ALKOR-Berichte

Student cruise: Observation techniques for Physical Oceanographers

Cruise No. AL599

August 14 – August 17, 2023,
Kiel (Germany) – Kiel (Germany)
CAU pherPraO

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2024

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1 Cruise Summary

1.1 Summary in English

The main purpose of the ALKOR cruise AL599 was the training of students in observational techniques used in physical oceanography. The students who participated in the trip attend the module "Measurement Methods of Oceanography" which is offered in the Bachelor program "Physics of the Earth System" at CAU Kiel. During the AL599 the students were instructed in instrument calibration and in the interpretation of measurement data at sea. In addition, the students had the opportunity to learn about working and living at sea and to explore and study the impact of physical processes on the western Baltic Sea, the sea at their doorstep. In addition, the students had the opportunity to learn about working and living at sea and to explore and investigate the effects of physical processes in the western Baltic Sea, the sea on their doorstep.

1.2 Zusammenfassung

Die RV ALKOR-Reise AL599 diente vorrangig der Ausbildung von Studierenden in Bezug auf Beobachtungsmethoden die von physikalischen Ozeanographen angewandt werden. Die Studierenden die an der Reise teilnahmen belegen das Modul Messmethoden der Ozeanographie das im Bachelor-Studiengang "Physik des Erdsystems" an der CAU Kiel angeboten wird. Während der AL599 wurden die Studierenden in Instrumentenkalibration und in die Interpretation von Messdaten auf See eingewiesen. Zudem bekamen die Studierenden die Möglichkeit das Arbeiten und Leben auf See kennenzulernen und das Wirken von physikalischen Prozessen in der westlichen Ostsee, dem Meer vor ihrer Haustür, zu erforschen und zu untersuchen.

2 Participants

2.1 Principal Investigators

Name	Institution
Karstensen, Johannes, Dr.	GEOMAR

2.2 Scientific Party

Name	Discipline	Institution
Karstensen, Johannes, Dr.	Cruise leader	GEOMAR
Dilmahamod, Ahmed Fehmi, Dr.	Physical Oceanography	GEOMAR
Rudloff, Daniel	Physical Oceanography	GEOMAR
Witt, Rene	Technician	GEOMAR
Kurpier, Regina	Technician	GEOMAR
Waldmann, Malina	Student	CAU
Drews, Helen	Student	CAU
Meyer, Marek	Student	CAU
Behr, Yurid	Student	CAU
Sandberg, Lina	Student	CAU

Ripke, Kim Lea	Student	CAU
Böhnert, Nele	Student	CAU
Kaufmann, Daniel	Student	CAU
Scheidereit, Leonie	Student	CAU
D'Heureuse, Annabelle	Student	CAU

2.3 Participating Institutions

GEOMAR Helmholtz-Zentrum für Ozeanforschung Kiel
CAU Christian-Albrechts-Universität zu Kiel

3 Research Program

3.1 Description of the Work Area

The cruise operated in the western Baltic region, from little east of the Fehmarn Belt and to the time series station Boknis Eck at the entrance of the Eckernförder Bay. The Fehmarn Belt, which is key region for the water exchange for the Baltic Sea, was surveyed twice to capture short term variability at the section. A section along the deepest ridge from the Small Belt towards Kiel captured the southwest (upper layer) and northeast (lower layer) spreading of the outflowing low salinity and inflowing North Sea water.

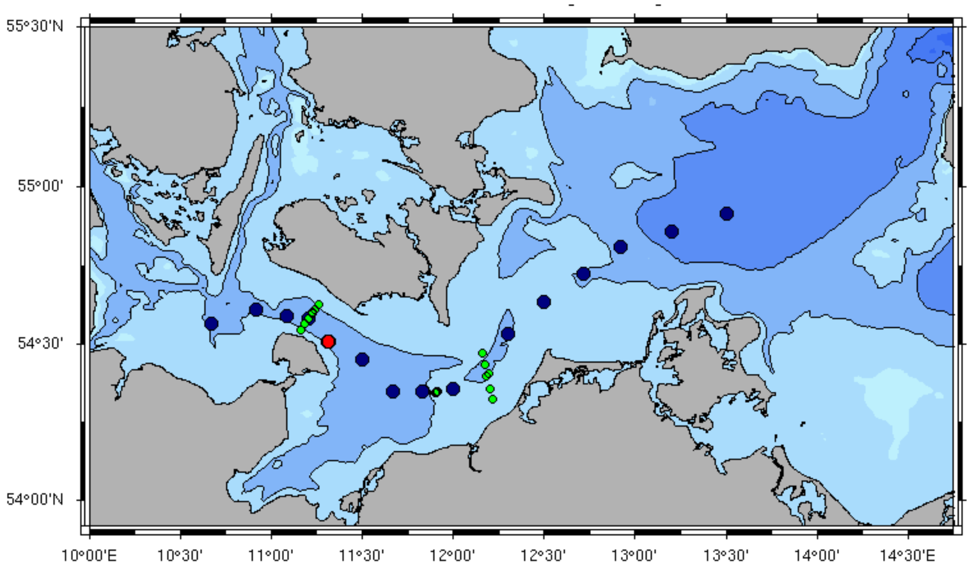

Fig. 3.1 Track chart of RV ALKOR Cruise AL599. Blue dots (L-section) and green dots (C-section and KR section) makr the positions where CTDs have been acquired, the red dot is the position of the mooring/lander.

3.2 Aims of the Cruise

The main purpose of the RV ALKOR cruise AL599 was the training of students in observational methods of physical oceanographers. Undergraduate students in the Bachelor program "Physik des Erdsystems" at the CAU Kiel are introduced into modern observational techniques in physical oceanography, including instrument calibration and interpretation of observations. The course (MNF-Pher-110b) is part of the "Messmethoden" lecture. The cruise will give the students an opportunity to experience the work and life at sea and also to explore and investigate physical oceanography processes in the western Baltic Sea, the ocean at their backyard. The scientific motivation of the cruise is to obtain a rather synoptic picture of the hydrography and water movement in the western Baltic.

3.3 Agenda of the Cruise

The cruise was executed in two legs: leg 1 leaving Kiel on 14. August 2023 and arriving in Warnemünde on the 15. August where a change in the student's science team took place, and leg 2 from 16. August to 17. August 2023 that went as far east as the Arkona basin and returned back to Kiel Kiel. During the cruise a grid of CTD stations were occupied (Figure 3.1) and a tripod mooring could be recovered and deployed at the southern exit of the Fehmarn Belt A section (named "L-section") that was oriented east/west and followed the deepest depth was intended to provide the base for a description of the vertical structure of the western Baltic Sea. In particular showing the decreasing influence of North Sea water towards the eastern Baltic proper. Meridional sections crossing the Fehmarn Belt (15. and 17. August) and the Kadett ridge (16. August) perpendicular to the topography were also performed.

The work at the different stations should mimic a "real" expedition, including active interactions with the ships crew (CTD stations, mooring operations). At the eastern exit of the Fehmarn Belt a tripod-mooring, located at the periphery of the restricted area "Marienleuchte", was redeployed to introduce time series work. The students participate in recovery or deployment and in the data recovery and sensor handling. The cruise was carry out in accordance with the declarations on responsible marine research (Appendices 1 to 3 of the GPF Cruise Proposal Preparation Instructions).

