



Results and conclusions

02.01.2020, 06.06.2020-31.08.2020, Jnr. 20/75

**REPORT
FROM THE RESEARCH CRUISE**

AREX 2020

RV OCEANIA

29.06.2020 - 25.08.2020



Coordination and leadership

Prof. Waldemar Walczowski

Scientific background and objectives of the annual AREX field campaigns

Understanding of Arctic climate processes is the main aim of the oceanographic and atmospheric studies carried on in the polar region. The Arctic region is one of the most visible indicators of the on-going changing climate. The recent Arctic sea ice decline is one of the main drivers of the extensive research activities, carried out in high latitudes. The impacts of climate change observed in the Arctic precede those observed at the lower latitudes. The effects of global warming in the Arctic include a steady temperature increase, observed both in the atmosphere and in the ocean. These changes influence both the thickness and extent of the sea ice in the sub-Arctic seas and Arctic Ocean as well as ocean climate and vulnerable Arctic ecosystems.

Large oceanic exchanges between the North Atlantic and the Arctic Ocean result in the strong conversion of water masses when warm and salty Atlantic water (AW), transported through the Nordic Seas into the Arctic Ocean mixes with surrounding local waters and undergoes cooling, freezing and melting. As a result a part of AW is transformed into freshened surface waters over the shallow shelves, sea ice and dense (and highly saline) deep waters. Southward transport of the Arctic origin waters is one of the main mechanisms of the global thermohaline circulation (THC). Better understanding of the variability of volume and heat transports between the North Atlantic and Arctic Ocean as well as processes of water mass conversion is necessary for improved qualitative and quantitative estimation of the large-scale meridional overturning circulation and its role in shaping the climate change in the northern hemisphere on inter-annual to decadal time scales.

The long-term AREX observational program has been carried on by IOPAN during annual cruises on the research vessel Oceania for the last 30 years in the Nordic Seas and the European Arctic. The AREX program is focused on multidisciplinary observations in areas such as physical oceanography, air-ocean interactions, ocean biogeochemistry and ecology to study the changes of abiotic and biotic Arctic environment. All these studies are carried out under the strategic research initiative addressing the role of the ocean in changing climate, its effects on the European seas and contemporary changes of the coastal ecosystems in the shelf seas. The data collected under the observational program AREX every year in the same way over the standard grid of stations, provide time series of key ocean variables which allow monitoring changes of the Arctic environment.

Oceanographic measurements and collection of water samples during the AREX 2020 cruise contributed to several IO PAN statutory research areas (I.3. I.4. I.5. I.7. III.1) and external research projects (international and national): Euro-Argo (ARGO-Poland), INTAROS (H2020), HIDEA, PROSPECTOR, AERONET, MAN, ReHearsol, SEAPOP II, MetaDiva, ABeFun, Arctic Blues and PhD grants. The field work during the AREX2020 cruise was focused on numerous research goals, subdivided into detailed tasks. A general overview is provided in the following sections.

Organization of work during a pandemic COVID-19

In 2020, there was a real danger of suspending the measurement campaign of collection observational data during the Arctic cruise. The global COVID-19 epidemic has led to an almost complete lockdown of international exchange and also froze the activities in the majority institutions in countries. The typical AREX cruises take place in the period between

June and August, last for about 2.5 months and are divided in a few legs with exchanges of scientific teams between the subsequent legs. The crew exchanges take place in the Norwegian ports (usually Tromsø and Longyearbyen). Due to the lockdown in Norway and quarantine requirements, it was impossible to exchange scientific crew during the cruise in 2020. Despite these difficulties, IOPAS decided to organize the annual cruise in the reduced scope, scaled down to the selected long-term monitoring stations and sections. To reduce the risk of Covid-19, the cruise was organized as a one-stage, two-month long expedition without changing crews and nobody embarking or disembarking in any ports during the duration of the cruise. All participants were tested for the Covid-19 before the cruise and had negative results when embarking in Gdansk. The vessel called Longyearbyen on Svalbard only to take necessary water and fuel supplies.

Implementation of the AREX 2020 cruise

The AREX cruise of the Institute of Oceanology Polish Academy of Sciences (IO PAS) research vessel Oceania. repeated every summer over the same time period. in 2020 took place from June 29 to August 25. The AREX 2020 cruise lasted 57 days and was devoted to collection of oceanographic, meteorological, aerosol, chemical and ocean ecosystem observations in the open ocean regions, including the eastern Norwegian and Greenland seas, Fram Strait and the southern Nansen Basin of the Arctic Ocean, and in the selected West Spitsbergen fjords (Hornsund, Isfjorden, Kongsfjorden). A scientific team of the same 11 persons took part in the entire cruise from the beginning in Gdansk to the end in Gdansk.

Table 1. List of the research team members during the AREX 2020 cruise.

No	Participant name	Institution	Dept.	Comments
1	Waldemar Walczowski	IOPAN	ZDM	Cruise leader
2	Przemysław Makuch	IOPAN	ZDM	Deputy cruise leader
3	Agnieszka Strzelewicz	IOPAN	ZDM	Physical oceanography leader
4	Miłosz Grabowski	IOPAN	ZFM	
5	Dominika Walecka	IOPAN	ZEM	
6	Kajetan Deja	IOPAN	ZEM	Ecology team leader
7	Agata Bigaj	IOPAN	ZEM	
8	Maciej Muzyka	IOPAN	ZDM	
9	Ewa Korejwo	IOPAN	ZChM	Chemistry team leader
10	Paulina Rudnicka	IOPAN	ZChm	
11	Karol Mazanowski	UG	ZEM	

The leaders of the hydrographic, ecological and chemical teams were responsible for coordinating the cruise activities for different teams. Work was performed in a three-shift system (three 4-hour shifts) during the open ocean part of the cruise. During the fjord part of the cruise, it was decided to adapt the work system to the weather conditions and sampling needs. The cruise was carried out in accordance to the AREX2020 scientific program with slight

modifications, mostly regarding the order of measurements and regions. The number of CTD stations in the open ocean was reduced and for logistical reasons the palaeoceanographic program was abandoned on the way back. The cruise plan contained 29 research objectives divided into detailed research tasks for the hydrographic, chemical, ecological and meteorological measurement teams. Work other than standard CTD stations was performed mostly during the day time, while the night time was used for CTD measurements, transit between stations or regions, or laying at anchor. The most of the planned measurement program (albeit already including cuts due to the Covid-19 limitations) was fulfilled during the AREX'2020 cruise and all research regions were covered according to the planned station grid. The cruise schedule is presented in Table 2.

