

ixnews

IXBLUE | APRIL 2019 | GEOSCIENCES SPECIAL ISSUE

DRIX USU

Looking back at one year in operation

GEODETIC MISSION

Canopus deployed off the coast of Sicily

SHARK RISK

Bringing safety back to the Reunion Island

PLANETARY SCIENCE

Building the next generation of seismometers





“

WE ARE ABLE TO CAPITALIZE ON THE KEY TECHNOLOGIES WE MASTER AND THAT PUT US AT THE HEART OF THE MAJOR CHANGES THE WORLD IS EXPERIENCING TODAY.

”

Through the study of Earth's complex surface, soils, oceans, rivers and lakes, geosciences investigate the past, observe the present and predict the future behavior of our planet. It also expands our knowledge of the universe by studying other planets, asteroids, and solar systems.

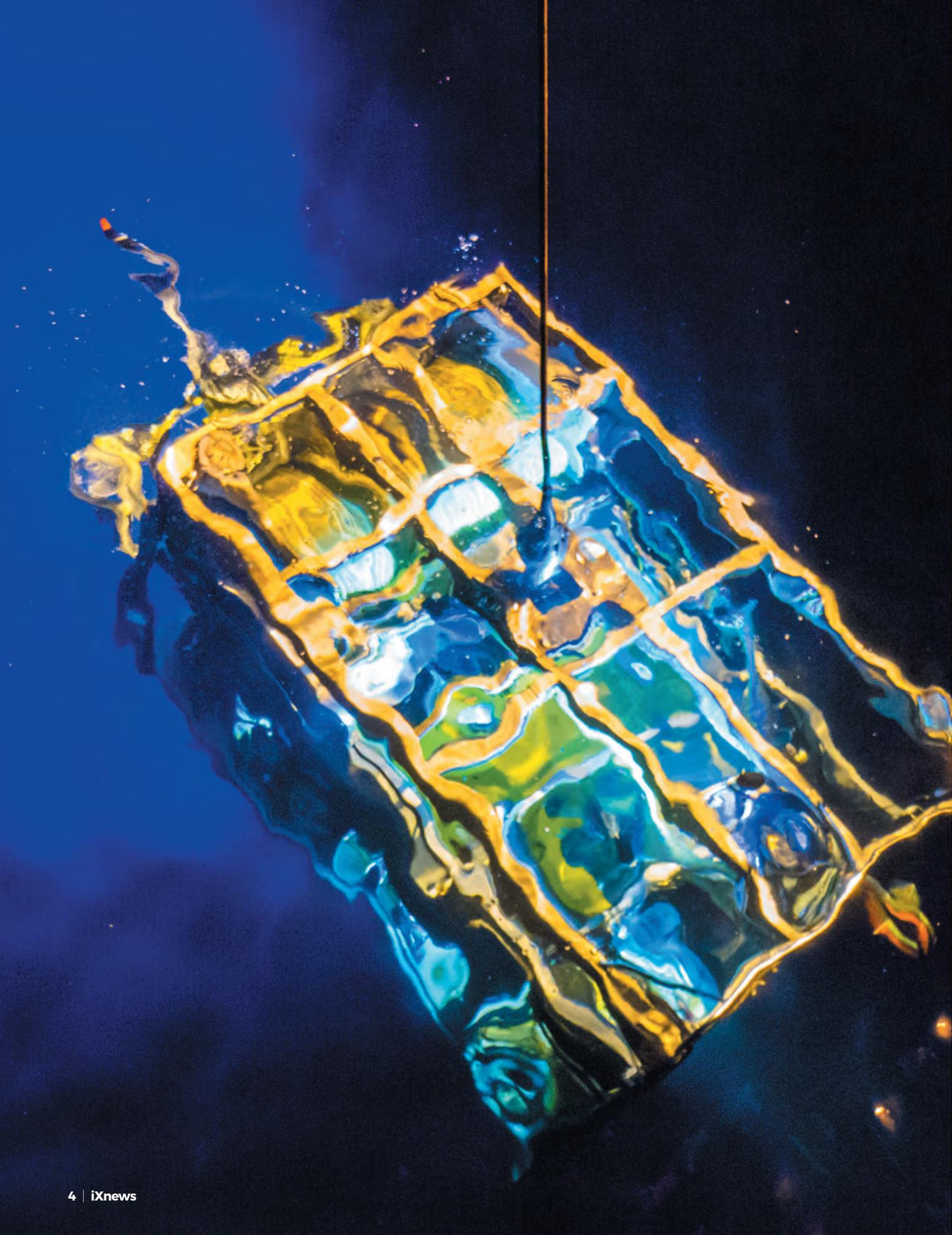
With a strong scientific spirit and a cultivated taste for challenges, iXblue strives to play a significant role in these explorations and support the works of academic research. To do so, we are able to capitalize on the key technologies we master around photonics, navigation, autonomy, subsea imagery, as well as acoustic positioning and that put us at the heart of the major changes the world is experiencing today.

Thanks to our users, it has led us to take part in the most exciting projects. iXblue has worked closely with agencies, institutes, research laboratories and private actors worldwide to develop the best instrumentation and our products have been used on the most exciting projects. Over the years, we were able to build a trusted portfolio of products and services and are continuing, today, to invest and develop new systems with continuous added value.

In the last years, we were able to release no less than five innovations: Canopus, our smart LBL for underwater positioning, DriX, already recognized as the most serious and flexible USV at sea, blueSeis our breakthrough product for rotational measurement seismology, SeapiX our sonar that brings more volume and resolution for complete environment monitoring and finally our completely reshaped range of INS for AUVs with the FOG based Phins Compact Series. The RETEX on these latest products is beyond our expectations and we are eager to share them with a wider audience. Of course, our star products such as Octans, Hydrins, Atlans, Gaps, Posidonia, Echoes, Delph and Oceano also continue to be endlessly enhanced to meet iXblue's users evolving requirements in terms of accuracy, reliability, ease-of-use and more efficient data collection, processing, and reporting.

In the following pages, you will discover some of the incredible stories we live with our customers everyday and that help us push back the limits of the unexplored. We hope you will enjoy reading them!

Jean-Marc
Binois
Sales Director



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CANOPUS

TAKING LBL TO THE NEXT GENERATION

An integrated approach to subsea navigation and positioning

Launched in London during Oceanology International in March 2018, Canopus, iXblue new LBL (Long Baseline) subsea positioning solution, did not go unnoticed. And its pink beacons were not the only reason behind whole the attention. Since its introduction over a year ago, iXblue has been busy deploying the new solution for various geosciences and offshore missions. Comprising a revised version of Ramses LBL transceiver, a new highly intelligent Canopus seabed transponder, and a global software to supervise operations, this new Canopus solution brings iXblue many steps forwards on the subsea positioning market.

Canopus – A new intelligent transponder

The family of iXblue acoustic transponders has welcomed a new member in the shape of the Canopus beacon, which takes the existing range to new peaks of performance and ease-of-use. This new transponder, that can be installed to 4,000 meters depths, offers inter-beacon and inter-product acoustic communication, new integrated environmental sensors (pressure, temperature, inclinometer and sound velocity) as well as the ability to be interfaced to external sensors, data recording capabilities and increased battery life (up to 4 years).

“iXblue was already covering the full spectrum of subsea positioning with the most modern methods that combine sparse array and navigation and that provide simple and cost-efficient solutions for highly performant and accurate subsea operations,” explains Hubert Pelletier, Head of the Acoustic Positioning and Communication division. “With this new Canopus transponder, we are widening our customers subsea positioning and subsea monitoring capabilities”.

Ramses – The next generation transceiver

To get the most out of the new Canopus solution, the other components of this subsea LBL positioning system have also been upgraded. This included iXblue’s Ramses transceiver. The new generation of Ramses built on this architecture thus benefits from the latest developments iXblue is working on and offers the brand-new inter-product acoustic communication capabilities, the necessary environmental sensors, as well as the entire range of new features developed for the Canopus transponder.

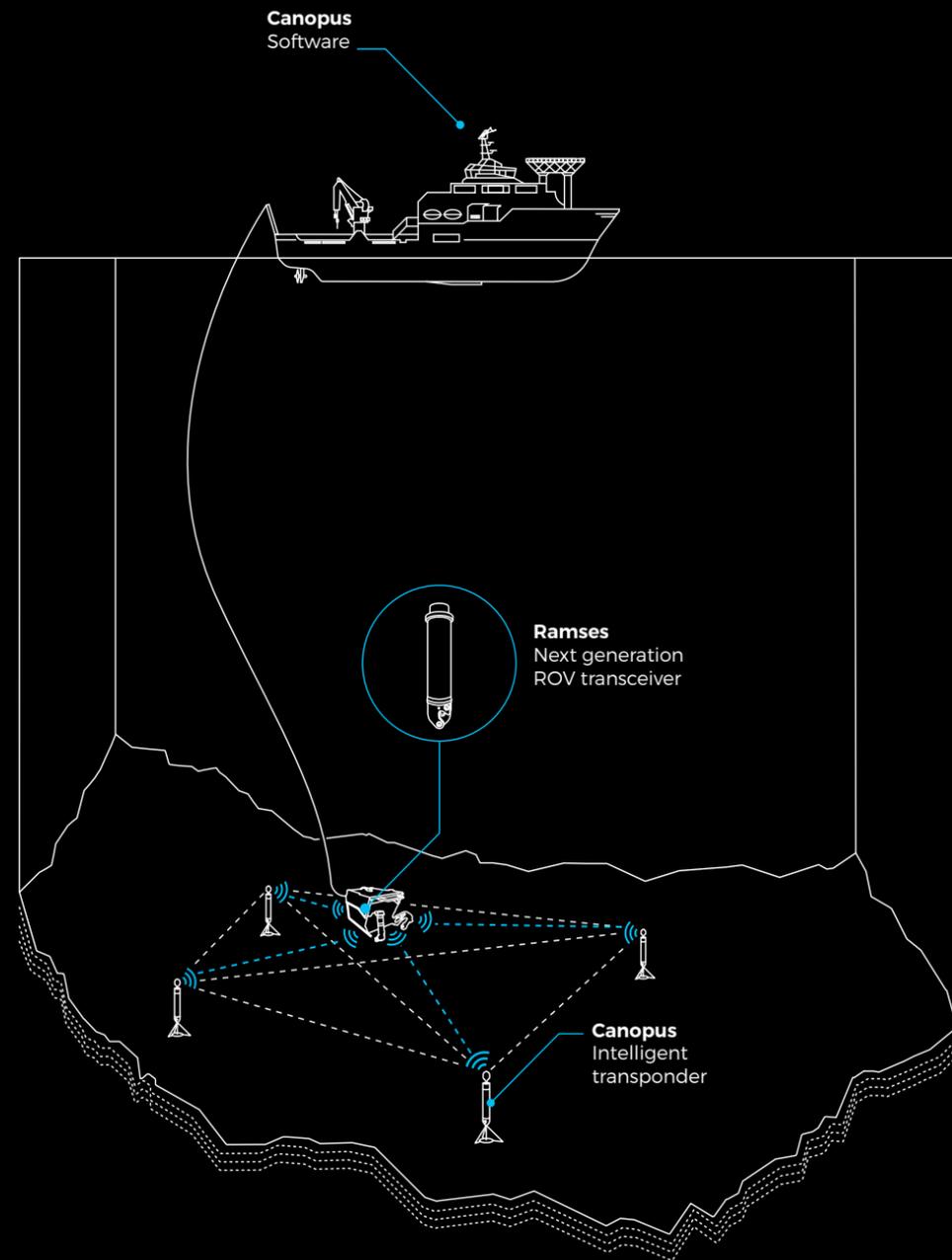
“While offering full LBL navigation capability, Ramses coupled with Canopus and iXblue INS provides our customers with a Sparse Array LBL navigation which allows, offering the

same navigation accuracy as conventional LBL approaches, a spatial and temporal reduction of the required transponders on a field,” says Hubert.

A new Supervision Software to manage the whole system

The second major step forward was the introduction of a new software layer that ties all the existing products together into a fully integrated positioning system. This allows a single user interface to control and monitor multiple subsea positioning components from a single location. Thanks to the new Canopus software, customers are now able to plan their operations, deploy and calibrate the devices needed, operate and monitor the whole system and post-process the data acquired.

