REPORT

Physical oceanography data from moorings in the Lofoten Basin, Norwegian Sea: June 2016 – September 2017

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1. Background

The data set described herein was collected as a part of the project "*Water mass transformation processes and vortex dynamics in the Lofoten Basin of the Norwegian Sea* (ProVoLo)". ProVoLo was led at the Geophysical Institute, University of Bergen (PI: Ilker Fer) and was funded by the Research Council of Norway (project number 250784) for the period 01.01.2016-31.12.2019.

The overall objective of ProVoLo was to describe and quantify the processes and pathways of energy transfer and mixing in the Lofoten Basin and their role in water mass transformation. The field component included cruises when temperature, salinity and current profiles, as well as ocean microstructure profiles were collected in summer and in winter. The observations were coordinated with deployments of gliders and RAFOS floats and an array of moorings (this report). The related cruises were on board *Håkon Mosby* (HM 2016611, 26 May – 15 June 2016), and *Kristine Bonnevie* (KB 2017606, 10 - 23 March 2017, and KB 2017618, 2 – 15 September 2017). The data sets from the three cruises including the measurements of currents, hydrography and ocean microstructure, together with cruise reports, can be obtained from *Fer et al.* [2019]

The oceanographic moorings were deployed during the HM 2016611 and recovered during the KB 2017618 cruise, returning 15 month long time series. This report summarizes the details of the moorings, instrument setups and processing, and gives an overview of the data collected. The data set covers the period from June 2016 to September 2017, and includes time series of ocean temperature, salinity and currents at the shelf break and upper slope of the Lofoten Escarpment, and in deeper water in the Lofoten Basin. The data from the slope moorings are analyzed and presented in *Fer et al.* [2020]. The data set is submitted to and openly available from the Norwegian Marine Data Centre. Metadata and attributes for each submitted netCDF file (ncdisp output) are provided as an appendix.

2. Moorings

2.1. Overview

In total, 6 bottom-anchored oceanographic moorings were deployed, 5 on the continental slope of the Lofoten Escarpment off the Lofoten Islands and 1 in the Lofoten Basin. The positions are detailed in Table 1 and shown in Figure 1. Mooring names follow South (MS), North (MN), West (MW), and Basin (MB). Along-isobath distance between MS to MN is 26 km. The cross-isobath distance, MN to MW is 6 km. Each mooring was equipped with instruments logging temperature, salinity and currents. The details of the instrumentation are given in Table 2 and in the mooring diagrams in the Appendix.

Because of the risk due to fishing activity in the region, we separated each MS and MN mooring into a bottom unit with a Microcat CTD and spherical buoy equipped with an uplooker ADCP, and a water column line including temperature loggers and CTDs. The bottom units are approximately 25 m tall, "short" moorings and are dubbed MSs and MNs. These units were deployed within a couple of 100 m distance to MS and MN. All moorings were deployed in June 2016 with anchor last, from the stern. No complications occurred.

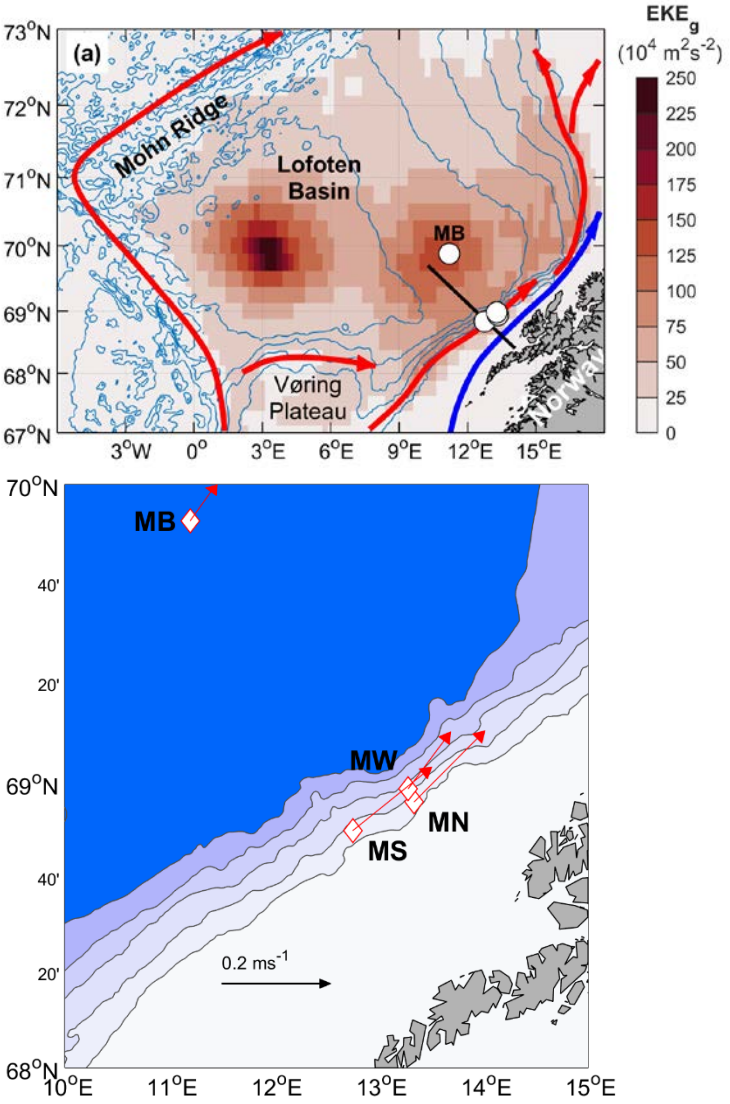


Figure 1. (a) Mooring positions, bathymetry of the Lofoten Basin (contours at 500 m intervals) and the geostrophic EKE from satellite altimeter observations, averaged over the period 1993 to 2018 (from *Fer et al.* [2020]). General circulation of the warm Atlantic Water (red) and the Norwegian Coastal Current (blue) are indicated. (b) A zoom-in to the moorings together with 200–600 m depth-averaged current vectors.

Table 1. Mooring deployment details. Deployment time is the anchor drop. Bottom depth is the best estimate using the ship's echo sounder measurement, instrument pressure records and the mooring part lengths.

Mooring	Latitude	Longitude	Depth (m)	Deployed (UTC)	Recovered (UTC)
MS	68 N 50.128	012E 45.082	670	31.05.2016 21:06	08.09.2017 06:20 (bottom part only)
MSs	68 N 50.038	012E 44.777	672	31.05.2016 21:50	08.09.2017 07:20
MN	68 N 56.06	013E 20.24	645	01.06.2016 00:02	24.08.2016 (upper part) 08.09.2017 09:00 (rest)
MNs	68 N 56.109	013E 19.866	655	01.06.2016 00:48	08.09.2017 10:00
MW	68 N 58.759	013E 16.845	1500	01.06.2016 05:37	08.09.2017 12:10
MB	69 N 52.89	011E 11.89	2925	02.06.2016 13:44	09.09.2017 04:10

2.2. Instrumentation and set-up

The moorings were equipped with Sea-Bird Electronics temperature (SBE39) and conductivity and temperature recorders (SBE37 Microcat), Aanderaa Instruments (AADI) point current meters (RCM-7/8 and Seaguard RCM), and acoustic Doppler current profilers (ADCP, RD-Instrument 300 kHz Sentinel and 75 kHz Longranger). Some of the instruments were equipped with a pressure sensor. The details of the mooring instrumentation are given in Table 2. Instrument depths listed in Table 2 are corrected using the instrument pressure records and the mooring part lengths, and may differ from the planned target heights.

All instruments were set to sample starting from 31 May 2016, 1200 UTC.

All SBE instruments were set to sample a single record every 300 s (5 min). The conductivity cell of all the Microcats was a flow through (i.e., none were equipped with an internal pump).

Seaguards were equipped with a double set of lithium batteries (2x35Ah) and recorded 10 min averages of 200 pings in burst mode. All Seaguards (SNs 240, 1902, 1904, 1898) were fitted with a temperature, pressure and conductivity (except SN240) sensors.

All ADCPs recorded in Earth coordinates. Their compasses were calibrated in Bergen, on 24 to 26 May 2016 on lawn, away from magnetic influence, to typical errors between 1° and 4°. The 300 kHz instruments were set to sample in long range (narrow band) mode with 35 depth cells of 4 m thickness, as 35 pings per ensemble. Time between pings was 1 second. Ensemble interval was 30 minutes. Single ping standard deviation was 1.26 cm/s. The 75 kHz instruments were set to sample in long range (narrow band) mode with 77 depth cells of 8 m thickness, as 35 pings per ensemble. Time between pings was 3 second. Ensemble interval was 60 minutes. Single ping standard deviation was 2.47 cm/s. The RDI deployment files are listed in Table 3.

Table 2. Mooring instrument details. Target depths are best estimates using mooring line lengths and pressure records from the instruments. 210:8:730 means 8 m increments from 210 m to 730 m. Parameters are temperature (T), conductivity (C), pressure (P), horizontal velocity (V) and vertical velocity (W). Instruments are given with their serial numbers (SN).

Mooring	Target Depth (m)	Parameter	Instrument
MB	68, 743, 1492	T, C, P	Microcat SN6097, 5452, 7222
	389, 2198, 2500	T, C	Microcat 7336, 4446, 7821
	136, 1593	T, P	SBE39 3252, 3143
	85,94,115	T	SBE56 4311, 4312, 4314
	187, 237,288, 490	T	SBE56 SN4315, 4316, 4318, 4320
	591, 993, 1242	T	SBE56 SN4322, 4319, 4323
	748	P	RDI 75kHz Longranger, SN10740
	210:8:730	V, W	------ // -------, uplooking profile
	1497	P	RDI 300kHz Longranger, SN11434
	1401:4:1485	V, W	------ // -------, uplooking profile
	1800	V, C, T, P	Seaguard-RCM, SN1904
	2775	V	RCM-8, SN9912
MW	75, 380, 980	T, C, P	Microcat SN13357, SN6017, SN6018
	177, 278, 480,	T	SBE56 SN5192, 1948, 1953
	580, 780, 880,	T	SBE56 SN1951, 1954, 1955
	1085, 1190, 1400	T	SBE56 SN1965, 4200, 4203
	742	P	RDI 75kHz Longranger, SN21447
	188:8:724	V, W	------ // -------, uplooking profile
	975	V	RCM-7, SN12338
	1476	V, C, T, P	Seaguard-RCM, SN1902
MN	165, 648	T, C, P	Microcat SN13351, SN7373
	455	T,C	Microcat SN7334
	262, 358, 551,	T	SBE56 SN4326, 4325, 4331
	647	V, W	RDI 75kHz Longranger, SN18447
	69:8:629		------ // -------, uplooking profile
	634	V, C, T, P	Seaguard-RCM, SN240
MS	665	T, C, P	Microcat SN7372
	664	V, W	RDI 75kHz Longranger, SN15963
	102:8:646		------ // -------, uplooking profile
	647	V, C, T, P	Seaguard-RCM, SN1898

Table 3. Provolo RDI ADCP deployment files (left column, Longranger; right column 300 kHz Sentinel)

```
; ---- 75 kHz ADCP -------
CR1
CQ255
CF11101
EA0
EB0
ED5900
ES35
EX11111
EZ1111101
WA50
WB1
WD111100000
WF0
WN77
WP35
WS800
WV175
TE01:00:00.00
TP00:03.00
TF16/05/31 14:00:00
CK
CS
;
;Instrument       = Workhorse Long Ranger
;Frequency        = 76800
;Water Profile    = YES
;Bottom Track     = NO
;High Res. Modes   = NO
;High Rate Pinging  = NO
;Shallow Bottom Mode= NO
;Wave Gauge       = NO
;Lowered ADCP     = NO
;Ice Track        = NO
;Surface Track    = NO
;Beam angle       = 20
;Temperature      = 3.00
;Deployment hours   = 10320.00
;Battery packs    = 4
;Automatic TP     = NO
;Memory size [MB]   = 256
;Saved Screen     = 2
;
;Consequences generated by PlanADCP version 2.06:
;First cell range   = 9.58 m
;Last cell range    = 617.58 m
;Max range        = 623.86 m
;Standard deviation = 2.47 cm/s
;Ensemble size    = 1694 bytes
;Storage required   = 16.67 MB (17482080 bytes)
;Power usage      = 1799.61 Wh
;Battery usage    = 4.0
;
; WARNINGS AND CAUTIONS:
; Advanced settings have been changed.
; Expert settings have been changed.
```

```
; ---- 300 kHz ADCP -------
CR1
CF11101
EA0
EB0
ED15000
ES35
EX11111
EZ1111101
WA50
WB1
WD111100000
WF0
WN35
WP35
WS400
WV175
TE00:30:00.00
TP00:01.00
TF16/05/31 15:00:00
CK
CS
;
;Instrument       = Workhorse Sentinel
;Frequency        = 307200
;Water Profile    = YES
;Bottom Track     = NO
;High Res. Modes   = NO
;High Rate Pinging  = NO
;Shallow Bottom Mode= NO
;Wave Gauge       = NO
;Lowered ADCP     = NO
;Ice Track        = NO
;Surface Track    = NO
;Beam angle       = 20
;Temperature      = 3.00
;Deployment hours   = 11520.00
;Battery packs    = 1
;Automatic TP     = NO
;Memory size [MB]   = 256
;Saved Screen     = 1
;
;Consequences generated by PlanADCP version 2.06:
;First cell range   = 4.34 m
;Last cell range    = 140.34 m
;Max range        = 155.03 m
;Standard deviation = 1.26 cm/s
;Ensemble size    = 854 bytes
;Storage required   = 18.76 MB (19676160 bytes)
;Power usage      = 403.57 Wh
;Battery usage    = 0.9
;
; WARNINGS AND CAUTIONS:
; Advanced settings have been changed.
; Expert settings have been changed.
```

2.3. Recovery notes

All moorings were recovered during the cruise KB 2017618 of *Kristine Bonnevie* on 8 September (MS, MN and MW) and 9 September (MB) 2017.

MN was adrift in August 2016. The drifting part of the mooring was recovered on 24.08.2016, from *Kystverket Strilborg*. This earlier recovered upper part of the mooring included Novatech ARGOS A04-007, a hardball float, 4x17" glass spheres, SBE37 SN 13351 and SBE56 SNs 4325 and 4326. The remaining part was successfully retrieved on 8 September 2017.

Upon release, only the bottom part of MS surfaced, including the release, the Seaguard SN 1898 and 4x17" glass spheres. The mooring line was cut by a trawler. The following instruments were lost: SBE56 SNs 4334, 4324 and 4330; SBE37 SNs 7335 and 13350; and ARGOS Xeos 738.

The acoustic release (AR2500 SN948) of MB did not respond to ranging; however, it released successfully. Upper SBE37 SN 6097 and SBE56 SN 4252 (70-80m) were at the same depth. Above the Longranger buoy, SBE37 SN 5452 (750 m) and SBE56 SN 4322 (600 m) were at the same depth. After inspection of the pressure records, the following was concluded: On 13 June 2016, 07:15 UTC, SBE37 SN 6097 slid down from 68 to 78 dbar. On 22 Nov 2016, 04:45 UTC, SBE56 SN 4322 slid downward and reached the Microcat SN 5452 below at 750m, at 08:05 UTC.

