

SHORT CRUISE REPORT

N/O THALASSA

cruise **SUBPOLAR**

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from Brest, France to St. John's, Canada

June 4 to July 12, 2005

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Objectives of the cruise

The deep water masses which are formed and/or modified in the subpolar North Atlantic, are an important part of the climate relevant thermohaline oceanic circulation (THC). Our own measurements made since 1996 in the framework of the German national program 'Dynamics of the Thermohaline Circulation Variability' as well as data from other groups have shown, that the hydrographic and tracer characteristic of the deep water masses are subject to significant annual changes. The pursuit of these changes led to the discovery of the main spreading paths and the time scales of spreading along the paths. The detailed and large scale surveys including CFC (chlorofluorocarbon) distributions since 1997 made it possible to calculate biannually the CFC inventories. The change of the CFC inventories with time is up to now the most suitable method to infer time series of deep water formation in the Labrador Sea. The results showed that the formation of deep water in the Labrador Sea decreased to about 3-4 Sv in 2001 and that the produced deep water got fresher and less dense. The THALASSA cruise is a continuation of that effort.

The goals are

- to compare the large scale distribution of the deep water masses with the observations in the time period 1996 – 2003
- to study the export pathways of deep water into the subtropical Atlantic
- to calculate the regional CFC inventories and compare them with the data from 1997 – 2003 and infer the formation rates of the deep water masses
- to assess the state of convection activities in the Labrador Sea in the winter 2004/05

Methods

The distribution of temperature, salinity, and oxygen with depth are measured with CTDO profiles (Seabird). Two LADCP 300kHz Workhorse, one upward and one downward looking, are connected to the 24x10L carousel and lowered together with the CTD. From the 10L bottles, water samples are taken to calibrate the oxygen and conductivity sensors and to measure the distribution of CFCs. Additionally, XBTs are deployed every 20nm and 7 ARGO floats were launched to assist the programs of the Bundesamt für Seeschifffahrt BSH (Hamburg, Germany). XBT data are sent directly to Coriolis at Ifremer (Brest), as well as the upper 1000m of the CTD profile. Two shipboard ADCPs (75kHz and 150kHz) are used to determine continually the velocity distribution in the upper 500-600m.

Cruise Narrative

The instalment of our instruments was delayed by one day due to technical problems of the ship and thus started at June 3 instead of June, 2. Since the CFC analysis system needs at least 3 days between begin of instalment and begin of analysis, the system could not be ready at the start of the CTD station work at June, 4 and 5.

The THALASSA left Brest at June, 4, 6 UTC, heading west. Under favourable weather conditions, the first CTD test station was carried out at 13:30 UTC. The pump for the

conductivity sensor did not work properly and had to be repaired. The second test station at June 5, 7 UTC was successful for the CTD sensors, but the LADCP suffered from data gaps, presumably caused by an erroneous plug. At the second try, the LADCP was functioning well. The first XBT was deployed at 48°54.5'N, 12°00.0'W, 17 UTC, and the average distance between the XBTs at the WOCE A2 section was 20nm.

The analysis of CFC water samples could not start before June, 6, 16 UTC. In order to minimize the spatial gap without CFC data, the horizontal distance between the CTD stations was set to 11nm until CTD 8 (48°36'N, 15°33'W). Westerly winds forced the Thalassa to speeds lower than 9 kn. With the start of the CFC sampling at CTD 8 the distance between the CTD profiles was increased to 45nm. The conductivity measurements from CTD profiles 1-8 suffered from a variable pump flow, but the problem was solved and the following profiles had high quality data.

A gap in the CFC analysis occurred at station CTD 11 (48°08'N, 18°56'W) due to technical problems. ARGO floats were deployed after finishing CTD 11 and CTD 12 (47°59'W, 20°03'W). When approaching the eastern flank of the Midatlantic Ridge (MAR), the CTD station spacing was reduced to 34nm (west of CTD 13 at 47°50'N, 21°11'W). This position was reached at June, 8, 13 UTC. At CTD 13, at CTD 15 (47°36'N, 22°52'W), and at CTD 17 (47°22'N, 24°31'W), floats were deployed shortly after finishing the CTD stations.

The weather remained favourable with very moderate winds and waves. The THALASSA entered the western Atlantic at June, 10, 11:30 UTC (CTD 21, 46°49'N, 27°38'W). This CTD station is located on the top of the MAR and a float was launched at the position of CTD 21. In the eastern Atlantic, starting at 12°W, 31 XBTs and 5 floats have been launched in total. The station spacing at the western flank of the MAR was set to 34-32nm, and we continued to launch XBTs every 20nm. In contrast to the survey in August 2003, no eddy with recently ventilated uLSW core was found this time on top of the MAR.

Starting at position 46°31'N, 33°07'W (CTD 28), the CTD station spacing increased to 40nm while the water depth was below 4000m. The winds increased to Bft 7, the CTD station work continued as usual. In the afternoon, the weather conditions deteriorated, the winds reached Bft 8-9 and turned again to westerly direction. The THALASSA had to run against wind and waves and slowed down to 5-7 kn. At June 13, the weather conditions remained the same. Due to the heavy pitch and roll of the ship and therefore of the wire and the carousel during station, the LADCP profiles from CTD 25 onward had a very low quality and on most of the stations no reliable profiles could be obtained. The ADCP in the slave mode had additional problems in the data communication.

The CFC analysis system broke down at June 13, 13UTC, and no CFC samples could be taken from CTD 32 and the following stations. It turned out that the control unit of the Gas-Chromatograph failed. The control unit could not be repaired at the ship but had to be exchanged. The transit of the spare parts from Bremen was immediately organized and its scheduled arrival in St. John's is June, 17. The station work continued in order to arrive in St. John's just in time to take some fuel and to receive the spare parts.

At CTD 33 and 34, the pinger, which was usually attached to the CTD system to determine the distance from the bottom, was removed to be reloaded and due to the strong ship's drift during station, the mechanical device to detect bottom didn't work. The bottom depth from the ship's echosounder was fluctuating too and thus the CTD profiles 33 and 34 were terminated about 100m above the presumed bottom.

At June, 14, under improved sea and weather conditions, the pitch and roll of THALASSA was moderate enough to permit the sampling of good LADCP data at CTD 35 (46°55'N, 40°03'W) to CTD 37 (47°0'N, 41°25.5'W). At CTD 35, the data flow from the CTD was interrupted at a depth of 4240m. After exchange of the fuse on the board unit we could complete the cast. The connection between the wire and the CTD was renewed, but at the next CTD station the connection was interrupted at a depth of 4400m. All cables and connections were checked and CTD 37 was carried out without problem. At June 15, 11 UTC the CTD was lowered below 1000m and then alternated between 1000m and 2900m depth for 12 hours. These measurements serve to estimate the deep vertical mixing in the Deep Western Boundary Current at the very steep continental slope (CTD 38 at 47°0'N, 43°11'W). During the last hour of the YoYo station, the data flow was again interrupted by a blowing fuse. In order to restore the CTD system, another 35 m of the wire were cut and the cable connecting the CTD to the wire was exchanged. CTD station work stopped on June 16, 0:30, so that the THALASSA reached St. John's in time to receive the spare parts for the CFC analysis system.

The THALASSA arrived in St. John's at June 17, 16UTC and left at 20 UTC. During this time the ship received fuel, and the requested spare parts to repair the CFC analysis system were delivered by the agent. After departure, the THALASSA headed toward the Labrador Sea to the position of CTD 40 (54°16'N, 47°45'W).

The Gas Chromatograph of the CFC system only worked for about 1 hour before another severe failure occurred. It took several days to get the CFC system running again (at CTD 51). The first station in the Labrador Sea (CTD 40) was carried out at June, 19. At the start of the CTD station it turned out that the connection between wire and CTD did not work properly. After a 4h repair, the station work could be carried out without further problems in the data transmission and we did not encounter them for the rest of the cruise. The LADCP profile, however, suffered from data gaps caused by interrupted power supply. It turned out that the battery case had a leakage and therefore had to be replaced.

The next two CTD stations (CTD 41 and 42) were carried out 31nm apart from each other at a course of 74° in order to intercept a mooring from IFM-GEOMAR, Kiel, which drifts since 2 years. The position of the mooring was sent via ARGOS. The approximate position was reached at June, 20, 6UTC. The ARGOS transmitter was on board at 7:30 UTC, but no instruments were attached.

After CTD 43 the data of the LADCP working in the slave mode were difficult to retrieve. The problem was caused by water leakage into the instrument although both ADCPs have been refurbished by RDI just before the cruise. The ADCP was replaced by another instrument. No velocity data could be obtained at CTD 44, since the voltage in the newly inserted battery pack was too weak. The pack was replaced and velocity profiles were obtained from CTD 45 to CTD 52. It turned out that the compass of the newly installed ADCP was not calibrated and displayed heading deviations dependent on the heading itself. Compared to the heading of the calibrated instrument in the master mode, the deviations were sinusoidal and could be corrected.

Starting with XBT 66 at 57°24.0'N, 52°17.0'W (i.e. between CTD 48 and 49), XBTs were launched about 15nm apart from the CTD stations (i.e. distance between XBTs is 31nm), starting at June 21, 21UTC.

At June 22, 16:30 UTC, the CFC sampling started again at CTD 52. The analysis time for one water sample was significantly longer than normal, but sufficient to resolve the features.

In checking the Bremen ADCP- slave, no lasting damage was obvious after drying and cleaning the instrument. Therefore, at June 22, 16:30 UTC, the Bremen ADCP was installed in the carousel and worked without problems for CTD 52 – CTD 56. At CTD 57, data communication with this instrument broke down again. After visual inspection the ADCP experienced a water leakage at the plug. Fortunately, the ADCP was upward looking and therefore the electronic boards seem unaffected. The ADCP will be returned to the manufacturer RDI (San Diego) as soon as we arrive in St. John's.

The velocity profile of CTD 59, however, was lost. Heavy winds and swell caused a too strong tilt ($>20^\circ$) of the instrument, while the ship drifted about 3nm during station. The northernmost CTD station of the cruise (CTD61) at $62^\circ24.0'N$ was reached at June, 24, 11 UTC at a water depth of 1400m. That far north, the sea was covered with a thick lens of less saline water and the upper boundary of the uLSW decreased along the section from 200m to about 700m depth.

Starting at June 24, 12 UTC, the THALASSA sailed towards Greenland, Cap Desolation, at a course of about 110° . The distance between CTD stations was set to 34nm. Under favourable conditions, the stations CTD 62 - 68 ($61^\circ N$, $51^\circ49'W$) were carried out. At CTD station 69 ($60^\circ48'N$, $50^\circ40'W$), June, 26, 5 UTC, the weather and sea conditions deteriorated, but station work continued. The station closest to Greenland (CTD 71, $60^\circ22'N$, $48^\circ24'W$) was reached at June 26, 18 UTC. The planned Yo-Yo station to estimate the role of deep mixing was eliminated, since the data would be too much affected by the ship's pitch and roll. Here the last XBT was launched.

The THALASSA followed the course of the former WOCE section AR7 west. The station spacing decreased to 10-16nm in order to resolve the boundary current at the continental slope. Strong, along-slope velocities exceeding 0.4m/s were found in the West Greenland Current. Shortly before the start of station CTD 76, the battery case for the ADCP workhorse broke at the mechanical fuses, presumably due to water leakage followed by a battery failure. The case was exchanged, and no ADCP profile was lost. Thanks to the help of the ship's mechanical and electronic workshop the broken battery case could be repaired.

