

CRUISE REPORT



R/V Aranda

Cruise 10/2019

Combine 2/2019
27th May – 7th June 2019

This report is based on preliminary data and is subject to changes.

ARANDA CRUISE REPORT
Cruise 10/2019, COMBINE 2
27.5.-7.6.2019

Chief scientist: Henrik Nygård

Description of the cruise

The COMBINE 2/2019 cruise was part of the HELCOM Baltic Sea integrated physical, chemical and biological monitoring programme. The main focus of the cruise was the long-term monitoring of macrozoobenthos and near-bottom water oxygen levels in the open sea area. The cruise also contributed to the long-term monitoring of zooplankton communities. Water and sediment samples were also taken for monitoring of radioactive substances (HELCOM MORS programme). In the Bothnian Bay a wave buoy was deployed by FMI and the wave buoy in Bothnian Sea was serviced. In addition, Argo floats were deployed in the Bothnian Sea and the Bothnian Bay and one Argo float was retrieved from the Bothnian Bay by FMI. Two hydrophones, one in the Archipelago Sea and one in the vicinity to Vaasa, were deployed to study the underwater soundscape in coastal areas. As a pilot study to investigate if the benthic community can be monitored by eDNA technique, water from 1 m above the bottom was filtered at four monitoring stations in the Gulf of Bothnia. Further analyses will be performed by Åbo Akademi University. Altogether 58 stations were visited.

Cruise route

The cruise departed from Helsinki and headed eastward to sample the stations closest to the Russian border (Figure 1). After that the cruise continued west along the Gulf of Finland and through the Archipelago Sea to the Bothnian Sea. The stations in the western part of Bothnian Sea were sampled before a stop in Vaasa. After a short stop in Vaasa, the cruise continued to the Bothnian Bay and on the way south the stations in the eastern part of Bothnian Sea were sampled. A few stations were sampled in the Åland Sea before continuing to the Northern Baltic Proper and finally sampling a few more stations in the western part of Gulf of Finland before returning to Helsinki. Station information is found in Table 1, whereas sampling details can be found in Appendix 1.

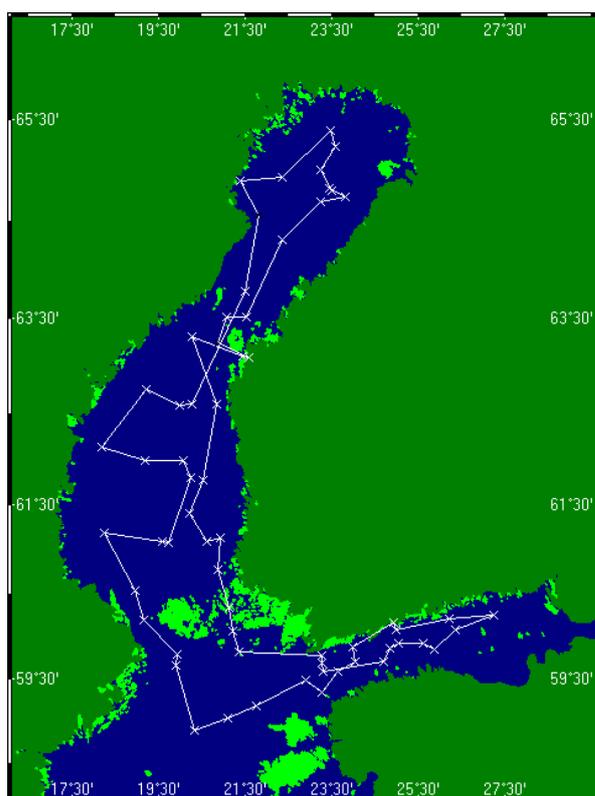


Figure 1. Route of the COMBINE 2/2019 cruise.

Table 1. Stations visited during the COMBINE 2 /2019 cruise.

Index	Station	Latitude	Longitude	Depth (m)	Date	Time (UTC)
299	39A	N60.0401	E024.5881	43	27.5.2019	2015
300	XIV3	N60.1220	E026.1158	78	28.5.2019	0101
301	XV1	N60.1500	E027.1482	66	28.5.2019	0531
302	LL3A	N60.0403	E026.2080	68	28.5.2019	0951
303	GF2	N59.5030	E025.5141	85	28.5.2019	1419
304	LL5	N59.5501	E025.3582	71	28.5.2019	1607
305	LL6A	N59.5501	E025.0181	75	28.5.2019	1848
306	LL7S	N59.5151	E024.5030	79	28.5.2019	2039
307	GF1	N59.4230	E024.4092	84	28.5.2019	2329
308	LL11	N59.3501	E023.1781	70	29.5.2019	0459
309	AMN	N59.4143	E023.1543	57	29.5.2019	0713
310	LANGDEN	N59.4662	E023.1577	57	29.5.2019	0901
311	IU7	N59.4891	E021.2020	95	29.5.2019	1746
312	IU5	N60.0349	E021.1191	90	29.5.2019	2116
313	IU3	N60.2000	E021.0680	51	30.5.2019	0133
314	IU1	N60.4601	E020.5080	34	30.5.2019	0544
315	SR8	N61.0760	E020.5580	49	30.5.2019	0859
316	SR7	N61.0502	E020.3578	78	30.5.2019	1055

