Suomen ympäristökeskus
Finlands miljöcentral
Finnish Environment Institute

ILMATIETEEN LAITOS

CRUISE REPORT



R/V Aranda

Cruise 07/2026

Ajelehtiminen2026

1.9.2026 – 10.9.2026

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

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Objectives of the cruise

The objectives of the cruise were:

1) to study the factors affecting the surface drift currents in the Gulf of Finland to develop and verify the accuracy of surface drift models.
2) to study the Baltic Sea as a source of aerosol particles acting as cloud condensation nuclei or ice-nucleating particles.
3) to compare several CTD sensors to evaluate their accuracy
4) to deploy, service and recover measuring equipment in the Northern Baltic Proper and in the Gulf of Finland.

Table 1 The scientific crew

Name	On board	Organization
Pettersson Heidi	1.-10.9.2026	FMI
Andersen Jaakko	1.-10.9.2026	FMI
Haapaniemi Veera	1.-10.9.2026	FMI
Miettunen Elina	1.-10.9.2026	FMI
Rantapusa Sami	1.-10.9.2026	FMI
Roine Tuomo	1.-10.9.2026	FMI
Twelves Andrew	1.-10.9.2026	FMI
Welti André	1.-10.9.2026	FMI

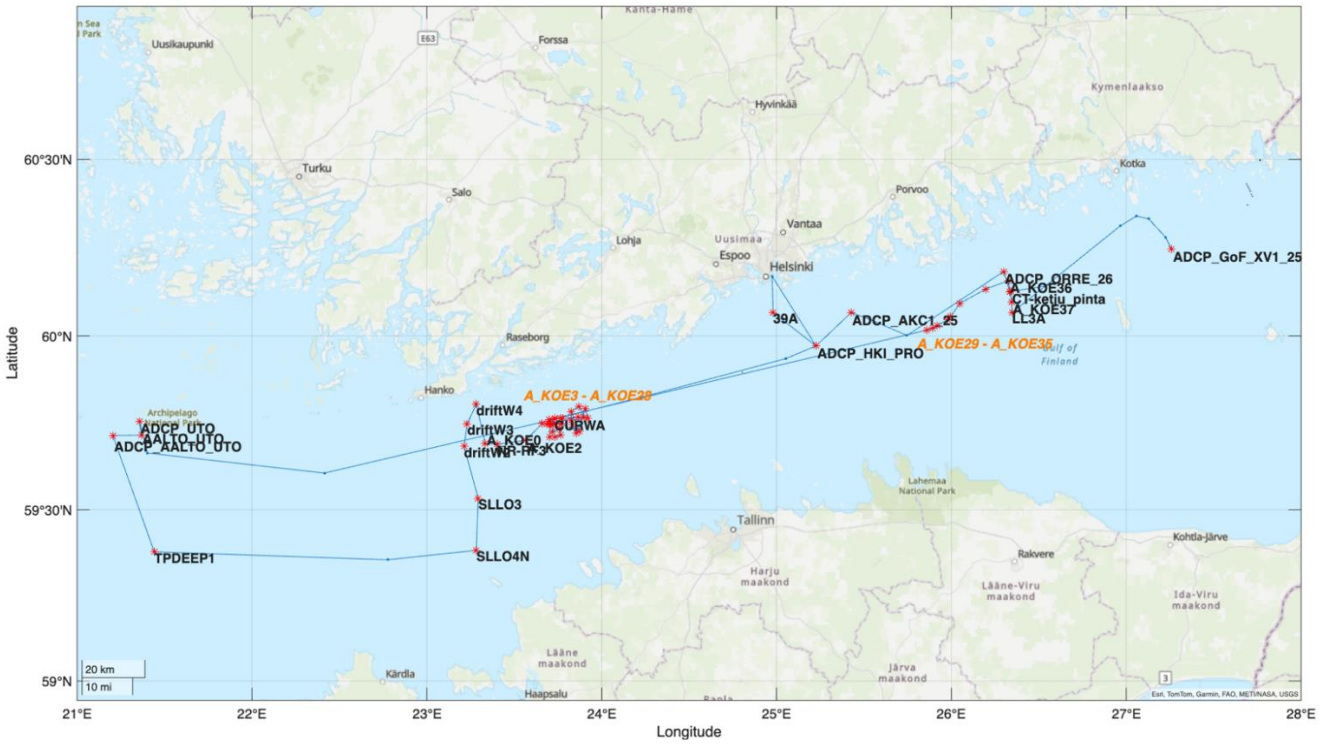


Figure 1. The route of the cruise and stations visited. The drifting experiments were carried in areas denoted by station names A_KOE3-A_KOE28 and A_KOE29-A_KOE35.

