

# **Cruise Report**

## **F.S. ALKOR Cruise No. 240**

**Dates of Cruise: 29.06. to 02.07.2004**

**Projects:**  
**BASEWECS**  
**and**  
**Student course in phys. oceanogr.**

Areas of Research: Physical oceanography

Port Calls: Warnemünde (29.06.; 01.07) and Sassnitz (30.06.)

Institute: IFM-GEOMAR Leibniz-Institut für Meereswissenschaften an der  
Universität Kiel

Chief Scientist: Dr. Johannes Karstensen

Number of Scientists: 16

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# Chapter 1

## Scientific personal

Cruise code: AL240

Cruise dates: 29.06. – 02.07.2004

Port calls: Kiel - Warnemünde - Sassnitz - Warnemünde - Kiel

Table 1.1: Scientific personal on AL240: IFM-GEOMAR: Leibniz-Institut für Meereswissenschaften, Kiel, Germany; CAU: Cristian Albrechts Universität Kiel, Kiel, Germany

Name	Institute	Function
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Blöhdorn, Björn	IFM-GEOMAR	Phys. Ocean.
Smarz, Christopher	IFM-GEOMAR	CTD lab.
Inga Eisenhardt	CAU	student
Lasse Heuer	CAU	student
Anna Jesuβek	CAU	student
Robert Kraeft	CAU	student
Tom Kwasnitschka	CAU	student
Finn Mielck	CAU	student
Ilka Riepenhausen	CAU	student
Jan R. Riethdorf	CAU	student
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# Chapter 2

## Scientific Background

ALKOR cruise AL240 was four day cruise. It was the second of three cruises in 2004 in the framework of the BMBF project Baltic Sea Water and Energy Cycle Study (BASEWECS), sub-project C (grant#. 01LD0025). The purpose of the cruises is to obtain a rather synoptic picture of the property distribution and velocities in the western Baltic and to maintain a mooring site at the southeastern opening of the Fehmarn Belt.

In general two section are occupied: one section crossing the Fehmarnbelt (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 is performed as well as continuously recording of current velocities using a vessel mounted ADCP. Mooring site (V431) is maintained, located at the southeastern opening of the Fehmarn Belt. The mooring consists of a Workhorse-ADCP (300 kHz), and a self containing CTD (Type MicoCat) mounted in a commercial shield (Flotation Technology). During AL240 an additional meridional section (although occupied during AL 229) was occupied in the eastern Mecklenburger Bucht.

Besides the scientific motivation, the cruises are utilized for educational purposes. Undergraduate students are introduced into modern observational techniques of physical oceanography, basics in instrument calibration and interpretation of the observations. In addition it should give the students to experience the work and life at sea in general and last but not least to explore/investigate the Baltic Sea, the 'ocean' at their back-yard. As 16 scientists (including 12 students) were on board during the cruise, a port call every night was necessary to allow four persons to sleep a shore.

# Chapter 3

## Cruise Narrative

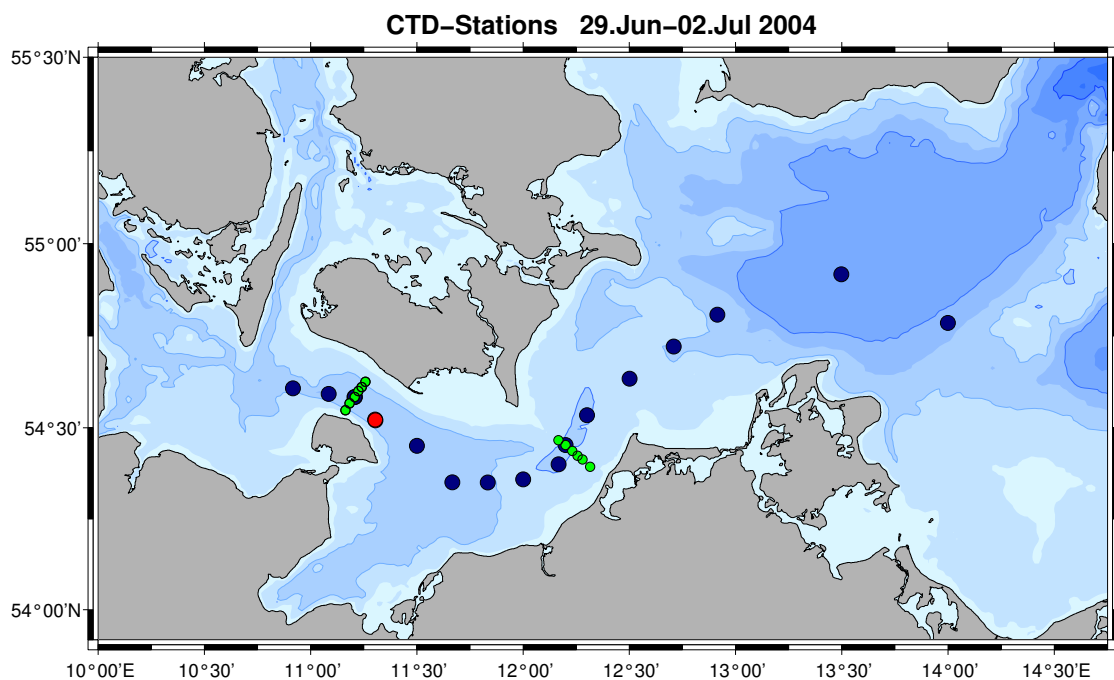


Figure 3.1: ALKOR 240 cruise track (black line, based on DATADIS recordings). Red dots are the CTD stations, black star is the location of the V431 mooring. CTD and vmADCP observations have been sampled along the meridional section in the eastern Mecklenburger Bucht (west of Warnemünde). AL240 had three port calls: two for Warnemünde (29.06.2004; 01.07.2004), one for Sassnitz (30.06.2004)

