DANMARKS OG GRØNLANDS GEOLOGISKE UNDERSØGELSE **RAPPORT 2023/25**

Survey report for the Danish North Sea, 2023

Geological screening for offshore wind farms, the Danish Energy Agency

Thomas Vangkilde-Pedersen, Lara F. Pérez, Niels Nørgaard-Pedersen, Luna H. Winther, Lars-Georg Rödel, Sigurd B. Andersen, Nicklas Christensen, Lis Allaart, Rasmus Ørnekoll Stenshøj, Lisbeth Lyngkjær Pedersen, Leonie Everding & Rasmus Andersen

GEOLOGICAL SURVEY OF DENMARK AND GREENLAND
DANISH MINISTRY OF CLIMATE, ENERGY AND UTILITIES

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1. Summary

GEUS has carried out fieldwork as part of a geological screening for offshore wind farms for the Danish Energy Agency (DEA) in 2023 in the Danish North Sea. The purpose of the survey was to acquire geophysical data, with particular focus on multichannel sparker seismic data, in regions with lack of data and geological information in order to establish a better basis for developing conceptual geological models and mapping geological units of importance for offshore wind farm development.

The survey, hereafter referred to as the ENS 2023 survey, started May 8 and was completed June 2. The ENS 2023 survey include most of the Danish North Sea. The activities were carried out using the survey vessel Arctic Ocean and involved three legs of geophysical mapping with single and multichannel seismic. Sub-bottom profiler, multibeam echo sounder and side scan sonar were obtained to support the seismic mapping.

Mobilization of the geophysical equipment took place in Esbjerg harbor from May 4 to May 7. The crew change between Leg 1 and Leg 2 took place in Hanstholm harbor between May 16 and May 18 due to weather standby. The crew change between Leg 2 and Leg 3 took place in Hirtshals harbor on May 24 and Thyborøn Harbor on May 25 due to weather standby. Demobilization after the survey took place in Hirtshals harbor on June 2.

The survey plan for the ENS 2023 survey included 4400 km of survey lines in the Danish North Sea.

Leg 1 acquisition started off Blåvandshuk on May 8 and continued in the eastern, central and western Danish North Sea through May 15 in good weather conditions. A total of 1401 km of data were acquired along planned lines before Leg 1 ended with GEUS crew change in Hanstholm on May 16.

Leg 2 acquisition started on May 18 after two days of weather standby. A GAMS calibration of the positioning system and patch test of the EdgeTech multibeam echosounder were performed upon departure from Hanstholm. Subsequent data acquisition was focused on the central and western North Sea. Strong winds and high seas in the western part of the Danish North Sea forced a transit to Jammerbugt towards the end of the leg. A total of 780 km of geophysical data were acquired along planned lines during Leg 2 in good to very good weather conditions before a GEUS crew change in Hirtshals on May 24.

Leg 3 acquisition started in the eastern part of the Danish North Sea on May 26 after two days of weather standby and transit to Thyborøn and later to the survey area. The data acquisition was focused on the central and western North Sea until strong winds and high seas in the west again forced a transit to Jammerbugt towards the end of the leg. A total of 933 km of geophysical data were acquired along planned lines during Leg 3 in good to challenging weather conditions before the ENS 2023 survey was finished in Hirtshals on June 2.

A total of 3114 km of geophysical data were acquired along the planned survey lines (Figure 1) during the ENS 2023 survey. Details on the survey lines and transits are provided in the survey log included as Appendix A.

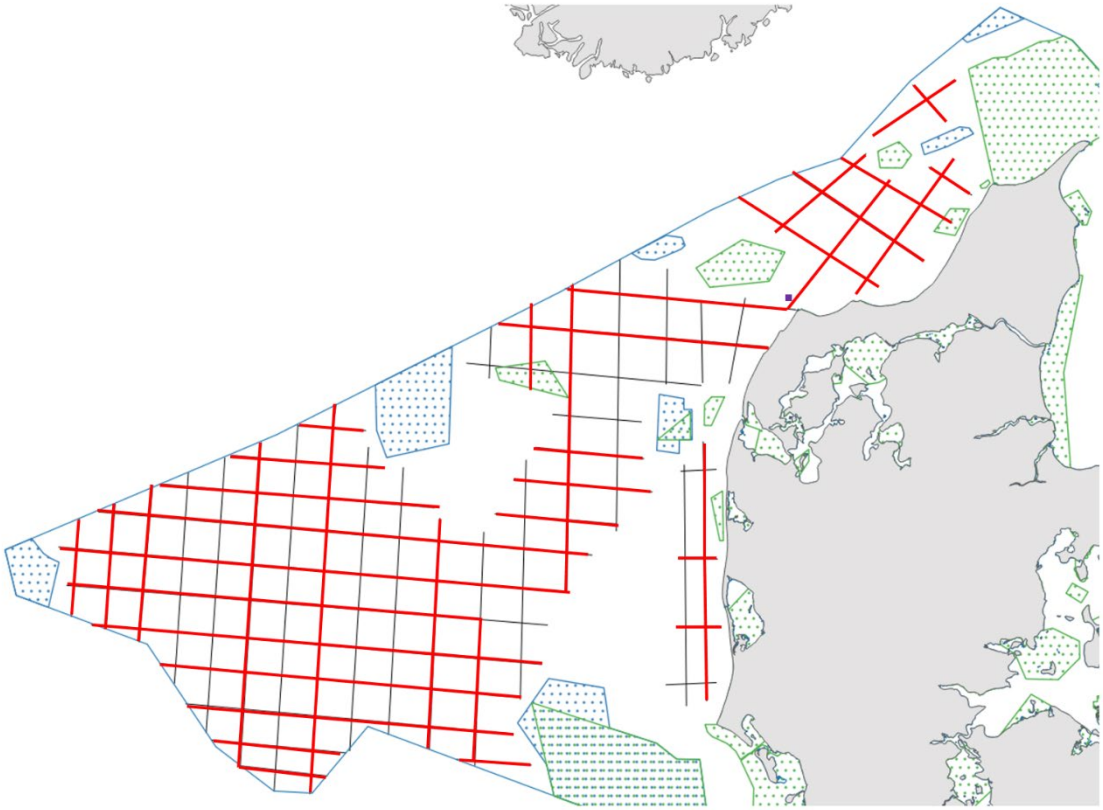


Figure 1. Survey lines planned (thin black) and recorded (thick red, patch test in purple) during the ENS 2023 survey, Leg 1, 2 and 3 in the Danish North Sea.

2. Introduction and purpose

GEUS has carried out a geophysical survey as part of a geological screening for offshore wind farms for the Danish Energy Agency (DEA) in 2023. The survey, hereafter referred to as the ENS2023 survey, includes most of the Danish North Sea. The data acquisition comprised single and multichannel sparker seismic and multibeam echo sounder, side scan sonar and sub-bottom profiler to support the seismic mapping.

The purpose of the survey was to acquire geophysical data in regions with lack of data and geological information aiming to establish a better basis for developing conceptual geological models and mapping geological units of importance for offshore wind farm development.

An overview of the planned lines with line names, planned and actual acquired length can be seen in Table 1. Details on the data acquisition are included in the survey log in Appendix A.

Table 1. Overview of the survey lines sailed during the ENS 2023 survey. Details are included in Appendix A.

Line name	Planned length (km)	Acquired length (km)	% achieved
NS_01	31,2	31,2	100
NS_02	18,0	18,0	100
NS_03	28,7	28,7	100
NS_04	15,4	15,4	100
NS_05	48,6	48,6	100
NS_06	Transit		
NS_07	45,7	45,7	100
NS_08	58,1	58,1	100
NS_09	51,1	51,1	100
NS_10	114,3	114,3	100
NS_11	62,7	62,7	100
NS_12	Transit		
NS_13	150,0	150,0	100
NS_14	185,9	185,9	100
NS_15	39,0	39,0	100
NS_16	214,2	214,2	100
NS_17	128,1	128,1	100
NS_18	95,3	91,5	96,0
NS_19	69,4	69,4	100
NS_20	48,7	48,7	100
NS_21	Transit		
NS_22	Transit		
NS_23	112,1	112,1	100
NS_24	Transit		
NS_25	33,8	33,8	100
NS_26	Transit		

NS_27	95,6	95,6	100
NS_28	29,4	29,4	100
NS_29	134,8	134,8	100
NS_30	55,1	55,1	100
NS_31	35,0	35,0	100
NS_32	135,1	135,1	100
NS_33	62,2	62,2	100
NS_34	26,9	26,9	100
NS_35	Transit		
NS_36	41,3	41,3	100
NS_37	18,8	18,8	100
NS_38	Test		
NS_39	208,0	208,0	100
NS_40	51,8	51,8	100
NS_41	202,5	174,5	86,1
NS_42	97,6	61,1	62,5
NS_43	161,4	161,4	100
NS_44	52,8	52,8	100
NS_45	64,8	64,8	100
NS_46	68,0	68,0	100
NS_47	69,2	69,2	100
NS_48	21,3	21,3	100
NS_49	37,3	0	0
NS_50	102,8	0	0
NS_51	36,2	0	0
NS_52	34,4	0	0
NS_53	47,6	0	0
NS_54	113,1	0	0
NS_55	98,1	0	0
NS_56	20,8	0	0
NS_57	111,3	0	0
NS_58	125,1	0	0
NS_59	151,7	0	0
NS_60	114,8	0	0
NS_61	88,4	0	0
NS_62	101,0	0	0
NS_63	20,5	0	0
NS_64	14,8	0	0
In total	**4399,8**	**3113,6**	**70,8 %**

3. Overview of survey activities

The ENS 2023 survey was carried out on board the survey vessel Arctic Ocean (Figure 2) provided by Foga Consult ApS. The survey includes multibeam bathymetry, side scan sonar, sub-bottom profiler and single and multichannel sparker seismic.

Figure 2. Survey vessel Arctic Ocean.

Mobilization of the geophysical equipment on board Arctic Ocean took place in Esbjerg harbor from May 4 to May 7. The subsequent survey was implemented in three legs with crew changes between legs.

Leg 1
Acquisition started off Blåvandshuk on May 8 and continued in the eastern, central and western Danish North Sea through May 15 in good weather conditions. A total of 1401 km of data were acquired before Leg 1 ended with GEUS crew change in Hanstholm on May 16.

Leg 2
Leg 2 started off Hanstholm on May 18 after two days of weather standby. A GAMS calibration of the positioning system and patch test of the EdgeTech multibeam echosounder were performed upon departure from Hanstholm. Subsequent data acquisition was focused on the central and western North Sea. Strong winds and high seas in the western part of the Danish North Sea forced a transit to Jammerbugt towards the end of the leg. A total of 780 km of geophysical data were acquired along planned lines during Leg 2 in good to very good weather conditions before a GEUS crew change in Hirtshals on May 24.

Leg 3
Leg 3 acquisition started in the eastern part of the Danish North Sea on May 26 after two days of weather standby and transit to Thyborøn and later to the survey area. The data acquisition was focused on the central and western North Sea until strong winds and high seas in the west again forced a transit to Jammerbugt towards the end of the leg. A total of 933 km of geophysical data were acquired along planned lines during Leg 3 in good to challenging weather conditions before the ENS 2023 survey was finished in Hirtshals on June 2.

In total 3114 km of geophysical data were acquired out 4400 km along planned survey lines (Figure 1, Table 1). Navigation data were collected in WGS84, UTM32N. A general overview of the survey activities is included in Table 1 and a detailed survey log in Appendix A, contains further details on the progress.

