SHORT CRUISE REPORT

RV METEOR: cruise M-62/1b

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from Fort de France, Martinique, France to Fortaleza, Brasil

July 10 to August 7, 2004

With contributions from C.Mertens, K.Kirchner, R.Steinfeldt, M.Walter

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Research Program

The cruise M62/1b is a german contribution to the international CLIVAR (Climate Variability and Predictability) program. The objective of the measurements is to estimate the inflow of warm water masses from the South Atlantic into the Caribbean through the passages south of Guadeloupe and across 16°N in the Atlantic east of Guadeloupe. The net interhemispheric transport of warm water is important for climate, and long term variability of that inflow might be related to climate change. The second aim of the cruise is to study the circulation of the deep water masses, forming the cold branch of the Atlantic meridional overturning. Of special interest is the time scale of spreading from the formation region of these deep water masses to the subtropical/tropical Atlantic, and the deep water exchange between the Deep Western Boundary Current DWBC and the interior of the basin in the region between 16°N and the equator.

The distribution of temperature, salinity and oxygen in the passages of the lesser Antilles, in the triangle St. Lucia – Barbados – Tobago, as well as along 16°N and along 10° N were determined by CTDO measurements, using a Seabird CTDO system attached to a 24x10l carousel. On all stations water samples were taken from 10L Niskin bottles to calibrate the conductivity- and the oxygen sensors. As a means to estimate spreading times of deep water components from the formation region to the tropical Atlantic, CFC (Chlorofluorocarbon) concentrations are analysed on water samples from the Niskin bottles. All oxygen, salinity and CFC analysis were done on board of RV METEOR.

The velocity distribution in the upper 600-1000m of the water column is measured continually with two vessel mounted Acoustic Doppler Current Profilers (vm-ADCPs, both from RD Instruments). The 75kHz Ocean Surveyor was installed in the ship's hull by divers in Fort de France one day before the start of the cruise. The 38.5kHz ADCP is located in the ship's well. The full water depth velocity profiles are determined at the location of the CTD stations by attaching two 300kHz ADCP Workhorse (from RD Instruments), one upward and one downward looking, to the CTD-carousel system, thus replacing 2 of the 24 Niskin bottles

In order to obtain year long time series of the warm water inflow into the Caribbean, moorings east of St. Lucia, north of Tobago and east of Barbados (dubbed CARIBA moorings) were deployed in June 2003 with RV SONNE (cruise S-171). The moorings are equipped with several temperature, salinity, and pressure sensors allowing to calculate the vertical density stratification and thus the baroclinic geostrophic velocity. The pressure – independent fluctuations will be estimated with bottom pressure sensors, and Inverted Echosounders (PIES) were also deployed. The CARIBA moorings are so called ‚end point' moorings, i.e. they will not give the transport through individual channels, but rather the integral transport fluctuations between Tobago and St. Lucia. In conjunction with the moorings at 16°N off Guadeloupe, the transport variations between St. Lucia and Guadeloupe will also be obtained. During M62/1b, the three CARIBA moorings were recovered and redeployed on the same locations together with two PIES.

Cruise Narrative

The RV METEOR departed on July, 10, 12 UTC local time and headed south towards the Martinique – St. Lucia Passage. On the way, the last checks on the newly installed 75kHz ADCP were successfully carried out. The weather conditions were mild with moderate winds.

After measuring the velocity field with the two vm-ADCPs across the passage (14°22.35'N, 60°52.30'W to 14°10.00'N, 60°54.30'W) the CARIBA mooring B7 located east of St. Lucia at 13°48'N, 60°41'W was recovered. Apparently, the mooring wire was cut with a sharp edge at about 75m depth, so that the top float with radio and flashlight, as well as the uppermost T/S sensor (Microcat) and a package of 5 buoyancy floats were missing. The recovery lasted

from 19:30 to 21:00 UTC. According to the temperature record in the uppermost current meter (at 86m depth), the loss of the top float occurred at January, 24, 2004. At this date, the temperature of the instrument dropped from 24°C to 8°C, indicating that the buoyancy above the instrument was lost and the current meter was now located in colder waters deeper in the water column.

The CTD test station at the same position suffered from a water leakage in the CTD-wire connection, which blowed the fuses in the CTD deck unit. After switching to a different wire the measurements with the CTDO/lADCP system could be carried out successfully. On the way to CARIBA mooring B6 off Barbados, 8 CTD casts were done. The position of B6 at 13°02'N, 59°48'W was reached at July, 11. 19 UTC. The two releasers responded immediately, and several minutes later the mooring surfaced. This time, corrosion on the chain connecting the top float with the mooring led to the loss of the top float with radio and flashlight. We recovered all instruments. On 20:00 UTC, the CTD/lADCP work continued on the way to the CARIBA mooring B5 north of Tobago and 10 CTD (CTD 9 – 18) stations were carried out before reaching the mooring position B5 (11°22'N, 60°24'W) on July, 12, 19:00 UTC. The mooring was released and seen a few minutes later. All instruments were recovered but the top float again was missing due to corrosion. On 20:00 UTC the recovery was finished and the work at the mooring position completed by a CTD station (CTD 19).

