



30 May, 2011

Cruise Report

r/v “Oceania”, AREX2010

Ship	r/v “Oceania”
Cruise	AREX2010
Dates	8.06.2010 – 20.07.2010
Port Calls	Gdansk (Poland), Tromsø (Norway), Longyearbyen (Spitsbergen)
Number of Scientist	14
Chief Scientist	Assoc. Prof. Waldemar Walczowski
Principal Project	EURO-ARGO, AWAKE
Research Area	the Norwegian, Greenland and Barents Seas

Hydrographic conditions in the Atlantic Domain of the Nordic Seas

Waldemar Walczowski, Jan Piechura, Ilona Goszczko, Piotr Wieczorek, Agnieszka Promińska, Daniel Rak

1. Observations in 2010

The Arctic Experiment of the Institute of Oceanology, Polish Academy of Sciences (IOPAS), the so-called AREX2010, was performed aboard RV Oceania between 20 June and 19 July, 2010. During this time vertical profiles along standard sections were done. As in previous years the sections were perpendicular to the general direction of the Atlantic Water (AW) inflow according to the West Spitsbergen Current (WSC) location, which is situated between the Barents Sea slope in the south-east area, the west Spitsbergen shelf-break/slope region in the north-east and a system of underwater ridges: Mohn Ridge and Knipovich Ridge on the west. Because of the convergence of the isobaths in the northern part, currents pattern and structure is complicated and forms a wedge, wide in the southern part and narrower on the north. As before, our main effort concentrated in the northern part of the Atlantic Domain where processes controlling the AW inflow into the Arctic Ocean through the Fram Strait and the westward recirculation occur.

All in all, 179 CTD profiles were taken along 11 sections (Fig.1, Tab.1). The Seabird CTD (SBE 911+) system with duplicate temperature and conductivity sensors (temperature sensors SBE3, conductivity sensors SBE4 and SBE 50 digital oceanographic pressure sensor, SBE 43 dissolved oxygen sensor and fluorometer) was used. Temperature and conductivity sensors were calibrated by the Sea-Bird Electronics service.

Currents measurements were performed at all the CTD stations with two (upper and down looking) lowered Acoustic Doppler Current Profilers (LADCP) as well. The self-recording 300 kHz RDI devices were used to profile entire water column during the standard CTD casts. Moreover, sustained currents measurements were performed during the whole cruise with the ship-mounted ADCP, RDI 150 kHz.

Additionally, three towed CTD sections, two on the shelf break near the fjords (Hornsund and Kongsfjorden) and one across the mouth of the Isfjorden were done. Four ARGO floats, two belonging to the IOPAS, two to the Alfred Wegener Institute (AWI) in Bremerhaven were launched under the EURO-ARGO Project. A mooring system (RDCP + CTD) was deployed in the entrance to Hornsund, in connection to the AWAKE Project.