During the survey, requirements from the Danish Energy Agency regarding marine mammals were followed. First of all, no seismic shooting and data recording took place in Natura 2000 areas designated based on marine mammals, including an extra 5 km buffer zone around these. In addition, Marine Mammal Observation (MMO) and Passive Acoustic Monitoring (PAM) (Figure 3) were performed before data acquisition started. The procedure comprised 30 minutes of MMO and PAM watch before the sparker seismic source was switched on. Once the MMO and PAM watches were completed without detection marine mammals, a 55 minute soft start procedure was applied where the sparker shooting was kept at minimum power, i.e., 100 J, with 1 shot every 2 seconds. When the soft start protocol was completed, the seismic shooting was adapted to the survey acquisition parameters (400 J, 2 shots every second).

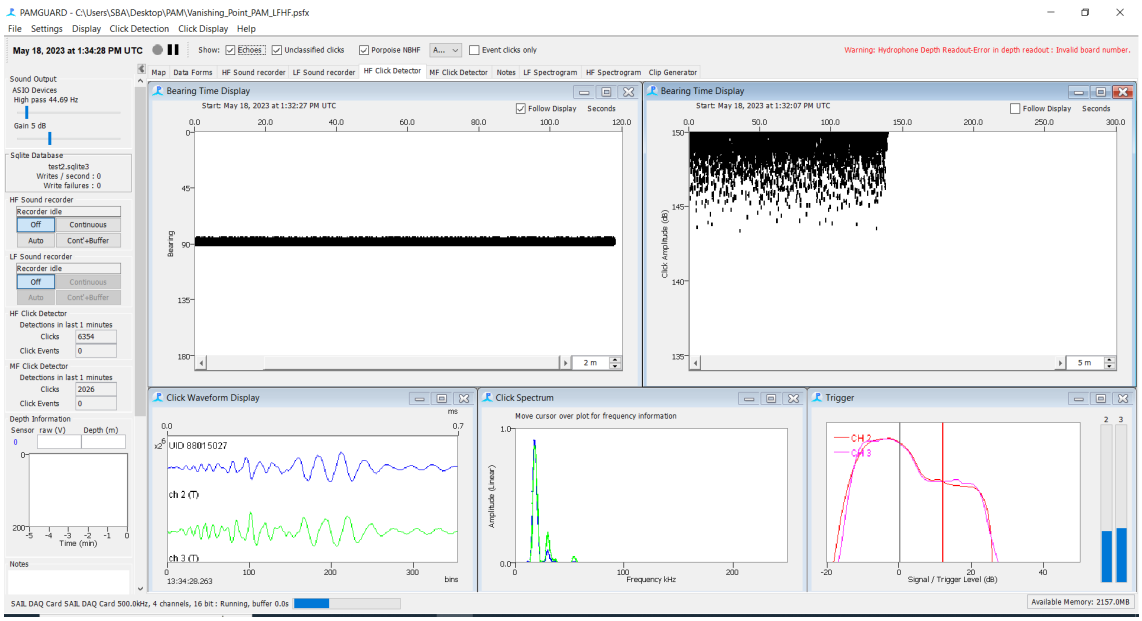


Figure 3. Passive Acoustic Monitoring interface during the ENS 2023 survey.

4. Personnel

Apart from the professional ship crew, GEUS had 4 people manning each leg of the ENS 2023 survey with the GEUS personnel being responsible for the geophysical data acquisition and quality control.

Two technicians carried out the mobilization and the sailing crew was formed by one cruise lead, one technician and two surveyors (one surveyor and one trainee on Leg 2 and 3). Data acquisition, quality control, reporting and data processing were carried out 24/7 during survey with fixed watches on the data acquisition and floating watches on the reporting and data processing. The complete list of GEUS personnel was as follows:

Mobilization

- Lars-Georg Rödel (Technician)
- Sigurd Bøgelund Andersen (Technician)

Leg 1

- Thomas Vangkilde-Pedersen (Cruise lead)
- Sigurd Bøgelund Andersen (Technician)
- Luna Holland Winther (Surveyor)
- Rasmus Ørnekoll Stenshøj (Surveyor)

The schedule for fixed watches was as follows:

- 00:00-03:00 / 12:00-15:00 Rasmus Ørnekoll Stenshøj
- 03:00-06:00 / 15:00-18:00 Luna Holland Winther
- 06:00-09:00 / 18:00-21:00 Thomas Vangkilde-Pedersen
- 09:00-12:00 / 21:00-24:00 Sigurd Bøgelund Andersen

Leg 2

- Lara F. Perez (Cruise lead)
- Sigurd Bøgelund Andersen (Technician)
- Nicklas Christensen (Surveyor)
- Lisbeth L. Pedersen (Trainee)

The schedule for fixed watches was as follows:

- 00:00-03:00 / 12:00-15:00 Lisbeth L. Pedersen
- 03:00-06:00 / 15:00-18:00 Nicklas Christensen
- 06:00-09:00 / 18:00-21:00 Lara F. Perez
- 09:00-12:00 / 21:00-24:00 Sigurd Bøgelund Andersen

Leg 3

- Niels Nørgaard-Pedersen (Cruise lead)
- Rasmus Andersen (Technician)
- Lis Allaart (Surveyor)
- Leonie Everding (Trainee)

The schedule for fixed watches was as follows:

- 00:00-04:00 / 12:00-16:00 Niels Nørgaard-Pedersen
- 04:00-08:00 / 16:00-20:00 Lis Allaart
- 08:00-12:00 Leonie Everding
- 20:00-24:00 Rasmus Andersen

5. Equipment

The Geophysical equipment used during the ENS 2023 survey is summarized in Table 2. Survey lines were defined in the HyPack64 2022 software.

Table 2. Summary of the equipment on board Arctic Ocean during the ENS 2023 survey.

Geophysical equipment	
Combined Multibeam echosounder and Side scan sonar	EdgeTech 6205
Sub-bottom profiler	Innomar SES 2000 Medium
Sound Velocity Profiler	Valeport Mini CTD
Positioning/Motion sensor system	Applanix PosMV v.5 and Seatex MRU-5-E Motionsensor
Sparker single channel streamer	GeoSense 1 channel, 8 elements, High resolution streamer
Sparker multichannel streamer	GeoEel LH 16 48 channels, 50 m
Sparker source	Geo-Spark 200
Sparker power supply	Geo-Spark 1000

5.1 Ship setup

The setup of the geophysical equipment relative to the ship is shown in Figure 4. See Table 3 for offset values for the different antennas and sensors.

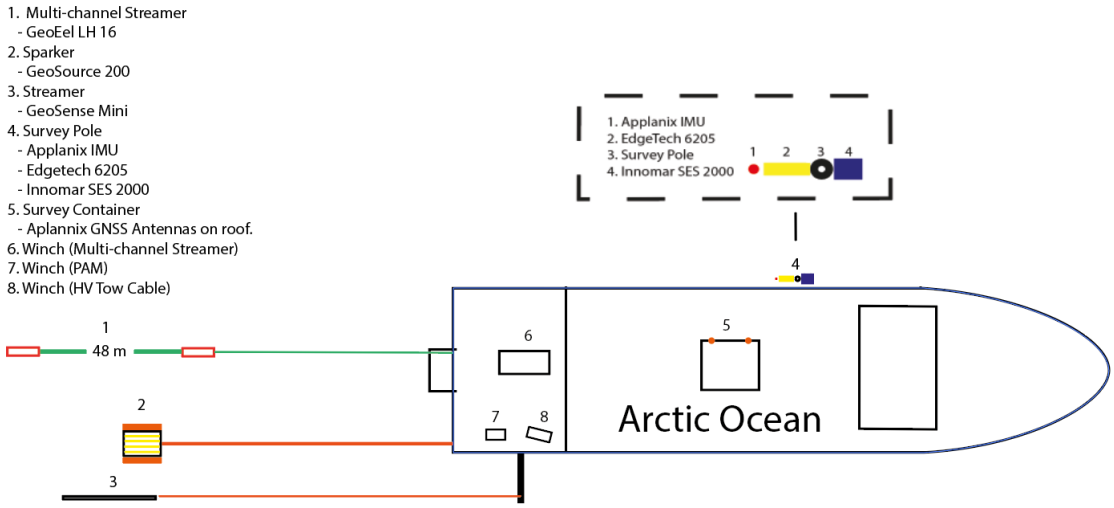


Figure 4. Sketch of the arrangement of the geophysical equipment on board Arctic Ocean during the ENS 2023 survey. The IMU unit of the Applanix PosMV system, located directly on the survey pole on the port side, was used as positioning reference point (PRP). The length of the passive acoustic monitoring (PAM) streamer was 100 m, and it was towed from the stern in starboard side.

Table 3. Offset values for antennas and sensors.

Object	X (m) starboard pos.	Y (m) aft negative	Z m up negative
Applanix PosMV IMU	0,00	0,00	0,00
Edgetech 6205	0,00	0,35	0,45
Innomar SES 2000 Medium	0,00	0,95	0,25
Primary GNSS antenna	3,76	-1,14	-10,41
Secondary GNSS antenna	3,74	-3,15	-10,41
Sparker source	9	-54	-
Single channel streamer	12,5	51,5 (active length 2,5)	-
Multichannel streamer	4	48 (ch. 1), 54 (ch. 6)	-

The IMU unit of the Applanix PosMV system, located below the water line directly on the survey pole on the port side, was used as positioning reference point (PRP). The sparker was towed with a layback of 54 m from the PRP, and the tow point was 9 m starboard of the PRP. The single channel streamer was towed with a layback of 51,5 m (for first hydrophone out of eight) and 54 m (for last hydrophone out of eight) from the PRP, and the tow point was 12,5 m starboard of the PRP. The multichannel streamer was towed with a layback of 48 m (48 m for channel 1 and 54 m for channel 6) from the PRP, and the tow point was 4 m starboard of the PRP. The length of the passive acoustic monitoring (PAM) streamer was 100 m and it was towed from the stern in starboard side.

5.2 Applanix PosMV positioning and motion sensor system

The GPS antennas for the Applanix PosMV positioning and motion sensor system (Figure 5) for the geophysical mapping was located on the roof of GEUS' survey container on the upper deck of Arctic Ocean (Figure 4). The Inertial Motion Sensor (IMU) unit was placed directly on the pole for the EdgeTech multibeam/side scan unit and the IMU was chosen as the positioning reference point (PRP). The Applanix PosMV merges position data from the Global Navigation Satellite System (GNSS) and NTRIP RTK corrections with angular rate and acceleration data from the IMU, together with heading from the GNSS Azimuth Measurement System (GAMS) to produce a robust and accurate full six degrees-of-freedom position and orientation solution. The positioning and motion sensor data were distributed to the respective acquisition software using HyPack64 2022 software.

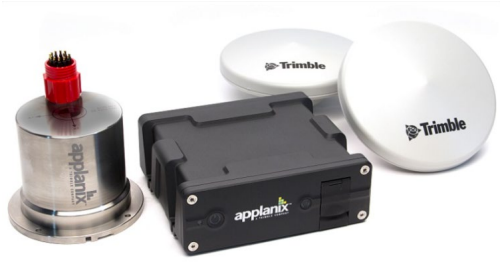


Figure 5. The Applanix PosMV positioning and motion sensor system.

5.2.1 GAMS calibration test

A GAMS calibration of the positioning system is required to check the offsets of the primary and secondary antennas of the GNSS and their correlation with the land observations during mobilization. The GAMS test was carried out at the beginning of Leg 2. A heading calibration test was therefore performed on the PosMV unit on May 18 off Hanstholm near the Lysegrund raw material area (Figure 6). During the GAMS calibration, the ship sailed sharp turns and figures of eight at variable speed. After the GAMS calibration the baseline vector was adjusted to: X component = -1.997 m, Y component = -0.130 m, Z component = -0.034 m with 0 degrees heading correction and a heading calibration threshold of 0.500 degrees. The new values were used during Leg 2 and Leg 3 and the deviation from the standard values used during Leg 1 (X=-1.999; Y=0; Z=0) is so small, that no further correction is needed for Leg 1 data.

