CRUISE REPORT

Cruise KB 2017606
with R.V. Kristine Bonnevie

10 - 23 March 2017

Working Areas:
Norwegian Sea, Lofoten Basin and Mohn Ridge

Geophysical Institute, University of Bergen

and

Institute of Marine Research

Compiled by Ilker Fer with inputs from
Henrik Søiland, Anthony Bosse and Pascal Bouruet-Aubertot

Table of Contents

1. Background

The cruise KB 2017606 aboard the Research Vessel *Kristine Bonnevie* is the second research cruise of the project "Watermass transformation processes and vortex dynamics in the Lofoten Basin of the Norwegian Sea (ProVoLo)". ProVoLo is led at the Geophysical Institute, University of Bergen (PI: Ilker Fer) and is funded by the Research Council of Norway (project number 250784/F20) for the period 01.01.2016-31.12.2019.

The overall objective of ProVoLo is to describe and quantify the processes and pathways of energy transfer and mixing in the Lofoten Basin and their role in watermass transformation. Three connected geographical regions of the Lofoten Basin (the Norwegian continental slope, the central basin with its persistent eddy (LBE), and the Mohn Ridge) will be studied in periods covering summer and wintertime conditions, and in the entire water column covering from spatial scale of turbulence to mesoscale. The field component includes dedicated process cruises in summer and in winter coordinated with deployments of moorings, gliders and Lagrangian floats. KB 2017606 is the winter cruise where we have deployed the remainder of RAFOS floats (6) and surface drifters (2) and conducted shipboard measurements of finescale temperature, salinity and current profiles, as well as ocean microstructure sampling. In the first ProVoLo cruise HM 2016611 (Fer, 2016) in summer 2016, we deployed current meter and sound source moorings, gliders, RAFOS floats, drifters. We conducted a shipboard measurements doing the same measurements as in the current cruise. This report provides an overview of the activity and the data collected during KB 2017606. More details can be found in the reports from HM 2016611 (available from Ilker.Fer@uib.no and also included with the data sets submitted to the Norwegian Marine Data Centre).

2. Cruise participants

	Name	Institute[1]	Responsibility[2]
Scientists	Henrik Søiland (cruise leader) henrik@imr.no	IMR	RAFOS, VM-ADCP
	Ilker Fer Ilker.fer@uib.no	UIB	VMP2000 & MR
	Pascale Bouruet-Aubertot	LOCEAN	VMP6000
	Anthony Bosse	UIB	Slocum Glider, VMP2000, LADCP
Technical personnel	Steinar Myking	UIB	VMP winch
	Reidar Johannesen	IMR	CTD
	Rune Strømme	IMR	CTD
	Olivier Menage	IFREMER	VMP6000
	Emilie Argouach	IFREMER	VMP6000

[1] UIB: University of Bergen; IMR: Institute of Marine Research, Bergen; IFREMER, University of Brest, France; LOCEAN, Sorbonne Universities, France.
[2] The instrument and acronyms are described in the report.

Captain : Tom Ole Drange

3. Cruise Overview

The cruise was conducted between 10 - 23 March 2017 with port calls Tromsø - Tromsø. Surveys and process studies were made at two sites: the main permanent anticyclonic LBE in the central basin (radial transects, and repeat occupation of the eddy close to maximum speed) and the Mohn Ridge (MR section across the ridge) at the northern edge of the basin. The cruise track is shown in Figure 1. Other operations include deployment of subsurface and surface drifters, and ocean glider deployment.

In total 45 CTD (conductivity temperature depth), 44 LADCP (lowered acoustic Doppler current profiler), and 36 microstructure profiles were collected. Of the microstructure profiles 13 were made using a telemetered microstructure profiler VMP2000 system and 23 free-fall VMP6000 systems.

The vessel-mounted 150 kHz ADCP (VM-ADCP) sampled continuously throughout the cruise. In addition 6 neutrally buoyant, acoustically-tracked subsurface drifters (RAFOS), 2 GPS-tracked surface drifters, a deep Slocum glider equipped with turbulence probes were deployed.

A cruise track is shown in Figure 1. The station map is shown in Figure 2. Zoom in to surveys in the Lofoten Basin Eddy (LBE) and over the Mohn Ridge are shown in Figure 3.

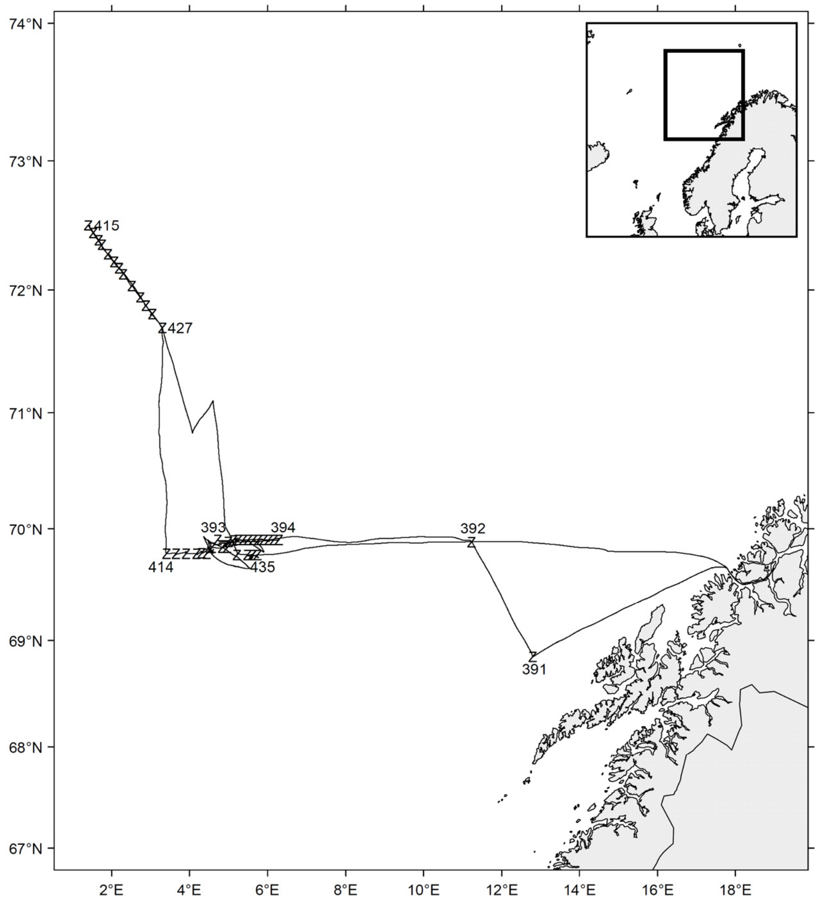

Figure 1. Cruise track and CTD map of KB 2017606. The cruise started and ended in Tromsø. CTD stations indicated with Z.