The weather remained favourable with moderate winds. The current velocities, however, were high especially off Barbados and off Tobago. Even at 1000m depth, velocities more than 20cm/s were measured. We reached the last CTD station east of St. Vincent on July, 13, 17:30 UTC. The T/S distribution in the St. Vincent – St Lucia Passage was measured with 6 CTDs, about 2-4nm apart. From our last cruises in this area we noticed the strong tides in the passage. In order to eliminate the tidal influence on the inflow transport the passage was repeatedly surveyed from 13°21.60'N, 61°07.00'W to 13°39.40'N, 60°54.00'W. The research in the passage was finished at July, 14, 15:40 UTC. After passing St. Lucia, the CTD work continued in the Martinique – St. Lucia passage on July 14, 19:20 UTC. 5 CTD stations were carried out in the passage with a mean distance of 2nm. The transport section through the passage extended from 14°10'N, 60°54.30'W to 14°22.35'N, 60°52.30'W and was repeated twice before heading to the Dominica-Martinique passage.

There, the CTD work started at July, 15, 8:00 UTC and after carrying out 6 CTD stations, we tested successfully four acoustic releasers (to be deployed on July, 17) in 1000m depth. On July 15, 18:50 UTC a CFC sampler was lowered for 4 hours to a depth of 2000m in the deepest location of the Dominica – Martinique passage. The CFC sampler is able to take 52 samples , can be moored for one year and is pressure resistant to 4000dbar. Despite numerous shipboard tests during the last years, followed by modifications of the design by the manufacturer EnviroTech (Chesapeake, USA), up to now the system did not work properly in depths lower than about 200m. Unfortunately, the test in 2000m depth failed again, the system stopped working after several minutes and was not able to even collect one water sample. In order to calibrate the 15 T/S sensors (Microcats) previously recovered from moorings B5, B6, B7, we attached the Microcats to the carousel (after removing the water bottles) and lowered them together with the CTD to 2000m depth.

The METEOR headed south to Fort de France and arrived at the entrance at the harbour at July, 16, 11UTC. The agent brought a new ITC transducer shipped from the USA which will be mounted on one of our PIES. The replacement of the transducer was necessary, since the original transducer in the instrument failed due to a manufacture problem. Afterwards, the METEOR headed towards Tobago to redeploy the mooring at 11°22'N, 60°24'W (CARIBA mooring B8). On the way, 3 CTD stations in the vicinity of the mooring position were carried out. The deployment of B8 began on July, 17. 12:30 UTC and the anchor weight was released at 14:50 UTC. The mooring's position is 11°21.70'W, 60°24,00'W, depth 1130m. The PIES No.56 was deployed in the vicinity at 11°21.70'N, 60°23.60'W at a depth of 1123m.

On the way to the 10N section, the vm-ADCPs measured the water transport through the Galleons passage between Trinidad and Tobago. The passage is narrow and shallower than 60m depth. The westernmost CTD station (CTD 48) at the 10°N section at 10°10'N, 60°06'W was reached at July, 17, 23:15 UTC. The distance between the CTD stations was 26nm and east of 58°W increased to 30nm. The continental slope declines moderately at 10°10'N and deepens from 300m at 60°W to 4000m at 57°W. The current in the upper 200m was directed towards the Windward Islands with velocities exceeding 1m/s west of 58°30'W. Although the CTD/carousel system was now operating with 1.20 m/s on the upcast, the attached ADCP workhorse had enough vertical range to obtain reliable velocity profiles from top to bottom. We encountered a lense of almost pure South Atlantic Water between 59°W and 58°W in the upper 500m. The eastern end of the section was at 12°02'N, 54°51.5'W and the CTD cast (CTD 60) was finished at July, 20, 13:30 UTC.

The RV METEOR then steamed west to Barbados to deploy the CARIBA mooring B9 southwest of the Island at the same position than the former mooring B6. The deployment began at July, 21, 16:30 UTC and the anchorweight was in the water at 19UTC. The position of the mooring B9 is 13°01.50'N, 59°47.60'W. About 1.5 nm north of the mooring, the releasers for the St. Lucia mooring were tested by lowering them to 900m depth. A CTD (CTD 61) cast followed at the same position. On the way to the St. Lucia mooring, the METEOR stopped at the deepest location on the route. Here a second test of the CFC sampler was carried out. To test at how much pressure the system still works, the sampler was lowered to 2000m and stopped every 100m and a sample was taken. At July 22, 6:50 UTC, the sampler was back on board. Although the sampler should work to depths of 4000m, the system stopped working in 600m depth.

