SHORT CRUISE REPORT

RV MERIAN: cruise MSM05-1

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from Las Palmas, Gran Cranaria, Spain to St. John's, Newfoundland, Canada

April 14 to May 3, 2007

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Research Program

The objectives of the cruise are (i) to estimate the deepwater formation rate in the Labrador Sea from inventories of the anthropogenic trace gases chlorofluorocarbons (CFCs) and sulphurhexafluoride (SF_6), (ii) to infer the transport variability of the subpolar gyre through combined data from moored Inverted Echo Sounders (PIES), shipboard measurements, float profiles from the ARGO program, and satellite altimetry, and (ii) to calculate the vertical turbulent mixing in the deep western boundary current using shipboard measurements and time series from moored sensors (velocity, temperature and salinity) The cruise is part of the german joint research project 'Nordatlantischer Ozean' and is supported by the german ministry of research and education, BMBF, and the german national science foundation, the DFG.

Cruise Narrative

The MERIAN left Las Palmas 8 days later than planned due to ship repair at April 14, 8UTC and headed course 320° towards the position of the southernmost PIES at 47°40'N, 31°10'W. The weather was fair, the winds weak to moderate, and the vessel proceeded with more than 13 knots. Before reaching the destination position, the scientific equipment was tested, and the scientific participants presented talks. After leaving the 200nm zone of Portugal (Acores), at April, 18 the shipboard ADCP (75KHz Acoustic Doppler Current Profiler) was switched on.

The working area was reached at April 18, 23:30 UTC. From 23:50 UTC to April 19, 0:40 , the topography around the position of the PIES B12 was surveyed with the Deep Sea Multibeam echosounder EM120, while the MERIAN steamed with 6 kn. Afterwards, the position of the PIES at the bottom was determined. This could not be done during the deployment cruise in August 2006, since we had bad communication with the instrument during descent and while at the bottom. This time, the PIES reacted promptly, and the position of the PIES at the bottom was found to be about 100m east of the deployment position. Beginning at 1 UTC the data from the eight months deployment of the PIES were acoustically received with a hydrophone attached to the retractable at the ships' hull. The last data were successfully transmitted at 2:30 UTC. During the transmit time, the ship was located at the position of the PIES, and all acoustic equipment (ADCP, echo sounders), and the pump with the inflow fixed at the retractable above the hydrophone were off in order to avoid disturbances of the transmission by acoustic signals, and the pump jet was turned off to avoid air bubbles near the hydrophone. Even without the pump jet, the MERIAN stayed at the same position during the transmission time.

The hydrography work began with the first CTD/LADCP station at April 19, 5 UTC near the PIES position. The CTDO instrument (Seabird) and the two 300kHz Workhorse Lowered ADCPs (RDI) were attached to a 24x10L carousel, with 2 bottles replaced with the two LADCPs. One instrument is upward looking, and one downward. The water bottles were sampled for the analysis of SF_6 and CFC-12 and for the calibration of the oxygen and the conductivity sensor of the CTD. In order to minimize the station time, the upward speed of the carousel was set to 1.5m/s and the bottles were closed without stopping. Since the cruise was delayed 8 days and could only be prolonged by 4 days, 96 hours of work time have been lost, and saving time is a necessity. The choice of the high upward speed deteriorated the number of valid profiles of the LADCP instruments, but we still received reasonable profiles.

Other problems were the strong rolling motion of the MERIAN when on station, which lead to abrupt changes in the speed of the carousel (between +0.5 and -1.5m/s while lowering the CTD, and +1.0 - -2.5 m/s during heaving) and disturbing the current measurements. This is a principal problem of the MERIAN, due to the strong rolling motion while at rest.

