Cruise Report
F.S. ALKOR Cruise No. 33/11

Dates of Cruise: 13. September to 17. September 2011

Projects:
Student course in phys. oceanogr.

Areas of Research: Physical oceanography
Port Call: Warnemünde (15. Sept. 2011)
Institute: IFM-GEOMAR Leibniz-Institut für Meereswissenschaften an der Universität Kiel
Chief Scientist: Dr. Johannes Karstensen
Number of Scientists: 10 & 10
Master: Norbert Hechler

Chapter 1

Scientific personal

Cruise code: AL 33/11
Cruise dates: 13.9. – 17.09.2011
Port call: Kiel – Warnemünde – Kiel

Table 1.1: Scientific personal AL 33/11: IFM-GEOMAR: Leibniz-Institut für Meereswissenschaften an der Universität Kiel, Kiel, Germany; CAU: Christian Albrechts Universität Kiel, Kiel, Germany

Name	Institute	Function	leg
Johannes Karstensen	IFM-GEOMAR	Chief scientist	1, 2
Rudolf Link	IFM-GEOMAR	PO	1, 2
Nadine Mengis	CAU	Master student	1, 2
Robert Kopte	IFM-GEOMAR	PO	1, 2
Svenja Reinlein	CAU	student	1
Mona Ziaeyan	CAU	student	1, 2
Valentin Kratzsch	CAU	student	1
Till Baumann	CAU	student	1
Sebastian Milinski	CAU	student	1
Hannes Hollmann	CAU	student	1
Ulrike Schröder	CAU	student	2
Sandro Dahlke	CAU	student	2
Florian Jamer	CAU	student	2
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Chapter 2

Scientific Background

The main purpose of the ALKOR cruise 3311 was the training of students in observational methods for physical oceanographers. The scientific motivation of the cruise was to obtain a rather synoptic picture of the hydrography and water movement in the western Baltic, to service a mooring site at the south-eastern opening of the Fehmarn Belt.

Hydrographic and current sections from the Fehmarn Belt (section 'C') and along the deepest topography from about 10°40 E to 14°21 E (section 'L'). From the mooring site at the south-eastern opening of the Fehmarn Belt the instruments (RADCP-600kHz with oxygen Optode, T and C; self containing CTD Type MicroCat) have been serviced.

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

Chapter 3

Cruise Narrative

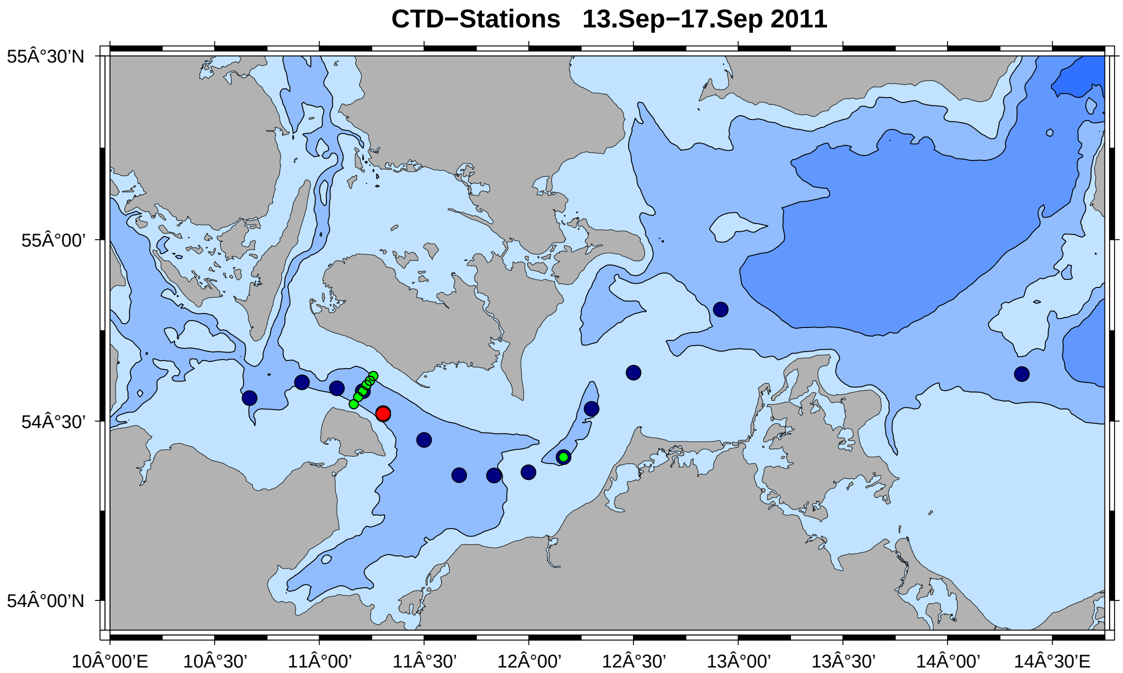

Figure 3.1: *ALKOR 33/11 cruise stations. Black (LG section)/ Green (FB section) and Red dot are the CTD stations, red dot is also location of the V431 mooring.*

DAY 1 (Tuesday, 13.09.2011):
We left Kiel Westufer at 08:15 (all times in the cruise narrative are local time Kiel). A strong wind from Southwest with about 7-8 Bft was blowing but fortunately along our sailing direction. Shortly after leaving the port, Rainer Nausch, the first officer, did a safety instruction. A short introduction of the planned program for the following days was given. Ship ADCP (hull mounted 600kHz) and TSG were switched on. We headed for the first CTD test station, which went well. Three more stations in the 'L' section were occupied, the last one in the Speergebiet. The weather condition did not permit to recover the V431 mooring - and we steamed back to start the Fehmarn

Belt 'C' section, first with CTDs (north-eastward), next with the ADCP (south-westward). After one other CTD profile (st. 11) from the 'L' section we steamed to our eastern most position to start an occupation of the 'L' section from the east on Wednesday morning.

DAY 2 (Wednesday, 14.09.2011):
At 08:00 we started with the CTD work again by occupying station 21, the farthest east. The wind and waves increased during that time and on our way to station 20 we decided to stop the CTD work, seeking for a protective spot off the Island of Rüegen. We waited until 22:00 as it was forecasted that the wind should calm down and we could start our journey back to Warnemünde to pick up the new students. The time was used to introduce the salinometer and to perform the measurements of the CTD, TSG and substandard bottles. This was done in groups of two students each. Moreover, the CTD and underway data was processed to a level at which the students were able to work with the data and to the exercises.

DAY 3 (Thursday, 15.09.2011):
We arrived in Warnemuende Passagierpier P2 at 10:00 and after custom clearance the new students came on board. As the wind was still strong we had to stay at the pier and waited until Friday morning to continue our work. The time on board was used to not only introduce the new group of students to the ship but to work on the data that has been collected so far.

DAY 4 (Friday, 16.09.2011):
We left Warnemuende Passagierpier P2 at 06:30 and headed towards the Marienleuchte Sperrgebiet to recover the V431 mooring. The weather calmed down and with the arrival at the restricted area "Marienleuchte" we found rather good conditions for the recovery. The first release command (12 kHz, Code A) was given at 08:35 UTC. We send several release commands drifting over the nominal mooring position several times but the surface element did not appear. At 11:10 we stopped searching for the mooring and did a CTD cast at the nominal mooring position. Further CTD stations towards the east, along the L section followed. At night we steamed back to the Fehmarn Belt section.

DAY 5 (Saturday, 17.09.2011):
At 08:00 we started a second CTD occupation of the C section followed by an ADCP occupation. At 10:00 we headed back to Kiel. At 14:42 we were moored at Kiel Westufer pier. All equipment stowed away during the passage was unloaded.

Chapter 4

Preliminary results

4.1 Mooring

4.1.1 V431 - TRBM Marienleuchte

The V431 was installed in the Speergebiet Marienleuchte in May 2002. During Al33-11 it was not possible to service the 21th deployment of the mooring. The first attempt on the 13.9. was cancelled due to bad weather conditions. For the second attempt, on the 16.9., the mooring did not came up to the surface.

After cruise note: On the 10th of October the buoyancy part of the mooring, including the RDCP 600, was found at a beach on Langeland, Danmark (54°59.221N, O10°53.173E). The system was recovered by G. Niehus and U. Papenburg on the 3. October 2011.

The RDCP was operating until the battery reached a critical level (04.July 2011, 08:00UTC). As we do not have data records after the 4th of July we can not determine when the system came loose and made its way up north the coats of Langeland. However, it is possible that it was only released during AL3311 but we failed to spot it, maybe it was held below the surface due to strong currents or was locked in the frame and became loose after we left the position. Nevertheless, the frame was strongly corroded and parts have been broke off.