3. Data processing

All data were downloaded and converted to physical units using the manufacturers' softwares. The first step of processing was to inspect the pressure records of the instruments, and using the information about their planned target depths and mooring element lengths, to identify the best estimate of the actual target depth after deployment. Using the pressure record from the bottommost instruments (and converting to depth at that the latitude) and the known instrument position from seabed, this also gives a best estimate for the total water depth.

We sought for a drift in the pressure record by inspecting the minimum pressure (proxy of target depth with minimum mooring blow down) in weekly moving windows, and looking for a significant trend. After correcting for a drift, if any, the in situ target depth was estimated from the average of lowest 5 percentile of the time series (least mooring blowdown leads to smaller pressures), and rounded downward to the nearest integer. Once the deployed target depths were obtained for each instrument, their time variable depth (pressure) was constructed at each time stamp using vertical interpolation of hourly averaged pressure time series. This approach was satisfactory, instead of applying a mooring dynamics model, because there were multiple pressure sensors available in each mooring line.

3.1. Salinity and temperature

Time series were inspected for drifts in temperature and salinity and were corrected if necessary (see mooring specific notes). Obvious outliers from salinity records were excluded (threshold values differed for each instrument). Salinity and temperature measurements from the RCM are excluded (C/T parameters for RCMs are not listed in Table 2, but several instruments were equipped with C/T sensors. None of the Microcats were pumped and caution is advised in interpreting the salinity data from the Microcats.

All temperature and salinity records were then compared against 1) a calibration cast after recovery, and 2) CTD profiles collected from the ship when the moorings were in water. When the ship CTD profiles had accompanying current profiles (lowered ADCP), they were also used to compare with the moored velocity profiles.

The calibration cast was sta785 (KB 2017618). All SBE instruments were attached to the CTD frame. The downcast was followed by 3 stops of 15-min duration during the upcast at approximately 850, 225 and 15 m depth (Figure 2). The ship's profile was processed as 1-dbar as well as 1-s averages for comparison with the mooring instruments. Note that all ship profiles were calibrated against water samples. The profile part was not useful for calibration of the moored sensors. Three comparison data points were obtained as time averages at the stop depths (Figure 2).

For all SBE instruments (except SBE37 SN7222, because of a drift identified later), pressure was good to within a few dbar and did not require any correction. For temperature and salinity, the comparison of average samples relative to the ship's calibration cast, is shown in Figure 3. The applied corrections following this analysis is listed for each instrument in Table 4.

The variability at 15 m level was too large to be used in the analysis, hence the samples from 15 m were excluded for the offset corrections. After applying the offset corrections, the agreement with the ship's CTD has significantly improved.

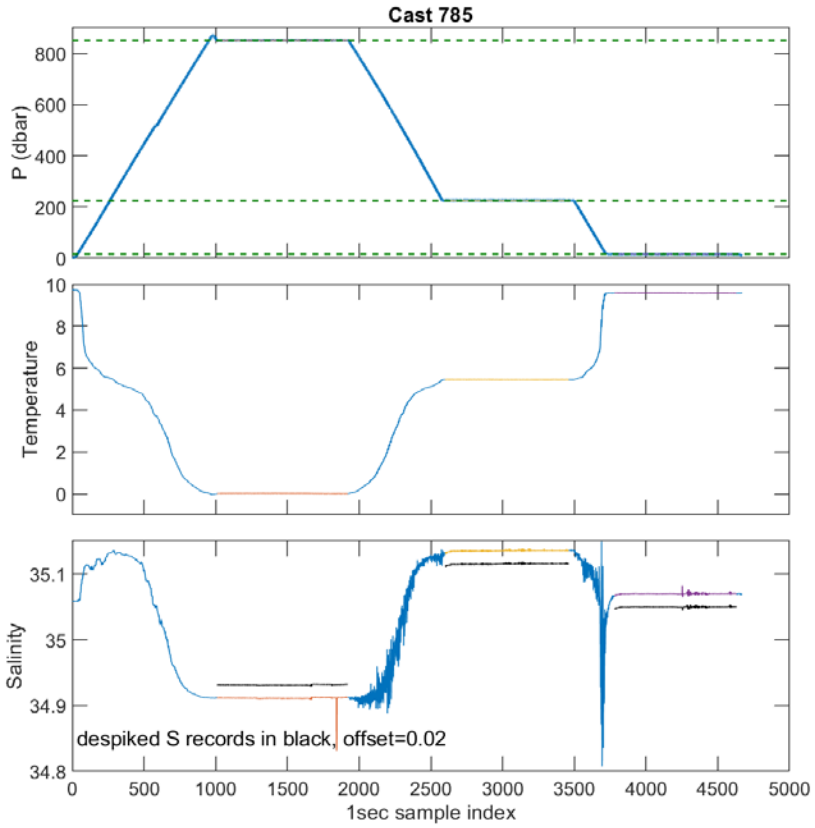


Figure 2. Calibration cast with all SBE instruments attached to the ship's CTD frame. Pressure, temperature and salinity record from the ship's CTD is shown as 1-sec averaged data. The three depth levels during the upcast are used for calibration. Average temperature and salinity from these periods, after despiking the salinity, are used as reference values.

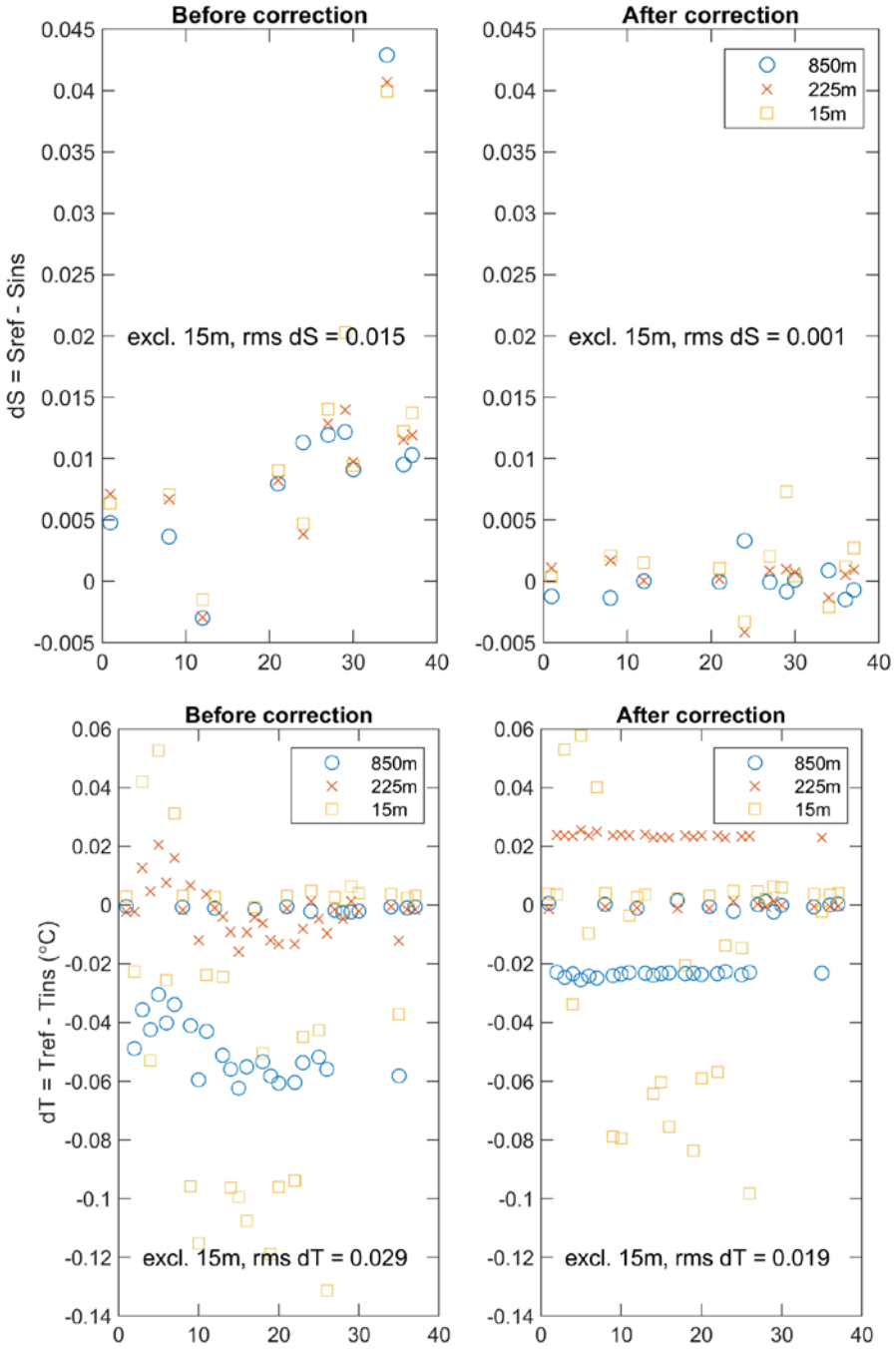


Figure 3. Difference between the reference values measured by the ship CTD and the measurements from the moored instruments for (upper row) salinity and (lower row) temperature. The horizontal axis is an arbitrary instrument counter. Data are shown for the three depth levels (15, 225 ad 850 m), and before and after the correction applied. Resulting rms error values are indicated (excluding the 15 m level with large variability).

The corrected data were then compared to the available CTD profiles during several cruises, collected nearby the moorings. The following profiles were available:

June 2016 (cruise HM 2016611): All casts after deployment. All without LADCP (except at MB).
MS = sta471; MN = sta472; MW = sta473; MB = sta475 (with LADCP)
Sep 2017 (cruise KB 2017618): All with LADCP and before recovery.
MS = sta782, MW = sta783; MB = sta784

The agreement was generally satisfactory. The bottommost 4 Microcats at MB (SN 5452, 7222, 4446, 7821) and SN 7334 at MN required corrections, as listed in the last column of Table 4. The comparison for June and September cruises are shown in Figure 4.

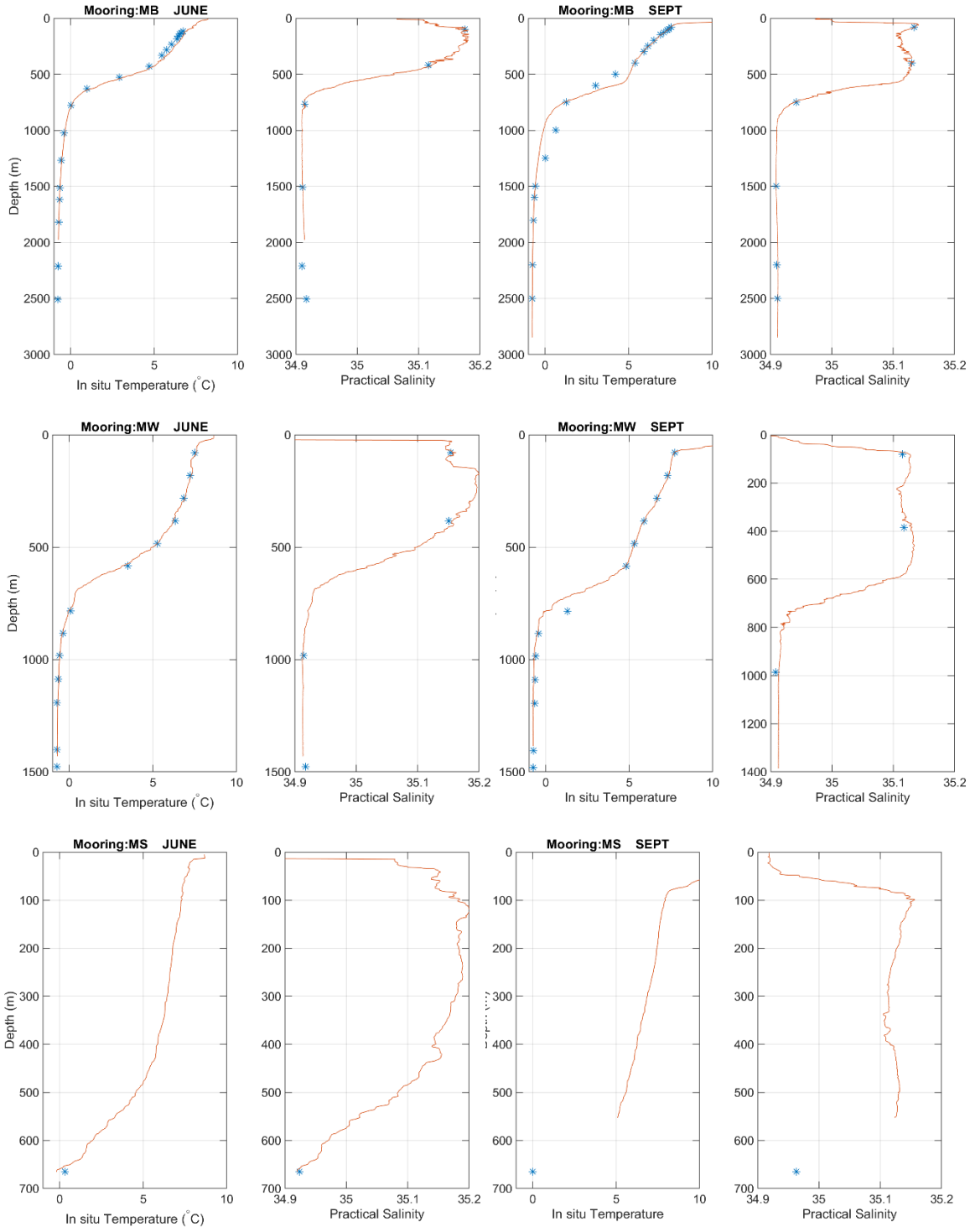


Figure 4. Comparison of temperature and salinity profiles (after offset corrections) from cruises in June and September collected nearby moorings MB, MW and MS.

Table 4. Temperature and salinity offsets inferred from the calibration cast. The last column is the salinity offset applied after comparison with various cruise CTD profiles.

SBE SN	Calibration cast Temperature offset $\times 10^{-3}$	Calibration cast Salinity offset $\times 10^{-3}$	Cruise profile Salinity offset $\times 10^{-3}$
6017	-1	5	
5192	-26		
1948	-11		
1953	-19		
1951	-5		
1954	-16		
1955	-9		
6018	-1	4	
1965	-17		
4200	-36		
4203	-20		
6097		-4	
4252	-28		
4311	-32		
4312	-39		
4314	-32		
3252	-3		
4315	-30		
4316	-35		
4318	-37		
7336		7	
4320	-37		
4322	-31		
5452		7	-5
4319	-28		
4323	-33		
7222	-2	12	-10
3143	-4		
4446		12	-5
7821	-2	9	-3
3351			
4326			
4325			
7334		41	-90
4331	-35		
7373	-1	10	
7372	-1	10	

Once the salinity data were corrected with offsets, a basic despiking was applied. Significant outliers were detected and removed in two passes using 5-minute time series. In the first pass, smoothed salinity (S_{mov_av}) and standard deviation over moving windows (S_{mov_std}; a continuous std, similar to the moving average operation) were calculated using 600 data point windows. Measurements exceeding a $S_{mov\_av} \pm 6S_{mov\_std}$ envelope were removed. In the second pass, the procedure was repeated with 120 point windows and a 4 std threshold. All removed data points were filled in with linear interpolation in time.

