CRUISE REPORT

HUDSON 96026

LABRADOR SEA

WOCE LINE AR7W

16 OCTOBER - 20 NOVEMBER, 1996

A. CRUISE NARRATIVE

1. Highlights

a. WOCE Designation: WOCE Line AR7W
Atlantic Circulation Experiment

b. Expedition Designation: Hudson 96026

c. Chief Scientist:
R. Allyn Clarke
Ocean Sciences Division
Department of Fisheries and Oceans
Bedford Institute of Oceanography
PO Box 1006
Dartmouth, NS, Canada B2Y 2A4

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Internet a_clarke@bionet.bio.dfo.ca

d. Ship: CSS Hudson

e. Ports of Call:

October 16	BIO, Dartmouth, NS, Canada
November 3-4	Botwood, Newfoundland, Canada
November 20	BIO, Dartmouth, NS, Canada

f. Cruise Dates: October 16 to November 20, 1996

2. Cruise Summary Information

a. Cruise Track

A cruise track is shown in Figure 1. Ship position at midnight on each day of the cruise is indicated with an asterisk.

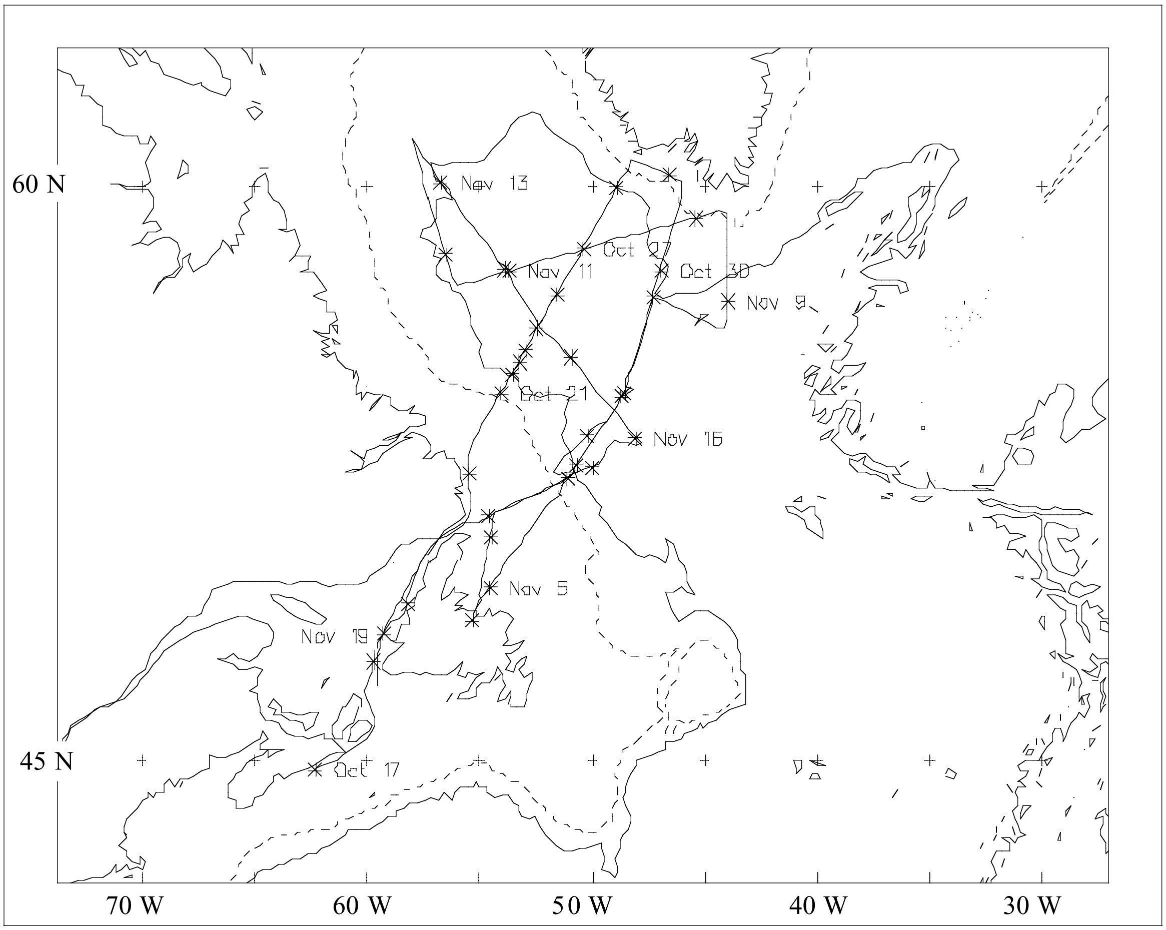

Figure 1. Cruise track for 18HU96026/1; * marks Hudsons position at 0000Z each day with some day labels indicated.

b. Total Number of Stations Occupied

The CTD and ROS station positions are shown in Figure 2. Some station numbers are indicated for clarity. The WHP stations are all contained in the box defined by 50-62°N and 43-60°W. Test CTD stations were also occupied outside of this box and are not shown here.

70 Full depth WHP small volume CTD stations with up to 23 rosette bottles. Depending on the station, water samples were analyzed for CFC's, carbon tetrachloride, methyl chloroform, total carbonate, alkalinity, oxygen, salinity, nutrients and oxygen isotopes.

