Cruise report

HM2024009015

1. Cruise overview

The cruise was organized as part of the course “Fjord oceanography” at the Geophysical Institute, UiB. We visited mainly Lurefjorden and Masfjorden to do mooring and hydrographic work (see Fig. 1).

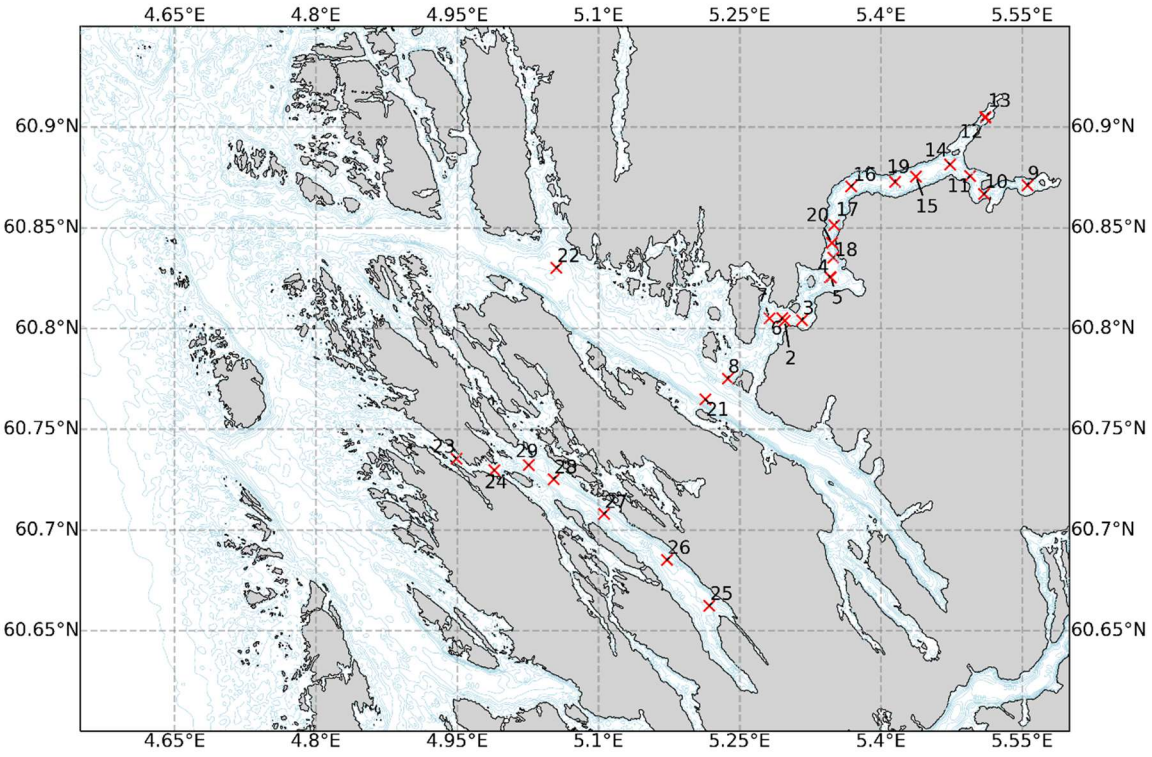

Figure 1: map over the study area

2. Cruise Participants

	Leg 1 (5-6/3)	Leg 2 (6-8/3)
Elin Darelius, Scientist		x
Torunn Sagen, PhD-student	x	
Helge Bryhni, Technician	x	
Eirik Kvamme	x	
Eskil Solhaug	x	
Mathilde Helbert		x

Marrianne Williams-Kerslake		x

3. CTD

We occupied a total of 28 CTD-casts during the cruise using the RBR Maestro sn 205914 available onboard. The conductivity, temperature, pressure, and PAR sensor were last calibrated in January, 2023.

1 cast (cast 9) was occupied using the RBR Maestro sn 207185, as the other instrument failed to connect (probably temperature related). This instrument does not have an oxygen sensor.

On most stations, the CTD was lowered to 10 depth and then brought back to the surface before the cast was started. This was done to make sure that the CTD started correctly.