The station positions followed the so called WOCE A2 section, except CTD 11. This station was located further south in order to sample the channel east of Pic Milne. The distance between the stations was in the beginning 47 nautical miles (nm). The weather stayed favourable considering the season. At April 20, 13UTC, at station CTD 6, ten water bottles were removed and replaced by Microcats (T/S sensors) for calibration purposes. The Microcats will be deployed in a few days at the western boundary current at 47°N. The calibration procedure was repeated for the 2nd set of Microcats at April 21, 16 UTC (CTD 10). Although occasionally the wind increased to Bft 8, the weather and wave conditions did not hinder the oceanographic work. Westerly winds, however, slowed the MERIAN to about 11-12kn. At April, 22, at CTD station 13, the measurements were severely disturbed by the strong rolling motion of the ship, leading to fast changes in the vertical motion of the CTD-LADCP-carousel, and no LADCP profile was obtained. The station lasted about one hour longer than planned, since the conductor wire jumped out of the guidance system of the winch.

At CTD 14, the measurements had to be abandoned at 1900dbar, because of an electronic failure of all CTD sensors. When the CTD-LADCP carousel was back on board, about 15m of the single conductor wire were cut because of wire isolation problems. At CTD 16 and 17, new isolation failures occurred, which have to be cut off. At April 23, after CTD station 17, six acoustic releasers were lowered to 1000m depth. Communication with the releasers was good and all releasers worked successfully. The station spacing remained rather high (40 nm), in order to save time, until reaching the Deep Western Boundary Current (DWBC) region at April 24. Here, the station spacing was reduced to 15nm. Due to frequent isolation problems with the single conductor wire used so far, the CTD-LADCP carousel was switched from the ‘violet’ to the ‘yellow’ wire beginning at CTD 20, and all following stations have been carried out with the so called ‘yellow’ winch. The station work at section A2 was finished after CTD 26 at April, 25, 10 UTC. The LADCP data quality was improved at the boundary current section, since the CTD was heaved with 1m/s and the MERIAN was not rolling much during the station due to favourable winds and waves. A medical emergency led to a stop of the scientific work and the MERIAN headed to St. John’s, where she arrived at April 26, 14UTC.

At 17UTC, The MERIAN left St. John’s and turned east to the boundary current region at 47°N. The weather stayed fair and we reached the working area at April 28, 19 UTC. The vertical mixing in the deep western boundary current (DWBC) was studied with a CTD/LADCP YoYo at 47°N, 43°11’W, which lasted 14 hours. The carousel was additionally equipped with a Posidonia transponder, and all water bottles were removed to facilitate the handling. The winds increased during the day to Bft 8 when the YoYo started. Again, the ‘violet’ wire was used in order to facilitate the handling of the carousel in the hangar instead of having to work outside. At the second profile, however, the measurements stopped at 1000m due to problems in the wire isolation. The carousel was hauled on deck and the profiling was continued with the ‘yellow’ wire on the working deck. The YoYo suffered from the severe weather conditions leading to a strong rolling motion of the vessel. Although the CTD/LADCP system was lowered with -1m/s, the vertical velocity increased regularly to +1.5 m/s, affecting the quality of the LADCP data.

At April 28, three moorings were deployed in the western boundary current. The moorings are equipped with acoustic current meters and Microcats (T/S sensors) in the depth range of the DWBC. After testing the drift of the MERIAN, the westernmost mooring (B16) was deployed, followed by the central mooring B17 and then B18 (3000m depth), about 3 nm further east and north. B16 lasted from 13:50 to 15:50, and the anchor was deployed at 47°01.90'N, 43°14.14'W. The top element submerged ca 100m south of the vessel, at 47°01.90'N, 43°14.13'W. B17 started at 17 UTC, and was finished at 19 UTC, the descent of the top element could not be observed. The third mooring was finished at 20:40 UTC, and the top element submerged about 200m aft of the vessel.

The boundary current section along 47°N started at 43°40'W, The CTD system for stations CTD 28 – 34 were equipped with a Posidonia transponder. The continental slope at 47°N is very steep, and the distance between the stations varied between 3 and 6 nm, while the depth increased by about 500m and 800m between the stations. The Posidonia remained in the ship's well during the stations, although the speed of the vessel was restricted to 6kn. The minimum time between stations is set by the time it takes to sample SF_6, CFCs, oxygen and salinity (~40 minutes), so that the reduced speed did not lead to a time loss.

