

Cruise report

RV Johan Hjort 19.09. – 9.10.2005

RV G.O Sars 1.10. – 10.10.2005

**Testing acoustic platforms and
methodology for studying behaviour of
demersal fish in a bottom trawl survey**

By

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1. Introduction

This field study was carried out with RV G.O. Sars and RV Johan Hjort in September-October 2005 (Appendix I, participants and cruise plan (in Norwegian)). The study area was along the eastern coast of Finnmark and the shallow areas around Bear Island (Figure 1 and 2). Part of the cruise with included tests of a new survey sampling trawl is not reported here.

The main objectives associated with this reporting are:

1. Testing functionality and operations of new instrumentation.
2. Using new instrumentation to study fish behaviour relative to surveying and trawling vessels.

Detailed survey plan and participation list are given in Appendix I

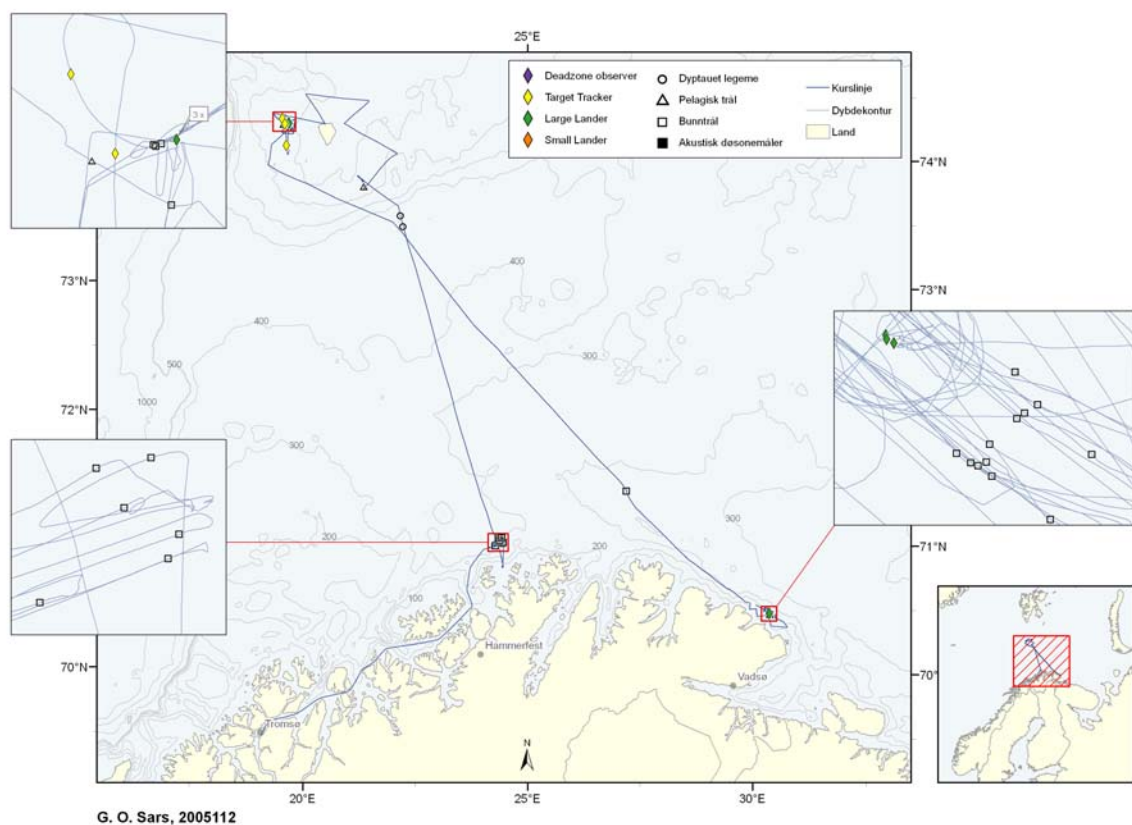


Figure 1. Map of course lines and activities of RV G.O. Sars.

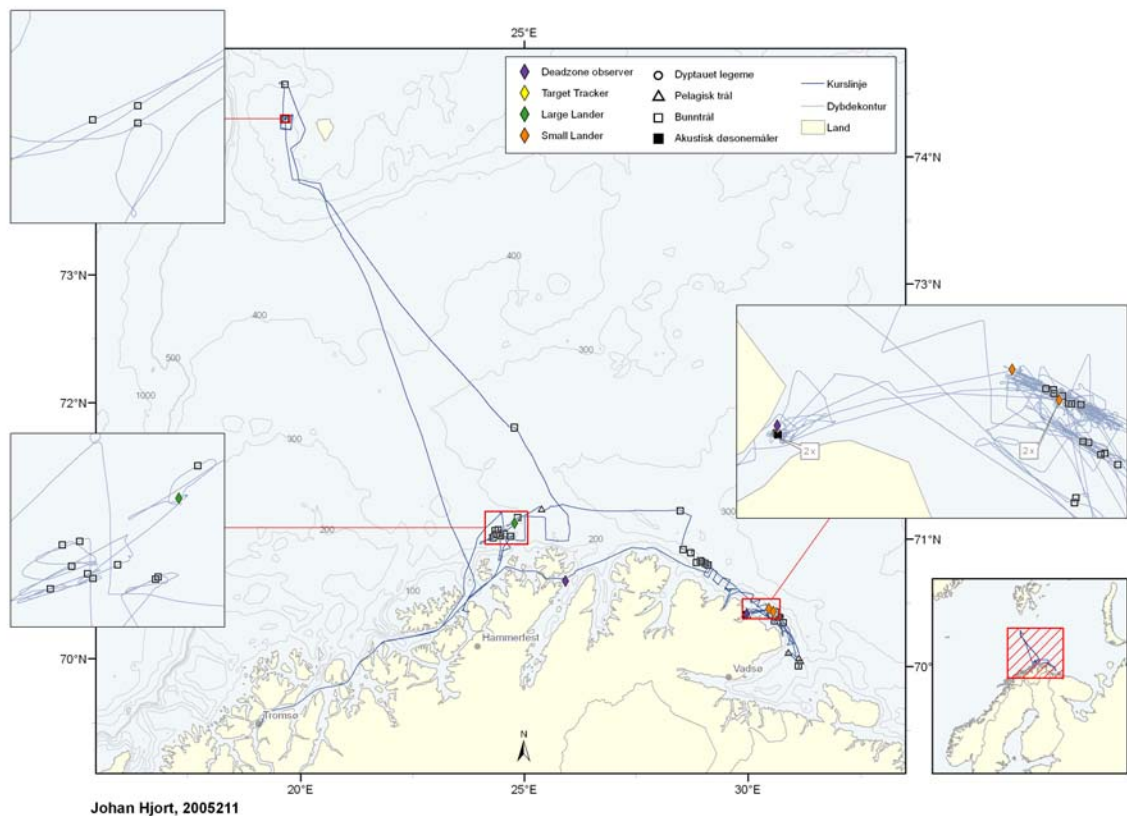


Figure 2. Map of course lines and activities of RV Johan Hjort.

2. Material and methods, with preliminary results

The survey was carried out 1. - 10. October 2005 with RV “Johan Hjort” 2005211 and RV ”G.O. Sars” (survey no.: 2005211, serial nos.: 83458, 83460, 83465, 83470 (JH) and survey no.: 2005112, serial nos. 83201-83225 (GOS)), with start and finish in Tromsø. The survey covered two main areas, one around Bear Island (116-133 m bottom depth), and the other outside the coast of eastern Finnmark (132-165 m bottom depth). Testing of acoustic equipment was also conducted in Syltefjord at the east coast of Finnmark. Figures 1 and 2 show survey tracks and stations for experiments.

The ships hull mounted acoustic systems were operated in standard mode throughout the survey to search for fish densities suitable for the experiments.

Several acoustic platforms were used to record behaviour of fish during the survey: a small and a large stationary platform (Landers), an acoustic buoy (BAB), a target tracker mounted

on the strapping rope of the bottom trawl, and the Deadzone observer. Except from the acoustic buoy BAB, none of the other instrument platforms were ready for use at the start of the cruise on the 18th September. Some platforms had been through an extensive modification since the last time they were used, while others were still under construction. Due to this, a considerable effort was needed onboard JH during the first two weeks of the cruise to get the instrument platforms up running. A detailed description of these preparations is given in Appendix II.

2.1 Stationary acoustic platform (Lander)

The Landers were originally designed and made for the MAR-ECO cruise (<http://www.mar-eco.no/>), which took place the summer of 2004. The technology with upward pointing transducer was developed for the Ocean HUB project where it was used for monitoring the spring spawning herring stock in Ofotfjorden. Ocean HUB was launched in September 2002. Since then particular algorithms for extracting of data have been developed, and valuable experience regarding interpretation of data is gained. The two types of Landers used in this survey are mechanically slightly different. The large Lander is made for longer deployment, holding high battery capacity, and other payload such as CTD, current meters, acoustic Doppler current profilers (ADCP), hydrophones, multiple echosounders and other instruments. This Lander was originally made with the transducers pointing upwards, but modifications were made to make the use of horizontally pointing transducers possible. The Small Lander is made as small and light as possible and can only be deployed for shorter periods. This Lander is constructed in a way allowing the user to choose if the transducer should be pointed upwards or downwards prior to deployment. On this Lander there is only space for one set of batteries, and one echosounder frequency. For downwards pointing transducer, a nylon rope has to be used for mooring. The nylon is nearly acoustically transparent, and would not create noise in the transducer beam. Two nylon ropes are made for the Lander, each 100 m long, one of them with attachment point for calibration sphere. The sphere can be placed approximately 20 meters below the transducer, for calibration of the transducer beam at the deployment depth.

2.1.1 Lander instrumentation and settings

The Landers were set up with standard instrumentation: Computer with EK60 software, 38 kHz split beam GPT and ES38DD transducer. They are also equipped with a sensor unit

within a separate pressure container consisting of compass, inclinometer and depth sensor and battery container. On the large Lander, the instruments are installed in an aluminum container, and the batteries installed in a carbon container. On the small Lander the instruments and the batteries are installed in two separate 40 cm glass spheres.

Settings of the instruments in the Landers prior to deployment are selected for the actual area and measure situation. Range, ping rate, and transmit power of the echosounder are selected from an external computer by using Ethernet and Net-Up remote control program. The Landers are pre-programmed to start transmitting at 10 meters depth. This prevents damage to the transducer due to transmitting above the water surface. Signals from a depth sensor and a water detector are used to control this function.

2.1.2 Lander deployment

The Landers can be deployed in two ways. A positive buoyancy Lander with weights, dropped with an acoustic release during retrieve, or a negative buoyancy Lander placed directly on the seafloor, with fixed rope to the surface. Both methods were used during the experiments.

The small Lander was deployed once with positive buoyancy from RV GOS to test this equipment and get experience with this Lander used at fish close to the bottom. Earlier this Lander has only been used at pelagic fish. In this experiment the transducer was pointing downwards, and the Lander suspended in 120 m nylon rope. The Lander was unstable and too heavily influenced by the current. The length of the rope was reduced to 75 m, solving this problem. We used two 400 mm glass spheres attached to the acoustic release to make it easier to pull in the releaser when retrieved. The spheres made it difficult to register fish close to bottom because of heavy reflections (Fig. 3). The small Lander must be deployed in a different way to prevent reflection.

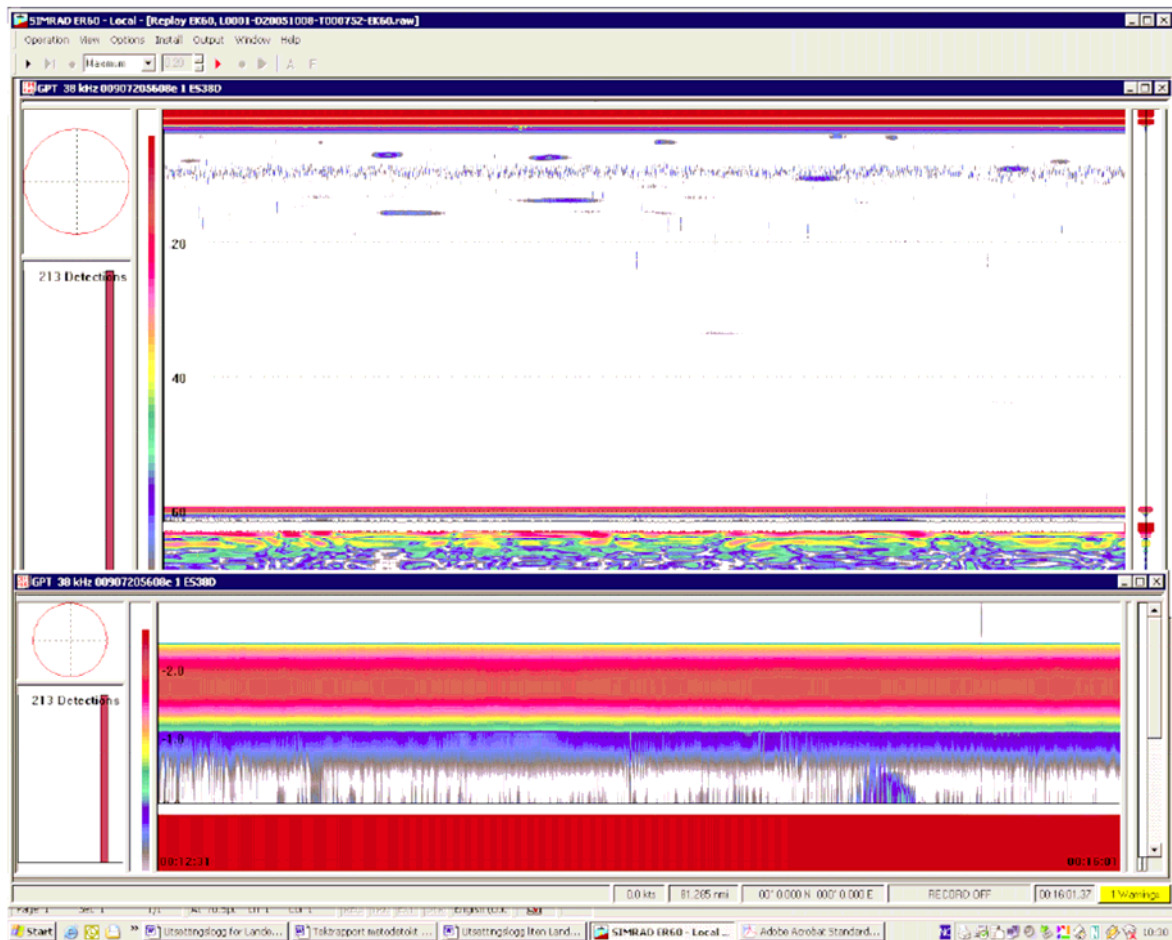


Figure 3. Reflection from glass spheres.

Three deployments were performed on RV JH, with transducer pointing upwards. During the night, when the fish was in the pelagic zone, several passes was made with the vessel right above the Lander (Fig. 4). Unfortunately, the fish density was too low for to get useful data for vessel avoidance. One example of a vessel passing is given in Figure 5.

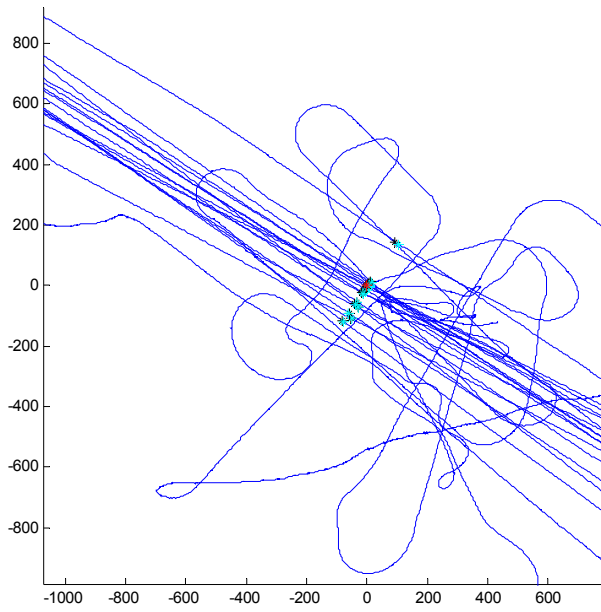


Figure 4. The passes over the Lander. The Lander position is the red asterisk. Cyan asterisks are the time for which the passing was registered on the bridge, and black asterisks are passing times estimated by the position of the vessel-Lander, i.e. closest position.

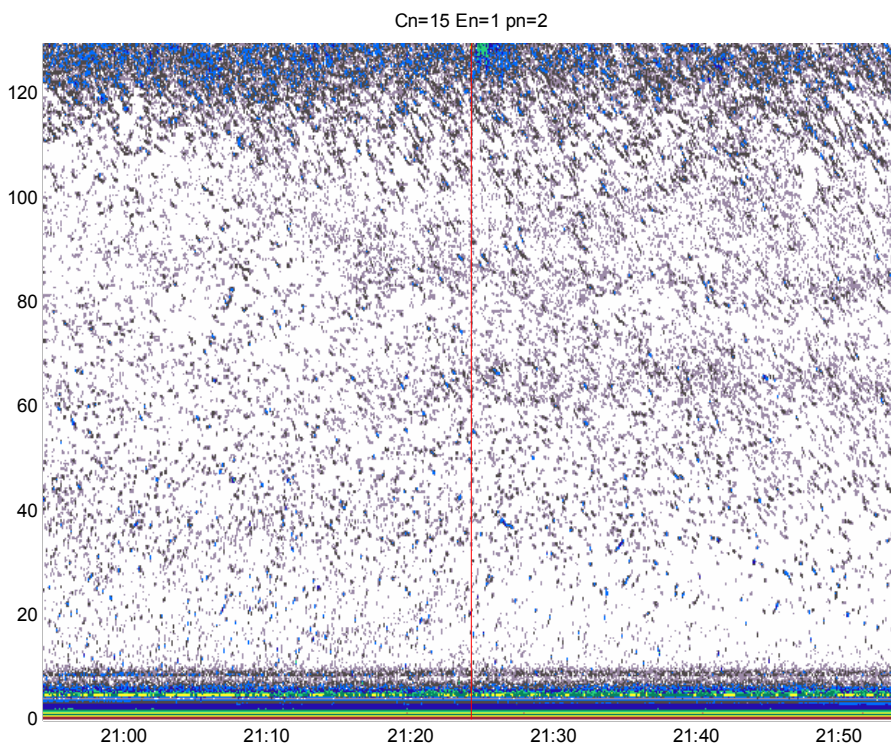


Figure 5. The echogram from the bottom mounted upward pointing Lander. The red line is the time of vessel passing.

When using the large Lander deployed on the seafloor with horizontally pointed transducer, detailed knowledge of the seafloor topography is vital before selecting a suitable area for the experiment. Selecting an area where trawling can be easily performed is important. Furthermore, reflections from objects at the seafloor should be avoided to be able to get clear single echoes from fish towards the sounder. The echo sounder transducer has two side lobes that can give unwanted reflections from the bottom (Fig 6). The deployment area should therefore be as flat as possible without hills, stones and rocks obstructing the transducer beam. It is important to select a trawl path where the trawl is clearly visible for the transducer.

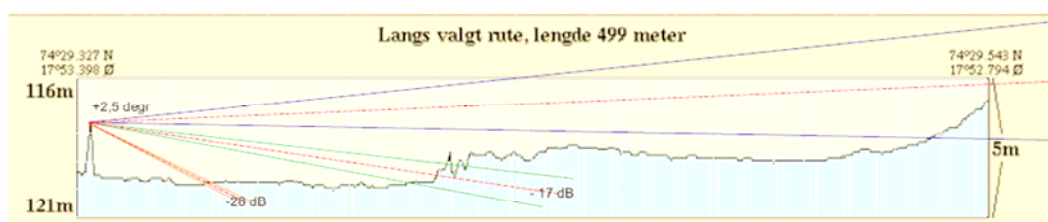


Figure 6. Where to trawl relative to the Lander (“channel” outside bottom echoes).

A Simrad multibeam (EM300/EM1002) bottom profiler system and Olex software were used to produce bottom maps of the area prior to deployment. These maps were used to find a suitable area for the experiments. An ADCP was used to determine the current direction. The information was used to select trawling direction. After trawling area was decided, we used the profile function in the Olex software to find a suitable place where the bottom was flat for the deployment and for the direction the transducer should point.

Totally eight deployments of the large Lander were performed. On the two deployments carried out from RV JH, weights and acoustic release were used. The floatation was adjusted to get an optimal transducer tilt angle. The first two of the five deployments from RV GOS were trial deployments. After the trial deployments, the decision was made to remove all the floatation from the Lander, and place the unit direct on the bottom floor. This resulted in a more stable platform. Weights and acoustic release were replaced with a rope to the surface for recovering of the Lander. The four last deployments resulted in acoustic recordings of fish behaviour related to bottom trawling. Deployment-log for the large Lander on RV GOS is given in Appendix III.

An example of an echogram is seen in Figure 7. The idea is to track the single individuals in the proximity of the trawl to get an estimate of the behaviour close to the trawl.

Unfortunately, the fish density was too low to get useful data other than proving that the method is suitable for such experiments. However, the preliminary results are showing us that this type of measurements is possible to perform. Wire, doors, net and cod end for the trawl can clearly be seen on the sounder. We can also see single fish detections in the trawling area.

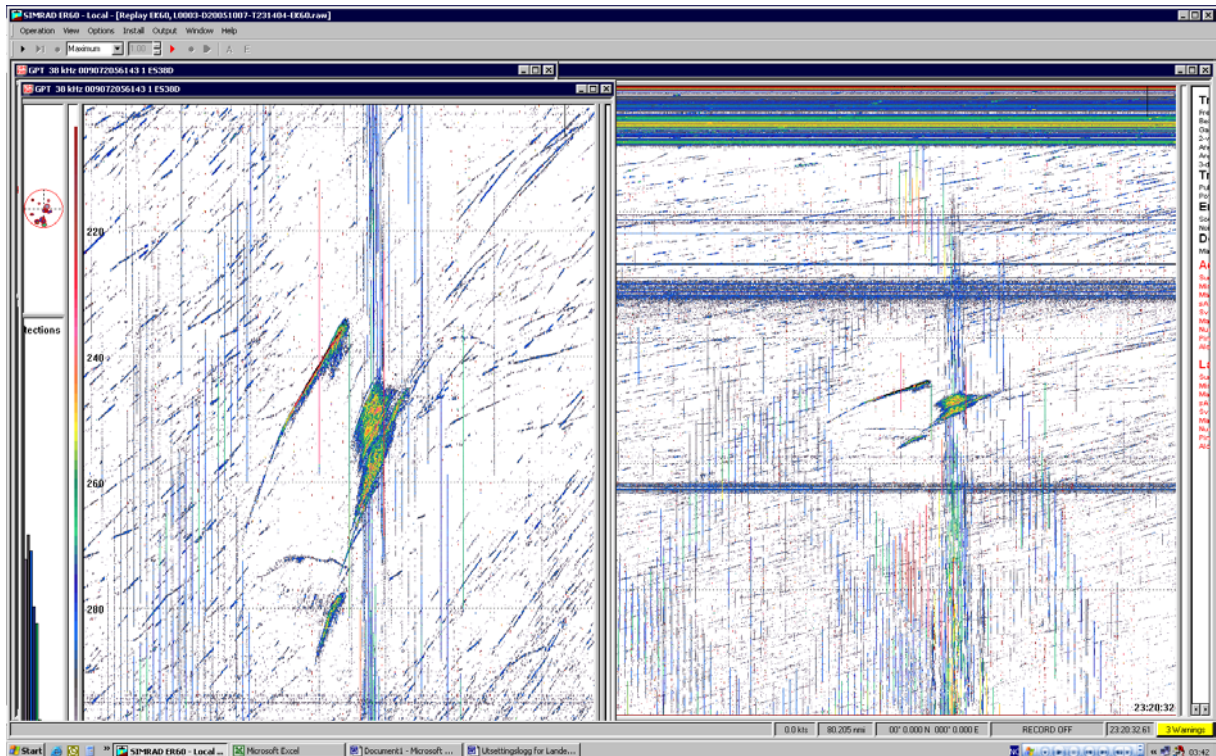


Figure 7. The echogram from the horizontal pointing Lander. This example is showing trawl passing at a distance of 250 meters from the Lander. Right side echogram with full range, left side: expanded scale of the trawl path. Trawl wire, doors and the net can be seen on the echogram. We can also see traces of echoes from single fish. The vertical stripes in the echogram are interference from the Scanmar sensors on the trawl.

2.2 Bergen Acoustic Buoy (BAB)

The Bergen Acoustic Buoy (Godø, O.R., Somerton, D., Totland, A., 1999. Fish behaviour during sampling, as observed from free-floating buoys – application for bottom trawl survey assessment. ICES CM 1999/J:10.) was deployed from the RV JH and equipped with a downward pointing transducer. The BAB system was set up and tested. No problems revealed. Due to lack of fish, no experiments were performed during the cruise.

2.3 The acoustic target tracker

The Target Tracker is designed to collect the tracks of single acoustic targets, and can be used for tracking the movements of e.g. individual fish in behavioural studies. The Target tracker is a X-GPT, computer and battery installed in an aluminium pressure container. Inclinometer, compass and depth sensor are also included. An ES120-7DD 120 kHz transducer is mounted on the pressure container. The transducer can be rotated perpendicular to the length of the pressure container. The unit starts pinging at a preset depth, collecting data at a rate and range preset prior to deployment. The horizontal level of the unit is controlled by a rudder unit mounted at the end of the pressure housing and balancing of the suspension points. The Target Tracker has battery capacity to collect data at a period of approximately 10 hours continuously. A specification sheet describing the Target Tracker in more detail is given in Appendix IV.

During this cruise the Target Tracker was used to study single fish reaction around and close to the trawl mouth. The Target Tracker was mounted on the strapping rope of the bottom trawl with transducer pointing vertically downwards. The Target Tracker was suspended in a rope parallel to the strap rope on the trawl wires. Starboard side was fixed while port side was running free on the wires. This would have worked ok if the wires have a stable tension. But it seems that when one of the doors are hooked into bottom obstacles, the wire would tension up, and when released again the wire would slacken, causing the ring on the strap to fall back and forced forward again. This is creating a lot of snatches to the suspension rope, causing the target tracker to move uncontrolled. We can clearly see this on the roll- and the heading sensor. A solution to try here is to make the unit neutral, and use the midpoint of the strap rope as towing point. This will also allow us to position the target tracker further back for better measurements closer to the trawl mouth. An even better, but not so easy method is to use the ships trawlsonde cable connected to the unit, and run the cable through a ring in the middle of the rope to guide the position of the target tracker. Then we would be able to see the picture on the sounder, and controlling the position of the Target tracker by the trawlsonde cable winch. Deployment-log for the Target Tracker is given in Appendix V.

There was a lot of noise on the 120 kHz GPT. This is a known problem, and are due to the fact that short pulse are selected. Using 1024 ms pulse length are reducing the bandwidth in the GPT receiver, thereby reducing the noise inside acceptable range of the sounder.

2.4 The acoustic deadzone observer

The acoustic dead zone observer (se description at:

http://www.imr.no/aktiviteter/forskningsgrupper/observasjonsmetodikk/projects/akust,_dodso ne) was tested out during the cruise on RV JH in Syltefjord, at the east coast of Finnmark.

In the first dive three 1 l floats was attached to the Observer to give it suitable default buoyancy (dependent on the sea water salinity). It took 40 minutes before the Observer went below the surface (normally it should take approx. 10 - 15 min). This was wrongly interpreted to be due to a far to high positive default buoyancy. When the Observer came back to the surface, it was taken onboard.

In the second dive the three floats was substituted by a 3 kg load. After only 7 minutes the Observer went down (Fig. 8). It did not come to surface at the end of the mission plan or at “mission time out”. The Observer has a so-called “fail safe” buoyancy system, which should give it maximum buoyancy after some time even if an error occurs. RV JH started the search using the “GearFinder” system. No contact was established. This has later been verified to be due to a malfunction of the transponder. Some days later RV GOS started a search using the HPR system (which JH does not have). They immediately managed to detect the Observer and miraculously saved it.