The stations are listed in Table 2.

4. Water sampling

Water samples were obtained from the Rosette available onboard during the upcast. As CTD data can not be viewed live, sample depths had to be chosen beforehand. Sample depths are listed in Table 3, were the depths are the depths given by the pressure sensor of the Rosette. A comparison between the pressure records from the CTD and the pressure from the Rosette shows that there is an offset of about 1 dbar between the two, with the Rosette showing the higher value.

The Rosette holds 6 bottles of 3.5L each, and when that was not enough, we first collected water from the largest depths and then did a second cast to obtain water from shallower depths.

a) Winkler titration

Samples for measuring dissolved oxygen were collected using a tube, ensuring each sample was as bubble-free and exposed to air as little as possible. Draw temp was measured before we added 1 mL $MnCl_2$ and 1 mL NaOH/NaI to the sample and put a cap on the flask. The sample was then shaken for about 20 sec, and stored dark and cool until Winkler titration started.

We used an automatic Winkler titration instrument, using UV light to determine the endpoint of the titration for each sample. We removed the cap, added 1 mL H_2SO_4 and a stirring bar to the sample, and placed the sample in the Winkler titration system, and started titrations.

b) Dissolved Inorganic Carbon / Alkalinity, and, nutrients

Samples for carbon analysis (dissolved inorganic carbon and alkalinity) were collected using a tube, adding a drop (ca 0.02 mL) of mercury to the sampled bottles. Samples were kept cool and dark, and brought back to GFI for analysis.

Samples for nutrients were collected by rinsing the flasks three times, then adding a drop of chloroform to the sample. Samples were stored in the fridge, and sent to IMR for analysis.

There was a bubble in the chloroform dispenser on station F06, and we are not sure that enough chloroform was added to the bottles.

A total of 13 samples were collected, respectively.

c) Salinity

The samples were collected following standard procedures, i.e., the bottles were rinsed three times and then brought back to GFI, where they were analyzed in the lab by the students, supervised by K. Jackson-Misje.

A total of 38 samples were collected.

d) Trace elements

Water samples for trace element analysis were collected at the bottom of selected stations for B. Risebrobakken, NORCE. The pre-cleaned bottles were rinsed three times before they were filled, and 1 ml of HCl was added using a pipette. The bottles were marked, double bagged, and stored in the fridge. The analysis was carried out by A. Tisserand at NORCE.

A total of nine samples were collected.

5. Moorings

a) Mooring recovery

One mooring, MF_inner, deployed during cruise KB2023006004 in February 2023 was recovered during the cruise; see

Table 1 and Figure 1. The acoustic release did not release, and the mooring had to be dragged. The release released nicely once on deck, and we think it has been placed too close to the steep bottom. We lost one SBE56 during the recovery (sn 4319) and sn 4323 has not recorded, probably because the wrong type of battery was used. Mooring diagrams are included at the end of the report.

b) Mooring deployment

Mooring MF_sill and MF_outer were deployed during the cruise, see Table 1 for details. Mooring **diagrams are included in the end of the report.**

c) Mini-mooring

A small mooring consisting only of a Nortek ECO-ADCP was deployed at the sill of the Haugsværfjorden during the cruise. See Table 1 for details.

Table 1: Mooring details

	Lon	Lat	In	Out	Depth	CTD
MF_inner	5° 22.011' E	60°52.163′ N	2023.02.15	2024.03.07 12:00		16
MF_sill	5° 17.875' E	60°48.231′ N	2024.03.07 14:00		84 m	2
MF_outer	5° 20.587' E	60°49.480′ N	2024.03.07 16:00		299 m	4
HF_mini	5° 29.116' E	60°53.235′ N	2024.03.07 11:00	2024.03.08 09:30	27 m	

6. Calibration of sensors

a) Salinity

The salinity of the water samples was determined by K. Jackson and the course students using a portasal. Values from bottles obtained during the upcast, i.e., higher up than the bottom, were discarded, as we have not waited long enough for the water column to settle. Only data collected at depths greater than 200 m show were included in the analysis.