Finnish Environment Institute
 Latokartanonkaari 11
 FI-00790 Helsinki
 Finland

<http://www.syke.fi/en>

Finnish Meteorological Institute
 Erik Palménin aukio 1
 P.O. Box 503
 FI-00101 Helsinki
 Finland
<http://en.ilmatieteenlaitos.fi/>

317	ARGO_SM	N61.2408	E020.1133	129	30.5.2019	1422
318	MS9	N61.4601	E020.3183	101	30.5.2019	1726
319	US7	N62.3602	E020.4977	26	31.5.2019	0001
320	F18	N63.1885	E020.1646	105	31.5.2019	0547
321	MELU_VAASA	N63.0663	E021.2344	13	31.5.2019	1110
322	F16	N63.3102	E021.0377	48	31.5.2019	1811
323	F15	N63.3100	E021.3079	48	31.5.2019	2051
324	BO3	N64.1812	E022.2059	110	1.6.2019	0253
325	AALTOPM	N64.4104	E023.1433	85	1.6.2019	1007
326	RR7	N64.4403	E023.4877	40	1.6.2019	1214
327	ARGO_PM	N64.4970	E023.2627	84	1.6.2019	1416
328	RR6	N64.4801	E023.2878	86	1.6.2019	1451
329	CV	N65.0002	E023.1478	87	1.6.2019	1744
330	CV1	N65.1402	E023.3377	69	1.6.2019	2054
331	F2	N65.2302	E023.2776	85	2.6.2019	0003
332	RR3	N64.5602	E022.2076	94	2.6.2019	0530
333	ARGO_NOSTO	N64.5458	E021.2402	25	2.6.2019	0902
334	F13	N63.4701	E021.2877	64	2.6.2019	1610
335	US6B	N62.3600	E020.1577	82	3.6.2019	0111
336	US5B	N62.3517	E019.5813	222	3.6.2019	0327
337	US3	N62.4554	E019.1173	175	3.6.2019	1116
338	MS3	N62.0807	E018.0977	83	3.6.2019	1827
339	MS6	N61.5903	E019.0982	73	3.6.2019	2348
340	F26	N61.5901	E020.0378	138	4.6.2019	0347
341	AALTO_SM	N61.4798	E020.1387	107	4.6.2019	0722
342	EB1	N61.0400	E019.4379	130	4.6.2019	1252
343	SR5	N61.0500	E019.3477	125	4.6.2019	1512
344	SR3	N61.1101	E018.1381	73	4.6.2019	2220
345	F33	N60.3199	E018.5626	135	5.6.2019	0348
346	F64	N60.1134	E019.0855	287	5.6.2019	0700
347	F69	N59.4700	E019.5579	193	5.6.2019	1353
348	TROSKAH	N59.3960	E019.5300	40	5.6.2019	1709
349	BY29	N58.5300	E020.1900	163	5.6.2019	2311
350	LL17	N59.0200	E021.0477	172	6.6.2019	0319
351	LL15	N59.1100	E021.4479	131	6.6.2019	0939
352	LL12	N59.2900	E022.5381	83	6.6.2019	1544
353	F62	N59.2001	E023.1581	97	6.6.2019	1907
354	JML	N59.3491	E023.3759	80	6.6.2019	2205
355	LL9	N59.4202	E024.0181	67	7.6.2019	0205
356	XII3	N59.5201	E023.5881	20	7.6.2019	0506

Participants

The scientific staff of the cruise consisted of employees of the Finnish Environment Institute (SYKE), Finnish Meteorological Institute (FMI) and Radiation and Nuclear Safety Authority in Finland (STUK). In addition two students from Saint Petersburg State University (SPBU) participated in the cruise (Table 2). A journalist was joining on the part from Helsinki to Vaasa.

Table 2. Participants on the COMBINE 2/2019 cruise.

Name	Institute
Henrik Nygård	SYKE
Susanna Hyvärinen	SYKE
Panu Hänninen	SYKE
Marko Jaale	SYKE
Heini Jalli	FMI
Tanja Kinnunen	SYKE
Pekka Kosloff	FMI
Olga Kovru	SYKE
Ilkka Lastumäki	SYKE
Okko Outinen	SYKE
Jere Riikonen	SYKE
Jouko Rissanen	SYKE
Tuomo Roine	FMI
Siru Tasala	SYKE
Pia Varmanen	SYKE
Mikko Teräväinen	STUK
Anastasia Tiugaleva	SPBU
Elena Novoselova	SPBU
Jessica Haapkylä	Journalist

Observations

Hydrography and nutrients

Selected CTD profiles including oxygen profiles are presented in Appendix 2.

In the Gulf of Finland the seasonal thermocline had developed at around 10-20 m depth. The halocline was not very pronounced, but salinity generally gradually increased between 20 to 60 m. Below 60 m the oxygen conditions were poor and hydrogen sulphide generally occurred below 65 m.

