

# **Cruise Report**

## **F.S. ALKOR Cruise No. 268**

**Dates of Cruise: 05.10. to 07.10.2005**

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

Areas of Research: Physical oceanography

Port Call: Warnemünde (05.10.)

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

Chief Scientist: Dr. Johannes Karstensen

Number of Scientists: 11

Master: Jan Lass

# Chapter 1

## Scientific personal

Cruise code: AL268

Cruise dates: 05.10. – 07.10.2004

Port calls: Kiel - Warnemünde - Kiel

Table 1.1: Scientific personal on AL268: IFM-GEOMAR: Leibniz-Institut für Meereswissenschaften an der Universität Kiel, Kiel, Germany; CAU: Cristian Albrechts Universität Kiel, Kiel, Germany

Name	Institute	Function
Karstensen, Johannes	IFM-GEOMAR	Chief scientist
Schmidt, Sunke	IFM-GEOMAR	Phys. Ocean.
Neumann, Uta	IFM-GEOMAR	Phys. Ocean.
Smarz, Christopher	IFM-GEOMAR	CTD lab.
Jacob, Florian	CAU	student
Schwarzkopf, Franziska	CAU	student
Behrens, Erik	CAU	student
Block, Jana	CAU	student
Didwischus, Sven-Helge	CAU	student
Simon, Thorsten	CAU	student
Schürch, Mark	CAU	student

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## Chapter 2

# Scientific Background

ALKOR cruise AL268 was three day cruise. It was the second cruises in 2005 to maintain the long term observations in in the western Baltic. The purpose of the cruises was 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 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 is performed as well as continuously recording of current velocities using a vessel mounted ADCP. A mooring site (V431) is maintained (battery change, data read-out), 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).

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.

# Chapter 3

## Cruise Narrative

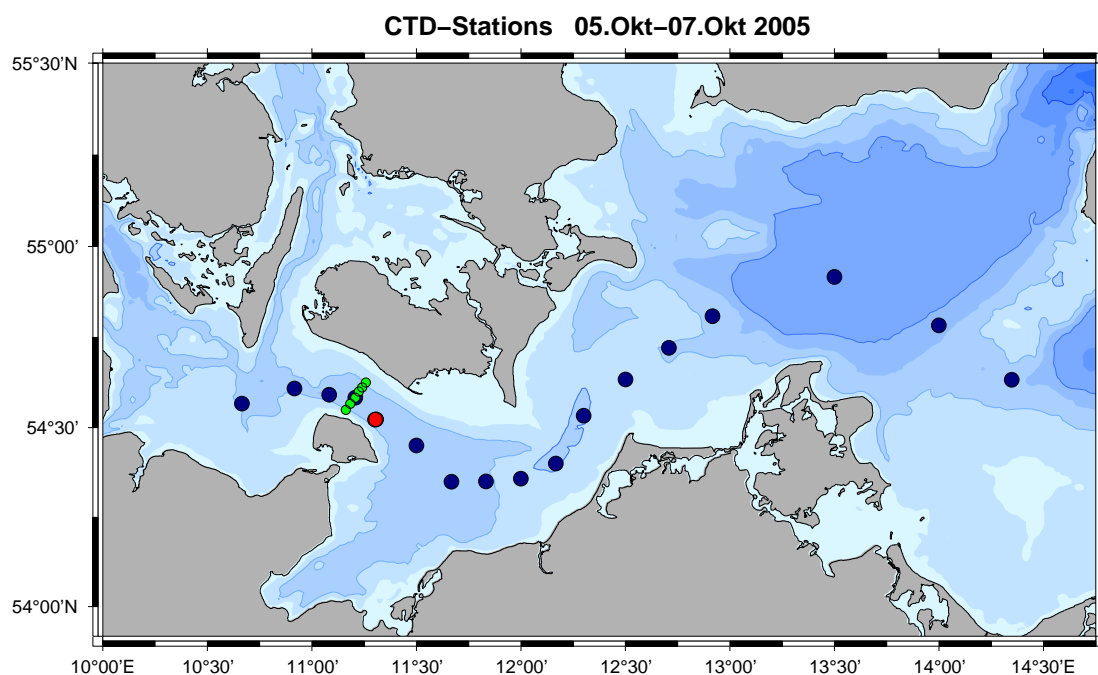


Figure 3.1: ALKOR 268 cruise track (black line, based on DATADIS recordings). Red dots are the CTD stations, black star is the location of the V431 mooring. AL268 had one port call for Warnemünde (05.10.2005)

DAY 1 (Monday, 05.10.2005):

We left IFM-GEOMAR pier (Westufer) at 08:00 (all times given in the narrative are ALKOR local time; MESZ) with 11 'scientists' on board, 6 of them were undergraduate students in physical oceanography, and one in geography.

Most equipment was set-up the day before the cruise (installation of computers, Salinometer). Except the ADCP which was set up during our sail to the first test station. As in earlier years the set up for the ADCP was a bit confusing in respect to COM port settings.

The first officer introduced the 7 students into the safety-on-board procedures and guided the students through the ship and its facilities. A brief introduction into the program for the next 3 days was given next.

A test station was performed to test the HydroBios CTD sonde. The oxygen sensor did not work and will be sent out for repair to HydroBios during ALKOR winter stop. A nice double-peak in chlorophyll-a was clearly visible.

At around 11:00 we started sampling the first two CTD stations for the zonal section ('L'). A rather large volume of water was collected at the station2, so called 'Substandard', which will be used on the following days to monitor the stability of the salinometer. Then the Fehmarnbelt section ('C') was sampled with a northward CTD section. After finishing the section, we headed for the V431 mooring at the southeastern opening of the Fehmarnbelt. On our way we did an ADCP section of the Fehmarnbelt heading southward to the 10m depth line with a constant speed of 10 kn. However, apparently there are still problems with the ADCP and the current setting for intensity minimum blanked the deeper part of the data out when the ship was too fast.

In the vicinity of the V431 mooring position a CTD cast was performed for calibration purposes. At 16:05 the release command was send and the mooring appeared shortly after that at the surface. No problems encountered during the mooring recovery.

Warnemünde Passagierkai was reached at 20:05. Customs came aboard and after clearance those who wanted to leave for a walk could did so.

#### DAY 2 (Tuesday, 06.10.2005):

We left at 08:00 Warnemünde to continue working on the L-section. It was a dusty but sunny morning and quite sea. At 09:30 we continued with sampling the L-section doing CTD work.

Measurements of the salinity samples (CTD, TSG) from the first day was planned. Samples are typically stored one day to allow for a temperature adjustment to lab temperature. However, again a problem with the Beckman salinometer appeared through extensive bubbles formation. After clearing the probe container with Mucosol and taking special care on a slow fill up of the probe-container the measurements went well.

During the day all CTD stations of the L-section east of Warnemünde were occupied. Last station was measured at about 20:00 and we slowly headed back to finish with work (CTD, mooring deployment) west of Warnemünde early Friday morning. In the evening, Jana Block gave a talk on salinity and method of determination in oceanology.

#### DAY 3 (Wednesday, 07.10.2005):

We started early (05:30) with a first CTD station as part of the L-section. Remaining bottle samples, mainly from the TSG, were analyzed with the Beckman salinometer.

After a calibration cast at the V431 mooring site the mooring V431 was redeployment the 11th time. Redeployment was at 07:20 UTC while instruments started recording three hours later as we did not expect to be at the site that early. The shield had lost paint over the last years and it is envisioned to pick up the shield in February 2006 and bring it to IFM-GEOMAR for maintenance. During that time a replacement using a test device Aanderaa (RDCP600) is envisioned.

After the mooring work we headed for the second hydrographic and ADCP Fehmarnbelt

sections. The scientific program was completed at 12:00. The vmADCP was unmounted at 13:00. ALKOR reached Kiel (IFM-GEOMAR pier Westufer) at 17:00.

# Chapter 4

## Preliminary results

### 4.1 Mooring V431: Tenth deployment period

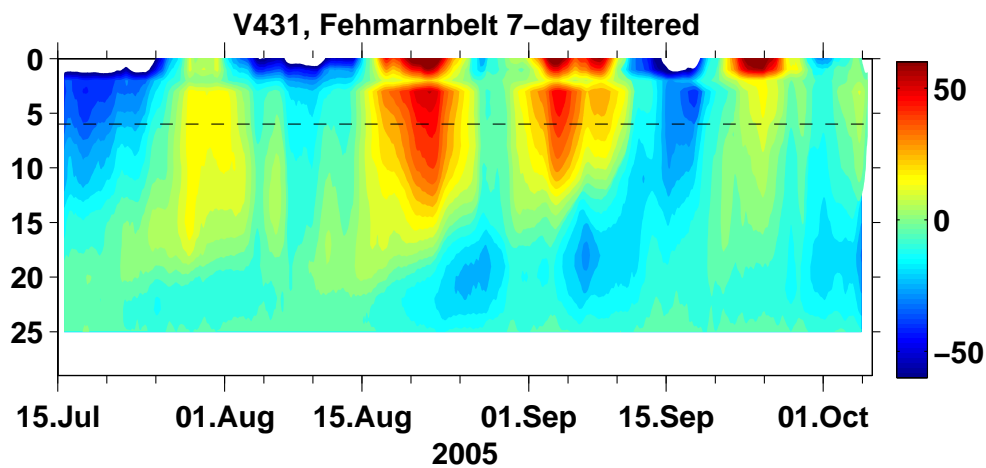


Figure 4.1: Mooring V431, upward looking Workhorse 300kHz ADCP - along bathymetry velocity (rotated to  $132^\circ$ ). Values are linear averaged over 7 days.

