MAREANO LEG 1 2023 EASTER CRUISE REPORT

Cruise Report 2023001005

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Sammendrag (norsk):

This cruise (onboard the RV G.O. Sars, 30.03.2023 to 12.04.2023 - 13 Days long starting and ending in Bergen, Norway) was focussed on surveying the coastal belt east of “Utsira Nord” (Utsira KB) and the two multibeam mapped areas close to “Sørlige Nordsjø II” (NSJ-1 and NSJ-2). These areas are of interest due to their proximity to the named offshore wind license areas and due to their overlap with “særlig verdiful områder” (SVO) which are areas of particular scientific and management interest.

The MAREANO baseline mapping method was applied, but this cruise was focussed upon completing the video lines in these areas, and testing the munin+ AUV for data uses and the integration of AUVs into the Mareano method. In addition, the Oil Directorate asked for 2 gravity cores from areas with suspected natural oil leakage, and limited physical sampling equipment was taken for contingency use.

One hundred and twenty reference stations were visited including completing 112 (225m long) video lines, along with 5 AUV missions (collecting EM2040, HISAS2040, SBP, CT, photo data). Furthermore, 8 CTDs, 5 Boxcores, 4 Multicores, 2 stations with grabs for checking if the gravity corer can be used (no proposed site had suitable substrate for gravity coring), and 2 stations with 5 replicate grabs each for biology/geology were completed. Topaz subbottom profiling (SBP) data was collected along and between video lines and all gravity corer proposed sites, with additional water column multibeam echosounder (EM302) data also collected over all the proposed gravity corer sites. Note that 3 video lines, 1 AUV mission and 2 CTD sites were within the fjords near stavanger (during poor weather) in areas where FOH granted declassificaiton for AUV activities.

Innhold

1 - Abbreviations

The following Abbreviations are use throughout this report:

AUV: **A**utonomous **U**nderwater **V**ehicle – here it is the Kongsberg Munin +.

CT: **C**onductivity and **T**emperature (but not Depth as is normal) – the AUV CT sensor does not collect pressure information that is converted into depth as standard, but it does have an altimeter/depth sensor as part of that navigation system so this data is also available.

CTD: **C**onductivity, **T**emperature and **D**epth sampling rosette

GC1, GC2, etc: **G**ravity **C**orer station where there had been requests from the Oil directorate to take gravity corer samples if possible. No sites had suitable sediment to take these samples in the end but the sites are still locations where sampling took place so are logged here.

HI: Havforsknings**I**nstituttet or the Institute of Marine Research as it is called in English.

MBE: Multi**B**eam **E**chosounder

NGU: Norsk **G**eologiske **U**ndersøkelse or the Norwegian Geological Survey as it is called in English.

NSJ-1; NSJ-2: Nord **Sj**ø mapping areas, ames assigned by Mareano but often informed by industry mapping names such as the Sørlige Nordsjø II area which is the official name assigned to an offshore wind licensing area.

SVO: Særlig **V**erdiful **O**mråde – translates to “Especially Valuable Area” and is a Norwegian management region that currently has no protection measures but indicates an area of particular ecological value.

Utsira KB: The Ustira **K**yst **B**elt – another Mareano mapping area name. Utsira is an island in the area and Norway’s smallest municipality.

2 - Aims

- Apply Mareano method, generally following the 30 stations/1000 km2 rule (for SVO/very variable environments), with a focus on Video sampling (using the Chimera towed camera rig).

  ACHIEVED

- Test AUV (Munin +) for data uses and integration into the Mareano method.

  ACHIEVED

- Take 2 x gravity cores at the request of the Oil Directorate in areas with possible natural oil seepages.

  CHECKED SITES WITH TOPAZ AND GRABS, NONE SUITED TO GRAVITY CORERS/ SHOWING CLEAR EVIDENCE OF OIL SEEPS, ADVISE RETURNING WITH VIBROCORER

- When there are issues with Chimera/AUV take Boxcores, Multicores, Grabs (in that order) at proposed full stations to reduce the load on the summer cruise.

  SOME SAMPLES TAKEN AT FULL STATIONS (DETAILS FOLLOW)

3 - Areas

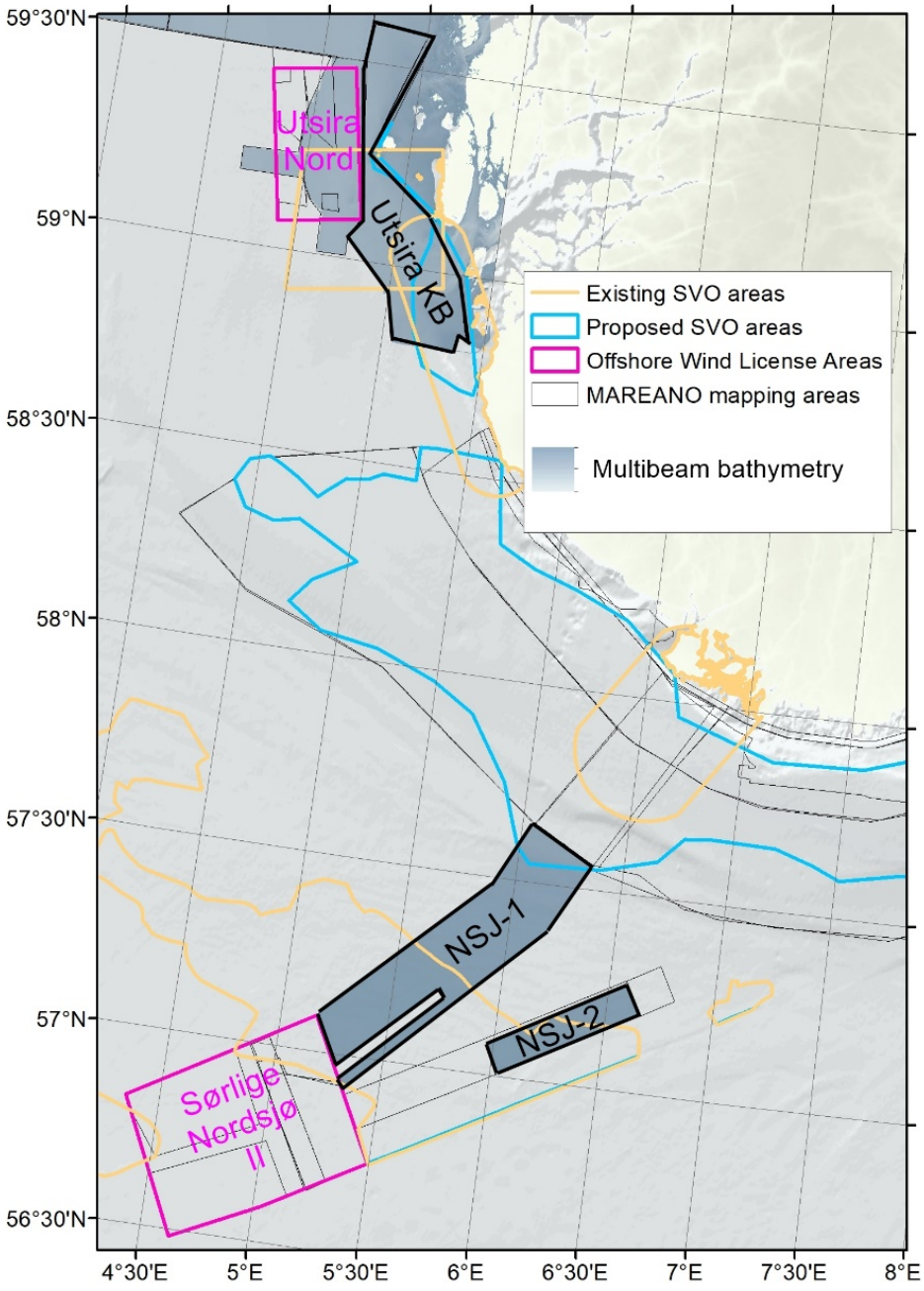


Figure 1 Cruise focus areas (Utsira KB, NSJ-1, NSJ-2) with reference to nearby offshore wind licence areas and proposed and existing SVO

This cruise was focussed on:

- Utsira KB = The coastal belt east of Utsira Nord offshore wind license area (including within the Kystebelt SVO), and
- NSJ-1 and NSJ-2 areas = Multibeam mapped areas which sit alongside the Sorlig Nordsjo II offshore wind license area and overlap with the Tobis SVO and a small corner of the Norskerenna proposed SVO.
- A small amount of additional sampling was performed in Fognafjorden (one of three sites in the fjords around

Stavanger where we had applied for, and received, permission from FOH for declassification of the seabed) as a bad weather retreat area where AUV testing could continue while waiting for improved conditions. A CTD was also taken at a second site closer to Stavanger, but that area had too much fishing gear in the way to proceed with AUV/video surveys.

4 - People

Surname	First name	Institute	Main Tasks
Bakkeplass	Kjell Gunnar	NMD	Data management
Christensen	Lene	HI	Biology/Instrument (AUV)
Dahl	Martin	HI	Instrument (Ship)
Ernstsen	Eyvind	HI	Instrument (AUV)
Fuglevik	Anders	HI	Chemistry (sampling)
Haugland	Barbro Taraldset	HI	Biology (video, sampling)
Johansen	Yngve Klungseth	HI	Biology (video, sampling)
Johansson	Maria Josefina	HI	Biology (video, sampling)
Kartveit	Kyrre Heldal	HI	Biology/Geology/Instrument (AUV)
Larsen	Sindre Nygård	HI	Instrument (Chimera)
Meek	Tor Jan	Kartverket	Hydrography (AUV)
Meyer	Heidi Kristina	HI	Biology (AUV)
Ohnstad	Leif Johan	HI	Instrument (AUV)
Piechaud	Nils	HI	Biology (AUV)
Plassen	Liv	NGU	Geology (video, sampling)
Plotkin	Alexander	HI	Biology (video, sampling)
Ross	Rebecca	HI	**Cruise leader** (biology, all)
Saint-André	Camille	HI	Biology (video, sampling)
Shyam	Chand	NGU	Geology (video, sampling, AUV)
Thorsnes	Terje	NGU	Geology (video, sampling, AUV)
Vee	Ida	HI	Biology (video, sampling)
Voronkov	Andrey	HI	Biology (video, sampling)
Wiberg	Daniel Hesjedal	NGU	Geology (video, sampling)

5 - Activities

Priority

- Chimera video stations (inc. attached mini grab; Biology, Geology)
- Gravity corer (Geology, Chemistry – at the request of the Oil Directorate)
- AUV testing and data collection (Geology, Hydrography, Biology)

Lower Priority

- Boxcorer (Chemistry, Biology)
- Multicorer (Chemistry, Geology, Biology)
- Grabs (Biology, Geology)

6 - Collected Data

Infrmation about the data collected is here shown in the form of overview maps and a table of stations. More details are available in the day by day overview appendix or can be given upon request.

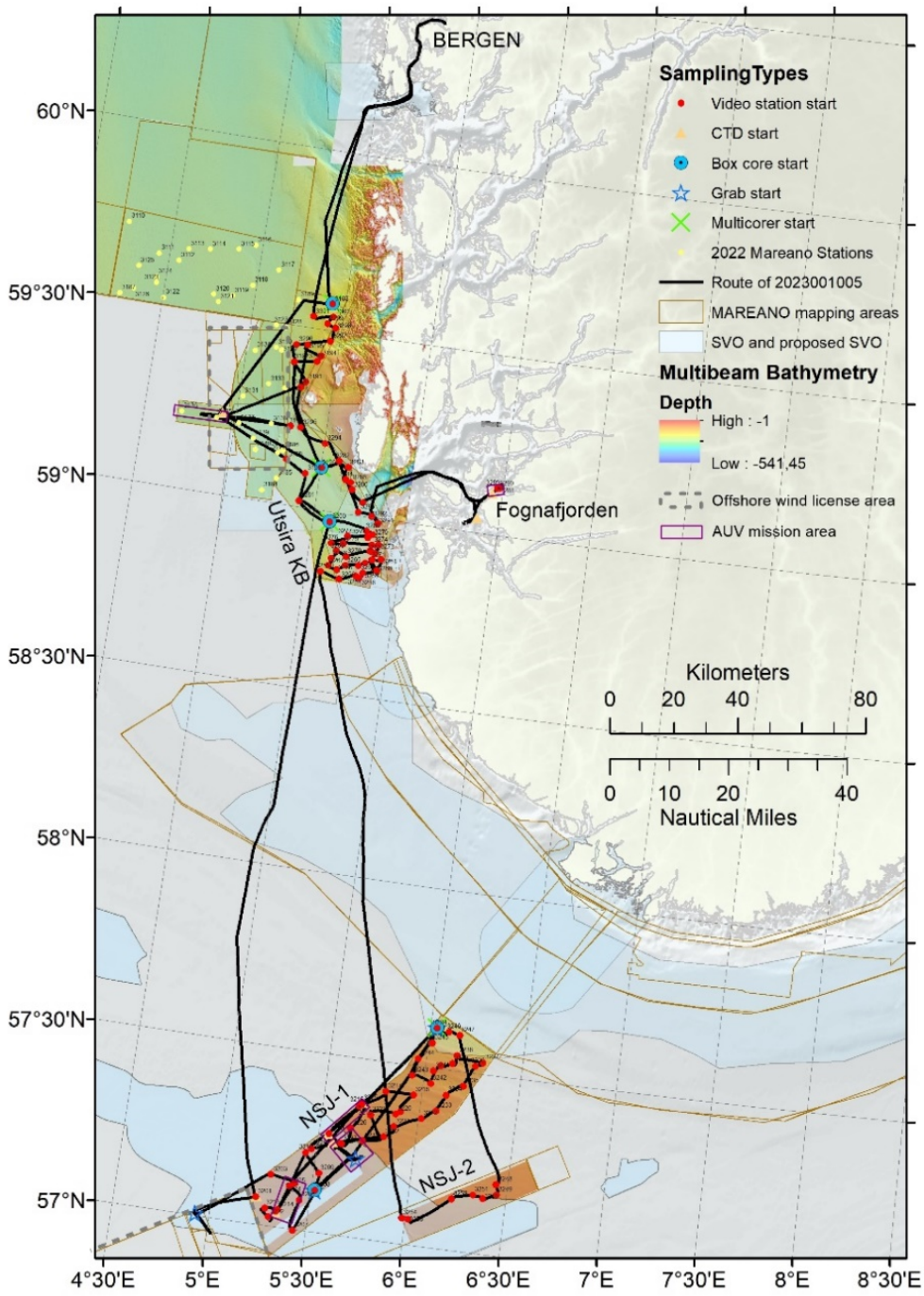


Figure 2 An overview map showing the route of the cruise: Bergen, Utisira KB, NSJ1, NSJ2, Utsira KB, Fognafjorden, Utsira KB, Bergen (zoomed in maps of subareas follow)

The following maps show the overview of the route of this cruise and the sampling stations. A table follows showing all stations, data types collected there and a short description of what was seen on video lines.

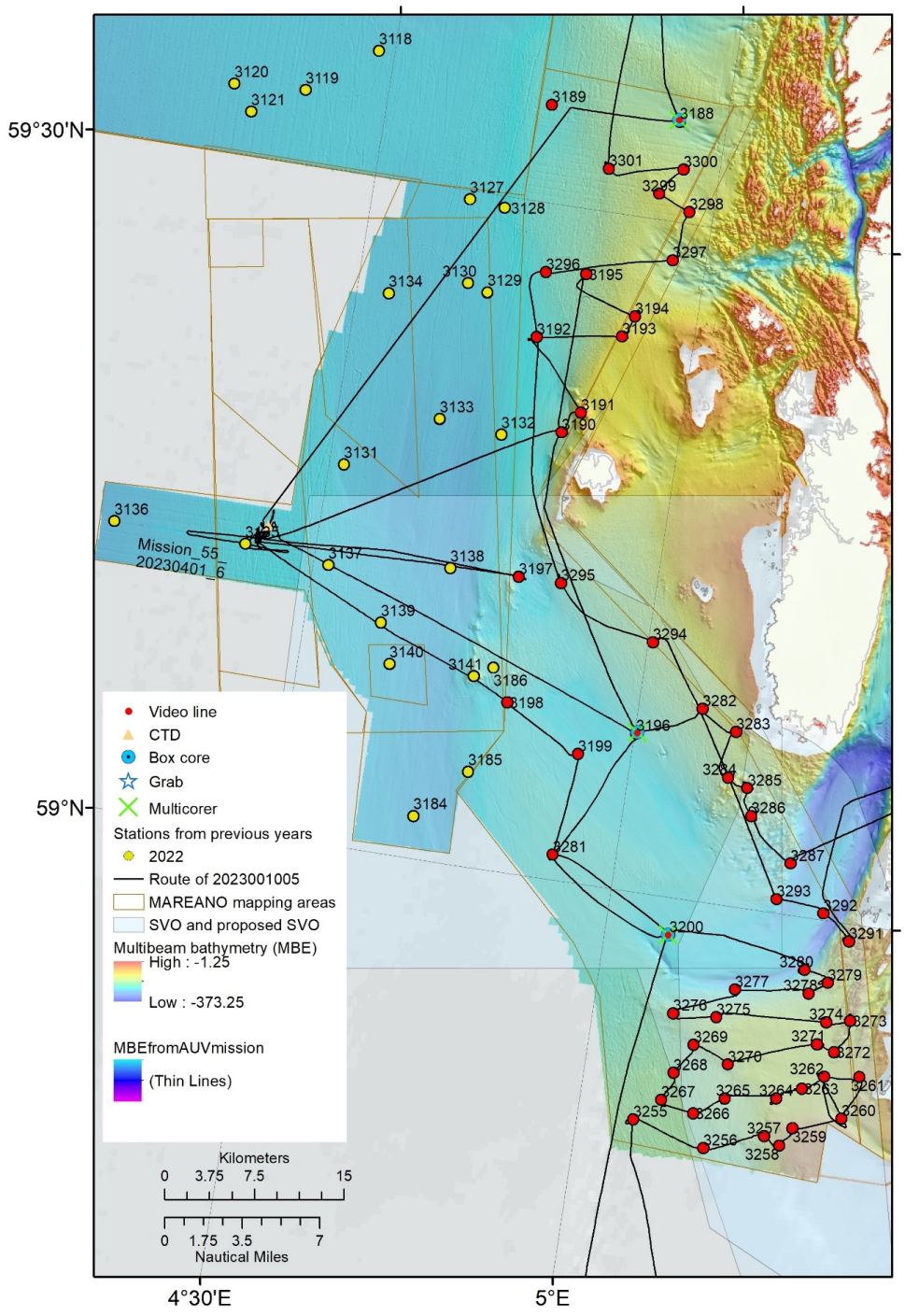


Figure 3 The Utsira Kyst Belt area showing reference station numbers sampled on this cruise (the numbering shows the order we visited them, starting at 3188-3200, then 3255-3301 excluding 3288-3290). Repeat visits to the area outside of 12nm were required for AUV testing.

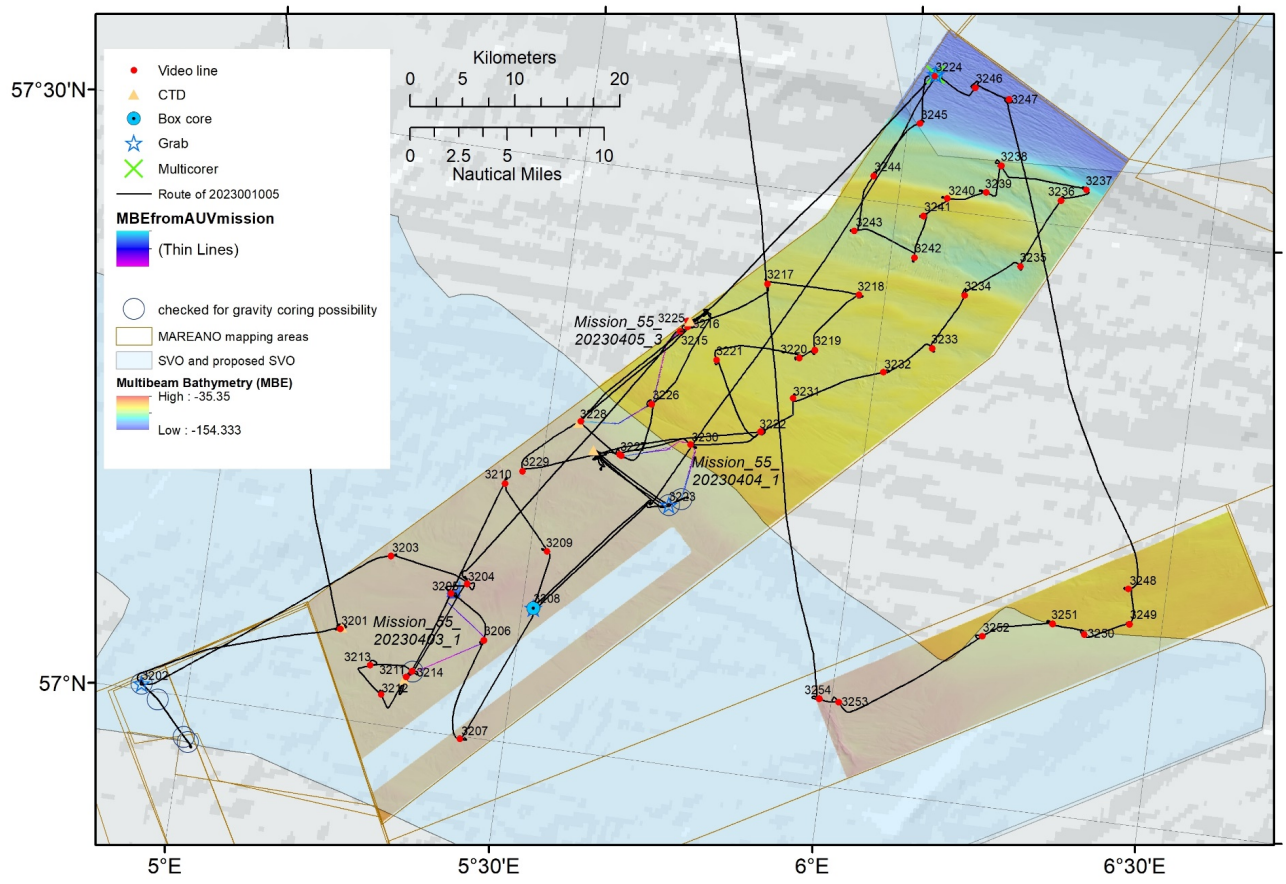


Figure 4 NSJ-1 (the larger area, reference stations 3201-3247, but excluding 3202 which is in the Sørlig Nordsjø II area and will be sampled in the future, here visited to check for the possibility of gravity coring with only a single grab sample taken) and NSJ-2 (smaller area, reference stations 3248-3254).

