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## Short Cruise Report

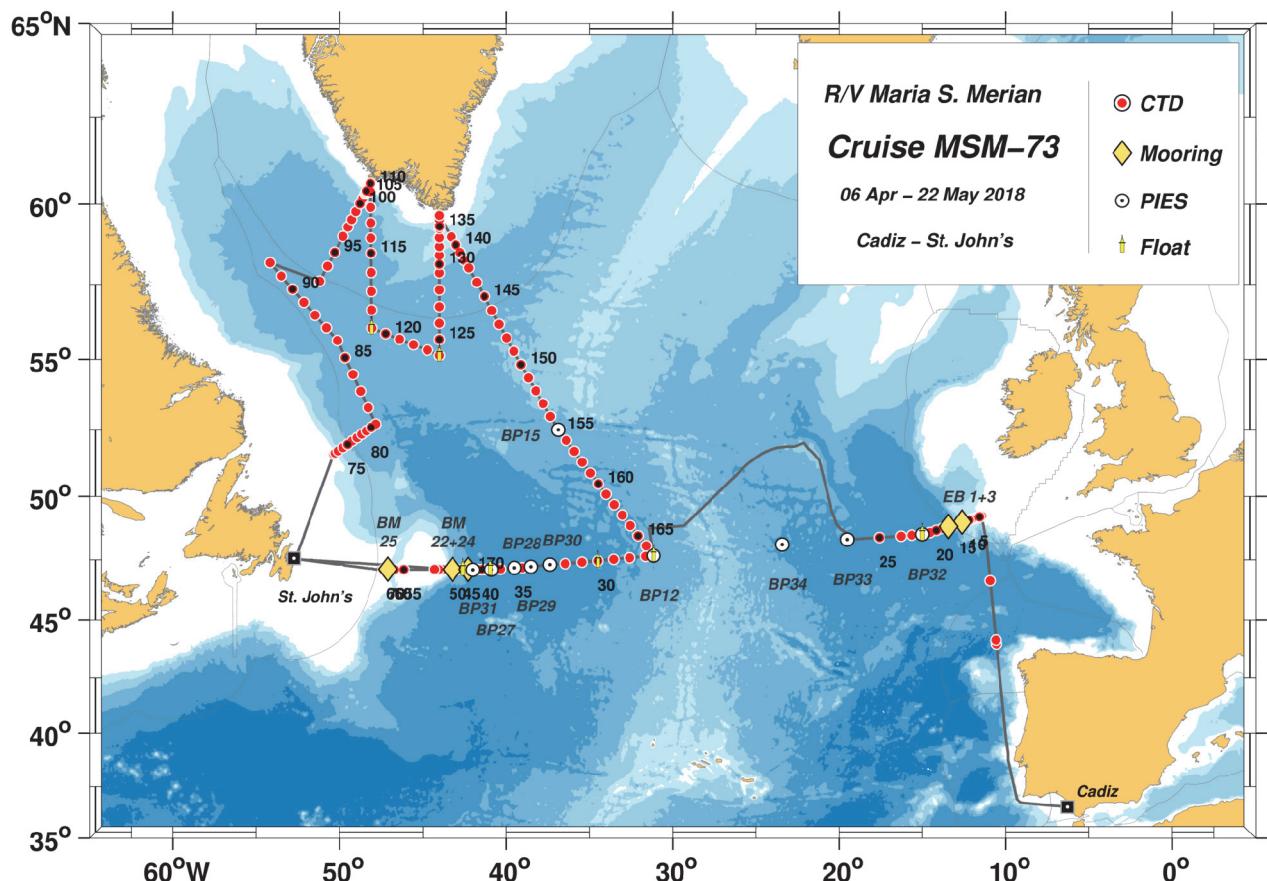
### - RV Maria S. Merian, cruise MSM-73 -

Cádiz/Spain – St. John's/Canada

06 Apr – 22 May 2018

**Chief Scientist: Dr. Dagmar Kieke**

**Captain: Ralf Schmidt**



**Figure 1.** Track of RV MARIA S. MERIAN, cruise MSM-73, and locations of hydrographic profiles (red, numbers denote profile numbers), deployed moorings (yellow), locations of inverted echo-sounders with pressure sensors (PIES, white), and Argo float deployments. Bathymetric contours are shown every 1000 m.

## **1. Objectives**

Physical oceanographic measurements conducted during cruise *MSM-73* contributed to two different scientific projects: *RACE-II* (“Regional Atlantic ChangE”), sub-project 1.2, funded by the *German Ministry for Education and Research* (BMBF), as well as the priority program *SeaLevel*, funded by the German Research Foundation (DFG). Scientific work during cruise *MSM-73* focused on collecting physical-oceanographic data along the geographic latitude of ~47°/48°N as well as along a net of survey lines crossing the Labrador Sea and the southern Irminger Sea and leading back from the Reykjanes Ridge to about 47°/48°N.

Scientific tools comprised profiling of the entire water column using two lowered Acoustic Doppler Current Profilers (LADCP) and a Conductivity-Temperature-Depth-Oxygen (CTDO) unit, all attached to a carousel water sampler. Water sampling activities consisted of taking oxygen and salinity samples for the sake of conductivity/oxygen-sensor calibration as well as taking samples for the analysis of anthropogenic trace gases (chlorofluorocarbon-12, CFC-12; sulphurhexafluoride, SF<sub>6</sub>). Furthermore, water samples were taken for a home-based analysis of oceanic concentrations of the noble gases helium and neon, carbon and oxygen isotopes ratios in seawater, as well total inorganic carbon (TIC) and total alkalinity (TA).

