Underwater Acoustics

History and latest technology

Science and Geopolitcs of
Himmalaya- Arctic- Antarctic

SIMRAD

Tonny Algroey,
Kongsberg Maritime

SIMRAD 70 YEARS 1947 2017

Agenda

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- Introduction to KONGSBERG
- Underwater acoustics – what is it, and what is it used for?
- Underwater acoustics – a history of joint development between academia and industry
- Underwater Science current product range
  - Research Vessel instrumentation
  - Alternative plaforms such as moorings and autonomous vessels provides for extended information

The Kongsberg Group

SIMRAD

PROVIDING ADVANCED SOLUTIONS
FOR EXTREME PERFORMANCE
UNDER EXTREME CONDITIONS

The Kongsberg Group

Business areas

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KONGSBERG MARITIME

Strong market position within advanced applications for vessel operation in the oil and gas and marine industries

KONGSBERG DEFENCE SYSTEMS

Modern product portfolio in growing defence and aerospace niches

KONGSBERG PROTECH SYSTEMS

Unrivalled global market leader in remote weapon stations

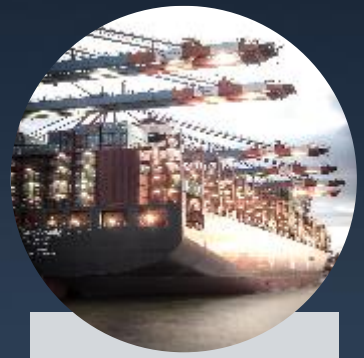
KONGSBERG DIGITAL

Developing the next generation of digitalized products and services

Kongsberg Maritime
Main Business areas

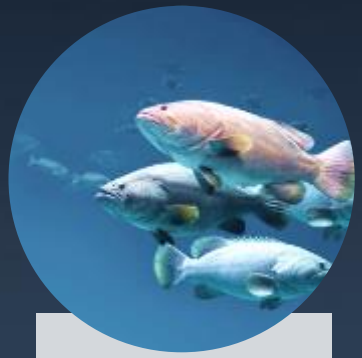
OIL AND GAS

Exploration
Development
Production
Decommissioning



SEABORN TRANSPORTATION

Liquid Bulk
Dry Bulk
General cargo
Passenger
LNG & LPG



MARINE

Fisheries
Aquaculture
Underwater mapping
Subsea monitoring
Research
Naval

Photo credit: Statoil

Underwater Acoustics
- what is it, and what is it used for?

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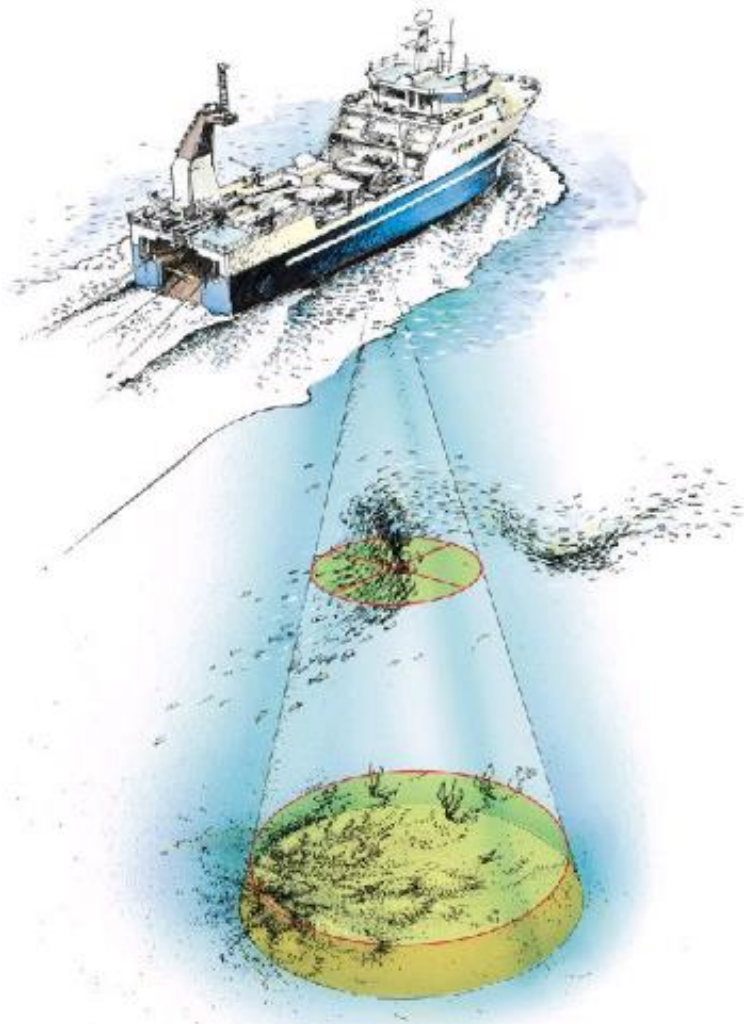
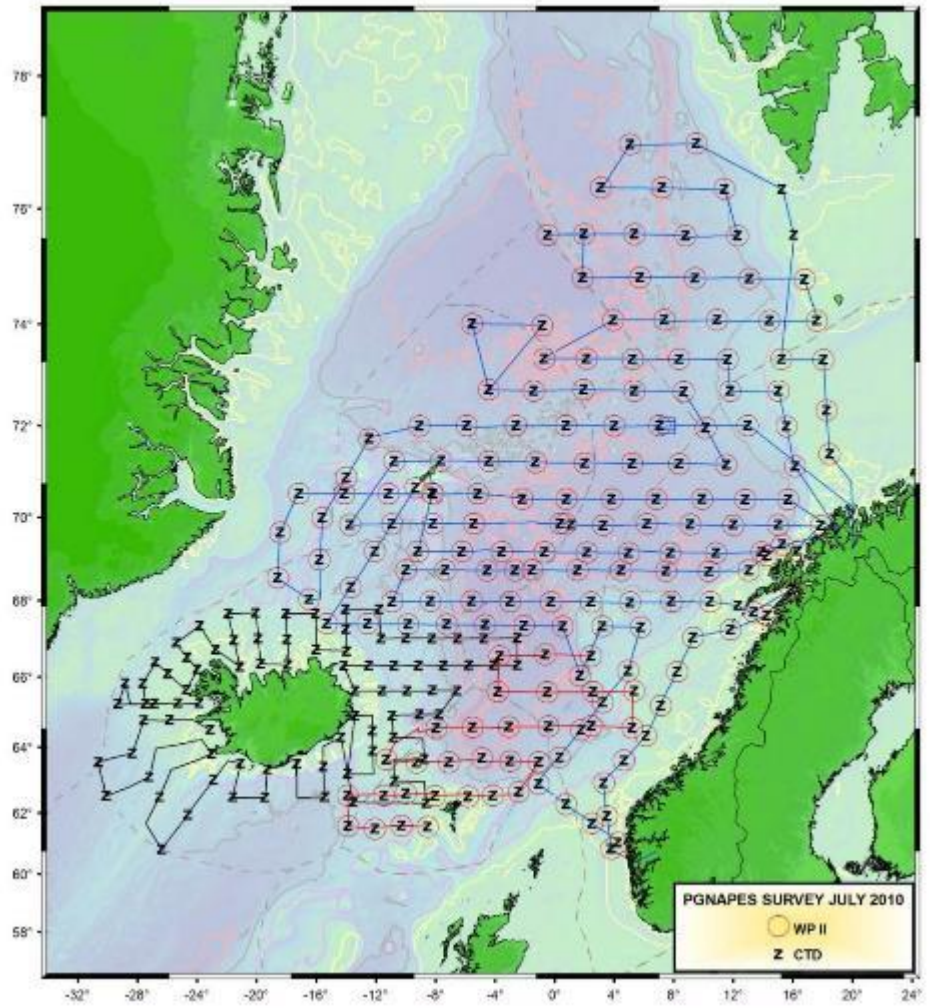


