

CRUISE REPORT



R/V Aranda

Cruise 04/2025

Combine 3
12.8.2025 – 25.8.2025

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

Objectives of the cruise

The objectives of the 1st leg of the cruise were:

- 1) Monitoring of general hydrography, nutrients, chlorophyll and phyto- and zooplankton communities of the Baltic Sea according to HELCOM COMBINE program and sampling of phycotoxins, POC, TOC, DOC and alkalinity.
- 2) Maintenance work for wave buoys, ADCP and turbulence profilers. A hydrophone deployed on seabed and scanning of a few sampling stations. In addition, sampling of airborne nano- and microplastics as well as microplastics on the sea surface.

The 1st leg of the cruise had special emphasis on the Gulf of Finland.

The objectives of the 2nd leg of the cruise were:

- 1) Monitoring of hydrography and water chemistry, chlorophyll-a, phytoplankton and zooplankton.
- 2) Sampling of oil compounds and phytotoxins samples for monitoring purposes.
- 3) Studies on carbon cycle (POC, TOC, DOC, CDOM) and microbial production.
- 4) Maintenance of hydrophones, wave buoys, current meters and anchoring and recovery of underwater recorders

The 2nd leg of the cruise covered the Archipelago Sea, Bay of Bothnia and the Northern Baltic Proper.

Table 1 The scientific crew

Name	On board	Organization
Maiju Lehtiniemi	12.-15.08.2025	Syke
Anne-Mari Lehto	12.-15.08.2025	Syke
Outi Setälä	12.-15.08.2025	Syke
Arto Hiltunen	12.-15.08.2025	TY
Adam Makatun	12.-15.08.2025	Gansk University, Puola
Tommi Juusela	12.-15.08.2025	John Nurmisen Säätiö
Helmi Pörhölä	12.-15.08.2025	John Nurmisen Säätiö
Ulla Rosenström	12.-15.08.2025	John Nurmisen Säätiö
Max Tallberg	12.-15.08.2025	John Nurmisen Säätiö
Pekka Kotilainen	15.-25.08.2025	Syke
Samu Elovaara	15.-25.08.2025	Syke
Noora Haavisto	15.-25.08.2025	FMI
Ilkka Lastumäki	15.-25.08.2025	Syke
Pia Varmanen	15.-25.08.2025	Syke
Riikka Mattsson	15.-25.08.2025	Syke

Tanja Kinnunen	15.-25.08.2025	Syke
Mira Granlund	15.-25.08.2025	Syke
Sami Rantapusa	15.-25.08.2025	FMI
Jukka Seppälä	15.-25.08.2025	Syke
Claire Evans	15-25.08.2025	NOC
Amandine Tisserand	15-25.08.2025	NORCE
Amy Gil	15-25.08.2025	NOC

Cruise Route

The 1st leg of the cruise started from Helsinki on the 12th of August 2025 at 10:00. The 1st leg started with the maintenance of the wave buoy (AALTO_STADI) of FMI. After that cruise continued with sampling on the stations 39A, XIV3 and XV1 towards the eastern Gulf of Finland. In the eastern GoF, also one hydrophone BIAS19 was taken up, maintained and deployed back to the sea. In the eastern Gulf of Finland an ADCP and turbulence measurement devices were deployed as well as and a wave buoy was maintained (AALTO_ORRE).

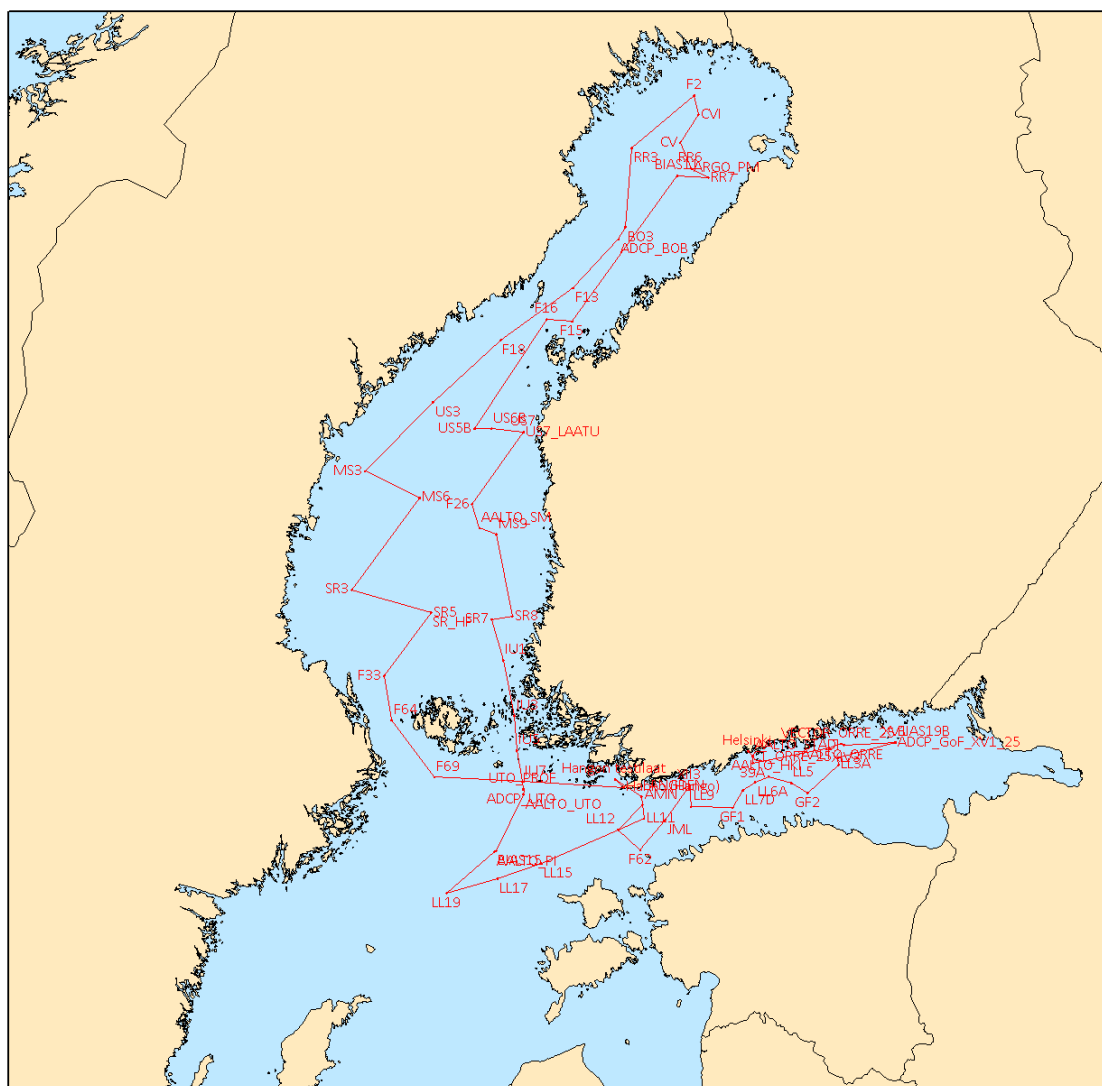
Then stations towards the middle of the GoF were sampled: LL3A, GF2, LL5. Wave buoy (AALTO_HKI) of FMI was lifted for the maintenance in the middle of the GoF. Then sampling continued on stations LL6A, LL7, GF1 and in the westernmost Gulf of Finland: LL9, XII3, JML, F62, LL12, LL11, AMN, and LANGDEN. After all sampling stations were completed, the cruise headed for seabed scanning tests to the Hanko test platform, and after that to Hanko port. The first leg of the cruise ended up to Hanko on Friday 15 August 2025 at 16:30 hours.