Figure 4.1: *The buoyancy part of the mooring stranded off Langeland, DK, October 2011.*

4.2 Meteorological observations

The general weather situation during the 5 day cruise from Tuesday the 13th of September 2011 to Saturday the 17th of September 2011 between Kiel Bight and Darss Ridge is dominated by a low pressure cell with its centre on a path from western Norway to Finland during the first three days (Fig. 4.2). This low pressure cell is characterized by close isobars indicating a strong surface pressure gradient, hence high wind velocities. The wind reached its peak on Wednesday (Fig. **??**). By Thursday the region was getting more and more under the influence of a high pressure system with moderate to low wind. On Friday little to no cloudiness and low wind from westerly directions dominated the situation. By Saturday night the high pressure cell separated and moved to the east and to the north, allowing a new low pressure area, that resided over Scotland, to move towards the east and infleuncing our region. Cloudy conditions with increasing veering wind were observed and related to an approaching occlusion.

Local observations of the air pressure data shows a good agreement with the DWD charts (Fig. **??**).

The air temperature (Fig. **??**) shows a slight cooling trend over time, maybe related to the wind from more northerly directions that bring in colder air masses. The sea surface temperature (Fig. **??**) is influenced by multiple factors such as location, air/sea interaction, local upwelling/downwelling etc. The general decrease over the duration of the expedition may imply some dependency on the air temperature (see also heat fluxes).

The upward emitted long wave radiation (4.4, left) from the sea surface shows values of about $400\,\mathrm{W\,m^{-2}}$ of heat loss, with maybe higher values during day time. This is because the longwave heat flux is tightly coupled to the sea surface temperature, which increases during the day and decreases at night. One can also observe a slight decay of the upward-directed long wave radiation, which fits into the general weather situation discussed above.

The downward emitted long wave radiation (mainly form clouds) is measured and by adding it to the upward we get the net longwave heat flux (4.4, right). The net long wave radiation, which is the total upward directed radiation from the sea surface at which the incoming short and long wave radiation as well as the sea surface temperature are taken into account, is between 300 and $380\,\mathrm{W\,m^{-2}}$.

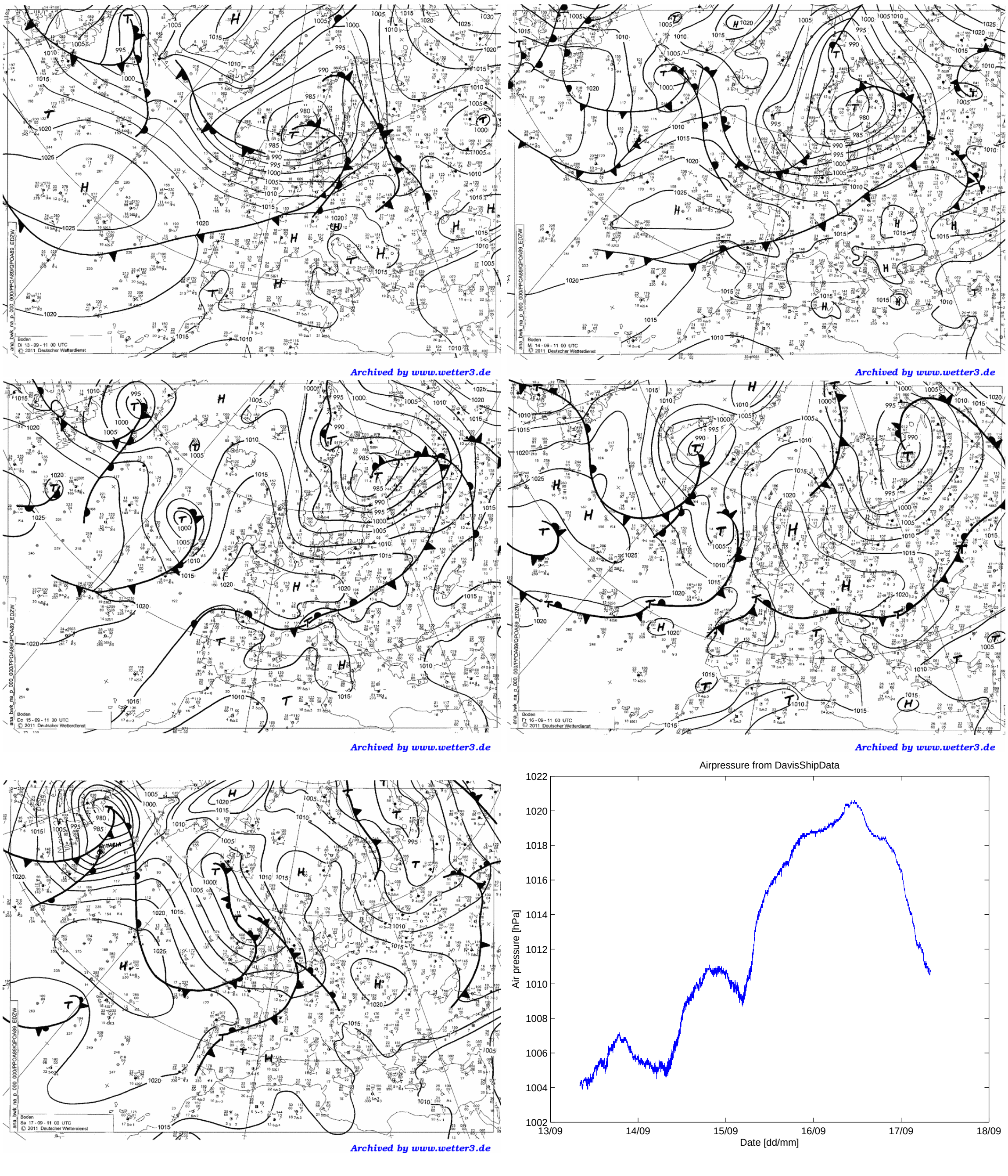

Figure 4.2: *Surface pressure analysis charts from DWD for the period September, 13 to September 17, 2011*

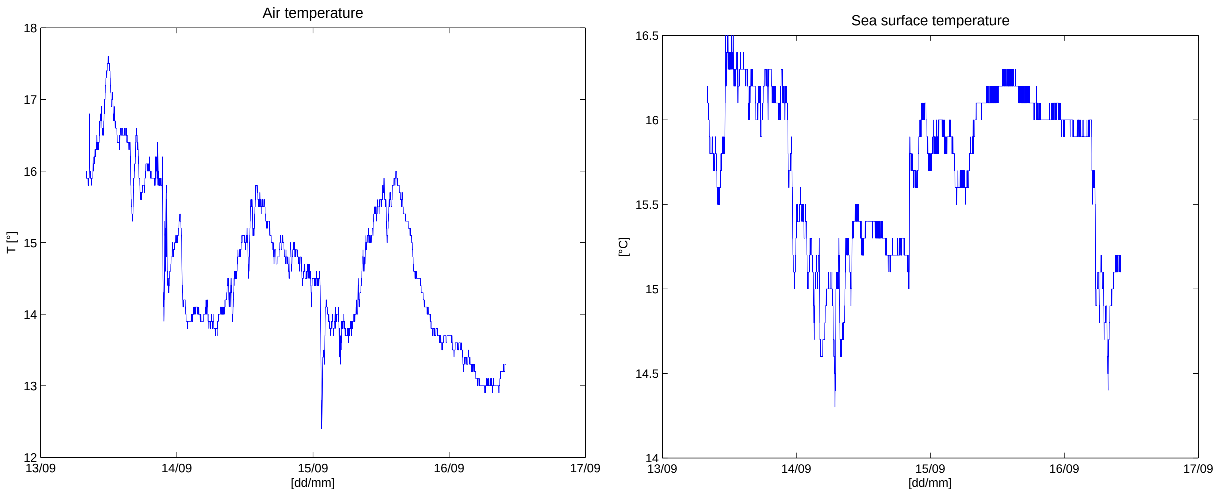

Figure 4.3: *Upper: observed shortwave and longwave heat fluxes, lower: calculated sensible and latent heat fluxes, and derived net heat flux*