The ADCP is placed at the bottom (about 28m water depth) and measure upward looking. Data points are obtained in 1 m depth cells averaged over 0.5 hours, pinging every 0.5 minutes (30 seconds). A rotation of the velocities by  $132^\circ$  makes one component parallel and one perpendicular to the topography. The current component parallel to the topography is shown in the upper figure. Alternating currents of southeast/northwest directions can be seen. The minimum in fluctuations is at about 13 to 14m depth. Note, currents above about 6m depth are influence through the surface reflections (and side lobes) and the data is corrupt. The current fluctuations are mainly related to the wind forcing.

An interesting feature in the temperature and salinity time series are the high frequency fluctuations which occur order every 5 days or so. The fluctuations occurs predominately after the

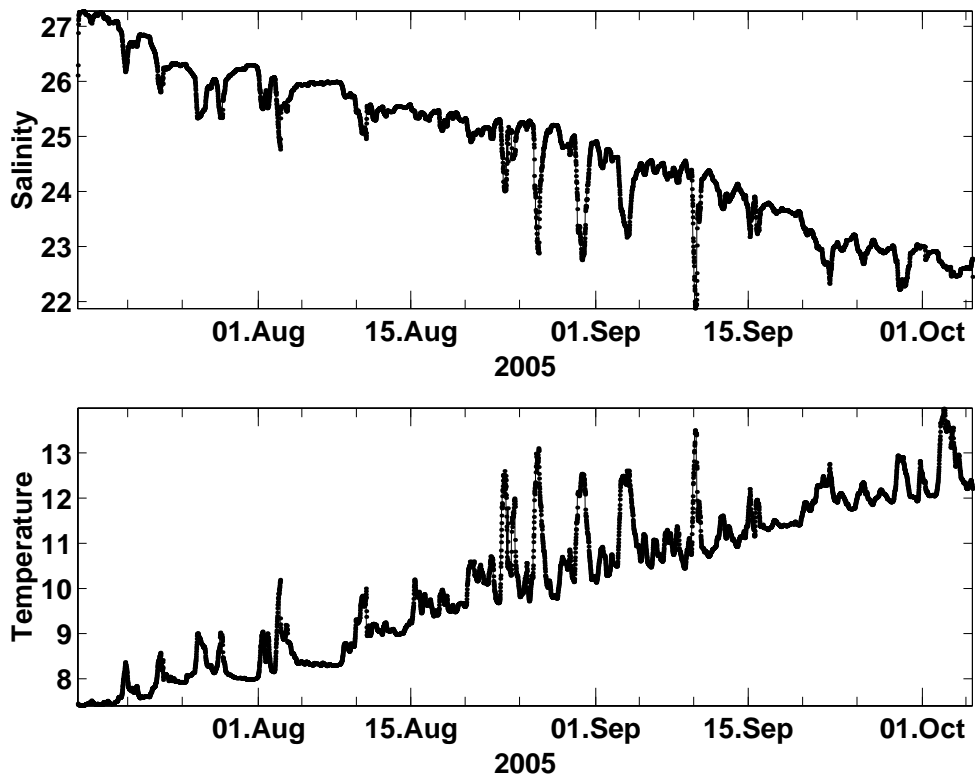


Figure 4.2: Time series salinity (upper) and temperature (lower) from the 10th deployment period.

peak salinity was reached in later June/early July which is also the time after the strongest increase in density.



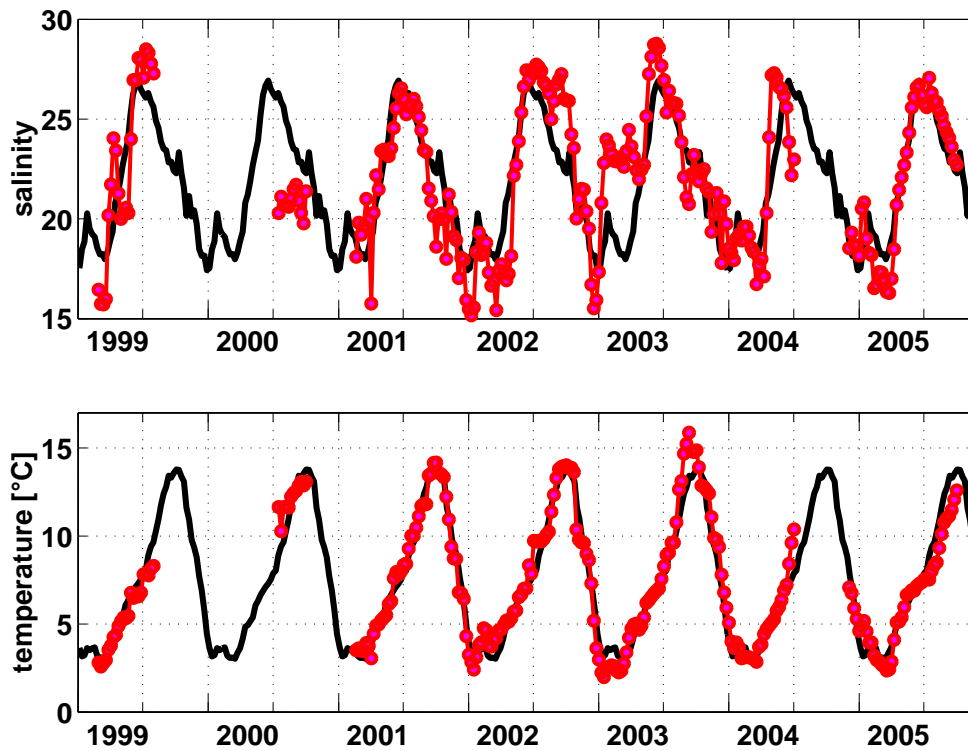


Figure 4.3: Time series salinity (upper) and temperature (lower) in reference to the mean annual cycle (black line) of Mooring V399 (since 23. Feb. 1999) and V431 (since 8. May 2002), Fehmarnbelt, western Baltic.

The temperature and salinity time series shown even at the bottom a pronounced seasonal cycle. Highest temperatures of up to  $15^{\circ}\text{C}$  occur in early October. The highest salinity appears to be end of June with a second, smaller peak late January. The summer peak is related to the entrainment of North Sea Water at mid depth while the winter peak is a results of occasional North Sea water inflow, the deep Baltic proper ventilation events.

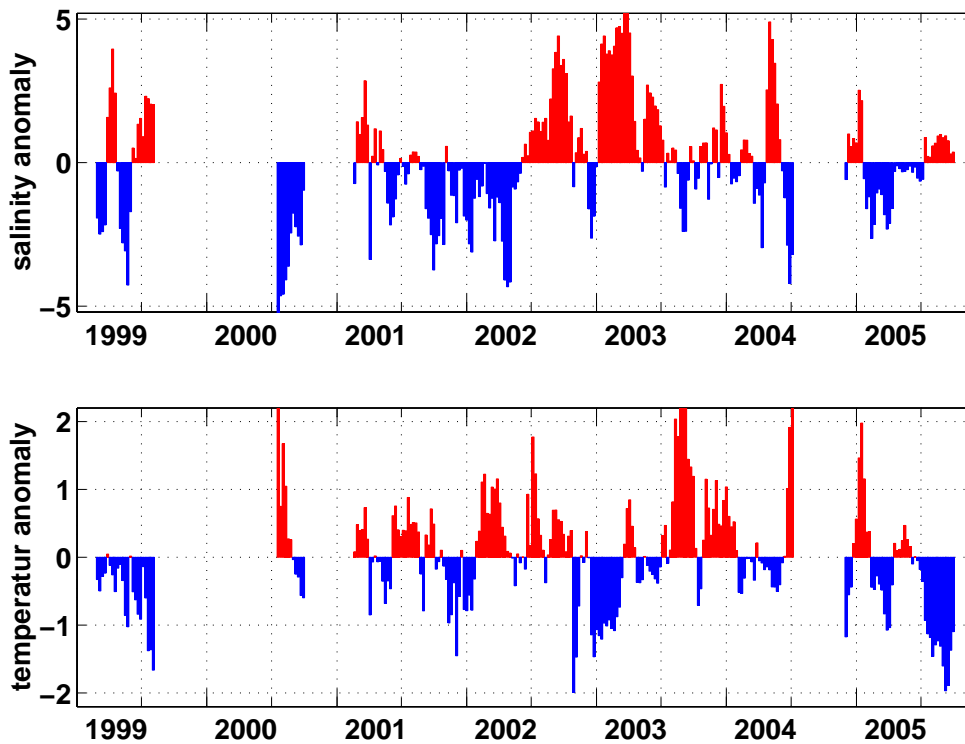


Figure 4.4: Time series salinity anomaly (upper) and temperature anomaly (lower) in reference to the mean annual cycle at Mooring V399 (since 23. Feb. 1999) and V431 (since 8. May 2002), Fehmarnbelt, western Baltic.