Away from the Greenland slope, the CTD spacing increased to 30nm. The THALASSA left the WOCE AR7 section at CTD 79 ($58^\circ13'N$, $50^\circ53'W$) and headed toward the southeast. The CTD stations were 38nm apart. This section is almost parallel to the CTD stations 40-61 and will help to fill the spatial gap in the CFC distribution, lasting from CTD 40 to 51 in the Labrador Sea. Some of the CTD profiles show a weaker stratification in the upper 1500m, comparable to the profiles measured in 2003, although shifted to higher salinities. These profiles could be remnants of deep convection in the winters 2003/4 or 2004/5. CTD 88 showed remnants of the convection activities before summer 2003. The southernmost station (CTD 89) of the section was located at $53^\circ06'N$, $43^\circ50.0'W$ and was carried out on June 30, 10:30 UTC. The weather conditions remained good.

The THALASSA sailed north along about $43^\circ45'W$ towards Cap Farvel at the southern tip of Greenland. The station spacing remained at 38nm. At CTD 96 at $57^\circ32'N$, $43^\circ45.5'W$, we found again recently formed uLSW, the layer thickness exceeding 1040m and the upper bound at 180m depth.

At the continental slope (CTD 97 – CTD 101) the station spacing decreased to 20nm and then to 12nm. CTD 97 was finished at July 2, 15 UTC and CTD 101 (59°03'N, 43°45'W) at the location closest to the coast of Greenland (40nm) at July, 3, 1:40 UTC. Between stations CTD 98 - CTD 101 several icebergs were visible. The next section covered the southern Irminger Sea from Greenland to the Reykjanes Ridge to follow the exit paths of the newly formed LSW. The station spacing increased to 38nm. On July 3, 12 UTC, CTD 103 had to be abandoned due to a failure of the vessel's propulsion. After about 2 hours the repair was finished, and CTD station 103 was carried out successfully. On stations 103 and 104, both located in the central Irminger Sea, the freshest uLSW outside the Labrador Sea was observed.

Wind and swell increased to Bft.8 on July, 4, followed by friendly, sunny weather on July, 5. In the morning of July 5, at 9 UTC, the THALASSA was drifting for 1.5 hrs due to ship's repair work. CTD 113 at 52°36'N, 35°52'W is located at the northern flank west of the Gibbs Fracture Zone (GFZ). Here, at July 6, 0 UTC, the salinities in the deep water exceeded 34.97. An ARGOS float was launched 20 nm further south at 52°16'N, 35°32.0'W.

The easternmost station and the end of this section was reached at July 7, 1 UTC with CTD 117 (50°28'N, 33°13'W). Here we encountered a deep reaching North Atlantic Current (NAC). Unfortunately, the too high inclination of the wire and therefore of the instrument prevented the LADCP from providing a reliable velocity profile. A float was launched after finishing the CTD station. A similar wire problem than at CTD 117 occurred at CTD 118 (no velocity profile). The THALASSA headed west, keeping the station spacing at roughly 40nm. The last float was deployed after CTD 119 at 49°28'N, 33°53'W at July 7, 17 UTC. The last CTD (CTD 129) with CFC and oxygen samples took place at July 10, 5:30 UTC at 49°01.0'N, 43°24.0'W.

At 48°51.0'N, 43°58.0'W in the Deep Western Boundary Current at a depth of 2400m, a Yo-Yo CTD was carried out in order to estimate the deep mixing. In the YoYo station at June 11 (CTD 138), the CTD was kept for 12 hours below 1000m depth, while the ship was slowly drifting downstream. This time, a CTD profile from top to bottom was taken, then the CTD was brought back on board, the ship sailed back to the starting position, and a new profile was taken. The YoYo station (CTD 130 – 138) lasted from July 10, 11 UTC to July 11, 0 UTC. The THALASSA sailed to St. John's and arrived at July 12, 11UTC.

We thank Commandant Herve Piton, his officers and crew for their kind assistance and cooperation.

Figure 1 CTDO stations, cruise SUBPOLAR, N/O THALASSA, June 4 – July 12, 2005

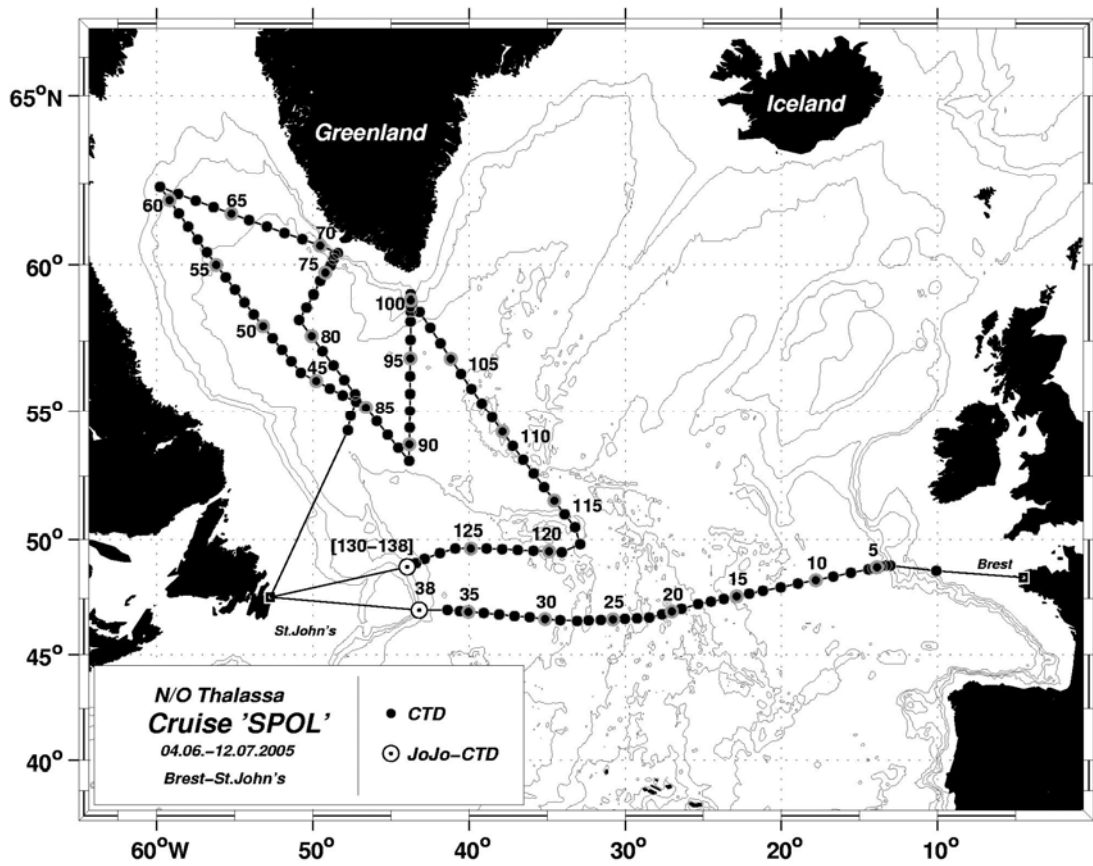
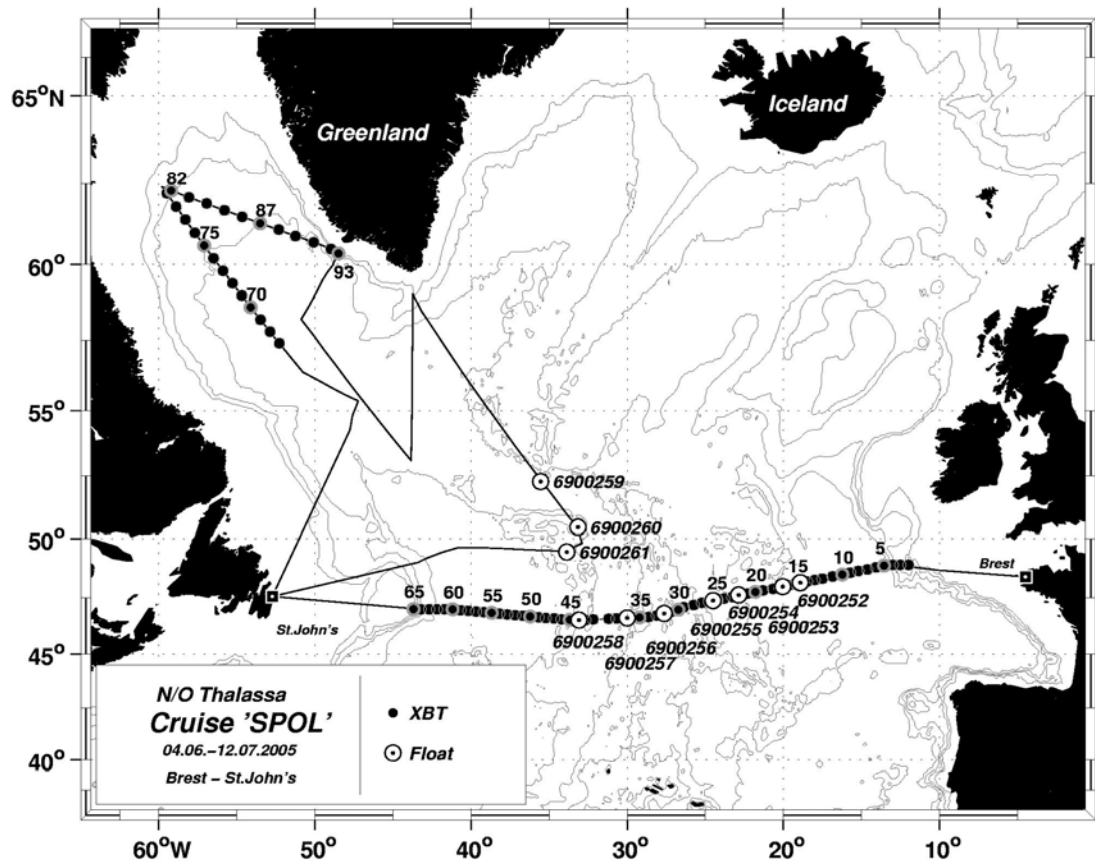


Figure 2: Positions of XBTs (dark dots) and ARGO floats, (circles with WMO number), cruise SUBPOLAR with N/O THALASSA, June 4 – July 12, 2005.



Technical Aspects

CTDO₂ Measurements Reiner Steinfeldt

Conductivity, temperature, pressure and dissolved oxygen were measured with a Sea-Bird 911+ CTD system. The device was connected to a water sampler carousel with 22 10 l Niskin bottles and 2 LADCPs. On the first profiles, the conductivity and especially the oxygen sensor showed large oscillations in the downcast profile towards the bottom. The density profiles revealed instabilities accompanied with circles in the T-S diagram. These features could be moderated by applying a time delay of 0.075 s for the temperature sensor in the CTD data processing. After profile 9, the outlet of the hose of the CTD pump was fixed at a higher position than before. This improved the quality of the CTD data. A profile with questionable data was number 123. There, salinity and oxygen again showed anormally large oscillations. The resulting instabilities could be moderated using a time delay for the temperature sensor of 0.75 s. Additionally, the oxygen was very low compared with the neighbouring stations. Later on, both sensors recovered and gave smooth profiles again. The oxygen profile 123 nevertheless could be used by calibrating it seperately. The later profiles also needed an extra calibration, as the behaviour of the oxygen sensor changed after profile 123.

