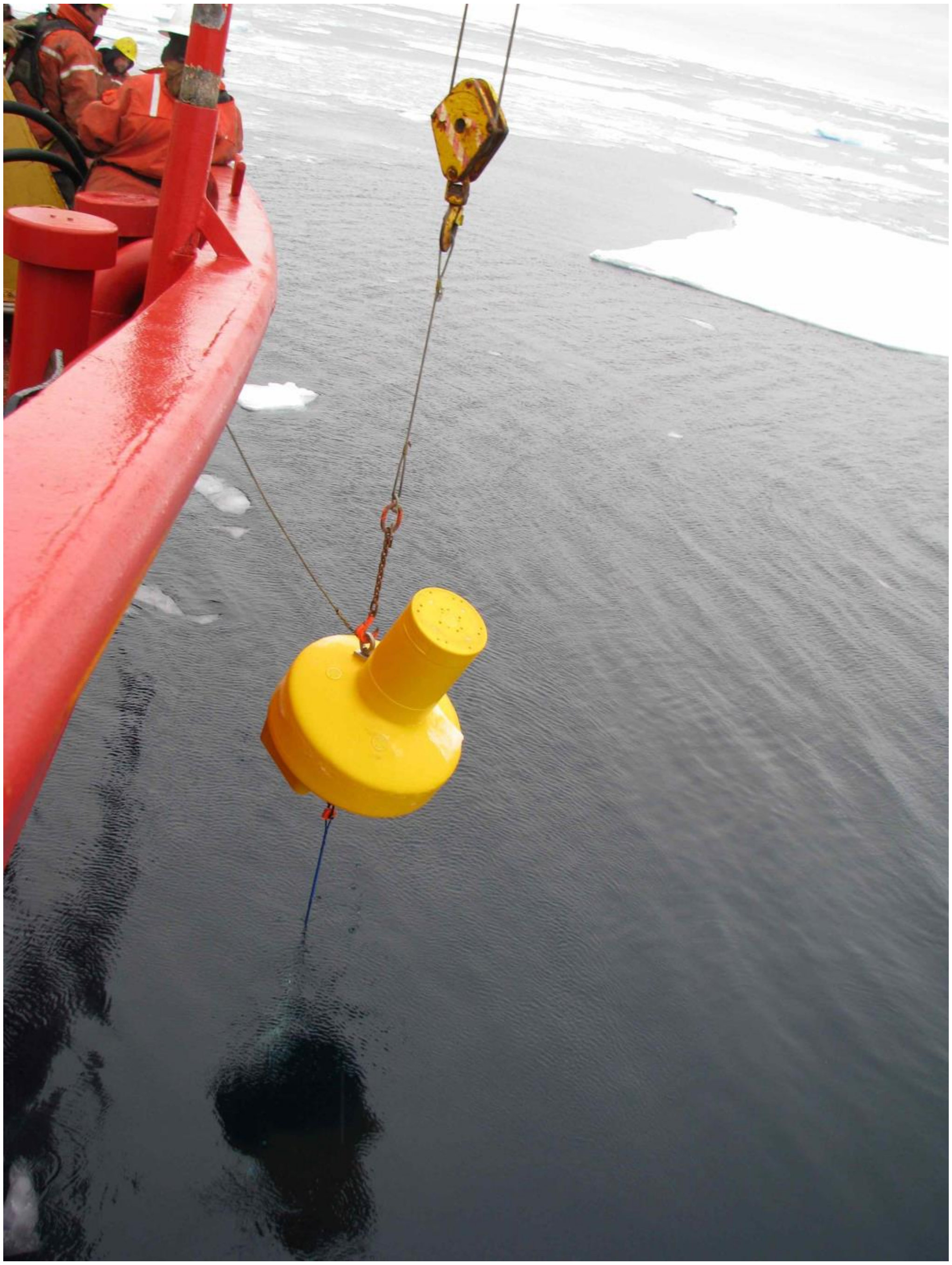


Photo showing secondary buoy 'A' against an ice floe shortly before retrieval.



Buoy ‘A’ being retrieved.

MetOcean Science Activities Summary Oct 2-4, 2009

University of Manitoba, CEOS

Reporters: Klaus Hochheim and Tim Papakyriakou
14:00Z, Oct 5, 2009

Position at time of report: N70° 55.672 W136°13.493 (Ajurak Block)

T_{Air} -2.7 °C

Winds 14 kts at 45°

Rh 94%,

Overcast

Summary:

Activities during this period as proceeding as normal. Ship activities are mainly revolving around coring, mooring deployment and retrieval and sea floor mapping. New ice was forming on October 1 and 2, in addition to pancake ice, and the loose fringe of the pack ice that drifted into block.

Figure 1. Ice within the northern portion of the Ajurak Block (Oct 2), a) Ice streamer from the pack ice (SIC <30%) , b) pancake ice formation (dark grey) and isolated second year ice (white).

The MetOcean activities are listed below.

Remote Sensing Activities - (Barber Group)

1. The C-band scatterometer is functional. Ship-based radiometers (SBR) continued to run in transit mode; some scans of new ice/pancake ice were made Oct 1-2.
2. The Ice Thickness camera off.
3. The Site Camera is logging in transit for sea state conditions and ice type, at a rate of 60 frames per hour.
4. No Hyperspectral profiling work was during this period.
5. The **EM Induction /video system** was deployed on October 2 (evening) over a second year ice floe located approximately 10nm from the ship. One transect was flown, the remaining transects were aborted to due to poor surface contrast (hummocks were barely visible to flat light conditions). The transect flown is summarized in Table 1 and Figure 1.

Table 1. Summary of EMI transects flown.

Date	Transect	LAT_S	LONG_S	LAT_E	LONG_E	Avg Ice Thk	Med Ice Thk
10/02/09	T1	70.734858	-135.707588	70.716400	-135.769727	1.15	0.95

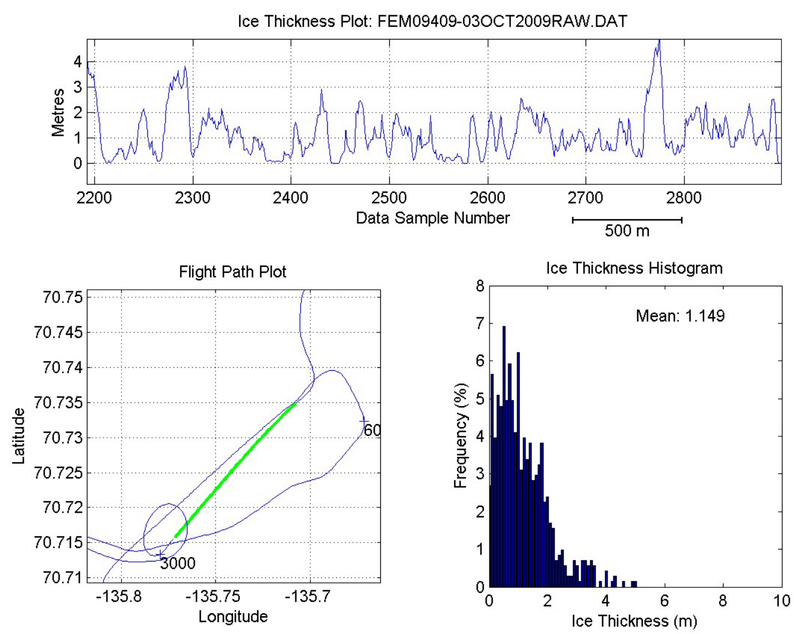


Figure 3. Consolidated second year ice, ice thickness profile and frequency , October 2 (October 3 UTC).

Meteorological Observations (Barber Group)

Manual Weather Observations are still being recorded every 3 hours, with the exception of 12pm to 6am. This is no longer being recorded at night due to low light and only 1 observer onboard.

- GPS location
- cloud fractional coverage (8/8, 7/8, etc)
- precipitation type and amount (light, med, heavy)
- visibility (approx 20 km, 10 km, fog etc)
- from AVOS record temperature, wind speed and direction and sea ice percent coverage/type

The ceilometer is still running problem free and continuously recording the cloud base height. Daily maintenance is performed to keep the window clear of dirt and debris.
The Microwave Profiler is still recording error free.
The All Sky camera stopped recording during the past few days (which day?). This is currently being troubleshoot to determine if it's the intervalometer or the camera that is causing the problems.
No problems to report with the laser precipitation gauge.
A total of 13 weather balloons were launched this leg. Several launches were cancelled due to winds > 25 kts.

Micro-Meteorological Observations (Papakyriakou Group)

1. <u>Underway pCO2 System</u>

-pCO2 system is operational. Data appear to be of high quality.

2. <u>Met/Flux Tower</u>

-The flux and met sensors on the foredeck tower are working, with the exception of our IR transducer, as noted in previous dispatches.

3. <u>Radiation Array</u>

-The radiation array is continuing to run normally.

4. <u>Met-Ocean (3m Discus) Buoy</u>

-The AXYS 3m ODAS buoy is securely stored on the foredeck and is being de-commissioned.

5. <u>Surface Buoys</u>

-The surface buoys have been de-commissioned and securely stored.

MetOcean Science Activities Summary 10-13 October 2009
CEOS
University of Manitoba

Reporter: Galley
13 October 2009

Lat: 71 19.596N

Lon: 127 33.136W

Tair: 0.4C

Winds: 10 knots NNW

Sea ice: 0/10

Summary:

We boarded Amundsen on 8 October 2009. On 10 October the Amundsen took shelter from high winds in the periphery of the Beaufort Sea ice pack west of Banks Island when mooring operations were suspended due to poor conditions. At this point, C-band scatterometer sampling of two multi-year ice floes was conducted in conjunction with physical samples of the same floes.

The ship has been conducting mooring operations in Amundsen Gulf and the southeastern Beaufort Sea nearly continuously since leg4A began. We have generally not been within 60nm of sea ice since the leg began.

Remote Sensing Activities - (Barber Group)

70. Two multi-year floes have been physically sampled in conjunction with scatterometer measurements.
71. The Site Camera is logging in transit for sea state conditions, at a rate of 60 frames per hour.
72. The EMI system has not been deployed.

EMI Helicopter Surveys / Ice Motion Beacons

No EMI surveys have been conducted on leg 4a as of today. No ice motion beacons have been put out on ice floes as of today.

Sea Ice Physical Sampling Activities (Barber Group)

Our group will continue to conduct extensive on-ice physical sampling activities, in parallel with our remote sensing program. We will continue to conduct scans with the scatterometer and SBR as opportunity arise. A team of scientists will then be deployed via ice cage, or directly onto the floe to collect the following data:

- Ice thickness and freeboard
- Ice temperature profile
- Ice salinity
- Snow temperature, salinity, and density samples (where snow exists)
- Snow grain size (where snow exists)
- Melt ponds (area, long-axis dimensions, roughness, fetch, depth)
- Site photography

Ice Mass-Balance Buoys

No opportunity has arisen this leg to deploy an ice mass balance system. Two such systems are set-up for instrumentation and satellite communications testing and are currently working well on-board.

Meteorological Observations (Barber Group)

62. Manual Weather Observations – recorded every 3 hours (00:00, 03:00, 06:00 etc) UTC
    - GPS location
    - Air temperature, wind speed and direction and sea ice percent coverage/type
    - cloud fractional coverage (8/8, 7/8, etc)
    - precipitation type and amount (light, med, heavy)
    - visibility (approx 20 km, 10 km, fog etc)
63. The ceilometer is continuously recording the cloud base height in feet for up to 3 levels.

64. The temperature and water vapour microwave profiler (TP/WVP 3000A) is functional and collecting data.
65. The all-sky camera is functional and collecting data.
66. Balloon launches have continued to capture fly-overs of the A-train satellites.

Micro-Meteorological Observations (Papakyriakou Group)

1. Underway pCO2 System

-pCO2 system has continued to operate adequately.

2. Met/Flux Tower

-The flux tower is now fully operational. The surface temperature sensor (IR transducer) which failed during leg 2b is now repaired and collecting data.
-The closed path eddy covariance system went operational on July 17, and seems to be operating properly.

3. Radiation Array

-The radiation array is continuing to run normally

MetOcean Science Activities Summary 14-16 October 2009
CEOS
University of Manitoba

16 October 2009

Lat: 70 39.904N

Lon: 122 59.915W

Tair: -2.5C

Winds: 20 knots E

Sea ice: 0/10

Summary:

Between 13 and 16 October the Amundsen has been conducting mooring operations (including both deployment and recovery) within Amundsen Gulf. The whole of Amundsen Gulf is still completely ice free, and we have not been within helicopter distance of the Beaufort Sea pack ice in the last three days.

Remote Sensing Activities - (Barber Group)

73. The Site Camera is logging in transit for sea state conditions, at a rate of 60 frames per hour.
74. The EMI system has not been deployed.

EMI Helicopter Surveys / Ice Motion Beacons

No EMI surveys have been conducted on leg 4a as of today. No ice motion beacons have been put out on ice floes as of today.

Sea Ice Physical Sampling Activities (Barber Group)

Our group will continue to conduct on-ice physical sampling activities, in parallel with our remote sensing program. We will continue to conduct scans with the scatterometer and SBR as opportunity arise. A team of scientists will then be deployed via ice cage, or directly onto the floe to collect the following data:

- Ice thickness and freeboard
- Ice temperature and salinity profiles
- Snow temperature, salinity, and density samples (where snow exists)
- Snow grain size (where snow exists)
- Site photography

Ice Mass-Balance Buoys

No opportunity has arisen this leg to deploy an ice mass balance system. Two such systems which were set up for instrumentation and satellite communications testing were turned off on 14 October after it was determined that they were in working order. It may be possible to deploy an IMB in the very eastern end of McClure Strait sometime in the next few days depending on the route the ship takes to Viscount Melville Sound and the weather.

Meteorological Observations (Barber Group)

67. Manual Weather Observations – recorded every 3 hours (00:00, 03:00, 06:00 etc) UTC
    - GPS location
    - Air temperature, wind speed and direction and sea ice percent coverage/type
    - cloud fractional coverage (8/8, 7/8, etc)
    - precipitation type and amount (light, med, heavy)
    - visibility (approx 20 km, 10 km, fog etc)
68. The ceilometer is continuously recording the cloud base height in feet for up to 3 levels.
69. The temperature and water vapour microwave profiler (TP/WVP 3000A) is functional and collecting data.
70. The all-sky camera is functional and collecting data.
71. Balloon launches have continued to capture fly-overs of the A-train satellites.

Micro-Meteorological Observations (Papakyriakou Group)

1. <u>Underway pCO2 System</u>

-pCO2 system has continued to operate adequately.

2. <u>Met/Flux Tower</u>

-The flux tower is fully operational. The surface temperature sensor (IR transducer) which failed during leg 2b is now repaired and collecting data.
-The closed path eddy covariance system went operational on July 17, and seems to be operating properly.

3. Radiation Array

-The radiation array is continuing to run normally

MetOcean Science Activities Summary 17-19 October 2009
CEOS
University of Manitoba

19 October 2009

Lat: 74 05.987N

Lon: 108 50.156W

Tair: -15.6C

Winds: 13 knots N

Sea ice: 9+/10

Summary:

Between 16 and 19 October the Amundsen has been sailing from eastern Amundsen Gulf to Viscount Melville Sound via Prince of Wales Strait, where two new station stops (450 and 460) were performed. An ice mass balance buoy (IMB02) was deployed by helicopter at the north east corner of Banks Island on 17 October and is transmitting successfully. The EMI system was flown on 19 October with mixed success due to the thinness of the sea ice in the western half of Viscount Melville Sound.

Remote Sensing Activities - (Barber Group)

75. The Site Camera is logging in transit for sea state conditions, at a rate of 60 frames per hour.
76. The EMI system was deployed on 19 October
77. IMB02 was deployed at the northeast corner of Banks Island in McClure Strait.

EMI Helicopter Surveys / Ice Motion Beacons

One EMI survey was performed on 19 October. I think that the ice was actually too thin to be detected in most cases, but video data was collected without any problem. No ice motion beacons have been put out on ice floes as of today.

Sea Ice Physical Sampling Activities (Barber Group)

Our group will continue to conduct on-ice physical sampling activities, in parallel with our remote sensing program. We will continue to conduct scans with the scatterometer and SBR as opportunity arise. A team of scientists will then be deployed via ice cage, or directly onto the floe to collect the following data:

- Ice thickness and freeboard
- Ice temperature and salinity profiles
- Snow temperature, salinity, and density samples (where snow exists)
- Snow grain size (where snow exists)
- Site photography

Ice Mass-Balance Buoys

An ice mass balance buoy was deployed in a multi-year ice floe (z_i = 2.20m) via helicopter at the north-east corner of Banks Island on 17 October 2009. It's original location was:

Lat 73 34.323

Lon 115 11.465

Meteorological Observations (Barber Group)

72. Manual Weather Observations – recorded every 3 hours (00:00, 03:00, 06:00 etc) UTC
    - GPS location
    - Air temperature, wind speed and direction and sea ice percent coverage/type
    - cloud fractional coverage (8/8, 7/8, etc)
    - precipitation type and amount (light, med, heavy)
    - visibility (approx 20 km, 10 km, fog etc)
73. The ceilometer is continuously recording the cloud base height in feet for up to 3 levels.
74. The temperature and water vapour microwave profiler (TP/WVP 3000A) is functional and collecting data.
75. The all-sky camera is functional and collecting data.
76. Balloon launches have continued to capture fly-overs of the A-train satellites.

Micro-Meteorological Observations (Papakyriakou Group)

1. Underway pCO2 System

-pCO2 system is operational. Data appear to be of high quality.

2. Met/Flux Tower

-The flux and met sensors on the foredeck tower are working, with the exception of our IR transducer, as noted in previous dispatches.

3. Radiation Array

-The radiation array is continuing to run normally.

4. Met-Ocean (3m Discus) Buoy

-De-commissioned.

5. Surface Buoys

-De-commissioned.

MetOcean Science Activities Summary 20-22 October 2009
CEOS
University of Manitoba

22 October 2009

Lat: 74 37.981N

Lon: 99 14.25W

Tair: -18.4C

Winds: 12 knots N

Sea ice: 10/10

Summary:

We have been sailing slowly through Viscount Melville Sound and are currently about 75NM west of Resolute. Two scatterometer station stops were performed today in conjunction with physical sampling of the top 60cm of the sea ice over two multi-year floes. CEOS_IMB03 was deployed today on a large piece of multi-year ice in the very east end of Viscount Melville Sound. I was able to stay with it until it made one set of successful measurements. Each instrument is working properly.

Remote Sensing Activities - (Barber Group)

78. The Site Camera is logging in transit for sea state conditions, at a rate of 60 frames per hour.
79. The EMI system was deployed on 21 October
80. CEOS_IMB03 was deployed on 22 October 2009

EMI Helicopter Surveys / Ice Motion Beacons

One EMI survey was performed on 21 October with mixed success due to imperfect flying conditions. No ice motion beacons have been put out on ice floes as of today.

Sea Ice Physical Sampling Activities (Barber Group)

Our group will continue to conduct on-ice physical sampling activities, in parallel with our remote sensing program. We will continue to conduct scans with the scatterometer and SBR as opportunity arise. A team of scientists will then be deployed via ice cage, or directly onto the floe to collect the following data:

- Ice thickness and freeboard
- Ice temperature and salinity profiles
- Snow temperature, salinity, and density samples (where snow exists)
- Snow grain size (where snow exists)
- Site photography

Ice Mass-Balance Buoys

An ice mass balance buoy was deployed in a multi-year ice floe (z_i = 2.49m) via helicopter at the east end of Viscount Melville Sound.

Meteorological Observations (Barber Group)

77. Manual Weather Observations – recorded every 3 hours (00:00, 03:00, 06:00 etc) UTC
    - GPS location
    - Air temperature, wind speed and direction and sea ice percent coverage/type
    - cloud fractional coverage (8/8, 7/8, etc)
    - precipitation type and amount (light, med, heavy)

- visibility (approx 20 km, 10 km, fog etc)

78. The ceilometer is continuously recording the cloud base height in feet for up to 3 levels.
79. The temperature and water vapour microwave profiler (TP/WVP 3000A) is functional and collecting data.
80. The all-sky camera is functional and collecting data.
81. Balloon launches have continued to capture fly-overs of the A-train satellites.

Micro-Meteorological Observations (Papakyriakou Group)

1. Underway pCO2 System

-pCO2 system is operational. Data appear to be of high quality.

2. Met/Flux Tower

-The flux and met sensors on the foredeck tower are working, with the exception of our IR transducer, as noted in previous dispatches.

3. Radiation Array

-The radiation array is continuing to run normally.

4. Met-Ocean (3m Discus) Buoy

-De-commissioned.

5. Surface Buoys

-De-commissioned.

MetOcean Science Activities Summary 23 October – 1 November 2009
CEOS
University of Manitoba

1 November 2009

Lat: 71 21.369N

Lon: 70 15.730W

T_{air}: -12.8C

Winds: 10 knots NNW

Sea ice: 8/10 [new and young ice]

Summary:

We have been without internet access since the morning of the 24th of October prohibiting dispatches on 25 and 28 October. Since the 22nd of October, We have sailed through Viscount Melville Sound, Lancaster Sound and have completed the Baffin Bay stations. Two C-band scatterometer station stops were performed on 22 October and an additional two stations were made on 27 October in conjunction with physical sampling of the top 60cm of the sea ice over two multi-year floes.

CEOS_IMB03 was deployed on 22 October on a large piece of multi-year ice in the very east end of Viscount Melville Sound. I was able to stay with it until it made one set of successful measurements. Each instrument was working properly.

Remote Sensing Activities - (Barber Group)

81. The Site Camera is logging in transit for sea state conditions (1pic/min).
82. The EMI system was deployed on 22, 24, 25, 27 October

83. CEOS_IMB03 was deployed on 22 October 2009

EMI Helicopter Surveys / Ice Motion Beacons

EMI surveys were conducted on 22, 24, 25, and 27 October with mixed success due to flying conditions.

Sea Ice Physical Sampling Activities (Barber Group)

Our group will continue to conduct on-ice physical sampling activities, in parallel with our remote sensing program. We are continuing to conduct scans with the scatterometer and SBR as opportunities arise, coincident with the following:

- Ice thickness and freeboard
- Ice temperature and salinity profiles
- Snow temperature, salinity, and density samples (where snow exists)
- Snow grain size (where snow exists)
- Site photography

Ice Mass-Balance Buoys

An ice mass balance system (CEOS_IMB03) was deployed in a multi-year ice floe (z_i = 2.49m) via helicopter at the east end of Viscount Melville Sound.

Meteorological Observations (Barber Group)

- Manual Weather Observations – recorded every 3 hours
- Location
- Air temperature, wind speed and direction and sea ice percent coverage/type
- cloud fractional coverage
- precipitation type and amount
- visibility (approx 20 km, 10 km, fog etc)

82. The ceilometer is continuously recording the cloud base height in feet for up to 3 levels.
83. The temperature and water vapour microwave profiler (TP/WVP 3000A) is functional and collecting data.
84. The all-sky camera is functional and collecting data.

85. Balloon launches have continued to capture fly-overs of the A-train satellites.

Micro-Meteorological Observations (Papakyriakou Group)

1. Underway pCO2 System

The pCO2 system is operational. Data appear to be of high quality.

2. Met/Flux Tower

-The flux and met sensors on the foredeck tower are working, with the exception of our IR transducer, as noted in previous dispatches.

3. Radiation Array

-The radiation array is continuing to run normally.

APPENDIX B: SHIP SCIENCE ACTIVITY LOGS

Stn	Date	Hour (LST)	Lat.	Lon.	Heading (°)	Activités	Depth (m)	Wind		Air (°C)	Water (°C)	P Baro	Hum (%)	Ice
								Dir	Speed					
n/a	05-Jun	10 h 22	48'44.3	68'09.97	270	Start ROV	151	230	22	9.5	5.8	1013	-	-
n/a	05-Jun	11 h 50	48'44.1	068'09.9	270	End ROV	151	230	10; 15	9.3	5.8	1012.7	-	-
n/a	05-Jun	14 h 02	48'44.49	68'10.18	325	Piston Core ↓	160	230	10	10.9	6.21	1011.7	-	-
n/a	05-Jun	14 h 30	48'.44.56	68'09.94	-	Piston Core ↑	343	250	10	11	6.22	1011.5	-	-
n/a	11-Jul	08 h 40	67'45.1	168'13.9	010	PMW	50	160	12	3.8	3.3	1019.3	-	-
n/a	12-Jul	13 h 10	71'42.80	157'13.40	100	Echantillonage d'eau debut	67	100	10; 15	3.4	1.8	1017.9	94	2/10
n/a	12-Jul	13 h 27	71'42.98	157'14.00	300	Echantillonage d'eau termine	61	110	10; 15	3.5	3.5	1018.05	94	2/10
n/a	13-Jul	13 h 06	70'39.36	143'34.62	175	Echantillonage d'eau debut	350	105	17	8.7	8.4	1018.6	90	1/10
n/a	13-Jul	13 h 15	70'39.36	143'34.62	150	Echantillonage d'eau termine	342	110	14	8.9	8.5	1018.9	90	1/10
n/a	14-Jul	13 h 20	70'38.02	135'37.44	270	Echantillonage d'eau debut	87	030	20	0.8	2.3	1018.1	98	2/10
n/a	14-Jul	13 h 30	70'38.04	135'37.95	285	Echantillonage d'eau termine	90	025	16	1.3	2.3	1018	98	2/10
n/a	14-Jul	21 h 05	70'37.6	136'02.9	123	Met. Balloon Launch	260	035	20	1.3	1.25	1021.3	92	8/10
1	18-Jul	02 h 24	70'29.160	135'05.79	136	Tucker Horizontal Net	61	085	6	-0.1	1.74	1014.62	98	1/10
1	18-Jul	02 h 43	70'29.107	135'03.405	047	Tucker Horizontal Net	61	085	6	-0.1	2	1014.56	99	1/10
1	18-Jul	03 h 15	70'29.214	135'03.338	139	Monster Vertical Net	61	085	6	0.1	2.1	1012.2	98	1/10
1	18-Jul	03 h 25	70'29.223	135'03.570	211	Monster Vertical Net	61	085	6	-0.1	2.12	1012.16	99	1/10
1	18-Jul	03 h 50	70'29.216	135'04.187	166	Water Pump ↓	60	085	8	-0.7	2.16	1012.09	99	1/10
1	18-Jul	05 h 30	70'28.923	135'06.251	159	Water Pump ↑	62	103	7	-0.7	2.41	1014.14	97	1/10
1	18-Jul	05 h 46	70'20.000	135'06.000	329	CTD Rosette Test ↓	62	082	3	-0.7	2.44	1014.14	97	1/10
1	18-Jul	06 h 24	70'28.862	135'07.485	333.5	CTD Rosette Test ↑	62	110	1.3	-0.1	2.45	1014.16	97	1/10
1	18-Jul	07 h 40	70'28.903	135'09.631	245	Box Coring 1 ↓	60	112	8.4	-0.1	2.37	1013.55	95	1/10
1	18-Jul	07 h 42	70'28.903	135'09.631	232	Box Coring 1 ↑	60	112	8.4	0.1	2.37	1013.55	95	1/10
1	18-Jul	08 h 17	70'28.992	135'10.083	220	Box Coring 2 ↓	60	060	10	-0.6	2.35	1013.63	96	1/10
1	18-Jul	08 h 20	70'29.004	135'10.141	228	Box Coring 2 ↑	60	080	9	-1.1	2.35	1013.57	96	1/10
1	18-Jul	09 h 02	70'29.024	135'11.169	250	Box Coring 3 ↓	61	080	8	-0.2	2.33	1013.5	95	1/10
1	18-Jul	09 h 06	70'29.030	135'11.214	242	Box Coring 3 ↑	61	070	6	-0.2	2.33	1013.5	95	1/10
1	18-Jul	12 h 31	70'29.733	135'07.997	223	Mouillage ↓	61	055	8	0.1	2.62	1011.17	98	1/10
1	18-Jul	12 h 42	70'29.787	135'07.819	247	Mouillage ↑	61	055	8	0	2.6	1011.17	98	1/10
1	18-Jul	13 h 33	70'29.494	135'08.397	242	Agassiz Trawl ↓	60	055	8	-0.2	2.6	1011.24	97	1/10
1	18-Jul	13 h 53	70'29.215	135'07.053	066	Agassiz Trawl ↑	61	055	8	-0.3	2.59	1011.34	97	1/10
2	18-Jul	18 h 16	70'39.350	135'38.237	280	Deploy Zodiac ↓	144	155	10	1.5	1.12	1011.59	96	2/10
2	18-Jul	19 h 30	70'39.431	135'38.996	302	Zodiac Returns ↑	144	120	10	1.6	1.22	1013.78	96	2/10
2	18-Jul	18 h 24	70'39.338	135.38.242	288	Rosette ↓	144	155	10	1.5	1.13	1011.44	96	2/10

2	18-Jul	18 h 53	70'39.376	135'38.595	276	Rosette ↑	144	120	10	1.7	1.19	1013.93	96	2/10
2	18-Jul	18 h 44	70'39.386	135'38.590	315	Water Pumping ↓	146	90	7.6	1.8	1.17	1013.93	95	2/10
2	18-Jul	19 h 45	70'39.469	135'39.205	300	Water Pumping ↑	165	110	10	1.5	1.22	1011.43	95	2/10
2	18-Jul	20 h 04	70'39.307	135'37.905	229	Tucker ↓	140	060	10	0.6	1.21	1013.66	98	2/10
2	18-Jul	20 h 16	70'39.300	135'37.570	305	Tucker ↑	142	055	10	0.4	1.21	1013.63	98	2/10
2(B)	18-Jul	20 h 50	70'39.404	135'38.161	105	Vertical Net "Monster" ↓	141	053	10	0.2	1.31	1013.66	99	2/10
2(B)	18-Jul	21 h 04	70'39.398	135'38.204	159	Vertical Net "Monster" ↑	148	058	9	-0.1	1.32	1013.67	99	2/10
2(B)	18-Jul	21 h 48	70'39.749	135'37.193	043	Box Core ↓	160	040	7	-0.2	1.32	1013.58	99	2/10
2(B)	18-Jul	21 h 51	70'39.758	135'37.183	039	Box Core Au Fond	161	043	7	-0.2	1.32	1013.68	99	2/10
2(B)	18-Jul	21 h 54	70'39.771	135'37.171	040	Box Core ↑	161	040	6	-0.2	1.32	1013.68	99	2/10
2(B)	18-Jul	22 h 15	70'40.057	135'37.259	356	Agassiz ↓	189	040	8	-0.2	1.32	1013.68	99	2/10
2(B)	18-Jul	22 h 52	70'39.703	135'37.877	137	Agassiz ↑	160	043	9	-0.8	1.33	1011.58	99	2/10
11(B)	19-Jul	00 h 20	70'44.148	135'33.682	280	Rosette ↓	368	032	10	-0.6	1.4	1011.84	99	1/10
11(B)	19-Jul	00 h 33	70'44.197	135'33.635	287	Rosette ↑ "Cancelled"	368	032	10	-0.4	1.42	1011.79	99	1/10
11(B)	19-Jul	00 h 49	70'43.967	135'33.518	258	Tucker ↓	370	060	4	-0.9	1.43	1011.74	99	1/10
11(B)	19-Jul	01 h 12	70'43.676	135'31.655	106	Tucker ↑	335	060	10	-1	1.45	1011.71	99	1/10
11(B)	19-Jul	01 h 36	70'44.282	135'33.781	085	Monster ↓	378	034	7	-0.8	1.6	1011.8	99	1/10
11(B)	19-Jul	02 h 03	70'44.320	135'33.429	121	Monster ↑	372	031	4	-1.1	1.51	1011.87	99	1/10
11(B)	19-Jul	02 h 20	70'44.265	135'33.324	244	Rosette ↓ 2 Reprise	372	052	3	-0.8	1.45	1011.87	99	1/10
11(B)	19-Jul	03 h 10	70'44.494	135'33.338	311	Rosette ↑ 2 Reprise	375	025	4	-0.7	1.33	1011.85	99	1/10
11(B)	19-Jul	03 h 36	70'44.123	135'33.843	160	Box Coring	375	023	4	-1.1	1.31	1011.79	99	1/10
11(B)	19-Jul	03 h 52	70'44.219	135'33.837	181	Box Coring	371	023	4	-1	1.32	1011.82	99	1/10
11(B)	19-Jul	04 h 06	70'44.260	135'33.808	086	Agassiz Trawl ↓	365	270	4.4	0.1	1.31	1014.27	99	1/10
11(B)	19-Jul	04 h 40	70'44.380	135'31.750	-	Agassiz Trawl ↑	365	-	6.5	-1.3	1.31	1014.54	99	1/10
11(B)	19-Jul	04 h 47	70'44.534	135'31.918	245	Agassiz Trawl ↓	351	170	2.3	-1.3	1.31	1014.54	99	1/10
11(B)	19-Jul	05 h 25	70'44.066	135'30.506	106	Agassiz Trawl ↑	315	114	6.9	-1.2	1.31	1014.55	99	1/10
11(B)	19-Jul	06 h 56	70'42.344	135'47.166	270	Rosette ↓	405	120	6	0.5	1.04	1014.82	99	1/10
11(B)	19-Jul	07 h 10	70'42.341	135'48.850	306	Water Pumping ↓	406	80	5	0.1	0.99	1014.86	99	1/10
11(B)	19-Jul	08 h 12	70'42.348	135'48.467	286	Rosette ↑	410	018	5	0.2	0.86	1014.79	99	4/10
11(B)	19-Jul	08 h 14	70'42.346	135'48.470	281	Water Pumping ↑	409	018	6	0.2	0.87	1014.8	99	4/10
11(B)	19-Jul	08 h 55	70'42.270	135'48.112	141	Tucker ↓	397	020	4	0.2	0.82	1014.83	99	4/10
11(B)	19-Jul	09 h 03	70'42.003	135'47.102	114	Tucker ↑	376	000	7	-0.2	0.81	1014.82	99	4/10
11(B)	19-Jul	09 h 35	70'42.238	135'47.632	049	Monster ↓	392	352	6	-0.1	0.88	1014.95	99	4/10
11(B)	19-Jul	10 h 01	70'42.221	135'47.224	040	Monster ↑	386	345	5	-0.3	0.86	1015.12	99	4/10
11(B)	19-Jul	10 h 35	70'42.368	135'47.257	013	Box Core ↓	397	351	4	-0.4	0.85	1015.08	99	4/10

11(B)	19-Jul	10 h 42	70'42.382	135'47.164	025	Box Core Au Fond	400	351	3	-0.3	0.85	1015.14	98	4/10
11(B)	19-Jul	10 h 51	70'42.390	135'47.048	040	Box Core ↑	400	338	3	-0.4	0.84	1015.22	99	4/10
11(B)	19-Jul	11 h 13	70'42.436	135'47.112	168	Agassiz Trawl ↓	400	307	2	0	0.82	1015.3	98	4/10
11(B)	19-Jul	11 h 45	70'41.765	135'45.445	133	Agassiz Trawl ↑	356	336	3	0	0.83	1015.53	98	5/10
11(B)	19-Jul	12 h 25	70'39.587	135'37.720	140	Met. Balloon Launch	129	308	2	0.1	0.88	1013.32	98	9/10
11(B)	19-Jul	15 h 15	70'40.031	135'35.919	000	Mouillage + Zodiac (B-09)	162	321	3	-0.6	0.97	1014.33	97	3/10
11(B)	19-Jul	15 h 37	70'39.964	135'35.908	053	Mouillage + Zodiac (B-09)	152	306	4	-0.6	1.01	1014.35	97	3/10
14(B)	19-Jul	18 h 25	70'34.825	135'57.278	222	CTD Rosette ↓	94	130	1.5	0.9	1.28	1014.57	98	1/10
14(B)	19-Jul	18 h 50	70'34.723	135'57.581	279	CTD Rosette ↑	92	100	2.1	0.4	1.28	1014.71	98	1/10
14(B)	19-Jul	19 h 17	70'34.794	135'58.595	198	Tucker ↓	94	160	1.9	0.5	1.26	1017.19	98	1/10
14(B)	19-Jul	19 h 24	70'34.813	135'58.067	351	Tucker ↑	95	335	1.9	0.5	1.23	1017.28	98	1/10
14(B)	19-Jul	19 h 45	70'34.883	135'58.340	177	Monster ↓	95	190	8	0.8	1.24	1017.32	97	1/10
14(B)	19-Jul	19 h 55	70'34.866	135'58.442	144	Monster ↑	94	023	7	-1	1.23	1017.34	98	3/10
14(B)	19-Jul	20 h 26	70'34.750	135'58.642	63	Box Core ↓	93	022	6	-0.8	1.1	1017.23	98	3/10
14(B)	19-Jul	20 h 28	70'34.752	135'58.634	51	Box Core Au Fond	93	022	6	-0.8	1.1	1017.23	98	3/10
14(B)	19-Jul	20 h 30	70'34.756	135'58.628	58	Box Core ↑	93	038	6	-1	1.08	1017.23	98	3/10
14(B)	19-Jul	20 h 46	70'34.314	135'59.509	143	Agassiz Trawl ↓	92	039	6	-1	1.1	1017.23	98	4/10
14(B)	19-Jul	21 h 02	70'34.302	135'58.535	4	Agassiz Trawl ↑	93	052	7	-1	1.12	1017.17	99	4/10
14(B)	19-Jul	23 h 09	70'38.820	135'56.540	328	Bottom Mapping	272	067	6	-0.1	0.27	1017.62	99	9/10
14(B)	19-Jul	23 h 40	70'39.130	135'57.210	100	Bottom Mapping	293	065	7	-0.2	0.14	1019.63	99	9/10
15(B)	20-Jul	00 h 17	70'39.260	135'55.874	5	CTD Rosette ↓	293	078	5	-1	0.1	1015.15	99	3/10
15(B)	20-Jul	01 h 00	70'39.372	135'55.764	309	CTD Rosette ↑	299	054	5	-0.5	0.23	1015.34	99	3/10
15(B)	20-Jul	01 h 14	70'39.474	135'55.729	14	Tucker ↓	305	055	6	-0.7	0.23	1015.33	99	3/10
15(B)	20-Jul	01 h 25	70'39.795	135'55.433	334	Tucker ↑	325	063	5	-0.3	0.23	1015.32	99	4/10
15(B)	20-Jul	01 h 43	70'39.869	135'54.873	77	Monster ↓	321	61	4	-1.4	0.35	1015.41	99	4/10
15(B)	20-Jul	02 h 05	70'39.927	135'54.871	156	Monster ↑	327	61	5	-1.5	0.45	1015.44	99	4/10
15(B)	20-Jul	02 h 29	70'40.200	135'55.200	145	Agassiz Trawl ↓	326	82	5	-1.4	0.49	1015.38	99	4/10
15(B)	20-Jul	03 h 57	70'40.438	135'53.646	315	Agassiz Trawl "FAILED"	338	84	5	-1.3	0.61	1015.44	99	4/10
15(B)	20-Jul	03 h 03	70'40.505	135'53.456	0	Agassiz Trawl 2 ↓	341	73	6	-1.2	0.67	1015.44	99	4/10
15(B)	20-Jul	03 h 32	70'41.186	135'53.636	303	Agassiz Trawl 2 ↑	381	85	7	-1.4	0.77	1015.54	99	4/10
15(B)	20-Jul	04 h 11	70'39.020	135'56.841	317	Box Coring ↓	284	191	6	-1.8	0.71	1017.96	99	4/10
15(B)	20-Jul	04 h 21	70'39.045	135'56.798	323	Box Coring ↑	283	82	6	-1.3	0.78	1017.02	99	4/10
15(B)	20-Jul	04 h 45	70'36.600	135'57.300	160	Met. Balloon Launch	180	135	5	-1.9	0.79	1018.05	99	4/10
17(B)	20-Jul	06 h 42	70'36.580	135'28.476	246	CTD Rosette ↓	730	60	8	-1.9	0.71	1017.88	98	1/10
17(B)	20-Jul	08 h 04	70'36.336	136'29.657	296	CTD Rosette ↑	729	59	7	0	0.68	1017.75	97	4/10