Phosphorus levels were increased in the bottom water and in the surface water the phosphate concentration varied between 0.1-0.2 $\mu\text{mol/l}$. Secchi depth was generally 5-6 m.

In the Northern Baltic Proper a thermocline was observed at around 20 m depth. The halocline was pronounced and situated at around 70 m. Below 70

m the oxygen was depleted and instead hydrogen sulphide was occurring. Secchi depth was generally 5.5-6 m.

In the Bothian Sea the halocline was weak or absent. The surface temperatures were still low, 5-7 °C, and the thermocline was only about to form. Oxygen conditions were generally good also close to the bottom. Secchi depth was generally 6-7 m.

In the Bothnian Bay, a preceding storm had mixed the water column and an almost homogenous water mass was observed down to 50 m. Secchi depth varied between 5 and 7.5 m.

Biological sampling

In the Gulf of Finland the benthic community was very reduced and only at the easternmost station and at the shallower stations in the western part animals were found in the 1 mm sieve. Stations where hydrogen sulphide was observed close to the bottom were not even sampled for benthos. This was also the case in the Northern Baltic Proper where hydrogen sulphide was observed at all sampling stations.

In the Archipelago Sea the benthic community was richer. However, due to the coarser sediment structure and leaking of the grab sampler, the samples could not be treated as quantitative.

The initial analysis of the zoobenthos samples from the Gulf of Bothnia revealed a quite similar community structure as was observed in 2017 when the area was sampled latest. At a first sight it seemed like the abundance of *Marenzelleria* spp. had decreased in the Bothnian Bay. However, further analysis of the samples are needed to confirm this.

Zooplankton samples were preserved in 70% ethanol and will need to be analysed further before any results are available.

Appendix 1. Sampling activities at the stations during the COMBINE 2/2019 cruise. Columns: O₂ BTM = Water sample 1 m above the bottom, eDNA = Water filtered for eDNA analyses, CTD+NTR = CTD cast and water samples with Rosette for nutrients and hydrography, CHLA = Water filtered for Chlorophyll a analyses, ZPL = Zooplankton net haul, W_STUK = Water samples for analyses of radioactivity, SECCHI = Secchi depth measurements (only during daytime), BENTHOS = Zoobenthos samples, SED_STUK = Sediment samples for analyses of radioactivity.