An average seasonal cycle is deduced from all mooring data available (V399: RCM; V431: MicroCat) in 52 weekly bins. The difference in observation and average seasonal cycle is shown in the figures above. Note that this anomaly is a bottom T/S anomaly. What sticks out clearly is the last major deep water ventilation event in 2002 (and 2003) manifested in a salinity anomaly (higher than average). The accompanied temperature anomalies are as such that the 2002 event was mainly cooler than the average, while the 2003 event was mainly warmer.

## 4.2 Meteorological observations

General weather situation (figure 4.5): During the 3 days of our expedition, there was a high pressure system over the whole Baltic Sea domination the weather. This system was moving eastwards very slowly.

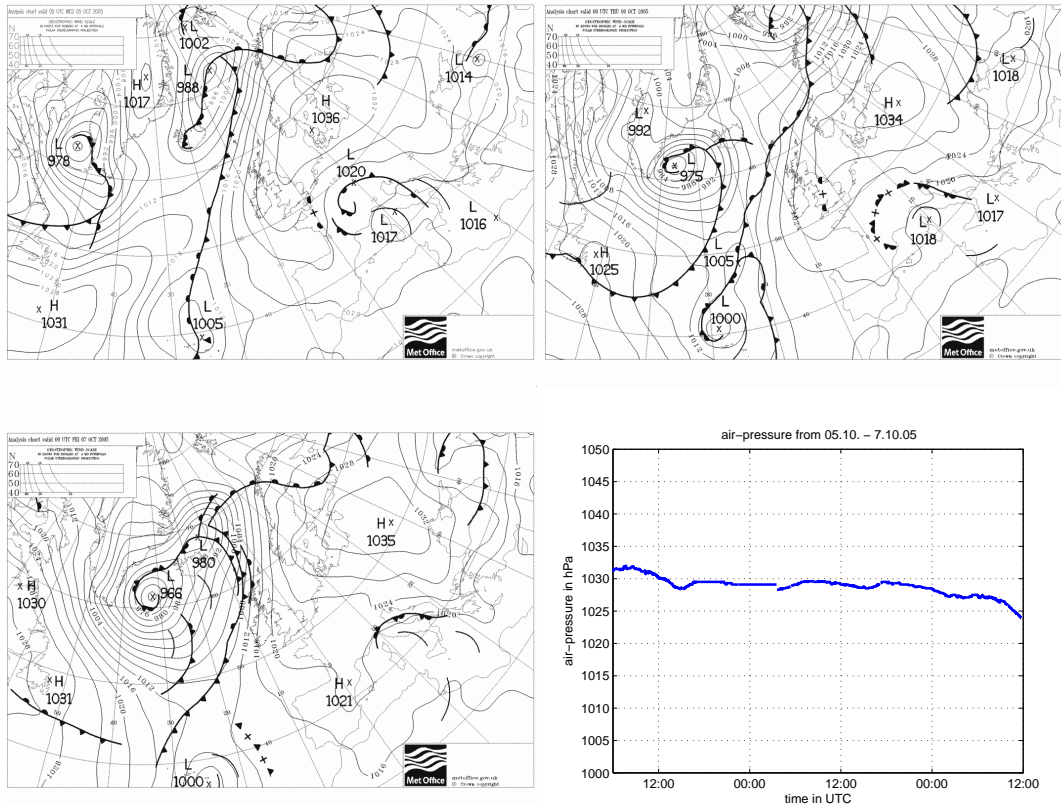


Figure 4.5: Surface pressure distribution 05. Oct to 07.Oct. 2005 (UKMO-Bracknell, UK). Lower left: pressure readings during AL268.

The pressure in the centre was stable between 1034 and 1036 hPa at the surface ((figure 4.5, lower left)). Due to the wide distance between the isobars, the weather conditions were very stable during the whole cruise. The cloud cover was always 0/8, the air temperature was varying between 10 and 16°C and the wind was mostly blowing between 5 to 10 m/s (4-5 Bft.) from easterly directions.

The dry air temperature graph (figure 4.6, left, blue) shows a typical diurnal cycle: The lowest temperatures are measured in the early morning around 6 am, just before sunrise. A quick increase after noon with a maximum temperature around 2 pm of about 15°C. In the afternoon and evening there is a slow decrease of temperature till the temperature reaches its minimum in the early morning again. The difference in temperature between day and night is about 5°C in

the first night and 2.5°C in the second night. This can be explained by the fact that we stayed in harbour during the first night, while we were on sea during the second night. Because the water mass doesn't cool so fast during the night as the landmass, the air temperature over sea is less extreme. The same plot shows also the graph of the humid temperature (figure 4.6, left, green). It shows a parallel course to the dry air temperature, but some degrees below, because of the reduction of the temperature due to the evaporation at the wet thermometer. So, we expect a more or less constant relative humidity during this period of time (figure 4.6, right).

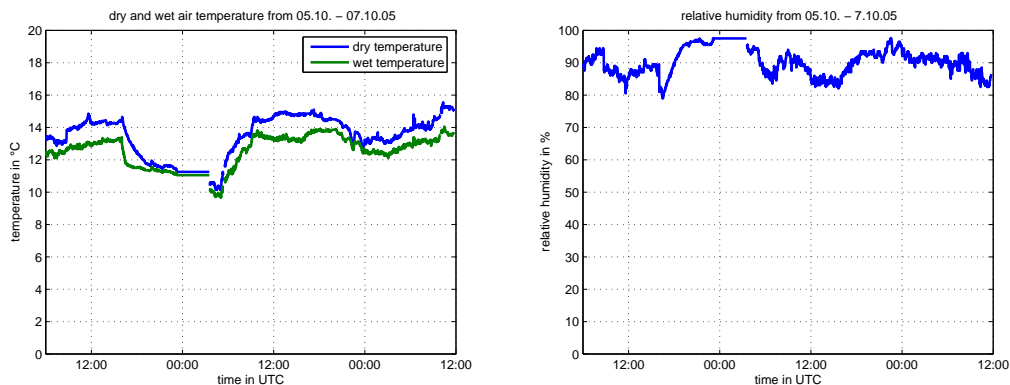


Figure 4.6: Timeseries of dry and wet temperature (left) and relative humidity (right). Data gap between 7 pm on 5/10/2005 and 5 am on 6/10/2005 (Harbour call Warnemünde).

The water temperature is quite constant during the first day, while it is more variable during the second and third day. In contrast to the air temperature, the water temperature (Figure 4.6, left) has a less extreme diurnal cycle varying by about 1.5°C. Small scale variability is probably due to the ship is crossing different water masses. During the first day the rather constant water temperature is due to the shallow waters between Kieler Förde and Warnemünde. Here higher temperature than in the open Baltic are expected. So due to our route, we would expect a decrease of the water temperature during the first two hours, but the influence of the course of day is working against this trend.

The wind speed is roughly proportional to the distance between the isobars. The rather constant pressure during the cruise caused a rather constant wind speed during the cruise with speeds between 5 and 10 m/s. We can difference three parameters that determine the wind speed during these three day. First there is a gradient wind from 5 to 7 m/s, that changes with the position of the high. Second we can observe an thermal influence, that increases the wind speed during the afternoons 2 to 3 m/s. Third, the decrease of wind speed in the harbour around 5 pm must be explained by the shelter of the landmasses, that slow the wind speed down. As the water is about one degree higher than the air temperature there is a constant 'heating' at the air/sea interface (negative sensible heat) and local upward movement of the air masses at the interface. This generates a low pressure tendency within the high pressure system.

The plot of the wind direction shows an average value of 100°, so almost east. During the first day there is a north component, during the second day, there is a south component to observe. The third day shows a stable direction of 100°. The big peaks in the graph don't show the real

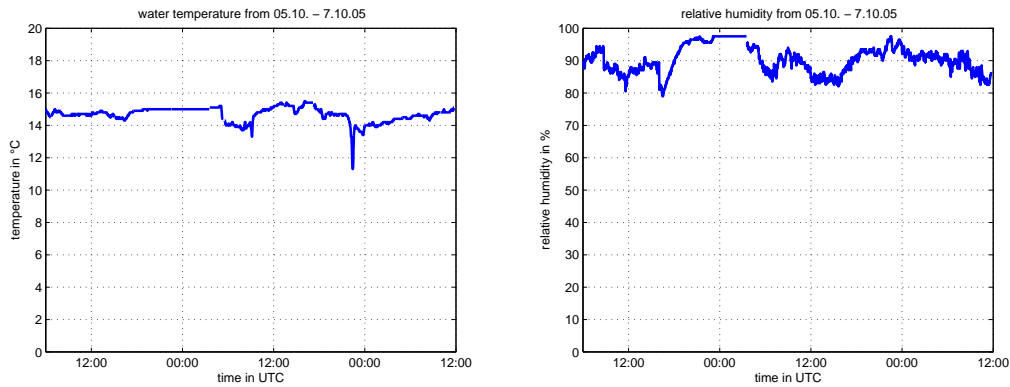


Figure 4.7: Timeseries of water temperature (left) and relative humidity. Data gap between 7 pm on 5/10/2005 and 5 am on 6/10/2005 (Harbour call Warnemünde).

wind direction. They are exactly at the same position as we did our stations for the CTDs. We explain these anomalies with the turning of the vessel during the stations and the time delay of the instruments. The general wind direction changing from little less than  $100^\circ$  to little more than  $100^\circ$  and back to  $100^\circ$  has to be explained by the southeast moving of the high, that changes the orientation of the isobars, which determines the direction of the gradient wind.

