Cruise report

HM2025009011

1. Cruise overview

The cruise was organized as part of the course GEOF337 at the Geophysical Institute, UiB, and we visited Masfjorden , Fensfjorden Lurefjorden to do hydrographic work, collect water samples and deploy moorings. We also included a station in Byfjorden. We brought an artist with us to the fjord.

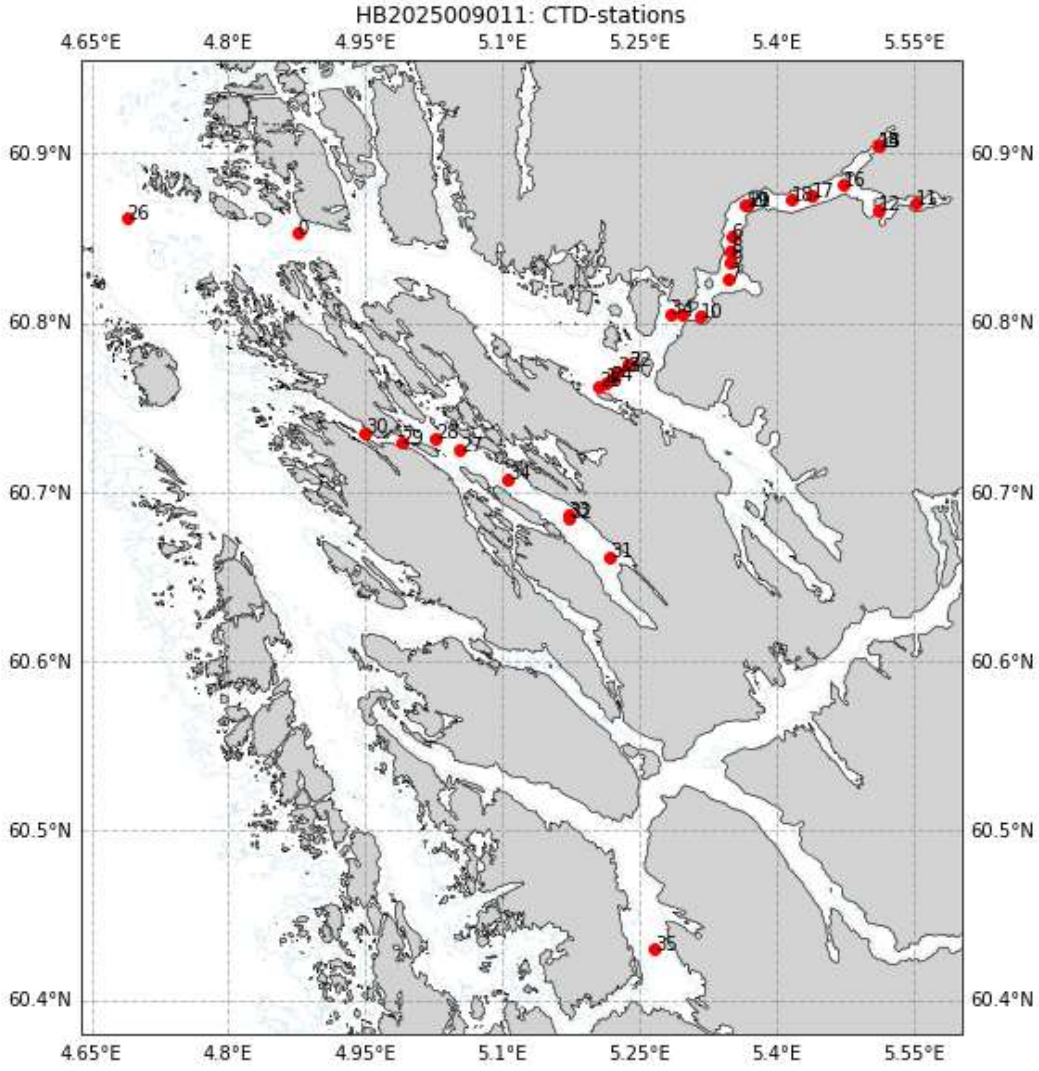

Figure 1; Map over the study area. The position of CTD-profiles are indicated by numbered red dots.