DAY 1 (Tuesday, 29.06.2004):

We left IfM-GEOMAR pier (Westufer) at 07:40 (all times given in the narrative are ALKOR local time; MESZ) with 16 'scientists' on board, 12 of them were students (Geology, Geography). First we had to deliver a 'Lander' to the 'Ostufer' pier. The Lander was on display during the Kieler Woche, which took place in the week before AL240. We left the Ostufer pier

at 08:15 and headed for the first station which is also the western most station of the 'L' section. The equipment was set-up on the day before the cruise (hull mounting of ADCP, installation of computer). The first officer (Andreas Pooker) gave an introduction into safety on board to the 12 students. Then a brief introduction into the program for the next 4 days was given by the chief scientist. After sampling two CTD stations along 'L' we reached the southern most station on the 'C' section, crossing the Fehmarnbelt. The CTD section to the north was followed from an ADCP section to the south. Finishing the section, we headed for the V431 mooring at the southeastern opening of the Fehmarnbelt. At 16:30 and about 0.2 nm away from the nominal position of the mooring the release code was transmitted but the mooring did not appear on the surface immediately. Several trials with the hydrophone in different depths were not successful either. Unfortunately, the releaser used in the mooring is not able to send a response signal. Finally the hydrophone was lowered immediately under the surface and the mooring appeared. A final CTD cast was performed at the mooring site as part of the L-section and for calibration purposes. We left immediately for port call at Warnemünde. Warnemünde Passagierkai was reached at about 21:00 and after customs clearance four students left for the Jugendherberge as not enough cabins are available for the 16 persons of the scientific crew (ALKOR has only space for 12 scientists).

#### DAY 2 (Wednesday, 30.06.2004):

At 06:40 the students who slept in the Jugendherberge were back on board the ALKOR and we left Warnemünde heading to complete the 'L' section. The first station was about 12 nm away. The weather cleared and it was a sunny day with virtually no wind. During the whole day we made CTD casts, recordings of meteorological parameters, and analyzed bottle samples from the first day using the Beckman salinometer. We reached Sassnitz at 18:00 and after customs clearance 4 students again left for a hotel. The nightlife in Sassnitz was dominated by the quarter-final of the European championship in soccer Portugal:Netherlands (2:1). It was a nice celebration in particular as one of the seamen was Portuguese.

#### DAY 3 (Thursday, 01.07.2004):

We left again Sassnitz relatively early (06:50) and headed for the Kadett-Ridge to start a section there at 13:00. During transit meteorological observations were made every half hour and further salinometer work on the bottle samples was conducted. At Kadett-Ridge we made 6 stations crossing the ridge. The captain and the officers did a great job during the probing as traffic is quite heavy. After the CTD section crossing the Kadett-Ridge we made a repeat section acquiring ADCP data with constant 8 kn speed. Then we headed for our second visit at Warnemünde port. At 18:30 we reached the Industrial port of Warnemünde as the Passagierkai was occupied by cruise ships. Four students left for a hotel (Jugendherberge was too far away from the pier).

#### DAY 4 (Friday, 02.07.2004):

The last day of the cruise. At 6:30 the four students which had to sleep on land were back on the vessel and we left port Warnemünde at 7:00 heading for the Praktikumsstation 14 (part of the 'L' section). After occupying a number of CTD stations we completed the 'L' section and approached the military zone of Marienleuchte at 11:50. The assembled shield mooring was re-deployed at 10:38 at position 54°31.343' N/ 11°18.223' E for the 8th deployment period. A

calibration CTD cast was performed after deployment. A second hydrographic and vmADCP occupation of the Fehmarn Belt section ('C') followed. This was the end of the scientific program. During transit to Kiel the equipment was packed for demobilization and some administrative matters were cleared. We reached IfM Pier (Westufer) at 18:00 immediately unloading the equipment.

# Chapter 4

## Preliminary results

### 4.1 Mooring V431: seventh deployment period

Temperature and conductivity (salinity) near the bottom are variable and follow the warming trend of the spring season summer (with a certain time lag). A noticeable feature is the sudden increase in salinity at the end of April 2004.

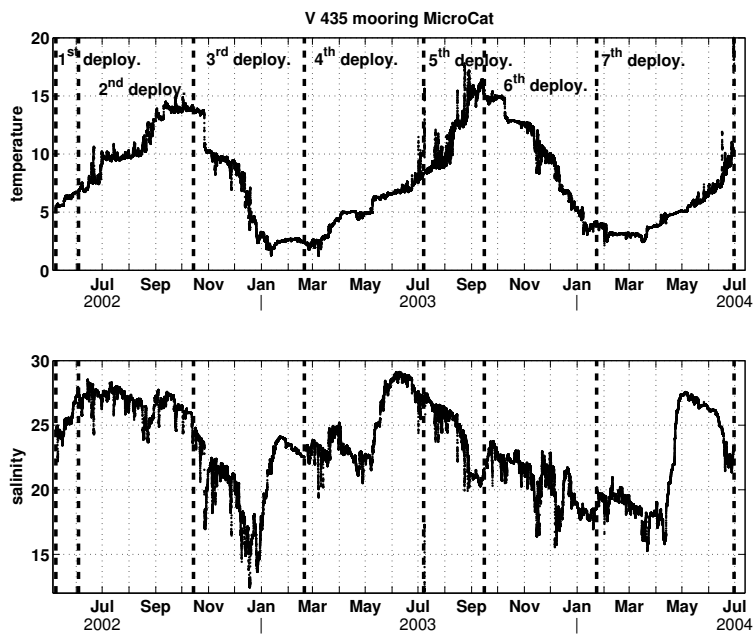


Figure 4.1: Mooring V431: Temperature (upper) and salinity (lower) at 28m depth for all V431 deployment periods.