Cruise Route

The cruise started from Helsinki 1.9.2026. The original cruise plan was tentative, since the exact areas for the drifting experiments were decided according to the prevailing environmental conditions. The first CTD-station was south of Helsinki, and a current profiler (ADCP) was deployed near Gulf of Finland wave buoy for testing purposes. The ship headed towards west, and a wave buoy and a current profiler was deployed in the area planned for the drifting experiment. The maintenance of deployed equipment near Utö and the CTD comparison were done in the Northern Baltic Proper. The ship headed back to the Gulf of Finland, and a cross section of CTD profiles was done in the mouth of the gulf. Four drifting experiments were conducted in the area southeast of the Hanko peninsula. Due to transmission problems with the drifters, the ship stayed quite close to the drifting buoys, and no large-scale monitoring of the salinity and temperature structure of the water column could be made. After these experiments, the wave buoy and current profiler deployed in the beginning of the cruise were recovered and the ship headed towards the eastern parts of Finnish territorial waters. The fifth drifting experiment was conducted in the sea area to the southwest of Kotka. After this last experiment, four current profiles and a chain measuring salinity and temperature profiles were recovered on the way back to Helsinki where the ship arrived in the morning of 10.9.2026. The route of the cruise with stations visited is plotted in Figure 1.

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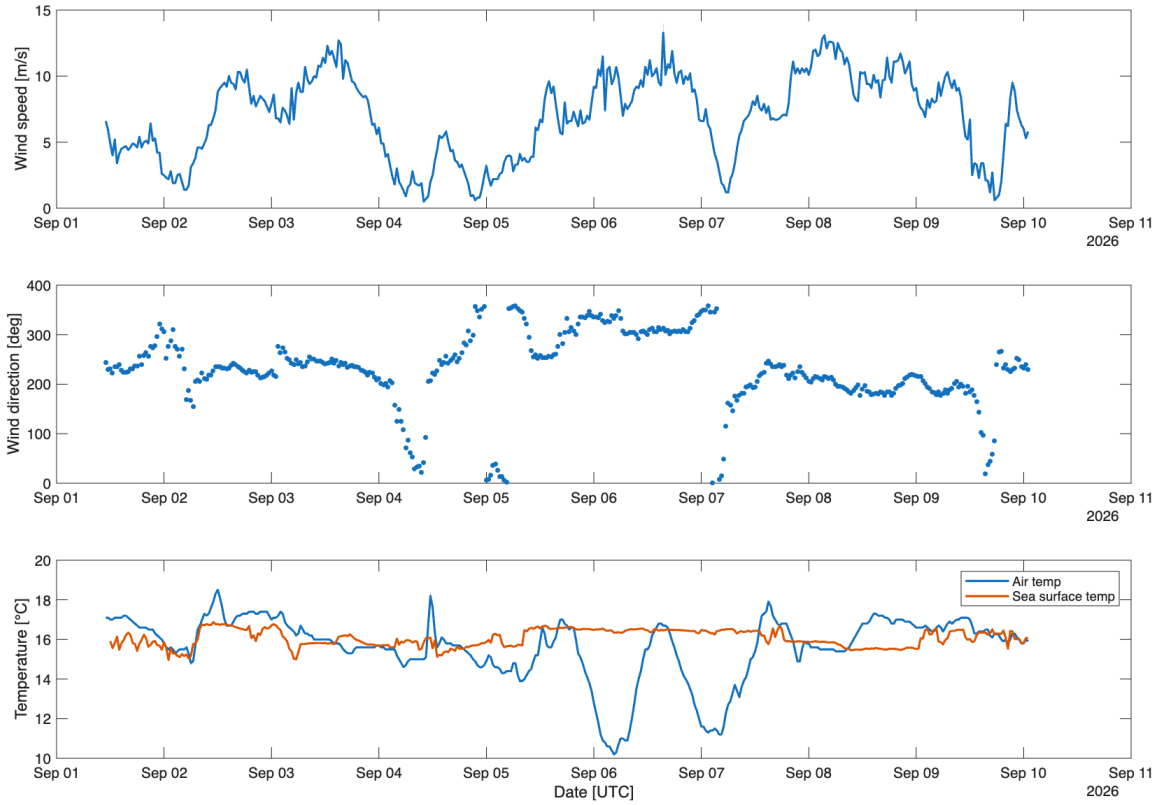


Figure 2. The meteorological conditions during the research cruise.

Observations and important findings

1. Drifting experiments

The meteorological conditions during the cruise are shown in Figure 2. The locations for the drifting experiments in the Gulf of Finland were selected based on the prevailing wind and current conditions. In the western part of the Gulf of Finland, denoted with A_KOE3-A_KOE28 in Figure1 four experiments were made. A wave buoy and a surface current profiler was deployed at station CURWA for the duration of the experiment. The first drifting experiment was during growing south-western waves 3-4.9., the second 4.-5.9. during NW-N winds, the third 5.-6.9. close to an observed marine salinity front, and the fourth 5.-6.9. during NW winds.

The fifth drifting experiment was made 7.-9.9. in the sea area southwest of Kotka denoted by A_KOE29-A_KOE35 in Figure 1. During the experiment the wind was from SW-SE.

The drifters were Pacific Gyre's Reef Lagrangian drifters, and depending on the conditions, 1 to 6 drifters were used simultaneously. The drifters used iridium satellites for transmissions. The structure of the water column close to the drifters were monitored with several CTD casts (Annex 2). Some examples of the vertical profiles of salinity and temperature are shown in Annex 1.

The length of the drifting experiments varied from experiment to experiment. The course of the drifters was continuously monitored, and the drifters were recovered before entering the heavily trafficked middle parts of the Gulf of Finland.