Actual survey design by IMR, NOR



Current status Acoustics

- The marine ecosystem pictured in sound

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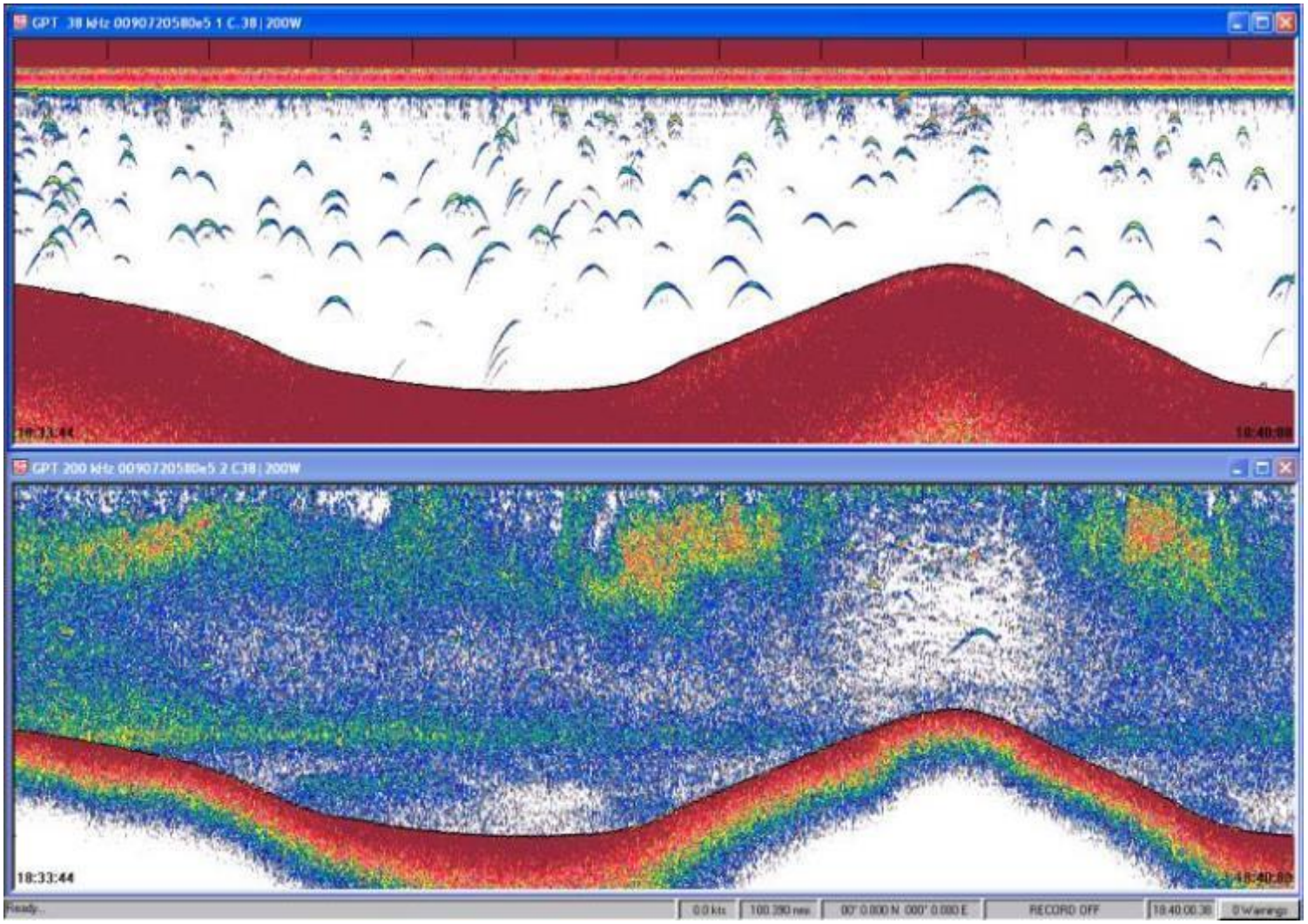
38 kHz