For calibration purpose, oxygen and salinity samples have been taken from the Niskin bottles. The number of measurements was 956 for oxygen and 439 for salinity, i.e. about 7-8 oxygen and 3-4 salinity samples per profile. Oxygen measurements were carried out by the Winkler titration method. The quality of the oxygen analyses was reduced by two effects: First, the standard varied within +/- 5% and the blank values were much too high (up to 0.042 ml titer). This problem was overcome by recalculating the oxygen concentrations assuming zero blank. The value of the standard was chosen in that way, that the oxygen saturation within the surface layer was between 100 and 110% and the concentrations in the North East Atlantic Deep Water (NEADW) lie between 5.5 and 5.6 ml/l as on earlier cruises.

Second, for the first 30 profiles, the scattering between the CTD oxygen and the direct measurements remained large after calibration. Additionally, the deviation of double samples was much larger (mean rms error 0.085 ml/l) for profiles 1-30 than later on (0.028 ml/l). After profile 31 the large scatter of the difference between CTD oxygen and the titrated samples vanished, maybe due to a change of some of the reactants used for titration. Calling at St. John's, a new dispenser for the standard measurements was obtained. After profile 45, the standard and blank values were in the correct range. The rms between CTD and titrated oxygen samples was 0.069ml/l for profiles 1-38 and 0.037ml/l from profile 39 onward.

Bottle salinities were determined by means of a Guildline Autosol salinometer. First, a salinometer of type 8400A was operated. When the room temperature had increased, the temperature of the water reservoir had to be enhanced from 21 to 24°C. Unfortunately, the salinometer could not be standardised at that temperature. The limited range of the potentiometer did not allow to display the conductivity of the standard. For the last two sessions an Autosol of type 8400B was used. The rms differences between bottle salinity and calibrated CTD values were 0.0024 (0.0021) for all (below 1000 dbar) samples.

IAPSO Standard Seawater of batch 141 was used for calibrating the salinometer. As was measured on cruise Meteor 59/2 (August 2003), a difference in salinity of 0.003 between this batch and batch 139 exists. So far, the salinities calibrated with batch 141 were adjusted by subtracting 0.003. If this is done, the salinities in the North East Atlantic Deep Water along

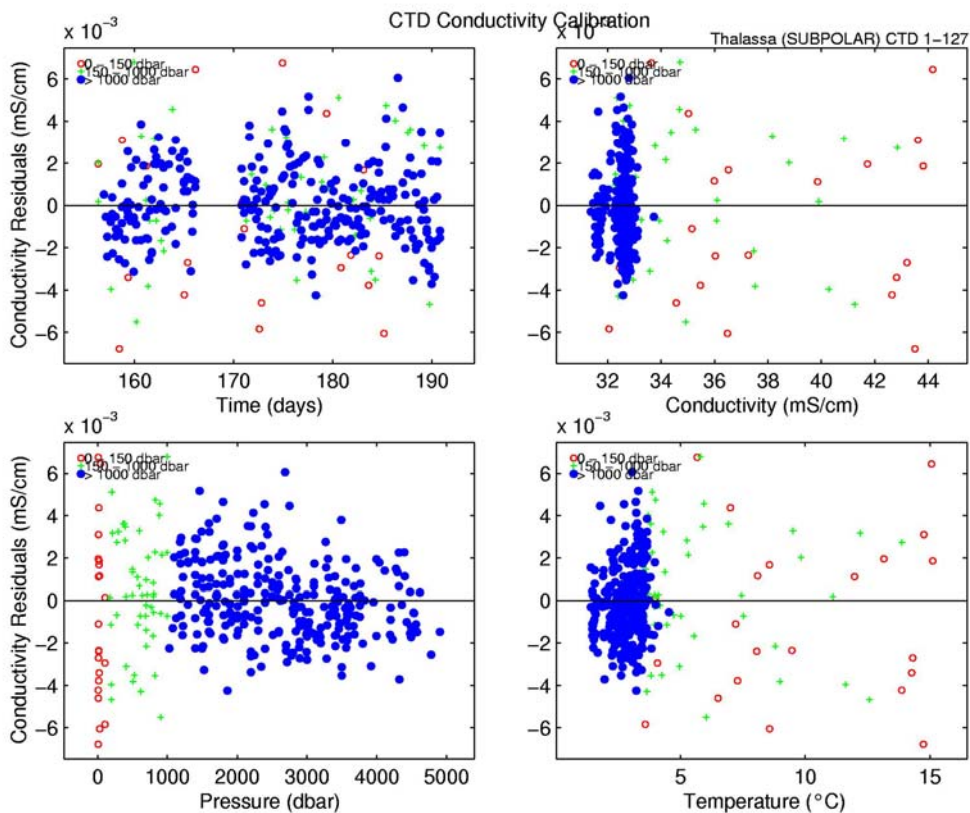
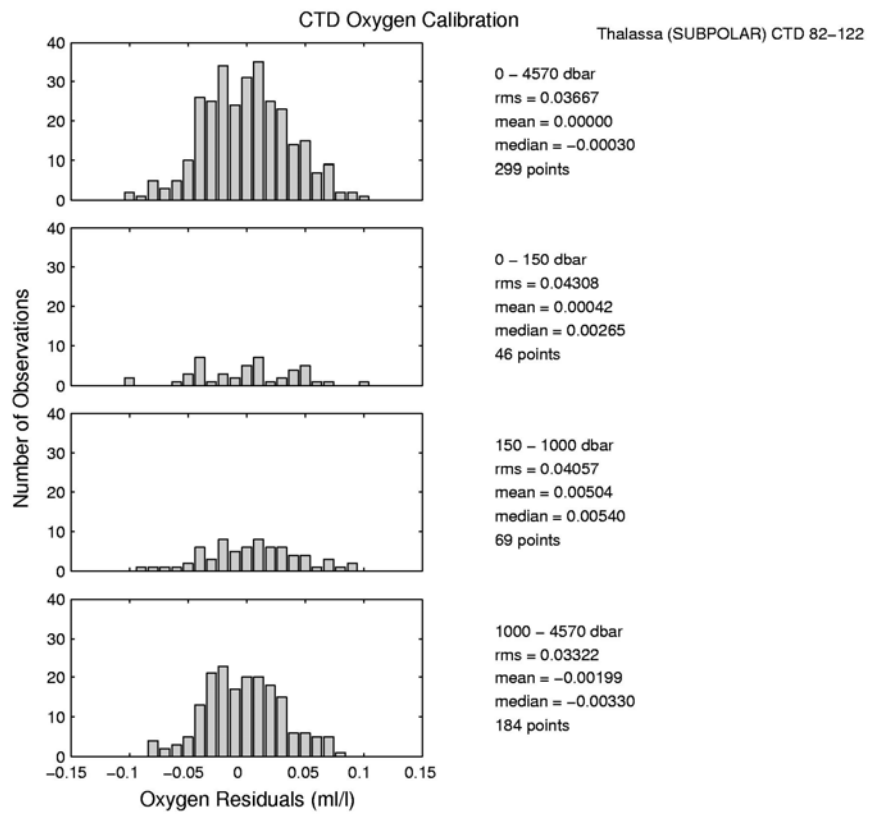


Figure 3 Calibration of the conductivity sensor, THALASSA cruise SUBPOLAR, June 4 – July 12, 2005.

the WOCE section A2 measured on Meteor cruises M30 (1994) - M59 (2003) and on this cruise agree within 0.002. Meanwhile, the IAPSO batch 145 is released, and it was measured on this cruise in order to compare with the questionable batch 141. If the salinometer is standardised with batch 141, the salinity of batch 145 can be reproduced within 0.001. It is therefore unlikely that the salinity of batch 141 is too high by 0.003. If no correction of the salinities from M59/2 and this cruise is applied, the salinity in NEADW increased continuously during the last 11 years by 0.004.



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Figure 4 Calibration of the oxygen sensor, THALASSA cruise SUBPOLAR

Lowered ADCP Profiles

Maren Walter

Most of the hydrographic stations were accompanied by current measurements with a lowered acoustic Doppler current profiler (LADCP) system attached to the CTD and water sampling carousel. Two RDI 300 kHz Workhorse Monitor instruments were used in a synchronized Master-and-Slave mode, with the upward looking as Slave and the downward looking as Master. The instruments were powered by an external battery supply, consisting of 35 commercial quality 1.5V batteries assembled in a pressure resistant Aanderaa housing. The system was set to a ping rate of 1 ping/s and a bin length (= vertical resolution) of 10 m when working in the Master-and-Slave mode and 12 m when only a single instrument was used.

In total, 135 LADCP profiles were occupied during the cruise. Station 38 was a yo-yo cast, where the instrument package was lowered and heaved between 1000 m and the seafloor while the ship drifted with a speed of approximately 1 kn. Stations 130 – 138 were a different kind of yo-yo station, where individual casts were taken at the same position, with the ship returning to the starting point between the casts.

Some of the data were affected by bad weather and instrument failure as detailed below: The profiles 26 to 34 experienced severe ships movement during storm, which caused instrument tilts $> 20^\circ$ and strong accelerations during lowering and heaving, resulting in data loss and/or bad quality, and rendering the profiles faulty. During profile 40, the power supply from the battery package broke down due to unknown reasons. Because of a water leakage into the upward looking instrument, profile 44 was carried out with a single downward looking instrument; the resulting data were not sufficient for a good-quality profile because of the halved range. Therefore, the following CTD casts 45, 46 & 47 were done without an ADCP, until the backup instrument was set up and mounted. However, the backup instrument exhibited a significant compass deviation in dependence on the heading; thus the original Slave was reinstalled after cleaning, drying, and replacement of sealing for the profiles 53 to 57, when the water leakage occurred again, and the instrument was removed for good. From then on, the backup instrument was used despite the compass error, which was corrected during post-processing as described below.

After profile 75, a short circuit (probably caused by water leakage through faulty plug) occurred in the battery unit. There was no data loss but considerable damage to the package including the plugs and the electric wiring. The profiles 55, 59, 69, 83, 116-118, 121, 123 were again affected by data loss due to strong ships motion and/or shear currents resulting in large instrument tilts. CTD cast 119 was used as a test run of the repaired battery pack without batteries, therefore no ADCP profile was taken.

The overall performance of the two instruments was very good; the range of each instrument was typically 150 m in the upper parts of the water column and 60 to 70 m at depth larger than 1500 m, with drops to 50 m where the water was particularly lacking in backscatterers, at depths larger than 3000 m. Thus, the total range of the package reached from 100 to 300 m. With lowering and heaving velocities between 0.8 and 1.2 m/s of the instrument package, this range amounted to 100 to over 200 shear estimates per depth bin in the deep water, and up to 500 estimates in the shallow layers, depending on the abundance of backscatterers.

Post processing of the raw data was done using an inverse method which incorporates the measured velocity shear, the surface drift of the ship during the cast, and the bottom track velocities measured by the downward looking instrument to produce profiles of velocity and shear. This resulted in high quality velocity profiles, even for profiles with very weak current velocities (<0.05 m/s) and zero mean. Larger errors occur only in profiles deeper than 4000 m with few backscatterers and weak velocities, where not enough information is available for a good inversion. For the casts with the single instrument, the reduction of range lead to a decrease of shear estimates per bin to less than 50 below 3500 m, too few for a good quality profile.

