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Short Cruise Report
- RV Meteor, cruise M164 (GPF-19-1_105) -
Emden/Germany – Emden/Germany
23 June – 31 July 2020

Chief Scientist: Dr. Dagmar Kieke
Captain: Rainer Hammacher

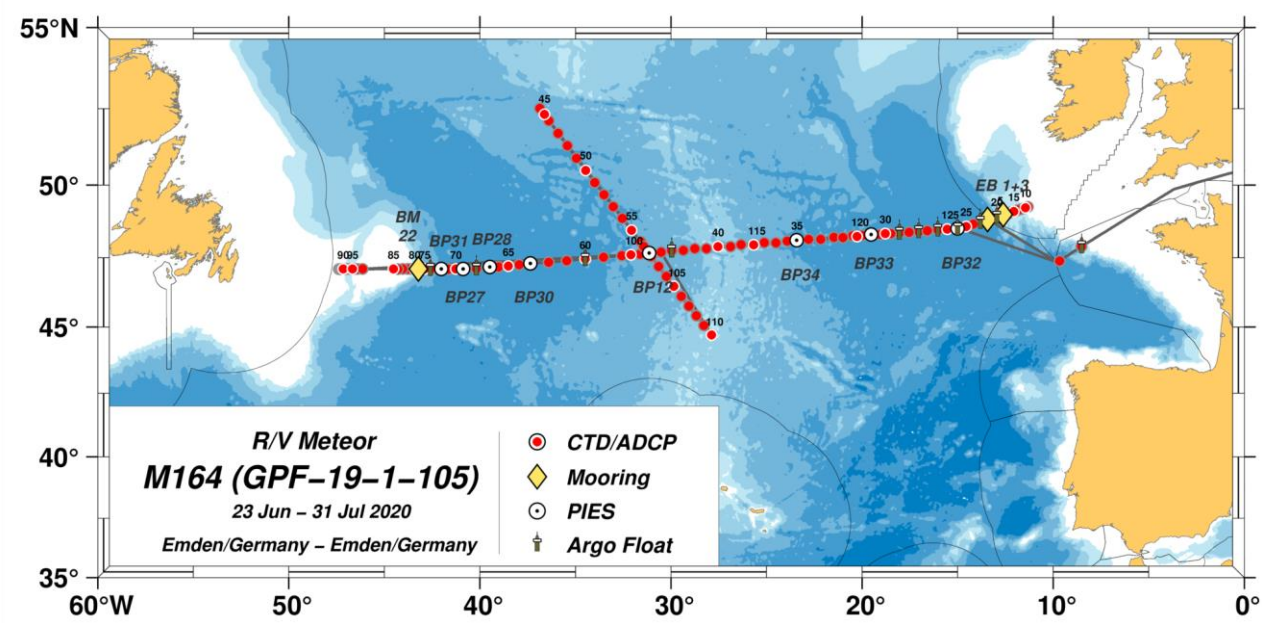

Figure 1. Track of RV METEOR, cruise M164 (GPF-19-1_105), and locations of hydrographic profiles (red numbers denote profile numbers), deep-sea moorings (yellow), locations of inverted echo-sounders with pressure sensors (PIES, white), and Argo float deployments. Bathymetric contours are shown every 1000 m.

Objectives

Scientific measurements conducted during cruise *M164 (GPF-19-1_105)* focused on collecting physical-oceanographic data along the geographic latitude of ~47°/48°N as well as along a line located at the western flank of the Mid-Atlantic Ridge (MAR) stretching from 44°40'N to about 52°30'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 calibrating the conductivity and oxygen sensors of the CTDO unit as well as taking samples for the onboard-analysis of anthropogenic trace gases (chlorofluorocarbon-12, CFC-12; sulphurhexafluoride, SF_6).

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). Several inverted echo-sounders carrying pressure sensors (PIES) were installed along 47°/48°N. Respective station work was related to data retrieval via acoustic telemetry and recovery of all deployed devices. The deep-sea moorings and the PIES form the oceanic long-term observatory *NOAC* ("North Atlantic Changes").