Hydrographic station work was complemented by the recovery and redeployment of deep-sea moorings located at the eastern and western continental margins of the North Atlantic (Goban Spur at the Irish shelf break; eastern flank of Flemish Cap; Flemish Pass). Several inverted echo-sounders carrying pressure sensors (PIES) were installed along 47°/48°N as well as near the western exit of the Charlie-Gibbs Fracture Zone near 52°30'N. Respective station work was related to data retrieval via acoustic telemetry, recovery, and redeployment of the devices. The deep-sea moorings and the PIES form the oceanic long-term observatory NOAC (“North Atlantic Changes”).

Two vessel-mounted ADCP systems operated at 38 kHz and 75 kHz delivered velocity data of the upper water column. Further underway measurements focused on standard meteorological data and near-surface water temperatures and salinity.

Measurements and data acquisition carried out during cruise *MSM-73* were related to the following scientific questions and research objectives:

- What is the inventory of the anthropogenic trace gases CFC-12 and SF<sub>6</sub> in 2018 regarding the different water masses contributing to North Atlantic Deep Water (NADW); what is the respective formation rate of Labrador Sea Water (LSW) in the period 2015/16 to 2018? What are the water mass properties and spreading pathways of the particular LSW vintage present in 2018?
- What is the storage rate of anthropogenic carbon in the subpolar North Atlantic in 2018? To what degree has it changed compared to previous years?
- What is the contribution of meltwater originating on the Greenland Ice Sheet to the water column in the eastern Labrador Sea off Greenland and to the south of Cape Farvel?
- How far does the saline tongue of Northeast Atlantic Deep Water (NEADW) that spreads along interior pathways extend towards west in 2018? What governs the existence of interior pathways?
- What is the strength of the deep water export across 47°/48°N in 2017-2018? What is the respective strength regarding the warm and saline import with the North Atlantic Current (NAC)? What is the portion of the NAC that crosses the Mid-Atlantic Ridge into the eastern basin in 2017-2018? To what degree is it linked to the location and variation of the Subpolar Front?
- How much LSW leaves the subpolar North Atlantic through Flemish Pass in 2017 to 2018, and how does it vary in comparison to the Deep Western Boundary Current (DWBC) located off Flemish Cap?
- What is the strength of the northward slope current at the eastern boundary in 2017 to 2018? What governs its variability? How variable is the general flow field in the eastern basin? Is there evidence for a southward recirculation across 47°/48°N in the eastern basin?

## **2. Narrative of cruise MSM-73**

*RV MARIA S. MERIAN* left its berth in Cádiz, Spain, on April 06<sup>th</sup>, 2018, at 06:30 UTC. The scientific mission of cruise MSM-73 started at 07:18 UTC the same day, when continuous logging of underway data was switched on. Course was set towards the Irish shelf break at Goban Spur. While on transit towards north, a number of test stations were carried out in

deep water during April 08<sup>th</sup> to April 09<sup>th</sup>. These served to check the performance of the CTDO unit and the two LADCPs attached to the carousel water sampler. Furthermore, the functioning of acoustic releases at depth was verified as well as first calibration casts for moored sensors were carried out. Between April 10<sup>th</sup> and 13<sup>th</sup>, we conducted a high-resolution CTDO/LADCP section along the crest of Goban Spur and started tracer sampling and data analysis. We also recovered and subsequently redeployed the two deep-sea moorings *EB-1* and *EB-3* as well as the PIES *BP-32*.

Station work continued along a westward track until the morning of April 15<sup>th</sup>, 04:00 UTC, when a huge storm system the size of the North Atlantic forced us to abandon any station work for the next four days. Being forced to circumnavigate the storm system on a northern track, we could neither visit the PIES locations *BP-33* and *BP-34* at 47°/48°N nor carry out the intended station work along this line.

We resumed scientific work on April 19<sup>th</sup> at 02:55 UTC, when we arrived at PIES station *BP-12*. The respective instrument was recovered, and hydrographic station work at distances of ~40 nm continued. Between April 21<sup>st</sup> and April 23<sup>rd</sup>, we recovered the bottom-mounted echo-sounders located at the PIES stations *BP-27*, *BP-28*, *BP-29*, and *BP-31* and performed data retrieval via acoustic telemetry on PIES station *BP-30*.

Between April 24<sup>th</sup> and April 25<sup>th</sup>, we recovered the two deep-sea moorings *BM-22* and *BM-24* and finished a high-resolution hydrographic section leading from the deep Newfoundland Basin to the shallow eastern side of Flemish Cap. Afterwards, we transited across Flemish Cap and carried out a CTDO/LADCP section across Flemish Pass. We recovered and redeployed mooring *BM-25* the same day and headed west towards St. John's, Newfoundland. Though all ship tanks were full of fuel at the beginning of the cruise, the available fuel was no longer sufficient for the remaining time of the cruise and distances to cover. Therefore, a port visit in St. John's, Newfoundland, was required.

Continuous logging of underway data was temporarily stopped on April 28<sup>th</sup>, 09:57 UTC, and at 10:30 UTC, we arrived at the pilot station of St. John's. While refueling at the bunker pier, one participant officially disembarked. Having finished fueling work, we left St. John's the same day, resumed scientific work at 12:42 UTC, and headed north towards the Canadian continental shelf break at about 51°30'N. Logging of underway measurements was resumed starting at 15:30 UTC. Between April 29<sup>th</sup> and 30<sup>th</sup>, we carried out a hydrographic section across the western boundary current system at station distances of

about 7-13 nm. Having arrived at 52°42.90'N/47°49.20'W, we turned towards the northwest and performed hydrographic casts at distances of about 40 nm. The clean-seawater system and thus the thermosalinograph was shut down for maintenance reasons between May 02<sup>nd</sup>, 14:00 UTC and May 03<sup>rd</sup>, 12:55 UTC. The same day, we followed the so-called AR7W-line, a repeat hydrography line spanning the width of the Labrador Sea, towards its northeastern end near Greenland. Sampling of noble gas isotopes started in the center of the Labrador Basin and was preliminary finished when reaching the limit of the Greenlandic 3 nm-zone on May 05<sup>th</sup>.

