ASOF-N 2004

Data Report

Jürgen Holfort and Edmond Hansen
Norwegian Polar Institute
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Introduction

In 2003 the Norwegian Polar Institute (NPI) made one cruise into the Fram Strait as part of ASOF-N. During this cruise a total of 97 CTD stations were taken, three moorings were recovered and seven moorings were deployed. Further information on positions of CTD stations and moorings can be found in the cruise report (appendix 2).

This report describes into more detail the CTD data from this cruise and the data from the recovered moorings. It does not goes much into the scientific interpretation of the data but gives an overview of the applied data processing, the data quality and some statistical information. The data referenced in this report is still not in final form.

CTD data

A total of 97 casts were taken with a Seabird 911 CTD. From two profiles large parts of the downcast were not recorded and therefore the upcast data had to be used (profile 47 and 70). A standard processing was done with the data, consisting of the following steps:

- conversion into physical units using the pre-cruise calibration coefficients.
- removing first cycles in air or when the pump was not running by manual inspection of each single profile
- remove upcast data (except profile 47 and 70)
- median filter to remove spikes in pressure (11cycles, 1dbar), temperature (11cycles, 0.02ºC) and conductivity (11cycles, 0.02 mS/cm)
- correction of time mismatch between temperature and conductivity
- cell thermal mass correction
- monotonize in pressure
- apply additional calibration (none for now)
- calculate salinity and remove spikes using a median filter (11cycles, 0.01)
- calculate mean values at 1dbar intervals

During the processing some problems were noticed and corrected in the following profiles:
26: Pressure spikes to values larger then 1700 dbar (maximum pressure of cast was about 1680 dbar) and smaller -0.6 dbar (the pressure offset at the beginning of the cast was about -0.3 dbar and at the end about -0.35 dbar). These spikes were recognized and deleted in the normal processing.
47: Large spikes in pressure (<-1.6dbar and >250dbar, while maximum pressure of cast was ~200dbar) and temperature (<2.6ºC and >7ºC, while minimum temperature of cast is about 2.64ºC). But even after correcting this larger spikes, some wrong values in down profile remain. The same holds for the conductivity. After visual inspection of the salinity it was decided, that the down profile is not usable. Therefore data from the upcast was used.
52: Many spikes in salinity due to strong gradients, these should disappear in the further processing.
56: Many spikes in salinity due to strong gradients, these should disappear in the further processing.
57: Uppermost 14.5 dbar not usable. They cannot be replaced by upcast values, as the upcast data only goes to about 30m.
62: Uppermost 16 dbar not usable. They could be replaced by upcast values, but as the upcast salinity does not show much structure the missing upper dbar were taken as well mixed.
70: At least the upper 210m of salinity data is wrong. Also the temperature seems to be not reliable in the upper 200m. The density referenced to 0dbar is similar for the up and down profile at about 315 dbar. So at least the upper 250m of the down profile should be replaced by the up profile. It was decided to forget the whole down profile and just use the upcast.

The temperature and conductivity sensors of the CTD are routinely calibrated (Table 1). During data processing the pre-cruise calibration was used. The change between pre- and post-cruise calibration in temperature was smaller then $0.2*10^{-3}$ ºC and therefore no further correction was applied. The drift of the conductivity sensor is so large (up to 0.009 mS/cm, see Figure 1) that it has to be taken into account. One reason for this large drift can be, that the sensor got a new conductivity cell in March 2003. The drift correction was done by fitting a polynom of 3rd order to the difference in pre- and post-cruise calibration. The CTD conductivity was then corrected using 6/8 of fitted difference. The factor 6/8 was used because the cruise took part about 6 months after the pre-cruise calibration and the time between calibrations was about 8 months. Salinity samples were taken on the cruise for latter processing on land. This processing was delayed and was done only some months later. Due to the longer storage the precision is probable not as high as if done directly after the cruise. A final calibration including the salinity samples is still not done.

Table 1: Calibration data for the CTD sensors.

Parameter	***Serialno.***	***date***	***g***	***h***	***i***	***j***
Temperature	4052	25.02.2003	4.37569960E-3	6.45432600E-4	2.23316560E-5	1.89617416E-6
		20.11.2003	4.37602756E-3	6.46143228E-4	2.28383386E-5	2.01425091E-6
Conductivity	2063	21.03.2003	-1.01165400E+1	1.40686609E+0	-4.17922238E-3	3.80853515E-4
		20.11.2003	-1.01139822E+1	1.40611556E+0	-3.86867383E-3	3.54596960E-4

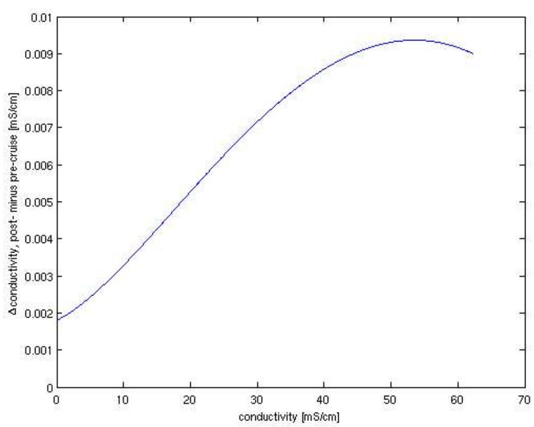

Figure 1: Conductivity difference between pre- and post cruise calibration of the CTD.

Sections of temperature and salinity across Fram Strait at 79ºN (Figure 2) show the different water masses present. As very little ice was encountered on this cruise, the CTD section could be made all the way to the East Greenland coast. So it is one of the few sections that shows the total area of the cold and low salinity Polar Water. The inflowing Atlantic water is warm and salty and is found in the upper 600m in the eastern part. The still warm and saline water at about 3ºW is the recirculating part (rAW) and the region of higher salinities at the Greenland continental slope seen till depths of about 1200m is Arctic Atlantic Water. The baroclinic part of the East Greenland current can be clearly seen in geostrophic calculations (Figure 3) relative to the bottom.

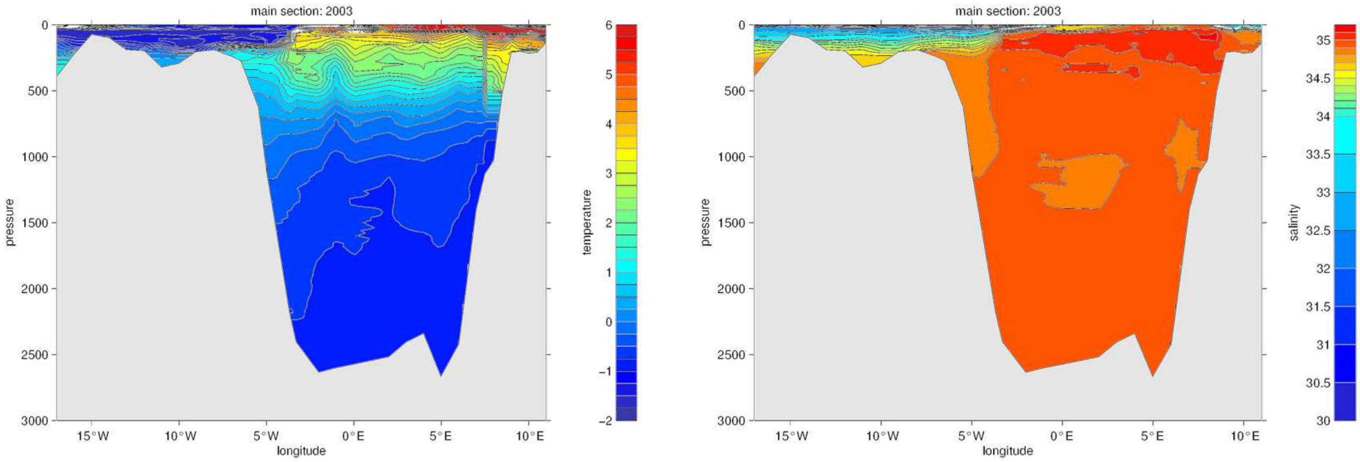

Figure 2: Section of temperature (left) and salinity (right) at 79ºN from the uncalibrated 2003 CTD data.

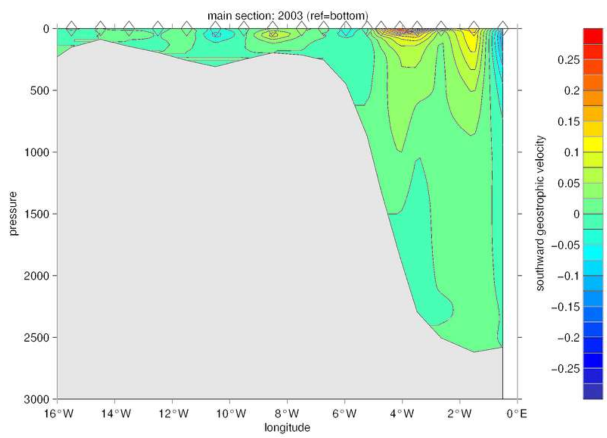

Figure 3: Section of geostrophic velocity along 79ºN in the western Fram Strait showing the East Greenland current.

Mooring data

From the five moorings deployed in 2002 only three could be fully recovered. Mooring F13 was a total loss. Two instruments from mooring F12 were picked out of the sea/ice in April 2003 by a fishing boat. Data from this instruments shows that the mooring surfaced due to unknown reasons at the beginning of April. Instrument loses therefore were large (in parenthesis percent of deployed instruments): two ULS (50%), two DCM (67%), five RCM (33%), two Microcat (50%) and two releasers (40%).

A common problem also occurring in these data is the presence of a large offset and drift in salinity of many RCM. This is mostly corrected using the difference to nearby CTD stations at the beginning and the end of the mooring deployment. This method has large errors if the temporal and spatial variability of the salinity is large near the instrument position. Near to the surface, where the largest errors occur, at two moorings there was an Microcat in less then 3m distance from the RCM. The nominal accuracy of a Microcat is much better then an RCM and therefore at these two moorings the salinity from the Microcat is used to calibrate the RCM conductivity using an offset and a linear temporal drift.

A comparison of the corrected RCM salinity and the Microcat salinity reveals a possible problem with the later. Small dirt particles entering the conductivity cell lead to erroneous measurements. As the conductivity cell is very small and not flushed with a pump like on a Seabird 911 CTD, dirt can accumulate and stay for prolonged time periods in the cell. With the RCM this problems is not as big, as the cell is much larger and more easily flushed.

These salinity problems can both be seen in the instrument pair RCM 843 and SBE 2413 on mooring F11. The uncorrected RCM salinities were much to high. A comparison with the Microcat 2413 above showed a conductivity offset of about 0.5 mS/cm and a small temporal trend. After this correction the RCM and Microcat salinity is very similar for most times, but during some periods SBE 2413 shows much smaller salinities (Figure 4). We can exclude a strong gradient exactly in between both instruments, because during a time of lower salinities the instruments itself made vertical excursions of more then 50dbar. We therefore assume some dirt in the Microcat sensor. No such problems are noticeable in the instrument pair RCM 836 SBE 1253 after correction of the conductivity offset (0.85) and drift.