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

Acquired measurements and data as well as recovery and redeployment of the moored instruments were carried out in order

- to observe and determine the strength of the deep water export across 47°/48°N in 2019 to 2020;
- to measure and quantify the respective strength regarding northward import of warm and saline water with the North Atlantic Current (NAC) into the subpolar gyre in this period;

- to determine the portion of the NAC that crosses the Mid-Atlantic Ridge into the eastern basin in 2020, and to what degree is it linked to the location and variation of the Subpolar Front;

- to quantify how much Labrador Sea Water (LSW) leaves the subpolar North Atlantic across 47°N and propagates into the eastern basin, and what are its present water mass characteristics;

- to refurbish and/or recover the moored components of the long-term observational observatory *NOAC* (North Atlantic Changes) deployed along ~47°/48°N.

Narrative of cruise *M164* (G*PF-19-1_105)*

RV METEOR left its berth in Emden, Germany, on June 23, 2020, at 07:12 UTC. The scientific mission of cruise *M164 (GPF-19-1_105)* started on June 25 at 07:30 UTC, when continuous logging of underway data was switched on. Course was set towards the French EEZ. There, a number of test stations were carried out in deep water during June 25 and 26, and a first Argo float was deployed. These test stations served to check the performance of the conductivity-temperature-depth-oxygen (CTDO) unit and the two Lowered Acoustic Doppler Current Profilers (LADCP) 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 June 27 and July 1, 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* and performed acoustic telemetry on the bottom-mounted pressure-sensor-equipped inverted echo-sounder (PIES) *BP-32*. This device was subsequently recovered without replacement. In the following, we headed across the West European Basin along 47°/48°N and continued the hydrographic sampling program as well as work on two additional PIES, *BP-33* and *BP-34*, with the first one to be recovered as well. Acoustic telemetry did not work regarding the latter. Due to worsening weather conditions, we postponed the recovery of the device to the end of the cruise.

Having arrived at PIES-station *BP-12* on July 6 2020, we changed to a northwestern course and headed north along the western flank of the Mid-Atlantic Ridge (MAR). On July 8, we resumed hydrographic measurements at the northern end of this line and, while doing station work, headed back along the same line towards the 47°/48°N section.

Between July 12 and July 17, we followed a westward course towards Flemish Cap, while performing hydrographic stations, acoustic work on the PIES *BP-27*, *BP-28*, *BP-30*, and *BP-31* including the recovery of all devices, and recovery of the mooring *BM-22*. After transiting across Flemish Cap, fieldwork continued in the Flemish Pass on July 18 and 19. There, we carried out a hydrographic section across the width of the passage and started to transit towards the eastern basin of the Atlantic Ocean.

On July 20, we reached the vicinity of the MAR again and continued the previously made section along the western flank of the ridge in southeastern direction. On July 22, we were back on the 47°/48°N section and continued hydrographic station work towards the eastern end of the section. The last remaining PIES, *BP-34,* located in the West European Basin, was recovered on July 25. Hydrographic station work finally ended on July 27, 2020. After all fieldwork was finished, we headed east towards Emden, Germany.

Continuous logging of underway data was stopped on July 29, 02:45 UTC, which marked the end of the scientific mission of cruise *M164 (GPF-19-1-105)* aboard *RV METEOR*. On July 31, the vessel arrived at the pilot station of Emden and was finally towed at the pier in Emden port the same day.

In total, 126 hydrographic profiles were carried out during cruise *M164 (GPF-19-1-105)*. Eight PIES and three deep-sea moorings were recovered, and two moorings were subsequently reinstalled again. Seven *Argo* floats of type *NKE ARVOR I* and eight floats of type *NKE Deep ARVOR* were deployed along 47°/48°N. While the first group was programmed to drift at a parking depth of 1000 dbar and to cycle between 2000 dbar and the sea surface every ten days, the second group of floats was programmed to drift at a parking depth of 2750 dbar and to cycle between 4000 dbar and the sea surface.