3.2. Speed and direction

The magnetic declination (positive east of true north) at the average position of the MS/MN/MW moorings (69N, 13E) was 5°E ± 0.54° on 1 Jan 2017, changing by 0.23° E per year. All velocity data (from the ADCPs, the RCMs ad the SGs) were corrected for magnetic declination using a constant 5° offset.

All ADCPs recorded in Earth coordinates and ensemble averaged data internally. The RDI ADCPs had 4 transducers, and 3-beam solutions were allowed. The averaged profiles from the instruments were further post-processed. We flagged data points as bad when the "percent-good" parameter was less than 50%, or when pitch or roll were in excess of 20°, or error velocity exceeded 1 m s^{-1}, or the vertical velocity exceeded 1 m s^{-1}, or the horizontal velocity exceeded 2 m s^{-1}. Depth cells close (within 10% of the total instrument range) to the surface (for upward pointing) or to the seabed (for downward pointing ADCPs) were also flagged as bad. After removing these points, together with the times prior to and after the deployment and recovery, we applied the following quality control. A smoothed version of the error velocity was calculated by moving averaging in time and range using 20 point length vertical and time windows. The standard deviation (std) of the original data at each bin was calculated. At each bin, outliers were identified as data points exceeding the ±3 std envelope of the smoothed values. Remaining spikes, identified as velocity measurements exceeding ±3 std in 40 ensemble windows at each bin, were removed. Short gaps less than 90 min length in time and two cell size in the vertical were interpolated.

3.3. Mooring specific notes

Mooring MB: We removed the pressure and salinity trend from SBE37 SN 7222, corresponding to -0.0573 dbar/day for pressure and 1.8478×10^{-5}/day for the salinity record. Adjustments were made for the sensors which slid vertically on the mooring line. We excluded the data from SBE56 4252 (at 78 dbar) after the time SBE37 SN 6097 slid to that depth. We excluded the record from SBE56 SN 4322 after 22 Nov 2016, 04:40 UTC. The Seaguard speed and direction measurements required an offset correction of -0.005 m s^{-1} and -5° to obtain a smooth vertical velocity profile at the mooring.

Mooring MW: The salinity record from the Seaguard SN1902 was of high quality and used in the final mooring gridded data after applying an offset correction of 0.03 to obtain a stable vertical profile. The first 315 points were noisy and excluded.

Mooring MN: Note that MN includes a bottom unit with a Microcat CTD and spherical buoy equipped with an uplooker ADCP, and a water column line including temperature loggers and CTDs. The units were deployed within a couple of 100 m distance to each other and treated as one mooring (water column line was lost 3 months into the deployment). We did not use the temperature from the Seaguard SN240 as we have a Microcat nearby. Seaguard fell to seabed when the flotation was cut on 22 Aug 2016, 15:00.

Mooring MS: Similar to MN, this mooring had a bottom unit and a water column line. The most part of the column line was lost with no data return, except a near-bottom Seaguard. We decided not to use the Seaguard for velocity, because the instrument was at the same level of the first good bin of the 75kHz ADCP. The salinity record from the Seaguard was not reliable (judged from the T/S plots). We retain it for the instrument-wise data product, but exclude it from the gridded data.

3.4. Gridded mooring data

Data from all instruments are first averaged into one hour intervals (if the sampling rate was faster) and then interpolated to a common 1-hour time stamp. As described in Section 3, the time variable depth (pressure) records were constructed at each time stamp and for each instrument using vertical interpolation of the known target depth (of instruments with pressure sensor) and the measured pressure to the target depths of all instruments. Hourly profiles of temperature, salinity and horizontal current were then vertically interpolated to 10-m vertical resolution. A depth level with a data coverage less than 30% of the total measurement duration was excluded. This 1-hour-10 m vertical homogenous, gridded data matrix was cleaned from short segments of data (especially in the outer ranges of the ADCPs) by filling with NaNs when a duration of segment with data was less than 3 days.

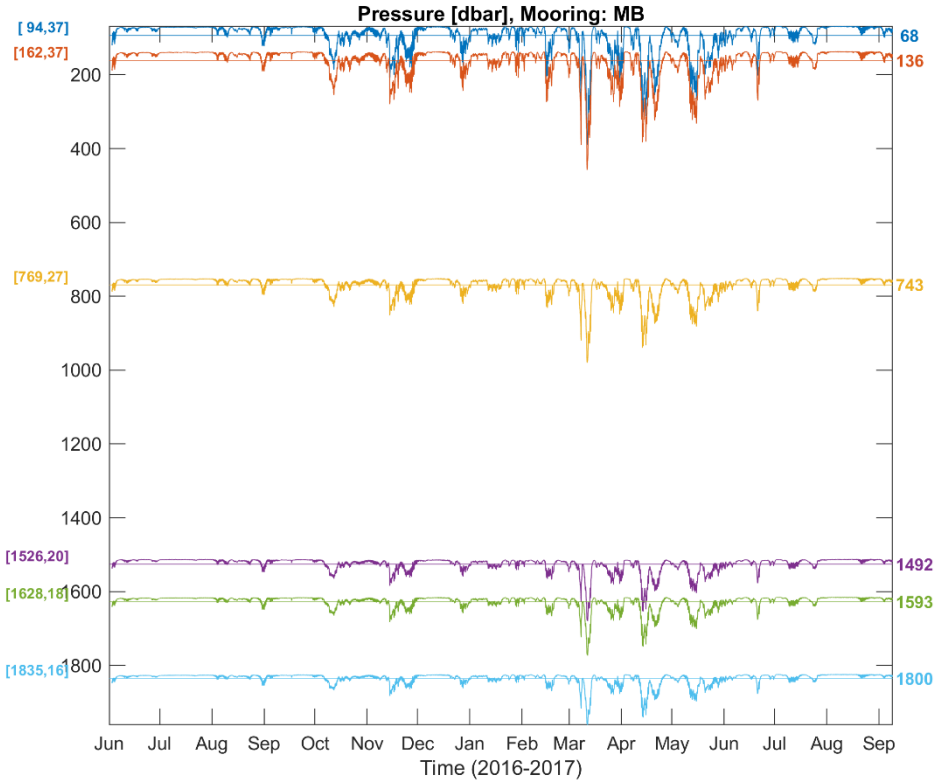
3.5. Accuracy and error

The initial accuracy of the SBE sensors are ± 2×10^{-3} °C for temperature, ±3×10^{-4} S m^{-1} for conductivity, and ±1 dbar for pressure (drift over 1 year is comparable to initial accuracy for temperature and pressure, and 10 times the initial accuracy for conductivity). The comparison with the calibration casts resulted in an rms error of 0.02 °C for temperature and 0.001 for salinity. For the deployment setup used, the ADCPs have a single ping (profile) statistical error of 2.5 cm s^{-1}, which reduces to 0.4 cms^{-1} for the ensemble average profile with 35 pings. The compass direction is accurate to ± 2°. Conservative error estimates are ± 1 cm s^{-1} for velocity, ± 10^{-2} °C for temperature and ±10^{-2} for practical salinity. The salinity data from the unpumped microcats, in general, must be used with caution. The 10-m vertically interpolated salinity product is not resolved and must be used with caution, referring to the target depths of conductivity sensors.

4. Summary plots

4.1. Pressure time series

In the following set of figures, the pressure time series are presented for each mooring. These records were used to construct the time variable instrument position for all sensors before gridding the data in the vertical.



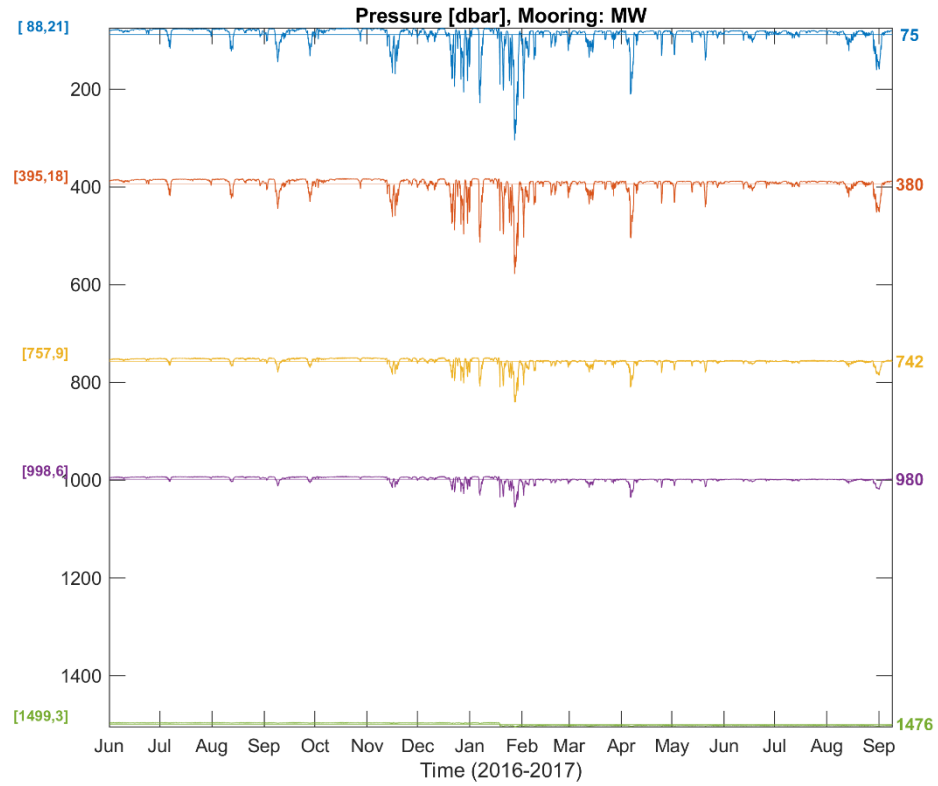
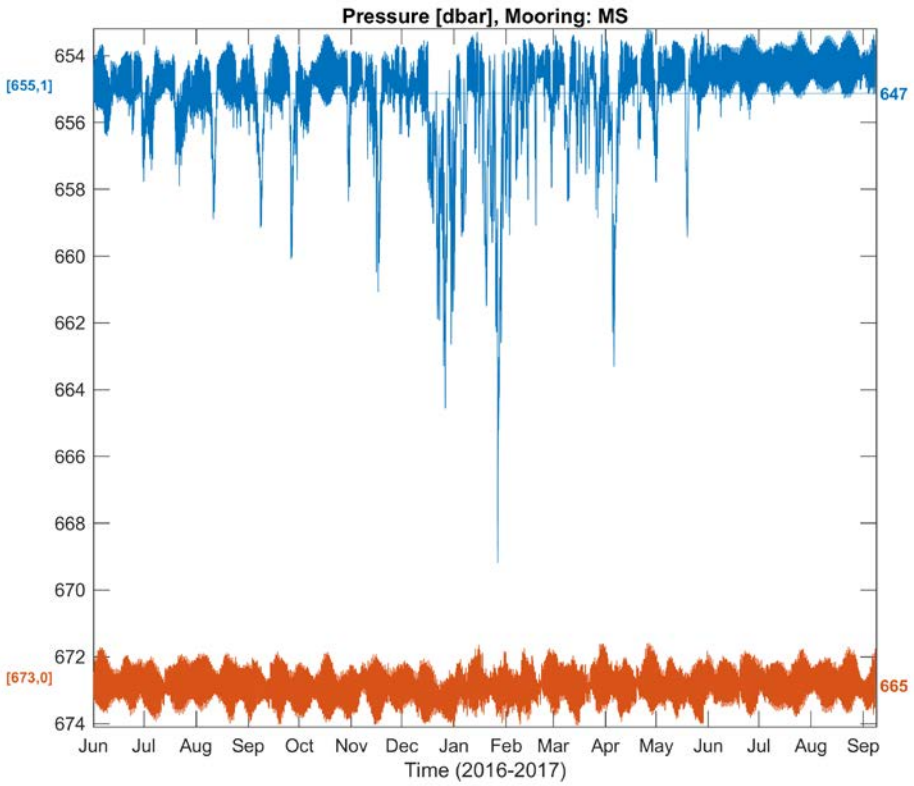


Figure 5. (2 pages) Pressure time series from various instruments on the moorings MB, MW, MN and MS. Values on the left in brackets are the average and one standard deviation of the pressure record. Values on the right are the target depths of the pressure sensor.



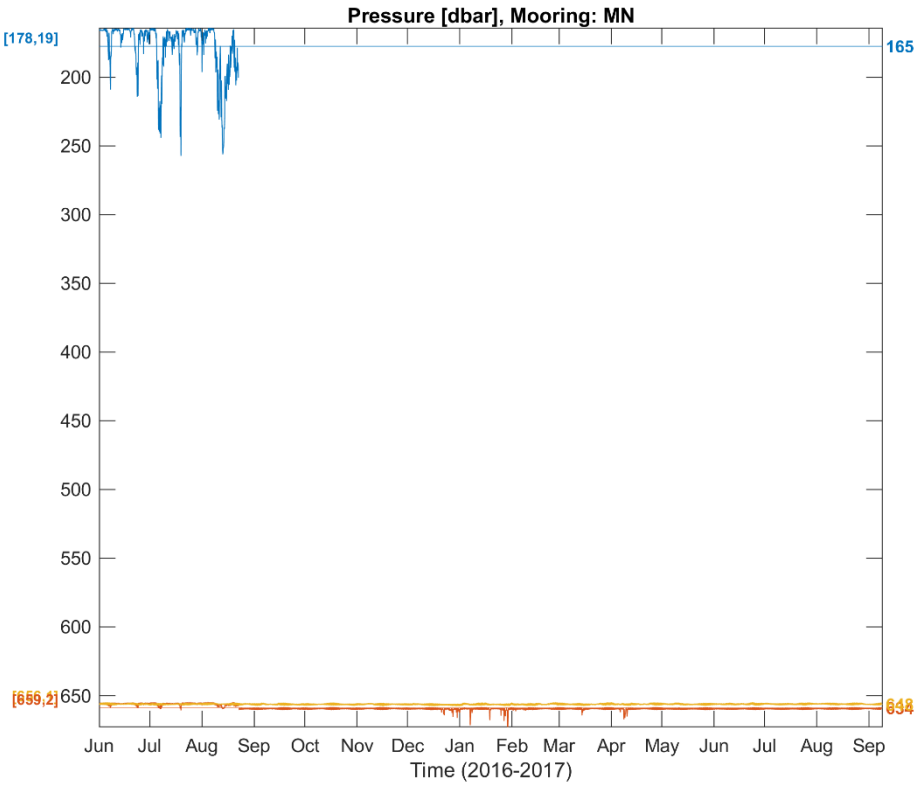


Figure 5 continued for MS and MN.