2. Cruise participants

Elin Darelius
Helge Bryhni (11-12/3, mooring technician)
Kristin M. Jackson (12-14/3, chemical technician)
Lars Øvre (student)
Anne Digranes Årvik (student)
Monica Ursin Jäger (Artist)

3. CTD

We occupied a total of 35 CTD-casts during the cruise using the RBR Maestro sn 205914 available onboard. The conductivity, temperature and pressure sensor were last calibrated in February, 2025, while the oxygen sensor was last calibrated in April, 2000.

The stations are listed in Table 2.

Several of the stations were occupied twice or even three times, with one cast to the bottom followed by a shallower cast to collect water samples from the upper part of the water column.

At the two innermost stations (M35 and HF), where we expect freshwater in the surface, we tested to lower the CTD to 10m, before rising it to the surface were they waited a minute before the cast was started. Cast number two at these location were occupied following the standard procedure: to wait 1 min in the surface before starting the cast.

4. Water sampling

Water samples were obtained from the Rosette available onboard during the upcast. As CTD data cannot be viewed live, sample depths had to be chosen beforehand. Sample depths are listed in

Table 3, where the depths are the depths given by the pressure sensor of the Rosette.

We waited at least one minute after the CTD was stopped before closing the bottle.

We took water samples for salt, dissolved oxygen, methane, DIC, Ph, nutrients and ammonium following standard procedures.

Test 1: At station M26, 80 m depth, we closed one bottle directly when the CTD stopped, one after 1 minute and one after 5 minutes. We were meant to take (double) DO and salt samples from all of them, but we ran out of water so there was no double sampling and no salt at all from the 5 min bottle.

M26, Cast 18	Niskin	Salinity	Dissolved Oxygen
0 min	4	X	X
1 min	5	x	X
5 min	6		X

Test 2: At station L04, 70 m depth we opened one bottle when the CTD was stopped, two after one minute and the rest after 6 minutes. We took two DO-samples from each interval and one salt bottle that was marked to be sampled twice in the lab.

L04, Cast 27	Niskin	Salinity	Dissolved Oxygen
0 min	1	X	XX
1 min	2-3	X	XX
6 min	4-6	X	XX

Surface samples

In addition, samples from the surface were collected using a separate water sampler. These samples were collected using a messenger with the sampler about 0.5 m below the surface.

Temperature is read from the thermometer in the sampling bottle.

The sampler gets stuck in a locked position every time it closes – you need a screwdriver or like open it.

For next time: make a clearly visible mark so that all samples are from the same depth. Note down salinity and take a salinity sample. Sample all variables from the same bottle.

Station	Cast	Date & time	Methane	Nutrients & ammonium	DIC	Salt	Temperature
M35	11	12/3	xxxx (bubble)	X			
HF	13	12/3	xxx	X			
HF2	14	12/3			x		
M24	19	13/3	xxx	x		x	2C
L03	28	13/3	xxx			x	6C
L06	32	14/3	xxx	x		x	5.5C

Winkler titration

Samples for measuring dissolved oxygen were collected using a tube, ensuring that each sample was as bubble-free and exposed to air as little as possible. Draw temp was measured before we added 1 mL MnCl2 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.

Winkler titration was carried out onboard by Kristin M. Jackson and the students using the semi-manual titration system.

a) 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.

Samples for NH4 were collected after rinsing the bottle three times, and the samples were placed in the freezer.

b) 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.

5. Mooring deployment & localization

Moorings “MF_outer” and “MF_sill”, were deployed without any problems (See Table 1 and Figure 5Figure 6.)

Table 1: Mooring details

	Lon	Lat	Date in	Depth	CTD
MF_sill	5° 17.897' E	60°48.2302′ N	2025.03.11 14:17	82 m	4
MF_outer	5° 20.603' E	60°49.4908′ N	2025.03.12 09:32	297 m	7

The exact position of mooring MF_inner was determined using triangulation and we then detected it on the echosounder at about 60 52’202’’N, 5 22’023’’. The upper buoys are at 80 m.