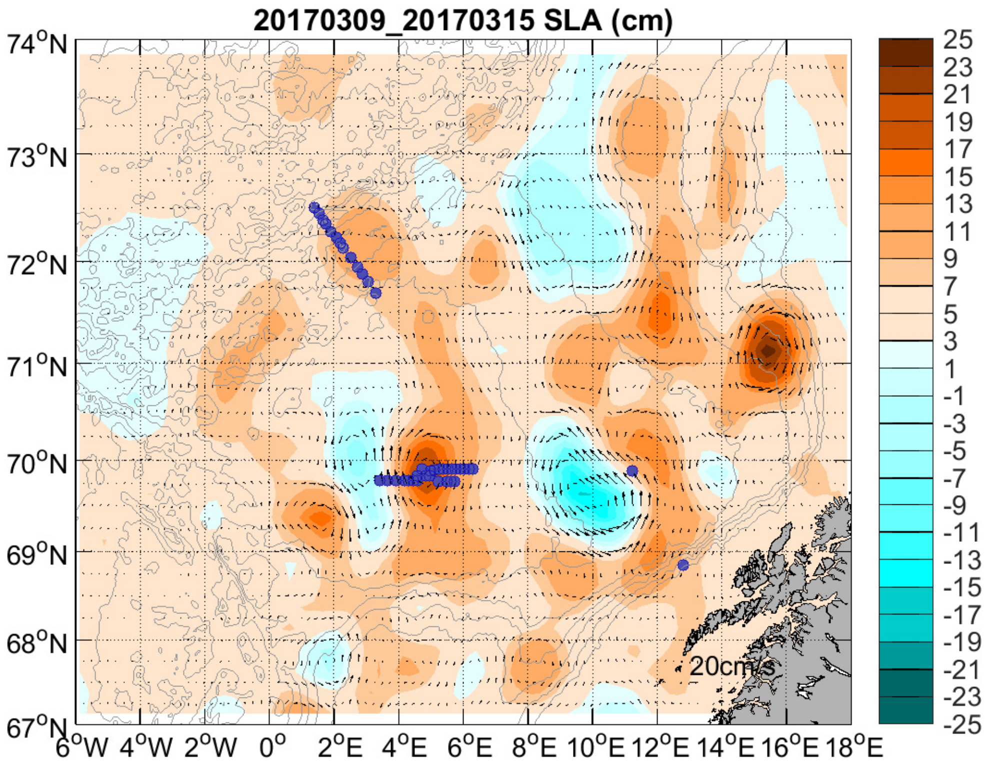

Figure 2. Station map overlain on satellite measured Sea Level (SLA).

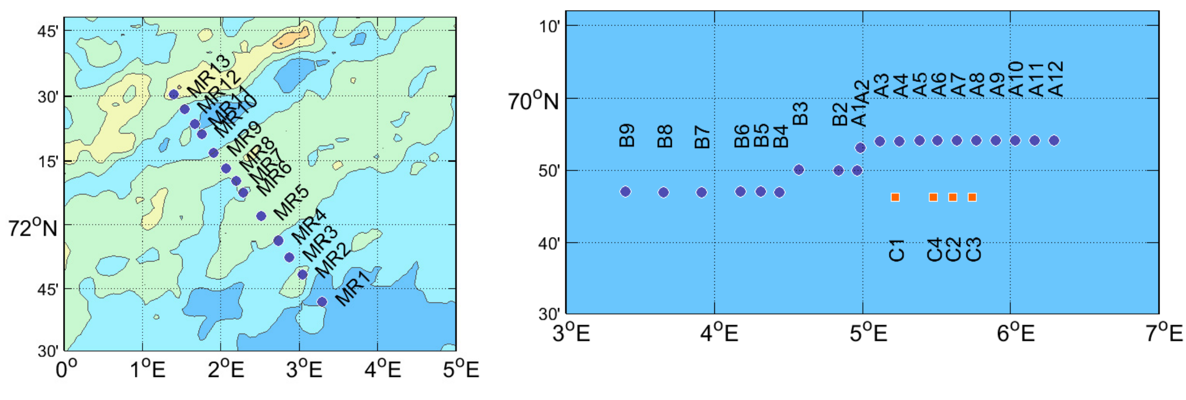

Figure 3. Station maps: zoom in to (left) Mohn Ridge and (right) Lofoten Eddy deployments.

4. Environmental conditions

Throughout the cruise we used maps of absolute dynamic topography and geostrophic currents derived from satellite altimetry to guide us toward the center of the LBE. The maps are produced daily, using all data gathered in one week windows. These images have been instrumental in planning the cruise and interpreting the surface currents observed by the VM-ADCP underway. See Figure 2, with stations shown.

Atmospheric wind speed and other atmospheric forcing measured by the ship's mast (15 m height) is shown in Figure 4. As can be seen the wind speeds were high during large parts of the cruise, reaching more than 30 m/s in 20 March.

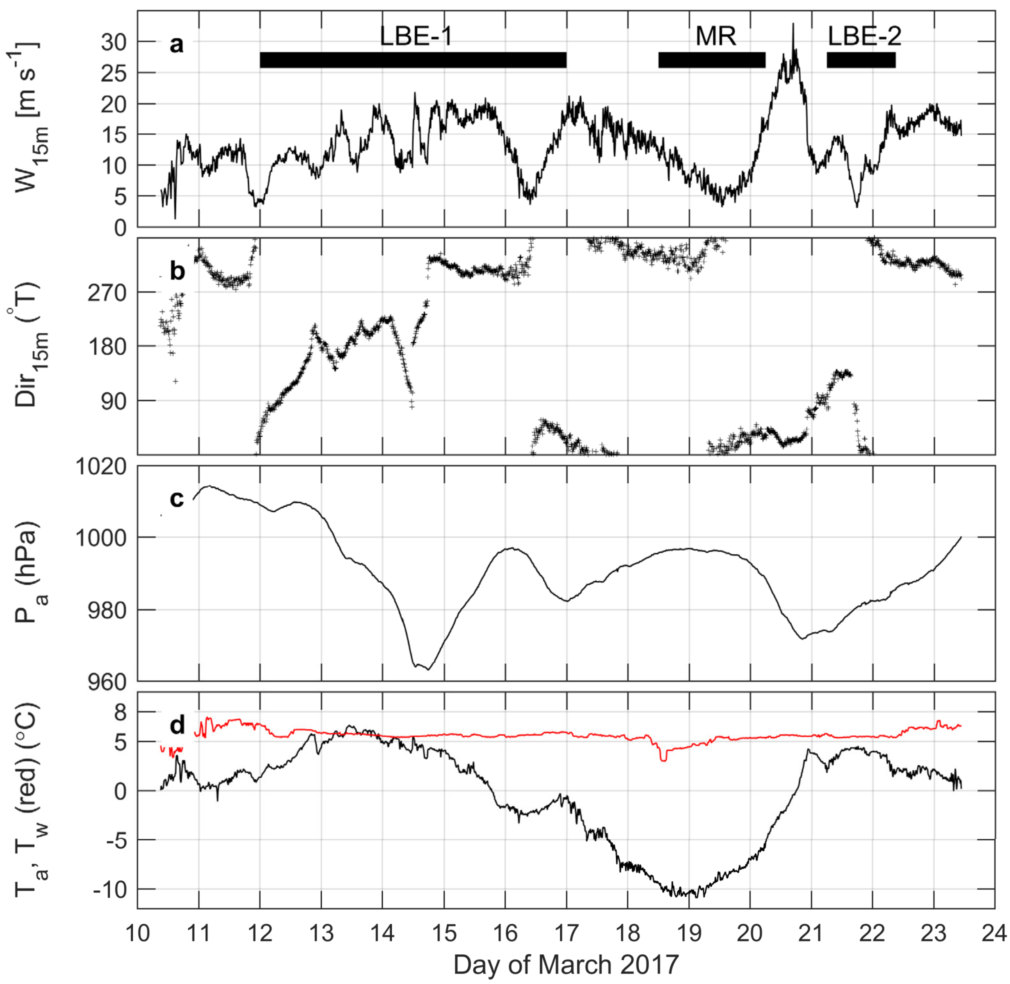

Figure 4. 10-minute averaged data from the ship's log: a) wind speed, b) direction, c) atmospheric pressure measured at 15-m height, and d) near-surface water (red) and 15-m height air temperature. Duration of activities are indicated at the top: the LBE site occupation 1, Mohn Ridge section (MR), and the LBE site occupation 2.