The zero crossing of the low-pass filtered current profiles separate the water column into the average inflowing/outflowing part. Average depth of this interface is at about 15m with an apparent interannual signal.

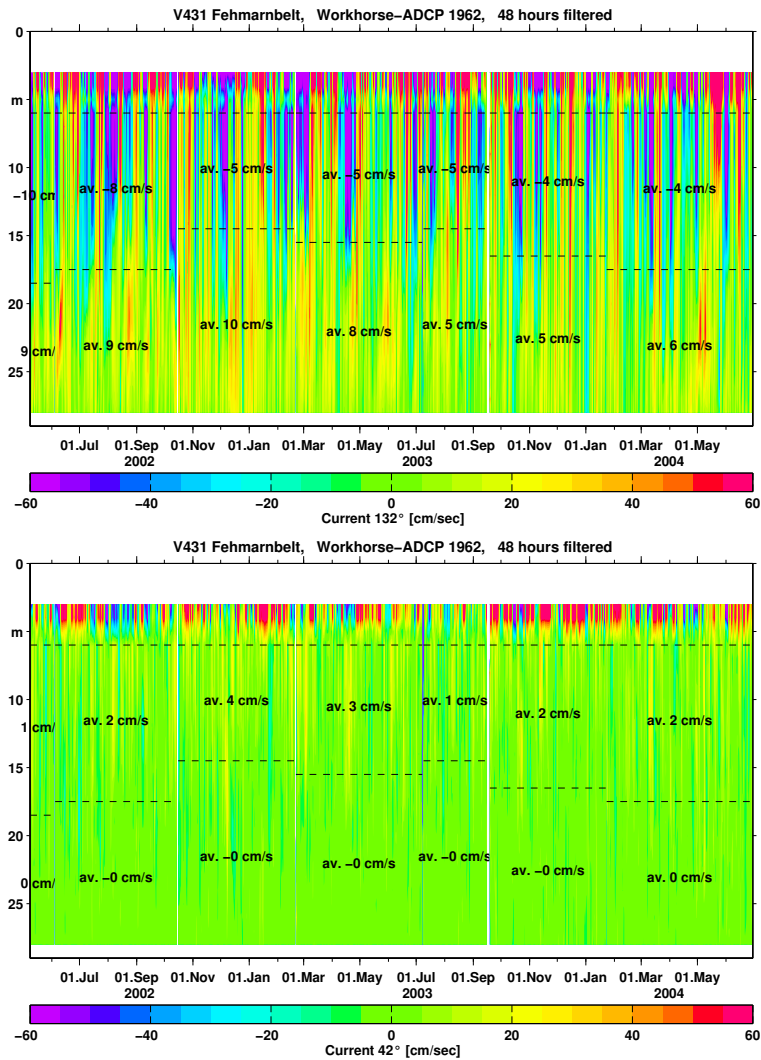


Figure 4.2: Mooring V431, upward looking Workhorse 300kHz ADCP - along bathymetry velocity (rotated to 132°) (upper), and perpendicular to bathymetry velocity (lower). Average in- and outflow situations are shown: with numbers and interface depth (broken lines). Upper 8m are ignored because of surface interferences.

## 4.2 Meteorological observations

The weather situation during the four days of our cruise (figure 4.3) was dominated by weak westerly wind. A low pressure system developed east of Island and moved westward. Air temperature was around 20°C.