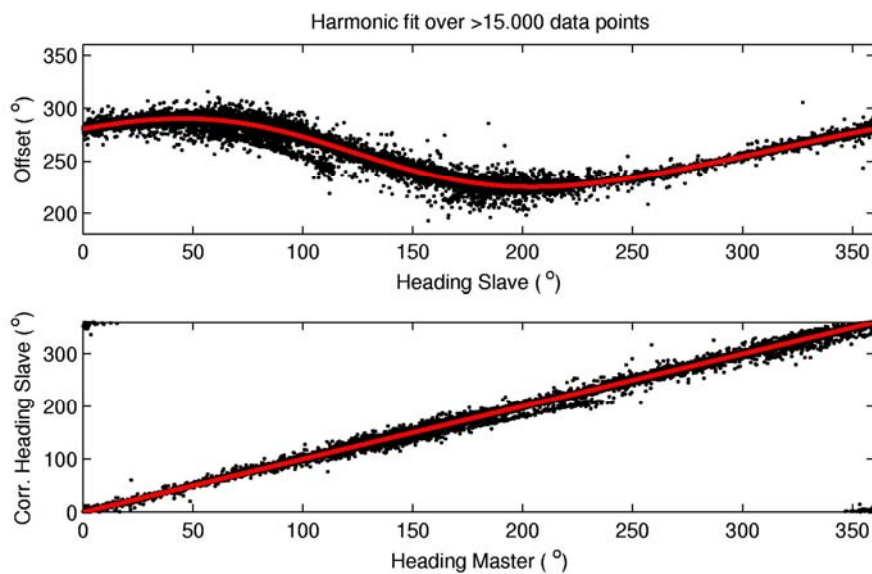


Figure 5 Compass fit between the calibrated Master and Slave

The compass error of the Slave backup instrument was addressed as follows: the difference between the heading of the Master and the Slave turned out to be sinusoidal with the heading. Taking the Master heading as the true heading, a second order harmonic fit for the heading difference between Master and Slave was conducted for the total of heading information available (Fig. 5). The fit was applied to the slave data to correct the heading and to rotate the earth coordinate velocities. After rotation, the directions of the velocities of Master and Slave were in good agreement.

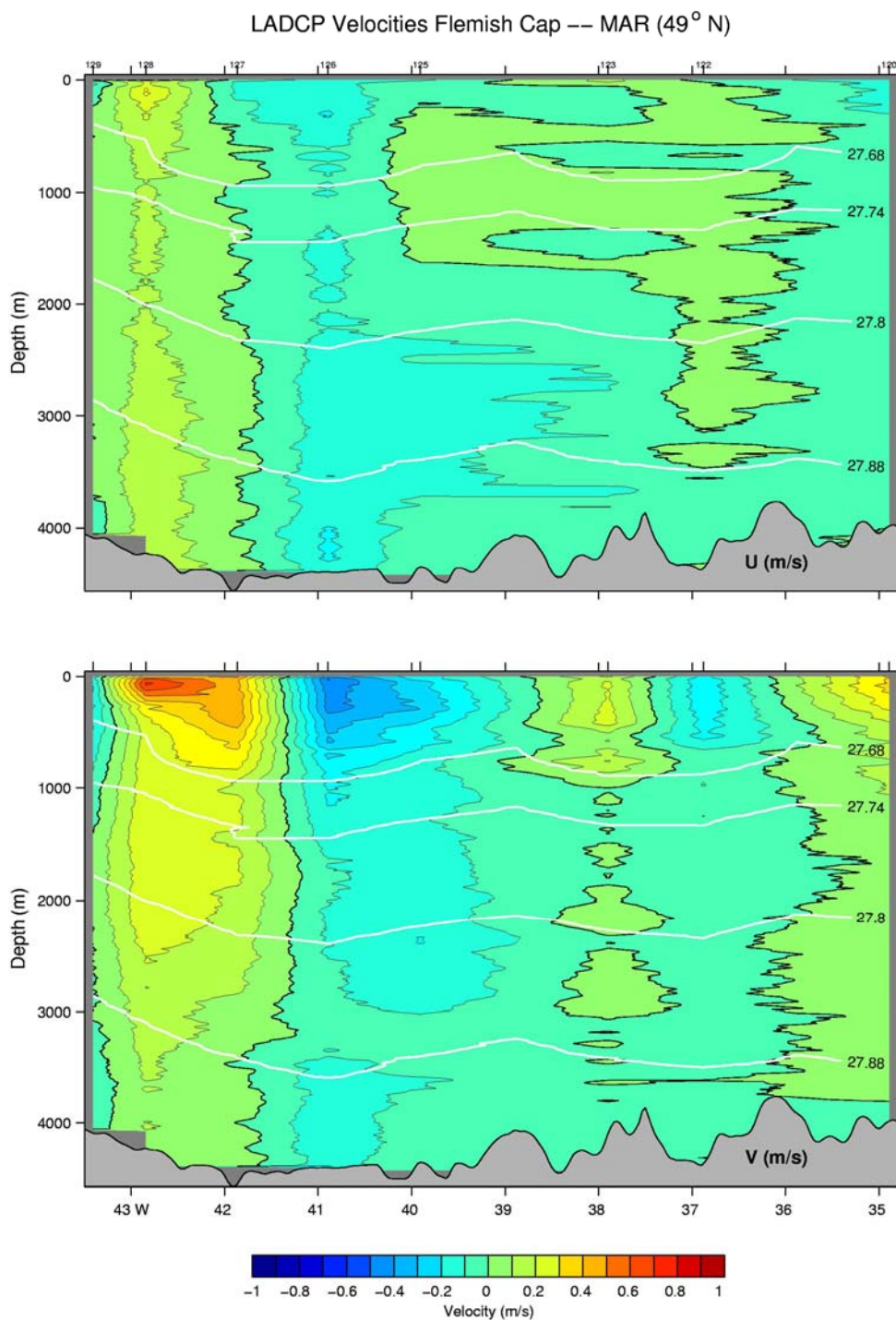


Figure 6 Velocity distributions measured with the LADCP along the 49°N section. Compare the upper 600m with shipboard ADCP distribution (Fig.7). upper figure: zonal velocity u (m/s), east:positive; lower figure: meridional velocity v (m/s), north: positive. The white lines are isopycnals separating the deep water masses uLSW, cLSW, ISOW and DSOW.

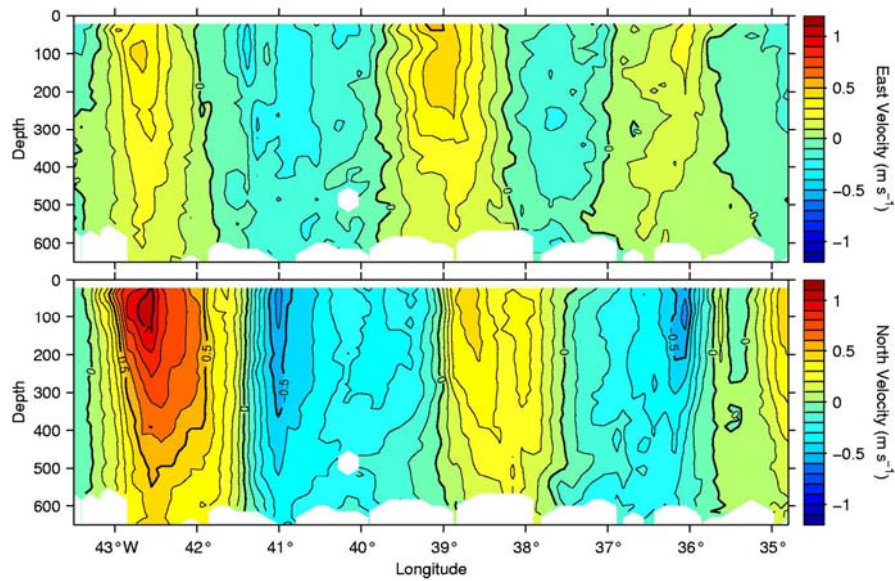


Figure 7 Velocity distribution along 49°N, from the 75kHz NB ADCP. Compare with Fig.6. upper figure: zonal velocity, lower figure: meridional velocity

Shipboard Acoustic Doppler Current Profiler (scADCP) Christian Mertens

Simultaneous single-ping data were recorded from two RD Instruments acoustic Doppler current profilers: A 150 kHz broadband and a 75 kHz narrowband model, both mounted into the hull of the ship. Both instruments were configured to collect water-profile data throughout most of the cruise. The data from the 150 kHz ADCP were recorded in 4m bins to get high vertical resolution in the upper water column. To achieve maximum range the 75 kHz ADCP data were collected in 16m bins. The data were recorded using RDI's TRANSECT software. Both systems operated flawless throughout the cruise.

Navigation and attitude (GPS and motion sensor) information were recorded together with the velocities. Both ADCPs used heading data from a GPS system with three antennas (SERCEL). During periods where GPS heading was not available, the ship's navigation system replaced them automatically with data from the motion sensor. The combined system of motion sensor and GPS SERCEL delivered reliable heading data except for a few very short periods. The single-ping data were recorded in beam coordinates and transformed into earth coordinates using the heading but ignoring pitch and roll information from the motion sensor.

A water-track calibration was carried out for both instruments to determine phase and amplitude of the transducer misalignment. For the 150 kHz ADCP the calibration resulted in a misalignment angle of 0.15° and an amplitude factor of 0.985. For the 75 kHz ADCP a misalignment angle of -0.13° and an amplitude factor of 0.965 were determined.

The range of the 150 kHz ADCP was between 100 m and 150 m with severe decreases of data quality and range during periods of rougher sea. Further the topmost bin was unusable and the other bins were disturbed by strong interferences. The interferences showed the same pattern during station work and underway. They were possibly caused by the 18 kHz echo sounder or more likely by the 75 kHz ADCP as both transducers are located very close to each other and were not synchronized. Underway no other acoustic equipment was running (the ship's uses an electromagnetic log). The 75 kHz ADCP achieved ranges of up to 700 m. It also showed a decrease of data quality in rough seas but no obvious acoustic interference.

CFC Analysis **Dagmar Kieke, Klaus Bulsiewicz**

During *Thalassa* cruise 'SUBPOLAR', chlorofluorocarbons (CFC) have been analyzed using a gas-chromatographic (GC) measurement unit with an electron-capture detector (ECD). Focus was on the components CFC-11 and CFC-12. All values are reported using the SIO-98 scale, concentrations are given in pmol/kg. Seawater samples were taken using a carousel that carried 22 Niskin bottles (10 liters) and a Seabird CTD/O system. The firing mechanism of bottle 22 was hampered by the too close proximity to the lowered ADCP. The wires attached to the bottle lids were prevented from closing the bottle correctly. Since the position of bottle 22 could not be changed, full-depth CFC profiles using only 21 bottles were taken.

The analysis for CFCs follows the procedure described by Bullister and Weiss (1988) and Bulsiewicz et al. (1998). Flow-through containers with integrated glass ampoules were used to extract about 90 ml of seawater from the Niskin bottles. Purified nitrogen was used as a carrier gas to insert 30 ml of the water sample into the purge-and-trap system. The trap was cooled using carbondioxide (CO_2). The gaseous components within a water sample were separated using a capillary column. Measurements were almost fully automated to ensure homogeneity between the particular runs and to allow extensive measurements of standards and blanks. Manual operations comprised the selection of the gas inlet port, the admittance of gas samples and the attachment of the glass ampoules. For the latter, seven positions were available. ECD-Signals were calibrated and converted into CFC concentrations by means of a known standard gas. Every 2nd or 3rd day, calibration curves were generated, assuming that changes between two respective calibration curves are linear.

