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Short Cruise Report - RV Maria S. Merian, cruise MSM-64 -

Southampton/UK – Galway/Ireland – St. John's/Canada
27 May – 23 Jun 2017
Chief Scientist: Dr. Dagmar Kieke
Captain: Björn Maaß

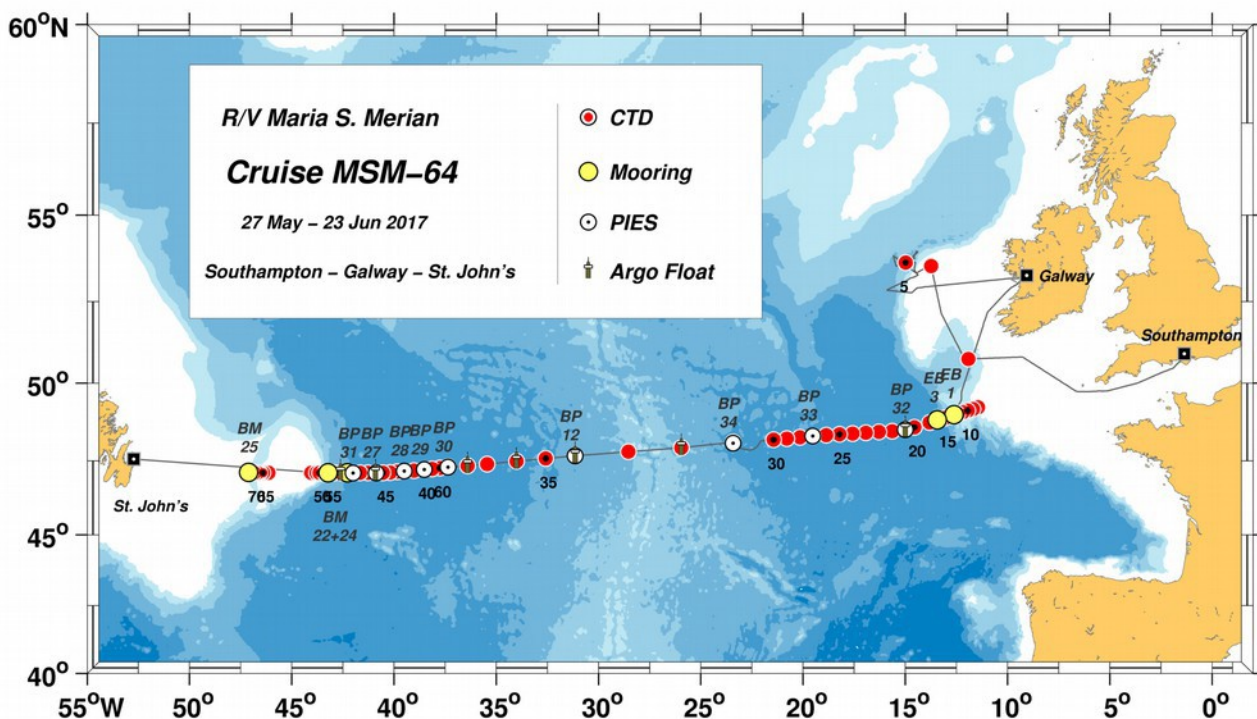


Figure 1. Track of RV MARIA S. MERIAN, cruise MSM-64, and locations of hydrographic profiles (red, numbers denote profile numbers), deployed moorings (yellow), inverted echo-sounders with pressure sensors (PIES, white), and Argo float deployments. Bathymetric contours are shown every 1000 m.

1. Objectives

Physical oceanographic measurements conducted during cruise *MSM-64* contributed to the scientific project *RACE-II* (“Regional Atlantic ChangE”), sub-project 1.2, funded by the *German Ministry for Education and Research* (BMBF). Scientific work during cruise *MSM-64* emphasized on a detailed mapping of water mass properties along 47°/48°N that was combined with comprehensive measurements of the current system. In addition to ship-based observations, recovery and redeployment of deep-sea moorings at the western and eastern boundaries of the North Atlantic was conducted. These serve to determine the export and import rates of subpolar or subtropical water masses in these regions. Various locations within the deep basins have been equipped (partly since 2006) with inverted echo-sounders carrying pressure sensors (PIES) that allow capturing variations of the different branches of the North Atlantic Current (NAC). Together with the deep-sea moorings these form the oceanic long-term observatory NOAC (“North Atlantic Changes”) deployed along 47°/48°N. In combination with satellite altimetry the data serve to investigate the main components of the Atlantic Meridional Overturning Circulation (AMOC) at this latitude.