Posidonia was in use till the station spacing increased to 9 nm at 47°N, 42°55'W. It takes about 30 minutes to remove Posidonia from the ship's well and the same to install it, and these actions have to be carried out while the vessel's speed is zero. Instead of roughly 3 hours for a 3000m CTD/LADCP station, we would need 4 hours, and letting Posidonia in the well would double the time between the stations. Due to the limited time available we refrained from using Posidonia further. At April, 30, 14 UTC, 47°N, 41°03'W we abandoned the scientific program after finishing CTD 40 and headed towards St. John's. The altered course was caused by a severe damage in the propulsion system. The MERIAN arrived in St. John's at May 2, 20 UTC. Due to the expected repair time of more than 14 days and the transit time of 3 days to the Labrador Sea and back, which would fill the remaining time till May, 19, the cruise was terminated. We thank captain, officers and crew of the FS MERIAN for their dedicated work and their effort to make this difficult cruise a success.

Acoustic Date Transfer PIES

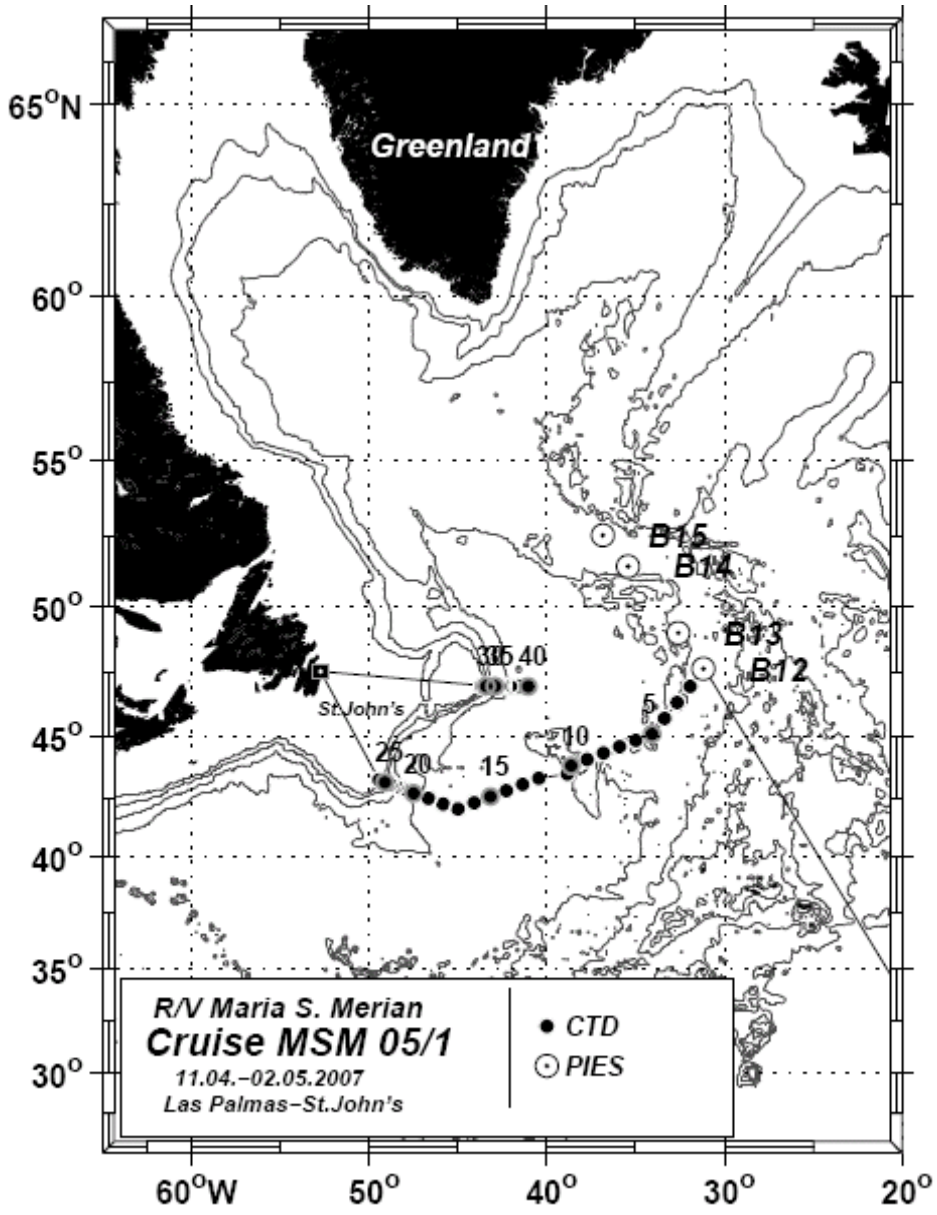
Name	PIESNo	Latitude	Longitude	Depth	Listening Date
B12	186	47°40.20'N	31°10.51'W	3986m	19.4.2007, 02:48-05:17