4 Narrative of the Cruise

RV ALKOR left port GEOMAR Westufer, Kiel, Germany, on the 14. August 2023 at 08:00 LT for cruise AL599. First activity after leaving port was the safety introduction by the first officer and a ship tour. This followed a first CTD test station at 10am which was executed without problem. The underway systems were started (TSG, ADCP 600kHz in moonpool). The students worked in two groups, one doing CTDs (instructed by Dr Fehmi Dilmahamod) and the other collecting observations at the air/sea interface (instructed by Daniel Rudloff). After a couple of more CTDs and an ADCP survey crossing the Fehmarn Belt (C-section) we arrived at the V431 mooring position round 5pm. The weather was very calm, sunny, and with great visibility, and the upper buoy element was spotted shortly after the release comment was sent. The recovery of all gear went well. A CTD cast at the V431 location ended the work at this location and a few more stations along the zonal ("L") section could be completed.

During night we headed further east and started CTD work again on the 15. August 2023 in the early morning at 7am. Moreover, the work on the salinometer was started, analyzing the CTD and TSG bottle samples. This data will later be used for calibrating these instruments. The standard work program went very well and without delay and we even had time to do at the location of Praktikumsstation #13 repeat CTD profiles (18 profiles) over a period of 1.5h that later shall be used to investigate fluctuations of the density field. We then headed southwest and arrived at around 3pm in Warnemünde at Pier 8. Shortly after, the 2nd cohort of students arrived on the ship and some joint activities were done incl. an introduction to the cruise report component of observational campaigns and registering for the oral examination of the module PherPraO. Later in the evening the first officer presented the safety measures and introduced the ships facilities and regulations.

We started the 2nd leg with the new cohort of students on August 16th at 8am and headed northeast, towards the Kadett ridge. At 9am a CTD test station was done to introduce this system to the new students and also the underway ocean/atmosphere observational program started. The students worked in two shifts, doing CTD and underway observations. At 3pm the salinometer work also was re-started and could be continued in parallel to the few CTD stations surveyed. The last, and most easterly CTD, was finished at around 7:30pm. The weather continued to be sunny, calm, and that eased all operations on board. During the night we steamed westward, towards the Fehmarn Belt, and started working again at 06:10am with the deployment of the V431 mooring. The mooring was lowered to the ground and installed at 06:34am 17 August 2023. A CTD occupation of the Fehmarnbelt (C-section) followed after a CTD at the mooring location. The CTD was closed at about 10am. Another ADCP section crossing the Belt was done (with 7kn) and then we headed back to Kiel where we arrived at the GEOMAR pier Westshore at 15:30.

5 Preliminary Results

5.1 Conductivity Temperature Depth (CTD) Sonde

(K. Ripke, R. Kurpiers, A. d’Heureuse, D. Kaufmann, D. Rudloff)

During the cruise AL599 a HydroBios CTD with Multi Water Sampler (MWS 12 SLIMLINE) was used. The rosette system can hold up to 12 sampling bottles, the CTD was equipped with sensors to measure conductivity, temperature, pressure, chlorophyll/fluorescence, and oxygen. The rosette is handled from the laboratory with an inductive cable. The software Ocean Lab 3 is used for data recording and conversion.

Fehrmanbelt Section - C Section

The Fehmarnbelt Section, also called C-Section, was surveyed two times during the cruise, on 14.08.2023 and on 17.08.2023. Six CTD casts were taken on each day (Fig. 5.1). The first measurement, on 14.08., was taken under calm and warm conditions in range of 21-22 °C in air temperature, and a wind speed of 5-8 m/s (10-15 kn) in westerly direction with similar conditions on the days beforehand. The second occupation (17.08.) also occurred on a calm day, with a wind speed of 6-9 m/s (12-17 kn) coming from the north-east. The air temperature was around 17 °C. The prior two days before had calmer wind conditions, with wind speeds ranging 3-7 m/s directed southerly and then westerly winds and rain. On both days of occupation, water temperatures between 14-20 °C were measured (not shown here) and a mixed layer base is found at around 5 m. On 14.08. the temperature maximum is found on the surface in the east and the minimum in 25 m depth in the west, therefore creating a vertical and a horizontal temperature gradient. The salinity shows a similar pattern, where the least saline water can be found on the surface and a range in salinity from 15-24 was documented. On the 17.08. the temperature maximum shifts to the east and a horizontal temperature gradient is found in 5m depth.

The thermocline is characterized by a vertical temperature gradient. The salinity on this day shows a similar pattern, where the salinity minimum is found on the surface between 54.58 °N and 54.60 °N and the salinity maximum on the ocean bottom. It ranges from 10 to 26, therefore the diversion of the salinity is larger than on the 14.08. Especially, the surface water becomes less saline due to the rain fall the days prior. The salinity in the bottom water rises slightly because of the inflow from the Northern Sea, caused by the turn of wind. On both days, the salinity is the driving factor of the potential density. Oxygen can be found in the whole water column with a concentration of 4 to 7.5 ml/l. The oxygen maximum is located on the sea surface due to wind induced mixing, then the concentration decreases towards the bottom. For the second occupation, the oxygen minimum is lower than on the first. The distribution of oxygen shows a resemblance of the distribution of temperature and salinity on both days. The chlorophyll concentration varies between 0 and 4 µg/l. In the upper layer, chlorophyll concentration is lower and more homogenous, whereas higher concentration can be found in a depth from 6-18 m. On the 14.08., a strongly defined maximum can be found in a depth of 8 m and from 54.58 °N - 54.60 °N. The concentration decreases then with depth. It is notable that the chlorophyll minimum of the 14.08. is on the surface, in contrast to the 17.08., where it is on the ocean ground.