Between May 05<sup>th</sup> and May 08<sup>th</sup>, we followed a southern track along 44°W and an eastern track towards 44°W. We used several stations for calibrating instruments to be moored at the end of the cruise against CTDO data and checked the functioning of acoustic releases in high pressure environments.

Noble gas sampling was resumed again on May 08<sup>th</sup> when following the 44°W meridian towards Cape Farvel at the southern tip of Greenland. Between May 10<sup>th</sup>, 08:20 UTC, and May 11<sup>th</sup>, 06:00 UTC, we had to cancel station work due to deteriorating weather and sea state. We finished the hydrographic section along 44°W the same day when reaching the limit of the Greenlandic 3 nm-zone.

Between May 10<sup>th</sup> and May 17<sup>th</sup> we headed along a southeastern section leading from Cape Farvel along the western flank of the Mid-Atlantic Ridge towards 47°/48°N and carried out water sampling for analyzing oceanic TIC and TA contents. On May 14<sup>th</sup>, we performed acoustic data retrieval at PIES location *BP-15*, and on May 17<sup>th</sup>, we redeployed an inverted echo-sounder at the PIES location *BP-12*. Afterwards, we headed west again along 47°/48°N. Between May 18<sup>th</sup> and 19<sup>th</sup>, we dropped three more PIES (*BP-27*, *BP-28*, and *BP-31*) along this latitude and redeployed the two deep-sea moorings *BM-22* and *BM-24* on May 19<sup>th</sup> and 20<sup>th</sup>, thus finishing station work.

Continuous logging of thermosalinograph data was stopped on May 22<sup>nd</sup>, 04:25 UTC. Logging of the remaining underway data was finished on 10:00 UTC the same day, which marked the end of the scientific mission MSM-73 of *RV MARIA S. MERIAN*. The vessel arrived at the pilot station of St. John's and was finally towed at pier 17 at 10:30 UTC the same day.

In total, 172 hydrographic profiles were carried out during cruise MSM-73. Five deep-sea moorings were recovered and subsequently reinstalled again. Six PIES were recovered,

and five were deployed again. Seven Argo floats of type APEX were deployed along 47°/48°N as well as in the Labrador Sea. All were programmed to drift at a parking depth of 1000 dbar and to cycle between 2000 dbar and the sea surface every ten days.

Due to severe weather and sea state conditions outlined above, overall we lost five days of working time. Another work day was initially lost due to a required fuel stop in St. John's, Newfoundland but could be compensated later through being able to proceed with 11-12 kn whenever possible. As a consequence, hydrographic station work and PIES activities planned for the central part of the 47°/48°N section could not be carried out, and sections located to the southwest and south of Greenland had to be shortened. The pCO<sub>2</sub>-system installed during the cruise to perform near-surface and atmospheric measurements of the partial pressure of carbon dioxide (CO<sub>2</sub>) could not be brought into operation due to severe multiple system malfunctioning.

## Acknowledgements

We would like to express our gratitude to the master of the vessel, Ralf Schmidt, and his entire crew for the assistance and great support granted to us during cruise MSM-73. This has been an extraordinary long cruise, and we greatly appreciate the very friendly working environment. The hospitality experienced onboard the vessel and the very professional and constructive cooperation between the different scientific teams and the ship's team is greatly acknowledged. We further thank Barbara Kozak and Dr. Achim Roessler at our home laboratory for assistance in the preparation of the cruise, the *Federal Ministry for Education and Research* (BMBF), the *German Research Foundation* (DFG), the DFG's former *Permanent Senate Commission on Oceanography*, and the *Control Station German Research Vessels* (*Leitstelle Deutsche Forschungsschiffe*) that provided the necessary ship time, funding, and support to pursue all scientific work, the *German Weather Service* (*Seewetteramt* Hamburg) that provided meteorological counseling.

**Table 1. Participants of cruise MSM-73.**

	Name	Institute	Field of Activity
1.	Kieke, Dagmar, Dr.	IUPHB/MARUM	chief scientist
2.	Arruda Monteiro da Silva, Ricardo (*)	DAL	pCO <sub>2</sub> analysis, CTDO/LADCP
3.	Binnemann, Nico	UHB	oxygen analysis
4.	Buinyi, Aleksei	IUPHB/MARUM	CTDO/LADCP, VMADCP processing
5.	Bulsiewicz, Klaus	IUPHB	tracer analysis
6.	Feucher, Charlène, Dr.	UEA	CTDO/LADCP, data analysis
7.	Huhn, Oliver, Dr.	IUPHB/MARUM	CTDO/LADCP, water sampling coordination
8.	Köllner, Manuela	BSH	mooring analysis, CTDO/LADCP
9.	Nowitzki, Hannah	IUPHB/MARUM	PIES and Aquadopp preparation, CTDO/LADCP
10.	Oelsmann, Julius	IUPHB/MARUM	CTDO/LADCP, data processing
11.	Röhler, Aaron	IUPHB/MARUM	tracer analysis
12.	Rohlfs, Nina	IUPHB/MARUM	tracer analysis
13.	Schneehorst, Anja	BSH	mooring preparation, Argo float deployments
14.	Steinfeldt, Reiner, Dr.	IUPHB/MARUM	CTDO data processing and calibration, data analysis, salinometry
15.	Uhde, Hans-Hermann	BSH	mooring preparation, Argo float deployment
16.	Wiegand, Kevin	IUPHB/MARUM	CTDO/LADCP, data processing
17.	Wischniewski, Fanny	IUPHB/MARUM	LADCP processing, mooring preparation/analysis