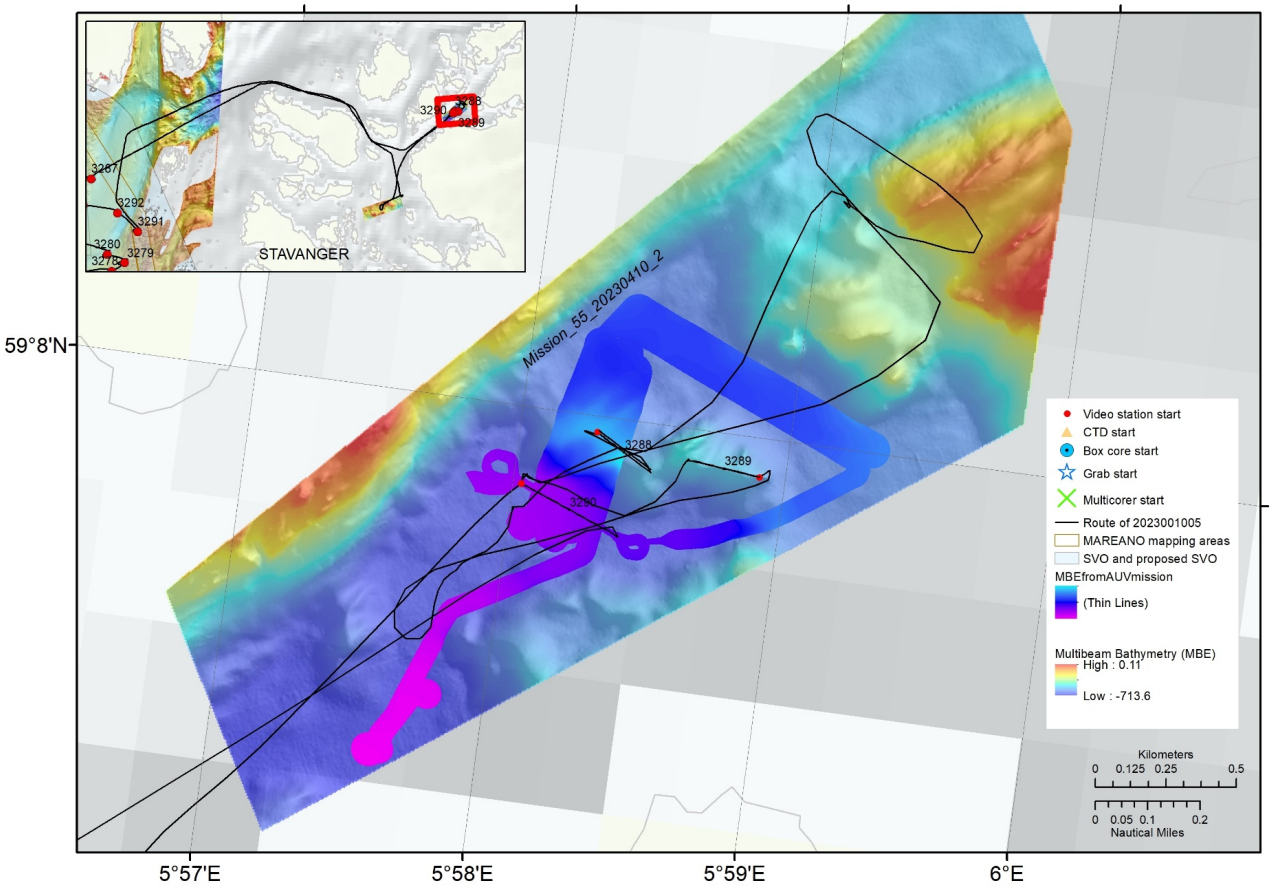


Figure 5 On our second visit to Utsira, poor weather sent us inshore near Stavanger to Fognafjorden (the plan B weather retreat area where FOH approved the declassification of the seafloor for AUV testing. The plan A area in Horgefjorden, see inset, was checked but had too much fishing gear, marked by floats, to have confidence that we could launch the AUV or chimera safely) showing the AUV survey area where we have complete data (some was lost at the end of the mission, not marked), and the three Chimera video lines (R stations 3288-3290) – again other sites were prioritised in the NE but we found too much fishing gear in the way.

Data Collection Overview Tables

Table 1 - Overview of activities in order of R station per area(broken down with more detail in subsequent tables)

Date Ended	Area	Pno	Rno	VLno	Ctd IDno	Box Corer IDno	Multi Corer IDno	Grab IDNo	AUV mission No	Comment
30.03	UtsiraKB	P42	3188	3269		2	3			
31.03	UtsiraKB	P114	3189	3270						

1.04	UtsiraKB	AUV_2023_Utsira_1a			253				Mission_55_20230401_6	ctd ON 31.03, auv 01.04, 1.5hrs data on 5.5hrs dive - 30m offset, low ping rate, blurry photos
31.03	UtsiraKB	P172	3190	3271						
31.03	UtsiraKB	P173	3191	3272						
31.03	UtsiraKB	P95	3192	3273						
31.03	UtsiraKB	P174	3193	3274						
31.03	UtsiraKB	P124	3194	3275						
1.04	UtsiraKB	P181	3195	3276						Bumped into wreck
9.04	UtsiraKB	P165	3196	3361		3	6			Samples on 01.04, VL on 09.04
1.04	UtsiraKB	P111	3197	3277						
1.04	UtsiraKB	P108	3198	3278						
1.04	UtsiraKB	P99	3199	3279						
9.04	UtsiraKB	P166	3281	3360						Topaz line on 01.04, VL on 09.04
9.04	UtsiraKB	P67	3200	3359		4	7			Samples on 02.04, VL on 09.04
2.04	NJS1	P548	3201	3280	254					
2.04	NJS1	GC1	3202					8		
2.04	NJS1	P569	3203	3281						
2.04	NJS1	P570	3204	3282						
2.04	NJS1	P588	3205	3283						
2.04	NJS1	P564	3206	3284						

3.04	NJS1	P580	3207	3285						
3.04	NJS1	P547	3208	3286		5		10-15		Grabs and boxcorer on 04.04
3.04	NJS1	P566	3209	3287						
3.04	NJS1	P587	3210	3288						
3.04	NJS1	P546	3211	3289	255					CTD as close to AUV station
3.04	NJS1	P579	3212	3290						
3.04	NJS1	P563	3213	3291						
3.04	NJS1	P577B/by GC5	3214	3292						
3.04	NJS1	AUV_2023_NSJ_2a							Mission_55_20230403_1	full dataset quality good, MBE pingrate too slow
3.04	NJS1	P584	3215	3293						
3.04	NJS1	P577A/by P584	3216	3294						
3.04	NJS1	P562	3217	3295						
3.04	NJS1	P575A/NW	3218	3296						
3.04	NJS1	P589	3219	3297						
3.04	NJS1	P576	3220	3298						
4.04	NJS1	P551	3221	3299						
5.04	NJS1	P582	3222	3300, 3307						VL3300 on 04.04 includes ony scanning still section before Chimeral fail, returned next day
4.04	NJS1	AUV_2023_NSJ_3c			256				Mission_55_20230404_6	full dataset quality good, MBE pingrate still too slow despite attempted change

4.04	NJS1	GC5B	3223					9		AUV dive has data inc photos here
6.04	NJS1	P543	3224	3323		6-7	8	16-21		Took video on 06.04
4.04	NJS1	Extra 1	3225	3301	257					Alongside P577A/ AUV launch site
4.04	NJS1	AUV_2023_NSJ_4a							Mission_55_20230405_3	full dataset quality good, MBE pingrate still too slow (but good on internal trigger)
4.04	NJS1	P560	3226	3302						
4.04	NJS1	P552	3227	3303						Jordfeil first time before VL - kept R and VL numbers for return later in day
6.04	NJS1	P550	3228	3304	258					
6.04	NJS1	P578	3229	3305						
6.04	NJS1	P586	3230	3306						
6.04	NJS1	P561	3231	3308						
6.04	NJS1	P575B/SE	3232	3309						
6.04	NJS1	P568	3233	3310						
6.04	NJS1	P581	3234	3311						
6.04	NJS1	P549	3235	3312						
6.04	NJS1	P573	3236	3313						
6.04	NJS1	P571	3237	3314						
6.04	NJS1	P553	3238	3315						
6.04	NJS1	P572	3239	3316						
6.04	NJS1	P574	3240	3317						

6.04	NJS1	P557	3241	3318						
6.04	NJS1	P558	3242	3319						
6.04	NJS1	P559	3243	3320						
6.04	NJS1	P554	3244	3321						
6.04	NJS1	P545	3245	3322						
6.04	NJS1	P544	3246	3324						
7.04	NJS1	P590	3247	3325						
7.04	NJS1	P567	3248	3326						
7.04	NSJ2	P555	3249	3327						
7.04	NSJ2	P556	3250	3328						
7.04	NSJ2	P542	3251	3329						Moved start point due to weather (changed angle to waves) to 57*09.833 N, 006*19.507 E
7.04	NSJ2	P583	3252	3330						Suspected wreck was a lost container, posibly 2 - one intact
7.04	NSJ2	P565	3253	3331						
7.04	NSJ2	P585	3254	3332						
8.04	UtsiraKB	P118	3255	3333						
8.04	UtsiraKB	P128	3256	3334						
8.04	UtsiraKB	P41	3257	3335						
8.04	UtsiraKB	P158	3258	3336						
8.04	UtsiraKB	P115	3259	3337						
8.04	UtsiraKB	P159	3260	3338						
8.04	UtsiraKB	P50	3261	3339						

8.04	UtsiraKB	P53	3262	3340						
8.04	UtsiraKB	P44	3263	3341						
8.04	UtsiraKB	P119	3264	3342						
8.04	UtsiraKB	P48	3265	3343						
8.04	UtsiraKB	P116	3266	3344						
8.04	UtsiraKB	P133	3267	3345						
8.04	UtsiraKB	P117	3268	3346						
8.04	UtsiraKB	P129	3269	3347						
8.04	UtsiraKB	P127	3270	3348						
9.04	UtsiraKB	P45	3271	3349						
9.04	UtsiraKB	P131	3272	3350						
9.04	UtsiraKB	P120	3273	3351						
9.04	UtsiraKB	P54	3274	3352						
9.04	UtsiraKB	P126	3275	3353						
9.04	UtsiraKB	P122	3276	3354						
9.04	UtsiraKB	P63	3277	3355						
9.04	UtsiraKB	P47	3278	3356						
9.04	UtsiraKB	P125	3279	3357						
9.04	UtsiraKB	P160	3280	3358						
9.04	UtsiraKB	P46	3282	3362						
9.04	UtsiraKB	P43	3283	3363						
9.04	UtsiraKB	P164	3284	3364						
9.04	UtsiraKB	P123	3285	3365						

10.04	UtsiraKB	P52	3286	3366						
10.04	UtsiraKB	P163	3287	3367						
10.04	StavangerFjords	AUV_stav_PlanA			259					
10.04	StavangerFjords	AUV_stav_PlanB			260				Mission_55_20230410_2	
10.04	StavangerFjords	FJ14	3288	3368						
10.04	StavangerFjords	FJ15	3289	3369						
10.04	StavangerFjords	FJ16	3290	3370						is 380m long for photo groundtruthing - but stop still ab at 225m and start c for the end
11.04	UtsiraKB	P130	3291	3371						
11.04	UtsiraKB	P161	3292	3372						
11.04	UtsiraKB	P162	3293	3373						
11.04	UtsiraKB	P49	3294	3374						
11.04	UtsiraKB	P171	3295	3375						
11.04	UtsiraKB	P106	3296	3376						
11.04	UtsiraKB	P176	3297	3377						
11.04	UtsiraKB	P132	3298	3378						
11.04	UtsiraKB	P121	3299	3379						
11.04	UtsiraKB	P51	3300	3380						
11.04	UtsiraKB	P110	3301	3381						

Table 2 - Video line data (in order of R station per area)

Date Ended 2023	Area	Pno	Rno	Vlno	Content of VL	VME (Yes No Maybe)

30.03	UtsiraKB	P42	3188	3269	Funiculina garden, predatory actiniaria	YES
31.03	UtsiraKB	P114	3189	3270	Ostur, E. spinax	YES
31.03	UtsiraKB	P172	3190	3271	Sea pen garden	YES
31.03	UtsiraKB	P173	3191	3272	Bedrock and sponges	YES
31.03	UtsiraKB	P95	3192	3273	Burrows, sea pens, some stones with HB sponges	MAYBE
31.03	UtsiraKB	P174	3193	3274	HB sponge garden	YES
31.03	UtsiraKB	P124	3194	3275	HB sponge garden	YES
1.04	UtsiraKB	P181	3195	3276	Ship wreck	NO
9.04	UtsiraKB	P165	3196	3361	Funiculina garden	YES
1.04	UtsiraKB	P111	3197	3277	HB sponge garden	YES
1.04	UtsiraKB	P108	3198	3278	Sponges	YES
1.04	UtsiraKB	P99	3199	3279	Funiculina garden	YES
9.04	UtsiraKB	P166	3281	3360	Fuiculina, virgulariidae field	YES
9.04	UtsiraKB	P67	3200	3359	Funiculina	YES
2.04	NJS1	P548	3201	3280	Sand waves, Astropecten, Asterias	NO
2.04	NJS1	P569	3203	3281	Modiolus eg. 60%, lithothamnion	YES
2.04	NJS1	P570	3204	3282	Asterias, sand ripples	NO
2.04	NJS1	P588	3205	3283	Gravel waves, Hysa, Pleuronectiformes	NO
2.04	NJS1	P564	3206	3284	Paguridae	NO
3.04	NJS1	P580	3207	3285	Buccinidae	NO
3.04	NJS1	P547	3208	3286	Pleuronectiformes,Asteriidae	NO
3.04	NJS1	P566	3209	3287	Pleuronectiformes, Buccinidae, Asteroidea	NO

3.04	NJS1	P587	3210	3288	Alcyonium digitatum, Modiolus e.g 10%	NO
3.04	NJS1	P546	3211	3289	Astropecten, Buccinoidea	NO
3.04	NJS1	P579	3212	3290	Astropecten	NO
3.04	NJS1	P563	3213	3291	Sand ripples, Astropecten, Asterias	NO
3.04	NJS1	P577B/ by GC5	3214	3292	Astropecten	NO
3.04	NJS1	P584	3215	3293	Mosaic, reteporella, bolocera, sea pens, diverse	YES
3.04	NJS1	P577A/ by P584	3216	3294	Virgulariidae	YES
3.04	NJS1	P562	3217	3295	Tobis (ammodytes)	NO
3.04	NJS1	P575A/ NW	3218	3296	Spatangus	NO
3.04	NJS1	P589	3219	3297	Epizoanthus	NO
3.04	NJS1	P576	3220	3298	Hippasteria	NO
4.04	NJS1	P551	3221	3299	Bolocera	NO
5.04	NJS1	P582	3222	33003307	Wreck	NO
6.04	NJS1	P543	3224	3323	Parastichopus	NO
4.04	NJS1	Extra 1	3225	3301	Virgulariidae garden, bolocera among rocks, filograna	YES
4.04	NJS1	P560	3226	3302	Astropecten	NO
4.04	NJS1	P552	3227	3303	Astropecten	NO
6.04	NJS1	P550	3228	3304	Sand, low diversity	NO
6.04	NJS1	P578	3229	3305	Alcyonium, asteroids, filograna	NO
6.04	NJS1	P586	3230	3306	Astropecten	NO
6.04	NJS1	P561	3231	3308	Virgulariidae, bolocera	YES

6.04	NJS1	P575B/ SE	3232	3309	Maxmuelleria faex	NO
6.04	NJS1	P568	3233	3310	Spatangus virgulariidae	NO
6.04	NJS1	P581	3234	3311	Gracilechinus	NO
6.04	NJS1	P549	3235	3312	Spatangus	NO
6.04	NJS1	P573	3236	3313	Sand then rocks and bolocera	NO
6.04	NJS1	P571	3237	3314	Cerianthidae, Luidia sarsi	NO
6.04	NJS1	P553	3238	3315	Spatangus, virgulariidae	YES
6.04	NJS1	P572	3239	3316	Luidia sarsi, sand waves	NO
6.04	NJS1	P574	3240	3317	Gracilechinus	NO
6.04	NJS1	P557	3241	3318	Spatangus, gracilechinus	NO
6.04	NJS1	P558	3242	3319	Virgulariidae sea pen garden	YES
6.04	NJS1	P559	3243	3320	Caridea, bolocera	NO
6.04	NJS1	P554	3244	3321	Gracilechinus	NO
6.04	NJS1	P545	3245	3322	Gracilechinus	NO
6.04	NJS1	P544	3246	3324	Parastichopus	NO
7.04	NJS1	P590	3247	3325	Parastichopus	NO
7.04	NJS1	P567	3248	3326	Spatangus, hyse	NO
7.04	NSJ2	P555	3249	3327	Alcyonium	NO
7.04	NSJ2	P556	3250	3328	Spatangus, astropecten	NO
7.04	NSJ2	P542	3251	3329	Gracilechinus, astropecten	NO
7.04	NSJ2	P583	3252	3330	Astropecten, lost container	NO
7.04	NSJ2	P565	3253	3331	Leptasterias	NO
7.04	NSJ2	P585	3254	3332	Echinus, Alcyonium	NO

8.04	UtsiraKB	P118	3255	3333	HB sponge garden	YES
8.04	UtsiraKB	P128	3256	3334	Isidella, bonellia	YES
8.04	UtsiraKB	P41	3257	3335	Oceanapia garden	NO
8.04	UtsiraKB	P158	3258	3336	Gravel, Wreck (U-boat?)	NO
8.04	UtsiraKB	P115	3259	3337	megawaves and ripples	NO
8.04	UtsiraKB	P159	3260	3338	Axinellidae, porifera dense branched	YES
8.04	UtsiraKB	P50	3261	3339	Munida, patches o HB sponge garden	YES
8.04	UtsiraKB	P53	3262	3340	Sand occasional parastichopus	NO
8.04	UtsiraKB	P44	3263	3341	Muddy sand, flat, parastichopus, Phakellia	NO
8.04	UtsiraKB	P119	3264	3342	Oceanapia sponge ground	NO
8.04	UtsiraKB	P48	3265	3343	Oceanapia, Etmopterus spinax	NO
8.04	UtsiraKB	P116	3266	3344	Bonellidae & HB sponge garden	YES
8.04	UtsiraKB	P133	3267	3345	HB sponge garden	YES
8.04	UtsiraKB	P117	3268	3346	Bonellidae, HB sponge garden	YES
8.04	UtsiraKB	P129	3269	3347	HB sponge garden	YES
8.04	UtsiraKB	P127	3270	3348	Oceanapia	NO
9.04	UtsiraKB	P45	3271	3349	Oceanapia, decapoda	NO
9.04	UtsiraKB	P131	3272	3350	Quasillina	NO
9.04	UtsiraKB	P120	3273	3351	HB sponges, crabs, porania	YES
9.04	UtsiraKB	P54	3274	3352	Parastichopus	NO
9.04	UtsiraKB	P126	3275	3353	sponge garden inc stryphnus, geodia	YES
9.04	UtsiraKB	P122	3276	3354	Edge of a HB sponge garden whole way	YES
9.04	UtsiraKB	P63	3277	3355	Nephrops, sparse funiculina	NO

9.04	UtsiraKB	P47	3278	3356	Oceanapia & Nephrops, patch HB sponge garden	YES
9.04	UtsiraKB	P125	3279	3357	HB sponge garden & munida on soft	YES
9.04	UtsiraKB	P160	3280	3358	Bolocera	NO
9.04	UtsiraKB	P46	3282	3362	Sea pen garden, parastichopus	YES
9.04	UtsiraKB	P43	3283	3363	Antho dichotoma	YES
9.04	UtsiraKB	P164	3284	3364	"OXLEY" submarine wreck	NO
9.04	UtsiraKB	P123	3285	3365	Ostur	YES
10.04	UtsiraKB	P52	3286	3366	Funiculina garden	YES
10.04	UtsiraKB	P163	3287	3367	HB coral garden	YES
10.04	Fognafjorden	FJ14	3288	3368	Funiculina, cerianthidae, net	YES
10.04	Fognafjorden	FJ15	3289	3369	Cerianthidae	NO
10.04	Fognafjorden	FJ16	3290	3370	Cerianthidae, net, sharks	NO
11.04	UtsiraKB	P130	3291	3371	Hard bottom sponge ground	YES
11.04	UtsiraKB	P161	3292	3372	Sparse sea pens, nephrops, neohela	YES
11.04	UtsiraKB	P162	3293	3373	Hard bottom sponge ground/ coral garden	YES
11.04	UtsiraKB	P49	3294	3374	Mixed sea pen garden, HB sponge garden patch	YES
11.04	UtsiraKB	P171	3295	3375	Wooden wreck covered in Primnoa	MAYBE
11.04	UtsiraKB	P106	3296	3376	Nephrops, patches of HB sponges	NO
11.04	UtsiraKB	P176	3297	3377	50% wreck, some sea pens, nephrops	MAYBE
11.04	UtsiraKB	P132	3298	3378	HB/ ostur sponge garden	YES
11.04	UtsiraKB	P121	3299	3379	HB/ ostur sponge garden	YES
11.04	UtsiraKB	P51	3300	3380	Sea pen field patchy	MAYBE

11.04	UtsiraKB	P110	3301	3381	HB/ ostur sponge garden	YES

Table 3 - Full Stations (in order of R station per area)

DateEnded	Area	Pno	Rno	Vlno	ctdIDno	BoxCIDno	MultiCIDno	GrabIDNo	Comment
30.03	UtsiraKB	P42	3188	3269		2	3		
31.03	UtsiraKB	P172	3190	3271					
9.04	UtsiraKB	P165	3196	3361		3	6		Samples on 01.04, VL on 09.04
9.04	UtsiraKB	P67	3200	3359		4	7		Samples on 02.04, VL on 09.04
8.04	UtsiraKB	P53	3262	3340					
2.04	NSJ1	P548	3201	3280	254				
3.04	NJS1	P547	3208	3286		5		10-15	Grabs and boxcorer on 04.04
6.04	NJS1	P543	3224	3323		6-7	8	16-21	Took video on 06.04

Table 4 - Petroleum Directorate gravity corer investigation sites, note that none were deemed suitable for gravity coring and therefore no gravity cores were taken on this cruise

Date Ended	Area	Pno	Rno	Topaz	Watercolumn MBE	Grab IDNo	Comment
2.04	Sørlige Nordsjø II	GC1	3202	YES	YES	8	Retained as possible future Mareano R station
2.04	Sørlige Nordsjø II	GC2		YES	YES		
2.04	Sørlige Nordsjø II	GC3		YES	YES		

2.04	Sørlige Nordsjø II	GC4		YES	YES		
3.04	NJS1	GC5		No	No		AUV Mission_55_20230403_1 has MBE/HiSAS/photo data here
4.04	NJS1	GC5B	3223	YES	YES	9	AUV Mission_55_20230404_1 has data here

Table 5 - AUV mission and associated CTD sites. Note that additional information is available about AUV dives in Appendix 2

Date Ended	Area	Pno	VLno overlaps	ctdIDno	AUV missionNo	Comment
1.04	UtsiraKB	AUV_2023_Utsira_1a	VL3216, VL3217	253	Mission_55_20230401_6	ctd ON 31.03, auv 01.04, 1.5hrs data on 5.5hrs dive - 30m offset, low ping rate, blurry photos
3.04	NJS1	AUV_2023_NSJ_2a	VL3284, VL3282	254 (at R3201)	Mission_55_20230403_1	full dataset quality good, MBE pingrate too slow
4.04	NJS1	AUV_2023_NSJ_3c	VL3306, VL3303	255 (at R3211), 256	Mission_55_20230404_6	full dataset quality good, MBE pingrate still too slow despite attempted change
4.04	NJS1	AUV_2023_NSJ_4a	VL3294, VL3293, VL3302, VL3304	257 (at R3225), 258 (at R3228)	Mission_55_20230405_3	full dataset quality good, MBE pingrate still too slow (but good on internal trigger)
10.04	Stavanger Fjords	AUV_stav_PlanA	n/a	259	n/a	too much fishing gear in the water, dive cancelled
10.04	Stavanger Fjords	AUV_stav_PlanB	VL3370	260	Mission_55_20230410_2	successful until last

7 - Issues

Chimera:

- Had one incident that I will take some blame for as the Chimera bumped into a wreck that I failed to flag as possibly present in advance of the dive: damage to the wire which needs reterminating, with Sindre swapping to the yellow cable as a temporary fix for the rest of the cruise. I will suggest that we build a better routine for dealing with possible wrecks – including having images of the multibeam at that spot that at least can guide where the wreck may occur in relation to distance along the video line. This procedure was adopted afterwards for all subsequent possible wrecks. Encountering wrecks is not normal for Mareano, which is used to working in the Norwegian Sea and Barents Sea, with new operations in the North Sea these encounters are likely to increase, so this is a good time to build procedures.
- Many faults from earth faults to pan and tilt issues to black outs. Sindre has worked very hard to keep the Chimera going and it worked out fine in the end but it is a good idea to ensure we have Chimera instrument cover for 24hrs even on AUV cruises in the future.
- We have had a request from the winch operators to upgrade the pilot cameras into a good quality forward facing camera and another downward facing camera to better monitor distance from bottom/objects passing underneath (e.g. wrecks). The existing pilot camera could be moved into the downward facing position requiring only the purchase of the better quality forward facing camera. Both should have a wide field of view.

