Cruise Report
F.S. ALKOR Cruise No. 223

Dates of Cruise: 07.07. - 09.07.2003

Projects:
BASEWECS
and
Student course in phys. oceanogr.

Areas of Research: Physical oceanography
Port Calls: Warnemünde, 07.07.-08.07.2003
Institute: Institut für Meereskunde, Kiel, Germany
Chief Scientist: Dr. Johannes Karstensen
Number of Scientists: 11

Contents

Chapter 1

Scientific peronal

Cruise code: AL223
Cruise dates: 07.07. - 09.07.2003
Port calls: Kiel - Warnemünde - Kiel

Table 1.1: Scientific personal on AL 223
Institut für Meereskunde an der Universität Kiel, Germany

Name	Institute	Function
Karstensen, Dr. Johannes	IFMK	Chief scientist
Macrander, Andreas, Dipl.-Oz.	IFMK	Phys. Ocean.
Begler, Christian	IFMK	Phys. Ocean.
Blöhdorn, Björn	IFMK	Phys. Ocean.
Smarz, Christopher	IFMK	CTD lab.
Melanie Herrmann	IFMK	Student
Henning May	IFMK	Student
Merle Resow	IFMK	Student
Meike Linnenschmidt	IFMK	Student
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Chapter 2

Scientific Background

ALKOR cruise AL223 is one of the three annual cruises performed since October 2001 within the BMBF project (subproject C) - Baltic Sea Water and Energy Cycle Study (BASEWECS) - (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.

In general two section are occupied: one section crossing the Fehmarnbelt (section 'C') and one section following the deedest 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.

In addition, a mooring site (V431) is maintained, located at the southeastern end of the Fehmarnbelt. The mooring consists of a Workhorse-ADCP (300 kHz), and a self containing CTD (Type MicroCat) mounted in a commercial shield (Flotation Technology).

Besides the scientific motivation, the cruises are utilized for educational purposes. Undergraduate students are introduced into modern observational techniques of physical oceanography and in the basics of instruments calibration and interpretation of the observations. In addition it should give the students a chance to explore/investigate the Baltic Sea, their ocean at the front door.

Chapter 3

Cruise Narrative

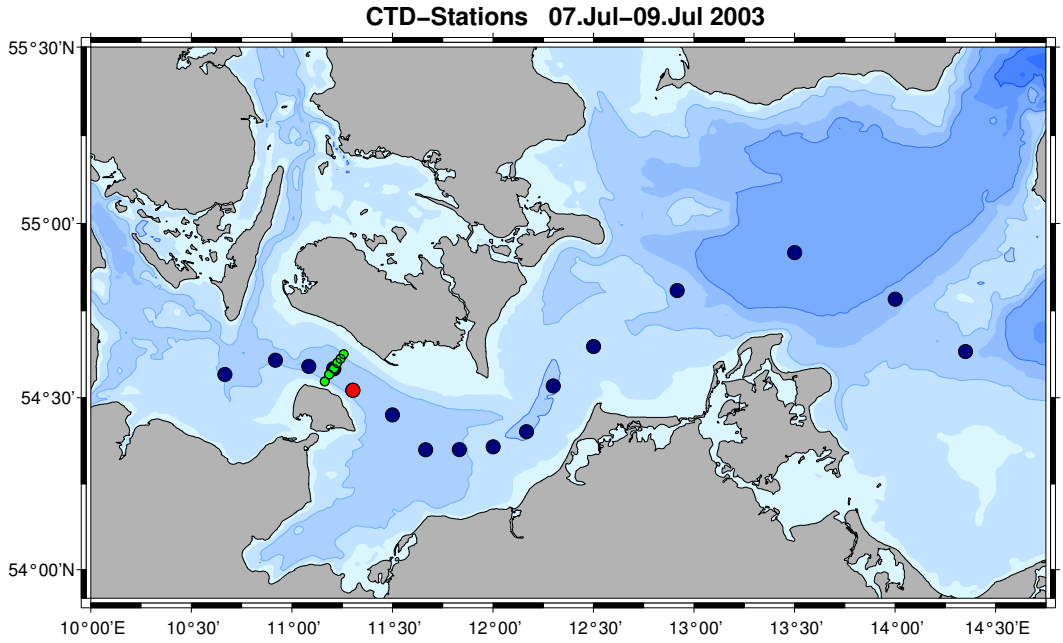

Figure 3.1: ALKOR 223: Location of CTD stations on zonal (L) and Fehmarnbelt section (C). The mooring location (V431, former V399) is at the southeastern opening of the Fehmarnbelt. Port call Warnemünde 07.07.2003.

DAY 1:
RV ALKOR left IfM pier for cruise AL223 on Monday the 07.07.2003 at 08:15 local time. The weather was cloudy but cleared later the day. All equipment was installed and recording/ready for recording. The CTD rosette and the vmADCP where still on board from the cruise before (AL222). During AL222 the bottom alarm sensor of the CTD was damaged (bent) in heavy weather. However, the sensor still worked well during AL223.

After a safety instruction from the first officer an introduction into the scientific program of the following three days was given. The first CTD test station in the Kiel bight was

reached at about 10:15 (station: P01). This station is also the western most station of the 'L' section from Vindsgrav into the Arkona basin.

The ADCP was switched on at 07.07.2003 07:52 (local time) while the ship was still on IfM pier. The instrument recorded during the whole cruise, except the port call at Warnemünde. It was observed during earlier cruises that the ADCP signal was disturbed through echoes and the signal was difficult to detect. For the AL222 cruise an improved ADCP mounting was tested: A foam cover was mounted on top of the ADCP and the mounting plate was widened to allow for better ray transmission into the water. A foam cover on top was trial tested during the February cruise (AL215), while the improved version at AL223 and 224 worked little better.