Acknowledgments

We would like to express our gratitude to the master of RV METEOR, Rainer Hammacher, and his entire crew for the assistance and great support granted to us during cruise *M164 GPF-19-1-105*. We have greatly appreciated 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. We further thank Barbara Kozak and Wolfgang Böke at our home laboratory for assistance in the preparation of the cruise, the Federal Ministry for Education and Research (BMBF) through the cooperative research program *RACE-Synthesis* and the *Geschäftsstelle des Gutachterpanels Forschungsschiffe* (GPF) of the *German Research Foundation* (DFG) that provided the necessary ship time and funding to pursue all scientific work. We particularly acknowledge the support of the *German Research Fleet Coordination Centre* (*University of Hamburg*) and the shipping company *Briese Research* in the preparation of this cruise.

Table 1. Participants of cruise M164 (GPF-19-1_105).

	Name	Institute	Field of Activity
1.	Kieke, Dagmar, Dr.	IUPHB/MARUM	chief scientist
2.	Bulsiewicz, Klaus	IUPHB	tracer sampling and analysis
3.	Gapp, Cyril	IUPHB/MARUM	CTDO/LADCP
4.	Hinse, Yannik	IUPHB/MARUM	tracer sampling and analysis
5.	Huhn, Oliver, Dr.	IUPHB/MARUM	tracer sampling and analysis
6.	Hunkemöller, Annette	IUPHB/MARUM	CTDO/LADCP
7.	Köllner, Manuela	BSH	mooring preparation, technics
8.	Krisztian, Lina	IUPHB/MARUM	CTDO/LADCP
9.	Leimann, Ilmar	IUPHB/MARUM	CTDO/LADCP, vmADCP data processing and mooring assistance
10.	Schneehorst, Anja	BSH	mooring preparation, technics, float deployments
11.	Steinfeldt, Reiner, Dr.	IUPHB/MARUM	CTDO data processing, calibration and analysis, salinometry and oxygen titration
12.	Stelzner, Martin	DWD	meteorology
13.	Stiehler, Jan Eric	IUPHB/MARUM	CTDO/LADCP, vmADCP data processing
14.	Svensson, Tobias	BSH	mooring preparation, technics, float deployments
15.	Wett, Simon	IUPHB/MARUM	PIES data processing and oxygen titration
16.	Wiegand, Kevin Niklas	IUPHB/MARUM	lowered ADCP processing, data evaluation

BSH	*Federal Maritime and Hydrographic Agency, Hamburg, Germany*
DWD	*German Weather Service, Hamburg, Germany*
IUPHB	*University of Bremen, Institute of Environmental Physics, Bremen, Germany*
MARUM	*University of Bremen, Center for Marine Environmental Sciences, Bremen, Germany*

Table 2. Argo float deployments during cruise *M164 (GPF-19-1_105*).

M164-Station	*Float s/n*	*WMO ID*	*Latitude*	*Longitude*	*Deployment Date/Time*	*CTD Profile #*
1-3	AI2600-20DE012	7900573	47°53.717'N	08°30.666'W	26 Jun 2020 02:09	*1*
20-2	AI2600-20DE006	7900572	48°55.524'N	12°57.113'W	29 Jun 2020 20:19	*20*
23-2	AI2600-20DE005	7900571	48°44.910'N	13°48.555'W	30 Jun 2019 07:30	*23*
26-3	AI2600-20DE004	7900570	48°31.088'N	15°00.092'W	01 Jul 2020 03:54	*26*
27-2	AI2600-20DE003	7900569	48°28.688'N	16°02.141'W	01 Jul 2020 11:36	*27*
28-2	AI2600-20DE002	7900568	48°25.356'N	17°02.343'W	01 Jul 2020 18:17	*28*
29-2	AI2600-20DE001	7900567	48°22.170'N	18°02.919'W	02 Jul 2020 01:09	*29*
42-2	AD2700-18FR011	6902972	47°44.917'N	29°57.998'W	06 Jul 2020 09:18	*42*
42-3	OIN-015-ARDP-01	6901756	47°44.893'N	29°58.032'W	06 Jul 2020 09:18	*42*
60-2	AD2700-18FR013	6902974	47°27.285'N	34°29.662'W	12 Jul 2020 00:41	*60*
60-2	OIN-015-ARDP-08	6901604	47°27.285'N	34°29.662'W	12 Jul 2020 00:41	*60*
68-2	AD2700-18FR014	6902975	47°06.833'N	40°11.064'W	14 Jul 2020 09:22	*68*
68-3	AD2700-18FR017	6902978	47°06.810'N	40°11.084'W	14 Jul 2020 09:23	*68*
75-2	AD2700-18FR010	6902971	47°06.025'N	42°35.499'W	16 Jul 2020 06:05	*74*
75-2	AD2700-18FR012	6902973	47°06.025'N	42°35.499'W	16 Jul 2020 06:05	*74*