(\*) left in St. John's, Canada, on 28 Apr 2018

BSH	Federal Maritime and Hydrographic Agency, Hamburg, Germany
DAL	Dalhousie University, Halifax, Canada
IUPHB	University of Bremen, Institute of Environmental Physics, Bremen, Germany
MARUM	University of Bremen, Center for Marine Environmental Sciences, Bremen, Germany
UEA	University of Alberta, Edmonton, Alberta, Canada
UHB	University of Bremen, Faculty 2, Biology/Chemistry, Bremen, Germany

**Table 2. Argo float deployments during cruise MSM-73.**

MSM-Station	Float s/n	WMO ID	Argos ID	Latitude	Longitude	Deployment Date/Time	CTD #
26-3	8448	3901666	53346	48°31.010'N	15°00.130'W	13 Apr 2018 08:37	22
30-3	8450	3901664	53350	47°39.708'N	31°08.850'W	19 Apr 2018 07:58	26
34-2	8451	3901663	53351	47°26.644'N	34°28.751'W	20 Apr 2018 10:03	30
42-4	8452	3901662	53352	47°07.306'N	40°55.969'W	23 Apr 2018 07:55	38
49-2	8453	3901661	53353	47°06.054'N	42°35.502'W	24 Apr 2018 23:32	45
122-2	8454	3901660	53344	56° 03.435'N	48°03.744'W	07 May 2018 15:15	119
127-2	8449	3901665	53357	55° 08.173'N	44°00.025'W	08 May 2018 15:53	124

All times are given as UTC. All deployed floats are of type *Teledyne APEX* and carry conductivity, temperature, and pressure sensors. The parking depth is 1000 dbar, the cycling period is 10 days.

**Table 3. Deep-Sea moorings recovered and deployed during cruise MSM-73.**

MSM-Station	Mooring ID	Latitude	Longitude	Depth [m]	Recovery Date/Time	Deployment Date/Time	CTD Profile
20-1	EB-1/2	49°00.02'N	12°37.08'W	1530	11 Apr 2018 17:04 – 18:10	–	13
22-1	EB-1/3	49°00.03'N	12°37.14'W	1534	---	12 Apr 2018 07:12 – 08:33	13
18-1	EB-3/2	48°49.98'N	13°25.98'W	4453	11 Apr 2018 05:43 – 09:03	–	17
19-1	EB-3/3	48°49.98'N	13°25.98'W	4453	---	11 Apr 2018 19:55 – 13:52	17
48-1	BM-22/8	47°06.19'N	43°13.37'W	3048	24 Apr 2018 14:54 – 17:30	–	44
175-2	BM-22/9	47°06.19'N	43°13.37'W	3048	---	20 May 2018 10:36 – 12:44	173
47-2	BM-24/5	47°06.21'N	42°16.47'W	4008	24 Apr 2018 08:52 – 11:57	--	43
173-1	BM-24/6	47°06.21'N	42°16.47'W	4008	–	19 May 2018 14:35 – 17:41	169
73-2	BM-25/5	47°07.11'N	47°06.38'W	1003	25 Apr 2018 18:10 – 18:43	–	70
73-4	BM-25/6	47°07.11'N	47°06.38'W	1003	–	25 Apr 2018 21:33 – 21:43	70

All times are given as UTC. The top buoy of all deployed moorings was equipped with radio beacons, flags, flashers, and *Iridium* or Argos beacons.

**Table 4. Activities related to inverted echo-sounders with pressure sensors (PIES).**

MSM Station	PIES ID	s/n	Latitude	Longitude	Depth [m]	Deploy-ment Date/Time	Telemetry Date/Time	Recovery Date/Time	CTD #
30	BP12/5	271	47°39.91'N	31°08.88'W	4090	---	---	19 Apr 2018 02:56–05:19	26
170	BP12/6	271	47°39.79'N	31°08.66'W	4094	17 May 2018 11:04–13:15	---	---	167
158	BP15/4	201	52°30.53'N	36°51.93'W	3387	---	14 May 2018 16:57–23:15	---	155
42	BP27/3	272	47°05.87'N*	40°52.54'W*	4200*	---	---	23 Apr 2018 01:28–03:35	38
172	BP27/4	302	47°06.11'N	40°53.04'W	4499	19 May 2018 06:35–08:04	---	---	169
39	BP28/3	302	47°10.29'N	39°29.63'W	4562	---	---	22 Apr 2018 03:44–05:24	35
171	BP28/4	272	47°10.21'N	39°28.70'W	4605	18 May 2018 17:55–22:02	---	---	168
38	BP29/3	303	47°12.68'N	38°30.93'W	4608	---	21 Apr 2018 18:15–21:00	21/22 Apr 2018 21:00–00:10	34
37	BP30/2	235	47°18.06'N	37°21.70'W	4539	---	21 Apr 2018 09:00–12:00	---	33
46	BP31/2	240	47°05.48'N	42°00.38'W	4219	---	---	23/24 Apr 2018 23:38–00:57	42
174	BP31/3	303	47°05.17'N	42°00.77'W	4246	20 May 2018 00:38–02:11	---	---	170
26	BP32/2	362	48°31.13'N	15°00.22'W	4793	---	13 Apr 2018 05:30–08:03 17:28–18:47	13 Apr 2018 19:55–21:49	22
26	BP32/3	075	48°31.09'N	15°00.10'W	4784	13 Apr 2018 21:57–23:50	---	---	22

All times are given as UTC. All instruments were equipped with flags, radio senders, and flashers.

PIES BP-27/3, BP-28/3, BP-29/3, and BP-31/2 were recovered carrying an additional currentmeter of type *Nortek Aquadopp* and additional buoyancy. They were redeployed without currentmeters.

\* The acoustic command system of the device showed problems. Therefore, no ranging possible, position/depth are only approximate values.