2. Baltic sea – aerosol - cloud interaction

The Aerosol and Cloud Group conducted continuous measurements of ambient particle number concentration and their size distribution throughout the cruise using a condensation particle counter (CPC) and a scanning mobility particle sizer (SMPS). The CPC recorded total particle number concentration at one-second resolution,

while the SMPS provided the particle number size distribution across the sub-micrometre size range. Figure 3 presents the combined time series for the cruise, with the upper panel showing the CPC total concentration together with the SMPS-derived total concentration, and the lower panel showing the corresponding timeseries of SMPS particle size distribution.

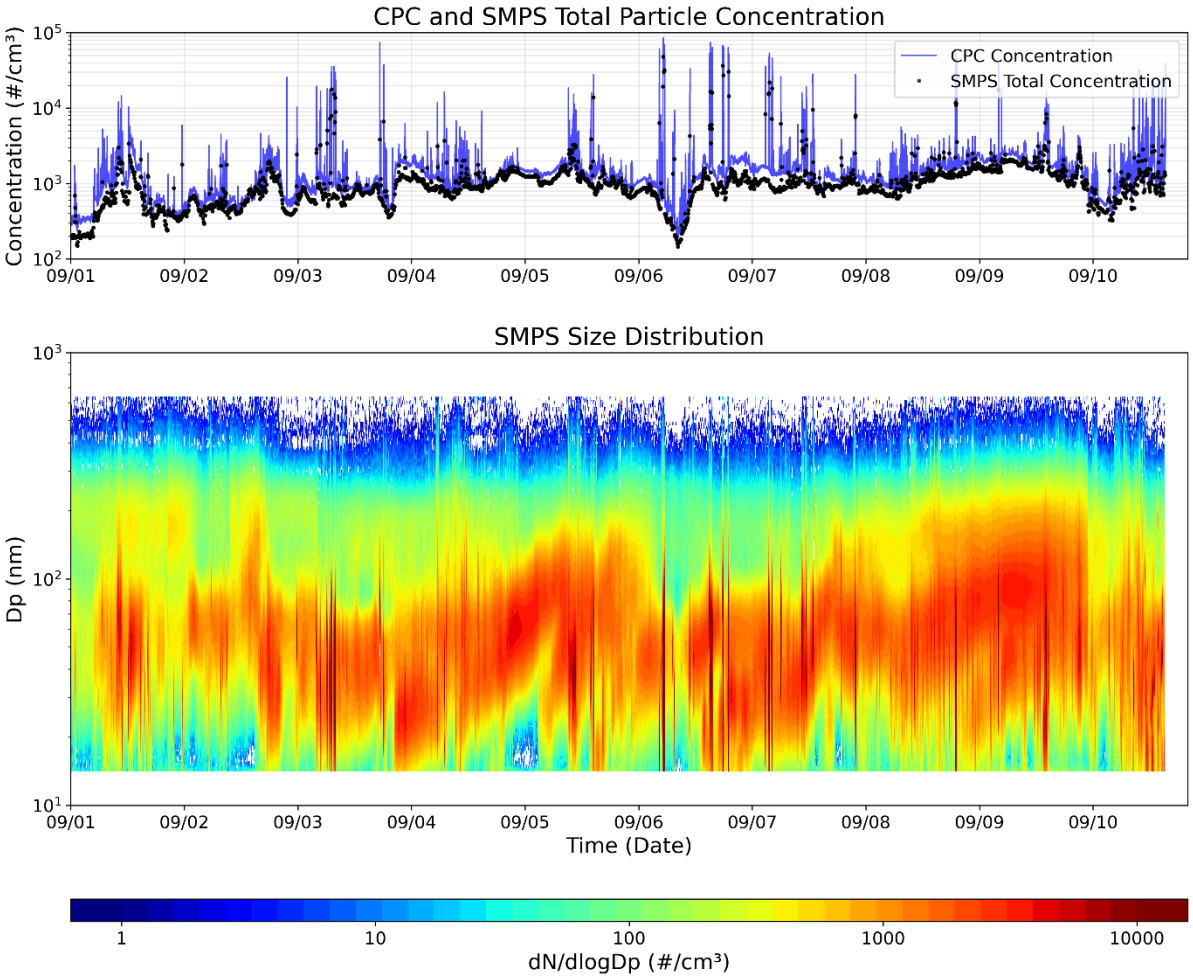


Figure 3. CPC and SMPS total particle number concentration (upper panel) and SMPS particle number size distribution (lower panel) recorded during the Aranda cruise.

In parallel with the physical aerosol measurements, a series of air filter and seawater samples were collected for the determination of ice-nucleating particle (INP) concentrations. Seawater samples were taken from the ship's CTD sampling system at one metre depth. Filter samples were collected on the upper deck at six-hour intervals throughout the cruise, capturing diurnal variation in INP concentration. Additional size-resolved aerosol sampling was carried out using a 8-stage MOUDI (Micro-Orifice Uniform Deposit Impactor) to investigate the size distribution of marine INPs. All collected filter, seawater and MOUDI samples will be analysed for INP concentration using the FrESH (Freezing Experiment Setup Helsinki) droplet freezing array.
In addition, size-segregated high-volume samples were collected using a TISCH sampler for DNA analysis across the different particle size fractions, aiming to establish whether marine biological aerosol becomes airborne as fragments or are ejected from the sea surface attached to other, non-biological particles.