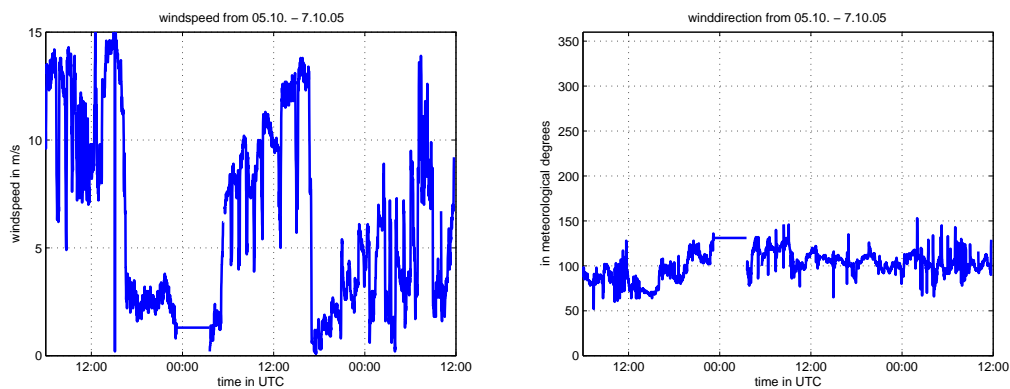


Figure 4.8: Timeseries of wind speed (left) and wind direction (right). Data gap between 7 pm on 5/10/2005 and 5 am on 6/10/2005 (Harbour call Warnemünde).

The incoming short wave radiation (ISWR) resamples the diurnal cycle of the temperature with a maximum around 11 UTC (noon local time). Due to the late season and the short days, there is a steep increase during the morning and a steep decrease in the afternoon. The maximum ISWR is around  $280 \text{ W m}^{-2}$ . This is a lot less than the climatological maximum in summer ( $360 \text{ W m}^{-2}$ ), because the sun's radiation approaches the surface in a smaller angle.

The graph of the relative humidity stays very high  $>80\%$  during all the measured time period. In the course of day you can observe a change by daytime. Due to the cooling in the night, the relative humidity increases, while it decreases in daytime. That's because warm air can hold

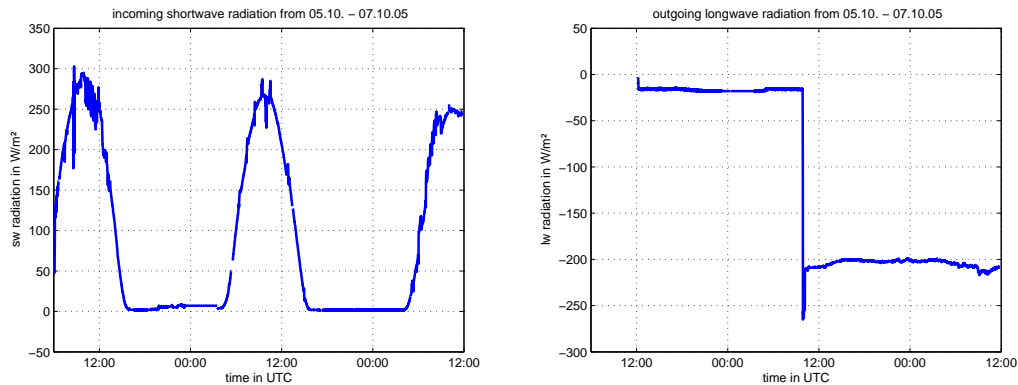


Figure 4.9: Timeseries of incoming shortwave radiation (left) and outgoing longwave radiation (right). Note the longwave sensor was replaced early morning 06.10.2005 and the earlier data is corrupt! Data gap between 7 pm on 5/10/2005 and 5 am on 6/10/2005 (Harbour call Warnemünde).

more water than cold air (curve of saturation), so the same amount of water in the air shows a higher relative humidity in cold temperatures than in warm temperatures. Another influence is the distance of the measurement to the land. The humidity over sea is higher than the humidity over land, because over sea there is always enough water to evaporate, while over land the water, that can be evaporated might be limited. We can see this effect in our plot at this time when we entered/left the harbour in the evening/morning. The daily increase/decrease of the r.h. is disturbed by the effect of land. A third influence is the temperature of the water. The warmer the water is, the more water will evaporate, because of the velocity of water molecules, that is higher in warm water. The higher this velocity is, the easier is it to evaporate.

The plot of the air pressure shows a more or less constant decrease of about 8 hPa, which is not a lot. The explanation for that is the fact, that the dominating high pressure system was slowly moving eastward, so our region was getting closer to the edge of the high, where the pressure is decreasing.

For the 06.10.2005 we plotted the heat balance (Figure 4.10, right) from 10 am to midnight, because the measurement for the outgoing long wave radiation during the first day and the first night are corrupt. The graph of the plot shows a diurnal cycle: because of the strong influence of the incoming short wave radiation, there is a maximum of heat gain shortly before midday. After that the relative influence of the outgoing long wave radiation is getting more important, so that the ocean loses heat, means the heat gain is negative.

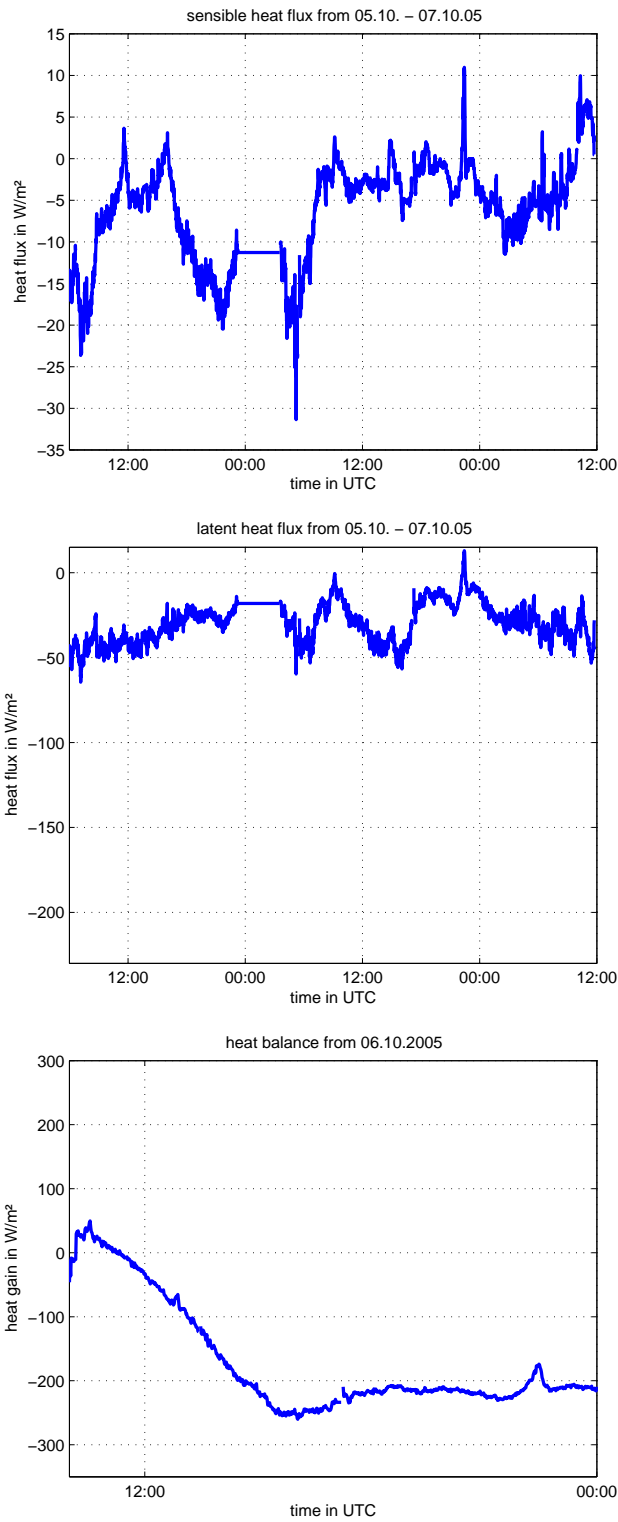


Figure 4.10: Sensible (left), latent (center) heat flux and heat balance for the period where reliable longwave radiation data was available (right).