Next two stations after the test station were again part of the zonal 'L' section (P02 u. P03). Then the six stations of section 'C' (Fehmarn Belt) are recorded. After finishing, we steamed towards the mooring site (V431) for the fourth recovery of the WH-ADCP and MircoCat since October 2002. After sending the release code it took some 20min. until the flotation was spotted. It was hooked at 13:31 UTC, exactly at its launching position of Feb. 2003 (54°31.33N/ 11°18.23E). The frame and flotation where in good shape. After un-mounting the ADCP Plexiglas cover it was discovered that some see stars, etc. had chosen the place to be there home one laying even one of the beams. They presumably entered through the small hole (diameter 12mm) in the Plexiglas cover. However, from a preliminary view on the data it appears they did not influence data recording/quality. From the first quick look, both instruments (WH-ADCP, MicroCat) registered continuously. After a CTD profile at the mooring site ALKOR steamed towards Warnemünde and was on Pier B2 on 07.07.2003, 19:00 (local time).

DAY 2:
On the 08.07.2003 at 08:00 (local time) we left Warnemünde to steam for P16, the first station of the eastern part of the zonal 'L' section. The weather was sunny. Station work was started at 07:23 UTC. During the day seven CTD stations could be occupied and the eastern most station (P21) of the 'L' section was finished at 17:39 UTC. During the following night we steamed northwest of Warnemünde to occupy the remaining western stations of 'L' section and to deploy the mooring V431 (fifth re-deployment). During transit the ADCP recorded continuously.

DAY 3:
Station work on the third day (09.07.2003) started northwest of Warnemünde at 04:30 UTC with a first CTD. We reached the V431 mooring site at 7:46 UTC and the for launching already prepared instrument was launched at 8:02 UTC at 54°31.31N/ 11°18.23E with water depth of 28.6m. This was the fifth deployment of V431. After a calibration CTD at the mooring site the 'C' section crossing the Fehmarnbelt was re-occupied and a ADCP section followed. We steamed to back to Kiel and arrived at 17:00 (local time) at IfM Pier.

Chapter 4

Preliminary results

4.1 Mooring V431: fourth deployment period

The mooring site V431 is located at 54°31.31N/ 11°18.23E which is at the eastern opening of the Fehmarn Belt. The V431 consists of a bottom-shield mounted upward looking ADCP and a MircoCat SBE27. It is maintained three time as year during the BASEWECS cruises.

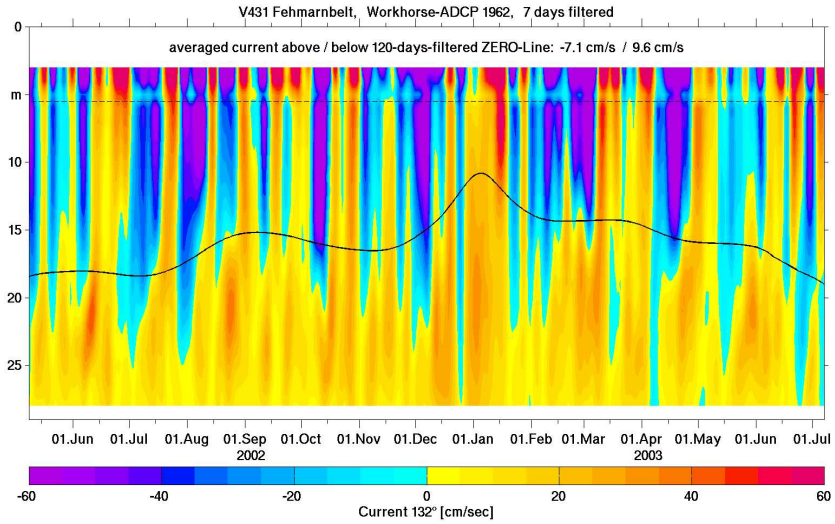

Figure 4.1: Mooring V431, upward looking Workhorse 300kHz ADCP - velocity component along 132°. Complete time series since deployment May 2002. Averaged over 168 hours (7 days).

V431 a replacement RCM equipped mooring V399 that was installed at that position in February 1999. The location was chosen as it is assumed to be a good monitoring site for the upper outflowing and lower inflowing branch of the Baltic.

The current near the bottom is nearly always into the Baltic while upper layer currents show much higher fluctuations between in and outflow situations. This is presumably

because of variable wind forcing generating direct wind driven as well as pressure gradient driven currents. A long term average zero velocity line is shown as well as upper rand lower layer currents.

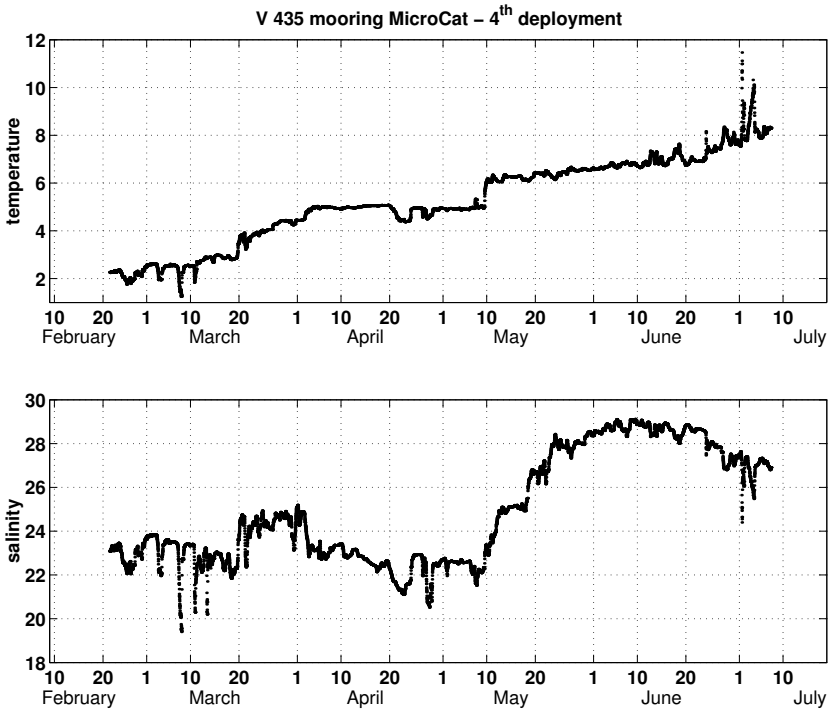

Figure 4.2: Mooring V431, fourth deployment period (upper) temperature and (lower) conductivity.