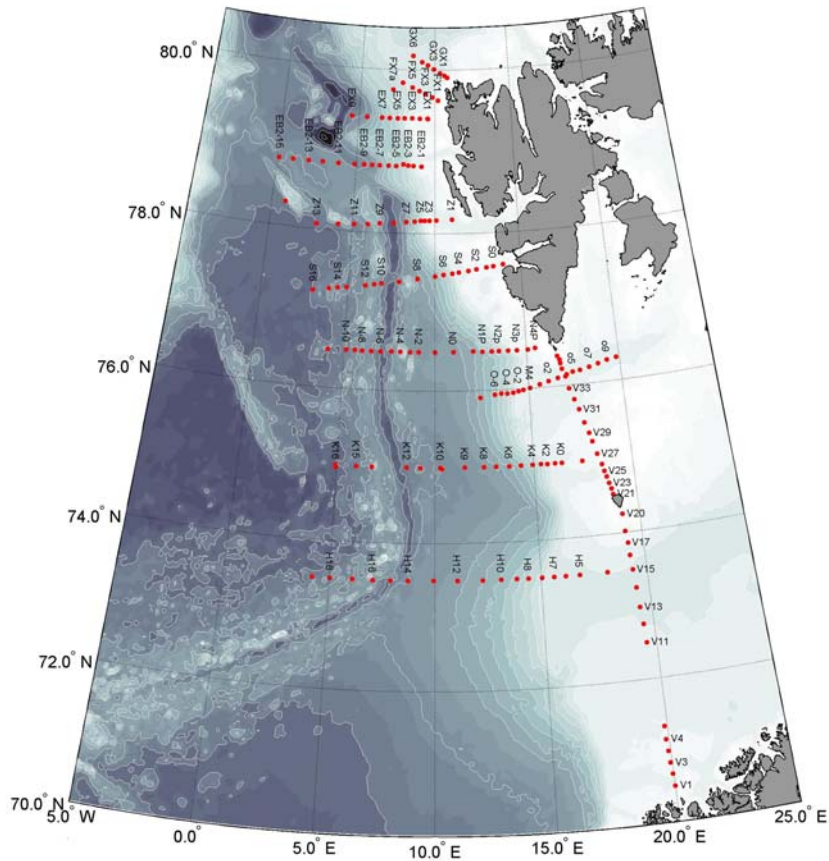


Figure 1: Geographical locations of CTD stations performed during IOPAS Arctic Experiment AREX2010 aboard RV Oceania in summer 2010.

Tabel 1. CTD stations and some of their main parameters. All in all 11 regular sections were performed during the oceanic part of 2010 cruise.

No	Station	Depth	Latitude	Longitude	Date	Time	File/Cast
1	V1	120	70°29.87N	020°00.39E	20-Jun-2010	20:51	AR10_001
2	V2	155	70°39.83N	019°58.25E	20-Jun-2010	22:51	AR10_002
3	V3	185	70°49.42N	019°55.59E	21-Jun-2010	00:44	AR10_003
4	V4	185	70°59.21N	019°54.23E	21-Jun-2010	02:46	AR10_004
5	V4	200	71°09.05N	019°51.89E	21-Jun-2010	04:48	AR10_005
6	V6	205	71°20.03N	019°51.90E	21-Jun-2010	07:26	AR10_006
7	V11	390	72°29.99N	019°33.94E	22-Jun-2010	09:50	AR10_007
8	V12	395	72°45.03N	019°31.15E	22-Jun-2010	13:49	AR10_008
9	V13	410	72°58.97N	019°27.97E	22-Jun-2010	18:53	AR10_009
10	V14	450	73°14.99N	019°23.93E	22-Jun-2010	23:53	AR10_010
11	V15	475	73°29.90N	019°20.08E	23-Jun-2010	03:30	AR10_011
12	H2	410	73°30.05N	018°09.01E	23-Jun-2010	06:52	AR10_012
13	H5	445	73°29.99N	016°50.09E	23-Jun-2010	10:47	AR10_013
14	H6	460	73°29.93N	016°10.27E	23-Jun-2010	13:47	AR10_014
15	H7	480	73°30.03N	015°36.50E	23-Jun-2010	16:20	AR10_015
16	H4	685	73°29.92N	015°02.69E	23-Jun-2010	19:12	AR10_016
17	H8	1020	73°30.00N	014°24.88E	23-Jun-2010	22:42	AR10_017
18	H9	1315	73°30.07N	013°51.50E	24-Jun-2010	01:15	AR10_018
19	H10	1590	73°30.01N	013°07.32E	24-Jun-2010	04:38	AR10_019
20	H11	1825	73°29.99N	012°14.65E	24-Jun-2010	08:21	AR10_020
21	H12	2090	73°30.10N	011°03.08E	24-Jun-2010	13:07	AR10_021
22	H13	2305	73°30.05N	009°56.00E	24-Jun-2010	17:18	AR10_022
23	H14	2520	73°30.04N	008°43.35E	24-Jun-2010	21:53	AR10_023
24	H15	3080	73°30.01N	007°52.47E	25-Jun-2010	01:36	AR10_024
25	H16	2290	73°30.02N	007°02.62E	25-Jun-2010	05:44	AR10_025
26	H17	1945	73°30.00N	006°05.63E	25-Jun-2010	09:18	AR10_026
27	H18	2805	73°29.95N	005°01.76E	25-Jun-2010	12:52	AR10_027
28	H19	2820	73°30.07N	004°11.47E	25-Jun-2010	16:22	AR10_028
29	K16	3175	74°58.39N	004°58.01E	26-Jun-2010	07:06	AR10_029
30	K16	255	75°00.18N	004°56.56E	26-Jun-2010	09:38	AR10_030
31	K15	2870	74°59.96N	006°00.43E	26-Jun-2010	12:20	AR10_031
32	K14	2250	74°59.99N	006°47.20E	26-Jun-2010	16:22	AR10_032
33	K12	2935	75°00.26N	008°33.90E	27-Jun-2010	15:52	AR10_033
34	K11	2600	75°00.06N	009°15.32E	27-Jun-2010	20:45	AR10_034
35	K10	2540	74°59.99N	010°15.52E	28-Jun-2010	00:49	AR10_035
36	K10	2035	74°59.15N	010°20.25E	28-Jun-2010	03:15	AR10_036
37	K9	2415	75°00.02N	011°30.13E	28-Jun-2010	08:02	AR10_037
38	K8	2035	75°00.05N	012°29.12E	28-Jun-2010	11:58	AR10_038