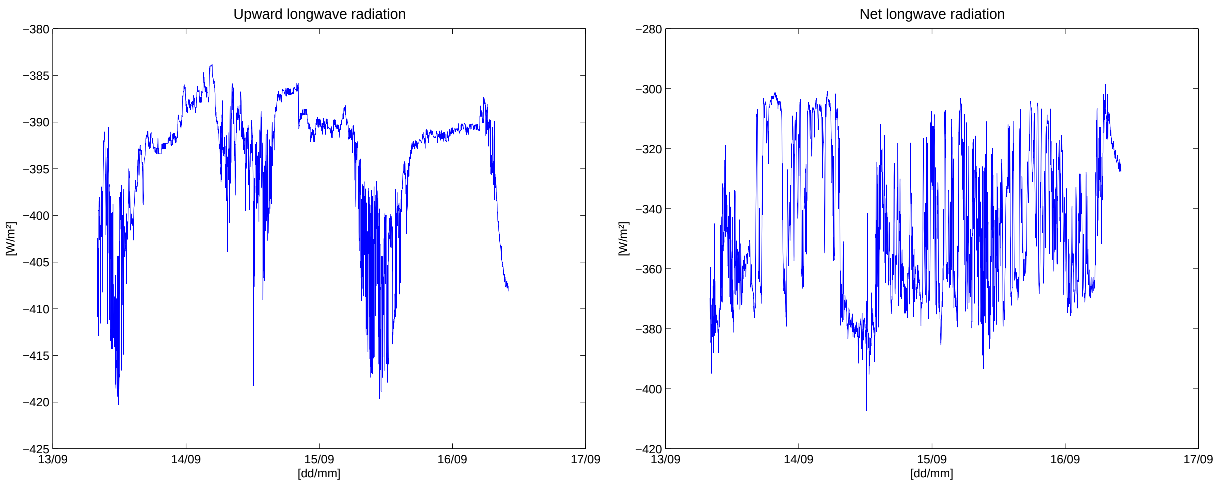

Figure 4.4: *Upper: observed upward longwave (left) and net longwave (right)*

4.3 Hydrographic and currents along C and L section

Fehmarn Belt (C section)

The first section through Fehmarn Belt, measured on Sept. 13th 2011, shows homogeneous distribution of temperature in the upper 14-16m with an average of about 16°C. Below, there is a temperature gradient starting in 15m depth in the northern part and in 20m depth for the southern part. The lowest temperatures are found near the bottom with about 14°C in the south and a small and certain minimum around 54°36'N in the northern part.

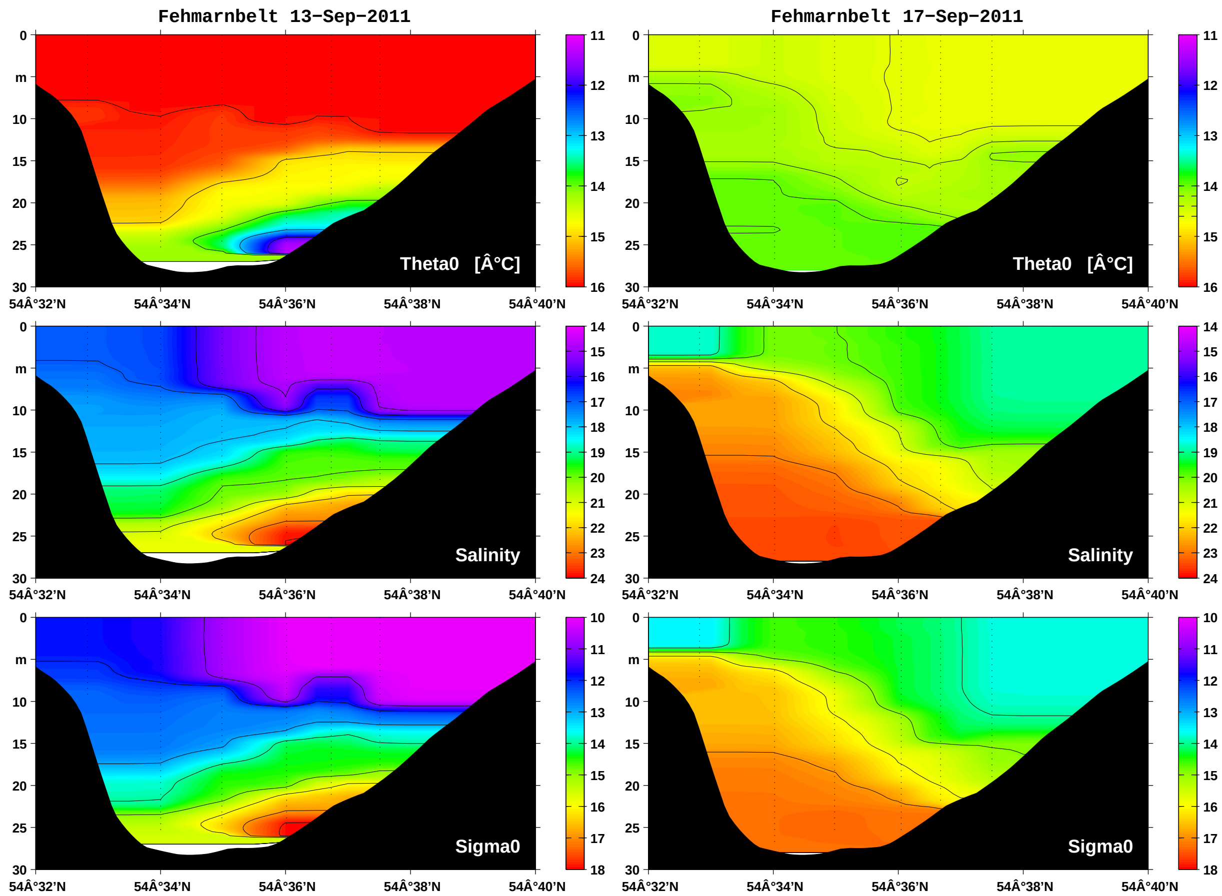

Figure 4.5: *Potential temperature, salinity and potential density distribution along Fehmarn Belt. Left: 13. Sept. 2011; right: 17. Sept. 2011*

Salinity increases with depth, but the distribution differs from south to north. The South shows respectively higher surface values (16-17), a more constant gradient starting at 5m and lower values on bottom (21). North of 54°35'N, there are surface water values around 14, a strong gradient beginning deeper in 10m depth and a strong salinity maximum (24) in the same place where temperature had its minimum. This salinity maximum can be identified as a salty North Sea water inflow. Density follows salinity due to a strong salinity and a weak temperature gradient. Density increases with depth, but also has a meridional gradient as described above. The density maximum can be found in the same place as the salinity maximum, so the salty North Sea inflow also is the densest water mass. Four days later, on Sept. 17th 2011, temperature distribution is almost homogeneous from the surface to the bottom with values around 14,5°C in the upper 10m and 14°C below. Salinity is now higher trough the whole section. With the near surface water still being fresher than deeper water, the depth in which a strong gradient can be found increases from south to north. Salinity increases fast between 3m and 6m depth (from 18,5 to 22,5) south of 54°34'N. Further north, the salinity increase is rather slow and takes place in 10 to 20m depth. The salinity maximum with a value around 24 is still existing, but now spread all over the bottom and it reaches up to 15m depth. Density is still dominated by the salinity effect and shows the same spreading is described above. The differences between the two sections were caused by strong SW winds during the four days. Those winds drove wind-driven mixing reaching very deep into the Baltic Sea. As a result temperature differences almost vanished and salty North Sea water got mixed into the whole bottom layer. Another effect that occured is coastal upwelling. It caused the salty bottom water to rise up to 5m depth at the southern coast.

