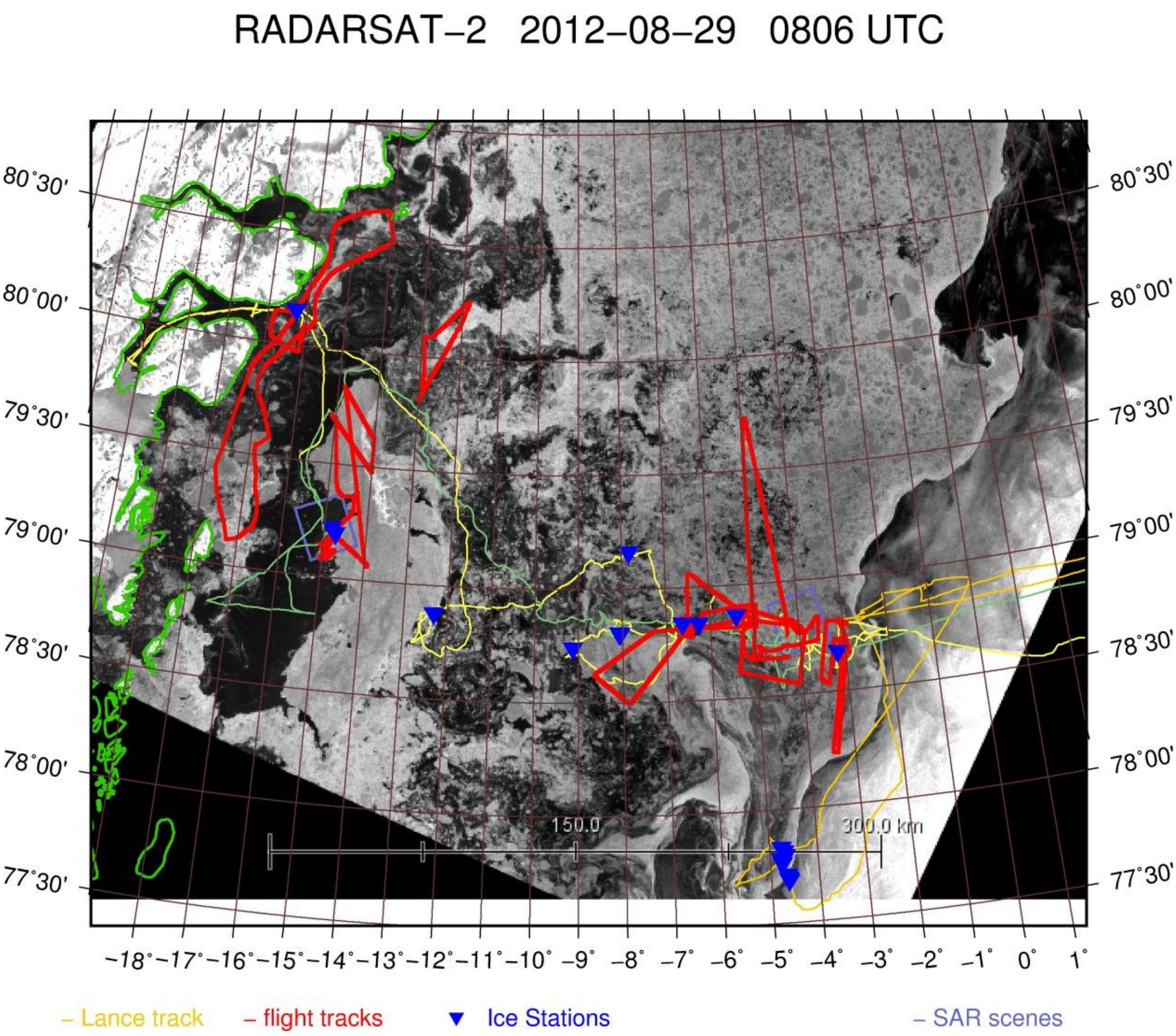
RV Lance
Fram Strait 19/8 – 13/9 2012-09-01

Cruise Report



1. Participants

Physical and chemical oceanography
1. Edmond Hansen, NPI, Cruise leader
2. Mats Granskog, NPI, Deputy cruise leader
3. Paul Dodd, NPI, CTD/tracer and LADCP responsible
4. Agneta Fransson, NPI, CTD/chemical oceanography
5. Melissa Chierici, IMR, CTD/chemical oceanography
6. Dmitri Divine (NPI, CTD/chemical oceanography)
7. Juni Vaardal-Lunde, UNIS, CTD/chemical oceanography
8. Kristen Fossan, NPI, technician, mooring work responsible
9. Marius Bratrein, NPI, technician, mooring work & EM bird
10. Anders Berg, Chalmers, CTD/tracer work and sea ice work

Sea ice
11. Sebastian Gerland, NPI, EM bird responsible
12. Thomas Kræmer, UiT
13. Gunnar Spreen, NPI
14. Are Bjørdal, NPI
15. Ole Christian Ekeberg, NTNU
16. Joar Aspenes Justad, NTNU/UNIS
17. Martin Doble, UPMC

Helicopter team
18. Bjørn Frode Amundsen, pilot, Airlift
19. Harold Edorsen, technician, Airlift

2. Cruise outline

The cruise took place in western Fram Strait. The main priority was to recover and redeploy the NPI moorings across the East Greenland Current at 78° 50 N, and to carry out the CTD, LADCP and tracer section across Fram Strait along the 78° 50 N line. In addition, sea ice physics work was made across the Transpolar Drift where it exits the Arctic. This included in situ work on the ice, and thickness sections made by helicopter and an EM bird instrument. Finally we made CTD sections that follow the assumed passage for warm Atlantic water to the Greenland coast, where it interacts with the floating glacier tongues through basal melting. The working region are illustrated in Figure 1, and listed in Table 1.

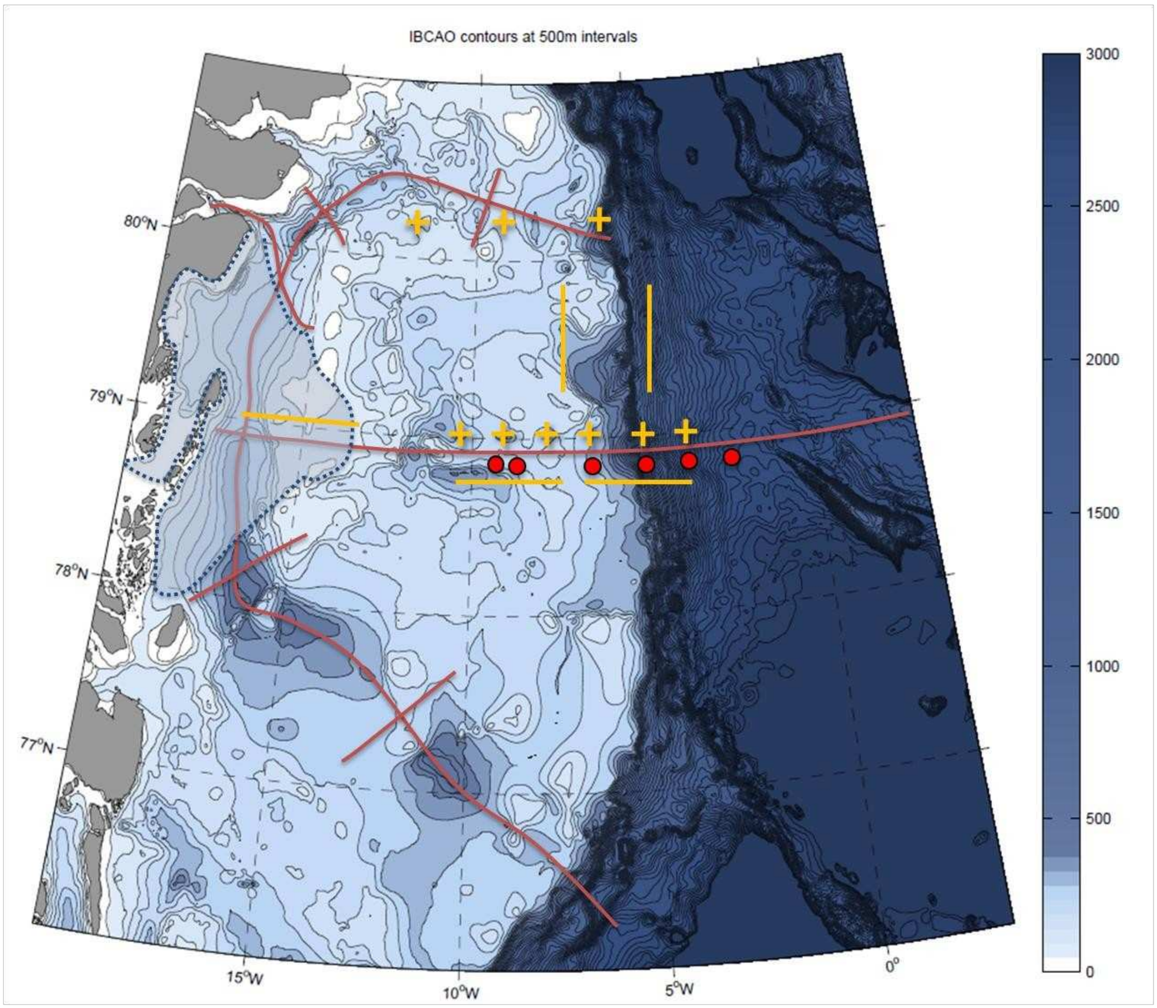


Figure 1. The main activities during the cruise. Red circles: mooring positions. Red lines: CTD, LADCP and tracer sections. Yellow crosses: Typical positions for sea ice work. Yellow lines: Typical EM bird sections. The blue dotted line illustrates the typical extent of the fast ice in recent years. We were not able to carry out the two southernmost sections across Norske trough, or the northeasternmost section across the Northwind Trough.

Table 1. Cruise overview.

Date	**Activity** (all times in UTC)
19.08	-Departure 0800. Staying in Isfjorden while preparing. -Loaded equipment. -Brought equipment onto deck, testing instruments, preparing. -Sailed across Fram Strait
20.08	-Sailed across Fram Strait. Touching the first ice 0745 -Arrived at F11 1415. Located the mooring on the sonar. -F11 released 1500 UTC in a lead. The top surfaces as planned, but the bottom set of floatation and instruments got stuck under the ice, despite strong pulling. Need to repeatedly break the ice and pull it out. -F11 on deck 1835. -Helicopter EM bird flight -CTDs
21.08	-CTDs during the night -Sailed to F12 position. Compact, heavy ice. Sailed around. -Arrived F12 1100, located it below a lead. -F12 released 1110. -F11 on deck 1215. The upper set of sensors and instrumentation appeared to be very biofouled. Biofouling was observed all the way down to the McLane steel floatation. -Helicopter EM bird flight -Sea ice station -CTDs
22.08	-CTDs during the night. -Arrived F13 0700, located it with the sonar. -F13 released 0705. -F13 on deck 07050. -Continued CTDs towards F14. RBR portable CTD attached to CTD stations 10 and 11 for comparison/calibration purposes. -Arrived at F14 1315, released immediately. -F14 on deck 1345. -Sea ice station.
23.08	-CTDs during the night. -Arrived F17 around breakfast 0630. -Determined the drift. Waited/drifted in an open lead that would drift over the mooring. -F17 released 0930. -F17 on deck 1000. -The RAS samplers of the mooring (two) were brought to the cargo hold. We immediately started emptying the bags and taking samples. -Rearranged equipment between the cargo rooms, making all equipment available. -Sailed towards F18 in compact ice. -Arrived F18 1340. -Released F18 1320. -F18 on deck 1340. -Sea ice station.
24.08	-Sailed westwards, CTDs underway. Penetrated compact ice until we reached

	009° W. CTD. -Sea ice station. -Sailed east and north to get around the compact patch of ice. -While underway we looked for O-buoy no 4 about to drift out of the Arctic Ocean.
25.08	-Located O-Buoy 4 0500. -Sea ice station at OB4 floe. Mapping the ice thickness across the floe (EM31). -Took OB4 onboard Lance 0740 in position 79° 09.9’ N 007° 52.1’ W. -Sailed west towards 10° W. -Resumed CTD work at 10° W.
26.08	-Reached the fast ice. On anchor over the night. -Sea ice station on the fast ice in 78° 52.61’ N 012° 18.76’ W. -Started sailing north towards Dijmphna Sund. -CTDs during the evening.
27.08	-CTDs during the night and morning, across the trough outside the mouth of Dijmphna Sund. - Two helicopter EMbird flights during the day. -Sailed into and along Dijmphna Sund towards the 79 N glacier front.
28.08	-CTDs across Dijmphna Sund at the glacier front and at the northern mouth. CTDs along the fjord/sound. -Sailed towards the western edge of the fast ice.
29.08	-Sea ice station at fast ice. -Installing IMB on fast ice. -CTD section westwards across the trough.
30.08	-CTD section westwards across the trough. -Started sailing towards F17 deployment site. -Helicopter EMbird flight while underway.
31.08	-Continued sailing towards F17 during the night. -Arrived deployment site 1040. -Mapped the drift. -Started deployment 1110. -F17deployed 1125 on 229 m depth, in position 78° 50.536’ N 008° 08.408’ W. -Sailed towards F18 deployment site. -Arrived 1230. -Deployed F18 1245 on 211 m depth in position 78° 48.250’ N 008° 04.694’ W. -CTD. -Sea ice station.
01.09	-Sailing to F14. -Prepared F14. -F14 deployed 10:55 on 267 m depth in position 78° 48.956’ N 006° 30.446’ W. -CTD. -Sea ice station. -Prepared F13. -Sailed to F13 deployment site.
02.09	-Prepared F13. -Two helicopter EM bird flights; one long flight westwards, and one shorter

	flight eastwards. -Deployed F13 12:10 on 1020 m depth in position 78° 49.972’ N 004° 59.256’ W. -Sea ice station. -Prepared F12.
03.09	-Prepared F12. -Helicopter EMbird flight. -Sailed to F12 deployment site, just outside the ice edge. -Deployed F12 14:20 on 1830 m depth, in position 78° 47.927’ N 004° 00.887’ W. -MIZ wave experiment during the evening by UPMC/M. Doble. -Prepared F11.
04.09	-Waited for weather to improve for deployment of F11 and CTD section. -Bad weather forecast, sailed to Ny-Ålesund to deliver helicopter and wait for better weather.
05.09	-Arrived Ny-Ålesund 05:00. -Waited at the pier.
06.09	-Helicopter departed Lance 08:00. -Left Ny-Ålesund 11:00, sailed towards easternmost CTD section on the Fram Strait section. -Resumed CTD work 13:00 -After three CTD stations the weather was again too bad. Stopped the CTD work, and started to sail towards F11 deployment site.
07.09	-CTD at F11 deployment site. -Much ice, waited for a band of ice to drift away from the site. Engine maintenance while we waited. -Started F11 deployment 12:20. -F11 deployed 13:50 on 2472 m depth in position 78° 48.068’ N 003° 04.767’ W. -CTDs at 1° W and 0° W. -Sailed south along the ice edge towards CTD section across Norske Trough (~78° N 12° W).
08.09	-MIZ wave experiment across the ice edge at ~78° N 5° W by UPMC/M. Doble. -Continued sailing westwards towards CTD section. -Sea ice station. Moving between different floes with zodiacs. -Continued westwards, but too compact ice slowed us down. A new satellite image came in, showing that much ice had moved into the region that we intended to survey. We decided to abandon the southern CTD section. -Keeping the latitudinal position over the night.
09.09	-Sea ice station after breakfast. -Cleaning and drying equipment. Packing.
10.09	-Cleaning and drying equipment. Packing. -Stowing all equipment in cargo rooms. -CTD section eastwards across Fram Strait.
11.09	-CTD section eastwards across Fram Strait..
12.09	-End of CTD section, sailing towards Longyearbyen -Arrived Longyearbyen 06:00. -Packing, offloading equipment.
13.09	-Packing, offloading equipment.

Mooring work

Six moorings were recovered, and six new moorings were redeployed. The setup of the recovered moorings is listed in Table 2. The details of the deployed moorings are summarized in Table 3. The recovered moorings are illustrated in Figures 8-13.

Table 2. Recovered moorings. Depths in meter.

Mooring	Position	Depth	Date and time	Instrument	Serial no	Instr depth
F11-13	78 48.198 N 003 04.720 W	2470	Deployed: 09.09.2011 16:00 UTC Recovered: 20.08.2012 18:35	IPS SBE37 RDCP600 SBE37 RCM9 SBE37 RCM11 SBE37 RCM8 AR861	51062 7054 28 3996 1049 7061 538 8226 10069 499	53 58 62 301 305 1554 1557 2456 2459 2463
F12-13	78 48.095 N 004 01.182 W	1833	Deployed: 08.09.2011 19:30 UTC Recovered: 21.08.2012 12:15	IPS SBE37 RDCP600 Seaguard SBE37 RCM9 SBE37 RCM11 SBE37 RCM11 AR861	51063 7055 758 639 3994 836 2962 556 8227 117 500	50 54 58 60 311 314 1517 1520 1820 1823 1826
F13-13	78 50.273 N 004 59.999 W	1014	Deployed: 06.09.2011 12:05 UTC Recovered: 22.08.2012 07:50	IPS WHS300 RCM9 SBE37 SBE37 RCM9 SBE37 RCM8 AR861	1047 727 1175 7059 7060 1326 3995 12322 743	49 57 59 58 248 251 1001 1004 1007
F14-13	78 48.841 N 006 30.360 W	270	Deployed: 05.09.2011 18:50 UTC Recovered: 22.08.2012 13:45	IPS RCM9 SBE37 SBE37 RCM7 AR861	51064 1325 7058 7057 9464 568	51 57 59 257 260 263
F17-8	78 50.507 N 008 08.571 W	229	Deployed: 01.09.2011 12:30 UTC Recovered: 23.08.2012 10:00	SBE16 RAS WHS300 SBE16 RAS AR661	6693 7636 6694 501	59 59 110 113 113 222
F18-7	78 48.202 N	215	Deployed:	DL7	1632	57-107

	008 04.097 W		01.09.2011 10:45 UTC Recovered: 23.08.2012 14:10	AR861	553	208

Table 3. Moorings deployed. Depths in meters, time in UTC.

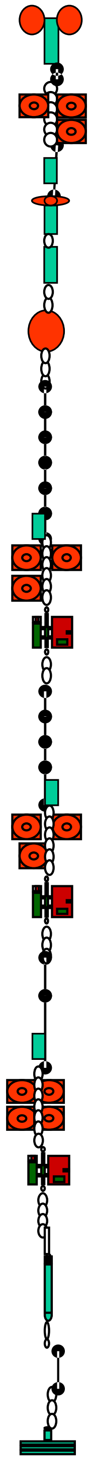
Mooring	Position	Depth	Date and time	Instrument	Serial no	Instr depth
F11-14	78° 48.068’ N 003° 04.767’ W	2472	Deployed: 07.09.2011 13:50	IPS	51062	54
				SBE37	3490	55
				ADCP	17461	60
				SBE37	4702	299
				RCM9	1324	303
				SBE37	3552	1553
				RCM11	494	1556
				SBE37	8821	2456
				RCM8	10071	2459
				AR861	287	2463
F12-14	78° 47.927’ N 004° 00.887’ W	1830	Deployed: 03.09.2012 14:20	IPS	51063	54
				SBE37	3489	56
				ADCP	17462	60
				SBE37	4837	313
				SGUARD	884	316
				SBE37	3554	1516
				RCM11	235	1519
				SBE37	8822	1819
				RCM11	228	1822
				AR861	182	1826
F13-14	78° 49.972’ N 004° 59.256’ W	1020	Deployed: 02.09.2012 12:10	IPS	1047	47
				SBE37	7056	49
				ADCP	16831	53
				SBE16	6693	67
				RAS		67
				AURAL		75
				SBE16	6694	146
				RAS		146
				SBE37	3993	247
				RCM9	1327	250
				SBE37	3551	1000
				RCM11	561	1003
				AR861	053	1007
F14-14	78° 48.956’ N 006° 30.446’ W	270	Deployed: 01.09.2012 10:55	IPS	51064	48
				SBE37	3492	52
				ADCP	16876	56
				SBE37	3992	256
				RCM9	1046	259
				AR861	409	263

F17-9	78° 50.536’ N 008° 08.408’ W	229	Deployed: 31.08.2012 11:25	ADCP SBE37 RAS AR661	7636 7062 110	109 113 113 222
F18-9	78° 48.250’ N 008° 94.694 ‘W	211	Deployed: 31.08.2012 12:45	DL7 AR861	1649 291	57-107 208

Figure 2. Recovered mooring F11-13.

Rigg F11-13 78 48,198N

Satt ut 9 SEP 2011 kl 16:00 003 04,720W

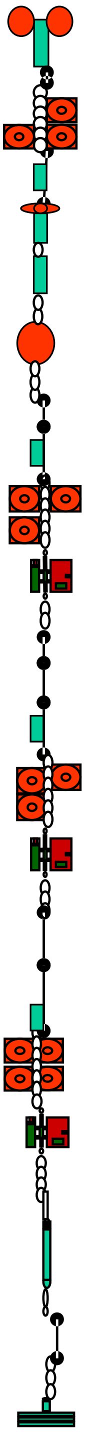


		Dyp:	Fra bunn:	Ut:
IPS	SNR. 51062	53	2417	15:58
3 Glasskuler gule				
2 m Kjetting galv.				
SBE37	SNR. 7054	58	2412	15:57
RDCP600	SNR: 28	62	2408	15:55
5 M Kevlar				
Batteribeholder til RDCP				
1 m Kjetting galvanisert				
Stålkule 37	McLane gul E	66	2404	
2 m Kjetting galvanisert				
10 m Kevlar				
100 m Kevlar				
50 m Kevlar				
20 m Kevlar				
50 m Kevlar				
5 m Kevlar				
SBE37	SNR. 3996	301	2169	15:41
3 Glasskuler oransje				
2 m Kjetting galvanisert				
RCM9	SNR.1049	305	2165	15:40
0,5 m Kjetting galv				
200 m Kevlar				
500 m Kevlar				
500 m Kevlar				
SBE37	SNR. 7061	1554	916	15:05
50 m Kevlar				
3 Glasskuler gule				
2 m Kjetting galvanisert				
RCM11	SNR.538	1557	913	15:04
0,5 m Kjetting galv				
500 m Kevlar				
200 m Kevlar				
200 m Kevlar				
SBE37	SNR. 8226	2456	14	14:38
4 Glasskuler gule				
2 m Kjetting galvanisert				
RCM8	SNR.10069	2459	11	14:37
0,5 m Kjetting rustfri				
Svivel				
AR861	SNR. 499 Pinger på: Pinger av: Release: Release m/ping:			
5 m Kevlar				
2 m Kjetting galvanisert				
ANKER 1100/(950) kg		2470	0	

Figure 3. Recovered mooring F12-13.

Rigg F12-13 78 48,095N

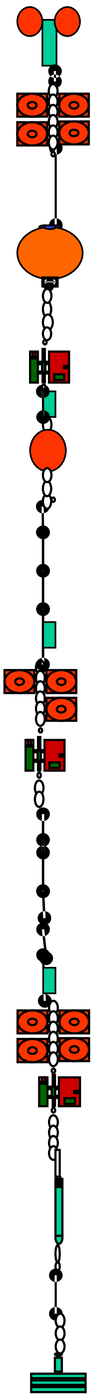
Satt ut 8 SEP 2011 kl 19:35 004 01,182W



			Dyp:	Fra bunn:	Ut:
IPS	SNR. 51063		50	1783	19:33
3 Glasskuler gule					
2 m Kjetting galv.					
5 M Kevlar					
SBE37	SNR. 7055		54	1779	19:00
RDCP600	SNR: 758		58	1775	19:00
SEAGUARD	SNR: 639				
1 m Kjetting galv./rustfri					
Stålkule 37	McD		60	1773	
2 m Kjetting galvanisert					
50 m Kevlar					
200 m Kevlar					
SBE37	SNR.3994		311	1522	
3 Glasskuler					
2 m Kjetting galvanisert					
RCM9	SNR.836		314	1519	18:40
0,5 m Kjetting galv					
500 m Kevlar					
500 m Kevlar					
200 m Kevlar					
SBE37	SNR.2962		1517	316	
3 Glasskuler					
2 m Kjetting galvanisert					
RCM11	SNR.556		1520	313	18:12
0,5 m Kjetting galv					
200 m Kevlar					
100 m Kevlar					
SBE37	SNR.8227		1820	13	
4 Glasskuler					
2 m Kjetting galvanisert					
RCM11	SNR.117		1823	10	18:00
0,5 m Kjetting rustfri					
Svivel					
AR861	SNR. 500	Pinger på: Pinger av: Release: Release m/ping:			
5 m Kevlar					
2 m Kjetting galvanisert					
ANKER	1100/(950) kg		1833	0	

Figure 4. Recovered mooring F13-13.

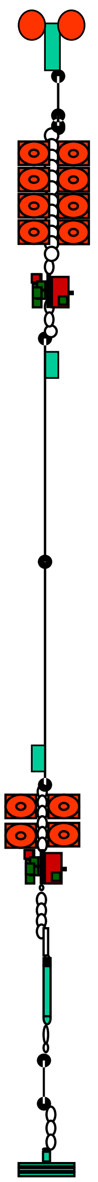
Rigg F13-13 — 78 50.273N
Satt ut 6 SEP 2011, kl 12:05 — 004 59.999W



		Dyp:	Fra bunn:	Ned i vann:
IPS4	SNR. 1047	49	965	11:05
4 Glasskuler gule				
2 m Kjetting galv.				
5 M Kevlar				
ADCP300	SNR: 727	57	957	11:00
2 m Kjetting galv.				
RCM 9	SNR: 1175	59	955	10:59
SBE37	SNR. 7059	58	956	10:59
2 m Kevlar				
Stålkule 37	SNR.	57	957	
2 m Kjetting galv				
20 m Kevlar				
20 m Kevlar				
50 m Kevlar				
100 m Kevlar				
SBE37	SNR.7060	248	766	10:50
3 Glasskuler				
2 m Kjetting galv.				
RCM9	SNR.1326	251	763	10:50
0,5 m Kjetting galv				
500 m Kevlar				
100 m Kevlar				
50 m Kevlar				
40 m Kevlar				
50 m Kevlar				
10 m Kevlar				
SBE37	SNR.3995	1001	13	10:30
4 Glasskuler				
2 m Kjetting galv.				
RCM8	SNR. 12322	1004	10	10:30
0,5 m Kjetting rustfri				
Svivel				
AR861	SNR. 743 Ping på: Ping av: Release: Release m/ping:			
5 m Kevlar				
2 m Kjetting galvanisert				
ANKER	1000/(900) kg	1014	0	

Figure 5. Recovered mooring F14-13.

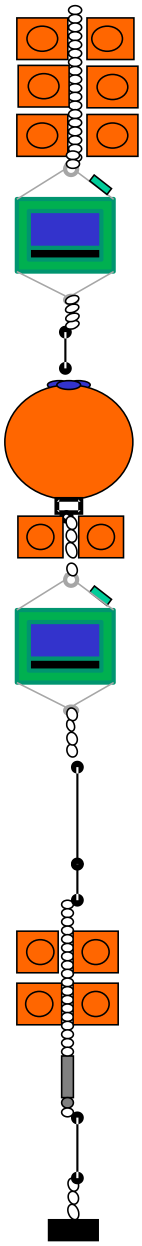
Rigg F14-13 78 48.841N
Satt ut 5 SEP 2011, kl 18:50 006 30,360W



			Dyp:	Fra bunn:	Ned i vann:
IPS	SNR. 51064		51	219	18:50
2 M Kevlar					
8 Glasskuler 3 m Kjetting galv.					
RCM 9	SNR: 1325		57	213	18:49
SBE37	SNR. 7058		59	211	18:49
10 m Kevlar					
200 m Kevlar					
SBE37	SNR.7057		257	13	18:26
4 Glasskuler					
2 m Kjetting Galv.					
RCM 7	SNR. 9464		260	10	18:25
Svivel					
AR861	SNR. 568	Ping på: Ping av: Release: Release m/ping:			
5 m Kevlar					
2 m Kjetting					
ANKER 770/(620) kg			270	0	

Figure 6. Recovered mooring F17-8.

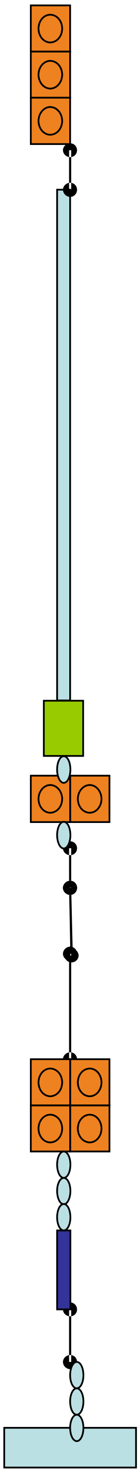
Rigg F17-8 78 50.507N
Satt ut 1 SEP 2011, kl 12:33 008 08.571W



			Dyp:	Fra bunn:	Ut:
6 Glasskuler Gule 2 m Kjetting galv.			57	172	12:32
SBE16	SNR. 6693		59	170	12:32
Vannhenter					
0,5 m Kjetting galv					
50 m Kevlar					
ADCP	SNR.7636		110	119	12:20
1 m Kjetting rustfri 2 Glasskuler Gule					
SBE16	SNR.6694		113	116	12:20
Vannhenter					
0,5 m Kjetting galv.					
100 m Kevlar					
5 m Kevlar					
2 m Kjetting galv.					
4 Glasskuler oransje			219	10	12:05
AR661	SNR. 501	Ping on: Release: Arm:			
5 m Kevlar.					
2 m Kjetting galv.					
ANKER	700/(560)kg		229	0	

Figure 7. Recovered mooring F18-7.

Rigg F18-7 78 48.202N Dyp: Fra bunn: Ut:
Satt ut 1 SEP 2011, kl 10:50 008 04.097W



52 163

3 Glasskuler
5 m Kevlar

57 158

DL7 Snr. 1632 107 108 10:35

2 Glasskuler
1 m Kjetting galv.

5 m Kevlar

40 m Kevlar

50 m Kevlar

4 Glasskuler

3 m Kjetting galv.

AR861 Snr. 553 Arm/range 9
Release
Ping on

5 m Kevlar
2 m Kjetting

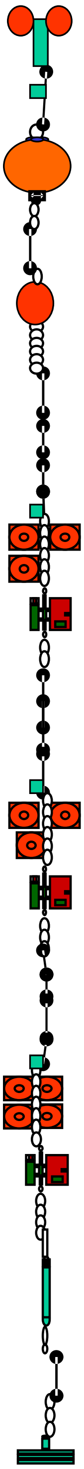
Anker 690/(560) Kg 215 0

Figure 8:Deployed mooring F11-14.

Rigg F11-14

Satt ut 7 SEP 2012 kl 13:54 78 48,06N 003 04,76W

Tatt opp AUG 20 kl



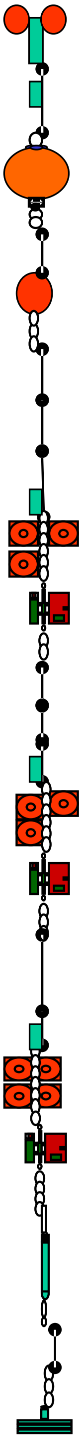
		Dyp:	Fra bunn:	Ut:
IPS	SNR. 51062	54	2416	13:30
SBE37	SNR. 3490	55	2415	13:30
5 m Kevlar				
ADCP300	SNR: 17461	60	2410	13:30
0,5 m Kjetting galvanisert				
10 m Kevlar				
Stålkule 37 (snr 596) McLane 7		74	2396	
0,5 m Kjetting galvanisert				
20 + 5 m Kevlar				
40 m Kevlar				
100 m Kevlar				
10 m Kevlar				
50 m Kevlar				
SBE37	SNR. 4702	299	2171	13:13
3 Glasskuler				
2 m Kjetting galvanisert				
RCM9	SNR.1324	303	2167	13:13
0,5 m Kjetting galv				
200 m Kevlar				
500 m Kevlar				
500 m Kevlar				
40 m Kevlar				
10 m Kevlar				
SBE37	SNR. 3552	1553	917	12:50
3 Glasskuler				
2 m Kjetting galvanisert				
RCM11	SNR.494	1556	914	12:50
0,5 m Kjetting galv				
500 m Kevlar				
100 m Kevlar				
100 + 100m Kevlar				
40 + 50 +10 m Kevlar				
SBE37	SNR. 8821	2456	14	12:32
4 Glasskuler				
2 m Kjetting galvanisert				
RCM8	SNR.10071	2459	11	12:32
0,5 m Kjetting rustfri				
Svivel				
AR861	SNR. 287	Pinger på: Pinger av: Release: Release m/ping:		
5 m Kevlar				
2 m Kjetting galvanisert				
ANKER 1200/(960) kg		2470	0	

Figure 9. Deployed mooring F12-14.

Rigg F12-14 78 47,93N

Settes ut 3 SEP 2012 kl 14:22 004 00,888W

Tatt opp AUG 20 kl



			Dyp:	Fra bunn:	Ut:
IPS	SNR. 51063		54	1779	14:18
SBE37	SNR.3489		56	1777	14:18
5 m Kevlar					
ADCP300	SNR: 17462		60	1773	14:18
0,5m Kjetting galvanisert					
10 m Kevlar					
Stålkule 37			72	1761	
0,5m Kjetting galvanisert					
20 m Kevlar					
20 m Kevlar					
200 m Kevlar					
SBE37	SNR.4837		313	1520	13:58
3 Glasskuler					
2 m Kjetting galvanisert					
SEAGUARD	SNR. 884		316	1517	13:58
0,5 m Kjetting galv					
500 m Kevlar					
500 m Kevlar					
200 m Kevlar					
SBE37	SNR.3554		1516	317	12:43
3 Glasskuler					
2 m Kjetting galvanisert					
RCM11	SNR.235		1519	314	12:43
0,5 m Kjetting galv					
200 m Kevlar					
100 m Kevlar					
SBE37	SNR. 8822		1819	14	12:30
4 Glasskuler					
2 m Kjetting galvanisert					
RCM11	SNR.228		1822	11	12:30
0,5 m Kjetting rustfri					
Svivel					
AR861	SNR. 182	Pinger på: Pinger av: Release Release m/ping:			
5 m Kevlar					
2 m Kjetting galvanisert					
ANKER 1200/(960) kg			1833	0	

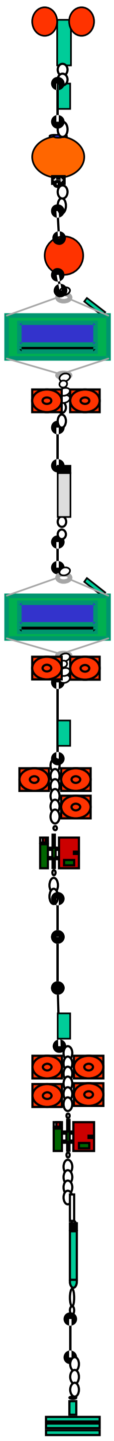
Figure 10. Deployed mooring F13-14

Rigg F13-14

78 47.972N

Settes ut 2 SEP 2012, kl 12:10 004 59.2W

Tatt opp AUG 201 kl :00

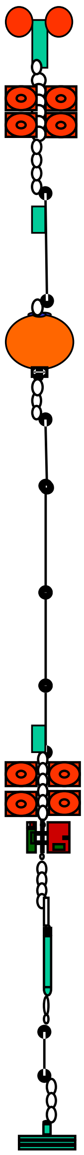


			Dyp:	Fra bunn:	Ned i vann:
IPS4	SNR. 1047		47	967	11:47
SBE37	SNR: 7056		49	965	11:47
5 m Kevlar					
ADCP300	SNR: 16831		53	961	11:47
0,5 m Kjetting galv					
10 m Kevlar					
Stålkule 37			64	950	
2 m Kevlar					
SBE16	SNR. 6693		67	947	11:38
Vannhenter					
1,5 m Kjetting galv.					
2 Glasskuler					
5 m Kevlar					
Hvallydopptaker			75	939	11:30
0,5 m Kjetting galv.					
50 + 20 m Kevlar					
SBE16	SNR. 6694		146	868	11:23
Vannhenter					
1 m Kjetting galv.					
2 Glasskuler					
100 m Kevlar					
SBE37	SNR.3993		247	767	11:18
3 Glasskuler					
2 m Kjetting galv.					
RCM9	SNR.1327		250	764	11:18
0,5 m Kjetting galv					
500 m Kevlar					
200 m Kevlar					
50 m Kevlar					
SBE37	SNR.3551		1000	14	10:59
4 Glasskuler					
2 m Kjetting galv.					
RCM11	SNR. 561		1003	11	10:59
0,5 m Kjetting rustfri					
Svivel					
AR861	SNR. 053	Ping på:			
		Ping av:			
		Release:			
5 m Kevlar		Release m/ping:			
2 m Kjetting galvanisert					
ANKER 1100/(880) kg			1014	0	

Figure 11. Deployed mooring F14-4.

Rigg F14-14
Satt ut 1 SEP 2012 , kl 11:00

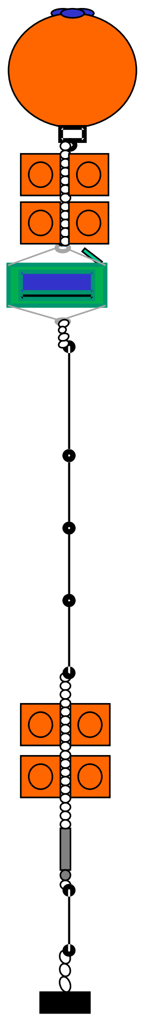
78 48.0N
006 30,4W



			Dyp:	Fra bunn:	Ned i vann:
IPS	SNR. 51064		48	222	10:57
4 Glasskuler 2 m Kjetting galv.					
SBE37	SNR: 3492		52	218	10:57
5 m Kevlar					
ADCP 300	SNR: 16876		56	214	10:49
1 m Kjetting Galv.					
40 m Kevlar					
100 m Kevlar					
50 m Kevlar					
10 m Kevlar					
SBE37	SNR.3992		256	14	10:40
4 Glasskuler 2 m Kjetting Galv.					
RCM9	SNR. 1046		259	11	10:40
Svivel					
AR861	SNR. 409	Arm: Range: Ping on:			
5 m Kevlar					
2 m Kjetting					
ANKER	900/(720) kg		270	0	

Figure 12. Deployed mooring F17-9.

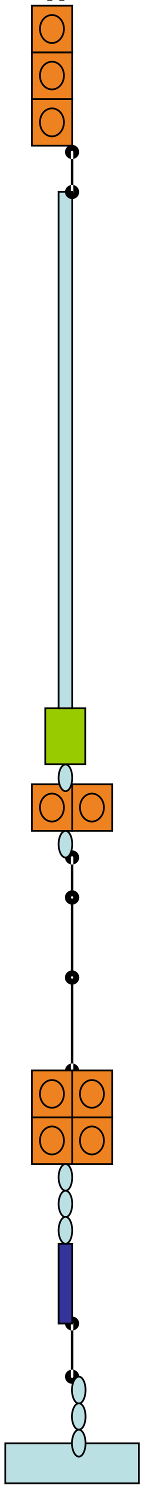
Rigg F17-9 78 50.54 N
Satt ut 31 AUG 2012 , kl 11:35 008 08.49W



			Dyp:	Fra bunn:	Ut:
ADCP	SNR.7636		109	120	11:31
2 m Kjetting galv.					
4 Glasskuler					
SBE37	SNR.7062		113	116	11:31
Vannhenter			113	116	11:31
50 m Kevlar					
40 m Kevlar					
10 m Kevlar					
5 m Kevlar					
2 m Kjetting galv.					
4 GLASSKULER			219	10	
AR661	SNR. 110	Ping on: Release:			
5 m Kevlar.					
2 m Kjetting galv.					
ANKER	780/(620)kg		229	0	

Figure 13. Deployed mooring F18-8.

Rigg F18-8 78 48.25N
Satt ut 31 AUG 2012, kl 12:53 008 04.77W
Tatt opp AUG kl



			Dyp:	Fra bunn:	Ut:
			52	163	
3 Glasskuler					
5 m Kevlar					
			57	158	
DL7	Snr. 1649		107	108	12:50
2 Glasskuler					
1 m Kjetting galv.					
50 m Kevlar					
40 m Kevlar					
5 m Kevlar					
4 Glasskuler					
2 m Kjetting galv.					
AR861	Snr. 291	Range Release		9	
5 m Kevlar					
2 m Kjetting					
Anker	650/(520) Kg		215	0	

CTD Measurements

The CTD used as an SBE911+ unit. Bottles were closed using the bottle fire command within the sea-bird acquisition software so that a .bl file was created for each deployment when bottles were fired.

NMEA time and position information was fed to the acquisition computer and added to each scan line of the data files. Cast starting times were automatically added to the header of all data files.

CTD Package Configuration

- Primary temperature sensor serial number 5299 was used for the entire cruise
- Secondary temperature sensor serial number 5258 was used for the entire cruise

- Primary conductivity sensor serial number 3742 was used for the entire cruise
- Secondary conductivity sensor serial number 3525 was used for the entire cruise

- Digiquartz pressure sensor serial number 117519 was used for the entire cruise

- CDOM flourometer serial number 1547 was used for the entire cruise

Station Locations

Table 4 lists the time, date and position of each CTD station along with the water depth at the station determined from the ships echo sounder. Figures 14 & 15 show the location of CTD stations.

CTD stations were organized along 5 sections.

1. An east-west section along the Fram Strait mooring array line at 78º 50 N

2. An Southeast-Northwest section across the Norske Trough on the east Greenland continental shelf close to 79 N

3. A section along Dijmphna Sund close to 79 N

4. A section across the mouth of Dijmphna Sund at the sill.

5. A section in front of Nioghalvfjerdsbreen at the head of Dijmphna Sund

Table 4.CTD stations occupied during the cruise.

STN	LATITUDE	LONGITUDE	DEPTH	SAMPLES COLLECTED
1	N 78.66	W 003.19	2296	Salinity δ18O Nutrients CDOM At & DIC
2	N 78.75	W 002.51	2649	Salinity δ18O Nutrients At & DIC
3	N 78.75	W 002.01	2729	Salinity δ18O Nutrients CDOM At & DIC
4	N 78.73	W 002.02	607	Salinity δ18O Nutrients CDOM At & DIC
5	N 78.77	W 003.97	1873	Salinity δ18O Nutrients CDOM At & DIC
6	N 78.75	W 003.50	2169	Salinity δ18O Nutrients
7	N 78.83	W 004.48	1253	None
8	N 78.82	W 004.42	1538	Salinity δ18O Nutrients CDOM At & DIC
9	N 78.85	W 005.04	1019	Salinity δ18O Nutrients CDOM At & DIC
10	N 78.91	W 005.51	768	Salinity δ18O Nutrients
11	N 78.90	W 005.98	373	Salinity δ18O Nutrients CDOM At & DIC
12	N 78.81	W 006.55	271	Salinity δ18O Nutrients
13	N 78.83	W 007.03	249	Salinity δ18O Nutrients CDOM At & DIC
14	N 78.85	W 007.91	193	Salinity δ18O Nutrients CDOM At & DIC
15	N 78.80	W 008.10	219	Salinity
16	N 78.76	W 009.16	188	Salinity δ18O Nutrients CDOM At & DIC
17	N 78.93	W 010.05	238	Salinity δ18O Nutrients CDOM At & DIC
18	N 78.92	W 011.01	255	Salinity δ18O Nutrients CDOM At & DIC
19	N 78.91	W 012.02	311	Salinity δ18O Nutrients CDOM At & DIC
20	N 79.92	W 014.01	72	Salinity δ18O Nutrients CDOM
21	N 80.00	W 015.00	172	δ18O At & DIC
22	N 80.00	W 015.36	235	Salinity δ18O Nutrients CDOM At & DIC
23	N 80.06	W 015.48	297	Salinity δ18O Nutrients
24	N 80.11	W 015.70	424	Salinity δ18O Nutrients CDOM At & DIC
25	N 80.13	W 015.91	207	Salinity δ18O Nutrients At & DIC
26	N 80.16	W 016.18	182	None
27	N 80.16	W 016.18	339	Salinity δ18O Nutrients CDOM At & DIC
28	N 80.17	W 016.38	142	Salinity δ18O Nutrients CDOM At & DIC
29	N 79.81	W 020.22	528	Salinity δ18O Nutrients CDOM At & DIC
30	N 79.80	W 020.09	204	Salinity δ18O Nutrients CDOM At & DIC
31	N 79.82	W 020.31	317	Salinity δ18O Nutrients CDOM At & DIC
32	N 79.89	W 020.00	311	Salinity δ18O Nutrients CDOM At & DIC
33	N 79.96	W 019.76	383	Salinity δ18O Nutrients CDOM At & DIC
34	N 80.00	W 019.54	522	Salinity δ18O Nutrients CDOM At & DIC
35	N 80.05	W 019.12	456	Salinity δ18O Nutrients CDOM At & DIC
36	N 80.08	W 018.67	221	Salinity δ18O Nutrients CDOM At & DIC
37	N 80.10	W 018.19	192	Salinity δ18O Nutrients CDOM At & DIC
38	N 80.13	W 017.70	204	Salinity δ18O Nutrients CDOM At & DIC
39	N 80.13	W 017.39	146	Salinity δ18O Nutrients CDOM At & DIC
40	N 80.16	W 017.33	169	Salinity δ18O Nutrients CDOM At & DIC
41	N 80.14	W 017.35	168	None
42	N 80.10	W 017.40	95	Salinity δ18O Nutrients CDOM At & DIC
43	N 80.11	W 017.39	119	None
44	N 80.14	W 016.84	227	None
45	N 78.83	W 015.00	77	Salinity δ18O Nutrients CDOM At & DIC
46	N 78.83	W 016.01	215	Salinity δ18O Nutrients CDOM At & DIC
47	N 78.83	W 016.51	334	None
48	N 78.83	W 017.01	390	Salinity δ18O Nutrients CDOM At & DIC

49	N 78.83	W 017.51	578	Salinity δ18O Nutrients CDOM At & DIC
50	N 78.80	W 008.06	222	None
51	N 78.82	W 006.49	278	None
52	N 78.83	W 005.00	1010	Salinity
53	N 78.79	W 004.03	1816	Salinity δ18O Nutrients At & DIC
54	N 78.92	E 010.00	74	Salinity δ18O Nutrients CDOM At & DIC
55	N 78.92	E 009.50	200	None
56	N 78.80	W 003.08	2501	Salinity δ18O Nutrients At & DIC
57	N 78.92	W 000.99	2660	Salinity δ18O Nutrients CDOM At & DIC
58	N 78.92	E 000.01	2526	Salinity δ18O Nutrients CDOM At & DIC
59	N 78.83	W 002.51	2613	Salinity δ18O Nutrients
60	N 78.88	W 002.00	2674	Salinity δ18O Nutrients At & DIC
61	N 78.92	E 001.00	2540	Salinity δ18O Nutrients At & DIC
62	N 78.92	E 002.00	2521	Salinity δ18O Nutrients CDOM At & DIC
63	N 78.92	E 003.00	2360	Salinity δ18O Nutrients
64	N 78.92	E 004.00	2540	Salinity δ18O Nutrients CDOM At & DIC
65	N 78.91	E 005.00	2622	Salinity δ18O Nutrients
66	N 78.92	E 006.01	2326	Salinity δ18O Nutrients CDOM At & DIC
67	N 78.92	E 006.51	1763	None
68	N 78.92	E 007.00	1328	Salinity δ18O Nutrients CDOM At & DIC
69	N 78.92	E 007.50	1184	None
70	N 78.92	E 008.01	1043	Salinity δ18O Nutrients CDOM At & DIC
71	N 78.92	E 008.50	448	None
72	N 78.92	E 009.00	212	Salinity δ18O Nutrients CDOM At & DIC

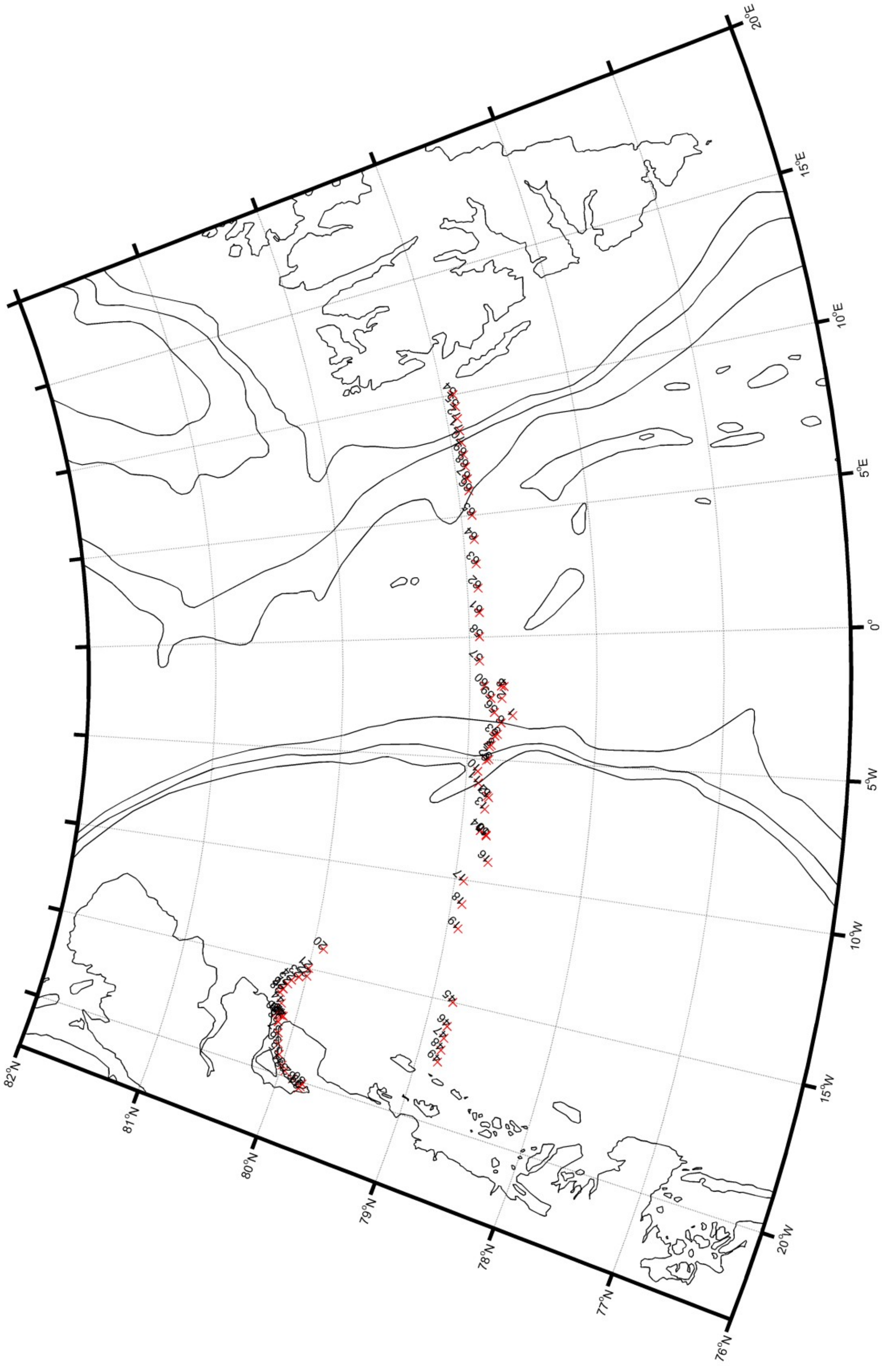


Figure 14: Map of CTD stations. Bathymetric contours drawn at 500, 1000 and 2000 m.