The 2nd leg of the COMBINE 3 monitoring cruise departed from Hanko on the 16th of August 2025. Departure from Hanko was delayed due to the summer storm in the Bothnian Sea.

Firstly, R/V Aranda headed to the Archipelago Sea where it was somehow sheltered conditions to work. The Bothnian Sea was reached on the following day and as the wind was still too strong, shelter was sought in DP behind the Isokari light house. The cruise continued along the Finnish coast SR7, SR8, MS 9, F26 and US stations US7, US6b and US5b. The Quarken was reached on the 19th of August F16 and F15. All stations RR7, RR6 CV CVI F2, RR3 and then the southernmost station in the Bothnian Bay, BO3 were sampled. Some maintenance and anchoring of instruments were carried out, too (Hydrophone and ADCP). Back in the Quarken, stations F13 and F18 were monitored.

As the cruise mainly followed the Swedish coastline, the stations US3, MS3, MS6 and SR3 were sampled. The station SR5 were sampled and a hydrophone recovered and installed in the middle of the southern Bothnian Sea. The stations between the Åland Island and Sweden, F33 and F64 were sampled.

The cruise continued to the station F69 and to the Archipelago Sea for the maintenance and recovery of the anchored instruments. Also, an earlier missed zooplankton net haul was conducted at IU7. After the instrumentation near Utö, R/V Aranda headed to the Northern Baltic Proper for the and the wave buoy and hydrophone (AALTO_PI and BIAS15). The last transect of stations LL19, LL17, LL15 and LL12 were sampled and Cruise headed via AMN and AALTO_Stadi to Helsinki arriving there on the 25th of 2025 at 08.00 (EET).



Picture 1: Cruise route.

Observations

1st leg of the Cruise

Gulf of Finland

The oxygen was depleted in the deeps of the Gulf of Finland (hypoxic bottom waters) and low concentrations were also found from the shallower stations in the eastern Gulf of Finland. Phosphate and nitrate concentrations close to the seabed were a bit above the average over the past years.

Conclusions

The prevailing winds from the east have caused halocline to rise which in turn enhances the inflow of nutrient rich-oxygen depleted bottom water from the Central Baltic Sea to the Gulf of Finland. Therefore, the waters below halocline, close to the bottom were oxygen depleted and nutrient rich.

2nd leg of the Cruise

Archipelago Sea

Hydrography

Low oxygen concentrations were observed, and in the south near the bottom concentration at IU7 measured concentration was 0.7 ml/l, this was lowest concentration for years. Also, salinity values were above the average. This indicated some inflow of saline water from the main basin.

Nutrients

Observed nutrient concentrations were higher than the long-term averages. Ammonium concentrations in the northern part of the region were higher than in average at surface layers and lower in the south, respectively.

Conclusions

It seems that saline and anoxic water had been flowing into the southern part and algal blooming had occurred earlier in the entire Archipelago.

Bothnian Sea

Hydrography

Higher salinity values and lower oxygen concentrations than the long-terms averages were observed especially at the western stations of the region.

Nutrients

High ammonium concentrations were observed in the productive layer (passed algae production / upwelling). Also, phosphate concentrations at deep were higher than the long-term averages in August (2010-2024).

Conclusions

More saline and anoxic water has flown into the Archipelago Sea from the Northern Baltic Proper

Similar event has taken place also in the Bothnian Sea as more saline and nutrient rich water has flown into the Bothnian Sea, observed oxygen concentrations were below the long-term average, especially on the west coast of the Bothnian Sea.

The Quarken

Hydrography

Observed oxygen concentrations in the southern part of the Quarken were below the long-term average and salinity near bottom higher than in average.

Nutrients

At F18 observed phosphate concentrations fairly high at deep layers, elsewhere at normal level.

Conclusions

Some upwelling at F18 might have happened.

Bothnian Bay

Hydrography

A well-defined oxycline was observed and in the southern part of the Bothnian Bay, low oxygen concentration was also detected.

Nutrients

Observed nutrients were close to the average and in general very close to a limit of detection apart from ammonium in the southern part of the region.

It seems that some algae blooming had occurred earlier in the region as phosphate concentrations in the productive layer were close to zero and at deeper layers below the limit of detection. Also, low oxygen concentrations at deep layers may indicate some decomposition of algae.

Northern Baltic Proper

Hydrography

The water column of the region was clearly stratified. Anoxic layer was observed at 75-meter depth. No changes in density or salinity compared to previous years were detected.

