METEOR-Berichte 05-?

Circulation and Variability in the Tropical Atlantic

Cruise No. 62, Leg 2
from Fortaleza, Brazil to Recife, Brazil
August 8 to August 31, 2004

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2.1.1 Participating Institutions

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2.2 Research Program

Research cruise M62/2 focussed on the physical oceanography of the western tropical Atlantic Ocean. The measurement program of M62/2 consisted of on-station hydrographic and current observations with a CTD-O2 probe and with an Acoustic Doppler Current Profiler (ADCP) attached to the CTD-rosette (lowered ADCP). Underway current measurements with the 75 kHz and the 38 kHz Ocean Surveyor ADCPs were of particular importance. At the 35°W section two sound source moorings that are part of a RAFOS float project funded by the German Science Foundation were deployed. The equatorial mooring at 35°W includes several instruments that allow the observation of the equatorial circulation. At 11°S the North Brazil Undercurrent moored array that is part of the German CLIVAR program was finally recovered. During the cruise several profiling APEX floats and acoustically tracked RAFOS floats were deployed. At 35°W and 28°W the CTD/ADCP profiles were measured down to 1400m, while at 11°S and 5°S they were measured down to the bottom.

Main research topic of M62/2 was the tropical-subtropical interaction and its variability. The measurements concentrated on a region where it is most strongly focussed, i.e. in the entrance zone of South Atlantic warm water transfer toward the equatorial zone. Previous work has shown that the equatorial warm water transport is mostly confined to the Brazilian continental slope between 5 and 11°S. The box from the 5°S section to the 11°S section (Fig. 2.1) is designed to investigate the continuity of the shallow western boundary currents near the Brazilian coast. The sections along 35°W and 28°W were measured at high resolution to resolve small-scale current branches. The transports and water mass parameters obtained at these sections can be compared with distributions measured during previous German, French and US cruises. These measurements are a good basis for the analysis of float data and results that will be obtained from the mooring at 35°W at the equator. A central objective of the work is to investigate transport- and water mass changes of the North Brazilian Undercurrent on time scales of months to several years. To record such changes, at 11°S a moored current meter array was maintained since March 2000. The array was finally recovered during M62/2.

To follow the southward flow of North Atlantic Deep Water along the western boundary, the hydrographic sections along 5°S and 11°S were carried out by deep CTD/ADCP profiles. The deep CTD/ADCP profiles at 11°S are also needed as reference measurements for the deep instruments within the mooring array. Due to enhanced levels of the intraseasonal variability in the Deep Western Boundary Current, previous ship sections along 11°S are strongly biased toward high transport values. This is evident for both the southward transport of North Atlantic Deep Water and the northward recirculation.

2.3 Narrative of the Cruise

Departure of RV METEOR from Fortaleza was delayed due to the late arrival of a group of 7 scientists as their flights from Lisbon to Fortaleza on August 6 and August 7 had been cancelled. After the group finally had arrived at RV METEOR, the vessel departed Fortaleza on August 8 near midnight, more than half a day later than originally planned. However, some of the instruments (profiling APEX floats) that should have been delivered to METEOR by air freight via DHL/Danzas were still missing at the time of departure. It was decided to ask for permission to take delivery of the instruments when the ship would pass by Recife's outer anchorage on our way to the mooring array at 11°S. The loss of time necessitated a change in the cruise track. The section along 40°W was cancelled and RV METEOR headed northeast toward the equator at 35°W where the scientific work started outside the 200nm zone of Brazil.

In the morning of August 10 two RAFOS floats were deployed with a short mission of 36h to test float performance. One float transmitted only incomplete messages and the other one did not transmitt any data. After contacting the float manufacturer Seascan as well as Service ARGOS it turned out that the incomplete messages were due to an error in the ARGOS system that was easily corrected. In addition, a problem occurred with corroding the float release wire during different tests in the Seascan laboratory. The compressee attachment to the floats was changed to fix the release wire problem. This technical problem with the RAFOS floats caused a delayed start of the planned float deployment.

At the equator and 35°W a new microstructure profiler was used for the first time. It measures the turbulence spectrum at vertical scales from millimeters to meters in the upper ocean. The nominal depth range of the profiler is 400 m. However, due to the very strong shear above the EUC (Equatorial Undercurrent) with westward flow at the surface of more than 0.5 m/s and eastward flow of more than 0.5 m/s in the core of the EUC at about 130 m, the profiler descended only to a depth of about 160 m. The CTD test station with the SBE-1 system at the same position showed erroneous conductivity values due to wrong calibration coefficients. The problem was resolved, however, the data of this station cannot be used for scientific analysis.

During the transit of METEOR to the first mooring position at 5°N 35°W, a mooring release test was carried out indicating that all releases performed well and were ready for use. On August 11, 17:30 UTC, there were only very weak winds from the south and after a short drift test the first mooring deployment of the cruise began. The mooring includes a sound source that transmits acoustic signals every 12 hours to be received by the RAFOS floats. The anchor was dropped at 19:20 UTC and the final mooring position is exactly at 5°N 35°W. After mooring deployment, the CTD section southward along 35°W began. The measurements along this section concentrated on the upper ocean. Thus the CTD probe was only lowered to a depth of 1300m. The CTD measurements were accompanied by current measurements with an ADCP attached to the CTD rosette as well as by two shipboard ADCPs, the so-called Ocean Surveyors of 38 kHz and 75 kHz, respectively. Both instruments were subjected to frequent failures of the 3D-ASHTECH GPS receiver. Thus, we decided to use a new 2D-GPS receiver as primary input for the OS. However, after the first failures of the ASHTECH-GPS receiver, the system was quite stable and we were able to compare the accuracy of the 3D-system with the 2D-system, indicating that the 3D-GPS receiver has a higher accuracy. Thus, we decided to use the 3D-GPS receiver whenever available as standard heading input for both ADCPs, and the 2D-GPS receiver during 3D-GPS failure time.

Along the southward cruise track, CTD stations were spaced apart by 30' of latitude beginning at 5°N, and by 20' near the equator. On August 12 in the afternoon, the first two RAFOS floats with a one-year mission as well as another test float with a 6-day mission were deployed. Since then

RAFOS floats have been deployed with a horizontal spacing of about 1° of latitude. Including test floats, this resulted in the deployment of 19 RAFOS floats along the 35°W section.

On August 13 after lunch, as METEOR approached the equator, a drift test for the second mooring deployment was carried out at 0°08'N. The ship headed into the wind coming from 135°T and a very strong current, the South Equatorial Current, flowing westward at about 2 kn. The chosen speed through the water of 2 kn results into a southward drift of less than 1 kn over ground. At 15:37 UTC the top element of the mooring was deployed, as were all other instruments subsequently. Thanks to a HYDROSWEEP survey on the way northward some days earlier, the topography in the deployment region was known to be fairly even. The mooring position was chosen to be far enough from the PIRATA mooring situated at 0°00.6'N, 34°59.7'W. The anchor was dropped at 17:46 UTC and submersion of the top element could be observed at 18:17 UTC. The final mooring position is 0°05.76'N, 35°01.19'W.

Following this mooring deployment, microstructure measurements were taken at the 35°W section at about 0°02'N. Again, due to the very strong shear above the EUC, measurements were only possible down to a depth of 100m. Seven microstructure profiles were obtained during a one hour period. Subsequent to a CTD/LADCP station at the same position, the weight at the microstructure profiler was increased, enabling a drop depth to 120 m.

On August 14 and 15 CTD/LADCP stations were taken on the way southward, accompanied by RAFOS float deployments at some of the stations. On the second to last station of the 35°W section, the pump of the CTD system failed at about 300 m water depth during the downcast. We decided to use the pump of the CTD backup system (SBE-2). However, there was no time to repeat the CTD/LADCP station, as METEOR had already been scheduled for Recife's outer anchorage area at 16:00 UTC on August 16 to load the APEX floats onboard. Thus METEOR headed southward onto the shelf off Brazil, taking the last CTD/LADCP station of the 35°W section at 19:30 UTC on August 15. Upon completion of the station, METEOR started its transit to Recife.

On August 16 after lunch, METEOR reached the outer anchorage area of Recife. Due to a strong swell of up to 3m it became quite difficult to bring the APEX floats on board METEOR. Once onboard, we started to reset the clocks of the APEX floats with RAFOS modules, as they were incorrectly set by the manufacturer. Meanwhile RV METEOR began an ADCP section across the Brazilian shelf toward 9°S, 33°50'W followed by a section parallel to the shelf toward our outermost mooring K4 at 10°56.4'N, 34°59.6'W. On August 17, 13:40 UTC METEOR approached the mooring position. Using the board unit with the hydrophone, we were unable to contact the releases. However at 14:00 UTC the release command was sent and only a few minutes later the top element of the mooring could be observed at the sea surface. The mooring was then recovered without any problems. We obtained a nearly complete data set from all instruments in the mooring. At the mooring position the first deep APEX float was deployed successfully.

Meanwhile, analysis of the last CTD cast of the 35°W section indicated that the density profile was partly unstable as the result of erroneous measurements. After recovery of the mooring K4, during the first CTD cast of the 11°S section, we tried to use pump and conductivity probe from the SBE-2 CTD system. However, salinity and oxygen measurements remained very noisy with partly unstable density profiles. At this point, we decided to use the complete backup system SBE-2 and then switched to the backup board unit, unfortunately without any improvements. The next step was the change the winch from W3 to W2. This made the situation worse with data transmission errors below 180 m water depth. At this point during the night from August 17 to August 18 the electronic technicians checked the resistance of the CTD cable and found a short at W2 and fluctuating resistance values at W3. The W3 cable received a new plug, and about 100 m of cable were cut from W2, and from W3 as well later on, but all without success. However, a resistance check of the W2 cable performed while lowering the cable to a water depth of 150m without the CTD-rosette attached showed that the W2 cable worked properly. We stepped back and used the complete CTD system SBE-1 together with W2 and we obtained the first reliable CTD measurements of the 11°S section at 23:00 UTC on August 18. Although it is not entirely clear what the reason of the malfunction of the CTD probe was, the most likely reason is a combination of malfunction of the SBE-2 CTD pump and CTD cables of both winches.

Despite the laborious and nerve-wrecking attempts to repair the CTD probe, we successfully recovered the two innermost moorings of our array at 11°S. The top element of mooring K2 with an ADCP and an ARGOS transmitter, as well as a MICROCAT, were cut off in May 2004 and had already been recovered by a Brazilian research vessel thanks to the ARGOS positioning system. Therefore, there was some apprehension on whether or not the remainder of the mooring was still in place. METEOR approached the mooring position in the morning of August 18, at 9:00 UTC. We obtained contact with the hydrophone and about 15 minutes after the release command the first packet of Benthos came to the surface. It took another 15 minutes until we knew that all instruments were still there, except for those recovered in May 2004. The recovery of the instruments was completed before breakfast. After some CTD tests described before, METEOR steamed toward mooring K1. A few minutes after the release command was sent, the top element came to the surface and the other two instruments of this very short mooring, an ARGONAUT and a MICROCAT, plus the releases, could be recovered within half an hour. After further CTD tests at the mooring position, we were able to start with the CTD section in the evening of August 18. The spacing between CTD stations near the shelf was less than 10 nm, and increasing farther offshore. Mooring work to recover our last mooring K3 started on August 19, 13:00 UTC. We were able to hear the reply from the releases, but with only one of the three hydrophones in use. After sending the release command, all instruments of the mooring were recovered successfully. Including the two instruments recovered by the Brazilian research vessel, we did not lose a single instrument of the entire mooring array. A first view on the obtained data showed that most of the instruments acquired complete data sets. Thus, the mooring activities of this cruise were completed with great success.

On August 19, 16:00 UTC the CTD section was continued along the boundary current array in south-eastward direction toward 11°30’S, 34°13’W and further in eastward direction toward 31°10’W beginning with 10 nm spacing, increasing to 60 nm.

As only one of two short-mission RAFOS floats that were deployed at 0°20’S, 35°W worked properly, we had decided to deploy another test float with a 6-day mission at 2°20’N. This float had ended its mission correctly and sent all data via satellite communication. Meanwhile, also the second test float, which had the release wire problem, reached the surface and transmitted its data. It was about one week late, but in the end the release wire must have released the drop weight. A comparison with CTD data at the deployment positions showed that all three floats reached the depths of their ballasted density surface within ±3 m. Analysis of the data from the hydrophone indicates that the deep floats heard acoustic signals from the moored sound sources at 23°W, 0°N and 28°W, 3°14’S. The float with the 6-day mission should also have heard the two new sound sources deployed during this cruise at the 35°W section. However, we found only the signal of the sound source deployed at 35°W, 0°N in the RAFOS float data. A failure of the other sound source deployed at 35°W, 5°N is the most likely reason for the missing signal in the data. The shallow float received only a signal from the mooring at 28°W, 3°14’S and only once out of two cycles indicating that acoustic conditions closer to the surface are not as favorable. Nevertheless, all test floats worked properly, except for the problem with the release wire that was fixed by changing the attachment of the compressee to the float. With the sound source at 35°W, 0°N, the coverage of sound sources in the tropical Atlantic should also be good enough for the shallow drifting floats.

The 11°30’S section was completed on August 22, 11:30 UTC. Following this section, the batteries of the NBADCP attached to the CTD rosette had to be changed. During a visual inspection of the instrument we found a deformed transducer surface at two of the four transducers. After contacting the manufacturer, we decided not to use the NBADCP for the rest of the cruise although it had worked very well during all stations. For the shallow stations we changed to our 300kHz up- and down-looking workhorse ADCPs and later for the deep stations at the 5°S sections to the workhorse ADCPs from the group of Monika Rhein, as these instruments in general show better performance in deep waters. From the end of the 11°30’S section METEOR headed in northeasterly direction with only three shallow CTD/LADCP stations on her way to 5°S, 28°10’W. Deep drifting APEX floats were deployed at these stations. On August 24, 7:00 UTC the meridional section along 28°10’W commenced with a spacing between CTD/LADCP stations of 30 nm, decreasing north of 2°S to 20 nm. There were some minor problems with the CTD system: On August 25, another shortage at the cable of winch W2 forced us to switch from W2 to W3, and on the same day in the evening the data acquisition PC stopped working during an upcast. However, the computer could be restarted while the CTD stayed at depth, resulting in no data loss.

Since we finally received permission from the Brazilian Ministry for Foreign Affairs to deploy the floats inside the Brazilian 200 nm zone which could not be deployed at the beginning of the cruise due to their late arrival, we deployed a total of 8 shallow drifting APEX floats, some with oxygen probes or RAFOS systems, along the 28°10’W section. In addition, 22 RAFOS floats were deployed along this section.

On August 24, 11:00 UTC we again performed microstructure measurements. During the first deployment, the microstructure profiler had reached only depths of about 100 m due to the very strong shear above the EUC. At the chosen location at 4°30’S, 28°10’W the situation was more favorable: although the SEUC (South Equatorial Undercurrent) had a subsurface maximum at 200 m water depth of more than 50 cm/s, the shear above was much weaker than during the last profiler deployment. We obtained 6 profiles during which the profiler descended to a depth of more than 350m almost monotonically. After the first three profiles the ship’s acoustic instruments (HYDROSWEEP, PARASOUND, ADCPs) were switched off as suggested by the manufacturer due to possible interference between acoustic noise and measurements. A first look at the data showed that both shear sensors worked well.

On August 26, 21:00 UTC the 28°10’W section was completed at 2°N and METEOR steamed southward toward the eastern end of the 5°S section at 30°10’W. The zonal section along 5°S commenced on August 28, 12:00 UTC with a shallow CTD/LADCP station down to a depth of 1300m and the deployment of one APEX and two RAFOS floats directly after the CTD rosette was onboard. After some shallow stations and another deployment of one APEX and two RAFOS floats, deep CTD/LADCP measurements down to the bottom were taken starting on August 29, 8:30 UTC at 33°W. As discussed before, along this section we used the two workhorse ADCPs from the Monika Rhein group as the lowered ADCP system. They yielded good data similar to our NBADCP. The spacing between CTD/LADCP stations was 30 nm continuously decreasing toward the shelf where it was about 9 nm. The last two RAFOS floats were deployed in the night of August 29 at 5°30’S and 34°10’W. The 5°S section was completed on August 30 at 14:30 UTC. There was about one hour time for testing again the pump of the SBE-2 CTD system. We performed a test station with the SBE-1 CTD system but with the pump of the SBE-2 CTD system. It could be shown that the SBE-2 pump has a malfunction leading to very noisy conductivity and oxygen data. After the CTD test METEOR steamed toward Recife where it arrived in the morning of August 31.