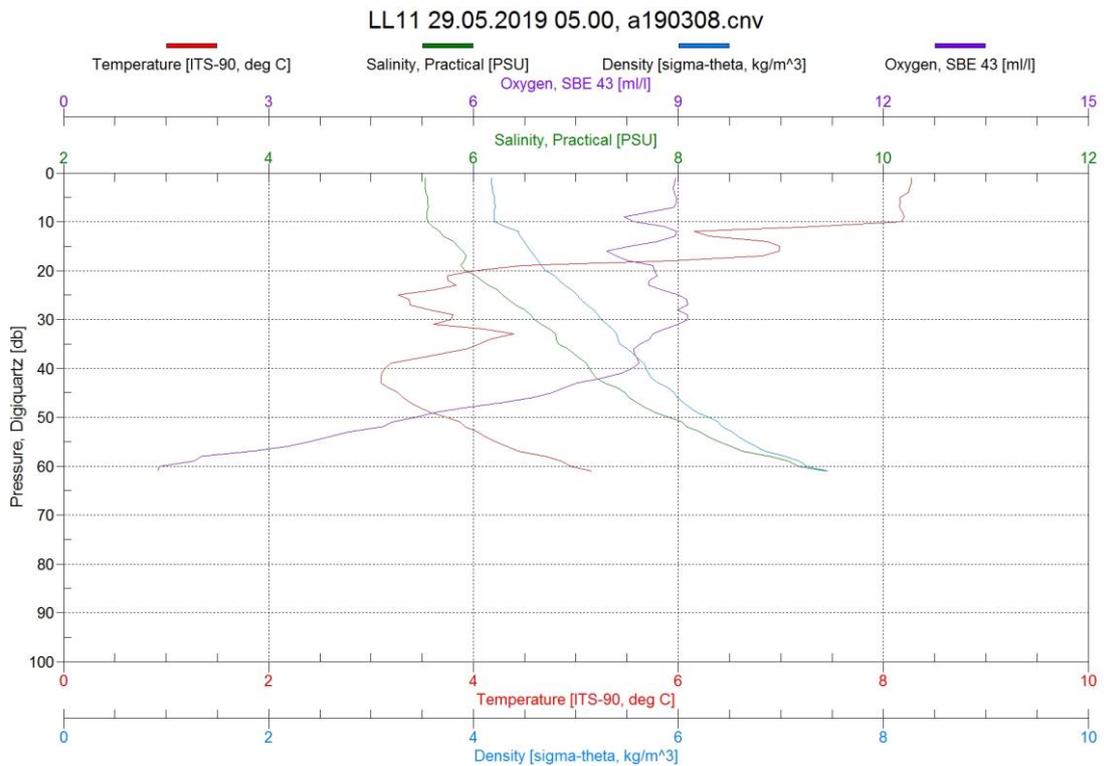
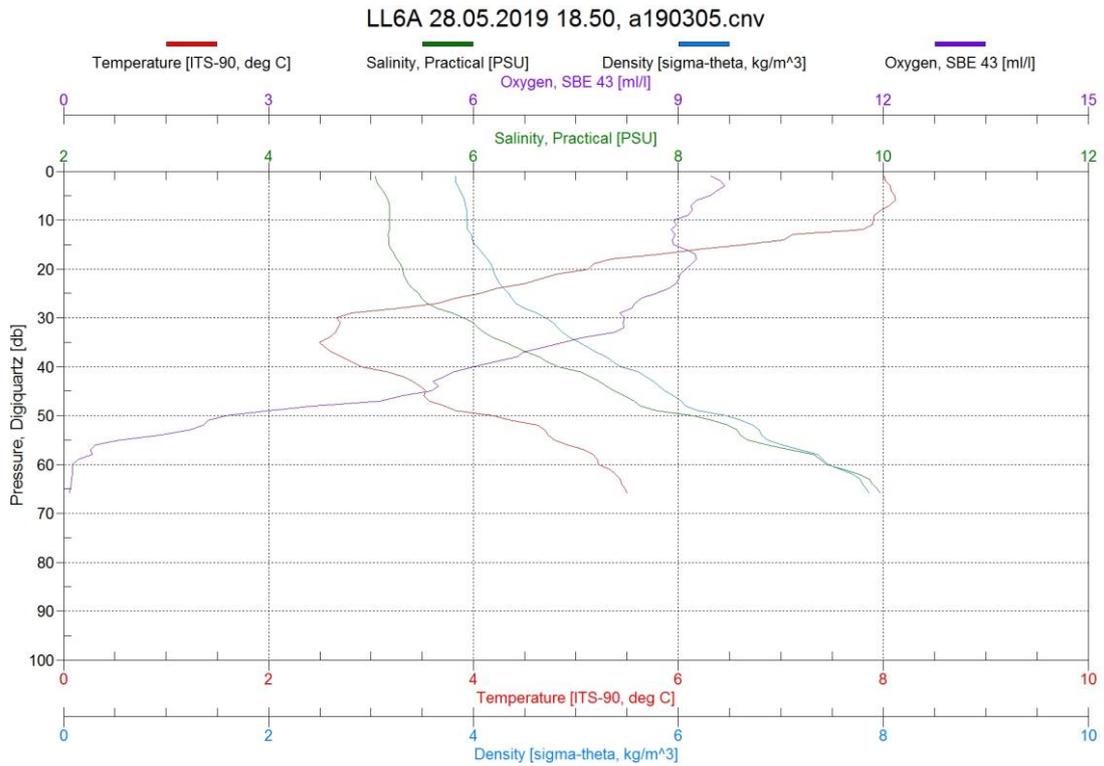
Index	Station	WATER PHASE							SEA BOTTOM		OTHER
		O ₂ BTM	eDNA	CTD+NTR	CHLA	ZPL	W_STUK	SECCHI	BENTHOS	SED_STUK	
299	39A	x		x	x	x ¹		x			
300	XIV3	x		x	x			x			
301	XV1	x		x	x	x		x	x		
302	LL3A	x		x	x	x	x	x	x	x	
303	GF2	x		x	x			x	x		
304	LL5	x		x	x			x	x		
305	LL6A	x		x	x			x	x		
306	LL7S	x		x	x	x		x	x		
307	GF1	x		x	x	x		x	x		
308	LL11	x		x	x			x	x		
309	AMN	x		x	x			x	x		
310	LÄNGDEN	x		x	x	x		x	x		
311	IU7	x		x	x	x		x			
312	IU5	x		x	x			x	x		
313	IU3	x		x	x			x	x		Hydrophone
314	IU1	x		x	x			x			
315	SR8	x		x	x			x			
316	SR7	x		x	x			x	x		
317	ARGO_SM										Buouy
318	MS9	x		x	x			x	x		