Measurements of CFC began on the third day of the cruise at CTD-station 7 and lasted on to CTD-station 31. Unfortunately, the measurements were interrupted after this profile. During a storm on June 13th, parts of the CFC system slipped from the table in the laboratory. Though only the sample inlet unit was directly affected but not severely harmed, this accident had consequences for the GC. Its main board malfunctioned. This could not be fixed until the main board was replaced by an adequate spare part. This had been ordered months prior to the cruise but was not delivered in time to be available during the cruise. After its arrival at the home laboratory colleagues at the University of Bremen, therefore, sent the main board to St. John's/Newfoundland where we picked it up on June 17th.

After the successful replacement of the main board it became obvious that another electronic controller card, the EPC (electronic pressure control) module, had crashed, too. This card is responsible for controlling all the flows in the CFC measurement system which enter the GC. To handle this problem the complete system had to be switched into a manual operation mode. This turned out to be very difficult since a pressure regulator appropriate for this case was not available. It took several days to perform major changes in the configuration of the system. Instead of using the normal 'temperature program' with temperatures in the range of 60°C-170°C, the GC was operated isothermally at 100°C. This can lead to irregular peaks which in turn can hamper the proper integration of the CFC-12 and CFC-11 peaks in the chromatogram.

On June 22nd, CFC measurements were resumed again at CTD-station 51 and continued until the end of the sampling program (CTD-station 129). The number of available sample inlet ports was reduced from seven to six, since water samples attached to inlet port 1 were contaminated by air drawn into the sample. Between CTD-stations 114 and 115 the sensitivity of the GC increased. This resulted in a change of the shape of the calibration curves. Several chromatograms showed particular peaks close to the CFC signals which made the integration of the CFC peaks more difficult. This lasted on until the end of the sampling program at CTD-station 129.

Despite all those major changes the fixed measurement system showed a quite good performance. But further checks have to be made in the home laboratory to give an overall accuracy. Altogether, about 1250 samples have been taken of which 30 have been analyzed twice. The reproducibility of the double samples was in the order of 0.6% for both components. The analysis of 16 air samples measured before and after the system change agreed within the error margins with assumed atmospheric values (546 ppt for CFC-12 and 253 ppt for CFC-11). The CFC-11/CFC-12 ratios were in the expected range of about 1.7 – 2.1, the overall mean ratio was 1.95. The mean surface saturation of the samples available at the time of this writing (profiles 7-31, 51-120) was $99.4 \pm 2.5\%$ for CFC-12 and $99.9 \pm 3.1\%$ for CFC-11. Undersaturation was present during the storm we encountered on June 11th to June 12th. At that time the layer thickness had significantly deepened. Further undersaturated values were found close to the Greenland continental shelf presumably due to partly ice cover, preventing gas-exchange.

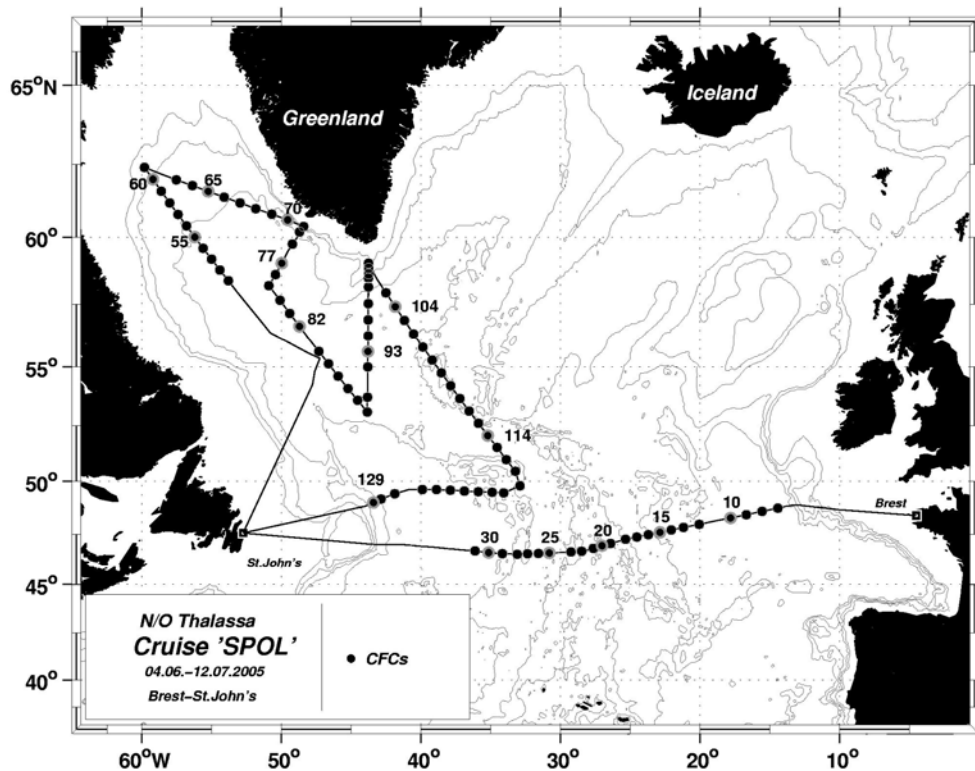
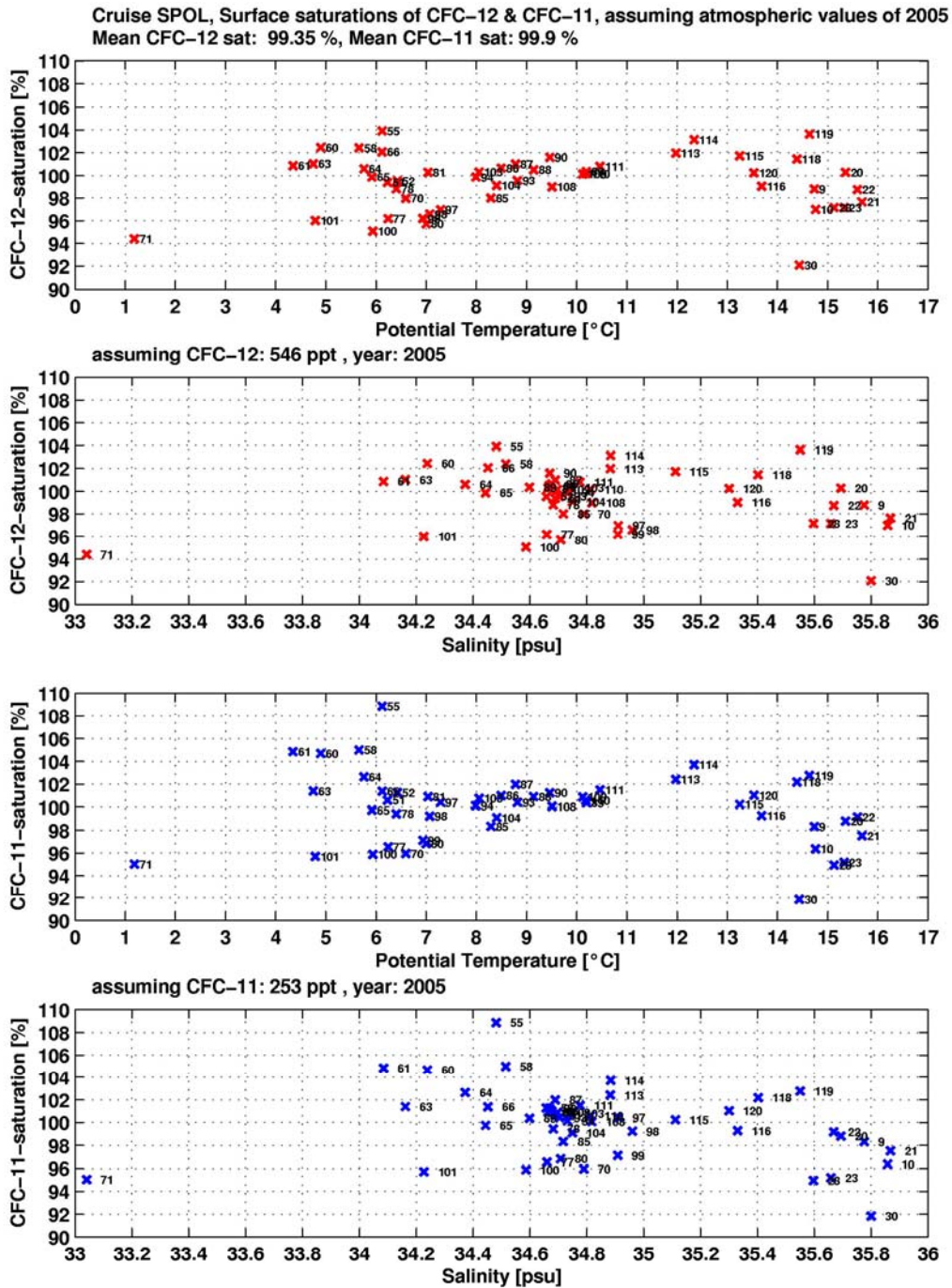


Figure 8 CTD stations with CFC-samples, THALASSA cruise SUBPOLAR, June 4 – July, 12, 2005.

References:

Bullister, J. L. and R. F. Weiss, 1988: Determination of CCl₃F and CCl₂F₂ in seawater and air, *Deep-Sea Res.*, 35, 839-853.