“The development of this new global positioning system was a major milestone for iXblue,” concludes Hubert. “With the Canopus transponder, Ramses transceiver, MTB beacon for AUVs applications and the new supervision software, iXblue’s subsea positioning and navigation offer is truly enhanced and offers significant efficiency to our customers’ subsea operations.” ■



Canopus

LBL AND SPARSE LBL INTELLIGENT TRANSPONDER

Features

- Long Baseline positioning
- Sparse array positioning
- USBL positioning
- Acoustic data telemetry and modem
- Embedded user interface (MMI)
- Standard environment sensors including: pressure, temperature, inclinometer

Benefits

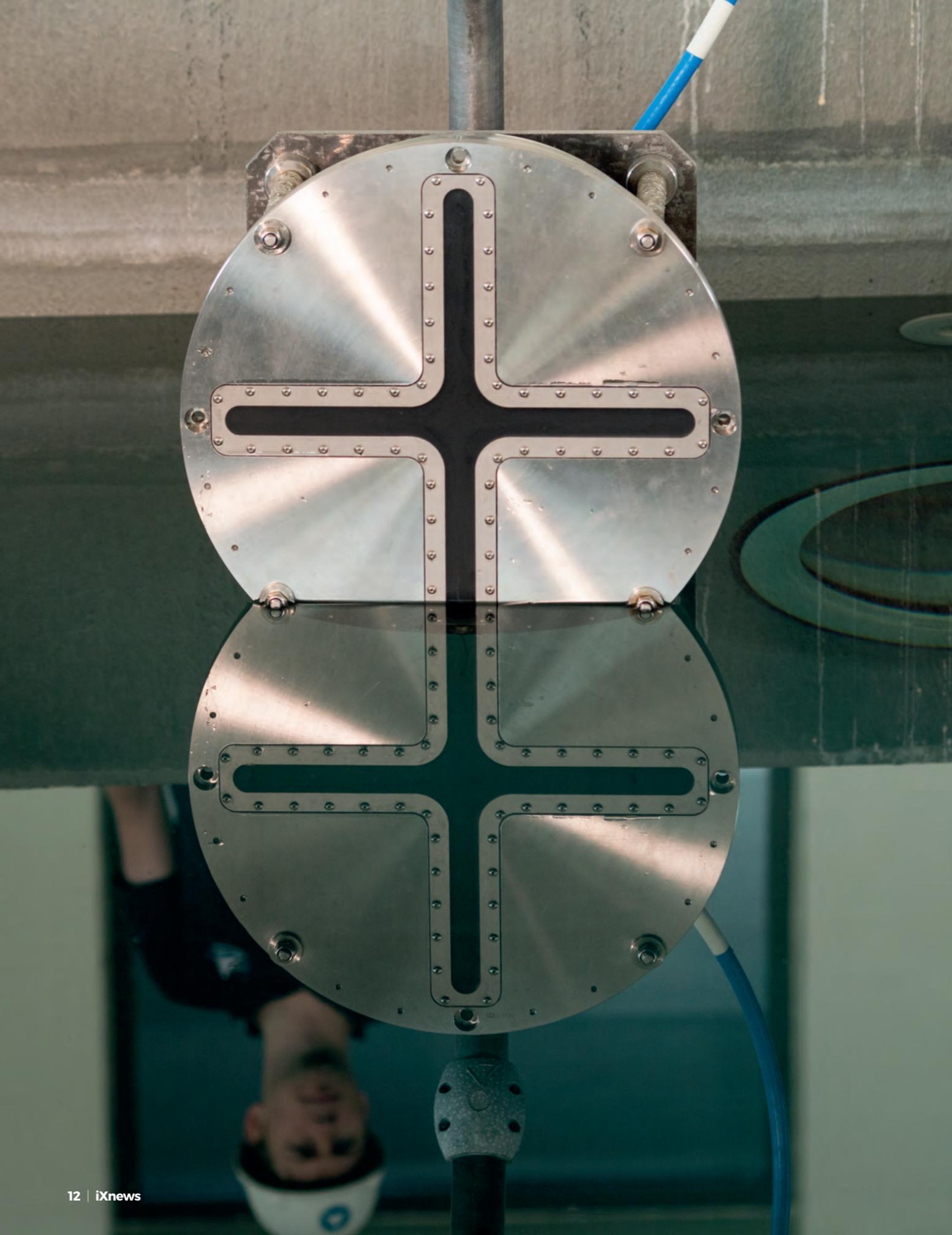
- Low power consumption
 - listening life: > 2 years
 - operation life: > 1,000,000 pings at maximum sound level
- A few hundredth unique wideband address codes
- Medium frequency band and omnidirectional transducer head

Physical

- Housing aluminum alloy with hard anodizing
- Weight (air/water) in kg: 28/16
- Size (ODxL) in mm: 180x1060
- Depth rating: 4,000 m standard (6,000 m in option)

Compatibility

- Gaps
- Ramses
- iXblue INS
- Third-party acoustic systems
- In option: SV sensors, Paroscientific™ Depth Sensors



SEAPIX SONAR SEABED CLASSIFICATION FEATURE

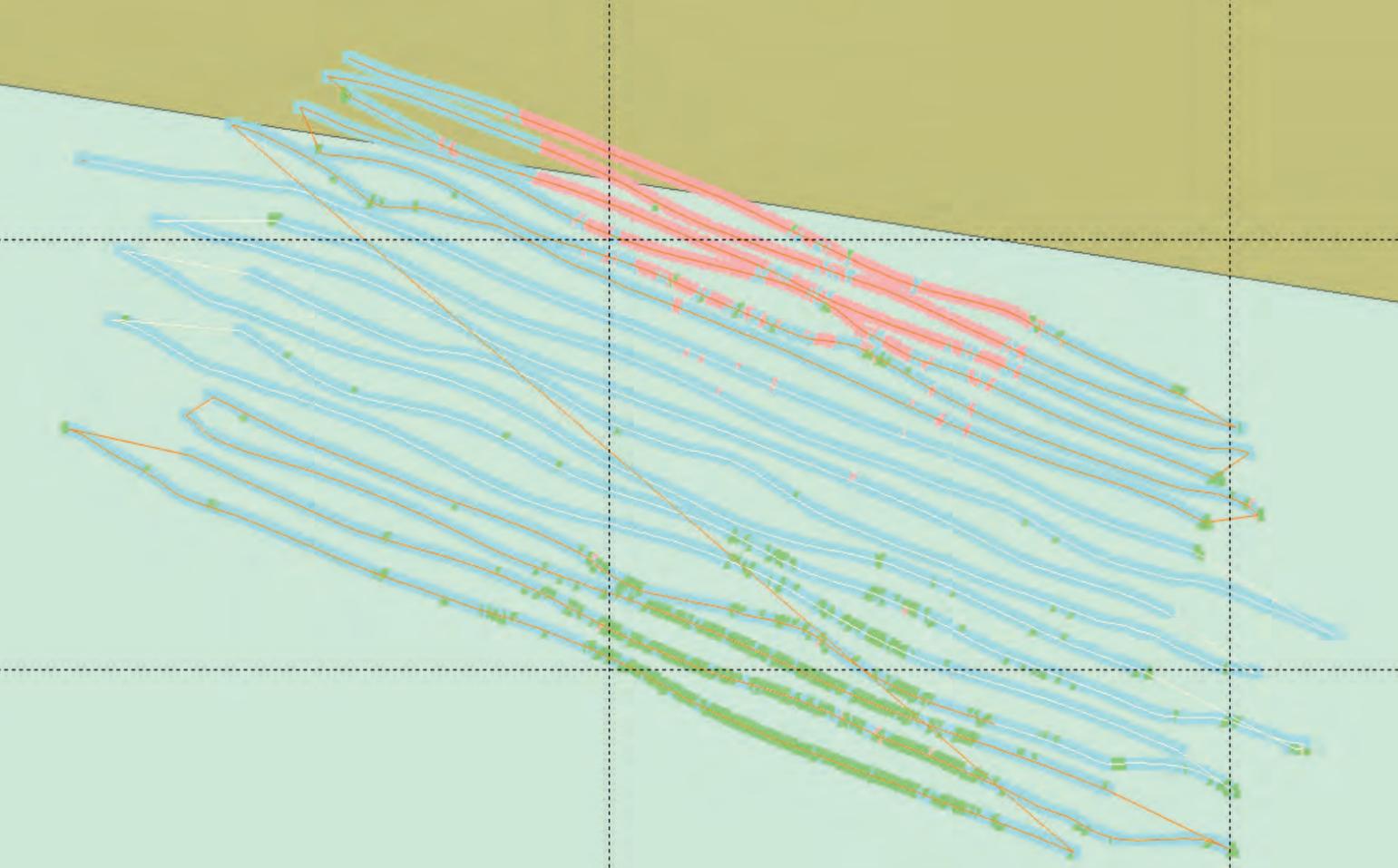
Launched in 2013, SeapiX, the first compact civilian system comprising a dual Mills Cross multi-beam sonar transducer, went through multiple changes to meet iXblue's customers evolving needs in various fields of applications. Its latest "seabed classification" feature offers all players working in fishing, ocean sciences, subsea construction and maritime security a new revolutionary tool to help them achieve their operations in the most efficient way as possible.

Based on military and scientific technologies, SeapiX is special in that it is equally efficient in terms of volume as in terms of metrology. Using a symmetrical double multibeam, the system is able to describe the information contained in a large volume of water. By generating one or more scan swaths along or across the vessel axis, SeapiX provides total three-dimensional coverage of the water column, a bathymetric profile of the seabed and a sediment identification analysis.

"SeapiX can describe the content of a volume of water up to 200 times greater than a standard sonar can in an identical analysis period," explains Christophe Corbières, Business Development Manager at iXblue. "In addition to its ability to analyze a large volume of water, the system is also an extremely reliable and efficient metrology solution for bathymetric

operations and seabed classification. The resolution of the images obtained is very high: a voxel at 100 meters depth is equivalent to 0.6 cubic meters, compared with 30 cubic meters for conventional seafloor sounders. Moreover, the SeapiX sonar has the advantage of being fully stabilized by its integrated inertial unit: it moves independently of the ship's motion, which enables it to generate a guaranteed high-quality image."

SeapiX transducer thus generates several multibeam transmissions and acoustic processes to yield quantitative and qualitative measurements of the whole marine environment. Its multiple advanced modulation modes, including CHIRP, combined with pulse compression guarantee the highest possible detection performance, even in difficult conditions.



