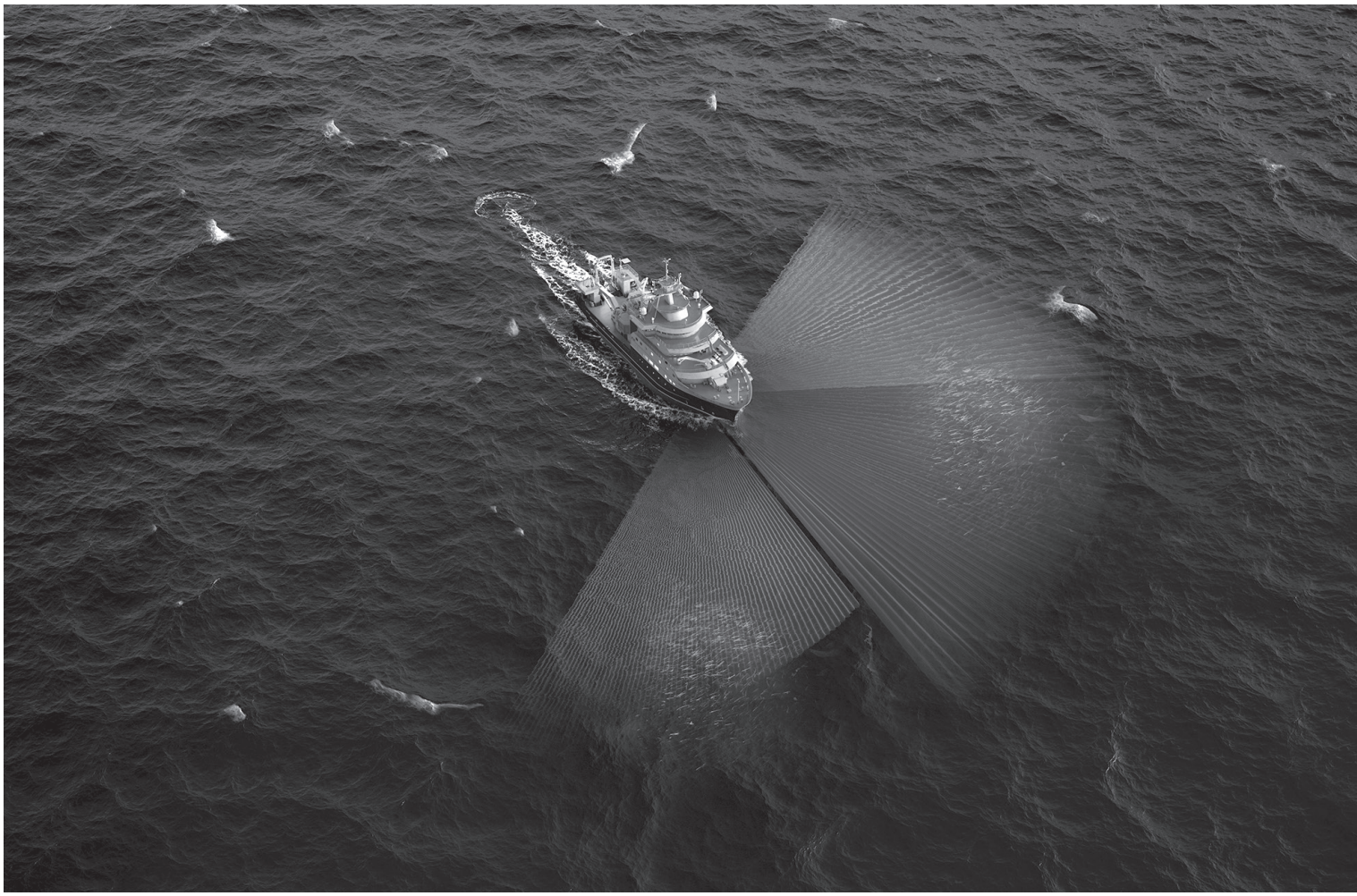
SIMRAD 70 YEARS 1947-2017

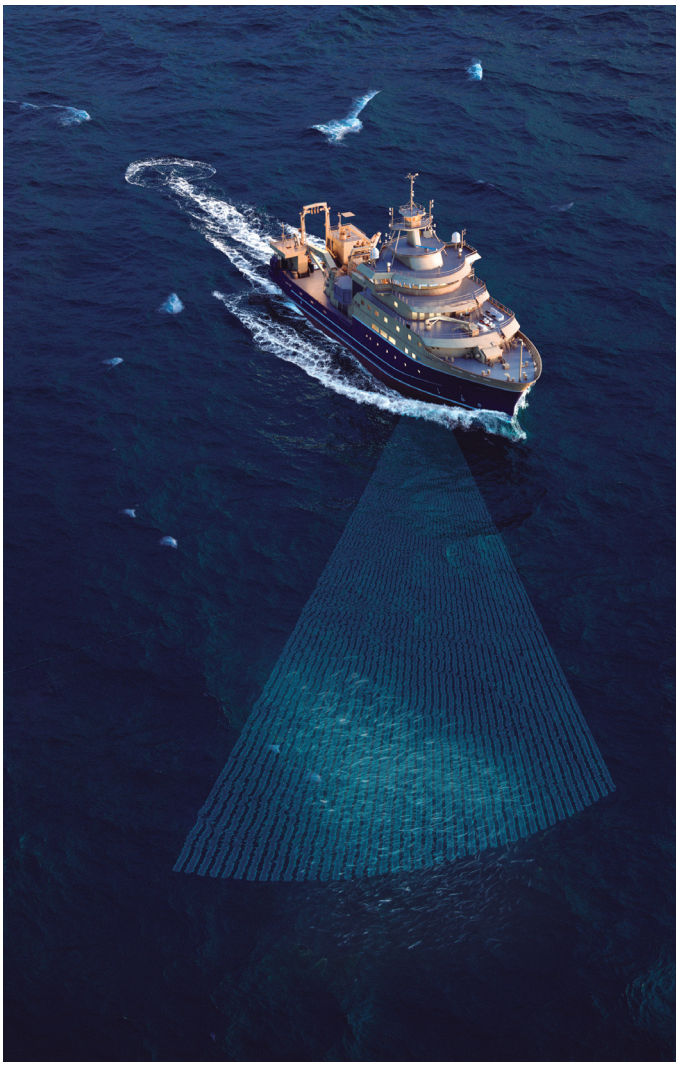
UNDERWATER SCIENCE

Multibeam Systems



TECHNOLOGY FOR SUSTAINABLE FISHERIES

SIMRAD ME SYSTEM



SIMRAD ME70 SCIENTIFIC MULTIBEAM ECHO SOUNDER

A scientific multibeam echo sounder can be seen as many EK sounders spread out in a fan of beams. Where the EK provides multifrequency analysis, the ME70 adds to the picture with morphology and volume information, improved horizontal resolution and in general, it samples more cubic of water along the survey line.

What makes the ME70 truly unique is that it combines the quantitative element from the split beam sounders with the resolution and the extended sampling volume from the multibeam world. As each beam is configured as split beam, standard split beam calibration techniques can be applied to the entire swath. When you have the system calibrated, you can both visualize and quantify your targets.

The combination of multiple, narrow beams with low side lobes strengthen your capability to measure targets in the acoustic dead zone close to the sea bottom. In addition to the obvious fish and marine mammals, other targets such as methane gas seeps and seafloor vegetation can be measured with calibrated backscatter values. The increased sampling volume from a swath system also addresses the acoustic dead zone in the upper layers of the water column as the fan of beams cover approximately 10 times the width compared to the 7° single beam.

