JWACS 2006 Cruise Report

Pacific Inflow to the Arctic Ocean

Arctic Ice Monitoring

Ice Hazards & Climate

Beaufort & Chukchi Seas

CCGS Sir Wilfrid Laurier

September 25 – October 9, 2006

Institute of Ocean Sciences Cruise 2006-02

Humfrey Melling – Chief Scientist

Pacific Inflow to the Arctic Ocean

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Overview

The *CCGS Sir Wilfrid Laurier* supported the activities of three over-lapping research projects in the Beaufort Sea during September-October 2006: 1) the *Pacific Inflow to the Arctic Ocean* study, which uses moored instruments and classical hydrography to determine the inflow and impact of Pacific-derived waters in the Arctic, 2) the *Arctic Ice Monitoring* project, which is an international initiative to determine the mass balance of the Arctic ice cap and 3) the *Pack Ice Hazards and Climate* study, which is focussed on dangerous ice features, their impact on offshore infrastructure and their response to climate change. Together the projects comprise the multi-disciplinary Joint Western Arctic Climate Study (JWACS) for 2006, exploring shelf circulation, the thermal regime of shelf and basin waters, ice ridging and motion and pack-ice mass balance.

This international partnership has strong emphasis on time-series observations and on climate change. Measurements of pack-ice thickness were initiated in 1990, and those of ocean current in Barrow Canyon in 1996. Systematic hydrographic sections have been occupied repeatedly since the late 1990s.

Supporting agencies include Fisheries and Oceans Canada, the Japan Agency for Marine-Earth Science and Technology (JAMSTEC), the Canadian federal Programme of Energy Research and Development (PERD), the US National Oceanic and Atmospheric Administration (NOAA) and IMV Projects Calgary.

Objectives

The primary objective for the *CCGS Sir Wilfrid Laurier* in 2006 was the recovery, servicing and re-deployment of internally recording instruments on sub-sea moorings. The instruments operate autonomously, recording new data at intervals ranging between 1 second and 30 minutes. The recorded variables are ice thickness, ice ridging, storm waves, sea level, ocean current, temperature, salinity and dissolved oxygen.

The secondary objective was the once-a-year mapping of temperature and salinity on a section following the 1000-m isobath between Banks Island and the Northwind Ridge.

Methods

Oceanographic moorings in Arctic waters are kept deeper than 30 m to reduce risk from drifting ice. Moorings are recovered through acoustic activation of an electromechanical hook that separates the buoyant part of the mooring from a dead-weight anchor. A successful recovery is contingent on the ship being able to reach the site (not always practical in heavy ice) and on the presence of sufficient ice-free surface over the mooring to ensure its appearance at the sea surface following release. A careful assessment of risk based on ice cover and acoustic ranging precedes each decision to release. Ideally, moorings are equipped with tandem releases for increased reliability. Since the moorings of this project are simple in design, they were recovered and deployed within relatively small ice-free patches, with deployment via a free fall to the seabed from the surface.

A CTD and rosette sampler (12 8-litre bottles, General Oceanics) was used to acquire samples for trace-chemical analysis following conventional oceanographic practice. The CTD system (SeaBird-25) provided continuous profiles of temperature, salinity, dissolved oxygen, light transmission and chlorophyll fluorescence. This year samples will be analyzed for salinity and dissolved oxygen (colourimetric titration) only.

DFO's TARS submersible was carried on Laurier in 2006 to assess its utility in the recovery of moorings with non-operable releases. A 500-lb weight was lowered on wire rope from the A-frame on the well deck to within about 10 m of the seabed. The umbilical of the ROV was secured to wire using cable ties, leaving 10-15 metres of freedom for the ROV at the lower end. Laurier manoeuvred along a search track while the seafloor within 50 m of the clump weight was explored using scanning sonar. The lights and video camera on the ROV are useful for inspection and intervention, but only within a few metres of the target.

Personnel

Joining at Kugluktuk on August 25 (7 persons)