6. Secchi disk

To test the transparency of the water we lowered a Secchi disk at selected stations / locations.

M26	12 m
Andevika	10 m
F05	6 m
L02	4 m
L05	3.5 m

7. Calibration of CTD sensors

a) Salinity

The salinity of the water samples was determined by K. Jackson and the students using a portasal. 26 samples were collected.

The mean offset (Bottle-CTD) for samples collected deeper than 95 dbar is 0.03. This includes 923 samples. Samples which are more than 2 std off are removed, this procedure was repeated 2 times. 3.0 samples were removed.

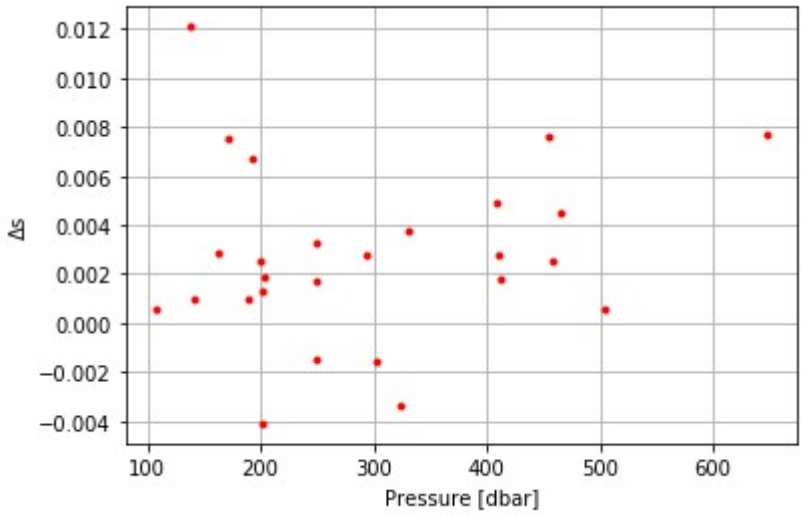

Figure 2: Difference between the salinity observed with the CTD and the salinity from the water samples as a function of pressure.

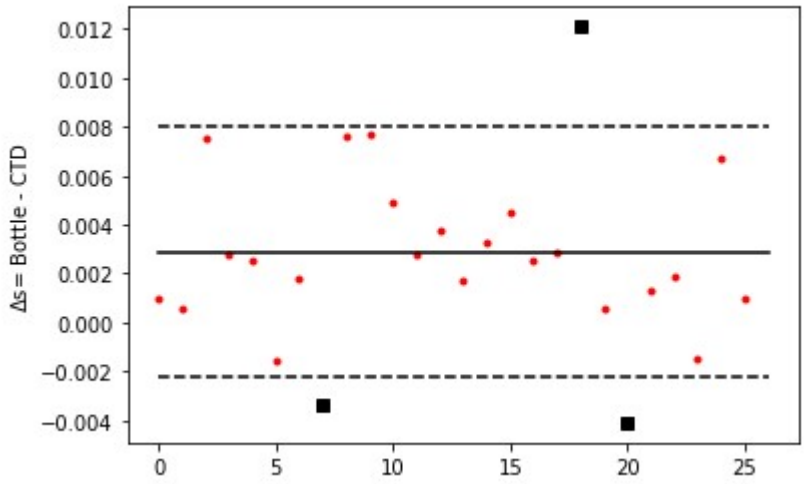

Figure 3: Salinity difference between the salinity value from bottles and the CTD. The black line shows the mean value, and the dashed lines show the mean value +/—2 times the standard deviation. Outliers are marked with black squares.

b) Dissolved Oxygen

Oxygen concentrations observed by the CTD and those determined through manual Winkler titration were converted to [umol/kg] and compared.

Samples collected at depth shallower than 100 m were excluded from the analysis.