AUV:

- The buoyancy is very hard to get right but once you do there is a good chance it will dive as planned. Any time the Munin+ fails to dive is most likely a need to fine tune the buoyancy. This is a design fault of the Munin+ which is particularly unhelpful when coupled with the 5min dive rule and restart procedure (see below). Leif is now setting up a buoyancy guide that responds to the density recorded by the CTD they need for the SVP input before the first dive in an area – this should help speed up the process of optimising the buoyancy but will not guarantee it dives on first try.
- If the vehicle does not dive in the first 5mins of trying it will automatically cancel the mission and not try again. As a result you must remove the vehicle from the water and restart the process (takes ~1hr).
- Restarts are very commonly needed, both from buoyancy issues, but also from minor faults/frequent error messages that require a restart to clear. Each time it takes ~1hr to be ready to dive again (multiple steps must be gone through and then the positional accuracy of the GPS needs to drop below 0.1 which takes the majority of the time - NB driving the ship in figures of eight can speed the GPS calibration up.)
- There seems to have been a connection problem between the vehicle computer (CP) and the NAS bottle (PP) which sometimes results in the vehicle stopping collecting data half way through a dive - this is not acceptable and must be fixed (I believe Leif and Jan Arne are chasing Kongsberg to look into this already)
- There were some issues noted with the MBE data from the AUV and problems with positioning – where overlapping lines in opposite directions have a mismatch in positioning and depth e.g. lines 6 or 7mins long, about 25mins apart with 180 degree turns between crossing the same point and showing 1m drift in position and 10cm drift in depth. This has already been relayed to Kongsberg. More details can be found in Appendix 3.
- It would be beneficial to do more testing with the AUV (not using project money!) to see what equipment and settings cause interference in the data (for example, we have had inconsistent results about using the internal trigger for the MBE - sometimes no sign of noise in the HiSAS, sometimes clear noise, so uncertain if there is something else causing the noise). Investigations could be made into turning on and off the topaz, fish echosounders etc from the ship while the AUV is in the water to monitor the effects (especially if there are distinctive patterns suggesting one particular piece of equipment is interfering). This would be useful to ensure appropriate routines are set up for switching things off/selecting appropriate settings when working in the same area as the AUV.
- Generally, a great improvement on Mareano's initial testing cruise in June 2022 (2022106), and huge thanks to the AUV team (Leif Johan, Eyvind, Lene, Kyrre) who worked very hard to minimise these issues – it is clear that there

are many limitations to the vehicle that they cannot work around and we all just have to wait for!

Appendix 1 - Day by Day Overview

30.03.2023 12.00 – 31.03. 2023 10.00 Bergen, Utsira

- all boarded ok by 12.00, security round at 13.00, ship leaving at 14.00 with waving committee, science meeting at 14.30
- smooth sailing south to Utsira (wind too strong at NSJ-1/2), aimed for P114 but amended to P42 as chimera was not ready to go upon arrival.
- P42: **R3188 took Boxcorer 2, Multicorer 5**
- P42 Chimera video rig test – all ok
- P42: **R3188 VL3269** video line
- P114: **R3189 VL 3270** video line
- Attempt P51 video line but Chimera has an earthing fault – wake Sindre to check, he stays up for 1hr, but cannot fix quickly.
- Start transit to AUV station (right beside previous R31357VL3217, outside of 12nm border) for arrival at 08.00 & AUV shift
- Meeting with captain & AUV team to go over protocol
- AUV in the water for buoyancy testing – all ok
- Some fails reported on AUV when on deck – need a little time for checks
- No issues seasickness reported

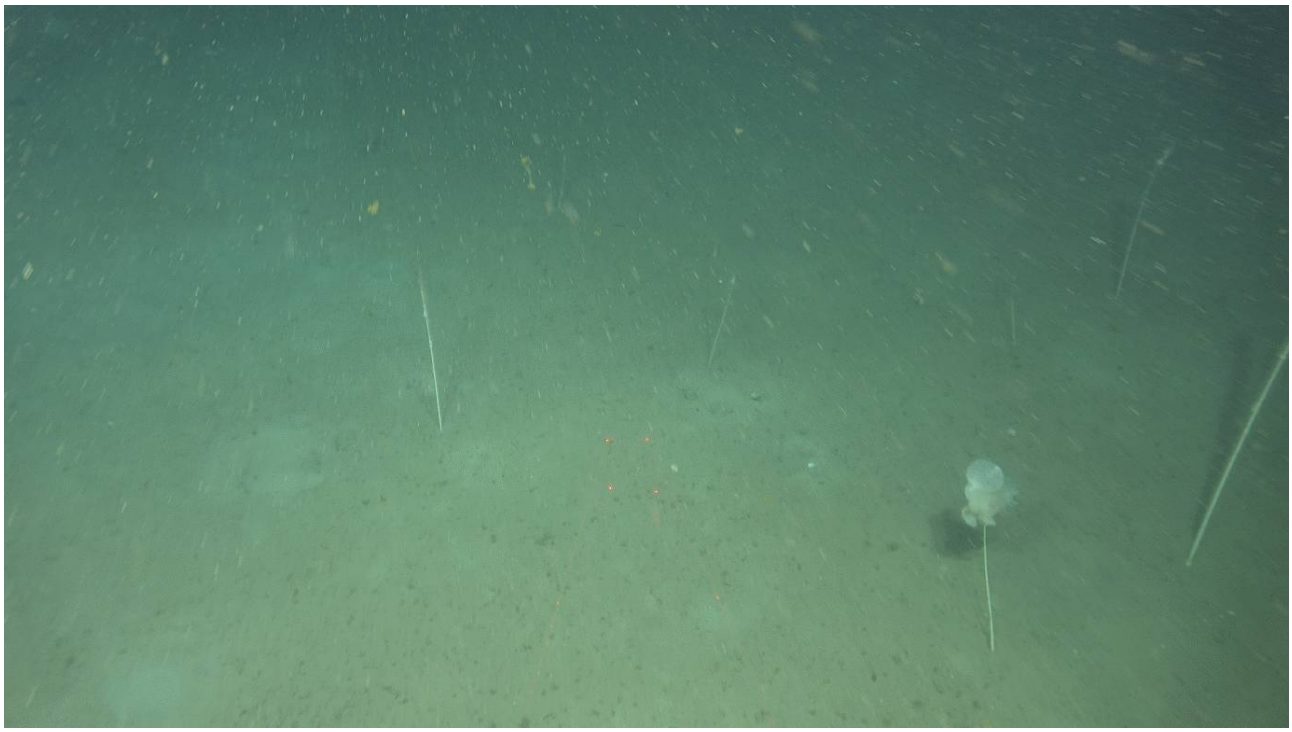


Figure 6 Funiculina quadrangularis garden with predatory actiniarian Ptychodactis patula R3188 VL3269

31.03.2023 10.00 – 01.04.2023 08.00 Utsira

- AUV GPS calibrated and CTD (#**253**) taken - NOTE AUV and CTD linked to AUV have been logged with R stations – this is not appropriate, but toktlogger is limited in how it can cope with this (needs a number >0 for the

superstation) As a result Kjell says that he will correct them afterwards, but we must remember to reuse that R number at the next station.

- AUV going in the water kl. 12.00 (4hrs set up) for AUV
- Several attempts – AUV will not dive (buoyancy too light, adjustments between)
- New shorter dive plan made (1.5hrs)
- Attempt to dive kl. 15.15 – lost radio contact while at the surface, automatic wait time of 15mins, should dive at end of wait period 15.30, no success
- AUV removed from water ~16.00 with AUV testing finished for the day (so that they can consult Kongsberg)
- Started transiting to full station P172 as chimera was still not working, but managed to have it ready for testing again by the time of arrival (~17.00) resulting in a successful VL: **R3190 VL3271**
- Then able to proceed with a series of video stations into the evening: P173 **R3191 VL3272**, P95 **R3192 VL3273,** P174 **R3193 VL3274**, P124 **R3194 VL3275**,
- P181 **R3195 VL3276** I failed to warn of the shipwreck (although this was marked on the map), VL started and they spotted debris and slowed until debris stopped and they sped up again with the Chimera bumping into the wreck.
- Chimera cable and a couple of connections damaged. Sindre working to re-terminate with the yellow cable.
- Transited to full station P165 **R3196** and took boxcore (for Stepan) and multicore before departing to head for the AUV site for arrival at 09.00.
- Kongsberg did not give a good explanation for the issues yesterday (suggested some possible causes that the team disagree with), but AUV restart looks good.

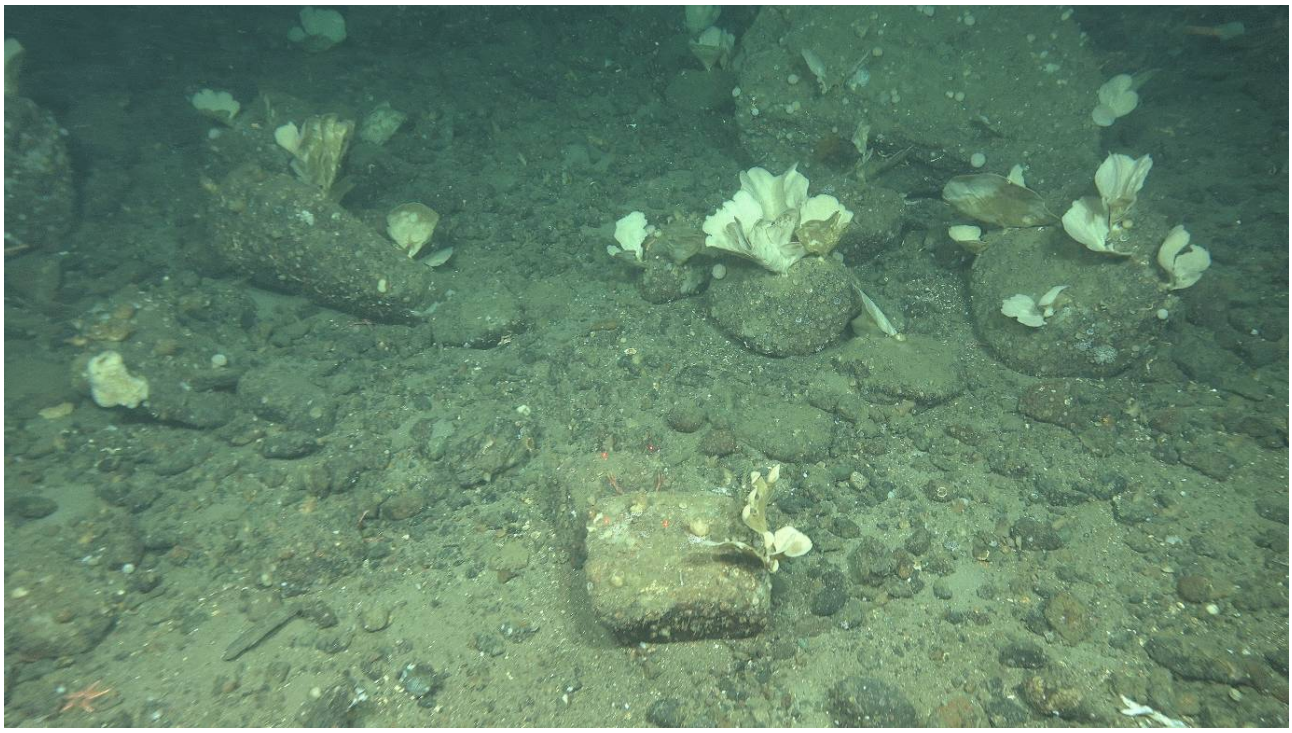


Figure 7 Hard bottom sponge garden at R3193 VL3274

01.04.2023 08.00 – 02.04.2023 08.00 Utsira, transit to NSJ-1

- AUV went in the water but again would not dive beneath the surface. Recovered to deck to adjust weight in nose, but encountered new issues with communications, and then the rope release system on the stinger.
- Chimera fixing and deck testing completed, then wet test at the AUV station down to 30m - all seems fixed and

ready to use.

- AUV_2023_utsira_1a (Dive 1, **Missions_55_20230401_6**) successful dive, pinged with ship then left to do video station.
- AUV sent satellite message that should only happen if at surface but time attached was 2hrs earlier – returned to check on it (30min diversion), but was fine and still on bottom so left to go to video station again.
- Went to P111 **R3197 VL3277**, successful video dive with hard bottom sponge garden
- Return to pick up AUV – some error messages reported upon arrival – data only collected in first 1.5hrs of 5hr dive, photos taken after all other sensors switched off – all blurry. Hoping focus is linked to lack of altimetry input. Sending reports to Kongsberg for explanation.
- Transit to evening video stations: P108 **R3198 VL3277**, P99 **R3199 VL3279** –had issues with pan and tilt wandering or freezing at both stations.
- P166 ran topaz but Chimera now not functioning at all ~kl.01:00
- P67 **R3200** took Boxcorer 4 and Multicorer 7
- ~Kl. 02:30 begin transit to NSJ-1 (13hrs).

Figure 8 A pandalid shrimp sitting on an Axinellid sponge on R3197 VL3277

02.04.2023 kl.08.00 – 03.04.2023 kl.08.00 Transit from Utsira, NSJ-1

- Chimera reported as working again at kl. 12.45
- Arrive 13.00 at NSJ-1 P548 to launch AUV (needed to take CTD (#**254**) then drive in figure of 8 to improve AUV navigational accuracy) but AUV had a communications issue kl.14.00 before launch.
- Take Video **R3201 VL3280** while AUV restarting (needs ~1hr to reset)
- Try again to launch AUV – would not dive and too late to try again today
- Collect AUV then proceed to GC1 (1hr away)
- Drive from G1 to G2, then GC3, then GC4 with topaz on
- Drive from GC4 to GC3, then GC2, then GC1 with watercolumn MBE on

- Take grab at GC1 to check suitability for gravity core (gave R station as may return next year)– no good, and rest of points were ruled out too (needs vibrocorer as is too sandy)
- Head over to do videos overnight: P569 **R3203 VL3281**, P570 **R3204 VL3282**, P588 **R3205 VL3283**, P564 **R3206 VL3284**, P580 **R3207 VL3285**, P547 **R3208 VL3286**, P566 **R3209 VL3287**, P587 **R3210 VL3288**

Figure 9 A Modiolus modiolus bed as seen on R3203 VL3281

03.04.2023 kl. 08.00 – 04.04.2023 NSJ-1 kl.08.00 NSJ-1

- Transit to AUV station near P546 arriving ~kl.09.00
- Deploy AUV which dives first time, receive some errors likely relating to difficulties with acoustic contact in shallow (57m) water, but occasional updates in the first 10mins were enough to reassure.
- Do videos while AUV is in the water: P546 **R3211 VL3289**, P579 **R3212 VL3290**, P563 **R3213 VL3291**, P577/GC5 **R3214 VL3292** (NB P577 we agreed to move but had enough time for one more before AUV pick up and not enough time to go somewhere else)
- Pick up AUV kl. 15.30 (near P570/R3204) – required MOB boat as AUV had not “popped its nose” (which releases the recovery rope)
- AUV dive was successful and collected 1.2TB in 5.5hrs (Dive 2, AUV_2023_NSJ_2a, **Missions_55_20230403_1)**.
- Transit for 1.5hrs to first video stations for the night: P584 **R3215 VL3293**, P577 (the one near the noise point/ P584) **R3216 VL3294**, P562 **R3217 VL3295**, P575A/NW **R3218 VL3296**, P589 **R3219 VL3297**, P576 **R3220 VL3298**, P551 **R3221 VL3299**
- Continued to P582 **R3222 VL3300** (a wreck site) and recorded still section of VL but the tilt broke on Chimera and was stuck pointing straight down (stayed for 2hrs to try to fix – the nearest full station was 2hrs away and it would be 2hrs back to the AUV site which we needed to be at within 4hrs).
- Left without having Chimera fixed and headed to the AUV site for arrival kl.08.00

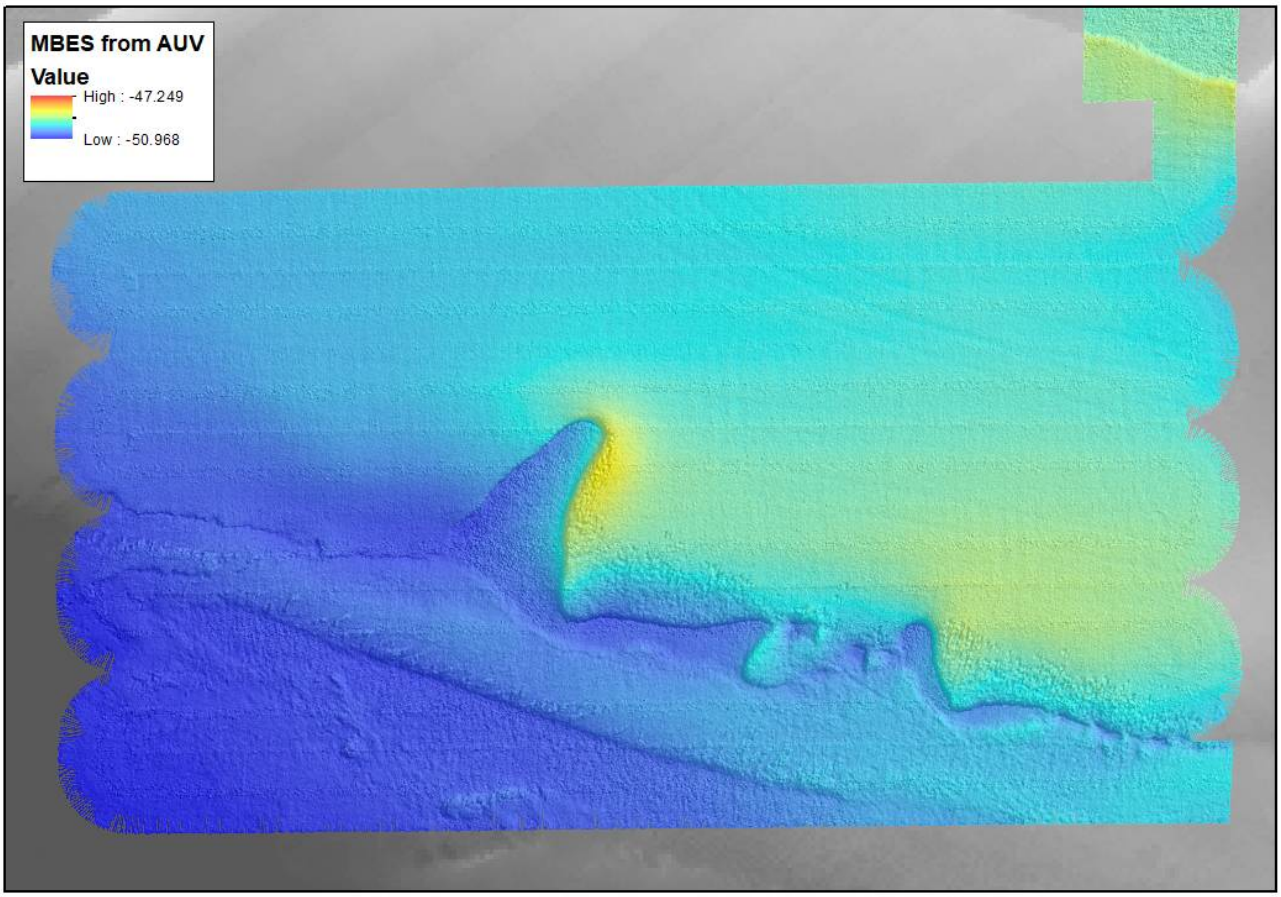


Figure 10 Image of multibeam bathymetry collected by AUV Missions_55_20230403_1 over a 1m high bedforms

