

# Glider Science Payload

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INTERNATIONAL UNDERWATER GLIDER CONFERENCE

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# Global presence



At a glance:

2300+

Instruments per year

160+

Employees worldwide

500M+ NOK

Turnover 2023

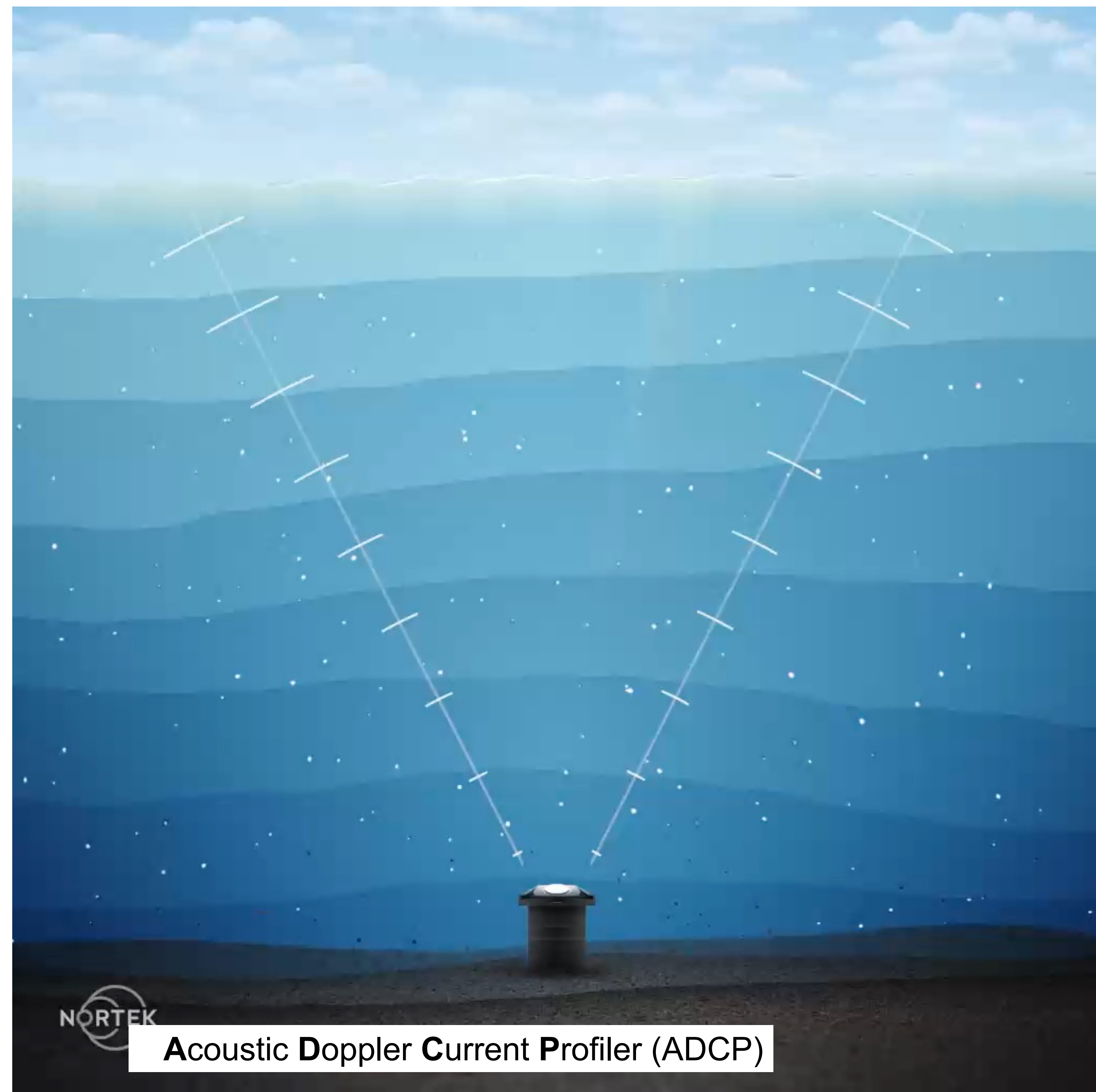
ISO 9001

Certified





# What we do?

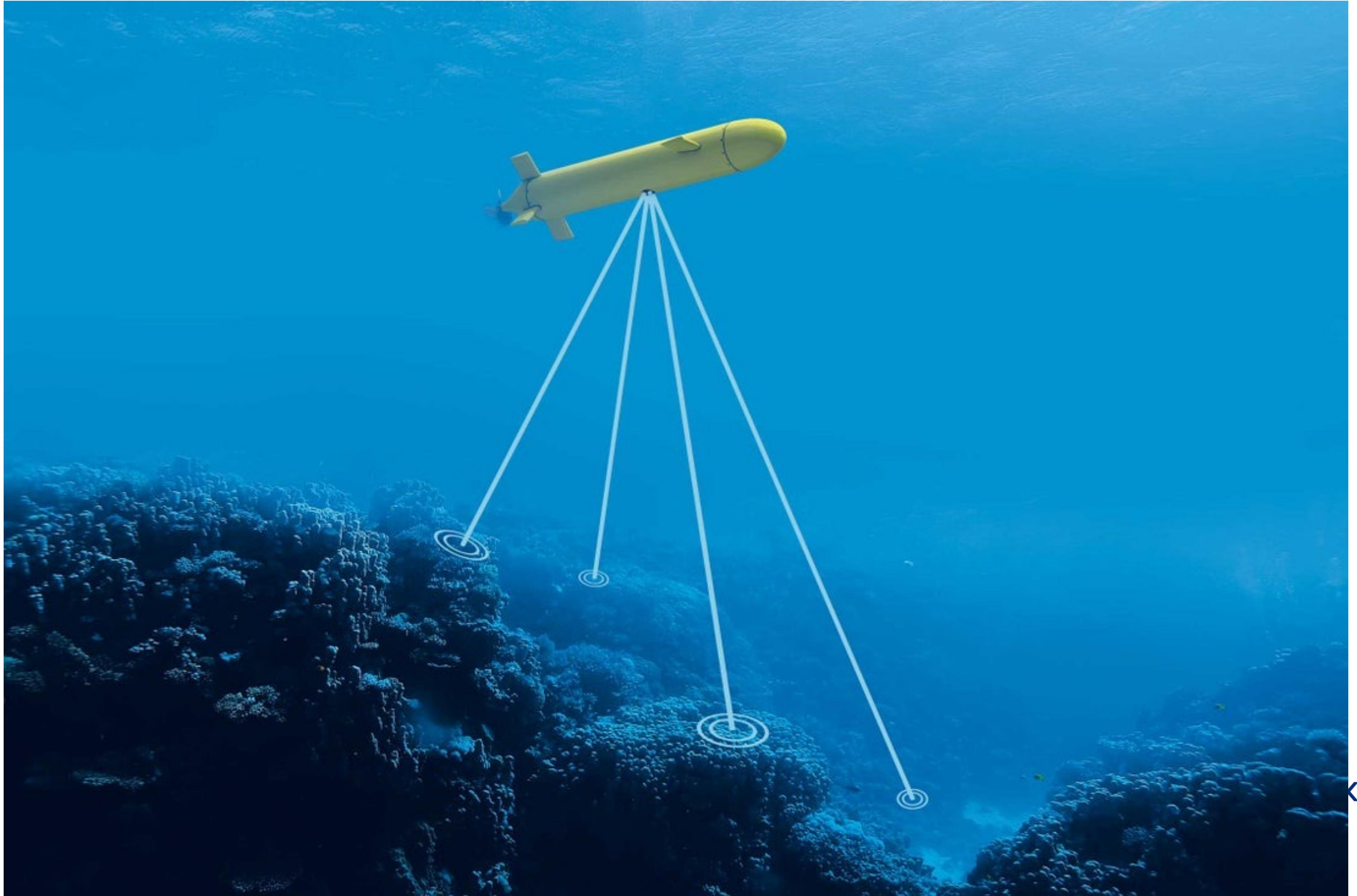


**Acoustic Doppler Current Profiler (ADCP)**

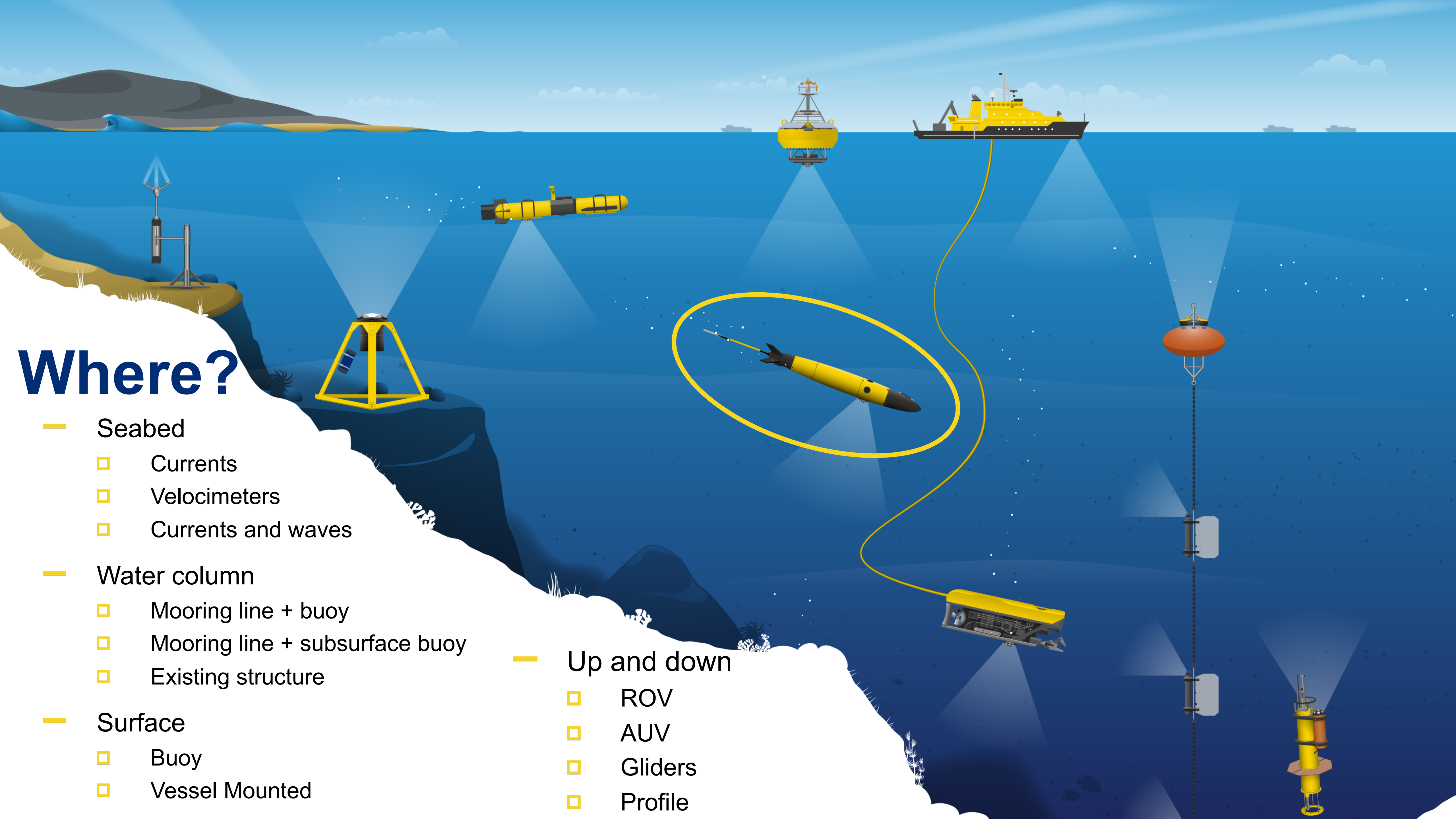




# What we also do?







# Where?

- Seabed
  - Currents
  - Velocimeters
  - Currents and waves
- Water column
  - Mooring line + buoy
  - Mooring line + subsurface buoy
  - Existing structure
- Up and down
  - ROV
  - AUV
  - Gliders
  - Profile
- Surface
  - Buoy
  - Vessel Mounted