17(B)	20-Jul	06 h 57	70'36.571	135'28.677	231	Water Pumping ↓	730	67	7	-2.1	0.72	1015.42	98	1/10
17(B)	20-Jul	08 h 02	70'36.345	136'29.615	294	Water Pumping ↑	729	58	8	0	0.68	1017.75	97	4/10
17(B)	20-Jul	08 h 17	70'37.171	136'32.390	181	Tucker ↓	792	65	7	-1.1	0.68	1017.92	96	4/10
17(B)	20-Jul	09 h 02	70'36.795	136'32.228	157	Tucker ↑	774	62	7	-0.9	72	1017.88	96	4/10
17(B)	20-Jul	09 h 19	70'36.728	136'32.426	135	Monster ↓	777	60	7	-0.9	0.76	1017.89	96	4/10
17(B)	20-Jul	10 h 14	70'36.678	136'33.268	103	Monster ↑	786	74	6	-0.6	0.84	1018.15	96	4/10
17(B)	20-Jul	10 h 41	70'36.671	136'33.453	134	Box Core ↓	788	67	6	-0.4	0.85	1018.13	96	4/10
17(B)	20-Jul	10 h 58	70'36.629	136'33.483	102	Box Core Au Fond	788	43	6	-0.5	0.86	1018.19	96	4/10
17(B)	20-Jul	11 h 12	70'36.670	136'33.630	1	Box Core ↑	789	61	7	-0.5	0.88	1018.26	96	4/10
17(B)	20-Jul	12 h 16	70'38.132	136'34.823	283	Agassiz Trawl ↓	875	36	7	-0.6	0.92	1015.94	96	2/10
17(B)	20-Jul	13 h 20	70'37.128	136'33.729	28	Agassiz Trawl ↑	813	35	7	0.1	1.07	1015.7	97	3/10
4(B)	20-Jul	14 h 45	70'38.029	136'16.737	94	Helicopter - Ice Profiler	579	42	8	0.3	0.97	1016.01	98	6/10
4(B)	20-Jul	18 h 20	n/a	n/a	n/a	Zodiac ↓	n/a	n/a	n/a	n/a	n/a	n/a	n/a	6/10
4(B)	20-Jul	19 h 34	70'45.791	136'00.106	132	Mouillage A1-09	688	51	8	0.8	-	-	-	6/10
4(B)	20-Jul	20 h 30	70'45.780	136'01.185	300	Rosette ↓	688	61	8	0.8	0.46	1018.34	98	6/10
4(B)	20-Jul	21 h 39	70'45.679	136'01.919	327	Rosette ↑	696	55	8	1.8	0.42	1018.34	96	6/10
4(B)	20-Jul	20 h 42	70'45.756	136'01.364	313	Water Pump ↓	695	52	8	1.4	0.52	1018.39	97	6/10
4(B)	20-Jul	21 h 44	70'45.676	136'01.972	323	Water Pump ↑	690	47	8	1.8	0.42	1018.34	96	6/10
4(B)	20-Jul	21 h 00	70'45.724	136'01.556	321	Met. Balloon Launch	691	55	6	1.5	0.46	1018.42	97	6/10
4(B)	20-Jul	22 h 49	70'45.358	136'03.430	115	Tucker ↓	672	60	5	0.4	0.5	1018.09	98	6/10
4(B)	20-Jul	23 h 06	70'45.395	136'02.116	346	Tucker ↑	674	42	10	0	0.52	1017.98	99	6/10
4(B)	20-Jul	23 h 30	70'45.486	136'02.585	47	Monster ↓	674	35	11	0	0.43	1017.9	99	6/10
4(B)	21-Jul	00 h 10	70'45.241	136'02.528	146	Monster ↑	657	54	12	-1.1	0.48	1015.47	99	6/10
4(B)	21-Jul	00 h 39	70'45.323	136'01.889	83	Box Core 1 ↓	667	57	4	-0.8	0.47	1015.34	99	6/10
4(B)	21-Jul	00 h 58	70'45.270	136'02.033	69	Box Core 1 ↑	675	55	7	-0.6	0.45	1015.6	99	6/10
4(B)	21-Jul	01 h 11	70'45.320	136'01.906	53	Box Core 2 ↓ Axys ↓	667	49	6	-0.2	0.44	1015.69	99	6/10
4(B)	21-Jul	01 h 28	70'45.307	136'02.040	67	Box Core 2 ↑ Axys ↑	668	51	7	-0.1	0.44	1015.67	99	6/10
4(B)	21-Jul	01 h 53	70'45.116	136'03.645	75	Agassiz Trawl ↓	664	52	8	0.3	0.46	1015.64	99	6/10
4(B)	21-Jul	02 h 32	70'45.418	136'07.844	278	Agassiz Trawl ↑	672	45	7	0.4	0.43	1015.8	99	6/10
10(B)	21-Jul	05 h 58	70'48.300	135'32.600	-	Met. Balloon Launch	-	-	-	-	-	-	-	-
10(B)	21-Jul	06 h 40	70'47.236	135'31.720	305	CTD Rosette ↓	434	37	9	0.8	0.31	1017.09	99	4/10
10(B)	21-Jul	06 h 50	70'47.241	135'31.674	320	Water Pumping ↓	432	41	8	0.9	0.34	1017.02	99	4/10
10(B)	21-Jul	07 h 25	70'47.232	135'31.563	298	Water Pumping ↑	431	43	7	0.9	0.36	1017	99	4/10
10(B)	21-Jul	08 h 30	70'47.310	135'33.300	138	Tucker ↓	426	21	9	0.4	0.43	1017.09	99	5/10
10(B)	21-Jul	08 h 39	70'47.147	135'32.929	125	Tucker ↑	438	18	6	0.4	0.43	1017.09	99	5/10

10(B)	21-Jul	09 h 00	70'47.311	135'33.476	136	Monster ↓	423	16	4	0.3	0.48	1017.12	98	5/10
10(B)	21-Jul	09 h 28	70'47.231	135'33.552	90	Monster ↑	434	355	2	0.5	0.48	1017.18	97	5/10
10(B)	21-Jul	10 h 09	70'47.489	135'33.780	330	Box Core ↓	421	270	3	0.3	0.44	1017.25	97	6/10
10(B)	21-Jul	10 h 19	70'47.478	135'33.736	350	Box Core Au Fond	420	280	3	0.3	0.35	1017.2	98	6/10
10(B)	21-Jul	10 h 32	70'47.473	135'33.731	336	Box Core ↑	421	301	3	0.2	0.27	1017.12	98	6/10
10(B)	21-Jul	11 h 02	70'47.990	135'31.741	-	Agassiz Trawl ↓	456	300	2	0.4	0.29	1016.65	97	6/10
10(B)	21-Jul	11 h 47	70'46.830	135'30.235	64	Agassiz Trawl ↑	399	310	3	0.9	0.63	1016.72	98	6/10
1-09(M)	21-Jul	15 h 28	70'48.876	134'32.641	97	Deploy Mooring I-09	72	34	7	0.7	0.55	1013.44	98	8/10
1-09(M)	21-Jul	15 h 24	70'48.891	134'32.658	108	Met. Balloon Launch	74	34	7	0.7	0.55	1013.44	98	8/10
1-09(M)	21-Jul	15 h 45	70'48.894	134'32.957	140	Rosette ↓	72	33	8	0.8	0.31	1013.39	97	8/10
1-09(M)	21-Jul	16 h 30	70'48.836	134'33.630	169	Rosette ↑	74	130	7	1.5	0.23	1015.55	93	8/10
23(B)	21-Jul	18 h 30	70'53.897	134'15.649	151	Deploy Mooring J-09	83	329	6	0.9	0.33	1014.86	98	6/10
23(B)	21-Jul	18 h 46	70'53.816	134'16.072	249	CTD Rosette ↓	83	90	8	1.2	0.33	1014.75	98	4/10
23(B)	21-Jul	19 h 10	70'53.740	134'16.149	229	CTD Rosette ↑	82	120	5	2.2	0.42	1014.35	97	4/10
23(B)	21-Jul	19 h 30	70'53.527	134'15.971	124	Tucker ↓	80	240	6	2.1	0.44	1014.09	97	2/10
23(B)	21-Jul	19 h 39	70'53.638	134'15.774	303	Tucker ↑	80	239	7	2.1	0.44	1014.12	97	2/10
23(B)	21-Jul	19 h 57	70'53.535	134'16.021	117	Monster ↓	80	330	8	1.1	0.51	1014.21	98	2/10
23(B)	21-Jul	20 h 05	70'53.526	134'15.985	87	Monster ↑	80	327	6	0.8	0.54	1014.29	99	2/10
23(B)	21-Jul	20 h 46	70'53.603	134'15.907	22	Box Core 1 ↓	80	322	7	0.7	0.61	1013.86	99	2/10
23(B)	21-Jul	20 h 47	70'53.602	134'15.887	27	Box Core Au Fond	80	320	6	0.7	0.61	1013.86	99	2/10
23(B)	21-Jul	20 h 49	70'53.601	134'15.876	31	Box Core ↑	80	320	5	0.7	0.61	1013.86	99	2/10
23(B)	21-Jul	21 h 05	70'53.563	134'15.758	86	Box Core 2 ↓	80	337	10	0.8	0.67	1013.68	99	2/10
23(B)	21-Jul	21 h 07	70'53.551	134'15.775	99	Box Core Au Fond	80	341	9	0.8	0.67	1013.68	99	2/10
23(B)	21-Jul	21 h 08	70'53.546	134'15.782	102	Box Core ↑	80	345	9	0.8	0.67	1013.68	99	2/10
23(B)	21-Jul	21 h 25	70'53.459	134'15.672	152	Box Core 3 ↓	81	327	6	0.6	0.71	1013.56	99	2/10
23(B)	21-Jul	21 h 27	70'53.454	134'15.660	150	Box Core Au Fond	81	330	5	0.6	0.71	1013.56	99	2/10
23(B)	21-Jul	21 h 29	70'53.447	134'15.646	149	Box Core ↑	80	332	6	0.6	0.71	1013.56	99	2/10
23(B)	21-Jul	21 h 50	70'53.359	134'15.548	161	Box Core ↓	80	330	6	1	0.72	1013.45	99	2/10
23(B)	21-Jul	21 h 52	70'53.350	134'15.540	164	Box Core Au Fond	80	332	6	0.8	0.71	1013.45	99	2/10
23(B)	21-Jul	21 h 54	70'53.342	134'15.532	167	Box Core ↑	81	327	6	0.8	0.71	1013.45	99	2/10
23(B)	21-Jul	22 h 09	70'53.149	134'15.416	150	Agassiz Trawl ↓	79	339	5	1.5	0.7	1013.3	99	4/10
23(B)	21-Jul	22 h 26	70'52.761	134'14.261	111	Agassiz Trawl ↑	79	336	7	0.8	0.71	1013.23	99	4/10

22(B)	22-Jul	01 h 40	70'49.088	134'30.588	143	Rosette ↓	72	300	6	0.6	0.12	1009.66	99	7/10
22(B)	22-Jul	02 h 01	70'49.082	134'30.605	201	Rosette ↑	73	323	7	1.4	0.1	1009.67	99	7/10
22(B)	22-Jul	02 h 13	70'48.908	134'31.101	18	Tucker ↓	72	311	5	1.4	0.11	1009.69	99	7/10
22(B)	22-Jul	02 h 27	70'49.182	134'30.828	57	Tucker ↑	72	332	4	0.4	0.12	1009.6	99	7/10
22(B)	22-Jul	02 h 46	70'48.971	134'31.538	353	Monster ↓	73	312	5	0.4	0.14	1009.48	99	7/10
22(B)	22-Jul	02 h 54	70'48.982	134'31.543	22	Monster ↑	71	309	4	0.3	0.15	1009.48	99	7/10
22(B)	22-Jul	03 h 18	70'48.957	134'31.674	70	Box Coring ↓	73	297	5	0.2	0.22	1009.41	99	7/10
22(B)	22-Jul	03 h 20	70'48.959	134'31.692	66	Box Coring ↑	72	299	6	0.2	0.22	1009.41	99	7/10
22(B)	22-Jul	03 h 46	70'48.912	134'31.654	67	Agassiz Trawl ↓	74	298	5	0.2	0.22	1009.42	99	7/10
22(B)	22-Jul	03 h 54	70'49.279	134'31.095	40	Agassiz Trawl ↑	73	300	6	0.1	0.28	1009.34	99	7/10
21(B)	22-Jul	09 h 11	71'00.986	134'38.139	51	Tucker ↓	334	317	7	0.3	1.02	1010.96	99	5/10
21(B)	22-Jul	09 h 22	71'01.221	134'37.336	41	Tucker ↑	338	329	7	0.4	1.08	1011.03	99	5/10
21(B)	22-Jul	09 h 41	71'01.301	134'37.928	354	Monster ↓	343	324	7	0.6	1.2	1011.16	99	5/10
21(B)	22-Jul	10 h 03	71'01.239	134'37.785	43	Monster ↑	344	330	6	0.5	1.21	1011.19	99	5/10
21(B)	22-Jul	10 h 28	71'01.111	134'37.976	273	Rosette ↓	337	356	9	0.5	1.22	1011.30	99	5/10
21(B)	22-Jul	11 h 26	71'00.740	134'38.375	246	Rosette ↑	330	11	8	1.1	1.2	1011.47	99	5/10
21(B)	22-Jul	10 h 38	71'01.054	134'38.012	254	Water Pump ↓	336	2	8	0.8	1.22	1011.30	99	5/10
21(B)	22-Jul	11 h 39	71'00.631	134'38.831	197	Water Pump ↑	337	11	8	1.9	1.21	1011.43	99	5/10
21(B)	22-Jul	12 h 25	71'00.333	134'39.203	72	Box Coring ↓	320	11	9	1	1.25	1011.43	97	5/10
21(B)	22-Jul	12 h 40	71'00.254	134'39.247	116	Box Coring ↑	318	10	9	1	1.28	1011.60	97	5/10
21(B)	22-Jul	13 h 00	71'00.250	134'39.613	38	Agassiz Trawl ↓	322	13	12	0.8	1.23	1011.69	98	4/10
21(B)	22-Jul	13 h 32	71'00.817	134'38.577	318	Agassiz Trawl ↑	332	11	13	0.4	1.39	1011.78	98	4/10
21(B)	22-Jul	16 h 06	71'01.239	134'41.208	317	Deploy Mooring	367	46	6	0.4	1.42	1012.26	93	4/10
18(B)	22-Jul	19 h 02	70'52.512	135'21.415	261	CTD Rosette ↓	496	40	12	0.4	1.94	1011.88	96	1/10
18(B)	22-Jul	19 h 20	70'52.554	135'21.709	308	Water Pump ↓	500	124	9	2	1.74	1011.93	92	1/10
18(B)	22-Jul	19 h 56	70'52.571	135'21.964	271	CTD Rosette ↑	506	50	8	2.9	1.83	1011.86	90	1/10
18(B)	22-Jul	20 h 14	70'52.595	135'22.217	310	Water Pump ↑	505	60	9	2.9	1.87	1011.85	90	1/10
18(B)	22-Jul	20 h 42	70'52.581	135'22.713	0	Tucker ↓	512	69	9	2	1.95	1012.05	92	2/10
18(B)	22-Jul	20 h 54	70'53.095	135'23.330	290	Tucker ↑	522	61	8	1.4	1.97	1012.08	94	2/10
18(B)	22-Jul	21 h 10	70'53.132	135'23.576	188	Monster ↓	523	59	7	0.7	2.06	1012.04	95	2/10
18(B)	22-Jul	21 h 41	70'53.101	135'23.636	150	Monster ↑	521	56	8	0.1	2.14	1011.87	98	2/10
18(B)	22-Jul	22 h 04	70'53.060	135'23.694	156	Box Core ↓	520	57	8	0.1	2.2	1011.84	98	2/10
18(B)	22-Jul	22 h 11	70'53.046	135'23.712	147	Box Core Au Fond	520	53	7	0.1	2.2	1011.83	98	2/10
18(B)	22-Jul	22 h 18	70'53.029	135'23.721	146	Box Core ↑	521	53	7	0.1	2.22	1011.83	98	4/10
18(B)	22-Jul	22 h 39	70'54.210	135'25.674	354	Agassiz Trawl ↓	560	56	8	0.5	2.28	1011.74	97	4/10

18(B)	22-Jul	23 h 18	70'54.703	135'26.307	277	Agassiz Trawl ↑	577	48	7	2.9	2.1	1012.01	86	4/10
8(B)	23-Jul	01 h 40	70'55.244	135'51.844	301	CTD Rosette ↓	786	70	10	0.5	1.07	1011.5	97	3/10
8(B)	23-Jul	02 h 48	70'54.831	135'53.084	338	CTD Rosette ↑	783	80	10	1.3	1.04	1011.46	93	3/10
8(B)	23-Jul	02 h 59	70'55.018	135'52.859	73	Tucker ↓	791	73	13	1	1.08	1011.86	95	3/10
8(B)	23-Jul	03 h 13	70'55.017	135'51.733	85	Tucker ↑	776	68	11	0.4	1.14	1011.11	97	3/10
8(B)	23-Jul	03 h 28	70'54.944	135'51.983	133	Monster ↓	781	75	11	0.4	1.23	1011.12	97	3/10
8(B)	23-Jul	04 h 07	70'55.038	135'52.827	267	Monster ↑	790	62	10	0.2	1.37	1011.18	98	3/10
8(B)	23-Jul	04 h 35	70'54.976	135'53.975	254	Box Core ↓	795	72	9	0.3	1.37	1011.63	96	3/10
8(B)	23-Jul	04 h 57	70'54.942	135'53.309	250	Box Core ↑	792	68	8	0.7	1.34	1011.02	95	3/10
8(B)	23-Jul	05 h 07	70'54.912	135'53.705	270	Agassiz Trawl ↓	799	56	8	0.6	1.31	1011.01	95	2/10
8(B)	23-Jul	05 h 48	70'54.474	135'55.959	176	Agassiz Trawl ↑	808	73	12	0.3	1.35	1010.86	95	2/10
20(B)	23-Jul	09 h 48	71'00.941	135'20.775	282	Rosette ↓	645	53	12	0.51	2.1	1009.94	93	4/10
20(B)	23-Jul	11 h 04	71'00.695	135'22.522	301	Rosette ↑	659	63	12	0.57	2.3	1009.86	86	4/10
20(B)	23-Jul	11 h 31	70'59.825	135'23.590	112	Tucker ↓	643	58	14	1.8	0.58	1009.68	91	4/10
20(B)	23-Jul	11 h 42	70'59.768	135'22.844	50	Tucker ↑	642	67	12	1.5	0.6	1009.54	93	4/10
20(B)	23-Jul	11 h 51	70'59.730	135'23.086	153	Monster ↓	638	63	11	1.4	0.61	1009.57	94	4/10
20(B)	23-Jul	12 h 34	70'59.412	135'23.955	157	Monster ↑	641	65	10	1.7	0.73	1009.57	93	4/10
20(B)	23-Jul	12 h 56	70'59.746	135'23.677	24	Helicopter EM Survey ↑	643	64	12	1.5	0.78	1009.38	95	4/10
20(B)	23-Jul	14 h 57	70'59.735	135'27.905	73	Helicopter EM Survey ↓	650	50	12	1.4	0.84	1009.4	95	4/10
20(B)	23-Jul	13 h 14	71'00.186	135'23.649	60	Box Coring 1 ↓	648	62	11	1.4	0.81	1009.4	96	4/10
20(B)	23-Jul	13 h 35	71'00.170	135'24.007	42	Box Coring 1 ↑	654	60	10	1.5	0.81	1009.57	94	4/10
20(B)	23-Jul	13 h 46	71'00.230	135'24.092	55	Box Coring 2 ↓	646	66	11	1.3	0.83	1009.52	96	4/10
20(B)	23-Jul	14 h 08	71'00.271	135'24.583	17	Box Coring 2 ↑	655	59	11	1.3	0.83	1009.32	96	4/10
20(B)	23-Jul	14 h 33	70'59.259	135'26.806	40	Agassiz Trawl ↓	654	55	13	2.9	0.8	1009.58	89	4/10
20(B)	23-Jul	15 h 35	70'00.203	135'27.367	264	Agassiz Trawl ↑	697	59	13	3.2	0.88	1009.38	87	4/10
20(B)	23-Jul	15 h 10	71'00.021	135'26.166	338	Met. Balloon Launch	664	48	13	1.8	0.88	1009.33	94	4/10
20(B)	23-Jul	16 h 15	71'00.207	135'27.731	142	Helicopter ↑	693	53	11	1.6	0.82	1009.2	93	4/10
20(B)	23-Jul	17 h 52	71'00.128	135'28.821	75	Helicopter ↓	696	45	11	3	0.96	1008.76	90	4/10
20(B)	23-Jul	18 h 51	71'00.118	135'28.785	225	Deploy Mooring G-09	699	30	11	2.6	0.84	1008.52	89	2/10
16	24-Jul	06 h 40	70'47.330	136'34.330	245	Met. Balloon Launch	1004	30	7	0.2	0.36	1009.54	99	4/10
16(B)	24-Jul	08 h 10	70'47.687	136'39.491	254	Rosette ↓	1097	35	6	0.7	0.81	1009.89	99	1/10
16(B)	24-Jul	09 h 28	70'47.436	136'40.594	289	Rosette ↑	1125	12	5	0.6	0.95	1010.33	98	1/10
16(B)	24-Jul	09 h 59	70'47.246	136'40.564	70	Tucker ↓	116	353	6	0.6	0.96	1010.54	97	1/10

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16(B)	24-Jul	10 h 11	70'47.454	136'39.598	38	Tucker ↑	1152	358	6	0.1	0.98	1010.54	97	1/10
16(B)	24-Jul	10 h 29	70'47.368	136'39.772	158	Monster ↓	1182	34	7	-0.1	1.04	1010.5	98	1/10
16(B)	24-Jul	11 h 43	70'47.071	136'40.528	141	Monster ↑	1206	15	4	0.1	1.32	1010.8	97	2/10
16(B)	24-Jul	12 h 22	70'47.880	136'38.990	0	Box Core 1 ↓	1071	36	5	0.5	1.3	1010.91	98	2/10
16(B)	24-Jul	12 h 36	70'47.873	136'39.027	2	Box Core 1 Au Fond	1074	42	4	0.6	1.28	1011.03	98	2/10
16(B)	24-Jul	12 h 51	70'47.831	136'39.104	321	Box Core 1 ↑	1072	49	6	0.7	1.31	1010.96	97	2/10
16(B)	24-Jul	13 h 20	70'47.883	136'39.003	359	Box Core 2 ↓	1072	51	4	0.7	1.33	1011.04	97	2/10
16(B)	24-Jul	13 h 41	70'47.883	136'38.978	348	Box Core 2 Au Fond	1072	8	3	0.8	1.32	1011.04	97	2/10
16(B)	24-Jul	14 h 06	70'47.794	136'39.061	274	Box Core 2 ↑	1073	25	5	1.8	1.32	1011.29	95	2/10
6(B)	24-Jul	21 h 47	70'55.861	136'24.659	259	Deploy Mooring F-09	1010	55	5	2.1	1.28	1012.84	89	3/10
6(B)	24-Jul	21 h 00	70'55.870	136'24.287	222	Met. Balloon Launch	1012	40	5	1.5	1.33	1012.76	93	3/10
6(B)	24-Jul	23 h 02	70'55.355	136'27.306	114	Tucker ↓	1009	50	5	0.6	1.24	1013.39	98	3/10
6(B)	24-Jul	23 h 13	70'55.345	136'26.216	85	Tucker ↑	996	42	4	0.6	1.34	1013.42	98	3/10
6(B)	24-Jul	23 h 31	70'55.315	136'25.533	82	Monster ↓	1022	36	4	0.6	1.55	1013.55	99	4/10
6(B)	25-Jul	12 h 28	70'56.215	136'25.904	-	Monster ↑ "Echel"	1023	55	5	0.3	1.4	1013.62	99	4/10
6(B)	25-Jul	12 h 51	70'56.157	136'25.783	267	CTD Rosette ↓	1014	58	4	0.8	1.37	1013.81	99	4/10
6(B)	25-Jul	02 h 07	70'56.198	136'26.420	342	CTD Rosette ↑	1016	44	6	1	1.25	1013.95	97	4/10
6(B)	25-Jul	01 h 00	70'56.246	136'26.998	287	Water Pump ↓	1014	76	6	0.9	1.26	1013.87	99	4/10
6(B)	25-Jul	01 h 55	70'56.180	136'26.241	338	Water Pump ↑	1014	80	7	0.9	1.28	1013.89	98	4/10
6(B)	25-Jul	02 h 36	70'56.220	136'26.151	153	Box Core ↓	1020	76	7	0.9	1.12	1014.01	98	4/10
6(B)	25-Jul	02 h 45	70'56.195	136'26.173	94	Box Core Au Fond	101	75	5	0.4	1.1	1014.04	99	4/10

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6(B)	25-Jul	03 h 15	70'56.197	136'26.454	145	Box Core ↑	1014	81	6	0.5	1.14	1014.22	99	4/10
6(B)	25-Jul	04 h 16	70'56.192	136'26.562	262	Monster ↓	1016	347	6	0.3	1.17	1014.25	99	4/10
6(B)	25-Jul	05 h 18	70'56.168	136'27.059	225	Monster ↑	1020	86	5	1.7	1.13	1014.49	93	4/10
7(B)	25-Jul	08 h 14	70'59.327	136'07.633	321	CTD Rosette ↓	1018	89	8	1.6	0.32	1015.03	93	4/10
7(B)	25-Jul	09 h 30	70'59.379	136'08.767	356	CTD Rosette ↑	1034	95	7	2.9	0.43	1015.58	90	4/10
7(B)	25-Jul	07 h 05	70'55.861	136'16.334	-	Met. Balloon Launch	-	-	-	-	-	-	-	-
7(B)	25-Jul	10 h 19	70'59.270	136'08.333	134	Monster ↓	1022	85	9	1.1	0.58	1015.64	96	5/10
7(B)	25-Jul	11 h 29	70'59.156	136'09.167	216	Monster ↑	1022	92	6	1	0.67	1015.89	95	5/10
7(B)	25-Jul	12 h 50	70'59.264	136'09.548	107	Box Core ↓	1022	74	7	3	0.55	1016.23	89	5/10
7(B)	25-Jul	13 h 14	70'59.132	136'09.628	113	Box Core Au Fond	1022	72	9	1.2	0.58	1016.35	95	5/10
7(B)	25-Jul	13 h 33	70'59.052	136'09.912	148	Box Core ↑	1022	76	8	1.2	0.66	1016.4	95	5/10
7(B)	25-Jul	15 h 03	70'57.588	136'10.837	184	Met. Balloon Launch	-	82	8	0.4	1.36	1017.06	95	9/10
A2-09	25-Jul	18 h 35	70'44.777	135'55.164	225	Deploy Mooring A2-09	618	92	7	1.3	1.18	1018.09	94	1/10
A2-10	25-Jul	20 h 49	70'44.246	135'55.126	6	CTD Rosette ↓	583	112	9	2.6	1.59	1018.59	90	1/10
A2-11	25-Jul	21 h 40	70'44.389	135'55.442	34	CTD Rosette ↑	595	143	6	3.1	1.68	1018.77	86	1/10
A2-12	25-Jul	21 h 50	70'44.387	135'55.002	139	Tucker ↓	596	130	7	3.2	1.69	1018.75	87	1/10
A2-13	25-Jul	22 h 00	70'44.246	135'54.135	73	Tucker ↑	583	144	8	1.9	1.7	1018.67	93	1/10
A2-14	25-Jul	22 h 20	70'44.373	135'54.342	269	Monster ↓	589	140	6	1.8	1.7	1018.78	92	1/10
A2-15	25-Jul	22 h 54	70'44.399	135'54.516	192	Monster ↑	595	126	6	1.9	1.68	1018.97	91	1/10
A2-16	25-Jul	23 h 18	70'44.392	135'54.547	178	Box Core ↓	592	122	6	1.8	1.68	1019.2	92	1/10
A2-17	25-Jul	23 h 27	70'44.385	135'54.554	177	Box Core Au Fond	592	115	7	1.8	1.69	1019.17	92	1/10
A2-18	25-Jul	23 h 43	70'44.374	135'54.643	225	Box Core ↑	592	135	9	1.7	1.74	1019.15	92	1/10
A2-19	26-Jul	00 h 00	70'44.310	135'54.765	186	Agassiz Trawl ↓	586	136	8	2	1.78	1019.3	90	1/10
A2-20	26-Jul	00 h 44	70'43.531	135'54.190	83	Agassiz Trawl ↑	526	135	8	1.4	1.71	1019.2	92	1/10
5	26-Jul	06 h 47	70'50.011	136'05.287	315	Box Core ↓	814	311	13	1.4	0.59	1019.77	82	4/10
5	26-Jul	07 h 27	70'50.027	136'06.050	14	Box Core ↑	819	143	13	6.2	0.64	1019.18	79	4/10
5	26-Jul	10 h 06	70'45.180	135'55.624	210	STN LF 03 ↓	642	138	15	4.3	0.6	1019.04	90	2/10

5	26-Jul	12 h 40	70'45.124	136'16.201	136	STN LF 02 ↓	619	127	14	3.7	1.07	1018.87	89	3/10
5	26-Jul	13 h 40	70'45.121	136'38.248	156	STN LF 01 ↓	1204	124	13	4.4	1.14	1018.47	86	4/10
5	26-Jul	14 h 44	70'39.060	136'27.825	110	STN LF 06 ↓	830	111	15	4.6	0.78	1018.1	87	4/10
5	26-Jul	n/a	n/a	n/a	n/a	STN LF 07 ↓	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a
5	26-Jul	16 h 54	70'38.970	136'06.663	247	Deploy Hydrophone	453	97	16	5.2	0.42	1017.86	81	8/10
5	26-Jul	18 h 45	70'33.113	135'55.971	146	STN LF 11 ↓	70	120	18	5.1	0.72	1017.24	85	8/10
13(B)	26-Jul	21 h 51	70'30.349	135'40.370	94	CTD Rosette ↓	66	95	18	6	1.62	1016.52	87	6/10
13(B)	26-Jul	22 h 14	70'30.482	135'40.599	342	CTD Rosette ↑	65	99	19	6.1	1.92	1016.44	86	6/10
13(B)	26-Jul	22 h 20	70'30.420	135'40.659	196	Tucker ↓	68	95	20	6.4	1.94	1016.96	85	6/10
13(B)	26-Jul	22 h 42	70'30.115	135'41.044	183	Tucker ↑	66	99	20	5.8	2.23	1016.35	87	6/10
13(B)	26-Jul	22 h 58	70'30.117	135'40.627	289	Monster ↓	68	97	17	6.5	2.49	1016.41	84	5/10
13(B)	26-Jul	23 h 09	70'30.165	135'40.770	305	Monster ↑	64	94	19	7	2.65	1016.43	83	5/10
13(B)	26-Jul	23 h 26	70'30.244	135'40.714	289	Box Core ↓	65	100	18	6.5	2.41	1016.38	86	5/10
13(B)	26-Jul	23 h 28	70'30.252	135'40.741	286	Box Core Au Fond	66	101	17	6.5	2.41	1016.35	86	5/10
13(B)	26-Jul	23 h 30	70'30.259	135'40.746	297	Box Core ↑	67	94	17	6.5	2.41	1016.38	86	5/10
13(B)	26-Jul	23 h 47	70'30.320	135'43.267	220	Agassiz Trawl ↓	67	98	17	6.9	2.25	1016.45	84	5/10
13(B)	27-Jul	00 h 01	70'29.964	135'43.806	163	Agassiz Trawl ↑	67	96	17	5.2	2.72	1016.15	90	5/10
13(B)	27-Jul	01 h 37	70'32.872	135'35.339	193	STN LF 12 ↓	67	91	17	4.1	2.25	1016.02	90	8/10
13(B)	27-Jul	05 h 03	70'33.171	135'13.508	172	STN LF 05 ↓	61	190	35	4	0.56	1016.42	92	10/10
13(B)	27-Jul	06 h 04	70'38.311	135'06.050	129	Met. Balloon Launch	62	102	17	3.8	0.19	1016.26	93	8/10
12(B)	27-Jul	08 h 09	70'38.392	135'05.988	86	Rosette ↓	61	122	12	4.6	0.18	1016.67	90	8/10
12(B)	27-Jul	08 h 27	70'38.438	135'06.024	31	Rosette ↑	62	126	14	4.9	0.18	1016.63	90	8/10
12(B)	27-Jul	09 h 11	70'38.406	135'06.296	150	Tucker ↓	60	117	17	5.1	0.19	1016.59	90	8/10
12(B)	27-Jul	09 h 25	70'38.269	135'05.525	72	Tucker ↑	62	121	17	5.2	0.19	1016.48	90	8/10
12(B)	27-Jul	09 h 46	70'38.205	135'05.122	303	Monster ↓	62	126	13	4.9	0.19	1016.55	91	8/10
12(B)	27-Jul	09 h 54	70'38.196	135'05.173	299	Monster ↑	62	130	13	6.5	0.19	1016.73	82	8/10
12(B)	27-Jul	10 h 16	70'38.248	135'05.511	309	Box Core 1 ↓	62	114	11	9.6	0.16	1016.89	74	8/10
12(B)	27-Jul	10 h 18	70'38.247	135'05.532	319	Box Core 1 Au Fond	62	113	10	9.6	0.16	1016.89	74	8/10
12(B)	27-Jul	10 h 20	70'38.250	135'05.558	313	Box Core 1 ↑	62	112	10	9.6	0.16	1016.89	74	8/10
12(B)	27-Jul	10 h 30	70'38.261	135'05.708	317	Box Core 2 ↓	62	114	11	6.6	0.17	1016.92	86	8/10
12(B)	27-Jul	10 h 32	70'38.267	135'05.741	329	Box Core 2 Au Fond	62	114	12	6.6	0.17	1016.92	86	8/10
12(B)	27-Jul	10 h 34	70'38.266	135'05.747	333	Box Core 2 ↑	63	118	12	6.6	0.17	1016.92	86	8/10
12(B)	27-Jul	10 h 52	70'38.358	135'04.098	180	Agassiz Trawl ↓	63	105	9	5.3	0.17	1017.1	90	7/10
12(B)	27-Jul	11 h 12	70'37.772	135'03.869	145	Agassiz Trawl ↑	62	94	13	6.3	0.17	1017.2	87	7/10

12(B)	27-Jul	14 h 30	70'38.326	135'22.284	137	STN LF 09 ↓	71	91	10	6.8	0.12	1018.02	83	7/10
235	24-Aug	03 h 45	71'44.609	130'30.803	264	Product-Line Recovery	776	67	8	1.1	1.33	1011.52	99	3/10
235	24-Aug	04 h 45	71'44.208	130'45.088	212	Rosette ↓	546	74	10	0.9	1.26	1011.49	99	3/10
235	24-Aug	05 h 15	71'44.187	130'45.006	308	Rosette ↑	546	75	11	1.7	1.21	1011.43	99	3/10
235	24-Aug	05 h 28	71'43.744	130'49.248	183	IOPs Package ↓	575	80	9	1.7	1.22	1011.43	99	3/10
235	24-Aug	05 h 57	71'43.590	130'49.091	232	IOPs Package ↑	565	65	10	0.8	1.19	1011.38	99	3/10
235	24-Aug	06 h 14	71'43.283	130'50.102	111	Zodiac Deployed ↓	567	57	9	0.9	1.22	1011.29	99	3/10
235	24-Aug	06 h 23	71'43.171	130'49.783	48	Rosette IOPs ↑	562	61	12	0.8	1.21	1011.25	99	3/10
235	24-Aug	07 h 04	71'42.934	130'49.855	302	Rosette IOPs ↓	575	70	13	1.1	1.2	1011.24	99	3/10
235	24-Aug	07 h 22	71'42.775	130'48.737	114	Zodiac Recovery ↑	562	80	15	0.7	1.19	1011.26	99	3/10
235	24-Aug	08 h 13	71'42.589	130'48.302	73	Recovery Drifting Trap	552	67	11	0.6	1.22	1011.19	99	3/10
235	24-Aug	08 h 32	71'42.749	130'47.785	345	Rosette ↓	543	79	12	0.6	1.22	1011.23	99	3/10
235	24-Aug	08 h 58	71'42.694	130'48.306	355	Rosette ↑	555	95	12	1.2	1.15	1011.1	99	3/10
235	28-Aug	21 h 00	70'41.600	126'01.800	315	Met. Balloon Launch	190	95	25	7.2	6.2	1002.7	97	0/10
S1	29-Aug	18 h 00	69'30.050	137'59.820	288	Rosette ↓	60	342	11	1.5	3.5	1008.6	96	0/10
S1	29-Aug	18 h 32	69'29.950	137'59.570	255	Rosette ↑	58.4	341	11	1.8	3.9	1008.6	96	0/10
S1	29-Aug	19 h 00	69'29.900	137'59.060	241	MOBs Buoy ↓	56	340	10	2.1	3.9	1008.5	94	0/10
S1	29-Aug	19 h 48	69'30.000	137'58.900	321	Foredeck Pump ↓	55.4	340	9	1.9	4	1010.9	90	0/10
S1	29-Aug	19 h 55	69'30.000	137'58.800	311	Foredeck Pump 2 ↓	55	355	10	1.9	4	1010.8	90	0/10
S1	29-Aug	22 h 28	69'29.900	137'57.200	77	Foredeck Pumps ↑	50	170	4	1.4	3.8	1009.2	90	0/10
S1	29-Aug	23 h 10	69'30.000	137'58.000	280	MOBs Buoy ↑	52	140	8	1.9	3.8	1008.5	91	0/10
S1	29-Aug	23 h 37	69'29.900	137'59.600	135	Rosette #2 ↓	58.7	140	11	2.2	3.7	1008	91	0/10
S1	29-Aug	23 h 47	69'29.900	137'59.600	134	Rosette #2 ↑	58.5	140	12	2.2	3.7	1007.8	92	0/10
S1	30-Aug	01 h 07	69'29.900	137'59.400	125	Rosette CTD #3 ↓	58	140	17	3.7	3.6	1006.2	91	0/10
S1	30-Aug	01 h 23	69'29.900	137'59.000	83	Rosette CTD #3 ↑	56	155	17	3.9	3.7	1006.1	91	0/10
S1	30-Aug	03 h 06	69'29.900	137'58.900	82	Rosette CTD #4 ↓	56	130	19	4.8	3.6	1004.1	89	0/10
S1	30-Aug	03 h 18	69'29.900	137'58.900	34	Rosette CTD #4 ↑	56	135	20	5.1	3.6	1003.7	88	0/10
S1.1	30-Aug	04 h 42	69'40.170	138'09.130	101	Rosette ↓	126	97	16	4.4	3.9	1000.1	94	0/10
S1.1	30-Aug	04 h 56	69'40.160	138'09.010	98	Rosette ↑	126	96	16	4.5	4.2	1001.03	93	0/10
S1.1	30-Aug	06 h 00	69'40.450	138'09.690	80	Rosette ↓	128	80	14	4.4	4.2	1000.6	94	0/10
S1.1	30-Aug	06 h 14	69'40.520	138'09.730	78	Rosette ↑	130	83	16	4.4	4.2	1000.4	94	0/10
S1.2	30-Aug	07 h 27	69'49.890	138'19.570	68	Rosette 1 ↓	189	67	12	3.1	3.6	1000.5	96	0/10
S1.2	30-Aug	07 h 52	69'49.800	138'20.100	53	Rosette 1 ↑	190	56	8	2.8	3.3	1003.6	97	0/10
S1.2	30-Aug	08 h 37	69'50.000	138'20.500	57	Rosette 2 ↓	191	50	7	2.6	3.1	1003.6	98	1/10
S1.2	30-Aug	08 h 49	69'50.000	138'20.600	45	Rosette 2 ↑	191	40	6	2.5	3.1	1003.6	98	1/10