After this disappointing test, the mooring position of CARIBA mooring B10 east of St. Lucia was reached at July 22, 11 UTC, and after 2 hours the mooring was placed exactly at the desired position at 13°48.00'N, 60°41.50'W. The PIES was located at 13°47.50'N, 60°41.80'W. On the way to Guadeloupe, the passages between St. Lucia and Martinique and Martinique and Dominica were again surveyed with the vm-ADCPs. This time, the flow in the Martinique – Dominica passage was eastward, i.e. out of the Caribbean with a maximum flow around 300-500m depth. In the Dominica – Guadeloupe passage, 5 CTD casts were carried out, before the METEOR headed east to the 16°N section.

The first station (CTD 68) on the 16°N section was carried out at July, 23, 16 UTC. Owing to the very steep topography, the following 5 CTD casts were only 2-4 nm apart. The station spacing increased to 10nm, and west of 60°W to 25nm. On July, 24-25, the weather conditions worsened with prolonged precipitation and increasing wind speeds, so that the METEOR's speed was reduced to 8-9knots. The vertical range of the 38.5kHz ADCP decreased from the usual 1000m to 600m. Although the CTD casts were now deeper than 5000m, the two 300kHz lADCPs sampled enough data to calculate a reliable velocity profile from top to bottom, although the upcast speed was maintained by 1.20m/s. On the 16°N section, two PIES were deployed, one at July 25, 18UTC at 16°10'N, 58°43'W and the other one at July 26, 18:30 UTC at 15°59'N, 56°57'W. On CTD cast 89, at a depth of 350m, the conductivity sensor malfunctioned, and the sensor had to be exchanged. Afterwards, a CTD cast at the same position was carried out to full depth (CTD 90) . In case the sensor did not work properly due to some biological or other material in the pumpe and/or tubing system, the sensor was cleaned and tested after CTD 91 by lowering the CTD to 10m depth, but the sensor failed again and will be send to Seabird for repair.

On the same position, another test of the CFC sampler was announced after contacting the manufacturer to find the source of the failure. Like the other tests at sea we did on our last three cruises the malfunction can be most likely attributed to material problems of the plunger in cold water below a pressure of 600 dbar. The system will be send back to the manufacturer. Despite our depressing experiences so far we do maintain some hope that

EnviroTech will be able to remedy the problem in the near future. The Meteor then headed south towards the eastern end of the 10°N section and a CTD cast was done every 26nm.

On July 29, at CTD cast 100, the recently installed conductivity sensor malfunctioned in the same way as the one who was replaced a few days ago. 22 Salinity samples were taken in the hope to recreate the salinity profile. Presumably, not the individual sensors but the CTD underwater-unit itself is responsible for the malfunction. In order to guarantee good data for the last three planned CTD casts, the Bremen CTD system was replaced by the under water unit from IFM-GEOMAR which will also be used on the next leg M62/2 (chief scientist P. Brandt, IFM-GEOMAR). The station work was finished on July, 31, 5 UTC after 103 CTD and lADCP profiles. The METEOR headed for Fortaleza. During transit the weather remained fair and we arrived in Fortaleta at August, 6, 8UTC. We thank Captain Kull, his officers and crew for their excellent assistance.

Technical Aspects

CTD-O_2 measurements (Reiner Steinfeldt)

CTD-O measurements on M62/1 were performed using a Sea-Bird 911 plus system. The underwater unit was connected to a water sampler caroussel with 22 Niskin bottles (2 of the 24 bottles have been replaced for the LADCPs). On two profiles, the conductivity and oxygen sensors failed shortly after beginning of the upcast, i.e. they showed unrealistic values. The oxygen sensor worked properly on the following profile, but the conductivity sensor did not recover and was replaced. The second sensor failed on profile 99, and the conductivity was much to high showed unusual ripples in the microstructure. After this incident, for the last three profiles the underwater unit of IFM-GEOMAR (Kiel) with a different set of sensors was brought into operation.

The CTD-O measurements were calibrated using water samples from the rosette. About 5 salinity samples and 5 to 15 oxygen samples (depending on the water depth) were taken for each profile. For the last three profiles with the new sensors, samples from all bottles were analysed in order to get a sufficient number of measurements for calibration. About 390 salinity and 760 oxygen samples were taken altogether.

Oxygen measurements were carried out by the Winkler titration method using a SIS dissolved oxygen analyser. The mean deviation between replicates was about 0.015 ml/l.
At the beginning, no reasonable values for the actual standard and blank could be determined, they had been replaced by their means. The calibration of the SBE43 dissolved oxygen sensor was done for subsets of profiles separately, as the sensor showed a temporal drift as well as a change of the depth dependence. The rms difference between the fitted CTD values and the titrated samples was 0.1 ml/l for the first subset (assuming a mean standard for the titration). For the other subsets, the difference was remarkable lower,
With an rms of 0.038 (0.0033) ml/l for all (below 1000 dbar) samples.