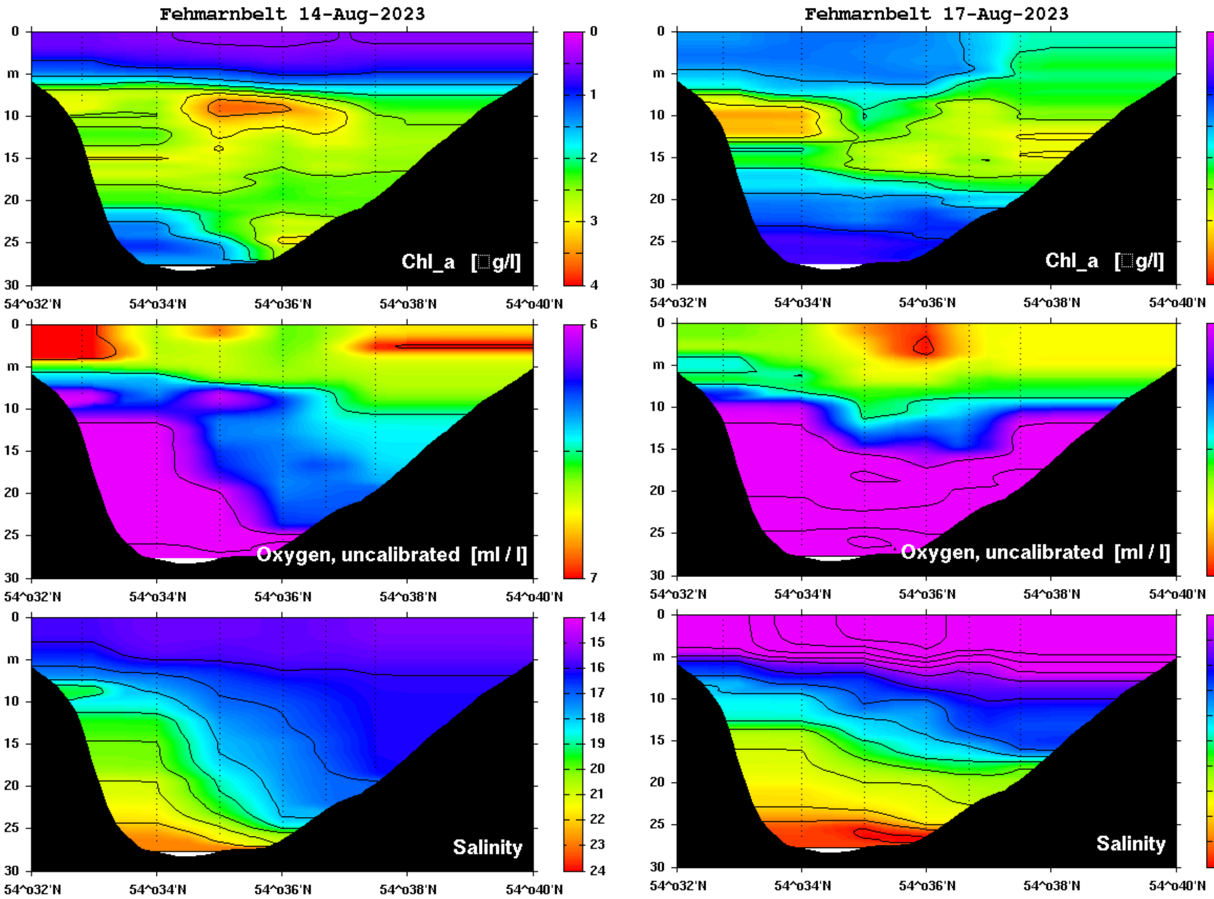

Fig 5.1 Two realizations of the C-section (Fehmarnbelt) during AL599: 14. August 2023 (left) Chlorophyll-a (upper; uncalibrated, derived from Fluorescence), oxygen (middle), salinity (lower); 17. August 2024 (right) Chlorophyll-a (upper; uncalibrated, derived from Fluorescence), oxygen (middle), salinity (lower).

Zonal Section - L Section

The measurements of the L-Section were not made consecutive, but during the time of 14.08. - 16.08.2023. At 14 different stations CTD measurements were done reaching from Kiel Bay to the Arkona Basin (Fig. 5.2). During the measurements, the weather was calm and warm, with winds between 3-10 m/s (1-5 kn) and temperatures from 19 °C to 23 °C. Rainfall was documented in the last half of the measurements.

The temperature distribution shows higher temperature in the western part of the section than in the eastern part. The lowest temperatures can be found in the Arkona Basin. The highest salinity values can be seen at the bottom in the west, decaying eastwards. This indicates high salinity water of North Sea origin spreading towards the east. The potential density behaves similarly, observations show highest densities in the western bottom of the section and lowest densities at the eastern surface.

The oxygen distribution shows oxygen poor bottom water and higher values near the surface, which is typical as the surface stands in exchange with the atmosphere. The chlorophyll distribution shows a maximum at 11.5°E and 15m depth.

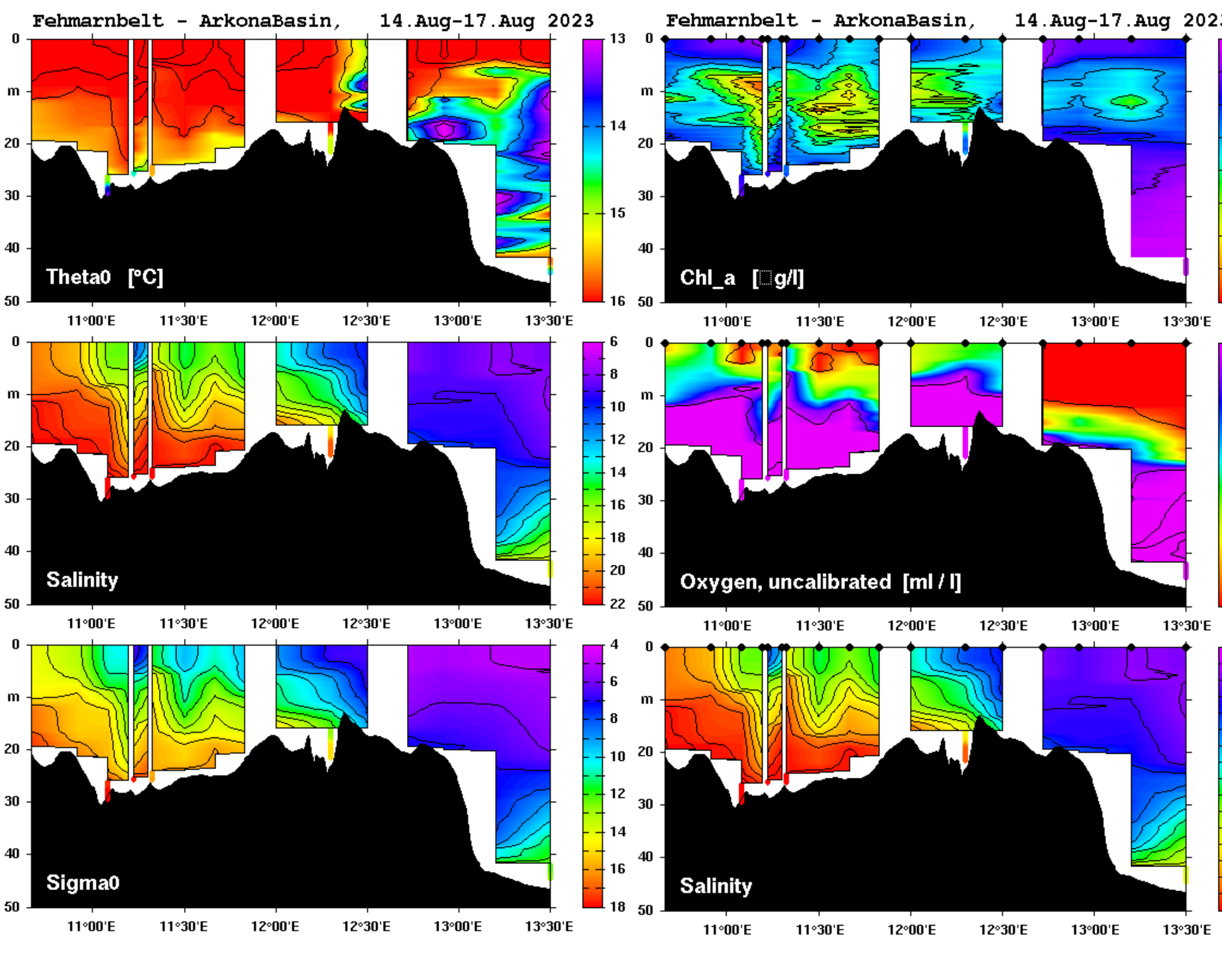

Fig 5.2 Four-day composite of L-section during AL599: left: Potential Temperature (upper), Salinity (middle), Potential Density (lower); right: Chlorophyll-a (upper; uncalibrated, derived from Fluorescence), oxygen (middle), and again salinity for comparison (lower).