All times are given as UTC. The first seven deployed floats are of type *NKE ARVOR I* and carry conductivity, temperature, and pressure sensors. Parking depth, cycling period, and pressure range are: 1000 dbar, 10 days, and 2000 dbar. The remaining eight deployed floats are of type *NKE Deep ARVOR* and carry an additional oxygen sensor. Parking depth, cycling period, and pressure range are: 2750 dbar, 10 days, and 4000 dbar.

Table 3. Deep-Sea moorings recovered and deployed during cruise *M164* (*GPF-19-1_105)*.

M164-Station	*Mooring ID*	*Latitude*	*Longitude*	*Depth [m]*	*Recovery Date/Time*	*Deployment Date/Time*	*CTD Profile #*
4-1	*EB-1/4*	*49°00.03'N*	*12°37.02'W*	*1553*	*27 Jun 2020 17:00 – 22:05*	---	*5*
19-1	*EB-1/5*	*49°00.22'N*	*12°37.01'W*	*1550*	---	29 Jun 2020 *16:00 – 17:20*	*5*
3-2	*EB-3/4*	*48°49.98'N*	*13°26.03'W*	*4454*	*27 Jun 2020 07:32 – 13:40*	---	*4*
18-1	*EB-3/5*	*48°50.45'N*	*13°25.30'W*	*4450*	---	*29 Jun 2020 07:54 – 12:38*	*4*
76-1	*BM-22/10*	*47°06.19'N*	*43°13.37'W*	*3048*	*16 Jul 2020 09:11 – 15:29*	---	*77*

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

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

M164-Station	*PIES ID*	*s/n*	*Latitude*	*Longitude*	*Depth [m]*	*Ranging Date/Time*	*Telemetry Date/Time*	*Recovery Date/Time*	*CTD Profile#*
26-1	BP 32/3	075	48°31.09'N	15°00.10'W	4784	---	30 Jun 2020 19:40–23:20	30 Jun–01 Jul 2020 23:06–00:50	26
31-2	BP 33/3	240	48°18.57'N	19°31.42'W	4532	02 Jul 2020 18:54–20:07	02 Jul 2020 20:47–00:54	03 Jul 2020 01:05–02:36	31
35-1	BP 34/3	362	48°06.47'N	23°25.09'W	4489	---	04 Jul 2020 04:18–05:35 telemetry failed	---	35
43-2	BP 12/6	271	47°39.79'N	31°08.66'W	4094	---	06 Jul 2020 16:34–20:02	06–07 Jul 2020 22:31–00:29	43
63-2	BP 30/2	235	47°18.06'N	37°21.70'W	4539	---	12 Jul 2020 18:17 – 21:44	12–13 Jul 2020 23:00–00:41	63
67-2	BP 28/4	272	47°10.21'N	39°28.70'W	4605	---	13-14 Jul 2020 20:30–01:32	14 Jul 20120 02:13 – 03:58	67
69-2	BP 27/4	302	47°06.11'N	40°53.04'W	4499	---	14 Jul 2020 14:55–18:19	14–15 Jul 2020 23:56–01:48	69
72-2	BP 31/4	201	47°05.90'N	42°01.02'W	4222	---	15 Jul 2020 13:12–16:14	15–16 Jul 2020 22:47–00:25	72
74-1	BP 31/3	303	47°05.17'N	42°00.77'W	4246	---	16 Jul 2020 00:50–01:28 communi-cation failed	---	72
119-2	BP 34/3	362	48°06.47'N	23°25.09'W	4489	24 Jul 2020 22:30-22:59	---	24-25 Jul 2020 23:23-00:59	119

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

Table 5. List of CTDO/lowered ADCP/water sampling stations carried out during cruise *M164 (GPF-19-1_105).*