## 4.3 Hydrographic and currents along C and L section

### 4.3.1 Fehmarnbelt (C section)

The temperature distribution (figure 4.11, upper) across Fehmarnbelt is quite homogeneous. There is a warm layer in the upper five meters in the south and the upper ten meters in the north, with temperatures about 14.7°C. Beneath, there is a layer about five meters with the temperature maximum at about 15°C. From there to the ground the temperature decreases continuously. The temperature minimum at the deepest point in the Fehmarnbelt is about 12.2°C.

The salinity distribution (figure 4.11, middle) shows horizontal layers in which the salinity increases with depth. At the surface the salinity is about 12 to 13 and on the ground about 22 to 23. There is a slope from south to north as earlier seen in the temperature distribution too.

The density (figure 4.11, lower) shows a stable distribution with denser water at about 19 kg m<sup>-3</sup> on the ground and less dense water at about 9 kg m<sup>-3</sup> above. It is very similar and consequently determined by the salinity distribution. The south north/slope here is also visible.

The chlorophyll-a concentration (figure 4.11, upper) in the upper five meters is about 1 to 2. In the following five meters it increases to 4.5. This is dependent on temperature, which has the upper limit of its maximum in this layer. Beneath, the chlorophyll-a in the middle of Fehmarnbelt decreases to the ground. In the south there is a decrease across the temperature maximum layer and another maximum in chlorophyll-a beneath it. From thirteen meter depth to the ground there is nearly no chlorophyll-a. In the north, the chlorophyll-a maximum ends at eleven meter depth and at about sixteen meters there again is a slight increase. The increase at depth is approximately due to the vertical mixing associated with a deepening of the mixed layer and nutrient enrichment from the North Sea water core. The upper waters are already depleted.



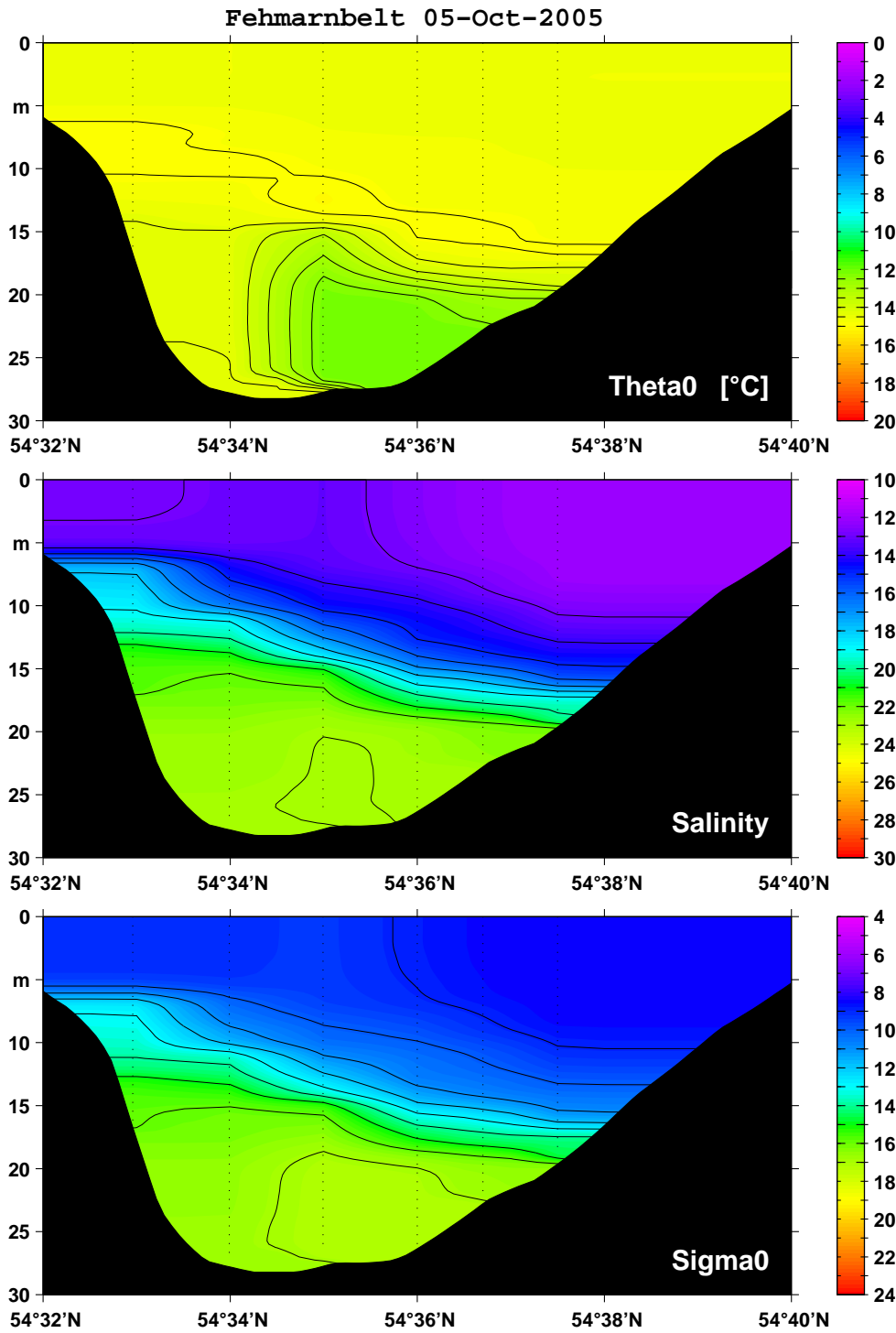


Figure 4.11: Temperature, salinity, and density as measured along the Fehmarn Belt section 5.10.2006.

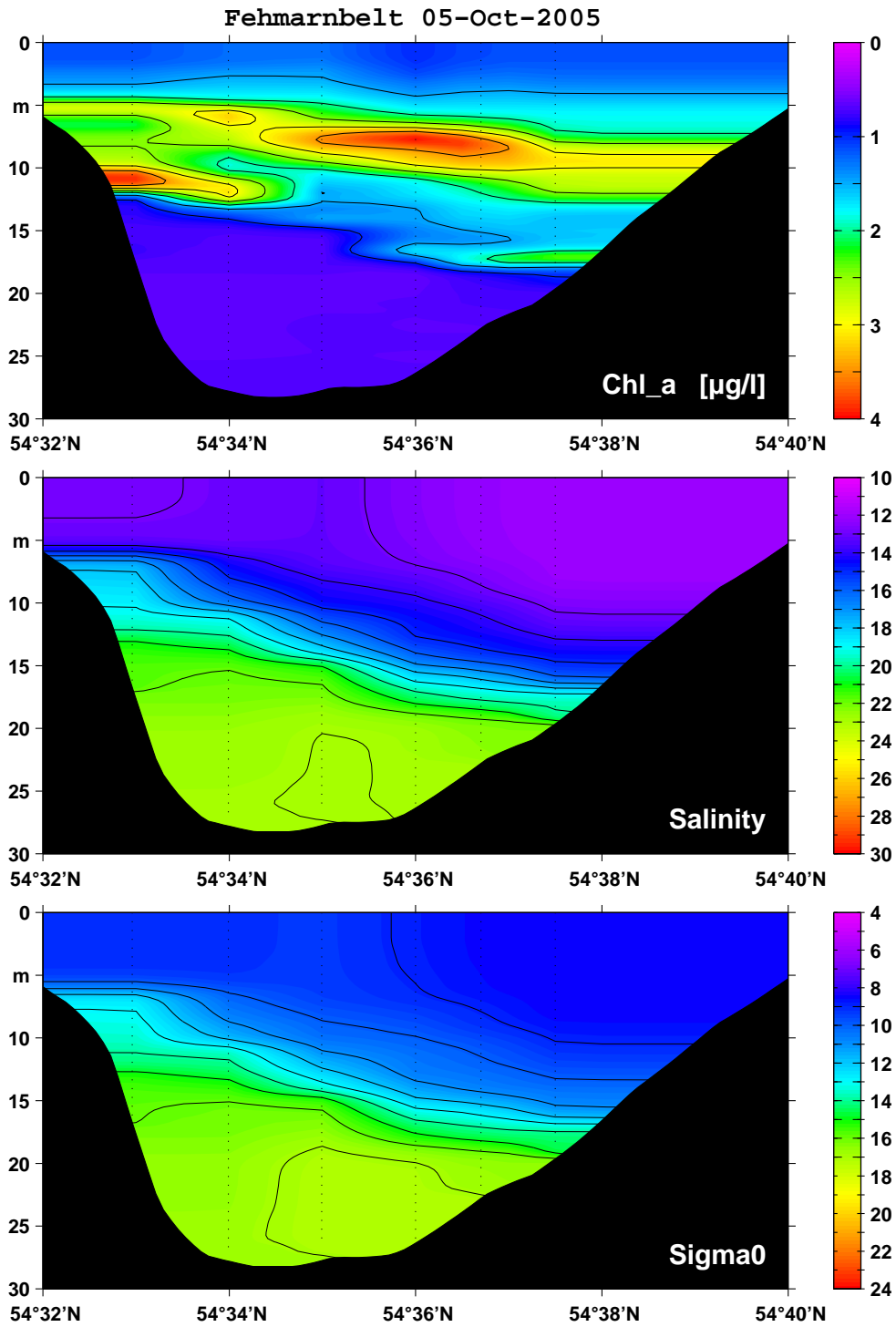


Figure 4.12: Chlorophyll-a, salinity, and density as measured along the Fehmarn Belt section 5.10.2006.

