JWACS/BGFE Canada Basin Climate Study – 2003

Cruise Report

The Joint Western Arctic Climate Studies (JWACS) and Beaufort Gyre Freshwater Experiment (BGFE) comprised a partnership between the Japan Marine Science and Technology Center (JAMSTEC), the Woods Hole Oceanographic Institution (WHOI) with funding from the U.S. National Science Foundation (NSF), and the Institute of Ocean Sciences of the Canadian Department of Fisheries and Oceans (IOS/DFO). This Canada Basin Climate Study project was conducted aboard the *CCGS "Louis S. St-Laurent"* between July 15 and September 7 of 2003.

Description:

The Joint Western Arctic Climate Study (JWACS) is part of an ongoing co-operative effort between Japan and Canada to study ocean-ice processes and climate change in the western Arctic Ocean using moorings and bio-geochemical hydrographic surveys. The 2003 program has been augmented by the Beaufort Gyre Exploration Project (BGEP), a new collaboration between the US-NSF and Canada to study the storage of freshwater in the central Canada Basin using moorings, drifting buoys and hydrographic surveys.

As part of JWACS, four stationary moorings were serviced: two moorings, deployed in 2002 near the Northwind Ridge and Chukchi Slope, were recovered and redeployed and two new stationary moorings were deployed near Hanna Shoal on the Chukchi Shelf. One J-CAD drifting ice buoy was successfully recovered and one new J-CAD buoy has been deployed. As part of BGFE, three stationary moorings and four drifting ice buoys were deployed in the deep central Canada Basin.

CTD/Rosette casts were conducted to obtain high quality profiles of water column properties, and water column samples from discrete depths have been collected to over 3800 m deep. Plankton nets have been used at the CTD/R locations for vertical hauls to 100 metres. XCTD probes were deployed to get profile observations of temperature and salinity between these CTD/R stations. Since the ice in the central parts of the Canada Basin was unexpectedly weak, thin and broken, the ship could make rapid progress with little effort. To take advantage of these favourable conditions, the hydrographic survey was extended to include sampling along an additional west-to-east section in the northern part of the Canada Basin and an extension of the section undertaken last year going into the deep Basin. The main pack of hard old ice was encountered on approach to the eastern side of the Canada Basin.

In an ongoing effort to develop a stronger observational network in the Arctic Ocean, several moorings and buoys were also deployed in support of other programmes: one stationary mooring was recovered and re-deployed in support of the IARC Canada Basin Observation Study (CABOS) programme, one drifting buoy was deployed in support of the International Arctic Buoy Programme (IABP). and one stationary mooring and one drifting buoy was deployed in support of collaborative work between CRREL and IOS.

The map below shows the ships track and the locations of the science stations at which CTD/rosette profiles and sampling were conducted and the mooring and ice buoy deployment sites.