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39	K8	155	75°00.01N	012°28.94E	28-Jun-2010	13:23	AR10_039
40	K7	2015	74°59.93N	013°05.30E	28-Jun-2010	15:17	AR10_040
41	K6	1825	75°00.05N	013°44.94E	28-Jun-2010	18:21	AR10_041
42	K5	1545	74°59.98N	014°20.50E	28-Jun-2010	21:22	AR10_042
43	K4	1130	75°00.10N	014°56.82E	28-Jun-2010	23:58	AR10_043
44	K3	820	75°00.22N	015°21.46E	29-Jun-2010	02:02	AR10_044
45	K2	355	74°59.99N	015°41.29E	29-Jun-2010	03:31	AR10_045
46	K1	215	75°00.07N	016°04.22E	29-Jun-2010	04:46	AR10_046
47	K0	180	75°00.01N	016°24.99E	29-Jun-2010	05:46	AR10_047
48	K-2	110	75°00.01N	017°27.59E	29-Jun-2010	08:10	AR10_048
49	V20	55	74°14.98N	019°10.27E	29-Jun-2010	15:46	AR10_049
50	V18	130	74°01.12N	019°12.35E	29-Jun-2010	18:26	AR10_050
51	V17	235	73°51.56N	019°15.42E	29-Jun-2010	19:59	AR10_051
52	V16	345	73°41.74N	019°17.74E	29-Jun-2010	21:36	AR10_052
53	V21	20	74°31.54N	018°49.94E	30-Jun-2010	09:44	AR10_053
54	V22	65	74°36.09N	018°46.47E	30-Jun-2010	10:35	AR10_054
55	V23	95	74°40.70N	018°41.60E	30-Jun-2010	11:22	AR10_055
56	V24	225	74°45.86N	018°36.08E	30-Jun-2010	12:15	AR10_056
57	V25	200	74°50.44N	018°31.23E	30-Jun-2010	13:08	AR10_057
58	V26	70	74°55.96N	018°26.06E	30-Jun-2010	14:03	AR10_058
59	V27	65	75°04.61N	018°14.96E	30-Jun-2010	15:40	AR10_059
60	V28	60	75°14.72N	018°04.80E	30-Jun-2010	17:07	AR10_060
61	V29	100	75°21.54N	017°57.84E	30-Jun-2010	18:19	AR10_061
62	V30	130	75°30.08N	017°45.49E	30-Jun-2010	19:51	AR10_062
63	V31	210	75°40.78N	017°34.06E	30-Jun-2010	21:37	AR10_063
64	V32	290	75°48.84N	017°22.13E	30-Jun-2010	23:00	AR10_064
65	V33	320	75°57.56N	017°07.83E	01-Jul-2010	00:31	AR10_065
66	V34	290	76°06.90N	017°00.81E	01-Jul-2010	02:02	AR10_066
67	V35	210	76°13.09N	016°51.58E	01-Jul-2010	03:10	AR10_067
68	V37	50	76°20.36N	016°46.13E	01-Jul-2010	04:42	AR10_069
69	V38a	30	76°23.22N	016°39.15E	01-Jul-2010	05:21	AR10_070
70	o5	305	76°10.18N	017°24.83E	01-Jul-2010	07:53	AR10_071
71	o6	280	76°10.85N	017°48.62E	01-Jul-2010	08:58	AR10_072
72	o7	245	76°12.71N	018°19.73E	01-Jul-2010	10:12	AR10_073
73	o8	260	76°14.64N	018°49.33E	01-Jul-2010	12:13	AR10_074
74	o9	255	76°16.52N	019°19.12E	01-Jul-2010	13:28	AR10_075
75	O10	235	76°17.88N	019°49.49E	01-Jul-2010	15:22	AR10_076
76	V34	280	76°08.39N	017°05.08E	01-Jul-2010	21:28	AR10_077
77	o3	340	76°06.26N	016°35.12E	01-Jul-2010	23:05	AR10_078
78	o2	390	76°04.39N	016°05.46E	02-Jul-2010	00:20	AR10_079
79	o1	365	76°02.46N	015°35.83E	02-Jul-2010	01:38	AR10_080
80	M4	335	76°00.30N	015°04.46E	02-Jul-2010	03:14	AR10_081
81	O-1	320	75°59.10N	014°42.23E	02-Jul-2010	04:23	AR10_082
82	O-2	335	75°58.22N	014°26.62E	02-Jul-2010	05:18	AR10_083
83	O-3	615	75°57.23N	014°09.49E	02-Jul-2010	06:13	AR10_084
84	O-4	910	75°56.99N	013°50.30E	02-Jul-2010	07:27	AR10_085
85	O-5	1165	75°57.02N	013°30.73E	02-Jul-2010	09:03	AR10_086
86	O-6	1395	75°56.27N	013°11.25E	02-Jul-2010	10:32	AR10_087
87	O-7	1805	75°54.24N	012°24.77E	02-Jul-2010	12:47	AR10_088