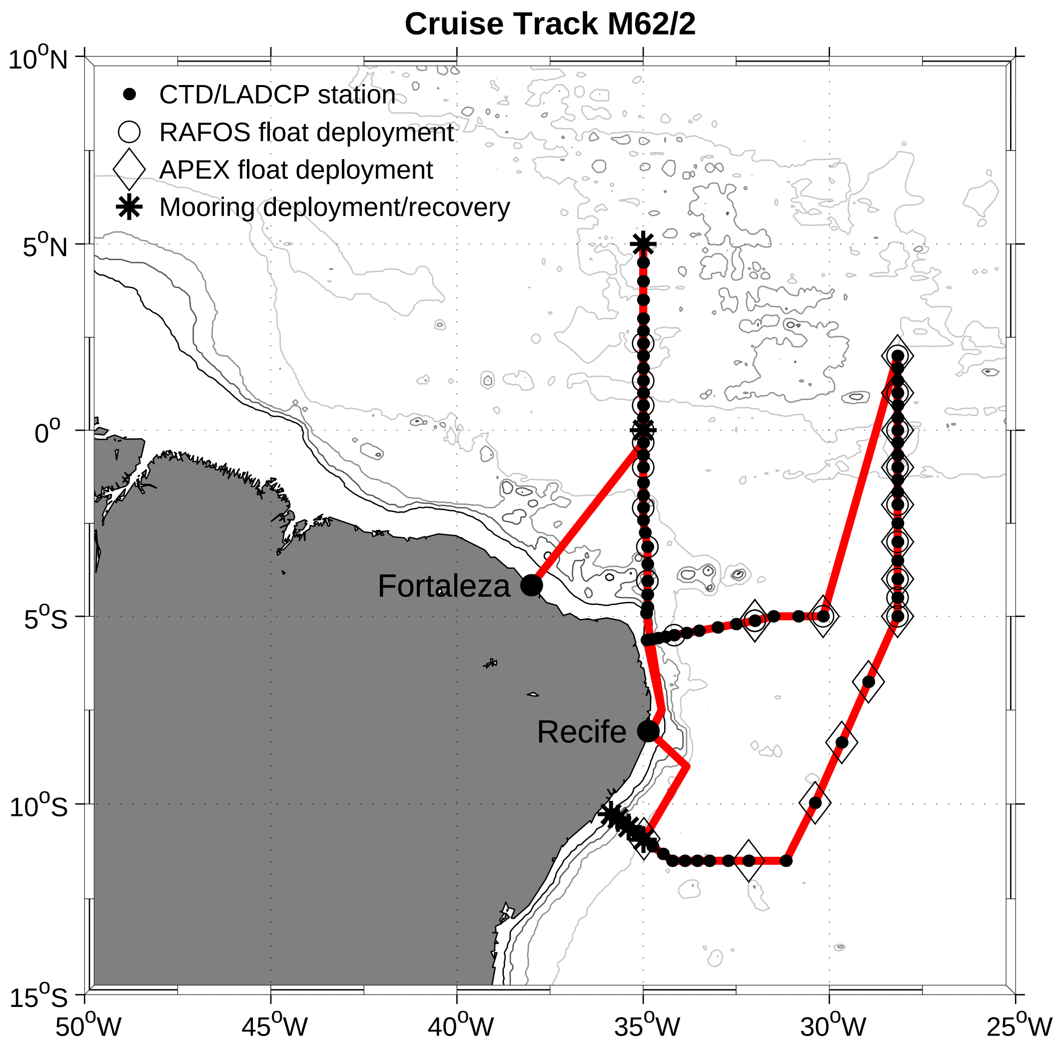

Fig.2.1: Cruise track M62/2 with CTD/LADCP stations, positions of float deployments and mooring work.

2.4 Preliminary Results

2.4.1 Water Masses and Variability Compared to Previous Years

(L. Stramma, K. Affler)

2.4.1.1 Calibration and Data Quality of CTD and Oxygen Measurements

The CTD-system used during the cruise METEOR M62/2 was a Seabird Electronics Inc. of Bellevue, Washington, USA (SBE) 9 plus. The IFM-GEOMAR Kiel SBE-1 with the serial number 09p22348-0572 was used. Connected were a pressure sensor (ser. nr. 75760), a temperature sensor (ser. nr. 2920) and a conductivity sensor (ser. nr. 2443). The oxygen sensor was a Seabird SBE-43 sensor (ser. nr. 430215) recording oxygen current but no oxygen temperature, as was the case in the former Beckman oxygen sensors. A second Seabird CTD, IFM-GEOMAR SBE-2, was available as backup system, but due to a bad pump, no reliable data from this CTD could be derived.

At the beginning, a test-CTD-profile had to be discarded due to unreadable data recording. Afterwards the data recording was successfully tested with the CTD on the ship, and starting with profile 1 the CTD-recording worked properly. On the 35°W section (CTD profiles 1-28) the CTD profiles were made only to 1300 m depth, as there was not enough ship-time available to do CTD profiles down to the bottom. Some problems appeared with the pump of the SBE1-CTD. Although the pump turned on after short waiting time at 10 m water depth, the salinity in the upper 10 m of a few stations was much too low and had to be removed and some profiles contain only extrapolated values for the upper 10 to 15 m of the ocean. The pump did not even start running in the water at profiles 24 and 25, and the CTD had to be taken back on the ship to flush water into the pump system, in order to begin the regular CTD cast. On station 26 the pump did not turn on, but with lowering the CTD to 40 m and returning to 10 m the pump started. After this station it was tried to repair the pump, but on station 27 the pump failed after working in the upper 278 m, and profile 27 was stopped at 278 m, hence no complete profile down to 1300 m could be gained. Before profile 28 was done, the SBE-1 pump was replaced by the SBE-2 pump, and on profile 28, the CTD seemed to work properly again. However, closer inspection showed that there was high variability in the conductivity profile and the density profile was unstable. Profile 28 is still included in the data set but has to be used only with great care because of bad data quality.

The first day on the 11°S section was governed by several CTD stations (29 to 33), which had to be removed as no reliable data were collected. Profile 34 was not even made. After several tests it turned out, that there had been some cable problems on both winches used for the CTD, responsible for the observed problems at the end of the 35°W section. It further turned out that in addition to the cable problems the density unstable values in profiles 28 to 33 were produced by the bad pump of the SBE-2 CTD-system. As good quality data are required for the 11°S section, the profiles 29 to 33 were removed and only from profile 35 onwards the profiles were processed and used for the 11°S section. Starting with profile 35 the SBE-1 pump was used again. The calibration showed that a shift in the conductivity calibration did appear after the profile problems had been resolved, and hence the conductivity calibration was made individually for profile 1 to 28 and 35 to 88. After the final station 88 some time was left for a test of the SBE-2 pump, and it could be proven, that the pump was causing the unstable CTD density-profiles.

The Seabird bottle release unit used with the rosette connected to the Seabird instrument worked properly and reliable.

CTD pressure and temperature were compared to six electronic ‘Deep Sea Reversing Pressure Meter and Reversing Thermometers’ attached to three of the rosette bottles. The lab calibration (from February 2003) for the pressure sensor was applied and the mean difference in pressure (0.9 dbar) was lower than the rms difference (1.1 dbar) compared to the Deep Sea Reversing Pressure Meter. Consequently no correction for pressure was applied. The lab calibration for temperature was carried out in May 2004 and the mean difference in temperature (-0.002) was lower than the rms difference (0.008°C) compared to the Deep Sea Reversing Thermometer and also no temperature correction was applied. The resultant calibrations were used for the conductivity and oxygen calibration.

For calibration purposes several water samples were taken from the rosette bottles at most stations. Bottle salinities were determined for the first box of water samples with Guildline (Guildline Instruments Inc, Smith Falls, Canada) Autosal salinometer. A quite new Guildline Autosal salinometer (Kiel AS8) was installed and the salinometer worked very well until August 25, when the filling tube suddenly disconnected from the measurement cell. After repairing the salinometer, the measurements were more unstable and air bubbles and dirt probably from the water bath were located in the cell. Therefore, the final measurements of the 5°S section were made with the Kiel AS4 Autosal salinometer which also worked well.

The CTD values to be calibrated were chosen from the downcast profiles to avoid hysteresis problems. Calibration of the SBE-1 CTD conductivity was carried out for the profiles 1 to 28 with a total of 79 sample pairs and for the profiles 35 to 88 with a total of 164 sample pairs. Bad or erroneous data were rejected when exceeding 2.8 times the standard deviation of the conductivity difference. This criterion still includes 98% of the calibration data. After correcting the conductivity with respect to temperature, pressure and conductivity itself as well as for a temporal trend, the rms differences between the bottle and CTD conductivity samples were 0.0021 mS/cm corresponding to 0.0022 in salinity for profiles 1 to 28 and 0.0025 mS/cm corresponding to 0.0026 in salinity for profiles 35 to 88.

Oxygen from the bottle samples was determined by the Winkler titration method with an electronic oxygen measurement system, the DO (dissolved oxygen) Analyser of Sensoren Instrumente Systeme GmbH, Kiel, Germany (SIS). At the beginning of the cruise, the titrated oxygen values coincided reasonably well with those of earlier cruises. However, another check at the end of the 11°S-section showed that the oxygen values were about 0.5 ml/l to high. All possible error sources were checked and it finally turned out that measurement changes in the standard caused the large deviations. As the standard was prepared from the same chemicals and even the same standard changed from one day to another the most likely reason seemed to be a problem of the DO Analyser itself. After the cruise the DO Analyser was tested in Kiel and it turned out that the buret (adding the chemicals) did leak randomly. Hence none of the oxygen measurements was usable, and no oxygen calibration was possible. Therefore, no oxygen values are contained in the CTD data.

2.4.1.2 Water Mass Variability in the Western Tropical Atlantic

Off Brazil on all repeated sections variability was observed for the hydrographic parameters of the different water masses. In the upper ocean, this variability is also connected to a seasonal cycle. During the cruise M62/2 in August 2004 on most sections the water masses showed variability but no parameter maxima or minima when compared to earlier cruises at most places.

One of a few exceptions was observed within the upper part of the Antarctic Intermediate Water (AAIW) at 35°W near the equator between 1°S and 1°N (Fig.2.2). During M62/2 in August 2004 (thick solid line in Fig. 2.2) the depth interval 500 to 650 m was less saline than during eight earlier cruises carried out between 1990 and 2003. A similar plot for 35°W off the Brazilian shelf south of 4°S (not shown here) showed relatively high salinity in August 2004, but the lowest salinities in the depth range 500 to 650 m for May 2003 and December 2000. Probably the low saline AAIW observed in the early 2000's near the Brazilian shelf did progress to the equator in August 2004, however, the exact spreading path of the low AAIW signal towards the equator is still unresolved. According to the flow schematics of Stramma and Schott (1999), the AAIW is transported with the Southern Intermediate Countercurrent at about 2°S towards the east and is than returning westward at the equator in the Equatorial Intermediate Current.

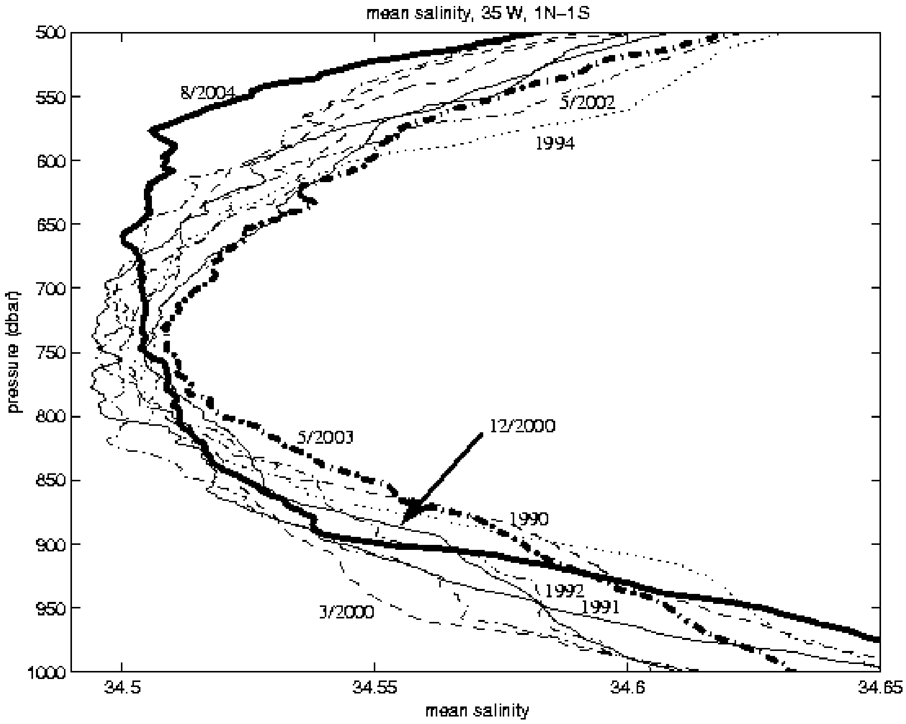

Fig. 2.2: Mean salinity profiles at 35°W between 1°S and 1°N for different cruises between 1990 and August 2004 in the depth range of the Antarctic Intermediate Water layer.

One water mass especially looked at is the Upper North Atlantic Deep Water (UNADW), as it is expected that low salinity water originating from the Labrador Sea should arrive at the equator in the next few years (e.g. Stramma and Rhein 2001). However, when looking at the two sections made down to the bottom at 5°S and 11°S, no sign of low saline Labrador Sea Water (LSW) was present in August 2004. Actually, at both locations, the salinity in the corresponding depth range was even more towards the higher salinities when compared to the earlier cruises.

For the 5°S section the mean salinity and the mean potential temperature west of 34°W on the isopycnal σ_θ=34.67 kgm^{-3} of all our 9 cruises since 1990 are shown in comparison to the records measured in the central Labrador Sea near the potential site of Labrador Sea Water formation (Fig.2.3). Stramma and Rhein (2001) estimated a spreading time of 15.25 years of the LSW signal from the Labrador Sea to the equator at 44°W carried in the Deep Western Boundary Current with a velocity of about 3 cms^{-1}. Using this value of 3 cms^{-1} for the distance from 44°W to 5°S leads to additional 1.25 years, or a total of 16.5 years when compared to the Labrador Sea. This offset was applied to the time series at 5°S. At 44°W the LSW should be 0.4 to 0.6°C warmer and 0.12 to 0.15 more saline than in the LSW formation region, according to maps on the density surface σ_θ=34.67 kgm^{-3} from the hydrobase dataset compiled by R. Curry. Although the data used to produce hydrobase include natural variability, we expect that it represents a smoothed climatological mean value and reduce the salinity and temperature observations at 5°S by these values in Fig. 2.3. The resulting curves in Fig.2.3 show that the increase in August 2004 in salinity and potential temperature on σ_θ=34.67 kgm^{-3} is not reproducing the trend from the LSW formation region, and that the arrival of the cold and less saline water off Brazil should be seen in the next few years.

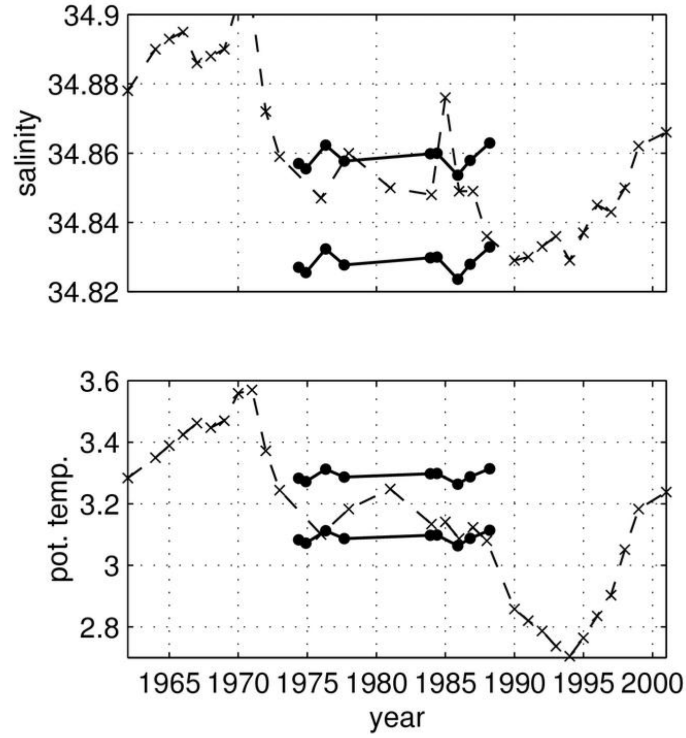

Fig. 2.3: Time series of salinity and potential temperature of Labrador Sea Water (LSW) from the central Labrador Sea [from Lazier used in Sy et al., 1997 and extended for 1997 to 2001 with own measurements] (crosses with dashed lines) and salinity and potential temperature on σ_θ=34.67 kgm^{-3} at 5°S west of 34°W shifted 16.5 years backward in time and reduced by 0.12 and 0.15 in salinity and 0.4 and 0.6°C in temperature (dots with solid line).

Although no extreme situations have been observed in August 2004 during M62/2 for the water mass distribution, the collected CTD data will be a valuable data set to study water mass variability in more detail in the near future.

2.4.2 Current profiling sections

(J. Fischer, M. Dengler)

2.4.2.1 Ocean Surveyor: Technical aspects

During M62/2 both of METEOR's vessel-mounted Ocean Surveyors (OS) were in use simultaneously. The 75 kHz OS was permanently installed in METEOR's fore-ship during her previous leg (see report of M62/1). The 38 kHz OS was installed in METEOR's well at mid-ship. The performance of the two OS was studied during several SONNE and METEOR cruises in both tropical and subpolar regions. During M62/2 we experienced several total data losses of the ASHTECH GPS/heading system during the first section of the cruise. This led to a modification of the navigation data stream such that another input line was generated containing GPS and heading information from an independent source, the Simrad HS50. The quality of this heading was less than that of the ASHTECH with an offset of 0.61° and we decided to use the ASHTECH data when available and to fill the gaps by this data source. To our surprise the ASHTECH drop outs ceased.