Table 2. The AREX'2020 cruise itinerary

Date	Time	Event/activity	Station
29.06.2020	13:00	Start of the cruise in Gdańsk	
07.07.2020	15:00	Arrival to the first research area. Start of section K	K19
10.07.2020	10:00 12:00-15:00	End of section K Work on section V2 Transit to Bjørnøya	K3 V26
12.07.2020	00:30 09:00 23:30	Landing of the research team on Bjørnøya Continuation of section V2 End of section V2	V27 V38
13.07.2020	01:00	Start of work on AUK station grid	AUK 22
14.07.2020	15:00	End of work on AUK station grid Beginning of CTD section in Horsund	
15.07.2020		Work in Hornsund	
16.07.2019		End of work in Hornsund. transit to Edgeøya	
17.07.2019		Work on Edgeøya	
18.07.2012		Return to the western side. work next to Torellbreen.	
19.07.2020		Work in Van Mijenfjorden	
20.07.2020		Start of work in Isfjorden	
25.07.2020	14:00	End of work in Isfjorden Start of section Z	Z1
27.07.2020	08:30 14:50	End of section Z Start of section S	Z15 S18
29.07.2020	16:00	End of section S	S0
30.07.2020	16:30	Start of section N	N4p
01.08.2020		End of section N	N12
02.08.2020	09:30	Start of section EB2	EB2-15
03.08.2020		Work on section EB2	EB2-12 – EB2-8p
04.08.2020	23:00	End of section EB2	EB2-1
05.08.2020		Start of work in Kongsfjorden	
06.08.2020		Work on Kongsfjorden section (LOPC/multinet)	
07.08.2020		End of section. work in the inner fjord	
08.08.2020	17:00	Calling Ny Alesund End of work in Kongsfjorden	
09.08.2020	08:00	Start of section NB	NB3

10.08.2020	01:00 07:30	End of section NB Start of section WB	NB13 WB1
11.08.2020	22:00	End of section WB	WB23
12.08.2020	06:00 22:00	Start of section Y End of section Y	Y15 Y2
14.08.2020	08:00-22:00	Call to Longyearbyen (water and fuel supplying)	
15.08.2020	11:00-21:00	Call to Hornsund	
16.08.2020	14:30-18:00	Bjørnøya	
17.08.2020		Transit to Lofoten	
25.08.2020	10:00	Arrival to Gdansk. end of the cruise.	

Field measurements during the AREX 2020 cruise

Hydrographic measurements in open ocean

Following oceanographic measurements were carried on during the open ocean part of the AREX 2020 cruise:

- Full-depth measurements of temperature, salinity, dissolved oxygen and ocean currents in the eastern part of the Norwegian Sea, the Greenland Sea and entry to the Barents Sea, Fram Strait and southern part of the Nansen Basin (CTD, LADCP, VMADCP).
- Collection of water samples for calibration of conductivity and oxygen sensors and nutrient analysis.

During the AREX2020 expedition all oceanographic measurements were conducted on the station grid consisting of standard sections repeated annually since 2000, and along new sections located north of Svalbard, repeated since 2013. The hydrographic survey carried out during the cruise consisted of 9 sections extending from the outer shelf across the slope into the deep basin in order to sample the northward flow of Atlantic water. A total of 173 conductivity-temperature-depth (CTD) full-depth stations were occupied within the geographical area 70°30'-81°15'N and 0-20°E. Location of oceanographic sections is shown on Figure 1. During of the cruise full-depth CTD stations were measured by SBE 9/11plus CTD (Sea-Bird Electronics) and SBE19plus (SeaCat), providing full depth profiles of temperature, salinity, dissolved oxygen (SBE43), and fluorescence. The specifications of the individual sensors are provided in Table 3. In addition to CTD casts, the ocean currents were measured on each station with a Lowered Acoustic Doppler Current Profiler (TRDI LADCP 300kHz). The CTD and LADCP system was mounted on the SeaBird bathymetric rosette equipped with 12 Niskin bottles (4x1.75 l, 8x10 l). Additionally, on 19 stations (at the selected levels) water samples were collected for nutrient analysis (185 samples). The samples were frozen on board and analyzed after the cruise in the IOPAN laboratory. On selected stations, water samples were collected for post-cruise calibration of conductivity sensors (34 samples) and oxygen sensors (47 samples). The detailed list and schedule of CTD casts is given in Table 4.