Temperature and salinity near the bottom are variable and follow the warming trend of the spring season summer (with a certain time lag). A noticible feature is the sudden increase in salinity around 10. to 15. May 2003. The temperature, salinity and density

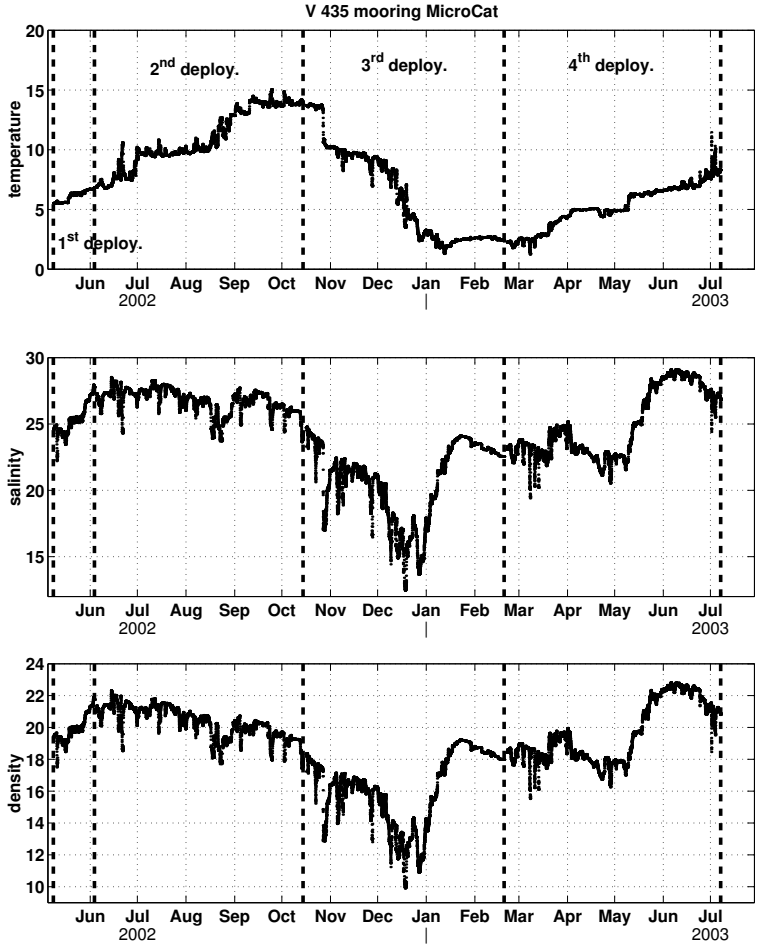

Figure 4.3: Mooring V431: Temperature (upper), salinity (middle), density (lower) recordings for the whole deployment period.

during the whole mooring period of V431 is shown in the figure. Noticeable a stepwise in and decreases of the temperature and salinity.

In particular a strong event in temperature was a decrease of more than 4°C at the end of October 2002. It can be associated with a strong wind event at the 27. to 28. of October with wind speed of 8 to 9 bft (figure 4.4, upper left). The whole water column was cooled down nearly to the surface air temperature of about 8°C (figure 4.4, upper right).

The salinity showed a very strong increase at the beginning of January 2003 associated with a saltwater throughflow of North Sea origin, another event occurred in the second week of May 2003. Nearly all of December 2002 the western Baltic was influenced through eastern winds (figure 4.4, lower) while in January 2003 westerly winds dominated. A typical situation that promotes the inflow of water of North Sea origin.