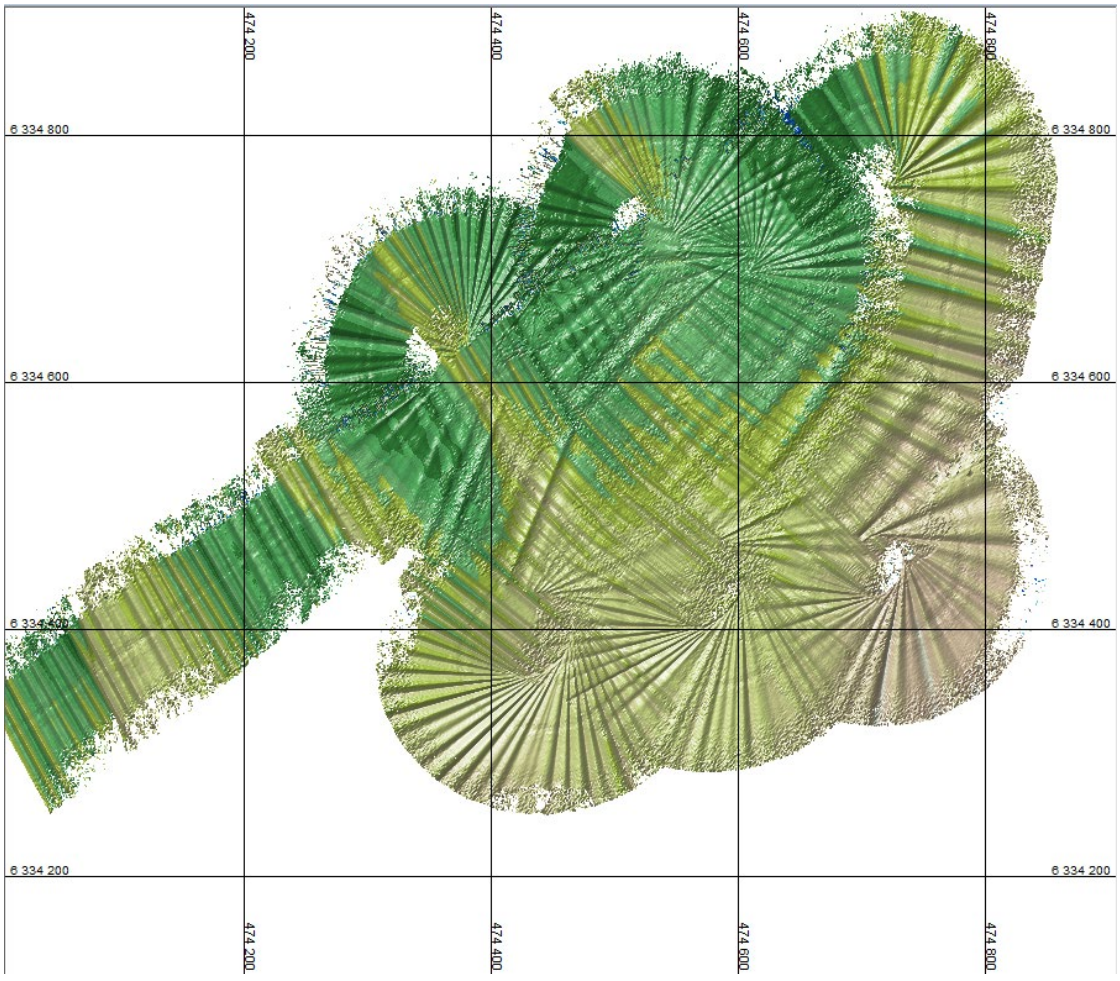


Figure 6. Figures of eight sailing pattern to the right for the GAMS test during the ENS 2023 survey.

5.3 EdgeTech 6205 multibeam and side scan sonar

The EdgeTech 6205 was mounted on a pole on the port side of the ship. The sensors of the EdgeTech were located 0,45 m below the positioning reference point (PRP). The combined multibeam and side scan sonar EdgeTech operates on two channels: one low frequency (LF) and one high frequency (HF). The recording range was 100 m or 150 m to each side, i.e. a

total width of 200 m or 300 m (Table 4). A screenshot of the recording window can be seen in Figure 7.

Table 4. Specifications of the Edgetech 6205 multibeam and side scan sonar.

Center Frequency	230/550 kHz
Recording range (per side)	100 or 150 m
Depth (acoustic center) below PRP	0,45 m
Pingrate	100 % of possible rate (depending on water depth)

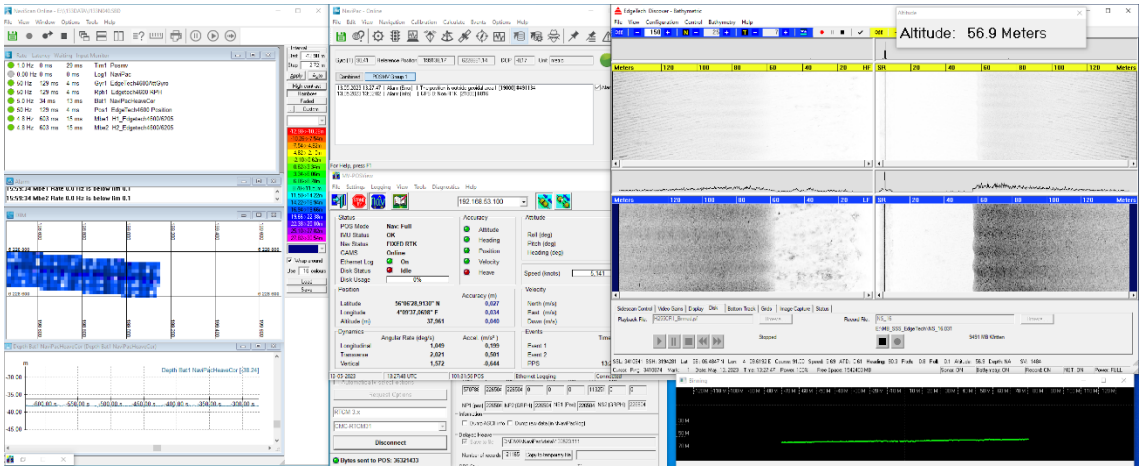


Figure 7. Screenshot of the recording window of the EdgeTech multibeam and side scan sonar.

5.3.1 Sound velocity profiles (SVP)

23 sound velocity profiles (SVP) were obtained during the ENS 2023 survey (Appendix A). The profiles were obtained with a Valeport Mini CTD probe manually dropped to the seafloor with a ship speed close to 0 kn. The SVPs were widespread across the survey areas and taken roughly every 24 hours, in order to ensure adequate coverage of velocity measurements in the water column to calibrate the multibeam data (Figure 8).

Unfortunately, 7 SVP measurements taken during Leg 3 of the survey did not include any valid data due to a technical error. However, this will not have any significant impact on the final quality of the multibeam data and no impact on the geological screening.

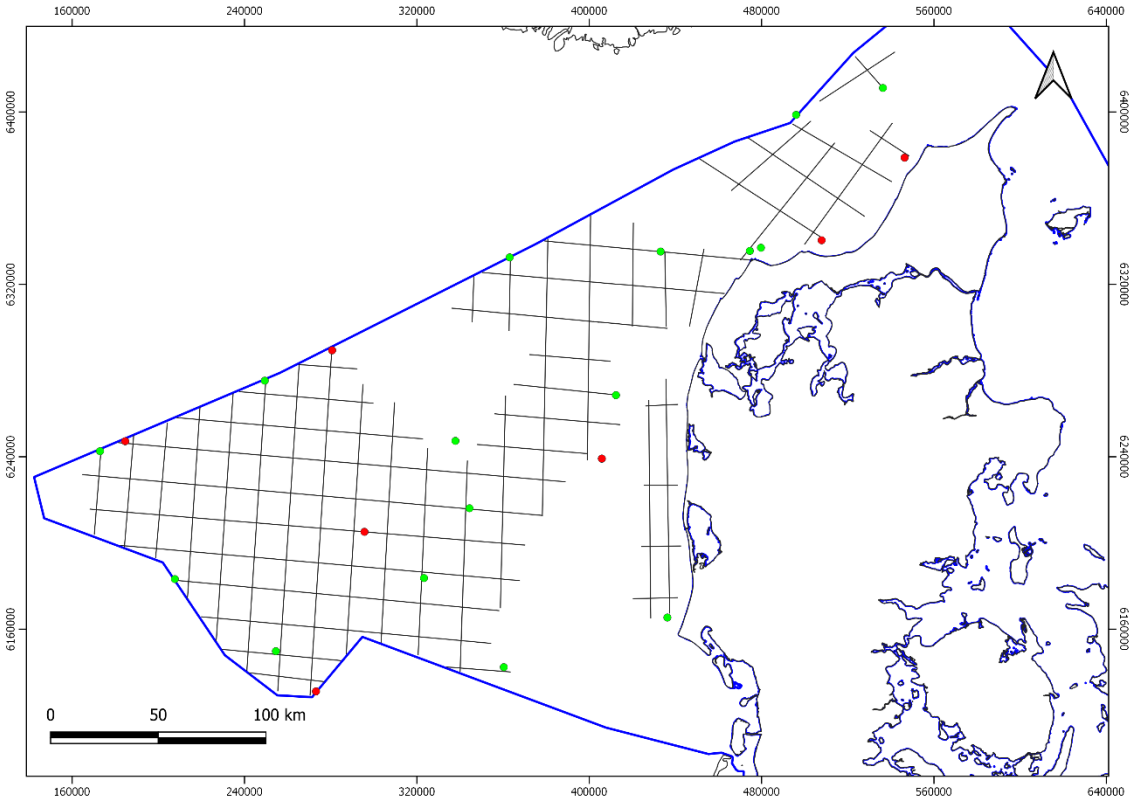


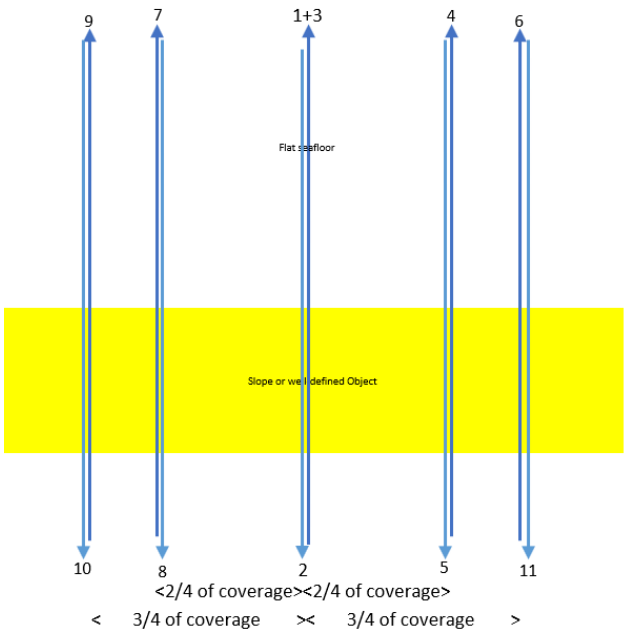
Figure 8. Location of the SVP measurements (marked with green and red) obtained during the ENS 2023 survey, see also Appendix A. Seven SVP measurements taken during Leg 3 and marked with red did not contain valid data due to a technical error.

5.3.2 Patch test

A Calibration of the multibeam system through a patch test was performed to 1) determine the mount angles of the multibeam transducer (roll, pitch and heading) in relation to the local coordinate system and the IMU; and 2) confirm the relationship between the time tagging on the multibeam and position data.

A standard patch test for a dual head multibeam was implemented. Calibration of the time validation, pitch, roll and heading requires a navigation pattern consisting of 5 parallel lines that are perpendicular to a sharp linear morphological feature (Figure 9). During the ENS 2023 survey, a sand bank located offshore Hanstholm served as morphological feature for the patch test performed on May 18 during 2 hours and 30 minutes (Figure 9).

