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Satellite-tracked Ice Beacon Program, 1999-2001

by

A. van der Baaren[•]

and

S. J. Prinsenberg

Ocean Sciences Division

Maritimes Region

Fisheries and Oceans Canada

Bedford Institute of Oceanography

P. O. Box 1006

Dartmouth, Nova Scotia

Canada, B2Y 4A2

[•] contractor, P. O. Box 1524, Wolfville, N. S., B0P1X0

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ABSTRACT

van der Baaren, A. and S. J. Prinsenberg. 2001. Satellite-tracked Ice Beacon Program, 1999-2001. *Can. Tech. Rep. Hydrogr. Ocean. Sci. 214*: x + 88 p.

For each winter from 1999 to 2001, ice beacons were deployed on landfast and mobile pack ice to measure ice and atmospheric properties. Four types of instruments were placed in the field: those that reported ice movement; those that measured ice pressure within floes, those that measured ice and air temperatures; and those that were equipped with anemometers to measure wind speed and direction and air temperature. Data were transmitted to satellites and relayed to the Bedford Institute of Oceanography for processing.

RÉSUMÉ

van der Baaren, A. and S. J. Prinsenberg. 2001. Satellite-tracked Ice Beacon Program, 1999-2001. *Can. Tech. Rep. Hydrogr. Ocean. Sci. 214*: x + 88 p.

Chaque hiver de 1999 à 2001, des balises ont été déployées sur des glaces de rive et des glaces mobiles afin de mesurer les propriétés de la glace et les propriétés atmosphériques. Quatre types d'instruments ont été placés sur le terrain : ceux signalant les mouvements de la glace, ceux mesurant la pression de la glace dans les floes, ceux mesurant la température de la glace et de l'air, et ceux munis d'anémomètres pour mesurer la vitesse et la direction du vent ainsi que la température de l'air. Les données recueillies étaient transmises par satellite et acheminées jusqu'à l'Institut océanographique de Bedford en vue de leur traitement.

1 INTRODUCTION

Field programs involving the study of sea ice properties were carried out in the Gulf of St. Lawrence during the winters from 1999 to 2001. These programs were extensions of similar programs from 1996-1999 (van der Baaren and Prinsenberg, 2000a). In addition, off the Labrador coast, GPS location beacons and pressure beacons were deployed during the winters of 2000 and 2001. This contract report presents positional information from the satellite-tracked ice beacons and atmospheric data. As well, it is a forum to present *insitu* ice/water samples taken at sea ice stations during beacon deployments and retrievals and CTD data from the Gulf of St. Lawrence. Most of the sea ice stations were used to groundtruth remotely observed ice property data by helicopter-borne sensors called EMProbe and IcePic (cf. http://www.mar.dfo-mpo.gc.ca/science/ocean/seaice/public.htm).

2 DATA COLLECTION AND PROCESSING

Satellite-tracked data are archived at the Bedford Institute of Oceanography and CTD data are archived within the Ocean Sciences Database.

2.1 GPS location beacons

GPS location beacons, manufactured by MetOcean Data Systems Ltd. and Seimac Ltd., both of Dartmouth, N. S., were deployed throughout the Gulf of St. Lawrence and off Labrador to provide hourly positional information. Beacon electronic components are contained within a sealed, fiberglass shell and the instrument is deployed such that the bottom section sits in a shallow ice hole. The beacons are designed to sink after the ice floe, on which they are deployed, melts, or they quit transmitting after 3 months. The battery pack of the beacons is capable of powering the internal components for at least 60 days at –35°C and 90 days at temperatures averaging –20°C. Systeme ARGOS satellites received the eight most recent hourly positions upon each pass. Beacon specifications and details of performance during stationery tests are given in van der Baaren and Prinsenberg (2000b).

Hourly GPS positions were translated from Systeme ARGOS data transmissions and spurious positions were edited. Hourly positions were compared to positions contained in Systeme ARGOS header information collected during satellite passes. All GPS positions and ARGOS header positions gave similar tracks for the beacons.

2.2 Meteorological beacon

MetOcean Data Systems, Ltd. of Dartmouth, N. S, manufactured the meteorological beacons deployed in the Gulf to measure wind vectors at various levels. The R. M. Young anemometers on the beacons computed 10-minute averages of wind speed and direction each hour at preset levels above the ice surface. Other sensors collected air temperature and air pressure. The beacons contained a Systeme ARGOS transmitter which transmitted the last six hourly atmospheric data to the Systeme ARGOS satellites as well as the beacon position during each pass. Displayed here are the positions recorded by Systeme ARGOS and stored in the headers for each satellite pass as well as

time series of wind vectors. The beacons were deployed with the purpose of measuring wind velocities at different levels over various ice surfaces. The data from 1999 were analyzed and variations in drag coefficients studied and presented in Prinsenberg and Peterson (2001).

2.3 Pressure beacons and temperature beacon

Satellite-tracked pressure beacons were deployed in 2000 and 2001 off Labrador as part of an ice pressure measurement program. The positions of the pressure beacons were recorded by Systeme ARGOS satellites and are displayed. Unfortunately, pressure data from the deployments were not usable.

A temperature beacon (beacon ID #1052) was deployed in Northumberland Strait in 2001. This beacon measured air temperature at 2 m and 6 m and recorded measurements for 6 hours before transmitting data to Systeme ARGOS satellites. Unfortunately temperature data from the beacon were unusable; only ARGOS positioning are reported here.

2.4 CTD

Conductivity (salinity), temperature, and depth (CTD) data were collected near beacon deployment locations. Scientists, who were dropped off on ice floes by helicopter, drilled holes through the ice and lowered the Seabird SBE-25 CTD probe to record water property data. The instrument's descent was by free-fall (gravity) and a gasoline-powered winch raised it. The accuracy/resolution of the instrument sensors is 0.004/0.0003°C for temperature, 0.0003/0.00004 Siemens/m for conductivity, and 0.25%/0.015% for depth (m). The range for each of the sensors is 0 S/m to 7 S/m for conductivity, -5°C to 35°C for temperature, and 60 m to 1000 m for depth. For a depth range of 2000 m to 10500 m, the accuracy/resolution is 0.15%/0.015% (Seabird Electronics, 1991).

2.5 *insitu* measurements

At many of the field stations, ice holes were drilled and floe thickness was measured and recorded. Salinity of snow/ice, brine, and water was also measured using an AO-10419 hand-held refractometer that reads to approximately ±0.5 psu (Peterson, *et al.*, 1995).

3 DATA

3.1 Satellite-tracked beacon locations and path of travel

3.1.1 1999 meteorological beacons

In 1999 two meteorological beacons were deployed side by side to make a meteorological station that measured wind speed and direction at three different altitudes. Beacon 5181 had its mast set at 2 m throughout the various deployments while beacon 4769 had its mast changed from 6 m to 4 m and finally to 2 m. The purpose of the experiment was to see effects of different ice surfaces on wind drag as well as effects of various anemometer heights on measurements when compared to a base height.

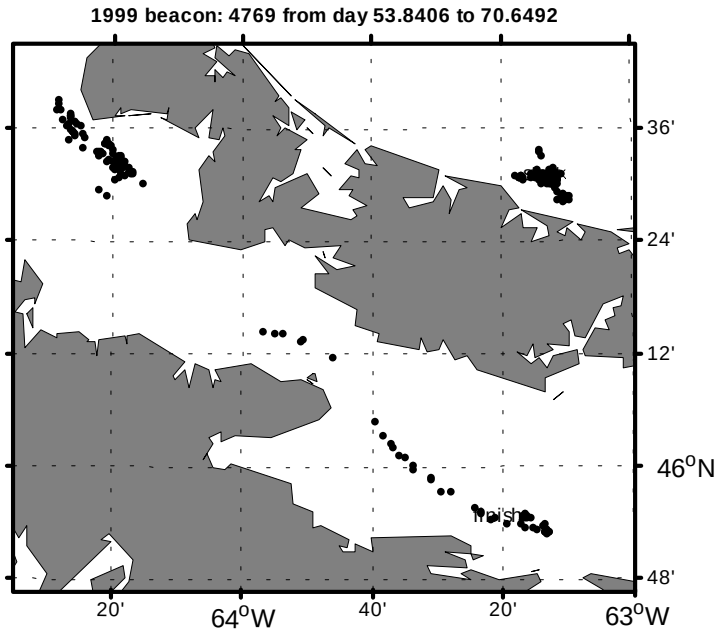


Figure 1 Beacon 4769 was initially deployed on February 22, at 46° 30.25'N, 63° 12.17'W, to measure wind speed and direction at 6 m. The sensor height was adjusted to 4 m and then later to 2 m. Beacon 5181, with sensor at 2 m, was placed beside beacon 4769 (Figures 6 - 8).

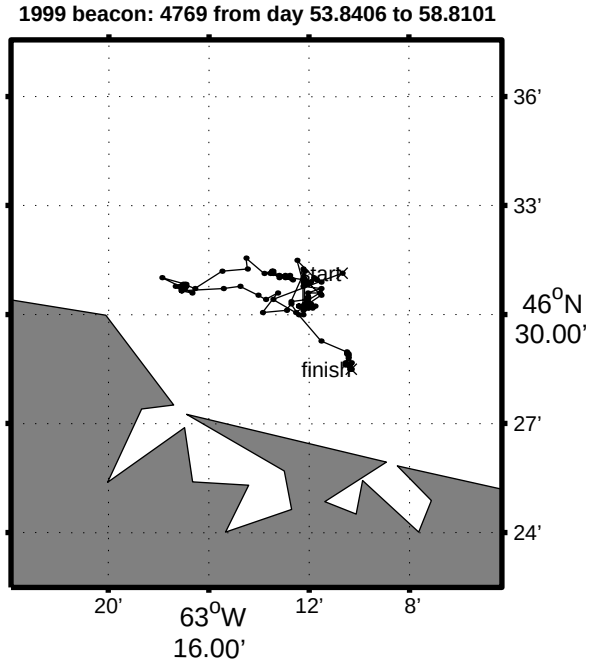


Figure 2 Enlargement of Figure 1 shows beacon 4769 north of Prince Edward Island; winds were blowing northerly or northwesterly except on February 25 (day 56) when winds were light southeasterlies.

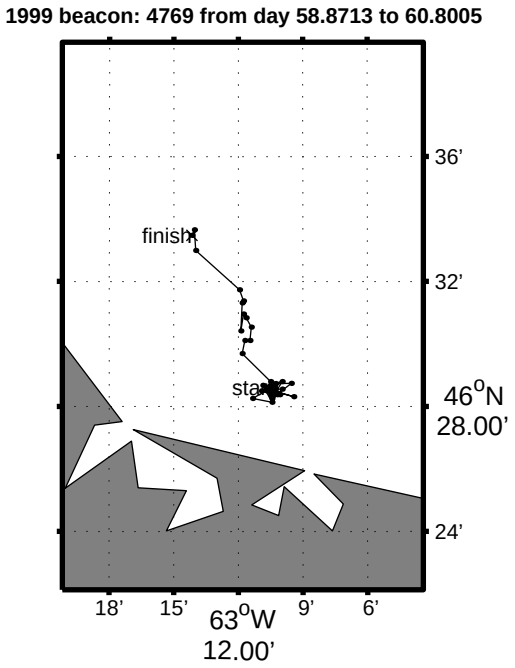


Figure 3 Beacon 4769 was recovered on March 1 while drifting to the northwest due to southeasterlies that day. The mast was moved from its initial 6 m to 4 m on February 24 and then to 2 m on February 27.

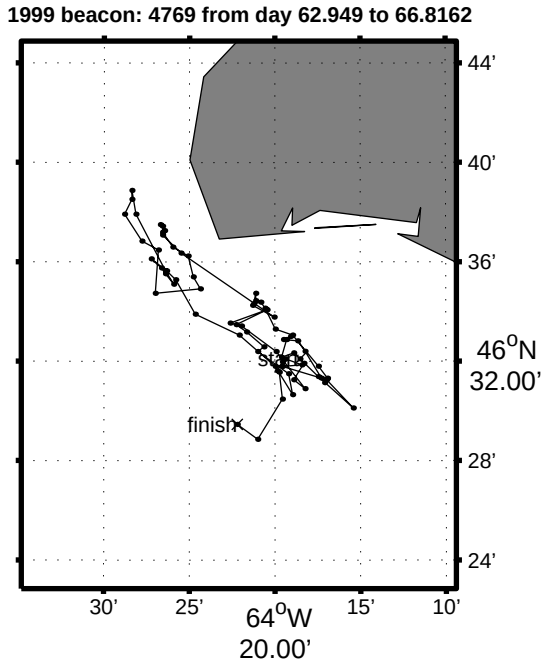


Figure 4 The meteorological beacons were redeployed on March 3 to west of Prince Edward Island.

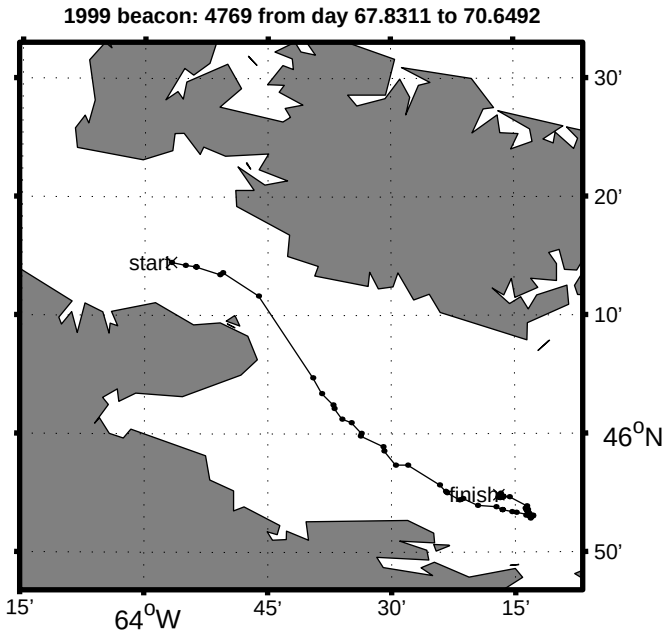


Figure 5 The station (beacons 4769 and 5181) was moved again and finally picked up on March 11.

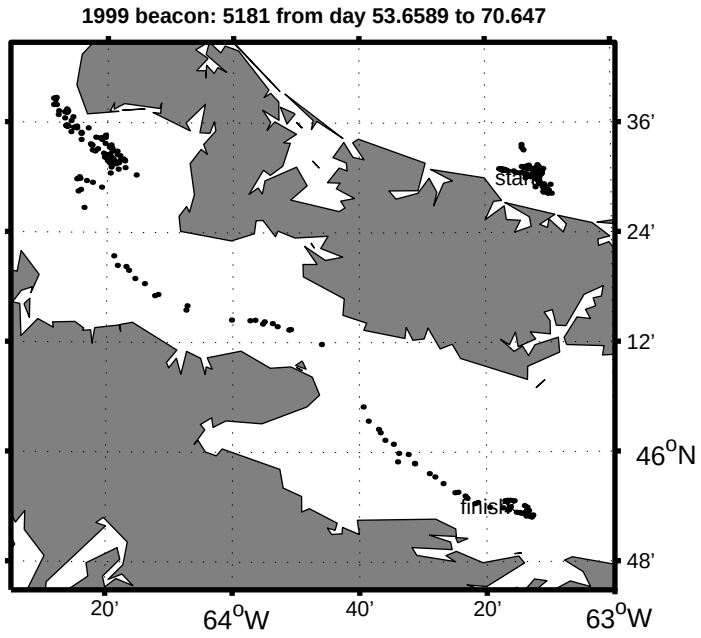


Figure 6 Beacon 5181 was deployed on February 22, at 46° 30.25'N, 63° 12.17'W, with its mast set at 2 m to measure wind speed and direction. The mast stayed at 2 m throughout this beacon's deployment. Its movements followed that of beacon 4769 since they were deployed side by side.

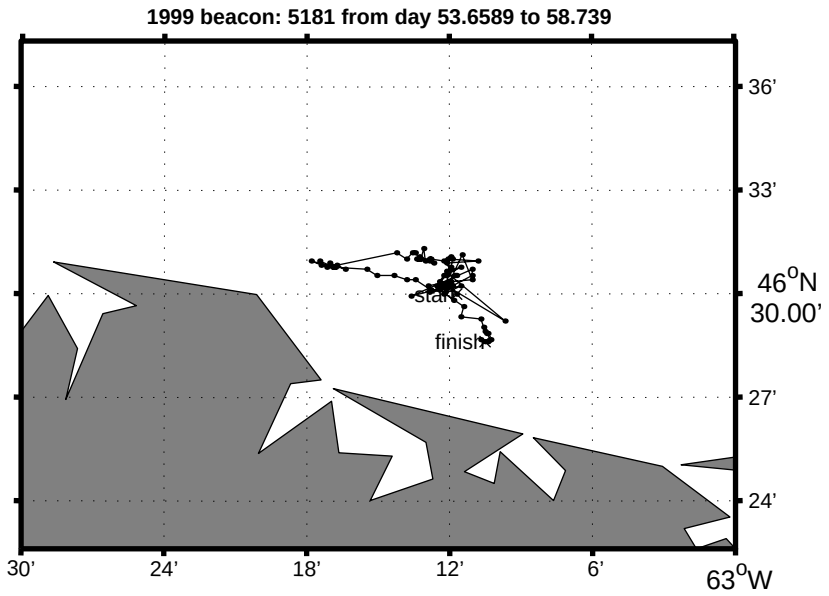


Figure 7 While beacon 5181 was north of Prince Edward Island, wind was blowing northerly or northwesterly except on February 25 when wind was a light southeasterly.

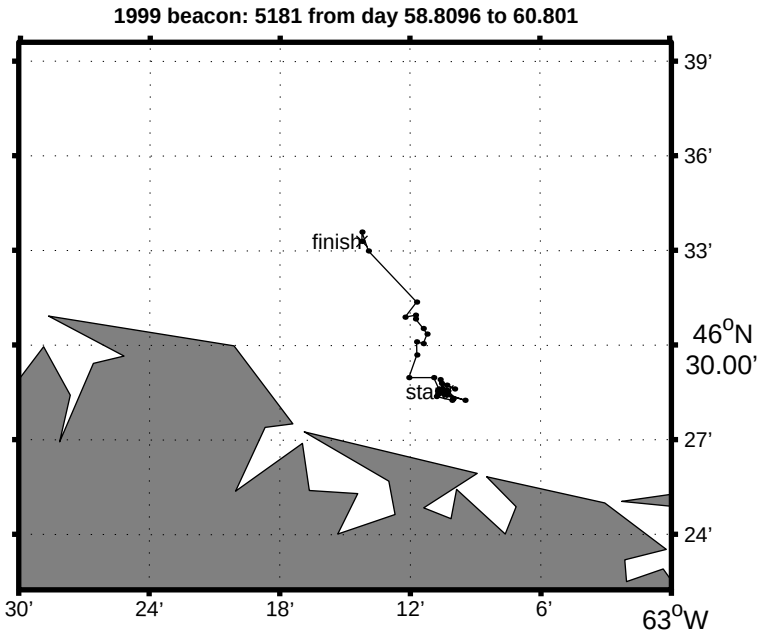


Figure 8 Beacon 5181 was recovered on March 1 while drifting to the northwest due to southeasterlies that day. Sensor height remained at 2 m.

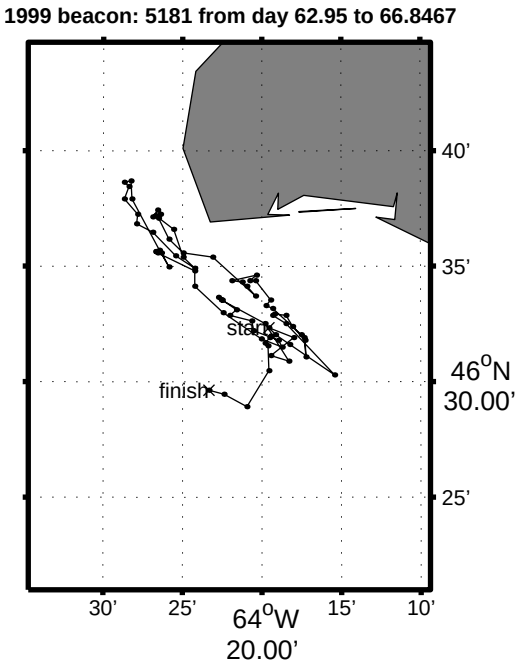


Figure 9 Beacon 5181 was moved with beacon 4769, on March 3, to west of Prince Edward Island.

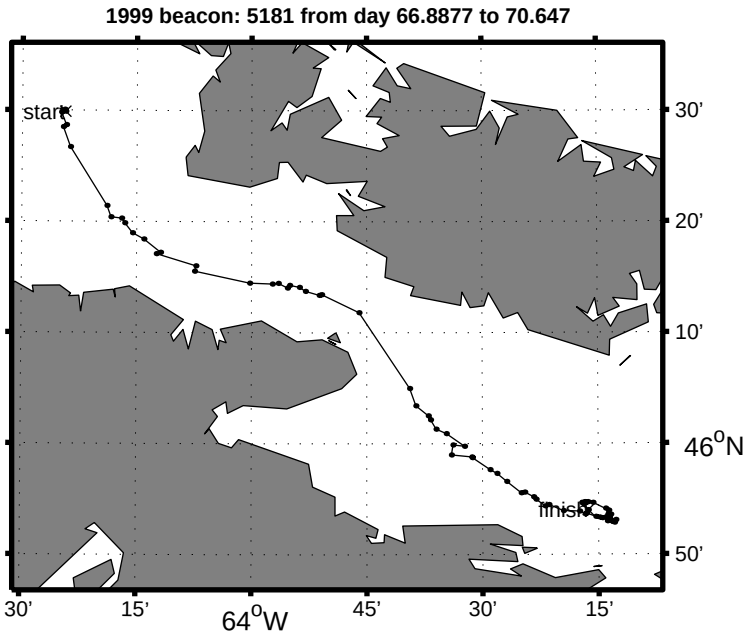


Figure 10 Beacons 5181 and 4769 were finally picked up on March 11.

3.1.2 1999 GPS location beacons

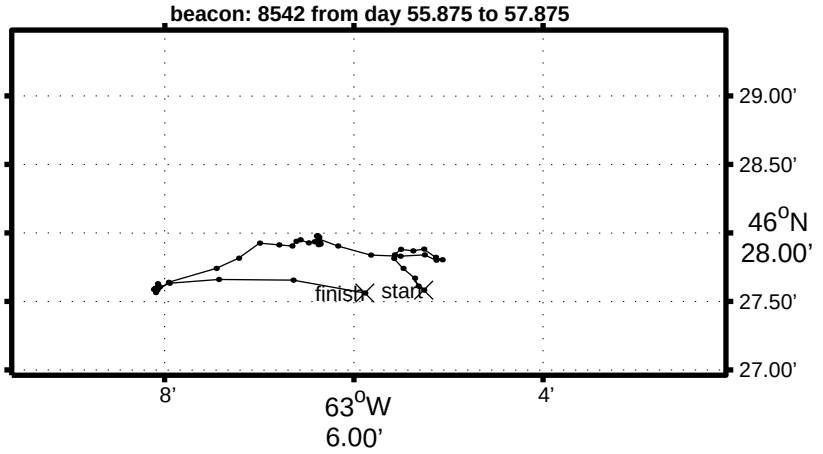


Figure 11 Beacon 8542 was deployed on February 24 at 17:50 AST near a ridge at 46.461°N and 63.083°W. It tracked the movement of a calibration line set out to validate helicopter-borne sensors.

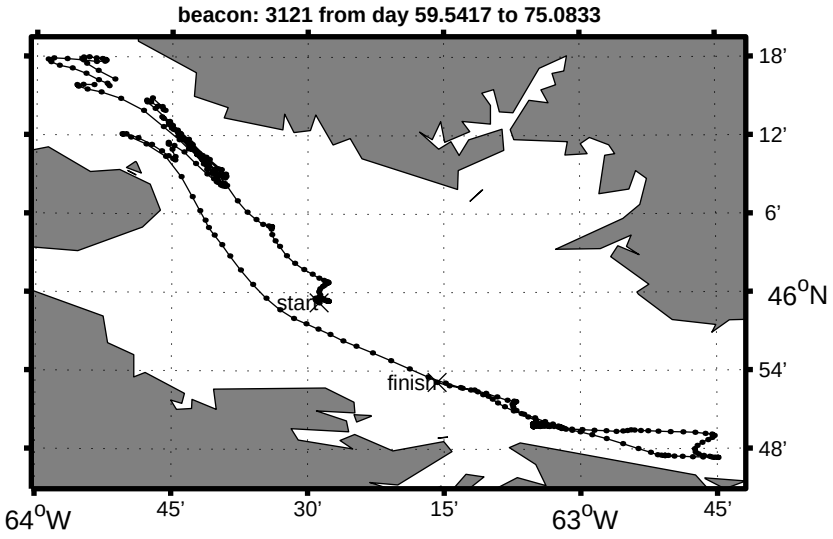


Figure 12 Beacon 3121 was deployed on February 28 at 9:40 AST. The floe size was 75 m x 75 m which was located at 45°59.24'N and 63°28.78'W. There was 35/36/40 cm of ice and no snow.

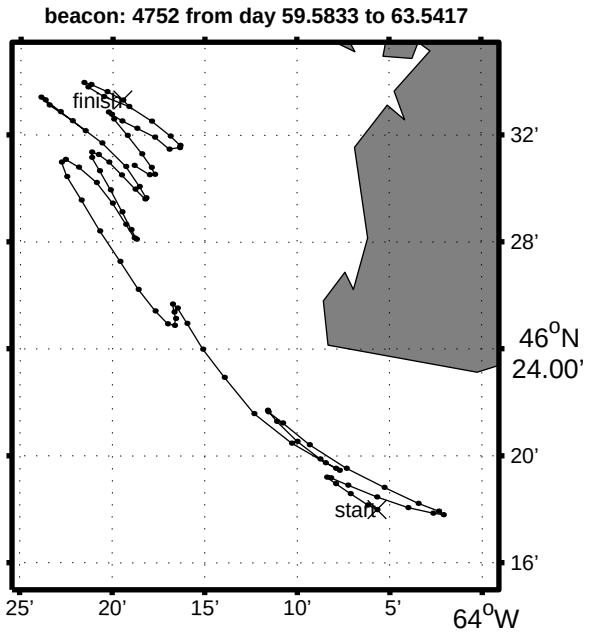


Figure 13 Beacon 4752 was deployed at 10:15 AST on February 28, west of Confederation Bridge. The floe size was 50 m x 50 m whereas larger floes in the area were 2 km x 3 km in size. There was 85/70/80 cm of ice and snow on the ice was 4-10 cm.

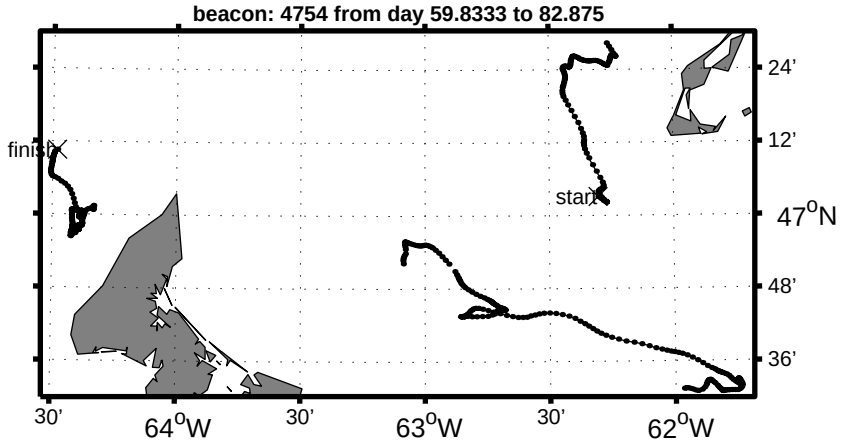


Figure 14 Beacon 4754 was deployed three times, in the Gulf of St. Lawrence, in 1999. It tracked possible sites for the deployment of meteorological beacons.

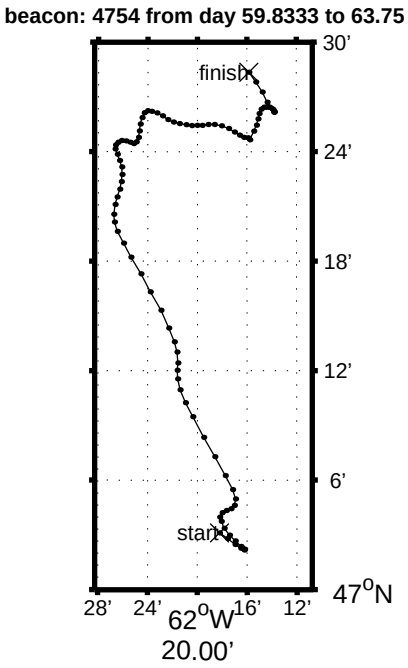


Figure 15 The first deployment of beacon 4754 was on February 28.