Station	Profile	Date	Time [UTC]	Latitude	Longitude	Water Depth [m]	Profile Depth [m]	SF6/CFC	Bottle Oxygen	LADCP	Remarks
M164_1-1	1	2020/06/25	21:34	47°53.68'N	08°30.89'W	2700	2664	x	x	x	
M164_1-2	2	2020/06/26	00:22	47°53.67'N	08°30.91'W	2692	1979	-	-	x	Test of acoustic releases
M164_2-1	3	2020/06/26	07:24	47°23.03'N	09°39.96'W	4380	3461	-	x	x	MicroCAT calibration
M164_3-1	4	2020/06/27	04:52	48°49.80'N	13°25.39'W	4454	4436	x	x	x	
M164_4-2	5	2020/06/27	22:33	48°59.44'N	12°37.62'W	1600	1587	x	x	x	
M164_5-1	6	2020/06/28	00:36	49°01.56'N	12°26.51'W	1283	1267	x	x	x	
M164_6-1	7	2020/06/28	02:37	49°04.74'N	12°11.67'W	1014	994	x	x	x	
M164_7-1	8	2020/06/28	04:27	49°07.77'N	11°56.56'W	855	845	x	x	x	
M164_8-1	9	2020/06/28	06:15	49°11.01'N	11°41.71'W	790	779	x	x	x	
M164_9-1	10	2020/06/28	08:09	49°14.14'N	11°26.67'W	465	452	-	x	x	
M164_10-1	11	2020/06/28	09:46	49°15.71'N	11°19.33'W	281	268	-	-	x	
M164_11-1	12	2020/06/28	11:26	49°12.59'N	11°34.21'W	620	618	-	x	x	
M164_12-1	13	2020/06/28	13:16	49°09.42'N	11°49.08'W	797	785	x	x	x	
M164_13-1	14	2020/06/28	15:05	49°06.25'N	12°03.98'W	920	906	-	-	x	
M164_13-2	15	2020/06/28	16:04	49°06.25'N	12°03.98'W	920	794	x	x	x	Argos beacon test
M164_14-1	16	2020/06/28	17:56	49°03.12'N	12°18.97'W	1135	1121	x	x	x	
M164_15-1	17	2020/06/28	20:37	48°58.49'N	12°41.12'W	1775	1761	x	x	x	
M164_16-1	18	2020/06/28	23:03	48°56.86'N	12°48.77'W	2096	2074	x	x	x	MicroCAT and RBR calibration
M164_17-1	19	2020/06/29	02:23	48°53.77'N	13°03.78'W	3627	260	-	-	x	Profile aborted
M164_20-1	20	2020/06/29	18:40	48°55.60'N	12°56.99'W	2624	2594	x	x	x	
M164_21-1	21	2020/06/29	21:03	48°53.84'N	13°03.74'W	3629	3612	x	x	x	
M164_22-1	22	2020/06/30	00:07	48°51.71'N	13°13.79'W	3757	3732	x	x	x	
M164_23-1	23	2020/06/30	04:47	48°44.91'N	13°48.38'W	4532	4515	x	x	x	
M164_24-1	24	2020/06/30	09:07	48°40.18'N	14°10.90'W	4550	4530	x	x	x	
M164_25-1	25	2020/06/30	13:31	48°35.49'N	14°33.20'W	4698	4682	x	x	x	
M164_26-2	26	2020/07/01	01:07	48°31.05'N	15°00.02'W	4813	4796	x	x	x	

