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Short Cruise Report

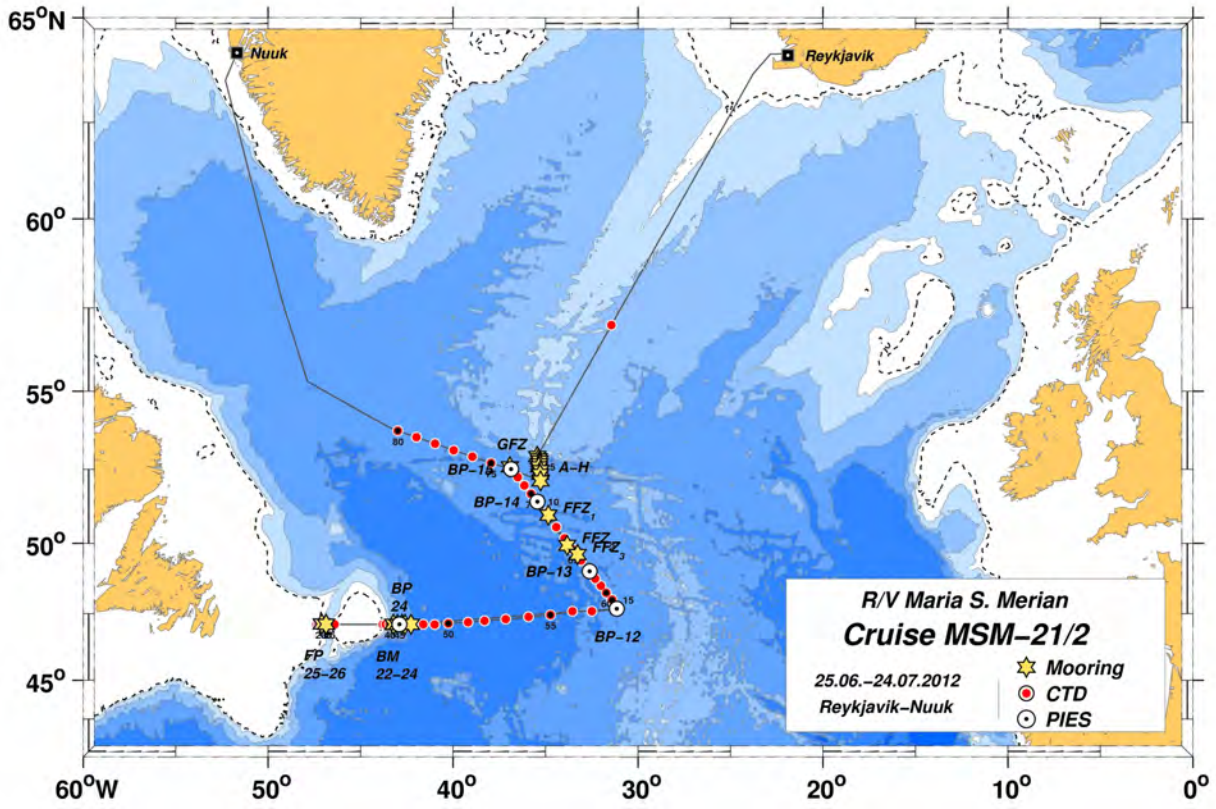
- RV Maria S. Merian, cruise MSM-21/2 -

Reykjavik – Nuuk

25h June - 24th July 2012

Chief Scientist: Dr. Dagmar Kieke

Captain: Ralf Schmidt



Track of RV *Maria S. Merian*, cruise MSM-21/2.

1. Objectives

Cruise MSM-21, leg 2, is funded by the German Federal Ministry of Education and Research (BMBF) as part of the cooperative research program 'North Atlantic'. The respective work package 2.1 is shared by the oceanographic groups of the Institute of Environmental Physics at Bremen University (UniHB) and the Federal Maritime and Hydrographic Agency (BSH) in Hamburg. Measurements with focus on the Flemish Pass region also contribute to the project FLEPVAR, funded by the German Science Foundation (DFG) and jointly conducted by the UniHB and the Institute of Oceanography affiliated to the Centre for Marine and Atmospheric Sciences of Hamburg University (ZMAW). Mooring activities carried out in the Charlie-Gibbs Fracture Zone (CGFZ) by members of the Woods Hole Oceanographic Institution (WHOI) were funded by the National Science Foundation.