In the beginning of the cruise we had superior measurement ranges from both systems, about 750 m at 75 kHz and about 1500 m at 38 kHz. However, turning southward at the northern point of the 35° W section resulted in drastic range reduction for the low frequency system with the ship heading against the swell. Later during the cruise the ranges were back to normal and about 1200 m could be reached.

The systems configuration is briefly described as follows: Both OS's were controlled by RDI's Vessel-Mounted Data Acquisition System (VMDAS, version 1.3) running under Microsoft Windows NT. Heading information from the Fiber Optic Compass (FOG) was directly supplied to both electronic chassis via a synchro interface to convert the velocities from beam to earth coordinates, which were then recorded by the VMDAS as single ping data. In addition to the velocities, the VMDAS was supplied with real time ASHTECH heading, and 2D-GPS position and heading via two serial interfaces. In post-processing, the erroneous heading from the synchro FOG signal (see Meteor-Berichte 01-2, Trans Atlantic 2000, Cruise No. 47, p. 1-10ff for details) needs to be corrected using the heading information from the ASHTECH system. The configuration of both OS via the VMDAS was not altered during the cruise. For the 75kHz OS we chose to record 100 bins at a sampling rate of about 2.4 s, a vertical bin length of 8 m and a blanking interval of 8 m, and the 38kHz OS was configured to record 50 bins at a sampling rate of about 3.4 s, a vertical bin length of 32 m and a blanking interval of 16 m. Both OS were set to record in narrow band mode, which is the preferable mode for open ocean current measurements (Fischer et al., 2003).

The misalignment angle obtained from a water-track calibration for the 75 kHz OS was 1.4° with a standard deviation of 0.49 degrees. The simultaneously obtained amplitude factor was 1.006 with a standard deviation of 0.008. In the case of the 38kHz OS, a change of the misalignment angle of about 1.04 degrees was observed during the cruise. A similar behavior was found during our previous cruises probably caused by a slight movement of the transducer in the moon pool. However, the misalignment angle was for the two separated data sets -1.11° and +0.97° with a combined standard deviation of 0.42°. The amplitude factor was very similar to the 75kHz OS, that is 1.006. As discussed in the cruise report of M53/2 the 75kHz OS is influenced by the transmissions of the 78kHz Doppler log leading to strongly reduced data quality and it is recommended to use the Doppler log as little as possible during measurements with the 75kHz OS.

2.4.2.2 LADCP: technical aspects

During M62/2 a Lowered Acoustic Doppler Current Profiler (LADCP) was attached to the rosette. The instrument used was a narrow-band ADCP (S/N 301) pinging at a frequency of 153 kHz. This LADCP was used during the 35°W section and the section along the moored array at 11°S. A velocity profile was obtained on almost every CTD-station. During the last refurbishment the transducers were renewed, but during routine inspection at the end of the 11°S section we detected bumps on the Urethane surfaces of two of the transducers. We contacted the manufacturer but with no definitive suggestion what to do. Moreover the manufacturer stated that they are unable to repair old Narrow-Band ADCP's (electronics and transducers). For the further course of the cruise we had to use our workhorse ADCP's instead. At shallow stations these work quite well and we successfully used them along the 28°W section (Table 2.1). We planned deep stations along 5°S and therefore switched to the University of Bremen ADCP's which performed well during the previous campaign. Initially we used single ping resolution, but it soon turned out that the time between stations was not sufficient to read the data from the two ADCP's. We therefore had to switch to ensemble averaging to reduce the amount of stored data.

Table 2.1: LADCP types used during M62/2

Profile No.	LADCP Type	Comment
Prof. 1 to 53	NBADCP 150	S/N 301 transducer defect after profile
Prof. 55 to 75	WHADCP 300	Kiel Instruments with 3 s ensembles (3 pings)
Prof. 77 to 81	WHADCP 300	UB Instruments with single ping storage
Prof. 82 to 88	WHADCP 300	UB Instruments with 3-ping ensembles

In post-processing, the individual profiles collected during descents and ascents of the rosette were combined to a single profile using an inverse method (Visbeck, 2002). The average profile is obtained by solving a sparse matrix, which also solves for the motion of the rosette. Usually, we used a strongly weighted bottom track signal in the matrix. However, as most of the profiles did not extend to the sea floor, we added constraints of prescribed upper layer velocity using on-station 75 kHz OS velocities to the sparse matrix. Despite some subjective judgment, the average profile obtained from this newly formulated inverse problem appeared much more realistic.

2.4.2.3 Currents by shipboard measurements

For a best estimate of the flow a combination of both the OS data and the LADCP data was generated by a weighted interpolation to a regular grid; thus, upper layer flow is dominated by the 75kHz OS, while at depth the LADCP provides the only data source.

Thus, a best estimate of the currents across the major sections along 11°S, 5°S, 35°W, and 28°W was achieved. The latter two sections were meridional, and the first two were oriented perpendicular to the topography. The flow across these sections is described briefly.

a) The 11° S section

The 11° S section runs from the Brazilian shelf break out to deep ocean, and is in its near coastal part parallel to the moored array. Near the coast, in the upper 1500m we observe the North Brazil Undercurrent (Figure 2.4) with maximum speeds of about 80 cm/s near 200 m water depth. The NBUC (North Brazil Undercurrent) has a clear undercurrent structure. Below the NBUC we see a core of southward flow that shows 20 cm/s in its maximum. This core, the Deep Western Boundary Current, is just some 30 nm wide and reaches from 1500m to 3000m depth. Different from the cruises in previous years, the timing of this section was during a phase of minimum southward flow in the moored records, while the other sections were conducted during maximum southward flow near the shelf break. In the intermediate layer (300-1000m) we observe a current band with reverse direction relative to the NBUC; similar to the flow at 5° S as will be seen later.

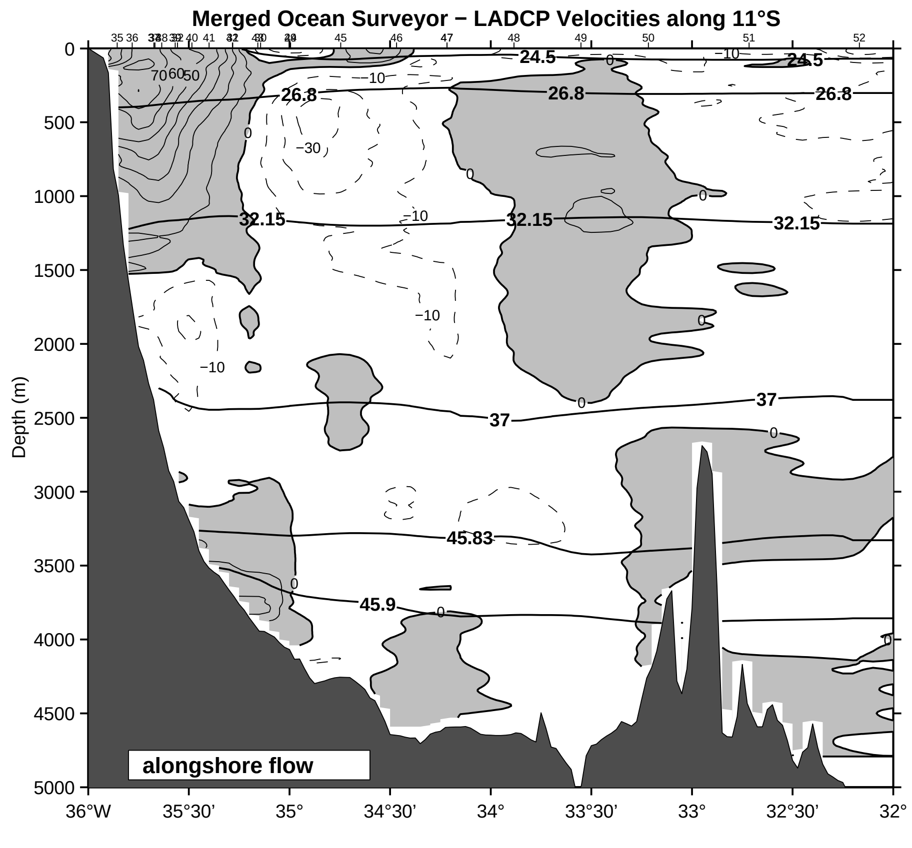

Fig. 2.4: Combined shipboard (Ocean Surveyor) and lowered ADCP data across the 11° S - section. Currents are rotated to alongshore direction (36° true), and shown is the flow parallel to the topography. Grey shading is for equatorward flow.

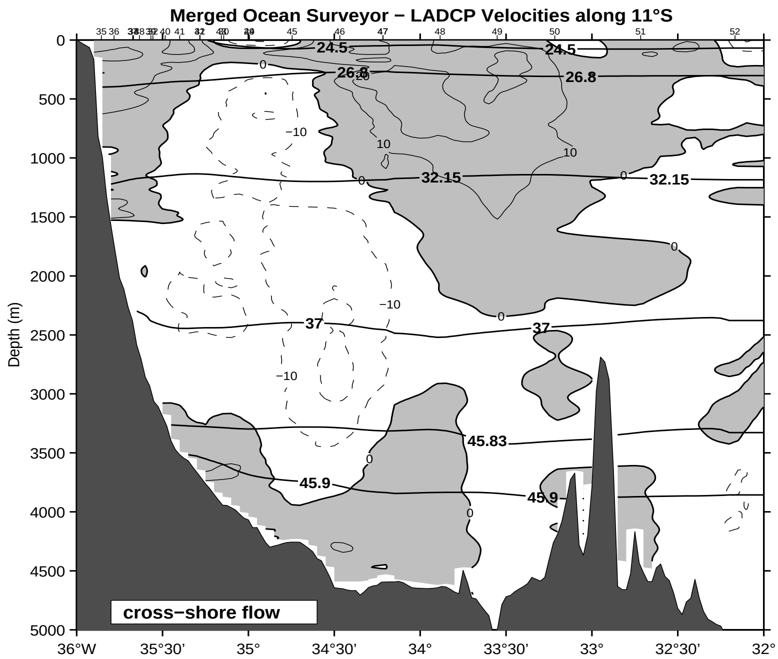

Fig 2.5: Combined shipboard and lowered ADCP data along the 11° S – section (cross shore component). Currents are rotated to alongshore direction (36° true). Grey shaded areas denote on-shore flow.

Interestingly, the cross-shore component (Fig. 2.5) shows off-shore velocities over a broad range. This structure would be compatible with a deep anticyclonic ring just approaching the section location from the north (for further information, see Dengler et al., 2004).

b) The 5° S section

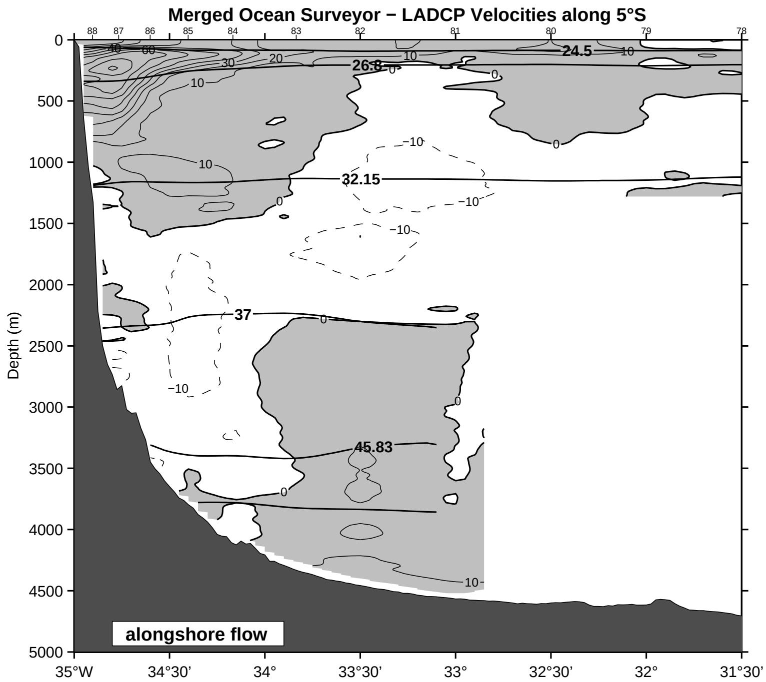

Fig. 2.6: Meridional currents at 5°S from merged Ocean Surveyor and WH-LADCP currents. Offshore of 33°W the LADCP profiles were only 1500m deep; northward currents in grey.

The 5°S section (Fig. 2.6) exhibits the NBUC just before arriving at the edge of Brazil (the easternmost part of Brazil). There is still a northward subsurface current core extending far offshore that is evident in all previous section occupations. In the Intermediate Water level a counter flow is located just east of the NBUC, very similar to what is found farther south. The DWBC (Deep Western Boundary Current) core is only weakly developed and appears to be detached from the topography.

c) The 35°W section

Due to time constraints all stations along 35° W were limited to 1300m deep casts, resulting in about 1500m deep current profiles. The section (Fig. 2.7) shows the banded structure of the near surface zonal flow; all current cores, as the SEUC, EUC, and NEUC (North Equatorial Undercurrent) at its northern limit are present. Near the coast, the NBUC has now turned westward directions and the superposition of the shallow SEC inflow led to a more surface intensified Western Boundary Current. In the intermediate depth range the current structure is less clear; a SICC (Southern Intermediate Countercurrent) is seen as the continuation of the SEUC; the EIC (Equatorial Intermediate Current, westward flow underneath the EUC) is not present as a current core (only small regions not connected among them were found); The NICC (Northern Intermediate Cuurrent) is then well developed with the 10cm/s isotach reaching down to 800 m depth. This illustrates in relation to previous occupations of the section that the intermediate layer variability is large; a more detailed investigation of the question whether the EIC is permanent or has no annual mean is underway (see mooring activities during the cruise).

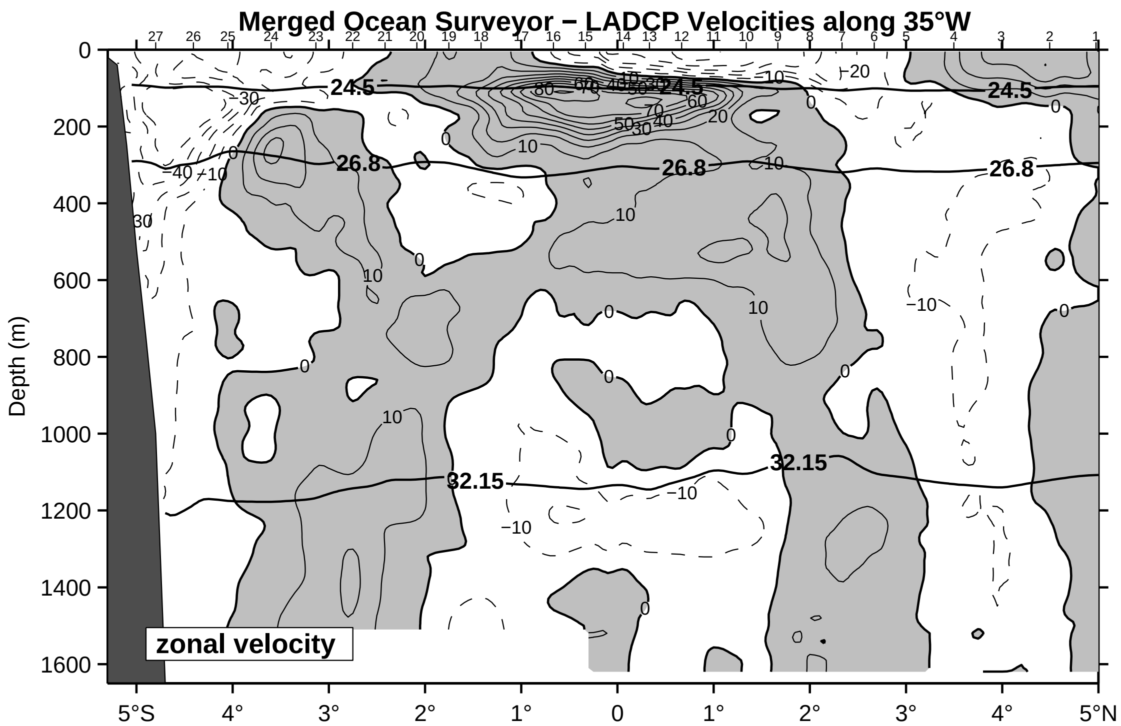

Fig. 2.7: Zonal currents at 35°W from merged Ocean Surveyor and WH-LADCP currents. LADCP profiles were only 1500m deep; eastward currents in grey.

d) The 28°W section

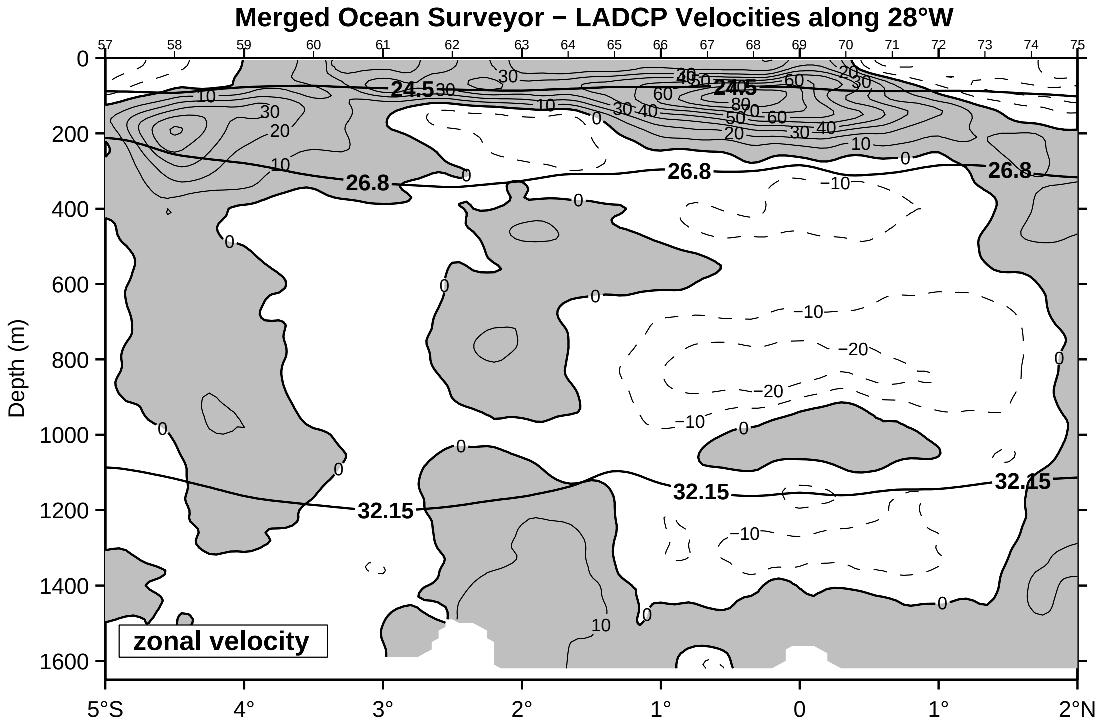

Fig. 2.8: Zonal currents at 28°W from merged Ocean Surveyor and WH-LADCP currents. LADCP profiles were only 1500m deep; eastward currents in grey.