5. Hydrography

The hydrographic work was carried out using a CTD-water sampling package from SeaBird Inc., acquiring data during both down and upcast. The package consisted of a SBE 911plus CTD with sensors listed below. The Benthos altimeter (200 kHz) allowed profiling close to the bottom. The CTD was equipped with a 12 position SBE 32 Caroussel, fitted with a single 5 litre sampling bottle for salinity calibration water. The CTD rosette, together with the acoustic Doppler current profilers, is shown in Figure 5. At all stations, water samples for salinity calibration were collected at the deepest sampling level.

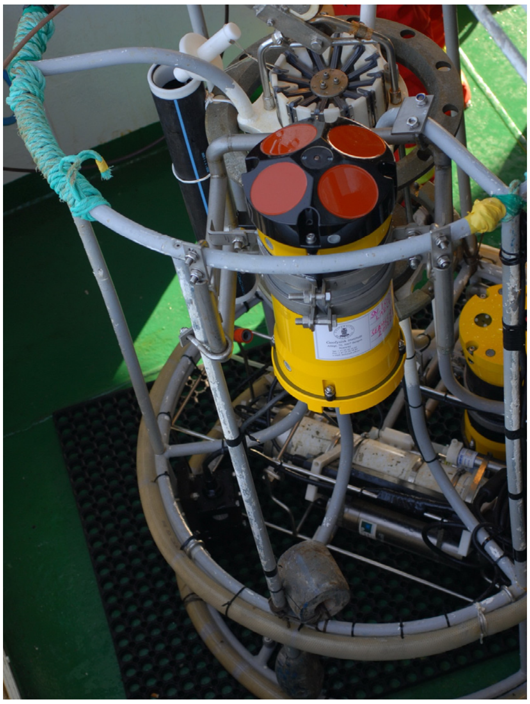

Figure 5. The CTD rosette together with the CTD sensors, one 5-liter Niskin bottle, a down and uplooker ADCP, and a benthos altimeter installed. The transducers of both ADCPs and the altimeter have a non-obstructed path. The position of the lead weights and the ADCPs are adjusted to have a negligible tilt of the entire system.

Data processing - SBEDataProcessing-Win32, standard Seabird Electronics software for Windows (version 7.23.2), is used for post-processing of the CTD data. Only data from downcasts are used to avoid turbulence caused by rosette package on upcast. Raw data (pressure, temperature and conductivity from dual sensors) are converted to physical units using calibration files modified for air pressure and conductivity slope factor (DATCNV). Outliers, differing more than 2 and 20 standard deviations for the first and second pass, respectively, from the mean of 100 scan windows are flagged and excluded from analysis (WILDEDIT). The thermal mass effects in the conductivity cell are corrected for (CELLTM, with parameters alpha = 0.03 and 1/beta = 7.0). Pressure is low-pass filtered with a time constant of 0.15 s. Both conductivity signals were low-pass filtered using a time constant of 0.03 s. Scans when the CTD package moved less than the set minimum fall rate of 0.25 m s^{-1} are flagged to remove pressure reversals due to ship heave (LOOPEDIT). Data are then averaged into 1 dbar bins (BINAVG). In the final (converted and bin-averaged) data files, temperature is saved using the ITS-68 scale, and salinity on the practical salinity scale (PSS-78). Pressure, temperature, and salinity data are accurate to ±0.5 dbar, $\pm 2\times10^{-3}$ °C, and $\pm 3\times10^{-3}$, respectively.

Conductivity correction from salinity bottle samples – A total of 43 salinity bottle samples are analyzed at IMR with a Guildline Portasal 8410 salinometer. 1 reading appears erroneous and is excluded from the analysis. Salinity and conductivity values from each bottle are merged with the corresponding CTD data. Bottle conductivity is calculated from bottle salinity and CTD temperature and pressure. Following the procedure recommended by UNESCO [1988], only data within the 95% confidence interval are used to correct the calibration of the CTD conductivity. Histogram of $\Delta C = C_{CTD} - C_{Bot}$, difference of conductivity measured by CTD and inferred from bottle salinity, is approximately normally distributed Following the recommendations given by Seabird Electronics, the conductivity values are corrected by the formula, $C_{new} = m\ C_{old}$, where m is the slope calculated by

$$m = \frac{\sum_{i=1}^{n} a_i \times b_i}{\sum_{i=1}^{n} a_i \times a_i}.$$

Here a_i and b_i are the CTD conductivity and the bottle conductivity, respectively and n is the total number of bottles. Using the 39 values inside the 95% confidence interval, the value for the slope is calculated to be **m = 1.00019**. Prior to correction, the conductivity difference between CTD and bottles, $\Delta C = C_{CTD} - C_{bot}$ averaged -5.7 (± 1.9) $\times 10^{-4}$ (± 1 standard deviation) over 42 samples. After correction ΔC = 0.0 (± 1.9) $\times 10^{-4}$ S/m. After applying conductivity slope correction, the RMS difference between bottle and CTD salinity before correction is 0.00953, and improves to 0.00446.