S1.2	30-Aug	09 h 44	69'50.300	138'21.100	36	Rosette 3 ↓	195	40	10	2.4	3	1003.7	99	0/10
S1.2	30-Aug	09 h 51	69'50.300	138'21.100	48	Rosette 3 ↑	194	43	11	2.2	3	1003.7	99	0/10
S2	30-Aug	11 h 06	70'00.000	138'30.200	50	Rosette Biology ↓	259	62	12	0.8	2.2	1003.9	99	0/10
S2	30-Aug	11 h 44	70'00.200	138'30.800	66	Rosette Biology ↑	260	60	10	0.5	2.1	1004.2	99	1/10
S2	30-Aug	14 h 22	70'00.520	138'30.340	112	Rosette Biogeochem ↓	260	0	8	0.5	1.8	1005.6	99	1/10
S2	30-Aug	14 h 45	70'00.500	138'30.200	109	Met. Balloon Launch	261	340	11	0.3	1.8	1005.9	99	1/10
S2	30-Aug	14 h 52	70'00.500	138'30.200	94	Rosette Biogeochem ↑	260	335	11	0.3	1.8	1006.2	99	1/10
S2	30-Aug	15 h 19	70'00.500	138'29.600	67	MOBs Buoy ↓	260	335	16	0.3	1.8	1006.9	99	1/10
S2	30-Aug	18 h 16	69'59.680	138'29.740	311	Rosette ↓	256	319	22	-0.3	1.6	1008.3	93	0/10
S2	30-Aug	18 h 33	69'59.700	138'30.070	316	Rosette ↑	256	327	18	-0.6	1.6	1008.6	93	0/10
S2	30-Aug	18 h 55	69'59.410	138'30.320	344	Start Deployment of Foredeck Pump	257	319	23	-0.5	1.5	1009.0	93	0/10
S2	30-Aug	19 h 16	69'59.340	138'30.360	341	Finish Deployment of Foredeck Pump	257	318	20	-0.5	1.5	1009.0	93	0/10
S2	30-Aug	23 h 08	69'58.600	138'32.300	355	Foredeck Pumps ↑	258	310	22	-1.0	1.5	1014.3	94	1/10
S2	30-Aug	23 h 55	69'54.200	138'34.710	46	MOBs Buoy ↑	221	320	22	-0.6	1.4	1014.5	78	1/10
S2	31-Aug	00 h 48	70'01.410	138'32.860	24	Rosette #3 ↓	271	305	19	-1.4	1.2	1014.7	79	0/10
S2	31-Aug	01 h 08	70'01.500	138'33.050	33	Rosette #3 ↑	271	305	16	-1.6	1.2	1014.8	78	0/10
S2	31-Aug	01 h 37	70'01.370	138'32.310	32	Moonpool Pump ↓	268	295	15	-1.9	1.1	1014.9	86	0/10
S2	31-Aug	03 h 08	70'01.990	138'32.270	350	Moonpool Pump ↑	269	300	16	-2	0.98	1014.6	81	0/10
L1	31-Aug	14 h 18	71'05.550	139'00.590	352	Met. Balloon Launch	1911	110	7	0.5	0.11	1009.9	78	7/10
L1	31-Aug	14 h 18	71'05.550	139'00.590	352	Rosette #1 Biology ↓	1911	110	7	0.5	0.11	1009.9	78	7/10
L1	31-Aug	14 h 22	71'05.560	139'00.650	352	Ice Team Deployed	1909	105	7	0.5	0.11	1009.9	78	7/10
L1	31-Aug	15 h 00	71'05.690	139'01.160	353	Helicopter Deployed (EM Team)	1912	100	9	1.4	0.12	1009.8	74	7/10
L1	31-Aug	15 h 48	71'05.830	139'01.410	356	Rosette #1 Biology ↑	1913	109	8	1.2	0.12	1006.9	75	8/10
L1	31-Aug	16 h 17	71'05.950	139'01.490	357	Helicopter Returns (EM Team)	1911	107	13	0.7	0.13	1006.3	82	8/10
L1	31-Aug	16 h 35	71'06.040	139'01.520	357	Rosette ↓	1911	104	12	0.2	0.13	1006.0	81	8/10
L1	31-Aug	17 h 47	71'06.320	139'01.490	356	Rosette ↑	1912	104	10	0.2	0.13	1008.1	82	8/10
L1	31-Aug	18 h 44	71'06.400	139'01.400	356	Helicopter Departs (EM Team)	1912	113	10-15	0.2	0.13	1007.1	85	8/10
L1	31-Aug	18 h 59	71'06.400	139'01.400	355	Helicopter Returns (EM Team)	194	100	17	-1.6	0.1	1006.5	88	8/10

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L1	31-Aug	20 h 05	71'06.400	139'01.400	355	Rosette ↓	1942	100	17	-1.6	0.1	1006.5	88	8/10
L1	31-Aug	20 h 10	71'06.400	139'01.400	355	Rosette ↑	1942	100	16	-1.5	0.1	1006.5	89	8/10
L1	31-Aug	20 h 17	71'06.300	139'01.500	353	Rosette ↓	1913	100	18	-1.5	0.1	1006.5	89	8/10
L1	31-Aug	21 h 41	71'06.000	139'02.500	352	Rosette ↑	1918	93	22	-1.8	0.1	1005.6	91	8/10
L1	31-Aug	22 h 25	71'05.900	139'03.400	351	Moonpool Pump ↓	1926	97	22	-1.6	0.1	1005.1	91	8/10
L1	01-Sep	01 h 33	71'05.940	139'08.870	354	Moonpool Pump ↑	1981	90	21	-1.4	0.1	1004.6	95	8/10
L1	01-Sep	03 h 11	71'06.410	139'11.370	354	LV Pump Moonpool ↓	1982	90	22	-1.1	0.1	1004.1	94	8/10
L1	01-Sep	08 h 35	71'07.640	139'12.400	352	LV Pump Moonpool ↑	1982	101	18	-0.4	0.08	1002.2	94	7/10
L1	01-Sep	09 h 05	71'07.400	139'11.900	350	Deploy Helicopter ↑	1982	97	16	0	0.1	1004.7	93	7/10
L1	01-Sep	09 h 12	71'07.400	139'11.900	350	Ice Team Deployed	1982	99	17	0.1	0.1	1004.7	93	7/10
L1	01-Sep	09 h 28	71'07.400	139'11.900	350	Rosette Nd ↓	1990	95	15	0.1	0.1	1004.8	93	7/10
L1	01-Sep	11 h 02	71'06.800	139'12.500	350	Rosette Nd ↑	1986	94	16	0.5	0	1002.75	97	7/10
L1	01-Sep	10 h 47	71'06.800	139'12.500	350	Helicopter Returns ↓	1987	95	18	0.5	0.1	1005.1	92	7/10
L1	01-Sep	11 h 57	71'06.540	139'13.530	350	Scan Start (Kerri-Ann)	1989	100	16	0.7	0.1	1005.2	92	7/10
L1	01-Sep	12 h 14	71'06.460	139'13.920	350	Scan Finish (Kerri-Ann)	-	100	18	0.9	0.1	1005.1	92	7/10
L1	01-Sep	12 h 38	71'06.360	139'14.630	350	LV Pump Moonpool ↓	1997	100	17	0.9	0.1	1005.1	92	7/10
L1	01-Sep	13 h 06	71'06.290	139'15.260	350	Ice Team Returns	1999	105	16	1.1	0.1	1005.2	91	7/10
L1	01-Sep	14 h 46	71'06.340	139'17.930	353	LV Pump Moonpool ↑	2015	110	13	1.3	0.1	1005.8	91	7/10
L1	01-Sep	14 h 54	71'06.370	139'18.120	353	Photogrammetry Start	2015	110	13	1.4	0.1	1005.8	91	7/10
L1	01-Sep	15 h 02	71'06.390	139'18.260	354	Rosette Th/Pa ↓	2016	110	14	1.4	0.1	1005.9	91	7/10
L1	01-Sep	15 h 47	71'06.580	139'19.070	357	Photogrammetry Finish	202	112	16	1.7	0.1	1006	92	7/10

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L1	01-Sep	16 h 48	71'06.910	139'19.840	0	Rosette Th/Pa ↑	2026	116	16	1.4	0.1	1006.1	94	7/10
L1	01-Sep	17 h 57	71'07.300	139'20.190	3	Rosette Atm ↓	2032	114	15	1.5	0.1	1006.02	96	7/10
L1	01-Sep	18 h 19	71'07.040	139'20.020	5	Rosette Atm ↑	2030	115	15	1.5	0.1	1006.03	97	7/10
L1	01-Sep	19 h 10	71'07.630	139'19.960	7	Rosette (Riulsin) ↓	2028	113	13	1.3	0	1006.3	98	7/10
L1	01-Sep	20 h 06	71'07.700	139'19.400	8	Scatterometer	2029	114	10	1.4	0.1	1006.8	98	7/10
L1	01-Sep	20 h 20	71'07.700	139'19.200	9	Rosette (Riulsin) ↑	2030	117	11	1.2	0.1	1006.8	99	7/10
L1	01-Sep	23 h 10	71'07.000	139'17.700	16	LV Pump ↓	2043	126	13	1.3	0	1007.2	95	7/10
L1	02-Sep	03 h 00	71'06.280	139'20.380	25	LV Pump Cast Si ↑	2044	140	11	1.3	0	1008.2	96	7/10
L1	02-Sep	03 h 20	71'06.280	139'20.640	26	Rosette RA-228 ↓	2048	145	11	1.4	0	1008.3	96	7/10
L1	02-Sep	04 h 33	71'06.400	139'21.330	30	Rosette RA-228 ↑	2050	148	10	1.2	0	1008.4	97	7/10
L1	02-Sep	05 h 12	71'06.520	139'21.490	31	Rosette (Cullen) ↓	2053	149	11	1.3	0	1008.5	97	7/10
L1	02-Sep	06 h 39	71'06.760	139'21.180	33	Rosette (Cullen) ↑	2052	137	11	1.1	0	1008.9	98	7/10
L1	02-Sep	07 h 07	71'06.810	139'20.890	34	Rosette Cast Cr/U ↓	2051	141	10	1.3	0	1009.06	97	7/10
L1	02-Sep	08 h 10	71'06.800	139'20.100	33	Scatterometer Start (10 mins)	2048	138	11	1.4	0	1009.3	96	6/10
L1	02-Sep	08 h 20	71'06.800	139'19.800	34	Scatterometer Finish	2046	144	11	1.5	0	1009.3	96	6/10
L1	02-Sep	08 h 40	71'06.800	139'19.500	34	Rosette Cast Cr/U ↑	2044	139	9	1.6	0	1009.6	96	6/10
L1	02-Sep	08 h 47	71'06.800	139'19.300	35	Deploy Ice Team ↑	2044	142	10	1.7	0	1009.6	95	6/10
L1	02-Sep	10 h 12	71'06.500	139'18.200	36	Deploy Helicopter ↑ (EM Team)	2038	141	14	1.9	0	1009.5	95	6/10
L1	02-Sep	10 h 30	71'06.500	139'18.100	37	TM Cast Pb ↓	2038	139	14	2.2	0	1009.4	94	6/10
L1	02-Sep	10 h 38	71'06.400	139'18.000	37	TM Cast Pb ↑	2037	140	13	2.3	0	1009.5	94	6/10

L1	02-Sep	10 h 48	71'06.400	139'17.900	37	Retrieve On-Ice Teams ↓	2035	143	11	2.3	0	1009.5	94	6/10
L1	02-Sep	11 h 21	71'06.200	139'17.800	37	Rosette RA-226 ↓	2034	133	10	3.2	0	1009.8	90	6/10
L1	02-Sep	12 h 15	71'05.830	139'17.650	38	Retrieve Helicopter	2031	240	4	2.1	0	1010.5	92	6/10
L1	02-Sep	12 h 42	71'05.640	139'17.660	39	Rosette RA-226 ↑	2025	165	5	2.9	0.01	1010.6	88	6/10
L1	02-Sep	13 h 04	71'05.490	139'17.710	40	Ice-Team - Replacement Beacon ↓	2023	150	5	3.2	0.01	1010.6	91	7/10
L1	02-Sep	13 h 14	71'05.430	139'17.750	40	Ice-Team - Replacement Beacon ↑	2022	130	3	3.2	0.01	1010.6	91	7/10
L1	02-Sep	13 h 58	71'05.140	139'18.090	42	Rosette TM Micrograzers ↓	2021	136	6	2.2	-0.01	1010.7	95	7/10
L1	02-Sep	15 h 23	71'04.760	139'19.220	45	Rosette TM Micrograzers ↑	2024	105	9	1.9	-0.01	1010.7	95	7/10
L1	02-Sep	15 h 51	71'06.590	139'17.990	6	Met. Balloon Launch	2037	123	12	2	0	1010.5	95	7/10
L1	03-Sep	08 h 50	73'19.000	139'23.100	215	Rosette ↓	3251	310	9	0.3	-0.2	1009.6	99	7/10
L1	03-Sep	09 h 45	73'18.800	139'22.800	195	Rosette ↑	3247	280	10	0.4	-0.2	1009.9	99	7/10
L2	03-Sep	18 h 08	74'39.150	137'22.920	133	Rosette Pa/Th ↓	3370	215	15	0.5	-0.5	1005.1	99	8/10
L2	03-Sep	19 h 07	74'38.900	137'21.500	138	Cage Sampling Start	3367	226	15	0.5	-0.5	1004.3	99	8/10
L2	03-Sep	19 h 20	74'38.850	137'21.320	142	Cage Sampling Finish	3366	222	16	0.5	-0.5	1004.03	99	8/10
L2	03-Sep	20 h 30	74'38.600	137'20.500	155	Rosette Pa/Th ↑	3365	221	14	0	-0.4	1003	99	8/10
L2	03-Sep	21 h 05	74'38.600	137'20.200	161	Rosette TM Cast ↓	3366	223	14	0.1	-0.4	1002.9	99	8/10
L2	03-Sep	22 h 16	74'38.500	137'19.200	158	Met. Balloon Launch	3373	230	15	0	-0.4	1002.3	99	9/10
L2	03-Sep	23 h 05	74'38.500	137'18.400	157	Rosette TM Cast ↑	3369	232	14	-0.2	-0.4	1001.8	99	9/10
L2	04-Sep	00 h 23	74'38.650	137'17.000	156	Rosette Ra ↓	3367	235	11	-0.2	-0.4	1001.1	99	9/10
L2	04-Sep	00 h 27	74'38.650	137'16.890	156	Met. Balloon Launch	3367	230	12	-0.2	-0.4	1000.9	99	9/10
L2	04-Sep	01 h 07	74'38.650	137'15.990	157	Rosette Ra ↑	3369	240	13	-0.2	-0.36	1000.7	99	9/10

L2	04-Sep	01 h 46	74'38.620	137'14.990	158	Pump Supor Moonpool ↓	3374	245	13	-0.2	-0.36	1000.5	99	9/10
L2	04-Sep	05 h 46	74'37.090	137'08.830	163	Pump Supor Moonpool ↑ - Begin Deployment	3339	285	15	-0.4	-0.33	1001.09	99	8/10
L2	04-Sep	07 h 24	74'36.130	137'07.650	156	Pump Supor Moonpool ↑ - Finish Deployment	3336	282	15	-1.4	-0.35	1001.76	90	8/10
L2	04-Sep	08 h 12	74'35.600	137'07.300	168	Met. Balloon Launch	3334	275	19	-1.1	-0.4	1001.8	94	9/10
L2	04-Sep	08 h 14	74'35.600	137'07.300	168	Rosette Biology ↓	3331	273	18	-1.1	-0.4	1001.8	94	9/10
L2	04-Sep	08 h 46	74'35.300	137'07.100	167	Rosette Biology ↑	3338	267	20	-1.1	-0.4	1001.8	93	9/10
L2	04-Sep	10 h 16	74'34.900	137'06.600	160	Rosette TM Cast ↓	3331	269	24	-0.6	-0.4	1001.6	93	9/10
L2	04-Sep	11 h 00	74'34.900	137'05.800	158	Rosette TM Cast ↑	3330	260	24	-0.4	-0.4	999.2	94	9/10
L2	04-Sep	11 h 14	74'34.870	137'04.880	158	Ice Team Departs (Kerri-Ann and Monika)	3329	265	22	-0.4	-0.4	1001.5	93	9/10
L2	04-Sep	12 h 35	74'34.850	137'03.360	158	Rosette Rivkin ↓	3329	264	27	-0.3	-0.4	1001.34	93	9/10
L2	04-Sep	12 h 43	74'34.850	137'03.360	158	Ice Team On Board (Kerri-Ann and Monika)	3329	264	27	-0.3	-0.4	1001.34	93	9/10
L2	04-Sep	13 h 21	74'34.800	137'01.470	158	Rosette Rivkin ↑	3327	263	26	-0.3	-0.38	1001.25	94	9/10
L2	04-Sep	15 h 26	74'34.160	136'54.800	172	Rosette Biogeochem ↓	3319	270	30	0.2	-0.42	1000.9	93	9/10
L2	04-Sep	17 h 50	74'32.470	136'47.410	170	Rosette Biogeochem ↑	3303	284	26	-0.1	-0.42	1002.1	89	9/10
L2	04-Sep	18 h 49	74'31.600	136'45.600	190	Rosette ↓	3295	280	26	-0.1	-0.42	1002.5	91	9/10
L2	04-Sep	18 h 49	74'31.600	136'45.500	190	Ice Team Departs (Monika & Kristina)	3295	280	26	-0.1	-0.42	1002.5	91	9/10
L2	04-Sep	18 h 40	74'31.600	136'45.500	190	Scatterometer Scan	3295	280	26	-0.1	-0.42	1002.5	91	9/10
L2	04-Sep	19 h 05	74.31.240	136'44.880	195	Ice Team On Board (Monika & Kristina)	3294	283	31	0	-0.42	1002.6	87	9/10
L2	04-Sep	19 h 21	74'30.980	136'44.460	194	Rosette ↑	3290	285	31	0	-0.4	1003.1	87	9/10
L2	04-Sep	19 h 30	74'30.750	136'44.190	195	Ice Team Deployed	3293	296	31	0	-0.42	1003.1	87	9/10
L2	04-Sep	19 h 55	74'30.440	136'43.820	190	Ice Team Returns	3290	290	25	-0.3	-0.4	1003.5	89	8/10

L2	04-Sep	21 h 37	74'26.500	136'28.000	205	Rosette Pgomics ↓	3242	300	19	-0.4	-0.5	1005.1	87	8/10
L2	04-Sep	21 h 52	74'26.300	136'28.200	182	Rosette Pgomics ↑	3241	300	22	-0.8	-0.5	1005.5	96	8/10
L2	04-Sep	22 h 39	74'25.900	136'28.800	182	Rosette Pgomics ↓	3240	300	24	-0.6	-0.5	1006.1	88	8/10
L2	04-Sep	22 h 49	74'25.800	136'28.900	182	Rosette Pgomics ↑	3240	303	25	-0.6	-0.5	1006.2	88	8/10
L2	04-Sep	23 h 24	74'25.600	136'29.300	215	Rosette Pgomics ↓	3240	320	22	-0.8	-0.5	1006.7	90	8/10
L2	04-Sep	23 h 29	74'25.500	136'29.400	209	Rosette Pgomics ↑	3240	311	20	-0.8	-0.5	1006.7	90	8/10
L2	04-Sep	23 h 39	74'25.400	136'29.500	200	Rosette Pgomics ↓	3241	309	23	-0.7	-0.5	1006.8	88	8/10
L2	04-Sep	23 h 48	74'25.400	136'29.600	189	Rosette Pgomics ↑	3241	305	21	-0.8	-0.5	1007	88	8/10
L2	05-Sep	00 h 30	74'25.150	136'30.030	207	Rosette Pgomics ↓	3241	306	22	-0.9	-0.5	1007.6	91	8/10
L2	05-Sep	00 h 47	74'25.080	136'30.130	213	Rosette Pgomics ↑	3242	302	20	-1.1	-0.5	1007.9	86	8/10
L2	05-Sep	01 h 25	74'25.040	136'30.010	213	Rosette Pgomics ↓	3241	307	18	-1	-0.5	1008.12	84	8/10
L2	05-Sep	01 h 36	74'25.040	136'29.920	213	Rosette Pgomics ↑	3241	297	21	-1	-0.5	1008.26	86	8/10
L2	05-Sep	02 h 48	74'25.910	136'30.060	209	Rosette Biogeochem ↓	3242	301	16	-1.1	-0.5	1009.2	91	7/10
L2	05-Sep	05 h 18	74'24.800	136'24.880	200	Rosette Out ↑	3228	289	10	-1.3	-0.5	1010.3	86	7/10
L2	05-Sep	06 h 48	74'25.200	136'26.430	290	Pump-puit delancement ↓	3233	236	11	-1.8	-0.5	1010.4	89	7/10
L2	05-Sep	09 h 44	74'24.200	136'26.000	200	Deploy Ice Team ↓	3228	203	10	-1.3	-0.6	1009.2	95	7/10
L2	05-Sep	09 h 50	74'24.000	136'25.000	198	Deploy MOBs Buoy ↓	3228	198	10	-1.3	-0.6	1009.1	96	7/10
L2	05-Sep	10 h 07	74'24.100	136'25.400	187	Profiler CTD ↓	3228	192	9	-1.4	-0.6	1008.9	96	7/10
L2	05-Sep	11 h 06	74'24.100	136'26.100	144	Retrieve MOBs Buoy ↑	3228	187	14	-1.1	-0.6	1007.7	97	7/10
L2	05-Sep	11 h 13	74'24.200	136'25.900	115	Retrieve Ice Team and MOBs Buoy ↑	3228	185	14	-1	-0.6	1007.5	97	7/10
L2	05-Sep	12 h 27	74'25.060	136'26.130	83	Rosette TM Cr/U ↓	3231	160	17	-0.5	-0.6	1005.1	95	8/10

L2	05-Sep	13 h 13	74'25.580	136'26.690	89	Met. Balloon Launch	3236	155	21	-0.5	-0.6	1003.9	93	8/10
L2	05-Sep	14 h 40	74'25.830	136'25.060	80	Rosette TM Cr/U ↑	3236	180	23	0.1	-0.6	1001.7	94	8/10
L2	05-Sep	18 h 20	74'27.260	136'19.710	245	Rosette TM ↓	3240	262	23	0.8	-0.7	999.98	99	8/10
L2	05-Sep	18 h 24	74'27.240	136'19.470	245	Met. Balloon Launch	3240	260	22	0.8	-0.7	999.98	99	8/10
L2	05-Sep	18 h 28	74'27.230	136'19.080	220	Rosette TM ↑	3240	260	22	0.8	-0.7	999.98	99	8/10
L2	05-Sep	19 h 04	74'26.810	136'14.320	280	Deploy Pump ↓	3234	285	27	0.7	-0.7	1000.6	99	8/10
L2	05-Sep	19 h 40	74'26.670	136'14.180	280	Pump Deployed ↑	3234	285	25	0.7	-0.7	1000.94	98	8/10
L2	05-Sep	23 h 30	74'23.300	136'09.300	176	Pump Recovered ↑	3213	288	23	0.3	-0.7	1004.8	84	8/10
L2	06-Sep	00 h 22	74'22.920	136'09.510	197	Rosette TM Pb ↓	3212	280	18	0.3	-0.7	1005.1	84	8/10
L2	06-Sep	01 h 08	74'22.710	136'10.050	166	Rosette TM Pb ↑	3212	265	16	0.6	-0.7	1005.6	83	8/10
L2	06-Sep	09 h 42	74'25.300	133'54.300	27	Deploy Ice Team ↓	3236	215	10	-0.9	-0.8	1006.3	95	9/10
L2	06-Sep	10 h 02	74'25.200	133'53.600	27	Deploy Helicopter	3109	212	10	-0.6	-0.8	1006.1	94	9/10
L2	06-Sep	10 h 10	74'25.100	133'53.400	27	Retrieve Ice Team ↑	3113	212	12	-0.8	-0.8	1006.3	95	9/10
L2	06-Sep	11 h 30	74'26.400	133'21.000	300	Recover Helicopter	3045	204	14	-0.8	-0.9	1005.6	96	9/10
L3	06-Sep	14 h 32	74'26.250	133'22.940	77	Ice Team Departs (Ryan Galley, Yves, Sebastien V.)	3051	210	15	0.2	-0.85	1005.4	94	9/10
L3	06-Sep	14 h 35	74'26.250	133'22.990	78	Ice Team Returns	3051	200	14	0.2	-0.85	1005.4	94	9/10
L3	06-Sep	14 h 35	74'26.250	133'23.000	78	EM Scan Begins	3051	200	14	0.2	-0.85	1005.4	94	9/10
L3	06-Sep	14 h 44	74'26.260	133'23.130	77	Ice Team Deploys Beacon	3052	210	13	0.2	-0.85	1005.2	94	9/10
L3	06-Sep	14 h 50	74'26.270	133'23.180	77	Beacon Installed	3051	205	14	0.2	-0.85	1005.1	94	9/10
L3	07-Sep	00 h 15	74'33.830	134'53.900	315	Met. Balloon Launch	2464	253	29	-0.5	-1	1001.77	82	9/10
L3	07-Sep	08 h 04	75'19.500	137'39.600	280	Rosette PA/Th ↓	3490	284	21	-0.9	-0.9	1006.3	83	7/10

L3	07-Sep	10 h 40	75'16.900	137'35.000	280	Rosette PA/Th ↑	3490	278	19	-1	-0.9	1008.9	87	7/10
L3	07-Sep	11 h 15	75'16.900	137'35.200	300	Pump Supor ↓	3482	282	20	-1	-0.9	1008.9	87	7/10
L3	07-Sep	12 h 54	75'16.990	137'35.590	313	Helicopter Deployed (EM Scan)	3483	270	18	-0.9	-0.9	1009.4	86	7/10
L3	07-Sep	13 h 22	75'16.980	137'35.690	340	Helicopter Returns (EM Scan)	3483	290	17	-1.2	-0.9	1009.8	93	7/10
L3	07-Sep	14 h 37	75'17.380	137'35.920	350	Met. Balloon Launch	3484	280	16	-1.2	-0.9	1010.9	90	7/10
L3	07-Sep	15 h 02	75'17.390	137'35.870	10	Pump Supor ↑	3483	275	13	-1.2	-0.9	1010.9	90	7/10
L3	07-Sep	15 h 25	75'16.790	137'33.880	321	Rosette Biology ↓	3482	285	15	-1	-0.9	1011.1	91	7/10
L3	07-Sep	15 h 48	75'16.750	137'33.900	208	Rosette Biology ↑	3482	290	14	-0.9	-0.9	1011.1	90	7/10
L3	07-Sep	16 h 19	75'16.630	137'33.440	296	Rosette TM ↓	3481	294	17	-1	-0.8	1011.5	87	7/10
L3	07-Sep	17 h 07	75'16.640	137'33.290	269	Rosette TM ↑	3481	280	15	-1	-0.8	1011.9	88	7/10
L3	07-Sep	18 h 19	75'16.890	137'28.750	278	Rosette Biogeochem ↓	3474	287	12	-1.1	-0.8	1012.5	92	7/10
L3	07-Sep	20 h 49	75'16.400	137'26.700	276	Rosette Biogeochem ↑	3470	276	15	-2.1	-0.8	1013.4	94	7/10
L3	08-Sep	09 h 29	73'16.600	135'34.800	165	Deploy Helicopter (EM Scan)	3527	0	6	-2.1	-0.9	1018.5	87	9/10
L3	08-Sep	15 h 05	72'40.400	136'02.600	225	Deploy Helicopter (Mathew and Simon)	2458	221	9	-1.1	-0.9	1018.78	84	9/10
L3	08-Sep	17 h 06	72'30.520	136'34.820	-	Helicopter Returns	2530	33	6	-1.6	-0.9	1016.05	87	9/10
L3	08-Sep	17 h 10	72'30.580	136'35.130	304	Scatterometer Start	2527	65	7	-0.2	-0.9	1018.6	80	8/10
L3	08-Sep	17 h 25	72'30.580	136'35.130	304	Scatterometer Finish	2527	65	7	-0.2	-0.9	1018.6	80	8/10
L1-1	08-Sep	17 h 49	72'30.630	136'35.490	329	Ice Team Deployed ↓	2530	37	6	-1.7	-0.9	1018.6	86	8/10
L1-1	08-Sep	18 h 10	72'30.700	136'35.680	303	Ice Team Returns ↑	2532	37	7	-1.2	-0.8	1018.5	83	8/10
L1-1	08-Sep	18 h 18	72'30.730	136'35.750	318	Rosette TM ↓	2533	27	9	-1.2	-0.8	1018.5	83	8/10
L1-1	08-Sep	18 h 28	72'30.760	136'35.860	305	Rosette TM ↑	2531	30	7	-2	-0.8	1018.5	87	8/10

L1-1	08-Sep	19 h 02	72'30.820	136'35.950	258	Rosette Pa/TH ↓	2531	18	8	-1.7	-0.8	1018.5	88	8/10
L1-1	08-Sep	20 h 59	72'30.600	136'35.500	306	Rosette Pa/TH ↑	2528	58	9	-2.2	-0.8	1018.5	90	8/10
L1-1	08-Sep	21 h 32	72'30.300	136'35.200	297	Rosette TM ↓	2525	51	11	-2.3	-0.8	1018.5	90	8/10
L1-1	08-Sep	21 h 55	72'30.100	136'35.100	297	Rosette TM ↑	2525	61	9	-2.3	-0.8	1018.5	90	8/10
L1-1	08-Sep	23 h 35	72'29.500	136'35.000	20	Moonpool Pump ↓	2516	93	10	-4.1	-0.7	1018.7	97	8/10
L1-1	09-Sep	03 h 16	72'29.160	136'40.550	72	Moonpool Pump ↑	2517	60	7	-5.4	-0.7	1018.4	96	8/10
L1-1	09-Sep	04 h 14	72'29.500	136'43.340	58	Rosette Ra ↓	2525	63	8	-5.3	-0.7	1018.2	96	8/10
L1-1	09-Sep	05 h 21	72'29.890	136'44.830	84	Rosette Ra ↑	2529	58	8	-5.3	-0.7	1018.3	96	8/10
L1-1	09-Sep	06 h 11	72'30.060	136'45.880	74	Rosette TM ↓	2528	61	9	-5.3	-0.7	1018.4	96	8/10
L1-1	09-Sep	06 h 40	72'30.250	136'46.450	31	Rosette TM ↑	2547	83	8	-5.5	-0.7	1018.5	96	8/10
L1-1	09-Sep	08 h 32	72'30.900	136'47.400	295	Rosette Biology ↓	2543	63	8	-4.6	-0.7	1018.3	96	9/10
L1-1	09-Sep	08 h 53	72'30.900	136'47.500	351	Rosette Biology ↑	2542	65	7	-4.7	-0.7	1018.4	96	9/10
L1-1	09-Sep	09 h 30	72'31.100	136'47.900	340	Deploy Helicopter (EM Team)	2554	64	7	-4.7	-0.7	1018.3	95	9/10
L1-1	09-Sep	09 h 35	72'31.000	136'47.700	272	Deploy Zodiac (Ice Team) ↓	2533	62	10	-4	-0.7	1018.4	96	9/10
L1-1	09-Sep	10 h 24	72'30.700	136'47.000	146	Recover Zodiac ↑	2535	58	13	-4.2	-0.7	1018.3	95	9/10
L1-1	09-Sep	10 h 50	72'30.800	136'44.300	65	Deploy Ice Team and MOBs Buoy	2536	71	17	-4.8	-0.7	1018.3	95	9/10
L1-1	09-Sep	11 h 30	72'30.700	136'45.000	350	Recover Helicopter (EM Team)	2534	73	15	-3.9	-0.7	1018.2	96	9/10
L1-1	09-Sep	12 h 25	72'30.700	136'46.400	353	Rosette TM ↓	2534	80	15	-4.2	-0.7	1018.1	96	9/10
L1-1	09-Sep	14 h 20	72'30.700	136'50.400	2	Met. Balloon Launch	2540	80	17	-3.2	-0.7	1017.9	90	9/10
L1-1	09-Sep	14 h 26	72'30.700	136'50.400	2	Rosette TM ↑	2540	80	17	-3.2	-0.7	1017.9	90	9/10
L1-1	09-Sep	15 h 13	72'30.100	136'50.000	59	Recover Ice Team	2533	80	15	-2.8	-0.67	1017.96	88	9/10

L1-1	09-Sep	15 h 30	72'29.600	136'55.500	47	Deploy Moonpool Pump	2554	85	17	-2.9	-0.67	1018	88	9/10
L1-1	09-Sep	16 h 05	72'29.860	136'56.290	67	Moonpool Pump Finish	2535	85	15	-2.5	-0.67	1017.9	87	9/10
L1-1	09-Sep	16 h 39	72'30.000	136'56.000	77	Recover MOBs Buoy	2537	85	15	-2.4	-0.67	1017.9	88	9/10
L1-1	09-Sep	18 h 29	72'30.910	136'59.030	80	Helicopter Returns	2543	88	17	-2.9	-0.6	1017.9	93	9/10
L1-1	09-Sep	19 h 42	72'31.510	136'59.650	72	Begin Recuperation of Pump	2547	84	18	-3.3	-0.6	1017.7	97	9/10
L1-1	09-Sep	20 h 12	72'31.600	136'59.600	85	Finsh Recuperation of Pump	2549	76	20	-3.3	-0.6	1017.7	97	9/10
L1-1	09-Sep	20 h 51	72'32.200	136'55.800	83	Rosette Biogeochem ↓	2552	80	16	-3.4	-0.6	1017.6	97	9/10
L1-1	09-Sep	22 h 38	72'32.400	136'55.500	80	Rosette Biogeochem ↑	2553	80	17	-3.7	-0.6	1017.7	97	9/10
L1-1	09-Sep	23 h 00	72'32.400	136'55.400	80	Rosette TM ↓	2551	80	18	-3.7	-0.6	1017.7	97	9/10
L1-1	10-Sep	00 h 31	72'32.400	136'55.300	82	Rosette TM ↑	2563	75	16	-3.4	-0.6	1017.5	98	9/10
L1-1	10-Sep	02 h 00	72'32.600	136'59.200	68	Rosette Proteomics 600m ↓	2555	80	18	-3.2	-0.5	1017.4	98	9/10
L1-1	10-Sep	02 h 26	72'32.700	136'59.100	69	Rosette Proteomics 600m ↑	2557	85	15	-3.2	-0.5	1017.4	98	9/10
L1-1	10-Sep	03 h 16	72'32.500	137'03.200	79	Rosette Genomics 600m ↓	2558	85	22	-3	-0.5	1016.9	98	9/10
L1-1	10-Sep	03 h 39	72'32.700	137'03.400	76	Rosette Genomics 600m ↑	2559	85	18	-2.8	-0.5	1016.8	98	9/10
L1-1	10-Sep	04 h 11	72'32.910	137'04.070	88	Rosette Surface ↓	2560	85	20	-2.8	-0.5	1016.8	98	9/10
L1-1	10-Sep	04 h 19	72'32.970	137'04.420	79	Rosette Surface ↑	2562	84	18	-2.8	-0.5	1016.8	98	9/10
L1-1	10-Sep	04 h 56	72'33.260	137'05.530	76	Rosette (Maldonodo) ↓	2567	86	21	-2.7	-0.5	1016.5	97	9/10
L1-1	10-Sep	05 h 04	72'33.340	137'05.630	81	Rosette (Maldonodo) ↑	2566	78	21	-2.6	-0.5	1016.4	97	9/10
L1-1	10-Sep	05 h 35	72'33.550	137'07.090	80	Pump Si Moonpool ↓	2570	83	22	-2.5	-0.5	1016.1	96	9/10
L1-1	10-Sep	06 h 08	72'33.730	137'06.990	93	Finish Descending Pump ↓	2573	80	22	-2.5	-0.5	1016.1	95	9/10
L1-1	10-Sep	09 h 14	72'34.900	137'09.000	80	Pump Si Moonpool ↑	2587	83	21	-2	-0.4	1015.2	92	9/10