▲ Seafloor classification survey with SeapiX

Another major advantage of SeapiX is its ability to provide real-time location-based data by integrating navigational, cartographic, and layers of fishery, bathymetric and sediment information without the need to use a post-processing software. Unlike SeapiX, conventional sounders – that cover only 7° – are not able to simultaneously provide seafloor mapping as well as generate a volumetric image of the water column in front of and to the side of the vessel. Nor can they offer a full survey capacity of the entire ecosystem, including both the water column and the seabed classification. With the implementation of this seabed classification feature, iXblue truly brings an innovative and efficient solution to its customers, allowing for the study of the interaction between the seabed and the water column. This new global approach enables scientists and operators alike to get precise and localized real-time data from the entire ecosystem from the seabed morphology to the water surface. “SeapiX particular design

offers a unique, safe and reliable operational mode for this new feature enabling real-time seabed classification from either an existing standard library stored into the system, or from a custom-made library created by the customers according to their needs,” explains Maxence Rioblan, Product Manager at iXblue. “SeapiX truly is a reliable system that is easy to use, even for non-specialists, as it does not require complex setting to work, making it accessible to all. This seabed classification feature is particularly helpful for various applications such as detection of oil or gas leaks, bottom trawling, risk assessment, MRE monitoring and environmental impact assessment, or even for volcanologists, to only name a few.” Already adopted by major shipowners and institutes worldwide, SeapiX has sparked lots of interest from customers since its launch. Featuring an extremely complex and innovative technology, SeapiX is truly unique as it combines several different capabilities that makes it the perfect solution for a wide array of uses. ■

SeapiX

3D MBES FOR WATER COLUMN ANALYSIS AND SEABED CLASSIFICATION

Features

- Real-time 3D sonar covering a pyramidal 120° water column with high resolution
- Compatibility with GECDIS systems, Olex (for bathymetry), Echoview (water column analysis) and Delph Software

Benefits

- Mills Cross dual Multi-beam swaths in a single compact antenna housing with embedded IMU
- Advanced chirp frequency modulation

Performance

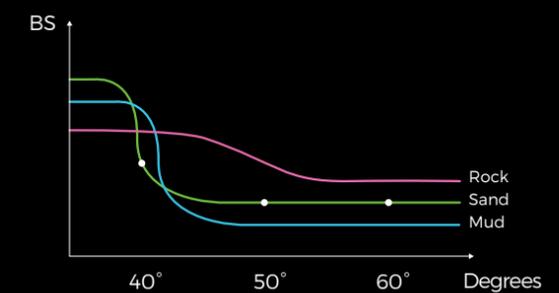
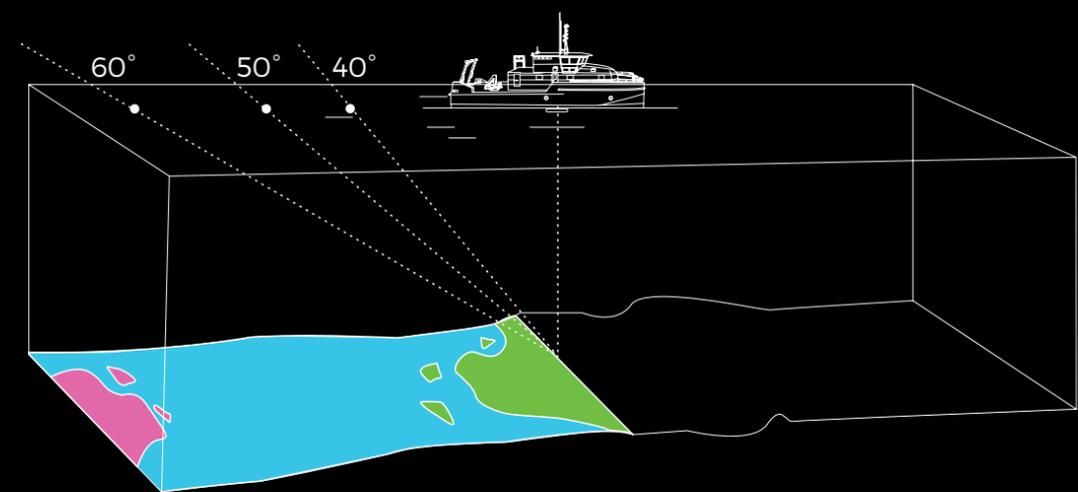
- Range resolution: 7.5 cm (constant)
- Resolution cell at 100 m depth: 0.6 m³
- Typical range: 400 m for fishing, 800 m for bathymetry

Physical

- Weight: 60 kg (24 kg for portable version)
- Transmission power: 2 kW (4 kW in option)

Applications

- Fishery and fishery research
- Hydrography
- Marine science





CHOOSING THE RIGHT SBP FOR GEOLOGICAL SURVEYS

Sub-bottom profiler (SBP) data acquisition and analysis of seafloor, lake, fluvial or any other waterways from natural and anthropic origins can provide crucial information for underwater studies. SBPs are used to identify and characterize the sediment layers below the seabed. Applications fields such as subsea construction inspection, biomass monitoring, resource control, pollution tracking, geo-archaeology or sedimentology are increasing and represent a growing market share that needs to be explored.

To meet the various needs of the sub-bottom profiling market, iXblue conceived a complete range of sub-bottom profilers: the Echoes Series. Developed over the past 30 years in close collaboration with the French Navy and several international Oceanographic Research Institute laboratories, including the French Research Institute IFREMER, iXblue's products quality and technology expertise come from extensive practicing and cumulative return on experience coupled with constant innovation and evolution.

High-performance thanks to complete vertical integration

Today, sub-bottom profilers use a broadband frequency shifting from low to high frequencies providing a wide range of penetration, resolution and directivity for the first 200 m of sediments. These acoustic signals use frequency (FM) and amplitude (AM) modulation over a defined duration. This signal is commonly called a "chirp" (Compressed High Intensity Radar Pulse). Sub-Bottom Profilers transmit this signal in water and listen to the reflected signal from the bottom and sediment layers. The received acoustic signal is digitized and then deconvoluted. This technique provides penetration that is comparable to low-frequency systems with a resolution of high-frequency systems. In addition, the correlation of the received data with the transmitted chirp signal performs a strong noise filtering to yield an additional gain in the signal to noise ratio. iXblue know-how in sub-bottom profiling is built from a custom Piezo-electric transducer design activity in the 150Hz to 400kHz range.

These high-power and wide bandwidth devices were especially suited for the development of a complete range of controlled pulse sub-bottom profiler projectors. Enhanced by in-house designed low distortion and high efficiency power amplifiers, all components are manufactured internally when many other companies only integrate off-the-shelf components. This mastering of the acquisition chain ensures that the acoustic signal transmitted is very close to the theoretical chirp waveform, thus ensuring the highest degree of resolution and quality resulting from the signal processing.

Covering the full spectrum of applications

The Echoes Series can be pole or hull mounted or integrated on Unmanned Surface Vessels (USV) and are therefore easily operated and mobilized from vessels of opportunity, covering a full spectrum of applications, from shallow to deep water: tomography, physical oceanography, sea-floor mapping,

oceanographic survey, industrial survey, geotechnical survey, marine archaeology, broadband projectors and deep ocean operations.

Unique features

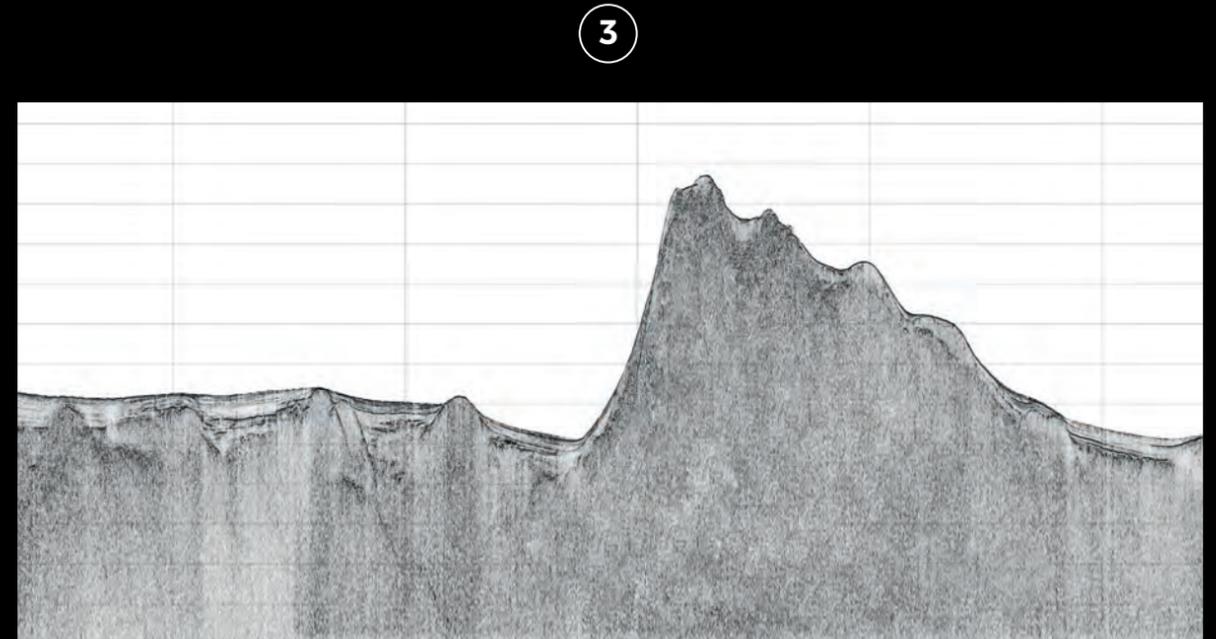
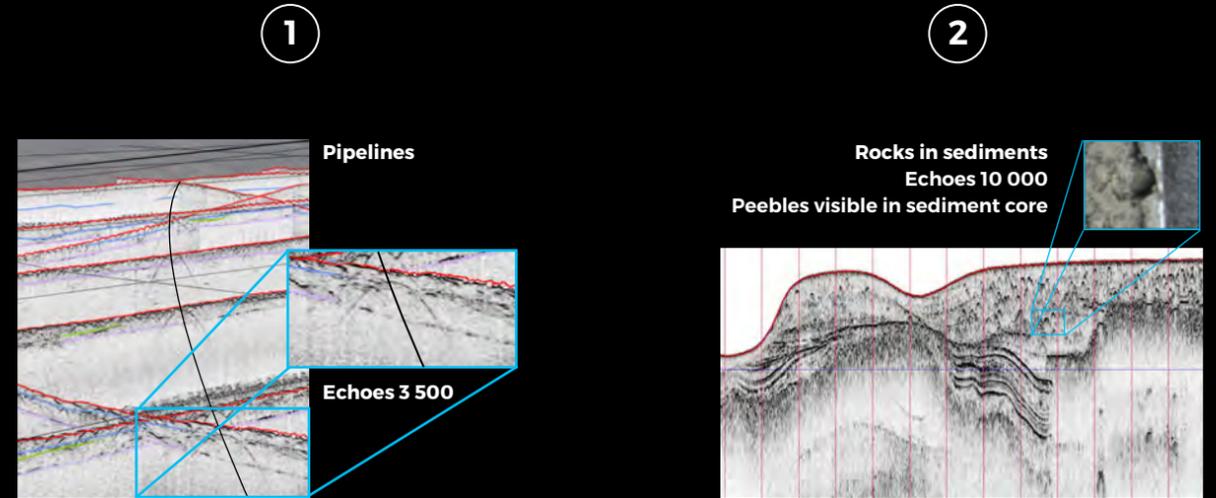
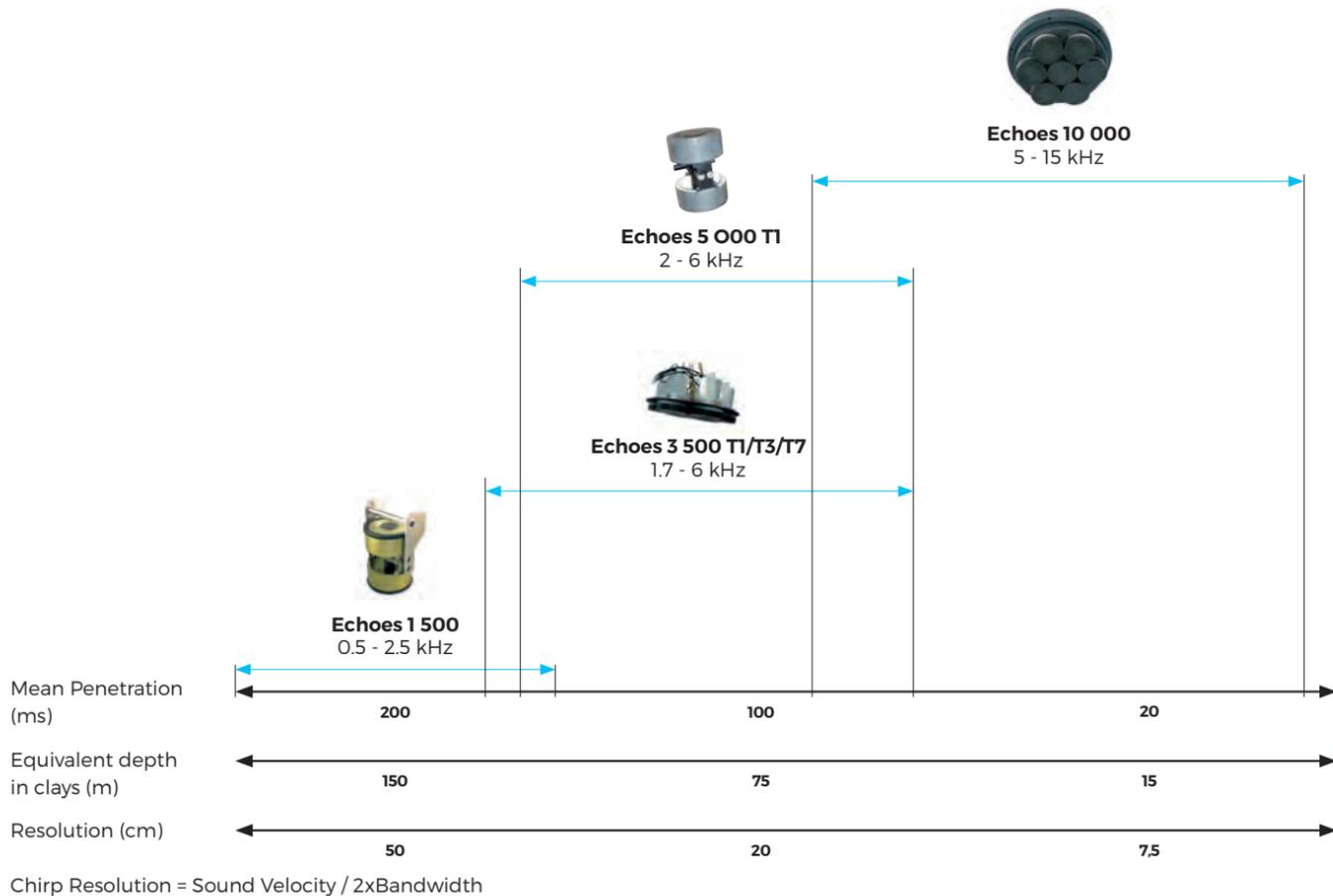
Echoes transducers' wide aperture is a key factor for object detection and to obtain maximum penetration whatever the seabed topography.