### 4.3.2 Zonalsection (L section)

In the west of Fehmarnbelt the temperature (figure 4.13, upper) is nearly the same with about 15°C across the whole water column. From Fehmarnbelt (11.2°E) to 12.5°E the temperature decreases eastward and with depth. From 12.5°E to 13.5°E it increases eastward and decreases with depth. At a depth of fourteen meters at 12.7°E there is a minimum in temperature with about 6.5°C. From 13.5°E to 14.3°E the temperature in the upper 18 meters is nearly homogeneous with about 15°C. From 13.5°E to 14°E the temperature decreases from 18 to 32 meters depth to 10.5°C and from there onto the ground there again is an increase of 2°C. From 14°E to 14.3°E the temperature decreases to its minimum with about 5°C at 27 meter depth.

The salinity distribution (figure 4.13, middle) can be subdivided into two sections: western of 12.7°E and eastern of 12.7°E. In the western part at the surface there is a salinity of about 10 to 14 decreasing eastward and across the water column increasing to its maximum at about 23. In the eastern part all the water above 20 meters depth has a very low salinity at about 7. Beneath, it increases slightly to 13 on the ground. The saltier water in the deeper west part has its origin in the north sea. It cannot pass the threshold at 12.5°E.

Density in general is dependent on temperature, salinity and pressure. Here, the density distribution (figure 4.13, lower) is very similar to the distribution of salinity, with its maximum at about 1018 kg m<sup>-3</sup> and its minimum at about 1005 kg m<sup>-3</sup>. In density there is the answer, why the water of the north sea cannot pass the threshold. It is too dense and with that too heavy.

The subdivision can be used for the chlorophyll-a distribution (figure figure 4.14, upper), too. In the western part there are a few places with rather high chlorophyll-a values up to 5. In the eastern part the chlorophyll-a concentration decreases with depth from 2.5 at the surface to 0.5 on the ground.

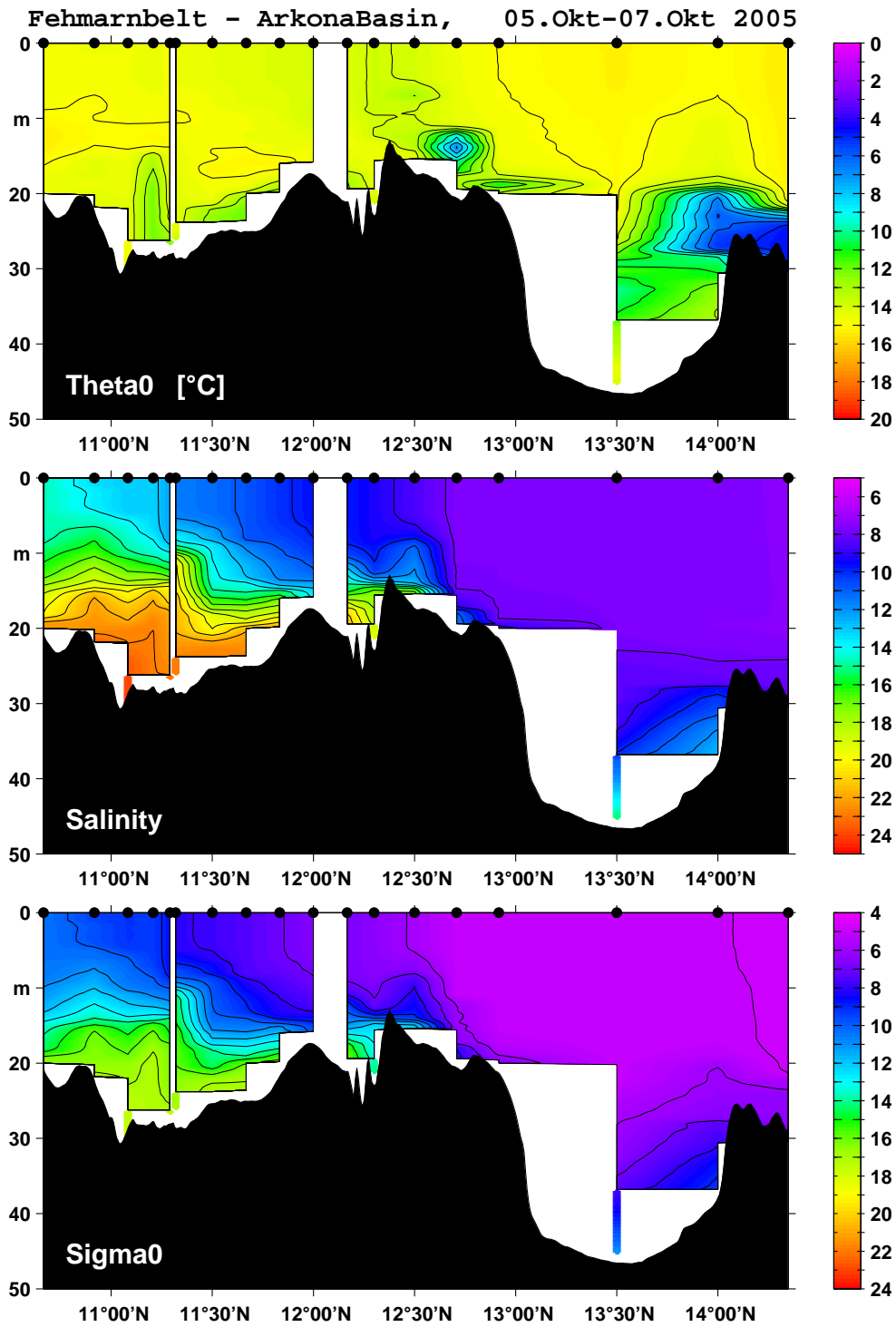


Figure 4.13: Chlorophyll-a, salinity, and density as measured along the Fehmarn Belt section 5.10.2006.

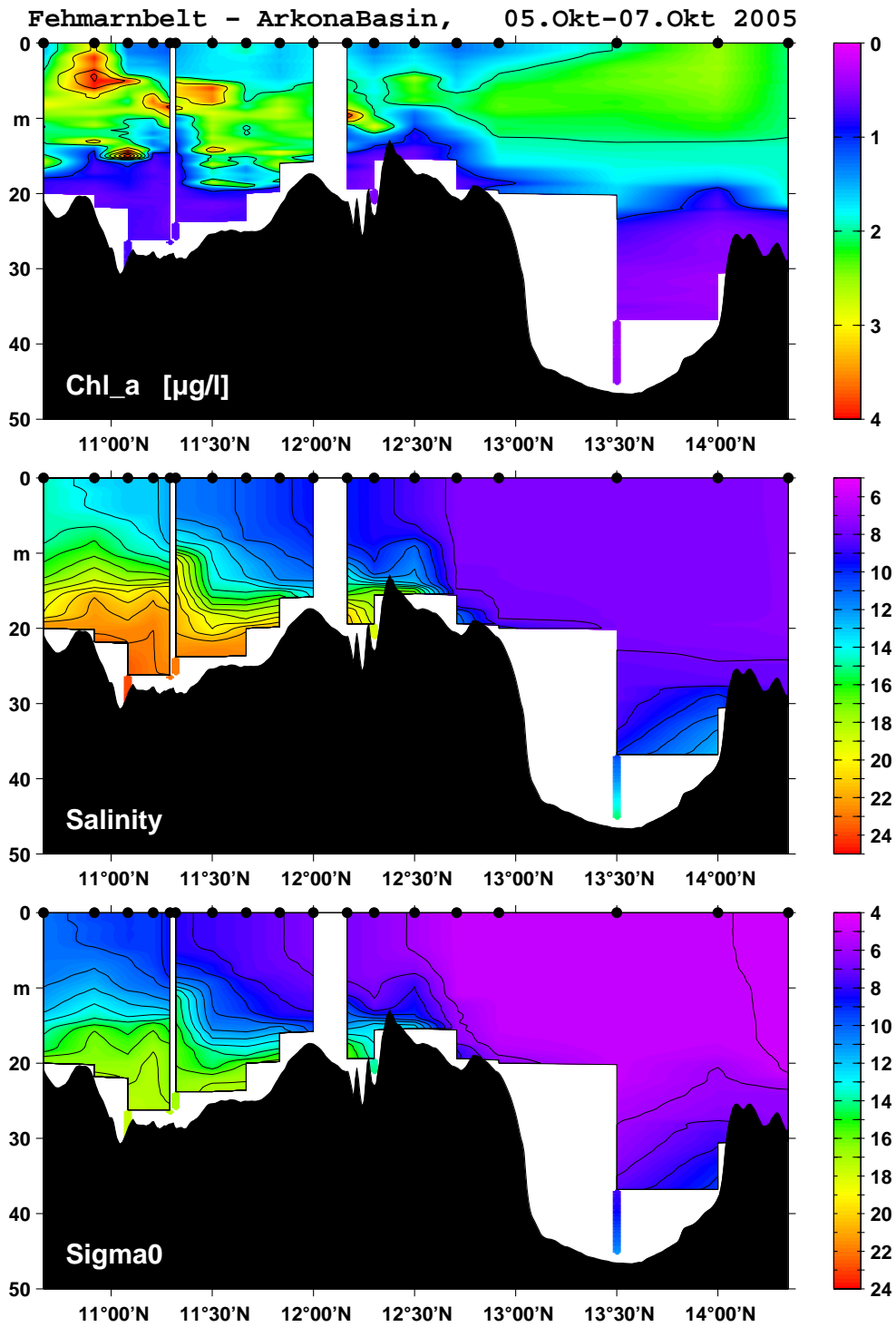


Figure 4.14: Chlorophyll-a, salinity, and density as measured along the Fehmarn Belt section 5.10.2006.