MORPHOLOGY AND BEHAVIOUR

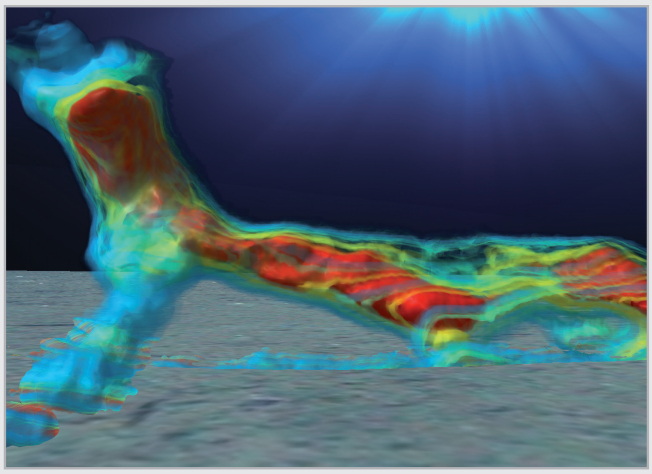
Much information can be derived from understanding the morphology of schooling fish. Perhaps most obvious; your estimation of the size on that particular school will improve. However, school morphology can also improve your species identification as various fish show different characteristics in the way they interact both within the school and together with the surrounding environment.

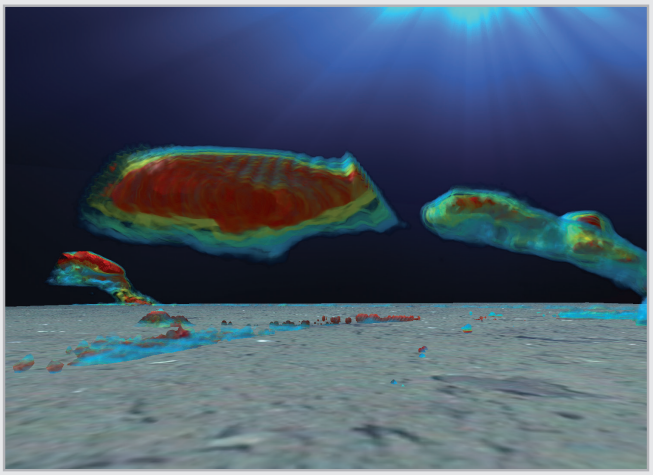
Predator/prey, or who is feeding on who, is also important information when you assess the ecosystem. The ME70 offers extremely low sidelobes and high dynamic range, something that is vital when it comes to measuring a fish close to bottom, or plankton near a school of fish. The two way side lobe suppression offered by the ME70 means that a school of fish will not be smeared out across the swath, but rather show the real boundaries of the school. The same applies for marine habitats where the bottom echo is the dominant scatterer. Thanks to the advanced beamforming and side lobe suppression techniques of the ME70, the bottom echo would not shadow other smaller targets.

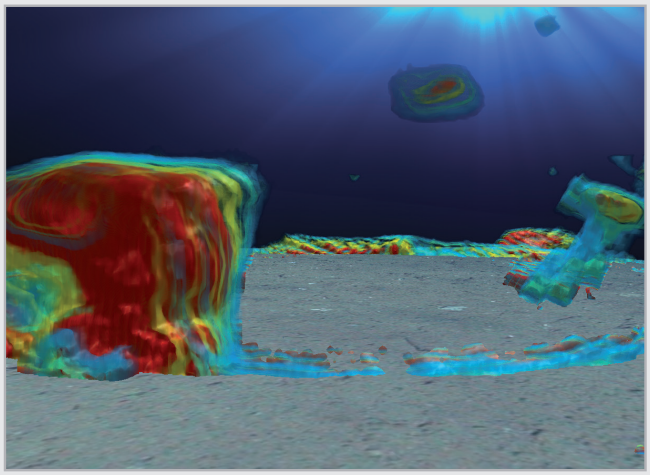
To investigate a complete marine ecosystem is a challenge. Using single beam acoustics can be compared with looking through a peephole, whereas the ME70 widens your vision and is more like looking through a window. The 3D information given by the ME70 adds spatial resolution and improves your stock assessment.