• Object detection (1 & 2):

With 20° aperture, Echoes allows to make the pipe ring and to clearly identify, it even within a rocky environment. Similarly, on the second profile, a 5-cm diameter rock embedded in sandy-silt sedimentary deposits can be detected.

• Penetration and signal to noise ratio (3):

On this profile, anyone can appreciate the image texture in such chaotic and mountainous subsea environments.



Estuary survey from shallow to down slopes with efficient bottom tracking (Canada)

A complete software suite for efficient data processing

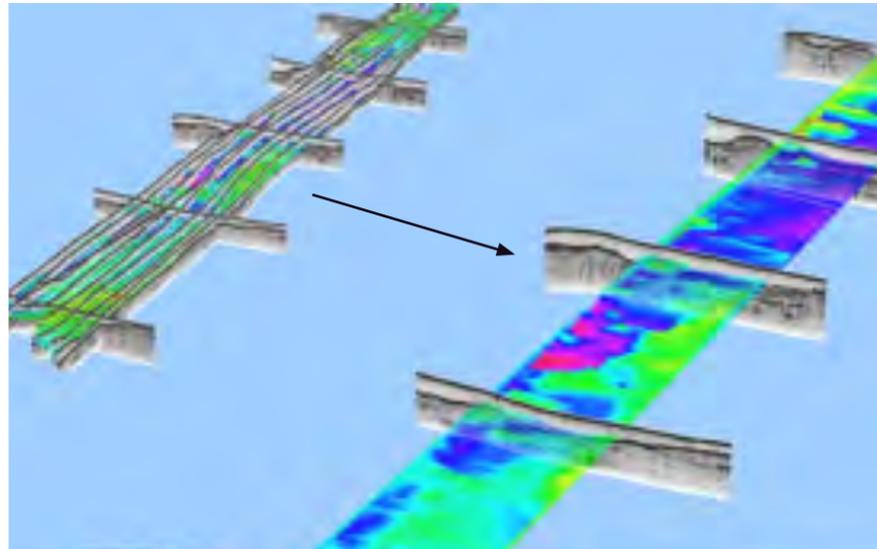
iXblue also develops an open software suite for acquiring, processing and mapping all kinds of hydrographic and geophysical data. The Delph Software Suite naturally makes the best from the Echoes sub-bottom profiler's data with possible improvement on the chirp processing and complete 3D geo-referencing of survey data both in real-time and offline.

Delph Interpretation is a complete software suite including applications and tools addressing the requirements for the processing and interpretation of geophysical datasets with optimized quality control. The software includes dedicated sensor modules (Delph Sonar / seismic / Mag) that are all linked to a mapping interface (Delph RoadMap) offering 3D visualization and quick access to raw and processed data.

An innovative approach to workflows on geophysical data offers flexibility and extreme efficiency in the management of large volumes of data and multi-sensor surveys. Users have a global multi-sensor display of sonar, bathymetry, seismic, magnetometer, geotechnical and cartographic data. All while still retaining the maximum level of detail for analyzing records. Batch data processing and production tools allow users to maximize the time being used for Q.C. and interpretation by eliminating the tedious and repetitive tasks.

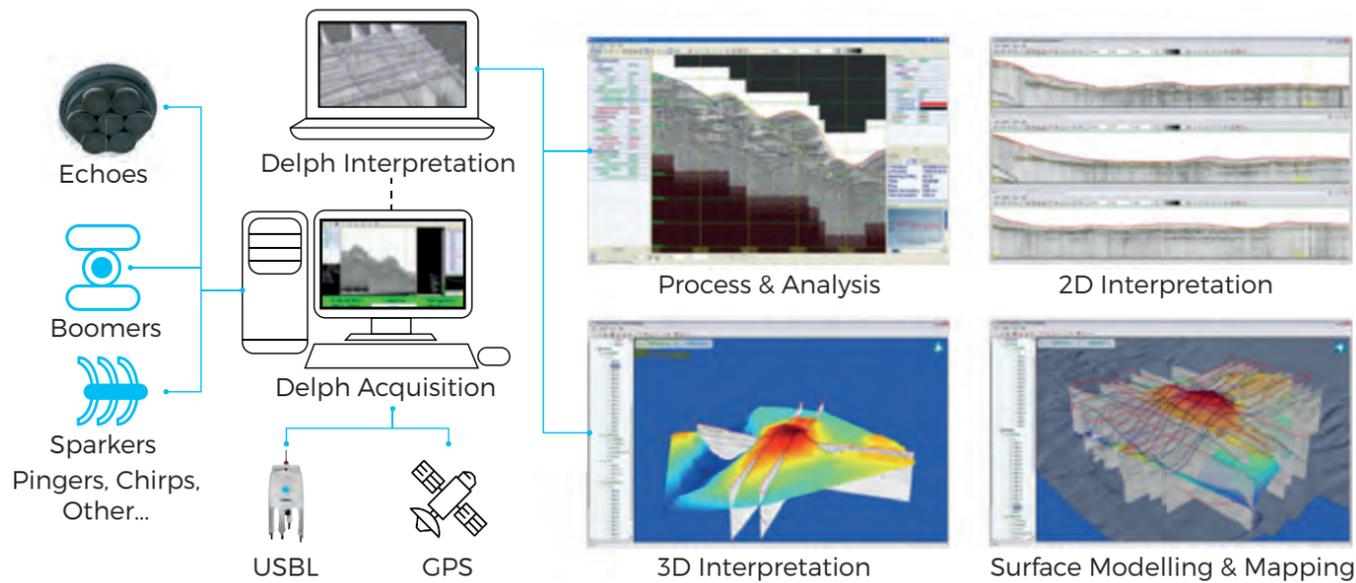
What next?

There is more innovation and integration to come: as iXblue is focusing on autonomous surveying, the company actively works on better efficient, compact and adapted solutions together with leading industry companies and partners with the aim of reducing survey costs while improving data resolution and coverage rate. ■



◀ Channel survey with Echoes 3 500 in sandy environment (Middle-East)

Delph Software Workflow



Delph Software Workflow

Echoes Series

SUB-BOTTOM PROFILER SOLUTIONS

Features

- Any integration: hull or pole mounted, towed or integrated on autonomous vehicles
- Any application: geoscience, industrial, offshore survey

Benefits

- The widest spectrum coverage (150Hz-15kHz transducers)
- True flat bandwidth ultimate resolution capacity & power efficiency
- Optimized processing and data interpretation software



Echoes 3 500

True flat bandwidth:
1.7 kHz - 5.5 kHz

Acoustic level¹:
180 - 198 dB

Resolution:
20 cm

Directivity:
20° - 30° - 45°

Transmission power:
2 kVA - 4 kVA - 6 kVA

¹ ref 1µPa@1 m



Echoes 5 000

True flat bandwidth:
2 kHz - 6 kHz

Acoustic level¹:
180 - 193 dB

Resolution:
20 cm

Directivity:
Omnidirectional

Transmission power:
1 kVA - 2 kVA



Echoes 10 000

True flat bandwidth:
5 kHz - 15 kHz

Acoustic level¹:
180 - 196 dB

Resolution:
8 cm

Directivity:
20° - 30°

Transmission power:
2 kVA - 4 kVA



DRiX ONE YEAR IN OPERATION

IN NOVEMBER 2017, ixBLUE PROCEEDED WITH THE COMMERCIAL LAUNCH OF DRiX, AN 8-METRE LONG, INTERNATIONALLY PATENTED AND HIGH SEAS GOING UNMANNED SURFACE VEHICLE (USV) WITH PROVEN OFFSHORE NAVIGATION AND HIGH-SPEED TRANSIT CAPABILITIES, AS WELL AS UNRIVALED SENSOR STABILITY. A YEAR LATER, RECORD IN THE SURVEY AND ENERGY MARKETS, AS WELL AS THE INTEREST SHOWN BY OTHER INDUSTRIES, IT SEEMS LIKE ixBLUE WAS RIGHT IN WHAT THE COMPANY BELIEVED TO BE ANY USV KEY SUCCESS FACTORS: HYDRODYNAMICS, AUTONOMY AND RESILIENCE. WHAT ixBLUE REALIZED, A YEAR LATER, IS THE FORMIDABLE ENHANCING EFFECT A PROPERLY AND FIT-FOR-PURPOSE DESIGNED USV SUCH AS DRiX HAD.

A first year filled with trials and jobs at sea

DriX started 2018 with an early adopter, Bibby HydroMap, a leading provider of hydrographic, geophysical, UXO, ROV and asset inspection surveys. Bibby was the first company to see the massive potential presented by DriX after iXblue's very own Sea Operations division. Bibby helped iXblue sharing that feeling with a number of other companies and developed applications, such as a first offshore windfarm trials which took place in the UK.

On the hydrographic survey side, iXblue conducted many operations, such as the seabed mapping of the Tonga Islands in the Pacific as well as a number of other surveys in the Mediterranean Sea and in New Zealand. On the fossil oil front, iXblue performed a job in Azerbaijan for Total, a major oil and gas operator, and teamed up with a forefront contractor to help them develop a new life of field model.

2018 was also the year DriX stepped into the academic world. iXblue thus became industrial partners of the University of New Hampshire where one DriX is now stationed and was invited at Scripps Institution of Oceanography to deliver a speech on DriX added value in UXO and debris surveys. The company furthermore developed tight collaborations with the U.S. National Oceanographic and Atmospheric Agency (NOAA) and The Maritime Alliance (TMA), that saw DriX's potential.

An asset that brings economic efficiency

iXblue went all the way from development trials to effective jobs at sea in less than a year and integrated a number of sensors from different manufacturers to a point where DriX is a technologically mature solution and tender winning asset.

It is also an easily upgradable asset. Because R&D does not stop once the project becomes a product, iXblue teams of engineers, sailors and software developers provided DriX with a number of add-ons which were asked for by clients. This includes a DriX Deployment System (DDS) that allows the safe and efficient deployment of the USV from the shore or from a vessel, using a davit, deck crane or A-frame, as well as a specially fitted transport container to ship the DriX system securely anywhere in the world. Further enhancements were also brought to the platform following the first jobs performed at sea such as communication range and user interfaces.

All in all, after a year in operation, DriX proved to be a simple, robust and flexible solution able to perform exceedingly well in both offshore and coastal environments, bringing better and faster results than surface vessels operating at the same time. DriX was indeed able to work longer and in harsher conditions while offering an extremely low downtime. It also showed great added value for operations conducted in more hazardous areas in which surveyors did not dare venture, such as uncharted waters, where they were able to send the USV.