L1-1	10-Sep	10 h 13	72'35.200	137'08.600	86	Rosette Nd ↓	2590	87	20	-1.7	-0.4	1014.9	91	9/10
L1-1	10-Sep	12 h 00	72'35.600	137'09.600	87	Rosette Nd ↑	2594	95	23	-1.9	-0.4	1014.5	97	9/10
L1-1	10-Sep	12 h 40	72'35.900	137'10.600	87	Moonpool Pump Deep Supor ↓	2600	95	24	-1.7	-0.4	1014.3	99	9/10
L1-1	10-Sep	14 h 50	72'36.300	137'13.100	99	Met. Balloon Launch	2606	95	20	-0.1	-0.4	1013.5	99	9/10
L1-1	10-Sep	16 h 00	72'36.700	137'14.500	104	Moonpool Pump Deep Supor ↑	2612	101	22	0.1	-0.3	1012.9	99	9/10
L1-1	10-Sep	16 h 57	72'37.100	137'15.600	100	Moonpool Pump Deep Supor - Recuperation Terminated	2615	100	25	0.2	-0.3	1012.2	99	9/10
L1-1	10-Sep	17 h 17	72'37.300	137'19.600	115	Rosette Geonomics ↓	2626	105	24	0.2	-0.3	1012.2	99	9/10
L1-1	10-Sep	17 h 30	72'37.400	137'18.700	106	Rosette Geonomics ↑	2628	104	23	0.3	-0.3	1012.5	99	9/10
L1-1	10-Sep	17 h 53	72'37.600	137'19.900	103	Rosette Proteomics ↓	2631	106	19	0.2	-0.3	1011.9	99	9/10
L1-1	10-Sep	18 h 03	72'37.700	137'19.800	95	Rosette Proteomics ↑	2632	109	22	0.2	-0.3	1011.8	99	9/10
L1-1	10-Sep	18 h 23	72'38.120	137'20.040	30	EM Scan Begins	2634	107	22	0.2	-0.3	1011.6	99	9/10
L1-1	10-Sep	18 h 33	72'38.400	137'20.350	31	EM Scan Terminated	2642	106	22	0.3	-0.3	1011.4	99	9/10
L1-1	10-Sep	18 h 42	72'38.800	137'21.200	268	EM Scan Begins	2636	103	20	0.3	-0.3	1011.4	99	9/10
S4	11-Sep	11 h 44	71'11.100	132'56.500	115	Rosette TM ↓	317	93	18	3.4	0.2	999.3	99	-
S4	11-Sep	12 h 01	71'11.100	132'56.600	104	Rosette TM ↑	317	100	16	3.4	0.2	999.2	99	-
n/a	14-Sep	03 h 46	70°49.0'	136°16.5'	320	Rosette CTD no.1 ↓	745	330	18	0	1.9	1008.7	99	0
n/a	14-Sep	04 h 10	70°48.9'	136°16.9'	320	Rosette CTD no.1 ↑	735	330	16	0	1.9	1009	99	0
n/a	14-Sep	04 h 50	70°48.73'	136°03.05'	236	Start map line #3	767	330	16	0	1.9	1009	99	0
n/a	14-Sep	07 h 05	70°41.44'	136°38.85'	236	End map line #3	971	320	20	0	1.4	1010.4	96	0
n/a	14-Sep	07 h 40	70°41.25'	136°20.26'	034	Start map line #5	652	313	22	-0.3	1.27	1010.79	96	0
n/a	14-Sep	09 h 40	70°50.1'	136°02.7'	036	End map line #5	794	315	17	-0.3	2	1011.9	97	0
n/a	14-Sep	09 h 49	70°50.1'	136°02.8'	333	Rosette CTD ↓	794	316	17	-0.3	2	1011.4	97	0
n/a	14-Sep	10 h 15	70°50.1'	136°03.0'	350	Rosette CTD ↑	794	317	20	-0.3	2	1011.4	97	0
n/a	14-Sep	10 h 34	70°49.4'	136°05.16'	191	Start map line #7	797	324	16	0.4	1.8	1012.2	96	0
n/a	14-Sep	12 h 40	70°38.5'	136°09.4'	192	End map line #7	481	300	15	0.6	2.2	1013.7	95	0

n/a	14-Sep	12 h 55	70°49.3'	136°06.0'	358	Start map line #8	451	300	18	-0.2	2.2	1013.7	97	0
n/a	14-Sep	14 h 39	70°49.2'	136°06.0'	358	End map line #8	797	310	19	0.3	2.1	1014.5	96	0
n/a	14-Sep	15 h 00	70°47.5'	136°14.3'	148	Start map line #26A	741	310	15	0.5	2.1	1014.5	96	0
n/a	14-Sep	15 h 45	70°44.9'	136°09.8'	148	End map line #26A	616	315	14	2	2.1	1015.8	92	0
n/a	14-Sep	15 h 45	70°44.9'	136°09.8'	135	Start map line #26B	616	315	14	2	2.1	1015.8	92	0
n/a	14-Sep	17 h 03	70°39.0'	135°52.4'	133	End map line #26B	616	315	14	2	2.1	1016.5	92	0
n/a	14-Sep	17 h 03	70°39.0'	135°52.4'	121	Start map line #26C	242	315	11	1.3	1.9	1016.5	91	0
n/a	14-Sep	17 h 31	70°37.2'	135°44.5'	121	End map line #26C	102	310	12	0.9	2.3	1016.7	93	0
n/a	14-Sep	17 h 31	70°37.2'	135°44.5'	137	Start map line #26D	102	310	12	0.9	2.3	1016.7	93	0
n/a	14-Sep	17 h 38	70°35.4'	135°41.5'	154	End map line #26D	47	312	14	1.6	2.3	1016.8	92	0
n/a	14-Sep	17 h 48	70°35.4'	135°41.0'	135	Start map line #26E	65	308	11	1.6	2.4	1016.8	92	0
n/a	14-Sep	17 h 54	70°34.9'	135°39.4'	137	End map line #26E	65	307	11	1.8	2.5	1016.8	91	0
n/a	14-Sep	18 h 07	70°34.9'	135°38.7'	296	Rosette CTD ↓	44	310	13	1.8	2.4	1016.9	91	0
n/a	14-Sep	18 h 13	70°35.9'	135°38.8'	310	Rosette CTD ↑	44	304	13	1	2.5	1017	94	0
n/a	14-Sep	18 h 47	70°34.7'	135°40.0'	313	Start map line #18D	70	306	13	0.7	2	1017.2	95	0
n/a	14-Sep	22 h 15	70°48.7'	136°32.5'	307	End map line #18D	1000	354	5	0.6	2.3	1019.4	96	0
n/a	14-Sep	22 h 30	70°48.8'	136°32.7'	049	Rosette CTD ↓	993	350	5	0.4	2.2	1019.9	96	0
n/a	14-Sep	22 h 58	70°48.9'	136°32.7'	064	Rosette CTD ↑	1019	355	6	0.4	2.2	1019.9	96	0
n/a	14-Sep	23 h 20	70°46.7'	136°34.8'	092	Start map line #10A	1015	000	5	0.5	2.1	1020.1	97	0
n/a	15-Sep	02 h 18	70°47.1'	135°45.3'	088	End map line #10A	568	020	3	0.1	1.1	1021.6	96	0
n/a	15-Sep	02 h 18	70°47.1'	135°45.3'	083	Start map line #10B	568	020	3	0.1	1.1	1021.6	96	0
n/a	15-Sep	03 h 15	70°47.9'	135°27.8'	081	End map line #10B	431	060	3	0.2	1.1	1021.9	97	0
n/a	15-Sep	03 h 41	70°46.2'	135°41.1'	269	Start map line #11	517	075	3	0.2	1.2	1022.1	97	0
n/a	15-Sep	06 h 10	70°45.98'	136°24.59'	270	End map line #11	809	085	6	0.8	1.8	1022.7	90	0
n/a	15-Sep	09 h 48	70°44.3'	135°26.7'	060	Rosette CTD ↓	262	122	9	1.3	1.6	1023.8	92	0
n/a	15-Sep	10 h 00	70°44.4'	135°26.8'	074	Rosette CTD ↑	266	110	9	1.6	1.9	1022.7	98	0
n/a	15-Sep	13 h 44	70°43.9'	136°00.9'	139	Buoy AXYS Deploy	546	120	16	1.9	1.5	1022.7	98	0
n/a	15-Sep	14 h 39	70°44.5'	136°22.7'	106	Rosette CTD ↓	811	110	18	1.7	1.6	1022.2	99	0
n/a	15-Sep	15 h 09	70°44.7'	136°22.5'	112	Rosette CTD ↑	787	105	14	2.1	1.6	1022.2	99	0
n/a	16-Sep	02 h 03	70°41.8'	136°43.8'	237	End map line #1	1080	115	17	2.9	1.2	1019.3	97	0
n/a	16-Sep	02 h 53	70°44.2'	136°26.4'	062	Start map line #2	918	120	16	3.2	1.1	1019.3	97	0

n/a	16-Sep	04 h 00	70°47.53'	136°11.43'	061	End map line #2	734	110	15/20	3.1	1.3	1019.4	97	0
n/a	16-Sep	04 h 07	70°46.81'	136°09.96'	221	Start map line #4	693	110	15/20	3.1	1.3	1019.4	97	0
n/a	16-Sep	05 h 30	70°41.28'	136°27.64'	221	End map line #4	795	110	15/20	3.1	1	1018.77	97	0
n/a	16-Sep	06 h 15	70°42.00'	136°10.5'	025	Start map line #6	555	108	15	3.1	1	1018.77	97	0
n/a	16-Sep	07 h 15	70°46.56'	136°07.64'	025	End map line #6	724	105	16	3.3	1.3	1018.3	98	0
n/a	16-Sep	07 h 21	70°46.54'	136°06.79'	109	CTD Mapline #6 ↓	727	100	16	3	1.3	1018.3	98	0
n/a	16-Sep	07 h 49	70°46.53'	136°06.82'	107	CTD Mapline #6 ↑	727	100	16	3.1	1.1	1018.3	98	0
n/a	16-Sep	09 h 41	70°43.7'	136°01.6'	105	#1 Buoy secondary ↓	560	115	14	5.2	2.6	1017.2	94	0
n/a	16-Sep	11 h 10	70°39.5'	135°36.4'	105	#2 Buoy secondary ↓	132	115	12	5.2	2.6	1017.2	94	0
n/a	16-Sep	11 h 30	70°39.3'	135°36.5'	090	Rosette CTD ↓	117	116	13	5.2	2.7	1018.1	94	0
n/a	16-Sep	11 h 40	70°39.3'	135°36.6'	076	Rosette CTD ↑	117	116	13	5.2	2.7	1017.1	94	0
n/a	16-Sep	13 h 11	70°39.9'	135°36.4'	094	recovery mooring B	160	120	13	5.2	2.9	1016.8	94	0
n/a	16-Sep	13 h 35	70°38.8'	135°36.2'	330	Start map line #24 modified	93	110	3	5.3	2.9	1016.8	94	0
n/a	16-Sep	14 h 29	70°44.8'	135°42.9'	343	End map line #24 modified	469	105	14	5.1	2.9	1016.3	94	0
n/a	16-Sep	14 h 45	70°44.0'	135°44.3'	317	Start map line #22	509	110	13	4.9	2.2	1016.3	94	0
n/a	16-Sep	15 h 53	70°48.8'	136°00.8'	313	End map line #22	772	095	15	5.4	1.6	1015.6	84	0
n/a	16-Sep	16 h 09	70°44.69'	136°22.53'	311	Start Calibration PC	764	083	15	3.2	1.7	1013.2	96	0
n/a	16-Sep	22 h 15	70°44.5'	136°21.7'	058	End Calibration PC	763	082	19	3.5	1.7	1010.8	93	0
n/a	16-Sep	22 h 30	70°44.5'	136°21.7'	068	Rosette CTD ↓	764	078	19	3.6	1.7	1010.8	93	0
n/a	16-Sep	22 h 56	70°44.5'	136°21.8'	064	Rosette CTD ↑	751	078	18	3.6	1.6	1010.6	94	0
n/a	16-Sep	23 h 35	70°48.8'	136°08.3'	116	Start map line #21b	788	069	20	2.8	1.4	1010.2	96	0
n/a	17-Sep	00 h 19	70°47.1'	135°58.9'	115	End map line #21b	708	075	22	3.2	1.1	1009.7	96	0
n/a	17-Sep	00 h 19	70°47.1'	135°58.9'	135	Start map line #21c	708	075	22	3.2	1.1	1009.7	96	0
n/a	17-Sep	00 h 47	70°44.4'	135°52.8'	136	End map line #21c	593	075	21	3.4	1.1	1009.4	95	0
n/a	17-Sep	00 h 47	70°44.4'	135°52.8'	153	Start map line #21d	593	075	21	3.4	1.1	1009.4	95	0
n/a	17-Sep	00 h 55	70°43.8'	135°52.2'	155	End map line #21d	550	075	21	3.4	1.1	1009.3	95	0
n/a	17-Sep	00 h 55	70°43.8'	135°52.2'	172	Start map line #21e-f	550	075	21	3.4	1.1	1009.3	95	0
n/a	17-Sep	01 h 54	70°36.8'	135°50.8'	166	End map line #21e-f	138	080	22	4.9	1.8	1008.2	94	0
n/a	17-Sep	02 h 48	70°37.2'	136°16.9'	060	Start map line #16	564	075	18	4.1	2.2	1007.2	95	0
n/a	17-Sep	04 h 38	70°43.11'	135°48.19'	057	End map line #16	450	070	20	4	1.5	1006.4	96	0
n/a	17-Sep	05 h 25	70°49.82'	135°29.42'	239	Start map line #15	469	070	20	3.6	2.8	1005.6	96	0
n/a	17-Sep	06 h 53	70°44.20'	135°52.86'	239	Interruption mapline #15	572	070	20	3	1.8	1005	96	0
n/a	17-Sep	11 h 40	70°44.3'	136°41.5'	057	Start mapline wp -22	105	043	19	2.5	1.9	1001.1	96	0

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n/a	17-Sep	12 h 13	70°43.8'	136°25.3'	054	Calibration, Interruption mapline #22	900	045	21	2.1	1.7	1000.56	98	0
n/a	17-Sep	13 h 05	70°44.0'	136°23.7'	225	End Calibration	794	055	24	3.4	1.9	1000.67	94	0
n/a	17-Sep	13 h 55	70°40.3'	136°14.6'	063	Start mapline #15	555	050	20	2.3	1.9	999.8	98	0
n/a	17-Sep	15 h 19	70°44.3'	135°51.8'	064	End mapline #15	552	050	20	2.3	1.9	999	97	0
n/a	17-Sep	15 h 45	70°44.6'	135°52.0'	062	Rosette CTD ↓	558	056	21	3.3	1.8	998.83	97	0
n/a	17-Sep	16 h 08	70°44.5'	135°52.3'	095	Rosette CTD ↑	569	058	22	3.4	1.6	998.64	97	0
n/a	17-Sep	16 h 44	70°42.8'	135°49.31'	324	Start map line #20	800	055	18	2.1	1.7	998.3	99	0
n/a	17-Sep	18 h 05	70°49.21'	136°10.06'	324	End map line #20	613	038	20	2.1	1.5	997.86	99	0
n/a	17-Sep	18 h 52	70°44.82'	136°10.32'	non	Start Piston core	613	038	20	2.1	1.5	996.82	99	0
n/a	17-Sep	20 h 28	70°45.0'	136°17.7'	non	Piston core on board	613	040	20	2.1	1.5	996.8	99	0
n/a	17-Sep	21 h 50	70°43.6'	136°25.4'	084	Start map line #14	427	035	27	2.7	3	992.9	98	0
n/a	18-Sep	00 h 41	70°43.1'	136°17.8'	083	End map line #14	170	035	27	2.9	3.4	992.5	98	0
n/a	18-Sep	01 h 48	70°48.1'	135°56.2'	271	Start map line #9	709	035	27	2.8	1.7	992.6	99	0
n/a	18-Sep	04 h 15	70°47.75'	136°41.04'	271	End map line #9	1152	030	25/30	2.8	3.4	992.8	98	0
n/a	18-Sep	04 h 35	70°44.22'	136°43.25'	105	Start map line #27	1288	030	25/30	2.8	3.4	992.8	98	0
n/a	18-Sep	13 h 00	70°46.7'	135°38.4'	55	End mapline # inshore 1000m	456	020	30/35	2.4	3.4	994.88	90	0
n/a	18-Sep	13 h 20	70°46.2'	135°37.5'	275	Start mapline inshore 2000m	460	020	30/35	2.4	3.4	994.88	90	0
n/a	18-Sep	14 h 32	70°39.0'	136°11.5'	235	End mapline # inshore 2000m	515	015	32	1.7	3.5	996.3	94	0
n/a	18-Sep	14 h 49	70°38.6'	136°10.3'	54	Start mapline inshore 3000m	497	015	30	0.9	3.2	996.2	95	0
n/a	18-Sep	17 h 07	70°46.1'	135°35.0'	57	End mapline # inshore 3000m	426	020	35	1	3.4	997.1	96	0
n/a	18-Sep	17 h 21	70°45.2'	135°36.0'	232	Start mapline inshore 4000m	415	020	32	1.3	3.3	997.7	95	0
n/a	18-Sep	22 h 00	70°44.6'	135°33.9'	237	Start mapline wp25 6000m	366	020	31	1.8	3.2	1000.9	88	0
n/a	18-Sep	23 h 18	70°57.8'	136°05.3'	237	End mapline # 6000m	347	018	29	1.8	3.5	1002.5	90	0
n/a	19-Sep	02 h 22	70°44.2'	135°31.6'	53	End mapline # inshore 7000m	339	20	31	0.2	3.2	1003.8	91	0

n/a	19-Sep	02 h 40	70°43.7'	135°31.4'	236	Start mapline inshore 8000m	306	10	33	0.7	3.2	1004.5	94	0
n/a	19-Sep	03 h 56	70°36.2'	136°06.8'	235	End mapline # inshore 8000m	275	15	26	0.5	3.4	1005.7	94	0
n/a	19-Sep	04 h 10	70°35.88'	136°05.36'	55	Start mapline inshore 9000m	244	15	25/30	0.5	3.4	1005.7	93	0
n/a	19-Sep	06 h 30	70°43.0'	135°28.58'	55	End mapline # inshore 9000m	214	15	25/30	0	3.2	1006.5	91	0
n/a	19-Sep	06 h 34	70°42.82'	135°29.42'	238	Start mapline inshore 10000m	215	15	25/30	0	3.2	1006.9	91	0
n/a	19-Sep	07 h 55	70°34.72'	136°05.04'	238	End mapline # inshore 10000m	113	15	20	0	3.1	1006.5	91	0
n/a	19-Sep	08 h 00	70°34.74'	136°04.86'	58	Start mapline inshore 11000m	73	15	25/30	0	3.1	1006.5	91	0
n/a	19-Sep	10 h 38	70°42.5'	135°27.5'	58	End mapline # inshore 11000m	185	20	20/25	0.5	3.8	1008.7	93	0
n/a	19-Sep	11 h 00	70°41.9'	135°27.7'	238	Start mapline inshore 12000A m	133	31	20/25	0.6	3.6	1009.3	89	0
n/a	19-Sep	12 h 30	70°39.5'	136°03.8'	239	End mapline # inshore 12000A m	18	20	20/25	0.9	3.9	1010.5	89	0
n/a	19-Sep	12 h 30	70°39.6'	136°03.8'	240	Start mapline inshore 12000B m	117	20	20/25	0.9	3.9	1010.5	89	0
n/a	19-Sep	12 h 55	70°33.06'	136°09.7'	241	Mapline interruption	120	20	21	2	3.8	1010.5	90	0
n/a	19-Sep	13 h 13	70°33.0'	136°09.8'	241	Restart mapline 12000B m	121	20	21	2	3.8	1010.5	90	0
n/a	19-Sep	15 h 00	70°26.7'	136°41.6'	238	End mapline # inshore 12000B m	305	25	18	0.6	3.8	1011.8	87	0
n/a	19-Sep	18 h 54	70°48.07'	136°05.92'	60	Box core on bottom	743	40	18	-1.2	2.73	1013.99	80	0
n/a	19-Sep	19 h 15	70°48.06'	136°05.97'	60	Box core on deck	743	40	12	-1.2	2.6	1015.2	79	0
n/a	19-Sep	20 h 00	70°48.06'	136°05.9'	60	Piston core ↓	743	40	12	-1.2	2.6	1015.2	79	0
n/a	19-Sep	20 h 34	70°48.0'	136°05.9'	60	Piston core ↑	743	40	12	-1.2	2.6	1015.2	79	0
n/a	19-Sep	21 h 08	70°47.9'	136°06.0'	73	Rosette CTD ↓	744	24	12	-1.2	2.6	1015.3	81	0
n/a	19-Sep	21 h 39	70°47.8'	136°06.0'	84	Rosette CTD ↑	756	25	16	-1.4	2.6	1015.6	80	0
n/a	19-Sep	22 h 35	70°54.4'	136°04.0'	237	Start mapline #20000	839	37	15	-1.6	2.4	1015.9	87	0
n/a	19-Sep	23 h 15	70°50.0'	136°09.3'	237	End mapline #20000	866	8	14	-0.9	2.2	1016.2	83	0
n/a	20-Sep	00 h 06	70°57.0'	136°07.1'	237	Start mapline #3704	906	35	16	-2.2	2.2	1016.5	89	0

n/a	20-Sep	01 h 32	70°46.2'	136°57.8'	237	End mapline #3704	2393	20	15	-2.2	2.3	1016.8	86	0
n/a	20-Sep	01 h 58	70°44.6'	136°54.1'	55	Start mapline #21000	1230	25	16	-2.2	2.4	1016.8	86	0
n/a	20-Sep	04 h 17	70°56.02'	136°00.68'	55	End mapline #21000	884	25	10/15	-2.8	2.6	1017.2	97	0
n/a	20-Sep	04 h 30	70°54.8'	136°00.1'	237	Start mapline #19000	824	35	10/15	-2.7	2.52	1017.2	97	0
n/a	20-Sep	06 h 30	70°44.38'	136°51.56'	237	End mapline #19000	1145	15	15/20	-2.4	2.28	1011.1	89	0
n/a	20-Sep	06 h 38	70°42.8'	136°50.8'	59	Start mapline #17000	1158	15	15/20	-2.4	2.28	1017.7	89	0
n/a	20-Sep	07 h 43	70°48.42'	136°24.20'	59	End mapline #17000	800	35	15/20	-3	2.65	1017.45	89	0
n/a	20-Sep	08 h 35	70°48.0'	136°06.1'	65	Poiton core ↓	674	34	12	-3.2	2.2	1018.1	89	0
n/a	20-Sep	09 h 25	70°48.0'	136°05.9'	68	Poiton core ↑	745	34	12	-3.5	2.2	1018.3	89	0
n/a	20-Sep	11 h 28	70°48.0'	136°05.9'	50	Poiton core ↓	745	30	12	-3.4	2.2	1018.6	92	0
n/a	20-Sep	12 h 13	70°48.0'	136°06.1'	33	Poiton core site 35 ↑	745	30	10	-3.1	2.2	1018.6	86	0
n/a	20-Sep	12 h 34	70°46.7'	136°10.1'	238	Start mapline 7667	706	40	12	-2.9	2.2	1018.6	86	0
n/a	20-Sep	13 h 18	70°44.8'	136°19.4'	240	End mapline 7667	628	50	10	-1.6	2.3	1018.6	83	0
n/a	20-Sep	14 h 13	70°45.8'	136°10.8'	35	Poiton core CL30 ↓	655	45	10	-2.7	2.4	1018.5	85	0
n/a	20-Sep	14 h 54	70°45.7'	136°10.8'	54	Poiton core CL30 ↑	650	35	11	-2.6	2.3	1018.5	85	0
n/a	20-Sep	15 h 12	70°46.2'	136°09.1'	55	Balloon launching	690	40	13	-2.3	2.3	1018.3	83	0
n/a	20-Sep	15 h 23	70°45.8'	136°08.4'	244	Start mapline 5667	686	40	13	-2.6	2.3	1018.3	91	0
n/a	20-Sep	15 h 55	70°44.2'	136°15.2'	237	End mapline 5667	594	30	12	-1.2	2.8	1018.4	85	0
n/a	20-Sep	16 h 22	70°44.6'	136°13.1'	43	Poiton core ↓	620	75	10	-2.3	0.4	1018.26	86	0
n/a	20-Sep	16 h 48	70°44.6'	136°13.5'	43	Poiton core ↑	40	40	12	-1.9	2.3	1018.22	83	0
n/a	20-Sep	18 h 15	70°48.5'	136°07.5'	154	Start mapline Greg 3	749	33	8	-2.3	2.1	1018.16	84	0
n/a	20-Sep	19 h 46	70°39.43'	135°58.21'	156	End mapline Greg 3	310	35	10/15	-1.2	2.4	1017.27	87	0
n/a	20-Sep	20 h 23	70°33.4'	135°57.1'	319	Start mapline 0.00 wp 2	65	27	15	0	3.1	1016.4	85	0
n/a	20-Sep	21 h 26	70°38.65'	136°09.8'	319	End mapline 0.00 wp 2	65	27	15	0	3.1	1016.4	85	0
n/a	20-Sep	21 h 55	70°41.2'	136°10.2'	302	Start mapline 27b	non	30	15	0	3.1	1016.3	84	0
n/a	20-Sep	22 h 37	70°42.9'	136°19.1'	302	End mapline 27b	non	35	15	0	3.1	1016.2	84	0
n/a	20-Sep	22 h 40	70°42.8'	136°19.8'	270	Start mapline 27c	791	52	15	0	3.1	1016.1	83	0
n/a	20-Sep	23 h 24	70°42.9'	136°33.3'	270	End mapline 27c	1123	54	16	0.1	3.1	1016	82	0
n/a	20-Sep	23 h 25	70°43.2'	136°33.7'	304	Start mapline 27d	1163	54	16	0.1	3.1	1016	82	0
n/a	20-Sep	23 h 36	70°43.8'	136°38.4'	304	End mapline 27d	124	59	18	0.1	3.1	1016	82	0

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n/a	20-Sep	23 h 37	70°43.8'	136°38.4'	281	Start mapline 27e	1247	59	18	0.1	3.1	1016	82	0
n/a	20-Sep	23 h 57	70°44.2'	136°43.4'	281	End mapline 27e	1291	45	18	0.5	2.7	1015.8	78	0
n/a	20-Sep	23 h 57	70°44.2'	136°43.4'	309	Start mapline 27f	1291	45	18	0.5	2.7	1015.8	78	0
n/a	21-Sep	00 h 18	70°45.9'	136°49.8'	310	End mapline 27f	1361	50	17	-0.2	2.7	1015.6	88	0
n/a	21-Sep	00 h 38	70°45.4'	136°55.6'	56	Start mapline 'James' 1852	1324	95	18	0.2	2.7	1015.9	81	0
n/a	21-Sep	02 h 11	70°56.6'	136°03.2'	56	End mapline 'James' 1852	880	40	18	-1.2	2.3	1015.1	86	0
n/a	21-Sep	02 h 30	70°53.8'	136°58.8'	241	Start mapline 17000	799	50	19	-1.5	1.9	1016.1	87	0
n/a	21-Sep	03 h 15	70°48.2'	136°23.6'	239	End mapline 17000	821	45	23	-0.5	2	1015.5	84	0
n/a	21-Sep	03 h 33	70°47.0'	136°23.7'	57	Start mapline 12667	713	55	22	-1.2	2	1015.5	86	0
n/a	21-Sep	05 h 38	70°43.8'	136°17.1'	28	Rosette CTD ↓	613	42	20	-0.7	2.09	1015.14	89	0
n/a	21-Sep	06 h 04	70°43.9'	136°17.8'	37	Rosette CTD ↑	613	35	23	-0.7	2.14	1015.11	91	0
n/a	21-Sep	06 h 40	70°43.49'	136°15.51'	non	Piston core ↓	599	47	20	-0.2	2.2	1015.01	98	0
n/a	21-Sep	07 h 39	70°43.51'	136°15.6'	non	Piston core ↑	599	47	20	-0.2	2.2	1015.01	98	0
n/a	21-Sep	07 h 53	70°43.21'	136°14.98'	57	Start mapline 3666	604	45	15/20	-0.1	2.1	1014.9	98	0
n/a	21-Sep	08 h 00	70°43.21'	136°15.6'	57	Start mapline 3667.4 wp23	590	62	19	-0.1	2.1	1015	95	0
n/a	21-Sep	08 h 30	70°45.1'	136°06.11'	57	End mapline 3667.4	595	62	18	-0.1	2.1	1015.2	95	0
n/a	21-Sep	08 h 44	70°45.4'	136°07.5'	237	Start mapline 4667.6 wp29	630	63	17	-0.1	2.1	1016	90	0
n/a	21-Sep	09 h 24	70°43.5'	136°16.4'	237	End mapline 4667.6 wp29	630	64	18	-0.1	2.1	1016.4	90	0
n/a	21-Sep	09 h 58	70°43.8'	136°15.1'	64	Piston core ↓	585	64	18	-0.1	2.1	1016.8	87	0
n/a	21-Sep	10 h 58	70°44.0'	136°15.4'	64	Piston core ↑	585	64	17	-0.1	2.1	1016.8	87	0
n/a	21-Sep	11 h 50	70°44.25'	136°16.18'	237	Start mapline 5667.80 wp36	647	64	17	-0.1	2.1	1016.8	87	0
n/a	21-Sep	12 h 00	70°43.6'	136°18.9'	237	End mapline 5667.80 wp36	647	55	16	-0.1	2.1	1016.8	87	0
n/a	21-Sep	12 h 23	70°42.9'	136°18.0'	55	Start mapline 4334.20	748	60	21	0	2	1016.6	88	0
n/a	21-Sep	12 h 52	70°44.3'	136°11.5'	58	Interruption mapline #4334.20	598	50	18	-0.8	2.1	1016.9	89	0
n/a	21-Sep	13 h 30	70°42.7'	136°17.3'	60	Piston core CL21 ↓	739	53	19	-0.6	2.1	1017.3	89	0
n/a	21-Sep	14 h 08	70°42.6'	136°17.3'	60	Piston core CL21 ↑	732	55	19	-0.9	2.2	1017.6	88	0
n/a	21-Sep	16 h 09	70°33.4'	135°57.2'	60	Box Core in	73	54	21	-0.2	3.3	1018.18	85	0

n/a	21-Sep	16 h 21	70°33.4'	135°57.2'	70	Box Core out	73	54	21	-0.2	3.3	1018.18	85	0
n/a	21-Sep	18 h 18	70°33.47'	135°57.19'	70	Piston core ↓	73	65	15/20	-0.7	3.6	1018.5	86	0
n/a	21-Sep	18 h 27	70°33.3'	135°57.4'	69	Piston core ↑	73	45	17/20	-0.9	3.4	1018.4	85	0
n/a	21-Sep	18 h 50	70°33.3'	135°58.7'	334	Deployment MVP	73	60	16	-0.6	3.4	1018.5	85	0
n/a	21-Sep	19 h 49	70°35.5'	136°01.79'	336	MVP on board	73	69	15	-1.5	3.7	1019.1	86	0
n/a	21-Sep	20 h 03	70°35.5'	136°01.8'	70	Rosette CTD ↓	185	72	15	-1.5	3.7	1019.1	86	0
n/a	21-Sep	20 h 14	70°35.5'	136°01.8'	70	Rosette CTD ↑	190	72	15	-1.5	3.7	1019.1	86	0
n/a	21-Sep	21 h 30	70°38.9'	136°07.3'	326	Cornell buoy 7↑	460	77	17	-1.7	3.5	1019.3	84	0
n/a	21-Sep	21 h 45	70°35.6'	136°05.8'	144	Start mapline 0.00 wp 2	244	61	18	-1.4	3.5	1019.1	84	0
n/a	21-Sep	22 h 08	70°34.7'	136°03.2'	149	End mapline 0.00 wp 2	130	54	14	-1.3	3.5	1019	83	0
n/a	21-Sep	22 h 11	70°34.8'	136°02.7'	58	Start mapline 11500 wp-48	132	54	14	-0.3	4.5	1019	83	0
n/a	21-Sep	23 h 14	70°39.9'	135°37.8'	58	End mapline 11500 wp-48	176	67	18	-1	3.7	1019	79	0
n/a	21-Sep	23 h 17	70°39.9'	135°37.8'	237	Start mapline 0.00 wp 2-1	176	67	18	-1	3.7	1019	79	0
n/a	21-Sep	23 h 25	70°39.5'	135°39.8'	237	End mapline 0.00 wp 2-1	172	67	18	-1	3.7	1019	79	0
n/a	21-Sep	23 h 30	70°39.3'	135°39.7'	58	Start mapline 25000 wp 3-4	160	74	16	-0.9	3.6	1018.9	79	0
n/a	21-Sep	23 h 40	70°39.7'	135°37.9'	58	End mapline 25000 wp 3-4	165	79	16	-0.9	3.6	1018.9	79	0
n/a	21-Sep	23 h 45	70°39.7'	135°37.4'	237	Start mapline 50000 wp 6-5	159	79	16	-0.9	3.6	1018.9	79	0
n/a	21-Sep	23 h 53	70°39.2'	135°39.4'	237	End mapline 50000 wp 6-5	146	72	16	-1.1	3.6	1019.2	80	0
n/a	22-Sep	00 h 02	70°39.8'	135°39.1'	58	Continue mapline 11500	188	72	16	-1.1	3.6	1019.2	80	0
n/a	22-Sep	00 h 28	70°42.2'	135°27.4'	57	End mapline 11500	142	60	15	-1	3.6	1018.6	77	0
n/a	22-Sep	00 h 36	70°42.5'	136°29.0'	235	Start mapline 10500	183	75	15	-1	3.6	1018.6	78	0
n/a	22-Sep	02 h 02	70°35.2'	136°03.8'	238	End mapline 10500	142	60	15	-1.1	3.6	1018.8	79	0
n/a	22-Sep	02 h 11	70°35.7'	136°04.4'	58	Start mapline 9500	231	60	15	-0.6	3.6	1018.6	79	0
n/a	22-Sep	03 h 42	70°43.1'	135°29.4'	59	End mapline 9500	253	80	17	-1.2	3.6	1018.7	85	0
n/a	22-Sep	03 h 49	70°43.4'	135°30.8'	240	Start mapline 8500	304	70	15	-1.3	3.6	1019.0	90	0
n/a	22-Sep	05 h 20	70°36.22'	136°05.6'	240	End mapline 8500	284	90	16	-0.7	3.6	1018.7	77	0
n/a	22-Sep	05 h 26	70°36.93'	136°04.91'	58	Start mapline 7500	278	90	16	-0.7	3.6	1018.7	77	0
n/a	22-Sep	06 h 25	70°41.18'	135°13.67'	58	Interruption mapline 7500	303	90	15	-0.5	3.67	1018.4	77	0
n/a	22-Sep	07 h 15	70°33.4'	135°57.4'	76	Rosette CTD ↓	66	71	19	-0.4	3.47	1018.1	78	0
n/a	22-Sep	07 h 19	70°33.4'	135°57.5'	81	Rosette CTD ↑	66	70	19	-0.14	3.67	1018.1	78	0
n/a	22-Sep	08 h 37	70°33.46'	135°57.2'	85	Piston Core ↓	75	80	23	-0.4	3.8	1018	77	0
n/a	22-Sep	09 h 05	70°33.5'	135°57.3'	85	Piston Core ↑	75	90	20	-0.5	3.8	1018	78	0

n/a	22-Sep	09 h 46	70°32.9'	135°56.48'	316	Cornell buoy 11↑	70	90	20	-0.5	3.8	1018	78	0
n/a	22-Sep	11 h 14	70°32.8'	135°35.5'	342	Cornell buoy 12 up	60	80	19	-0.2	3.8	1017.9	78	0
n/a	22-Sep	12 h 36	70°33.2'	135°13.8'	345	Cornell buoy 5 up	55	80	18	-0.7	4.1	1018.4	78	0
n/a	22-Sep	13 h 53	70°38.3'	135°22.4'	3.3	Cornell buoy 9 up	70	90	24	-0.6	4.2	1018.4	79	0
n/a	22-Sep	14 h 49	70°39.3'	135°45.8'	90	Cornell buoy 8 up	225	80	18	0.3	4	1018.7	77	0
n/a	22-Sep	14 h 53	70°37.9'	135°47.1'	237	Start mapline inshore infill	795	88	18	-0.3	3.9	1018.5	80	0
n/a	22-Sep	15 h 26	70°35.3'	136°01.6'	237	End mapline inshore infill	138	85	21	-0.4	3.7	1018.6	77	0
n/a	22-Sep	15 h 38	70°35.5'	136°02.6'	80	Box Core CL 4 down	210	88	19	-0.1	3.7	1018.5	76	0
n/a	22-Sep	15 h 50	70°35.5'	136°02.6'	95	Box Core CL 4 up	210	80	19	0	3.8	1018.3	77	0
n/a	22-Sep	16 h 10	70°35.52'	136°02.54'	75	Piston Core down	210	90	20	-0.1	3.75	1018.4	77	0
n/a	22-Sep	16 h 54	70°35.53'	136°02.55'	72	Piston Core up	211	90	21	-0.1	3.72	1018.5	77	0
n/a	22-Sep	18 h 14	70°39.23'	136°27.85'	90	Deployment cornell	611	101	23	0	3.4	1017.9	77	0
n/a	22-Sep	18 h 55	70°38.99'	136°28.37'	non	Cornell up	611	103	20	-0.1	3.05	1017.7	77	0
n/a	22-Sep	21 h 04	70°45.1'	136°38.9'	90	Rosette CTD ↓	1212	111	20	0.2	2.2	1016.9	80	0
n/a	22-Sep	21 h 33	70°45.2'	136°39.0'	70	Rosette CTD ↑	1219	103	23	0	2	1016.9	78	0
n/a	22-Sep	21 h 50	70°45.5'	136°41.1'	237	Start mapline 18000 wp-38	1233	103	23	0.4	2.1	1016.9	77	0
n/a	22-Sep	22 h 12	70°43.2'	136°51.8'	237	End mapline 18000 wp-38	1175	100	26	-0.1	2	1016.8	77	0
n/a	22-Sep	22 h 21	70°42.4'	136°49.7'	57	Start mapline 10000 wp-34	1169	120	24	0.3	2.1	1016.1	78	0
n/a	22-Sep	23 h 56	70°53.6'	135°56.4'	57	End mapline 10000 wp-34	783	124	20	0.3	2.1	1016	79	0
n/a	23-Sep	00 h 02	70°52.9'	135°57.2'	233	Start mapline 15000	756	120	21	0.2	2.5	1015.09	79	0
n/a	23-Sep	02 h 18	70°41.9.	136°49.2'	234	End mapline 15000	1139	110	28	0.8	2.8	1015	78	0
n/a	23-Sep	02 h 24	70°41.5'	136°47.9'	62	Start mapline 14000	1155	120	27	0.7	2.8	1014.6	78	0
n/a	23-Sep	04 h 45	70°52.57'	135°59.90'	62	End mapline 14000	805	120	25	0.4	2.54	1014.6	79	0
n/a	23-Sep	04 h 49	70°52.06'	135°55.32'	238	Start mapline 13000	708	124	26	0.6	2.54	1014.16	79	0
n/a	23-Sep	05 h 56	70°46.63'	135°20.83'	235	Interruption mapline 13000	673	112	23	0.6	2.5	1013.31	79	0
n/a	23-Sep	07 h 30	70°47.27'	136°12.98'	337	Start mapline 9335.20	718	115	25	0.6	2.5	1010.39	79	0
n/a	23-Sep	08 h 03	70°45.2'	136°22.5'	237	End mapline 9335.20	771	121	22	0.7	2.8	1011.4	89	0
n/a	23-Sep	08 h 11	70°44.8'	136°21.2'	57	Start mapline 8335.0 wp-52	718	121	22	0.7	2.8	1011.4	89	0
n/a	23-Sep	08 h 47	70°47.0'	136°10.8'	57	End mapline 8335.0	767	107	21	0.9	2.5	1011.3	90	0

n/a	23-Sep	09 h 20	70°46.9'	136°12.3'	105	Piston core down	702	106	21	0.9	2.4	1011.3	92	0
n/a	23-Sep	10 h 07	70°46.2'	136°19.0'	105	Piston core up	690	107	21	0.9	2.4	1011.1	92	0
n/a	23-Sep	11 h 42	70°45.1'	136°16.6'	12	Correll buoy 2 up	618	127	24	1	2.4	1009.5	92	0
n/a	23-Sep	13 h 13	70°45.1'	135°56.0'	335	Correll buoy 3 up	628	120	21	0.7	2.5	1009.3	96	0
n/a	23-Sep	14 h 30	70°45.0'	135°34.6'	40	Correll buoy 4 up	395	120	17	0.4	2.8	1008.8	98	0
n/a	23-Sep	15 h 35	70°45.2'	135°14.0'	98	Correll buoy 10 up	82	100	19	0.9	3.1	1008.2	99	0
n/a	23-Sep	16 h 25	70°47.57'	135°33.74'	271	Piston Core down	412	104	20	1.2	3.2	1007.19	98	0
n/a	23-Sep	16 h 56	70°47.48'	135°33.62'	271	Piston Core up	412	105	20	1.2	3.2	1007.19	98	0
n/a	23-Sep	19 h 05	70°47.57'	135°33.75'	64	Piston Core down	420	90	21	1.5	3.2	1004.68	99	0
n/a	23-Sep	19 h 41	70°47.4'	135°33.0'	81	piston core up	420	86	19	1.5	3.2	1004.68	99	0
n/a	23-Sep	19 h 52	70°47.5'	135°33.9'	78	CTD down	418	89	22	1.5	3.3	1004	99	0
n/a	23-Sep	20 h 10	70°47.6'	135°34.1'	86	CTD up	418	86	22	1.6	3.3	1003.8	99	0
n/a	23-Sep	20 h 40	70°47.2'	135°38.6'	237	Start mapline 0.00 wp-1-2	489	93	20	2.1	3.3	1004	98	0
n/a	23-Sep	22 h 50	70°35.0'	136°36.3'	237	End mapline 0.00 wp-1-2	674	96	14	2.8	3.1	1002.2	93	0
n/a	23-Sep	22 h 59	70°35.5'	136°36.2'	57	Start mapline 1000.00 wp4-3	731	96	14	2.8	3.1	1002.2	93	0
n/a	24-Sep	00 h 25	70°43.8'	135°58.9'	60	Interrup. mapline 1000.00 wp4-3	559	80	16	2.7	2.8	1001.9	92	0
n/a	24-Sep	00 h 42	70°43.4'	136°03.9'	85	Start mapline 333.40	561	75	14	2.5	2.9	1002.1	92	0
n/a	24-Sep	01 h 17	70°41.1'	136°14.5'	236	End mapline 333.40	579	70	13	2.5	2.9	1001.9	92	0
n/a	24-Sep	01 h 29	70°41.3'	136°14.6'	60	Start mapline 666.80	583	60	15	2.7	2.8	1001.5	93	0
n/a	24-Sep	02 h 04	70°43.5'	136°04.2'	59	End mapline 666.80	558	60	17	2.5	2.8	1001.3	92	0
n/a	24-Sep	02 h 17	70°43.5'	135°59.0'	60	Start mapline 1000.00	537	60	19	2.5	2.8	1001.1	89	0
n/a	24-Sep	02 h 50	70°46.8'	135°43.8'	57	End mapline 1000.00	558	60	20	2.3	2.9	1000.8	89	0
n/a	24-Sep	03 h 10	70°47.0'	135°38.2'	238	Start mapline 500.00	477	60	20	2.1	3.1	1001.2	90	0
n/a	24-Sep	04 h 18	70°40.12'	136°11.19'	238	End mapline 500.00	495	60	20	2.5	3.1	1001.3	90	0
n/a	24-Sep	04 h 22	70°39.77'	136°09.52'	57	Start mapline 1500.00	505	60	20	2.7	3.06	1001.34	86	0
n/a	24-Sep	05 h 30	70°46.84'	135°35.87'	37	End mapline 1500.00	465	50	19	1.9	3.14	1000.55	91	0
n/a	24-Sep	05 h 35	70°46.26'	135°35.64'	262	Start mapline 2500.00	440	50	19	1.9	3.14	1000.55	91	0
n/a	24-Sep	06 h 20	70°39.68'	136°07.25'	225	Balloon launching	469	55	17	2.8	3.16	1001.46	85	0
n/a	24-Sep	06 h 30	70°39.16'	136°09.59'	238	End mapline 2500.00	489	55	17	2.8	3.16	1001.46	85	0
n/a	24-Sep	07 h 25	70°35.68'	136°02.71'	54	CTD down	194	42	19	1.6	3.01	1001.12	89	0
n/a	24-Sep	07 h 34	70°35.72'	136°03.00'	32	CTD up	207	64	20	1.5	3.15	1001.25	89	0
n/a	24-Sep	08 h 42	70°35.5'	136°02.6'	60	Piston core cl4 down	198	42	19	1.3	3.5	1001.7	87	0
n/a	24-Sep	09 h 06	70°35.5'	136°02.5'	60	Piston core cl4 up	198	42	19	1.3	3.5	1001.7	87	0