The mean offset (Bottle-CTD) for samples collected at the bottom and at a depth greater than 200 m was -0.002. Fourteen samples were included in the analysis and three samples were removed as outliers.

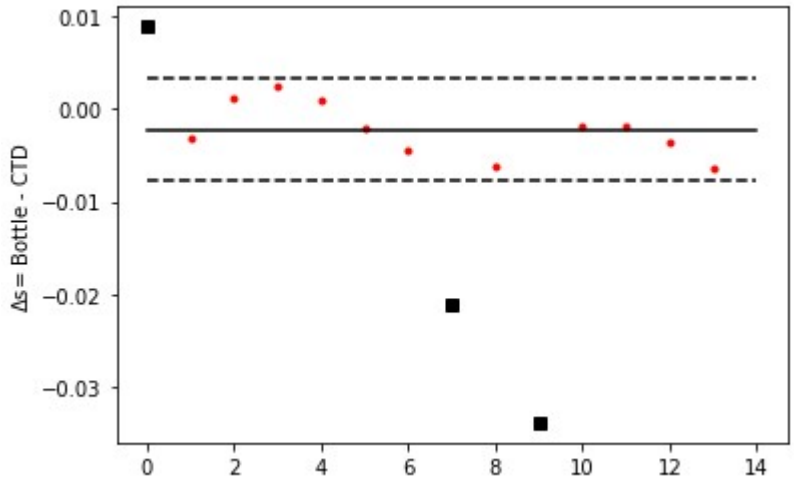

Figure 2: Salinity difference between the salinity value from bottles and the CTD for samples collected at the bottom and deeper than 200 m. The black line shows the mean value, and the dashed lines show the mean value +/—2 times the standard deviation. Outliers are marked with black squares.

b) Dissolved Oxygen

Oxygen concentrations observed by the CTD and those determined through Winkler titration was converted to [umol/kg] and compared – one obvious outlier (The difference between CTD and Winkler was more than 2.5 standard errors off the mean difference) was flagged and removed from further analysis.

When the difference between doubles (samples taken from the same depth and station, but not necessarily the same Niskin) was lower than 3 umol/kg, the mean value was retained. If the value was higher than 3 umol/kg both samples were removed.

Samples collected shallower from depths than 100 m were removed.

We fitted a line to the data using linear regression, and samples with an error larger than 2.5 times the root mean square error was removed. This procedure was repeated until either no more samples were removed or the root means square error of the remaining samples was smaller than 2 umol/kg.

A total of 32 samples were included in the analysis, and 248 samples were included in the final regression (Figure 3). The offset depends strongly on the oxygen concentration (

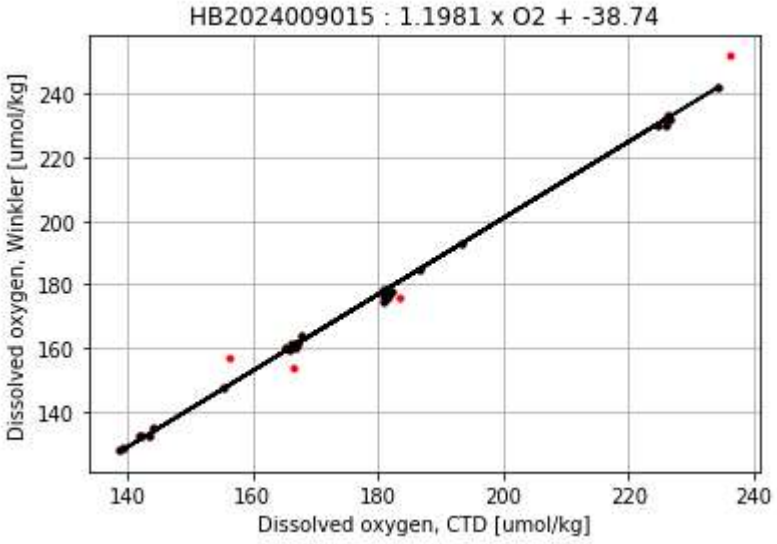

Figure 3: Dissolved oxygen concentration observed with the CTD versus that determined through Winkler titration. The black line shows the regression line used to correct the CTD data, and the black (red) dots are the samples included (not included) in the final regression analysis.