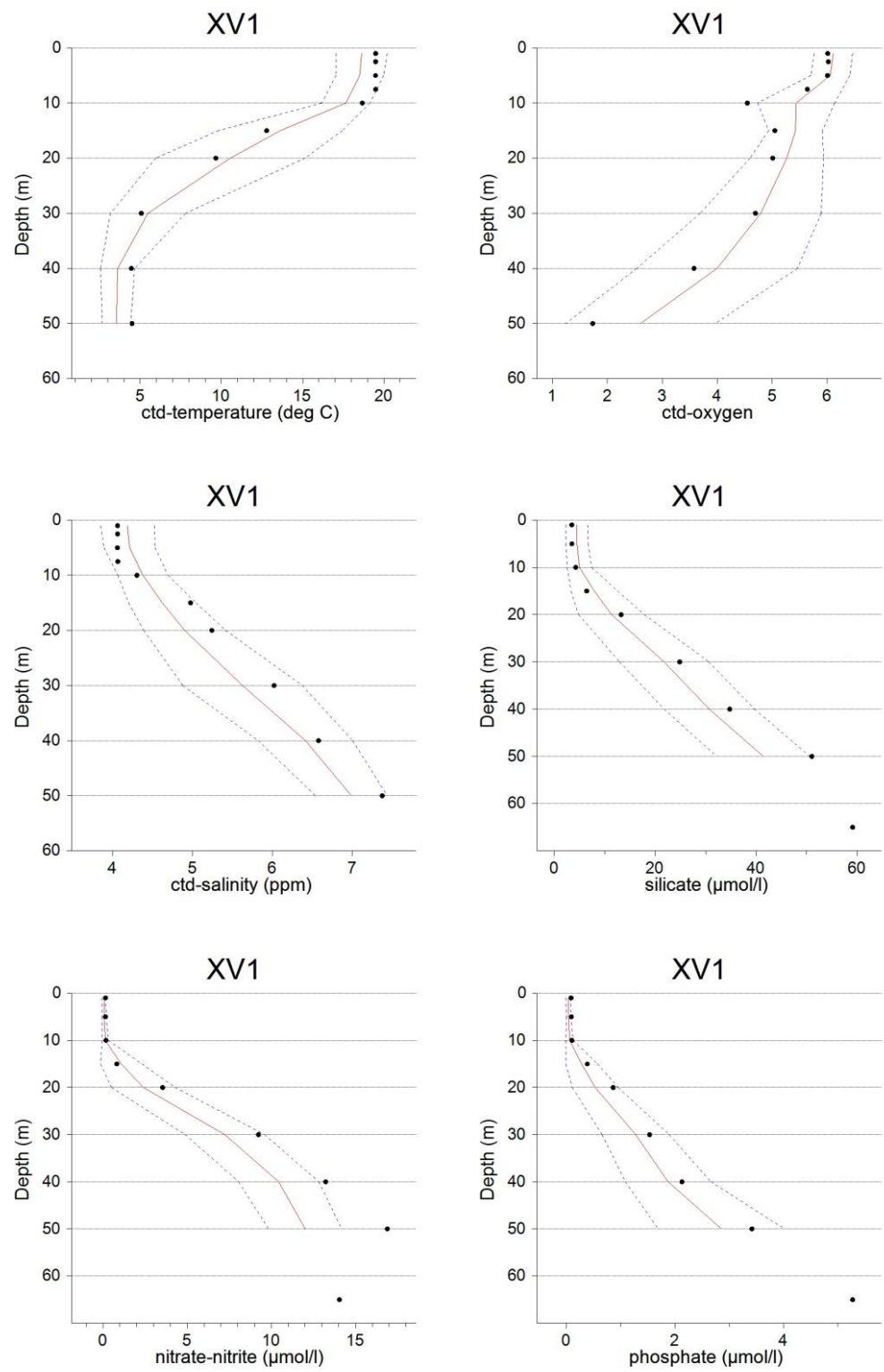
In the northern part of the region, Åland Sea, some inflow of saline and anoxic water was detected. Oxygen concentration at F69 was close to 0.0 ml/l, but no H₂S was observed.

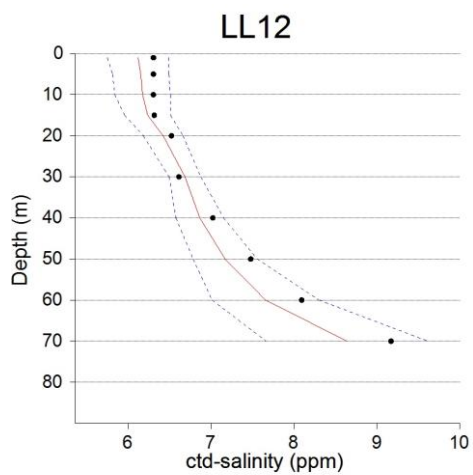
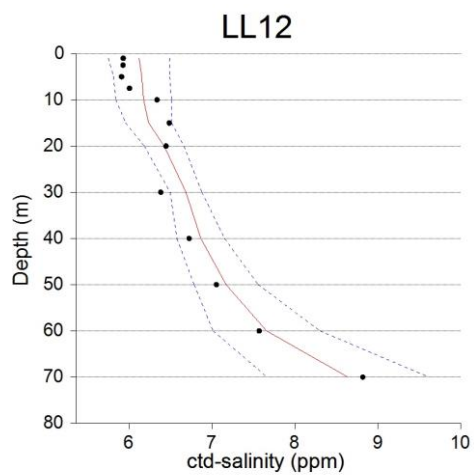
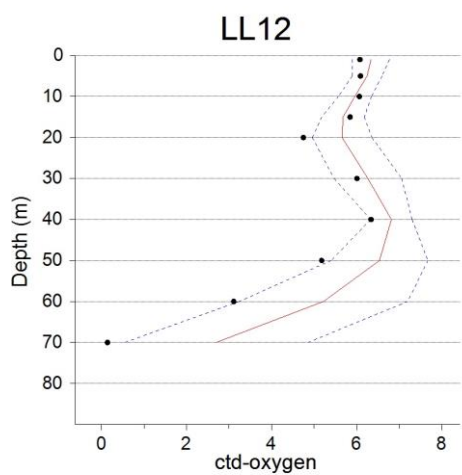
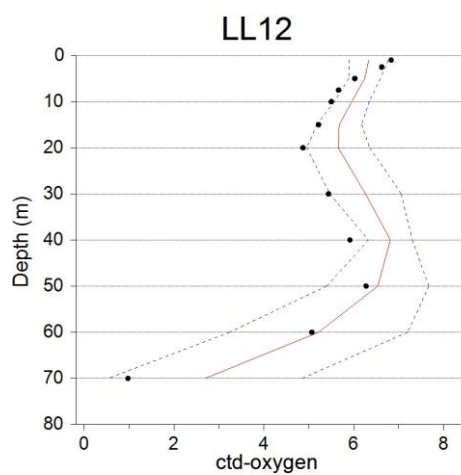
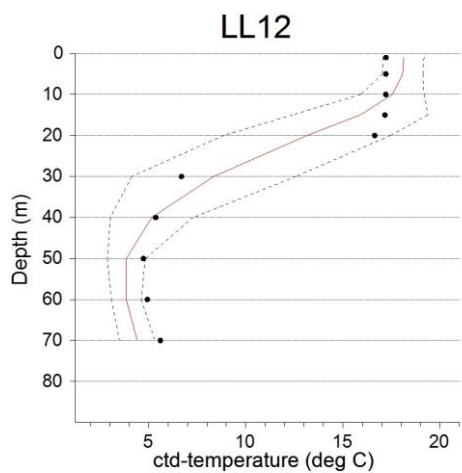
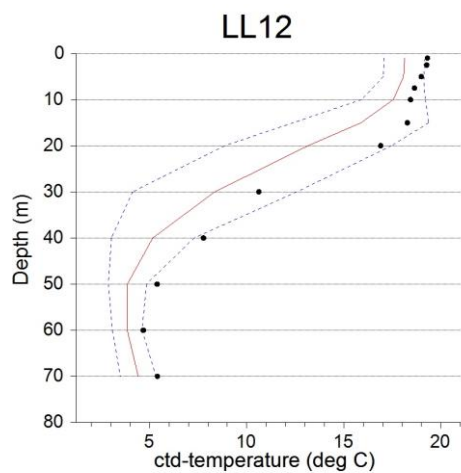
Nutrients