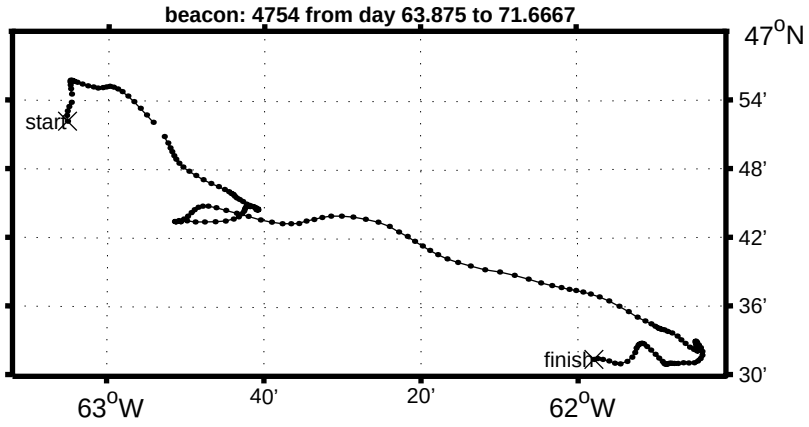


Figure 16 Beacon 4754 was picked up near the Magdalen Islands and redeployed closer to Prince Edward Island on March 4 at 16:55 AST. The new deployment was at 46°52.0'N and 63°10.0'W.

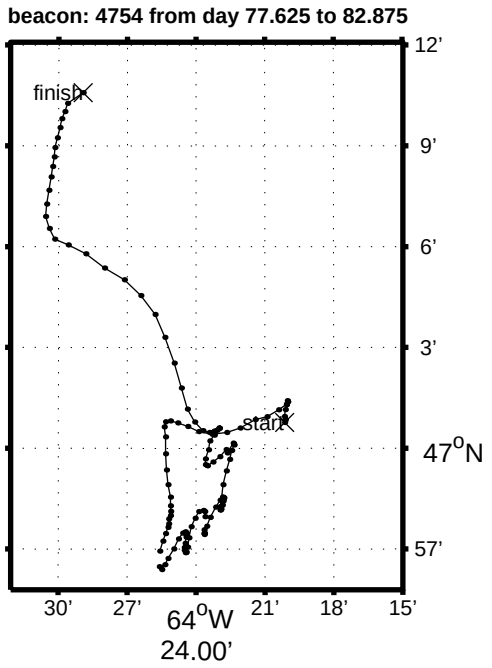


Figure 17 Beacon 4754 had its third deployment on March 18 at 11:10 AST. The ice was thin (35 cm) and ridged to $2m^{+}$ at the edge.

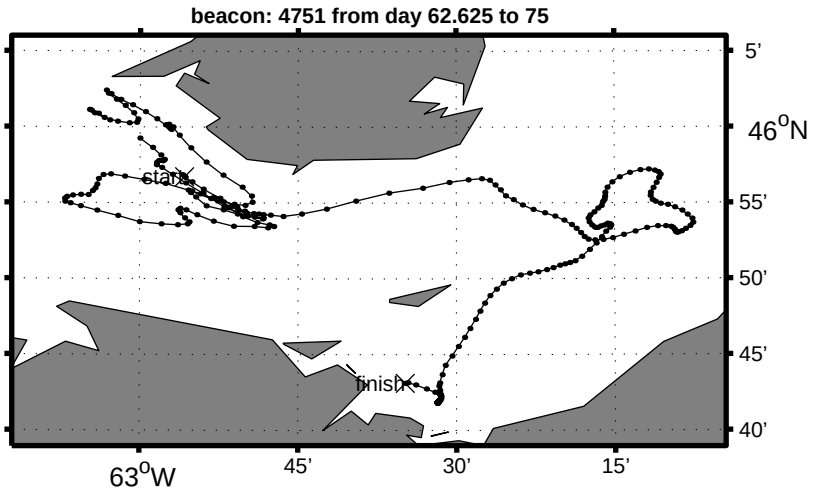


Figure 18 Beacon 4751 was deployed on March 3 at 11:10 AST, at 45°56.72'N and 62°55.79'W, south of Point Prim. The size of the floe was 150 m x 150 m with ice thickness at 28/30/28 cm (soft ice and no snow).

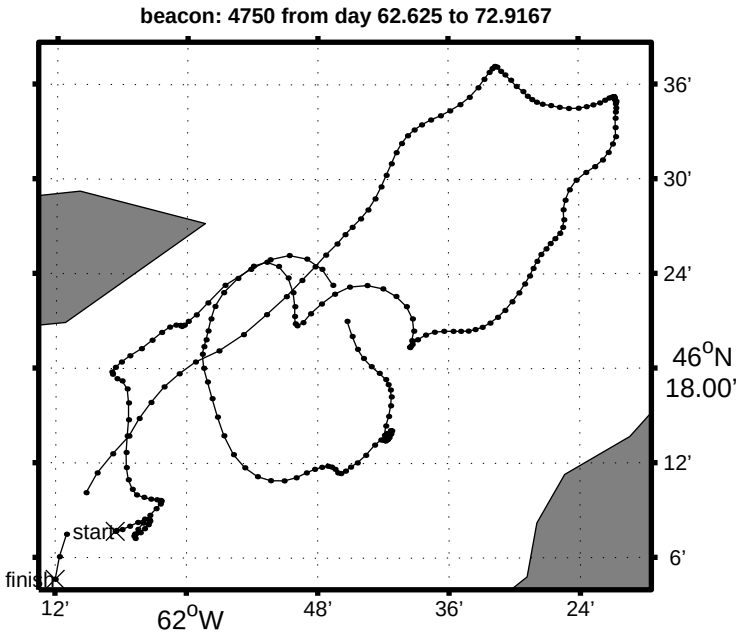


Figure 19 Beacon 4750 was deployed on March 3 at 11:50 AST at 46°07.72'N and 62°05.40'W. The ice thickness was 40/42/40 cm and the snow was crystal. The floe had a ridge to the southeast.

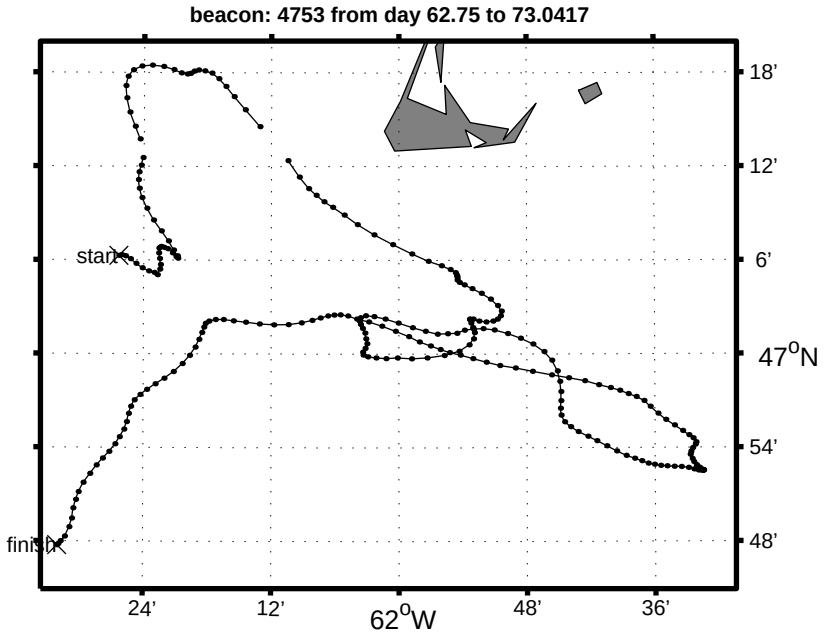


Figure 20 Beacon 4753 was deployed halfway between Prince Edward Island and the Magdalen Islands on March 3.

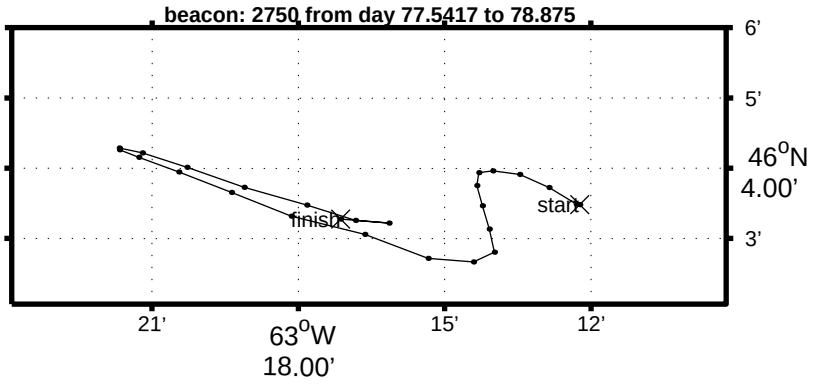


Figure 21 Beacon 2750 was deployed on March 18 at 9:55 AST, east of Confederation Bridge on a 1000 m x 1000 m large floe.

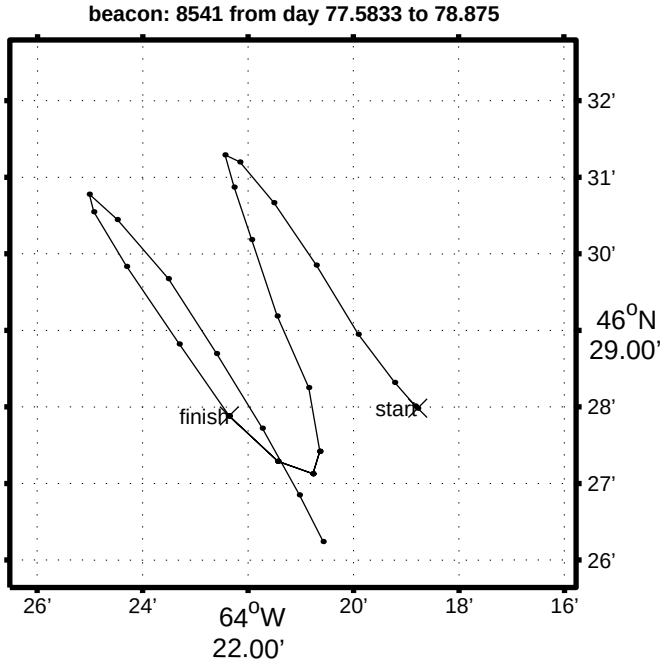


Figure 22 Beacon 8541 was deployed on March 18 at 10:35 AST, west of Confederation Bridge. The floe on which it was placed was small (50 m x 50 m), in the centre of the pan, below freeboard, and had a ridged edge.

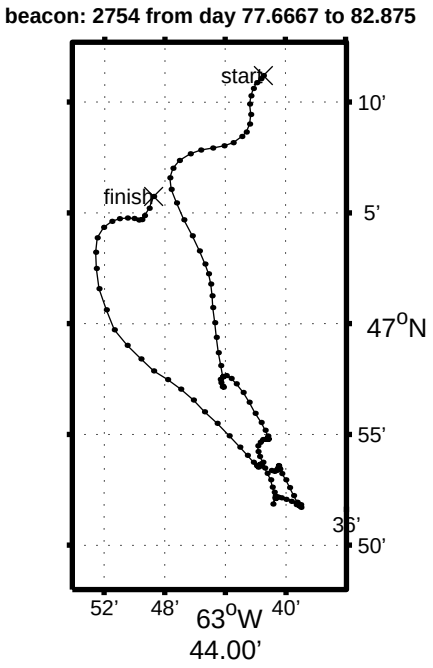


Figure 23 Beacon 2754 was deployed on a 100 m x 100 m floe between smaller floes. The floe was covered with 24 cm of snow/slush. The beacon was set out at 12:30 AST on March 18.

3.1.3 2000 meteorological beacons

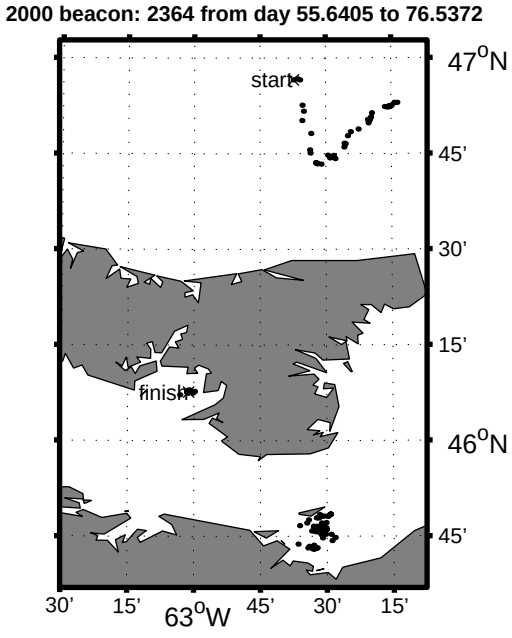


Figure 24 Beacon 2364 was initially placed on the ice on February 24, 2000. It was equipped with an R. M. Young anemometer at 120 cm height. This beacon was deployed as part of a station with beacons 4769 and 5181.

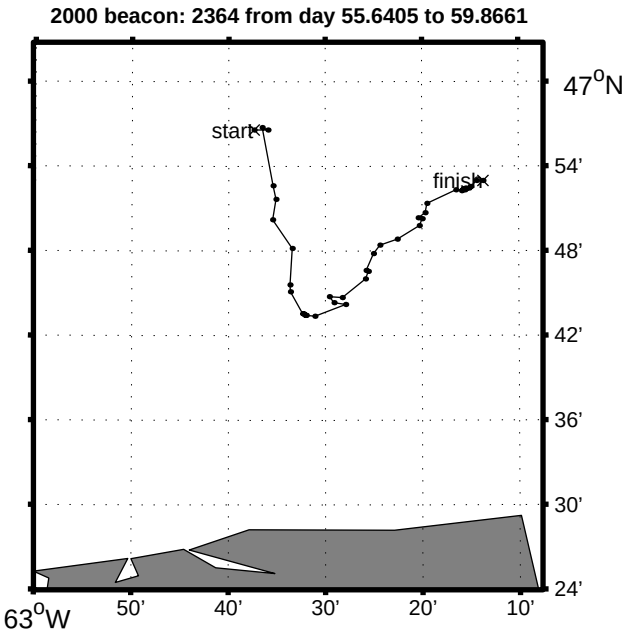


Figure 25 The meteorological station (beacons 2364, 4769, and 5181) was removed on February 28 to be redeployed.

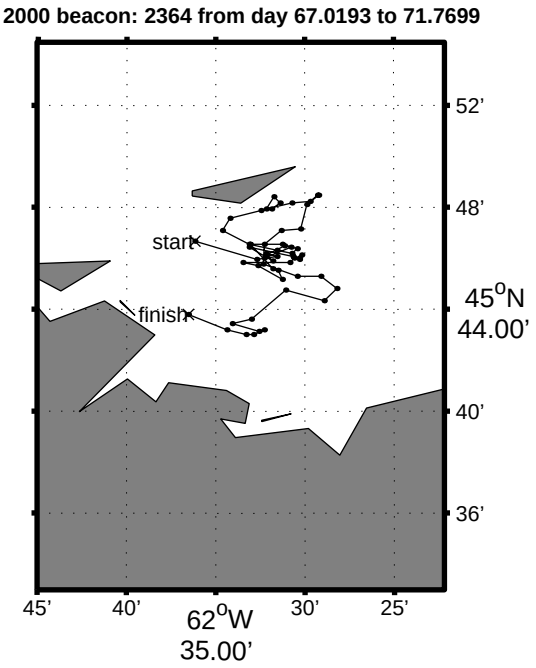


Figure 26 The meteorological station was deployed off Pictou Island, in Northumberland Strait, on March 6 (45°46.25'N 62°34.71'W). The mast on beacon 2364 was at 1 m initially and changed to 0.6 m on March 8.

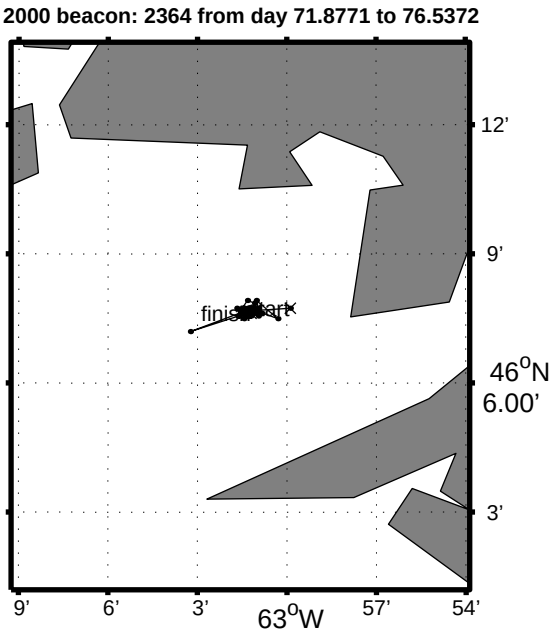


Figure 27 On March 11 the meteorological station was moved to Hillsborough Bay and was removed on March 16. The mast for beacon 2364 was set to 1 m.

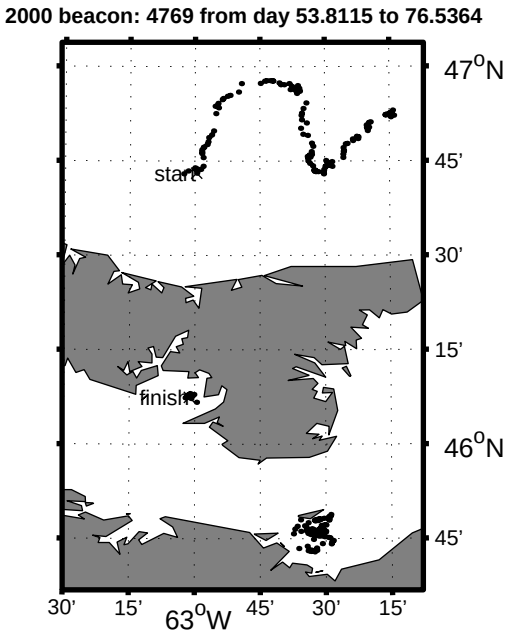


Figure 28 Beacon 4769 was initially deployed north of Prince Edward Island on February 22 at 46°43.48'N 63°01.28'W. It was then moved off Pictou Island, in Northumberland Strait, on March 6, 2000, and later to Hillsborough Bay on March 11.

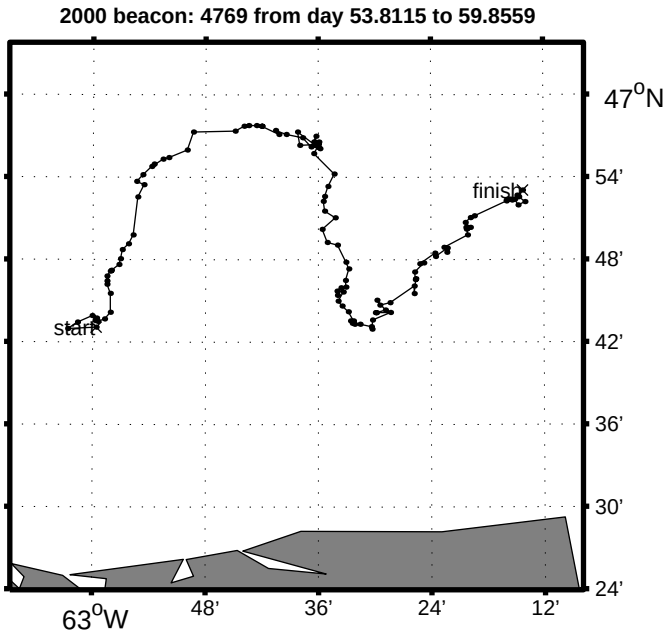


Figure 29 This beacon (4769) and beacon 5181 had drifted NE 40 mi by February 24. The meteorological station was removed on February 28.

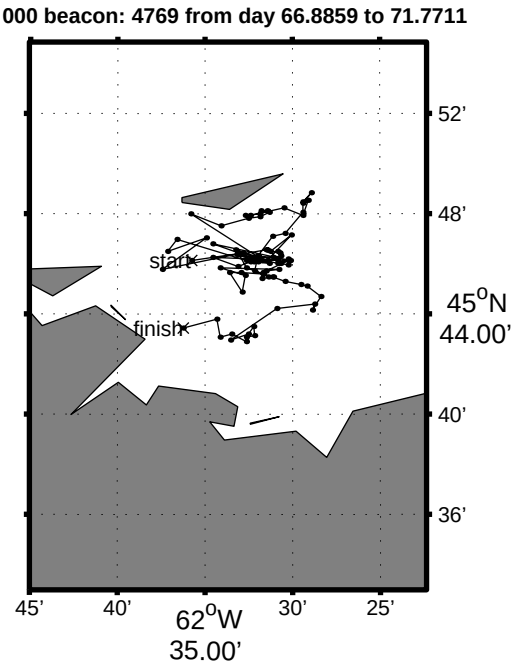


Figure 30 The meteorological station was deployed off Pictou Island, in Northumberland Strait, on March 6 (45°46.25'N 62°34.71'W). The mast on beacon 4769 was at 6 m initially and changed to 4 m on March 8.

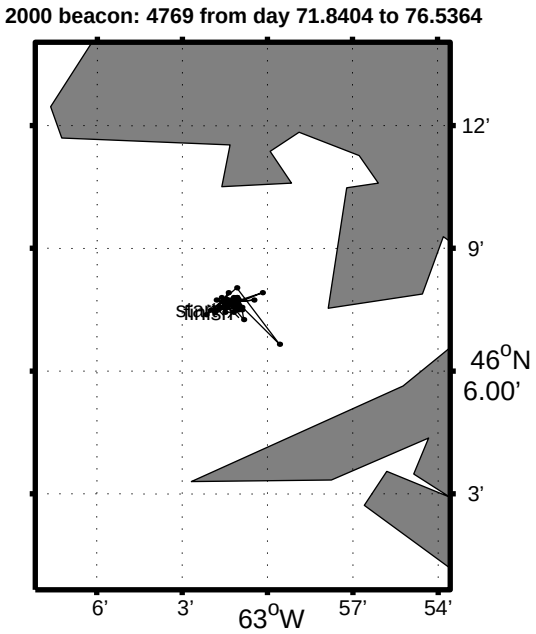


Figure 31 On March 11 the meteorological station was moved to Hillsborough Bay and was removed on March 16. The mast for beacon 4769 was set to 6 m.

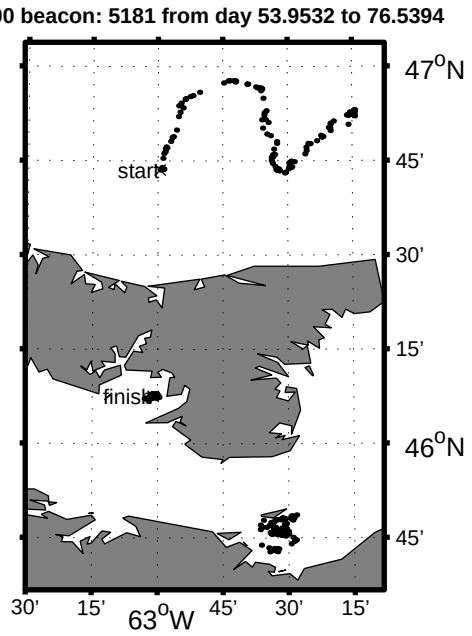


Figure 32 Beacon 5181, like beacon 4769, was initially deployed north of Prince Edward Island on February 22 (about 3 mi into the pack ice), then moved off Pictou Island on March 6, 2000, and later moved to Hillsborough Bay on March 11.

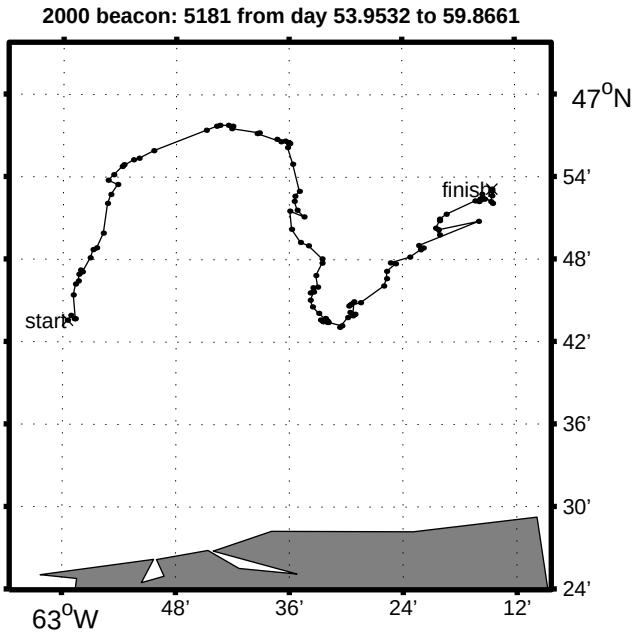


Figure 33 All three beacons (5181, 4769, and 2364) had drifted NE 40 mi by February 24. The meteorological station was removed on February 28.

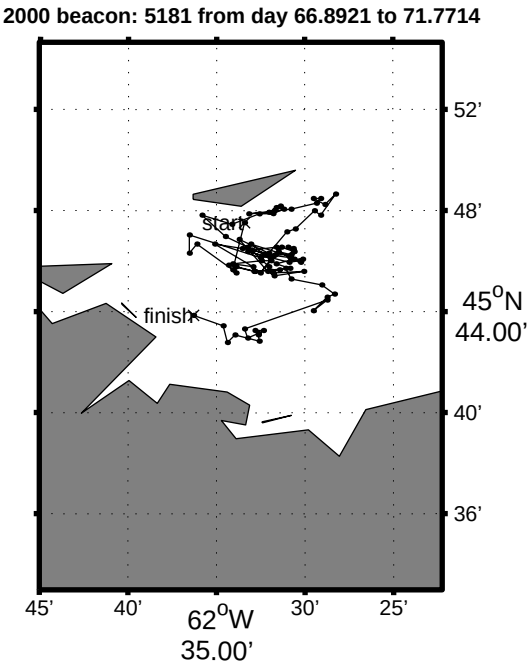


Figure 34 The meteorological station was deployed off Pictou Island, in Northumberland Strait, on March 6 (45°46.25'N 62°34.71'W). The mast on beacon 5181 was at 2 m.

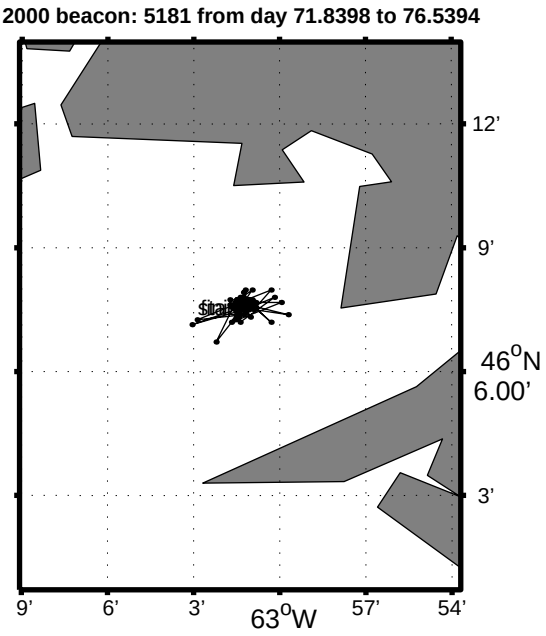


Figure 35 On March 11 the meteorological station was moved to Hillsborough Bay and was removed on March 16. The mast for beacon 5181 was set to 2 m.

3.1.4 2000 pressure beacons

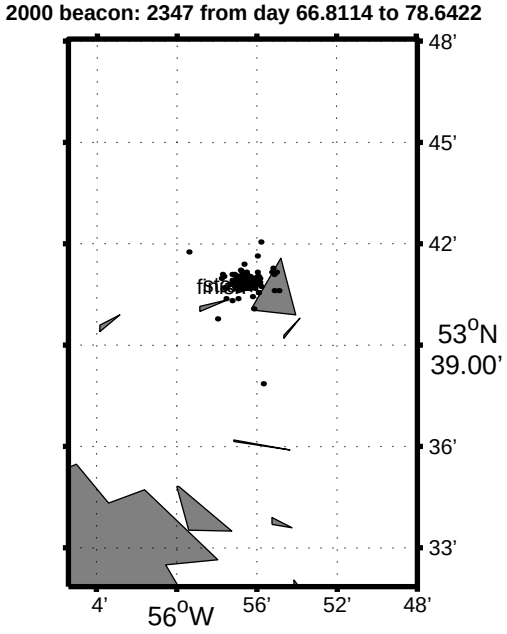


Figure 36 The pressure beacon, 2347, was part of a configuration to measure pressure in the pack ice off Labrador. It was deployed on March 6, 2000.

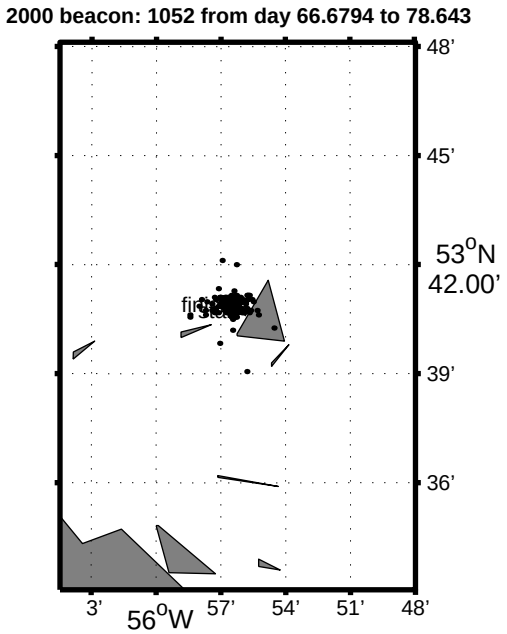


Figure 37 Pressure beacon, 1052, was deployed on 6 March 2000 off Labrador. Shown here are the positions recorded by Systeme ARGOS satellites in their record headers for each pass.