The primary objectives of cruise MSM-21/2 are:

1) To exchange two deep-sea mooring arrays installed at the western flank of the Mid-Atlantic Ridge (MAR) as well as in the Deep Western Boundary Current east of Flemish Cap. Both arrays serve to establish time series of the deep water flow and variability, deep water properties, as well as of the strength of the North Atlantic Current (NAC).
2) To retrieve time series from pressure-recording inverted echo sounders (PIES) installed at the MAR and along 47°N via acoustic telemetry. When combined with hydrographic and remote-sensing data, these time series allow to obtain integral transport time series of the strength of the subpolar gyre.
3) To recover a mooring array deployed in the CGFZ in summer 2010 that serves to obtain a better insight into the strength and variability of the westward deep water flow through CGFZ.
4) To deploy a mooring array in Flemish Pass that builds on the pilot array established in summer 2011. Expected data together with shipboard measurements shall provide insight into the strength and variability of the deep water branch passing through Flemish Pass.
5) To assess the variability in the formation and properties of deep water components using hydrographic measurements and anthropogenic tracers like chlorofluorocarbon (CFC).

2. Narrative of cruise MSM-21/2

RV Maria S. Merian left Reykjavik on June 25th, 2012, at 18:00 UTC. After passing the 30nm-zone[1], the continuous logging of underway data (thermosalinograph and vessel-mounted Acoustic Doppler Current Profiler) was switched on at 23:18 UTC. On June 27th, a test-station was carried out on the eastern flank of the Reykjanes Ridge. This served to check the performance of the carousel water sampler, the conductivity/temperature/depth (CTD) sensor package and the two attached lowered Acoustic Doppler Current Profilers (lADCP).

On June 28th, 2012, *RV Maria S. Merian* arrived at the northern channel of the Charlie-Gibbs Fracture Zone (CGFZ). Throughout the day four deep-sea moorings (*CGFZ A-D*) deployed in summer 2010 by the WHOI group were recovered. The respective stations were revisited during the night when CTD casts at the mooring sites were carried out and water samples for home-lab analysis of chlorofluorocarbon (CFC) were taken.

On June 29th, another set of three WHOI moorings (*CGFZ E-G*) was recovered. CTD casts on all remaining WHOI mooring sites followed again during the night. The last WHOI mooring (*CGFZ H*) was recovered on June 30th. Course was then set to the northwest, when *RV Maria S. Merian* headed towards the northern end of the co-called PIES-line, a line of pressure-recording inverted echo-sounders (PIES) installed along the western flank of the Mid-Atlantic Ridge (MAR). The northernmost PIES *BP-15/2*, located at 52°30.50’N, 36°51.60’W, was visited in the evening of June 30th, and the data set was successfully retrieved via acoustic telemetry.

From June 30th to July 04th *RV Maria S. Merian* followed the PIES-line in southeastern direction. All remaining PIES (*BP-14* to *BP-12*) installed along this line were visited. Data was received again via acoustic telemetry, and CTD casts for calibration purposes were carried out near the PIES locations. Despite winds of 5-6 Bf and respective sea state oceanic acoustic conditions were extraordinary excellent which allowed for the first time performing CTD casts and telemetric activities in parallel on PIES stations *BP-14*, *BP-13*, and *BP-12*.

While following the PIES-line towards the southeast the mooring array of the BSH group was exchanged. On July 1st mooring *FFZ-1* was recovered. Visibility was continuously changing due to moving fields of light and dense fog. In the afternoon hours mooring *FFZ-1* was subsequently redeployed. Mooring *FFZ-2* was recovered on July 2nd and redeployed the same day. The third BSH-mooring *FFZ-3* was recovered on July 3rd and placed further south on July 4th at a new location at the western exit of Maxwell Fracture Zone. Having reached the southern end of the

1 nm = nautical mile

PIES-line, PIES *BP-12* was telemetrically read out and subsequently recovered the same night after three years in water and replaced by a new instrument.