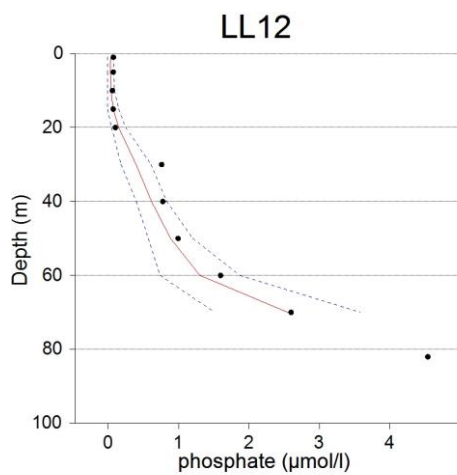
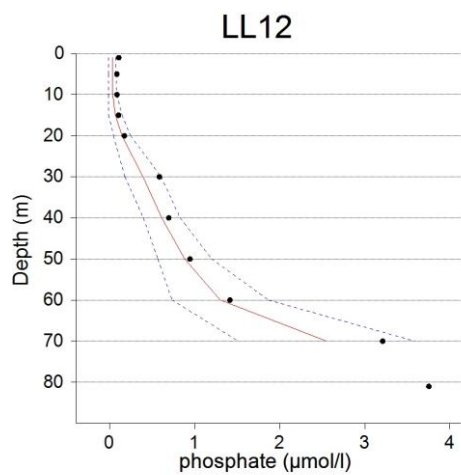
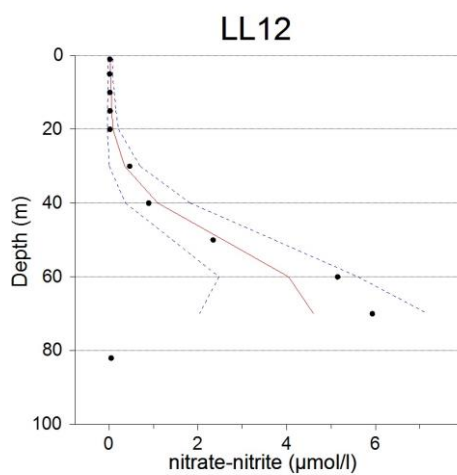
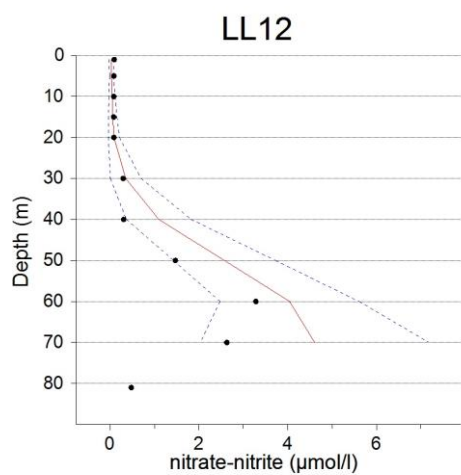
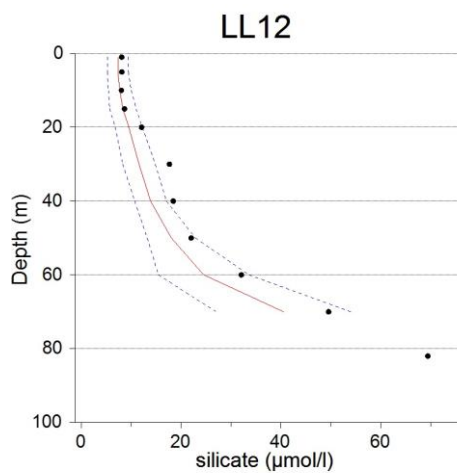
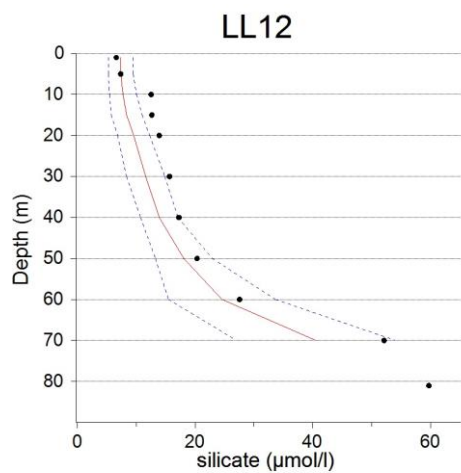
High ammonium and dissolved nitrogen concentrations were observed at 40-50 m depth indicating some decomposition of passed algal blooming.

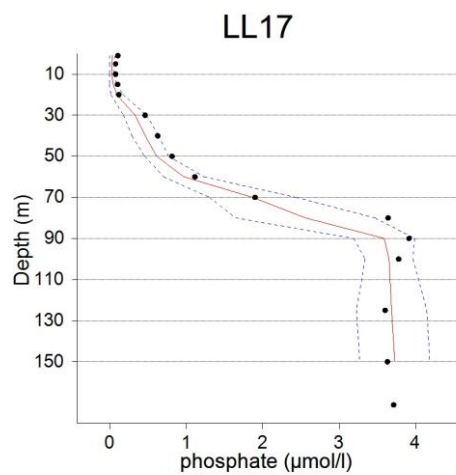
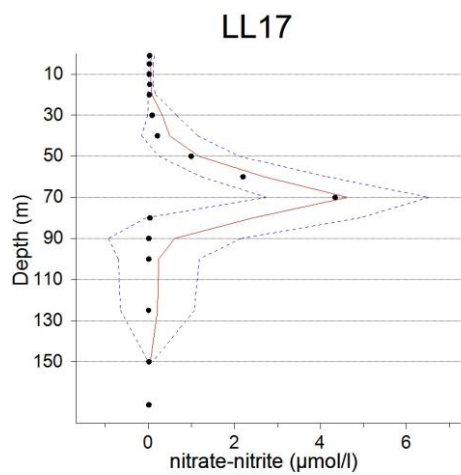
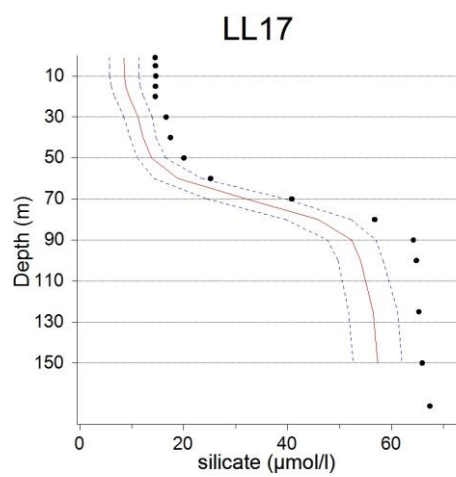
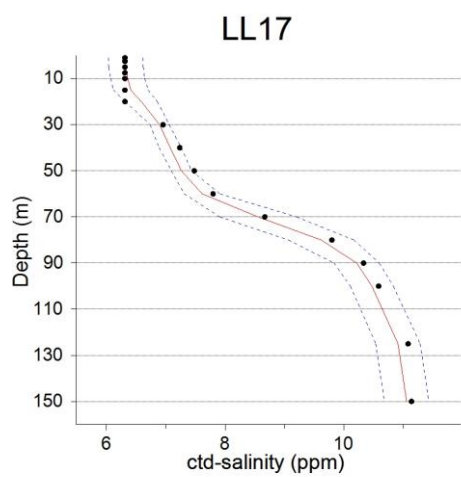
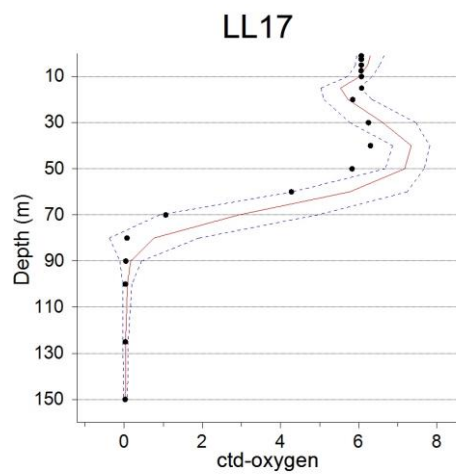
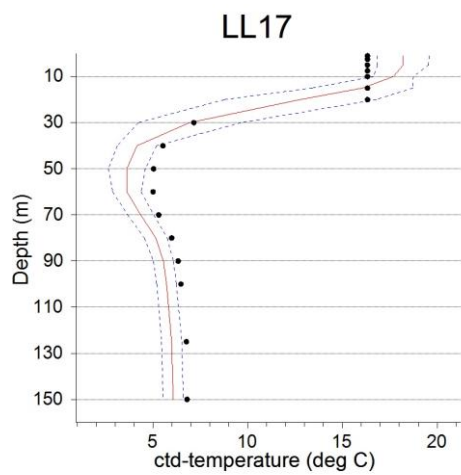
Station LL12 was monitored on the both legs. The sampling for profiles below and on the left (LL12) were taken on 15 of August and on the right, ten days later, on the 24th of August. Some inflow of saline and anoxic water was observed.