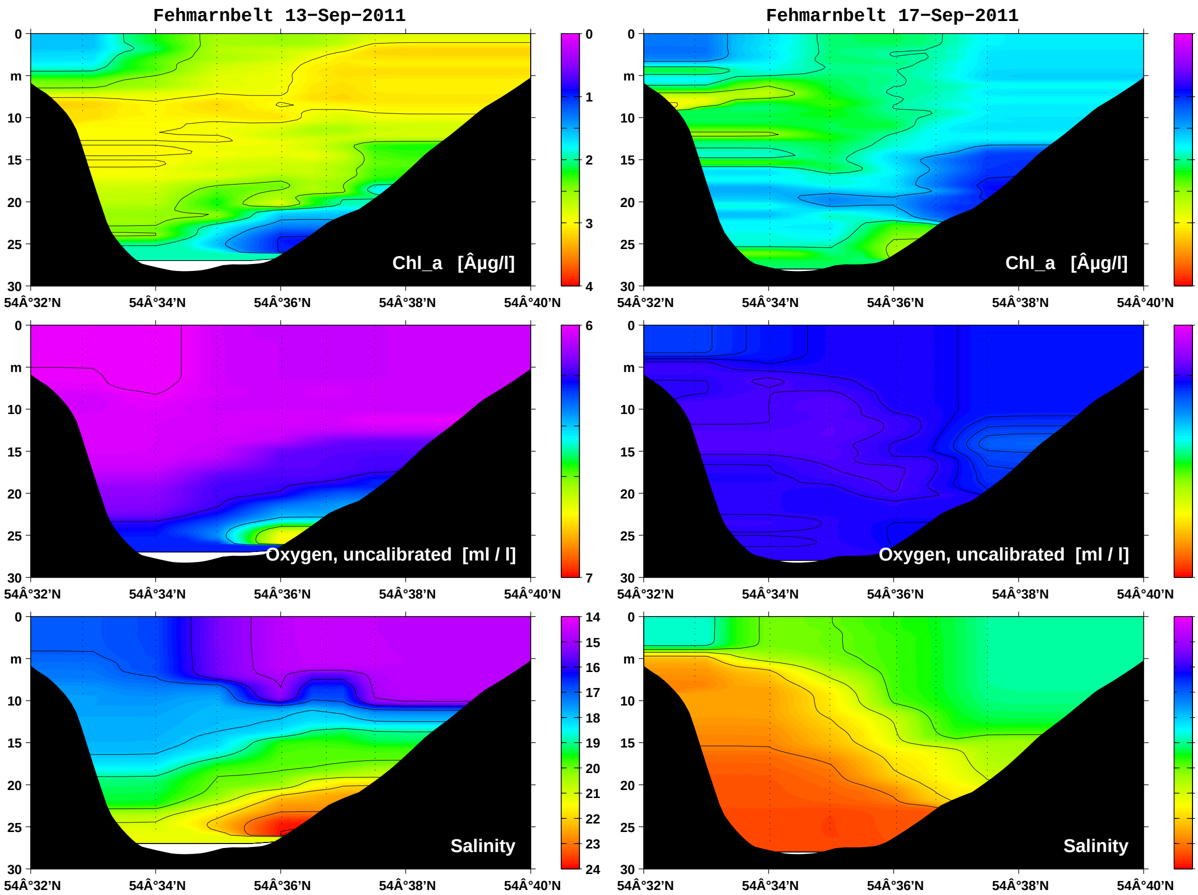

Figure 4.6: *Chlorophyll, oxygen and salinity distribution along Fehmarn Belt. Left: 13. Sept. 2011; right: 17. Sept. 2011*

The wind-driven mixing and North Sea inflow can also be seen in the oxygen values. First, oxygen is low above 15-20m depth and has its maximum in the same place as the salinity due to oxygen rich North Sea water. Four days later, oxygen values are almost the same throughout the whole section with higher surface values than before; an oxygenation of the near surface water has taken place. As the core of this high salinity water from the North Sea inflow tends to stay at the northern side of the belt on September 13th , we have to figure out how this can work against geostrophic conditions. The saline inflow is accompanied with an eastward flow, so with respect to Coriolis-deflection to the right, the resulting current should be more intense in the southern part of the belt. The reason for this behaviour is probably due to flow interaction with the topography of the Fehmarn Belt, which is no more relevant after the strong wind induced mixing event during the cruise.

Zonalsection (L section)

In the zonal section you can see a typical temperature distribution. In general the temperature decrease from west to east and ranges from 13 to 16°C. In the upper part, meaning the upper 15m you can see the warm outflowing Baltic Sea water which yields the temperature maximum with around 16 °C. The water below is significantly colder which characterizes the cold water inflow from the North Sea. Here, the temperature drops to 13.5 â 14°C. The temperature minimum is found in the most eastern part of the section around 14°20' E, where the water is 13°C cold in a depth of 25m, which might be caused by a current in the eastern basin.

The salinity distribution again shows the Baltic Sea outflow in the upper 15m with a salinity of 18 and below the salty water coming from the North Sea, which reaches up to 12°00'E and has a salinity of up to 22. This represents the salinity maximum. Between 12°30'E and 13°00'E there is a strong horizontal gradient, where salinity drops from 15 to 9. The minimum is again found around 14°00'E with a salinity of 4 in the upper 25m. It is typical for the Baltic Sea that salinity in the west is much higher than in the east, where there is a lot of freshwater inflow. The density distribution is dominated by the salinity distribution because it shows a much higher gradient than the temperature. Oxygen is nearly homogeneous in the western part of the section which might be due to the strong winds and the resulting mixing in the upper layer. At about 12°30'E the oxygen increases slightly, this is the area where the salinity and density distribution showed the strong lateral gradient. Far in the east at 14°20' E we find a for the Baltic Sea a reverse stratification compared to the normal condition. Usually there is unventilated water, that is low on oxygen at the bottom and oxygen richer water in the upper layer of the water column due to wind induced mixing. Here, the oxygen is at 7 ml/l between 25 and 30m depth and only about 6.6 ml/l above.

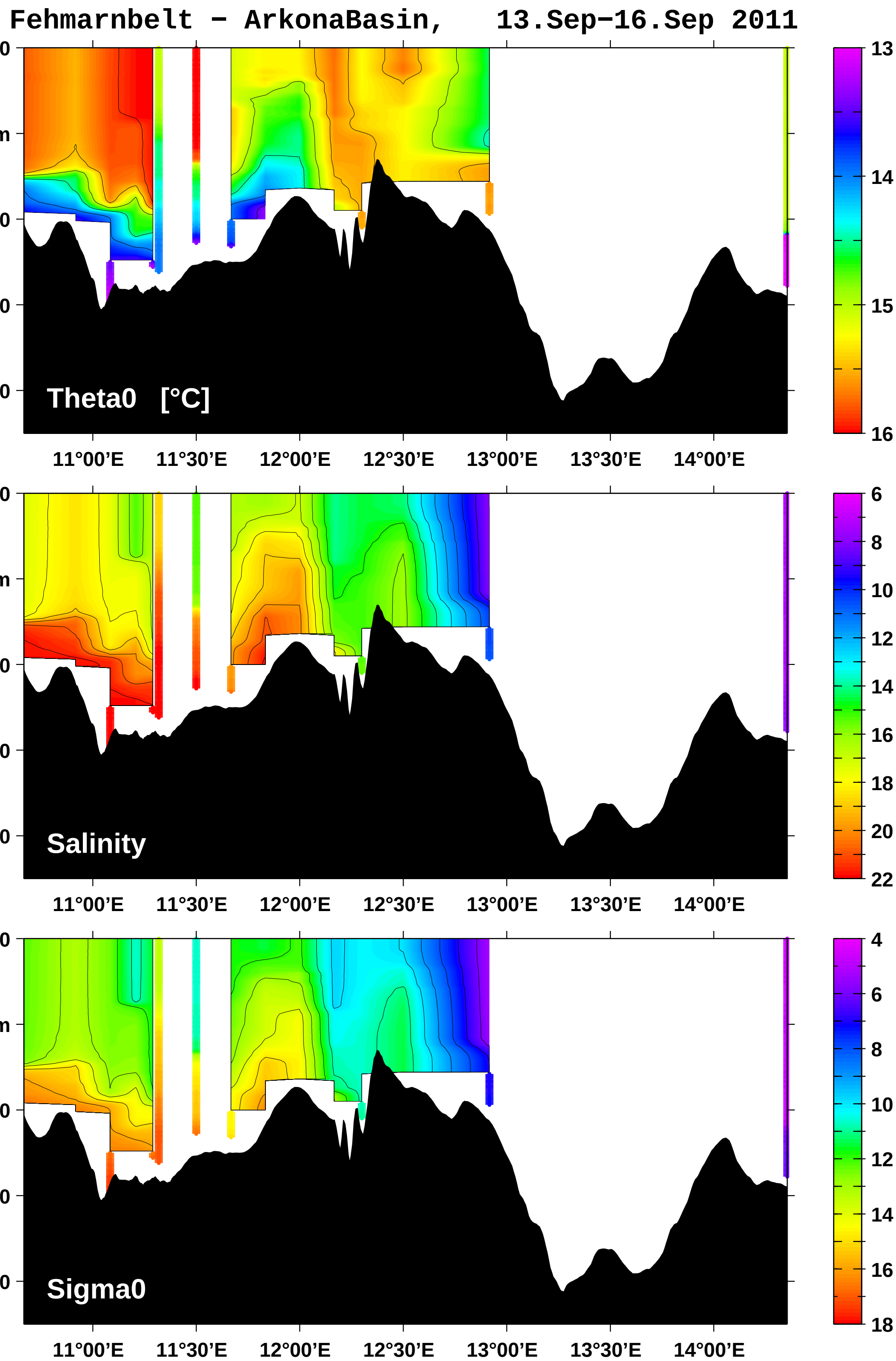

Figure 4.7: *Temperature, salinity, and density as measured along the Zonalsection. 13. Sept. to 17. Sept. 2011.*

Comparison to model results (BSH)

The observations were compared with the output from a pre-operational model operated by the BSH, Hamburg, Germany. The model simulations are part of the MyOcean Project.