Course was set towards west, and *RV Maria S. Merian* followed ~47°N towards the region of the Deep Western Boundary Current (DWBC). Having arrived there on July 6th, the first of three UniHB moorings, *BM-24/1*, was successfully recovered in the afternoon of July 6th despite foggy conditions. In the following, fog became, however, too dense which made any subsequent recovery of mooring *BM-23/3* the same day impossible. Instead, time was used to range the mooring from three different positions which served to determine the exact mooring position. Ranging results showed that the mooring was located about 860m to the south of its assumed position. During the night PIES *BP-24* was read out via telemetry. The intention to install it at a new position made its recovery necessary. But again dense fog conditions prevailing during the night prevented any recovery of this instrument. In the morning of July 7th, mooring *BM-22/3* was released at a time when visibility was comparatively good. But dense fog came in quickly and heavily reduced the visibility to values below 200m. At 08:28 UTC the radio signal of the top buoy was received, but it took until 10:30 UTC to spot the mooring at the surface. Recovery of the entire mooring directly followed.

Recovery of the last DWBC mooring *BM-23/3* was carried out in the afternoon hours, followed by a day-light release of PIES *BP-24* that was successfully detected at the surface and recovered. Similar to the PIES recovered days earlier at station *BP-12*, also the instrument formerly located at *BP-24* showed oil leakages of unknown origin and extent. Therefore, these instruments were not available for any redeployment, but will be sent to the manufacturer for closer inspection.

RV Maria S. Merian then headed west into Flemish Pass. Activities there lasted on from July 8th to July 9th and included a CTD/lADCP section across the Flemish Pass, a YoYo-CTD cast lasting 6.5 hours, the deployment of two short moorings (*BM-25/1* and *BM-26/1*), and four visits at different times that served to recover mooring *FP-02-11*, deployed in summer 2011 by the ZMAW group. Similar to cruise MSM-21/1a, when this mooring was visited first, any communication to the releaser could not be established. Heavy fog with visibilities less than 100m experienced during each of the four visits prevented any release of the mooring. Therefore, it was left in place, and Canadian colleagues running a monitoring program in Flemish Pass were contacted to check with them for other possibilities releasing it.

On July 10th, mooring activities began again in the DWBC region. Throughout the day, moorings *BM-24/2*, *BM-23/4*, and *BM-22/4* were deployed. Shortly after the anchor weight of mooring *BM-*

22/4 was slipped and the descend of the mooring to depth was expected major parts of the mooring remained still afloat, indicating that the mooring was ripped. Immediate recovery was started, and all instruments except the releasers could be retrieved back. The rope carrying the releasers' floatation was torn, and the releasers were lost.

Starting at 47°06'N, 43°47.5'W, a CTD/lADCP section with tracer sampling was conducted and crossed the DWBC towards east during nighttime. In the morning of July 11th, the section was interrupted, and mooring *BM-22/4* was successfully deployed. CTD station work continued afterwards, and *RV Maria S. Merian* headed further east, thereby following again ~47°N until she arrived at the location of PIES *BP-12*. Along the 47°N section the first four out of nine profiling floats were deployed.

On July 15th a CTD cast was carried out at the location of the previously deployed mooring *MFZ*. During the CTD upcast the carousel water sampler got into contact with the rope of mooring *MFZ*, and the mooring was lifted as the water sampler was retrieved back. While the water sampler was secured, a titanium ring connecting two mooring ropes broke, ripping the mooring into two halves. The water sampler was put on deck without any noticeable damage. Found afloat, the upper half of the mooring was subsequently recovered. The lower half was received back by activating the acoustic releasers. The entire equipment except the anchor weight was rescued. Mooring *MFZ* was redeployed later the same day, but after slipping the anchor weight and awaiting the descend of the mooring, it remained afloat. Having rescued the mooring again a shackle/ring connection made of titanium and located above the acoustic releasers was obviously broken, and the releasers were lost in the absence of any remaining buoyancy. For this reason, deploying another mooring at this location could no longer be pursued.

While heading along the PIES-line to the northwest again, CTD/lADCP casts were carried out, tracer samples were taken on every second station, and three profiling floats were deployed. On July 18th, the last mooring activity was performed, and the BSH mooring *GFZ* was installed at the northern end of the PIES-line.