At 28°W another meridional section across the equator with shallow CTD/LADCP casts was performed (Fig. 2.8). The section runs from 5°S to 2°N, thus covering the SEUC at its southern end and the equatorial zonal flow. Different from the observations father west (Fig. 2.7) a well developed EIC is visible underneath the EUC. SICC and NICC are weakly developed, with the NICC barely covered by the section.

Summarizing, an excellent data set of the upper ocean currents in the western tropical Atlantic has been obtained. The processing of the data set is finished and the final data have already been used in scientific work (Schott et al., 2005).

2.4.3 Mooring operations aboard M62/2

(R. Zantopp, J. Fischer)

2.4.3.1 Deployments

Two moorings were deployed during METEOR cruise M62/2, one RAFOS sound source only and one a combined current meter and CTD mooring, including a RAFOS sound source. See Fig. 2.9 for mooring locations (open squares).

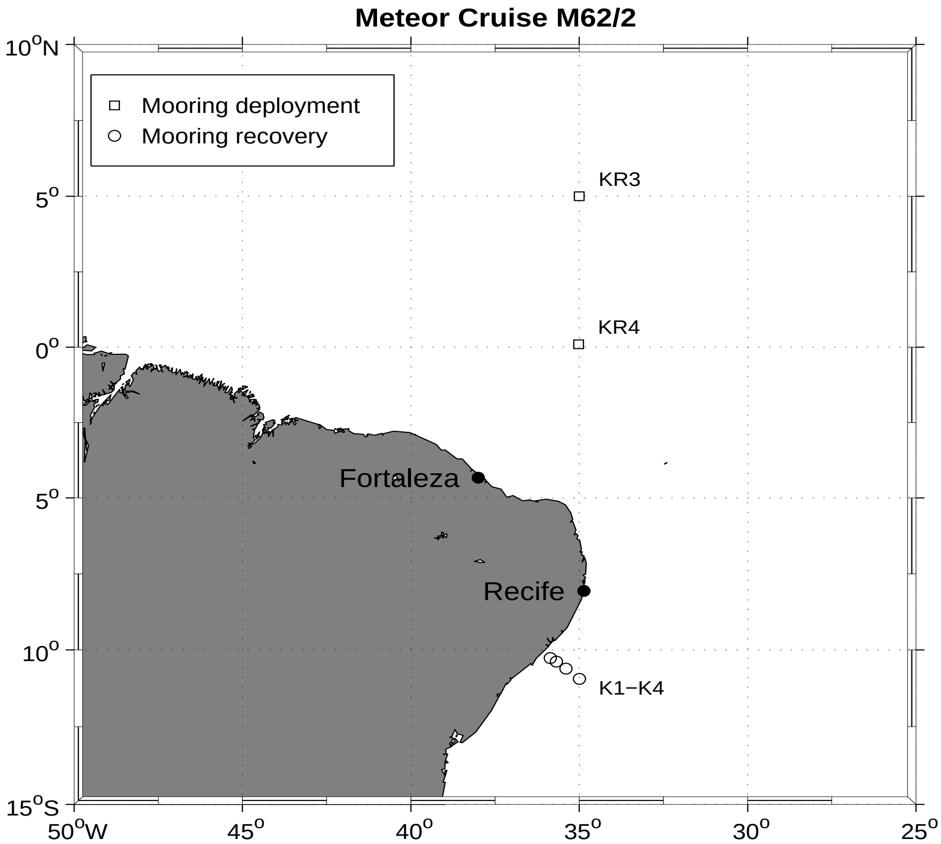

Fig. 2.9: Mooring locations

a) Mooring: KR3

The deployment of the sound source mooring at 5°N, 35°W (Table 2.2) was the first mooring activity during M62/2 and was carried out on August 11 between 17:29 UTC and 19:03 UTC. Work at this station began with a topographic survey showing a water depth of about 3740 m at target position (HYDROSWEEP depth), thus 90 m shallower than our prior estimate (3650 m). We added 100 m of wire below the single release. After a very short drift simulation we began the deployment 3 nm north of the target position. The deployment went very smoothly and the anchor was dropped 0.3 nm south of the target. The final position was estimated to be right on target (5°N, 35°W). Submersion could be clearly observed. The RAFOS Sound Source will transmit at 01:00 UTC and 13:00 UTC; twice a day for roughly 2.5 years.

Table 2.2: Deployment information, instrumentation and release codes of mooring KR3

Deployment Time:	Position	Water Depth:	Top:	Magnetic Deviation:
11-Aug-2004, 16:58 UTC	05°00.0’N, 35°00.0’W	3753 m	Radio (27.045MHz), Flashlight	-19° (W)

Depth (m)	Instrument Type	Serial No.	Record. interval (min)	Parameter
804	RAFOS	23	12h / 01:00 UTC	804
1422	Mors - Release	103	--	--

Release No.	Interrogate Code	Release Code	Disable Code	Mode
103	C761	C762	--	A

b) Mooring: KR4-CM

The second deployment of the combined current meter and sound source mooring was carried out on August 13. The position was chosen north of the 35°W PIRATA mooring at a safe location (see mooring table). The mooring simulation showed a rather complicated scenario with strong westward currents (SEC) and southeasterly winds. Heading against the wind and steaming with almost 2 kn through the water led to a southward ship speed at 1 kn SOG. We assumed a deployment duration of about 3 h and began the deployment about 3 nm north of the target position. Operations were quick and safe, and after a little more than 2 h we completed the deployment with the anchor drop at 0° 05.40'N, 35° 00.81'W. Water depth was fairly constant within 20 m at 4540 m (HYDROSWEEP depth with sound speed correction) and we decided to use the predetermined wire length. The radio beacon reception (METEOR receiver) was not very clear and came in best at 27.048 MHz. Final position was north of target (see table), and the mooring top was observed to submerge at 18:17 UTC. This Sound Source is scheduled to transmit at 01:40 UTC and 13:40 UTC.

Table 2.3: Deployment information, instrumentation and release codes of mooring KR4-CM

Deployment Time:	Position	Water Depth:	Top:	Magnetic Deviation:
13-Aug-2004, 15:10 UTC	00°05.76'N, 35°01.19'W	4540 m	Radio (27.050 MHz), Flashlight	-19.5° (W)

Depth (m)	Instrument Type	Serial No.	Record. interval (min)	Parameter
196	Mini TD	41	60	P,T
196	RDI – SC 150	267	120	U,V,T
199	MICROCAT	2249	30	T,C
201	RDI – SC 150	393	120	U,V,T
344	MICROCAT	2251	30	T,C
549	ARGONAUT	D294	120	T,U,V,W
700	Mini TD	42	60	P,T

702	ARGONAUT	D299	120	T,U,V,W
800	RAFOS	22	12h / 01:40 UTC	
859	ARGONAUT	D304	120	T,U,V,W
1012	MICROCAT	3144	30	T,C
1157	ARGONAUT	D329	120	T,U,V,W
1535	Mors - Release	107	--	--
1535	Mors - Release	271	--	--

Release No.	Interrogate Code	Release Code	Disable Code	Mode
107	E957	E959	--	A
271	1405 (ARM)	Arm + 1455	--	B

2.4.3.2 Recoveries

A total number of 4 moorings with 34 instruments were recovered during METEOR cruise M62/2 at 11°S off the coast of Brazil. Two additional instruments were retrieved at sea by our Brazilian colleagues and subsequently loaded onto the ship in Recife (see mooring K2_4).

a) Mooring K4_4

Beginning with mooring K4_4 in the morning of August 17, recovery of the array commenced. We used both of our Oceano deck units and two different hydrophones to interrogate the releases. We were not able to obtain a single reliable distance measurement and decided to release without confirmation that the mooring was there. However, shortly after the release comand the top element was at the surface and immediately detected visually; no radio signal was received as the antenna of the radio beacon was lost. Recovery went very well and at 16:40 UTC all elements were recovered safely. All instruments were read out during the remainder of the day and provided a nearly complete data set. The Sound Source in this mooring sent its signal at 16:57 UTC; i.e. about 3 hours later than the planned time (14:00 UTC). The reason for this discrepancy will be checked in the lab.

b) Mooring K2_4

Mooring K2_4 had lost its top element with an ADCP earlier this year and was recovered by Brazilian colleagues (warehoused in Recife). The rest of the mooring was still in place and we were able to contact the releases with all three deck units and hydrophones. Releases were at 1900 m, much shallower than those in K4_4. Release command was sent at 09:03 UTC on August 18, and the first Benthos flotation group was seen at the surface 15 min later. Recovery went very well and by 10:09 UTC all elements were safely recovered.

c) Mooring K1_3

Mooring K1_3 was the second recovery on August 18. This mooring was located at a water depth of 900 m, significantly deeper than during the previous deployment periods (550 m). The rational for this shift was to avoid the area of intense fishing activities, assisted by the fact that the Long Ranger ADCP could be placed as the top element at a depth of 450 m. We had experienced significant losses in earlier deployments which were most likely caused by corrosion. Very close to the mooring location we observed the front between the colored coastal waters and the blue open ocean with the mooring in the latter. The releases responded promptly to the command sent at 17:56 UTC, and by 18:16 UTC the top float with the Long Ranger ADCP came on board. The recovery was completed at 18:30 UTC with no instrument losses.

d) Mooring K3_3

Mooring K3_3 had a narrow band ADCP as top element and the release command was sent after trying to locate the mooring with all three release units available on board. Only the unit of the University of Bremen allowed proper ranging. Release command was sent at 13:15 UTC and about 5 min later the top element was seen at the surface. Recovery went very smooth, and by 15:38 UTC all instruments were safely recovered.
Mooring locations are shown in Fig. 2.9 (open circles).

Table 2.4: Rates of instrument and data recoveries

Type	Recovery rate
Moorings & instruments	100.0%
Pressure records	99.3%
Temperature records	91.7%
Current speed records	88.6%

Instrument types used were upward looking RDI Acoustic Doppler Current Profilers (ADCP standard 150 kHz and Long Ranger), Seabird temperature and conductivity recorders SBE37 (MICROCAT) and SBE16 (SEACAT), temperature and pressure recorders (Mini-TD), Aanderaa current meters (RCM-8), FSI acoustic current meters (FSI), and Sontek acoustic current meters (ARGONAUT). Only one Mini-TD record ended prematurely due to battery failure.
Mooring and instrument configurations were as follows:

Table 2.5: Mooring and instrument configurations

Clivar Array Mooring K1_3				Notes	
Latitude	10	16.00	S		
Longitude	35	51.70	W		
Water depth	900 m				
Deployment	10-May-2003	10:14			
Recovery	18-Aug-2004	17:56			
I.D.	Depth	Instr.	s/n	Notes	Parameter
K1_301	450	ADCP LR	2290	good data	T U V W
K1_302	455	MICROCAT	53	good data	T C
K1_303	622	ARGONAUT	141	good data	T U V W

Clivar Array Mooring K2_4				Notes	
Latitude	10	22.80	S	top float (ADCP) and Microcat separated	
Longitude	35	40.80	W	on May 6, 2004; retrieved by Brazilian	
Water depth	2320 m			research vessel	
Deployment	10-May-2003	17:04			
Recovery	18-Aug-2004	09:03			
I.D.	Depth	Instr.	s/n	Notes	Parameter
K2_401	444	ADCP LR	2395	Records end early in May 2004	T U V W
K2_402	447	MICROCAT	2245	Records end early in May 2004	T C
K2_403	601	FSI	1354	no data	no data
K2_404	601	Mini-TD	34	good data	T P
K2_405	753	MICROCAT	2246	good data	T C
K2_406	909	RCM-8	6122	no speed 1/17/04-8/15/04	T U V P
K2_407	1407	FSI	1355	good data	T U V W
K2_408	1693	SEACAT	941	spikes, questionable values	no data
K2_409	1899	ARGONAUT	145	good data	T U V W

Clivar Array Mooring K3_3				Notes	
Latitude	10	36.50	S		
Longitude	35	23.60	W		
Water depth	3520 m				
Deployment	11-May-2003	13:56			
Recovery	19-Aug-2004	13:15			
I.D.	Depth	Instr.	s/n	Notes	Parameter
K3_301	309	ADCP	270	good data	T U V W
K3_302	309	Mini-TD	3	good data	T P
K3_303	311	MICROCAT	2247	good data	T C
K3_304	506	RCM-8	9930	good data	T U V P
K3_305	648	SEACAT	1307	good data	T C
K3_306	903	ARGONAUT	183	questionable data, mostly noise	no data
K3_307	1400	RCM-8	9933	good data	T U V P
K3_308	1653	SEACAT	1531	questionable data, 50 days of noise	T C
K3_309	1900	FSI	1374	good data	T U V W
K3_310	2142	MICROCAT	2248	good data	T C
K3_311	2438	RCM-8	12782	good data	T U V P
K3_312	2936	ARGONAUT	179	good data	T U V W

Clivar Array Mooring K4_4				Notes	
Latitude	10	56.40	S		
Longitude	34	59.60	W		
Water depth	4115 m				
Deployment	11-May-2003	21:14			
Recovery	17-Aug-2004	14:40			
I.D.	Depth	Instr.	s/n	Notes	Parameter
K4_401	115	Mini-TD	10	good data, dead battery, 1 mo short	T P
K4_402	122	MICROCAT	2250	good data	T C

Clivar Array Mooring K4_4				Notes	
K4_403	123	ARGONAUT	38	good data	T U V W
K4_404	309	SEACAT	1532	good data	T C
K4_405	310	FSI	1378	good data	T U V W
K4_406	515	RCM-8	12783	good data	T U V P
K4_407	919	ARGONAUT	182	good data	T U V W
K4_408	1416	ARGONAUT	184	good data	T U V W
K4_409	1668	SEACAT	1533	good data	T C
K4_410	1913	RCM-8	9349	good data	T U V P
K4_411	2410	FSI	1377	good data	T U V W
K4_412	3402	ARGONAUT	151	good data	T U V W

2.4.3.3 Data processing

Instrument data were downloaded and processed immediately after mooring recovery.

ADCP: Both instruments processed to date worked well and delivered a full data set up to 40 m below the surface. The RDI Long Ranger from K2_4 (s/n 2395) was retrieved in Recife (Brazil) and was processed after the cruise. The instrument yielded excellent data until May 2004. Pressure time series for bin depth calculation were derived from the surface reflection (maximum of echo intensity) and co-located MiniTD instruments, respectively.

ARGONAUT: Seven of 8 acoustic current meters performed well and within specifications, one instrument (s/n 183) recorded only noise and no detectable oceanographic signal. This instrument must be sent for refurbishment. The remaining 7 instruments are suitable for redeployment. Battery failures experienced during earlier deployments were not present.

FSI: One acoustic current meter (s/n 1354) recorded only 6 data cycles immediately after start-up and failed to record any deployment data. All other 4 instruments worked well and are suitable for redeployment.

RCM-8: The only failure in all 6 current meters, one (s/n 6122) did not record any speed between 17-Jan-2004 and 15-Aug-2004 but started again 3 days before recovery. This instrument must be refurbished with a new rotor counter. The missing speed record was approximated from a fairly tight correlation between speed and pressure during the initial 8 months of deployment. All other instruments worked well and are suitable for redeployment.

MICROCAT: All Microcat instruments processed to date worked well and are suitable for redeployment. The instrument from K2_4 (s/n 2245) was retrieved in Recife (Brazil) and was processed after the cruise.