200 kHz



Current status Acoustics

- The marine ecosystem pictured in sound

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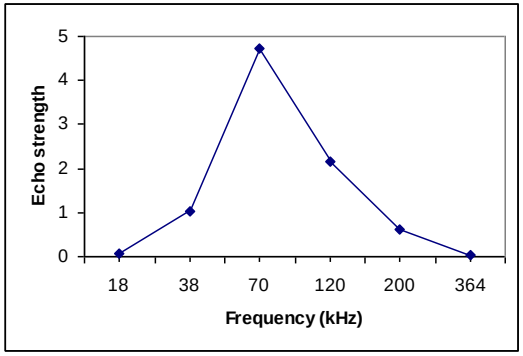
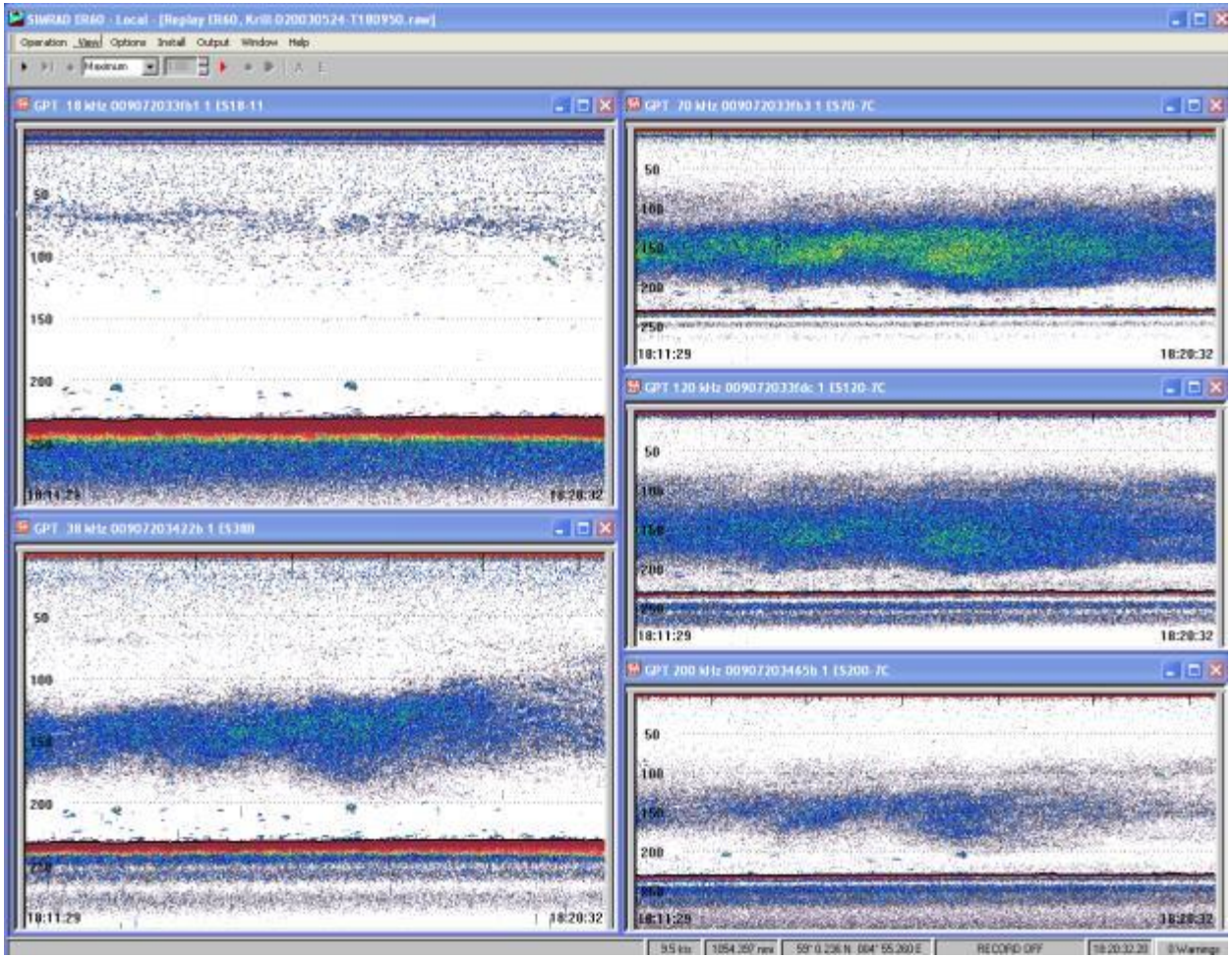
Krill (*Meganyctiphanes norvegica)*



Euphausiid – «fluid like»



IMR, with permission

Current status Acoustics

- Multifrequency species separation

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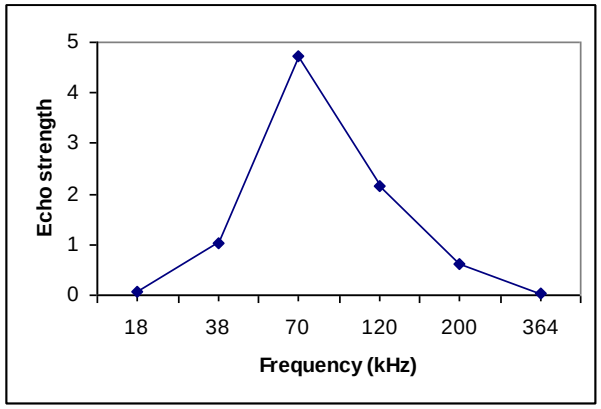