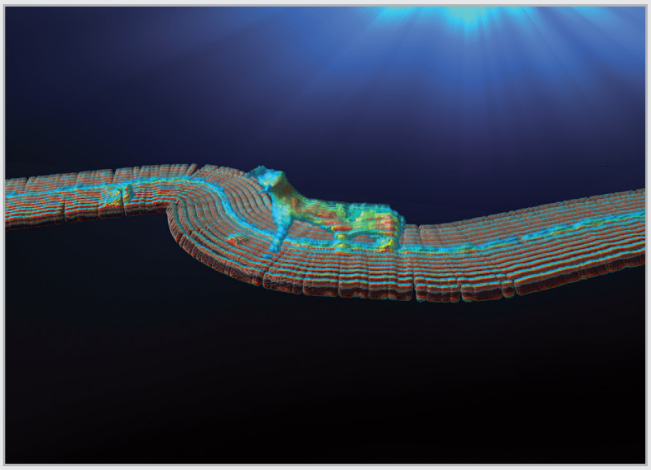
This picture shows a school of sand eel close to the bottom. The sand eel typically burrows in the sand to escape predators during daytime, while at night time it feeds on plankton and other small creatures. You can actually see how the school maintains contact with the sand even when the main population feeds in the water column. The only reason we can record such details near the bottom is the ultra-low sidelobes coupled with the advantages of frequency rotation between the beams.

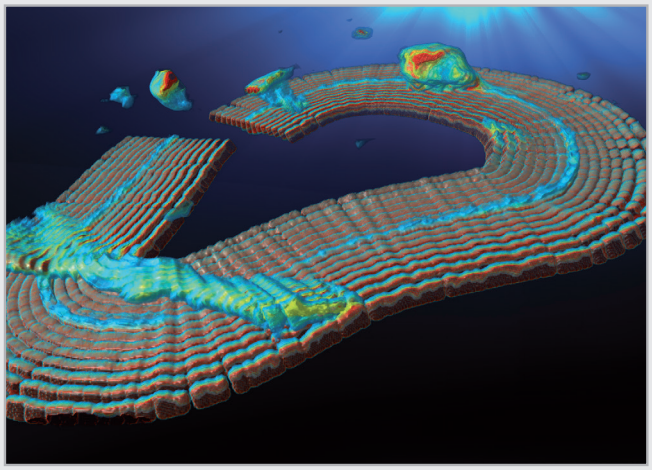
This data were recorded with the ME70 and has since then been processed and visualized by a third party software. As with all SIMRAD RAW data, the ME70 data format is open and well documented.









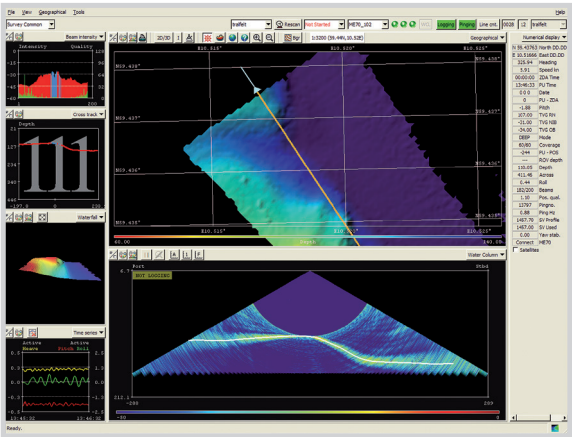


ME70 BATHYMETRIC OPTION

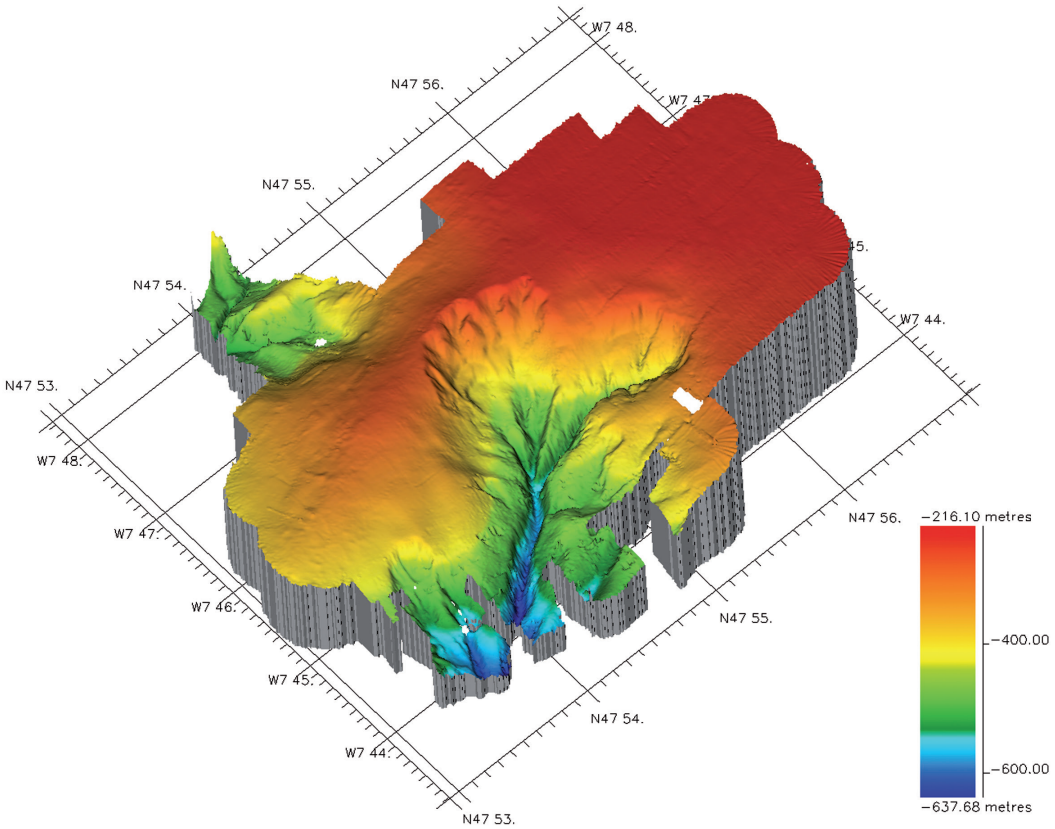
The seafloor is an important component of the marine ecosystem. Perhaps you are looking at vegetation that grows on the bottom or fish that thrive near the bottom. Or perhaps the bottom structures themselves are of interest to the assessment such as presence of coral reefs in the area.