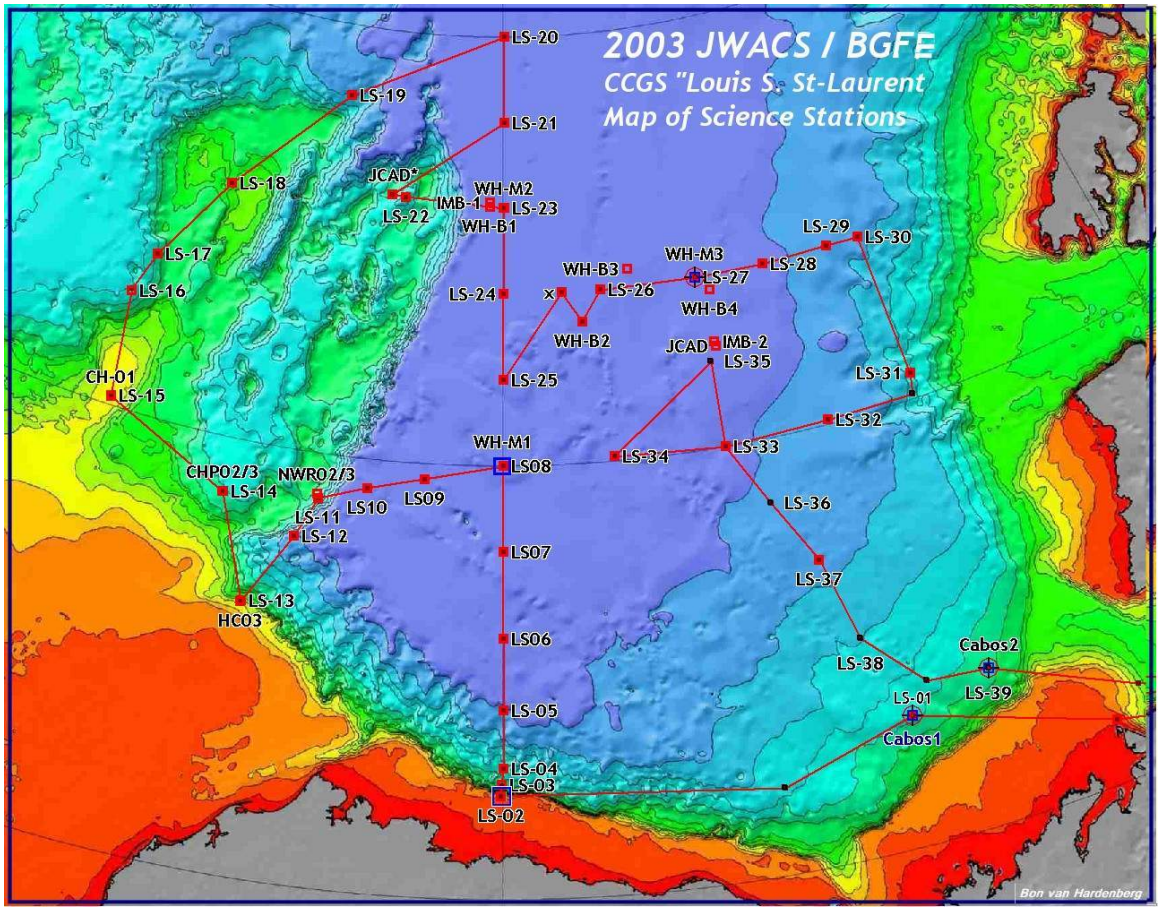


Figure 1. Science stations where CTD/rosette casts were done or Moorings/Buoys deployed.

Science Team personnel:

During the first leg of the journey, from the ship's home port in Dartmouth, Nova Scotia, JAMSTEC scientist Hirokatsu Uno deployed XCTD probes along a section through Davis Strait and Baffin Bay. The main Canada Basin program started on August 7 when the rest of the Science Team flew out to Kugluktuk (formerly Coppermine) to board the ship. The members of the science team were:

Bon van Hardenberg	IOS	Expedition Leader
Koji Shimada	JAMSTEC	JWACS Coordina tor
Andrey Proshutinsky	WHOI	BGFE Coordinator
Doug Sieberg	IOS	Moorings, Logistics, Salts
Motoyo Itoh	JAMSTEC	CTD/Rosette
Valerie Forsland,	IOS	CO2
Linda White	IOS	Nutrients
Mary Steel	IOS	Dissolved oxygen
Wendy Richardson	IOS	CFCs
Uno, Hirokatsu	JAMSTEC	Moorings
Kiyoshi Hatakeyama	JAMSTEC	Moorings
Rick Krishfield	WHOI	Moorings
Will Ostrum	WHOI	Moorings
Celine Gueguen	ARC	Chl-a, CDOM/COM
Naoaki Uzuka	IARC	18O
Camille Coray	UAF	Zooplankton Sampling

Scientific activities included:

- CTD/Rosette operations (to 3800m)
- vertical net hauls (to 100m, a few to 500m)
- mooring deployments and recoveries
- buoy deployments and recoveries
- XCTD operations.



Science Operations:

CTD/Rosette sampling was conducted on a 24-hour basis as ship's schedule allowed. An effort was made to conduct mooring activities during regular daytime hours but this was adjusted to make efficient use of the available ship time and avoid periods of inactivity for the ship. Profile data obtained with the electronic sensors were pre-processed and inspected for quality. Water samples obtained with the rosette were either analyzed in the laboratories on board or sealed, packed and stored in suitable lab-, freezer- or cooler space as required. The drifting ice moorings (J-CAD, IMB, WHOI-buoys) required identifying and locating suitable floes of multi-year ice, deemed large and thick enough to survive for one one year or more. The helicopter was used for ice reconnaissance, to locate those larger floes along the track that were tentatively identified on Radarsat imagery, and to transport science personnel with augers to drill test holes. Ice buoy deployments and recoveries were accomplished by coming alongside a floe and putting personnel and gear over the side, including an armed polar bear watch.

Achievements:

The following is a brief summation of our achievements in this mission:

- The total distance travelled by the ship was over 4200 nautical miles,
- We deployed 8 new instrumented oceanographic moorings,
- Recovered three moorings that were deployed in previous years,
- Placed 8 data-transmitting buoys on the sea ice,
- Completed the first successful recovery of a J-CAD drifting ice buoy,
- Obtained high resolution CTD profiles from 47 CTD/rosette casts at 39 stations,
- Did 46 plankton net hauls at 24 different stations, and
- Launched 118 XCTD probes along the track of the ship.

Light broken ice conditions in the deep Canada Basin area made it possible for us to gather an impressive amount of high quality physical and bio-geochemical data along multiple sections through the Basin, thus filling in new territory that in the recent past has been referred to as the Canadian Data Hole.