No sample was flagged as bad during the 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. One set of doubles was 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 were 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 37 samples were included in the regression analysis, and 37 samples were included in the final regression (4). There difference between the value observed with the CTD and that from Winkler titration increase with decreasing DO-concentration

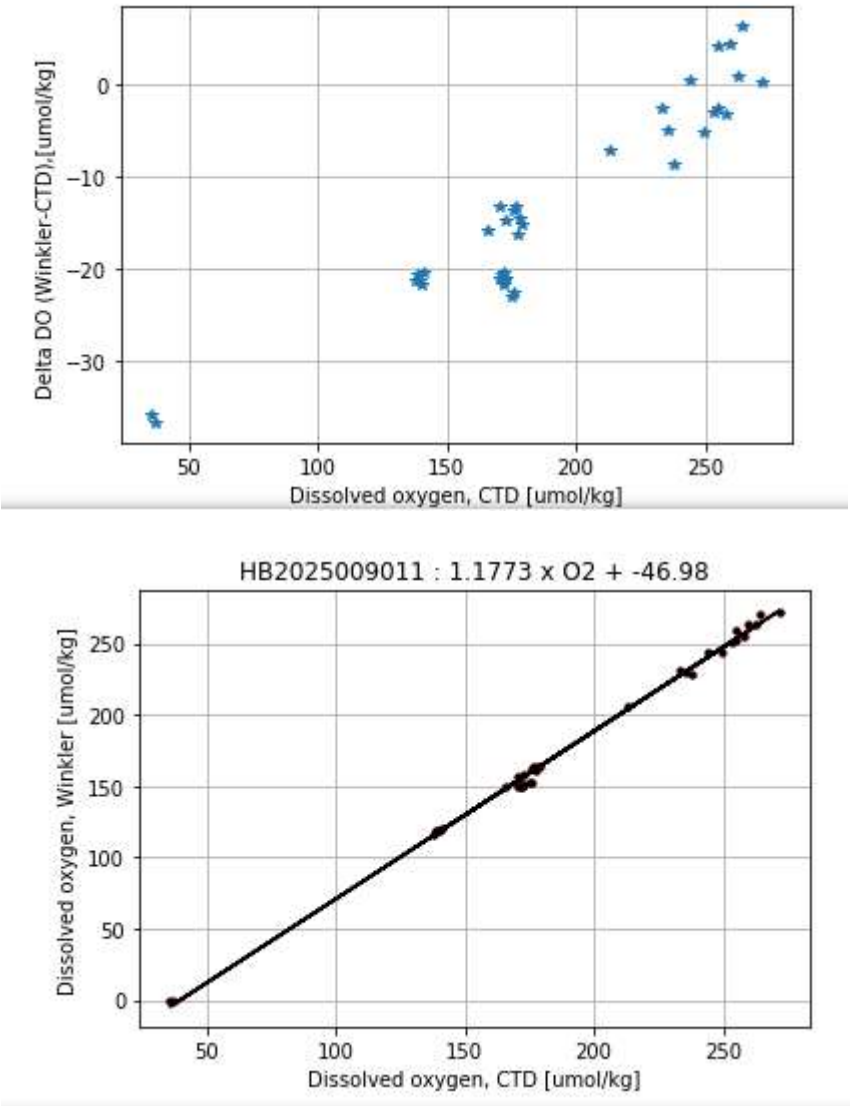

Figure 4: Dissolved oxygen concentration observed with the CTD versus that determined through Winkler titration. The black line shows the regression line used to correct the CTD data, and the black (red) dots are the samples included (not included) in the final regression analysis.

8. **Cruise diary – not complete.**

<u>11 March</u>

08:20 Departure from Bergen

Started RBR Solo, RBR CTD - had to update firmware. We did so but still got a warning – so we started to log with 1 min sampling frequency while starting the AQD to verify that it did collect data (it did).

11:05 First CTD – F03

14:17 MF_sill deployed.

14:40 CTD cast (cast 5) at MF24 with 2 x AR attached: 3 m below + 1 m below. Do not use the data! Both releases answered and released, but not every time.