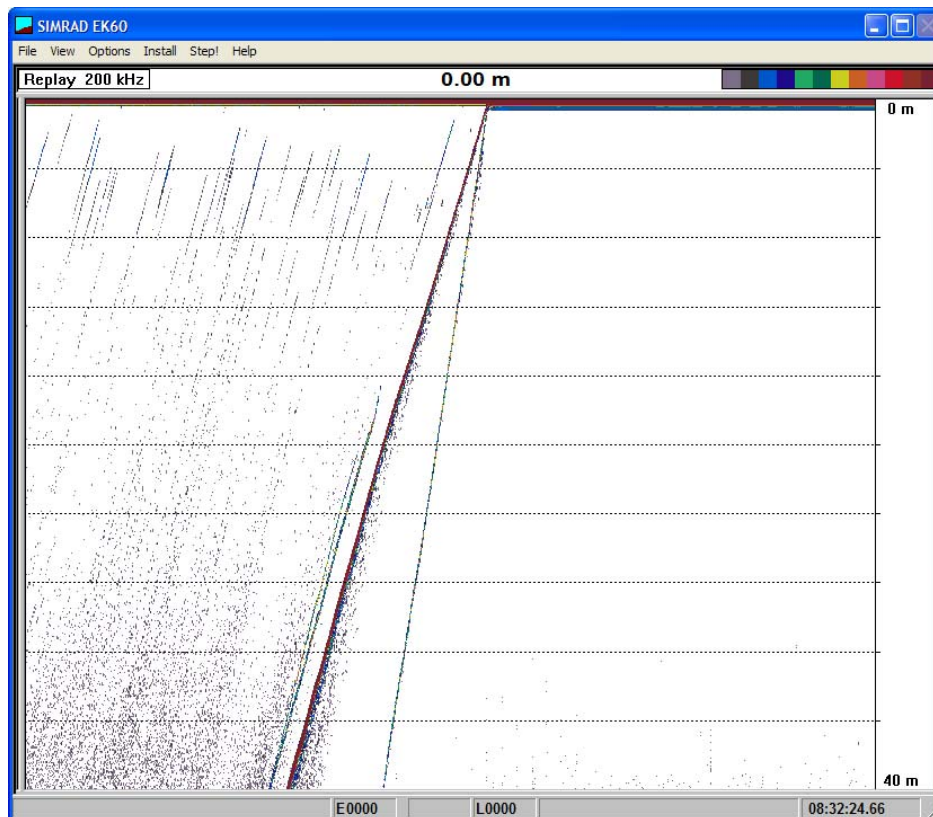


Figure 8. Deadzone Observer dive 2. The Observer has a very steep descend straight down to the bottom. It remains at the bottom until G.O. Sars' rescue.

2.5 Biological sampling

A total of 28 bottom trawl hauls and 2 pelagic trawl hauls were taken for species identification and length samples and to study behaviour when passing the Landers. In addition 4 Lander passes were made with bottom trawl with open codend. The bottom trawl was a Campelen 1800 shrimp trawl with 80 mm stretched mesh size in front and a codend with 22 mm stretched mesh size. The length of the sweep wires was 40 m, and the trawl was equipped with rockhopper ground gear. Pelagic trawl hauls were taken with a modified pelagic trawl (Åkratrål). The modifications include about 40% enlarged trawl opening, and larger mesh size in the front end compared to the standard Åkratrål. Otoliths for age reading and stomach samples were taken from 45 cod individuals at bottom trawl station 83225. The data from the biological samples can be found in the IMR database under the respective cruise numbers for the two vessels. Similarly, the CTD stations can be found in the IMR database.

3. Discussion

The cruise gave new information related to both the function of the new instrumentation and what further work is needed to improve functionality. This concerns both the practical operation of the equipment and the need for adjustments and further development of the instrumentation. Although the fish distributions were unfavourable for behavioural studies, we confirmed that the method with a horizontal looking echo sounder could provide data fish behavioural in relation to the fish capture situation. Below are some general thought on how to run a multitasking, multi-equipment cruise like this, followed by a more in depth recommendations of how to improve the different equipments.

3.1 General discussion

The experience from this field effort demonstrated that method development cruises demand careful planning both to get the equipment ready and routines for their operation and prioritising after the cruise have been initiated. Enough backup activities must be included to give the possibility to adjust program according to actual natural conditions (weather and fish distribution).

For the 2005 cruise there was a hectic activity the last weeks before the cruise to get all the instrument systems up running, and two and a half week into the cruise the last system was finally in operation. These experiences show the importance of starting the planning of an experimental cruise long time ahead. The amount of planning and time required to finalize such an experiment should neither be underestimated.

When sharing boat time with other interests, the time allocate to the different tasks should be carefully planned before leaving the port, and the responsible scientist should be able to prioritise between the different competing needs for boat time during the cruise.

In general, underwater positioning systems (e.g. HPR) are needed for all experiments, and should be a prioritized activity/channel of funds.

3.2 The acoustic target tracker

The target tracker was the most immature of the equipment tested during the cruise. To be able to track fish, the problem with the stability should be addressed.

3.3 Small Lander

The small Lander works fine and need only minor improvements. A mounting bracket for the NorTek ADCP could preferably be fitted. The reason for not getting the desired results from this experiment was unfavorable fish distributions.

3.4 Large Lander

The large Lander showed very promising results. There are, however, some improvements that could be made. There are two main improvements required for the equipment: A tiltable transducer and a communication channel. Below are some of the experiences gained and suggestions for the improvement of the equipment.

The deployment is crucial to the success of the experiment, especially when looking horizontally. The deployment procedure should be changed a slightly to get as correct info regarding bottom profile as possible.

The first step is to select an appropriate area. Use the info from the Olex to select a suitable deployment area, as flat as possible. Two topics have to be taken into consideration: minimum reflections from the bottom on the Lander sounder, and suitable trawling ground. By using an ADCP, establish current direction and decide trawl direction and trawl path. Use then the profile option on Olex to decide an area with minimum bottom contour across the trawl path.

Deploy the Lander in the selected area. Tilt and train the transducer for optimal direction and tilt for minimum reflections from the bottom, according to the picture from the sounder, and info from the sensor module. Use the direction info from the compass in the sensor module to plot direction on Olex map. A remote controlled tilt and roll of the transducer (under construction) would greatly improve the ability to obtain a optimal tilt angle with respect to bottom topography and closeness to bottom.

After the experiment, by using the timestamp from the sounder in the Lander when the trawl passing, and the exact position of the ship, direction and distance to trawl, we should be able to pinpoint exact position of the trawl at the Olex when passing. Than we should use this info to correct the direction on Olex, and get an exact profile of bottom along the transducer beam.

Preferably, a positioning system should be mounted both on the Lander and on the trawl for the analysis of the data.

Interference from the Scanmar equipment on the trawl gave interference on the sounder installed in the Lander. We also tried Simrad ITI trawl system. This system did not give any interference on the sounder and should be preferred used in future experiments. Simrad ITI can in addition to trawl parameters give position to each single sensor, *which is crucial information for the post processing of the data.*

An ADCP should be mounted on the Lander to extract fish behaviour from currents. The NorTek ADCP seems to work fine for this purpose.

To sum what we need for the large Lander:

- Develop, design and make the tilt- and trainable transducer gimbal.
- Install fiber optical plug in the electronic container making us able to communicate with, the Lander, and control the transducer gimbal, while deployed (Underwater fiber cable already in place). Alternatively install an acoustic link.
- A small floating stage at the surface, containing the upper end of the cable, and radio communication to get real time echograms from the Lander while performing the trawling (Same as BAB).
- Mounting bracket for the NorTek ADCP
- Mounting bracket for the Simrad HPR, both on Lander and on trawl or another positioning device.

3.5 The acoustic deadzone observer

The conclusions are for a large part drawn based on data from dive 2 and work done on the Observer after the cruise. The conclusions are:

- There is a leakage in the buoyancy system between pressure air and oil. During dive 1 the Observer had correct default buoyancy, but could not regulate the buoyancy due to the error.
- During dive 2 the Observer had negative default buoyancy and could never come to surface on its own. Air pockets in the construction kept it afloat a few minutes after launching.

- Based on the discussion around this incident a number of improvements will be made though some of them are not related to what happened in Syltefjord:
- Make holes to avoid air pockets at a number of places
- Attach a Scanmar sensor in addition to the HPR transponder
- Write the name, address and email of IMR on the Observer in case it gets lost.
- Introduce “watch dog” functionality to speed up ascending if there is a hang on the software.
- Attach loads with corrosion tread (of suitable duration for the mission).
- Update software to limit descend speed.

Appendix I (Participants and Cruise plan (in Norwegian))

Participants

Ansvarshavende: Olav Rune Godø

RV G.O, Sars

Deltakere:	Gruppe nr/navn:	Tidsrom:
Hans Petter Knudsen	620 Instrumentseksjonen	30.09.-15.10.05
Asgeir Steinsland	620 Instrumentseksjonen	30.09.-15.10.05
Terje Torkelsen	307 Observasjonsteknologi	30.09.-10.10.05
Ronald Pedersen	307 Observasjonsteknologi	30.09.-10.10.05
Kirsti B Eriksen	305 Tekn. operasjonelle ress	30.09.-10.10.05
Hildegunn Græsdal	305 Tekn. operasjonelle ress	30.09.-10.10.05
Olav R. Godø (toktleder)	410 Observasjonsmetodikk	30.09.-10.10.05
Geir Odd Johansen	410 Observasjonsmetodikk	30.09.-10.10.05
Kjell Rong Utne	410 Observasjonsmetodikk	30.09.-10.10.05
Johannes Hamre (Gjest)	410 Observasjonsmetodikk	30.09.-10.10.05

RV Johan Hjort

Deltakere:	Gruppe nr/navn:	Tidsrom:
Øivind Torgersen	620 Instrumentseksjonen	19.09.-10.10.05
Bjarte Kvinge	620 Instrumentseksjonen	19.09.-10.10.05
Jan Tore Øvredal	307 Observasjonsteknologi	18.09.-03.10.05
Atle Totland	307 Observasjonsteknologi	18.09.-10.10.05
Arild Leithe	305 Tekn. operasjonelle ress	19.09.-10.10.05
Jan Henrik Nilsen	305 Tekn. operasjonelle ress	19.09.-10.10.05
Nils Olav Handegard (toktleder)	410 Observasjonsmetodikk	19.09.-10.10.05

Detailed cruise plan

RV Johan Hjort

18 september JH til Tromsø *Atle og Jan Tor* går om bord og får alt utstyr fra lageret (Kræmer). *Jan Tore* lager liste over trålutstyr etc som AF skal ha med.

19 september Går på fjorden kl 0800 for testing av dødsonemåler. Tilbake kl 1600. Går til Hurtigrutekaien og plukker opp resten av utstyret (ansvarlig: *Atle og Jan Tore*). Da kommer også øvrig personell om bord.

Avgang Tromsø til Østfinnmark kl 2000 eller når man er klar.

20 september. Funksjonstest ny trål underveis til Østfinnmark

21-30 september. Forsøk Østfinnmark

- Uttesting av ny trål – *Jon Willy* lager detaljert plan og beskrivelse av utstyr som legges ved toktplan til båtene.
- Forøk med bøye, Landere og dødsonemåler som opereres innimellom trålforsøkene. *Nils Olav* lager oversikt over utstyr og plan for arbeidet som legges ved toktplan til båtene. *Jan Tore* skaffer Gearfinder til bruk på dødsonemåler.

30 september eller 1 oktober. Forsøk avsluttes og JH går mot Vestfinnmark for å møte G.O. Sars

RV G.O. Sars

30 september. GO Sars kommer til Tromsø. Våre folk går om bord.

1 oktober. Avgang GO Sars kl 0800. Går mot Østfinnmark for å treffe JH.

2-3 oktober. Samtråling. Utveksling av utstyr og folk i sjøen dersom forholdene tillater det. Johan Hjort går til Hammerfest med personell fra AF.

3- 9 oktober. Forsøk ved Bjørnøya med JH og GO Sars i samarbeid. Nils Olav lager operasjonsplan

- Slepesonde (Target tracker) på strappetau
- Operasjon av to Landere – horisontal og vertikal
- Tråling med Campelen og Åkratrål
- Akustisk bøye
- Dødsonemåler
- Minisurvey

9 oktober kl 2400 Ankomst Tromsø for mannskapskifte skifte av forskere.

10-15 oktober. Overlevingsforsøk i Troms med Terje Jørgensen.

Appendix II

Below is a resume of the status of the acoustic platforms at the beginning of the cruise and the work done:

Small Lander:

Status at the start of the cruise:

- The hardware of the instrument glass sphere was ready for use
- One glass sphere with new lead batteries was almost ready

Work done:

- The building of the first battery glass sphere was completed
- To be able to run the small Lander more or less continuously, a second battery sphere was needed. Spare batteries from the BAB system was used to make battery sphere number two. Both batteries have a capacity sufficient to supply the Lander for 48 hours.
- Software was installed, the rigging of the entire system was completed and successful sea trials were performed.

Large Lander:

Status at the start of the cruise:

- A 180 cm pressure battery container (previously used in the Deadzone Observer) and a corresponding new lead batteries assembly were available.
- Components needed to fill a new aluminium instrument container were available.
- Various mechanical parts to mount the battery, instrument container and a tilted echo sounder transducer were present.

Work done:

- The final assembling of the battery was done.
- Instruments, PC, converters etc. was mounted in the new instrument container. The work included mechanical modifications, the making of converter circuits, and system software set up.

- Due to malfunction of the pressure sensor (which starts and stop the echo sounder when the system is submerged) a seawater detector circuit was constructed as a substitute. The software was updated to handle this change.
- The Lander was made ready for the mounting of the new battery, instrument container and the tilted transducer.

Deadzone observer:

Status at the start of the cruise:

Since the successful sea trials in Bergen in June 2005 some modifications had been done:

- The battery system was upgraded to allow charging without having to take the battery out of the pressure container.
- The combined Iridium/GPS antenna (which malfunctioned on the last dive in Bergen) was substituted with two new antennas.
- An antenna mast was made.
- An independent ARGOS transmitter (surface use) and a HPR transponder (subsea use) had been bought to locate a missing Observer. In addition a Gearfinder transponder (subsea use) was borrowed for this cruise.

Work done:

The system was set up and deck trials were performed with the following results:

- Initial poor connection on the Iridium link was caused by a too long antenna cable on the ship. Using a shorter cable and thus improving the S/N ratio eliminated the problem.
- The new GPS antenna is suspected of not having the same performance as the previously used antenna. Conclusions will be made when FFI finish their tests on this antenna.
- Charging of the updated battery system went fairly well. An unstable data connection on long RS232 cables ought to be improved by changing the data transfer to RS485 (a small modification). The charging of the battery has to be performed in several intervals as it automatically stops after some hours due to high temperature. This occurs in spite of the system being flushed with pressure air.
- Results and conclusions from the sea trials are described in a different chapter.

Appendix III (Deployment-log for large Lander)

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Introduction

Stationary acoustic platform (Lander)

The Landers was originally designed and made for the MAR-ECO cruise, which took place the summer of 2004. The technology with upward pointed transducer was developed for the Ocean HUB project where it was used for monitoring the spring spawning herring stock in Ofotfjorden. Ocean HUB was launched in September 2002. Since then particular algorithms for extracting of data have been developed, and valuable experience regarding interpretation of data is gained. The Lander is made for longer deployment, holding high battery capacity, several echo sounder frequencies, and other payload such as CTD, current meters, current profilers, hydrophones and other instruments. The Lander was originally made with the transducers pointing upwards, but modifications are done to make the use of horizontally pointing transducers possible.

Lander instrumentation and settings

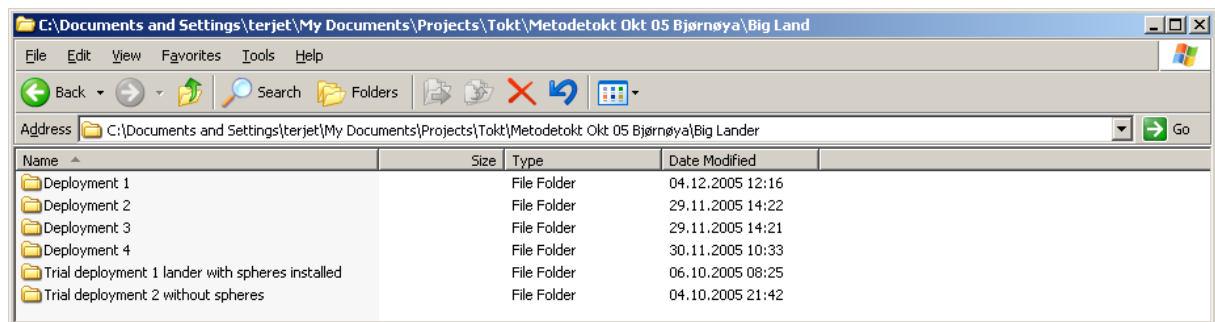
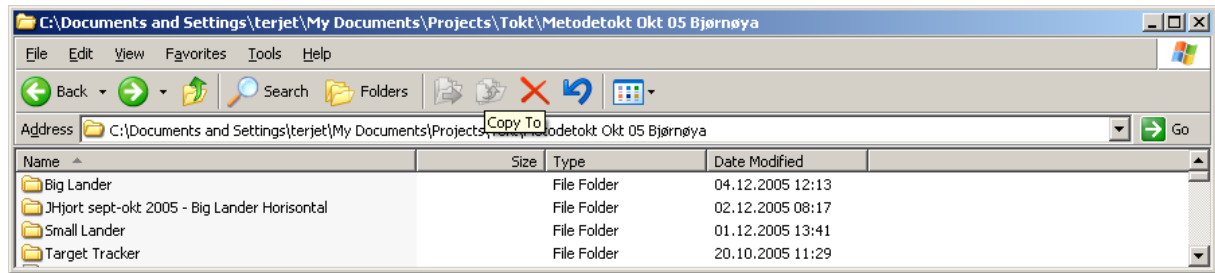
The Landers was set up with standard instrumentation: Computer with EK60 software, 38 kHz split beam GPT and ES38DD transducer. A sensor unit within a separate pressure container consisting of compass, inclinometer and depth sensor is installed. The instruments are installed in an aluminum container, and eight 48 A/h batteries are installed in a carbon container. Settings of the instruments in the Landers prior to deployment are selected for the actual area and measure situation. Range, ping rate, and transmit power of the echo sounder are selected from an external computer by using Ethernet and Net-Up remote control program. The Landers are pre-programmed to start transmitting at 10 meters depth. This prevents damage to the transducer due to transmitting above the water surface. Signals from a depth sensor and a water detector are used to control this function.

Lander deployment

The Landers can be deployed in two ways. A positive buoyancy Lander with weights, dropped with an acoustic release during retrieve, or a negative buoyancy Lander placed directly on the seafloor, with fixed rope to the surface. Both methods were used during the experiments.

Structure in data files

Dvd



Trial deployment

Setup

EK60 setup

Scale: 500m

Pulse length: 0,256 ms

Ping rate: Max

Transducer angle: App 6 degrees above the horizontal level.

Suspension: Two wheels, one at each side of the Lander in crowfoot longitude to the tilt axes. Rope to surface supplied with sea-dog (4 small and 1 big trawl float) two blathers and a flag buoy with flashing light.

Note: The transducer is installed 180° wrong, so forward will be down on the beam diagram.

Deployed: 4 October at 17:30 UTC

Retrieved: 4 October at 17:45 UTC

Heading from compass: 144°

Corrected heading; 324°

Estimated heading from GOS: Not estimated

Lander level: -3x° in roll and
12° in tilt

1st trial deployment

We deployed the Lander for a short period to confirm the conditions. At first we tried in traditional way, with positive Lander, and tree rail wheels in chain suspension as weight, but the current were rather strong in the area, causing the Lander to tilt up to 12°. With other words; the transducer ended up with +18° tilt. We got a strong acoustic reflection from the surface. Looking closer at the sensor file, and compare with the registrations on the sounder, we can see that the variation in reflection from surface are caused by variation in tilt of the Lander, caused by the current.

Heading from the compass: 144°. Since the transducer are mounted wrong, so it is pointed backwards on the Lander (For minimum reflections) the heading will be 180° wrong. Correct heading are 324°, which are close to estimated bearing.



Figure 1: Lander w/flotation and weight.

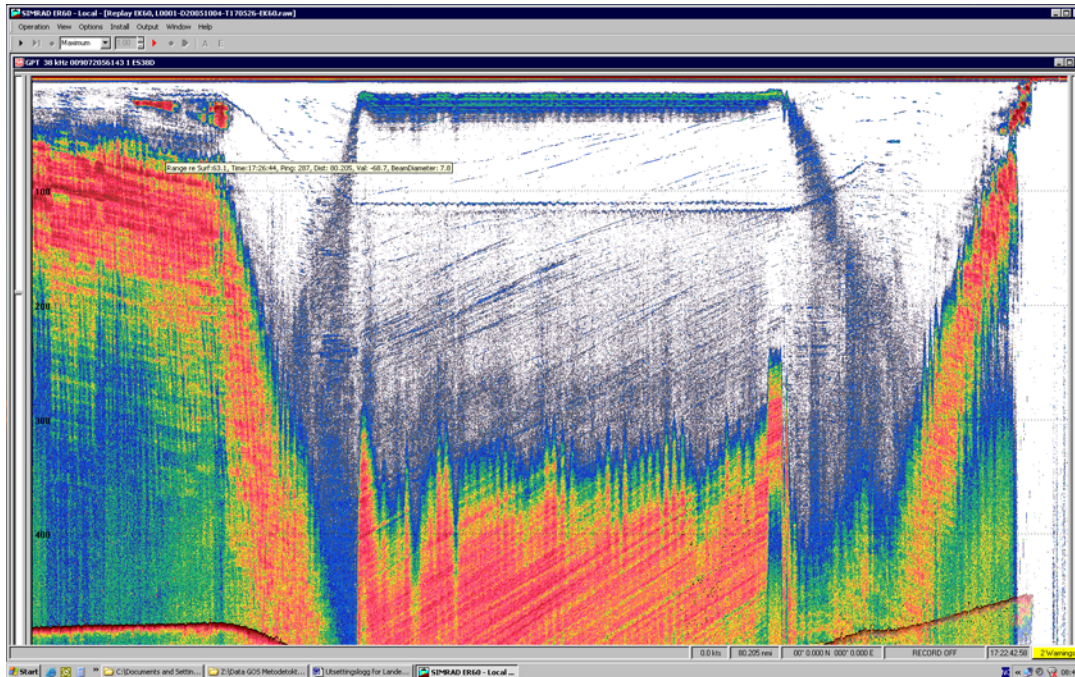


Figure 2: Picture from Lander in standard suspension at 17:22.

Data files

Name	Size	Type	Date Modified
DT20051004170503	1 KB	Text Document	04.10.2005 18:05
Dybde20051004170503	6 KB	Text Document	04.10.2005 18:58
EZ20051004170503	611 KB	Text Document	04.10.2005 18:58
L0001-D20051004-T170526-EK60	68 357 KB	Echosounder Replay	04.10.2005 18:49
L0001-D20051004-T170526-EK60.out	63 KB	OUT File	04.10.2005 18:49
Magnetometer20051004170503	682 KB	Text Document	04.10.2005 18:58
Shortcut to Stor Lander Test	1 KB	Shortcut	06.10.2005 08:25

Figure 3: Data files from 1st trial deployment.

2nd trial deployment

Setup

EK60 setup

Scale: 500m

Pulse length: 0,256 ms

Ping rate: Max

Transducer angle: App 6 degrees above the horizontal level.

Suspension: No suspension used. Rope to surface supplied with sea-dog (4 small and 1 big trawl float) two blathers and a flag buoy with flashing light.

Note: The transducer is installed 180° wrong, so forward will be down on the beam diagram.

Deployed: 4 October at 19:51 UTC

Retrieved: 4 October at 20:34 UTC

Heading from compass: 310°

Corrected heading; 130°

Estimated heading from GOS: Not estimated

Lander level: -1,3° in roll and
3,2° in tilt

2nd trial deployment

We tried to remove the flotation, and make then Lander negative buoyancy. All flotation spheres were removed from the Lander and the Lander was placed directly on the bottom. This gave a much more stable platform, and a much better result. The only negative aspect is that we are dependent on a rather flat deployment area to be able to get the tilt and roll angles as close to zero as possible. This trial gave good results, and we decided to continue the experiments with this setup.

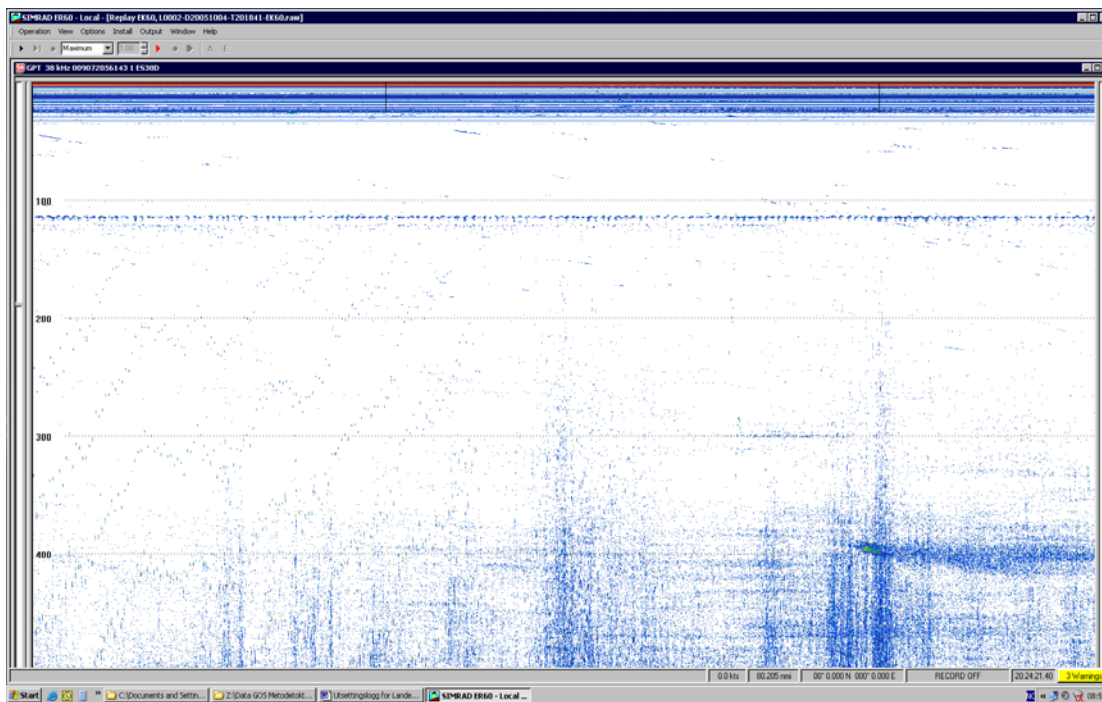


Figure 4: Lander on bottom without flotation at 20:24.

Time	Roll	Pitch	Temp	Compass
20:24:32	-1.39	3.21	11.5	309.0
20:24:32	-1.42	3.18	11.4	310.8
20:24:32	-1.39	3.18	11.4	310.7
20:24:32	-1.42	3.18	11.4	310.6
20:24:33	-1.37	3.18	11.4	310.8
20:24:33	-1.39	3.21	11.4	310.6
20:24:33	-1.42	3.16	11.4	310.7
20:24:33	-1.39	3.18	11.4	310.9
20:24:33	-1.44	3.20	11.4	310.4
20:24:34	-1.37	3.16	11.4	310.9

Data files

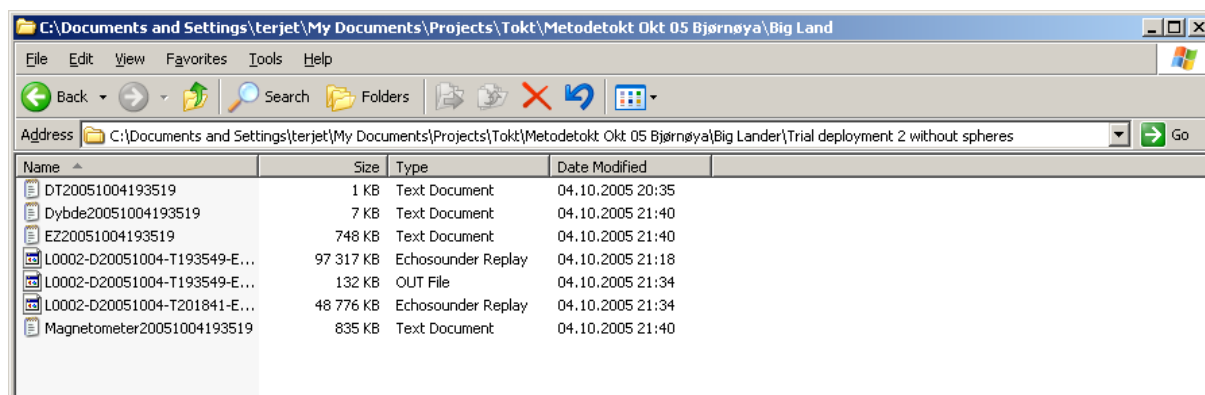


Figure 5: Data files from 2nd trial deployment

1st deployment

Setup

EK60 setup

Scale: 500m

Pulse length: 0,256 ms

Ping rate: Max

Transducer angle: App 6 degrees above the horizontal level.