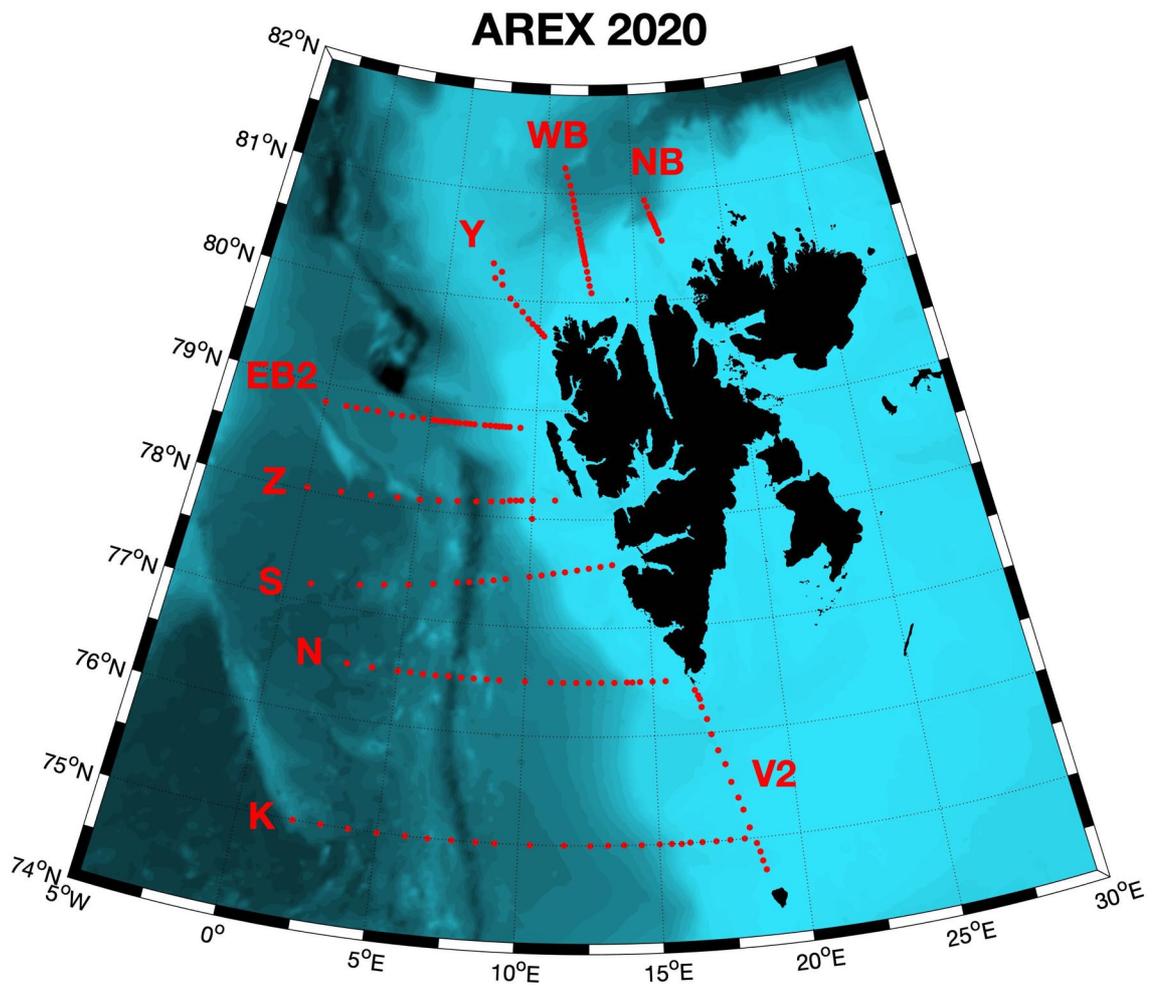


Figure 1. Distribution of CTD stations during the open ocean part of the AREX 2020 cruise.

Table 3. Specifications of the individual sensors used for CTD measurements during the AREX'2020 cruise.

<i>SeaBird SBE9/11 system</i>			<i>SeaBird SBE19plus system</i>		
<i>Sensor</i>	<i>SN</i>	<i>Calibration date</i>	<i>Sensor</i>	<i>SN</i>	<i>Calibration date</i>
pressure	100967	2018-04-18	pressure	2096460	2020-01-15
conductivity 1	2971	2020-04-29	conductivity	6922	2020-01-16
conductivity 2	3342	2020-05-12			
temperature 1	2937	2020-04-09	temperature	6922	2020-01-16
temperature 2	4670	2020-05-06			
oxygen SBE43	1620	2019-03-01	oxygen Optode	-	-

Table 4. List of CTD stations occupied during the open ocean part of the AREX'2020 cruise

ID	Log_ID	Date Time UTC	Station	Latitude	Longitude	Bottom pressure (dbar)
1	ar20_001	2020-07-07 12:57	K19	74.9988	2.0073	2782
2	ar20_002	2020-07-07 18:21	K18	74.9995	3.0057	2504
3	ar20_003	2020-07-07 22:15	K17	74.9997	3.9802	2993
4	ar20_004	2020-07-08 03:12	K16	74.9995	5.0033	3185
5	ar20_005	2020-07-08 08:02	K15	74.9998	6.0053	2879
6	ar20_006	2020-07-08 11:43	K14	74.9983	6.8050	2082
7	ar20_007	2020-07-08 14:47	K13	74.9977	7.6527	2239
8	ar20_008	2020-07-08 17:40	K12	75.0000	8.5003	2893
9	ar20_009	2020-07-08 20:55	K11	74.9998	9.1675	2652
10	ar20_010	2020-07-09 01:13	K10	74.9978	10.4185	2530
11	ar20_011	2020-07-09 05:54	K9	75.0005	11.6350	2396
12	ar20_012	2020-07-09 09:11	K8	74.9998	12.5500	2167
13	ar20_013	2020-07-09 12:13	K7	74.9998	13.1843	2005
14	ar20_014	2020-07-09 15:18	K6	75.0010	13.7533	1823
15	ar20_015	2020-07-09 18:17	K5	74.9998	14.3678	1555
16	ar20_016	2020-07-09 21:09	K4	75.0003	15.0003	1130
17	ar20_017	2020-07-09 23:31	K3	74.9982	15.4267	827
18	ar20_018	2020-07-10 01:46	K2	74.9953	15.7880	359
19	ar20_019	2020-07-10 03:02	K1	75.0008	16.0857	209
20	ar20_020	2020-07-10 04:16	K0	75.0015	16.5047	222
21	ar20_021	2020-07-10 05:41	K-1	75.0000	17.0020	120
22	ar20_022	2020-07-10 07:02	K-2	75.0000	17.5013	113
23	ar20_023	2020-07-10 08:20	K-3	74.9997	18.0002	152
24	ar20_024	2020-07-10 09:31	V26	74.9498	18.4147	73
25	ar20_025	2020-07-10 10:20	V25	74.8682	18.5080	187
26	ar20_026	2020-07-10 11:20	V24	74.7843	18.5737	213
27	ar20_027	2020-07-10 12:18	V23	74.7005	18.6683	92
28	ar20_028	2020-07-12 07:02	V27	75.1002	18.2170	60
29	ar20_029	2020-07-12 08:20	V28	75.2665	18.0500	62
30	ar20_030	2020-07-12 09:22	V29	75.3830	17.9175	105
31	ar20_031	2020-07-12 11:16	V30	75.5320	17.7135	125
32	ar20_032	2020-07-12 12:44	V31	75.6983	17.5532	205
33	ar20_033	2020-07-12 14:47	V32	75.8333	17.3335	287
34	ar20_034	2020-07-12 16:13	V33	75.9833	17.1342	314
35	ar20_035	2020-07-12 17:34	V34	76.1252	16.9985	284
36	ar20_036	2020-07-12 19:19	V35	76.2413	16.8310	214
37	ar20_037	2020-07-12 20:11	V36	76.3163	16.7837	107
38	ar20_038	2020-07-12 20:44	V37	76.3500	16.7350	53
39	ar20_039	2020-07-12 21:20	V38	76.3997	16.6158	30
40	ar20_158	2020-07-25 11:50	Z1	78.1742	11.0028	250
41	ar20_159	2020-07-25 14:17	Glider	78.0007	10.0035	154
42	ar20_160	2020-07-25 18:21	Z2	78.1667	9.9988	269