From Fisheries and Oceans Canada, Institute of Ocean Sciences

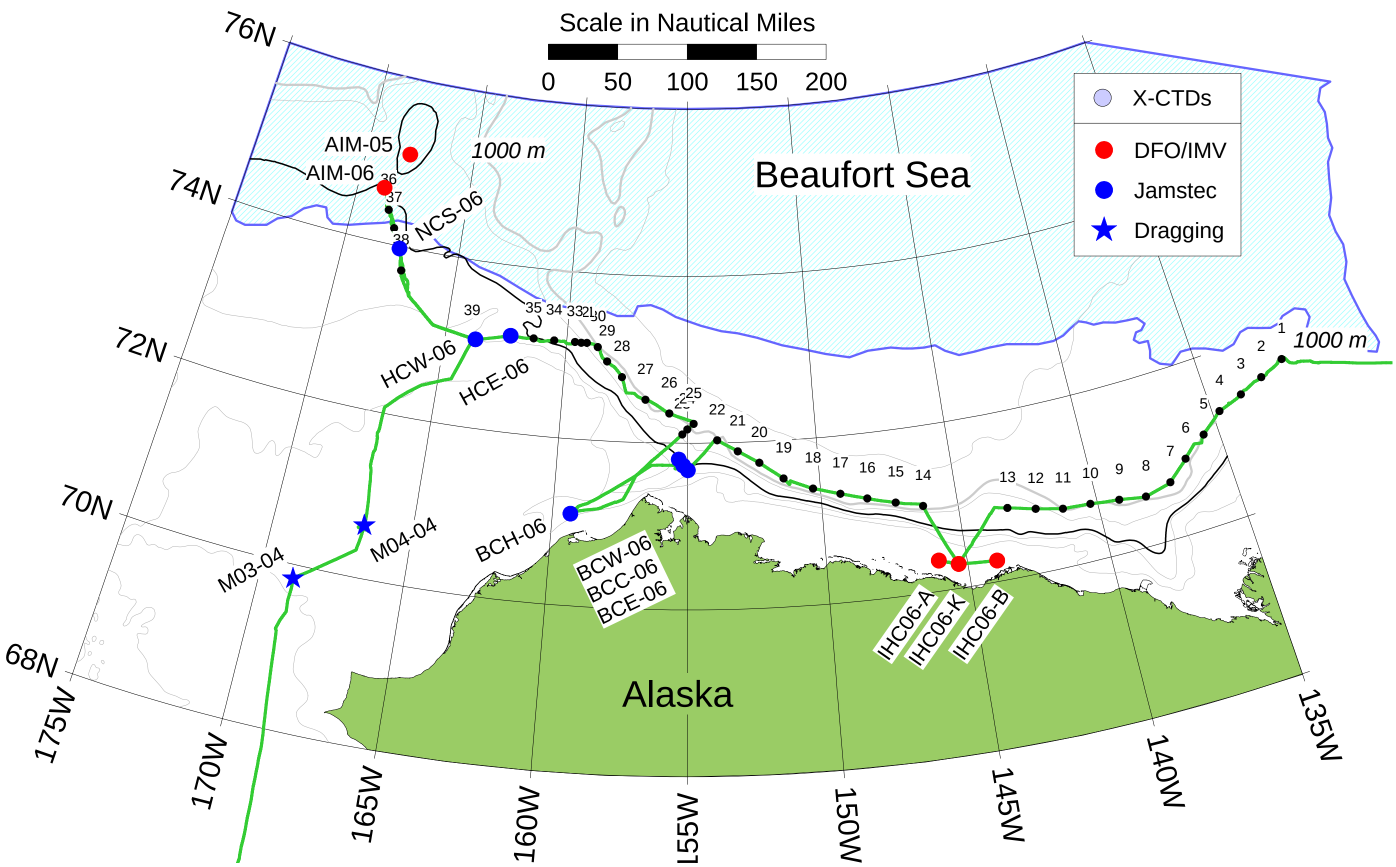
Humfrey Melling, Ron Lindsay

From ASL Environmental Sciences Inc

Dave English

From JAMSTEC

Motoyo Itoh, Masuo Hosono, Akinori Murata, Masaki Taguchi



Activities

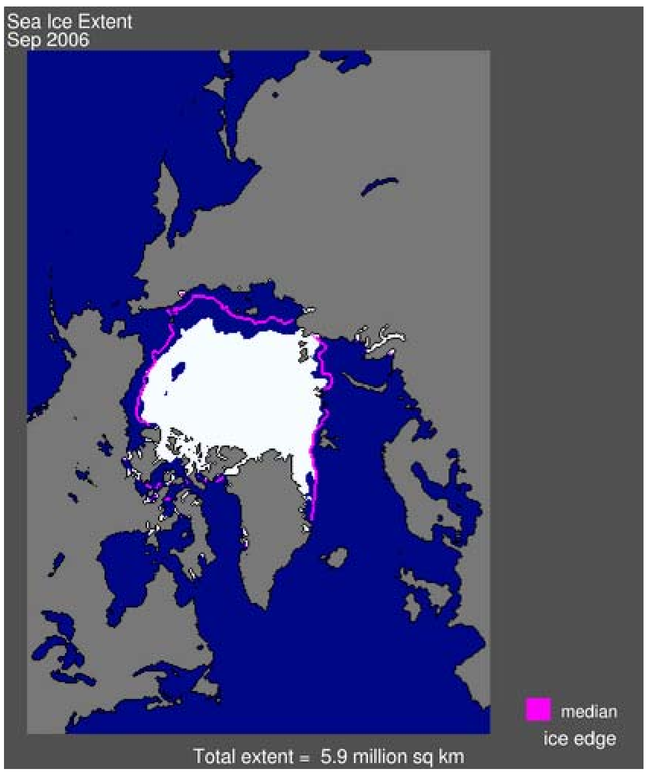
The map above summarizes the ship's activity within the Beaufort and Chukchi Seas. The green line is the ship's track, block dots mark locations of XCTD drops, colour-filled circles indicate the sites of instrumented moorings, where CTD profiles were also acquired and stars mark sites of moorings no longer operational. The shaded area approximates the domain of pack ice at greater than 4 tenths concentration on 9 October. Ice was encountered as a nuisance at other locations, notably near XCTD sites 28-35 and near mooring site BCH-06.

The following list summarizes our activities and accomplishments:

- Salinity and temperature of surface water drawn from the ship's sea-bay were recorded at 10-second intervals along most of the cruise track
- Soundings were recorded at a spacing of once cable in areas of interest that are poorly charted, anmely Camden and the northern Chukchi shelf
- 10 CTD-rosette casts were completed. The SBE25 CTD was equipped with several supplementary sensors and recorded pressure, temperature, conductivity, dissolved oxygen, light transmission and chlorophyll fluorescence
- Water was sampled from the rosette on 5 of the CTD-rosette casts. Samples were withdrawn for salinity and dissolved oxygen analyses. DO analysis was completed on board ship
- 39 X-CTDs were deployed primarily over the continental slope along approximately the 1000- m isobath
- 13 oceanographic moorings were retrieved after deployments of 1 or 2 years. One recovery was accomplished by dragging after the mooring failed to surface despite acknowledgement of the release command (defective EdgeTech 8242XS). Instruments measured water-column temperature, salinity and current, ice drift, surface waves, sea level, storm surge, ice thickness, ice topography and biogenic acoustic scattering
- 14 oceanographic moorings were deployed for periods of 1 or 2 years. The instruments will extend the time series of ice thickness observations that was initiated in 1990 and of ocean observations dating back to the mid 1990s.