The Kadett Ridge section

The five stations in the Kadett rideg were measured consecutively on 16.08.2023 between 08:21 and 10:54 (Fig 5.3). The occupation took place during warm surface air temperatures and on a rather calm day with 3-5 m/s (2-3 kn) wind speed. The vertical structure of temperature and salinity clearly show the existence of saltier water of North Sea origin and less salty water above with a separation at about 7m depth. The surface temperature reaches maximum values of partially more than 20°C. A mixed layer of less than 5 m is seen in the temperature distribution. The oxygen distribution again shows higher values at the surface than at the bottom, indicating that the lower water is an older water mass and can be assigned to the North Sea. In the chlorophyll distribution (not shown here) minimum values are found at the surface and close to the bottom and an subsurface maximum at around 10m.

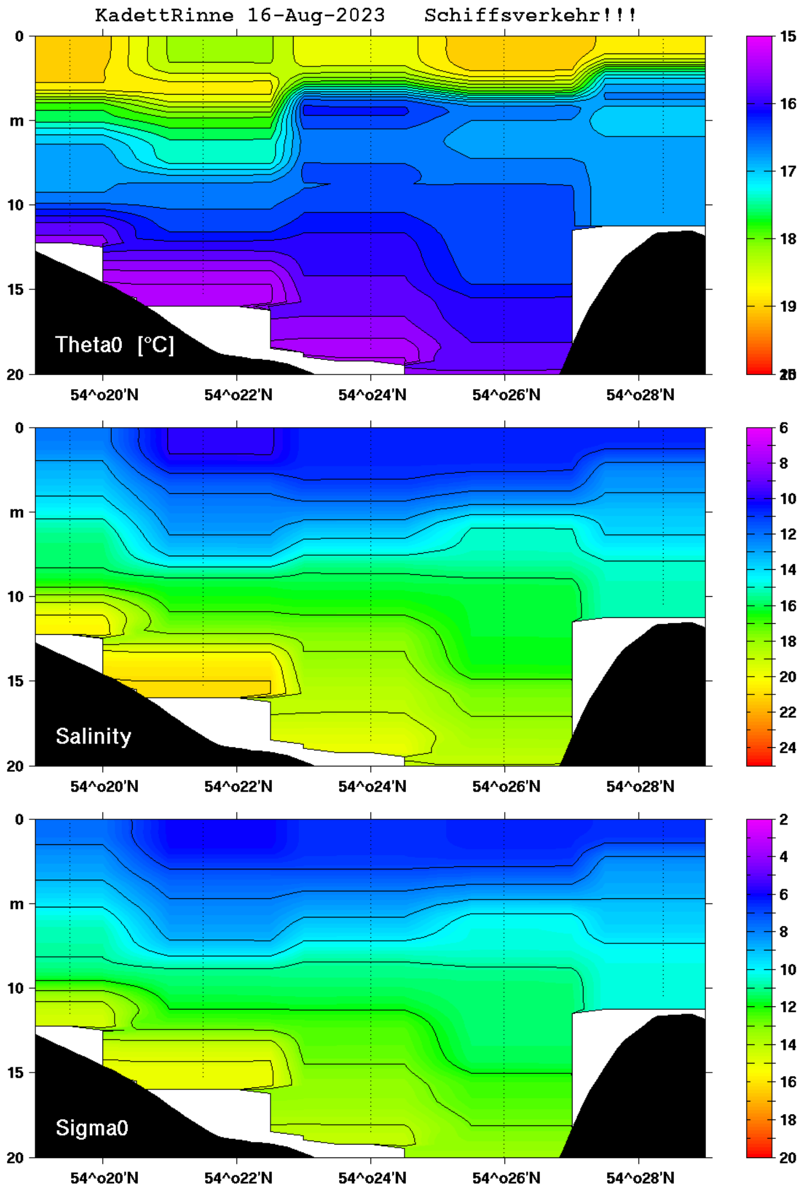

Fig 5.3 (from top to bottom): Potential temperature, salinity, and Potential Density in the Kadettrinne during cruise AL599.

Yoyo-CTD

A CTD-Yoyo was deployed at station 21_1 on the 2023/08/15 between 08:41 UTC and 11:40 UTC (Figure 5.4). The water depth was about 19 m. Variability is seen in all variables during the 3h long survey. By plotting the properties against density the heaving/lowering of isopycnals e.g. through internal waves, is eliminated from the profiles and it can be seen that most variability is suppressed and therefore not the result of water mass changes. This is most prominently seen in salinity which collapses to a line, also because density is mostly dependent on salinity in this region. The two layer vertical structure also is evident not only in salinity but in temperature and with an separation at potential density approx. 11.5 kg m3. Only in oxygen a stronger signal of variability remains in the potential density diagram and that indicate arrival of other water mass or at least the existence of a local gradient in the lower layer.

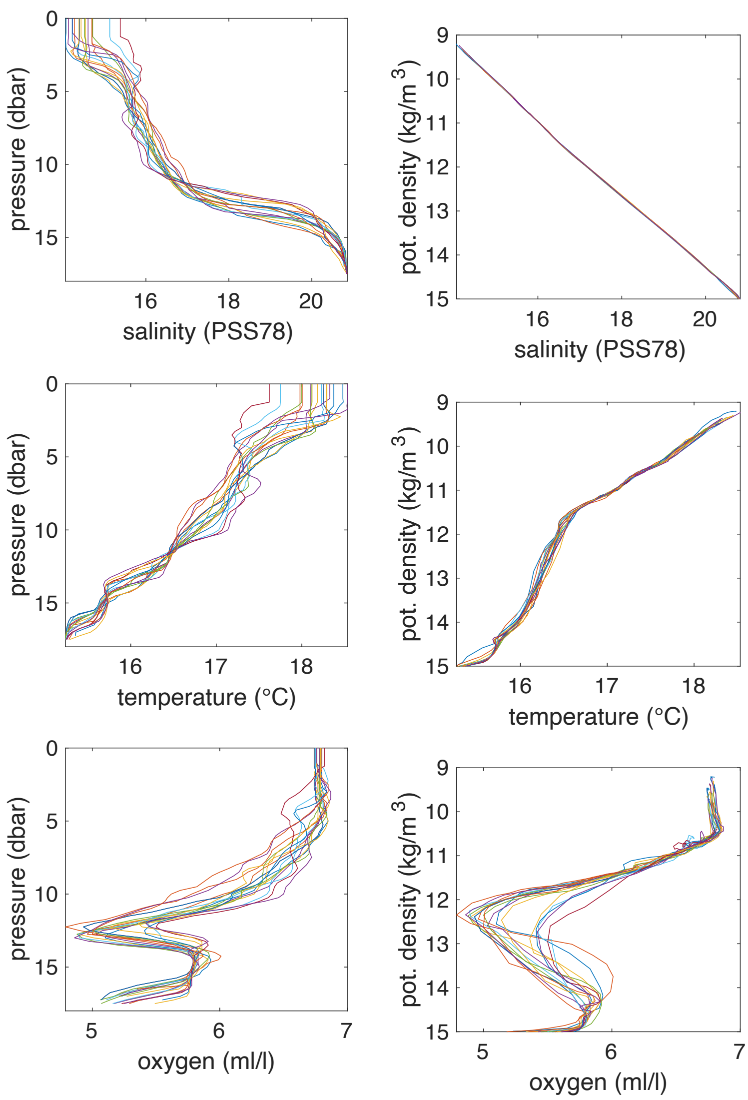

Fig 5.4 Variability of properties during a 3h yoyo-CTD station (left) against depth and (right) against potential density. See panel label for respective property.