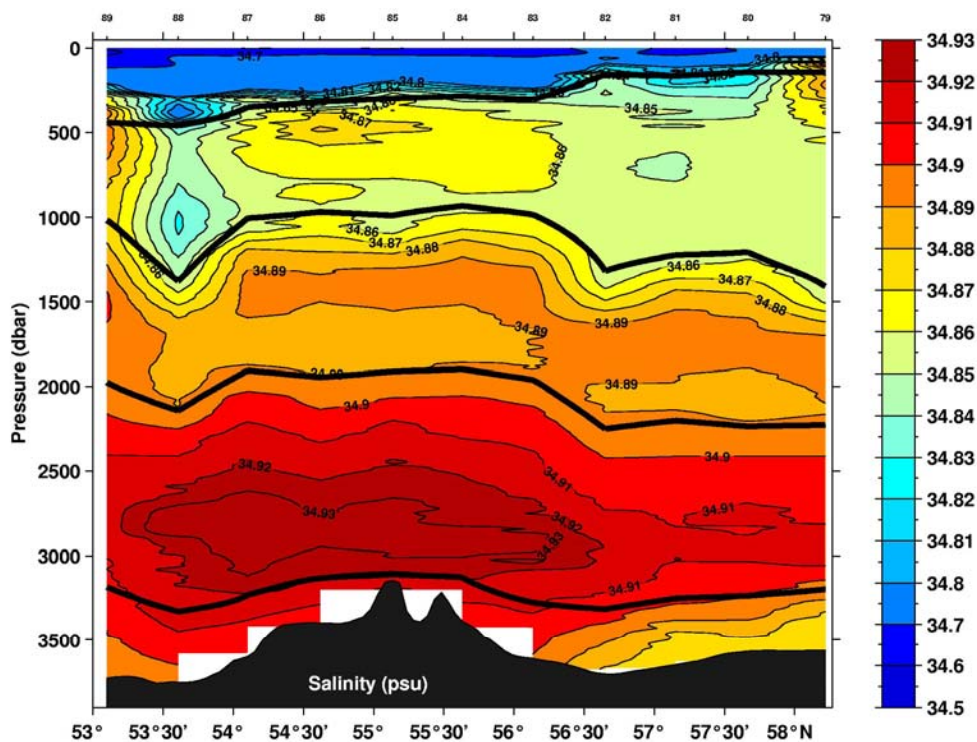
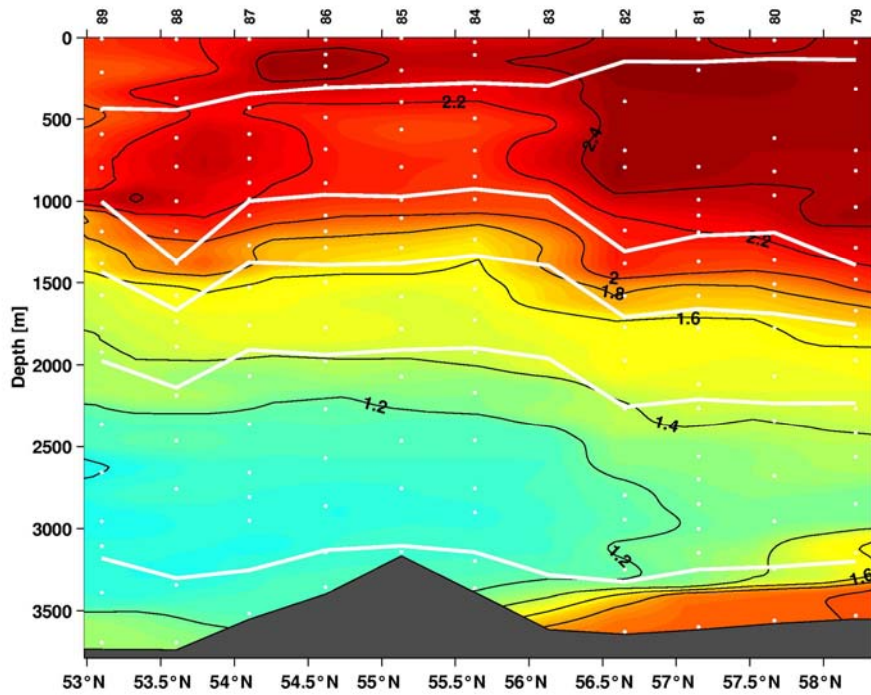
Bulsiewicz, K., H. Rose, O. Klatt, A. Putzka, and W. Roether, 1998: A capillary-column chromatographic system for efficient chlorofluorocarbon measurements in ocean waters, *J. Geophys. Res.*, 103(C8), 15,959-15,970.



2005/07/11 01:59

Figure 9 CFC-11 and CFC-12 - Surface saturation vs salinity and temperature.

Figure 10 upper figure: CFC-12 (pmol/kg) distribution along the central Labrador Sea. The white lines are the isopycnals separating the deep water masses uLSW, cLSW, ISOW and DSOW. The highest CFC-12 concentrations and the thickest uLSW layers are observed at the northern part of the section. Here, the upper bound of the uLSW is at about 130m depth. Fig. 10b: Salinity along the same section. Here the isopycnals are black lines.



XBT measurements and deployment of ARGO floats Birgit Klein, BSH

XBT measurements The Bundesamt für Seeschifffahrt und Hydrographie BSH operates a high density XBT survey along a line (AX3) connecting the English Channel and Newfoundland. XBTs are expendable temperature probes which measure the upper ocean temperature field from moving ships. XBT sampling along the AX3 line is normally conducted from merchant vessels participating in the Ship of Opportunity Program (SOOP). The sampling takes place every 6 month with a nominal distance of less than 50 km. Repairs on the respective merchant vessel made it impossible to perform the measurements within the regular sampling interval. Fortunately the cruise track of the expedition ‘SUBPOLAR’ with N/O THALASSA covered the AX3 line and the XBT sampling could be performed during this cruise. A total of 63 XBTs was deployed along the section. The XBTs were also

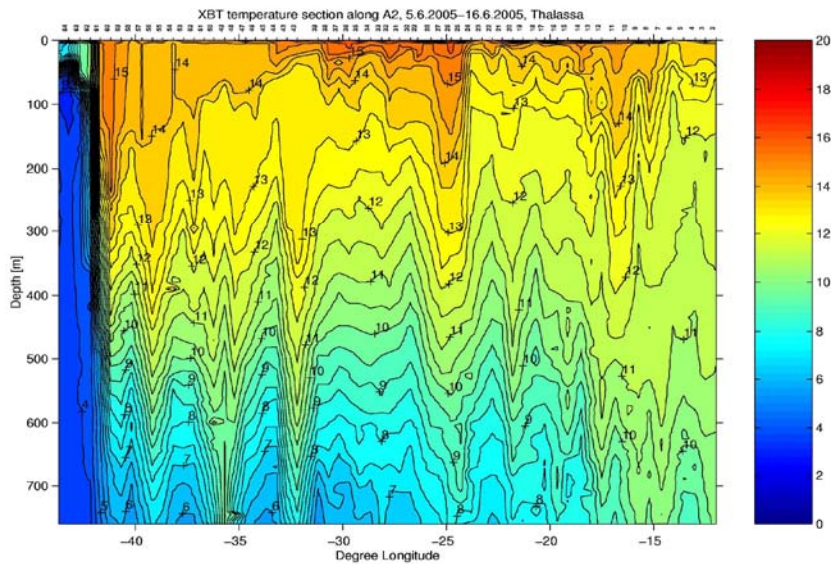
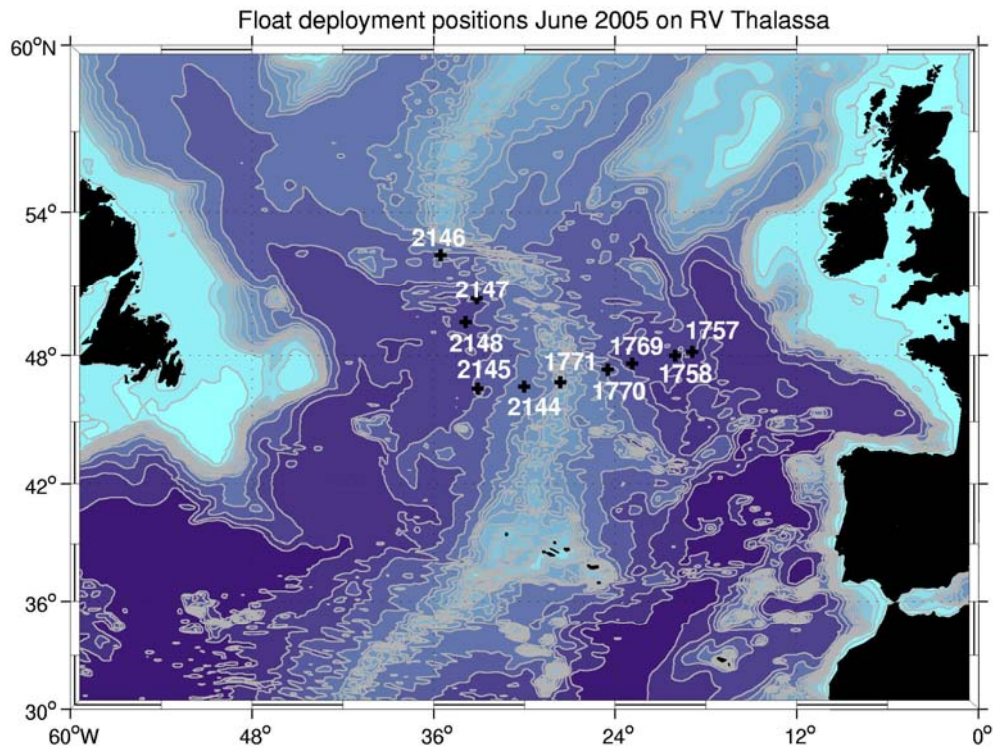


Figure 11: Temperature field along 46°N. Units are °C, contour interval is 0.5 °C.

transmitted in near-real time to the French data centre Coriolis at IFREMER, Brest, where they are made available to the modelling community and other users. Fig. 11 shows the temperature field in the upper 750 m obtained by the XBTs. The temperature field is generally dominated by the small scale eddy field which has scales of <30 km at 46° N. Along the western boundary the huge temperature gradient is evident. It separates warm subtropical waters carried northward by the Gulf Stream from cold water flowing in the opposite direction along the coast. XBT sampling was resumed in the Labrador Sea along two sections. A total of 100 XBTs was deployed during the cruise.

Figure 12: Position of Argo floats deployed during the cruise. The numbers are the Webb Float –IDs (see Figure 2 for the WMO numbers)



Float deployments A total of 10 APEX floats have been deployed during the cruise. APEX floats are freely drifting buoys which are programmed to float at a depth of 1500m. Every 15 days they rise to the surface and measure temperature and conductivity during the ascend. At the surface the data are transmitted to ARGOS satellites and send to data centres. The deployment positions are given in Fig. 11. The floats deployed during the cruise are part of the international ARGO programme. The Bundesamt für Seeschifffahrt und Hydrographie BSH is one of three partners in the German Argo project. It is the aim of the project to contribute to an ocean observing system with floating buoys which monitor the upper ocean temperature and salinity variability.

Participants THALASSA cruise SUBPOLAR

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Table 1 CTD/LADCP stations, THALASSA cruise SUBPOLAR

Thalassa SUBPOLAR			CTD Stations				Page 1			
Prof.	Sta.	Date	Time	Latitude	Longitude	Water Depth	Prof. Depth	Measurements CFCs	LADCP	Comment
1	1	2005/06/05	07:05	48° 41.06' N	10° 4.94' W	700	719		x	
2	2	2005/06/05	20:48	48° 54.50' N	13° 1.00' W	3388	3281		x	
3	3	2005/06/06	00:33	48° 54.50' N	13° 18.00' W	3750	3724		x	
4	4	2005/06/06	04:19	48° 51.96' N	13° 34.76' W	4494	4489		x	
5	5	2005/06/06	08:37	48° 50.00' N	13° 52.00' W	4517	4515		x	
6	6	2005/06/06	12:26	48° 47.50' N	14° 7.00' W	4504	4498		x	
7	7	2005/06/06	16:37	48° 45.03' N	14° 25.29' W	4557	4530	x	x	
8	8	2005/06/07	00:17	48° 36.00' N	15° 33.00' W	4822	4821	x	x	
9	9	2005/06/07	08:03	48° 26.50' N	16° 40.50' W	4663	4686	x	x	
10	10	2005/06/07	15:35	48° 17.46' N	17° 48.01' W	3963	3937	x	x	
11	11	2005/06/07	22:19	48° 8.50' N	18° 56.00' W	4152	4112	x	x	
12	12	2005/06/08	05:59	47° 59.00' N	20° 2.95' W	4316	4310	x	x	
13	13	2005/06/08	13:01	47° 50.00' N	21° 10.90' W	4476	4449	x	x	
14	14	2005/06/08	19:34	47° 42.50' N	22° 3.50' W	4438	4442	x	x	
15	15	2005/06/09	01:57	47° 36.00' N	22° 52.00' W	4165	4124	x	x	
16	16	2005/06/09	08:18	47° 29.13' N	23° 41.54' W	3893	3887	x	x	
17	17	2005/06/09	14:13	47° 22.00' N	24° 31.00' W	3363	3351	x	x	
18	18	2005/06/09	20:02	47° 15.62' N	25° 20.00' W	2833	2806	x	x	
19	19	2005/06/10	02:32	47° 3.00' N	26° 24.00' W	2797	2770	x	x	
20	20	2005/06/10	07:01	46° 56.50' N	27° 1.00' W	2611	2549	x	x	
21	21	2005/06/10	11:28	46° 49.00' N	27° 38.00' W	2349	2217	x	x	
22	22	2005/06/10	16:32	46° 40.12' N	28° 28.24' W	2805	2892	x	x	
23	23	2005/06/10	21:34	46° 38.50' N	29° 14.50' W	3277	3250	x	x	
24	24	2005/06/11	02:52	46° 37.00' N	30° 1.00' W	3547	3505	x	x	
25	25	2005/06/11	08:28	46° 35.50' N	30° 47.50' W	3420	3432	x	x	
26	26	2005/06/11	14:03	46° 34.00' N	31° 34.00' W	3735	3721	x	x	
27	27	2005/06/11	19:57	46° 32.54' N	32° 20.70' W	3981	3970	x	x	
28	28	2005/06/12	01:48	46° 31.18' N	33° 5.03' W	3864	3839	x	x	
29	29	2005/06/12	09:00	46° 33.37' N	34° 9.63' W	4267	4265	x	x	
30	30	2005/06/12	16:34	46° 36.38' N	35° 8.24' W	4390	4345	x	x	
31	31	2005/06/13	00:58	46° 41.06' N	36° 6.93' W	4133	4156		x	
32	32	2005/06/13	11:26	46° 44.40' N	37° 5.77' W	4562	4537		x	
33	33	2005/06/13	21:22	46° 48.49' N	38° 4.86' W	4557	4244		x	
34	34	2005/06/14	05:53	46° 52.05' N	39° 4.02' W	4588	4225		x	
35	35	2005/06/14	13:26	46° 55.47' N	40° 2.96' W	4563	4164		x	
36	36	2005/06/14	18:37	46° 57.39' N	40° 35.93' W	4585	4578		x	