Ice conditions across the Arctic, September 2006

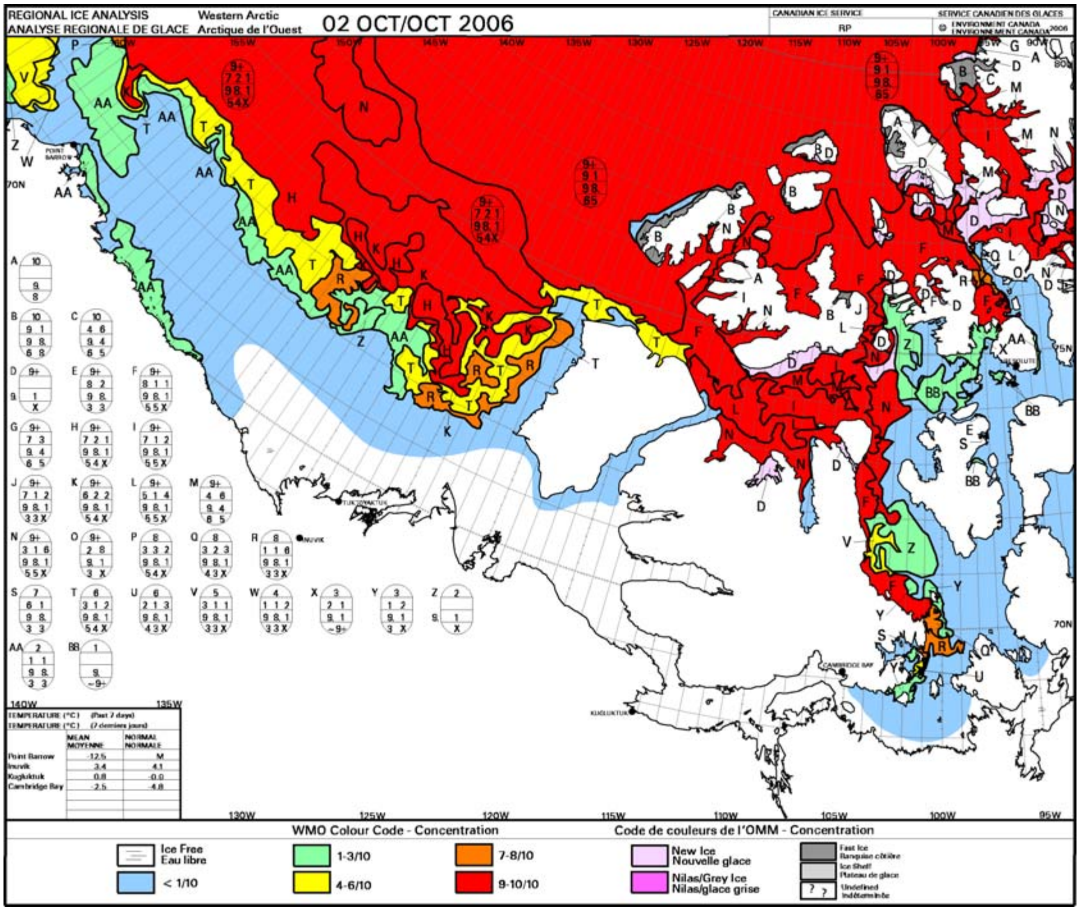
The adjacent map summarizes Arctic ice cover in September 2006, as revealed by satellite-based microwave sensors (http://nsidc.org/data/seaice_index/). Within our working domain in the Beaufort and eastern Chukchi Seas, the ice edge was only slightly to the north of its median position over the last 30 years. The principal retreat from climatology in 2006 occurred in the Western Chukchi, East Siberian and Laptev Seas (and also in the southern Canadian Archipelago). Not evident in the map is the lower than average (i.e less than 9 tenths) ice concentration for one to two hundred kilometres north of the ice edge. Although this anomaly contributed further to the low overall presence of Arctic ice in late September, it made little difference to the region of practical navigability by CCGS Sir Wilfrid Laurier.



The weekly ice chart of the Canadian Ice Service, issued on October 2 (next page), displays local ice conditions in more detail. Areas of ice at low concentration, in Camden Bay, north of Barrow and west of Barrow, are coloured green or yellow.

Impact of ice conditions and weather

Ice prevented execution of the science plan only in the extreme northwest of the domain, at 75.1°N 168°W, where an ice-measuring mooring was to be recovered and replaced. CCGS Sir Wilfrid Laurier pushed to within 25 miles of the mooring and the remaining distance was reconnoitred via helicopter. The barrier to the ship was a band of old ice in floes



up to 300 m in diameter and at concentration close to 9 tenths. This band was about 10-15 miles wide. Beyond the band, waters were quite navigable with 4 tenths old ice (floes a few tens of metres in extent) in a matrix of new ice. But the mooring itself lay beneath a multi-year floe about 7 km across, which was certainly out of bounds to the Laurier. We deployed the replacement mooring about 30 nautical miles SSW of the original site, close to our northernmost latitude.

The weather was dull but benign for most of the trip. However after October 3, a persistent and strong southeast wind and high sea state impeded dragging and ROV operations at JAMSTEC sites HCW, M4 and M3. We worked for a day each at the first two sites, with a successful retrieval by dragging at HCW. However, we were forced off M4 and M3 before achieving our objectives.

Planned activities that were not completed

Completion to the Northwind Ridge of the XCTD section along the 1000-m isobath (Explanation: ice).

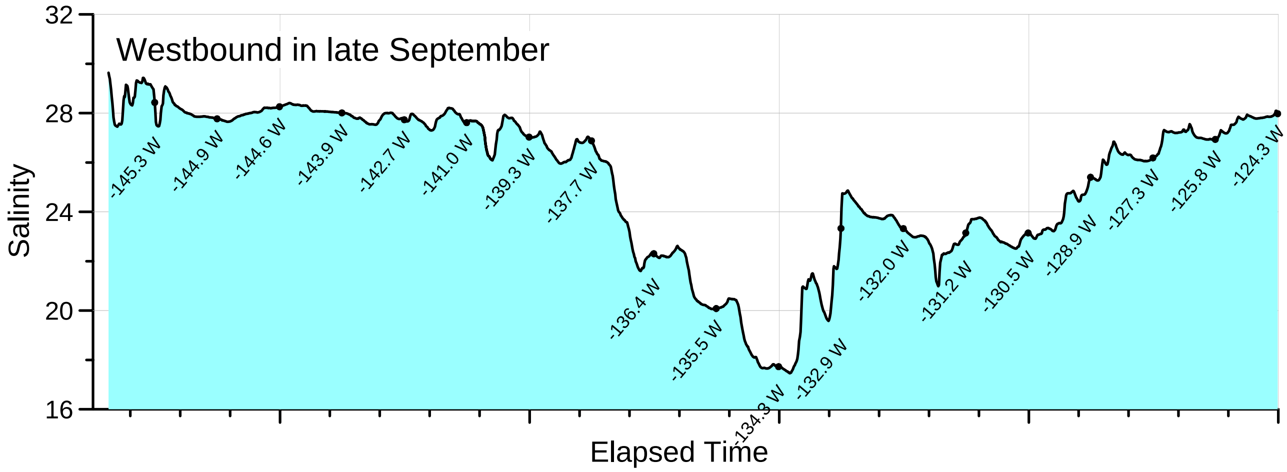
Recovery of the AIM05 mooring at 75.1°N 168°W (Explanation: ice).

Recovery of JAMSTEC M4-04 and M3-04 moorings by dragging or ROV (Explanation: Challenging undertaking, complicated by high wind & waves).

Preliminary Scientific Highlights

Included here are some graphic highlights derived from a cursory inspection of the large volume of data recovered.