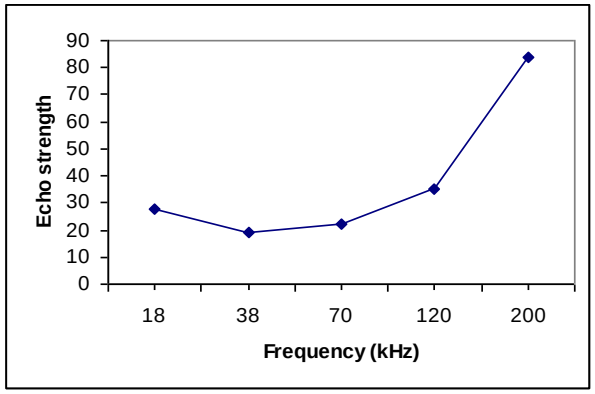

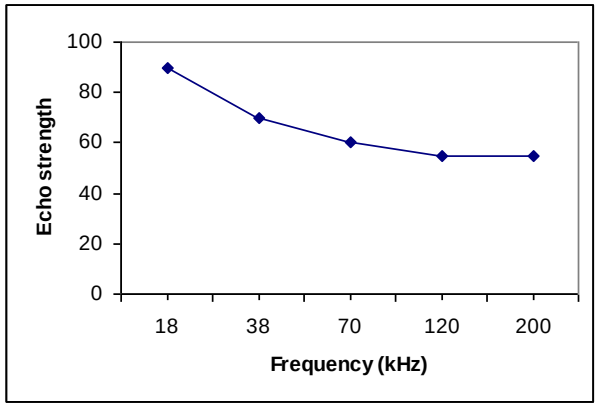

Krill

Mackerel

Herring

Research Vessels

- Oceanographic applications for scientific systems

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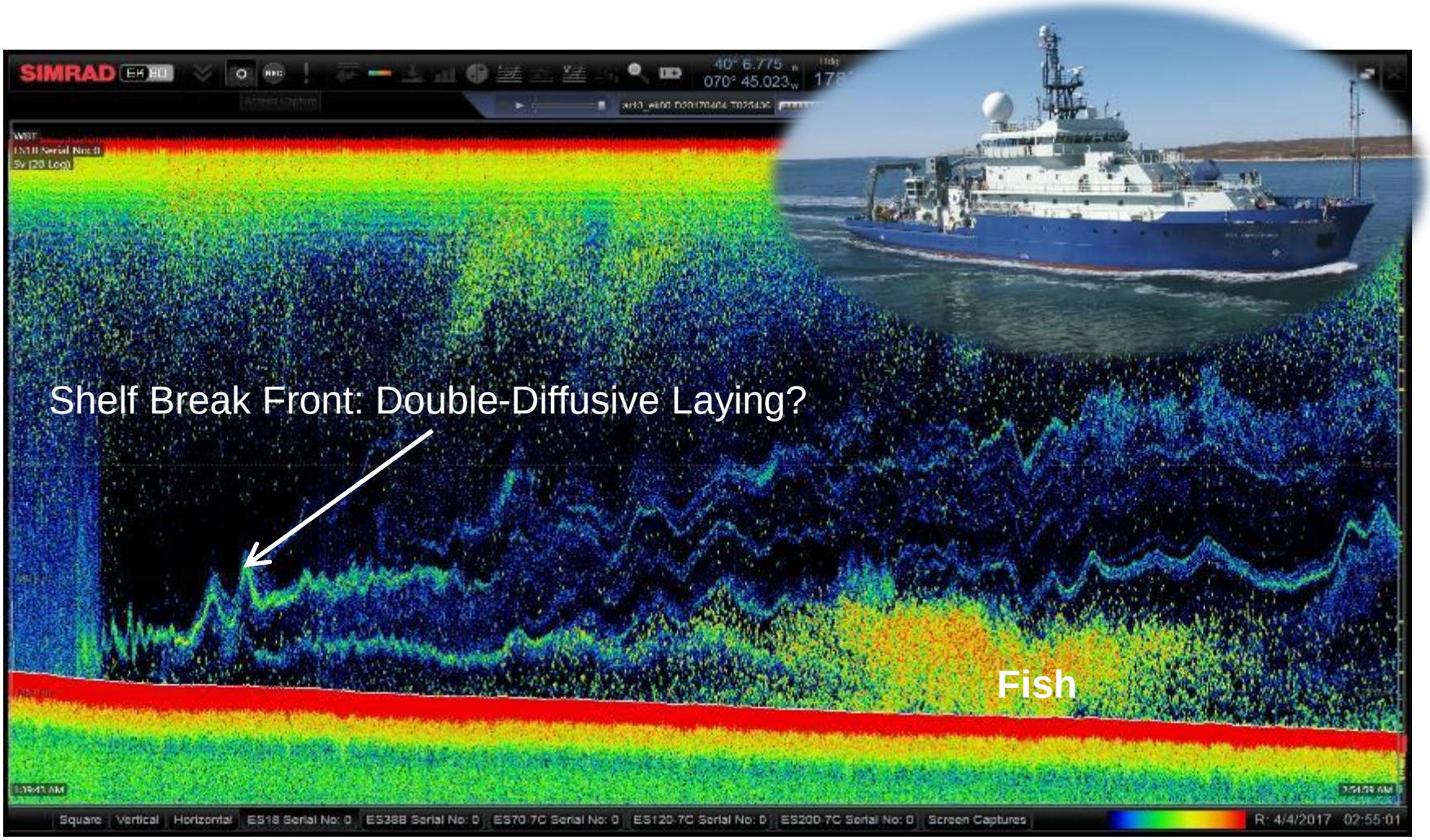

Data from Andone Lavery, Woods Hole Oceanographic Institution
Paper: Timothy F. Duda et al, Methods in Oceanography 17 (2016) 264-281

Underwater Acoustics History
– First publication, Nature, Sundt (1935)

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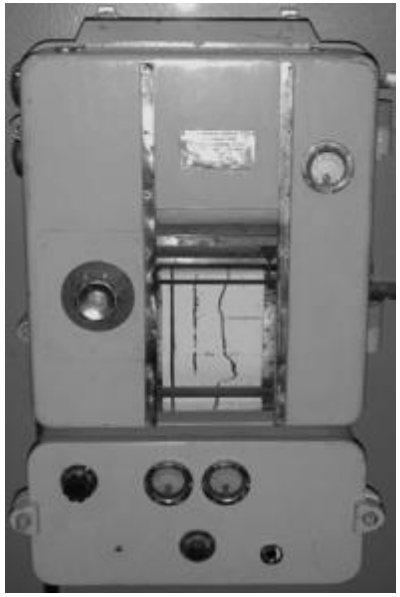

RV Johan Hjort

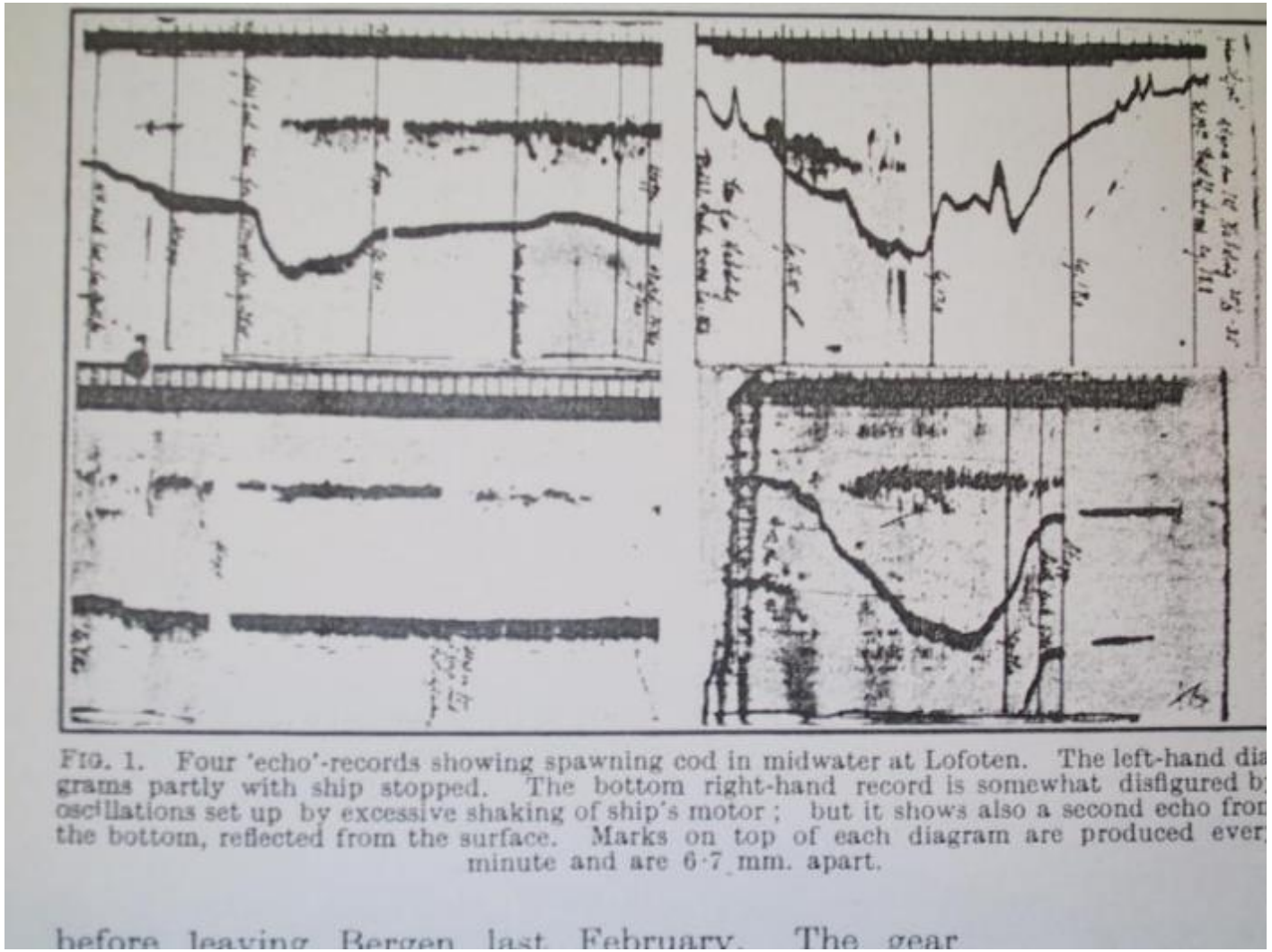

FIG. 1. Four 'echo'-records showing spawning cod in midwater at Lofoten. The left-hand dia grams partly with ship stopped. The bottom right-hand record is somewhat disfigured b oscillations set up by excessive shaking of ship's motor; but it shows also a second echo fro the bottom, reflected from the surface. Marks on top of each diagram are produced ever minute and are 6·7 mm. apart.