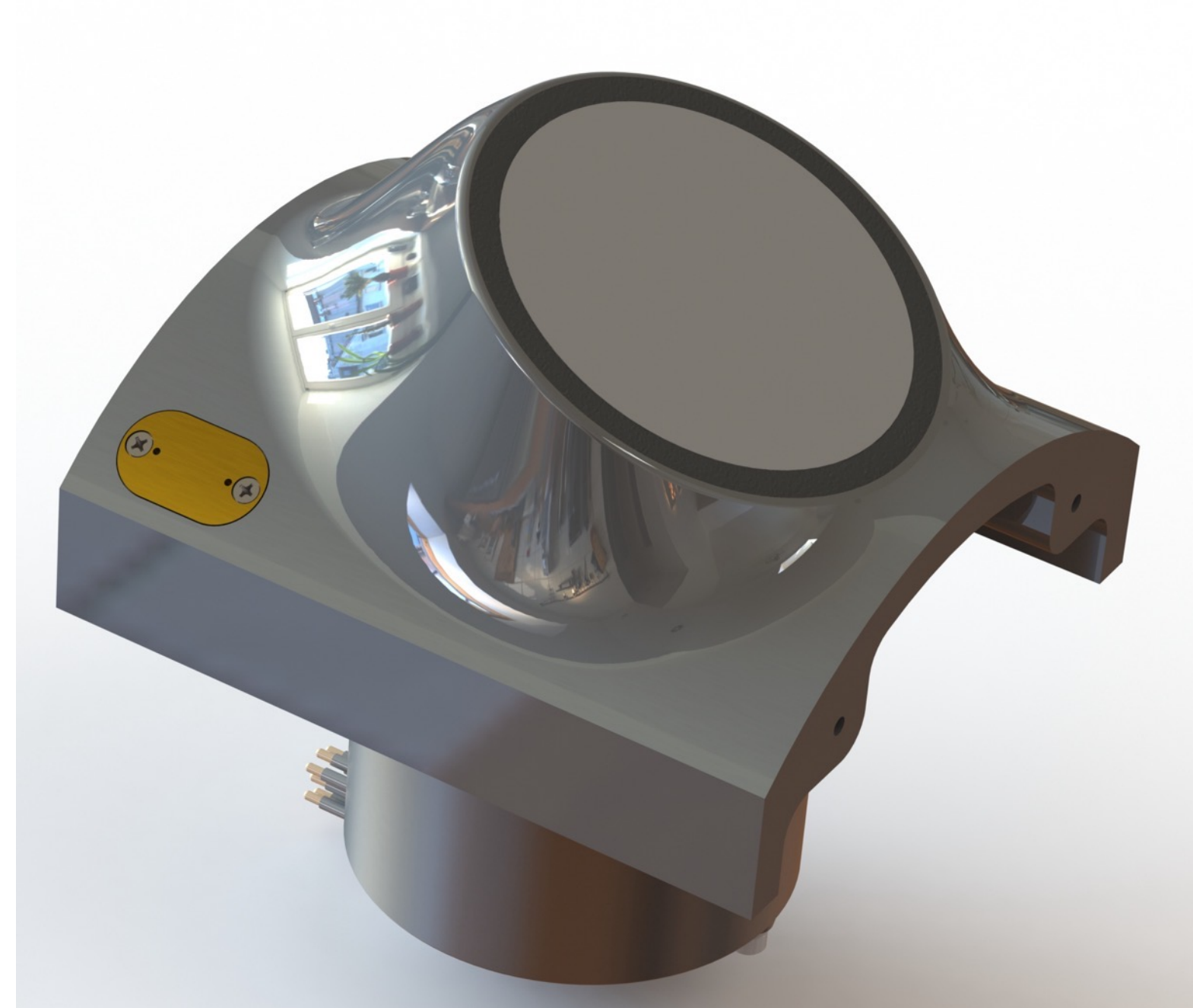


# What is Nortek manufacturing for gliders?

- AD2CP current profiler

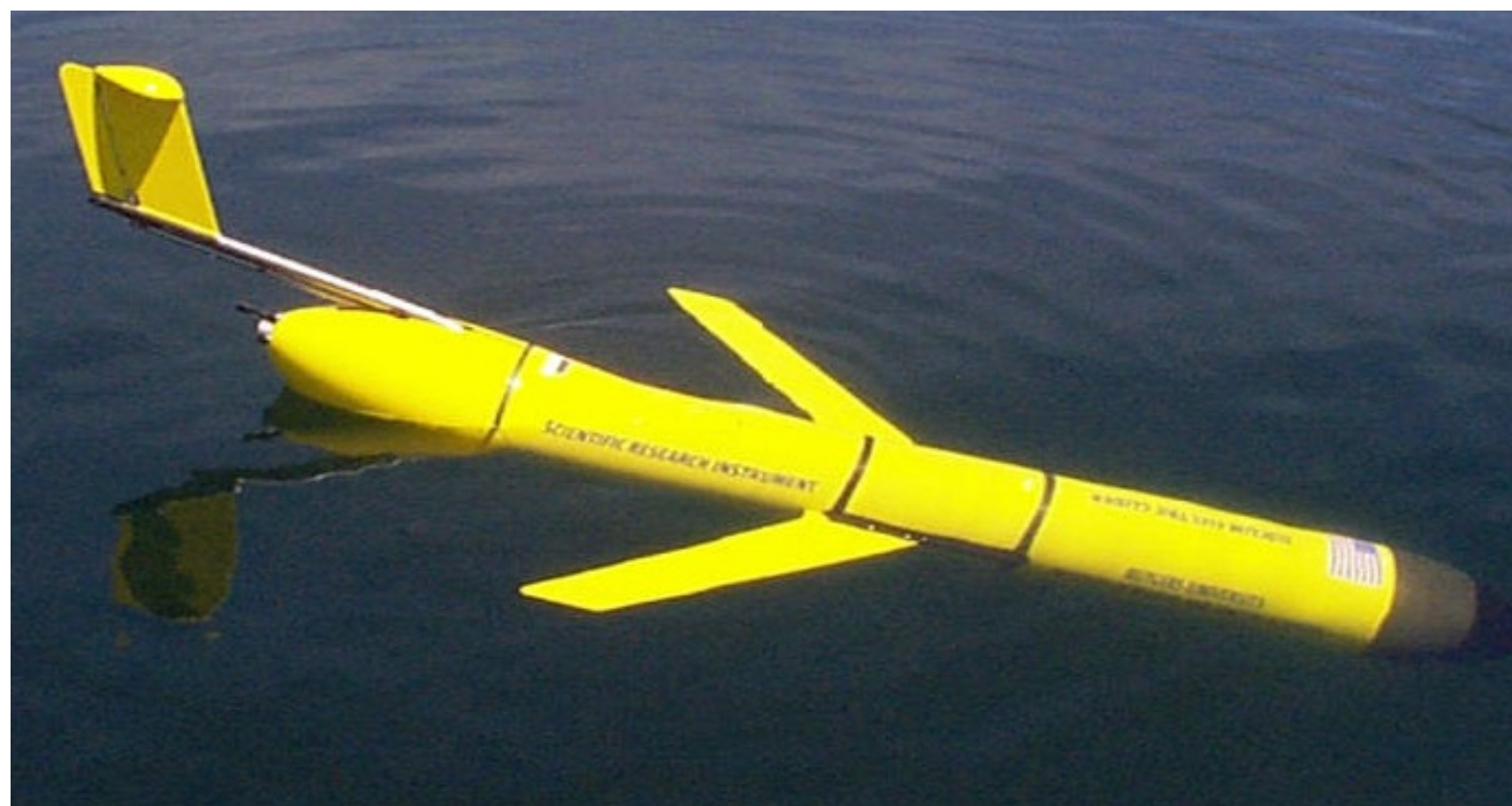


- ECHOSOUNDER





# AD2CP



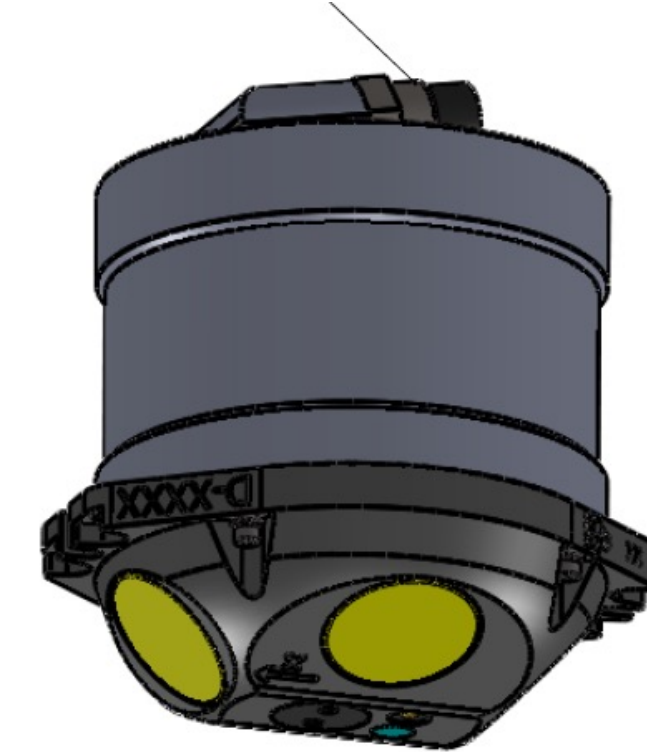
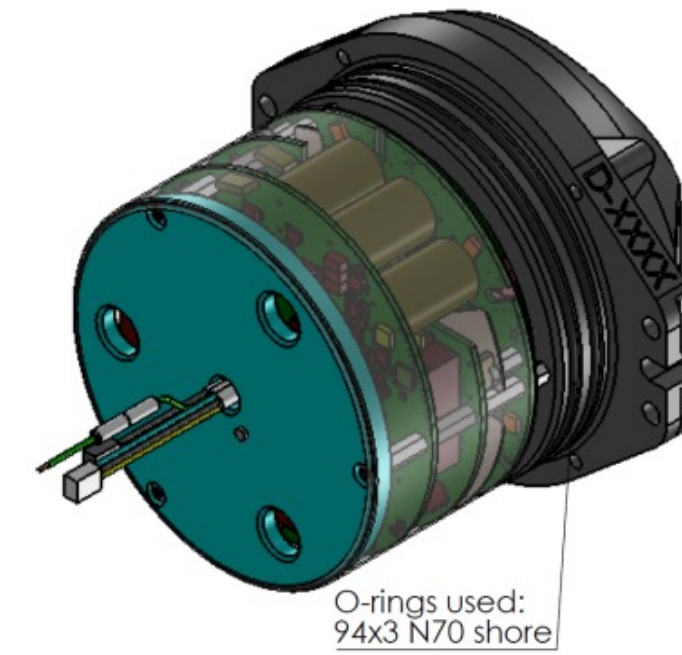


# AD2CP

## — Current profiler

- Emits ultrasonic waves (1 MHz) backscattered by particles in suspension
- 4 beams. Lateral transducers angle =  $25^\circ$ . Transversal transducers, angle =  $47.5^\circ$

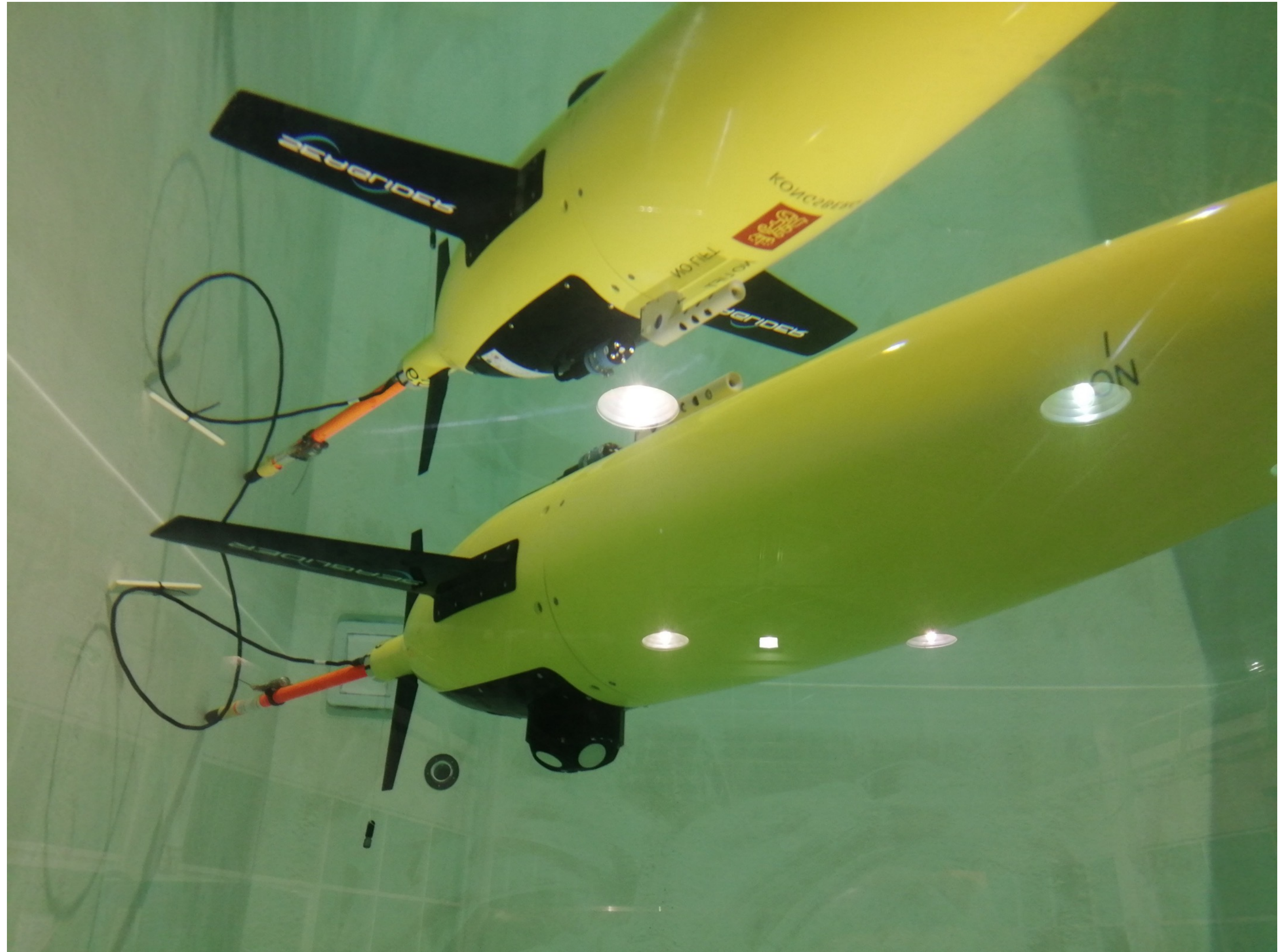
- Seaglider (UW)
- Spray Glider (Scripps)
- Slocum (Webb)
- Seaexplorer (Alseamar)