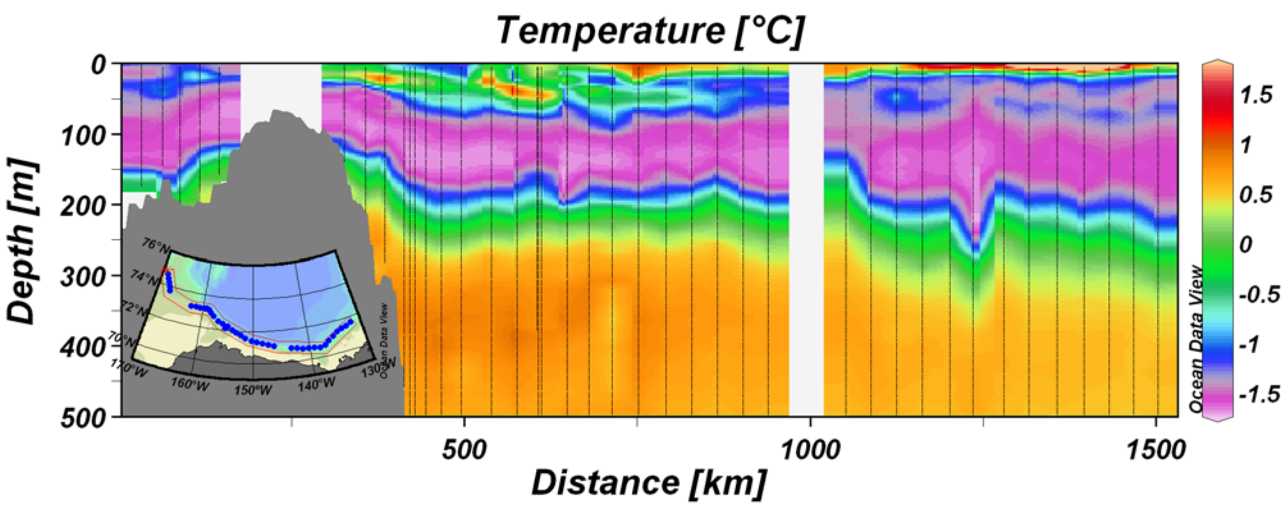
The illustration at the top of the following page depicts the salinity of surface water drawn into the ship's sea-bay between central Amundsen Gulf and Camden Bay. The curve is plotted against time and annotated with longitude. Much of the path followed the 1000-m isobath. The influence of Mackenzie River inflow as



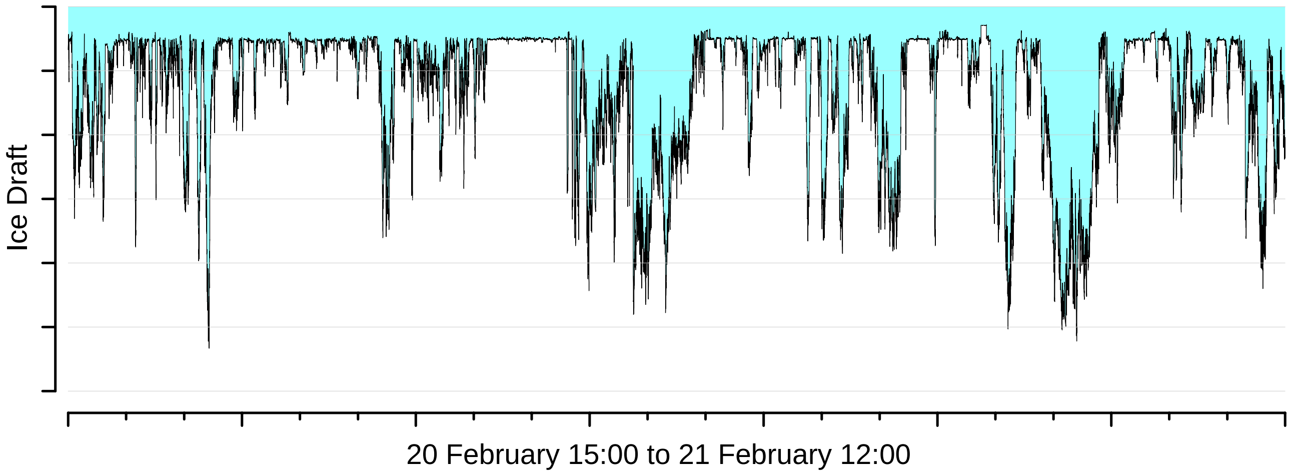
reduced salinity between 127° and 138° W is clear. Lowest salinity (less than 18) was found directly north of the Delta.

XCTDs were dropped to measure vertical profiles of temperature and salinity at locations roughly 20 miles apart along the 1000-m isobath. The illustration below is a colour-contoured cross-section of temperature. Features worthy of note are:

1) Cooling of the thick layer of warm water (yellow tones below 300-m depth) from west to east. This water left the North Atlantic almost 20 years ago and has cooled by more than 2°C as it travelled counter-clockwise around the Arctic Basin (west to east in this illustration).
2) Thickening of the overlying layer of cold water (purples) from west to east. This layer is renewed via of ice growth in winter within the Arctic shelf seas. We monitor the flow of some of this water into the Arctic basins using the instruments moored in Barrow Canyon.
3) A thin layer of warmer water (green to red) centred at 50-m depth north of Alaska. This shallow warm layer, which has a significant impact on ice growth and melting, enters the Arctic from the North Pacific via Bering Strait.



Sonar used in this project measure the draft of pack ice and its velocity of drift. The data have value for understanding the mass balance of Arctic ice and how it may respond to changing climate. They are also applied to predictions of the recurrence interval for extreme ice features that may threaten offshore structures and pipelines. Ice-measuring sonar at the Arctic Ice Monitoring (AIM) site was not recovered this year. The site was easily accessible in unusually light ice conditions in 2003, 2004 and 2005. But it is actually well