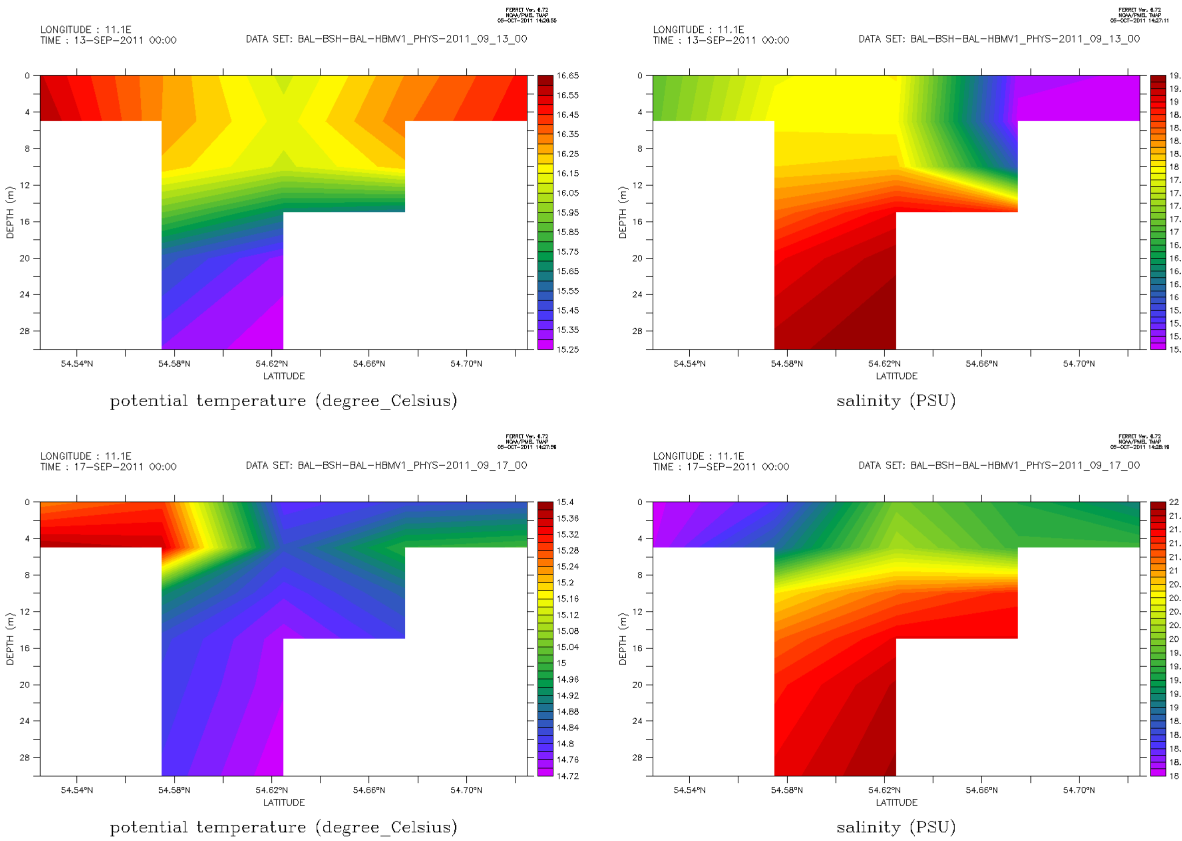

Figure 4.8: *Temperature (above) and salinity (down) in Fehmarn Belt at 13. September 2011 (left) and the 17. September 2011 (right) from BSH model (kindly provided by F. Jansen/T Brüning, BSH, Hamburg).*

The model results for September 13th show a similar temperature distribution in the Fehmarn Belt, including the temperature maximum near the surface, the sharp temperature gradient at 15 â 20 m depth and the temperature minimum at the bottom northern of the side of the section which we associated with the North Sea inflow (see figure 4). It is striking that the temperature ranges differ significantly (11 â 16°C measured and 15.2 â 16.6°C calculated), therefore the model shows a much smaller range. Further, the model shows lower surface temperatures in the centre of the section at 54.64°N. Results in salinity show a high correlation to the measured distribution on September 13th, with the drawback of smaller salinity ranges in general (15.2 â 19.4 from model and 14 â 24 from CTD) . The previous mentioned horizontal and vertical gradients (northern salinity minimum at surface, northern salinity maximum at bottom) are clearly visible.

The calculated data from September 17th are shown in figure 5. CTD measurements show a far reaching homogenization of properties like temperature and salinity through the whole water column which is due to a strong wind induced mixing event during the cruise. Looking at the model calculated temperature distribution in the Fehmarn Belt, there has been strong cooling of about 0,5 â 1,2 degrees in the whole section within the four days. This leads to a very weak thermal stratification, which was also measured with the CTD. Model salinity shows a different distribution than measured, whereas the range is similar (18 â 23). The more saline bottom water is still recognizable but its horizontal density gradient peaks towards the south, whereas the measured salinity shows a small horizontal gradient towards the north. Model surface salinity has its maximum in the centre of the section, just as measured. There is also a significant surface salinity minimum at the southern end of the belt, with values about 18.0.

The model data for the zonal section of the Baltic Sea shows similarities in the temperature distribution. Clearly visible is the cold water at the bottom between 10.6°E and 11.6°E, which is, as mentioned earlier, the cold inflow of the North Sea. However there is a difference in the thermocline depth between the measured data and the model. The observed data reveals a strong gradient (boundary between warm Baltic Sea and cold North Sea water) at about 15m depth in the west and a little bit deeper towards the west. In the model data the thermocline is at about 10m depth with the temperature minimum of 15°C below 15m depth. The minimum temperature is with 13°C also lower in the measured dataset than in the model. The upper layer (0-15m) seems not to be as homogeneous in the model than in the real data, but it is mislead by the different temperature scales of the two plots. In general the model predicts higher temperatures than we measured.

In comparison to the measured salinity, the model data again shows a slightly smaller range. The minimum of salinity is 10 but the measurements show a minimum of 6. The same happens at the top end of the range (20 in model, 22 measured). The distribution is nevertheless similar. Between 10.6°E and 11.6°E you can identify the less salty Baltic Sea water in the upper layer and the more salty inflow of the North Sea below 15 to 20m. Like in the measured data, there is a strong horizontal gradient in the middle of the section, where the salinity drops from 18 in the west to an average of 11 in the eastern basin. However the boundary happens to be a little bit more west (11.7°E) than in our measured dataset (12.1°E). The salinity minimum is also found in the far eastern side of the section with a value of 10, which corresponds with our data. Overall the model results coincide with the measured data, with a few differences in value ranges and the location of key features.

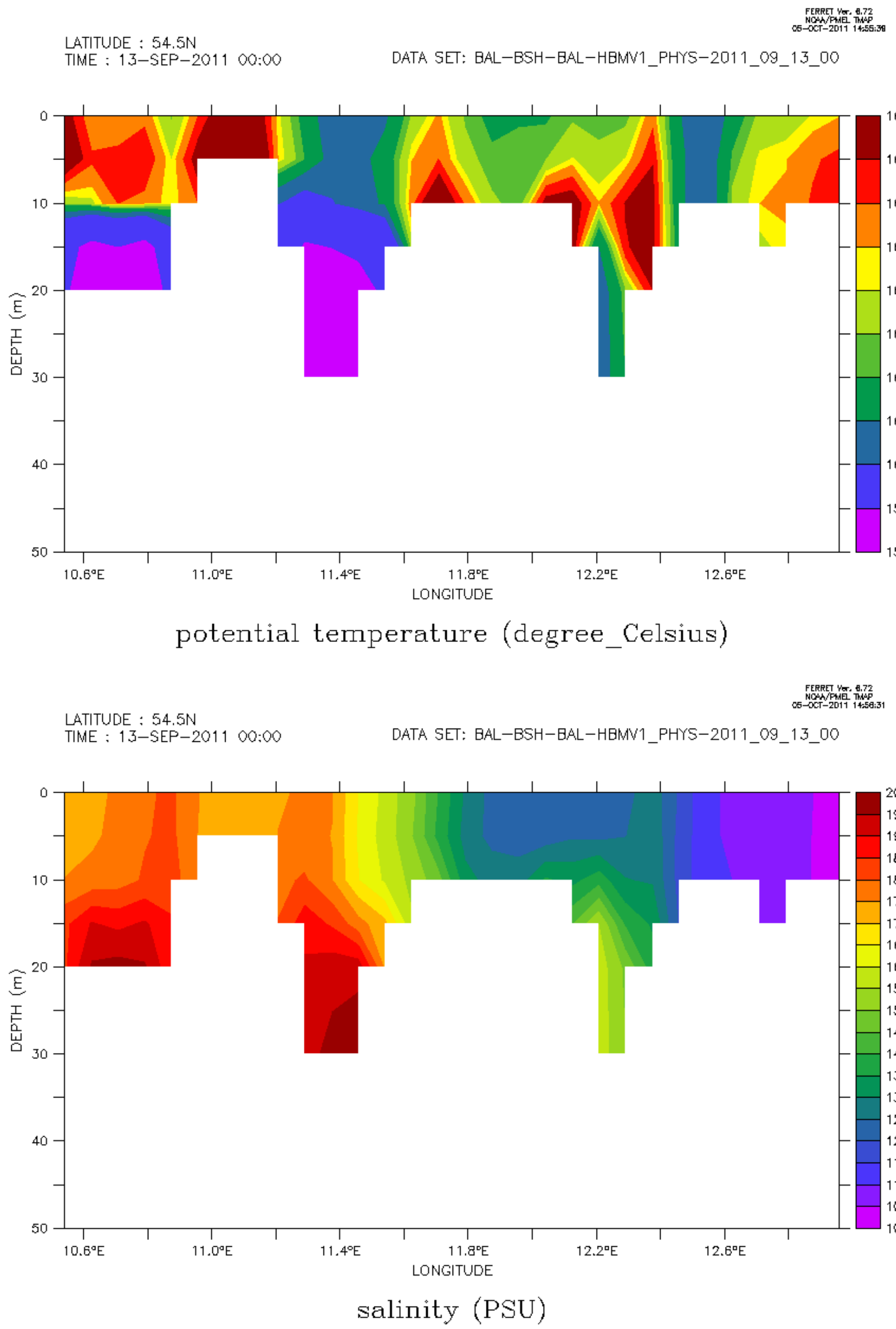

Figure 4.9: *Temperature (above) and salinity (below) along the L section as represented in the BSH model (data kindly provided by F. Jansen/T Brüning, BSH, Hamburg).*