# AD2CP

— Mec. Integration

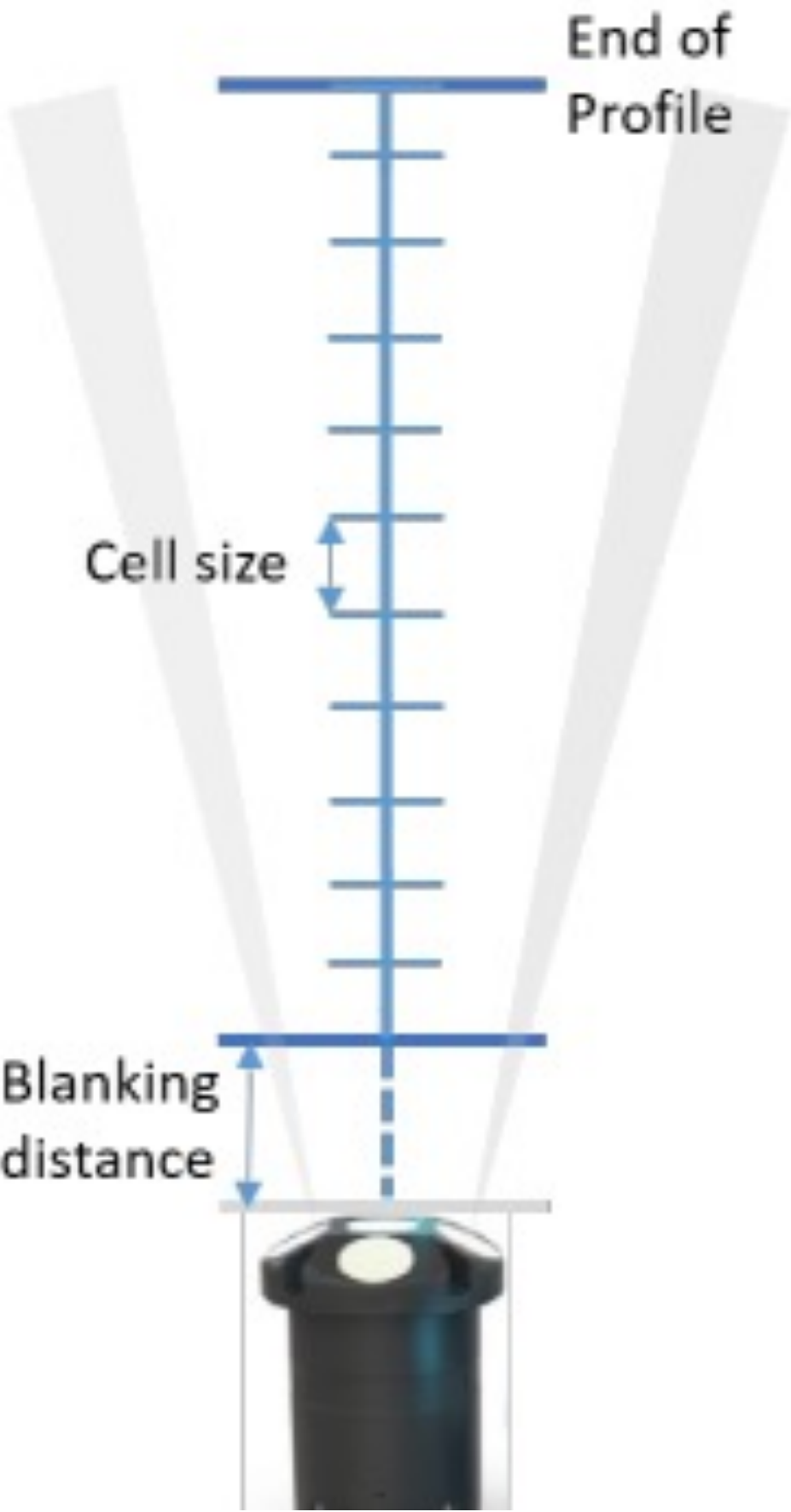




# AD2CP

— Elec. Integration

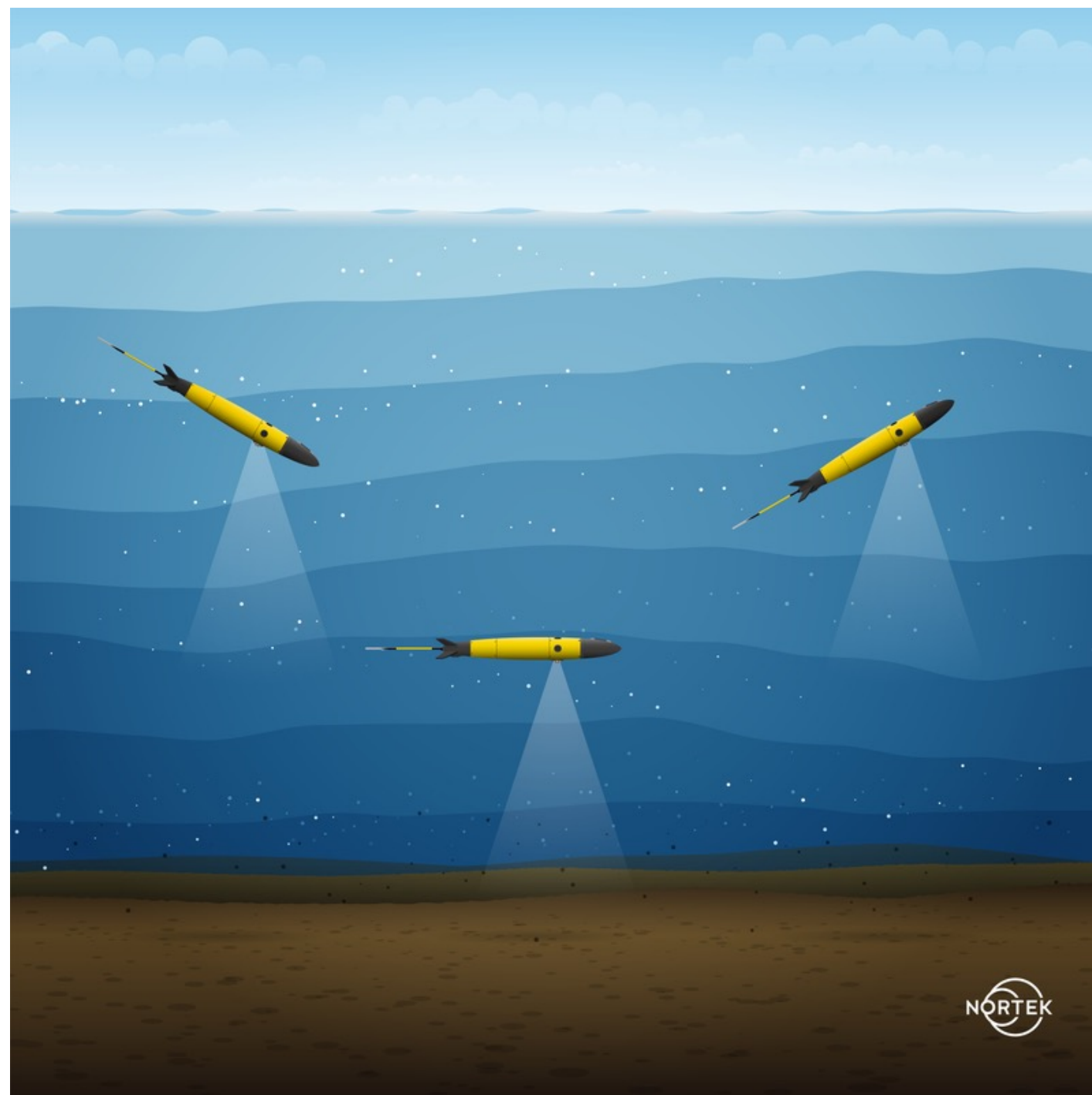
Name	Abbreviation	Description
<b>Blanking distance</b>	<i>BD</i>	<i>Distance from the sensor not considered in the data processing to avoid data noise from transducer ringing</i>
<b>Cells size</b>	<i>CS</i>	<i>Discrete interval for which returns are recorded by the ADCP (~ vertical resolution of the ADCP)</i>
<b>Number of cells</b>	<i>NC</i>	<i>Number of cells for an individual profile</i>
<b>Number of pings</b>	<i>NPING</i>	<i>Number of pings averaged in each cell</i>
<b>Pings rate</b>	<i>dt</i>	<i>Time between pings (~sampling interval)</i>



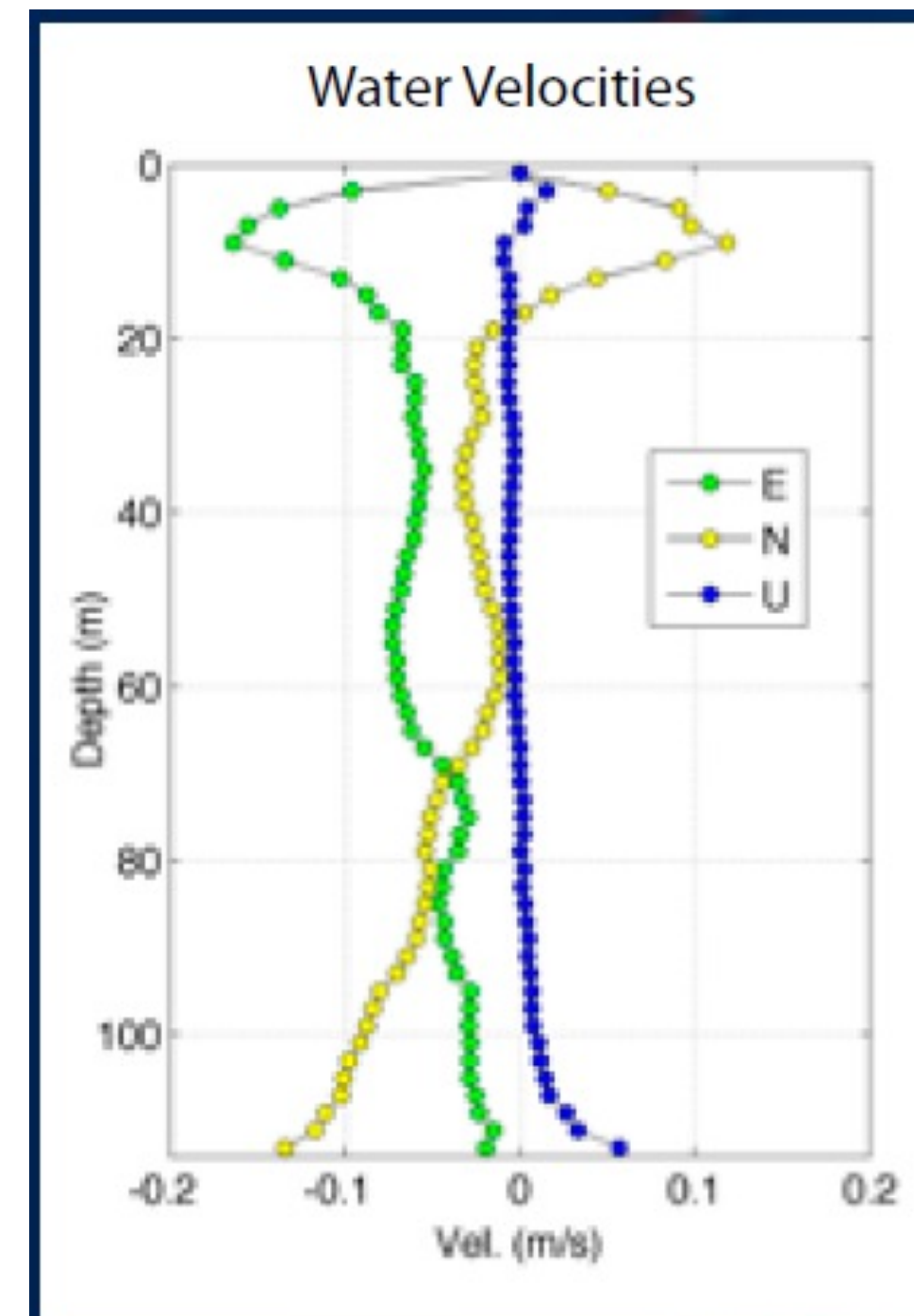
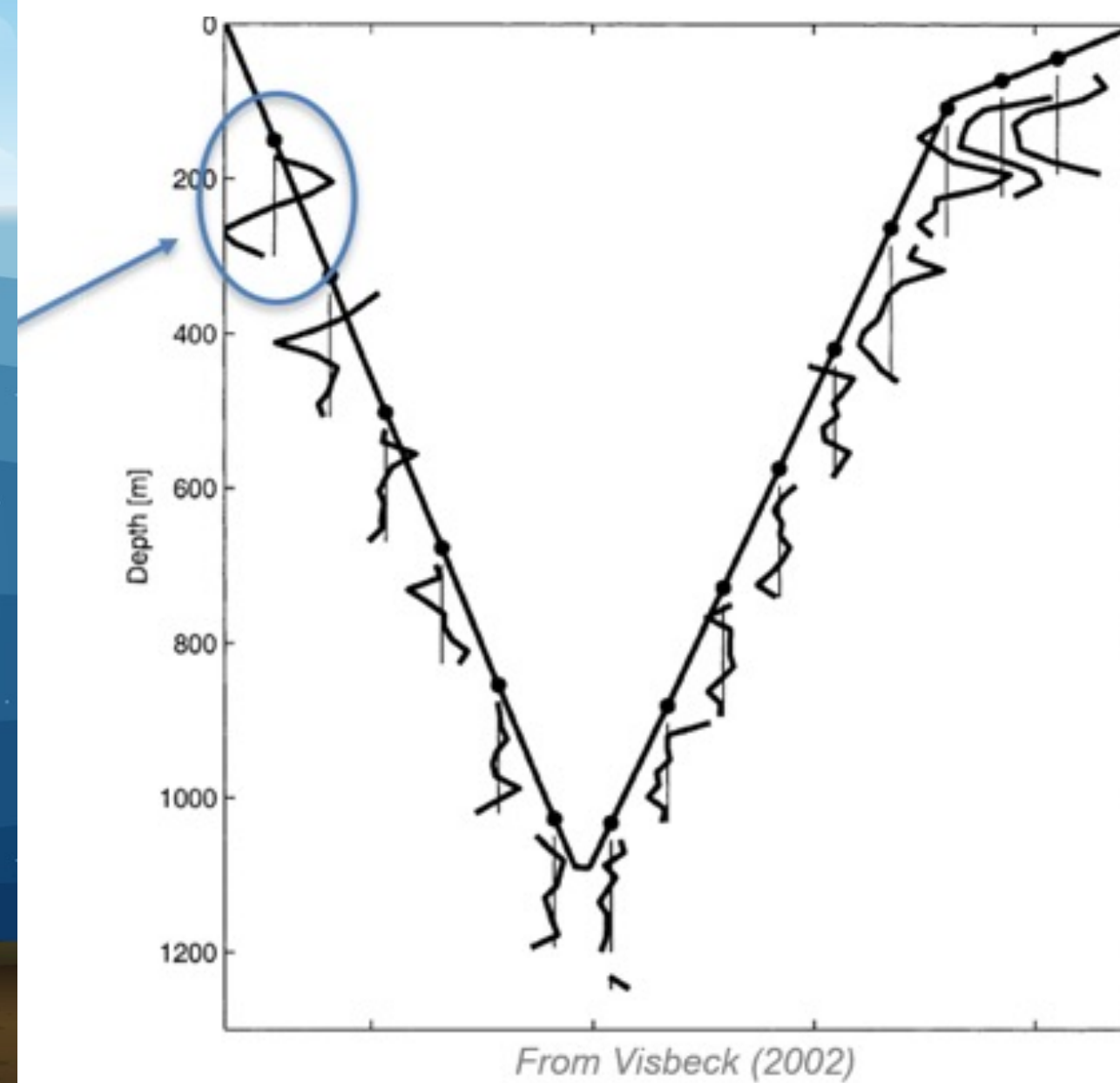


# AD2CP

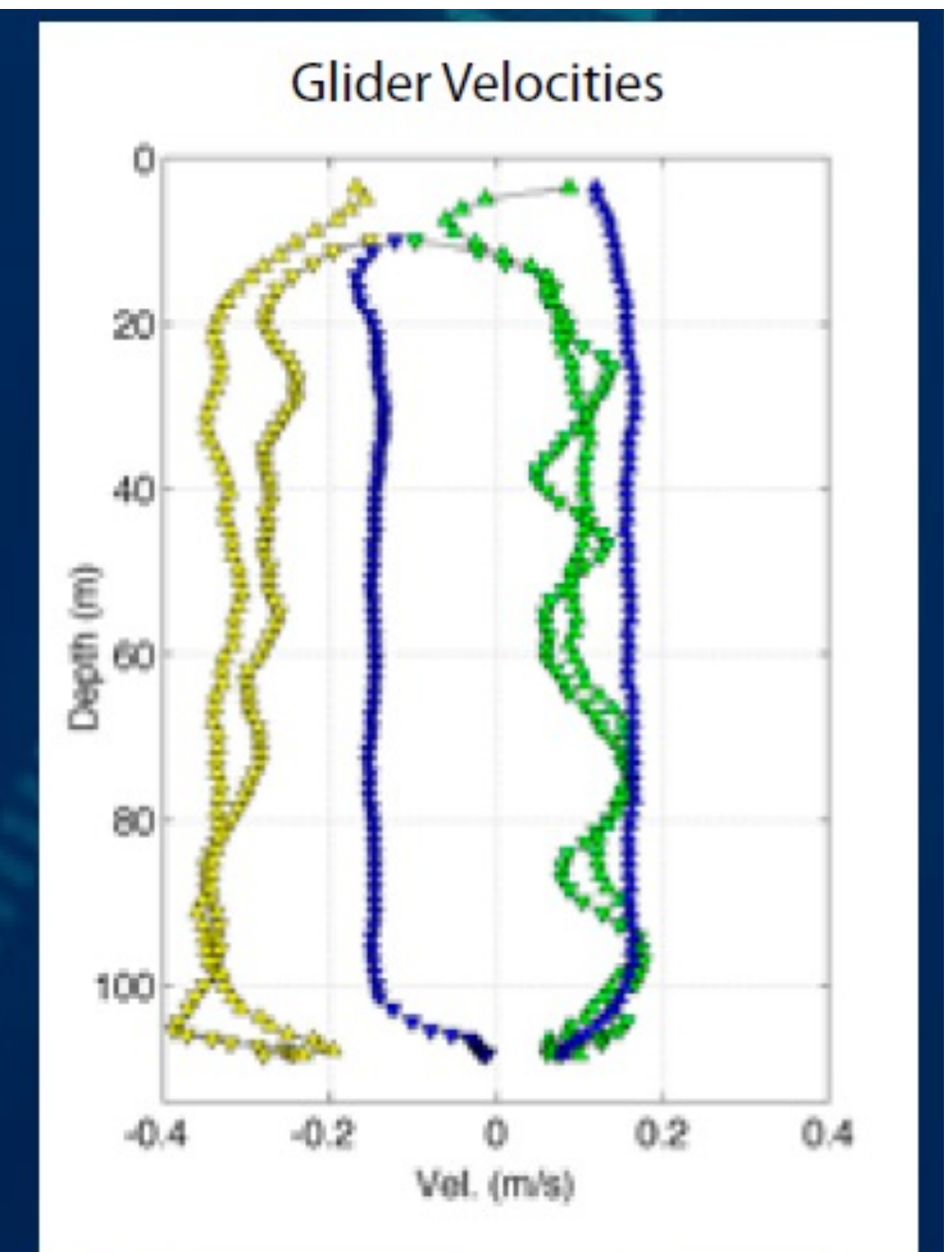
## — Processing of the data



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After processing, measurements yield water East (●), North (●), and up (●) velocity components.