In addition to this program, the two multibeam echo-sounder systems installed in the vessel's hull (*Kongsberg EM-712* and *EM-122*) were calibrated, and the required sea acceptance test for the *EM-712* device was carried out by a technical-scientific team. Due to this, the cruise was split into two separate legs (Southampton-Galway, Galway-St. John's) with personnel being exchanged in Galway/Ireland on June 02nd, 2017.

The primary objectives of cruise *MSM-64* were:

- 1) to capture the strength and the variability of the eastern boundary current off Goban Spur at the Irish shelf edge, which required the recovery and redeployment of deep-sea moorings
- 2) to recover data recorded by bottom-mounted PIES. This data serves to investigate the strength and variability of the NAC crossing 47°/48°N in the Newfoundland Basin and in the West European Basin
- 3) to analyze the deep water export in the Deep Western Boundary Current (DWBC) across 47°N in the Newfoundland Basin as well as the export of Labrador Sea Water (LSW) through Flemish Pass by means of deep-sea moorings and ship-

based observations

- 4) to capture the water column properties and identify changes in the components of North Atlantic Deep Water
- 5) to investigate the strength of the NAC from PIES and ship observations as the NAC crosses the Mid-Atlantic Ridge and enters the eastern basin.

Due to the echo-sounder calibration and sea acceptance test added to cruise *MSM-64*, the cruise was longer than originally scheduled, but the available time to pursue the original scientific program of cruise *MSM-64* needed to be shortened. As further time was lost in the eastern basin due to bad weather, the section along the western flank of the Mid-Atlantic Ridge could not be carried out, and thus objective 5 could not be met.

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 CTDO-sensor calibration as well as taking samples for the analysis of anthropogenic tracers (chlorofluorocarbons) and carbon and oxygen isotopes ratios in seawater. Vessel-mounted ADCP measurements delivered velocity data of the upper water column. Seven Argo floats of type *NKE ARVOR* were deployed along 47°/48°N and programmed to drift at a parking depth of 1000 dbar and to cycle between 2000 dbar and the sea surface every ten days. Work related to deploying and recovering deep-sea moorings concentrated on the boundary currents at the eastern and western continental margins (Goban Spur at the Irish shelf break; eastern flank of Flemish Cap; Flemish Pass). Telemetry, recovery, and (re-)deployment of inverted echo-sounders equipped with pressure sensors (PIES) focused on devices installed in the deep basins along the 47°/48°N section.

2. Narrative of cruise *MSM-64*

RV MARIA S. MERIAN left the berth in Southampton, UK, on May 27th, 2017, at 09:30 UTC. When heading towards the southern exit of the English Channel, the scientific mission of cruise *MSM-64* started at 13:24 UTC the same day, when continuous logging of underway data was switched on. Course was set towards the Irish shelf break near Porcupine Bank, where a number of test stations were carried in deep and shallow water during May 28th to May 31st. These served to check the performance acoustic releases at depth, checks of

the CTDO unit and the two LADCPs attached to the carousel water sampler. Furthermore, the water sample analysis devices were tested. During May 28th to May 31st the two multibeam echo-sounding devices for shallow and deep water applications were calibrated along a specific calibration track. Also, the sea acceptance test for the previously newly installed EM-712 multibeam echo-sounder was successfully carried out. On June 02nd, *RV MARIA S. MERIAN* approached Galway/Ireland and, while lying on the roads in the Galway Bay, we exchanged scientists and technicians. After finishing this exchange, the original scientific field program of cruise *MSM-64* began, and we headed south towards Goban Spur at the Irish shelf break. Between June 03rd and June 09th, we recovered and redeployed mooring *EB-1*. As the recovery of the two moorings *EB-2* and *EB-3* unfortunately failed, we could only redeploy mooring *EB-3*. Furthermore, hydrographic casts including measurements of the oceanic current field were done, and the two eastern PIES were exchanged. On June 09th/10th, a severe storm system required interrupting station work and deviating from the original cruise track. After finishing station work in the West European Basin, we crossed the Mid-Atlantic Ridge and continued station work in the Newfoundland Basin. While approaching Flemish Cap, several PIES were recovered and partly immediately redeployed. Data recorded by the devices over the past year was retrieved via acoustic telemetry. Hydrographic station work was continued until reaching the Deep Western Boundary Current east of Flemish Cap. There, we recovered the two moorings *BM-22* and *BM-24* on June 17th 2017. Between June 18th and June 21st, we carried out a densely spaced CTD section across the western flank of Flemish Cap, reinstalled the remaining PIES in the deep Newfoundland Basin and redeployed the moorings *BM-22* and *BM-24*. On June 21st, we crossed Flemish Cap and continued hydrographic station work along 47°N in Flemish Pass. On June 22nd, we recovered and subsequently redeployed mooring *BM-25*.