04.04.2023 kl. 08.00 – 05.04.2023 NSJ-1 kl.08.00 NSJ-1

- CTD (#**256**) taken
- AUV required restart (1hr delay) so transited to GC5B and drove Multibeam watercolumn line over GC5B and GC5A then back again with topaz – looks hard and not suitable for a gravity corer.
- Returned to AUV launch location and tried to launch again – AUV failed to dive again, so needed 1hr for restart. Chimera still not operational and no physical samples needed in immediate area (nearest is 1hr drive away). Stayed in position to await AUV restart/ Chimera to be fixed.
- Launched AUV again, again failed to dive, so moved to GC5B during 1hr restart for a Grab (**R3223 Grab9**) – Chemistry, Geology, UiB rest sample.
- Flipped AUV dive to start from same location: removed nearly all air from AUV and successfully dived down so was left to continue mission
- Transit to P547 (**R3208**) for 5x grab samples (grab was on the wire so we took that first includes 1 failed **#10-15**), 1x boxcorer (**#5**)
- Transit to pick up AUV – successful dive (AUV_2023_NSJ_3c, **Missison_55_20230404_6**)
- Chimera still out of service so transit to full station 3hours away P543 (**R3224)** and take boxcorer for chemistry (**#6-7**), multicorer **(#8**), grab x 5 **(#16-21**)**.**
- Sindre worked on Chimera all night – no activity during this time
- Decided to move to the AUV launch position

Figure 11 Launching the grab as seen from the back of the hanger

05.04.2023 kl. 08.00 – 06.04.2023 NSJ-1 kl.08.00 NSJ-1

- Chimera ready for testing 1hr before the AUV, so designed an “extra” station alongside AUV launch site (~500m away) to test Chimera in the water over a useful target - success: **R3225 VL3301**
- Took CTD (**#257**) at same site for AUV benefit – only 500m from AUV launch site
- At AUV launch site, AUV needed 2 restarts on deck, dropped one more weight into the water (unpredictably) while one end is hanging over the side to get GPS signal – ship drove in figure of eight to improve GPS accuracy asap.
- Launched AUV which dove first attempt – permitted to leave by AUV team.
- Took one video: P560, **R3226 VL3302** – NB due to (my) planning error we were at this site with the Chimera at the same time as the AUV (close call!), although the AUV was on the HiSAS line 70m away from the Chimera. I was warned by the AUV team 15mins in advance, but was given permission by them to continue after dive plan inspection showed it would be >50m away doing HiSAS coverage of the video line. They appreciated the HiPAP signal contact, but I will make efforts to avoid this happening again (!). Therefore we may see the Chimera on the HiSAS at this site.
- Jossan started a påskekrim game onboard: pull a name from a pot (all ships crew included) – that person you have to “kill” by being alone with them in a room when they are not doing a work task/at their normal work station, you then collect their target name(s) and are told who is next to “kill”. Winner announced on Saturday (person with the most names) – good way to build morale and get to know the crew.
- Had list of several more videos to achieve while AUV was in the water but before starting recording at the second site (P552), the chimera had an earthing fault (jordfeil) before start rec. and was brought back on deck (kl.13.30)

- Ship electricians and instrument worked to fix it and succeeded but not before we had to leave the site
- Moved to P550 to take a CTD (**#258**) for AUV MBES corrections (located at the far end of the AUV dive)
- Returned to the AUV start position for AUV pick up kl. 16.15 – successful pick up **Mission_55_20230405_3**
- Transit back to P550 to start video lines for rest of the night: P550 **R3228 VL3304**, P578 **R3229 VL3305**, P552 (where jordfeil happened earlier, reused numbers as no rec taken) **R3227 VL3303,** P586 **R3230 VL3306**, P582 **R3222 VL3307** (wreck site were previous chimera feil had occurred – second VL at that site, previous was only still section), P561 **R3231 VL3308**, P575B **R3232 VL3309**, P568 **R3233 VL3310**, P581 **R3234 VL3311**, P549 **R3235 VL3312**

Figure 12 Inspecting HiSAS data from an earlier dive (clockwise from back: Tor Jan Meek, Terje Thorsnes, Kyrre Heldal Kartveit, and Shyam Chand)

06.04.2023 kl. 08.00 – 07.04.2023 NSJ-1 kl.08.00 NSJ-1, NSJ-2

- Windier today – no AUV dive as a result
- Continue video lines all day finishing NSJ1 ~02.00: P573 **R3236 VL3313**, P571 **R3237 VL3314**, P553 **R3238 VL3315**, P572 **R3239 VL3316**, P574 **R3240 VL3317**, P557 **R3241 VL3318**, P558 **R3242 VL3319**, P559 **R3243 VL3320**, P554 **R3244 VL3321**, P545 **R3245 VL3322,** P543 **R3246 VL3323**, P544 **R3247 VL3324**, P590 **R3248 VL3325**.
- Transit to NSJ2 and continue with video lines: P567 **R3249 VL3326**, P555 **R3250 VL3327**, P556 **R3251 VL3328**, P542 **R3252 VL3329**

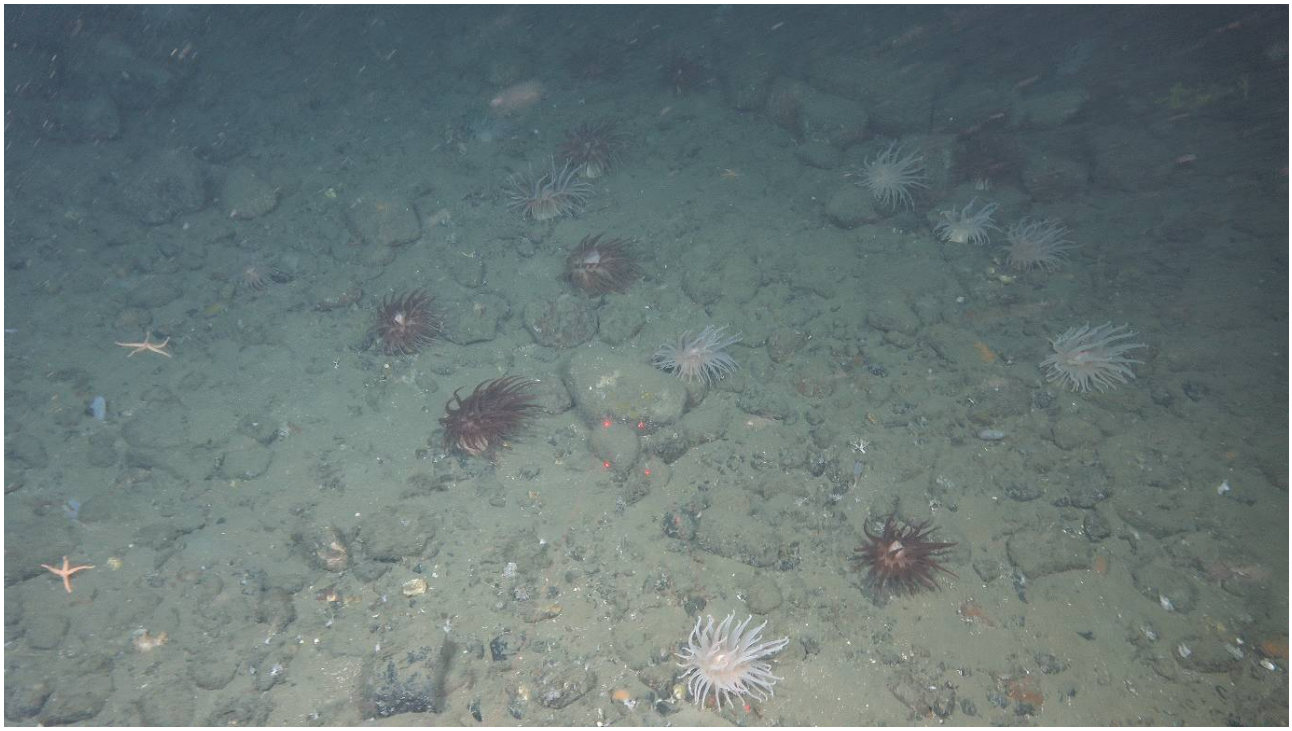


Figure 13 Two colours of Bolocera anemones on a rocky sea floor at R3236 VL3313

07.04.2023 kl. 08.00 – 08.04.2023 NSJ-1 kl.08.00 NSJ-2, Utsira

- Continue video lines, finishing NSJ2 kl.~15.00: P583 **R3252 VL3330**, P565 **R3253 VL33**31, P585 **R3254 VL3332**
- Weather still too rough to make detour for AUV at Modiolus bed, so begin transit to Utsira (arrival kl.01.00)
- Begin video stations – includes some sponge gardens (hard bottom Axinellid/ Oceanapia), an *Isidella* bed, and one unexpected shipwreck (possible U-boat): P118 **R3255 VL3333**, P128 **R3256 VL3334**, P41 **R3257 VL3335**, P158 **R3258 VL3336** (wreck).
- One station skipped as a large tanker ship was sitting on the spot (targeted station P157)

Figure 14 The team in the video room logging a video line crossing a wreck

08.04.2023 kl. 08.00 – 09.04.2023 NSJ-1 kl.08.00 Utsira

- continue with video stations: P115 **R3259 VL3337**, P159 **R3260 VL3338**, P50 **R3261 VL3339**
- participate in practice with search and rescue helicopter for 20mins.
- back to video stations (many hard bottom sponge grounds and *Oceanapia* gardens): P53 **R3262 VL3340,** P44 **R3263 VL3341,** P119 **R3264 VL3342,** P48 **R3265 VL3343,** P116 **R3266 VL3344,** P133 **R3267 VL3345,** P117 **R3268 VL3346,** P129 **R3269 VL3347,** P127 **R3270 VL3348,** P45 **R3271 VL3349,** P131 **R3272 VL3350,** P120 **R3273 VL3351,** P54 **R3274 VL3352,** P126 **R3275 VL3353**
- (Markus from the crew won the påskekrim game, with 20 kills!)

Figure 15 Quick 20min break to help Search and Rescue do a helicopter rescue practice

09.04.2023 kl. 08.00 – 10.04.2023 NSJ-1 kl.08.00 Utsira

- continue video lines throughout the day, doing a circle outside of Stavanger fjords knowing that we will have to go in around 04.00 (the weather is worsening and the bridge wants 4hrs to drive to the declassified AUV site): P126 **R3275 VL3353**, P122 **R3276 VL3354**, P63 **R3277 VL3355**, P47 **R3278 VL3356**, P125 **R3279 VL3357**, P160 **R3280 VL3358**, P67 **R3200 VL3359**, P166 **R3281 VL3360**, P165 **R3196 VL3361**, P46 **R3282 VL3362**, P43 **R3283 VL3363**, P164 **R3284 VL3364**, P123 **R3285 VL3365**, P52 **R3286 VL3366**, P163 **R3287 VL3367**
- **Planned 13 possible video lines in the fjords near AUV areas as plans for when AUV is in the water/ during AUV restarts**
- drive in towards the Plan A AUV area for arrival by 08.00

Figure 16 A Stryphnus sponge covered in a yellow Hexadella sponge and associated epifauna, while sea pens and sea cucumbers sit in the background R3284 VL3364

10.04.2023 kl. 08.00 – 11.04.2023 NSJ-1 kl.08.00 Horgefjorden, Fognafjorden

- Took CTD (#259) by AUV Plan A area (Horgefjorden) while adjusting AUV buoyancy in the water
- Instructed to take a video line while doing and AUV restart, however whilst manoeuvring into position several floats marking fishing gear were spotted in the area – decided this was both dangerous for the Chimera and for the AUV as there is no information on extent or type of fishing and adjustments to the dive would be difficult/considerable and result in a much more unproductive dive given the positioning of the fishing floats: moved to Plan B area (Fognafjorden)
- Took CTD (#260) to check for differences relating to the Plan A area
- Launch AUV at Plan B area, successfully dove below the surface with a couple of seconds to spare, likely assisted by the wake of a passing hurtigbåt.
- Aimed to do two planned VLs in the NE of the Plan B area, but fund a fishing gear float between them so had to replan
- Planned 2 more VL in the middle of the AUV area (top of hill, AUV working around the bottom (FJ14, FJ15)
- Did Chimera VL FJ14 **R3288 VL3368** included stop to pass lost fishing gear
- Picked up AUV: **Mission_55_20230410_2**
- Did second planned Chimera VL while waiting for improvements in weather FJ15 **R3289 VL3369**
- Planned and did a third Chimera VL while waiting FJ16 **R3290 VL3370** – this one is 350m long to give the same line as the photo lines from the AUV for comparison. It is split into ab (normal Mareano sample ~225m) and c (the remainder) recordings. Again pause due to lost fishing gear.
- Lene reported the lost fishing gear that we encountered on FJ14 and FJ16 (later examination of the AUV data shows this is one net spanning 450m in length)
- Decided at dinner to stop adding extra video lines and now await a weather window – plan for possible departure at 20.00 but delayed until kl. 00.00
- Transit to P130 to resume Mareano stations en route back towards Bergen starting kl.04.00 when conditions were

finally good enough: P130 **R3291 VL3371**, P161 **R3292 VL3372**, P162 **R3293 VL3373**

11.04.2023 kl. 08.00 – 12.04.2023 NSJ-1 kl.12.00 Utsira, Bergen

- Began packing away sampling equipment through the day
- Continue with the final video lines throughout the day, ending at around 23.00: P49 **R3294 VL3374**, P171 **R3295 VL3375**, P106 **R3296 VL3376**, P176 **R3297 VL3377**, P132 **R3298 VL3378**, P121 **R3299 VL3379**, P51 **R3300 VL3380**, P110 **R3301 VL3381**.
- Begin transit to Bergen arriving ~06.00
- Demobilisation until ~15.00

Appendix 2 - AUV Dive Plans

Here are the dive plans for any AUV missions that collected data - not all were completed according to plan, but these are the plans that the AUV was asked to complete (sometimes internal errors resulted in data stopping being collected after e.g. a couple of hours but the AUV still followed the full route and reappeared where it was expected to).

Naming of Dives

Auv dives are assigned a name in the format:

Mission_<vehicle number>_<date: yyyymmdd>_<dive/restart number that day>

These are the completed dives from this cruise together with their planning name. The planning names generally used a format:

<Dive number when transferred to AUV computer for checks> <Area>_SubAreaNumber><letter denoting new iterations of that dive plan>

	Mission Name	Planning Name	Area
1	Mission_55_20230401_6	Dive 1 Utsira_1a	Utsira
2	Mission_55_20230403_1	Dive 3 NSJ1_2a	NSJ-1
3	Mission_55_20230404_1	Dive 4 NSJ1_3c	NSJ-1
4	Mission_55_20230405_3	Dive 6 NSJ1_4a	NSJ-1
5	Mission_55_20230410_2	Dive8Alt Stav_b	Fognafjorden

Maps of AUV dive locations

The following overview maps show where the AUV dives took place. Dive plans follow in the next section and use both the mission number name (which is indicated in these maps) and the planning name for better orientation.

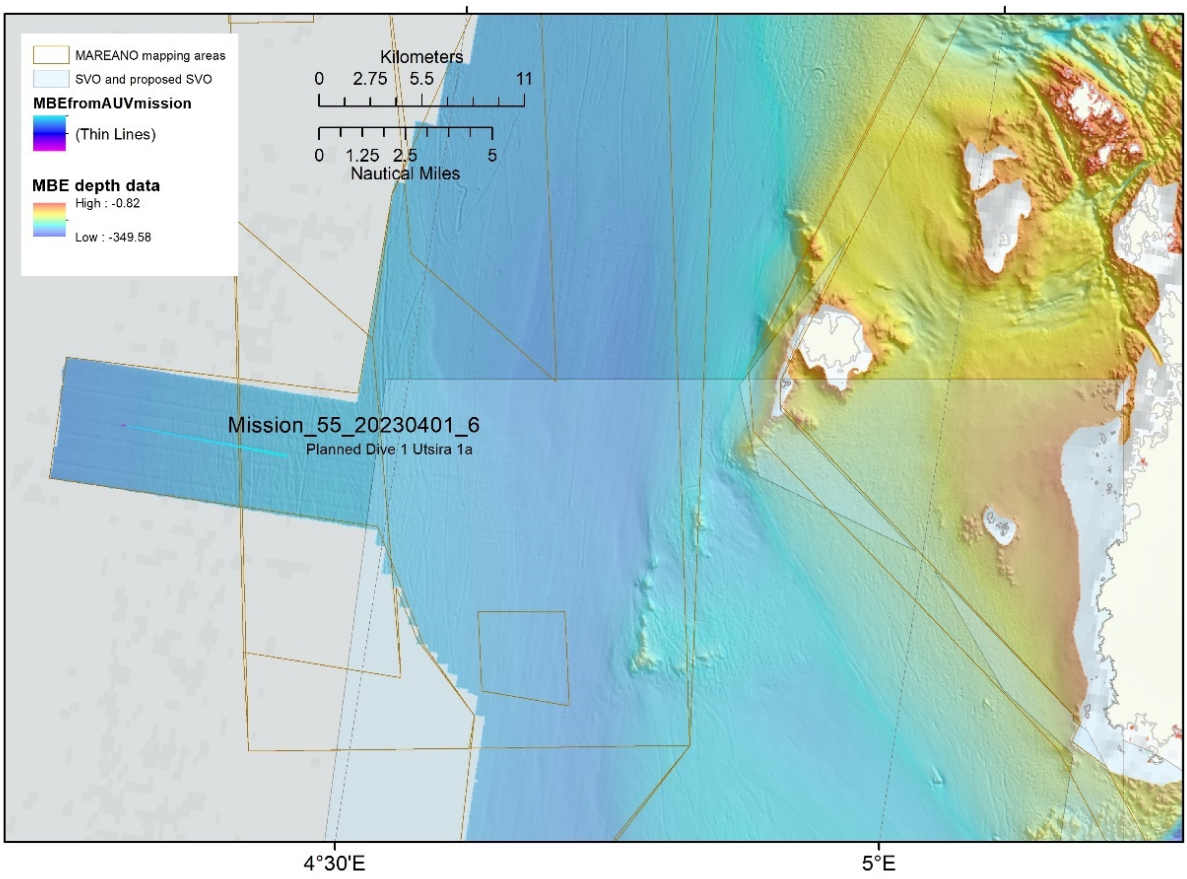


Figure 17 Location of 1st AUV dive (Mission_55_20230401_6) in Utsira area (enters Utsira North Havvind area and outside to the west. The whole dive is outside of 12nm to avoid classification of the seabed issues (FOH did not grant our applications to operate within 12nm in time).

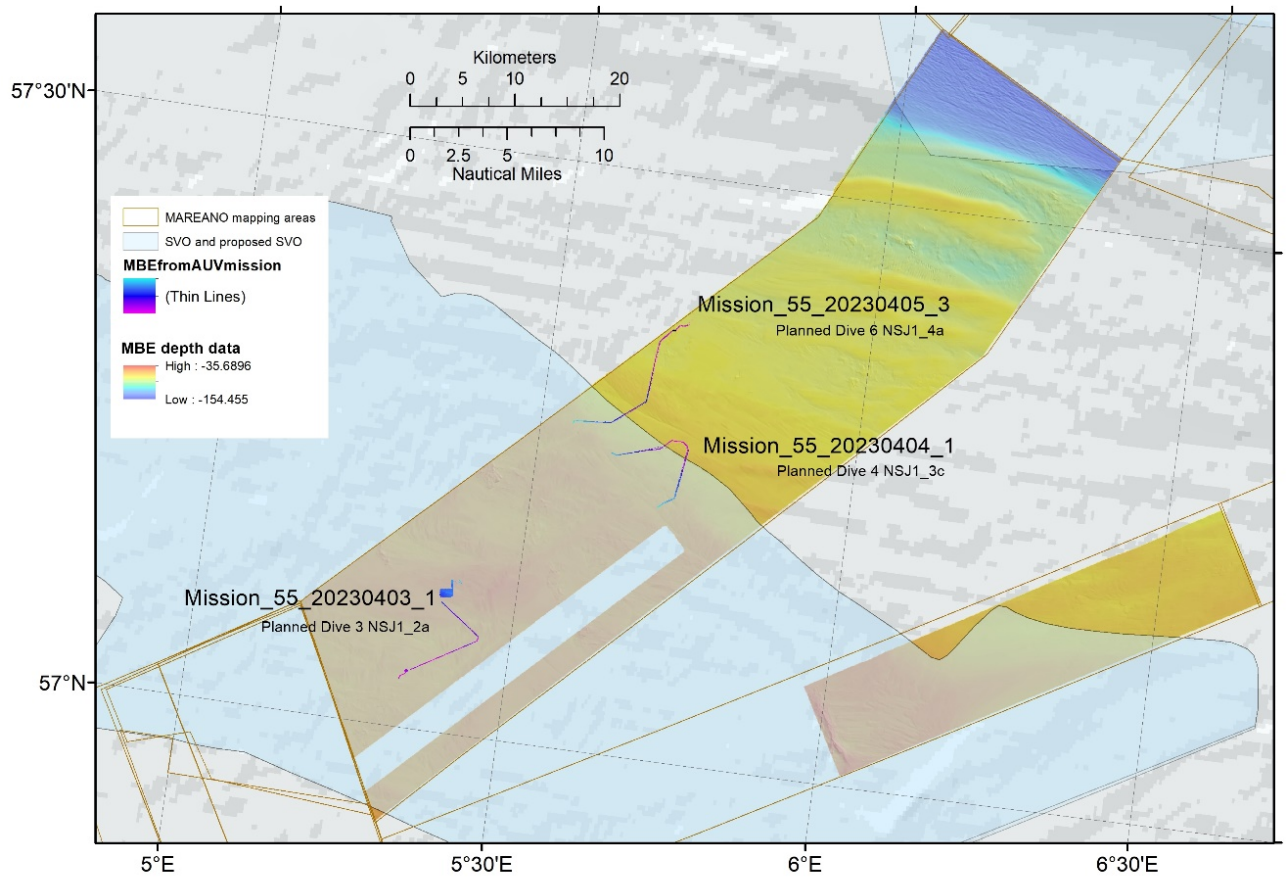


Figure 18 The locations of the 2nd, 3rd, and 4th AUV dives (Mission_55_20230403_1, Mission_55_20230404_1, Mission_55_20230405_3) in the NSJ-1 area

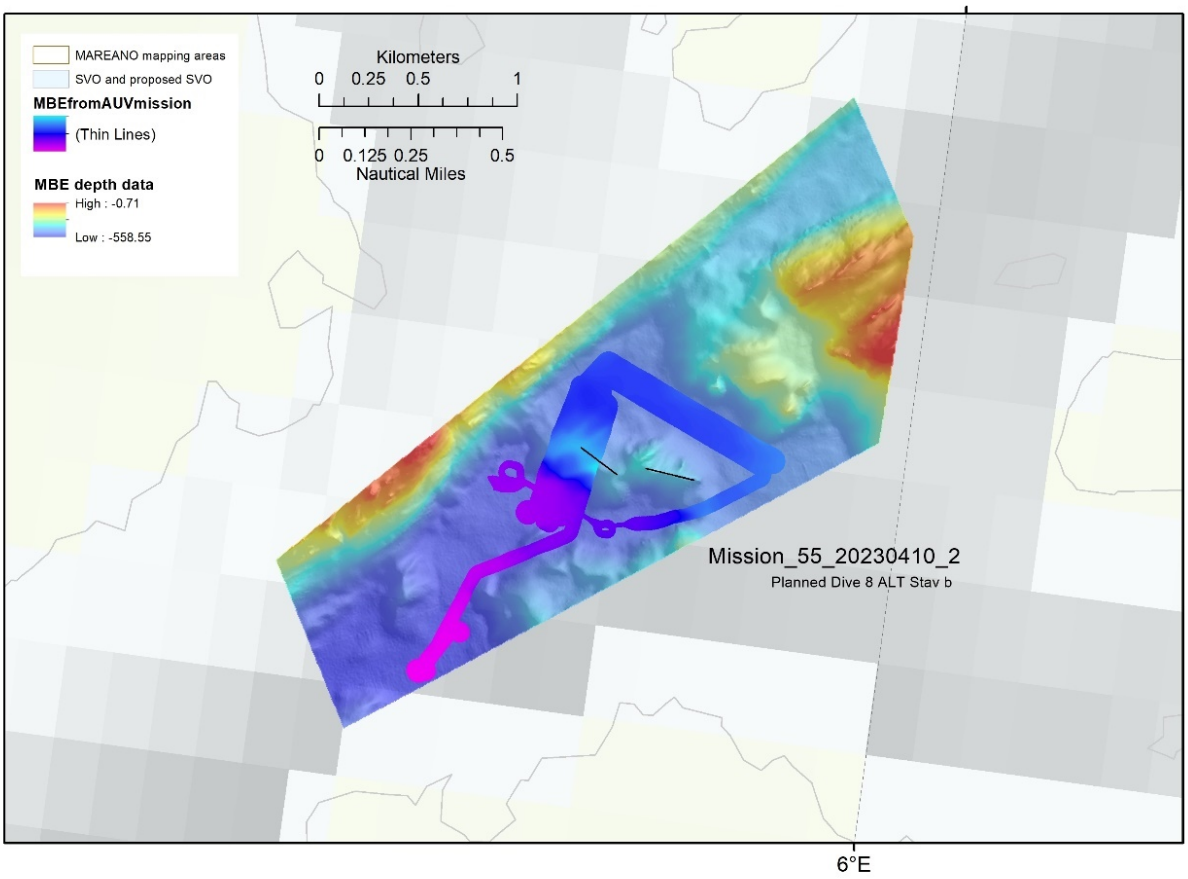


Figure 19 The location of the 5th AUV dive (Mission_55_20230410_2) in Fognafjorden where FOH granted our applicaiton to declssify the seabed and operate within the marked area

AUV dive plans from Hugin OS

It is beneficial to have an overview of what the AUV dive plan was, and how the data was labelled, what was tested, etc. This section is included to help try and discern more of what the collected data holds.