Thalassa SUBPOLAR			CTD Stations			Page 2				
Prof.	Sta.	Date	Time	Latitude	Longitude	Water Depth	Prof. Depth	Measurements		Comment
								CFCs	LADCP	
37	37	2005/06/15	00:50	47° 0.18' N	41° 23.14' W	4348	4323		x	
38	38	2005/06/15	10:56	46° 59.98' N	43° 11.47' W	3120	3124		x	CTD yo-yo
39	39	2005/06/16	01:30	47° 0.06' N	43° 19.87' W	1489	1427		x	
40	40	2005/06/19	17:37	54° 16.02' N	47° 45.61' W	3709	3764			
41	41	2005/06/19	23:18	54° 49.01' N	47° 35.94' W	3471	3488		x	
42	42	2005/06/20	04:54	55° 21.21' N	47° 13.95' W	3240	3242		x	
43	43	2005/06/20	12:31	55° 34.99' N	48° 5.82' W	3425	3432		x	
44	44	2005/06/20	17:30	55° 49.86' N	48° 54.91' W	3598	3692		x	
45	45	2005/06/20	23:08	56° 5.94' N	49° 47.65' W	3655	3700			
46	46	2005/06/21	05:45	56° 23.31' N	50° 46.71' W	3588	3545			
47	47	2005/06/21	11:46	56° 47.99' N	51° 22.95' W	3523	3553			
48	48	2005/06/21	17:11	57° 11.88' N	51° 58.98' W	3473	3497		x	
49	49	2005/06/21	22:53	57° 35.88' N	52° 35.27' W	3455	3478		x	
50	50	2005/06/22	04:14	58° 0.08' N	53° 11.40' W	3436	3458		x	
51	51	2005/06/22	09:05	58° 24.02' N	53° 47.56' W	3382	3405	x	x	
52	52	2005/06/22	14:03	58° 48.02' N	54° 23.51' W	3351	3374	x	x	
53	53	2005/06/22	18:53	59° 11.94' N	54° 59.71' W	3272	3289	x	x	
54	54	2005/06/22	23:44	59° 35.91' N	55° 35.66' W	3112	3129	x	x	
55	55	2005/06/23	04:41	60° 0.01' N	56° 11.54' W	3125	3135	x	x	
56	56	2005/06/23	10:26	60° 23.93' N	56° 47.58' W	2984	3011	x	x	
57	57	2005/06/23	16:00	60° 47.92' N	57° 23.34' W	2870	2889	x	x	
58	58	2005/06/23	20:38	61° 12.02' N	57° 59.71' W	2687	2703	x	x	
59	59	2005/06/24	01:17	61° 35.96' N	58° 35.47' W	2414	2409	x	x	
60	60	2005/06/24	06:39	61° 59.99' N	59° 11.24' W	2128	2125	x	x	
61	61	2005/06/24	11:05	62° 23.91' N	59° 47.61' W	1401	1403	x	x	
62	62	2005/06/24	15:50	62° 10.97' N	58° 38.28' W	2178	2199		x	
63	63	2005/06/24	20:41	61° 59.11' N	57° 30.69' W	2531	2548	x	x	
64	64	2005/06/25	02:07	61° 47.45' N	56° 21.83' W	2658	2694	x	x	
65	65	2005/06/25	07:20	61° 35.58' N	55° 13.78' W	2738	2753	x	x	
66	66	2005/06/25	12:39	61° 23.61' N	54° 5.54' W	2919	2946	x	x	
67	67	2005/06/25	17:40	61° 12.00' N	52° 57.04' W	3070	3089	x	x	
68	68	2005/06/25	22:56	61° 0.00' N	51° 49.24' W	3034	3053	x	x	
69	69	2005/06/26	05:24	60° 48.52' N	50° 40.51' W	2988	2990	x	x	
70	70	2005/06/26	12:01	60° 36.56' N	49° 32.10' W	2817	2821	x	x	
71	71	2005/06/26	18:11	60° 22.51' N	48° 24.11' W	1154	1208	x	x	
72	72	2005/06/26	19:52	60° 19.01' N	48° 35.89' W	2662	2735		x	

Thalassa SUBPOLAR			CTD Stations			Page 3				
Prof.	Sta.	Date	Time	Latitude	Longitude	Water Depth	Prof. Depth	Measurements		Comment
								CFCs	LADCP	
73	73	2005/06/26	22:45	60° 11.01' N	48° 41.31' W	2824	2875	x	x	
74	74	2005/06/27	02:14	59° 58.41' N	48° 52.11' W	2962	2982		x	
75	75	2005/06/27	05:48	59° 44.98' N	49° 12.24' W	3167	3192	x	x	
76	76	2005/06/27	09:45	59° 29.00' N	49° 31.91' W	3351	3379		x	
77	77	2005/06/27	14:50	59° 3.04' N	49° 58.10' W	3420	3453	x	x	
78	78	2005/06/27	19:41	58° 37.86' N	50° 24.72' W	3469	3506	x	x	
79	79	2005/06/28	00:43	58° 13.03' N	50° 52.97' W	3500	3530	x	x	
80	80	2005/06/28	07:01	57° 40.00' N	50° 5.11' W	3528	3562	x	x	
81	81	2005/06/28	12:52	57° 9.07' N	49° 23.56' W	3565	3600	x	x	
82	82	2005/06/28	18:42	56° 38.98' N	48° 41.49' W	3593	3628	x	x	
83	83	2005/06/29	00:37	56° 8.03' N	47° 59.91' W	3564	3609		x	
84	84	2005/06/29	06:34	55° 37.93' N	47° 18.05' W	3338	3364	x	x	
85	85	2005/06/29	12:24	55° 8.08' N	46° 36.52' W	3116	3144	x	x	
86	86	2005/06/29	18:07	54° 37.05' N	45° 55.08' W	3350	3357	x	x	
87	87	2005/06/29	23:52	54° 6.00' N	45° 12.92' W	3502	3517	x	x	
88	88	2005/06/30	05:38	53° 36.39' N	44° 31.51' W	3687	3694	x	x	
89	89	2005/06/30	11:41	53° 5.96' N	43° 50.11' W	3683	3693	x	x	
90	90	2005/06/30	17:38	53° 43.96' N	43° 49.54' W	3610	3615	x	x	
91	91	2005/07/01	00:06	54° 21.94' N	43° 47.88' W	3500	3500		x	
92	92	2005/07/01	06:11	55° 0.04' N	43° 47.60' W	3358	3354	x	x	
93	93	2005/07/01	12:24	55° 37.99' N	43° 46.98' W	3310	3299	x	x	
94	94	2005/07/01	18:22	56° 16.02' N	43° 46.35' W	3427	3422	x	x	
95	95	2005/07/02	00:37	56° 53.95' N	43° 46.05' W	3362	3382	x	x	
96	96	2005/07/02	06:58	57° 32.06' N	43° 45.50' W	3385	3399	x	x	
97	97	2005/07/02	13:16	58° 9.99' N	43° 44.91' W	2845	2845	x	x	
98	98	2005/07/02	17:42	58° 30.09' N	43° 44.66' W	2179	2158	x	x	
99	99	2005/07/02	20:12	58° 39.43' N	43° 44.35' W	1792	1782	x	x	
100	100	2005/07/02	22:51	58° 52.06' N	43° 44.46' W	1547	1533	x	x	
101	101	2005/07/03	01:14	59° 3.13' N	43° 44.77' W	1749	1733	x	x	
102	102	2005/07/03	06:06	58° 29.07' N	43° 10.01' W	2532	2534		x	
103	103	2005/07/03	14:13	57° 56.95' N	42° 29.70' W	3214	3223	x	x	
104	104	2005/07/03	20:00	57° 25.08' N	41° 50.07' W	3300	3308	x	x	
105	105	2005/07/04	01:56	56° 52.90' N	41° 10.53' W	3367	3381	x	x	
106	106	2005/07/04	07:29	56° 20.92' N	40° 31.01' W	3203	3213	x	x	
107	107	2005/07/04	13:45	55° 48.91' N	39° 50.97' W	3024	3048	x	x	
108	108	2005/07/04	19:25	55° 17.07' N	39° 10.88' W	2852	2852	x	x	