Continuous logging of underway data was stopped on June 23rd, 17:30 UTC, which marked the end of the scientific mission *MSM-64* of *RV MARIA S. MERIAN*. The vessel arrived at the pilot station of St. John's and was finally towed at pier 17 at 19:00 UTC the same day. In total, 91 hydrographic stations were carried out during cruise *MSM-64*. Seven Argo floats were deployed. Four deep-sea moorings were recovered, and five were installed again. Seven PIES were recovered, and seven were deployed again, partly upgraded with an additional currentmeter that turned these devices into C-PIES.

Acknowledgements

We would like to thank the master of the vessel, Björn Maaß, and his entire crew for the assistance and great support granted to us during the two legs of cruise *MSM-64*. The professional and constructive cooperation between the different scientific teams and the ship's team, the hospitality experienced onboard the vessel, and the friendly working environment is greatly appreciated.

Further thanks go to Barbara Kozak at our home laboratory, the *Federal Ministry for Education and Research* (BMBF), the *German Research Foundation* (DFG), the DFG's *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.

Table 1. Participants of cruise MSM-64

	Name	Institute	Field of Activity	Leg
1.	Kieke, Dagmar, Dr.	IUPHB/MARUM	chief scientist	1+2
2.	Altona, Karim	IUPHB/MARUM	sampling of tracers and isotopes	2
3.	Buinyi, Aleksei	IUPHB/MARUM	CTDO/LADCP watch, VMADCP processing	1+2
4.	dos Santos Ferreira, Christian	MARUM	multibeam calibration	1
5.	Frahm, Laura	UHH	multibeam calibration	1
6.	Garcia Quintana, Yarisbel	UEA	CTDO/LADCP watch	1+2
7.	Gerken, Jan	IUPHB/MARUM	CTDO/LADCP watch	2
8.	Gerriets, Andrea	LDF	multibeam calibration	1
9.	Harbas, Teo	Briese	superintendent	1
10.	Herland, Asmund	Kongsberg	multibeam calibration	1
11.	Köllner, Manuela	BSH	mooring analysis	1+2
12.	Küper, Svea	UHB	oxygen analysis	2
13.	Meyer, Christian	Briese	technical support	1
14.	Mirau, Bastian	IUPHB/MARUM	moorings	1+2
15.	Nowitzki, Hannah	IUPHB/MARUM	CTDO/LADCP watch, PIES analysis	2
16.	Pennelly, Clark	UEA	CTDO/LADCP watch	1+2
17.	Retsch, Matthias	MPI	aerosol measurements	2
18.	Roessler, Achim, Dr.	IUPHB/MARUM	ADCP and PIES data processing	1+2
19.	Schneehorst, Anja	BSH	moorings, Argo float deployments	1+2
20.	Steinfeldt, Reiner, Dr.	IUPHB/MARUM	CTD/O data processing, calibration, data analysis, salinometry	1+2
21.	Stokland, Gard	Kongsberg	multibeam calibration	1
22.	Sültenfuß, Pia	IUPHB/MARUM	sampling of tracers and isotopes	2
23.	Uhde, Hans-Hermann	BSH	moorings, Argo float deployment	1+2
24.	Wischnewski, Fanny	IUPHB/MARUM	CTDO/LADCP watch, LADCP processing	1+2