4.2. Time-depth distributions of u, v, T and S

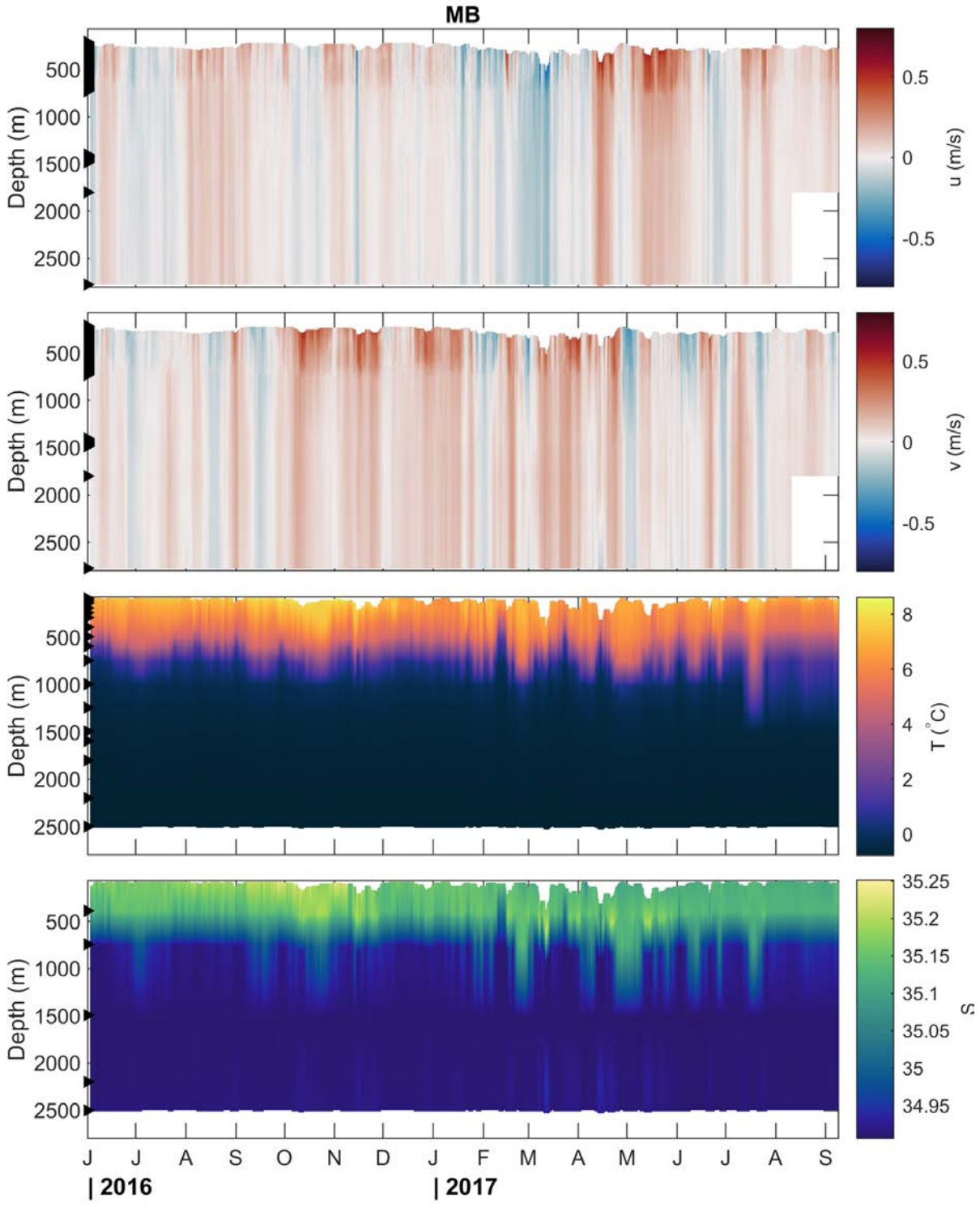


Figure 6 (4 pages). Time-depth distribution of east and north velocity components, temperature and practical salinity for Mooring MB, (following pages) MW, MN, and MS. Measurement target depths are indicated on the vertical axis. The hourly and 10-m gridded fields are shown without any smoothing or filtering. Gaps in data are due to instruments stopping recording, mooring blow down or the limited range of the ADCPs.

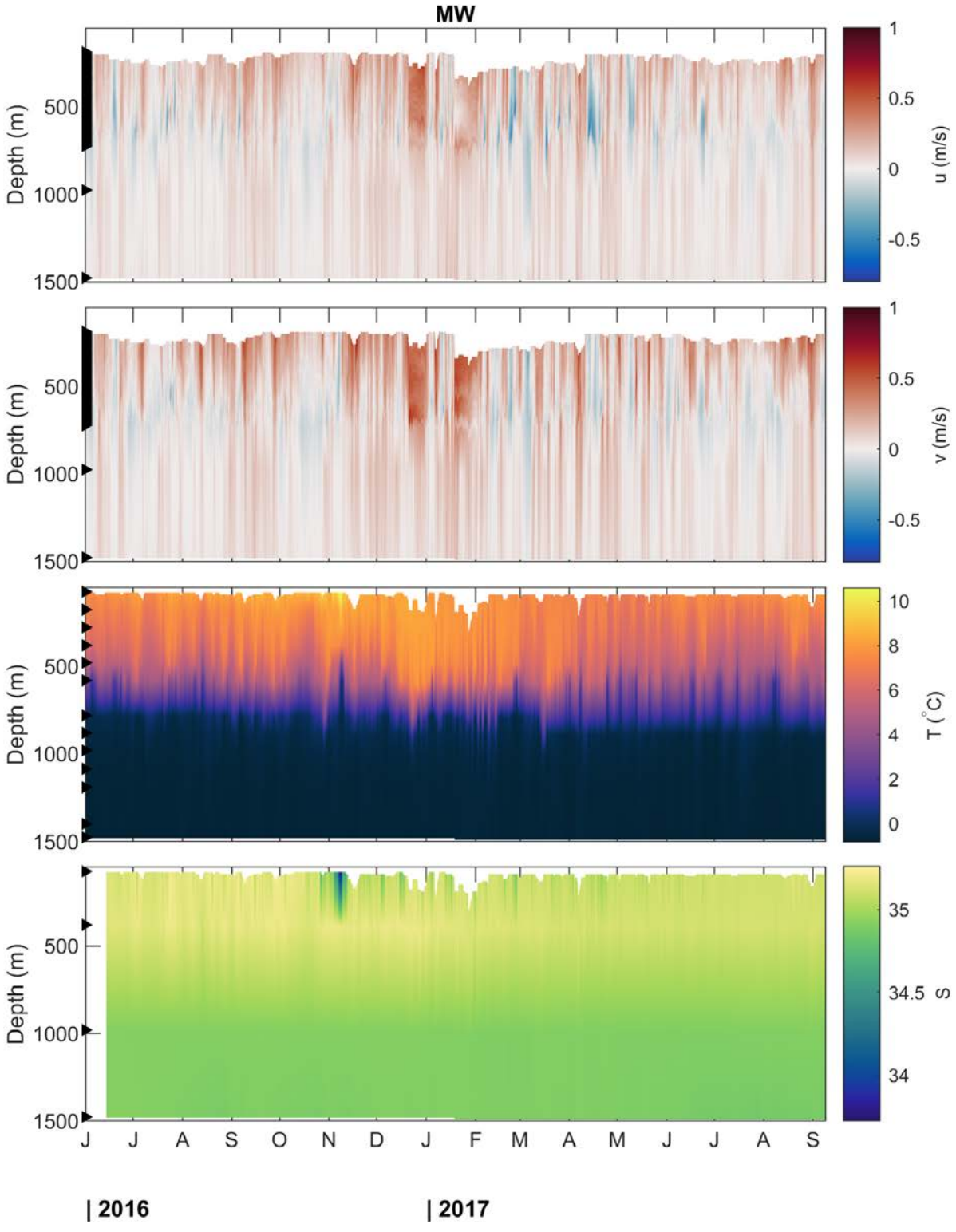


Figure 6 continued for MW. The bottommost salinity is from the Seaguard. The early record in the second Microcat and the Seaguard was removed due to bad quality and the reaming two instruments were not vertically interpolated leaving the gap in the beginning of the time series.

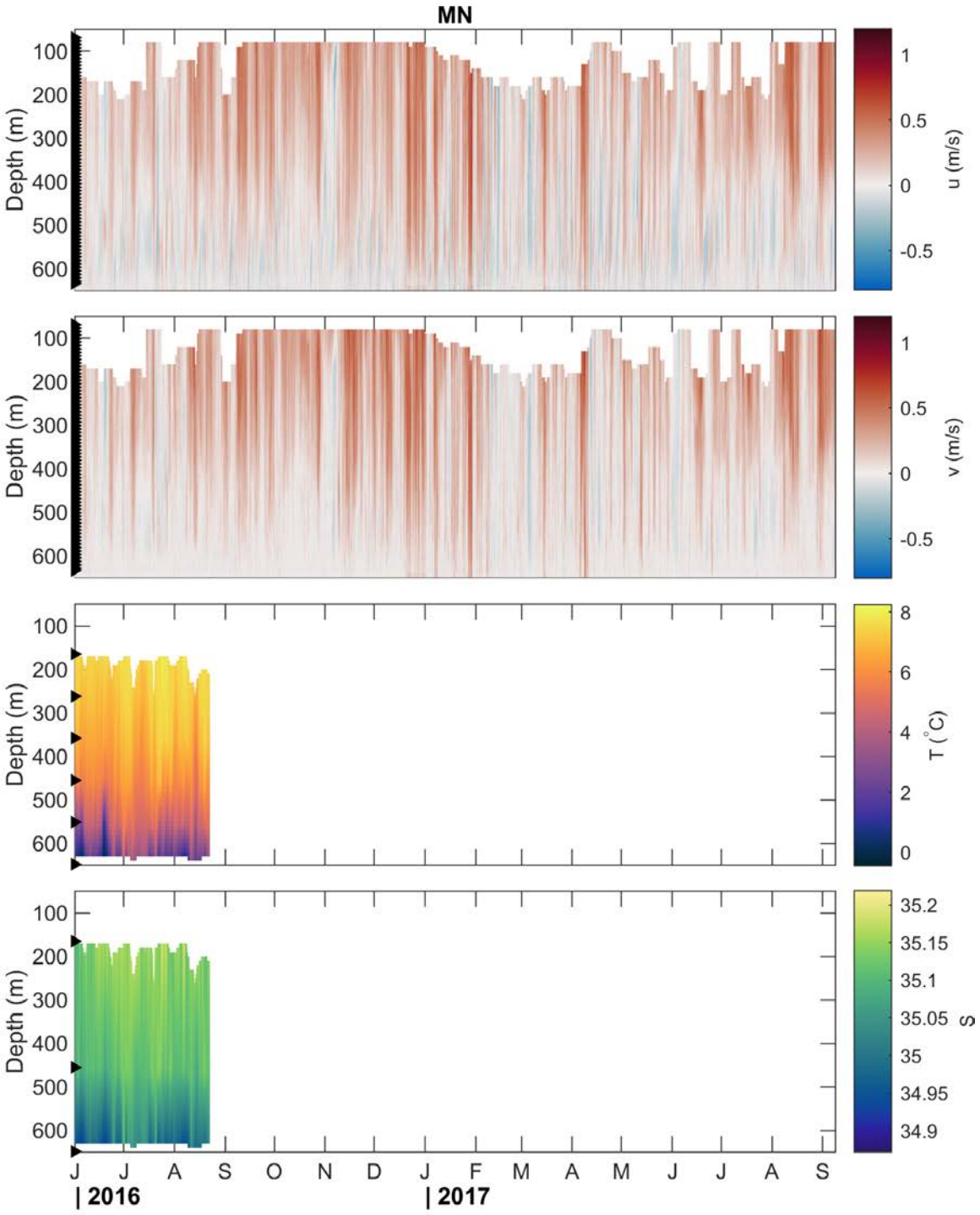


Figure 6 continued for MN. The velocity structure is from the short, bottom unit. The temperature salinity structure is from the water column unit which was cut 3 months into the time series.

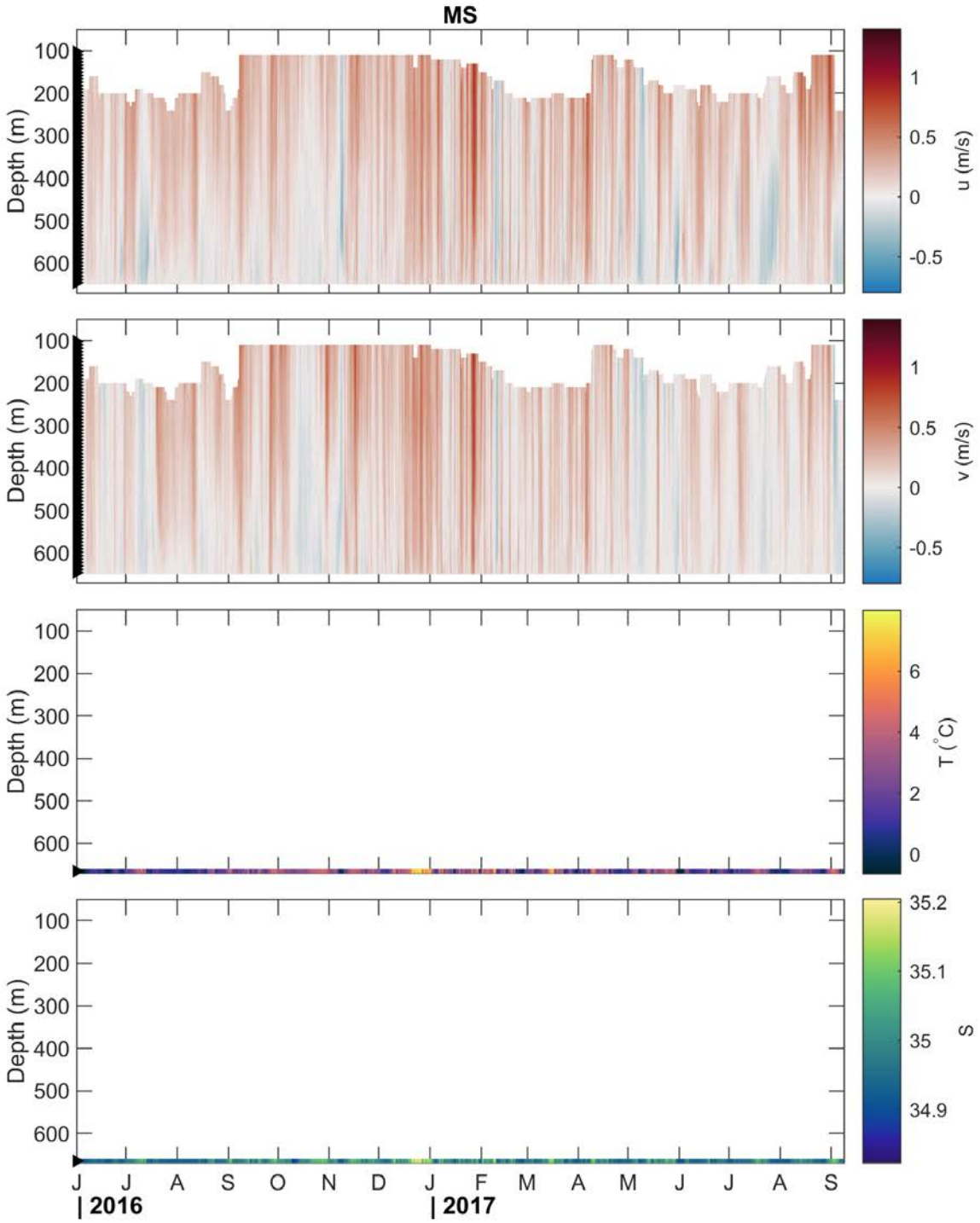


Figure 6 continued for MS. The velocity structure is from the short, bottom unit. The temperature salinity structure is from a single Microcat on the bottom unit. The water column line was lost.