This was an outstanding effort, with close cooperation between the dedicated partners involved. Science team members were always prepared to lend each other a hand with any of the many components that made up our total work load. It was a pleasure and a privilege to work with experts from such diverse backgrounds and interests.

Summary of the chemical sampling:

The following is a list of all chemistry samples collected during this mission:

CFC	- 151 samples sealed in glass ampoules
O2	- 751 samples / 59 duplicates
TCO2	- 103 samples / 11 duplicates
13C	- 51 samples / 4 duplicates
DOC(IOS)	– 121 samples / 12 duplicates
Helium & Tritium	– 119 samples
14C	- 23 samples
Salinity	- 774 samples / 128 duplicates – sampled all chemistry stations
Nutrients	- 719 sample / 64 duplicates
18-O	- 456 samples
Ba	- 426 samples
Iodine (JAMSTEC)	– 181 samples
Iodine (BIO)	- 86 samples
Cesium	- 67 samples
Chla-T	- 414 samples
Chla-10/2	- 205 samples
DOC (IARC)	- 282 samples
POC (IARC)	- 280 samples
C-DOM (IARC)	– 282 samples
CHO (IARC)	- 282 samples
HCH (IOS)	- 10 samples

Nutrients, salinity duplicates and dissolved oxygen (O2) were analyzed on board. Chla total and Chla size fraction 10/2 were filtered and analyzed on board. Iodine and Cesium samples were collected for BIO, Tritium and Helium samples for Lamont-Doherty, DOC/POC/CDOM for IARC

Oxygen Analysis:

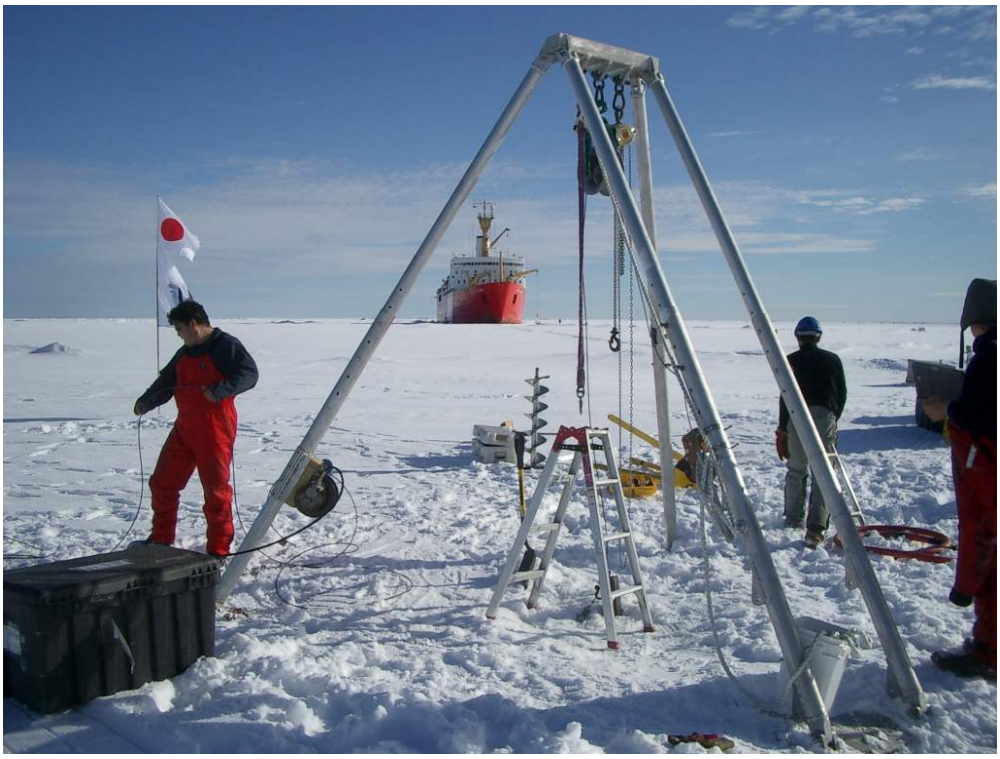
Samples for dissolved oxygen analysis were collected at 38 science stations and analysed on board between the successive stations. Problems with the automatic colorimeter started during analysis of samples from station LS20, and samples from all later stations were manually titrated (from mid-way in samples from station LS24 through samples from LS38). Corrected final values in ml/L must be calculated from the appropriate flask calibration values on file at IOS.