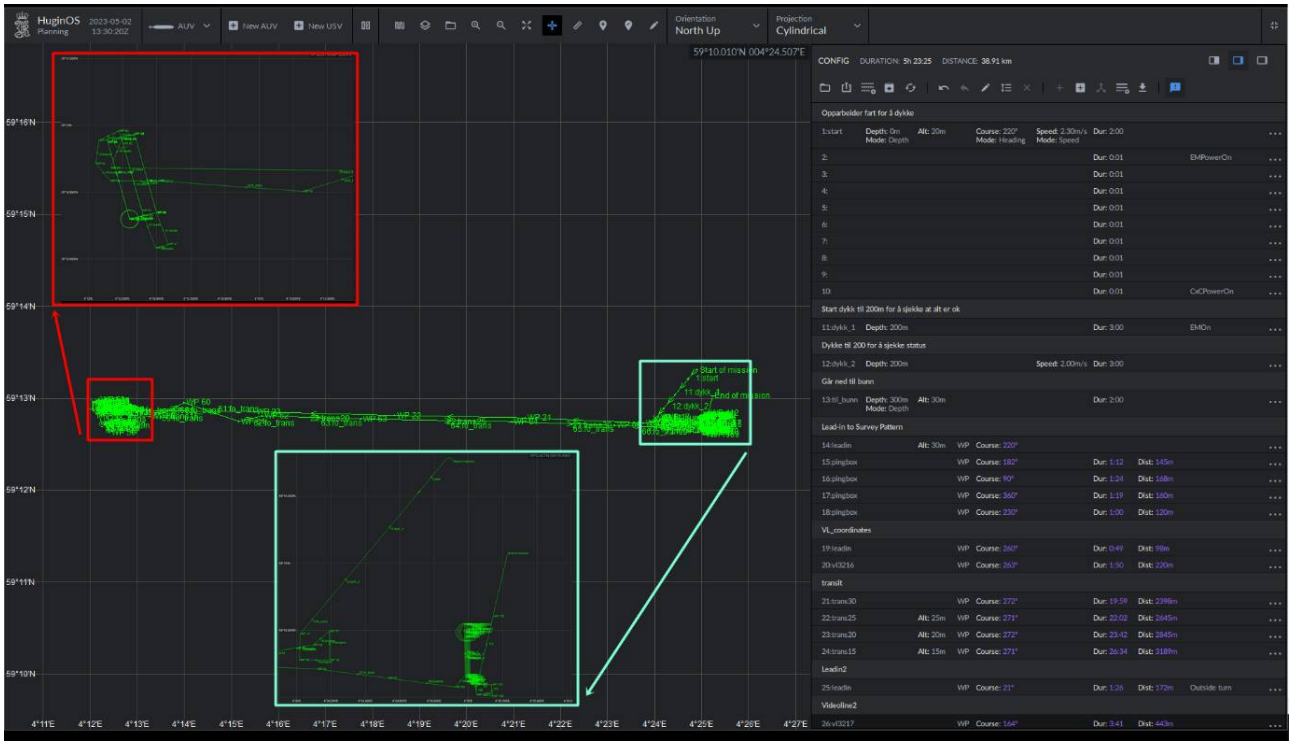
In each section there is:

- An overview image from the Hugin OS view of that dive (possibly with a couple of zooms if it helps),
- A very brief text of what happened on the dive.
    - This is all acoustic data unless photo data are specifically mentioned.
    - Photolines usually are done at 3 or 4m height and any turns with steep angles must be done at 7m height as the vehicle dips when turning and we want to avoid emergency ascent measures.
    - HiSAS lines along video lines are offset to the side of the video line so that the video line runs through the HiSAS portion of the data (usually planned to be ~70m away from the video line), photo lines will follow the Video Line as preceisely as possible and are not offset from the video line.
- A copy of the text file that forms the whole of the mission plan that is loaded into Hugin OS. This can be copied to a text file, saved with a .mp file extension, and loaded into Hugin OS in order to explore the dive in more detail.

1.9.3.1 - 1st Dive - Mission_55_20230401_6 (Planning Dive 1 Utsira_1a)

Hugin OS overview

(Planned for) 5hrs 23mins, 38.91 km (have data from roughly the first third of this)



Text summary

Dive to bottom, do a pingbox (i.e. a chance for the ship to sit in middle and send a message with updated positioning to the AUV as AUV circles below, staying close to the ship – increases chance of succeeding with message sending).

Drive along VL3216 (acoustic data only at 30m height), transit west stepping down through different heights (30m, 25m, 20m, 15m), drive along VL3217 at 15m height.

(AFTER ROUGHLY THIS POINT, DATA WAS NOT COLLECTED DUE TO A FAULT ON THE VEHICLE DURING THE DIVE)

Do a hiSAS comparison box at different heights over the same piece of seafloor (15m, 20m, 25m, 30m, 35m), do photo collection along VL3217 (west to east at 3m height), do photo transect back from west to east along the full length of dive in the HiSAS data, pass the pingbox doing photos, do a photo patch at 4m height (mow the lawn style) over an iceberg ploughmark feature, pingbox again, before ascent.

HuginOS mission plan

MP13

#

Kongsberg Maritime AUV Mission Plan

Saved 2023-04-01 16:23:44 by hugin

#

#:Tag Depth Alt DMo Latitude Longitude Course GMo Speed SMo Dur Dist Flags

#

Opparbeider fart for å dykke

:start 0.0 20.0 D - - 220.0 H 2.30 S 120 - ETPowerOn

: = = = - - = = = = 1 - EMPowerOn

: = = = - - = = = = 1 - SASPowerOn

: = = = - - = = = = 1 - SASHighPower

: = = = - - = = = = 1 - SASMode1

: = = = - - = = = = 1 -

: = = = - - = = = = 1 - DistTrigger

: = = = - - = = = = 1 - EM400Ext

: = = = - - = = = = 1 - ETOn

: = = = - - = = = = 1 - CxCPowerOn

Start dykk til 200m for å sjekke at alt er ok

:dykk_1 200.0 = = - - = = = = 180 - EMOn

Dykke til 200 for å sjekke status

:dykk_2 200.0 = = - - = = 2.00 = 180 -

Går ned til bunn

:til_bunn 300.0 30.0 T - - = = = = 120 - SASOn

Lead-in to Survey Pattern

:leadin = 30.0 = 59:12.7899N 004:24.0201E (220) = = = - - Auto

:pingbox = = = 59:12.7118N 004:24.0153E (182) = = = (72) (145)

:pingbox = = = 59:12.7117N 004:24.1918E (090) = = = (84) (168)

:pingbox = = = 59:12.7978N 004:24.1909E (360) = = = (79) (160)

:pingbox = = = 59:12.7564N 004:24.0937E (230) = = = (60) (120)

VL_coordinates

:leadin = = = 59:12.7470N 004:23.9922E (260) = = = (49) (98)

:vl3216 = = = 59:12.7319N 004:23.7626E (263) = = = (110) (220)

transit

:trans30 = = = 59:12.7877N 004:21.2457E (272) = = = (1199) (2398)

:trans25 = 25.0 = 59:12.8134N 004:18.4682E (271) = = = (1322) (2645)

:trans20 = 20.0 = 59:12.8541N 004:15.4809E (272) = = = (1422) (2845)

:trans15 = 15.0 = 59:12.8727N 004:12.1311E (271) = = = (1594) (3189)

Leadin2

:leadin = = = 59:12.9593N 004:12.1960E (021) = = = (86) (172) OutsideTurn

Videoline2

:vl3217 = = = 59:12.7296N 004:12.3224E (164) = = = (221) (443)

:leadin = = = 59:12.7194N 004:12.2421E (256) = = = (39) (79) OutsideTurn

HiSAS_comp

:sq_hi15 = = = 59:12.9497N 004:12.1148E (344) = = = (222) (444)

:leadin = = = 59:12.9750N 004:12.2703E (072) = = = (77) (155)

:sq_hi15 = = = 59:12.7390N 004:12.3998E (164) = = = (227) (455)

:leadin = 20.0 = 59:12.7192N 004:12.2421E (256) = = = (77) (155) OutsideTurn

:sq_hi20 = = = 59:12.9501N 004:12.1150E (344) = = = (222) (445)

:leadin = = = 59:12.9749N 004:12.2700E (073) = = = (77) (155)

:sq_hi20 = = = 59:12.7390N 004:12.3994E (164) = = = (227) (455)

:leadin = 25.0 = 59:12.7191N 004:12.2432E (256) = = = (76) (153) OutsideTurn

:sq_hi25 = = = 59:12.9500N 004:12.1150E (344) = = = (222) (446)

:leadin = = = 59:12.9750N 004:12.2700E (073) = = = (77) (155)

:sq_hi25 = = = 59:12.7392N 004:12.3994E (164) = = = (227) (455)

:leadin = 30.0 = 59:12.7201N 004:12.2417E (257) = = = (77) (154) OutsideTurn

:sq_hi30 = = = 59:12.9500N 004:12.1148E (344) = = = (221) (444)

:leadin = = = 59:12.9750N 004:12.2700E (073) = = = (77) (155)

:sq_hi30 = = = 59:12.7389N 004:12.3993E (164) = = = (227) (455)

:leadin = 35.0 = 59:12.7201N 004:12.2417E (257) = = = (77) (154) OutsideTurn

:sq_hi35 = = = 59:12.9500N 004:12.1148E (344) = = = (221) (444)

:leadin = = = 59:12.9750N 004:12.2700E (073) = = = (77) (155)

:sq_hi35 = = = 59:12.7389N 004:12.3993E (164) = = = (227) (455)

Videotrans

:leadin = 10.0 = 59:12.6449N 004:12.4673E (160) = = = (93) (186) CxCSOn

Safe distance 2 m

: = = = - - = = = = 1 - SafeDist2

Critical hight 1 m

: = = = - - = = = = 1 - CritHeight1

:leadin = = = 59:12.6330N 004:12.3945E (160) = = = - - SASOff

:leadin = 3.0 = 59:12.7455N 004:12.3126E (340) = = = (111) (223)

:fotovl = = = 59:12.9459N 004:12.2031E (344) = = = (193) (386)

transit_foto

:transit = 10.0 = 59:12.9842N 004:12.1797E (343) = = = (37) (75)

:transit = = = 59:12.9556N 004:12.0629E (244) = = = (61) (123)

:transit = = = 59:12.8859N 004:12.0436E (188) = = = (65) (131)

:leadin = 3.0 = 59:12.8343N 004:12.1298E (139) = = = (63) (126)

:fo_trans = = = 59:12.8324N 004:12.4422E (091) = = = (148) (297)

:fo_trans = = = 59:12.8027N 004:13.2573E (094) = = = (388) (778)

:fo_trans = = = 59:12.8652N 004:13.6515E (073) = = = (196) (393)

:fo_trans = = = 59:12.9532N 004:13.9881E (063) = = = (179) (360)

:fo_trans = = = 59:12.7493N 004:15.1527E (109) = = = (585) (1172)

:fo_trans = = = 59:12.8087N 004:15.6497E (077) = = = (242) (486)

:fo_trans = = = 59:12.7761N 004:17.7406E (092) = = = (995) (1991)

:fo_trans = = = 59:12.7450N 004:20.9580E (091) = = = (1531) (3064)

:fo_trans = = = 59:12.7065N 004:23.1450E (092) = = = (1041) (2083)

:fo_trans = = = 59:12.6847N 004:24.1167E (093) = = = (462) (926)

:fo_trans = = = 59:12.6577N 004:24.5306E (097) = = = (198) (397)

:leadinfo = = = 59:12.6310N 004:24.9221E (098) = = = (188) (376)

Lead-in to Survey Pattern

:leadin = 4.0 = 59:12.6662N 004:24.9816E (041) = = = (43) (86)

:fm_1 = = = 59:12.7812N 004:24.9779E (359) = = = (106) (214)

:turn = 7.0 = 59:12.8175N 004:24.9768E (359) = = = (33) (67)

:turn = = = 59:12.8177N 004:25.0304E (090) = = = (25) (51)

:turn = = = 59:12.7948N 004:25.0307E (180) = = = (21) (43)

:turn = = = 59:12.7943N 004:24.9809E (269) = = = (23) (47) OutsideTurn

:fm_2 = 4.0 = 59:12.6665N 004:24.9859E (179) = = = (118) (237)

:turn = 7.0 = 59:12.6476N 004:24.9862E (180) = = = (17) (35)

:turn = = = 59:12.6478N 004:25.0258E (089) = = = (18) (38)

:turn = = = 59:12.6608N 004:25.0258E (000) = = = (12) (24)

:turn = = = 59:12.6603N 004:24.9900E (268) = = = (17) (34)

:fm_3 = 4.0 = 59:12.7814N 004:24.9861E (359) = = = (112) (225)

:turn = 7.0 = 59:12.8176N 004:24.9871E (001) = = = (33) (67)

:turn = = = 59:12.8176N 004:25.0494E (090) = = = (29) (59)

:turn = = = 59:12.7952N 004:25.0487E (181) = = = (20) (42)

:turn = = = 59:12.7942N 004:24.9901E (268) = = = (27) (56) OutsideTurn

:fm_4 = 4.0 = 59:12.6664N 004:24.9943E (179) = = = (118) (237)

:turn = 7.0 = 59:12.6605N 004:24.9945E (179) = = = (5) (11)

:turn = = = 59:12.6607N 004:25.0333E (089) = = = (18) (37)

:turn = = = 59:12.6485N 004:25.0333E (180) = = = (11) (23)

:turn = = = 59:12.6478N 004:24.9990E (268) = = = (16) (33)

:fm_5 = 4.0 = 59:12.7811N 004:24.9942E (359) = = = (123) (248)

:turn = 7.0 = 59:12.8179N 004:24.9939E (360) = = = (34) (68)

:turn = = = 59:12.8172N 004:25.0629E (091) = = = (32) (66)

:turn = = = 59:12.7954N 004:25.0629E (180) = = = (20) (40)

:turn = = = 59:12.7946N 004:24.9985E (269) = = = (30) (61) OutsideTurn

:fm_6 = 4.0 = 59:12.6664N 004:25.0025E (179) = = = (119) (238)

:turn = 7.0 = 59:12.6606N 004:25.0027E (179) = = = (5) (11)

:turn = = = 59:12.6608N 004:25.0370E (089) = = = (16) (33)

:turn = = = 59:12.6482N 004:25.0371E (180) = = = (11) (23)

:turn = = = 59:12.6478N 004:25.0074E (268) = = = (14) (28)

:fm_7 = 4.0 = 59:12.7813N 004:25.0030E (359) = = = (123) (248)

:turn = 7.0 = 59:12.8176N 004:25.0019E (359) = = = (33) (67)

:turn = = = 59:12.8177N 004:25.0699E (090) = = = (32) (65)

:turn = = = 59:12.7964N 004:25.0712E (178) = = = (19) (40)

:turn = = = 59:12.7946N 004:25.0082E (267) = = = (30) (60) OutsideTurn

:fm_8 = 4.0 = 59:12.6661N 004:25.0108E (179) = = = (119) (239)

: = 20.0 = 59:12.6400N 004:25.0116E (179) = = = (24) (48)

: = = = 59:12.6401N 004:25.0431E (090) = = = (14) (30)

: = = = 59:12.6087N 004:25.0460E (177) = = = (29) (58)

: = = = 59:12.6041N 004:25.1400E (095) = = = (44) (90)

: = = = 59:12.6381N 004:25.1350E (356) = = = (31) (63)

: = = = 59:12.6394N 004:25.0521E (272) = = = (39) (79)

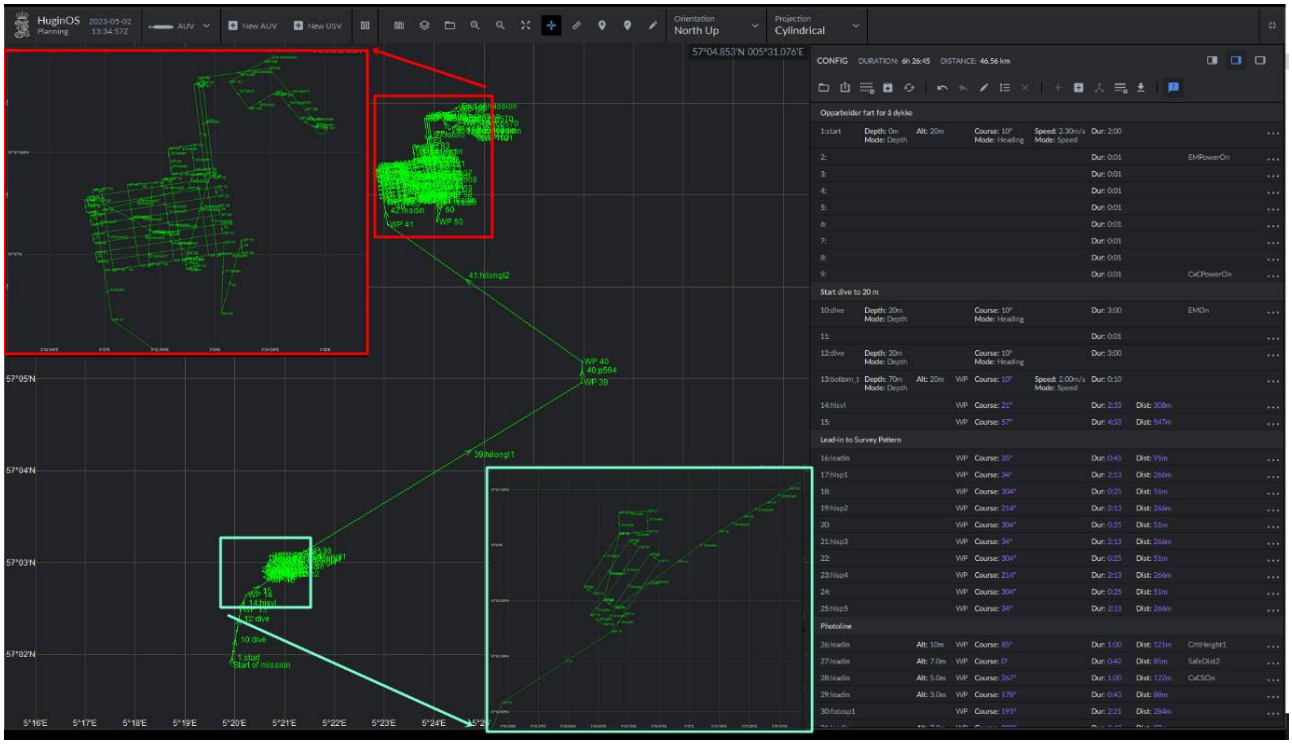
: = = = 59:12.8420N 004:25.1438E (013) = = = (193) (386)

: = = = - - = = = = 1 - Ascent

1.9.3.2 - 2nd Dive - Mission_55_20230403_1 (Planning Dive 3 NSJ-1_2a)

Hugin OS overview

6hrs 26mins, 46.56Km



Text Summary

Descend, (no pingbox necessary as is shallow area and can detect bottom from launch), head NE at 20m altitude to area of one of the gravity corer proposed sites (GC4, with potential natural oil leakage), do acoustic patch over GC5 point area. Turn and descend to 3m and do 2 photo lines over the acoustic data.

Ascend to 20m altitude and transit to the NE to meat video line (planning ID P564, now VL 3284), do acoustic line over video line. Transit to NW to way point 41.

From waypoint 41 do an acoustic mow the lawn survey pattern patch over an interesting sand feature, first with a HiSAS mow the lawn pattern at 20m height (roughly north south), then with a multibeam mow the lawn pattern at a right angle to the hiSAS pattern (roughly east west) still at 20m height to waypoint 76.

From waypoint 76 the acoustics continue roughly Northwards to cross a sand ripple channel feature, then return parallel down to the NE corner of the survey pattern patch.

Descend to 3m and do photolines across the acoustic patch in a rough triangle (Westwards, SE with a kink, NE to top NE corner of survey pattern patch). Continue photoline roughly north across acoustics that cross the sand ripple channel to waypoint 98.