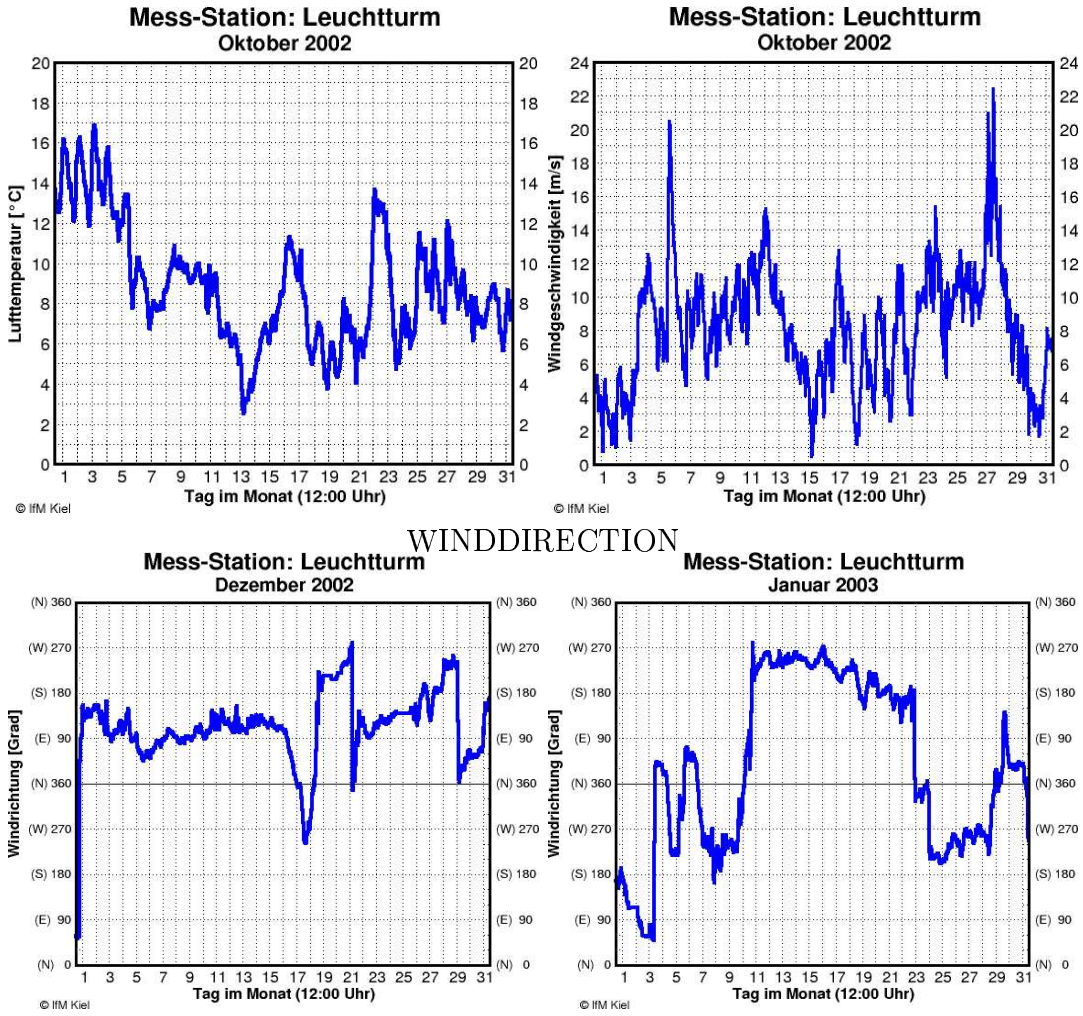

Figure 4.4: (upper) Air temperature and wind speed at location IfM Leuchtturm in October 2002. Note the high wind speed event at the end of the October associated with a drop in temperature at the bottom mooring location. (lower) Wind direction at location IfM Leuchtturm December 2002 (left) and January 2003 (right). Note the prevailing eastern (left) and western (right) wind directions.

4.2 Meteorological observations

During AL 223 the western Baltic was under the influence of a high pressure system (figure 4.5). The weather was calm, with only scattered clouds and low wind.

The weather chart of Monday (07.07.2003) shows that there were laying three low pressure areas above Greenland, Iceland and in the north of Canada. But our area wasn't influenced by them. It was influenced by the Azure high pressure area which was moving towards the north during the three days. So we had nearly constant pressure around 1015hPa during all three days.

On Tuesday (08.07.2003) the high pressure area moved north and the deep pressure area above Canada separated. But this process didn't affect our area that much, so there were again no sudden changes in the weather situation.

On Wednesday (09.07.2003) the three low pressure areas united above Iceland, Canada and Greenland, so there has been a little pressure decrease approximately 3hPa in our area.

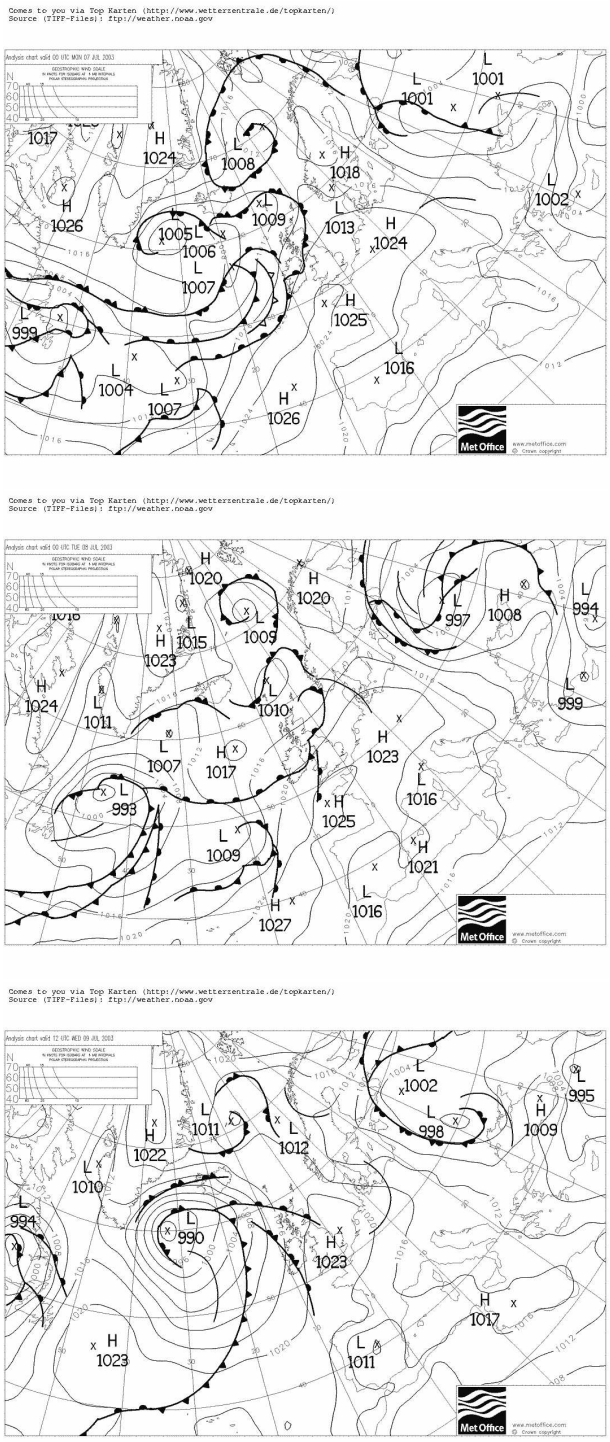

Figure 4.5: Surface pressure from UK Met office (Brackwell) during AL223 .