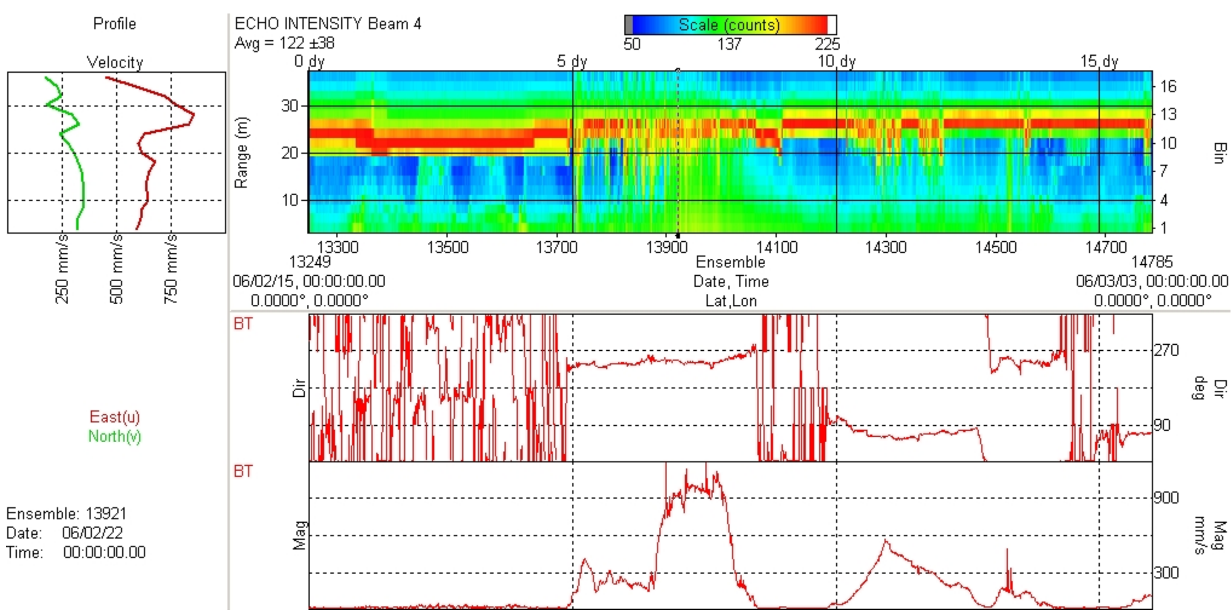


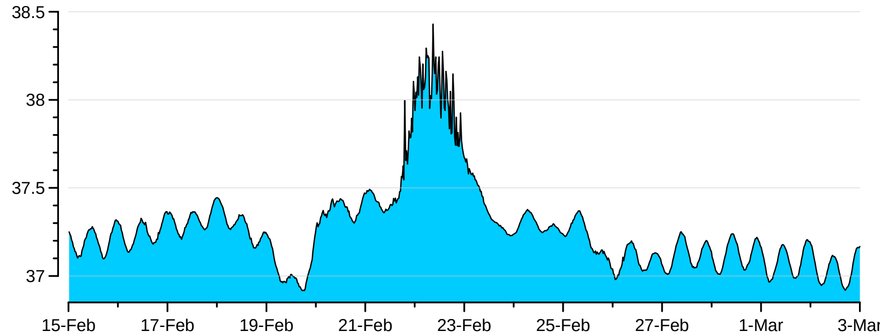
north of the long-term median ice edge in late September. Multi-year ice returned early in 2006, but conditions more benign than the historical norm remain prevalent.

We use data from the shallow waters of Camden Bay as examples. The graph above illustrates the sub-surface topographic profile of ice ridges that passed over the moorings in February 2006 with only a few metres to spare.

The adjacent photograph, from CCGS Sir Wilfrid Laurier in late July 2006, shows the top side – compact and highly deformed ice that crowded the Alaskan coastwell into the summer.

Data collected for ice research have value in the study of other oceanographic processes. The illustration below displays the impact of an intense Beaufort storm in late February, which moved heavy pack ice south-eastward at a metre per second.





The same storm created a surge (increase in sea level; see above) of over a metre – no mean feat in winter when water can only be piled up against the coast if intervening ice is fractured and piled into new ridges.

Issues

For DFO Science…

1) The pallet jack for handling the sampling rosette is inoperable and requires servicing.
2) Temperature recorded by the thermosalinograph is well above ambient because of compromises in plumbing; if such data are to be of routine interest, this issue needs attention, in coordination with the ship's engineers (see under issues for CCGS Sir Wilfrid Laurier).
3) Both the seawater pump and the seawater drain for the thermosalinograph operation freeze up when surface water reaches freezing temperature; if such data are to be of routine interest, this issue needs attention, in coordination with the ship's engineers (see under issues for CCGS Sir Wilfrid Laurier).
4) Impulse connectors on the Sea Bird CTD are a continuing problem with leakage common when operating at low temperatures; during 2006-02 the connector on the sea cable leaked and short-circuited the SBE33 power supply; full conversion to a more cold-tolerant connectors, or a well equipped and well maintained inventory of spares is recommended.
5) A large supply (5 boxes) of the fuse protecting the output power supply of the SBE33 deck unit should always be packed; trouble-shooting of malfunctions can use these at a great rate.
6) The release hook of the ORE (EdgeTech) 8242XS release transponder appears prone to not swinging free after activation of the release; some diagnosis and remedy is required (dragging up a moorings was required for this reason both last year and this).
7) 9 ORE (EdgeTech) CART releases purchased new for this project failed to operate at temperatures encountered during Arctic operation; ORE apparently understands the problem, but special modified deck units are required for mooring recovery in 2007.
8) A higher wire pay-out speed for the winch would facilitate dragging activity from CCGS Sir Wilfrid Laurier; is modification possible?
9) The integration of sonar sub-systems on the TARS submersible must be improved and tested. Replacement of the video monitor with a modern version would be beneficial.
10) This year's activities demonstrated the value of the Imagenex rotary scanning sonar for locating moorings in shallow water (less than 100 m); a long (~ 100 m) 4-conductor connecting cable, powered RS-485 interface and a well designed deployment assembly are required to facilitate this application.
11) A high-voltage supply challenge (circuit breaker activated) for the TARS control unit should be diagnosed and corrected (needs a coordinated effort with the ship's engineers; see under issues for CCGS Sir Wilfrid Laurier).

For CCGS Sir Wilfrid Laurier…

1) Temperature recorded by the thermosalinograph is well above ambient because the sensor is distant from the intake and there is appreciable re-circulation of water from the pump outlet back to the intake.
2) Both the seawater pump and the sweater drain needed for thermosalinograph operation freeze up when surface water reaches freezing temperature; there may or may not be a viable solution to this problem, but it needs discussion.
3) A high-voltage supply glitch (circuit breaker activated) for the TARS control unit (fore-deck container lab) must be diagnosed and corrected.
4) There is a need for <u>secure</u> 110-volt plug-ins for refrigerators and chest freezers used to store samples in the 'tween-decks space of the hold; during 2006-02, freezers were accidentally unplugged for some time, allowing undesirable thawing and partial thawing of stored samples.
5) Digital logging of data from the 12-kHz echo sounder with links to workstations around the ship, including the bridge would have obvious merit.
6) Safe and effective operation of the Hawboldt CTD winch in cold weather, when the pulley, spooling gear and drum accumulate ice remains unresolved; there was no cold (-10°C) weather this year to test a compressed air diffuser for stripping the cable clean of water before reaching the pulley.