In the following, course was set to west-northwest. While performing CTD/lADCP casts *RV Maria S. Merian* approached the longitude of 44°W. In the morning hours of July 20th CTD/lADCP cast 80 (station 500) was conducted. When the CTD package was at a depth of ~2440 m all sensors experienced severe malfunctioning. While still veering the water sampler system heavy swell together with the proper motions of the vessel resulted in large heave and veer movements of the water sampler. The CTD cast was aborted, and inspection of the conducting wire showed several

kinks which allowed seawater to intrude into the electronic cable leading to electronic shortcuts in the sensor package. While proceeding towards the next station the termination of the conducting wire was renewed, but weather and sea state conditions did not allow further measurements. Originally, it was intended to follow 44°W towards Cape Farewell at the southern tip of Greenland. However, a huge atmospheric pressure low was expected to cross the track resulting in expected wind forces of up to 12 Bf on the way towards Greenland. Available weather forecasts did not show any considerable improvements. Station 500 already provided insight into the very bad data quality, when performing CTD casts at high sea state conditions. Any proceeding along the intended track would have raised the risk of losing instruments when being forced to lower the sensor package during expected swell heights of 8-9 m. For this reason the scientific program was aborted on July 20th, 09:45 UTC, and *RV Maria S. Merian* started to circumnavigate the storm system as safe as possible. The last two floats were deployed on July 20th without any nearby CTD station.

On July 21st at 55°22'N, 47°57'W, *RV Maria S. Merian* started her transit towards Nuuk. Continuous data recording was stopped on July, 23rd, 12:30 UTC, and RV *Maria S. Merian* arrived in Nuuk harbour on July 24th, 17:24 UTC where she completed the second leg of cruise MSM-21.

Acknowledgements

We would like to thank the master of *RV Maria S. Merian*, Ralf Schmidt, and his entire crew for the support and valuable assistance during the cruise which made our stay aboard very comfortable. Commitment and team spirit among all groups laid the ground for a successful cruise. Further thanks goes to the agencies that provided the necessary ship time and funding to pursue all scientific work.

Table 1. Participants, RV Maria S. Merian, cruise MSM-21/2

	Name	Institution	Field of Activity
1.	Dr. Kieke, Dagmar	UniHB	chief scientist, data evaluation
2.	Böke, Wolfgang	UniHB	technics, CTD, PIES, UniHB moorings
3.	Denker, Claudia	BSH	BSH moorings, data evaluation
4.	Grobelny, T. Alex	UniHB	CTD/lADCP
5.	Hertzberg, Stefan	UniHB	CTD/lADCP
6.	Hogue, Brian P.	WHOI	technics, WHOI moorings
7.	Horn, Myriel	UniHB	CTD/lADCP
8.	Kattein, Ole	BSH	technics, BSH moorings, Argo floats
9.	Löb, Jonas	UniHB	CTD/lADCP
10.	Ludwig, Reimund	BSH	technics, BSH moorings, Argo floats
11.	Dr. Mertens, Christian	UniHB	vessel-mounted ADCP, UniHB mooring analysis
12.	Müller, Vasco	UniHB	CTD/lADCP
13.	Rößler, Achim	UniHB	PIES telemetry and data evaluation
14.	Schneider, Linn	UniHB	lADCP data evaluation
15.	Schwenke, Theresa M.	UniHB	tracer sampling
16.	Stake, Jürgen	UniHB	UniHB moorings
17.	Dr. Steinfeldt, Reiner	UniHB	salinometry, sensor calibration, data evaluation
18.	Dr. Stendardo, Ilaria	UniHB	CTD/lADCP, data evaluation
19.	Sültenfuß, Pia R.	UniHB	tracer sampling
20.	Uhde, Hans-Hermann	BSH	technics, BSH moorings, Argo floats
21.	Whelan, Sean P.	WHOI	technics, WHOI moorings

BSH: Bundesamt für Seeschifffahrt und Hydrographie, Hamburg, Germany

UniHB: Universität Bremen, Institut für Umweltphysik, AG Ozeanographie Bremen, Germany