The advantages of using a multibeam system when studying the seafloor are obvious, multiple detection points from an array of narrow beams are better than a single, wide beam. With the introduction of the ME70 scientists can now survey the seafloor while doing quantitative studies for biology at the same time. The ME70 is calibrated with a sphere with known target strength, and backscatter data can therefore be compared across various study areas.

If you want one multibeam system to do both quantitative water column work and bottom mapping, the ME70 is your only logical choice. The system can provide IHO S44 Order 1 data, and fulfils the demanding LINZ order 1 survey specification to be met in full. The bathymetric system includes a special bathymetric processor unit for bottom detection, ray tracing, extra motion correction, and x,y,z data generation developed by the hydrographic department of Kongsberg Maritime.



Kongsberg's own Seafloor Identification System (SIS) is also included in the delivery, adding an extensive set of graphical displays for data quality control, as well as system calibration, data cleaning, gridding, and visualization.



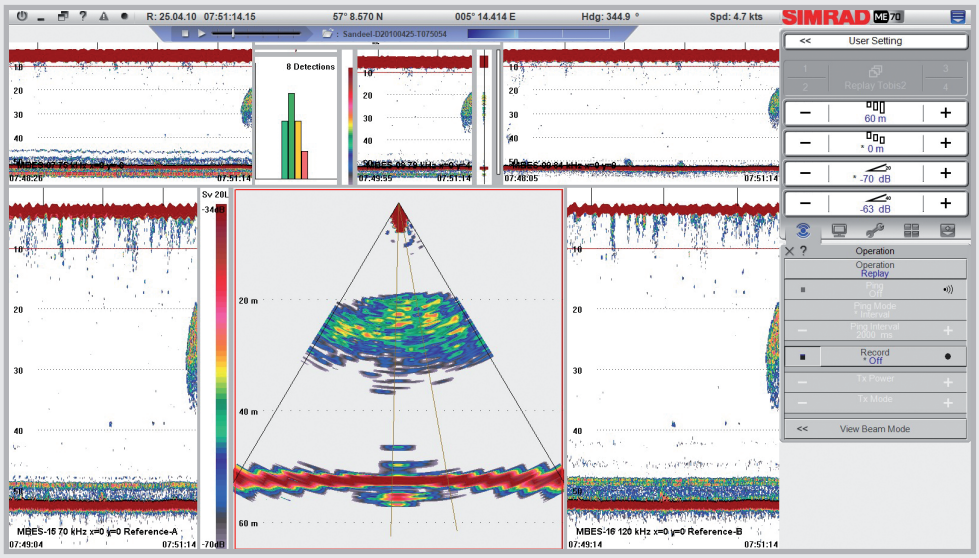
EXTERNAL SENSORS AND GEOMETRICAL MEASUREMENTS OF VESSEL

The multibeam echo sounder needs the following information from external sensors to function correctly:

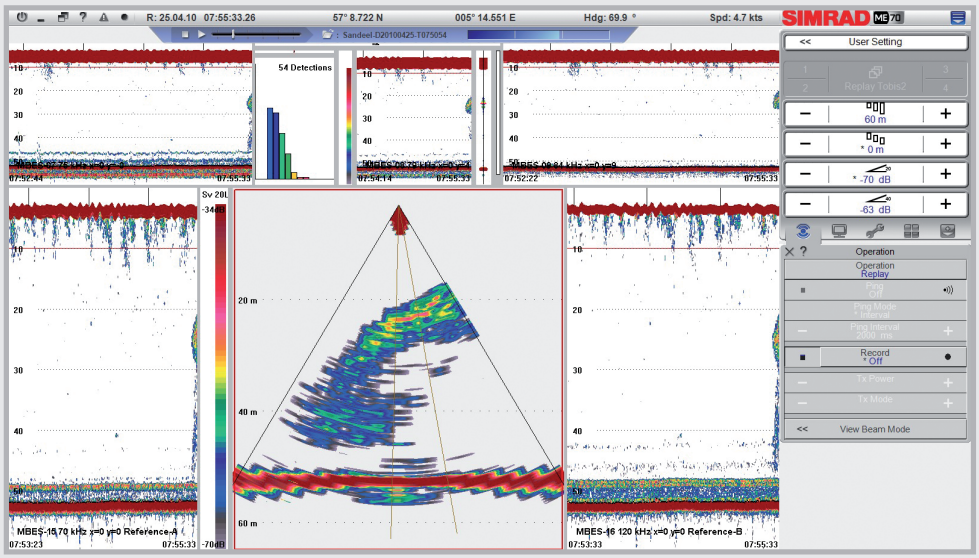
- Position
- Heading
- Vessel motion: pitch, roll and heave
- Sound velocity at the transducer depth
- Sound velocity profile through water column
- Potentially others, such as very accurate time stamp

Which sensor to use depends on the survey requirements. Kongsberg Maritime's Seapath 300 family provides a combined motion sensor and GPS that produces position, heading, and vessel motions from one integrated device. Upon request, we can suggest external sensors that fulfill the particular survey needs.

It is also recommended to do a very accurate measurement of the vessel including transducer position inside the hull. The need for accuracy varies with user need, but we always recommend to use land surveying techniques that can be performed by third party companies.