Chlorophyll Analysis:

Samples were drawn for Chlorophyll a and Phaeophytin analysis at 32 stations. Samples were filtered then stored in the freezer. Samples were steeped in 90% acetone / 10% DMQ water for 24 hours in the freezer. Prior to reading the samples were allowed to equilibrate, in the dark, to room temperature (approx. 1 hour) and read on a AU 10 Turner Fluorometer. The fluorometer was calibrated against Sagami purified chlorophyll a June 4, 2003. Chlorophyll sample were drawn typically from 300m or 200m to the surface. Over 400 samples were analysed for Total Chlorophyll and around 200 each for 2u and 10u size fractions. Full total, 2u and 10u Chlorophyll fractions were analysed up to station LS16. A partial profile for fractions was analysed for another eight stations. All analysis and data reduction was completed on board.

Nutrient Analysis:

Fresh seawater samples were analysed on a three channel Technicon Autoanalyser. A standard envelope of NO3+NO2, Si(OH)4, and PO4, Low, Medium and High concentrations were analysed at the beginning and end of each day's run. A medium check standard was analysed after each nutrient profile. A 3.2% NaCl was used as a rinse between samples.
An internationally accepted reference standard (Wako - nitrate 20umolar and silicate 50umolar) and a shipboard seawater reference sample were analysed daily.
The nitrate colorimeter exhibited a serious drift problem and was replaced with the backup colorimeter. The phosphate colorimeter exhibited a faulty response so the phosphate nutrient chemistry was run through the silicate channel. The appropriate filter and phototube were exchanged. A Nanopure system was installed for ultra-clean water.



Acknowledgements:

I want to express my appreciation for the efforts made by all team members to provide the very best support in this somewhat stressful situation: we had a small sampling team based on expectations of slow progress through heavy ice to hopefully a reasonable part of the original plan. When initial sampling problems became evident, a series of extra casts was done in efforts to remedy the situation. And when the light ice conditions permitted a much more rapid progress through stations, we were definitely understaffed to deal with the added sampling load. Everyone worked hard to make the best possible use of this opportunity.

We extend our special thanks to Captain Bryon Gibbons and the officers and crew of the "Louis S. St-Laurent", who have made us feel welcome on board, and who have generously helped us above and beyond the call of duty, in our quest to make the most of this science mission.

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Appendix 1

The following is a list of the CTD/rosette and Mooring/Buoy stations, showing position, date and depth information for the Science Station activities:

2003-21 Station name	Cast #	Lat Deg	Lat Min	Lon Deg	Lon Min	Sample Depth (m)	Bottom Depth (m)	Activity	Stn Time (hr)	Actual Time (UTC)	Actual Time (LSL)
Kugluktuk		68	0.000	115	0.000	----	----	Start Science	6.0		**09-Aug 08:00**
CABOS-1+A45		71	23.060	134	3.800	1634	1644	Mooring-recovery	6.0	11-Aug 17:00	11-Aug 11:00
LS01	1	71	23.490	133	59.800	1146	1151	CTD/Rosette & Bongo	1.2	11-Aug 20:38	11-Aug 14:38
XCTD		71	19.410	135	12.000	----	1100	XCTD	0.0	12-Aug 00:18	11-Aug 18:18
XCTD		71	20.500	136	31.300	----	1700	XCTD	0.0	12-Aug 02:15	11-Aug 20:15
XCTD		71	19.300	137	40.200	----	1750	XCTD	0.0	12-Aug 04:15	11-Aug 22:15
XCTD		71	26.484	138	41.400	----	2140	XCTD	0.0	12-Aug 06:14	12-Aug 00:14
XCTD		71	27.938	139	57.785	----	2330	XCTD	0.0	12-Aug 08:30	12-Aug 02:30
XCTD		71	42.700	142	42.800	----	2950	XCTD	0.0	12-Aug 13:22	12-Aug 07:22
TEST-CTD		71	37.400	143	13.000			Test cast for CTD ssystem	0.1	12-Aug 14:30	12-Aug 08:30
XCTD		71	29.880	143	41.890	----	3100	XCTD	0.0	12-Aug 15:58	12-Aug 09:58
XCTD		71	25.863	145	13.000	----	2950	XCTD	0.0	12-Aug 18:02	12-Aug 12:02
XCTD		71	19.560	146	58.950	----	?	XCTD	0.0	12-Aug 20:25	12-Aug 14:25
XCTD		71	14.769	148	24.875	----	?	XCTD	0.0	12-Aug 22:23	12-Aug 16:23
LS02	2	71	11.989	149	59.920	68	73	CTD/Rosette & Bongo(2)	0.6	13-Aug 00:54	12-Aug 18:54
LS03	3	71	15.810	149	59.990	551	556	CTD/Rosette	0.9	13-Aug 02:52	12-Aug 20:52
LS04	4	71	29.970	150	0.160	1925	1930	CTD/Rosette	1.7	13-Aug 05:11	12-Aug 23:11
LS05	5	72	0.330	149	59.550	3135	3140	CTD/Rosette	2.3	13-Aug 09:04	13-Aug 03:04
LS06	6	73	0.010	149	59.800	3695	3700	CTD/Rosette	2.7	13-Aug 15:22	13-Aug 09:22
LS07	7	74	0.000	149	59.900	3780	3785	CTD/Rosette	2.7	13-Aug 22:44	13-Aug 16:44
LS08	8	75	0.660	149	58.600	3896	3901	CTD/Rosette +Bongo	2.8	14-Aug 06:02	14-Aug 00:02
LS08-2	9	75	0.527	150	1.016	3795	3800	CTD/Rosette & Bongo(2)	2.7	14-Aug 11:39	14-Aug 05:39
WH-M1		**75**	**0.390**	**149**	**58.752**	----	3818	Mooring-deploy	12.0	14-Aug 18:20	14-Aug 12:20