before leaving Bergen last February. The gear

Underwater Acoustics

History – SIMonsen RADio established in 1947

- Learned new technologies during WW II
- Company started with Radio's
- First echosounder released in 1951
- Close collaboration with the Norwegian Defence Establishment (FFI) and the Institute of Marine Research (IMR) from the start of the company

History
1947-1980

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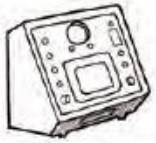

1947
SIMRAD foundation

1951
First SIMRAD Echosounder

1958
First fishery research sonar and echo sounder, Simrad 580-10

1968
First generation EK scientific echo sounders with calibrated output at 12,18, 38 and 120 kHz

1970
Rack version of EK sounder, EK-S and the first analogue Echo integrator Simrad QM

History
1980 - 2017

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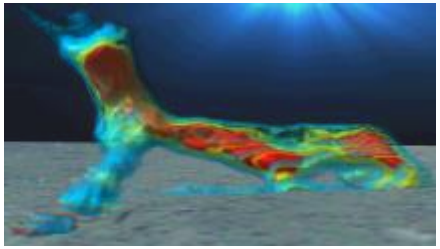


1980
EK400 and digital echo integrator Simrad QD

1984
Simrad ES400 First split beam echo sounder

1989
SIMRAD EK500. First echosounder with high instantaneous dynamic range

2002
First composite transducer

2003
EK60 introduced with BI60 post processing software, computer style, with frequencies 12 to 400 kHz

2005
Simrad ME70, first scientific multibeam echosounder

2006
Simrad MS70, first scientific multibeam sonar

2013
RAW data output on omni directional sonars

2015
Simrad EK80, first scientific wideband echo sounder

2016
WBAT, first wideband autonomous echo sounder

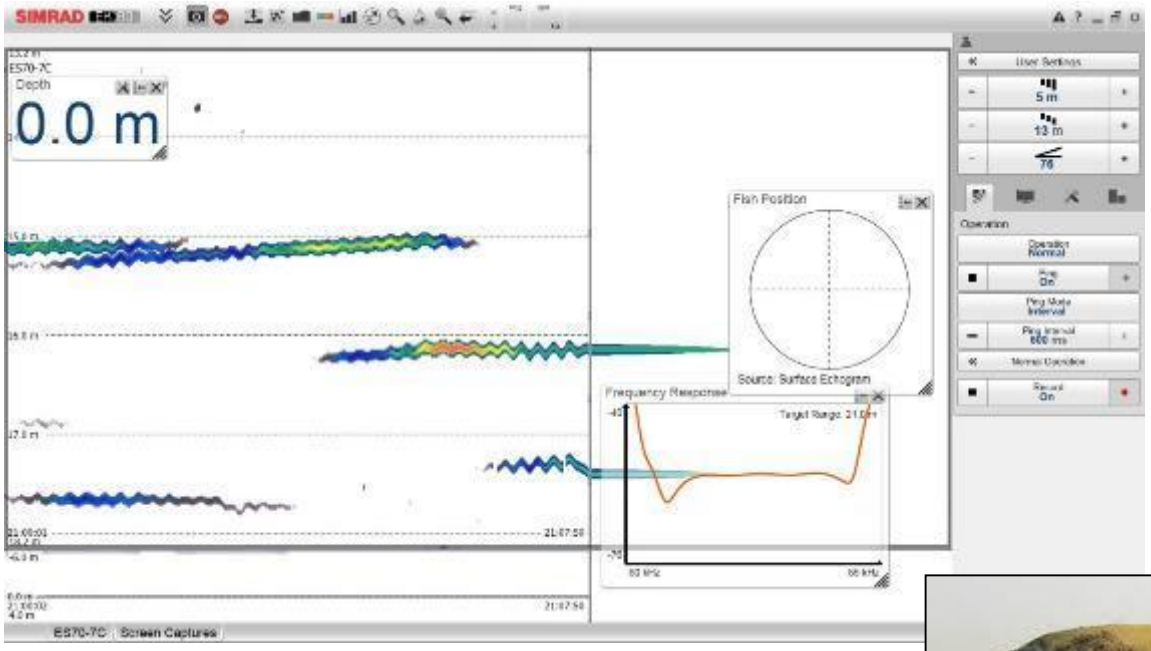
2017
TD50, first real time 3D visualization software

Current status Acoustics
- Introducing EK80 Wideband system

- What is EK80:
  - Replaces EK60 but has same functionality
  - And **Wideband** (Broadband) functionality
  - New Wide Band Transceiver (WBT)
  - New operating software (EK80)
  - Use existing transducers