CCGS Sir Wilfrid Laurier & Crew

CCGS Sir Wilfrid Laurier is well suited to the work carried out during this expedition. The large, low working deck, high-lift crane and the buoy-tending skills of the ship's officers and crew contributed to straightforward and efficient deck operations.

CCGS Sir Wilfrid Laurier is an excellent platform for multi-tasked operations that include scientific research in the Canadian Arctic. The advantage of multi-tasking in reducing the average cost per operational science day should not be over-looked. Cost comparisons with dedicated Arctic science vessels such as *Amundsen* or *USCG Healy* are very favourable.

I take pleasure in acknowledging the hard work and competence of the Laurier's White Crew. The members of this crew, in their diverse capacities, can take credit for the success of this expedition and the scientific knowledge that will emerge from it.

I thank Captain Mark Taylor for his strong interest in and focus on the scientific programme.

Narrative

23 September, Saturday

CCGS Sir Wilfrid Laurier at Cambridge Bay. Air delivery of dragging wire precluded by inclement weather.

24 September, Sunday

CCGS Sir Wilfrid Laurier at Kugluktuk. Scheduled flight bringing scientific group from Yellowknife cancelled for fog and low visibility.

25 September, Monday

CCGS Sir Wilfrid Laurier at Kugluktuk. Scientific party arrived at 11:35. IOS group calibrates ADCP compasses before joining the ship. CCGS Sir Wilfrid Laurier leaves Kugluktuk at 15:00. Scientific group receives ship safety briefing.

26 September, Tuesday

CCGS Sir Wilfrid Laurier transited Amundsen Gulf. Continuous measurement of sea surface temperature and salinity initiated. Mooring preparations commenced in the foredeck workshop container and in the ‘tween-decks workspace.

27 September, Wednesday

Along-slope section of temperature and salinity by expendable CTD probes initiated at XCTD-1, 71.5º N 131.4º W. CCGS Sir Wilfrid Laurier transited south-west along the 1000-m isobath.

28 September, Thursday

XCTD-13 drop completed. CCGS Sir Wilfrid Laurier crossed the shelf SSW to Camden Bay. Detection of oceanographic mooring by scanning sonar demonstrated at site K. 2 moorings recovered at site K. Overnight transit to site B. Shutdown of CCGS Sir Wilfrid Laurier for engine maintenance.

29 September, Friday

Mooring detection by scanning sonar demonstrated at site B. 2 moorings recovered at site B; 2 deployed. 2 moorings recovered at site A; 2 deployed. 2 moorings deployed at site K. Along-slope section picked up again at XCTD-16.

30 September, Saturday

CCGS Sir Wilfrid Laurier continued along-slope section to XCTD-24. Mooring on eastern side of Barrow sea valley (BCE-05) recovered. Replacement mooring (BCE-06) deployed.

1 October, Sunday

Mooring on western side of Barrow sea valley (BCW-05) recovered. Replacement mooring (BCW-06) deployed. Mooring on axis of Barrow sea valley (BCC-05) recovered. Replacement mooring (BCC-06) deployed. Leaking Impulse connector at the sea-cable termination diagnosed and replaced. Rosette cast completed for sampling dissolved oxygen (DO). CCGS Sir Wilfrid Laurier transited southwest to BCH-05.

2 October, Monday

Mooring at the head of Barrow sea valley (BCH-05) recovered. Replacement mooring (BCH-06) deployed. CCGS Sir Wilfrid Laurier transited northeast to pick up the along-slope section at XCTD-25 (2 additional drops across the shelf break). Dave English flown off the ship at Barrow.

3 October, Tuesday

Drop at XCTD-29 completed; further progress along the 1000-m isobath blocked by ice. CCGS Sir Wilfrid Laurier transited west to HCE-05. 4 supplementary XCTD drops made at intervals across the shelf break. Mooring near the mouth of Hanna sea valley (HCE-05) recovered. Replacement mooring (HCE-06) deployed. Rosette cast completed for sampling dissolved oxygen (DO). Recovery at HCW-05 attempted, but mooring remained at the seabed following activation of the release. CCGS Sir Wilfrid Laurier transited northwest towards the AIM05 site overnight.

4 October, Wednesday

CCGS Sir Wilfrid Laurier stopped by compact old ice near 74º 40'N before reaching AIM05. Ship's helicopter was flown on reconnaissance to the AIM site. The southern half of the transit offered significant impediment to passage of CCGS Sir Wilfrid Laurier; the AIM05 site lay beneath a vast floe of multi-year ice. AIM05 mooring was not recovered. AIM06 mooring was deployed 30 miles to the south-southwest of planned location. CCGS Sir Wilfrid Laurier retreated south to NCS-05, with 2 XCTDs dropped on route. Mooring at NCS-05 recovered. Replacement mooring (NCS-06) deployed. Rosette cast completed for sampling dissolved oxygen (DO). CCGS Sir Wilfrid Laurier transited overnight back to HCW-05, with 2 XCTD drops on route.

5 October, Thursday

CCGS Sir Wilfrid Laurier was at HCW-05 before daybreak – wind 40 kt, temperature -2ºC, waves damped by ice-limited fetch. The day was spent dragging for the Jamstec mooring at this site; it was recovered at 19:45 on the second drag. The wire was set in almost two complete 150-m diameter loops around the transponder (100-m deep) and drawn in from 750-m back. Replacement mooring HCW-06 was deployed in wind 40G45. Discovered that chest freezer containing samples from Laurier Leg 1 and from LSSL Beaufort-gyre cruises had been unplugged. CCGS Sir Wilfrid Laurier transited overnight to M4-04.

6 October, Friday

Day spent in attempted recovery of Jamstec mooring at M4-04 – transponder operational. Mooring position was confirmed via 3-point ranging. TARS ROV was deployed, but the evolution was delayed by problems with AC power to the control unit, and its effectiveness was hindered by inoperability of both the acoustic homing receiver and the scanning sonar. The scanning sonar was deployed independently to sweep a zone 100 m wide and 200 m long across the transponder location – no targets were sighted. A dragging wire was set in 2 loops around the location and drawn in from a point 450 m to the west; the drag was completed at 21:10, with nothing retrieved. Subsequent 3-point ranging indicated that the transponder had been moved westward by about 180 m during the evolution.