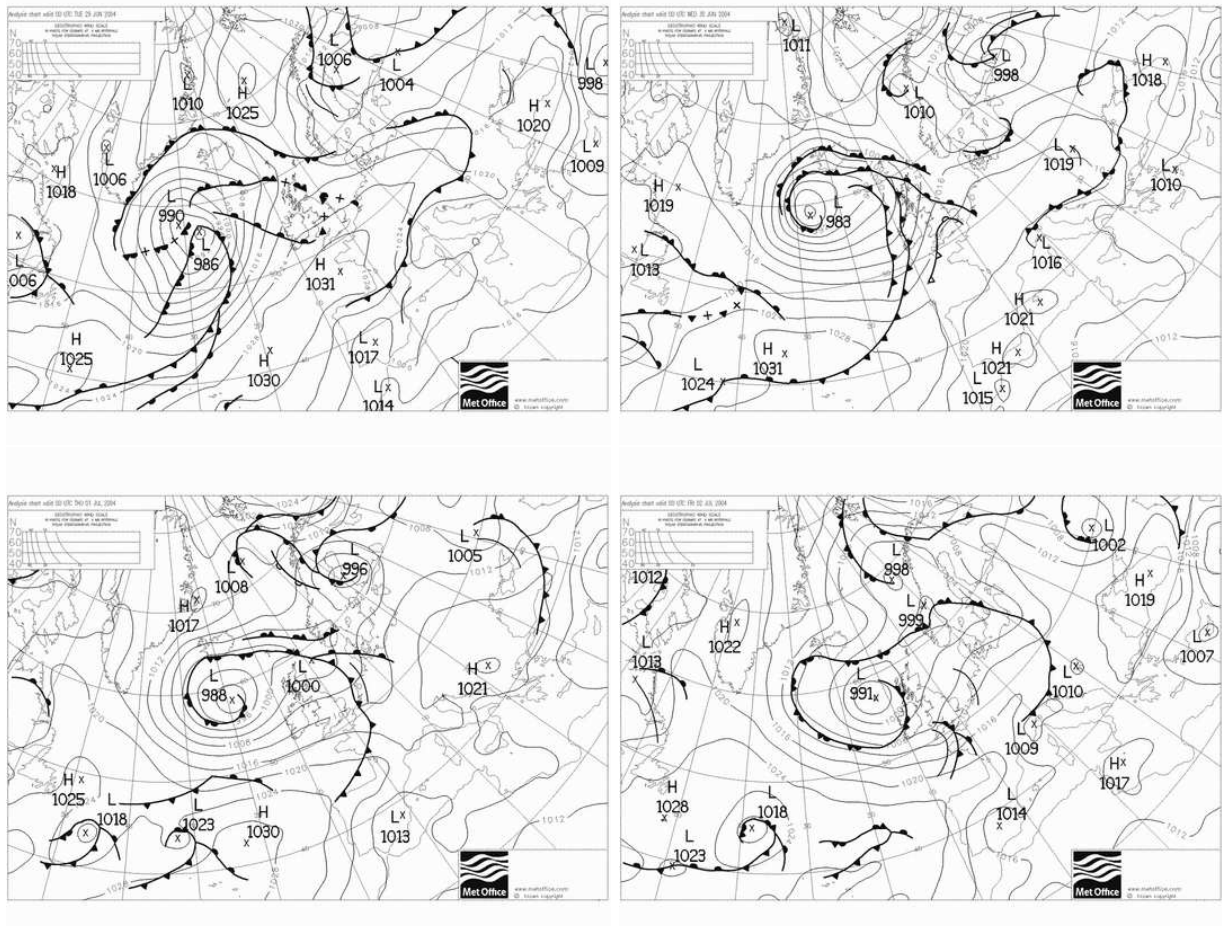


Figure 4.3: Air pressure distribution over Europe from 29. June to 2. July 2004 (figures from UK Met Office).

## 4.3 Hydrographic conditions along section C and L

### 4.3.1 CTD - Measurements

#### C section (Fehmarnbelt)

The hydrographic situation in the Fehmarn Belt was a typical summer situation with a homogenized warm and fresh upper layer (down to about 20m depth) and underlying colder but saline water of North Sea origin. There is not much of a difference between the first and the second occupation except of somewhat warmer surface waters probably through heat gain from the atmosphere.

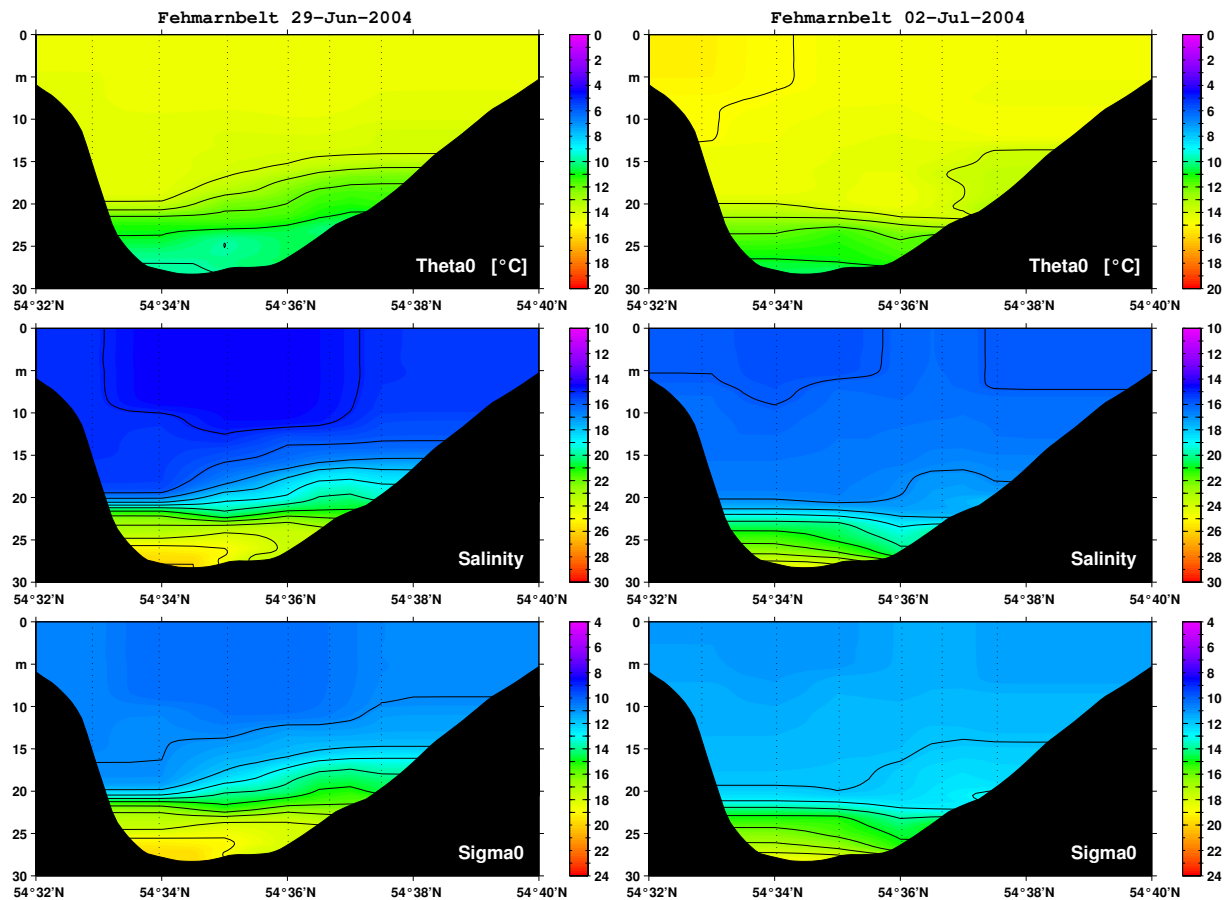


Figure 4.4: Temperature, salinity and density along the Fehmarnbelt section (C section). (left) First occupation, (right) second occupation.