9 CTD casts with no water samples
35 Full depth velocity profiles using a lowered ADCP

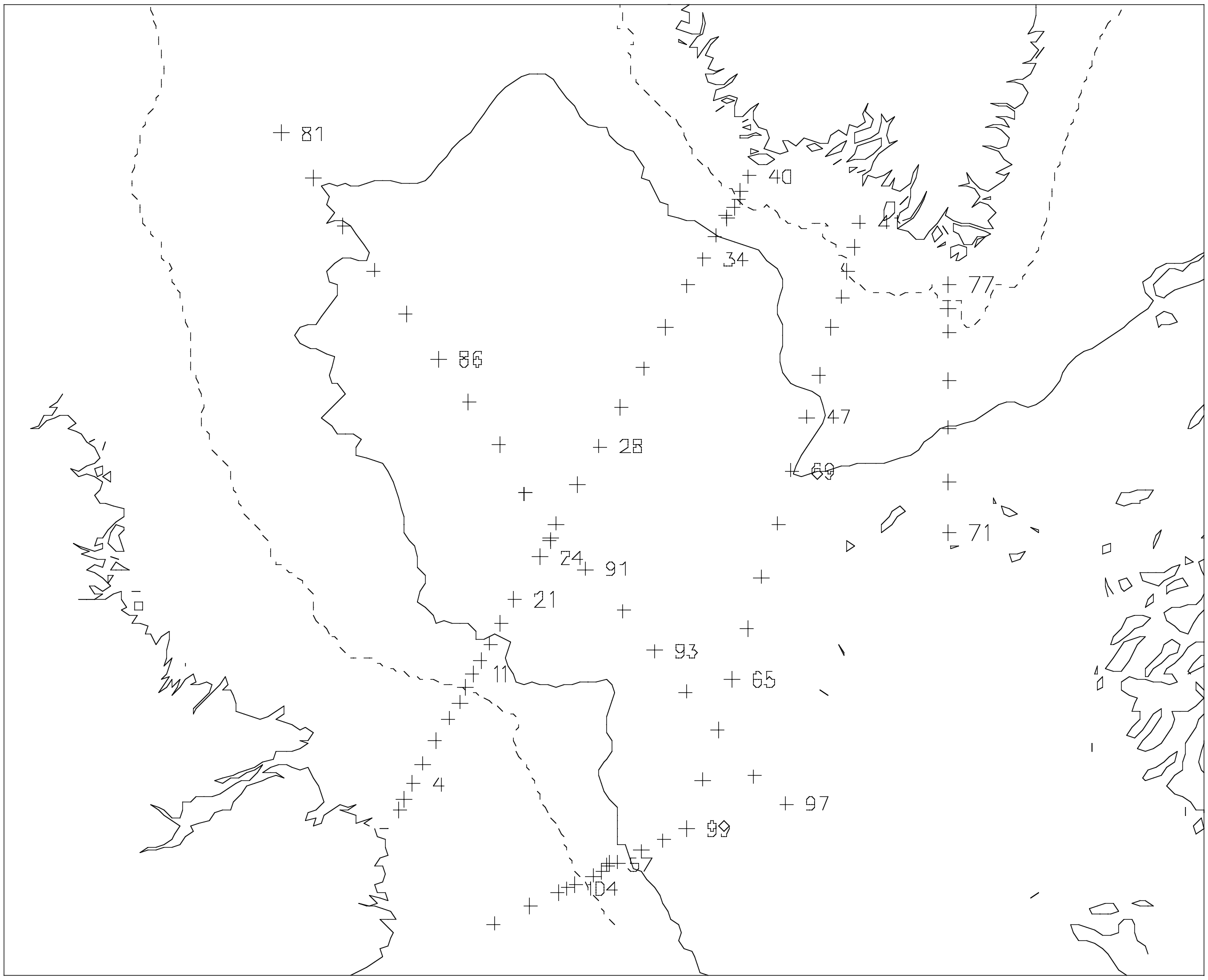

Figure 2. CTD/ROS/Tracer station positions for Hudson 18HU96026/1.

26 spectral radiometer profile stations to 100 metres
26 pump lowerings to 100 metres
24 stations sampled for DOC profiles, size fractionation of DOC and plankton respiration
19 vertical net hauls to 100 metres, 5 deep net hauls to the bottom or 3000 metres

c. Floats and Drifters deployed

The deployment sites for meteorological drifters (Δ), profiling ALACE floats (+), mixed layer floats (×) and RAFOS floats (O) are shown in Figure 3.

38 profiling ALACE floats launched at 33 stations
4 RAFOS floats launched at 2 stations
18 surface meteorological drifters launched at 13 stations
3 mixed layer floats launched at 2 stations

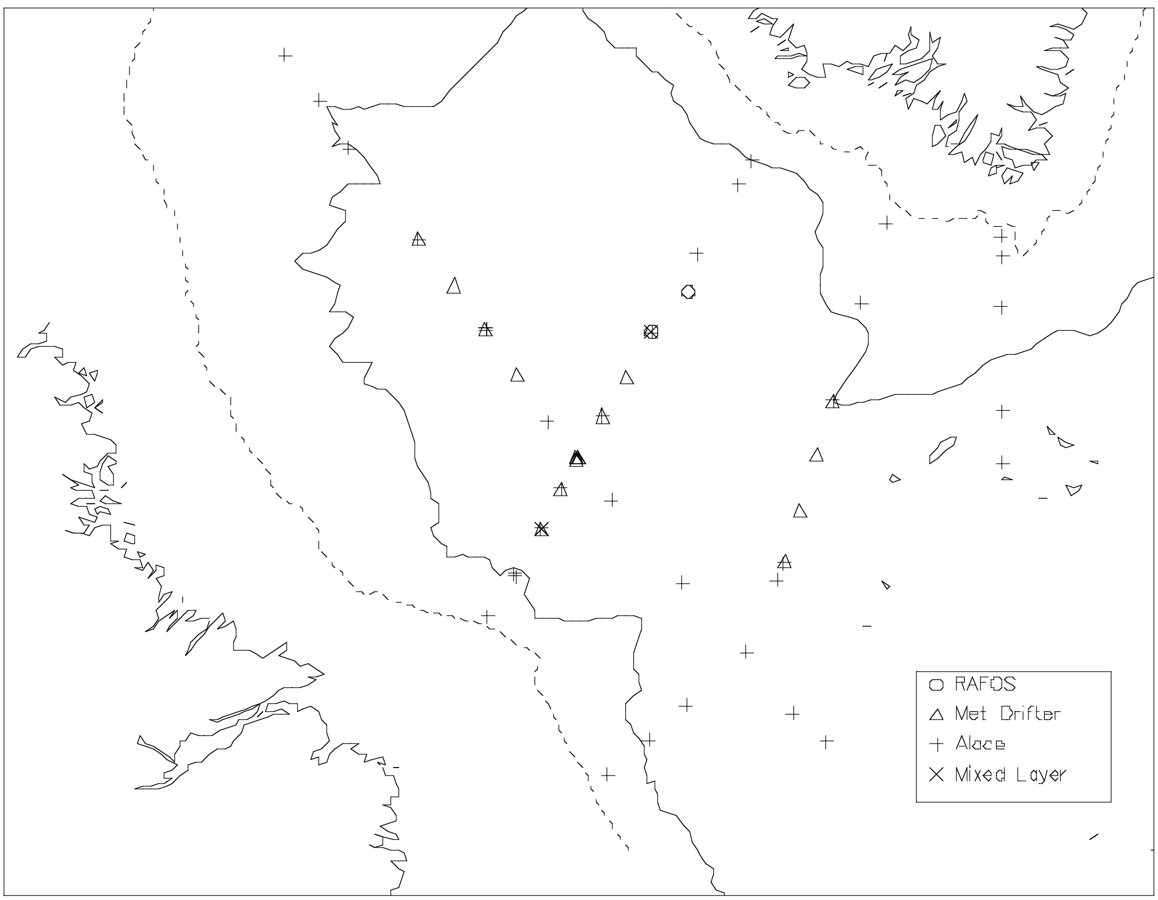

Figure 3. RAFOS, meteorlogical drifter, ALACE and mixed layer float deployment positions during Hudson 18HU96026/1.

d. Moorings deployed or recovered

The deployment and recovery sites of the various moorings are shown in Figure 4. The following summarizes the mooring operations and provides a legend for Figure 4.

3 standard current meter moorings were set across the Labrador Slope along AR7W (20 month deployments); denoted in Figure 4 as M1244, M1245 and M1246.

3 Inverted Echo Sounders and bottom pressure gauges were deployed (20 month deployments); denoted in Figure 4 as P86, P87 and P88.

1 multi-instrument mooring was set near OWS Bravo on AR7W replacing the mooring set in 1995 (WOCE Expocode 18HU95011) and partially recovered in the spring of 1996 (18HU96006) as well as on the present cruise. The deployed mooring consisted of 6 Seacat temperature/conductivity recorders, 6 Aanderaa current meters, 1 acoustic doppler current profiler (ADCP), 1 WOTAN (weather observations through ambient noise) and 1 CTD with a device for measuring the total partial pressure of dissolved gas in the water; denoted in Figure 4 as M1226.

1 dragging operation on the fragments of current meter mooring 1194 lost in May, 1996 was conducted. A release, Seacat and Aanderaa current meter were recovered; denoted in Figure 4 as Drag.

1 release test mooring was recovered (5 month deployment) ; denoted in Figure 4 as RTEST.

4 Sound Source moorings were set to provide acoustic positioning for RAFOS deployments in the Labrador Sea and NW Atlantic over the next 18 months; denoted in Figure 4 as SSE, SSN, SSS, SSW.

1 surface meteorological buoy was moored near OWS Bravo site (4 month deployment) ; denoted in Figure 4 as Met.

1 profiling CTD mooring was set on AR7W section (4 month deployment) ; denoted in Figure 4 as CTD.

1 tomographic mooring was set (8 month deployment); denoted in Figure 4 as Tom.

3 transponders were set in proximity to the tomographic mooring; denoted in Figure 4 as T1, T2 and T3.

Figure 4. Mooring positions during Hudson 18HU96026/1. See text for label description.