3.1.5 2000 GPS location beacons

GPS location beacons deployed in 2000 were manufactured by Seimac Ltd. Beacons were deployed in the Gulf of St. Lawrence to supplement the helicopter survey and off Labrador as part of the program to test ice pressure beacons.

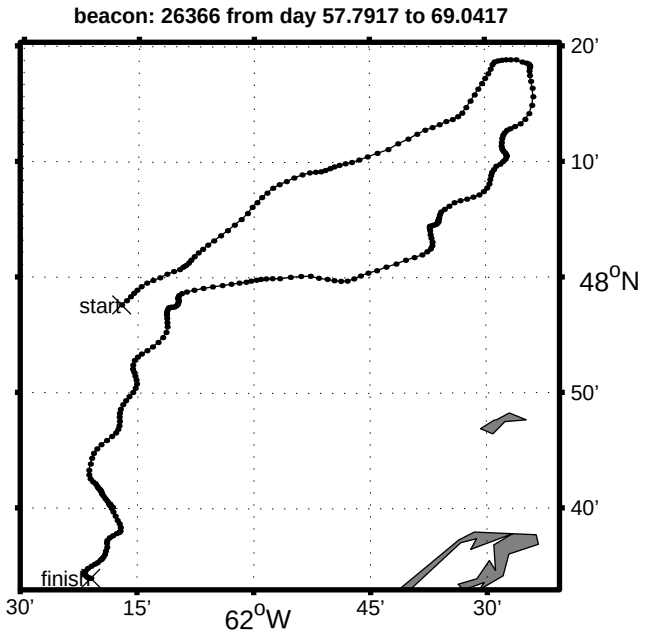


Figure 38 Plot of beacon positions where the positions are those taken from ARGOS data file header. No information is available on the deployment of this beacon.

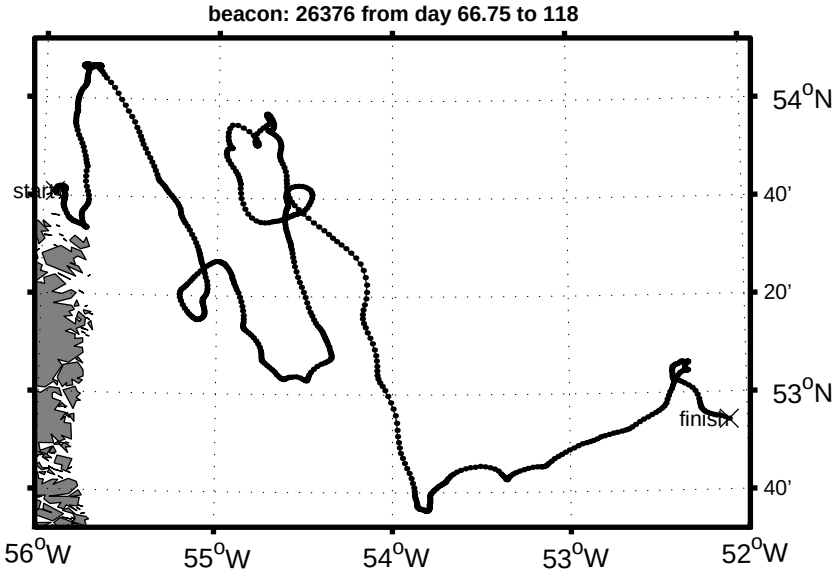


Figure 39 Beacon 26376 was deployed off the coast of Labrador in March 2000 at 53°41.855'N 55°56.029W on March 6, 2000.

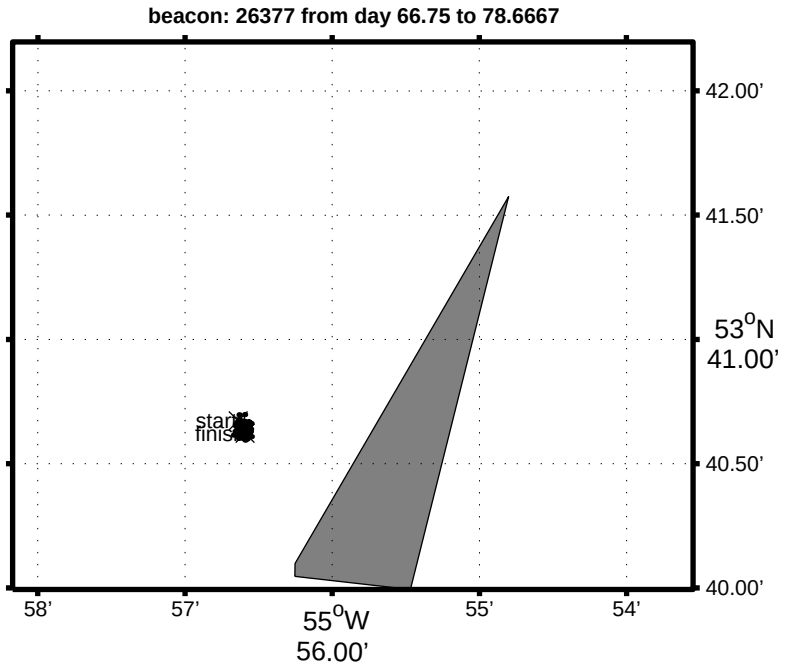


Figure 40 Beacon 26377 was deployed on landfast ice off Labrador on 6 March 2000 at 53°40.650'N 55°56.609'W.

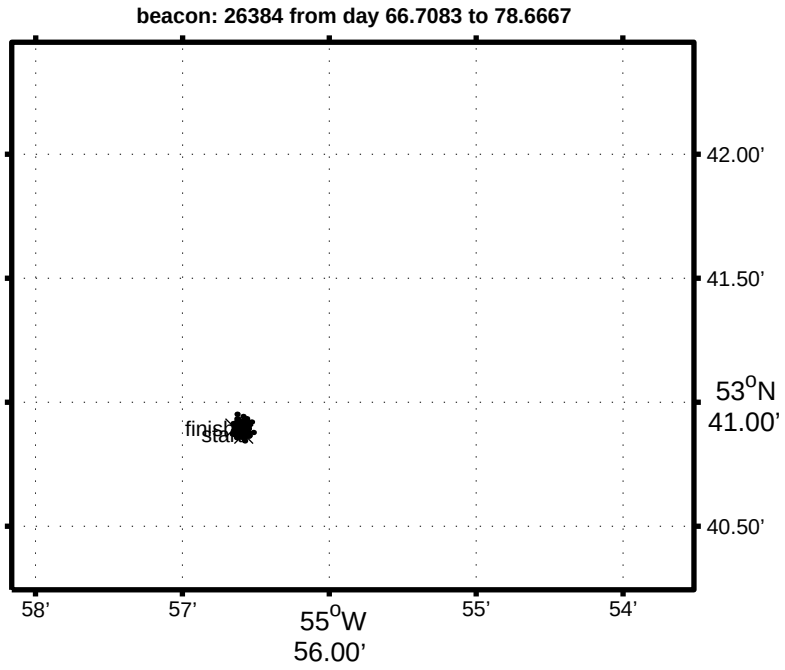


Figure 41 Hourly positions for beacon 26384 that was deployed off Labrador on 6 March 2000 at 53°41.094'N 55°56.613'W.

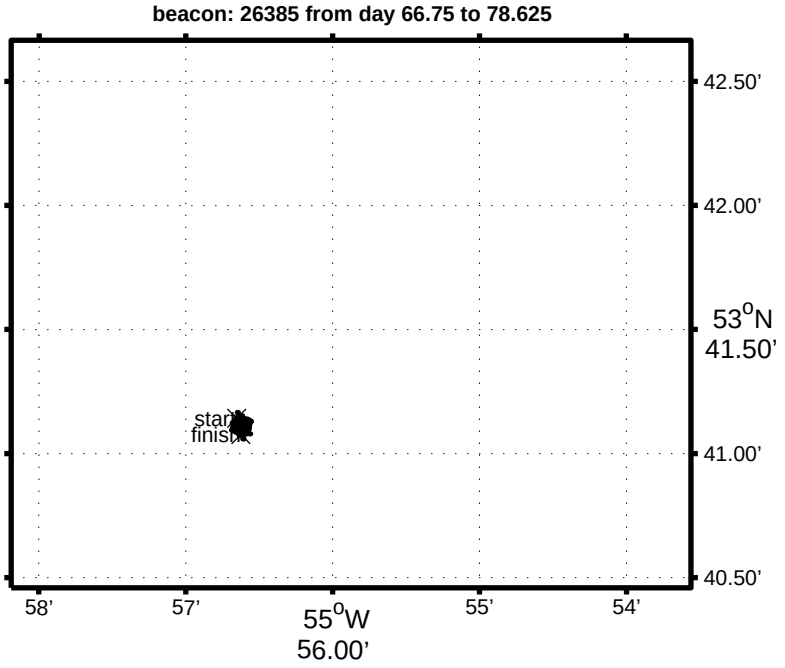


Figure 42 Beacon 26385 was deployed off Labrador on 6 March 2000. There is no further information on this deployment. Shown here are the positions recorded in the satellite pass header by Systeme ARGOS satellites.

3.1.6 2001 meteorological beacons

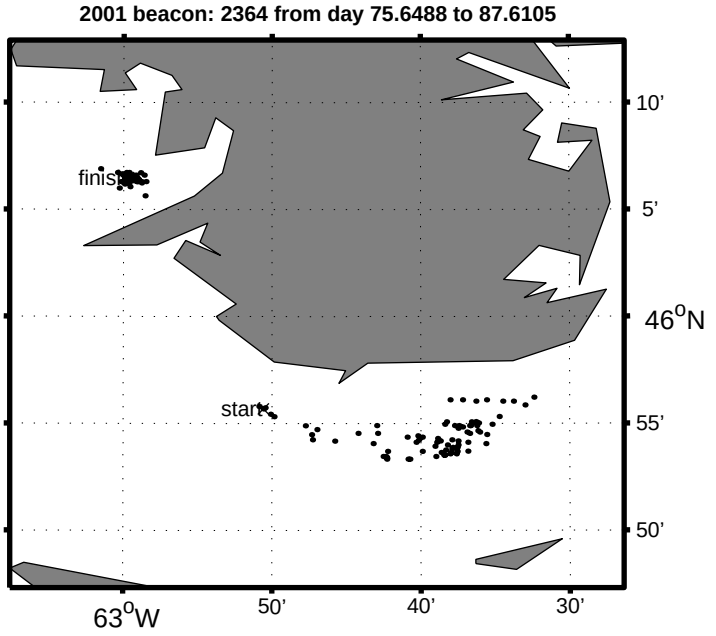


Figure 43 Beacon 2364 was deployed in Northumberland Strait on March 16, 2001 at 45°55.837'N 62° 50.915'W, near Pictou Island, with beacons 4769 and 5181. The beacon was deployed at 10:15 (AST).

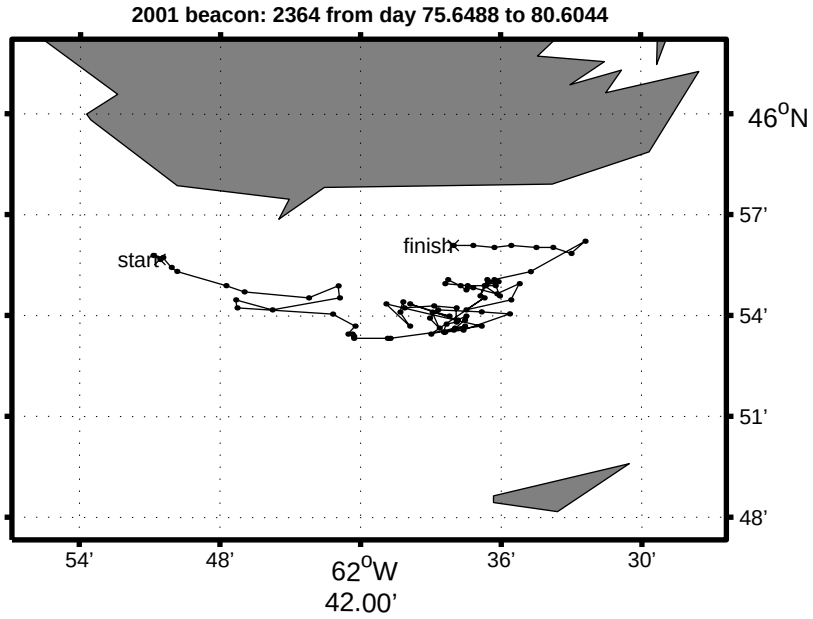


Figure 44 The anemometer on 2364 was at 1 m directed into a NW wind. Ice thickness was about 75 cm in a small flat area (40 m x 30 m).

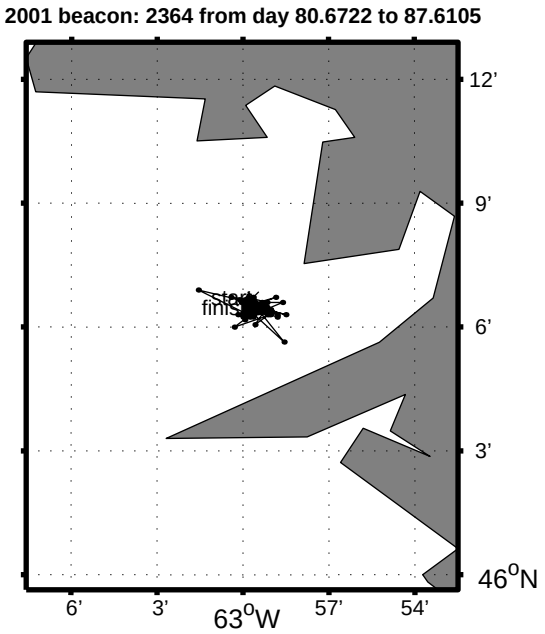


Figure 45 Beacon 2364 was moved to Hillsborough Bay on March 21, 2001 at 12:30 AST.

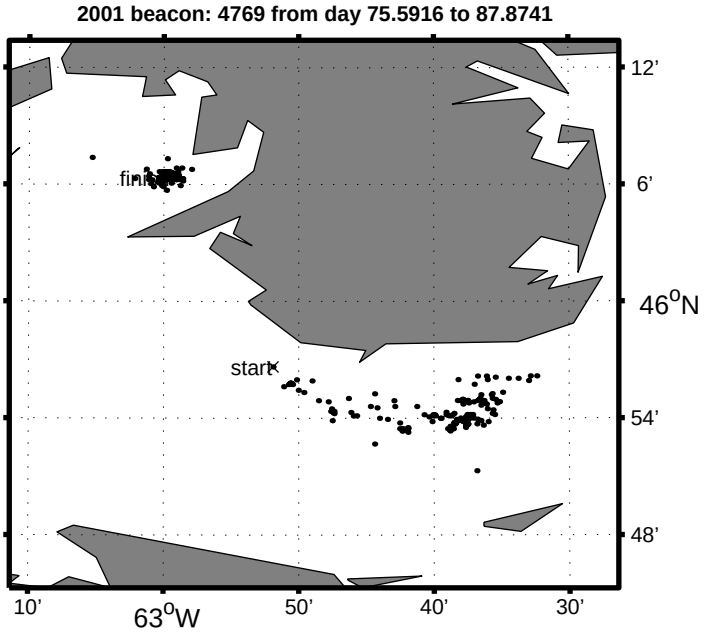


Figure 46 Beacon 4769 was deployed in Northumberland Strait on March 16, 2001 at 45°55.837'N 62° 50.915'W, near Pictou Island, with beacons 2364 and 5181. The beacon was deployed at 10:15 (AST).

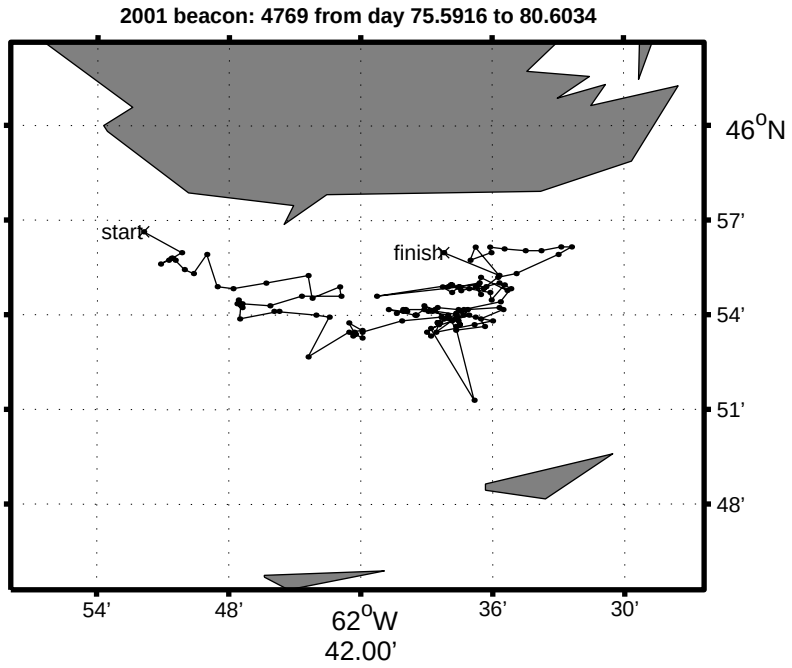


Figure 47 The anemometer on beacon 4769 measured winds at 6 m. This beacon was deployed with 2364 and 5181.

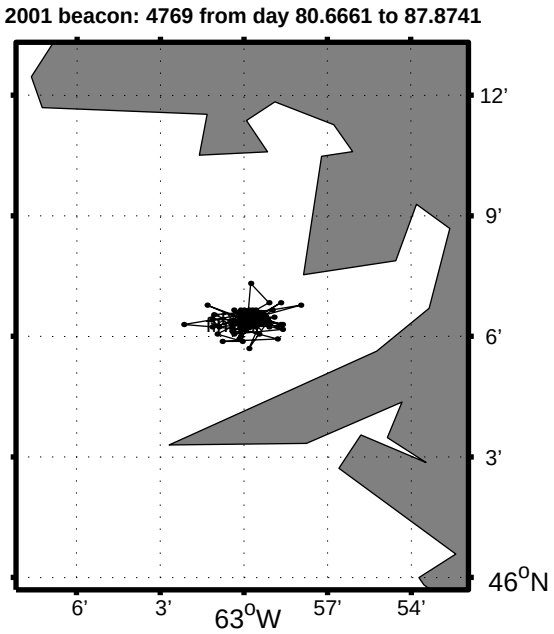


Figure 48 Beacon 4769 was moved to Hillsborough Bay from Pictou Island on March 21, 2001 at 12:30 AST.

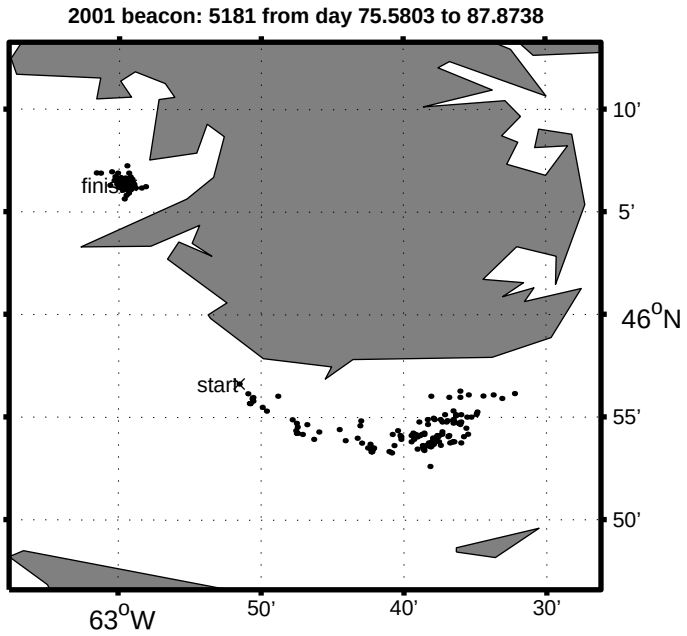


Figure 49 Beacon 5181 was deployed in Northumberland Strait on March 16, 2001 at 45°55.837'N 62° 50.915'W, near Pictou Island, with beacons 4769 and 2364. The beacon was deployed at 10:15 (AST).

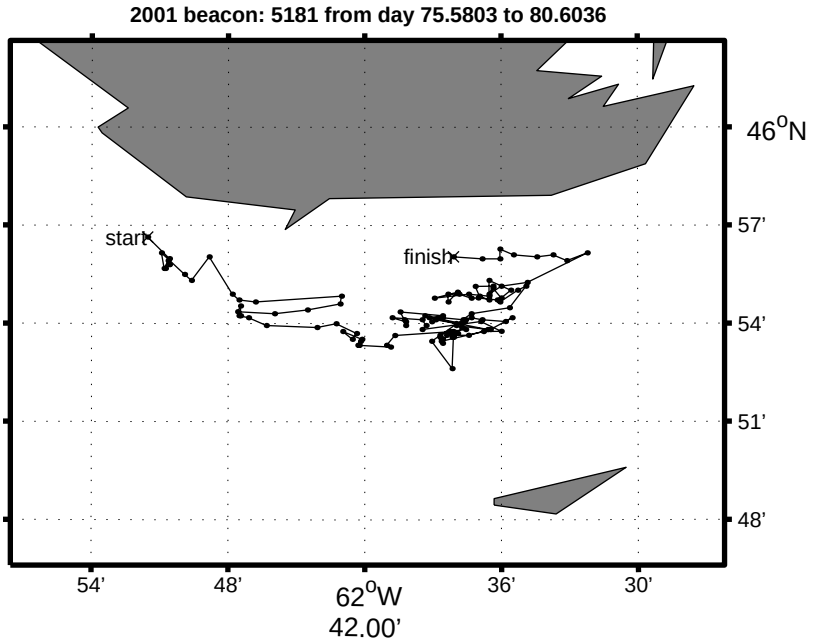


Figure 50 The anemometer on beacon 5181 measured winds at 2 m. This beacon was deployed with 2364 and 4769.

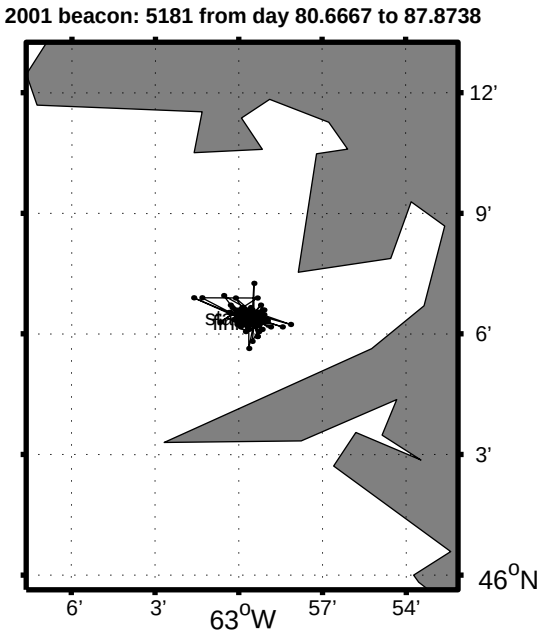


Figure 51 Beacon 5181 was moved to Hillsborough Bay from Pictou Island on March 21, 2001 at 12:30 AST.

3.1.7 2001 pressure beacons

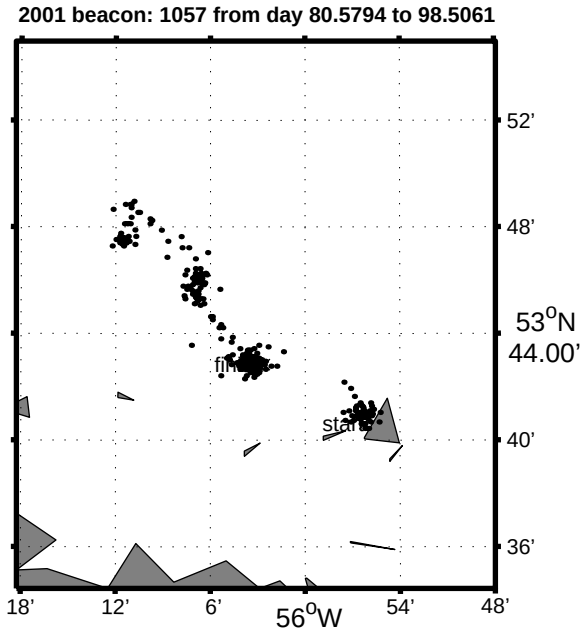


Figure 52 This beacon, 1057, was deployed twice off Labrador.

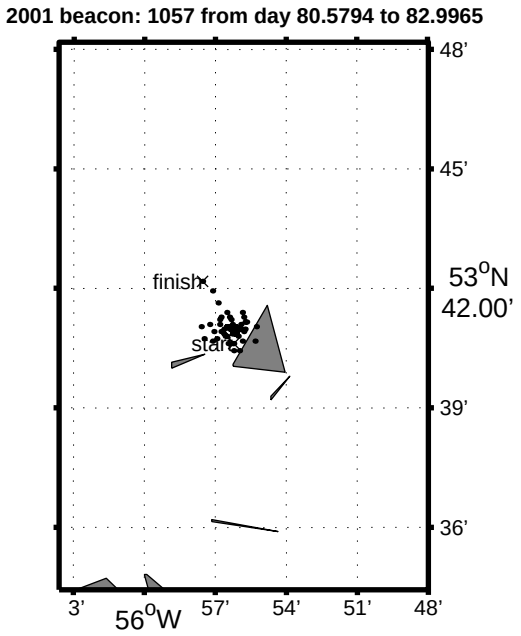


Figure 53 This beacon was deployed off Labrador on March 21, 2001. It was part of an experiment to measure ice pressure within the pack ice. Deployment position was 53°40.981'N 55° 56.296'W.

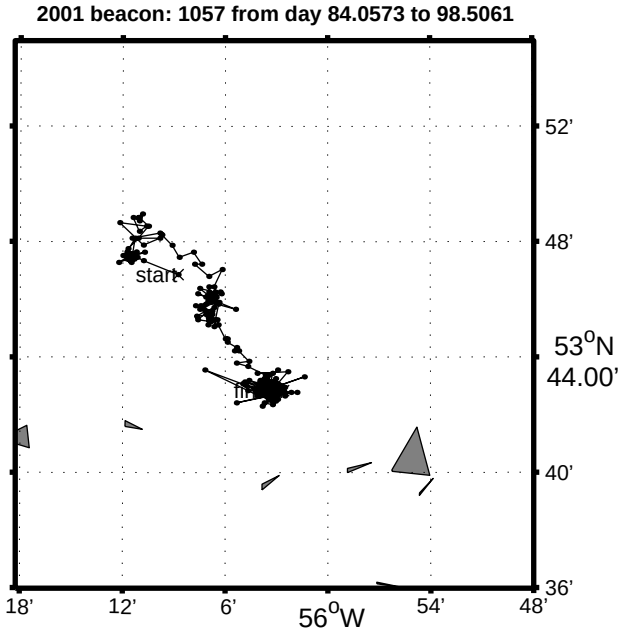


Figure 54 Beacon 1057 was moved on 25 March to a more northerly point whereby it travelled southwards for several days.

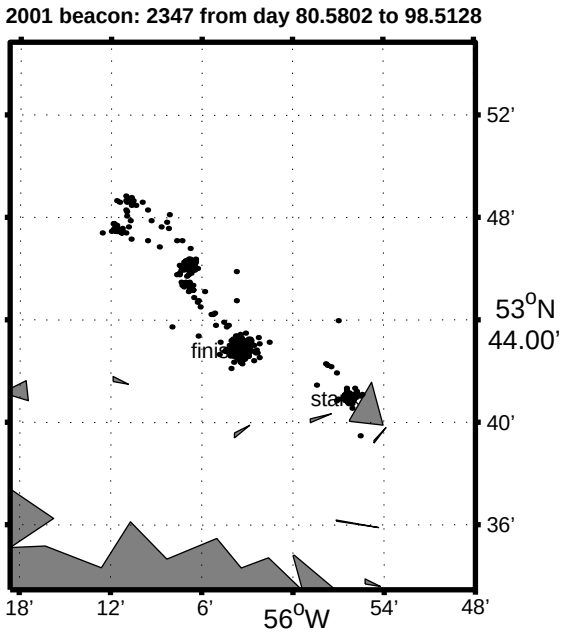


Figure 55 Beacon 2347 was deployed twice off Labrador.

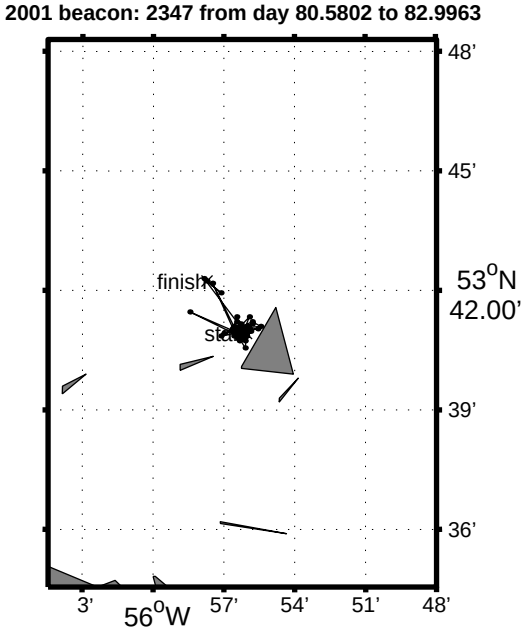


Figure 56 Beacon 2347 was deployed near beacon 1057 on March 21, 2001 at 53°714'N 56°067'W.