#### L section

Along the way from the western part of the cruise around Fehrman Belt to the eastern most station off Sassnitz a decrease in temperature, salinity and density can be seen. The clear signal

of water with North Sea origin can be identified all along the bottom. An intrusion of colder water at mid-depth (order 20 to 30m) can be seen in the Arkona Basin.

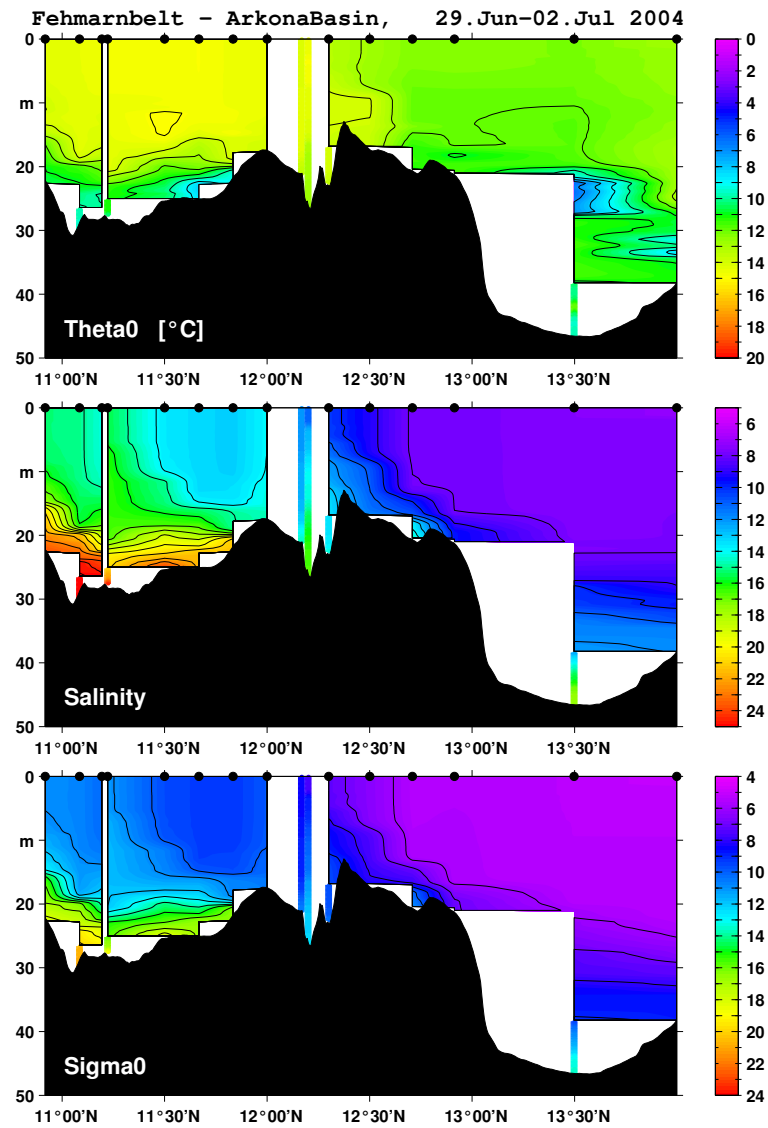


Figure 4.5: Temperature, salinity and density along the zonal section (L section).

## Kadett Ridge section

Crossing the Kadett Ridge quite one can identify the North Sea Water signal from the salinity stratification. However, the vertical gradients are diminished compared to the Fehmarnbelt section. Overall the salinity is much lower than in the Fehrmanbelt section.