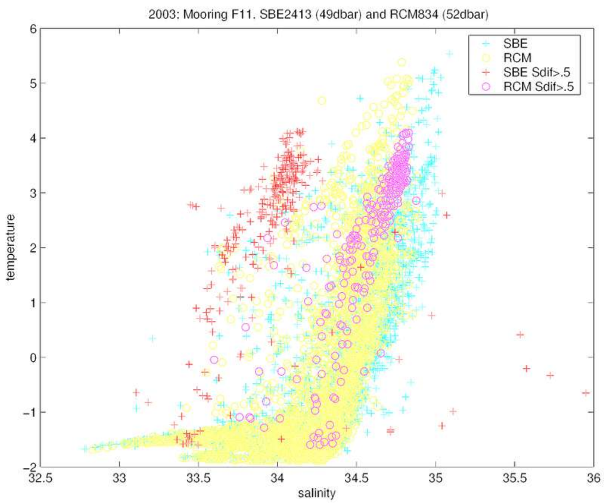

Figure 4: Temperature salinity diagram of two instruments at almost the same depth on Mooring F11 (Microcat 2413 and drift and offset corrected RCM 834). For times where the difference between both is larger then 0.5 the Microcat values lie outside the main TS characteristics while the RCM values lie within.

Both recovered ULS had problems with the pressure sensor. This can clearly seen by comparing with other instruments nearby. For the ULS 17 this is the Microcat 1253; for the ULS 48 it is the DCM 17 and the Microcat 2414. The ULS record total pressure while the Microcat and DCM measure pressure relative to the mean atmospheric pressure. This is corrected by adding a standard atmospheric pressure of 1013.5mbar onto the Microcat and DCM data. The Microcat is not at the same depth, but as the depth difference is small the pressure should behave similar to the ULS. While the temporal evolution of the DCM and Microcat pressure, apart from an offset due to vertical instrument separation, is almost identical, the pressure from the ULS differs. The pressure difference between ULS and the two other instruments is a non linear function in time (Figure 5). No simple correlation of the pressure difference with temperature or pressure could be found.

The ULS 17 can only be compared with a Microcat. The minimum pressure (reached when the mooring is standing upright) is more constant in the SBE data then in the ULS data. Therefore the SBE data, as with the other mooring, is probably most trustworthy then the ULS data. Clearly more work is necessary to get better ULS pressure data, specially as these data is an important part in the ice thickness calculation.

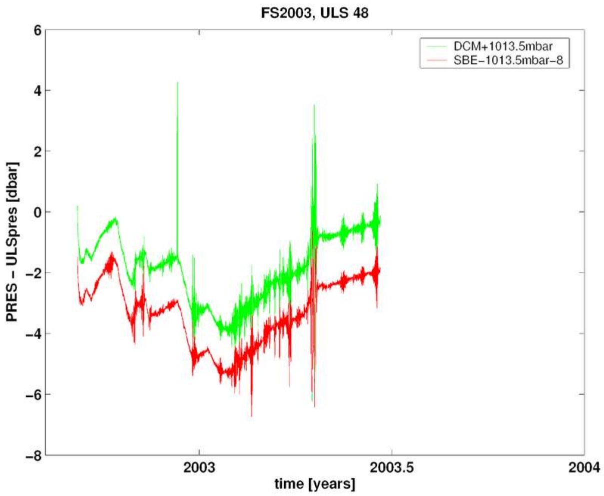

Figure 5: Pressure difference between ULS 48 and the DCM 17 in the same instrument package and the Microcat 2413 some meters below.

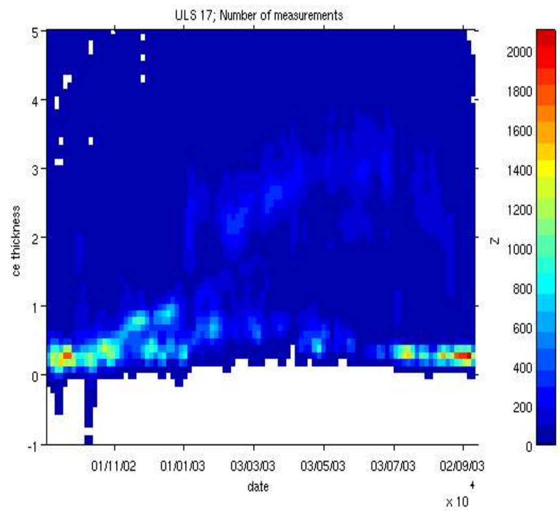

Figure 6: Frequency of ice thickness (number of measurements within a certain thickness and time class) from a preliminary calculation from ULS 17.

A new method for the calculation of ice thickness is being developed at the NPI. High quality data of ice thickness from the ULS data will therefore not be available before 2005. But the data the ULS data is available once the new method is established and has also the potential as can be seen in a preliminary, rough estimate of the ice thickness (Figure). This rough calculations used just one of the four available travel time measurements, did not take into account the signal envelope and used just the mean sea level pressure from the NCEP reanalysis with 2.5º spatial and 6 hour temporal resolution. But even so the increase of ice thickness during winter, mostly open water in Summer 2003, and other features are visible.

A simple tidal analysis was performed on the velocity data from the moorings. For most of the instruments the largest amplitudes was found in the M2 tide. Further results are given, together with the basic statistic information (mean values, eddy kinetic energy etc.) in appendix 1.

Appendix 1 to data report:

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 FILE: fs2003/dcm17_0.nc
Start date:  06-Sep-2002 13:58:08   Stop date:   07-Sep-2003 06:00:00
No. of cycles:      4389    Sampling intervall:   120 minutes
Pressure:    Median=     0,  Mean=     1+-   4.5,  Range=     0 to     49   missing values:    31
U-Velocity:  Median= -3.55,  Mean= -3.14+- 24.41,  Range=-106.6 to  165.2   MKE:      9.8   EKE:    595.7
V-Velocity:  Median=-18.78,  Mean=-18.47+- 29.78,  Range=-140.5 to  113.2   MKE:    341.3   EKE:    886.7
Tides (snr>2):
No. tide    Period     major     emaj      minor     emin       inc       pha
 5  P1       24.07      1.67     1.09      -0.27     1.18      58.2     193.3
 2  K1       23.93      2.25     1.34      -0.32     1.22     109.9     248.2
 1  M2       12.42      3.42     1.44      -0.79     1.61      84.9      59.7
 4  LDA2     12.22      1.93     1.33      -0.66     1.60      69.2      39.7
 3  S2       12.00      1.94     1.26      -0.64     1.48     122.2      88.4
after 30h low pass filter:
U-Velocity:  Median= -3.42,  Mean= -2.56+- 21.16,  Range= -88.9 to  113.7   MKE:      6.6   EKE:    447.6
V-Velocity:  Median=-19.11,  Mean=-18.16+- 25.69,  Range=-104.6 to   96.7   MKE:    329.8   EKE:    659.8

 FILE: fs2003/dcm17_1.nc
Start date:  06-Sep-2002 13:58:08   Stop date:   07-Sep-2003 06:00:00
No. of cycles:      4389    Sampling intervall:   120 minutes
Pressure:    Median=     6,  Mean=     7+-   4.8,  Range=     6 to     57   missing values:    31
U-Velocity:  Median= -0.88,  Mean= -1.15+- 12.93,  Range= -59.7 to  117.7   MKE:      1.3   EKE:    167.1
V-Velocity:  Median=-10.06,  Mean=-11.42+- 12.78,  Range= -79.9 to   64.7   MKE:    130.5   EKE:    163.3
Tides (snr>2):
No. tide    Period     major     emaj      minor     emin       inc       pha
 1  M2       12.42      1.80     0.89      -0.45     0.96      80.4      57.5
after 30h low pass filter:
U-Velocity:  Median= -1.14,  Mean= -0.92+- 10.29,  Range= -37.9 to   69.4   MKE:      0.8   EKE:    105.9
V-Velocity:  Median=-10.85,  Mean=-11.32+-  9.22,  Range= -47.0 to   35.6   MKE:    128.1   EKE:     85.0

 FILE: fs2003/dcm17_2.nc
Start date:  06-Sep-2002 13:58:08   Stop date:   07-Sep-2003 06:00:00
No. of cycles:      4389    Sampling intervall:   120 minutes
Pressure:    Median=    12,  Mean=    14+-   5.1,  Range=    12 to     65   missing values:    31
U-Velocity:  Median= -2.79,  Mean= -3.16+- 13.52,  Range= -92.4 to  106.5   MKE:     10.0   EKE:    182.7
V-Velocity:  Median=-12.28,  Mean=-13.49+- 15.04,  Range= -68.1 to   48.7   MKE:    181.9   EKE:    226.1
Tides (snr>2):
No. tide    Period     major     emaj      minor     emin       inc       pha
 1  SA     8766.23      7.64     3.40      -1.86     3.15      90.5      65.6
 3  SSA    4382.91      4.16     2.86       2.88     2.69     124.6     179.4
 2  MSM     763.49      4.96     2.62       0.46     3.26     134.7     179.5
 4  MM      661.31      3.94     2.70      -0.03     3.23      21.8     259.9
 8  P1       24.07      0.98     0.61       0.10     0.63      75.1     197.9
 6  S1       24.00      1.66     0.98       0.32     0.84      35.6     206.1
 7  K1       23.93      1.41     0.54      -0.02     0.57     108.6     241.5
 5  M2       12.42      2.76     1.04      -0.89     0.94      74.6      62.6
after 30h low pass filter:
U-Velocity:  Median= -2.99,  Mean= -3.05+- 10.64,  Range= -40.5 to   37.9   MKE:      9.3   EKE:    113.1
V-Velocity:  Median=-12.01,  Mean=-13.51+- 12.47,  Range= -55.6 to   22.5   MKE:    182.4   EKE:    155.6