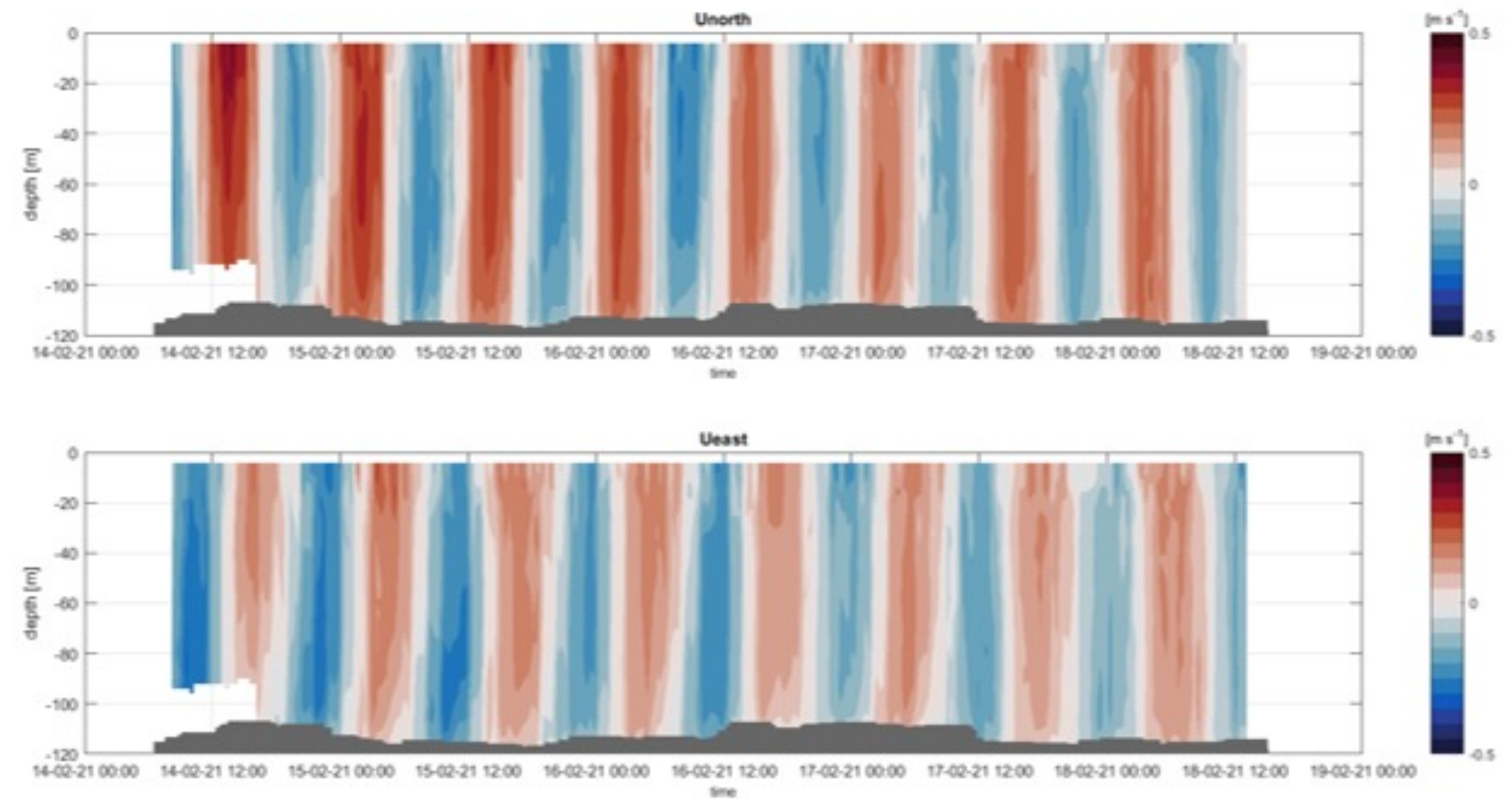
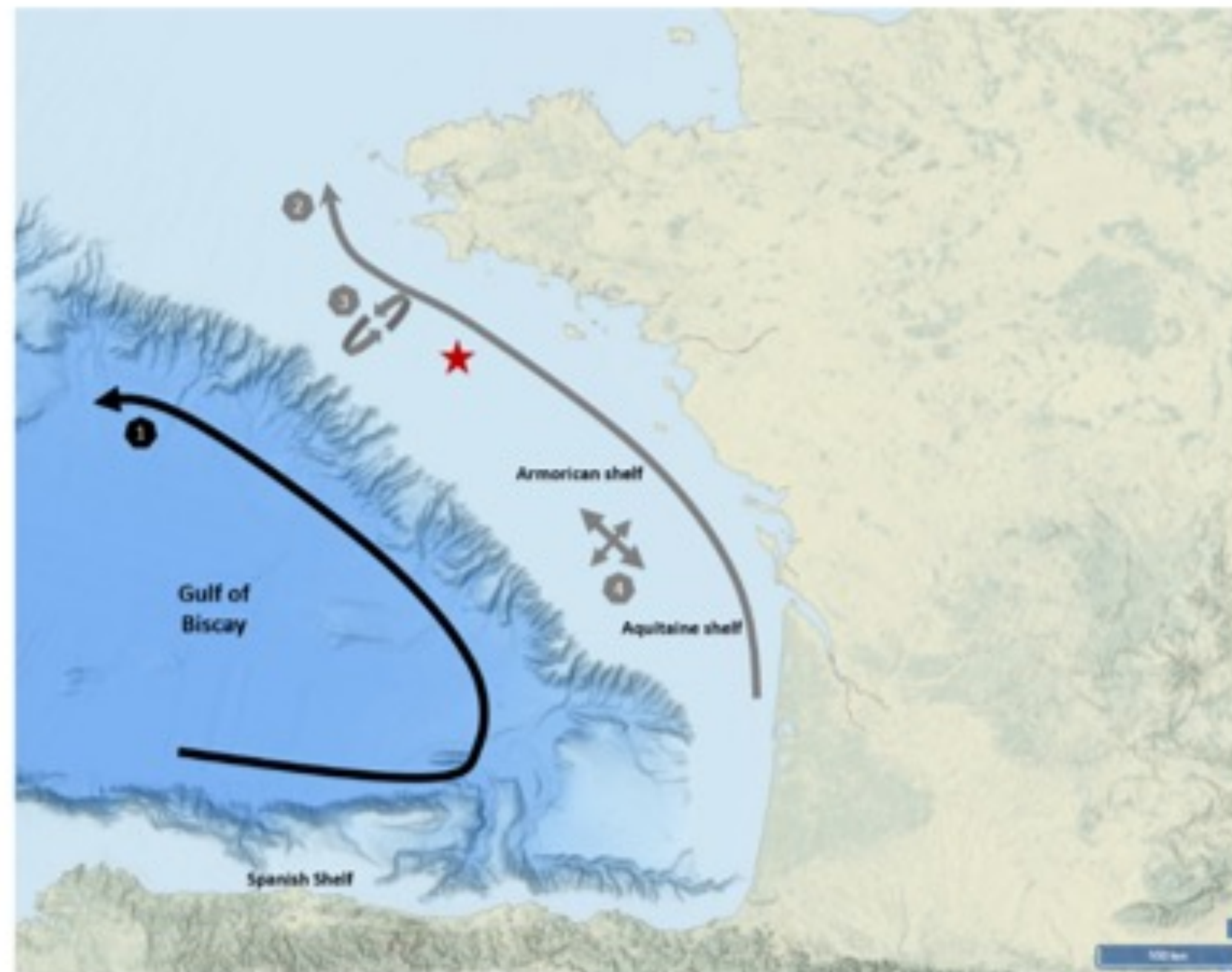


Glider ENU components on descent (▼) and ascent (▲) (same colors as water).



# AD2CP

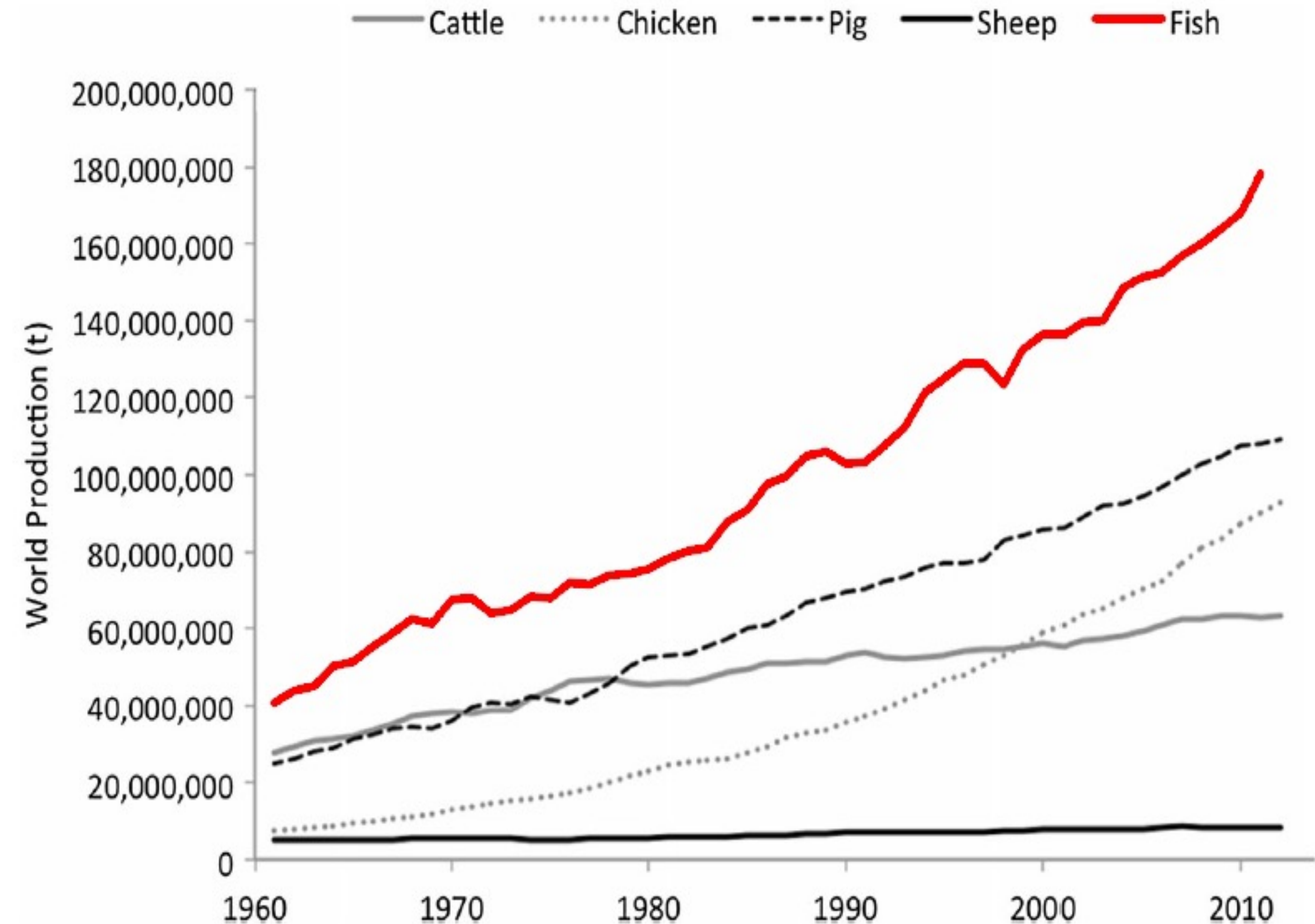
## — Processing of the data





# ECHOSOUNDER

- World demand for animal-derived protein expected to double (*UN FAO 2013*)
  - Population expected to reach 9.7 billion by 2050 (*UN DESA 2015*)
  - Emerging economies
  - Increasing urbanization
  - Recognition of protein's role in a healthy diet
  - Increased need for protein in elderly population
- Fish stocks can potentially make vast contributions to global protein requirements