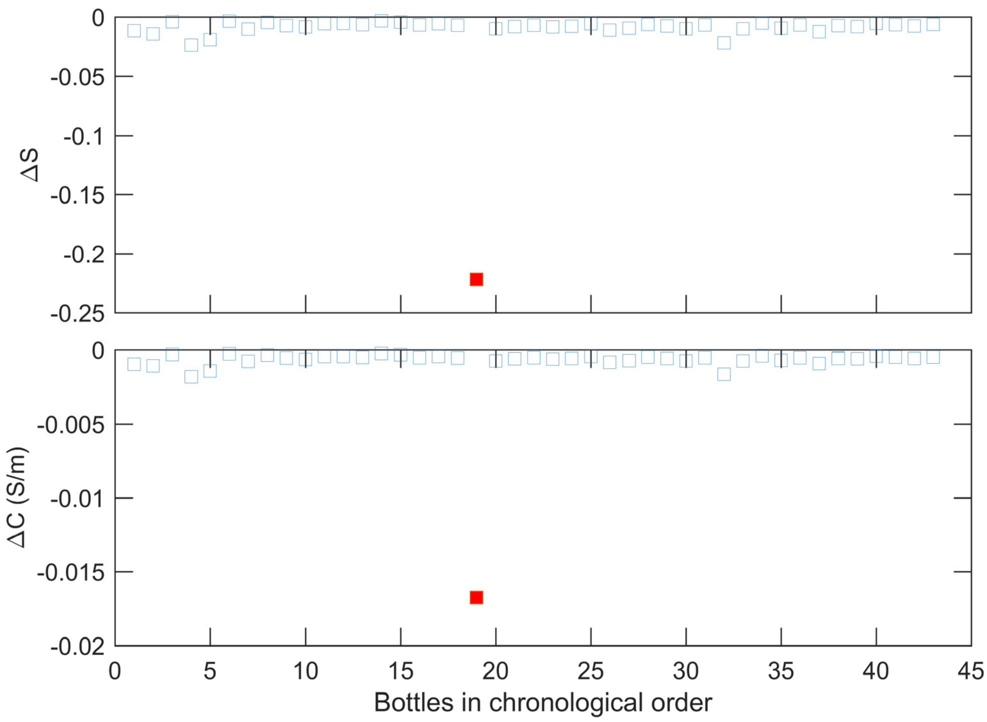

Figure 6. Difference between CTD-derived and bottle data: upper panel, salinity, lower panel, conductivity. One outlier marked in red is excluded from the analysis.

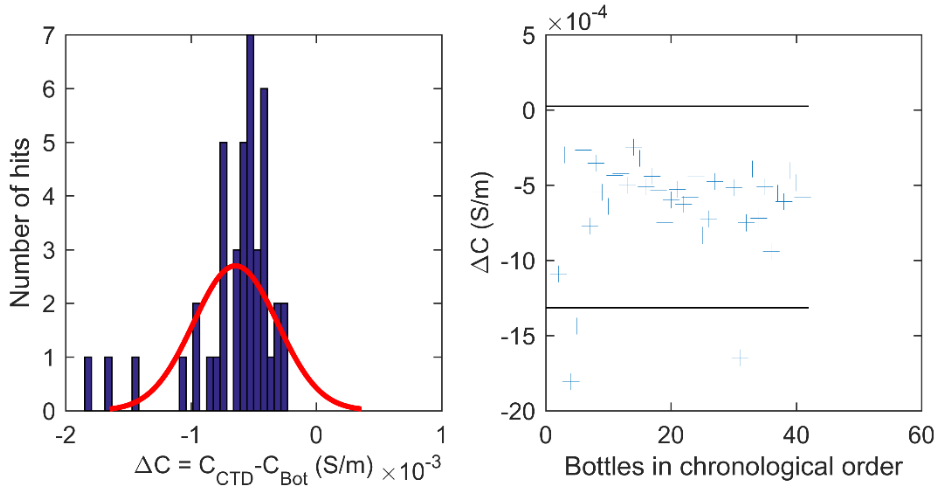

Figure 7. (Left) Histogram of CTD-derived and bottle conductivity differences. Red curve is the normal-distribution fit for the sample mean and standard deviation. (Right) ΔC in chronological order with 95% confidence intervals on the mean indicated (black envelopes).

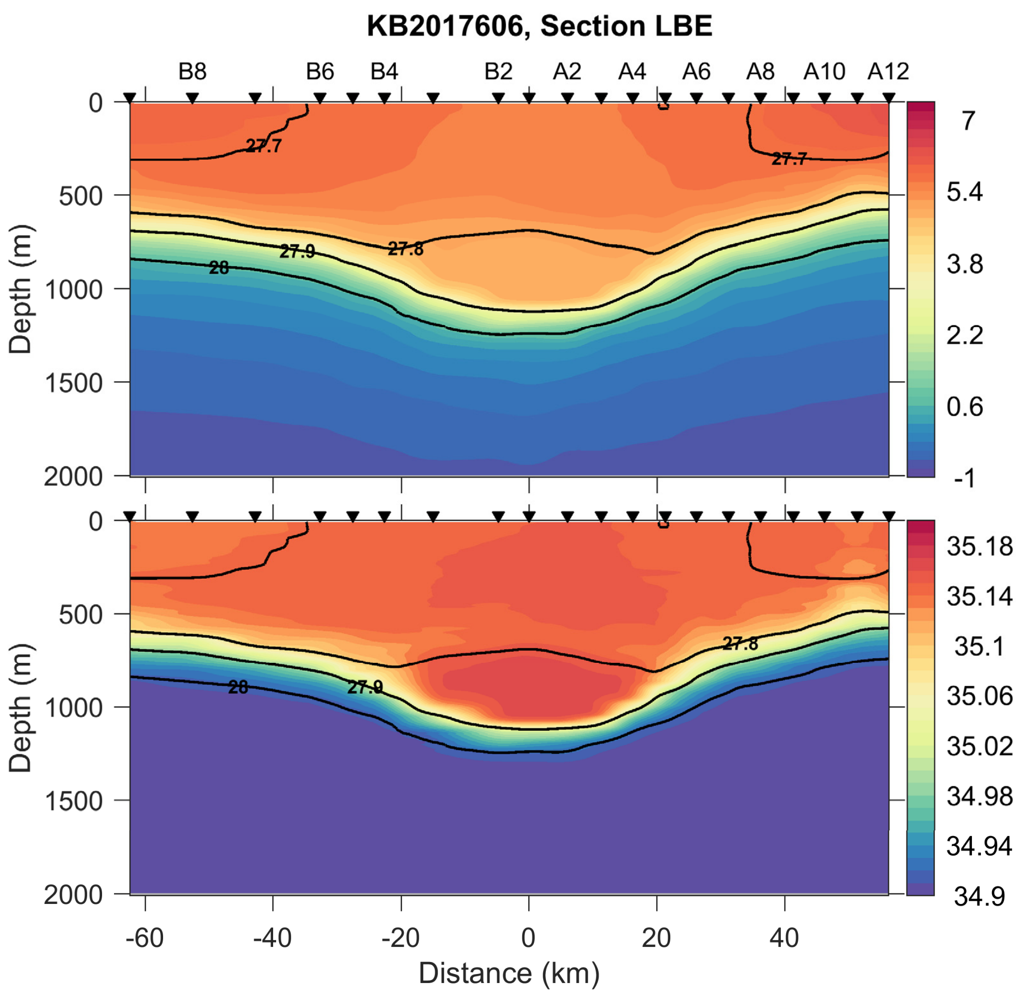

Figure 8. Contours of potential temperature (θ) and practical salinity (S) for the LBE transect. Isolines of potential density anomaly (σ_θ) are also shown (black) on each panel. Distance is relative to the eddy center. The center location is not accurately calculated for this presentation.