Bottle salinities were determined by means of a Guildline Autosal 8400A. During the third measurement session, the Autosal did not show constant values due to an electronical contact problem at the main switch. Since then, another Autosal of type 8400B was used instead. The resulting correction for all three conductivity cells comprised an offset as well as a linear pressure term. For the cell used at the first half of the cruise, a linear temporal drift was considered, and for the second cell a temperature dependence of the conductivity was added. The rms differences between bottle salinity and CTD values of the three sensors were in the range of 0.0099 (0.0055) and 0.0042 (0.0025) for all (below 1000 dbar) measurements. The calibrated salinities agree with former results for the range of the Antarctic Bottom Water only, if an offset of 0.003 is subtracted. As measured on cruise M59/2 (August 2003), where two standardisation batches were in use (P141, P139), this is

the salinity difference of the standardisation batch P141 used on this cruise and batch P139 used during the years before.

Lowered ADCP measurements (Maren Walter)

All of the 102 hydrographic stations (Stations 1-88, 90-103) with water depths down to 5500 m were accompanied by 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 the set-up in a synchronised Master-and-Slave mode, with the upward looking (SN 2161) as Slave and the downward looking (SN 1973) 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.

An inverse method which incorporates the bottom track velocities was used for the postprocessing of the raw data. This resulted in high quality velocity profiles, even for profiles with very weak current velocities (<0.05 m/s) and zero mean. 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 typical lowering (1 m/s) and heaving (1.2 m/s) velocities of the instrument package, this range amounted to 100 to over 200 shear estimates per depth bin in the deep water, and more in the shallow layers, depending on the abundance of backscatterers.

During three hydrographic stations, profiles 78,79 and 80, a loose contact in one of the plugs connecting the two instruments with the battery unit and with each other lead to short communication failures between master and slave during the casts. These failures caused data gaps in the slave record because the slave instrument depends on the signal from the master to ping properly. Thus, only the data from the master could be used in postprocessing, which lead to a reduced accuracy in the final velocity profiles caused by the diminished range of the set-up. Since the affected velocities are still in reasonable good agreement with complementary measurements from the vessel mounted ADCPs and the structure of the density field, they are included in the final data set.

Vessel mounted Acoustic Doppler Current Profiler ADCP (Christian Mertens)

Simultaneous single-ping data were recorded from two RD Instruments acoustic Doppler current profilers: A 75 kHz and a 38 kHz Ocean Surveyor (OS) model with flat phased-array transducers. The 75 kHz OS was mounted into the hull of the ship, and the 38 kHz instrument was located in the ship's well. The 75 kHz OS was installed by divers in Fort de France as a replacement for its broken predecessor. Dock side diagnostic tests were performed for the new instrument while the ship was still in the harbor, but the interference and bandwidth verification tests failed, while the 38 kHz OS was not failing the tests. Both tests were repeated in deeper water and the ship drifting, as recommended by the RDI field service (San Diego), and both instruments passed the tests. According to the RDI field service it is possible that multipath reflections from external noise sources sometimes cause test failures on a good ADCP.

Both instruments were configured to collect narrow bandwidth water-profile data throughout the cruise. The data from the 75 kHz OS were recorded in 8 m bins to get high vertical resolution data in the upper water column. To achieve maximum range the 38 kHz OS data were collected in 32 m bins. Both systems operated flawless throughout the cruise. The ship's 78 kHz Doppler log is known to cause a considerable reduction in range and data quality of the 75 kHz Ocean Surveyor and was therefore switched off.

Navigation and heading (GPS, Ashtech) information were recorded together with the velocities. Both ADCPs used the synchro version of the Fiber Optic Compass (FOG) heading connected directly to the chassis of the ADCP to transform the measured velocities into earth coordinates although it has been found on an earlier cruise (M47/1) that the FOG has a heading dependent error. Because of this error the data were corrected by substituting the synchro-FOG heading values of each single ping with heading values from the Ashtech system. The Ashtech receiver operated continuously throughout most of the cruise, except for the last two days where several crashes occured.

A water-track calibration of the angle between the transducers and the Ashtech antenna system has been carried out for both instruments. For the 75 kHz OS the calibration resulted in a misalignment angle of -1.37° and an amplitude factor of 1.004. For the 38 kHz OS a misalignment angle of -0.23° and an amplitude factor of 1.005 were determined.

The range of the 75 kHz OS was between 600 m and 750 m with smaller ranges during periods of rougher sea. The 38 kHz OS achieved ranges of up to 1300 m, but was much more sensitive to ship motion in rougher sea than the 75 kHz OS. Along the 16° N section, where the ship was steaming against the waves, the range decreased to as low as 600 m.