SEACAT: Performance of the Seacats was somewhat disappointing, considering that they had come from refurbishment at the manufacturer (Seabird) just prior to deployment. One instrument (s/n 941) shows an unexplained jump in both parameters after only 20 days, and neither temperature nor conductivity have reasonable values before or after the jump. Recalibration with CTD or lab procedures may still yield a usable data set. One other instrument (s/n 1531) shows an unexplained and uncorrectable jump to noisy temperature data for 50 days, with conductivity unaffected. Temperature was corrected using the conductivity/temperature correlatrion, but salinity was not useful during that time period.

MiniTD: One instrument (s/n 10) had a dead battery upon recovery and failed to record the last month of deployment. All instruments are suitable for redeployment.

Overview of current meter data:
Vector time series (stick plots) for all current meters processed to date are shown by mooring (Fig. 2.10 – 2.13), with a mean profile of the alongshore component shown to the left, including the profile from previous data sets (2000-2003, dashed curve). (Depth of the instrument (in m) is shown to the right of the respective sticks.

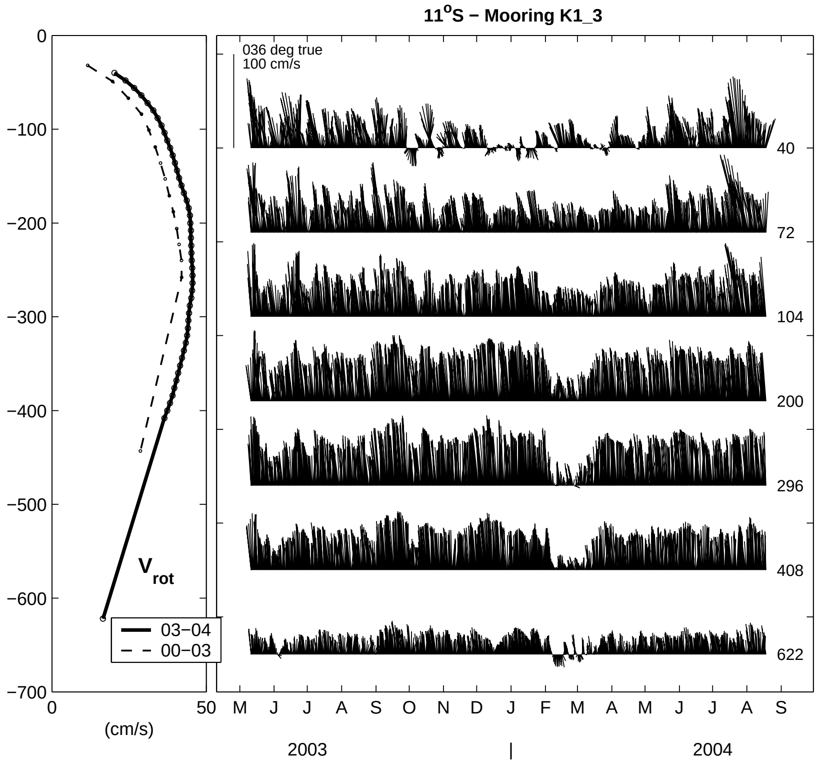

Fig. 2.10: Mooring K 1_3

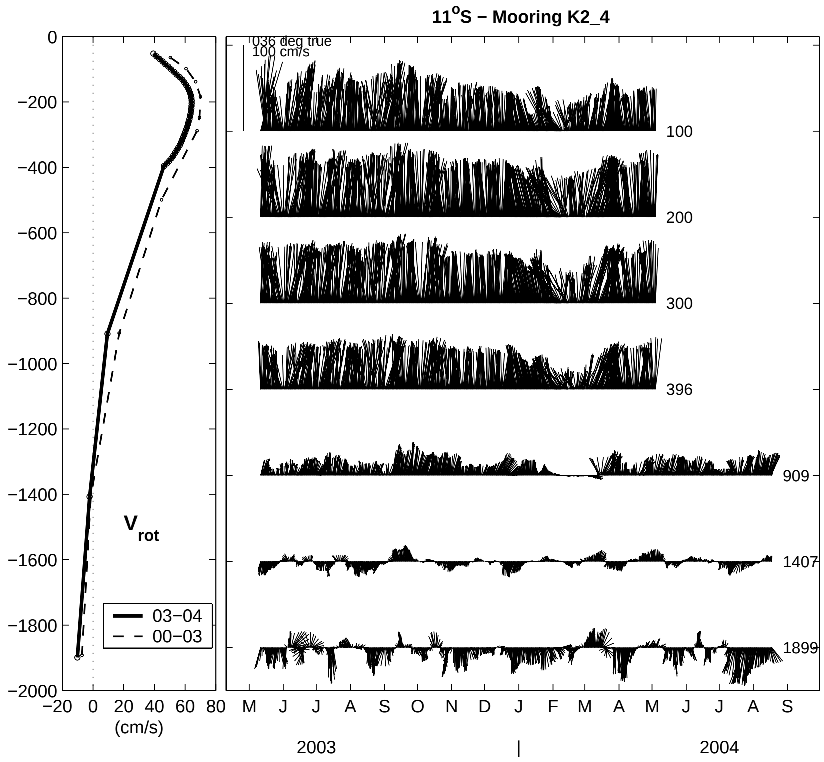

Fig. 2.11: Mooring K 2_4

Note: The last third (1/17/04-8/15/04) of the speed record at 909 m (Aanderaa s/n 6122) is calculated from a quadratic fit to the pressure record, based on the simplistic assumption that increased pressure (increased vertical displacement of the instrument) is caused by increased velocity. The rotor count of the instrument had failed during this time period.

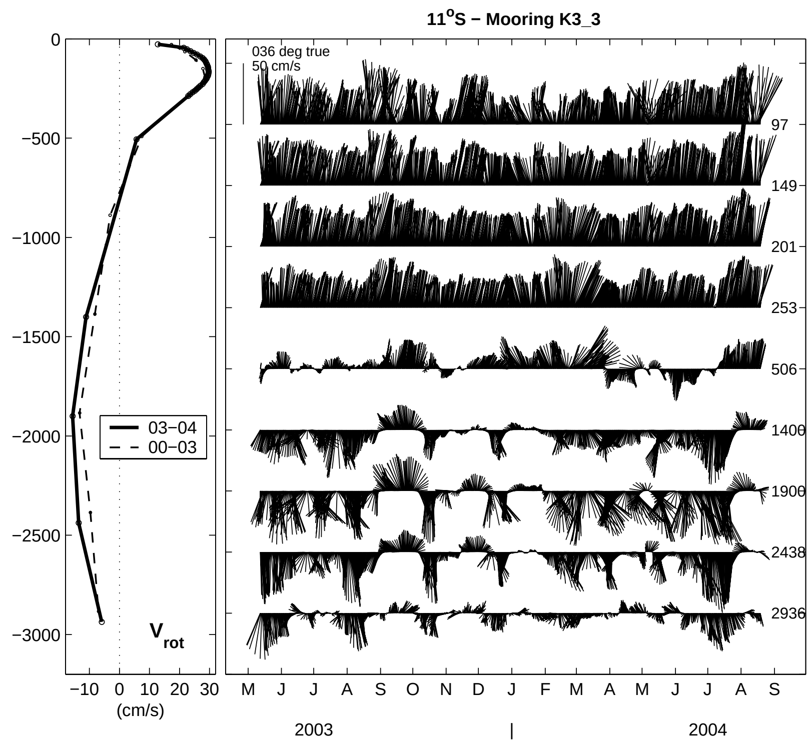

Fig. 2.12: Mooring K 3_3

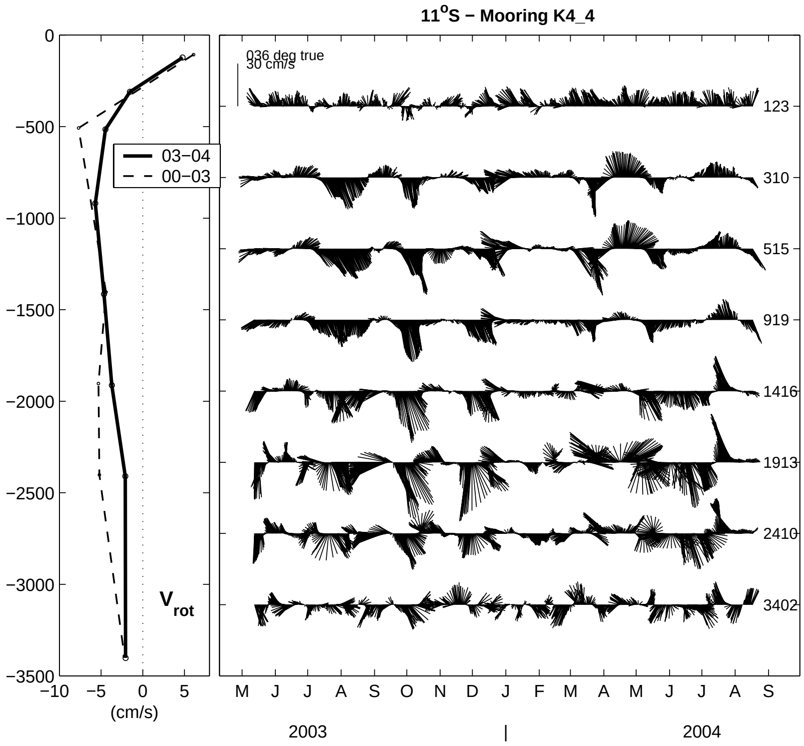

Fig. 2.13: Mooring K 4_4

2.4.4 Float Deployments

(J. Fischer, A. Funk, P. Brandt)

2.4.4.1 Apex Floats

Fifteen APEX floats (Table 2.6) of the German ARGO program 'TROPAT' were expected to be on board Meteor when we arrived in Fortaleza. However, the airfreight from the manufacturer to Fortaleza was delayed and we therfore had to leave Fortaleza without the 15 APEX floats. The result was that we could not deploy five of these at the planned locations along 40°W and 35°W. The close passage to Recife on our way south to the mooring array allowed us to take these floats on board while METEOR was waiting for a carrier boat outside of Recife port. This enabled us to deploy the floats along the 11°S and 28°W sections as planned and add 5 positions along the cruise track for the first five floats. So, the float coverage at 28°W was somewhat denser than originally planned, but it is expected that the floats will be dispersed soon after deployment by the equatorial current sytem. We even got permission from the Brazilian authorities to launch 3 of these in Brazilian waters.

Five floats carried a RAFOS hydrophon and these were programmed at wrong times. The time was reprogrammed on board to UTC. During that process two of the floats appeared to have lost their ARGOS Id's and we had to reinstall them. This led to the recommendation to check every float prior to deployment. The first deployments were at the 11°S section (S/N 1656, 1655). These two together with another four floats that were deployed during the first part of the cruise (1651 to 1656) drift at deep (1500 m) park levels. The first floats with shallow park depths and additional sensors (oxygen or RAFOS) were launched on August 24/25. Until the evening of August 28 all floats except two for the 5°S section were deployed and their test transmissions received by the ARGOS satellite system. On board we were able to receive the test transmissions by the Gonio receiver, but the 28 bit Ids could not be displayed adequately, as the receiver was only suited for 20 bit Ids.

Altogether 6 floats were deployed south of 5°S, 7 floats along 28°W and two at the 5°S section. The last float (1644) was deployed early morning of August 29, and as for the previous floats the deployment went very well.

Table 2.6: APEX Float deployments

Float S/N	WMO	ID (DEC)	Deployment Time	Longitude	Latitude	Sensors T,C,P,O2, RAF	Park/ Profile depth
1642	3900274	53247	08.28.04 13:10 UTC	30° 09.88 W	5° 00.07' S	T,C,P,O2	200/2000
1643	3900275	53248	08.25.04 01:58 UTC	28° 09.77' W	2° 59.84' S	T,C,P,O2	200/2000
1644	3900276	53249	29.08.04 01:50 UTC	31° 59.80' W	5° 7.10' S	T,C,P,RAF	200/2000
1645	3900277	53250	08.24.04 18:20 UTC	28° 09.63' W	4° 00.02' S	T,C,P,RAF	200/2000
1646	3900278	53251	08.26.04 21:02 UTC	28° 09.77' W	2° 00.24' N	T,C,P,RAF	200/2000
1647	3900279	53252	08.06.04 03:56 UTC	28° 09.51' W	0° 00.22' N	T,C,P,RAF	200/2000
1648	3900280	53253	08.25.04 09:43 UTC	28° 09.41' W	2° 00.21' S	T,C,P,RAF	200/2000
1649	3900281	53254	08.25.04 19:02 UTC	28° 09.62' W	0° 59.88' S	T,C,P,O2	200/2000
1650	3900282	53255	08.26.04 12:34 UTC	28° 10.00' W	0° 59.90' N	T,C,P	200/2000
1651	3900283	53256	08.24.04 08:09 UTC	28° 09.57' W	5° 00.03' S	T,C,P	1500/2000
1652	3900284	53257	08.23.04 20:40 UTC	28° 56.81' W	6° 44.82' S	T,C,P	1500/2000
1653	3900285	53258	08.23.04 09:58 UTC	29° 39.47' W	8° 22.00' S	T,C,P	1500/2000
1654	3900286	53259	08.22.04 23:36 UTC	30° 22.60' W	9° 57.67' S	T,C,P	1500/2000
1655	3900287	53260	08.22.04 01:44 UTC	32° 10.25' W	11° 29.99' S	T,C,P	1500/2000
1656	3900288	53261	08.17.04 19:17 UTC	34° 59.39' W	10° 56.43' S	T,C,P	1500/2000

2.4.4.2 RAFOS Floats

On board of the ship were 42 isopycnal RAFOS floats and 1 isobaric RAFOS float, funded by the German Science Foundation as part of the TROPAT (RAFOS) project. One half of the isopycnal floats were ballasted to potential density surface σ_θ = 25.7 kg m^{-3} and the other half to σ_θ = 26.8 kg m^{-3}. The floats with the even serial numbers were the shallow ones, while the odd numbers were the deeper ones. From the 42 floats the numbers 596 to 611 had an older version of the mainboard, while the numbers 612 to 637 had a newer version.

Before deployment we read the internal status of the floats. The internal test routine for the vacuum was run and the current in the release wire was measured. The floats with the older mainboards had a current of some 260 mA, while the floats of the newer series had about 100 mA. Seascan assured the smaller current would be ok. The hydrophone was tested two times. The resulting hex numbers differed from one test to the other due to the general noise. We were not able to interpret the resulting numbers. The ARGOS antenna was tested and our Telonics Receiver got the correct ARGOS IDs and a 32 Byte signal.

The clocks of the floats were set to GPS UTC time received by our magnavox. The deviation of the original time and our Magnavox stayed within plus or minus 4 seconds. The initialisation of the floats was checked and the dive start day and the mission length were updated. In general, on the 35°W section we set the dive start day to the first day at which the float was in the water at 0:00 UTC. On the 28°W section we set the dive start day to the next day after the actual day. The number of cycles to acquire was set to 750, which corresponds to 375 days. Only the three test floats #611, #612 and #613 had shorter missions. The float was set to run and the sail loop was disconnected.

In the morning of August 10 the two RAFOS floats #611 and #612 were deployed at 0°20'S, 35°W with a short mission of 36h to test float performance. This was one shallow and one deep float as well as one from the old and one from the new series. The floats were prepared the evening before and the dive start day was set to August 10. The deployment was done with a PVC pipe, which was closed at one end and which had some bore holes inside. Float and pipe were irrigated with salty water while putting the float into the pipe. The weather was fine and the deployment was smooth.

On August 11 at noon the two floats were expected to come to the surface and send their data. Float #611 was first located by ARGOS at 12:17 UTC but transmitted only incomplete messages of 4 byte length. The other float #612 was first located by ARGOS a week later at August 18. After contacting the float manufacturer Seascan as well as Service ARGOS it turned out that the incomplete messages were due to an error in SERVICE ARGOS that was easily corrected. After the message length was corrected by SERVICE ARGOS we got correct messages of float #611.We also did a test with the float #599, which we started on board in control mode for one cycle. We received complete ARGOS messages from float #599 with our Telonics receiver and verified that the mission was done correctly.

Seascan did a test of the release wire with a float of the new series and attached compressee in their pressure tank. They discovered that at low pressure the current in the release wire sank from 100 mA to below 30 mA, which is not enough to fully corrode the wire. It is claimed that the reason is the formation of gas bubbles at low pressure that cannot dissolve in the small volume between compressee and float. Seascan suggested the use of a lanyard to attach the compressee not so close to the float, as bubbles generated by corrosion can easily flow away.

As there is an increased risk for fish bites, we decided to use a lanyard for all floats only as long as the compressee hangs slightly below the hydrophone. At August 12 18:00 UTC we decided to deploy another test float #613 from the new series with the smaller current in the release wire. This was already prepared with a dive start day August 12 and we changed only the number of cycles to acquire. It was set to 6 days. The float was deployed at August 12 18:36 UTC together with two floats from the old series #598 and #599 at 2°20'N, 35°W.

The first test float #611 heard the two sound sources #02 at 23°W and #13 at 28°W both times. The pressure and temperature values compare well with the CTD profile at the deployment position. The remaining 14 floats of the old series were deployed on the 35°W section between 1°20'N and 4°S between August 13 and August 15. Float #615 of the new series was deployed at August 15 at 4°S, 35°W.