Suspension: No suspension used. All flotation spheres were removed, and The Lander was placed directly on the bottom. A rope to surface supplied with sea-dog (4 small and 1 big trawl float) two blathers and a flag buoy with flashing light.

Note: The transducer is installed 180° wrong, so forward will be down on the beam diagram.

Deployed: 4 October at 21:05 UTC

Retrieved: 5 October at 15:56 UTC

Heading from compass: 143°

Corrected heading; 323°

Estimated heading from GOS: App. 290°

Lander level: -3° in roll and
2,5° in tilt

Deployment area

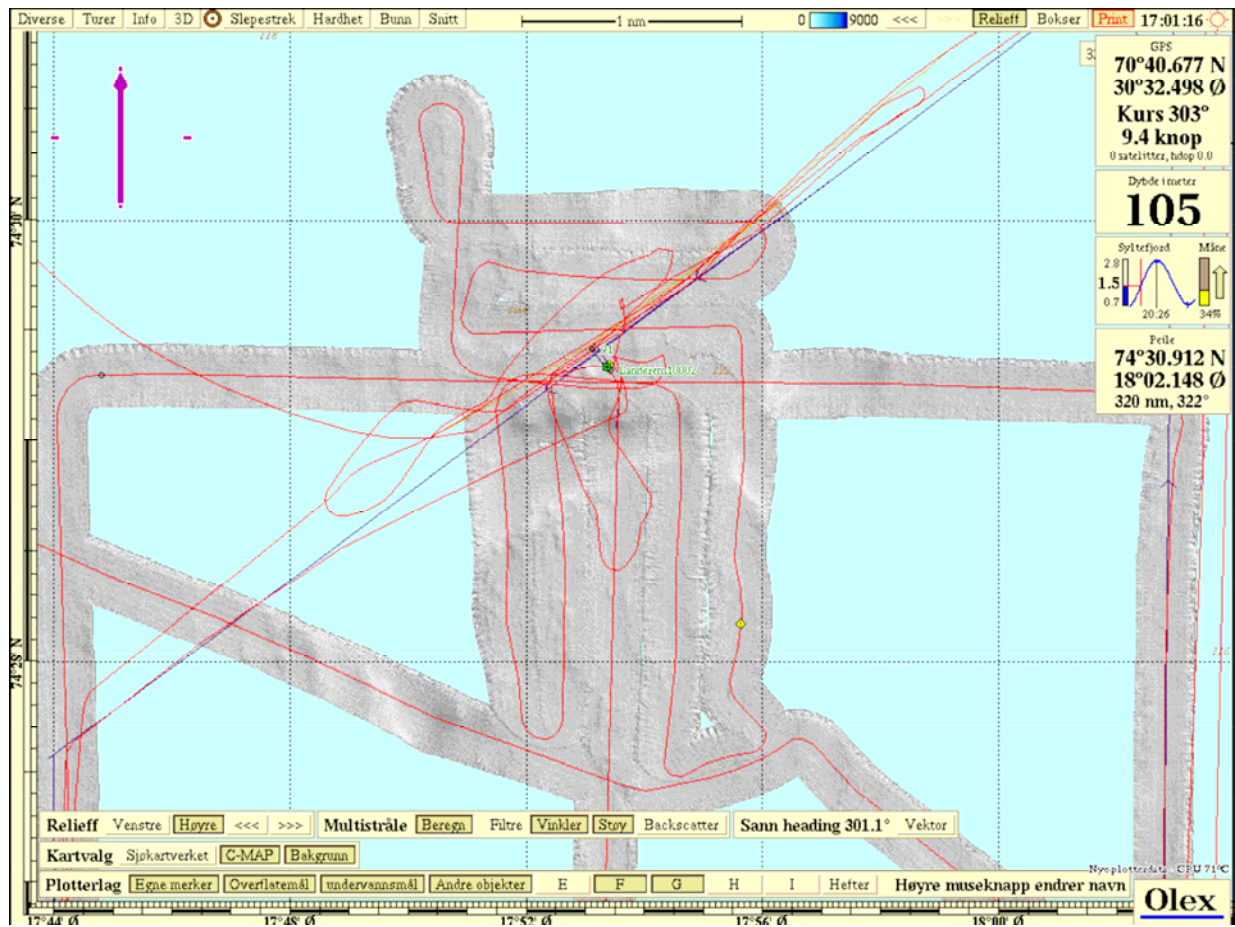


Figure 6: Map over deployment area.

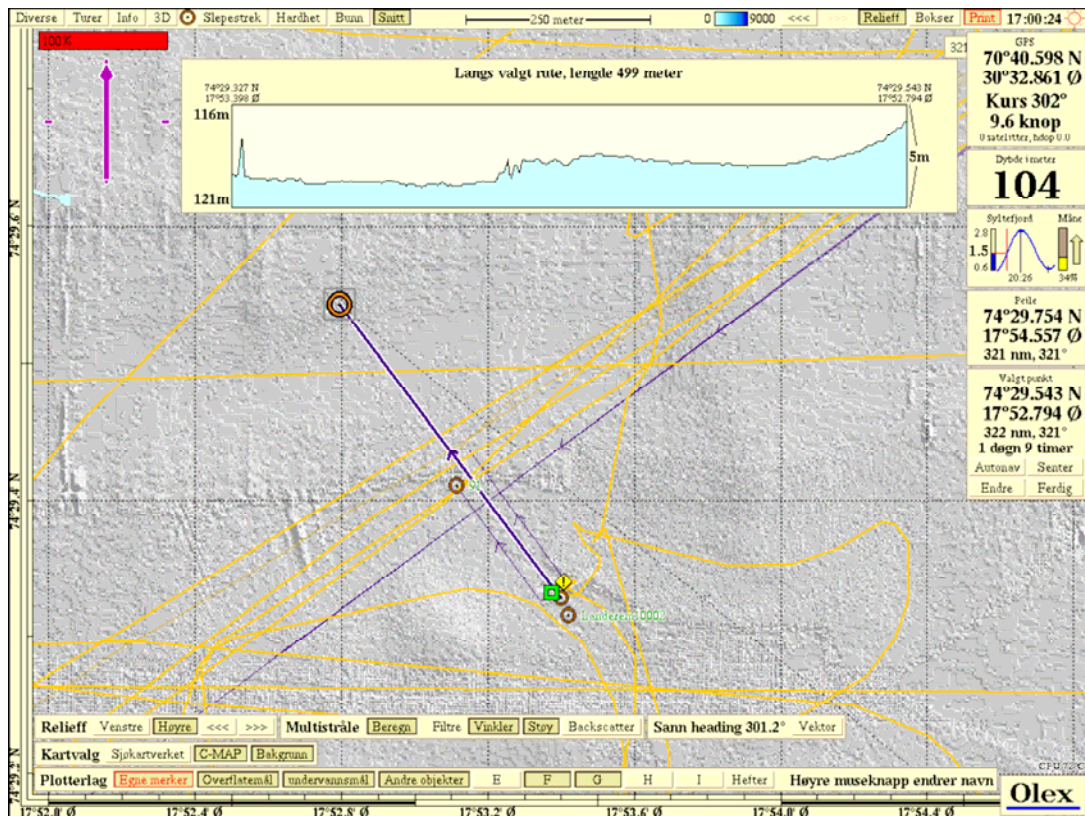


Figure 7: Estimated direction of transducer beam.

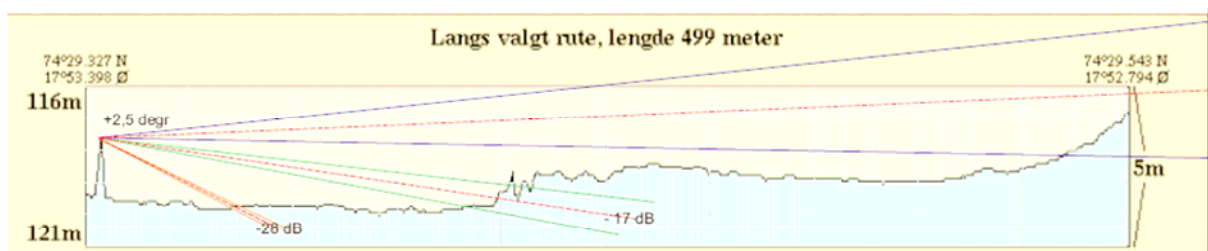


Figure 8: Profile in estimated transducer beam.

Sensor data

Data from EZ compass shows that there are little variations in tilt and roll during deployment period. The registered variation within the period is probably due to the fact that the Lander slowly is sinking into the bottom sediment.

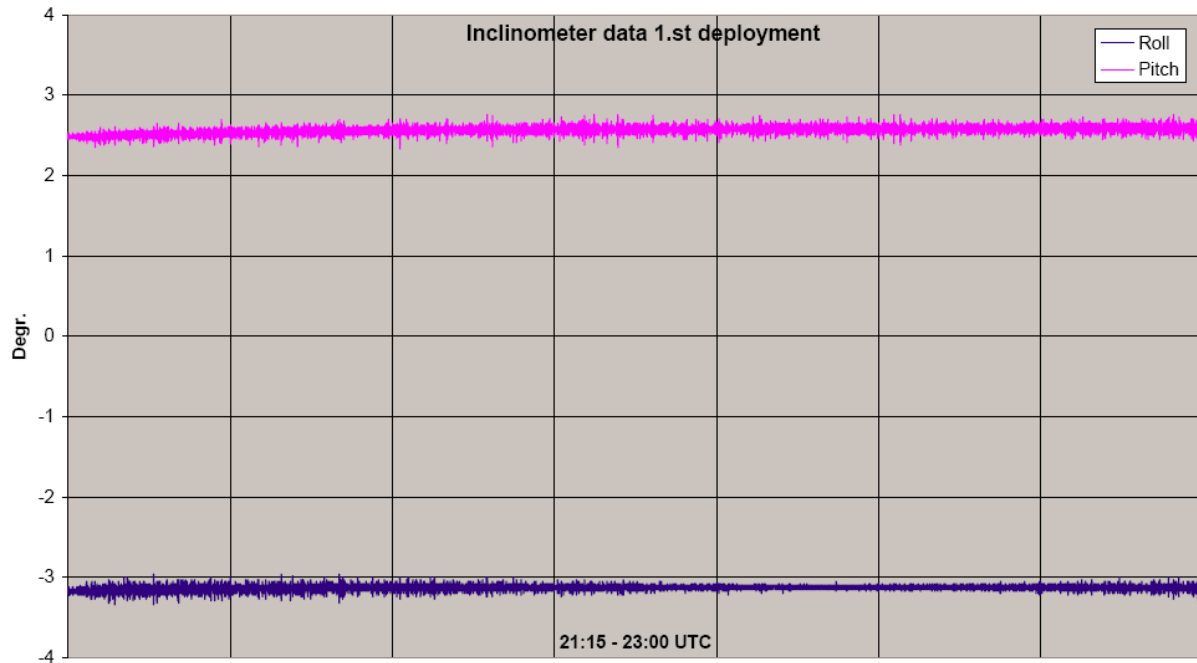


Figure 9: Inclinometer data

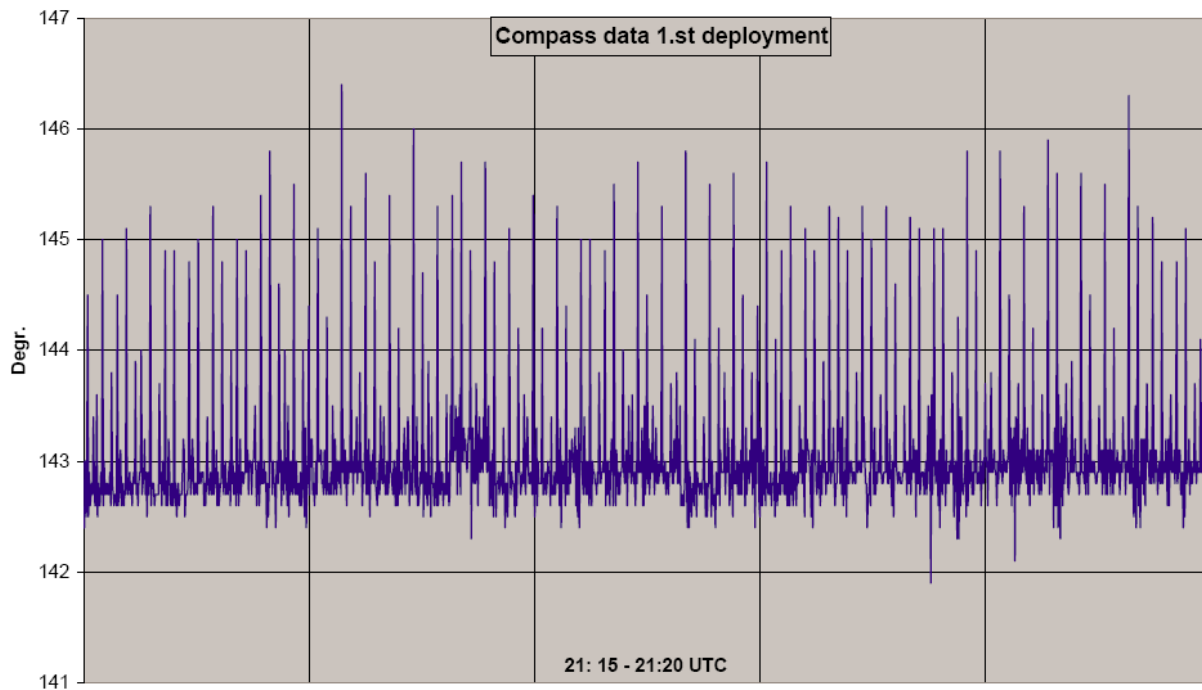


Figure 10: Compass data

Data files

Name	Size	Type	Date Modified
DT20051004205314	1 KB	Text Document	04.10.2005 21:53
Dybde20051004205314	124 KB	Text Document	05.10.2005 17:09
EZ20051004205314	13 271 KB	Text Document	05.10.2005 17:08
EZ20051004205314	6 707 KB	Microsoft Excel Worksheet	29.11.2005 13:36
EZ20051004205314 compass	20 KB	Adobe Acrobat 7.0 Document	29.11.2005 13:23
EZ20051004205314 Inclinometer	259 KB	Adobe Acrobat 7.0 Document	29.11.2005 13:37
L0002-D20051004-T205339-EK60	97 294 KB	Echosounder Replay	04.10.2005 23:06
L0002-D20051004-T205339-EK60.out	3 007 KB	OUT File	05.10.2005 17:01
L0002-D20051004-T220602-EK60	97 286 KB	Echosounder Replay	05.10.2005 00:09
L0002-D20051004-T230931-EK60	97 286 KB	Echosounder Replay	05.10.2005 01:13
L0002-D20051005-T001300-EK60	97 286 KB	Echosounder Replay	05.10.2005 02:16
L0002-D20051005-T011629-EK60	97 286 KB	Echosounder Replay	05.10.2005 03:19
L0002-D20051005-T021958-EK60	97 286 KB	Echosounder Replay	05.10.2005 04:23
L0002-D20051005-T032326-EK60	97 286 KB	Echosounder Replay	05.10.2005 05:26
L0002-D20051005-T042655-EK60	97 286 KB	Echosounder Replay	05.10.2005 06:30
L0002-D20051005-T053023-EK60	97 286 KB	Echosounder Replay	05.10.2005 07:33
L0002-D20051005-T063352-EK60	97 286 KB	Echosounder Replay	05.10.2005 08:37
L0002-D20051005-T073720-EK60	97 286 KB	Echosounder Replay	05.10.2005 09:40
L0002-D20051005-T084049-EK60	97 286 KB	Echosounder Replay	05.10.2005 10:44
L0002-D20051005-T094417-EK60	97 286 KB	Echosounder Replay	05.10.2005 11:47
L0002-D20051005-T104746-EK60	97 286 KB	Echosounder Replay	05.10.2005 12:51
L0002-D20051005-T115114-EK60	97 286 KB	Echosounder Replay	05.10.2005 13:54
L0002-D20051005-T125443-EK60	97 286 KB	Echosounder Replay	05.10.2005 14:58
L0002-D20051005-T135811-EK60	97 286 KB	Echosounder Replay	05.10.2005 16:01
L0002-D20051005-T150140-EK60	91 360 KB	Echosounder Replay	05.10.2005 17:01
Magnetometer20051004205314	14 814 KB	Text Document	05.10.2005 17:08
Snitt 1	193 KB	CorelDRAW 12.0 Graphic	29.11.2005 10:45
Snitt 1	24 KB	Adobe Acrobat 7.0 Document	10.10.2005 08:52

Figure 11: Data files from 1st deployment

Screen dumps from trawl passing

1st trawl haul

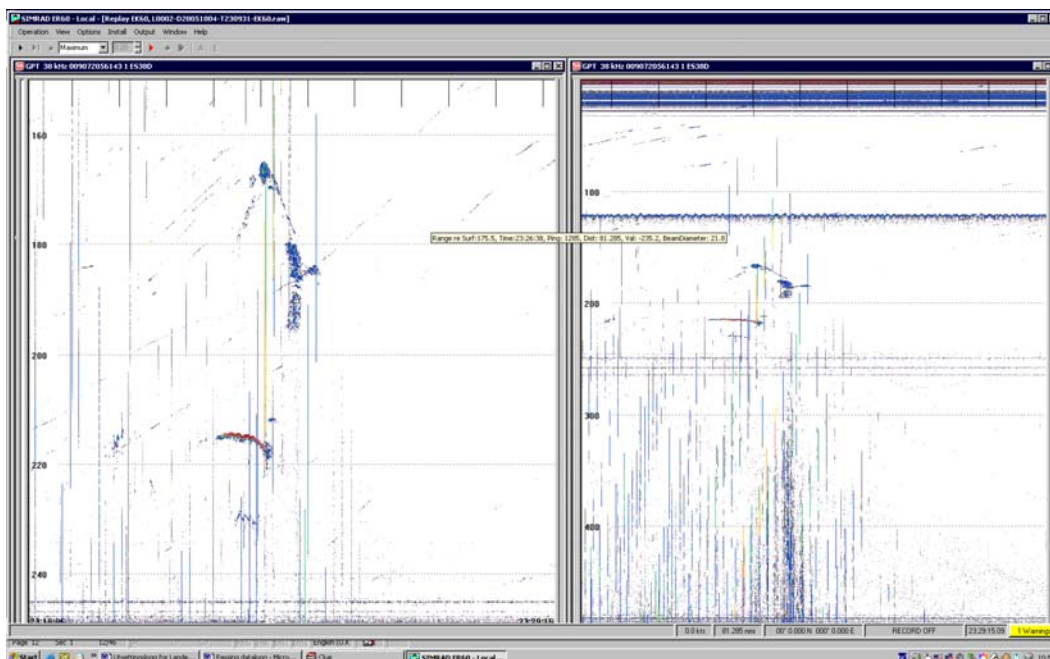


Figure 12: First trawl passing, GOS at 23:23

2nd trawl haul

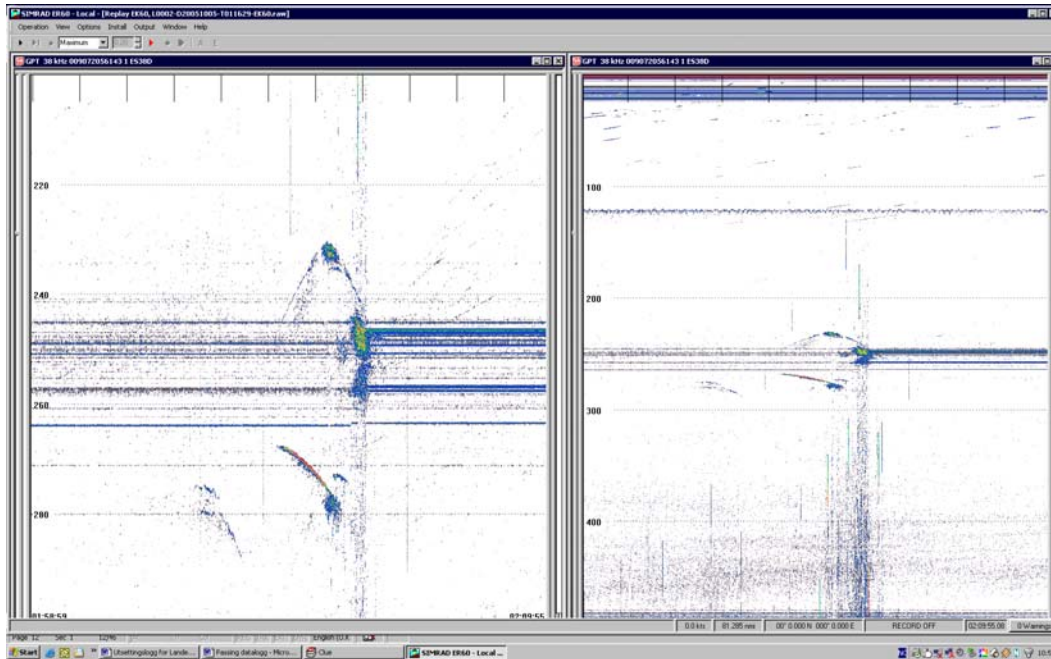


Figure 13: Second trawl passing. JH at 02:05

Note how the reflection from the bottom topography is changed after the trawl has passed.

3rd trawl haul

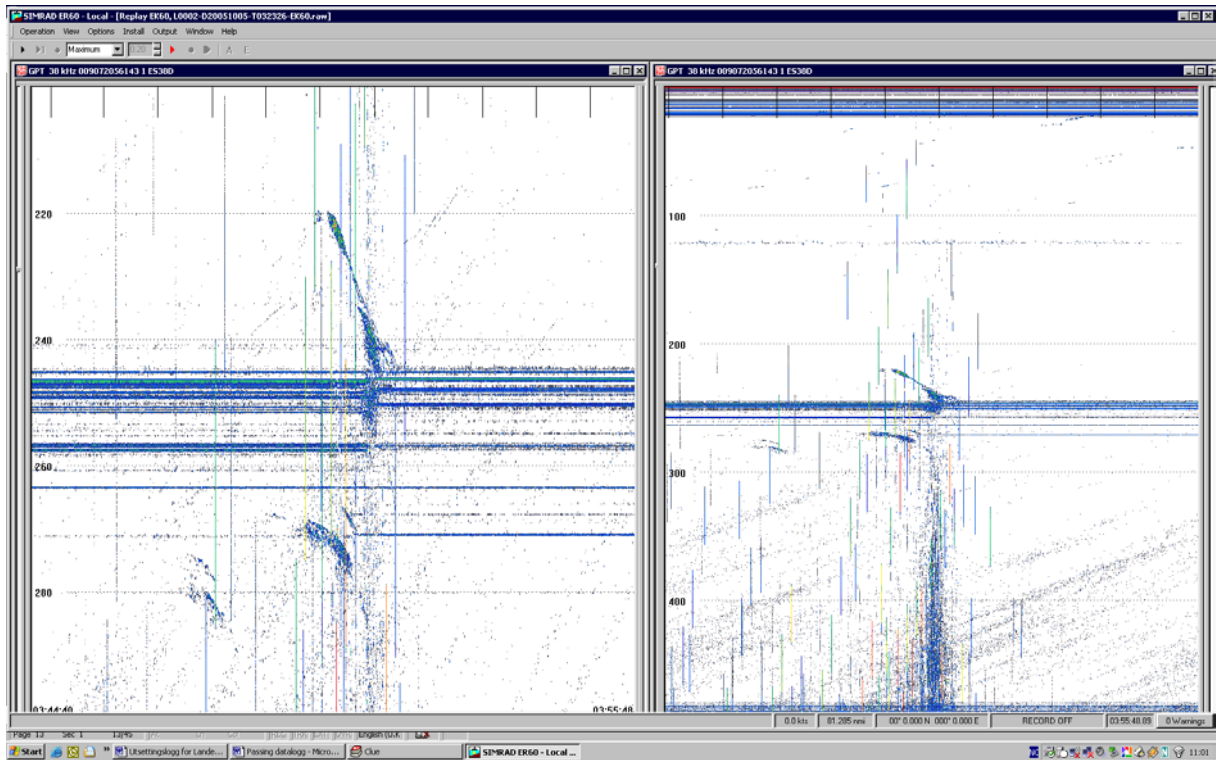


Figure 14: Third trawl passing. GOS at 03:50

4th trawl haul

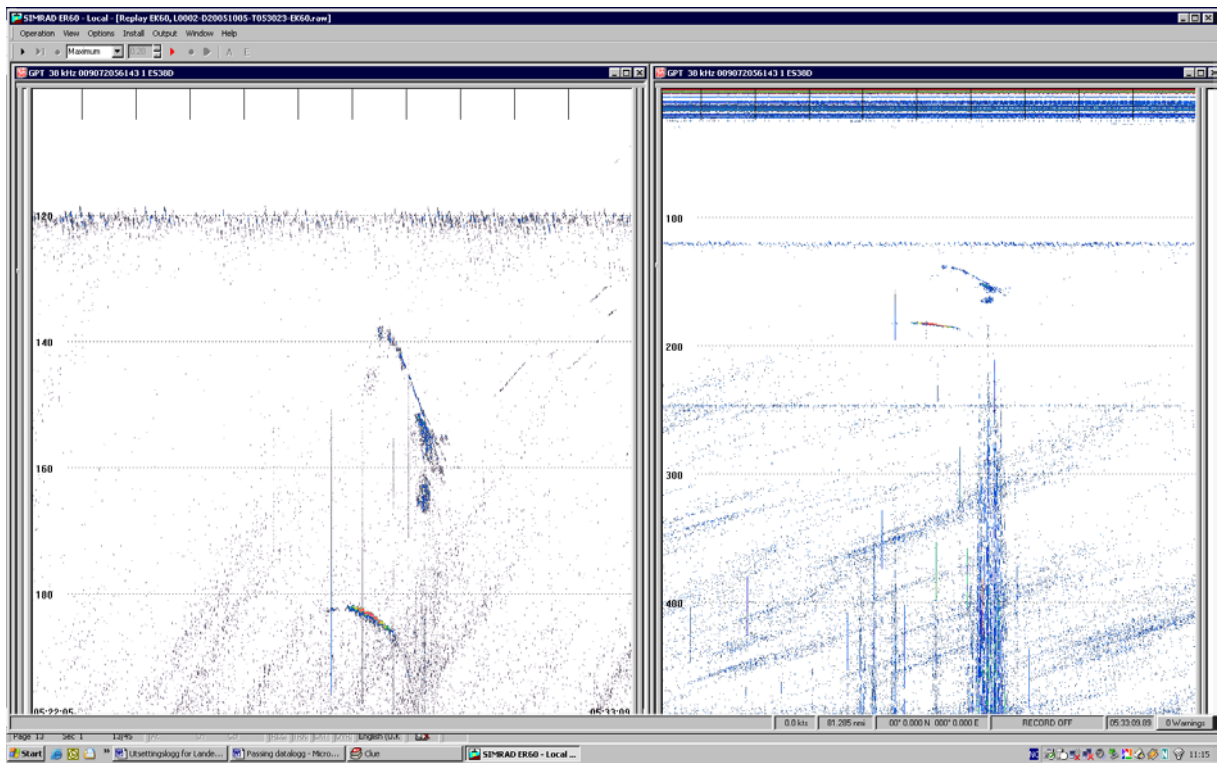


Figure 15: Fourth trawl passing. JH at 05:28

5th trawl haul.