# Chapter 5

## Equipment/instruments

### 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; Serial number 1962) and a self containing T/S recorder of type SBE-MicroCat (serial number 2936).

Table 5.1: V431: Summary on 10th recovery and 11th deployment of trawl resistant bottom mooring V431.

date; time (UTC)	latitude	longitude	depth	comment
05.10.2005; 14:20				Recovery.
07.10.2005; 07:20	54°31.33'N	11°18.21'E	28.2 m	11th Redeployment.

### 5.2 CTD/Rosette and Salinometer

#### 5.2.1 CTD

A Hydro-Bios CTD was used during the cruise. Last lab calibration indicated an accuracy of order 0.001 K in temperature.

#### 5.2.2 Beckmann Salinometer

The robust and portable Beckmann Salinometer was used to analyse the water samples. The Beckman Salinometer uses an inductive method to measure the salinity of a water sample. To achieve good measurements (precision order 0.0008/accuracy order 0.003) the samples are stored for 24h in the lab to allow for a temperature adjustment.

Up to three repeat measurements have been performed on each sample (CTD, TSG, Substandard) or until the difference in salinity (which is determined through the 'Salino' program that reads out the data from the Beckman Salinometer via a COM port connector) is less than 0.01.

Before the first measurement the instrument is calibrated against standard seawater. After a substandard is used which is a large volume of Baltic Sea Water collected at the first station. Ideally this should stay constant during all measurements. For our measurements (Figure 5.1) no systematic trend in the difference between subsequent substandard measurements can be seen.

The repeat measurement suggest the salinities are determined better than order 0.02.

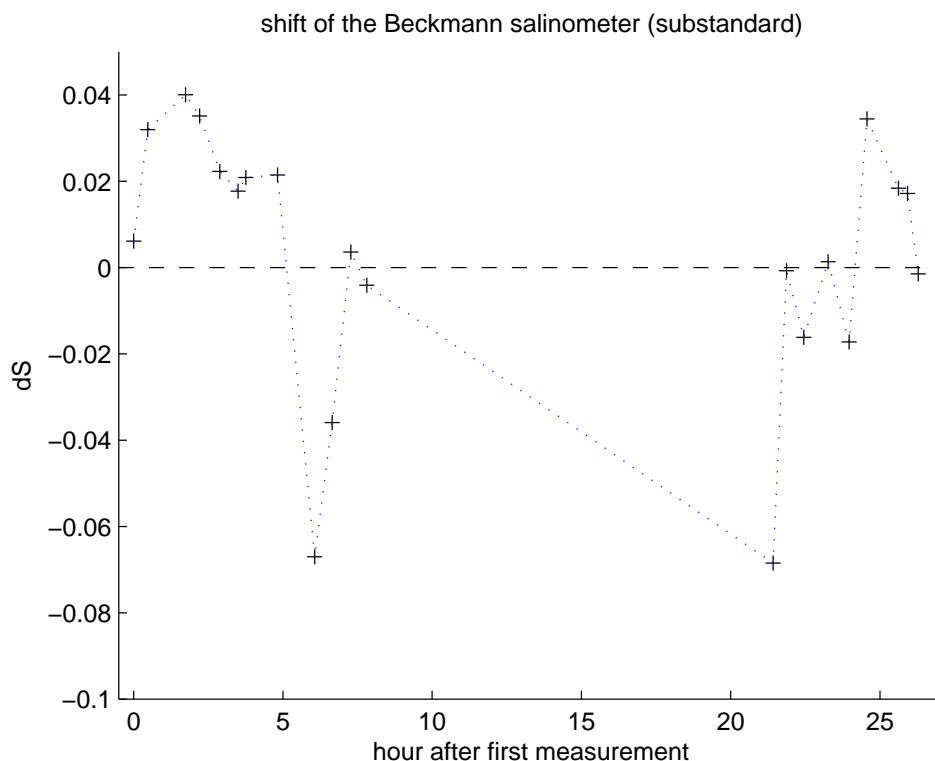


Figure 5.1: *Difference in substandard measurements during cruise*

### 5.2.3 Salinity measurements

Some typical salinity profiles are shown in the following that document the strong variability and provide examples for what will be discussed in reference to differences in the salinity determination using TSG, bottle samples and CTD.

Profile 5 (Figure 5.2, left) shows very good the water mass distribution of the western baltic sea. The upper water mass has a low salinity, it comes from the northern baltic sea. There the water-inflow from rivers and precipitation is much higher than evaporation. In the lower water mass the salinity is much higher. It comes from the north sea. Because of that you can see a

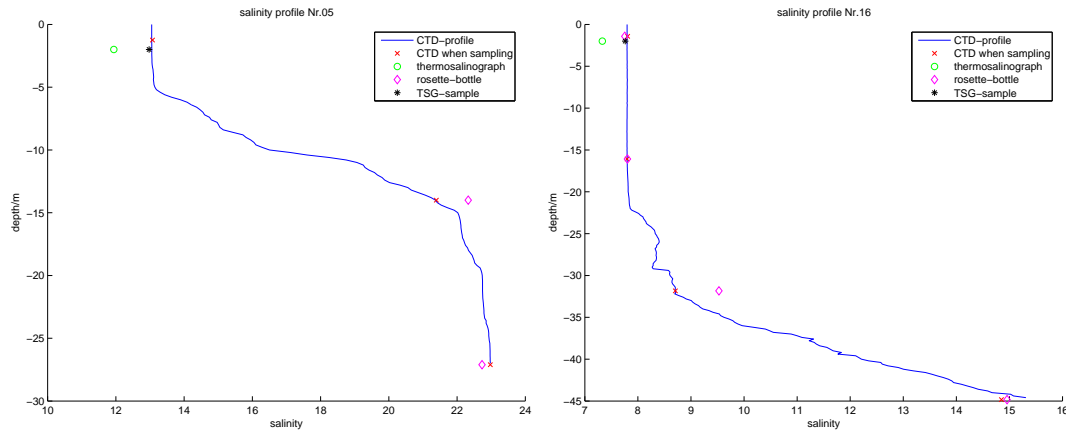


Figure 5.2: Salinity at station 5 (left) and 19 (right)

halocline.

Profile 16 (Figure 5.2, right) is from a station more eastern. There the water inflow from the north sea is not as strong as in profile 5.

#### 5.2.4 Differences and errors: CTD versus Bottle samples

As one can see in Figure ??, the salinity determined with different instruments or methods provides for a certain depth provide rather different results. Besides the differences between up- and down-cast of the CTD other difference have been identified.

There is a huge different between the TSG- and the CTD-values (Figure 5.3). The TSG-values are mostly lower than the CTD ones. As the Salinometer agrees well with the CTD salinity, the difference is caused by the TSG.

Because the CTD-values were used for the evaluation of this cruise, it is most important to know about the errors of this measurement. CTD samples from different depth have been collected during the cruise and later analysed with the Beckmann-Salinometer (Figure 5.4). Surface near salinities are quite similar, this is also true for samples near the bottom. Largest differences occur where the salinity gradient is strong (halocline).

The error is defined as the difference between CTD-value and Beckmann-value of the bottle, and an uncertainty of the error which is the difference between mean salinity over the column and the CTD-measurement. Figure 5.5 shows that error as well as the uncertainty is largest at the halocline.

We suggest this 'error' is mainly caused by the differences in volumes of water which are under consideration: Because the height of the water sample bottle is about 85cm the sample analysed with the Beckman Salinometer is the average salinity over the height of the rosette-bottle. The CTD in contrast measures the salinity at very small volume occupied by its conductivity cell (Figure 5.5). Consequently the Beckman salinometer values (the bottle samples) are average salinities over the height of the rosette-bottle (85cm) and compared it with the CTD-value from single point.