On August 18 0:00 UTC the test float #613 was expected to come to the surface. Indeed it was first located by ARGOS at August 18 12:54 UTC. This means it was one cycle too late. We believe this results from the actual start time lying behind the dive start day. The pressure and temperature values were not in the right order indicating that the float started to record data in the middle of its cycle. The float #613 heard the sound sources #22 (0°06’N, 35°01’W), sound source #13 (3°15’S, 28°31’W), sound source #02 at (0°00’N, 23°07’W) and even sound source #68 (6°02’S, 10°01’W), the latter with small correlation numbers. The sound source #23 (5°00’N, 35°00’W) could not be heard although it was only 295km apart. We think the most probable reason is that the sound source is not working. The sound source #24 (0°58’N, 9°56’W) was outside the listening window.

On August 18 12:58 the first ARGOS message from float #612 was received. The pressure and temperature values were compared with the CTD station and the values were fine. The first On On August 18 12:58 the first ARGOS message from float #612 was received. The pressure and temperature values were compared with the CTD station and the values were fine. The first position at the surface was 0°37'S and 30°32'W. This corresponds to a velocity of 70cm/s. During its two listening cycles this float heard only the sound source #13 that is about 791 km far from deployment position and heard it only one time. From our test floats we state that although the acoustic conditions are not as favorable for shallow floats as for the deep ones the number and distribution of sound sources in the region should also allow a tracking of the shallow floats.

17 isopycnal floats of the new series were deployed on the 28°W section. The isobaric float #493 was deployed at 4°S, 28°W together with an APEX float with RAFOS element and the floats 620 and 621. The remaining six floats from the new series were deployed at the 5°S section (Table 2.7).

Table 2.7: RAFOS float deployment

Float S/N	Latitude	Longitude	Deployment Time [UTC]	End of Mission	Density Surface σ_θ [kg/m³]
611	S 0°20.054'	W 35°00.023'	10-08-04 07:27	11-08-04 12:00	26.8
612	S 0°20.095'	W 35°00.006'	10-08-04 07:30	11-08-04 12:00	25.7
599	N 2°19.96'	W 35°00.02'	12-08-04 18:38	22-08-05 00:00	26.8
598	N 2°19.96'	W 35°00.08'	12-08-04 18:41	22-08-05 00:00	25.7
613	N 2°19.98'	W 34°59.99'	12-08-04 18:36	18-08-04 00:00	26.8
596	N 1°20.30'	W 34°59.96'	13-08-04 04:11	24-08-05 00:00	25.7
597	N 1°20.31'	W 34°59.99'	13-08-04 04:14	24-08-05 00:00	26.8
600	N 0°40.05'	W 34°59.98'	13-08-04 10:35	24-08-05 00:00	25.7
601	N 0°40.01'	W 35°00.04'	13-08-04 10:37	24-08-05 00:00	26.8
604	N 0°04.06'	W 35°01.81'	13-08-04 21:52	24-08-05 00:00	25.7
605	N 0°04.02'	W 35°01.81'	13-08-04 21:55	24-08-05 00:00	26.8
608	S 0°59.86'	W 34°59.697'	14-08-04 08:10	25-08-05 00:00	25.7

Float S/N	Latitude	Longitude	Deployment Time [UTC]	End of Mission	Density Surface σ_θ [kg/m³]
609	S 0°59.92'	W 34°59.71'	14-08-04 08:13	25-08-05 00:00	26.8
606	S 2°05.05'	W 34°59.91'	14-08-04 18:17	25-08-05 00:00	25.7
607	S 2°05.08'	W 34°59.93'	14-08-04 18:18	25-08-05 00:00	26.8
602	S 3°08.14'	W 34°52.63'	15-08-04 04:06	26-08-05 00:00	25.7
603	S 3°08.18'	W 34°52.70'	15-08-04 04:08	26-08-05 00:00	26.8
610	S 4°02.83'	W 34°53.23'	15-08-04 12:09	26-08-05 00:00	25.7
615	S 4°02.87'	W 34°53.23'	15-08-04 12:11	26-08-05 00:00	26.8
616	S 4°59.99'	W 28°09.76'	24-08-04 08:01	03-09-05 00:00	25.7
617	S 4°59.99'	W 28°09.70'	24-08-04 08:05	03-09-05 00:00	26.8
614	S 4°28.40'	W 28°11.13'	24-08-04 13:40	03-09-05 00:00	25.7
493	S 4°00.02'	W 28°09.62'	24-08-04 18:26	03-09-05 00:00	isobaric 200m
620	S 4°00.03'	W 28°09.66'	24-08-04 18:22	03-09-05 00:00	25.7
621	S 4°00.02'	W 28°09.64'	24-08-04 18:24	03-09-05 00:00	26.8
624	S 2°59.97'	W 28°09.82'	25-08-04 01:49	04-09-05 00:00	25.7
625	S 2°59.93'	W 28°09.80'	25-08-04 01:51	04-09-05 00:00	26.8
628	S 2°00.21'	W 28°09.67'	25-08-04 09:35	04-09-05 00:00	25.7
629	S 2°00.23'	W 28°09.51'	25-08-04 09:40	04-09-05 00:00	26.8
630	S 0°59.90'	W 28°09.72'	25-08-04 18:58	04-09-05 00:00	25.7
631	S 0°59.89'	W 28°09.69'	25-08-04 19:00	04-09-05 00:00	26.8
618	N 0°00.14'	W 28°09.61'	26-08-04 03:50	05-09-05 00:00	25.7
619	N 0°00.14'	W 28°09.58'	26-08-04 03:52	05-09-05 00:00	26.8
622	N 0°59.94'	W 28°10.06'	26-08-04 12:31	05-09-05 00:00	25.7
623	N 0°59.92'	W 28°10.09'	26-08-04 12:34	05-09-05 00:00	26.8
634	N 2°00.19'	W 28°09.86'	26-08-04 20:58	06-09-05 00:00	25.7
635	N 2°00.22'	W 28°09.82'	26-08-04 21:00	06-09-05 00:00	26.8
626	S 5°00.09’	W 30°09.98’	28-08-04 13:08	07-09-05 00:00	25.7
627	S 5°00.08’	W 30°09.93’	28-08-04 13:11	07-09-05 00:00	26.8
636	S 5°07.00’	W 31°59.90’	29-08-04 01:46	08-09-05 00:00	25.7
637	S 5°07.06’	W 31°59.86’	29-08-04 01:49	08-09-05 00:00	26.8
632	S 5°30.07’	W 34°09.90’	30-08-04 01:34	09-09-05 00:00	25.7
633	S 5°30.03’	W 34°09.87’	30-08-04 01:36	09-09-05 00:00	26.8

2.4.5 Microstructure measurements

(M. Dengler, J. Schafstall)

Turbulence in the ocean can be observed by fast responding shear probes and high resolution temperature sensors that measure the oceans microstructure on vertical scales between a few millimeters and 1 m. In March 2004, Forschungsbereich 1 of the Leibniz-Institut für Meereswissenschaften purchased a microstructure profiling system (MSS). The system was manufactured by ISW-Messtechnik (Dr. Hartmut Prandke) in collaboration with Sea and Sun Technology (Trappenkamp, Germany) and consists of a profiler, a winch and a data interface. The profiler can operate 16 channels with a very high data transmission rate (1024 Hz) that is sufficient to resolve the small vertical scales of turbulent dissipation in the ocean (Fig. 2.14). It is equipped with two shear sensors (airfoil, 4 ms response time), a fast-responding temperature sensor (microthermistor, 10 ms response time), an acceleration sensor and conductivity, temperature and depths sensors that sample at a lower frequency (24 Hz). The free-falling profiler is optimized to sink at a rate of about 0.6 m s^{-1} and is capable of measuring microstructure up to a depth of 500 m. Shear and temperature fluctuations recorded due to vibration of the profiler while sinking can be diagnosed from the spectra of the acceleration sensor time series (Fig. 2.14). The MSS was successfully tested during a cruise on FS POLARFUCHS in the Kieler Förde in July 2004.

During METEOR cruise M62/2 we successfully completed the first open-ocean measurements using the microstructure profiling system. We chose two sites to test the performance of the MSS system: on the equator at 35°W and within the SEUC at 4°30'S, 28°W (Fig. 2.15). At both locations, the presence of the zonal undercurrents generate strong background vertical shear that increases the likelihood for the occurrence of Kelvin-Helmholtz instabilities and thus increased turbulence. From previous measurement programs in the Pacific it is well known that strong turbulence is found above the EUC core, particularly during nighttime.

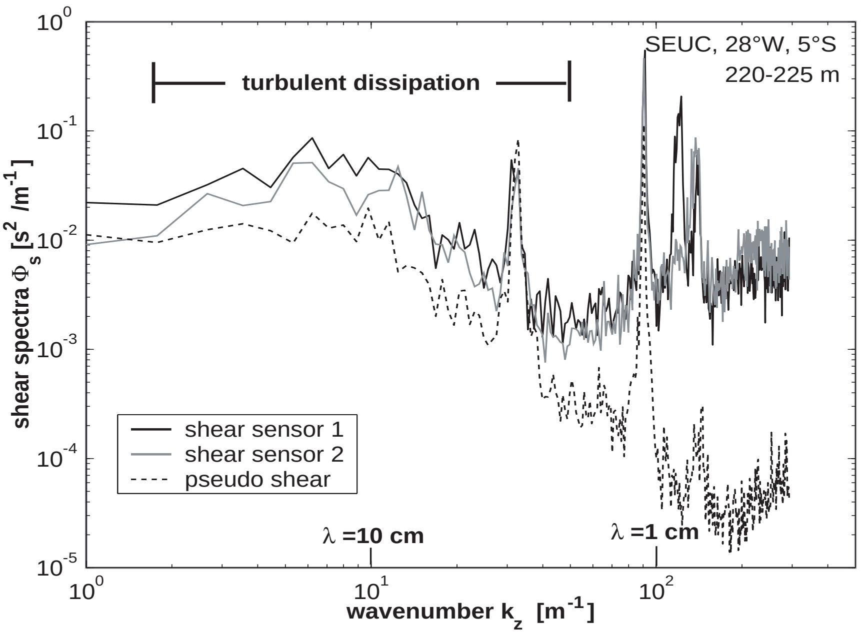

Fig. 2.14: Average turbulent shear spectra calculated from the microstructure shear sensor data and pseudo shear determined from acceleration sensor within the SEC between 220 and 225 m depth. Turbulent shear spectra peaks for wavenumbers of 6 m^{-1}. Drop sonde induced vibrations are found at wavenumbers of 30 m^{-1} and 100 m^{-1}.

The MSS system worked well at both sites and a total 24 microstructure profiles were recorded. The equatorial site at 35°W was occupied twice, the first time while METEOR was heading northward on August 10 and a second time while returning southward on August 13. A total of 18 profiles were collected at this location. During both occupations, the intense background vertical shear in the depths range between the westward SEC and the eastward EUC (Fig. 2.7) significantly slowed down the free-falling drop sonde below 70 m depth. During three casts we thus increased the sinking velocity to 0.9 m s^{-1} to reduce this effect. Profiling depths of all casts were between 100 m and 150 m depths.

Within the region of the SEUC at 28°W, 6 profiles were collected. As the SEUC sits deeper in the water column than the EUC (Fig. 2.15), we chose a larger profiling depth of up to 350 m. An unexpected result from data analysis was the finding of very low diapycnal mixing rates below the mixed layer. Eddy diffusivities of only $1x10^{-5}$ m^2 s^{-1} were determined for the depth region between the base of the mixed layer and the SEUC (Fig. 2.15). This indicates very low diapycnal exchange of heat and salt within the SEUC region in the western tropical Atlantic. However, these first results have to be treated with caution, because our measurements were performed during daytime only.

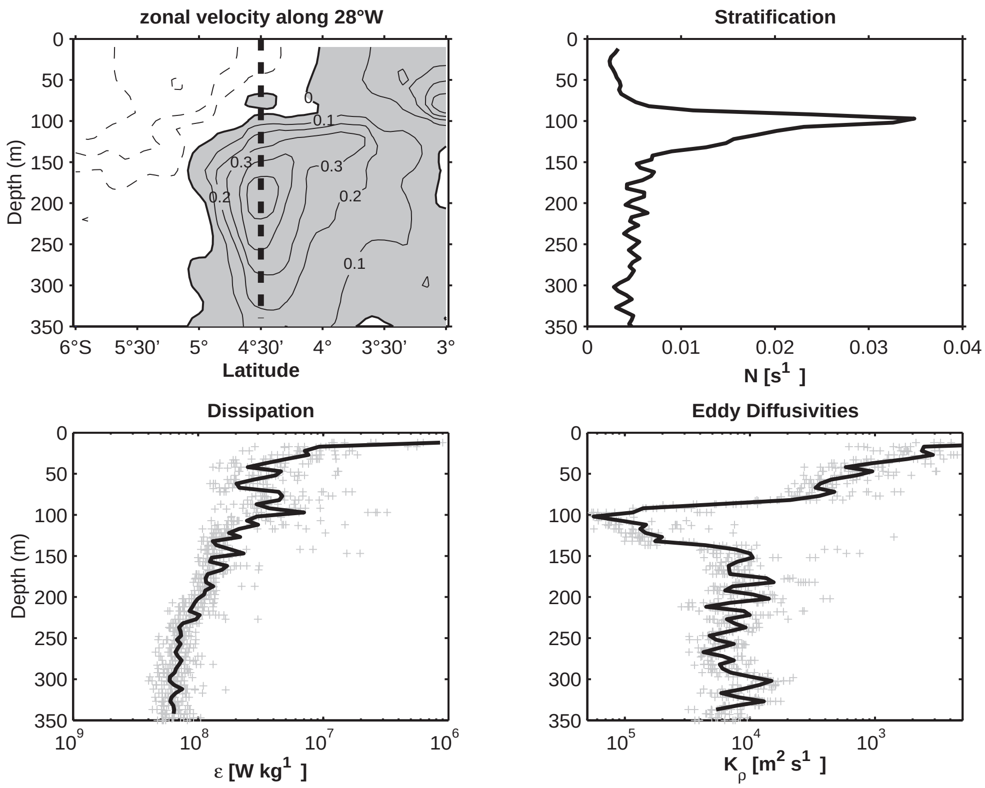

Fig. 2.15: Zonal velocity (upper left) and stratification (upper right) across the South Equatorial Undercurrent at 4°30'S, 28°W recorded during M62/2 in August 2004. Location of microstructure measurement site is indicated by the black dashed line in the upper left panel. Turbulent dissipation rate (lower left) and eddy diffusivities (lower right) determined from microstructure shear measurements.

Table 2.8: METEOR M62/2 Microstructure Profiling Stations

Station	Profile	MSS-Profile	Date	Time	Position		Code	Depth
Nr.	Nr.	Nr.	mmddyy	UTC	Latitude S/N	Longitude W		m
782	1	1	081004	0935	0°N 0.01	35°W 00.31	BE	
782	1	1	081004	0944	0°N 0.04	35°W 00.37	EN	20
782	1	2	081004	0942	0° N0.04	35°W 00.52	BE	
782	1	2	081004	0948	0°N 0.07	35°W 00.67	EN	100
782	1	3	081004	0952	0°N 0.09	35°W 00.77	BE	
782	1	3	081004	0957	0°N 0.11	35°W 00.90	EN	114
782	1	4	081004	1010	0°N 0.16	35°W 01.23	BE	
782	1	4	081004	1014	0°N 0.17	35°W 01.34	EN	160
782	1	5	081004	1020	0°N 0.19	35°W 01.48	BE	
782	1	5	081004	1024	0°N 0.20	35°W 01.59	EN	154
782	1	6	081004	1029	0°N 0.22	35°W 01.71	BE	
782	1	6	081004	1033	0°N 0.24	35°W 01.81	EN	155
802	14	1	081304	1856	0°N 2.73	35°W 00.28	BE	
802	14	1	081304	1900	0°N 2.80	35°W 00.38	EN	101
802	14	2	081304	1904	0° N2.85	35°W 00.47	BE	
802	14	2	081304	1908	0°N 2.91	35°W 00.57	EN	97
802	14	3	081304	1911	0°N 2.96	35°W 00.67	BE	
802	14	3	081304	1915	0°N 3.02	35°W 00.77	EN	103
802	14	4	081304	1919	0°N 3.08	35°W 00.88	BE	
802	14	4	081304	1923	0°N 3.12	35°W 00.97	EN	98
802	14	5	081304	1926	0°N 3.16	35°W 01.05	BE	
802	14	5	081304	1930	0°N 3.22	35°W 01.15	EN	102
802	14	6	081304	1933	0°N 3.28	35°W 01.24	BE	
802	14	6	081304	1937	0°N 3.32	35°W 01.33	EN	97
802	14	7	081304	1940	0°N 3.37	35°W 01.43	BE	
802	14	7	081304	1944	0°N 3.44	35°W 01.54	EN	96
802	14	8	081304	1948	0°N 3.49	35°W 01.64	BE	
802	14	8	081304	1951	0°N 3.54	35°W 01.73	EN	105
802	14	9	081304	1955	0°N 3.60	35°W 01.83	BE	
802	14	9	081304	2000	0°N 3.67	35°W 01.94	EN	96
802	14	10	081304	2004	0°N 3.73	35°W 02.06	BE	
802	14	10	081304	2008	0°N 3.79	35°W 02.17	EN	103
802	14	11	081304	2132	0°N 3.77	35°W 01.47	BE	
802	14	11	081304	2135	0°N 3.82	35°W 01.55	EN	122
802	14	12	081304	2140	0°N 03.89	35°W 01.65	BE	
802	14	12	081304	2143	0°N 03.94	35°W 01.73	EN	112
846	58	1	082404	1200	4°S 29.92	28°W 09.84	BE	
846	58	1	082404	1210	4°S 29.71	28°W10.01	EN	358

Station	Profile	MSS-Profile	Date	Time	Position		Code	Depth
Nr.	Nr.	Nr.	mmddyy	UTC	Latitude S/N	Longitude W		m
846	58	2	082404	1219	4°S 29.58	28°W 10.09	BE	
846	58	2	082404	1229	4°S 29.43	28°W 10.22	EN	347
846	58	3	082404	1238	4°S 29.30	28°W 10.34	BE	
846	58	3	082404	1248	4°S 29.16	28°W 10.47	EN	342
846	58	4	082404	1257	4°S 29.03	28°W 10.58	BE	
846	58	4	082404	1307	4°S 28.88	28°W 10.72	EN	355
846	58	5	082404	1316	4°S 28.76	28°W10.82	BE	
846	58	5	082404	1326	4°S 28.61	28°W 10.94	EN	359
846	58	6	082404	1335	4°S 28.46	28°W11.07	BE	
846	58	6	082404	1346	4°S 29.29	28°W 11.22	EN	354

BE= Begin
EN=End

2.4.6 DVS and Thermosalinograph observations

(M. Dengler, A. Dispert, R. Hummels)

The Werum central data distributor (DVS) system continuously records a large set of oceanographic and atmospheric parameters from several sensors throughout the cruise. In order to complete the data set obtained from CTD/LADCP measurements and the Ocean Surveyor, several parameters were post-processed and calibrated. These variables were sea-surface temperature (SST) and salinity (SSS) from the thermosalinograph, meteorological parameters including wind speed, wind direction, air temperature, air pressure and humidity as well as bathymetry. The post-processed dataset was made available to the public by submitting the data to appropriate international data centers.