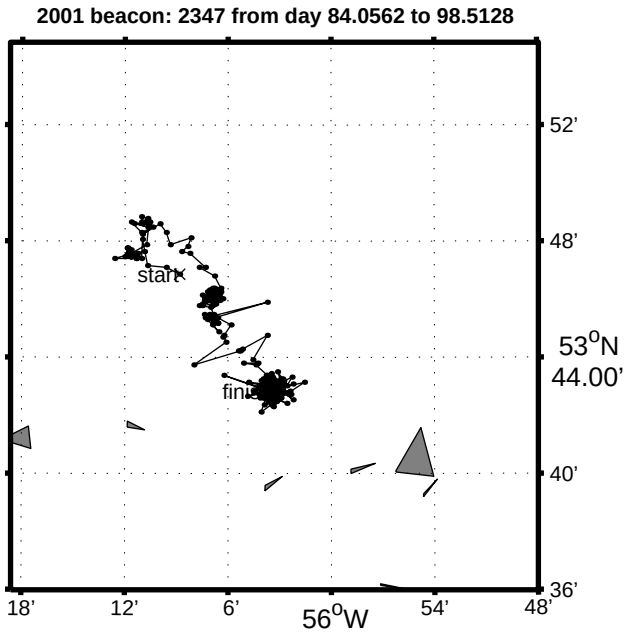


Figure 57 The second section of beacon 2347's deployment follows a pattern similar to that of beacon 1057.

3.1.8 2001 temperature beacons

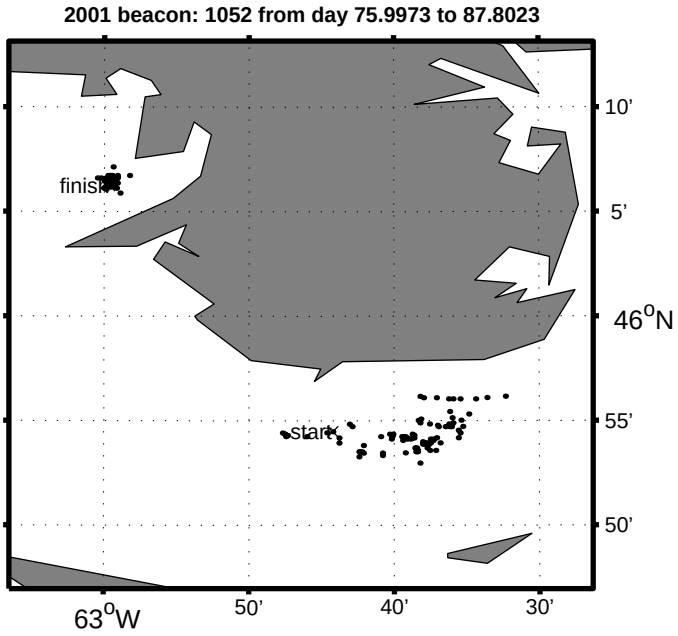


Figure 58 The temperature beacon, 1052, was deployed twice in the Northumberland Strait with the meteorological beacons 2364, 4769, and 5181.

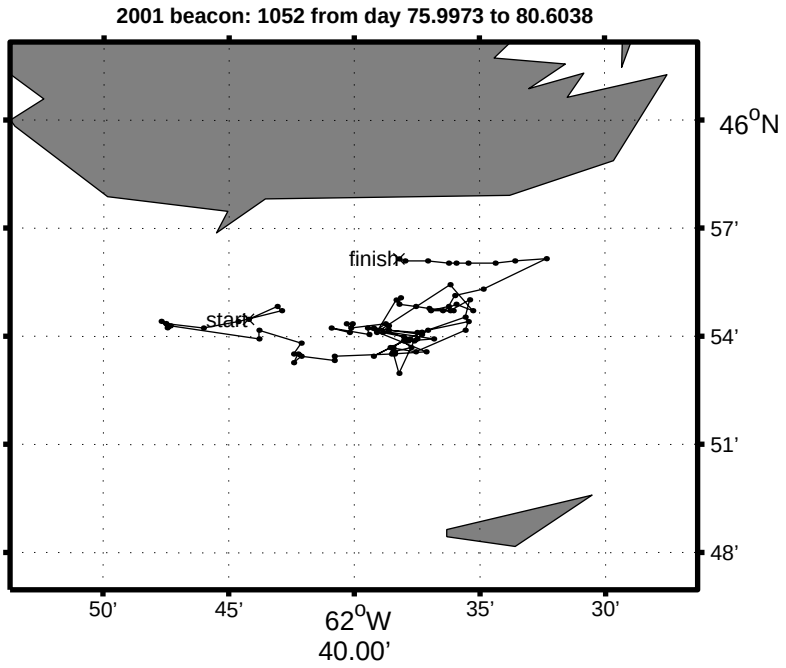


Figure 59 Beacon 1052 was deployed with the meteorological beacons near Pictou Island in the Northumberland Strait to measure temperatures at 2 m and 6 m. Deployment time was March 16, 2001 at about 10:00 AST; position was 45°55.837'N 62°50.915'W.

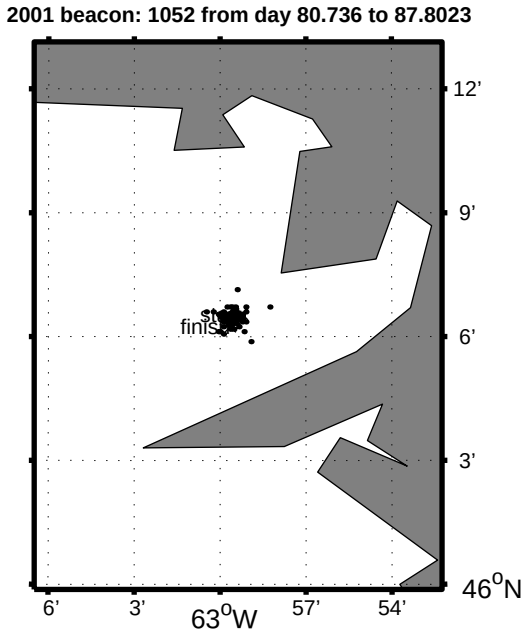


Figure 60 This temperature beacon was moved, with the meteorological stations, to Hillsobourough Bay on March 21, 2001. All beacons were out by 12:30 AST.

3.1.9 2001 GPS location beacons

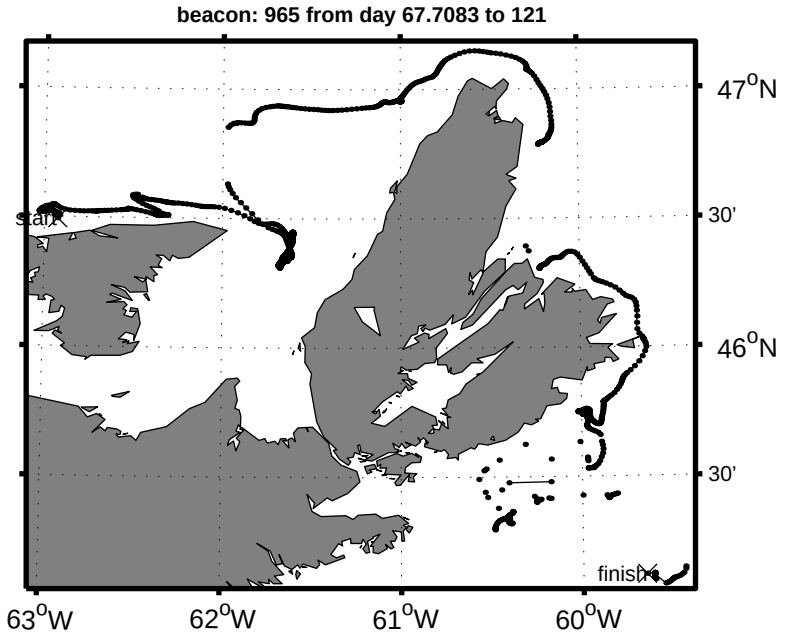


Figure 61 Beacon 965 was deployed on 8 March 2001 in the Gulf of St. Lawrence.

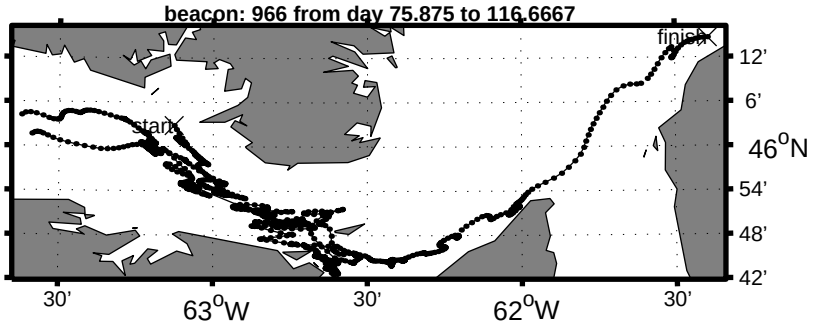


Figure 62 Beacon 966 was deployed in Northumberland Strait on March 16, 2001.

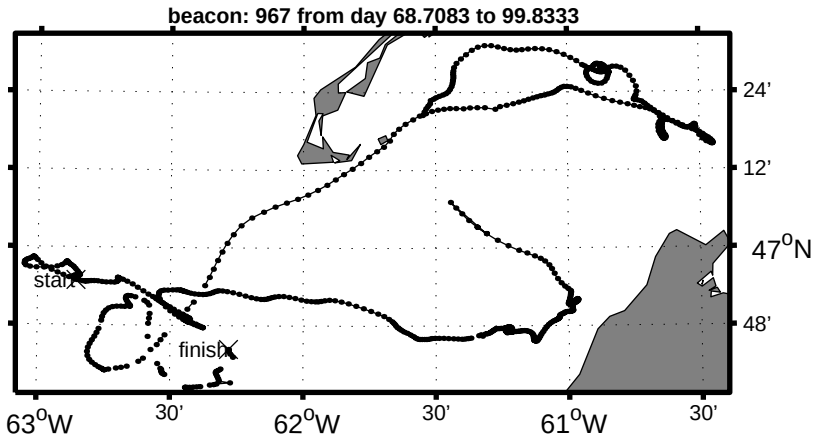


Figure 63 Beacon 967 was deployed on March 8, 2001. These are the positions as recorded in the ARGOS headers for each satellite pass.

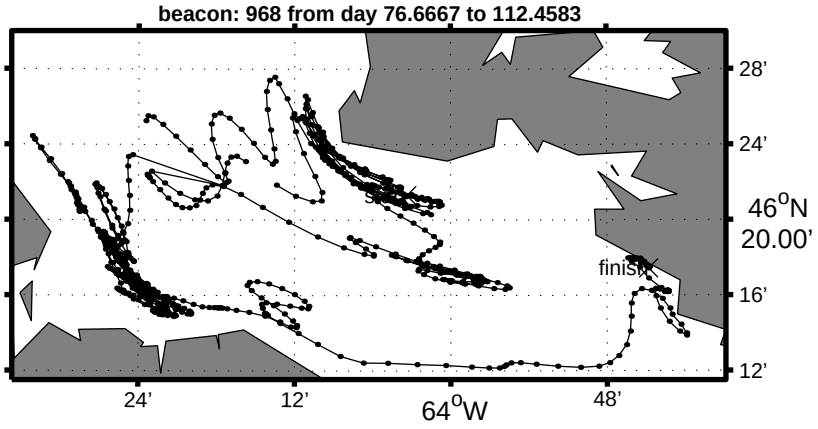


Figure 64 GPS hour positions are plotted for beacon 968 which was deployed on March 17, 2001 in Northumberland Strait. The beacon stopped and started transmitting several times.

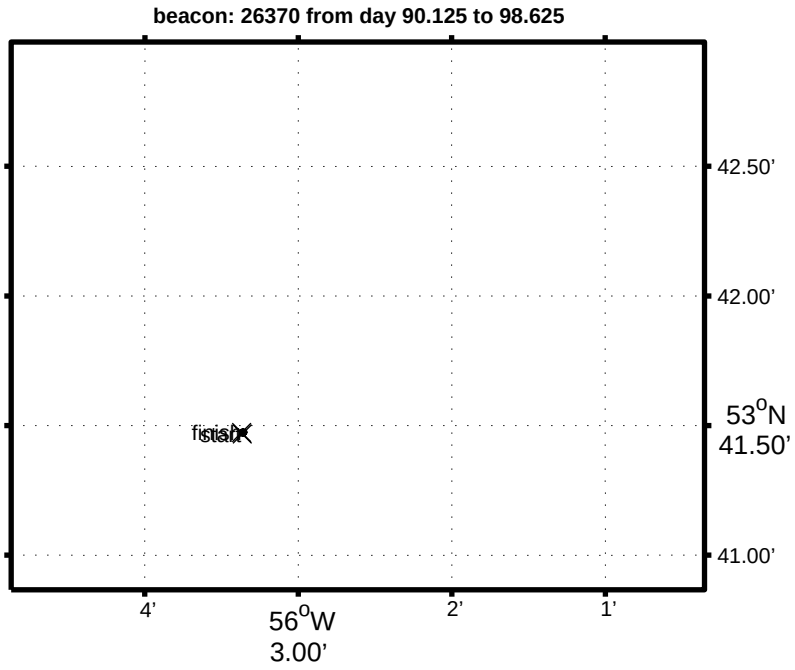


Figure 65 Beacon 26370 was deployed on March 31, 2001 off Labrador as part of an ice pressure measurement program.

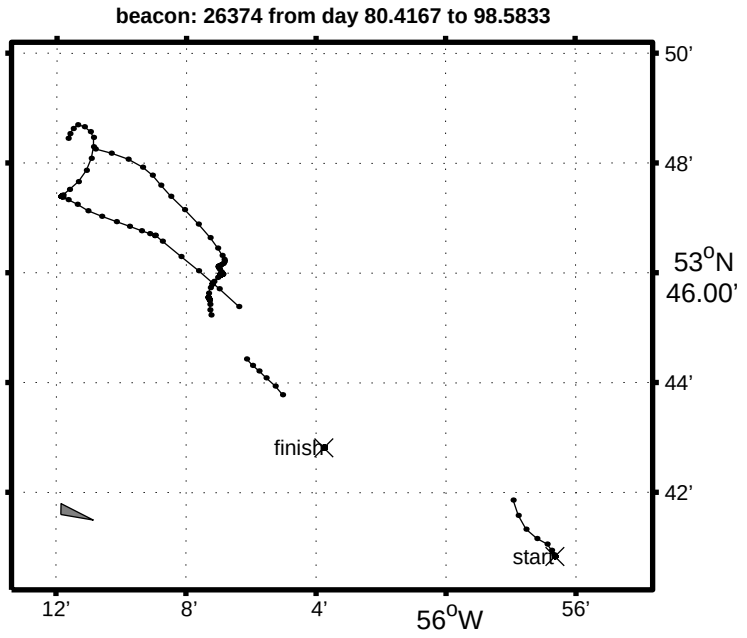


Figure 66 Beacon 26374 was deployed on March 21, 2001 at 53°40.841'N 55°56.343'W.

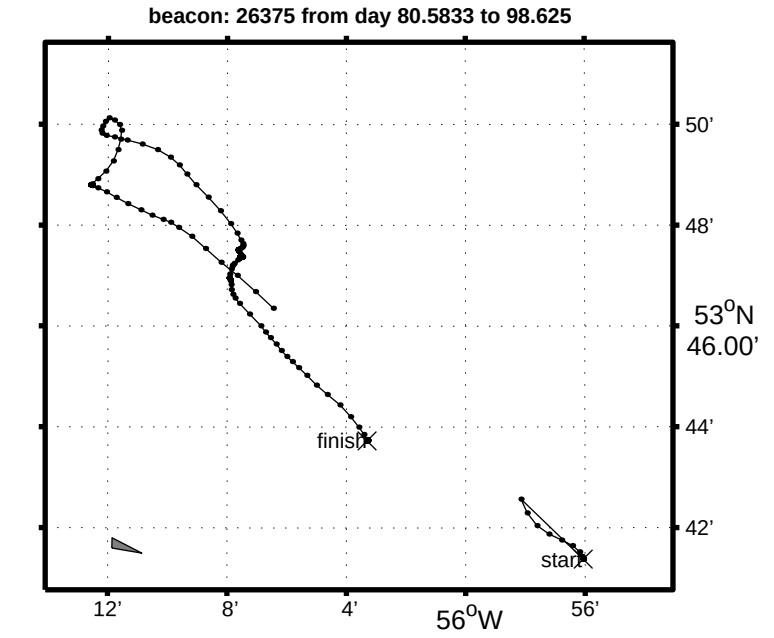


Figure 67 Beacon 26375 was deployed off Labrador on March 21, 2001 at 53°41.383'N 55°56.062'W.

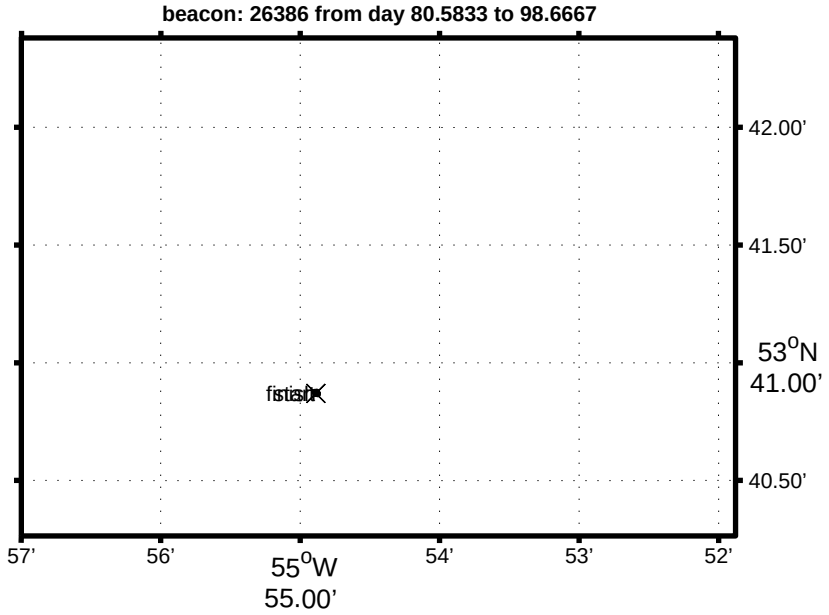


Figure 68 Beacon 26386 was deployed off Labrador on 21 March.

3.2 Meteorological data from beacons

Meteorological data from 1998/1999 were used in a recent study looking at variations in drag coefficient over ice (Prinsenberg and Peterson, 2001).

3.2.1 1999 wind data

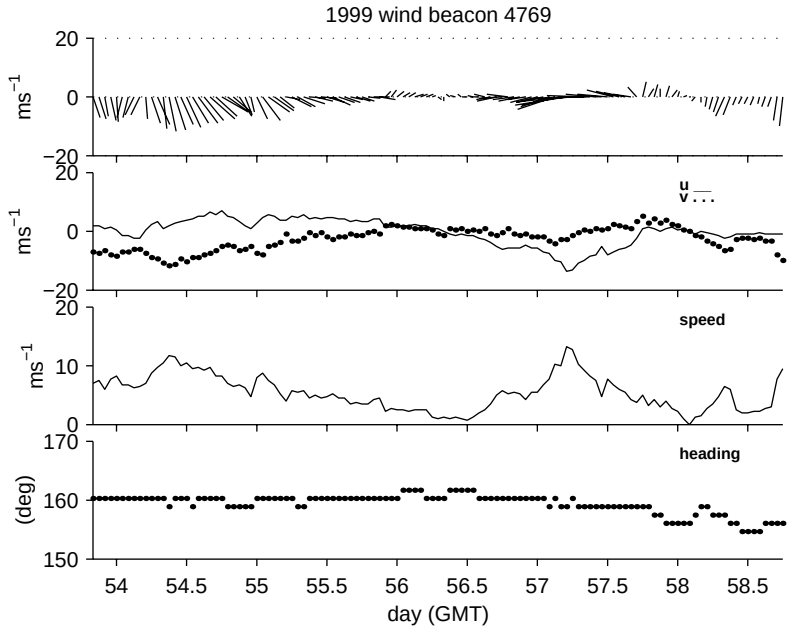


Figure 69 During the first part of the deployment, north of Prince Edward Island, winds were mostly from the north/northwest. Beacon 4769 initially had its mast at 6 m but then it was lowered to 4 m on February 24 (day 55). The heading shows little rotation of floes in pack ice.

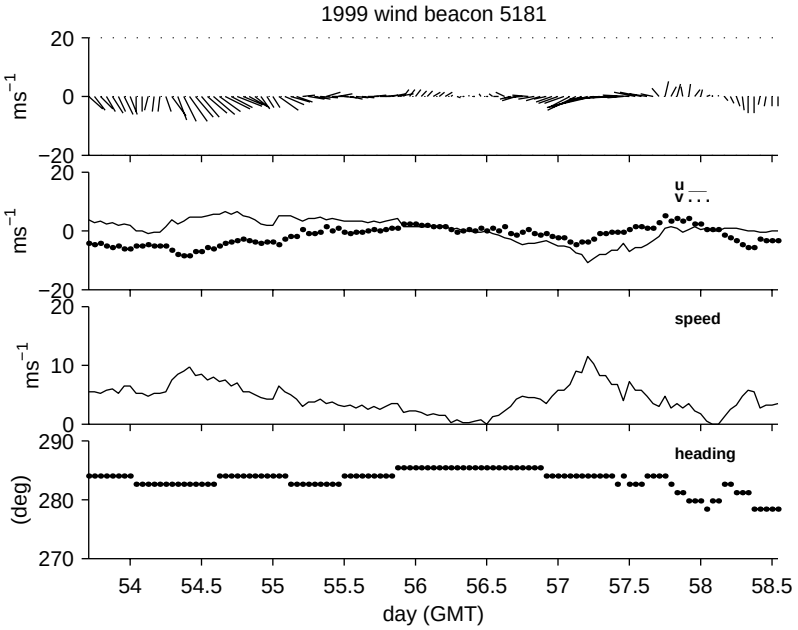


Figure 70 During the first part of the deployment of beacon 5181 (2 m mast), north of Prince Edward Island, winds were mostly from the north/northwest.

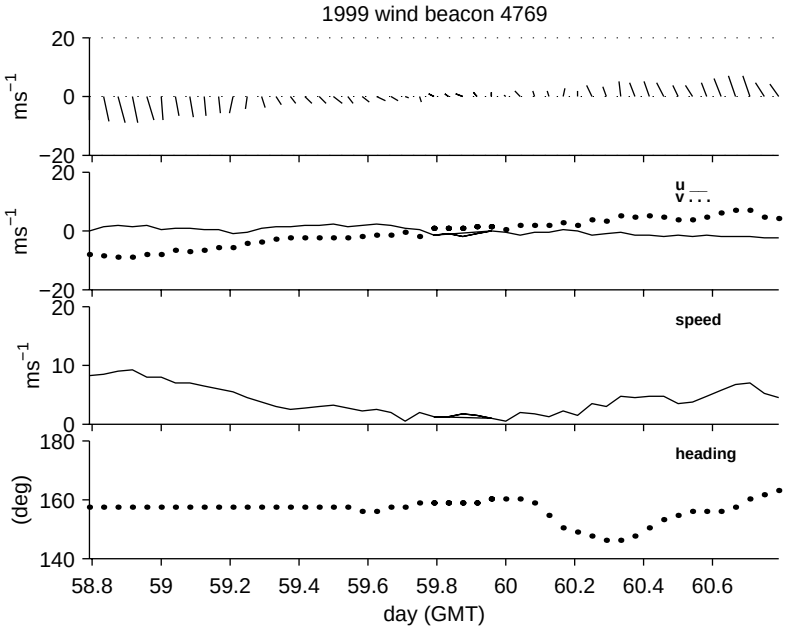


Figure 71 Beacon 4769 had its mast directed to 155° (clockwise from North) and its sensor lowered to 2 m. Winds were north to northwesterly at first and on March 1 (day 60) they changed to a southeasterly direction.

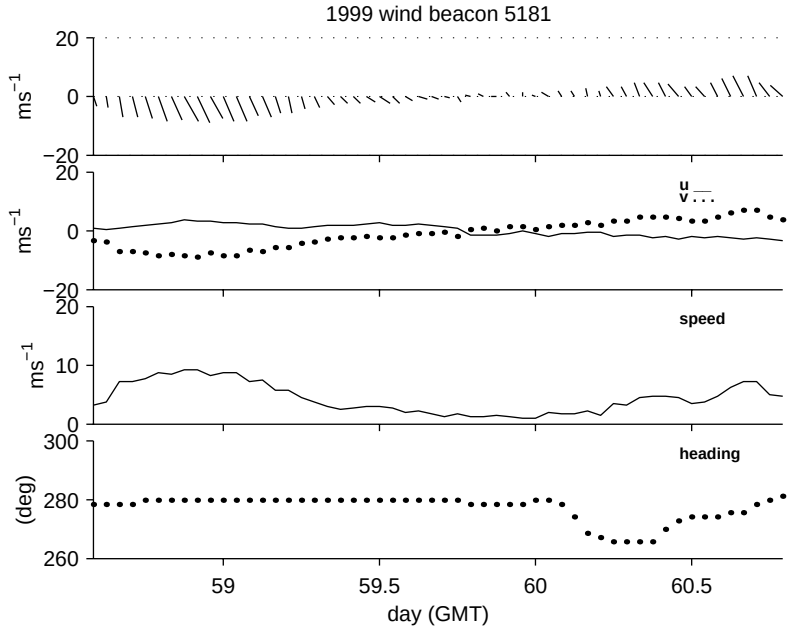


Figure 72 Beacon 5181 shows that winds were north to northwesterly at first and changed to southeasterly on March 1 (day 60).

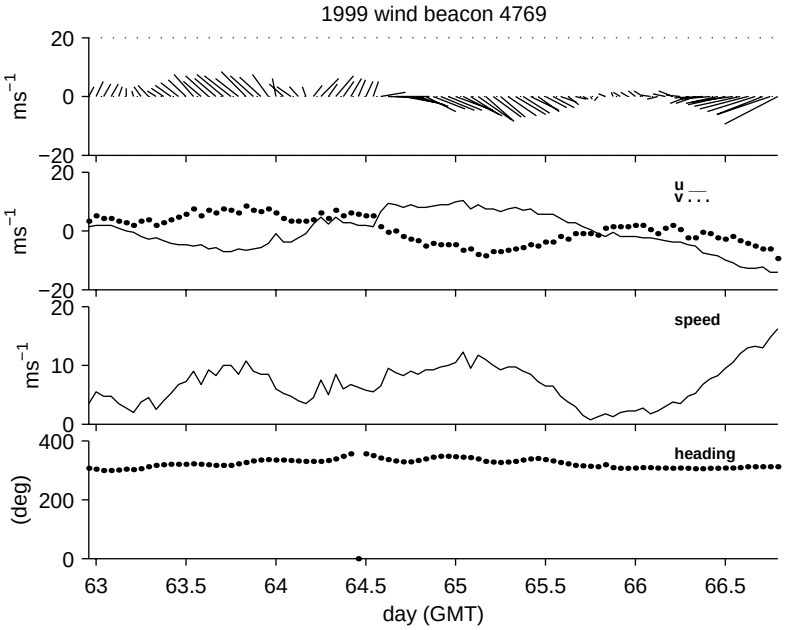


Figure 73 On day 60 (March 1), the meteorological station was moved to west of the island. Wind was southeasterly/southerly from March 1 to March 5 but changed a day later on March 6 (day 65) to westerly.

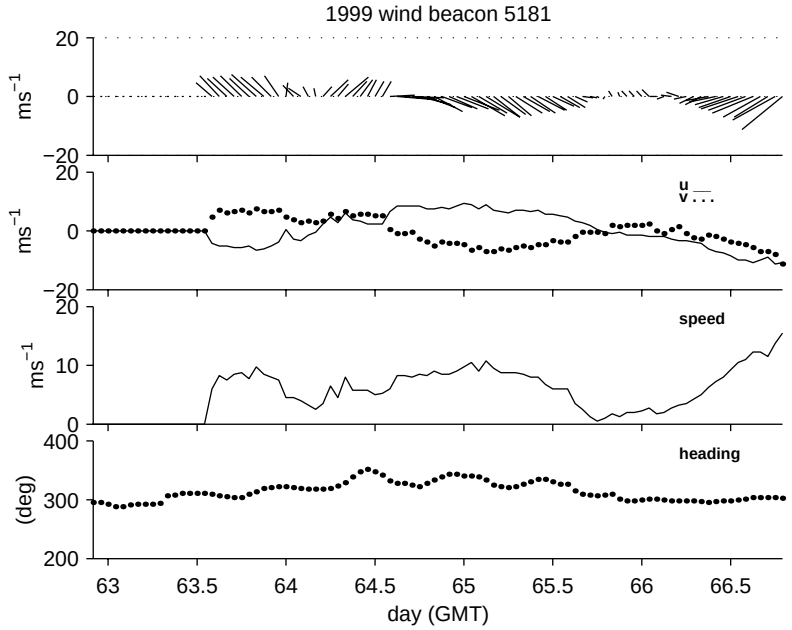


Figure 74 Although the meteorological station was moved to west of the island, beacon 5181 was not plugged in to transmit data until mid-day on March 4. Wind was southeasterly/southerly from March 1 to March 5 but changed a day later on March 6 (day 65) to westerly.