n/a	24-Sep	09 h 56	70°37.3'	135°58.5'	55	Box Core cl5 down	221	31	16	0.9	3.4	1002.2	86	0
n/a	24-Sep	10 h 11	70°37.3'	135°58.6'	70	Box Core cl5 up	221	22	20	0.3	3.4	1002.6	86	0
n/a	24-Sep	10 h 38	70°37.2'	135°58.6'	65	Piston core cl5 down	221	22	20	0.3	3.4	1002.6	92	0
n/a	24-Sep	10 h 58	70°37.2'	135°58.7'	65	Piston core cl5 up	221	22	20	0.3	3.4	1002.6	92	0
n/a	24-Sep	11 h 37	70°35.1'	136°00.5'	58	Start mapline 0.00 wp1-2	122	12	19	0.4	3.5	1003.3	86	0
n/a	24-Sep	11 h 49	70°36.3'	135°54.7'	58	End mapline 0.00 wp1-2	135	14	21	0.3	3.6	1002.5	85	0
n/a	24-Sep	11 h 54	70°36.0'	135°54.9'	238	Start mapline 500.04	112	30	19	0.3	3.6	1002.5	85	0
n/a	24-Sep	12 h 05	70°34.8'	136°00.4'	237	End mapline 500.04	106	25	19	0.8	3.7	1003.3	86	0
n/a	24-Sep	12 h 42	70°37.3'	135°58.6'	45	Piston core cl5-2 down	225	20	15	0	3.7	1003.7	84	0
n/a	24-Sep	13 h 10	70°37.1'	135°58.2'	70	Piston core cl5-2 up	210	15	16	-0.2	3.6	1004.3	83	0
n/a	24-Sep	13 h 49	70°34.9'	136°00.5'	46	Start mapline 250.02	113	355	21	-0.5	3.8	1004.7	90	0
n/a	24-Sep	14 h 17	70°36.3'	135°54.2'	57	End mapline 250.02	124	355	21	-0.5	3.8	1004.7	88	0
n/a	24-Sep	14 h 27	70°37.3'	135°50.9'	20	box core cl6	167	352	14	-0.7	3.9	1005.5	90	0
n/a	24-Sep	16 h 00	70°34.26'	135°50.90'	20	Piston core down	168	0	12	-0.9	3.9	1006.7	86	0
n/a	24-Sep	16 h 20	70°37.12'	135°50.9'	non	Piston core up	168	0	14	0.9	3.9	1006.7	86	0
n/a	24-Sep	17 h 03	70°35.9'	135°54.4'	236	Start mapline 750.06	108	25	12	-0.8	3.9	1007.4	84	0
n/a	24-Sep	17 h 15	70°34.7'	136°00.2'	238	End mapline 750.06	97	20	12	-0.8	3.9	1007.5	84	0
n/a	24-Sep	17 h 25	70°35.1'	136°01.8'	38	Start mapline (transit to cl33)	134	0	14	-0.7	3.9	1007.6	84	0
n/a	24-Sep	17 h 51	70°38.65'	135°56.8'	4	Start mapline cl33	262	8	12	-1.2	3.8	1007.6	88	0
n/a	24-Sep	18 h 35	70°38.9'	135°56.79'	40	Piston core down	213	359	10	-1.3	3.55	1008.45	89	0
n/a	24-Sep	19 h 05	70°38.89'	135°56.80'	60	piston core up	213	359	11	-1.4	3.5	1008.45	90	0
n/a	24-Sep	19 h 18	70°38.97'	135°56.7'	33	CTD down	2779	354	12	-1.3	3.55	1008.54	91	0
n/a	24-Sep	19 h 30	70°38.94'	135°56.77'	31	CTD up	279	351	13	-1.2	3.57	1008.68	90	0
n/a	24-Sep	19 h 45	70°38.8'	135°57.48'	150	MVP down	277	18	10	-1.4	3.6	1008.72	92	0
n/a	24-Sep	20 h 25	70°38.59'	135°57.9'	150	MVP up	277	345	10	-1.3	3.6	1008.8	87	0
n/a	24-Sep	20 h 55	70°41.9'	135°43.4'	58	Start mapline 7500.60	321	357	10	-1.4	3.6	1009.1	86	0
n/a	24-Sep	21 h 52	70°46.1'	135°21.0'	58	End mapline 7500.60	234	8	10	-1.4	3.5	1009.1	86	0
n/a	24-Sep	21 h 58	70°46.6'	135°21.9'	238	Start mapline 6500.52	272	8	8	-1.4	3.6	1009.2	86	0
n/a	24-Sep	23 h 14	70°37.0'	136°07.3'	238	End mapline 6500.52	338	10	8	-1.4	3.5	1009.4	86	0
n/a	24-Sep	23 h 20	70°37.5'	136°08.0'	58	Start mapline 5500.00	395	10	7	-1.4	3.5	1009.5	86	0
n/a	25-Sep	01 h 05	70°47.1'	135°22.5'	57	End mapline 5500.00	305	340	11	-2.2	3.5	1009.7	91	0
n/a	25-Sep	01 h 16	70°47.4'	135°24.3'	236	Start mapline 4500	335	20	10	-2.1	3.5	1009.7	91	0
n/a	25-Sep	02 h 33	70°37.9'	136°09.4'	237	End mapline 4500	436	15	11	-1.9	3.4	1009.9	89	0

n/a	25-Sep	02 h 43	70°38.9'	136°09.6'	58	Start mapline 3500	487	10	9	-1.9	3.5	1009.9	90	0
n/a	25-Sep	04 h 30	70°47.88'	135°24.92'	55	End mapline 3500	370	10	7	-2.3	3.5	1009.82	87	0
n/a	25-Sep	04 h 36	70°48.17'	135°25.22'	238	Start mapline 3000	386	7	5	-2.3	3.3	1009.81	86	0
n/a	25-Sep	05 h 52	70°38.49'	136°12.3'	238	End mapline 3000	517	34	10	-2.1	3.05	1009.6	86	0
n/a	25-Sep	05 h 58	70°38.34'	136°14.84'	237	Start mapline 2000	548	35	15	-2.1	3.05	1009.6	86	0
n/a	25-Sep	06 h 55	70°38.74'	136°10.18'	57	End mapline 2000	496	10	9	-2.1	3.27	1009.2	90	0
n/a	25-Sep	07 h 07	70°58.82'	136°10.46'	24	Rosette MAP 2000	496	20	9	-2.1	3.27	1009.2	90	0
n/a	25-Sep	07 h 24	70°38.81'	136°11.15'	12	Rosette MAP 2000	496	20	10	-2.5	3.42	1009.5	91	0
n/a	25-Sep	08 h 30	70°38.5'	136°09.2'	55	Piston core cl3 down	475	23	12	-2.5	3.1	1009.4	90	0
n/a	25-Sep	09 h 00	70°39.1'	136°09.6'	55	Piston core cl3 up	472	23	12	-2.5	3.1	1009.4	90	0
n/a	25-Sep	09 h 19	70°39.1'	136°12.5'	238	Start mapline 0.00 wp1-2	527	33	11	-2.2	3	1009.3	93	0
n/a	25-Sep	09 h 28	70°38.3'	136°16.4'	238	End mapline 0.00 wp1-2	564	30	12	-2.1	2.9	1009.4	93	0
n/a	25-Sep	09 h 39	70°32.7'	136°13.3'	58	Start mapline 1000.00 wp4-3	574	27	12	-2.1	2.9	1009.5	93	0
n/a	25-Sep	09 h 47	70°39.6'	136°13.4'	58	End mapline 1000.00 wp4-3	536	30	13	-2.5	2.9	1009.2	92	0
n/a	25-Sep	10 h 30	70°38.1'	136°09.6'	50	Piston core cl3 down	475	24	11	-2.4	2.8	1009.3	91	0
n/a	25-Sep	10 h 55	70°38.0'	136°09.9'	60	Piston core cl3 up	477	24	18	-2.5	2.8	1009.3	90	0
n/a	25-Sep	11 h 39	70°42.7'	136°07.8'	237	Start mapline 1333.60 wp9-8	587	21	11	-2.3	2.8	1009.3	88	0
n/a	25-Sep	12 h 14	70°41.6'	136°15.4'	235	End mapline 1333.60 wp9-8	643	30	11	-0.1	2.6	1009.6	81	0
n/a	25-Sep	12 h 46	70°40.38'	136°14.13'	38	Piston cl14 down	554	4	11	-2.3	2.53	1009.6	87	0
n/a	25-Sep	13 h 04	70°40.3'	136°14.1'	90	Balloon launching	554	10	12	-2.4	2.6	1009.7	86	0
n/a	25-Sep	13 h 09	70°40.3'	136°14.2'	122	Piston core cl14 up	554	20	10	-2.4	2.6	1009.6	86	0
n/a	25-Sep	14 h 35	70°31.1'	136°10.04'	40	Piston core cl15 down	530	20	9	-2.5	2.6	1009.9	87	0
n/a	25-Sep	15 h 00	70°41.0'	136°10.1'	103	Piston core cl15 up	526	20	9	-2.5	2.6	1009.9	87	0
n/a	25-Sep	15 h 28	70°41.8'	136°15.2'	55	Start mapline 1667	658	10	13	-2.3	2.6	1009.9	89	0
n/a	25-Sep	16 h 32	70°44.34'	136°08.66'	30	Piston core down	613	15	5/10	-2.8	2.5	1009.9	90	0
n/a	25-Sep	17 h 13	70°43.95'	136°08.80'	90	Piston core up	613	340	5/10	-2.4	2.5	1010.2	89	0
n/a	25-Sep	18 h 10	70°44.03'	136°07.11'	238	Start mapline 2333	611	15	5/10	-2.8	2.6	1010.19	91	0
n/a	25-Sep	18 h 48	70°41.89'	136°17.57'	235	End mapline 2333	595	10	5	-2.9	2.57	1010.49	91	0
n/a	25-Sep	18 h 58	70°41.33'	136°16.54'	14	CTD down	591	10	5	-3	2.52	1010.49	90	0
n/a	25-Sep	19 h 18	70°41.35'	136°16.93'	47	CTD up	596	32	8	-2.9	2.48	1010.58	90	0
n/a	25-Sep	20 h 21	70°36.0'	136°37.4'	57	Start mapline 2000	797	29	6	-2.8	2.6	1010.4	92	0

n/a	25-Sep	22 h 20	70°47.3'	135°44.3'	57	End mapline 2000	569	0	7	-2.7	2.8	1010.6	85	0
n/a	25-Sep	22 h 24	70°47.4'	135°46.9'	237	Start mapline 3000	601	23	6	-2.7	2.8	1010.6	85	0
n/a	26-Sep	00 h 12	70°36.4'	136°38.8'	237	End mapline 3000	866	40	9	-3	2.6	1011.3	88	0
n/a	26-Sep	00 h 18	70°37.0'	136°38.9'	59	Start mapline 4000	882	30	6	-3	2.6	1011.3	88	0
n/a	26-Sep	02 h 11	70°48.0'	135°46.6'	58	End mapline 4000	625	10	10	-2.7	2.8	1011.6	82	0
n/a	26-Sep	02 h 19	70°48.4'	135°48.1'	236	Start mapline 5000	629	0	10	-2.5	2.9	1011.8	82	0
n/a	26-Sep	04 h 14	70°38.06'	136°40.24'	58	Start mapline 6000	933	40	5/10	-2.8	2.8	1012.4	88	0
n/a	26-Sep	04 h 08	70°37.95'	136°37.95'	236	End mapline 5000	654	40	5/10	-2.8	2.8	1012.5	80	0
n/a	26-Sep	06 h 05	70°48.77'	135°49.56'	58	End mapline 6000	661	4	5/10	-3.4	2.8	1013.39	87	0
n/a	26-Sep	06 h 10	70°49.96'	135°46.46'	237	Start mapline 7000	664	5	5/10	-3.4	2.8	1013.39	86	0
n/a	26-Sep	06 h 32	70°46.99'	136°01.17'	238	Balloon launching	721	10	10	-3.4	2.96	1013.6	87	0
n/a	26-Sep	07 h 04	70°44.78'	136°11.88'	334	CTD down	614	330	6	-3.5	2.97	1013.8	93	0
n/a	26-Sep	07 h 25	70°44.74'	136°12.53'	7	CTD up	612	20	10	-3.6	2.92	1014.03	92	0
n/a	26-Sep	08 h 23	70°41.3'	136°06.1'	55	Piston core cl 25 down	640	340	1	-3.5	3	1014.6	89	0
n/a	26-Sep	08 h 47	70°44.3'	136°06.9'	63	Piston core cl 25 up	640	340	1	-3.5	3	1014.6	89	0
n/a	26-Sep	09 h 18	70°45.7'	136°08.0'	237	Start mapline 5333.76	683	315	1	-3.3	3.1	1014.6	90	0
n/a	26-Sep	09 h 55	70°43.4'	136°18.8'	38	End mapline 5333.76	678	121	3	-2.9	3	1015.1	89	0
n/a	26-Sep	10 h 30	70°44.9'	136°28.3'	55	Piston core cl 28 down	1005	22	3	-3	2.7	1015.6	88	0
n/a	26-Sep	11 h 00	70°44.8'	136°28.7'	90	Piston core cl 28 up	1011	4	6	-3.2	2.5	1015.8	91	0
n/a	26-Sep	11 h 43	70°42.5'	136°17.1'	57	Start mapline 3333.60	719	268	2	-2.9	2.5	1016	90	0
n/a	26-Sep	12 h 18	70°44.8'	136°06.3'	56	End mapline 3333.60	659	330	8	-2.9	2.7	1016.3	89	0
n/a	26-Sep	12 h 25	70°44.5'	136°05.9'	233	Start mapline 2666.88	641	315	5	-3	2.8	1016.3	90	0
n/a	26-Sep	13 h 02	70°42.2'	136°16.8'	237	End mapline 2666.88	703	270	5	-2.6	2.9	1016.7	90	0
n/a	26-Sep	13 h 35	70°39.5'	136°05.6'	350	Piston core cl12 down	448	300	4	-2.3	2.9	1017.2	88	0
n/a	26-Sep	14 h 00	70°39.5'	136°05.6'	350	Piston core cl12 up	448	320	2	-2.2	2.9	1017.2	87	0
n/a	26-Sep	15 h 12	70°40.5'	136°01.1'	3	Box core cl13 down	432	295	2	-2.2	2.9	1017.8	88	0
n/a	26-Sep	15 h 30	70°40.4'	136°01.1'	24	Box core cl13 up	440	310	3	-2.2	2.9	1017.9	88	0
n/a	26-Sep	16 h 18	70°40.4'	136°01.15'	39	Piston core cl13 down	440	calm	calm	-2.2	2.97	1018.24	87	0
n/a	26-Sep	16 h 35	70°40.4'	136°01.17'	39	Piston core cl13 up	440	calm	calm	-1.6	3.02	1018.38	85	0
n/a	26-Sep	17 h 07	70°39.4'	136°01.5'	150	Start mapline 1000.00	355	calm	calm	-1.4	3.1	1018.6	86	0
n/a	26-Sep	17 h 26	70°36.8'	135°57.8'	152	End mapline 1000.00	212	calm	calm	-1.5	3.1	1018.6	84	0

n/a	26-Sep	17 h 36	70°36.53'	135°59.33'	335	Start mapline 0.00	210	calm	calm	-1.5	3.1	1018.6	84	0
n/a	26-Sep	17 h 55	70°39.61'	136°03.59'	335	End mapline 0.00	220	calm	calm	NA	NA	NA	84	0
n/a	26-Sep	18 h 24	70°40.48'	136°01.19'	52	Piston core cl 136 down	440	240	6	-1.3	3.07	1018.82	79	0
n/a	26-Sep	18 h 49	70°40.50'	136°01.26'	17	Piston core cl 136 up	440	240	6	-1	3.18	1018.88	77	0
n/a	26-Sep	19 h 14	70°40.56'	136°02.54'	344	CTD CL13 down	457	240	2	-1.2	3.23	1019	79	0
n/a	26-Sep	19 h 31	70°40.52'	136°03.23'	310	CTD CL13 up	461	194	6	-1.1	3.27	1019.5	79	0
n/a	26-Sep	20 h 00	70°41.77'	136°05.69'	237	Start mapline 7000	500	240	8	-1	3.3	1019.02	79	0
n/a	26-Sep	21 h 18	70°38.3'	136°42.1'	237	End mapline 7000	973	291	12	-0.4	2.8	1019	79	0
n/a	26-Sep	21 h 25	70°39.0'	136°43.6'	57	Start mapline 9000	1081	291	12	-0.4	2.8	1019	79	0
n/a	26-Sep	23 h 16	70°50.3'	135°51.4'	57	End mapline 9001	687	284	8	-1.2	3	1019.9	92	0
n/a	26-Sep	23 h 23	70°49.8'	135°50.5'	237	Start mapline 8000	672	284	8	-1.2	3	1019.9	92	0
n/a	27-Sep	00 h 39	70°42.7'	136°24.0'	238	End mapline 8000	861	280	6	-1.4	3	1020.2	92	0
n/a	27-Sep	00 h 50	70°43.8'	136°25.0'	55	Start mapline 10000	950	290	9	-1.3	3	1020.2	92	0
n/a	27-Sep	02 h 19	70°50.8'	135°51.8'	56	End mapline 10000	694	280	7	-0.8	3	1020.6	78	0
n/a	27-Sep	02 h 26	70°51.2'	135°53.3'	23	Start mapline 11000	699	260	7	-0.8	3	1020.5	77	0
n/a	27-Sep	04 h 17	70°40.03'	136°46.14'	237	End mapline 11000	1152	230	10/15	-0.3	2.9	1020.5	83	0
n/a	27-Sep	04 h 23	70°39.48'	136°47.34'	150	Start mapline OLI	1147	230	10/15	-0.3	2.87	1020.5	82	0
n/a	27-Sep	04 h 45	70°34.31'	136°38.92'	150	End mapline OLI	643	243	15	-0.1	2.48	1020.99	85	0
n/a	27-Sep	06 h 43	70°40.21'	135°42.21'	7	Piston (carruttier) down	246	250	10/12	0	3.3	1021.69	82	0
n/a	27-Sep	06 h 55	70°40.23'	135°42.23'	55	Piston (carruttier) up	246	250	10	0	3	1021.62	82	0
n/a	27-Sep	08 h 51	70°35.4'	135°45.1'	310	Box core cl 10 down	76	268	14	0.2	3.5	1021.7	86	0
n/a	27-Sep	08 h 59	70°35.4'	135°45.1'	270	Box core cl 10 up	76	268	14	0.2	3.5	1021.7	86	0
n/a	27-Sep	09 h 50	70°35.4'	135°45.1'	264	Piston core cl 10 down	76	257	14	0.3	3.6	1021.9	80	0
n/a	27-Sep	10 h 00	70°35.4'	135°45.2'	290	Piston core cl 10 up	74	257	14	0.3	3.6	1021.9	80	0
n/a	27-Sep	10 h 23	70°35.4'	135°44.9'	269	CTD down	74	253	13	0.3	3.6	1021.8	82	0
n/a	27-Sep	10 h 30	70°35.4'	135°44.9'	287	CTD up	74	236	15	0.3	3.6	1021.8	82	0
n/a	27-Sep	11 h 00	70°35.4'	135°45.1'	265	Piston core down	74	244	14	-0.6	3.6	1021.9	88	0
n/a	27-Sep	11 h 07	70°35.4'	135°45.0'	278	Piston core up	74	244	12	-0.6	3.6	1021.9	88	0
n/a	27-Sep	11 h 20	70°35.2'	135°46.6'	244	Start mapline 750.06	70	250	9	0	3.6	1021.6	85	0
n/a	27-Sep	11 h 37	70°34.4'	135°51.5'	244	End mapline 750.06	65	279	9	0.1	3.6	1021.7	84	0
n/a	27-Sep	11 h 40	70°54.5'	135°51.4'	64	Start mapline 500.04	66	279	9	0.1	3.6	1021.7	84	0
n/a	27-Sep	11 h 58	70°36.3'	135°40.3'	64	End mapline 500.04	67	275	11	0	3.6	1022	84	0

n/a	27-Sep	12 h 02	70°36.4'	135°41.0'	244	Start mapline 250.02	68	275	11	0	3.6	1022	84	0
n/a	27-Sep	12 h 19	70°34.6'	135°52.3'	244	End mapline 250.02	66	250	9	0.1	3.5	1021.6	86	0
n/a	27-Sep	12 h 23	70°34.8'	135°51.7'	62	Start mapline 0.00	68	260	12	0.2	3.5	1021.6	85	0
n/a	27-Sep	12 h 41	70°36.6'	135°40.3'	65	End mapline 0.00	68	245	10	0.4	3.5	1022.2	80	0
n/a	27-Sep	12 h 46	70°36.2'	135°40.3'	243	Start mapline 750.06	67	260	12	0.4	3.5	1022.2	80	0
n/a	27-Sep	12 h 55	70°35.2'	135°46.6'	244	interrup mapline 750.06	67	265	11	0.4	3.5	1021.8	82	0
n/a	27-Sep	13 h 25	70°37.4'	135°45.1'	275	Box core cl11 down	110	255	16	-0.8	3.5	1022.12	95	0
n/a	27-Sep	13 h 35	70°37.4'	135°45.0'	350	Box core cl11 up	110	255	17	-0.6	3.6	1021.9	92	0
n/a	27-Sep	14 h 08	70°37.4'	135°45.1'	266	Piston core cl 11 down	110	248	16	0.2	3.6	1022	79	0
n/a	27-Sep	14 h 27	70°37.4'	135°45.1'	282	Piston core cl 11 up	110	235	18	-0.2	3.6	1022.1	85	0
n/a	27-Sep	14 h 43	70°37.6'	135°46.5'	294	Start mapline	145	240	20	0	3.6	1022.1	80	0
n/a	27-Sep	15 h 34	70°40.6'	136°05.6'	295	interrup mapline	460	250	20	-0.3	3.4	1021.5	86	0
n/a	27-Sep	15 h 47	70°40.5'	136°05.9'	229	CTD down	461	250	20	-0.3	3.41	1021.49	86	0
n/a	27-Sep	16 h 09	70°40.3'	136°05.6'	234	CTD up	455	250	20	-0.3	3.31	1021.51	86	0
n/a	27-Sep	17 h 00	70°43.66'	136°21.15'	57	Start mapline 6333	700	250	20	-0.6	3	1021.5	86	0
n/a	27-Sep	17 h 38	70°46.37'	136°07.6'	58	End mapline 6333	620	250	20	-0.6	2.7	1021.47	75	0
n/a	27-Sep	18 h 30	70°43.96'	136°21.84'	58	Start mapline 7000	617	250	20	-0.6	2.7	1021.25	80	0
n/a	27-Sep	19 h 18	70°46.01'	136°08.85'	58	End mapline 7000	717	240	15/20	-0.1	2.45	1020.67	80	0
n/a	27-Sep	19 h 22	70°46.64'	136°09.47'	241	Start mapline 7333	671	250	15/20	0.9	3.45	1021.67	80	0
n/a	27-Sep	19 h 55	70°44.1'	136°21.6'	241	End mapline 7333	747	245	20	-0.4	2.4	1020.7	82	0
n/a	27-Sep	20 h 01	70°44.4'	136°20.8'	57	Start mapline 7667.28	674	245	20	-0.4	2.4	1020.7	82	0
n/a	27-Sep	20 h 09	70°45.0'	136°18.5'	57	End mapline 7667.28	627	249	15	-0.4	2.4	1020.7	82	0
n/a	27-Sep	20 h 24	70°44.7'	136°21.4'	57	Start mapline 8334.00	719	251	17	-0.4	2.4	1020.3	82	0
n/a	27-Sep	21 h 00	70°47.1'	136°10.4'	57	End mapline 8334.00	714	251	17	-0.3	2.3	1020.3	85	0
n/a	27-Sep	21 h 10	70°47.3'	136°10.4'	237	Start mapline 8667.36	721	251	17	-0.3	2.3	1020.2	87	0
n/a	27-Sep	21 h 47	70°44.9'	136°21.7'	237	End mapline 8667.36	759	238	20	-0.3	2.5	1019.7	87	0
n/a	27-Sep	21 h 50	70°45.2'	136°22.2'	57	Start mapline 9334.08	717	261	18	-0.2	2.4	1019.5	86	0
n/a	27-Sep	22 h 32	70°47.5'	136°11.6'	57	End mapline 9334.08	732	283	15	-1	2.3	1020	92	0
n/a	27-Sep	22 h 40	70°47.4'	136°13.0'	237	Start mapline 9667.44	732	285	12	-0.7	2.4	1019.8	88	0
n/a	27-Sep	23 h 17	70°45.3'	136°22.7'	237	End mapline 9667.44	732	280	16	-0.9	2.5	1019.8	87	0
n/a	27-Sep	23 h 30	70°46.2'	136°20.7'	57	Start mapline 10334.16	659	290	13	-1.8	2	1020.3	84	0
n/a	28-Sep	00 h 00	70°48.0'	136°12.1'	56	End mapline 10334.16	753	325	17	-1.9	2.24	1020.3	89	0
n/a	28-Sep	00 h 08	70°47.8'	136°14.7'	236	Start mapline 10667.52	753	330	16	-2.1	2.29	1020.15	92	0
n/a	28-Sep	00 h 45	70°45.8'	136°23.4'	242	End mapline 10667.52	680	320	16	-2.4	2.3	1020.5	88	0
n/a	28-Sep	00 h 58	70°46.0'	136°23.5'	53	Start mapline 11000.88	689	320	17	-2.4	2.3	1020.5	88	0

n/a	28-Sep	01 h 32	70°48.3'	136°12.9'	55	End mapline 11000.88	742	310	15	-3.3	2.1	1021.1	88	0
n/a	28-Sep	01 h 41	70°48.4'	136°13.5'	240	Start mapline 11334.24	755	330	13	-3.5	2.1	1021.1	85	0
n/a	28-Sep	02 h 17	70°46.1'	136°24.2'	237	End mapline 11334.24	702	330	13	-3.3	2.1	1021.3	82	0
n/a	28-Sep	02 h 27	70°46.3'	136°24.4'	57	Start mapline 11667.60	724	330	14	-3.2	2.1	1021.3	80	0
n/a	28-Sep	02 h 33	70°46.6'	136°22.6'	57	End mapline 11667.60	689	320	15	-3.5	2.2	1021.4	79	0
n/a	28-Sep	02 h 45	70°47.0'	136°23.9'	238	Start mapline 12667.68	707	320	10	-3.6	2.3	1021.4	80	0
n/a	28-Sep	02 h 50	70°46.7'	136°25.5'	236	End mapline 12667.68	716	330	12	-3.5	2.3	1021.4	81	0
n/a	28-Sep	03 h 00	70°46.6'	136°24.9'	58	Start mapline 12334.32	714	340	9	-3.6	2.3	1021.6	80	0
n/a	28-Sep	03 h 36	70°48.9'	136°14.1'	58	End mapline 12334.32	755	330	12	-4	2.2	1021.8	77	0
n/a	28-Sep	03 h 44	70°48.7'	136°13.9'	235	Start mapline 12000.96	760	340	9	-3.9	2.1	1021.8	80	0
n/a	28-Sep	04 h 19	70°46.42'	136°24.97'	235	End mapline 12000.96	699	330	5/10	-3.6	2.2	1021.8	80	0
n/a	28-Sep	04 h 30	70°46.06'	136°23.60'	236	Start mapline 11000.13	688	330	5/10	-3.82	2.3	1021.93	78	0
n/a	28-Sep	05 h 30	70°40.89'	136°48.04'	236	End mapline 11000	1079	300	10	-3.7	2.3	1021.84	75	0
n/a	28-Sep	05 h 41	70°40.49'	136°46.79'	236	Start mapline 12000	1079	300	10	-3.7	2.3	1021.84	75	0
n/a	28-Sep	06 h 22	70°45.57'	136°22.87'	56	Balloon launching	673	285	12	-3.9	1.9	1022.21	75	0
n/a	28-Sep	06 h 22	70°45.57'	136°22.87'	56	Start mapline 10000	673	285	12	-3.9	1.9	1022.21	75	0
n/a	28-Sep	07 h 02	70°47.96'	136°11.87'	56	End mapline 10000	749	290	8	-3.8	2.5	1021.9	80	0
n/a	28-Sep	07 h 07	70°47.96'	136°11.81'	278	CTD down	749	290	8	-3.8	2.5	1021.9	80	0
n/a	28-Sep	07 h 37	70°48.01'	136°12.19'	259	CTD up	750	287	6	-3.4	2.44	1021.7	79	0
n/a	28-Sep	08 h 45	70°43.2'	136°02.8'	265	Piston core cl16 down	550	229	9	-3.1	2.8	1021.4	80	0
n/a	28-Sep	09 h 01	70°43.2'	136°02.8'	275	Piston core cl16 up	550	190	10	-3.3	2.8	1021.3	86	0
n/a	28-Sep	11 h 20	70°43.2'	135°51.6'	305	Piston core cl18 down	511	303	13	-3.4	2.8	1021	85	0
n/a	28-Sep	11 h 47	70°43.2'	135°51.6'	320	Piston core cl18 up	518	309	12	-3.4	2.9	1021	80	0
n/a	28-Sep	12 h 18	70°44.4'	136°0.00'	341	Start mapline 0.00	586	320	13	-3.5	2.8	1020.9	87	0
n/a	28-Sep	12 h 30	70°45.9'	136°01.5'	343	End mapline 0.00	689	315	13	-3.8	2.8	1020.9	83	0
n/a	28-Sep	12 h 38	70°45.5'	136°03.0'	163	Start mapline 0.00	666	320	14	-3.8	2.8	1020.9	83	0
n/a	28-Sep	12 h 47	70°44.4'	136°02.11'	162	End mapline 0.00	596	300	18	-3.5	2.8	1021.2	81	0
n/a	28-Sep	13 h 40	70°43.2'	135°53.4'	320	Piston core cl19 down	495	305	10	-3.9	2.8	1021.4	80	0
n/a	28-Sep	13 h 58	70°43.2'	135°53.4'	320	Piston core cl19 up	495	305	10	-3.9	2.8	1021.4	80	0
n/a	28-Sep	15 h 27	70°40.2'	135°37.8'	341	Piston core cl08 down	202	335	10	-3.7	2.9	1021.3	79	0
n/a	28-Sep	15 h 37	70°40.1'	135°37.7'	350	Piston core cl08 up	202	345	9	-3.7	2.9	1021.3	82	0
n/a	28-Sep	15 h 54	70°40.1'	135°37.7'	45	Start mapline 0.00	192	5	10	-4	2.9	1021.3	82	0
n/a	28-Sep	16 h 45	70°46.0'	135°20.0'	238	Start mapline 9500	196	338	15	-4.4	3	1020.9	89	0
n/a	28-Sep	17 h 01	70°43'	135°29.7'	238	End mapline 9500	250	330	13	-4.6	3	1021.1	90	0

n/a	28-Sep	17 h 07	70°43.4'	135°29.5'	56	Start mapline 9000 72	276	325	13	-4.6	3	1021.1	90	0
n/a	28-Sep	17 h 24	70°45.4'	135°19.7'	56	End mapline 9000 72	170	325	12	-4.8	3	1021.3	85	0
n/a	28-Sep	18 h 02	70°45.2'	135°33.15'	non	Piston core down	377	310	9	-4.8	3	1021.42	82	0
n/a	28-Sep	18 h 18	70°45.19'	135°33.17'	319	Piston core up	377	312	9	-4.8	2.9	1021.81	81	0
n/a	28-Sep	19 h 03	70°45.46'	135°33.86'	311	CTD calibration with MVP down	392	314	10	-4.9	2.9	1021.75	83	0
n/a	28-Sep	19 h 13	70°45.51'	135°33.91'	300	CTD calibration with MVP up	394	320	10	-5	2.9	1021.77	85	0
n/a	28-Sep	19 h 28	70°45.36'	135°33.66'	non	MVP down	385	319	11	-5	2.9	1021.73	86	0
n/a	28-Sep	19 h 49	70°43.74'	135°30.91'	57	Start mapline 8000.64	339	318	15	-4.3	2.75	1021.6	86	0
n/a	28-Sep	20 h 12	70°46.00'	135°19.8'	57	End mapline 8000.64	192	305	14	-5.3	2.8	1021.5	84	0
n/a	28-Sep	20 h 26	70°45.7'	135°20.1'	238	Start mapline 8500.68	186	316	9	-5.4	2.9	1021.5	83	0
n/a	28-Sep	20 h 55	70°43.5'	135°30.6'	238	End mapline 8500.68	303	323	10	-5	3	1021.6	86	0
n/a	28-Sep	20 h 57	70°43.2'	135°30.8'	143	Start mapline 0.00	285	323	10	-5	3	1021.6	86	0
n/a	28-Sep	21 h 17	70°40.9'	135°25.3'	143	End mapline 0.00	92	325	13	-4.9	3	1021.5	84	0
n/a	28-Sep	21 h 19	70°40.6'	135°25.4'	238	Start mapline 500	83	325	13	-4.9	3	1021.5	84	0
n/a	28-Sep	23 h 31	70°25.5'	136°43.0'	238	End mapline 500	82	338	9	-5.1	3.1	1021.2	85	0
n/a	28-Sep	23 h 54	70°26.4'	136°43.7'	53	Start mapline 11000	301	320	10	-5.2	3	1021.3	85	0
n/a	29-Sep	01 h 06	70°35.0'	136°03.1'	57	End mapline 11000	158	320	10	-5.7	3	1020.9	88	0
n/a	29-Sep	01 h 14	70°35.3'	136°04.8'	237	Start mapline 10000	223	320	6	-5.6	3	1020.8	87	0
n/a	29-Sep	02 h 22	70°26.7'	136°45.5'	238	End mapline 10000	346	345	5	-5.3	3	1020.7	85	0
n/a	29-Sep	02 h 29	70°27.3'	136°45.4'	57	Start mapline 9000	387	340	9	-5.2	3	1020.6	85	0
n/a	29-Sep	03 h 40	70°35.9'	136°04.8'	57	End mapline 9000	257	330	10	-5.4	2.3	1020.3	87	0
n/a	29-Sep	03 h 48	70°36.3'	136°06.4'	237	Start mapline 8000	271	310	7	-5.3	2.9	1020.2	85	0
n/a	29-Sep	04 h 55	70°27.53'	136°48.54'	237	End mapline 8000	440	340	7	-4.6	3	1019.6	81	0
n/a	29-Sep	05 h 03	70°28.13'	136°47.83'	236	Start mapline 7000	458	313	7	-4.6	3	1019.59	81	0
n/a	29-Sep	06 h 15	70°36.92'	136°06.43'	59	End mapline 7000	320	325	7	-5	2.9	1019.27	82	0
n/a	29-Sep	06 h 22	70°37.49'	136°08.36'	240	Start mapline 5600	390	320	8	-5	2.9	1019.26	82	0
n/a	29-Sep	06 h 52	70°33.23'	136°08.36'	237	End mapline 5600	484	303	6	-5.1	2.9	1019.05	81	0
n/a	29-Sep	07 h 08	70°33.28'	136°28.84'	308	CTD down	487	303	6	-5.1	2.9	1019.05	81	0
n/a	29-Sep	07 h 25	70°33.36'	136°28.94'	332	CTD up	492	305	5	-5.2	3.88	1019	81	0
n/a	29-Sep	08 h 12	70°37.3'	136°07.5'	238	Start mapline 6000	366	315	5	-5	2.9	1018.4	81	0
n/a	29-Sep	09 h 02	70°32.1'	136°34.9'	238	End mapline 6000	495	315	5	-5	2.9	1018.4	81	0
n/a	29-Sep	09 h 05	70°32.1'	136°34.6'	58	Start mapline 5000	496	315	5	-5	2.9	1018.4	81	0
n/a	29-Sep	09 h 48	70°37.6'	136°08.8'	58	End mapline 5000	426	29	6	-4.4	3.1	1017.8	80	0
n/a	29-Sep	10 h 59	70°35.7'	136°04.8'	238	Start mapline 9500	228	17	6	-4.3	3.2	1017.6	78	0

n/a	29-Sep	11 h 05	70°35.0'	136°08.9'	238	End mapline 9500	240	47	7	-4	3.2	1017.6	77	0
n/a	29-Sep	16 h 12	70°37.51'	136°00.26'	260	Return Zodiac		20	7	-4.3	3	1016.7	73	0
n/a	29-Sep	16 h 42	70°37.54'	136°00.84'	242	Return to ROV		5	10	-4.1	3	1016.6	70	0
n/a	29-Sep	18 h 34	70°43.6'	136°00.7'	63	Return buoy AXYS	547	35	3	-5.4	2.1	1016.2	80	0
n/a	29-Sep	22 h 15	70°32.1'	136°18.3'	58	Start mapline 10500	317	322	4	-5	2.6	1015.3	80	0
n/a	29-Sep	22 h 40	70°35.1'	136°04.0'	58	End mapline 10500	200	322	4	-5	2.6	1015.3	80	0
n/a	29-Sep	22 h 46	70°34.7'	136°03.9'	238	Start mapline 11500	133	322	4	-5	2.6	1015.3	80	0
n/a	29-Sep	23 h 57	70°26.2'	136°43.5'	238	End mapline 11500	274	12	5	-4.7	2.7	1015.2	79	0
n/a	30-Sep	00 h 02	70°25.8'	136°42.0'	58	Start mapline 12500	150	0	8	-4.7	2.7	1015.3	80	0
n/a	30-Sep	01 h 09	70°34.3'	136°02.1'	58	End mapline 12500	111	310	9	-4.6	2.7	1014.9	84	0
n/a	30-Sep	01 h 19	70°33.5'	136°01.2'	237	Start mapline 14001.12	81	calm	calm	-4.5	2.7	1014.6	81	0
n/a	30-Sep	02 h 28	70°25.0'	136°41.6'	237	End mapline 14001.12	67	calm	calm	-4.4	2.8	1014.6	85	0
n/a	30-Sep	02 h 34	70°25.0'	136°44.3'	326	Start mapline 0.00	106	290	7	-4.4	2.8	1014.6	84	0
n/a	30-Sep	02 h 49	70°27.8'	136°49.8'	326	End mapline 0.00	446	250	8	-4.4	2.7	1014.6	86	0
n/a	30-Sep	02 h 55	70°28.6'	136°48.3'	57	Start mapline 6000.48	468	280	7	-4.2	2.7	1014.6	86	0
n/a	30-Sep	03 h 20	70°31.59'	136°34.50'	57	End mapline 6000.48	460	266	8	-4.2	2.7	1014.6	86	0
n/a	30-Sep	03 h 23	70°32.1'	136°34.86'	237	Start mapline 5000.00	470	260	7	-4.2	2.7	1014.6	89	0
n/a	30-Sep	03 h 48	70°28.97'	136°49.93'	237	End mapline 5000.00	497	286	6	-3.7	2.68	1014.15	90	0
n/a	30-Sep	03 h 51	70°29.05'	136°50.82'	57	Start mapline 4000.00	494	285	8	-3.7	2.68	1014.5	90	0
n/a	30-Sep	05 h 05	70°38.52'	136°08.14'	57	End mapline 4000.00	469	56	10	-3.5	2.64	1013.99	92	0
n/a	30-Sep	05 h 10	70°38.72'	136°10.05'	237	Start mapline 3000.00	494	255	9	-3.5	2.6	1013.99	92	0
n/a	30-Sep	05 h 50	70°33.70'	136°33.19'	237	End mapline 3000.00	532	250	7	-3.2	2.5	1013.99	92	0
n/a	30-Sep	05 h 54	70°33.79'	136°30.84'	82	Start mapline 0.00 wp-1	553	266	9	-3	2.58	1013.39	91	0
n/a	30-Sep	06 h 57	70°37.73'	135°50.56'	82	MVP down	191	330	6	-3.2	2.73	1013.64	92	0
n/a	30-Sep	07 h 27	70°39.95'	135°40.0'	82	MVP up	205	340	10	-3.3	2.75	1013.6	92	0
n/a	30-Sep	07 h 58	70°41.6'	135°28.8'	238	Start mapline 1200.96	144	352	10	-3.4	2.6	1013.5	86	0
n/a	30-Sep	08 h 12	70°40.1'	135°36.3'	238	End mapline 1200.96	170	333	6	-3.2	2.6	1013.7	80	0
n/a	30-Sep	08 h 45	70°39.4'	135°36.2'	338	Return secondary buoy	126	335	9	-3.2	2.6	1013.7	80	0
n/a	30-Sep	11 h 30	70°28.6'	135°27.1'	173	Start mapline 0.00	60	198	7	-3.3	2.9	1013.6	86	0
n/a	30-Sep	13 h 38	70°00.2'	135°16.5'	170	End mapline 0.00	27	calm	calm	-3.5	2.7	1014.5	72	0
n/a	30-Sep	13 h 48	70°00.5'	135°18.2'	354	Start mapline	28	calm	calm	-3.4	2.6	1014.6	72	0
n/a	30-Sep	14 h 06	70°04.8'	135°26.4'	352	End mapline	35	calm	calm	-3.5	2.7	1014.5	72	0