4.3. Time-averaged profiles

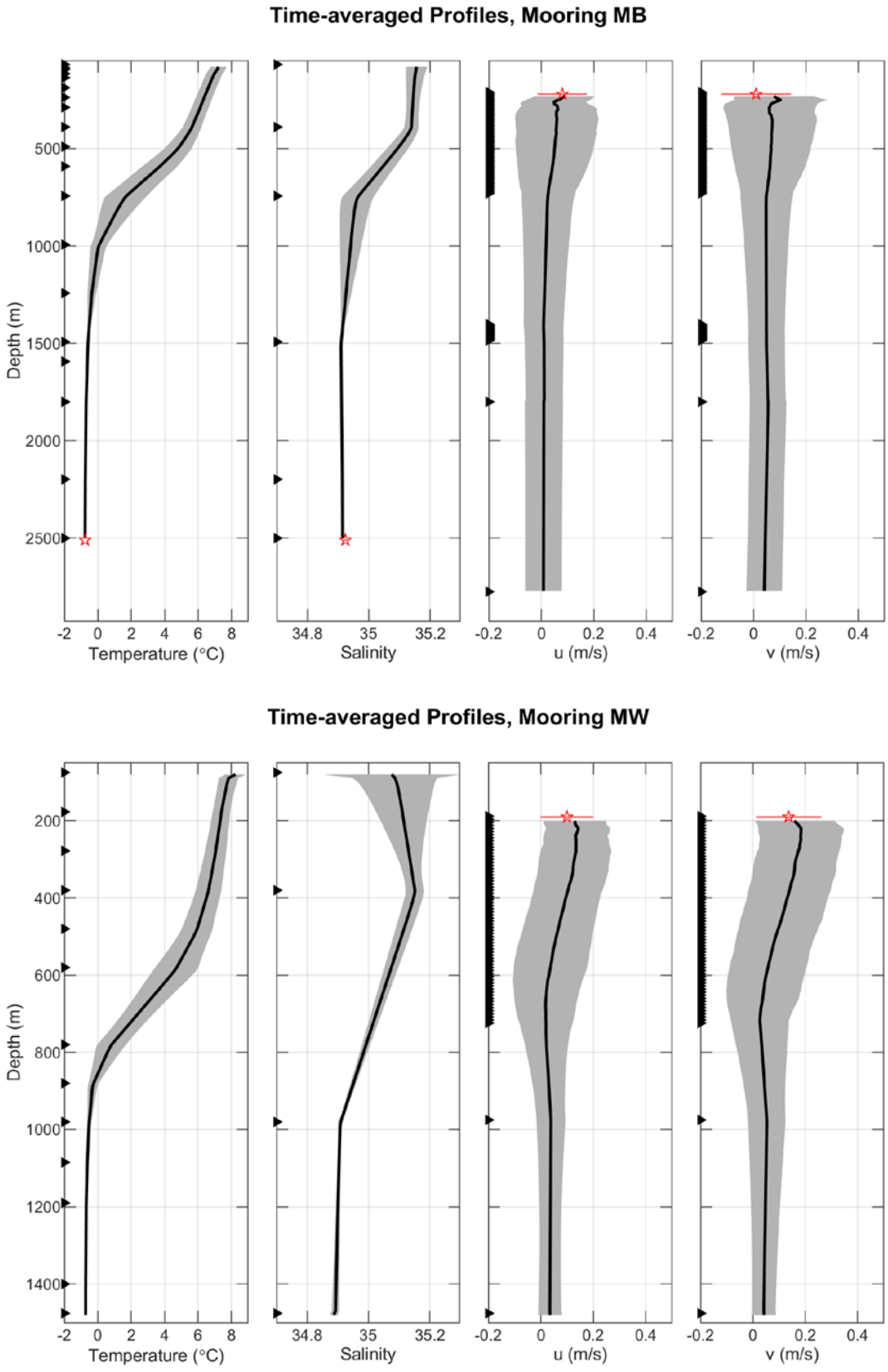


Figure 7. Time-averaged profiles from the gridded data. Mean (black) and one std (gray envelope) are shown. Measurement target depths are on the vertical axis. *If the length of the record at a depth level is less than 80% of the total length, the data points is shown with a red pentagram.

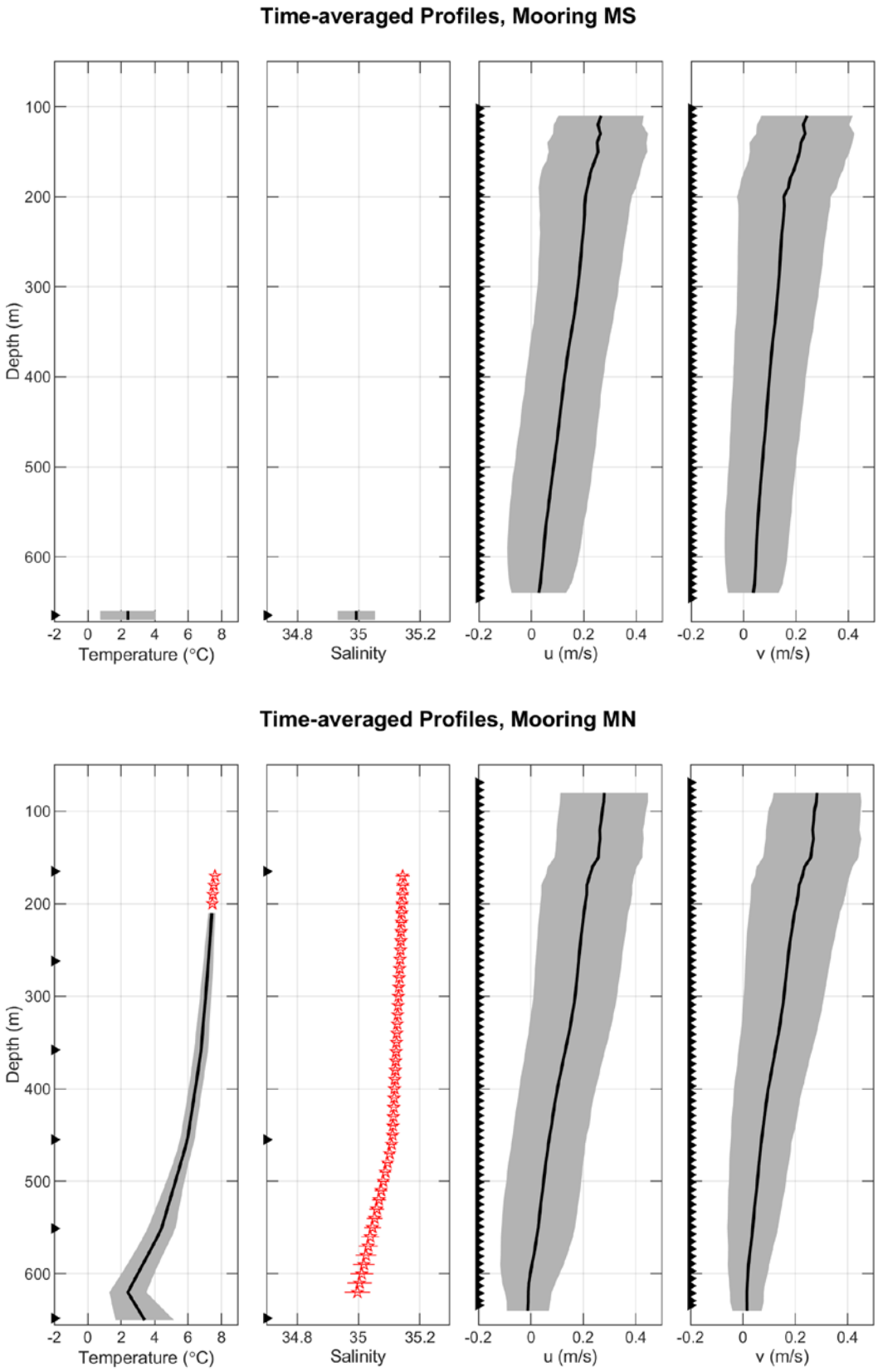


Figure 7. continued.

5. Acknowledgements

This study received funding from the Research Council of Norway, through the project Water mass transformation processes and vortex dynamics in the Lofoten Basin in the Norwegian Sea (PROVOLO), project 250784. We thank the crew and participants of the deployment and recovery cruises, and particularly Helge Bryhni, Algot Peterson and Henrik Søiland for their help with the mooring work, and Anthony Bosse with assistance on data calibration and interpretation.

6. References

Fer, I., A. Bosse, and J. Dugstad (2020), Norwegian Atlantic Slope Current along the Lofoten Escarpment, *Ocean Sci. Discuss.*, *2020*, 1-23, 10.5194/os-2020-15.

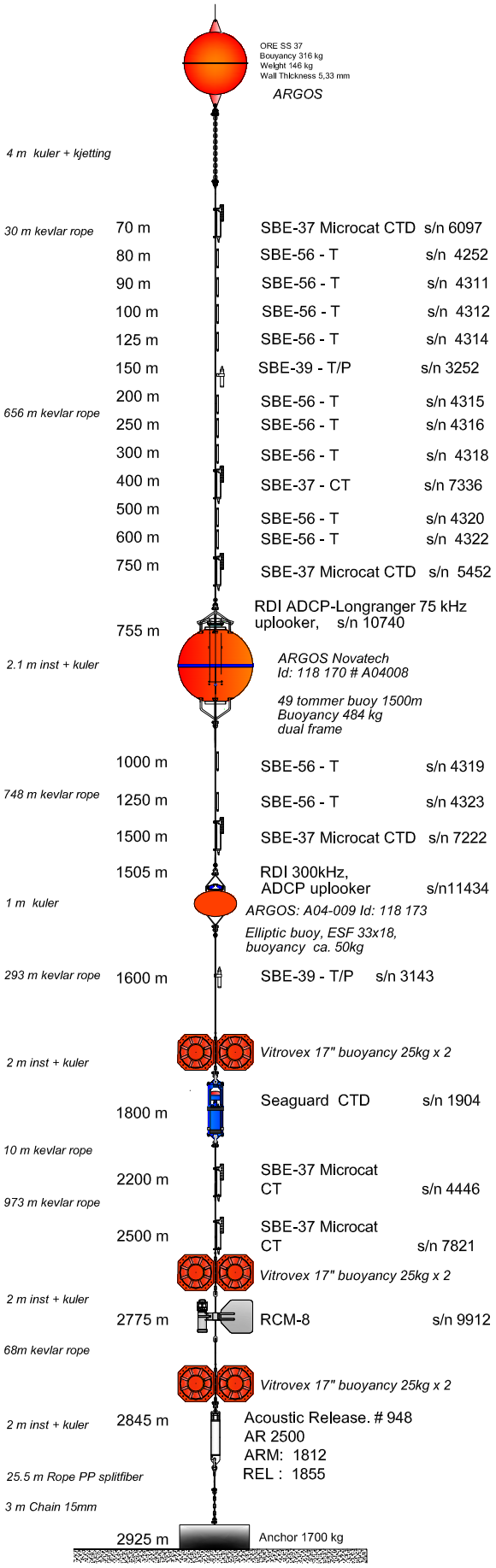
Fer, I., A. Bosse, H. Søiland, B. Ferron, and P. Bouruet-Aubertot (2019), Ocean currents, hydrography and microstructure data from PROVOLO cruises, Geophysical Institute University of Bergen (Norway), doi: 10.21335/NMDC-1093031037.

7. Appendices

A. Mooring drawings

B. Metadata and attributes for each netCDF file (ncdisp output)

MB



UNIVERSITETET I BERGEN
Geofysisk Institutt

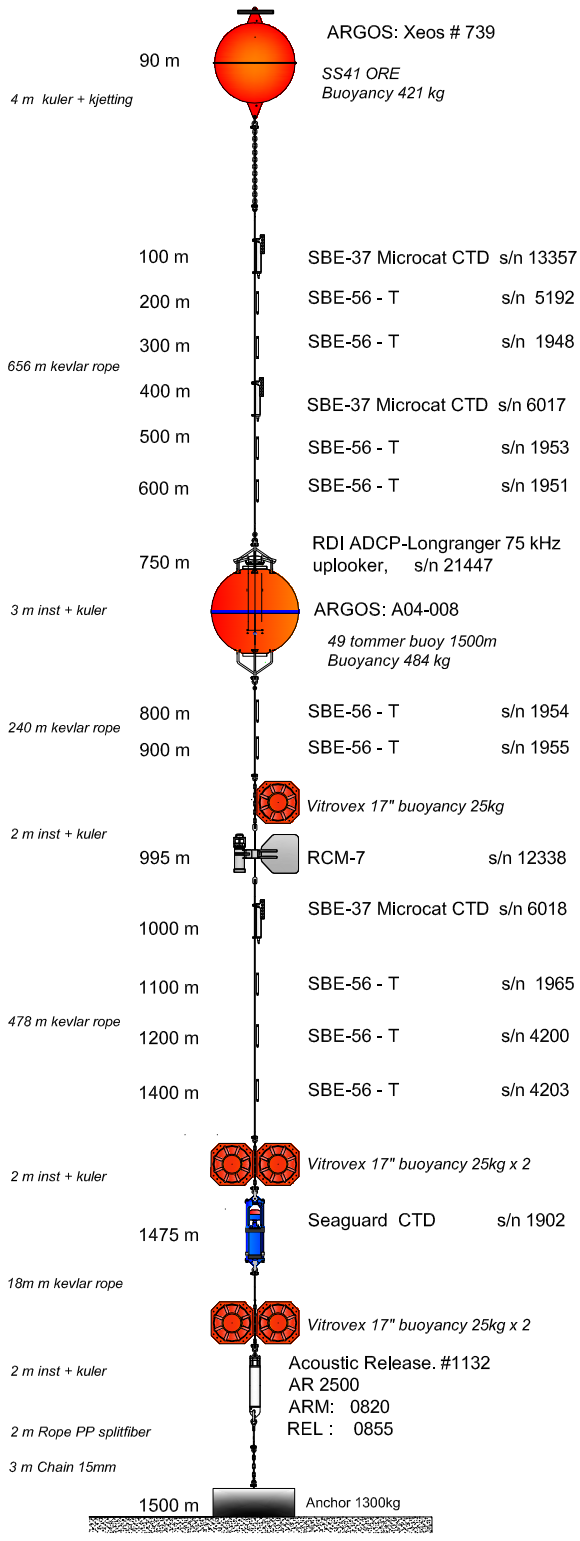
Project:
Location:
Position: 69 N 52.89´ 011 E 11.89´
Depth: 2925 m
Deployment: 2 June 2016, 13:44 UTC
Recover: 9 Sep 2017, 0410 UTC

6097 & 4252 were at the same depth when recovered (Microcat slid down)

4322 & 5452 were at the same depth when recovered (SBE56 slid down)

30 m kevlar
656 m kevlar
748 m kevlar
293 m kevlar
10 m kevlar
973 m kevlar
68 m kevlar
25 m PP rope