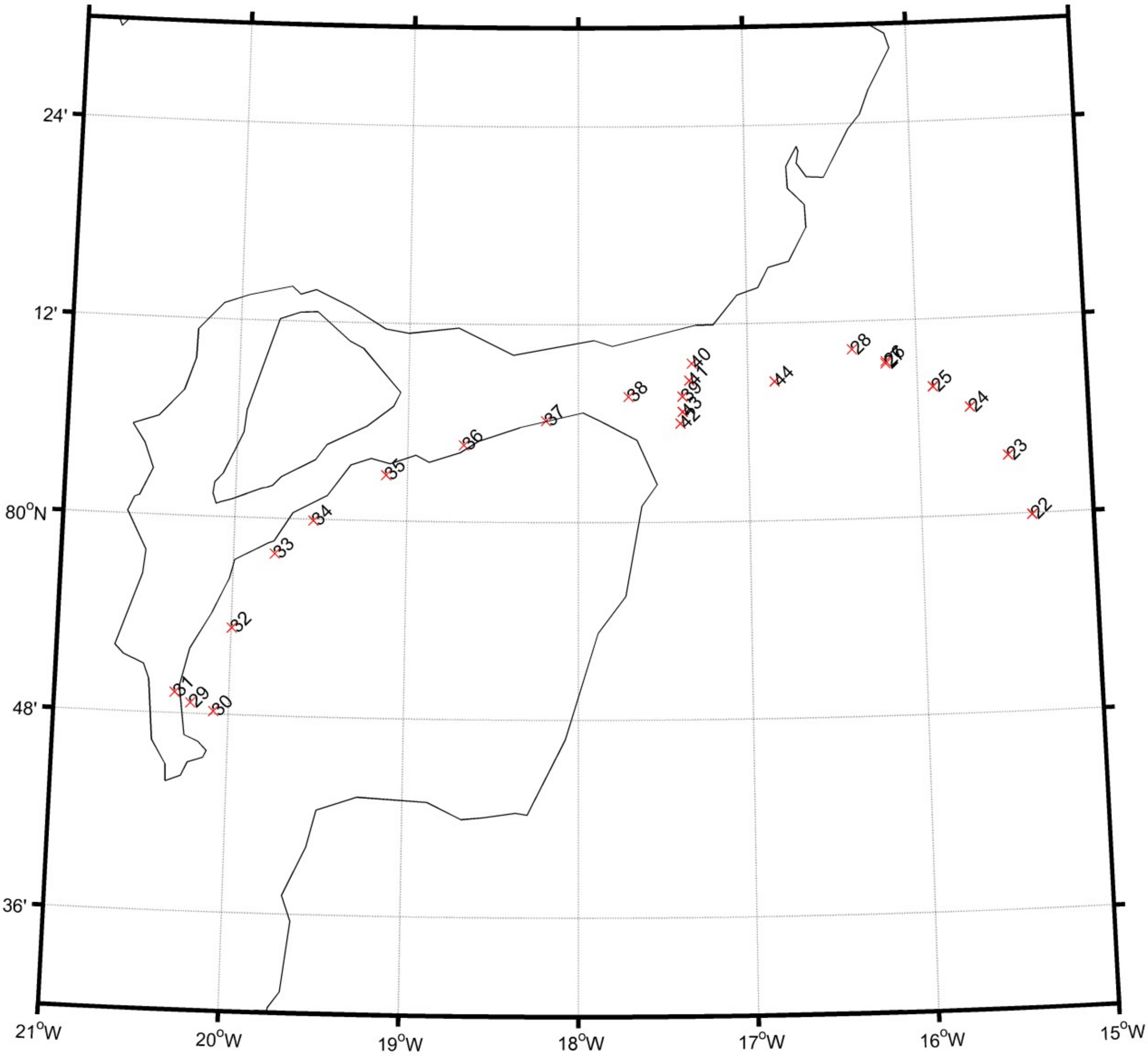


Figure 16: Larger scale map of CTD stations occupied in and close to Dijmphna Sund.

Section plots

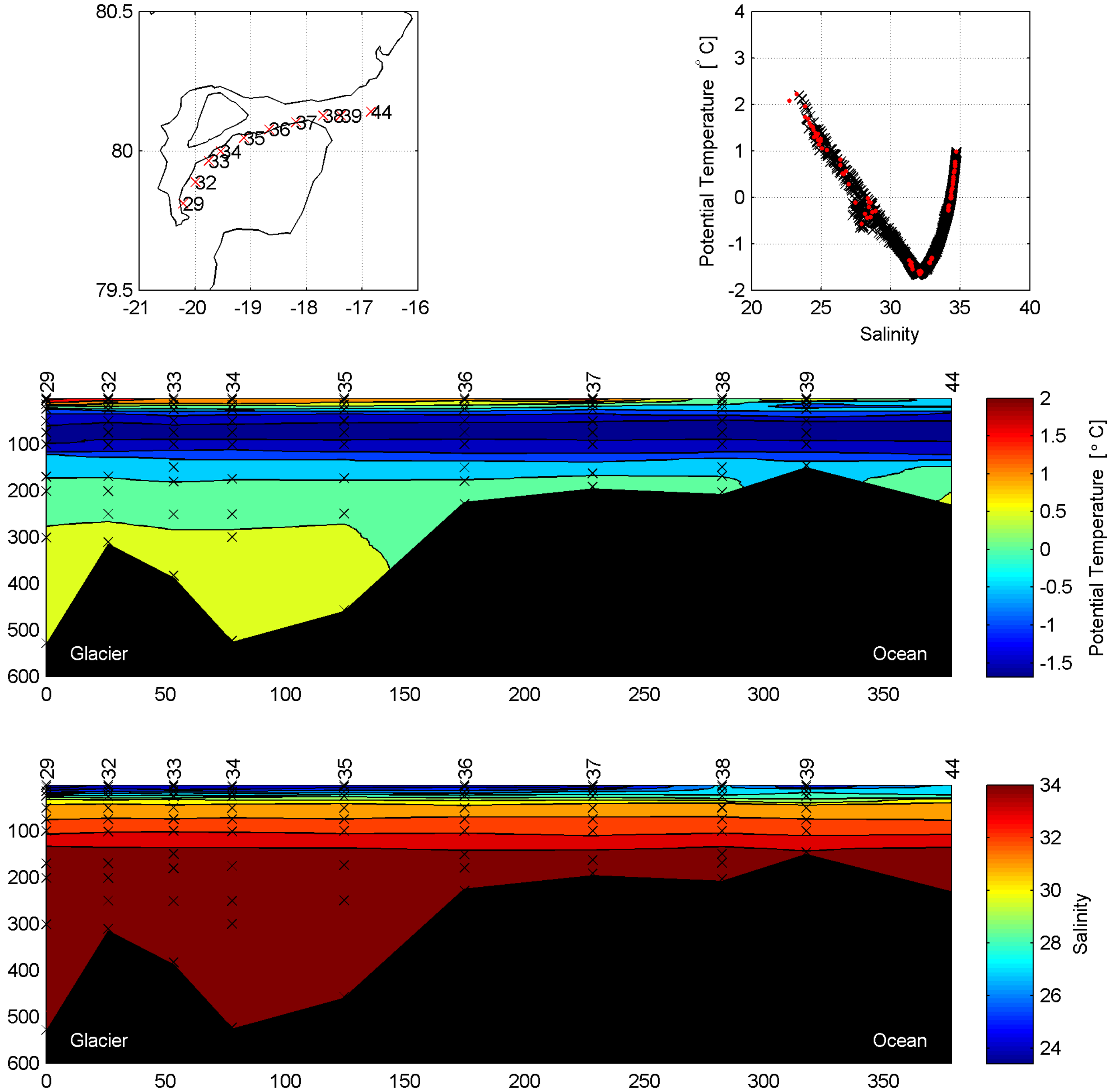


Figure 17: CTD section along Dijmphna Sund. Numbers above the potential temperature and salinity sections indicate station numbers shown on the map (upper left panel). Crosses on the sections indicate the location of water samples. Water samples are also shown as red points in the potential temperature salinity plot (upper right pane). The x-axis shows distance in kilometres.

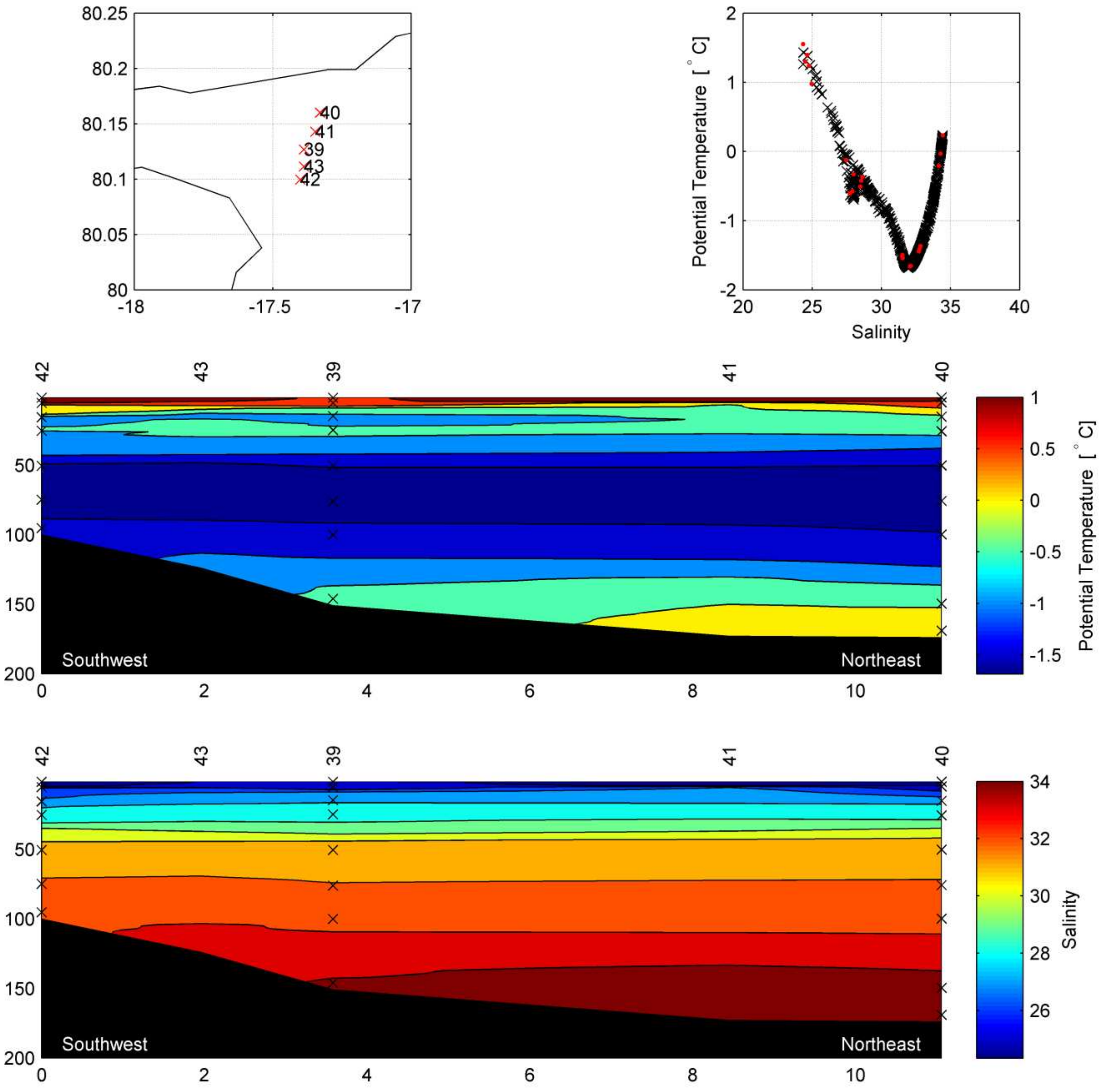


Figure 18: CTD section across the mouth of Dijmphna Sund. Numbers above the potential temperature and salinity sections indicate station numbers shown on the map (upper left panel). Crosses on the sections indicate the location of water samples. Water samples are also shown as red points in the potential temperature salinity plot (upper right pane). The x-axis shows distance in kilometres.

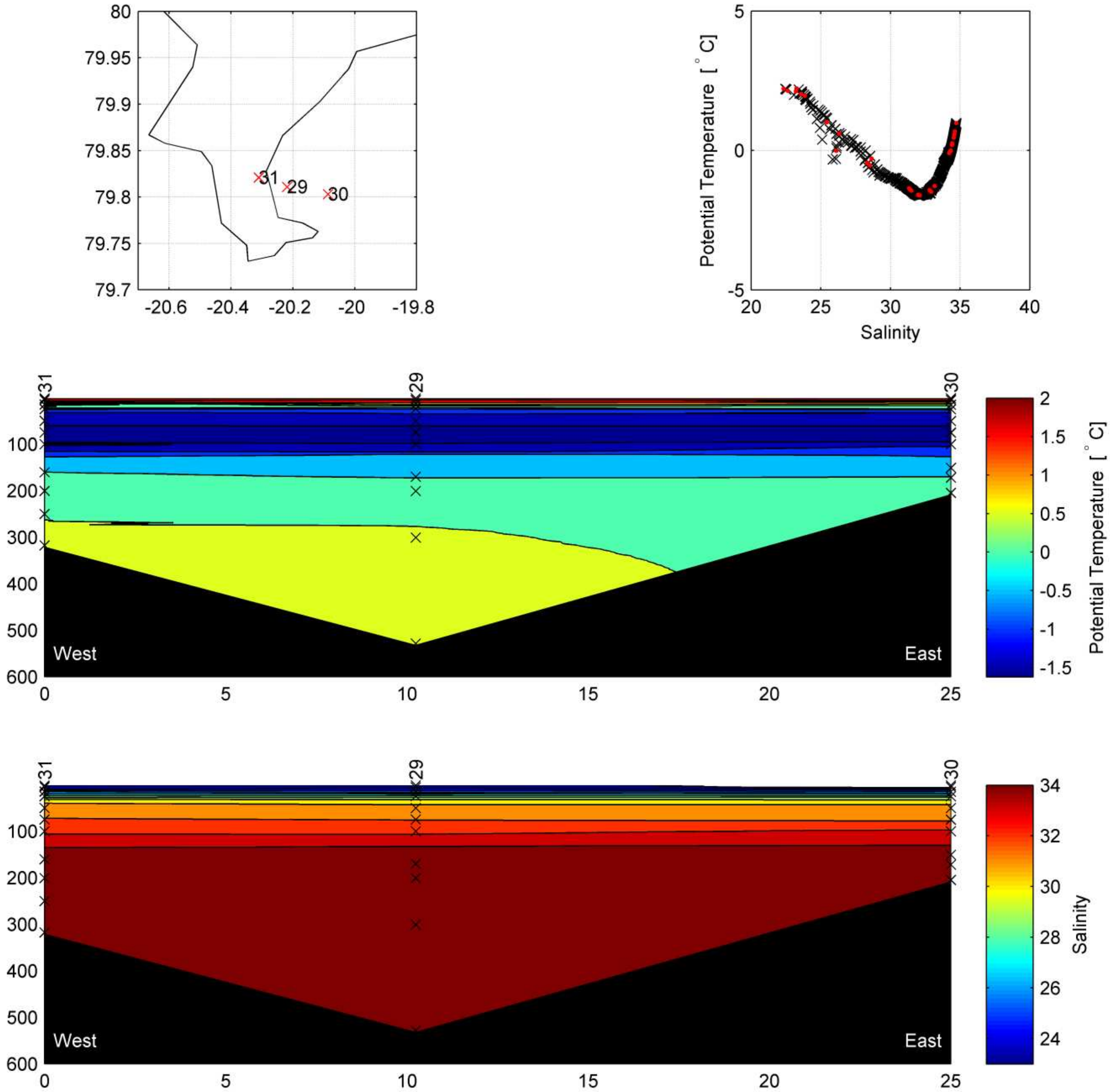


Figure 19: CTD section across Nioghalvfjerdsbreen at the head of Dijmphna Sund. Numbers above the potential temperature and salinity sections indicate station numbers shown on the map (upper left panel). Crosses on the sections indicate the location of water samples. Water samples are also shown as red points in the potential temperature salinity plot (upper right pane). The x-axis shows distance in kilometres.

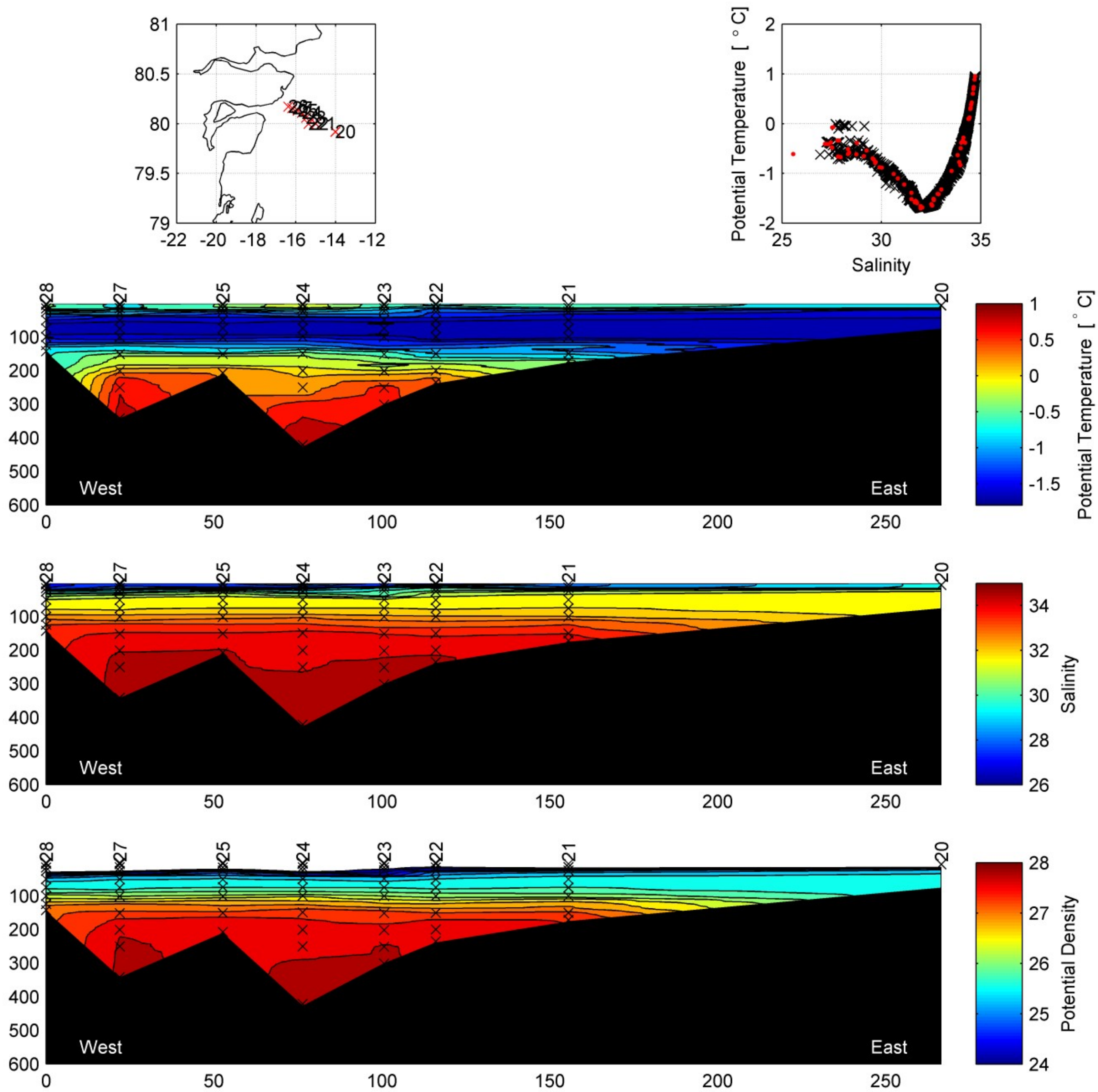


Figure 20: CTD section across the Norske Trough on the east Greenland continental shelf. Numbers above the potential temperature and salinity sections indicate station numbers shown on the map (upper left panel). Crosses on the sections indicate the location of water samples. Water samples are also shown as red points in the potential temperature salinity plot (upper right pane). The x-axis shows distance in kilometres.

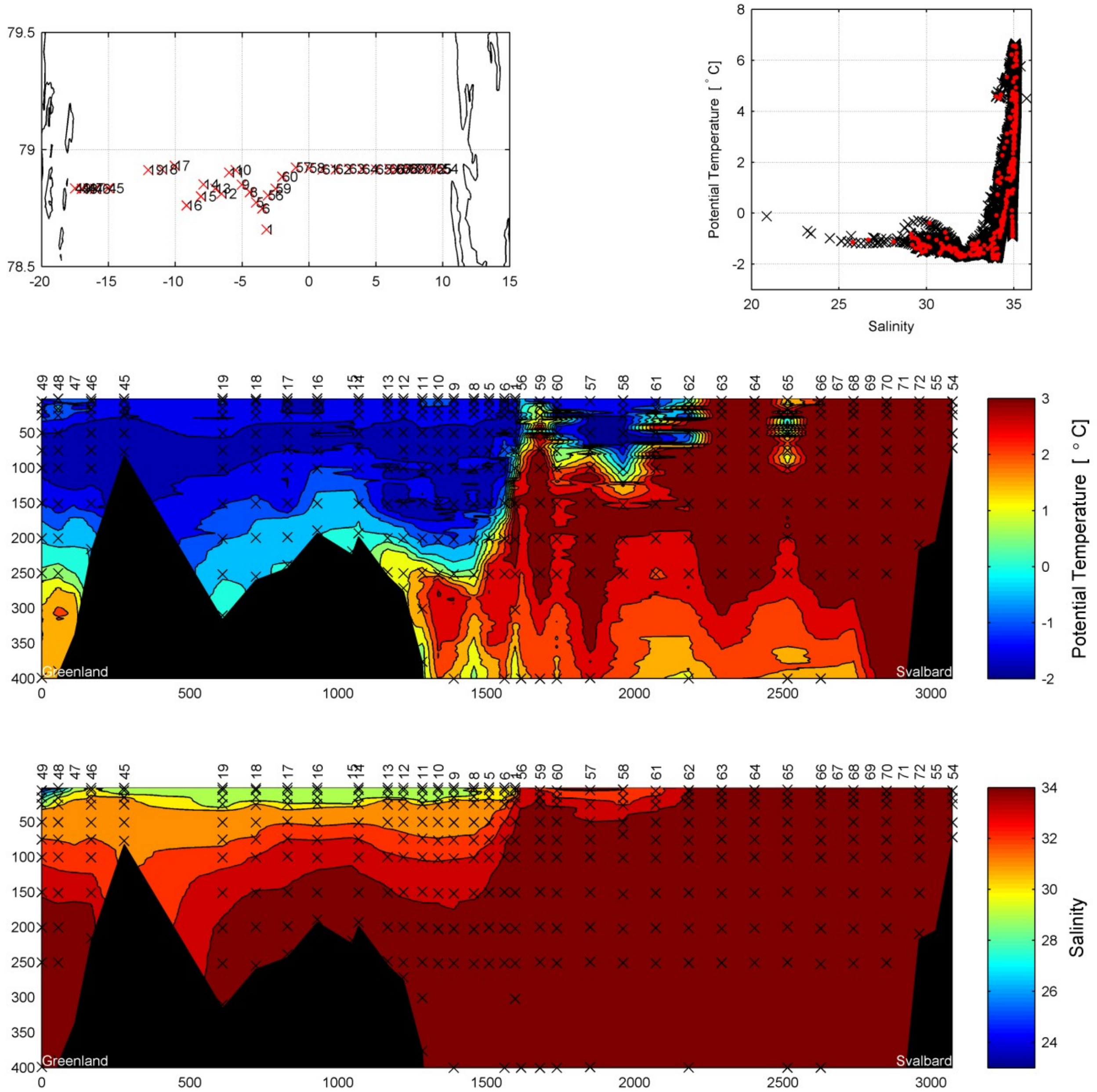


Figure 21: CTD section across the Fram Strait . Numbers above the potential temperature and salinity sections indicate station numbers shown on the map (upper left panel). Crosses on the sections indicate the location of water samples. Water samples are also shown as red points in the potential temperature salinity plot (upper right pane). The x-axis shows distance in kilometres.

Sensor Calibration

Water samples for laboratory salinity measurement were collected at most CTD stations. Where tracer samples were collected, salinity samples were collected at standard depths of 5, 15, 25, 50, 75, 100, 150, 200 and 300 dbar, plus two samples from the bottom of the water column. Where tracer samples were not collected, samples for salinity measurement were collected from deep parts of the water column where the salinity gradient was shallow. Deep regions provide the best data for conductivity sensor calibration as the water trapped in the Niskin bottles is the most similar to that sampled by the CTD.

Salinity samples were analysed abroad Lance using a Guildline Portasal portable salinometer which was standardised after every 24 measurements using IAPSO standard seawater. Comparison of laboratory salinity measurements and CTD-salinity measurements revealed an offset of around 0.000 – 0.002 practical salinity units (figure 22). The difference between CTD and Laboratory salinity measurements decreased slightly during the cruise, but the small offset is of the same order of magnitude as the accuracy of the laboratory salinometer. No provisional calibration offset will be applied to that CTD data. A final calibration will be performed when post-deployment calibration data are available for the sensors used during the cruise.

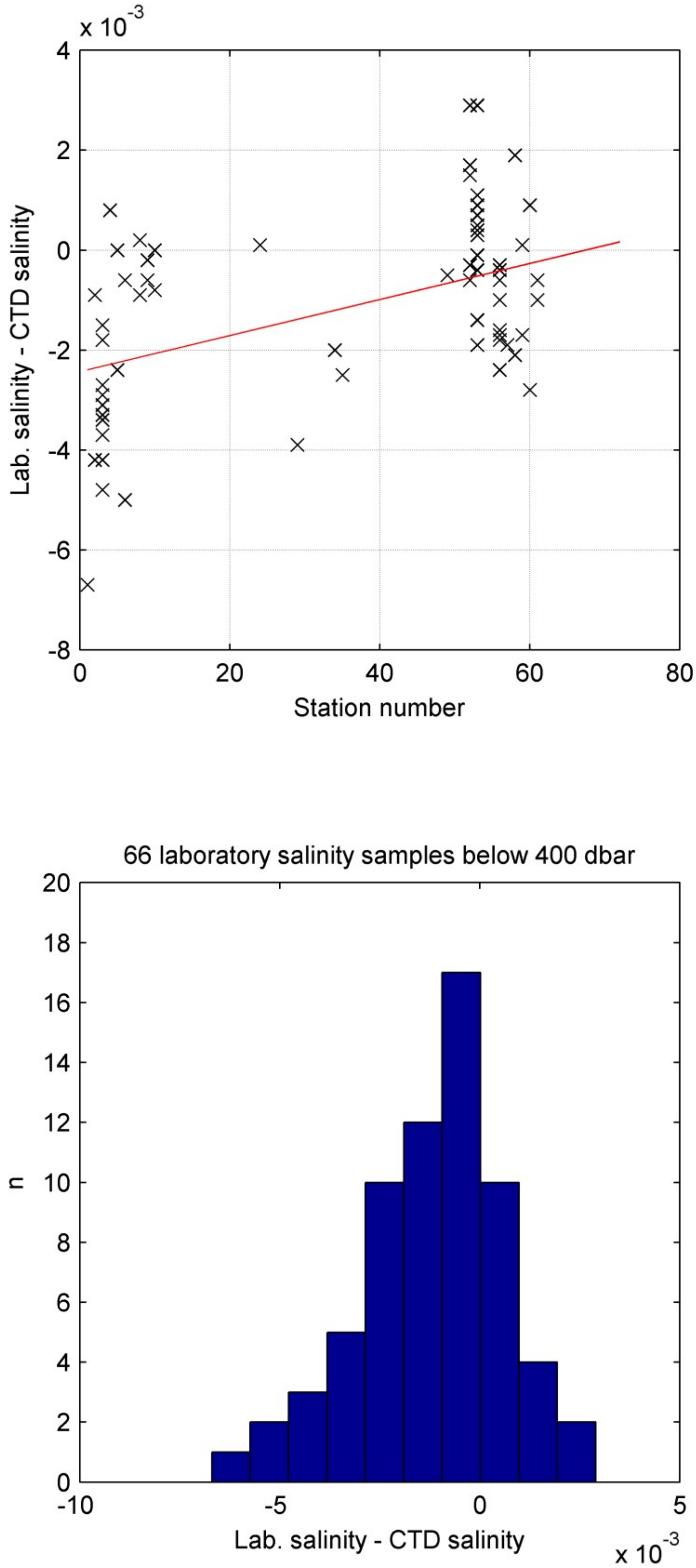


Figure 22: Laboratory and CTD derived salinity measurements.

Lowered ADCP Measurements

An RDI workhorse ADCP was deployed from the CTD rosette in a downward looking position at all CTD stations.

The ADCP was deployed with the following script.

```
$P
*****************************************************************************
$P *******  LADCP Deployment with one ADCP.  Usually looking down **********
$P
*****************************************************************************
; Set to factory defaults:
CR1
; Record data internally:
CF11111
; Name data file (changed on each station):
RN L001_
; Heading alignment set to 0 degrees:
EA0
; Heading bias:
EB-0360
; Set transducer depth to zero:
ED0
; Set salinity to 35ppt:
ES35
; Set system coordinate:
EX11111
; Set to use a fixed speed of the sound:
EZ1111111
; Set LADCP to output Velocity, Correlations, Amplitude, and Percent Good:
LD111100000
; Set blank to 176 cm (default value) (Use WF if LADCP option is not enabled):
LF0176
; Set to record 20 bins (Use WN if LADCP option is not enabled):
LN020
; Set one ping per ensemble (Use WP if LADCP option is not enabled):
LP1
; Set bin size to 400 cm. (Use WS if LADCP option is not enabled).
LS400
; Set max radial (along the axis of the beam) water velocity to 176 cm/sec
; (Use WV if LADCP option is not enabled):
LV175
; Set ADCP to narrow bandwidth and extend range by 10%:
LW1
; Set one ensemble/sec
TE00:00:01.00
; Set one second between pings
TP00:01.00
```

```
; Save set up:
CK
; Start pinging
CS
;
;Instrument         = Workhorse Sentinel
;Frequency          = 307200
;Water Profile      = YES
;Bottom Track       = NO
;High Res. Modes    = NO
;High Rate Pinging  = NO
;Shallow Bottom Mode= NO
;Wave Gauge         = NO
;Lowered ADCP       = YES
;Beam angle         = 20
;Temperature        = 5.00
;Deployment hours   = 6.00
;Battery packs      = 1
;Automatic TP       = YES
;Memory size [MB]   = 16
;Saved Screen       = 1
;
;Consequences generated by PlanADCP version 2.02:
;First cell range   = 6.13 m
;Last cell range    = 82.13 m
;Max range          = 113.20 m
;Standard deviation = 2.96 cm/s
;Ensemble size      = 548 bytes
;Storage required   = 15.05 MB (15782400 bytes)
;Power usage        = 12.63 Wh
;Battery usage      < 0.1
;
; WARNINGS AND CAUTIONS:
; Lowered ADCP feature has to be installed in Workhorse to use selected option.
; Advanced settings has been changed.
```

Lowered ADCP clock synchronisation

Repeatedly synchronising the LADCP clock with the GPS time leads to sudden jumps in the LADCP clock drift. During fs212 we tracked the clock drift relative to GPS time so that it can be corrected later by applying a correction. Table 5 lists LADCP clock checks were made during fs 2012:

GPS time (UTC)	Lowered ADCP (UTC)
12/08/29 24:00:00	12/08/29,23:59:30
12/09/09 14:27:00	12/09/09,14:26:25
12/09/10 23:07:00	12/09/10,23:06:24
12/09/11 10:56:00	12/09/11,10:55:24

Table 5: LADCP clock synchronisation information.

Lowered ADCP problems

The LADCP reports an error about the active flux gate compass calibration matrix on start-up. This error occurred last year and has not been corrected. The LADCP may be collecting bad data due to the error and should be repaired.

The LADCP was often unable to transmit data files to the host PC after deployment. When this problem occurred, files could usually be recovered by requesting the data from the previous deployment – the LADCP would then actually transmit the file from the desired deployment. However, data from stations 013 and 027 could not be recovered in this way and this data has been lost. There seems to be some kind of corruption in the LADCPs internal software or memory. It should be repaired to avoid losing more data.

Tracer Samples

Tracer samples were collected at standard pressures of 5, 15, 25, 50, 75, 100, 150, 200, 250, 400 dbar and at the bottom of the cast. At stations in the ice, where the surface layer was not mixed an additional surface sample was collected from the very surface using a Niskin bottle deployed by hand (on a rope) and closed with a brass messenger.

Samples for laboratory salinity analysis

Samples for laboratory salinity analysis were collected from all Niskin bottles. When the surface of the water column is strongly stratified, the salinity of water trapped in Niskin bottles can be significantly different from that measured by the conductivity sensor at the bottom of the CTD package, which is approximately 1 meter deeper then the top of the Niskin bottles. Independent laboratory salinity measurements give salinity measurements which correspond exactly to the other tracer measurements made from Niskin bottles. Laboratory measurements were made with a Guildline Portasal 8400b salinometer, which was standardized every 24 samples using P-series seawater supplied by OSIL.

Samples for oxygen isotope ratio analysis and dissolved nutrient analysis

Samples for $\delta^{18}O$ isotope ratio analysis and dissolved nutrient analysis were collected at the locations listed in appendecies 1 and 2. Note that samples for $\delta^{18}O$ and dissolved nutrient were always collected concurrently.

Coloured dissolved organic matter sample

Samples for CDOM analysis were collected at the locations listed in appendix 3. Samples for $\delta^{18}O$ isotope ratio analysis and dissolved nutrient analysis were always collected when CDOM samples were collected.

Total Alkalinity and Dissolved Inorganic Carbon samples

Samples total alkalinity and dissolved inorganic carbon analysis were collected at the locations listed in appendix 4. Samples for $\delta^{18}O$ isotope ratio analysis and dissolved nutrient analysis were always collected when Total Alkalinity and Dissolved Inorganic Carbon samples samples were collected.

Niskin bottle problems

The rubber bands which hold the Niskin bottles closed had lost some of their elasticity when the cruise began. This is probably because they had been left in a stretched state for a long period of time before the cruise began.

During the first CTD stations it became apparent that the bands were not elastic enough to hold bottles closed tightly. Many Niskin bottles were found to leak during the first CTD stations. No spare rubber bands were carried on board, but the leaking was remedied by removing the bands from Niskin bottles and shortening them by adding knots. However, the shortened bands made it difficult to arm the water sample before deployment. Moreover, the shortened, over-stretched bands continued to lose elasticity and required futher shortening during the cruise. Time was often wasted tying extra knots in the bands after bottles were found to leak and a number of samples may have been affected (see individual CTD log sheets for details of leaking bottles). The rubber bands are not expensive or difficult to fit.

All the rubber bands should be replaced with new ones at the beginning of future cruises to ensure this problem does not reoccur.

A single Niskin bottle was deployed on a rope over the rail to collect a surface sample after each cast. This bottle was closed with a brass messenger. Half way through the cruise the plastic closing mechanism cracked and the bottle was repaired. On the next deployment it cracked again and could not be repaired. When Niskin bottles are used at the surface the messenger hits the release mechanism harder than when they are used at depth. In cold conditions the release mechanism becomes brittle and is easily damaged by impact of the messenger. Breakage can be avoided by using a bottle with a release mechanism made of a less brittle ‘waxy’ plastic rather than the brittle grey plastic material that the bottles themselves are made of. Bottles which are suitable for use in cold conditions should be explicitly specified in future.

Remote Access Water Samplers

Recovery

Two remote access water samplers were recovered from mooring F17 during the fs2012.

Serial number MLl12239-01 was deployed at 55 m depth. Seacat serial number 16p61772-6694 was attached to MLl12239-01. MLl12239-01's clock read 13:20:17 (UTC) at GPS (UTC) 13:57:00, a difference of 37 minutes and 43 seconds.

Serial number MLl12239-02 was deployed at 100 m depth. Seacat serial number 16p61772-6693 was attached to MLl12239-02. MLl12239-02's clock read 13:51:32 (UTC) at GPS (UTC) 14:30:00, a difference of 39 minutes and 28 seconds.

Samples for δ18O, dissolved nutrients and CDOM were collected from both samplers. Sample bags contained a significant volume of water after samples were collected. Bags were retained and labelled with the hope that the remaining water can be analysed for total alkalinity. All bags contained 5 ml of saturated HgCl2 solution before deployment.

MLl12239-01 and MLl12239-02 were programmed to perform a 10 ml acid flush before each sample collection, but both samplers contained a full bag of acid after deployment. The reason for this is not known. Air in the acid bag may have caused the bag to seal against the containing tube when it was compressed at depth, preventing the acid from being pushed out of the bag.

Table 6 summarises the samples collected from remote access water samplers during fs2012.

Table6 .RAS samples.

SAMPLER	BAG	WEIGHT	Δ18O	NUTRIENT	CDOM	AT (Bag)
ml12239-01	1	289	1001	1001	1001	1001
ml12239-01	2	350	1002	1002	1002	1002
ml12239-01	3	287	1003	1003	1003	1003
ml12239-01	4	310	1004	1004	1004	1004
ml12239-01	5	276	1005	1005	1005	1005
ml12239-01	6	310	1006	1006	1006	1006
ml12239-01	7	340	1007	1007	1007	1007
ml12239-01	8	340	1008	1008	1008	1008
ml12239-01	9	390	1009	1009	1009	1009
ml12239-01	10	330	1010	1010	1010	1010
ml12239-01	11	300	1011	1011	1011	1011
ml12239-01	12	310	1012	1012	1012	1012
ml12239-01	13	340	1013	1013	1013	1013
ml12239-01	14	340	1014	1014	1014	1014
ml12239-01	15	315	1015	1015	1015	1015
ml12239-01	16	320	1016	1016	1016	1016
ml12239-01	17	330	1017	1017	1017	1017
ml12239-01	18	320	1018	1018	1018	1018
ml12239-01	19	345	1019	1019	1019	1019

ml12239-01	20	300	1020	1020	1020	1020
ml12239-01	21	380	1021	1021	1021	1021
ml12239-01	22	320	1022	1022	1022	1022
ml12239-01	23	325	1023	1023	1023	1023
ml12239-01	24	355	1024	1024	1024	1024
ml12239-01	25	400	1025	1025	1025	1025
ml12239-01	26	305	1026	1026	1026	1026
ml12239-01	27	405	1027	1027	1027	1027
ml12239-01	28	320	1028	1028	1028	1028
ml12239-01	29	350	1029	1029	1029	1029
ml12239-01	30	295	1030	1030	1030	1030
ml12239-01	31	335	1031	1031	1031	1031
ml12239-01	32	325	1032	1032	1032	1032
ml12239-01	33	310	1033	1033	1033	1033
ml12239-01	34	330	1034	1034	1034	1034
ml12239-01	35	310	1035	1035	1035	1035
ml12239-01	36	350	1036	1036	1036	1036
ml12239-01	37	305	1037	1037	1037	1037
ml12239-01	38	325	1038	1038	1038	1038
ml12239-01	39	325	1039	1039	1039	1039
ml12239-01	40	310	1040	1040	1040	1040
ml12239-01	41	255	1041	1041	1041	1041
ml12239-01	42	335	1042	1042	1042	1042
ml12239-01	43	340	1043	1043	1043	1043
ml12239-01	44	360	1044	1044	1044	1044
ml12239-01	45	320	1045	1045	1045	1045
ml12239-01	46	0	0	0	0	0
ml12239-01	47	0	0	0	0	0
ml12239-01	48	0	0	0	0	0
ml12239-02	1	310	1046	1046	1046	1046
ml12239-02	2	320	1047	1047	1047	1047
ml12239-02	3	325	1048	1048	1048	1048
ml12239-02	4	320	1049	1049	1049	1049
ml12239-02	5	340	1050	1050	1050	1050
ml12239-02	6	275	1051	1051	1051	1051
ml12239-02	7	240	1052	1052	1052	1052
ml12239-02	8	310	1053	1053	1053	1053
ml12239-02	9	325	1054	1054	1054	1054
ml12239-02	10	305	1055	1055	1055	1055
ml12239-02	11	0	0	0	0	0
ml12239-02	12	300	1057	1057	1057	1057
ml12239-02	13	325	1058	1058	1058	1058
ml12239-02	14	290	1059	1059	1059	1059
ml12239-02	15	295	1060	1060	1060	1060
ml12239-02	16	295	1061	1061	1061	1061
ml12239-02	17	335	1062	1062	1062	1062

ml12239-02	18	300	1063	1063	1063	1063
ml12239-02	19	405	1064	1064	1064	1064
ml12239-02	20	295	1065	1065	1065	1065
ml12239-02	21	325	1066	1066	1066	1066
ml12239-02	22	315	1067	1067	1067	1067
ml12239-02	23	335	1068	1068	1068	1068
ml12239-02	24	250	1069	1069	1069	1069
ml12239-02	25	335	1070	1070	1070	1070
ml12239-02	26	270	1071	1071	1071	1071
ml12239-02	27	310	1072	1072	1072	1072
ml12239-02	28	325	1073	1073	1073	1073
ml12239-02	29	310	1074	1074	1074	1074
ml12239-02	30	310	1075	1075	1075	1075
ml12239-02	31	305	1076	1076	1076	1076
ml12239-02	32	285	1077	1077	1077	1077
ml12239-02	33	315	1078	1078	1078	1078
ml12239-02	34	305	1079	1079	1079	1079
ml12239-02	35	320	1080	1080	1080	1080
ml12239-02	36	285	1081	1081	1081	1081
ml12239-02	37	325	1082	1082	1082	1082
ml12239-02	38	320	1083	1083	1083	1083
ml12239-02	39	325	1084	1084	1084	1084
ml12239-02	40	305	1085	1085	1085	1085
ml12239-02	41	255	1086	1086	1086	1086
ml12239-02	42	315	1087	1087	1087	1087
ml12239-02	43	325	1088	1088	1088	1088
ml12239-02	44	330	1089	1089	1089	1089
ml12239-02	45	290	1090	1090	1090	1090
ml12239-02	46	0	0	0	0	0
ml12239-02	47	0	0	0	0	0
ml12239-02	48	0	0	0	0	0

Table 7: water samples collected from remote access water samplers during fs2012

Deployment

Three remote access water samplers were deployed during the fs2012.

1. Serial number MLl12239-01 was deployed at 113 m depth at F17 microcat serial number 37sm54280-7062 was attached to MLl12239-01. The Microcat was programmed to measure at 15 minute intervals beginning at 00:00

2. Serial number ML12852-01 was deployed at 067 m depth at F13. Seacat serial number Seacat 16p61772-6693 was attached to ML12852-01. The Seacat was programmed to measure at 15 minute intervals beginning at 00:00

3. Serial number ML12852-02 was deployed at 146 m depth at F13. Seacat serial number Seacat 16p61772-6694 was attached to ML12852-02. The Seacat was programmed to measure at 15 minute intervals beginning at 00:00

0.07 g of $HgCl_2$ dissolved in 1 ml of filtered low nutrient seawater (salinity ~35) provided by OSIL was added to all samples bags in all samplers deployed during fs2012. Salinity (sample 925), δ18O (sample 464), nutrients (sample 9999) , At (2280 umol/l) and Ct (2027 umol/l) samples were taken from this water.

Sample tubes (between the value and the bag) of samplers ML12852-01 and ML12852-02 were filled with the same low nutrient sea water provided by OSIL.

Sample tubes (tubes between the rotary value and the bag) of sampler MLl12239-01 were filled with filtered seawater. Salinity (763), δ18O (1094 & 1095), nutrient (1091) and CDOM (XXX) samples were collected from this water. A sample for total alkalinity and DIC was also collected: this sample was labelled "filter seawater - 12239-01".

The acid bag of sampler MLl12239-01 was filled with only half the volume of acid (about 250 ml) and extra care was taken to remove as much air as possible. No air bubbles were visible in the bag or tubing at all.

The gears and seals in the micro pump of MLl12239-01 were replaced before deployment. The old gears showed no sign of wear, but the micro pump cavity was slightly corroded around the seals. The pump might need to be replaced soon.

On deck, immediately before deployment some orange bio-fouling was noticed growing on the outside of the acid bag in MLl12239-01. The pressure compensation tube was removed from the acid tube and **3 ml of saturated $HgCl_2$ was injected into the seawater surrounding the acid bag in MLl12239-01** to combat the bio-fouling. The pressure compensation tube was then re-attached.

The sampler, Microcat and Seacat clocks were set to GPS (UTC) time before deployment. The following sampling schedules were specified:

ML112239-01 sampling schedule:

```
Header A| Deployed at F17, at 110 m
       B| paul.dodd@npolar.no
       C| Microcat 37sm54280-7062 attached to frame

 Acid   D| Pre-sample acid flush:    Enabled
       E| Flushing volume     =        4  [ml]
       F| Flushing time limit =        1  [min]
       G| Exposure time delay =        5  [min]

 Water  H| Flushing volume     =      100  [ml]
       I| Flushing time limit =        5  [min]

 Sample J| Sample volume       =      450  [ml]
       K| Sample time limit   =       23  [min]

 Acid   L| Post-sample acid flush:   Disabled
       M| Flushing volume     =       NA  [ml]
       N| Flushing time limit =       NA  [min]

 Timing P| Pump data period    =        1  [min]

 Event   1 of  48 = 09/01/2012 12:00:00
 Event   2 of  48 = 09/08/2012 12:00:00
 Event   3 of  48 = 09/15/2012 12:00:00
 Event   4 of  48 = 09/22/2012 12:00:00
 Event   5 of  48 = 09/29/2012 12:00:00
 Event   6 of  48 = 10/06/2012 12:00:00
 Event   7 of  48 = 10/13/2012 12:00:00
 Event   8 of  48 = 10/20/2012 12:00:00
 Event   9 of  48 = 10/27/2012 12:00:00
 Event  10 of  48 = 11/03/2012 12:00:00
 Event  11 of  48 = 11/10/2012 12:00:00
 Event  12 of  48 = 11/17/2012 12:00:00
 Event  13 of  48 = 11/24/2012 12:00:00
 Event  14 of  48 = 12/01/2012 12:00:00
 Event  15 of  48 = 12/08/2012 12:00:00
 Event  16 of  48 = 12/15/2012 12:00:00
 Event  17 of  48 = 12/22/2012 12:00:00
 Event  18 of  48 = 12/29/2012 12:00:00
 Event  19 of  48 = 01/05/2013 12:00:00
 Event  20 of  48 = 01/12/2013 12:00:00
 Event  21 of  48 = 01/19/2013 12:00:00
 Event  22 of  48 = 01/26/2013 12:00:00
 Event  23 of  48 = 02/02/2013 12:00:00
 Event  24 of  48 = 02/09/2013 12:00:00
 Event  25 of  48 = 02/16/2013 12:00:00
 Event  26 of  48 = 02/23/2013 12:00:00
 Event  27 of  48 = 03/02/2013 12:00:00
```

```
Event  28 of  48 = 03/09/2013 12:00:00
Event  29 of  48 = 03/16/2013 12:00:00
Event  30 of  48 = 03/23/2013 12:00:00
Event  31 of  48 = 03/30/2013 12:00:00
Event  32 of  48 = 04/06/2013 12:00:00
Event  33 of  48 = 04/13/2013 12:00:00
Event  34 of  48 = 04/20/2013 12:00:00
Event  35 of  48 = 04/27/2013 12:00:00
Event  36 of  48 = 05/04/2013 12:00:00
Event  37 of  48 = 05/11/2013 12:00:00
Event  38 of  48 = 05/18/2013 12:00:00
Event  39 of  48 = 05/25/2013 12:00:00
Event  40 of  48 = 06/01/2013 12:00:00
Event  41 of  48 = 06/08/2013 12:00:00
Event  42 of  48 = 06/15/2013 12:00:00
Event  43 of  48 = 06/22/2013 12:00:00
Event  44 of  48 = 06/29/2013 12:00:00
Event  45 of  48 = 07/06/2013 12:00:00
Event  46 of  48 = 07/13/2013 12:00:00
Event  47 of  48 = 07/20/2013 12:00:00
Event  48 of  48 = 07/27/2013 12:00:00
```

ML12852-01 sampling schedule:

```
Header A| Deployed at F14, shallowest position
       B| paul.dodd@npolar.no
       C| Seacat 16p61772-6693 attached

 Acid   D| Pre-sample acid flush:    Enabled
       E| Flushing volume     =      5  [ml]
       F| Flushing time limit =      1  [min]
       G| Exposure time delay =      1  [min]

Water  H| Flushing volume     =    100  [ml]
       I| Flushing time limit =      5  [min]

 Sample J| Sample volume      =    450  [ml]
       K| Sample time limit   =     23  [min]

 Acid   L| Post-sample acid flush:   Disabled
       M| Flushing volume     =     NA  [ml]
       N| Flushing time limit =     NA  [min]

 Timing P| Pump data period    =     15  [sec]

Event  1 of 48 at 09/03/12 12:00:00
Event  2 of 48 at 09/11/12 06:22:58
Event  3 of 48 at 09/19/12 00:45:56
Event  4 of 48 at 09/26/12 19:08:54
Event  5 of 48 at 10/04/12 13:31:52
Event  6 of 48 at 10/12/12 07:54:50
Event  7 of 48 at 10/20/12 02:17:48
Event  8 of 48 at 10/27/12 20:40:46
Event  9 of 48 at 11/04/12 15:03:44
Event 10 of 48 at 11/12/12 09:26:42
Event 11 of 48 at 11/20/12 03:49:40
Event 12 of 48 at 11/27/12 22:12:38
Event 13 of 48 at 12/05/12 16:35:36
Event 14 of 48 at 12/13/12 10:58:34
Event 15 of 48 at 12/21/12 05:21:32
Event 16 of 48 at 12/28/12 23:44:30
Event 17 of 48 at 01/05/13 18:07:28
Event 18 of 48 at 01/13/13 12:30:26
Event 19 of 48 at 01/21/13 06:53:24
Event 20 of 48 at 01/29/13 01:16:22
Event 21 of 48 at 02/05/13 19:39:20
Event 22 of 48 at 02/13/13 14:02:18
Event 23 of 48 at 02/21/13 08:25:16
Event 24 of 48 at 03/01/13 02:48:14
Event 25 of 48 at 03/08/13 21:11:12
Event 26 of 48 at 03/16/13 15:34:10
Event 27 of 48 at 03/24/13 09:57:08
```

Event 28 of 48 at 04/01/13 04:20:06
Event 29 of 48 at 04/08/13 22:43:04
Event 30 of 48 at 04/16/13 17:06:02
Event 31 of 48 at 04/24/13 11:29:00
Event 32 of 48 at 05/02/13 05:51:58
Event 33 of 48 at 05/10/13 00:14:56
Event 34 of 48 at 05/17/13 18:37:54
Event 35 of 48 at 05/25/13 13:00:52
Event 36 of 48 at 06/02/13 07:23:50
Event 37 of 48 at 06/10/13 01:46:48
Event 38 of 48 at 06/17/13 20:09:46
Event 39 of 48 at 06/25/13 14:32:44
Event 40 of 48 at 07/03/13 08:55:42
Event 41 of 48 at 07/11/13 03:18:40
Event 42 of 48 at 07/18/13 21:41:38
Event 43 of 48 at 07/26/13 16:04:36
Event 44 of 48 at 08/03/13 10:27:34
Event 45 of 48 at 08/11/13 04:50:32
Event 46 of 48 at 08/18/13 23:13:30
Event 47 of 48 at 08/26/13 17:36:28
Event 48 of 48 at 09/03/13 11:59:26

ML12852-02 sampling schedule:

```
Header A| Deployed at F14, deepest position
       B| paul.dodd@npolar.no
       C| Seacat 16p61772-6694 attached

 Acid   D| Pre-sample acid flush:    Enabled
       E| Flushing volume     =      5  [ml]
       F| Flushing time limit =      1  [min]
       G| Exposure time delay =      1  [min]

 Water  H| Flushing volume     =    100  [ml]
       I| Flushing time limit =      5  [min]

 Sample J| Sample volume       =    450  [ml]
       K| Sample time limit   =     23  [min]

 Acid   L| Post-sample acid flush:   Disabled
       M| Flushing volume     =     NA  [ml]
       N| Flushing time limit =     NA  [min]

 Timing P| Pump data period    =     15  [sec]

Event  1 of 48 at 09/03/12 12:00:00
Event  2 of 48 at 09/11/12 06:22:58
Event  3 of 48 at 09/19/12 00:45:56
Event  4 of 48 at 09/26/12 19:08:54
Event  5 of 48 at 10/04/12 13:31:52
Event  6 of 48 at 10/12/12 07:54:50
Event  7 of 48 at 10/20/12 02:17:48
Event  8 of 48 at 10/27/12 20:40:46
Event  9 of 48 at 11/04/12 15:03:44
Event 10 of 48 at 11/12/12 09:26:42
Event 11 of 48 at 11/20/12 03:49:40
Event 12 of 48 at 11/27/12 22:12:38
Event 13 of 48 at 12/05/12 16:35:36
Event 14 of 48 at 12/13/12 10:58:34
Event 15 of 48 at 12/21/12 05:21:32
Event 16 of 48 at 12/28/12 23:44:30
Event 17 of 48 at 01/05/13 18:07:28
Event 18 of 48 at 01/13/13 12:30:26
Event 19 of 48 at 01/21/13 06:53:24
Event 20 of 48 at 01/29/13 01:16:22
Event 21 of 48 at 02/05/13 19:39:20
Event 22 of 48 at 02/13/13 14:02:18
Event 23 of 48 at 02/21/13 08:25:16
Event 24 of 48 at 03/01/13 02:48:14
Event 25 of 48 at 03/08/13 21:11:12
Event 26 of 48 at 03/16/13 15:34:10
Event 27 of 48 at 03/24/13 09:57:08
```

Event 28 of 48 at 04/01/13 04:20:06
Event 29 of 48 at 04/08/13 22:43:04
Event 30 of 48 at 04/16/13 17:06:02
Event 31 of 48 at 04/24/13 11:29:00
Event 32 of 48 at 05/02/13 05:51:58
Event 33 of 48 at 05/10/13 00:14:56
Event 34 of 48 at 05/17/13 18:37:54
Event 35 of 48 at 05/25/13 13:00:52
Event 36 of 48 at 06/02/13 07:23:50
Event 37 of 48 at 06/10/13 01:46:48
Event 38 of 48 at 06/17/13 20:09:46
Event 39 of 48 at 06/25/13 14:32:44
Event 40 of 48 at 07/03/13 08:55:42
Event 41 of 48 at 07/11/13 03:18:40
Event 42 of 48 at 07/18/13 21:41:38
Event 43 of 48 at 07/26/13 16:04:36
Event 44 of 48 at 08/03/13 10:27:34
Event 45 of 48 at 08/11/13 04:50:32
Event 46 of 48 at 08/18/13 23:13:30
Event 47 of 48 at 08/26/13 17:36:28
Event 48 of 48 at 09/03/13 11:59:26

Sea-ice chemistry samples on the Fram Strait 2012 cruise

Agneta Fransson and Melissa Chierici

We sampled ice cores for chemistry analyses at 6 ice stations; ice stations FS 12-2-1, 3-1, 5-1, 7-1, 9-1 and 11-1, covering different types of sea ice (120-297cm thick). The ice cores were cut into 10 cm pieces, put into gas-tight bags (Tedlar) and evacuated from air, for slowly melting. The melted samples were then transferred into bottles for total inorganic carbon (DIC), total alkalinity (AT), stable oxygen isotope-18 (O18) and nutrients. All samples for DIC and AT were analyzed directly onboard the ship, for DIC using gas extraction of acidified water sample and coulometric titration with photometric detection, and for AT potentiometric titration with hydrochloric acid. We used standard seawater for calibration of the instruments.