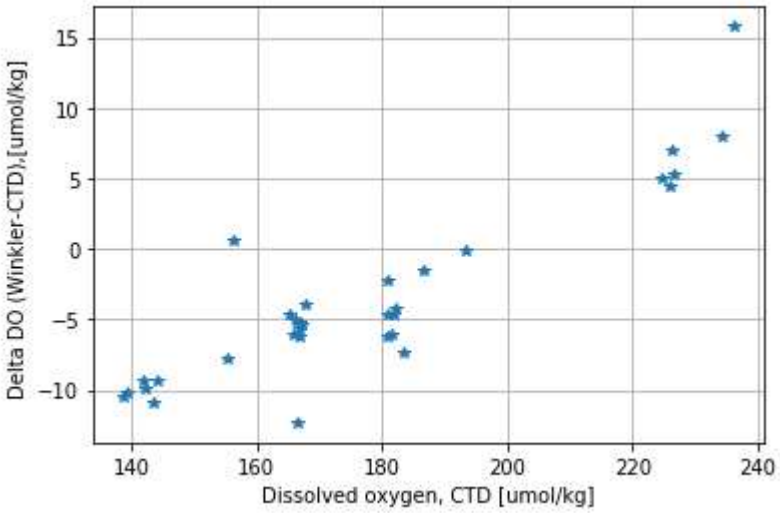

Figure 4: Offset between CTD and Winkler as a function of the dissolved oxygen concentration observed by CTD.

c) Rosette pressure sensor vs Pressure sensor of the RBR CTD

A comparison of the depth registered from the Rosette and that of the pressure records from the RBR when the instrument has held at a constant depth suggests an offset of about 1 bar, with values on the rosette being higher.

7. Cruise diary

05.03.2024

08:02 Leaving Nykirikekaien

08:20 Fuel

09:05 Byfjorden CTD full stasjon

10:45 Transit to Masfjorden

13:44 CTD MFSill

14:00 MFSill deployed ((60N 48,240 min), (5E 17,884))

14:25 CTD M14

15:05 CTD (M16) with paleo sampling & for MF Outer deployment

15:25 Start MF Outer deployment

15:56 MF Outer deployed (60N 49.471, 5E 20.566)

CTD M12, M11 & M07

18:10 Arrived at Masfjordnes, stayed overnight

06.03.2024

07:10 Go to Matre. Start standards and blanks for O2 analysis

08:10 Start CTD Masfjorden at M35. In parallell; O2 analysis

09:30 CTD in Haugsværfjorden

11:00 HF Mini mooring at Haugsværfjorden sill (to be recovered the next day)

11:30 Continue with CTD Masfjorden

14:48 At Masfjordnes, getting ready for personnel change

07.03.2024

06.30 Headed out for first CTD station

07:30 Fishing for MF_inner

Gave up and headed towards HF to recover the mini-mooring

09:30 Mini-mooring recovered at 60 53.235'N, 5 29.116'E at 27.3 m depth

Returned trying to recover MF_inner. Mooring at deck at 13:30. The release released at first try when on deck

Struggled with standards and blanks.

Air bubbles in Chloroform dispenser for Nutrients at F06.

Spent the night in Lurefjorden.

8/3

CTD in Lurefjorden

Analyzing O2

Downloaded SBE56, no data on 4323. Double check that it is logging before re-deploying. Didn't work when being re-started either ☹. DO NOT REDEPLOY. Not SAFT-battery – can that be the problem?