**Table 5. List of CTD/lowered ADCP/water sampling stations carried out during cruise MSM-73**

MSM Station	Profile	Date	Time [UTC]	Latitude	Longitude	Water Depth [m]	Profile Depth [m]	SF <sub>6</sub> /CFC	He/Ne	<sup>13</sup> C/ <sup>18</sup> O	TIC/TA	Bottle Oxygen	LADCP	Comments
1	1	2018/04/08	11:31	43°58.21'N	10°33.42'W	5306	1980	-	-	-	-	x	x	test station; test of acoustic release
2	2	2018/04/08	14:03	44°08.25'N	10°34.78'W	5306	3995	-	-	-	-	-	x	calibration stops for MicroCATs, Aquadopps & NKE loggers
3	3	2018/04/09	07:59	46°38.27'N	10°56.02'W	4781	3996	-	-	-	-	x	x	profile interrupted between 2300 m and 2436 m; calibration stops for Seaguards
4	4	2018/04/10	03:10	49°14.17'N	11°26.76'W	461	454	-	-	-	-	x	x	Argos transmitter test
5	5	2018/04/10	04:28	49°12.59'N	11°34.21'W	626	615	-	-	-	-	-	x	
6	6	2018/04/10	05:44	49°11.02'N	11°41.78'W	785	782	-	-	-	-	x	x	
7	7	2018/04/10	07:02	49°09.42'N	11°49.10'W	789	785	-	-	-	-	-	x	
8	8	2018/04/10	08:26	49°07.78'N	11°56.59'W	850	844	-	-	-	-	x	x	
9	9	2018/04/10	09:46	49°06.26'N	12°04.03'W	914	907	-	-	-	-	-	x	

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10	10	2018/04/10	11:13	49°04.75'N	12°11.68'W	1012	1004	-	-	-	-	x	x
11	11	2018/04/10	12:39	49°03.10'N	12°19.11'W	1134	1130	-	-	-	-	x	x
12	12	2018/04/10	14:05	49°01.56'N	12°26.52'W	1282	1272	-	-	-	x	x	x
13	13	2018/04/10	15:46	48°59.34'N	12°34.87'W	1535	1540	-	-	-	-	x	x
14	14	2018/04/10	17:22	48°58.42'N	12°41.29'W	1766	1765	-	-	-	x	x	x
15	15	2018/04/10	19:10	48°56.86'N	12°48.79'W	2079	2073	-	-	-	-	x	x
16	16	2018/04/10	21:15	48°55.54'N	12°57.00'W	2597	2602	-	-	-	x	x	x
17	17	2018/04/11	01:14	48°48.86'N	13°26.16'W	4432	4424	-	-	-	x	x	x
21	18	2018/04/11	23:45	48°53.76'N	13°03.78'W	3639	3609	-	-	-	-	x	x
23	19	2018/04/12	13:15	48°44.97'N	13°48.46'W	4530	4518	x	-	-	x	x	x
24	20	2018/04/12	17:33	48°40.22'N	14°10.90'W	4543	4529	x	-	-	x	x	x

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25	21	2018/04/12	21:52	48°35.49'N	14°33.23'W	4692	4681	x	-	-	-	x	x
26	22	2018/04/13	02:41	48°31.15'N	15°00.19'W	4816	4797	x	-	x	-	x	x
27	23	2018/04/13	11:58	48°28.91'N	15°38.75'W	4844	4824	x	-	-	-	x	x
28	24	2018/04/14	05:06	48°26.70'N	16°17.32'W	4679	4616	x	-	x	-	x	x
29	25	2018/04/14	14:35	48°23.57'N	17°34.56'W	4211	4144	x	-	x	-	x	x
30	26	2018/04/19	05:27	47°39.72'N	31°08.80'W	4085	4075	x	-	x	-	x	x
31	27	2018/04/19	10:05	47°38.41'N	31°37.45'W	3760	3755	x	-	-	-	x	x
32	28	2018/04/19	16:25	47°34.48'N	32°34.69'W	3965	3948	x	-	x	-	x	x
33	29	2018/04/19	22:47	47°30.86'N	33°32.17'W	4095	4083	x	-	-	-	x	x
34	30	2018/04/20	07:17	47°27.27'N	34°29.46'W	4406	4385	x	-	x	-	x	x
35	31	2018/04/20	15:20	47°23.70'N	35°26.91'W	4304	4323	x	-	-	-	x	x

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36	32	2018/04/20	23:30	47°20.01'N	36°27.19'W	4272	4232	x	-	x	-	x	x	cast repeated; 1 <sup>st</sup> cast aborted @250 m
37	33	2018/04/21	05:57	47°18.06'N	37°21.56'W	4550	4535	x	-	-	-	x	x	
38	34	2018/04/21	16:26	47°12.69'N	38°30.94'W	4605	4605	x	-	x	-	x	x	acoustic release test 30 m above bottom
39	35	2018/04/22	05:52	47°10.85'N	39°29.28'W	4580	4574	x	-	-	-	x	x	
40	36	2018/04/22	10:18	47°10.24'N	39°01.19'W	4585	4578	x	-	x	-	x	x	
41	37	2018/04/22	19:52	47°07.10'N	40°20.36'W	4560	4539	x	-	-	-	x	x	
42	38	2018/04/23	05:04	47°06.72'N	40°54.66'W	4500	4480	x	-	x	-	x	x	cast repeated; 1 <sup>st</sup> cast aborted @960 m
43	39	2018/04/23	09:11	47°05.71'N	41°10.76'W	4455	4438	-	-	-	-	x	x	
44	40	2018/04/23	13:33	47°05.71'N	41°27.14'W	4339	2118	-	-	-	-	x	x	cast repeated; 1 <sup>st</sup> cast aborted @530 m; 2 <sup>nd</sup> cast @2100 m
45	41	2018/04/23	20:00	47°05.70'N	41°44.02'W	4270	4256	x	-	x	-	x	x	
46	42	2018/04/24	01:02	47°05.35'N	42°00.44'W	4222	4215	x	-	-	-	x	x	