 FILE: fs2003/dcm17_3.nc
Start date:  06-Sep-2002 13:58:08   Stop date:   07-Sep-2003 06:00:00
No. of cycles:      4389    Sampling intervall:   120 minutes
Pressure:    Median=    18,  Mean=    20+-   5.5,  Range=    18 to     72   missing values:    31
U-Velocity:  Median= -3.66,  Mean= -4.16+- 11.31,  Range= -48.7 to   45.5   MKE:     17.3   EKE:    127.9
V-Velocity:  Median=-12.14,  Mean=-13.74+- 14.28,  Range= -72.2 to   31.3   MKE:    188.8   EKE:    203.9
Tides (snr>2):
No. tide    Period     major     emaj      minor     emin       inc       pha
 1  SA     8766.23      6.85     3.77      -0.81     2.60     101.2      59.3
 2  SSA    4382.91      4.94     3.10       1.35     2.74      91.8     175.0
 3  MSM     763.49      4.88     3.05       0.14     2.88     120.9     176.0
 4  MM      661.31      4.20     2.70      -1.05     2.83      27.4     243.0
 6  K1       23.93      1.36     0.55       0.05     0.53      92.7     230.1
 5  M2       12.42      3.07     0.72      -1.28     0.67      73.6      61.2
 8  LDA2     12.22      1.04     0.61      -0.47     0.61      61.6      31.4
 7  S2       12.00      1.22     0.60      -0.78     0.66     107.6     108.3
 9  K2       11.97      0.82     0.53      -0.56     0.53      79.5     161.5
after 30h low pass filter:
U-Velocity:  Median= -3.83,  Mean= -4.08+-  9.42,  Range= -39.8 to   29.3   MKE:     16.6   EKE:     88.7
V-Velocity:  Median=-11.95,  Mean=-13.80+- 12.62,  Range= -59.6 to   23.2   MKE:    190.5   EKE:    159.3
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FILE: fs2003/dcm17_4.nc
Start date: 06-Sep-2002 13:58:08 Stop date: 07-Sep-2003 06:00:00
No. of cycles: 4389 Sampling intervall: 120 minutes
Pressure: Median= 25, Mean= 27+- 5.9, Range= 23 to 80 missing values: 31
U-Velocity: Median= -3.56, Mean= -3.98+- 10.70, Range= -49.8 to 38.1 MKE: 15.9 EKE: 114.6
V-Velocity: Median=-11.48, Mean=-12.99+- 14.26, Range= -70.9 to 36.7 MKE: 168.7 EKE: 203.2
Tides (snr>2):

No.	tide	Period	major	emaj	minor	emin	inc	pha
1	SA	8766.23	6.03	3.47	-0.17	2.53	106.7	56.6
2	SSA	4382.91	5.24	3.34	0.89	2.57	84.4	179.0
3	MSM	763.49	5.02	3.36	0.19	2.89	116.1	174.9
4	MM	661.31	4.04	2.53	-1.63	2.57	30.8	233.6
8	O1	25.82	0.60	0.36	-0.03	0.43	115.6	180.6
7	K1	23.93	1.46	0.39	0.07	0.43	103.6	237.4
5	M2	12.42	3.39	0.78	-1.15	0.71	79.0	59.2
6	S2	12.00	1.50	0.63	-0.74	0.65	98.0	132.0

after 30h low pass filter:
U-Velocity: Median= -3.89, Mean= -3.92+- 9.07, Range= -36.7 to 29.3 MKE: 15.3 EKE: 82.2
V-Velocity: Median=-11.11, Mean=-13.10+- 12.95, Range= -59.5 to 23.6 MKE: 171.5 EKE: 167.8

FILE: fs2003/dcm17_5.nc
Start date: 06-Sep-2002 13:58:08 Stop date: 07-Sep-2003 06:00:00
No. of cycles: 4389 Sampling intervall: 120 minutes
Pressure: Median= 31, Mean= 33+- 6.3, Range= 29 to 88 missing values: 31
U-Velocity: Median= -3.30, Mean= -3.74+- 9.77, Range= -49.3 to 34.3 MKE: 14.0 EKE: 95.4
V-Velocity: Median=-10.42, Mean=-11.99+- 13.32, Range= -68.8 to 29.6 MKE: 143.8 EKE: 177.3
Tides (snr>2):

No.	tide	Period	major	emaj	minor	emin	inc	pha
1	SA	8766.23	5.26	2.89	0.30	2.35	109.4	53.1
2	SSA	4382.91	4.89	3.33	0.77	2.62	79.3	178.0
3	MSM	763.49	4.52	3.16	0.37	2.39	111.6	171.4
4	MM	661.31	3.94	2.62	-1.33	2.56	28.3	231.0
9	O1	25.82	0.69	0.33	0.08	0.31	115.4	193.5
7	K1	23.93	1.50	0.37	0.10	0.32	101.8	242.4
5	M2	12.42	3.44	0.66	-1.31	0.61	79.3	61.1
8	LDA2	12.22	0.83	0.57	-0.57	0.49	22.1	62.7
6	S2	12.00	1.52	0.67	-0.69	0.57	101.8	131.7
10	K2	11.97	0.67	0.44	-0.36	0.53	121.5	138.2
11	2MK6	4.09	0.20	0.14	-0.02	0.15	24.9	114.6

after 30h low pass filter:
U-Velocity: Median= -3.50, Mean= -3.70+- 8.41, Range= -33.9 to 26.4 MKE: 13.7 EKE: 70.7
V-Velocity: Median=-10.13, Mean=-12.12+- 12.20, Range= -56.1 to 21.2 MKE: 146.8 EKE: 148.7

FILE: fs2003/rcm10069.nc
Start date: 06-Sep-2002 14:00:56 Stop date: 07-Sep-2003 05:57:11
No. of cycles: 4389 Sampling intervall: 120 minutes
Temperature: Median=-0.794, Mean=-0.803+- 0.033, Range=-0.901 to -0.708
Salinity: Median=35.336, Mean=35.334+- 0.016, Range=35.270 to 35.375
Velocity: Median= 6.22, Mean= 7.07+- 4.57, Range= 0.0 to 28.0
U-Velocity: Median= -0.47, Mean= -0.27+- 3.94, Range= -18.0 to 15.6 MKE: 0.1 EKE: 15.5
V-Velocity: Median= -1.20, Mean= -1.23+- 7.33, Range= -27.5 to 23.8 MKE: 1.5 EKE: 53.8
Tides (snr>2):

No.	tide	Period	major	emaj	minor	emin	inc	pha
3	O1	25.82	0.72	0.16	0.09	0.18	103.7	205.5
5	P1	24.07	0.47	0.17	-0.06	0.18	114.6	257.2
2	K1	23.93	1.38	0.17	0.33	0.18	103.0	266.6
6	N2	12.66	0.32	0.10	0.08	0.14	88.6	75.9
9	H1	12.44	0.13	0.09	-0.06	0.11	63.0	330.1
1	M2	12.42	1.63	0.11	0.28	0.13	86.1	97.8
4	S2	12.00	0.51	0.12	0.16	0.13	76.2	135.0
7	R2	11.98	0.18	0.09	-0.07	0.08	99.9	338.2
8	K2	11.97	0.13	0.09	0.08	0.09	27.7	113.0
10	MS4	6.10	0.07	0.04	-0.03	0.04	85.0	276.8

after 30h low pass filter:
U-Velocity: Median= -0.36, Mean= -0.27+- 3.68, Range= -16.6 to 15.6 MKE: 0.1 EKE: 13.5
V-Velocity: Median= -1.25, Mean= -1.23+- 7.03, Range= -25.4 to 20.8 MKE: 1.5 EKE: 49.4

FILE: fs2003/rcm11059.nc
Start date: 03-Sep-2002 13:58:08   Stop date: 08-Sep-2003 09:59:04
No. of cycles: 4439   Sampling intervall: 120 minutes
Temperature: Median=-1.561, Mean=-1.418+- 0.693, Range=-1.924 to 3.395
Velocity: Median= 7.20, Mean= 7.80+- 4.27, Range=   1.1 to   28.7
U-Velocity: Median= -1.92, Mean= -1.76+- 5.46, Range= -17.8 to   20.2   MKE: 3.1   EKE: 29.9
V-Velocity: Median= -1.17, Mean= -1.05+- 6.71, Range= -28.6 to   22.2   MKE: 1.1   EKE: 45.0
Tides (snr>2):

No.	tide	Period	major	emaj	minor	emin	inc	pha
6	O1	25.82	0.59	0.15	0.25	0.15	158.1	242.8
9	P1	24.07	0.42	0.15	0.11	0.16	161.4	297.7
4	K1	23.93	1.17	0.15	0.52	0.14	160.4	301.8
8	2N2	12.91	0.47	0.31	-0.29	0.29	95.3	336.7
3	N2	12.66	1.27	0.31	-0.84	0.34	65.1	40.0
1	M2	12.42	5.61	0.29	-3.25	0.28	66.2	73.8
7	LDA2	12.22	0.50	0.24	-0.47	0.27	21.4	96.4
2	S2	12.00	2.16	0.33	-1.25	0.29	73.0	124.2
13	R2	11.98	0.31	0.21	-0.25	0.21	76.7	211.0
5	K2	11.97	0.62	0.25	-0.28	0.27	55.5	132.4
10	MSN2	11.79	0.38	0.24	-0.31	0.26	91.6	257.3
11	ETA2	11.75	0.35	0.21	-0.28	0.21	117.8	234.8
15	MN4	6.27	0.18	0.09	-0.13	0.10	100.5	139.9
12	M4	6.21	0.32	0.10	-0.16	0.10	129.4	153.2
14	MS4	6.10	0.26	0.11	-0.11	0.09	121.7	211.7

after 30h low pass filter:
U-Velocity: Median= -2.09, Mean= -1.76+- 3.88, Range= -15.6 to   10.6   MKE: 3.1   EKE: 15.1
V-Velocity: Median= -0.85, Mean= -1.05+- 4.64, Range= -20.2 to   13.3   MKE: 1.1   EKE: 21.5

FILE: fs2003/rcm117.nc
Start date: 03-Sep-2002 14:00:56   Stop date: 08-Sep-2003 10:04:41
No. of cycles: 4439   Sampling intervall: 120 minutes
Pressure: Median=   634, Mean=   634+-   0.0, Range=   634 to   634
Temperature: Median= 0.260, Mean= 0.266+- 0.094, Range= 0.024 to 0.589
Salinity: Median=36.259, Mean=36.282+- 0.121, Range=36.067 to 36.648
Velocity: Median= 4.00, Mean= 4.54+- 2.73, Range=   0.0 to   18.9
U-Velocity: Median= 1.61, Mean= 1.49+- 2.85, Range= -12.5 to   12.3   MKE: 2.2   EKE: 8.1
V-Velocity: Median= -1.43, Mean= -1.30+- 4.01, Range= -14.0 to   18.0   MKE: 1.7   EKE: 16.0
Tides (snr>2):