PIES: Inverted Echo Sounder with Pressure sensor
Time in UTC

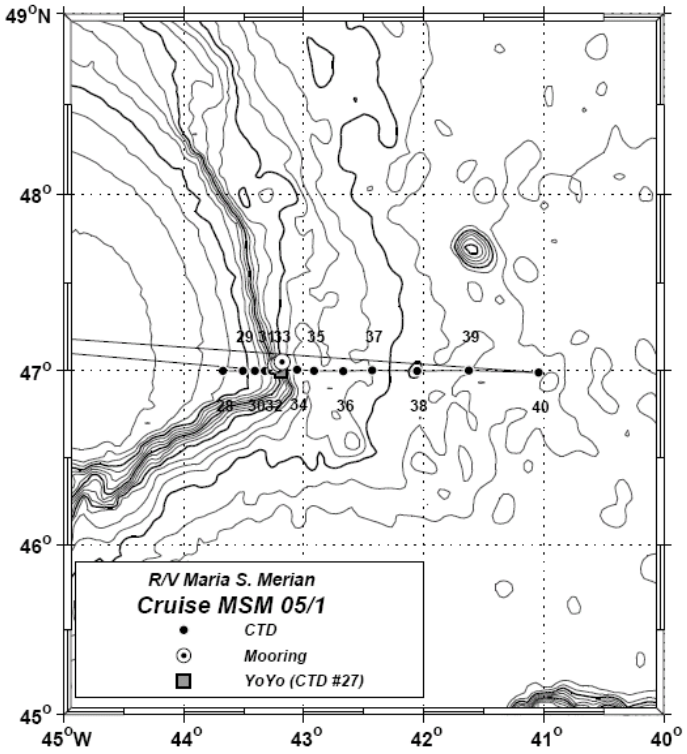
MOORING Positions

Name	Latitude	Longitude	Depth	Deployment Date
B16	47°01.88'N	43°14.09'W	2844m	28.4.2007
	with radio beacon (12kHz), flashlight			
B17	47°02.44'N	43°12.63'W	3155m	28.4.2007
	With radio beacon (12kHz), flashlight			
B18	47°03.06'N	43°10.89'W	3280m	28.4.2007

with radio beacon (12kHz), flashlight



Cruise map of MERIAN cruise MSM05-1 (14.4. – 2.5.2007)