Table 2. Affiliations of cruise participants

Institution	Affiliation
Briese	Briese Schifffahrts GmbH & Co KG, Leer, Germany
BSH	Federal Maritime and Hydrographic Agency, Hamburg, Germany
IUPHB	University of Bremen, Institute of Environmental Physics, Dep. Oceanography, Bremen, Germany
Kongsberg	Kongsberg Maritime AS, Norway
LDF	Control Station German Research Vessels, University of Hamburg, Hamburg, Germany
MARUM	University of Bremen, Center for Marine Environmental Sciences, Bremen, Germany
MPI	Max Planck Institute for Meteorology, Hamburg, Germany
UEA	University of Alberta, Edmonton, Alberta, Canada
UHB	University of Bremen, Faculty 2, Biology/Chemistry, Bremen, Germany
UHH	University of Hamburg, Institute of Geophysics, Hamburg, Germany

Table 3. Argo float deployments during cruise MSM-64

MSM-Station	Float s/n	WMO ID	Argos ID	Latitude	Longitude	Deployment Date/Time	CTD #
25-3	AL250017DE005	3901624	170341	48°31.081'N	15°00.066'W	06 Jun.2017 08:47	19
40-2	AL250017DE006	3901625	170342	47°55.889'N	25°57.218'W	11 Jun.2017 17:27	32
42-2	AL250017DE007	3901626	170343	47°40.048'N	31°08.665'W	12 Jun 2017 19:06	34
44-2	AL250017DE008	3901627	170344	47°28.879'N	34°00.899'W	13 Jun 2017 23:22	36
46-2	AL250017DE009	3901628	170345	47°20.053'N	36°24.371'W	14 Jun 2017 15:31	38
54-3	AL250017DE010	3901629	170346	47°05.296'N	40°54.534'W	17 Jun 2017 00:29	46
67-2	AL250017DE011	3901630	170347	47°05.649'N	42°37.110'W	18 Jun 2017 18:31	57

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

Table 4. Deep-Sea moorings recovered and deployed during cruise MSM-64.

MSM-Station	Mooring ID	Latitude	Longitude	Depth [m]	Recovery Date/Time	Deployment Date/Time	CTD Profile
9-1	EB-1/1	49°00.02'N	12°37.08'W	1530	03 Jun 2017 13:44 – 15:40	–	6
17-1	EB-1/2	49°00.02'N	12°37.08'W			04 Jun 2017 15:20 – 16:35	6
10-1	EB-2/1	48°55.02'N	13°00.00'W	3065	03 Jun 2017 17:23 – 17:55 mooring lost	–	-
17-1	EB-3/1	48°49.98'N	13°25.98'W	4453	03 Jun 2017 19:42 – 20:11 mooring lost	–	13
23-1	EB-3/2	48°49.98'N	13°25.98'W	4453	---	05 Jun 2017 08:31– 15:55	13
57-1	BM-22/7	47°06.19'N	43°13.37'W	3048	17 Jun 2017 14:54 – 17:310	–	54
76-1	BM-22/8	47°06.19'N	43°13.37'W	3048	---	21 Jun 2017 10:57-14:44	54
56-1	BM-24/4	47°06.20'N	42°16.50'W	4000	17 Jun 2017 08:52 – 11:57	--	47
69-1	BM-24/5	47°06.21'N	42°16.47'W	4008	–	19 Jun 2017 10:19-12:15	59
91-1	BM-25/4	47°07.11'N	47°06.38'W	1003	22 Jun 2017 15:18 – 15:57	–	78
91-1	BM-25/5	47°07.11'N	47°06.38'W	1003	–	22 Jun 2017 18:18 – 18:32	78

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 5. Activities related to inverted echo-sounders with pressure sensors (PIES)