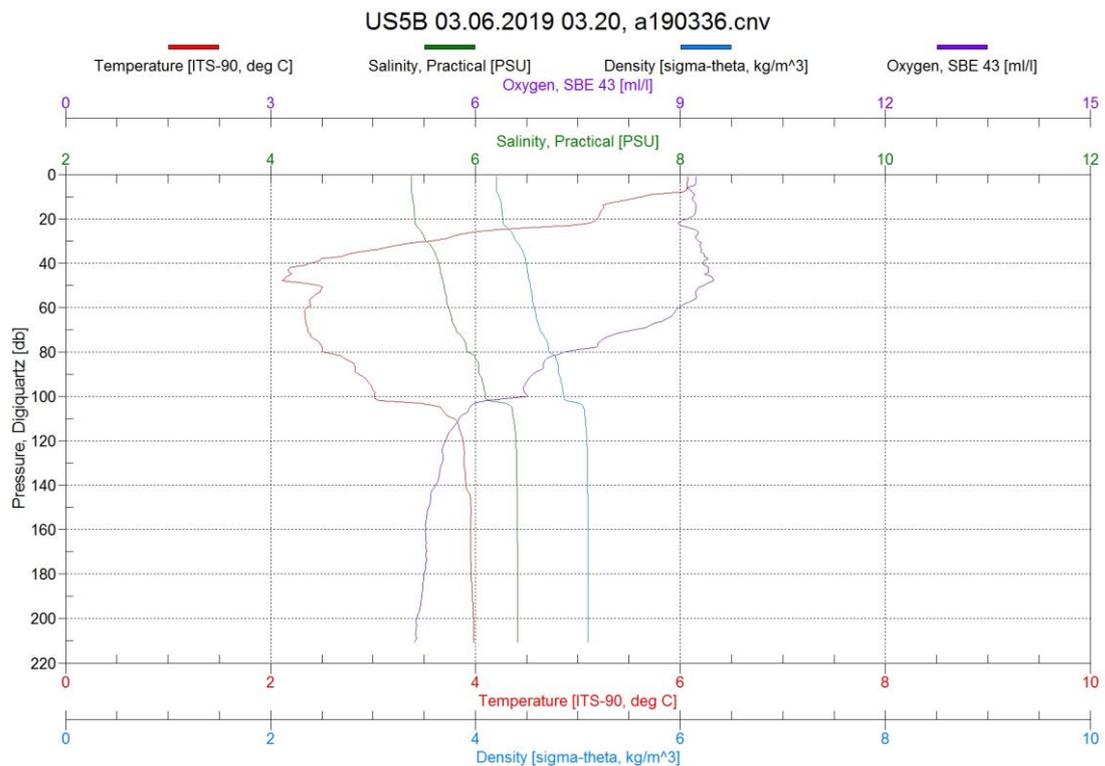
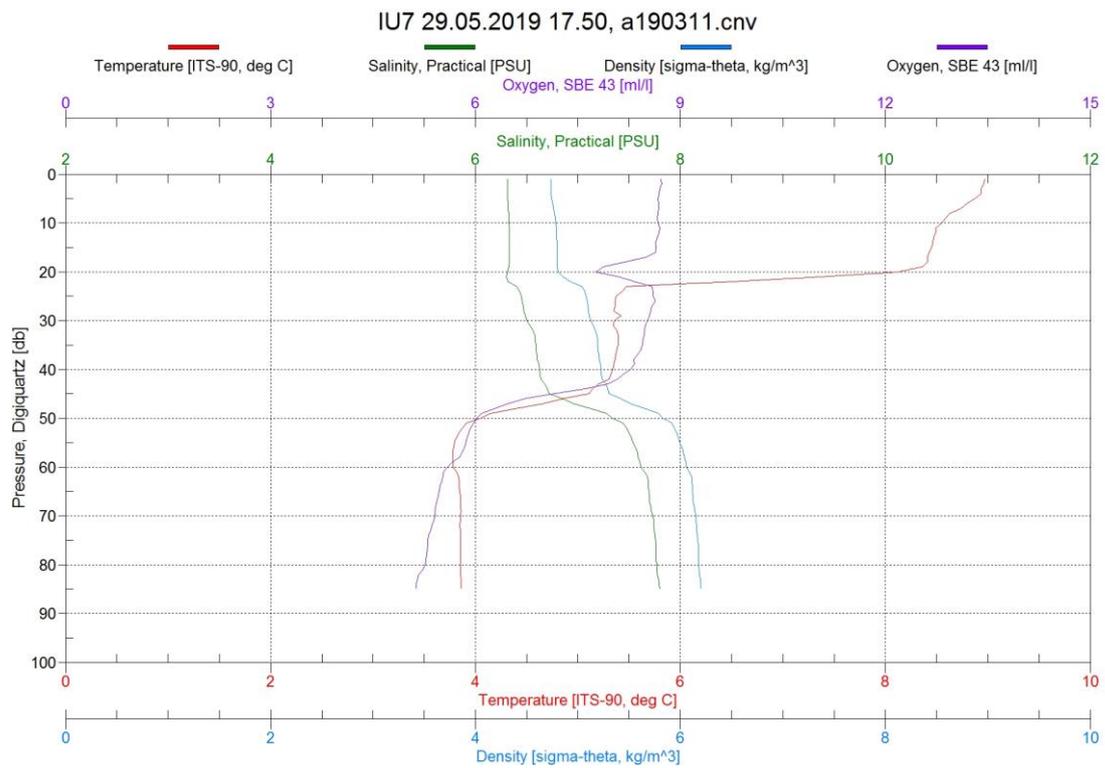
319	US7	x		x	x			x			
320	F18	x		x	x			x	x		
321	MELU_VAASA										Hydrophone
322	F16	x		x	x	x		x	x		
323	F15	x		x	x			x	x		
324	BO3	x	x	x	x	x		x	x		
325	AALTO_PM										Buouy
326	RR7	x		x	x			x			
327	RR6	x		x	x			x	x		
328	ARGO_PM										Buouy
329	CV	x		x	x			x	x		
330	CVI	x	x	x	x		x	x	x	x	
331	F2	x		x	x	x		x			
332	RR3	x		x	x			x	x		
333	ARGO_NOSTO										Buouy
334	F13	x		x	x			x			
335	US6B	x		x	x			x	x		
336	US5B	x	x	x	x	x	x	x	x	x	
337	US3	x		x	x			x	x		
338	MS3	x		x	x			x	x		
339	MS6	x		x	x			x	x		
340	F26	x		x	x			x	x		
341	AALTO_SM										Buouy
342	EB1			x ²			x			x	
343	SR5	x	x	x	x	x	x	x	x	x	
344	SR3	x		x	x			x	x		