7 October, Saturday

CCGS Sir Wilfrid Laurier was hove to at M4-04 overnight. Northeast winds strengthened to 35G40 kt overnight and seas rose to 4-5 m. Wind and sea conditions at daybreak were too severe for both dragging and for operation of the ROV. Moreover, US NWS forecast weather indicated a continuation of strong northeast winds (seas 12-15 feet) until Tuesday, at which time winds would swing to the west at 30 kt. In the face of present and forecast future conditions, the challenging recoveries by dragging of Jamstec moorings at sites M4-04 and M3-04 were cancelled. CCGS Sir Wilfrid Laurier set course for Nome. The presence of an operable transponder at M3-04 was confirmed in passing.

8 October Sunday

By mid afternoon, the wind had diminished and the seas had calmed down. CCGS Sir Wilfrid Laurier stopped briefly at Fairway Rock for the traditional regatta of the Royal Arctic Yacht Club, before continuing on towards Nome.

9 October Monday

CCGS Sir Wilfrid Laurier was anchored off Nome before daylight. Members of the scientific team disembarked for flights south via Anchorage and Seattle.

Appendix 1: Locations of Moorings in the Beaufort Sea

Site	Latdeg	Latmin	Londeg	Lonmin	DBT (m)	Depth (m)	Action	Owner
IHC06-B1	70	15.0574	143	57.2630	27.0	31.6	Deploy	DFO/IMV
IHC06-B2	70	15.0632	143	57.4516	27.2	31.8	Deploy	DFO/IMV
IHC06-K1	70	17.3748	145	19.3425	27.1	31.7	Deploy	DFO/IMV
IHC06-K2	70	17.3944	145	19.1666	27.5	32.1	Deploy	DFO/IMV
IHC06-A1	70	21.9585	146	00.1683	26.5	31.1	Deploy	DFO/IMV
IHC06-A2	70	21.9997	146	00.0221	27.0	31.6	Deploy	DFO/IMV
BC-E-06	71	40.4814	154	58.9115	103.0	105.0	Deploy	Jamstec
BC-C-06	71	43.8700	155	09.6527	285.5	281.3	Deploy	Jamstec
BC-W-06	71	48.2406	155	20.0430	171.6	171.3	Deploy	Jamstec
BC-H-06	71	06.2474	159	20.0787	78.5	81.3	Deploy	Jamstec
HC-E-06	73	09.5659	162	19.7555	201.0	199.7	Deploy	Jamstec
HC-W-06	73	03.6359	163	44.9639	99.8	101.9	Deploy	Jamstec
NC-S-06	73	58.3753	167	34.9925	206.1	204.6	Deploy	Jamstec
AIM05-1	75	06.0009	167	59.9113	163.7	163.7	Under ice	DFO/NOAA
AIM06-1	74	38.6883	168	48.7604	187.3	186.5	Deploy	DFO/NOAA
M04-04	70	38.0500	166	44.9200	42.8	46.9	Dragging	Jamstec
M03-04	69	49.9700	168	49.4100	42.0	46.1	Dragging	Jamstec

Positions referenced to NAD83

Appendix 2: Locations of CTD profiles

Number	Station	Depth (m)	Date	In Time (UTC)	Lat (deg)	Lat (decmin)	Lon (deg)	Lon (decmin)	Pressure (max)
2006-02-0001	IHC06-B	31	29-Sep	17:58	70	15.006	143	57.738	22.2
2006-02-0002	IHC06-A	31	29-Sep	23:37	70	21.971	146	00.496	25.3
2006-02-0003	IHC06-K	31	30-Sep	1:51	70	17.289	145	19.099	29.6
2006-02-0004	BCE-06	104	01-Oct	2:55	71	40.601	154	58.938	100.5
2006-02-0005	BCW-06	163	01-Oct	15:20	71	48.062	155	20.548	155.8
2006-02-0006	BCC-06	282	02-Oct	7:33	71	43.924	155	09.785	282.5
2006-02-0007	BCH-06	81	02-Oct	17:21	71	06.230	159	19.825	72.9
2006-02-0008	HCE-06	200	03-Oct	22:25	73	09.594	162	19.640	193.2
2006-02-0009	AIM06-1	183	04-Oct	21:24	74	38.686	168	49.162	175.3
2006-02-0010	NCS-06	198	05-Oct	2:55	73	58.030	167	36.745	190.0

Appendix 3: Locations of XCTD profiles

Stn ID	SeqNo	LatDeg	LatMin	LonDeg	LonMin	Date&Time
XCTD-01	1	71	37.353	131	50.688	27-Sep-06 14:52
XCTD-02	2	71	30.610	132	48.886	27-Sep-06 17:44
XCTD-03	3	71	24.184	133	45.704	27-Sep-06 19:27
XCTD-04	4	71	18.094	134	43.671	27-Sep-06 21:31
XCTD-05	5	71	05.781	135	34.150	27-Sep-06 23:47
XCTD-06	6	70	53.282	136	28.500	28-Sep-06 02:28
XCTD-07	7	70	40.364	137	15.539	28-Sep-06 04:17
XCTD-08	8	70	35.409	138	15.062	28-Sep-06 06:03
XCTD-09	9	70	38.331	139	12.646	28-Sep-06 07:41
XCTD-10	10	70	40.717	140	15.613	28-Sep-06 09:26
XCTD-11	11	70	41.902	141	16.043	28-Sep-06 11:06
XCTD-12	12	70	46.123	142	14.109	28-Sep-06 12:42
XCTD-13	13	70	50.849	143	14.277	28-Sep-06 14:24
XCTD-16	14	71	02.543	146	16.471	30-Sep-06 06:14
XCTD-17	15	71	07.641	147	15.731	30-Sep-06 07:57
XCTD-18	16	71	13.055	148	17.462	30-Sep-06 09:38
XCTD-19	17	71	18.367	149	16.243	30-Sep-06 11:15
XCTD-20	18	71	23.798	150	16.537	30-Sep-06 12:55
XCTD-21	19	71	32.526	151	21.442	30-Sep-06 15:58
XCTD-22	20	71	44.728	152	14.876	30-Sep-06 17:39
XCTD-23	21	71	53.556	153	03.503	30-Sep-06 19:07
XCTD-24	22	72	01.888	153	50.623	30-Sep-06 20:33
	23	72	06.269	155	11.896	03-Oct-06 05:21
	24	72	09.891	155	00.242	03-Oct-06 05:48
XCTD-25	25	72	13.883	154	45.341	03-Oct-06 06:21
XCTD-26	26	72	21.295	155	42.992	03-Oct-06 08:02
XCTD-27	27	72	30.835	156	40.493	03-Oct-06 09:40
XCTD-28	28	72	46.534	157	38.883	03-Oct-06 11:57
XCTD-29	29	72	57.266	158	17.053	03-Oct-06 13:22
	30	73	07.168	158	42.108	03-Oct-06 15:15
XCTD-30	31	73	09.693	159	09.694	03-Oct-06 16:23
	32	73	09.496	159	23.626	03-Oct-06 16:52
	33	73	09.693	159	39.299	03-Oct-06 17:25
	34	73	09.559	160	31.071	03-Oct-06 19:02
	35	73	09.587	161	22.342	03-Oct-06 20:21
	36	74	23.851	168	24.445	04-Oct-06 23:18
	37	74	11.852	167	59.900	05-Oct-06 00:45
	38	73	43.132	167	19.161	05-Oct-06 05:47
	39	73	02.095	163	52.469	06-Oct-06 04:08