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43	ar20_161	2020-07-25 19:55	Z3	78.1633	9.5003	269
44	ar20_162	2020-07-25 20:41	Z4	78.1607	9.2492	712
45	ar20_163	2020-07-25 21:48	Z5	78.1572	8.9940	1115
46	ar20_164	2020-07-25 23:27	Z6	78.1462	8.6585	1577
47	ar20_165	2020-07-26 01:37	Z7	78.1388	8.1617	2236
48	ar20_166	2020-07-26 04:20	Z8	78.1288	7.5120	3478
49	ar20_167	2020-07-26 08:13	Z9	78.1167	6.6660	2305
50	ar20_168	2020-07-26 10:49	Z10	78.0995	5.8357	2511
51	ar20_169	2020-07-26 13:51	Z11	78.0893	5.0030	2447
52	ar20_170	2020-07-26 16:48	Z12	78.0830	4.0140	2836
53	ar20_171	2020-07-26 20:12	Z13	78.0663	2.8347	3060
54	ar20_172	2020-07-26 23:58	Z14	78.0502	1.4988	3101
55	ar20_173	2020-07-27 04:20	Z15	78.0282	0.0045	3089
56	ar20_174	2020-07-27 12:50	S18	77.1662	1.0007	3229
57	ar20_175	2020-07-27 19:19	S16	77.2337	2.9947	2936
58	ar20_176	2020-07-27 23:00	S15	77.2667	4.0002	2621
59	ar20_177	2020-07-28 04:41	S13	77.2995	4.9910	2340
60	ar20_178	2020-07-28 08:46	S12	77.3333	6.0008	2618
61	ar20_179	2020-07-28 12:23	S10	77.3663	7.0007	2682
62	ar20_180	2020-07-28 16:11	S9P	77.3820	7.5020	3358
63	ar20_181	2020-07-28 19:51	S9	77.4000	8.0013	2316
64	ar20_182	2020-07-28 22:20	S8P	77.4162	8.5013	1481
65	ar20_183	2020-07-29 00:30	S8	77.4332	9.0000	2076
66	ar20_184	2020-07-29 03:42	S7	77.4650	9.9997	1614
67	ar20_185	2020-07-29 05:47	S6	77.4822	10.5045	1259
68	ar20_186	2020-07-29 07:51	S5	77.5000	11.0008	718
69	ar20_187	2020-07-29 09:17	S4	77.5162	11.5008	277
70	ar20_188	2020-07-29 10:23	S3	77.5330	12.0012	166
71	ar20_189	2020-07-29 11:57	S2	77.5500	12.5005	90
72	ar20_190	2020-07-29 13:01	S1	77.5665	12.9983	130
73	ar20_191	2020-07-29 14:06	S0	77.5828	13.5017	133
74	ar20_192	2020-07-30 04:06	N4P	76.4997	15.5088	133
75	ar20_193	2020-07-30 05:13	N4	76.4998	15.0015	158
76	ar20_194	2020-07-30 06:24	N3P	76.4997	14.4993	226
77	ar20_195	2020-07-30 07:16	N3PP	76.5000	14.2002	429
78	ar20_196	2020-07-30 08:09	N3	76.5002	14.0005	766
79	ar20_197	2020-07-30 09:45	N2P	76.5000	13.4973	1273
80	ar20_198	2020-07-30 11:45	N2	76.5000	12.9988	1557
81	ar20_199	2020-07-30 14:02	N1P	76.4998	12.5078	1753
82	ar20_200	2020-07-30 16:39	N1	76.4982	12.0073	1907
83	ar20_201	2020-07-30 19:11	N0P	76.5002	11.5005	2040
84	ar20_202	2020-07-30 21:35	N0	76.4998	11.0008	2111
85	ar20_203	2020-07-31 01:49	N-1	76.4995	10.0022	2253
86	ar20_204	2020-07-31 05:25	N-2	76.4987	8.9963	2294
87	ar20_205	2020-07-31 09:42	N-3	76.4995	8.4998	2277
88	ar20_206	2020-07-31 12:30	N-4	76.4997	8.0003	1915

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89	ar20_207	2020-07-31 15:05	N-5	76.4978	7.4988	2534
90	ar20_208	2020-07-31 18:12	N-6	76.5000	6.9993	2867
91	ar20_209	2020-07-31 21:19	N-7	76.4998	6.5000	2476
92	ar20_210	2020-08-01 00:21	N-8	76.4995	5.9987	2596
93	ar20_211	2020-08-01 04:28	N-9	76.4997	5.4983	2557
94	ar20_212	2020-08-01 07:28	N-10	76.4998	5.0007	2427
95	ar20_213	2020-08-01 10:53	N-11	76.4998	3.9998	2541
96	ar20_214	2020-08-01 14:45	N-12	76.4998	2.9963	2805
97	ar20_215	2020-08-02 07:23	EB2-15	78.8332	-0.0003	2620
98	ar20_216	2020-08-02 10:41	EB2-14P	78.8332	1.0002	2469
99	ar20_217	2020-08-02 13:43	EB2-14	78.8332	1.4985	2503
100	ar20_218	2020-08-02 17:17	EB2-13	78.8333	1.9963	2543
101	ar20_219	2020-08-02 20:13	EB2-12P	78.8335	2.4997	2509
102	ar20_220	2020-08-02 23:32	EB2-12	78.8332	3.1672	2405
103	ar20_221	2020-08-03 02:33	EB2-11P	78.8317	3.6693	2274
104	ar20_222	2020-08-03 05:17	EB2-11	78.8313	4.1658	2400
105	ar20_223	2020-08-03 08:20	EB2-10P	78.8332	4.6683	2647
106	ar20_224	2020-08-03 10:46	EB2-10	78.8328	5.1623	2616
107	ar20_225	2020-08-03 14:29	EB2-9P	78.8330	5.4038	2594
108	ar20_226	2020-08-03 17:47	EB2-9	78.8332	5.6642	2502
109	ar20_227	2020-08-03 20:28	EB2-8P	78.8332	5.9175	2491
110	ar20_228	2020-08-03 22:56	EB2-8	78.8332	6.1642	2334
111	ar20_229	2020-08-04 01:11	EB2-7P	78.8333	6.4145	2074
112	ar20_230	2020-08-04 03:49	EB2-7	78.8320	6.6773	1752
113	ar20_231	2020-08-04 06:57	EB2-6P	78.8333	6.8840	1552
114	ar20_232	2020-08-04 08:59	EB2-6	78.8335	7.0995	1363
115	ar20_233	2020-08-04 10:57	EB2-5	78.8335	7.6005	1102
116	ar20_234	2020-08-04 12:58	EB2-4P	78.8332	7.8532	1051
117	ar20_235	2020-08-04 14:27	EB2-4	78.8335	8.1062	968
118	ar20_236	2020-08-04 16:03	EB2-3P	78.8332	8.2825	829
119	ar20_237	2020-08-04 17:23	EB2-3	78.8332	8.4418	633
120	ar20_238	2020-08-04 18:35	EB2-2P	78.8333	8.6005	402
121	ar20_239	2020-08-04 19:30	EB2-2	78.8333	8.7672	207
122	ar20_240	2020-08-04 20:37	EB2-1	78.8332	9.2665	203
123	ar20_275	2020-08-09 06:00	NB1	80.5507	16.5422	49
124	ar20_276	2020-08-09 06:43	NB2	80.6165	16.3980	132
125	ar20_277a	2020-08-09 08:25	NB3	80.6648	16.3675	53
126	ar20_277	2020-08-09 07:15	NB3	80.6460	16.3267	162
127	ar20_278	2020-08-09 08:49	NB4	80.6780	16.2587	172
128	ar20_279	2020-08-09 09:20	NB5	80.6947	16.2238	323
129	ar20_280	2020-08-09 09:58	NB6	80.7098	16.1898	565
130	ar20_281	2020-08-09 11:18	NB7	80.7245	16.1555	661
131	ar20_282	2020-08-09 12:08	NB8	80.7412	16.1197	903
132	ar20_283	2020-08-09 13:15	NB9	80.7562	16.0875	963
133	ar20_284	2020-08-09 14:33	NB10	80.7723	16.0378	1144
134	ar20_285	2020-08-09 16:01	NB11	80.8023	15.9720	1589