To support the investigation, a Swisens Poleno Jupiter bioaerosol sensor was also installed aboard the Aranda. The Poleno is a real-time airflow cytometer that detects individual airborne particles above roughly 5 micrometres in diameter, combining digital holographic imaging with multi-wavelength fluorescence spectroscopy and light-scattering measurements. Classification of these combined optical, fluorescence and morphological signals allow the instrument to detect and, where reference libraries exist, identify bioaerosol particles such as pollen, fungal spores and bacteria, as well as non-biological particles such as microplastics, giving real-time information on bioaerosol abundance and composition during the cruise. It was the first time a Poleno was used for ship-based measurements.

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3. CTD comparison and maintenance of moored equipment

The CTD comparisons were done in the beginning of the cruise in the Northern Baltic Proper mainly at station TPDEEP1. The comparisons continued also at the station A_KOE0. The comparison was made to ensure the precision, accuracy and functioning of the CTD instruments in use. Aranda's main CTD, SBE911plus, is calibrated by the manufacturer and it was used as a reference. In total, 15 CTD instruments were attached to Aranda's CTD frame and deployed to depths with homogenous water masses for conducting the comparison.

In addition to the current and wave sensors deployed for the duration of the research cruise (stations ADCP_HKI_PRO and CURWA), several other sensors were maintained or recovered: two current profilers (ADCP) and a wave buoy in the Northern Baltic Proper, and three ADCPs and a CT-chain (salinity and temperature profiles) were recovered in the easternmost areas of the cruise.

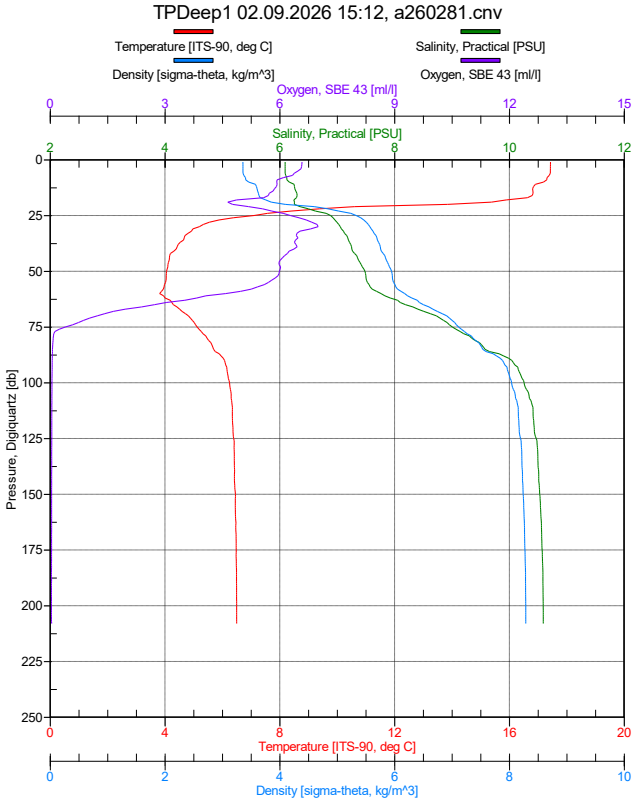
Conclusions

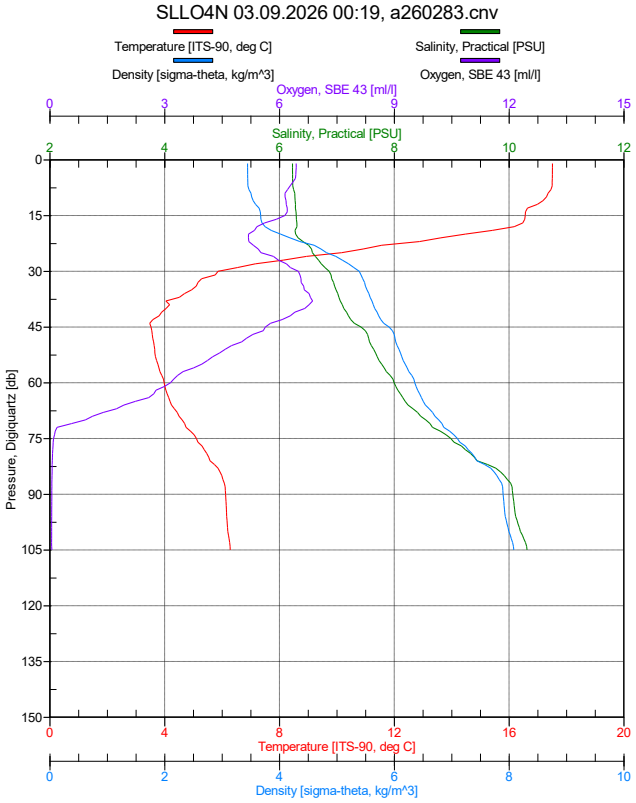
The experiments and observations made during the cruise provided large data set for further analysis of the factors affecting the surface drift and for developing the surface drift models in the Gulf of Finland. The marine aerosol measurements help to understand the role of the Baltic Sea as a source of aerosols and also the usability of a new sensor type in marine conditions. The accuracy of the routinely used CTD instruments were inspected and the planned deployments, maintenance and recoveries of moored equipment were successfully done.