n/a	30-Sep	14 h 36	70°07.5'	135°31.0'	83	Start mapline 0.00 wp-2	48	330	5	-3.4	2.5	1014.5	69	0
n/a	30-Sep	14 h 55	70°08.2'	135°11.3'	84	Balloon	45	calm	calm	-3.3	2.6	1014.6	70	0
n/a	30-Sep	15 h 14	70°08.4'	135°05.5'	83	End mapline 0.00 wp-2	45	calm	calm	-3.3	2.6	1014.5	70	0
n/a	30-Sep	15 h 35	70°09.76'	135°10.48'	288	Picture with whale	46.3	calm	calm	-3.4	2.5	1014.59	70	0
n/a	30-Sep	15 h 49	70°10.1'	135°14.0'	263	Start mapline 3704.00	50	calm	calm	-3.4	2.5	1014.6	69	0
n/a	30-Sep	16 h 24	70°10.58'	135°35.05'	263	End mapline 3704.00	50	calm	calm	-3.1	2.6	1014.58	68	0
n/a	30-Sep	16 h 30	70°11.29'	135°33.94'	81	Start mapline 7408.00	55	calm	calm	-3.1	2.6	1014.58	68	0
n/a	30-Sep	17 h 00	70°12.16'	135°13.47'	81	End mapline 7408.00	44	calm	calm	-3.2	2.6	1014.48	68	0
n/a	30-Sep	17 h 10	70°14.13'	135°14.28'	70	Start mapline 12000	48	calm	calm	-3.2	2.6	1014.48	68	0
n/a	30-Sep	18 h 20	70°12.47'	136°00.51'	270	End mapline 12000	43	170	3	-3	2.47	1014.44	68	0
n/a	30-Sep	18 h 30	70°10.61'	136°56.38'	82	Start mapline 7408	40	calm	calm	-3	2.47	1014.44	68	0
n/a	30-Sep	21 h 00	70°33.2'	136°00.1'	238	Start mapline 15001.20	70	calm	calm	-3.6	2.8	1014.7	78	0
n/a	30-Sep	22 h 09	70°24.6'	135°40.4'	238	End mapline 15001.20	62	calm	calm	-3.9	2.8	1015.1	80	0
n/a	30-Sep	22 h 13	70°24.7'	136°41.1'	58	Start mapline 14501.16	64	calm	calm	-3.9	2.8	1015.1	80	0
n/a	30-Sep	23 h 23	70°53.0'	136°00.4'	58	End mapline 14501.16	81	calm	calm	-3.8	2.8	1015.1	79	0
n/a	30-Sep	23 h 28	70°33.9'	136°01.0'	238	Start mapline 13501.08	88	calm	calm	-3.8	2.8	1015.1	79	0
n/a	01-Oct	00 h 37	70°25.1'	136°42.5'	238	End mapline 13501.08	73	330	5	-3.5	2.7	1015.3	74	0
n/a	01-Oct	00 h 44	70°25.1'	136°46.1'	326	Start mapline 926.00	190	270	5	-3.5	2.7	1015.4	76	0
n/a	01-Oct	01 h 05	70°28.9'	136°53.8'	327	End mapline 926.00	573	260	5	-3.9	2.7	1015.4	77	0
n/a	01-Oct	01 h 14	70°30.0'	136°50.5'	57	Start mapline 3000.24	531	calm	calm	-3.9	2.7	1015.5	80	0
n/a	01-Oct	01 h 47	70°34.0'	136°31.9'	57	End mapline 3000.24	532	19	9	-4.2	2.6	1015.4	89	0
n/a	01-Oct	01 h 54	70°34.6'	136°35.3'	238	Start mapline 1000.08	605	350	10	-4.2	2.6	1015.4	89	0
n/a	01-Oct	02 h 24	70°30.9'	136°52.8'	237	End mapline 1000.08	619	0	12	-4.3	2.6	1015.7	92	0
n/a	01-Oct	02 h 30	70°30.5'	136°51.3'	54	Start mapline 2000.16	550	345	16	-4.6	2.5	1015.7	93	0
n/a	01-Oct	03 h 17	70°36.1'	136°24.9'	57	End mapline 2000.16	670	0	12	-4.3	2.6	1015.7	90	0

n/a	01-Oct	03 h 56	70°38.4'	136°48.5'	336	Start mapline 0.00	1041	340	6	-5.2	2.5	1016.1	91	0
n/a	01-Oct	04 h 19	70°43.22'	136°51.44'	336	End mapline 0.00	1266	0	10/15	-5	2.4	1015.9	90	0
n/a	01-Oct	04 h 22	70°43.25'	136°51.8'	56	Start mapline 18000	1192	0	10/15	-6	2.04	1016.31	88	0
n/a	01-Oct	05 h 52	70°54.59'	136°58.59'	55	End mapline 18000	814	337	10	-6.7	1	1016.78	88	0
n/a	01-Oct	06 h 00	70°55.34'	136°01.07'	240	Start mapline 20000	849	335	8	-6.7	1	1016.78	88	0
n/a	01-Oct	06 h 18	70°52.37'	136°16.32'	240	Balloon	865	335	6	-6.7	0.74	1016.86	88	0
n/a	01-Oct	07 h 27	70°44.3'	136°53.07'	240	End mapline 20000	1212	4	10	-6	0.92	1017.34	84	0
n/a	01-Oct	08 h 33	70°45.0'	136°38.3'	45	CTD down	1205	296	9	-5.9	1.5	1017.9	83	0
n/a	01-Oct	09 h 06	70°45.0'	136°38.2'	15	CTD up	1200	296	8	-5.8	1.7	1018.2	82	0
n/a	01-Oct	10 h 26	70°45.6'	136°00.5'	62	CTD down	669	316	9	-6	0.9	1018.5	83	0
n/a	01-Oct	10 h 47	70°45.5'	136°00.7'	17	CTD up	672	286	10	-5.8	0.9	1018.5	83	0
n/a	01-Oct	11 h 51	70°45.4'	136°00.9'	60	Mooring A1 up	656	304	13	-6	0.8	1019.1	88	0
n/a	01-Oct	14 h 50	70°39.8'	136°14.2'	0	Recover secondary buoy	546	330	10	-6.2	0.7	1020.7	84	1/10
n/a	01-Oct	19 h 20	70°47.76'	136°12.49'	56	Start mapline 12000.96	737	290	15	-4.1	0.17	1022.65	76	0
n/a	01-Oct	20 h 45	70°55.6'	135°52.2'	57	End mapline 12000.96	625	302	18	-5	0.1	1023.6	83	0
n/a	01-Oct	20 h 50	70°55.5'	135°32.9'	237	Start mapline 11000.88	625	302	18	-5	0.1	1023.6	83	1/10
n/a	01-Oct	21 h 24	70°44.3'	135°40.8'	237	End mapline 11000.88	701	303	19	-5.1	0	1024	86	1/10
n/a	01-Oct	21 h 29	70°50.8'	135°51.8'	57	Start mapline 10000.80	681	303	19	-5.1	0	1024	86	1/10
n/a	01-Oct	22 h 11	70°55.5'	135°29.5'	57	End mapline 10000.80	611	301	19	-5.2	0	1024.4	87	1/10
n/a	01-Oct	22 h 17	70°55.0'	135°28.9'	237	Start mapline 9000.72	611	301	19	-5.2	0	1024.4	87	1/10
n/a	01-Oct	23 h 00	70°50.4'	135°50.7'	237	End mapline 9000.72	674	300	19	-5.4	0	1024.9	88	1/10
n/a	01-Oct	23 h 04	70°49.8'	135°50.3'	57	Start mapline 8000.64	673	300	19	-5.4	0	1024.9	88	1/10
n/a	01-Oct	23 h 50	70°54.4'	135°27.8'	57	End mapline 8000.64	574	305	13	-5.5	0	1025.3	85	1/10
n/a	01-Oct	23 h 53	70°54.0'	135°27.9'	237	Start mapline 7000.56	564	305	13	-5.6	-0.1	1025.9	83	1/10
n/a	02-Oct	00 h 31	70°49.4'	135°49.4'	237	End mapline 7000.56	637	290	9	-5.6	-0.1	1025.9	86	1/10
n/a	02-Oct	00 h 37	70°49.0'	135°48.0'	56	Start mapline 6000.48	639	310	15	-5.6	-0.1	1026.1	86	1/10
n/a	02-Oct	01 h 32	70°55.1'	135°19.3'	56	End mapline 6000.48	539	315	19	-5.4	-0.1	1026.9	79	1/10
n/a	02-Oct	01 h 38	70°54.6'	135°18.9'	237	Start mapline 5000.40	514	300	15	-5.4	-0.1	1026.9	80	1/10
n/a	02-Oct	02 h 28	70°48.5'	135°48.0'	238	End mapline 5000.40	661	310	7	-4.8	-0.1	1027.3	76	1/10
n/a	02-Oct	02 h 34	70°48.1'	135°46.6'	55	Start mapline 4000.32	614	300	17	-4.7	-0.1	1027.3	75	1/10
n/a	02-Oct	03 h 28	70°54.3'	135°17.0'	55	End mapline 4000.32	495	300	16	-4.8	-0.1	1028.1	80	1/10

n/a	02-Oct	03 h 34	70°53.8'	135°16.7'	336	Start mapline 3000.24	457	300	11	-4.8	-0.05	1028	79	1/10
n/a	02-Oct	04 h 25	70°47.76'	136°45.59'	236	End mapline 3000	549	318	15	-4.4	0.07	1028.99	76	1/10
n/a	02-Oct	04 h 28	70°48.0'	135°44.31'	56	Start mapline 2000	583	318	15	-4.4	0.07	1028.5	76	1/10
n/a	02-Oct	04 h 53	70°49.02'	135°35.46'	56	End mapline 2000	501	300	12	-4.5	0.07	1029.04	76	1/10
n/a	02-Oct	06 h 30	70°47.44'	136°05.53'	non	ROV down	785	300	13	-4.3	0	1030.16	72	0
n/a	02-Oct	09 h 47	70°46.8'	136°05.8'	45	ROV up	785	303	9	-4.3	0.1	1032.3	79	0
n/a	02-Oct	13 h 28	70°45.6'	136°00.5'	60	Mooring 11 down	666	320	8	-4	0	1033.9	80	1/10
n/a	02-Oct	14 h 50	70°44.5'	136°22.5'	0	balloon	789	230	5	-4.1	0	1034.6	71	1/10
n/a	02-Oct	15 h 31	70°44.5'	136°22.6'	81	ROV down	800	cal m	calm	-3.5	0.02	1034.9	68	1/10
n/a	02-Oct	17 h 15	70°44.5'	136°22.7'	80	ROV up	800	cal m	calm	-3.7	0.1	1035.2	70	1/10
n/a	02-Oct	22 h 01	70°43.8'	135°30.7'	238	Start mapline 8000.64	303	139	7	-3.2	0.6	1035.4	73	1/10
n/a	02-Oct	23 h 05	70°36.6'	136°05.1'	238	End mapline 8000.64	282	104	8	-2.6	0.5	1035	70	1/10
n/a	02-Oct	23 h 10	70°36.9'	136°06.2'	58	Start mapline 7000.56	325	104	8	-2.6	0.5	1034.9	68	1/10
n/a	03-Oct	00 h 39	70°46.4'	135°21.3'	57	End mapline 7000.56	272	90	13	-2.7	0.2	1034.9	69	1/10
n/a	03-Oct	00 h 46	70°46.7'	135°22.8'	236	Start mapline 6000.48	288	100	11	-2.9	0.2	1034.9	82	1/10
n/a	03-Oct	02 h 09	70°37.3'	136°07.7'	237	End mapline 6000.48	365	70	15	-2.4	0.1	1034.3	74	1/10
n/a	03-Oct	02 h 16	70°37.8'	136°08.2'	57	Start mapline 5000.40	433	65	15	-2.5	0.1	1034.1	80	1/10
n/a	03-Oct	03 h 44	70°47.3'	135°23.1'	57	End mapline 5000.40	324	90	19	-2.1	0.2	1033.1	81	1/10
n/a	03-Oct	03 h 51	70°47.6'	135°24.7'	237	Start mapline 4000.32	352	100	20	-2.1	0.2	1033.4	79	1/10
n/a	03-Oct	05 h 10	70°38.2'	136°09.6'	237	End mapline 4000.32	468	115	20	-1.6	0.06	1032.86	75	1/10
n/a	03-Oct	05 h 25	70°35.91'	136°05.39'	57	Start mapline 9000	249	100	15	-1.1	0.19	1031.35	72	1/10
n/a	03-Oct	06 h 33	70°43.44'	135°29.41'	57	End mapline 9000	280	127	15	-1	0.34	1031.95	73	1/10
n/a	03-Oct	06 h 40	70°42.63'	135°30.41'	237	Start mapline 10000	220	125	15	-1.1	0.3	1032.04	73	1/10
n/a	03-Oct	08 h 10	70°35.1'	136°05.5'	136	CTD down	213	110	21	-1	0.7	1032.4	63	1/10
n/a	03-Oct	08 h 20	70°25.1'	136°05.5'	136	CTD up	313	204	20	-1.2	0.9	1031.2	64	1/10
n/a	03-Oct	10 h 15	70°29.4'	135°07.9'	125	ROV down	57	112	20	-2.3	1.4	1030.6	65	1/10
n/a	03-Oct	12 h 25	70°29.7'	135°08.1'	110	ROV up	57	110	22	-2.9	1.42	1029.6	70	0
n/a	03-Oct	13 h 31	70°29.8'	135°08.1'	128	Mooring site C	60	118	21	-3.1	1.5	1029.4	74	0
n/a	03-Oct	15 h 45	70°45.9'	136°04.2'	118	Piston core cl 32 down	697	101	26	-3.2	0.6	1028.5	78	1/10
n/a	03-Oct	16 h 20	70°45.95'	136°03.42'	120	Piston core cl 32 up	692	102	28	-3.2	0.6	1028.08	76	1/10
n/a	03-Oct	18 h 15	70°48.73'	136°06.05'	115	Piston core cl 34 down	782	98	28	-2.4	0.37	1026.01	77	1/10
n/a	03-Oct	18 h 48	70°48.86'	136°06.08'	91	Piston core cl 34 up	792	106	24	-2.3	0.38	1026.3	77	1/10
n/a	03-Oct	21 h 02	70°52.9'	135°14.6'	237	Start mapline 1000.08	403	95	25	-1.1	0.5	1026.8	76	1/10
n/a	03-Oct	21 h 44	70°47.8'	135°39.2'	237	End mapline 1000.08	513	120	26	-0.9	0.6	1023.7	82	1/10

n/a	03-Oct	21 h 49	70°47.4'	135°37.8'	57	Start mapline 0.00	483	120	26	-0.9	0.6	1023.7	82	1/10
n/a	03-Oct	22 h 33	70°52.3'	135°14.2'	57	End mapline 0.00	381	109	23	-0.9	0.5	1024	80	1/10
n/a	03-Oct	22 h 38	70°52.0'	135°12.9'	237	Start mapline 1000.08	341	109	23	-0.9	0.5	1024.5	78	1/10
n/a	03-Oct	23 h 19	70°47.1'	135°36.2'	237	End mapline 1000.08	465	116	25	-1	0.5	1024.3	80	1/10
n/a	03-Oct	23 h 24	70°46.5'	135°55.8'	57	Start mapline 2000.16	477	116	25	-1.1	0.5	1024	81	1/10
n/a	04-Oct	00 h 39	70°51.5'	135°11.8'	57	End mapline 2000.16	315	100	27	-0.2	0.4	1022.9	78	1/10
n/a	04-Oct	00 h 46	70°51.0'	135°11.5'	237	Start mapline 3000.24	291	100	25	-0.4	0.4	1022.9	77	1/10
n/a	04-Oct	01 h 17	70°47.3'	135°29.5'	237	End mapline 3000.24	398	98	23	-0.8	0.52	1023.1	80	1/10
n/a	04-Oct	01 h 21	70°47.3'	135°30.9'	283	Start mapline	418	109	19	-0.8	0.5	1023.1	80	1/10
n/a	04-Oct	01 h 36	70°48.6'	135°39.6'	283	End mapline	536	101	21	-0.6	0.5	1023.2	79	1/10
n/a	04-Oct	01 h 36	70°48.6'	135°39.6'	10	Start mapline	536	101	21	-0.6	0.5	1023.2	79	1/10
n/a	04-Oct	02 h 23	70°55.9'	135°35.6'	10	End mapline	644	107	25	-0.3	0.82	1022.5	81	1/10
n/a	04-Oct	02 h 30	70°56.3'	135°35.5'	237	Start mapline 13000	652	94	27	-0.6	0.64	1022.5	80	1/10
n/a	04-Oct	03 h 03	70°52.4'	135°53.9'	237	End mapline 13000	733	104	25	-1.1	0.44	1022.6	81	1/10
n/a	04-Oct	03 h 12	70°52.6'	135°52.5'	57	Start mapline 14000	748	113	26	-1.1	0.44	1022.6	81	1/10
n/a	04-Oct	03 h 47	70°56.9'	135°35.4'	57	End mapline 14000	666	106	25	-0.6	0.31	1021.75	81	1/10
n/a	04-Oct	03 h 50	70°57.4'	135°36.5'	237	Start mapline 15000	660	105	25	-0.6	0.31	1021.75	81	1/10
n/a	04-Oct	04 h 25	70°53.15'	135°56.09'	237	End mapline 15000	759	105	25	-0.6	0.32	1021.75	81	1/10
n/a	04-Oct	04 h 33	70°53.51'	135°57.27'	57	Start mapline 16000	776	95	25	-1	0.2	1022.4	81	1/10
n/a	04-Oct	04 h 56	70°56.31'	135°45.29'	57	End mapline 16000	707	98	15/25	-0.9	0.19	1021.63	84	1/10
n/a	04-Oct	05 h 02	70°56.08'	135°48.47'	37	Start mapline 17000	729	100	20/25	-0.9	0.19	1021.63	84	1/10
n/a	04-Oct	06 h 20	70°56.04'	135°46.14'	37	End mapline 17000	718	100	20	-1.2	0.15	1022.15	90	1/10
n/a	04-Oct	06 h 25	70°56.2'	135°44.71'	57	Start mapline 16000	732	100	20	-1.2	0.15	1022.15	90	1/10
n/a	04-Oct	06 h 50	70°59.24'	135°32.89'	57	End mapline 16000	677	95	20	-0.8	0.13	1021.43	91	1/10
n/a	04-Oct	06 h 57	71°00.02'	135°35.68'	237	Start mapline 19000	723	95	20	-0.8	0.13	1021.43	92	1/10
n/a	04-Oct	07 h 40	70°54.4'	136°02.15'	237	End mapline 19000	816	100	20	-1	0.09	1021.57	89	1/10
n/a	04-Oct	08 h 30	70°52.3'	136°12.2'	100	Piston core cl 1 down	890	86	18	-0.5	0.2	1020.8	86	1/10
n/a	04-Oct	09 h 10	70°52.3'	136°12.2'	100	Piston core cl 1 up	890	86	18	-0.5	0.2	1020.8	86	1/10
n/a	04-Oct	10 h 55	70°48.1'	136°03.9'	90	Piston core cl 36 down	779	84	17	-0.2	0.2	1020.1	97	1/10
n/a	04-Oct	11 h 26	70°48.1'	136°04.1'	90	Piston core cl 36 up	779	84	17	-0.2	0.2	1020.1	97	1/10
n/a	04-Oct	13 h 15	70°44.0'	136°01.5'	75	Piston core cl 2 down	575	90	15	0.2	0.7	1019.4	97	1/10
n/a	04-Oct	13 h 30	70°44.0'	136°01.5'	75	Piston core cl 2 up	572	90	15	0.2	0.7	1019.4	97	1/10
n/a	04-Oct	14 h 30	70°47.9'	136°18.7'	98	Piston core cl 24 down	692	80	15	0.1	0.5	1019.2	96	1/10
n/a	04-Oct	15 h 00	70°47.9'	136°18.6'	94	Piston core cl 24 up	692	80	16	0	0.5	1019.3	97	1/10
n/a	04-Oct	15 h 33	70°47.9'	136°18.7'	100	CTD down	687	90	13	0.1	0.4	1019.3	98	1/10

n/a	04-Oct	16 h 00	70°47.9'	136°18.7'	100	CTD up	687	90	13	0.1	0.4	1019.2	97	1/10
n/a	04-Oct	16 h 40	70°50.97'	136°27.57'	60	Start mapline 22001.76	938	77	12	0	0.3	1018.97	98	1/10
n/a	04-Oct	17 h 26	70°56.3'	136°02.3'	56	End mapline 22001.76	870	80	14	-0.1	0.3	1018.6	99	1/10
n/a	04-Oct	17 h 37	70°58.17'	136°05.37'	243	Start mapline 26000	919	85	15	-0.2	0.27	1018.64	99	1/10
n/a	04-Oct	19 h 06	70°46.89'	136°58.97'	235	End mapline 26000	1400	85	13	-0.3	0.19	1018.9	99	1/10
n/a	04-Oct	19 h 10	70°48.22'	136°55.54'	55	Start mapline 27000	1344	75	11	-0.3	0.19	1018.77	99	1/10
n/a	04-Oct	20 h 43	70°58.11'	136°07.3'	57	Start mapline 27002.16	931	59	13	-0.8	0.2	1018.6	99	1/10
n/a	04-Oct	20 h 47	70°58.9'	136°07.9'	237	Start mapline 28002.24	977	59	13	-0.8	0.2	1018.6	99	1/10
n/a	04-Oct	21 h 32	70°53.5'	136°33.8'	237	End mapline 28002.24	1005	68	15	-0.9	0.2	1018.6	99	1/10
n/a	04-Oct	21 h 36	70°54.0'	136°34.3'	57	Start mapline 29002.32	1033	68	15	-0.9	0.3	1018.5	99	1/10
n/a	04-Oct	22 h 21	70°59.3'	136°09.2'	57	End mapline 29002.32	1062	68	15	-1	0.3	1018.5	99	1/10
n/a	04-Oct	22 h 26	70°59.7'	136°10.2'	237	Start mapline 30002.40	1062	68	15	-1	0.3	1018.5	99	1/10
n/a	04-Oct	23 h 32	70°54.4'	136°35.4'	237	End mapline 30002.40	1039	66	16	-0.9	0.3	1018.4	99	1/10
n/a	04-Oct	23 h 36	70°54.7'	136°37.0'	57	Start mapline 31002.48	1054	61	12	-0.7	0.2	1017.9	99	1/10
n/a	05-Oct	00 h 21	71°00.3'	136°10.5'	57	End mapline 31002.48	1064	60	14	-0.8	0.3	1017.6	99	1/10
n/a	05-Oct	00 h 28	71°00.6'	136°12.1'	237	Start mapline 32002.56	1089	65	13	-1	0.3	1017.5	99	1/10
n/a	05-Oct	01 h 27	70°55.1'	136°38.1'	237	End mapline 32002.56	1051	57	15	-1.1	0.27	1018.31	99	1/10
n/a	05-Oct	01 h 32	70°55.5'	136°39.3'	57	Start mapline 33002.64	1098	57	15	-1.1	0.27	1018.31	99	1/10
n/a	05-Oct	02 h 18	71°01.2'	136°11.9'	57	End mapline 32002.56	1090	50	19	-1.3	0.3	1017.76	97	2/10
n/a	05-Oct	02 h 18	71°01.2'	136°11.9'	109	Start mapline 0.00	1094	50	19	-1.3	0.3	1017.5	97	2/10
n/a	05-Oct	03 h 13	70°57.3'	135°37.6'	109	End mapline 0.00	722	50	20	-1.6	0.2	1017.8	97	3/10
n/a	05-Oct	03 h 15	70°57.3'	135°36.4'	57	Start mapline 15001.20	676	50	20	-1.6	0.2	1017.8	97	3/10
n/a	05-Oct	03 h 24	70°58.9'	135°30.7'	57	End mapline 15001.20	700	65	20	-1.6	0.15	1017.6	96	3/10
n/a	05-Oct	03 h 33	70°59.1'	135°34.1'	237	Start mapline 17001.36	700	57	15	-1.6	0.1	1017.6	96	3/10
n/a	05-Oct	03 h 43	70°58.9'	135°38.5'	237	End mapline 17001.36	700	50	18	-1.7	0	1018.12	96	2/10

n/a	05-Oct	03 h 46	70°59.3'	135°39.5'	57	Start mapline 18001.44	714	56	16	-1.7	0	1018.4	96	2/10
n/a	05-Oct	03 h 58	70°59.9'	135°34.9'	57	End mapline 18001.44	725	60	19	-1.6	0	1018.1	96	2/10
n/a	05-Oct	04 h 05	71°01.06'	135°34.46'	237	Start mapline 20000	772	60	15/20	-1.6	0	1018.55	96	2/10
n/a	05-Oct	04 h 42	70°55.24'	135°01.6'	237	End mapline 20000	842	55	15	-1.5	0	1018.55	96	2/10
n/a	05-Oct	04 h 46	70°55.85'	136°01.47'	57	Start mapline 21000	861	55	15	-1.5	0	1018.55	96	2/10
n/a	05-Oct	05 h 20	70°59.34'	135°48.16'	57	End mapline 21000	781	57	14	-2	0.07	1018.13	96	4/10
n/a	05-Oct	05 h 50	70°56.52'	136°04.28'	57	Start mapline 23000	890	50	17	-2	0.07	1018.73	96	4/10
n/a	05-Oct	06 h 10	70°59.70'	135°52.6'	57	End mapline 23000	822	70	15	-2	0.07	1018.51	94	1/10
n/a	05-Oct	06 h 15	71°00.04'	135°50.96'	57	balloon	811	65	15	-2	0.07	1018.2	95	1/10
n/a	05-Oct	06 h 20	70°59.58'	135°51.57'	37	Start mapline 24000	940	55	15	-2.1	0.09	1018.79	96	1/10
n/a	05-Oct	07 h 18	71°52.58'	135°26.09'	237	End mapline 24000	940	55	15	-2.1	0.09	1018.79	96	1/10
n/a	05-Oct	07 h 24	70°53.29'	135°25.66'	57	Start mapline 25000	945	55	15	-2.1	0.09	1018.8	96	1/10
n/a	05-Oct	07 h 50	70°55.6'	136°13.5'	57	End mapline 25000	945	55	15	-2.3	0	1018.7	95	1/10
n/a	05-Oct	08 h 28	70°55.6'	136°13.5'	65	Piston core cl 37 down	952	34	15	-2.7	0.1	1018.7	94	1/10
n/a	05-Oct	08 h 54	70°55.7'	136°13.6'	50	Piston core cl 37 up	952	47	14	-2.5	0.1	1018.8	93	1/10
n/a	05-Oct	10 h 05	70°46.1'	136°18.8'	60	Piston core cl 29 down	648	35	13	-2.6	0.1	1018.8	91	1/10
n/a	05-Oct	10 h 30	70°46.1'	136°19.0'	60	Piston core cl 29 up	648	35	13	-2.6	0.1	1018.8	91	1/10
n/a	05-Oct	11 h 19	70°41.4'	136°27.1'	55	Piston core cl 39 down	794	23	14	-2.7	0.4	1018.9	91	1/10
n/a	05-Oct	11 h 40	70°41.3'	136°27.0'	70	Piston core cl 39 up	794	26	15	-2.7	0.4	1018.9	91	1/10
n/a	05-Oct	13 h 15	70°43.9'	136°39.8'	45	Piston core cl 41 down	126 2	35	16	-3	0.5	1019	81	1/10
n/a	05-Oct	14 h 00	70°43.9'	136°39.5'	55	Piston core cl 41 up	126 2	10	18	-3.5	0.6	1019.2	86	1/10
n/a	05-Oct	15 h 02	70°47.8'	136°38.9'	54	Piston core cl 38.C down	107 3	14	17	-4	0.5	1019.6	84	1/10
n/a	05-Oct	15 h 37	70°47.8'	136°38.6'	45	Piston core cl 38.C up	107 3	15	13	-4.2	0.4	1019.8	84	1/10
n/a	05-Oct	18 h 32	70°42.92'	136°32.46'	38	Piston core down	111 8	23	15	-5.6	0.2	1020	90	1/10
n/a	05-Oct	19 h 15	70°42.94'	136°32.47'	36	Piston core up	111 8	24	16	-6.3	0.18	1020.4	95	1/10
n/a	05-Oct	21 h 15	70°34.0'	135°59.2'	238	MVP down	82	30	15	-5.2	0.8	1022.4	95	1/10
n/a	05-Oct	22 h 24	70°30.0'	136°18.4'	238	MVP up	71	30	15	-5.7	0.8	1022.4	95	1/10
n/a	05-Oct	23 h 09	70°25.3'	136°41.8'	58	Start mapline 1000.08	78	10	12	-5.8	1	1022.4	95	1/10
n/a	06-Oct	00 h 20	70°34.0'	136°01.3'	56	End mapline 1000.08	94	0	19	-6.5	1	1022.1	95	0
n/a	06-Oct	00 h 25	70°33.5'	136°00.8'	237	Start mapline 2000	83	7	15	-6.7	1	1022.3	94	0
n/a	06-Oct	01 h 35	70°24.8'	136°41.5'	237	End mapline 2000	65	25	17	-6.4	1.1	1024	95	0

n/a	06-Oct	01 h 42	70°25.6'	136°42.4'	57	Start mapline 500.04	92	0	14	-6.2	1.2	1024.1	95	0
n/a	06-Oct	02 h 55	70°34.4'	136°01.2'	57	End mapline 500.04	103	17	15	-6.9	1.06	1024.4	94	0
n/a	06-Oct	02 h 59	70°34.5'	136°02.0'	237	Start mapline 000	110	9	18	-6.9	1.06	1024.4	94	0
n/a	06-Oct	03 h 18	70°32.1'	136°13.0'	237	End mapline 000	122	26	16	-6.6	1.06	1025.2	94	0
n/a	06-Oct	03 h 21	70°32.2'	136°14.4'	57	Start mapline 500	154	0	16	-6.6	1.06	1025.2	94	0
n/a	06-Oct	03 h 42	70°34.7'	136°02.6'	57	End mapline 500	123	0	15	-6.9	1	1025	94	0
n/a	05-Oct	13:15	70° 43.9	136° 39.8	045	Piston Core Down CL 41	1262	035	16	-3.0	0.50	1019.00	81	1/10
n/a	05-Oct	14:00	70° 43.9	136° 39.5	055	Piston Core Up CL 41	1262	010	18	-3.5	0.60	1019.20	86	1/10
n/a	05-Oct	15:07	70° 47.8	136° 38.9	054	Piston Core Down Cl_38_C	1073	014	17	-4.0	0.50	1019.60	84	1/10
n/a	05-Oct	15:37	70° 47.8	136° 38.6	045	Piston Core Up Cl_38_C	1073	015	13	-4.2	0.40	1019.80	84	1/10
n/a	05-Oct	18:32	70° 42.92	136° 32.46	038	Piston Core Down	1118	023	15	-5.6	0.20	1020.00	90	1/10
n/a	05-Oct	19:15	70° 42.94	136° 32.47	036	Piston Core Up	1118	024	16	-6.3	0.18	1020.60	95	1/10
n/a	05-Oct	21:25	70° 34.0	135° 59.2	238	MUP deploy Down	82	030	15	-5.7	0.80	1022.40	95	1/10
n/a	05-Oct	22:24	70° 30.0	136° 10.4	238	MUP recover Up	71	030	15	-5.7	0.80	1022.40	95	1/10
n/a	05-Oct	23:09	70° 25.3	136° 41.8	058	Debut Map Line 1000.08	78	010	12	-5.8	1.00	1022.40	95	1/10
n/a	06-Oct	0:20	70° 34.0	136° 01.3	056	Finish Map Line 1000.08	94	000	19	-6.5	1.00	1022.10	95	1/10
n/a	06-Oct	0:26	70° 33.5	136° 00.8	237	Debut Map Line 2000	83	007	15	-6.7	1.00	1022.30	94	-
n/a	06-Oct	1:35	70° 24.8	136° 41.5	237	Finish Map Line 2000	65	025	17	-6.4	1.10	1024.00	95	-
n/a	06-Oct	1:42	70° 25.6	136° 42.4	057	Debut Map Line 500.04	92	000	14	-6.2	1.20	1024.10	95	-
n/a	06-Oct	2:55	70° 34.4	136° 01.2	057	Finsh Map Line 500.04	108	017	15	-6.9	1.06	1024.40	94	-
n/a	06-Oct	2:59	70° 34.5	136° 02.0	237	Debut Map Line 000	110	009	18	-6.9	1.06	1024.40	94	-
n/a	06-Oct	3:18	70° 32.1	136° 13.0	237	Finsh Map Line 000	122	036	16	-6.6	10.60	1025.20	94	-
n/a	06-Oct	3:21	70° 32.2	136° 14.4	057	Debut Map Line 500	154	000	16	-6.6	10.60	1025.20	94	-
n/a	06-Oct	3:42	70° 34.7	136° 02.6	057	Finish Map Line 500	123	000	15	-6.9	1.00	1025.00	94	-
n/a	09-Oct	9:10	71° 20.8	127° 47.7	000	Mooring Integerrogation	207	105	9	-2.6	1.80	1043.90	74	-
n/a	09-Oct	9:35	71° 18.7	127° 34.8	035	CTD Down	213	110	7	-2.7	1.80	1043.80	76	-
n/a	09-Oct	9:55	71° 18.8	127° 35.1	026	CTD Up	212	131	13	-3.2	1.80	1043.80	77	-
n/a	09-Oct	10:20	71° 18.8	127° 35.2	248	Mooring Recup. Debut	212	132	8	-3.8	1.80	1043.90	79	-
n/a	09-Oct	10:45	71° 18.9	127° 35.5	236	Mooring Recup. Finish	213	147	7	-4.1	1.80	1043.80	79	-
n/a	09-Oct	11:29	71° 24.6	127° 38.4	012	CTD Down	243	100	6	-3.6	1.80	1043.80	78	-
n/a	09-Oct	11:40	71° 24.7	127° 38.8	022	CTD Up	244	100	8	-2.8	1.90	1043.70	77	-

n/a	09-Oct	12:50	71° 24.46	127° 38.55	250	Mooring Recup. (1315 finish)	242	147	7	-3.8	2.03	1043.51	77	-
n/a	10-Oct	12:15	71° 35.98	134° 24.057	004	n/a	1400	132	30	-2.0	0.00	1024.40	87	-
n/a	10-Oct	17:35	71° 37.60	134° 18.38	89.7	n/a	1359	120	30	-2.0	-0.06	1022.40	87	-
n/a	10-Oct	19:05	71° 38.80	134° 19.86	001.7	n/a	1358	120	30	-1.6	-0.06	1022.70	83	-
n/a	11-Oct	22:00	71° 48.08	126° 30.86	355	n/a	306	148	22	-0.1	0.46	1027.30	80	-
n/a	11-Oct	23:01	71° 47.06	126° 29.16	348	CTD Down	315	155	24	0.5	0.46	1026.90	79	-
n/a	11-Oct	23:36	71° 47.05	126° 29.48	30	CTD Up	317	140	24	2.5	0.48	1026.90	73	-
n/a	11-Oct	23:55	71° 47.04	126° 29.36	325	Veritcal Net Down	317	150	20	2.5	0.48	1026.90	80	-
n/a	12-Oct	0:18	71° 47.174	126° 29.100	334	Finish Vertical Net Up 307m	313	150	26	-1.1	0.45	1026.88	83	-
n/a	12-Oct	0:43	71° 47.514	126° 29.834	243	Horizontal Net Down	309	157	24	-1.8	0.45	1026.81	75	-
n/a	12-Oct	0:58	71° 47.391	126° 30.987	135	Horizontal Net Up	321	154	23	-0.8	0.47	1026.42	82	-
n/a	12-Oct	2:02	71° 47.748	126° 29.571	347	Rosette Contaminants-Et-Diversity Down	297	152	20	0.0	0.49	1026.33	79	-
n/a	12-Oct	2:25	71° 47.798	126° 29.680	326	Rosette Contaminants-Et-Diversity Up	296	150	21	0.4	0.50	1026.32	77	-
n/a	12-Oct	9:35	71° 46.98	126° 29.11	335	Rosette Down	323	150	24	-0.1	0.60	1024.20	82	-
n/a	12-Oct	10:53	71° 46.96	126° 29.26	340	Rosette Up	329	163	24	0.8	0.63	1024.00	80	-
n/a	12-Oct	10:50	71° 47.50	126° 29.33	346	Mooring Recovery Debut	307	160	22	0.3	0.30	1023.70	80	-
n/a	12-Oct	11:30	71° 47.65	126° 29.12	008	Mooring Recovery Finish	302	148	23	-0.6	0.60	1023.80	84	-
n/a	12-Oct	13:43	71° 47.655	126° 30.578	339	IOPS - Package Down	308	170	20	-0.9	0.60	1023.22	86	-
n/a	12-Oct	13:58	71° 47.770	126° 30.515	325	IOPS - Package Up	303	160	21	-0.5	0.61	1023.83	84	-
n/a	12-Oct	14:33	71° 47.221	126° 32.570	255	Zodiac Deployment Down	340	170	27	-1.0	0.62	1022.64	86	-
n/a	12-Oct	15:00	71° 47.394	126° 30.056	239	Zodiac Deployment Up	313	166	20	-0.7	0.62	1022.06	85	-
n/a	12-Oct	15:06	71° 47.630	126° 30.757	000	PNF	310	158	21	-0.9	0.62	1022.35	86	-
n/a	12-Oct	15:40	71° 47.737	126° 30.651	306	PNF	307	67	21	0.0	0.62	1022.53	84	-
n/a	12-Oct	15:50	71° 47.068	126° 29.812	340	Rosette Primary Production Down	319	164	19	3.4	0.62	1021.99	73	-
n/a	12-Oct	17:05	71° 47.215	126° 29.230	335	Box Core Down station 437	310	168	21	1.1	0.62	1021.12	80	-
n/a	12-Oct	17:10	71° 47.223	126° 29.107	344	Box Core Up	311	164	21	0.3	0.64	1021.06	83	-
n/a	12-Oct	19:30	71° 47.184	126° 30.510	333	Box Core Down station 437	323	165	23	0.9	0.64	1019.09	80	-
n/a	12-Oct	19:35	71° 47.155	126° 30.541	339	Box Core Up	323	163	20	1.1	0.64	1019.09	80	-
n/a	12-Oct	19:57	71° 47.806	126° 30.272	334	Box Core Down station 437	322	164	24	-0.3	0.66	1018.94	86	-
n/a	12-Oct	20:03	71° 47.113	126° 30.240	343	Box Core Up	322	170	22	0.3	0.65	1018.83	84	-
n/a	12-Oct	20:10	71° 47.08	126° 30.09	350	Box Core Up 'A Bord	321	167	23	-0.3	0.66	1018.60	85	-
n/a	12-Oct	20:33	71° 47.44	126° 30.13	318	Agassiz Sledge Down	311	176	21	-0.5	0.65	1018.40	87	-