LS09	10	74	50.006	153	30.070	3913	3918	CTD/Rosette	2.8	15-Aug 00:19	14-Aug 18:19
LS10	11	74	39.948	156	0.277	3845	3850	CTD/Rosette	2.7	15-Aug 06:17	15-Aug 00:17
NWR02		74	29.380	158	1.890	----	1550	Mooring-recovery	3.0	15-Aug 14:30	15-Aug 08:30
LS11	12	74	29.518	158	1.175	1470	1475	CTD/Rosette	1.4	15-Aug 16:46	15-Aug 10:46
NWR03		**74**	**29.653**	**158**	**2.582**	----	**1445**	Mooring-deploy	6.0	16-Aug 00:23	15-Aug 18:23
LS12	13	73	59.730	158	49.617	3475	3480	CTD/Rosette +Bongo	2.5	16-Aug 05:38	15-Aug 23:38
LS13	14	73	9.928	160	29.013	284	289	CTD/Rosette	0.8	16-Aug 13:27	16-Aug 07:27
HC03		**73**	**8.650**	**160**	**30.351**	----	**249**	Mooring-deploy	1.5	16-Aug 19:21	16-Aug 13:21
LS14	15	74	1.866	162	3.720	1475	1480	CTD/Rosette & Bongo(3)	1.4	17-Aug 02:18	16-Aug 20:18
CPH02		74	22.370	162	8.890	----	1500	Mooring-recovery	3.0	17-Aug 13:30	17-Aug 07:30
CPH03		**74**	**23.929**	**162**	**9.385**	----	**1500**	Mooring-deploy	6.0	17-Aug 20:13	17-Aug 14:13
LS15	16	75	5.989	167	59.834	152	157	CTD/Rosette	0.7	18-Aug 12:12	18-Aug 06:12
CRREL/IOS		**75**	**6.000**	**168**	**0.000**	----	**166**	Mooring-deploy	3.0	18-Aug 15:16	18-Aug 09:16
LS16		76	24.947	168	39.831	280	290	CTD/Rosette	0.8	19-Aug 00:49	18-Aug 18:49
LS17		76	48.857	168	3.852	2465	2475	CTD/Rosette	2.0	19-Aug 05:35	18-Aug 23:35
LS18		77	51.929	165	14.473	3315	3325	CTD/Rosette	2.4	19-Aug 17:15	19-Aug 11:15
LS19-1		79	8.812	159	54.365	3790	3800	CTD/Rosette	2.7	20-Aug 12:31	20-Aug 06:31
LS19-2		79	8.837	159	52.966	3790	3800	CTD/Rosette	2.7	20-Aug 13:55	20-Aug 07:55
LS20		80	1.116	150	5.868	3714	3724	CTD/Rosette	2.7	21-Aug 11:36	21-Aug 05:36
LS20-2		80	0.770	150	0.327	3714	3724	CTD/Rosette & Bongo(2)	2.7	21-Aug 13:14	21-Aug 07:14
LS21	24	79	0.628	149	57.421	3709	3719	CTD/Rosette & Bongo(2)	2.7	22-Aug 05:49	21-Aug 23:49
JCAD*		**77**	**49.500**	**153**	**45.570**	----	1635	JCAD-recovery	12.0	22-Aug 20:30	22-Aug 14:30
LS22	25	77	48.643	153	21.172	3714	3724	CTD/Rosette (same time)	**2.7**	23-Aug 00:45	22-Aug 18:45
WH-B1, IMB-1		**77**	**49.500**	**153**	**45.570**	---		CRREL Ice Mass Balance Buoy & WHOI Ice Buoy	**3.0**	23-Aug 00:30	22-Aug 18:30
LS23	26	78	0.325	149	54.891	1551	1561	CTD/Rosette & Bongo(2)	1.5	23-Aug 20:06	23-Aug 14:06
WH-M2		**78**	**1.491**	**149**	**49.378**	----	3822	Mooring-deploy	7.0	24-Aug 04:05	23-Aug 22:05
LS24	27	76	59.647	150	6.097	3815	3825	CTD/Rosette & Bongo(2)	2.7	24-Aug 14:15	24-Aug 08:15