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47	43	2018/04/24	04:40	47°06.22'N	42°14.97'W	4038	4016	x	-	-	x	x
48	44	2018/04/24	17:12	47°05.85'N	43°14.63'W	2975	2952	x	-	x	-	x
49	45	2018/04/24	21:22	47°06.03'N	42°35.44'W	3661	3653	x	-	-	x	x
50	46	2018/04/25	00:41	47°06.06'N	42°53.65'W	3451	3443	x	-	-	x	x
51	47	2018/04/25	03:47	47°06.11'N	43°07.14'W	3515	3494	-	-	-	x	x
52	48	2018/04/25	06:35	47°06.04'N	43°17.81'W	2590	2566	x	-	-	x	x
53	49	2018/04/25	08:33	47°05.92'N	43°20.13'W	1900	1812	x	-	-	x	x
54	50	2018/04/25	10:28	47°06.02'N	43°25.26'W	1275	1265	x	-	x	-	x
55	51	2018/04/25	12:11	47°05.99'N	43°38.37'W	760	752	x	-	-	x	x
56	52	2018/04/25	13:35	47°05.99'N	43°47.45'W	577	573	x	-	-	x	x
57	53	2018/04/25	15:13	47°06.06'N	44°02.51'W	349	344	-	-	-	-	x

*Short Cruise Report, RV Maria S. Merian, Cruise MSM-73, Cadiz – St. John's, 06 Apr – 22 May 2018*

58	54	2018/04/25	16:45	47°06.09'N	44°17.87'W	243	238	-	-	-	-	-	X
59	55	2018/04/26	00:30	47°06.06'N	46°08.36'W	323	317	-	-	-	-	-	X
60	56	2018/04/26	02:02	47°06.12'N	46°24.15'W	348	344	-	-	-	-	-	X
61	57	2018/04/26	03:07	47°06.05'N	46°33.25'W	487	477	X	-	-	-	X	X
62	58	2018/04/26	04:00	47°06.08'N	46°36.63'W	803	795	X	-	-	-	X	X
63	59	2018/04/26	05:03	47°06.06'N	46°39.99'W	1094	1082	X	-	-	-	-	X
64	60	2018/04/26	06:13	47°06.01'N	46°42.44'W	1127	1123	-	-	-	X	-	X
65	61	2018/04/26	07:45	47°06.03'N	46°51.18'W	1160	1154	X	-	-	-	-	X
66	62	2018/04/26	09:18	47°06.07'N	47°00.54'W	1123	1112	X	-	-	X	-	X
67	63	2018/04/26	10:43	47°05.92'N	47°05.84'W	1014	1008	X	-	-	-	-	X
68	64	2018/04/26	11:52	47°05.94'N	47°09.28'W	880	873	X	-	-	X	-	X
													test of radio beacon

**Short Cruise Report, RV Maria S. Merian, Cruise MSM-73, Cadiz – St. John's, 06 Apr – 22 May 2018**

69	65	2018/04/26	13:01	47°06.00'N	47°12.49'W	723	714	x	-	-	-	-	-	x
70	66	2018/04/26	14:01	47°05.92'N	47°15.83'W	470	465	x	-	-	x	-	x	x
71	67	2018/04/26	14:54	47°05.78'N	47°19.46'W	300	294	-	-	-	-	-	-	x
72	68	2018/04/26	15:39	47°05.67'N	47°22.82'W	235	226	-	-	-	-	-	-	x
73	69	2018/04/26	17:11	47°05.89'N	47°06.59'W	983	973	-	-	-	-	-	-	x
73	70	2018/04/26	20:37	47°06.62'N	47°06.19'W	1005	989	-	-	-	-	-	-	x
74	71	2018/04/29	16:59	51°36.12'N	50°21.49'W	483	455	x	-	-	x	-	x	x
75	72	2018/04/29	17:55	51°38.51'N	50°16.05'W	1024	1006	x	-	-	x	-	x	x
76	73	2018/04/29	19:33	51°43.56'N	50°04.64'W	1865	1871	x	-	-	x	-	x	x
77	74	2018/04/29	21:52	51°50.97'N	49°47.69'W	2530	2547	x	-	-	x	-	x	x
78	75	2018/04/30	00:32	51°58.36'N	49°30.65'W	2919	2909	x	-	-	x	-	x	x

**Short Cruise Report, RV Maria S. Merian, Cruise MSM-73, Cadiz – St. John's, 06 Apr – 22 May 2018**

79	76	2018/04/30	03:30	52°05.86'N	49°13.81'W	3170	3165	x	-	-	-	x	x
80	77	2018/04/30	06:35	52°13.24'N	48°56.92'W	3655	3347	x	-	-	-	x	x
81	78	2018/04/30	09:43	52°20.63'N	48°40.00'W	3613	3613	x	-	-	-	x	x
82	79	2018/04/30	13:07	52°28.03'N	48°23.02'W	3748	3747	-	-	-	-	x	x
83	80	2018/04/30	16:30	52°35.47'N	48°06.03'W	4826	3820	x	-	-	-	x	x
84	81	2018/04/30	20:41	52°42.88'N	47°49.20'W	3890	3889	x	-	-	-	x	x
85	82	2018/05/01	03:14	53°18.18'N	48°16.75'W	3844	3826	x	-	-	-	x	x
86	83	2018/05/01	09:01	53°53.34'N	48°44.31'W	3790	3775	x	-	-	-	x	x
87	84	2018/05/01	14:41	54°28.56'N	49°11.87'W	3708	3703	x	-	-	-	x	x
88	85	2018/05/01	20:21	55°03.79'N	49°39.42'W	3600	3587	x	-	-	-	x	x
89	86	2018/05/02	01:52	55°39.02'N	50°07.03'W	3635	3623	x	-	-	-	x	x