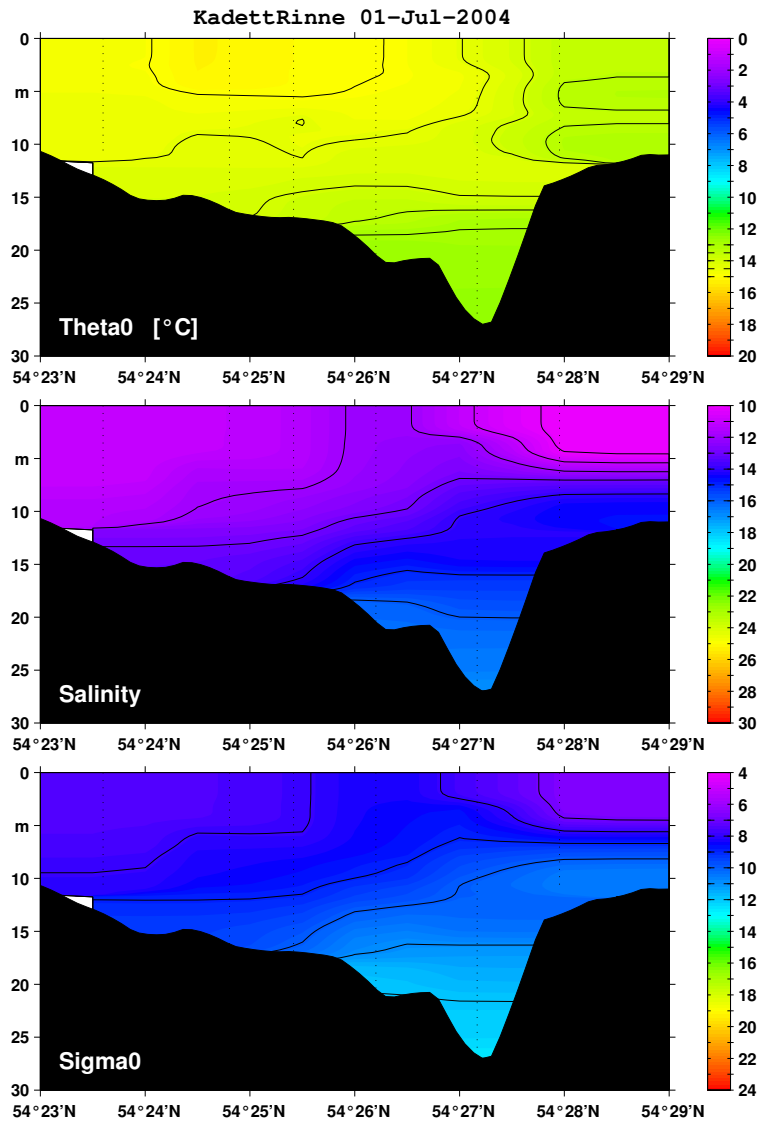


Figure 4.6: Temperature, salinity and density section Fehmarnbelt (C section). (left) First occupation, (right) second occupation.

### 4.3.2 ADCP - current profiles

During the cruise there were no heading information recorded in the appropriate files and heading information which is needed to process the data have been retrieved from the DATADIS data. However, allocating the right heading to the ADCP sample was tricky as there were in addition certain synchronization problem between the ADCP clock and the DATADIS clock.

Both occupation of the Fehmarnbelt (C section) showed outflowing water more or less over the whole section. No core of the inflowing water at the bottom, which is typically found, can be seen.

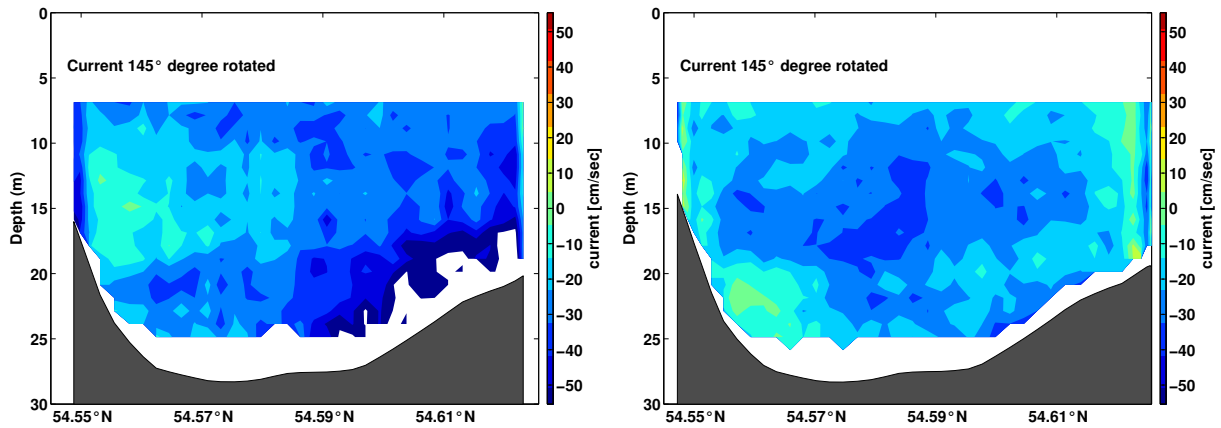


Figure 4.7: Currents (rotated to align with the bathymetry (145°) in Fehmarnbelt (C section). (left) First occupation, (right) second occupation.

The Kadett ridge section shows eastward flow at depth, probably associated with the spreading of high salinity water of North Sea origin.

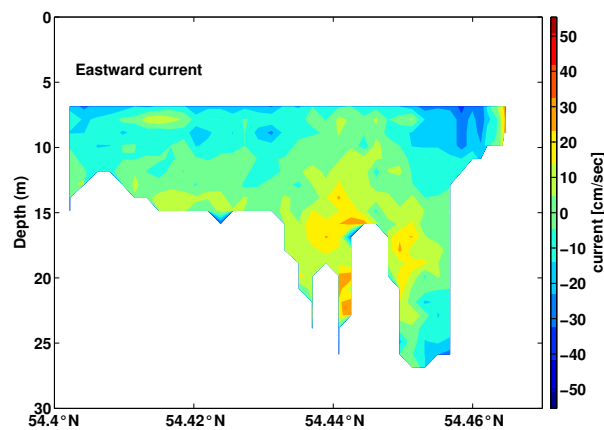


Figure 4.8: Eastward currents for Kadett Ridge section.

# Chapter 5

## Equipment/instruments

Mooring deployment site V431 is located in the military zone of Marienleuchte at the southeastern opening of the Fehmarnbelt. Water depth is about 29m. V431 consists of a Workhorse ADCP (300kHz) and a self containing T/S recorder of type SBE-MicroCat.

Table 5.1: V431: Summary on 7th recovery and 8th launch of trawl resistant bottom mooring V431.

year; time (UTC)	latitude	longitude	depth	comment
29.06.2004; 16:01				recovery, after several release commands have been send. Successful after sending command near the surface.
02.07.2004; 10:38	54°31.343'N	11°18.223'E	28.2 m	deployed, no comments

During the maintenance days (16.09. and 17.09.) data has been uploaded from the mooring instruments (MicroCat, ADCP). Maintenance include checking for possible cracked etc., cleaning of instruments and sensors. New batteries were installed in the releaser, ADCP had battery exchange on 23 January 2004, MicroCAT on 16. September 2003. Finally the shield is assembled again and made ready for the next deployment

### 5.1 CTD/Rosette and Salinometer

During AL240 an OTS-Multisonde was used with dissolved oxygen and chlorophyll (fluorometer) sensors attached. The frame of the sonde allow to mount 12 sampling bottles. As the bottle samples are used for salinity calibration only (oxygen was not calibrated) we used/attached on most stations only two bottles. An electronic thermometer and a pressure sensor have been mounted on these two bottles to verify the release depths. Temperature and pressure sensors of the OTS sonde have been lab calibrated in 2001 and these coefficients are used during AL240. From the standard calibration of the conductivity cell a preliminary (uncalibrated) salinity is

calculated. The salinity is later calibrated using the bottle samples salinities measure with a Beckman type salinometer.