Detailed map of the mooring positions and the 47°N section

Maria S. Merian MSM05/1				CTD Stations				Page 1		
Prof.	Sta.	Date	Time	Latitude	Longitude	Water Depth	Prof. Depth	Measurements CFCs	Measurements LADCP	Comment
1	394	2007/04/19	05:40	47° 41.00' N	31° 8.98' W	4080	4072	x	x	
2	395	2007/04/19	12:22	46° 59.01' N	31° 56.45' W	3894	3884	x	x	
3	396	2007/04/19	18:41	46° 21.46' N	32° 39.43' W	3785	3778	x	x	
4	397	2007/04/20	01:03	45° 44.04' N	33° 22.45' W	3784	3774	x	x	
5	398	2007/04/20	07:36	45° 6.99' N	34° 5.00' W	3624	3612	x	x	
6	399	2007/04/20	13:45	44° 51.50' N	34° 59.44' W	4239	4271	x	x	
7	400	2007/04/20	20:56	44° 36.52' N	35° 54.02' W	3971	3919	x	x	
8	401	2007/04/21	03:45	44° 21.01' N	36° 48.98' W	4200	4195	x	x	
9	402	2007/04/21	10:07	44° 5.51' N	37° 43.48' W	4151	4113	x	x	
10	403	2007/04/21	16:04	43° 50.02' N	38° 37.93' W	3599	3600	x	x	
11	404	2007/04/21	21:04	43° 30.00' N	38° 50.52' W	4390	4394	x	x	
12	405	2007/04/22	06:12	43° 19.49' N	40° 26.97' W	4815	4816	x	x	
13	406	2007/04/22	13:43	43° 3.97' N	41° 21.94' W	4827	4800	x	x	
14	407	2007/04/22	20:56	42° 48.52' N	42° 16.46' W	4700	1820		x	no data below 1900 m
15	408	2007/04/23	02:22	42° 33.46' N	43° 10.98' W	4865	4812	x	x	
16	409	2007/04/23	08:46	42° 18.20' N	44° 5.67' W	4890	4896	x	x	
17	410	2007/04/23	15:05	42° 2.54' N	44° 59.97' W	4836	4826	x	x	
18	411	2007/04/23	23:06	42° 15.03' N	45° 49.98' W	4700	4699	x	x	
19	412	2007/04/24	05:40	42° 29.03' N	46° 39.90' W	4434	4420	x	x	
20	413	2007/04/24	11:50	42° 42.01' N	47° 30.02' W	3777	3764	x	x	
21	414	2007/04/24	16:37	42° 47.47' N	47° 49.42' W	3640	3612	x	x	
22	415	2007/04/24	20:41	42° 53.00' N	48° 9.03' W	3300	3320	x	x	
23	416	2007/04/25	00:30	42° 58.52' N	48° 28.51' W	2900	2820	x	x	
24	417	2007/04/25	03:49	43° 3.99' N	48° 47.97' W	2185	2159	x	x	
25	418	2007/04/25	06:44	43° 9.53' N	49° 7.00' W	1360	1115	x	x	
26	419	2007/04/25	09:07	43° 15.01' N	49° 26.52' W	500	292		x	
27	420	2007/04/27	22:52	46° 59.70' N	43° 11.50' W	3142	3043		x	CTD yo-yo
28	424	2007/04/28	23:10	46° 59.99' N	43° 40.46' W	760	739	x	x	
29	425	2007/04/29	01:07	46° 59.98' N	43° 30.46' W	981	960	x	x	
30	426	2007/04/29	02:44	47° 0.00' N	43° 24.48' W	1233	1200	x	x	
31	427	2007/04/29	04:20	47° 0.00' N	43° 19.43' W	1537	1499	x	x	
32	428	2007/04/29	06:00	47° 0.00' N	43° 15.97' W	1830	1772	x	x	
33	429	2007/04/29	07:57	47° 0.18' N	43° 11.80' W	3130	3073	x	x	
34	430	2007/04/29	11:07	47° 0.38' N	43° 3.40' W	3285	3238	x	x	
35	431	2007/04/29	15:00	46° 59.98' N	42° 54.85' W	3518	3478	x	x	
36	432	2007/04/29	18:03	46° 59.91' N	42° 40.28' W	3647	3622	x	x	
37	433	2007/04/29	21:41	47° 0.17' N	42° 25.83' W	3828	3807	x	x	
38	434	2007/04/30	01:33	46° 59.96' N	42° 3.32' W	4212	4190	x	x	
39	435	2007/04/30	05:40	47° 0.11' N	41° 37.43' W	4280	4263	x	x	
40	436	2007/04/30	11:28	46° 59.44' N	41° 2.54' W	5003	4491	x	x	