CARIBA Moorings on cruise M62/1b

Name	Latitude	Longitude	Depth	Deployment Date	Retrieval date
B5	11°21.79‘N	60°24.04‘W	1105m	11.6.2003, 18:30	**10.7.2004, 20:09**
PIES	11°21.73‘N	60°23.50‘W	1120m	11.6.2003, 18:58	on MY Bahia, 14.6.2004
B6	13°01.77‘N	59°47.70‘W	1030m	12.6.2003, 5:50	**11.7.2004, 19:54**
B7	13°48.25‘N	60°41.29‘W	1002m	10.6.2003, 21:20	**12.7.2004, 21:04**
PIES	13°48.01‘N	60°41.52‘W	993m	10.6.2003, 22:54	on MY Bahia, 15.6.,2004

PIES: Inverted Echo Sounder with Pressure sensor
Bold dates: work done during M62/1b cruise
Time in UTC

Name	Latitude	Longitude	Depth	Deployment Date	Retrieval planned
B8	11°21.70‘N	60°24.00‘W	1130m	**17.7.2004, 14:48**	Sep. 2005
PIES56	11°21.70‘N	60°23.60‘W	1123m	**17.7.2004, 15:15**	Sep. 2005
B9	13°01.60‘N	59°47.60‘W	1007m	**21.7.2004, 18:57**	Sep.2005
B10	13°48.00‘N	60°41.50‘W	1002m	**22.7.2004, 11:00**	Sep. 2005
PIES75	13°47.50‘N	60°41.80‘W	993m	**22.7.2004, 13:50**	Sep. 2005

PIES: Inverted Echo Sounder with Pressure sensor
Time in UTC
Bold dates: work done during M62/1b cruise

Recovered CARIBA Mooring B7/St. Lucia

Instrument	Number	Depth	Comments
Releaser	SN521	955m	ok
Releaser	SN520	955m	ok
RCM11	89	954m	ok
MicroCat C,T	1932	947m	ok
MicroCat C,T	1931	547m	ok
MicroCat C,T	2050	346m	ok
RCM11	94	344m	ok
MicroCat C,T	2015	188m	ok
RCM11	93	86m	ok
MicroCat C,T	2052	70m	***not recovered** Top float also missing

Sampling rate for all instruments : 30min.
RCM: Anderaa Acoustic Current Meter, +P: with pressure sensor
MicroCat C,T : SBE, measurement of temperature and conductivity
Radio frequency: 160.785 MHz

Recovered CARIBA Mooring B6/Barbados

Instrument	Number	Depth	Comments
Releaser	SN531	985m	ok
Releaser	SN826	985m	did not release
MicroCat C,T	2277	953m	ok
MicroCat C,T	1943	551m	ok
MicroCat C,T	1936	350m	ok
RCM11	95	349m	ok
MicroCat C,T	1915	193m	ok
RCM11	91	92m	ok
MicroCat C,T	1888	75m	ok
			top float missing (corrosion)

RCM: Anderaa Acoustic Current Meter, +P: with pressure sensor
MicroCat C,T : SBE, measurement of temperature and conductivity
Radio frequency: 160.725 MHz

Recovered CARIBA Mooring B5/Tobago

Instrument	Number	Depth	Comments
Releaser	SN517	1055m	ok
Releaser	SN798	1055m	ok
MicroCat C,T	2476	953m	ok
RCM11	98	951m	ok
MicroCat C,T	2454	549m	ok
MicroCat C,T	2438	348m	ok
RCM11	97	346m	ok
MicroCat C,T	2377	194m	ok
MicroCat C,T	1934	93m	ok
RCM11	92	91m	ok
MicroCat C,T	1933	75m	ok
			top float missing (corrosion)

Sampling rate for all instruments : 30min.
RCM: Anderaa Acoustic Current Meter, +P: with pressure sensor
MicroCat C,T : SBE, measurement of temperature and conductivity

Deployed CARIBA Mooring B8/Tobago

Instrument	Number	Depth	Comments
Releaser	AR517	1055m	
Releaser	AR798	1055m	
MicroCat C,T	2476	953m	
MicroCat C,T	2454	753m	
MicroCat C,T	2438	552m	
RCM11	93	350m	
MicroCat C,T	2377	352m	
MicroCat C,T	2277	195m	
RCM11	91	93m	
MicroCat C,T	2051	78m	

Sampling rate for all instruments : 30min.
RCM: Anderaa Acoustic Current Meter, +P: with pressure sensor
MicroCat C,T : SBE, measurement of temperature and conductivity
no radio transmitter, no flashlight

Deployed CARIBA Mooring B9/Barbados

Instrument	Number	Depth	Comments
Releaser	RT520	985m	
Releaser	RT521	985m	
MicroCat C,T	2050	952m	
MicroCat C,T	1943	751m	
MicroCat C,T	1931	550m	
RCM11	89	449m	
MicroCat C,T	1933	342m	
MicroCat C,T	1915	193m	
RCM11	94	90m	
MicroCat C,T	1888	73m	

RCM: Anderaa Acoustic Current Meter, +P: with pressure sensor
MicroCat C,T : SBE, measurement of temperature and conductivity
no radio transmitter, no flashlight

Deployed CARIBA Mooring B10 / St. Lucia

Instrument	Number	Depth	Comments
Releaser	RT531	955m	
Releaser	AR810	955m	
MicroCat C,T	3199	949m	
MicroCat C,T	3198	748m	
MicroCat C,T	3197	547m	
MicroCat C,T	1936	346m	
RCM11	92	344m	
MicroCat C,T	1934	189m	
RCM11	95	87m	
MicroCat C,T	1932	71m	