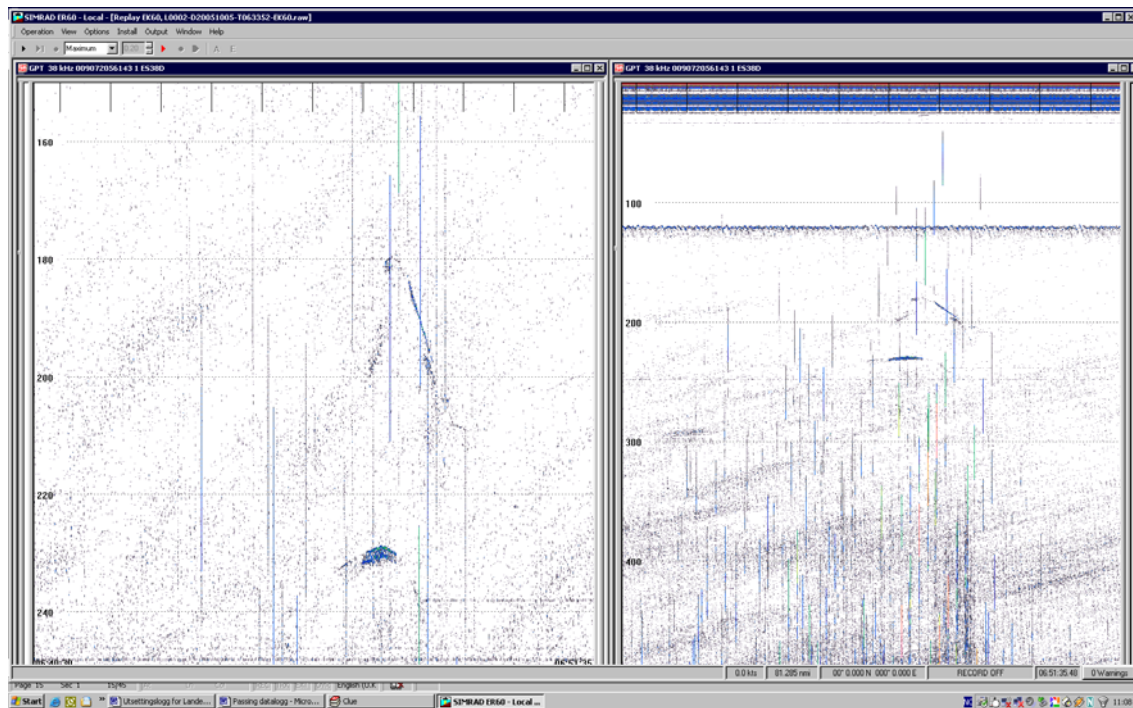


Figure 16: Fifth trawl passing. GOS at 06:47

Seems that the trawl are passing in shadow area behind a "hill" which we can see reflections from at a distance of app. 120 meters from the transducer.

6th trawl haul

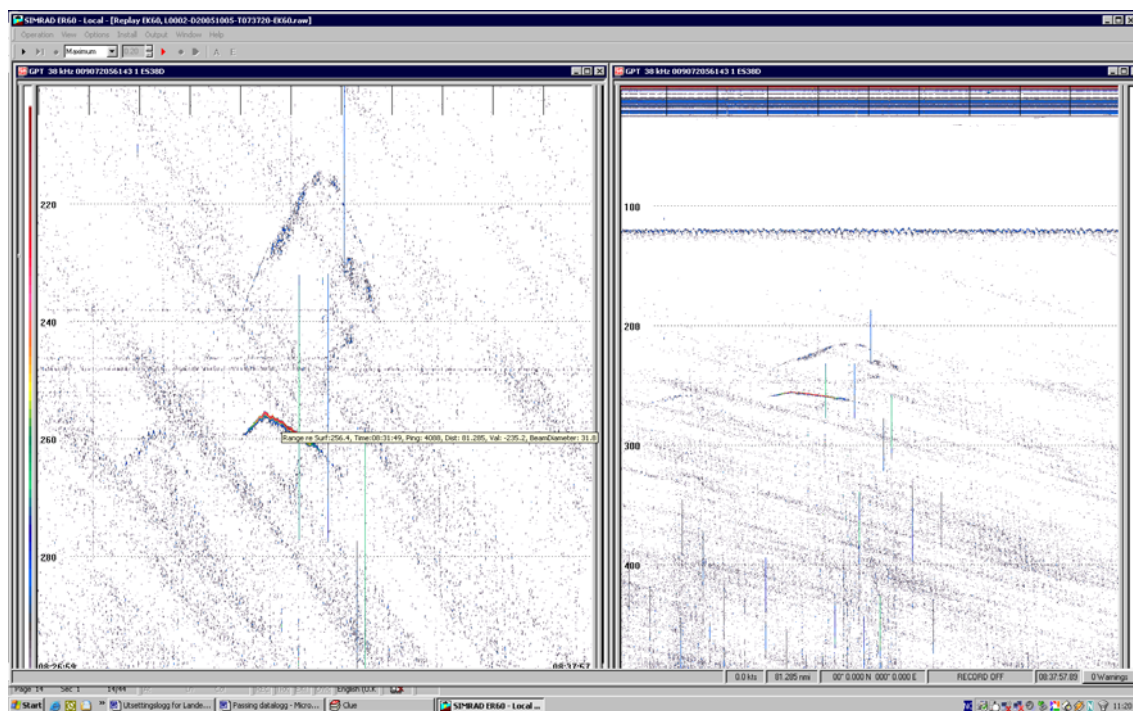


Figure 17: Sixth trawl haul. JH at 08:31

Other screen dumps from sounder

Ship passing

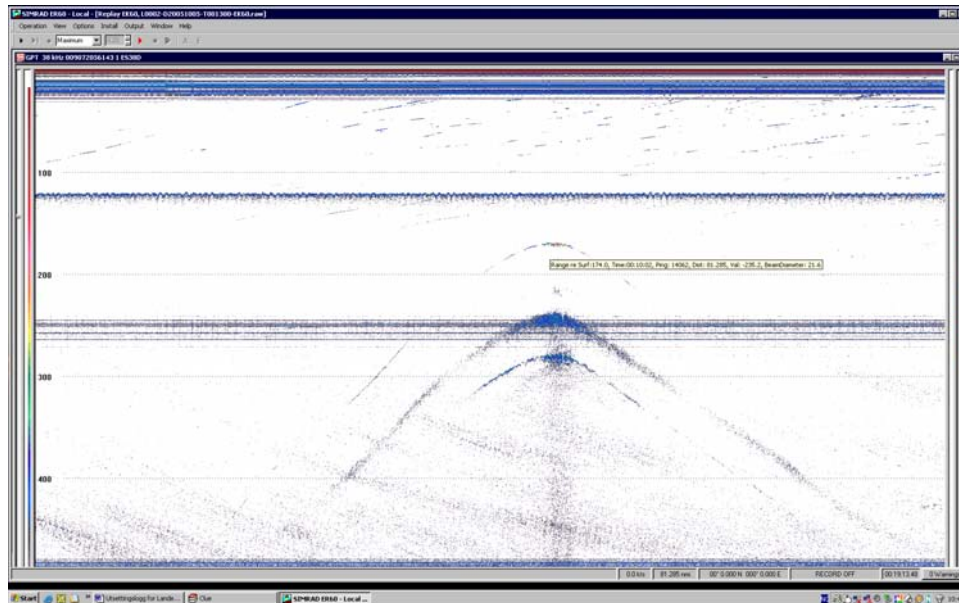


Figure 18: Ship passing at 00:10 (JH?)

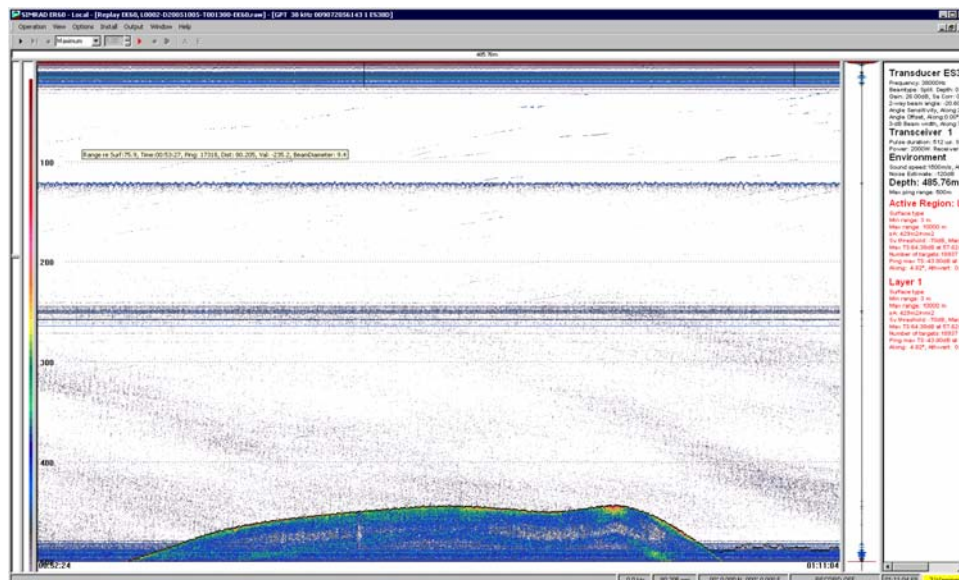


Figure 19: Ship passing at 01:11 (JH?)

Here we can see directly reflections from the ship passing, must likely in one of the side lobes. At the end of the diagram, could it be that we see the ship moving away, and the propeller water is left?

Fish reaction

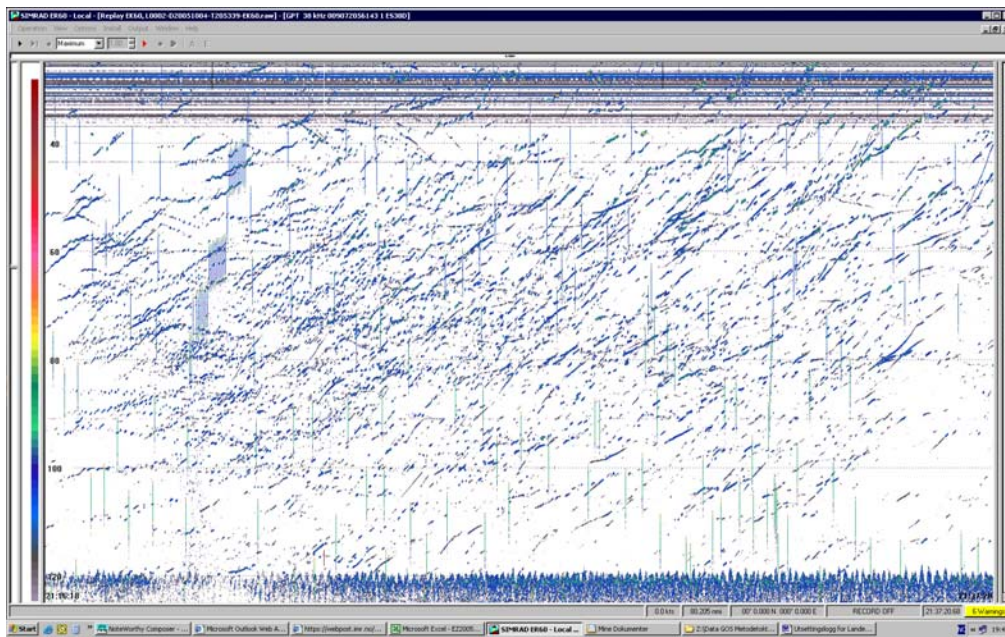


Figure 20: During deployment at 21:37.

There is clearly difference in behaviour of the fish, while GOS are above the Lander, and just after GOS has left the area.

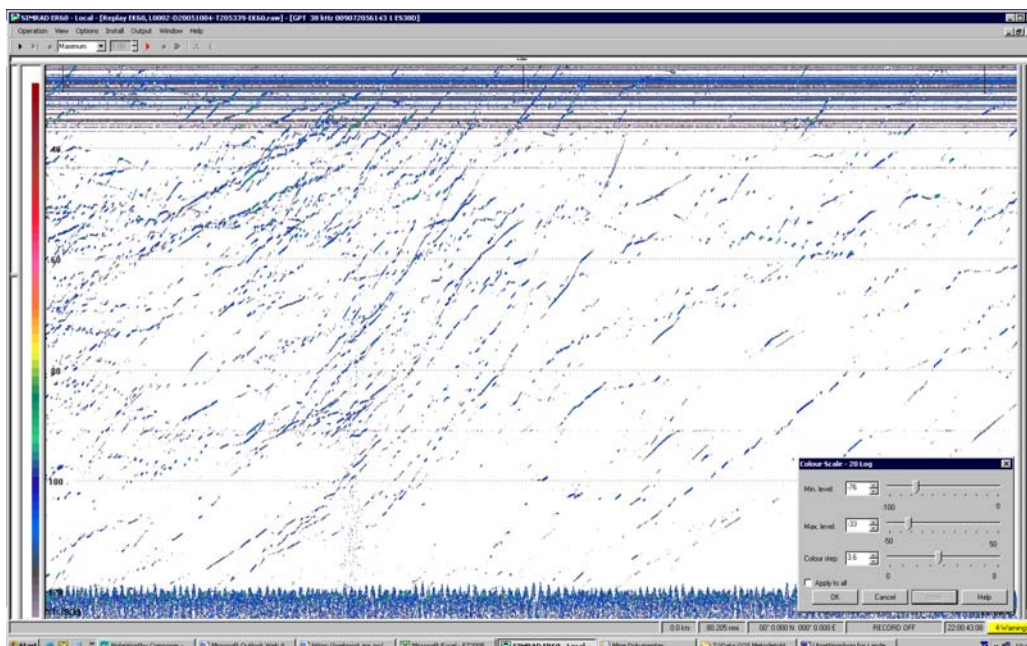


Figure 21: Just after GOS has left the area at 22:00.

Current and wind

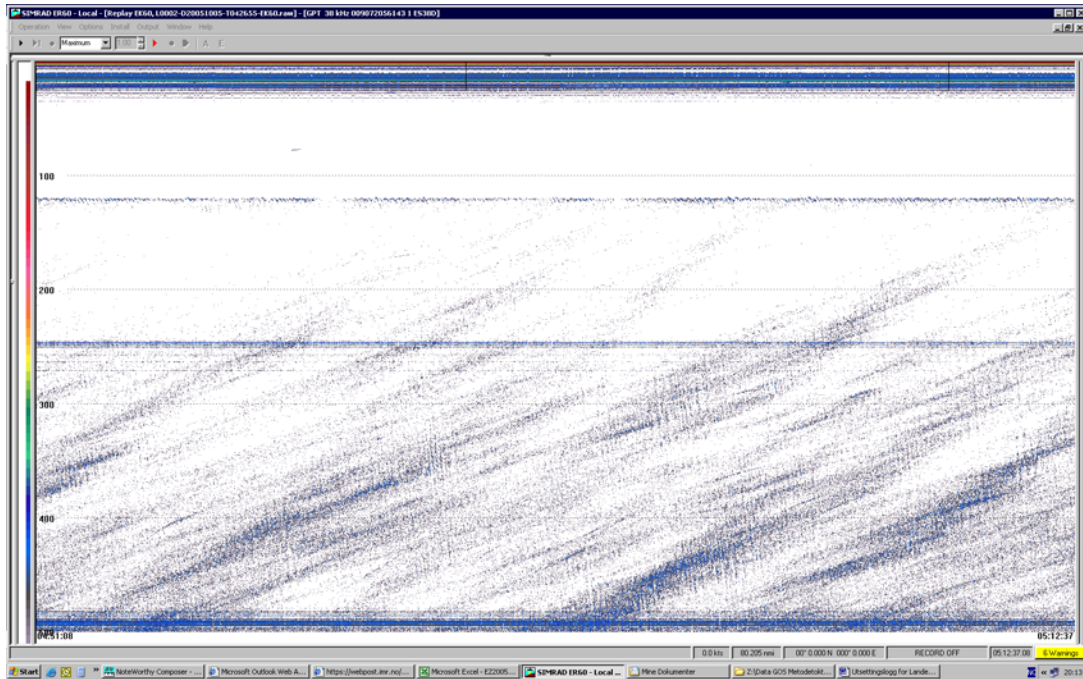


Figure 22: The current is flowing against the transducer beam at 05:12

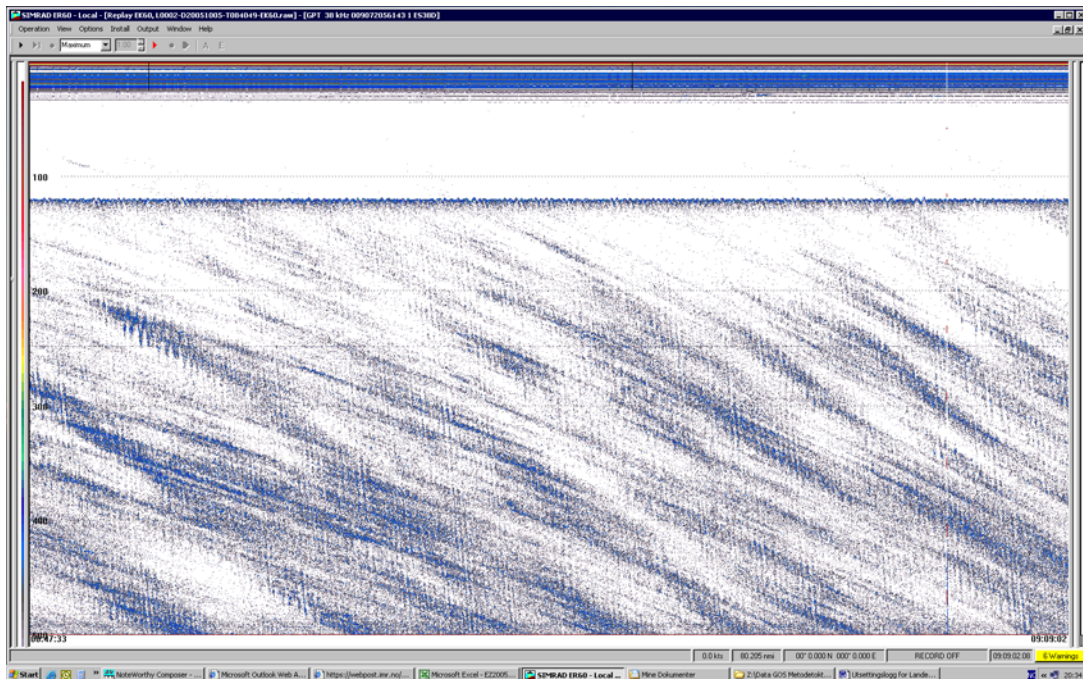


Figure 23: Current flowing in the opposite direction at 09:09

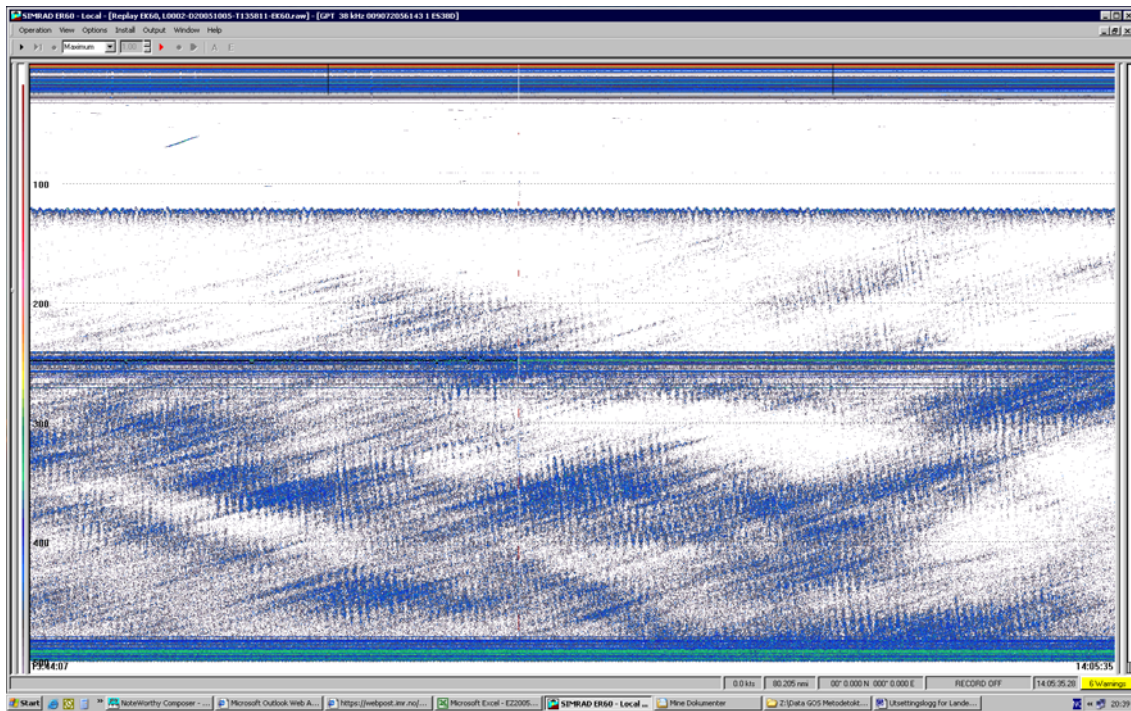


Figure 24: Current flowing against the transducer beam, at higher sea state at 14:05

This is probably reflection from air bubbles washed into the water column by the waves. And we can see the bubbles are carried along by the current, in the same direction as the current.

2nd deployment

Setup

Scale: 500m

Pulse length: 0,256 ms

Ping rate: Max.

Transducer angle: App 6°g above the horizontal level.

Suspension: All floating spheres are removed, and the Lander is placed directly on the bottom. Rope to surface supplied with sea-dog (4 small and 1 big trawl float) two blathers and a flag buoy with flashing light.

Rudder: A rudder is installed (leather with 0,6 x 1,0 m plywood plate on end) 90° on the transducer face, causing the Lander to turn in such manner that the transducer are looking across the current direction. By doing so, we are able to trawl along the current.

Note: **The transducer is now corrected** in such manner that forward on the transducer beam will be up in the beam diagram on the sounder display. Roll angle will still be the same, but tilt angle have changed value (pos/neg) Since the transducer are mounted horizontal, and looking backwards, a + angle will in reality give a lower angle (-) on the front side, and a – roll will move starboard side down, seen from the Lander:

With other words: A - angle in tilt of Lander will give + angel on tilt seen from the transducer Roll will effect the direction of transducer, and finally. Direction from compass will give roll on transducer.

Heading from compass 191°. The transducer is looking backwards of the Lander, so the heading will be 180° wrong. Right heading here is 11°

Deployed:	7 th October at 08:10 UTC
Retrieved:	7 th October at 11:10 UTC
Heading from compass:	191°
Corrected heading;	11°
Estimated heading from GOS:	App. 215°
Lander level:	-7,5° in roll and 0° in tilt

Note:

The heading, estimated from GOS, seems to be 180° different than the heading from the Lander compass. The estimation from GOS could be wrong. We could have detected the back beam of the transducer instead of the main beam. Looking at the echoes from the trawl, we can see that the trawl is moving away from the transducer, which can confirm that the heading from the Lander compass is correct.

Locating transducer beam

We used ER60, 38 kHz onboard GOS to try to determine the direction of the transducer beam of the Lander. We used the ER in passive mode with a ping rate as close as possible to the ping rate of the ER60 in the Lander. 1,25 sec ping rate gave us a very nice echo from the Lander transmitting pulse.

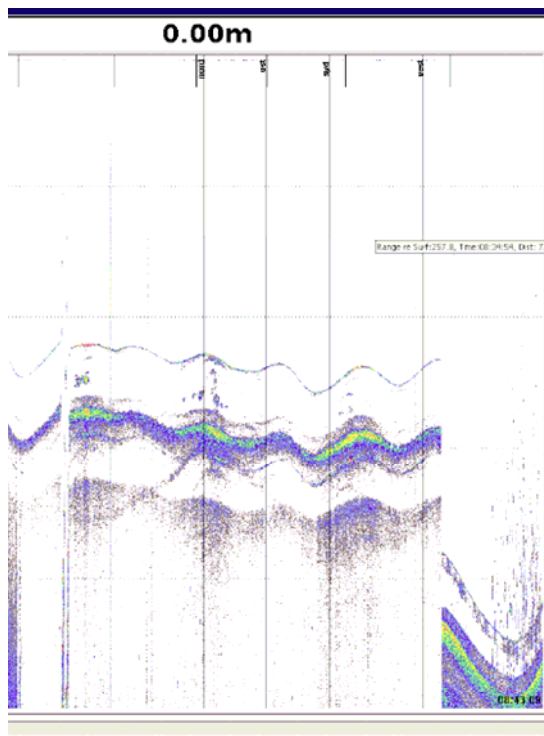


Figure 25: Echogram from GOS. Estimation of transducer direction

Deployment area

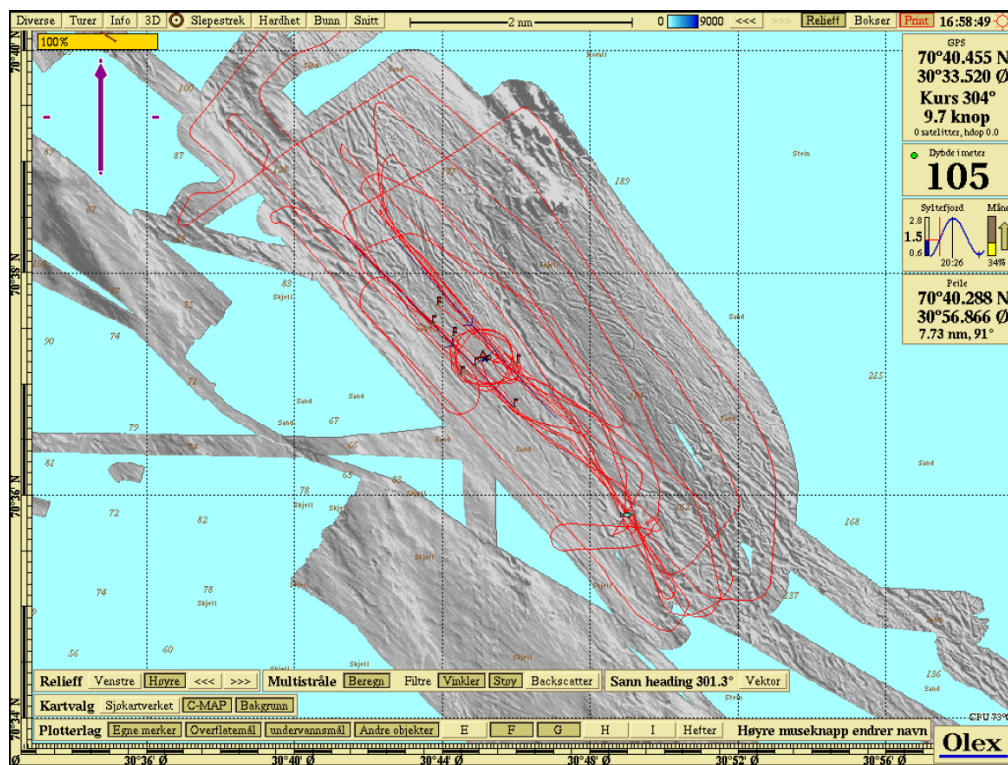


Figure 26 Map over the deployment area

This deployment area is east coast of Finnmark

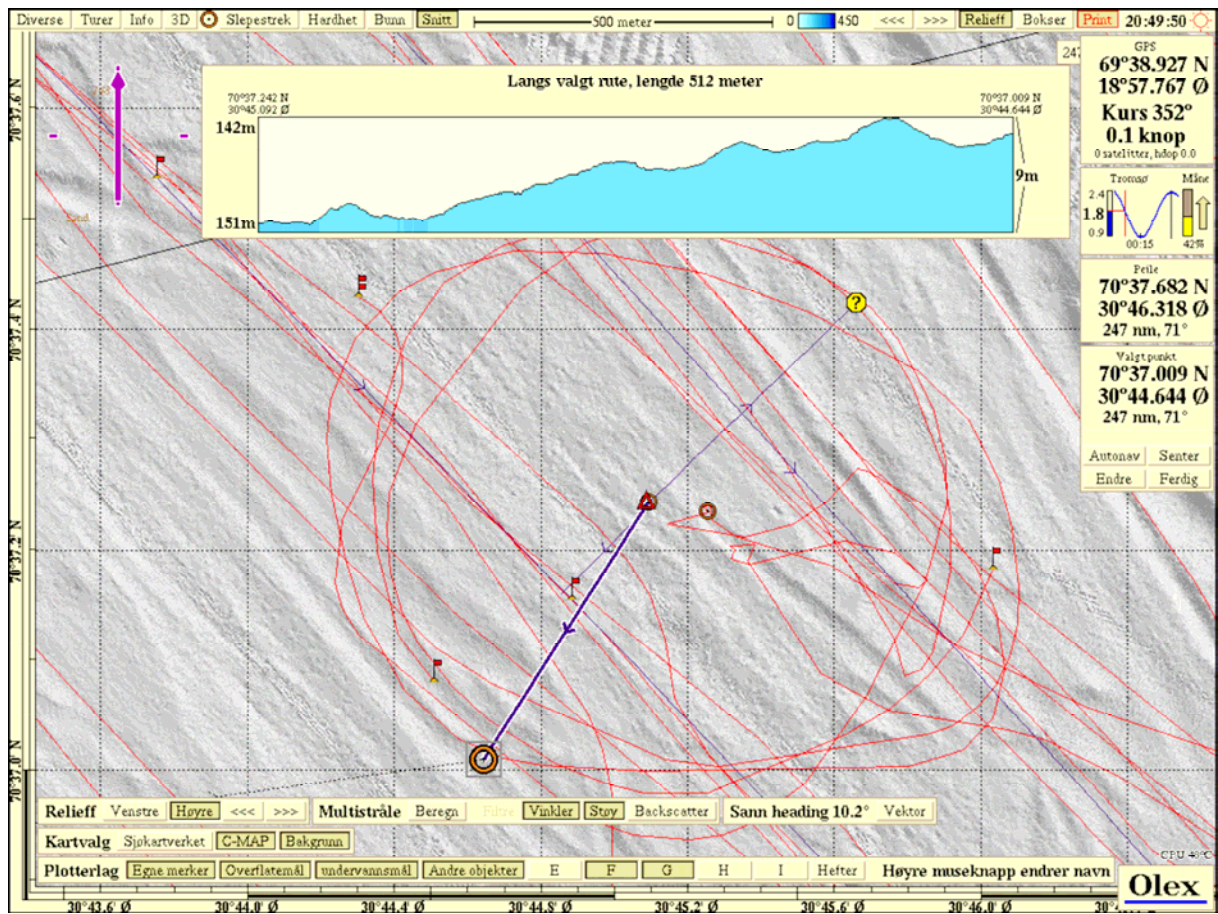


Figure 27: Estimated direction of transducer beam.