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135	ar20_286	2020-08-09 18:46	NB12	80.8667	15.8377	1893
136	ar20_287	2020-08-09 21:17	NB13	80.9293	15.6927	2011
137	ar20_288	2020-08-10 05:36	WB1	80.0897	12.6368	179
138	ar20_289	2020-08-10 06:24	WB2	80.1550	12.5583	176
139	ar20_290	2020-08-10 07:08	WB3	80.2193	12.4822	193
140	ar20_291	2020-08-10 08:23	WB4	80.2858	12.4042	190
141	ar20_292	2020-08-10 09:11	WB5	80.3513	12.3218	168
142	ar20_293	2020-08-10 09:43	WB6	80.3835	12.2878	183
143	ar20_294	2020-08-10 11:02	WB7	80.4162	12.2475	215
144	ar20_295	2020-08-10 11:40	WB8	80.4333	12.2247	353
145	ar20_296	2020-08-10 12:19	WB9	80.4498	12.2040	467
146	ar20_297	2020-08-10 13:41	WB10	80.4663	12.1865	571
147	ar20_298	2020-08-10 14:36	WB11	80.4820	12.1608	654
148	ar20_299	2020-08-10 15:41	WB12	80.5155	12.1215	811
149	ar20_300	2020-08-10 17:14	WB13	80.5472	12.0763	942
150	ar20_301	2020-08-10 18:41	WB14	80.5800	12.0457	1041
151	ar20_302	2020-08-10 20:05	WB15	80.6283	11.9843	1188
152	ar20_303	2020-08-10 21:33	WB16	80.6790	11.9173	1298
153	ar20_304	2020-08-10 23:13	WB17	80.7427	11.8438	1448
154	ar20_305	2020-08-11 01:09	WB18	80.8087	11.7587	1641
155	ar20_306	2020-08-11 03:24	WB19	80.8732	11.6720	1803
156	ar20_307	2020-08-11 06:01	WB20	80.9405	11.6115	1979
157	ar20_308	2020-08-11 08:03	WB21	80.9997	11.5002	2059
158	ar20_309	2020-08-11 10:42	WB22'	81.0772	11.4123	2109
159	ar20_310	2020-08-11 13:31	WB23	81.1560	11.2363	2104
160	ar20_311	2020-08-11 16:39	WB24	81.2363	11.0913	1712
161	Ar20_312	2020-08-12 03:46	Y15'	80.3248	7.3343	608
162	Ar20_313	2020-08-12 05:16	Y14'	80.2555	7.8055	609
163	Ar20_314	2020-08-12 06:40	Y13	80.1908	7.4735	573
164	Ar20_315	2020-08-12 07:59	Y12	80.1337	7.9030	537
165	Ar20_316	2020-08-12 11:24	Y10	80.0145	8.3725	490
166	Ar20_317	2020-08-12 12:36	Y9	79.9550	8.7072	475
167	Ar20_318	2020-08-12 14:21	Y8	79.8967	9.0502	451
168	Ar20_319	2020-08-12 15:39	Y7	79.8368	9.3753	448
169	Ar20_320	2020-08-12 16:53	Y6	79.7938	9.6013	422
170	Ar20_321	2020-08-12 18:13	Y5	79.7595	9.8422	379
171	Ar20_322	2020-08-12 19:10	Y4	79.7297	9.9688	311
172	Ar20_323	2020-08-12 19:57	Y3	79.7070	10.0997	132
173	Ar20_324	2020-08-12 20:31	Y2	79.6837	10.2298	85

Hydrographic measurements in the West Spitsbergen fjords

Oceanographic measurements carried out during the fjord part of the ARES 2020 cruise included high-resolution hydrographic measurements with a towed CTD system (scan-fish) or vertical CTD profiles. During the fjord part of the cruise hydrographic measurements were conducted in the main studied areas: Isfjorden, Van Mijenfjorden, Hornsund (and the foreground) and Kongsfjorden (and the foreground) on 116 stations in total. Measurements on all stations were collected using the Sea-Bird Electronics SBE19 plus SeaCat probe (4 Hz). Two sections were occupied in Hornsund and Kongsfjorden. Additionally, vertical CTD casts were made at most of the ecological stations. The location of the stations is shown on Fig. 3. The detailed list and schedule of fjord casts is given in the station list (Table 5).