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Annex 1. Temperature (red), salinity (green), density (blue) and oxygen (magenta) profiles from some of the stations stations along the cruise track. TPDEEP1, SLL04N, SLL03, driftW2, driftW3, A_KOE0 and A_KOE13 are in the western part of the cruise track and A_KOE29, LL3A and ADCP_GOF_XV1_25 are in the eastern part of the cruise track.

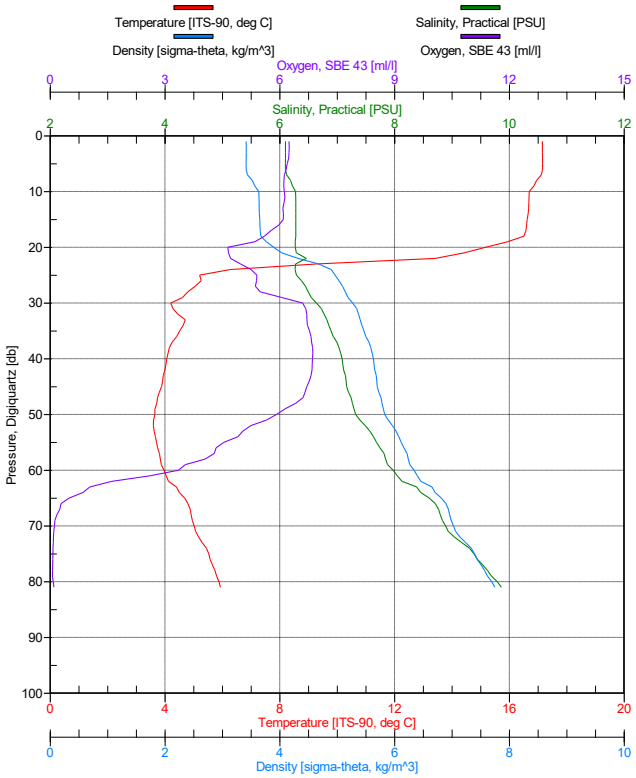




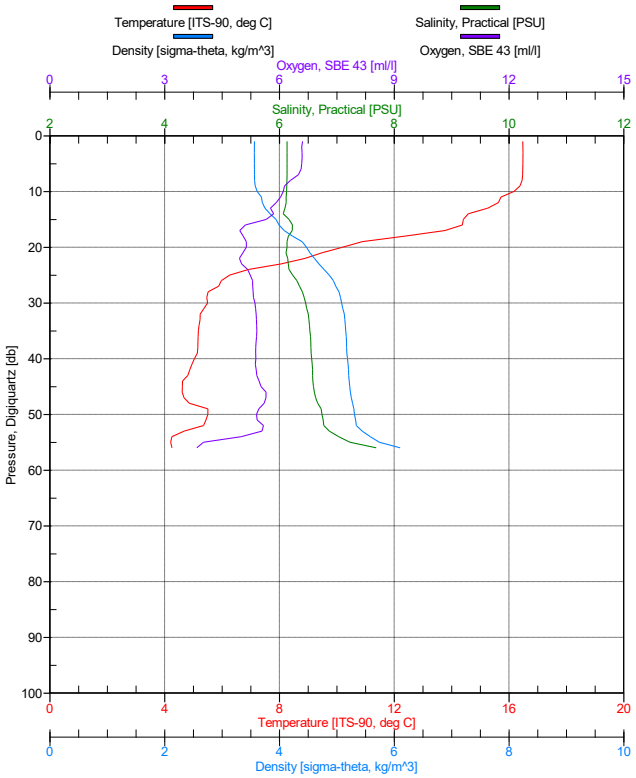
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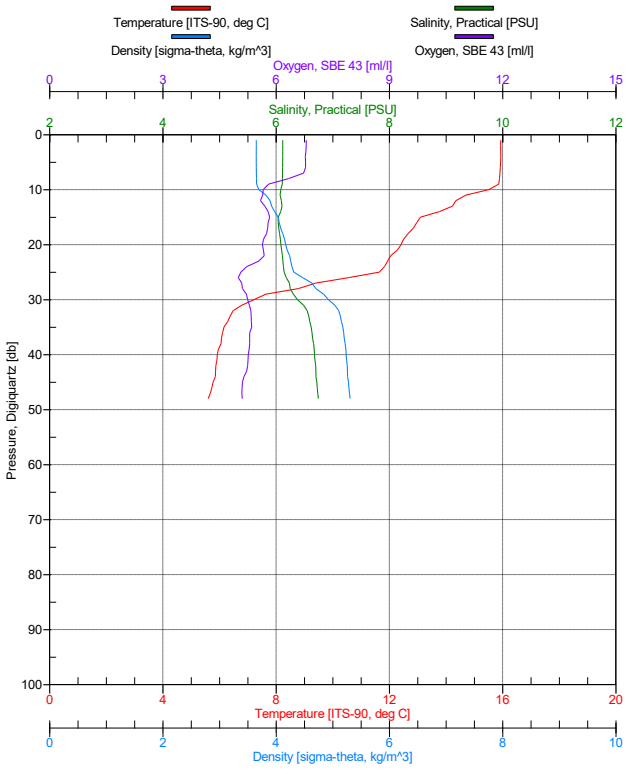
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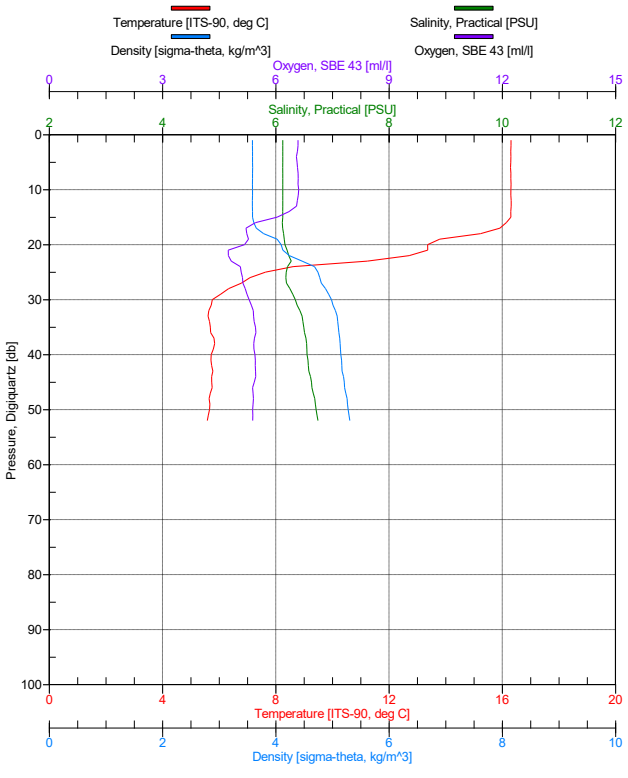
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DriftW3 03.09.2026 04:17, a260286.cnv