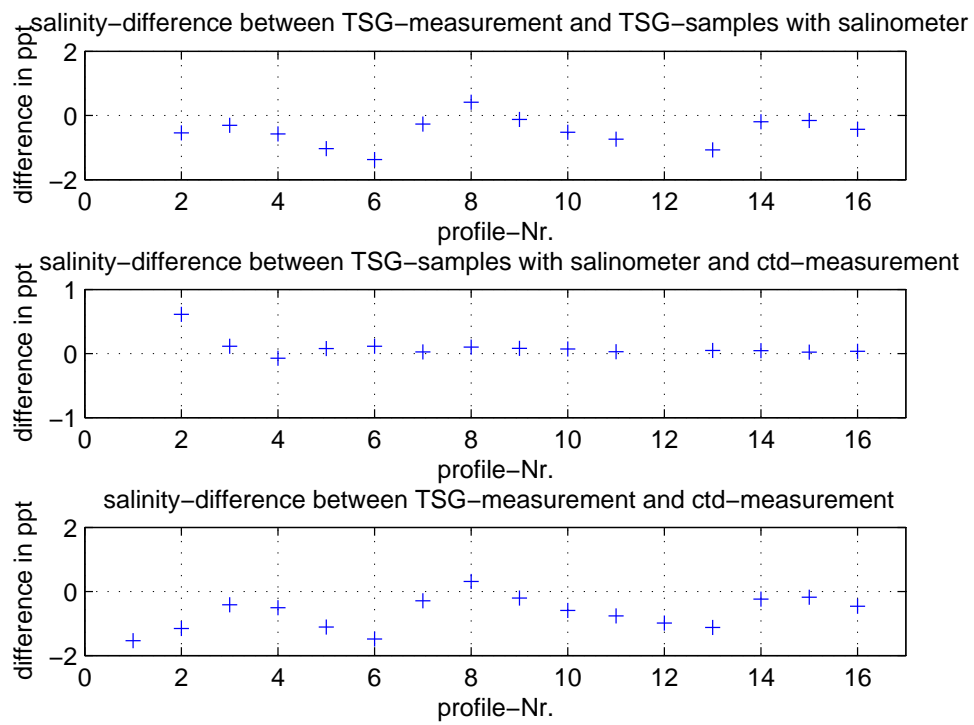


Figure 5.3: Comparison of salinity from TSG-, CTD-measurements and TSG-samples

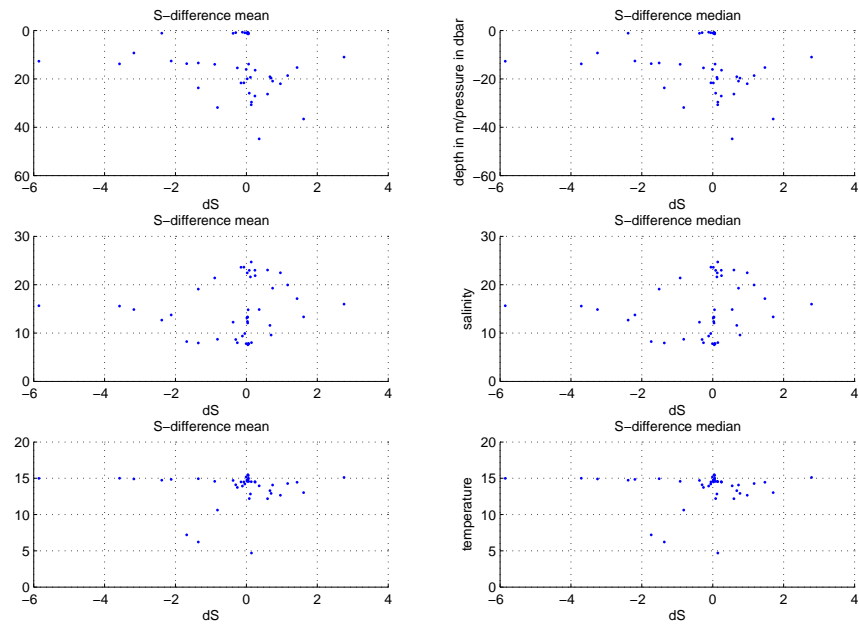


Figure 5.4: Difference in salinity from CTD(mean, median) and CTD-rosette(Beckmann) against depth, salinity and temperature

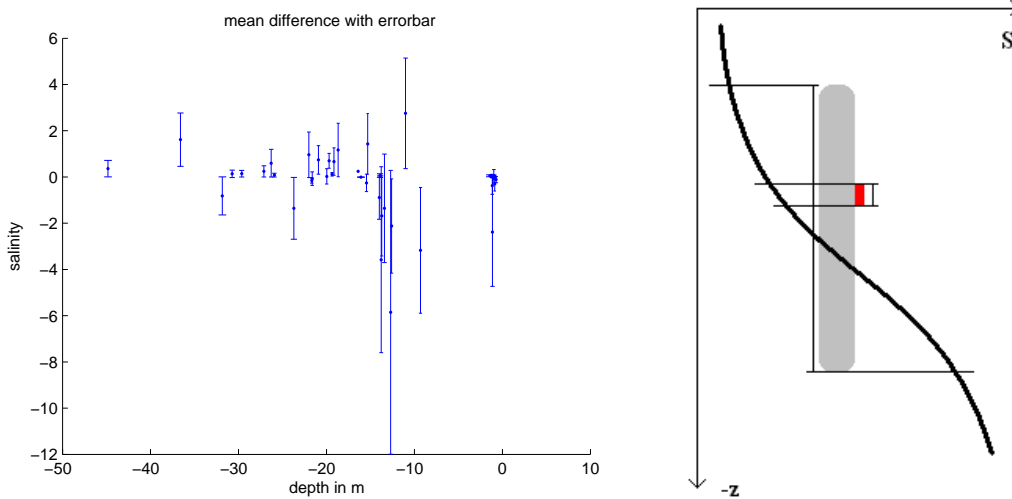


Figure 5.5: Error and uncertainty of error in CTD-salinity measurement (left), schematic of position of the CTD in comparison to the sample bottle (right).

## **5.3 Underway Measurements**

### **5.3.1 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. The Maritec Engineering DATADIS includes now UTC GPS based time stamps. However, SIMRAD depth soundings are still not available.

### **5.3.2 Navigation**

ALKOR has a GPS navigational system as well as a gyro compass available. Data is fed into DATADIS and from there available for other devices. For the use with the ADCP system a converter is needed that 'translates' the DATADIS string into a ADCP readable string (for heading only).

Two new monitors in the wet lab and in the dry lab allow to follow the navigation (way point, current position, distance and time to way point, ...) and to see the information embedded into a navigational map. This is a great new feature and very much appreciated.

### **5.3.3 Meteorological Data**

ALKOR is equipped with meteorological sensors measuring air temperature, wind (speed and direction), wet-temperature, air-pressure, long and shortwave radiation. During our cruise Christopher Smarz installed a new EPLAB (Eppley Laboratory, Inc.) Precision Infrared Radiometer (Model PIR). The PIR could only be connected in a mode that does not consider the case temperature which results in a lower precision. There is a need for a battery change every 4 to 6 months (Feb. to Apr. 2006).

### **5.3.4 Echo sounder**

During AL 268 the ER 60 SIMRAD echo sounder was switched on but the data not recorded.

### **5.3.5 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 after analysis of bottle samples.

### **5.3.6 Vessel mounted ADCP**

A 300 kHz workhorse ADCP from RD Instruments was mounted in the ship's hull. The vmADCP is used with bottom tracking mode. Navigational data comes from the DATADIS system of



Figure 5.6: (left) Old PIR, corroded switch, no dry element, batteries empty; (right) Christopher Smarz installing the new PIR.

ALKOR. However, apparently there was again a problem with the heading source and interpolation of DTATDIS data to the navigational data was necessary.

Absolute (earth coordinate) velocities are calculated using ships navigation. When the ship was underway data gaps occurred during 'high' speed.

# Chapter 6

## Acknowledgement

Herzlichen Dank an Kapitän  $\frac{1}{2}$ n Jan Lass und die 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	2005	10	05	08	36	54	34.00	10	39.93	21.0	01
02	2005	10	05	09	40	54	36.52	10	55.01	23.0	02
03	2005	10	05	10	24	54	35.49	11	04.97	31.0	03
04	2005	10	05	11	02	54	32.96	11	09.73	18.0	04
05	2005	10	05	11	25	54	33.99	11	11.03	28.0	05
06	2005	10	05	11	45	54	34.99	11	12.47	28.0	06
07	2005	10	05	12	03	54	36.00	11	13.48	27.5	07
08	2005	10	05	12	21	54	36.70	11	14.46	24.0	08
09	2005	10	05	12	36	54	37.50	11	15.48	20.0	09
10	2005	10	05	13	45	54	31.39	11	18.45	28.0	10
11	2005	10	06	07	25	54	24.01	12	10.00	21.0	15
12	2005	10	06	08	27	54	31.99	12	18.01	23.5	16
13	2005	10	06	09	26	54	38.02	12	30.01	18.0	17
14	2005	10	06	10	23	54	43.26	12	42.50	21.0	18
15	2005	10	06	11	28	54	48.50	12	54.98	22.5	18.5
16	2005	10	06	13	46	54	55.00	13	29.97	47.4	19
17	2005	10	06	16	01	54	47.00	13	59.97	39.0	20