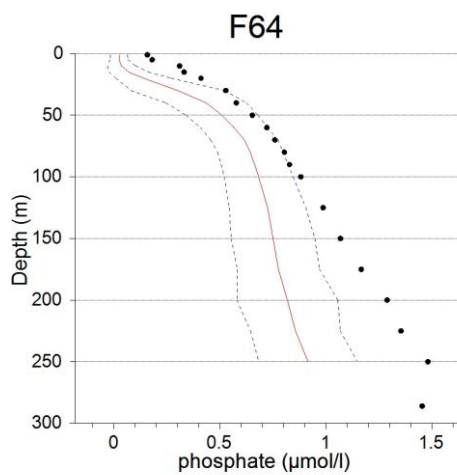
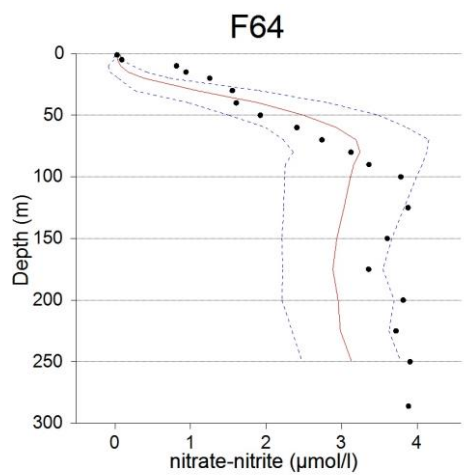
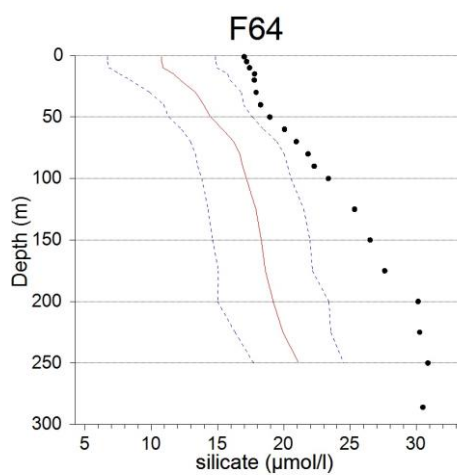
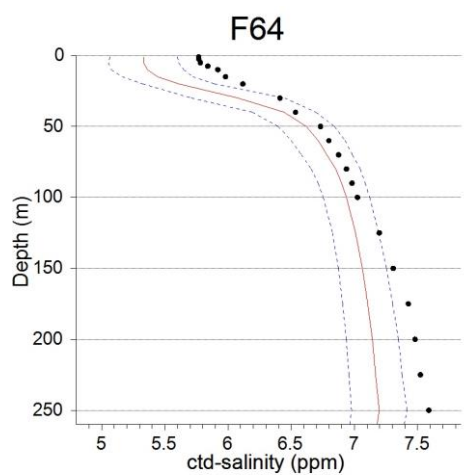
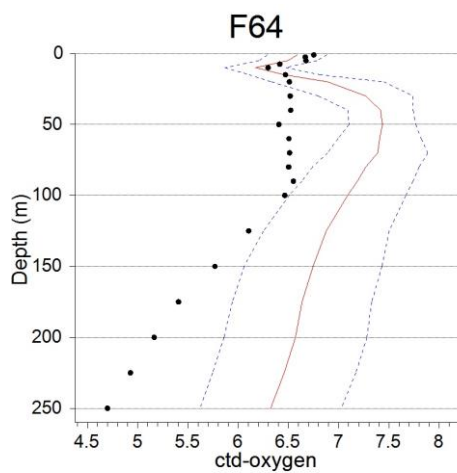
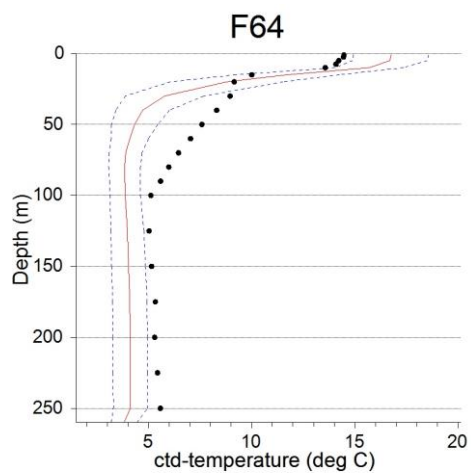
Annex 1. Selected variables at the stations XV1, LL12, LL17, F64, SR5, US5B, BO3 and F2. Mean (red solid line) and standard deviation (blue dotted lines) represent the data collected at the same time of season since the year 2000.