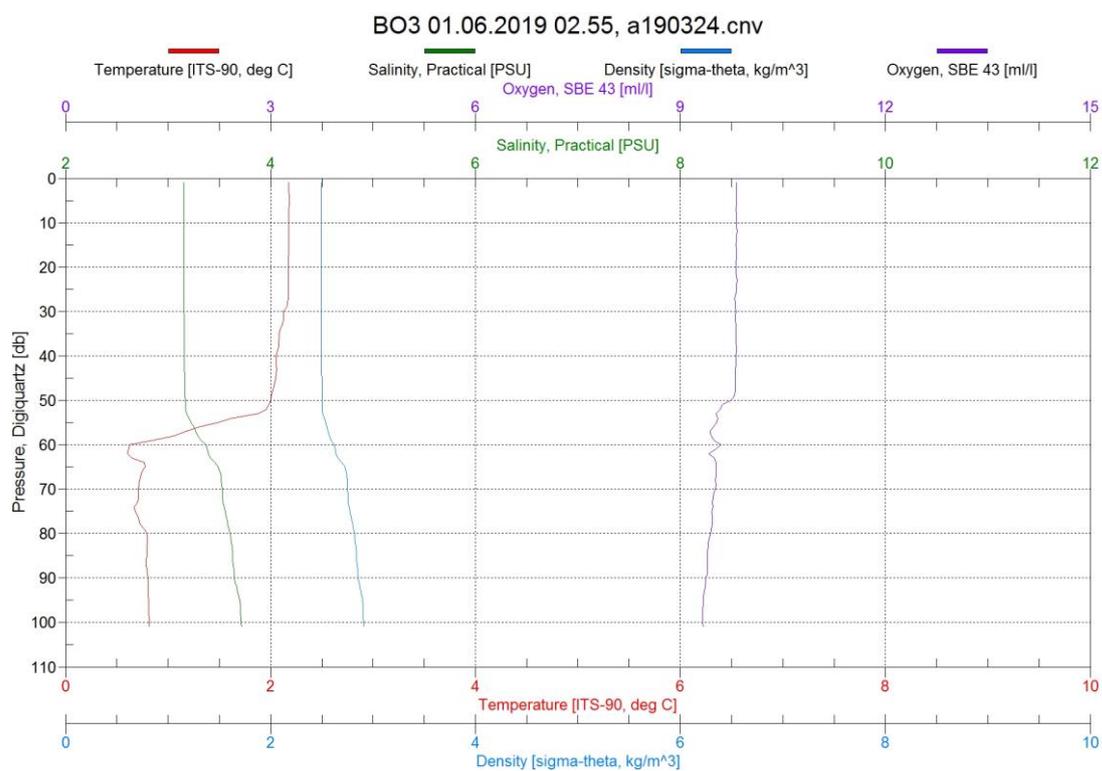
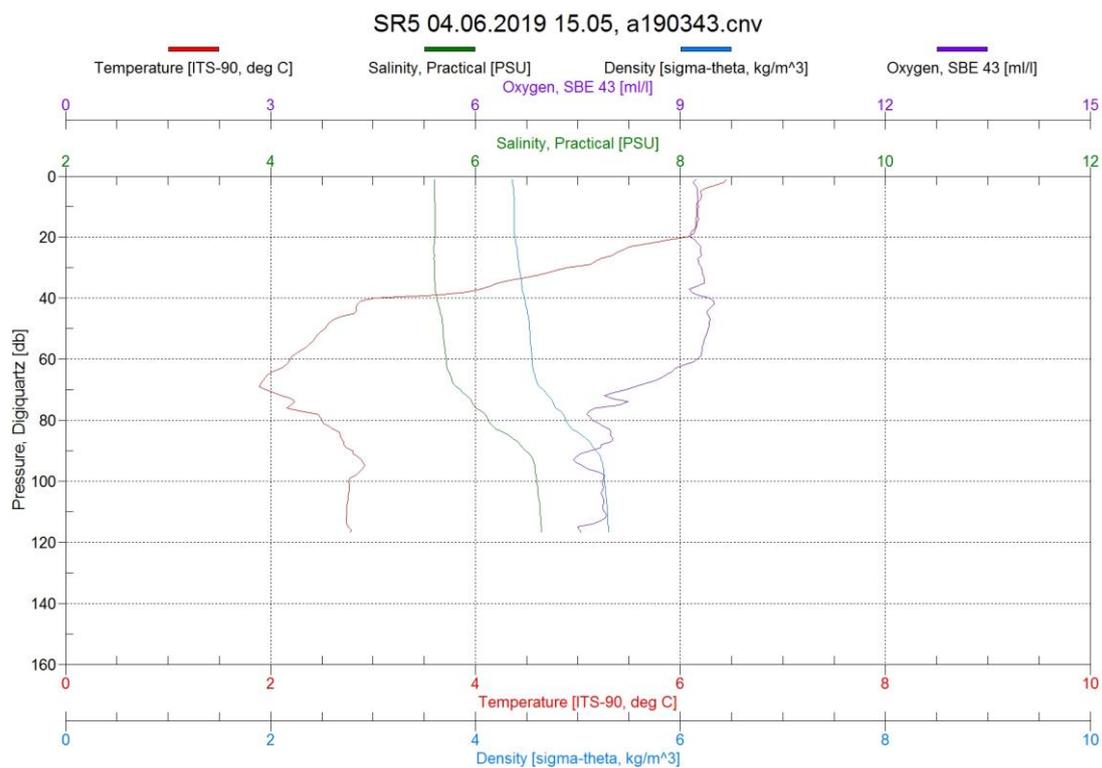
345	F33	x		x	x			x			
346	F64	x		x	x	x		x	x		
347	F69	x		x	x			x	x		
348	TROSKAH	x		x	x			x			
349	BY29	x		x	x			x	x		
350	LL17	x		x	x	x	x	x	x	x	
351	LL15	x		x	x			x	x		
352	LL12	x		x	x	x		x	x		
353	F62	x		x	x			x			
354	JML	x		x	x		x	x	x	x	
355	LL9	x		x	x			x			
356	XII3	x		x	x			x			