15:00 (?) Triangulation to locate MF_inner. We did four stations around the supposed position – distances were around 450 m. Results are very sensitive to Release height. When we passed over, the top buoys showed up at 80 m depth at 60 52.202N, 5 22.023E

12 Mars, 2025

07:00 Mooring preparations at quai

08:50 Deployment started

09:25 Last instrument mounted

09:33 Anchor released

Top: Sphere – ring – 1m Kevlar – 2+1 Sphere, RBR is placed 2 m below the spheres

Between the two ropes: ring – Seaguard – ring

Bottom: Anchor – 10 m (chain + stropp) AR -2.5 m chaing with 2 x spheres - ring

13:00 Started CTD in Matrefjorden, M35. Many water samples = 2 casts. On the first, the CTD was lowered to 10m, waited 15 s, taken back to the surface, waited 1 min, then started the downcast. This was repeated in Haugsværfjorden (or at least the crew were told to do so).

Three casts in Haugsværfjorden – two casts with surface sampler (Methane and nutrients from the first, DIC from the second).

Much less bubbles in methane samples when the vials were knocked gently on the deck while overfilling.

16:25 last CTD – M22

Stopped 16:45 to do oxygen

Seaguard: SD-card erased, batteries changed, clock was 6 min late - > corrected. (Followed instructions in Elin's cheat sheet). Sampling interval set to 1h. Armed to start 12/3 09:00 2025.

Table 2: Details about CTD-stations occupied during HB2025009011. Information on 13/3 are from the toktlogger, as the original document was lost.

	St.name	Date			UTC	Depth	Latitude/ N		Longitude/ E		Salt	O2	CT/nutrients	Ammonium	Methane	
CAST		year	mon	day	hh:mm	m	deg	min	deg	min						
0	F03	2025	3	11	11:06	462	60	51,184	4	52,511	x	x				
1	M04	2025	3	11	12:28	656	60	45,904	5	12,77	x	x				
2	M07	2025	3	11	00:00	0	60	0,00	0	0	x	x				
3	M11	2025	3	11	13:43	198	60	48,331	5	16,996	x	x				
4	M12	2025	3	11	14:05	115	60	48,314	5	17,717	x					
5	M24	2025	3	11	14:43	101	60	52,192	5	21,925						test releases, high speed do not use profile
6	M22	2025	3	11	16:10	420	60	51,075	5	20,997	x	x				
7	M16	2025	3	12	09:38	297	60	49,53	5	20,778	x	x				
8	M20	2025	3	12	10:06	358	60	50,557	5	20,932	x	x				
9	M18	2025	3	12	10:37	198	60	50,123	5	20,961	x	x				
10	M14	2025	3	12	11:01	149	60	48,258	5	19,017	x	x				
11	M35	2025	3	12	13:03	178	60	52,26	5	33,114	x	x	x	x	x	
12	M35	2025	3	12	13:44	178	60	52,01	5	30,64					x	
13	HF	2025	3	12	14:22	120	60	54,28	5	30,64		x	x	x	x	Ctd lowered to bottom, up to 100m and down to bottom again
14	hf	2025	3	12	15:08	120	60	54,28	5	30,64		x	x	x	x	
15	hf	2025	3	12	15:45	121	60	54,289	5	30,64			x	x	x	
16	M31	2025	3	12	16:27	270	60	52,88	5	28,37	x	x				
17	M28	2025	3	13	07:04	422	60	52,53	5	26,2454						
18	M26	2025	3	13	07:47	476	60	52,38	5	25						
19	M24	2025	3	13	08:35	469	60	52.1822	5	22,0598						
20	M24	2025	3	13	09:17	469	60	52.1822	5	22,0598						
21	M24	2025	3	13	09:57	469	60	52.1822	5	22,0598						
22	M07	2025	3	13	11:17	139	60	46,52	5	14,2487						
23	M06	2025	3	13	11:33	299	60	46.2926	5	13,5557						
24	M05	2025	3	13	11:50	494	60	46,02	5	13,0844						
25	M02	2025	3	13	12:21	120	60	45,77	5	12,3165						
26	F01	2025	3	13	13:49	497	60	51,72	4	41,3321						
27	L04	2025	3	13	15:25	248	60	43,51	5	3,1298						
28	L03	2025	3	13	15:55	173	60	43,92	5	1,5554						
29	L02	2025	3	13	16:14	86	60	43,78	4	59,3478						
30	L01	2025	3	13	16:27	66	60	44,13	4	56,9361						
31	L07	2025	3	14	07:15	307	60	39,71	5	13.053						
32	L06	2025	3	14	07:38	421	60	41,11	5	10.358	x	x	x	x	x	
33	L06	2025	3	14	08:20	422	60	41,20	5	10.287			x	x	x	
34	L05	2025	3	14	08:52	385	60	42,48	5	6.355		x				
35	byfjord 4	2025	3	14	10:52	331	60	25,81	5	15,936	x					