Sampling rate for all instruments : 30min.
RCM: Anderaa Acoustic Current Meter, +P: with pressure sensor
MicroCat C,T : SBE, measurement of temperature and conductivity
Radio frequency: 160.785 MHz

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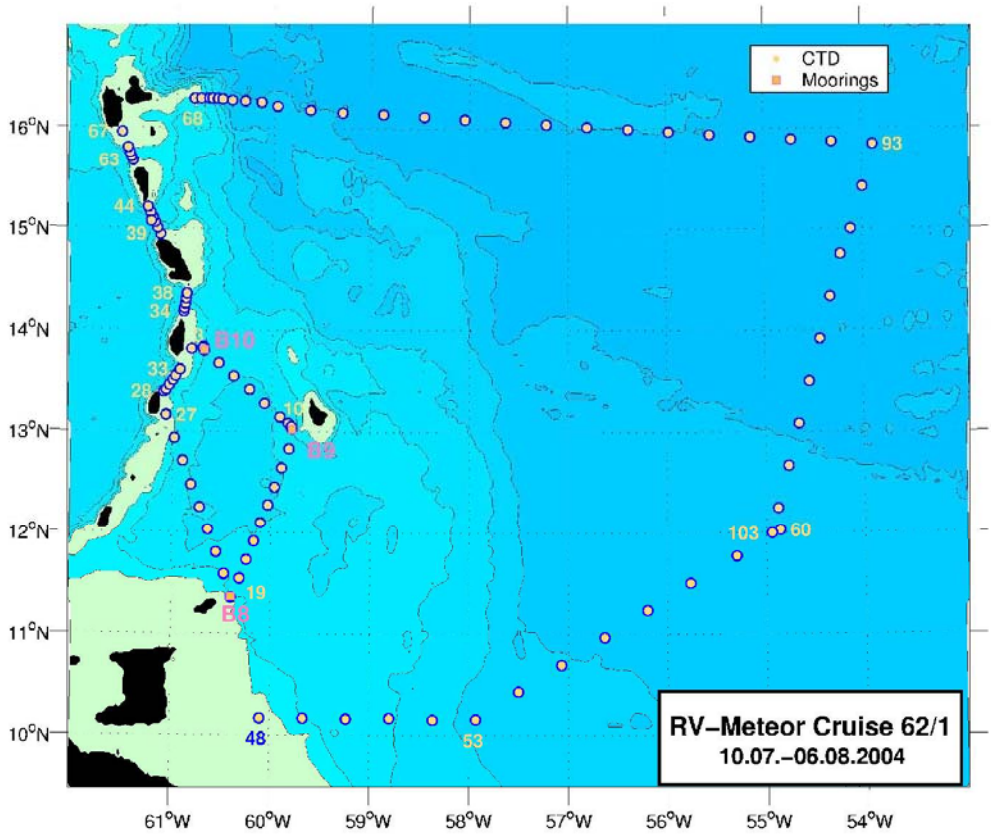
Meteor M62/1			**CTD Stations**						**Page 1**
Prof.	Sta.	Date	Time	Latitude	Longitude	Water Depth	Prof. Depth	Measurements CFCs	LADCP	Comment
1	663	2004/07/10	21:07	13° 49.82' N	60° 41.72' W	968	673		x	no CTD data > 670 m
2	663	2004/07/10	22:37	13° 47.90' N	60° 41.35' W	1015	991	x	x	
3	664	2004/07/11	00:31	13° 48.71' N	60° 49.07' W	450	499		x	
4	665	2004/07/11	03:31	13° 40.58' N	60° 32.43' W	1500	1486		x	
5	666	2004/07/11	06:14	13° 32.68' N	60° 23.23' W	1949	1922		x	
6	667	2004/07/11	09:11	13° 24.88' N	60° 13.60' W	2161	2128	x	x	
7	668	2004/07/11	12:07	13° 16.82' N	60° 4.41' W	2225	2173	x	x	
8	669	2004/07/11	15:09	13° 8.76' N	59° 54.93' W	1700	1672	x	x	
9	670	2004/07/11	17:15	13° 4.86' N	59° 49.94' W	1417	1354	x	x	
10	671	2004/07/11	20:10	13° 1.78' N	59° 47.75' W	1045	1025	x	x	
11	672	2004/07/11	22:17	12° 50.01' N	59° 49.33' W	1300	1346	x	x	
12	673	2004/07/12	00:35	12° 38.61' N	59° 53.67' W	1800	1786	x	x	
13	674	2004/07/12	03:22	12° 27.32' N	59° 57.86' W	2100	2077	x	x	
14	675	2004/07/12	06:24	12° 16.52' N	60° 1.84' W	1799	1806	x	x	
15	676	2004/07/12	08:56	12° 5.92' N	60° 6.29' W	2010	1984	x	x	
16	677	2004/07/12	11:39	11° 54.73' N	60° 10.24' W	1804	1778	x	x	
17	678	2004/07/12	14:28	11° 43.74' N	60° 14.66' W	1540	1505	x	x	
18	679	2004/07/12	17:08	11° 32.82' N	60° 18.78' W	1135	1500	x	x	
19	680	2004/07/12	21:37	11° 21.35' N	60° 23.92' W	1065	1117	x	x	
20	681	2004/07/12	23:45	11° 35.21' N	60° 28.21' W	1000	1012	x	x	
21	682	2004/07/13	01:48	11° 48.35' N	60° 33.05' W	1500	1495	x	x	
22	683	2004/07/13	04:08	12° 1.75' N	60° 38.20' W	2299	2270	x	x	
23	684	2004/07/13	07:08	12° 15.18' N	60° 43.22' W	2312	2285	x	x	
24	685	2004/07/13	10:00	12° 28.63' N	60° 48.68' W	2262	2243	x	x	
25	686	2004/07/13	12:52	12° 42.52' N	60° 53.82' W	1500	1449	x	x	
26	687	2004/07/13	15:22	12° 56.01' N	60° 59.04' W	1200	1082	x	x	
27	688	2004/07/13	17:30	13° 9.76' N	61° 4.19' W	473	389		x	
28	690	2004/07/13	19:25	13° 23.46' N	61° 5.79' W	537	621		x	
29	691	2004/07/13	20:25	13° 24.42' N	61° 4.38' W	670	821	x	x	
30	692	2004/07/13	21:49	13° 27.51' N	61° 2.28' W	892	836	x	x	
31	693	2004/07/13	23:08	13° 30.33' N	61° 0.25' W	436	377	x	x	
32	694	2004/07/14	00:00	13° 32.85' N	60° 58.63' W	311	322	x	x	
33	695	2004/07/14	01:02	13° 36.50' N	60° 56.03' W	367	372	x	x	
34	703	2004/07/14	19:18	14° 10.70' N	60° 54.14' W	385	437	x	x	
35	704	2004/07/14	20:12	14° 12.74' N	60° 53.83' W	774	773	x	x	
36	705	2004/07/14	21:21	14° 15.31' N	60° 53.29' W	852	875	x	x	