¹Zooplankton sample to test ethanol preservation, ²Only CTD, no nutrients

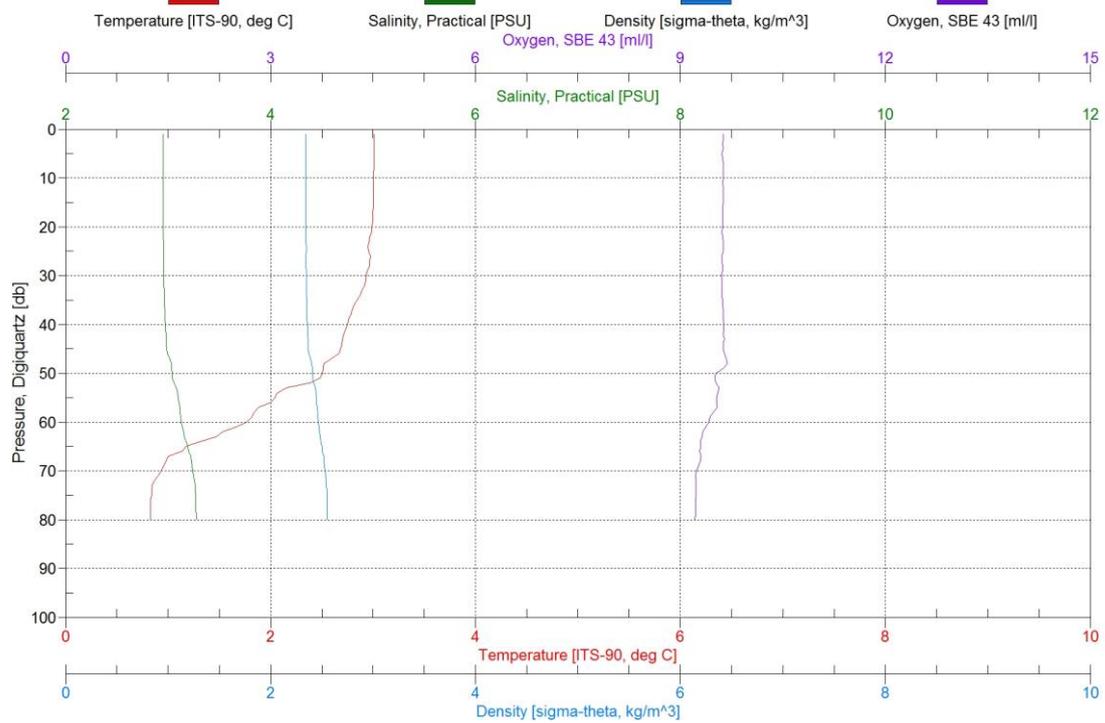
Appendix 2. Selected CTD profiles from the COMBINE 2/2019 cruise.



