Cruise Report
F.S. ALKOR Cruise No. 321

Dates of Cruise: 30. June to 02. July 2008

Projects:
Student course in phys. oceanogr.

Areas of Research: Physical oceanography
Port Call: None
Institute: IFM-GEOMAR Leibniz-Institut für Meereswissenschaften an der Universität Kiel
Chief Scientist: Dr. Johannes Karstensen
Number of Scientists: 8
Master: Jan-Peter Lass

Chapter 1

Scientific personal

Cruise code: AL 321
Cruise dates: 30.06. – 02.07.2008
Port calls: Kiel - Kiel

Table 1.1: Scientific personal AL 321: IFM-GEOMAR: Leibniz-Institut für Meereswissenschaften an der Universität Kiel, Kiel, Germany; CAU: Christian Albrechts Universität Kiel, Kiel, Germany

Name	Institute	Function
Johannes Karstensen	IFM-GEOMAR	Chief scientist
Uwe Koy	IFM-GEOMAR	PO
Martin Voigt	IFM-GEOMAR	PO
Kristian Rother	IFM-GEOMAR	PO, Azubi
Johannes Stampa	CAU	student
Christian Krause	CAU	student
Michael Nolde	CAU	student
Malte Sommer	CAU	student

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Chapter 2

Scientific Background

ALKOR cruise AL321 was three day cruise - the only student cruise in 2008. The scientific motivation of the cruise was to obtain a rather synoptic picture of the hydrography and water movement in the western Baltic and to maintain a mooring site at the southeastern opening of the Fehmarn Belt.

In general two section have been occupied: one section crossing the Fehmarn Belt (section 'C') and one section following the deepest topography from about 10°40 E to 14°21 E (section 'L'). Along both sections CTD/rosette sampling was performed as well as continuously recording of current velocities using a vessel mounted ADCP.

From the mooring site at the southeastern opening of the Fehmarn Belt the instruments (300 kHz Workhorse-ADCP; self containing CTD Type MicoCat) have been recovered. The shield mooring is taken to the IFM-GEOMAR for exchanging the instruments.

The main purpose of the cruise is educational. Undergraduate students are introduced into modern observational techniques of physical oceanography, basics in instrument calibration and interpretation of the observations. In addition the observations should give the students the opportunity to experience work and life at sea and to explore/investigate the Baltic Sea, the 'ocean' at their backyard.

Chapter 3

Cruise Narrative

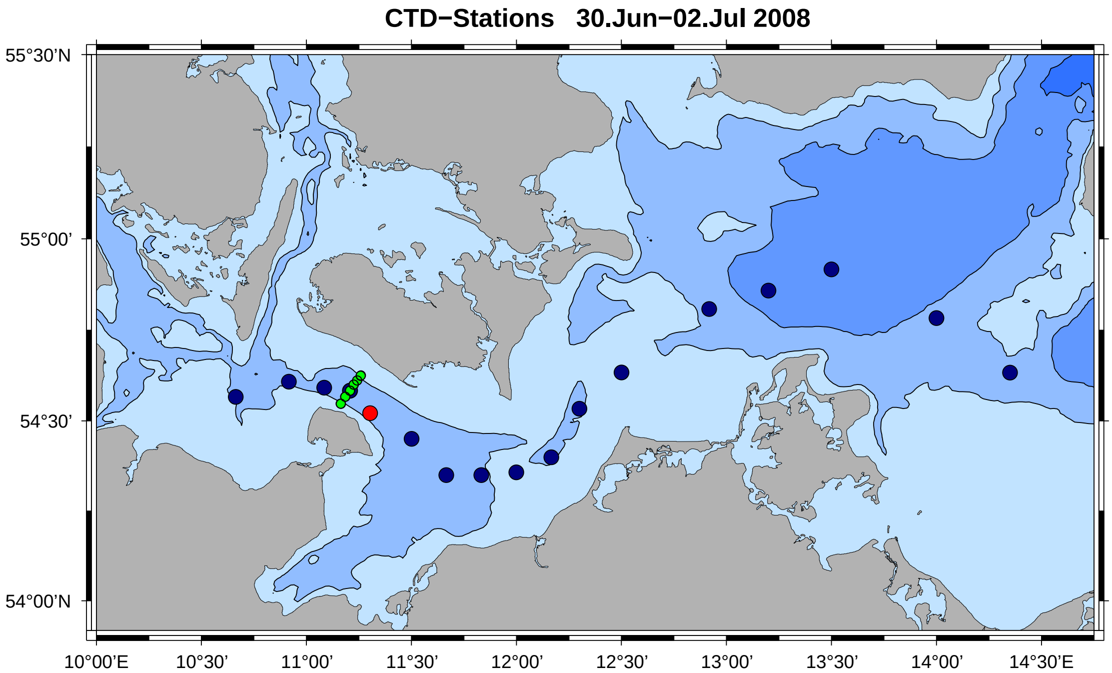

Figure 3.1: ALKOR 321 cruise track. Black (LG section)/ Green (FB section) and Red dot are the CTD stations, red dot is also location of the V431 mooring.