At three occasions, we sampled and analyzed newly formed sea ice (six samples, 1-4 cm thick) and under-ice water; one from small boat (30/8-12, 1cm) and at two ice stations (15-1, 8/9: 2cm and 18-1, 9/9: 4cm). We sampled slush on new ice on station 18-1.

At all ice stations (except 7-1 and 11-1) we sampled and analyzed under-ice water (UIW; 0.1 m) using a submersible pump and "brine/melt water" from partly drilled sackholes. At station 7-1 we sampled snow.

At four ice stations (2-1, 3-1, 5-1, 7-1) we collected and analyzed the water from meltponds.

Salinity was measured on all samples before analyses, and in-situ temperature (for ice cores every 5 cm) was measured on all samples, including melted ice, snow, UIW, brine/melt water, slush and water from meltponds.

At two ice-core stations (7-1, 9-1), vertical profiles of salinity, temperature, pressure and dissolved oxygen were conducted from surface to 40 m using a MicroCat sensor (Seabird). At one site (FS 12-9-1) we measured salinity, temperature, chlorophyll, CDOM and oxygen from the surface to 40 m from the ice edge using the SeaCat (Seabird). We also used oxygen optode (Aanderaa) and Trilux sensor for chlorophyll and pigments under the ice and in meltponds at several sites.

NTNU contribution to FS2012: Borehole jack and ice ridge morphology studies, Fram Strait 2012

Datareport from Scientific survey arranged by the Norwegian Polar Institute

Ole-Christian Ekeberg, PhD student NTNU
Joar Aspenes Justad, SAMCoT

All references to page numbers and figures are releative to this part of the cruise re page and figure numbers are reset to zero and starting on 1 from here on.

Preface

Annually the Norwegian Polar Institute (NP) organizes a scientific cruise to the Fram Strait, an area between North Greenland and Svalbard. Mainly the cruise is arranged to perform sea ice and oceanography research. In particular the goal is to recover and re-deploy moorings which are situated on the sea bottom, monitoring oceanographic and sea ice parameters. Researchers from NTNU (Norwegian University of Science and Technology) and/or UNIS (University Centre in Svalbard) are each year invited to participate in expedition. This year Ole-Christian Ekeberg (PhD student, NTNU) and Joar A. Justad (SAMCoT) participated in the expedition aiming to investigate ridge morphology and to perform borehole jack (BHJ) tests in sea ice. The expedition was organized on R/V Lance in Fram Strait area and lasted from 19th of August to 13th of September 2012. During these days there were several longer or shorter ice stations depending on ice conditions, ship activity and common schedule. According to that our working activity was adjusted from one task to another, where ridge morphology is considered as the most time consuming part. Fieldwork descriptions and results of all stations are described in this report. In total 10 stations were performed on ice and activities of each are shown in the Table 1. Ridge morphology was investigated by drilling with 2 inch augers and coring samples with 7.5 cm core drill from Kovacks Enterprises. BHJ tests were carried out with the exclusively constructed hydraulic machine made by M-TECH in Trondheim in 2010 on request from NTNU.

Table 1: Overview of sea ice stations, date, activity and name of raw data files.

Ice station	Date	Activity	Raw data files
#1	21.08.12	BHJ	210812.dat
#2	22.08.12	Ridge profiling	2012_08_22_Sea Ice Station2_ridge1.xls
#3	23.08.12	BHJ	230812.dat
#4	24.08.12	Ridge profiling	2012_08_24_Sea Ice Station4_ridge2.xls
#5	26.08.12	BHJ	260812.dat
#6	29.08.12	Core sampling	-
#7	31.08.12	BHJ	310812.dat
#8	02.09.12	Ridge profiling	2012_09_02_Sea Ice Station8_ridge3.xls
#9	08.09.12	BHJ	080912.dat
#10	09.09.12	Ridge profiling	2012_09_09_Sea Ice Station10_ridge4.xls

The report is divided into two parts; Part A concerns ridge morphology and Part B BHJ testing.

We thank NP for inviting us on this expedition and supplying us with valuable data on physical properties of sea ice whenever needed. Also thanks to the crew aboard R/V Lance who made it a pleasant journey.

Ole-Christian Ekeberg

Joar Aspenes Justad

Longyearbyen, 25.09.12

Contents (NTNU part of the report)

Part A: Ice ridge morphology

Ice station no # 2

1st ridge investigated.

Table 2: Ice station #2 information.

Date	22.08.12
Activity	Morphology
Northing	78°50'N
Westing	6°34'W
Ice	Small weathered ridge.
Weather	Overcast
Water temperature	-?°C
Air temperature	-0.4°C

This was the first ice station doing morphology studies and some trial and error occurred with respect to how to coordinate drilling and notes with two people. Since we did not bring our own thickness measurement we were supposed to borrow this from NPI when they finished their work. Unfortunately some holes froze up before this was available and therefore no precise thickness is registered. The thickness noted from the drilling and categorizing of the resistance should be within +- 10 cm from the actual depth.

Figure 1. The ridge which was drilled. Unfortunately the excact location of the profile cannot be indicated.

The profile of salinity, temperature and density was done at the hole 1 m to the left of the top hole. The top holes the one at 0 m in Figure 2.

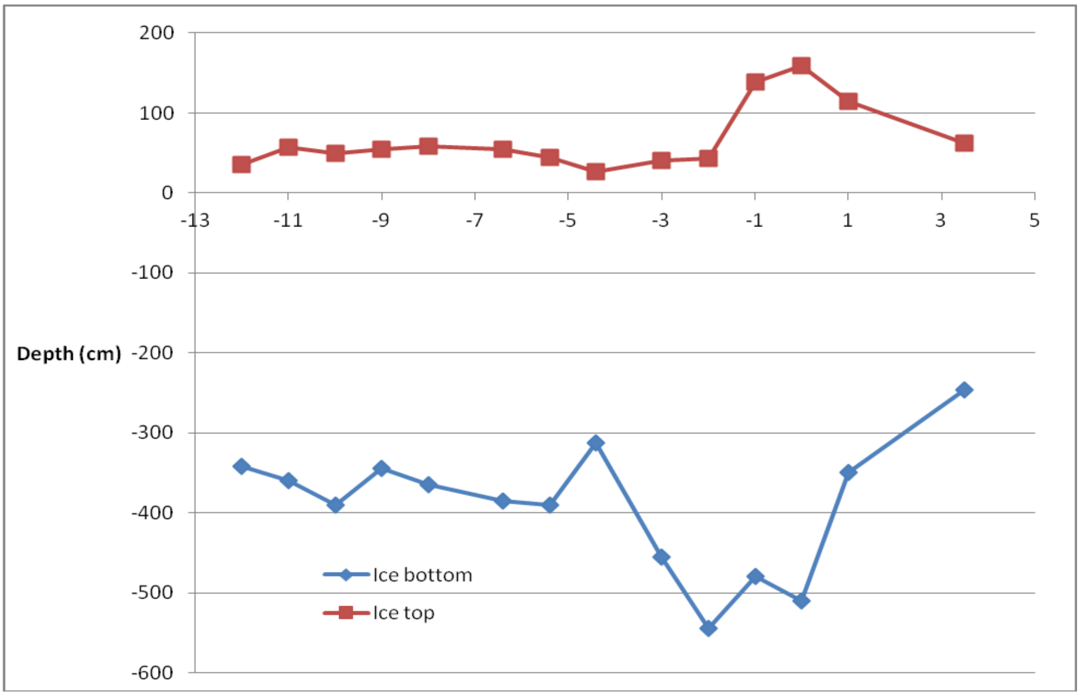


Figure 2. Ice ridge profile. Horizontal values are distance from the top point.

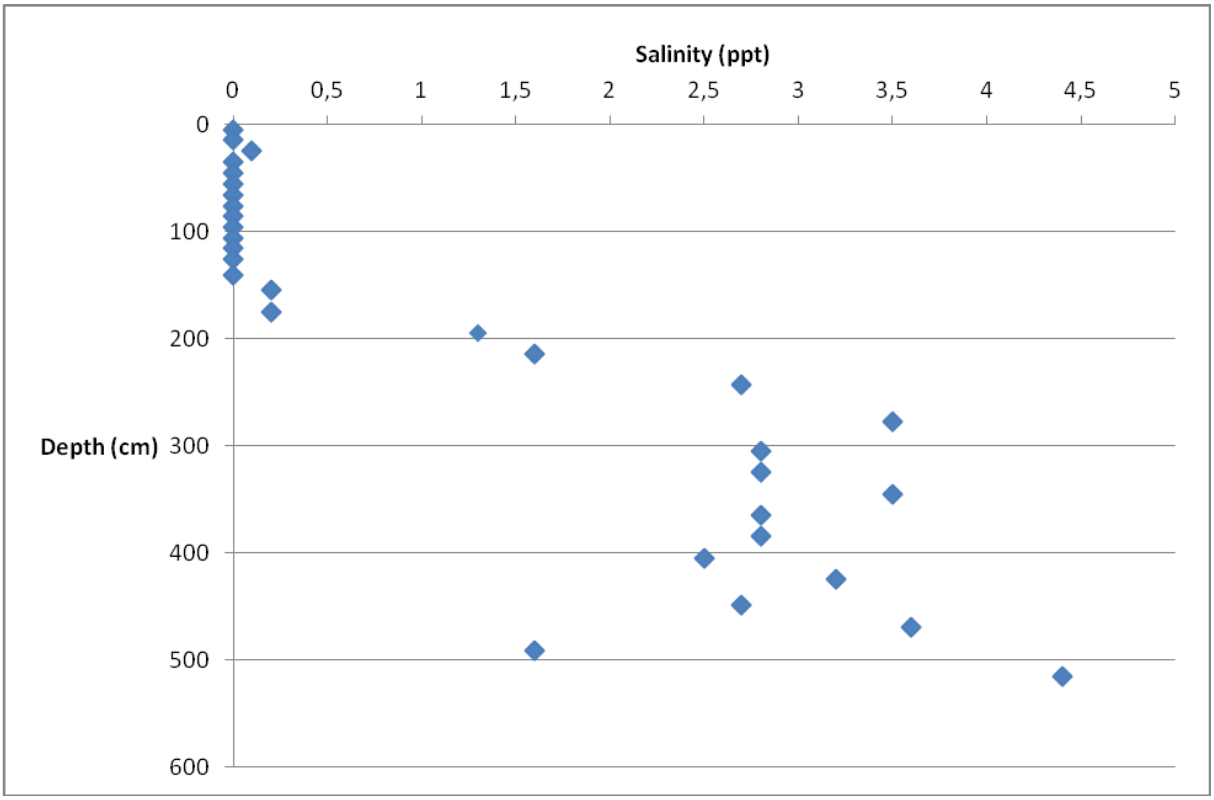


Figure 3. Salinity at 1 m to the left of the top in Figure 2.

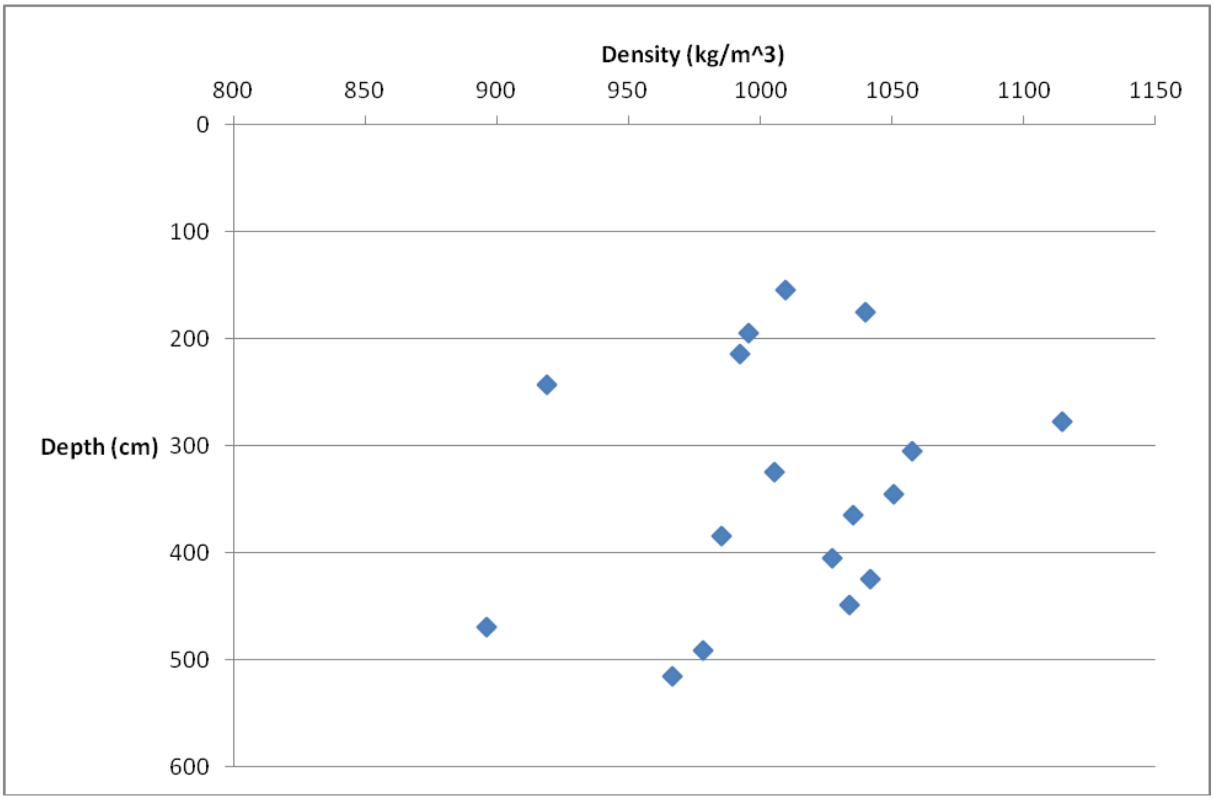


Figure 4. Density 1 m to the left of the top in figure describing the ridge above.

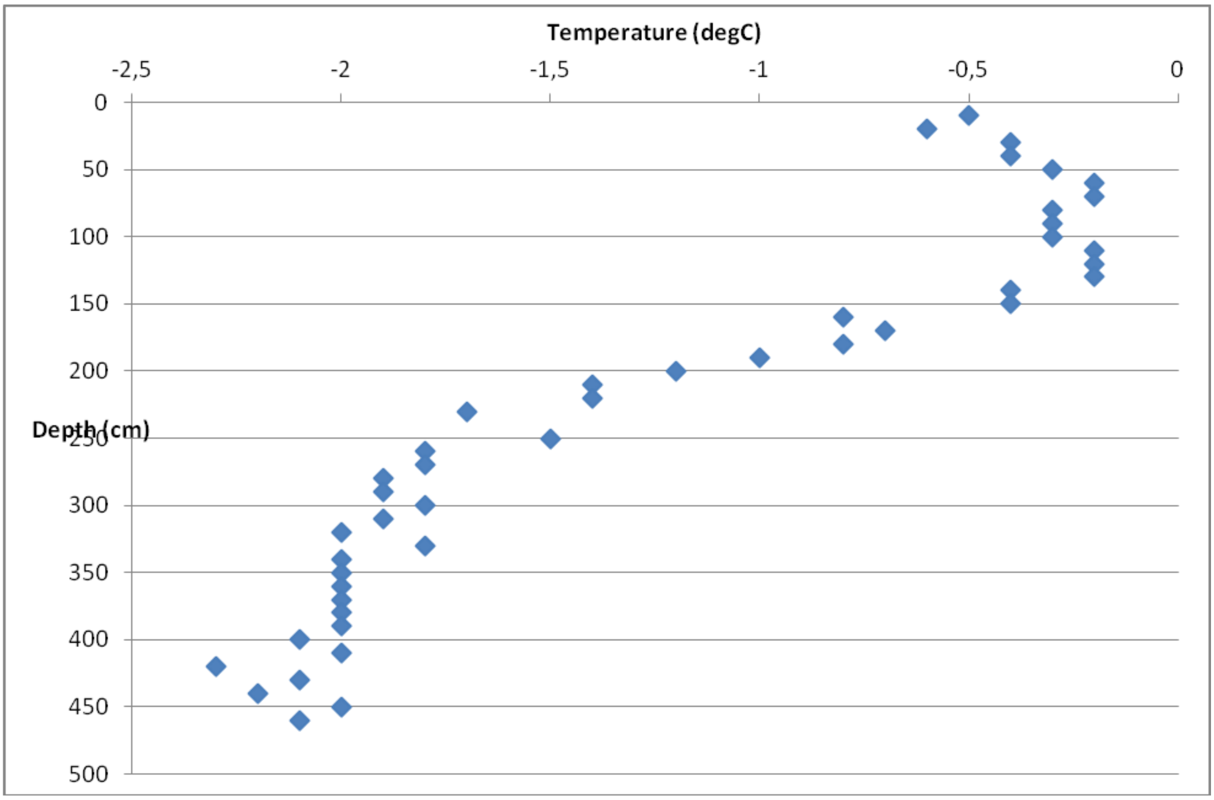


Figure 5. Temperature profile at ridge top.

Ice station no #4

2nd ridge investigated.

Table 3: Ice station #4 information.

Date	24.08.12
Activity	Morphology
Northing	78°46’ N
Westing	9°6’W
Ice	Ridge with frozen empty meltponds on the sides.
Weather	Overcast
Water temperature	-?°C
Air temperature	-0.3°C

No problems with the equipment occurred except for at the deepest hole (top of the ridge). Here a 0.5 m gap was registered 390 cm from the top. When the drilling was continued the drill got stuck. We speculate that this happened due to a very skew entering into an ice block. This could have caused that the auger got bent and consequently stuck. The auger was not retrieved and neither the Stihl engine, a manual drill or warm water helped. Two 2’’-augers and a drill bit was left behind. This is why the freeboard and the total depth is lacking at the deepest point of the ridge.

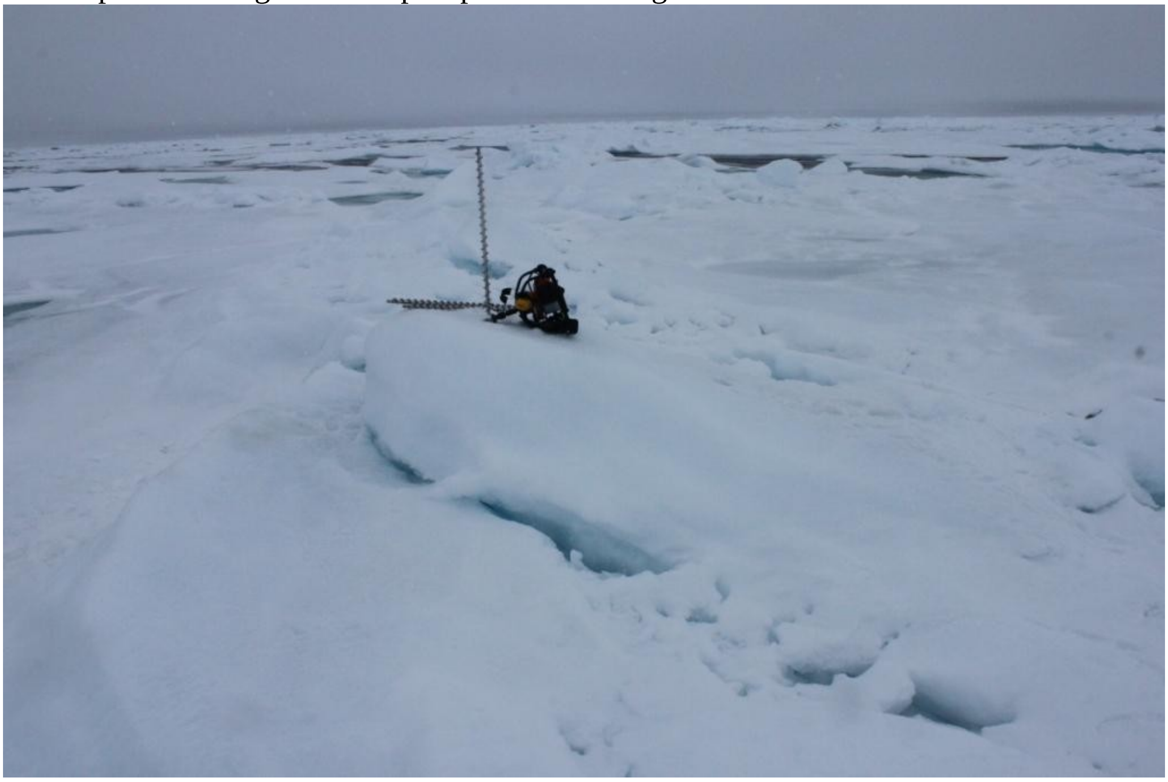


Figure 6. Ridge no. 2 With the top point indicated by the drill.

The profile of this ridge was done 1 m to the right (see Figure 7) of the top hole which is the reference hole at 0 m.

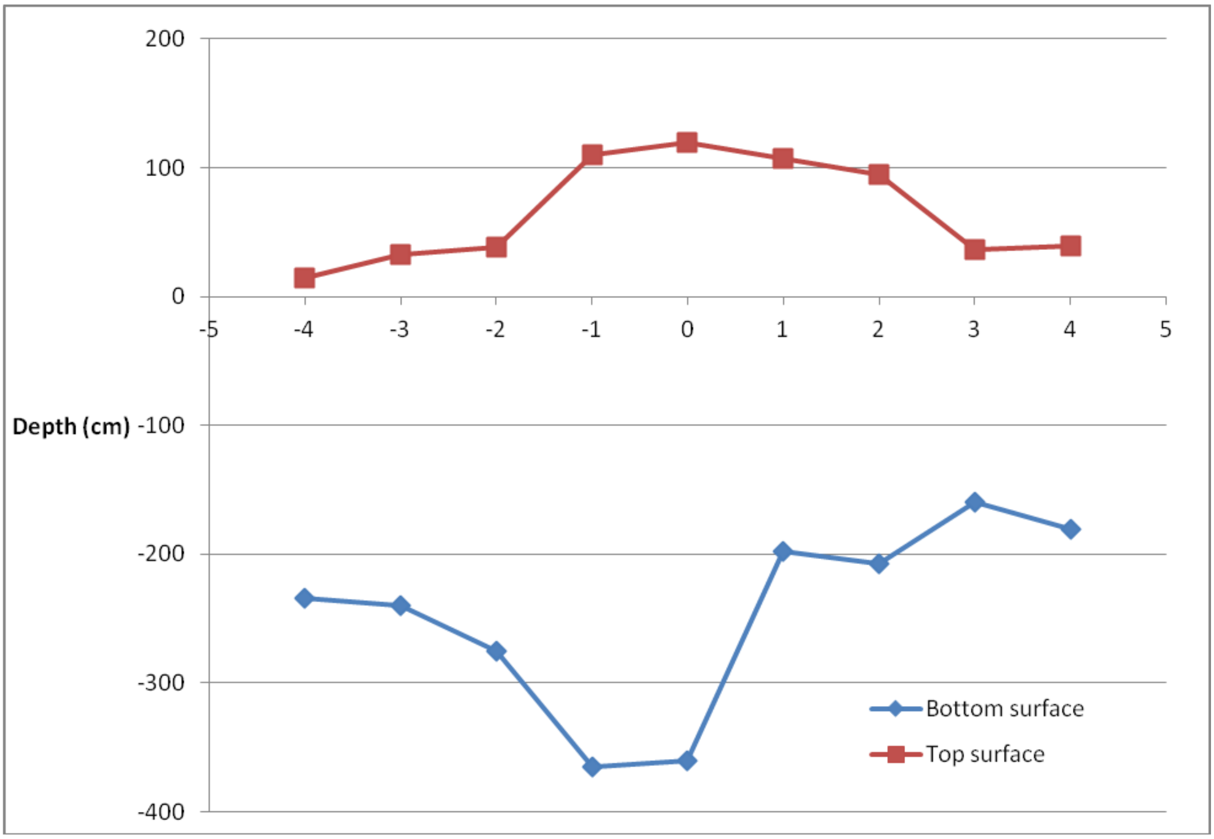


Figure 7. Ice ridge number 2. Profile of the ridge with top and bottom surface plotted.

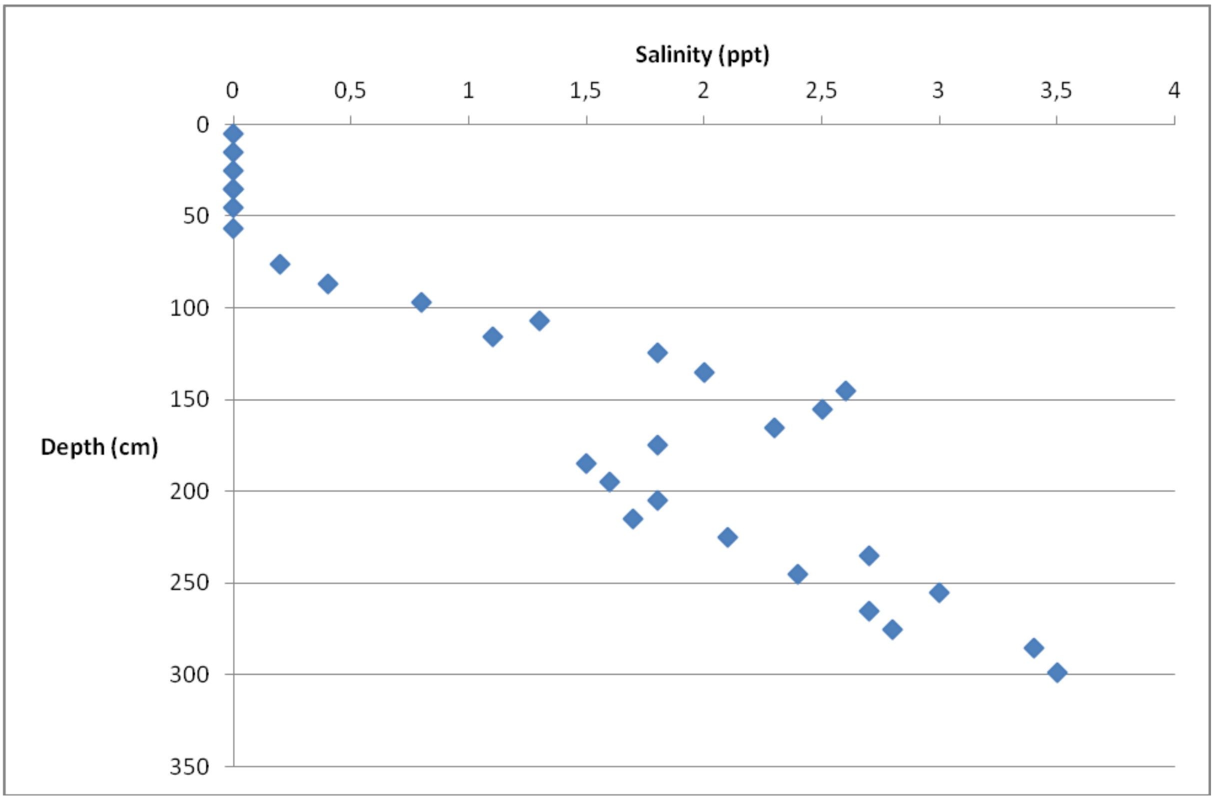


Figure 8. Salinity profile for ridge #2.

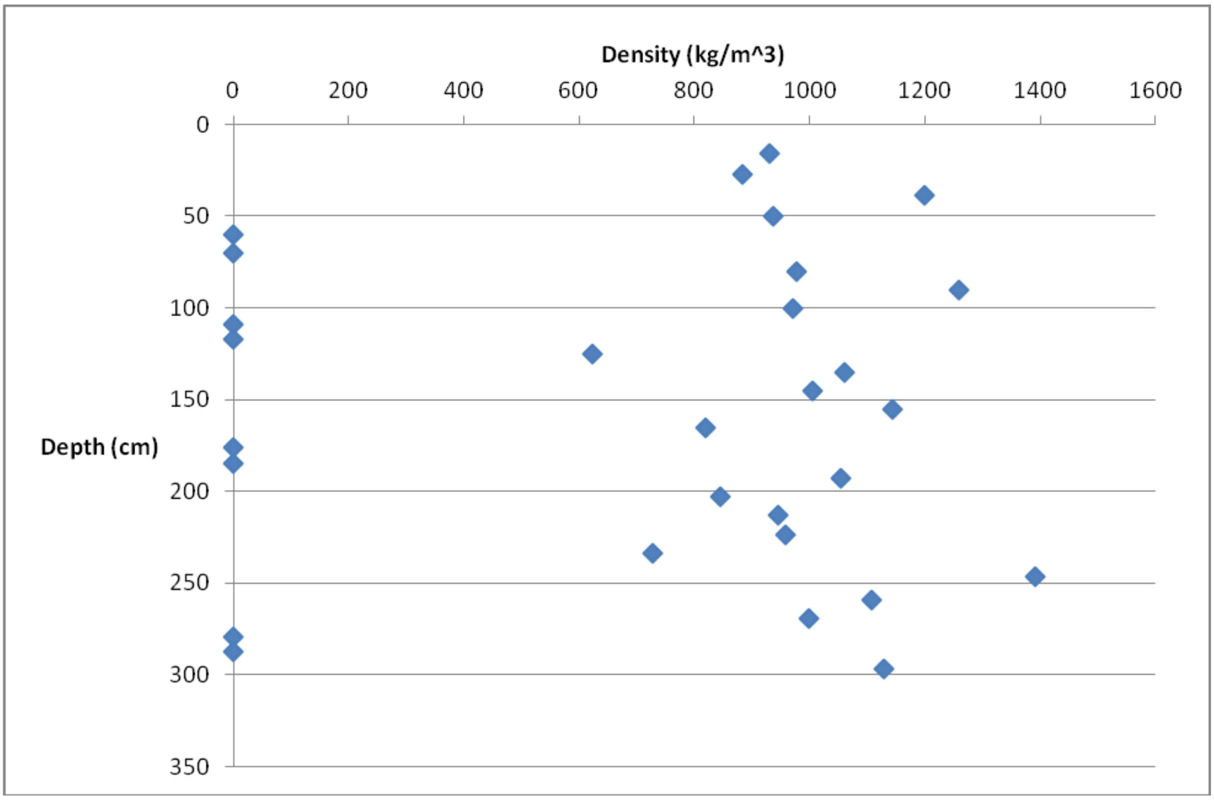


Figure 9. Density profile of ridge # 2.

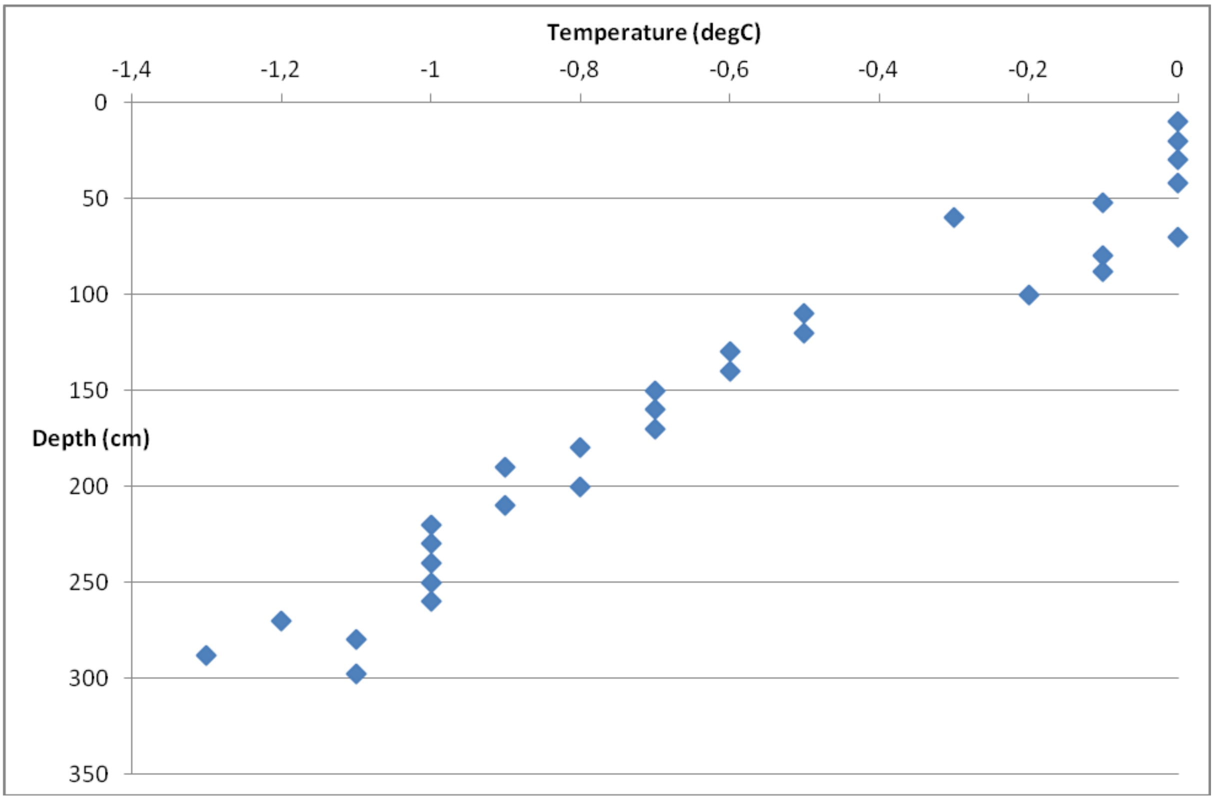


Figure 10. Temperature profile for ridge #2.

Ice station no #8

Ice ridge morphology. 3rd ridge investigated.

Table 3: Ice station #8 information.

Date	02.09.12
Activity	Morphology
Northing	78° 52’,
Westing	5° 24’
Ice	
Weather	Overcast
Water temperature	-?°C
Air temperature	-2.2°C

Pressure within the ridge and the ice type of the surface layer of this ridge created problems with augers and Kovacs getting stuck. Coring for the DTS measurements had to be aborted as the hole collapsed inwards. When finished with the second core (approx 1-2 m) from the hole the Kovacs got stuck and it had to be retrieved with hot water. Due to time constrains the temperature and salinity is from the level part of the floe where NP had their station (about 20 m from the hole + 3). Further the 2 inch got stuck in the crust of the ice and to avoid this problem we had to remove the 30-40 cm of the ice to avoid to get stuck further. Still the 2inch got stuck at hole no. -1 and was only retrieved when the upper 50-100 cm of ice was removed. This consumed a lot of time and it was decided to

only drill every 2 meters. At the second last hole at +3 m 9 m of augers were lost and the work was discontinued.
From the measurements it seems that there is a larger piece of ice below the ridge which creates at gap at about 5 m below the sea surface. The gap was found to be varying between 1 and 3 m and the ice sheet below seems to be about 2 m deep thick (not shown).

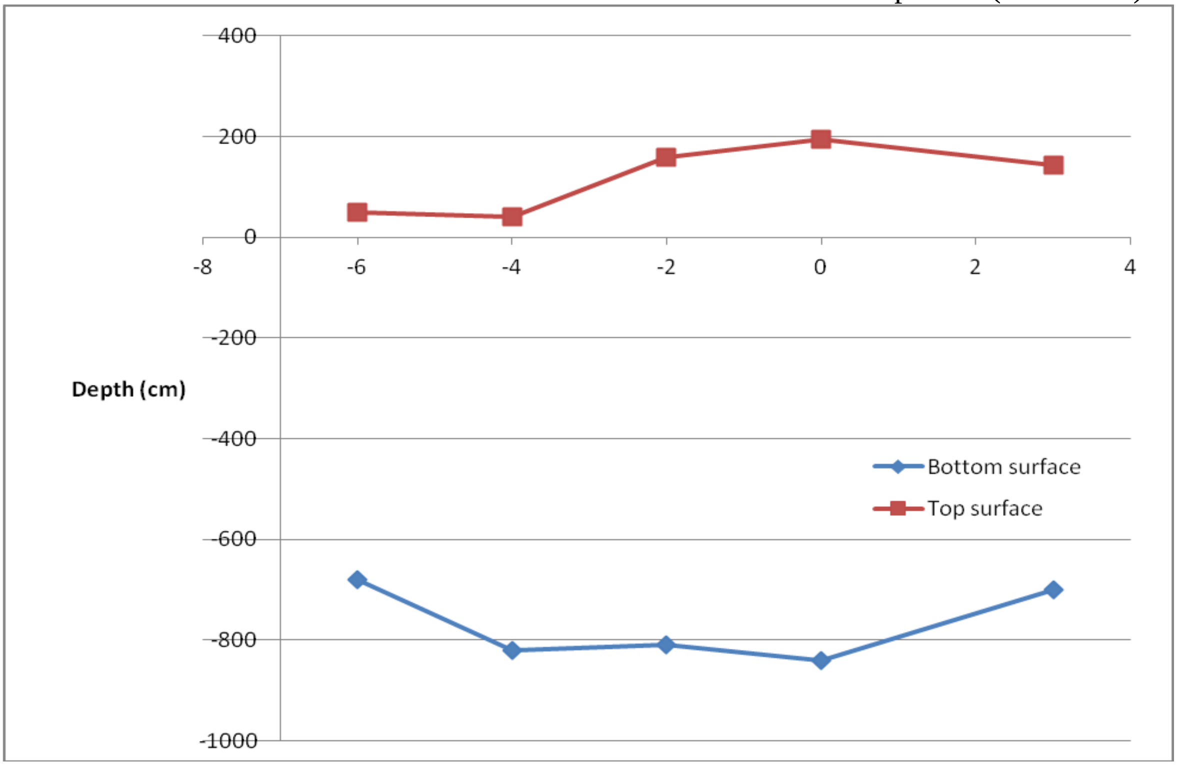


Figure 11. The topography of ridge no. 3

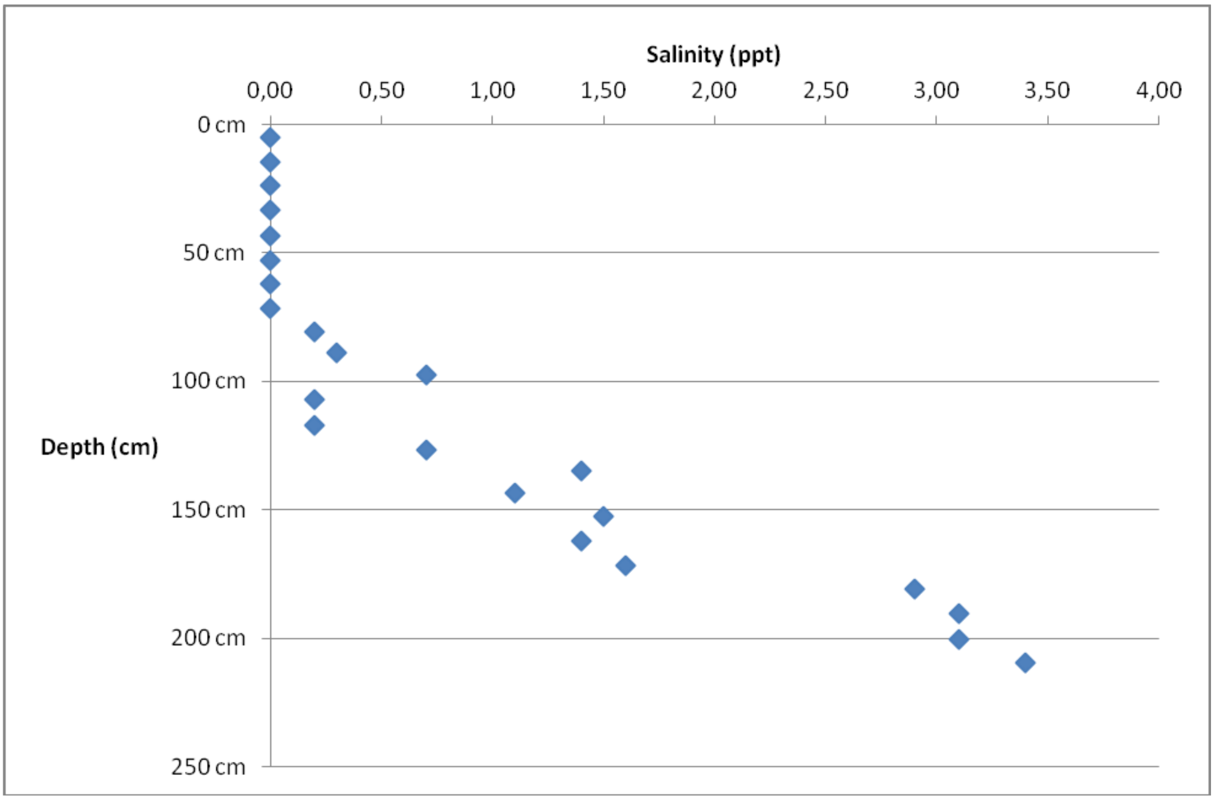


Figure 12. Temperature profile of level ice sampled by NPI close to ridge no. 3.

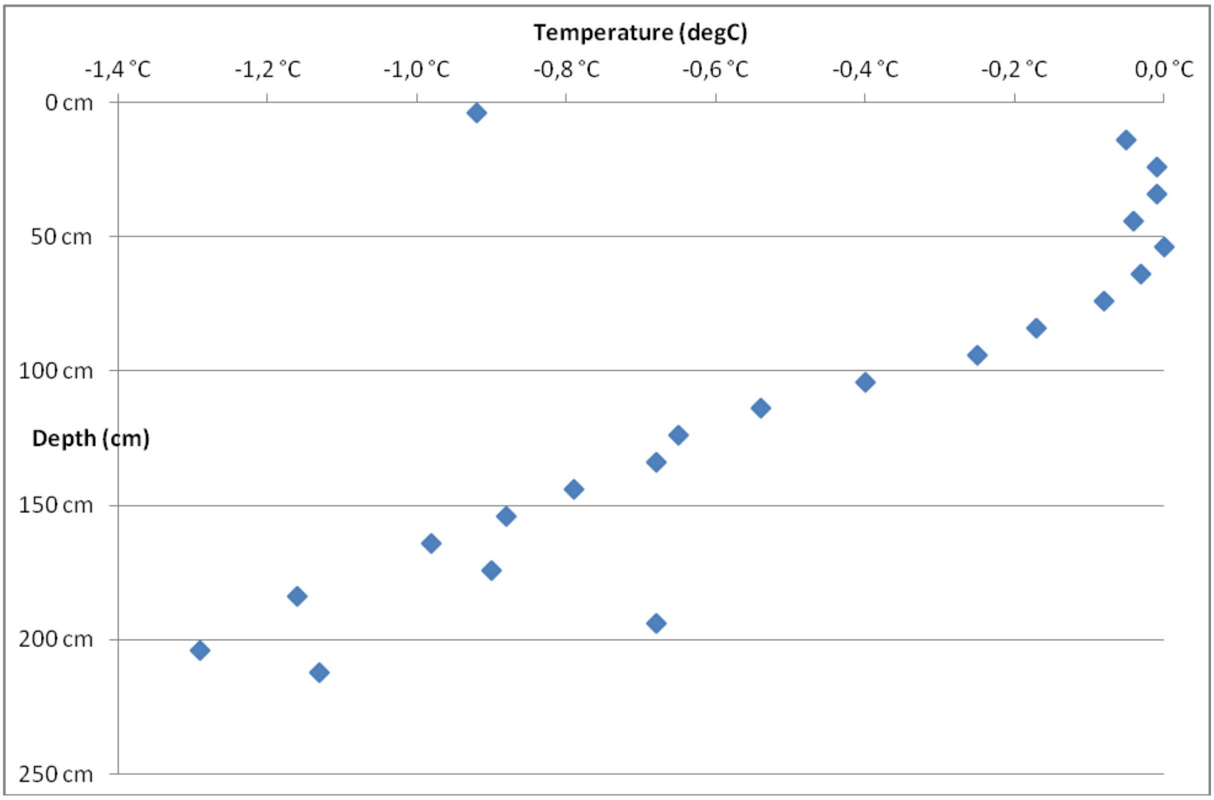


Figure 13. Temperature profile of level ice as measured by NPI close to ridge no. 3.

Ice station no #10

4th ridge investigated.

Table 4: Ice station #10 information.

Date	09.09.12
Activity	Morphology
Northing	77° 46'
Westing	4° 45'
Ice	
Weather	Overcast
Water temperature	-?°C
Air temperature	-2.3°C

The profile is about 6 m along the ridge from the highest point. This was chosen as this cross section was less steep than that of the highest point. The highest point was about 0.5-1 m higher than this location. Density measurements were not conducted due to time constrains and the poor results on previous stations (too high densities). The ridge was quite weathered.

Figure 14. Ridge no. 4 seen from the ship. The approximate location of the profile is indicat

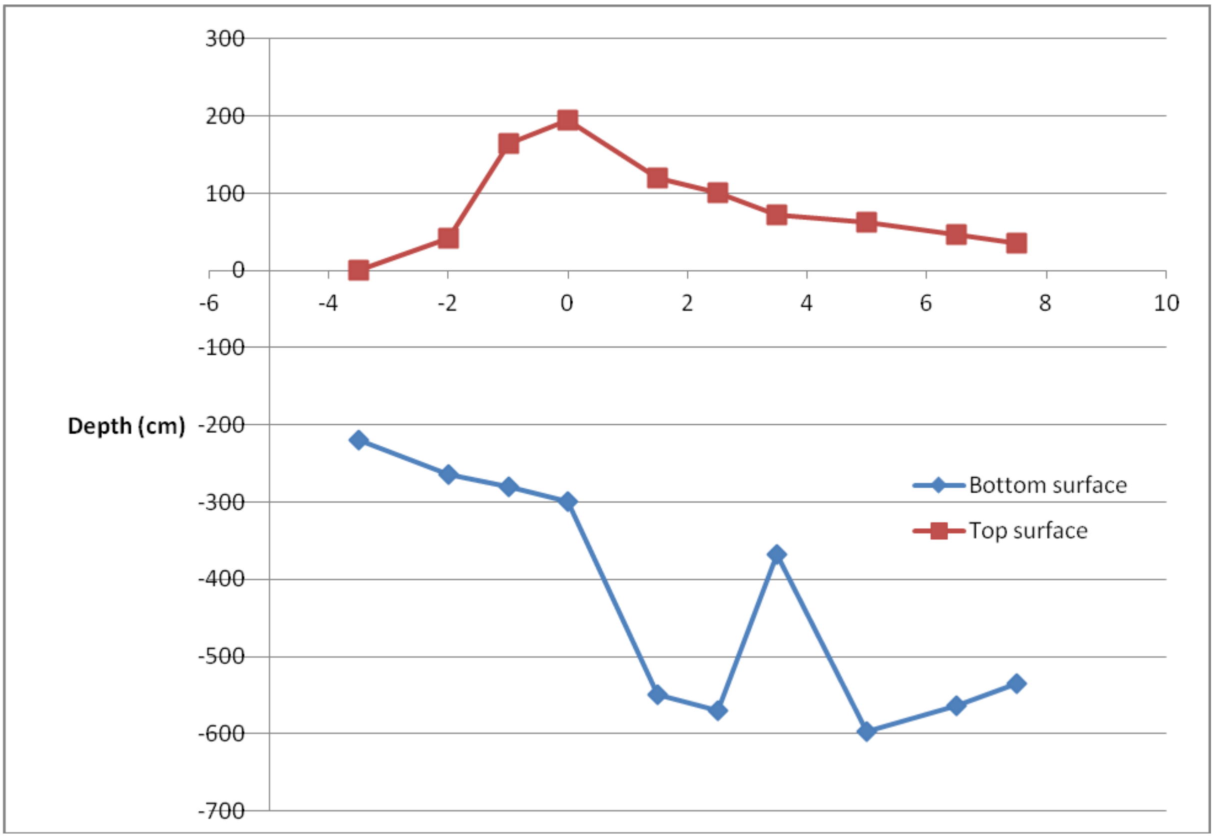


Figure 15. Profile of ridge number 4.

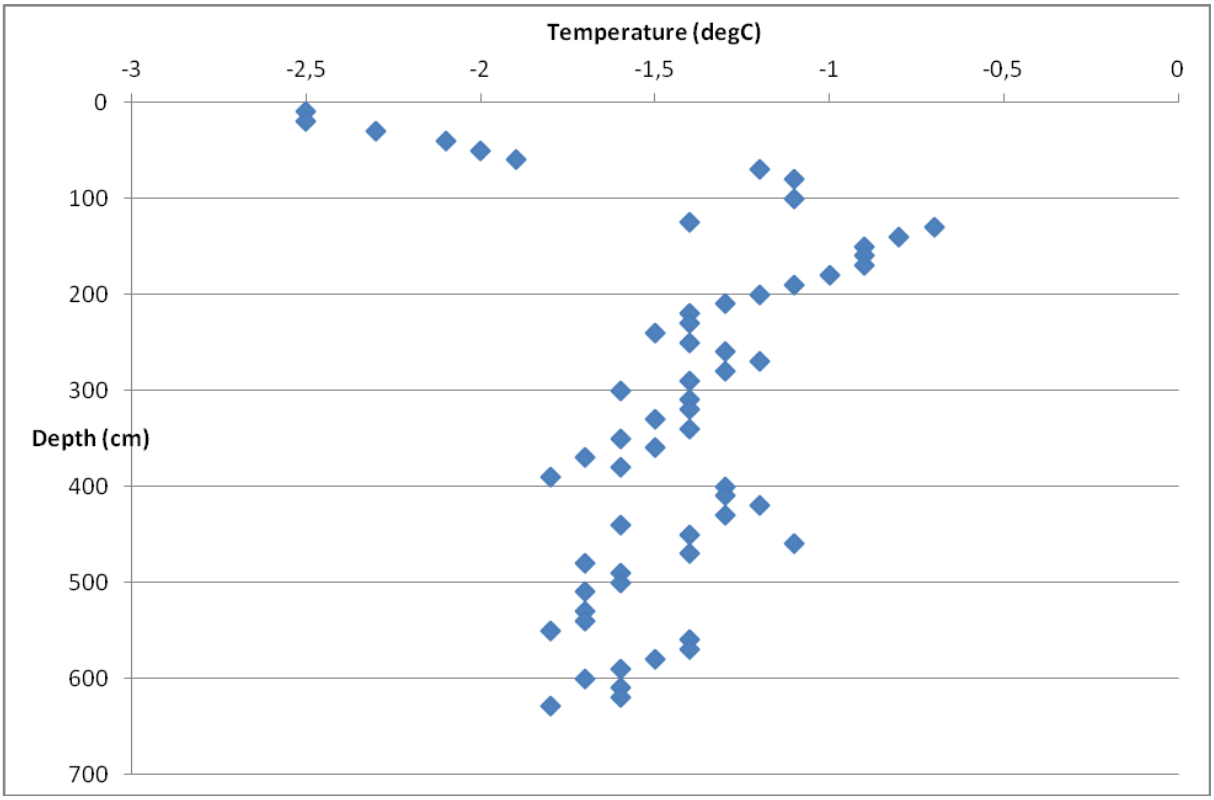


Figure 16. Tempereature profile of ridge 4.