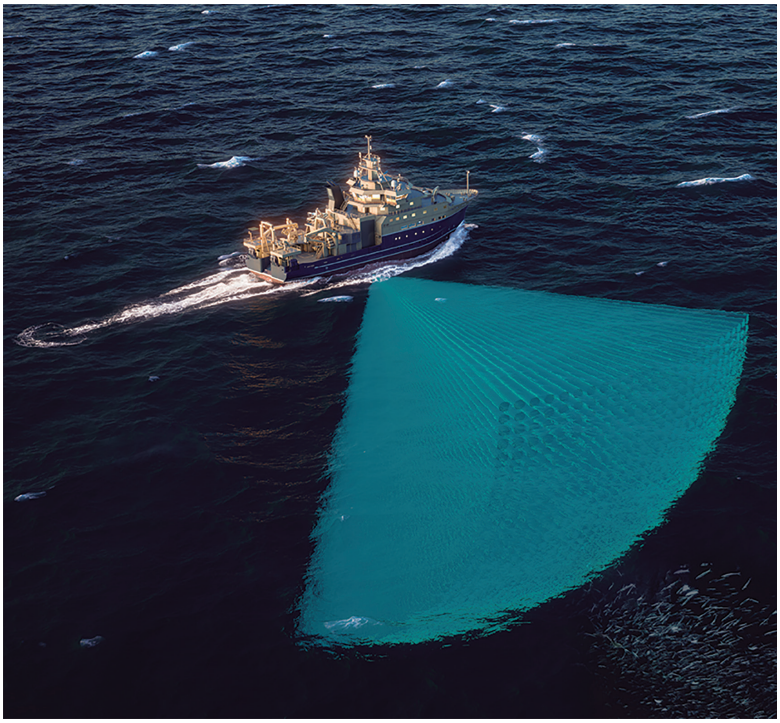


Here we have a screenshot from the ME70 acquisition software. On the centre of the image we see the combined swath of beams athwartship. The software is flexible: it not only shows the individual beams of your choice, but you can also see split beam information, such as size, from each beam.



In this screenshot we can see another school, but this one displaying very different schooling behaviour. Understanding the school's morphology has never been so easy.

SIMRAD MS70 SCIENTIFIC MULTIBEAM SONAR

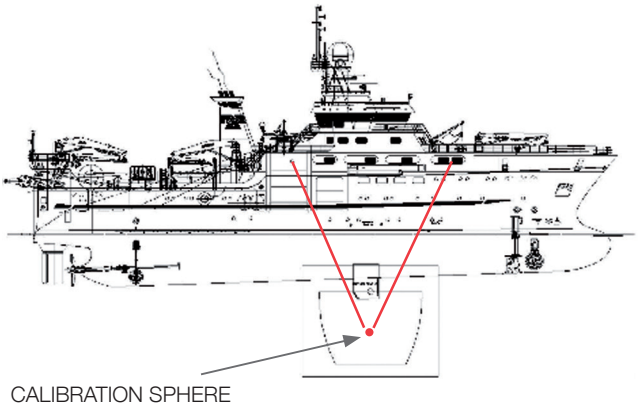


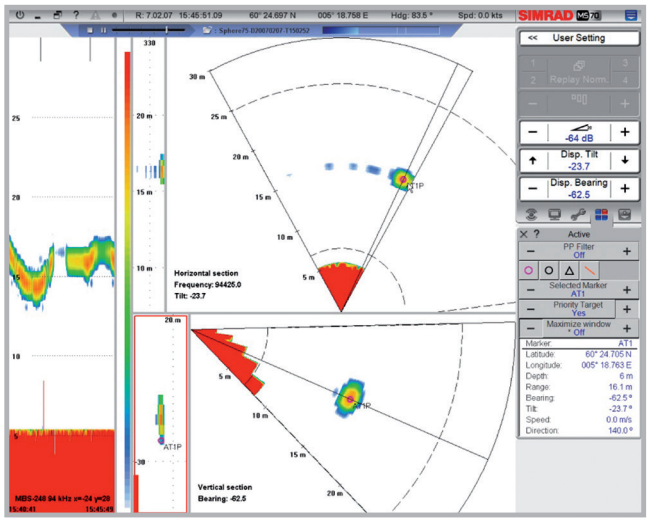
The MS70 provides an acoustic matrix of stabilized and calibrated beams for biomass estimation and study of school behaviour. Advanced beam forming is used to form 500 beams, spread out 60° horizontally by 45° vertically. As a result of this optimized horizontal transmission of narrow beams, the MS70 allows the user to detect and characterize schools of fish even very close to the sea surface.

Where the ME70 adds a third dimension to your survey, the MS70 adds a 4th dimension. When you add up distance, vertical and horizontal swath of beams in addition to time from multiple transmissions, in reality what you have is an acoustic camera. As a school of fish changes shape and density constantly, the MS70 is the best possible tool to understand these dynamics with remote sensing.

As with all Simrad scientific systems, a calibration utility is implemented as a special built-in function in the SW. The sonar is calibrated using a reference sphere that needs to be located on the side of the ship.

During the calibration process, the MS70 automatically generates 500 split beams in order to measure the target position within each beam. Individual gain parameters for each beam are adjusted to provide calibrated target strength and volume backscattering strength.



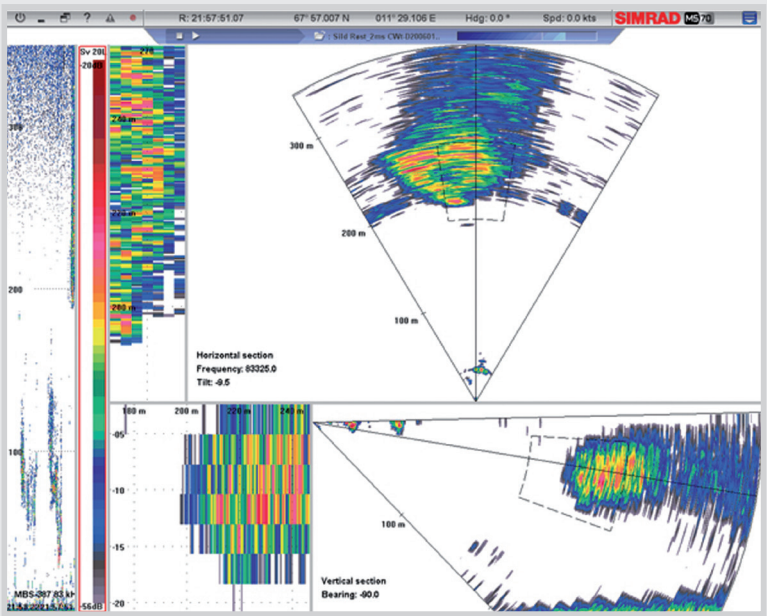


THE CHALLENGE OF STUDYING SCHOOLING FISH CLOSE TO SURFACE

Low sidelobes are important for at least two reasons. The obvious one is to avoid that a strong target in the side lobes are mistaken for weak targets in the main lobe. Secondly, you do not wish to see strong bottom echoes from the sidelobes.