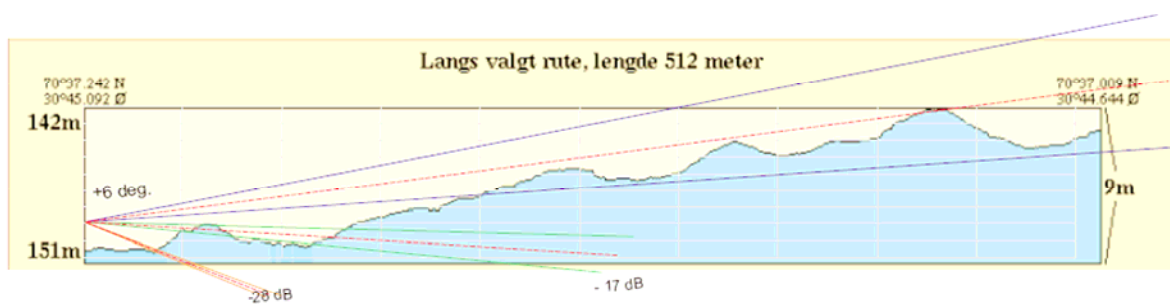


Figure 28: Bottom profile in estimated transducer beam.

Sensor data

Stabile angel with $-7,5^\circ$ roll and 0° tilt. Deviation $< 0,5^\circ$

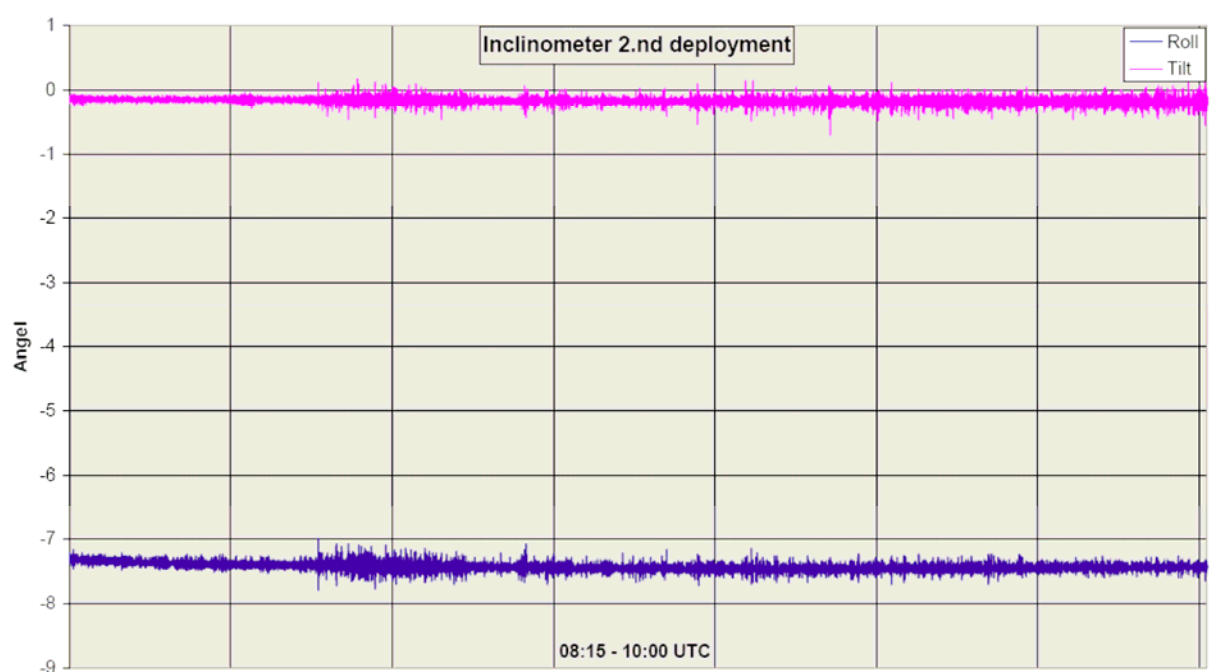


Figure 29: Inclinometer data

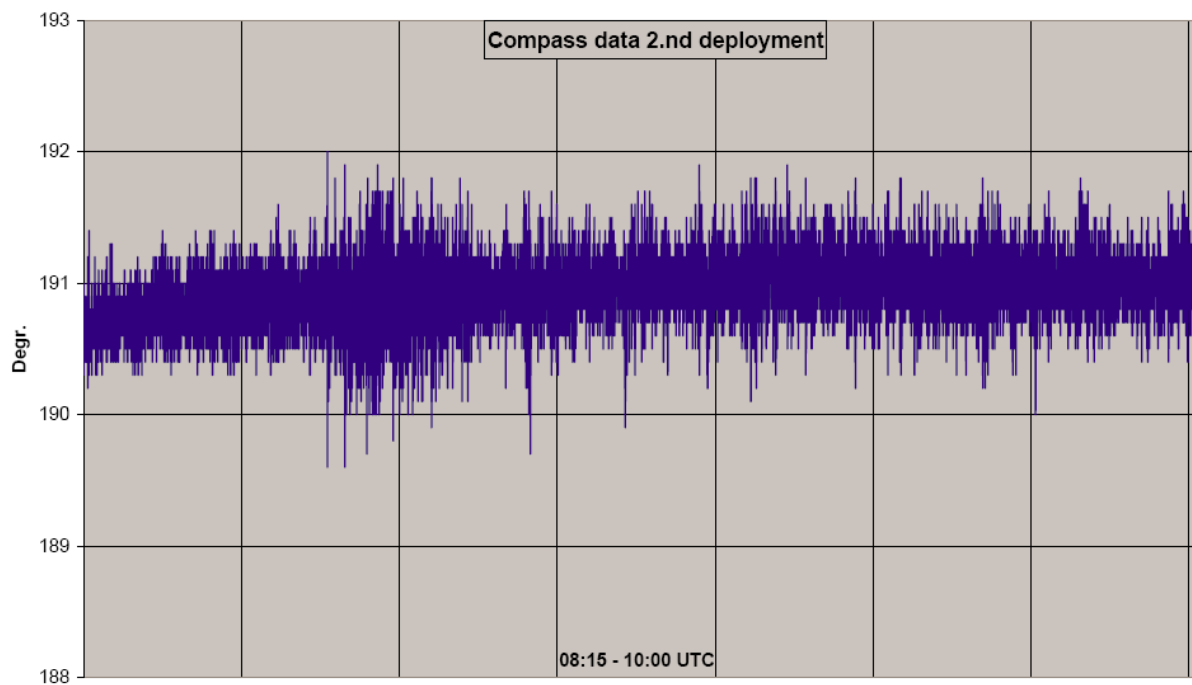


Figure 30: Compass data

Data files

Name	Size	Type	Date Modified
DT20051007071814	1 KB	Text Document	07.10.2005 08:18
Dybde20051007071814	37 KB	Text Document	07.10.2005 14:02
EZ20051007071814	4 047 KB	Text Document	07.10.2005 14:02
EZ20051007071814	7 207 KB	Microsoft Excel Wor...	29.11.2005 13:51
EZ20051007071814 Compass	145 KB	Adobe Acrobat 7.0 ...	29.11.2005 13:51
EZ20051007071814 inclinometer	285 KB	Adobe Acrobat 7.0 ...	29.11.2005 13:45
L0002-D20051007-T071836-EK60	97 286 KB	Echosounder Replay	07.10.2005 09:52
L0002-D20051007-T071836-EK60.out	802 KB	OUT File	07.10.2005 13:52
L0002-D20051007-T085232-EK60	97 286 KB	Echosounder Replay	07.10.2005 10:56
L0002-D20051007-T095601-EK60	97 286 KB	Echosounder Replay	07.10.2005 11:59
L0002-D20051007-T105929-EK60	97 286 KB	Echosounder Replay	07.10.2005 13:02
L0002-D20051007-T120258-EK60	76 014 KB	Echosounder Replay	07.10.2005 13:52
Magnetometer20051007071814	4 509 KB	Text Document	07.10.2005 14:02

Figure 31: Data files from 2nd deployment

1st Trawl haul

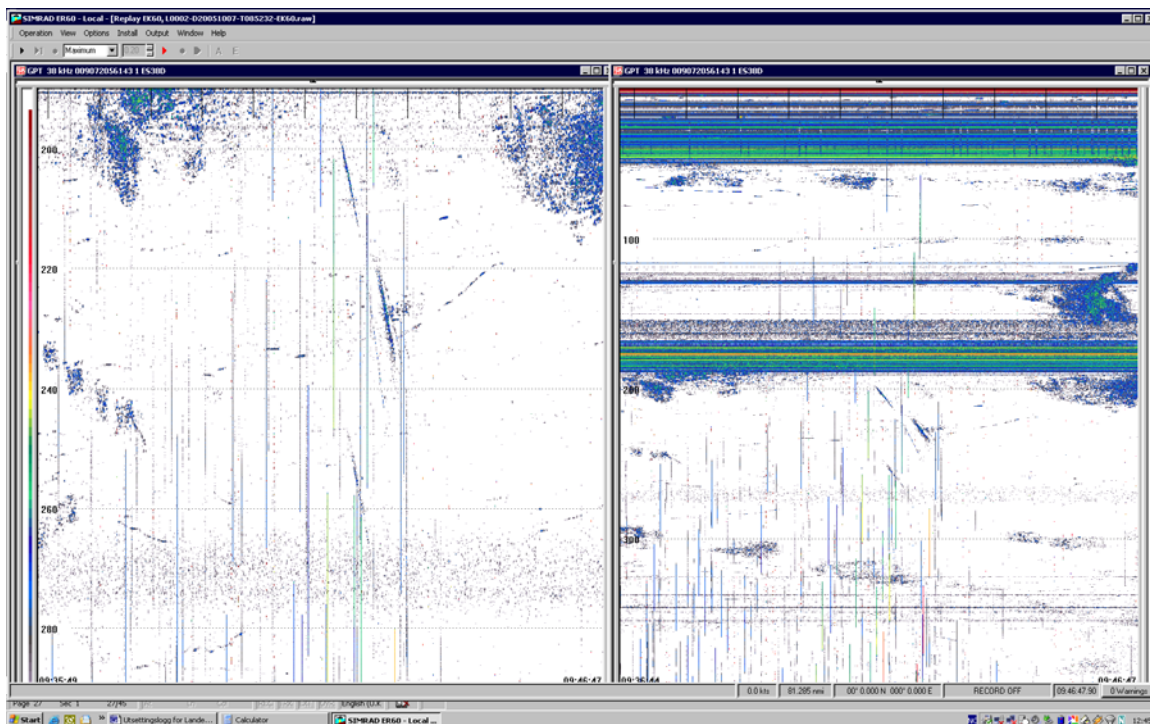


Figure 32: Trawl passing at 09:44

2nd trawl haul

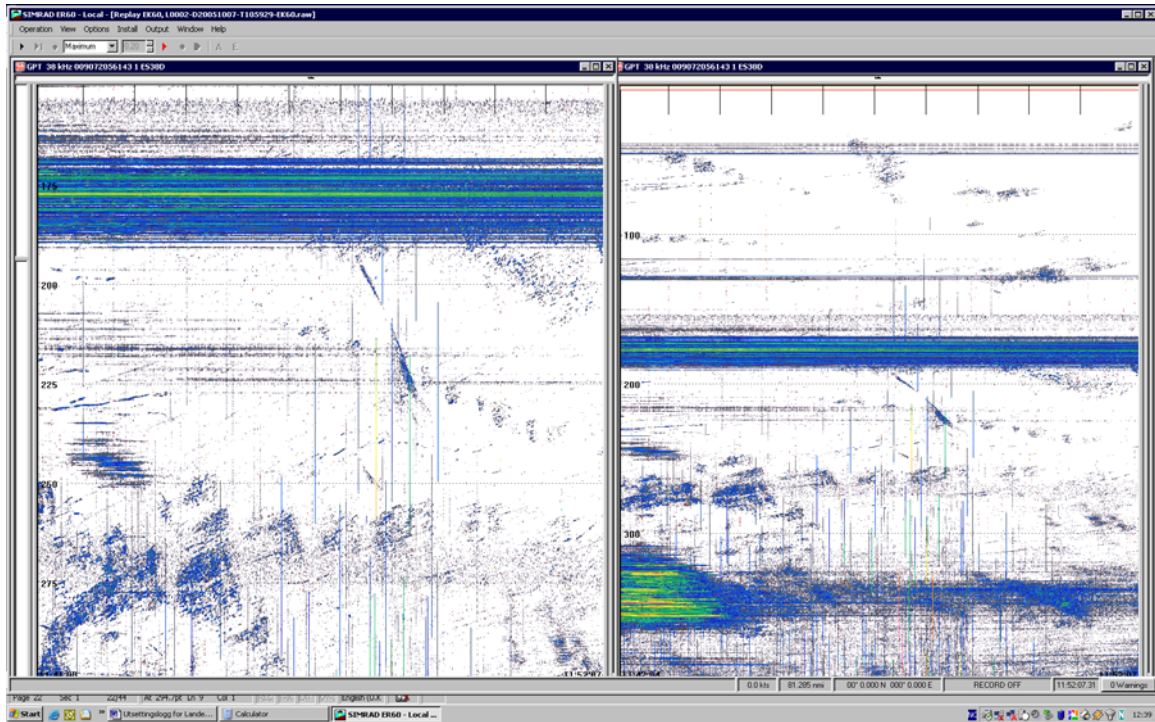


Figure 33: Trawl passing at 11:50

Other screen dumps from sounder

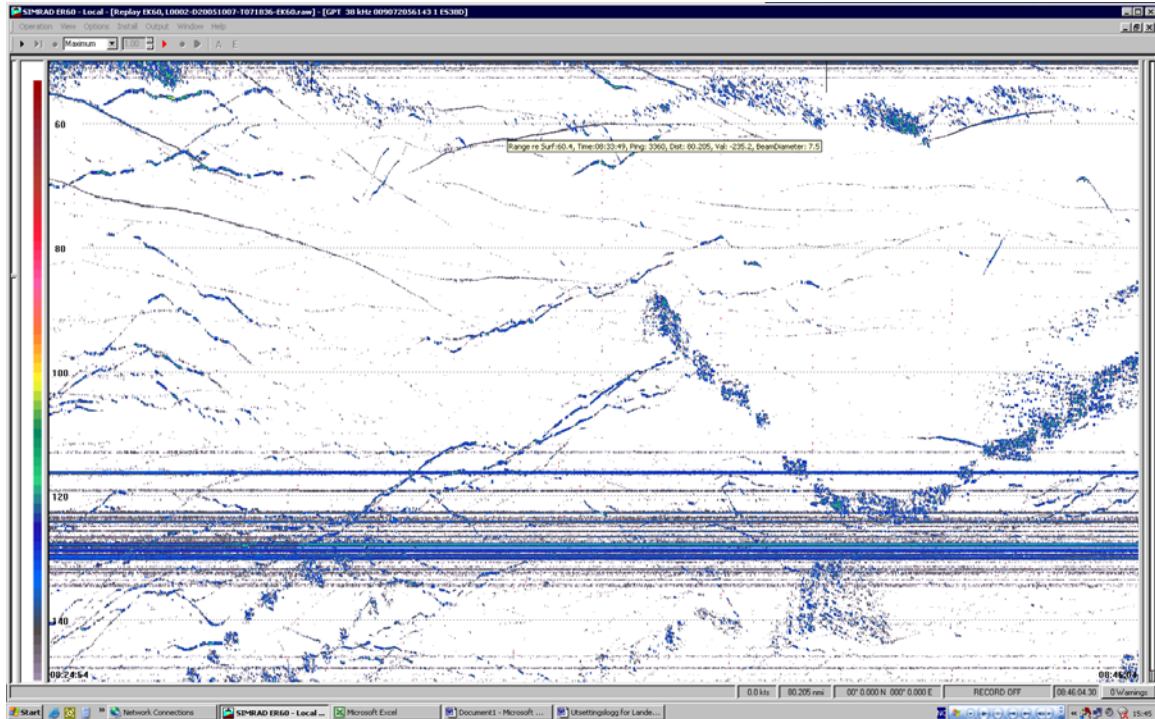


Figure 34: Single fish echoes at 08:46

3rd deployment

Setup

Scale:	500m
Pulse length:	0,256 ms
Ping rate:	Max.
Transducer angle:	App 6°g above the horizontal level.
Suspension:	All floating spheres are removed, and the Lander is placed directly on the bottom. Rope to surface supplied with sea-dog (4 small and 1 big trawl float) two blathers and a flag buoy with flashing light.
Rudder:	A rudder is installed (leather with 0,6 x 1,0 m plywood plate on end) 90° on the transducer face, causing the Lander to turn in such manner that the transducer are looking across the current direction. By doing so, we are able to trawl along the current.
Deployed:	7 October at 13:48 UTC
Retrieved:	8 October at 00:30 UTC
Heading from compass:	203°
Corrected heading;	23°
Estimated heading from GOS:	App. 45°
Lander level:	-8° in roll and 1° in tilt