The time series of shortwave radiation, long wave radiation, wind speed, air temperature, sea surface temperature, and relative humidity are shown in figure 4.6. Besides the daily cycle the smaller fluctuations in short wave radiation are caused by clouds. Long wave radiation variability is more complex and related to the water temperature and lower cloud coverage. The wind speed was on average around 5 to 6 m/s and increased towards the end of the cruise. The air temperature was around 16°C and did not showed a daily cycle as expected over sea. Water temperature were a little higher then air temperatures. Relative humidity which was around 90%.

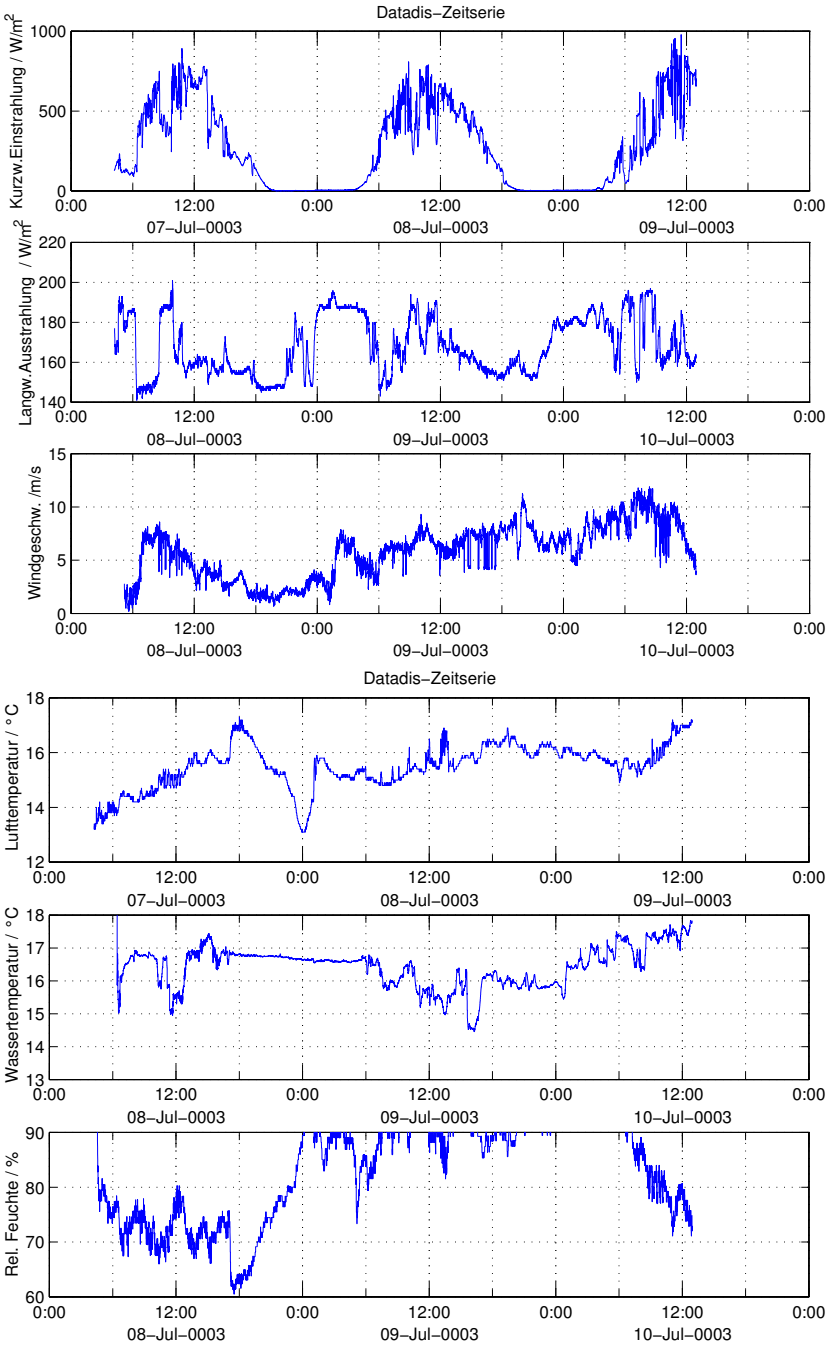

Figure 4.6: Time series of meteorological parameters. From upper to lower: shortwave radiation, long wave radiation, wind speed, air temperature, sea surface temperature, rel. humidity.

4.2.1 Hydrography and currents along Fehmarnbelt section (C)

Hydrographic section 'C' probing the Fehmarnbelt was occupied two times (Figure 4.7), on the 7. July and the 9. July 2003.

Intense stratification in temperature and salinity can be observed through the inflowing water of North Sea origin at the bottom and the outflowing Baltic Sea water. The water was warmer and less saline during the second occupation.