MSM Station	PIES ID	s/n	Latitude	Longitude	Depth [m]	Deployment Date/Time	Telemetry Date/Time	Recovery Date/Time	CTD #
41	BP12/5	271	47°39.91'N	31°08.88'W	4090	---	12 Jun 2017 19:40 – 22:50	---	34
54	BP27/2	302	47°05.75'N	40°53.82'W	4503	---	16 Jun 2017 18:13 – 21:02	16/17 Jun 2017 22:54 – 00:26	46
70	BP27/3	272	47°05.87'N*	40°52.54'W*	4200*	19 Jun 2017 16:29:17:40	---	---	46
50	BP28/2	240	47°09.72'N	39°29.12'W	4591	---	15 Jun 2017 19:53 – 22:51	15/16 Jun 2017 22:56 – 00:40	42
71	BP28/3	302	47°10.29'N	39°29.63'W	4562	19 Jun 2017 22:04–23:43	---	---	42
48	BP29/2	272	47°12.55'N	38°30.95'W	4612	---	---	15 Jun 2017 03:41 – 05:12	40
48	BP29/3	303	47°12.68'N	38°30.93'W	4608	15 Jun 2017 05:48–07:25	---	---	40
47	BP30/2	235	47°18.06'N	37°21.70'W	4539	---	14 Jun 2017 19:35 – 22:27	---	39
68	BP31/1	075	47°05.84'N	41°59.94'W	4236	---	18 Jun 2017 20:53 – 01:22	19 Jun 2017 01:35 – 03:02	47/58
68	BP31/2	240	47°05.48'N	42°00.38'W	4219	19 Jun 2017 03:24–04:49	---	---	47/58
25	BP32/1	270	48°31.12'N	15°00.02'W	4796	---	06 Jun 2017 01:36 – 02:33	06 Jun 2017 02:39 – 04:13	19
25	BP32/2	362	48°31.13'N	15°00.22'W	4793	06 Jun 2017 04:36–05:51	---	---	19
31	BP33/1	268	48°18.50'N	19°31.74'W	4560	---	07/08 Jun 2017 22:22 – 01:22	08 Jun 2017 01:45 – 03:35	27
31	BP33/2	363	48°18.66'N	19°31.30'W	4553	08 Jun 2017 03:48–05:15	---	---	27
38	BP34/1	269	48°06.60'N	23°25.32'W	4486	---	10 Jun 2017 19:22 – 22:30	10/11 Jun 2017 23:04 – 00:56	31
38	BP34/2	188	48°06.69'N	23°25.16'W	4484	11 Jun 2017 01:15–02:44	---	---	31

All times are given as UTC. All instruments are equipped with flags, radio senders, and flashers. PIES BP-27/3, BP-28/3, BP-29/3, and BP-31/2 were deployed as a C-PIES, i.e., it carried an additional currentmeter of type *Nortek Aquadopp* and additional buoyancy.

Table 6. List of CTDO/lowered ADCP/water sampling stations carried out during cruise MSM-64

MSM-Station	Profile	Date	Time [UTC]	Latitude	Longitude	Water Depth [m]	Profile Depth [m]	SF ₆ /CFC	CFC off-line	¹³ C/ ¹⁸ O	Bottle Oxygen	LADCP	Comments
01	1	2017/05/28	15:52	50°45.47'N	11°54.90'W	2000	2005	-	-	-	-	-	test of acoustic releases; depth test of Iridium and radio beacons; IADCP failure; substandard for salinometry
02	2	2017/05/29	05:52	53°33.09'N	13°44.21'W	250	240	-	-	-	-	-	test of acoustic releases; depth test of Iridium and radio beacons; IADCP failure
03	3	2017/05/29	14:54	53°32.62'N	13°44.28'W	244	234	-	-	-	-	-	depth test of Argos beacons; IADCP failure
04	4	2017/05/30	12:09	53°38.46'N	14°58.93'W	2874	2870	-	-	-	-	-	test of acoustic release, s/n 2263; calibration stops for NKE loggers & MicroCATs; IADCP failure
05	5	2017/05/31	05:52	53°38.54'N	14°58.64'W	2878	2871	-	-	-	-	x	test of several acoustic releases; calibration stops for Seaguards
06	6	2017/06/03	10:24	49°00.69'N	12°35.72'W	1474	1473	-	-	-	-	x	
11	7	2017/06/03	18:17	48°50.06'N	13°25.31'W	4453	4442	-	-	-	x	x	calibration stops for Seaguards & MicroCATs
12	8	2017/06/04	04:30	49°14.16'N	11°26.77'W	470	453	-	-	-	x	x	
13	9	2017/06/04	06:02	49°11.06'N	11°41.74'W	790	777	-	-	-	x	x	
14	10	2017/06/04	07:50	49°07.85'N	11°56.55'W	855	845	-	-	-	x	x	
15	11	2017/06/04	09:41	49°04.76'N	12°11.50'W	1015	1002	-	-	-	x	x	
16	12	2017/06/04	11:35	49°01.61'N	12°26.43'W	1279	1263	-	x	-	x	x	
17	13	2017/06/04	14:52	48°59.67'N	12°38.62'W	1620	1614	-	-	-	x	x	
19	14	2017/06/04	17:00	48°56.88'N	12°48.82'W	2100	2078	-	x	-	x	x	
20	15	2017/06/04	19:37	48°53.77'N	13°03.79'W	3624	3612	-	-	-	x	x	
21	16	2017/06/04	23:08	48°50.62'N	13°18.60'W	3800	3776	-	x	-	x	x	
23	17	2017/06/05	02:10	48°50.00'N	13°26.02'W	4456	4442	-	-	-	x	x	
24	18	2017/06/05	17:34	48°44.91'N	13°48.49'W	4530	4517	-	-	-	x	x	
25	19	2017/06/06	05:56	48°31.07'N	14°59.99'W	4800	4799	x	-	x	x	x	Argo float deployment, WMO-ID 3901624
26	20	2017/06/06	11:03	48°35.51'N	14°33.23'W	4698	4685	-	-	-	x	x	