Figure 5: MF_inner (recovered)

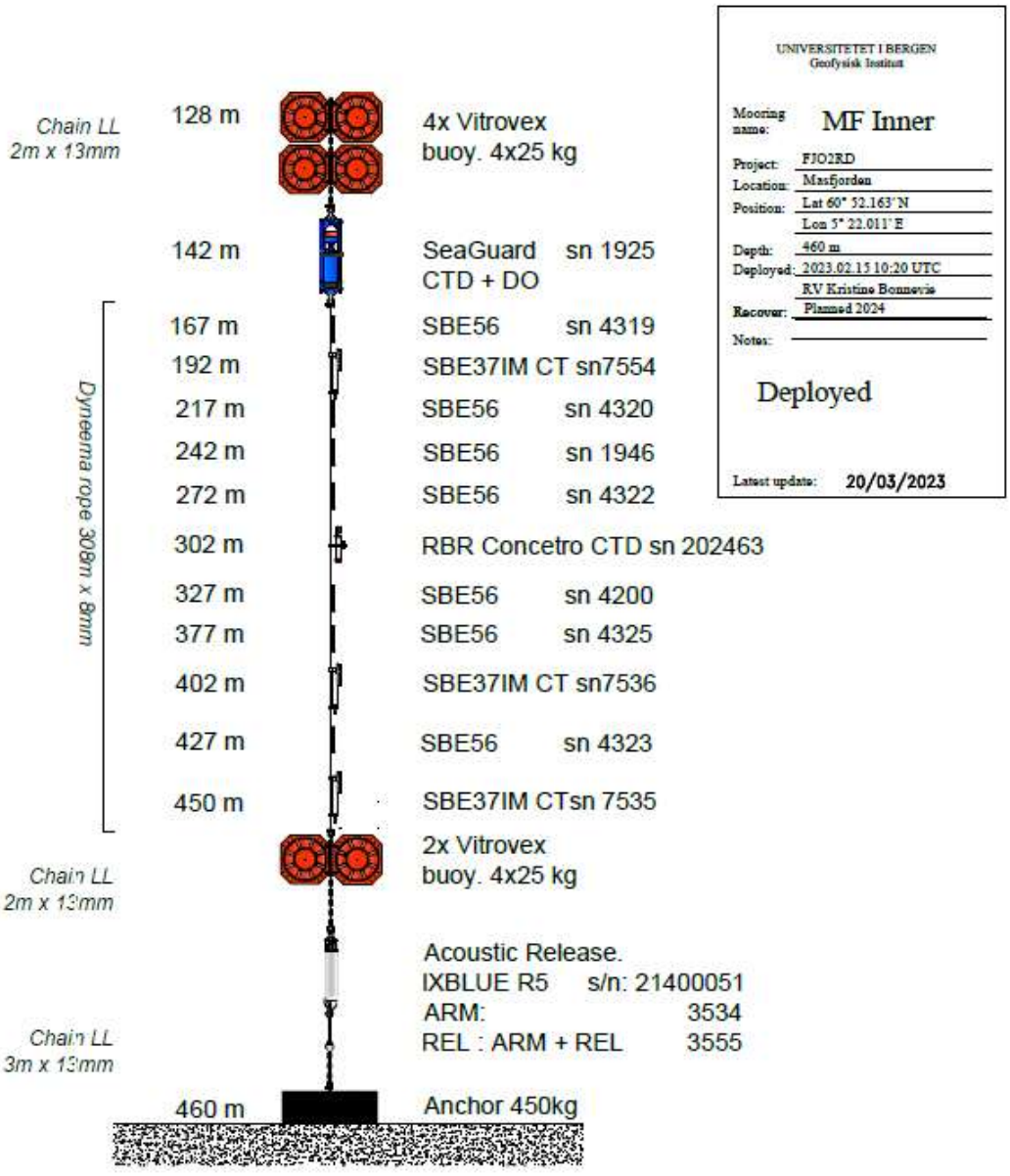

Figure 6: MF_sill (deployed)

Figure 7: Mooring drawing of MF_outer (deployed)

Table 2: Details about CTD-stations occupied during HB2024009015.