5.2 Underway data DSHIP

(M. Waldmann, H. Drews, N. Böhnert, F. Dilmahamod)

The RV ALKOR is equipped with a meteorological sensor package maintained by the Deutsche Wetterdienst (DWD). It consists of sensors for air temperature (PT-100; 1/3 DIN B resolution) and a humidity sensor (voltage reading 0-100mV) both mounted in a Young-cage at 27m, air pressure (0.1 hPa resolution) is mounted underneath the bridge, water temperature (PT-100; 1/3 DIN B resolution) recorded at 3m water depth, wind direction (resolution 2.5°) and speed (resolution 0.3m/s) mounted at top of mast at (29m). The IR- and SW radiation is recorded with Eppley PIR and a Kipp & Zonen CM11, respectively. The Thermosalinograph (TSG) is a SeaBird SBE21 with remote temperature sensor SBE38, a Valeport SV+T Sonde and a Wetlabs ECO-FLRT.

On the first day the weather was dominated by a low pressure system, but from the second day on it was replaced by a high pressure system, which led to a rising pressure during the journey (Figure 5.5). The sky was mostly clear and sunny, with just a few clouds and therefore good visibility. On the last day the weather turned rather rainy with limited visibility. The sea surface remained very calm during the cruise.

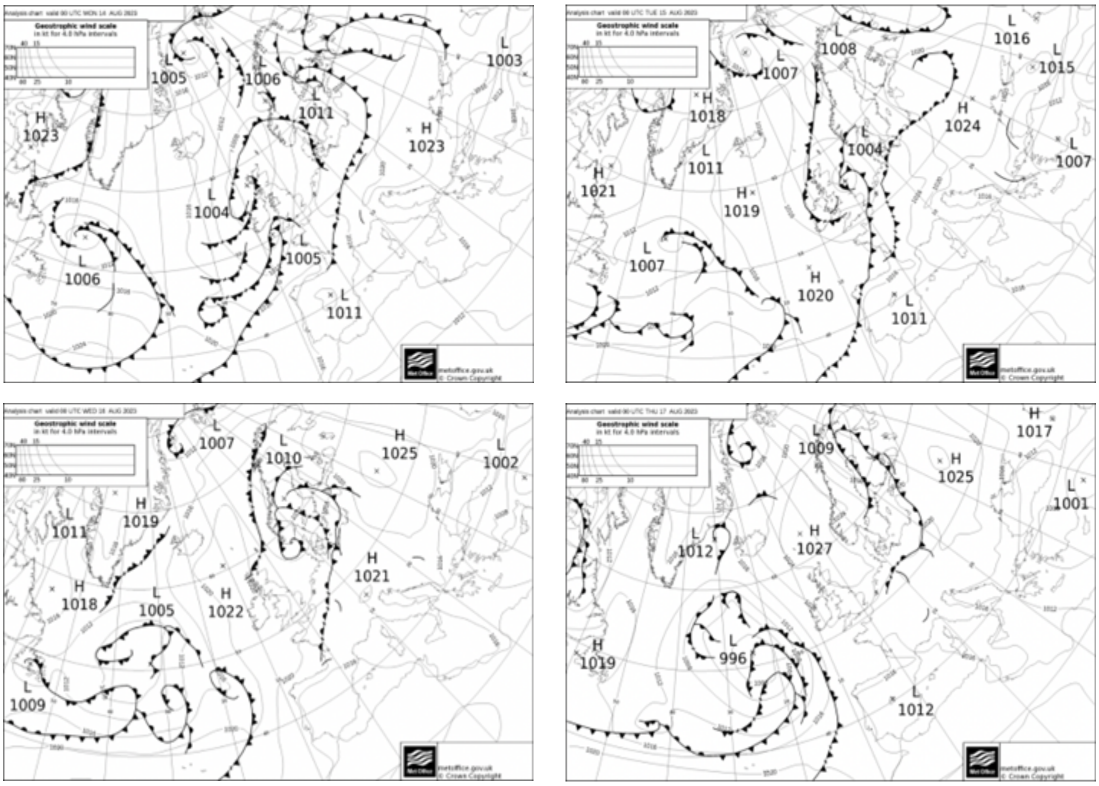

Fig 5.5 Surface air pressure and fronts for August 14th (upper left), August 15th (upper right), August 16th (lower left) and August 17th (lower right) (download via www.wetterzentrale.de/).

The large-scale atmospheric pattern while the AL599 cruise is also reflected in the recorded weather observations (Figure 5.6). The sea surface temperature (SST) was mostly between 18 to 19°C. SST tended to be lower in the eastern regions with less salinity, with measurements of the TSG between 15.4 to 18.8°C at the most. During the Fehmarn Belt passage, SST remained pretty constant between 18.4 and 19°C at both times. Sea surface salinity (SSS) was highest in Kiel with about 18 psu and lowest with about 8 psu at the most eastward point. The eastward decrease in SSS generally reflects the reduction in influence of the North Sea. In the Fehmarn Belt significantly higher values in SSS were measured on August 14th than on August 17th with approximately 15.4 psu and 11.3 psu, respectively.

The air temperature was very constant and varied due to the day-night cycle between 16°C and 22 °C. When we docked in Warnemünde, the temperature was at its highest with nearly 28°C, while the humidity was at its lowest.

The global shortwave radiation follows the day-night cycle with the highest radiation being at around 12:00 UTC. Deviations are visible on August 15th around 10:00 UTC with a short period of rain as well as on August 17th with rainy conditions that last throughout the day. The radiation also shows that there was little influence of clouds except for the late morning of August 14th and the rainy periods. The net longwave radiation remained fairly constant with the lowest values measured on August 17th.

The relative humidity varied between 59 and 91% during the cruise. Most of the time, relative humidity remained between 77 and 87% and was highest on average on August 17th due to the rainy conditions.

The air pressure dropped until the second day, because of the low pressure system in the beginning of the cruise and then the air pressure has generally increased during the trip due to the high pressure system.

The wind speed was very low while the cruise peaked on August 14th at about 17:00 UTC with about 11 m/s. On the first day the wind mainly came from the north-west direction and turned throughout the day with a decreased wind-speed to a easterly and turned again on August 15th accompanied by a strengthened wind back to a remaining north-westerly. On the 17th of August the wind changed direction and blew from the north-east.