Deployment area

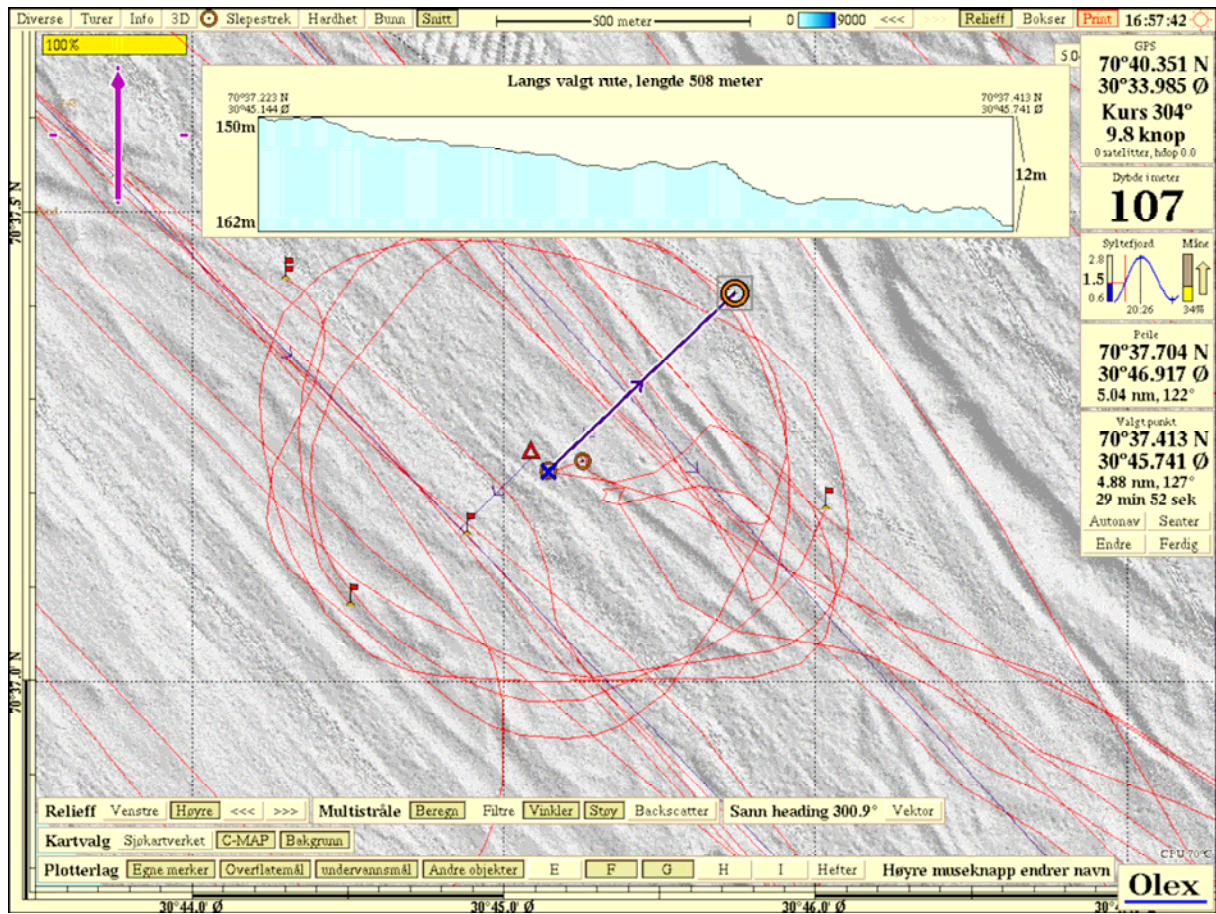


Figure 35: Estimated direction of transducer beam

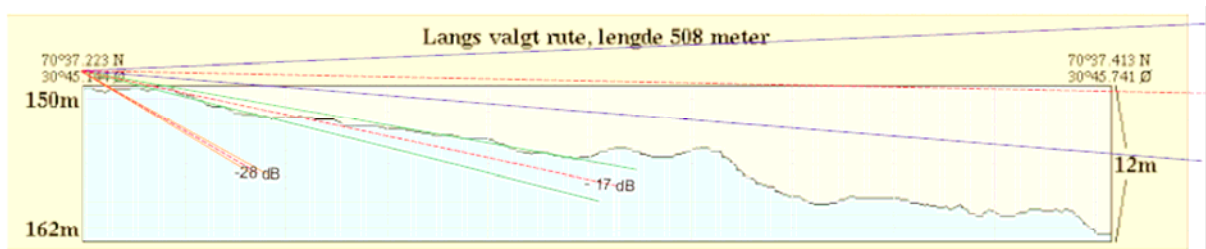


Figure 36 Bottom profile in estimated transducer beam

Sensor data

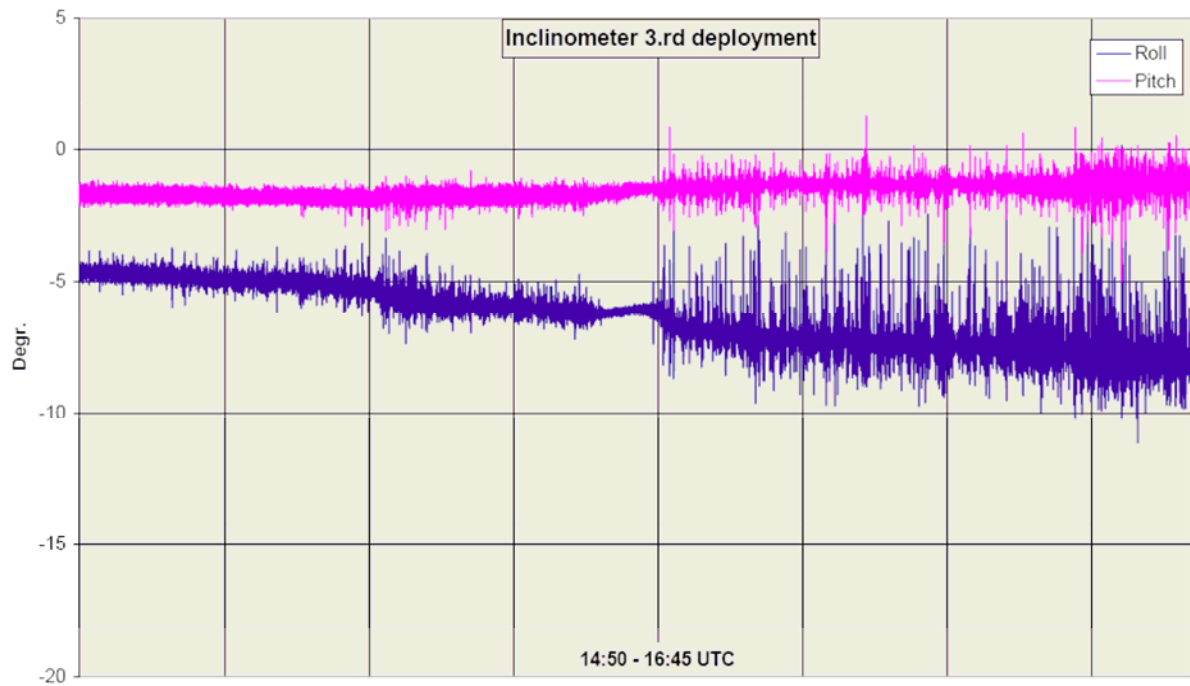


Figure 37: Inclinometer data

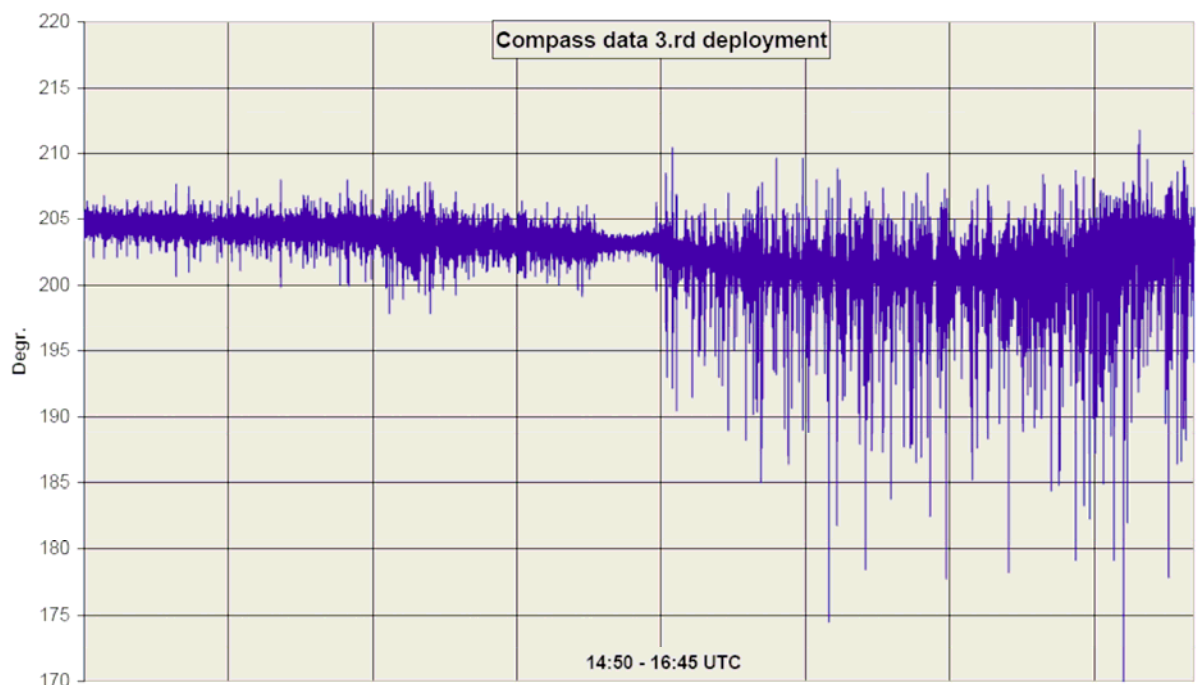


Figure 38: Compass data

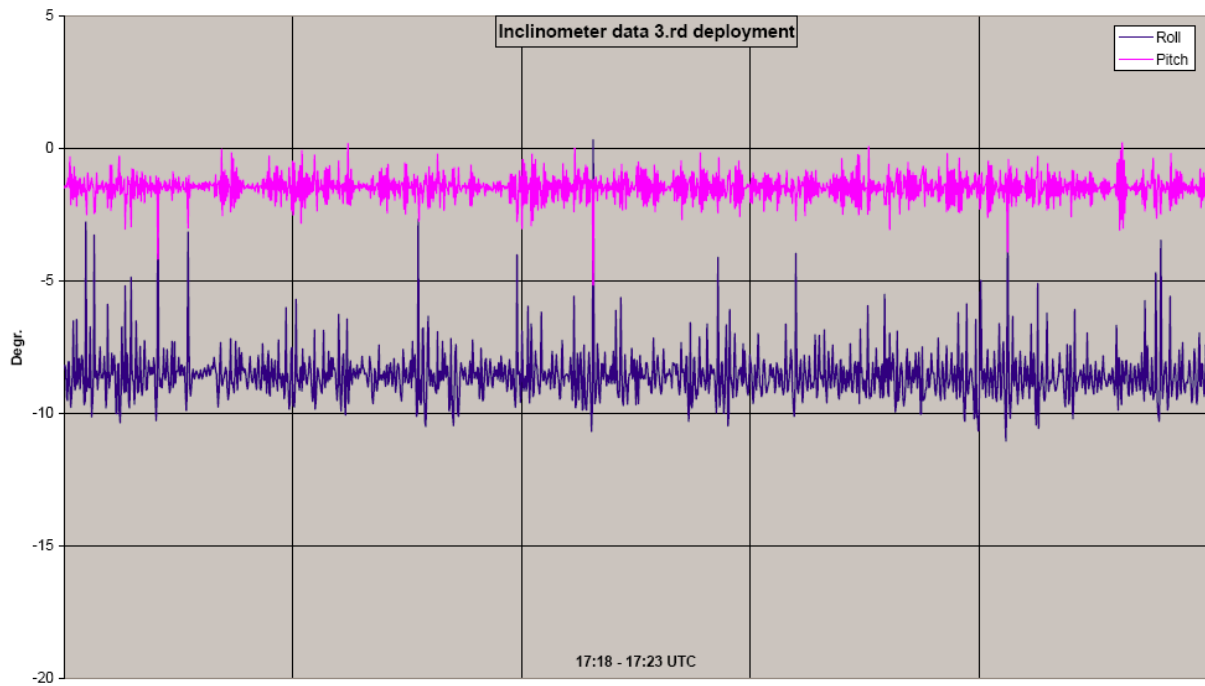


Figure 39: Inclinometer data

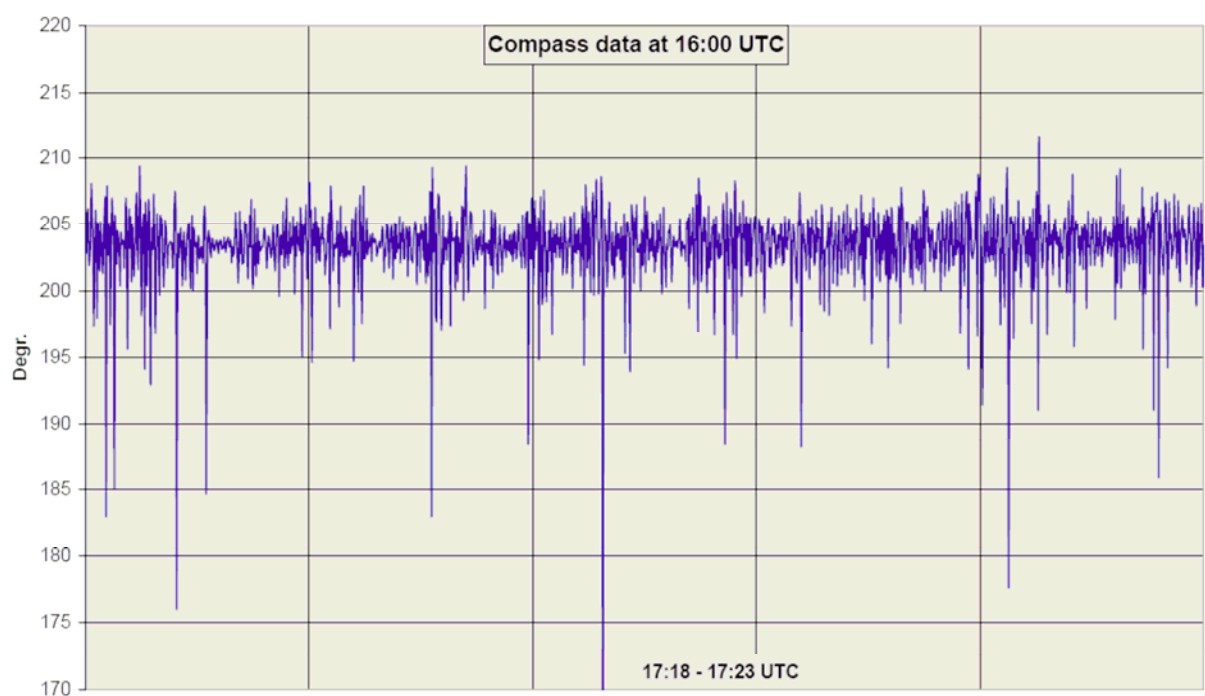
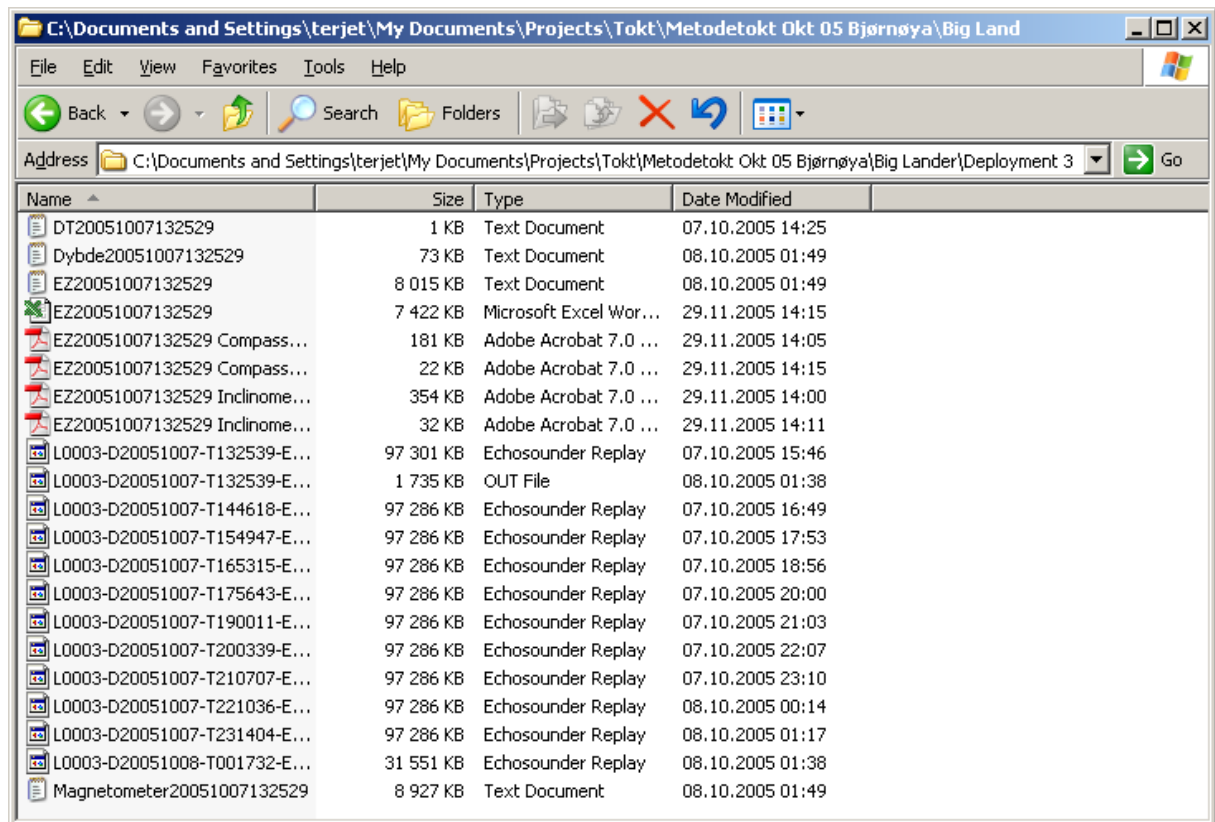


Figure 40: Compass data

Data files



Name	Size	Type	Date Modified
DT20051007132529	1 KB	Text Document	07.10.2005 14:25
Dybde20051007132529	73 KB	Text Document	08.10.2005 01:49
EZ20051007132529	8 015 KB	Text Document	08.10.2005 01:49
EZ20051007132529	7 422 KB	Microsoft Excel Wor...	29.11.2005 14:15
EZ20051007132529 Compass...	181 KB	Adobe Acrobat 7.0 ...	29.11.2005 14:05
EZ20051007132529 Compass...	22 KB	Adobe Acrobat 7.0 ...	29.11.2005 14:15
EZ20051007132529 Inclinome...	354 KB	Adobe Acrobat 7.0 ...	29.11.2005 14:00
EZ20051007132529 Inclinome...	32 KB	Adobe Acrobat 7.0 ...	29.11.2005 14:11
L0003-D20051007-T132539-E...	97 301 KB	Echosounder Replay	07.10.2005 15:46
L0003-D20051007-T132539-E...	1 735 KB	OUT File	08.10.2005 01:38
L0003-D20051007-T144618-E...	97 286 KB	Echosounder Replay	07.10.2005 16:49
L0003-D20051007-T154947-E...	97 286 KB	Echosounder Replay	07.10.2005 17:53
L0003-D20051007-T165315-E...	97 286 KB	Echosounder Replay	07.10.2005 18:56
L0003-D20051007-T175643-E...	97 286 KB	Echosounder Replay	07.10.2005 20:00
L0003-D20051007-T190011-E...	97 286 KB	Echosounder Replay	07.10.2005 21:03
L0003-D20051007-T200339-E...	97 286 KB	Echosounder Replay	07.10.2005 22:07
L0003-D20051007-T210707-E...	97 286 KB	Echosounder Replay	07.10.2005 23:10
L0003-D20051007-T221036-E...	97 286 KB	Echosounder Replay	08.10.2005 00:14
L0003-D20051007-T231404-E...	97 286 KB	Echosounder Replay	08.10.2005 01:17
L0003-D20051008-T001732-E...	31 551 KB	Echosounder Replay	08.10.2005 01:38
Magnetometer20051007132529	8 927 KB	Text Document	08.10.2005 01:49

Figure 41: Data files from 3rd deployment

Screen dumps from trawl passing

1st trawl haul

There is some reflections in the start of the experiment. The amount of reflections decreases around 15:50 UTC. The Lander is probable settling better on the bottom floor, giving a better transducer angle according to the bottom profile.

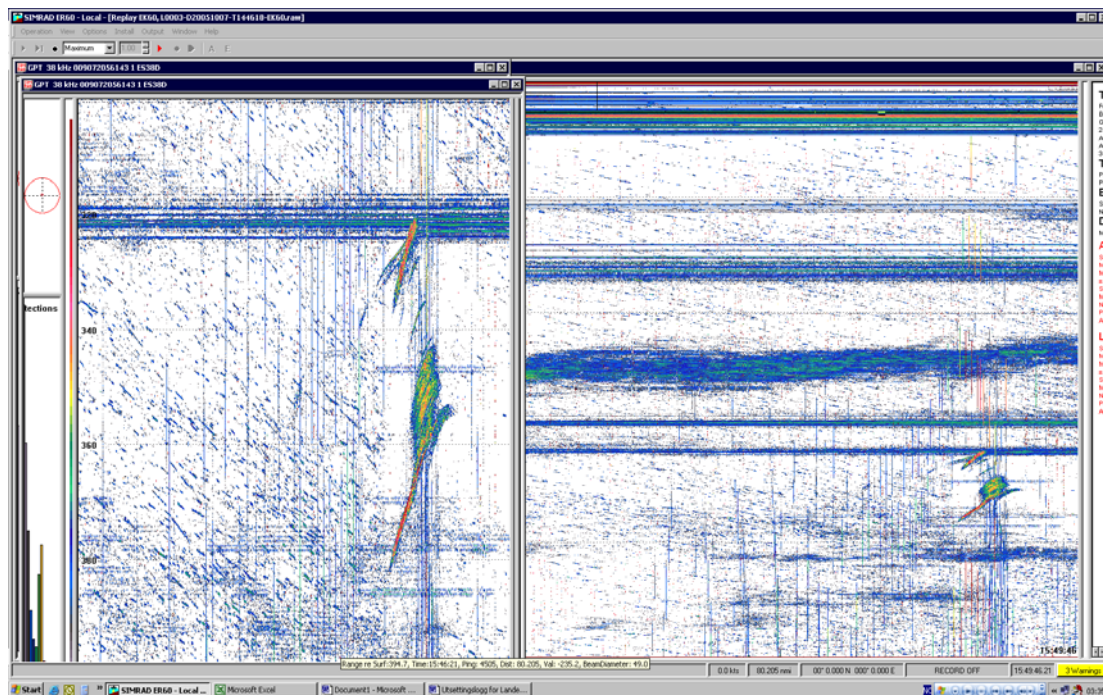


Figure 42: Trawl passing at 15:48

2nd trawl haul

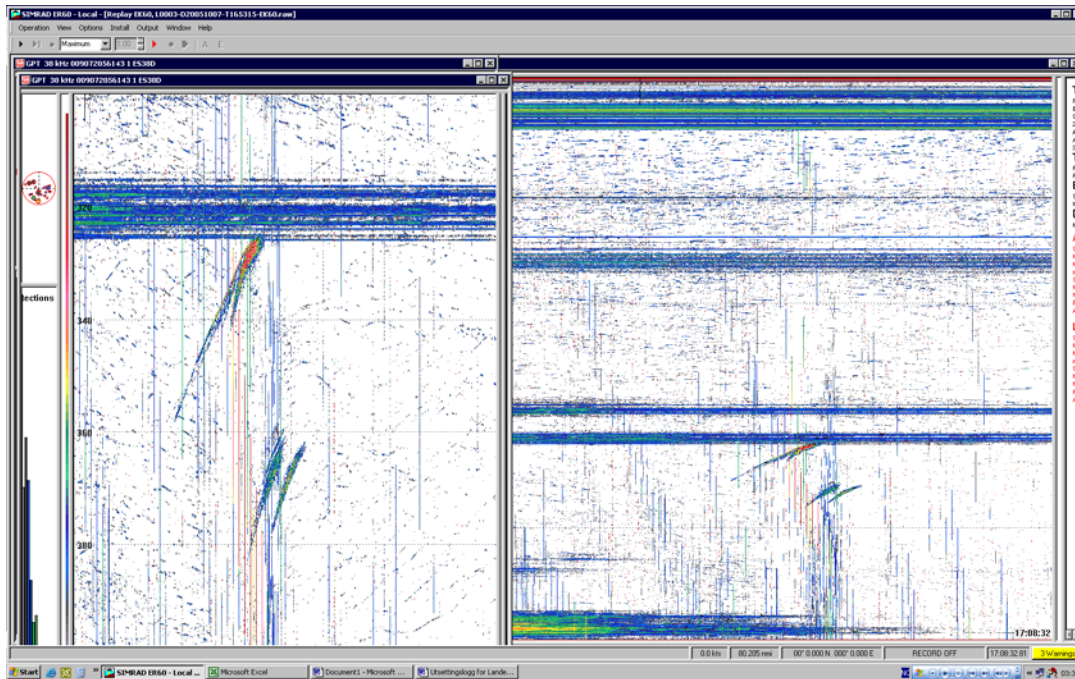


Figure 43: Trawl passing at 17:05

3rd trawl haul

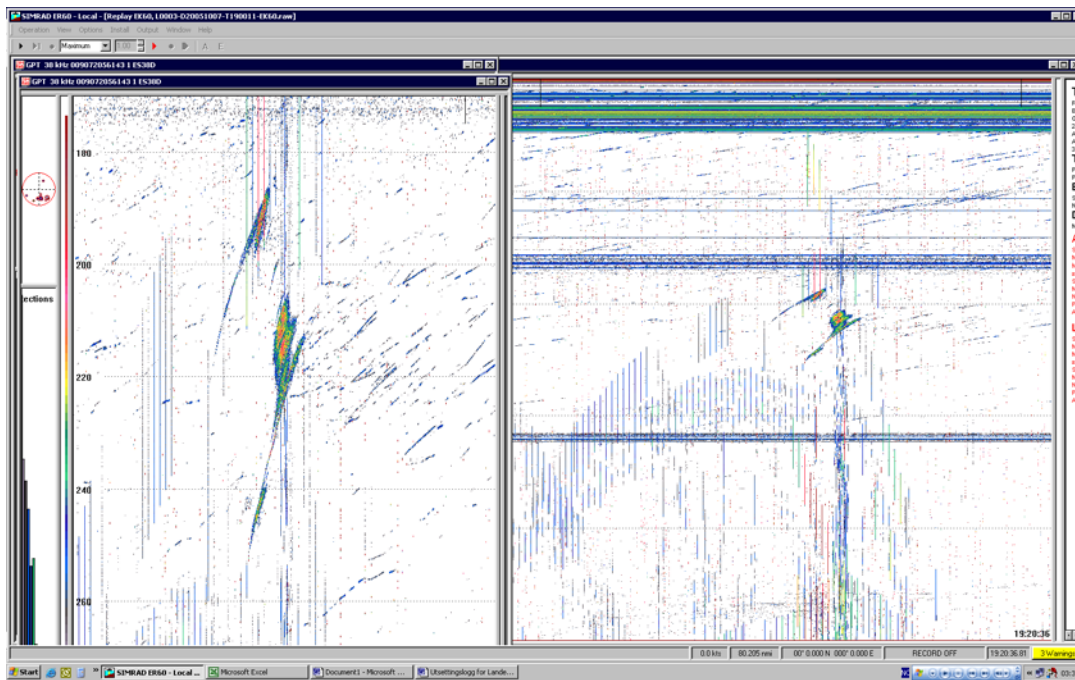


Figure 44: Trawl passing at 19:19

4th trawl haul

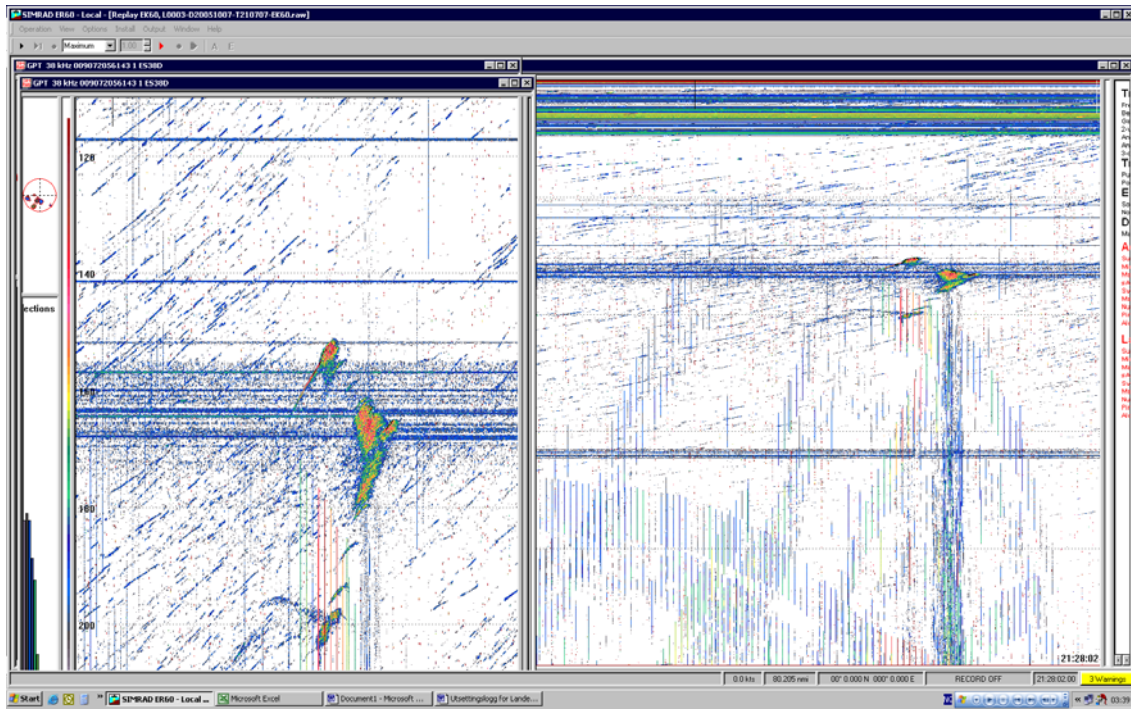


Figure 45: Trawl passing at 21:27

5th trawl haul

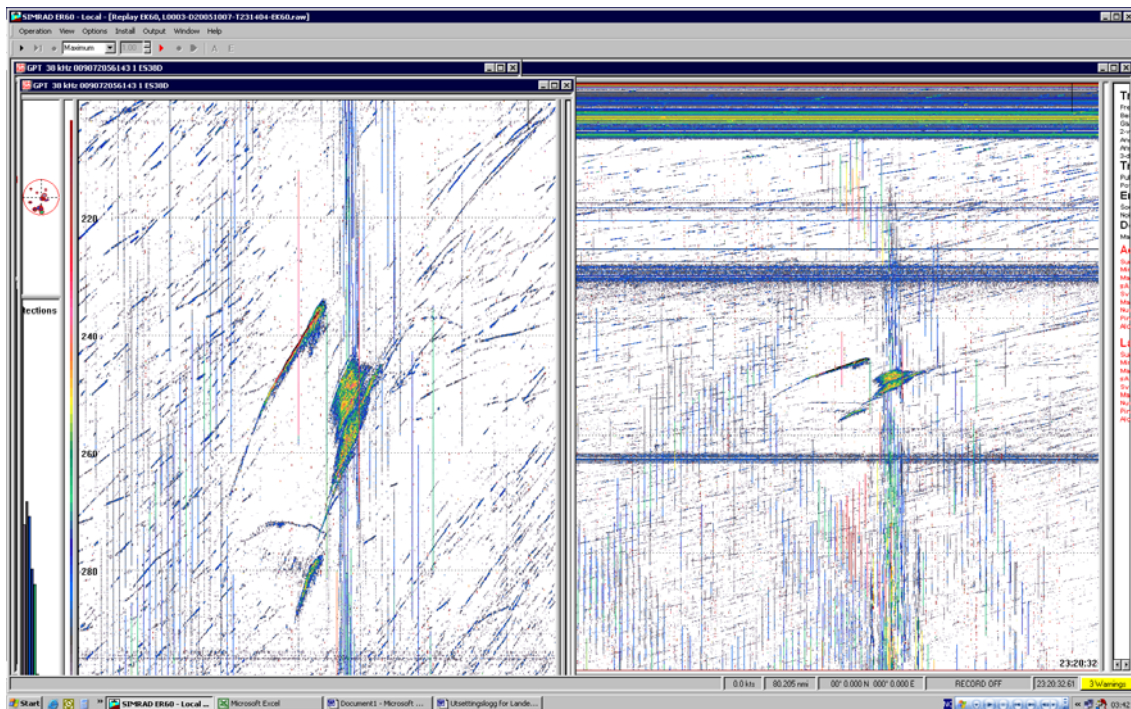


Figure 46: Trawl passing at 23:18

4th deployment

Setup

Scale:	500m
Pulse length:	0,256 ms
Ping rate:	Max.
Transducer angle:	App 6°g above the horizontal level.
Suspension:	All floating spheres are removed, and the Lander is placed directly on the bottom. Rope to surface supplied with sea-dog (4 small and 1 big trawl float) two blathers and a flag buoy with flashing light.
Rudder:	A rudder is installed (leather with 0,6 x 1,0 m plywood plate on end) 90° on the transducer face, causing the Lander to turn in such manner that the transducer are looking across the current direction. By doing so, we are able to trawl along the current.
Deployed:	8 October at 01:10 UTC
Retrieved:	8 October at 14:06 UTC
Heading from compass:	338°
Corrected heading;	158°
Estimated heading from GOS:	App. 225°
Lander level:	-3° in roll and 3° in tilt