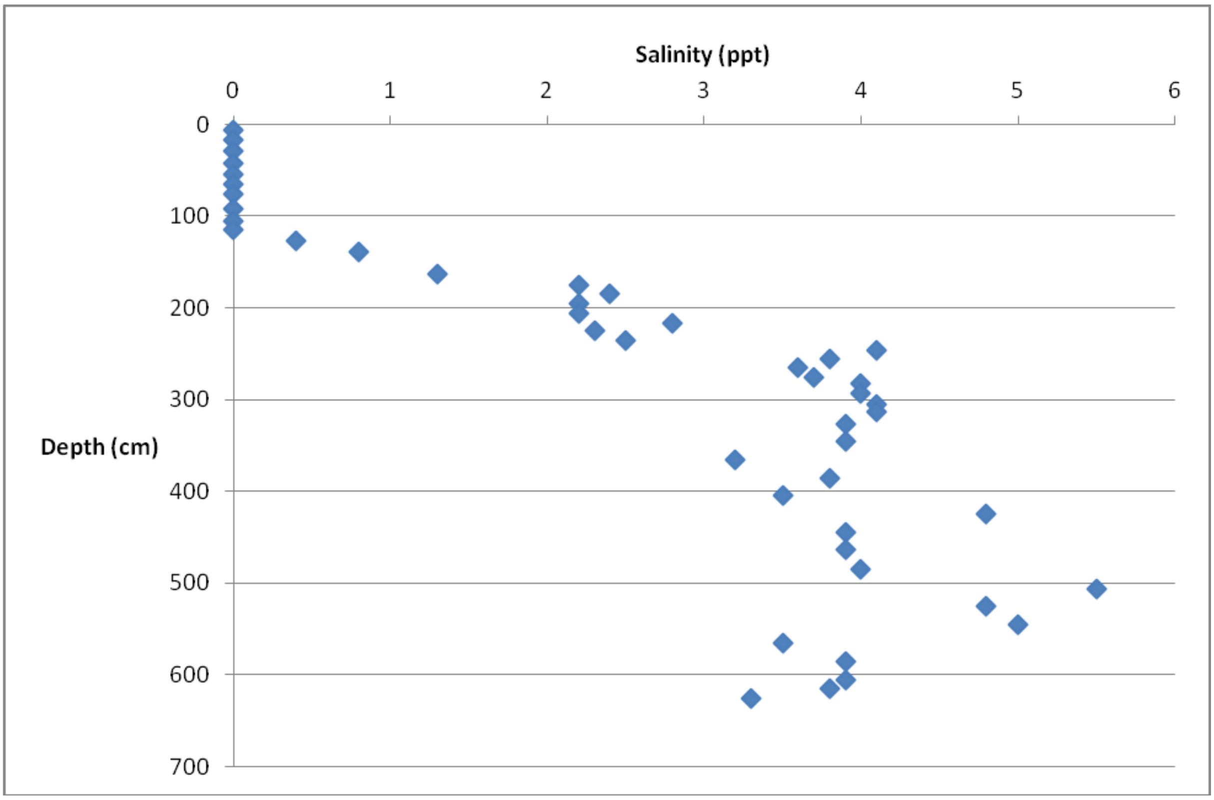


Figure 17. Salinity profile of ridge #4.

Part B: Borehole jack

Introduction

A borehole jack (BHJ) is an instrument capable of measuring the confined compressive strength of ice. In short, a BHJ works as follows; a hole is drilled in the ice in which a piston is lowered to a desired test depth. An electric motor runs a hydraulic pump, which in turn provides oil pressure to the piston that compresses the ice. Pressure, displacement and time are recorded throughout the experiment. Figure 16 shows the equipment on an arbitrary test location.

In order to conduct an experiment one first has to drill a hole in the ice of 150 mm, which fits the jack shown in Figure 17 and 18. The number of tests to be run in each BH (borehole) depends on the thickness of the ice. If a core drill is used, the core may be used for measuring properties such as temperature, salinity and density of the ice.

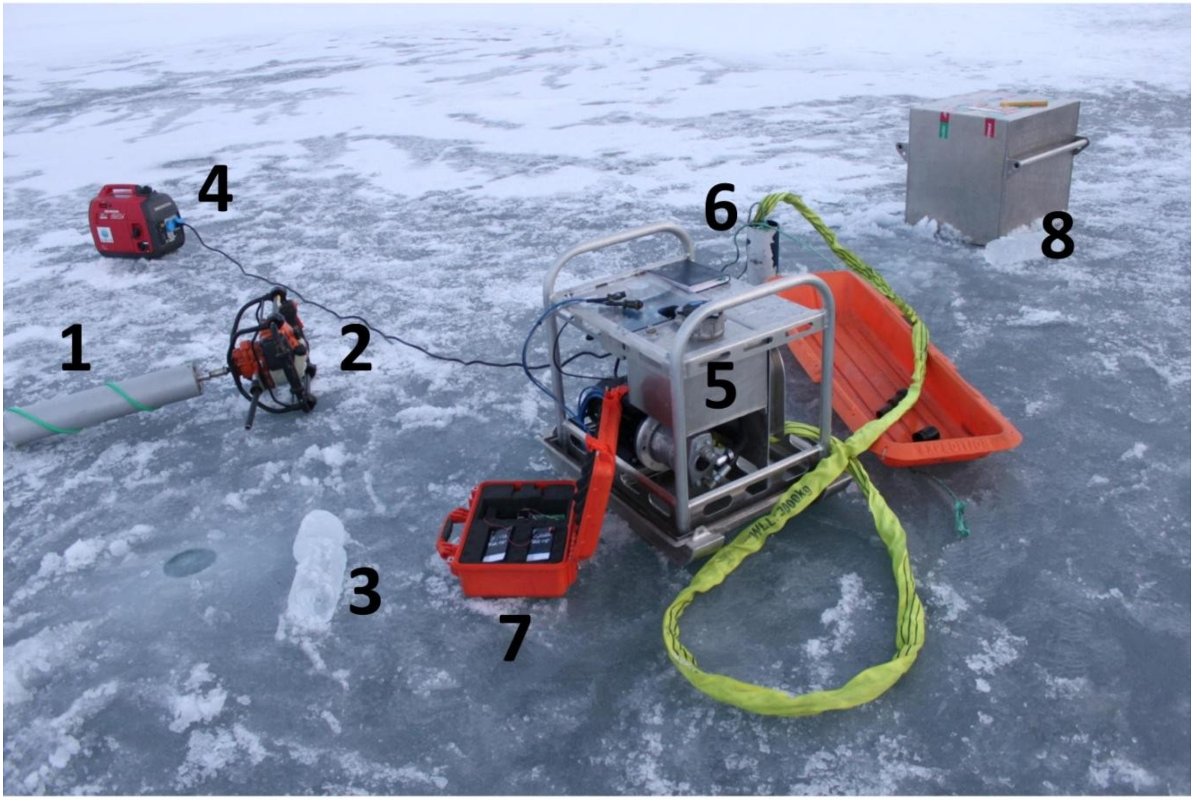


Figure 16: The UNIS-BHJ system on test location; 1) 150 mm core drill, 2) Stihl engine, 3) extracted ice core, 4) generator of 2.0 kWh, 5) electric motor and hydraulic pump, 6) “the jack”, a cylinder house containing piston with indentor and displacement sensor, 7) CR1000 Wiring Panel (transducer) with two 12 V batteries and 8) steel cover.

Figure 17: Piston fully retracted.

Figure 18: Piston fully extracted at 50 mm.

On this expedition a total number of 60 BHJ tests have been done, divided on 5 ice stations. We put emphasis on thorough investigations of the ice conditions on test locations, which limited the time left for BHJ-testing. The priority on interpretation of the data has been to validate the newly installed displacement sensor. Unfortunately, no data on the displacement was obtained from the latter two ice stations due to a malfunction of the system.

The majority of the measurements of the different ice stations stated that the ice was thicker than two meters. Most of the measurements of this parameter was done by NP in the vicinity of the test locations, and not for each BH as would be ideal. Salinity and temperature profiles found by NP on relevant locations, i.e. close to BHJ tests or ridge profiling, are presented in the Appendix A together with information that we collected ourselves; density, salinity and temperature profiles. Table 5 sums up the ice station information and what measurements of physical and mechanical properties were measured.

The density profiles are not regarded exact information as this is a parameter difficult to measure. Considering the equipment we used, a spring weight and a folding rule, and the working conditions with occasionally strong winds, it turned out difficult to obtain reliable data. We do however believe that the measurements give indications of how the density varies throughout an ice sheet.

The tests have been classified using the classification system shown in Figure 19, based on stress – time development.

Sinha (2011) suggests a use of 2 or 5 mm displacement for obtaining the flow strength of dual-indentor BHJs, equivalent to $\sigma_{0.2\%}$ in tensile tests of steel and aluminum. Therefore, as the UNIS-BHJ has only one indentor, the BH strengths of flow stress failures are here consistently obtained at 10 mm displacement regardless of when contact with the BH wall are established. Naturally, the flow strength could not be obtained where displacement data lacked.

A constant displacement rate allows for new interpretation methods of BHJ data, e.g. calculating the Effective modulus or the mechanical work put into the ice. The former parameter may be compared to the Young's modulus obtained in uniaxial experiments of ice cores taken nearby. Another approach is investigating the mechanical work put into each test, here being introduced as the borehole energy (BHE). The idea is based on working diagrams regularly used in e.g. concrete technology, calculated from the area created by the force – displacement curve. Opposed to the regular interpretation of the stress-displacement curves of BHJ records where the stress at failure of the ice, maximal stress value or stress at a certain displacement usually are investigated; the new method accounts for the work induced to the ice throughout the entire test.

The theoretical maximum BHE is calculated from Equation (1)

$$BHE_{max} = F_{max} \times D \quad (1)$$

where F_{max} is the maximal pressure, 18.3 MPa, times the indentor area, 0.0064 m^2, and D is the displacement from fully retracted to fully extracted piston, 0.05 m (here assuming contact between the BH wall and the indentor established immediately). Hence, the BHE_{max} becomes 5821 Nm.

Table 5: Available data and grid sizes from the ice stations where BHJ tests were conducted or intended conducted.

			Indentor depth(s) [cm]			Measurements at indentor depth			Profiles (Appendix A)		
Ice station	Grid size	Tests	33	66	99	T	S	D	T	S	D
#1	3x3	9	Yes	No	No	Yes	Yes	Yes	Yes (NP)	Yes (NP)	No
#3	2x2	4	Yes	No	No	Yes	Yes	Yes	Yes	Yes	Yes
#5	2x2	12	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
#6	-	-	-	-	-	-	-	-	Yes (NP)	Yes (NP)	Yes
#7	3x3	27	Yes	Yes	Yes	No	No	No	Yes (NP)	Yes (NP)	Yes
#9	4x2	8	Yes	No	No	Yes	No	No	Yes (NP)	Yes (NP)	No

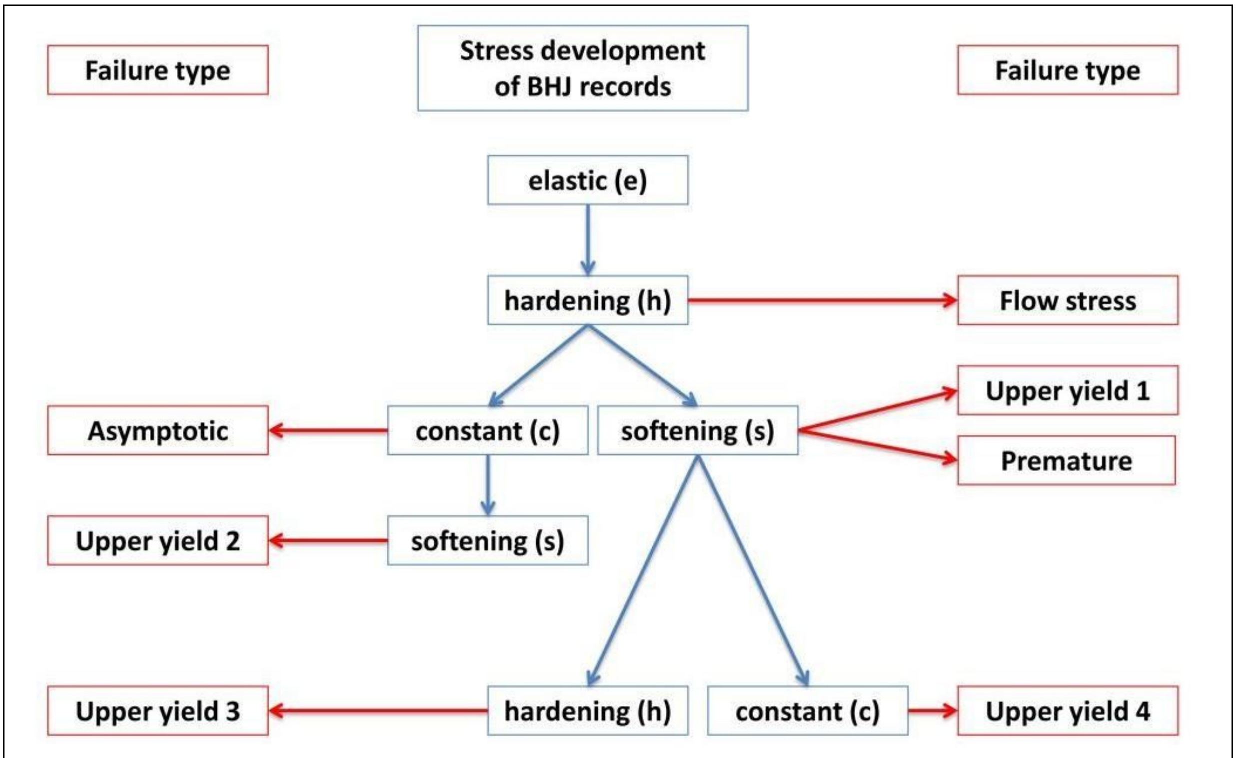


Figure 19: Classification system by Justad (2012).

Fieldwork preparations

After the field season ended in May 2012 the UNIS-BHJ was non-functional due to extensive use. Maintenance was needed and the BHJ was sent to the manufacturer, M-Tech, in Trondheim. During July 2012 the hydraulic oil was changed, the displacement sensor replaced by a new one and the wires of the data logger resoldered. The rubber tubes were investigated and found OK for further use. Figure 20 and 21 show the dismounted jack at M-Tech's premises, July 13.

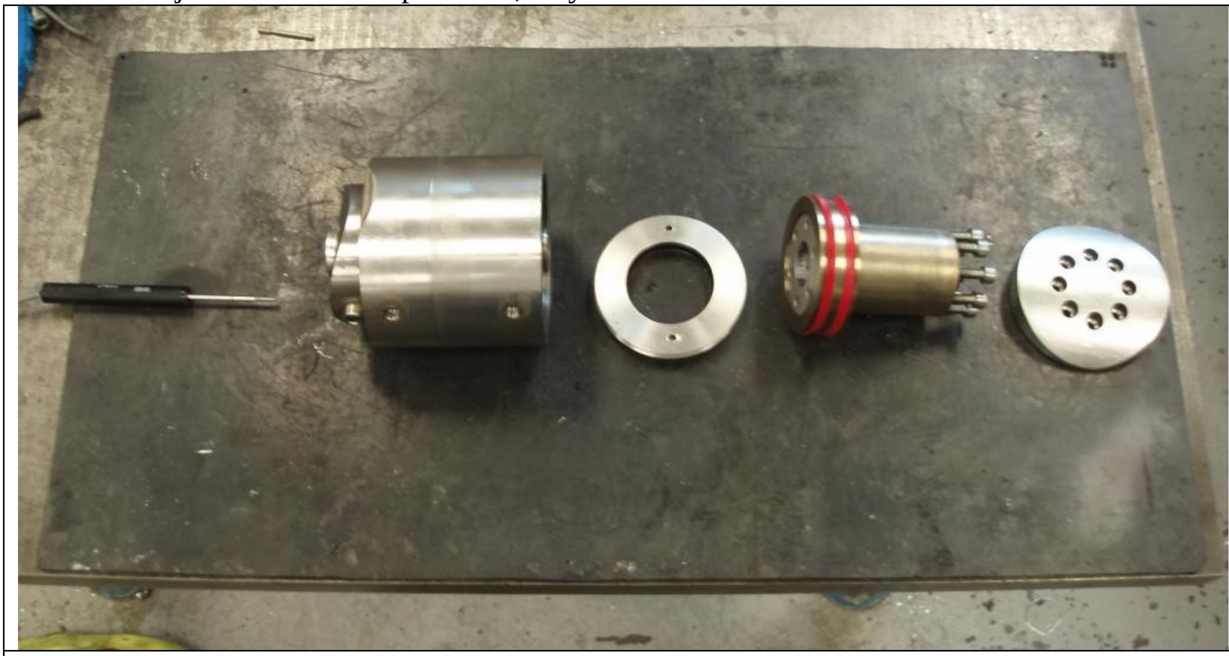


Figure 20: Dismounted jack with displacement sensor, jack, gasket, piston and indentor.

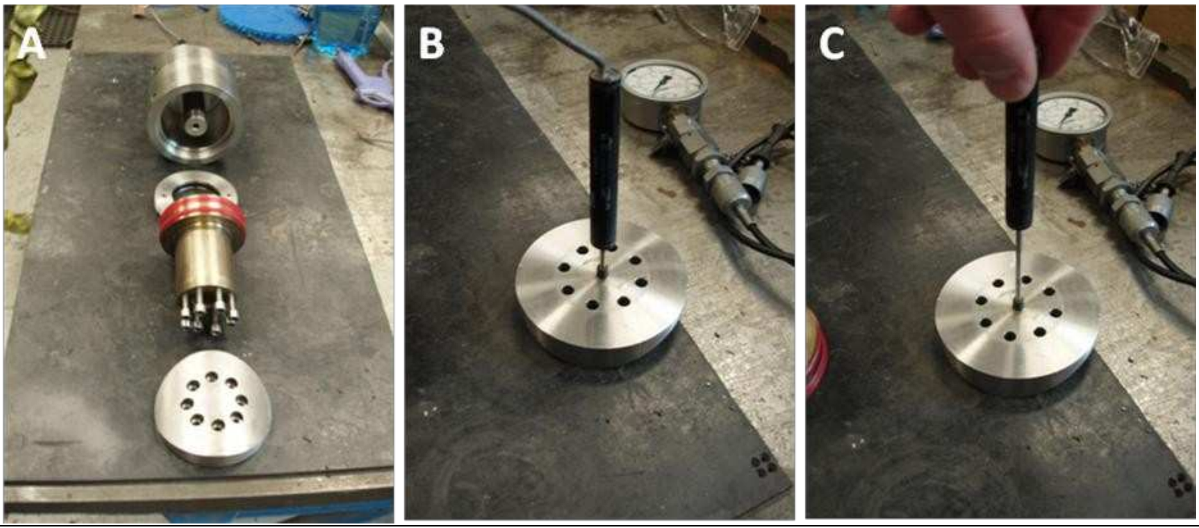


Figure 21 A, B, C: Figure A shows the parts in Figure 20 from a different angle. B and C show the old displacement sensor connected to the indentor, fully retracted and extracted respectively.

Together with Anatoly Sinitsyn we performed a stress calibration August 18 using Knekkis at UNIS. A linear fitting of the results are shown in Figure 22. (For information, this calibration deviates at 2100 mV by 9 kN from the calibration performed March 3.)

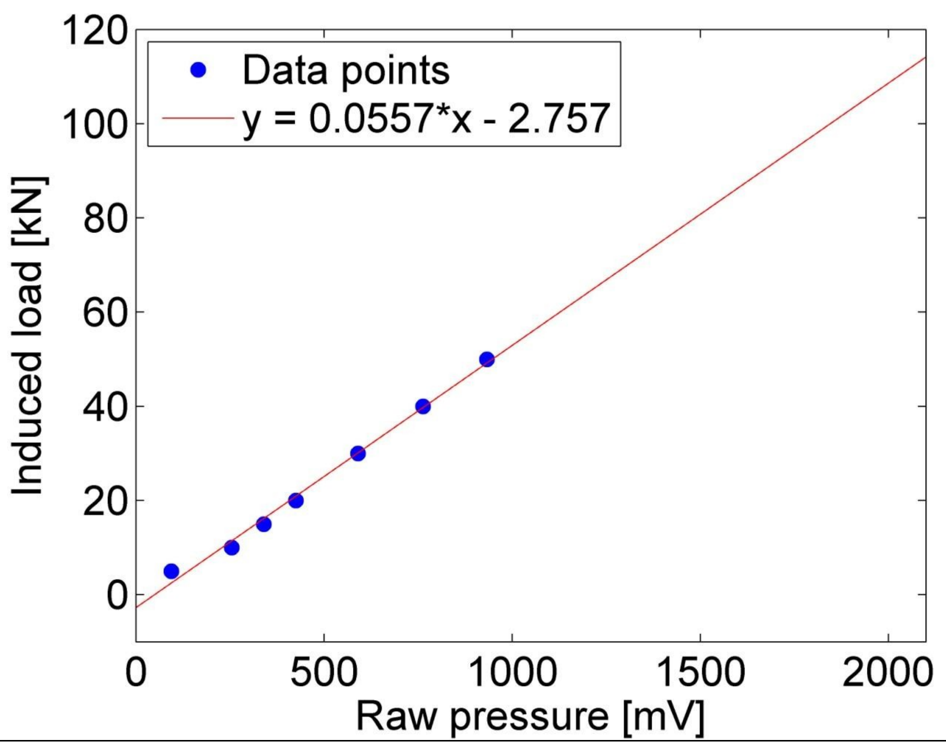


Figure 22: Induced load by Knekkis plotted vs the recorded raw pressure in the data logger of the UNIS-BHJ.

Fieldwork descriptions

Ice station #1

Table 6 sums up time, location and conditions of Ice station #1. We established a 3 by 3 grid with 2 m spacing in vicinity of melted and refrozen ponds in multiyear pack ice. Figure 23 shows a panorama view from the vessel with the location of the test area.

Inspection of the ice cores extracted revealed an ongoing recrystallization process. Grain diameters were estimated to greater than 4 mm.

Table 6: Ice station #1 information.

Date	21.08.12
Activity	BHJ
Northing	78°37’
Westing	003°49’
Ice	Multiyear pack ice with open and refrozen melt ponds
Weather	Overcast
Water temperature	-1.1°C
Air temperature	-0.2°C
Ice thickness	180, >485.5 and 244 cm at three locations (by NP)

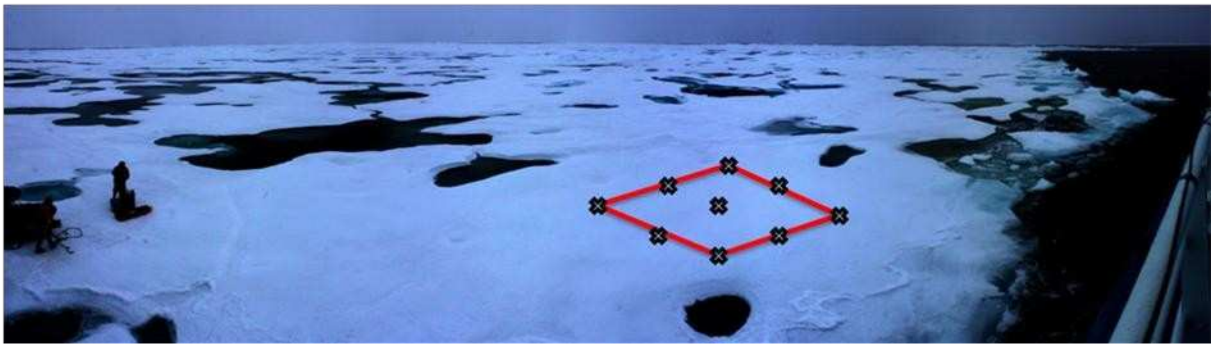


Figure 23: Panorama view from the front deck of R/V Lance. A 3 by 3 grid (36 m^2) was established between melt ponds of multiyear pack ice.

One test was conducted in each BH, resulting in 9 tests. All tests were done at 35 cm where also temperature measurements were done. Salinity and density were measured by cutting discs of thicknesses 5 cm off the core extracted, the former from 32.5 to 37.5 cm and the latter 27.5 to 32.5 cm depth. The exception is BH 9 where density and salinity were measured from the same disc at 32 to 37 cm. Snow depth and ice thickness were measured 2 meters outside the grid, resulting in 4 cm and 2.4 m respectively. The ice thicknesses in each BH are all known to be greater than 70 cm, as this is the length of the core drill used. Freeboard was measured for each BH. The piston twisted about 90° in Test#5. It was however gradually aligned during the next tests, and eventually back in the originally position at Test#8. All tests were done in the same direction, parallel to the ice edge and R/V Lance. NP did three ice thickness measurements resulting in 180, 244 and greater than 485.5 cm (didn’t get through) from the same ice floe.

Ice station #3

Table 7 sums up time, location and conditions of Ice station #3.

Table 7: Ice station #3 information.

Date	23.08.12
Activity	BHJ
Northing	78° 48’

Westing	008° 03’
Ice	Multiyear pack ice with open and refrozen melt ponds
Weather	Overcast
Water temperature	-1.0°C
Air temperature	-0.5°C
Ice thickness	>270 cm at one location (by NP)

A 2 by 2 grid with 4 m spacing was established in multiyear pack ice with open and refrozen melt ponds, see Figure 24. One test was conducted in each BH at test depth 43 cm, where also temperature was measured. Salinity and density was found for discs cut from 42.5 to 47.5 cm in each BH. The thickness of the ice was not found, but must have been greater than 270 cm, which was the depth reached when drilling core for the temperature profile.

Figure 24: Ice station #3. The orange square shows where the grid was established.

Ice station #5

Table 8 sums up time, location and conditions of Ice station #5. At this station we decided to do a new 2x2 grid, Figure 25, with 4 m spacing and but now testing the BH strength at three different test depths, namely 33, 66 and 99 cm. The ones at 33 and 99 cm were directed towards R/V Lance and those at 66 cm parallel to R/V Lance.

Table 8: Ice station #5 information.

Date	26.08.12
Activity	BHJ
Northing	78°52’
Westing	012°18’
Ice	Multiyear fast ice
Weather	Overcast
Water temperature	-0.2°C
Air temperature	-0.2°C
Ice thickness	320, 243, 274, 338 and 410 cm at five locations (by NP)

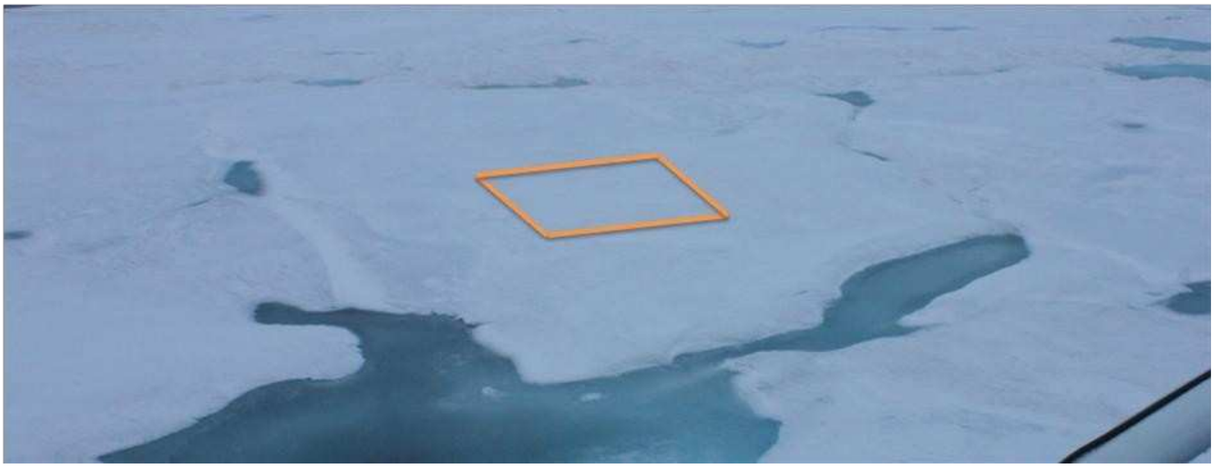


Figure 25: Ice station #5. The orange square shows the location of the grid in multiyear fast ice anchored to ice bergs.

Ice station #6

Table 9 sums up time, location and conditions of Ice station #6. A planned 3 by 3 grid was not done due to malfunction of the displacement sensor of the BHJ. A value of -1.3 mm was consistently recorded regardless of position of the piston. Further checks of the wires of the data logger were conducted in the lab and on deck the following day, neither revealing a solution to the problem. It seemed to us that the displacement sensor was no longer attached to the indentor.
We did a density profile of the first 100 cm of the ice as well as sampling cores to be used in laboratory education at UNIS. They are now stored in the cold room in the Logistics at UNIS, marked "Aleksey Marchenko – Fram Strait 2012".
Table 9: Ice station #6 information.

Date	29.08.12
Activity	BHJ
Northing	79° 13'
Westing	014° 49'
Ice	Multiyear fast ice, anchored to grounded icebergs
Weather	Overcast
Water temperature	-1.1°C
Air temperature	-1.3°C
Ice thickness	225, 649, 431 and 116 cm at four locations (by NP)

Ice station #7

Table 10 sums up time, location and conditions of Ice station #7. A 3 by 3 grid with internal distances 3 m was established. Tests were conducted at 33, 66 and 99 cm depth, corresponding to chain-link 5, 13 and 21. TDS at test depth was therefore only measured at tests depth for BH. After drilling two of the holes, the knives of the core drill were too blunt to be further used. We therefore changed to a 150 mm auger. Hence, no temperature, salinity or density measurements were done at the following test depths, but the NP did salinity and temperature profiles on the same ice floe, approximately 5 meters from our grid. At last we established a density profile in the same area as NP had worked. The ice thickness was here measured to 385 cm and freeboard 54 cm.

Table 10: Ice station #7 information.

Date	31.08.12
Northing	78°48’
Westing	008°10’
Ice	Multiyear, possibly rafted, ice floe of approx size 100 by 60 m
Weather	Overcast and fog
Water temperature	-0.6°C
Air temperature	0.0°C
Ice thickness	385 cm at one location (by us)

The weather was overcast with some fog, see Figure 26, and swells. Swells cause tension and compression in the ice, but considering this floe had a minimum measured thickness of 3.5 m, we assume the swells to have a negligible effect on the results. The tests at 33 and 99 cm were done towards R/V Lance, while the ones at 66 cm were done parallel to the vessel.

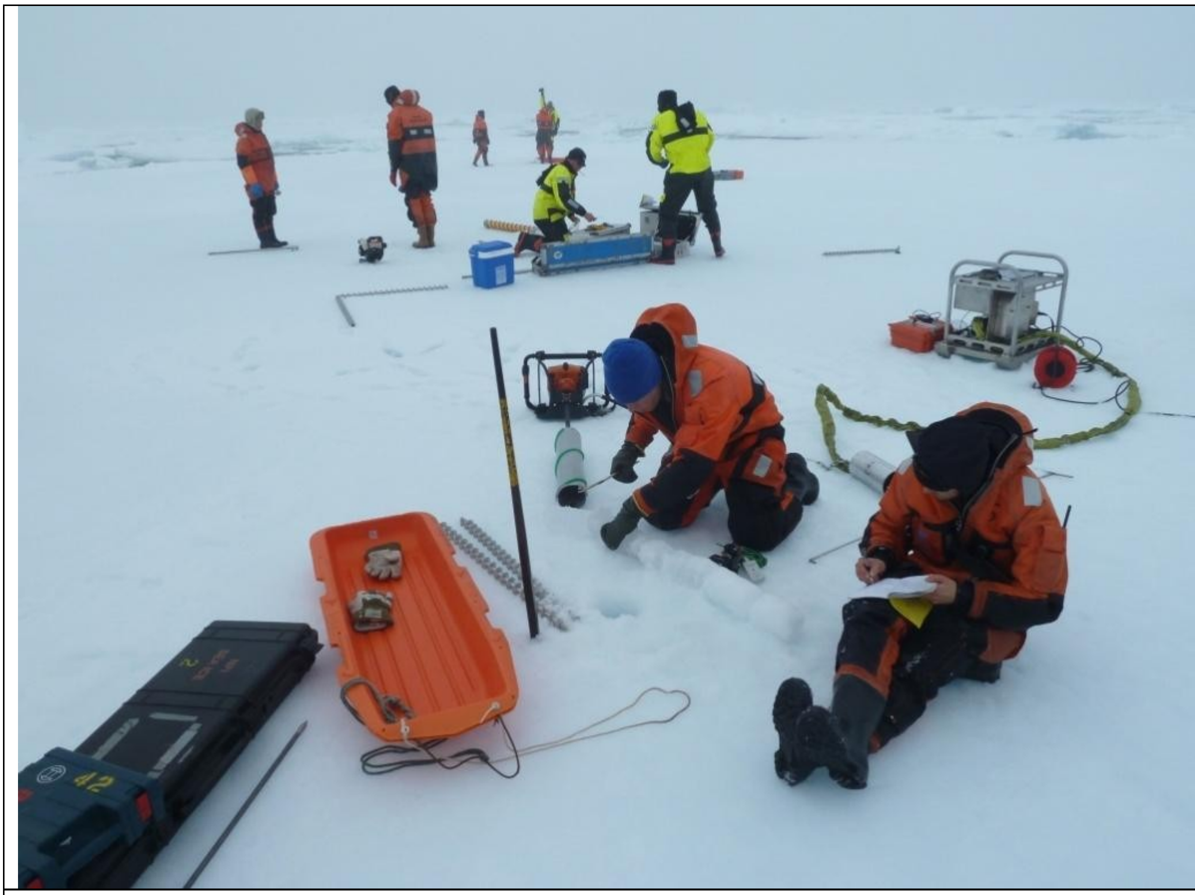


Figure 26: Working on an arbitrary core extracted from a BH on Ice station #7. The BHJ is

here stationed approximately in the center of the grid. Photo courtesy of Gunnar Spreen of NP.

Cracking noises were often observed for tests conducted at 33 cm. Snow/ice crystals of diameter larger than 3 mm was typical for the approx 20 top cm of the ice cover (reminded of hail).

Ice station #9

Table 11 sums up time, location and conditions of Ice station #9. The first four tests were done in what appeared to be relatively flat ice, in distance approx 3 m from the edge of the floe, see Figure 27. The next four (going back) were done in rubble/rafted and weathered ice. All tests were done at 33 cm depth, where also temperature was measured, with indentor direction parallel to R/V Lance.
The ice was less porous than what has been encountered before on the cruise, which was substantiated by cracking noises for most of the tests. Brittle failures with radial cracking and spalling failures also occurred.
It is questionable if the NP profiles representative for our floe as these were done on the other side of the ice ridge going across the floe.

Table 11: Ice station #9 information.

Date	08.09.12
Northing	77°51’
Westing	W 004°46’
Ice	Multiyear rafted and riged ice floe of approx size 70 by 70 m.
Weather	Clear sky
Water temperature	-1.6°C (ship log), -0.2°C measured
Air temperature	-2.6°C (-3.2°C at surface)
Ice thickness (on other side of the floe)	268 and 253 cm at two locations (by NP)
Pictures	from 0393 corresponds to the last BH

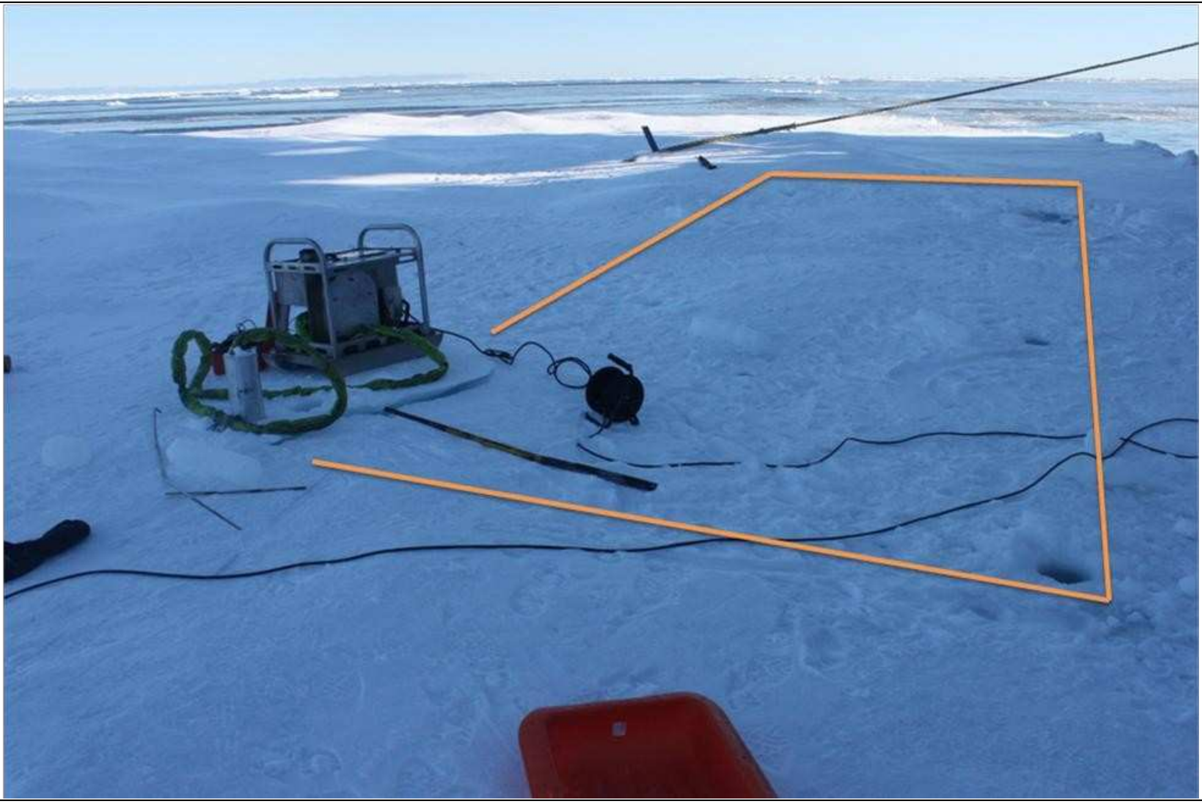


Figure 27: Ice station #9. The orange square shows the location of the grid and BHJ at test 8 where a spalling failure occurred.

Results

This chapter presents the BHJ records plotted as stress-indentation or stress-time with all available data on ice conditions. It also looks into the recorded displacement where a flow stress and an asymptotic failure are compared. It further shows how the borehole strength (BHS) varies with T, S, D and borehole energy (BHE) where these parameters are available. The spatial variability of T, S, D and BH strength (BHS) was found for Ice stations #1, #3 and #5 and are presented in Appendix B.

BHJ test descriptions

Ice station #1:

Table 12 to 16 sums up the collected data for all tests conducted, while Figure 28 to 39 show all tests plotted stress-indentation or stress-time curves.

Table 12: BHJ data from Ice station #1. All tests were done at 33 cm depth.

Test#	BH	FB [cm]	T [degC]	S [ppt]	Density [kg/m^3]	Failure type	BHS [MPa]
1	1.1	29.0	0.0	0.0	874.98	FS	9.71
2	2.1	35.0	-0.1	0.0	924.24	FS	7.19
3	3.1	27.0	-0.1	0.4	954.53	FS	7.26
4	3.2	25.0	0.0	0.2	806.53	FS	7.59
5	3.3	17.0	-0.4	0.2	927.48	UY3	2.47
6	2.3	21.0	-0.2	0.0	930.73	FS	6.16
7	1.3	31.0	-0.2	0.0	854.05	UY3	12.4
8	1.2	29.0	-0.2	0.0	1075.37	AS	13.4
9	2.2	22.0	-0.2	0.0	822.51	FS	7.4

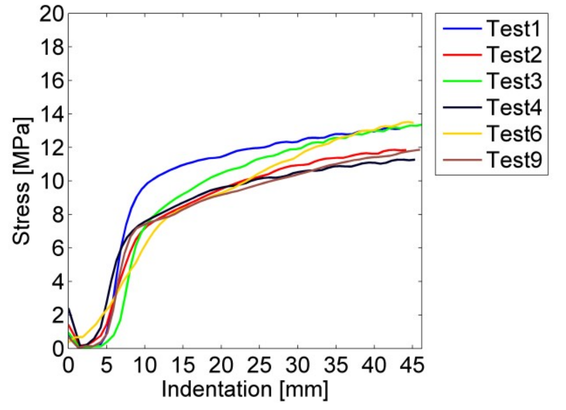


Figure 28: Flow stress failures at Ice station #1.

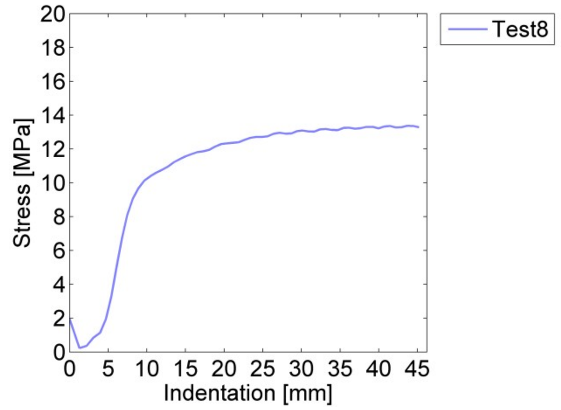


Figure 29: Asymptotic failures at Ice station #1

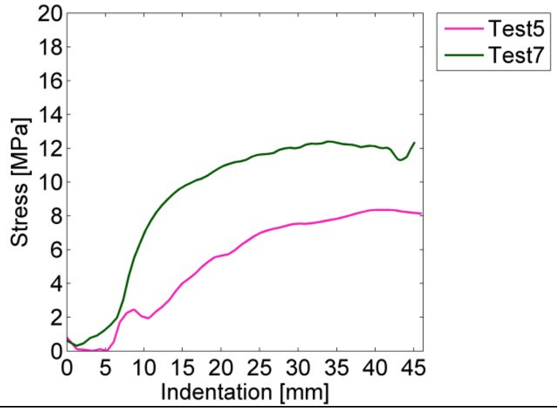


Figure 30: Upper yield 3 failures at Ice station #1.

Ice station #3:

Table 13: Local conditions in BHs at test depth as well as failure type of ice station #3.

Test#	BH	h_s [cm]	FB [cm]	T [°C]	S [ppt]	Density [kg/m^3]	Failure type	BHS [MPa]
1	1.2	3.0	49.0	-0.1	0.0	985.76	FS	11.50
2	1.1	-	42.0	0.0	0.0	933.32	AS	14.00
3	2.1	3.0	47.0	-0.1	0.3	999.21	FS	5.19
4	2.2	2.0	-	0.0	0.0	933.32	FS	9.15

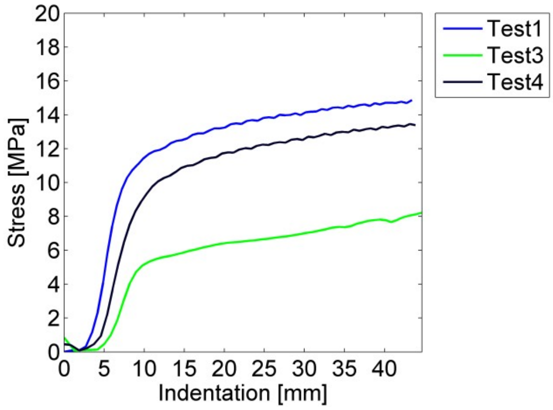


Figure 31: FS failures of Ice station #3.

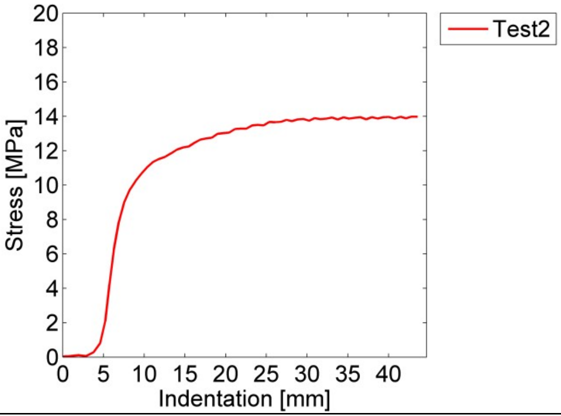


Figure 32: AS failure of Ice station #3.

Ice station #5:

Table 14: Snow depth, ice thickness and freeboard for the respective BHs in addition to temperature, salinity and density at indentor depths at Ice station #5.

Test#	BH	h_s [cm]	h_i [cm]	FB [cm]	ID [cm]	T [degC]	Salinity [ppt]	Density [kg/m^3]	Failure type	BHS [MPa]
1	1.2	-	242	33	33	0.1	0.0	961.08	UY3	16.31
2	1.2	-	242	33	66	-0.3	1.4	988.54	FS	7.47
3	1.2	-	242	33	99	-0.6	1.6	985.76	AS	16.90
4	1.1	1.0	300	40	33	-0.1	0.0	961.81	AS	15.30
5	1.1	1.0	300	40	66	-0.4	0.9	1006.15	AS	11.80
6	1.1	1.0	300	40	99	-0.9	2.2	975.21	AS	16.90
7	2.1	2.0	336	36	33	0.1	0.0	994.72	FS	8.67
8	2.1	2.0	336	36	66	-0.5	0.7	969.21	FS	9.30
9	2.1	2.0	336	36	99	-1.0	1.6	997.21	AS	17.20
10	2.2	2.5	243	32	33	0.0	0.0	914.68	FS	8.33
11	2.2	2.5	243	32	66	-0.4	1.7	1061.03	FS	6.27
12	2.2	2.5	243	32	99	-0.7	2.3	982.44	FS	11.30

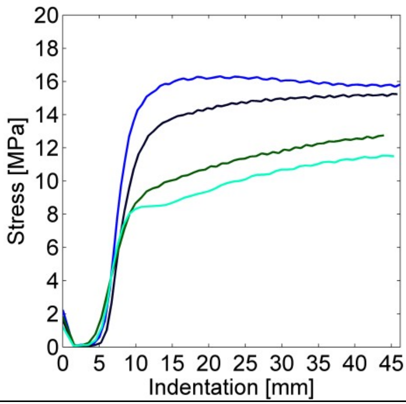


Figure 33: Tests done at 33 cm depth, Ice station #5.

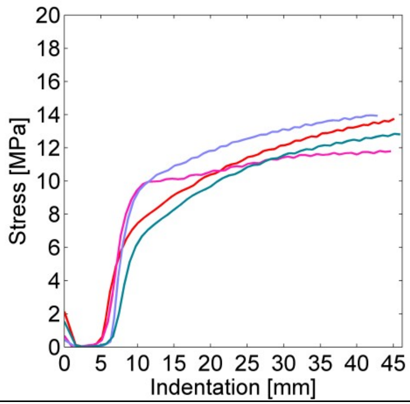


Figure 34: Tests done at 66 cm depth, Ice station #5.

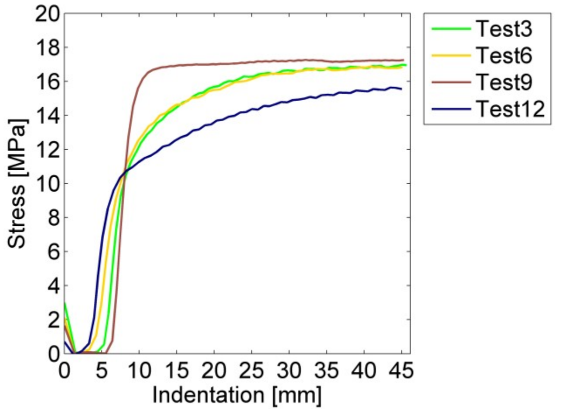


Figure 35: Tests done at 99 cm depth, Ice station #5.

Ice station #7:

Table 15: Snow depth, ice thickness and freeboard for the respective BHs in addition to temperature, salinity and density at indentor depths at Ice station #7. The ice thickness was not found for any of the BHs.

Test#	BH	h_s [cm]	h_i [cm]	ID [cm]	FB [cm]	T [degC]	Failure type	BHS [MPa]
1	3.1	0.5	-	33	47	0.2	FS	-
2	3.1	0.5	-	66	47	-0.1	FS	-
3	3.1	0.5	-	99	47	-0.4	FS	-
4	1.1	0.5	-	33	24	0.2	FS	-
5	1.1	0.5	-	66	24	0.2	FS	-
6	1.1	0.5	-	99	24	-0.4	FS	-
7	2.1	0	-	33	39	-	FS	-
8	2.1	0	-	66	39	-	FS	-
9	1.2	4	-	33	12	-	FS	-
10	1.2	4	-	66	12	-	FS	-
11	1.2	4	-	99	12	-	FS	-
12	2.2	4	-	33	15	-	FS	-
13	2.2	4	-	66	15	-	FS	-
14	2.2	4	-	99	15	-	FS	-
15	3.2	1.5	-	33	28	-	FS	-
16	3.2	1.5	-	66	28	-	FS	-
17	3.2	1.5	-	99	28	-	FS	-
18	1.3	0.5	-	33	39	-	FS	-
19	1.3	0.5	-	66	39	-	FS	-
20	1.3	0.5	-	99	39	-	FS	-
21	2.3	1	-	33	54	-	FS	-
22	2.3	1	-	66	54	-	FS	-
23	3.3	1	-	33	50	-	FS	-
24	3.3	1	-	66	50	-	FS	-
25	3.3	1	-	99	50	-	UY3	5.35
26	2.1	0	-	99	39	-	FS	-
27	2.3	1	-	99	54	-	FS	-

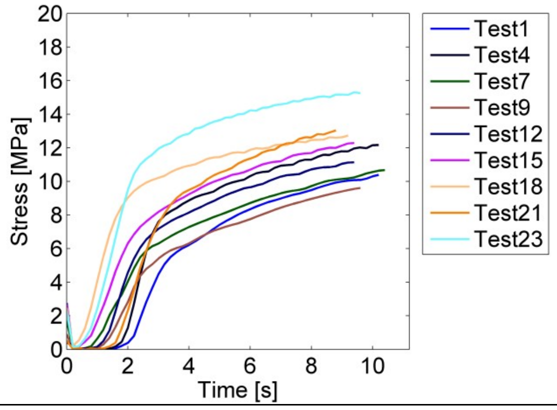


Figure 36: Tests done at 33 cm depth, Ice station #7.

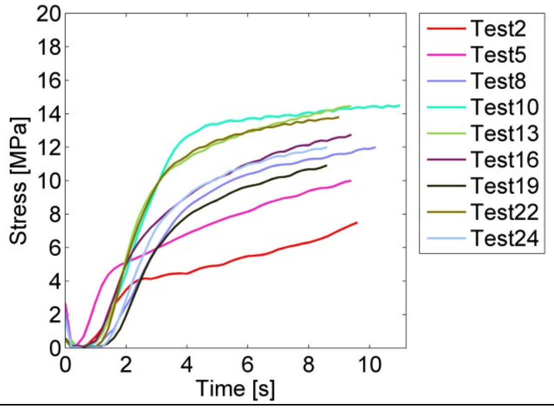


Figure 37: Tests done at 66 cm depth, Ice station #7.

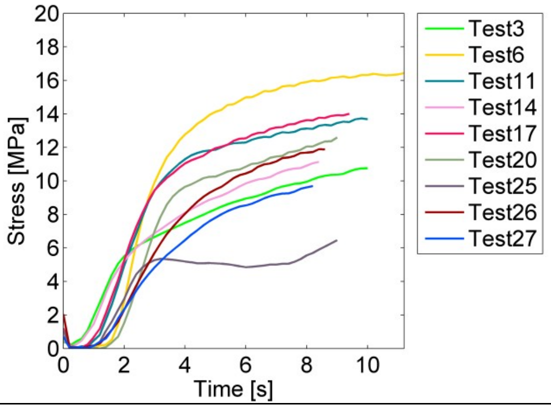


Figure 38: Tests done at 99 cm depth, Ice station #7.

Ice station #9:

Table 16: Freeboard for all BHs and temperature measurements at test depth, 33 cm, for Ice station #9.