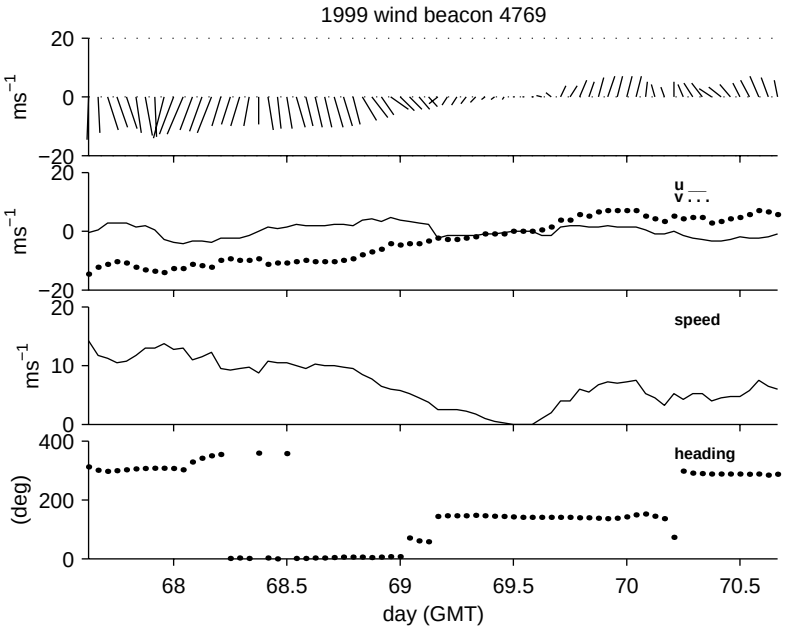


Figure 75 Beacon 4769 was restarted on March 8 (day 67). Wind was north-northeasterly at this time. When the meteorological station was recovered on day 70 (March 11), the wind was light (15 knots).

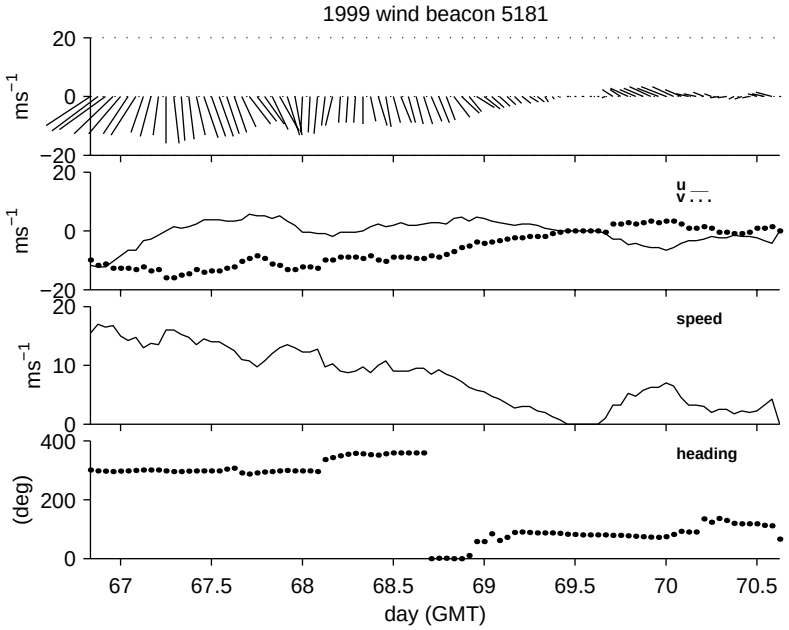


Figure 76 Winds were north-northeasterly at day 67 at this time. When the meteorological station was recovered on day 70 (March 11), the wind was light (15 knots).

3.2.2 2000 wind data

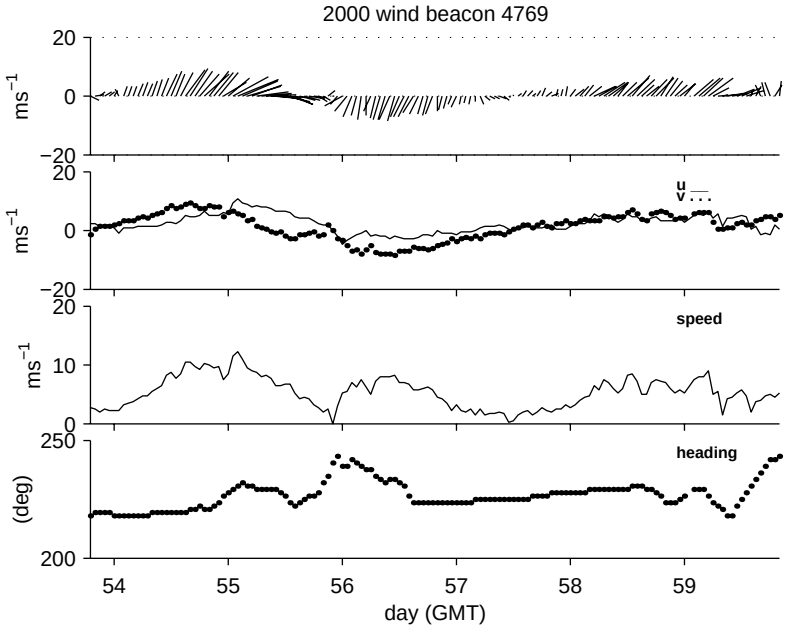


Figure 77 Beacon 4769 had its mast at 4 m. On February 22 the wind was westerly. On February 27 (day 58) its mast was changed to 6 m; that day the wind was southerly at 10 kph.

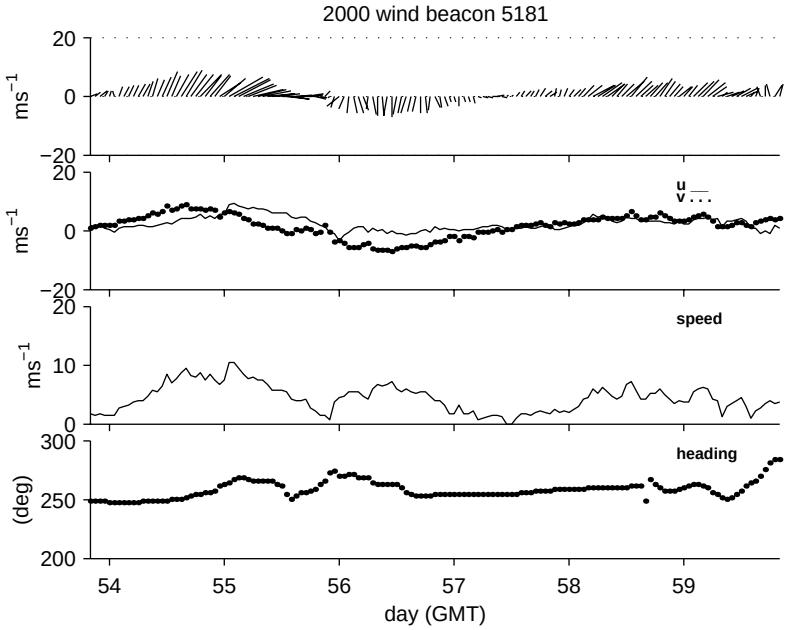


Figure 78 Beacon 5181 was deployed beside beacon 4769.

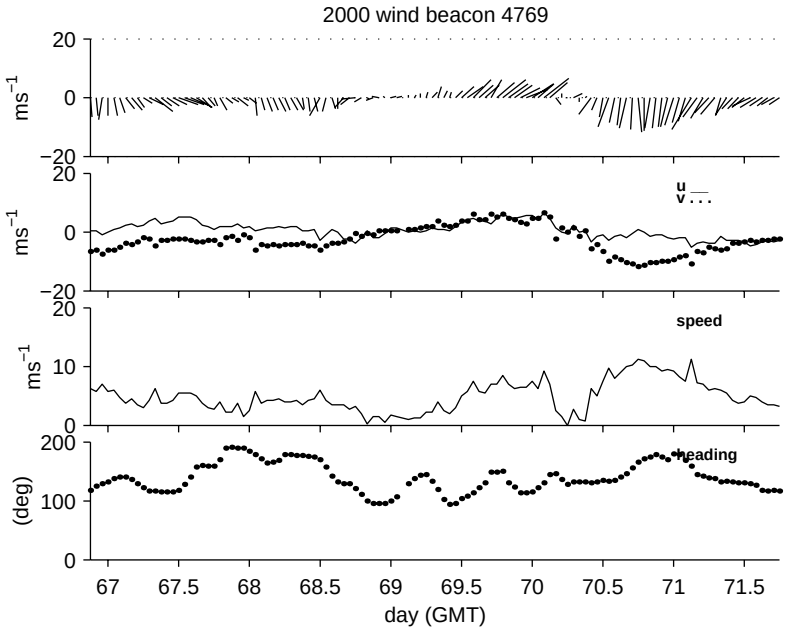


Figure 79 When the meteorological station was deployed on March 6 the wind was northerly. Beacon 4769 had its mast at 6 m. On March 9 (day 69), the wind was southeasterly according to field logs.

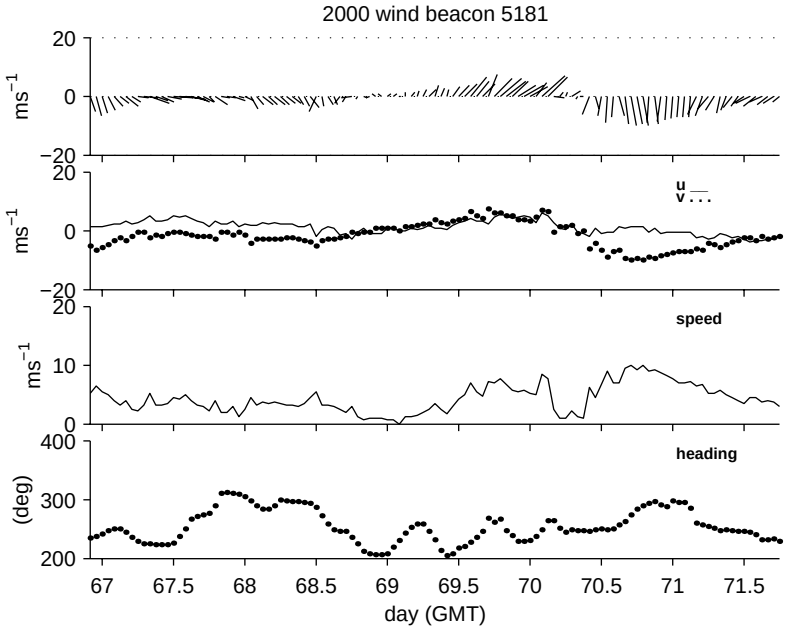


Figure 80 When the meteorological station was deployed on March 6 the wind was northerly. Beacon 5181 had its mast at 2 m. On March 9 (day 69), the wind was southeasterly according to field logs.

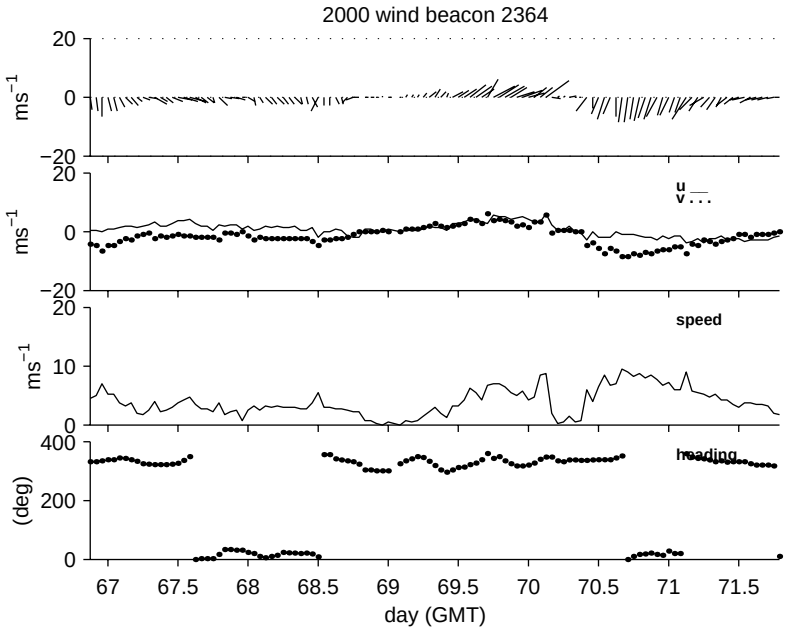


Figure 81 When the meteorological station was deployed on March 6 the wind was northerly. Beacon 2364 had its mast at 1 m. On March 9 (day 69), the wind was southeasterly according to field logs.

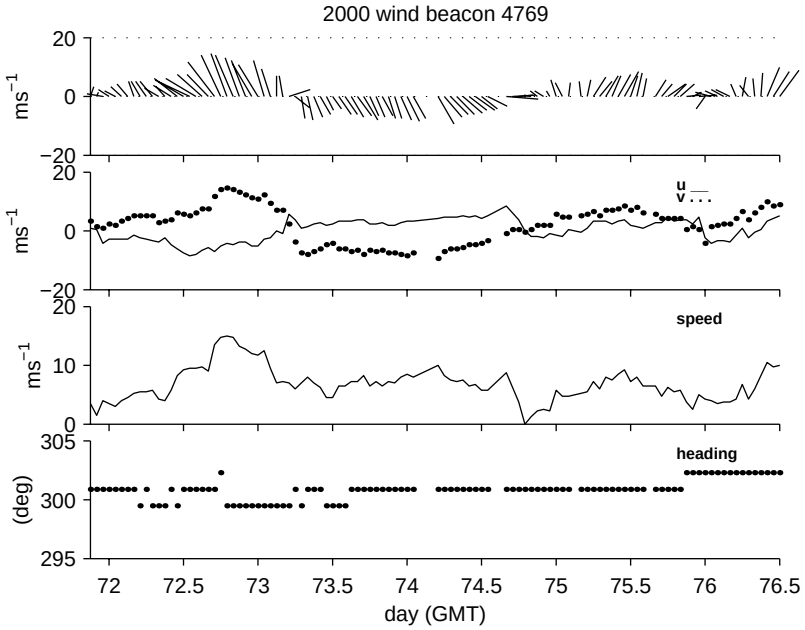


Figure 82 During its final deployment, beacon 4769 had its mast at 6 m. On March 14, day 74, the wind was northwesterly then it changed to southerly the next day.

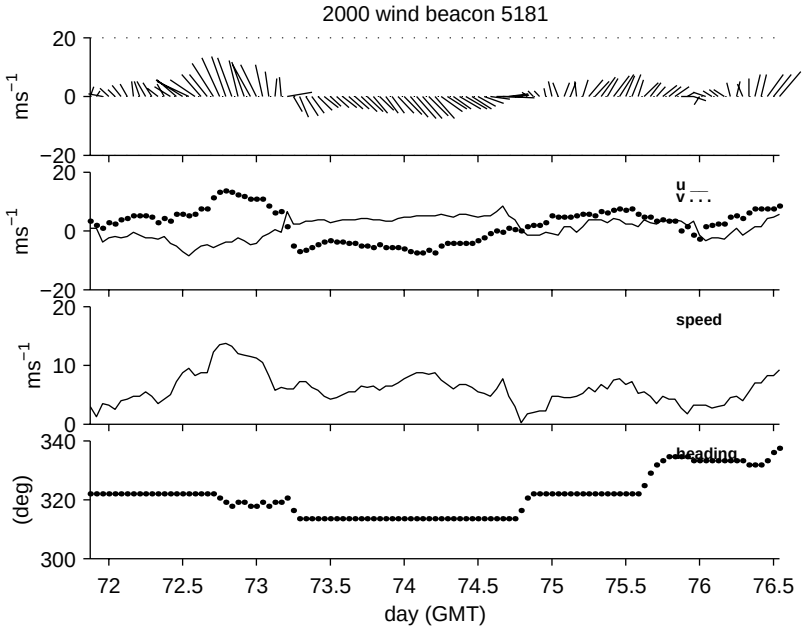


Figure 83 During its final deployment, beacon 5181 had its mast at 2 m. On March 14, day 74, the wind was northwesterly then it changed to southerly the next day.

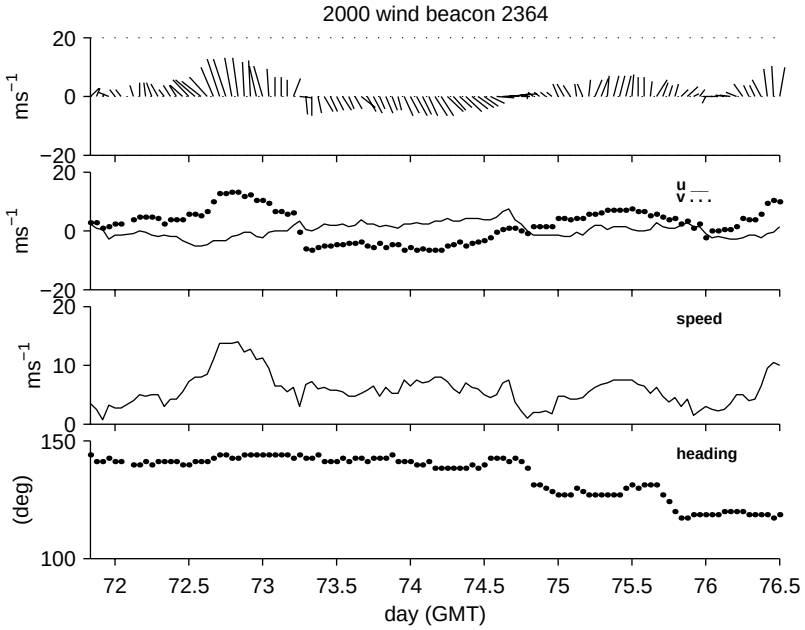


Figure 84 During its final deployment, beacon 2364 had its mast at 1 m. On March 14, day 74, the wind was northwesterly then it changed to southerly the next day.

3.2.3 2001 wind data

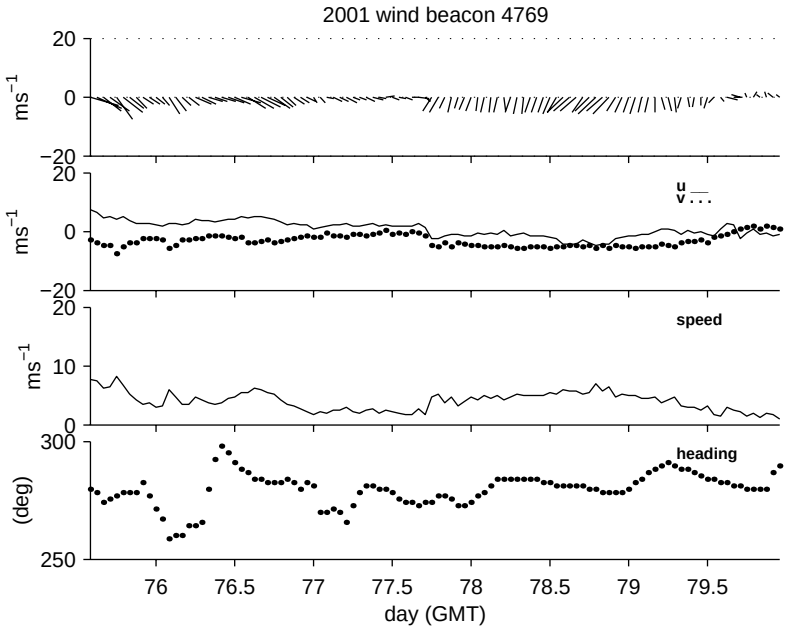


Figure 85 Beacon 4769, with its mast at 6 m, was deployed on March 16 (day 75). Wind was from the northwest.

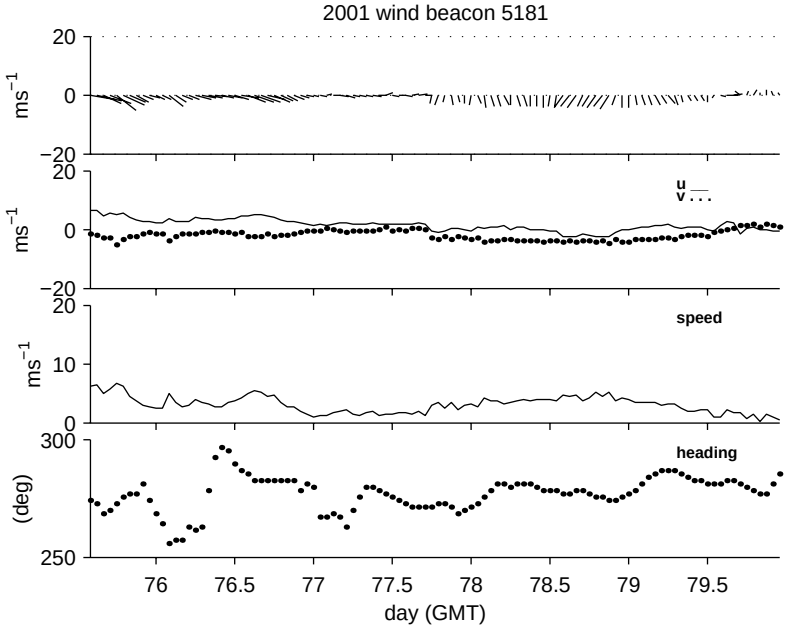


Figure 86 Beacon 5181, with its mast at 2 m, was deployed on March 16 (day 75). Wind was from the northwest.

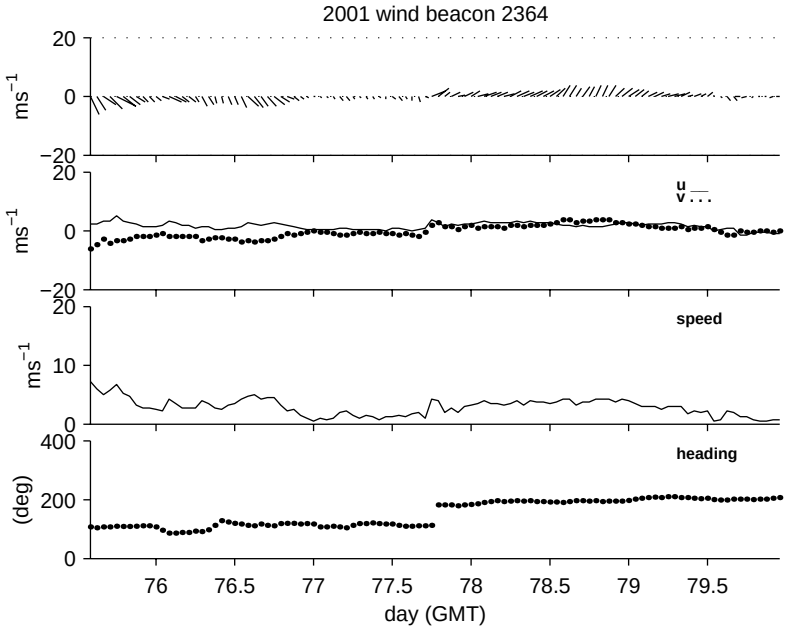


Figure 87 Beacon 2364, with its mast at 1 m, was deployed on March 16 (day 75). Wind was from the northwest.

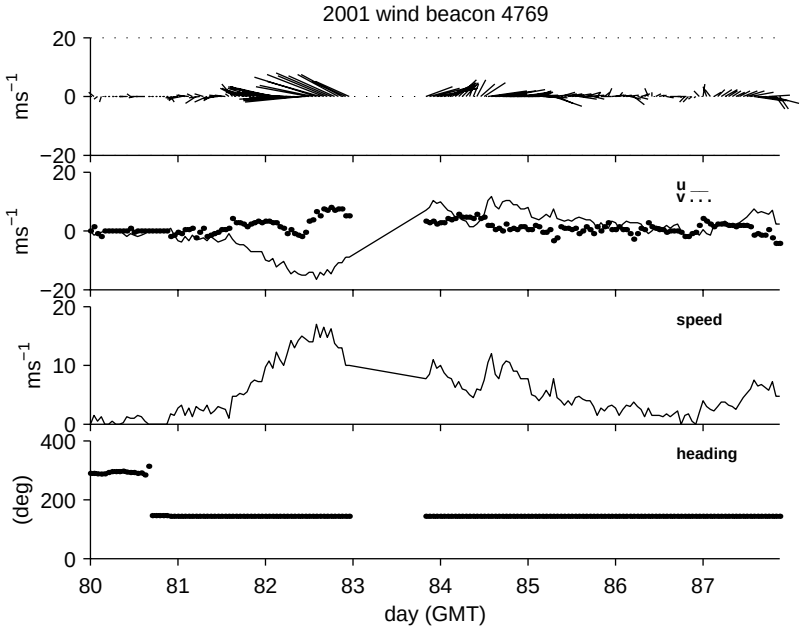


Figure 88 On March 21 (day 80) beacon 4769 was moved to Hillsborough Bay. Wind was northwesterly; a day later it was southeasterly according to field notes. On day 87, March 28, the meteorological station was removed.

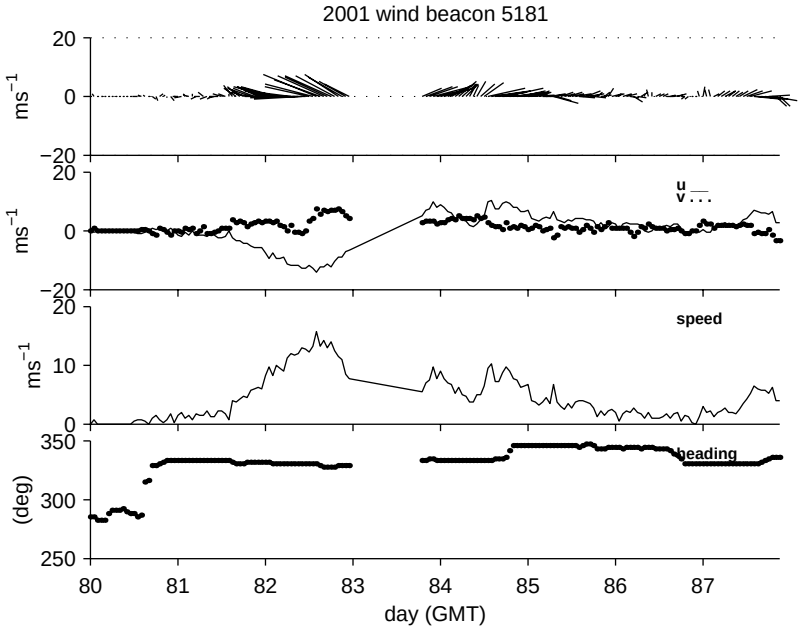


Figure 89 On March 21 (day 80) beacon 5181 was moved to Hillsborough Bay. Wind was northwesterly; a day later it was southeasterly according to field notes. On day 87, March 28, the meteorological station was removed.