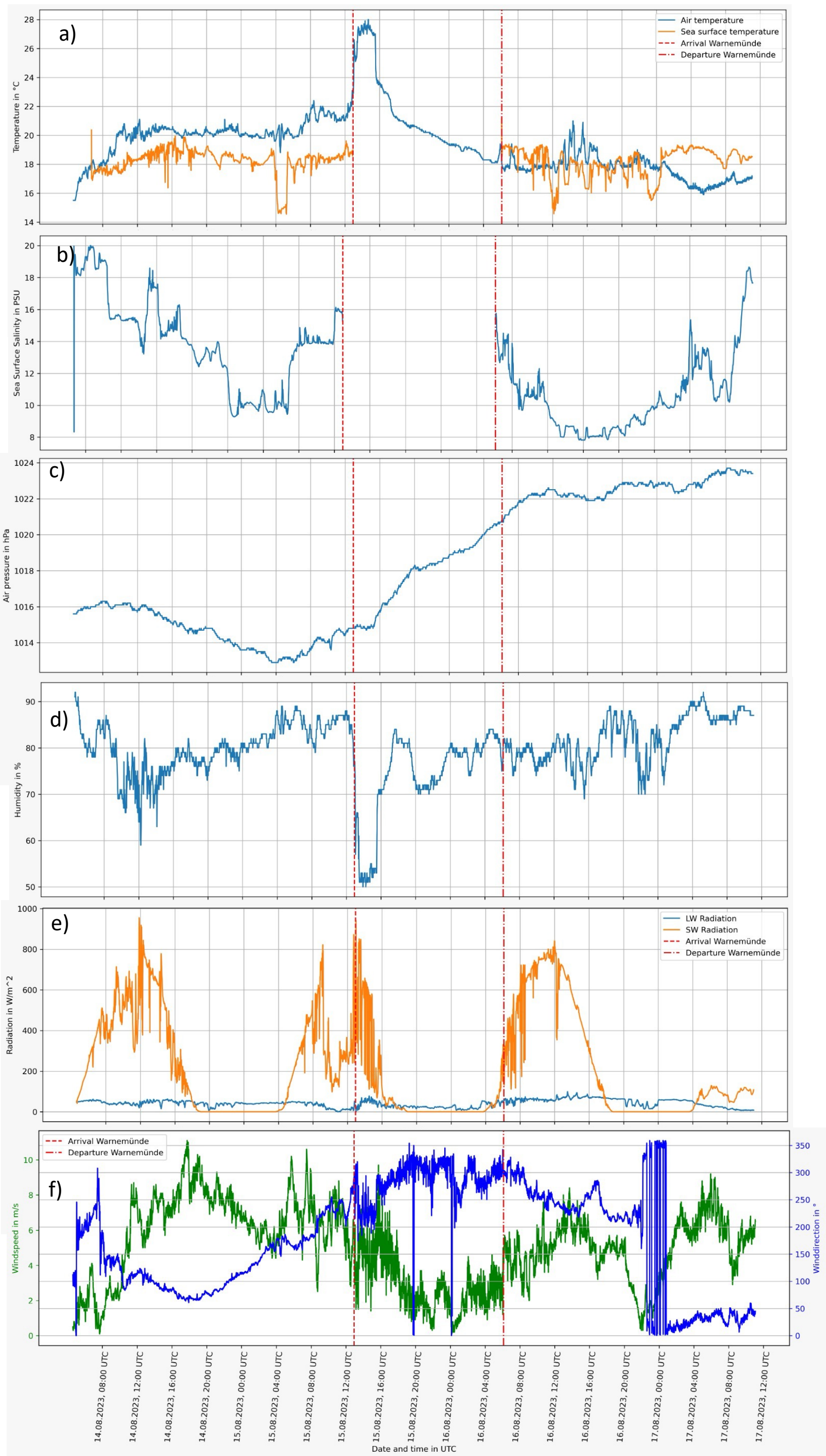

Fig 5.6 Time series of underway data from AL599 for a) temperature (air and sea surface), b) salinity, c) relative humidity, d) air pressure, e) shortwave (blue) and net longwave (orange) radiation, and f) wind speed and direction. The time is in UTC.

5.3 Salinometer and Calibration

(Y. Behr, L. Schneidereit, M. Meyer, L. Sandberg, J. Karstensen)

The Beckmann RS10 salinometer was used to calibrate the salinity measurements from the CTD and thermosalinograph during the AL599 cruise. As the CTD measures accurately but not precise, it is necessary to check if the data against a reference. This is done with the help of a salinometer, The Beckman RS 10 in the case of the AL599.

The operation of the RS10 salinometer is based on the coupling of two coils that are placed in a seawater bath. The coupling depends on the conductivity and temperature of the seawater. By measuring the temperature with a calibrated sensor, the conductivity is derived. To ensure precise measurements the salinometer is calibrated with a reference, the IAPSO (International Association for the Physical Sciences of the Ocean) standard seawater (here we used batch: P160, K15 = 0.99983). In order to check the stability of the device, a so called “substandard” of unknown but constant conductivity is measured more frequently (approx. every sixth measurements). To confirm eventual drift in substandard values another IAPSO standard is used. However, this was not necessary during AL599.

In total two different substandards were used, both taken from several Niskin bottles of the CTD rosette closed at the same level. A homogeneous salinity should have been achieved at the latest in the canister in which the substandard was stored. Both substandards showed no signs of drift and varied by a maximum salinity of 0.02 (Figure 5.7). The first one had a mean salinity of 24.046 and a standard deviation of 0.017 while the second substandard had a mean salinity of 8.180 and a standard deviation of 0.003. Several measurements were made from each bottle sample, until two measurements were identical to the second decimal place, so that the final result for multiple measurements had an accuracy of 0.01.

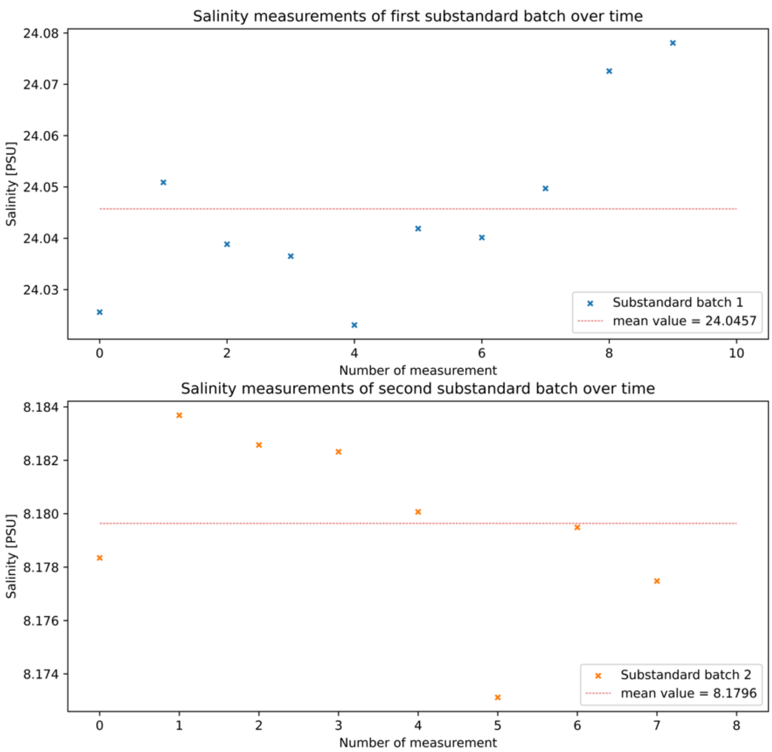

Fig. 5.7 Salinity measurements of the two substandard batches over time. The mean value of each batch is indicated by the red dashed line.

Overall, the deviation between the salinity of the CTD and salinometer readings was never greater than 2.5 psu and showed no clear trend over time (Figure 5.8). The salinity deviation was averaged for each profile. From profile 19 to 36 there are no sample data. This is because several profiles were taken at one station without sampling in between (Yoyo-CTD). Most of the time we took two samples from different depths per profile. Towards the end we often took only one sample.