DAY 1 (Monday, 30.06.2008):
As the Kieler Woche took happen the week and weekend before the cruise started mobilization could not happen before Monday morning. We started to set up the equipment at 07:15 local Kiel time. The new 600kHz ADCP was installed as well as the new Thales DGPS navigation device. The 4 undergraduate students and an Azubi from the Technik and Logistiks Zentrum of the IFM-GEOMAR all appeard at 07:30 and help to set up the equipment.

At 09:30 Rainer Nausch, the first officer, introduced us to the safety procedures on board. Next a brief introduction into the program for the following days was given. At 10:30 we left the

IFM-GEOMAR Westufer pier and headed for the first station west of the Fehmarnbelt. Weather was calm and sunny.

The first station was part of the zonal 'L' section and also a test station to test the functioning of the CTD. In addition we sampled a rather large volume of wateto be used as 'Substandard' for salinity calibration (see details below). Next the Fehmarnbelt section ('C') was sampled with a northward CTD section and a repeat section using the ADCP with 7 kn. After finishing the section, we headed for the V431 mooring at the southeastern opening of the Fehmarnbelt. In parallel to the CTD work the meteorological observations were made.

The mooring is located in teh Military zone 'Marienleuchte' and we were told before hand, when asking for permission to enter the zone, that there was military activity was starting on the day of our arrival. We encountered the zone and asked for permission for the acustic release of the buoy. At about 21:00 (local time) we had all equipment on board. The buoy will be taken to Kiel and will be refurbished and equipped with a new multifunction instrument (Aanderaa RDCP600 with optode and salinity sensor).

After a final CTD at the buoy location we steamed over night to the eastern side of Rügen to start with the eastern most station of the 'L'section on the next morning

DAY 2 (Tuesday, 01.07.2008):
At 07:30 we started CTD work again heading from east to west with meteorological observations in parallel. The weather was fine, sunny and with low winds and a very good sight. The salinometer work begun with an introduction of the measurement procedures (samples, substandard) to the whole group of students and a calibration of the instrument against IAPSO standard seawater. There were again a few problems with the Beckman Salinometer. A first analysis of the mooring data revealed that the ADCP did not worked properly - only data to the beginning of 2008 has been recorded. This was due to a problem with the memory. The remaining CTD stations from the 'L' section were occupied during the day. CTD work was stopped at about 22:00 north of Warnemünde and we slowly moved northwestward to redeploy the mooring and do a second 'C' section occupation on the following day. We slowly headed westward to start the next day with a ADCP occupation of the Fehmarnbelt.

DAY 3 (Wednesday, 02.07.2008):
We started at 05:00 local time with an ADCP section (7 knots) of the 'C' section heading from south to north. After that the second CTD occupation started at 06:00 from north to south.

After the CTD section was occupied the scientific program was completed at 09:00 with stopping the ships ADCP and the TSG. ALKOR reached Kiel (IFM-GEOMAR pier Westufer) at 13:00.

Chapter 4

Preliminary results

4.1 Mooring V431: 17th deployment period

The ADCP is placed in a shield frame at the bottom (about 28m water depth) of the Fehmarn Belt and measures current speed and direction upward looking. Data points are obtained in 1 m depth cells averaged over 0.5 hours, pinging every 0.5 minutes (30 seconds).

The time series of temperature, conductivity, and salinity (figure 4.1) at the bootom of the Fehmarn Belt (28m) show a seasonal signal in T and S. As expected, lowest temperatures can be found in winter. T decreases more rapidly during the cooling season than it increases during the warming season. Highest temparatures are found in September, indicating a quick response from surface to the bottom of the Fehmarn Belt. Salinity shows more variable conditions very likely due to the movements of the North Sea Water core.

4.1.1 Long term changes

The V431 mooring is the successor of the V399 mooring which operated at the Fehmarnbelt since 1999. The V399 was a surface mooring with an RCM used to record current speed and direction as well as T/S.

The seaonal cylce from the 2007/2008 period fits in general to the long term records (Figure 4.2) of tempertaure, salinity and density at the bottom of the FB. Utilizing all available weekly data of all years and creating a wekk average allows to derive the anomaly over such an average by subtracting the actual wekkly mean of the original time series (Figure 4.3). Warmer, colder, more saline/less saline period can be identified.