The navigation during the patch test fulfil the calibration of: a) time validation: lines surveyed at survey speed and repeated with the same heading at twice the speed; b) pitch: three lines was surveyed twice with opposite headings at survey speed; c) roll: a line was surveyed with opposite headings at identical survey speed on flat seafloor; and d) heading: two parallel lines were surveyed with the same heading with approximately 3/4 of the full coverage in separation allowing swath overlap.



Calibration type	Lines
Time	1+3
Pitch_0 (Port)	7+8, 1+2 or 4+5
Roll_0 (Port)	7+2 or 1+5
Heading_0 (Port)	9+7 or 5+11
Pitch_1 (Starboard)	7+8, 1+2 or 4+5
Roll_1 (Starboard)	4+2 or 1+8
Heading_1 (Starboard)	4+6 or 8+10

Figure 9. Predefined sailing pattern of a patch test to determine the mount angles and time validation. Light blue and dark blue arrows illustrate the sailing lines in opposite directions for the four calibration types (time, roll, pitch and heading).

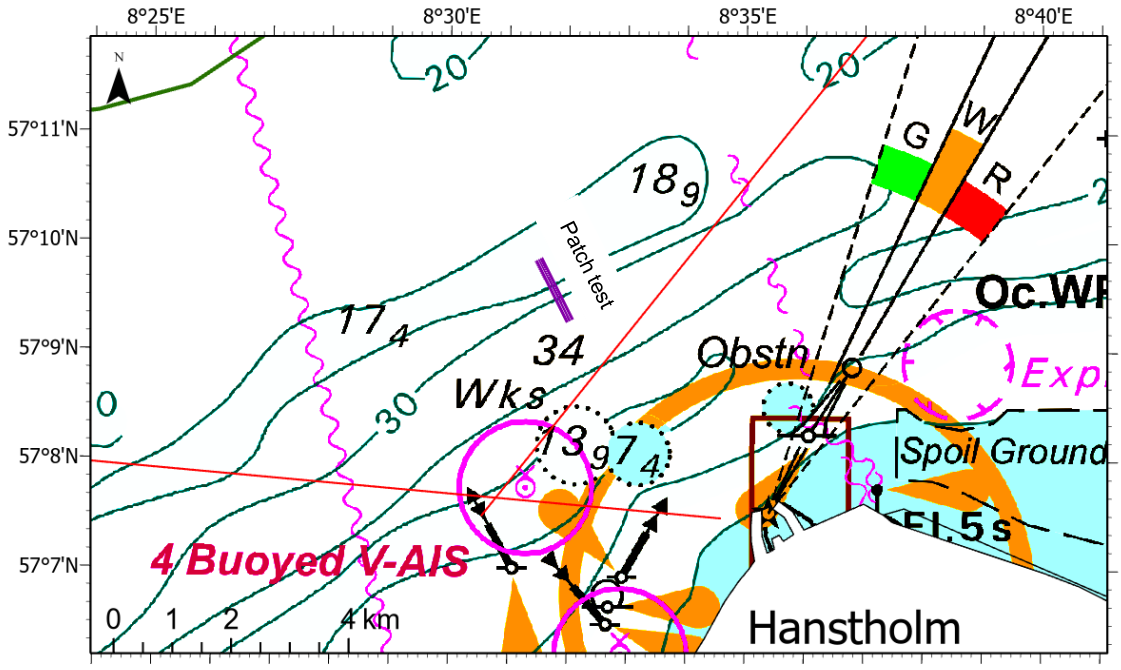


Figure 10. Location of the patch test lines during the ENS 2023 survey offshore Hanstholm shown in dark purple.

5.4 Innomar SES 2000 Medium (Sub-bottom profiler)

The Innomar SES 2000 sub-bottom profiler was also mounted on the port pole in front of the EdgeTech and 0,25 m below the positioning reference point (PRP). A separate Seatex MRU 5 motion reference unit for the Innomar was placed directly on top of the pole. The Innomar was operated in a low frequency band from 2-22 kHz with a center frequency of 12 kHz and

a high frequency band from 85-115 kHz with a center frequency of 100 kHz. The trigger interval was synchronized with the multibeam, and thus changing with depth. The recording window was set to 51 m, but the penetration of the Innomar record in the North Sea area was generally low and only a few meters under the seafloor. Table 5 show the sub-bottom profiler settings and the recording window can be seen in Figure 11.

Table 5. General settings of the Innomar sub-bottom profiler system.

Primary frequencies	12 kHz and 100 kHz
Recording window	51 m
LF Gain	0 dB
HF Gain	0 dB
Trigger interval	Synchronized with EdgeTech
Depth (acoustic center) below PRP	0,25 m
Pulse energy level	2 (possible range 1-5)

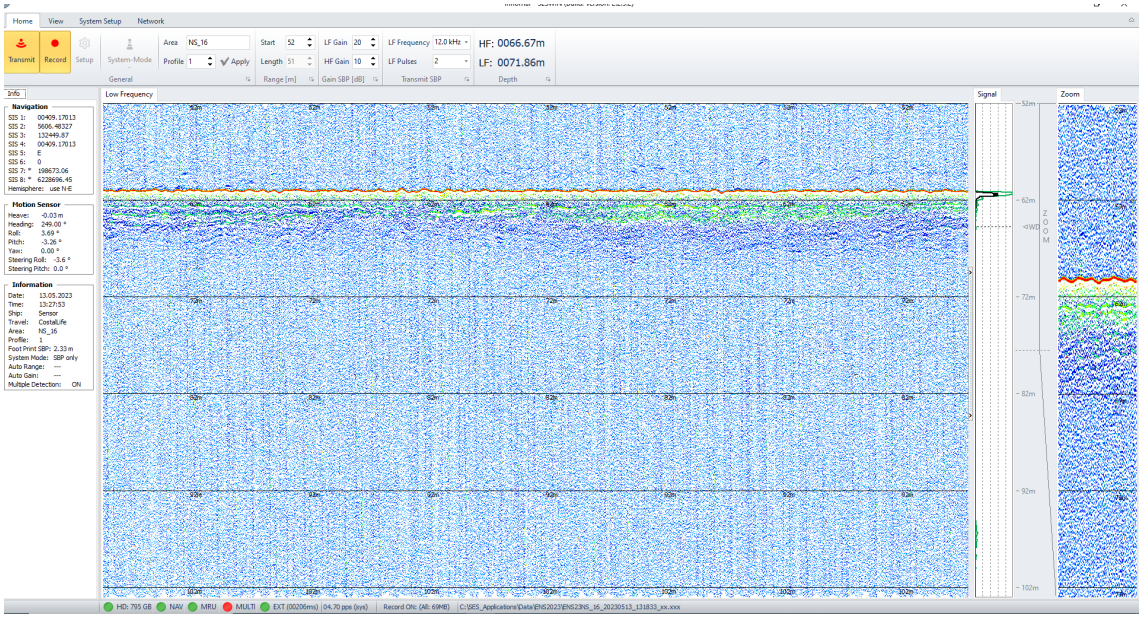


Figure 11. Screenshot of the Innomar sub-bottom profiler recording window.

5.5 Seismic system

The seismic system consisted of a sparker, a multichannel streamer and a single channel streamer.

The source was a Geo-Source 200 sparker towed after the ship with a layback of approximately 54 m relative to the Applanix PosMV IMU chosen to be the positioning reference point (PRP). The tow point was 9 m starboard of the PRP. The output from the Geo-Spark 1000 sparker power supply was 400 J during survey.

The seismic data were recorded through a single channel Geo-Sense 8 streamer and a multichannel 50 m Geo-Eel 48 channel streamer.

The single channel streamer was towed with a layback of 51,5 m (for first hydrophone out of eight) and 54 m (for last hydrophone out of eight) from the PRP, and the tow point was 12,5 m starboard of the PRP. For line NS_01 to NS_16, the layback was 56,5 m and 59 m for first and last hydrophone, respectively.

The multichannel streamer was towed with a layback of 48 m (48 m for channel 1 and 54 m for channel 6) from the PRP, and the tow point was 4 m starboard of the PRP. For line NS_01, the multichannel streamer layback for channel 1 was 54 m.

The seismic data was recorded with a Mini-Trace II acquisition system and GeoSuite acquisition software (single channel) and a Geometrics Geo-Eel power supply and Geometrics acquisition software (multichannel). Specifications of the seismic system are summarized in Table 6 and screenshots of the recording windows can be seen in Figure 12 and Figure 13.

The length of the passive acoustic monitoring (PAM) streamer was 100 m and it was towed from the stern in starboard side.

Table 6. Specifications of the seismic acquisition system.

Power Supply	Geo-Spark 1000
Power output	400 J
Sparker source	Geo-Source 200
Layback from positioning reference point	54 m
Offset from positioning reference point	9 m to starboard
Firing interval	0,5 s
Multichannel Streamer	Geo-Eel 48 channels, 50 m
Layback from positioning reference point	48 m ch.1, 54 m ch. 6 (54 m ch. 1 for line NS_01)
Offset from positioning reference point	4 m to starboard
Single channel Streamer	Geo-Sense 8 element single channel
Layback from positioning reference point	51,5 m (first hydrophone) active length 2,5 m (for line NS_01 to NS_16 56,5 m (first hydrophone)
Offset from positioning reference point	12,5 m to starboard
Acquisition unit multichannel	Geometrics Geo-Eel power supply and acquisition software
Sample interval	0,125 ms
Recording delay	0 ms
Record length	412 ms
Acquisition unit single channel	Minitrace II recording unit and GeoSuite software
Sample interval	0,1 ms
Recording delay	3 ms
Record length	400 ms

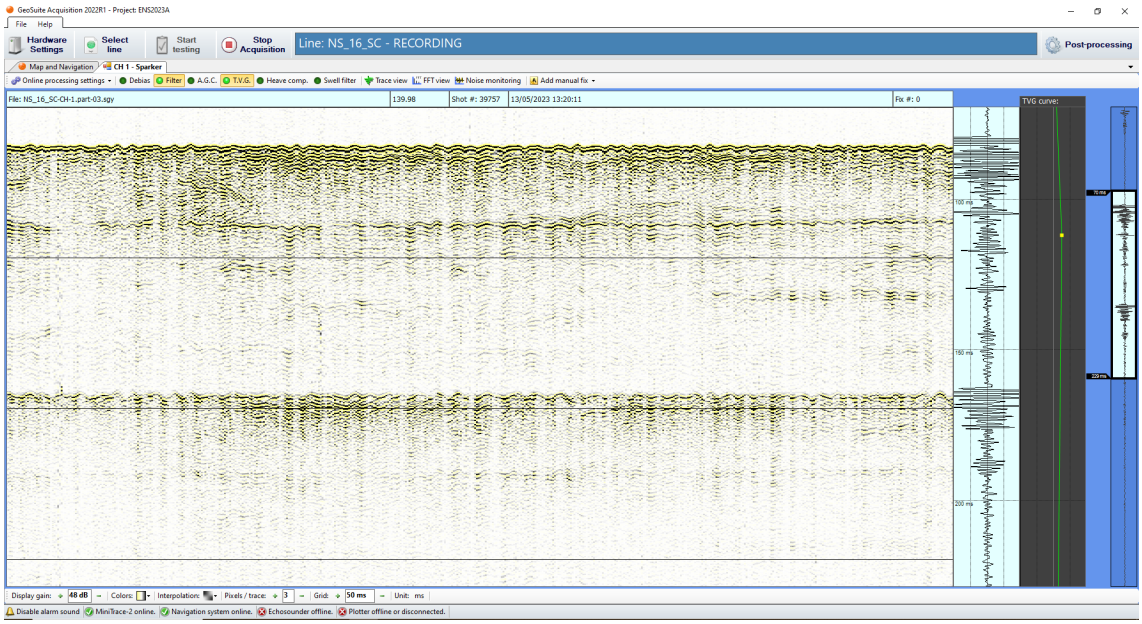


Figure 12. Screenshot of the recording window of the GeoSuite single channel sparker acquisition software.