It was also observed that, from a human perspective, surveyors were changing the way they worked, which came naturally from them. They were not forced into developing new concepts of operations because of a new technology. On the contrary, DriX is perfectly adaptable to "the old ways" and brings them to a whole new level of efficiency. ■

DriX

UNMANNED SURFACE VEHICLE

Features

- Design optimized for both coastal and offshore missions
- Removable and replaceable gondola
- DriX Deployment System (DDS) included

Benefits

- Excellent platform stability up to sea state 4 and higher
- Excellent manoeuvring capabilities and a wide range of speeds (from 2 to 14 knots)
- Unmanned architecture providing an extended working domain
- Long endurance (ranging from 5 to 10 days)
- Reduced fuel consumption

Specifications

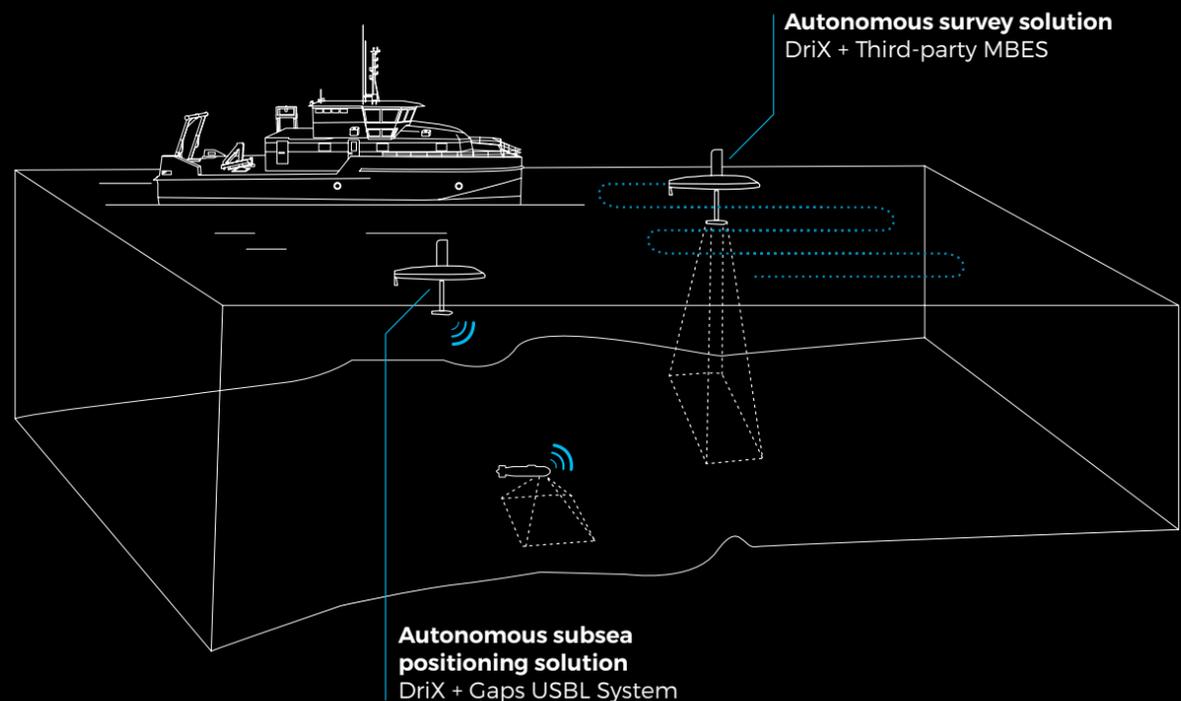
- Control: fully autonomous, semi-autonomous, direct remote control
- Communications: line of sight (WIFI, radio, contact us for SATCOM)

Applications for survey operations

- Hydrographic survey
- Coastal and harbour monitoring
- Hydro acoustic survey
- Seabed mapping
- Seabed automatic classification
- AUV tracking with USBL

Applications for subsea operations

- Box-in of seabed transponder arrays;
- ROV tracking for Touch Down Monitoring (pipe and cable laying)
- AUV tracking and control/ command
- Ultra-deep tow fish tracking





BLUESEIS: A REVOLUTION IN THE HISTORY OF THE GEOSCIENCES!

Launched in 2016, the blueSeis project is revolutionizing the market for seismometers. Developed in partnership with the seismology teams of the University of Munich, this new product makes it possible to obtain complete measurements of a seismic wave, taking into account both translational and rotational movements.

blueSeis, the first 3-components rotational seismometer

In order to accurately characterize the seismic waves which occur during an earthquake, it is necessary to measure both the translational movements of the ground (linear displacements) in addition to its rotational movements (yaw, pitch and roll). To do this, it is necessary to have six sensors, corresponding to the six degrees of freedom (three accelerometers to measure translations, three gyroscopes for rotations). Until now, seismologists, having no gyroscopes suitable for their needs, were only able to measure translations, using three accelerometers.

The blueSeis project was thus born of a real need: about five years ago, the Geophysics Observatory of the University of Munich approached iXblue to work on the development of a fiber optic gyroscope specifically designed for the seismology market. They were looking for a highly mobile, easily deployable, gyroscope that was highly sensitive to noise and capable of measuring extremely small rotations.

The blueSeis-3A represents a significant step for seismologists all over the world; until now, researchers have deduced rotational movements based on assumptions derived from translational measurements. The result was unreliable, and several days were needed to characterize the seismic wave. Today, thanks to blueSeis, seismologists have access to the ultimate value of the rotational speed, and now have complete measurements of the movement in real time.



Installation of blueSeis on the Stromboli.

The use of blueSeis significantly improves, within a measuring station that has already been deployed, the sensitivity of the network. The number of sensors installed can be reduced by at least three as part of the deployment of a new station. This product is, therefore, of real interest for state institutions that are required to ensure seismic monitoring in their territory, as well as for players in the oil & gaz market.

A field-proven seismometer

Over the past 3 years, the blueSeis-3A was installed for temporary measurements on many sites around the world to prove its performances and reliability and the results turned out to be excellent on various fields of application

• On volcanoes:

To understand the volcanoes' internal mechanisms, iXblue collaborated with the Ludwig-Maximilians-University of Munich (LMU), The Italian Institute for Geoscience and Volcanology (INGV), the Dublin Institute for Advanced Studies, the Instituto Geofisico in Equator and many other research centers to test the sensor in Hawaii, the Galapagos and on the Stromboli in Sicily.

• On building monitoring:

blueSeis-3A also proved to be efficient for building monitoring. The system aimed to understand the building's resonant modes to characterize the materials of which it is constructed and its structure, in order to participate in its conservation. As a test, two sensors were installed on the top of the Giotto Campanile of Florence cathedral.

• On seismology:

iXblue is collaborating with the French CEA to demonstrate the blueSeis-3A capabilities compared to traditional seismometers.

Over the past 2 years, blueSeis has built an impressive track-record of its performances through tests, demonstrations and sales to the main players in seismology (LMU, BGR IRIS, GFZ, ETH, UNAM, ...). It has been featured in numerous publications on rotational seismology and geosciences conferences, proving the interest of this new system. 2019 will also be an important year for blueSeis, with new tests, publications and conferences lined-up (EGU, SSA, IWGORS, AGU...). ■



In the meantime, the blueSeis team worked on an adaptation of the iXblue gyrocompass Quadrans to align seismometers to the true North and to offer a complete solution to its partners and customers. Indeed to guarantee high precision and reliability of seismologists' measures, it is crucial to make sure that rotation and translation sensors are perfectly aligned. iXblue's Quadrans is a guarantee for a perfect alignment of sensors. Customized to the need of the end-users, the Quadrans can be mounted on a tripod or directly on the seismometer.

blueSeis

PORTABLE, 3-COMPONENT ROTATIONAL SEISMOMETER

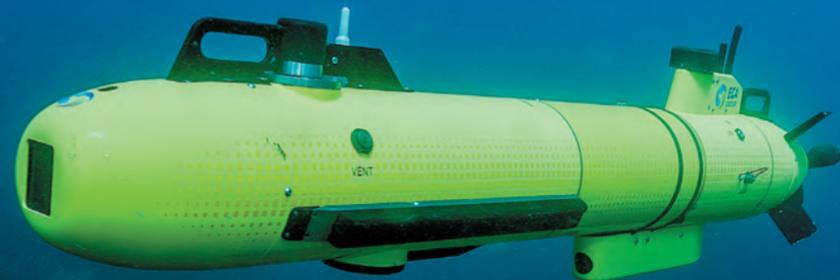
Features

- Broadband (DC to 50 Hz)
- Low noise (< 20 nrad/s/√Hz from 0.01 to 50 Hz)
- High dynamic range 0.5 rad/s
- 3 Interferometric Fiber Optic Gyroscopes (I-FOG) for low self-noise and broadband measurement
- DC signal for absolute rotation measurement
- High dynamic range
- Ethernet output of time stamped data
- Field-proven technology
- Flat frequency response

Benefits

- Rotation as a new observable in seismology
- Easy to deploy: no calibration, no tilt range limitation, insensitive to environmental conditions
- Heading provided by the system
- 2-in-1: «weak motion» low-noise + «strong motion» dynamic
- Plug and play interfaces





Courtesy of ECA Group

PHINS COMPACT SERIES

MORE ROBUST AUTONOMY FOR ALL AUVS

The rise of autonomous platforms

Recent years have seen the rise of all types of autonomous vehicles, from Unmanned Aerial Vehicles (UAVs), to untethered Autonomous Underwater Vehicles (AUVs) operating in the challenging subsea environment. Offering a flexible turnkey solution for a wide range of applications, AUVs continue to evolve as a growing, dynamic solution. Able to operate in difficult-to-access as well as hazardous areas where navigation is challenging, AUVs offer a flexible, cost-efficient and safer alternative that acts as a force multiplier and enhances the performance of traditional solutions for various applications including exploration, Metocean, as well as environmental, geophysical, and hydrographic surveys.

“In many regards, AUVs are some of the most, if not the most advanced autonomous platforms in the world. They are the only ones that are always forced to operate in a GNSS-denied environment,” explains Robert O’Malley, Business Development Manager at iXblue. “This is why the navigation solution is such an essential component. Because the navigation brings such a critical capability, we understand the importance of our position on the market. iXblue is not just a supplier of inertial navigation systems. We believe that we can actually bring more robust autonomy to the platform including a growing importance in providing the positioning solution with our Gaps Global Acoustic Positioning System.”

Leveraging state-of-the-art expertise in inertial navigation systems (INS), iXblue has developed the Phins Compact Series, a complete range of subsea INS specifically designed to improve accuracy, bring reliable cost-efficient navigation solutions to all AUVs and that is now recognized as a world leader for autonomous navigation.

Reliable navigation for enhanced autonomy

iXblue, recognized worldwide throughout the industry for its pioneering work on the development of Fiber-Optic Gyroscope (FOG) technology that has revolutionized maritime inertial navigation systems (INS), has put extensive efforts in R&D to develop new innovative autonomy technologies. A key focus for the company, resilient navigation solutions have thus been developed by iXblue and the company is now considered a major actor of this new autonomous era.

Over the years, iXblue has developed long-lasting partnerships with various key industry players including private companies, research institutes and governments, to fully understand and anticipate the needs of the AUV market in order to remain at the forefront of technological advancements. By truly understanding all specific aspects of the AUV market and its challenges, iXblue was thus able to develop the Phins Compact Series INS, especially designed to offer a scalable and highly accurate and reliable navigation solution that enhances AUV autonomy.



▲ An AUV is being deployed

Phins Compact Series: the world leading solution for AUVs navigation

The Phins Compact Series is a genuine strap-down solid-state system free of moving parts that offers quiet and stealth autonomous navigation and does not interfere with sonars and other payloads acoustic noise, while also providing increased autonomy to the subsea platforms thanks to its very low-power consumption. Launched back in May 2016, the Phins Compact Series has since then been chosen by major AUVs manufacturers and integrators to provide reliable autonomous subsea navigation.

Comprising the Phins C3, C5 and C7, the Series offers a fully scalable solution that allows AUVs industry players to choose the inertial navigation system the most suited to their needs, whatever the platform's size and mission type. Available in OEM versions, the Phins C3, C5 and C7 share identical architectures and interfaces and incorporate the same algorithms and software, enabling customers to re-use the control system on any other type of AUV via modern interfaces such as Ethernet, reducing initial integration costs. Benefiting from an MTBF (Mean Time Between Failures) of over 100,000 hours, without any need for preventive maintenance, the Phins Compact Series guarantees the highest level of reliability and robustness and is now considered as the standard navigation solution on which AUVs can rely to be fully autonomous.