3. List of Principal Investigators

Name	Affiliation	Responsibility
Allyn Clarke	BIO a_clarke@bionet.bio.dfo.ca	senior scientist overall co-ordination
Glenn Cota	Old Dominion University cota@ccpo.odu.edu	Bio-Optical properties of the upper ocean
Russ Davis	SIO davis@nemo.ucsd.edu	profiling ALACE floats
Howard Freeland	IOS - Pat Bay hjfree@ios.bc.ca	profiling ALACE floats
Bob Gershey	BDR Research rgershey@fox.nstn.ns.ca	alkalinity, carbonate, CFC's

Glen Harrison	BIO, g_harrison@bionet.bio.dfo.ca	Co-ordinator biological program nitrate and ammonium utilization by phytoplankton
Erica Head	BIO erica.head@maritimes.dfo.ca	macrozooplankton distribution, abundance and metabolism
Robert Houghton	LDEO houghton@ldeo.columbia.edu	oxygen isotopes
Paul Kepkay	BIO p_kepkay@bionet.bio.dfo.ca	dissolved organic carbon, colloid chemistry and plankton respiration
Peter Jones	BIO p_jones@bionet.bio.dfo.ca	alkalinity, carbonate, CFC's
John R. N. Lazier	BIO j_lazier@bionet.dfo.ca	oxygen, CTD data, moored instrument data
Bill Li	BIO bill.li@maritimes.dfo.ca	pico-plankton distribution and abundance
Peter Niiler	SIO niiler@nepac.uscd.edu	meteorological drifters
Robert Pickart	WHOI pickart@rsp.whoi.edu	lowered ADCP
Mark Prater	URI mark@seip.gso.uri.edu	RAFOS floats and Sound Sources
Peter Rhines	UW rhines@killer.ocean.washington.edu	moored instrumentation data
Uwe Send	IFM Kiel usend@ifm.uni-kie.de	tomography mooring
Peter Strain	BIO p_strain@bionet.bio.dfo.ca	nutrients
John Toole	WHOI toole@whoi.edu	CTD profiler mooring
Randy Watts	URI randy@drw.gso.uri.edu	IES

See Section 7 for addresses.

4. Scientific Programme and Methods

4.1 Physical - Chemical Program

a. Narrative

This expedition was conducting physical and chemical oceanographic operations in support of two ongoing scientific initiatives.

The first initiative is the Atlantic Circulation Experiment of the World Ocean Circulation Experiment (WOCE). One element of this experiment seeks to map the hydrographic and tracer fields of the subpolar gyre of the North Atlantic in both the fall of 1996 and the spring of 1997 to provide a measure of the winter cooling and water mass transformations over the entire region. Hudson 96026 was planned to map the Labrador Sea part of the sub-polar gyre as well as to deploy current meter moorings, a profiling CTD mooring, bottom pressure gauges and inverted echo sounders (PIES) and profiling ALACE floats which will measure the changes in the hydrographic structure and the gyre circulation over the coming 20 months (two cooling cycles).

The second initiative includes the Accelerated Research Initiative on Oceanic Deep Convection of the US Office of Naval Research and the Atlantic Climate Change Program (ACCP) of NOAA. These programs seek to better understand the process and details of oceanic deep convection by a focused study of the formation of Labrador Sea Water in the western part of the Labrador Sea over the winter of 1996/97. Hudson 96026 is contributing to this program by setting a sound source array, a tomographic mooring to complete a German tomographic array and a surface meteorological mooring. In addition, the vessel is to deploy surface meteorological drifters, mixed layer floats and RAFOS floats in support of this initiative. The US Office of Naval Research has contributed to the vessel operating costs in support of these elements of the program.

The primary focus of the expedition was to conduct a hydrographic / tracer survey of the entire Labrador Sea during the fall of 1996 in order to establish the initial conditions for the 1996/1997 cooling season. The initial survey design (see Figure 5) consisted of five sections crossing the Labrador Sea with the northernmost section (section L1) striking north-easterly towards Greenland from Nain Bank and the easternmost along

44°W from Cape Farewell to Flemish Cap. The central section of the survey is the WHP Repeat Section AR7W and this was the first section to be occupied. On completion of this section, the vessel began occupying section L4 leading from Cape Farewell to northern Newfoundland. While moving down the continental slope, the CTD package was lost when the termination came apart. This required the vessel to go to Botwood, Newfoundland to pick up another CTD and rosette package. On leaving Botwood with a new rosette package on board, Hudson worked stations along L4 from the South Sound Source Mooring north-easterly to the station at which the CTD was lost. The vessel then steamed easterly to the Cape Farewell - Flemish Cap Section (L5) and started working stations northward from the Sound Source East location. The northern part of this section was completed to Cape Farewell. However, due to so much lost time resulting from the loss of the CTD and problems associated with the mooring of the various sound sources, the two northern most sections (L1 and L2) were replaced by a long section (L6) running down the western side of the Labrador Sea from 61°N to 53° 46' N (see Figure 1 from November 13 to November 16). The western part of section L4 was completed from Sound Source South before the vessel had to depart the working area. In spite of the lost time, Hudson probably managed to sample most of the water that is likely to participate in the winter of 96/97 cooling and mixing.

During this cruise, an ADCP was added to the CTD/rosette package to provide a estimate of the full depth velocity profile at each CTD station. This data will be useful for the detection and definition of various subsurface currents such as the deep western boundary undercurrents.

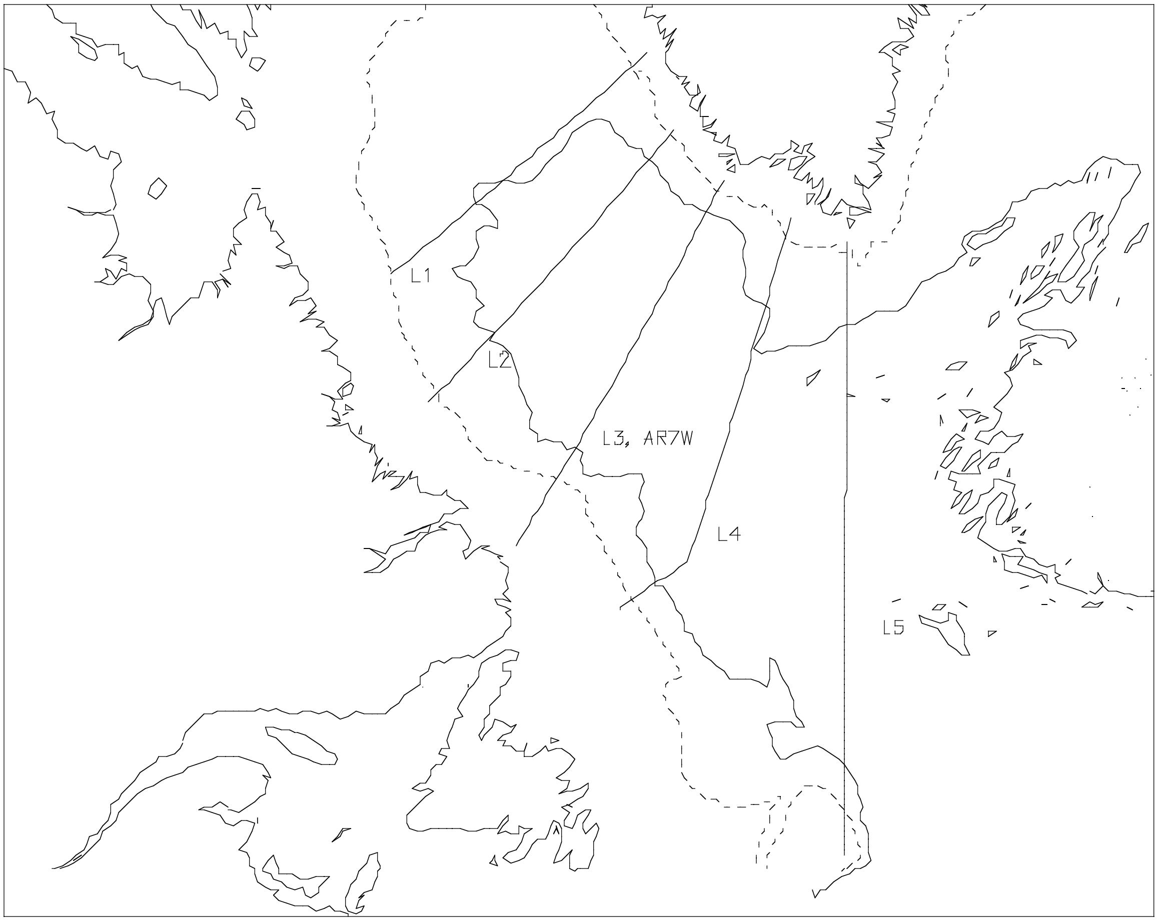

Figure 5. Initially planned lines L1 to L5. Refer to Figure 1 for actual cruise track.