**Short Cruise Report, RV Maria S. Merian, Cruise MSM-73, Cadiz – St. John's, 06 Apr – 22 May 2018**

90	87	2018/05/02	07:04	56°04.38'N	50°47.55'W	3630	3620	x	-	-	-	x	x
91	88	2018/05/02	12:00	56°29.78'N	51°28.00'W	3583	3573	x	-	-	-	x	x
92	89	2018/05/02	17:40	56°55.18'N	52°08.52'W	3519	3513	x	x	-	-	x	x
93	90	2018/05/02	22:52	57°20.58'N	52°49.03'W	3467	3460	x	-	-	-	x	x
94	91	2018/05/03	04:02	57°45.99'N	53°29.54'W	3430	3423	x	-	-	-	x	x
95	92	2018/05/03	09:11	58°11.36'N	54°10.05'W	3400	3383	x	-	-	-	x	x
96	93	2018/05/03	20:15	57°36.26'N	51°11.16'W	3645	3637	x	x	-	-	x	x
97	94	2018/05/04	03:07	58°04.97'N	50°43.15'W	3554	3538	x	x	-	-	x	x
98	95	2018/05/04	08:39	58°31.17'N	50°17.37'W	3760	3511	x	x	-	-	x	x
99	96	2018/05/04	14:24	59°1.14'N	49°47.35'W	3451	3438	x	x	-	-	x	x
100	97	2018/05/04	18:27	59°18.38'N	49°29.91'W	3400	3395	x	x	-	-	x	x
acoustic release test 30 m above bottom and @2500 m													
test of radio beacon & flasher													

**Short Cruise Report, RV Maria S. Merian, Cruise MSM-73, Cadiz – St. John's, 06 Apr – 22 May 2018**

101	98	2018/05/04	21:56	59°31.67'N	49°16.40'W	3352	3347	x	x	-	-	x	x
102	99	2018/05/05	01:28	59°46.59'N	49°01.06'W	3180	3149	x	x	-	-	x	x
103	100	2018/05/05	04:52	60°00.83'N	48°46.34'W	2942	2939	-	x	-	-	x	x
104	101	2018/05/05	07:44	60°10.54'N	48°36.30'W	2820	2806	x	x	-	-	x	x
105	102	2018/05/05	10:20	60°18.75'N	48°27.73'W	2588	2580	-	x	-	-	x	x
106	103	2018/05/05	12:58	60°20.14'N	48°26.50'W	1941	1871	x	x	-	-	x	x
107	104	2018/05/05	14:58	60°22.50'N	48°23.90'W	1169	1143	x	x	-	-	x	x
108	105	2018/05/05	16:26	60°23.32'N	48°22.92'W	755	732	x	x	-	-	x	x
109	106	2018/05/05	17:37	60°24.72'N	48°21.41'W	217	209	-	x	-	-	x	x
110	107	2018/05/05	18:27	60°26.94'N	48°19.06'W	150	136	-	x	-	-	x	x
111	108	2018/05/05	19:19	60°29.21'N	48°16.75'W	142	128	-	x	-	-	x	x

**Short Cruise Report, RV Maria S. Merian, Cruise MSM-73, Cadiz – St. John's, 06 Apr – 22 May 2018**

112	109	2018/05/05	20:18	60°32.94'N	48°12.75'W	133	118	-	x	-	-	x	x
113	110	2018/05/05	21:15	60°36.75'N	48°08.72'W	112	96	-	x	-	-	x	x
114	111	2018/05/05	22:53	60°22.03'N	48°08.28'W	150	141	-	-	-	-	-	x
115	112	2018/05/06	01:39	59°54.02'N	48°07.99'W	2961	2945	-	-	-	-	x	x
116	113	2018/05/06	06:14	59°25.96'N	48°07.40'W	3170	3161	x	-	-	-	x	x
117	114	2018/05/06	10:28	58°57.70'N	48°06.92'W	3258	3250	x	-	-	-	x	x
118	115	2018/05/06	14:41	58°29.58'N	48°06.36'W	3420	3408	x	-	-	-	x	x
119	116	2018/05/06	19:48	57°52.99'N	48°05.67'W	3371	3308	x	-	-	-	x	x
120	117	2018/05/07	01:46	57°16.40'N	48°05.02'W	3404	3379	x	-	-	-	x	x
121	118	2018/05/07	06:59	56°39.88'N	48°04.35'W	3630	3616	x	-	-	-	x	x
122	119	2018/05/07	12:28	56°03.41'N	48°03.69'W	3634	3616	x	-	-	-	x	x

**Short Cruise Report, RV Maria S. Merian, Cruise MSM-73, Cadiz – St. John's, 06 Apr – 22 May 2018**

123	120	2018/05/07	17:56	55°52.33'N	47°13.64'W	3427	3419	x	-	-	-	x	x
124	121	2018/05/07	23:22	55°41.30'N	46°23.57'W	3190	3187	x	-	-	-	x	x
125	122	2018/05/08	04:39	55°30.21'N	45°33.51'W	3325	3315	x	-	-	-	x	x
126	123	2018/05/08	09:22	55°19.16'N	44°43.46'W	3370	3356	x	-	-	-	x	x
127	124	2018/05/08	13:52	55°08.08'N	43°59.91'W	3394	3379	x	-	-	-	x	x
128	125	2018/05/08	19:49	55°40.87'N	43°59.96'W	3290	3285	x	x	-	-	x	x
129	126	2018/05/09	01:15	56°13.68'N	43°59.93'W	3418	3402	x	x	-	-	x	x
130	127	2018/05/09	07:06	56°46.54'N	43°59.98'W	3360	3361	x	x	-	-	x	x
131	128	2018/05/09	12:05	57°19.34'N	44°00.02'W	3444	3434	x	x	-	-	x	x
132	129	2018/05/09	16:47	57°52.12'N	44°00.01'W	3212	3207	x	x	-	-	x	x
133	130	2018/05/09	20:30	58°08.78'N	43°59.94'W	2770	2771	x	x	-	-	x	x