WHOI: Woods Hole Oceanographic Institution, Woods Hole, MA, USA

Table 2. PIES activities during cruise MSM-21/2, 2012

PIES ID	S/N	Latitude	Longitude	Depth [m]	Deployment Date/Time	Telemetry Date/Time	Recovery Date/Time	CTD profile #
BP-12/3	240	47°40.25'N	31°08.94'W	4072	---	04.07.2012 03:39-07:12	04.07.2012 22:56-00:36	412 / 014
BP-12/4	201	47°40.11'N	31°08.95'W	4091	04.07.2012 20:59	---	---	412 / 014 470 / 058
BP-13/3	272	49°01.15'N	32°36.69'W	3968	---	03.07.2012 15:50-18:46	---	410 / 013 478 / 063
BP-14/2	271	51°25.70'N	35°26.33'W	3641	---	01.07.2012 00:07-02:57	---	403 / 010 486 / 069
BP-15/2	75	52°30.50'N	36°51.60'W	3404	---	30.06.2012 18:23-21:34	---	400 / 009 494 / 074
BP-24/1	235	47°05.90'N	42°53.73'W	3440	---	06.07.2012 21:22-01:42	07.07.2012 17:14-18:45	421 / 017

All times are given as UTC. PIES: inverted echo-sounders with pressure sensor; all instruments are equipped with flashlights and radio beacons.

Table 3. Charlie Gibbs Fracture Zone Moorings, WHOI, MSM-21/2, 2012

Mooring ID	Latitude	Longitude	Depth [m]	Recovery Date	Recovery Time	CTD profile #
CGFZ-A	52°55.50'N	35°26.68'W	2000	28.06.2012	08:56 – 11:15	387 / 001
CGFZ-B	52°50.80'N	35°22.40'W	2775	29.06.2012	12:00 – 13:46	388 / 002
CGFZ-C	52°46.48'N	35°19.44'W	3000	29.06.2012	14:30 – 16:50	389 / 003
CGFZ-D	52°40.82'N	35°19.85'W	3725	28.06.2012	17:46 – 19:55	390 / 004
CGFZ-E	52°35.09'N	35°20.63'W	2975	29.06.2012	08:35 – 10:48	394 / 005
CGFZ-F	52°27.54'N	35°16.07'W	3009	29.06.2012	12:32 – 14:49	395 / 006
CGFZ-G	52°20.12'N	35°17.81'W	3879	29.06.2012	15:27 – 19:08	396 / 007
CGFZ-H	52°07.09'N	35°15.35'W	3866	30.06.2012	09:47 – 11:30	397 / 008

All times given as UTC. All moorings were equipped with *Xeos* flashlights and *Xeos Argos* beacons. Three out of eight Argos beacons and one flasher showed water intrusions. The current meter attached to the recovered moored profiler included in mooring CGFZ-C was disarranged while the mooring was ascending to or already floating at the surface.

Table 4. Mid-Atlantic Ridge Moorings, BSH, MSM-21/2, 2012

Mooring ID	Latitude	Longitude	Depth [m]	Deployment Date/Time	Recovery Date/Time	CTD profile #
FFZ-1/3	50°58.35'N	34°51.00'W	4329	---	01.07.201012 09:54 – 14:24	485 / 068
FFZ-1/4	50°58.35'N	34°51.00'W	4329	01.07.2012 16:00 – 19:32	---	485 / 068
FFZ-2/3	49°55.66'N	33°49.66'W	4198	---	02.07.2012 11:51 – 15:40	407 / 011
FFZ-2/4	49°55.66'N	33°49.66'W	4194	02.07.2012 16:53 – 20:24	---	407 / 011
FFZ-3/3	49°36.48'N	33°15.97'W	4101	---	03.07.2012 08:00 – 11:41	408 / 012
MFZ	48°00.00'N	31°25.00'W	4094	04.07.2012 09:45 – 12:51	15.07.2012 07:24 – 12:56	415 / 015
“	“	“	“	15.07.2012 14:28 – 17:40	15.07.2012 17:57 – 20:18	471 / 059
GFZ	52°35.00'N	36°56.00'W	3280	18.07.2012 14:45 – 17:25	---	492 / 073

All times are given as UTC. All recovered moorings were equipped with *Xeos* radio beacons. Only one worked properly (mooring FFZ-2). All deployed moorings carried *Iridium* beacons.