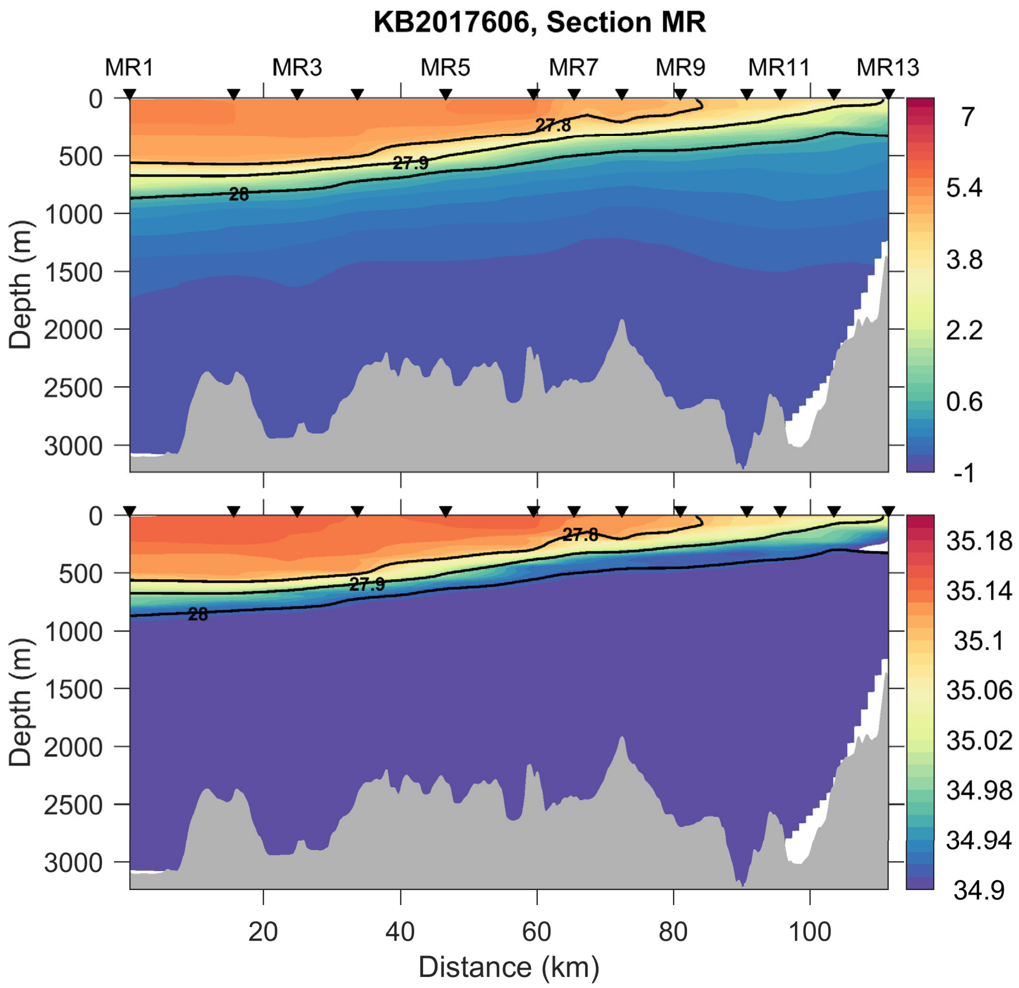

Figure 9. Contours of potential temperature (θ) and practical salinity (S) for the MR section. Isolines of potential density anomaly (σ_θ) are also shown (black) on each panel. Bottom topography is from the high-resolution multi beam data, interpolated along the section at 100 m horizontally.

6. Current Profiling

6.1. Lowered-ADCP (LADCP)

Two LADCP-profilers (RD Instruments) were mounted on the CTD rosette in order to obtain current profiles (Figure 5). The ADCPs are 6000 m-rated 300 kHz Sentinel Workhorses with internal batteries. Each ADCP has the L-ADCP option installed and has the firmware v16.3. The ADCPs were configured to sample in master/slave mode to ensure synchronization. The master ADCP pointed downward (SN 10012) and the slave ADCP pointed upward (SN 10151). Communication with the instruments, start & stop of data acquisition and data download were done using BBTalk software. PC time (UTC) was transferred to each instrument before each cast. The vertical bin size (and pulse length) was set to 8 m for each ADCP. Single ping data were recorded in narrow bandwidth (to increase range), in beam coordinates, with blank distance set to zero. The data from the first bin are discarded during post processing. In order to mitigate a possible influence of previous pinging, especially close to steep slopes, staggered pinging with alternating sampling intervals of 0.8 s and 1.2 s were used. The altimeter worked reliably and no sign of degradation of LADCP data quality was observed. The command files for the master and slave LADCPs are identical to that reported in the first PROVOLO cruise report (HM6112016, in Appendix G).

The LADCP data are processed using the LDEO software version IX-12 based on *Visbeck* [2002]. For each master/slave profile data, synchronized time series of CTD and navigation is used. For the purpose, NMEA GPS stream is added to each scan of the ship CTD and the data files are processed as 1-s bin averages, similar to the ADCP ping rate. LADCP-relevant processing of the CTD data included the following steps in the SBE-Data Processing software: DatCnv, WildEdit, CellTm, Filter, Binavg (1 s) and Derive. 3-min averaged VMADCP profiles are included for additional constraint on the inversion of the LADCP data.

6.2. Vessel-mounted ADCP (VMADCP)

The Vessel Mounted Acoustic Doppler Velocity Profiler (VMADCP) is a 150 kHz RDI ADCP on board the RV *Kristine Bonnevie*, and continuously collected velocity profiles below the ship.

It was the first research cruise with the newly installed UHDAS software. The new software automates the editing to a large degree. 8 m depth bins were used during the cruise (on the shelf, early in the cruise, until 10 March, 20:17 UTC, 4 m depth bins were used). Final processed files are 3-min averaged. Typical final processed horizontal velocity uncertainty is 2-3 cm s^{-1}.

7. Ocean microstructure measurements (VMP 2000 and VMP 6000)

Ocean microstructure measurements were made using the vertical microstructure profilers VMP6000 and VMP2000, each manufactured by Rockland Scientific International.

7.1. VMP6000

A total of 23 profiles were collected, 15 in the Lofoten Basin eddy and 7 along the Mohn ridge section. A map of the VMP stations is displayed in Figure 10 and detailed information on the stations are given in Appendix B. In the Lofoten Basin Eddy we retrieve the main features as those evidenced last spring namely dissipation enhancement at the eddy thermoclines in the eddy center (Figure 11). A new interesting observation is a local dissipation enhancement at depth around 3000m over about 100m depth range. This localized event is clearly outside from the bottom boundary layer that we do not resolve with our VMP measurements and insights on its origin should be provided by CTD & LADCP data. Mohn Ridge section reveals a contrasted pattern in dissipation rate that differs from that observed last spring (Figure 12). This difference quite likely results from different currents and stratification conditions to be determined.

Sensors: we found sometimes a slight shift of S2 compared to S1 but not systematic and it often came back to normal so we did not change the sensor. Micro conductivity probe had a few temporary problems at the beginning and then worked perfectly well. Microprobe T2 also encountered a few localized problems but came back to normal. Eventually the SBE temperature sensor gave many spikes during the first profiles, the connections were cleaned up and this resolved the problem.