A current meter mooring array of four moorings was set along the western end of the WHP section AR7W from the 2800 metre to the 3500 metre isobath. These moorings will be recovered in spring of 1998. These moorings plus a mooring set in the spring of 1996 on the 1000 metre isobath and three Kiel current meter moorings set in August 1996, will provide a good estimate of the variation of the western boundary current system of the Labrador Sea over

the late fall and winter season and will show whether a more intense cyclonic circulation develops in the western Labrador Sea during winter convection.

An extensive number of profiling ALACE floats were deployed throughout the Labrador Sea. These instruments should provide weekly information on the changes in the heat and salt distributions of the upper 1500 metres of the water column throughout the cooling season.

The sound sources were placed in support of a large RAFOS float deployment planned for the winter 97 Knorr expedition. These instruments will be used to follow the waters formed in the Labrador Sea by the winter convection. Four RAFOS floats were deployed to verify the range and operation of the sound sources and also to test a new version of these floats.

The surface meteorological buoy and the 18 meteorological drifters were set to provide better coverage of the surface meteorological fields during the fall and winter cooling season. Initial reports from the meteorological drifters indicate that 5 drifters suffered failures and 13 units are producing usable data on surface currents, atmospheric pressure, SST, wind speed and direction. The first data report will be presented at the NSCAT/CAL VAL meeting on 20-22 January in Honolulu, HI.

The Tomographic mooring was set to complement the three tomographic moorings set by Kiel in August. The acoustic paths between these moorings map the area in which convection had been observed to be maximum during the winters of 75/76 and 77/78.

4.2 Biological Program

a. Narrative

The objectives of the biological program of Hudson 96026 were two-fold: (1) to provide a historical perspective on the large-scale late fall distribution of the major plankton groups in the Labrador Sea for comparison with studies done in the mid-60’s and mid 80’s and (2) to provide new information on other important biogeochemical properties of the region as background for the proposed Phase III of Canadian JGOFS. Objective (1) will contribute to the debate about the link between northern fish stock declines and long-term changes in food chain structure; objective (2) will contribute to DFO’s role in Canadian Climate Change research.

The positions of various activities in support of the biologial program are shown in Figure 6.

5. Major Problems and Goals Not Achieved

5.1 Loss of Shipment of Meteorological Drifters

In the week prior to the loading period for Hudson, the meteorological drifters intended for this expedition were lost in a plane accident. It was only with a great deal of effort on the part of the manufacturer that 18 replacement instruments were assembled and delivered to Halifax for deployment in the Labrador Sea. This was less than the 36 meteorological drifters that had originally been called for but a good distribution was achieved..

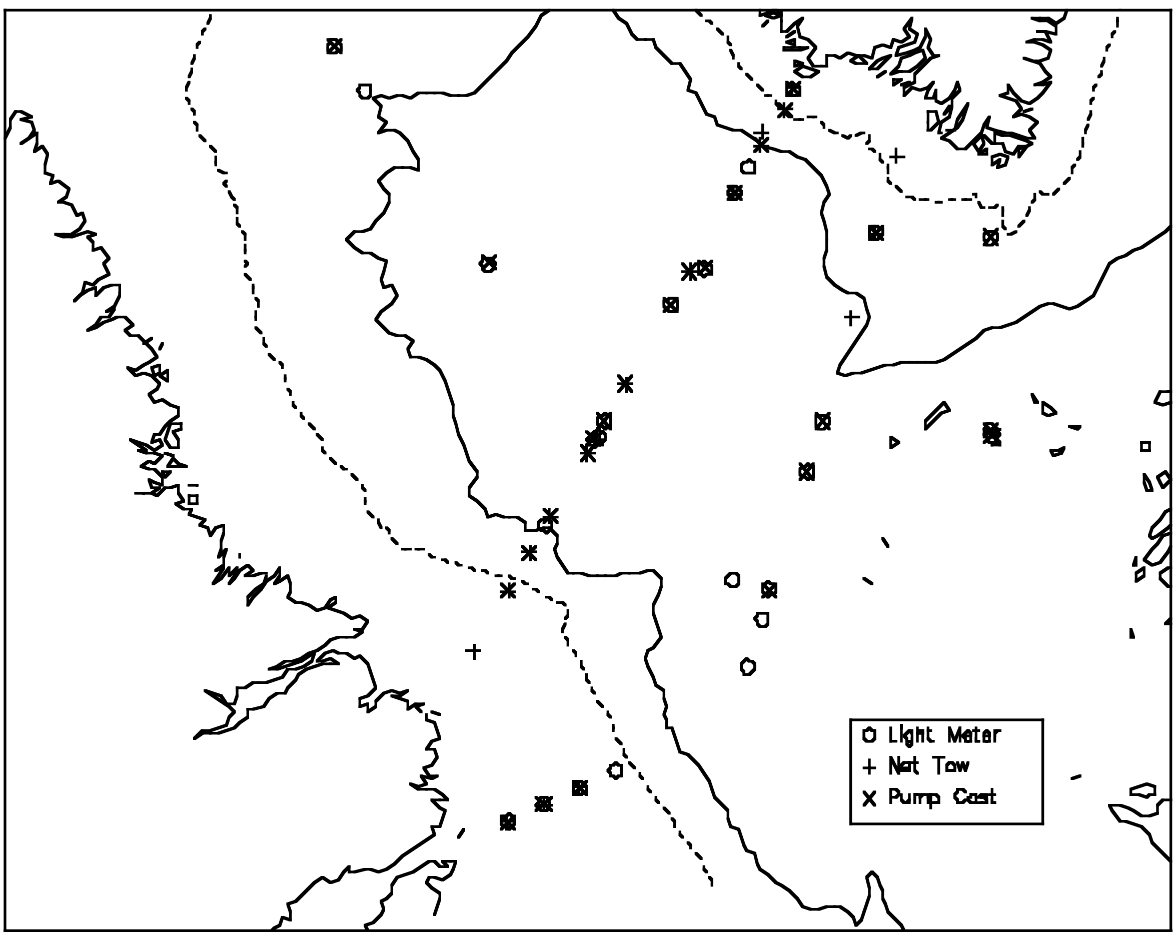

Figure 6. Biology station positions for 18HU96026/1.

5.2 Loss of CTD/Rosette Package

A major problem was the loss of our CTD / rosette package on station 47 (L4_18) southwest of Cape Farewell. It is believed that the loss occurred due to the package unscrewing itself from the fitting used at the end of the CTD cable. The fitting consists of two parts: 1) a piece that grips the end of the cable by means of a conical cross section and a conical insert that fits inside the outer armour of the wire, and 2) a piece that can be shackled to the CTD. These two pieces simply screw together. After the loss, we realized that there were no lock washers, set screws or cotter pins to prevent the assembly from unscrewing under the appropriate torsion load on the wire or the package. The assembly had been securely tightened; however, once loosened, there was nothing to prevent the assembly from coming unscrewed and the package being released. That is what we believe happened.