Chapter 5

Equipment/instruments

5.1 Technical: Mooring V431

Mooring deployment site V431 is located in the military zone of Marienleuchte at the south-eastern opening of the Fehmarn Belt. Water depth is about 28m. V431 consists of a Aanderaa RDCP600, serial 227 with temperature (serial 2639, type:3621), conductivity (serial 85, type: 4019A), oxygen Optode (3830) and a self containing T/S recorder of type SBE-MicroCat (serial number 2936). The ADCP and all other parameter logging was programmed for every hour, the MicroCat (not recovered yet) record every 15 minutes.

The Aanderaa RDCP600 is configured for current recordings in 1.5m depth cells covering the whole water column. So far no 100% successful deployment can be reported, and agin we had a problem with the battery power during the deployment - as the battery seem to be not able to last long enough (1 year) although the battery calculator indicates. This could be due to the lower power availability of the lithium batteries in cold waters (nominal energy density is calculated against 20°C).

The time series shows a nice seasonal cycle of T and S and even oxygen seems to follow some seasonal evolution. As the instrument is in about 28m water depth the cooling in autumn sets in later (mid October) than triggered by the net heat loss at the surface (September). The winter 2010/2011 had cold periods at the beginning of December and by March, which are reflected by very deep temperature observed at the mooring. In between warmer and more saline waters of North Sea origin had an influence on the bottom hydrography. Interesting is also the oxygen concentration at the bottom (5.1, lower) being depleted at the end of summer, with the onset of the heat loss and deeper mixing the oxygen content quickly increases and reach saturation by end of October. This stays like it until the stratifications set in again in April.

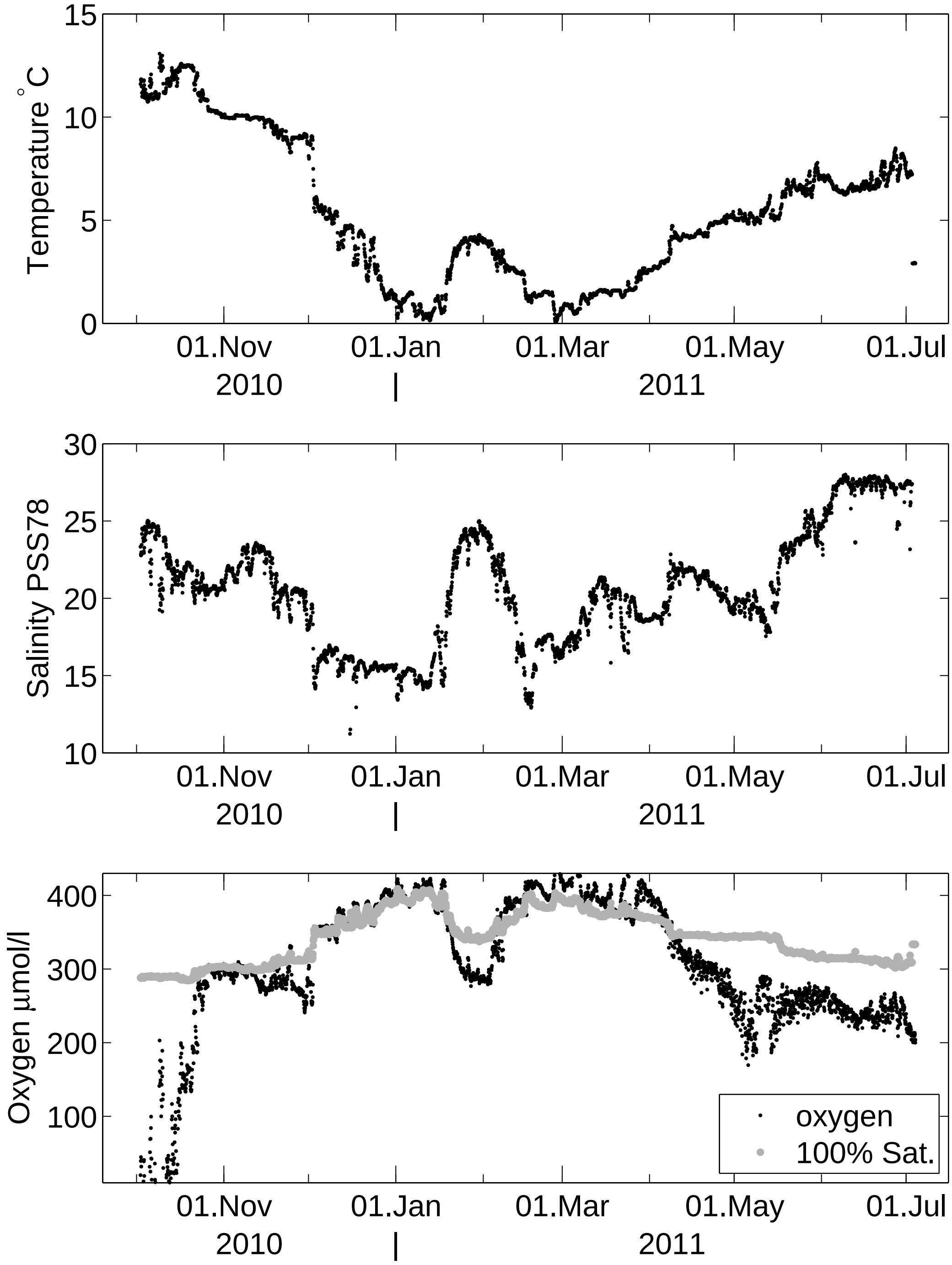

Figure 5.1: (upper) temperature, (middle) salinity, and (lower) oxygen from RDCP 600 at V431 position at 28m water depth. Note the battery reached a critical level by the 4. July and the RDCP instrument (with all sensors attached) stopped recording.

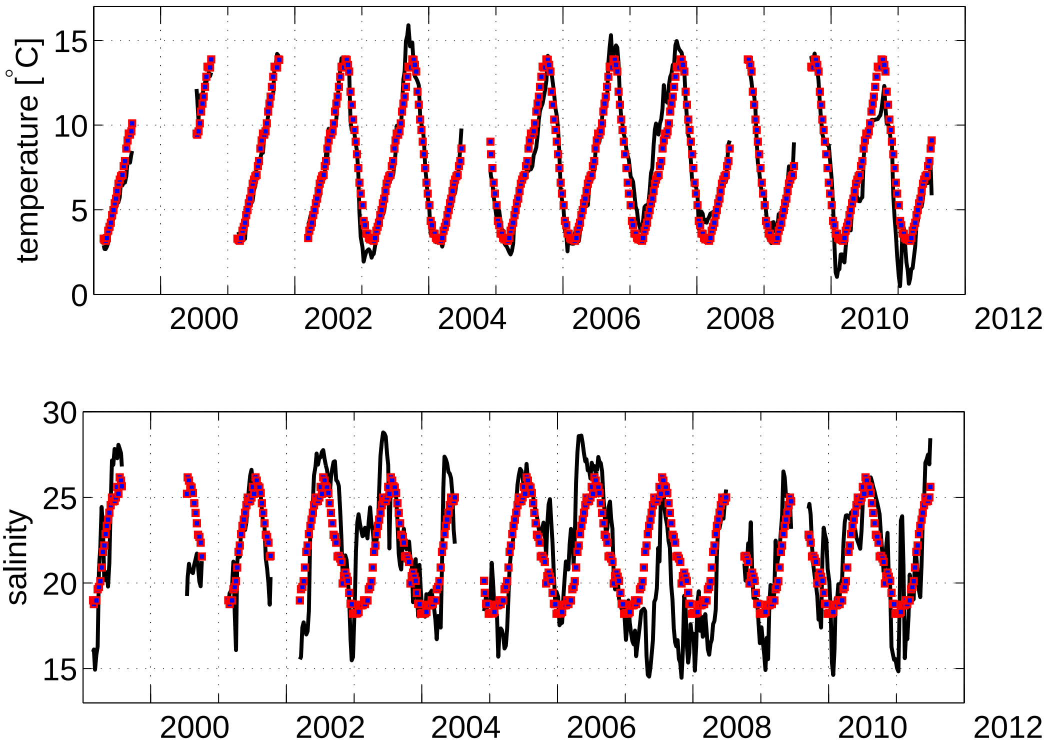

Figure 5.2: (upper) temperature and (lower) salinity between 1999 and 2011 at the bottom (28m) of the Fehmarn Belt. Red squares indicate the average weekly cycle.