Prof.	Sta.	Date	Time	Latitude	Longitude	Water Depth	Prof. Depth	Measurements CFCs	Measurements LADCP	Comment
37	706	2004/07/14	22:36	14° 18.52' N	60° 52.83' W	935	894	x	x	
38	707	2004/07/14	23:48	14° 21.37' N	60° 52.46' W	460	437	x	x	
39	711	2004/07/15	08:00	14° 56.35' N	61° 9.05' W	354	349		x	
40	712	2004/07/15	09:09	14° 59.96' N	61° 10.83' W	354	616		x	
41	713	2004/07/15	10:18	15° 3.40' N	61° 12.44' W	1447	1423	x	x	
42	714	2004/07/15	11:50	15° 5.99' N	61° 13.75' W	2100	2035	x	x	
43	715	2004/07/15	13:50	15° 8.96' N	61° 15.16' W	1513	1492	x	x	
44	716	2004/07/15	15:31	15° 12.23' N	61° 16.89' W	686	680	x	x	
45	721	2004/07/17	06:45	11° 35.39' N	60° 28.18' W	1033	1028	x	x	
46	722	2004/07/17	09:05	11° 32.60' N	60° 18.77' W	1114	1503	x	x	
47	723	2004/07/17	11:43	11° 21.40' N	60° 24.05' W	1065	1089	x	x	
48	726	2004/07/17	23:18	10° 10.07' N	60° 6.05' W	298	278	x	x	
49	727	2004/07/18	02:27	10° 9.95' N	59° 39.99' W	1020	1002	x	x	
50	728	2004/07/18	06:00	10° 9.79' N	59° 14.01' W	1581	1563	x	x	
51	729	2004/07/18	09:58	10° 10.00' N	58° 48.01' W	1980	1952	x	x	
52	730	2004/07/18	13:52	10° 9.27' N	58° 21.87' W	2600	2579	x	x	
53	731	2004/07/18	18:10	10° 9.47' N	57° 55.82' W	3251	3227	x	x	
54	732	2004/07/18	23:25	10° 25.88' N	57° 29.98' W	3698	3667	x	x	
55	733	2004/07/19	04:53	10° 41.66' N	57° 4.11' W	3947	3928	x	x	
56	734	2004/07/19	10:39	10° 58.04' N	56° 38.08' W	4190	4173	x	x	
57	735	2004/07/19	16:26	11° 14.03' N	56° 12.11' W	4463	4446	x	x	
58	736	2004/07/19	22:19	11° 30.09' N	55° 46.01' W	4568	4557	x	x	
59	737	2004/07/20	04:24	11° 46.01' N	55° 18.04' W	4690	4684	x	x	
60	738	2004/07/20	10:28	12° 1.86' N	54° 51.50' W	4724	4710	x	x	
61	739	2004/07/21	20:18	13° 3.06' N	59° 48.01' W	1037	1015		x	
62	741	2004/07/22	14:13	13° 49.34' N	60° 42.13' W	945	934		x	
63	744	2004/07/23	07:50	15° 40.21' N	61° 26.50' W	745	724	x	x	
64	745	2004/07/23	08:56	15° 42.09' N	61° 27.52' W	1089	1065	x	x	
65	746	2004/07/23	10:15	15° 44.87' N	61° 28.46' W	654	596	x	x	
66	747	2004/07/23	11:20	15° 48.01' N	61° 29.73' W	472	463	x	x	
67	748	2004/07/23	12:52	15° 57.26' N	61° 33.39' W	258	250	x	x	
68	749	2004/07/23	18:23	16° 17.41' N	60° 49.03' W	553	545	x	x	
69	750	2004/07/23	19:33	16° 17.56' N	60° 45.12' W	1059	965	x	x	
70	751	2004/07/23	21:03	16° 17.55' N	60° 40.05' W	1982	1942	x	x	
71	752	2004/07/23	22:52	16° 17.52' N	60° 38.07' W	2487	2429	x	x	
72	753	2004/07/24	01:17	16° 17.45' N	60° 34.71' W	3350	3277	x	x	