The loss of the CTD/rosette required an unscheduled port stop in Botwood, Newfoundland to load another rosette sampler sent from IOS Pat Bay. This cost us nearly 4 days in direct steaming and port time. It also got us out of sequence with our sections so we had to expend even more time to steaming and less time to stations. While we were able to locate replacements for our rosette, bottles, pinger and CTD; we were without the lowered ADCP and fluorometer for the rest of the expedition.

5.3 Start Time of Tomographic Mooring Sound Source

The sound source for the tomographic mooring was fully set up before we departed BIO. At that time, the WHOI and IFM Kiel technicians believed that Hudson would be returning to BIO on November 15 rather than November 20. The sound source was programmed to come to full power at 0800 UTC on November 13. If the source came to full power in air, it would be damaged. When trying to reschedule the hydrographic stations following our unscheduled port stop in Newfoundland, it was clear that if we tried to set the tomographic mooring while occupying section L2, we could not get to its mooring location before November 13th. We also did not have the equipment and expertise on board to reprogram the source. After considerable discussion, we decided to replace the two northernmost transverse sections with a longitudinal section down the central axis of the Labrador Sea, setting the tomographic sound source on our passage to the northern end of this new section.

5.4 Damage to Container Laboratory

While steaming westward along section L4 on October 31st, the vessel was struck by a wave on the port side. The wind and waves were at the time on the port quarter. The wave stove in the outboard side of the forwardmost container on the port side and also broke the latch hardware on the door to the container. The deck was also flooded to a considerable depth; water entering through the cracks around the doors of all three containers along the port side. An individual was working in the middle container at the time of the damage. He was aware of the impact of the wave on his container and saw the damage to the forward container as he exited his container to enter the vessel.

The outboard side of the container was pushed in 10-20 cm centred about 1 metre from the deck of the container. This caused the bench, shelves and inner wall to break away from the outboard wall. The contents of drawers were spilled onto the deck. The electrical services along this side of the container were also pulled apart. Fortunately, the computer and cytometer were on the benches along the inboard wall and did not appear to be damaged. The vessel altered course to allow the container to be cleaned up and secured. Later as we approached Botwood, Dr. Li discovered a problem with the cytometer. It is not known whether this problem was related to the container damage or was an independent failure of a component of this instrument. Dr. Li left the vessel in Botwood.

5.5 Failure of Brake on Pumping System

During the last week of operations in the Labrador Sea we experienced sustained below zero conditions. At this point, the hydraulic brake on the submersible pumping system used by the biological program stopped working (station 86). Without the appropriate drawings and experienced people on board it seemed futile to attempt any repairs. It is possible that the problem could have been caused by water in the hydraulics freezing and blocking valves in the system. This system will need to be modified if it is to be used in late fall and winter seasons at these latitudes.

6. Other Incidents of Note

none

7. List of Cruise Participants

Name	Responsibility	Affiliation
Jeff Anning	Biological Underway Sampling	BIO
Larry Bellefontaine	Salinometer	BIO
Paul Bouchard	Moorings	WHOI
John Bouthillette	Moorings	WHOI
Jay Bugden	DOC Levels	BIO
Allyn Clarke	Chief Scientist	BIO
Kurt Clement	Ocean optics	ODU
Bob Gershey	CFC/Alkalinity/Carbonate Research	BDR
Glen Harrison	Assistant Senior Scientist	BIO
Albert Hartling	Moorings, Watchkeeper	BIO
Erica Head	Macrozooplankton Distribution	BIO
Anthony Isenor	Data Quality/Watchkeeper	BIO
John Lazier	Assistant Senior Scientist	BIO
Bill Lee	Picoplankton Distribution	BIO
Jonathon Lilly	Watchkeeper	UW
Manon Poliquin	CFC/Alkalinity/Carbonate Research	BDR
Mark Prater	RAFOS, PIES, sound sources	URI
Peter Rhines	Scientist	UW
Murray Scotney	Moorings/CTD/Watchkeeper	BIO
Igor Yashayaev	Scientist	BIO

BIO Bedford Institute of Oceanography
PO Box 1006
Dartmouth, NS, B2Y 2A4

BDR BDR Research Ltd.
Box 652, Station 'M'
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IFM-Kiel Institut für Meereskunde an der Universität Kiel
Düsternbrooker Weg 20
D-24105 Kiel, Germany

IOS-Pat Bay	Institute of Ocean Sciences P.O. Box 6000 Sidney, B.C., V8L 4B2
LDEO	Lamont -Doherty Geological Observatory Columbia University Palisades, New York 10964
SIO	Scripps Institute of Oceanography University of California at San Diego La Jolla, CA 92093
ODU	CCPO Old Dominion University Norfolk, VA 23529 USA
URI	University of Rhode Island Narraganset Marine Lab South Ferry Road, Narragansett Rhode Island 02882
UW	University of Washington Seattle, WA 98195
WHOI	Woods Hole Oceanographic Institution Woods Hole, MA 02543

B. UNDERWAY MEASUREMENTS

1. Navigation and Bathymetry

(Anthony W. Isenor)

The navigation system onboard CSS Hudson consists of a Trimble Navigation Loran-GPS 10X decoder and AGCNAV. The decoder receives the satellite fixes and decodes the signals to obtain latitude, longitude and time. The decoder signals are about 1 Hz. The navigation data were logged at one minute intervals on a PC. This PC was running the AGCNAV software package, a PC based display, and way-point setting software package developed at the Atlantic Geoscience Centre at BIO. This software graphically displays ship position, way-points, course, speed, etc. to the various science working areas.

The echo sounder system used for collecting bathymetric data consisted of a Raytheon Line Scan Recorder, Model LSR 1811-2 (serial number A117) connected to a hull mounted 12kHz transducer. The transducer beam width is 15 degrees. The sweep rate of the record was adjusted throughout the course of data collection to aid in identifying the bottom signal. The recorder was also linked to a clock, and thus could indicate 5 minute intervals on the sounder paper. The system was used to collect bathymetric soundings at 5 minute intervals while underway between stations.

Initially a Raytheon PDD converter and a Black Box BCD-ASCII Converter were used to automatically digitize soundings from the LSR. These soundings were then broadcast throughout the ship using nmea-nav string SSDBK. This allowed the storage of the signal via the AGANAV software. In shallow water and with the operator setting a depth envelop for the return signals, the system worked reasonable well. However, in water depths exceeding 150 fathoms the system was not able to consistently determine a proper bottom depth. For this reason, the sounding digitizing was carried out manually the entire cruise.

2. Acoustic Doppler Current Profiler
(Murray Scotney)

The Hudson was equipped with a hull mounted RDI acoustic doppler current profiler. The transducer (serial number 177) had SC ADCP electronics (serial number 607) converted for ship board use. Logging, using Transect software on a 386 PC, was started on October 16 at 2014Z along the Scotian Shelf. The configuration of the equipment results in a bin length of 4 metres and a total of 128 bins. The raw data are stored to disk and backed up every few days. The data are also averaged in real-time over 10 minute intervals. ADCP logging was stopped on November 20, 1996 at 1013Z in Halifax Harbour.

3. Continuous Flow Multisensor Package (CFMP)
(Jeff Anning)

Water from approximately 4 m was pumped continuously up to the forward lab. The temperature, conductivity and fluorescence of this flow was continuously measured and logged every 30 seconds. The temperature and conductivity were measured with Seabird sensors and the fluorescence by a Wetlabs flowthrough fluorometer. Incident Photosynthetically Active Radiation was measured with a Biospherical PAR sensor and the data merged with the sea water parameters. Exact positions were logged at the same time from a Northstar GPS.