Station	Profile	Date	Time [UTC]	Latitude	Longitude	Water Depth [m]	Profile Depth [m]	SF6/CFC	Bottle Oxygen	LADCP	Remarks
M164_27-1	27	2020/07/01	08:39	48°28.56'N	16°01.87'W	4836	4822	x	x	x	
M164_28-1	28	2020/07/01	15:52	48°25.32'N	17°02.27'W	4204	4152	x	x	x	
M164_29-1	29	2020/07/01	22:29	48°22.03'N	18°02.69'W	4512	4492	x	x	x	
M164_30-1	30	2020/07/02	03:50	48°20.53'N	18°46.92'W	4355	4339	x	x	x	
M164_31-1	31	2020/07/02	09:18	48°18.68'N	19°31.23'W	4565	4552	x	x	x	
M164_32-1	32	2020/07/02	14:07	48°17.11'N	19°59.97'W	4436	4415	x	x	x	
M164_33-1	33	2020/07/03	07:37	48°15.80'N	20°29.85'W	4180	4163	x	x	x	
M164_34-1	34	2020/07/03	15:26	48°12.73'N	21°28.49'W	4456	4438	x	x	x	
M164_35-2	35	2020/07/04	05:46	48°06.95'N	23°24.54'W	4509	4487	x	x	x	
M164_36-1	36	2020/07/04	11:05	48°08.44'N	22°47.82'W	4200	4185	x	x	x	
M164_37-1	37	2020/07/04	20:22	48°05.11'N	23°54.91'W	4094	4078	x	x	x	
M164_38-1	38	2020/07/05	04:00	48°01.68'N	25°07.44'W	3887	3868	x	x	x	
M164_39-1	39	2020/07/05	11:13	47°57.53'N	26°20.00'W	3078	3039	x	x	x	
M164_40-1	40	2020/07/05	17:47	47°53.34'N	27°32.51'W	3423	3358	x	x	x	
M164_41-1	41	2020/07/06	00:28	47°49.16'N	28°45.16'W	2750	2700	x	x	x	
M164_42-1	42	2020/07/06	06:43	47°45.03'N	29°57.82'W	3495	3469	x	x	x	
M164_43-1	43	2020/07/06	13:45	47°40.08'N	31°08.34'W	4100	4075	x	x	x	
M164_44-1	44	2020/07/08	10:18	52°30.55'N	36°51.97'W	3375	3341	x	x	x	
M164_45-1	45	2020/07/08	13:48	52°18.87'N	36°37.38'W	3714	3688	x	x	x	
M164_46-1	46	2020/07/08	17:26	52°06.86'N	36°23.13'W	3341	3316	x	x	x	
M164_47-1	47	2020/07/08	23:00	51°42.43'N	35°54.56'W	3432	3415	x	x	x	
M164_48-1	48	2020/07/09	04:09	51°18.20'N	35°25.55'W	3698	3685	x	x	x	
M164_49-1	49	2020/07/09	09:20	50°53.67'N	34°56.73'W	3516	3512	x	x	x	
M164_50-1	50	2020/07/09	14:28	50°29.44'N	34°28.03'W	4060	4034	x	x	x	
M164_51-1	51	2020/07/09	19:55	50°05.13'N	33°59.29'W	4240	4227	x	x	x	
M164_52-1	52	2020/07/10	01:38	49°40.72'N	33°30.37'W	3997	3989	x	x	x	
M164_53-1	53	2020/07/10	06:47	49°16.40'N	33°01.49'W	3801	3792	x	x	x	
M164_54-1	54	2020/07/10	11:54	48°52.01'N	32°32.68'W	3840	3824	x	x	x	
M164_55-1	55	2020/07/10	16:52	48°27.67'N	32°03.63'W	4211	4191	x	x	x	