"iXblue's success on the AUVs market rely on many factors. One is, of course, our unrivaled FOG technology. But another of our strong suits are our advanced algorithms. Everything is about data nowadays, and data is key to highly reliable navigation. We can think of an AUV as being a mix of a lot of very good sensors, including DVL, GPS, USBL and LBL to only name a few. The challenging part to make the platform fully autonomous, is to merge all those data to provide a reliable navigation capability," states Robert O'Malley. "Thanks to our advanced algorithms and Unscented Kalman Filter, our inertial navigation systems have now become the prime sensor fusion engine, from a navigation, position and timing standpoint. This is why we are able to bring more robust autonomy to those unmanned platforms. Overall, we have the best technology available for the navigation of AUVs today and this translates into the sheer number of iXblue systems that are now roaming the oceans in full autonomy." ■

Phins Compact Series

MOST COMPACT INERTIAL NAVIGATION SYSTEM FOR AUVs

Features

- Most compact high grade INS
- Low power consumption for an increased autonomy
- Software and algorithms dedicated for subsea operations
- Genuine strapdown solid-state system

Benefits

- Stealth autonomous navigation
- Very accurate heading, roll, pitch speed and position
- Common interfaces
- Seamless integration
- Open architecture with 3rd party brand sensors



Phins C3

Performance

- Heading: 0.15 deg
- Roll pitch: 0.05 deg
- Position accuracy: 0.2% DT
- Power consumption: 12 watts

Environment characteristics

- Weight: 1.6 kg
- Volume: 0.4 L
- Diameter: 115 mm

Electrical interfaces

- Serial: RS 232/422
- Ethernet: UDP/TCP
- Pulse: TTL



Phins C5

Performance

- Heading: 0.05 deg
- Roll pitch: 0.01 deg
- Position accuracy: 0.1% DT
- Power consumption: 20 watts

Environment characteristics

- Weight: 4.77 kg
- Volume: 5.9 L
- Diameter: 154 mm

Electrical interfaces

- Serial: RS 232/422
- Ethernet: UDP/TCP
- Pulse: TTL



Phins C7

Performance

- Heading: 0.01 deg
- Roll pitch: 0.01 deg
- Position accuracy: 0.05% DT
- Power consumption: 20 watts

Environment characteristics

- Weight: 3.5 kg
- Volume: 4.6 L
- Diameter: 200 mm

Electrical interfaces

- Serial: RS 232/422
- Ethernet: UDP/TCP
- Pulse: TTL

From 2 to 5 independent input data flows

02

CUSTOMER STORIES

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legendary shipwreck

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Bringing safety back
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ON THE HUNT FOR THE LEGENDARY SHIPWRECK “LA CORDELIÈRE”

During Summer 2018, the “André Malraux”, the DRASSM (the French Department of Underwater Archeological Researches) scientific ship, built by iXblue Shipyard division, took part in a 3-week mission, to locate the wrecks of 2 warships, sunk near Brest over 500 years ago: “La Cordelière” and its English opponent, the Regent. A multidisciplinary team of scientists, historians and divers, lead by Michel L’Hour, head of the DRASSM, backed with high-end equipment designed by iXblue, embarked on this exciting journey to explore underwater heritage.

A multidisciplinary team of scientists, historians and divers, backed with high-end equipment designed by iXblue, embarked on this exciting journey to explore underwater heritage.

“La Cordelière”, Duchess Anne’s flagship, and Henry VIII’s the Regent were some of the largest battleships of their time. They sank together during an epic battle of the Breton-French war against the English, after both ships caught fire and exploded. No-one knows exactly where the battle took place and searches carried out in 1996 and 2001 failed to locate the shipwrecks. This time, the team’s efforts focused on a new perimeter, based on a new interpretation of tidal movements and archives documents. During these 3 weeks, the mission explored a 6 km² seabed perimeter and the results were quite unexpected!

The André Malraux, a state-of-the-art scientific vessel

Delivered in 2012, the “André Malraux” is one of two vessels built by iXblue and owned by the DRASSM. This 36-metre Multipurpose Research Vessel, that offers more than 70 sqm of work areas, can welcome up to 40 crew members, scientists and divers for surveys up to 8 days. Her mission is to act as a support for human or robotic diving operations in the frame of underwater archeological researches. Made out of composite material, which does not rust, is easy to fix, and provides an unrivaled cost of ownership, the “André Malraux” is propelled by a diesel-electric engine. This versatile survey vessel sails about 160 days per year and has become iconic among the profession.

The ship integrates an Echoes 10 000, iXblue’s ultra-high-resolution sub-bottom profiler, designed for shallow water environment. Coupled to a magnetometer, it can detect buried anomalies in the sediments. The vessel also includes, Gaps, iXblue’s USBL system, which positions the sonar, the magnetometer and the ROV, while the Octans, iXblue’s gyrocompass,

counterbalances the multi-beam echosounder’s movement. Delph Suite, iXblue seabed mapping software, is also on board the “André Malraux”. It combines an advanced 3D cartographic visualization feature with smart and fast tools for processing, mapping and interpreting data from the sonar, the sub-bottom profiler and the magnetometer and thus facilitates the search for seabed anomalies, which could lead to both shipwrecks.

A third vessel uncovered

The mission, while not successful in finding the two battleships, came across the wreck of a third vessel, temporary named “Sud Minou1”, in reference to the name of the fort and lighthouse nearby. Presumably it looks like a commercial vessel from the 14th or 15th century, an unexpected discovery but nonetheless highly interesting for the archeologists.

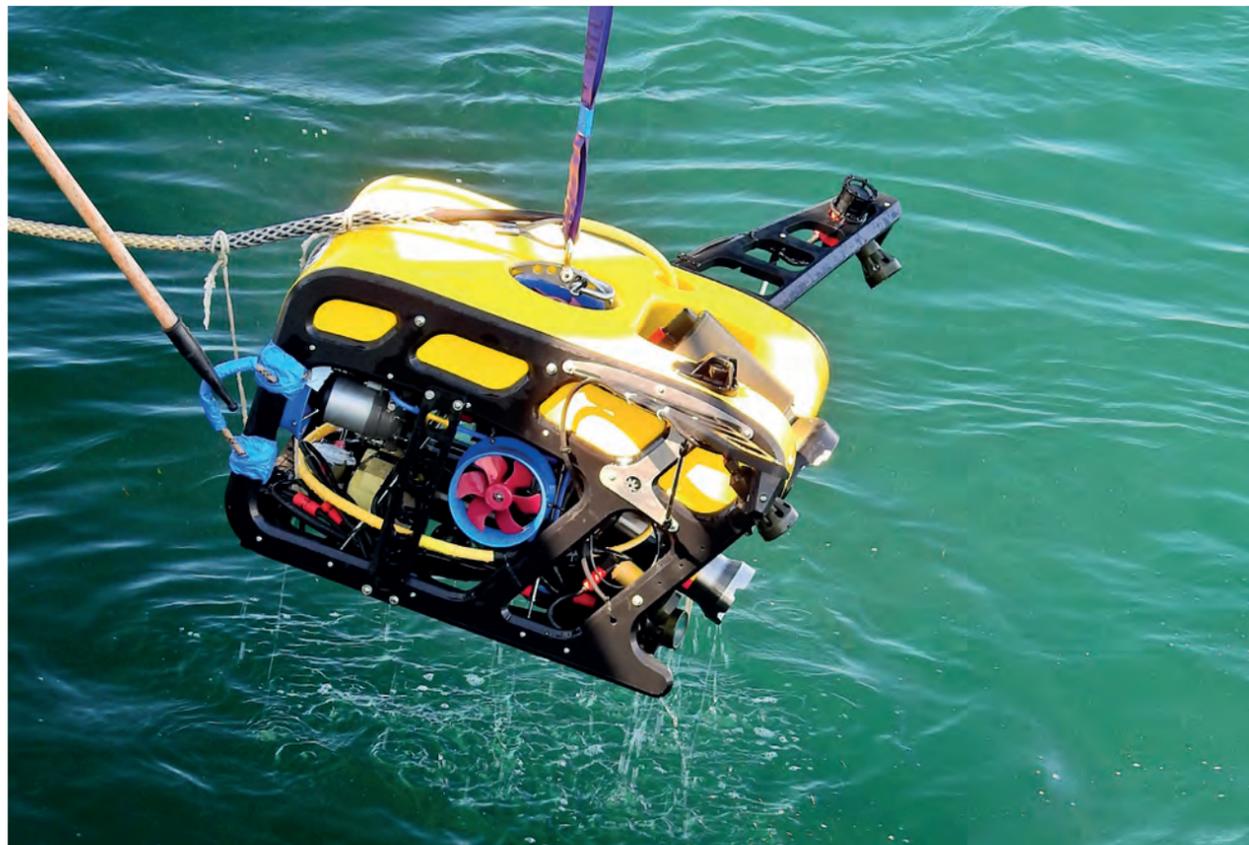
The DRASSM and its partners are now processing the data gathered by the robots, the echosounder and sonars and are currently focusing on analysing the anomalies detected in the sediments.

A new search campaign in June 2019

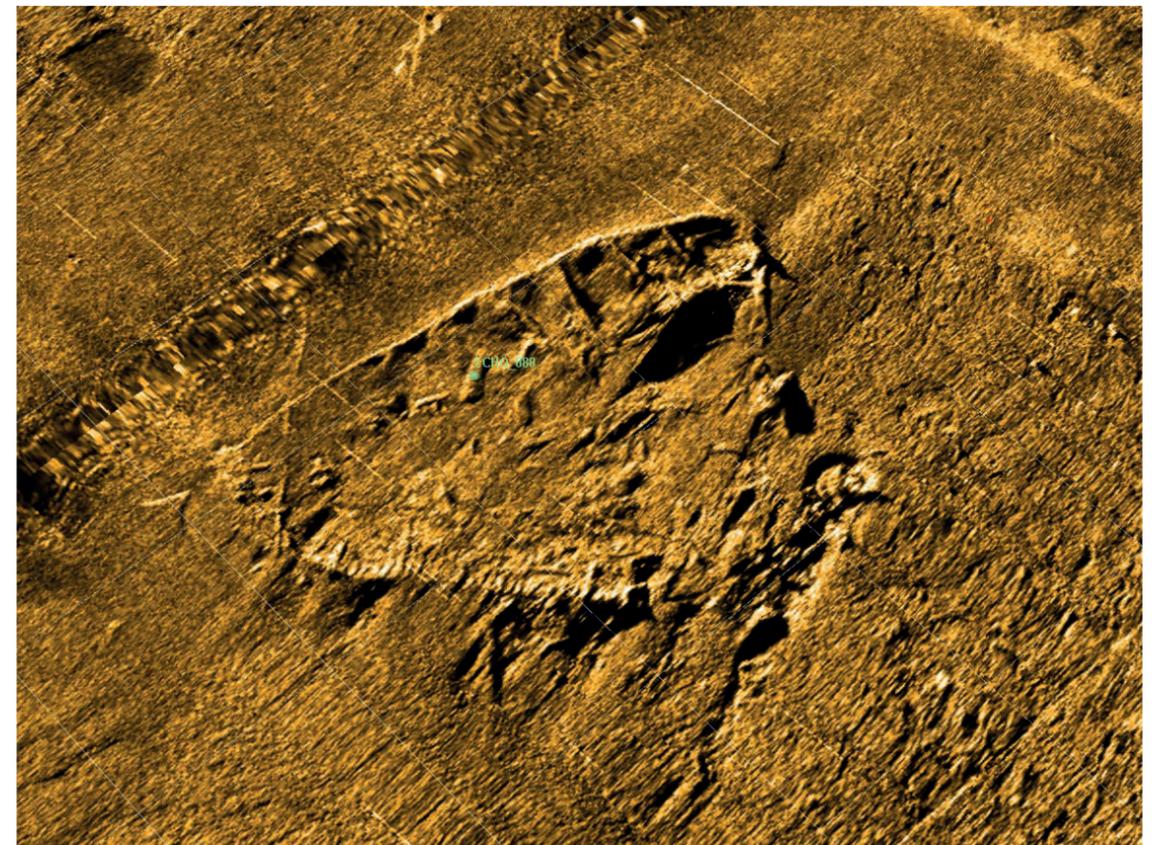
Searches for “La Cordelière” and the Regent will resume in June 2019 on-board of the “André Malraux” vessel. A new perimeter could be defined based on documentary search about the Regent in the Portsmouth History center’s archive and the data gathered during the 2018 mission. The new uncovered wreck will also be explored with archaeologist divers and high-tech robotics systems.