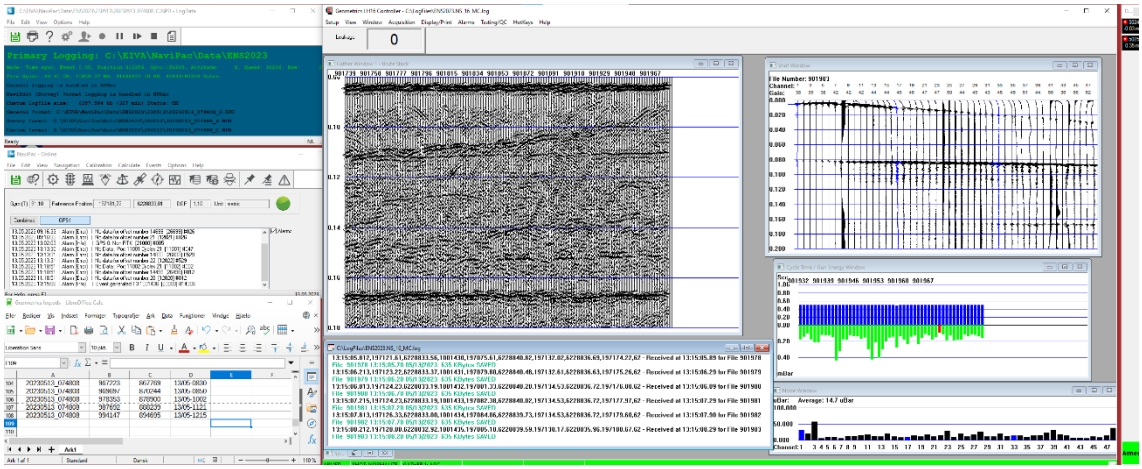


Figure 13. Screenshot of the recording window of the Geometrics multichannel sparker acquisition software.

6. Unintended events

The general overview of the survey activities during the ENS 2023 survey appears from Table 1 and the survey log in Appendix A. Survey activities ran according to plans and the only delays were related to weather and sea conditions, with a total of four days of weather standby during the survey. At the end of the survey, it was discovered that 7 SVP measurements taken during Leg 3 of the survey did not include any valid data due to a technical error. However, this will not have any significant impact on the final quality of the multibeam data.

7. Survey activity report

The GEUS survey team headed by the GEUS cruise lead was responsible for the geophysical data acquisition, backup and onboard quality control of the acquired data. The GEUS cruise lead managed the overall planning and daily/weekly reporting and the GEUS technician was responsible for the technical performance of the equipment.

During the ENS 2023 survey, geophysical data were acquired in most of the Danish North Sea, in total 3114 km along the 4400 km of planned lines. Data acquired during Leg 1 include 1401 km, during Leg 2 780 km and during Leg 3 933 km. Single channel sparker seismic data were processed on board, while a selected section of the multichannel sparker seismic data were submitted to an external consultant (Aarhus University) for preliminary processing and quality control (Figure 14). The examples in the following sections are excerpts from processed single channel sparker lines since the multichannel processing will only be done in the following months after the survey.

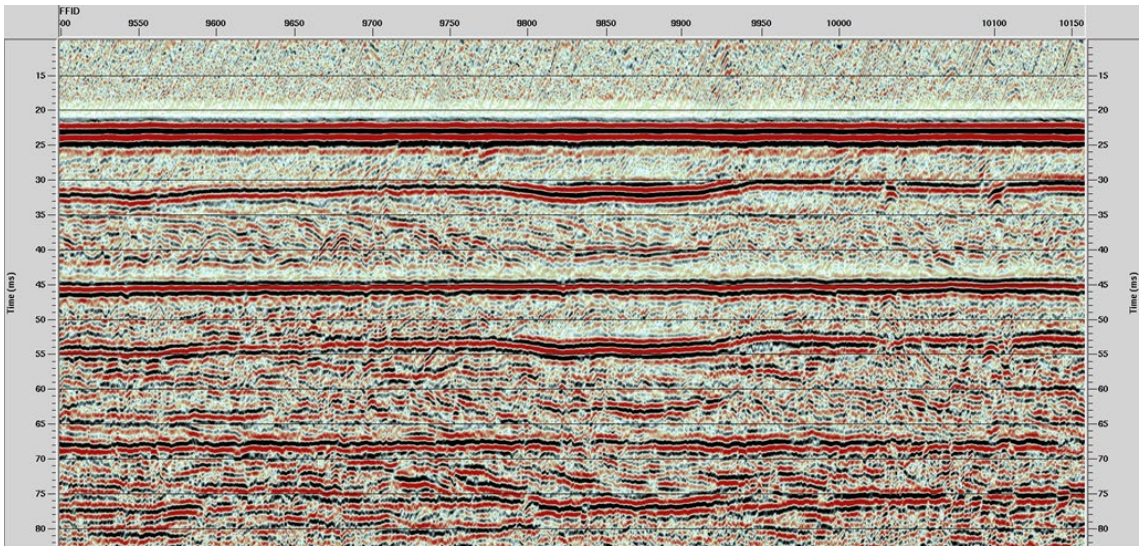


Figure 14. Processed section of multichannel sparker seismic test line from the ENS 2023 survey.

7.1 Leg 1

The survey activities of Leg 1 of the ENS 2023 survey (Figure 15) were conducted between May 8 and May 16 (Appendix A). The weather conditions were generally good to very good and data acquisition took place without interruptions and with good data quality (Figure 16). In total 1401 km of data were acquired along the planned survey lines, corresponding to 32 % of the planned lines (Table 1).

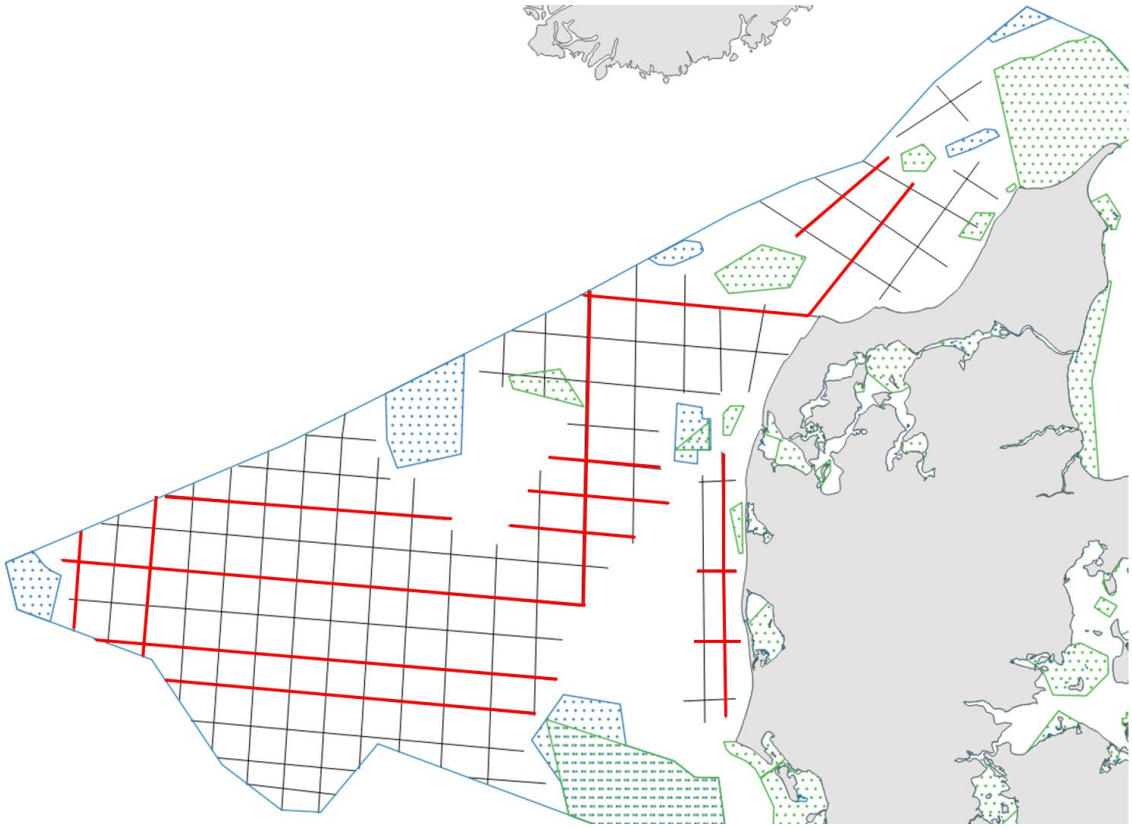


Figure 15. Data acquisition along planned seismic lines (thin black lines) during Leg 1 of the ENS 2023 survey shown with thick red lines.

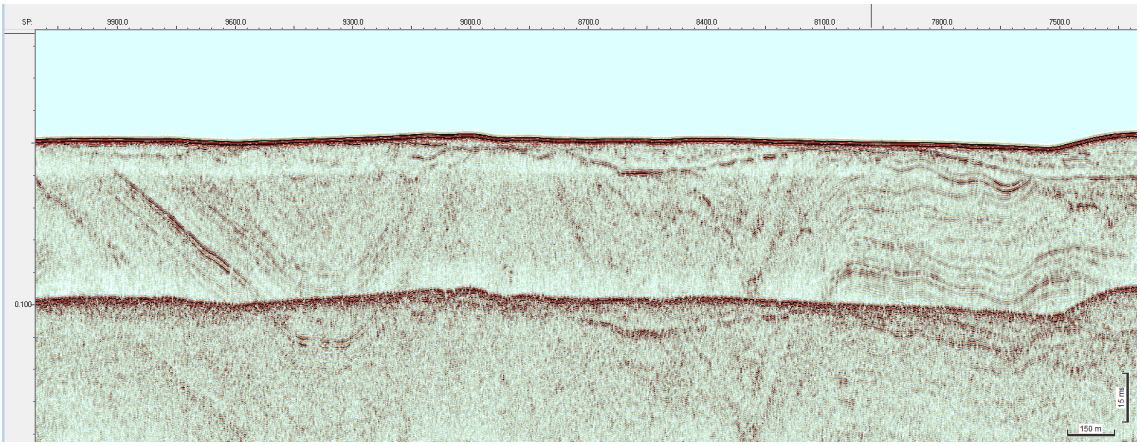


Figure 16. Example of single channel sparker seismic profile from line NS_09 acquired during Leg 1.

7.2 Leg 2

The survey activities of Leg 2 of the ENS 2023 survey (Figure 17) were conducted between May 18 and May 24 (Appendix A) after two days of weather standby between May 16 and May 18. Weather conditions were good to very good. However, strong winds (>13 m/s) and high seas (>2 m waves) in the west forced a transit to Jammerbugt towards the end of the leg, but data acquisition was only interrupted during the transit between western and eastern North Sea. Data quality was good to very good (Figure 18). In total 780 km of data were

acquired along the planned survey lines, corresponding to 18 % of the planned lines (Table 1).