Table 5. Deep Western Boundary Current Moorings, UniHB, MSM-21/2, 2012

Mooring ID	Latitude	Longitude	Depth [m]	Deployment Date/Time	Recovery Date/Time	CTD profile #
BM-22/3	47°05.67'N	43°13.80'W	2999	---	07.07.2012 07:58-12:41	449 / 043
BM-22/4	47°06.00'N	43°13.70'W	3000	10.07.2012 19:44-21:58	10.07.2012 22:21-00:14	449 / 043
“	“	“	“	11.07.2012 16:40-18:52	---	449 / 043
BM-23/3	47°05.67'N	42°59.96'W	3568	---	07.07.2012 13:57-16:31	454 / 045
BM-23/4	47°06.00'N	42°45.00'W	3622	10.07.2012 14:48-17:39	---	454 / 045
BM-24/1	47°05.85'N	42°35.55'W	3660	---	06.07.2012 15:46-17:33	455 / 046
BM-24/2	47°06.00'N	42°16.50'W	4050	10.07.2012 09:54-12:45	---	440 / 037

All times are given as UTC. All moorings were equipped with radio beacons and flashers. Those moorings deployed in 2011 carried one, while those deployed in 2012 had two radio senders and a flag. Moorings BM-22/3 and BM-24/2 carried an additional *Argos* beacon.

Table 6. Flemish Pass Moorings, UniHB/ZMAW, MSM-21/2, 2012

Mooring ID	Latitude	Longitude	Depth [m]	Deployment Date/Time	Recovery Date/Time	CTD profile #
FP-02-11	47°05.99'N	47°06.18'W	1001	---	not released due to heavy fog and very low visibility	430 / 021
BM-25/1	47°07.13'N	47°06.20'W	1009	09.07.2012 10:53-11:02	---	430 / 021
BM-26/1	47°05.94'N	46°51.58'W	1170	09.07.2012 13:29-13:39	---	437 / 028-036

All times are given as UTC. All moorings except FP-02-11 were equipped with radio beacons, flashers, and flags.

Table 7. APEX-Float Deployments, BSH, MSM-21/2, 2012

Float s/n	WMO ID	ARGOS ID	Latitude	Longitude	Deployment Date	Time [UTC]	CTD profile #
6042	4901410	109130	47°06.10'N	43°07.11'W	11.07.2012	15:50	450 / 044
6043	4901411	109131	47°08.08'N	40°50.67'W	12.07.2012	16:42	458 / 049
6044	4901412	109132	47°10.63'N	39°11.28'W	13.07.2012	03:50	461 / 051
6290	4901413	118965	47°40.07N	31°08.93'W	15.07.2012	01:34	470 / 058
6291	4901414	118966	50°10.28'N	33°58.19'W	17.07.2012	05:35	482 / 066
6292	4901415	118967	51°57.91'N	36°08.57'W	18.07.2012	05:54	489 / 071
6293	4901416	118968	54°06.71'N	44°13.57'W	20.07.2012	14:00	---

All times are given as UTC. All *APEX* floats were equipped with temperature and conductivity sensors as well as *Argos* communication facilities.

Table 8. NOVA-Float Deployments, BSH, MSM-21/2, 2012

Float s/n	IMEI ID	Latitude	Longitude	Deployment Date	Time [UTC]	CTD profile #
44	300034013659400	53°52.37'N	43°28.88'W	20.07.2012	10:43	---
45	300034013058670	47°21.92'N	35°53.46'W	13.07.2012	23:08	465 / 054

All times are given as UTC. All *NOVA* floats were equipped with temperature and conductivity sensors as well as *Iridium* communication facilities.