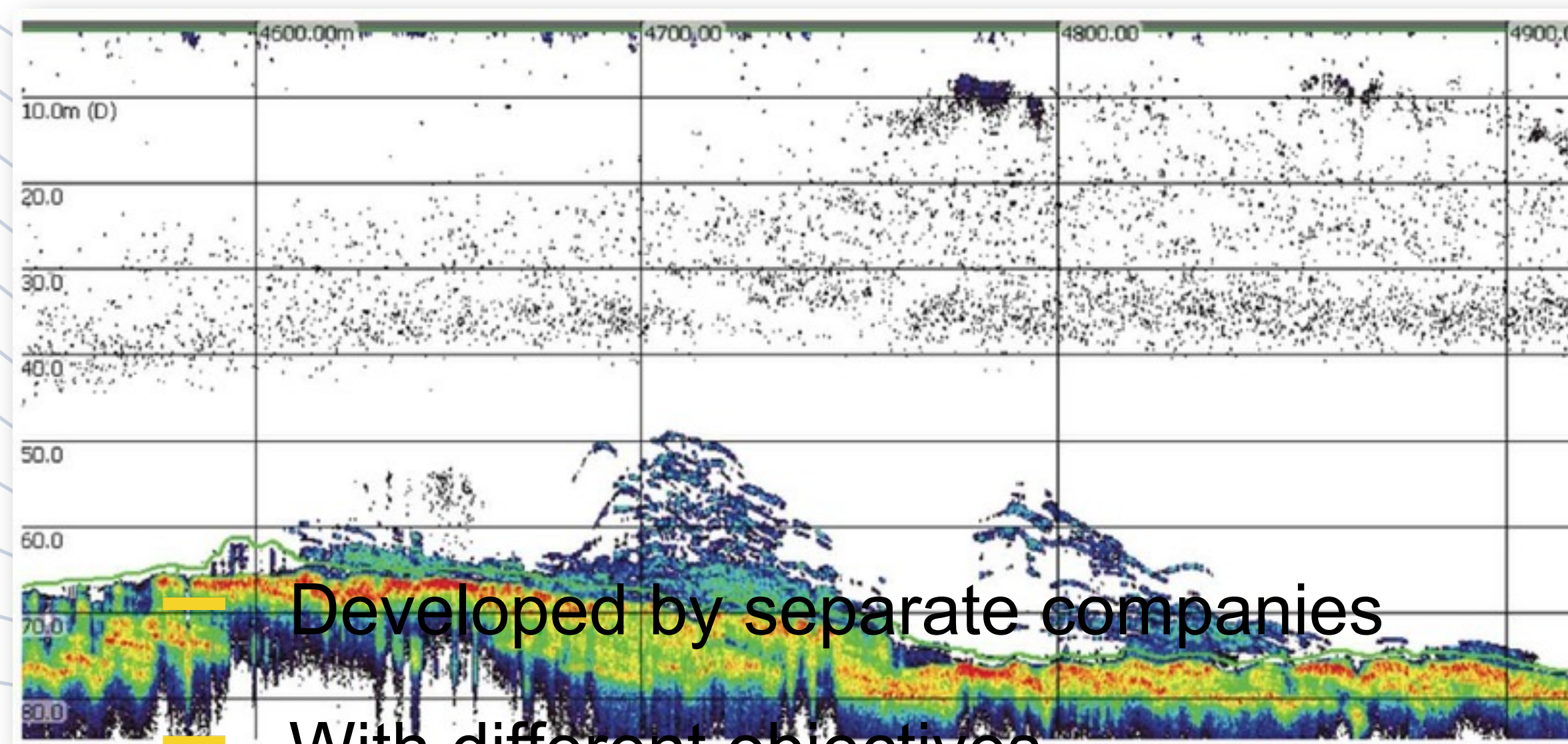


FAO Statistic 2011



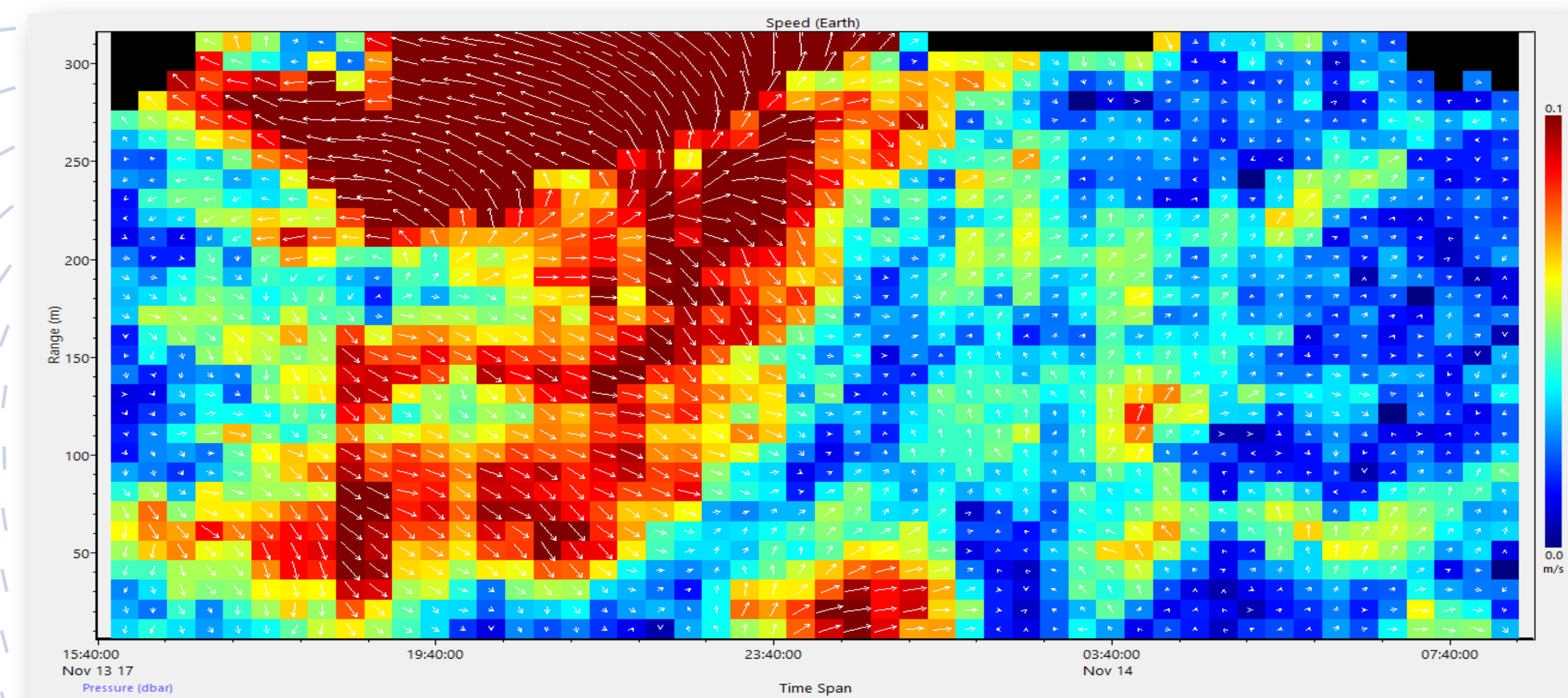
# Problem Definition

- Fisheries Scientist need to understand the structure, dynamics, function and quantity of fish stocks
- Acoustic technology is widely used in this process:
  - Biological Echosounders
  - Acoustic Doppler Current Profilers (ADCPs)



Developed by separate companies

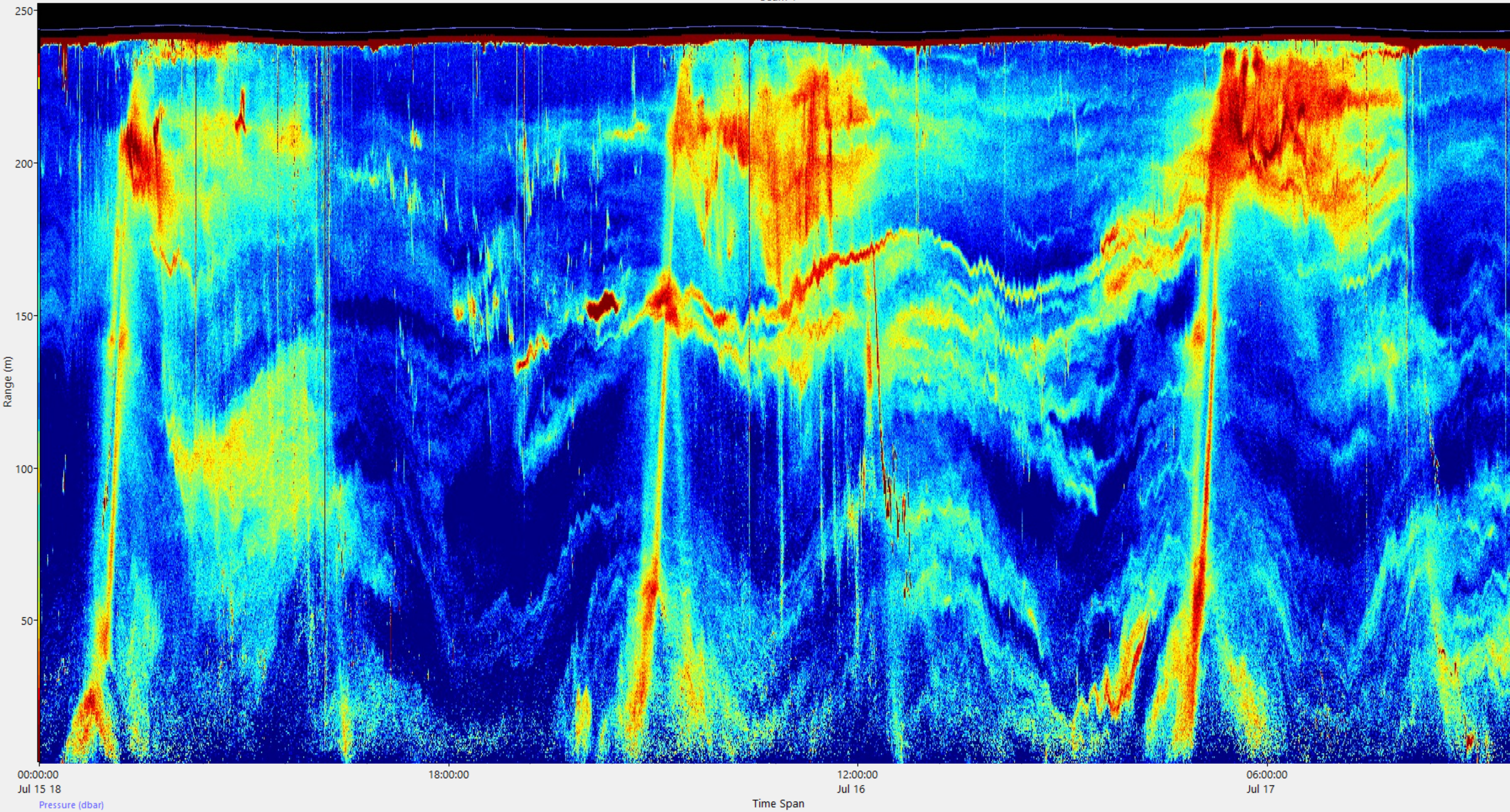
With different objectives



- Leave the end user to do the system integration and data assimilation by themselves