calibration stops for  
Aquadopp currentmeters

calibration stops for  
Aquadopp currentmeters

**Short Cruise Report, RV Maria S. Merian, Cruise MSM-73, Cadiz – St. John's, 06 Apr – 22 May 2018**

134	131	2018/05/10	00:02	58°25.42'N	43°59.95'W	2208	2195	x	x	-	-	x	x
135	132	2018/05/10	03:16	58°42.06'N	43°59.98'W	1550	1541	-	x	-	-	x	x
136	133	2018/05/10	07:02	58°58.71'N	44°00.01'W	1740	1731	x	x	-	-	x	x
137	134	2018/05/11	08:11	59°15.36'N	43°59.98'W	1330	1323	x	x	-	x	x	x
138	135	2018/05/11	09:50	59°19.63'N	43°59.83'W	1000	973	x	x	-	x	x	x
139	136	2018/05/11	11:24	59°23.50'N	44°00.13'W	500	443	x	x	-	x	x	x
140	137	2018/05/11	12:52	59°32.01'N	44°00.10'W	202	186	-	x	-	x	x	x
141	138	2018/05/11	14:11	59°39.49'N	44°00.09'W	162	146	-	x	-	x	x	x
142	139	2018/05/11	19:00	59°00.20'N	43°17.27'W	1640	1636	x	-	-	x	x	x
143	140	2018/05/11	21:48	58°45.32'N	43°01.44'W	2210	2098	x	-	-	x	x	x
144	141	2018/05/12	01:06	58°30.83'N	42°45.88'W	2590	2569	x	-	-	x	x	x

**Short Cruise Report, RV Maria S. Merian, Cruise MSM-73, Cadiz – St. John's, 06 Apr – 22 May 2018**

145	142	2018/05/12	04:52	58°16.13'N	42°30.22'W	2934	2908	x	-	-	x	x	x
146	143	2018/05/12	08:28	58°01.40'N	42°14.72'W	3150	3148	x	-	-	x	x	x
147	144	2018/05/12	13:37	57°33.95'N	41°46.01'W	3261	3259	x	-	-	x	x	x
148	145	2018/05/12	18:34	57°06.46'N	41°18.08'W	3265	3252	x	-	-	x	x	x
149	146	2018/05/12	23:12	56°38.98'N	40°51.55'W	2942	3011	x	-	-	x	x	x
150	147	2018/05/13	03:38	56°11.50'N	40°25.18'W	3006	3049	x	-	-	x	x	x
151	148	2018/05/13	08:05	55°44.05'N	39°58.51'W	2980	2830	x	-	-	x	x	x
152	149	2018/05/13	12:41	55°16.61'N	39°32.20'W	3084	3088	x	-	-	x	x	x
153	150	2018/05/13	17:27	54°49.12'N	39°05.84'W	2769	2746	x	-	-	x	x	x
154	151	2018/05/13	21:56	54°21.64'N	38°39.38'W	2930	2932	x	-	-	x	x	x
155	152	2018/05/14	02:37	53°54.17'N	38°12.93'W	2860	2877	x	-	-	x	x	x

acoustic release test 30 m  
above bottom

cast repeated; 1<sup>st</sup> cast  
aborted @250 m

**Short Cruise Report, RV Maria S. Merian, Cruise MSM-73, Cadiz – St. John's, 06 Apr – 22 May 2018**

156	153	2018/05/14	07:16	53°26.74'N	37°46.44'W	2973	2969	x	-	x	x	x
157	154	2018/05/14	11:48	52°59.25'N	37°19.97'W	3736	3730	x	-	x	x	x
158	155	2018/05/14	16:56	52°30.54'N	36°51.90'W	3368	3335	x	-	x	x	x
159	156	2018/05/15	01:52	52°06.82'N	36°23.17'W	3325	3331	x	-	x	x	x
160	157	2018/05/15	06:29	51°42.47'N	35°54.44'W	3420	3414	x	-	x	x	x
161	158	2018/05/15	11:00	51°18.14'N	35°25.56'W	3686	3687	x	-	x	x	x
162	159	2018/05/15	15:58	50°53.69'N	34°56.65'W	3447	3422	x	-	x	x	x
163	160	2018/05/15	20:33	50°29.43'N	34°28.05'W	4037	4048	x	-	x	x	x
164	161	2018/05/16	01:30	50°05.08'N	33°59.23'W	4235	4224	x	-	x	x	x
165	162	2018/05/16	07:10	49°40.72'N	33°30.40'W	4005	3968	x	-	x	x	x
166	163	2018/05/16	12:33	49°16.42'N	33°01.51'W	3795	3767	x	-	x	x	x

**Short Cruise Report, RV Maria S. Merian, Cruise MSM-73, Cadiz – St. John's, 06 Apr – 22 May 2018**

167	164	2018/05/16	17:29	48°52.01'N	32°32.72'W	3840	3826	x	-	-	x	x
168	165	2018/05/16	22:26	48°27.71'N	32°03.95'W	4201	4183	x	-	-	x	x
169	166	2018/05/17	03:27	48°03.33'N	31°35.09'W	3918	3922	x	-	-	x	x
170	167	2018/05/17	08:18	47°39.91'N	31°08.83'W	4060	4043	x	-	-	x	x
171	168	2018/05/18	19:07	47°10.29'N	39°29.61'W	4598	4014	-	-	-	-	x
172	169	2018/05/19	03:33	47°05.88'N	40°52.50'W	4492	4012	-	-	-	-	x
173	170	2018/05/19	17:57	47°06.06'N	42°14.88'W	4036	4006	-	-	-	-	x
174	171	2018/05/19	21:44	47°05.48'N	42°00.36'W	4222	4011	-	-	-	-	x
175	172	2018/05/20	08:13	47°06.19'N	43°13.28'W	3880	3031	-	-	-	-	x