Station	Profile	Date	Time [UTC]	Latitude	Longitude	Water Depth [m]	Profile Depth [m]	SF6/CFC	Bottle Oxygen	LADCP	Remarks
M164_56-1	56	2020/07/10	22:06	48°03.35'N	31°35.06'W	3943	3924	x	x	x	
M164_57-1	57	2020/07/11	02:52	47°37.48'N	31°37.46'W	3760	3745	x	x	x	
M164_58-1	58	2020/07/11	09:26	47°34.46'N	32°34.68'W	3953	3953	x	x	x	
M164_59-1	59	2020/07/11	15:46	47°30.87'N	33°32.12'W	4138	4087	x	-	x	
M164_60-1	60	2020/07/11	22:00	47°27.27'N	34°29.50'W	4299	4396	x	x	x	
M164_61-1	61	2020/07/12	04:03	47°23.56'N	35°27.07'W	4180	4309	x	x	x	
M164_62-1	62	2020/07/12	09:56	47°20.07'N	36°24.32'W	4224	4228	x	x	x	
M164_63-1	63	2020/07/12	15:37	47°17.78'N	37°22.37'W	4489	4507	x	x	x	
M164_64-1	64	2020/07/13	02:56	47°15.08'N	37°56.65'W	4570	4589	x	x	x	
M164_65-1	65	2020/07/13	07:37	47°12.40'N	38°31.06'W	4619	4610	x	x	x	
M164_66-1	66	2020/07/13	12:20	47°10.24'N	39°01.08'W	4588	4584	x	x	x	
M164_67-1	67	2020/07/13	16:41	47°09.80'N	39°28.40'W	4586	4579	x	x	x	MicroCAT and NKE calibration
M164_68-1	68	2020/07/14	06:41	47°06.59'N	40°11.26'W	4561	4554	x	x	x	
M164_69-1	69	2020/07/14	12:13	47°06.57'N	40°52.64'W	4502	4478	x	x	x	
M164_70-1	70	2020/07/14	19:49	47°05.95'N	41°15.44'W	4442	4417	x	x	x	
M164_71-1	71	2020/07/15	04:57	47°05.61'N	41°37.69'W	4296	4279	x	x	x	
M164_72-1	72	2020/07/15	09:03	47°05.24'N	41°59.54'W	4229	4212	x	x	x	
M164_73-1	73	2020/07/15	17:30	47°06.25'N	42°16.31'W	4009	3995	x	x	x	
M164_75-1	74	2020/07/16	03:56	47°06.09'N	42°35.49'W	3676	3654	x	x	x	
M164_77-1	75	2020/07/16	16:27	47°06.05'N	42°53.65'W	3473	3443	x	x	x	
M164_78-1	76	2020/07/16	19:29	47°06.08'N	43°07.07'W	3516	3549	x	x	x	
M164_79-1	77	2020/07/16	22:15	47°06.17'N	43°13.35'W	3049	3030	x	x	x	
M164_80-1	78	2020/07/17	00:46	47°06.02'N	43°17.85'W	2680	2562	-	x	x	
M164_81-1	79	2020/07/17	02:48	47°05.90'N	43°20.17'W	1846	1788	x	x	x	
M164_82-1	80	2020/07/17	04:31	47°06.00'N	43°25.25'W	1291	1268	x	x	x	
M164_83-1	81	2020/07/17	06:29	47°05.99'N	43°38.35'W	777	755	x	x	x	
M164_84-1	82	2020/07/17	07:48	47°05.99'N	43°47.42'W	597	572	x	x	x	
M164_85-1	83	2020/07/17	09:24	47°06.07'N	44°02.53'W	363	345	-	-	x	
M164_86-1	84	2020/07/17	11:00	47°05.59'N	44°17.94'W	250	235	-	-	x	