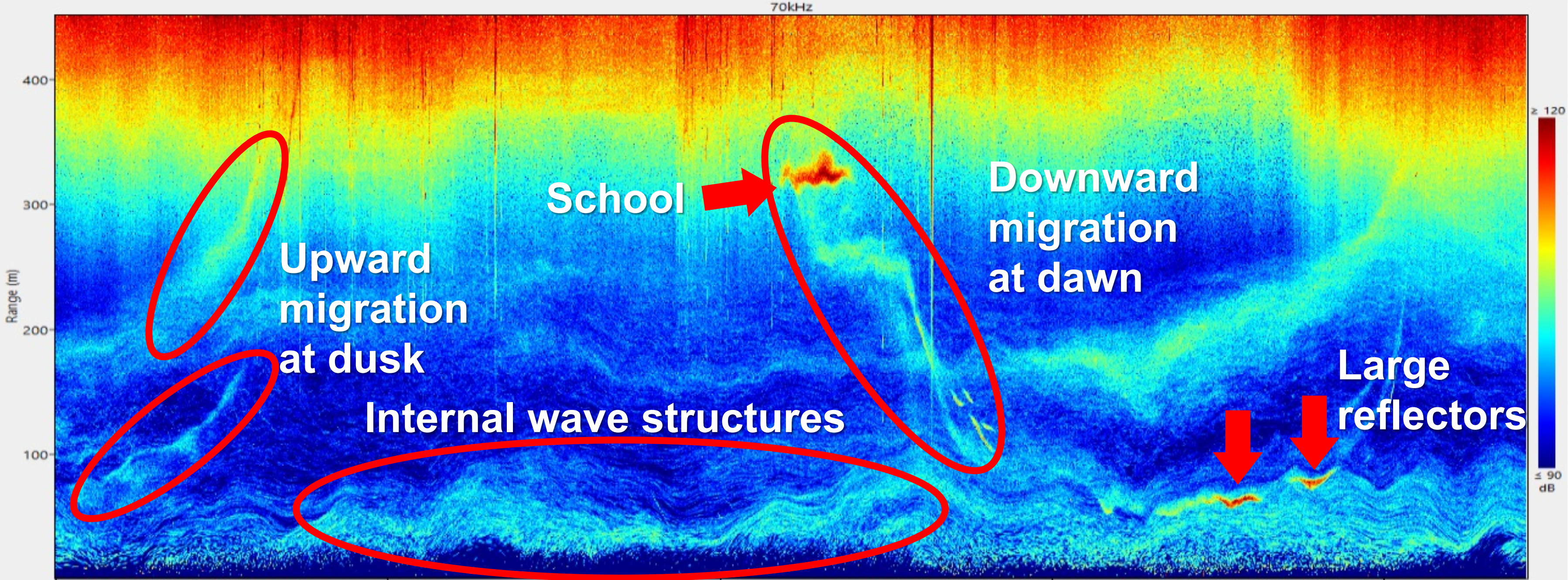
Beam 1



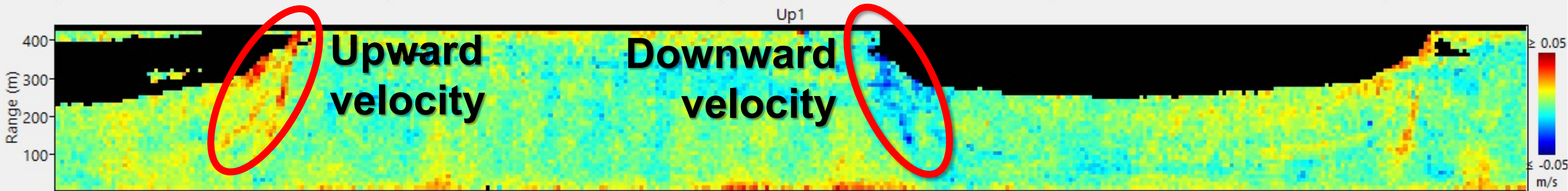


# Results

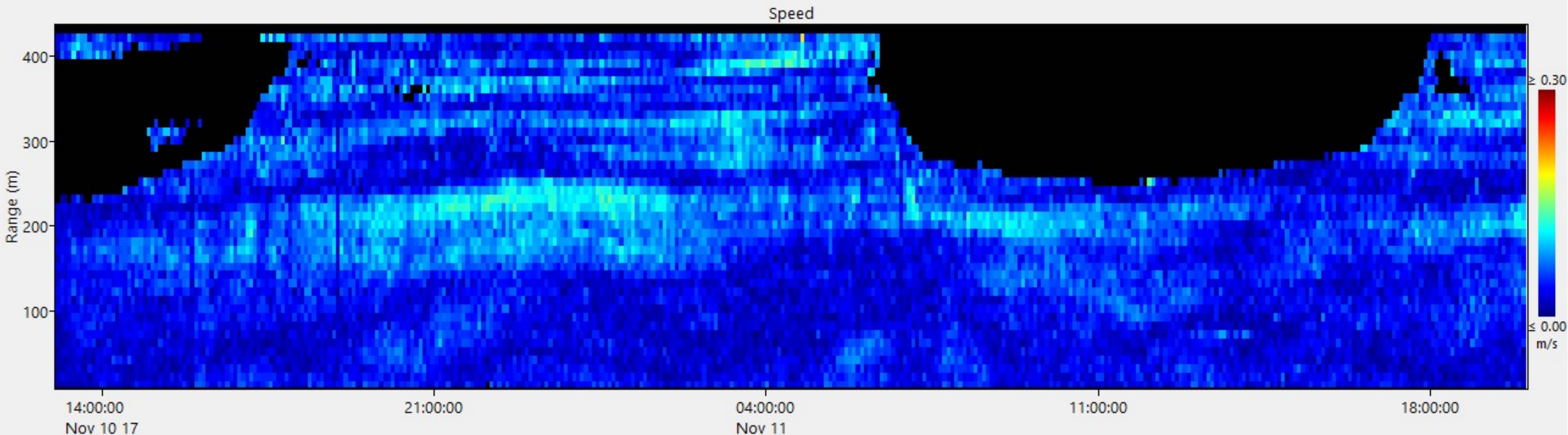
Echogram



Vertical Velocity



Horizontal Velocity

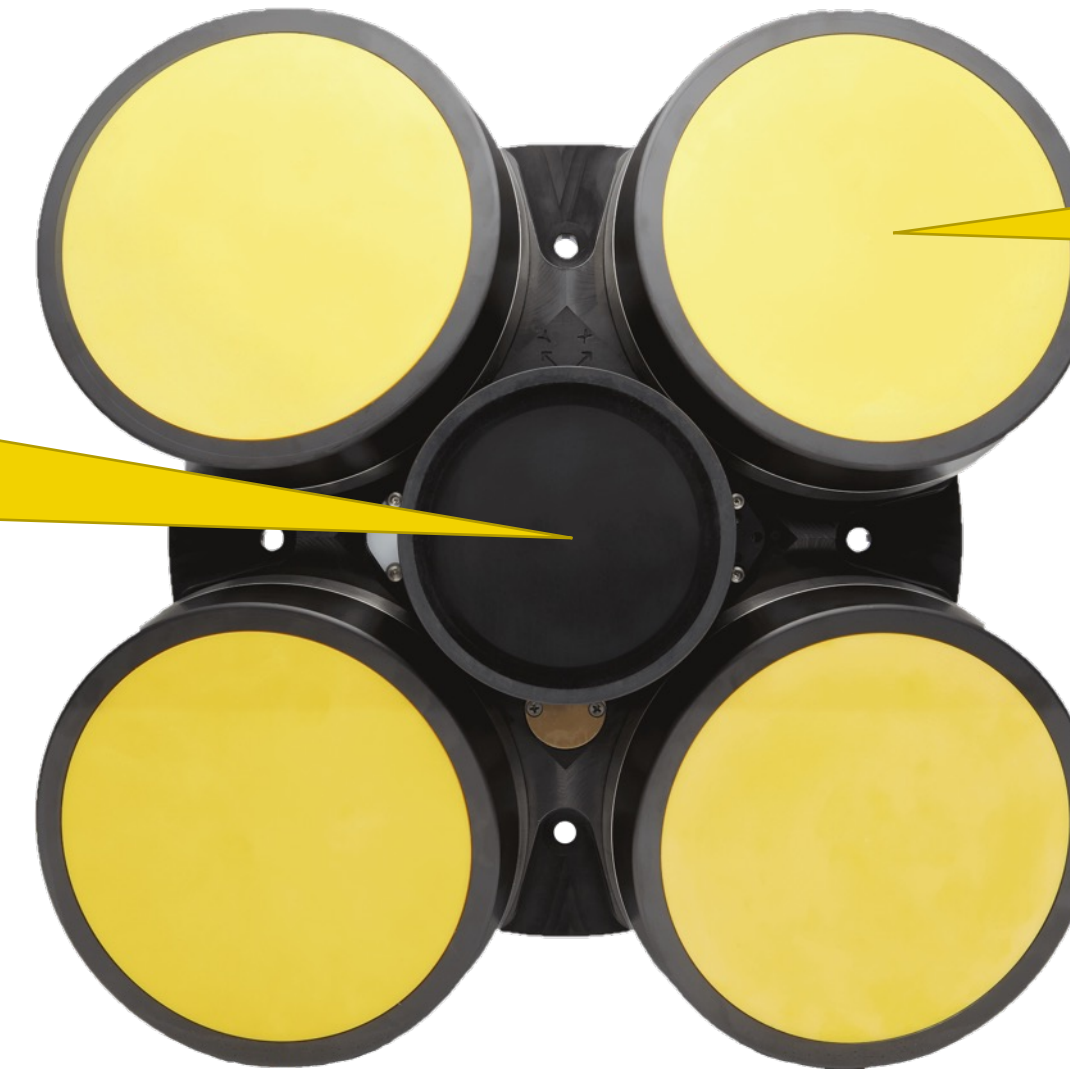




# System Description



Echosounder  
Multi-frequency



ADCP  
100 kHz

Echosounder Pulses	70 kHz	90 kHz	120 kHz
Type	Monochromatic	Monochromatic	Monochromatic
Bandwidth	2.9%	2.2%	1.7%

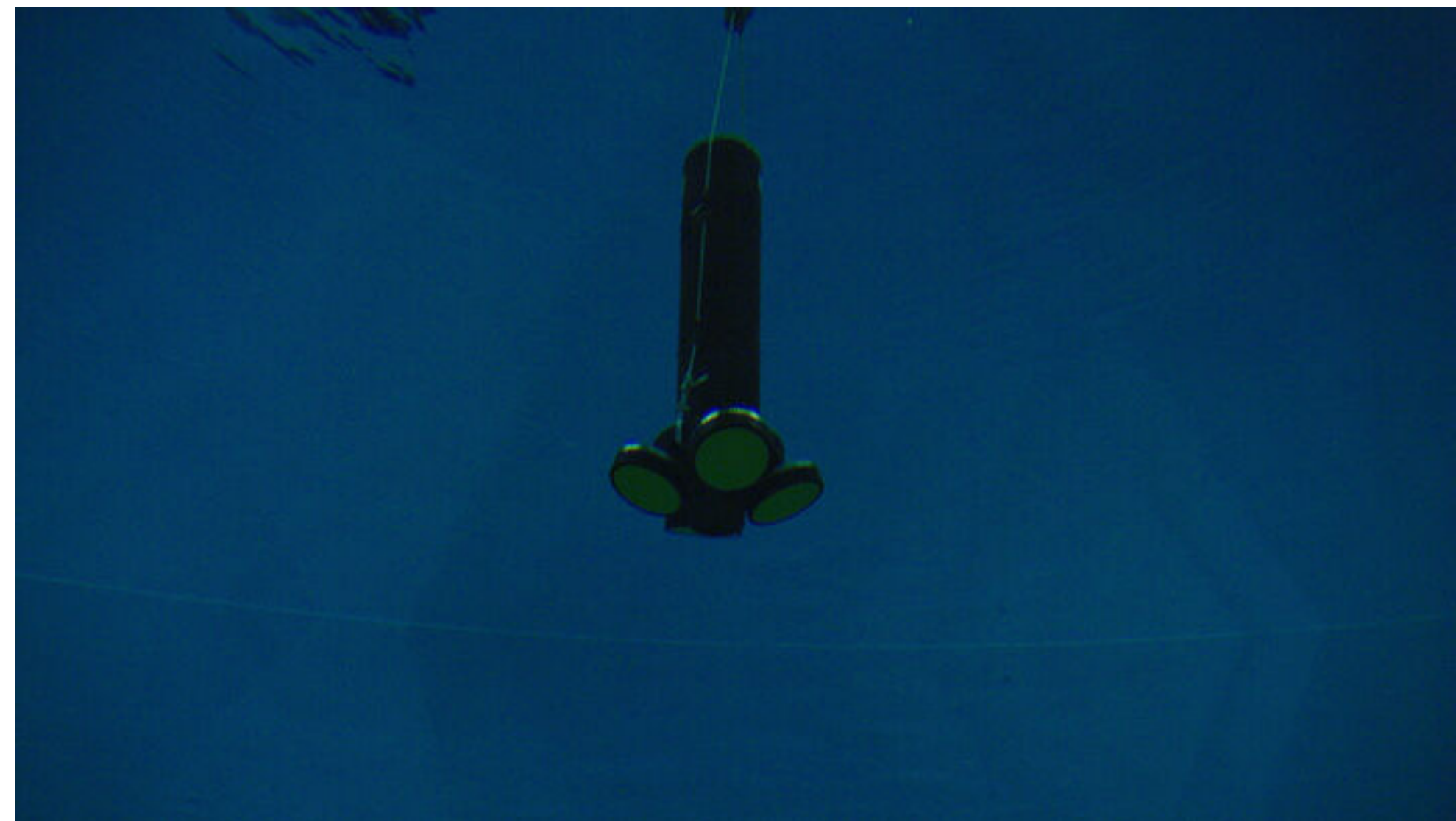
- Up to 3 echograms can be recorded (+ currents)
- Pulse Compression support with up to 5 frequency bands
- Demodulated I/Q (complex) data stored as an option





# NOAA Southwest Fisheries

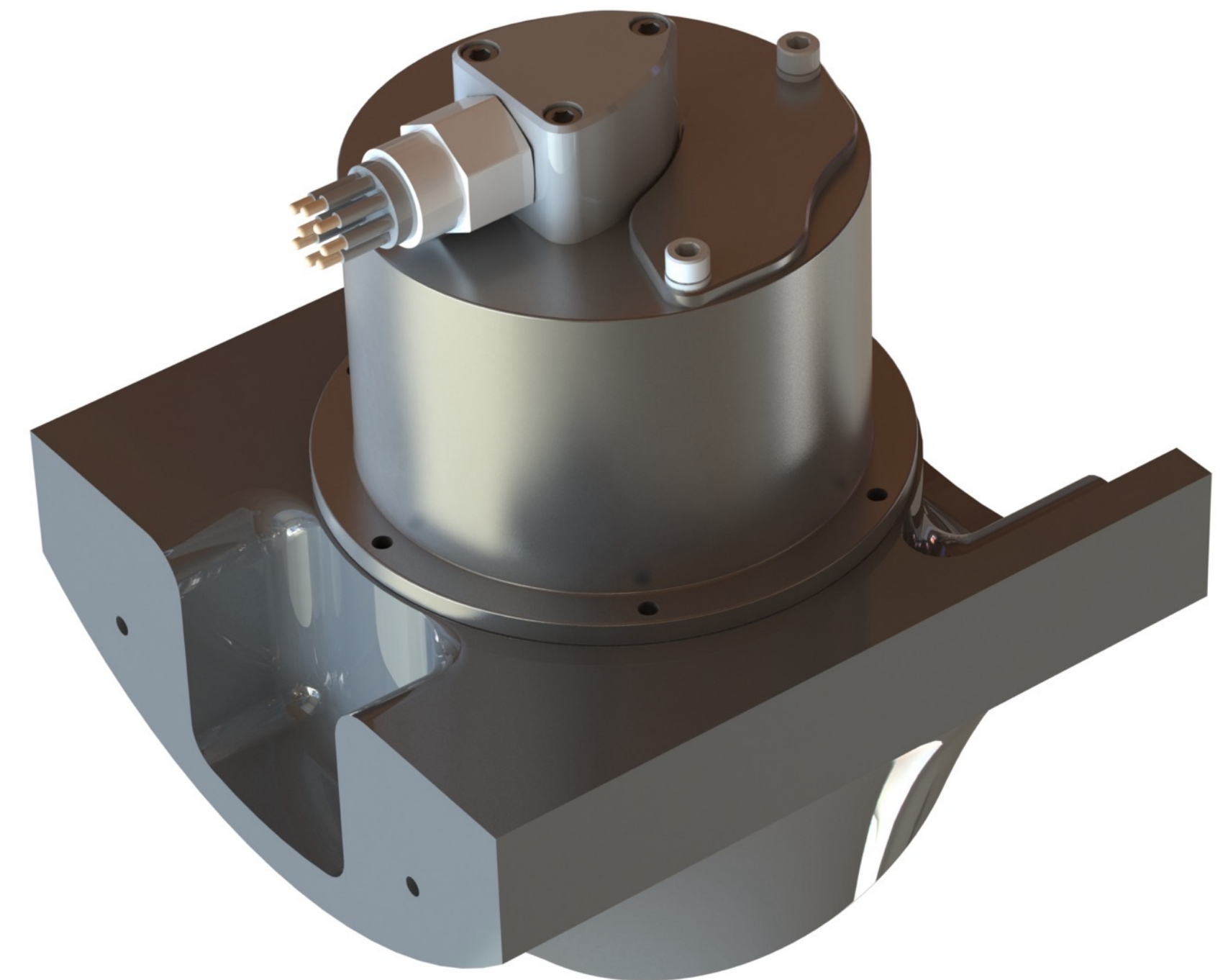
- Great success with Signature100 Echosounder
- Krill biomass estimates
- Interest in glider applications
- Contracted to build 4 echosounder glider units





# Creating the Glider Version

- 70-120kHz multifrequency
  - 70, 90, 120kHz pulses or a wideband linear chirp with 50% bandwidth centred at 90kHz, processed into 73.8, 82.3, 90.9, 99.4, and 107.9kHz
- 256GB SD card with telemetry output options
  - Telemetered diagnostic information sent to science bay
- 6 second sample rate, three ping sequences
- 1500m depth rating
- 300m sampling range
- Compact form factor and low power requirements
- Upward or Downward orientation possible, 23-degree angle
- Subconn connector for operation, dedicated ethernet (RJ45) connector covered by plate for data download after the mission
- Data readable by Nortek Ocean Contour software or Echoview software suites