This time serie now reveals that the last winter was particular warm and less saline compared with the long term.

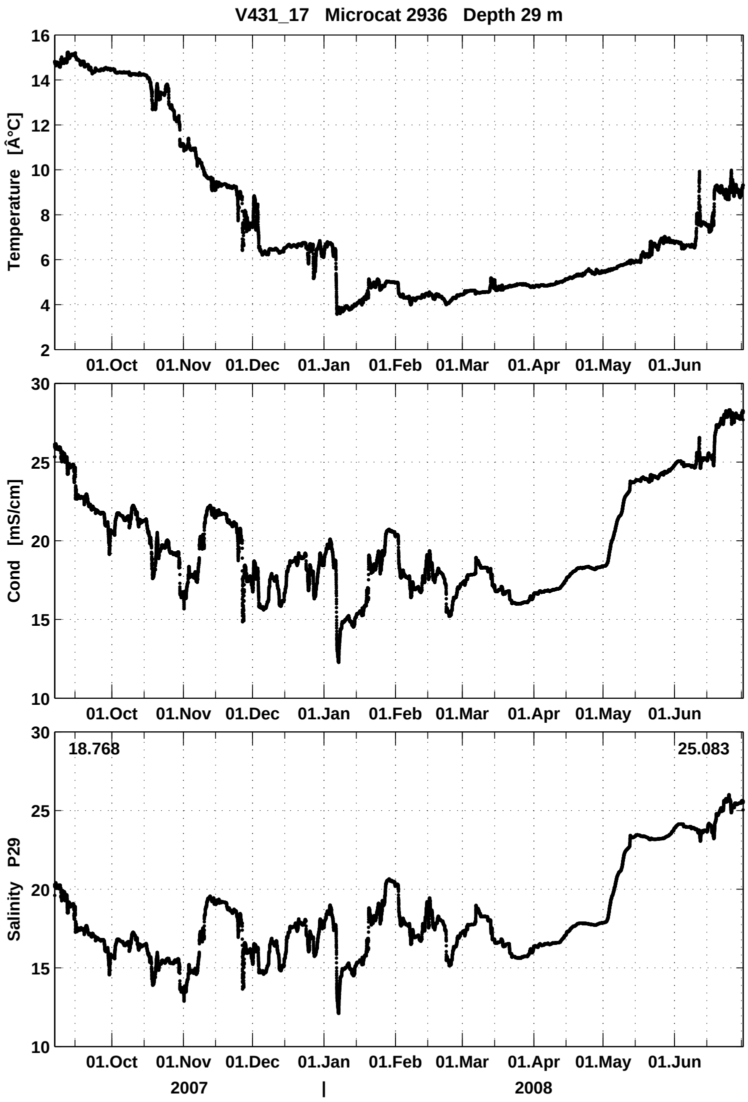

Figure 4.1: *Time series temperature (lower) and conductivity (lower) from the 17th deployment period of V431 (06.09.2007 - 30.06.2008).*