Table 9. CTD/LADCP/Tracer-Stations, MSM-21/2, 2012

Maria S. Merian	**MSM21/2**	**CTD Stations**					**Measurements**		**Page 1**
Prof.	Sta.	Date	Time	Latitude	Longitude	Water Depth	Prof. Depth	CFC	LADCP	Comments
0	383	2012/06/27	10:00	56° 59.91' N	31° 26.46' W	2488	2469	x	x	Test-Station
1	387	2012/06/28	21:22	52° 55.49' N	35° 26.68' W	2040	2030	x	x	
2	388	2012/06/28	23:34	52° 50.79' N	35° 22.43' W	2720	2729	x	x	
3	389	2012/06/29	02:14	52° 46.46' N	35° 19.41' W	3064	3040	x	x	
4	390	2012/06/29	04:45	52° 40.81' N	35° 19.82' W	3724	3714	x	x	
5	394	2012/06/29	20:48	52° 35.12' N	35° 20.64' W	3001	2964	x	x	
6	395	2012/06/29	23:30	52° 27.54' N	35° 16.05' W	3022	3000	-	x	
7	396	2012/06/30	02:10	52° 20.14' N	35° 17.80' W	3885	3868	x	x	
8	397	2012/06/30	06:43	52° 7.28' N	35° 17.94' W	3873	3860	x	x	
9	400	2012/06/30	21:49	52° 30.61' N	36° 51.08' W	3440	3423	-	x	
10	403	2012/07/01	23:19	51° 25.64' N	35° 26.26' W	3605	3596	-	x	
11	407	2012/07/02	20:59	49° 54.88' N	33° 49.22' W	4074	4055	-	x	
12	408	2012/07/03	01:52	49° 36.01' N	33° 16.37' W	4112	4103	-	x	
13	410	2012/07/03	15:28	49° 0.59' N	32° 36.94' W	3935	3929	-	x	MicroCAT calib.
14	412	2012/07/04	03:30	47° 40.25' N	31° 8.94' W	4076	4071	-	x	
15	415	2012/07/04	13:26	47° 59.78' N	31° 23.81' W	4011	4009	-	x	
16	416	2012/07/04	16:44	47° 59.77' N	31° 23.81' W	4011	1801	-	-	MicroCAT calib.
17	421	2012/07/06	20:49	47° 5.90' N	42° 53.82' W	3464	3449	-	x	
18	427	2012/07/08	10:56	47° 6.02' N	47° 22.64' W	250	231	-	x	
19	428	2012/07/08	12:07	47° 5.99' N	47° 15.93' W	480	461	x	x	
20	429	2012/07/08	13:18	47° 6.00' N	47° 9.54' W	891	858	x	x	
21	430	2012/07/08	14:28	47° 6.48' N	47° 6.13' W	1028	992	-	x	
22	431	2012/07/08	15:48	47° 6.00' N	47° 0.52' W	1148	1116	x	x	
23	432	2012/07/08	17:26	47° 6.00' N	46° 51.58' W	1190	1152	x	x	
24	433	2012/07/08	19:18	47° 5.99' N	46° 42.50' W	1161	1125	x	x	
25	434	2012/07/08	20:44	47° 6.00' N	46° 40.07' W	1123	1090	-	x	
26	435	2012/07/08	22:30	47° 6.02' N	46° 33.41' W	510	490	x	x	
27	436	2012/07/08	23:52	47° 5.99' N	46° 24.44' W	370	345	-	x	
28	437	2012/07/09	02:07	47° 6.01' N	46° 51.57' W	1187	1155	-	x	YoYo-profile
29	437	2012/07/09	02:52	47° 6.01' N	46° 51.57' W	1187	1154	-	x	YoYo-profile
30	437	2012/07/09	03:35	47° 6.01' N	46° 51.58' W	1187	1156	-	x	YoYo-profile
31	437	2012/07/09	04:17	47° 6.01' N	46° 51.57' W	1187	1156	-	x	YoYo-profile
32	437	2012/07/09	05:00	47° 6.01' N	46° 51.58' W	1187	1155	-	x	YoYo-profile
33	437	2012/07/09	05:44	47° 6.01' N	46° 51.58' W	1187	1156	-	x	YoYo-profile
34	437	2012/07/09	06:27	47° 6.01' N	46° 51.56' W	1187	1153	-	x	YoYo-profile
35	437	2012/07/09	07:11	47° 6.02' N	46° 51.56' W	1187	1153	-	x	YoYo-profile
36	437	2012/07/09	07:55	47° 6.01' N	46° 51.56' W	1187	1153	-	x	YoYo-profile
37	440	2012/07/10	05:27	47° 5.97' N	42° 16.52' W	4002	3986	-	x	MicroCAT calib.
38	444	2012/07/11	02:40	47° 6.02' N	43° 47.54' W	577	567	x	x	
39	445	2012/07/11	03:53	47° 6.01' N	43° 38.46' W	758	754	x	x	
40	446	2012/07/11	05:29	47° 6.02' N	43° 25.31' W	1273	1261	x	x	
41	447	2012/07/11	06:57	47° 5.93' N	43° 20.15' W	1830	1800	x	x	