CAST	St.name	CTD File	Date			UTC	Depth	Latitude/ N		Longitude/ E		Water samples						Comments
			year	mon	day	hh:mm	m	deg	min	deg	min	Salt	O2	CT/nutrients	filtering	Isotopes	Trace m.	
0	Byfjorden		2024	3	5	09:05	321	60	25.782	5	15.927	x	x	x				
1	Eyfjorden-2		2024	3	5	10:10	321	60	25.782	5	15.927	x	x	x				
2	MFSill		2024	3	5	13:45	78	60	48.230	5	17.867							CTD for MFSill deployment
3	M14		2024	3	5	14:25	147	60	48.246	5	18.970	x	x					
4	M16		2024	3	5	14:55	298	60	49.525	5	20.752							CTD for MF Outer deployment. Forgot to turn on Watersampling Instrument
5	M16		2024	3	5	15:05	299	60	49.524	5	20.809	x	x				x	Retake M16, watersampling instrument activ
6	M12		2024	3	5	16:10	107	60	48.312	5	17.714							
7	M11		2024	3	5	16:20	203	60	48.305	5	16.893							
8	M07	DL	2024	3	5	16:39	136	60	46.506	5	14.234	x	x				x	
9	M35	DL	2024	3	6	08:11	180	60	52.265	5	33.327	x	x				x	Taken with spare CTD due to no connection to normal CTD
10	M33		2024	3	6	08:45	180	60	52.007	5	30.560							Forgot to log this station - values are estimates
11	M32		2024	3	6	09:05	155	60	52.542	5	29.68	x	x					
12	HF		2024	3	6	09:30	120	60	54.282	5	30.648	x	x	x			x	
13	HF-2		2024	3	6	10:10	121	60	54.305	5	30.654	x	x	x				
14	M31		2024	3	6	11:37	267	60	52.303	5	20.394	x	x					
15	M28		2024	3	6	12:15	426	60	52.524	5	26.227	x	x				x	
16	M24		2024	3	6	13:10	460	60	52.235	5	22.098	x	x				x	
17	M22	DL	2024	3	6	13:56	418	60	51.978	5	21.008	x	x					
18	M18		2024	3	7	07:11	198	60	50.113	5	20.963	x	x					Bottles released at the bottom, check depth in
19	M26		2024	3	7	08:54	480	60	52.368	5	24.898	x	x				x	
20	M20		2024	3	7	10:03	365	60	50.557	5	20.867	x	x					
21	M04		2024	3	7	14:10	661	60	45.386	5	12.806	x	x					
22	F06		2024	3	7	15:20	545	60	49.308	5	03.313	x		x			x	
23	L01		2024	3	7	16:50	70	60	44.120	4	56.947							
24	L02		2024	3	7	16:56	86	60	43.780	4	59.368							
25	L07		2024	3	8	06:59	310	60	39.743	5	13.059	x	x					
26	L06		2024	3	8	7:33	421	60	41.107	5	10.363							
27	L05		2024	3	8	8:15	389	60	42.479	5	06.353	x	x					
28	L04		2024	3	8	8:43	255	60	43.511	5	03.136	x	x				x	
29	L03		2024	3	8	09:06	182	60	43.931	5	01.556	x						

Table 3: Pressure (dbar) where the Niskin bottles were closed.

Cast	Station Name						
		Bottle 1	Bottle 2	Bottle 3	Bottle 4	Bottle 5	Bottle 6
0	Byfjorden	303	303	303	203	203	203
1	Byfjorden-2	101	101	51	51	11	11
2	MFSill						
3	M14	148	148				
4	M16						
5	M16	298	298	298	203	203	203
6	M12						
7	M11						
8	M07	130	130	130	81	81	81
9	M35	178	178	178	102	102	102
10	M33						
11	M32	152	152	152	82	82	82
12	HF						
13	HF-2	37	37	37	12	12	12
14	M31	269	269	269	62	62	62
15	M28	428	428	428	203	203	203
16	M24	468	468	468	203	203	203
17	M22	423	423	423	203	203	203
18	M18	193	193	193	193	193	193
19	M26	486	486	406	406	204	204
20	M20	358	358	203	203		
21	M04	663	608	557	506	406	304
22	F06	546	546	203	77	11	
23	L01						
24	L02						
25	L07	310	310				
26	L06	420	420	379	379		
27	L05	359	369	303	303		
28	L04	249	249	249	249	249	249
29	L03	181	181	181	181	181	181