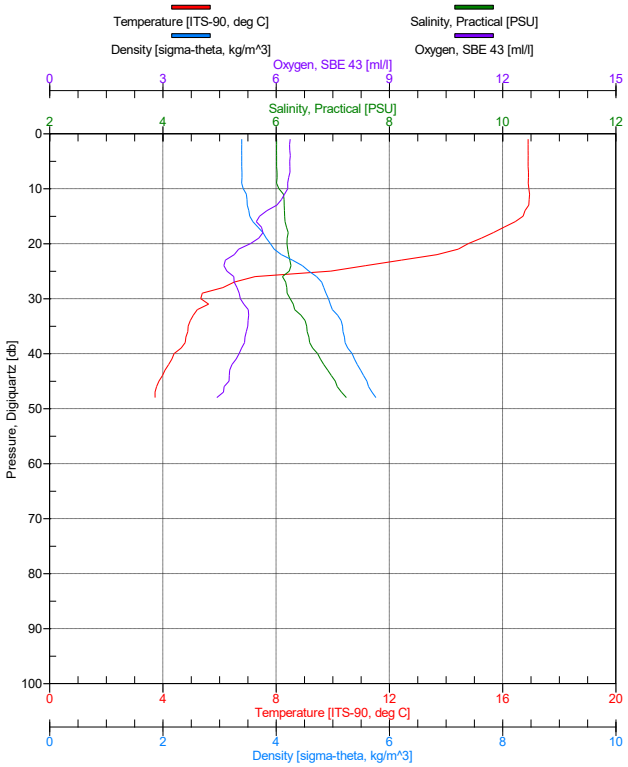
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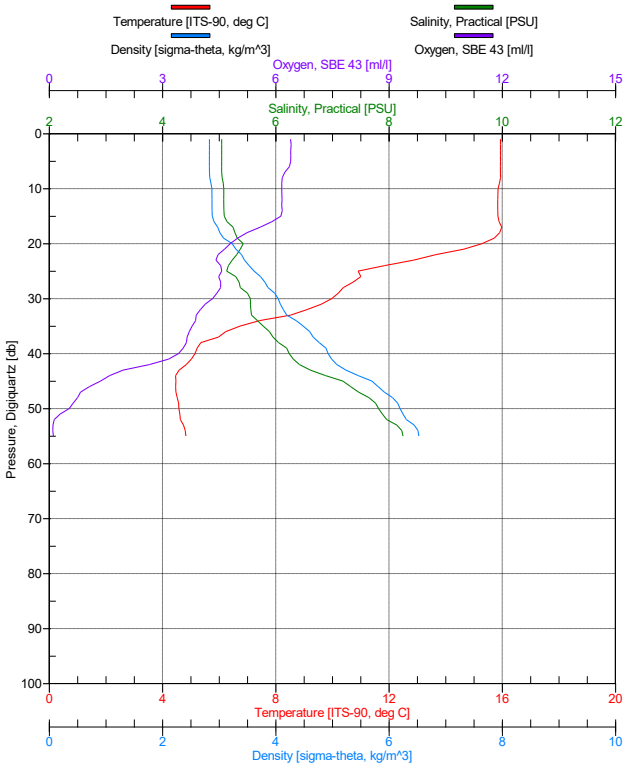
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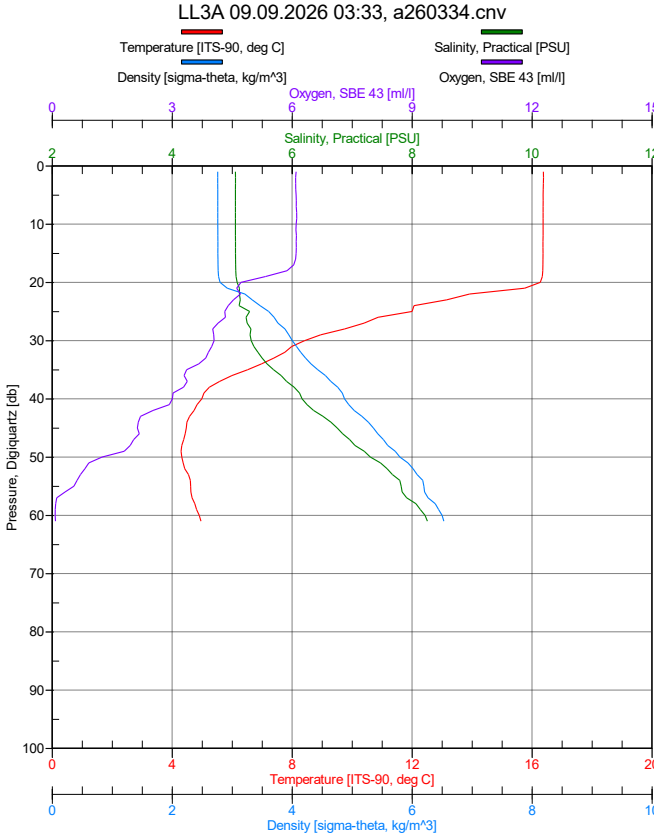