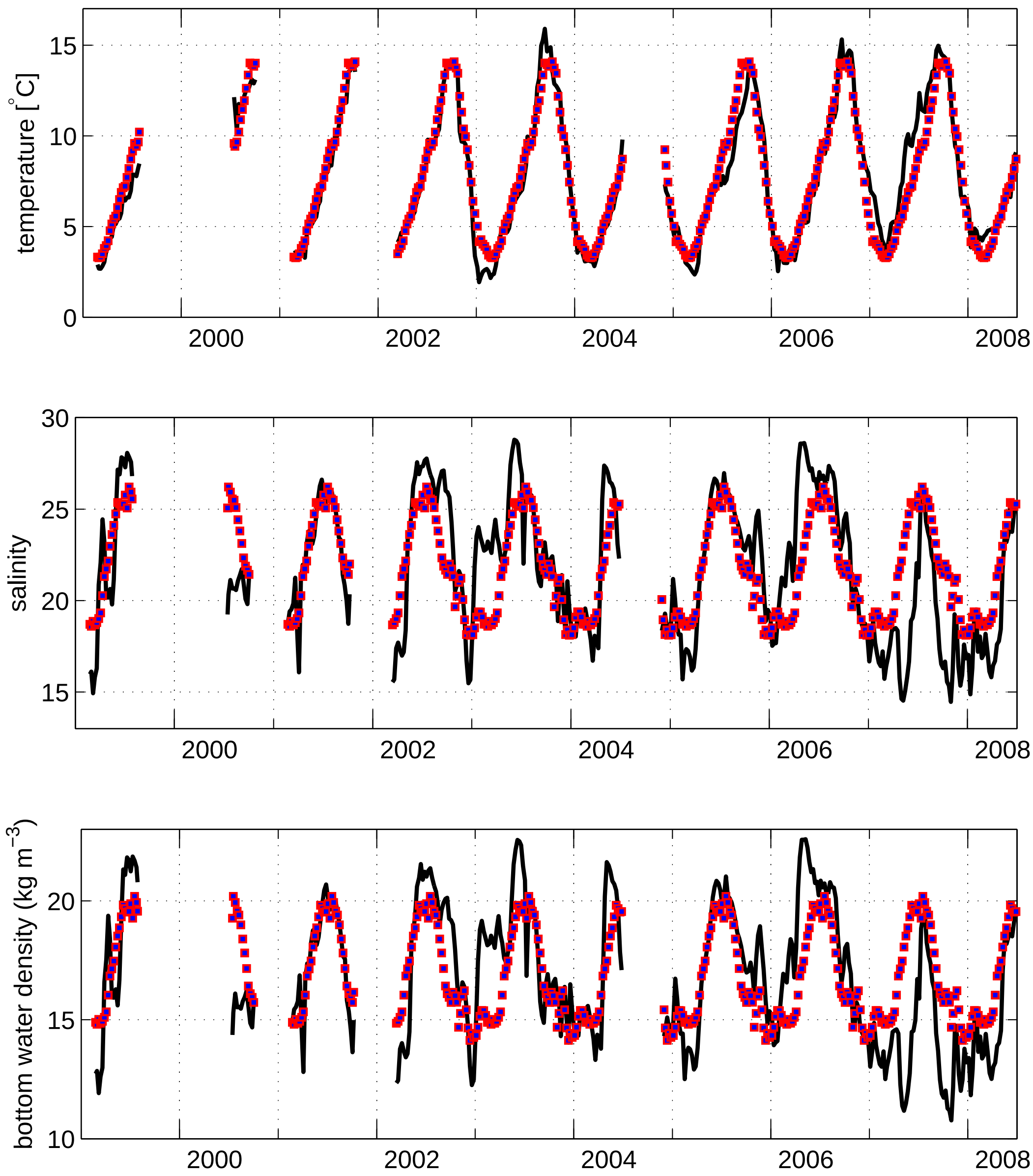

Figure 4.2: *Time series of temperature (upper), salinity (middle), and density (lower) at the bottom of the Fehmarnbelt from February 1999 to July 2008.*

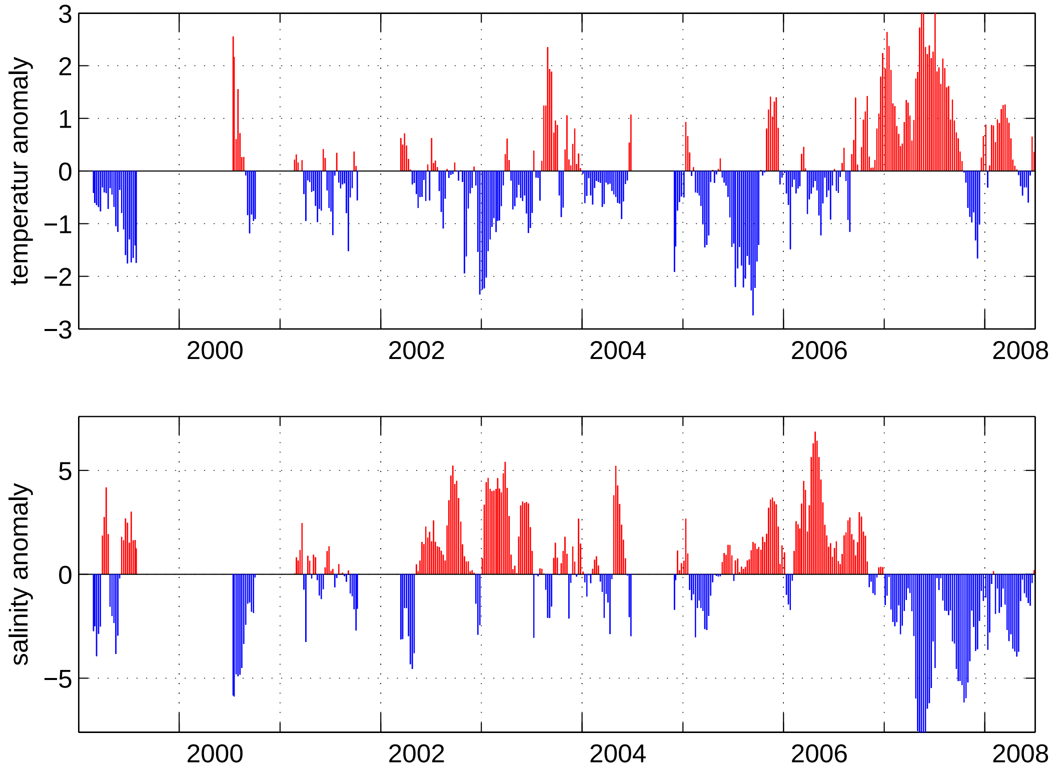

Figure 4.3: *Time series of temperature anomalies (upper) and salinity anomalies (lower) at the bottom of the Fehmarnbelt.*