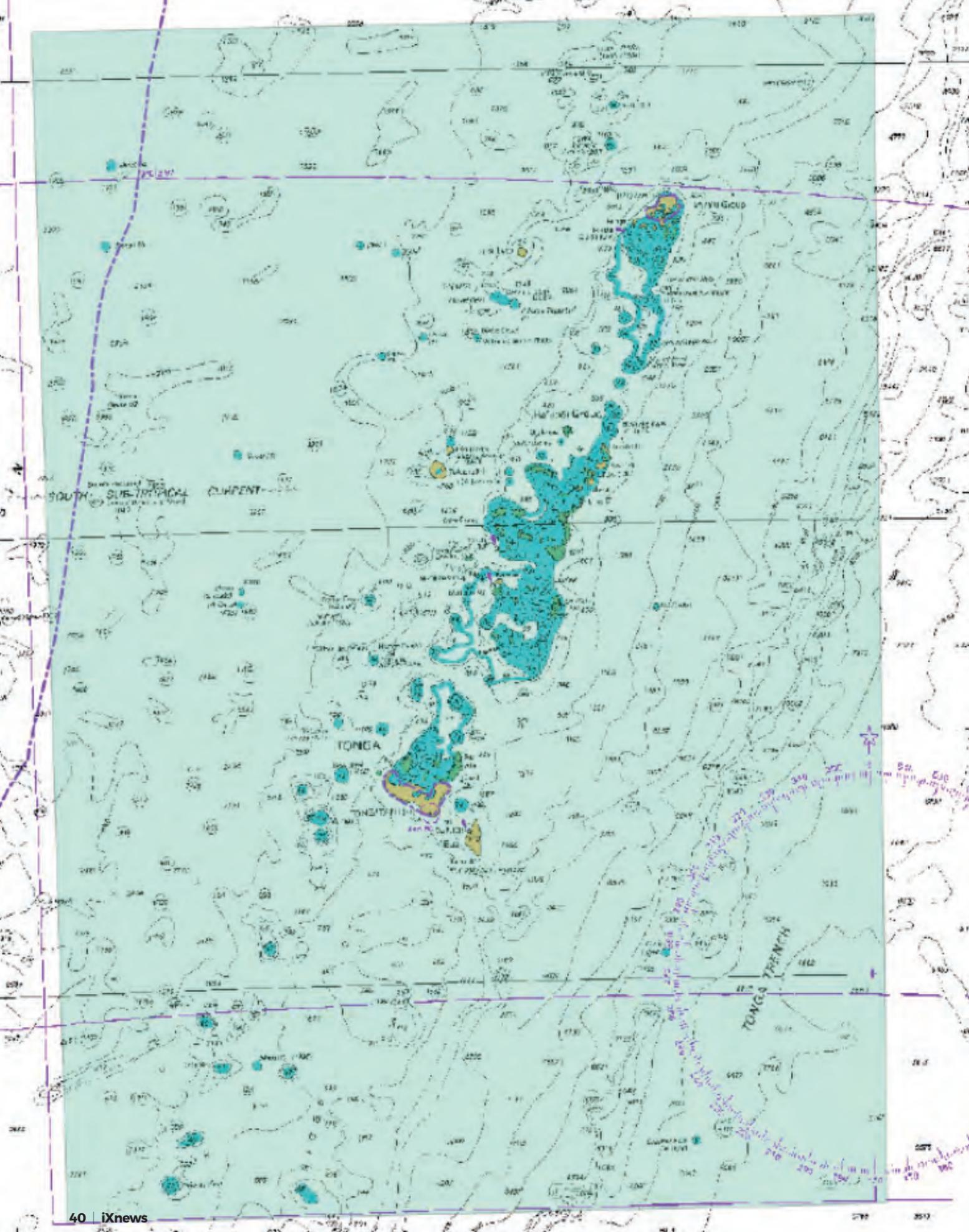
Another very exciting adventure, at the crossroads of the most advanced underwater technologies and the meticulous and thorough archives work on ancient documents. ■

The ROV is being deployed from the André Malraux



The wreck of a third vessel was uncovered during the mission





◀ Over 5,300nm have been surveyed during the operation

MULTI-SENSOR SURVEY IN THE SOUTH PACIFIC

Back in 2018, the marine surveys teams of iXblue conducted one of the largest multi-sensor survey projects in the world. Making use of Satellite Derived Bathymetry, Airborne Lidar Bathymetry and iXblue's Unmanned Surface Vessel, DriX, fitted with a Multibeam Echosounder, this project saw the charting of over 5,300nm in South West Pacific waters around the Tongan and Niue Islands.

The survey, funded by the New Zealand government, was part of a larger maritime project named Pacific Regional Navigational Initiative (PRNI). The aim of this program is to increase navigation safety in the South Pacific, a region of the world that is poorly mapped with many charts still displaying depths in fathoms and containing data that was collected with lead line and positioned with sextants.

With over 100,000 line miles surveyed worldwide, iXblue is considered one of the leading survey contractors for high resolution seafloor surveys in the Australasian region. The company was thus contacted by Land Information New Zealand (LINZ), a government agency responsible for hydrographic survey work around New Zealand and the South West Pacific and that produces nautical charts that are relied upon by commercial and recreational mariners for safe navigation in the region.

"Despite being heavily serviced by ships, the South Pacific region remains very poorly charted. This poses a serious threat from a navigational and environmental safety perspective," explains David Donohue, Director of iXblue Sea Operations division in Australia. "This is why LINZ sought to improve the quality of nautical charting in this region. Due to the extensive area in need of modern survey and charting, and a relatively small budget, LINZ needed a clever, multi-sensor approach to yield maximum return on investment with the project. LINZ thus decided to undertake a phased approach over the course of 12 months, using a variety of survey technologies including Satellite Derived Bathymetry (SDB), Airborne Laser bathymetry (ALB) and Multibeam bathymetry using iXblue's USV."

A new multi-sensor approach for survey work

The introduction of Multibeam Echosounders (MBES) over 20 years ago, revolutionized safety of navigation surveys by allowing surveyors to obtain full bathymetric coverage over the entire seabed, which was not previously possible with single beam echosounders and side scan sonars. However, MBES surveys, requiring the use of large vessels, are slow and expensive to conduct. Which is particularly true for shallow water areas.



Faster and cheaper methods for collecting bathymetry have been developed and now include the use of laser scanners mounted onto aircraft as well as the use of satellite imagery. The use of SDB and ALB is particularly effective in areas where water clarity is high – such as in the SW Pacific. However, neither technology can meet the feature detection requirements in depths greater than 20m. Accordingly, vessel mounted MBES systems are required for surveys in depths greater than 20m.

“We quickly realized that no satisfactory solution existed to bring down the cost for these surveys and decided that we needed to manufacture our own asset that would be a game changer for the survey market,” continues David. “Our team of marine survey specialists worked closely with our shipyard in France to design and manufacture a dedicated and specialist survey vessel that could be deployed from a mothership – a force multiplier if you will. This is how we came up with DriX, an 8 meter-long USV with exceptional seakeeping qualities and unrivaled sensor stability. Our teams first used it to conduct the Tonga Islands mission for LINZ and it truly proved to be an efficient, cost-effective and safe solution for large area and long duration surveys.”

Satellite Derived Bathymetry

The PRNI Project began in early 2018 with German firm EOMAP, iXblue’s partner for this mission, completing one of the largest Satellite Derived Bathymetry (SDB) surveys ever undertaken. Full topographic coverage and shallow bathymetry over a 1,500 km² area in the Tonga region was thus obtained using high resolution satellite imagery. Offering accurate modelling of bathymetry, the SDB allowed LINZ to precisely position all of the islands across the surveyed area in a very cost-effective manner. The ability to derive bathymetry from historical satellite imagery and new fly satellite imagery being considerably more efficient in terms of costs than having to mobilise aircraft or vessels to a particular site. The EOMAP SDB data allowed LINZ to reposition all of the islands relative to WGS84 and allowed for more robust planning of the next phase, the Airborne Lidar Bathymetry (ALB) campaign, by identifying shallow water areas of interest that would have otherwise been missed.

Tides and Geodetics

All bathymetry, whether it be SDB, ALB or MBES, needing to be referenced to a common datum for charting purposes, a dedicated five-week campaign was undertaken by iXblue to measure and record the tides across the survey area. At the same time, the team also checked the accuracy of existing geodetic benchmarks and when necessary, established new ones. Thanks to this work, the long-term monitoring of sea-level rise will be greatly facilitated whilst allowing for proper referencing of the data on the new charts.

Airborne Lidar Bathymetry

The next phase of the mission then saw U.S. based firm Geomatics Data Solutions (GDS), conduct an ALB survey of the low-lying reefs and atolls that characterize the Tongan region. “The use of Airborne Lidar Bathymetry (ALB), a highly effective solution to survey extensive areas of shallow waters, offers a cost-efficient and faster solution compared to the use of a vessel. This technology also has the advantage of enabling the survey of shallow, dangerous waters without the risk of grounding that a workboat can encounter. Accordingly, when the water clarity is high, this solution is not only faster and cheaper, it is also much safer,” explains David. “Another advantage of ALB is its capability to detect small features that may pose a danger to surface navigation. Under the right environmental conditions, ALB can truly meet the feature detection requirements needed by the survey standards being specified today.” During this mission, the ALB system used was able to survey the whole area to depths exceeding 20 meters and provided complete knowledge of all navigationally significant features of the surveyed area. This in turn enabled valuable time savings for the subsequent multibeam bathymetry. Indeed, the shallow waters now being surveyed, the vessels used for the next phase were free to safely navigate the region day and night at any speed without fear of grounding on an uncharted or poorly charted feature.

Multibeam Bathymetry

With the airborne survey phase completed, the five-week multibeam survey could then begin. This phase was planned to fill in any areas that could be adequately covered with the ALB survey and all areas deeper than 20m. After a one-week transit from New Zealand, DriX USV and its 30 meters mothership – MV

Silent Wings –, arrived on site, ready to survey the estimated 5,000nm required to complete the survey. A Multibeam Echosounder (MBES) and iXblue’s Phins Inertial Navigation System (INS) were both fitted onto DriX’ gondola, approximately 2 meters below the surface in optimum acoustic conditions for accurate and reliable data gathering.

Featuring an acoustically quiet hull form and unrivaled seakeeping capabilities, DriX was able to collect high quality bathymetry at high survey speeds of up to 10 knots. The 8-meter long USV proved to be able to survey in the same wind and sea conditions as the 30m mothership and often achieved in excess of 170nm per day. Together, DriX and the Silent Wings collected over 5,300nm of sounding data in a five-week period only.

For this mission, four iXblue survey personnel worked in shifts around the clock to operate DriX and the mothership survey system in order to ensure that the data collected was of a high quality. The survey fieldwork was then finalized with the recovery of all tidal sensors as well as the collection video imagery and seabed sampling across the survey area.