n/a	12-Oct	21:06	71° 47.01	126° 32.32	2112	Agassiz Sledge Up	320	170	23	-0.5	0.65	1018.40	87	-
n/a	12-Oct	22:10	71° 47.52	126° 34.28	270	Mapping Debut	405	170	23	0.0	0.60	1017.10	86	-
n/a	13-Oct	3:55	71° 18.470	127° 34.746	176	Mapping Finish	204	198	24	-0.4	0.93	1013.00	75	-
n/a	13-Oct	4:09	71° 18.435	127° 35.155	015	Rosette Down Station 408	201	208	25	-0.5	0.92	1013.12	74	-
n/a	13-Oct	4:32	71° 18.501	127° 35.330	356	Rosette Up	202	214	23	-0.8	0.91	1013.15	75	-
n/a	13-Oct	4:50	71° 18.589	127° 35.542	016	Vertical Net Down Station 408	202	217	23	-0.3	0.91	1013.40	73	-
n/a	13-Oct	5:04	71° 18.546	127° 35.71	036	Vertical Net Up	202	216	23	-0.9	0.93	1013.38	73	-
n/a	13-Oct	5:21	71° 18.618	127° 35.95	042	Horizontal Net Down Station 408	200	216	23	0.4	0.92	1013.37	71	-
n/a	13-Oct	5:40	71° 18.207	127° 35.42	350	Horizontal Net Up	207	217	22	0.0	0.93	1013.72	71	-
n/a	13-Oct	6:40	71° 18.994	127° 35.609	046	Rosette Down station 408	205	233	22	-1.1	0.96	1012.59	77	-
n/a	13-Oct	7:00	71° 18.995	127° 35.609	039	Rosette Up	205	229	22	-0.5	0.96	1012.60	76	-
n/a	13-Oct	8:35	71° 18.996	127° 35.22	062	Hydrobios Down	207	230	18	-0.6	0.98	1012.00	82	-
n/a	13-Oct	8:52	71° 18.997	127° 35.25	062	Hydrobios Up	209	230	17	0.7	0.99	1011.80	79	-
n/a	13-Oct	11:24	71° 18.998	127° 34.12	340	RMT Debut	211	250	13	-0.5	0.98	1011.30	90	-
n/a	13-Oct	11:46	71° 19.55	127° 35.64	300	RMT Finish	210	250	13	-0.3	0.99	1011.40	91	-
n/a	13-Oct	12:48	71° 18.479	127° 35.430	018	Secchi PNF Down	199	280	10	-0.4	0.99	1011.32	94	-
n/a	13-Oct	12:50	71° 18.543	127° 35.327	016	PNF Down	201	280	10	0.4	0.99	1011.00	94	-
n/a	13-Oct	12:57	71° 18.575	127° 35.293	020	PNF Up	202	280	12	0.4	0.99	1011.00	94	-
n/a	13-Oct	13:15	71° 18.668	127° 34.67	169	Rosette Primary Production Down	205	280	9	0.6	1.01	1011.45	94	-
n/a	13-Oct	13:42	71° 18.816	127° 34.233	156	Rosette Primary Production Up	210	280	11	1.2	1.02	1011.85	93	-
n/a	13-Oct	14:23	71° 19.060	127° 33.688	051	10PS Package Down	215	310	8	0.1	1.02	1009.46	95	-
n/a	13-Oct	14:38	71° 19.142	127° 33.527	067	10PS Package Up	219	320	10	-0.2	1.02	1011.90	95	-
n/a	13-Oct	15:25	71° 19.440	127° 33.197	081	Balloon Meteo	220	335	10	-0.4	1.03	1011.85	96	-
n/a	13-Oct	19:10	71° 19.072	127° 35.602	177	Mooring Deployment Station 408	206	031	9	-2.0	1.01	1012.90	97	-
n/a	13-Oct	19:52	71° 19.314	127° 35.448	228	CTD Down station 408	208	014	9	-1.8	1.01	1012.90	97	-
n/a	13-Oct	20:00	71° 19.32	127° 35.56	260	CTD Up station 408	208	022	8	-2.3	0.90	1012.90	96	-
n/a	13-Oct	20:43	71° 17.16	127° 46.93	082	Boxcore Down	152	068	3	-2.3	0.90	1012.90	96	-
n/a	13-Oct	20:50	71° 17.17	127° 47.06	075	Boxcore Up	152	068	3	-2.3	0.90	1012.90	96	-
n/a	13-Oct	21:08	71° 17.18	127° 47.39	133	Boxcore Down	151	027	5	-2.3	0.87	1012.90	96	-
n/a	13-Oct	21:15	71° 17.18	127° 47.49	140	Boxcore Up	151	027	5	-2.6	0.87	1012.90	96	-
n/a	13-Oct	21:38	71° 17.20	127° 48.00	190	Boxcore Down	151	060	4	-2.6	0.83	1013.00	96	-
n/a	13-Oct	21:45	71° 17.20	127° 48.06	191	Boxcore Up	152	060	4	-2.6	0.83	1013.00	96	-
n/a	13-Oct	22:00	71° 17.10	127° 48.29	160	Agassiz Sledge Debut	148	050	5	-2.3	0.81	1012.90	97	-
n/a	13-Oct	22:30	71° 17.30	127° 48.41	130	Agassiz Sledge Finish	149	040	6	-2.3	0.81	1012.90	97	-
n/a	13-Oct	23:50	71° 18.12	127° 44.22	48	CTD Down	167	040	2	-2.0	0.83	1013.30	97	-

n/a	14-Oct	0:14	71° 18.185	127° 44.588	55	CTD Rosette Down	167	055	0	-1.8	0.82	1013.21	97	-
415	14-Oct	1:03	71° 21.690	127° 33.299	323	Rosette Nutrient CTD Down	242	028	1	-2.4	0.94	1013.72	98	-
415	14-Oct	1:13	71° 21.691	127° 33.462	311	Rosette Nutrient CTD Up	241	092	0	-2.5	0.97	1013.09	98	-
414	14-Oct	1:50	71° 25.326	127° 21.664	22	Rosette Nutrient CTD Down	306	231	3	-2.7	1.02	1013.17	98	-
414	14-Oct	2:16	71° 25.363	127° 22.007	343	Rosette Nutrient CTD Up	306	226	2	-2.8	1.04	1013.67	98	-
413	14-Oct	3:13	71° 29.687	127° 08.074	64	Rosette Nutrient CTD Down	375	305	4	-2.5	1.08	1013.19	98	-
413	14-Oct	3:28	71° 29.669	127° 08.089	42	Rosette Nutrient CTD Up	373	320	3	-2.5	1.10	1013.31	98	-
412	14-Oct	4:11	71° 33.847	126° 55.549	265	Rosette Nutrient Down	418	244	3	-2.4	1.02	1013.18	98	-
412	14-Oct	4:47	71° 33.938	126° 55.307	348	Rosette Nutrient Up	414	230	5	-2.2	1.04	1013.15	98	-
411	14-Oct	5:50	71° 37.786	126° 42.516	352	CTD Down	438	243	5	-2.3	0.94	1012.65	99	-
411	14-Oct	6:08	71° 37.815	126° 42.437	346	CTD Up	438	222	3	-2.2	0.90	1012.51	99	-
410	14-Oct	6:57	71° 41.920	126° 29.327	098	Rosette Nutrient Down	408	219	3	-1.8	0.83	1012.39	99	-
410	14-Oct	7:33	71° 41.985	126° 28.846	120	Rosette Nutrient Up	399	183	3	-1.5	0.83	1012.21	99	-
437	14-Oct	8:35	71° 46.73	126° 28.64	337	Boxcore Down	320	196	8	-0.9	0.67	1011.90	98	-
437	14-Oct	8:50	71° 46.79	126° 28.43	205	Boxcore Up	322	200	6	-1.6	0.66	1012.00	98	-
437	14-Oct	9:02	71° 46.87	126° 28.35	293	Boxcore Down	318	195	8	-1.5	0.65	1012.00	98	-
437	14-Oct	9:15	71° 46.95	126° 28.32	282	Boxcore Up	315	191	5	-1.5	0.65	1012.00	98	-
437	14-Oct	12:50	71° 45.247	126° 30.355	281	CTD Down	367	185	8	-1.4	0.72	1011.59	99	-
437	14-Oct	13:05	71° 45.338	126° 30.346	284	CTD Up	367	204	8	-1.5	0.72	1011.00	99	-
437	14-Oct	13:50	71° 45.134	126° 30.331	131	Begin Recooping Mooring	354	188	7	-1.4	0.73	1011.57	99	-
437	14-Oct	14:19	71° 45.225	126° 29.747	114	Finish Recooperation Mooring	238	238	5	-1.2	0.75	1011.51	99	-
437	14-Oct	14:51	71° 47.200	126° 29.429	323	Zodiac Recovery	313	222	5	-1.6	0.73	1011.57	99	-
437	14-Oct	15:12	71° 47.192	126° 29.051	110	Rosette Primary Production Down	311	190	8	-1.1	0.73	1011.42	99	-
437	14-Oct	15:37	71° 47.234	126° 28.226	121	Rosette Primary Production Up	303	185	7	-0.9	0.75	1011.07	99	-
437	14-Oct	16:40	71° 47.134	126° 30.056	319	IOPS Package Down	320	191	7	-1.3	0.78	1010.77	99	-
437	14-Oct	16:55	71° 47.189	126° 29.985	278	IOPS Package Up	318	188	6	-1.3	0.78	1010.74	99	-
437	14-Oct	17:15	71° 47.200	126° 29.987	277	Zodiac Recovery	315	186	8	-1.4	0.77	1010.66	99	-
437	14-Oct	20:00	71° 45.24	126° 30.50	195	Debut Mooring	354	170	10	-0.8	0.69	1010.40	99	-
437	14-Oct	20:23	71° 45.30	126° 30.53	285	Mooring Finished	354	193	10	-0.9	0.70	1010.40	99	-
437	14-Oct	21:10	71° 45.44	126° 31.15	000	CTD Down	355	165	7	-0.7	0.69	1010.00	98	-
437	14-Oct	21:27	71° 45.51	126° 31.10	340	CTD Up	354	185	7	-0.4	0.69	1009.90	97	-
405	15-Oct	5:32	70° 39.881	122° 59.841	044	Rosette Contaminants Down	560	157	9	0.4	1.10	1009.01	92	-
405	15-Oct	6:10	70° 39.870	123° 00.277	072	Rosette Up	560	162	10	0.8	1.05	1008.95	91	-
405	15-Oct	6:28	70° 39.828	122° 59.232	177	Vertical Net Down	565	151	9	0.6	1.05	1008.95	92	-
405	15-Oct	7:00	70° 39.732	122° 59.774	257	Vertical Net Up	576	155	9	0.1	1.08	1009.08	92	-

405	15-Oct	7:16	70° 39.690	123° 00.238	263	Horizontal Net Down	585	149	8	0.1	1.10	1009.09	92	-
405	15-Oct	7:31	70° 39.193	123° 01.270	163	Horizontal Net Up	601	152	7	0.3	1.11	1009.09	92	-
405	15-Oct	8:10	70° 39.84	122° 59.74	069	Rosette and Boxcore Down	561	170	6	0.8	1.06	1008.09	90	-
405	15-Oct	8:47	70° 39.75	123° 00.40	100	Rosette Up	579	170	6	1.2	1.08	1008.90	89	-
405	15-Oct	9:01	70° 39.77	123° 00.53	350	RMT Debut	584	162	6	0.2	1.10	1009.00	88	-
405	15-Oct	9:25	70° 39.76	123° 03.30	020	RMT Finish	559	162	6	0.1	1.10	1009.00	88	-
405	15-Oct	10:00	70° 39.73	123° 00.18	118	Secchi PNF Down	583	180	3	0.3	1.05	1009.10	83	-
405	15-Oct	10:30	70° 39.61	123° 00.44	100	Secchi PNF Up	585	138	3	0.2	1.05	1009.10	85	-
405	15-Oct	10:40	70° 39.84	122° 59.83	030	Mooring Interrogation	585	085	2	0.1	1.05	1009.10	85	-
405	15-Oct	11:03	70° 39.78	123° 00.22	048	Rosette Down	585	097	4	0.1	1.04	1009.20	85	-
405	15-Oct	11:55	70° 39.54	123° 01.19	047	Rosette Up	585	093	6	0.1	1.02	1009.30	91	-
408	15-Oct	20:35	71° 24.79	127° 38.89	245	Mooring Deploy Debut	237	075	16	1.2	1.15	1010.10	86	-
408	15-Oct	21:45	71° 24.34	127° 09.11	116	MVP Debut Transit	237	067	13	0.2	1.17	1009.40	91	-
408	16-Oct	4:00	70° 54.95	124° 11.2	114	MVP Finish Transit	560	100	21	-0.4	1.50	1008.50	78	-
408	16-Oct	5:15	70° 46.213	123° 39.635	198	Mooring Recovery	528	067	25	-1.7	1.33	1008.79	91	-
405	16-Oct	5:45	70° 45.150	123° 32.795	340	n/a	549	064	22	-1.5	1.23	1008.36	92	-
405	16-Oct	6:05	70° 44.043	123° 25.764	325	n/a	415	069	23	-1.7	1.26	1006.01	92	-
405	16-Oct	6:30	70° 42.995	123° 19.223	245	n/a	444	060	16	-2.4	1.31	1008.48	95	-
405	16-Oct	6:55	70° 41.827	123° 12.432	233	n/a	521	054	20	-2.5	1.29	1008.26	95	-
405	16-Oct	7:22	70° 40.713	123° 05.659	227	n/a	487	065	25	-2.5	1.07	1008.13	94	-
405	16-Oct	7:45	70° 39.872	122° 59.728	067	n/a	560	051	23	-2.4	0.99	1008.11	94	-
405	16-Oct	8:24	70° 39.84	123° 00.43	230	Hydrobios Down	573	050	23	-1.8	0.91	1008.30	88	-
405	16-Oct	8:56	70° 39.90	123° 00.857	230	Hydrobios Up	553	060	23	-2.6	0.88	1008.50	84	-
405	16-Oct	9:35	70° 39.79	123° 02.18	240	IOPS Package Down	567	060	22	-2.7	0.84	1008.50	82	-
408	16-Oct	9:53	70° 39.82	123° 02.50	226	IOPS Package Up	559	063	23	-3.0	0.84	1008.30	86	-
408	16-Oct	10:10	70° 39.74	123° 03.157	225	Zodiac Deploy	564	060	18	-2.3	0.84	1008.30	82	-
408	16-Oct	10:33	70° 39.81	123° 03.08	250	Rosette DOM Down	558	060	20	-2.5	0.82	1008.50	82	-
408	16-Oct	11:05	70° 39.85	123° 03.38	240	Rosette DOM Up	553	060	24	-2.5	0.82	1008.30	82	-
408	16-Oct	11:40	70° 39.68	123° 04.44	235	Zodiac Recovery	563	070	24	-3.2	0.80	1008.00	85	-
408	16-Oct	12:43	70° 39.903	122° 59.870	245	Boxcore Down	558	061	19	-2.8	0.81	1008.28	83	-
408	16-Oct	13:07	70° 39.895	122° 00.025	231	Boxcore Up	557	064	28	-2.7	0.81	1008.31	82	-
408	16-Oct	13:23	70° 39.879	122° 59.743	238	Boxcore Down	559	062	26	-1.6	0.80	1008.29	80	-
408	16-Oct	13:42	70° 39.860	122° 59.916	235	Boxcore Up	564	060	21	-2.3	0.81	1008.49	82	-
408	16-Oct	13:58	70° 39.720	122° 00.625	233	Agassiz Sledge Down	577	068	24	-2.7	0.81	1008.53	83	-
408	16-Oct	14:39	70° 38.216	122° 00.435	127	Agassiz Sledge Up	615	062	28	-3.8	0.72	1008.35	86	-

446	17-Oct	1:30	71° 38.976	119° 41.518	305	Rosette CTD Down	142	040	14	-11.2	-0.04	1013.99	77	-
446	17-Oct	1:38	71° 38.871	119° 41.793	318	Rosette CTD Up	143	040	11	-11.1	-0.02	1013.92	77	-
450	17-Oct	5:01	72° 05.555	119° 47.497	213	Rosette Down	95	350	9	-14.3	0.11	1016.28	86	-
450	17-Oct	5:33	72° 05.412	119° 47.674	237	Rosette Up	95	013	12	-12.0	-0.04	1016.61	83	-
450	17-Oct	5:52	72° 05.328	119° 47.980	137	Vertical Net Down	95	015	10	-13.3	-0.03	1016.52	87	-
450	17-Oct	6:01	72° 05.317	119° 48.058	137	Vertical Net Up	95	009	10	-13.5	-0.03	1016.63	88	-
450	17-Oct	6:30	72° 04.721	119° 48.815		Agassiz Sledge Down	97	006	9	-12.9	-0.04	1016.64	87	-
450	17-Oct	6:50	72° 04.544	119° 48.631		Agassiz Sledge Up	95	014	12	-13.0	-0.05	1016.84	88	-
308	19-Oct	17:05	74° 06.153	108° 49.614	338	Secchi Down	545	001	9	-15.8	-0.46	1012.78	82	-
308	19-Oct	17:07	74° 06.154	108° 49.615	338	Secchi Up	545	001	9	-15.8	-0.46	1012.78	82	-
308	19-Oct	17:15	74° 06.152	108° 49.796	370	Rosette Down	587	001	9	-15.6	-0.46	1012.78	82	-
308	19-Oct	18:11	74° 06.147	108° 49.842	301	Rosette Up	544	349	7	-15.5	-0.48	1012.70	84	-
308	19-Oct	18:35	74° 06.166	108° 49.842	113	Vertical Net Down	545	351	7	-15.9	-0.49	1012.86	85	-
308	19-Oct	19:10	74° 06.177	108° 49.818	021	Vertical Net Up	546	338	8	-15.6	-0.52	1013.00	86	-
308	19-Oct	19:37	74° 06.172	108° 49.824	018	Vertical Net Down	545	337	8	-15.4	-0.52	1013.02	86	-
308	19-Oct	20:02	74° 06.171	108° 49.833	018	Vertical Net Up	545	321	7	-15.6	-0.50	1013.16	86	-
308	19-Oct	20:12	74° 06.170	108° 49.844	012	IOPS Package Down	557	330	7	-15.2	-0.47	1013.18	87	9/10
308	19-Oct	20:30	74° 06.133	108° 49.883	013	IOPS Package Up	556	325	9	-15.2	-0.46	1013.17	87	9/10
308	19-Oct	20:49	74° 06.157	108° 50.034	171	Rosette Down	544	342	10	-14.9	-0.44	1013.11	87	9/10
308	19-Oct	21:22	74° 06.157	108° 50.028	262	Rosette Up	544	346	9	-15.6	-0.41	1013.17	86	9/10
308	19-Oct	22:00	74° 06.152	108° 50.084	260	Hydrobios Down	544	352	10	-15.0	-0.36	1013.16	87	9/10
308	19-Oct	22:32	74° 06.148	108° 50.118	257	Hydrobios Up	543	000	12	-14.7	-0.33	1013.20	87	9/10
308	19-Oct	23:25	74° 06.090	108° 50.006	066	Boxcore Down	541	350	14	-15.6	-0.38	1013.48	87	9/10
308	19-Oct	23:45	74° 06.087	108° 50.041	066	Boxcore Up	541	353	12	-15.7	-0.39	1013.59	87	9/10
308	20-Oct	0:02	74° 06.073	108° 50.148	088	Boxcore Down	541	353	14	-15.4	-0.41	1013.45	87	9/10
308	20-Oct	0:22	74° 06.072	108° 50.263	110	Boxcore Up	541	352	10	-15.4	-0.41	1013.49	86	9/10
308	20-Oct	8:22	74° 05.878	108° 52.866	245	ROV Down	532	005	22	-12.9	0.11	1015.96	85	9/10
308	20-Oct	12:04	74° 05.142	108° 52.828	243	ROV Up	497	350	25	-12.4	0.20	1015.43	84	9/10
308	21-Oct	20:03	74° 19.720	102° 47.747	020	Ice Raid Out	200	547	15	-15.4	-0.66	1020.24	86	9/10
308	21-Oct	20:52	74° 19.464	102° 47.359	020	Ice Raid In	220	350	12	-14.3	-0.49	1020.40	88	9/10
308	22-Oct	7:25	74° 18.429	102° 46.020	045	Ice Raid Out	220	348	12	-14.7	0.57	1022.67	85	9/10
308	22-Oct	8:10	74° 18.192	102° 45.532	045	Ice Raid In	225	350	12	-14.9	0.10	1022.90	83	9/10
308	22-Oct	9:50	74° 17.977	102° 45.460	226	Ice Raid Out	226	340	10	-14.7	0.08	1023.54	86	9/10
308	22-Oct	10:22	74° 17.878	102° 45.185	225	Ice Raid In	223	350	10	-15.0	-0.03	1023.83	86	9/10
308	22-Oct	11:05	74° 17.845	102° 45.044	242	Rosette Down	223	350	8	-15.4	-0.01	1023.92	86	9/10

308	22-Oct	10:28	74° 17.75	102° 44.92	181	Rosette Up	223	356	7	-15.4	-0.05	1023.76	86	9/10
304	23-Oct	17:22	74° 18.738	91° 20.014	314	Rosette Down	340	312	6	-8.9	-0.71	1021.20	84	9/10
304	23-Oct	18:05	74° 18.760	91° 20.866	281	Rosette Up	340	312	3	-8.9	-0.73	1021.44	89	9/10
304	23-Oct	18:35	74° 18.790	91° 21.293	352	IOPS Package Down	335	340	5	-8.9	-0.73	1021.54	88	9/10
304	23-Oct	18:53	74° 18.810	91° 21.963	052	IOPS Package Up	335	345	6	-9.2	-0.73	1021.69	88	9/10
304	23-Oct	19:00	74° 18.810	91° 21.963	052	Vertical Net Down	335	345	6	-9.2	-0.73	1021.69	88	9/10
304	23-Oct	19:36	74° 18.838	91° 22.511	055	Vertical Net Up	335	316	5	-9.3	-0.66	1021.68	90	9/10
304	23-Oct	19:56	74° 18.899	91° 23.004	258	Rosette Down	332	317	7	-8.9	-0.60	1021.60	91	9/10
304	23-Oct	20:18	74° 18.922	91° 23.326	253	Rosette Up	331	320	7	-8.7	-0.59	1021.45	90	9/10
304	23-Oct	20:45	74° 18.959	91° 23.707	255	Hydrobios Down	331	335	5	-8.6	-0.51	1021.42	90	9/10
304	23-Oct	21:05	74° 18.981	91° 23.911	255	Hydrobios Up	336	325	5	-8.5	-0.49	1021.46	90	9/10
304	23-Oct	21:33	74° 19.014	91° 24.160	254	Boxcore Down	331	335	5	-8.4	-0.46	1021.35	90	9/10
304	23-Oct	21:47	74° 19.035	91° 24.267	254	Boxcore Up	336	355	6	-8.3	-0.42	1021.96	90	9/10
304	23-Oct	22:03	74° 19.058	91° 24.378	253	Boxcore Down	331	335	5	-8.2	-0.41	1021.42	90	9/10
304	23-Oct	22:15	74° 19.072	91° 24.444	253	Boxcore Up	334	355	5	-8.2	-0.40	1021.40	90	9/10
330	24-Oct	5:42	74° 08.399	87° 51.368	312	Rosette Nutrient Down	419	070	12	-9.6	-0.86	1020.91	89	9/10
330	24-Oct	6:34	74° 08.719	87° 51.369	331	Rosette Nutrient Up	420	050	11	-9.3	-0.84	1020.94	89	9/10
325	24-Oct	21:40	73° 49.083	80° 29.873	208	Rosette Down	680	030	26	-7.1	-0.94	1015.89	88	1/10
325	24-Oct	22:22	73° 49.674	80° 28.188	252	Rosette Up	662	030	28	-7.6	-0.89	1015.69	90	1/10
323	25-Oct	3:13	74° 09.361	80° 30.181	212	Vertical Net Down	796	030	26	-9.0	-0.94	1014.71	86	1/10
323	25-Oct	4:01	74° 09.413	80° 31.553	206	Vertical Net Up	774	024	29	-7.8	-0.93	1014.94	86	1/10
323	25-Oct	4:23	74° 09.228	80° 31.855	190	Horizontal Net Down	771	026	29	-5.7	-0.92	1014.85	81	1/10
323	25-Oct	4:32	74° 09.138	80° 32.343	240	Horizontal Net Up	773	020	36	-7.4	-0.92	1014.76	85	1/10
323	25-Oct	5:24	74° 09.690	80° 30.555	204	Rosette Down	786	020	28	-8.2	-0.89	1015.03	86	1/10
323	25-Oct	6:16	74° 09.857	80° 31.240	203	Rosette Up	783	020	25	-7.3	-0.88	1015.72	84	-
323	25-Oct	8:10	74° 10.646	80° 31.904	210	Rosette Down	778	035	25	-8.5	-0.89	1015.68	80	3/10
323	25-Oct	9:00	n/a	n/a	202	Horizontal Net	755	035	30		n/a	n/a	n/a	3/10
323	25-Oct	9:48	74° 11.028	80° 35.302	269	IOPS Package Down	764	034	27	-8.0	-0.89	1015.55	78	6/10
323	25-Oct	10:10	74° 11.141	80° 35.875	220	IOPS Package Up	766	025	28	-8.1	-0.90	1015.63	76	6/10
323	25-Oct	10:56	74° 10.970	80° 37.912	226	Box Core Down	774	020	22	-7.9	-0.85	1015.74	78	6/10
323	25-Oct	11:18	74° 10.915	80° 38.563	286	Box Core Up	773	035	25	-6.4	-0.84	1015.28	75	6/10
323	25-Oct	12:21	74° 10.349	80° 43.539	206	Box Core Down	786	015	25	-5.9	-0.88	1015.14	73	6/10
323	25-Oct	12:43	74° 10.333	80° 43.498	237	Box Core Up	788	020	14	-5.3	-0.85	1015.55	72	2/10
323	25-Oct	13:05	74° 10.006	80° 44.010	192	Seckie Down and Up	798	030	17	-8.5	-0.83	1015.62	80	2/10
323	25-Oct	13:10	74° 10.001	80° 43.899	168	PNF	799	000	18	-8.1	-0.82	1015.54	78	2/10

323	25-Oct	13:17	74° 09.975	80° 43.906	171	PNF	795	025	17	-8.1	-0.82	1015.54	78	2/10
323	25-Oct	14:05	74° 09.249	80° 33.019	112	Surface Layer Sampling Down	775	030	22	-8.8	-0.83	1015.34	78	8/10
323	25-Oct	14:28	74° 08.959	80° 33.868	079	Surface Layer Sampling Up	777	010	15	-9.0	-0.89	1015.36	77	8/10
323	25-Oct	15:28	74° 08.211	80° 38.995		Rosette Down	798	010	16	-7.0	-0.92	1015.87	74	8/10
323	25-Oct	16:10	74° 07.841	80° 39.352	292	Rosette Up	794	034	19	-7.7	-0.90	1015.76	88	8/10
323	25-Oct	16:20	74° 07.784	80° 39.957	140	Surface Micro Layer Down	796	021	18	-8.1	-0.89	1015.69	90	8/10
323	25-Oct	16:50	74° 07.264	80° 40.753	102	Surface Micro Layer Up	796	070	19	-8.8	-0.87	1015.63	88	8/10
323	25-Oct	17:33	74° 07.013	80° 40.601	252	Rosette (Nutrients) Down	783	020	25	-7.6	-0.84	1015.67	85	8/10
323	25-Oct	18:20	74° 06.609	80° 42.473	314	Rosette (Nutrients) Up	781	027	20	-8.6	-0.84	1015.64	85	8/10
300	25-Oct	20:05	74° 19.544	80° 30.732	273	Rosette (Nutrients) Down	694	026	20	-9.5	-0.97	1015.40	86	9/10
300	25-Oct	20:48	74° 18.820	80° 33.384	277	Rosette (Nutrients) Up	701	030	23	-9.4	-0.92	1015.42	87	9/10
322	25-Oct	22:25	74° 29.595	80° 36.709	298	Rosette (Nutrients) Down	660	030	17	-8.5	-0.86	1015.69	83	8/10
322	26-Oct	0:15	74° 28.824	80° 42.373	246	Rosette (Nutrients) Up	662	040	14	-7.8	-0.87	1015.94	85	8/10
103	26-Oct	18:43	76° 21.277	76° 32.194	218	Rosette Down	155	351	27	-10.2	-0.97	1015.93	87	9/10
103	26-Oct	19:00	76° 20.810	76° 32.678	263	Rosette Up	155	001	22	-9.4	-0.95	1016.20	88	9/10
103	26-Oct	19:30	76° 20.158	76° 33.371	095	IOPS Package Down	188	349	24	-10.2	-0.93	1016.02	88	9/10
103	26-Oct	19:45	76° 19.837	76° 33.780	097	IOPS Package Up	188	346	27	-10.2	-0.93	1015.91	88	9/10
103	26-Oct	20:03	76° 19.453	76° 34.555	182	Vertical Net Down	202	350	20	-10.1	-0.91	1015.94	87	9/10
103	26-Oct	20:13	76° 19.311	76° 34.667	211	Vertical Net Up	204	350	26	-8.1	-0.89	1016.17	84	9/10
103	26-Oct	20:55	76° 18.081	76° 36.966	275	Hydrobios Down	190	350	22	-9.1	-0.86	1016.21	84	9/10
103	26-Oct	21:10	76° 17.770	76° 37.275	285	Hydrobios Up	192	355	24	-10.1	-0.85	1016.19	87	9/10
103	26-Oct	21:32	76° 17.161	76° 38.276	095	Microlayer Sampling Start	193	355	28	-10.8	-0.86	1016.00	88	9/10
103	26-Oct	22:10	76° 16.409	76° 39.760	043	Microlayer Sampling	195	350	28	-11.0	-0.85	1016.06	85	9/10
103	26-Oct	22:32	76° 15.846	76° 40.038	018	Microlayer Sampling Finish	188	350	28	-11.0	-0.85	1016.06	85	9/10
103	27-Oct	0:00	76° 20.651	76° 35.291	247	Rosette chemistry contaminants Down	161	359	27	-11.0	-0.87	1016.58	87	9/10
103	27-Oct	0:25	76° 20.234	76° 35.900	249	Rosette chemistry contaminants Up	182	340	20	-11.2	-0.87	1016.67	88	9/10
103	27-Oct	1:40	76° 18.928	76° 38.025	250	Box Core Down	195	350	22	-10.9	-0.80	1017.01	85	9/10
103	27-Oct	1:55	76° 18.610	76° 38.717	226	Box Core Up	192	350	24	-11.1	-0.80	1016.89	85	9/10
103	27-Oct	3:20	n/a	n/a	n/a	Balloon Meteo	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a
103	27-Oct	4:45	n/a	n/a	n/a	EM Measurements	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a
103	27-Oct	5:00	76° 17.294	76° 49.717	338	Ice Raid Down	279	303	16	-12.0	-0.78	1017.78	82	9/10
103	27-Oct	6:22	76° 15.844	76° 50.990	335	Ice Raid Up	261	286	19	-12.3	-0.77	1017.79	87	3/10
103	27-Oct	7:24	76° 15.442	76° 50.112	252	Ice Raid Down	261	302	16	-12.0	-0.83	1017.71	87	9/10
103	27-Oct	7:55	76° 14.935	76° 50.499	257	Ice Raid Up	246	305	17	-11.7	-0.84	1017.82	83	9/10

105	27-Oct	11:32	76° 18.710	76° 46.144	165	Hydrobios Down	327	320	24	-9.0	-0.92	1017.16	89	5/10
105	27-Oct	11:50	76° 18.147	76° 46.091	162	Hydrobios Up	324	320	22	-8.4	-0.91	1017.34	87	5/10
105	27-Oct	12:30	76° 15.794	76° 51.093	225	UV Profiles Down	359	310	19	-9.3	-0.94	1017.92	89	5/10
105	27-Oct	12:49	76° 15.365	76° 50.590	086	UV Profiles Up	352	318	17	-8.7	-0.87	1017.95	90	5/10
105	27-Oct	12:50	76° 15.194	76° 50.575	075	Secchi amd PNF Down	355	318	20	-8.7	-0.87	1017.95	90	5/10
105	27-Oct	12:59	76° 14.995	76° 50.681	068	Secchi and PNF Up	357	329	21	-8.7	-0.87	1017.95	90	5/10
105	27-Oct	13:04	76° 14.837	76° 50.604	182	Rosette Down	352	320	19	-9.2	-0.84	1017.95	90	5/10
105	27-Oct	13:37	76° 14.324	76° 50.560	163	Rosette Up	359	328	20	-8.4	-0.82	1018.29	88	5/10
105	27-Oct	14:08	76° 13.277	76° 53.844	155	IOPS Package Down	367	319	18	-8.5	-0.84	1018.40	87	5/10
105	27-Oct	14:25	76° 12.953	76° 54.724	129	IOPS Package Up	366	335	21	-7.8	-0.84	1018.55	85	5/10
105	27-Oct	14:42	76° 11.711	76° 55.790	148	Micrloayer Sampling Down	340	340	15	-6.5	-0.79	1018.69	82	5/10
105	27-Oct	15:34	76° 10.154	76° 58.402	253	Microlayer Sampling Up	351	337	21	-9.0	-0.74	1018.77	88	5/10
105	27-Oct	15:53	76° 09.907	76° 57.888	169	Vertical Net Down	355	319	18	-7.6	-0.70	1019.07	83	5/10
105	27-Oct	16:15	76° 09.540	75° 58.458	155	Verical Net Up	355	319	15	-8.6	-0.64	1019.24	84	5/10
105	27-Oct	16:30	76° 09.443	75° 58.724	142	Horizontal Net Down	348	328	16	-5.4	-0.61	1019.31	80	5/10
105	27-Oct	17:02	76° 08.338	75° 57.798	120	Horizontal Net Up	348	339	17	-9.1	-0.56	1019.40	89	5/10
105	27-Oct	18:34	76° 17.972	75° 44.766	177	Rosette Down	313	355	17	-8.7	-0.66	1019.32	93	10/10
105	27-Oct	18:54	76° 17.767	75° 45.535	188	Rosette Up	315	341	19	-5.6	-0.65	1019.63	86	10/10
105	27-Oct	19:18	76° 17.601	75° 45.828	199	Box Core Down	313	341	16	-3.9	-0.64	1019.83	79	10/10
105	27-Oct	19:32	76° 17.571	75° 45.896	212	Box Core Up	313	351	16	-5.9	-0.70	1020.03	86	10/10
106	27-Oct	20:38	76° 18.468	75° 21.270	174	CTD Down	380	009	20	-7.0	-0.80	1019.54	92	1/10
106	27-Oct	20:55	76° 18.429	75° 21.484	198	CTD Up	379	000	17	-6.9	-0.80	1019.58	89	1/10
107	27-Oct	21:40	76° 16.837	74° 59.328	200	Rosette Nutrients Down	438	014	15	-7.6	-0.71	1019.59	88	1/10
107	27-Oct	22:10	76° 16.759	74° 59.178	214	Rosette Nutrients Up	437	355	21	-7.1	-0.62	1019.61	86	1/10
108	27-Oct	23:05	76° 15.764	74° 36.123	204	CTD Down	447	350	22	-6.3	-0.68	1019.36	78	Icebergs
108	27-Oct	23:23	76° 15.720	74° 36.188	155	CTD Up	446	010	21	-5.4	-0.69	1019.28	80	-
109	28-Oct	1:08	76° 17.226	74° 06.454	170	Hydrobios Down	450	353	21	-5.8	-0.86	1018.89	83	-
109	28-Oct	1:37	76° 17.058	74° 06.226	168	Hydrobios Up	450	345	15	-4.7	-0.87	1018.93	77	-
109	28-Oct	1:52	76° 17.074	74° 06.361	173	Vertical Net Down	452	345	18	-5.7	-0.86	1018.91	79	-
109	28-Oct	2:23	76° 16.974	74° 06.506	154	Verical Net Up	446	345	18	-6.1	-0.88	1018.98	79	-
109	28-Oct	2:42	76° 17.303	74° 06.130	199	Horizontal Net Down	457	342	20	-6.2	-0.88	1018.61	79	-
109	28-Oct	3:00	76° 17.208	74° 04.472	120	Horizontal Net Up	455	354	21	-6.6	-0.92	1018.79	80	-
109	28-Oct	3:27	76° 17.424	74° 07.317	218	RMT Down	452	345	21	-6.5	-0.93	1018.79	80	-
109	28-Oct	3:44	76° 17.241	74° 06.666	255	RMT Up	254	339	22	-6.7	-0.94	1018.98	81	-

109	28-Oct	4:17	76° 17.211	74° 06.953	190	Rosette Down	447	322	21	-6.7	-0.95	1018.86	85	-
109	28-Oct	4:56	76° 17.200	74° 05.972	177	Rosette Up	455	332	18	-5.8	-0.94	1018.96	84	-
109	28-Oct	5:27	76° 16.955	74° 05.607	145	IOPS Package Down	447	338	24	-6.6	-0.89	1018.80	84	-
109	28-Oct	5:43	76° 16.870	74° 05.763	157	IOPS Package Up	450	350	20	-6.9	-0.87	1018.79	84	-
109	28-Oct	6:03	76° 16.574	74° 04.780	249	Microlayer Sampling Down	448	342	22	-8.1	-0.85	1018.70	86	-
109	28-Oct	6:15	76° 16.244	74° 04.166	093	Microlayer Sampling Up	443	338	24	-7.7	-0.84	1018.63	87	-
109	28-Oct	7:12	76° 17.199	74° 08.049	153	Rosette Down	448	350	20	-7.2	-0.93	1018.47	83	-
109	28-Oct	7:40	76° 17.101	74° 08.097	179	Rosette Up	450	322	25	-5.1	-0.95	1018.49	78	-
109	28-Oct	8:38	76° 17.588	74° 07.939	160	Hydrobios Down	455	335	20	-8.5	-0.96	1018.42	82	-
109	28-Oct	9:06	76° 17.506	74° 08.585	166	Hydrobios Up	454	330	28	-7.8	-0.93	1018.20	82	-
109	28-Oct	9:55	76° 17.540	74° 07.095	144	Boxcore Down	454	350	29	-9.2	-0.87	1017.39	80	-
109	28-Oct	10:12	76° 17.514	74° 07.828	175	Boxcore Up	452	325	25	-8.7	-0.85	1017.85	79	-
109	28-Oct	10:28	76° 17.370	74° 08.213	168	Boxcore Down	451	325	25	-9.3	-0.84	1017.87	80	-
109	28-Oct	10:45	76° 17.205	74° 08.588	139	Boxcore Up	446	336	30	-9.3	-0.81	1017.98	81	-
109	28-Oct	11:10	76° 16.762	74° 08.723	090	Agassiz Sledge Down	442	330	25	-11.1	-0.82	1017.72	86	-
109	28-Oct	11:45	76° 17.335	74° 05.636	180	Agassiz Sledge Up	455	318	28	-11.1	-0.82	1017.82	86	-
110	28-Oct	13:10	76° 17.712	73° 37.510	142	Rosette Down	526	320	25	-8.1	-0.77	1017.32	85	-
110	28-Oct	13:50	76° 17.523	73° 37.357	n/a	Rosette Up	522	306	31	-7.4	-0.71	1017.35	85	-
111	28-Oct	14:43	76° 18.065	73° 12.598	150	IOPS Package Down	580	320	31	-7.5	-0.78	1017.17	79	9/10
111	28-Oct	14:59	76° 17.930	73° 13.104	115	IOPS Package Up	566	335	25	-8.4	-0.82	1017.11	79	9/10
111	28-Oct	15:12	76° 17.705	73° 12.718	128	Rosette Down	559	325	28	-8.4	-0.83	1017.06	80	9/10
111	28-Oct	15:51	76° 17.613	73° 11.925	209	Rosette Up	557	325	25	-6.0	-0.89	1017.31	74	9/10
111	28-Oct	16:12	76° 17.601	73° 11.305	194	Vertical Net Down	560	320	26	-4.1	-0.91	1017.35	70	9/10
111	28-Oct	16:54	76° 17.406	73° 11.728	148	Verical Net Up	555	330	25	-6.6	-0.92	1017.57	75	9/10
111	28-Oct	17:17	76° 17.334	73° 13.579	173	Horizontal Net Down	680	340	30	-7.4	-0.92	1017.58	77	9/10
111	28-Oct	18:25	76° 17.310	73° 14.130	145	Rosette Down	560	322	26	-8.1	-0.97	1018.15	78	9/10
111	28-Oct	18:50	76° 17.142	73° 14.000	171	Rosette Up	565	330	25	-7.5	-0.99	1018.43	76	9/10
111	28-Oct	19:18	76° 17.087	73° 13.063	167	Boxcore Down	565	314	23	-4.4	-0.99	1018.76	71	9/10
111	28-Oct	19:39	76° 16.989	73° 13.220	176	Boxcore Up	565	309	29	-5.8	-0.99	1018.74	78	9/10
111	28-Oct	19:54	76° 17.699	73° 13.053	146	Agassiz Sledge Down	566	340	25	-7.8	-0.98	1018.92	78	9/10
111	28-Oct	20:42	76° 15.706	73° 07.132	136	Agassiz Sledge Up	558	335	20	-9.1	-0.94	1018.75	81	Iceber gs
112	28-Oct	21:42	76° 18.896	72° 42.335	155	CTD Down	560	325	24	-9.0	-0.86	1018.66	78	-
112	28-Oct	22:03	76° 18.870	72° 42.615	128	CTD Up	563	335	25	-7.5	-0.87	1018.98	72	-
113	28-Oct	22:58	76° 19.315	72° 13.717	120	Rosette Down	550	315	22	-8.0	-0.92	1019.12	73	8/10 Frazil