Time series of bottom water temperature and salinity (Figure 5.2) show a clear seasonal cycle in T and S (and also in density). Warmest temperatures of more than 16°C were recorded in autumn 2003, coldest in the winter 2010/2011. Fresher conditions since 2006 may be reported. Based on weekly anomalies (Figure 5.3) the out of phase changes between T/S can be seen quite well, while the temperature anomalies follow in part the Air-temperature anomalies, as recorded by a near by meteorological station on Fehmarn (Westermarkelsdorf). For example the anomalous warm condition from mid 2006 to mid 2007 are re-sampled in the bottom temperatures although the second peak in bottom water temperatures in summer 2007 is not related to particular warm conditions in the atmosphere.

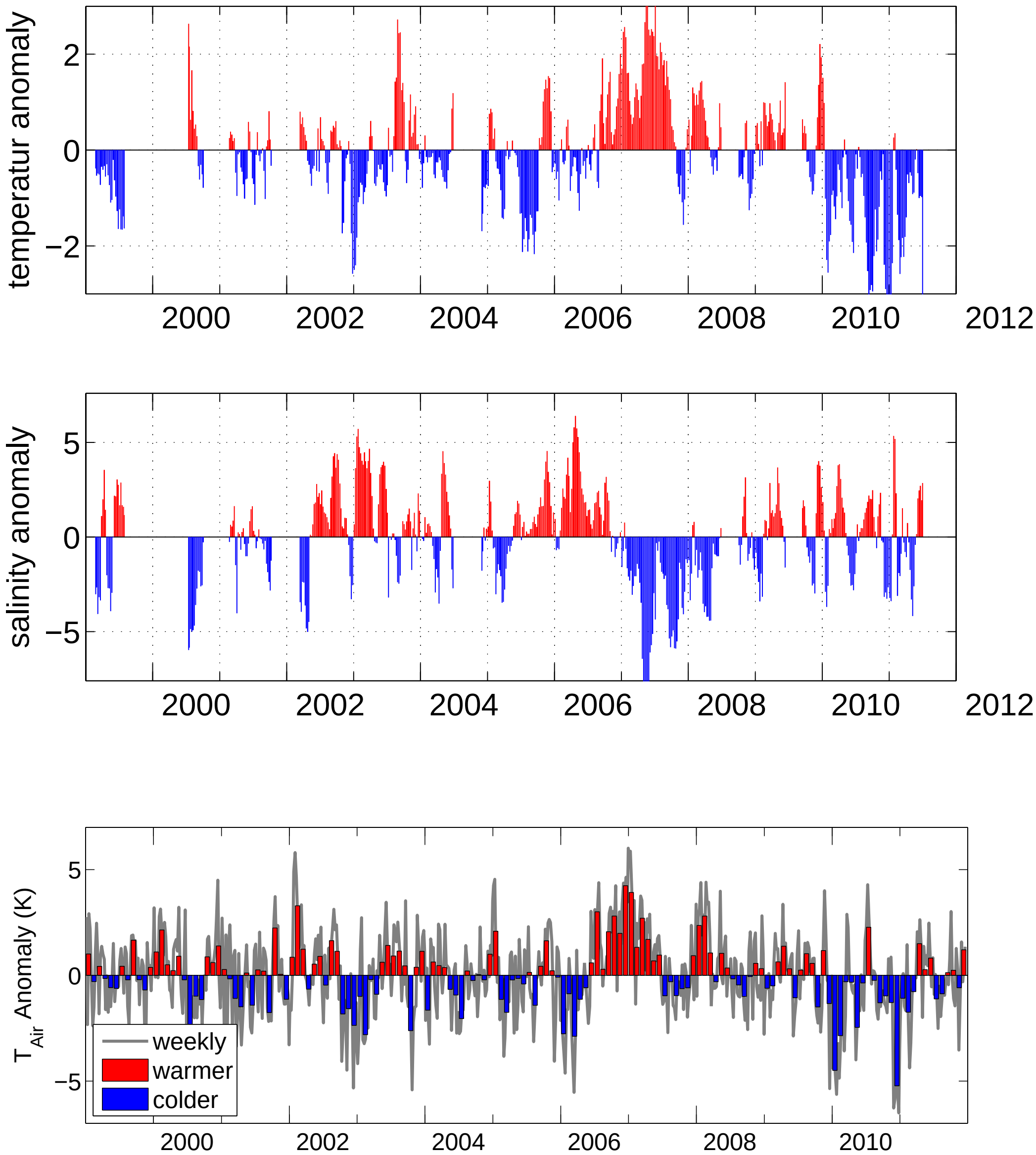

Figure 5.3: (upper) temperature and (middle) salinity anomaly based on all available data between 1999 and 2011. (lower) Air-temperature anomalies derived from daily data from Station Westermarkelsdorf (Fehmarn) provided by DWD via website. Anomalies based on weekly averages (gray line) and monthly averages (bars) are shown.

5.2 CTD/Rosette and Salinometer

5.2.1 CTD

A Hydro-Bios CTD was used during the cruise. For in-situ calibration of the conductivity sensor bottle samples were taken and analysed with a Beckman Salinometer. The salinometer was calibrated at the beginning of the cruise with Standard Water (R125). The difference between the measurement and the known salinity leads to a coefficient that is needed for the correction of the following measurements. Before a sample could be measured with the salinometer it had to stay for at least one day in the lab to adapt to room temperature. This procedure is necessary to reach the assumed accuracy of 0.002 which can only be achieved when the temperature of the samples differs with no more than 1K.

We analysed samples collected from the Thermosalinograph (TSG) and from the Rosette bottles mounted next to the CTD. In order to achieve the highest accuracy, at least three consecutive measurements per sample were necessary (the number of repetition depended on difference between at least two measurements should be less than 0.01).

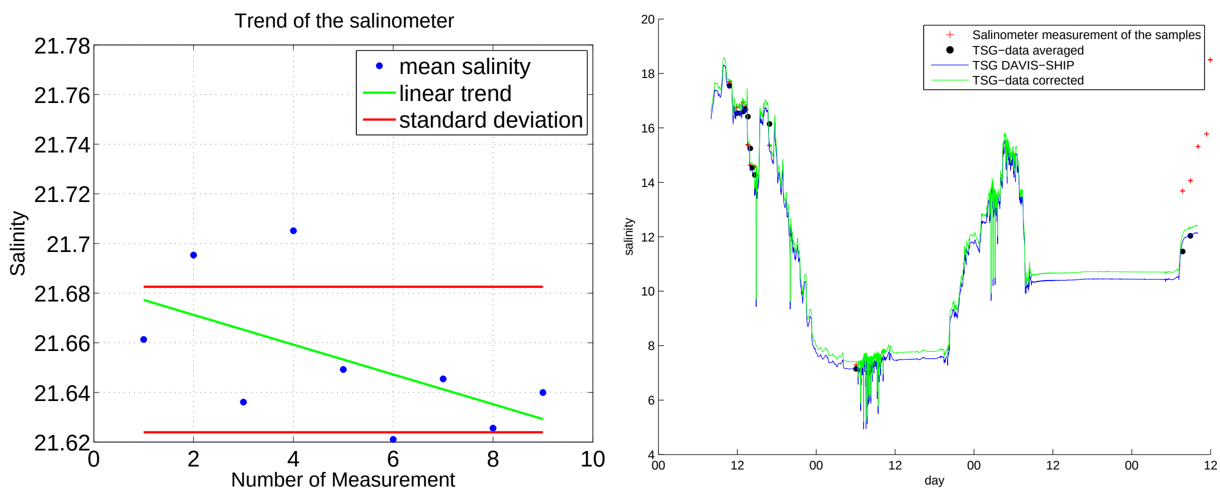

Figure 5.4: *(left) Trend of the salinometer based on Substandard measurements. (right) Observations from the Thermosalinograph.*

To estimate the temporary drift of the salinometer, regular control measurements with so called Substandard Water had to be done (typically after 3 samples). The Substandard is a larger amount of seawater we collected at the beginning of the cruise. The exact salinity is unknown but should remains constant during the cruise. The difference between the various Substandard measurements may indicate a drift of the salinometer (but other factors as Lab-temperature changes may also contribute to a drift).