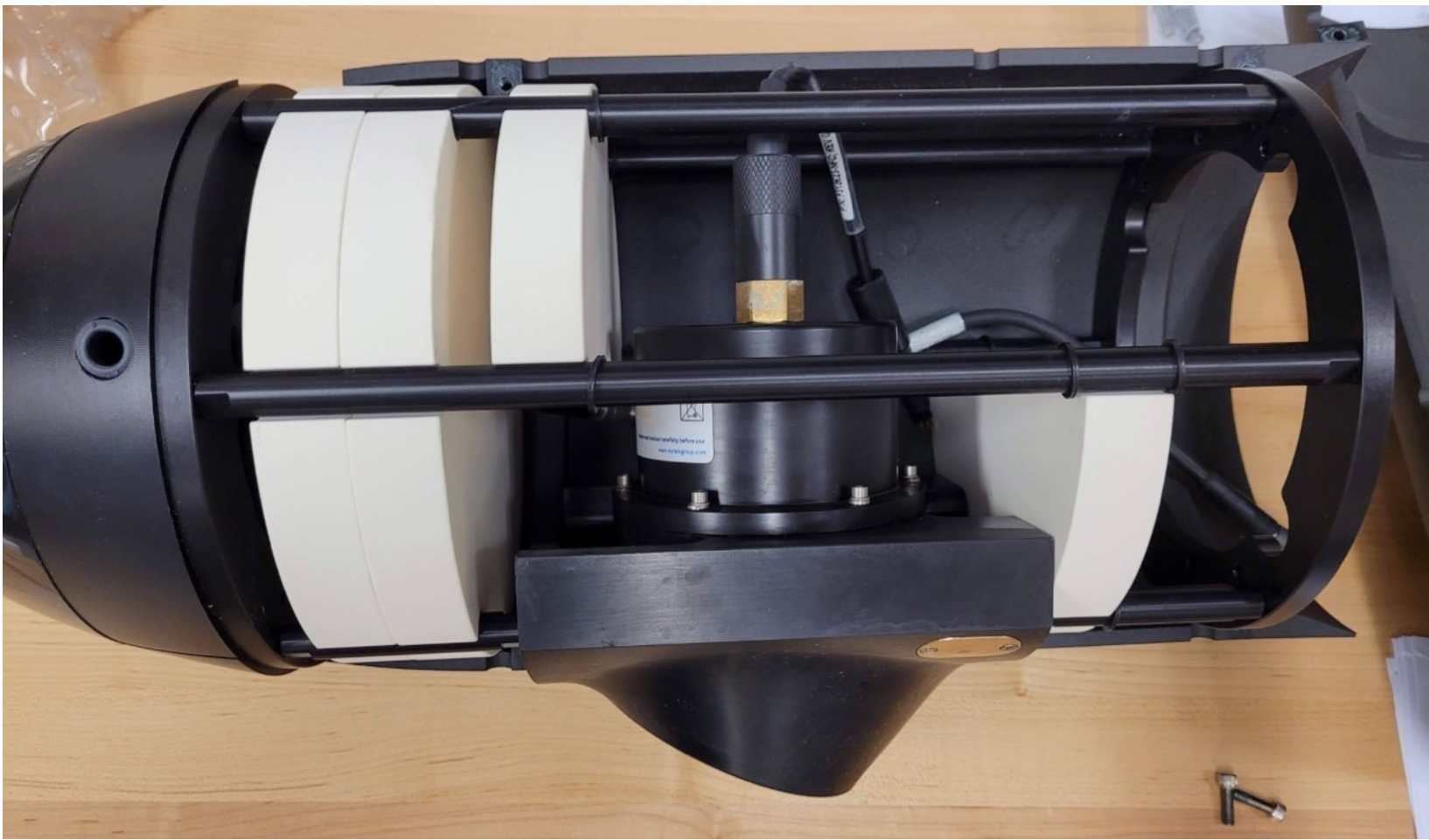




# Mechanical Integration

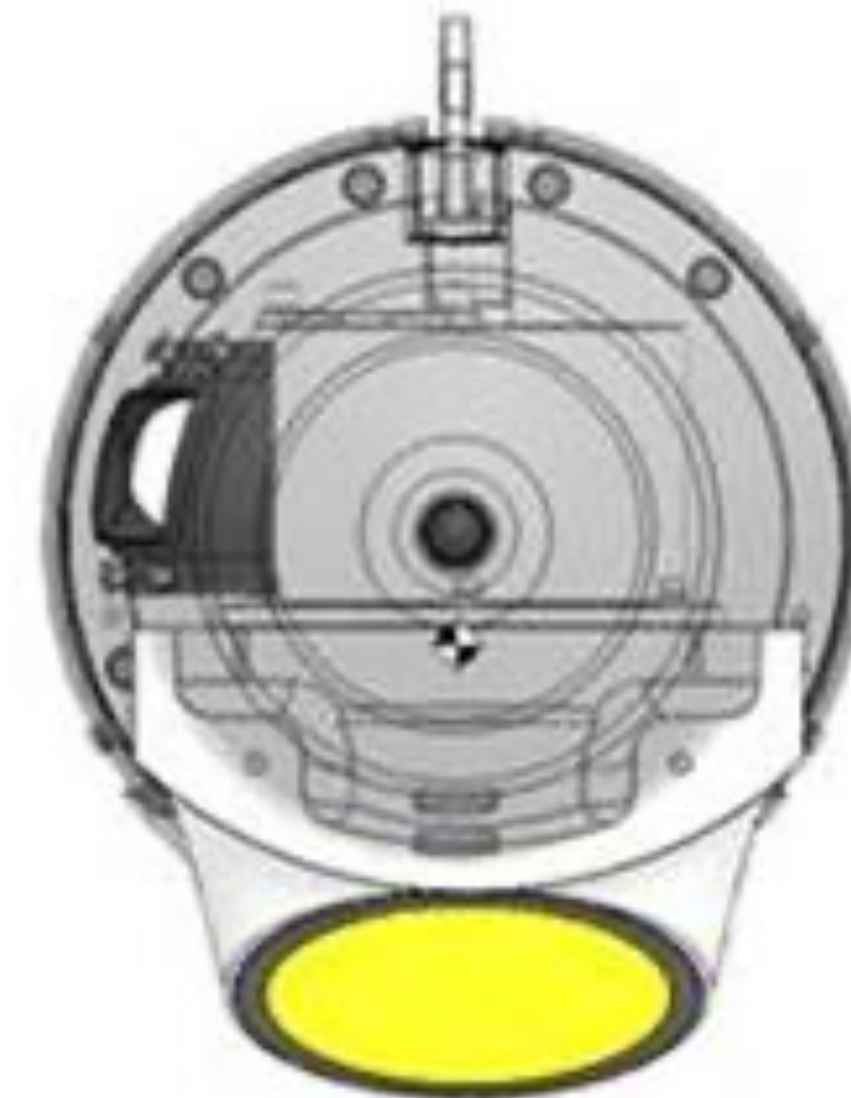
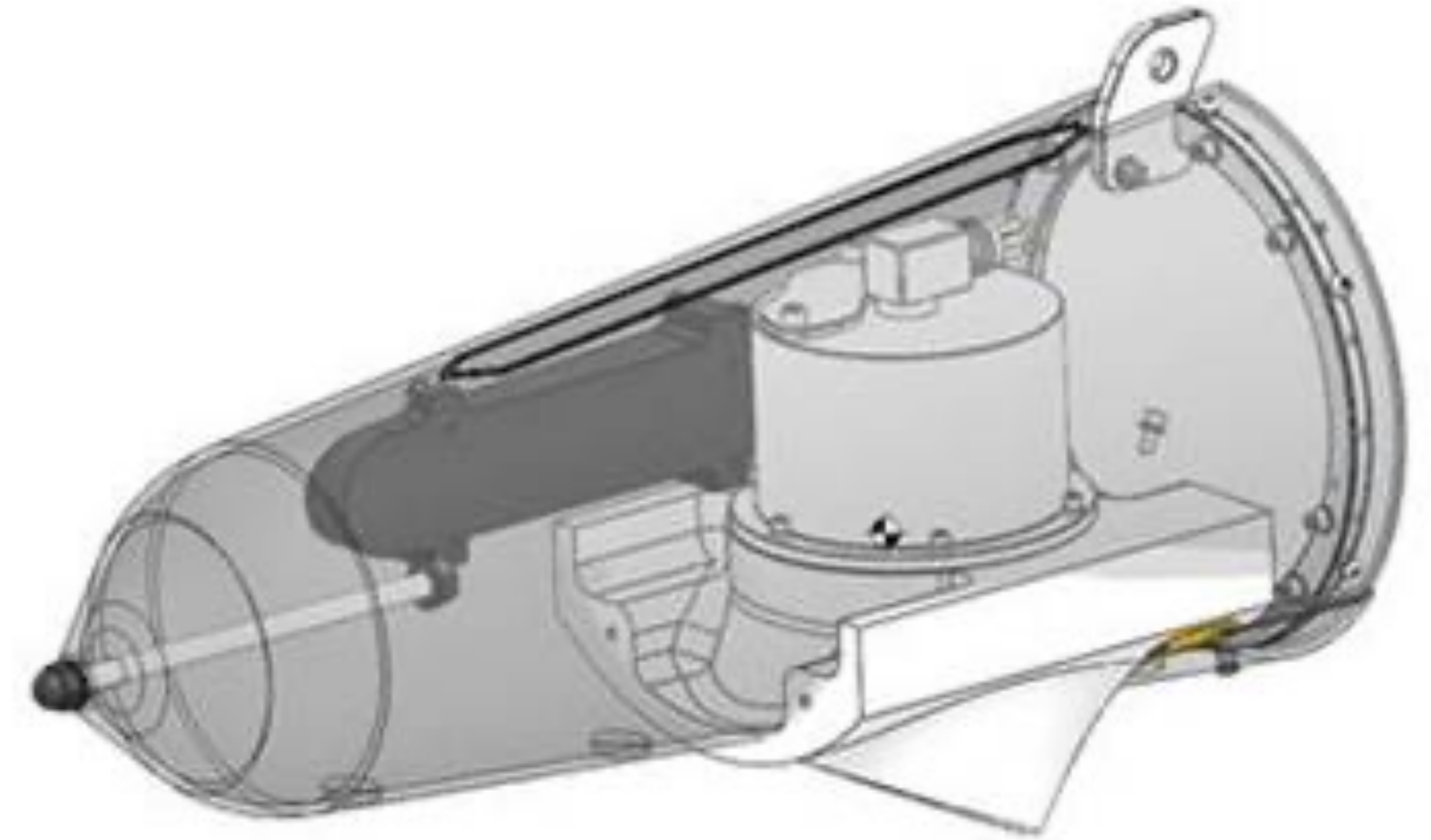
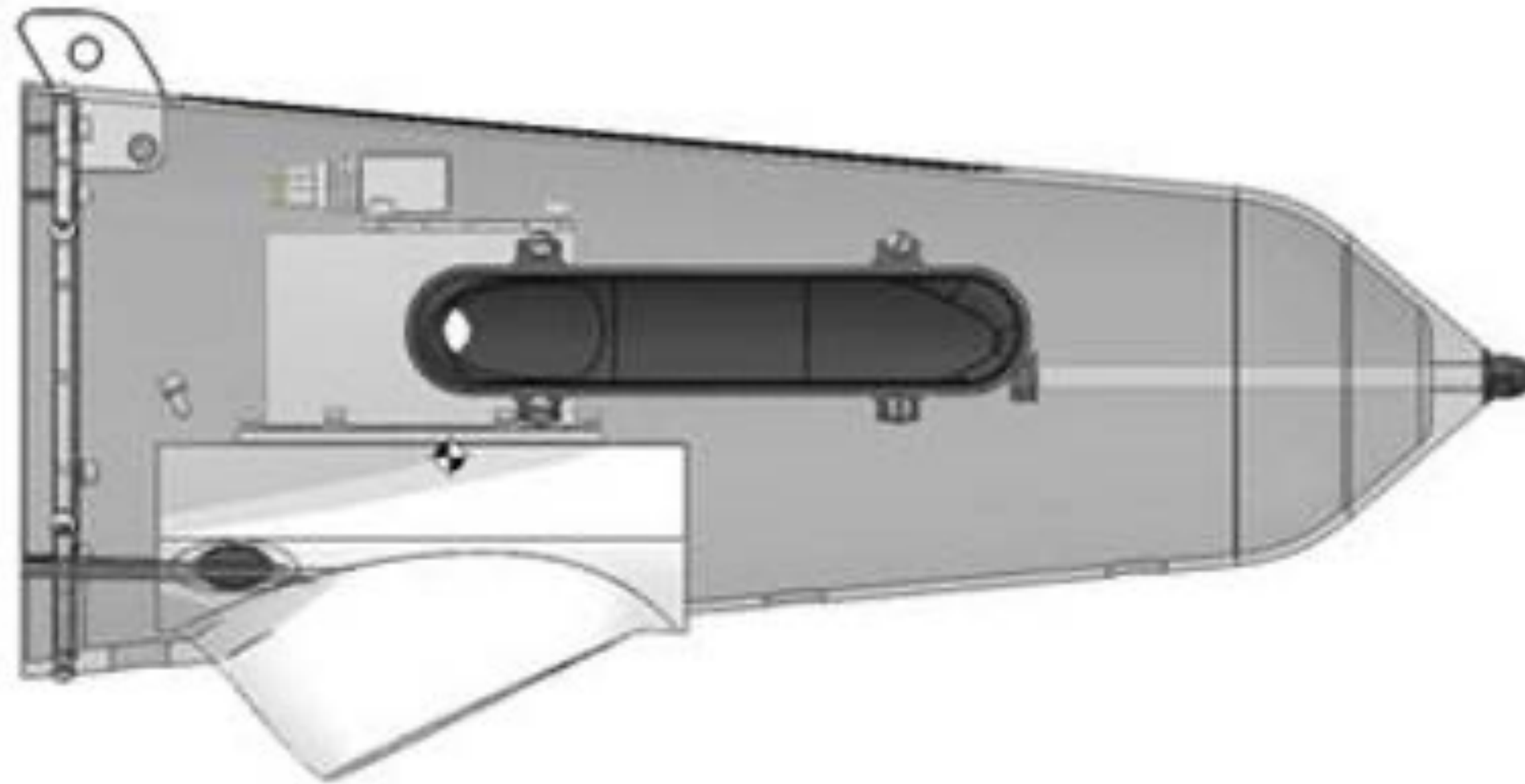