Test#	BH	FB [cm]	T [degC]	Failure type	BHS [MPa]	Comments
1	1.1	9	-0.2	FS	-	
2	1.2	13	-0.2	UY1	16.6	Radial cracks
3	1.3	12	-1.7	P	13.4	
4	1.4	28	-1.4	UY2max	18.3	Radial cracks and spalling failure
5	2.4	30	-1.1	FS	-	
6	2.3	30	-0.8	Asmax	18.1	
7	2.2	15	-0.1	FS	-	
8	2.1	31	-1.9	UY2max	18.5	Spalling failure

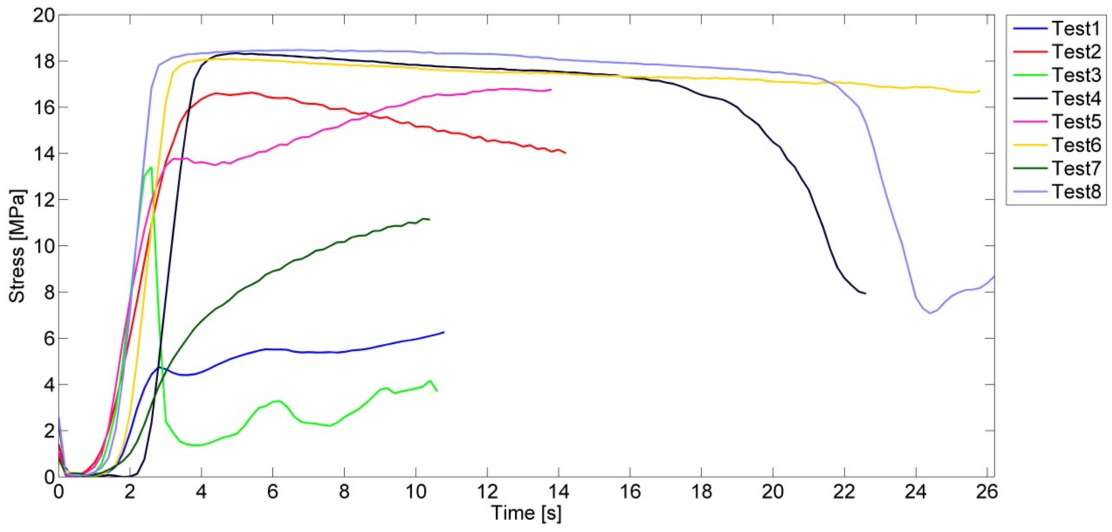
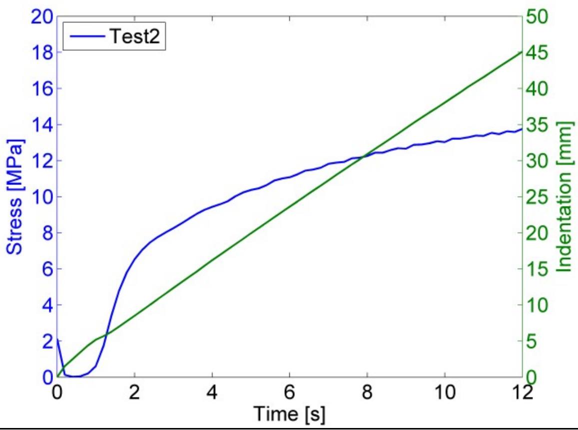


Figure 39: Stress vs time plotted for all tests done at Ice station #9. All tests conducted at 33 cm and reached 50 mm displacement.

Displacement

Figure 40 and 41 A and B compare the development of a flow stress and an asymptotic failure to each other, A) showing stress and indentation and B) indentation rate vs time from Ice station #5.

A



B

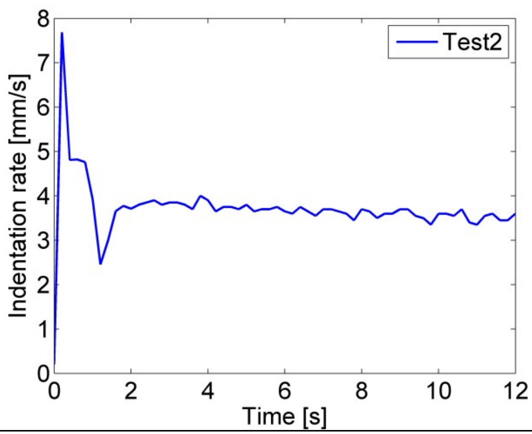
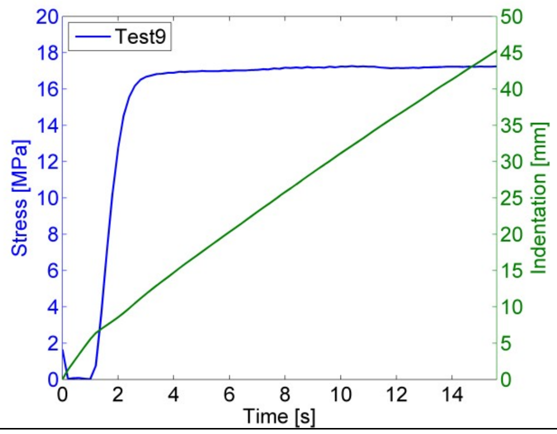


Figure 40: A) Stress and indentation and B) indentation rate for Test 2 at Ice station #5.

A



B

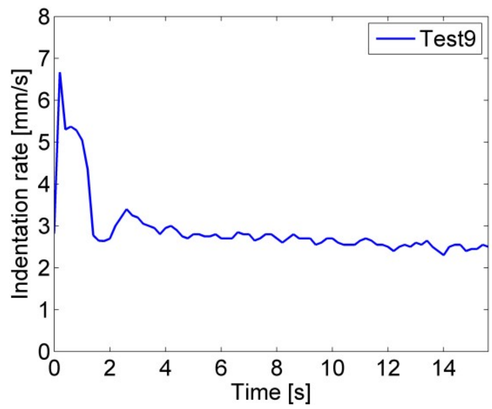
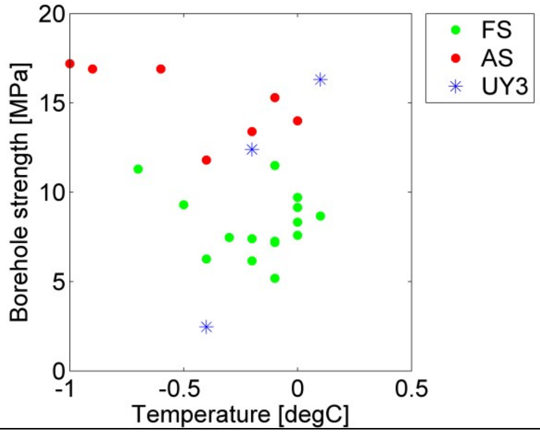


Figure 41: A) Stress and indentation and B) indentation rate for Test 9 at Ice station #5.

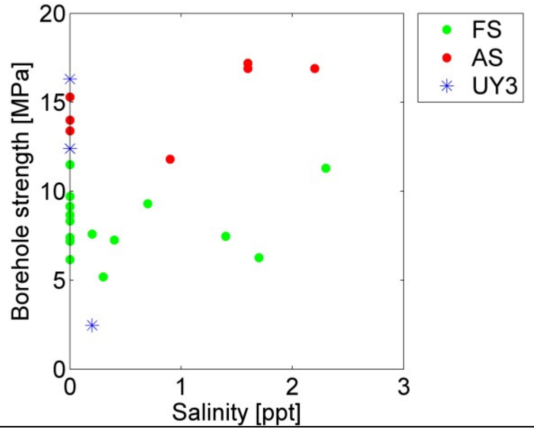
Summing up Ice station #1, #3 and #5

Figures 42 A, B, C, D and E show how the BHS vary with T, S, D, ID and BHE for ice stations #1, #3 and #5.

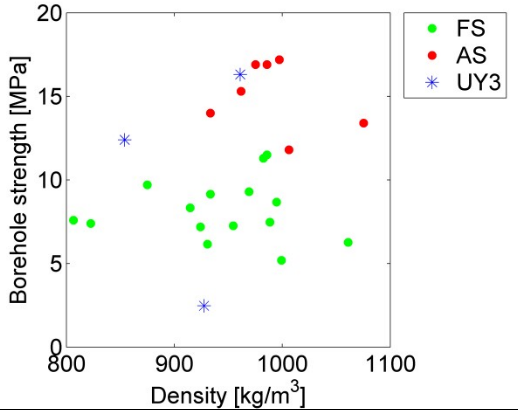
A



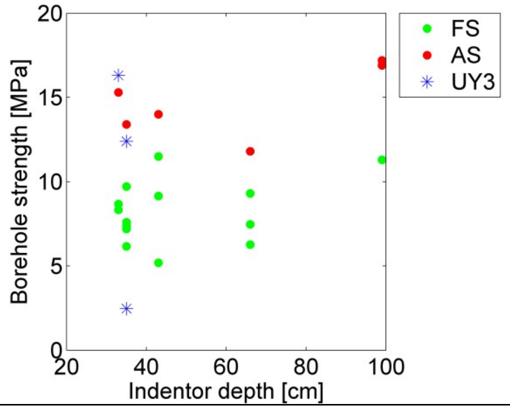
B



C



D



E

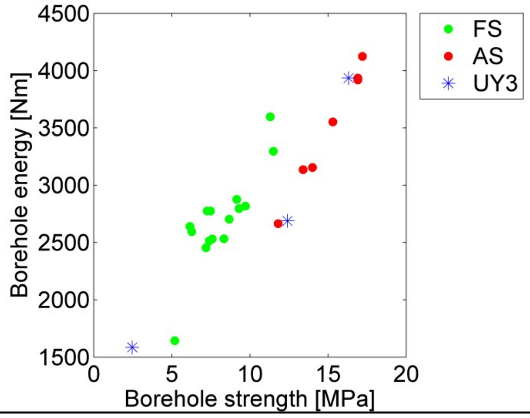


Figure 42 A, B, C, D, E: BHS plotted vs T, S, D and BHE.

Discussion

Displacement sensor

With a new displacement sensor installed it is possible to evaluate data also on this parameter. It is tested in air and found accurate down to +/- 3 mm. It is further seen that the displacement is linearly increasing, exemplified in Figure 40 A. It is noted that this is also the case for the higher loads encountered in Figure 41 A, where approx 90% of the capacity of the system is required. This may open for studies also on strain rate dependent parameters of BHJ experiments. ASmax failures were not encountered and the displacement of the indentor while encountering strong and stiff ice is therefore not yet known. Assistance from M-Tech may come necessary in order to fix the problem with the displacement sensor, but the first priority should be getting a map of the wires of the data logger, so that these can be checked.

Displacement rate

From Figure 40 A, B and 41 A, B it is seen that the rate is slightly greater before contact is established with the BH wall. The two tests compared are typical for all tests conducted; a near constant displacement rate after contact is established with the BH wall. It is also noted that the displacement rate is varying during the two first seconds, unfortunately leaving the Effective modulus a questionable parameter to describe with the current UNIS-BHJ system.
The right y-axis should be named Displacement rather than Indentation, as the indentation of the BH wall does not immediately.

BHE vs BHS

BHE vs T, S, D etc are not plotted here since the difference between BHS and BHE is marginal, as seen from Figure 42 E. The fact that the difference is so small questions the necessity of this new parameter. The fracture energy, another parameter frequently used in concrete technology, has not been evaluated here, but is also a parameter that could be investigated. Here, it would be calculating the BH energy it takes for a failure to occur. However, this parameter is not suitable for describing the flow stress and asymptotic failures, as these do not fail in that sense.

Flow strength

The flow strength of the ice cannot be found using the definition by Sinha (2011) without a working displacement sensor. An option may be to introduce a method based on time instead of displacement, but this conflict with the principle of the mechanical response in materials exposed to loadings.

References

Justad, J. A. (2012), ‘The UNIS Borehole Jack; Description, fieldwork and new classification system’, Master thesis NTNU/UNIS.

Sinha, N. K. (2011), ‘Borehole indentor – A tool for assessing in-situ bulk ice strength and micromechanics’, *Cold Regions Science and Technology*.

Appendices NTNU report (full report appendices at the end)

NTNU Appendix A: TSD profiles

Ice station #1

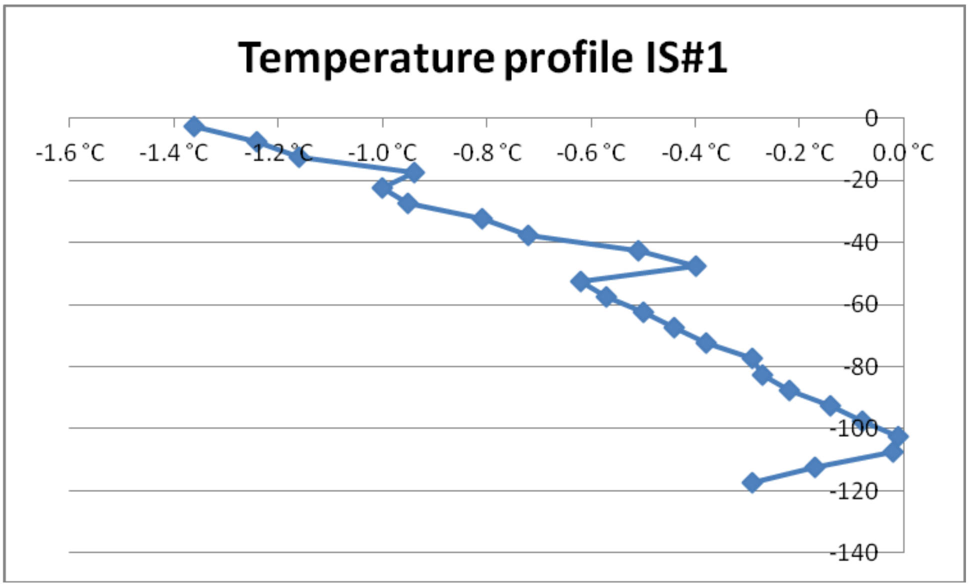


Figure A1: Temperature profile from center of Ice station #1. x-axis represent values in °C and y-axis cm, NP (2012).

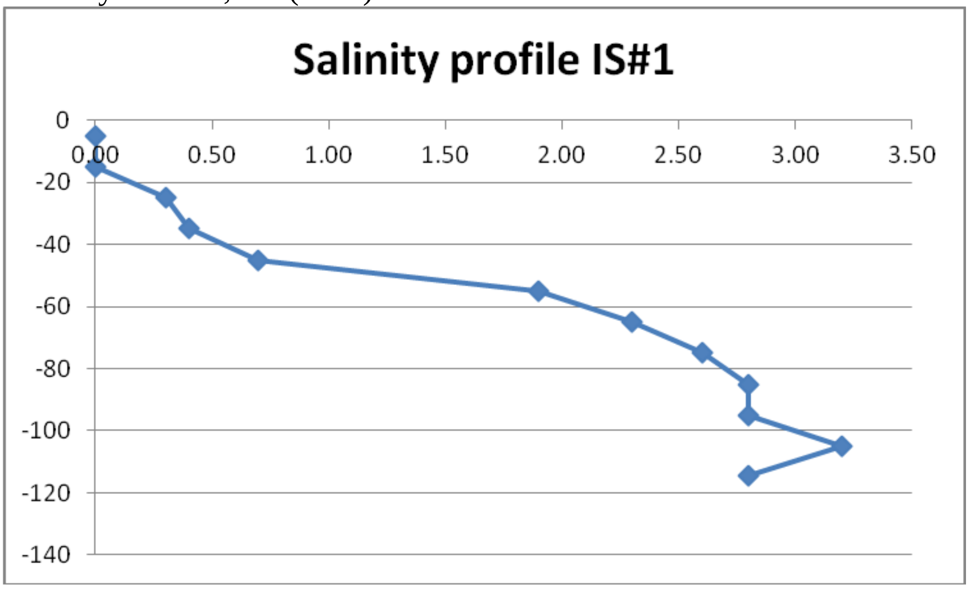


Figure A2: Salinity profile from center of Ice station #1. x-axis represent values in ppt and y-axis cm, NP (2012).

Ice station #3

Temperature was measured down to 270 cm while salinity and density measured were measured to 198 and 183 cm respectively. The thickness of the ice was not found.

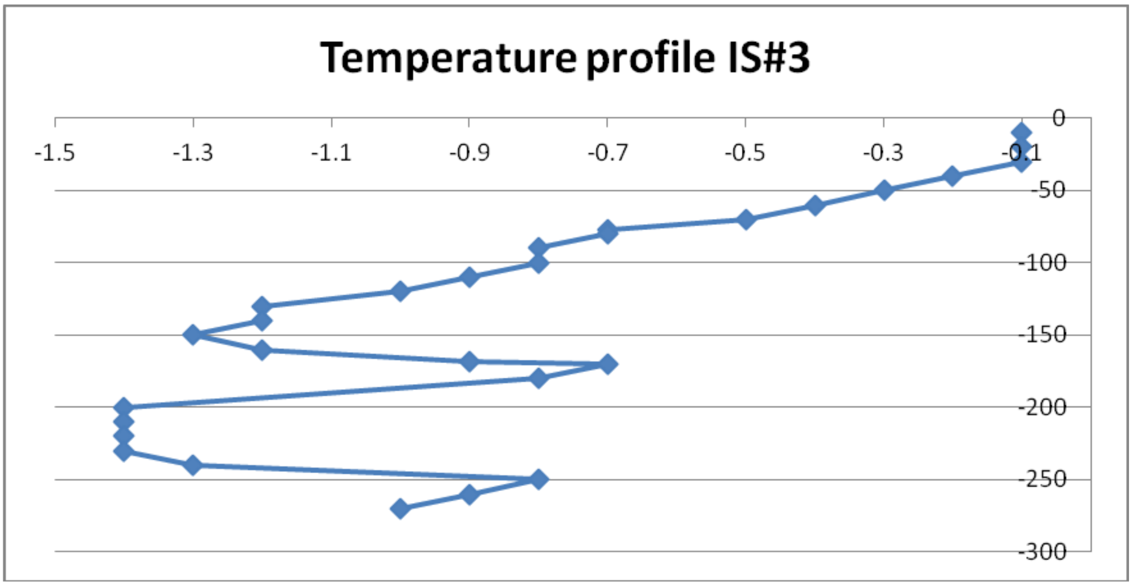


Figure A3: Temperature profile from center of Ice station #3. x-axis represent values in °C and y-axis cm.

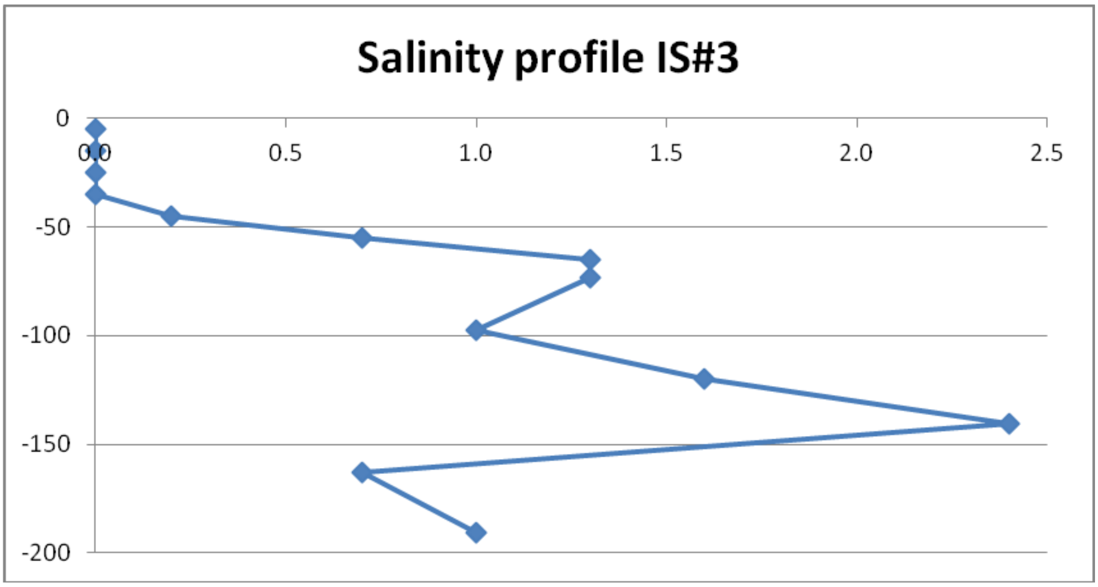


Figure A4: Salinity profile from center of Ice station #3. x-axis represent values in ppt and y-axis cm.

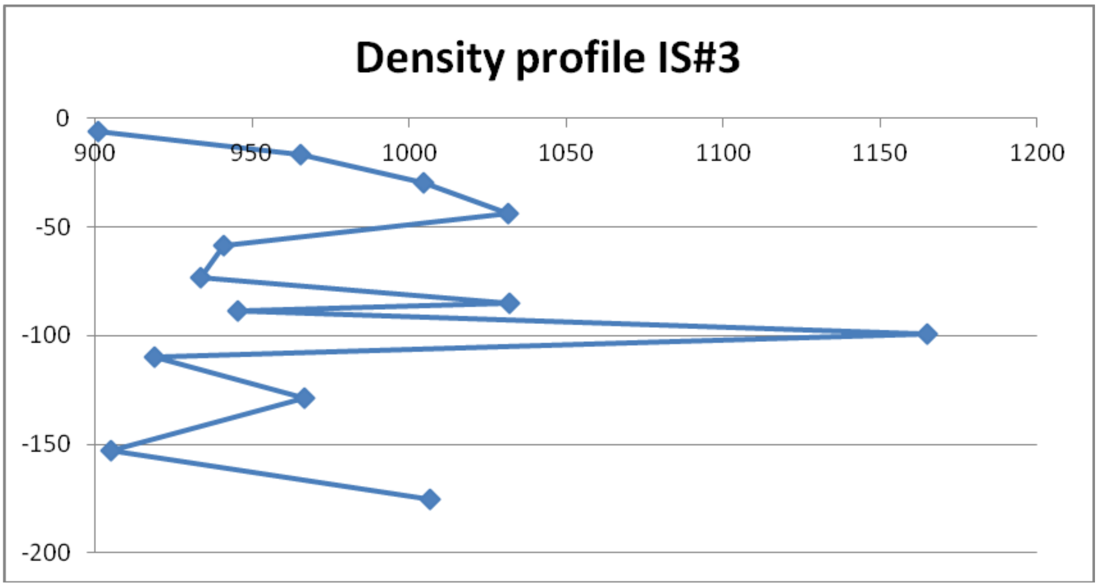


Figure A5: Density profile from center of Ice station #3. x-axis represent values in kg/m^3 and y-axis cm.

Ice station #5

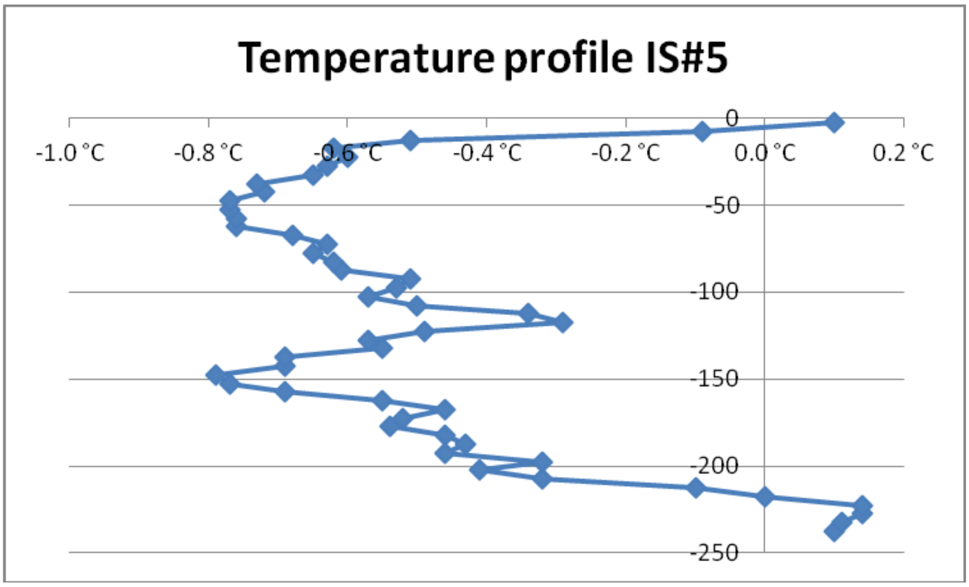


Figure A6: Temperature profile from center of Ice station #5. x-axis represent values in °C and y-axis cm, NP (2012).

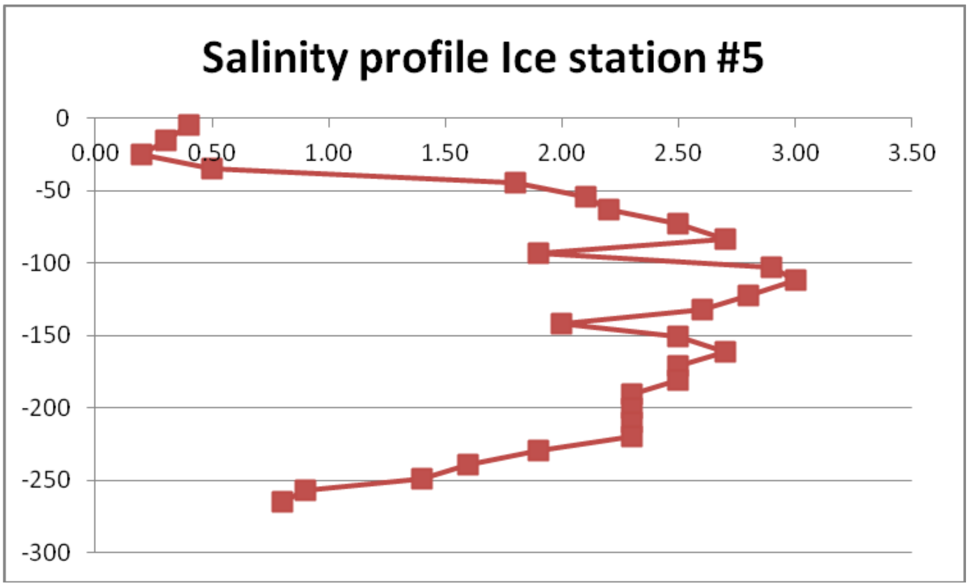


Figure A7: Salinity profile provided by NP approximately 10 meters from the outer edge of our grid. x-axis represent values in ppt and y-axis cm (NP, 2012).

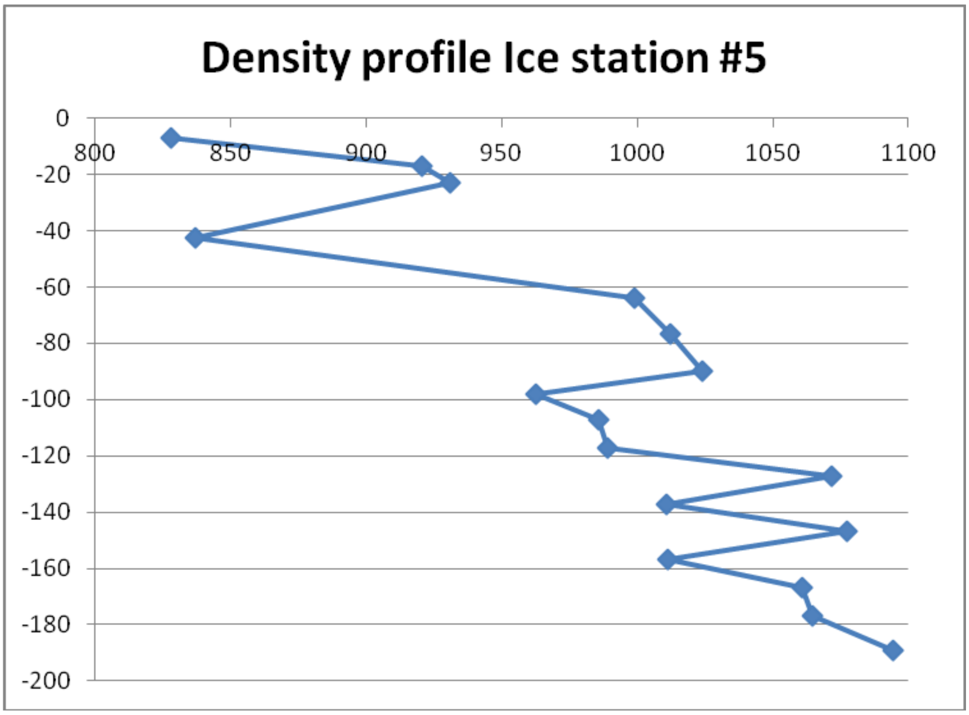


Figure A8: Density profile. x-axis represent values in kg/m^3 and y-axis cm.

Ice station #6

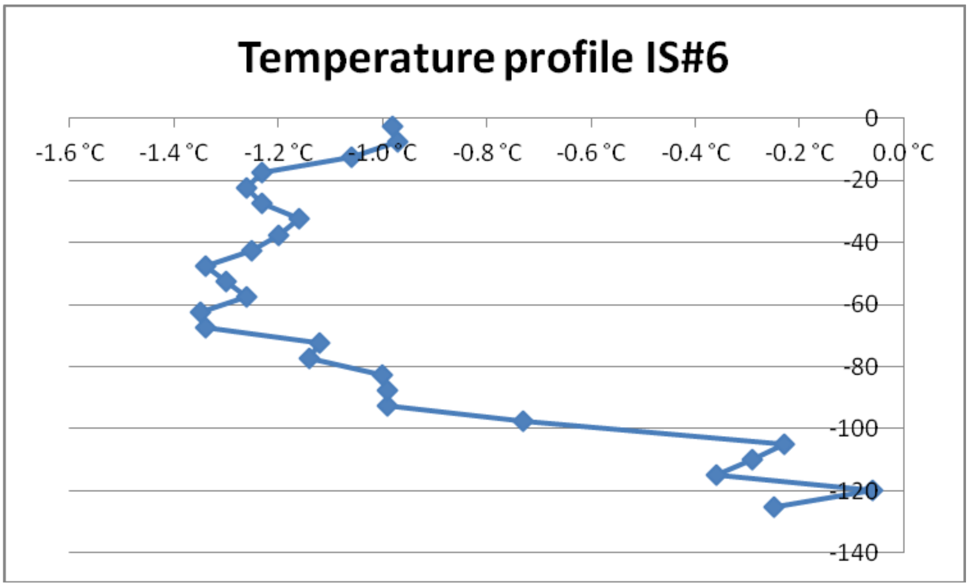


Figure A9: Temperature profile from center of Ice station #6. x-axis represent values in °C and y-axis cm, NP (2012).

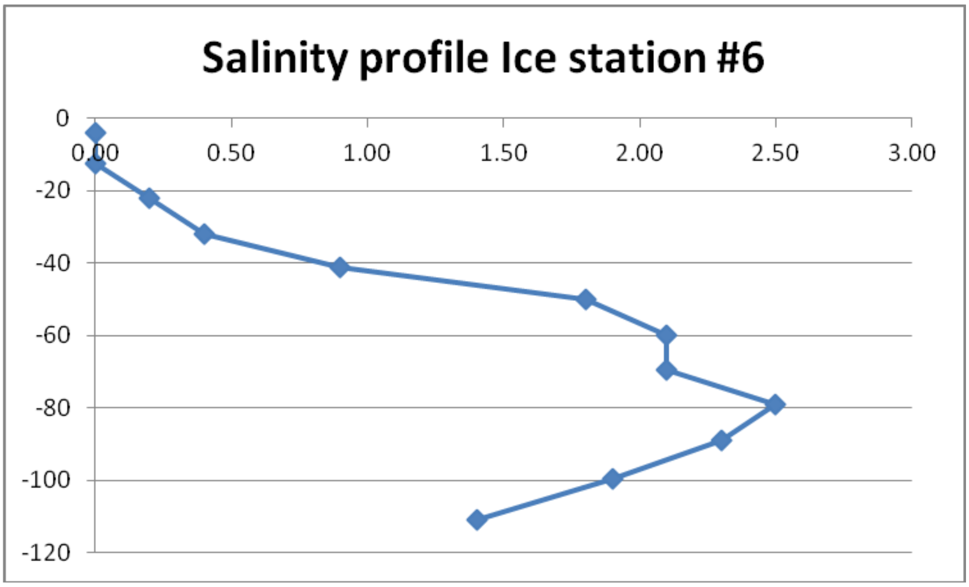


Figure A10: Salinity profile provided by NP from the same ice floe as Ice station #5 was established. x-axis represent values in ppt and y-axis cm (NP, 2012).

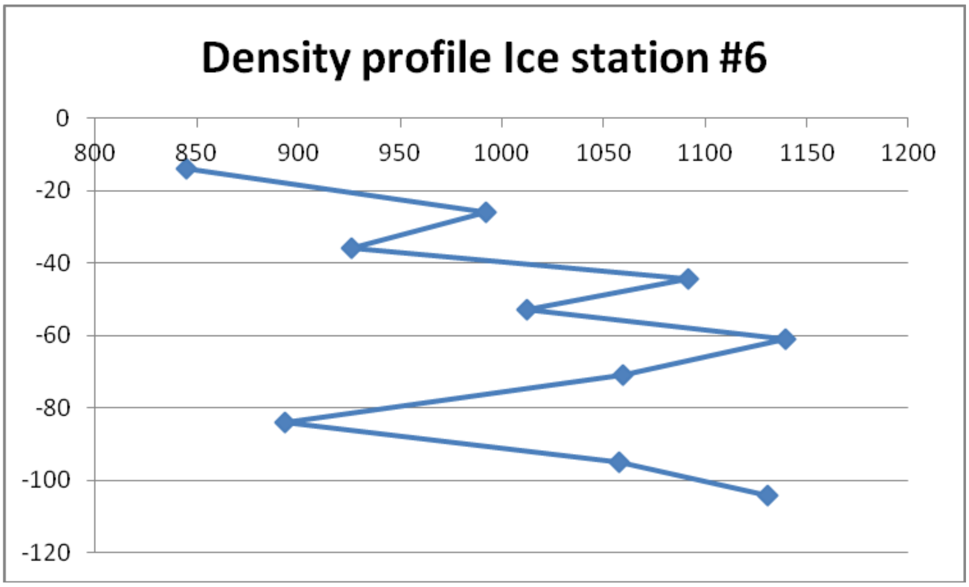


Figure A11: Density profile from Ice station #5. x-axis represent values in kg/m^3 and y-axis cm.

Ice station #7

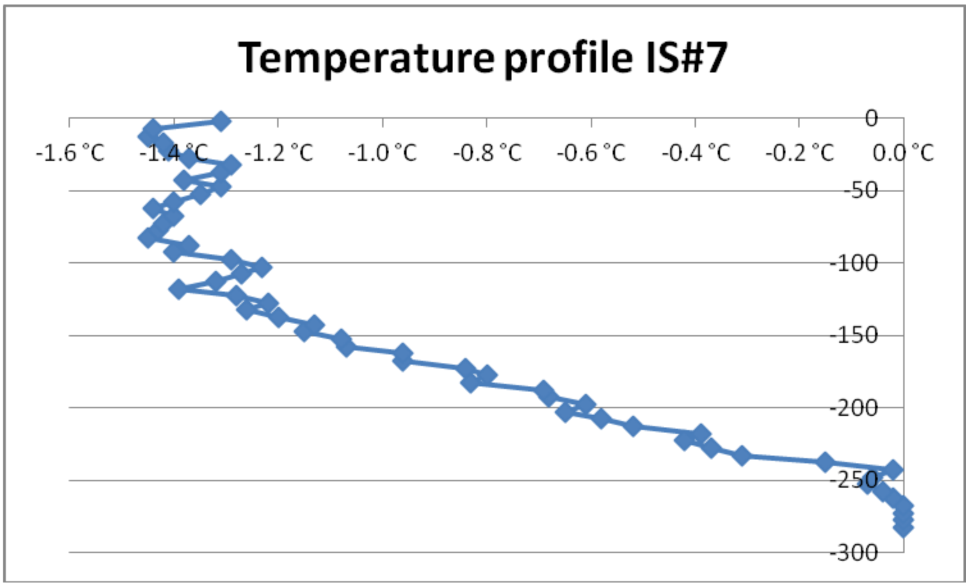


Figure A12: Temperature profile from center of Ice station #7. x-axis represent values in °C and y-axis cm, NP (2012).

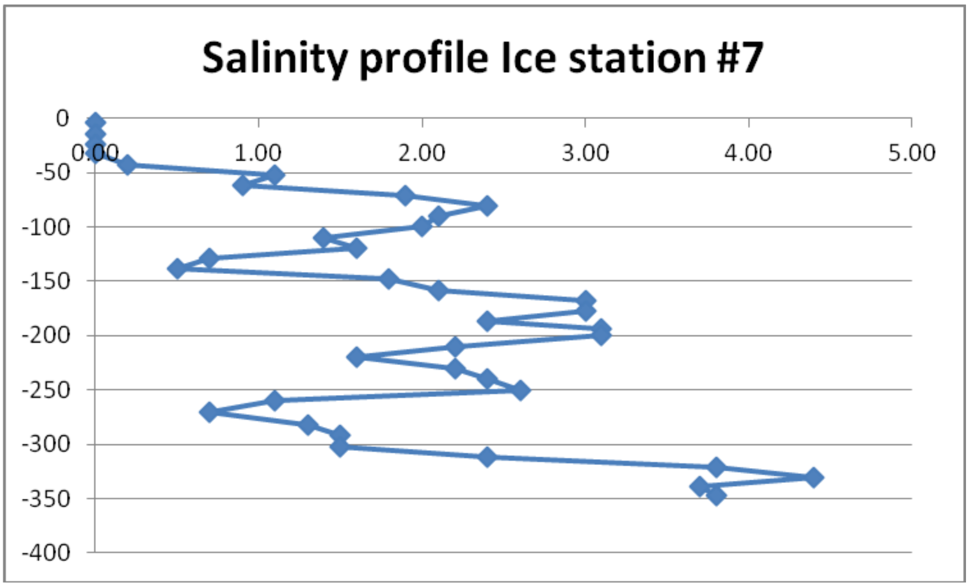


Figure A13: Salinity profile provided by NP from the same ice floe as Ice station #7 was established. x-axis represent values in ppt and y-axis cm (NP, 2012).

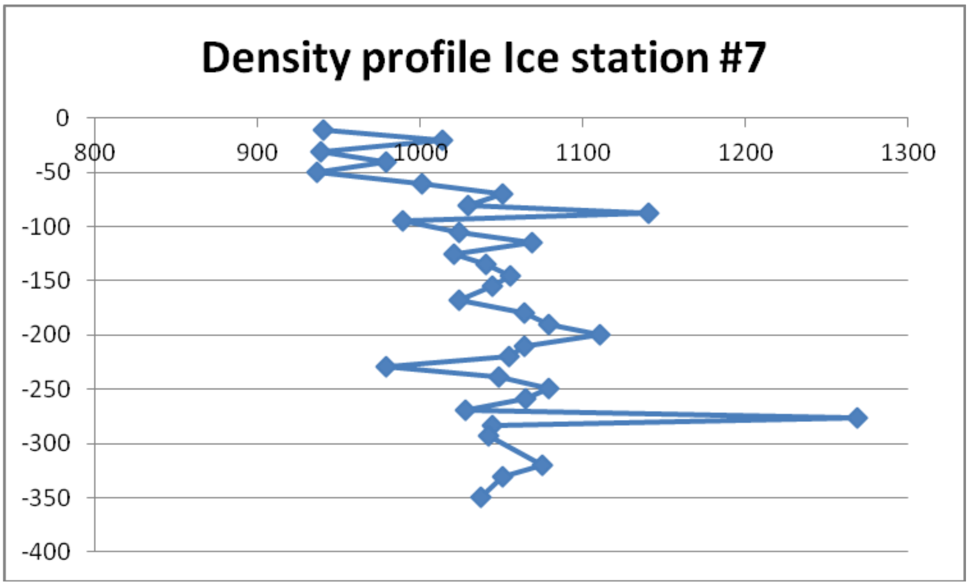


Figure A14: Density profile from Ice station #7. x-axis represent values in kg/m^3 and y-axis cm.

Ice station #9

The profiles given here (all from NP) was collected on the other side of a ridge which went across the ice floe. It is therefore not known if the profiles are valid for the ice which BHJ tests were conducted.

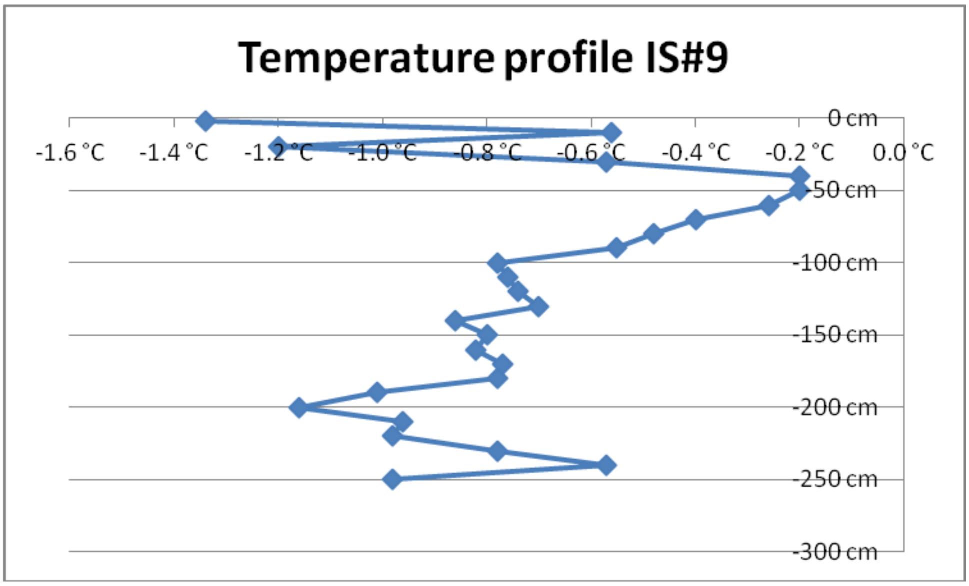


Figure A15: Temperature profile from center of Ice station #9. x-axis represent values in °C and y-axis cm, NP (2012).

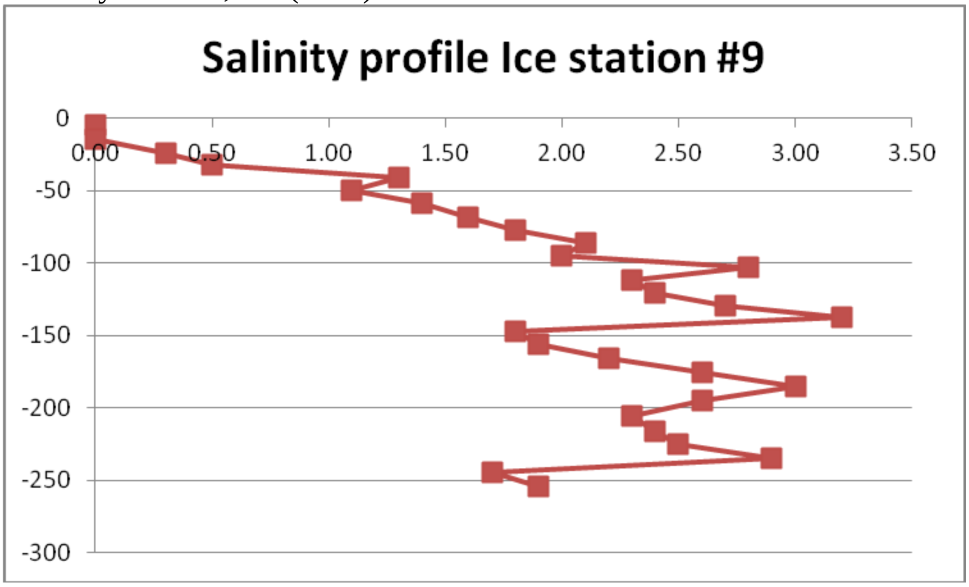


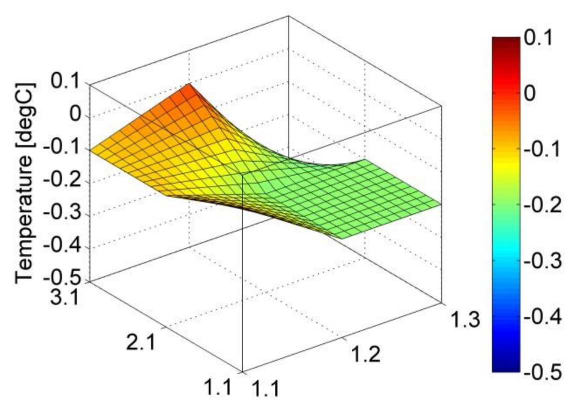
Figure A16: Salinity profile from Ice station #9. x-axis represent values in ppt and y-axis cm, NP (2012).

NTNU Appendix B: Spatial variability of TSD and BHS

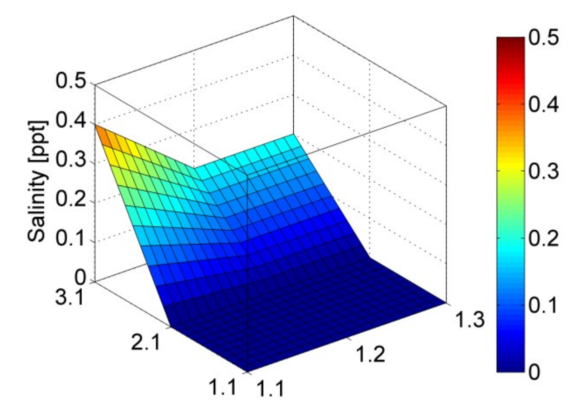
Ice station #1

Figures B1 A, B, C and D show the spatial variation of temperature, salinity and density at test depth, as well as the BH strength of Ice station #1.

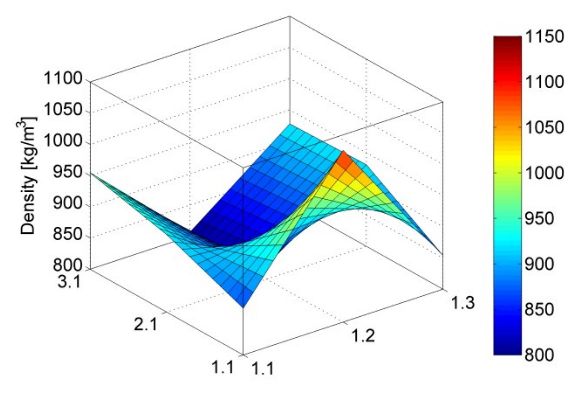
A



B



C



D

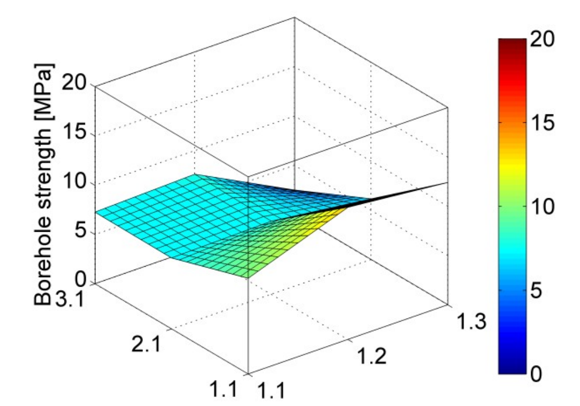
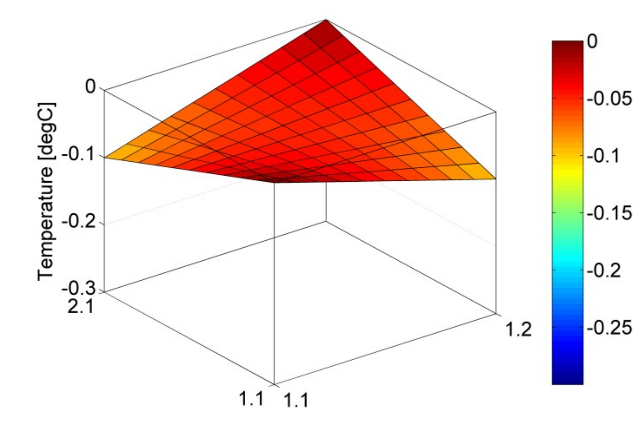


Figure B1 A, B, C, D: Temperature, salinity and density measured at test depths and BH strength of Ice station #1.

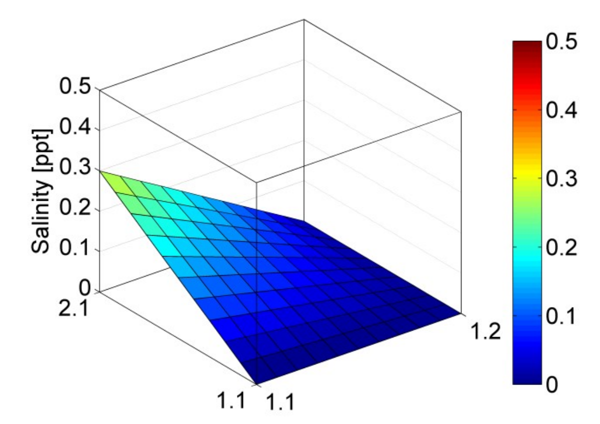
Ice station #3

Figures B2 A, B, C and D show the spatial variation of temperature, salinity and density at test depth, as well as the BH strength of Ice station #3.

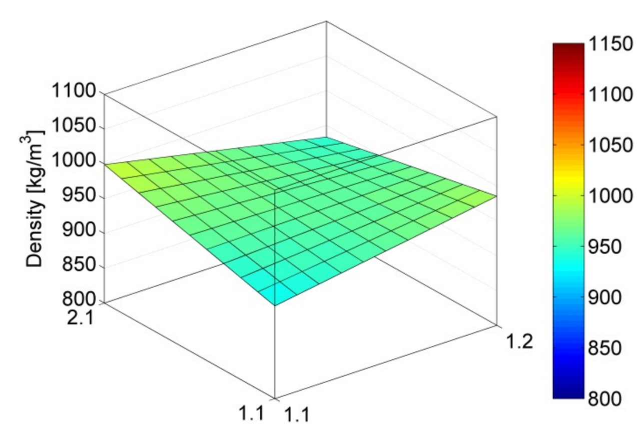
A



B



C



D

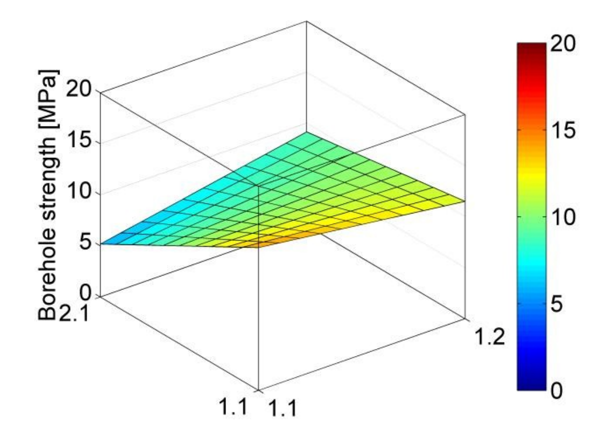
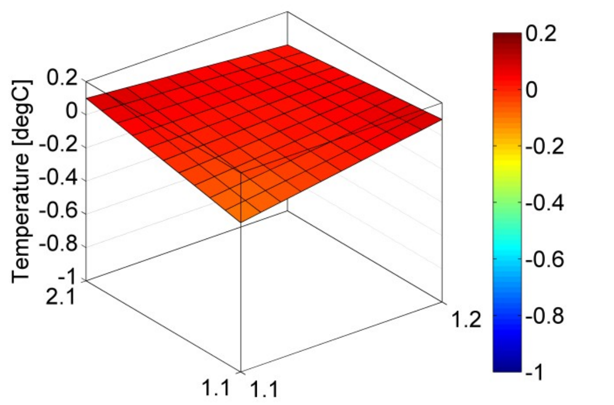


Figure B2 A, B, C, D: Temperature, salinity and density measured at test depths and BH strength of Ice station #3.

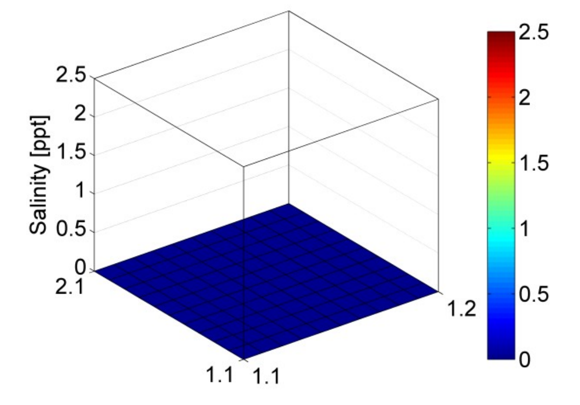
Ice station #5

Figure B3, B4 and B5 (all A, B, C and D) show the spatial variation of temperature, salinity and density at test depths 33, 66 and 99 cm, as well as the BH strength of Ice station #5.