The thermosalinograph is an automated sea surface temperature and salinity measurement system. The measurements are made on board and the ship uses a water intake. A conductivity cell and a thermistor cell provide conductivity and temperature measurements. Salinity is derived from these two parameters conductivity and temperature. The ship's position is given by a GPS. A computer makes the data acquisition, data processing, recording, and controls the real-time transmission of the data. The thermosalinograph (TSG) on ALKOR is a Salzgitter Elektronik and permanently installed. It measures the water temperature and salinity from about 4m depth. The data is streamed into DATADIS. For the calibration of the thermosalinograph water samples have been taken for each CTD station. This revealed an offset of about 0.1 in salinity between TSG and samples. A temperature offset could not be detected.

We started to measure the water samples with the Beckmann-Salinometer on the second cruise day in order to adapt the samples to lab-temperature. But before starting with the measurements of the sea water samples the salinometer was calibrated with IAPSO Standard Seawater which has an precisely known electrical conductivity ratio. Possible trends in the conductivity sensor of the Beckman salinometer is estimated from a number of measurements of a reference water. We used a volume of Baltic Sea water which was drawn on the first day. This sample is called 'substandard' as it is used like a standard. Then the first substandard measurement was done. After measuring a few bottle samples the substandard is measured again. This has to be repeated periodically after five measurements. Plotting substandard salinity versus the time of

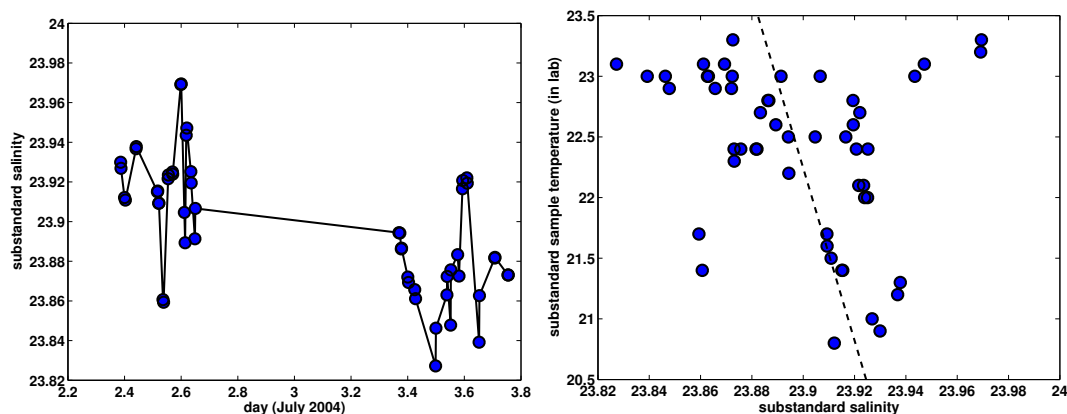


Figure 5.1: (left) Substandard salinities versus time of measurement in lab. (right) Substandard salinity versus temperature of the sample in lab. A best linear fit (broken line) and the regression equation is given.

the measurement (Figure 5.1, left) reveals a 'jump' in the salinity between the two days of the measurements. A possibility for the 'jump' might be different temperatures of the samples on day 2 and day 3. However, a clear linear dependency between the samples temperature and the measured salinity can not be seen (Figure 5.1, right). The overall average value for the substandard was  $23.8979 \pm 0.033$  (median 23.8995) and we see the 0.033 as the uncertainty in the salinities measure with the salinometer.



The difference between CTD and bottle samples is shown versus depth in figure 5.2 (left). In general largest difference, up to -0.8 (CTD is 0.8 higher than bottle sample salinity), occur. These difference can be explained by the difference in sampling depth between CTD (lower) and bottles (rosette is higher up in the water column). The CTD sensor is deeper in the water column and samples the typical more saline water at greater depth. We decided not to apply any corrections from the comparison between CTD and bottle samples as only a few value can be assumed to sample the same body of water.

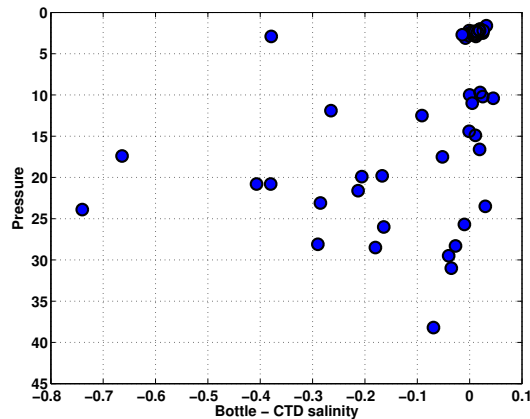


Figure 5.2: Difference between bottle sample salinity and CTD salinity versus depth (pressure).

For the calibration of the thermosalinograph water samples have been taken for each CTD station. This revealed an offset of about 0.1 in salinity between TSG and samples. No temperature offset could be detected.

## 5.2 Underway Measurements

### 5.2.1 Datadis

ALKOR has a central data collection system, called DATADIS. Here data from a number of sources (sensors) is merged into a single file which can be used from other devices or/and stored for later processing. Recently there was an 'update' of the DATADIS system by Maritec Engineering. Apparently, the old BW monitors in the labs were removed but unfortunately not replaced. Currently only one monitor is available in the 'dry lab'. In addition a number of shortcomings were found during our cruise:

- There is no UTC (e.g. from the GPS system) available at the output (screen/file).
- Currently there is no depth sounding (SIMRAD) at the output (screen/file).
- There is only a monitor in the 'dry lab' which makes the reading of critical data during work at deck sometimes laborious.