Discrete water samples were collected every 15 minutes by an auto sampler for later analysis for phosphate, nitrate and silicate.

A NAS 2E nitrate analyser was incorporated into the flowthrough system. Nitrate concentration was measured every 15 minutes. This data will be compared with the concentrations found in the discrete samples.

4. XBT and XCTD

No probes were used

5. Meteorological observations

Routine reporting of meteorological variables was carried out by the ship's crew.

6. Atmospheric Chemistry

There was no atmospheric chemistry programme.

Cruise Plan for 1996 Labrador Sea Occupation
Atlantic Circulation Experiment of WOCE - 96026

Senior Scientist:	R.Allyn Clarke
Assistant Senior Scientists**:**	John R.N. Lazier
	W. Glen Harrison
Cruise:	Hudson 96026
Vessel:	CSS Hudson
Institution:	Ocean Sciences Division Department of Fisheries and Oceans Bedford Institute of Oceanography Dartmouth, NS, Canada

Dates:	Ocotber 15, 1996	Depart Dartmouth, Nova Scotia
	November 20, 1996	Arrive Dartmouth, Nova Scotia

Overview of the Hydrographic Program

This will be the first detailed fall occupation of sections across the Labrador Sea and the second occupation of AR7W this year. This cruise will transect the Labrador Sea along five lines (see Figure 1). The cruise will consist of CTD stations, float and drifter deployment, current meter mooring deployment and sound source deployment.

The planned sections sample a number of the water masses of the Northwest Atlantic which exhibit interannual variability in their properties. The focus of this program is to obtain a fall description of each water mass in terms of its volume, temperature, salinity, oxygen, carbon dioxide, alkalinity, nutrient, and CFC content. These data can then be used to; sort out space/time ambiguities for the larger North Atlantic WOCE hydrographic data set which is not being sampled synoptically; test models that relate changes in the atmospheric forcing of the North Atlantic to changes in these water masses and test abyssal transport/mixing parameterizations in a regional model of the Labrador Sea/Baffin Bay system.

The planned cruise track consists of an initial transect of the Labrador Sea enroute to the northernmost CTD site. We expect to moor the acoustic sources at the beginning of the cruise as we transect the Labrador Sea. The mooring locations are given in Table 2. We will want to carry out these isolated mooring operations when we arrive at the site, regardless of the time of day provided the weather conditions are suitable.

The CTD locations are given in Table 1. Approximately 120 CTD stations are planned. CTD stations will be occupied to within 10 metres of the bottom every 30 mile or less along the sections. We will try to schedule our night time CTD work so that we are on site ready to commence mooring operations at 0600. The current meter moorings and the meteorological buoy (see Table 2) will be moored during the day. We want to deploy two moorings a day on two or three days while working the centre section (see Figure 2).

Overview of the Biological Program

The objectives of the biological program for HUDSON 96-026 are

(1) to provide a historical perspective on the large-scale distribution of the major plankton groups in the Labrador Sea for comparison with similar studies done in the mid-60's and mid 80's, and

(2) to provide information on other important biogeochemical properties of the region as background for the proposed Phase III of Canadian JGOFS.

Objective (1) will contribute to the debate about the link between northern fish stock declines and long-term changes in food chain structure. Objective (2) will contribute to DFO's role in Canadian Climate Change research.

Hydrographic Sampling Program

Will continuously sample Temperature, Conductivity, Pressure and Oxygen and velocity within a few metres of the bottom using a Seabird 911/Plus CTD system with a 12 khz bottom pinger and a 150 kHz RDI Acoustic Doppler Current Profiler (supplied by WHOI). Twenty-three depths will be sampled at all stations using a General Oceanics rosette system with ten litre sampling bottles. Additional depths may be sampled on some stations, time permitting.

Will measure the upper ocean velocity field along the ships track using an 150 kHz RDI ADCP and a GPS based navigation system.

Salinity samples from all depths will be analysed at sea using a Guildline Autosal Salinometer Model 8400 standardized using IAPSO standard water.

In situ temperature will be measured using mercury in glass and/or electronic thermometers at two or more depths on most casts. Thermometric depth will be determined when required.

Will freeze and store duplicate samples of water for later analysis of silicate, phosphate and total nitrate for all depths. Samples will be analysed at BIO upon return.

Will carry out oxygen analysis for all depths using an automatic titration system based on the Winkler technique. Duplicate samples will be collected from one or more rosette bottles on all stations.

Samples for Freon-11, Freon-12, Freon-113, carbon tetrachloride and methyl chloroform will be collected and analyzed at all depths on approximately 75% of the stations. Analysis will be done using an analytical system and procedure developed at BIO. We are limited by the analysis system to about 50 samples/day.

Samples for alkalinity and total carbonate will be collected and analyzed for all depths for approximately half of the stations. The number of analyses are limited by the analysis system. Total carbonate samples will be analyzed with a coulometric technique using a URI Somma extration system, total alkalinity by potentiometric titration.

Will attempt to recover through dragging operations, the partial mooring lost during recovery operations on Hudson 96006 (EXPOCODE 18HU96006/1).

Will set 4 current meter moorings across the Labrador slope offshore of Hamilton Bank.

Will moor 4 acoustic sources (supplied by WHOI) around the periphery of the Labrador Sea to provide the acoustic tracking for RAFOS floats to be released during this cruise and a winter WHOI cruise into the same area.

Will moor a meteorological buoy (supplied by Scripps) near the old Ocean Weather Station Bravo site in the west central Labrador Sea.

Will moor a acoustic transceiver mooring (supplied by WHOI) to complete a tomographic array set by IFM Kiel in August, 1996.

Will moor a profiling CTD system (supplied by WHOI) near the old Ocean Weather Station Bravo site in the west central Labrador Sea.

Will deploy 36 surface velocity drifters in the western and central Labrador Sea to measure sea surface temperature as well as surface velocity through the winter cooling season.

Will deploy 10 RAFOS floats supplied by University of Rhode Island.

Will deploy 57 ALACE floats supplied by Scripps and IOS, Pat Bay.

Will operate the bottom sounder and the ADCP between stations through out the cruise.

Biological Sampling Program

Will occupy biological stations (in most cases, coincident with hydrographic stations) which will consist of the deployment of the following gear:

- Net tows (winch room)
- CTD/rosette (winch room)
- Light meter at daytime stations (fore-deck)
- Pump profiles (quarter-deck)

The biological team will have responsibility for the following studies:

1. Erica Head (OSD/BIO) - macrozooplankton distribution, abundance and metabolism and biological stations.

2. Bill Li (OSD/BIO) - picoplankton distribution and abundance at biological stations.

3. Jeff Anning (OSD/BIO) - continuous (underway) measurements of solar radiation, and temperature, salinity, nitrate and chlorophyll levels in surface waters and primary production and biological stations.

4. Glen Harrison (OSD/BIO) - phytoplankton nitrate utilization underway and at biological stations.

5. Jay Bugden (for Paul Kepkay, OSD/BIO) - Dissolved organic carbon and plankton respiration at biological stations.

6. Kurt Clemente (for Glenn Cota, Old Dominion Univ.) - biooptical properties of upper ocean at daylight biological stations.

Hydrographic Data

The CTD data will be reduced to TSEAC messages using initial CTD calibration information and will be inserted onto the GTS within 30 days of the completion of the cruise.

The CTD and rosette data will be processed and delivered to the WHP Office as quickly as possible, hopefully within the prescribed time frames.

The lowered ADCP data will be processed and analyzed by Dr. Pickart of WHOI.