Regional Operations Centre

Canadian Coast Guard – Pacific

PACIFIC REGION CCG VESSEL -POST CRUISE REPORT

NAME OF SHIP/PLATFORM: **CCGS Sir Wilfrid Laurier**

DATES: 25 September - 9 October 2006

SCIENCE CRUISE NUMBER: 2006-02 **SHIP'S PATROL NUMBER:**

CHIEF SCIENTIST[S]: Humfrey Melling, DFO/IOS

AREAS OF OPERATION: Beaufort and Chukchi Sea

INTRODUCTION/PROGRAM BACKGROUND:

JWACS (Joint Western Arctic Climate Studies) is an ongoing multi-disciplinary joint research program between the Department of Fisheries and Oceans Canada and various partners from other nations, institutes and universities.

This component involved scientists from the Institute of Ocean Sciences (Sidney, B.C.), the Japan Marine Science and Technology Center (JAMSTEC) and ASL Environmental Sciences Inc.

CRUISE OBJECTIVE/OBJECTIVES:

The objectives of the science program were the recovery and re-deployment of a series of instrumented oceanographic moorings both in the Beaufort Sea and in the Chukchi Sea, and collection of hydrographic profiles and seawater samples for trace chemical analysis at stations along the shelf break and at moorings.

DAYS ALLOCATED: **DAYS OF OPERATION:**

10

DAYS LOST DUE TO WEATHER:

1

RESULTS:

Nearly all of the objectives of the program were successfully completed. Sea ice cover in the north-eastern Chukchi Sea blocked access to a few of the target 1000-m stations and to the Arctic Ice Monitoring mooring at 75.1°N. Otherwise, most targeted moorings were recovered, except that strong winds and high seas, predicted to last several days, curtailed use of the TARS submersible and various dragline strategies in the recovery of two JAMSTEC moorings at locations in the central Chukchi Sea.

RADIOISOTOPE USE:

None

PROBLEMS [SCIENTIFIC GEAR AND OPERATIONS]:

Temperature recorded by the thermosalinograph is well above ambient because the sensor is distant from the intake and there is appreciable re-circulation of water from the pump outlet back to the intake.

Both the seawater pump and the sweater drain needed for thermosalinograph operation froze up when surface water reached freezing temperature; there may or may not be a viable solution to this problem, but it needs discussion.

A high-voltage supply glitch (circuit breaker activated) for the TARS control unit (fore-deck container lab) precluded use of high voltage power with the ROV.

Storage chest freezers in the cargo hold were accidentally unplugged for some time, allowing undesirable thawing and partial thawing of stored samples. There is a need for secure 110-volt plug-ins for refrigerators and chest freezers used to store samples in the 'tween-decks space of the hold.

Digital logging of data from the 12-kHz echo sounder with links to workstations around the ship, including the bridge would have obvious merit.

afe and effective operation of the Hawboldt CTD winch in cold weather, when the pulley, spooling gear and drum accumulate ice remains unresolved; there was no cold (-10°C) weather this year to test a compressed air diffuser for stripping the cable clean of water before reaching the pulley.

SUCCESSES [SCIENTIFIC]:

Salinity and temperature of surface water drawn from the ship's sea-bay were recorded at 10-second intervals along most of the cruise track

Soundings were recorded at a spacing of once cable in areas of interest that are poorly charted, anmely Camden and the northern Chukchi shelf

10 CTD-rosette casts were completed. The SBE25 CTD was equipped with several supplementary sensors and recorded pressure, temperature, conductivity, dissolved oxygen, light transmission and chlorophyll fluorescence

Water was sampled from the rosette on 5 of the CTD-rosette casts. Samples were withdrawn for salinity and dissolved oxygen analyses. DO analysis was completed on board ship

39 X-CTDs were deployed primarily over the continental slope along approximately the 1000- m isobath

13 oceanographic moorings were retrieved after deployments of 1 or 2 years. One recovery was accomplished by dragging after the mooring failed to surface despite acknowledgement of the release command (defective EdgeTech 8242XS). Instruments measured water-column temperature, salinity and current, ice drift, surface waves, sea level, storm surge, ice thickness, ice topography and biogenic acoustic scattering

14 oceanographic moorings were deployed for periods of 1 or 2 years. The instruments will extend the time series of ice thickness observations that was initiated in 1990 and of ocean observations dating back to the mid 1990s.

PROBLEMS [SHIP'S EQUIPMENT/OPERATIONS/PLATFORM SUITABILITY]:

See: PROBLEMS [SCIENTIFIC GEAR AND OPERATIONS]

SUCCESSES [SHIP]:

CCGS Sir Wilfrid Laurier is an excellent platform for multi-tasked operations that include scientific research in the Canadian Arctic. The advantage of multi-tasking in reducing the average cost per operational science day should not be over-looked. Cost comparisons with dedicated Arctic science vessels such as Amundsen or USCG Healy are very favourable.

DELAYS [OTHER THAN WEATHER]:

Boarding of science team delayed by 1 day through cancellation of flight into Kugluktuk.

SAFETY CONCERNS:

HAZARDOUS OCCURRENCES:.

None

EVENT LOG:

SUMMARY/FINAL COMMENTS:

Near the end of the short Arctic summer, as sudden storms and rough seas become frequent and difficult to predict, and daylight hours rapidly get shorter, it becomes a challenge to complete the science mission objectives.

Our special thanks go to the tireless work of the captain, officers and crew without whose contribution we would not have been able to achieve so many of the science plan objectives.