Surface is a very strong reflector, and the two-way vertical side lobe suppression of the MS70 secures that reflections from the surface does not contribute to the school estimate. Also, the frequency band of the system is distributed out across the matrix, with minimal leakage between the many beams.

The frequency bandwith is distributed between the 500 beams.



This screenshot shows a school of herring. Even though the MS70 detects and records data from all 500 beams, only two sectors can be shown in a traditional 2D view. One is a horizontal slice, while the other is a vertical slice through the matrix. In addition to that, you can have a zoon view and an echogram from the single beam shared by the two sectors.

SIMRAD TD SOFTWARE

SIMRAD TD50 MULTIBEAM 3D VISUALIZATION SOFTWARE

The Simrad TD50 enables live streaming of 3D data generated by scientific multibeam systems. The Simrad TD50 software reads the incredibly clean raw data from the ME70 and MS70 in real time, and delivers accurate live visualisation of the oceanspace beneath the vessel to the scientific lab as well as any other location onboard wtih network access. Previously this data had to be post-processed before the 3D potential of the system was realised.

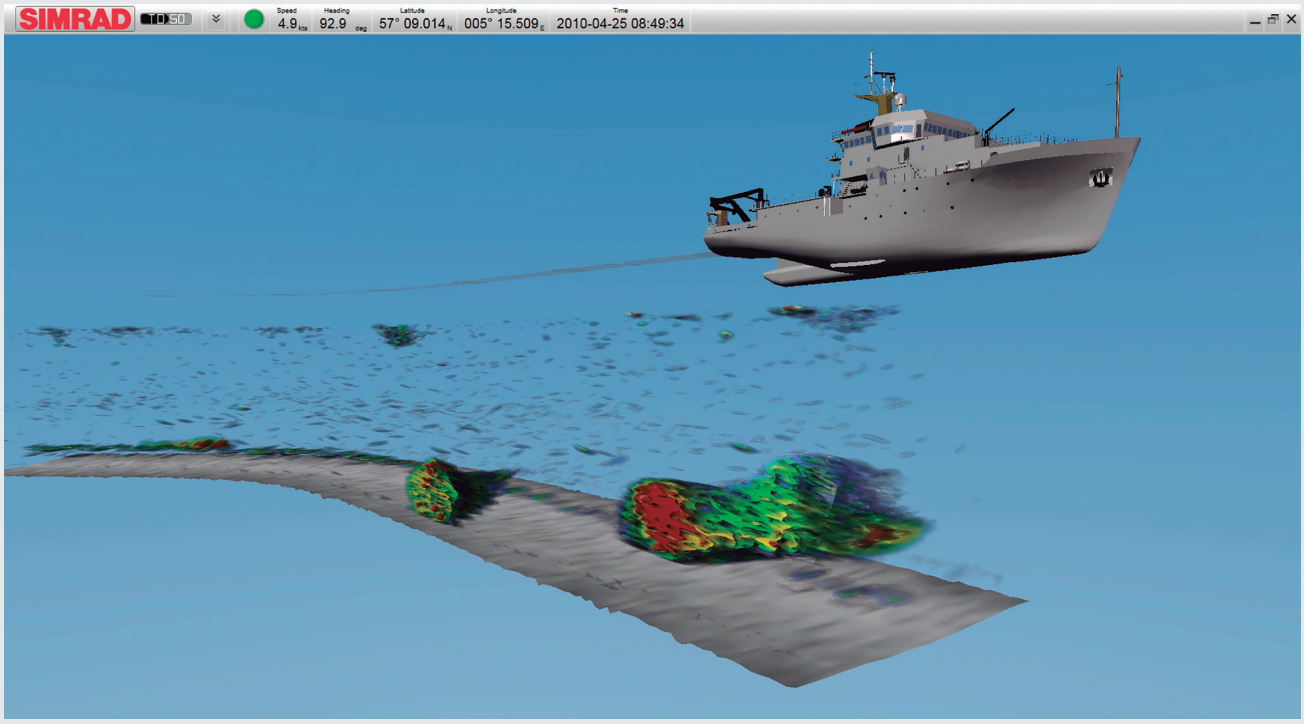
Accurate 3D visualisation gives users a better understanding of the marine ecosystem by i.e. enabling precise measurement of schools of fish rather than estimating size and shapes based on models. Additionally, 3D view of bottom topography and the relating bottom habitats further enhances the understanding of the marine ecosystems. When accurate 3D visualisation is delivered in real-time, the benefits are significant.

The TD50 provides researchers and vessel crew with a highly effective decision tool, allowing for informed decisions to be taken immediately.