If the mooring dragging operation is successful, the current meters and Seacats on the mooring will be returned to BIO, the data translated and quality controlled. Initial statistics from this mooring will be delivered as quickly as possible to Bob Dickson for inclusion in his summary of long term current meter mooring statistics. Final edited and quality controlled data will be delivered to the WOCE Current Meter Data Centre.

Scientific Personnel

Name	Responsibility	Affiliation
J. Anning	Underway Sampling, photosynthesis	Ocean Sciences Division
L. Bellefontaine	Salts	Ocean Sciences Division
J. Bugden	DOC Levels, respiration rates	J&S Envirotech, Dartmouth
R. A. Clarke	Senior Scientist	Ocean Sciences Division
K. Clement	Ocean optics	Old Dominion University
B. Gershey	Scientist, CO_2, CFC's, Alkalinity	BDR Research, Dartmouth
G. Harrison	Assistant Scientist	Ocean Sciences Division
B. Hartling	Technician, moorings	Ocean Sciences Division
E. Head	Zooplankton	Ocean Sciences Division
M. Hingston	Technician, CO_2, CFC's, Alkalinity	BDR Research, Dartmouth
A. Isenor	Data Manager	Ocean Sciences Division
J. Lazier	Assistant Scientist	Ocean Sciences Division
B. Li	Bacteria	Ocean Sciences Division
J. Lilly		University of Washington
M. Poliquin	Oxygen	Polytech Sci Ser
P. Rhines	Scientist	University of Washington
P. Roussel		Dalhousie University
B. Ryan	Technician, CTD	Ocean Sciences Division
M. Visbeck	Scientist	Lamont
I. Yashayaev	Scientist, Data	Ocean Sciences Division

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Table 1. Planned Station Positions

Place	Latitude degrees and minutes		Longitude degrees and minutes		Stn No.
BIO	44	44.0	63	36.8	1
Biology 1	51	51.0	54	18.0	2
Biology 2	52	3.0	53	30.0	3
Biology 3	52	15.0	52	42.0	4
L4_01	52	27.0	51	54.0	5
L4_02	52	37.0	51	35.0	6
L4_03	52	45.0	51	13.0	7
L4_04	52	53.0	50	52.0	8
L4_05	53	3.0	50	25.0	9
L4_06	53	15.0	49	57.0	10
L4_07	53	27.0	49	29.0	11
L4_08	53	56.0	49	17.0	12
L4_09	54	23.0	49	0.0	13
L4_10	54	51.0	48	45.0	14
Sound S	55	0.0	48	42.0	15
L4_11	55	18.0	48	32.0	16
L4_12	55	47.0	48	17.0	17
L4_13	56	16.0	48	1.0	18
L4_14	56	43.0	47	45.0	19
L4_15	57	12.0	47	31.0	20
L4_16	57	38.0	47	15.0	21
L4_17	58	7.0	46	58.0	22
L4_18	58	33.0	46	43.0	23
L4_19	59	3.0	46	27.0	24
L4_20	59	22.0	46	15.0	25
L4_21	59	37.0	46	7.0	26
L4_22	59	52.0	46	0.0	27
Biology 4	60	7.0	45	53.0	28
Biology 5	60	7.0	45	53.0	28
Biology 6	61	34.0	49	36.0	29
L2_17	61	22.0	50	0.0	30
L2_16	61	12.0	50	20.0	31
L2_15	61	0.0	50	42.0	32

L2_14	60	46.0	51	8.0	33
Sound North	60	42.0	51	0.0	34
L2_13	60	24.0	51	50.0	35
L2_12	60	3.0	52	28.0	36
L2_11	59	40.0	53	9.0	37
L2_10	59	18.0	53	50.0	38
L2_09	58	55.0	54	30.0	39
L2_08	58	34.0	55	8.0	40
L2_07	58	13.0	55	47.0	41
Tomographic	58	0.0	55	30.0	42
Sound West	57	58.0	56	10.0	43
L2_06	57	50.0	56	24.0	44
L2_05	57	28.0	57	3.0	45
L2_04	57	11.0	57	34.0	46
L2_03	56	57.0	57	59.0	47
L2_02	56	46.0	58	18.0	48
L2_01	56	35.0	58	36.0	49
Biology 7	56	23.0	59	0.0	50
Biology 8	56	11.0	59	24.0	51
Biology 9	55	59.0	59	48.0	52
Biology 10	55	59.0	59	48.0	52
L3_01	53	40.8	55	33.1	53
L3_02	53	47.8	55	26.3	54
L3_03	53	59.3	55	15.0	55
L3_04	54	13.3	55	1.4	56
L3_05	54	29.5	54	45.4	57
L3_06	54	45.7	54	29.2	58
L3_07	54	57.3	54	17.6	59
L3_08	55	6.6	54	8.3	60
L3_09	55	15.9	53	59.0	61
L3_10	55	25.1	53	49.6	62
RL 2	55	27.0	53	46.0	63
L3_11	55	36.8	53	37.9	64
RL 3	55	42.0	53	32.0	65
L3_12	55	50.7	53	23.6	66
L3_13	56	6.9	53	7.0	67
RL 4	56	8.0	53	4.0	68

L3_14	56	32.2	52	40.7	69
RL_Bravo	56	45.2	52	27.4	70
L3_15	56	57.4	52	14.2	71
L3_16	57	22.6	51	47.3	72
L3_17	57	47.9	51	20.2	73
L3_18	58	13.1	50	52.7	74
L3_19	58	38.3	50	25.0	75
L3_20	59	3.6	49	56.8	76
L3_21	59	28.8	49	28.3	77
L3_22	59	45.1	49	9.8	78
L3_23	59	59.0	48	53.9	79
L3_24	60	10.6	48	40.5	80
L3_25	60	17.5	48	32.5	81
L3_26	60	22.2	48	27.1	82
L3_27	60	26.8	48	21.7	83
L3_28	60	33.8	48	13.6	84
Biology 11	60	33.8	48	13.6	84
L1_17	62	40.0	50	55.0	85
L1_16	62	28.0	51	18.0	86
L1_15	62	22.0	51	43.0	87
L1_14	62	7.0	52	13.0	88
L1_13	61	53.0	52	44.0	89
L1_12	61	42.0	53	13.0	90
L1_11	61	23.0	53	58.0	91
L1_09	61	4.0	54	42.0	92
L1_08	60	45.0	55	22.0	93
L1_07	60	27.0	56	8.0	94
L1_06	60	7.0	56	54.0	95
L1_05	59	47.0	57	38.0	96
L1_04	59	28.0	58	20.0	97
L1_03	59	8.0	59	5.0	98
L1_02	58	55.0	59	33.0	99
L1_01	58	45.0	59	54.0	100
Biology 12	58	23.0	60	39.0	101
Biology 13	58	11.0	61	3.0	102
Biology 14	57	59.0	61	27.0	103
Biology 15	57	59.0	61	27.0	103

L2.5_S	59	3.0	52	6.0	
L2.5_E	56	42.0	53	18.0	109
I3.5_S	55	9.0	57	54.0	
I3.5_E	57	54.0	49	6.0	115
Biology 16	57	54.0	49	6.0	115
L5_27	59	30.0	44	0.0	116
L5_26	59	15.0	44	0.0	117
L5_25	59	0.0	44	0.0	118
L5_24	58	30.0	44	0.0	119
L5_23	58	0.0	44	0.0	120
L5_22	57	30.0	44	0.0	121
L5_21	57	0.0	44	0.0	122
Sound East	56	42.0	44	0.0	123
L5_20	56	30.0	44	0.0	124
L5_19	56	0.0	44	0.0	125
L5_18	55	30.0	44	0.0	126
L5_17	55	0.0	44	0.0	127
L5_16	54	30.0	44	0.0	128
L5_15	54	0.0	44	0.0	129
L5_14	53	30.0	44	0.0	130
L5_13	53	0.0	44	0.0	131
L5_12	52	30.0	44	0.0	132
L5_11	52	0.0	44	0.0	133
L5_10	51	30.0	44	0.0	134
L5_09	51	0.0	44	0.0	135
L5_08	50	30.0	44	0.0	136
L5_07	50	0.0	44	0.0	137
L5_06	49	30.0	44	0.0	138
L5_05	49	0.0	44	0.0	139
L5_04	48	30.0	44	0.0	140
L5_03	48	0.0	44	0.0	141
L5_02	47	30.0	44	0.0	142
L5_01	47	0.0	44	0.0	143