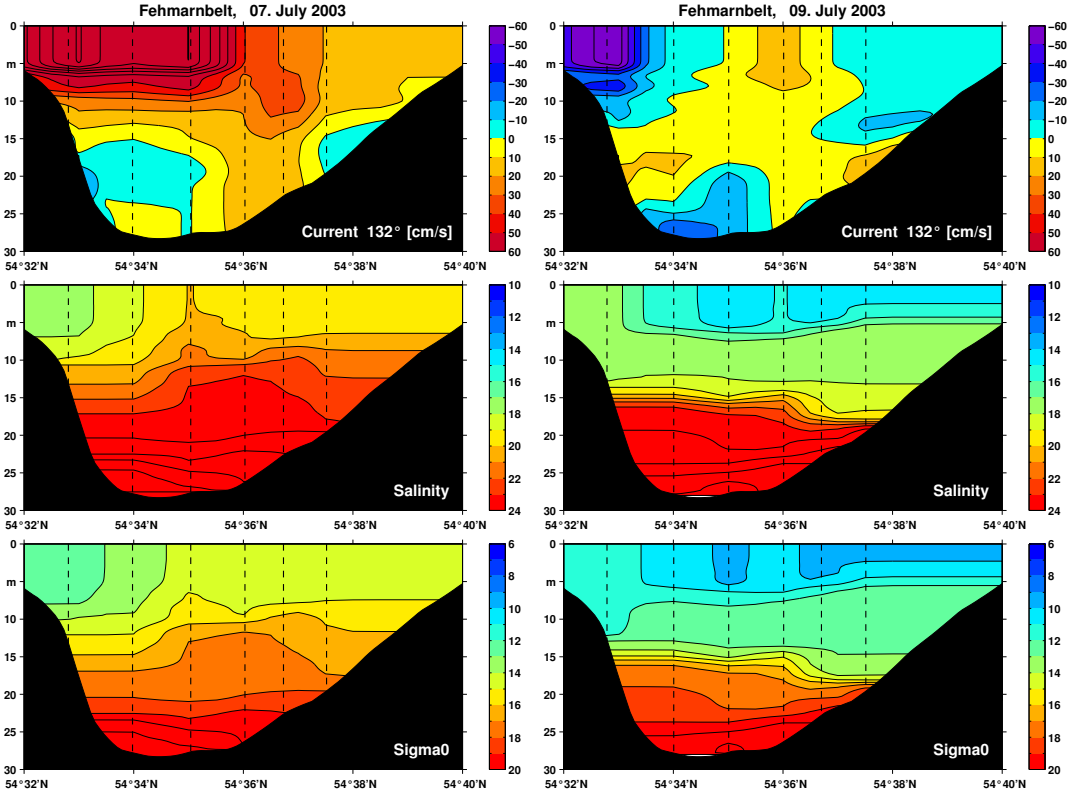

Figure 4.7: Current (upper) normal to the section and salinity and temperature along section 'C' through the Fehmarnbelt on the 7. July 2003 (left) and the 9. July 2003 (right).

4.2.2 Hydrography and currents along the Zonal section (C)

The long zonal 'L' section is a composite from stations taken during all 3 days of the cruise.

As a general trend, the water column is getting colder and less saline towards the east but also less dense. This is mainly an effect of the fershwater surplus from run-off and precipotation excess. At depth the inflowing saline North Sea water can be seen, with particular high salinities in the Arkona Basin. The last inflow event was in January 2003.

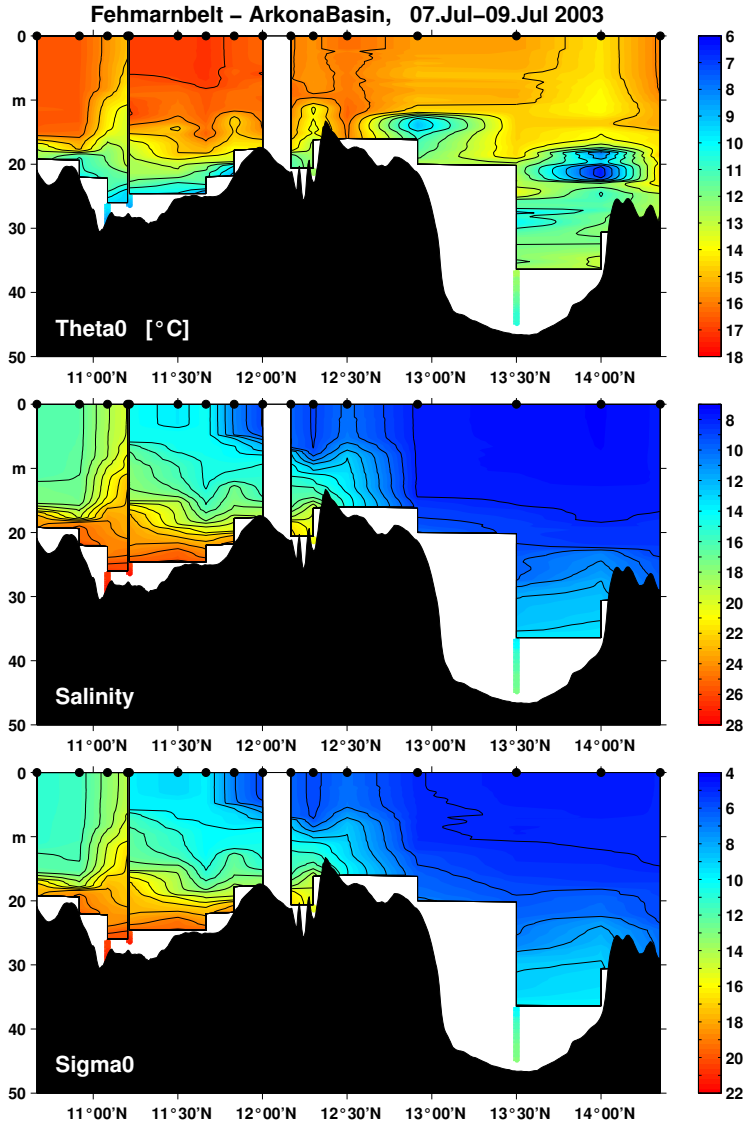

Figure 4.8: Quasi zonal hydrographic section 'L'.

Chapter 5

Scientific equipment/mooring equipment

5.1 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 29m. V431 consists of a Workhorse ADCP (300kHz) and a self containing T/S recorder of type SBE-MicroCat. In parallel, from July 2002 to April 2003 mooring V399 recorded velocities at 26 and 27m depth, using current meters of type Aanderraa RCM4 and RCM9, respectively. Recovery of V399 was planned for October 2002 but failed because of a missing head buoy. However, divers from BSH recovered the mooring in April 2003.