Table 9. continued …

Maria S. Merian	MSM21/2	CTD Stations					Measurements		Page 2
Prof.	Sta.	Date	Time	Latitude	Longitude	Water Depth	Prof. Depth	CFC	LADCP	Comments
42	448	2012/07/11	08:35	47° 6.00' N	43° 17.91' W	2548	2560	x	x	
43	449	2012/07/11	10:41	47° 6.04' N	43° 13.49' W	3020	3024	x	x	
44	450	2012/07/11	13:16	47° 6.10' N	43° 7.10' W	3515	3515	x	x	
45	454	2012/07/11	20:15	47° 5.92' N	42° 53.70' W	3457	3442	x	x	
46	455	2012/07/11	23:30	47° 5.96' N	42° 35.45' W	3665	3655	x	x	
47	456	2012/07/12	03:30	47° 5.87' N	42° 10.86' W	4250	4096	x	x	
48	457	2012/07/12	08:22	47° 6.05' N	41° 36.58' W	4296	4284	-	x	
49	458	2012/07/12	13:22	47° 5.50' N	40° 59.67' W	4489	4445	-	x	
50	460	2012/07/12	18:52	47° 8.02' N	40° 15.42' W	4538	4547	-	x	
51	461	2012/07/13	01:07	47° 10.68' N	39° 11.40' W	4572	4585	-	x	
52	463	2012/07/13	06:48	47° 13.77' N	38° 17.94' W	4584	4592	-	x	
53	464	2012/07/13	13:03	47° 17.42' N	37° 9.38' W	4447	4367	-	x	SeaCAT calib.
54	465	2012/07/13	20:22	47° 22.42' N	35° 54.93' W	4329	4340	-	x	
55	467	2012/07/14	02:54	47° 26.54' N	34° 43.99' W	4073	4078	-	x	
56	468	2012/07/14	09:28	47° 34.57' N	33° 32.54' W	3947	3944	-	x	
57	469	2012/07/14	15:31	47° 34.61' N	32° 29.32' W	3897	3908	-	x	
58	470	2012/07/14	23:00	47° 40.10' N	31° 8.92' W	4071	4073	x	x	
59	471	2012/07/15	03:52	48° 0.01' N	31° 25.08' W	3997	4017	-	x	
60	475	2012/07/15	22:33	48° 14.98' N	31° 42.97' W	3853	3855	x	x	
61	476	2012/07/16	02:52	48° 30.04' N	32° 0.97' W	4198	4197	-	x	
62	477	2012/07/16	07:28	48° 45.00' N	32° 18.85' W	3705	3698	x	x	
63	478	2012/07/16	11:41	49° 1.07' N	32° 36.95' W	3940	3951	-	x	
64	480	2012/07/16	16:57	49° 23.70' N	33° 4.40' W	3788	3769	x	x	
65	481	2012/07/16	21:56	49° 47.00' N	33° 31.28' W	4229	4205	-	x	
66	482	2012/07/17	03:21	50° 10.32' N	33° 58.22' W	3733	3711	x	x	
67	484	2012/07/17	08:31	50° 33.68' N	34° 25.21' W	4164	4145	-	x	
68	485	2012/07/17	14:09	51° 4.13' N	34° 53.62' W	4151	4131	x	x	
69	486	2012/07/17	19:08	51° 25.16' N	35° 26.15' W	3608	3578	-	x	
70	488	2012/07/17	23:26	51° 41.47' N	35° 47.20' W	3660	3636	x	x	
71	489	2012/07/18	03:31	51° 57.91' N	36° 8.59' W	3867	3844	x	x	
72	491	2012/07/18	07:48	52° 14.53' N	36° 30.11' W	3618	3590	x	x	
73	492	2012/07/18	12:07	52° 34.99' N	36° 55.99' W	3280	3255	x	x	
74	494	2012/07/18	18:56	52° 30.59' N	36° 51.79' W	3385	3355	-	x	
75	495	2012/07/19	00:31	52° 42.58' N	37° 56.99' W	3901	3875	-	x	
76	496	2012/07/19	06:32	52° 55.10' N	38° 57.42' W	3303	3291	-	x	
77	498	2012/07/19	11:58	53° 7.69' N	39° 57.92' W	3610	3578	-	x	
78	498	2012/07/19	17:52	53° 20.24' N	40° 58.42' W	3554	3523	-	x	
79	499	2012/07/19	23:38	53° 32.80' N	41° 58.99' W	3645	3617	-	x	
80	500	2012/07/20	06:10	53° 45.32' N	42° 59.26' W	3673	2342	-	x	profile aborted