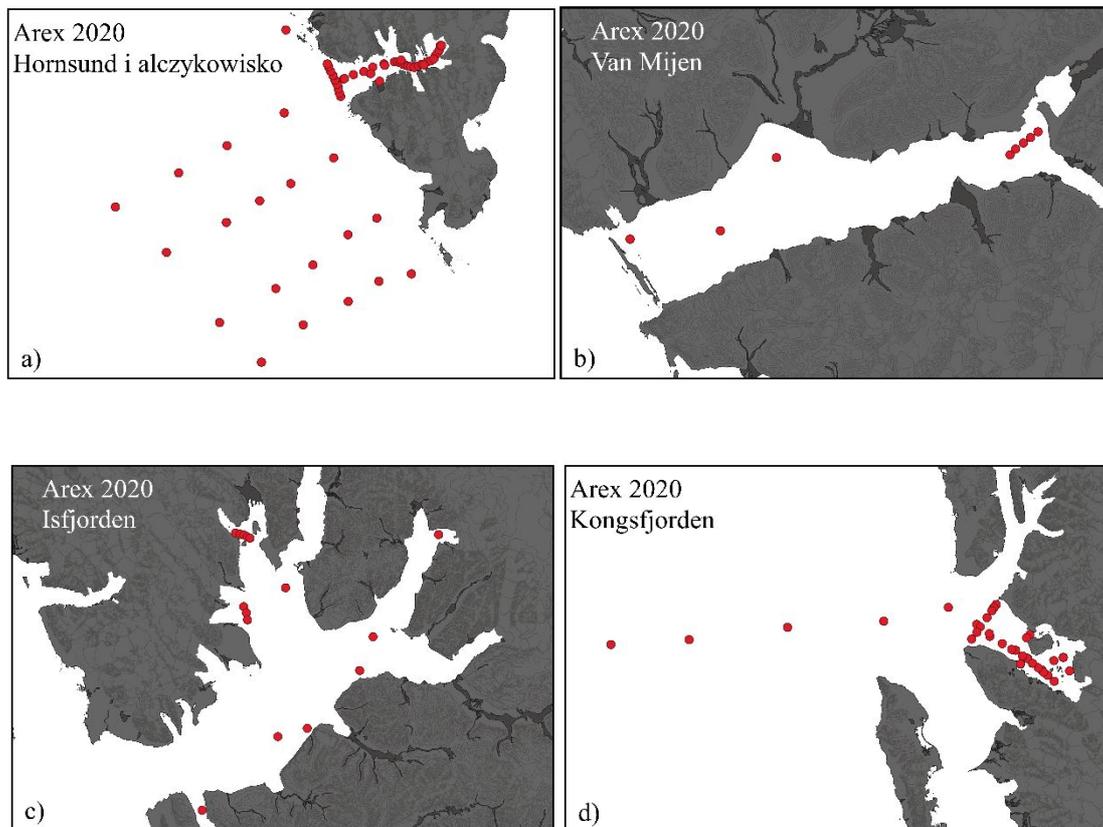


Figure 3. Positions of CTD stations during the fjord part of the ARES 2020 cruise.

Table 5. List of CTD stations occupied during the fjord part of the ARES'2020 cruise

ID	Log_ID	Date Time UTC	Station	Latitude	Longitude	Bottom pressure (dbar)
1	Ar20_040	2020-07-12 23:25	auk22	76.4460	16.1582	35
2	Ar20_041	2020-07-13 00:15	auk21	76.4283	15.7983	87
3	Ar20_042	2020-07-13 01:19	auk20	76.3765	15.4593	144
4	Ar20_043	2020-07-13 02:31	auk19	76.3163	14.9645	314
5	Ar20_044	2020-07-13 03:59	auk18/19	76.2188	14.5112	474
6	Ar20_045	2020-07-13 05:31	auk18/H7	76.3205	14.0498	589

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7	Ar20_046	2020-07-13 08:30	AUK16	76.4102	14.6620	598
8	Ar20_048	2020-07-13 10:52	AUK15	76.4718	15.0715	179
9	Ar20_050	2020-07-13 13:13	AUK14	76.5502	15.4617	91
10	Ar20_052	2020-07-13 14:54	AUK13	76.5923	15.7845	31
11	Ar20_053	2020-07-13 16:26	AUK12	76.7498	15.3070	46
12	Ar20_055	2020-07-13 18:48	AUK11/H6	76.6828	14.8233	227
13	Ar20_057	2020-07-13 20:55	AUK10	76.6380	14.4768	201
14	Ar20_059	2020-07-13 22:44	AUK09	76.5807	14.1080	186
15	Ar20_060	2020-07-14 00:09	AUK07	76.4998	13.4502	504
16	Ar20_061	2020-07-14 01:52	AUK6/H5	76.6135	12.8657	508
17	Ar20_062	2020-07-14 05:13	AUK4	76.7067	13.5642	203
18	Ar20_064	2020-07-14 07:53	AUK3	76.7802	14.1025	98
19	Ar20_066	2020-07-14 10:39	AUK2	76.8665	14.7470	98
20	Ar20_068	2020-07-14 13:12	AUK1/H1	76.9350	15.3607	168
21	Ar20_069	2020-07-14 15:34	H1e	76.9547	15.4275	131
22	Ar20_070	2020-07-14 16:34	R1	76.9657	15.5393	158
23	Ar20_071	2020-07-14 17:15	R2	76.9732	15.6588	94
24	Ar20_072	2020-07-14 18:03	H2	76.9842	15.7620	226
25	Ar20_073	2020-07-14 19:55	R3	76.9925	15.8903	170
26	Ar20_074	2020-07-14 20:59	H4	76.9972	16.0108	106
27	Ar20_075	2020-07-14 22:08	R4	76.9968	16.0460	84
28	Ar20_076	2020-07-14 22:35	R5	76.9945	16.0763	67
29	Ar20_077	2020-07-14 22:53	R6	76.9905	16.1095	55
30	Ar20_078	2020-07-14 23:11	R6a	76.9880	16.1383	41
31	Ar20_079	2020-07-14 23:28	R7	76.9858	16.1657	56
32	Ar20_080	2020-07-14 23:46	R8	76.9840	16.1963	102
33	Ar20_081	2020-07-15 00:08	R9	76.9818	16.2392	102
34	Ar20_082	2020-07-15 00:32	R10	76.9857	16.2862	111
35	Ar20_083	2020-07-15 00:54	HRb	76.9898	16.3257	114
36	Ar20_084	2020-07-15 01:19	R11	76.9947	16.3828	123
37	Ar20_085	2020-07-15 01:45	R12	76.9983	16.4300	123
38	Ar20_086	2020-07-15 02:30	HIDEA/H3	77.0117	16.4837	112
39	Ar20_087	2020-07-15 04:15	R13	77.0178	16.5057	90
40	Ar20_088	2020-07-15 04:47	R14	77.0257	16.5320	85
41	Ar20_089	2020-07-15 05:17	HRc/AZB3	77.0372	16.5422	65
42	Ar20_090	2020-07-15 10:43	HRc/AZB3	77.0370	16.5557	66
43	Ar20_091	2020-07-15 14:16	HB1	77.0027	16.4638	115
44	Ar20_092	2020-07-15 16:32	HRb	76.9882	16.3485	111
45	Ar20_093	2020-07-15 18:19	HB2	77.0013	16.0880	80
46	Ar20_094	2020-07-15 20:52	Rm9	76.9092	15.3908	50
47	Ar20_095	2020-07-15 21:07	Rm8	76.9175	15.3777	135
48	Ar20_096	2020-07-15 21:27	Rm7	76.9283	15.3657	166
49	Ar20_097	2020-07-15 21:49	Rm6	76.9402	15.3502	150
50	Ar20_098	2020-07-15 22:13	Rm5	76.9513	15.3283	162
51	Ar20_099	2020-07-15 22:38	Rm4	76.9632	15.3050	135
52	Ar20_100	2020-07-15 23:03	Rm3	76.9745	15.2777	114