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88	N4P	140	76°30.77N	015°28.48E	07-Jul-2010	16:20	AR10_089
89	N4	170	76°29.99N	015°05.13E	07-Jul-2010	17:33	AR10_090
90	N3p	215	76°30.02N	014°29.90E	08-Jul-2010	02:03	AR10_091
91	N3	765	76°30.08N	014°00.16E	08-Jul-2010	03:30	AR10_092
92	N2p	1280	76°29.98N	013°30.04E	08-Jul-2010	05:19	AR10_093
93	N2	1555	76°29.83N	013°05.62E	08-Jul-2010	07:10	AR10_094
94	N1P	1760	76°29.97N	012°36.26E	08-Jul-2010	09:29	AR10_095
95	N1	1910	76°30.25N	012°05.76E	08-Jul-2010	11:51	AR10_096
96	N0	2115	76°30.04N	011°00.09E	08-Jul-2010	15:23	AR10_097
97	N-1	2265	76°29.98N	010°00.15E	08-Jul-2010	18:47	AR10_098
98	N-2	2290	76°30.06N	009°06.49E	08-Jul-2010	21:59	AR10_099
99	N-3	2290	76°30.10N	008°37.12E	09-Jul-2010	00:26	AR10_100
100	N-4	1970	76°30.21N	008°05.80E	09-Jul-2010	02:44	AR10_101
101	N-5	2560	76°30.22N	007°36.73E	09-Jul-2010	04:56	AR10_102
102	N-6	2780	76°29.95N	007°00.09E	09-Jul-2010	07:41	AR10_103
103	N-7	2485	76°30.04N	006°29.96E	09-Jul-2010	10:07	AR10_104
104	N-8	2600	76°29.98N	006°00.12E	09-Jul-2010	12:21	AR10_105
105	N-9	2540	76°30.14N	005°35.46E	09-Jul-2010	15:03	AR10_106
106	N-10	2475	76°30.10N	005°06.89E	09-Jul-2010	17:23	AR10_107
107	N-11	2625	76°29.57N	004°06.46E	09-Jul-2010	20:31	AR10_108
108	S16	2930	77°13.95N	002°59.99E	10-Jul-2010	03:22	AR10_109
109	S15	2605	77°15.97N	003°53.97E	10-Jul-2010	07:21	AR10_110
110	S14	2325	77°16.90N	004°24.06E	10-Jul-2010	10:04	AR10_111
111	S13	2400	77°17.82N	004°54.65E	10-Jul-2010	12:36	AR10_112
112	S12	2615	77°19.96N	005°59.55E	10-Jul-2010	16:26	AR10_113
113	S11	2135	77°21.00N	006°29.19E	10-Jul-2010	19:23	AR10_114
114	S10	2680	77°22.02N	006°53.65E	10-Jul-2010	21:54	AR10_115
115	S9	2330	77°23.65N	007°55.21E	11-Jul-2010	01:56	AR10_116
116	S8	2085	77°26.04N	008°58.16E	11-Jul-2010	06:04	AR10_117
117	S7	1615	77°27.98N	009°59.90E	11-Jul-2010	09:17	AR10_118
118	S6	1255	77°28.98N	010°29.62E	11-Jul-2010	11:09	AR10_119
119	S5	725	77°29.99N	010°59.54E	11-Jul-2010	12:59	AR10_120
120	S4	275	77°30.89N	011°23.04E	11-Jul-2010	14:19	AR10_121
121	S3	170	77°31.95N	011°56.74E	11-Jul-2010	15:44	AR10_122
122	S2	95	77°32.94N	012°24.39E	11-Jul-2010	17:00	AR10_123
123	S1	130	77°33.97N	012°59.44E	11-Jul-2010	18:21	AR10_124
124	S0	140	77°34.93N	013°23.95E	11-Jul-2010	19:37	AR10_125
125	S-1	140	77°35.93N	013°57.45E	11-Jul-2010	20:44	AR10_126
126	Z1	255	78°10.51N	011°00.60E	12-Jul-2010	04:45	AR10_127
127	Z2	265	78°10.09N	010°04.81E	12-Jul-2010	06:30	AR10_128
128	Z3	265	78°09.81N	009°39.58E	12-Jul-2010	07:35	AR10_129
129	Z4	690	78°09.75N	009°21.43E	12-Jul-2010	08:26	AR10_130
130	Z5	1115	78°09.64N	009°07.16E	12-Jul-2010	09:25	AR10_131
131	Z6	1575	78°09.08N	008°45.20E	12-Jul-2010	10:52	AR10_132
132	Z7	2230	78°08.57N	008°15.70E	12-Jul-2010	12:56	AR10_133
133	Z8	3495	78°07.81N	007°30.08E	12-Jul-2010	16:14	AR10_134
134	Z9	2285	78°07.01N	006°39.97E	12-Jul-2010	19:43	AR10_135
135	Z10	2520	78°06.08N	005°55.98E	12-Jul-2010	22:16	AR10_136
136	Z11	2555	78°05.42N	005°07.44E	13-Jul-2010	00:51	AR10_137
137	Z12	2935	78°04.97N	004°08.68E	13-Jul-2010	03:51	AR10_138