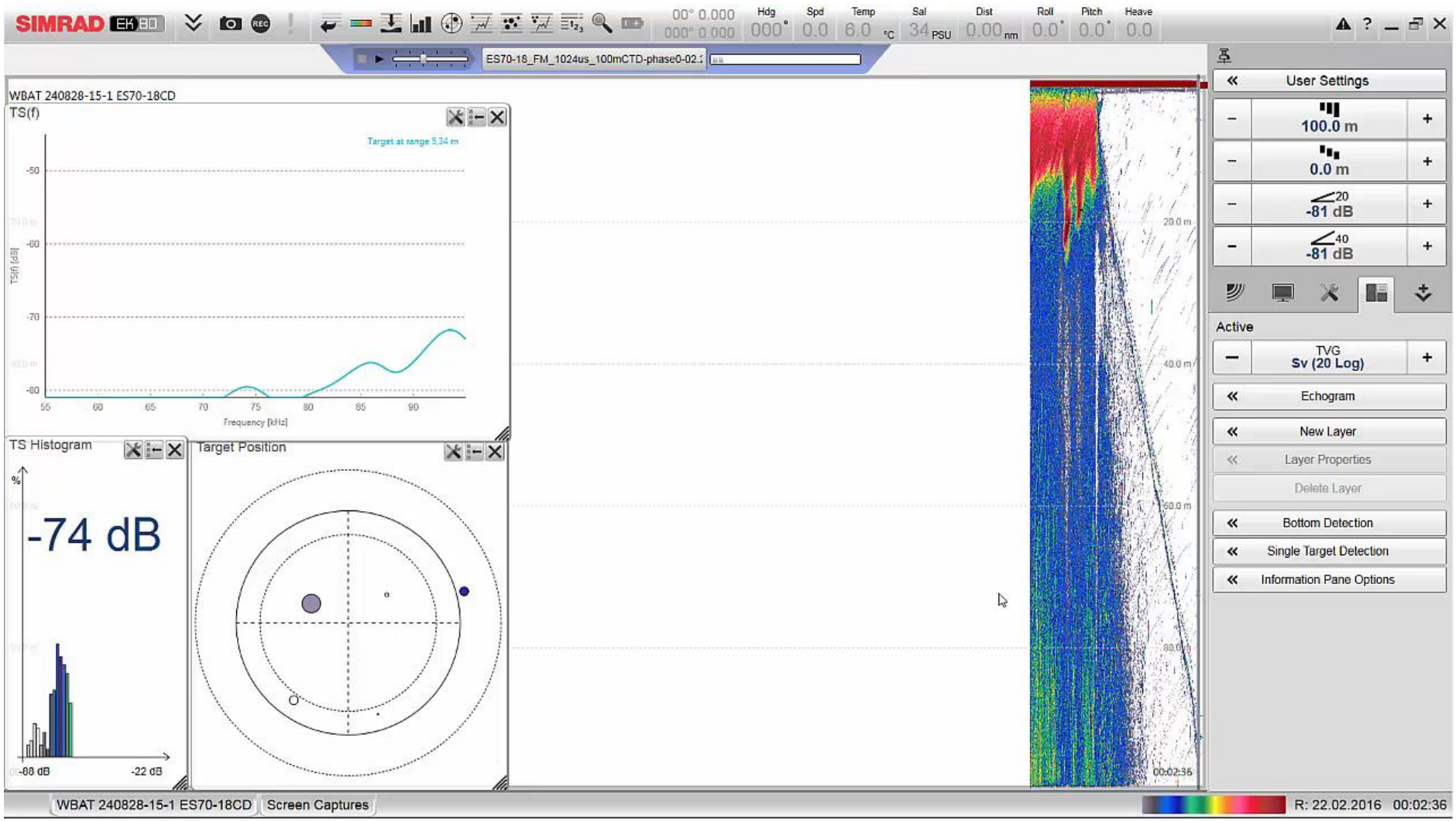
Current status Acoustics
- Wideband benefits

- Increased range resolution **AND** Long range
- Continuous target frequency response



Wideband in Summary

Resolution and frequency spectrum



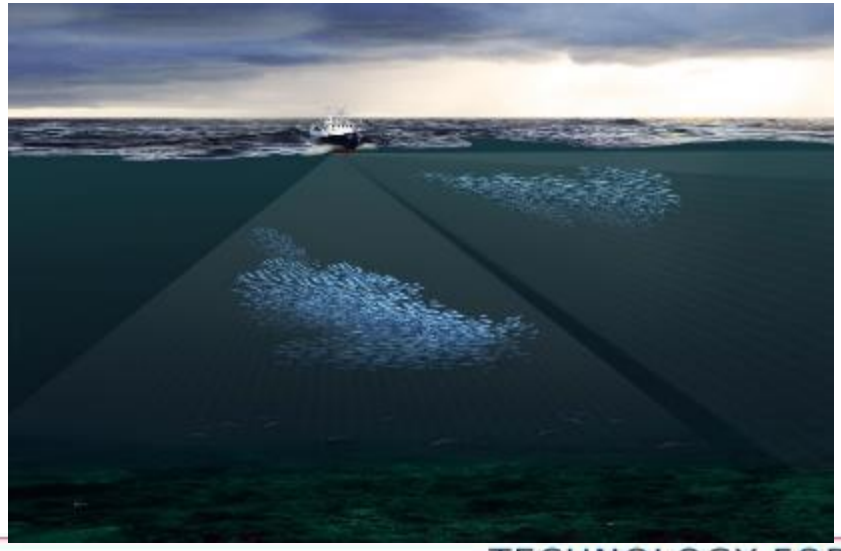
The KM Ocean Observation System

-Scientific Multibeam Systems adds 3D and 4D information

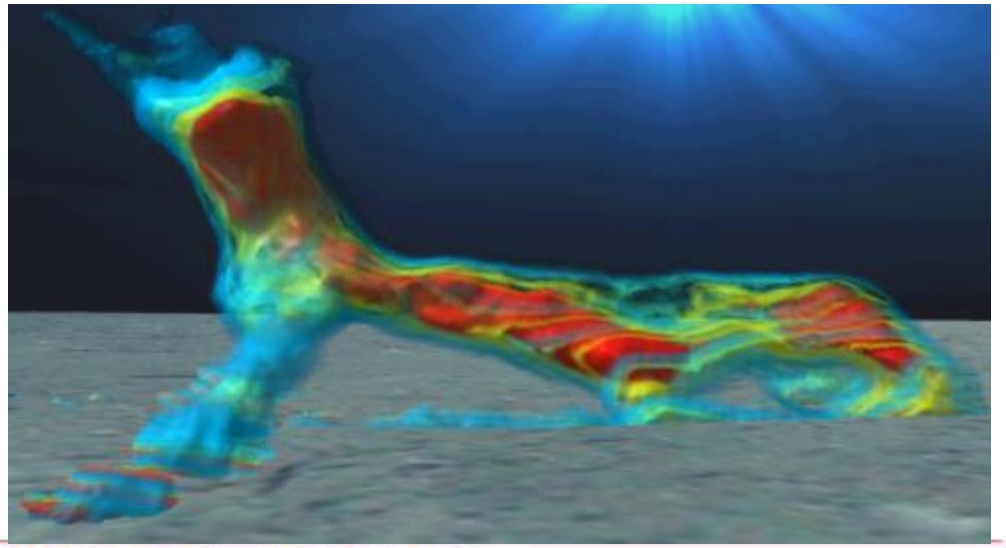
SIMRAD

- Use beamforming to add multiple beams
- Used for quantitative water column surveys
- 3D and 4D info from the oceanspace
- All beams calibrated with calibration sphere
- Extremely low side lobes (-35 to -70 dB)
- Extremely low cross talk (-35 to -70 dB)