No.	tide	Period	major	emaj	minor	emin	inc	pha
2	SSA	4382.91	1.42	0.94	0.07	0.64	115.1	79.9
5	O1	25.82	0.62	0.13	0.33	0.13	138.3	233.3
7	P1	24.07	0.41	0.17	0.15	0.14	158.7	288.5
3	K1	23.93	1.29	0.13	0.57	0.15	139.0	294.8
6	N2	12.66	0.55	0.21	-0.14	0.20	69.1	72.7
1	M2	12.42	1.84	0.24	0.26	0.22	84.5	108.9
4	S2	12.00	0.98	0.23	-0.17	0.21	162.1	223.5
9	R2	11.98	0.28	0.15	-0.22	0.15	16.3	63.0
8	K2	11.97	0.40	0.18	-0.21	0.17	175.0	245.5

after 30h low pass filter:
U-Velocity: Median= 1.59, Mean= 1.49+- 1.95, Range= -6.2 to   8.0   MKE: 2.2   EKE: 3.8
V-Velocity: Median= -1.47, Mean= -1.30+- 3.34, Range= -11.6 to   14.5   MKE: 1.7   EKE: 11.2

FILE: fs2003/rcm11889.nc
Start date: 03-Sep-2002 12:00:00   Stop date: 08-Sep-2003 11:51:34
No. of cycles: 4441   Sampling intervall: 120 minutes
Pressure: Median=   278, Mean=   278+-   0.4, Range=   277 to   280
Temperature: Median= 0.776, Mean= 0.778+- 0.167, Range= 0.179 to 1.099
Velocity: Median= 5.44, Mean= 5.84+- 2.94, Range=   0.4 to   17.8
U-Velocity: Median= 0.48, Mean= 0.50+- 3.76, Range= -11.2 to   14.6   MKE: 0.3   EKE: 14.1
V-Velocity: Median= -1.15, Mean= -1.00+- 5.24, Range= -16.8 to   15.9   MKE: 1.0   EKE: 27.4
Tides (snr>2):

No.	tide	Period	major	emaj	minor	emin	inc	pha
5	O1	25.82	0.70	0.17	-0.31	0.15	178.1	287.3
12	NO1	24.83	0.18	0.12	-0.02	0.11	3.6	98.4
8	P1	24.07	0.44	0.18	-0.21	0.18	171.7	319.9
2	K1	23.93	1.61	0.14	-0.59	0.15	168.6	336.9
9	2N2	12.91	0.40	0.26	-0.19	0.28	80.7	45.7
4	N2	12.66	0.96	0.24	-0.56	0.30	85.6	54.5
11	NU2	12.63	0.36	0.22	-0.23	0.26	106.5	31.1
7	H1	12.44	0.57	0.23	-0.48	0.23	44.7	171.3
1	M2	12.42	4.28	0.29	-2.39	0.31	71.4	89.2
10	H2	12.40	0.39	0.25	-0.03	0.28	70.2	136.9
3	S2	12.00	1.54	0.29	-0.84	0.31	46.3	114.6
6	K2	11.97	0.68	0.22	-0.36	0.24	47.6	121.9
13	MK4	6.09	0.11	0.08	-0.07	0.08	168.4	94.4

after 30h low pass filter:
U-Velocity: Median= 0.46, Mean= 0.50+- 1.73, Range= -7.2 to   8.3   MKE: 0.3   EKE: 3.0
V-Velocity: Median= -0.85, Mean= -1.00+- 3.55, Range= -12.6 to   11.9   MKE: 1.0   EKE: 12.6

FILE: fs2003/rcm12643.nc
Start date: 06-Sep-2002 09:59:04   Stop date: 08-May-2003 17:57:11
No. of cycles: 2933   Sampling intervall: 120 minutes
Temperature: Median= 1.209, Mean= 1.027+- 1.072, Range=-1.929 to 3.186
Salinity: Median=35.161, Mean=35.094+- 0.245, Range=34.166 to 35.455
Velocity: Median= 7.20, Mean= 7.40+- 4.13, Range=   0.2 to   27.0   missing values: 444
U-Velocity: Median= -0.41, Mean= -0.43+- 3.33, Range= -13.1 to   12.2   MKE: 0.2   EKE: 11.1
V-Velocity: Median= -5.59, Mean= -4.86+- 6.08, Range= -25.5 to   26.9   MKE: 23.6   EKE: 36.9
Tides (snr>2):

No.	tide	Period	major	emaj	minor	emin	inc	pha
4	O1	25.82	0.82	0.13	0.14	0.12	102.4	198.1
12	NO1	24.83	0.17	0.08	-0.03	0.09	86.8	224.3
5	P1	24.07	0.71	0.14	0.09	0.14	109.7	279.2
2	K1	23.93	1.52	0.15	0.27	0.14	107.6	267.2
11	PHI1	23.80	0.21	0.13	-0.00	0.12	140.2	83.3
9	MU2	12.87	0.32	0.20	-0.13	0.19	64.6	8.9
8	N2	12.66	0.51	0.25	-0.17	0.19	73.5	73.9
1	M2	12.42	2.92	0.26	-0.86	0.21	73.6	94.0
10	MKS2	12.39	0.29	0.18	-0.05	0.17	68.4	257.8
6	L2	12.19	0.63	0.28	-0.38	0.26	109.4	89.4
3	S2	12.00	0.92	0.23	-0.24	0.19	76.9	132.0
7	K2	11.97	0.60	0.19	-0.37	0.18	85.7	142.1
13	M4	6.21	0.09	0.06	-0.00	0.06	169.9	182.2
14	2MN6	4.17	0.07	0.03	0.01	0.04	26.5	167.7

after 30h low pass filter:
U-Velocity: Median= -0.15, Mean= -0.42+- 2.79, Range= -10.2 to   11.0   MKE: 0.2   EKE: 7.8
V-Velocity: Median= -5.59, Mean= -4.85+- 5.25, Range= -20.0 to   24.0   MKE: 23.6   EKE: 27.5

FILE: fs2003/rcm12644.nc
Start date: 06-Sep-2002 14:00:56   Stop date: 07-Sep-2003 06:02:49
No. of cycles: 4389   Sampling intervall: 120 minutes
Temperature: Median= 2.086, Mean= 2.119+- 0.530, Range= 0.197 to 3.524
Salinity: Median=35.071, Mean=35.066+- 0.058, Range=34.862 to 35.204
Velocity: Median= 9.24, Mean= 10.11+- 6.63, Range=   0.0 to   41.8
U-Velocity: Median= -1.61, Mean= -1.87+- 6.18, Range= -26.7 to   21.9   MKE: 3.5   EKE: 38.2
V-Velocity: Median= -5.83, Mean= -6.15+- 8.17, Range= -41.8 to   20.0   MKE: 37.8   EKE: 66.7
Tides (snr>2):

No.	tide	Period	major	emaj	minor	emin	inc	pha
4	O1	25.82	0.93	0.23	0.09	0.26	96.9	200.1
7	P1	24.07	0.41	0.21	0.20	0.22	84.0	250.9
2	K1	23.93	1.61	0.23	0.12	0.24	101.5	262.5
5	N2	12.66	0.52	0.24	-0.08	0.23	81.6	90.8
1	M2	12.42	2.99	0.25	-0.76	0.26	76.8	98.4
3	S2	12.00	1.17	0.20	-0.28	0.24	91.4	156.9
8	R2	11.98	0.33	0.17	-0.25	0.16	110.6	151.9
6	K2	11.97	0.46	0.19	-0.19	0.20	77.0	138.9

after 30h low pass filter:
U-Velocity: Median= -1.72, Mean= -1.87+- 5.89, Range= -24.2 to   19.4   MKE: 3.5   EKE: 34.7
V-Velocity: Median= -5.94, Mean= -6.15+- 7.55, Range= -36.6 to   16.4   MKE: 37.8   EKE: 57.0

FILE: fs2003/rcm12646.nc
Start date: 06-Sep-2002 09:59:04   Stop date: 08-May-2003 18:05:38
No. of cycles: 2933   Sampling intervall: 120 minutes
Temperature: Median=-1.645, Mean=-1.484+- 0.599, Range=-1.895 to 3.398
Salinity: Median=34.080, Mean=33.942+- 0.727, Range=32.236 to 35.138
Velocity: Median= 15.05, Mean= 17.63+- 11.59, Range=   0.4 to   59.2   missing values: 521
U-Velocity: Median= -1.16, Mean= -1.64+- 8.60, Range= -37.5 to   28.0   MKE: 2.7   EKE: 74.0
V-Velocity: Median=-13.12, Mean=-14.44+- 12.64, Range= -50.5 to   22.3   MKE: 208.6   EKE: 159.7
Tides (snr>2):

No.	tide	Period	major	emaj	minor	emin	inc	pha
1	SSA	4382.91	8.49	3.12	2.63	2.57	98.2	242.1
3	MSF	354.37	3.93	2.52	0.42	3.17	147.7	45.6
7	O1	25.82	0.79	0.32	0.37	0.31	112.8	214.2
8	P1	24.07	0.75	0.38	0.18	0.34	102.5	263.0
5	K1	23.93	1.38	0.34	0.34	0.34	106.3	268.1
10	PHI1	23.80	0.46	0.29	-0.16	0.31	123.2	193.6
2	M2	12.42	4.42	0.53	-2.39	0.59	70.2	86.4
6	LDA2	12.22	0.89	0.42	-0.73	0.43	28.4	90.4
4	S2	12.00	2.16	0.49	-1.33	0.52	82.5	139.3
9	K2	11.97	0.66	0.42	-0.48	0.47	106.7	149.3

after 30h low pass filter:
U-Velocity: Median= -1.04, Mean= -1.64+- 7.75, Range= -27.8 to   24.6   MKE: 2.7   EKE: 60.1
V-Velocity: Median=-12.39, Mean=-14.44+- 11.69, Range= -46.9 to   16.7   MKE: 208.5   EKE: 136.5

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 FILE: fs2003/rcm12733.nc
Start date:  06-Sep-2002 14:00:56   Stop date:   07-Sep-2003 05:57:11
No. of cycles:      4389    Sampling intervall:   120 minutes
Temperature: Median=-0.625,  Mean=-0.621+- 0.088,  Range=-0.806 to -0.422
Velocity:    Median=  4.59,  Mean=  5.34+-  4.27,  Range=   0.0 to   24.9
U-Velocity:  Median= -0.53,  Mean= -0.63+-  2.74,  Range= -16.2 to   12.7   MKE:       0.4   EKE:      7.5
V-Velocity:  Median= -1.60,  Mean= -2.36+-  5.77,  Range= -24.1 to   17.1   MKE:       5.6   EKE:     33.3
Tides (snr>2):
No. tide    Period     major     emaj      minor     emin       inc       pha
 4  O1       25.82      0.74     0.10       0.09     0.09      98.5     206.5
 8  PI1      24.13      0.15     0.10       0.01     0.09      99.5     246.8
 5  P1       24.07      0.48     0.10       0.03     0.09     105.1     256.1
 2  K1       23.93      1.56     0.10       0.23     0.08      95.8     263.5
 6  N2       12.66      0.40     0.17      -0.02     0.11      72.9      67.0
 1  M2       12.42      2.32     0.16      -0.09     0.10      84.7     103.8
 3  S2       12.00      0.83     0.14      -0.05     0.11      82.1     135.7
 7  K2       11.97      0.17     0.12       0.07     0.09     109.3     189.2
after 30h low pass filter:
U-Velocity:  Median= -0.55,  Mean= -0.63+-  2.57,  Range= -15.8 to   11.9   MKE:       0.4   EKE:      6.6
V-Velocity:  Median= -2.19,  Mean= -2.36+-  5.20,  Range= -22.4 to   12.7   MKE:       5.6   EKE:     27.1