LS25	28	76	0.695	150	0.386	3824	3829	CTD/Rosette & Bongo(2)	2.7	25-Aug 00:35	24-Aug 18:35
WHOI-Buoy2		**76**	**51.500**	**146**	**41.000**	----	---	Buoy-deploy	1.0	25-Aug 18:00	25-Aug 12:00
LS26	29	77	0.788	145	0.738	3787	3792	CTD/Rosette & Bongo	2.7	25-Aug 21:29	25-Aug 15:29
WHOI-Buoy3		**77**	**6.600**	**142**	**47.700**	----	----	Buoy-deploy	1.5	26-Aug 12:30	26-Aug 06:30
LS27	30	76	59.230	140	6.079	3721	3726	CTD/Rosette & Bongo(2)	2.7	26-Aug 18:16	26-Aug 12:16
WHOI-M3		**75**	**59.254**	**139**	**54.229**	----	3705	Mooring-deploy	4.0	27-Aug 01:03	26-Aug 19:03
WHOI-Buoy4		**76**	**50.020**	**139**	**29.810**	----	----	Buoy-deploy	1.0	27-Aug 03:00	26-Aug 21:00
LS28	31	77	0.679	136	30.984	3632	3637	CTD/Rosette	2.6	27-Aug 13:02	27-Aug 07:02
LS29	32	77	0.119	132	57.201	3370	3375	CTD/Rosette	2.5	27-Aug 20:37	27-Aug 14:37
LS30	33	76	57.805	131	52.243	3211	3216	CTD/Rosette + **ROV**	2.4	28-Aug 00:57	27-Aug 18:57
LS31	34	75	13.910	131	41.364	2612	2617	CTD/Rosette	2.1	29-Aug 00:14	28-Aug 18:14
LS32	35	75	4.456	135	13.152	3406	3411	CTD/Rosette & Bongo	2.5	29-Aug 08:57	29-Aug 02:57
LS33	36	75	4.220	140	0.607	800	3600	partial cast-CTD failed	0.5	29-Aug 20:05	29-Aug 14:05
LS33+1/3	37	75	3.811	141	33.211	1200	3600	partial cast-CTD test	0.8	30-Aug 00:43	29-Aug 18:43
LS33+2/3	38	75	2.692	143	16.873	1100	3600	partial cast-CTD test	0.8	30-Aug 05:00	29-Aug 23:00
LS34	39	75	3.800	145	3.712	3748	3768	CTD/Rosette	2.7	30-Aug 09:43	30-Aug 03:43
LS35	40	76	12.541	139	49.573	800	3620	CTD/R (Cesium)	1.2	31-Aug 02:45	30-Aug 20:45
LS35-2	41	76	12.725	139	48.801	3615	3620	CTD/Rosette & Bongo(2)	2.6	31-Aug 04:09	30-Aug 22:09
JCAD deploy		76	17.000	139	50.000	----	----	JCAD-deploy	30.0	31-Aug 18:00	31-Aug 12:00
IMB-2 buoy		76	17.000	139	50.000	----	----	Ice Mass Buoy deploy	1.0	31-Aug 20:30	31-Aug 14:30
LS33	42	75	0.080	140	0.461	800	3585	CTD/R (Cesium)	1.5	02-Sep 02:48	01-Sep 20:48
LS33-2	43	74	59.798	139	59.378	3617	3622	CTD/Rosette	2.5	02-Sep 04:04	01-Sep 22:04
LS36	44	74	14.821	138	30.894	1600	3400	CTD/Rosette (D.O.)	1.2	02-Sep 13:34	02-Sep 07:34
LS37	45	73	29.910	136	54.800	3128	3133	CTD/Rosette ***(STN-A)***	2.5	02-Sep 20:55	02-Sep 14:55
LS38	46	72	39.965	136	9.954	1600	2585	CTD/Rosette (D.O.)	1.2	03-Sep 04:50	02-Sep 22:50
LS39	47	71	46.036	131	49.892	1102	1107	CTD	1.0	03-Sep 22:35	03-Sep 16:35
CABOS2		72	30.000	131	10.000	1563	1573	Mooring-deploy	6.0	03-Sep 23:45	03-Sep 17:45
Kugluktuk		68	0.000	115	0.000	----	----	----	0.0	05-Sep 16:00	05-Sep 10:00

Appendix 2

The following is a list of the date, time, location and depth of the XCTD probe deployments.