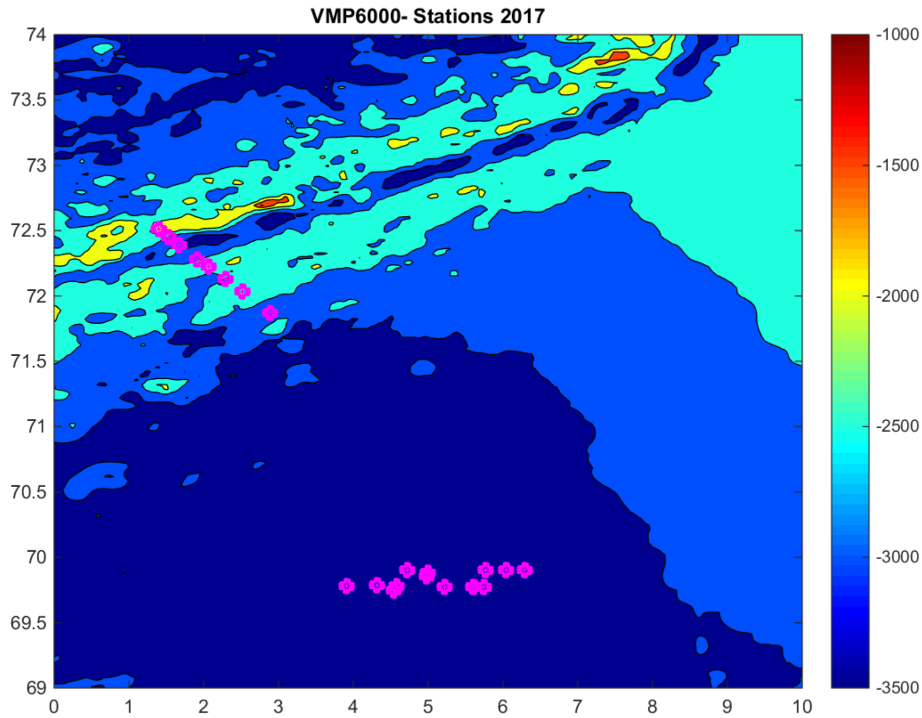

Figure 10. VMP6000 stations.

Timeline:

Friday 10th : mount of the vmp, check the vhf

Sensors : Shear 1 : 753, shear 2 : 754, T1 : 399, T2 : 417; Pressure test : 11 508

Test profiles on the deck to check the sensors. Since we did not delete all test files on the VMP the first "in-situ" VMP profile starts with file number 4. In Table 1, we refer to VMP1 for the first VMP profile and so on, while the corresponding file number is indicated (4 for the first profile, etc). Note that after profile VMP16 another test file was created (when connecting the VMP to the computer while the computer was shut down), thus file number for profile VMP17 is 21 and so on for the following.

Saturday 11th: quite big waves, we decided not to deploy the vmp at the first station, preferring better rater conditions for the first profile

Sunday 12th: beginning of the sampling of eddy, the center and then stations every 5km from edge

Monday 13th: one VMP only then bad weather conditions, only CTD/LADCP

Tuesday 14th: time slot of weaker wind & waves, 2 profiles but for the second, in the eddy center, one while high winds (38 nots); we decreased the safety length to 60m as the bottom topography is so flat, in the hope to resolve part of the bottom boundary layer, no sign of it but evidence for a 100m vertical extent increased dissipation within [3000-3100m]

Wednesday 15th: bad weater

Thursday 16th: follow-up of the Lofoten eddy stations, then bad weather and route to Mohn ridge

Saturday 18th and Sunday 19th: Mohn Ridge section, began with MR13

Monday 20th: very bad weather, winds up to 120km/h, route to Lofoten eddy

Tuesday 21st: nice weather conditions with sun, problem with the engine in the afternoon, the problem was fixed after about 2h30 during which the VMP drifted at the surface; but we'll need to come back earlier, on Friday morning for engine repair, new sampling of the Lofoten eddy with a focus on the eddy core (center-20km)

Wednesday 22nd: pursuit of the Lofoten eddy stations and route to Tromsø.

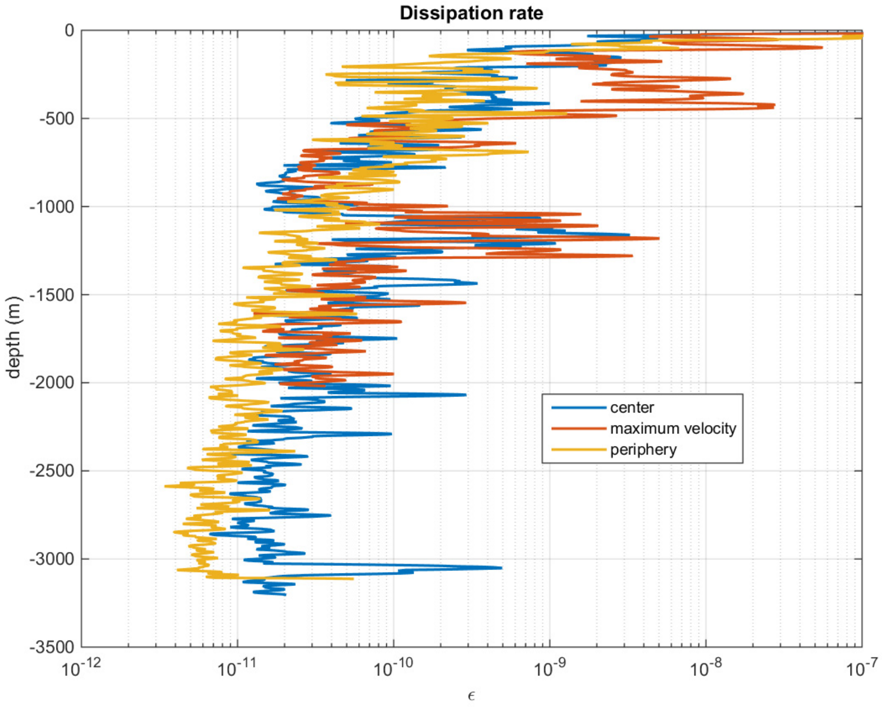

Figure 11. Examples of dissipation profiles in the Lofoten Basin Eddy: at the eddy center, at the maximum velocity and at the periphery. Note at depth the enhanced dissipation in the eddy center (profiles VMP6, VMP20 and VMP2). A 10m shifting average has been applied to the epsilon values for better visualization.