2.4.6.1 Thermosalinograph data

Sea-surface temperature and salinity were measured by a thermosalinograph with an intake at the ships hull at 6m depth. The thermosalinograph worked well throughout the cruise. During post-processing, the temperature and salinity records were calibrated against CTD temperature and salinity data from 6m depth collected during the cruise. Only a small difference between CTD temperature and temperature from the thermosalinograph of -0.005° was found (Fig. 2.16). For thermosalinograph salinity, an offset of -0.049 psu was determined. As indicated by the relatively low standard deviations of the CTD-thermosalinograph differences in temperature and salinity, the thermosalinograph data are of high quality. During post-processing, both thermosalinograph data sets were corrected by eliminating the offsets. The dataset was submitted to the CORIOLIS Thermosalinograph Data Center, at IFREMER, Brest, France.

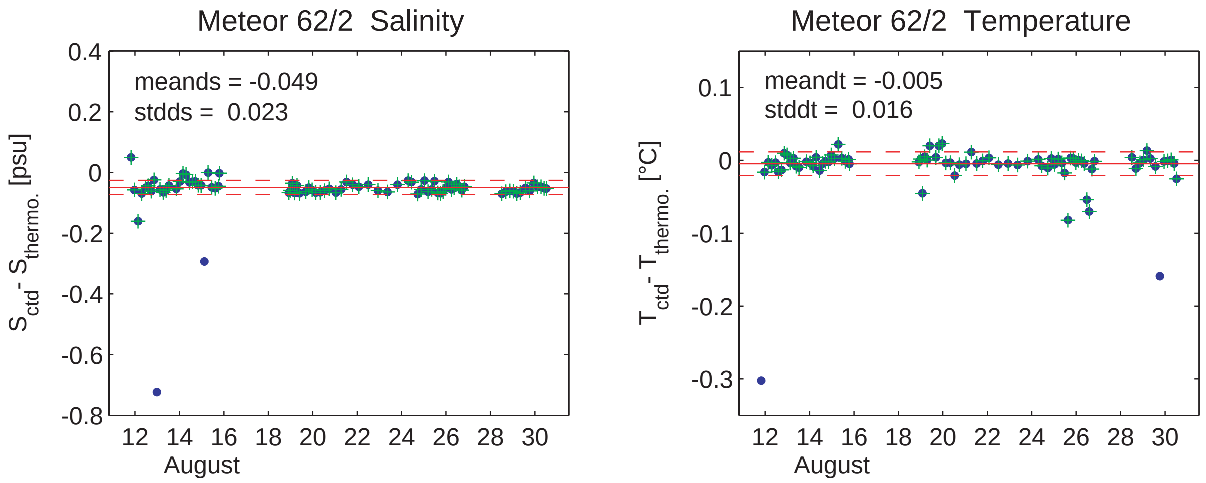

Fig. 2.16: Differences between CTD and thermosalinograph temperature (left panel) and salinity (right panel) against time.

2.4.6.2 Meteorological data

On FS METEOR, air temperature and wind are both measured by two sensors, located on the main mast on port and starboard side. Small differences between the port and starboard sensors were found while the vessel was turned into the wind during CTD station. These differences were eliminated during post-processing. For the final data product, the luv sensor was chosen to obtain best accuracy. After removing outliers, the meteorological parameters true wind speed and direction, air temperature, humidity and pressure were averaged into 5-minute ensembles. The meteorological data set was submitted to the Research Vessel Surface Meteorology Data Center at the Center for Ocean-Atmospheric Prediction Studies, Florida State University.

2.5 Ship's Meteorological Station

2.6 Station List M62/2

Table 2.9: METEOR M62/2 CTD/LADCP stations

R/V METEOR cruise M62/2 CTD-stations															
Ship	Station	Profile	Date	UTC		Position						Uncorr.	Max	No. of	
EXPOCODE	No.	No.	mmddyy	Time	Code	Latitude			Longitude			Depth	Press	Bottles	Par.
06ME62/2	788	1	081104	1941	BE	04	58,78	N	34	59,78	W	3797	CTD		
06ME62/2	788	1	081104	20 11	BO	04	58,43	N	34	59,57	W	3781	1299	8	1,2
06ME62/2	788	1	081104	2038	EN	04	58,33	N	34	59.37	W	3910			
06ME62/2	789	2	081104	2315	BE	04	29,82	N	35	00,25	W	3866			
06ME52/2	789	2	081104	2348	BO	04	29,60	N	34	59,78	W	3854	1303	8	1,2
06ME62/2	789	2	081204	0312	EN	04	29,41	N	34	59,45	W	3832			
06ME62/2	790	3	081204	0338	BE	03	59,86	N	34	59,95	W	3505			
06ME62/2	790	3	081204	0424	BO	03	59,46	N	34	59,92	W	3525	1303	6	1,2
06ME62/2	790	3	081204	0323	EN	03	59,27	N	34	59,92	W	3546			
06ME62/2	791	4	081204	0717	BE	03	29,94	N	35	00,00	W	3976			

Ship	**Station**	**Profile**	**Date**	**UTC**		**Position**						**Uncorr.**	**Max**	**No. of**	
EXPOCODE	**No.**	**No.**	**mmddyy**	**Time**	**Code**	**Latitude**			**Longitude**			**Depth**	**Press**	**Bottles**	**Par.**
06ME62/2	791	4	081204	0747	BO	03	29,85	N	34	59,96	W	3970	1298	0	
06ME62/2	791	4	081204	0814	EN	03	29,90	N	34	59,96	W	3972			
06ME62/2	792	5	081204	1108	BE	03	00,14	N	35	00,20	W	3818			
06ME62/2	792	5	081204	1140	BO	03	00,27	N	35	00,10	W	3824	1301	8	1,2
06ME62/2	792	5	081204	1208	EN	03	00,26	N	35	00,04	W	3824			
06ME62/2	793	6	081204	1415	BE	02	40,12	N	35	00,27	W	3988			
06ME62/2	793	6	081204	1446	BO	02	40,11	N	35	00,16	W	3997	1298	8	1,2
06ME62/2	793	6	081204	1513	EN	02	40,21	N	35	00,11	W	3997			
06ME62/2	794	7	081204	1727	BE	02	20,21	N	35	00,32	W	4150			
06ME62/2	794	7	081204	1757	BO	02	20,13	N	35	00,14	W	4152	1298	8	1,2
06ME62/2	794	7	081204	1825	EN	02	55,55	N	35	00,00	W	4152			
06ME62/2	795	8	081204	2043	BE	02	00,07	N	35	00,07	W	4186			
06ME62/2	795	8	081204	2113	BO	02	00,09	N	34	59,97	W		1300	8	1,2
06ME62/2	795	8	081204	2139	EN	02	00,06	N	34	59,88	W	4156			
06ME62/2	796	9	081204	2346	BE	01	40,13	N	35	00,28	W	4052			
06ME62/2	796	9	081304	0016	BO	01	40,08	N	35	00,23	W	4059	1301	8	1,2
06ME62/2	796	9	081304	0044	EN	01	40,10	N	35	00,05	W	4052			
06ME62/2	797	10	081304	0306	BE	01	20,30	N	35	00,27	W	4141			
06ME62/2	797	10	081304	0337	BO	01	20,32	N	35	00,08	W	4141	1299	8	1,2
06ME62/2	797	10	081304	0403	EN	01	20,30	N	34	59,96	W	4158			
06ME62/2	798	11	081304	0625	BE	01	00,01	N	35	00,19	W	3588			
06ME62/2	798	11	081304	0656	BO	01	00,02	N	35	00,08	W	3597	1300	8	1,2
06ME62/2	798	11	081304	0722	EN	01	00,05	N	35	00,02	W	3602			
06ME62/2	799	12	081304	0930	BE	00	40,01	N	35	00,11	W	4635			
06ME62/2	799	12	081305	1001	BO	00	40,00	N	35	00,03	W	4635	1321	8	1,2
06ME62/2	799	12	081304	1028	EN	00	40,09	N	34	59,95	W	4635			
06ME62/2	800	13	081304	1246	BE	00	19,95	N	35	00,03	W	4551			
06ME62/2	800	13	081304	1319	BO	00	20,05	N	34	59,86	W	4543	1300	8	1,2
06ME62/2	800	13	081304	1347	EN	00	20,12	N	34	59,09	W	4546			
06ME62/2	801	14	081304	2029	BE	00	03,06	N	35	01,69	W	4539			
06ME62/2	801	14	081304	2101	BO	00	03,61	N	35	01,57	W	4543	1299	8	1,2
06ME62/2	801	14	081304	2127	EN	00	03,71	N	35	01,41	W	4542			
06ME62/2	802	15	081404	0031	BE	00	20,00	S	35	00,19	W	4483			
06ME62/2	802	15	081404	0103	BO	00	19,87	S	35	00,03	W	4482	1302	8	1,2
06ME62/2	802	15	081404	0130	EN	00	19,80	S	35	00,86	W	4482			
06ME62/2	803	16	081404	0351	BE	00	39,98	S	35	00,06	W	4422			
06ME62/2	803	16	081404	0422	BO	00	39,90	S	34	59,84	W	4422	1298	8	1,2
06ME62/2	803	16	081404	0448	EN	00	39,84	S	34	59,63	W	4424			
06ME62/2	804	17	081404	0705	BE	00	59,97	S	35	00,11	W	4326			
06ME62/2	804	17	081404	0738	BO	00	59,83	S	34	59,98	W	4290	1301	8	1,2

Ship	**Station**	**Profile**	**Date**	**UTC**		**Position**						**Uncorr.**	**Max**	**No. of**	
EXPOCODE	**No.**	**No.**	**mmddyy**	**Time**	**Code**	**Latitude**			**Longitude**			**Depth**	**Press**	**Bottles**	**Par.**
06ME62/2	804	17	081404	0804	EN	00	59,75	S	34	59,77	W	4272			
06ME62/2	805	18	081404	1048	BE	01	25,02	S	35	00,09	W	4293			
06ME62/2	805	18	081404	1118	BO	01	25,06	S	34	59,96	W	4292	1300	6	1,2
06ME62/2	805	18	081404	1146	EN	01	25,03	S	34	59,91	W	4294			
06ME62/2	806	19	081404	1358	BE	01	45,13	S	34	59,92	W	4034			
06ME62/2	806	19	081404	1431	BO	01	45,24	S	34	59,80	W	4037	1300	6	1,2
06ME62/2	806	19	081404	1458	EN	01	45,16	S	34	59,88	W	4037			
06ME62/2	807	20	081404	1710	BE	02	05,19	S	35	00,23	W	3948			
06ME62/2	807	20	081404	1742	BO	02	05,07	S	34	59,98	W	3960	1301	8	1,2
06ME62/2	807	20	081404	1807	EN	02	04,98	S	34	59,95	W	3962			
06ME62/2	808	21	081404	2024	BE	02	24,92	S	35	00,09	W	3828			
06ME62/2	808	21	081404	2056	BO	02	24,88	S	35	00,02	W	3829	1299	8	1,2
06ME62/2	808	21	081404	2120	EN	02	24,88	S	34	59,96	W	3829			
06ME62/2	809	22	081404	2331	BE	02	45,19	S	34	57,11	W	3762			
06ME62/2	809	22	081504	0003	BO	02	45,14	S	34	57,03	W	3761	1303	8	1,2
06ME62/2	809	22	081504	0033	EN	02	45,12	S	34	57,07	W	3762			
06ME62/2	810	23	081504	0302	BE	03	08,01	S	34	52,96	W	3737			
06ME62/2	810	23	081504	0331	BO	03	08,09	S	34	52,85	W	3736	1301	8	1,2
06ME62/2	810	23	081504	0357	EN	03	08,07	S	34	52,65	W	3738			
06ME62/2	811	24	081504	0657	BE	03	35,98	S	34	53,24	W	3106			
06ME62/2	811	24	081504	0742	BO	03	36,03	S	34	53,16	W	3213	1300	8	1,2
06ME62/2	811	24	081504	0806	EN	03	36,02	S	34	53,06	W	3170			
06ME62/2	812	25	081504	1055	BE	04	03,02	S	34	53,18	W	3466			
06ME62/2	812	25	081504	1135	BO	04	02,87	S	34	53,22	W	3465	1301	6	1,2
06ME62/2	812	25	081504	1159	EN	04	02,82	S	34	53,25	W	3456			
06ME62/2	813	26	081504	1436	BE	04	24,98	S	34	52,99	W	3266			
06ME62/2	813	26	081504	1516	BO	04	24,38	S	34	53,17	W	3467	1304	7	1,2
06ME62/2	813	26	081504	1541	EN	04	24,06	S	34	53,32	W	3501			
06ME62/2	814	27	081504	1811	BE	04	45,15	S	34	53,00	W	1405			
06ME62/2	814	27	081504	1833	EN	04	44,45	S	34	53,34	W	1496	278	Crash at 278	m
06ME62/2	815	28	081504	1918	BE	04	48,63	S	34	53,73	W	901			
06ME62/2	815	28	081504	1942	BO	04	47,98	S	34	53,97	W	909	858	0, bad data	
06ME62/2	815	28	081504	1959	EN	04	47,51	S	34	54,12	W	926			
06ME62/2	816	29	081704	1658	BE	10	56,36	S	34	59,94	W	4172			
06ME62/2	816	29	081704	1809	BO	10	56,42	S	34	59,73	W	4165	CTD	unusable	
06ME62/2	816	29	081704	1909	EN	10	56,45	S	34	59,45	W	4116			
06ME62/2	818	30	081704	2030	BE	10	49,13	S	35	09,01	W	3956			
06ME62/2	818	30	081704	2152	BO	10	49,11	S	35	08,67	W	3952	CTD	unusable	
06ME62/2	818	30	081704	2302	EN	10	49,05	S	35	08,24	W	3961			
06ME62/2	819	31	081804	0059	BE	10	41,91	S	35	16,87	W	3721	CTD	unusable	