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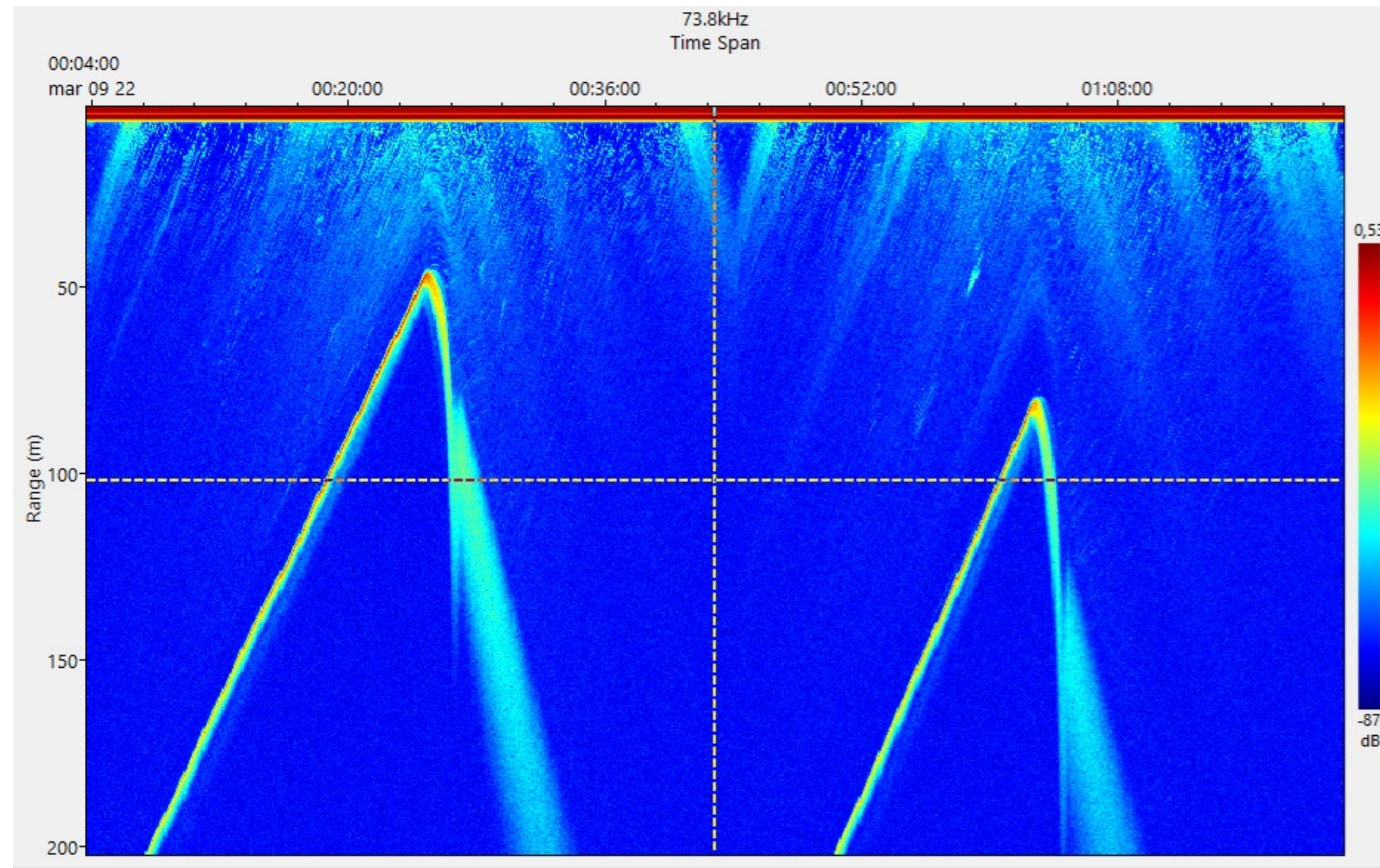


# Mechanical integration





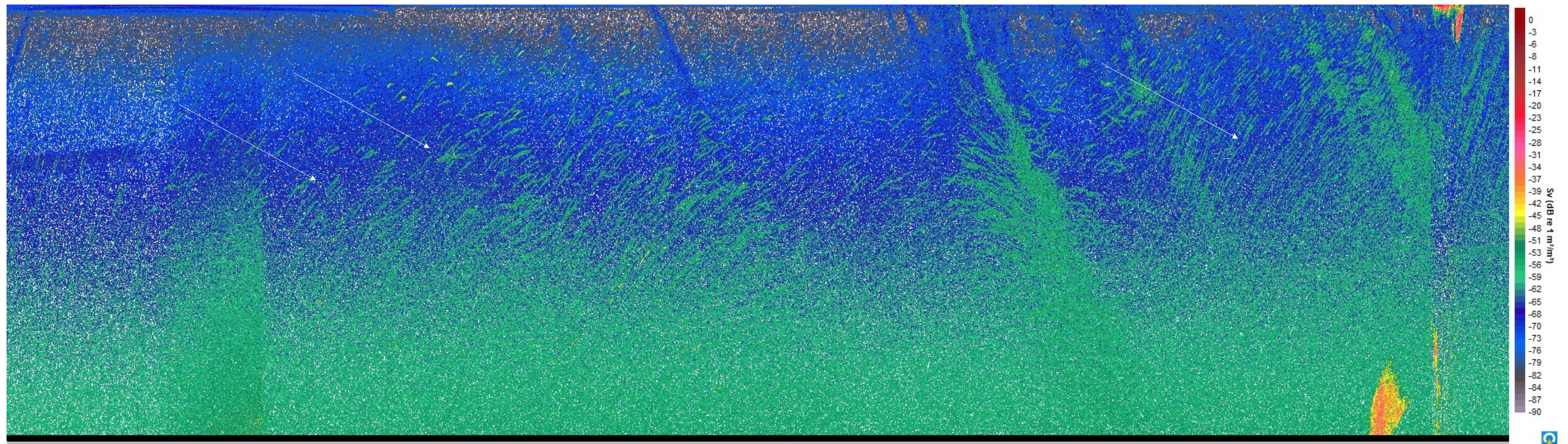
# NOAA Initial Data





# Dec 2022 70 kHz - Antarctica

Notice the small biology moving.

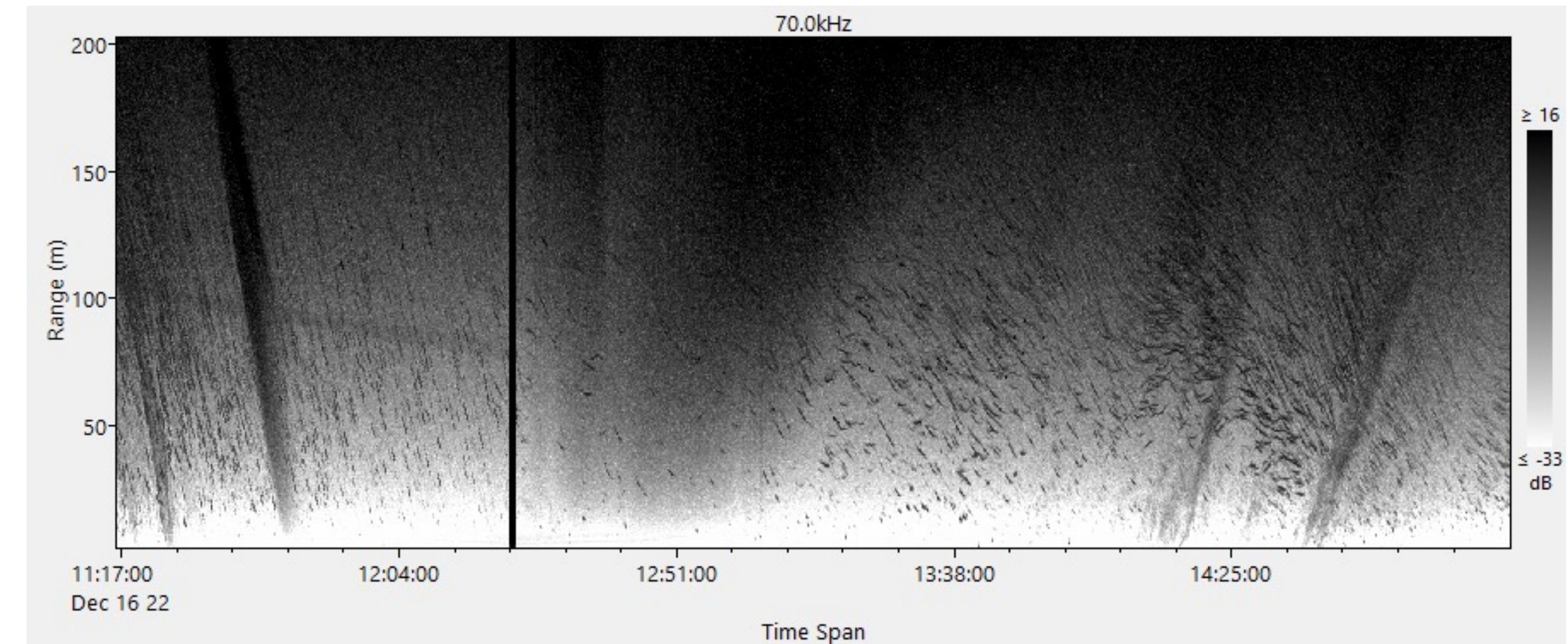
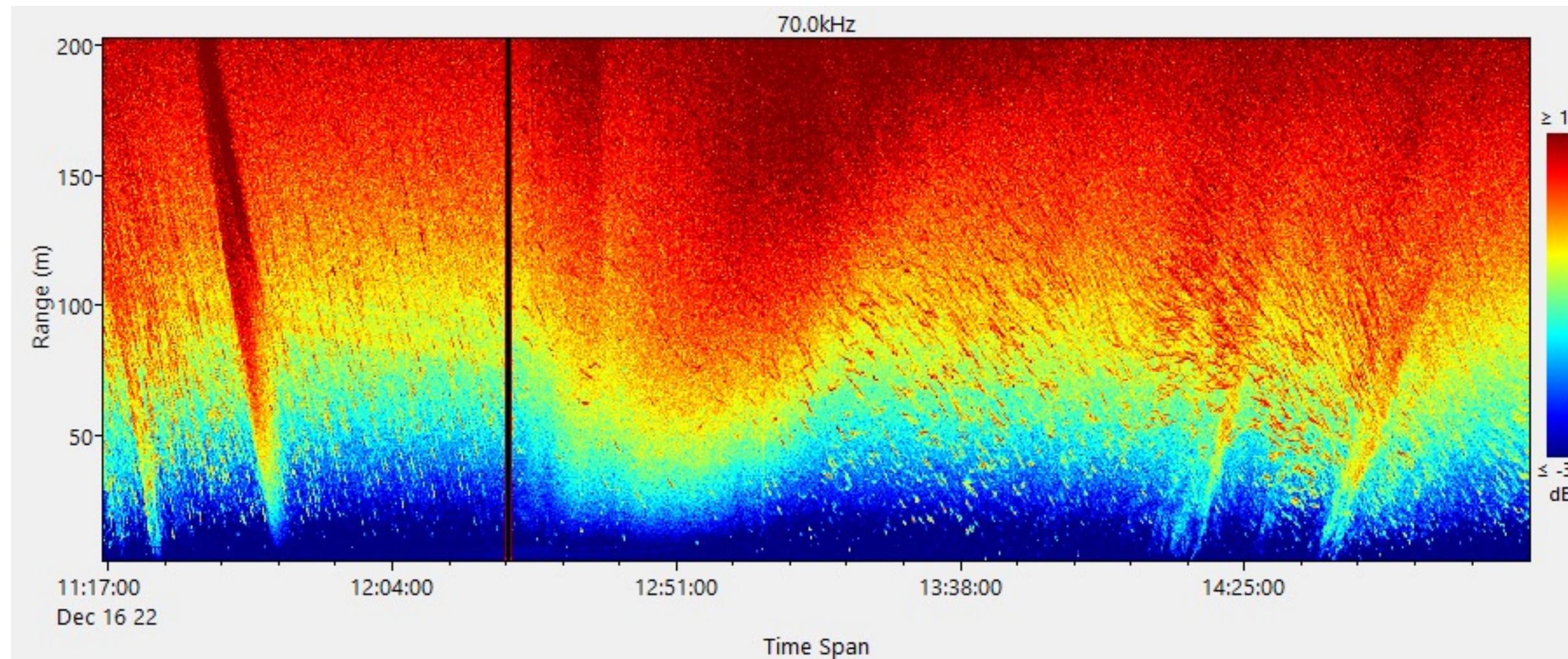


Courtesy of Christian Reiss and Anthony Cossio



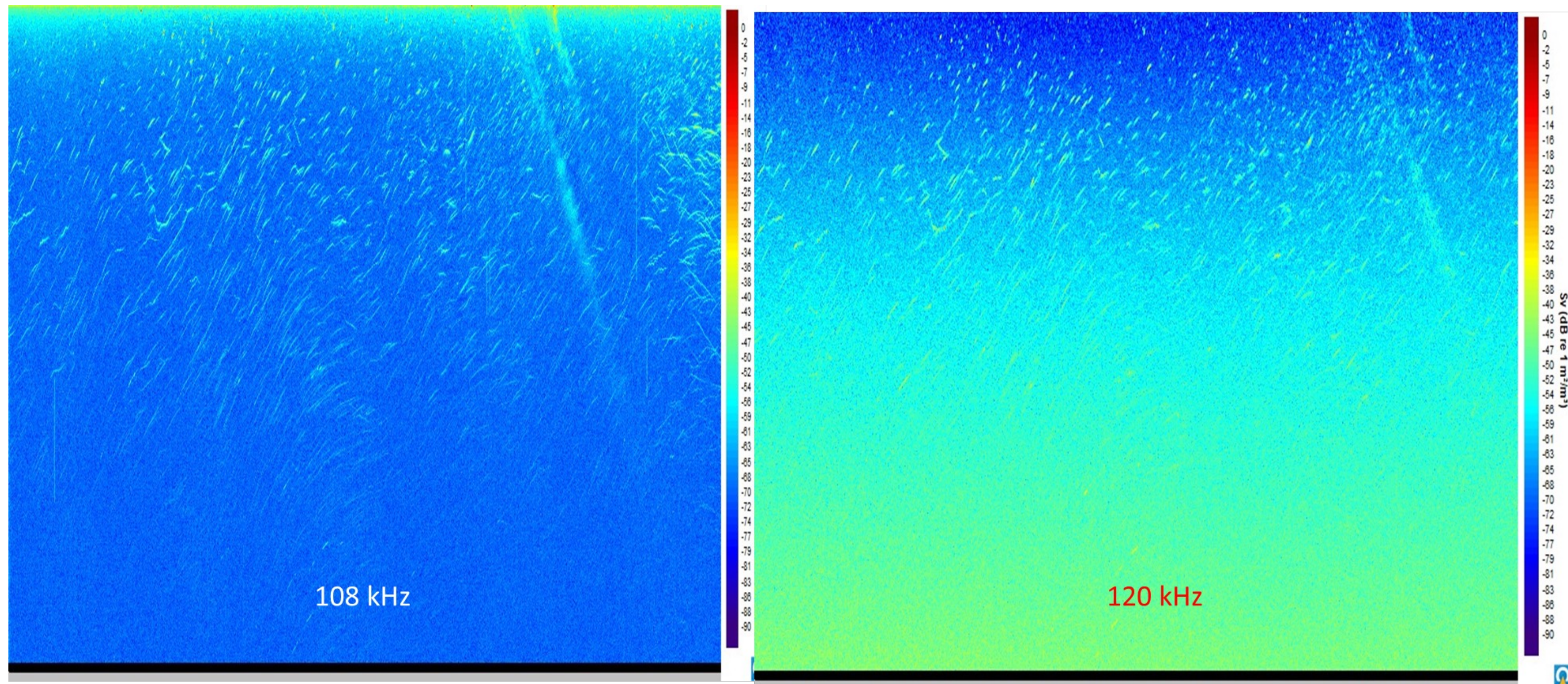


# Dec 2022 70 kHz - Antarctica





# Comparison



Courtesy of Christian Reiss and Anthony Cossio



# What is Nortek manufacturing for gliders?

- AD2CP Current Profiler / Echosounder
  - Small
  - Low power consumption
  - State of the art technology
  - Easy to integrate









# Thank you

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