 FILE: fs2003/rcm834.nc
Start date:  06-Sep-2002 13:58:08   Stop date:   07-Sep-2003 05:48:45
No. of cycles:      4389    Sampling intervall:   120 minutes
Pressure:    Median=    53,  Mean=    56+-   9.9,  Range=    51 to    190
Temperature: Median=-1.378,  Mean=-0.410+- 1.718,  Range=-1.881 to  5.382
Salinity:    Median=34.253,  Mean=34.233+- 0.331,  Range=32.829 to 34.890
Velocity:    Median= 12.54,  Mean= 14.97+-  9.60,  Range=   0.0 to   53.5
U-Velocity:  Median= -4.70,  Mean= -4.70+-  8.64,  Range= -33.1 to   26.9   MKE:      22.1   EKE:     74.7
V-Velocity:  Median= -8.35,  Mean= -9.76+- 11.15,  Range= -53.3 to   19.5   MKE:      95.3   EKE:    124.2
Tides (snr>2):
No. tide    Period     major     emaj      minor     emin       inc       pha
 1  MM      661.31      3.76     2.61      -0.52     2.95      22.6     234.0
 5  O1       25.82      0.93     0.31       0.09     0.28     104.4     208.8
 3  K1       23.93      1.51     0.30       0.10     0.24      95.5     257.6
 2  M2       12.42      3.48     0.47      -1.43     0.50      73.8      91.1
 6  LDA2     12.22      0.79     0.44      -0.71     0.45     179.9     291.2
 4  S2       12.00      1.26     0.46      -0.52     0.49     100.7     174.3
 7  K2       11.97      0.51     0.34      -0.34     0.37     127.5     170.9
after 30h low pass filter:
U-Velocity:  Median= -4.40,  Mean= -4.70+-  8.01,  Range= -27.3 to   23.5   MKE:      22.1   EKE:     64.1
V-Velocity:  Median= -8.25,  Mean= -9.76+- 10.36,  Range= -50.2 to   14.4   MKE:      95.3   EKE:    107.4

 FILE: fs2003/rcm836.nc
Start date:  03-Sep-2002 12:00:00   Stop date:   08-Sep-2003 11:43:08
No. of cycles:      4441    Sampling intervall:   120 minutes
Pressure:    Median=    53,  Mean=    53+-   0.4,  Range=    52 to     59
Temperature: Median=-1.635,  Mean=-1.642+- 0.163,  Range=-1.874 to -0.967
Salinity:    Median=33.417,  Mean=33.274+- 0.585,  Range=31.741 to 34.126
Velocity:    Median=  8.16,  Mean=  9.30+-  5.67,  Range=   0.0 to   38.6
U-Velocity:  Median= -1.42,  Mean= -1.47+-  7.16,  Range= -35.3 to   33.0   MKE:       2.1   EKE:     51.3
V-Velocity:  Median= -1.26,  Mean= -1.19+-  7.99,  Range= -34.5 to   37.2   MKE:       1.4   EKE:     63.9
Tides (snr>2):
No. tide    Period     major     emaj      minor     emin       inc       pha
 2  SA     8766.23      3.32     1.87      -0.80     1.14      68.7     238.7
 3  SSA    4382.91      2.55     1.73      -0.18     1.17     112.2     348.2
 8  O1       25.82      0.57     0.34      -0.24     0.41     163.4     277.2
 6  K1       23.93      1.21     0.44      -0.35     0.43     148.2     328.2
 5  N2       12.66      1.33     0.53      -0.83     0.64      56.3      22.8
 7  H1       12.44      1.08     0.55      -0.58     0.59     138.8      51.2
 1  M2       12.42      5.69     0.72      -3.86     0.73      41.7      68.6
 4  S2       12.00      1.41     0.52      -0.60     0.61      54.6     116.1
after 30h low pass filter:
U-Velocity:  Median= -1.36,  Mean= -1.46+-  3.47,  Range= -19.9 to    7.5   MKE:       2.1   EKE:     12.0
V-Velocity:  Median= -1.54,  Mean= -1.19+-  5.18,  Range= -19.8 to   18.8   MKE:       1.4   EKE:     26.9

 FILE: fs2003/sbe1253.nc
Start date:  03-Sep-2002 11:00:56   Stop date:   08-Sep-2003 14:00:56
No. of cycles:      8884    Sampling intervall:    60 minutes
Pressure:    Median=    50,  Mean=    50+-   0.4,  Range=    49 to     56
Temperature: Median=-1.620,  Mean=-1.629+- 0.169,  Range=-1.860 to -0.981
Salinity:    Median=33.393,  Mean=33.272+- 0.589,  Range=32.005 to 34.176

 FILE: fs2003/sbe2413.nc
Start date:  06-Sep-2002 15:00:00   Stop date:   07-Sep-2003 06:00:00
No. of cycles:      8776    Sampling intervall:    60 minutes
Pressure:    Median=    50,  Mean=    53+-   9.9,  Range=    48 to    193
Temperature: Median=-1.366,  Mean=-0.409+- 1.712,  Range=-1.865 to  5.538
Salinity:    Median=34.213,  Mean=34.217+- 0.372,  Range=32.779 to 36.041
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Appendix 2 to data report:

Fram Strait September 2003 Cruise on R/V Lance

Cruise Report

Edmond H. Hansen

Norwegian Polar Institute

1. General information

The Fram Strait September 2003 cruise was performed with R/V Lance in the period 7 to 27 September. The purpose of the cruise was to acquire hydrographic data across the Fram Strait (CTD, ADCP) along the monitoring line on 78° 50' N, and along various sections in the strait. The purpose was also to recover the existing five moorings in the East Greenland Current (EGC) and replace them with new.

Cruise participants:
Edmond Hansen, NPI (cruise leader, data responsible)
Ole Anders Nøst, NPI
Pål Erik Isachsen, NPI
Kristen Fossan, NPI
Marika Marnela, FIMR
Harvey Goodwin, NPI (first leg)
Jürgen Holfort, AWI/IfM Hamburg (first leg)
Jean-Claude Gascard, LODYC (second leg)
Jacky Lanoiselle, LODYC (second leg)

Lance captain was Hermod Isaksen.

2. Moorings

2. 1 Recovered morings

Mooring F11-5, F-14-5 and FNY were recovered in good shape. Mooring F12-5 and F13-5 was lost. The upper 250 meter of F12 was found by sealers near the island of Jan Mayen in April 2003, except the ES300 and DCM12 on the very top. Hence two current meters were recovered; RCM7 sn12646 and sn12643. The instruments were severely damaged (most likely destroyed), but the data was intact. No contact could be made with the acoustic releaser on the mooring position, and dredging for remnants of the mooring gave no result.

The releaser of F13 was in position and communicated with the deck unit. It signalled its location and verified its release, but no mooring surfaced. Dredging was performed in three rounds over several hours, but without success.

The details of the recovered moorings are summarized in Table 1 below. Lost instruments are highlighted with red fonts. A visual impression and overview of the setup of the recovered moorings is given in Appendix 1, where drawings of the mooring configuration are provided.

NPI has maintained an array of moorings in this location since 1990, and have, except for the loss of an entire mooring in 2002, not experienced any significant losses (to the knowledge of the author of this report). However, on this particular cruise extraordinary many tabular icebergs were observed. Hundred to two hundred meter deep icebergs were seen floating in the horizon across the East Greenland shelf on 78° 50`` N. Figure 1 illustrates a typical observation. The Danish Meteorological Institute

Figure 1: Icebergs in the horizon on the East Greenland shelf

reports the same observation on a cruise with coast guard vessel Triton to this area earlier in September this year.

Although it is impossible to find the cause of the recent losses, it is clear that a collision with one of the many icebergs in the area is a likely candidate. Such collisions have earlier not been a problem, as icebergs are few in this area. However, in some years the floating glacier shelves on the East Greenland fjords may disintegrate and drift out on the shelf. This is connected to the existence of fast ice, which tend to keep the floating glaciers in place (see Reeh, Thomsen, Higgins and Weidick, 2001. Sea ice and the stability of north and northeast Greenland floating glaciers, Annals of Glaciology, Vol. 33 2001, pp.474-480). As observed from Lance, there were no or very little fast ice at the coast this particular year.

Since it is likely that we are presently in a climate regime which allows the floating glaciers to disintegrate and drift away from the coast, we must reconsider our mooring configuration in order to avoid future losses. Preliminary discussions during the cruise seem to lead to the conclusion that the top of the moorings should be located deeper, and maybe even be built into a protecting shell.

Table 1: Recovered moorings in the Fram Strait September 2003

Mooring	Latitude Longitude	Water depth (m)	Date and time of deploymen t	Instrumen t type	Serial number	Instrument depth (m)
F11-5	78° 49.963 N 03° 16.740 W	2360	07.09.2002 13:20	ES300 DCM12 SBE16 RCM9 RCM7 RCM8 RCM8	48 17 2413 834 12644 12733 10069	41 41 49 50 243 1445 2351
F12-5[1]	78° 49.578 N 04° 03.597 W	1829	07.09.2002 10:40	ES300[1] DCM12[1] RCM7 RCM7 RCM8[1] SBE37[1] RCM8[1]	44 47 12646 12643 12587 443 12732	46 46 55 307 1509 1814 1820
F13-5[2]	78° 49.580 N 05° 00.600 W	980	05.09.2002 08:50	ES300[2] DCM12[2] SBE16[2] RCM7[2] RCM7[2] RCM8[2]	32 134 1974 9465 9708 10873	43 43 55 56 238 970
F14-5	78° 49.152 N 06° 27.538 W	282	04.09.2002 10:30	ES300 SBE16 RCM9 RCM8	17 1253 836 11889	51 59 60 272
FNY[3]	78° 49.951 N 05° 24.654 W	605	04.09.2002 13:10	RCM7 RCM11	11059 117	95 598

[1] Remnants of mooring F12-5 were found by sealers near the island of Jan Mayen in April 2003. The top 250 m of the mooring was recovered, except the ES300 and DCM12 which was lost. Two RCM8 were also lost, while two RCM7 were recovered by the sealers and brought to NPI