Thalassa SUBPOLAR			CTD Stations			Page 4				
Prof.	Sta.	Date	Time	Latitude	Longitude	Water Depth	Prof. Depth	Measurements		Comment
								CFCs	LADCP	
109	109	2005/07/05	00:56	54° 45.15' N	38° 31.45' W	2952	2956	x	x	
110	110	2005/07/05	06:32	54° 13.03' N	37° 51.61' W	2799	2797	x	x	
111	111	2005/07/05	13:07	53° 40.56' N	37° 12.00' W	2736	2647	x	x	
112	112	2005/07/05	18:26	53° 8.61' N	36° 32.15' W	2971	2970	x	x	
113	113	2005/07/06	00:03	52° 36.57' N	35° 51.92' W	3257	3254	x	x	
114	114	2005/07/06	06:21	52° 4.44' N	35° 11.90' W	3697	3731	x	x	
115	115	2005/07/06	12:26	51° 32.59' N	34° 32.35' W	3584	3636	x	x	
116	116	2005/07/06	18:18	50° 59.95' N	33° 52.97' W	4000	4239	x	x	
117	117	2005/07/07	01:04	50° 28.14' N	33° 13.07' W	4069	4047			
118	118	2005/07/07	07:53	49° 48.12' N	32° 53.36' W	3570	3517	x		
119	119	2005/07/07	15:01	49° 28.06' N	34° 3.85' W	3769	3733	x		
120	120	2005/07/07	21:25	49° 30.16' N	34° 52.96' W	4220	4195	x	x	
121	121	2005/07/08	03:24	49° 31.45' N	35° 52.94' W	4295	4280	x	x	
122	122	2005/07/08	10:03	49° 33.46' N	36° 52.90' W	4479	4475	x	x	
123	123	2005/07/08	16:15	49° 35.61' N	37° 53.16' W	3869	3854	x	x	
124	124	2005/07/08	22:04	49° 37.47' N	38° 52.83' W	4267	4250	x	x	
125	125	2005/07/09	04:15	49° 37.55' N	39° 53.23' W	4426	4411	x	x	
126	126	2005/07/09	10:41	49° 37.32' N	40° 53.03' W	4408	4396	x	x	
127	127	2005/07/09	17:37	49° 26.02' N	41° 52.22' W	4423	4397	x	x	
128	128	2005/07/10	01:19	49° 11.07' N	42° 50.90' W	4079	4051	x	x	
129	129	2005/07/10	06:36	49° 0.95' N	43° 23.92' W	3827	3781	x	x	
130	130	2005/07/10	11:16	48° 50.94' N	43° 57.81' W	2399	2366	x	x	CTD yo-yo
131	131	2005/07/10	12:46	48° 50.94' N	43° 57.97' W	2392	2367	x	x	CTD yo-yo
132	132	2005/07/10	14:16	48° 50.98' N	43° 58.02' W	2394	2368	x	x	CTD yo-yo
133	133	2005/07/10	15:56	48° 50.80' N	43° 58.33' W	2360	2369	x	x	CTD yo-yo
134	134	2005/07/10	17:34	48° 51.05' N	43° 57.95' W	2403	2381	x	x	CTD yo-yo
135	135	2005/07/10	19:02	48° 51.01' N	43° 57.63' W	2404	2406	x	x	CTD yo-yo
136	136	2005/07/10	20:41	48° 51.09' N	43° 58.10' W	2391	2382	x	x	CTD yo-yo
137	137	2005/07/10	22:07	48° 50.95' N	43° 57.59' W	2401	2385	x	x	CTD yo-yo
138	138	2005/07/10	23:33	48° 50.98' N	43° 57.80' W	2390	2372	x	x	CTD yo-yo

Table 2 List of BSH XBT drops:

XBT-Nr.	Date	Time /UTC	Latitude N/S	Longitude E/W	Kommentar
1			N	W	file does not exist
2	05/06/2005	16:17:03	48° 54.350' N	11° 58.960' W	begin AX3 section
3	05/06/2005	18:32:44	48° 54.492' N	12° 30.343' W	
4	05/06/2005	20:37:17	48° 54.485' N	12° 59.376' W	
5	06/06/2005	04:05:47	48° 52.496' N	13° 32.972' W	
6	06/06/2005	12:09:51	48° 48.152' N	14° 4.034' W	
7	06/06/2005	20:17:08	48° 42.971' N	14° 37.174' W	
8	06/06/2005	22:31:51	48° 39.000' N	15° 11.640' W	
9	07/06/2005	04:05:40	48° 34.780' N	15° 43.007' W	
10	07/06/2005	06:09:37	48° 30.030' N	16° 13.928' W	
11	07/06/2005	11:47:41	48° 25.060' N	16° 51.002' W	
12	07/06/2005	14:20:31	48° 19.463' N	17° 29.983' W	
13	07/06/2005	18:48:13	48° 15.896' N	17° 59.805' W	
14	07/06/2005	20:39:57	48° 11.969' N	18° 29.108' W	
15	08/06/2005	02:23:12	48° 7.030' N	19° 08.618' W	
16	08/06/2005	04:17:08	48° 02.158' N	19° 38.716' W	
17	08/06/2005	09:24:23	47° 56.990' N	20° 15.058' W	
18	08/06/2005	11:19:52	47° 53.025' N	20° 40.060' W	
19	08/06/2005	16:32:22	47° 49.022' N	21° 18.456' W	
20	08/06/2005	18:25:51	47° 45.009' N	21° 47.799' W	
21	08/06/2005	23:37:52	47° 40.983' N	22° 18.002' W	
22	09/06/2005	01:25:39	47° 36.803' N	22° 46.641' W	
23	09/06/2005	06:33:20	47° 32.072' N	23° 16.818' W	
24	09/06/2005	11:13:31	47° 27.854' N	23° 47.772' W	
25	09/06/2005	13:09:48	47° 23.980' N	24° 17.578' W	
26	09/06/2005	17:37:36	47° 19.505' N	24° 46.057' W	
27	09/06/2005	19:26:12	47° 16.489' N	25° 13.358' W	
28	09/06/2005	23:30:27	47° 11.149' N	25° 44.711' W	
29	10/06/2005	01:28:56	47° 05.03' N	26° 22.967' W	
30	10/06/2005	05:49:51	46° 58.606' N	26° 43.792' W	
31	10/06/2005	09:57:50	46° 52.032' N	27° 15.956' W	
32	10/06/2005	13:31:30	46° 48.452' N	27° 44.758' W	

XBT-Nr.	Date	Time /UTC	Latitude N/S	Longitude E/W	Kommentar
33	10/06/2005	14:59:17	46° 43.530' N	28° 06.871' W	
34	10/06/2005	19:06:37	46° 39.469' N	28° 38.946' W	
35	10/06/2005	21:15:29	46° 38.484' N	29° 12.842' W	
36	11/06/2005	01:25:19	46° 37.222' N	29° 41.077' W	
37	11/06/2005	05:49:43	46° 36.471' N	30° 10.751' W	
38	11/06/2005	07:46:56	46° 35.972' N	30° 41.038' W	
39	11/06/2005	12:13:46	46° 35.024' N	31° 11.054' W	
40	11/06/2005	17:01:29	46° 33.379' N	31° 42.506' W	
41	_____	_____	_____N	_____W	profile non-existent
42	11/06/2005	19:01:50	46° 33.066' N	32° 11.065' W	
43	11/06/2005	23:53:41	46° 31.351' N	32° 40.988' W	
44	12/06/2005	04:42:33	46° 31.028' N	33° 11.071' W	
45	12/06/2005	06:48:55	46° 32.498' N	33° 41.022' W	profile had spike
46	12/06/2005	12:16:32	46° 33.496' N	34° 12.958' W	
47	12/06/2005	14:15:08	46° 35.649' N	34° 41.022' W	
48	12/06/2005	19:54:57	46° 36.965' N	35° 13.196' W	
49	12/06/2005	22:25:49	46° 39.017' N	35° 41.160' W	
50	13/06/2005	05:25:10	46° 41.020' N	36° 13.035' W	
51	13/06/2005	08:40:37	46° 42.972' N	36° 40.955' W	profile had spike
52	13/06/2005	14:54:41	46° 44.538' N	37° 10.963' W	
53	13/06/2005	18:28:14	46° 46.522' N	37° 41.039' W	
54	14/06/2005	00:57:45	46° 48.460' N	38 ° 10.958' W	
55	14/06/2005	03:47:44	46° 50.497' N	38° 40.962' W	
56	14/06/2005	09:15:21	46° 52.511' N	39° 11.020' W	
57	14/06/2005	11:36:46	46° 53.999' N	39° 41.032' W	
58	14/06/2005	16:40:16	46° 55.998' N	40° 11.053' W	
59	14/06/2005	21:44:05	46° 57.512' N	40° 41.068' W	
60	14/06/2005	23:40:07	46° 59.507' N	41° 11.011' W	
61	15/06/2005	04:55:15	46° 59.978' N	41° 42.356' W	
62	15/06/2005	06:53:25	46° 59.971' N	42° 10.996' W	
63	15/06/2005	08:52:09	46° 59.983' N	42° 41.000' W	
64	15/06/2005	01:00:10	46° 59.682' N	43° 14.006' W	
65	16/06/2005	04:26:58	47° 0.069' N	43° 41.900' W	End of AX3 section
66	21/06/2005	21:07:06	57° 24.057' N	52° 17.019' W	Start of Greenland Sea sections

XBT-Nr.	Date	Time /UTC	Latitude N/S	Longitude E/W	Kommentar
67	22/06/2005	02:36:08	57° 47.757' N	52° 53.037' W	
68	22/06/2005	07:39:26	58° 12.074' N	53° 29.559' W	
69	22/06/2005	12:29:41	58° 36.096' N	54° 05.613' W	Erroneous profile
70	22/06/2005	12:35:50	58° 36.998' N	54° 07.092' W	
71	22/06/2005	17:25:46	58° 59.951' N	54° 41.371' W	
72	22/06/2005	22:15:35	59° 24.014' N	55° 17.480' W	
73	23/06/2005	03:04:13	59° 47.969' N	55° 53.298' W	
74	23/06/2005	08:29:51	60° 11.941' N	56° 29.769' W	
75	23/06/2005	13:45:21	60° 35.929' N	57° 05.477' W	
76	23/06/2005	19:13:26	61° 00.005' N	57° 41.648' W	
77	23/06/2005	23:43:16	61° 24.005' N	58° 16.962' W	Erroneous profile
78	23/06/2005	23:47:09	61° 24.574' N	58° 17.833' W	
79	24/06/2005	05:03:37	61° 47.912' N	58° 53.382' W	
80	24/06/2005	09:28:56	62° 11.790' N	59° 28.716' W	Erroneous profile
81	24/06/2005	09:32:31	62° 12.313' N	59° 29.505' W	
82	24/06/2005	13:56:34	62° 17.015' N	59° 12.942' W	
83	24/06/2005	18:47:47	62° 04.948' N	58° 04.459' W	
84	25/06/2005	00:04:53	61° 54.032' N	56° 56.470' W	
85	25/06/2005	05:31:26	61° 41.437' N	55° 48.123' W	
86	25/06/2005	10:48:07	61° 29.496' N	54° 40.022' W	
87	25/06/2005	15:56:47	61° 17.477' N	53° 30.944' W	
88	25/06/2005	21:18:05	61° 06.034' N	52° 19.492' W	
89	26/06/2005	02:56:30	60° 53.95' N	51° 15.076' W	
90	26/06/2005	09:55:39	60° 42.459' N	50° 06.007' W	Erroneous profile
91	26/06/2005	09:58:56	60° 42.272' N	50° 05.062' W	
92	26/06/2005	15:57:16	60° 29.488' N	48° 58.361' W	
93	26/06/2005	19:22:39	60° 20.982' N	48° 29.550' W	

Table 3 Deployment of Floats (BSH Hamburg, Germany)

Float-id	Wmo-id	Argos-id	Date	Time	Latitude	Longitude	Stationsdaten
1757	6900252	24497	08/06/2005	02:25	48 08.935 N	18 54.970 W	CTD 011
1758	6900253	24505	08/06/2005	09:22	47 58.827 N	20 02.900 W	CTD 012
1769	6900254	24508	09/06/2005	04:42	47 37.420 N	22 52.150 W	CTD 015
1770	6900255	24510	09/06/2005	16:25	47 22.570 N	24 30.230 W	CTD 017
1771	6900256	24557	10/06/2005	13:06	46 48.700 N	27 38.460 W	CTD 021
2144	6900257	24564	11/06/2005	05:03	46 36.790 N	30 00.880 W	CTD 024
2145	6900258	24586	12/06/2005	04:16	46 31.330 N	33 05.700 W	CTD 028
2146	6900259	24606	06/07/2005	04:14	52 17.146 N	35 33.011 W	CTD 113
2147	6900260	24613	07/07/2005	02:30	50 27.736 N	33 09.580 W	CTD 117
2148	6900261	24649	07/07/2005	17:09	49 26.795 N	33 52.436 W	CTD 119