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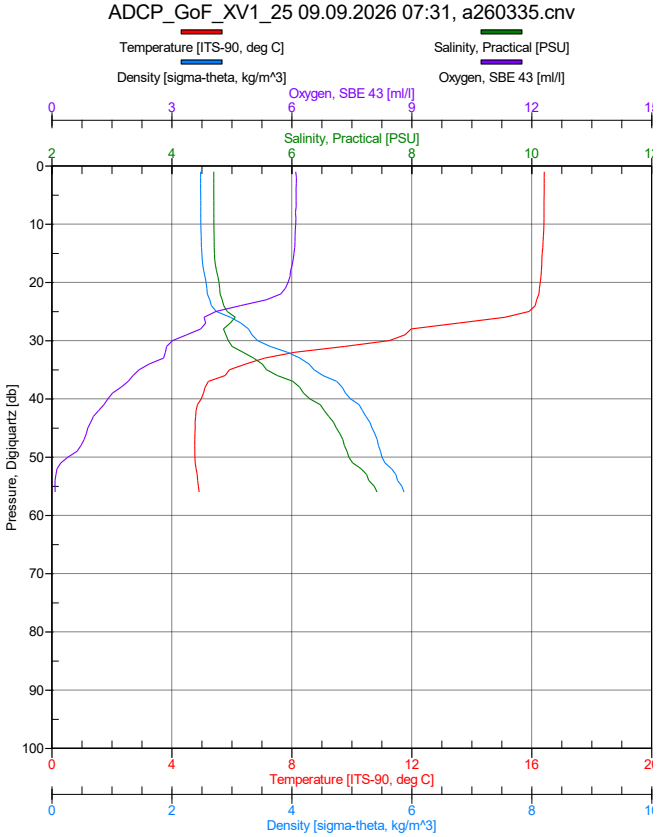
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LL3A 09.09.2026 03:33, a260334.cnv