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53	Ar20_101	2020-07-15 23:26	Rm2	76.9867	15.2533	116
54	Ar20_102	2020-07-15 23:46	Rm1	76.9937	15.2410	64
55	Ar20_103	2020-07-16 10:55	HB3	76.9677	15.7353	236
56	Ar20_105	2020-07-16 14:20	HRa	76.9885	15.8967	167
57	Ar20_107	2020-07-16 17:19	H1e	76.9552	15.4368	137
58	Ar20_108	2020-07-16 19:00	H2eB	76.9475	15.8383	26
59	Ar20_109	2020-07-18 10:22	TO2	77.0820	14.7632	134
60	Ar20_110	2020-07-19 06:20	VM1	77.8565	16.7477	44
61	Ar20_111	2020-07-19 07:09	VM2	77.8505	16.7087	53
62	Ar20_112	2020-07-19 07:42	VM3	77.8448	16.6713	65
63	Ar20_113	2020-07-19 08:20	VM4	77.8387	16.6312	72
64	Ar20_114	2020-07-19 09:23	VM5	77.8325	16.6017	75
65	Ar20_115	2020-07-19 12:08	VM4a	77.8338	15.4157	62
66	Ar20_116	2020-07-19 14:35	VMBref	77.7553	15.1305	103
67	Ar20_117	2020-07-19 16:46	VMB2	77.7462	14.6745	66
68	Ar20_118	2020-07-20 06:00	I1	78.0617	14.1600	146
69	Ar20_126	2020-07-20 15:14	I2	78.2240	14.9562	212
70	Ar20_127	2020-07-21 06:11	Ek1	78.6693	14.4855	51
71	Ar20_128	2020-07-21 07:12	Ek2	78.6667	14.5368	46
72	Ar20_129	2020-07-21 08:06	Ek3	78.6648	14.5797	37
73	Ar20_130	2020-07-21 09:00	Ek4	78.6610	14.6150	39
74	Ar20_131	2020-07-21 09:58	Ek5	78.6583	14.6455	44
75	Ar20_133	2020-07-21 12:54	IsfAZ4	78.5498	15.0393	103
76	Ar20_134	2020-07-21 14:47	Yol3	78.5082	14.5823	55
77	Ar20_135	2020-07-21 16:08	Yol2	78.4947	14.6127	62
78	Ar20_136	2020-07-21 17:20	Yol1	78.4793	14.6237	62
79	Ar20_139	2020-07-21 21:13	IsfAZ2	78.3675	15.8395	173
80	Ar20_141	2020-07-22 12:34	BAB	78.6612	16.7333	185
81	Ar20_142	2020-07-22 17:26	ISF3	78.4408	15.9890	143
82	Ar20_143	2020-07-22 23:02	ISA	78.2422	15.2700	183
83	Ar20_241	2020-08-05 06:21	KGa/KG5	78.9308	12.1220	137
84	Ar20_242	2020-08-05 08:43	KGb/KG4	78.9502	12.2375	78
85	Ar20_243	2020-08-05 11:09	KG3a	78.9403	11.9008	72
86	Ar20_244a	2020-08-05 13:14	KG3b	78.9525	11.9698	330
87	Ar20_244	2020-08-05 12:25	KG3b	78.9523	11.9677	262
88	Ar20_245	2020-08-05 14:24	KGc	78.9668	11.8447	298
89	Ar20_246	2020-08-05 16:13	E4/KG1	78.9912	11.5732	277
90	Ar20_247	2020-08-05 19:12	Mi2/KG2	78.9988	11.9802	66
91	Ar20_248	2020-08-06 06:03	V6	78.9080	7.7523	609
92	Ar20_249	2020-08-06 10:40	V10	78.9353	8.5327	356
93	Ar20_250	2020-08-06 15:14	V12	78.9788	9.5138	217
94	Ar20_251	2020-08-06 18:51	V14	79.0070	10.4845	272
95	Ar20_252	2020-08-06 21:43	KB0	79.0428	11.1320	321
96	Ar20_253	2020-08-06 23:55	KB1	79.0133	11.4325	319
97	Ar20_254	2020-08-07 02:35	KB2	78.9785	11.7047	308
98	Ar20_255	2020-08-07 04:31	KB3	78.9563	11.9172	350