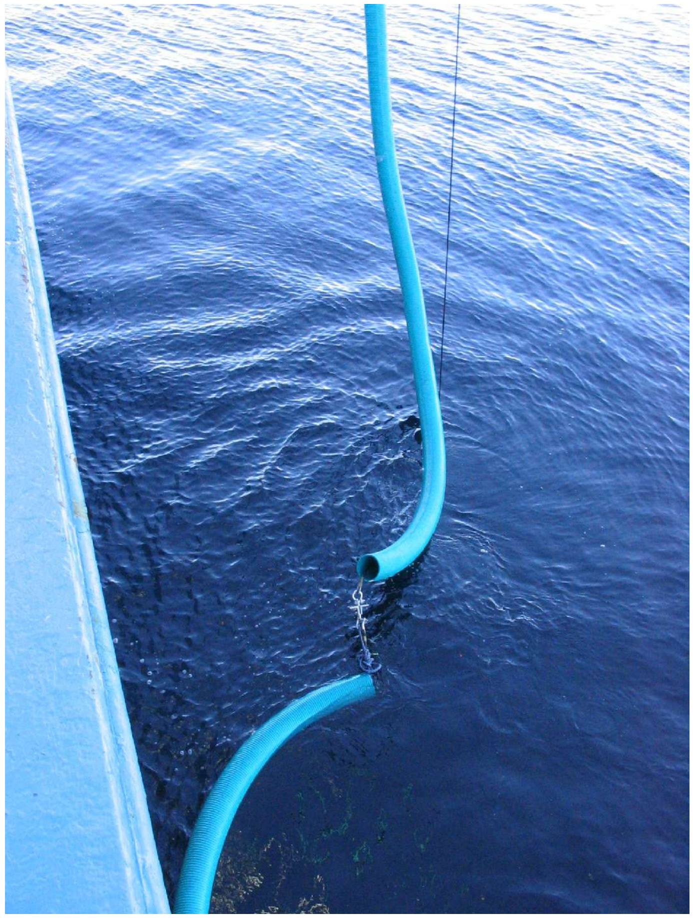
[2] Mooring F13-5 was lost

[3] Mooring FNY was deployed as a test on how well we are able to resolve the EGC with the present configuration of the mooring array

2. 2 Deployed moorings

Seven new moorings were deployed to replace the recovered ones, and to extend the measurements onto the shelf. F11-6 to F14-6 were deployed as before over the EGC, while three new moorings were deployed on the shelf; F17 to F19.

F11 to F14 has very much the same configuration as in previous years. F17 is a test of a kind of tube mooring, where two Microcats are placed inside a flexible fibre reinforced hose. The upper end of the hose is only ten meters below the surface. However, two major errors were done in the construction and deployment of this mooring: First, the hose was cut in three parts to make the procedure of mounting flotation and instruments inside it simpler. The strength of the mooring is hence reduced, since this creates edges and openings where ice can get hold of the mooring. Secondly, the mooring was mounted upside down during the deployment, so that the top flotation was located at the bottom. Hence the tube is not able to stand properly up in an upright position. Figure 2 and 3 demonstrates this mooring, see also Appendix 2.



F18 is a mooring containing only an ADCP on 122 meters depth. F19 is a "regular" tube mooring manufactured by the IfM Hamburg, with two Microcats inside. This mooring is a joint mooring by IfM, AWI and NPI. Responsible scientist here was Jürgen Holfort from IfM/AWI, now at NPI.

Details on the deployed moorings are found in Table 2 below, while drawings of the configurations are provided in Appendix 2.

Table 2: Deployed moorings

Mooring	Latitude Longitude	Water depth (m)	Date and time of deployment	Instrument type	Serial number	Instrument depth (m)
F11-6	78° 49.921 N 03° 16.077 W	2376	14.09.2003 15:40	ES300 DCM12 SBE16 RCM9 RCM7 RCM11 RCM8	19 190 4321 1046 11475 228 10071	65 65 73 74 259 1462 2365
F12-6	78° 49.770 N 04° 02.868 W	1841	14.09.2003 10:50	ES300 SBE37 RCM7 RCM7 RCM11 RCM8S	52 2963 11854 10349 234 11625	70 72 91 325 1528 1831
F13-6	78° 50.728 N 05° 00.994 W	980	13.09.2003 16:00	ES300 DCM12 SBE37 RCM7 RCM11 RCM8	51 17 2962 7718 235 12733	47 47 48 57 227 1014
F14-6	78° 48.996 N 06° 26.915 W	282	12.09.2003 07:15	ES300 SBE16 RCM9 RCM8	37 4322 834 12644	88 98 99 273
F17 (FnyA)	78° 49.818 N 08° 59.251 W	238	11.09.2003 12:20	ADCP	727	122
F18[1] (FnyB)	78° 49.953 N 08° 54.146 W	246	11.09.2003 14:40	SBE37 SBE37	2813 2814	
F19[2]	78° 49.821 N 12° 29.876 W	189	11.09.2003 05:00	SBE37 SBE37 AWI releaser	2967 2942 207	Upper Lower

[1]F18 (FnyB) was deployed upside down due to a mistake. This changed the location of the flotation in the mooring, and thereby its vertical shape. Final instrument depth uncertain, check pressure sensors
[2]Joint IfM Hamburg/NPI/AWI mooring. Responsible: Jürgen Holfort

3. CTD stations

96 CTD stations were taken. All CTD stations are plotted in Fig. 4. A complete CTD station list is enclosed in Appendix 3.

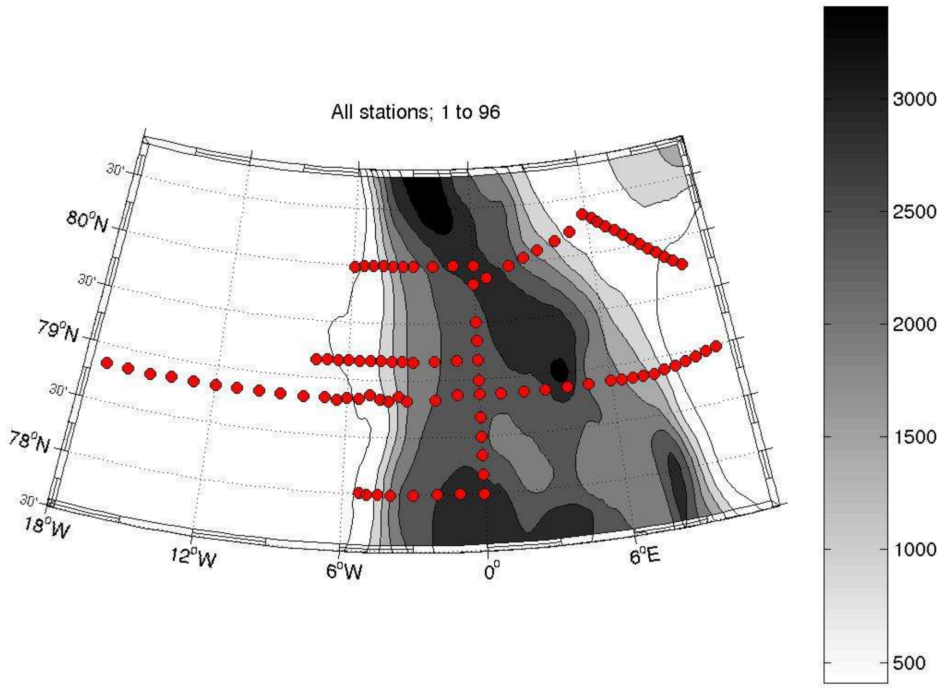


Figure 4. The position of all CTD stations

The measurements were taken with a standard Seabird SBE 9 CTD with a SBE 11+ deck unit. The temperature and conductivity sensors came directly from calibration. There were no major problems with the equipment. One to three salinity samples were taken on each station for calibration purposes.

4. ADCP

The ADCP was switched on on the westernmost point of the cruise, near Greenland. It therefore logged during the complete across-Fram Strait-section, and was left on until the meridional section ended. No processing or analysis of the data has been performed during the cruise.

5. Sea ice work

The sea ice work was led by H. Goodwin (NPI) under the internal NPI project "*Surface properties and thickness of multi-year sea ice in the Fram Strait for calibration/validation of CRYOSAT*" (PI: S. Gerland, NPI). The basic idea of this project is to gain detailed *in situ* ice thickness and related information for the locations in the western Fram Strait, the area where the four NPI-ULS moorings are installed. As one product, ice thickness distribution functions can be calculated from electromagnetic profiling and later compared with ice draft distributions for the same locations, derived from ULS measurements. Those data will be important for calibration and validation of the CRYOSAT mission.

In total work on 6 sea ice stations was conducted during this cruise (see table below).

Sea ice Station	Date	Latitude	Longitude	Number of thickness drillings	EM profiles (length in m)
1	08-SEP-03	78 50.882 N	5 1.818 W	1	1 (50)
2	09-SEP-03	78 49.557 N	6 26.688 W	4	1 (88)
3	11-SEP-03	78 48.895 N	4 55.927 W	3	1 (37)
4	11-SEP-03	78 48.557 N	4 54.265 W	-	1 (100)
5	13-SEP-03	78 49.617 N	5 0.912 W	3	1 (50)
6	13-SEP-03	78 50.165 N	5 2.506 W	3	1 (40)
6				**14**	**365 m**

Depending on available station time and station settings, several or all of the following investigations and measurements were applied: Ice thickness drillings, snow thickness sounding, freeboard measurement in boreholes and at the sea ice floe edges, electromagnetic profiling for the indirect measurement of total ice thickness (using NPI's Geonics EM31 instrument), surface water salinity measurement, and surface snow crystal characterization. The table above lists the length of EM31 profiles in the last column.

In addition, as for previous cruises with RV "Lance", regular ice observations were undertaken every 3 hrs. from the bridge, using a standardised scheme, which includes e.g. the different appearing ice classes and estimates of ice concentration. Those observations are consecutively implemented in NPI's GIS database with shipboard sea ice observations.

For 2004, a continuation and extension of the in situ sea ice work with a larger amount of measurements is planned.