113	28-Oct	23:38	76° 18.922	72° 13.628	138	Rosette Up	543	310	22	-6.7	-0.92	1019.37	72	8/10 Frazil
114	29-Oct	0:40	76° 19.428	72° 46.751	141	CTD Down	613	296	21	-7.7	-0.99	1019.28	74	3/10
114	29-Oct	1:04	76° 19.327	71° 46.340	142	CTD Up	619	290	20	-7.4	-0.99	1019.52	71	3/10
115	29-Oct	2:07	76° 19.897	71° 11.543	147	Hydrobios Down	671	290	13	-7.9	-0.94	1019.51	75	-
115	29-Oct	2:50	76° 19.964	71° 10.006	092	Hydrobios Up	635	299	15	-6.7	-0.77	1019.59	75	-
115	29-Oct	3:35	76° 22.9	71° 10.9	120	Mapping Start	468	284	16	-7.5	-0.49	1019.68	74	-
115	29-Oct	8:55	76° 22.2	71° 15.0	085	Mapping Finish	645	285	18	-8.0	-0.64	1018.33	81	Iceber gs
115	29-Oct	9:10	76° 19.874	71° 13.173	118	IOPS Package Down	646	285	18	-8.0	-0.64	1018.33	81	Iceber gs
115	29-Oct	9:28	76° 19.784	71° 12.982	086	IOPS Package Up	655	285	20	-7.4	-0.59	1018.60	80	-
115	29-Oct	9:30	76° 19.762	71° 12.889	080	Secchi amd PNF Down	651	285	20	-8.2	-0.56	1018.58	80	-
115	29-Oct	9:40	76° 19.693	71° 12.706	103	Secchi and PNF Up	651	285	18	-8.8	-0.54	1018.52	81	-
115	29-Oct	10:00	76° 19.907	71° 11.735	136	Rosette Down	672	280	16	-8.1	-0.51	1018.38	80	-
115	29-Oct	10:53	76° 19.818	71° 12.084	085	Rosette Up	641	270	15	-5.9	-0.53	1018.16	73	-
115	29-Oct	11:28	76° 19.800	71° 13.062	082	Hydrobios Down	652	250	21	-6.1	-0.45	1017.90	73	-
115	29-Oct	12:05	76° 19.852	71° 13.522	145	Hydrobios Up	655	230	17	-7.1	-0.46	1017.66	78	-
115	29-Oct	12:16	76° 19.809	71° 13.124	237	UV Profiler Down	653	230	14	-8.0	-0.46	1017.56	81	-
115	29-Oct	12:35	76° 19.833	71° 12.192	039	UV Profiler Up	653	230	15	-9.0	-0.45	1017.26	78	-
115	29-Oct	12:45	76° 19.870	71° 11.771	020	Zodiac Deployment Down	671	220	12	-7.2	-0.44	1017.21	76	-
115	29-Oct	14:04	76° 20.513	71° 12.677		Zodiac Deployment Up	652	182	14	-7.9	-0.39	1016.01	66	-
115	29-Oct	13:03	76° 20.005	71° 11.731	78	Rosette Down	669	190	17	-8.5	-0.44	1016.86	75	-
115	29-Oct	13:56	76° 20.430	71° 12.853	122	Rosette Up	652	190	5	-7.6	-0.40	1016.15	75	-
115	29-Oct	14:27	76° 20.746	71° 13.162	286	Vertical Net Down	652	150	10	-8.3	-0.37	1015.79	70	-
115	29-Oct	15:06	76° 21.024	71° 14.158	233	Vertical Net Up	652	100	10	-8.4	-0.32	1015.50	63	-
115	29-Oct	15:31	76° 19.932	71° 12.044	257	Horizontal Net Down	672	080	7	-8.2	-0.39	1014.87	65	-
115	29-Oct	15:47	76° 20.090	71° 12.926	247	Horizontal Net Up	666	100	7	-8.1	-0.46	1014.88	67	-
115	29-Oct	16:08	76° 20.195	71° 13.415	263	RMT Down	662	100	4	-7.7	-0.42	1014.85	75	-
115	29-Oct	16:28	76° 19.724	71° 14.466	133	RMT Up	666	075	11	-8.4	-0.40	1014.78	75	-
115	29-Oct	16:50	76° 19.997	71° 14.533	235	Rosette Down	666	088	10	-8.1	-0.47	1014.46	67	-
115	29-Oct	17:31	76° 20.369	71° 15.142	297	Rosette Up	665	083	10	-7.4	-0.43	1014.12	66	-
115	29-Oct	17:55	76° 19.986	71° 14.477	038	Boxcore Down	667	070	10	-7.7	-0.43	1013.84	64	-
115	29-Oct	18:20	76° 20.062	71° 14.262	266	Boxcore Up	668	070	8	-7.3	-0.48	1013.59	65	-
115	29-Oct	18:32	76° 20.059	71° 14.258	328	Boxcore Down	669	088	9	-7.6	-0.48	1013.40	65	-
115	29-Oct	18:56	76° 20.151	71° 14.440	240	Boxcore Up	669	105	10	-7.4	-0.45	1013.23	66	-

115	29-Oct	18:40	n/a	n/a		Balloon Launch	n/a	n/a	n/a	n/a	n/a	n/a	n/a	-
115	29-Oct	19:08	76° 20.298	71° 14.293	247	Agassiz Sledge Down	666	100	9	-7.7	0.47	1013.02	66	-
115	29-Oct	20:30	76° 19.880	71° 14.610	243	Agassiz Sledge Up	655	020	5	-8.0	-0.62	1011.97	78	-
115	29-Oct	21:15	76° 19.682	71° 13.647	135	ROV Dive Down	655	350	10	-6.7	-0.65	1011.30	61	-
115	29-Oct	22:47	76° 19.621	71° 13.634	096	ROV Dive Up	655	320	18	-5.4	-0.62	1010.29	61	-
136	30-Oct	9:55	74° 46.617	73° 34.124	116	Secchi/PNF Down	785	315	25	-11.6	-1.04	1009.30	78	8/10
136	30-Oct	10:07	74° 46.415	73° 33.775	151	Secchi/PNF Up	785	300	28	-11.6	-1.04	1009.42	78	8/10
136	30-Oct	10:28	74° 45.831	73° 26.610	135	Rosette Down	808	315	25	-11.4	-1.05	1008.68	77	8/10
136	30-Oct	11:22	74° 45.172	73° 24.242	145	Rosette Up	809	300	28	-11.2	-1.02	1008.40	75	8/10
136	30-Oct	11:43	74° 44.767	73° 22.943	134	IOPS Package Down	813	315	28	-10.9	-1.00	1008.32	73	8/10
136	30-Oct	11:59	74° 44.662	73° 22.916	120	IOPS Package Up	811	308	23	-12.0	-1.00	1008.24	69	8/10
136	30-Oct	12:12	74° 44.029	73° 20.108	072	UV Profiler Down	822	311	22	-13.2	-1.00	1008.32	70	8/10
136	30-Oct	12:28	74° 43.692	73° 19.380	37	UV Profiler Up	822	393	26	-12.0	-1.00	1007.94	75	8/10
136	30-Oct	13:17	74° 45.528	73° 33.758	166	Rosette Down	784	304	29	-12.7	-1.03	1007.98	80	9/10
136	30-Oct	14:18	74° 44.715	73° 30.678	189	Rosette Up	791	301	33	-12.5	-1.03	1007.40	81	9/10
136	30-Oct	14:49	74° 44.277	73° 29.132	176	Hydrobios Down	790	294	26	-12.3	-0.98	1007.12	82	9/10
136	30-Oct	15:35	74° 43.743	73° 26.929	177	Hydrobios Up	798	206	31	-11.8	-0.92	1006.50	82	9/10
136	30-Oct	15:58	74° 43.371	73° 26.21	141	Vertical Net Down	800	203	32	-11.8	-0.89	1006.34	80	9/10
136	30-Oct	16:50	74° 42.866	73° 25.541	101	Vertical Net Up	800	364	26	-11.9	-0.93	1005.26	77	9/10
136	30-Oct	17:14	74° 42.421	73° 24.063	191	Rosette Down	804	3-5	33	-11.9	-0.93	1005.24	79	9/10
136	30-Oct	17:57	74° 42.176	73° 22.551	151	Rosette Up	808	296	32	-12.7	-0.91	1004.66	79	9/10
136	30-Oct	18:34	74° 41.217	73° 20.915	123	Boxcore Down	810	301	22	-8.7	-0.85	1004.86	78	9/10
136	30-Oct	19:06	74° 40.907	73° 19.400	145	Boxcore Up	815	297	29	-9.1	-0.88	1003.74	77	9/10
141	31-Oct	20:00	71° 27.910	70° 02.581	165	CTD Down	615	290	9	-11.2	-0.85	996.94	79	9/10
141	31-Oct	20:27	71° 27.636	70° 01.550	185	CTD Up	586	310	19	-10.4	-0.85	996.72	82	9/10
141	31-Oct	20:55	71° 25.347	69° 56.048	228	Mapping Start		315	18	-11.8	-0.85	996.37	83	9/10
						Eastern Standard Time								
141	01-Nov	8:25	71° 24.918	70° 19.986	227	Mapping Finish		325	25	-11.6	-0.81	993.50	79	8/10
141	01-Nov	9:25	71° 24.799	70° 15.340	143	CTD Down	680	350	17	-12.0	-0.75	993.02	79	8/10
141	01-Nov	9:52	71° 24.684	70° 15.461	164	CTD Up	680	340	15	-10.7	-0.71	993.20	76	8/10
141	01-Nov	10:30	71° 23.585	70° 15.591	182	Surface Skimmer Start	667	010	15	-11.2	-0.73	993.17	74	8/10
141	01-Nov	12:35	71° 22.500	70° 15.087	273	ROV Test Dive Down	643	345	12	-11.7	-0.70	993.32	72	8/10
141	01-Nov	15:32	71° 21.394	70° 15.751		ROV Test Dive Up		349	10	-12.9	-0.50	993.58	72	9/10
141	01-Nov	15:32	71° 21.394	70° 15.762		Balloon Meteo		349	10	-12.9	-0.50	993.58	72	9/10
141	01-Nov	16:41	71° 23.678	70° 08.807	186	Rosette Down	423	327	12	-13.0	-0.54	993.59	71	9/10

141	01-Nov	16:41	71° 23.223	70° 08.514	245	Rosette Up	408	350	8	-12.0	-0.61	993.65	73	9/10
141	01-Nov	18:15	71° 23.723	70° 09.107	212	Microlayer Sampling Down	462	323	12	-13.2	-0.65	993.33	76	9/10
141	01-Nov	18:45	71° 23.286	70° 09.123	221	Microlayer Sampling Up	430	330	9	-12.0	-0.58	993.25	71	9/10
141	01-Nov	19:12	71° 23.038	70° 09.139	113	Boxcore Down	415	313	8	-11.8	-0.50	993.15	69	9/10
141	01-Nov	19:26	71° 22.881	70° 09.256	098	Boxcore Up	505	328	3	12.7	-0.47	993.20	69	9/10
141	01-Nov	19:40	71° 22.758	70° 09.253	080	Boxcore Down	397	308	3	13.1	-0.46	992.94	71	9/10
141	01-Nov	19:55	71° 22.629	70° 09.306	088	Boxcore Up	383		0	-13.1	-0.45	992.75	71	9/10
141	01-Nov	20:00	71° 22.576	70° 09.327	095	Boxcore Down	376	280	6	-12.9	-0.44	992.68	69	9/10
141	01-Nov	20:15	71° 22.500	70° 09.215	122	Boxcore Up	363	245	5	-12.3	-0.43	992.59	70	9/10
141	01-Nov	20:32	71° 22.215	70° 08.605	140	Boxcore Down	289	355	2	-11.9	-0.39	992.64	69	9/10
141	01-Nov	20:42	71° 22.157	70° 08.536	133	Boxcore Up	280	370	5	-11.9	-0.41	992.67	69	9/10
141	01-Nov	21:30	71° 21.858	70° 06.918	048	Bottom Mapping Start	275			-12.7	-0.57	992.43	69	9/10
141	02-Nov	7:25	71° 22.826	70° 18.575	045	Bottom Mapping Finish	670	335	2	-14.4	-0.75	996.93	65	9/10
141	02-Nov	8:00	71° 23.910	70° 09.292	238	IOPS Package Down	474	130	5	-14.7	-0.21	997.12	71	9/10
141	02-Nov	8:17	71° 23.887	70° 09.435	232	IOPS Package Up	480	150	5	-14.5	-0.66	997.13	71	9/10
141	02-Nov	8:20	71° 23.884	70° 09.464	232	Secchi/PNF Down	484	150	6	-14.5	-0.66	997.13	71	9/10
141	02-Nov	8:28	71° 23.885	70° 09.492	223	Secchi/PNF Up	487	170	6	-14.3	-0.61	997.17	71	9/10
141	02-Nov	8:45	71° 23.948	70° 09.274	090	Rosette Down	470	230	12	-13.6	-0.57	997.34	67	9/10
141	02-Nov	9:40	71° 24.183	70° 07.373	148	Rosette Up	376	240	14	-14.1	-0.37	997.92	63	9/10
141	02-Nov	9:48	71° 24.279	70° 06.823	202	UV Profiler Down	358	215	11	-14.0	-0.33	997.90	63	9/10
141	02-Nov	10:15	71° 24.511	70° 06.141	220	UV Profiler Up	338	215	14	-14.3	-0.27	998.05	61	9/10
141	02-Nov	11:50	71° 22.775	70° 04.180	315	ROV Dive Start	263	310	12	-14.4	-0.49	999.51	70	9/10
141	02-Nov	17:30	71° 22.720	70° 04.615	N/A	ROV Dive Up	267	229	6	-13.7	-0.51	1003.95	55	9/10
141	02-Nov	18:17	71° 22.433	70° 06.294	346	Vertical Net Down	265	132	6	-13.4	-0.56	1004.15	56	9/10
141	02-Nov	18:35	71° 22.404	70° 06.615	287	Vertical Net Up	268	183	8	-12.9	-0.59	1004.29	58	9/10
141	05-Nov	12:50	68° 37.35	63° 37.12	N/A	Balloon Meteo	150	260	11	-7.4	-0.40	1007.71	N/A	-
141	05-Nov	13:45	63° 07.853	67° 47.810	032	Skimmer Down	451	290	7	-7.8	-0.29	1009.15	52	-
141	05-Nov	0:00	63° 07.671	67° 47.114	63	Skimmer Up	469	300	6	-8.3	0.32	1009.56	53	-
352	07-Nov	9:10	61° 15.935	64° 45.228	313	Rosette Down	274	220	22	-4.4	0.08	1013.75	59	-
352	07-Nov	9:50	61° 16.072	64° 48.205	113	Rosette Up	263	205	25	-4.4	0.05	1013.34	65	-
354	07-Nov	11:36	61° 00.517	64° 44.272	037	Rosette Down	496	180	22	-0.6	0.07	1012.36	66	-
354	07-Nov	12:12	61° 00.975	64° 43.896	N/A	Rosette Up	473	178	26	-3.2	0.08	1012.06	55	-
356	08-Nov	2:05	59° 05.342	63° 25.895	033	Hydrobios Down	204	210	8	-4.3	0.67	997.15	62	-
356	08-Nov	2:23	59° 05.26	63° 25.92	078	Hydrobios Up	203	250	6	-5.1	0.72	997.18	64	-
356	08-Nov	2:43	59° 05.25	63° 25.84	072	IOPS Package Down	203	210	14	-4.4	0.72	996.87	62	-

356	08-Nov	2:55	59° 05.28	63° 25.78	024	IOPS Package Up	201	230	10	-3.8	0.73	996.61	62	-
356	08-Nov	N/A	59° 05.275	63° 25.951	084	Rosette Down	203	248	5	-4.9	0.73	996.21	62	-
356	08-Nov	4:11	59° 05.275	63° 26.009	045	Vertical Net Down	204	197	11	-4.8	0.83	995.41	61	-
356	08-Nov	4:25	59° 05.306	63° 26.036	032	Vertical Net Up	204	233	8	-2.8	0.82	995.21	57	-
356	08-Nov	4:45	59° 05.182	63° 26.052	040	Horizontal Net Down	204	243	8	-4.6	0.78	994.78	64	-
356	08-Nov	5:06	59° 05.549	63° 25.522	007	Horizontal Net Up	204	223	8	-4.7	0.76	994.43	63	-
356	08-Nov	5:43	59° 05.194	63° 25.762	098	Rosette Down	204	240	10	-3.8	0.74	993.57	61	-
356	08-Nov	6:08	59° 05.255	63° 25.767	092	Rosette Up	203	253	7	-3.6	0.76	993.74	63	-
600	08-Nov	6:25	59° 05.324	63° 25.885	057	Boxcore Down	204	238	8	-3.3	0.77	993.45	64	-
600	08-Nov	6:34	59° 05.329	63° 25.823	033	Boxcore Up	204	232	8	-4.1	0.77	993.40	64	-
600	08-Nov	6:52	59° 05.125	63° 25.925	044	Agassiz Sledge Down	201	239	6	-4.2	0.77	993.38	64	-
600	08-Nov	7:20	59° 05.783	63° 25.809	290	Agassiz Sledge Up	297	239	8	-4.0	0.75	993.21	66	-
600	08-Nov	7:23	59° 05.799	63° 25.892	278	Agassiz Sledge Down	296	231	8	-4.0	0.75	993.21	66	-
600	08-Nov	8:12	59° 05.406	63° 26.166	263	Agassiz Sledge Up	205	255	4	-3.3	0.72	992.15	71	-
601	08-Nov	9:03	59° 02.976	63° 36.388	170	CTD Down	165	285	5	-3.3	0.72	992.15	71	-
601	08-Nov	9:24	59° 02.945	63° 36.142	176	CTD Up	167	320	3	-2.5	0.68	991.86	71	-
601	08-Nov	9:35	59° 03.014	63° 36.520	235	CTD Down	167	245	6	-2.6	0.70	991.79	72	-
601	08-Nov	9:52	59° 02.984	63° 36.461	184	CTD Up	166	280	6	-3.1	0.69	991.47	74	-
606	08-Nov	14:48	59° 02.575	63° 42.284	227	Piston Off McCormick Down	158	238	2	-1.2	0.80	988.98	70	-
606	08-Nov	15:10	59° 02.601	63° 42.226	145	Piston Off McCormick Up	159	245	3	-1.1	0.89	989.14	72	-
602	08-Nov	16:50	59° 03.205	63° 52.164	070	Hydrobios Down	151	285	7	-1.5	0.67	989.73	91	-
602	08-Nov	17:02	59° 03.175	63° 52.144	129	Hydrobios Up	151	254	5	-2.1	0.71	989.93	97	-
602	08-Nov	18:10	59° 03.131	63° 52.226	144	Vertical Net Down	150	110	2	-1.7	0.82	990.13	97	-
602	08-Nov	18:19	59° 03.146	63° 52.248	162	Vertical Net Up	150	110	0	-1.2	0.82	990.21	98	-
602	08-Nov	18:37	59° 03.124	63° 52.207	83	Horizontal Net Down	150	110	0	-1.6	0.85	990.30	98	-
602	08-Nov	18:53	59° 03.452	63° 52.569	340	Horizontal Net Up	155	110	0	-1.7	0.85	990.41	98	-
602	08-Nov	19:08	59° 03.139	63° 52.300	127	Rosette Down	150	110	0	-1.6	0.81	990.55	98	-
602	08-Nov	19:26	59° 03.056	63° 52.276	127	Rosette Up	150	110	0	-1.7	0.73	990.71	98	-
602	08-Nov	20:38	59° 03.159	63° 52.206	195	Piston Off McCormick Down	151	90	5	-2.2	0.82	991.01	98	-
602	08-Nov	21:10	59° 03.154	63° 52.621	162	Piston Off McCormick Up	151	90	5	-2.2	0.84	991.13	98	-
602	08-Nov	21:37	59° 03.148	63° 52.109	093	Boxcore Down	151	90	5	-2.1	0.84	991.16	98	-
602	08-Nov	21:43	59° 03.158	63° 52.148	090	Boxcore Up	151	90	3	-2.1	0.81	991.22	98	-
604	08-Nov	22:45	58° 59.587	63° 53.697	308	Rosette Down	62	170	4	-1.9	0.75	991.42	98	-
604	08-Nov	23:30	58° 59.672	63° 53.540	278	Rosette Up	62	170	4	-2.4	0.91	991.84	98	-
612	08-Nov	6:36	58° 28.162	62° 59.090	303	Rosette Down	44	266	2	-1.2	0.75	997.26	98	-

612	08-Nov	6:45	58° 28.162	62° 59.129	294	Rosette Up	44	274	1	-1.2	0.75	997.57	98	-
613	09-Nov	8:15	58° 28.999	63° 13.172	345	Rosette Down	240	315	8	-0.7	0.73	998.79	99	-
613	09-Nov	8:47	58° 29.001	63° 12.982	355	Rosette Up	240	350	13	0.3	0.80	999.02	81	-
613	09-Nov	12:37	58° 28.974	63° 13.319	336	Skinner Down	240	236	7	0.4	0.94	1002.84	77	-
613	09-Nov	13:07	58° 29.065	63° 13.129	175	Rosette Down	241	311	22	-0.7	0.94	1003.31	75	-
613	09-Nov	13:20	58° 29.004	63° 12.824	79	Rosette Up	241	324	21	1.7	0.96	1003.37	64	-
613	09-Nov	14:15	58° 28.971	63° 11.514	28	Skinner Up	243	285	10	1.2	0.99	1004.56	65	-
618	09-Nov	15:20	58° 28.813	63° 13.417	172	Piston Core Down	241	306	10	1.2	1.00	1005.94	65	-
618	09-Nov	15:37	58° 28.834	63° 13.360	159	Piston Core Up	239	315	12	2.0	1.02	1006.28	62	-
614	09-Nov	16:42	58° 24.122	63° 23.391	140	Rosette Down	100	277	5	1.1	0.86	1007.28	63	-
614	09-Nov	16:50	58° 24.111	63° 23.355	141	Rosette Up	100	263	10	1.5	0.84	1007.38	59	-
615	09-Nov	18:11	58° 19.381	63° 32.505	224	Rosette Down	138	320	8	0.4	0.82	1008.36	58	-
615	09-Nov	18:31	58° 19.372	63° 32.461	169	Rosette Up	138	320	9	0.3	0.84	1008.56	58	-
615	09-Nov	18:45	58° 19.405	63° 32.436	110	Vertical Net Down	138	270	4	0.1	0.85	1008.80	59	-
615	09-Nov	18:55	58° 19.432	63° 32.491	101	Vertical Net Up	138	N/A	0	0.3	0.86	1008.84	58	-
615	09-Nov	19:08	58° 19.402	63° 32.354	060	Horizontal Net Down	138	170	6	0.4	0.87	1009.02	57	-
615	09-Nov	19:22	58° 19.837	63° 32.232	296	Horizontal Net Up	138	310	3	-0.1	0.90	1009.22	62	-
615	09-Nov	19:45	58° 19.335	63° 32.423	145	Hydrobios Down	138	310	4	-1.2	0.88	1009.43	64	-
615	09-Nov	19:55	58° 19.376	63° 32.292	138	Hydrobios Up	136	300	12	0.2	0.85	1009.59	60	-
615	09-Nov	20:17	58° 19.406	63° 32.423	305	Boxcore Down	138	290	4	-1.4	0.86	1009.89	66	-
615	09-Nov	20:24	58° 19.430	63° 32.413	315	Boxcore Up	138	290	8	-1.4	0.86	1009.89	66	-
615	09-Nov	21:03	58° 19.664	63° 32.216	339	MVP Down	17	N/A	N/A	-2.0	0.92	1010.32	70	-
615	09-Nov	22:00	58° 22.471	63° 25.625	030	MVP Stops, Problem with winch	170	250	6	-2.2	0.84	1010.59	65	-
615	09-Nov	23:47	58° 26.604	63° 20.042	036	MVP Up	183	N/A	N/A	-2.2	0.80	1010.70	57	-
610	10-Nov	2:22	58° 31.260	62° 50.402	100	Rosette Down	134	262	14	-2.1	0.88	1010.30	58	-
610	10-Nov	2:43	58° 28.96	62° 47.75	142	Rosette Up	120	276	12	-1.6	0.91	1010.47	59	-
610	10-Nov	3:28	58° 30.000	62° 41.375	72	Vertical Net Down	136	251	12	-2.8	0.91	1010.61	63	-
610	10-Nov	3:39	58° 29.936	62° 41.244	106	Vertical Net Up	135	240	16	-2.9	0.88	1010.61	61	-
610	10-Nov	3:55	58° 30.063	62° 41.223	11	Horizontal Net Down	142	252	12	-3.1	0.89	1010.59	61	-
610	10-Nov	4:12	58° 30.069	62° 41.780	170	Horizontal Net Up	155	267	7	-3.5	0.90	1010.66	61	-
610	10-Nov	4:48	58° 30.127	62° 41.234	74	Hydrobios Down	138	216	15	-2.9	0.86	1010.76	61	-
610	10-Nov	4:59	58° 30.072	62° 41.214	36	Hydrobios Up	138	226	9	-3.6	0.87	1010.71	62	-
610	10-Nov	5:12	58° 30.027	62° 41.377	33	Agassiz Sledge Down	136	225	11	-3.2	0.88	1010.72	58	-
610	10-Nov	5:40	58° 30.596	62° 40.697	353	Agassiz Sledge Up	76	236	12	-4.4	0.87	1010.60	60	-
617	10-Nov	6:08	58° 29.931	62° 41.286	046	Boxcore Down	134	220	9	-4.3	0.87	1010.57	58	-

617	10-Nov	6:14	58° 29.924	62° 41.273	069	Boxcore Up	134	230	8	-4.4	0.87	1010.68	58	-
617	10-Nov	6:57	58° 29.970	62° 41.307	057	Rosette Down	135	230	11	-4.6	0.91	1010.56	60	-
617	10-Nov	7:35	58° 30.080	62° 41.061	061	Rosette Up	137	225	9	-1.9	0.90	1010.45	58	-
617	10-Nov	7:05	58° 29.980	62° 41.266	053	Secchi/PNF Down	134	226	10	-3.1	0.91	1010.55	60	-
617	10-Nov	7:12	58° 29.999	62° 41.215	051	Secchi/PNF Up	135	215	8	-3.2	0.90	1010.49	60	-
617	10-Nov	7:48	58° 30.113	62° 41.029	061	IOPS Package Down	138	222	8	-3.2	0.90	1010.43	61	-
617	10-Nov	8:53	58° 30.052	62° 40.966	069	IOPS Package Up	138	220	10	-4.5	0.90	1010.30	69	-
633	10-Nov	22:43	57° 36.352	61° 53.80	138	Hydrobios Down	181	325	17	-1.8	1.26	1015.68	76	-
633	10-Nov	22:58	57° 36.350	61° 53.792	146	Hydrobios Up	180	320	12	-2.7	1.27	1013.85	90	-
633	10-Nov	23:15	57° 36.362	61° 53.957	135	IOPS Package Down	181	290	12	-2.6	1.29	1013.94	92	-
633	10-Nov	23:30	57° 36.325	61° 53.894	160	IOPS Package Up	180	270	12	-1.4	1.30	1013.97	88	-
633	10-Nov	23:57	57° 36.207	61° 53.473	081	Rosette Down	169	307	17	-2.6	1.32	1014.09	91	-
633	11-Nov	0:18	57° 36.050	61° 53.282	152	Rosette Up	153	284	19	-4.3	1.34	1014.13	81	-
633	11-Nov	0:31	57° 36.380	61° 53.625	123	IOPS Package Down	180	300	18	-3.8	1.35	1014.10	81	-
633	11-Nov	0:46	57° 36.372	61° 53.600	120	IOPS Package Up	180	300	16	-2.2	1.35	1014.39	75	-
633	11-Nov	0:51	57° 36.360	61° 53.525	126	Vertical Net Down	178	300	13	-2.2	1.35	1014.44	76	-
633	11-Nov	1:10	57° 36.301	61° 53.525	150	Verical Net Up	147	300	14	-2.7	1.36	1014.78	73	-
633	11-Nov	1:20	57° 36.340	61° 53.593	057	Horizontal Net Down	179	300	9	-2.0	1.36	1014.87	70	-
633	11-Nov	1:40	57° 36.348	61° 53.440	025	Horizontal Net Up	180	283	10	-3.6	1.36	1015.10	70	-
633	11-Nov	2:03	57° 36.284	61° 53.485	084	RMT Down	173	292	16	-3.9	1.36	1015.09	67	-
633	11-Nov	2:20	57° 36.127	61° 53.269	187	RMT Up	175	300	20	-3.5	1.36	1014.90	66	-
633	11-Nov	2:50	57° 36.401	61° 53.771	114	Boxcore Down	182	286	14	-4.0	1.36	1015.03	64	-
633	11-Nov	3:00	57° 36.402	61° 53.720	136	Boxcore Up	183	275	15	-3.0	1.34	1015.27	62	-
633	11-Nov	3:11	57° 36.459	61° 53.597	026	Agassiz Sledge Down	183	263	13	-2.5	1.35	1015.42	64	-
633	11-Nov	3:46	57° 36.501	61° 53.545	348	Agassiz Sledge Up	182	252	8	-3.8	1.33	1015.82	67	-
632	11-Nov	5:13	57° 39.999	62° 03.391	153	Rosette Down	83	307	7	-5.2	1.07	1016.13	69	-
632	11-Nov	5:25	57° 33.986	62° 03.339	192	Rosette Up	83	320	3	-3.9	1.05	1016.27	67	-
632	11-Nov	6:42	57° 34.000	62° 03.301	108	Boxcore Down	83	294	5	-4.3	1.06	1016.32	64	-
632	11-Nov	6:48	57° 33.991	62° 03.327	108	Boxcore Up	83	322	6	-4.3	1.06	1016.32	64	-
632	11-Nov	11:15	57° 33.973	62° 03.299	124	Piston Core Down	90	280	14	-3.1	1.09	1016.28	59	-
632	11-Nov	11:18	57° 33.960	62° 03.279	129	Piston Core Melts	90	280	13	-3.1	1.09	1016.28	59	-
632	11-Nov	11:30	57° 34.049	62° 03.229	135	Piston Core Up	91	270	14	-1.1	1.21	1016.39	58	-
631	11-Nov	14:20	57° 29.722	62° 11.191	352	Skimmer Down	91	244	10	-3.2	1.22	1017.54	58	-
631	11-Nov	14:40	57° 29.575	62° 11.621	68	Rosette Down	93	259	9	-4.2	1.16	1017.68	60	-
631	11-Nov	14:53	57° 29.584	62° 11.674	25	Rosette Up	91	260	69	-4.1	1.12	1017.79	60	-

631	11-Nov	15:12	57° 29.640	62° 11.465	353	IOPS Package Down	92	240	7	-5.3	1.13	1017.97	61	-
631	11-Nov	15:21	57° 29.300	62° 11.500	353	IOPS Package Up	92	270	7	-5.3	1.13	1017.95	61	-
631	11-Nov	15:45	57° 29.601	62° 11.684	229	Boxcore Down	92	270	5	-5.3	1.13	1017.90	61	-
631	11-Nov	15:48	57° 29.596	62° 11.673	214	Boxcore Up	92	300	5	-5.5	1.11	1018.12	62	-
631	11-Nov	16:10	57° 29.493	62° 11.554	200	Skimmer Up	89	305	6	-5.2	1.11	1018.28	65	-
630	11-Nov	18:07	57° 28.337	62° 26.501	87	Rosette Down	51	270	8	-8.1	1.06	1018.96	67	Frazil
630	11-Nov	18:20	57° 28.318	62° 26.500	89	Rosette Up	51	270	7	-8.3	1.09	1019.10	67	Frazil
630	11-Nov	18:32	57° 28.278	62° 26.573	102	Vertical Net Down	50	270	6	-8.9	1.27	1019.33	74	Frazil
630	11-Nov	18:37	57° 28.278	62° 26.545	067	Verical Net Up	50	270	6	-8.9	1.27	1019.33	74	Frazil
630	11-Nov	18:55	57° 28.243	62° 26.568	145	Horizontal Net Down	50	300	4	-9.3	1.41	1019.45	71	Frazil
630	11-Nov	19:00	57° 28.161	62° 26.375	91	Horizontal Net Up	66	300	8	-8.8	1.45	1019.47	71	Frazil
630	11-Nov	19:15	57° 28.287	62° 26.792	115	RMT Down	48	290	6	-8.9	1.49	1019.57	72	Frazil
630	11-Nov	19:25	57° 28.259	62° 26.509	070	RMT Up	50	270	6	-9.3	1.52	1019.58	73	Frazil
630	11-Nov	19:30	57° 28.242	62° 26.490	108	RMT Down	50	300	5	-9.9	1.56	1019.48	75	Frazil
630	11-Nov	19:35	57° 28.199	62° 26.276	074	RMT Up	52	300	5	-9.9	1.56	1019.48	75	Frazil
630	11-Nov	20:10	57° 28.305	62° 26.318	173	Hydrobios Down	51	295	6	-10.0	1.61	1019.30	82	-
630	11-Nov	20:18	57° 28.242	62° 26.230	101	Hydrobios Up	52	285	8	-10.0	1.61	1019.30	82	-
630	11-Nov	20:39	57° 28.313	62° 26.559	107	Boxcore Down	50	310	8	-11.3	1.72	1019.20	84	-
630	11-Nov	20:45	57° 28.287	62° 26.555	072	Boxcore Up	49	300	6	-11.3	1.72	1019.20	84	-
630	11-Nov	21:12	57° 28.142	62° 26.348	050	Rosette Down	51	280	7	-11.9	1.75	1019.11	90	-
630	11-Nov	21:16	57° 28.126	62° 26.255	091	Rosette Up	53	280	7	-11.9	1.75	1019.11	90	-
634	12-Nov	1:51	57° 34.134	61° 56.419	327	Rosette Down	102	193	6	-9.8	1.01	1017.17	83	-
634	12-Nov	2:07	57° 34.135	61° 56.421	81	Rosette Up	102	182	7	-9.5	1.00	1017.14	82	-
634	12-Nov	2:28	57° 34.167	61° 56.449	000	Boxcore Down	101	175	5	-8.5	1.06	1017.08	80	-
634	12-Nov	2:34	57° 34.150	61° 56.455	15	Boxcore Up	101	127	3	-8.9	1.08	1017.11	79	-
634	12-Nov	4:30	57° 34.188	61° 56.432	14	Piston Core Down	100	170	3	-9.3	1.29	1016.70	84	-
634	12-Nov	4:33	57° 34.183	61° 56.440	13	Piston Core Melts	100	140	3	-9.7	1.32	1016.76	85	-
634	12-Nov	4:40	57° 34.177	61° 56.471	16	Piston Core Up	100	140	3	-9.7	1.32	1016.76	85	-
634	12-Nov	15:43	56° 23.83	61° 12.98	95	Rosette Down	96	163	6	-3.2	1.65	1011.99	89	-
634	12-Nov	16:00	56° 23.830	61° 13.010	20	Rosette Up	93	156	3	-2.8	1.73	1011.90	90	-
634	12-Nov	16:15	56° 23.854	61° 12.964	350	IOPS Package Down	94	233	2	-2.7	1.77	1011.93	89	-
634	12-Nov	16:23	56° 23.849	61° 12.902	320	IOPS Package Up	95	195	1	-3.1	1.80	1011.97	90	-
620	12-Nov	16:43	56° 23.800	61° 13.120	165	Vertical Net Down	93	204	1	-3.1	1.83	1012.10	92	-
620	12-Nov	16:52	56° 23.773	61° 13.093	226	Verical Net Up	95	140	5	-3.1	1.84	1012.09	93	-
620	12-Nov	17:08	56° 23.822	61° 13.040	280	Horizontal Net Down	94	130	6	-3.2	1.84	1012.00	93	-

620	12-Nov	17:20	56° 23.639	61° 13.572	190	Horizontal Net Up	92	150	7	-3.2	1.86	1012.01	93	-
620	12-Nov	17:38	56° 23.601	61° 13.751	135	RMT Down	90	140	6	-3.0	1.89	1012.06	94	-
620	12-Nov	17:51	56° 23.620	61° 13.230	340	RMT Up	90	140	7	-2.9	1.91	1012.04	93	-
620	12-Nov	18:24	56° 23.825	61° 12.960	339	Hydrobios Down	94	130	5	-2.4	1.91	1012.24	91	-
620	12-Nov	18:32	56° 23.840	61° 12.941	293	Hydrobios Up	94	140	6	-2.3	1.93	1012.29	91	-
620	12-Nov	18:47	56° 23.816	61° 12.927	309	Agassiz Sledge Down	94	N/A	0	-2.9	1.94	1012.25	93	-
620	12-Nov	19:12	56° 23.586	61° 13.711	147	Agassiz Sledge Up	90	090	5	-2.9	1.94	1012.47	94	-
620	12-Nov	19:50	56° 23.795	61° 12.992	338	Boxcore Down	94	120	3	-1.9	1.96	1012.66	93	-
620	12-Nov	19:53	56° 23.795	61° 13.001	147	Boxcore Up	94	120	2	-1.9	1.96	1012.66	93	-
620	12-Nov	20:02	56° 23.802	61° 13.041	010	Boxcore Down	93	0	0	-2.0	1.97	1012.75	94	-
620	12-Nov	20:07	56° 23.805	61° 13.051	013	Boxcore Up	93	0	0	-2.0	1.97	1012.75	94	-
621	12-Nov	22:17	56° 24.901	61° 31.073	226	CTD Down	113	300	6	-2.5	1.99	1013.61	92	-
621	12-Nov	22:24	56° 24.876	61° 31.018	196	CTD Up	110	300	3	-2.4	1.98	1013.88	92	-
622	12-Nov	23:10	56° 24.973	61° 43.938	255	CTD Down	85	315	3	-3.1	2.03	1014.71	90	-
622	12-Nov	23:27	56° 24.880	61° 43.943	210	CTD Up	83	300	2	-3.0	2.01	1014.85	89	-
623	13-Nov	0:25	56° 26.839	61° 56.442	215	Rosette Down	118	245	9	-3.0	2.03	1015.22	86	-
623	13-Nov	0:44	56° 26.872	61° 56.325	42	Rosette Up	120	251	11	-2.2	2.06	1016.09	83	-
624	13-Nov	1:30	56° 25.209	62° 04.330	150	Rosette Down	71	213	4	-3.7	2.05	1016.87	88	-
624	13-Nov	1:44	56° 25.21	62° 04.32	36	Rosette Up	67	213	5	-3.8	2.02	1017.30	89	-
624	13-Nov	1:57	56° 25.230	62° 04.279	36	Vertical Net Down	68	211	2	-3.2	2.07	1017.45	87	-
624	13-Nov	1:59	56° 25.236	62° 04.253	47	Verical Net Up	68	214	4	-3.9	2.12	1017.62	87	-
624	13-Nov	2:10	56° 25.233	62° 04.250	74	Horizontal Net Down	76	221	5	-3.9	2.13	1017.63	87	-
624	13-Nov	2:17	56° 25.514	62° 03.869	304	Horizontal Net Up	84	216	5	-3.0	2.17	1017.72	85	-
624	13-Nov	2:34	56° 25.243	62° 04.066	78	RMT Down	68	214	3	-3.6	2.15	1018.02	87	-
624	13-Nov	2:41	56° 25.407	62° 04.066	274	RMT Up	77	215	4	-3.5	2.15	1018.23	87	-
624	13-Nov	3:01	56° 25.181	62° 04.361	96	Hydrobios Down	63	214	5	-3.7	2.18	1018.34	88	-
624	13-Nov	3:08	56° 25.202	62° 04.352	115	Hydrobios Up	66	230	5	-3.4	2.19	1018.50	87	-
624	13-Nov	4:53	56° 26.177	61° 59.309	086	Boxcore Down	115	230	3	-2.5	2.06	1019.55	84	-
624	13-Nov	5:00	56° 26.182	61° 59.317	N/A	Boxcore Up	115	290	4	-2.3	2.08	1019.54	83	-
624	13-Nov	6:25	56° 26.195	61° 59.292	140	Piston Core Down	115	N/A	0	-1.7	2.22	1020.71	84	-
624	13-Nov	6:28	56° 26.172	61° 59.291	142	Piston Core Melts	115	N/A	0	-1.7	2.22	1020.71	84	-
624	13-Nov	6:40	56° 26.159	61° 59.229	142	Piston Core Up	115	N/A	0	-1.6	2.26	1020.89	82	-
624	13-Nov	7:26	56° 26.149	61° 59.075	195	Cage Skimmer Down	115	N/A	0	-1.5	2.40	1021.12	83	-
624	13-Nov	8:02	56° 26.153	61° 59.118	268	Cage Skimmer Up	115	280	2	-1.3	2.47	1021.51	82	-
n/a	14-Nov	12:02	54° 07.07	55° 34.87	269	Bonita Science (24 Bottles)	N/A	200	17	3.3	1.71	1013.09	75	-

APPENDIX C: DATA CHART