Station	Profile	Date	Time [UTC]	Latitude	Longitude	Water Depth [m]	Profile Depth [m]	SF6/CFC	Bottle Oxygen	LADCP	Remarks
M164_87-1	85	2020/07/17	12:33	47°06.04'N	44°31.25'W	162	151	-	-	x	
M164_88-1	86	2020/07/17	22:40	47°05.66'N	47°22.80'W	245	228	-	-	x	
M164_89-1	87	2020/07/17	23:27	47°05.75'N	47°19.45'W	313	293	x	x	x	
M164_90-1	88	2020/07/18	00:17	47°05.90'N	47°15.83'W	483	463	-	-	x	
M164_91-1	89	2020/07/18	01:11	47°05.98'N	47°12.49'W	737	716	x	x	x	
M164_92-1	90	2020/07/18	02:14	47°05.92'N	47°09.27'W	893	863	-	-	x	
M164_93-1	91	2020/07/18	03:15	47°05.90'N	47°05.84'W	1035	1012	x	x	x	
M164_94-1	92	2020/07/18	04:30	47°06.05'N	47°00.56'W	1137	1113	-	-	x	
M164_95-1	93	2020/07/18	06:05	47°06.04'N	46°51.16'W	1181	1155	x	x	x	
M164_96-1	94	2020/07/18	07:33	47°05.97'N	46°42.48'W	1148	1124	-	-	x	
M164_97-1	95	2020/07/18	08:41	47°06.08'N	46°40.01'W	1106	1083	x	x	x	
M164_98-1	96	2020/07/18	10:03	47°06.08'N	46°36.67'W	821	799	-	-	x	
M164_99-1	97	2020/07/18	11:18	47°06.09'N	46°33.25'W	503	484	x	x	x	
M164_100-1	98	2020/07/18	12:37	47°06.12'N	46°24.17'W	363	343	-	-	x	
M164_101-1	99	2020/07/18	14:24	47°06.04'N	46°08.45'W	336	317	-	-	x	
M164_102-1	100	2020/07/20	14:24	47°36.24'N	32°06.03'W	4050	4074	-	x	x	MicroCAT & Aquadopp calibration
M164_103-1	101	2020/07/20	20:30	47°53.82'N	31°25.68'W	3882	3867	-	x	x	
M164_104-1	102	2020/07/21	01:08	47°32.55'N	31°02.27'W	3710	3695	-	x	x	
M164_105-1	103	2020/07/21	05:42	47°11.27'N	30°38.53'W	3607	3589	x	x	x	
M164_106-1	104	2020/07/21	10:11	46°49.90'N	30°14.85'W	3087	3087	x	x	x	
M164_107-1	105	2020/07/21	14:31	46°28.58'N	29°51.16'W	3125	3122	x	-	x	
M164_108-1	106	2020/07/21	18:57	46°07.29'N	29°27.54'W	3125	3144	x	x	x	
M164_109-1	107	2020/07/21	23:21	45°45.95'N	29°03.87'W	3275	3274	x	x	x	
M164_110-1	108	2020/07/22	03:38	45°24.68'N	28°40.19'W	2648	2640	x	x	x	
M164_111-1	109	2020/07/22	07:35	45°03.36'N	28°16.53'W	2219	2226	-	x	x	
M164_112-1	110	2020/07/22	11:30	44°42.00'N	27°52.89'W	1405	1432	x	-	x	
M164_113-1	111	2020/07/23	06:58	47°41.66'N	30°31.21'W	3518	3501	-	x	x	
M164_114-1	112	2020/07/23	13:05	47°45.40'N	29°21.13'W	3061	3040	-	x	x	
M164_115-1	113	2020/07/23	19:15	47°49.34'N	28°08.50'W	2392	2407	-	x	x	

Station	Profile	Date	Time [UTC]	Latitude	Longitude	Water Depth [m]	Profile Depth [m]	SF6/CFC	Bottle Oxygen	LADCP	Remarks
M164_116-1	114	2020/07/24	00:56	47°53.40'N	26°53.12'W	2834	2763	-	x	x	
M164_117-1	115	2020/07/24	06:39	47°57.27'N	25°40.47'W	3352	3378	-	x	x	
M164_118-1	116	2020/07/24	12:48	48°01.02'N	24°30.45'W	4040	4030	-	x	x	
M164_119-1	117	2020/07/24	19:06	48°06.74'N	23°24.42'W	4493	4486	-	x	x	
M164_120-1	118	2020/07/25	05:18	48°08.57'N	22°10.29'W	4455	4447	-	x	x	
M164_121-1	119	2020/07/25	12:22	48°12.37'N	21°00.13'W	4238	4193	-	x	x	
M164_122-1	120	2020/07/25	17:37	48°14.77'N	20°16.01'W	4416	4412	-	x	x	
M164_123-1	121	2020/07/26	00:24	48°18.64'N	19°03.29'W	4011	4008	-	x	x	
M164_124-1	122	2020/07/26	05:09	48°20.45'N	18°29.58'W	4591	4589	-	x	x	
M164_125-1	123	2020/07/26	11:01	48°23.56'N	17°32.45'W	4232	4227	-	x	x	
M164_126-1	124	2020/07/26	16:48	48°26.60'N	16°35.26'W	4805	4803	-	x	x	
M164_127-1	125	2020/07/26	23:19	48°29.98'N	15°32.96'W	4838	4830	-	x	x	
M164_128-1	126	2020/07/27	05:09	48°31.84'N	14°56.67'W	4813	4810	-	x	x	