6. Cruise log

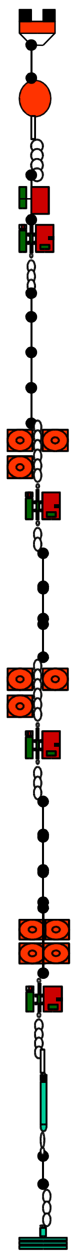
Date	Activity
Sun 7/9	Departure Longyearbyen 1000 UTC Steaming toward F11
Mon 8/9	Arrival F11-5 0600 UTC. F11 on deck 0740 UTC Arrival F12 -51100 UTC. No contact, F12 lost Arrival F13-5 1500 UTC. Communicates, does not release. Dredging 1600-2100. No result Sea ice station 1, 1600-1930 UTC CTD stations 001 to 004
Tue 9/9	Dredging for F13-5 0800-0945 UTC. Arrival FNY 1030. FNY on deck 1110 Arrival F14-5 1400 UTC. F14 on deck 1425 UTC Sea ice station 2 CTD stations 005 to 010
Wed 10/9	Steaming/CTD westward CTD stations 011 to 018

Thu 11/9	F19 deployed 0500 UTC F17 (FnyA) deployed 1020 UTC F18 (FnyB) deployed 1240 Sea ice stations 3 & 4
Fri 12/9	F14-6 deployed 0710 UTC CTD stations 019 to 028
Sat 13/9	F13-6 deployed 1405 UTC Dredging for F13-5 1600-1900 CTD stations 029 to 031 Sea ice stations 5 & 6
Sun 14/9	F12-6 deployed 1150 UTC F11-6 deployed 1350 UTC CTD stations 032 to 035
Mon 15/9	CTD stations 036 to 046
Tue 16/9	CTD stations 047 to 049 Arrival Ny-Ålesund 0530 Changing scientific crew Fixing hydraulic system Loading of cargo Steaming for Yermak Plateau 1600 UTC
Wed 17/9	CTD stations 050 to 067
Thu 18/9	CTD stations 068 to 073
Fri 19/9	CTD stations 074 to 079
Sat 20/9	CTD stations 080 to 085
Sun 21/9	CTD stations 086 to 094
Mon 22/9	CTD stations 094 to 096 Steaming toward LODYC mooring deployment site SW of Spitsbergen
Tue 23/9	CTD station 097 LODYC mooring deployment
Wed 24/9	Steaming south toward LODYC floats
Thu 25/9	Steaming south toward LODYC floats Recovery float 1 Recovery float 2
Fri 26/9	Steaming Recovery float 3
Sat 27/9	Steaming toward Tromsø Arrival Tromsø 0600 UTC

Appendix 1: Drawings of recovered moorings

Rigg F11-5
Satt ut 7 SEP 2002 13:24

78 49,963N
003 16,740W



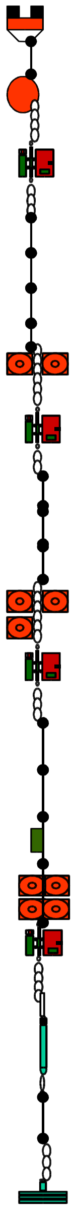
				Dyp:	Fra bunn:	Ut:
ES300	SNR. 48			41	2319	13:21
DCM12	SNR. 17					
ARGOS	SNR. 041	ID23050				
Kevlar	5 m					
Stålkule 37	SNR.603					
Svivel						
1 m Kjetting						
SEACAT	SNR. 2413			49	2311	13:21
RCM9	SNR.834			50	2310	13:21
10 m Kevlar						
40 m Kevlar						
40 m Kevlar						
100 m Kevlar						
3 Glasskuler						
RCM7	SNR.12644			243	2117	13:10
200 m Kevlar						
500 m Kevlar						
500 m Kevlar						
3 Glasskuler						
RCM8	SNR.12733			1445	915	12:54
500 m Kevlar						
200 m Kevlar						
200 m Kevlar						
4 Glasskuler						
5 m Kevlar						
RCM8	SNR.10069			2351	9	12:39
Svivel						
AR661	SNR. 577	Int Range:	4A11			
		Release:	4A12			
5 m Kevlar						
2 m Kjetting						
ANKER 1110/(960) kg				2360	0	

Rigg F12-5

78 49,578N

Satt ut 7 SEP 2002, 10:40

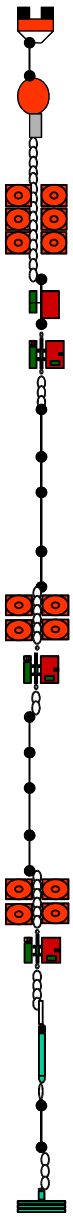
004 03,597W



				Dyp:	Fra bunn:	Ned i vann:
ES300	SNR. 44			46	1783	09:27
DCM12	SNR. 47					
ARGOS	SNR. 048	ID29859				
5 m Kevlar						
Stålkule 37	SNR. 605					
2 m Kjetting						
RCM7	SNR.12646			55	1774	09:27
10 m Kevlar						
40 m Kevlar						
100 m Kevlar						
100 m Kevlar						
2 Glasskuler						
RCM7	SNR.12643			307	1522	09:18
500 m Kevlar						
500 m Kevlar						
200 m Kevlar						
3 Glasskuler						
RCM8	SNR.12587			1509	320	08:49
200 m Kevlar						
100 m Kevlar						
Microcat	SNR. 0443			1814	15	08:38
5 m Kevlar						
4 Glasskuler						
RCM8	SNR.12732			1820	9	07:57
Svivel						
AR861	SNR. 052	Int Range:	043E + 0447			
		Release:	043E + 0455			
5 m Kevlar						
2 m Kjetting						
ANKER	1110/(960) kg			1829	0	

Rigg F13-5

Satt ut 5 SEP 2002, 08:49 — 78 49,580N, 005 00,600W

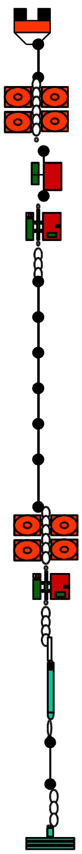


				Dyp:	Fra bunn:	Ned i vann:
ES300 DCM12	SNR. 32 SNR. 134			43	937	09:48
Kevlar	5 m					
Stålkule 30	SNR. M882					
Svivel						
2 m Kjetting						
6 Glasskuler						
SEACAT	SNR. 1974			55	925	09:12
RCM7	SNR. 9465			56	924	09:12
20 m Kevlar						
50 m Kevlar						
100 mKevlar						
10 m Kevlar						
4 Glasskuler						
RCM7	SNR.9708			238	742	08:54
500 m Kevlar						
200 m Kevlar						
10 m Kevlar						
20 m Kevlar						
4 Glasskuler						
RCM8	SNR.10873			970	10	08:33
Svivel						
AR661	SNR. 84	Int Range: Release:	6130 6139			
5 m Kevlar						
2 m Kjetting						
ANKER	1020/(900) kg			980	0	

Rigg F14-5

Satt ut 4 SEP 2002, 10:27

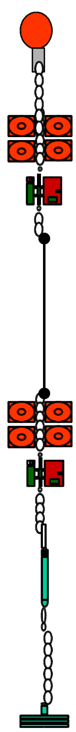
78 49,152N
006 27,538W



				Dyp:	Fra bunn:	Ned i vann:
ES300	SNR. 17			51	231	10:24
Kevlar	5 m					
4 Glasskuler						
SEACAT	SNR. 1253			59	221	10:23
RCM9	SNR. 836			60	220	10:23
20 m Kevlar						
20 m Kevlar						
20 m Kevlar						
50 m Kevlar						
50 m Kevlar						
50 m Kevlar						
4 Glasskuler						
RCM8	SNR. 11889			272	10	10:12
Svivel						
AR661	SNR. 110	Int Range: Release:	6151 6152			
5 m Kevlar						
2 m Kjetting						
ANKER	610/(530) kg			282	0	

Rigg FNY 78 49,951N

Satt ut 4 SEP 2002, 13:10 005 24,654W

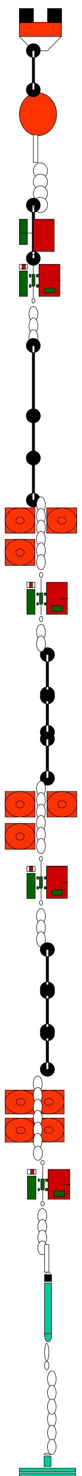


				Dyp:	Fra bunn:	Ned i vann:
Stålkule 30	SNR. M597			80	620	
Svivel						
4 Glasskuler						
RCM7	SNR. 11059			95	510	12:16
500 m Kevlar						
4 Glasskuler						
RCM11	SNR. 117			598	7	12:05
Svivel						
AR661	SNR. 290	Int Range: Release:	C343 C344			
4 m Kjetting						
ANKER 670/(580) kg				605	0	

Appendix 2: Drawings of deployed moorings

Rigg F11-6

Settes ut 14 SEP 2003 15:40 — 78 49,921N, 003 16,077W



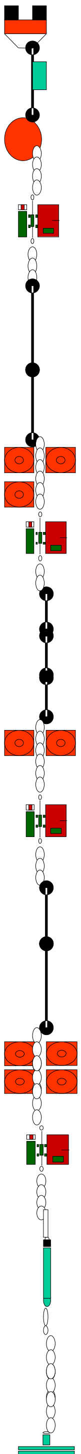
			Dyp:	Fra bunn:	Ut:
ES300	SNR. 19		65	2311	13:21
DCM12	SNR. 190				
ARGOS	SNR. 23050	ID041			
Kevlar	5 m				
Stålkule 37	SNR.596				
Svivel					
1 m Kjetting rustfri					
SEACAT	SNR. 4321		73	2303	13:16
RCM9	SNR.1046		74	2302	13:16
0,5 m Kjetting rustfri					
40 m Kevlar					
40 m Kevlar					
100 m Kevlar					
3 Glasskuler					
4 m Kjetting galvanisert					
RCM7	SNR.11475		259	2117	13:03
0,5 m Kjetting rustfri					
200 m Kevlar					
500 m Kevlar					
500 m Kevlar					
3 Glasskuler					
2 m Kjetting rustfri					
RCM11	SNR.228		1462	914	12:40
0,5 m Kjetting rustfri					
500 m Kevlar					
200 m Kevlar					
200 m Kevlar					
4 Glasskuler					
2 m Kjetting rustfri					
RCM8	SNR.10071		2365	11	12:23
0,5 m Kjetting rustfri					
Svivel					
AR861	SNR. 053	Pinger på: 043F + 0447			
		Pinger av: 043F + 0448			
		Release: 043F + 0455			
		Release m/ping: 043F + 0456			
7 m Kjetting galvanisert					
ANKER 1110/(960) kg			2376	0	

Rigg F12-6

78 49,770N

Settes ut 14 SEP 2003, 10:48

004 02.868W

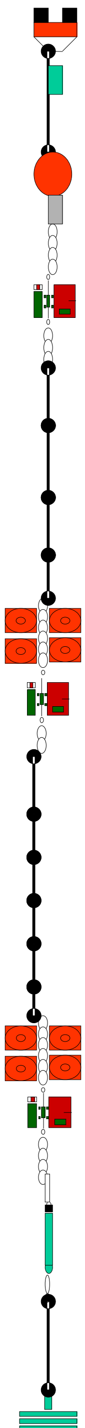


				Dyp:	Fra bunn:	Ned i vann:
ES300	SNR. 52			70	1771	10:48
Microcat	SNR.2963			72	1769	10:48
5 m Kevlar						
Stålkule 37	SNR.602					
2 m Kjetting rustfri						
RCM7	SNR.11854			91	1760	10:48
0,5 m Kjetting rustfri						
40 m Kevlar						
200 m Kevlar						
3 Glasskuler						
3 m Kjetting galvanisert						
RCM7	SNR10349.			325	1516	07:52
0,5 m Kjetting rustfri						
500 m Kevlar						
500 m Kevlar						
200 m Kevlar						
2 Glasskuler						
2 m Kjetting galvanisert						
RCM11	SNR. 234			1528	313	07:27
0,5 m Kjetting rustfri						
200 m Kevlar						
100 m Kevlar						
4 Glasskuler						
2 m Kjetting rustfri						
RCM8S	SNR.11625			1831	10	07:7
0,5 m Kjetting rustfri						
Svivel						
AR861	SNR. 182	Ping på:	04AF + 0447			
		Ping av:	04AF + 0448			
		Release:	04AF + 0455			
		Release m/ping:	04AF + 0456			
7 m Kjetting						
ANKER 1110/(960) kg				1841	0	