MW

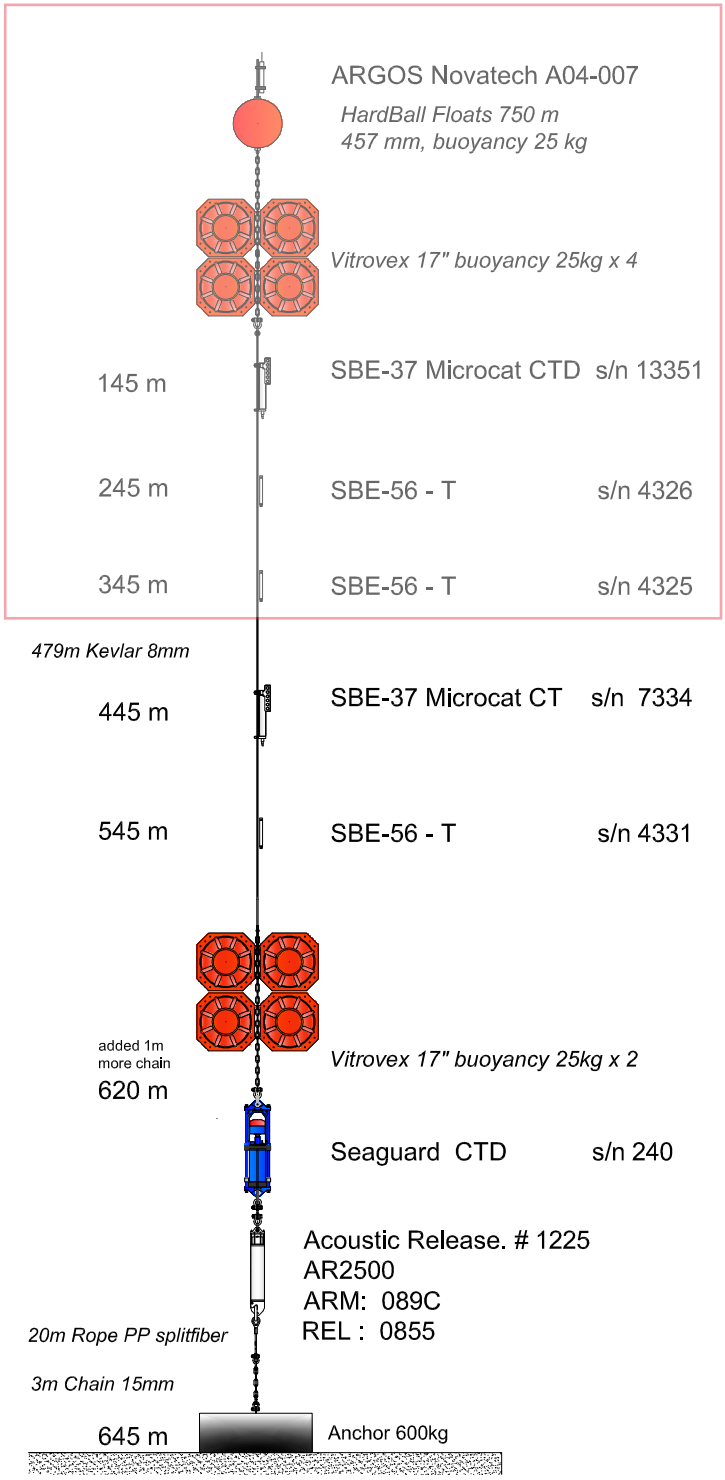


UNIVERSITETET I BERGEN
Geofysisk Institutt

Project:
Location:
Position: 68N 58.759´ 013E 16.845´
Depth: 1500 m
Deployment: 1 June2016, 05:37 UTC
Recover: 8 Sep 2017, 12:10 UTC

CTD before recovery, sta783

MN

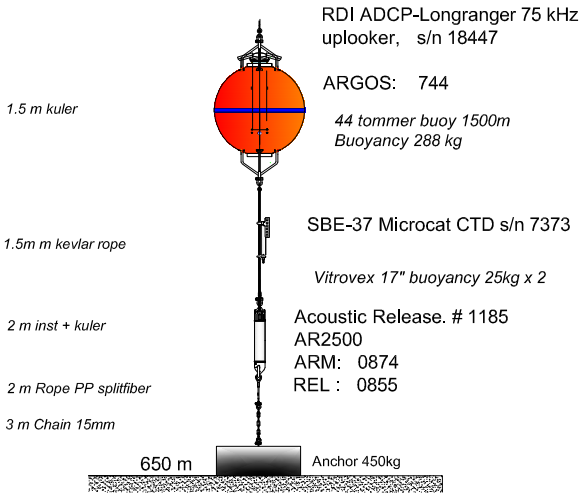


UNIVERSITETET I BERGEN
Geofysisk Institutt

Project:	
Location:	
Position:	68 N 56.06´ 013 E 20.24´
Depth:	645 m
Deployment:	1 June 2016, 00:02 UTC
Recover:	8 Sept 2017, 0900 UTC

The data return from this upper part is until 22 Aug 2016, 15:00, when it was cut loose and recovered by a fisherboat. After losing the buoyancy, the instruments on the lower part sank. The Seaguard data are OK thanks to the 4 glass spheres.

MNs

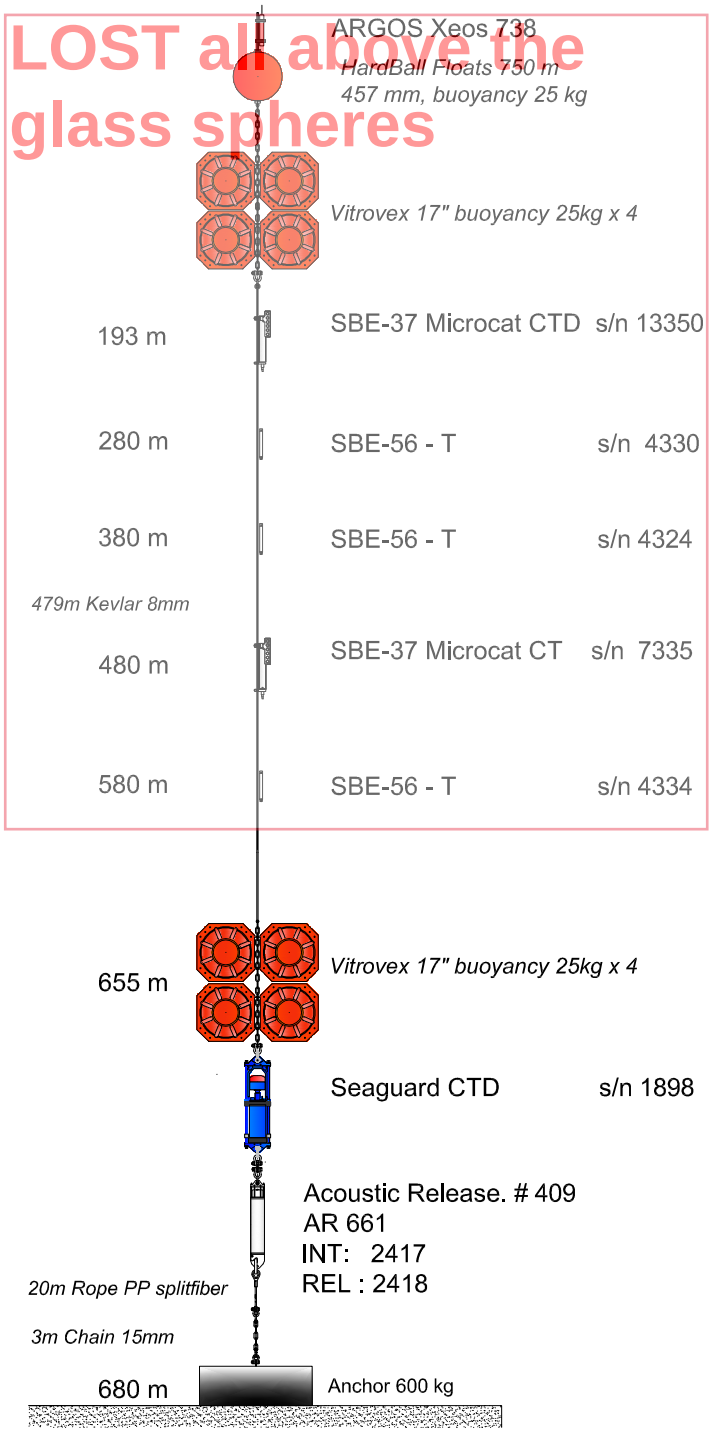


UNIVERSITETET I BERGEN
Geofysisk Institutt

Project:	
Location:	
Position:	N68 56.109' E 013 19.866'
Depth:	650 m
Deployment:	1 june 2016 00:48 UTC
Recover:	8 Sep 2017, 10:00 UTC

Time averaged pressure from microcat (converted to depth) is 648 m

MS



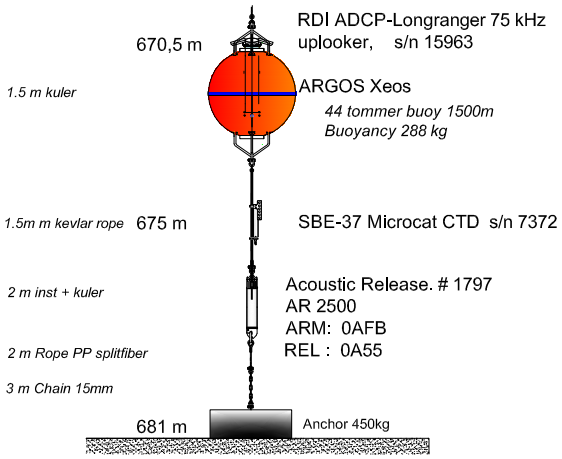
UNIVERSITETET I BERGEN
Geofysisk Institutt

Project:
Location:
Position: 68 N 50.128' 012 E 45.082´
Depth: 680 m
Deployment: 31 May 2016, 21:06 UTC
Recover: 8 Sep 2017, 0620 UTC

CTD sta782 before recovery

Position from sonar:
68 N 50.169' 012 E 45.201´

MSs



UNIVERSITETET I BERGEN
Geofysisk Institutt

Project:
Location:
Position: N68 50.038' E 012 44.777'
Depth: 681 m
Deployment: 31 May 2016, 21: 50 UTC
Recover: 8 Sep 2017, 07:20 UTC

SBE37 mean depth from time average of P is 665 m

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           history                        = 'Version 1'
           summary                        = 'As a part of the "Water mass transformation processes and vortex dynamics in the Lofoten Basin of
                                              the Norwegian Sea" (PROVOLO) project, a set of 4 moorings was deployed in the eastern Lofoten Basin.
                                              The observations cover a 14-month period from June 2016 to September 2017.
                                              This data set is from the Mooring Basin (MB), in the basin at 69.88 N, 11.198 E, at 2925 m
                                              water depth. MB was located in an energetic location but away from the slope to address the mesoscale
                                              variability in the basin. Other three moorings were located on the shelf break and slope of the
                                              Lofoten Escarpment (Mooring North MN, South MS, and West MW).

                                              All time series are averaged into a common, uniform 1-hour resolution time stamp.
                                              Two sets of hourly-averaged time series of temperature, salinity and horizontal currents are provided.
                                              One 10 m vertically gridded (interpolated) after mooring motion correction (variables u, v, TEMP, PSAL),
                                              and one as time series at time-variable measurement level because of mooring motion (variables TEMP_ins,
                                              PRES_ins, u_ins etc. with corresponding depth records zTEMP_ins, zPRES_ind, zu_ins etc.
                                              See the variable names for details. The dimensions follow the number of sensors on the mooring.)
                                              These fields are used for gridding. Details on the data processing, mooring drawings and a detailed
                                              list of instrumentation are provided in the attached report. A brief overview is given in the comment.
                                              PROVOLO was supported by the Research Council of Norway (project number 250784).
                                              '
           comment                        = 'Data from pressure sensors are used to correct for the mooring motion.
                                              Magnetic declination (5degE) is corrected for. Gappy segments with record length less than 3 days
                                              are filled with NaN in the gridded data set.
                                              Conductivity sensor is not pumped and the salinity data must be used with caution.

                                              The initial accuracy of the SBE sensors are 2x10-3C for temperature, 3x10-4 S/m for
                                              conductivity, and 1 dbar for pressure. A calibration cast resulted in an rms error of 0.02C
                                              for temperature and 0.001 for salinity. The statistical error of velocity measurements for
                                              the ensemble average profile is less than 1 cm/s. The compass direction is accurate to 2deg.
                                              Error estimates are 1 cm/s for velocity, 0.01C for temperature and 0.01 for practical salinity.
                                              The 10-m vertically interpolated salinity product is not resolved and must be used with caution.

                                              The distribution of the instruments on this mooring is as follows. (T=TEMP; S=PSAL; V=u,v; P=PRES)
                                              Target Depth (m) || Parameter  || Instrument
                                              68, 743, 1492    || T, S, P    || Microcat SN6097, 5452, 7222
                                              389, 2198, 2500  || T, S       || Microcat 7336, 4446, 7821
                                              136, 1593        || T, P       || SBE39 3252, 3143
                                              85,94,115        || T          || SBE56 4311, 4312, 4314
                                              187, 237,288, 490|| T          || SBE56 SN4315, 4316, 4318, 4320
                                              591, 993, 1242   || T          || SBE56 SN4322, 4319, 4323
                                              748              || P          || RDI 75kHz Longranger, SN10740
                                              210:8:730        || V          || --- uplooking profile ---
                                              1497             || P          || RDI 300kHz Longranger, SN11434
                                              1401:4:1485      || V          || --- uplooking profile ---
                                              1800             || V, S, T, P || Seaguard-RCM, SN1904
                                              2775             || V          || RCM-8, SN9912

                                              Offset corrections applied to various sensors are described in the attached report.
                                              The bottommost 4 Microcats required corrections with the following constant salinity offsets:
                                                  SN5452, +0.002; SN7222, +0.002; SN4446, +0.007; SN7821, +0.006.
                                              We further removed the pressure and salinity trend from SBE37 SN7222, corresponding to
                                              -0.0573 dbar/day for pressure and 1.8478x10-5/day for the salinity record.
                                              We excluded the record from SBE56 SN4322 after 22 Nov 2016, 04:40 UTC when it slid vertically
```