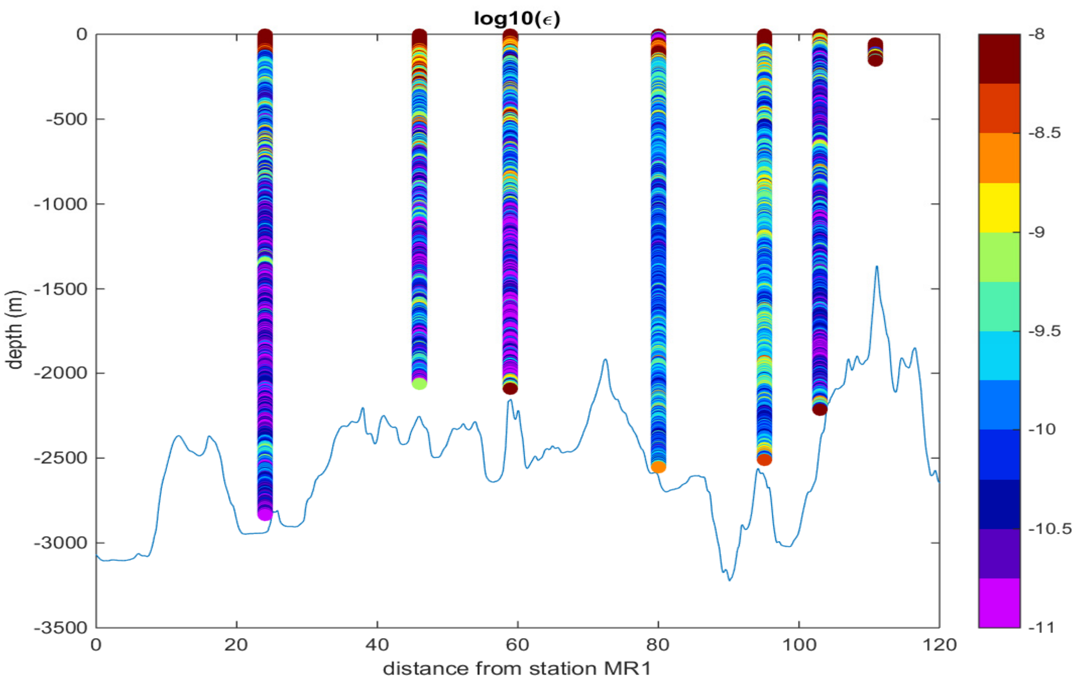

Figure 12. Mohn Ridge section of dissipation rate in Winter 2017

7.2. VMP2000

The VMP2000 is 2000-m depth rated, loosely tethered vertical microstructure profiler (http://www.rocklandscientific.com), for the measurement of dissipation-scale turbulence to depths down to 2000 m. During the cruise VMP SN009 was deployed. A complete list of casts is provided in Appendix B. It is equipped with high-accuracy conductivity temperature depth (CTD) sensors (P Keller, T, SBE-3F, C, SBE-4C with pump SBE-5T), microstructure velocity probes (shear probes), one high-resolution temperature sensor (FP07-38-1 thermistor), one high-resolution micro-conductivity sensor (SBE7-38-1 micro-C), and three accelerometers. VMP samples signal-plus-signal-derivative on thermistor, micro-conductivity and pressure transducer, and derivative for shear signals, which is crucial for turbulence measurements, especially for the temperature microstructure. Data are transmitted in real time to a ship-board data acquisition system. VMP has an overall length of 2 m with 40/3.5 kg weight in air/water and with a nominal fall rate of 0.6 m/s.

Deployments were made using a Sytech Research Ltd. CMK-2 Hydraulic winch with Linepuller (an active line payout system) and 2500 m deployment cable. We used the ship's hydraulics for the VMP winch, bypassing the hydraulic/electric motor. TThe winch and line puller system was designed to feed cable over the side of the ship, allowing the profiler to free-fall through the water column.

Microstructure sensors:

casts	S1	S2	T1	T2	C1
all	M1109	M1293	T1175	T1176	C200

8. Final remarks

The 150 kHz VMADCP on the R/V Kristine Bonnevie allows us to profile to only about 400 m. This is much shallower than the reach of the 75 kHz VMADCP used on R/V Håkon Mosby on the first ProVoLo cruise in June 2016. The 75 kHz typically reach more than 600 m and on occasions as deep as 800 m. The LBE is a feature with a deep velocity maximum and thus the mapping of the LBE with the 150 kHz VMADCP is not satisfactory. This a general problem that the 150 kHz has to shallow penetration and thus preventing mapping of open ocean currents.

The extreme weather conditions reduced the number of stations possible to occupy. High winds are expected at that time of the year in the Norwegian Sea, but the weather was particularly inclement during the cruise. However, this was a calculated risk that we were willing to take to obtain the first

9. Appendix A: List of CTD stations

Table 1. List of CTD stations. Echo depth is from the ship's echo sounder corrected for transducer depth and depth averaged (adjusted for full depth) speed of sound. Last three columns indicates the cast number in file names for corresponding master/slave LADCP, VMP2000, and VMP6000 profiles (e.g., staXXX_LADCPM.000, VMP6000_0XX.p, etc.)

CTD	Station	Date	Time (UTC)	LAT	LON	EDepth (m)	LADCP	VMP - 2000	VMP-6000
391	G10	2017-03-11	04:11	68N50.98	012E48.13	670	-	-	-
392	MB	2017-03-11	12:43	69N53.06	011E13.80	2905	392	1	-
393	A1/B1	2017-03-12	07:44	69N54.17	004E43.39	3211	393	-	4
394	A12	2017-03-12	14:28	69N54.17	006E17.61	3170	394	-	5
395	A11	2017-03-12	19:10	69N54.13	006E09.84	3182	395	2	-
396	A10	2017-03-12	21:26	69N54.13	006E01.87	3189	396	-	6
397	A9	2017-03-13	00:32	69N54.15	005E54.13	3197	397	3	-
398	A8	2017-03-13	03:33	69N54.18	005E46.15	3176	398	-	7
399	A7	2017-03-13	07:35	69N54.14	005E38.32	3201	399	-	-
400	A6	2017-03-13	12:34	69N54.16	005E30.52	3210	400	-	-
401	A5	2017-03-13	15:30	69N54.10	005E22.84	3210	401	-	-
402	A4	2017-03-13	17:56	69N54.06	005E14.76	3210	402	-	-
403	A3	2017-03-14	04:55	69N54.02	005E07.00	3260	403	-	-
404	A2	2017-03-14	07:31	69N53.16	004E59.08	3210	404	-	8
405	A1/B1	2017-03-14	11:48	69N49.97	004E57.73	3218	405	-	9
406	B2	2017-03-14	15:00	69N49.96	004E50.19	3219	406	-	-
407	B3	2017-03-14	18:17	69N50.07	004E34.23	3219	407	-	-
408	B3	2017-03-16	01:38	69N46.99	004E34.34	3220	408	-	10
409	B4	2017-03-16	06:09	69N46.98	004E26.39	3226	409	-	11
410	B5	2017-03-16	08:55	69N47.07	004E18.62	3227	410	-	12
411	B6	2017-03-16	12:30	69N47.00	004E10.65	3227	411	4	-
412	B7	2017-03-16	14:55	69N46.91	003E54.78	3229	412	-	13
413	B8	2017-03-16	19:17	69N46.95	003E39.47	3232	413	5	-
414	B9	2017-03-16	22:13	69N47.03	003E24.19	3233	414	-	-
415	MR13	2017-03-18	13:37	72N30.48	001E24.14	1248	415	-	14
416	MR12	2017-03-18	15:32	72N26.98	001E32.07	2390	416	-	15
417	MR11	2017-03-18	18:16	72N23.50	001E40.18	2629	417	-	16
418	MR10	2017-03-18	20:51	72N21.30	001E45.19	3230	418	7	-
419	MR9	2017-03-19	01:45	72N16.91	001E54.49	2661	419	-	17
420	MR8	2017-03-19	04:44	72N13.31	002E04.06	2012	420	-	18
421	MR7	2017-03-19	08:40	72N10.35	002E11.74	2413	421	8	-
422	MR6	2017-03-19	10:47	72N07.66	002E17.42	2103	422	-	19
423	MR5	2017-03-19	13:29	72N02.02	002E30.73	2155	423	-	21
424	MR4	2017-03-19	17:54	71N56.43	002E44.13	2511	424	10	-
425	MR3	2017-03-19	20:16	71N52.46	002E52.69	2924	425	-	22
426	MR2	2017-03-20	01:15	71N48.46	003E02.45	2479	426	11	-
427	MR1	2017-03-20	04:00	71N41.81	003E17.78	3059	427	-	-
428	C1	2017-03-21	10:20	69N46.29	005E13.16	3203	428	-	23
429	C2	2017-03-21	13:06	69N46.29	005E36.62	3202	429	-	24
430	C2	2017-03-21	15:13	69N46.23	005E36.59	3202	430	-	25
431	C2	2017-03-21	21:26	69N46.33	005E36.59	3202	431	12	-
432	C2	2017-03-22	00:49	69N46.18	005E36.59	3202	432	13	-
433	C3	2017-03-22	02:50	69N46.28	005E44.61	3202	433	-	26
434	C2	2017-03-22	05:13	69N46.15	005E36.04	3203	434	-	27
435	C4	2017-03-22	07:58	69N46.23	005E28.89	3204	435	-	-