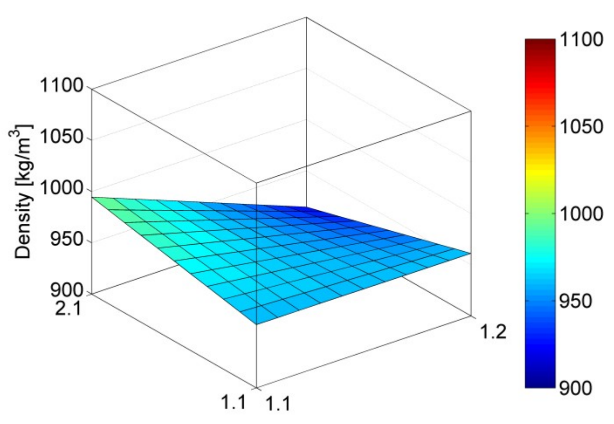
A



B



C



D

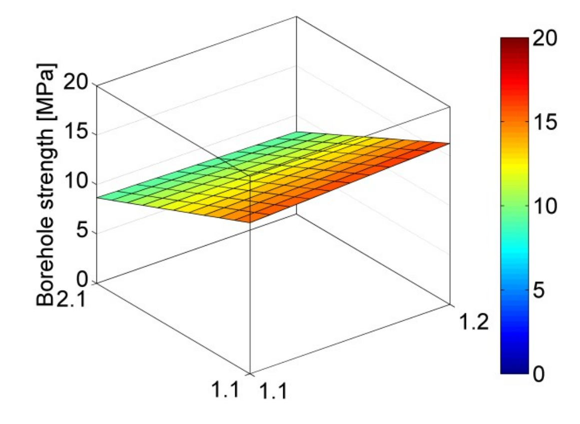
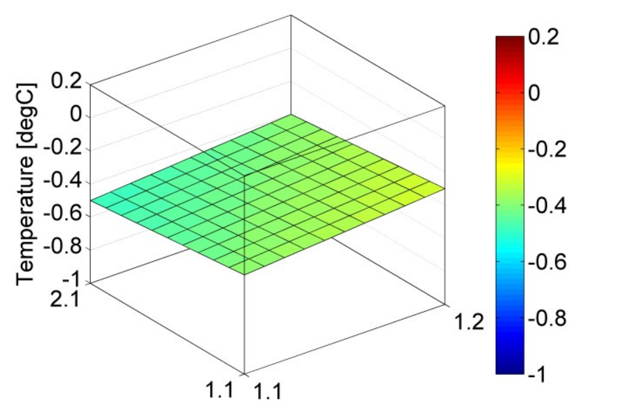
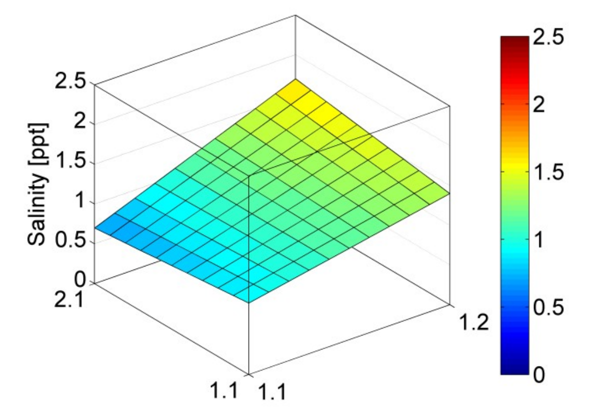


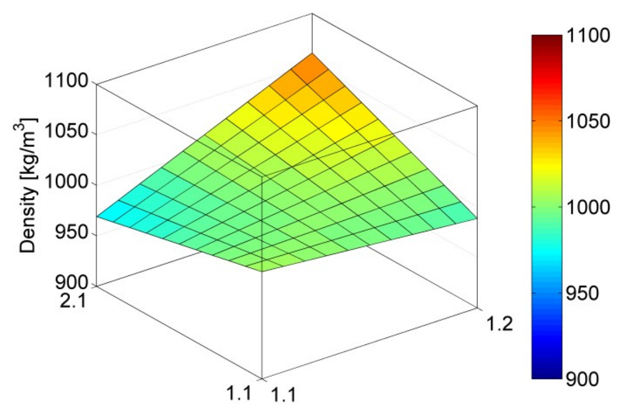
Figure B3 A, B, C, D: Temperature, salinity and density measured at test depths and BH strength of Ice station #5 at 33 cm depth.

A	B





C	D



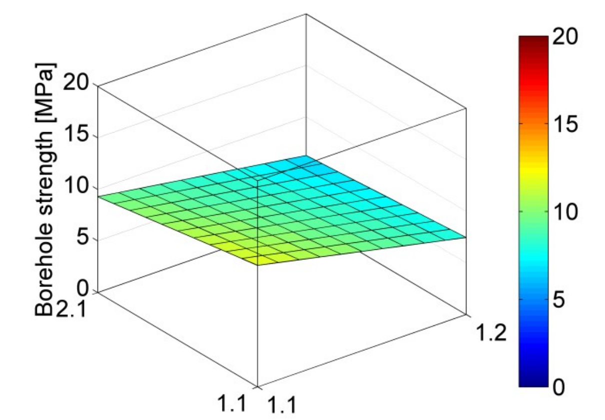
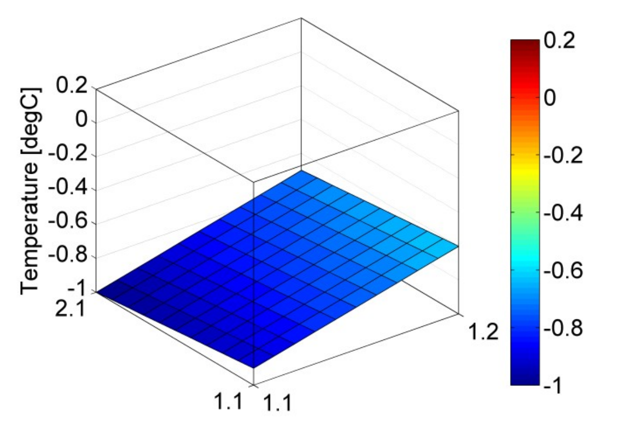
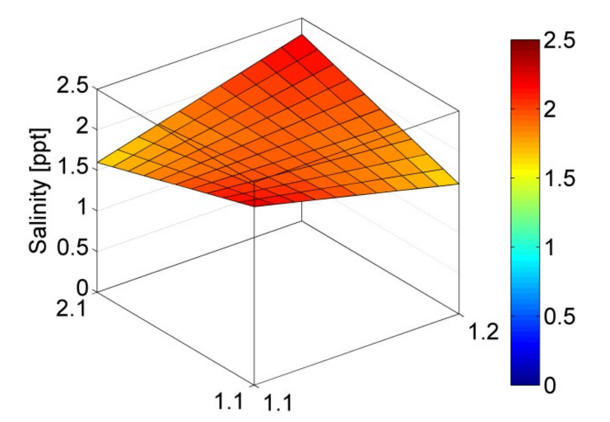


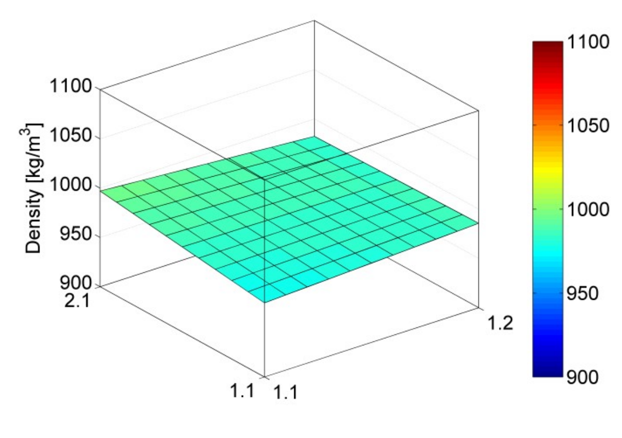
Figure B4 A, B, C, D: Temperature, salinity and density measured at test depths and BH strength of Ice station #5 at 66 cm depth.

A	B





C	**D**



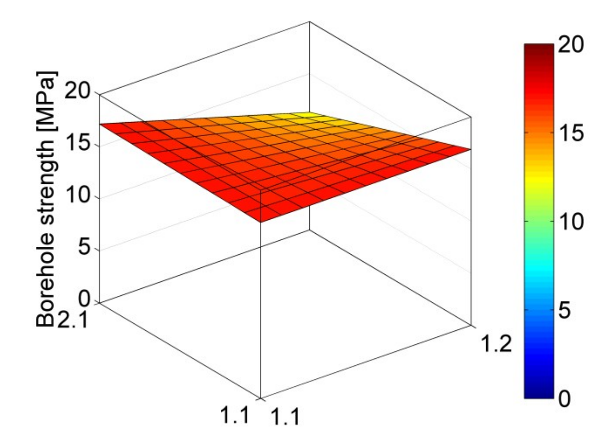
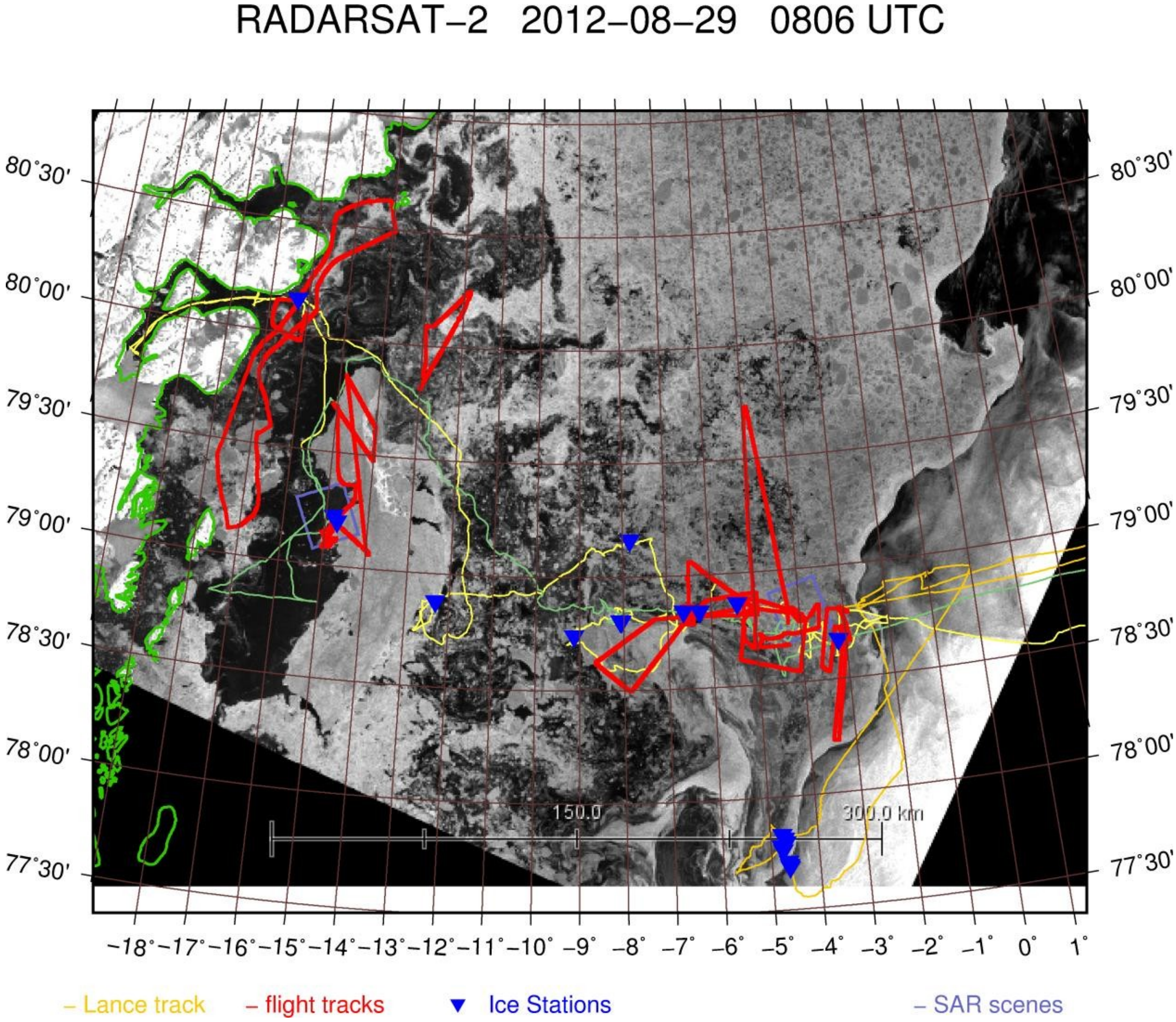


Figure B5 A, B, C, D: Temperature, salinity and density measured at test depths and BH strength of Ice station #5 at 99 cm depth.

NTNU Appendix C: Map of the entire cruise



Appendix 1 : $\delta^{18}O$ samples collected during FS 2012

Sample #, Station#, Latitude, Longitude, Sea depth, CTD salinity, Laboratory salinity

001	1	78.66	-003.19	2275	-0.767	34.924	34.917
002	1	78.66	-003.19	0302	+1.910	34.950	34.946
003	1	78.66	-003.19	0251	+2.100	34.943	34.952
004	1	78.66	-003.19	0202	+2.365	34.952	34.947
005	1	78.66	-003.19	0151	+1.853	34.850	34.841
006	1	78.66	-003.19	0100	+0.556	34.525	34.527
007	1	78.66	-003.19	0076	-0.807	34.223	34.223
008	1	78.66	-003.19	0049	-1.633	33.941	34.953
009	1	78.66	-003.19	0024	-1.567	33.266	33.296
010	1	78.66	-003.19	0015	-1.408	32.607	32.822
011	1	78.66	-003.19	0005	-1.369	30.909	NaN
012	1	78.66	-003.19	0001	-0.764	34.926	30.852
013	2	78.75	-002.51	2649	-0.791	34.917	34.913
014	2	78.75	-002.51	0400	+1.837	35.010	35.009
015	2	78.75	-002.51	0250	+3.050	35.072	35.073
016	2	78.75	-002.51	0200	+3.434	35.101	35.101
017	2	78.75	-002.51	0150	+3.560	35.098	35.092
018	2	78.75	-002.51	0100	+3.877	35.108	35.106
019	2	78.75	-002.51	0075	+4.226	35.123	32.128
020	2	78.75	-002.51	0049	+5.103	35.112	35.117
021	2	78.75	-002.51	0025	+6.186	34.865	34.943
022	2	78.75	-002.51	0015	+4.904	34.192	34.279
023	2	78.75	-002.51	0005	-0.268	31.286	31.369
024	2	78.75	-002.51	0001	-0.791	34.916	31.235
025	3	78.75	-002.01	2728	-0.745	34.923	34.919
026	3	78.75	-002.01	2600	-0.748	34.921	34.916
027	3	78.75	-002.01	2400	-0.751	34.917	34.915
028	3	78.75	-002.01	2200	-0.743	34.916	34.913
029	3	78.75	-002.01	2000	-0.709	34.916	34.913
030	3	78.75	-002.01	1601	-0.606	34.915	34.912
031	3	78.75	-002.01	1400	-0.560	34.911	34.910
032	3	78.75	-002.01	1200	-0.456	34.910	34.907
033	3	78.75	-002.01	1003	-0.273	34.912	34.910
034	3	78.75	-002.01	0800	+0.023	34.914	34.910
035	3	78.75	-002.01	0602	+0.738	34.939	34.937
036	4	78.73	-002.02	0500	+0.875	34.930	34.931
037	4	78.73	-002.02	0400	+1.956	35.001	35.002
038	4	78.73	-002.02	0251	+3.172	35.084	35.085
039	4	78.73	-002.02	0202	+3.555	35.114	35.112
040	4	78.73	-002.02	0150	+3.769	35.119	35.118
041	4	78.73	-002.02	0101	+4.075	35.128	35.127
042	4	78.73	-002.02	0075	+4.192	35.114	35.114

043	4	78.73	-002.02	0050	+4.978	35.133	35.130
044	4	78.73	-002.02	0024	+6.582	35.044	NaN
045	4	78.73	-002.02	0014	+5.707	34.602	34.691
046	4	78.73	-002.02	0005	-0.697	31.178	NaN
047	4	78.73	-002.02	0001	+0.426	34.913	34.147
048	5	78.77	-003.97	1873	-0.555	34.924	34.922
049	5	78.77	-003.97	0402	+1.979	34.965	34.965
050	5	78.77	-003.97	0252	+2.743	34.971	34.970
051	5	78.77	-003.97	0200	+0.732	34.603	34.623
052	5	78.77	-003.97	0150	-1.774	34.052	34.061
053	5	78.77	-003.97	0101	-1.762	33.799	33.843
054	5	78.77	-003.97	0075	-1.434	32.992	33.082
055	5	78.77	-003.97	0050	-1.713	31.993	32.028
056	5	78.77	-003.97	0025	-1.369	31.368	31.422
057	5	78.77	-003.97	0015	-1.175	30.822	30.846
058	5	78.77	-003.97	0005	-1.340	30.200	30.267
059	5	78.77	-003.97	0001	-0.555	34.924	30.215
060	6	78.75	-003.50	2163	-0.769	34.925	34.920
061	6	78.75	-003.50	0400	+1.799	34.956	34.955
062	6	78.75	-003.50	0251	+3.293	35.059	35.064
063	6	78.75	-003.50	0201	+3.135	35.005	35.001
064	6	78.75	-003.50	0150	-0.144	34.465	34.474
065	6	78.75	-003.50	0100	-1.738	34.046	34.054
066	6	78.75	-003.50	0074	-0.784	33.891	33.913
067	6	78.75	-003.50	0049	-1.534	33.114	33.221
068	6	78.75	-003.50	0025	-1.600	31.700	31.785
069	6	78.75	-003.50	0015	-1.576	30.759	30.883
070	6	78.75	-003.50	0005	-1.561	30.750	30.757
071	6	78.75	-003.50	0001	-0.768	34.925	30.754
072	8	78.82	-004.42	1536	-0.473	34.918	34.917
073	8	78.82	-004.42	0401	+0.907	34.879	34.879
074	8	78.82	-004.42	0252	+1.384	34.752	34.744
075	8	78.82	-004.42	0203	-0.339	34.376	NaN
076	8	78.82	-004.42	0152	-1.707	33.974	33.972
077	8	78.82	-004.42	0102	-1.417	33.050	33.171
078	8	78.82	-004.42	0076	-1.642	32.227	32.313
079	8	78.82	-004.42	0051	-1.692	31.883	31.895
080	8	78.82	-004.42	0023	-1.380	31.136	31.173
081	8	78.82	-004.42	0014	-1.285	30.094	30.130
082	8	78.82	-004.42	0005	-1.302	29.961	29.922
083	8	78.82	-004.42	0001	-0.474	34.918	30.002
084	9	78.85	-005.04	1019	-0.092	34.887	34.886
085	9	78.85	-005.04	0400	+1.811	34.928	34.928
086	9	78.85	-005.04	0251	+0.892	34.641	34.638
087	9	78.85	-005.04	0202	-0.932	34.189	34.183
088	9	78.85	-005.04	0152	-1.682	33.883	33.894

089	9	78.85	-005.04	0102	-1.647	33.003	33.060
090	9	78.85	-005.04	0076	-1.642	32.088	32.150
091	9	78.85	-005.04	0051	-1.641	31.840	31.851
092	9	78.85	-005.04	0024	-1.294	31.306	31.334
093	9	78.85	-005.04	0015	-1.075	29.561	29.842
094	9	78.85	-005.04	0004	-0.957	29.146	29.206
095	9	78.85	-005.04	0001	-0.092	34.886	29.145
096	10	78.91	-005.51	0757	+0.152	34.874	34.874
097	10	78.91	-005.51	0401	+2.148	34.965	34.964
098	10	78.91	-005.51	0252	+1.979	34.812	34.765
099	10	78.91	-005.51	0202	-0.648	34.258	34.250
100	10	78.91	-005.51	0152	-1.174	33.868	33.845
101	10	78.91	-005.51	0102	-1.619	32.768	32.770
102	10	78.91	-005.51	0077	-1.656	32.105	32.093
103	10	78.91	-005.51	0050	-1.665	31.849	31.847
104	10	78.91	-005.51	0026	-1.372	31.295	31.264
105	10	78.91	-005.51	0016	-1.145	29.517	29.522
106	10	78.91	-005.51	0005	-0.811	29.125	29.134
107	10	78.91	-005.51	0001	+0.153	34.874	29.138
108	11	78.90	-005.98	0376	+0.799	34.894	34.893
109	11	78.90	-005.98	0301	+2.158	34.944	34.942
110	11	78.90	-005.98	0250	+1.930	34.813	34.812
111	11	78.90	-005.98	0200	-0.576	34.281	34.285
112	11	78.90	-005.98	0149	-1.716	33.910	33.925
113	11	78.90	-005.98	0100	-1.353	32.872	32.975
114	11	78.90	-005.98	0074	-1.653	32.051	32.092
115	11	78.90	-005.98	0050	-1.655	31.849	31.858
116	11	78.90	-005.98	0025	-1.276	30.943	31.061
117	11	78.90	-005.98	0015	-1.022	29.494	29.521
118	11	78.90	-005.98	0005	-1.009	29.481	29.483
119	11	78.90	-005.98	0001	+0.793	34.894	29.489
120	12	78.81	-006.55	0271	+1.300	34.799	34.797
121	12	78.81	-006.55	0250	+1.296	34.797	34.796
122	12	78.81	-006.55	0200	-0.206	34.421	34.441
123	12	78.81	-006.55	0150	-1.379	33.948	33.966
124	12	78.81	-006.55	0100	-1.479	33.045	33.139
125	12	78.81	-006.55	0074	-1.677	32.186	32.267
126	12	78.81	-006.55	0050	-1.705	31.895	31.910
127	12	78.81	-006.55	0026	-1.372	31.601	31.627
128	12	78.81	-006.55	0015	-1.337	29.979	30.028
129	12	78.81	-006.55	0005	-1.222	29.768	29.773
130	12	78.81	-006.55	0001	+1.300	34.798	29.785
131	13	78.83	-007.03	0249	+1.355	34.803	34.802
132	13	78.83	-007.03	0200	+0.229	34.522	34.517
133	13	78.83	-007.03	0151	-1.722	34.042	34.037
134	13	78.83	-007.03	0100	-1.251	33.300	33.317

135	13	78.83	-007.03	0050	-1.691	31.890	31.906
136	13	78.83	-007.03	0025	-1.429	31.409	31.517
137	13	78.83	-007.03	0015	-1.232	29.863	30.221
138	13	78.83	-007.03	0005	-1.224	29.722	29.828
139	13	78.83	-007.03	0001	+1.358	34.803	29.732
140	14	78.85	-007.91	0193	+0.037	34.431	34.433
141	14	78.85	-007.91	0151	-0.356	34.272	34.291
142	14	78.85	-007.91	0100	-1.285	33.689	33.707
143	14	78.85	-007.91	0075	-1.384	32.938	33.064
144	14	78.85	-007.91	0051	-1.579	31.985	32.081
145	14	78.85	-007.91	0024	-1.407	30.924	31.174
146	14	78.85	-007.91	0014	-1.232	29.877	30.180
147	14	78.85	-007.91	0005	-1.266	29.768	29.839
148	14	78.85	-007.91	0001	+0.038	34.432	29.778
149	16	78.76	-009.16	0189	-0.007	34.407	34.395
150	16	78.76	-009.16	0150	-0.279	34.270	34.284
151	16	78.76	-009.16	0101	-0.985	33.817	33.847
152	16	78.76	-009.16	0076	-1.555	32.922	33.016
153	16	78.76	-009.16	0050	-1.498	31.770	31.990
154	16	78.76	-009.16	0024	-1.487	29.957	30.778
155	16	78.76	-009.16	0015	-1.528	29.763	29.783
156	16	78.76	-009.16	0005	-1.524	29.759	29.761
157	16	78.76	-009.16	0001	-0.009	34.406	29.765
158	17	78.93	-010.05	0238	+0.080	34.450	34.442
159	17	78.93	-010.05	0199	-0.451	34.301	34.305
160	17	78.93	-010.05	0150	-1.367	34.039	34.040
161	17	78.93	-010.05	0099	-1.460	33.787	33.817
162	17	78.93	-010.05	0074	-1.499	32.964	33.085
163	17	78.93	-010.05	0049	-1.575	31.805	32.005
164	17	78.93	-010.05	0025	-1.483	29.920	30.387
165	17	78.93	-010.05	0015	-1.537	29.732	29.750
166	17	78.93	-010.05	0005	-1.521	29.732	29.737
167	17	78.93	-010.05	0001	+0.077	34.449	29.739
168	18	78.92	-011.01	0255	-0.064	34.385	34.386
169	18	78.92	-011.01	0200	-0.233	34.321	34.322
170	18	78.92	-011.01	0151	-0.715	34.047	34.062
171	18	78.92	-011.01	0100	-1.378	33.091	33.159
172	18	78.92	-011.01	0075	-1.632	32.050	32.208
173	18	78.92	-011.01	0051	-1.689	31.869	31.889
174	18	78.92	-011.01	0026	-1.426	31.310	31.523
175	18	78.92	-011.01	0015	-1.338	29.627	29.856
176	18	78.92	-011.01	0005	-1.293	29.616	29.624
177	18	78.92	-011.01	0002	-1.301	29.573	29.619
178	19	78.91	-012.02	0310	+0.448	34.588	34.579
179	19	78.91	-012.02	0251	-0.041	34.403	34.403
180	19	78.91	-012.02	0151	-1.030	33.673	33.704

181	19	78.91	-012.02	0101	-1.555	32.444	32.474
182	19	78.91	-012.02	0075	-1.690	31.906	31.929
183	19	78.91	-012.02	0050	-1.454	31.689	31.715
184	19	78.91	-012.02	0025	-1.392	29.628	29.865
185	19	78.91	-012.02	0015	-0.982	29.339	29.366
186	19	78.91	-012.02	0004	-0.953	29.305	29.314
187	19	78.91	-012.02	0001	+0.445	34.587	29.319
188	20	79.92	-014.01	0006	-0.723	29.622	29.628
189	22	80.00	-015.36	0235	+0.438	34.552	34.552
190	22	80.00	-015.36	0200	+0.131	34.435	34.445
191	22	80.00	-015.36	0150	-0.770	33.916	33.929
192	22	80.00	-015.36	0100	-1.643	32.549	32.561
193	22	80.00	-015.36	0074	-1.657	31.968	31.991
194	22	80.00	-015.36	0050	-1.551	31.723	31.771
195	22	80.00	-015.36	0025	-1.102	30.834	31.072
196	22	80.00	-015.36	0015	-0.875	29.904	30.343
197	22	80.00	-015.36	0005	-0.611	28.329	27.744
198	22	80.00	-015.36	0002	-0.610	25.570	26.964
199	23	80.06	-015.48	0301	+0.712	34.632	34.629
200	23	80.06	-015.48	0251	+0.617	34.598	34.603
201	23	80.06	-015.48	0201	+0.107	34.410	34.413
202	23	80.06	-015.48	0151	-0.489	33.985	33.999
203	23	80.06	-015.48	0100	-1.535	32.640	32.662
204	23	80.06	-015.48	0075	-1.700	31.970	32.055
205	23	80.06	-015.48	0049	-1.518	31.516	31.640
206	23	80.06	-015.48	0024	-0.880	30.022	30.120
207	23	80.06	-015.48	0015	-0.653	29.119	29.610
208	23	80.06	-015.48	0005	-0.478	27.516	27.751
209	23	80.06	-015.48	0001	-0.482	27.525	27.533
210	24	80.11	-015.70	0421	+0.976	34.712	34.713
211	24	80.11	-015.70	0250	+0.306	34.474	34.479
212	24	80.11	-015.70	0200	+0.105	34.384	34.382
213	24	80.11	-015.70	0149	-0.339	34.102	34.100
214	24	80.11	-015.70	0100	-1.415	32.874	33.020
215	24	80.11	-015.70	0075	-1.683	32.059	32.123
216	24	80.11	-015.70	0050	-1.566	31.685	31.731
217	24	80.11	-015.70	0025	-0.790	29.691	30.061
218	24	80.11	-015.70	0015	-0.386	28.766	28.909
219	24	80.11	-015.70	0004	-0.068	27.566	27.673
220	24	80.11	-015.70	0002	-0.074	27.529	27.577
221	25	80.13	-015.91	0207	+0.396	34.515	34.514
222	25	80.13	-015.91	0151	-0.278	34.133	34.142
223	25	80.13	-015.91	0101	-1.320	33.020	32.974
224	25	80.13	-015.91	0074	-1.685	32.013	32.131
225	25	80.13	-015.91	0051	-1.568	31.762	31.776
226	25	80.13	-015.91	0025	-1.013	30.623	30.724

227	25	80.13	-015.91	0015	-0.535	29.259	29.861
228	25	80.13	-015.91	0004	-0.335	27.794	27.838
229	25	80.13	-015.91	0002	-0.335	27.856	27.833
230	27	80.16	-016.18	0342	+0.903	34.693	34.691
231	27	80.16	-016.18	0250	+0.750	34.645	34.644
232	27	80.16	-016.18	0201	+0.330	34.493	34.492
233	27	80.16	-016.18	0151	-0.374	34.015	34.087
234	27	80.16	-016.18	0101	-1.510	32.622	32.695
235	27	80.16	-016.18	0076	-1.692	31.982	NaN
236	27	80.16	-016.18	0051	-1.577	31.676	32.055
237	27	80.16	-016.18	0026	-0.770	29.708	31.737
238	27	80.16	-016.18	0014	-0.583	28.372	30.063
239	27	80.16	-016.18	0005	-0.670	27.943	28.592
240	27	80.16	-016.18	0002	-0.660	27.823	28.029
241	28	80.17	-016.38	0142	-0.625	33.836	33.835
242	28	80.17	-016.38	0125	-0.947	33.524	33.571
243	28	80.17	-016.38	0100	-1.413	32.831	32.874
244	28	80.17	-016.38	0075	-1.687	31.999	32.019
245	28	80.17	-016.38	0050	-1.391	31.509	31.605
246	28	80.17	-016.38	0025	-0.697	29.564	30.102
247	28	80.17	-016.38	0015	-0.378	27.460	27.832
248	28	80.17	-016.38	0005	-0.407	27.331	27.406
249	28	80.17	-016.38	0001	-0.407	27.163	27.235
250	29	79.81	-020.22	0528	+1.014	34.725	34.721
251	29	79.81	-020.22	0301	+0.589	34.573	34.575
252	29	79.81	-020.22	0201	+0.210	34.423	34.422
253	29	79.81	-020.22	0170	-0.002	34.305	34.312
254	29	79.81	-020.22	0100	-1.413	32.802	32.888
255	29	79.81	-020.22	0075	-1.596	32.001	32.061
256	29	79.81	-020.22	0050	-1.354	31.345	31.534
257	29	79.81	-020.22	0024	-0.439	28.314	28.808
258	29	79.81	-020.22	0014	+1.020	25.421	26.126
259	29	79.81	-020.22	0005	+1.967	23.845	24.040
260	29	79.81	-020.22	0001	+2.231	23.256	23.466
261	30	79.80	-020.09	0205	+0.223	34.426	34.421
262	30	79.80	-020.09	0172	+0.008	34.309	34.315
263	30	79.80	-020.09	0151	-0.082	34.207	34.216
264	30	79.80	-020.09	0100	-1.273	33.175	33.349
265	30	79.80	-020.09	0075	-1.581	31.973	32.012
266	30	79.80	-020.09	0050	-1.385	31.393	31.523
267	30	79.80	-020.09	0025	-0.288	28.632	29.409
268	30	79.80	-020.09	0015	+0.613	26.318	26.658
269	30	79.80	-020.09	0005	+2.152	22.632	23.331
270	30	79.80	-020.09	0001	+2.222	22.327	22.481
271	31	79.82	-020.31	0317	+0.706	34.617	34.613
272	31	79.82	-020.31	0250	+0.473	34.529	34.531

273	31	79.82	-020.31	0201	+0.271	34.446	34.453
274	31	79.82	-020.31	0160	-0.001	34.314	34.323
275	31	79.82	-020.31	0100	-1.475	32.922	32.937
276	31	79.82	-020.31	0075	-1.605	32.108	32.173
277	31	79.82	-020.31	0050	-1.428	31.497	31.543
278	31	79.82	-020.31	0025	-0.528	28.512	28.962
279	31	79.82	-020.31	0015	-0.002	26.107	26.267
280	31	79.82	-020.31	0005	+2.033	23.568	23.679
281	31	79.82	-020.31	0002	+2.129	23.217	23.378
282	32	79.89	-020.00	0311	+0.683	34.609	34.602
283	32	79.89	-020.00	0250	+0.450	34.521	34.514
284	32	79.89	-020.00	0201	+0.198	34.417	34.409
285	32	79.89	-020.00	0169	-0.012	34.319	34.316
286	32	79.89	-020.00	0101	-1.303	32.997	33.124
287	32	79.89	-020.00	0075	-1.583	32.147	32.222
288	32	79.89	-020.00	0050	-1.445	31.463	31.613
289	32	79.89	-020.00	0025	-0.204	28.427	29.254
290	32	79.89	-020.00	0015	+0.568	26.799	26.759
291	32	79.89	-020.00	0005	+1.700	24.043	24.629
292	32	79.89	-020.00	0001	+2.090	22.719	23.382
293	33	79.96	-019.76	0384	+0.711	34.618	34.617
294	33	79.96	-019.76	0251	+0.352	34.483	34.487
295	33	79.96	-019.76	0180	+0.009	34.333	34.332
296	33	79.96	-019.76	0150	-0.277	34.151	34.179
297	33	79.96	-019.76	0100	-1.332	32.921	33.079
298	33	79.96	-019.76	0075	-1.596	32.009	32.166
299	33	79.96	-019.76	0050	-1.405	31.481	31.555
300	33	79.96	-019.76	0025	-0.109	28.570	29.134
301	33	79.96	-019.76	0014	+0.816	26.365	26.300
302	33	79.96	-019.76	0005	+1.385	24.605	24.822
303	33	79.96	-019.76	0001	+1.515	24.415	24.515
304	34	80.00	-019.54	0523	+0.789	34.645	34.642
305	34	80.00	-019.54	0300	+0.556	34.560	34.561
306	34	80.00	-019.54	0251	+0.392	34.498	34.504
307	34	80.00	-019.54	0175	-0.003	34.335	34.344
308	34	80.00	-019.54	0101	-1.321	32.946	33.159
309	34	80.00	-019.54	0075	-1.591	32.193	32.318
310	34	80.00	-019.54	0051	-1.444	31.479	31.586
311	34	80.00	-019.54	0026	-0.097	28.449	29.411
312	34	80.00	-019.54	0015	+0.519	26.526	27.128
313	34	80.00	-019.54	0005	+1.376	24.788	24.894
314	34	80.00	-019.54	0002	+1.459	24.462	24.686
315	35	80.05	-019.12	0457	+0.753	34.632	34.629
316	35	80.05	-019.12	0250	+0.437	34.514	34.514
317	35	80.05	-019.12	0174	+0.017	34.332	34.328
318	35	80.05	-019.12	0100	-1.310	32.952	32.987

319	35	80.05	-019.12	0075	-1.601	32.205	32.131
320	35	80.05	-019.12	0050	-1.466	31.473	31.612
321	35	80.05	-019.12	0025	-0.292	28.914	29.300
322	35	80.05	-019.12	0015	+0.699	26.377	27.273
323	35	80.05	-019.12	0005	+1.261	24.951	25.126
324	35	80.05	-019.12	0001	+1.323	24.701	24.854
325	36	80.08	-018.67	0229	+0.302	34.460	34.453
326	36	80.08	-018.67	0180	+0.058	34.337	34.334
327	36	80.08	-018.67	0150	-0.247	34.142	34.146
328	36	80.08	-018.67	0101	-1.326	32.933	33.004
329	36	80.08	-018.67	0074	-1.624	32.187	32.206
330	36	80.08	-018.67	0050	-1.453	31.411	31.598
331	36	80.08	-018.67	0025	-0.013	28.337	29.074
332	36	80.08	-018.67	0015	+0.503	26.608	27.101
333	36	80.08	-018.67	0005	+1.066	25.045	25.504
334	36	80.08	-018.67	0002	+1.149	24.833	24.937
335	37	80.10	-018.19	0192	+0.175	34.392	34.388
336	37	80.10	-018.19	0163	-0.004	34.286	34.287
337	37	80.10	-018.19	0100	-1.398	32.760	32.808
338	37	80.10	-018.19	0075	-1.641	32.087	32.157
339	37	80.10	-018.19	0051	-1.492	31.530	31.581
340	37	80.10	-018.19	0025	-0.317	28.670	29.370
341	37	80.10	-018.19	0015	+0.289	26.975	27.740
342	37	80.10	-018.19	0005	+1.600	24.167	25.532
343	37	80.10	-018.19	0001	+1.741	23.851	24.364
344	38	80.13	-017.70	0204	+0.124	34.361	34.347
345	38	80.13	-017.70	0169	+0.000	34.287	34.285
346	38	80.13	-017.70	0150	-0.168	34.177	34.183
347	38	80.13	-017.70	0100	-1.300	32.935	32.978
348	38	80.13	-017.70	0075	-1.638	32.115	32.151
349	38	80.13	-017.70	0050	-1.549	31.569	31.682
350	38	80.13	-017.70	0025	-0.356	28.169	28.685
351	38	80.13	-017.70	0015	-0.107	27.456	27.668
352	38	80.13	-017.70	0005	+1.220	24.962	25.581
353	38	80.13	-017.70	0001	+1.537	24.305	24.675
354	39	80.13	-017.39	0146	-0.196	34.147	34.060
355	39	80.13	-017.39	0100	-1.402	32.775	32.788
356	39	80.13	-017.39	0076	-1.653	32.077	32.083
357	39	80.13	-017.39	0050	-1.496	31.518	31.574
358	39	80.13	-017.39	0025	-0.418	28.541	28.816
359	39	80.13	-017.39	0015	-0.573	27.901	28.317
360	39	80.13	-017.39	0005	+1.240	24.750	27.059
361	39	80.13	-017.39	0001	+1.303	24.494	25.268
362	40	80.16	-017.33	0169	+0.240	34.427	34.419
363	40	80.16	-017.33	0150	-0.025	34.279	34.291
364	40	80.16	-017.33	0100	-1.441	32.706	32.747

365	40	80.16	-017.33	0076	-1.661	32.061	32.094
366	40	80.16	-017.33	0050	-1.539	31.541	31.604
367	40	80.16	-017.33	0025	-0.362	28.628	28.057
368	40	80.16	-017.33	0015	-0.328	27.994	28.078
369	40	80.16	-017.33	0005	-0.122	27.432	27.634
370	40	80.16	-017.33	0001	+0.980	24.964	26.874
371	42	80.10	-017.40	0095	-1.365	32.828	32.747
372	42	80.10	-017.40	0075	-1.653	32.117	32.156
373	42	80.10	-017.40	0050	-1.514	31.502	31.591
374	42	80.10	-017.40	0025	-0.505	28.474	28.632
375	42	80.10	-017.40	0015	-0.607	27.716	27.873
376	42	80.10	-017.40	0005	+1.397	24.645	26.249
377	42	80.10	-017.40	0001	+1.557	24.335	24.789
378	45	78.83	-015.00	0077	-1.657	31.851	31.853
379	45	78.83	-015.00	0050	-1.649	31.797	31.811
380	45	78.83	-015.00	0025	-1.517	31.434	31.582
381	45	78.83	-015.00	0015	-1.525	30.802	31.162
382	45	78.83	-015.00	0005	-1.381	29.438	29.618
383	45	78.83	-015.00	0002	-1.365	29.353	29.450
384	46	78.83	-016.01	0216	-0.019	34.409	34.403
385	46	78.83	-016.01	0151	-1.386	33.501	33.526
386	46	78.83	-016.01	0101	-1.624	32.536	32.569
387	46	78.83	-016.01	0075	-1.683	32.065	32.096
388	46	78.83	-016.01	0050	-1.641	31.831	31.853
389	46	78.83	-016.01	0025	-1.375	31.674	31.719
390	46	78.83	-016.01	0016	-0.972	31.160	31.541
391	46	78.83	-016.01	0005	-1.043	30.567	30.735
392	46	78.83	-016.01	0002	-0.940	30.116	NaN
393	48	78.83	-017.01	0389	+1.741	34.943	34.941
394	48	78.83	-017.01	0250	+0.839	34.665	34.660
395	48	78.83	-017.01	0200	-0.317	34.325	34.322
396	48	78.83	-017.01	0151	-1.192	33.780	33.778
397	48	78.83	-017.01	0100	-1.650	32.565	32.651
398	48	78.83	-017.01	0075	-1.662	31.964	32.055
399	48	78.83	-017.01	0050	-1.522	31.764	31.772
400	48	78.83	-017.01	0025	-0.747	31.068	31.074
401	48	78.83	-017.01	0016	-0.373	30.164	30.039
402	48	78.83	-017.01	0001	-1.034	26.666	26.958
403	49	78.83	-017.51	0579	+1.536	34.932	34.932
404	49	78.83	-017.51	0399	+1.653	34.932	34.934
405	49	78.83	-017.51	0250	+0.778	34.652	34.663
406	49	78.83	-017.51	0200	-0.105	34.395	34.416
407	49	78.83	-017.51	0150	-0.941	33.874	33.941
408	49	78.83	-017.51	0100	-1.630	32.771	32.897
409	49	78.83	-017.51	0075	-1.671	32.034	32.129
410	49	78.83	-017.51	0050	-1.510	31.767	31.813

411	49	78.83	-017.51	0025	-1.229	29.180	29.650
412	49	78.83	-017.51	0015	-1.117	28.123	28.452
413	49	78.83	-017.51	0005	-1.132	25.785	25.803
414	53	78.79	-004.03	1813	-0.613	34.924	34.922
415	53	78.79	-004.03	1699	-0.562	34.923	34.922
416	53	78.79	-004.03	1599	-0.523	34.923	34.922
417	53	78.79	-004.03	1500	-0.495	34.920	34.919
418	53	78.79	-004.03	1400	-0.477	34.914	34.916
419	53	78.79	-004.03	1299	-0.442	34.909	34.910
420	53	78.79	-004.03	1200	-0.349	34.908	34.909
421	53	78.79	-004.03	1002	-0.228	34.893	34.894
422	53	78.79	-004.03	0803	-0.042	34.880	34.881
423	53	78.79	-004.03	0604	+0.664	34.906	34.907
424	53	78.79	-004.03	0402	+1.937	34.975	34.977
425	54	78.92	+010.00	0072	+4.028	34.939	34.945
426	54	78.92	+010.00	0051	+5.322	35.036	35.041
427	54	78.92	+010.00	0025	+6.582	34.953	34.959
428	54	78.92	+010.00	0016	+6.232	34.873	34.867
429	54	78.92	+010.00	0005	+4.585	33.987	33.989
2381	56	78.80	-003.08	2502	-0.760	34.923	34.922
2382	56	78.80	-003.08	2200	-0.762	34.917	34.916
2383	56	78.80	-003.08	2001	-0.747	34.915	34.913
2384	56	78.80	-003.08	1801	-0.698	34.915	34.913
2385	56	78.80	-003.08	1600	-0.637	34.914	34.913
2386	56	78.80	-003.08	1401	-0.557	34.912	34.910
2387	56	78.80	-003.08	1200	-0.458	34.910	34.910
2388	56	78.80	-003.08	1000	-0.266	34.912	34.910
2389	56	78.80	-003.08	0799	-0.079	34.904	34.904
2390	56	78.80	-003.08	0600	+0.960	34.958	34.957
2391	56	78.80	-003.08	0400	+2.056	35.007	35.007
430	57	78.92	-000.99	2659	-0.744	34.922	34.921
431	57	78.92	-000.99	0399	+2.590	35.036	35.035
432	57	78.92	-000.99	0249	+3.432	35.083	35.081
433	57	78.92	-000.99	0200	+3.559	35.078	35.078
434	57	78.92	-000.99	0150	+3.373	35.006	35.007
435	57	78.92	-000.99	0100	+1.774	34.698	34.730
436	57	78.92	-000.99	0075	-0.679	34.312	34.322
437	57	78.92	-000.99	0050	-1.644	34.056	34.072
438	57	78.92	-000.99	0025	-1.432	33.807	33.844
439	57	78.92	-000.99	0005	-1.213	32.745	32.757
440	58	78.92	+000.01	2522	-0.755	34.923	34.921
441	58	78.92	+000.01	0402	+1.739	34.957	34.959
442	58	78.92	+000.01	0251	+2.572	34.994	34.994
443	58	78.92	+000.01	0202	+2.613	34.973	34.979
444	58	78.92	+000.01	0153	+2.925	34.978	34.973
445	58	78.92	+000.01	0101	+0.384	34.556	34.558

446	58	78.92	+000.01	0067	-0.850	34.205	34.166
447	58	78.92	+000.01	0051	-1.723	34.047	34.052
448	58	78.92	+000.01	0026	-1.673	33.782	33.785
449	58	78.92	+000.01	0015	-1.235	32.572	32.589
450	58	78.92	+000.01	0004	-1.236	32.575	32.580
2392	59	78.83	-002.51	2614	-0.758	34.920	34.919
2393	59	78.83	-002.51	0400	+2.116	35.021	35.022
2394	59	78.83	-002.51	0250	+3.406	35.096	35.097
2395	59	78.83	-002.51	0200	+3.707	35.121	35.121
2396	59	78.83	-002.51	0150	+3.485	35.067	35.063
2397	59	78.83	-002.51	0100	+3.825	35.049	35.055
2398	59	78.83	-002.51	0075	+3.437	34.911	34.923
2399	59	78.83	-002.51	0050	+3.735	34.805	34.829
2400	59	78.83	-002.51	0025	+1.311	34.080	34.084
2401	59	78.83	-002.51	0015	+1.258	34.052	34.062
2402	59	78.83	-002.51	0005	-1.370	32.799	32.852
2403	60	78.88	-002.00	2674	-0.743	34.923	34.920
2404	60	78.88	-002.00	0400	+2.158	34.998	34.999
2405	60	78.88	-002.00	0251	+2.708	35.006	35.007
2406	60	78.88	-002.00	0201	+2.875	35.007	35.006
2407	60	78.88	-002.00	0151	+3.007	34.989	34.989
2408	60	78.88	-002.00	0100	+0.693	34.623	34.637
2409	60	78.88	-002.00	0076	-0.263	34.421	34.430
2410	60	78.88	-002.00	0050	-1.608	34.113	34.119
2411	60	78.88	-002.00	0025	-0.088	33.996	34.005
2412	60	78.88	-002.00	0015	-1.259	32.858	32.967
2413	60	78.88	-002.00	0005	-1.400	32.731	32.735
2414	61	78.92	+001.00	2540	-0.749	34.926	34.925
2415	61	78.92	+001.00	0401	+1.634	34.941	34.940
2416	61	78.92	+001.00	0251	+2.529	34.986	34.985
2417	61	78.92	+001.00	0201	+3.012	35.015	35.016
2418	61	78.92	+001.00	0151	+3.018	34.990	NaN
2419	61	78.92	+001.00	0101	+3.197	34.831	NaN
2420	61	78.92	+001.00	0076	+2.825	34.597	NaN
2421	61	78.92	+001.00	0050	+1.186	34.210	NaN
2422	61	78.92	+001.00	0026	-1.596	33.778	NaN
2423	61	78.92	+001.00	0015	-1.124	32.965	NaN
2424	61	78.92	+001.00	0006	-1.187	32.602	NaN
451	62	78.92	+002.00	2521	-0.775	34.919	NaN
452	62	78.92	+002.00	0400	+1.542	34.948	NaN
453	62	78.92	+002.00	0251	+2.735	35.020	NaN
454	62	78.92	+002.00	0201	+2.983	35.027	NaN
455	62	78.92	+002.00	0151	+3.137	35.018	NaN
456	62	78.92	+002.00	0100	+3.552	35.014	NaN
457	62	78.92	+002.00	0076	+4.671	35.065	NaN
458	62	78.92	+002.00	0050	-0.469	34.366	NaN

459	62	78.92	+002.00	0025	+3.127	34.585	NaN
460	62	78.92	+002.00	0015	+1.415	34.273	NaN
461	62	78.92	+002.00	0005	+0.737	34.056	NaN
462	63	78.92	+003.00	2360	-0.800	34.916	NaN
463	63	78.92	+003.00	0401	+1.943	35.017	NaN
464	63	78.92	+003.00	0251	+3.457	35.106	NaN
465	63	78.92	+003.00	0202	+3.556	35.102	NaN
466	63	78.92	+003.00	0151	+3.912	35.128	NaN
467	63	78.92	+003.00	0100	+4.261	35.137	NaN
468	63	78.92	+003.00	0074	+4.537	35.121	NaN
469	63	78.92	+003.00	0050	+4.552	34.982	NaN
470	63	78.92	+003.00	0025	+4.484	34.950	NaN
471	63	78.92	+003.00	0015	+4.487	34.950	NaN
472	63	78.92	+003.00	0005	+4.474	34.950	NaN
473	64	78.92	+004.00	2540	-0.763	34.921	NaN
474	64	78.92	+004.00	0402	+1.724	34.982	NaN
475	64	78.92	+004.00	0250	+3.221	35.089	NaN
476	64	78.92	+004.00	0201	+3.512	35.103	NaN
477	64	78.92	+004.00	0151	+3.744	35.111	NaN
478	64	78.92	+004.00	0100	+4.174	35.136	NaN
479	64	78.92	+004.00	0075	+4.604	35.097	NaN
480	64	78.92	+004.00	0050	+4.777	34.925	NaN
481	64	78.92	+004.00	0025	+4.671	34.901	NaN
482	64	78.92	+004.00	0015	+4.670	34.901	NaN
483	64	78.92	+004.00	0005	+4.665	34.900	NaN
484	65	78.91	+005.00	2622	-0.742	34.926	NaN
485	65	78.91	+005.00	0400	+1.433	34.937	NaN
486	65	78.91	+005.00	0250	+2.931	35.041	NaN
487	65	78.91	+005.00	0200	+2.970	35.031	NaN
488	65	78.91	+005.00	0149	+3.206	35.034	NaN
489	65	78.91	+005.00	0100	+2.028	34.844	NaN
490	65	78.91	+005.00	0075	+1.640	34.703	NaN
491	65	78.91	+005.00	0050	+1.366	34.595	NaN
492	65	78.91	+005.00	0025	+2.571	34.439	NaN
493	65	78.91	+005.00	0015	+2.275	34.341	NaN
494	65	78.91	+005.00	0004	+1.584	34.122	NaN
495	66	78.92	+006.01	2326	-0.770	34.922	NaN
496	66	78.92	+006.01	0400	+1.660	34.997	NaN
497	66	78.92	+006.01	0253	+3.235	35.091	NaN
498	66	78.92	+006.01	0202	+3.587	35.115	NaN
499	66	78.92	+006.01	0150	+3.859	35.123	NaN
500	66	78.92	+006.01	0101	+4.181	35.127	NaN
501	66	78.92	+006.01	0076	+4.944	35.103	NaN
502	66	78.92	+006.01	0051	+5.333	35.096	NaN
503	66	78.92	+006.01	0024	+5.164	34.966	NaN
504	66	78.92	+006.01	0014	+4.460	34.856	NaN

505	66	78.92	+006.01	0005	+3.774	34.759	NaN
506	68	78.92	+007.00	1328	-0.847	34.910	NaN
507	68	78.92	+007.00	0401	+1.597	34.990	NaN
508	68	78.92	+007.00	0251	+3.388	35.094	NaN
509	68	78.92	+007.00	0202	+3.736	35.117	NaN
510	68	78.92	+007.00	0151	+4.048	35.130	NaN
511	68	78.92	+007.00	0100	+4.431	35.144	NaN
512	68	78.92	+007.00	0074	+4.697	35.144	NaN
513	68	78.92	+007.00	0050	+5.816	35.101	NaN
514	68	78.92	+007.00	0024	+6.029	35.051	NaN
515	68	78.92	+007.00	0015	+5.763	34.964	NaN
516	68	78.92	+007.00	0005	+5.765	34.963	NaN
517	70	78.92	+008.01	1041	-0.837	34.909	NaN
518	70	78.92	+008.01	0402	+3.575	35.119	NaN
519	70	78.92	+008.01	0251	+3.956	35.133	NaN
520	70	78.92	+008.01	0201	+4.126	35.135	NaN
521	70	78.92	+008.01	0150	+4.584	35.149	NaN
522	70	78.92	+008.01	0100	+6.131	35.111	NaN
523	70	78.92	+008.01	0075	+6.524	35.107	NaN
524	70	78.92	+008.01	0049	+6.523	35.107	NaN
525	70	78.92	+008.01	0025	+6.533	35.104	NaN
526	70	78.92	+008.01	0014	+6.582	35.083	NaN
527	70	78.92	+008.01	0006	+6.574	35.061	NaN
528	72	78.92	+009.00	0209	+4.377	35.077	NaN
529	72	78.92	+009.00	0151	+5.348	35.143	NaN
530	72	78.92	+009.00	0100	+5.828	35.159	NaN
531	72	78.92	+009.00	0074	+6.002	35.160	NaN
532	72	78.92	+009.00	0049	+6.291	35.156	NaN
533	72	78.92	+009.00	0025	+5.349	34.590	NaN
534	72	78.92	+009.00	0015	+4.670	34.254	NaN
535	72	78.92	+009.00	0005	+4.509	34.176	NaN

Appendix 2 : Nutrient samples collected during FS 2012

Sample #, Station#, Latitude, Longitude, Sea depth, CTD salinity, Laboratory salinity