ME70 and MS70i in combination covers the water column from surface to bottom

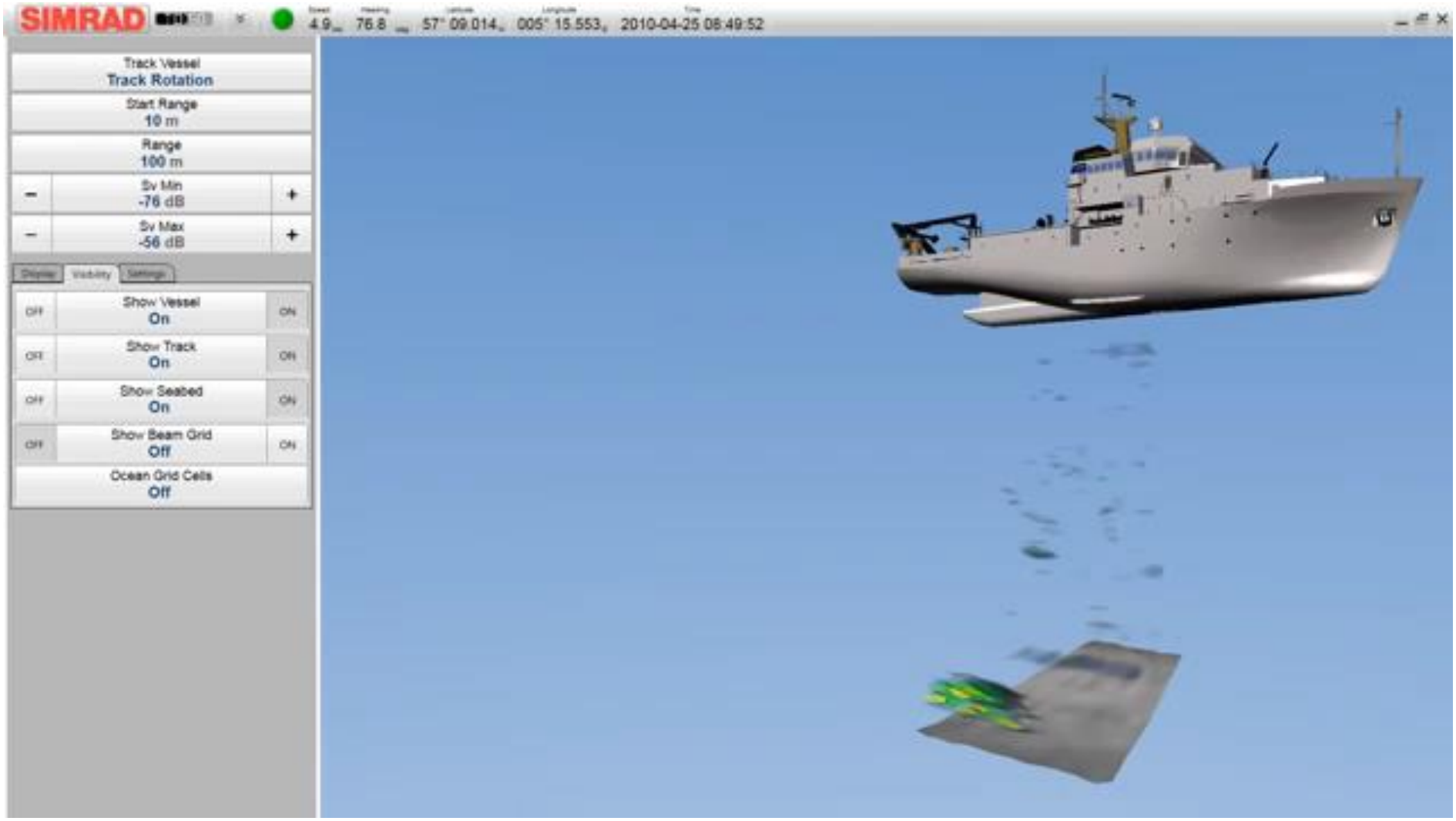


Schooling Sand Eel close to bottom in the North Sea mapped with Simrad ME70 scientific multibeam



The KM Ocean Observation System

-real time 3D information



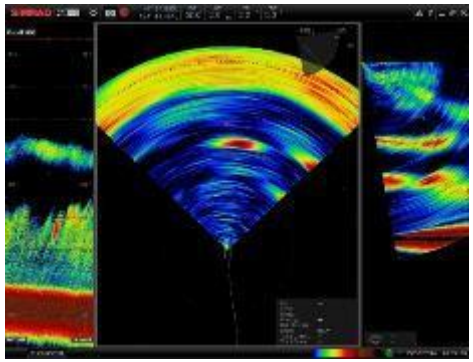
Omnidirectional Sonars

-your eyes under water

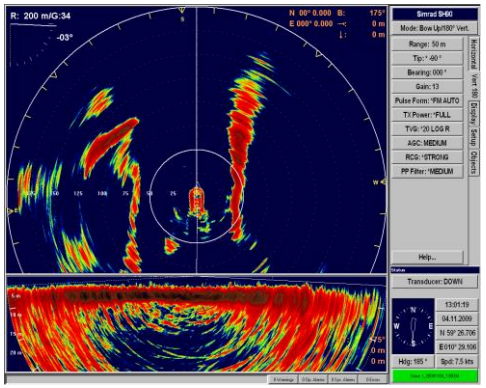
SIMRAD

- Creates a radar like image around the vessel
- Up to 8 000 meter horizontal range
- 360 degree horizontal coverage
- 180 degree vertical coverage
- Advanced beamforming and noise filtering
- RAW data recording for further processing
- Low frequency versions (SU90 & SX90)
- High frequency version (SH90)
- Horizontal multibeam version (SN90)
- Transducers delivered on retractable hull units

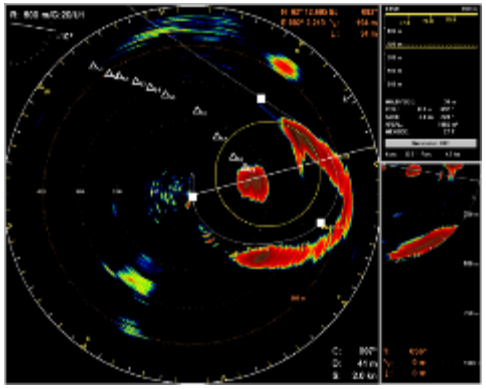
Mixed Krill & Hake aggregations



Navigation in confined waters



Schooling fish entering fishing net



Research Vessels

- a powerful platform equipped for modern ecosystem surveys

SIMRAD







A new standard for marine ecosystem assessments:

1. EK80 Wideband System
2. ME70 and/or MS70 Scientific Multibeam System
3. Omnidirectional Sonar Systems
4. Wired and Wireless Trawl Monitoring

Real time 3D visualization:


Alternative Platforms

SIMRAD

- The rationale (I):
  - Research vessels are limited in numbers, and expensive to operate
  - Leads to limited spatial and temporal resolution in data series
  - Increased interest for ocean data
  - Growth in data collection must come from alternative acoustic platforms
- The rationale (II):
  - Difficult to resolve single targets in dense aggregations or at depth (Ts)
  - Wideband fix range resolution, but acoustic beam still have an opening angle
- The rationale (III):
  - Reaching deep scattering layers with higher frequencies
    - Loss increase with frequency
  - Increased interest in mesopelagic zones (commercial and scientific)
- And so much more:
  - Silent, can reach new areas etc.

The KM Ocean Observation System

-EK80, a version for any platform

SIMRAD

- Succeed the EK60 as the world standard for biomass assessment & water column studies
- Split beam reception
- Wideband capable
- Built in calibration
- Documented common RAW data output
- One version for all platforms, including vessels, autonomous vessels (surface and underwater) as well as drifting and stationary.
- Special portable version to be released this year!