4.2 Meteorological observations

On the 30th of June, most of the Eastern sea was under the influence of a pronounced low-pressure area. This activated the mid-warm air above the atlantic to move into the Eastern sea region, and because the high got more and more intense the air masses could warm up to a temperature of about 20 - 22°C. The wind direction was west by southwest, the weather was in general sunny and dry. On the beginning of July, the high stayed stable, so the dry conditions continued and temperature increased to a peak value of about 24°C. You can see this development especially in the air-temperature chart, and a little less pronounced in the water-temperature chart. Because the water was warmer on 1. and 2. of July, the transpiration also increased and caused the humidity to increase in the same way, which you can see in the humidity - chart. The continuosly high humidity values are of course to be explained by the measurement position off shore.

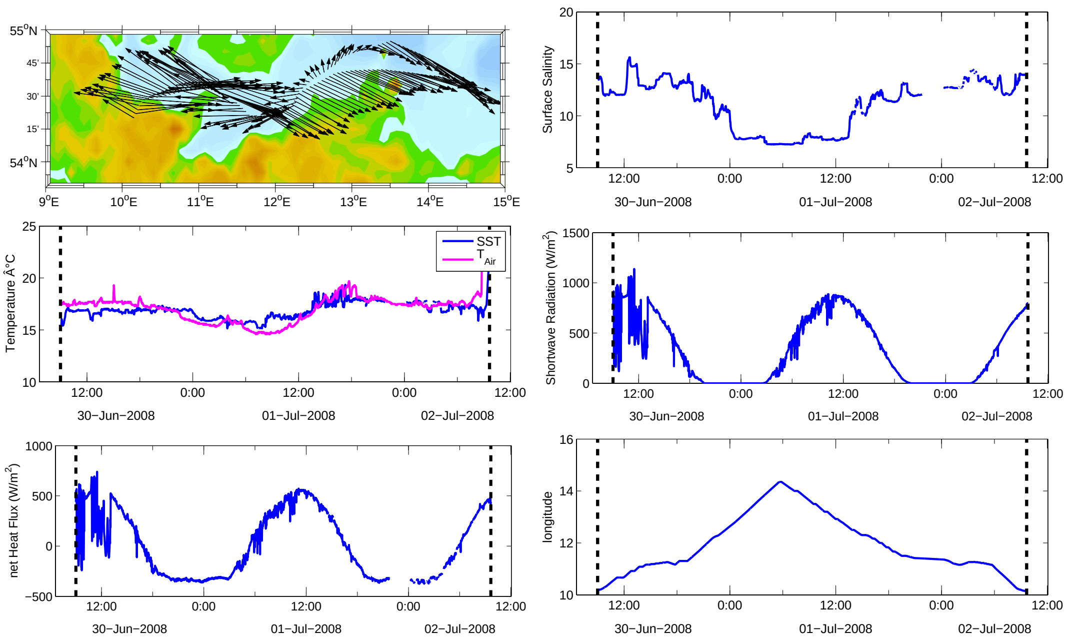

Figure 4.4: *Time series of surface and meteorological parameters during AL 362.*

Examining the temperature during the three days, the cooling during the night with amounts of three to four degree Celsius can be observed. With time passing by, the anticyclonal influence warmed up the air. The significant increasing of temperature on the last day due to the entering of the Kieler Fjord and its onshore weather influence.

The humidity is influenced by the temperature trend. Cold temperatures imply low relative humidity. Additional to the temperature increasing on the last day, dry onshore influence reduced the humidity.

Caused by low cloudiness the global radiation depended mainly on solar injection angle. While short wave radiation is decreasing towards evening, the long wave radiation is increasingly emmited by the earth. It can be assumed that no temporal water temperature gradient was measured because of the short measureing time. So a horizontal temparature gradient can a expected. When we drove eastwards, the temperature decreased and vice versa.

Longwave flux downwards is the long wave radiation from the earth refelected by the clouds. During evenings, clouds occur because of the cooling of earth and high relative humidity. So, the reflection values are higher during the night.

Longwave flux upwards is the long wave radiation from the earth. On the first day of the trip, it was comparatively cloudy with low incoming radiation, so the emitting of long wave radiation was lower in respect to that. In the following two nights, emitting values were higher because of higher gain during daytime.