Table 2. Planned Mooring Positions along AR7W

Mooring Type	Depth (metres)	Latitude		Longitude	
recovery Bravo mooring	3500	56	45	52	27
Profiling CTD mooring	3500	56	45	52	27
Meteorological mooring	3500	56	45	52	27
CM Mooring RL 2	2800	55	27	53	46
CM Mooring RL 3	3050	55	42	53	32
CM Mooring RL 4	3400	56	8	53	4
South Sound Source		55	0	55	42
West Sound Source		57	58	56	10
North Sound Source		60	42	51	0
East Sound Source		57	0	44	0
Tomographic mooring		58	0	55	30

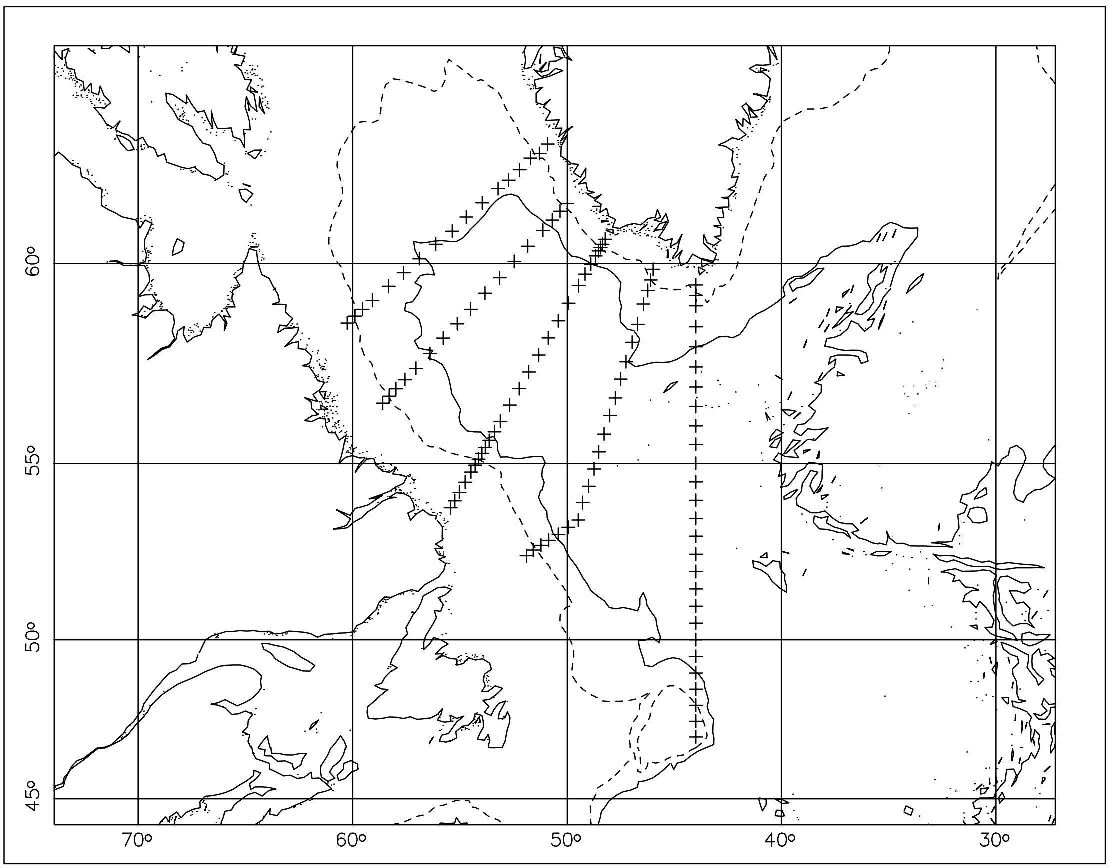

Figure 1. Initial CTD / rosette station plan, HUDSON 96026

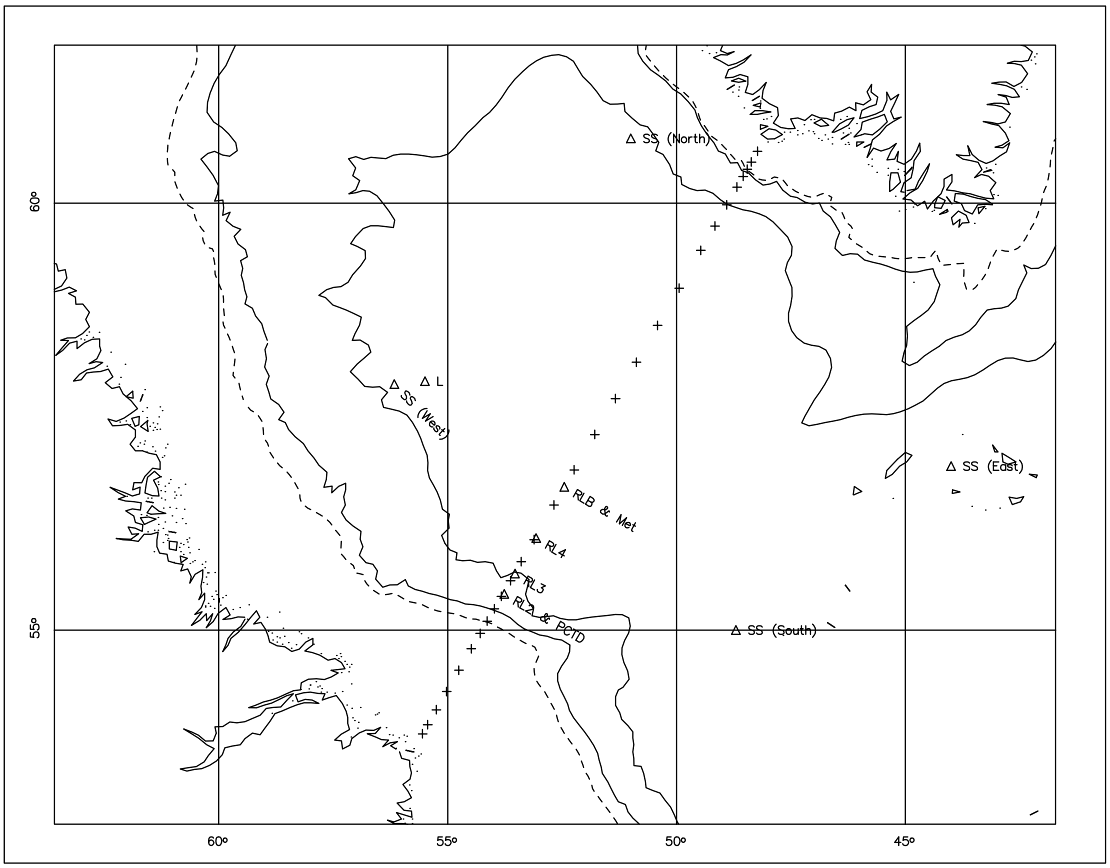

Figure 2: Mooring plan for Hudson 96026. Mooring locations marked by Δ's; +'s mark the positions of CTD / rosette stations along WOCE repeat section AR7W, the centre section of the five planned sections on figure 1. Moorings SS North, SS West and L are on the second CTD section, SS South is on section 4 and SS East is on section 5.