```
                                          to the level of the Microcat below.
                                          The Seaguard SN1904 speed and direction measurements required an offset correction of -0.005 m/s
                                          and -5deg to obtain a smooth vertical velocity profile at the mooring.
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            longitude                     = 11.1982
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            geospatial_lat_max            = 69.8815
            geospatial_lon_min            = 11.1982
            geospatial_lon_max            = 11.1982
            time_coverage_start           = '2016-06-02T15:00:00Z'
            time_coverage_end             = '2017-09-08T23:00:00Z'
            institution                   = 'University of Bergen'
            principal_investigator        = 'Ilker Fer'
            principal_investigator_ORCID  = '0000-0002-2427-2532'
            author                        = 'Ilker Fer'
            author_ORCID                  = '0000-0002-2427-2532'
            contact                       = 'ilker.fer@uib.no'
            project_name                  = 'PROVOLO'
            source                        = 'https://nmdc.no/'
            license                       = 'CC-BY 4.0'
            references                    = 'Fer, I., Bosse, A., and Dugstad, J.: Norwegian Atlantic Slope Current along
                                          the Lofoten Escarpment, Ocean Sci. Discuss.,
                                          https://doi.org/10.5194/os-2020-15, in review, 2020'
            keywords                      = 'Norwegian Sea, Lofoten Basin, oceanography, currents, hydrography'
            creator_name                  = 'Ilker Fer'
            creator_email                 = 'ilker.fer@uib.no'
            creator_url                   = 'https://www.uib.no/gfi'
            acknowledgement               = 'This data set is made possible by the funding from the Research Council of Norway, project number 250784'
            date_created                  = '2020-03-16'
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            ZT    = 19
            ZS    = 6
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                        axis          = 'T'
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            Dimensions: DEPTH
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                        units         = 'm'
                        long_name     = 'Vertical distance below the sea surface'
                        axis          = 'Z'
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            Dimensions: DEPTH,TIME
            Datatype:   double
            Attributes:
                        standard_name = 'sea_water_temperature'
                        units         = 'degree_Celsius'
                        long_name     = 'sea water temperature in-situ ITS-90 scale'
      PSAL
            Size:       272x11121
            Dimensions: DEPTH,TIME
            Datatype:   double
            Attributes:
                        standard_name = 'sea_water_practical_salinity'
                        units         = '1'
                        long_name     = 'Practical salinity on the PSS-78 scale'
      u
            Size:       272x11121
            Dimensions: DEPTH,TIME
            Datatype:   double
            Attributes:
                        standard_name = 'eastward_sea_water_velocity'
                        units         = 'm s-1'
                        long_name     = 'Absolute eastward sea water velocity'
      v
            Size:       272x11121
            Dimensions: DEPTH,TIME
            Datatype:   double
            Attributes:
                        standard_name = 'northward_sea_water_velocity'
                        units         = 'm s-1'
                        long_name     = 'Absolute northward sea water velocity'
      zPRES_ins
            Size:       6x11121
            Dimensions: ZP,TIME
            Datatype:   double
            Attributes:
                        units     = 'm'
                        long_name = 'Vertical distance below sea surface of pressure sensor at time-varying measurement level (not gridded)'
      zTEMP_ins
            Size:       19x11121
            Dimensions: ZT,TIME
            Datatype:   double
            Attributes:
                        units     = 'm'
                        long_name = 'Vertical distance below sea surface of temperature sensor at time-varying measurement level (not gridded)'
      zPSAL_ins
            Size:       6x11121
            Dimensions: ZS,TIME
            Datatype:   double
            Attributes:
                        units     = 'm'
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```
                        long_name = 'Vertical distance below sea surface of conductivity sensor at time-varying measurement level (not gridded)'
    zu_ins
           Size:       90x11121
           Dimensions: ZU,TIME
           Datatype:   double
           Attributes:
                       units     = 'm'
                       long_name = 'Vertical distance below sea surface of horizontal velocity sensor at time-varying measurement level (not gridded)'
    PRES_ins
           Size:       6x11121
           Dimensions: ZP,TIME
           Datatype:   double
           Attributes:
                       units     = 'decibar'
                       long_name = 'Sea water pressure at time-varying measurement level (not gridded), equals 0 at sea-level'
    TEMP_ins
           Size:       19x11121
           Dimensions: ZT,TIME
           Datatype:   double
           Attributes:
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                       long_name = 'sea water temperature at time-varying measurement level (not gridded), in-situ ITS-90 scale'
    PSAL_ins
           Size:       6x11121
           Dimensions: ZS,TIME
           Datatype:   double
           Attributes:
                       units     = '1'
                       long_name = 'Practical salinity at time-varying measurement level (not gridded), PSS-78 scale'
    u_ins
           Size:       90x11121
           Dimensions: ZU,TIME
           Datatype:   double
           Attributes:
                       units     = 'm s-1'
                       long_name = 'Absolute eastward sea water velocity at time-varying measurement level (not gridded)'
    v_ins
           Size:       90x11121
           Dimensions: ZU,TIME
           Datatype:   double
           Attributes:
                       units     = 'm s-1'
                       long_name = 'Absolute northward sea water velocity at time-varying measurement level (not gridded)'
>>
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        history                     = 'Version 1'
        summary                     = 'As a part of the "Water mass transformation processes and vortex dynamics in the Lofoten Basin of
                                      the Norwegian Sea" (PROVOLO) project, a set of 4 moorings was deployed in the eastern Lofoten Basin.
                                      The observations cover a 14-month period from June 2016 to September 2017.
                                      This data set is from the Mooring West (MW), on the upper slope at 68.979 N, 13.28 E, at 1500 m
                                      water depth. MW is one of the three moorings located on the shelf break and slope of the
                                      Lofoten Escarpment (Mooring North MN, South MS, and West MW). The fourth mooring was located
                                      deeper in the basin (Mooring Basin MB).

                                      All time series are averaged into a common, uniform 1-hour resolution time stamp.
                                      Two sets of hourly-averaged time series of temperature, salinity and horizontal currents are provided.
                                      One 10 m vertically gridded (interpolated) after mooring motion correction (variables u, v, TEMP, PSAL),
                                      and one as time series at time-variable measurement level because of mooring motion (variables TEMP_ins,
                                      PRES_ins, u_ins etc. with corresponding depth records zTEMP_ins, zPRES_ind, zu_ins etc.
                                      See the variable names for details. The dimensions follow the number of sensors on the mooring.)
                                      These fields are used for gridding. Details on the data processing, mooring drawings and a detailed
                                      list of instrumentation are provided in the attached report. A brief overview is given in the comment.
                                      PROVOLO was supported by the Research Council of Norway (project number 250784).
                                      '
        comment                     = 'Data from pressure sensors are used to correct for the mooring motion.
                                      Magnetic declination (5degE) is corrected for. Gappy segments with record length less than 3 days
                                      are filled with NaN in the gridded data set.
                                      Conductivity sensor is not pumped and the salinity data must be used with caution.

                                      The initial accuracy of the SBE sensors are 2x10-3C for temperature, 3x10-4 S/m for
                                      conductivity, and 1 dbar for pressure. A calibration cast resulted in an rms error of 0.02C
                                      for temperature and 0.001 for salinity. The statistical error of velocity measurements for
                                      the ensemble average profile is less than 1 cm/s. The compass direction is accurate to 2deg.
                                      Error estimates are 1 cm/s for velocity, 0.01C for temperature and 0.01 for practical salinity.
                                      The 10-m vertically interpolated salinity product is not resolved and must be used with caution.

                                      The distribution of the instruments on this mooring is as follows. (T=TEMP; S=PSAL; V=u,v; P=PRES)
                                      Target Depth (m) || Parameter  || Instrument
                                      75, 380, 980     || T, S, P    || Microcat SN13357, SN6017, SN6018
                                      177, 278, 480    || T          || SBE56 SN5192, 1948, 1953
                                      580, 780, 880    || T          || SBE56 SN1951, 1954, 1955
                                      1085, 1190, 1400 || T          || SBE56 SN1965, 4200, 4203
                                      742              || P          || RDI 75kHz Longranger, SN21447
                                      188:8:724        || V          || uplooking profile
                                      975              || V          || RCM-7, SN12338
                                      1476             || V, S, T, P || Seaguard-RCM, SN1902

                                      Offset corrections applied to various sensors are described in the attached report.
                                      The salinity record from the Seaguard SN1902 was of high quality and used in the final mooring
                                      gridded data after applying an offset correction of 0.03 to obtain a stable vertical profile.
                                      The first 315 points were noisy and excluded.
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            longitude                      = 13.2807
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            time_coverage_end              = '2017-09-08T12:00:00Z'
            institution                    = 'University of Bergen'
            principal_investigator         = 'Ilker Fer'
            principal_investigator_ORCID   = '0000-0002-2427-2532'
            author                         = 'Ilker Fer'
            author_ORCID                   = '0000-0002-2427-2532'
            contact                        = 'ilker.fer@uib.no'
            project_name                   = 'PROVOLO'
            source                         = 'https://nmdc.no/'
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            references                     = 'Fer, I., Bosse, A., and Dugstad, J.: Norwegian Atlantic Slope Current along
                                              the Lofoten Escarpment, Ocean Sci. Discuss.,
                                              https://doi.org/10.5194/os-2020-15, in review, 2020'
            keywords                       = 'Norwegian Sea, Lofoten Basin, oceanography, currents, hydrography'
            creator_name                   = 'Ilker Fer'
            creator_email                  = 'ilker.fer@uib.no'
            creator_url                    = 'https://www.uib.no/gfi'
            acknowledgement                = 'This data set is made possible by the funding from the Research Council of Norway, project number 250784'
            date_created                   = '2020-03-16'
Dimensions:
            TIME  = 11143
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            ZT    = 13
            ZS    = 4
            ZU    = 70
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                        units         = 'Days since 2016-01-01T00:00:00Z'
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                        units         = 'm'
                        long_name     = 'Vertical distance below the sea surface'
                        axis          = 'Z'
    TEMP
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            Dimensions: DEPTH,TIME
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            Datatype:   double
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                        units         = 'degree_Celsius'
                        long_name     = 'sea water temperature in-situ ITS-90 scale'
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            Size:       141x11143
            Dimensions: DEPTH,TIME
            Datatype:   double
            Attributes:
                        standard_name = 'sea_water_practical_salinity'
                        units         = '1'
                        long_name     = 'Practical salinity on the PSS-78 scale'
      u
            Size:       141x11143
            Dimensions: DEPTH,TIME
            Datatype:   double
            Attributes:
                        standard_name = 'eastward_sea_water_velocity'
                        units         = 'm s-1'
                        long_name     = 'Absolute eastward sea water velocity'
      v
            Size:       141x11143
            Dimensions: DEPTH,TIME
            Datatype:   double
            Attributes:
                        standard_name = 'northward_sea_water_velocity'
                        units         = 'm s-1'
                        long_name     = 'Absolute northward sea water velocity'
      zPRES_ins
            Size:       5x11143
            Dimensions: ZP,TIME
            Datatype:   double
            Attributes:
                        units     = 'm'
                        long_name = 'Vertical distance below sea surface of pressure sensor at time-varying measurement level (not gridded)'
      zTEMP_ins
            Size:       13x11143
            Dimensions: ZT,TIME
            Datatype:   double
            Attributes:
                        units     = 'm'
                        long_name = 'Vertical distance below sea surface of temperature sensor at time-varying measurement level (not gridded)'
      zPSAL_ins
            Size:       4x11143
            Dimensions: ZS,TIME
            Datatype:   double
            Attributes:
                        units     = 'm'
                        long_name = 'Vertical distance below sea surface of conductivity sensor at time-varying measurement level (not gridded)'
      zu_ins
            Size:       70x11143
            Dimensions: ZU,TIME
            Datatype:   double
            Attributes:
                        units     = 'm'
                        long_name = 'Vertical distance below sea surface of horizontal velocity sensor at time-varying measurement level (not gridded)'
      PRES_ins
```

```
            Size:       5x11143
            Dimensions: ZP,TIME
            Datatype:   double
            Attributes:
                        units     = 'decibar'
                        long_name = 'Sea water pressure at time-varying measurement level (not gridded), equals 0 at sea-level'
    TEMP_ins
            Size:       13x11143
            Dimensions: ZT,TIME
            Datatype:   double
            Attributes:
                        units     = 'degree_Celsius'
                        long_name = 'sea water temperature at time-varying measurement level (not gridded), in-situ ITS-90 scale'
    PSAL_ins
            Size:       4x11143
            Dimensions: ZS,TIME
            Datatype:   double
            Attributes:
                        units     = '1'
                        long_name = 'Practical salinity at time-varying measurement level (not gridded), PSS-78 scale'
    u_ins
            Size:       70x11143
            Dimensions: ZU,TIME
            Datatype:   double
            Attributes:
                        units     = 'm s-1'
                        long_name = 'Absolute eastward sea water velocity at time-varying measurement level (not gridded)'
    v_ins
            Size:       70x11143
            Dimensions: ZU,TIME
            Datatype:   double
            Attributes:
                        units     = 'm s-1'
                        long_name = 'Absolute northward sea water velocity at time-varying measurement level (not gridded)'
>>
```

```
Source:
          \\tjalve.uib.no\home\ngfif\work\MOORED\Lofoten_2016\DataSubmit_NMDC\PROVOLO_Mooring_MN.nc
Format:
          netcdf4_classic
Global Attributes:
          title                          = 'Mooring MN: physical oceanography data from the Lofoten Basin, June 2016 - September 2017'
          history                        = 'Version 1'
          summary                        = 'As a part of the "Water mass transformation processes and vortex dynamics in the Lofoten Basin of
                                            the Norwegian Sea" (PROVOLO) project, a set of 4 moorings was deployed in the eastern Lofoten Basin.
                                            The observations cover a 14-month period from June 2016 to September 2017.
                                            This data set is from the Mooring North (MN), on the shelf break at 68.935 N, 13.33 E, at 655 m
                                            water depth. MN is one of the three moorings located on the shelf break and slope of the
                                            Lofoten Escarpment (Mooring North MN, South MS, and West MW). The fourth mooring was located
                                            deeper in the basin (Mooring Basin MB).
                                            MN was composed of a bottom unit (a current profiler and a CTD sensor), and a water-column
                                            line with CTD sensors. The water column line is cut after 3 months (see attached report).

                                            All time series are averaged into a common, uniform 1-hour resolution time stamp.
                                            Two sets of hourly-averaged time series of temperature, salinity and horizontal currents are provided.
                                            One 10 m vertically gridded (interpolated) after mooring motion correction (variables u, v, TEMP, PSAL),
                                            and one as time series at time-variable measurement level because of mooring motion (variables TEMP_ins,
                                            PRES_ins, u_ins etc. with corresponding depth records zTEMP_ins, zPRES_ind, zu_ins etc.
                                            See the variable names for details. The dimensions follow the number of sensors on the mooring.)
                                            These fields are used for gridding. Details on the data processing, mooring drawings and a detailed
                                            list of instrumentation are provided in the attached report. A brief overview is given in the comment.
                                            PROVOLO was supported by the Research Council of Norway (project number 250784).
                                            '
          comment                        = 'Data from pressure sensors are used to correct for the mooring motion.
                                            Magnetic declination (5degE) is corrected for. Gappy segments with record length less than 3 days
                                            are filled with NaN in the gridded data set.
                                            Conductivity sensor is not pumped and the salinity data must be used with caution.

                                            The initial accuracy of the SBE sensors are 2x10-3C for temperature, 3x10-4 S/m for
                                            conductivity, and 1 dbar for pressure. A calibration cast resulted in an rms error of 0.02C
                                            for temperature and 0.001 for salinity. The statistical error of velocity measurements for
                                            the ensemble average profile is less than 1 cm/s. The compass direction is accurate to 2deg.
                                            Error estimates are 1 cm/s for velocity, 0.01C for temperature and 0.01 for practical salinity.
                                            The 10-m vertically interpolated salinity product is not resolved and must be used with caution.