Prof.	Sta.	Date	Time	Latitude	Longitude	Water Depth	Prof. Depth	Measurements CFCs	Measurements LADCP	Comment
73	754	2004/07/24	04:05	16° 16.99' N	60° 31.95' W	4273	4243	x	x	
74	755	2004/07/24	07:29	16° 16.47' N	60° 25.94' W	4757	4765	x	x	
75	756	2004/07/24	11:26	16° 16.02' N	60° 17.93' W	4698	4681	x	x	
76	757	2004/07/24	15:33	16° 15.14' N	60° 7.91' W	4908	4933	x	x	
77	758	2004/07/24	19:55	16° 12.92' N	59° 58.01' W	5000	4777	x	x	
78	759	2004/07/25	01:21	16° 10.71' N	59° 37.82' W	4854	4861	x	x	
79	760	2004/07/25	07:03	16° 9.49' N	59° 17.97' W	5018	5034	x	x	
80	761	2004/07/25	13:16	16° 8.47' N	58° 52.92' W	5466	5498	x	x	
81	763	2004/07/25	19:51	16° 6.85' N	58° 27.87' W	5534	5545	x	x	
82	764	2004/07/26	01:49	16° 5.39' N	58° 2.94' W	5400	5199	x	x	
83	765	2004/07/26	07:33	16° 3.96' N	57° 38.12' W	5368	5378	x	x	
84	766	2004/07/26	13:22	16° 2.48' N	57° 13.00' W	5205	5223	x	x	
85	768	2004/07/26	19:37	16° 1.04' N	56° 48.05' W	4854	4854	x	x	
86	769	2004/07/27	01:07	15° 59.41' N	56° 22.94' W	4943	4942	x	x	
87	770	2004/07/27	06:46	15° 58.00' N	55° 58.10' W	5012	5010	x	x	
88	771	2004/07/27	12:26	15° 56.48' N	55° 33.00' W	5072	5074	x	x	
89	772	2004/07/27	18:37	15° 55.01' N	55° 7.93' W	5160	0			no data
90	772	2004/07/27	19:15	15° 54.93' N	55° 7.98' W	5161	5167	x	x	
91	773	2004/07/28	01:03	15° 53.52' N	54° 42.94' W	5464	5475	x	x	
92	774	2004/07/28	07:01	15° 51.99' N	54° 18.11' W	5472	5475	x	x	
93	775	2004/07/28	12:52	15° 50.62' N	53° 53.04' W	5475	5482	x	x	
94	776	2004/07/28	23:17	15° 24.99' N	53° 59.54' W	5451	5466	x	x	
95	777	2004/07/29	05:14	14° 59.98' N	54° 7.09' W	5412	5415	x	x	
96	778	2004/07/29	10:20	14° 44.98' N	54° 13.52' W	5390	5398	x	x	
97	779	2004/07/29	16:11	14° 19.97' N	54° 20.01' W	5272	5277	x	x	
98	780	2004/07/29	22:00	13° 54.91' N	54° 26.50' W	5326	5338	x	x	
99	781	2004/07/30	03:51	13° 30.04' N	54° 33.16' W	5251	5258	x	x	
100	782	2004/07/30	09:39	13° 5.02' N	54° 39.69' W	5060	5057	x	x	
101	783	2004/07/30	16:12	12° 40.08' N	54° 46.10' W	4719	4706	x	x	
102	784	2004/07/30	21:41	12° 15.03' N	54° 52.65' W	4700	4692	x	x	
103	785	2004/07/31	02:14	11° 59.97' N	54° 56.53' W	4702	4694	x	x	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