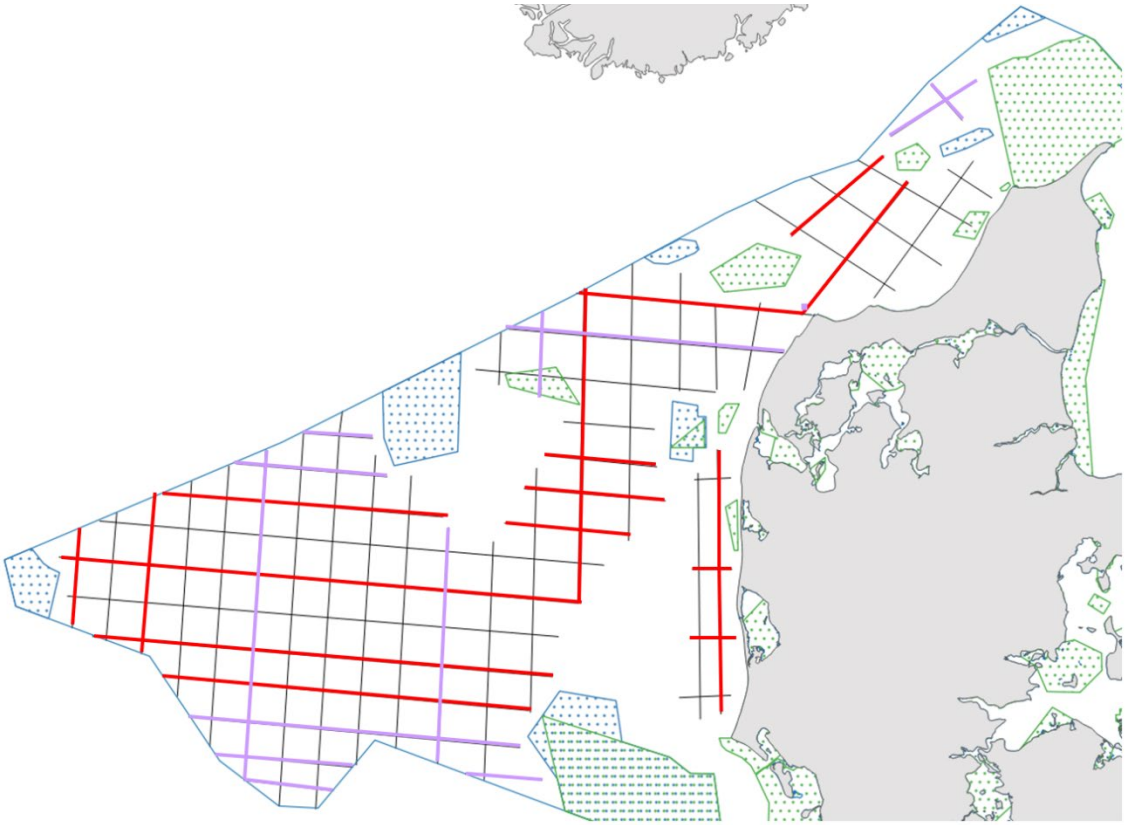


Figure 17. Data acquisition along planned seismic lines (thin black lines) during Leg 2 of the ENS 2023 survey shown with thick purple lines (Leg 1 in red). Patch test area also marked in purple.

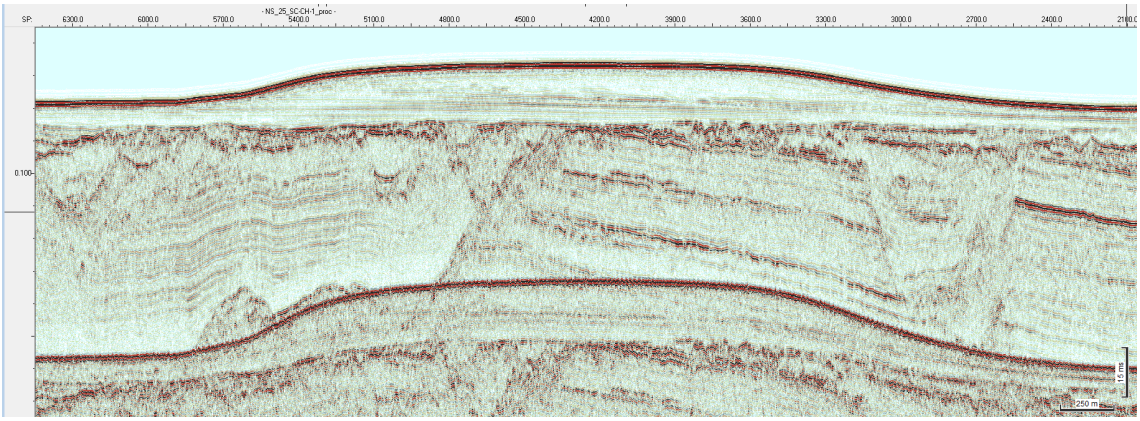


Figure 18. Example of single channel sparker seismic profile from line NS_25 acquired during Leg 2.

7.3 Leg 3

The survey activities of Leg 3 of the ENS 2023 survey (Figure 19Figure 17) were conducted between May 26 and June 2 (Appendix A) after two days of weather standby and transit to Thyborøn between May 24 and May 26. Weather conditions were good to challenging and strong winds and high seas again forced a transit to Jammerbugt towards the end of the leg. However, data acquisition was only interrupted during this transit between western and

eastern North Sea. Data quality was good to very good (Figure 20). In total 933 km of data were acquired along the planned survey lines, corresponding to 21 % of the planned lines (Table 1).

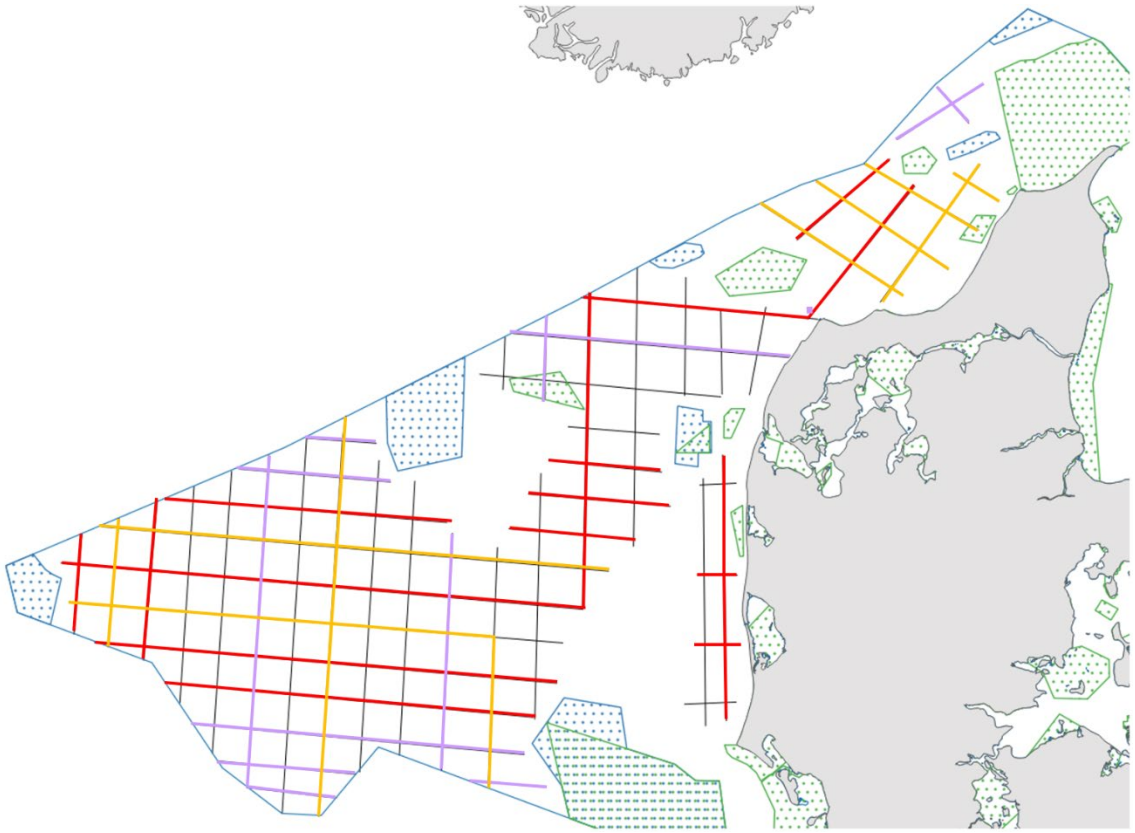


Figure 19. Data acquisition along planned seismic lines (thin black lines) during Leg 3 of the ENS 2023 survey shown with thick orange lines (Leg 1 and 2 in red and purple, respectively).

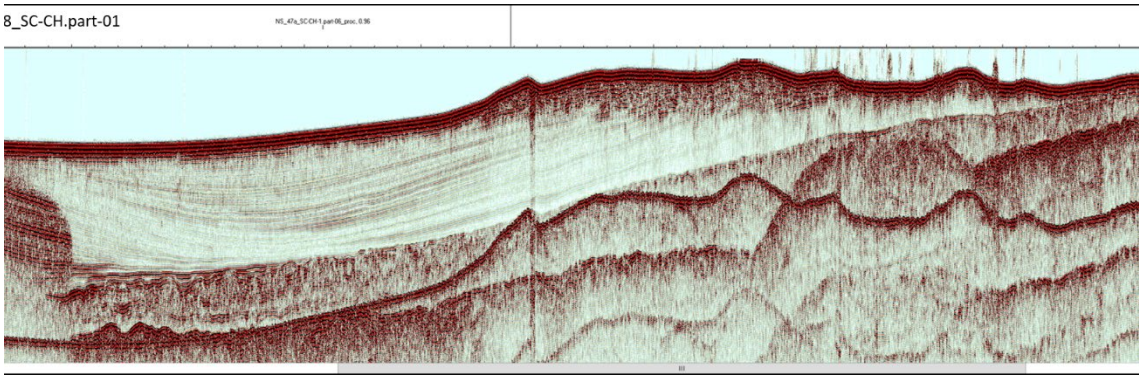


Figure 20. Example of single channel sparker seismic profile from line NS_48 acquired during Leg 3.

8. Concluding remarks

GEUS has carried out seismic fieldwork as part of a geological screening for offshore wind farms for the Danish Energy Agency (DEA) in 2023 in the Danish North Sea.

The ENS 2023 survey was completed on board the survey vessel Arctic Ocean between May 8 and June 2 and the survey was divided into three survey legs.

During Leg 1 geophysical data were collected along 1401 km of planned survey lines recording multibeam echo sounder, side scan sonar, sub-bottom profiler as well as shallow single channel and multichannel sparker seismic (Figure 1, Table 1 and Table 2). During Leg 2 geophysical data were collected along 780 km of planned survey lines and during Leg 3 along 933 km. Thus, a total of 3114 km of geophysical data were acquired along the planned survey lines (Figure 1) during the ENS 2023 survey (i.e., excluding turns and connecting lines). Details on the survey lines and transits are provided in the survey log included as Appendix A.

The ship, crew and survey equipment performed satisfactorily and there were no incidents to report. The weather conditions and weather standby only had a minor impact on the quality and quantity of acquired data. The first quality assessment of the data reveals high quality for all data and serving the purpose of the survey.