JWACS2003 X-CTD Observations

Station	Start				Depth(m)
	Date	Time	Lat. [N]	Long. [W]	
1	03/08/02	05:32	63 - 59.70	55 - 01.61	—
2	03/08/02	07:18	64 - 20.04	55 - 33.28	—
3	03/08/02	09:03	64 - 40.05	56 - 05.57	1,200
4	03/08/02	10:48	64 - 59.95	56 - 38.72	672
4	03/08/02	10:54	65 - 00.93	56 - 40.46	595
5	03/08/02	12:30	65 - 20.00	57 - 11.09	—
6	03/08/02	14:09	65 - 37.97	57 - 43.87	575
7	03/08/02	15:51	66 - 00.18	58 - 16.59	541
8	03/08/02	17:31	66 - 20.08	58 - 49.47	620
9	03/08/02	19:15	66 - 39.41	59 - 24.00	643
10	03/08/02	21:00	66 - 59.87	59 - 54.29	925
11	03/08/02	23:11	67 - 20.13	60 - 35.33	980
12	03/08/03	00:51	67 - 40.52	61 - 00.78	1,500
13	03/08/03	04:48	68 - 20.32	61 - 46.88	1,750
14	03/08/03	08:13	69 - 00.13	62 - 29.78	1,870
15	03/08/03	11:21	69 - 40.07	63 - 15.41	1,935
16	03/08/03	14:02	70 - 20.08	64 - 00.62	2,035
17	03/08/03	16:37	71 - 00.35	64 - 45.72	2,075
18	03/08/03	19:13	71 - 40.41	65 - 28.78	2,290
19	03/08/03	21:47	72 - 20.00	66 - 15.31	2,330
20	03/08/04	00:23	73 - 00.13	67 - 01.10	2,275
21	03/08/04	02:04	73 - 07.57	68 - 30.17	2,150
22	03/08/04	03:51	73 - 18.09	70 - 00.76	1,675
23	03/08/04	04:59	73 - 24.03	71 - 00.40	1,250
24	03/08/04	06:06	73 - 30.11	72 - 00.64	1,080
25	03/08/04	07:11	73 - 36.26	72 - 59.63	860
26	03/08/04	08:14	73 - 42.05	73 - 59.75	875
27	03/08/04	09:49	73 - 51.15	75 - 30.00	920
28	03/08/04	11:35	74 - 00.05	76 - 59.80	855
29	03/08/04	14:36	74 - 04.47	80 - 00.38	780
30	03/08/04	19:37	74 - 11.65	84 - 59.94	530
31	03/08/05	02:49	74 - 21.33	89 - 59.98	290
32	03/08/12	00:19	71 - 19.42	135 - 11.72	1,100
33	03/08/12	02:15	71 - 21.66	136 - 41.44	1,700
34	03/08/12	04:15	71 - 19.43	137 - 39.77	1,750
35	03/08/12	06:14	71 - 26.38	138 - 41.33	-
36	03/08/12	08:29	71 - 27.97	139 - 52.61	-

Station	Start				Depth(m)
	Date	Time	Lat. [N]	Long. [W]	
37	03/08/12	11:09	71 - 31.24	141 - 21.16	-
38	03/08/12	13:22	71 - 42.68	142 - 42.58	2,950
39	03/08/12	15:58	71 - 29.88	143 - 41.43	3,100
40	03/08/12	18:02	71 - 25.88	145 - 12.76	-
41	03/08/12	20:25	71 - 19.57	146 - 58.98	2,950
42	03/08/12	22:23	71 - 14.78	148 - 24.64	2,950
43	03/08/13	12:52	72 - 29.03	150 - 01.28	-
44	03/08/13	19:47	73 - 29.42	150 - 02.45	3,760
45	03/08/14	02:48	74 - 29.72	149 - 57.64	3,770
46	03/08/14	22:02	74 - 54.95	151 - 45.40	3,800
47	03/08/15	04:34	74 - 41.26	154 - 42.46	3,800
48	03/08/15	10:43	74 - 37.67	156 - 44.63	3,790
49	03/08/15	11:45	74 - 32.56	157 - 14.06	3,790
50	03/08/15	12:23	74 - 29.15	157 - 42.02	-
51	03/08/16	03:54	74 - 20.46	158 - 45.40	1,510
52	03/08/16	04:42	74 - 09.76	158 - 41.88	1,880
53	03/08/16	09:50	73 - 47.69	159 - 15.65	2,980
54	03/08/16	10:59	73 - 35.33	159 - 44.40	2,250
55	03/08/16	12:06	73 - 22.11	160 - 05.72	1,320
56	03/08/16	21:44	73 - 27.61	160 - 58.79	385
57	03/08/16	23:04	73 - 45.82	161 - 21.58	750
58	03/08/17	00:24	74 - 02.92	161 - 45.74	430
59	03/08/17	23:29	74 - 29.00	163 - 07.42	-
60	03/08/18	01:50	74 - 35.89	164 - 00.07	780
61	03/08/18	06:16	74 - 51.07	166 - 00.20	450
62	03/08/18	20:31	75 - 59.71	168 - 25.42	450
63	03/08/18	21:37	76 - 07.28	168 - 26.70	-
64	03/08/18	21:47	76 - 07.07	168 - 23.54	1,155
65	03/08/18	22:57	76 - 14.62	168 - 31.35	-
66	03/08/19	08:04	76 - 55.14	167 - 39.84	1,070
67	03/08/19	11:19	77 - 16.55	166 - 44.17	625
68	03/08/20	02:11	78 - 30.03	162 - 41.52	701
69	03/08/20	06:41	78 - 54.34	160 - 50.04	965
70	03/08/20	08:53	79 - 01.17	160 - 22.45	-
71	03/08/20	10:18	79 - 04.54	160 - 00.81	-
72	03/08/20	19:41	79 - 07.20	157 - 51.01	3,800
73	03/08/20	22:34	79 - 10.67	156 - 22.00	3,760
74	03/08/21	00:30	79 - 16.51	155 - 36.33	3,760
75	03/08/21	01:50	79 - 22.30	154 - 44.34	2,915
76	03/08/21	04:13	79 - 32.84	153 - 05.94	3,770
77	03/08/21	06:32	79 - 46.48	152 - 02.44	3,760
78	03/08/21	18:26	79 - 40.58	149 - 33.38	3,760