Table 5.1: V431: Summary on 4th lauch/recovery and 5th launch of trawl resistant bottom mooring V431.

year; time (UTC)	latitude	longitude	depth	comment
21.02.2003; 07:40	54°31.33'N	11°18.23'E	29 m	deployed
07.07.2003; 13:34	54°31.33'N	11°18.23'E	29 m	recovered
09.07.2003; 08:02	54°31.31'N	11°18.23'E	28.6 m	deployed

5.2 CTD/Rosette and Salinometer

During AL223 an OTS-Multisonde was used with dissolved oxygen and chlorophyll (fluorometer) senors 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.

Senor Calibration

CTD temperature

Temperature and pressure have been lab calibrated in 2001 and these coefficients are used during AL223.

Substandard repeated measurements

The repeated measurements of the substandard are shown in figure 5.2. gives a time series of substandard measurements that may allow to detect temporal trends in the salinometer measurements. The error bar within the salinometer plot (see figure 1) lies in the order of 0.08. There is no proof for drift of the salinometer determinable from these data. Therefore there is no need for a correction of the data.

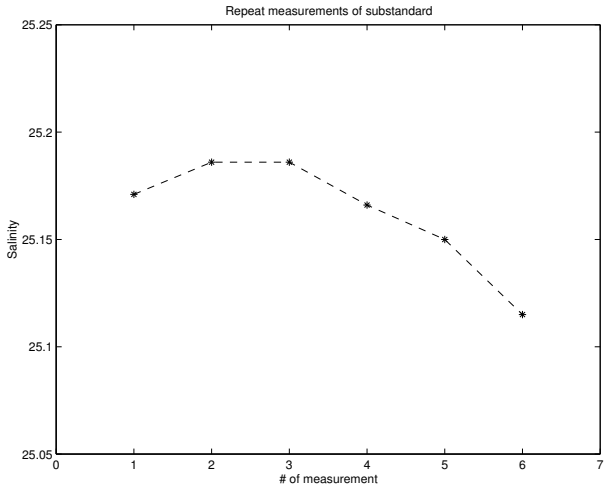

Figure 5.1: Repeat measurements of Substandard during AL223

CTD salinity

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. Accuracy of the Beckman salinometer is estimated from a number of measurements on the same sample, the so called 'substandard'. This is a mixture of what is left from the first few bottle samples. First salinometer measurements were done on the second cruise day to allow the samples to adapt to the lab-temperature. First, the salinometer was calibrated using IAPSO Standard Seawater. Then the first substandard measurement was done. After measuring a few bottle samples again the substandard is measured and so forth (see above).

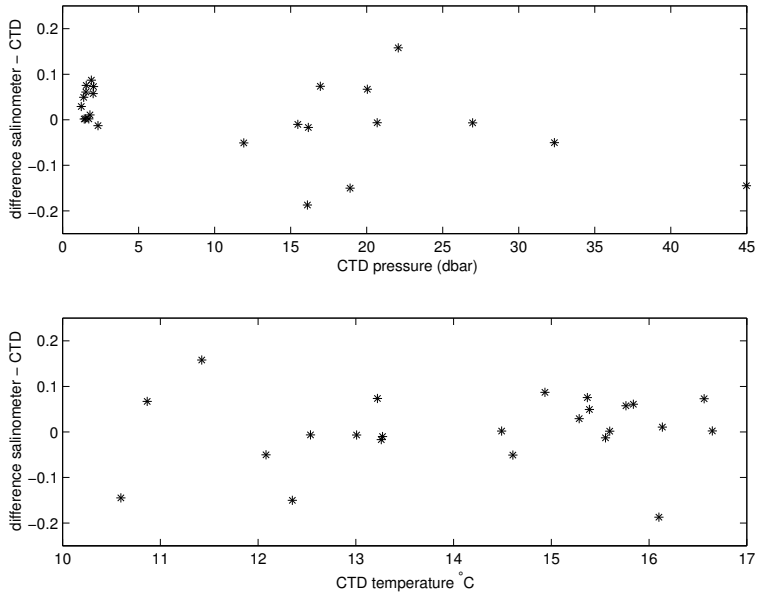

Figure 5.2: Difference between salinity as measured with the salinometer and with the OTS sonde (CTD): (upper) in relation to CTD pressure, (lower) in relation to CTD temperature.

Thermosalinograph

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.

5.3 Underway Measurements

Datadis

A central underway data acquisition system, called DATADIS, is installed on board ALKOR that gathers all navigation, depth, data from meteorological sensors, and data from the thermosalinograph. Based on the DATADIS the data is distributed for display into the individual labs, provided at ports and archived into files.

Navigation

ALKOR has a GPS navigational system as well as a gyro compass available. Data is fed into DATADIS and from their available for other devices.

Meteorological Data

ALKOR is well equipped with meteorological sensors measuring air temperature, wind (speed and direction), wet-temperature, air-pressure, long and shortwave radiation. Radi-

ation sensors are cleaned at the beginning of the cruise. The general maintenance of the radiation sensor is in the responsibility of IfM (Dr. K. Uhlig).

Echo sounder

Just before the AL223 cruise a SIMRAD echo sounder has been installed on ALKOR. The device however was not yet implemented into the DATADIS and depth where only on display and recorded in parallel on a notebook at the bridge. Unfortunately the data could not be retrieved from the notebook after the cruise and no depth data is available.

Thermosalinograph

The thermosalinograph (TSG) on ALKOR is a SeaBird and permanently installed. It measures the water temperature and salinity from about 4 m depth. The data is streamed into DATADIS.