Appendix A – Survey log and SVP log

Contractor: Energistyrelsen				Project name: ENS Havvind screening - ENS 2023 survey			Vessel: Arctic Ocean (call sign OZGP2)					GEUS survey crew:					Leg 1:Thomas Vangkilde-Pedersen (tvp), Sigurd Bøgelund Andersen (sba), Luna Holland Winther (lhw), Rasmus Ørnekoll Stenshøj (raste); Leg 2: Lara F. Perez (lfp), Sigurd Bøgelund Andersen (sba), Nicklas Christensen (nichr), Lisbeth Lyngkjær Pedersen (llp); Leg 3: Niels Nørgaard-Pedersen (nnp), Rasmus Andersen (ra), Lis Allaart (lisal), Leonie Everding (leoe)
Initials	**Date**	**Start time UTC**	**End time UTC**	**Line name**	**Nav file name**	**Subbottom profiler**	**Single Channel Seismic**	**Multichannel Seismic**	**EdgeTech SSS**	**EdgeTech MB**	**Heading**	**Line length km**	**Acc. length km**	**Wind m/sec**	**Sea state**	**Backup status**	**Comments**
tvp	07-05-2023	19.08	19.25	NS_test	0002_1917	ENS23NS_test_20230507_190848	NS_test_SC	NS_test_MC	NS_test	J127N019	315	-	-	5	2	x	Test line.
tvp	08-05-2023	05.45	07.30														PAM and MMO 30 min., no observations, soft start 55 min. no observations.
lhw	08-05-2023	08.00	11.32	NS_01	0020_0800	ENS23NS_01a_20230508_075958	NS_01_SC	NS_01_MC	NS_01	J128N003	0	31,20	31,2		2	x	Recording started. Innomar recorded without syncronizing, changed to NS_01a when synchronized, SVP taken before line c. 06:12. 3 ms recording delay introduced on SC during the line and onward
lhw	08-05-2023	11.32	15.30	NS_02	0028_1129_001	ENS23NS_02_20230508_113250	NS_02_SC	NS_02_MC	NS_02	J128N015	90	18,00	49,2		2	x	Multichannel streamer retrieved to change batteries in the GPS's. SC and MC line started at: 12:35. Entered layback for sparker and SC streamer into GeoSuite (before it was not typed in/registered). GeoEel MC streamer layback changed so ch. 6 is at same layback as sparker (before it was ch. 1 at same layback as sparker).
lhw	08-05-2023	15.30	19.24	NS_03	0020_1527	ENS23NS_03_20230508_153031	NS_03_SC	NS_03_MC	NS_03	J128N027	0	28,70	77,9		2	x	
raste	08-05-2023	19.24	21.47	NS_04	0021_1926	ENS23NS_04_20230508_192430	NS_04_SC	NS_04_MC	NS_04	J128N039	270	15,40	93,3	6	3	x	Some loss in remote GPS signal (not as stable as we want it to be) .
raste	08-05-2023	21.47	04.25	NS_05	0020_2147	ENS23NS_05_20230508_214757	NS_05_SC	NS_05_MC	NS_05	J128N047	359	48,60	141,9	10	3	x	Less frequent "Signal loss" errors on NaviPac MC GPS in the beginning. Around 01:24 data loss again (GPS: 6229405, 436241), backup started, SC acquisition stopped, restarted on 05a, and 05b around 01:45
tvp	09-05-2023	04.25	07.30	NS_06	0052_0427	ENS23NS_06_20230508_042509	NS_06_SC	NS_06_MC	NS_06	J129N014	275	-	-	10	3	x	SC acquisition restarted as 06a around 06:41, 2 SVP taken at start of line NS_07 around 07:15. Old fishing buoy caught in pole. Pole up to remove buoy before start of line NS_07 around 07:30
tvp	09-05-2023	08.00	13.36	NS_07	0052_0801	ENS23NS_07_20230509_080439	NS_07_SC	NS_07_MC	NS_07	J129N024	275	45,70	187,6	10	3->4	x	
lhw	09-05-2023	13.36	22.21	NS_08	0053_1336	ENS23NS_08_20230509_133934	NS_08_SC	NS_08_MC	NS_08	J129N041	95	58,10	245,7	10	4->3	x	21:12 Geometrics LogFiles event/file problem, NaviPac restartet. 21:30 NaviPac restartet again after LogFiles problem caused by NaviPac helmsman display.
raste	09-06-2023	22.21	06.16	NS_09	0050_2217	ENS23NS_09_20230509_221817	NS_09_SC	NS_09_MC	NS_09	J129N068	274	51,10	296,8	7	3	x	23:42 SC stopped. New line created "NS_09a_SC".
tvp	10-05-2023	06.16	22.24	NS_10	0038_0616	ENS23NS_10_20230510_061629	NS_10_SC	NS_10_MC	NS_10	J130N018	275	114,30	411,1	6->3	3->2	x	SVP 07:20. MiniTrace II restarted as 10a 10:36. At 17:25 minor 90 deg. deviation from line to check influence of wave direction on sparker source strength. From line NS_10d_SC to NS_10e_SC, the 3 ms time delay in aquisition was removed - this was done in order to obtain a better spiking deconvolution in the processing. NaviPac- ENS2023 restarted 19:45. GPS1 (Applanix) antenna hight was 2 m and should be about 42 m.
raste	10-05-2023	22.24	05.55	NS_11	0034_2221	ENS23NS_11_20230510_222518	NS_11_SC	NS_11_MC	NS_11	J130N067	184	62,70	473,8	5	3	x	MV_POSView closed down 00:05 after error messages writing "Access violation at address 00414DA4 in module "MV_POSView.exe". Read of address 69565513. Numbers and names varied across the alarm errors. Re-opened MV-POSView and re-connected to ethernet at 00:07. MV-POSView files stored in default dir. (to be located).
tvp	11-05-2023	05.55	07.27	NS_12	0035_0554	ENS23NS_12_20230510_055506	NS_12_SC	NS_12_MC	NS_12	J131N018	135	-	-	2	2	x	
tvp	11-05-2023	07.27	00:17	NS_13	0043_0725	ENS23NS_13_20230510_072700	NS_13_SC	NS_13_MC	NS_13	J131N023	95	150,00	623,8	2	2	x	SSS recording folder changed to E:\MB_SSS_Edgetech. MV-POSView files back in D:\Data\PosPac. NTRIP connected. The 3 ms recording delay is needed to avoid internal instrument noise and was applied again on line NS_13e_SC and onwards after testing on line NS_13a-d_SC. 19:45 MV-POSView closed down
raste	12-05-2023	00:17	01:05	NS_14	0042_0013	ENS23NS_14_20230512_001702	NS_14_SC	NS_14_MC	NS_14	J32N001	275	185,90	809,7	10	3->4	x	Higher noise level from wind and waves on both SC and MC, when heading north. Higher noise at far end of streamer and sparker energy lower on Geometrics monitor window. Good data quality at the start of the planned line heading west. All batteries changed around 07:30 in sparker buoy and streamer buoys/paravanes and streamer tailbuoy light (sparker gps battery was out and we decided to change all). SVP taken during short break. SC restartet as 14b (at earlier freeze restart as 14a) and MC restartet as 14a.
lhw	13-05-2023	01:05	07:50	NS_15	0032_0105	ENS23NS_15_20230512_010829	NS_15_SC	NS_15_MC	NS_15	J133N003	5	39,00	848,7	10	4	x	
sba	13-05-2023	07:50	10:25	NS_16	0049_0756	ENS23NS_16_20230513_075008	NS_16_SC	NS_16_MC	NS_16	J133N024	183	214,20	1062,9	9	3	x	SVP 07:02.
raste	14-05-2023	10:25	00:45	NS_17	0029_1023	ENS23NS_17_20230514_102417	NS_17_SC	NS_17_MC	NS_17	J134N031	1.15	128,10	1191,0	4->2	3->1	x	Single channel streamer layback reduced with 5 m so the end of the active section (hydrophone 8) is aligned with the sparker (the beginning of the active section was probably c. 2,5 m behind the sparker before)
raste	15-05-2023	00:45	11:29	NS_18	0054_0043	ENS23NS_18_20230514_004631	NS_18_SC	NS_18_MC	NS_18	J135N003	95,27	91,50	1282,5	4	2	x	08:35 MV-POSView Restartet, Ethernet Logging (POSPac) startet.
raste	15-05-2023	11:29	19:28	NS_19	0010_1126	ENS23NS_19_20230515_113005	NS_19_SC	NS_19_MC	NS_19	J135N036	38,8	69,40	1351,9	6	3	x	
raste	15-05-2023	19:28	03:25	NS_20	0024_1924	ENS23NS_20_20230515_192827	NS_20_SC	NS_20_MC	NS_20	J135N060	228,85	48,70	1400,6	3	4	x	
lhw	16-05-2023	03:25	07:00	NS_21	0010_0325	ENS23NS_21_20230516_032936	NS_21_SC	NS_21_MC	NS_21	J136N010	180	-	-	6	4	x	End of Leg 1.
													1400,6				
lfp	18-05-2023	09:00		NS_PT	002_0920								1400,6			x	Start of Leg 2.
lfp	18-05-2023	09:32	10:06	NS_GAMS										6	3	x	GAMS calibration start.
lfp	18-05-2023	10:30		PT_SVP												x	SVP before patch test.
lfp	18-05-2023	10:36		NS_PT_01												x	Patch test starts\ slope is not enough for the test so we find a new location.
nichr	18-05-2023	11:20	11:27	NS_PT_02						J138N003	155					x	PT_central line.
nichr	18-05-2023	11:27	11:44	NS_PT_03						J138N004	340					x	PT_central line.
nichr	18-05-2023	11:44	11:59	NS_PT_04						J138N005	155					x	PT_-40.
nichr	18-05-2023	11:59	12:08	NS_PT_05						J138N006	340					x	PT_-40.
nichr	18-05-2023	12:08	12:21	NS_PT_06						J138N007	155					x	PT_-60.
nichr	18-05-2023	12:21	12:34	NS_PT_07						J138N008	340					x	PT_-60.
nichr	18-05-2023	12:34	12:46	NS_PT_08						J138N009	155					x	PT_+40.
nichr	18-05-2023	12:46	12:59	NS_PT_09						J138N010	340					x	PT_+40.
nichr	18-05-2023	12:59	13:09	NS_PT_10						J138N011	155					x	PT_+60.
nichr	18-05-2023	13:09	13:23	NS_PT_11						J138N012	340					x	PT_+60.
nichr	18-05-2023	13:23	13:45	NS_PT_11						J138N013	155					x	PT_central line with half of the speed: MMO whatch starts.
nichr	18-05-2023	13:31															PAM watch starts.
llp	18-05-2023	13:47															Harbor porpoise <500 m from starboard side --> We extent MMO and PAM watch for 30 mins more.
nichr	18-05-2023	14:23															Start of slow start.
lfp	18-05-2023	14:40	16:26	NS_22	0008_1442	ENS23NS_22_20230518_144701	NS_22_SC	NS_22_MC	NS_22	J138N19	216			6	3	x	Recording start. 14:32 MC and SC recording start, but sparker power is only 100 J every 2 seconds. 15:20 increase sparker to 500 joule 2 times a second.
lfp	18-05-2023	16:26	05:15	NS_23	009_1628	ENS23NS_23_20230518_164328	NS_23_SC	NS_23_MC	NS_23	J138N25	275	112,10	1512,7	6	3	x	Start first planned line of Leg 2. 18:47 SC freeze so the MiniTrace II was restarted and the line changed to NS_23a_SC.
lfp	19-05-2023	05:15	07:01	NS_24	0037_0511	ENS23NS_24_20230519_051615	NS_24_SC	NS_24_MC	NS_24	J139N016	185			5	3	x	Transit line. NTRIP disconected for a few minutes at the beginning of the line. SVP taken at EOL.
lfp	19-05-2023	07:01	10:59	NS_25	0038_0701	ENS23NS_25_20230519_070628	NS_25_SC	NS_25_MC	NS_25			33,80	1546,5	4	2	x	
llp	19-05-2023	10:59	18:20	NS_26	0031_1056	ENS23NS_26_20230519_105945	NS_26_SC	NS_26_MC	NS_26	J139N034	129					x	Transit line.
lfp	19-05-2023	18:20	05:13	NS_27	0031_1821	ENS23NS_27_20230519_182319	NS_27_SC	NS_27_MC	NS_27	J139N057	185	95,60	1642,100	2	2	x	23:39 MC warning "Incomplete data on file 1607908 Missing section(s) 1,2". Missing 5-10 minnuts of SC data due to freeze and the software started without "external trigger on". 27a, 27b, 27c, and 27d
lfp	20-05-2023	05:13	10:22	NS_28	0046_0511	ENS23NS_28_20230520_051545	NS_28_SC	NS_28_MC	NS_28	J140N015	80	29,40	1671,5	5	2	x	
llp	20-05-2023	10:22	02:49	NS_29	0044_1022	ENS23NS_29_20230520_102230	NS_29_SC	NS_29_MC	NS_29	J140N031	280	134,80	1806,3	2	3	x	SSS started later than the other instruments. 00:07 SSS Bathymetry not on. 00:21 SC stopped and started again.
nichr	21-05-2023	02:49	10:54	NS_30	0045_0246	ENS23NS_30_20230521_025242	NS_30_SC	NS_30_MC	NS_30	J141N009	93	55,10	1861,4	3	3	x	MiniTrace II restarted a few times during the line, SC line renamed as 30a, 30b and so on. 07:25 stop sparker for SVP.
llp	21-05-2023	10:54	16:11	NS_31	0041_1051	ENS23NS_31_20230521_105447	NS_31_SC	NS_31_MC	NS_31	J141N034	280	35,00	1896,4	5	3	x	
lfp	21-05-2023	16:11	07:58	NS_32	0033_1608	ENS23NS_32_20230521_161332	NS_32_SC	NS_32_MC	NS_32	J141N050	3	135,10	2031,5	8	3	x	21:25 MV-POSView restarted. 06:40 deviation from the line towards port side due to navigation restrictions around oil platform.
lfp	22-05-2023	07:58	16:40	NS_33	0039_0756	ENS23NS_33_20230522_080036	NS_33_SC	NS_33_MC	NS_33	J142N024	95	62,20	2093,7	7	3	x	
lfp	22-05-2023	16:40	21:57	NS_34	0040_1638	ENS23NS_34_20230522_164239	NS_34_SC	NS_34_MC	NS_34	J142N051	280	26,90	2120,6	5	3	x	Equipment retrieved and secured on deck. Transit to Jammerbugten starts.