001	1	78.66	-003.19	2275	-0.767	34.924	34.917
002	1	78.66	-003.19	0302	+1.910	34.950	34.946
003	1	78.66	-003.19	0251	+2.100	34.943	34.952
004	1	78.66	-003.19	0202	+2.365	34.952	34.947
005	1	78.66	-003.19	0151	+1.853	34.850	34.841
006	1	78.66	-003.19	0100	+0.556	34.525	34.527
007	1	78.66	-003.19	0076	-0.807	34.223	34.223
008	1	78.66	-003.19	0049	-1.633	33.941	34.953
009	1	78.66	-003.19	0024	-1.567	33.266	33.296
010	1	78.66	-003.19	0015	-1.408	32.607	32.822
011	1	78.66	-003.19	0005	-1.369	30.909	NaN
012	1	78.66	-003.19	0001	-0.764	34.926	30.852
013	2	78.75	-002.51	2649	-0.791	34.917	34.913
014	2	78.75	-002.51	0400	+1.837	35.010	35.009
015	2	78.75	-002.51	0250	+3.050	35.072	35.073
016	2	78.75	-002.51	0200	+3.434	35.101	35.101
017	2	78.75	-002.51	0150	+3.560	35.098	35.092
018	2	78.75	-002.51	0100	+3.877	35.108	35.106
019	2	78.75	-002.51	0075	+4.226	35.123	32.128
020	2	78.75	-002.51	0049	+5.103	35.112	35.117
021	2	78.75	-002.51	0025	+6.186	34.865	34.943
022	2	78.75	-002.51	0015	+4.904	34.192	34.279
023	2	78.75	-002.51	0005	-0.268	31.286	31.369
024	2	78.75	-002.51	0001	-0.791	34.916	31.235
025	3	78.75	-002.01	2728	-0.745	34.923	34.919
026	3	78.75	-002.01	2600	-0.748	34.921	34.916
027	3	78.75	-002.01	2400	-0.751	34.917	34.915
028	3	78.75	-002.01	2200	-0.743	34.916	34.913
029	3	78.75	-002.01	2000	-0.709	34.916	34.913
030	3	78.75	-002.01	1601	-0.606	34.915	34.912
031	3	78.75	-002.01	1400	-0.560	34.911	34.910
032	3	78.75	-002.01	1200	-0.456	34.910	34.907
033	3	78.75	-002.01	1003	-0.273	34.912	34.910
034	3	78.75	-002.01	0800	+0.023	34.914	34.910
035	3	78.75	-002.01	0602	+0.738	34.939	34.937
036	4	78.73	-002.02	0500	+0.875	34.930	34.931
037	4	78.73	-002.02	0400	+1.956	35.001	35.002
038	4	78.73	-002.02	0251	+3.172	35.084	35.085
039	4	78.73	-002.02	0202	+3.555	35.114	35.112
040	4	78.73	-002.02	0150	+3.769	35.119	35.118
041	4	78.73	-002.02	0101	+4.075	35.128	35.127
042	4	78.73	-002.02	0075	+4.192	35.114	35.114

043	4	78.73	-002.02	0050	+4.978	35.133	35.130
044	4	78.73	-002.02	0024	+6.582	35.044	NaN
045	4	78.73	-002.02	0014	+5.707	34.602	34.691
046	4	78.73	-002.02	0005	-0.697	31.178	NaN
047	4	78.73	-002.02	0001	+0.426	34.913	34.147
048	5	78.77	-003.97	1873	-0.555	34.924	34.922
049	5	78.77	-003.97	0402	+1.979	34.965	34.965
050	5	78.77	-003.97	0252	+2.743	34.971	34.970
051	5	78.77	-003.97	0200	+0.732	34.603	34.623
052	5	78.77	-003.97	0150	-1.774	34.052	34.061
053	5	78.77	-003.97	0101	-1.762	33.799	33.843
054	5	78.77	-003.97	0075	-1.434	32.992	33.082
055	5	78.77	-003.97	0050	-1.713	31.993	32.028
056	5	78.77	-003.97	0025	-1.369	31.368	31.422
057	5	78.77	-003.97	0015	-1.175	30.822	30.846
058	5	78.77	-003.97	0005	-1.340	30.200	30.267
059	5	78.77	-003.97	0001	-0.555	34.924	30.215
060	6	78.75	-003.50	2163	-0.769	34.925	34.920
061	6	78.75	-003.50	0400	+1.799	34.956	34.955
062	6	78.75	-003.50	0251	+3.293	35.059	35.064
063	6	78.75	-003.50	0201	+3.135	35.005	35.001
064	6	78.75	-003.50	0150	-0.144	34.465	34.474
065	6	78.75	-003.50	0100	-1.738	34.046	34.054
066	6	78.75	-003.50	0074	-0.784	33.891	33.913
067	6	78.75	-003.50	0049	-1.534	33.114	33.221
068	6	78.75	-003.50	0025	-1.600	31.700	31.785
069	6	78.75	-003.50	0015	-1.576	30.759	30.883
070	6	78.75	-003.50	0005	-1.561	30.750	30.757
071	6	78.75	-003.50	0001	-0.768	34.925	30.754
072	8	78.82	-004.42	1536	-0.473	34.918	34.917
073	8	78.82	-004.42	0401	+0.907	34.879	34.879
074	8	78.82	-004.42	0252	+1.384	34.752	34.744
075	8	78.82	-004.42	0203	-0.339	34.376	NaN
076	8	78.82	-004.42	0152	-1.707	33.974	33.972
077	8	78.82	-004.42	0102	-1.417	33.050	33.171
078	8	78.82	-004.42	0076	-1.642	32.227	32.313
079	8	78.82	-004.42	0051	-1.692	31.883	31.895
080	8	78.82	-004.42	0023	-1.380	31.136	31.173
081	8	78.82	-004.42	0014	-1.285	30.094	30.130
082	8	78.82	-004.42	0005	-1.302	29.961	29.922
083	8	78.82	-004.42	0001	-0.474	34.918	30.002
084	9	78.85	-005.04	1019	-0.092	34.887	34.886
085	9	78.85	-005.04	0400	+1.811	34.928	34.928
086	9	78.85	-005.04	0251	+0.892	34.641	34.638
087	9	78.85	-005.04	0202	-0.932	34.189	34.183
088	9	78.85	-005.04	0152	-1.682	33.883	33.894

089	9	78.85	-005.04	0102	-1.647	33.003	33.060
090	9	78.85	-005.04	0076	-1.642	32.088	32.150
091	9	78.85	-005.04	0051	-1.641	31.840	31.851
092	9	78.85	-005.04	0024	-1.294	31.306	31.334
093	9	78.85	-005.04	0015	-1.075	29.561	29.842
094	9	78.85	-005.04	0004	-0.957	29.146	29.206
095	9	78.85	-005.04	0001	-0.092	34.886	29.145
096	10	78.91	-005.51	0757	+0.152	34.874	34.874
097	10	78.91	-005.51	0401	+2.148	34.965	34.964
098	10	78.91	-005.51	0252	+1.979	34.812	34.765
099	10	78.91	-005.51	0202	-0.648	34.258	34.250
100	10	78.91	-005.51	0152	-1.174	33.868	33.845
101	10	78.91	-005.51	0102	-1.619	32.768	32.770
102	10	78.91	-005.51	0077	-1.656	32.105	32.093
103	10	78.91	-005.51	0050	-1.665	31.849	31.847
104	10	78.91	-005.51	0026	-1.372	31.295	31.264
105	10	78.91	-005.51	0016	-1.145	29.517	29.522
106	10	78.91	-005.51	0005	-0.811	29.125	29.134
107	10	78.91	-005.51	0001	+0.153	34.874	29.138
108	11	78.90	-005.98	0376	+0.799	34.894	34.893
109	11	78.90	-005.98	0301	+2.158	34.944	34.942
110	11	78.90	-005.98	0250	+1.930	34.813	34.812
111	11	78.90	-005.98	0200	-0.576	34.281	34.285
112	11	78.90	-005.98	0149	-1.716	33.910	33.925
113	11	78.90	-005.98	0100	-1.353	32.872	32.975
114	11	78.90	-005.98	0074	-1.653	32.051	32.092
115	11	78.90	-005.98	0050	-1.655	31.849	31.858
116	11	78.90	-005.98	0025	-1.276	30.943	31.061
117	11	78.90	-005.98	0015	-1.022	29.494	29.521
118	11	78.90	-005.98	0005	-1.009	29.481	29.483
119	11	78.90	-005.98	0001	+0.793	34.894	29.489
120	12	78.81	-006.55	0271	+1.300	34.799	34.797
121	12	78.81	-006.55	0250	+1.296	34.797	34.796
122	12	78.81	-006.55	0200	-0.206	34.421	34.441
123	12	78.81	-006.55	0150	-1.379	33.948	33.966
124	12	78.81	-006.55	0100	-1.479	33.045	33.139
125	12	78.81	-006.55	0074	-1.677	32.186	32.267
126	12	78.81	-006.55	0050	-1.705	31.895	31.910
127	12	78.81	-006.55	0026	-1.372	31.601	31.627
128	12	78.81	-006.55	0015	-1.337	29.979	30.028
129	12	78.81	-006.55	0005	-1.222	29.768	29.773
130	12	78.81	-006.55	0001	+1.300	34.798	29.785
131	13	78.83	-007.03	0249	+1.355	34.803	34.802
132	13	78.83	-007.03	0200	+0.229	34.522	34.517
133	13	78.83	-007.03	0151	-1.722	34.042	34.037
134	13	78.83	-007.03	0100	-1.251	33.300	33.317

135	13	78.83	-007.03	0050	-1.691	31.890	31.906
136	13	78.83	-007.03	0025	-1.429	31.409	31.517
137	13	78.83	-007.03	0015	-1.232	29.863	30.221
138	13	78.83	-007.03	0005	-1.224	29.722	29.828
139	13	78.83	-007.03	0001	+1.358	34.803	29.732
140	14	78.85	-007.91	0193	+0.037	34.431	34.433
141	14	78.85	-007.91	0151	-0.356	34.272	34.291
142	14	78.85	-007.91	0100	-1.285	33.689	33.707
143	14	78.85	-007.91	0075	-1.384	32.938	33.064
144	14	78.85	-007.91	0051	-1.579	31.985	32.081
145	14	78.85	-007.91	0024	-1.407	30.924	31.174
146	14	78.85	-007.91	0014	-1.232	29.877	30.180
147	14	78.85	-007.91	0005	-1.266	29.768	29.839
148	14	78.85	-007.91	0001	+0.038	34.432	29.778
149	16	78.76	-009.16	0189	-0.007	34.407	34.395
150	16	78.76	-009.16	0150	-0.279	34.270	34.284
151	16	78.76	-009.16	0101	-0.985	33.817	33.847
152	16	78.76	-009.16	0076	-1.555	32.922	33.016
153	16	78.76	-009.16	0050	-1.498	31.770	31.990
154	16	78.76	-009.16	0024	-1.487	29.957	30.778
155	16	78.76	-009.16	0015	-1.528	29.763	29.783
156	16	78.76	-009.16	0005	-1.524	29.759	29.761
157	16	78.76	-009.16	0001	-0.009	34.406	29.765
158	17	78.93	-010.05	0238	+0.080	34.450	34.442
159	17	78.93	-010.05	0199	-0.451	34.301	34.305
160	17	78.93	-010.05	0150	-1.367	34.039	34.040
161	17	78.93	-010.05	0099	-1.460	33.787	33.817
162	17	78.93	-010.05	0074	-1.499	32.964	33.085
163	17	78.93	-010.05	0049	-1.575	31.805	32.005
164	17	78.93	-010.05	0025	-1.483	29.920	30.387
165	17	78.93	-010.05	0015	-1.537	29.732	29.750
166	17	78.93	-010.05	0005	-1.521	29.732	29.737
167	17	78.93	-010.05	0001	+0.077	34.449	29.739
168	18	78.92	-011.01	0255	-0.064	34.385	34.386
169	18	78.92	-011.01	0200	-0.233	34.321	34.322
170	18	78.92	-011.01	0151	-0.715	34.047	34.062
171	18	78.92	-011.01	0100	-1.378	33.091	33.159
172	18	78.92	-011.01	0075	-1.632	32.050	32.208
173	18	78.92	-011.01	0051	-1.689	31.869	31.889
174	18	78.92	-011.01	0026	-1.426	31.310	31.523
175	18	78.92	-011.01	0015	-1.338	29.627	29.856
176	18	78.92	-011.01	0005	-1.293	29.616	29.624
177	18	78.92	-011.01	0002	-1.301	29.573	29.619
178	19	78.91	-012.02	0310	+0.448	34.588	34.579
179	19	78.91	-012.02	0251	-0.041	34.403	34.403
180	19	78.91	-012.02	0151	-1.030	33.673	33.704

181	19	78.91	-012.02	0101	-1.555	32.444	32.474
182	19	78.91	-012.02	0075	-1.690	31.906	31.929
183	19	78.91	-012.02	0050	-1.454	31.689	31.715
184	19	78.91	-012.02	0025	-1.392	29.628	29.865
185	19	78.91	-012.02	0015	-0.982	29.339	29.366
186	19	78.91	-012.02	0004	-0.953	29.305	29.314
187	19	78.91	-012.02	0001	+0.445	34.587	29.319
188	20	79.92	-014.01	0006	-0.723	29.622	29.628
189	22	80.00	-015.36	0235	+0.438	34.552	34.552
190	22	80.00	-015.36	0200	+0.131	34.435	34.445
191	22	80.00	-015.36	0150	-0.770	33.916	33.929
192	22	80.00	-015.36	0100	-1.643	32.549	32.561
193	22	80.00	-015.36	0074	-1.657	31.968	31.991
194	22	80.00	-015.36	0050	-1.551	31.723	31.771
195	22	80.00	-015.36	0025	-1.102	30.834	31.072
196	22	80.00	-015.36	0015	-0.875	29.904	30.343
197	22	80.00	-015.36	0005	-0.611	28.329	27.744
198	22	80.00	-015.36	0002	-0.610	25.570	26.964
199	23	80.06	-015.48	0301	+0.712	34.632	34.629
200	23	80.06	-015.48	0251	+0.617	34.598	34.603
201	23	80.06	-015.48	0201	+0.107	34.410	34.413
202	23	80.06	-015.48	0151	-0.489	33.985	33.999
203	23	80.06	-015.48	0100	-1.535	32.640	32.662
204	23	80.06	-015.48	0075	-1.700	31.970	32.055
205	23	80.06	-015.48	0049	-1.518	31.516	31.640
206	23	80.06	-015.48	0024	-0.880	30.022	30.120
207	23	80.06	-015.48	0015	-0.653	29.119	29.610
208	23	80.06	-015.48	0005	-0.478	27.516	27.751
209	23	80.06	-015.48	0001	-0.482	27.525	27.533
210	24	80.11	-015.70	0421	+0.976	34.712	34.713
211	24	80.11	-015.70	0250	+0.306	34.474	34.479
212	24	80.11	-015.70	0200	+0.105	34.384	34.382
213	24	80.11	-015.70	0149	-0.339	34.102	34.100
214	24	80.11	-015.70	0100	-1.415	32.874	33.020
215	24	80.11	-015.70	0075	-1.683	32.059	32.123
216	24	80.11	-015.70	0050	-1.566	31.685	31.731
217	24	80.11	-015.70	0025	-0.790	29.691	30.061
218	24	80.11	-015.70	0015	-0.386	28.766	28.909
219	24	80.11	-015.70	0004	-0.068	27.566	27.673
220	24	80.11	-015.70	0002	-0.074	27.529	27.577
221	25	80.13	-015.91	0207	+0.396	34.515	34.514
222	25	80.13	-015.91	0151	-0.278	34.133	34.142
223	25	80.13	-015.91	0101	-1.320	33.020	32.974
224	25	80.13	-015.91	0074	-1.685	32.013	32.131
225	25	80.13	-015.91	0051	-1.568	31.762	31.776
226	25	80.13	-015.91	0025	-1.013	30.623	30.724

227	25	80.13	-015.91	0015	-0.535	29.259	29.861
228	25	80.13	-015.91	0004	-0.335	27.794	27.838
229	25	80.13	-015.91	0002	-0.335	27.856	27.833
230	27	80.16	-016.18	0342	+0.903	34.693	34.691
231	27	80.16	-016.18	0250	+0.750	34.645	34.644
232	27	80.16	-016.18	0201	+0.330	34.493	34.492
233	27	80.16	-016.18	0151	-0.374	34.015	34.087
234	27	80.16	-016.18	0101	-1.510	32.622	32.695
235	27	80.16	-016.18	0076	-1.692	31.982	NaN
236	27	80.16	-016.18	0051	-1.577	31.676	32.055
237	27	80.16	-016.18	0026	-0.770	29.708	31.737
238	27	80.16	-016.18	0014	-0.583	28.372	30.063
239	27	80.16	-016.18	0005	-0.670	27.943	28.592
240	27	80.16	-016.18	0002	-0.660	27.823	28.029
241	28	80.17	-016.38	0142	-0.625	33.836	33.835
242	28	80.17	-016.38	0125	-0.947	33.524	33.571
243	28	80.17	-016.38	0100	-1.413	32.831	32.874
244	28	80.17	-016.38	0075	-1.687	31.999	32.019
245	28	80.17	-016.38	0050	-1.391	31.509	31.605
246	28	80.17	-016.38	0025	-0.697	29.564	30.102
247	28	80.17	-016.38	0015	-0.378	27.460	27.832
248	28	80.17	-016.38	0005	-0.407	27.331	27.406
249	28	80.17	-016.38	0001	-0.407	27.163	27.235
250	29	79.81	-020.22	0528	+1.014	34.725	34.721
251	29	79.81	-020.22	0301	+0.589	34.573	34.575
252	29	79.81	-020.22	0201	+0.210	34.423	34.422
253	29	79.81	-020.22	0170	-0.002	34.305	34.312
254	29	79.81	-020.22	0100	-1.413	32.802	32.888
255	29	79.81	-020.22	0075	-1.596	32.001	32.061
256	29	79.81	-020.22	0050	-1.354	31.345	31.534
257	29	79.81	-020.22	0024	-0.439	28.314	28.808
258	29	79.81	-020.22	0014	+1.020	25.421	26.126
259	29	79.81	-020.22	0005	+1.967	23.845	24.040
260	29	79.81	-020.22	0001	+2.231	23.256	23.466
261	30	79.80	-020.09	0205	+0.223	34.426	34.421
262	30	79.80	-020.09	0172	+0.008	34.309	34.315
263	30	79.80	-020.09	0151	-0.082	34.207	34.216
264	30	79.80	-020.09	0100	-1.273	33.175	33.349
265	30	79.80	-020.09	0075	-1.581	31.973	32.012
266	30	79.80	-020.09	0050	-1.385	31.393	31.523
267	30	79.80	-020.09	0025	-0.288	28.632	29.409
268	30	79.80	-020.09	0015	+0.613	26.318	26.658
269	30	79.80	-020.09	0005	+2.152	22.632	23.331
270	30	79.80	-020.09	0001	+2.222	22.327	22.481
271	31	79.82	-020.31	0317	+0.706	34.617	34.613
272	31	79.82	-020.31	0250	+0.473	34.529	34.531

273	31	79.82	-020.31	0201	+0.271	34.446	34.453
274	31	79.82	-020.31	0160	-0.001	34.314	34.323
275	31	79.82	-020.31	0100	-1.475	32.922	32.937
276	31	79.82	-020.31	0075	-1.605	32.108	32.173
277	31	79.82	-020.31	0050	-1.428	31.497	31.543
278	31	79.82	-020.31	0025	-0.528	28.512	28.962
279	31	79.82	-020.31	0015	-0.002	26.107	26.267
280	31	79.82	-020.31	0005	+2.033	23.568	23.679
281	31	79.82	-020.31	0002	+2.129	23.217	23.378
282	32	79.89	-020.00	0311	+0.683	34.609	34.602
283	32	79.89	-020.00	0250	+0.450	34.521	34.514
284	32	79.89	-020.00	0201	+0.198	34.417	34.409
285	32	79.89	-020.00	0169	-0.012	34.319	34.316
286	32	79.89	-020.00	0101	-1.303	32.997	33.124
287	32	79.89	-020.00	0075	-1.583	32.147	32.222
288	32	79.89	-020.00	0050	-1.445	31.463	31.613
289	32	79.89	-020.00	0025	-0.204	28.427	29.254
290	32	79.89	-020.00	0015	+0.568	26.799	26.759
291	32	79.89	-020.00	0005	+1.700	24.043	24.629
292	32	79.89	-020.00	0001	+2.090	22.719	23.382
293	33	79.96	-019.76	0384	+0.711	34.618	34.617
294	33	79.96	-019.76	0251	+0.352	34.483	34.487
295	33	79.96	-019.76	0180	+0.009	34.333	34.332
296	33	79.96	-019.76	0150	-0.277	34.151	34.179
297	33	79.96	-019.76	0100	-1.332	32.921	33.079
298	33	79.96	-019.76	0075	-1.596	32.009	32.166
299	33	79.96	-019.76	0050	-1.405	31.481	31.555
300	33	79.96	-019.76	0025	-0.109	28.570	29.134
301	33	79.96	-019.76	0014	+0.816	26.365	26.300
302	33	79.96	-019.76	0005	+1.385	24.605	24.822
303	33	79.96	-019.76	0001	+1.515	24.415	24.515
304	34	80.00	-019.54	0523	+0.789	34.645	34.642
305	34	80.00	-019.54	0300	+0.556	34.560	34.561
306	34	80.00	-019.54	0251	+0.392	34.498	34.504
307	34	80.00	-019.54	0175	-0.003	34.335	34.344
308	34	80.00	-019.54	0101	-1.321	32.946	33.159
309	34	80.00	-019.54	0075	-1.591	32.193	32.318
310	34	80.00	-019.54	0051	-1.444	31.479	31.586
311	34	80.00	-019.54	0026	-0.097	28.449	29.411
312	34	80.00	-019.54	0015	+0.519	26.526	27.128
313	34	80.00	-019.54	0005	+1.376	24.788	24.894
314	34	80.00	-019.54	0002	+1.459	24.462	24.686
315	35	80.05	-019.12	0457	+0.753	34.632	34.629
316	35	80.05	-019.12	0250	+0.437	34.514	34.514
317	35	80.05	-019.12	0174	+0.017	34.332	34.328
318	35	80.05	-019.12	0100	-1.310	32.952	32.987

319	35	80.05	-019.12	0075	-1.601	32.205	32.131
320	35	80.05	-019.12	0050	-1.466	31.473	31.612
321	35	80.05	-019.12	0025	-0.292	28.914	29.300
322	35	80.05	-019.12	0015	+0.699	26.377	27.273
323	35	80.05	-019.12	0005	+1.261	24.951	25.126
324	35	80.05	-019.12	0001	+1.323	24.701	24.854
325	36	80.08	-018.67	0229	+0.302	34.460	34.453
326	36	80.08	-018.67	0180	+0.058	34.337	34.334
327	36	80.08	-018.67	0150	-0.247	34.142	34.146
328	36	80.08	-018.67	0101	-1.326	32.933	33.004
329	36	80.08	-018.67	0074	-1.624	32.187	32.206
330	36	80.08	-018.67	0050	-1.453	31.411	31.598
331	36	80.08	-018.67	0025	-0.013	28.337	29.074
332	36	80.08	-018.67	0015	+0.503	26.608	27.101
333	36	80.08	-018.67	0005	+1.066	25.045	25.504
334	36	80.08	-018.67	0002	+1.149	24.833	24.937
335	37	80.10	-018.19	0192	+0.175	34.392	34.388
336	37	80.10	-018.19	0163	-0.004	34.286	34.287
337	37	80.10	-018.19	0100	-1.398	32.760	32.808
338	37	80.10	-018.19	0075	-1.641	32.087	32.157
339	37	80.10	-018.19	0051	-1.492	31.530	31.581
340	37	80.10	-018.19	0025	-0.317	28.670	29.370
341	37	80.10	-018.19	0015	+0.289	26.975	27.740
342	37	80.10	-018.19	0005	+1.600	24.167	25.532
343	37	80.10	-018.19	0001	+1.741	23.851	24.364
344	38	80.13	-017.70	0204	+0.124	34.361	34.347
345	38	80.13	-017.70	0169	+0.000	34.287	34.285
346	38	80.13	-017.70	0150	-0.168	34.177	34.183
347	38	80.13	-017.70	0100	-1.300	32.935	32.978
348	38	80.13	-017.70	0075	-1.638	32.115	32.151
349	38	80.13	-017.70	0050	-1.549	31.569	31.682
350	38	80.13	-017.70	0025	-0.356	28.169	28.685
351	38	80.13	-017.70	0015	-0.107	27.456	27.668
352	38	80.13	-017.70	0005	+1.220	24.962	25.581
353	38	80.13	-017.70	0001	+1.537	24.305	24.675
354	39	80.13	-017.39	0146	-0.196	34.147	34.060
355	39	80.13	-017.39	0100	-1.402	32.775	32.788
356	39	80.13	-017.39	0076	-1.653	32.077	32.083
357	39	80.13	-017.39	0050	-1.496	31.518	31.574
358	39	80.13	-017.39	0025	-0.418	28.541	28.816
359	39	80.13	-017.39	0015	-0.573	27.901	28.317
360	39	80.13	-017.39	0005	+1.240	24.750	27.059
361	39	80.13	-017.39	0001	+1.303	24.494	25.268
362	40	80.16	-017.33	0169	+0.240	34.427	34.419
363	40	80.16	-017.33	0150	-0.025	34.279	34.291
364	40	80.16	-017.33	0100	-1.441	32.706	32.747

365	40	80.16	-017.33	0076	-1.661	32.061	32.094
366	40	80.16	-017.33	0050	-1.539	31.541	31.604
367	40	80.16	-017.33	0025	-0.362	28.628	28.057
368	40	80.16	-017.33	0015	-0.328	27.994	28.078
369	40	80.16	-017.33	0005	-0.122	27.432	27.634
370	40	80.16	-017.33	0001	+0.980	24.964	26.874
371	42	80.10	-017.40	0095	-1.365	32.828	32.747
372	42	80.10	-017.40	0075	-1.653	32.117	32.156
373	42	80.10	-017.40	0050	-1.514	31.502	31.591
374	42	80.10	-017.40	0025	-0.505	28.474	28.632
375	42	80.10	-017.40	0015	-0.607	27.716	27.873
376	42	80.10	-017.40	0005	+1.397	24.645	26.249
377	42	80.10	-017.40	0001	+1.557	24.335	24.789
378	45	78.83	-015.00	0077	-1.657	31.851	31.853
379	45	78.83	-015.00	0050	-1.649	31.797	31.811
380	45	78.83	-015.00	0025	-1.517	31.434	31.582
381	45	78.83	-015.00	0015	-1.525	30.802	31.162
382	45	78.83	-015.00	0005	-1.381	29.438	29.618
383	45	78.83	-015.00	0002	-1.365	29.353	29.450
384	46	78.83	-016.01	0216	-0.019	34.409	34.403
385	46	78.83	-016.01	0151	-1.386	33.501	33.526
386	46	78.83	-016.01	0101	-1.624	32.536	32.569
387	46	78.83	-016.01	0075	-1.683	32.065	32.096
388	46	78.83	-016.01	0050	-1.641	31.831	31.853
389	46	78.83	-016.01	0025	-1.375	31.674	31.719
390	46	78.83	-016.01	0016	-0.972	31.160	31.541
391	46	78.83	-016.01	0005	-1.043	30.567	30.735
392	46	78.83	-016.01	0002	-0.940	30.116	NaN
393	48	78.83	-017.01	0389	+1.741	34.943	34.941
394	48	78.83	-017.01	0250	+0.839	34.665	34.660
395	48	78.83	-017.01	0200	-0.317	34.325	34.322
396	48	78.83	-017.01	0151	-1.192	33.780	33.778
397	48	78.83	-017.01	0100	-1.650	32.565	32.651
398	48	78.83	-017.01	0075	-1.662	31.964	32.055
399	48	78.83	-017.01	0050	-1.522	31.764	31.772
400	48	78.83	-017.01	0025	-0.747	31.068	31.074
401	48	78.83	-017.01	0016	-0.373	30.164	30.039
402	48	78.83	-017.01	0001	-1.034	26.666	26.958
403	49	78.83	-017.51	0579	+1.536	34.932	34.932
404	49	78.83	-017.51	0399	+1.653	34.932	34.934
405	49	78.83	-017.51	0250	+0.778	34.652	34.663
406	49	78.83	-017.51	0200	-0.105	34.395	34.416
407	49	78.83	-017.51	0150	-0.941	33.874	33.941
408	49	78.83	-017.51	0100	-1.630	32.771	32.897
409	49	78.83	-017.51	0075	-1.671	32.034	32.129
410	49	78.83	-017.51	0050	-1.510	31.767	31.813

411	49	78.83	-017.51	0025	-1.229	29.180	29.650
412	49	78.83	-017.51	0015	-1.117	28.123	28.452
413	49	78.83	-017.51	0005	-1.132	25.785	25.803
414	53	78.79	-004.03	1813	-0.613	34.924	34.922
415	53	78.79	-004.03	1699	-0.562	34.923	34.922
416	53	78.79	-004.03	1599	-0.523	34.923	34.922
417	53	78.79	-004.03	1500	-0.495	34.920	34.919
418	53	78.79	-004.03	1400	-0.477	34.914	34.916
419	53	78.79	-004.03	1299	-0.442	34.909	34.910
420	53	78.79	-004.03	1200	-0.349	34.908	34.909
421	53	78.79	-004.03	1002	-0.228	34.893	34.894
422	53	78.79	-004.03	0803	-0.042	34.880	34.881
423	53	78.79	-004.03	0604	+0.664	34.906	34.907
424	53	78.79	-004.03	0402	+1.937	34.975	34.977
425	54	78.92	+010.00	0072	+4.028	34.939	34.945
426	54	78.92	+010.00	0051	+5.322	35.036	35.041
427	54	78.92	+010.00	0025	+6.582	34.953	34.959
428	54	78.92	+010.00	0016	+6.232	34.873	34.867
429	54	78.92	+010.00	0005	+4.585	33.987	33.989
2381	56	78.80	-003.08	2502	-0.760	34.923	34.922
2382	56	78.80	-003.08	2200	-0.762	34.917	34.916
2383	56	78.80	-003.08	2001	-0.747	34.915	34.913
2384	56	78.80	-003.08	1801	-0.698	34.915	34.913
2385	56	78.80	-003.08	1600	-0.637	34.914	34.913
2386	56	78.80	-003.08	1401	-0.557	34.912	34.910
2387	56	78.80	-003.08	1200	-0.458	34.910	34.910
2388	56	78.80	-003.08	1000	-0.266	34.912	34.910
2389	56	78.80	-003.08	0799	-0.079	34.904	34.904
2390	56	78.80	-003.08	0600	+0.960	34.958	34.957
2391	56	78.80	-003.08	0400	+2.056	35.007	35.007
430	57	78.92	-000.99	2659	-0.744	34.922	34.921
431	57	78.92	-000.99	0399	+2.590	35.036	35.035
432	57	78.92	-000.99	0249	+3.432	35.083	35.081
433	57	78.92	-000.99	0200	+3.559	35.078	35.078
434	57	78.92	-000.99	0150	+3.373	35.006	35.007
435	57	78.92	-000.99	0100	+1.774	34.698	34.730
436	57	78.92	-000.99	0075	-0.679	34.312	34.322
437	57	78.92	-000.99	0050	-1.644	34.056	34.072
438	57	78.92	-000.99	0025	-1.432	33.807	33.844
439	57	78.92	-000.99	0005	-1.213	32.745	32.757
440	58	78.92	+000.01	2522	-0.755	34.923	34.921
441	58	78.92	+000.01	0402	+1.739	34.957	34.959
442	58	78.92	+000.01	0251	+2.572	34.994	34.994
443	58	78.92	+000.01	0202	+2.613	34.973	34.979
444	58	78.92	+000.01	0153	+2.925	34.978	34.973
445	58	78.92	+000.01	0101	+0.384	34.556	34.558

446	58	78.92	+000.01	0067	-0.850	34.205	34.166
447	58	78.92	+000.01	0051	-1.723	34.047	34.052
448	58	78.92	+000.01	0026	-1.673	33.782	33.785
449	58	78.92	+000.01	0015	-1.235	32.572	32.589
450	58	78.92	+000.01	0004	-1.236	32.575	32.580
2392	59	78.83	-002.51	2614	-0.758	34.920	34.919
2393	59	78.83	-002.51	0400	+2.116	35.021	35.022
2394	59	78.83	-002.51	0250	+3.406	35.096	35.097
2395	59	78.83	-002.51	0200	+3.707	35.121	35.121
2396	59	78.83	-002.51	0150	+3.485	35.067	35.063
2397	59	78.83	-002.51	0100	+3.825	35.049	35.055
2398	59	78.83	-002.51	0075	+3.437	34.911	34.923
2399	59	78.83	-002.51	0050	+3.735	34.805	34.829
2400	59	78.83	-002.51	0025	+1.311	34.080	34.084
2401	59	78.83	-002.51	0015	+1.258	34.052	34.062
2402	59	78.83	-002.51	0005	-1.370	32.799	32.852
2403	60	78.88	-002.00	2674	-0.743	34.923	34.920
2404	60	78.88	-002.00	0400	+2.158	34.998	34.999
2405	60	78.88	-002.00	0251	+2.708	35.006	35.007
2406	60	78.88	-002.00	0201	+2.875	35.007	35.006
2407	60	78.88	-002.00	0151	+3.007	34.989	34.989
2408	60	78.88	-002.00	0100	+0.693	34.623	34.637
2409	60	78.88	-002.00	0076	-0.263	34.421	34.430
2410	60	78.88	-002.00	0050	-1.608	34.113	34.119
2411	60	78.88	-002.00	0025	-0.088	33.996	34.005
2412	60	78.88	-002.00	0015	-1.259	32.858	32.967
2413	60	78.88	-002.00	0005	-1.400	32.731	32.735
2414	61	78.92	+001.00	2540	-0.749	34.926	34.925
2415	61	78.92	+001.00	0401	+1.634	34.941	34.940
2416	61	78.92	+001.00	0251	+2.529	34.986	34.985
2417	61	78.92	+001.00	0201	+3.012	35.015	35.016
2418	61	78.92	+001.00	0151	+3.018	34.990	NaN
2419	61	78.92	+001.00	0101	+3.197	34.831	NaN
2420	61	78.92	+001.00	0076	+2.825	34.597	NaN
2421	61	78.92	+001.00	0050	+1.186	34.210	NaN
2422	61	78.92	+001.00	0026	-1.596	33.778	NaN
2423	61	78.92	+001.00	0015	-1.124	32.965	NaN
2424	61	78.92	+001.00	0006	-1.187	32.602	NaN
451	62	78.92	+002.00	2521	-0.775	34.919	NaN
452	62	78.92	+002.00	0400	+1.542	34.948	NaN
453	62	78.92	+002.00	0251	+2.735	35.020	NaN
454	62	78.92	+002.00	0201	+2.983	35.027	NaN
455	62	78.92	+002.00	0151	+3.137	35.018	NaN
456	62	78.92	+002.00	0100	+3.552	35.014	NaN
457	62	78.92	+002.00	0076	+4.671	35.065	NaN
458	62	78.92	+002.00	0050	-0.469	34.366	NaN

459	62	78.92	+002.00	0025	+3.127	34.585	NaN
460	62	78.92	+002.00	0015	+1.415	34.273	NaN
461	62	78.92	+002.00	0005	+0.737	34.056	NaN
462	63	78.92	+003.00	2360	-0.800	34.916	NaN
463	63	78.92	+003.00	0401	+1.943	35.017	NaN
464	63	78.92	+003.00	0251	+3.457	35.106	NaN
465	63	78.92	+003.00	0202	+3.556	35.102	NaN
466	63	78.92	+003.00	0151	+3.912	35.128	NaN
467	63	78.92	+003.00	0100	+4.261	35.137	NaN
468	63	78.92	+003.00	0074	+4.537	35.121	NaN
469	63	78.92	+003.00	0050	+4.552	34.982	NaN
470	63	78.92	+003.00	0025	+4.484	34.950	NaN
471	63	78.92	+003.00	0015	+4.487	34.950	NaN
472	63	78.92	+003.00	0005	+4.474	34.950	NaN
473	64	78.92	+004.00	2540	-0.763	34.921	NaN
474	64	78.92	+004.00	0402	+1.724	34.982	NaN
475	64	78.92	+004.00	0250	+3.221	35.089	NaN
476	64	78.92	+004.00	0201	+3.512	35.103	NaN
477	64	78.92	+004.00	0151	+3.744	35.111	NaN
478	64	78.92	+004.00	0100	+4.174	35.136	NaN
479	64	78.92	+004.00	0075	+4.604	35.097	NaN
480	64	78.92	+004.00	0050	+4.777	34.925	NaN
481	64	78.92	+004.00	0025	+4.671	34.901	NaN
482	64	78.92	+004.00	0015	+4.670	34.901	NaN
483	64	78.92	+004.00	0005	+4.665	34.900	NaN
484	65	78.91	+005.00	2622	-0.742	34.926	NaN
485	65	78.91	+005.00	0400	+1.433	34.937	NaN
486	65	78.91	+005.00	0250	+2.931	35.041	NaN
487	65	78.91	+005.00	0200	+2.970	35.031	NaN
488	65	78.91	+005.00	0149	+3.206	35.034	NaN
489	65	78.91	+005.00	0100	+2.028	34.844	NaN
490	65	78.91	+005.00	0075	+1.640	34.703	NaN
491	65	78.91	+005.00	0050	+1.366	34.595	NaN
492	65	78.91	+005.00	0025	+2.571	34.439	NaN
493	65	78.91	+005.00	0015	+2.275	34.341	NaN
494	65	78.91	+005.00	0004	+1.584	34.122	NaN
495	66	78.92	+006.01	2326	-0.770	34.922	NaN
496	66	78.92	+006.01	0400	+1.660	34.997	NaN
497	66	78.92	+006.01	0253	+3.235	35.091	NaN
498	66	78.92	+006.01	0202	+3.587	35.115	NaN
499	66	78.92	+006.01	0150	+3.859	35.123	NaN
500	66	78.92	+006.01	0101	+4.181	35.127	NaN
501	66	78.92	+006.01	0076	+4.944	35.103	NaN
502	66	78.92	+006.01	0051	+5.333	35.096	NaN
503	66	78.92	+006.01	0024	+5.164	34.966	NaN
504	66	78.92	+006.01	0014	+4.460	34.856	NaN

505	66	78.92	+006.01	0005	+3.774	34.759	NaN
506	68	78.92	+007.00	1328	-0.847	34.910	NaN
507	68	78.92	+007.00	0401	+1.597	34.990	NaN
508	68	78.92	+007.00	0251	+3.388	35.094	NaN
509	68	78.92	+007.00	0202	+3.736	35.117	NaN
510	68	78.92	+007.00	0151	+4.048	35.130	NaN
511	68	78.92	+007.00	0100	+4.431	35.144	NaN
512	68	78.92	+007.00	0074	+4.697	35.144	NaN
513	68	78.92	+007.00	0050	+5.816	35.101	NaN
514	68	78.92	+007.00	0024	+6.029	35.051	NaN
515	68	78.92	+007.00	0015	+5.763	34.964	NaN
516	68	78.92	+007.00	0005	+5.765	34.963	NaN
517	70	78.92	+008.01	1041	-0.837	34.909	NaN
518	70	78.92	+008.01	0402	+3.575	35.119	NaN
519	70	78.92	+008.01	0251	+3.956	35.133	NaN
520	70	78.92	+008.01	0201	+4.126	35.135	NaN
521	70	78.92	+008.01	0150	+4.584	35.149	NaN
522	70	78.92	+008.01	0100	+6.131	35.111	NaN
523	70	78.92	+008.01	0075	+6.524	35.107	NaN
524	70	78.92	+008.01	0049	+6.523	35.107	NaN
525	70	78.92	+008.01	0025	+6.533	35.104	NaN
526	70	78.92	+008.01	0014	+6.582	35.083	NaN
527	70	78.92	+008.01	0006	+6.574	35.061	NaN
528	72	78.92	+009.00	0209	+4.377	35.077	NaN
529	72	78.92	+009.00	0151	+5.348	35.143	NaN
530	72	78.92	+009.00	0100	+5.828	35.159	NaN
531	72	78.92	+009.00	0074	+6.002	35.160	NaN
532	72	78.92	+009.00	0049	+6.291	35.156	NaN
533	72	78.92	+009.00	0025	+5.349	34.590	NaN
534	72	78.92	+009.00	0015	+4.670	34.254	NaN
535	72	78.92	+009.00	0005	+4.509	34.176	NaN

Appendix 3 : CDOM samples collected during FS 2012

Sample #, Station#, Latitude, Longitude, Sea depth, CTD salinity, Laboratory salinity

001	1	78.66	-003.19	2275	-0.767	34.924	34.917
002	1	78.66	-003.19	0302	+1.910	34.950	34.946
003	1	78.66	-003.19	0251	+2.100	34.943	34.952
004	1	78.66	-003.19	0202	+2.365	34.952	34.947
005	1	78.66	-003.19	0151	+1.853	34.850	34.841
006	1	78.66	-003.19	0100	+0.556	34.525	34.527
007	1	78.66	-003.19	0076	-0.807	34.223	34.223
008	1	78.66	-003.19	0049	-1.633	33.941	34.953
009	1	78.66	-003.19	0024	-1.567	33.266	33.296
010	1	78.66	-003.19	0015	-1.408	32.607	32.822
011	1	78.66	-003.19	0005	-1.369	30.909	NaN
012	1	78.66	-003.19	0001	-0.764	34.926	30.852
013	3	78.75	-002.01	2728	-0.745	34.923	34.919
014	3	78.75	-002.01	2600	-0.748	34.921	34.916
015	3	78.75	-002.01	2400	-0.751	34.917	34.915
016	3	78.75	-002.01	2200	-0.743	34.916	34.913
017	3	78.75	-002.01	2000	-0.709	34.916	34.913
018	3	78.75	-002.01	1601	-0.606	34.915	34.912
019	3	78.75	-002.01	1400	-0.560	34.911	34.910
020	3	78.75	-002.01	1200	-0.456	34.910	34.907
021	3	78.75	-002.01	1003	-0.273	34.912	34.910
022	3	78.75	-002.01	0800	+0.023	34.914	34.910
023	3	78.75	-002.01	0602	+0.738	34.939	34.937
024	4	78.73	-002.02	0500	+0.875	34.930	34.931
025	4	78.73	-002.02	0400	+1.956	35.001	35.002
026	4	78.73	-002.02	0251	+3.172	35.084	35.085
027	4	78.73	-002.02	0202	+3.555	35.114	35.112
028	4	78.73	-002.02	0150	+3.769	35.119	35.118
029	4	78.73	-002.02	0101	+4.075	35.128	35.127
030	4	78.73	-002.02	0075	+4.192	35.114	35.114
031	4	78.73	-002.02	0050	+4.978	35.133	35.130
032	4	78.73	-002.02	0024	+6.582	35.044	NaN
033	4	78.73	-002.02	0014	+5.707	34.602	34.691
034	4	78.73	-002.02	0005	-0.697	31.178	NaN
035	4	78.73	-002.02	0001	+0.426	34.913	34.147
036	5	78.77	-003.97	1873	-0.555	34.924	34.922
037	5	78.77	-003.97	0402	+1.979	34.965	34.965
038	5	78.77	-003.97	0252	+2.743	34.971	34.970
039	5	78.77	-003.97	0200	+0.732	34.603	34.623
040	5	78.77	-003.97	0150	-1.774	34.052	34.061
041	5	78.77	-003.97	0101	-1.762	33.799	33.843
042	5	78.77	-003.97	0075	-1.434	32.992	33.082

043	5	78.77	-003.97	0050	-1.713	31.993	32.028
044	5	78.77	-003.97	0025	-1.369	31.368	31.422
045	5	78.77	-003.97	0015	-1.175	30.822	30.846
046	5	78.77	-003.97	0005	-1.340	30.200	30.267
047	5	78.77	-003.97	0001	-0.555	34.924	30.215
048	8	78.82	-004.42	1536	-0.473	34.918	34.917
049	8	78.82	-004.42	0401	+0.907	34.879	34.879
050	8	78.82	-004.42	0252	+1.384	34.752	34.744
051	8	78.82	-004.42	0203	-0.339	34.376	NaN
052	8	78.82	-004.42	0152	-1.707	33.974	33.972
053	8	78.82	-004.42	0102	-1.417	33.050	33.171
054	8	78.82	-004.42	0076	-1.642	32.227	32.313
055	8	78.82	-004.42	0051	-1.692	31.883	31.895
056	8	78.82	-004.42	0023	-1.380	31.136	31.173
057	8	78.82	-004.42	0014	-1.285	30.094	30.130
058	8	78.82	-004.42	0005	-1.302	29.961	29.922
059	8	78.82	-004.42	0001	-0.474	34.918	30.002
060	9	78.85	-005.04	1019	-0.092	34.887	34.886
061	9	78.85	-005.04	0400	+1.811	34.928	34.928
062	9	78.85	-005.04	0251	+0.892	34.641	34.638
063	9	78.85	-005.04	0202	-0.932	34.189	34.183
064	9	78.85	-005.04	0152	-1.682	33.883	33.894
065	9	78.85	-005.04	0102	-1.647	33.003	33.060
066	9	78.85	-005.04	0076	-1.642	32.088	32.150
067	9	78.85	-005.04	0051	-1.641	31.840	31.851
068	9	78.85	-005.04	0024	-1.294	31.306	31.334
069	9	78.85	-005.04	0015	-1.075	29.561	29.842
070	9	78.85	-005.04	0004	-0.957	29.146	29.206
071	9	78.85	-005.04	0001	-0.092	34.886	29.145
072	11	78.90	-005.98	0376	+0.799	34.894	34.893
073	11	78.90	-005.98	0301	+2.158	34.944	34.942
074	11	78.90	-005.98	0250	+1.930	34.813	34.812
075	11	78.90	-005.98	0200	-0.576	34.281	34.285
076	11	78.90	-005.98	0149	-1.716	33.910	33.925
077	11	78.90	-005.98	0100	-1.353	32.872	32.975
078	11	78.90	-005.98	0074	-1.653	32.051	32.092
079	11	78.90	-005.98	0050	-1.655	31.849	31.858
080	11	78.90	-005.98	0025	-1.276	30.943	31.061
081	11	78.90	-005.98	0015	-1.022	29.494	29.521
082	11	78.90	-005.98	0005	-1.009	29.481	29.483
083	11	78.90	-005.98	0001	+0.793	34.894	29.489
084	13	78.83	-007.03	0249	+1.355	34.803	34.802
085	13	78.83	-007.03	0200	+0.229	34.522	34.517
086	13	78.83	-007.03	0151	-1.722	34.042	34.037
087	13	78.83	-007.03	0100	-1.251	33.300	33.317
088	13	78.83	-007.03	0050	-1.691	31.890	31.906

089	13	78.83	-007.03	0025	-1.429	31.409	31.517
090	13	78.83	-007.03	0015	-1.232	29.863	30.221
091	13	78.83	-007.03	0005	-1.224	29.722	29.828
092	13	78.83	-007.03	0001	+1.358	34.803	29.732
093	14	78.85	-007.91	0193	+0.037	34.431	34.433
094	14	78.85	-007.91	0151	-0.356	34.272	34.291
095	14	78.85	-007.91	0100	-1.285	33.689	33.707
096	14	78.85	-007.91	0075	-1.384	32.938	33.064
097	14	78.85	-007.91	0051	-1.579	31.985	32.081
098	14	78.85	-007.91	0024	-1.407	30.924	31.174
099	14	78.85	-007.91	0014	-1.232	29.877	30.180
100	14	78.85	-007.91	0005	-1.266	29.768	29.839
101	14	78.85	-007.91	0001	+0.038	34.432	29.778
102	16	78.76	-009.16	0189	-0.007	34.407	34.395
103	16	78.76	-009.16	0150	-0.279	34.270	34.284
104	16	78.76	-009.16	0101	-0.985	33.817	33.847
105	16	78.76	-009.16	0076	-1.555	32.922	33.016
106	16	78.76	-009.16	0050	-1.498	31.770	31.990
107	16	78.76	-009.16	0024	-1.487	29.957	30.778
108	16	78.76	-009.16	0015	-1.528	29.763	29.783
109	16	78.76	-009.16	0005	-1.524	29.759	29.761
110	16	78.76	-009.16	0001	-0.009	34.406	29.765
111	17	78.93	-010.05	0238	+0.080	34.450	34.442
112	17	78.93	-010.05	0199	-0.451	34.301	34.305
113	17	78.93	-010.05	0150	-1.367	34.039	34.040
114	17	78.93	-010.05	0099	-1.460	33.787	33.817
115	17	78.93	-010.05	0074	-1.499	32.964	33.085
116	17	78.93	-010.05	0049	-1.575	31.805	32.005
117	17	78.93	-010.05	0025	-1.483	29.920	30.387
118	17	78.93	-010.05	0015	-1.537	29.732	29.750
119	17	78.93	-010.05	0005	-1.521	29.732	29.737
120	17	78.93	-010.05	0001	+0.077	34.449	29.739
121	18	78.92	-011.01	0255	-0.064	34.385	34.386
122	18	78.92	-011.01	0200	-0.233	34.321	34.322
123	18	78.92	-011.01	0151	-0.715	34.047	34.062
124	18	78.92	-011.01	0100	-1.378	33.091	33.159
125	18	78.92	-011.01	0075	-1.632	32.050	32.208
126	18	78.92	-011.01	0051	-1.689	31.869	31.889
127	18	78.92	-011.01	0026	-1.426	31.310	31.523
128	18	78.92	-011.01	0015	-1.338	29.627	29.856
129	18	78.92	-011.01	0005	-1.293	29.616	29.624
130	18	78.92	-011.01	0002	-1.301	29.573	29.619
131	19	78.91	-012.02	0310	+0.448	34.588	34.579
132	19	78.91	-012.02	0251	-0.041	34.403	34.403
133	19	78.91	-012.02	0151	-1.030	33.673	33.704
134	19	78.91	-012.02	0101	-1.555	32.444	32.474

135	19	78.91	-012.02	0075	-1.690	31.906	31.929
136	19	78.91	-012.02	0050	-1.454	31.689	31.715
137	19	78.91	-012.02	0025	-1.392	29.628	29.865
138	19	78.91	-012.02	0015	-0.982	29.339	29.366
139	19	78.91	-012.02	0004	-0.953	29.305	29.314
190	19	78.91	-012.02	0001	+0.445	34.587	29.319
142	20	79.92	-014.01	0006	-0.723	29.622	29.628
143	22	80.00	-015.36	0235	+0.438	34.552	34.552
144	22	80.00	-015.36	0200	+0.131	34.435	34.445
145	22	80.00	-015.36	0150	-0.770	33.916	33.929
146	22	80.00	-015.36	0100	-1.643	32.549	32.561
147	22	80.00	-015.36	0074	-1.657	31.968	31.991
148	22	80.00	-015.36	0050	-1.551	31.723	31.771
149	22	80.00	-015.36	0025	-1.102	30.834	31.072
150	22	80.00	-015.36	0015	-0.875	29.904	30.343
151	22	80.00	-015.36	0005	-0.611	28.329	27.744
152	22	80.00	-015.36	0002	-0.610	25.570	26.964
153	24	80.11	-015.70	0421	+0.976	34.712	34.713
154	24	80.11	-015.70	0250	+0.306	34.474	34.479
155	24	80.11	-015.70	0200	+0.105	34.384	34.382
156	24	80.11	-015.70	0149	-0.339	34.102	34.100
157	24	80.11	-015.70	0100	-1.415	32.874	33.020
158	24	80.11	-015.70	0075	-1.683	32.059	32.123
159	24	80.11	-015.70	0050	-1.566	31.685	31.731
160	24	80.11	-015.70	0025	-0.790	29.691	30.061
161	24	80.11	-015.70	0015	-0.386	28.766	28.909
162	24	80.11	-015.70	0004	-0.068	27.566	27.673
163	24	80.11	-015.70	0002	-0.074	27.529	27.577
164	27	80.16	-016.18	0342	+0.903	34.693	34.691
165	27	80.16	-016.18	0250	+0.750	34.645	34.644
166	27	80.16	-016.18	0201	+0.330	34.493	34.492
167	27	80.16	-016.18	0151	-0.374	34.015	34.087
168	27	80.16	-016.18	0101	-1.510	32.622	32.695
169	27	80.16	-016.18	0076	-1.692	31.982	NaN
170	27	80.16	-016.18	0051	-1.577	31.676	32.055
171	27	80.16	-016.18	0026	-0.770	29.708	31.737
172	27	80.16	-016.18	0014	-0.583	28.372	30.063
173	27	80.16	-016.18	0005	-0.670	27.943	28.592
174	27	80.16	-016.18	0002	-0.660	27.823	28.029
175	27	80.16	-016.18	0001	+0.899	34.691	27.866
176	28	80.17	-016.38	0142	-0.625	33.836	33.835
177	28	80.17	-016.38	0125	-0.947	33.524	33.571
178	28	80.17	-016.38	0100	-1.413	32.831	32.874
179	28	80.17	-016.38	0075	-1.687	31.999	32.019
180	28	80.17	-016.38	0050	-1.391	31.509	31.605
181	28	80.17	-016.38	0025	-0.697	29.564	30.102