## **5.2.2 Navigation**

ALKOR has a GPS navigational system as well as a gyro compass available. Unfortunately the data is only in part fed into the DATADIS system and therefore the informations are not readily available for other devices (see DATADIS section).

## **5.2.3 Meteorological Data**

ALKOR is well equipped with meteorological sensors measuring air temperature, wind (speed and direction), wet-temperature, air-pressure, shortwave radiation. However, the longwave radiation sensor does not deliver any data at all. Radiation sensors are cleaned at the beginning of the cruise.

## **5.2.4 Echo sounder**

During AL 240 ER 60 SIMRAD echo sounder measured the depth. Unfortunately the instrument is yet not implemented into the DATADIS system and besides its display in the drylab, the data is stored at an instrument own hard disc. Measured depth are based on the sound speed of  $1453 \text{ m}^2 \text{ s}^{-1}$  as calculated from a temperature ( $8^\circ\text{C}$ ) and salinity (11)

## **5.2.5 Thermosalinograph**

The thermosalinograph (TSG) on ALKOR is permanently installed at about 4m depth and a S/MT 148 type of Salzgitter Elektronik GmbH. TSG data is directly fed into the DATADIS. Calibration was done after the cruise through bottle samples.

## **5.2.6 Vessel mounted ADCP**

A 300 kHz workhorse ADCP from RD Instruments was mounted in the ships hull. After a number of recent improvement in terms mounting the instrument (ALKOR cruise AL04/03) the data was still questionable, in particular a number of large data gaps near the bottom occurred. The vmADCP is used with bottom tracking mode. At AL240 no heading data was recorded and the heading was retrieved after the cruise from the recorded navigational data. However, there is a problem in allocating the exact time of the heading to the sample number of the ADCP and substantial errors are possible.

# Chapter 6

## Acknowledgment

Herzlichen Dank an Kapitän Jan Lass und die Offiziere Andreas Pooker, Rainer Nannen und Peter Strehlow sowie der gesamten Besatzung der ALKOR für ihre professionelle Unterstützung und die nette Atmosphäre an Bord. BASEWECS ist ein BMBF Projekt das zum DEKLIM Programm gehört und die Fördernummer 01LD0025 besitzt.

# Chapter 7

## Appendix

```
FileName    = ifmk_2004_06_info.ctd
Cruise     = NF SS 2004
Instrument  = OTS
StartDate   = 2004/06/29
EndDate    = 2004/07/02
Columns     = NR:LAT:LON:D:YY:MM:DD:HH:lg:fb:mr:rg:kd
 1  54.6074 10.9173 24 2004 06 29 9.53 1 0 0 0 0
 2  54.5925 11.0848 32 2004 06 29 10.43 1 0 0 0 0
 3  54.5483 11.1639 13 2004 06 29 11.17 0 1 0 0 0
 4  54.5660 11.1832 27 2004 06 29 11.53 0 1 0 0 0
 5  54.5841 11.2063 27 2004 06 29 11.88 1 1 0 0 0
 6  54.6002 11.2247 27 2004 06 29 12.25 0 1 0 0 0
 7  54.6112 11.2418 24 2004 06 29 12.65 0 1 0 0 0
 8  54.6249 11.2576 20 2004 06 29 12.95 0 1 0 0 0
 9  54.5202 11.3052 27 2004 06 29 14.35 0 0 1 0 0
10  54.3999 12.1670 20 2004 06 30 6.42 1 0 0 0 0
11  54.5342 12.3008 22 2004 06 30 7.50 1 0 0 0 0
12  54.6338 12.5008 17 2004 06 30 8.50 1 0 0 0 0
13  54.7213 12.7087 21 2004 06 30 9.48 1 0 0 0 0
14  54.8077 12.9142 21 2004 06 30 10.55 1 0 0 0 0
15  54.9172 13.4973 46 2004 06 30 12.70 1 0 0 0 0
16  54.7854 13.9986 39 2004 06 30 14.67 1 0 0 0 0
17  54.3933 12.3153 13 2004 07 01 9.07 0 0 0 0 1
18  54.4134 12.2794 17 2004 07 01 11.50 0 0 0 0 1
19  54.4236 12.2563 18 2004 07 01 11.83 0 0 0 0 1
20  54.4367 12.2310 26 2004 07 01 12.18 0 0 0 0 1
21  54.4528 12.1997 26 2004 07 01 12.52 1 0 0 0 1
22  54.4659 12.1665 12 2004 07 01 13.00 0 0 0 0 1
23  54.3586 12.0003 18 2004 07 02 6.33 1 0 0 0 0
24  54.3502 11.8336 22 2004 07 02 7.05 1 0 0 0 0
25  54.3507 11.6670 25 2004 07 02 7.75 1 0 0 0 0
26  54.4505 11.5000 26 2004 07 02 8.67 1 0 0 0 0
```

27	54.5223	11.3038	28	2004 07 02	9.78	0	0	1	0	0
28	54.5474	11.1639	12	2004 07 02	10.57	0	1	0	0	0
29	54.5672	11.1835	28	2004 07 02	10.83	0	1	0	0	0
30	54.5838	11.2089	28	2004 07 02	11.17	1	1	0	0	0
31	54.6004	11.2248	28	2004 07 02	11.43	0	1	0	0	0
32	54.6111	11.2392	24	2004 07 02	11.73	0	1	0	0	0
33	54.6257	11.2583	20	2004 07 02	12.08	0	1	0	0	0