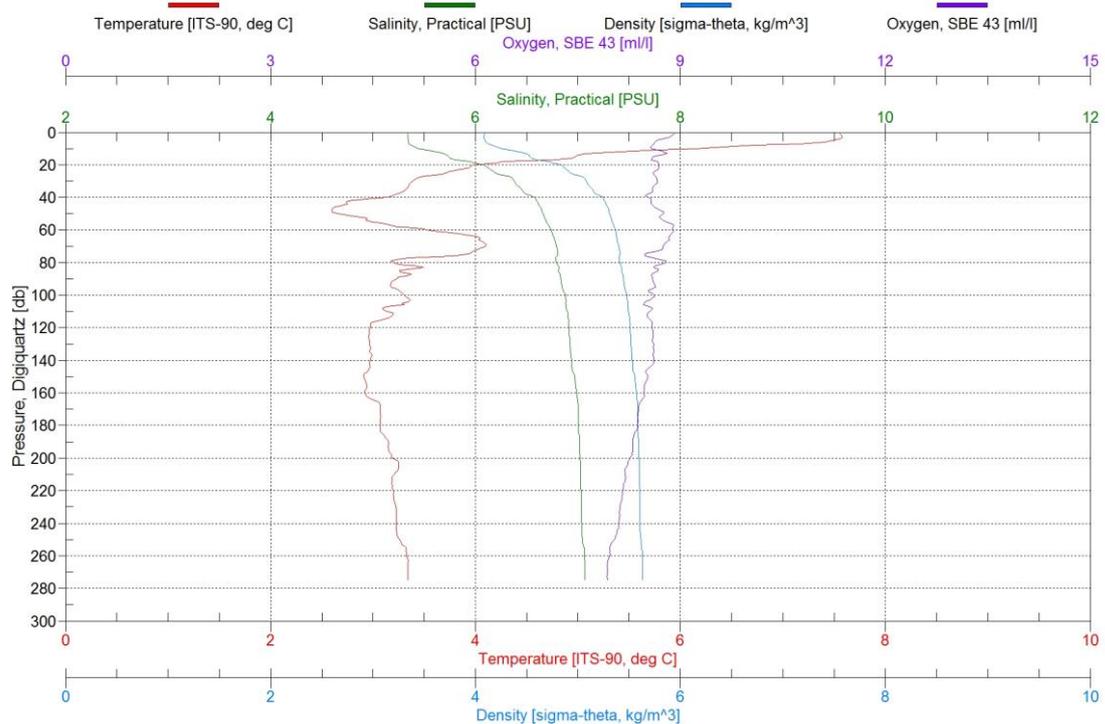




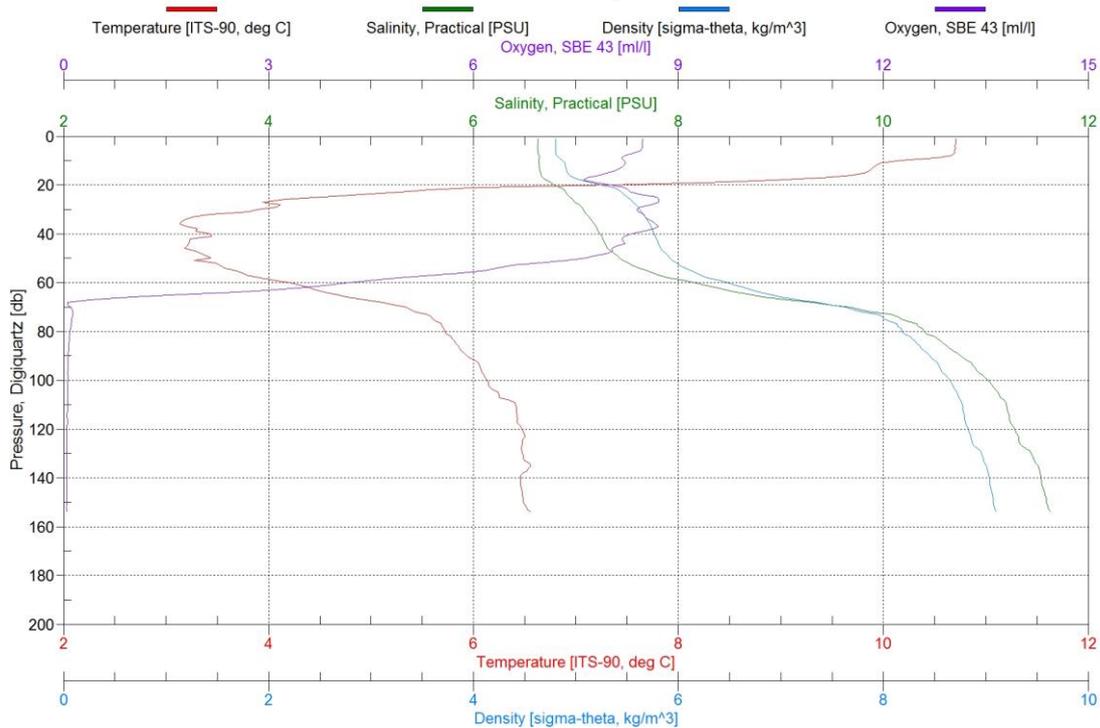
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F64 05.06.2019 07.05, a190346.cnv



BY29 05.06.2019 23.15, a190349.cnv



LL12 06.06.2019 15.35, a190352.cnv