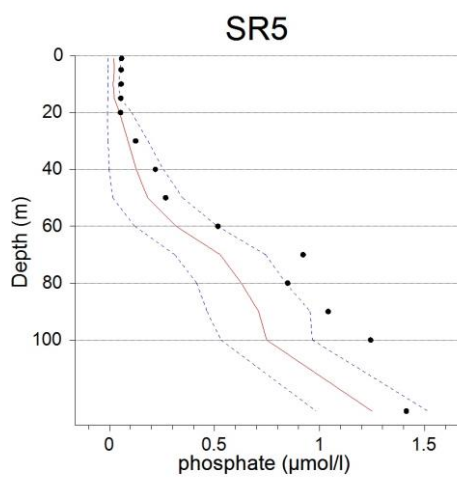
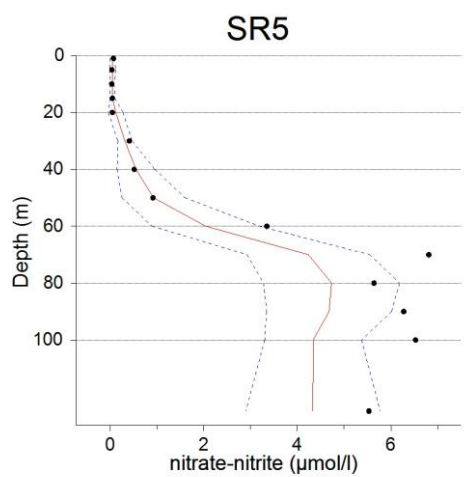
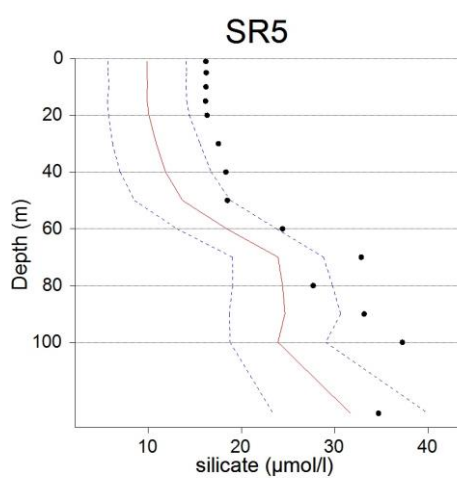
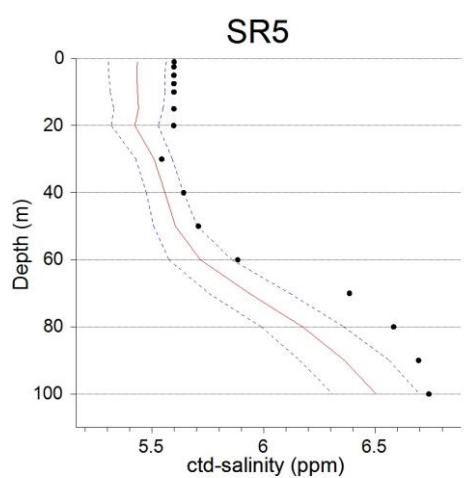
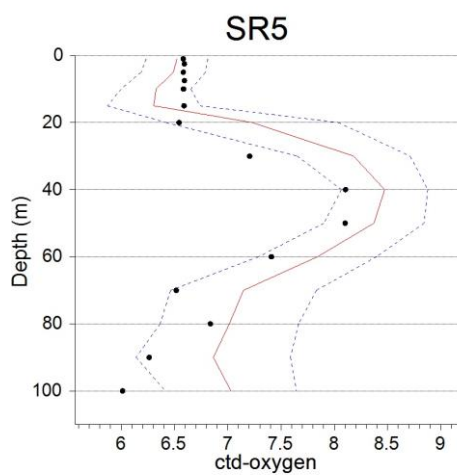
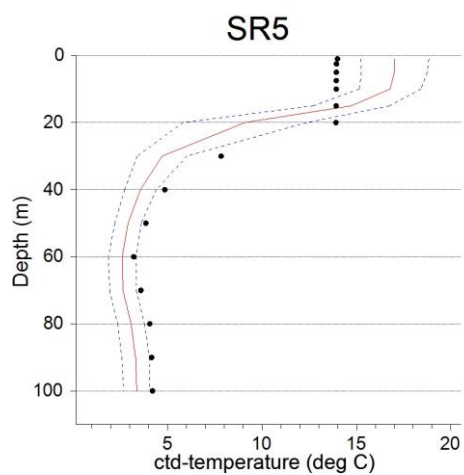


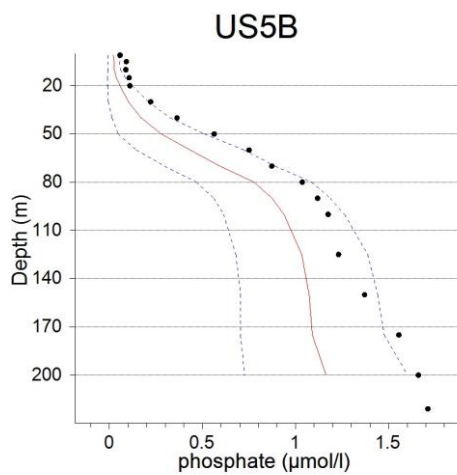
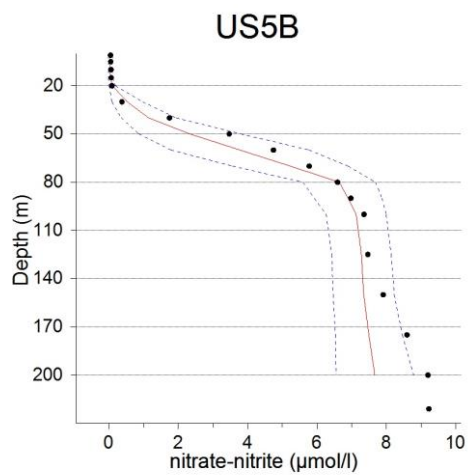
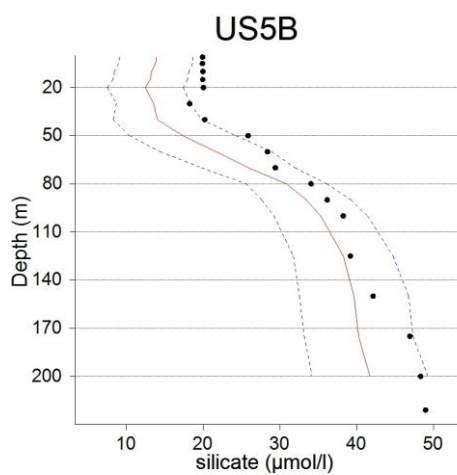
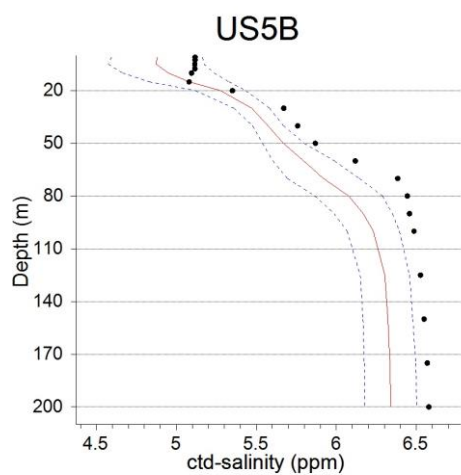
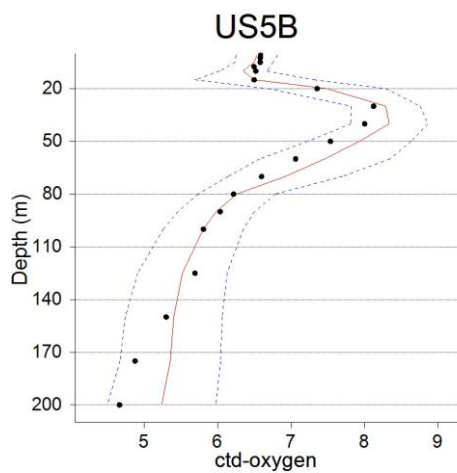
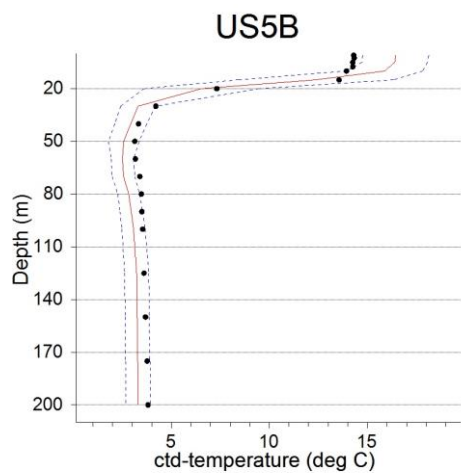