Rigg F13-6

Satt ut 13 SEP 2003, 16:04

78 50,728N
005 00,994W

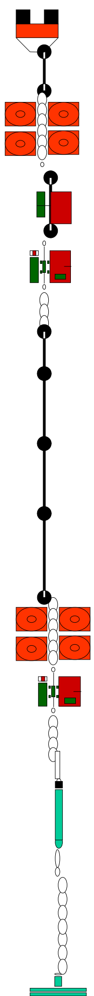


				Dyp:	Fra bunn:	Ned i vann:
ES300	SNR. 51			47	977	14:04
DCM12	SNR.17			47	977	14:04
Microcat	SNR. 2962					
Kevlar	5 m					
Stålkule 37	SNR.McLane					
Svivel						
2 m Kjetting						
RCM7	SNR.7718			57	965	14:04
50 m Kevlar						
100 m Kevlar						
10 mKevlar						
5 m Kevlar						
4 Glasskuler						
RCM11	SNR.235			227	795	13:38
500 m Kevlar						
200 m Kevlar						
10 m Kevlar						
20 m Kevlar						
40 m Kevlar						
10 m Kevlar						
4 Glasskuler						
RCM8	SNR. 12733			1014	8	13:16
Svivel						
AR661	SNR.30	Int Range: Release:	9270 9279			
5 m Kevlar						
ANKER	1020/(900) kg			1022	0	

Rigg F14-6

Satt ut 12 SEP 2003, 07:14

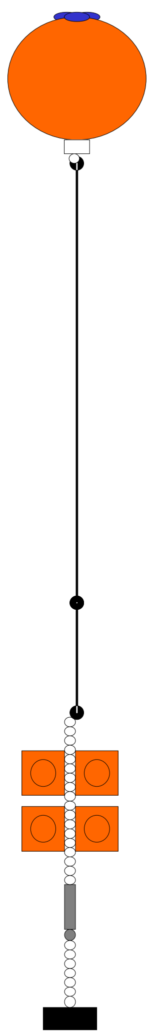
78 48,996N
006 26,915W



				Dyp:	Fra bunn:	Ned i vann:
ES300	SNR. 37			88	203	07:10
Kevlar	5 m					
4 Glasskuler						
SEACAT	SNR.4322			98	193	07:04
RCM9	SNR. 834			99	192	07:04
20 m Kevlar						
50 m Kevlar						
50 m Kevlar						
50 m Kevlar						
4 Glasskuler						
RCM7	SNR. 12644			273	9	06:52
Svivel						
AR661	SNR. 291	Int Range: Release:	C345 C346			
7 m Kjetting						
ANKER	610/(530) kg			282	0	

F17

Rigg FnyA		78 49.818N	Dyp:	Fra bunn:		Ned i vann:
Satt ut 11 SEP 2003, 12:21		008 59.251W				

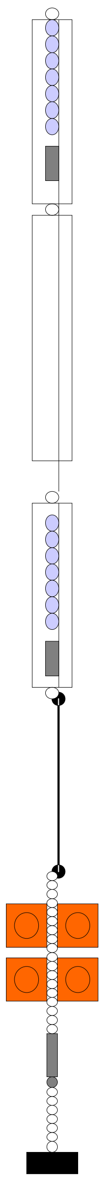


ADCP	SNR.727	122				110
100 m Kevlar						
10 m Kevlar						
4 GLASSKULER				10		222
AR661	SNR. 110	Int Range:		6151	eller	6125
		Release:		6152	eller	6126
ANKER	630/(520)kg			0		

F18

Rigg FnyB 78 49.953N Dyp: Fra bunn: Ned i vann:
Satt ut 11 SEP 2003, 14:40 008 54.146W

Toppen av denne riggen ble i farten montert opp ned slik at Microcat'en ble øverst og ikke slik nederst figuren viser og der den skulle ha vært.



5 m SLANGE/ OPPDRIFT			
MICROCAT	SNR. 2814	14	226
10 m Slange			
5 m SLANGE/ OPPDRIFT			
MICROCAT	SNR. 2813	29	211
200 m Kevlar			
4 GLASSKULER		232	8
AR661	SNR. 77	Int Range: Release:	6125 eller 6151 6126 eller 6152
ANKER	630/(520)	240	0

Appendix 3: CTD station list

Station	YYYY	MM	DD	HH(UTC)	MIN	Lat	Lon	Depth
1	2003	9	8	9	48	78.823	-3.298	2405
2	2003	9	8	14	46	78.820	-4.117	1810
3	2003	9	8	23	11	78.867	-4.983	1118
4	2003	9	9	1	10	78.835	-4.497	1509
5	2003	9	9	4	51	78.858	-3.675	2184
6	2003	9	9	13	22	78.832	-5.463	624
7	2003	9	9	16	41	78.818	-6.460	273
8	2003	9	9	21	33	78.832	-7.010	238
9	2003	9	9	23	25	78.830	-7.997	190
10	2003	9	10	1	54	78.833	-9.018	204
11	2003	9	10	3	49	78.832	-9.998	290
12	2003	9	10	5	52	78.832	-10.998	321
13	2003	9	10	7	33	78.835	-11.995	196
14	2003	9	10	9	16	78.830	-13.005	190
15	2003	9	10	10	39	78.835	-13.997	98
16	2003	9	10	11	59	78.827	-14.992	73
17	2003	9	10	13	20	78.835	-16.013	226
18	2003	9	10	14	44	78.832	-17.002	393
19	2003	9	12	10	18	78.835	-6.002	326
20	2003	9	12	13	1	79.160	-7.508	216
21	2003	9	12	14	4	79.167	-7.000	238
22	2003	9	12	14	55	79.167	-6.500	320
23	2003	9	12	15	52	79.167	-5.998	752
24	2003	9	12	16	59	79.167	-5.500	1120
25	2003	9	12	18	22	79.167	-5.005	1407
26	2003	9	12	20	3	79.168	-4.508	1658
27	2003	9	12	21	53	79.167	-4.010	1894
28	2003	9	12	23	52	79.167	-3.510	2097
29	2003	9	13	2	35	79.157	-3.000	2261
30	2003	9	13	5	36	79.165	-2.015	2489
31	2003	9	13	8	57	78.830	-2.008	2604
32	2003	9	14	18	32	78.867	-1.017	2600
33	2003	9	14	21	38	78.867	-0.002	2560
34	2003	9	15	0	57	78.867	0.992	2477
35	2003	9	15	3	40	78.867	2.008	2486
36	2003	9	15	6	20	78.868	2.992	2392
37	2003	9	15	9	15	78.865	3.988	2323
38	2003	9	15	11	59	78.865	4.980	2632
39	2003	9	15	14	35	78.870	6.002	2405
40	2003	9	15	16	43	78.867	6.498	1899
41	2003	9	15	18	22	78.865	6.988	1407
42	2003	9	15	19	56	78.867	7.495	1132
43	2003	9	15	21	23	78.867	7.992	1031
44	2003	9	15	22	53	78.883	8.490	517
45	2003	9	16	0	14	78.902	9.002	209
46	2003	9	16	1	8	78.918	9.500	202
47	2003	9	16	2	15	78.940	10.005	216
48	2003	9	16	3	11	78.967	10.497	209
49	2003	9	16	4	7	78.983	10.990	136
50	2003	9	17	2	8	79.753	10.340	117
51	2003	9	17	2	55	79.802	9.947	391
52	2003	9	17	3	46	79.853	9.582	450
53	2003	9	17	4	44	79.902	9.217	458
54	2003	9	17	5	42	79.953	8.837	473

55	2003	9	17	6	50	80.008	8.468	488
56	2003	9	17	8	1	80.062	8.105	499
57	2003	9	17	8	56	80.112	7.727	572
58	2003	9	17	9	52	80.163	7.347	539
59	2003	9	17	10	51	80.210	6.915	545
60	2003	9	17	11	43	80.262	6.565	555
61	2003	9	17	12	32	80.300	6.290	556
62	2003	9	17	13	29	80.345	5.868	555
63	2003	9	17	15	3	80.217	5.053	836
64	2003	9	17	16	41	80.147	4.220	1269
65	2003	9	17	18	38	80.090	3.278	2210
66	2003	9	17	21	3	80.032	2.567	2577
67	2003	9	17	23	51	79.972	1.775	2308
68	2003	9	18	9	3	79.885	0.622	2390
69	2003	9	18	13	26	80.000	-0.998	2663
70	2003	9	18	16	28	79.998	-2.023	2726
71	2003	9	18	20	28	79.997	-3.008	2492
72	2003	9	18	23	36	79.995	-4.012	2053
73	2003	9	19	1	35	79.998	-3.495	2316
74	2003	9	19	4	29	80.003	-4.493	1685
75	2003	9	19	6	33	80.000	-5.000	1251
76	2003	9	19	8	52	80.000	-5.483	775
77	2003	9	19	11	45	79.987	-5.948	329
78	2003	9	19	21	58	79.995	-0.003	2588
79	2003	9	20	1	31	79.835	-0.047	2714
80	2003	9	20	9	54	79.500	0.010	2759
81	2003	9	20	12	42	79.338	-0.010	2670
82	2003	9	20	15	13	79.172	-0.010	2670
83	2003	9	20	17	58	79.168	-0.988	2316
84	2003	9	20	20	50	78.992	-0.003	2532
85	2003	9	21	0	11	78.668	-0.012	2700
86	2003	9	21	2	13	78.498	0.007	2715
87	2003	9	21	4	44	78.335	0.008	3000
88	2003	9	21	6	47	78.168	-0.022	3060
89	2003	9	21	9	19	77.998	-0.015	3100
90	2003	9	21	12	22	78.003	-1.005	3058
91	2003	9	21	15	16	78.005	-2.002	2980
92	2003	9	21	18	10	77.992	-3.003	2832
93	2003	9	21	21	22	77.997	-3.997	2585
94	2003	9	22	0	37	77.998	-5.005	1147
95	2003	9	22	2	29	78.008	-5.288	479
96	2003	9	22	4	50	78.000	-4.530	2115