lfp	23-05-2023	16:15	17:15	NS_35	0022_1630	ENS23NS_35_20230523_163045	NS_35_SC	NS_35_MC	NS_35	J143N001						x	SVP at SOL. It is a test line.15:00 MMO watch starts, 15:37 PAM watch starts after putting down the pole. Deployment of sparker, single channel and multichannel streamers. 16:15 Start soft start at 100 J every 2 seconds
lfp	23-05-2023	17:15	22:29	NS_36	0022_1713	ENS23NS_36_20230523_173323	NS_36_SC	NS_36_MC	NS_36	J143N004	55	41,30	2161,9	3	3	x	Innomar line started later due to screen failure.
llp	23-05-2023	22:29	03:39	NS_37	0023_2249	ENS23NS_37_20230523_222905	NS_37_SC	NS_37_MC	NS_37	J143N020	140	18,80	2180,7	4	3	x	22:26: MC warning "Incomplete data on file 2152490 Missing section(s) 3".
lfp	24-05-2023	09:00															Arrival to Hirtshals harbor for crew change and handover test deployment. End of the Leg 2.
nnp	24-05-2023	12:04	13:45	NS_38		ENS23NS_38_20230523_120434	NS_38_SC	NS_38_MC	NS_38		100-210-280			5	2	x	Test line and test deployment.
nnp	24-05-2023	17:30												14	4		Transit to Thyborøn for weather standby.
nnp	26-05-2023	5:40															Leaving Thyborøn for survey around 05:30.
lisal	26-05-2023	12:00															SVP at 12:00 (X405845, Y6239118), MMO and PAM watch starts 12:15, SOL 39.
nnp	26-05-2023	13:02		NS_39	0048_1248	ENS23NS_39_20230526_130202	NS_39_SC	NS_39_MC	NS_39	J146000	274	208,00	2388,7	10	4-3	x	SC problem with constant rising reflectors incl. sea bed from c. 17:00. Fixed 18:15. Setting external trigger gain to ON solved problem.
lisal	27-05-2023		16:55	NS_39												x	At 00:45 signal to SC lost. Restarting a couple of times did not solve the problem. Starting new project solved problem. SC acquisition up and running again from ~02:00. Numerous new sub lines, starting with 39a, b, c etc., but NS_39_SC_h probably the only one with da
nnp	27-05-2023	16:55	23:55	NS_40	00_1653	ENS23NS_40_20230527_165920	NS_40_SC	NS_40_MC	NS_40	J147N052	183	51,80	2440,5	10	3	x	Include transit to planned line NS_40. SVP at SOL.
lisal	27-05-2023	23:55	22:06	NS_41	0047_2351	ENS23NS_41_20230527_235511	NS_41_SC	NS_41_MC	NS_41	J147N074	95	174,50	2615,0	6	3	x	SVP at 295679E 6205155N 2805, 16:50, depth 48 m.
lisal	28-05-2023	22:06	05:21	NS_42	0003_2204	ENS23NS_42_20230528_220553	NS_42_SC	NS_42_MC	NS_42	J148N066	181,98	61,10	2676,1	10	4	x	Turned south from line NS_41 earlier than planned due to weather.
nnp	29-05-2023	05:21		NS_43	0036_1415	ENS23NS_43_20230529_05243	NS_43_SC	NS_43_MC	NS_43	J149N016	288,220, 2	161,40	2837,5	12	4	x	SVP at SOL NS_43, 14:55. SVP at EOL NS_43, 11:45. Equipment retrieved and transit to Jammerbugt due to weathe
	30-05-2023		11:45	NS_43												x	
nnp	31-05-2023	07:32	15:58	NS_44	0019_0757	ENS23NS_44_20230531_073208	NS_44_SC	NS_44_MC	NS_44	J151N020	60, 118	52,80	2890,3	12	4	x	SVP at SOL 477842 6386718, 55 m, 07:01 PAM and MMO start.
nnp	31-05-2023	15:58		NS_45	0026_1626	ENS23NS_45_20230531_155821	NS_45_SC	NS_45_MC	NS_45	J151N025	298	64,80	2955,1	10	4	x	
	01-06-2023		03:11	NS_45												x	
nnp	01-06-2023	03:11	14:26	NS_46	0026_0315	ENS23NS_46_20230601_031151	NS_46_SC	NS_46_MC	NS_46	J152N010	118	68,00	3023,1	7	3	x	
nnp	01-06-2023	14:26	00:06	NS_47	001_1431	ENS23NS_47_20230601_142657	NS_47_SC	NS_47_MC	NS_47	J152N043	40	69,20	3092,3	9	3	x	SVP at SOL. Stopped MC 16:17 due to Nav problem. OK again 16:28 after restart of PC. New file: NS_47a_MC.
lisal	02-06-2023	00:06	04:03	NS_48	0025_0001	ENS23NS_48_20230602_001126	NS_48_SC	NS_48_MC	NS_48	J135N000	123	21,30	3113,6	6	2	x	
nnp	02-06-2023	04:27	06:12														Equipment up, SVP and transit to Hirtshals for demob. End of survey.

Project: ENS Havvind Survey 2023				Vessel: Arctic Ocean (call sign OZGP2)							
Danish summertime in some filenames				Very roughly estimated position							
Location	**SVP**	**Date**	**Time (UTC)**	**Coordinate**	**Degrees**	**Minutes**	**Seconds**	**Degrees**	**Decimal minutes**	**Decimal degrees**	**Comments**
Before start of line NS_01	V00001	08-05-2023	06.12	Latitude	55	37	48,961	55	37,81601667	55,63026694	
	20230508_081257_both_0_01.svp			Longitude	7	59	16,328	7	59,27213333	7,987868889	
Before start of line NS_07	V00002	09-05-2023	07.15	Latitude	56	33	11,785	56	33,19641667	56,55327361	
	20230509_091551_both_0_01.svp			Longitude	7	34	30,153	7	34,50255	7,5750425	
Beginning of line NS_10	V00006	10-05-2023	07.20	Latitude	56	20	35,245	56	20,58741667	56,34312361	
	20230510_092004_both_0_01.svp			Longitude	6	22	37,434	6	22,6239	6,377065	
Before start of line NS_13	V00003	11-05-2023	07.19	Latitude	55	42	23,749	55	42,39581667	55,70659694	
	20230511_091958_both_0_01.svp			Longitude	4	20	46,145	4	20,76908333	4,346151389	
After first 1/4 of Line NS_14	V00007	12-05-2023	07.32	Latitude	55	46	0,633	55	46,01055	55,7668425	
	20230512_093203_both_0_01.svp			Longitude	6	11	0,747	6	11,01245	6,183540833	
End of Line NS_15	V00002	13-05-2023	07.41	Latitude	56	12	55,511	56	12,92518333	56,21541972	
	20230513_094137_both_0_01.svp			Longitude	3	43	25,216	3	43,42026667	3,723671111	
27700 m from end of Line NS_16	V00002	14-05-2023	07.02	Latitude	56	3	52,89	56	3,8815	56,06469167	
	20230514_090220_both_0_01.svp			Longitude	6	30	4,179	6	30,06965	6,501160833	
Middle of Line NS_18	V00003	15-05-2023	07.19	Latitude	57	9	18,908	57	9,315133333	57,15525222	
	20230515_091924_both_0_01.svp			Longitude	7	53	40,851	7	53,68085	7,894680833	
EOL NS_21	V00001	16-05-2023	07.21	Latitude	57	10	32,366	57	10,53943333	57,17565722	
	20230516_092153_both_0_01.svp			Longitude	8	39	51,881	8	39,86468333	8,664411389	
PatchTest 1		18-05-2023	10.30	Latitude	57	9,7143		57	9,7143	57,161905	
	20230518_122758_both_0_01.svp			Longitude	8	35		8	34,7504	8,579173333	
EOL NS_24	V00001	19-05-2023	06.46	Latitude	57	6,9358		57	6,9358	57,11559667	
	20230519_085646_both_0_01.svp			Longitude	6	44,3233		6	44,3233	6,738721667	
EOL NS_28	V00001	20-05-2023	10.14	Latitude	55	24,4546		55	24,4546	55,40757667	
	20230520_121436_both_0_01.svp			Longitude	6	47,6547		6	47,6547	6,794245	
Line NS_30	V00001	21-05-2023	07.24	Latitude	55	25,954		55	25,954	55,43256667	
	20230521_092414_both_0_01.svp			Longitude	5	7,1985		5	7,1985	5,119975	
EOL Line NS_32	V00001	22-05-2023	07.48	Latitude	56	33,3		56	33,3	56,555	
	20320522_094814_both_0_01.svp			Longitude	4	55,32		4	55,32	4,922	
SOL Line NS_35		23-05-2023	13.23	Latitude	57	43,8		57	43,8	57,73	
	20230522_152311_both_0_01.svp			Longitude	8	56		8	56	8,933333333	
Location	**SVP**	**Date**	**Time (UTC)**	**Coordinate**	**UTM32N**	**WGS84**		**UTM32N**	**WGS84**	**UTM32N, WGS84**	**Comments**
EOL Line NS_37		24-05-2023	04.11	UTM N	6411121			6411121		6411121	
	20230524_061148_both_0_01.svp			UTM E	536312			536312		536312	
SOL NS_39		26-05-2023	12.00	UTM N	6239118			6239118		6239118	Failed
	202305_26_120000			UTM E	405845			405845		405845	
EOL NS_39		27-05-2023	17.00	UTM N	6247202			6247202		6247202	Failed
	202305_27_170000			UTM E	184620			184620		184620	
Mid line NS_41		28-05-2023	16.50	UTM N	6205155			6205155		6205155	Failed
	202305_28_165000			UTM E	295679			295679		295679	
SOL NS_43		29-05-2023	14.55	UTM N	6131129			6131129		6131129	Failed
	202305_29_145500			UTM E	273166			273166		273166	
EOL NS_43		30-05-2023	12.20	UTM N	6289373			6289373		6289373	Failed
	202305_30_122000			UTM E	280673			280673		280673	
SOL NS_47		01-06.2023	14.20	UTM N	6340447			6340447		6340447	Failed
	202306_01_142000			UTM E	507872			507872		507872	
EOL NS_48		02-06.2023	04.27	UTM N	6378795			6378795		6378795	Failed
	202306_02_042700			UTM E	546402			546402		546402	