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138	Z13	3045	78°03.94N	002°50.64E	13-Jul-2010	07:34	AR10_139
139	Z-EB	2815	78°17.98N	000°50.17E	13-Jul-2010	13:08	AR10_140
140	EB2-15	2605	78°49.90N	000°06.95E	13-Jul-2010	20:57	AR10_141
141	EB2-14	2460	78°49.96N	000°59.97E	14-Jul-2010	00:57	AR10_142
142	EB2-13	2540	78°50.00N	001°59.95E	14-Jul-2010	03:57	AR10_143
143	EB2-12	2455	78°50.04N	002°53.26E	14-Jul-2010	06:54	AR10_144
144	EB2-11	2335	78°50.03N	003°52.07E	14-Jul-2010	10:06	AR10_145
145	EB2-10	2675	78°50.03N	004°53.25E	14-Jul-2010	12:50	AR10_146
146	EB2-9	2590	78°50.00N	005°30.60E	14-Jul-2010	15:07	AR10_147
147	EB2-8	2455	78°50.01N	006°00.70E	14-Jul-2010	17:14	AR10_148
148	EB2-7	1945	78°50.17N	006°29.55E	14-Jul-2010	19:17	AR10_149
149	EB2-6	1390	78°50.08N	007°03.22E	14-Jul-2010	21:04	AR10_150
150	EB2-5	1130	78°50.08N	007°32.63E	14-Jul-2010	22:32	AR10_151
151	EB2-4	985	78°51.41N	007°58.93E	14-Jul-2010	23:56	AR10_152
152	EB2-3	715	78°50.42N	008°18.05E	15-Jul-2010	01:06	AR10_153
153	EB2-2	215	78°50.25N	008°37.63E	15-Jul-2010	02:06	AR10_154
154	EB2-1	205	78°49.89N	009°08.81E	15-Jul-2010	03:10	AR10_155
155	EX-1	130	79°24.78N	009°31.71E	16-Jul-2010	19:42	AR10_156
156	FX1	60	79°38.09N	010°10.98E	17-Jul-2010	17:55	AR10_157
157	FX2	285	79°40.23N	009°49.26E	17-Jul-2010	19:20	AR10_158
158	FX3	380	79°42.58N	009°21.35E	17-Jul-2010	20:27	AR10_159
159	FX4	445	79°44.86N	008°56.23E	17-Jul-2010	21:34	AR10_160
160	FX5	520	79°47.35N	008°28.68E	17-Jul-2010	22:41	AR10_161
161	FX6	650	79°50.57N	007°49.05E	18-Jul-2010	00:04	AR10_162
162	FX7a	835	79°45.54N	007°11.18E	18-Jul-2010	02:06	AR10_163
163	GX5	510	80°05.65N	009°07.41E	18-Jul-2010	06:26	AR10_164
164	GX6	535	80°10.03N	008°29.78E	18-Jul-2010	07:54	AR10_165
165	GX4	500	80°03.30N	009°29.70E	18-Jul-2010	10:02	AR10_166
166	GX3	485	80°00.64N	009°54.35E	18-Jul-2010	11:07	AR10_167
167	GX2	435	79°57.74N	010°18.99E	18-Jul-2010	12:08	AR10_168
168	GX1	260	79°55.86N	010°37.19E	18-Jul-2010	13:00	AR10_169
169	GX0	35	79°54.35N	010°49.45E	18-Jul-2010	13:37	AR10_170
170	EX1	120	79°25.01N	009°30.54E	18-Jul-2010	20:04	AR10_171
171	EX2	130	79°24.96N	008°59.76E	18-Jul-2010	21:06	AR10_172
172	EX3	190	79°24.99N	008°30.37E	18-Jul-2010	21:55	AR10_173
173	EX4	415	79°25.04N	007°59.99E	18-Jul-2010	22:51	AR10_174
174	EX5	915	79°24.85N	007°32.02E	18-Jul-2010	23:42	AR10_175
175	EX6	1215	79°24.94N	007°00.34E	19-Jul-2010	00:57	AR10_176
176	EX7	1485	79°25.04N	006°31.40E	19-Jul-2010	02:19	AR10_177
177	EX8	2250	79°25.00N	005°31.25E	19-Jul-2010	04:43	AR10_178
178	EX9	2660	79°25.17N	004°31.62E	19-Jul-2010	07:48	AR10_179