182	28	80.17	-016.38	0015	-0.378	27.460	27.832
183	28	80.17	-016.38	0005	-0.407	27.331	27.406
184	28	80.17	-016.38	0001	-0.407	27.163	27.235
172	29	79.81	-020.22	0528	+1.014	34.725	34.721
185	29	79.81	-020.22	0301	+0.589	34.573	34.575
186	29	79.81	-020.22	0201	+0.210	34.423	34.422
187	29	79.81	-020.22	0170	-0.002	34.305	34.312
188	29	79.81	-020.22	0100	-1.413	32.802	32.888
189	29	79.81	-020.22	0075	-1.596	32.001	32.061
190	29	79.81	-020.22	0050	-1.354	31.345	31.534
191	29	79.81	-020.22	0024	-0.439	28.314	28.808
193	29	79.81	-020.22	0014	+1.020	25.421	26.126
194	29	79.81	-020.22	0005	+1.967	23.845	24.040
195	29	79.81	-020.22	0001	+2.231	23.256	23.466
196	30	79.80	-020.09	0205	+0.223	34.426	34.421
197	30	79.80	-020.09	0172	+0.008	34.309	34.315
198	30	79.80	-020.09	0151	-0.082	34.207	34.216
199	30	79.80	-020.09	0100	-1.273	33.175	33.349
200	30	79.80	-020.09	0075	-1.581	31.973	32.012
201	30	79.80	-020.09	0050	-1.385	31.393	31.523
202	30	79.80	-020.09	0025	-0.288	28.632	29.409
203	30	79.80	-020.09	0015	+0.613	26.318	26.658
204	30	79.80	-020.09	0005	+2.152	22.632	23.331
206	30	79.80	-020.09	0001	+2.222	22.327	22.481
192	31	79.82	-020.31	0317	+0.706	34.617	34.613
207	31	79.82	-020.31	0250	+0.473	34.529	34.531
208	31	79.82	-020.31	0201	+0.271	34.446	34.453
209	31	79.82	-020.31	0160	-0.001	34.314	34.323
210	31	79.82	-020.31	0100	-1.475	32.922	32.937
211	31	79.82	-020.31	0075	-1.605	32.108	32.173
212	31	79.82	-020.31	0050	-1.428	31.497	31.543
213	31	79.82	-020.31	0025	-0.528	28.512	28.962
214	31	79.82	-020.31	0015	-0.002	26.107	26.267
215	31	79.82	-020.31	0005	+2.033	23.568	23.679
216	31	79.82	-020.31	0002	+2.129	23.217	23.378
217	32	79.89	-020.00	0311	+0.683	34.609	34.602
218	32	79.89	-020.00	0250	+0.450	34.521	34.514
219	32	79.89	-020.00	0201	+0.198	34.417	34.409
220	32	79.89	-020.00	0169	-0.012	34.319	34.316
221	32	79.89	-020.00	0101	-1.303	32.997	33.124
222	32	79.89	-020.00	0075	-1.583	32.147	32.222
223	32	79.89	-020.00	0050	-1.445	31.463	31.613
224	32	79.89	-020.00	0025	-0.204	28.427	29.254
225	32	79.89	-020.00	0015	+0.568	26.799	26.759
226	32	79.89	-020.00	0005	+1.700	24.043	24.629
227	32	79.89	-020.00	0001	+2.090	22.719	23.382

228	33	79.96	-019.76	0384	+0.711	34.618	34.617
229	33	79.96	-019.76	0251	+0.352	34.483	34.487
234	33	79.96	-019.76	0180	+0.009	34.333	34.332
235	33	79.96	-019.76	0150	-0.277	34.151	34.179
236	33	79.96	-019.76	0100	-1.332	32.921	33.079
237	33	79.96	-019.76	0075	-1.596	32.009	32.166
238	33	79.96	-019.76	0050	-1.405	31.481	31.555
239	33	79.96	-019.76	0025	-0.109	28.570	29.134
240	33	79.96	-019.76	0014	+0.816	26.365	26.300
241	33	79.96	-019.76	0005	+1.385	24.605	24.822
242	33	79.96	-019.76	0001	+1.515	24.415	24.515
230	34	80.00	-019.54	0523	+0.789	34.645	34.642
231	34	80.00	-019.54	0300	+0.556	34.560	34.561
232	34	80.00	-019.54	0251	+0.392	34.498	34.504
233	34	80.00	-019.54	0175	-0.003	34.335	34.344
243	34	80.00	-019.54	0101	-1.321	32.946	33.159
244	34	80.00	-019.54	0075	-1.591	32.193	32.318
245	34	80.00	-019.54	0051	-1.444	31.479	31.586
246	34	80.00	-019.54	0026	-0.097	28.449	29.411
247	34	80.00	-019.54	0015	+0.519	26.526	27.128
248	34	80.00	-019.54	0005	+1.376	24.788	24.894
249	34	80.00	-019.54	0002	+1.459	24.462	24.686
250	35	80.05	-019.12	0457	+0.753	34.632	34.629
251	35	80.05	-019.12	0250	+0.437	34.514	34.514
252	35	80.05	-019.12	0174	+0.017	34.332	34.328
253	35	80.05	-019.12	0100	-1.310	32.952	32.987
254	35	80.05	-019.12	0075	-1.601	32.205	32.131
255	35	80.05	-019.12	0050	-1.466	31.473	31.612
256	35	80.05	-019.12	0025	-0.292	28.914	29.300
257	35	80.05	-019.12	0015	+0.699	26.377	27.273
258	35	80.05	-019.12	0005	+1.261	24.951	25.126
259	35	80.05	-019.12	0001	+1.323	24.701	24.854
260	36	80.08	-018.67	0229	+0.302	34.460	34.453
261	36	80.08	-018.67	0180	+0.058	34.337	34.334
262	36	80.08	-018.67	0150	-0.247	34.142	34.146
263	36	80.08	-018.67	0101	-1.326	32.933	33.004
264	36	80.08	-018.67	0074	-1.624	32.187	32.206
265	36	80.08	-018.67	0050	-1.453	31.411	31.598
266	36	80.08	-018.67	0025	-0.013	28.337	29.074
267	36	80.08	-018.67	0015	+0.503	26.608	27.101
268	36	80.08	-018.67	0005	+1.066	25.045	25.504
269	36	80.08	-018.67	0002	+1.149	24.833	24.937
270	37	80.10	-018.19	0192	+0.175	34.392	34.388
271	37	80.10	-018.19	0163	-0.004	34.286	34.287
272	37	80.10	-018.19	0100	-1.398	32.760	32.808
273	37	80.10	-018.19	0075	-1.641	32.087	32.157

274	37	80.10	-018.19	0051	-1.492	31.530	31.581
275	37	80.10	-018.19	0025	-0.317	28.670	29.370
276	37	80.10	-018.19	0015	+0.289	26.975	27.740
277	37	80.10	-018.19	0005	+1.600	24.167	25.532
278	37	80.10	-018.19	0001	+1.741	23.851	24.364
279	38	80.13	-017.70	0204	+0.124	34.361	34.347
280	38	80.13	-017.70	0169	+0.000	34.287	34.285
281	38	80.13	-017.70	0150	-0.168	34.177	34.183
282	38	80.13	-017.70	0100	-1.300	32.935	32.978
283	38	80.13	-017.70	0075	-1.638	32.115	32.151
284	38	80.13	-017.70	0050	-1.549	31.569	31.682
285	38	80.13	-017.70	0025	-0.356	28.169	28.685
286	38	80.13	-017.70	0015	-0.107	27.456	27.668
287	38	80.13	-017.70	0005	+1.220	24.962	25.581
288	38	80.13	-017.70	0001	+1.537	24.305	24.675
289	39	80.13	-017.39	0146	-0.196	34.147	34.060
290	39	80.13	-017.39	0100	-1.402	32.775	32.788
291	39	80.13	-017.39	0076	-1.653	32.077	32.083
292	39	80.13	-017.39	0050	-1.496	31.518	31.574
293	39	80.13	-017.39	0025	-0.418	28.541	28.816
294	39	80.13	-017.39	0015	-0.573	27.901	28.317
295	39	80.13	-017.39	0005	+1.240	24.750	27.059
296	39	80.13	-017.39	0001	+1.303	24.494	25.268
297	40	80.16	-017.33	0169	+0.240	34.427	34.419
298	40	80.16	-017.33	0150	-0.025	34.279	34.291
299	40	80.16	-017.33	0100	-1.441	32.706	32.747
300	40	80.16	-017.33	0076	-1.661	32.061	32.094
301	40	80.16	-017.33	0050	-1.539	31.541	31.604
302	40	80.16	-017.33	0025	-0.362	28.628	28.057
303	40	80.16	-017.33	0015	-0.328	27.994	28.078
304	40	80.16	-017.33	0005	-0.122	27.432	27.634
305	40	80.16	-017.33	0001	+0.980	24.964	26.874
306	42	80.10	-017.40	0095	-1.365	32.828	32.747
307	42	80.10	-017.40	0075	-1.653	32.117	32.156
308	42	80.10	-017.40	0050	-1.514	31.502	31.591
309	42	80.10	-017.40	0025	-0.505	28.474	28.632
310	42	80.10	-017.40	0015	-0.607	27.716	27.873
311	42	80.10	-017.40	0005	+1.397	24.645	26.249
312	42	80.10	-017.40	0001	+1.557	24.335	24.789
313	45	78.83	-015.00	0077	-1.657	31.851	31.853
314	45	78.83	-015.00	0050	-1.649	31.797	31.811
315	45	78.83	-015.00	0025	-1.517	31.434	31.582
316	45	78.83	-015.00	0015	-1.525	30.802	31.162
317	45	78.83	-015.00	0005	-1.381	29.438	29.618
318	45	78.83	-015.00	0002	-1.365	29.353	29.450
319	46	78.83	-016.01	0216	-0.019	34.409	34.403

320	46	78.83	-016.01	0151	-1.386	33.501	33.526
321	46	78.83	-016.01	0101	-1.624	32.536	32.569
322	46	78.83	-016.01	0075	-1.683	32.065	32.096
323	46	78.83	-016.01	0050	-1.641	31.831	31.853
324	46	78.83	-016.01	0025	-1.375	31.674	31.719
325	46	78.83	-016.01	0016	-0.972	31.160	31.541
326	46	78.83	-016.01	0005	-1.043	30.567	30.735
327	46	78.83	-016.01	0002	-0.940	30.116	NaN
328	48	78.83	-017.01	0389	+1.741	34.943	34.941
329	48	78.83	-017.01	0250	+0.839	34.665	34.660
330	48	78.83	-017.01	0200	-0.317	34.325	34.322
331	48	78.83	-017.01	0151	-1.192	33.780	33.778
332	48	78.83	-017.01	0100	-1.650	32.565	32.651
333	48	78.83	-017.01	0075	-1.662	31.964	32.055
334	48	78.83	-017.01	0050	-1.522	31.764	31.772
335	48	78.83	-017.01	0025	-0.747	31.068	31.074
336	48	78.83	-017.01	0016	-0.373	30.164	30.039
337	48	78.83	-017.01	0001	-1.034	26.666	26.958
338	49	78.83	-017.51	0579	+1.536	34.932	34.932
339	49	78.83	-017.51	0399	+1.653	34.932	34.934
340	49	78.83	-017.51	0250	+0.778	34.652	34.663
341	49	78.83	-017.51	0200	-0.105	34.395	34.416
342	49	78.83	-017.51	0150	-0.941	33.874	33.941
343	49	78.83	-017.51	0100	-1.630	32.771	32.897
344	49	78.83	-017.51	0075	-1.671	32.034	32.129
345	49	78.83	-017.51	0050	-1.510	31.767	31.813
346	49	78.83	-017.51	0025	-1.229	29.180	29.650
347	49	78.83	-017.51	0015	-1.117	28.123	28.452
348	49	78.83	-017.51	0005	-1.132	25.785	25.803
349	54	78.92	+010.00	0072	+4.028	34.939	34.945
350	54	78.92	+010.00	0051	+5.322	35.036	35.041
351	54	78.92	+010.00	0025	+6.582	34.953	34.959
352	54	78.92	+010.00	0016	+6.232	34.873	34.867
353	54	78.92	+010.00	0005	+4.585	33.987	33.989
354	57	78.92	-000.99	2659	-0.744	34.922	34.921
355	57	78.92	-000.99	0399	+2.590	35.036	35.035
356	57	78.92	-000.99	0249	+3.432	35.083	35.081
357	57	78.92	-000.99	0200	+3.559	35.078	35.078
358	57	78.92	-000.99	0150	+3.373	35.006	35.007
359	57	78.92	-000.99	0100	+1.774	34.698	34.730
360	57	78.92	-000.99	0075	-0.679	34.312	34.322
361	57	78.92	-000.99	0050	-1.644	34.056	34.072
362	57	78.92	-000.99	0025	-1.432	33.807	33.844
363	57	78.92	-000.99	0005	-1.213	32.745	32.757
364	58	78.92	+000.01	2522	-0.755	34.923	34.921
365	58	78.92	+000.01	0402	+1.739	34.957	34.959

366	58	78.92	+000.01	0251	+2.572	34.994	34.994
367	58	78.92	+000.01	0202	+2.613	34.973	34.979
368	58	78.92	+000.01	0153	+2.925	34.978	34.973
369	58	78.92	+000.01	0101	+0.384	34.556	34.558
370	58	78.92	+000.01	0067	-0.850	34.205	34.166
371	58	78.92	+000.01	0051	-1.723	34.047	34.052
372	58	78.92	+000.01	0026	-1.673	33.782	33.785
373	58	78.92	+000.01	0015	-1.235	32.572	32.589
374	58	78.92	+000.01	0004	-1.236	32.575	32.580
375	62	78.92	+002.00	2521	-0.775	34.919	NaN
378	62	78.92	+002.00	0400	+1.542	34.948	NaN
379	62	78.92	+002.00	0251	+2.735	35.020	NaN
380	62	78.92	+002.00	0201	+2.983	35.027	NaN
381	62	78.92	+002.00	0151	+3.137	35.018	NaN
382	62	78.92	+002.00	0100	+3.552	35.014	NaN
383	62	78.92	+002.00	0076	+4.671	35.065	NaN
384	62	78.92	+002.00	0050	-0.469	34.366	NaN
385	62	78.92	+002.00	0025	+3.127	34.585	NaN
386	62	78.92	+002.00	0015	+1.415	34.273	NaN
387	62	78.92	+002.00	0005	+0.737	34.056	NaN
388	64	78.92	+004.00	2540	-0.763	34.921	NaN
389	64	78.92	+004.00	0402	+1.724	34.982	NaN
390	64	78.92	+004.00	0250	+3.221	35.089	NaN
391	64	78.92	+004.00	0201	+3.512	35.103	NaN
392	64	78.92	+004.00	0151	+3.744	35.111	NaN
393	64	78.92	+004.00	0100	+4.174	35.136	NaN
394	64	78.92	+004.00	0075	+4.604	35.097	NaN
395	64	78.92	+004.00	0050	+4.777	34.925	NaN
396	64	78.92	+004.00	0025	+4.671	34.901	NaN
397	64	78.92	+004.00	0015	+4.670	34.901	NaN
398	64	78.92	+004.00	0005	+4.665	34.900	NaN
399	66	78.92	+006.01	2326	-0.770	34.922	NaN
400	66	78.92	+006.01	0400	+1.660	34.997	NaN
401	66	78.92	+006.01	0253	+3.235	35.091	NaN
402	66	78.92	+006.01	0202	+3.587	35.115	NaN
403	66	78.92	+006.01	0150	+3.859	35.123	NaN
404	66	78.92	+006.01	0101	+4.181	35.127	NaN
405	66	78.92	+006.01	0076	+4.944	35.103	NaN
406	66	78.92	+006.01	0051	+5.333	35.096	NaN
407	66	78.92	+006.01	0024	+5.164	34.966	NaN
408	66	78.92	+006.01	0014	+4.460	34.856	NaN
409	66	78.92	+006.01	0005	+3.774	34.759	NaN
410	68	78.92	+007.00	1328	-0.847	34.910	NaN
411	68	78.92	+007.00	0401	+1.597	34.990	NaN
412	68	78.92	+007.00	0251	+3.388	35.094	NaN
413	68	78.92	+007.00	0202	+3.736	35.117	NaN

414	68	78.92	+007.00	0151	+4.048	35.130	NaN
415	68	78.92	+007.00	0100	+4.431	35.144	NaN
416	68	78.92	+007.00	0074	+4.697	35.144	NaN
417	68	78.92	+007.00	0050	+5.816	35.101	NaN
418	68	78.92	+007.00	0024	+6.029	35.051	NaN
419	68	78.92	+007.00	0015	+5.763	34.964	NaN
420	68	78.92	+007.00	0005	+5.765	34.963	NaN
421	70	78.92	+008.01	1041	-0.837	34.909	NaN
422	70	78.92	+008.01	0402	+3.575	35.119	NaN
423	70	78.92	+008.01	0251	+3.956	35.133	NaN
424	70	78.92	+008.01	0201	+4.126	35.135	NaN
425	70	78.92	+008.01	0150	+4.584	35.149	NaN
426	70	78.92	+008.01	0100	+6.131	35.111	NaN
427	70	78.92	+008.01	0075	+6.524	35.107	NaN
428	70	78.92	+008.01	0049	+6.523	35.107	NaN
429	70	78.92	+008.01	0025	+6.533	35.104	NaN
430	70	78.92	+008.01	0014	+6.582	35.083	NaN
431	70	78.92	+008.01	0006	+6.574	35.061	NaN
432	72	78.92	+009.00	0209	+4.377	35.077	NaN
433	72	78.92	+009.00	0151	+5.348	35.143	NaN
434	72	78.92	+009.00	0100	+5.828	35.159	NaN
435	72	78.92	+009.00	0074	+6.002	35.160	NaN
436	72	78.92	+009.00	0049	+6.291	35.156	NaN
437	72	78.92	+009.00	0025	+5.349	34.590	NaN
438	72	78.92	+009.00	0015	+4.670	34.254	NaN
439	72	78.92	+009.00	0005	+4.509	34.176	NaN

Appendix 4 : Total alkalinity samples collected during FS 2012

Sample #, Station#, Latitude, Longitude, Sea depth, CTD salinity, Laboratory salinity

001	1	78.66	-003.19	2275	-0.767	34.924	34.917
002	1	78.66	-003.19	0302	+1.910	34.950	34.946
003	1	78.66	-003.19	0251	+2.100	34.943	34.952
004	1	78.66	-003.19	0202	+2.365	34.952	34.947
005	1	78.66	-003.19	0151	+1.853	34.850	34.841
006	1	78.66	-003.19	0100	+0.556	34.525	34.527
007	1	78.66	-003.19	0076	-0.807	34.223	34.223
008	1	78.66	-003.19	0049	-1.633	33.941	34.953
009	1	78.66	-003.19	0024	-1.567	33.266	33.296
010	1	78.66	-003.19	0015	-1.408	32.607	32.822
011	1	78.66	-003.19	0005	-1.369	30.909	NaN
012	1	78.66	-003.19	0001	-0.764	34.926	30.852
013	2	78.75	-002.51	2649	-0.791	34.917	34.913
014	3	78.75	-002.01	2728	-0.745	34.923	34.919
015	3	78.75	-002.01	2600	-0.748	34.921	34.916

016	3	78.75	-002.01	2400	-0.751	34.917	34.915
017	3	78.75	-002.01	2200	-0.743	34.916	34.913
018	3	78.75	-002.01	2000	-0.709	34.916	34.913
019	3	78.75	-002.01	1601	-0.606	34.915	34.912
020	3	78.75	-002.01	1400	-0.560	34.911	34.910
021	3	78.75	-002.01	1200	-0.456	34.910	34.907
022	3	78.75	-002.01	1003	-0.273	34.912	34.910
023	3	78.75	-002.01	0800	+0.023	34.914	34.910
024	3	78.75	-002.01	0602	+0.738	34.939	34.937
025	4	78.73	-002.02	0500	+0.875	34.930	34.931
026	4	78.73	-002.02	0400	+1.956	35.001	35.002
027	4	78.73	-002.02	0251	+3.172	35.084	35.085
028	4	78.73	-002.02	0202	+3.555	35.114	35.112
029	4	78.73	-002.02	0150	+3.769	35.119	35.118
030	4	78.73	-002.02	0101	+4.075	35.128	35.127
031	4	78.73	-002.02	0075	+4.192	35.114	35.114
032	4	78.73	-002.02	0050	+4.978	35.133	35.130
033	4	78.73	-002.02	0024	+6.582	35.044	NaN
034	4	78.73	-002.02	0014	+5.707	34.602	34.691
035	4	78.73	-002.02	0005	-0.697	31.178	NaN
036	4	78.73	-002.02	0001	+0.426	34.913	34.147
037	5	78.77	-003.97	1873	-0.555	34.924	34.922
038	5	78.77	-003.97	0402	+1.979	34.965	34.965
039	5	78.77	-003.97	0252	+2.743	34.971	34.970
040	5	78.77	-003.97	0200	+0.732	34.603	34.623
041	5	78.77	-003.97	0150	-1.774	34.052	34.061
042	5	78.77	-003.97	0101	-1.762	33.799	33.843
043	5	78.77	-003.97	0075	-1.434	32.992	33.082
044	5	78.77	-003.97	0050	-1.713	31.993	32.028
045	5	78.77	-003.97	0025	-1.369	31.368	31.422
046	5	78.77	-003.97	0015	-1.175	30.822	30.846
047	5	78.77	-003.97	0005	-1.340	30.200	30.267
048	5	78.77	-003.97	0001	-0.555	34.924	30.215
049	8	78.82	-004.42	1536	-0.473	34.918	34.917
050	8	78.82	-004.42	0401	+0.907	34.879	34.879
051	8	78.82	-004.42	0252	+1.384	34.752	34.744
052	8	78.82	-004.42	0203	-0.339	34.376	NaN
053	8	78.82	-004.42	0152	-1.707	33.974	33.972
054	8	78.82	-004.42	0102	-1.417	33.050	33.171
055	8	78.82	-004.42	0076	-1.642	32.227	32.313
056	8	78.82	-004.42	0051	-1.692	31.883	31.895
057	8	78.82	-004.42	0023	-1.380	31.136	31.173
058	8	78.82	-004.42	0014	-1.285	30.094	30.130
059	8	78.82	-004.42	0005	-1.302	29.961	29.922
060	8	78.82	-004.42	0001	-0.474	34.918	30.002
061	9	78.85	-005.04	1019	-0.092	34.887	34.886

062	9	78.85	-005.04	0400	+1.811	34.928	34.928
063	9	78.85	-005.04	0251	+0.892	34.641	34.638
064	9	78.85	-005.04	0202	-0.932	34.189	34.183
065	9	78.85	-005.04	0152	-1.682	33.883	33.894
066	9	78.85	-005.04	0102	-1.647	33.003	33.060
067	9	78.85	-005.04	0076	-1.642	32.088	32.150
068	9	78.85	-005.04	0051	-1.641	31.840	31.851
069	9	78.85	-005.04	0024	-1.294	31.306	31.334
070	9	78.85	-005.04	0015	-1.075	29.561	29.842
071	9	78.85	-005.04	0004	-0.957	29.146	29.206
072	9	78.85	-005.04	0001	-0.092	34.886	29.145
073	11	78.90	-005.98	0376	+0.799	34.894	34.893
074	11	78.90	-005.98	0301	+2.158	34.944	34.942
075	11	78.90	-005.98	0250	+1.930	34.813	34.812
076	11	78.90	-005.98	0200	-0.576	34.281	34.285
077	11	78.90	-005.98	0149	-1.716	33.910	33.925
078	11	78.90	-005.98	0100	-1.353	32.872	32.975
079	11	78.90	-005.98	0074	-1.653	32.051	32.092
080	11	78.90	-005.98	0050	-1.655	31.849	31.858
081	11	78.90	-005.98	0025	-1.276	30.943	31.061
082	11	78.90	-005.98	0015	-1.022	29.494	29.521
083	11	78.90	-005.98	0005	-1.009	29.481	29.483
084	11	78.90	-005.98	0001	+0.793	34.894	29.489
085	13	78.83	-007.03	0249	+1.355	34.803	34.802
086	13	78.83	-007.03	0200	+0.229	34.522	34.517
087	13	78.83	-007.03	0151	-1.722	34.042	34.037
088	13	78.83	-007.03	0100	-1.251	33.300	33.317
089	13	78.83	-007.03	0050	-1.691	31.890	31.906
090	13	78.83	-007.03	0025	-1.429	31.409	31.517
091	13	78.83	-007.03	0015	-1.232	29.863	30.221
092	13	78.83	-007.03	0005	-1.224	29.722	29.828
093	13	78.83	-007.03	0001	+1.358	34.803	29.732
094	14	78.85	-007.91	0193	+0.037	34.431	34.433
095	14	78.85	-007.91	0151	-0.356	34.272	34.291
096	14	78.85	-007.91	0100	-1.285	33.689	33.707
097	14	78.85	-007.91	0075	-1.384	32.938	33.064
098	14	78.85	-007.91	0051	-1.579	31.985	32.081
099	14	78.85	-007.91	0024	-1.407	30.924	31.174
100	14	78.85	-007.91	0014	-1.232	29.877	30.180
101	14	78.85	-007.91	0005	-1.266	29.768	29.839
102	14	78.85	-007.91	0001	+0.038	34.432	29.778
103	16	78.76	-009.16	0189	-0.007	34.407	34.395
104	16	78.76	-009.16	0150	-0.279	34.270	34.284
105	16	78.76	-009.16	0101	-0.985	33.817	33.847
106	16	78.76	-009.16	0076	-1.555	32.922	33.016
107	16	78.76	-009.16	0050	-1.498	31.770	31.990

108	16	78.76	-009.16	0024	-1.487	29.957	30.778
109	16	78.76	-009.16	0015	-1.528	29.763	29.783
110	16	78.76	-009.16	0005	-1.524	29.759	29.761
111	16	78.76	-009.16	0001	-0.009	34.406	29.765
112	17	78.93	-010.05	0238	+0.080	34.450	34.442
113	17	78.93	-010.05	0199	-0.451	34.301	34.305
114	17	78.93	-010.05	0150	-1.367	34.039	34.040
115	17	78.93	-010.05	0099	-1.460	33.787	33.817
116	17	78.93	-010.05	0074	-1.499	32.964	33.085
117	17	78.93	-010.05	0049	-1.575	31.805	32.005
118	17	78.93	-010.05	0025	-1.483	29.920	30.387
119	17	78.93	-010.05	0015	-1.537	29.732	29.750
120	17	78.93	-010.05	0005	-1.521	29.732	29.737
121	17	78.93	-010.05	0001	+0.077	34.449	29.739
122	18	78.92	-011.01	0255	-0.064	34.385	34.386
123	18	78.92	-011.01	0200	-0.233	34.321	34.322
124	18	78.92	-011.01	0151	-0.715	34.047	34.062
125	18	78.92	-011.01	0100	-1.378	33.091	33.159
126	18	78.92	-011.01	0075	-1.632	32.050	32.208
127	18	78.92	-011.01	0051	-1.689	31.869	31.889
128	18	78.92	-011.01	0026	-1.426	31.310	31.523
129	18	78.92	-011.01	0015	-1.338	29.627	29.856
130	18	78.92	-011.01	0005	-1.293	29.616	29.624
131	18	78.92	-011.01	0002	-1.301	29.573	29.619
132	19	78.91	-012.02	0310	+0.448	34.588	34.579
133	19	78.91	-012.02	0251	-0.041	34.403	34.403
135	19	78.91	-012.02	0151	-1.030	33.673	33.704
136	19	78.91	-012.02	0101	-1.555	32.444	32.474
137	19	78.91	-012.02	0075	-1.690	31.906	31.929
138	19	78.91	-012.02	0050	-1.454	31.689	31.715
139	19	78.91	-012.02	0025	-1.392	29.628	29.865
140	19	78.91	-012.02	0015	-0.982	29.339	29.366
141	19	78.91	-012.02	0004	-0.953	29.305	29.314
142	19	78.91	-012.02	0001	+0.445	34.587	29.319
143	21	80.00	-015.00	0172	-0.375	34.220	NaN
144	21	80.00	-015.00	0150	-0.828	33.974	NaN
145	21	80.00	-015.00	0100	-1.619	32.508	NaN
146	21	80.00	-015.00	0075	-1.691	32.017	NaN
147	21	80.00	-015.00	0050	-1.598	31.786	NaN
148	21	80.00	-015.00	0024	-1.223	31.145	NaN
149	21	80.00	-015.00	0014	-0.614	28.736	NaN
150	21	80.00	-015.00	0005	-0.508	28.326	NaN
151	22	80.00	-015.36	0235	+0.438	34.552	34.552
152	22	80.00	-015.36	0200	+0.131	34.435	34.445
153	22	80.00	-015.36	0150	-0.770	33.916	33.929
154	22	80.00	-015.36	0100	-1.643	32.549	32.561

155	22	80.00	-015.36	0074	-1.657	31.968	31.991
156	22	80.00	-015.36	0050	-1.551	31.723	31.771
157	22	80.00	-015.36	0025	-1.102	30.834	31.072
158	22	80.00	-015.36	0015	-0.875	29.904	30.343
159	22	80.00	-015.36	0005	-0.611	28.329	27.744
160	22	80.00	-015.36	0002	-0.610	25.570	26.964
161	24	80.11	-015.70	0421	+0.976	34.712	34.713
162	24	80.11	-015.70	0250	+0.306	34.474	34.479
163	24	80.11	-015.70	0200	+0.105	34.384	34.382
164	24	80.11	-015.70	0149	-0.339	34.102	34.100
165	24	80.11	-015.70	0100	-1.415	32.874	33.020
166	24	80.11	-015.70	0075	-1.683	32.059	32.123
167	24	80.11	-015.70	0050	-1.566	31.685	31.731
168	24	80.11	-015.70	0025	-0.790	29.691	30.061
169	24	80.11	-015.70	0015	-0.386	28.766	28.909
170	24	80.11	-015.70	0004	-0.068	27.566	27.673
171	24	80.11	-015.70	0002	-0.074	27.529	27.577
172	25	80.13	-015.91	0207	+0.396	34.515	34.514
173	25	80.13	-015.91	0151	-0.278	34.133	34.142
174	25	80.13	-015.91	0101	-1.320	33.020	32.974
175	25	80.13	-015.91	0074	-1.685	32.013	32.131
176	25	80.13	-015.91	0051	-1.568	31.762	31.776
177	25	80.13	-015.91	0025	-1.013	30.623	30.724
178	25	80.13	-015.91	0015	-0.535	29.259	29.861
179	25	80.13	-015.91	0004	-0.335	27.794	27.838
180	25	80.13	-015.91	0002	-0.335	27.856	27.833
181	27	80.16	-016.18	0342	+0.903	34.693	34.691
182	27	80.16	-016.18	0250	+0.750	34.645	34.644
183	27	80.16	-016.18	0201	+0.330	34.493	34.492
184	27	80.16	-016.18	0151	-0.374	34.015	34.087
185	27	80.16	-016.18	0101	-1.510	32.622	32.695
186	27	80.16	-016.18	0076	-1.692	31.982	NaN
187	27	80.16	-016.18	0051	-1.577	31.676	32.055
188	27	80.16	-016.18	0026	-0.770	29.708	31.737
189	27	80.16	-016.18	0014	-0.583	28.372	30.063
190	27	80.16	-016.18	0005	-0.670	27.943	28.592
191	27	80.16	-016.18	0002	-0.660	27.823	28.029
192	28	80.17	-016.38	0142	-0.625	33.836	33.835
193	28	80.17	-016.38	0125	-0.947	33.524	33.571
194	28	80.17	-016.38	0100	-1.413	32.831	32.874
195	28	80.17	-016.38	0075	-1.687	31.999	32.019
196	28	80.17	-016.38	0050	-1.391	31.509	31.605
197	28	80.17	-016.38	0025	-0.697	29.564	30.102
198	28	80.17	-016.38	0015	-0.378	27.460	27.832
199	28	80.17	-016.38	0005	-0.407	27.331	27.406
200	28	80.17	-016.38	0001	-0.407	27.163	27.235

202	29	79.81	-020.22	0528	+1.014	34.725	34.721
203	29	79.81	-020.22	0301	+0.589	34.573	34.575
204	29	79.81	-020.22	0201	+0.210	34.423	34.422
205	29	79.81	-020.22	0170	-0.002	34.305	34.312
206	29	79.81	-020.22	0100	-1.413	32.802	32.888
207	29	79.81	-020.22	0075	-1.596	32.001	32.061
208	29	79.81	-020.22	0050	-1.354	31.345	31.534
209	29	79.81	-020.22	0024	-0.439	28.314	28.808
210	29	79.81	-020.22	0014	+1.020	25.421	26.126
211	29	79.81	-020.22	0005	+1.967	23.845	24.040
212	29	79.81	-020.22	0001	+2.231	23.256	23.466
213	30	79.80	-020.09	0205	+0.223	34.426	34.421
214	30	79.80	-020.09	0172	+0.008	34.309	34.315
215	30	79.80	-020.09	0151	-0.082	34.207	34.216
216	30	79.80	-020.09	0100	-1.273	33.175	33.349
217	30	79.80	-020.09	0075	-1.581	31.973	32.012
218	30	79.80	-020.09	0050	-1.385	31.393	31.523
219	30	79.80	-020.09	0025	-0.288	28.632	29.409
220	30	79.80	-020.09	0015	+0.613	26.318	26.658
221	30	79.80	-020.09	0005	+2.152	22.632	23.331
222	30	79.80	-020.09	0001	+2.222	22.327	22.481
223	31	79.82	-020.31	0317	+0.706	34.617	34.613
224	31	79.82	-020.31	0250	+0.473	34.529	34.531
225	31	79.82	-020.31	0201	+0.271	34.446	34.453
226	31	79.82	-020.31	0160	-0.001	34.314	34.323
227	31	79.82	-020.31	0100	-1.475	32.922	32.937
228	31	79.82	-020.31	0075	-1.605	32.108	32.173
229	31	79.82	-020.31	0050	-1.428	31.497	31.543
230	31	79.82	-020.31	0025	-0.528	28.512	28.962
231	31	79.82	-020.31	0015	-0.002	26.107	26.267
232	31	79.82	-020.31	0005	+2.033	23.568	23.679
233	31	79.82	-020.31	0002	+2.129	23.217	23.378
234	32	79.89	-020.00	0311	+0.683	34.609	34.602
235	32	79.89	-020.00	0250	+0.450	34.521	34.514
236	32	79.89	-020.00	0201	+0.198	34.417	34.409
237	32	79.89	-020.00	0169	-0.012	34.319	34.316
238	32	79.89	-020.00	0101	-1.303	32.997	33.124
239	32	79.89	-020.00	0075	-1.583	32.147	32.222
240	32	79.89	-020.00	0050	-1.445	31.463	31.613
241	32	79.89	-020.00	0025	-0.204	28.427	29.254
242	32	79.89	-020.00	0015	+0.568	26.799	26.759
243	32	79.89	-020.00	0005	+1.700	24.043	24.629
244	32	79.89	-020.00	0001	+2.090	22.719	23.382
245	33	79.96	-019.76	0384	+0.711	34.618	34.617
246	33	79.96	-019.76	0251	+0.352	34.483	34.487
247	33	79.96	-019.76	0180	+0.009	34.333	34.332

248	33	79.96	-019.76	0150	-0.277	34.151	34.179
249	33	79.96	-019.76	0100	-1.332	32.921	33.079
250	33	79.96	-019.76	0075	-1.596	32.009	32.166
251	33	79.96	-019.76	0050	-1.405	31.481	31.555
252	33	79.96	-019.76	0025	-0.109	28.570	29.134
253	33	79.96	-019.76	0014	+0.816	26.365	26.300
254	33	79.96	-019.76	0005	+1.385	24.605	24.822
255	33	79.96	-019.76	0001	+1.515	24.415	24.515
256	34	80.00	-019.54	0523	+0.789	34.645	34.642
257	34	80.00	-019.54	0300	+0.556	34.560	34.561
258	34	80.00	-019.54	0251	+0.392	34.498	34.504
259	34	80.00	-019.54	0175	-0.003	34.335	34.344
260	34	80.00	-019.54	0101	-1.321	32.946	33.159
261	34	80.00	-019.54	0075	-1.591	32.193	32.318
262	34	80.00	-019.54	0051	-1.444	31.479	31.586
263	34	80.00	-019.54	0026	-0.097	28.449	29.411
264	34	80.00	-019.54	0015	+0.519	26.526	27.128
265	34	80.00	-019.54	0005	+1.376	24.788	24.894
266	34	80.00	-019.54	0002	+1.459	24.462	24.686
267	35	80.05	-019.12	0457	+0.753	34.632	34.629
268	35	80.05	-019.12	0250	+0.437	34.514	34.514
269	35	80.05	-019.12	0174	+0.017	34.332	34.328
270	35	80.05	-019.12	0100	-1.310	32.952	32.987
271	35	80.05	-019.12	0075	-1.601	32.205	32.131
272	35	80.05	-019.12	0050	-1.466	31.473	31.612
273	35	80.05	-019.12	0025	-0.292	28.914	29.300
274	35	80.05	-019.12	0015	+0.699	26.377	27.273
275	35	80.05	-019.12	0005	+1.261	24.951	25.126
276	35	80.05	-019.12	0001	+1.323	24.701	24.854
277	36	80.08	-018.67	0229	+0.302	34.460	34.453
278	36	80.08	-018.67	0180	+0.058	34.337	34.334
279	36	80.08	-018.67	0150	-0.247	34.142	34.146
280	36	80.08	-018.67	0101	-1.326	32.933	33.004
281	36	80.08	-018.67	0074	-1.624	32.187	32.206
282	36	80.08	-018.67	0050	-1.453	31.411	31.598
283	36	80.08	-018.67	0025	-0.013	28.337	29.074
284	36	80.08	-018.67	0015	+0.503	26.608	27.101
285	36	80.08	-018.67	0005	+1.066	25.045	25.504
286	36	80.08	-018.67	0002	+1.149	24.833	24.937
287	37	80.10	-018.19	0192	+0.175	34.392	34.388
288	37	80.10	-018.19	0163	-0.004	34.286	34.287
289	37	80.10	-018.19	0100	-1.398	32.760	32.808
290	37	80.10	-018.19	0075	-1.641	32.087	32.157
291	37	80.10	-018.19	0051	-1.492	31.530	31.581
292	37	80.10	-018.19	0025	-0.317	28.670	29.370
293	37	80.10	-018.19	0015	+0.289	26.975	27.740

294	37	80.10	-018.19	0005	+1.600	24.167	25.532
295	37	80.10	-018.19	0001	+1.741	23.851	24.364
296	38	80.13	-017.70	0204	+0.124	34.361	34.347
297	38	80.13	-017.70	0169	+0.000	34.287	34.285
298	38	80.13	-017.70	0150	-0.168	34.177	34.183
299	38	80.13	-017.70	0100	-1.300	32.935	32.978
300	38	80.13	-017.70	0075	-1.638	32.115	32.151
301	38	80.13	-017.70	0050	-1.549	31.569	31.682
302	38	80.13	-017.70	0025	-0.356	28.169	28.685
303	38	80.13	-017.70	0015	-0.107	27.456	27.668
304	38	80.13	-017.70	0005	+1.220	24.962	25.581
305	38	80.13	-017.70	0001	+1.537	24.305	24.675
306	39	80.13	-017.39	0146	-0.196	34.147	34.060
307	39	80.13	-017.39	0100	-1.402	32.775	32.788
308	39	80.13	-017.39	0076	-1.653	32.077	32.083
309	39	80.13	-017.39	0050	-1.496	31.518	31.574
310	39	80.13	-017.39	0025	-0.418	28.541	28.816
311	39	80.13	-017.39	0015	-0.573	27.901	28.317
312	39	80.13	-017.39	0005	+1.240	24.750	27.059
313	39	80.13	-017.39	0001	+1.303	24.494	25.268
314	40	80.16	-017.33	0169	+0.240	34.427	34.419
315	40	80.16	-017.33	0150	-0.025	34.279	34.291
316	40	80.16	-017.33	0100	-1.441	32.706	32.747
317	40	80.16	-017.33	0076	-1.661	32.061	32.094
318	40	80.16	-017.33	0050	-1.539	31.541	31.604
319	40	80.16	-017.33	0025	-0.362	28.628	28.057
320	40	80.16	-017.33	0015	-0.328	27.994	28.078
321	40	80.16	-017.33	0005	-0.122	27.432	27.634
322	40	80.16	-017.33	0001	+0.980	24.964	26.874
323	42	80.10	-017.40	0095	-1.365	32.828	32.747
324	42	80.10	-017.40	0075	-1.653	32.117	32.156
325	42	80.10	-017.40	0050	-1.514	31.502	31.591
326	42	80.10	-017.40	0025	-0.505	28.474	28.632
327	42	80.10	-017.40	0015	-0.607	27.716	27.873
328	42	80.10	-017.40	0005	+1.397	24.645	26.249
329	42	80.10	-017.40	0001	+1.557	24.335	24.789
333	45	78.83	-015.00	0077	-1.657	31.851	31.853
334	45	78.83	-015.00	0050	-1.649	31.797	31.811
335	45	78.83	-015.00	0025	-1.517	31.434	31.582
336	45	78.83	-015.00	0015	-1.525	30.802	31.162
337	45	78.83	-015.00	0005	-1.381	29.438	29.618
338	45	78.83	-015.00	0002	-1.365	29.353	29.450
339	46	78.83	-016.01	0216	-0.019	34.409	34.403
340	46	78.83	-016.01	0151	-1.386	33.501	33.526
341	46	78.83	-016.01	0101	-1.624	32.536	32.569
342	46	78.83	-016.01	0075	-1.683	32.065	32.096

343	46	78.83	-016.01	0050	-1.641	31.831	31.853
344	46	78.83	-016.01	0025	-1.375	31.674	31.719
345	46	78.83	-016.01	0016	-0.972	31.160	31.541
346	46	78.83	-016.01	0005	-1.043	30.567	30.735
347	46	78.83	-016.01	0002	-0.940	30.116	NaN
348	48	78.83	-017.01	0389	+1.741	34.943	34.941
349	48	78.83	-017.01	0250	+0.839	34.665	34.660
350	48	78.83	-017.01	0200	-0.317	34.325	34.322
351	48	78.83	-017.01	0151	-1.192	33.780	33.778
352	48	78.83	-017.01	0100	-1.650	32.565	32.651
353	48	78.83	-017.01	0075	-1.662	31.964	32.055
354	48	78.83	-017.01	0050	-1.522	31.764	31.772
355	48	78.83	-017.01	0025	-0.747	31.068	31.074
356	48	78.83	-017.01	0016	-0.373	30.164	30.039
357	48	78.83	-017.01	0001	-1.034	26.666	26.958
358	49	78.83	-017.51	0579	+1.536	34.932	34.932
359	49	78.83	-017.51	0399	+1.653	34.932	34.934
360	49	78.83	-017.51	0250	+0.778	34.652	34.663
361	49	78.83	-017.51	0200	-0.105	34.395	34.416
362	49	78.83	-017.51	0150	-0.941	33.874	33.941
363	49	78.83	-017.51	0100	-1.630	32.771	32.897
364	49	78.83	-017.51	0075	-1.671	32.034	32.129
365	49	78.83	-017.51	0050	-1.510	31.767	31.813
366	49	78.83	-017.51	0025	-1.229	29.180	29.650
367	49	78.83	-017.51	0015	-1.117	28.123	28.452
368	49	78.83	-017.51	0005	-1.132	25.785	25.803
371	53	78.79	-004.03	1813	-0.613	34.924	34.922
372	53	78.79	-004.03	1699	-0.562	34.923	34.922
373	53	78.79	-004.03	1599	-0.523	34.923	34.922
374	53	78.79	-004.03	1500	-0.495	34.920	34.919
375	53	78.79	-004.03	1400	-0.477	34.914	34.916
376	53	78.79	-004.03	1299	-0.442	34.909	34.910
377	53	78.79	-004.03	1200	-0.349	34.908	34.909
378	53	78.79	-004.03	1002	-0.228	34.893	34.894
379	53	78.79	-004.03	0803	-0.042	34.880	34.881
380	53	78.79	-004.03	0604	+0.664	34.906	34.907
381	53	78.79	-004.03	0402	+1.937	34.975	34.977
382	54	78.92	+010.00	0072	+4.028	34.939	34.945
383	54	78.92	+010.00	0051	+5.322	35.036	35.041
384	54	78.92	+010.00	0025	+6.582	34.953	34.959
385	54	78.92	+010.00	0016	+6.232	34.873	34.867
386	54	78.92	+010.00	0005	+4.585	33.987	33.989
387	56	78.80	-003.08	2502	-0.760	34.923	34.922
388	56	78.80	-003.08	2200	-0.762	34.917	34.916
389	56	78.80	-003.08	2001	-0.747	34.915	34.913
390	56	78.80	-003.08	1801	-0.698	34.915	34.913

391	56	78.80	-003.08	1600	-0.637	34.914	34.913
392	56	78.80	-003.08	1401	-0.557	34.912	34.910
393	56	78.80	-003.08	1200	-0.458	34.910	34.910
394	56	78.80	-003.08	1000	-0.266	34.912	34.910
395	56	78.80	-003.08	0799	-0.079	34.904	34.904
396	56	78.80	-003.08	0600	+0.960	34.958	34.957
397	56	78.80	-003.08	0400	+2.056	35.007	35.007
398	57	78.92	-000.99	2659	-0.744	34.922	34.921
399	57	78.92	-000.99	0399	+2.590	35.036	35.035
400	57	78.92	-000.99	0249	+3.432	35.083	35.081
401	57	78.92	-000.99	0200	+3.559	35.078	35.078
402	57	78.92	-000.99	0150	+3.373	35.006	35.007
403	57	78.92	-000.99	0100	+1.774	34.698	34.730
405	57	78.92	-000.99	0075	-0.679	34.312	34.322
406	57	78.92	-000.99	0050	-1.644	34.056	34.072
407	57	78.92	-000.99	0025	-1.432	33.807	33.844
408	57	78.92	-000.99	0005	-1.213	32.745	32.757
409	58	78.92	+000.01	2522	-0.755	34.923	34.921
410	58	78.92	+000.01	0402	+1.739	34.957	34.959
411	58	78.92	+000.01	0251	+2.572	34.994	34.994
412	58	78.92	+000.01	0202	+2.613	34.973	34.979
413	58	78.92	+000.01	0153	+2.925	34.978	34.973
414	58	78.92	+000.01	0101	+0.384	34.556	34.558
415	58	78.92	+000.01	0067	-0.850	34.205	34.166
416	58	78.92	+000.01	0051	-1.723	34.047	34.052
417	58	78.92	+000.01	0026	-1.673	33.782	33.785
418	58	78.92	+000.01	0015	-1.235	32.572	32.589
419	58	78.92	+000.01	0004	-1.236	32.575	32.580
420	60	78.88	-002.00	2674	-0.743	34.923	34.920
421	60	78.88	-002.00	0400	+2.158	34.998	34.999
422	60	78.88	-002.00	0251	+2.708	35.006	35.007
423	60	78.88	-002.00	0201	+2.875	35.007	35.006
424	60	78.88	-002.00	0151	+3.007	34.989	34.989
425	60	78.88	-002.00	0100	+0.693	34.623	34.637
426	60	78.88	-002.00	0076	-0.263	34.421	34.430
427	60	78.88	-002.00	0050	-1.608	34.113	34.119
428	60	78.88	-002.00	0025	-0.088	33.996	34.005
429	60	78.88	-002.00	0015	-1.259	32.858	32.967
430	61	78.92	+001.00	2540	-0.749	34.926	34.925
431	61	78.92	+001.00	0401	+1.634	34.941	34.940
432	61	78.92	+001.00	0251	+2.529	34.986	34.985
433	61	78.92	+001.00	0201	+3.012	35.015	35.016
434	61	78.92	+001.00	0151	+3.018	34.990	NaN
435	61	78.92	+001.00	0101	+3.197	34.831	NaN
436	61	78.92	+001.00	0076	+2.825	34.597	NaN
437	61	78.92	+001.00	0050	+1.186	34.210	NaN

438	61	78.92	+001.00	0026	-1.596	33.778	NaN
439	61	78.92	+001.00	0015	-1.124	32.965	NaN
440	61	78.92	+001.00	0006	-1.187	32.602	NaN
441	62	78.92	+002.00	2521	-0.775	34.919	NaN
442	62	78.92	+002.00	0400	+1.542	34.948	NaN
443	62	78.92	+002.00	0251	+2.735	35.020	NaN
444	62	78.92	+002.00	0201	+2.983	35.027	NaN
445	62	78.92	+002.00	0151	+3.137	35.018	NaN
446	62	78.92	+002.00	0100	+3.552	35.014	NaN
447	62	78.92	+002.00	0076	+4.671	35.065	NaN
448	62	78.92	+002.00	0050	-0.469	34.366	NaN
449	62	78.92	+002.00	0025	+3.127	34.585	NaN
450	62	78.92	+002.00	0015	+1.415	34.273	NaN
451	62	78.92	+002.00	0005	+0.737	34.056	NaN
452	64	78.92	+004.00	2540	-0.763	34.921	NaN
453	64	78.92	+004.00	0402	+1.724	34.982	NaN
454	64	78.92	+004.00	0250	+3.221	35.089	NaN
455	64	78.92	+004.00	0201	+3.512	35.103	NaN
456	64	78.92	+004.00	0151	+3.744	35.111	NaN
457	64	78.92	+004.00	0100	+4.174	35.136	NaN
458	64	78.92	+004.00	0075	+4.604	35.097	NaN
459	64	78.92	+004.00	0050	+4.777	34.925	NaN
460	64	78.92	+004.00	0025	+4.671	34.901	NaN
461	64	78.92	+004.00	0015	+4.670	34.901	NaN
462	64	78.92	+004.00	0005	+4.665	34.900	NaN
463	66	78.92	+006.01	2326	-0.770	34.922	NaN
464	66	78.92	+006.01	0400	+1.660	34.997	NaN
465	66	78.92	+006.01	0253	+3.235	35.091	NaN
466	66	78.92	+006.01	0202	+3.587	35.115	NaN
467	66	78.92	+006.01	0150	+3.859	35.123	NaN
468	66	78.92	+006.01	0101	+4.181	35.127	NaN
469	66	78.92	+006.01	0076	+4.944	35.103	NaN
470	66	78.92	+006.01	0051	+5.333	35.096	NaN
471	66	78.92	+006.01	0024	+5.164	34.966	NaN
472	66	78.92	+006.01	0014	+4.460	34.856	NaN
473	66	78.92	+006.01	0005	+3.774	34.759	NaN
474	68	78.92	+007.00	1328	-0.847	34.910	NaN
475	68	78.92	+007.00	0401	+1.597	34.990	NaN
476	68	78.92	+007.00	0251	+3.388	35.094	NaN
477	68	78.92	+007.00	0202	+3.736	35.117	NaN
478	68	78.92	+007.00	0151	+4.048	35.130	NaN
479	68	78.92	+007.00	0100	+4.431	35.144	NaN
480	68	78.92	+007.00	0074	+4.697	35.144	NaN
481	68	78.92	+007.00	0050	+5.816	35.101	NaN
482	68	78.92	+007.00	0024	+6.029	35.051	NaN
483	68	78.92	+007.00	0015	+5.763	34.964	NaN

484	68	78.92	+007.00	0005	+5.765	34.963	NaN
485	70	78.92	+008.01	1041	-0.837	34.909	NaN
486	70	78.92	+008.01	0402	+3.575	35.119	NaN
487	70	78.92	+008.01	0251	+3.956	35.133	NaN
488	70	78.92	+008.01	0201	+4.126	35.135	NaN
489	70	78.92	+008.01	0150	+4.584	35.149	NaN
490	70	78.92	+008.01	0100	+6.131	35.111	NaN
491	70	78.92	+008.01	0075	+6.524	35.107	NaN
492	70	78.92	+008.01	0049	+6.523	35.107	NaN
493	70	78.92	+008.01	0025	+6.533	35.104	NaN
494	70	78.92	+008.01	0014	+6.582	35.083	NaN
495	70	78.92	+008.01	0006	+6.574	35.061	NaN
496	72	78.92	+009.00	0209	+4.377	35.077	NaN
497	72	78.92	+009.00	0151	+5.348	35.143	NaN
498	72	78.92	+009.00	0100	+5.828	35.159	NaN
499	72	78.92	+009.00	0074	+6.002	35.160	NaN
500	72	78.92	+009.00	0049	+6.291	35.156	NaN
501	72	78.92	+009.00	0025	+5.349	34.590	NaN
502	72	78.92	+009.00	0015	+4.670	34.254	NaN
503	72	78.92	+009.00	0005	+4.509	34.176	NaN