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27	21	2017/06/06	19:11	48°28.26'N	15°38.62'W	4840	4831	-	x	-	x	x	
28	22	2017/06/07	00:45	48°26.71'N	16°17.26'W	4670	4694	-	-	-	x	x	
29	23	2017/06/07	06:30	48°25.14'N	16°55.91'W	4680	4670	-	x	x	x	x	
30	24	2017/06/07	12:05	48°23.58'N	17°34.50'W	4205	4186	-	-	-	x	x	depth test of radio beacon, s/n V01-024
32	25	2017/06/08	10:01	48°21.96'N	18°13.20'W	4450	4441	-	x	-	x	x	
33	26	2017/06/08	16:04	48°20.38'N	18°51.88'W	4232	4223	-	-	-	x	x	
34	27	2017/06/08	21:26	48°18.59'N	19°31.34'W	4562	4551	-	x	x	x	x	
35	28	2017/06/09	03:12	48°16.24'N	20°09.32'W	4433	4421	-	-	-	x	x	
36	29	2017/06/09	09:09	48°13.78'N	20°47.73'W	4361	4346	-	x	-	x	x	
37	30	2017/06/09	14:28	48°11.46'N	21°26.26'W	4460	4438	-	-	-	x	x	
39	31	2017/06/11	02:51	48°06.65'N	23°24.96'W	4502	4486	-	x	x	x	x	
40	32	2017/06/11	15:35	47°55.90'N	25°57.21'W	2843	2826	-	x	x	x	x	test of acoustic release, s/n 761; depth test of radio beacon, s/n V09-044; Argo float deployment, WMO-ID 3901625
41	33	2017/06/12	03:39	47°47.81'N	28°32.57'W	3253	3237	-	x	x	x	x	
42	34	2017/06/12	16:00	47°39.95'N	31°08.81'W	4094	4075	-	x	x	x	x	calibration stops for Aquadopps, Argo float deployment, WMO-ID 3901626
43	35	2017/06/13	08:45	47°34.46'N	32°34.72'W	3964	3949	-	x	x	x	x	
44	36	2017/06/13	20:27	47°29.05'N	34°00.77'W	4730	4716	-	x	x	x	x	Argo float deployment, WMO-ID 3901627
45	37	2017/06/14	06:23	47°23.67'N	35°26.92'W	4320	4305	-	x	x	x	x	
46	38	2017/06/14	12:48	47°20.10'N	36°24.31'W	4244	4228	-	x	-	x	x	Argo float deployment, WMO-ID 3901628
47	39	2017/06/14	19:03	47°18.10'N	37°21.69'W	4540	4531	-	x	x	x	x	
48	40	2017/06/15	07:30	47°12.45'N	38°31.20'W	4618	4608	x	-	x	x	x	
49	41	2017/06/15	12:07	47°10.25'N	39°01.24'W	4593	4582	-	-	-	x	x	
50	42	2017/06/15	16:37	47°09.77'N	39°29.10'W	4599	4578	x	-	x	x	x	
51	43	2017/06/16	02:07	47°08.21'N	39°50.17'W	4593	4559	-	-	-	x	x	
52	44	2017/06/16	06:39	47°06.58'N	40°11.28'W	4560	4557	x	-	-	x	x	
53	45	2017/06/16	10:48	47°06.14'N	40°32.54'W	4530	4542	-	-	-	x	x	
54	46	2017/06/16	15:07	47°05.75'N	40°53.70'W	4498	4483	x	-	x	x	x	Argo float deployment, WMO-ID 3901629
55	47	2017/06/17	04:23	47°05.81'N	41°59.88'W	4218	4209	x	-	x	x	x	
58	48	2017/06/17	20:21	47°06.06'N	44°02.56'W	357	346	-	x	-	x	x	
59	49	2017/06/17	21:45	47°05.98'N	43°47.49'W	580	573	-	x	-	x	x	