Despite our efforts to do the most accurate measurements, the standard deviation of our Substandard repeat measurements was about 0.03 and as such more than an order of magnitude higher than the nominal accuracy for the Beckman as given by the manufacturer (0.002). This leads to the assumption that the execution of our measurements was highly erratic. The most important failures might be the bubbles sucked in by the salinometerâs vacuum pump. These bubbles occurred a lot during our measurements and have a great influence of the salinity displayed by the instrument. However, bubbles would lead to a lower conductivity and hence a more of a systematic difference should be found.

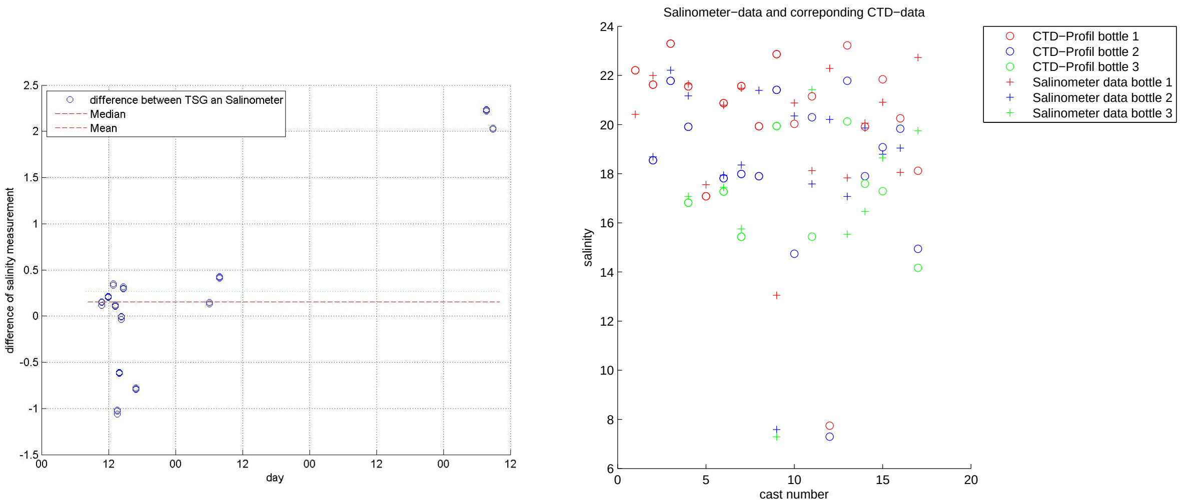

Figure 5.5: *(left) Difference between TSG and the Beckman-Salinometer measurements. (right) Salinometer-data and corresponding CTD-Data.*

Other sources of errors may include ship pitch and roll due to rough seas, temperature fluctuations in the room etc. To estimate the trend of the salinometer, we averaged the consecutive measurements after rejecting obviously false data. As is shown in Fig. 5.4 the instrumental drift is within the standard deviation, which means that it can not be defined properly and so it is irrelevant for our following data processing.

The continuous TSG measurements are plotted in Fig. 5.4 (right), additionally the TSG data were averaged over 15 minutes before and after the time when a sample were taken. The salinity and the temperature from these samples were determined with the Beckmann-Salinometer. The graph of the salinity shows the whole trip including the one day of the cruise which we stayed in the harbor. This is visible in the data set at the midday of the third day. After this the salinity is unusually high and has a high variation - it is unclear what caused this. But it seems likely that it was not a false measurement because the salinometer data shows clearly higher salinity too, but has still a higher difference to the TSG than the day before. Maybe the pump was malfunctioning.

Figure 5.5 (left) shows the differences between the TSG measurements and the salinometer measurements. The median is 0.15 with the standard deviation of 0.26.

During the cruise several CTD casts have been performed. The measurements provide continuous vertical profiles for salinity and temperature. We took three water samples from different depths with small salinity and temperature gradients for each cast. Analyses of these samples with the Beckman-Salinometer provide a base for calibration of the ctd salinity measurements.

In Fig. 5.5 (right), the measured salinity from the CTD for the sample depths and the salinometer measurements are plotted.

Apart from some wide variations, the corresponding measurements match quite well. Furthermore, we examined the data to find a systematic deviation of the CTD measurements or an instrument drift with time. In Fig. 5.6, the difference between the CTD and salinometer measurements for each sample is depicted. Apart from very few data points, the values of the calculated difference are inside the standard deviation, thus we can not assume a significant deviation of the CTD measurements. The data points outside the standard deviation range do not show a distinct deviation or drift.

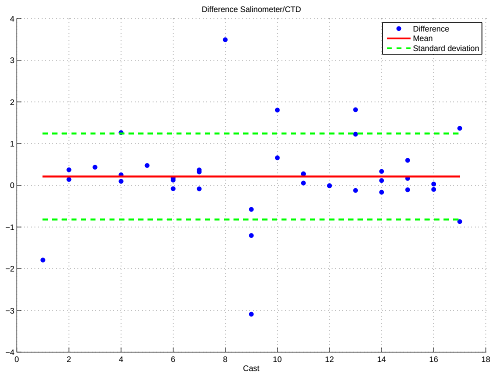

Figure 5.6: *Difference between salinometer and ctd-measurements.*

5.3 Underway Measurements

5.3.1 WERUM

ALKOR has a new central data collection system from WERUM. The system worked perfect during the cruise and facilitated 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 installed on ALKOR.

5.3.2 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.

5.3.3 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 Infra-red Radiometer (Model PIR).

5.3.4 Echo sounder

The ER 60 SIMRAD echo sounder was activated during the cruise.

5.3.5 Thermosalinograph

The thermosalinograph (TSG) on ALKOR is permanently installed at about 4m depth, takes up about one litre per second.

5.3.6 Vessel mounted ADCP

A 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) is available via a THALES 3011 dGPS system. The connections have been corrupt after the last ship yard visit of the ALKOR and some recalibration had to be done during the cruise.

Chapter 6

Acknowledgement

Thanks to Norbert Hechler (master), Rainer Nannen (1st) and all the crew of ALKOR a successful and comfortable cruise could be performed.

Chapter 7

Appendix

Station table

NR	LATITUDE	LONGITUDE	Depth	YY	MM	DD	HH	lg:fb:mr:rg:kd
1	54.5640	10.6668	20	2011	09	13	8.78	1 0 0 0 0
2	54.6077	10.9175	21	2011	09	13	9.97	1 0 0 0 0
3	54.5910	11.0837	32	2011	09	13	10.85	1 0 0 0 0
4	54.5190	11.3048	27	2011	09	13	11.95	1 0 1 0 0
5	54.5472	11.1643	10	2011	09	13	12.92	0 1 0 0 0
6	54.5667	11.1857	27	2011	09	13	13.27	0 1 0 0 0
7	54.5830	11.2082	27	2011	09	13	13.65	1 1 0 0 0
8	54.6003	11.2258	27	2011	09	13	14.02	0 1 0 0 0
9	54.6122	11.2423	23	2011	09	13	14.37	0 1 0 0 0
10	54.6252	11.2582	20	2011	09	13	14.72	0 1 0 0 0
11	54.4477	11.5003	24	2011	09	13	16.90	1 0 0 0 0
12	54.6305	14.3545	31	2011	09	14	6.05	1 0 0 0 0
13	54.5223	11.3048	28	2011	09	16	11.90	1 0 1 0 0
14	54.3500	11.6680	25	2011	09	16	12.00	1 0 0 0 0
15	54.3490	11.8340	22	2011	09	16	12.77	1 0 0 0 0
16	54.3582	11.9982	18	2011	09	16	13.60	1 0 0 0 0
17	54.4000	12.1662	21	2011	09	16	14.40	1 0 0 0 1
18	54.5340	12.3002	23	2011	09	16	15.47	1 0 0 0 0
19	54.6340	12.5002	18	2011	09	16	16.50	1 0 0 0 0
20	54.8083	12.9165	22	2011	09	16	18.52	1 0 0 0 0
21	54.5470	11.1645	10	2011	09	17	5.97	0 1 0 0 0
22	54.5670	11.1857	28	2011	09	17	6.40	0 1 0 0 0
23	54.5830	11.2068	27	2011	09	17	6.80	1 1 0 0 0
24	54.6008	11.2253	26	2011	09	17	7.27	0 1 0 0 0
25	54.6113	11.2415	23	2011	09	17	7.58	0 1 0 0 0
26	54.6250	11.2575	20	2011	09	17	7.93	0 1 0 0 0