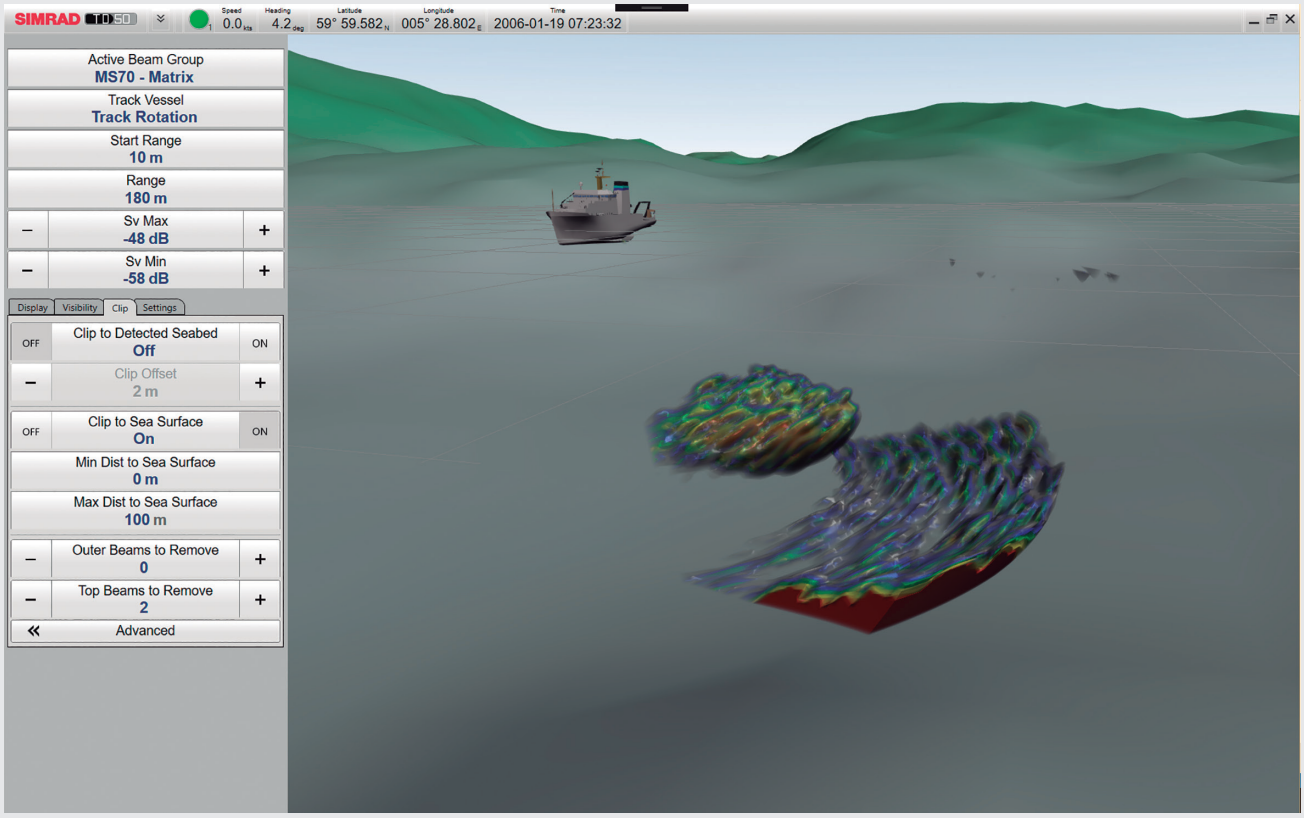
The system is especially relevant to projects using adaptive sampling, as the live 3D stream of the survey area enables researchers to see specific attributes as the vessel passes over them, allowing action for further inspection to be taken immediately.

SITUATIONAL AWARENESS

The live 3D stream can be delivered to multiple locations on board which allows for better interaction between scientists and the vessel operators. This is typically important in demanding operations where the vessel interacts with objects in the water column. Research vessels engaged in active sampling of biology such as trawling can also improve their capabilities, with the Simrad TD50 system effectively providing a 'long range camera' below the surface.



The Simrad TD50 Multibeam 3D Visualisation Software is shown presenting sand eels on sand bottom. The raw data is taken from the Simrad ME70 Scientific multibeam echo sounder on M/S Simrad Echo.

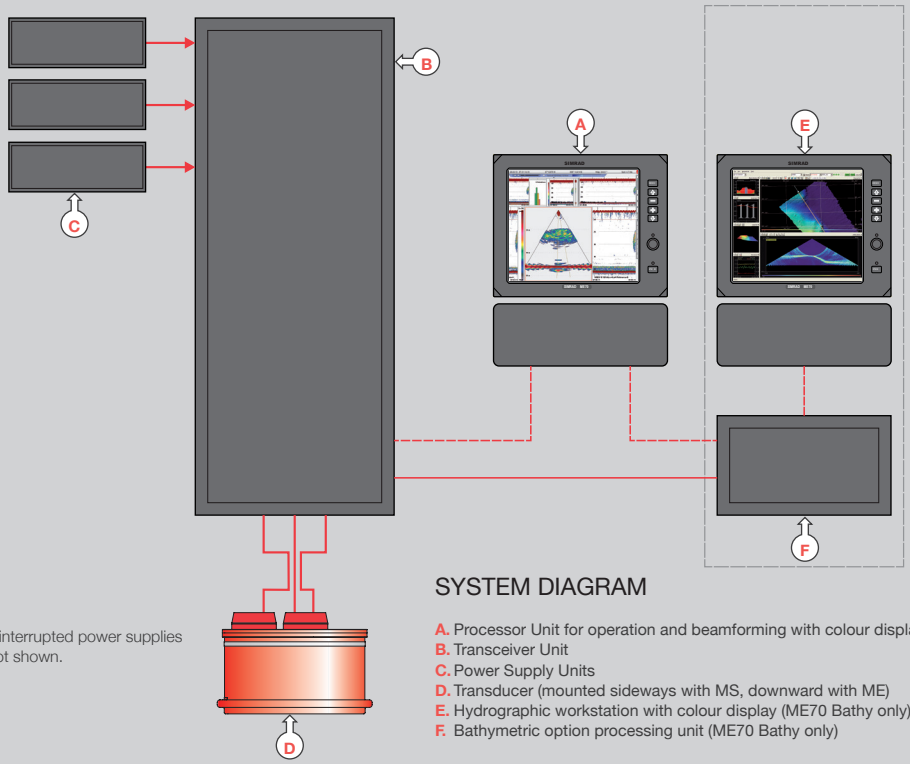


The TD50 can also import and display a chart overlay. This picture shows TD50 with MS70 data, Vessel, a school of fish and bottom backscatter is shown to give full situational awareness.