Station	Start				Depth(m)
	Date	Time	Lat. [N]	Long. [W]	
79	03/08/21	21:41	79 - 20.12	149 - 54.03	3,700
80	03/08/22	11:36	78 - 38.12	151 - 32.48	3,780
81	03/08/22	13:27	78 - 25.74	152 - 20.83	3,790
82	03/08/22	15:08	78 - 15.57	152 - 46.29	3,250
83	03/08/22	16:52	78 - 06.89	153 - 20.99	1,825
84	03/08/23	00:39	77 - 49.78	153 - 42.07	-
85	03/08/23	10:23	77 - 52.42	152 - 30.72	-
86	03/08/23	10:31	77 - 52.44	152 - 30.57	-
87	03/08/23	13:01	77 - 55.88	152 - 16.47	-
88	03/08/24	08:05	77 - 39.78	150 - 02.03	3,870
89	03/08/24	11:03	77 - 20.41	149 - 53.49	3,780
90	03/08/24	18:33	76 - 39.62	149 - 53.90	3,772
91	03/08/24	21:40	76 - 19.93	149 - 59.39	3,775
92	03/08/25	14:44	76 - 59.99	146 - 51.76	3,660
93	03/08/26	14:41	77 - 01.03	142 - 32.17	3,720
94	03/08/27	06:47	76 - 59.99	138 - 15.02	3,650
95	03/08/27	17:32	76 - 59.54	134 - 47.01	3,740
96	03/08/29	03:56	75 - 13.61	132 - 34.07	2,700
97	03/08/29	05:33	75 - 07.91	133 - 27.33	3,150
98	03/08/29	14:01	75 - 02.62	136 - 39.59	3,405
99	03/08/29	17:08	75 - 02.55	138 - 19.55	3,460
100	03/08/30	15:23	75 - 17.44	143 - 49.02	3,700
101	03/08/30	19:02	75 - 30.77	142 - 52.73	3,800
102	03/08/30	22:08	75 - 45.09	141 - 03.57	3,670
103	03/08/31	00:49	76 - 05.87	140 - 05.93	3,645
104	03/09/01	22:17	75 - 40.14	139 - 58.33	-
105	03/09/02	00:31	75 - 19.06	140 - 07.17	3,620
106	03/09/02	08:24	74 - 45.71	139 - 30.14	3,540
107	03/09/02	08:38	74 - 45.63	139 - 29.83	3,540
108	03/09/02	11:13	74 - 30.02	139 - 12.73	3,490
109	03/09/02	16:35	74 - 00.09	137 - 52.23	3,300
110	03/09/02	18:14	73 - 45.00	137 - 29.05	3,240
111	03/09/03	00:33	73 - 13.00	136 - 45.10	2,840
112	03/09/03	02:39	72 - 57.54	136 - 26.21	2,810
113	03/09/02	10:22	72 - 10.02	136 - 27.21	2,300
114	03/09/02	14:00	71 - 51.67	135 - 39.42	2,050
115	03/09/03	17:25	71 - 42.03	134 - 22.98	1,415
116	03/09/03	20:17	71 - 42.44	133 - 06.85	1,250
117	03/09/04	02:35	71 - 41.12	131 - 10.95	793
118	03/09/04	03:26	71 - 34.00	130 - 55.02	486