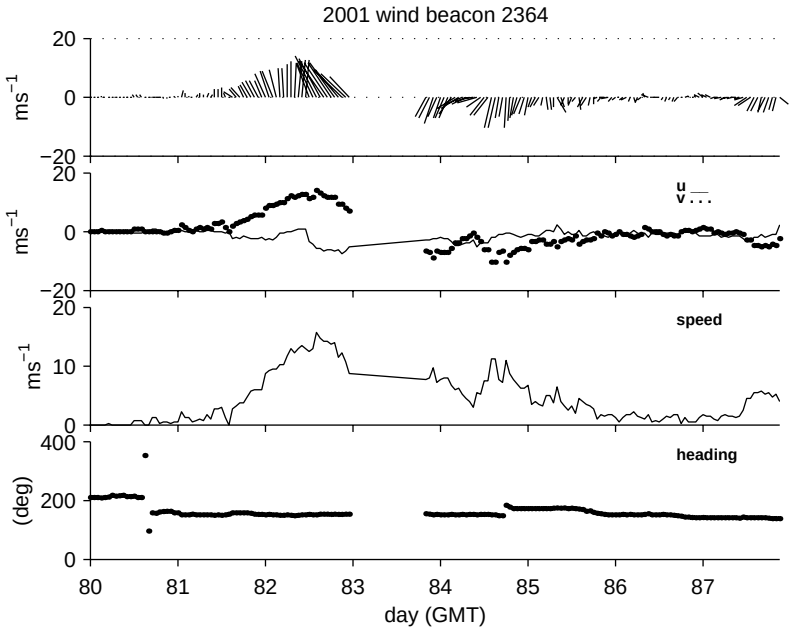
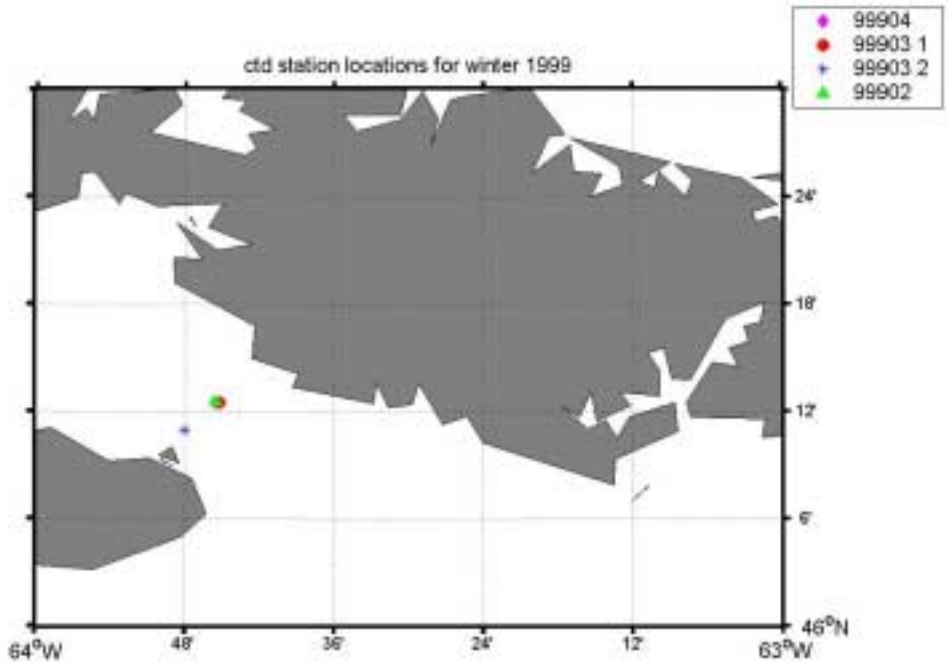


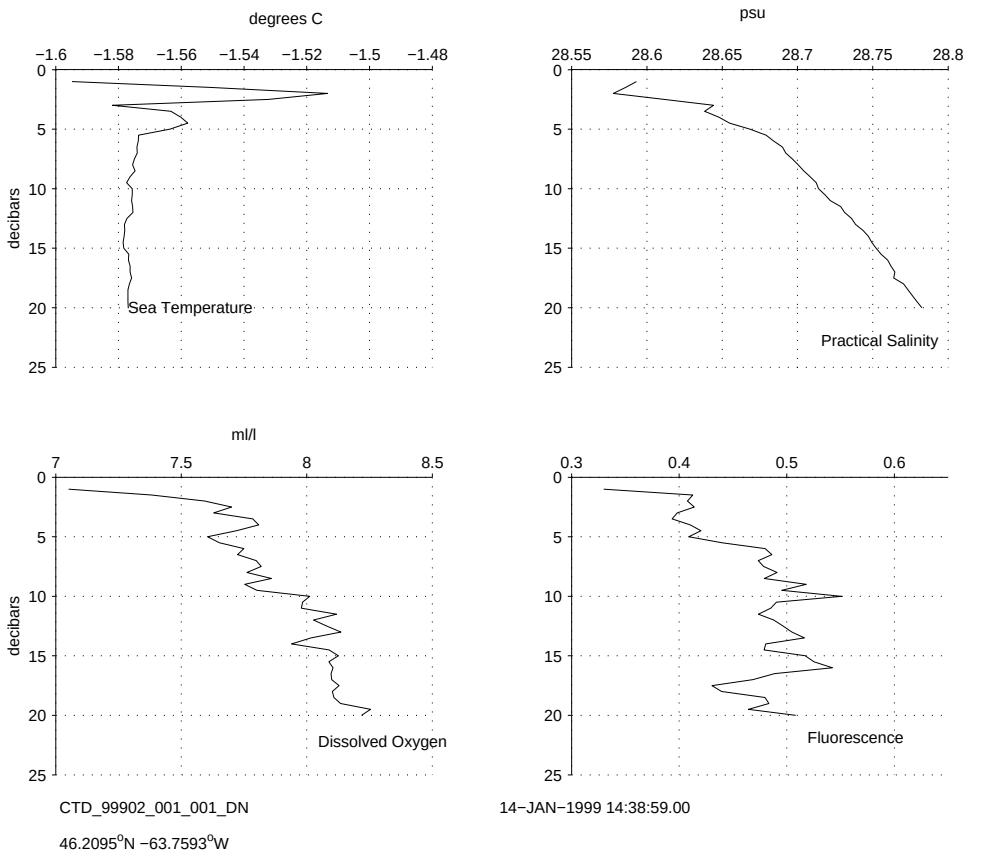
Figure 90 On March 21 (day 80) beacon 2364 was moved to Hillsborough Bay. Wind was northwesterly; a day later it was southeasterly according to field notes. On day 87, March 28, the meteorological station was removed.

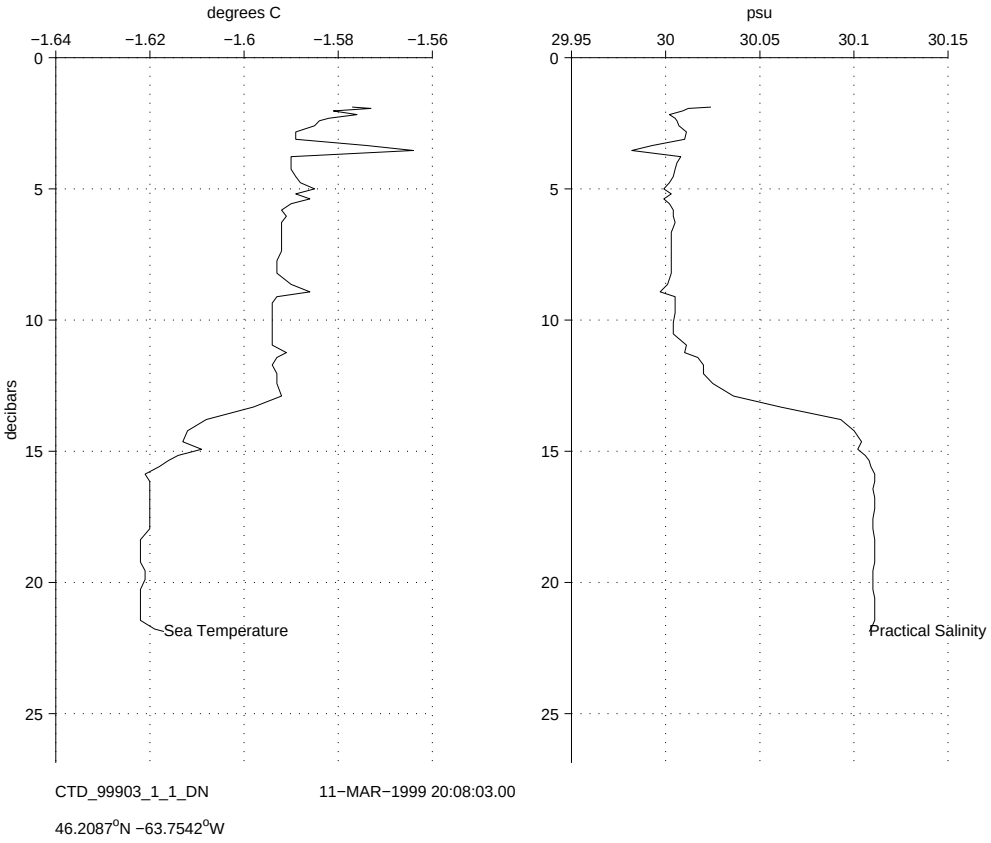
3.3 CTD

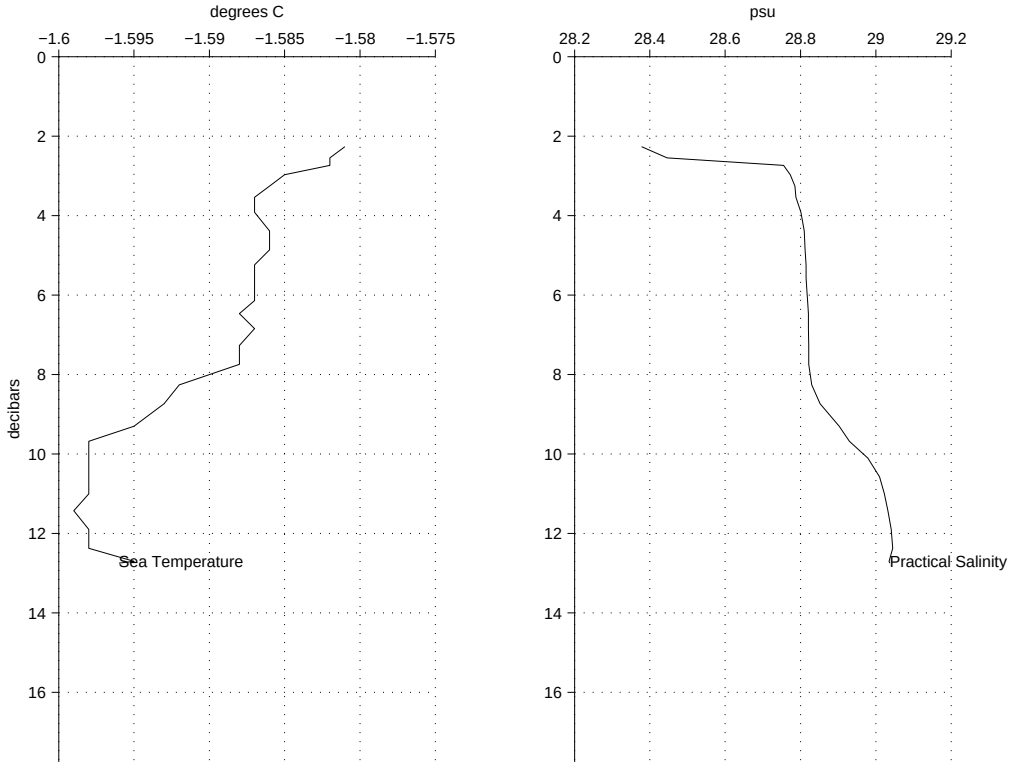
CTD casts were performed for calibration of instruments. This section displays the CTD data for the Gulf of St. Lawrence field programs, 1999-2001.

3.3.1 1999 CTD



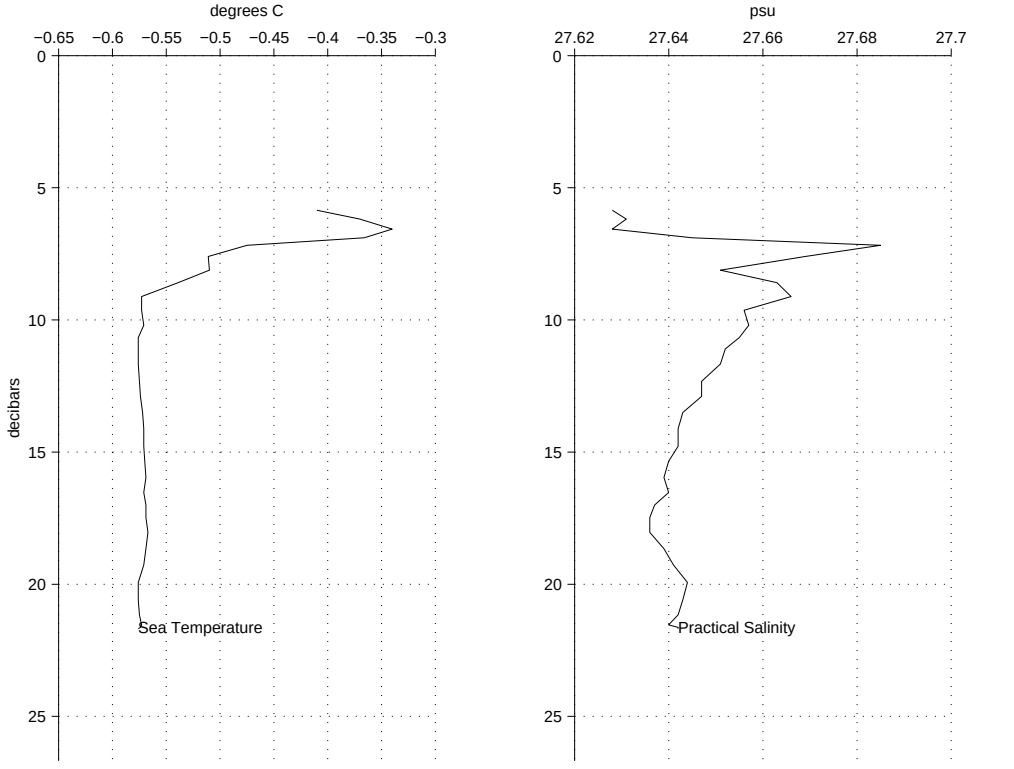

degrees C
−1.6 −1.58 −1.56 −1.54 −1.52 −1.5 −1.48
0 5 10 15 20 25
decibars
Sea Temperature
psu
28.55 28.6 28.65 28.7 28.75 28.8
Practical Salinity
ml/l
7 7.5 8 8.5
Dissolved Oxygen
0.3 0.4 0.5 0.6
Fluorescence
CTD_99902_001_001_DN
14−JAN−1999 14:38:59.00
46.2095°N −63.7593°W


degrees C
−1.64 −1.62 −1.6 −1.58 −1.56
0 5 10 15 20 25
decibars
Sea Temperature
psu
29.95 30 30.05 30.1 30.15
Practical Salinity
CTD_99903_1_1_DN
11−MAR−1999 20:08:03.00
46.2087°N −63.7542°W



CTD_99903_2_1_DN 11−MAR−1999 20:30:56.00

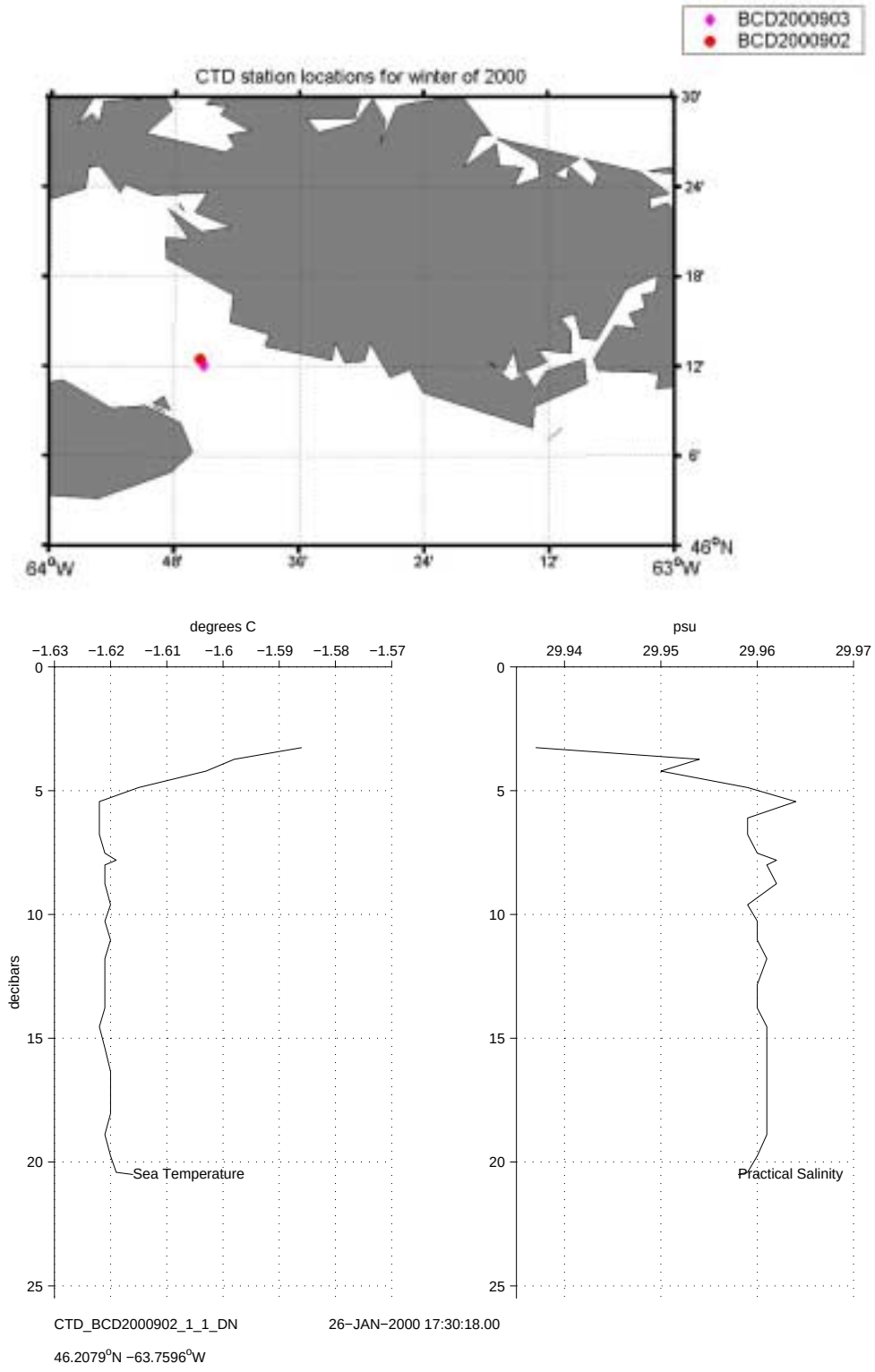
46.1826°N −63.8004°W

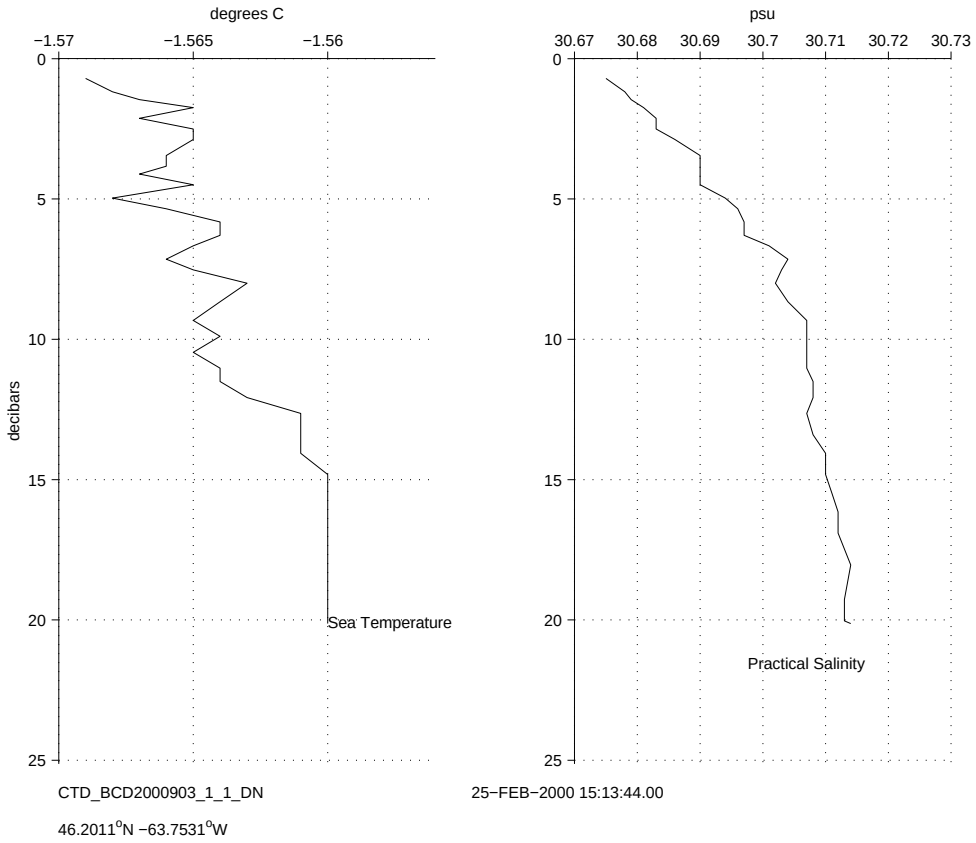


CTD_99904_1_1_DN 15−APR−1999 15:10:52.00

46.2095°N −63.7593°W

3.3.2 2000 CTD


BCD2000903
BCD2000902
CTD station locations for winter of 2000
30'
24'
18'
12'
6'
46°N
64°W
48'
36'
24'
12'
63°W
degrees C
−1.63 −1.62 −1.61 −1.6 −1.59 −1.58 −1.57
psu
29.94 29.95 29.96 29.97
0
5
10
15
20
25
decibars
Sea Temperature
Practical Salinity
CTD_BCD2000902_1_1_DN
26−JAN−2000 17:30:18.00
46.2079°N −63.7596°W


degrees C
−1.57
−1.565
−1.56
0
5
10
15
20
25
decibars
Sea Temperature
psu
30.67
30.68
30.69
30.7
30.71
30.72
30.73
Practical Salinity
CTD_BCD2000903_1_1_DN
25−FEB−2000 15:13:44.00
46.2011°N −63.7531°W

3.4 2000 *insitu* measurements

Table 1 Calibration Line 46 06.04N, 63 03.20W; Hillsborough Bay, land-fast ice.

Bag	Distance (cm)	Snow (cm)	Ice (cm)	Freeboard (cm_)
1N**	320	0	80	9
1N**	320	0	75	8
1N**	320	0	65	6
2	300	0	75	8
2	300	0	77	7
2	300	0	65	6
3*	280	0	62	7
3*	280	0	115	9
3*	280	0	68	7
4	260	0	66	7
4	260	0	65	7
4	260	0	74	8
5*	240	0	85	8
5*	240	0	70	7
5*	240	0	75	7
6	220	0	120	9
6	220	0	85	8
6	220	0	110	9
7*	200	0	85	8
7*	200	0	70	7
7*	200	0	75	7
8	180	0	80	8
8	180	0	85	8
8	180	0	70	6
9*	160	0	110	8
9*	160	0	65	5
9*	160	0	67	6
10	140	0	90	8
10	140	0	110	8
10	140	0	90	8
11*	120	0	95	9
11*	120	0	90	7
11*	120	0	85	8
12	100	0	70	7
12	100	0	90	9
12	100	0	80	8
13*	80	0	68	7
13*	80	0	120	9
13*	80	0	105	8
14	60	0	70	9
14	60	0	68	7

Bag	Distance (cm)	Snow (cm)	Ice (cm)	Freeboard (cm_)
14	60	0	85	8
15*	40	0	90	10
15*	40	0	74	9
15*	40	0	95	10
16	20	0	105	6
16	20	0	95	8
16	20	0	110	7
17*	0	10	200+	17
17*	0	15	200+	48
17*	0	10	200+	28

#17 = edge of ridge (21 m wide)
10.7 m of water at ridge, 26 ppt
ridge sail up to 2 m, width 21 m

Bag	Distance (cm)	Snow (cm)	Ice (cm)	Freeboard (cm)
R18*	0	15	200+	?
19	20	0	40	13
19	20	0	146	16
19	20	0	150	17
20*	40	0	50	5
20*	40	0	50	5
20*	40	0	55	5
21	60	0	45	5
21	60	0	45	5
21	60	0	45	5
22*	80	0	36	4
22*	80	0	44	4
22*	80	0	42	4
23	100	0	42	4
23	100	0	48	6
23	100	0	49	8
24*	120	0	41	2
24*	120	0	42	4
24*	120	0	42	4
25	140	0	95	4
25	140	0	150	28
25	140	0	72	14
26*	160	0	140	14
26*	160	0	40	20
26*	160	0	200+	16
27	180	0	80	17
27	180	0	110	10
27	180	0	45	4
28*	200	0	74	12
28*	200	0	94	9
28*	200	0	58	7

Bag	Distance (cm)	Snow (cm)	Ice (cm)	Freeboard (cm)
29	220	0	32	6
29	220	0	103	11
29	220	0	55	6
30*	240	0	60	6
30*	240	0	38	6
30*	240	0	45	8
31	260	0	61	8
31	260	0	46	6
31	260	0	41	2
32*	280	0	58	7
32*	280	0	70	9
32*	280	0	45	4
33	300	0	46	6
33	300	0	55	5
33	300	0	46	5
34**	320	0	42	7
34**	320	0	71	9
34**	320	0	71	5

small ridge is at bag #25

ACKNOWLEDGMENT

The researchers involved in this project gratefully acknowledge the financial support from the Program of Energy Research and Development and helicopter and logistical support from the Canadian Coast Guard (Maritime Region). Ron Moores and Ian Henderson, of the Canadian Coast Guard stationed in Charlottetown, Prince Edward Island, are thanked for their valuable support during the field program.

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5 APPENDIX: FIELD NOTES

5.1 Gulf 1999 field notes/data (S. Prinsenberg; ed. A. van der Baaren)

Sunday, February 21 -10°C, clear; N winds

15:30 -GF/SP to PEI with all beacons and computers

Monday, February 22 -20°C, Clear
NW winds at 35 km/h

Met station at 46° 30.25' N, 63° 12.17' W
Floe has a flat centre; refrozen melt pond very slippery (ice 50/55 cm)
Ridges 1-1.4 m height blocks 20 cm thick, floe ~50x25 m
Wind speed/direction at 2 m #5181 and 6 m #4769 (15:30 winds 240° magnetic)
End of role #1 of pictures.

Tuesday, February 23 -16°C, clear
NW winds at 15 km/h

Met station centre pan solid now 51/54/55 cm of ice
Looking for ridge and calibration line N of PEI
Location 46° 27.29' N and 63° 05.30' W thin part 27/29/30/30 east side of ridge
Rafted area 60/50/33/31 cm
16:00 -Visited old cal line in Hillsborough Bay
before going the new line north of PEI; put out bag at 40 m spacing.
Thin lead east of ridge had frost flowers see pictures (Digital pictures to 79)

Wednesday, February 24 -15°C, clear
W winds 15 km/h

Probe flights (see list) 13:30 leaving Moncton and 14:00 turning to met station
Picture 12 before bridge at 12:00, 13/14 to PEI, 18 after background

16:30 -with IP and LL to Met Stn put 4769 to 4 m
Ice now 62/66/70 cm of ice; location 46 30.528N and 63 11.936W

Calibration line (16:55 – 17:30), no snow

# bags	Stn#	Dist. (m)	Ice thickness (cm)	
**	1	200	36/85/81	East side
*	2	160	38/34/35/36	
*	3	120	125/30/34/36	
*	4	80	38/41/31/57	
*	5	40	43/30/30/51	
	5.5	10	49/47/76	
*	6	0		Ridge edge
*	7	-25	fb 105 cm; sail heights 2-2.5 m	Ridge edge
*	8	-65	38/108/39	
	8.5	-75 to -95	20 m wide lead	
*	9	-105	33/73/30	

Ridge to south of line i.e. 85/81 at bag #1, fb in ridge was used to get sail height
Beacon place by ridge #8542 at 17:50; location 46.461°N and 63.083°W

Thursday, February 25 — -10°C, cloudy
Light SE winds

-Morning install video pod
-Afternoon test video sensor
-15:00-15:30 Probe/video test before snow start north of PEI
Painted top of bird orange.

Friday, February 26 — 0 to –3°C, cloudy
Freezing rain

No flying

Saturday, February 27 — -2 to -7°C, clearing
N winds 35 km/h

Met Stn. drifted to 46°28:2N and 63°10:20W
Ridge drifted to 46°27:54N and 63°04:20W

14:20 - Met stn #4769 mast at 155° clockwise from North
- #5181 mast at 310 from #4769
-changed 4769 to 2 m 14:30 and measured ridge heights around floe

direction to #4769	distance (m) #4769	ridge (cm) height
360	30	110
20	35	100
45	25	80
75	21	75
90	22	25
110	25	150
130	24	140
160	30	100
180	25	75
220	17	25
240	14	50
300	15	75
320	17	10
340	20	30

14:20 -mast holder of #4769 directed to 155°
-beacon 5181 NW (310°) of #4769
15:00 -Removed beacon 8542 from ridge ;not reporting?
-test flight of radar (afternoon) and video/probe (morning)
Relative spacing: tower 25 m from north ridge and 30 m from south ridge
#5181 at 310^{o} from tower; mast of tower at 155^{o} relative to beacon case

Sunday, February 28 -5 to +3^{o}C, clear
N to NW winds

-Radar test and placing beacons in Strait as markers for afternoon Probe flight
Beacon east of bridge planned for 46°00.0N and 63°30.0W
Beacon west of bridge planned for 46°20.0N and 64°15.0W
Above PEI 46°50.0N and 62°30.0W

Stn 28-1 35/36/40 cm of ice, no snow
Floe 75x75 m at 45°59.24'N and 63°28.78'W
Beacon # 3121 (east of bridge; 09:40)
Role #3: 3-4

Stn 28-2 85/70/80 cm of ice, snow on ice 4-10 cm
Larger floes in area (2x3 km), Floe 50 x 50 m
Beacon #4752 out at 10:15. Picture 9 to PEI from 28-2, 10-11 W of bridge

From Probe list: Morning probe flight over beacons/bridge
Over bridge (ADCP), ice moving to west/westerly light winds
12:50: shadow of bridge to west
North from Summerside to Gulf side:

Stn 28-3 -Seals at 46.47°N 62.413°W landed 353 at 15:45 (with probe)
-Large area of pancake ice south of Maggies (role 4)

Monday, March 1 SE Winds strong
Up to +8°C

Video mosaic in Morning of Bridge area
Too windy in morning for Probe
Met stn drifting to NW, large leads just SE of pan, 13:38, picture to #15 on way back to PEI
Recovered Met station 46 33.2N and 63 13.7W at 15:45 pack ice breaking up
Lead 50m to SE opening and closing, Stn at 46 33.2N and 63 13.7W, all recovered

Tuesday, March 2 +2°C, foggy
S winds at 15 km/h

Clearing by 11:00
Video flight, video cable broke and fixed
Snow radar flight 11:30- 12:30
Scott doing Probe /Video flights; probe had problems with altimeter

Wednesday, March 3

Probe/video flights; morning video cable broke again
Put out beacons along flight line

Stn 3-01 Beacon # 4751 out at 11:10
South of Pnt. Prim; 150x150 m floe
Ice thickness: 28/30/28 (soft ice, no snow)
45 56.72N and 62 55.79W
3 pictures last on role #4

Stn. 3-02 Beacon #4750 out at 11:50
Flag out, ridge to SE
Ice thickness: 40/42/40; crystal snow
46 07.72N and 62 06.40W

Stn. 3-03 Andy took beacon #4753
Half way to Maggies

Used 212 to put out Met Stn. On flat ice west of bridge
18:15 out but 2 m (#5181) cable not connected (just location transmitted)

Thursday, March 4 S winds at 15 km/h
1°C clouds coming in

Stn. 4-01 Beacon #4752
46°33.25N and 64°19.28W

At Met stn to plug in 5181 cable at 09:30
Tower up at 09:38 (not sure why we had to take it down)
Beacon 4 m apart/ camera acting up
5181 mast towards 310° to left of North; 4769 mast at 330°
Video spider pattern over met. stn
Probe flight in same area

Beacon 4752 re-deployed at 10:16 it was not reporting
Now closer to the bridge, about 10 miles north of ice edge

Beacon 4753 by Greg/acoustic beacon
47/05/53N and 62/21/04W
Picked up beacon 4754 off Maggies and re-deployed closer to PEI
2 miles of the planned location: 46°52.0'N and 63°10.0'W. 16:55
Rain starting on way back, winds 40 km/h from SE. End role #5

Friday, March 5 — S winds at 30 knots, +2°C, clear

Louis packing/leaving. Scott flying probe whole day
10:00 Andy checked tower and re-leveled it, lots of rain melting had occurred.
Rain and snow hindered Probe flights.