2. Hydrographic conditions

Distribution of physical parameters at standard section N along the 76°30'N shows the WSC core over the west Spitsbergen slope (Fig.2). High records of the AW temperature and salinity were observed in summer 2006. After that both parameters decreased rapidly in 2007 and 2008, in summer 2009 the AW parameters raised again. According to our measurements, both temperature and salinity anomalies in 2010 were still above the mean, however, compared to the last year salinity was higher but temperature was lower. Temperature at standard section N in July 2010 (50-200 dbar layer) equaled 3.44°C, 0.25°C more than 1996-2010 mean. Salinity reached value of 35.10, about 0.039 more than 1996-2010 mean (Fig.3). Both temperature and salinity trends are positive.

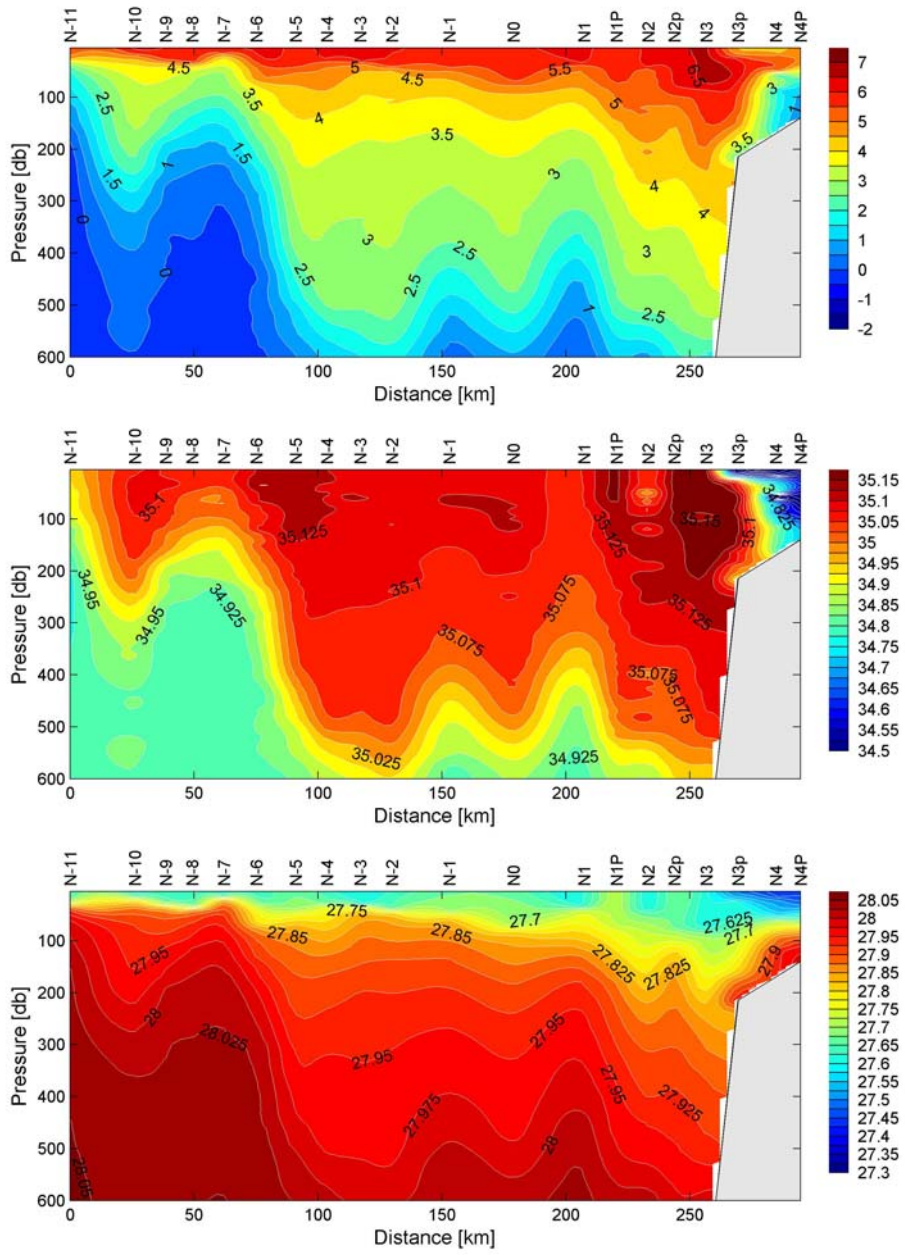


Figure 2: Temperature (θ), salinity and density (σ_0) distribution along section N ($76^{\circ}30'N$) in the AW layer.

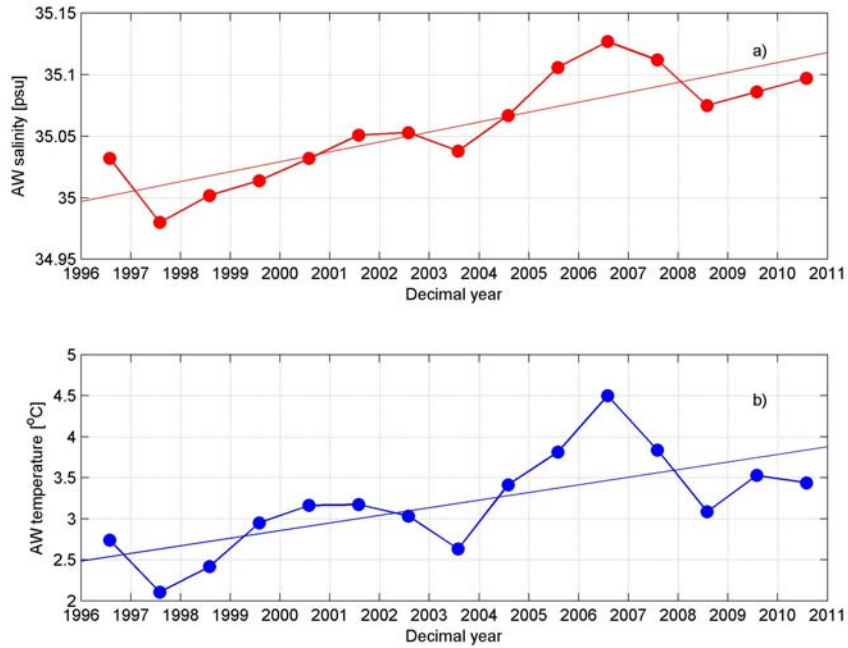


Figure 3: AW a) salinity and b) temperature at the standard section N (76°30'N, between 9°E and 12°E).