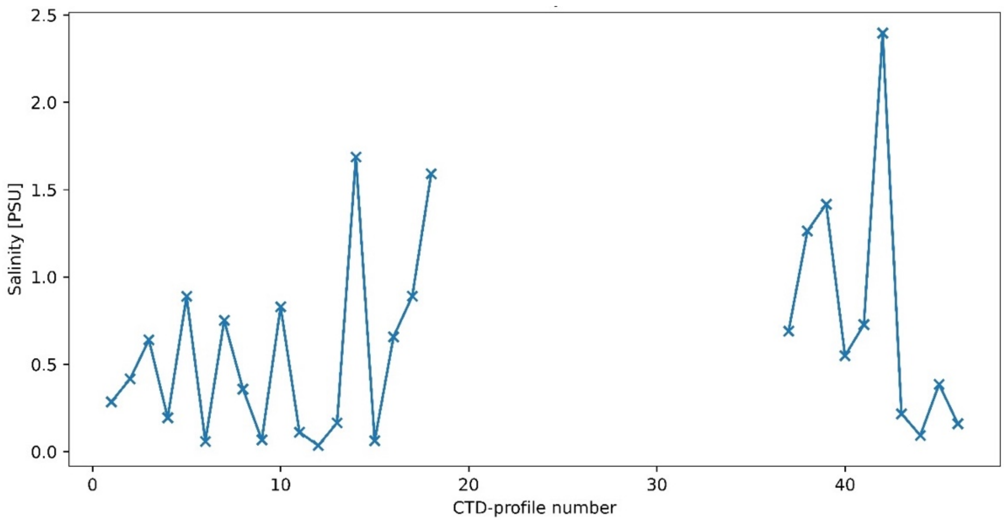

Fig. 5.8 Mean difference between the salinity measured by the salinometer and salinity measured by the CTD for each CTD-profile.

At the beginning and after the group change, we mostly took more than two samples to learn the sampling procedure. Here we could see some differences in the deviations, but no pattern of significant correlation with depth (Figure 5.9). That's why we used the average deviations per profile. At the profiles 18 and 42 the first Niskin bottle did not close properly. That's why we couldn't determine the salinity from these bottles but luckily the other bottles closed correctly and could be used for the salinity measurement with the salinometer.

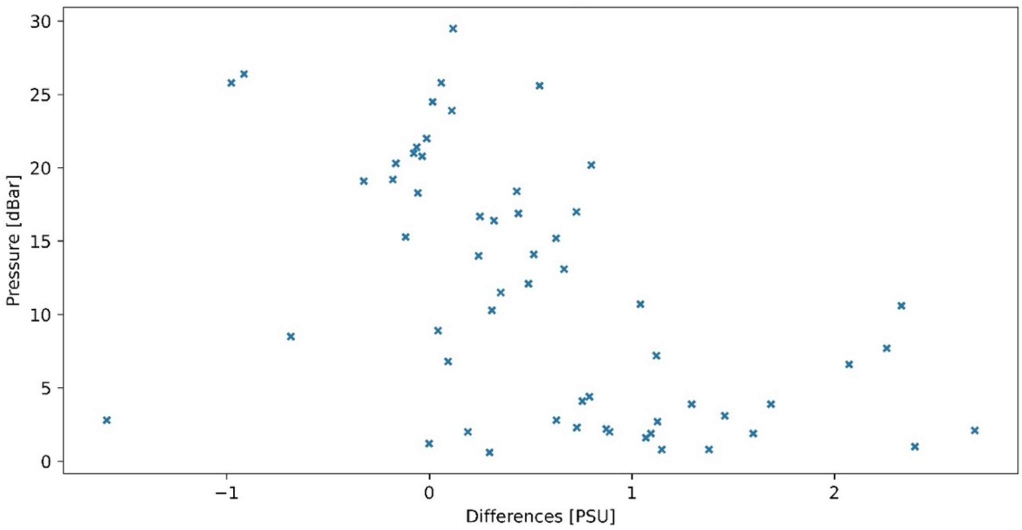

Fig. 5.9 Relationship between pressure and the difference in salinity.

From salinometer analysis higher salinities of the salinometer are found compared with the CTD (Figure 5.9). However, with higher CTD salinities the difference with the salinometer decreases.

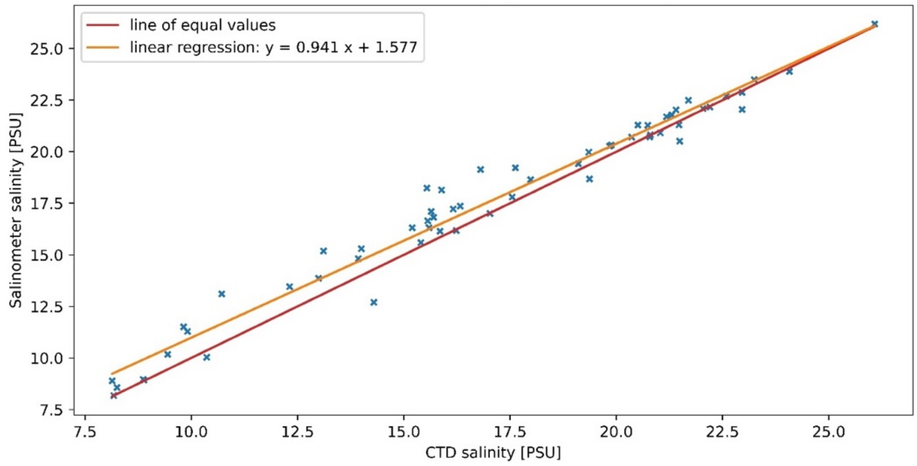

Fig. 5.10 Salinity measured at the salinometer against salinity measured by the CTD. The red line represents the ideal course, where the salinities of both measurements match. The orange line shows the linear regression performed on the data.

A linear correlation indicates an offset of 1.5 for the CTD salinities (Figure 5.10). However, no clear trend in differences in salinity and pressure (Figure 5.8) or salinity gradient (Figure 5.11) is found. Nevertheless, the differences are slightly higher at lower pressure. This could be explained by higher stratification near the surface and therefore less homogeneous water in the Niskin bottles. That's why the Niskin bottles are normally closed at homogeneous depth in the water column.

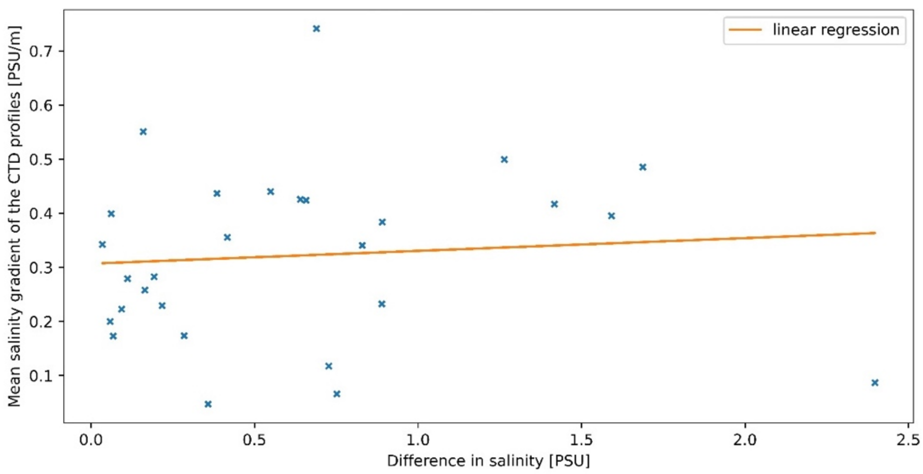

Fig. 5.11 Salinity gradient averaged over each profile against the difference in salinity. The orange line shows the linear regression performed on the data.

5.4 Mooring V431 at Marienleuchte

(J. Karstensen, R. Witt)

During AL599 the tripod mooring at the southern part of the Fehmarn Belt, at border to the military exclusion Marienleuchte was serviced. Recovery was done on the 14. August (15:34 UTC) and redeployment on the 17. August (04:37 UTC). Each time a CTD profile was acquired for reference to the moored sensors.