4.3 Hydrographic and currents along C and L section

All hydrography was recorded with a Hydro-Bios CTD. No calibration measurements were taken during this cruise.

4.3.1 Fehmarnbelt (C section)

Two repeat section were occupied along the Femarnbelt (C-section). Not much changes can be seen between the two occupations of the C-section (Figure 4.5). The densest waters are on the northern part of the section at the bottom, this water is colder and more saline than on the southern bottom area. A subsurface chlorophyll-a/fluoresence maximum can be seen centered at around 10m depth.

4.3.2 Zonalsection (L section)

The stations occupied along the L-section (Figure 4.6) are not necessarly synchronized in zonal direction and as such non-synoptic effects may have stronger impact on the observed distribution. Still general statements about the hydrography can be made. Concentrating on the bottom layer, more saline waters are found in the west, which si alos closer to the *source*, the North Sea. Coldest bottom waters are found in the east, at the entrence to the Bornholm Basin. Surface water tempertaure decreases towards the open Arkiona Basin. A Chl-a subsurface maximum centered at about 10 m is clearly visisble. Oxygen levels are highest at the bottom, but not necessarly from west to east decreasing, but here the temperature effect on the solubility also plays a role and vaues can not be directly compared as the are.

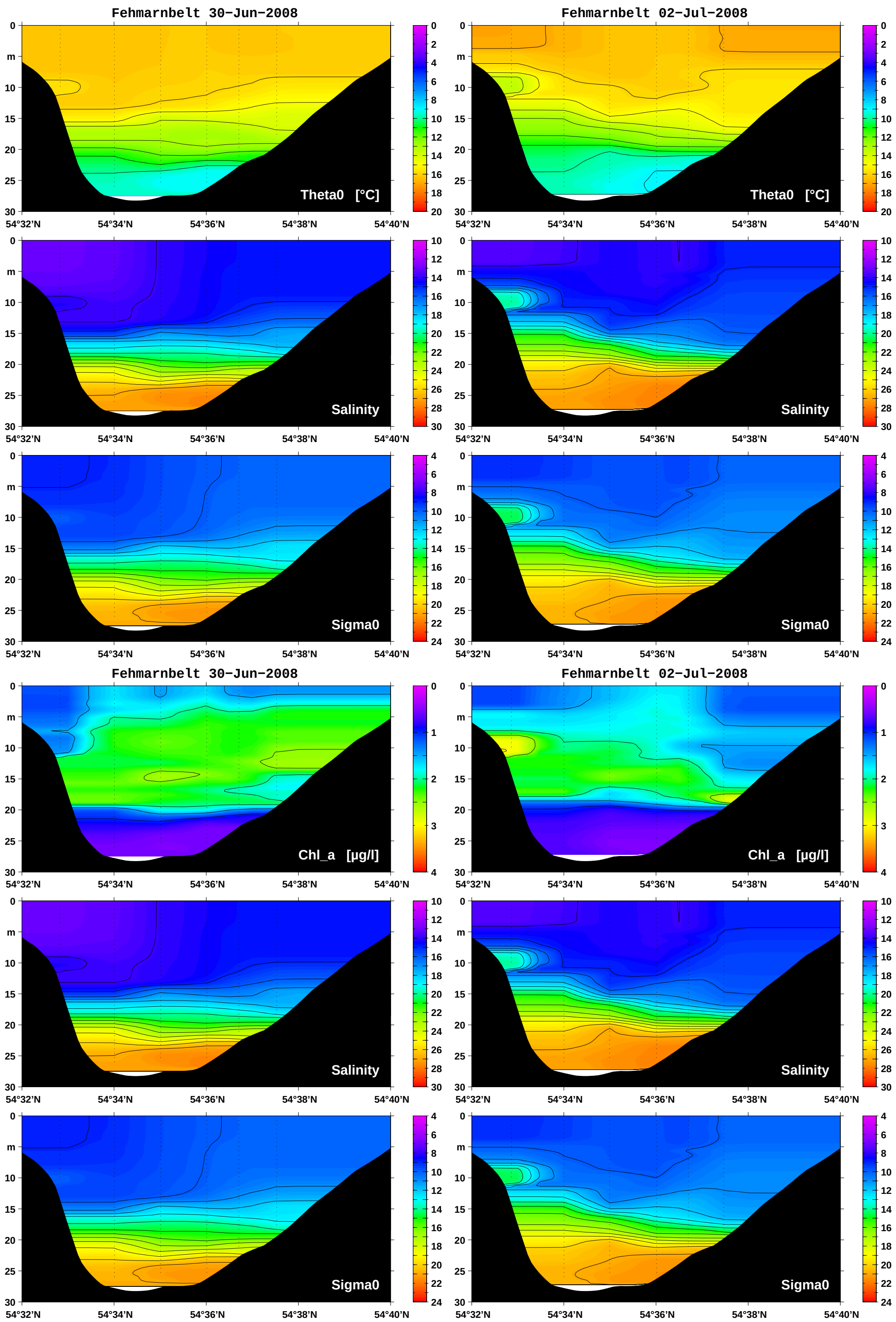

Figure 4.5: C-section 1st (left - 30.06.) and 2nd (right - 02.07.) occupation.