Table 3: Pressure (dbar) where the Niskin bottles were closed. For 13/3, depths are from the log sheet, with "bottom" replaced by depth-10. Bottle 7 refers to surface samples

Cast	Station Name	Bottle 1	Bottle 2	Bottle 3	Bottle 4	Bottle 5	Bottle 6	Bottle 7
0	F03	455.6	455.6	455.6	302.9	302.9	302.9	
1	M04	647.5	647.5	505.6	505.6	404.4	303.5	
2	M07	137.7	137.7	137.7	137.7	137.7	137.7	
3	M11	189.9	189.9	189.9	189.9	189.9	189.9	
4	M12	109.1	109.1	109.1	109.1	109.1	109.1	
5	M24							
6	M22	409.3	409.3	203.3	203.3	203.3	203.3	
7	M16	294.7	294.7	203.3	203.3	203.3	203.3	
8	M20	332.3	332.3	203.5	203.5	203.5	203.5	
9	M18	193.3	109.3	193.3	193.3	193.3	193.3	
10	M14	142.6	142.6	142.6	142.6	142.6	142.6	
11	M35	172.2	172.2	152.8	101.5	81.7	61.2	2
12	M35	52.1	41.6	30.1	21.5	11.3	5.9	
13	HF	116.0	116.0	102.2	102.2	82.0	71.9	2,0
14	hf	66.1	60.3	55.2	50.4	44.9	44.9	
15	hf	41.1	36.1	31.1	21.1	10.9	5.6	
16	M31	250.5	250.5	250.5	250.5	250.5	250.5	
17	M28	412,0	250,0	200	200	200		
18	M26	466,0	466,0	400	80	80	80	
19	M24	459,0	459,0	400	400	300	300	2,0
20	M24	250,0	200,0	100	80	50	20	
21	M24	50,0	10,0	5	5	5	5	
22	M07	129,0	129,0	129,0	129,0	129,0	129,0	
23	M06	289,0	289,0	289,0	289,0	289,0	289,0	
24	M05	484	484	400	400,0	400,0	400,0	
25	M02	110	110	110	110	110	110	
26	F01	487	487	200	200	200	200,0	
27	L04	70	70	70	70	70	70	
28	L03	163	163					2
29	L02	76						
30	L01	56,0						
31	L07	304.1	304.1	202.9	202.9	202.9	202.9	
32	L06	414.2	414.2	354.0	303.4	252.8	202	2,0
33	L06	101.8	81.6	51.3	21,0	45910,0	45843,0	
34	L05	363.3	363.3	303.1	303.1	202.8	202.8	
35	byfjord 4	324.9	324.9	324.9	324.9	324.9	324.9	

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Mooring name: MF Outer

Project: FJO2RD

Location: Masfjorden
Position: Lat 60°49.4908' N
Lon 5° 20.603' E
Depth: 297 m
Deploy: 2025.03.12 09:32 UTC
Recover: Planned Feb. 2026
Latest update: 24/03/2025

Notes:
Deployed from H. Brattström BH2025009011.