Ship	Station	Profile	Date	UTC		Position						Uncorr.	Max	No. of	
EXPOCODE	**No.**	**No.**	**mmddyy**	**Time**	**Code**	**Latitude**			**Longitude**			**Depth**	**Press**	**Bottles**	**Par.**
06ME62/2	819	31	081804	0230	EN	10	41,91	S	35	16,94	W	3724			
06ME62/2	820	32	081804	0528	BE	10	29,06	S	35	33,73	W	2984			
06ME62/2	820	32	081804	0631	BO	10	28,92	S	35	33,25	W	2993	CTD	unusable	
06ME62/2	820	32	081804	0741	EN	10	28,70	S	35	33,04	W	2999			
06ME62/2	822	34	081804	1043	BE	10	22,84	S	35	40,72	W	2337			
06ME62/2	822	34	081804	1131	BO	10	22,33	S	35	40,00	W	2351	CTD	unusable	
06ME62/2	822	34	081804	1212	EN	10	21,99	S	35	39,55	W	2392			
06ME62/2	823	35	081804	2217	BE	10	14,60	S	35	50,54	W	830			
06ME62/2	823	35	081804	2242	BO	10	14,37	S	35	50,33	W	884	777	5	1
06ME62/2	823	35	081804	2259	EN	10	14,16	S	35	50,20	W	894			
06ME62/2	824	36	081804	2352	BE	10	19,96	S	35	47,29	W	1685			
06ME62/2	824	36	081904	0033	BO	10	19,40	S	35	46,93	W	1627	1668	8	1,2
06ME62/2	824	36	081904	0104	EN	10	18,97	S	35	46,55	W	1658			
06ME62/2	825	37	081904	0159	BE	10	23,06	S	35	40,92	W	2327			
06ME62/2	825	37	081904	0251	BO	10	22,37	S	35	40,44	W	2320	2307	8	1,2
06ME62/2	825	37	081904	0334	EN	10	21,92	S	35	39,94	W	2361			
06ME62/2	826	38	081904	0418	BE	10	26,77	S	35	38,53	W	2653			
06ME62/2	826	38	081904	0522	BO	10	26,21	S	35	37,94	W	2677	2664	8	1,2
06ME62/2	826	38	081904	0612	EN	10	25,86	S	35	37,63	W	2678			
06ME62/2	827	39	081904	0701	BE	10	29,56	S	35	34,52	W	2967			
06ME62/2	827	39	081904	0805	BO	10	28,85	S	35	33,96	W	2967	2958	8	1,2
06ME62/2	827	39	081904	0901	EN	10	28,40	S	35	33,57	W	2985			
06ME62/2	828	40	081904	0953	BE	10	33,62	S	35	29,35	W	3314			
06ME62/2	828	40	081904	1102	BO	10	33,06	S	35	29,01	W	3292	3287	7	1,2
06ME62/2	828	40	081904	1201	EN	10	32,64	S	35	28,79	W	3273			
06ME62/2	829	41	081904	1622	BE	10	37,25	S	35	24,31	W	3484			
06ME62/2	829	41	081904	1738	BO	10	36,68	S	35	23,71	W	3525	3519	8	1,2
06ME62/2	829	41	081904	1841	EN	10	36,52	S	35	23,61	W	3534			
06ME62/2	830	42	081904	1944	BE	10	42,39	S	35	17,28	W	3714			
06ME62/2	830	42	081904	2100	BO	10	42,12	S	35	16,96	W	3718	3729	8	1,2
06ME62/2	830	42	081904	2205	EN	10	41,96	S	35	16,68	W	3728			
06ME62/2	831	43	081904	2317	BE	10	49,39	S	35	09,85	W	3947			
06ME62/2	831	43	082004	0041	BO	10	49,07	S	35	09,28	W	3947	3972	7	1,2
06ME62/2	831	43	082004	0155	EN	10	48,93	S	35	08,97	W	3953			
06ME62/2	832	44	082004	0319	BE	10	56,66	S	34	59,87	W	4095			
06ME62/2	832	44	082004	0445	BO	10	56,50	S	34	59,74	W	4107	4129	8	1,2
06ME62/2	832	44	082004	0602	EN	10	56,43	S	34	59,65	W	4116			
06ME62/2	833	45	082004	0800	BE	11	07,10	S	34	45,01	W	4259			
06ME62/2	833	45	082004	0926	BO	11	07,43	S	34	44,73	W	4261	4294	8	1,2
06ME62/2	833	45	082004	1042	EN	11	07,59	S	34	44,44	W				

Ship	**Station**	**Profile**	**Date**	**UTC**		**Position**						**Uncorr.**	**Max**	**No. of**	
EXPOCODE	**No.**	**No.**	**mmddyy**	**Time**	**Code**	**Latitude**			**Longitude**			**Depth**	**Press**	**Bottles**	**Par.**
06ME62/2	834	46	082004	1245	BE	11	18,88	S	34	28,13	W	4641			
06ME62/2	834	46	082004	1415	BO	11	19,02	S	34	27,96	W	4644	4694	8	1,2
06ME62/2	834	46	082004	1536	EN	11	18,98	S	34	27,96	W	4643			
06ME62/2	835	47	082004	1740	BE	11	30,04	S	34	13,07	W	4582			
06ME62/2	835	47	082004	1917	BO	11	29,96	S	34	13,01	W	4584	4622	0	
06ME62/2	835	47	082004	2030	EN	11	29,76	S	34	12,96	W	4585			
06ME62/2	836	48	082104	0104	BE	11	29,97	S	33	53,00	W	4625			
06ME62/2	836	48	082104	0240	BO	11	29,98	S	33	52,98	W	4625	4671	8	1,2
06ME62/2	836	48	082104	0406	EN	11	29,91	S	33	53,06	W	4622			
06ME62/2	837	49	082104	0650	BE	11	29,97	S	33	33,10	W	4959			
06ME62/2	837	49	082104	0842	BO	11	29,96	S	33	33,02	W	4957	5034	8	1,2
06ME62/2	837	49	082104	1015	EN	11	29,93	S	33	33,03	W	4952			
06ME62/2	838	50	082104	1237	BE	11	30,08	S	33	13,03	W	4280			
06ME62/2	838	50	082104	1400	BO	11	30,01	S	33	12,95	W	4287	4326	7	1,2
06ME62/2	838	50	082104	1519	EN	11	29,99	S	33	12,96	W	4281			
06ME62/2	839	51	082104	1856	BE	11	30,01	S	32	43,01	W	4412			
06ME62/2	839	51	082104	2030	BO	11	30,04	S	32	42,93	W	4443	4476	8	1,2
06ME62/2	839	51	082104	2145	EN	11	29,99	S	32	42,85	W	4469			
06ME62/2	840	52	082204	0148	BE	11	30,01	S	32	10,17	W	5052			
06ME62/2	840	52	082204	0334	BO	11	30,01	S	32	09,98	W	5046	4996	8	1,2
06ME62/2	840	52	082204	0504	EN	11	30,03	S	32	10,09	W	5045			
06ME62/2	841	53	082204	1154	BE	11	30,04	S	31	09,95	W	5292			
06ME62/2	841	53	082204	1224	BO	11	29,93	S	31	09,83	W	5288	1299	8	1,2
06ME62/2	841	53	082204	1250	EN	11	29,86	S	31	09,69	W	5289			
06ME62/2	842	54	082204	2233	BE	09	57,99	S	30	23,03	W	5310			
06ME62/2	842	54	082204	2303	BO	09	57,96	S	30	22,89	W	5312	1298	8	1,2
06ME62/2	842	54	082204	2326	EN	09	57,85	S	30	22,76	W	5315			
06ME62/2	843	55	082304	0855	BE	08	21,99	S	29	39,96	W	5425			
06ME62/2	843	55	082304	0924	BO	08	21,97	S	29	39,82	W	5427	1299	8	1,2
06ME62/2	843	55	082304	0950	EN	08	21,93	S	29	39,66	W	5426			
06ME62/2	844	56	082304	1936	BE	06	44,99	S	28	57,07	W	5172			
06ME62/2	844	56	082304	2008	BO	06	44,90	S	28	56,99	W	5167	1300	8	1,2
06ME62/2	844	56	082304	2032	EN	06	44,85	S	28	56,88	W	5167			
06ME62/2	845	57	082404	0659	BE	04	59,89	S	28	09,96	W	5429			
06ME62/2	845	57	082404	0730	BO	05	00,00	S	28	09,88	W	5422	1300	7	1,2
06ME62/2	845	57	082404	0755	EN	04	59,97	S	28	09,81	W	5424			
06ME62/2	846	58	082404	1055	BE	04	29,93	S	28	10,06	W	5357			
06ME62/2	846	58	082404	1125	BO	04	29,98	S	28	09,99	W	5357	1300	7	1,2
06ME62/2	846	58	082404	1150	EN	04	29,96	S	28	09,87	W	5358			
06ME62/2	847	59	082404	1719	BE	03	59,95	S	28	09,99	W	5218			

Ship	Station	Profile	Date	UTC		Position						Uncorr.	Max	No. of	
EXPOCODE	**No.**	**No.**	**mmddyy**	**Time**	**Code**	**Latitude**			**Longitude**			**Depth**	**Press**	**Bottles**	**Par.**
06ME62/2	847	59	082404	1750	BO	03	59,95	S	28	09,87	W	5218	1301	8	1,2
06ME62/2	847	59	082404	1815	EN	04	00,01	S	28	09,78	W	5210			
06ME62/2	848	60	082404	2106	BE	03	29,90	S	28	10,01	W	5179			
06ME62/2	848	60	082404	2137	BO	03	29,94	S	28	09,78	W	5180	1299	8	1,2
06ME62/2	848	60	082404	2201	EN	03	29,95	S	28	09,63	W	5176			
06ME62/2	849	61	082504	0042	BE	02	59,96	S	28	10,09	W	5070			
06ME62/2	849	61	082504	0115	BO	02	59,89	S	28	09,90	W	5073	1298	8	1,2
06ME62/2	849	61	082504	0140	EN	02	59,93	S	28	09,83	W	5067			
06ME62/2	850	62	082504	0436	BE	02	30,01	S	28	10,00	W	5004			
06ME62/2	850	62	082504	0511	BO	02	30,08	S	28	09,66	W	5001	1310	7	1,2
06ME62/2	850	62	082504	0542	EN	02	30,31	S	28	09,40	W	5003			
06ME62/2	851	63	082504	0836	BE	01	59,95	S	28	10,02	W	4883			
06ME62/2	851	63	082504	0905	BO	02	00,07	S	28	09,91	W	4918	1298	8	1,2
06ME62/2	851	63	082504	0929	EN	02	00,14	S	28	09,80	W	4953			
06ME62/2	852	64	082504	1137	BE	01	39,99	S	28	10,01	W	5060			
06ME62/2	852	64	082504	1207	BO	01	40,04	S	28	09,95	W	5066	1300	8	1,2
06ME62/2	852	64	082504	1233	EN	01	39,99	S	28	09,83	W	5059			
06ME62/2	853	65	082504	1508	BE	01	19,87	S	28	10,10	W	4070			
06ME62/2	853	65	082504	1539	BO	01	19,96	S	28	09,97	W	4094	1311	8	1,2
06ME62/2	853	65	082504	1603	EN	01	19,88	S	28	09,84	W	4113			
06ME62/2	854	66	082504	1753	BE	01	00,04	S	28	09,97	W	3517			
06ME62/2	854	66	082504	1827	BO	00	59,92	S	28	09,88	W	3486	1311	8	1,2
06ME62/2	854	66	082504	1854	EN	00	59,89	S	28	09,78	W	3482			
06ME62/2	855	67	082504	2055	BE	00	39,77	S	28	10,00	W	4128			
06ME62/2	855	67	082504	2126	BO	00	39,86	S	28	09,88	W	4127	1307	7	1,2
06ME62/2	855	67	082504	2151	EN	00	39,83	S	28	09,64	W	4125			
06ME62/2	856	68	082504	2346	BE	00	20,03	S	28	10,05	W	3827			
06ME62/2	856	68	082604	0016	BO	00	20,08	S	28	09,84	W	3823	1296	8	1,2
06ME62/2	856	68	082604	0041	EN	00	20,00	S	28	09,74	W	3819			
06ME62/2	857	69	082604	0241	BE	00	00,10	S	28	10,04	W	4141			
06ME62/2	857	69	082604	0312	BO	00	00,13	S	28	09,82	W	4140	1299	8	1,2
06ME62/2	857	69	082604	0344	EN	00	00,02	S	28	09,67	W				
06ME62/2	858	70	082604	0556	BE	00	19,99	N	28	10,27	W	3119			
06ME62/2	858	70	082604	0625	BO	00	20,02	N	28	10,08	W	3095	1319	7	1,2
06ME62/2	858	70	082604	0651	EN	00	20,04	N	28	09,98	W	3066			
06ME62/2	859	71	082604	0844	BE	00	40,01	N	28	10,16	W	3029			
06ME62/2	859	71	082604	0912	BO	00	40,01	N	28	10,05	W	2990	1298	8	1,2
06ME62/2	859	71	082604	0936	EN	00	40,08	N	28	09,97	W	3050			
06ME62/2	860	72	082604	1131	BE	01	00,07	N	28	10,21	W	4147			
06ME62/2	860	72	082604	1200	BO	00	59,96	N	28	10,10	W	4099	1300	6	1,2

Ship	Station	Profile	Date	UTC		Position						Uncorr.	Max	No. of	
EXPOCODE	No.	No.	mmddyy	Time	Code	Latitude			Longitude			Depth	Press	Bottles	Par.
06ME62/2	860	72	082604	1226	EN	00	59,97	N	28	10,11	W	4090			
06ME62/2	861	73	082604	1422	BE	01	20,05	N	28	10,01	W	1742			
06ME62/2	861	73	082604	1450	BO	01	20,04	N	28	10,00	W	1738	1303	7	1,2
06ME62/2	861	73	082604	1517	EN	01	20,11	N	28	10,00	W	1738			
06ME62/2	862	74	082604	1710	BE	01	40,07	N	28	10,03	W	3360			
06ME62/2	862	74	082604	1740	BO	01	40,05	N	28	10,01	W	3359	1311	8	1,2
06ME62/2	862	74	082604	1807	EN						W	3350			
06ME62/2	863	75	082604	1958	BE	02	00,07	N	28	10,04	W	3438			
06ME62/2	863	75	082604	2027	BO	02	00,15	N	28	09,91	W	3429	1299	8	1,2
06ME62/2	863	75	082604	2052	EN	02	00,22	N	28	09,96	W	3429			
06ME62/2	864	76	082804	1209	BE	05	00,14	S	30	10,22	W	4982			
06ME62/2	864	76	082804	1237	BO	05	00,13	S	30	10,23	W	4975	1299	8	1,2
06ME62/2	864	76	082804	1302	EN	05	00,10	S	30	10,10	W	4977			
06ME62/2	865	77	082804	1638	BE	05	00,03	S	30	49,99	W	4900			
06ME62/2	865	77	082804	1709	BO	05	00,01	S	30	49,99	W	4897	1299	8	1,2
06ME62/2	865	77	082804	1735	EN	04	59,97	S	30	50,07	W	4898			
06ME62/2	866	78	082804	2102	BE	04	59,98	S	31	30,08	W	4699			
06ME62/2	866	78	082804	2132	BO	05	00,01	S	31	30,02	W	4704	1299	8	1,2
06ME62/2	866	78	082804	2157	EN	05	00,03	S	31	29,93	W	4707			
06ME62/2	867	79	082904	0047	BE	05	07,01	S	32	00,01	W	4610			
06ME62/2	867	79	082904	0118	BO	05	06,98	S	31	59,98	W	4615	1302	8	1,2
06ME62/2	867	79	082904	0141	EN	05	06,96	S	31	59,98	W	4614			
06ME62/2	868	80	082904	0435	BE	05	12,23	S	32	30,13	W	4603			
06ME62/2	868	80	082904	0506	BO	05	12,20	S	32	29,88	W	4604	1310	8	1,2
06ME62/2	868	80	082904	0533	EN	05	12,08	S	32	29,79	W	4606			
06ME62/2	869	81	082904	0814	BE	05	17,68	S	33	00,07	W	4565			
06ME62/2	869	81	082904	0939	BO	05	17,66	S	33	00,00	W	4564	4610	7	1,2
06ME62/2	869	81	082904	1056	EN	05	17,63	S	32	59,94	W	4565			
06ME62/2	870	82	082904	1342	BE	05	23,05	S	33	29,99	W	4456			
06ME62/2	870	82	082904	1508	BO	05	22,92	S	33	30,00	W	4459	4497	7	1,2
06ME62/2	870	82	082904	1630	EN	05	22,94	S	33	29,96	W	4461			
06ME62/2	871	83	082904	1823	BE	05	26,60	S	33	50,21	W	4325			
06ME62/2	871	83	082904	1955	BO	05	26,50	S	33	50,07	W	4314	4356	7	1,2
06ME62/2	871	83	082904	2107	EN	05	26,57	S	33	50,04	W	4334			
06ME62/2	872	84	082904	2259	BE	05	30,16	S	34	10,10	W	4123			
06ME62/2	872	84	083004	0021	BO	05	30,19	S	34	09,98	W	4125	4159	8	1,2
06ME62/2	872	84	083004	0128	EN	05	30,10	S	34	09,97	W	4126			
06ME62/2	873	85	083004	0258	BE	05	32,67	S	34	23,98	W	3783			
06ME62/2	873	85	083004	0416	BO	05	32,17	S	34	24,16	W	3785	3797	0	
06ME62/2	873	85	083004	0525	EN	05	32,00	S	34	24,27	W	3785			

Ship	Station	Profile	Date	UTC		Position						Uncorr.	Max	No. of	
EXPOCODE	**No.**	**No.**	**mmddyy**	**Time**	**Code**	**Latitude**			**Longitude**			**Depth**	**Press**	**Bottles**	**Par.**
06ME62/2	874	86	083004	0640	BE	05	34,96	S	34	36,15	W	3360			
06ME62/2	874	86	083004	0751	BO	05	34,14	S	34	36,11	W	3404	3418	0	
06ME62/2	874	86	083004	0853	EN	05	33,58	S	34	36,03	W	3463			
06ME62/2	875	87	083004	1001	BE	05	36,90	S	34	46,04	W	2776			
06ME62/2	875	87	083004	1057	BO	05	36,23	S	34	46,00	W	2788	2655	0	
06ME62/2	875	87	083004	1144	EN	05	35,66	S	34	45,92	W	2872			
06ME62/2	876	88	083004	1241	BE	05	37,94	S	34	54,14	W	1436			
06ME62/2	876	88	083004	1328	BO	05	37,82	S	34	54,23	W	1446	1498	0	
06ME62/2	876	88	083004	1356	EN	05	37,13	S	34	54,37	W				

Code: BE = begin, BO = bottom, EN = end
Parameters (Par.): 1= salinity, 2 = oxygen (samples taken but no useful measurements possible)

2.7 Acknowledgements

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2.8 References

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