Deployment area

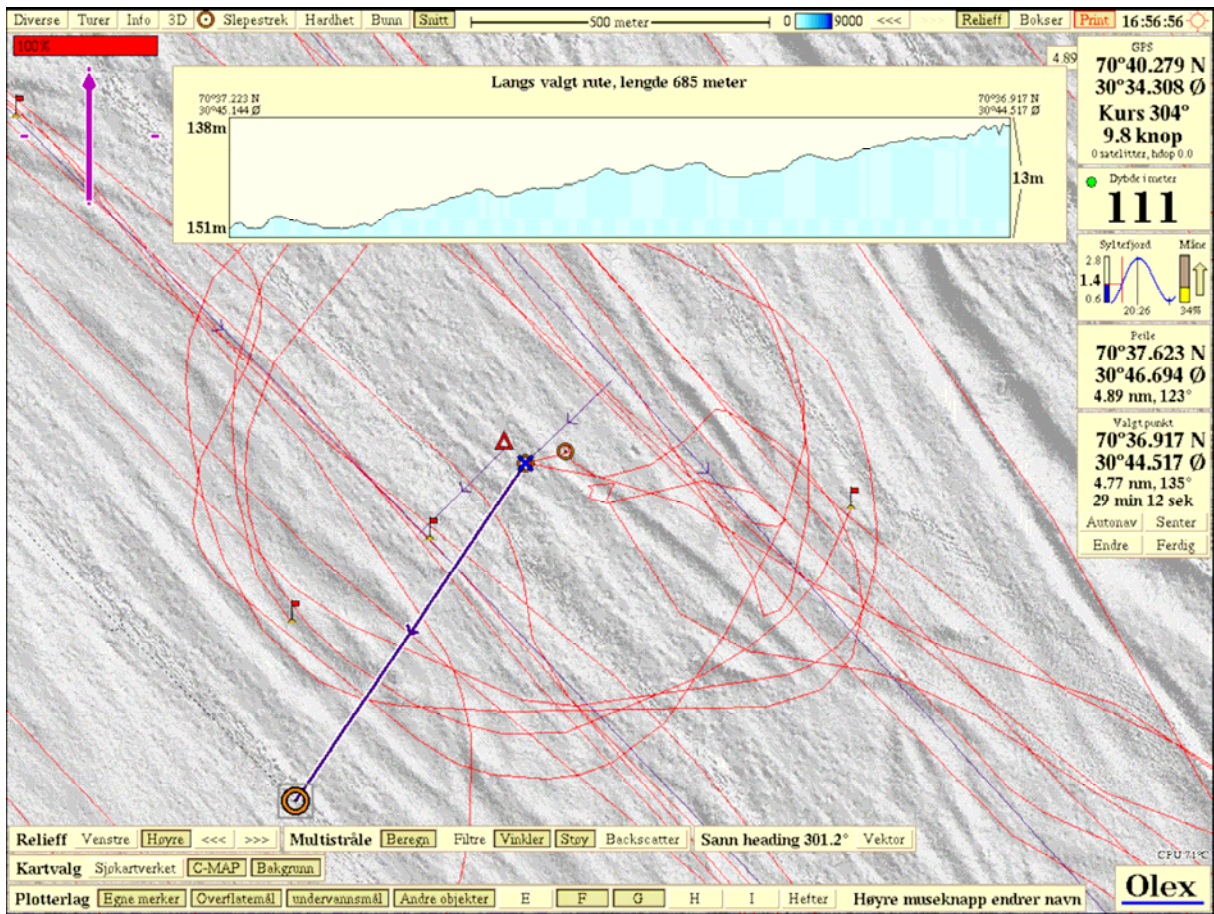


Figure 47: Estimated direction of transducer beam

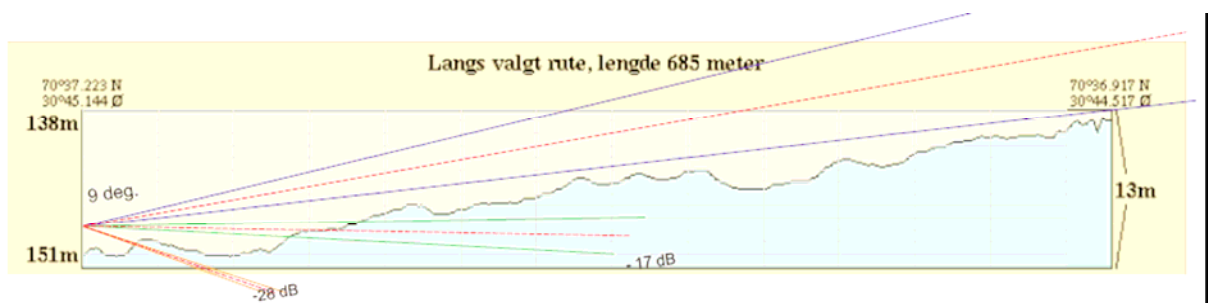


Figure 48: Bottom profile in estimated transducer beam

Sensor data

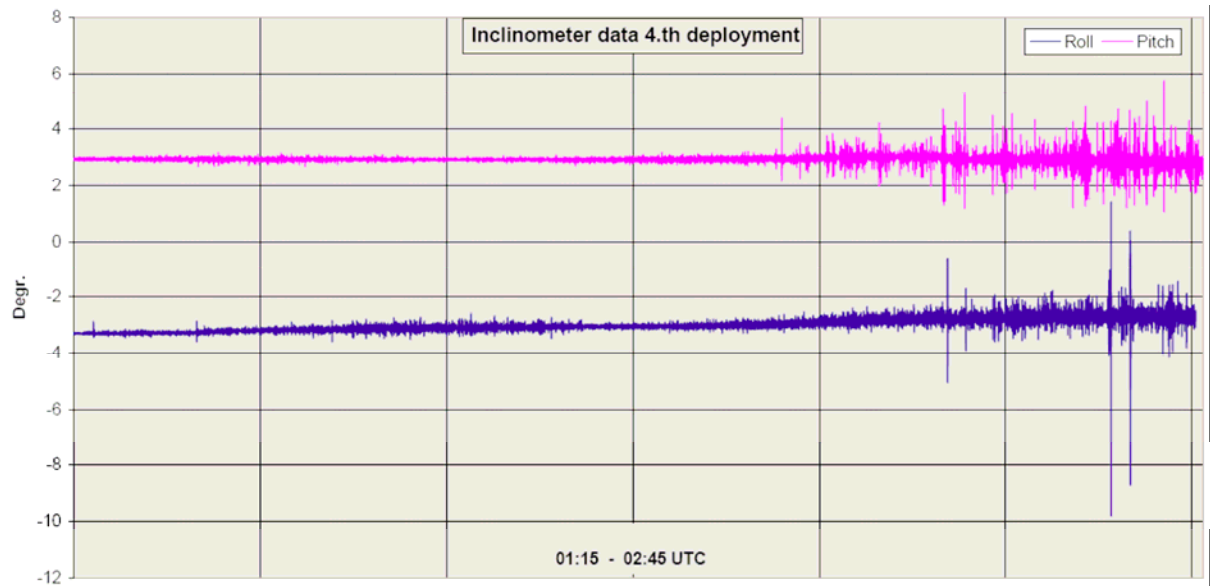


Figure 49: Inclinometer data

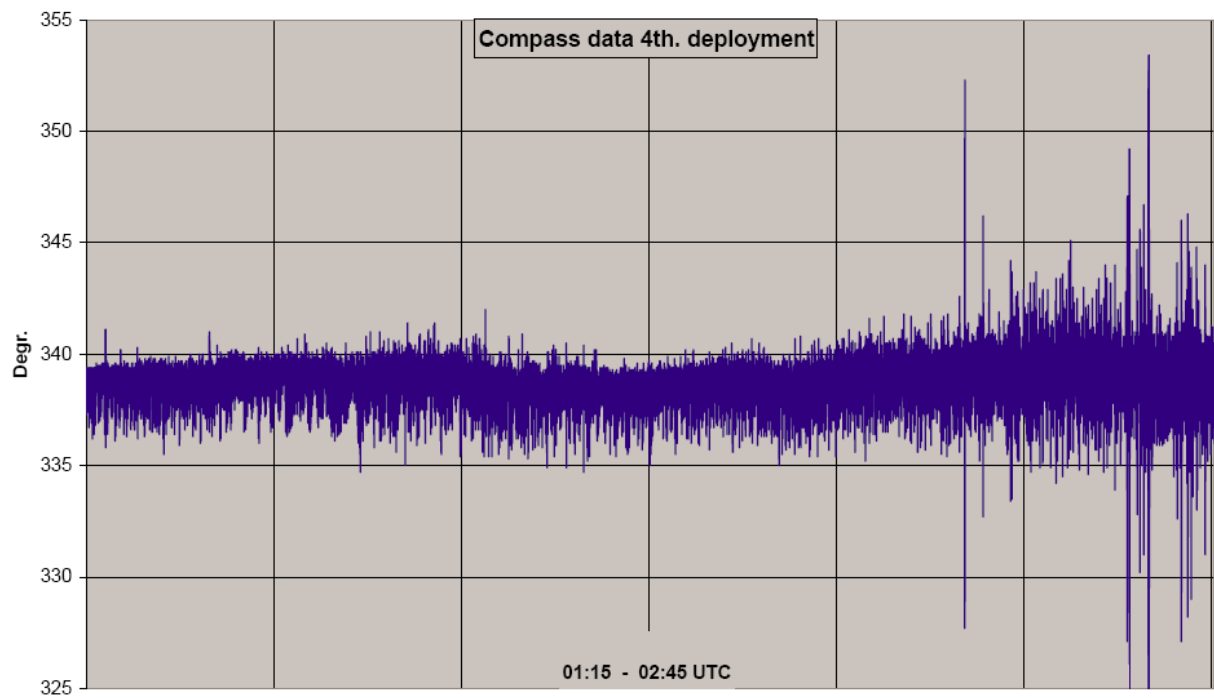


Figure 50: Compass data

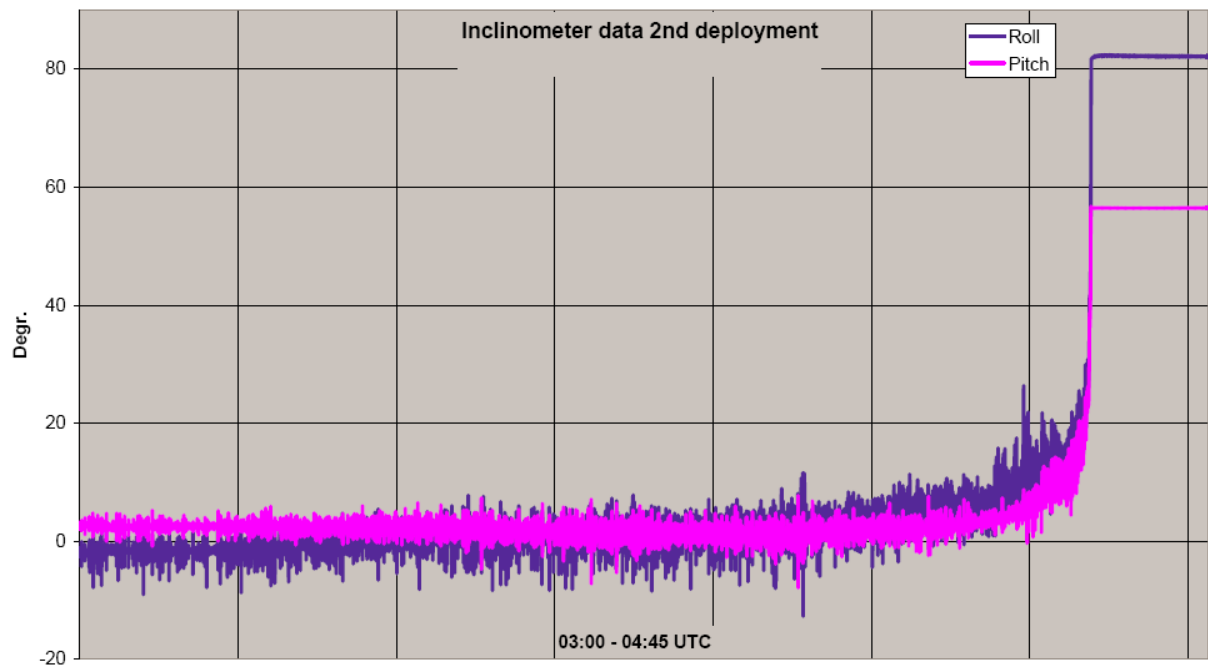
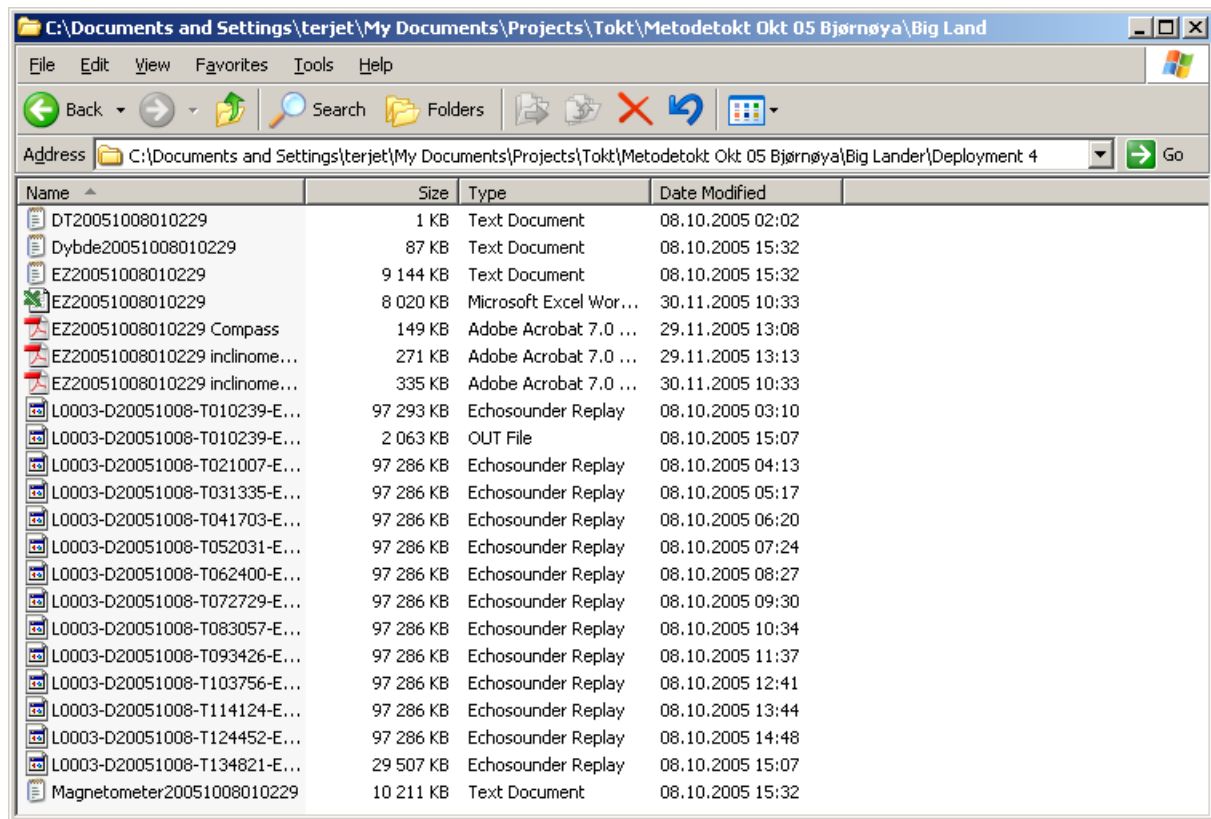


Figure 51: Inclinometer data

Here we can clearly see that the Lander is tilted over to one of the side at app 04:42 UTC. Pitch is increased to close to 60° and roll to more than 80°

Data files



Name	Size	Type	Date Modified
DT20051008010229	1 KB	Text Document	08.10.2005 02:02
Dybde20051008010229	87 KB	Text Document	08.10.2005 15:32
EZ20051008010229	9 144 KB	Text Document	08.10.2005 15:32
EZ20051008010229	8 020 KB	Microsoft Excel Wor...	30.11.2005 10:33
EZ20051008010229 Compass	149 KB	Adobe Acrobat 7.0 ...	29.11.2005 13:08
EZ20051008010229 inclinome...	271 KB	Adobe Acrobat 7.0 ...	29.11.2005 13:13
EZ20051008010229 inclinome...	335 KB	Adobe Acrobat 7.0 ...	30.11.2005 10:33
L0003-D20051008-T010239-E...	97 293 KB	Echosounder Replay	08.10.2005 03:10
L0003-D20051008-T010239-E...	2 063 KB	OUT File	08.10.2005 15:07
L0003-D20051008-T021007-E...	97 286 KB	Echosounder Replay	08.10.2005 04:13
L0003-D20051008-T031335-E...	97 286 KB	Echosounder Replay	08.10.2005 05:17
L0003-D20051008-T041703-E...	97 286 KB	Echosounder Replay	08.10.2005 06:20
L0003-D20051008-T052031-E...	97 286 KB	Echosounder Replay	08.10.2005 07:24
L0003-D20051008-T062400-E...	97 286 KB	Echosounder Replay	08.10.2005 08:27
L0003-D20051008-T072729-E...	97 286 KB	Echosounder Replay	08.10.2005 09:30
L0003-D20051008-T083057-E...	97 286 KB	Echosounder Replay	08.10.2005 10:34
L0003-D20051008-T093426-E...	97 286 KB	Echosounder Replay	08.10.2005 11:37
L0003-D20051008-T103756-E...	97 286 KB	Echosounder Replay	08.10.2005 12:41
L0003-D20051008-T114124-E...	97 286 KB	Echosounder Replay	08.10.2005 13:44
L0003-D20051008-T124452-E...	97 286 KB	Echosounder Replay	08.10.2005 14:48
L0003-D20051008-T134821-E...	29 507 KB	Echosounder Replay	08.10.2005 15:07
Magnetometer20051008010229	10 211 KB	Text Document	08.10.2005 15:32

Figure 52: Data files from 4th deployment

Screen dumps from trawl passing

1st trawl haul

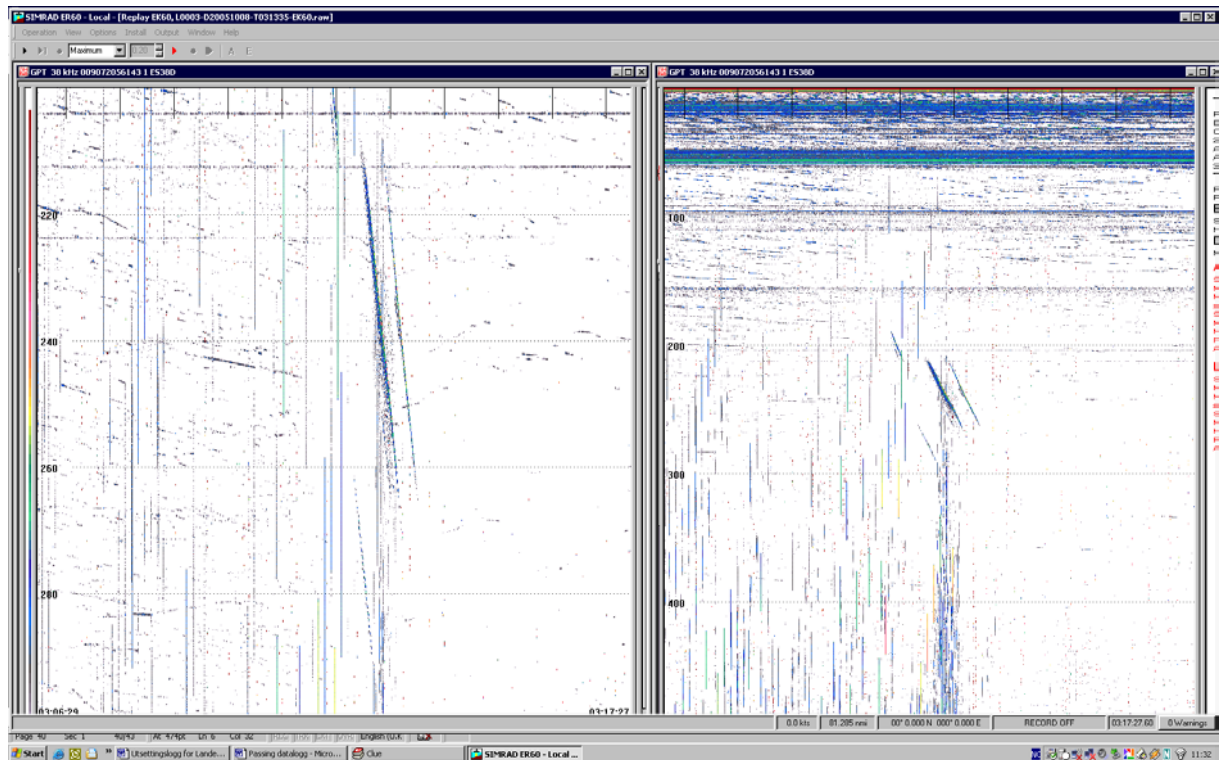


Figure 53: First trawl passing at 03:12

Other screen dumps from sounder

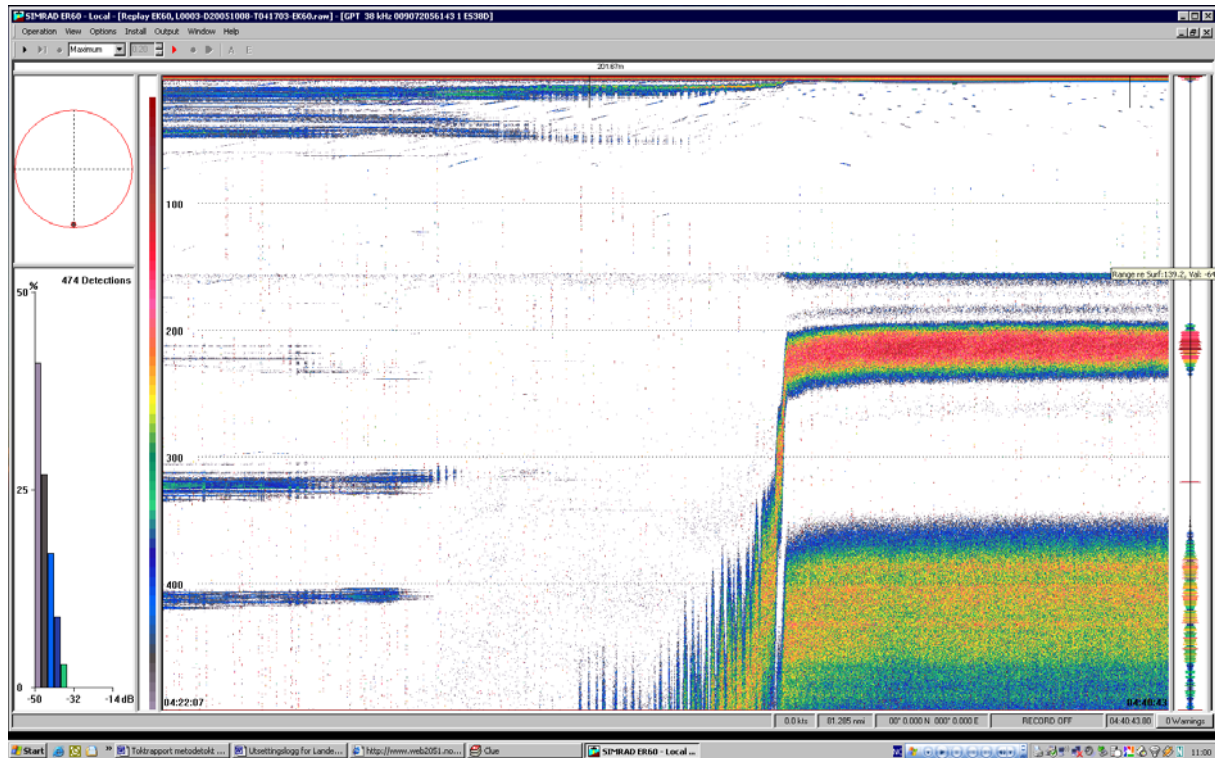


Figure 54: Lander turning over at side at 04:38

Here we can see that the Lander have tilted over to one side (backside seen from transducer). We can see the surface on the echogram. Confirming that positive angle on inclinometer is Lander tilting with transducer face tilting up.

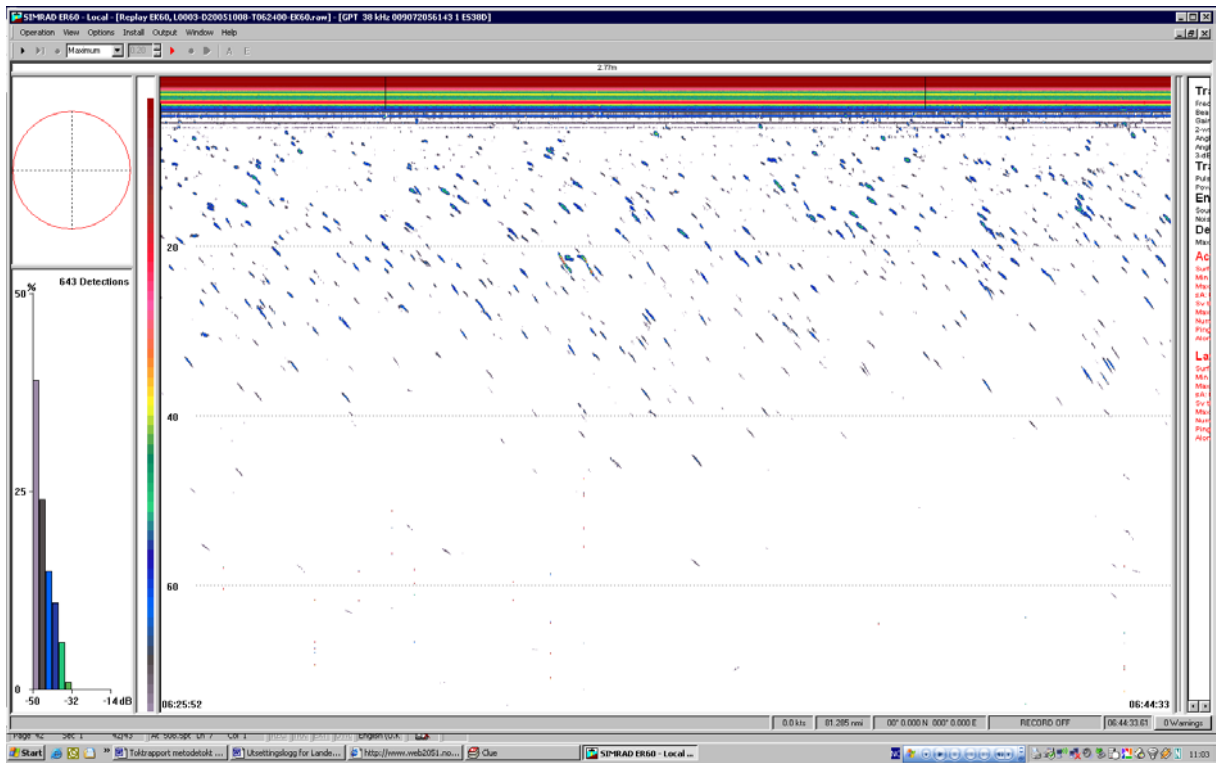


Figure 55: Registration of single echoes at 06:44

When the Lander had tilted over to one side, the transducer was pointing app.60° up. There is some registration of single fish. Could these registrations be used for something?

What could we do better?

If we are able to communicate via cable to the Lander after deployment, we could have performed a much better experiment. The deployment procedure should be changed a bit to get as correct info regarding bottom profile as possible.

Select area.

Use the info from the Olex to select a suitable deployment area. Select an area as flat as possible. Two topics have to be taken into consideration: minimum reflections from the bottom on the Lander sounder, and suitable trawling ground.

Select deployment area

By using ADCP, establish current direction and decide trawl direction and trawl path. Use the profile option on Olex to decide an area with minimum bottom contour across the trawl path.

Deployment

Deploy the Lander in the selected area. Tilt and train the transducer for optimal direction and tilt for minimum reflections from the bottom, according to the picture from the sounder and info from the sensor module. Use the direction info from the compass in the sensor module to plot direction on Olex map.

Exact beam direction

After the experiment, by using the timestamp from the sounder in the Lander when the trawl passing, and the exact position of the ship, direction and distance to trawl, we should be able to pinpoint exact position of the trawl at the Olex when passing. Then we should use this info to correct the direction on Olex, and get an exact profile of bottom along the transducer beam

Mechanical disturbance

By using a rope to the surface, we could get a lot of mechanical disturbance to the Lander. We can clearly see that the Lander is moving due to high pull in the rope from the waves lifting up the buoys. This occurs especially when the current is strong, keeping high tension to the rope. If we are to use cable to surface, this has to be taken into consideration. Several

solutions can be taken into consideration. Higher weight supplied to the Lander. Install a more elastic suspension to the rope.

Acoustic disturbance.

When using Scanmar trawl sensors on the trawl, these sensors are creating a lot of noise on the sounder. We tried to use Simrad ITI, which gave no noise to the sounder.

Other Equipment used.

By using ITI on trawl, and HPR transponder, we are able to get exact position of trawl and Lander, making navigation close to the Lander easier.

Appendix IV

Institute Of Marine Research
Target Tracker

Spec

02.12.2005



Spec:	Depth rate:	1 000 m
	Battery capacity:	App 10 hour
	Size:	300 x 900 mm
	Weight in air:	45 Kg
	Weight in Water:	5 kg
Sounder:	Transceiver	Simrad GPT, 120 kHz
	Transducer:	Simrad ES120-7DD Splitbeam
	Software	Simrad ER60
Computer:	PCM 9581	1,6 GHz
	HDD	100 GB
Depth sensor:	Scansense	DTS 100 (1000 m)
Motion sensor:	AOZ	EZ Compass with Pitch and Roll
Battery:	YUASA NP7	12V, 21 A/h
External:	Cable, 300 m	2x optic multimode fibre. 2 x 3 sq mm for power.

Appendix V (Deployment-log for Target Tracker)

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Testing of 120 kHz

Comparison between 120 kHz GPT for GOS and for Target Tracker.

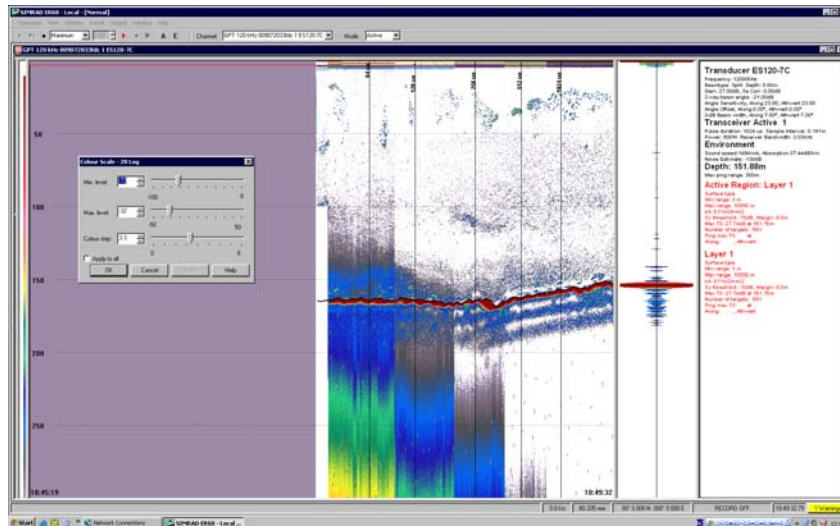


Figure 56 GOS GPT with GOS transducer

First line showing noise at $64\mu\text{s}$, next $128\mu\text{s}$, $256\mu\text{s}$, $612\mu\text{s}$ and finally $1024\mu\text{s}$ at minimum level set to -72dB at 20 LogR

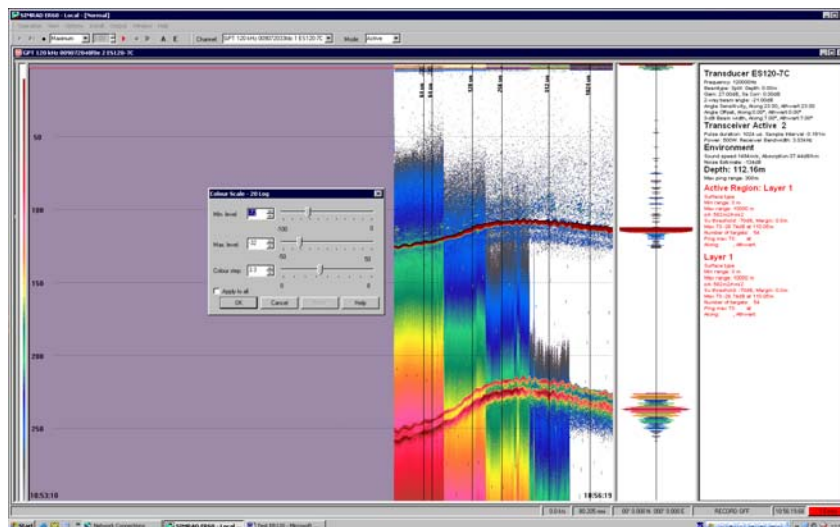


Figure 57 Target Tracker GPT with GOS transducer

First line showing noise at $64\mu\text{s}$, next $128\mu\text{s}$, $256\mu\text{s}$, $612\mu\text{s}$ and finally $1024\mu\text{s}$ at minimum level set to -72dB at 20 LogR . The noise is reduced by increased pulse length because the bandwidth of the receiver is decreased with increased pulse length.