99	Ar20_256	2020-08-07 08:22	KB5/V1	78.9100	12.2510	86
100	Ar20_257	2020-08-07 15:49	draga1	78.9575	12.3313	57
101	Ar20_258	2020-08-07 17:20	draga2	78.9315	12.4013	51
102	Ar20_259	2020-08-07 19:44	draga4	78.9927	11.9482	120
103	Ar20_260	2020-08-07 21:20	draga5	79.0475	11.5950	78
104	Ar20_261	2020-08-07 22:12	2RK010	79.0547	11.6212	20
105	Ar20_262	2020-08-07 22:30	2RK009	79.0480	11.5987	68
106	Ar20_263	2020-08-07 22:47	2RK008	79.0418	11.5790	126
107	Ar20_264	2020-08-07 23:17	2RK006	79.0277	11.5335	227
108	Ar20_265	2020-08-07 23:54	2RK004	79.0088	11.4710	375
109	Ar20_266	2020-08-08 00:36	2RK003	78.9982	11.4412	367
110	Ar20_267	2020-08-08 01:20	2RK001	78.9840	11.3917	176
111	Ar20_268	2020-08-08 02:05	1RK003	78.9965	11.5673	213
112	Ar20_269	2020-08-08 02:53	1RK004	78.9680	11.8037	274
113	Ar20_270	2020-08-08 04:16	1RK008	78.9210	12.1828	60
114	Ar20_271	2020-08-08 04:33	1RK007	78.9267	12.1378	94
115	Ar20_272	2020-08-08 04:52	1RK006	78.9348	12.0823	193
116	Ar20_273	2020-08-08 05:17	1RK005	78.9430	12.0228	243

Ecological measurements

a) Plankton sampling

During the AREX expedition zoo- and phytoplankton samples were collected at the selected stations in the open ocean part (Norwegian, Barents and Greenland seas) and in the Kongsfjorden, Hornsund and Isfjorden. The measurements included vertical profiles of size and distribution of planktonic organisms measured with laser optical particle counter (LOPC) during transects from Billefjorden to Adventfjorden, in the Hornsund fjord and along the hydrographic sections in Kongsfjorden and Hornsund. Additionally, plankton samples were collected with MPS (Multiple Plankton Sampler) net 180 µm and WP2/60 µm net at the stations on the outer shelf and in the central part of the Hornsund fjord. Zooplankton samples were also collected at stations in the foreground of the Hornsund fjord with the WP2/500 µm net, including 8 stations with the WP2/180 µm net. During the following part of the cruise. zooplankton samples were collected at monitoring stations in the foreground and inside the Kongsfjorden (with MPS/180 and MPS/60). Additional samples were collected on the selected monitoring stations with the WP2/180 µm net for the Seapop2 project. Locations of the plankton sampling stations are shown on Fig. 4a.

b) Benthos sampling

As part of the long-term monitoring of benthic fauna (infauna) samples were collected at five monitoring stations in the Hornsund and Kongsfiorden fjords. Three replications of benthos samples were collected on stations located in Kongsfjorden (Mi2, V1, E4) and four for all stations located in Hornsund (HB1, HB2, HB3). On each station benthos sampling included samples for the identification of macrofauna (with the van Veen's grab), meiofauna samples, samples for the determination of environmental conditions (HCN, granulometry, chlorophyll concentration), and genetic samples from the surface layers of the sediment (samples from the sediment core collected with the box-corer). Additionally, a set of macrobenthic samples (with

no replications) was collected in Hornsund and Kongsfjorden together with one core in each fjord to measure the rate of sediment accumulation at six chemical stations: HRa, HRb and HRc (in Hornsund), and KGa, KGb and KGc (in Kongsfjorden). According to the cruise plan macro- and meiofauna samples as well as samples to determine the sediment granulometry chlorophyll a concentration, CHN and genetic samples were collected from the sediment surface layers at stations in Isfjorden and Van Mijenfjorden. Video sections with drop-camera were made at stations located in Isfjorden (Colesbukta, Tempelfjorden and Yoldiabukta) and in Kongsfjorden. In addition, a film documentation of the sea bottom and coastal fauna was created in order to identify the distribution of benthic fauna in disturbed habitats of glacial bays. Locations of the benthos sampling stations are shown on Fig. 4b.

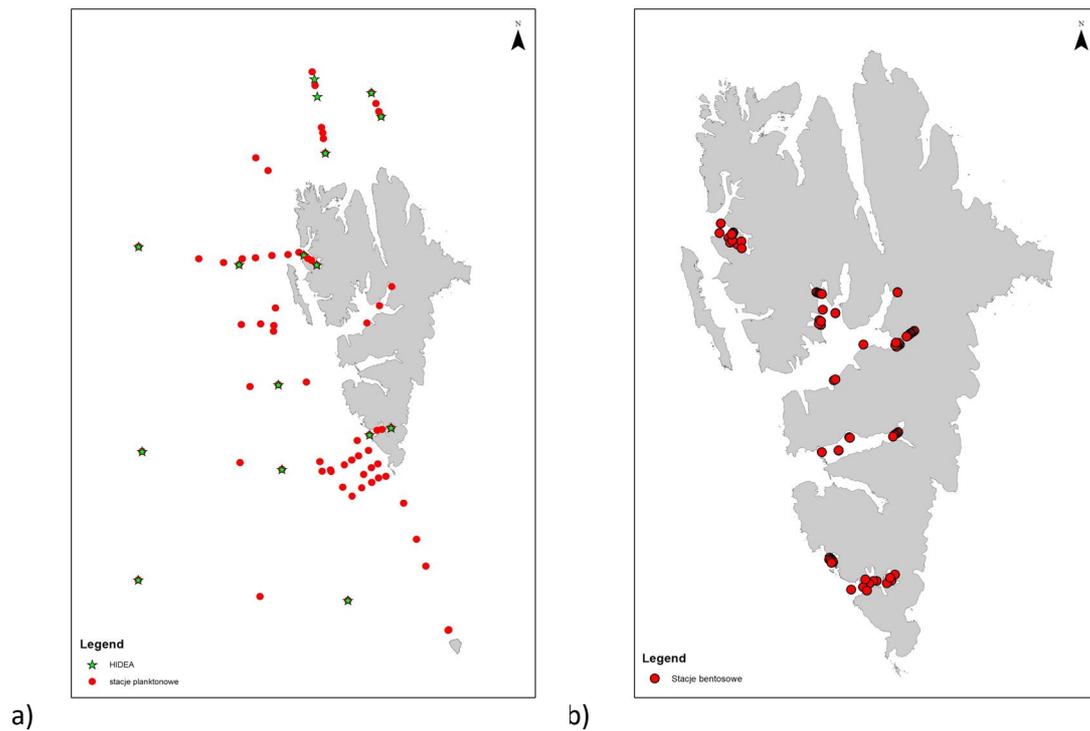


Figure 5. Locations of (a) plankton and (b) benthos sampling stations during the fjord part of the AREX'2020 cruise.

Waldemar Walczowski

Prof. Waldemar Walczowski
AREX'2020 cruise leader