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Annex 2. List of sampled stations of the cruise. Mooring denotes mooring, recovery or maintenance of current, wave and CT-sensors.

Index	Station	Latitude [N]	Longitude [E]	Depth [m]	Date	Time UTC	CTD	Surface water aerosols	Atmos. Aerosols	Secchi	Moor-ing	Drifting experi-ment
274	39A	60.0400	024.5880	42	20260901	0836	X	X	X	X		
275	ADCP_HKI_PRO	59.5829	025.1354	32	20260901	1032	X	X	X	X	X	
276	CURWA	59.4569	023.4385	58	20260901	1812	X	X	X		X	
277	ADCP_UTO	59.4532	021.2139	75	20260902	0211	X		X		X	
278	AALTO_UTO	59.4293	021.2202	71	20260902	0333	X		X		X	
279	TPDeep1	59.2269	021.2647	216	20260902	0812	X	X	X			
280	TPDEEP1	59.2269	021.2647	217	20260902	1110	X		X			
281	TPDEEP1	59.2269	021.2647	217	20260902	1516	X		X			
282	TPDEEP1	59.2269	021.2647	217	20260902	1734	X		X			
283	SLLO4N	59.2294	023.1694	114	20260903	0017	X	X	X			
284	SLLO3	59.3198	023.1762	87	20260903	0153	X	X	X			
285	driftW2	59.4102	023.1276	63	20260903	0320	X	X	X			
286	driftW3	59.4488	023.1385	51	20260903	0416	X	X	X			
287	driftW4	59.4826	023.1696	45	20260903	0512	X	X	X			
288	A_KOE0	59.4149	023.2004	57	20260903	0634	X	X	X	X		X
289	A_KOE0	59.4149	023.2004	57	20260903	0742	X		X			X
290	NR-RF3	59.4136	023.2411	44	20260903	2150	X	X	X			X
291	A_KOE2	59.4204	023.3397	56	20260904	0542	X	X	X			X
292	A_KOE3	59.4496	023.3959	50	20260904	1248	X	X	X	X		X
293	A_KOE4	59.4495	023.4233	62	20260904	1922	X	X	X			X
294	A_KOE5	59.4472	023.4268	54	20260904	2221	X	X	X			X
295	A_KOE6	59.4472	023.4266	52	20260905	0037	X	X	X			X
296	A_KOE7	59.4482	023.4217	54	20260905	0234	X	X	X			X
297	A_KOE8	59.4485	023.4106	50	20260905	0628	X	X	X	X		X
298	A_KOE9	59.4609	023.5200	58	20260905	0910	X	X	X	X		
299	A_KOE9	59.4610	023.5200	58	20260905	1009	X		X			
300	A_KOE10	59.4584	023.4651	33	20260905	1111	X		X			
301	A_KOE9	59.4608	023.5202	58	20260905	1305	X	X	X	X		X
302	A_KOE11	59.4596	023.5390	50	20260905	1850	X	X	X			X
303	driftW21	59.4787	023.5224	55	20260905	1956	X	X	X			X
304	A_KOE12	59.4702	023.4949	48	20260906	0103	X	X	X			X
305	A_KOE13	59.4553	023.4954	54	20260906	0144	X	X	X			X
306	A_KOE14	59.4589	023.5521	53	20260906	0240	X	X	X			X
307	A_KOE15	59.4757	023.5442	42	20260906	0326	X	X	X			X
308	A_KOE16	59.4328	023.5134	55	20260906	0610	X	X	X	X		X
309	A_KOE17	59.4469	023.4987	56	20260906	0726	X	X	X	X		X
310	A_KOE13	59.4553	023.4954	54	20260906	0755	X	X	X	X		X
311	A_KOE12	59.4701	023.4950	50	20260906	0858	X	X	X	X		X
312	A_KOE18	59.4357	023.5240	60	20260906	1246	X	X	X	X		X

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313	A_KOE19	59.4563	023.4187	38	20260906	1419	X		X	X		X
314	CURWA	59.4580	023.4388	40	20260906	1504	X		X	X		X
315	A_KOE20	59.4590	023.4590	51	20260906	1618	X		X			X
316	A_KOE21	59.4490	023.4591	43	20260906	2108	X	X	X			X
317	A_KOE22	59.4490	023.4399	52	20260906	2206	X		X			X
318	A_KOE23	59.4486	023.4209	55	20260906	2256	X		X			X
319	A_KOE24	59.4265	023.4213	54	20260906	2356	X	X	X			X
320	A_KOE25	59.4264	023.4385	52	20260907	0052	X		X			X
321	A_KOE26	59.4291	023.4591	56	20260907	0124	X		X			X
322	A_KOE27	59.4408	023.4558	60	20260907	0223	X		X			X
323	A_KOE28	59.4348	023.4309	58	20260907	0922	X	X	X	X		X
324	CURWA	59.4582	023.4403	52	20260907	1023	X	X	X		X	
325	A_KOE29	60.0100	025.5162	62	20260907	1909	X	X	X			X
326	A_KOE30	60.0131	025.5368	55	20260907	2332	X	X	X			X
327	A_KOE31	60.0174	025.5520	34	20260908	0236	X		X			X
328	A_KOE32	60.0281	025.5863	56	20260908	0623	X	X	X			X
329	A_KOE33	60.0332	025.5967	50	20260908	1032	X		X			X
330	A_KOE34	60.0557	026.0293	49	20260909	0010	X	X	X			X
331	A_KOE35	60.0801	026.1175	44	20260909	0110	X	X	X			
332	A_KOE36	60.0946	026.1966	55	20260909	0207	X	X	X			
333	A_KOE37	60.0579	026.2063	68	20260909	0254	X	X	X			
334	LL3A	60.0402	026.2081	67	20260909	0331	X	X	X			
335	ADCP_GoF_XV1_25	60.1478	027.1557	62	20260909	0730	X	X	X	X		
336	ADCP_GoF_XV1_25	60.1478	027.1557	62	20260909	0934	X	X	X		X	
337	CT-ketju_pinta	60.0760	026.2036	63	20260909	1410	X	X	X	X	X	
338	CT-ketju_pohja	60.0752	026.2006	59	20260909	1609	X		X		X	
339	ADCP_ORRE_26	60.1101	026.1794	58	20260909	1834	X		X		X	
340	ADCP_AKC1_25	60.0399	025.2560	66	20260909	2305	X	X	X		X	
341	ADCP_HKI_PRO	59.5829	025.1354	35	20260910	0109	X	X	X		X	

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