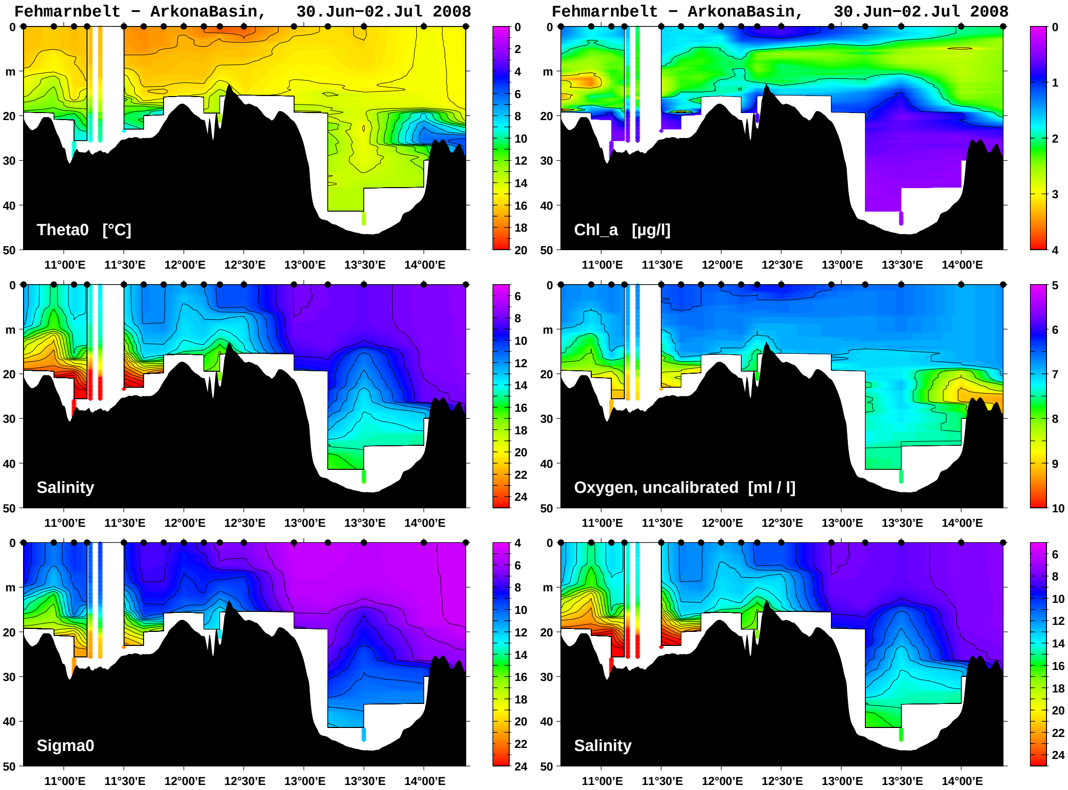

Figure 4.6: L-section (30.06. – 02.07.).

Chapter 5

Equipment/instruments

5.1 Technical: Mooring V431

Mooring deployment site V431 is located in the military zone of Marienleuchte at the southeastern opening of the Fehmarnbelt. Water depth is about 28m. V431 consists of a Workhorse ADCP (300kHz; Serial number 1962) and a self containing T/S recorder of type SBE-MicroCat (serial number 2936). The ADCP was programmed to record every 1800s, the MicroCat every 900s.

The mooring was NOT redeployed during the cruise as it needs a maintenance check at the IFM-GEOMAR and will be equipped with new sensors. In particular it is planned to install an Aanderaa RDCP600 current meter with additional temperature sensor, oxygen optode (3835 - shallow water), and a conductivity cell (4019, range: 0-75mS, accuracy: +-0.005S/m).

Table 5.1: V431: Summary on 17th recovery of trawl resistant bottom mooring V431.

date; time (UTC)	latitude	longitude	depth	comment
05.09.2007; 04:41	54°31.33'N	011°18.22' E	28	Deployment.
30.06.2008; 18:53	54°31.33'N	011°18.22' E	28	All equipment on deck / Recovery.
				No Redeployment.