Saturday, March 6 — W winds at 15 km/h, Clear, -10°C on ice

Probe calibration line marked with xmas trees
Location: Hillsborough Bay. 46°06.37'N and 63°00.60'W

# trees	distance(m)	ice/snow (cm)			
		E	C	W	
Ridge	-180		105/12 1/125		
Lead	-100		58		
**	0	52/5	49/6	54/0	68/72 fb 7 cm
	40	58/6	55/6	60/6	
Flag	80	62/5	55/3	52/5	water 9.4/9.5m
Big	120	81/75/6	51/53/6	51/5	
Small	160	55/56/5	50/51/5	75/69/6	
Big	200	64/64/7	70/62/5	61/58/5	
Small	240	60/55/6	54/56/6	74/85/7	black spot to side (w)
Big	280	62/60/6	59/54/6	59/59/7	raft to 90 cm

No lead up bag to North but two black marks are to the North
Water depth 10.8 m at ridge, line direction 190°. Done by 12:55

Met Stn. 16:08 done, put plywood under legs
Moved 5181 1 m farther away same direction (West Point)
2 m was tilted, beacons 50 m from ridge on very flat floe
Lots of over flights, tower at 4 m and a bit tilted.

Probe flights over Calibration line 17:00-18:00
Water sample 28 PPT, wiped out video data by accident/cal flight
Some recovered from recycle bin S-N #63435, N-S #63580 and S-N #63672

Sunday, March 7 Snow storm, -7°C

Monday, March 8 NNE winds at 30 km/h

Restarted 4679
Floe remained the same shape/ both on ARGOS transmitter
Snow storm all day and Tuesday and Wednesday

Thursday. March 11

Murray to Bridge, Andy to land-fast and SP to Met stn
All ice out of Hillsborough Bay, no calibration line

CTD #1	46°12.502'N and 63°45.2534'W at 2007Z	Temp +4 wind 060 at 15 knots
CTD #2	46°10.957'N and 63°48.026'W at 2031Z Ice from 110° to 290°	

Thursday, March 18 Clear, 2° C
Light winds

Early to PEI, at Hanger at 09:00 (Picture Role #5)

Beacon 2750 out at 09:55 east of Bridge
Large floe 1 km x 1 km, 64 cm of ice no snow

Beacon 8541 out at 10:35 west of Bridge/ West Point
Small floe 50 m x 50 m, centre of pan below freeboard, ridged edge

Beacon 4754 out at 11:10
Thin ice (35 cm) ridged to 2m+ at edge.
Role #5. Pictures to 9. Later #12-15 smaller floes and more slush between them.

Beacon 2754 out at 12:30
100 m x 100 m floe in between smaller floes, covered with 24 cm of snow/slush
Pictures 10-13; on way to next site pictures 17/18 small pancakes of ice

Beacon 8542 on at 13:02 end of role #5

Flying probe in afternoon:
16:12: Flight 50; To bridge, to NB on east side current is to west, open water at NB shore
17:58 Flight 51, different ice from wave damaged ice
18:05 large 10 x 10 km floes. Flight 51 North of PEI, lat/long spikes

March 19, Friday Snow flurries

636 out to pick up beacon by Ron/Andy
Packed Radar bird, second pod
Seal lines in afternoon:

100 ft to W, 200 ft to E
300 ft to W, 400 ft to E
500 ft to W, 600 ft to E
800 ft to W and 1000 ft to E

North-south line over second floe:
1000 ft to N, 200 ft to S,
after this returned to 1000 ft towards E (CCG icebreaker)

5.2 Field schedule PEI 2000 (S. Prinsenberg; ed. A. van der Baaren)

Wednesday, Feb. 16, 2000 -3°C, overcast, snow winds light SW

-Left 11:00
-On bridge 13:34, light winds ice against PEI coast
-Unpacked instruments, OCP to Jones, Clarke

Thursday, Feb. 17, 2000 -6°C, overcast, winds NW at 20 km/h

-Mounted range finder
-IML people packing pressure sensors off Maggies
-Check for calibration site and Met. Stn. sites
-Found Calibration site, Hillsbury Bay, 10.7m of water
Three holes 80, 112 and 100 cm of ice 1 cm snow dunes
-Tested video in afternoon, no luck
-Rest of afternoon checking for possible lost plane
-Phoned Louis at night, solved some of video problems for now. No Radar altimeter data

Friday, Feb. 18, 2000 -19°C, clear, winds W at 19 km/h

-Reset range finder in the bay
-Video over Strait and Bridge
23 to west (2197), 24 to East (2261), 24 to West (2350) and 23 East (2488)
-little tidal current to West
-10:28, 2690 along bridge (23/24) 10:28 going to NB

-10:30, NB to PEI west of bridge, shear ridge at 3025
-To Summerside (10:35)

-Off at 11:30 to 63°30'W, 46°50'N File F008
-at 2000 ft the first part, then to 200 ft (3800) no GPS or laser
-beacon 4754 out at 12.04 , 46°52.5'N and 63°26.3'W
-four holes: 69,32,35 and 60 cm of ice, snow 6, 11, 2, and 13 cm, freeboard 2,1,1, and 2 cm
-Video and laser no longitude, just latitude

12:30 – 13:30 at Maggies, overcast winds 15 km/h
-Flight back to PEI Lat. only
-49F014, 3 sec interval. Back at hanger at 16:00
-Digital pictures to J. Clack
-Phoned Scott, Budget and arranged shipping of Probe.

Saturday, Feb. 19, 2000 -10^{o}C, clear, winds E at 10 km/h

-Set out Calibration line in the Bay, Bags only
-Scott here by noon helped in afternoon with the line (done by 17:30)
-Plotted images on Epson.

Sunday, Feb. 20, 2000 -19^{o}C, clear, winds W at 19 km/h

-Truck arrived with Probe 10:00
-Video to bridge, still no Long
-24 to W 6104; 23 to E 6130 changed rate to 1 sec
-24 to W 6190; 23 to E 6269 (all around 100m)
-23 to E 6269; 24 to W 6338 and 23 to E 6397
-To Summerside 6438 shear line to landfast 6661

-11:15 left Summerside time interval 0.3 sec
-Back in hanger at 12:30, wiped out bad video data just kept bridge data
-Probe unpacked and tested 15:30 – 16:30

Monday, Feb. 21, 2000 -13^{o}C, clear, winds W at 20-40 km/h

-Very windy but probe flew anyway
-Calibration line 30 holes on north side of line
-Process lines in evening and sent dat files to CIS

Tuesday, Feb. 22, 2000 13^{o}C, clear, winds W at 25 km/h

-07:30 To Maggies from CIS beacons
-digital pictures L14 Maggies shore to 11248, L13 2 miles out 8.5 from 11248

-L12 looking down shearline; L11 in Gap W: L10 in Gap E
-L9 11250 at 47 39.1 and 61 50.2; 11248 47 37.03 and 61 50.2
-beacon 11247 at 47 41.9 and 61 28.6 at 10:58 left on the ice
-At Maggies at 11.35

-13:30 out to Met. Stn. 2 with 363, 353 has engine troubles
-15:30 4769 (4) at 46°3.48' and 63°1.28'
-5181 at 16:10, sn. aout 3 miles into the pack ice
-Pancake ice composite floes of Stanhope

Wednesday, Feb. 23, 2000 6^{o}C, overcast, winds S at 10 km/h

-Probe used 363 since is grounded
-Probe flight to Cape North (maybe wrong date on it Feb 22 instead of Feb 23
-Drilled more holes along calibration line as weather is bad for Probe work
-08:30 George Sates here, Murray to Bridge
-Louis sick in Halifax, will drive in by car Thursday

Thursday, Feb. 24, 2000 -+3^{o}C, clear, winds SW at 10 km/h

-Found station at 46°56.9'N and 62°38.6'W
-Drifted 40 miles to NE, (beacon 02364) 120 cm RM Young out at 10:00
-On way home took pictures of pancake composite floes, new bands at the ice edge
-Scott left to east of the Maggies at 12:40, back late in afternoon
-Probe flew to west of Maggies and into PEI
-Processed Probe data and e-mailed dat flies to CIS
-Louis here by car fixing Radar for tomorrow

Friday, Feb. 25, 2000 clear, winds W at 19 km/h

-Morning conference call at Wilf office; we have to pay overtime/travel
-Scott left late 13:00. Both 353 and 363 ready
-Probe /Video flight to bridge to NB side end loop east of bridge, video 44623 start east side; current to west; ice edge at 24, 23 no ice, 44860 start on west side along bridge

Summerside for fuel, 15:30
-to West Point and Cape North
-E-mailed three DAT lines in the evening

Saturday, Feb. 26, 2000 -13^{o}C, clear, winds NW at 8 km/h

-Probe flight over Met. Stn. and to Maggies. Lost some files but all real-time data on Video CD-ROMs
-Probe file not started or closed properly plus probe laptop froze up
-Pattern flown over the seal herd, found at 47 57 62 10 (63538 - 63560)
-47 57.6 62 17.5 (6300 – 63635)

-47 58 62 17.0 (64195) returned to Maggies

-14:00 off to Maggies to Cape Britain then into PEI
-Very rough ice off Cape Britain
-16:30 off to the Met. Stn Louis is using both Pods
-Cannot find Met Station Range finder needs to be reset

Louis helped with DAT files, new dat viewer used to plot dat files

Sunday, Feb. 27, 2000 +1^{o}C, overcast, winds S at 10 km/h

-Ingrid E-mail location, Found it with Range finder now that it is reset
-Faxed Bernie and Jim the Position and ice thicknesses
-Met. Stn. at 46°48.6'N and 62°23.06'W at 12:30
-sensors at 6 m and 60 cm, check height of "1 m" setting it appears 125 cm
-Finished the holes along the calibration line 15:00
-15:50 off to Met stn. to do Video/laser lines
-lines every +/-30 m, Louis and Ron flew lines SP marked position of lines

Monday, Feb. 28, 2000 +8^{o}C, cloudy, winds S at 15 km/h

-Louis to Radar lake with two pods
-Wrote up ASIP, too cloudy for the probe
-15:15 to 15:45 afternoon calibration probe flights
-left for Met. Stn 16:00 removed station 16:30, fog everywhere

Tuesday, Feb. 29, 2000 +3^{o}C, overcast and foggy, winds light

-Packed for Cartwright, left by noon but got stuck at the Maggies.
-Left by fix-wing to Halifax, helicopter at Maggies until Sunday March 5.

Monday, March 6, 2000 -2^{o}C, clear, winds N at 24 km/h

-left at 07:45 for PEI (SP and BB)
-Mini mast was 120 cm long before being cut to 1 m
-Put out Met. Stn. off Pictou Island (17:15) at 45°46.25'N and 62°34.71'W (1 m, 2 m, and 6 m)

Tuesday, March 7, 2000 -3^{o}C, cloudy, winds N at 15 km/h

-Alex coming down for snow video; second helicopter called
-353 down in morning because of fuel pump; two helicopters by afternoon
-Probe flight started to seal area, from Summerside, stopped offshore by snow
-No flying due to snow and fog

Wednesday, March 8, 2000 -3^{o}C, winds N at 20 km/h

-Long probe –video flight to Seal area (landed there), Maggies and back
-Laptop froze up, no radar altimeter after landing (radar cable damaged.)
-Weather channel (Shelley Steeves) for 2 hr with both helicopters
-Off to Met Stn. Changed mast to 60 cm, 2m and 4m
-Sent data plus plots to CIS , IML (seal) and others CCG and IcePic (Bernie Weir)

Thursday, March 9, 2000 Cloudy, winds SE at 10 km/h

-09:10 Met Stn. Video flight (no radar)
-NE to SW lines all at same height 50m
-east of station to #86840 (F104) west of Stn. #86868 – 88440
-back to PEI 388440 (F105)
-Floe size .74N miles long and ½ the width
-to Seal herd with new beacons, 10 miles out starting to ice-up and returned to hanger
-Left for Bedford in afternoon

Saturday, March 11

-Ron and Ian moved Met. Stn. from Pictou Island location to Hillsborough Bay

Monday, March 13

-Left for PEI 11:00 after obtaining a 2m mast for mini Met. Stn
-Moved all files from video laptop to Jaz drives.

Tuesday, March 14, 2000 clear, -4^{o}C winds NW at 10 km/h

-Changed Met. Stn. to 1 m, 2 m, and 6 m
-Video laser survey with Nicki, Simone
-Probe flight to bridge and offshore N of PEI
-Probe does not work, Radar works on Video
-Tried to fix probe rest of afternoon

Wednesday, March 15, 2000 clearing, -2^{o}C winds S at 20 km/h

-Worked on probe, no luck
-Afternoon Video/laser flights over beach lines for AGC 4 out of 5 lines
-Probe taken out of 353, Ronny left for Cartwright in afternoon
-Plot show good data of test flight north of PEI (RAW flies may contain data Tuesday/Wednesday)

Thursday, March 16, 2000 clear, +2^{o}C winds East at 25 km/h

-Removed Met. Stn from the ice 09:30, data good to 09:00
-Placed Met. Stn. outside hanger, building blocks wind to NE

-Data to start at 11:00, all three beacons now at 2 m above ground
-Talked to Scott and checked data plots: problem is the radar cable
-Left for Halifax with broken cable
-Ronny stuck in Nfld, Cartwright work done on Saturday (M18), travel back on Sunday (M19)

Monday, March 20, 2000 clear, -3^{o}C winds NE at 15 km/h

-Left for PEI with Radar cable and second cable coming from Scott
-Installed Probe into 353, test flight in afternoon Radar/video okay but probe not working
-Checked probe rest of afternoon with Scott/James help but no luck
-Main connector not connected proper (one possibility)

Tuesday, March 21, 2000 clear, -2^{o}C winds N at 15 km/h

-Changed beacons between 08:00 and 09:00 to different position away from building
-Worked on Probe rest of the day but could not solved it

Wednesday, March 22, 2000 clear, -2^{o}C winds N at 20 km/h

-Had probe apart in three pieces but could not make it work
-Stopped working on it and packed it up for the season
-Video flight over AGC lines

Thursday, March 23, 2000 clear, -0^{o}C winds W at 10 km/h

-Removed the beacons from hanger location (07:55)
-AGC flight with video/laser sensor 9:00-11:30
-Packed up equipment (17 boxes in PEI)

5.3 Sea Ice field work February - March 2001 (S. Prinsenberg; ed. A. van der Baaren)

Sunday, February 4, 2001 clear/sunny, -5^{o}C
12:00, Light SW winds

- Left Bedford 08:30; At bridge 11:30
- Ice compacted against east side of bridge, thin ice against PEI coast
- Unpacked, no CTD winch or battery pack for mini-met. Station
- Louis here unpacking and modifying Alex's Pod
- Evening SE winds 7 km/hr, -11^{o}C

Monday, February 5, 2001 Foggy, clearing, -10^{o}C
08:00, no wind

- Emailed from Hanger, clearing by 11:00
- Louis/Simon in 362 test new laser/video

- Did not work: broken GPS helicopter port
- Broken video cable on Laptop

- 13:00 Scott unpacking 363 back from Ice Reconnaissance — Clear, light SW winds
- 363: Louis/Simon and Dave Padden in 363 for video check
- Hillsborough Bay several lines at different heights
- 1: -200 m-to land; 2: -150 m- to Channel; 3: -100 m- to land; 4: -50 m to channel
- 5: -250 m-to land. Pictures 7-11 along line looking from SE flying to channel
- 362: Scott/Ronny mounted IcePic ready 15:00 when 363 returned
- Tested sensor on some ice
- 363: added radar pod went out to Hillsborough Bay for test, very flat light over
- snow. Both returned to hanger by 16:15

Tuesday, February 6, 2001 — Blizzard, -3°C
08:00, 50km/h E-NE-N-NW

- At hotel until weather clears (11:30)
- 13:45-14:45 Scott/Ronny went out with IcePic
- Sampled one spot by rotating helicopter by 90 degrees — Fem0009.dat
- 24 26 cm of ice, no snow at this place in Hillsborough Bay — -3°C
- Freezing rain on way back — 17:00, 24 km/h W

Wednesday, February 7, 2001 — Variable clouds, -6°C
07:30, 19 km/h W

- 363 Louis/Mike to Radar lake and Tracadie Bay
- Two pods: new video/laser and Radar (Alex's)
- 362 Scott/Simon/Ronny to Strait
- Flat light, low clouds over harbour
- #14/15 thin ice ~ couple of cm
- 09:30 #17 5-7 cm of ice, background
- #18, flying fast 70 knots at 2 m: flat 5-30 cm
- 09:40 slow flying speed average 10 cm (5-10 cm)
- #19, less than meter up to 2 m rough rafted 09:45

- Big floe 45.98°N, 62.98°W (09:45-10:45) — File fem00010.dat
- Bag 1 34/36/36 cm of ice&snow, water to top of snow
- 15 cm of snow
- at 21 m North 55/52/54 cm of ice&snow, snow 15-20 cm
- at 33 m North 44/45/45 cm of ice&snow, snow 20 cm
- at 48 m North 31/29/30 cm of ice&snow, snow 3-5 cm
- at 49 m North 31/32/30 cm of ice&snow, snow 3-5 cm

- To Pictou looking for old ice, but not there, blown eastwards during storm
- Rough floe: file fem00011 (32 cm) and fem00012
- Picture #21/22 instantaneous and averaging mode
- Up to 3 m one spot 3.6 m, 10:50 to Point Prim

- Land-fast ice, dat file fem00013 (29 cm)
- 30-40 cm started flat, then thick/rough 0.6 to 2 m 11:10
- Snowing on the way back, flew long way home along tree line

13:20 Convair over Strait
- 362 Ronny/Scott/Simon to Strait
- Back to large floe measured before File fem00014
- Measured total floe 1 mile x 2.5 miles, South to North
- No GPS; mean 55 cm flat ice 37 cm
- File fem00015 No GPS (floe numbers minus one as floe #1 is on fem00014)

2nd floe made up of three floes
- 35 cm +/-20 cm, middle part thin flying 60 knots
- sample on fem0015: 600-1200

3rd floe big pan 48 +/-20 cm sample 700-2100

4th floe 54 cm +/-25 cm sample 2900-3400
- white/snow and rafted (older than previous floe)

5th start to see square floe cut by bridge some thin young floes
- 40 cm average 4300-4600
- loop and background

6th cut floe thin grey ice 15 cm small

7th small floe old 1m+ very rough/white

8th young floe grey ice 15-16 cm thick some open water

9th picture #29 young grey floe 9+/-7 cm; ~ sample 7560-7660

10th young ice 10 +/-11 cm; Augured ice 11 cm

11th old floe three holes 55/35/45, rafted snow&ice 15 cm of snow slush layer
- sample 8000-8500 (015)

12th thin floe sample 8700-8860, 11 cm thick

File fem00015 inside Point Prim

- 73/75/75 cm snow&ice 25 cm of snow and 10 cm of slush

File fem00016: 400-1800/ no GPS
- Slush layer seem to be ignored by model snow&ice calculations??

Back 14:45, all GPS files were lost of afternoon flight 19:30, -5°C, 15 km/h NW

Thursday, February 8, 2001 Clear, -5°C
07:30, 34 km/h NW

- 363 to IML sealers
- 362 Simon/Ronny/Scott with IcePic to Strait fem00017???
- First time SP to fly IcePic, looking for dry 30 cm thick ice floe
- Set line in lee of small ridge 60 m long but perpendicular to wind

- Bag south end 6 m from #1 fem00018
- #1 35/33/36 snow&ice 5 cm snow
- #3 34/34/34 snow&ice 7 cm snow
- #5 30/30/30 snow&ice 6 cm snow

- #7 38/37/36 snow&ice 8 cm snow
- #9 38/35/39 snow&ice 5 cm snow
- #11 40/35/40 snow&ice 5 cm snow
- #13 46/45/45 snow&ice 9 cm snow

- Bag at #13, 60 m from #1, 10 m between sites
- Sampled by IcePic resting and hovering
- Slush layer salinity sample 18 ppt, pictures up to #46

Afternoon Strait to bridge with IcePic in 362 fem00019

- First section sample 0-8000 track to bridge
- Floe #1 behind the Earl Grey, thin floe (380-520)--29.4 cm
- Background, #2 grey thin ice (one day old) #47 (980-1080)--8.5 cm
- Up high again #48 to PEI
- #3 thick floe, slow flying #49 (1820-1959)--96.9 cm
- #4 square cut floes start, white floe 65 cm, #50,51
- Up again #52, #5 rough floe 40 cm, #53/54, background
- #6 old floe 1.8 to 2.0 m beaten up floe average 1.28 cm; 85 cm flat section
- #7 flat ice no rafting 35 cm, #57 (36.2 cm)
- #9 old rafted ridged floe 1.5 m picture of 1.0m block #57
- #10 thin floes 10-20 cm no rafting (17.7 cm in flat area)
- At bridge, no current very weak to west, shadow of bridge on west side
- To NB 22/23 then back to 24 moving both side ways // to bridge
- 30 cm average flying sideways but // to bridge
- Perpendicular to bridge flight lines about 100 m 24 and then 22/23
- #67 to NB and #68 to PEI 68/69 over 24
- 3 m thick floe near pier floe stuck trying to move through bridge area
- #70 30 cm rafting at pier, #71 brash ice of 30 cm type ice
- Return to hanger 14:45
- Change 362 to Ice Probe flying, 363 to Tracadie and Radar lake
- Lake had 30 cm of slush/snow on it deeper snow not frozen thinner snow all slush and top frozen. To Hillsborough Bay for radar on ice test.
- 362 there with Probe, return to hanger
- Probe needs more fixing 10:00 -5^{o}C, 13 km/h, clear

Friday, February 9, 2001 Clear, -6^{o}C
07:30, 5 km/h W

- 09:00, 363 Simon, Louis and Mike to Hillsborough Bay
- New laser/video brightness tests
- At CCG base both Terry Fox and Earl Grey
- 10:00 on Ice setting out 3 // lines, 2 bags each 50 m apart, line spaced 30 m
- Line facing outer harbour and flied of rubble, snow covered ice
- Northern bag 5 m from ridge, middle line bag 15 m and southern line bag 36 m
- Pictures 75-84 from the area, all to Charlottetown, done by 11:00
- Did two height versus laser brightness tests to 1200 ft 21:00, -6^{o}C, cloudy

- Probe apart; afternoon packing Radar and working on Probe. light snow, 9 km/h SE

Saturday, February 10, 2001 — Cloudy/rain, +2°C
07:30, 10 km/h SE

- Ice Probe repair, done by afternoon but no flying weather window
- Louis changed Dat viewer for Mean Value in histograms and use of altimeter data
- 11:30 left for Moncton as Ac plane did not land (Fog)
- Cold front coming in; clear and windy in Moncton 14:30
- Back in Charlottetown by 16:30
- Strong westerly all night down to -15 °C

Sunday, February 11, 2001 — Cloudy/snow, -14°C
08:00, 45 km/h W

- Final fix on Probe, one NEC laptop internal battery is gone
- Cleaned/Packed Met tower, it needs plywood feet
- Checking/correcting IcePic calibration constants — 20:00, -18 °C
- Blizzard conditions the whole day, too cold in the hanger — 50km/h W

Monday, February 12, 2001 — Clear, -14°C
08:00, 25 km/h W

- Still too windy, put on IcePic for test and flight for Bernie Wier
- Mate to Earl Grey and Ronny went out to Irving Arctic coming in to Charlottetown
- Took the IcePic to height dependency test before going for a test flight with Probe.
- Probe problems originate in rack, can not find it. Stopped at 20:00.
- Camera back to Shearwater with Robert Maclean. — -14 °C, clear
- James Lee worked all night on a debugging program for the Probe. — 15 km/h W

Tuesday, February 13, 2001 — Clear/flurries, -12°C
08:00, 10 km/h S

- James sent a debug program by E-mail
- Scott rebuild board during the day
- Flag/poles readied — -15°C/clearing
- Snowing during the afternoon. 15 km/h W
- Put in new calibration factors in IcePic

Wednesday, February 14, 2001 — Clear, -14°C
08:00, 10 km/h W

- IcePic with Ice observer 08:30-10:45
- Produce Dat file pictures, sent to 10 people
- Not yet to NRC, Probe flight not there yet
- !4:45 Possible program error on acquisition Disk
- IcePic data: Fem25
  - -thin floe 7.0 cm (1360)
  - 35.0 cm (6240)
  - 51.0 cm (9780)
  - 32.0 and 39.0 cm (15060)

- Fem 26 -19.0 cm (1755)
- Fem 27 -32.0 cm (1000)
  -47.6 cm (1780)
- Left 16:00 for Halifax, dropped Scott off at Airport

Friday, February 23, 2001 -19°C, Clear high overcast
Winds 9 km/h from SE

- Data collected by Ronny and Ice Observer
- File 29, 31, and 32 towards Gaspé Bay
- 29a Spot sample 1.84 m in 80-100 thick pack ice, 50 km east of Cape North
- 29b two spot sample 2.4 m and 1.07 m
- 29c short 400 m line 0.5 m of ice
- 31a Inside Bay 20 - 50 cm of Ice
- 32a Off west point thin ice 12 cm
- 32b Spot sample 69.5 cm of ice
- 12:00-13:00 high speed IcePic test!
- E-mailed Word file of flight 34 which had a bad GPS data file (also to NRC)
- Sent Dat files to Ingrid, Matt and Lori
- Worked on Probe in evening some blown chips, GPS now working still spikes in data? 21:00 -11°C, overcast, 17 km/h N

Saturday, February 24, 2001 -11°C, snowing
NW 28 km/h

- Sent Telonics back to Bedford Institute (10:00)
- Snow storm and windy the whole day
- Wrote CDs, processed data and plotted figures
- 20:00 probe seems to be ready to be tested
- James corrected some software 21:15 -10°C, clear, 31 km/h NW

Sunday, February 25, 2001 -14°C, Clear
12 km/h NW

- 09:00 Ice Probe flight, pulled cable
- Test looks good but appears on the light side (10 cm)
- Ice observer flight. Charley Daigle. Only IcePic connected
- Fem 35 to bridge Pictures 1286-1324 bridge area to 1357
- Square cut floes even as far down as Point Prim
- First stop 56.57 cm, to Pictou Isl., same file #35 at 11:23
- Open water/frazil ice east of PEI
- Landed south of Pictou Isl. for profile 23/22 cm of ice for an 7.8 cm average
- Third stop S of Pictou Isl. 36 cm flat
- Fourth, landed twice 59/60 cm, profile over ridge
- Fifth stop strange large floe average to 1.88m but as thick as 2.4m
- Sixth smooth floe 15 cm, auger 12-14 cm
- #7: finger rafting 12 cm average. (12:00 turn to NB)
- #8: Newer darker floes, no ridging 27/28 cm but looks like frozen slush
- New ice only cut by bridge once, with lots of new ice south of PEI

- #9: 22 cm flat frozen snow white ice; average 28 cm landed very flat with ridge in centre
- #10: grey finger rafting (7 cm); end of file #35

- Started new file at bridge (#36), changed camera flash card but could not reset time and day
- At bridge, no motion at pier 24; first did 22-23 then 24, tide change
- Ice pulled back from west of piers and start going to west (12:45)
- Need splitters of power and GOPS to fly both IcePic and video
- Set out line (Simon, Ron and Charley)
- Total thick calibration line 350m with bags 50 m apart
- Spot sampling on Fem 37 lines on Fem 38

Stn/bags/distance (m)	Left	Middle	Right
30m Lead/*/475m	----	21/21/20	----
#9/--/400m	----	----	----
#8/*/350m	51/49.8	60/59.7	52/53.0
#7/*/300m	50/49.3	55/54.5	56/55.8
#6/*/250m	54/54.7	63/63.0	61/61.1
#5/*/200m	61/56.8	64/83.2	71/71.1
#4/*/150m	67/66.0	66/66.6	56/56.4
#3/*/100m	57/56.7	61/61.2	55/55.4
#2/*/50m	58/57.9	56/55.8	56/56.3
#1/**/0 m	48/48.3	54/54.1	44/44.3
Ridge/-/-70m	----	----	----

- First number is from read-out in helicopter and second from histogram plot
- Site #9 to NW (Charlottetown) and #1 to SE (Point Prim)
- Three lines flown at different heights all towards #9, done by 15:20
- Probe flight over same line and video; none really worked.
- North of PEI. Laptop went blank and Probe laptop went blank, no Dat file but stored as Raw file
- Tried to go back to Cal line but Laser stopped and run out of daylight.