Deployed 2025

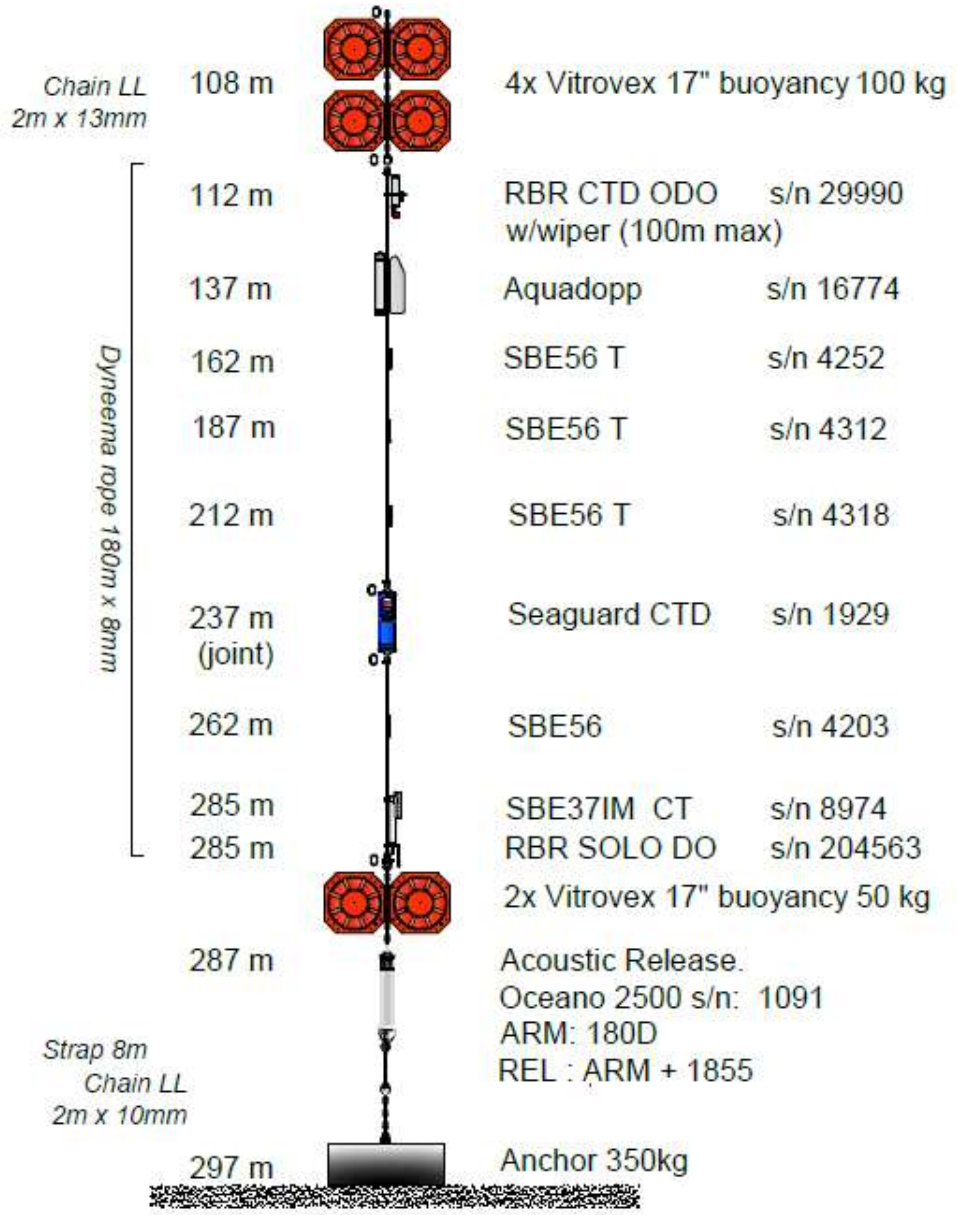

Figure 5: Mooring drawing MF_outer