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60	50	2017/06/17	22:56	47°06.02'N	43°38.41'W	768	753	-	x	-	x	x	
61	51	2017/06/18	00:37	47°05.99'N	43°25.27'W	1280	1265	-	x	x	x	x	
62	52	2017/06/18	02:00	47°05.90'N	43°20.17'W	1797	1761	-	x	-	x	x	
63	53	2017/06/18	03:33	47°06.03'N	43°17.83'W	2556	2551	-	x	-	x	x	
64	54	2017/06/18	05:32	47°06.20'N	43°13.26'W	3040	3027	-	x	x	x	x	
65	55	2017/06/18	08:05	47°06.05'N	43°07.14'W	3497	3504	-	x	-	x	x	
66	56	2017/06/18	11:13	47°06.04'N	42°53.60'W	3460	3444	-	x	-	x	x	calibration stops for MicroCATs
67	57	2017/06/18	15:15	47°06.02'N	42°35.42'W	3668	3646	-	x	-	x	x	test of acoustic releases, s/n 761+798; calibration stops for MicroCATs; Argo float deployment, WMO-ID 3901630
68	58	2017/06/18	21:06	47°05.83'N	41°59.80'W	4224	4206	-	-	-	-	x	test of acoustic release, s/n 798
69	59	2017/06/19	05:57	47°06.19'N	42°16.50'W	4000	3986	-	x	-	x	x	
72	60	2017/06/20	04:47	47°15.79'N	37°45.39'W	4519	4535	-	x	x	x	x	
73	61	2017/06/20	08:54	47°14.01'N	38°07.98'W	4500	4533	-	x	-	x	x	test of acoustic release, s/n 798 + 810
74	62	2017/06/20	23:10	47°06.18'N	41°16.87'W	4439	4404	x	-	-	x	x	
75	63	2017/06/21	03:07	47°06.20'N	41°39.41'W	4305	4273	x	-	-	x	x	
77	64	2017/06/21	23:53	47°06.05'N	46°08.37'W	330	320	-	-	-	x	x	
78	65	2017/06/22	01:15	47°06.02'N	46°24.15'W	350	343	-	-	-	-	x	
79	66	2017/06/22	02:20	47°06.05'N	46°33.23'W	490	477	-	x	-	x	x	
80	67	2017/06/22	03:08	47°06.03'N	46°36.61'W	800	791	-	x	-	x	x	
81	68	2017/06/22	04:05	47°06.04'N	46°40.02'W	1099	1085	-	-	-	-	x	
82	69	2017/06/22	05:09	47°06.02'N	46°42.46'W	1136	1124	-	x	-	x	x	
83	70	2017/06/22	06:30	47°06.03'N	46°51.21'W	1170	1154	-	x	-	-	x	
84	71	2017/06/22	07:57	47°06.08'N	47°00.58'W	1130	1113	-	x	-	x	x	
85	72	2017/06/22	09:07	47°05.96'N	47°05.87'W	1024	1008	-	x	-	-	x	
86	73	2017/06/22	10:16	47°05.99'N	47°09.34'W	880	866	-	x	-	x	x	
87	74	2017/06/22	11:20	47°06.02'N	47°12.47'W	728	716	-	x	-	-	x	
88	75	2017/06/22	12:18	47°05.96'N	47°15.85'W	475	462	-	x	-	x	x	
89	76	2017/06/22	13:11	47°05.79'N	47°19.45'W	306	293	-	-	-	-	x	
90	77	2017/06/22	13:58	47°05.80'N	47°22.83'W	240	229	-	-	-	-	x	
91	78	2017/06/22	16:08	47°06.98'N	47°06.05'W	1010	998	-	-	-	-	x	