-Processed data Fem 35-38 and made plots sent E-mails. -10^{o}C, overcast 10 km/h SE

Feb 25 dat-file plots:

35a 56.7 cm spot sample 3250-3680
35b 37.5 cm spot sample 6400-6800
35c 37.1 cm spot sample 7600-7700
35e total 19 1050-1100
35e(1) 150 cm spot sample 2.43m
35f spot sample is 1.3m
35h spot sample, young ice 27 cm
35i spot sample 22 cm, then profile average 28.4 cm
35j spot sample thin ice 9 cm

36a all three sample from bridge area

36b piers 22-23 perpendicular to bridge 47 cm
36c pier 24 perpendicular to bridge 38.6 cm
36d 24-22 parallel to bridge 22 cm

37a 6 spot samples 52 cm
37b 8 spot samples 58 cm
37c 5 spot samples 59 cm
37d 6 spot samples 53 cm Mean 56 cm this includes all data
38 lines over thick calibration line

Middle line average 53.6 cm, with ridge 69 cm, ridge 3.72 m
350-700 alt 2.01m over line and 2.7m over ridge
Left (W) line average 55.9 cm, with ridge 66 cm, ridge 3.64 m
1200-1500 alt 2.07m over line and 2.9m over ridge
Right (E) line average 53.4 cm, with ridge 67 cm, ridge 2.98 m
2000-2250 alt 2.5m over line and 2.98 over ridge

All lines no ridges 55 cm similar to total spot samples (including up/down error)

From Dat-files spot samples:

Left line spots	Middle line spots	Right line spots
.498	.597	.530
.493	.545	.558
.547	.630	.611
.568	.632	.711
.660	.666	.564
.567	.612	.554
.574	.558	.563
.483	.541	.443
0.549 mean (0.559 line)	0.598 mean (0.536 line)	0.566 mean (0.534 line)

Monday, 26 Feb., 2001 Overcast, freezing rain
-2^{o}C, 15 km/h SE

Left Hanger 10:00 after packing up, dropped James Lee off at Halifax Airport.

Thursday, March 1, 2001 Clear, -10^{o}C
10:25, winds SW

-To bridge Derek Brittain/Simon 10:25

-Calibration line#1: 15:00
-10.7 m of water at bag 1; 9.1 m of water at bag 9
-Snow crust (ice) 1.0-1.5 cm thick made by freezing rain
-Bags 50 m apart, bag #1 is 60 m (L/R lines) and 70 m (Middle line) from ridge, site #9 is 50 m from bag #8 and 75 m from frozen lead; at 30 degrees to lines (left line longer)

-Salinities: water 29 ppt, snow dry from 6-8 cm 4 ppt, wet snow from 2- cm 30 ppt, surface ice 13 ppt, ice at 10 cm 9 ppt, ice at 20 cm 7 ppt, ice at 28 cm 3 ppt and ice at 36 cm 8 ppt

Bag 1 45/46/45 cm of ice 45+10=55 cm
11/08/11 cm of snow
01/02/03 cm of freeboard

Bag 2 45/46/53 cm of ice 48+15=63 cm
15/16/15 cm of snow
01/02/03 cm of freeboard

Bag 3 47/44/44 cm of ice 45+10=55 cm
10/11/10 cm of snow
02/00/00 cm of freeboard

Bag 4 48/52/57 cm of ice 52+9=61 cm
10/08/11 cm of snow
02/03/03 cm of freeboard

Bag 5 61/65/61 cm of ice 62+15=77 cm
16/10/10 cm of snow
04/03/02 cm of freeboard

Bag 6 50/51/54 cm of ice 52+14=66 cm
11/17/13 cm of snow
02/02/02 cm of freeboard

Bag 7 52/49/54 cm of ice 52+6=58 cm
06/07/06 cm of snow
02/02/02 cm of freeboard

Bag 8 50/48/45 cm of ice 48+11=59 cm
09/11/13 cm of snow
02/02/02 cm of freeboard

---- 9 45/45/49 cm of ice 46+17=63 cm
19/15/19 cm of snow
00/00/01 cm of freeboard

<u>Snow plus ice mean = 62 cm March 1, 2001</u>

Comparison to IcePic and Probe data from March 2, 2001

IcePic: Spot samples 62.5 cm (fem 44) and 61.7 cm (fem45)

Lines middle 54.9 cm/alt 1.7 m;
east (left) 54.7 cm/alt 1.8 m;
west (right) 55.7 cm/alt 1.8 m average 55.2 cm 7 cm thinner

Probe: Mar02f21 51.0 cm and 55.6 cm average 53 cm 9 cm thinner
Snow depth (cm) at Calibration Line on March 1 along the centre line 5m apart

Bag	(m)	cm	Bag	(m)	cm	Bag	(m)	cm
	-25	6	#4	150	10		325	7
	-20	12		155	12		330	11
	-15	13		160	10		335	13
	-10	15		165	26		340	11
	-5	18		170	16		345	17
#1	0	11		175	10	#8	350	9
	5	9		180	9		355	13
	10	14		185	13		360	11
	15	13		190	13		365	10
	20	7		195	14		370	12
	25	6	#5	200	19		375	13
	30	9		205	10		380	10
	35	17		210	13		385	7
	40	11		215	16		390	14
	45	6		220	8		395	9
#2	50	15		225	7	#9	400	14
	55	9		230	12		405	13
	60	6		235	12		410	12
	65	9		240	13		415	10
	70	15		245	15		420	13
	75	13	#6	250	12		425	16
	80	12		255	9		430	11
	85	14		260	10		435	8
	90	14		265	12		440	10
	95	11		270	15		445	12
#3	100	10		275	8		450	10
	105	12		280	10		455	9
	110	19		285	12		460	12
	115	14		290	11		465	10
	120	18		295	13		470	9
	125	12	#7	300	6		475	8
	130	10		305	15			
	135	11		310	18			
	140	12		315	11			
	145	11		320	11			
#4	150	10		325	7			

Ridge at –60/70m from Bag #1

Back at hanger at 18:30, Ronny updating his night flying
All night calm, clear -18°C (some additional ice had grown overnight)

Friday March 2, 2001 -14°C, clear
Calm

-Worked on Video Pods, open up laptop strain relief box
-Put out met stations beacons 5181 and 4769
-Ice observer flight to bridge (10:45). Pictures taken; shadow west of bridge, ice moving to west. Fem42a 44 cm, Fem 42b 18 cm and Fem42c 22 cm
-Fem 43 at bridge, see plots of both 42 and 43 sent to "Data distribution"
-13:00 to Calibration Line. Frozen lead north of Cal#1 now 24/32/26 cm was 22/22/26 cm. Set out bags on thin lead ice east of thick calibration line

Lead up bag #1 (SE) 22/23 cm of ice no snow
Bag #2 (70 m) 24 cm of ice no snow
Bag #3 (140 m) 19 cm of ice no snow
Bag #4 (210 m) 19 cm of ice no snow
Bag #5 (280 m) 18 cm of ice no snow mean 20.5 cm

30 m from Bag #5 to end of lead (rubble start ~1 m sail height)
Depth of water 9.5 m

-Processed data and Emailed flight Fem 42/43 (15:00)
-Changed equipment to other helicopter
-Flew Probe to 18:30 calibration line only
-Flurries, -12°C winds NE at 9 km/h
-Derek found broken video cable on Grey box, fixed it
-Flight 44-48 over calibration lines.

Bag/site#	Fem44	Fem45	Auger holes
1	58.4	57.5	55
2	60.4	59.9	63
3	56.8	57.2	55
4	69.6	68.7	62
5	71.4	66.4	77
6	60.9	62.0	66
7	59.9	64.8	58
8	62.7	57.2	59
9	---	---	63
mean	62.5	61.7	62

IcePic lines:	fem45	Middle line	54.9 cm/alt 1.7 m
	Cal line #1	Left line	54.7 cm/alt 1.8 m
		Right	55.7 cm/alt 1.8 m

Fem46 Line 1 18.0 cm/alt 1.98 m
Cal line #2 Line 2 18.8 cm/alt 1.72 m
Line 3 18.5 cm/alt 1.22 m
Cross line over Cal line #2 (Fem 48)

Across Bag 3 16.6 cm/alt 1.30 m
Across Bag 4 18.0 cm/alt 1.49 m (March 2)
Across Bag 5 16.0 cm/alt 1.24 m 46.115° N/-63.0535° W

Mar02F21 3 passes over thin line and 2 over thick line

Saturday March 3, 2001 Light flurries, calm
06:45, -11°C

-Tip of blades were changed/waiting for third helicopter to leave (11:00)
-Several passes over both lines with IcePic plus pull-up test by Ronny
-Ice thickness of frozen lead north of Cal line#1 now 24/32/26 cm
-Took three water sample: 28/28/29 ppt

Pull up test by Ronny Fem50 1987-1995 sample #
Ice 45 cm reduce to 0 cm as alt goes from 1 to 2 m

Fem 51:	275-500	1.9m	56.4 cm	
	780-980	3.1m	49.4 cm	
	1215-1460	5.1m	38.9 cm	kicks out
Fem 52	255-545	1.78m	53.6 cm	
	780-1100	3.01m	49.1 cm	
Fem53	300-550	1.42 m	22.7 cm	
	910-1070	2.65m	15.9 cm	
	1320-1480	5.0m	9.5 cm	kicks out

-Probe flight North of PEI flt. 024
-Video problems with altimeter
-Probe works but underestimate ice thickness ~10 cm
-Turned around because of snow up ahead, probe started to give incorrect numbers (01 and 145 cm). Three tries to restart
-16:15 out again to north of PEI with IcePic (Fem 58)
-Spot sample 20/15/88 cm

Sunday March 4, 2001 -10°C, light flurries
13 km/h NW

-Radar splitter checked out, soft land on thin cal line on way to bridge
-Bag #2/23 cm; Bag #3/22 cm and bag #4/23 cm; bag 3 moved. (fem60)

-Continued to Bridge area; two profiles done
-21 cm spot and profile (fem 61)
-Water sample from edge 29 and 39 ppt,
-25 cm/22 cm spot sample plus profile and 38 cm spot sample (fem 62)
-Generator light came on and we headed home.
-Ron fell badly on helicopter pad/ Mike Hammel arrived
-Processed files 60-62 and Probe 24
-Emailed files to distribution/left for Halifax (home 17:00)

Tuesday March 6, 2001 -4^{o}C, light flurries
10 km/h NW

-12:00 Scott here working on Probe
-16:00 left Bedford/snowing cleared by Airport but snow drifts on road
-evening no test flight/ checked cables all appears to be connected

Wednesday March 7, 2001 -3^{o}C, light flurries
13 km/h NW

- IcePic flight with Ice observer
- Probe test flight, looks okay but some changes required
- 14:30 IcePic flight for AGC lines

- 62 40W line at 2.5 miles thin rafted blocks, then thicker blocks
- at 4.o miles thinner ice 30 cm; at 7 miles 2m sail heights
- Thinner ice at end picture (2) up high going to next line
- Background at 5 miles, plot fem65a

- 62 50W line Several (5) pictures low soft land at start 2.65 m
- Large floe at ~1 mile, shear lead at ~2.2 miles
- Flat thin ice, 3.0 miles thick ice, 4.5 miles flat old ice
- Old pan soft land 69 cm, old pancake ice frozen solid into floe
- Pictures (2) of pancake ice, then pictures high up (2). Plot: Fem 66a

- 63:00W line Soft-land 1.65 cm several pictures (2)
- Total area rafted, soft landed at 3.3m pictures (2)
- Freeboard pictures (3) going to next line. Plot Fem 67a

- 63 10W line Stanhope area 2 pictures Plot: Fem 67a
- soft landed .73 cm 2 pictures
- 1 mile out flat area, then big ridge and lead
- Rubble with heavy blocks, then thinner ice / thicker ice
- Thin ice with thick blocks, at 4 miles flat area
- At 5 miles soft landed took long time to slow down (ignore data before landing)
- At end 3m sail heights, lots of fresh cracks. Plot Fem 68a
- 63 20W line to the start line Picture, crack appear to indicate ice drift to west
- Compressed submerged ice against coast. Plot Fem 70a
- Soft landed 42 cm, first rough ice then thin flat ice, rubble with thin blocks

- The thin ice with heavy blocks, ridge and flat ice; long flat ice 4 miles 30 cm.
- Soft landed 2.9m ice rubble field 2 pictures; 2-3 pictures along the line before
- Processed plots

Thursday March 8, 2001 -3°C, light flurries
13 km/h NW

- E-mailed plots of AGC lines in early morning
- Probe out doing AGC lines, Two beacons on board 967 and 965. Started at 9:00
- One beacon gave problems so several restarts
- 11:30 probe back from AGC lines down-loaded dat/raw files
- 12:15 Out again with Probe to Maggies, one beacon on end of AGC line and other with Mike Hammel seals
- Processed dat Probe files Mar08f34.dat. and made and E-mailed plots
- Probe flight done by 16:00, dropped Ron off at pool
- 16:30 back to hanger to process probe files 37-41 and write CDs

Friday March 9, 2001 -8°C, clear/calm

- Late start 09:30: Quick flight to Cal lines. Thin Calibration line
- Bag 5 –20 cm, bag 4 –20 cm, bag 3 –21 cm north side of bag 5 20 cm
- Height test over thin ice; IcePic program not fixed yet
- Fem 0074 over Cal Line#; 1 all spots too low, average ~50 cm
- Helicopter with ice observer to Maggies, for no reason
- E-mailed Probe plots in early morning
- 15:30 second test, drilled thick ice SE of bag #1 (flight show thinner ice)
- Bag #1 46 cm of ice and 13 cm of snow for a total of 59 cm
- At –20m 43/11 for 54 cm total (right)
  42/12 for 55 cm total
  40/19 for 59 cm total (left)

- At –30m 46/05 for 51 cm total (right)
  47/05 for 52 cm total
  48/06 for 54 cm total (left)

- At –40m 49/13 for 62 cm total (right)
  100/25 for 125 cm total just edge of raft
  43/09 for 52 cm total (left)

High look at bridge area – no ice there as far we can see

Clouding over/ phoned/E-mailed Alex Herman

- 17:00 third test of IcePic program. Data appears okay now at various heights
- Fem 77: several spot samples 22/24/27 23.3/20.5 cm and line average of 20.5 cm/alt 1.4 m and 15.1 cm/alt 3.0 m.

- Fem 78: Cal line: lines 56.8 cm and 58.4 cm and spots: 8/57.8 cm, 7/54.0 cm, 6/62.0 cm, 5/67.0 cm, 4/59.7 cm, 3/52.0 cm, 2/62.9 cm, 1/59.8 cm, at-30/53.0 cm at ridge/300 cm and past ridge/ 135 cm
- Several pictures of snow over frozen snow and of Calibration lines
- Soft landed along Thick calibration line (not at #9) between bag #1 and ridge, at ridge and past ridge (20 m)
- Stopped at 17:00, wrote CDs in Hotel

Saturday March 10, 2001 -3°C; snowing
08:00; 10 km/h E to S

- At hanger wrote CDs, working on IcePic program and typing
- Clearing by noon, out at 15:45 to Hillsborough Bay
- IcePic flight over both calibration lines. Looks heavier now as you fly higher??
- Cal line/68 cm, cal line 33 cm, cal line 29.4 cm
- Spots 24 cm, 23 cm, 23 cm, 22 cm, 24 cm and 25 cm
- Snow maybe thinner due to Weight of ice layer
- At thinner ice Bag #5 23/23 cm Snow on ice wet 4-5 cm
- Too snowy/rain all around us to fly the Ice Probe. Done by 16:45
- Wrote CDs and plotted data. Looked at dat-files 81/79 and 72/78

Sunday March 11, 2001 -2°C; clear
08:00; 20 km/h W

- Closed flying window of height of IcePic flying to 5.5 m
- Probe test at 9:30 to East Point some data on raw file but no real-time dat-file
- Replaced DSP board and flight tested again, still no data 13:30
- Seems to be working but still no real-time data, possibly have rough files
- Changed code of dat files in text file 73-81 and 82-89 (no 86 and 87 short)
- 16:15 IcePic check at Hillsborough Bay. Staying in PEI for another night
- Wrote CDs last March 8 (90) and some March 11 (91-94)

Monday March 12, 2001 +2°C; clear
08:00; 10 km/h NW

- Left helicopter for Alex after Ice observer flight
- Ronny stuck at Maggies until 9:30
- Fixed the ice probe; changed rack to just back seat computer set-up
- Dropped Scott off at airport 17:00

Wednesday March 14, 2001 +2°C; clear
11:00; 13 km/h SW

- Left for PEI with George after picking up Met. Oceans Beacons
- Arrived at PEI at 16:00; Ronny is stuck at Maggies
- At Hanger in evening readied Met Stn. And George made GPS splitter

Thursday March 15, 2001 +1°C; overcast

07:30; 10 km/h W

- Ronny arrived from Maggies 09:30 with broken antenna
- Out with Ice observer 12:00-15:30; then Alex
- Second helicopter (363) arrived (Bruce Kendall) to exchange helicopters
- Alex took his helicopter instead; Ronny had to go out and show where line was
- Put Met Stn. beacons in both helicopters for morning take-off
- Sent plots up from March 11 (late) to distribution including J. Francis
- - Changed programs with Scott's patches 20:00 +1^{o}C; 10 km/h NW

Friday March 16, 2001 -3^{o}C; clear

07:30; 10 km/hr NW

- Out with both helicopters to wards Pictou Island
- Met station out at Lat. 45°55.837N and Long. 62°50.915
- Ice thickness ~75 cm small flat area 40 x 30 m directed into wind (NW)
- Winds outside harbour were from NW(270) at 24 km/h
- Beacons out at 10:15: 1 m and 2 m okay at 10:00.
- 1052 temperatures at 2 and 6 m
- 4769 winds at 6m: 5181 at 2 m. and 2364 at 1m
- Beacons lined along long axis to NW with all mast on NW side
- Pictures 1497-1513: four flags out at Stn., helicopter north of beacons
- Big floe at entrance to Hillsborough Bay 14 NW of Met Stn
- Alex out with 363 back at 15:00; also second helicopter from Maggies here
- Switched Alex to second helicopter: 363 out with Probe Met station to bridge
- File #52 to met station, turn to bridge file #53 and at bridge #54
- Files 52 on laptop and dat-file files 53 and 54 not on laptop maybe on Zip disk
- Tide reversing again, tide presently to west and wind to east
- None of ice west of bridge has not been damaged by bridge, winds dying.
- Profile along the bridge is west of bridge.
- Two cold starts with the Probe between files. Note the CAP #1 connector loose
- Also video plug was lose. On way in second helicopter brought out #966 beacon placed on large floe Terry Fox was breaking it in two

Saturday March 17 2001 -1^{o}C; clear

07:30; 7 km/h NW

- Met. station now at 45°53.9'N and 62°43.7'W at 9:45; drifted 5.3 miles to SE
- Spider web Video/laser profiles at 50 m over Met Stn. N
- IcePic lines over Met Stn, floe (fem 83) and land-fast floe
- Picture 1522-1526 of Met Stn. and 1527-1533 of bridge
- To bridge and at bridge (fem 85): we lost #84 data to bridge
- Beacon out east of bridge #968 at 11:30
- Laser pull-up test V2001 76-126 Min 48-54
- E-mailed IcePic plots to distribution; In afternoon to north of PEI 14:00
- 2 pictures of thin ice 24 cm inshore pack ice (fem 88)
- Logging video at back ground around frame #50022
- Large thin ice floe before rough ice with Hood seals on them

- Rough ice 1-1.5m (fem 89) done by 2:46, at end into thin ice again
- Background video sample area 50280
- Last file to west (fem 90) 3 ended up in seal area when doing last background
- Helicopter sensors of second generator acted up so we return to base early
- Pictures 1548-1552 at 14:00-15:00
- Emailed IcePic plots to distribution
- Left for Bedford at 17:00; home at 21:00

Wednesday March 21, 2001 +1°C; clear
10:00; 10 km/h NW

- Left for PEI at 05:00 with extra Gelcell and range finder
- Ready to go to Met Stn. 10:00 (Jeff Brittain - engineer)
- Location by Ingrid 45°55.98'N 62°36.06W'
- Second range finder worked but not zeroed, found station by eyeball
- Last good data at 10:00, all beacons off the ice by 11:30 some damage to tower
- Small beacon had melted into the ice by ~4 cm, floe had not changed its orientation although it had drifted over 10 miles down the Strait
- No change in floe properties since the video flight documented its properties
- Moved Beacons to Hillsborough Bay, 1 and 2 m out by 12:30
- Temperature on helicopter thermometer in sun was 7°C with NW winds
- Took broken mast piece to welding shop at the CCG base
- Afternoon Ice Probe flight but could not start the video laptop (no hard drive)
- Hard dive flown in by air freight; here by evening
- File numbers increased on GPS files due to trying to spot laptop
- Flew via the Northumberland Strait towards the M. Black but fog stopped us
- Cut across the east part of the Island and profiled back towards Charlottetown
- Data on three probe files 56, 57, and 68. (No video). Back by 16.25
- To Met. Stn. to put 6 m vane up 17:50. Processed probe data
- E-mailed plots and dat files to 4 people (10:30). -4°C, clear and E winds at 6 km/h

Thursday March 22, 2001 -5°C; clear
07:30; calm

- Ice observer went out to M. Black, too much fog for Probe
- Files numbers 95 and 96 but they do not have lat/long data
- 11:30 north of PEI to Terry Fox and M. Black east of East Point
- Only Alt and GPS updated during background, no ice thickness on laptop
- First back ground quickly then one before changing files after passing Terry Fox
- Did a triangle around the icebreakers before re-fuelling on the M. Black (13:30)
- After picking up Probe from ice followed the track the Terry Fox would take to Charlottetown
- Big land-fast floe with beacon was still in three pieces in front of Hillsborough Bay

- Went out with the IcePic for Scott and Louis tests
- Test over airport fem 97 file sharp descends 10 Fid points at start/end of drop
- Test drops over ice (fem 98) and left side kicks on fem99 each three Fid points
- Fem file 100 is ice thickness flights over met station (pull-ups over tower)

- Fem file 101 is the spider web at 50m for video/laser data over Met. Stn
- Winds out of 125 (SE direction) GPS 81F334.GPS -Video 65420-65720
- Fem file 102 is the dark ice pull up test for the laser calibration
- 81F338.GPS, ice is only 5 cm thick according to IcePic
- Wrote CDs in evening and processed data E-mailed plots at 11:15
- At night storm started -1^{o}C SE winds at 25 km/h

Friday March 23, 2001 -1^{o}C; snowing
07:30; 45 km/h E

- Working at hanger until 13:00; writing CDs
- Left for Halifax 13:00 - 17:00; rain and windy all day ~0^{o}C

Sunday March 25, 2001

- Ronny out to met station 11:30, all okay mini met stn tilted.
- Strong winds westerly, -4^{o}C. Wrote tables of Ice Probe and IcePic data

Tuesday March 27, 2001 +3^{o}C; clear

- Drove to PEI 16:00-18:00
- Northwind Hotel, no room at Inns on Great George
- Sent Louis and Scott test data from Hanger 11:00

Wednesday March 28, 2001 -3^{o}C; snowing
SE Winds 7 km/h

- 09:30 snow showers, delayed until 10:00
- Ice observer flight Eric Vaillant, 363 refueled on M. Black off Cape Brittain
- Read Scott's IcePic report. IcePic flights done in afternoon
- Checked Met St. in Hillsborough Bay, mini met stn again leaning to NE
- Winds okay for NW and SE; but others reduced in strength
- Flight to Pictou Isl. And to Bridge. Some low flying Video
- Video flight to Pictou Island at 50 m (GPS 340)
- Fem 104 a big file, GPS files 342-346, no ice at bridge piers
- Ice rubble filed of Summerside GPS 347: Pictures 69871-69877
- Going back out for Met Stn.: all beacons off the ice by 16:45
- Digital pictures of stranded ice rubble 1590-1604
- E-mailed pictures and plots to distribution at 21:30 clear -4^{o}C, NW 10 km/h

Thursday March 29, 2001 -2^{o}C; clear
NW winds 5 km/h

- Off by 09:00, several mistakes: probe laptop, breaker off, non power to video
- All working by 10:45 with additional fuel. To Pictou Island and Bridge
- 12:30 at bridge; shadow to West and ice moving slowly to East
- Some large floes 2-4 km to West of bridge
- End file F65 at bridge new file after bridge March 26 F66

- Fem 106 tune-up Fem 107 bridge. 15:13 at ice besides bridge pier #23; floe was stuck while other ice moved to West. Floe thickness .57 m; 1.62 m and 47 cm at edge
- Floe cracked length-wise upstream at 15:13 and two pieces separated around pier
- Tide going hard to west; changed file to Fem 108
- Shadow now at East side of bridge. Returned to Hanger and processed probe files 63, 64 and 65. Packed the Ice Probe and was hung on the wall by late afternoon
- E-mailed processed probe plots and wrote CDs at hotel (Great George)

- Friday March 29, 2001 -2C; clear, Calm

- Down loaded GPS beacon locations. #965 and # 967 north of Cape Breton
- #966 of Charlottetown picked up March 30 late afternoon
- #968 east of bridge, Ronny could not find it March 30
- Wrote CDs and packed video and Probe. Two boxes Rack and Grey box shipped to James Lee in Sutherland. Two red boxes of video upstairs in hanger
- Met station tower stored along with tow large MetOcean beacons/RM Young masts
- GPS beacons in Hanger: 966, 969, 26379, 26377 and 26384
- Left PEI with Computers/laptops/min met stn tower grey box at 16:00

Ice probe flights Gulf 2001

Probe Flight #	Date	Place	Video
9-11	Feb 25	Hillsborough Bay and Cal. Line	No
12	Feb 25	North of PEI (too thin)	No
19-21	March 2	Cal. Lines	No
24	March 3	North of PEI (laptop problems)	Yes
30	March 7	Cal. Lines	Yes
32	March 8	N of PEI, AGC to east line	Yes
34	March 8	AGC lines north of PEI	Yes
37-38	March 8	North of PEI to seals	Yes
39-40	March 8	To Maggies	Yes
41	March 8	Back from Maggies	Yes
44	March 11	Cal. Lines	Yes
45-47	March 11	Point Prim to/from Pictou Isl.	Yes
49-51	March 11	N. PEI to East Pt. to Pictou Isl. To Pt. Prim	Yes
52-54	March 16	Pt. Prim to Met. Stn to Bridge, // to bridge	Yes
55-58	March 21	Pt. Prim to Pictou Isl. To E. Pt. to N. of PEI	No
59-62	March 22	N. of PEI to E. Pt. refuel on M. Black To Pictou Isl. And Pt. Prim	Yes
63	March 29	Over /pass Hillsborough Bay	No
64-66	March 29	Hillsborough Bay to Pictou Island, Pictou Isl. to Bridge and Bridge (can not find Rubble floe)	Yes

IcePic flights Gulf 2001

IcePic Flight #	Date	Place
2-10	Feb. 7	Hillsborough Bay
11-13	Feb. 7	To/from Pictou Island
14-16	Feb. 7	No GPS
17-18	Feb. 8	To Seal Isle and cal. Line in Strait
19	Feb. 8	To Bridge and at Bridge
22/23	Feb. 12	Ronny and Mate in Strait
25-27	Feb. 14	Pictou Isl. To Bridge and land-fast at bridge
29-32	Feb. 16	Ice Observer to Gaspé Bay
35-36	Feb. 25	Northumberland Strait and Bridge
37-38	Feb. 25	Hillsborough Bay spot samples/lines
40	March 1	Cal line
42/43	March 2	Ice Observer to E. Pt. to Bridge
44-48	March 2	Cal. Lines
50-53	March 3	Calibration line and Pull-up test (fem 50)
58	March 3	North of PEI along Probe #24 flight path
60-62	March 4	Cal. Line and flight to bridge (generator problem)
63-64	March 7	Ice Observer
65-70	March 7	AGC lines north of PEI
72-73	March 9	Cal. Line then Ice Observer to Maggies (73)
74-82	March 10	Cal. Lines
83	March 17	Met Stn. and land-fast floe
85-87	March 17	At bridge, thick floe pictures
88-90	March 17	North of PEI, thin ice, hood seals and towards W
95/96	March 22	Ice Observer flight no GPS
96-99	March 22	Motion test for Scott
100/101	March 22	Ice thickness and spider web over Met. Stn.
102/103	March 28	Ice Observer to M. Black off Cape Britain
104/105	March 28	Point Prim to Pictou Isl., to bridge and ice rubble floe
106-108	March 29	Bridge and bridge piers