MULTIBEAM SPECIFICATIONS

	ME70	ME70 BATHY MODE	MS70
Beam organization	Fan		Matrix
Operating sector	2 to 140°	120°	60° x 45° (H x V)
Minimum beamwidths	2° x 2°	3° x 2° (along x athw.)	4° x 3° (H x V)
Operating frequency	70-120 kHz		75-112 kHz
Max no. beams	45 split beams	81 split beams	500
Beam stabilization	Roll & pitch		Roll
SIDELOBE SUPPRESSSION			
Sidelobe levels	-35 to -70 dB	-35 x -25 (along x atw.)	H: -35 dB, V: -25 dB
Pulse duration	64 to 5120 µs	64 to 5120 µs	2-10 ms
DYNAMIC RANGE			
Max. source level	225 dB	216 dB	206 dB
TRANSCEIVER UNIT			
TX/RX channels	800 individual channels		
Modulation	CW or chirp		
Communication	2 x 1 Gb Ethernet lines		
Physical size	1200 x 600 x 900 (H x B x D)		
TRANSDUCER UNIT			
Number of elements	800 individual elements		
Material	Ceramic polymer composite		
Physical size	Circular, 670 mm, H; 400 mm		

SIMRAD SCIENTIFIC MULTIBEAM SYSTEMS



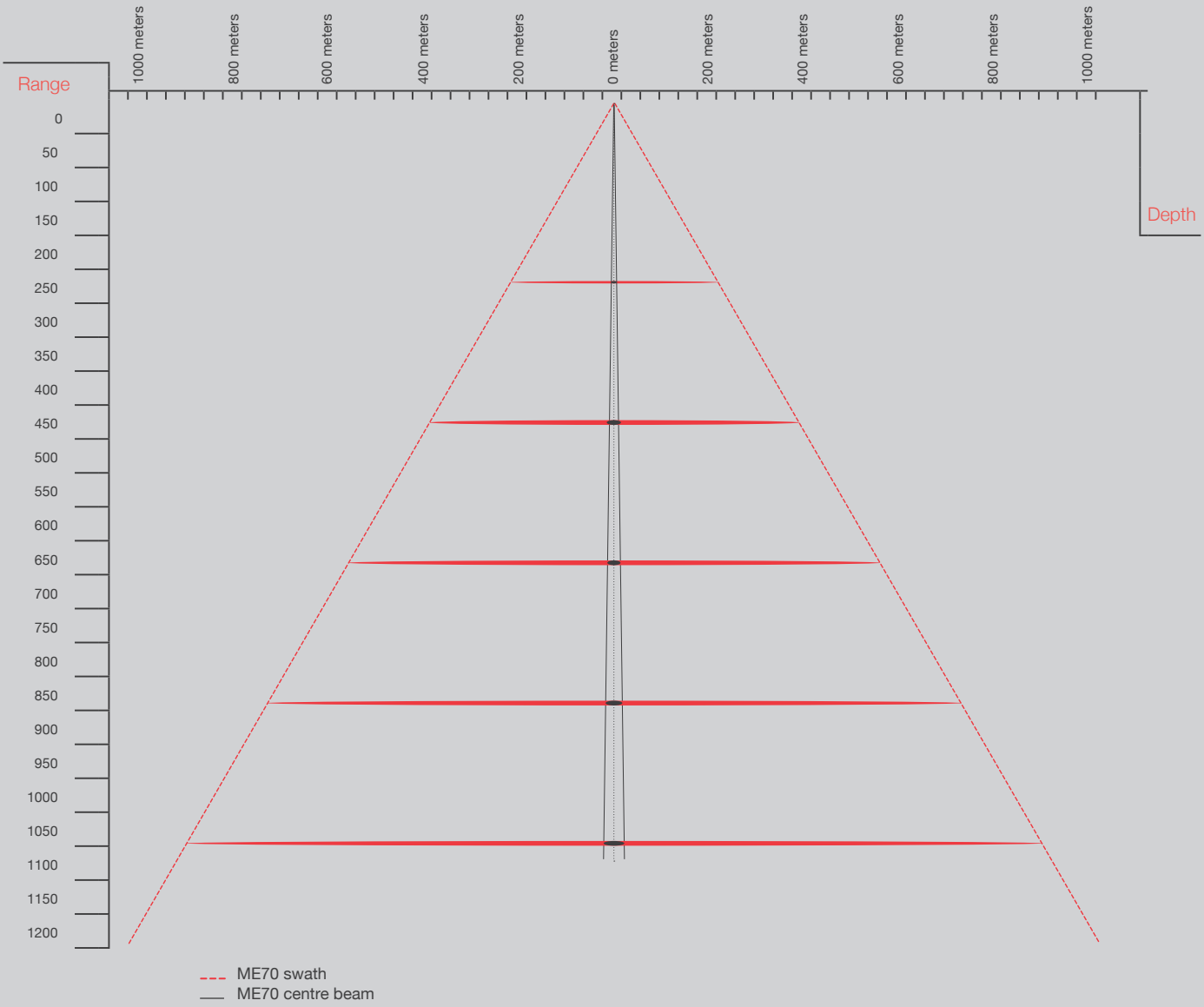
Interface capabilities, uninterrupted power supplies and power cables are not shown.

SYSTEM DIAGRAM

A. Processor Unit for operation and beamforming with colour display
B. Transceiver Unit
C. Power Supply Units
D. Transducer (mounted sideways with MS, downward with ME)
E. Hydrographic workstation with colour display (ME70 Bathy only)
F. Bathymetric option processing unit (ME70 Bathy only)

INCREASED EFFECTIVE SAMPLING VOLUME

A scientific multibeam echo sounder can be seen as many EK sounders spread out in a fan of beams. With more narrow beams spread out in a wide swath, you increase both your resolution and sample volume at the same time. The system can be configured to fit your preferences. Below, we can see a 60° swath and its corresponding sampling volume.



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