Platforms & Applications

Stationary Landers & Long term monitoring

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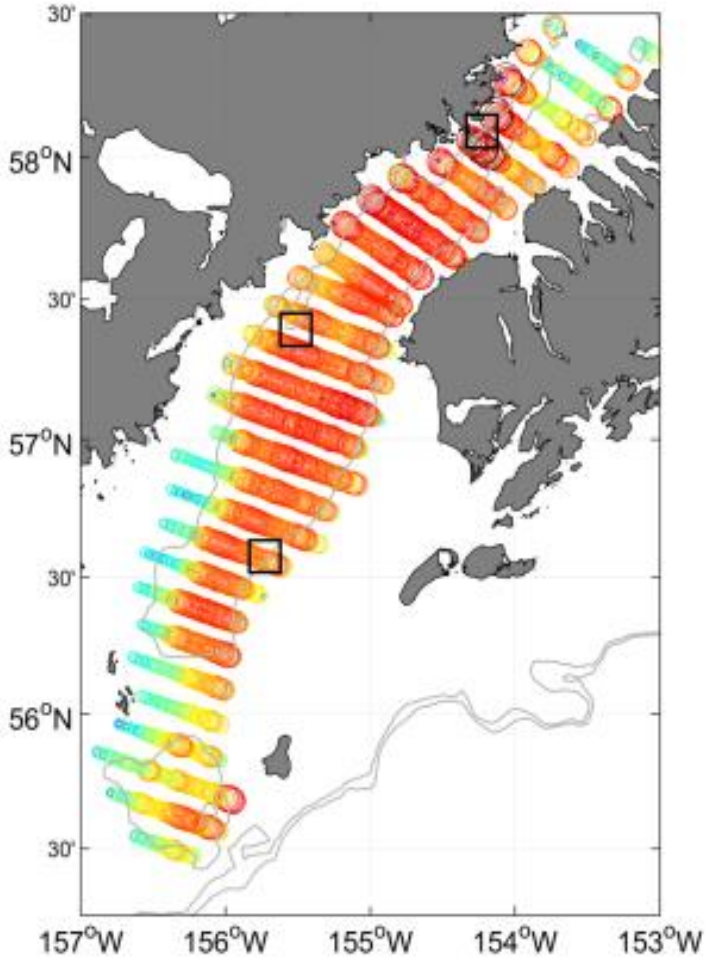

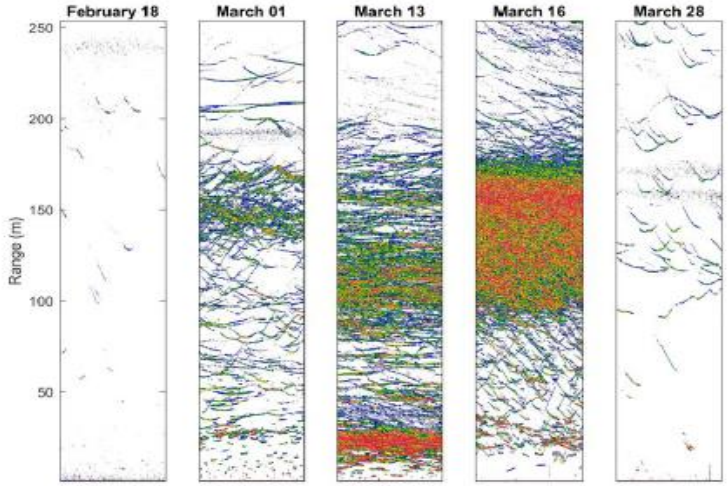

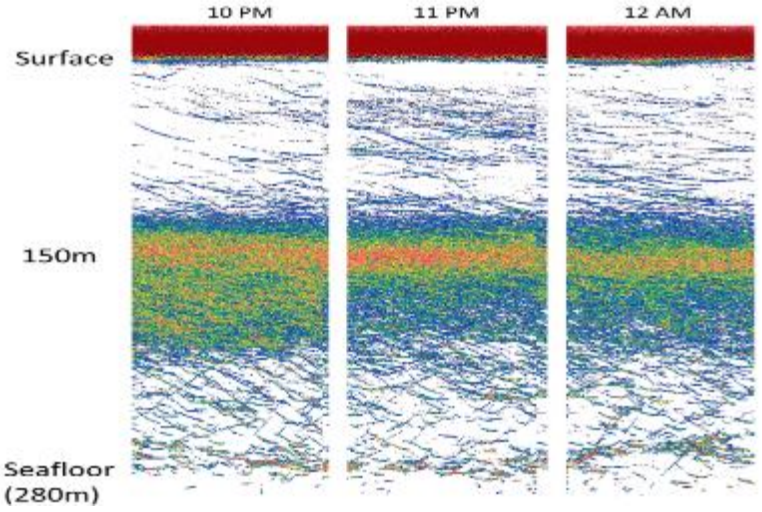

Alex de Robertis, AFS/NOAA
-with permission

Platforms & Applications

WBAT mounted on CTD probe

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Egil Ona, IMR
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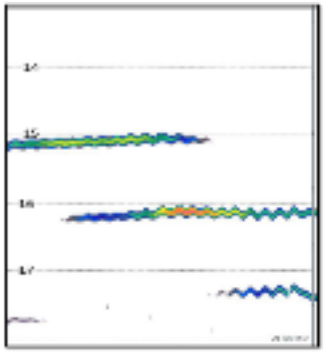
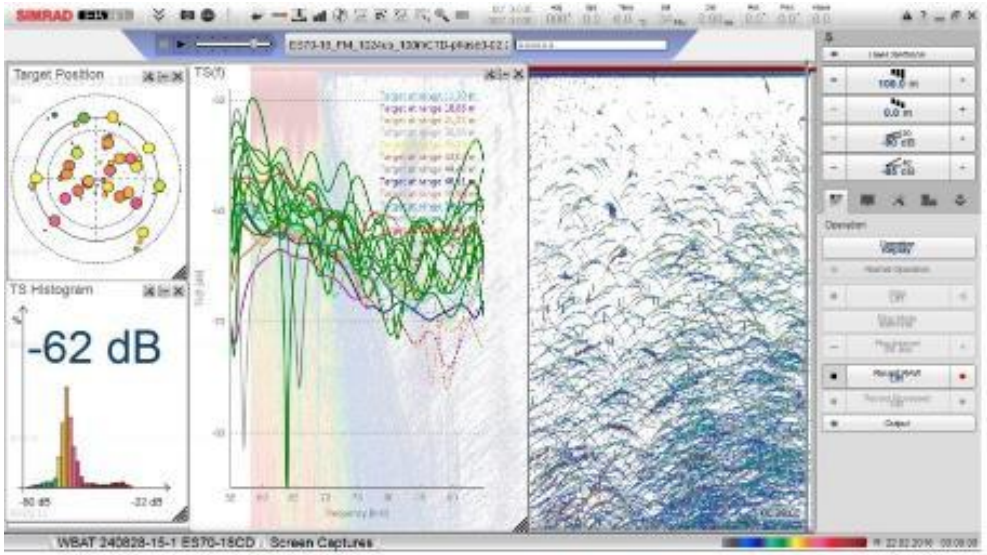


Mychtophides

(*Bentosema glaciale)*
400 m depth
Dorsal wideband TS measurements



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