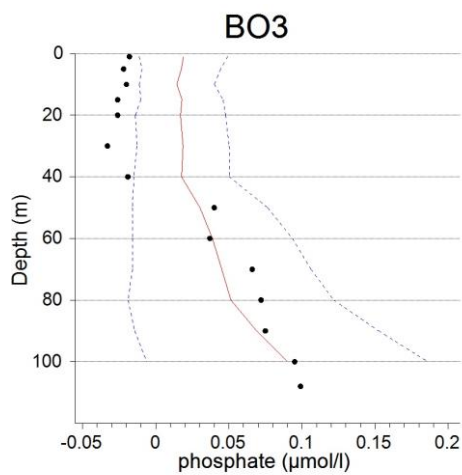
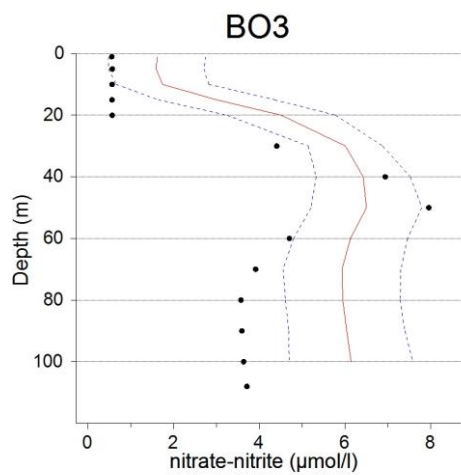
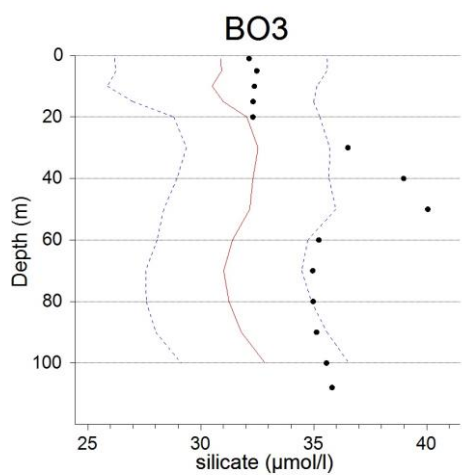
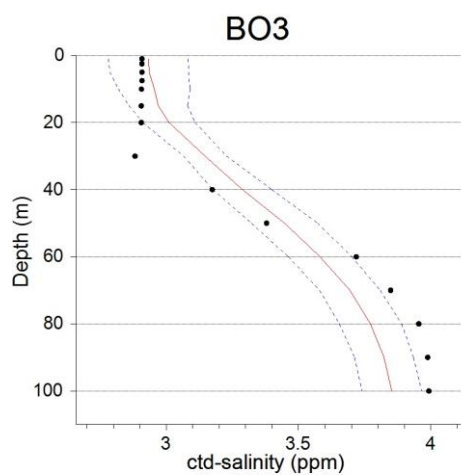
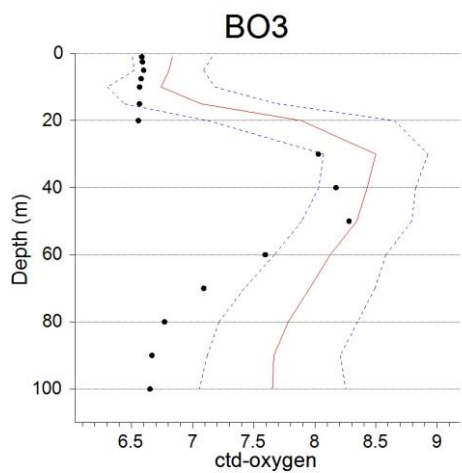
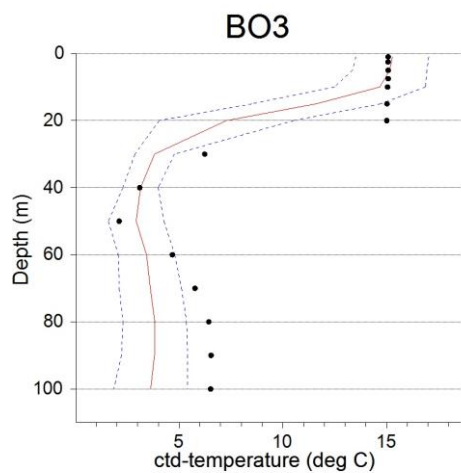