We can see that this GPT has app same value of noise on a pulse length, as GOS GPT has at a lower pulse length.

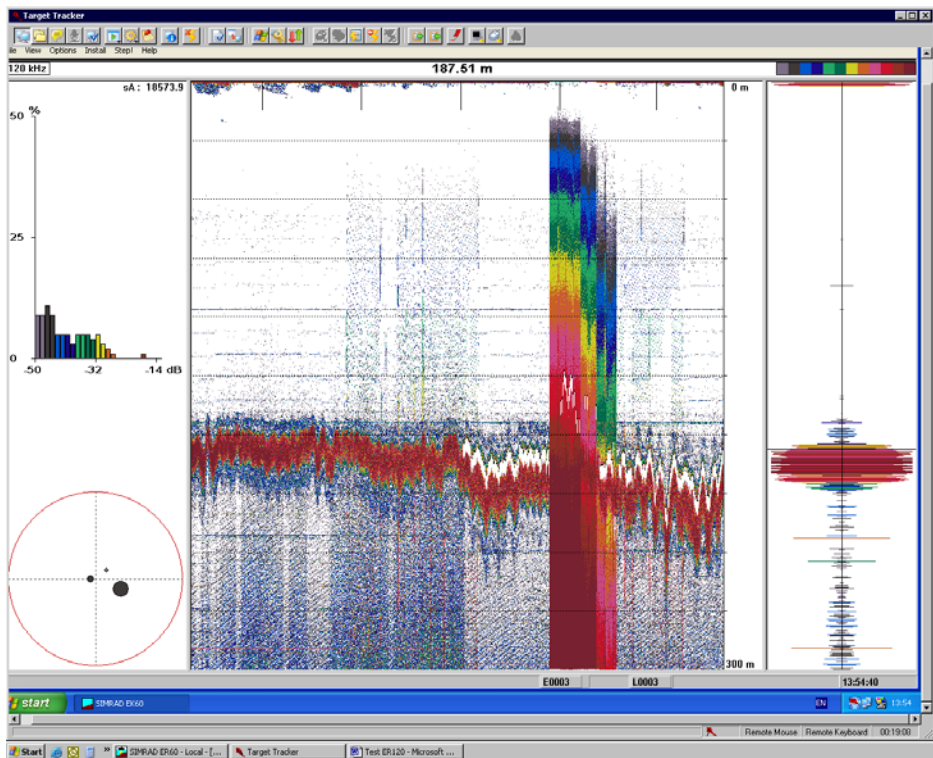
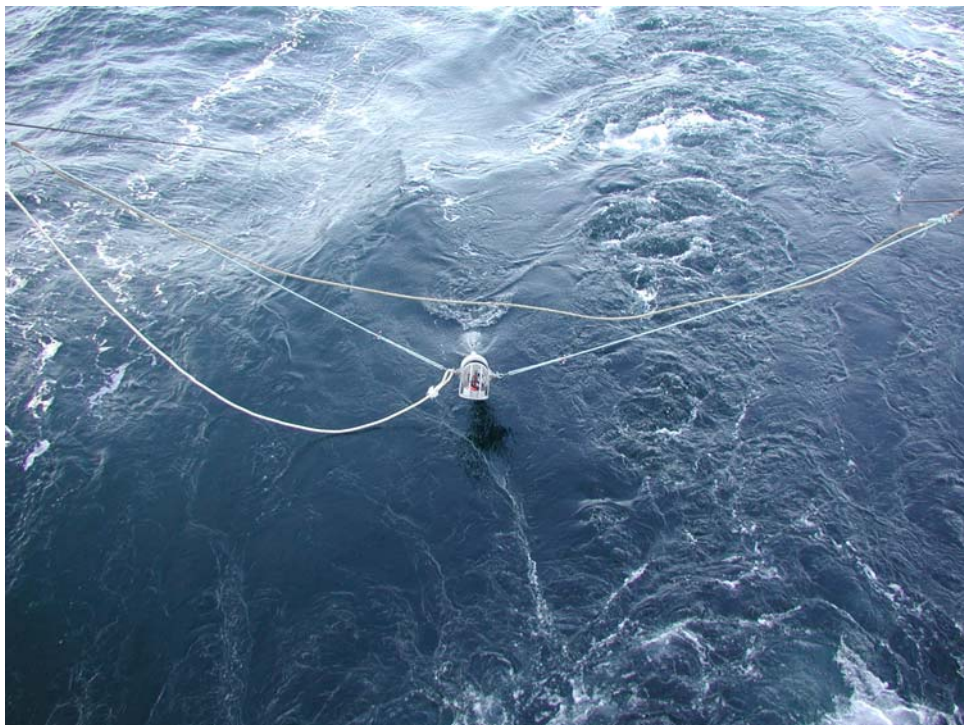


Figure 58 Target Tracker along GOS side. Different pulse length

Here we can see the noise is increasing tremendously buy decreasing the pulse length from 1024 μ s to 64 μ s. (Red bar in middle of the echogram) We can also se the scattering noise in the echogram appears, and disappears after a while. This could be noise from the ship.

Suspension



Sounder settings

Power:	500 W
Pulse length:	1,024 ms
Scale:	100 m
Bottom detector:	0 m
TVG:	40 logR set to 50.
Ping rate:	Maximum
Ekstern trigg:	On
Bi dialog:	0 – 100 m
	-5 to 15 m

Inclinometer is mounted in such manner that compass forward is the same as transducer forward

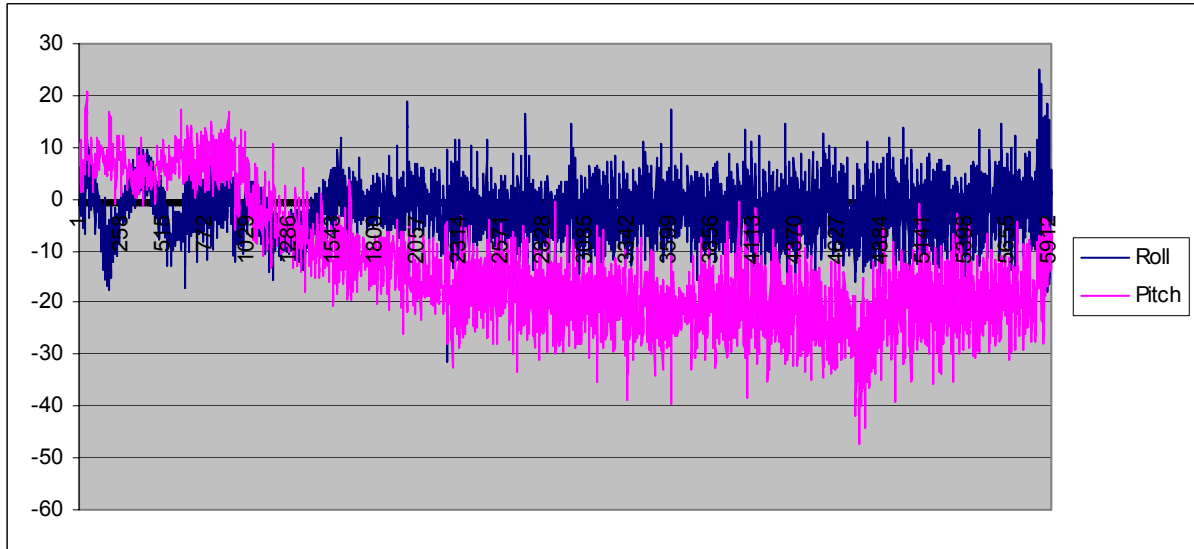
+ Tilt is moving the forward part of the transducer downwards, seen from the horizontal plane.

+ Roll is moving the starboard side of the transducer downwards, seen from the horizontal plane.

1st Deployment

The unit is suspended in a rope, which is parallel to the strap rope, but 2 metres more in length. The suspension rope is fastened in the loop of the strap rope.

Stability



Echogram

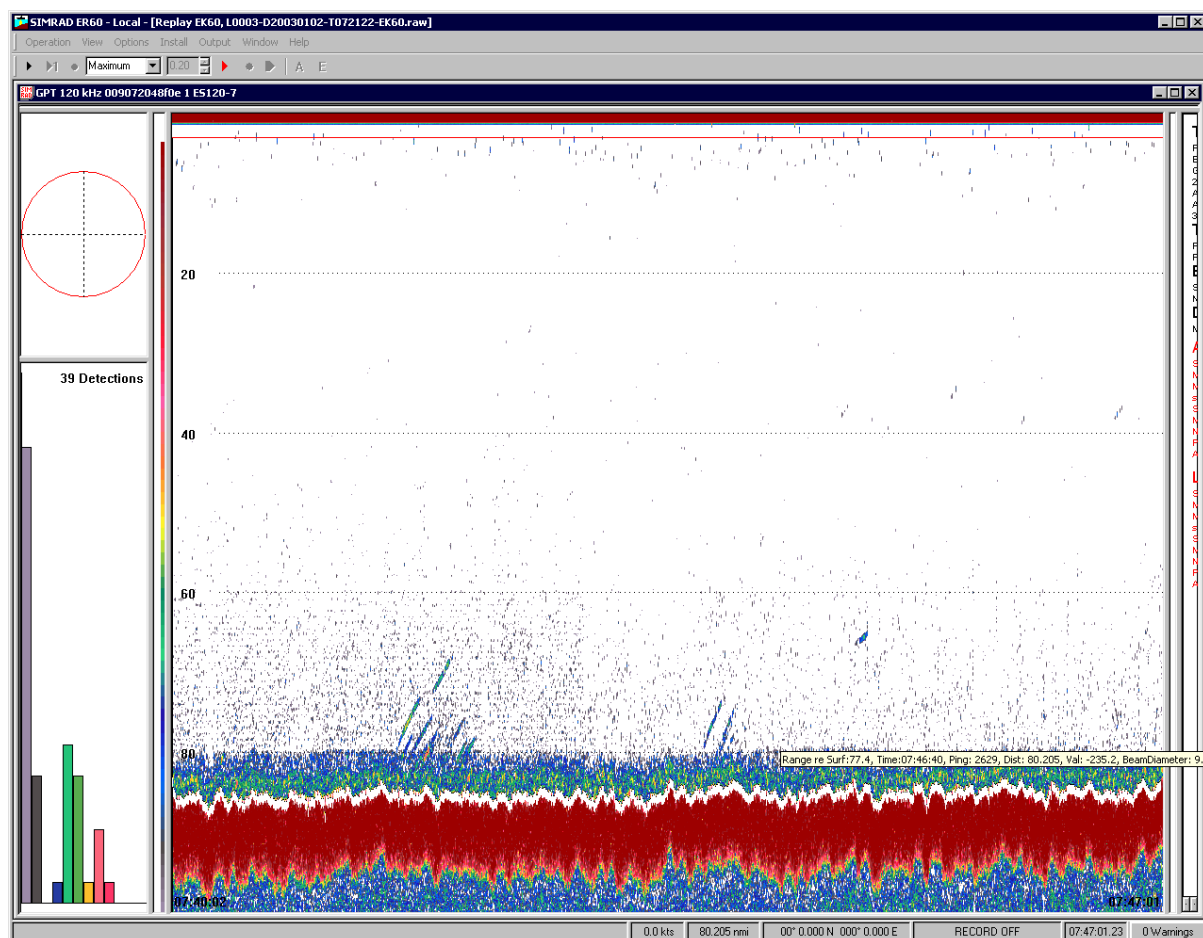


Figure 59. Echogram from the first deployment

Looking at the echogram, we can clearly see from the echoes from fish, that the transducer front is pointing upwards. (According to sensor 20 degrees.)

2nd Deployment

The unit is suspended in a rope, which is parallel to the strap rope, but 1/2 m shorter than the strap rope. The suspension rope is fastened in the loop of the strap rope.

Now the suspension rope is acting as a strap rope.

Stability

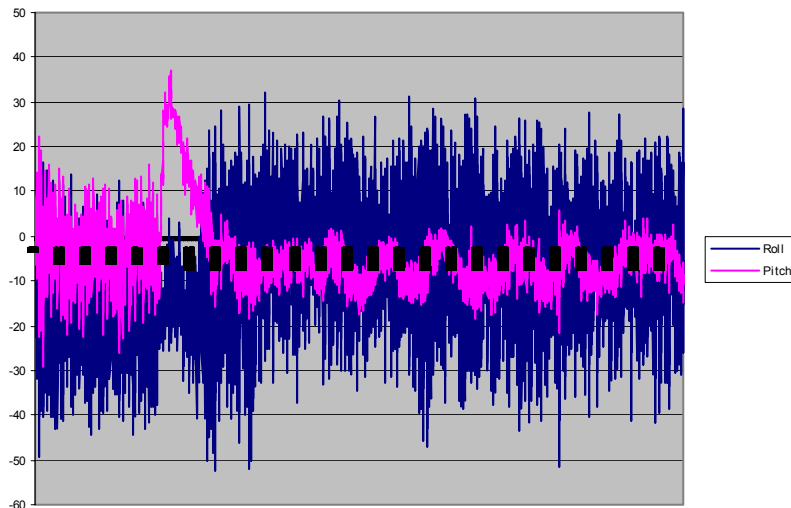


Figure 60 Tilt and roll during the whole trawling period

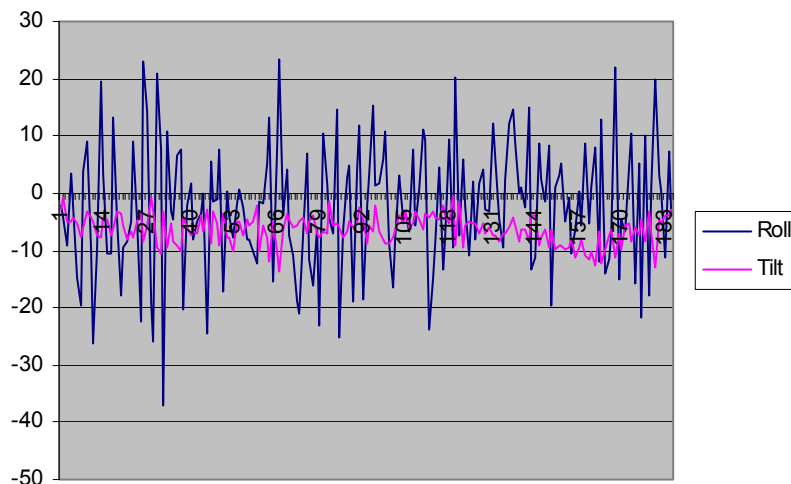


Figure 61 Tilt and Roll over one minute period

On the data from the Sensor module, we can clearly see that the Target Tracking is rolling from side to side. This is due to the unstable tension on the wires, caused by the trawl doors, which is dragged along the bottom. One side of the strap rope is fastened direct to the trawl

wire, while the other end is a ring, moving freely up or down the wire according to the tension of the wire.

Echogram

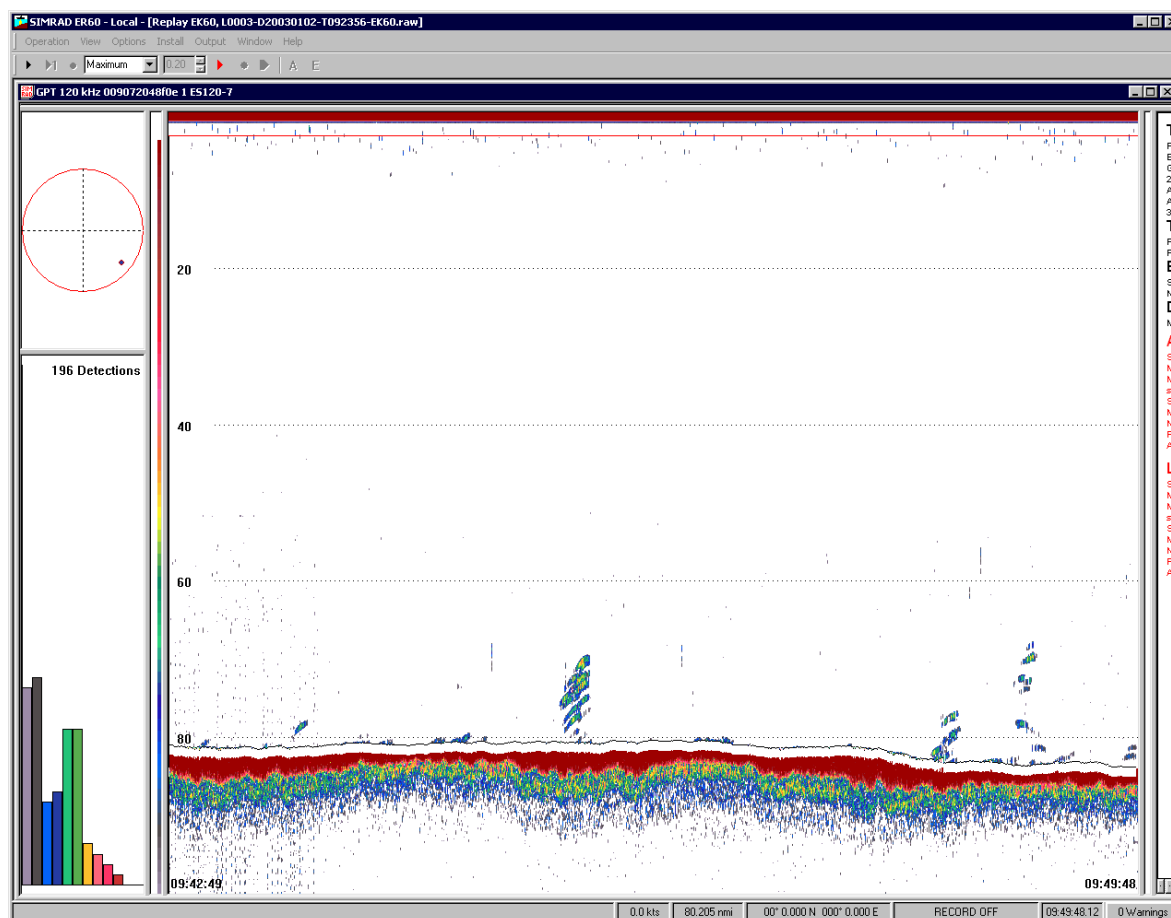


Figure 62. Sample of echogram, from 2nd deployment.

Now we can see that the bottom contour are much better, and that echoes from fish are much clearer and defined. The noise level on the sounder is also lower at this deployment.

Note the noise that starts from 60 meters at the first end of the echogram, is disappearing after a short while.

3rd Deployment

The unit is suspended in a rope, which is parallel to the strap rope, but 1/2 metre shorter than the strap rope (same as previous deployment). The suspension rope is fastened in the loop of the strap rope in the same manner.

To get a more stabile platform, we tied a fish basket to the tail of the Target tracker, hanging in a 10-meter long rope. The drag from the basket should create a tension to the Target Tracker in longitudinally direction, stabilizing the platform better from being jammed by the jerk from the wires

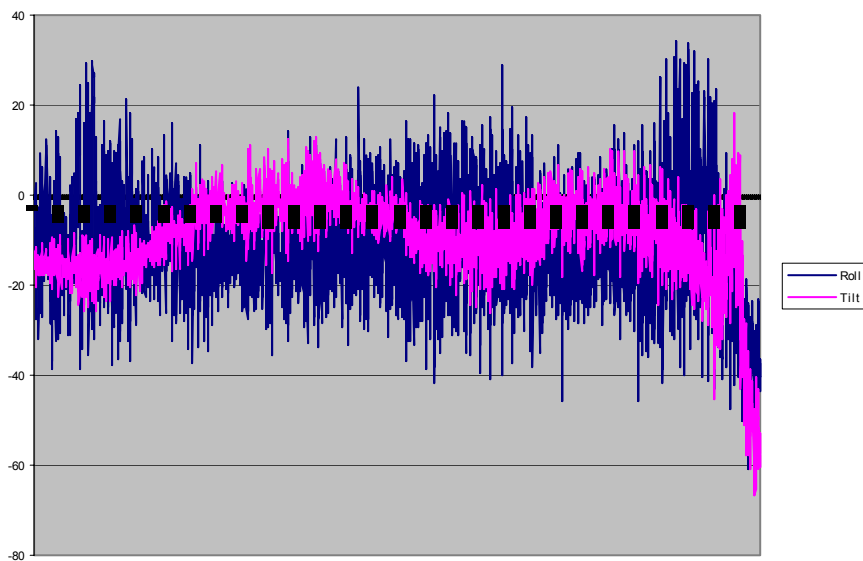


Figure 63 Tilt and roll from the deployment

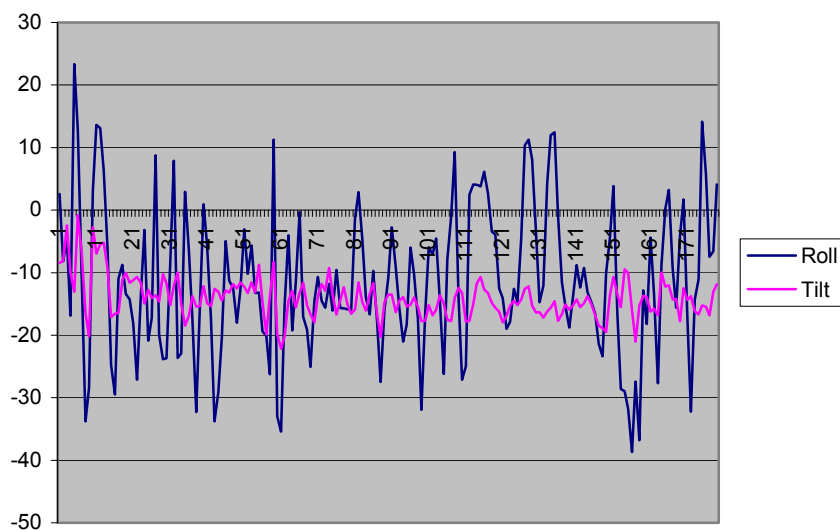


Figure 64 Tilt and roll sample from a 1-minute period.

Echogram

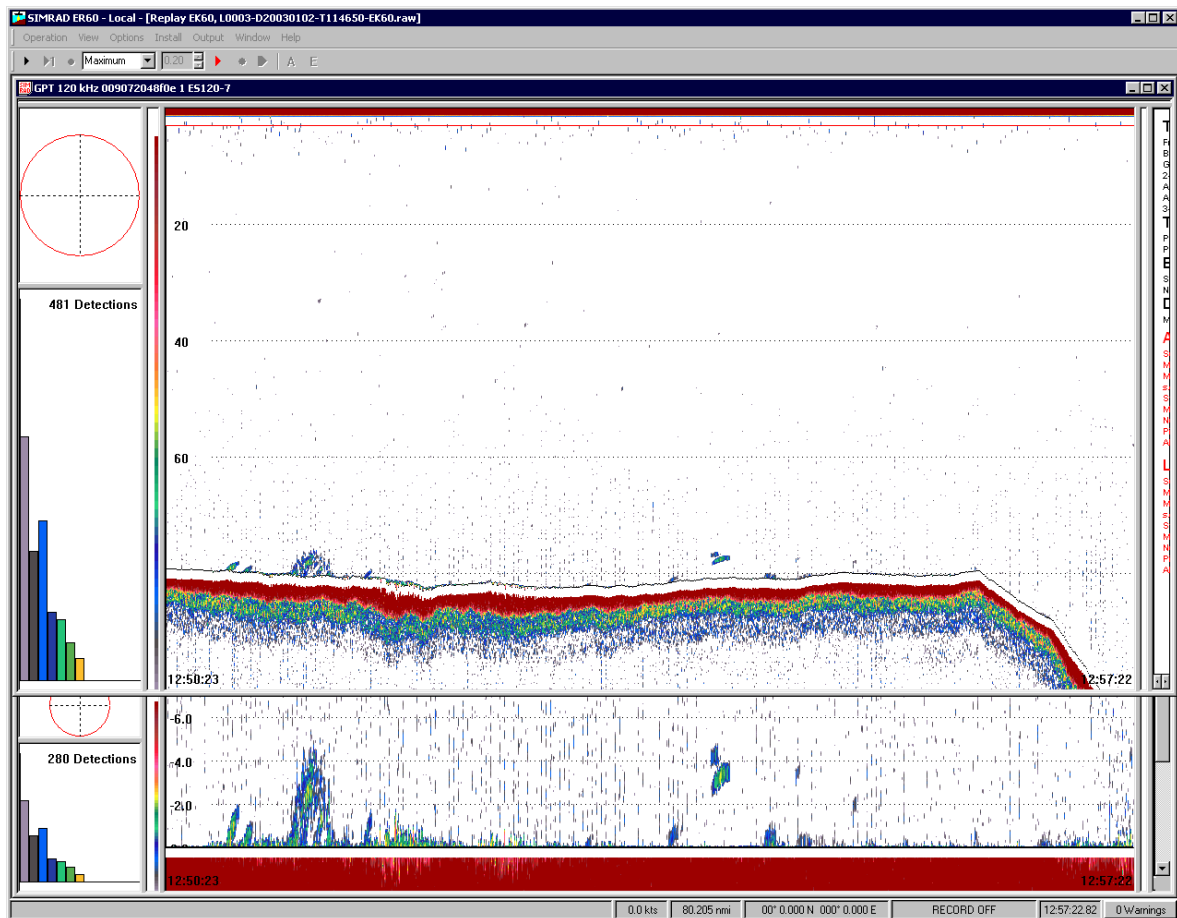


Figure 65. Sample of echogram from the deployment.

There is more noise to the sounder again. But the echoes from fish are clear.

This noise starts to appear at 60 meters depth with the sensitivity we are using in this case.

Conclusion

The conclusion from the first use of this unit so far, is that this unit can provide us with valuable data, if we are able to make it more stable than it is today. Following points should have been looked into, and investigated, to improve the system.

Noise.

The noise on the sounder is rather strong. This is probably electrical noise, caused by internal generated noise in the GPT unit. However an effort should be made to try to locate the noise source, and try to reduce it if possible.

A better grounding system should have been implemented with a large ground area into the sea. For this purpose a grounding bar that is made for pleasure boats are available. The bars are app. 10 x 15 cm and are made of millions of small brass balls, pressed together in a bar, giving an effective surface area of approximately 4 square metres.

If we are comparing GPT from GOS and Target Tracker, we can see that there is a lot of noise on this unit as well. The noise is normally not giving much problem on GOS, since they are using 1.024 ms most of the time. We should have used as low pulse as possible to be able to get better definition of the target, and at short pulse, the noise is much worse.

Ballasting

To balance the Target Tracker in this trial, we moved the fastening bracket longitudinally to obtain as good balance as possible. This could have been done better.

To reduce the instability, the Target Tracker should have been equilibrated prior to use. This should have been done prior to the cruise, but short time frame prevented us from doing so. The unit should have been ballasted in such manner that the unit was close to neutral, and floating in horizontal plane. This would have made the suspension much easier.

Suspension

A better suspension should have been used for this trial. An alternative is to fasten a ring in the middle of the strap rope, and let the target tracker hang from the centre in a single suspension.

Other alternative is to use much longer suspension ropes, so the movements of the wires did not affect the unit. The suspension ropes should be so long that they could be fastened direct to both trawl wires. The length should be much longer than maximum deviation in length between both wires, so the ropes do not snap, in case using Auto trawl.

A third alternative is to have a separate rope/wire from the ship to the target Tracker, and just use the ring in centre of the strap rope as guidance.

In this case, we can slacken the target tracker back to wanted position somewhere between the strap rope and the head rope of the trawl.

In all three cases we need to ballast the Target Tracker so it is floating neutral in horizontal plane.