The mooring consisted of a GEOMAR made tripod frame that consists of a recoverable frame and a releasable (acoustic) flotation element that is connected with a robe to the frame in order to recover all mooring pieces during service. Mounted to the tripod are a SBE-37 SeaBird Mircocat (temperature and conductivity), an GEOMAR logger with AADI oxygen optode, and a Nortek SIGNATURE 500 acoustic doppler current profiler (for details see table 5.1).

Table 5.1 Details on mooring operations related to AL599

Mooring	**V431_33**	**V431_34**
Deployment		
Cruise	AL578	**AL599**
Time	18. Aug. 2022 05:00 UTC	17. Aug. 2023 04:37 UTC
Position	54°30.530'N/0121°18.720'E	54°30.529'N/0121°18.712'E
Waterdepth	26.7m	24.0m
Recovery		
Cruise	**AL599**	Tbd.
Time	14. Aug. 2023 15:20UTC	
Devices		
Releaser	Edgetech Port LS # 56239	Edgetech Port LS # 56239
ADCP	Signature 500kHz # 101720	Signature 500kHz # 101720
MicroCat	SBE37/11 # 7951	SBE37/11 # 7952
Optode logger	AADI3830 # 1070	AADI3830 # 940

6 Ship's Meteorological Station

The RV ALKOR has an automated metrological station ('Automatische Bordwetterstation, ABWSt) under the auspice of the German Weather Service. It consists of a Thies wind direction sensor (resolution 2.5°), a Thies anemometer (resolution 0.3 m sec^{-1}) with a range from 0 to 50 m sec^{-1}, a Friedrichs air temperature sensor (PT-100 type) in a Young instrument shelter with a precision of 1/3 DIN B (about 0.1-0.2K), an analog Rotronic humidity sensor (also in the Young shelter), an AIR air pressure sensor (resolution 0.1 hPa and precision 0.3 hPa). The air pressure provided is considering the air temperature.

7 Station List AL599

Gear Codes: CTD: CTD rosette sampling; MOOR: Mooring operations, ADCP: ADCP switched on, TSG: Thermosalinograph started

ALKOR Station number	Gear	Date / time	Latitude	Longitude	Water depth (m)
AL599_1-1	ADCP, TSG	14.08.23 07:07	54° 28.960' N	010° 18.453' E	18
AL599_2-1	CTD	14.08.23 08:32	54° 33.983' N	010° 40.070' E	21
AL599_3-1	CTD	14.08.23 09:55	54° 36.504' N	010° 54.979' E	22
AL599_4-1	CTD	14.08.23 10:57	54° 35.465' N	011° 04.954' E	31
AL599_5-1	CTD	14.08.23 11:46	54° 32.820' N	011° 09.758' E	10
AL599_6-1	CTD	14.08.23 12:07	54° 34.010' N	011° 10.997' E	28
AL599_7-1	CTD	14.08.23 12:33	54° 35.006' N	011° 12.448' E	27
AL599_8-1	CTD	14.08.23 12:56	54° 36.013' N	011° 13.481' E	27
AL599_9-1	CTD	14.08.23 13:19	54° 36.723' N	011° 14.473' E	23
AL599_10-1	CTD	14.08.23 13:39	54° 37.495' N	011° 15.551' E	20
AL599_12-1	MOOR	14.08.23 15:34	54° 30.527' N	011° 18.755' E	27
AL599_13-1	CTD	14.08.23 15:49	54° 30.511' N	011° 18.851' E	27
AL599_14-1	CTD	14.08.23 16:54	54° 27.025' N	011° 29.973' E	25
AL599_15-1	CTD	14.08.23 18:01	54° 21.045' N	011° 39.970' E	25
AL599_16-1	CTD	14.08.23 18:59	54° 21.057' N	011° 49.833' E	22
AL599_17-1	CTD	15.08.23 05:01	54° 38.000' N	012° 29.995' E	17
AL599_18-1	CTD	15.08.23 06:09	54° 31.942' N	012° 17.980' E	23
AL599_19-1	CTD	15.08.23 07:09	54° 24.494' N	012° 11.878' E	21
AL599_20-1	CTD	15.08.23 08:07	54° 21.446' N	012° 00.098' E	17
AL599_21-1	CTD	15.08.23 08:41	54° 20.989' N	011° 54.989' E	19
AL599_22-1	CTD	15.08.23 09:14	54° 20.941' N	011° 54.815' E	19
AL599_23-1	CTD	16.08.23 07:21	54° 17.657' N	012° 08.930' E	12
AL599_24-1	CTD	16.08.23 08:22	54° 19.499' N	012° 12.972' E	13
AL599_25-1	CTD	16.08.23 08:53	54° 21.495' N	012° 12.019' E	17
AL599_26-1	CTD	16.08.23 09:39	54° 24.021' N	012° 11.072' E	20
AL599_27-1	CTD	16.08.23 10:16	54° 25.981' N	012° 10.312' E	26
AL599_27-2	CTD	16.08.23 10:18	54° 25.983' N	012° 10.307' E	26
AL599_28-1	CTD	16.08.23 10:56	54° 28.360' N	012° 09.577' E	12
AL599_29-1	CTD	16.08.23 13:33	54° 43.489' N	012° 43.012' E	21
AL599_30-1	CTD	16.08.23 14:38	54° 48.490' N	012° 55.026' E	21
AL599_31-1	CTD	16.08.23 15:51	54° 51.512' N	013° 12.025' E	43
AL599_32-1	CTD	16.08.23 17:13	54° 54.972' N	013° 30.048' E	46
AL599_33-1	MOOR	17.08.23 04:37	54° 30.530' N	011° 18.711' E	27
AL599_34-1	CTD	17.08.23 05:05	54° 30.493' N	011° 18.664' E	27
AL599_35-1	CTD	17.08.23 05:59	54° 32.796' N	011° 09.747' E	10
AL599_36-1	CTD	17.08.23 06:22	54° 34.001' N	011° 11.077' E	27
AL599_37-1	CTD	17.08.23 06:47	54° 35.012' N	011° 12.487' E	27
AL599_38-1	CTD	17.08.23 07:10	54° 35.995' N	011° 13.491' E	27
AL599_39-1	CTD	17.08.23 07:31	54° 36.703' N	011° 14.495' E	23
AL599_40-1	CTD	17.08.23 07:52	54° 37.494' N	011° 15.497' E	20

8 Data and Sample Storage and Availability

In Kiel a joint Datamanagement-Team is active, which stores the data in a web-based multiuser-system. The data will be made public by distributing them to national and international data archives through the GEOMAR data management team, but also by sending it to the Deutsches Ozeanographisches Datenzentrum (DOD) at the BSH in Hamburg, Germany.

Table 7.1 Overview of data availability.

Type	Database	Available	Free Access	Contact
CTD	DOD	12/2023	11/2024	jkarstensen@geomar.de
mooring	DOD	12/2023	11/2024	jkarstensen@geomar.de

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10 References

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11 Abbreviations

ADCP: Acoustic Doppler Current Profiler
Bft: Beaufort scale for wind speed
BSH: Bundesamt für Seeschifffahrt und Hydrographie
CAU: Christian-Albrechts-Universität zu Kiel
CTD: Conductivity Temperature Depth sonde
DOD: Deutsches Ozeanographisches Datenzentrum
DWD: Deutscher Wetterdienst
GEOMAR: Helmholtz-Zentrum für Ozeanforschung Kiel
IR: Infraread
MWS: Multiwasserschöpfer
SSS: Seasurface salinity
SST: Seasurface temperature
SW: Shortwave
TSG: Thermosalinograph