3. Dynamics

Distribution of baroclinic currents and temperature at 100 dbar (calculated for the reference level of 1000 m) in summer 2010 is showed in Fig.4. Baroclinic inflow into the Fram Strait is intensive, flow into the Barents Sea seems to be weaker. Two branches of the WSC are clearly visible, as well. Calculation made for AW at standard section N indicates increasing of baroclinic volume and heat transport (Fig.5) during the last fifteen years.

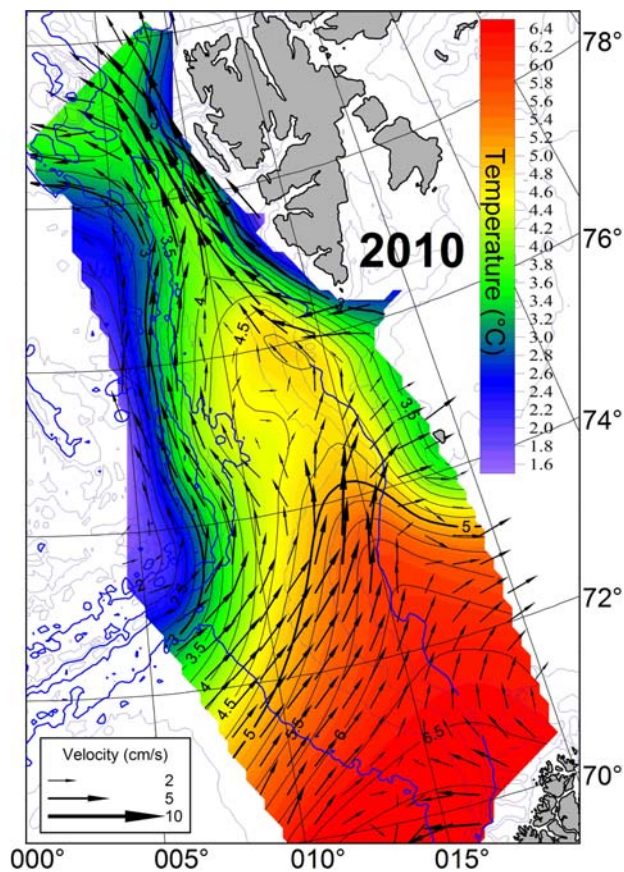


Figure 4: Temperature and baroclinic currents at 100 dbar. Data from Gimsøy section provided by the Institute of Marine Research, Bergen were used.

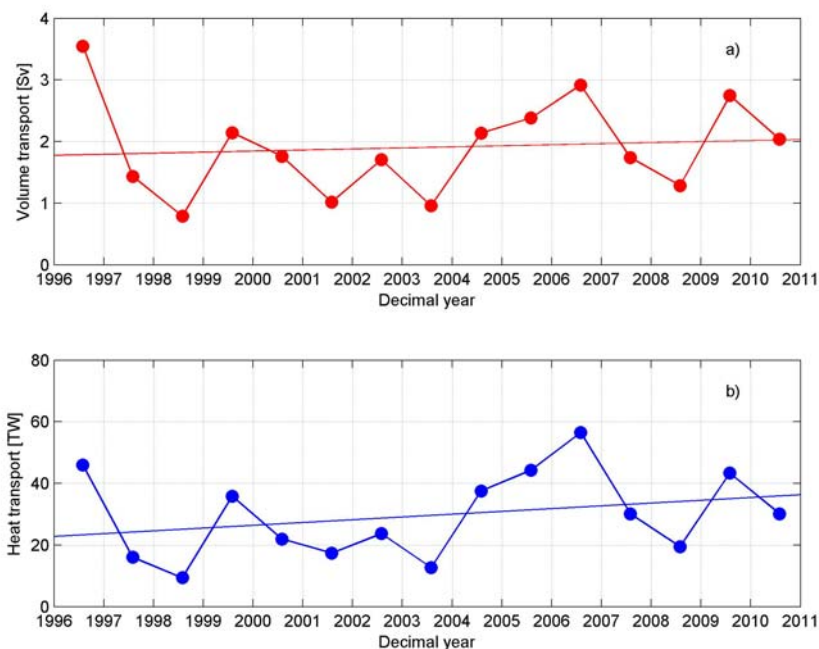


Figure 5: AW baroclinic a) volume and b) heat transport across the standard section N (76°30'N, between 9°E and 12°E).