5.2 Underway Measurements

5.2.1 WERUM

ALKOR has a new central data collection system from WERUM. The system worked perfect during the cruise and faciliated our work in providing on-line cruise map, a downloadable station book as well as export of relevant data. The WERUM is a substitute for the former 'DATADIS' system that caused a lot of trouble during the last years and we are very happy that this new WERUM system was installe don ALKOR.

5.2.2 Navigation

ALKOR has a GPS navigational system as well as a gyro compass available and distributed via WERUM. The WERUM map viewer allowed to follow the cruise track online. A caveat so far is that the data is not easily accessible from any port. A THALES 3011 DGPS system was also installed which provided the navigational data (including ships heading) for the ADCP system. The Thales system is fixed installe don ALKOR now and has been provided via the Kiel-Exzellenz Cluster 'The Future Ocean'.

5.2.3 Meteorological Data

Since March 2006 ALKOR is equipped with a so called automatic weather station which should acquires the basic meteorological parameters (air temperature, wind speed and direction, wet-temperature, humidity, air-pressure). Shortwave radiation is also measured. Long wave radiation is recorded with an EPLAB (Eppley Laboratory, Inc.) Precision Infrared Radiometer (Model PIR).

5.2.4 Echo sounder

The ER 60 SIMRAD echo sounder was activated during the cruise but the data was not stored.

5.2.5 Thermosalinograph

The thermosalinograph (TSG) on ALKOR is permanently installed at about 4m depth, takes up about one litre per second and is a S/MT 148 type of Salzgitter Elektronik GmbH. TSG data is directly fed into the DATADIS. Calibration was done after the cruise only by comparison with the CTD data as no bottle samples could be taken.

5.2.6 Vessel mounted ADCP

A new 600kHz workhorse ADCP from RD Instruments was mounted in the ships hull. The vmADCP is used with bottom tracking mode. Navigational data (including ships heading) comes mainly form the THALES 3011 dGPS system also new installed on ALKOR thanks to the Exzellenz Cluster Kiel 'The Future Ocean'..

Chapter 6

Acknowledgement

Herzlichen Dank an Kapitän Jan Lass und den 1. Offizier Rainer Nannen sowie der gesamten Besatzung der ALKOR für ihre professionelle Unterstützung und die nette Atmosphäre an Bord.

Chapter 7

Appendix

Station table Station #, Year, Month, Day, Hour, Minute, lat, latmin, long, longmin, depth, Praktikum station #

01	2008	06	30	11	37	54	33.98	10	39.83	20.0	01
02	2008	06	30	12	53	54	36.50	10	54.99	22.5	02
03	2008	06	30	13	49	54	35.50	11	05.10	61.6	03
04	2008	06	30	14	34	54	32.83	11	09.87	11.7	04
05	2008	06	30	15	08	54	34.01	11	11.16	27.9	05
06	2008	06	30	15	40	54	35.01	11	12.50	27.1	06
07	2008	06	30	16	04	54	36.01	11	13.56	27.2	07
08	2008	06	30	16	28	54	36.71	11	14.54	23.3	08
09	2008	06	30	16	47	54	37.53	11	15.55	20.0	09
10	2008	06	30	18	55	54	31.29	11	18.20	27.6	10
11	2008	07	01	05	39	54	37.99	14	21.01	31.3	21
12	2008	07	01	07	23	54	46.99	14	00.02	37.8	20
13	2008	07	01	09	31	54	55.00	13	30.02	45.8	19
14	2008	07	01	10	47	54	51.51	13	12.02	43.1	19a
15	2008	07	01	12	03	54	48.49	12	55.06	21.5	18
16	2008	07	01	13	54	54	38.02	12	30.02	17.5	17
17	2008	07	01	15	01	54	32.01	12	18.00	22.9	16
18	2008	07	01	16	13	54	23.97	12	09.99	20.9	15
19	2008	07	01	17	02	54	21.46	11	59.99	17.6	14
20	2008	07	01	17	47	54	20.98	11	49.95	21.9	13
21	2008	07	01	18	32	54	20.99	11	39.96	24.8	12
22	2008	07	01	19	32	54	27.03	11	30.03	25.5	11
23	2008	07	02	03	57	54	37.47	11	15.47	20.4	09
24	2008	07	02	04	14	54	36.70	11	14.49	23.6	08
25	2008	07	02	04	32	54	36.01	11	13.45	27.4	07
26	2008	07	02	04	53	54	34.99	11	12.42	27.3	06
27	2008	07	02	05	12	54	34.00	11	11.06	27.9	05
28	2008	07	02	05	32	54	32.86	11	09.79	12.1	04