10. Appendix B: List of VMP stations

Table 2. List of the VMP6000 deployments.

Cast	Sta.	Date, Time (UTC)		LAT	LON	ED (m)	CTD File	Comments
4	A1/B1	2016-03-12	07:30	69N54.13	04E43.34	3214	393	LBE core, calm, Batt. 12.15- 11.8v, Safety depth range=100m
5	A12	2016-03-12	14:20	69N54.18	06E17.59	3134	394	60 km, Bigger waves, Batt.12.4-11.7V
6	A10	2016-03-12	21:12	69N54.18	06E02.56	3188	396	50 km (after Gnå + VMP6000)
7	A8	2016-03-13	03:24	69N54.18	05E46.15	3197	398	40 km, Recovery difficult, spikes on SBT, cleaned connections
8	A2	2016-03-14	07:23	69N53.05	04E59.30	3210	404	10 km, Reduced safety range to 60 m, Batt 12.03V
9	A1/B1	2016-03-14	11:18	69N51.39	04E58.98	3218	405	core, windy, touch bottom, sensors OK
10	B3	2016-03-16	01:27	69N46.78	04E34.85	3209	408	VMP6000 early at surface (about 1000 m)
11	B4	2016-03-16	05:52	69N44.84	04E32.35	3226	409	-20 km (2000 m, both ctd & vmp)
12	B5	2016-03-16	08:46	69N47.07	04E18.63	3227	410	-25 km (2000 m, both ctd & vmp)
13	B7	2016-03-16	14:45	69N46.92	03E54.90	3229	412	-40 km, (2000 m, both ctd & vmp)
14	MR13	2016-03-18	13:26	72N30.49	01E24.15	1248	415	VMP 160m only…pb of weight release
15	MR12	2016-03-18	15:25	72N26.99	01E32.07	2390	416	
16	MR11	2016-03-18	18:10	72N23.51	01E40.17	2629	417	
17	MR9	2016-03-19	01:38	72N16.93	01E54.49	2661	419	T2 OK
18	MR8	2016-03-19	04:36	72N13.33	02E04.05	2012	420	
19	MR6	2016-03-19	10:39	72N07.64	02E17.53	2161	422	
21	MR5	2016-03-19	13:22	72N02.03	02E30.73	2251	423	
22	MR3	2016-03-19	20:07	71N52.46	02E52.89	2941	425	
23	C1	2016-03-21	10:12	69N46.29	05E13.13	3203	428	LBE core, 2000 m (both vmp & ctd)
24	C2	2016-03-21	13:00	69N46.31	05E36.56	3202	429	15km, 2000m
25	C2	2016-03-21	15:08	69N46.28	05E36.60	3202	431	2000m, vmp drift for 2h, low battery 11.4V
26	C3	2016-03-22	02:38	69N46.22	05E44.78	3202	433	20km, 2000m
27	C2	2016-03-22	05:07	69N46.23	05E36.29	3203	434	15 km, 2000m

Table 3. List of the VMP2000 deployments. Echo depth (ED) is from the ship's echo sounder. Start and end pressures mark the reading on the VMP data acquisition software when started and stopped logging. CTD file is the corresponding ship CTD cast taken before the VMP deployment.

Cast	Sta.	Date, Time (UTC)		LAT	LON	ED (m)	Start (m)	End (m)	CTD File	Comments
1	MB	2017-03-11	14:49	69N53.50	11E12.50	2906	4.0	1250	391	Test near basin mooring, Pair=0.8
2	A11	2017-03-12	17:46	69N54.00	06E10.00	3183	4.0	1170	395	55 km
3	A9	2017-03-13	01:49	69N54.16	05E54.05	3195	5.0	1130	397	45 km
4	B6	2017-03-16	11:21	69N46.86	04E10.78	3227	3.0	1190	411	-30 km
5	B8	2017-03-16	17:46	69N46.63	03E39.71	3232	4.0	1185	413	-50 km
6	MR10	2017-03-18	23:16	72N16.91	01E54.45	3133	3.0	15	418	do not process
7	MR10	2017-03-18	23:20	72N16.91	01E54.45	3133	3.0	1710	418	
8	MR7	2017-03-19	07:05	72N10.23	02E11.32	2410	2.0	1650	421	before ctd
9	MR4	2017-03-19	16:00	71N57.20	02E42.91	2488	3.0	40	424	do not process, VMP warm up
10	MR4	2017-03-19	16:05	71N57.20	02E42.91	2488	3.0	2000	424	
11	MR2	2017-03-19	23:34	71N48.55	03E01.92	2467	4.0	1740	426	shear1 not good in first 50m
12	C2	2017-03-21	19:38	69N46.25	05E36.49	3203	4.0	1735	431	15 km
13	C2	2017-03-21	22:56	69N46.22	05E36.46	3203	3.0	1686	432	bad data in upper 15 m

11. Appendix C: List of RAFOS float deployments

Table 4. List of RAFOS float deployments.

#	Float #	IMEI#	Date (UTC)	Time (UTC)	LAT	LON	Echo Depth (m)	Target Depth	Added wght (g)	CTD #	Comments
26	1283	300234060305470	2017-03-14	16:10	69N50.88	04E32.98	3219	200	0.0	407	Speed maximum, nominal 15 km from LBE center
27	1266	300234060771670	2017-03-14	16:10	69N50.88	04E32.98	3219	500	5.5	407	Speed maximum, nominal 15 km from LBE center
28	1265	300234060778690	2017-03-14	16:10	69N50.88	04E32.98	3219	800	12.7	407	Speed maximum, nominal 15 km from LBE center
29	1284	300234060309190	2017-03-16	16:10	69N47.63	04E25.56	3226	200	0.0	409	Speed maximum, nominal 20 km from LBE center
30	1277	300234060877230	2017-03-16	16:10	69N47.63	04E25.56	3226	500	6.5	409	Speed maximum, nominal 20 km from LBE center
31	1269	300234060771720	2017-03-16	16:10	69N47.63	04E25.56	3226	800	12.9	409	Speed maximum, nominal 20 km from LBE center