Return to 15m height and transit Eastwards to northern end of video line (with planned ID P570, now VL 3282) and run HiSAS along video line. Descend to 3m and do photo line over video line (P570, VL3282).

Ascend a little and do pingbox (after a long dive to check drift) before ascending to the surface.

Hugin OS mission plan

MP13

#

Kongsberg Maritime AUV Mission Plan

Saved 2023-04-03 12:24:56 by hugin

#

#:Tag Depth Alt DMo Latitude Longitude Course GMo Speed SMo Dur Dist Flags

#

Opparbeider fart for å dykke

:start 0.0 20.0 D - - 010.0 H 2.30 S 120 - ETPowerOn

: = = = - - = = = = 1 - EMPowerOn

: = = = - - = = = = 1 - SASPowerOn

: = = = - - = = = = 1 - SASHighPower

: = = = - - = = = = 1 - SASMode1

: = = = - - = = = = 1 - DistTrigger

: = = = - - = = = = 1 - EM400Ext

: = = = - - = = = = 1 - ETOn

: = = = - - = = = = 1 - CxCPowerOn

Start dive to 20 m

:dive 20.0 = D - - 010.0 H = = 180 - EMOn

: = = = - - = = = = 1 -

:dive 20.0 = D - - 010.0 H = = 180 -

:bottom_t 70.0 20.0 T 57:02.4909N 005:20.1150E (010) = 2.00 S 10 - SASOn

:hisvl = = = 57:02.6456N 005:20.2249E (021) = = = (153) (308) Auto

: = = = 57:02.8057N 005:20.6785E (057) = = = (273) (547)

Lead-in to Survey Pattern

:leadin = = = 57:02.8455N 005:20.7303E (035) = = = (45) (91)

:hisp1 = = = 57:02.9645N 005:20.8774E (034) = = = (133) (266)

: = = = 57:02.9798N 005:20.8355E (304) = = = (25) (51)

:hisp2 = = = 57:02.8608N 005:20.6883E (214) = = = (133) (266)

: = = = 57:02.8761N 005:20.6464E (304) = = = (25) (51)

:hisp3 = = = 57:02.9951N 005:20.7935E (034) = = = (133) (266)

: = = = 57:03.0105N 005:20.7516E (304) = = = (25) (51)

:hisp4 = = = 57:02.8915N 005:20.6045E (214) = = = (133) (266)

: = = = 57:02.9068N 005:20.5625E (304) = = = (25) (51)

:hisp5 = = = 57:03.0258N 005:20.7097E (034) = = = (133) (266)

Photoline

:leadin = 10.0 = 57:03.0310N 005:20.8286E (085) = = = (60) (121) CritHeight1

:leadin = 7.0 = 57:03.0769N 005:20.8286E (000) = = = (42) (85) SafeDist2

:leadin = 5.0 = 57:03.0737N 005:20.7085E (267) = = = (60) (122) CxCSOn

:leadin = 3.0 = 57:03.0265N 005:20.7109E (178) = = = (43) (88) SASOff

:fotosp1 = = = 57:02.8777N 005:20.6467E (193) = = = (141) (284)

:leadin = 7.0 = 57:02.8433N 005:20.5890E (222) = = = (43) (87)

:leadin = = = 57:02.8214N 005:20.6447E (126) = = = (34) (69)

:leadin = 3.0 = 57:02.8589N 005:20.6986E (038) = = = (44) (88)

:fotosp2 = = = 57:02.9628N 005:20.9514E (053) = = = (160) (320)

Acoustic survey

:leadin = 20.0 = 57:03.0310N 005:21.1231E (054) = = = (107) (215) CxCOff

:hilongl1 = = = 57:03.0643N 005:21.2237E (059) = = = (59) (119) SASOn

:hilongl1 = = = 57:03.0959N 005:21.3192E (059) = = = (56) (113) CritHeight4

:hilongl1 = = = 57:03.1275N 005:21.4147E (059) = = = (56) (113) SafeDist6

:hilongl1 = = = 57:04.9592N 005:26.9599E (059) = = = (3278) (6557)

:p564 = = = 57:05.1860N 005:26.9691E (001) = = = (210) (421)

:hilongl2 = = = 57:06.6784N 005:23.0678E (305) = = = (2408) (4817)

Lead-in to Survey Pattern

:leadin = = = 57:06.9214N 005:22.9937E (351) = = = (228) (457)

:himo01 = = = 57:07.3156N 005:22.8901E (352) = = = (369) (739)

: = = = 57:07.3220N 005:22.9686E (081) = = = (40) (80)

:himo02 = = = 57:06.9249N 005:23.0783E (171) = = = (372) (745)

: = = = 57:06.9440N 005:23.3139E (082) = = = (120) (241)

:himo03 = = = 57:07.3412N 005:23.2043E (351) = = = (372) (745)

: = = = 57:07.3505N 005:23.4306E (086) = = = (114) (229)

:himo04 = = = 57:06.9504N 005:23.3925E (183) = = = (371) (744)

: = = = 57:06.9696N 005:23.6281E (081) = = = (120) (241)

:himo05 = = = 57:07.3667N 005:23.5185E (351) = = = (372) (745)

: = = = 57:07.3731N 005:23.5971E (081) = = = (40) (80)

:himo06 = = = 57:06.9760N 005:23.7066E (171) = = = (372) (745)

: = = = 57:06.9952N 005:23.9423E (081) = = = (120) (241)

:himo07 = = = 57:07.3923N 005:23.8327E (351) = = = (372) (745)

: = = = 57:07.3987N 005:23.9113E (081) = = = (40) (80)

:himo08 = = = 57:07.0015N 005:24.0208E (171) = = = (372) (745)

:leadin = 30.0 = 57:07.0062N 005:24.2443E (088) = = = (112) (226)

: = = = 57:07.0696N 005:24.2412E (358) = = = (58) (118)

: = = = 57:06.7083N 005:24.0561E (196) = = = (348) (696)

Lead-in to Survey Pattern

:leadin = = = 57:07.0585N 005:24.0808E (002) = = = (325) (651)

:mbmo01 = = = 57:06.9634N 005:22.9300E (261) = = = (587) (1175)

: = = = 57:07.0087N 005:22.9173E (351) = = = (42) (85)

:mbmo02 = = = 57:07.1038N 005:24.0681E (081) = = = (587) (1175)

: = = = 57:07.1491N 005:24.0554E (351) = = = (42) (85)

:mbmo03 = = = 57:07.0540N 005:22.9046E (261) = = = (587) (1175)

: = = = 57:07.0993N 005:22.8919E (351) = = = (42) (85)

:mbmo04 = = = 57:07.1944N 005:24.0427E (081) = = = (587) (1175)

: = = = 57:07.2397N 005:24.0300E (351) = = = (42) (85)

:mbmo05 = = = 57:07.1446N 005:22.8792E (261) = = = (587) (1175)

: = = = 57:07.1899N 005:22.8666E (351) = = = (42) (85)

:mbmo06 = = = 57:07.2850N 005:24.0173E (081) = = = (587) (1175)

: = = = 57:07.3303N 005:24.0046E (351) = = = (42) (85)

:mbmo07 = = = 57:07.2352N 005:22.8539E (261) = = = (587) (1175)

: = = = 57:07.2805N 005:22.8412E (351) = = = (42) (85)

:mbmo08 = = = 57:07.3756N 005:23.9919E (081) = = = (587) (1175)

: = = = 57:07.8421N 005:23.8850E (353) = = = (436) (873)

: = = = 57:07.8348N 005:23.8072E (260) = = = (39) (80)

: = = = 57:07.4172N 005:23.9062E (173) = = = (390) (781)

Photoline

:leadin = 20.0 = 57:07.3931N 005:23.6056E (262) = = = (153) (307) SASOff

:leadin = 10.0 = 57:07.4561N 005:23.5897E (352) = = = (59) (118) SafeDist2

:leadin = = = 57:07.5191N 005:23.5738E (352) = = = (59) (118) CritHeight1

:leadin = 5.0 = 57:07.5354N 005:23.7851E (082) = = = (107) (215) CxCSOn

:leadin = 3.0 = 57:07.4156N 005:23.8137E (173) = = = (112) (224)

:fotobx1 = = = 57:07.3246N 005:23.7593E (198) = = = (88) (178)

:fotobx2 = = = 57:07.2175N 005:22.9774E (256) = = = (407) (814)

:turn = 7.0 = 57:07.2048N 005:22.8355E (261) = = = (72) (145)

:turn = = = 57:07.2672N 005:22.8170E (351) = = = (58) (117)

:turn = 3.0 = 57:07.2620N 005:22.9498E (094) = = = (67) (134)

:fotobx3 = = = 57:07.1111N 005:23.4380E (120) = = = (283) (567)

:fotobx4 = = = 57:07.1077N 005:23.5786E (093) = = = (71) (142)

:fotobx5 = = = 57:07.0069N 005:23.7419E (139) = = = (124) (249)

:turn = 7.0 = 57:06.9427N 005:23.8142E (149) = = = (69) (140)

:turn = = = 57:06.9276N 005:23.7372E (250) = = = (41) (83)

:turn = 3.0 = 57:06.9781N 005:23.7340E (358) = = = (46) (94)

:fotobx6 = = = 57:07.3846N 005:23.9516E (016) = = = (392) (786)

:fotolo = = = 57:07.8256N 005:23.8523E (353) = = = (412) (825)

: = 10.0 = 57:07.8642N 005:23.8436E (353) = = = (36) (72)

Hisas VL

:leadin = 15.0 = 57:07.9125N 005:24.4841E (082) = = = (326) (653) CxCOff

:hip570 = = = 57:07.7115N 005:24.8088E (139) = = = (248) (497) SASOn

photolin

:leadin = 10.0 = 57:07.6184N 005:24.9645E (138) = = = (116) (234) OutsideTurn SASOff

:leadin = 5.0 = 57:07.6278N 005:24.8803E (282) = = = (43) (87) CxCSOn

:leadin = 3.0 = 57:07.6688N 005:24.7623E (303) = = = (70) (141)

:fotop570 = = = 57:07.7819N 005:24.5872E (320) = = = (137) (274)

: = 7.0 = 57:07.7876N 005:24.5244E (279) = = = (32) (64)

Pingbox

:pho5 = 5.0 = 57:07.7154N 005:24.3024E (239) = = = (130) (261)

:pho5 = = = 57:07.8461N 005:24.1285E (324) = = = (149) (299)

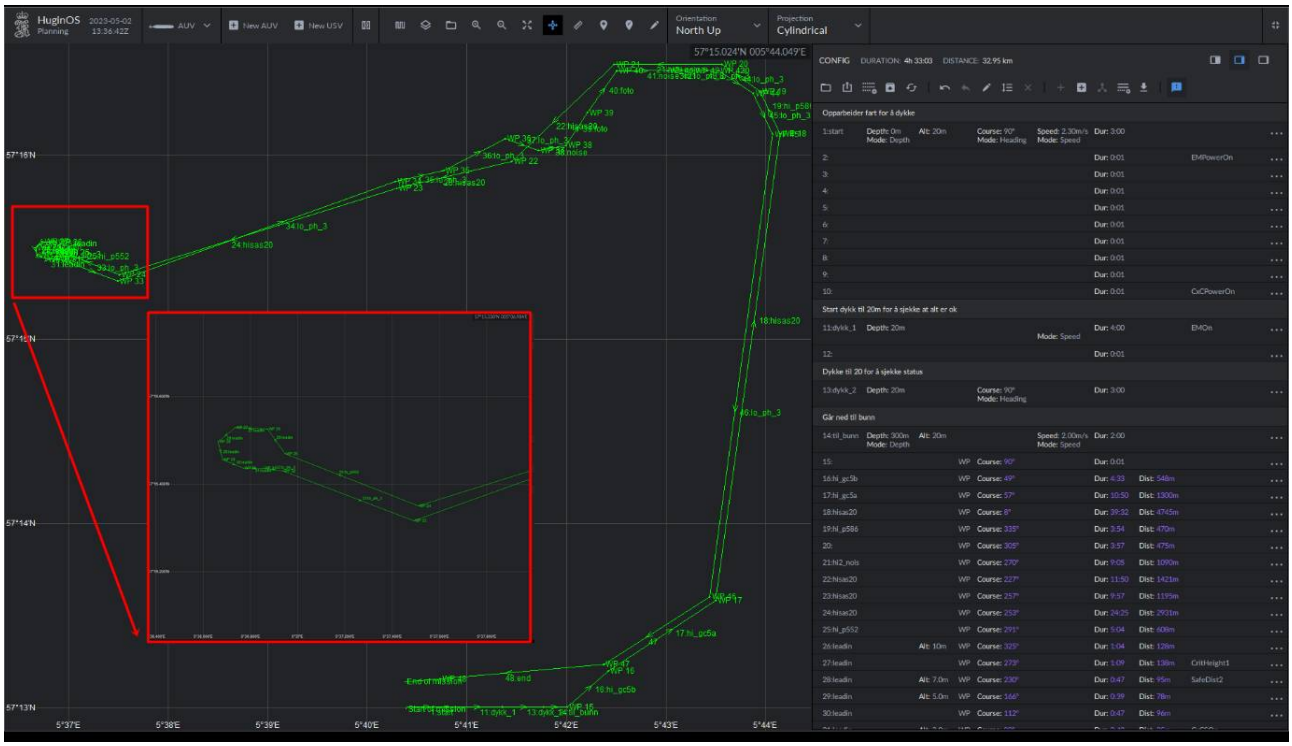
:acentlea = = = 57:07.9444N 005:24.4383E (060) = = = (181) (362) CxCOff

: = = = - - = = = = 60 - Ascent

1.9.3.3 - 3rd Dive - Mission_55_20230404_1 (Planning Dive 4 NSJ-1_3c)

HuginOS overview

4hrs 33mins, 32.95km



Text Summary

Descend close to gravity coring (GC) request sites (where it is possible there are natural leakages of oil). Start HiSAS

lines at 20m over GC sites (GC5B then GC5A - sites that were added later in planning but NB are not located beside GC5), continue roughly northwards. HiSAS line over video line (planning ID P586, now VL3306). HiSAS covering Karverket flagged noise point in the north, transit towards SW covering another potential noise point in Hisas line 22. Cross over varying terrains, transit NW to cover video line (planned ID P552, now VL 3303) with HiSAS data.

Do turn to lower to 3m height and cover video line (P552, VL3303), varying terrains towards the NE, pass over noise point (line 38) that is in hisas line 22, transit to northernmost point (still taking pictures at 3m). Pass over other suspected noise point (noise3m1, hisas line “hi2_nois”).

(**AT ROUGHLY THIS POINT THE AUV TOOK AN AVOIDANCE MEASURE AND ASCENDED ABOVE AN ALTITUDE WHERE THE BOTTOM IS VISIBLE, IT NEVER DESCENDED AGAIN TO THE PHOTO HEIGHT OF 3M – LEARNED TO REPEAT THE ALTITUDE COMMAND MORE OFTEN IN THE PLAN SO THAT THE AUV WILL TRY TO DESCEND AGAIN IF THERE HAD BEEN AN AVOIDANCE MEASURE – ALL PHOTOS AFTER THIS ARE OF THE WATER COLUMN**)

Do photo line (intended to continue at 3m but instead was done much higher) towards the SE over video line (P586, VL3306), do photoline following HiSAS line back Southwards, do photo line over the hisas data where the GC points are found, ascend.

HuginOS mission plan

MP13

#

Kongsberg Maritime AUV Mission Plan

Saved 2023-04-04 14:31:18 by a37686

#

#:Tag Depth Alt DMo Latitude Longitude Course GMo Speed SMo Dur Dist Flags

#

Opparbeider fart for å dykke

:start 0.0 20.0 D - - 090.0 H 2.30 S 180 - ETPowerOn

: = = = - - = = = = 1 - EMPowerOn

: = = = - - = = = = 1 - SASPowerOn

: = = = - - = = = = 1 - SASHighPower

: = = = - - = = = = 1 - SASMode1

: = = = - - = = = = 1 -

: = = = - - = = = = 1 - DistTrigger

: = = = - - = = = = 1 - EM400Ext

: = = = - - = = = = 1 - ETOn

: = = = - - = = = = 1 - CxCPowerOn

Start dykk til 20m for å sjekke at alt er ok

:dykk_1 20.0 = = - - = = = S 240 - EMOn

: = = = - - = = = = 1 -

Dykke til 20 for å sjekke status

:dykk_2 20.0 = = - - 090.0 H = = 180 -

Går ned til bunn

:til_bunn 300.0 20.0 T - - = = 2.00 S 120 - SASOn

: = = = 57:13.0055N 005:42.0086E (090) = = = 1 - Auto

:hi_gc5b = = = 57:13.1997N 005:42.4180E (049) = = = (273) (548)

:hi_gc5a = = = 57:13.5830N 005:43.4990E (057) = = = (650) (1300)

:hisas20 = = = 57:16.1151N 005:44.1457E (008) = = = (2372) (4745)

:hi_p586 = = = 57:16.3441N 005:43.9473E (335) = = = (234) (470)

: = = = 57:16.4921N 005:43.5618E (305) = = = (237) (475) SASOn

:hi2_nois = = = 57:16.4905N 005:42.4775E (270) = = = (545) (1090)

:hisas20 = = = 57:15.9649N 005:41.4502E (227) = = = (710) (1421)

:hisas20 = = = 57:15.8187N 005:40.2927E (257) = = = (597) (1195)

:hisas20 = = = 57:15.3503N 005:37.5102E (253) = = = (1465) (2931)

:hi_p552 = = = 57:15.4694N 005:36.9468E (291) = = = (304) (608)

:leadin = 10.0 = 57:15.5258N 005:36.8728E (325) = = = (64) (128)

:leadin = = = 57:15.5293N 005:36.7356E (273) = = = (69) (138) CritHeight1

:leadin = 7.0 = 57:15.4968N 005:36.6629E (231) = = = (47) (95) SafeDist2

:leadin = 5.0 = 57:15.4560N 005:36.6823E (165) = = = (39) (78) SASOff

:leadin = = = 57:15.4363N 005:36.7704E (112) = = = (47) (96)

:leadin = 3.0 = 57:15.4363N 005:36.8551E (090) = = = (42) (85) CxCSOn

:lo_ph_3 = = = 57:15.4299N 005:36.9381E (098) = = = (42) (84)

:lo_ph_3 = = = 57:15.3163N 005:37.4914E (111) = = = (297) (595)

:lo_ph_3 = = = 57:15.8561N 005:40.2793E (070) = = = (1488) (2978)

:lo_ph_3 = = = 57:15.9159N 005:40.7674E (077) = = = (251) (503)

:lo_ph_3 = = = 57:16.0883N 005:41.3855E (063) = = = (349) (699)

:lo_ph_3 = = = 57:16.0245N 005:41.7172E (110) = = = (176) (354)

:noise = 3.0 = 57:16.0515N 005:41.9945E (080) = = = (141) (283)

:foto = 3.0 = 57:16.2291N 005:42.2093E (033) = = = (197) (394)

:foto = 3.0 = 57:16.4566N 005:42.5042E (035) = = = (257) (516)

:noise3m1 = 3.0 = 57:16.4574N 005:43.0169E (090) = = = (257) (515)

:lo_ph_3 = = = 57:16.4578N 005:43.2733E (090) = = = (128) (258)

:lo_ph_3 = = = 57:16.4582N 005:43.5297E (090) = = = (128) (258)

:lo_ph_3 = = = 57:16.3348N 005:43.8754E (123) = = = (208) (416)

:lo_ph_3 = = = 57:16.1130N 005:44.0711E (154) = = = (228) (456)

:lo_ph_3 = = = 57:13.6033N 005:43.4395E (188) = = = (2350) (4701)

: = = = 57:13.2361N 005:42.3744E (238) = = = (635) (1271)

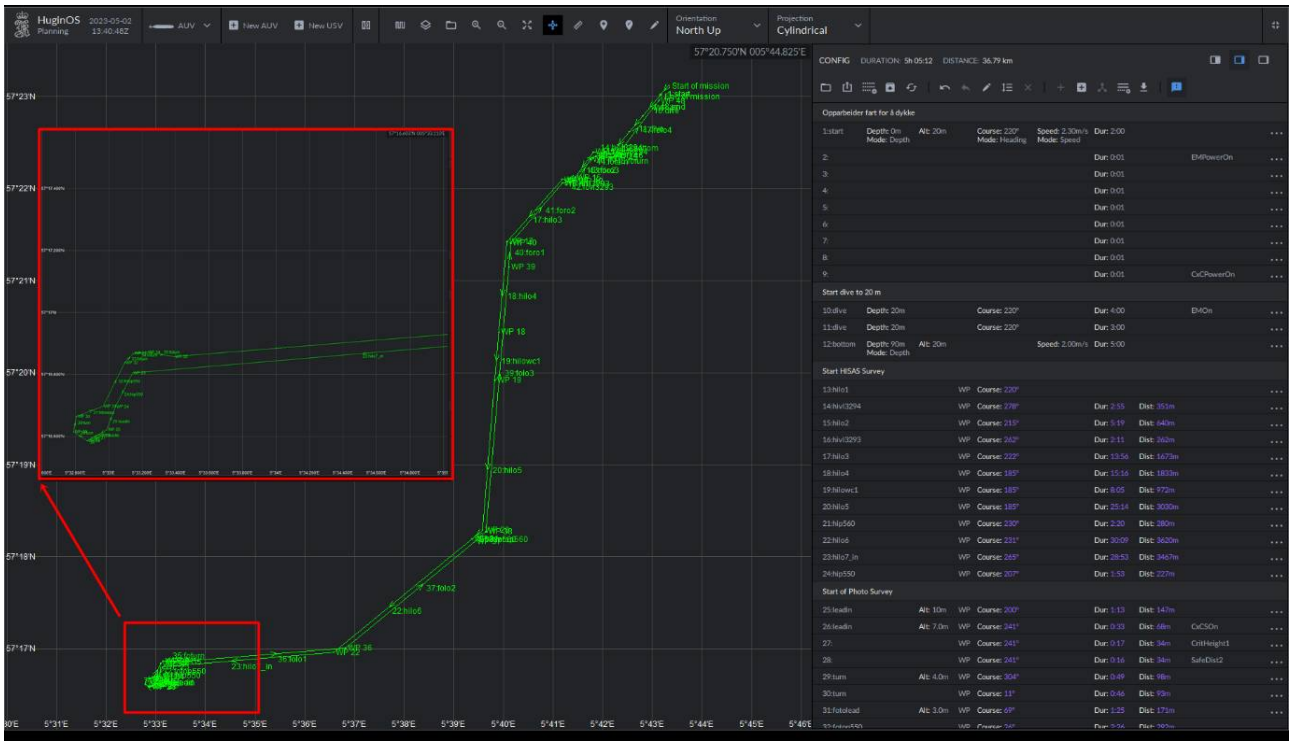
:end = 15.0 = 57:13.1577N 005:40.7283E (265) = = = (831) (1664) CxCOff

:ascend = = = 57:15.6462N 005:36.1577E (315) = = = (3259) (6518) Ascent

1.9.3.4 - 4th Dive - Mission_55_20230405_3 (Planning Dive 6 NSJ-1_4a)

HuginOS overview

5hrs 05mins, 36.79km



Text Summary

Descend to 20m altitude. Do hisas line over video line (VL3294), transit to next video line, do hisas over video line (VL3293), both of these include flagged kartverket noise points for checking. Transit past another noise point (in HiLo3). Turn roughly southwards and transit towards video line. Do hiSAS line over video line (planned ID P560, now VL3302). Transit SW to cover features of interest, transit west towards another video line, do hisas over video line (planned ID P550, now VL3304).