                                            The distribution of the instruments on this mooring is as follows. (T=TEMP; S=PSAL; V=u,v; P=PRES)
                                            Target Depth (m) || Parameter  || Instrument
                                            165, 648         || T, S, P    || Microcat SN13351, SN7373
                                            455              || T, S       || Microcat SN7334
                                            262, 358, 551    || T          || SBE56 SN4326, 4325, 4331
                                            647              ||            || RDI 75kHz Longranger, SN18447
                                            69:8:629         || V          || uplooking profile from Longranger
                                            634              || V, S, T, P || Seaguard-RCM, SN240

                                            MN includes a bottom unit (a Microcat and a spherical buoy with an uplooker ADCP) and a water column
                                            line including temperature loggers and CTDs. The units were deployed within a couple of 100 m distance
                                            to each other and treated as one mooring. The water column line was cut on 22 Aug 2016 but the
                                            instruments were recovered. Data from SBE37 SNs 13351 and 7334, SBE56 SNs 4325, 4326 and 4331, and
                                            Seaguard SN240 are thus until 22 Aug 2016, 15:00 UTC. We did not use the temperature from the Seaguard
                                            SN240 as we have a Microcat nearby. The salinity of Microcat SN 7334 required a correction of -0.049.
                                            '
          type                           = 'Hourly-averaged time series of temperature, salinity and horizontal velocity'
          creation_time                  = '2020-03-16T13:38:09Z'
          date_update                    = '2020-03-16T13:38:09Z'
```

```
            Conventions                     = 'CF-1.6, ACDD-1.3'
            data_mode                       = 'D'
            platform_type                   = 'Mooring'
            area                            = 'Norwegian Sea, Lofoten Basin, Lofoten Escarpment'
            latitude                        = 68.9351
            longitude                       = 13.3311
            sea_floor_depth_below_sea_level = 655
            geospatial_lat_min              = 68.9351
            geospatial_lat_max              = 68.9351
            geospatial_lon_min              = 13.3311
            geospatial_lon_max              = 13.3311
            time_coverage_start             = '2016-06-01T02:00:00Z'
            time_coverage_end               = '2017-09-08T08:00:00Z'
            institution                     = 'University of Bergen'
            principal_investigator          = 'Ilker Fer'
            principal_investigator_ORCID    = '0000-0002-2427-2532'
            author                          = 'Ilker Fer'
            author_ORCID                    = '0000-0002-2427-2532'
            contact                         = 'ilker.fer@uib.no'
            project_name                    = 'PROVOLO'
            source                          = 'https://nmdc.no/'
            license                         = 'CC-BY 4.0'
            references                      = 'Fer, I., Bosse, A., and Dugstad, J.: Norwegian Atlantic Slope Current along
                                               the Lofoten Escarpment, Ocean Sci. Discuss.,
                                               https://doi.org/10.5194/os-2020-15, in review, 2020'
            keywords                        = 'Norwegian Sea, Lofoten Basin, oceanography, currents, hydrography'
            creator_name                    = 'Ilker Fer'
            creator_email                   = 'ilker.fer@uib.no'
            creator_url                     = 'https://www.uib.no/gfi'
            acknowledgement                 = 'This data set is made possible by the funding from the Research Council of Norway, project number 250784'
            date_created                    = '2020-03-16'
Dimensions:
            TIME  = 11143
            DEPTH = 58
            ZP    = 3
            ZT    = 6
            ZS    = 3
            ZU    = 72
Variables:
    TIME
            Size:       11143x1
            Dimensions: TIME
            Datatype:   double
            Attributes:
                        standard_name = 'time'
                        long_name     = 'Decimal day'
                        units         = 'Days since 2016-01-01T00:00:00Z'
                        axis          = 'T'
    DEPTH
            Size:       58x1
            Dimensions: DEPTH
            Datatype:   double
            Attributes:
                        standard_name = 'Z'
                        units         = 'm'
                        long_name     = 'Vertical distance below the sea surface'
                        axis          = 'Z'
    TEMP
```

```
            Size:       58x11143
            Dimensions: DEPTH,TIME
            Datatype:   double
            Attributes:
                        standard_name = 'sea_water_temperature'
                        units         = 'degree_Celsius'
                        long_name     = 'sea water temperature in-situ ITS-90 scale'
      PSAL
            Size:       58x11143
            Dimensions: DEPTH,TIME
            Datatype:   double
            Attributes:
                        standard_name = 'sea_water_practical_salinity'
                        units         = '1'
                        long_name     = 'Practical salinity on the PSS-78 scale'
      u
            Size:       58x11143
            Dimensions: DEPTH,TIME
            Datatype:   double
            Attributes:
                        standard_name = 'eastward_sea_water_velocity'
                        units         = 'm s-1'
                        long_name     = 'Absolute eastward sea water velocity'
      v
            Size:       58x11143
            Dimensions: DEPTH,TIME
            Datatype:   double
            Attributes:
                        standard_name = 'northward_sea_water_velocity'
                        units         = 'm s-1'
                        long_name     = 'Absolute northward sea water velocity'
      zPRES_ins
            Size:       3x11143
            Dimensions: ZP,TIME
            Datatype:   double
            Attributes:
                        units     = 'm'
                        long_name = 'Vertical distance below sea surface of pressure sensor at time-varying measurement level (not gridded)'
      zTEMP_ins
            Size:       6x11143
            Dimensions: ZT,TIME
            Datatype:   double
            Attributes:
                        units     = 'm'
                        long_name = 'Vertical distance below sea surface of temperature sensor at time-varying measurement level (not gridded)'
      zPSAL_ins
            Size:       3x11143
            Dimensions: ZS,TIME
            Datatype:   double
            Attributes:
                        units     = 'm'
                        long_name = 'Vertical distance below sea surface of conductivity sensor at time-varying measurement level (not gridded)'
      zu_ins
            Size:       72x11143
            Dimensions: ZU,TIME
            Datatype:   double
            Attributes:
                        units     = 'm'
```

```
                        long_name = 'Vertical distance below sea surface of horizontal velocity sensor at time-varying measurement level (not gridded)'
    PRES_ins
           Size:       3x11143
           Dimensions: ZP,TIME
           Datatype:   double
           Attributes:
                       units     = 'decibar'
                       long_name = 'Sea water pressure at time-varying measurement level (not gridded), equals 0 at sea-level'
    TEMP_ins
           Size:       6x11143
           Dimensions: ZT,TIME
           Datatype:   double
           Attributes:
                       units     = 'degree_Celsius'
                       long_name = 'sea water temperature at time-varying measurement level (not gridded), in-situ ITS-90 scale'
    PSAL_ins
           Size:       3x11143
           Dimensions: ZS,TIME
           Datatype:   double
           Attributes:
                       units     = '1'
                       long_name = 'Practical salinity at time-varying measurement level (not gridded), PSS-78 scale'
    u_ins
           Size:       72x11143
           Dimensions: ZU,TIME
           Datatype:   double
           Attributes:
                       units     = 'm s-1'
                       long_name = 'Absolute eastward sea water velocity at time-varying measurement level (not gridded)'
    v_ins
           Size:       72x11143
           Dimensions: ZU,TIME
           Datatype:   double
           Attributes:
                       units     = 'm s-1'
                       long_name = 'Absolute northward sea water velocity at time-varying measurement level (not gridded)'
>>
```

```
Source:
        \\tjalve.uib.no\home\ngfif\work\MOORED\Lofoten_2016\DataSubmit_NMDC\PROVOLO_Mooring_MS.nc
Format:
        netcdf4_classic
Global Attributes:
        title                       = 'Mooring MS: physical oceanography data from the Lofoten Basin, June 2016 - September 2017'
        history                     = 'Version 1'
        summary                     = 'As a part of the "Water mass transformation processes and vortex dynamics in the Lofoten Basin of
                                      the Norwegian Sea" (PROVOLO) project, a set of 4 moorings was deployed in the eastern Lofoten Basin.
                                      The observations cover a 14-month period from June 2016 to September 2017.
                                      This data set is from the Mooring South (MS), on the shelf break at 68.834 N, 12.746 E, at 672 m
                                      water depth. MS is one of the three moorings located on the shelf break and slope of the
                                      Lofoten Escarpment (Mooring North MN, South MS, and West MW). The fourth mooring was located
                                      deeper in the basin (Mooring Basin MB).
                                      MS was composed of a bottom unit (a current profiler and a CTD sensor), and a water-column
                                      line with CTD sensors. The water column line was lost with no data return (see attached report).
                                      As a result, salinity and temperature are available only near the bottom at MS and are not gridded
                                      vertically.

                                      All time series are averaged into a common, uniform 1-hour resolution time stamp.
                                      Two sets of hourly-averaged time series are provided. 1) The horizontal currents only (no temperature
                                      and salinity) are 10 m vertically gridded (interpolated) after mooring motion correction (variables u, v).
                                      2)Hourly time series of currents, temperature, pressure and salinity at time-variable measurement level
                                      (variables TEMP_ins, PRES_ins, u_ins etc. with corresponding depth records zTEMP_ins, zPRES_ind,
                                      zu_ins etc. See the variable names for details. The dimensions follow the number of sensors on the
                                      mooring.)
                                      These fields (of horizontal velocity) are used for gridding. Details on the data processing, mooring
                                      drawings and a detailedlist of instrumentation are provided in the attached report.
                                      PROVOLO was supported by the Research Council of Norway (project number 250784).
                                      '
        comment                     = 'Data from pressure sensors are used to correct for the mooring motion.
                                      Magnetic declination (5degE) is corrected for. Gappy segments with record length less than 3 days
                                      are filled with NaN in the gridded data set.
                                      Conductivity sensor is not pumped and the salinity data must be used with caution.
                                      This mooring differs from MN, MW and MB in that there is no gridded temperature and salinity.

                                      The initial accuracy of the SBE sensors are 2x10-3C for temperature, 3x10-4 S/m for
                                      conductivity, and 1 dbar for pressure. A calibration cast resulted in an rms error of 0.02C
                                      for temperature and 0.001 for salinity. The statistical error of velocity measurements for
                                      the ensemble average profile is less than 1 cm/s. The compass direction is accurate to 2deg.
                                      Error estimates are 1 cm/s for velocity, 0.01C for temperature and 0.01 for practical salinity.
                                      The 10-m vertically interpolated salinity product is not resolved and must be used with caution.

                                      The distribution of the instruments on this mooring is as follows. (T=TEMP; S=PSAL; V=u,v; P=PRES)
                                      Target Depth (m) || Parameter  || Instrument
                                      665              || T, S, P    || Microcat SN7372
                                      664              || -          || RDI 75kHz Longranger, SN15963
                                      102:8:646        || V          || uplooking profile from Longranger
                                      647              || V, S, T, P || Seaguard-RCM, SN1898

                                      The most part of the column line was lost with no data return, except the near-bottom Seaguard.
                                      The Seaguard velocity is not used in gridding because the instrument was at the same level of the
                                      first good bin of the 75kHz ADCP. The salinity record from the Seaguard was not reliable.
                                      We retain the salinity in the instrument-wise data product, but exclude it from the gridded data.
                                      '
        type                        = 'Hourly-averaged time series of temperature, salinity and horizontal velocity'
        creation_time               = '2020-03-16T12:40:12Z'
        date_update                 = '2020-03-16T12:40:12Z'
```

```
            Conventions                     = 'CF-1.6, ACDD-1.3'
            data_mode                       = 'D'
            platform_type                   = 'Mooring'
            area                            = 'Norwegian Sea, Lofoten Basin, Lofoten Escarpment'
            latitude                        = 68.834
            longitude                       = 12.7463
            sea_floor_depth_below_sea_level = 672
            geospatial_lat_min              = 68.834
            geospatial_lat_max              = 68.834
            geospatial_lon_min              = 12.7463
            geospatial_lon_max              = 12.7463
            time_coverage_start             = '2016-06-01T01:00:00Z'
            time_coverage_end               = '2017-09-08T06:00:00Z'
            institution                     = 'University of Bergen'
            principal_investigator          = 'Ilker Fer'
            principal_investigator_ORCID    = '0000-0002-2427-2532'
            author                          = 'Ilker Fer'
            author_ORCID                    = '0000-0002-2427-2532'
            contact                         = 'ilker.fer@uib.no'
            project_name                    = 'PROVOLO'
            source                          = 'https://nmdc.no/'
            license                         = 'CC-BY 4.0'
            references                      = 'Fer, I., Bosse, A., and Dugstad, J.: Norwegian Atlantic Slope Current along
                                               the Lofoten Escarpment, Ocean Sci. Discuss.,
                                               https://doi.org/10.5194/os-2020-15, in review, 2020'
            keywords                        = 'Norwegian Sea, Lofoten Basin, oceanography, currents, hydrography'
            creator_name                    = 'Ilker Fer'
            creator_email                   = 'ilker.fer@uib.no'
            creator_url                     = 'https://www.uib.no/gfi'
            acknowledgement                 = 'This data set is made possible by the funding from the Research Council of Norway, project number 250784'
            date_created                    = '2020-03-16'
Dimensions:
            TIME  = 11142
            DEPTH = 54
            ZP    = 2
            ZT    = 1
            ZS    = 1
            ZU    = 69
Variables:
    TIME
            Size:       11142x1
            Dimensions: TIME
            Datatype:   double
            Attributes:
                        standard_name = 'time'
                        long_name     = 'Decimal day'
                        units         = 'Days since 2016-01-01T00:00:00Z'
                        axis          = 'T'
    DEPTH
            Size:       54x1
            Dimensions: DEPTH
            Datatype:   double
            Attributes:
                        standard_name = 'Z'
                        units         = 'm'
                        long_name     = 'Vertical distance below the sea surface'
                        axis          = 'Z'
    u
```

```
            Size:       54x11142
            Dimensions: DEPTH,TIME
            Datatype:   double
            Attributes:
                        standard_name = 'eastward_sea_water_velocity'
                        units         = 'm s-1'
                        long_name     = 'Absolute eastward sea water velocity'
      v
            Size:       54x11142
            Dimensions: DEPTH,TIME
            Datatype:   double
            Attributes:
                        standard_name = 'northward_sea_water_velocity'
                        units         = 'm s-1'
                        long_name     = 'Absolute northward sea water velocity'
      zPRES_ins
            Size:       2x11142
            Dimensions: ZP,TIME
            Datatype:   double
            Attributes:
                        units     = 'm'
                        long_name = 'Vertical distance below sea surface of pressure sensor at time-varying measurement level (not gridded)'
      zTEMP_ins
            Size:       1x11142
            Dimensions: ZT,TIME
            Datatype:   double
            Attributes:
                        units     = 'm'
                        long_name = 'Vertical distance below sea surface of temperature sensor at time-varying measurement level (not gridded)'
      zPSAL_ins
            Size:       1x11142
            Dimensions: ZS,TIME
            Datatype:   double
            Attributes:
                        units     = 'm'
                        long_name = 'Vertical distance below sea surface of conductivity sensor at time-varying measurement level (not gridded)'
      zu_ins
            Size:       69x11142
            Dimensions: ZU,TIME
            Datatype:   double
            Attributes:
                        units     = 'm'
                        long_name = 'Vertical distance below sea surface of horizontal velocity sensor at time-varying measurement level (not gridded)'
      PRES_ins
            Size:       2x11142
            Dimensions: ZP,TIME
            Datatype:   double
            Attributes:
                        units     = 'decibar'
                        long_name = 'Sea water pressure at time-varying measurement level (not gridded), equals 0 at sea-level'
      TEMP_ins
            Size:       1x11142
            Dimensions: ZT,TIME
            Datatype:   double
            Attributes:
                        units     = 'degree_Celsius'
                        long_name = 'sea water temperature at time-varying measurement level (not gridded), in-situ ITS-90 scale'
      PSAL_ins
```

```
            Size:       1x11142
            Dimensions: ZS,TIME
            Datatype:   double
            Attributes:
                        units     = '1'
                        long_name = 'Practical salinity at time-varying measurement level (not gridded), PSS-78 scale'
      u_ins
            Size:       69x11142
            Dimensions: ZU,TIME
            Datatype:   double
            Attributes:
                        units     = 'm s-1'
                        long_name = 'Absolute eastward sea water velocity at time-varying measurement level (not gridded)'
      v_ins
            Size:       69x11142
            Dimensions: ZU,TIME
            Datatype:   double
            Attributes:
                        units     = 'm s-1'
                        long_name = 'Absolute northward sea water velocity at time-varying measurement level (not gridded)'

```