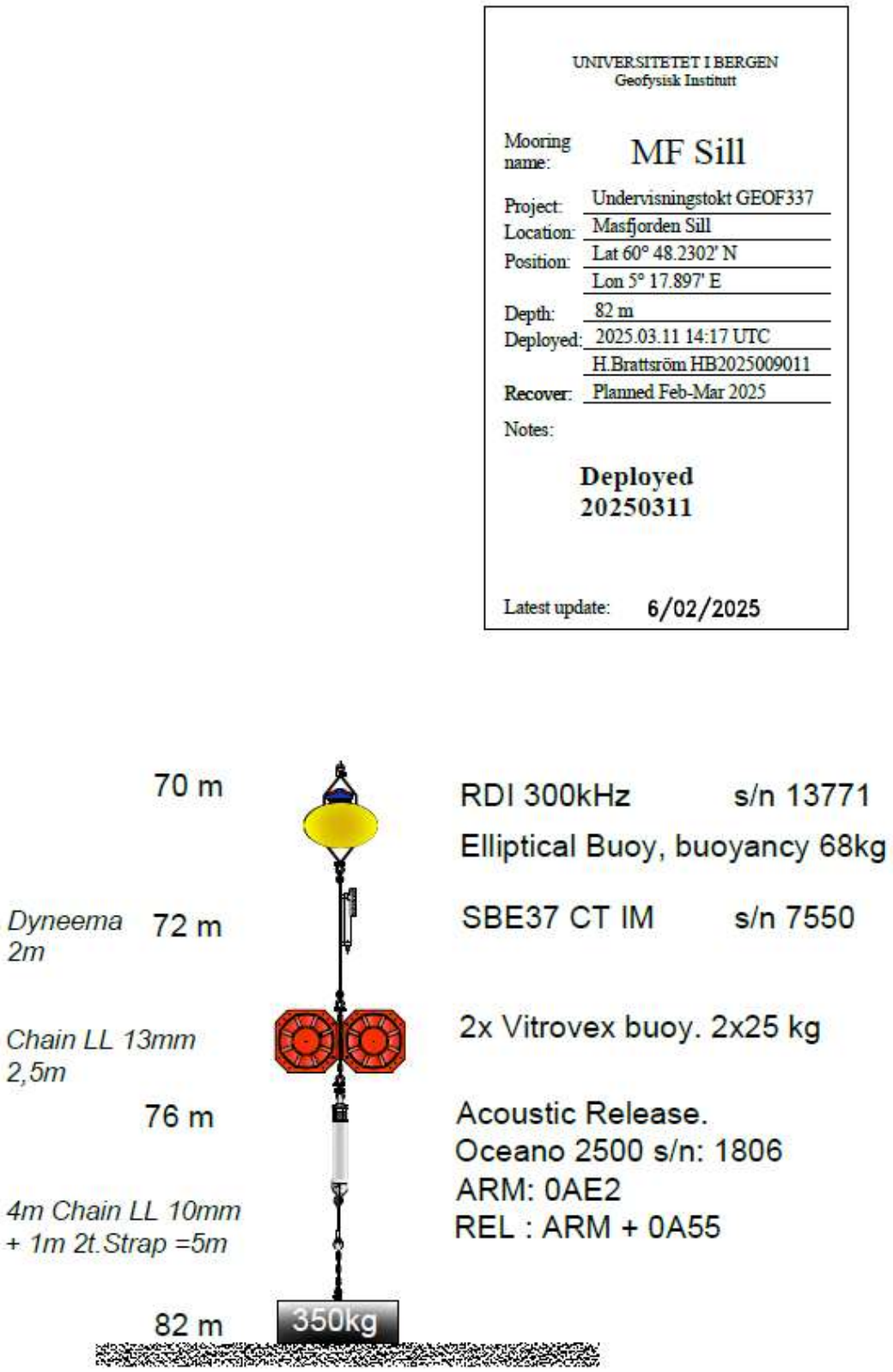

Figure 6: Mooring drawing, MF_sill