Vessel mounted ADCP

A 300 kHz workhorse ADCP from RD Instruments was mounted for AL222 and used also at AL223. The ADCP was unmounted after the cruise and went back to the IfM lab. A number of problems reported in the past have been diminished due to a more sophisticated mounting. However, still the measurements have obviously erroneous velocities during steaming period of the ship. The vmADCP is used with bottom tracking mode. Navigational data comes from the DATADIS system of ALKOR, hence GPS and gyro compass. Absolute (earth coordinate) velocities are calculated using the vmDAS software provided through RD Instruments.

Chapter 6

Appendix

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ALKOR cruise 223: Station and sample log
Kiel-Kiel, 7-Jul-2003 to 9-July-2003

List of abbreviations:
St  : station no.
C   : CTD cast no., monotonically increasing during the cruise;
      all casts to near bottom if not indicated else
P   : position no. of practical course
Wd  : water depth from sounding/m, based on 1470 m/s
Id  : max. depth of instrument
In  : (major) Type of instrumentation or mooring or equipment
S   : type of samples taken ( see below)
x     1 vADCP    : way point vessel mounted RDI ADCP, 300 kHz
x     1 Datadis  : way point of on-line log of underway data,
x     2 OTS1     : CTD, CTD with O2 and fluorometer sensor,
x                  IFMK internal ID 1, 3x2.5 l bottle rosette attached
x     5 mooring : V431
P   : fixed position no. in student's course

Samples taken
S  : 6     salinity (for CTD calibration only)

Legend for hydrographic and vADCP sections
C  section across Fehmarnbelt
L  section along Vinds Grav, Fehmarnbelt, Kadetrinne to Arkona Basin

Date Time    St   C  P Latitude   Longitude   Wd Id In  S Remarks
year 2003
      UTC              North       East
MM DD hh mm            DD MM.MM   DDD MM.MM   m   m
X-------------------------------------------------------------------------
Day 1
07 07 06 15   -9 -9 -9 54 20.00   010 09.00  -9   0  1  0 sail Kiel, start vADCP
07 07 07 45   -9 -9 -9 54 29.00   010 17.00  21  21  1  0 WP
07 07 08 37  565  1  1 54 34.01   010 40.02  22  22  2  0 CTD test
07 07 09 38  566  2  2 54 36.48   010 55.08  23  23  2  0 L west, CTD
07 07 10 20  567  3  3 54 35.51   011 05.04  33  33  2  0 L, CTD
07 07 10 54  568  4  4 54 32.81   011 09.84  10  10  2  0 C, CTD
07 07 11 12  569  5  5 54 33.98   011 11.09  29  29  2  0 C, L, CTD
07 07 11 31  570  6  6 54 35.04   011 12.48  28  28  2  6 C, CTD
07 07 11 51  571  7  7 54 36.03   011 13.54  28  28  2  6 C, CTD
07 07 12 10  572  8  8 54 36.73   011 14.48  24  24  2  6 C, CTD
07 07 12 26  573  9  9 54 37.52   011 15.46  21  21  2  6 C, CTD
07 07 13 48  574 -9 10 54 31.29   011 18.18  28  28  5  0 L, CTD, recover mooring V431/04
07 07 17 45   -9 -9 -9 54 14.00   012 04.00  -9  -9  1  0 WP
07 07 18 15   -9 -9 -9 54 07.00   012 05.50  -1  -1  1  0 Warnemuende, end vADCP
```

```
Day2
08 07 06 00   -9 -9 -9 54 07.00   012 05.50  -1  -1  1  0 sail Warnemuende, start vADCP
08 07 06 30   -9 -9 -9 54 14.00   012 04.00  -9  -9  1  0 WP
08 07 07 23  575 11 15 54 24.11   012 10.04  22  22  2  0 L, CTD
08 07 08 25  576 12 16 54 32.02   012 18.01  23  24  2  0 L, CTD
08 07 09 58  577 13 17 54 38.84   012 30.04  18  17  2  0 L, CTD
08 07 11 46  578 14 18 54 48.50   012 54.98  22  20  2  0 L, CTD
08 07 13 53  579 15 19 54 55.02   013 30.02  48  46  2  0 L, CTD
08 07 16 00  580 16 20 54 47.01   014 00.02  39  37  2  0 L, CTD
08 07 17 35  581 17 21 54 37.98   014 21.02  32  30  2  0 L east, CTD
08 07 -9 -9   -9 -9 -9 54 46.97   013 30.10  -9  -9  1  0 WP

Day 3
09 07 -9 -9   -9 -9 -9 54 25.91   012 10.05  -9  -9  1  0 WP
09 07 04 30  582 18 14 54 21.48   012 00.06  18  18  2  0 L, CTD
09 07 05 18  583 19 13 54 20.98   011 49.97  22  16  2  0 L, CTD
09 07 06 00  584 20 12 54 20.97   011 39.95  26  26  2  0 L, CTD
09 07 06 59  585 21 11 54 27.01   011 30.03  26  26  2  0 L, CTD
09 07 08 05  586 22 10 54 31.28   011 18.23  29  28  2  0 L, CTD, launch V431/05
09 07 08 49  587 23 04 54 32.79   011 09.81  10  10  2  0 C south, CTD
09 07 09 14  588 24 05 54 34.01   011 11.12  29  29  2  0 C, CTD
09 07 09 33  589 25 06 54 35.01   011 12.50  28  26  2  0 C, CTD
09 07 09 50  590 26 07 54 36.01   011 13.48  28  27  2  0 C, CTD
09 07 10 05  591 27 08 54 36.70   011 14.51  24  22  2  0 C, CTD
09 07 10 19  592 28 07 54 37.51   011 15.43  21  20  2  0 C north, CTD
09 07 -9 -9   -9 -9 -9 54 29.00   010 17.00  21  21  1  0 WP to Kiel
09 07 15 00   -9 -9 -9 54 20.00   010 09.00  -9  -9  1  0 call Kiel
```