Descen to 3m to do photo line over video line (P550, VL3304), continue photolines along acoustic data to east, NE, then over video line (P560, VL3302). Continue roughly Northwards, ascend to 4m as mutibeam shows rockier landscape (from line labelled “foro1”). Do photolines in vicinity of noise points and over VL3293. Photoline transit to then along VL3294, descend to 3m to continue photoline over flatter terrain (folo4) until ascending to end the dive.

HuginOS mission plan

MP13

#

Kongsberg Maritime AUV Mission Plan

Saved 2023-04-05 07:10:22 by hugin

#

#:Tag Depth Alt DMo Latitude Longitude Course GMo Speed SMo Dur Dist Flags

#

Opparbeider fart for å dykke

:start 0.0 20.0 D - - 220.0 H 2.30 S 120 - ETPowerOn

: = = = - - = = = = 1 - EMPowerOn

: = = = - - = = = = 1 - SASPowerOn

: = = = - - = = = = 1 - SASHighPower

: = = = - - = = = = 1 - SASMode1

: = = = - - = = = = 1 - DistTrigger

: = = = - - = = = = 1 - EM400Ext

: = = = - - = = = = 1 - ETOn

: = = = - - = = = = 1 - CxCPowerOn

Start dive to 20 m

:dive 20.0 = = - - 220.0 = = = 240 - EMOn

:dive 20.0 = = - - 220.0 = = = 180 -

:bottom 90.0 20.0 T - - = = 2.00 = 300 - SASOn

Start HISAS Survey

:hilo1 = = = 57:22.3731N 005:42.1562E (220) = = = - - Auto

:hivl3294 = = = 57:22.3990N 005:41.8096E (278) = = = (175) (351)

:hilo2 = = = 57:22.1184N 005:41.4393E (215) = = = (319) (640)

:hivl3293 = = = 57:22.0994N 005:41.1802E (262) = = = (131) (262)

:hilo3 = = = 57:21.4253N 005:40.0735E (222) = = = (836) (1673)

:hilo4 = = = 57:20.4421N 005:39.9073E (185) = = = (916) (1833)

:hilowc1 = = = 57:19.9204N 005:39.8274E (185) = = = (485) (972) EMWCOn

:hilo5 = = = 57:18.2936N 005:39.5814E (185) = = = (1514) (3030) EMWCOff

:hip560 = = = 57:18.1965N 005:39.3679E (230) = = = (140) (280) SASOn

:hilo6 = = = 57:16.9623N 005:36.5789E (231) = = = (1809) (3620)

:hilo7_in = = = 57:16.8049N 005:33.1420E (265) = = = (1733) (3467) EM400Int

:hip550 = = = 57:16.6962N 005:33.0391E (207) = = = (113) (227)

Start of Photo Survey

:leadin = 10.0 = 57:16.6216N 005:32.9888E (200) = = = (73) (147) SASOff

:leadin = 7.0 = 57:16.6038N 005:32.9298E (241) = = = (33) (68) CxCSOn

: = = = 57:16.5948N 005:32.9003E (241) = = = (16) (34) CritHeight1

: = = = 57:16.5859N 005:32.8708E (241) = = = (16) (34) SafeDist2

:turn = 4.0 = 57:16.6154N 005:32.7897E (304) = = = (49) (98)

:turn = = = 57:16.6647N 005:32.8069E (011) = = = (46) (93)

:fotolead = 3.0 = 57:16.6976N 005:32.9661E (069) = = = (85) (171)

:fotop550 = = = 57:16.8386N 005:33.0953E (026) = = = (146) (292)

:foturn = = = 57:16.8682N 005:33.1456E (043) = = = (37) (75)

:foturn = = = 57:16.8718N 005:33.2269E (085) = = = (40) (82)

:foturn = = = 57:16.8578N 005:33.3916E (099) = = = (83) (168)

:folo1 = = = 57:17.0083N 005:36.8180E (085) = = = (1727) (3455)

:folo2 = = = 57:18.1692N 005:39.4285E (051) = = = (1697) (3395)

:fotop560 = = = 57:18.2753N 005:39.6488E (048) = = = (148) (296)

:folo3 = = = 57:21.1479N 005:40.1100E (005) = = = (2675) (5352)

:foro1 = 4.0 = 57:21.4107N 005:40.1453E (004) = = = (244) (489)

:foro2 = = = 57:22.0624N 005:41.1870E (041) = = = (799) (1598)

:fovl3293 = = = 57:22.0834N 005:41.4776E (082) = = = (147) (294)

:foro3 = = = 57:22.3223N 005:41.7545E (032) = = = (261) (523)

:foturn = = = 57:22.3559N 005:41.8681E (061) = = = (64) (130)

:fovl3294 = = = 57:22.3339N 005:42.1720E (098) = = = (153) (307)

:foturn = 3.0 = 57:22.3619N 005:42.2891E (066) = = = (64) (128)

:folo4 = = = 57:22.8740N 005:43.0034E (037) = = = (595) (1190)

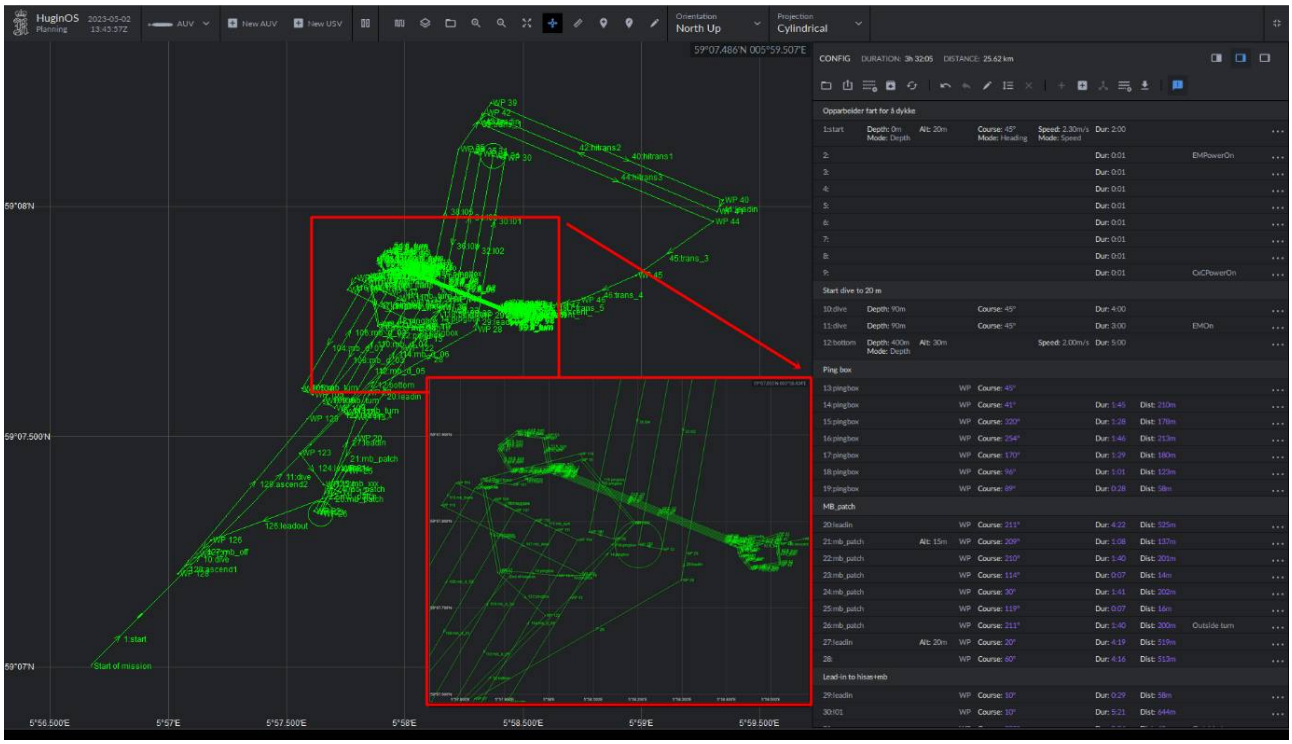
:end = 15.0 = 57:22.9570N 005:43.1299E (039) = = = (99) (200) CxCOff

:endend = = = 57:23.0301N 005:43.2530E (042) = = = (91) (183) Ascent

1.9.3.5 - 5th Dive - Mission_55_20230410_2 (Planning Dive 8 ALT Stav_b)

HuginOS overview

3hrs 32mins, 25.62km (but stopped collecting data after about 3hrs due to a fault on the vehicle during the dive)



Text Summary

Descend (east of anchor points to a fish farm), transit to centre of area to do a ping box (pentagonal) at 30m altitude. Transit to SW and descend to 15m to begin multibeam patch (over a small feature, the intention is to cross this patch again at the end to monitor drift).

Ascend to 20m while transiting towards hill feature and HiSAS & MBE patch crossing hill in roughly north south direciton (Waypoints 28-38). Transt to vally and do HiSAS/MBE patch there in roughly east west patterm.

Transit round the side of the hill feature following the deeper plan/valley and begin photo mosaic at 3m altitude that crosses lower edge of the hill HiSAS patch (later video line VL3370 overlaps this patch).

Transit to 20m altitude for large HiSAS patch in roughly SW/NE direction (waypoints 103-114) then do two crosslines in roughly NW/SE direction near top end of patch.

<NOTE THAT AGAIN AN INTERNAL FAULT RESULTED IN NO DATA BEING COLLECTED AT SOME POINT DURING THIS HISAS PATCH; NO FURTHER DATA WAS COLLECTED AFTER THIS>

Pentagonal pingbox, then return to multibeam patch over small feature at 15m altitude for crosscheck of drift before ascending.

HuginOS mission plan

MP13

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Kongsberg Maritime AUV Mission Plan

Saved 2023-04-10 08:14:16 by hugin

#

#:Tag Depth Alt DMo Latitude Longitude Course GMo Speed SMo Dur Dist Flags

#

Opparbeider fart for å dykke

:start 0.0 20.0 D - - 045.0 H 2.30 S 120 - ETPowerOn

: = = = - - = = = = 1 - EMPowerOn

: = = = - - = = = = 1 - SASPowerOn

: = = = - - = = = = 1 - SASHighPower

: = = = - - = = = = 1 - SASMode1

: = = = - - = = = = 1 - DistTrigger

: = = = - - = = = = 1 - EM400Int

: = = = - - = = = = 1 - ETOn

: = = = - - = = = = 1 - CxCPowerOn

Start dive to 20 m

:dive 90.0 = = - - 045.0 = = = 240 -

:dive 90.0 = = - - 045.0 = = = 180 - EMOn

:bottom 400.0 30.0 T - - = = 2.00 = 300 - SASOn

Ping box

:pingbox = = = 59:07.7118N 005:58.0474E (045) = = = - - Auto

:pingbox = = = 59:07.7977N 005:58.1906E (041) = = = (105) (210)

:pingbox = = = 59:07.8710N 005:58.0709E (320) = = = (88) (178)

:pingbox = = = 59:07.8389N 005:57.8566E (254) = = = (106) (213)

:pingbox = = = 59:07.7436N 005:57.8906E (170) = = = (89) (180)

:pingbox = = = 59:07.7372N 005:58.0191E (096) = = = (61) (123)

:pingbox = = = 59:07.7376N 005:58.0794E (089) = = = (28) (58)

MB_patch

:leadin = = = 59:07.4964N 005:57.7921E (211) = = = (262) (525)

:mb_patch = 15.0 = 59:07.4316N 005:57.7229E (209) = = = (68) (137)

:mb_patch = = = 59:07.3384N 005:57.6164E (210) = = = (100) (201)

:mb_patch = = = 59:07.3352N 005:57.6302E (114) = = = (7) (14)

:mb_patch = = = 59:07.4291N 005:57.7373E (030) = = = (101) (202)

:mb_patch = = = 59:07.4250N 005:57.7519E (119) = = = (7) (16)

:mb_patch = = = 59:07.3327N 005:57.6435E (211) = = = (100) (200) OutsideTurn

:leadin = 20.0 = 59:07.5949N 005:57.8323E (020) = = = (259) (519)

: = = = 59:07.7322N 005:58.2984E (060) = = = (256) (513)

Lead-in to hisas+mb

:leadin = = = 59:07.7631N 005:58.3087E (010) = = = (29) (58)

:l01 = = = 59:08.1047N 005:58.4232E (010) = = = (321) (644)

: = = = 59:08.1094N 005:58.3728E (280) = = = (24) (49) OutsideTurn

:l02 = = = 59:07.7678N 005:58.2546E (190) = = = (322) (644)

: = = = 59:07.7732N 005:58.2019E (281) = = = (25) (51) OutsideTurn

:l03 = = = 59:08.1140N 005:58.3220E (010) = = = (321) (643)

: = = = 59:08.1188N 005:58.2767E (282) = = = (22) (44)

:l04 = = = 59:07.7797N 005:58.1457E (191) = = = (320) (642)

: = = = 59:07.7877N 005:58.0908E (286) = = = (27) (54)

:l05 = = = 59:08.1234N 005:58.2264E (012) = = = (318) (637)

:trans_1 = = = 59:08.2245N 005:58.3633E (035) = = = (114) (229)

:hitrans1 = = = 59:08.0133N 005:59.3439E (113) = = = (507) (1014)

:leadin = = = 59:07.9886N 005:59.3198E (207) = = = (25) (51)

:hitrans2 = = = 59:08.2021N 005:58.3365E (293) = = = (509) (1019)

:leadin = = = 59:08.1806N 005:58.3119E (210) = = = (23) (46)

:hitrans3 = = = 59:07.9670N 005:59.3032E (113) = = = (512) (1026)

:trans_3 = = = 59:07.8498N 005:58.9764E (235) = = = (190) (380)

:trans_4 = = = 59:07.7967N 005:58.7370E (247) = = = (124) (249)

:trans_5 = = = 59:07.7853N 005:58.6280E (258) = = = (53) (106) SafeDist2

:descent_ = 10.0 = 59:07.7796N 005:58.5736E (258) = = = (26) (53) CritHeight1

:descent_ = 5.0 = 59:07.7739N 005:58.5191E (258) = = = (26) (53) CxCSOn

Lead-in to photo mosaic

:leadin = 3.0 = 59:07.7835N 005:58.4004E (279) = = = (57) (115) SASOff

:fl_01 = = = 59:07.8585N 005:58.0378E (292) = = = (186) (373) EM400Int

:fl_turn = 8.0 = 59:07.8657N 005:58.0053E (293) = = = (16) (34)

:fl_turn = = = 59:07.8996N 005:57.9950E (351) = = = (31) (64)

:fl_turn = = = 59:07.9041N 005:57.9259E (277) = = = (33) (66)

:fl_turn = = = 59:07.8884N 005:57.8862E (232) = = = (23) (48)

:fl_turn = = = 59:07.8604N 005:57.9157E (152) = = = (29) (59)

:fl_turn = 5.0 = 59:07.8639N 005:58.0014E (085) = = = (41) (82)

:leadin_f = 3.0 = 59:07.8572N 005:58.0370E (110) = = = (18) (36)

:fl_02 = = = 59:07.7822N 005:58.3992E (112) = = = (186) (373)

:fl_turn = 8.0 = 59:07.7743N 005:58.4483E (107) = = = (24) (49)

:fl_turn = = = 59:07.7856N 005:58.5147E (072) = = = (33) (67)

:fl_turn = = = 59:07.7530N 005:58.5219E (174) = = = (30) (61)

:fl_turn = = = 59:07.7476N 005:58.4560E (261) = = = (31) (64)

:fl_turn = = = 59:07.7612N 005:58.4381E (326) = = = (15) (30)

:fl_turn = 5.0 = 59:07.7716N 005:58.4327E (345) = = = (9) (20)

:leadin_f = 3.0 = 59:07.7810N 005:58.3982E (298) = = = (18) (37)

:fl_03 = = = 59:07.8560N 005:58.0357E (292) = = = (186) (373)

:fl_turn = 8.0 = 59:07.8630N 005:58.0004E (291) = = = (18) (36)

:fl_turn = = = 59:07.8967N 005:57.9896E (351) = = = (31) (63)

:fl_turn = = = 59:07.9014N 005:57.9266E (278) = = = (30) (61)

:fl_turn = = = 59:07.8848N 005:57.8859E (232) = = = (24) (50)

:fl_turn = = = 59:07.8585N 005:57.9150E (150) = = = (28) (56)

:fl_turn = 5.0 = 59:07.8618N 005:57.9995E (086) = = = (40) (81)

:leadin_f = 3.0 = 59:07.8547N 005:58.0348E (111) = = = (18) (36)

:fl_04 = = = 59:07.7796N 005:58.3973E (112) = = = (186) (373)

:fl_turn = = = 59:07.7711N 005:58.4443E (109) = = = (23) (48)

:fl_turn = 8.0 = 59:07.7827N 005:58.5137E (072) = = = (34) (70)

:fl_turn = = = 59:07.7512N 005:58.5210E (173) = = = (29) (59)

:fl_turn = = = 59:07.7463N 005:58.4556E (262) = = = (31) (63)

:fl_turn = = = 59:07.7597N 005:58.4339E (320) = = = (16) (32)

:fl_turn = 5.0 = 59:07.7693N 005:58.4281E (343) = = = (9) (19)

:leadin_f = 3.0 = 59:07.7784N 005:58.3963E (299) = = = (17) (35)

:fl_05 = = = 59:07.8534N 005:58.0334E (292) = = = (186) (373)

:fl_turn = 8.0 = 59:07.8607N 005:57.9972E (291) = = = (18) (37)

:fl_turn = = = 59:07.8956N 005:57.9849E (350) = = = (32) (66)

:fl_turn = = = 59:07.9000N 005:57.9268E (278) = = = (28) (56)

:fl_turn = = = 59:07.8823N 005:57.8836E (231) = = = (26) (53)

:fl_turn = = = 59:07.8569N 005:57.9128E (149) = = = (27) (55)

:fl_turn = 5.0 = 59:07.8596N 005:57.9956E (086) = = = (39) (79)

:leadin_f = 3.0 = 59:07.8525N 005:58.0310E (111) = = = (18) (36)

:fl_06 = = = 59:07.7770N 005:58.3959E (112) = = = (187) (375)

:fl_turn = 8.0 = 59:07.7674N 005:58.4419E (112) = = = (23) (47)

:fl_turn = = = 59:07.7792N 005:58.5102E (071) = = = (34) (69)

:fl_turn = = = 59:07.7493N 005:58.5191E (171) = = = (28) (56)

:fl_turn = = = 59:07.7449N 005:58.4530E (263) = = = (31) (64)

:fl_turn = = = 59:07.7596N 005:58.4294E (320) = = = (17) (35)

:fl_turn = 5.0 = 59:07.7695N 005:58.4237E (344) = = = (9) (19)

:leadin_f = 3.0 = 59:07.7759N 005:58.3946E (293) = = = (15) (30)

:fl_07 = 3.0 = 59:07.8512N 005:58.0297E (292) = = = (187) (375)

:end_foto = 20.0 = 59:07.8577N 005:57.9940E (290) = = = (18) (36) CxCSOn

:trans = = = 59:07.8424N 005:57.9169E (249) = = = (39) (79) CritHeight4

:trans = = = 59:07.8467N 005:57.8539E (278) = = = (30) (61) SafeDist6

Lead-in to Survey Pattern

:leadin = = = 59:07.8383N 005:57.8332E (232) = = = (12) (25) SASOn

:mb_d_01 = = = 59:07.6047N 005:57.5654E (211) = = = (251) (503)

:mb_turn = = = 59:07.5907N 005:57.6105E (121) = = = (25) (50)

:mb_d_02 = = = 59:07.8257N 005:57.8771E (030) = = = (252) (505)

:mb_turn = = = 59:07.8129N 005:57.9227E (119) = = = (24) (50)

:mb_d_03 = = = 59:07.5779N 005:57.6552E (210) = = = (252) (506)

:mb_turn = = = 59:07.5625N 005:57.7026E (122) = = = (26) (54)

:mb_d_04 = = = 59:07.8012N 005:57.9695E (030) = = = (255) (511)

:mb_turn = = = 59:07.7902N 005:58.0164E (115) = = = (24) (49)

:mb_d_05 = = = 59:07.5535N 005:57.7432E (211) = = = (255) (511)

:mb_turn = = = 59:07.5418N 005:57.7898E (116) = = = (24) (49)

:mb_d_06 = = = 59:07.7785N 005:58.0649E (031) = = = (255) (512)

:mb_trans = = = 59:07.8445N 005:57.7904E (295) = = = (144) (289)

:mb_trans = = = 59:07.8185N 005:57.7570E (213) = = = (28) (58)

:mb_xline = = = 59:07.7393N 005:58.0718E (116) = = = (167) (334)

Pingbox

:pingbox = = = 59:07.7983N 005:58.1951E (047) = = = (80) (161)

:pingbox = = = 59:07.8781N 005:58.0685E (321) = = = (95) (191)

:pingbox = = = 59:07.8488N 005:57.8470E (256) = = = (109) (218)

:pingbox = = = 59:07.7407N 005:57.8845E (170) = = = (101) (204)

:pingbox = = = 59:07.6912N 005:57.9917E (132) = = = (68) (138)

:leadin_x = = = 59:07.4641N 005:57.5558E (225) = = = (296) (592)

X-line MB-patch

:leadinx = 15.0 = 59:07.3964N 005:57.6548E (143) = = = (78) (157) SASOff

:mb_xxx = = = 59:07.3799N 005:57.7280E (114) = = = (38) (76)

:leadout = = = 59:07.2753N 005:57.1789E (250) = = = (279) (559)

:mb_off = = = 59:07.2452N 005:57.1230E (224) = = = (38) (77) EMOff

:ascend1 = 100.0 = 59:07.2025N 005:57.0392E (225) = = = (56) (113)

:ascend2 = = = 59:07.5390N 005:57.5881E (040) = = = (407) (815)