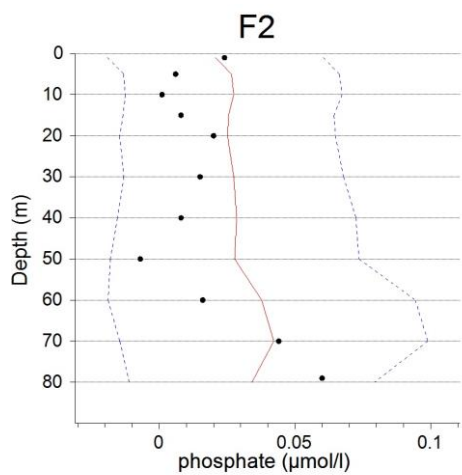
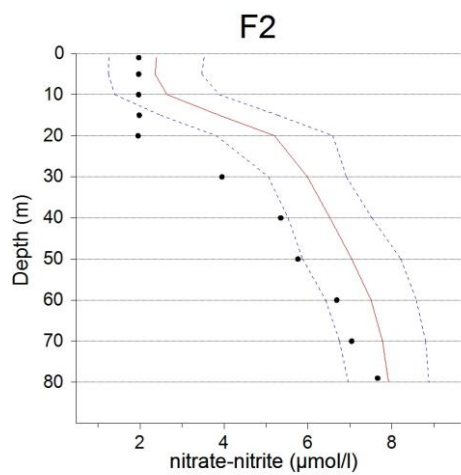
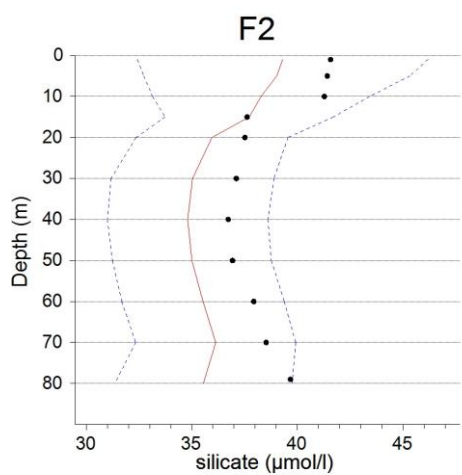
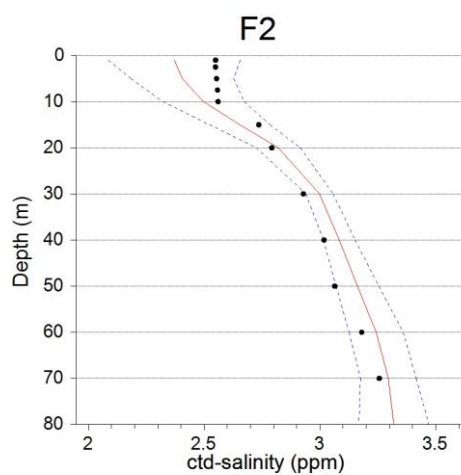
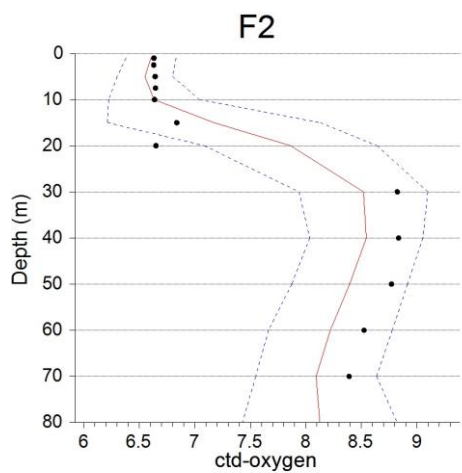
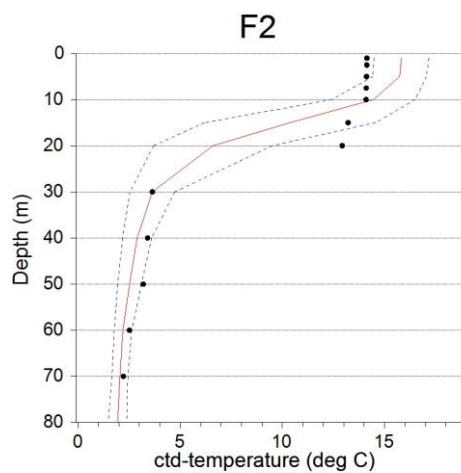












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2025010161	AALTO STADI	60.12363	24.97272	21	2025-08-12	07.46											
2025010162	39A	60.06690	24.98027	42	2025-08-12	09.46	x	x	x	x				x			x
2025010163	XIV3	60.20330	26.19303	78	2025-08-12	15.41	x	x	x	x				x			x
2025010164	VECTOR ORRE 25	60.23627	26.38312	22	2025-08-12	18.01											
2025010165	AALTO ORRE	60.22773	26.42995	33	2025-08-12	20.15											
2025010166	ADCP GoF_XV1 25	60.24648	27.25807	62	2025-08-13	01.03											
2025010167	BIAS19B	60.24845	27.24772	65	2025-08-13	01.59											
2025010168	XV1	60.24995	27.24708	66	2025-08-13	02.43	x	x	x	x	x	x		x			x
2025010169	CT ORRE 25	60.12482	26.33420	70	2025-08-13	07.33	x		x								x
2025010170	LL3A	60.06715	26.34667	69	2025-08-13	09.17	x	x	x	x	x	x		x	x		x
2025010171	GF2	59.83843	25.85682	85	2025-08-13	13.26	x	x	x	x				x			x
2025010172	LL5	59.91675	25.59720	70	2025-08-13	15.33	x	x	x	x				x			x
2025010173	AALTO HKI	59.96428	25.23600	72	2025-08-13	18.59											
2025010174	LL6A	59.91687	25.03025	73	2025-08-13	21.20	x	x	x	x				x			
2025010175	LL7D	59.84652	24.83740	102	2025-08-13	23.41	x	x	x	x	x	x		x			
2025010176	GF1	59.70505	24.68217	84	2025-08-14	05.09	x	x	x	x	x	x		x			x
2025010177	LL9	59.70015	24.03022	66	2025-08-14	09.08	x	x	x	x	x	x		x			x
2025010178	XII3	59.86417	23.98542	35	2025-08-14	11.30	x	x	x	x				x			x
2025010179	JML	59.58183	23.62688	80	2025-08-14	14.47	x	x	x	x				x			x
2025010180	F62	59.33342	22.26368	97	2025-08-14	20.16	x	x	x	x				x			
2025010181	LL12	59.48353	22.89660	82	2025-08-14	23.37	x	x	x	x	x	x		x			
2025010182	LL11	59.58358	23.29687	67	2025-08-15	02.34	x	x	x	x				x			
2025010183	AMN	59.69055	23.25702	55	2025-08-15	04.23	x	x	x	x				x			x
2025010184	LANGDEN	59.75680	23.23197	47	2025-08-15	06.00	x	x	x	x	x	x		x			x
2025010185	Hangon testilaat	59.88070	22.80160	45	2025-08-15	09.47											
Hanko (Hango)	Hanko (Hango)	59.82160	22.94885		2025-08-15	13.43											
2025010186	IU7	59.81508	21.33682	92	2025-08-16	21.43	x	x	x	x	x			x			
2025010187	IU5	60.05813	21.19842	87	2025-08-17	01.05	x	x	x	x				x			
2025010188	IU3	60.33332	21.11332	51	2025-08-17	05.01	x	x	x	x				x			

INDEX	STATION	latitude	longitude	depth	DATE	time	ctd	pH	ox	nu	ph	zo	be	chl	oil	tox	secchi
2025010224	UTO_PROF	59.75662	21.36787	71	2025-08-23	11.14											
2025010225	AALTO_UTO	59.71367	21.36537	71	2025-08-23	13.49											
2025010226	BIAS15	59.25020	21.01607	93	2025-08-23	18.22											
2025010227	AALTO_PI	59.24580	20.99793	111	2025-08-23	18.45											
2025010228	LL19	58.88062	20.31078	170	2025-08-23	23.19	x	x	x	x				x			
2025010229	LL17	59.03323	21.07957	172	2025-08-24	06.00	x	x	x	x	x	x		x	x		x
2025010230	LL15	59.18338	21.74683	131	2025-08-24	11.28	x	x	x	x				x			x
2025010231	LL12	59.48348	22.89708	83	2025-08-24	17.03	x	x	x	x				x			x
2025010232	AMN	59.69040	23.25748	56	2025-08-24	20.42											
2025010233	AALTO_Stadi	60.07371	24.58311	21	2025-08-25	04.00											

Parameters: ox = oxygen, nu = nutrients, ph = phytoplankton, zo = zooplankton, be = benthos, chl = chlorophyll a, oil = dissolved oil, tox = phytotoxins.