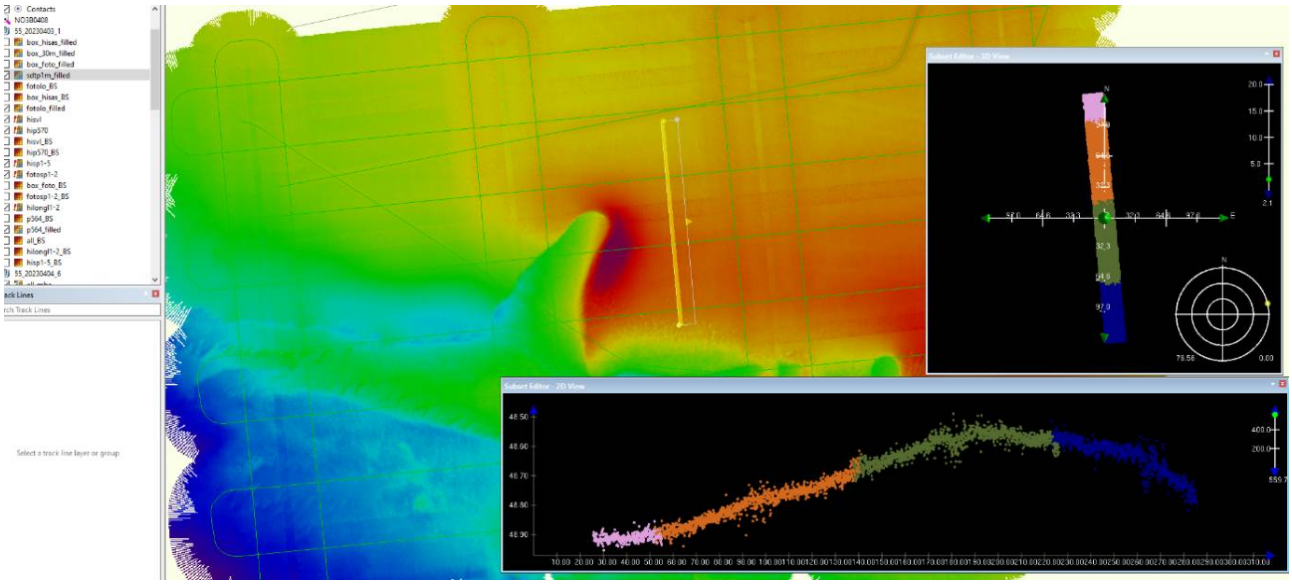
: = = = 59:07.0746N 005:56.7893E (221) = = = (575) (1151) Ascent

Appendix 3 - Details of AUV MBE Issues

Information provided by Tor Jan Meek, Kartverket

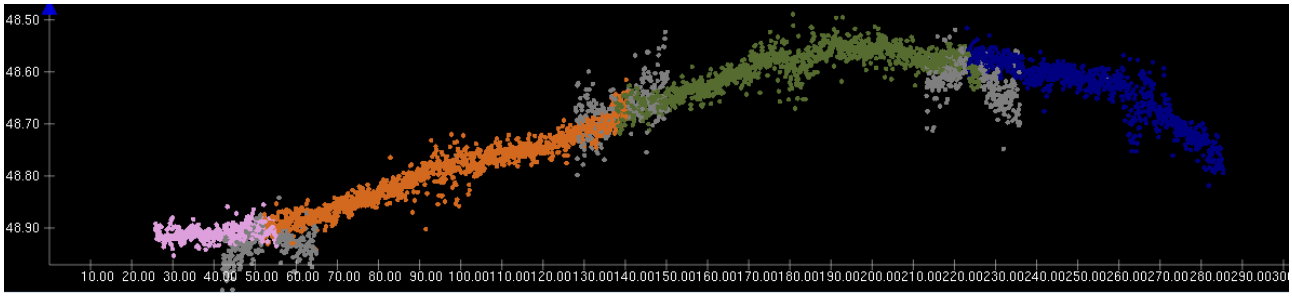
As we saw last year on the “metodetokt”, the general quality of the MBE data is very good. There are a few outliers as can be expected but they are within +/- 10 cm and can easily be filtered out.

Example1:



These data from dive 55_20230403_1 have not been filtered except from trimming the outer beams to minimize the effect of slightly incorrect sound velocity. Each line has a different colour in the 2D and 3D window while surface in the window behind is coloured by depth.

Incorrect sound velocity:



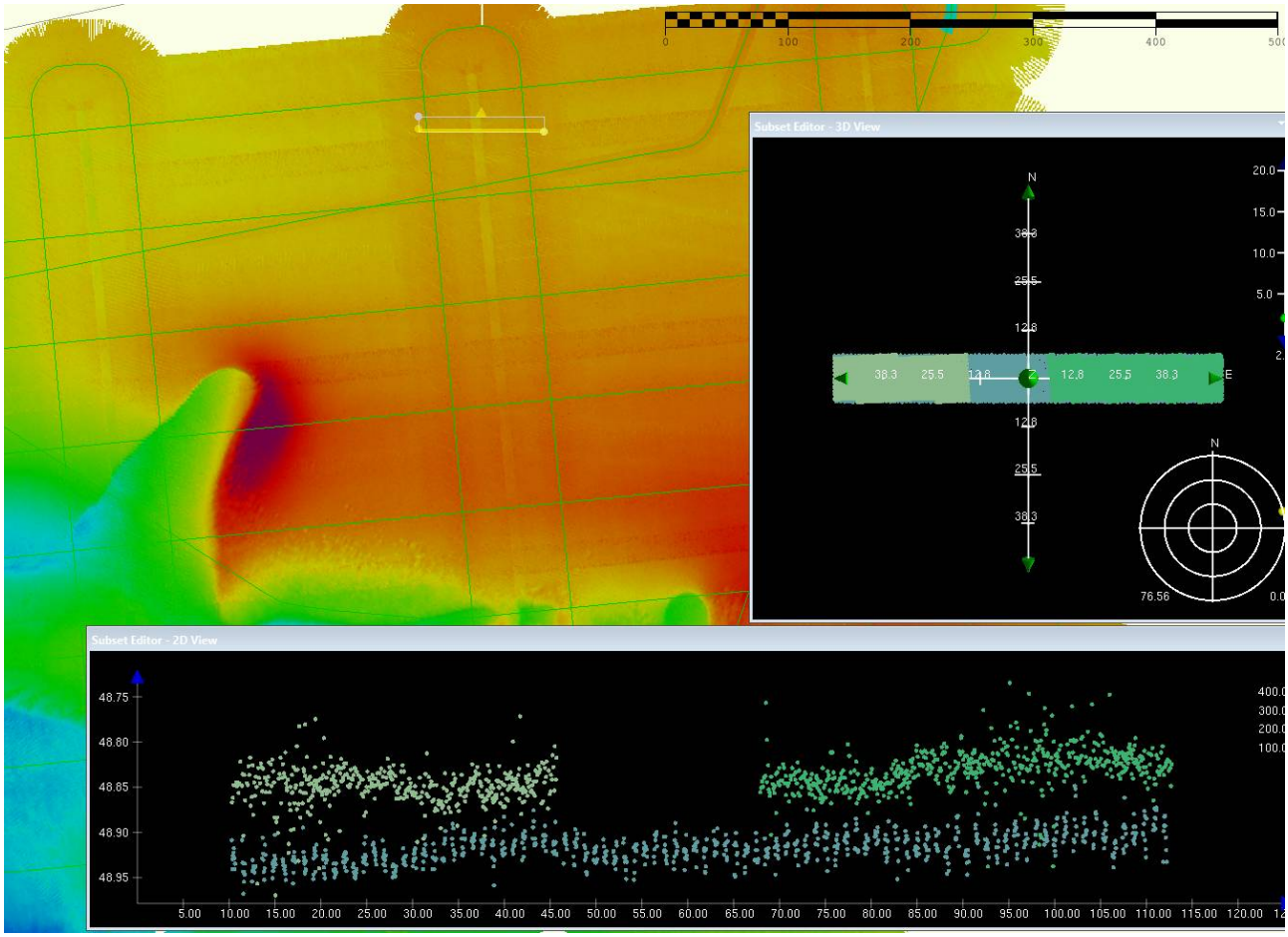
Grey dots showing points from outer beams that have been filtered out.

In shallow areas like this it would be beneficial with more CTD profiles spread out in time and position to avoid or minimize problems with sound velocity.

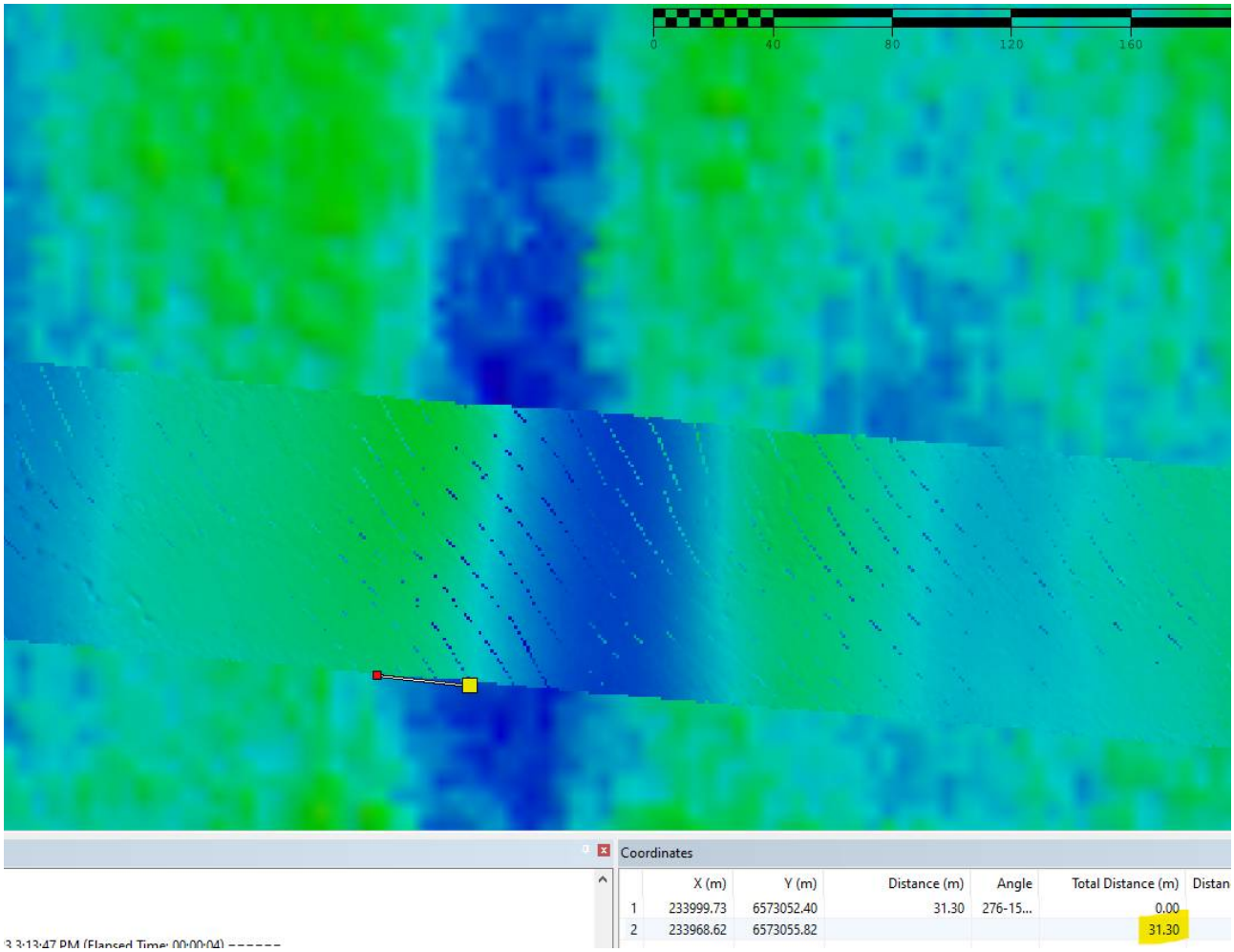
As we can see in example1 above, there is good correlation between lines surveyed within a short timeframe. The four lines in the 2D window were surveyed within a timeframe of 30 minutes.

However, when comparing the lines going east-west to the lines going north-south, surveyed about one and a half hour later, we can see that there are misalignments between the lines. It is to some degree noticeable in the surface but is more evident when looking at the lines in the 2D window.

Example2:



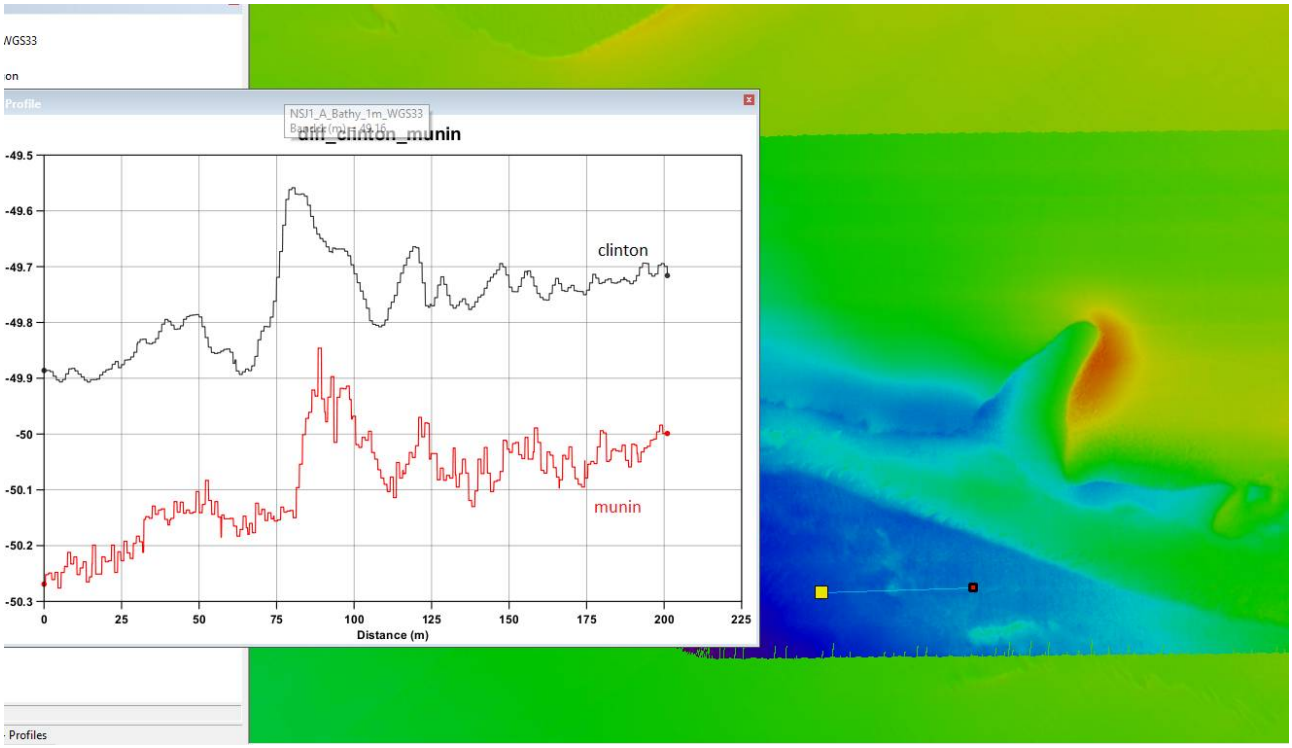
We have also found some significant errors in absolute position when comparing data from “Munin” to data from surface vessels. The most concerning error was found on 55_20230401_6 where we could observe an error of around 30 meters.

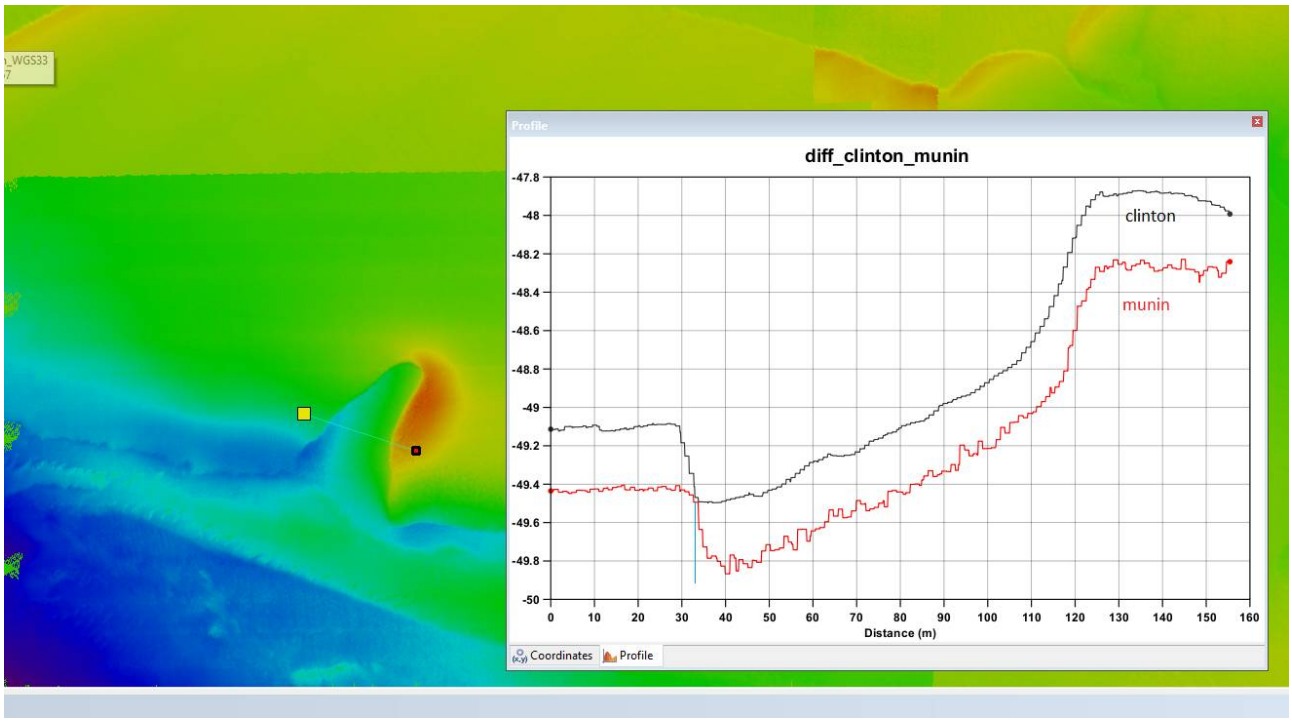


Data from surface vessel behind and data from “Munin” on top.

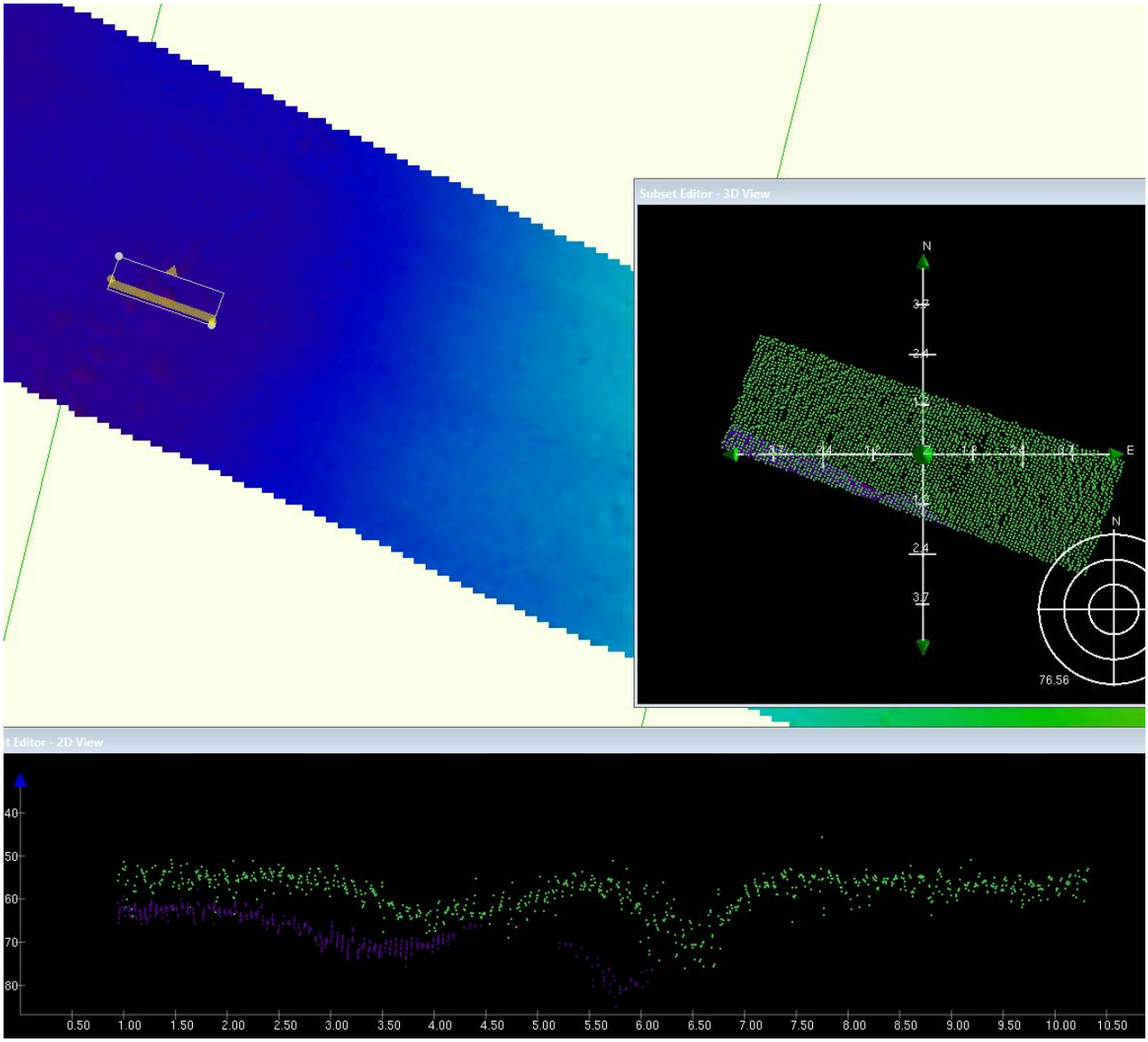
When discussing this with Kongsberg they think it can be related to HiPap problems but that is not yet confirmed and needs looking into.

We also could observe smaller but still significant difference in other areas too as shown below





There were also some problems with position errors between adjacent surveylines as shown below in an example from 55_20230410_2.



These were lines run 25 minutes apart as part of a photo mission. They were short lines about 6-7 minutes long with 180 degree turns between. According to Kongsberg this is optimal for minimizing the drift in navigation but still we can observe a drift around one meter in position and 10 cm in depth in less than 30 minutes.

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