“We are very pleased with the survey results and are highly confident that the multi-sensor approach has exceeded all expectations of our client – LINZ. Their decision to award a project of this scale which utilises SDB, ALB and a USV fitted with MBES, has proven very successful. We are confident that this approach to undertake the large area survey of the PRNI Project will pave the way for many similar projects in this region in the coming years,” David Donohue concludes. “The use of DriX was the first time that an unmanned surface vessel had been used for a contract hydrographic survey in the Southern Hemisphere. It was also the first time that iXblue had employed an USV on any survey project and it certainly proved to be a very successful test on its first outing. Our entire team was pleasantly surprised by the ease at which DriX could be deployed and operated as a force multiplier from the mother vessel. The data quality, safety, efficiency and cost effectiveness that DriX now offers us is very exciting. There is no doubt that this vessel will change the way that large area surveys are undertaken in the future. It has proven the utility of USVs and will certainly encourage their use by other companies and organisations in the future”. ■

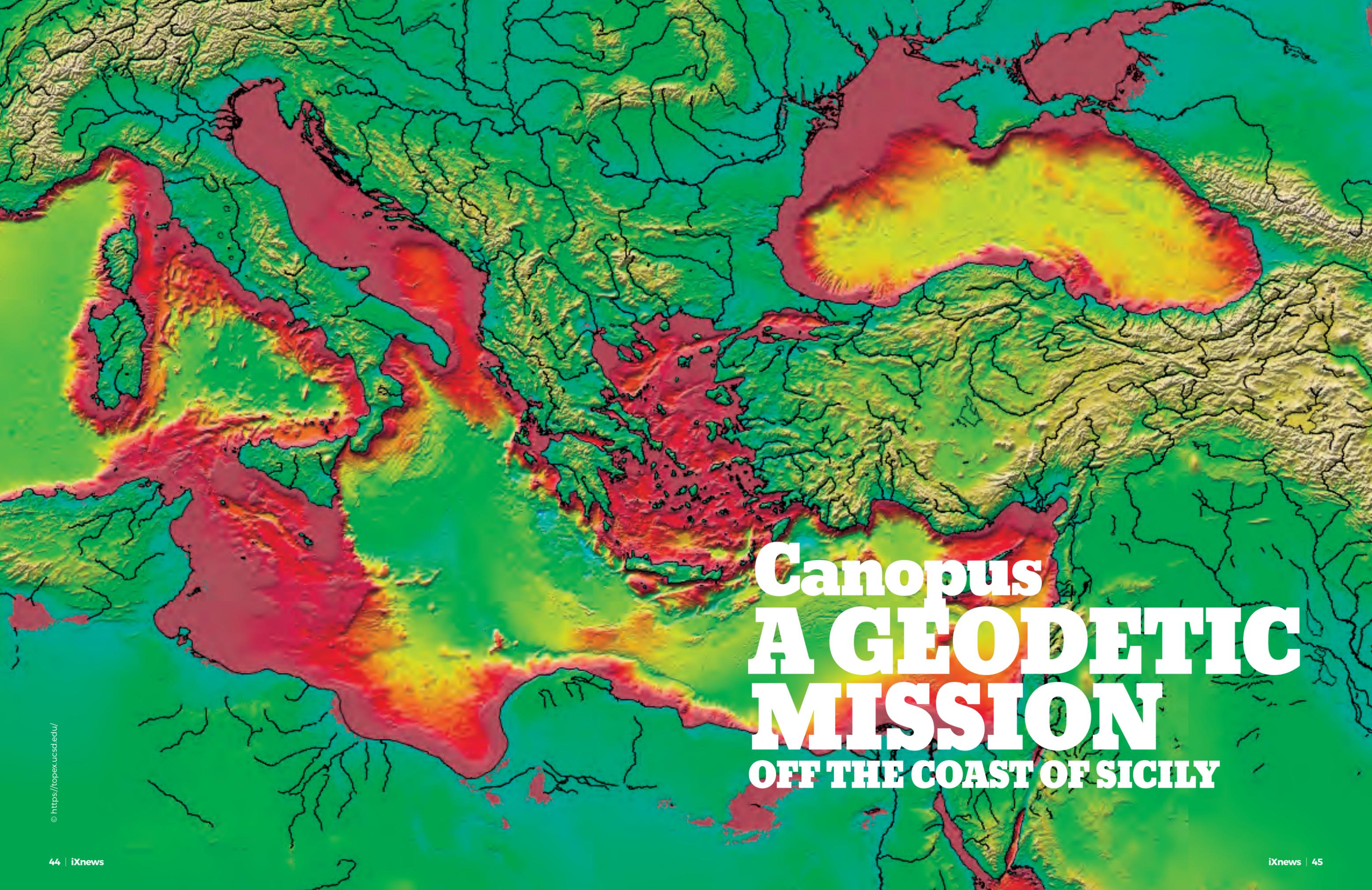


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THE DATA QUALITY, SAFETY, EFFICIENCY AND COST EFFECTIVENESS THAT DRIX NOW OFFERS US IS VERY EXCITING. THERE IS NO DOUBT THAT THIS VESSEL WILL CHANGE THE WAY THAT LARGE AREA SURVEYS ARE UNDERTAKEN IN THE FUTURE.

- DAVID DONOHUE, DIRECTOR OF IXBLUE SEA OPERATIONS DIVISION, AUSTRALIA

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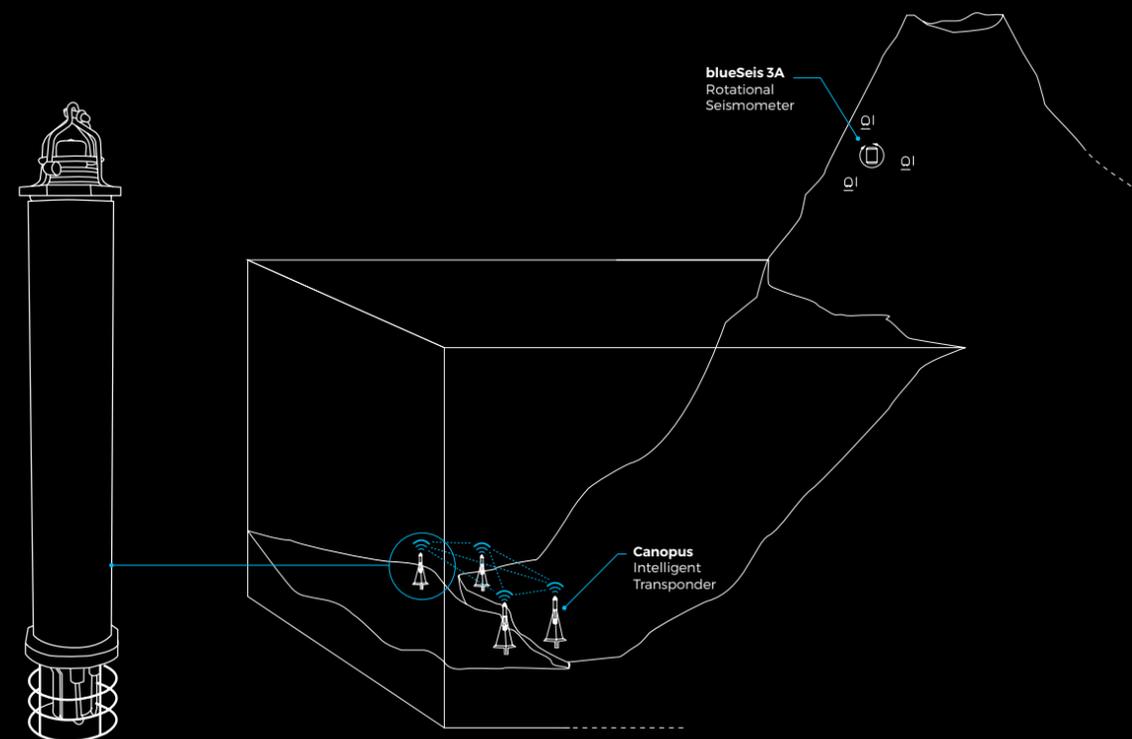
Canopus
A GEODETIC
MISSION
OFF THE COAST OF SICILY

iXblue has been chosen by the European Institute for Marine Studies (IUEM) to provide 8 Canopus LBL transponders for a major geodetic mission off the coast of Sicily. Deployed on the seabed, 2,500 meters below the surface, the Canopus transponders will measure the crustal deformation along the North-South Alfeo faults with a millimeter-scale resolution over the course of 4 years.

“We are very proud to have been chosen by such a leading institute for this major geodetic project,” states Hubert Pelletier, Head of iXblue Acoustic division. “The fact that the IUEM, a long-standing partner of iXblue, trusts our new Canopus transponders for this challenging project is a big vote of confidence. Because the Canopus transponders precisely meet the exacting requirements of such a long-term subsea project, iXblue was chosen to provide autonomous and continuous monitoring of the movements of the tectonic plates along a 2 kilometers segment of the North-South Alfeo faults. Installed on the seafloor along the faults, the transponders will measure, over the course of 4 years, the acoustic distance travel-time from one transponder to another to precisely determine their accurate distance. Thanks to those measurements, the IUEM will then be able to better characterize the way the fault behaves and will gain valuable insight into seismic risks.”

“We needed a highly accurate and reliable system able to provide precise measurements over many years,” explains Jean-Yves Royer, in charge of the project at the IUEM. “The autonomy provided by the Canopus transponder, along with its ease-of-use and the availability of the iXblue teams during the tests phase were decisive factors in our choice of transponders for this major project.”

Enhancing iXblue’s offer in subsea positioning solutions, the Canopus LBL transponder was developed in tight collaboration with major scientific partners. Easy to deploy and to use thanks to its user-friendly MMI (Man-Machine Interface), it is especially suited for scientific and industrial applications that require high autonomy, instrumentation, repeatability and accuracy. Thanks to its hundreds of acoustic codes for interrogation and reply, Canopus can be used in the most complex environments without any acoustic interferences. It features underwater acoustic communication between transponders, transceivers and surface equipment and embeds environmental temperature, pressure, sound velocity and inclinometer sensors. Offering extremely low power consumption (up to 4 years of battery life in listening mode) and intelligent ping management, Canopus is perfectly suited for subsea operations such as seafloor Geodesy, subsea monitoring, construction, or subsea mining. ■



«We needed a highly accurate and reliable system able to provide precise measurements over many years. The autonomy provided by the Canopus transponder, along with its ease-of-use and the availability of the iXblue teams during the tests phase were decisive factors in our choice of transponders for this major project.»

Jean-Yves Royer,
in charge of the project at the IUEM

SEAPIX SONAR TO BRING
SAFETY BACK
TO THE REUNION ISLAND





The CRA is looking for new innovative, effective and safe ways to detect sharks before they reach the coasts and become a threat to recreational beach users.

Recent years have seen the dramatic rise of shark attacks on the Reunion Island. For the past seven years, over 20 attacks have taken place there, making the small French oceanic island the most dangerous place in the world for shark attacks according to its coastline length. Going through a real crisis, the Reunion Island is now being called “shark island”, “shark aquarium” or “shark attack capital of the world”, nicknames that convey a negative reputation that led to disastrous economic consequences for the island and its population. To address the situation, the French government and local authorities have thus decided to create a new agency, the CRA (Centre de Ressources et d'Appui à la Gestion du Risque Requin), whose mission is to manage and reduce the shark risk on the Reunion Island. To that end, the agency contacted iXblue, with the wish to test SeapiX 3D volumic sonar for the long-range detection of sharks.

“The CRA is looking for new innovative, effective and safe ways to detect sharks before they reach the coasts and become a threat to recreational beach users,” explains Olivier Lerda, R&D engineer at iXblue. “The current means of monitoring beaches and surf spots are limited. For instance many of the gillnets used have a significant impact on marine biodiversity and their operating costs are very high. Aerial or subsea surveillances,

by drones or freedivers, are limited to good weather conditions and to human perception capabilities. The SeapiX sonar solution would therefore be very complementary to existing methods. This system could be used in any weather and would offer new perspectives for observations. For instance our first simulations showed a detection range of more than 100 meters, when competing systems can only reach 50 meters. Being able to detect sharks at a greater distance would mean more reaction time to alert beach users and surfers, saving lives.”

The challenge was great for the iXblue teams, as sharks are an especially hard specie to detect. Indeed, their acoustic signature is difficult to confirm due to their lack of swim bladder, an internal gas-filled organ that contributes to the ability of many bony fish to control their buoyancy and that usually increases the amount of acoustic energy returned to the sonar by the target.

“Many thoughts have been put into it in order to maximize our chances of detecting a shark,” explains Olivier. “In the end, we decided that an “FLS” (Forward-Looking Sonar) installation would be best. SeapiX would thus be vertically deployed on the seabed to monitor a horizontal layer of water. This configuration allows the observation of a target during its approach. In addition, the redundancy of detections should allow us to confirm and track the target. An insonification strategy, based on a sequence of narrow and broad transmission beams (for long-distance detection and to cover

a larger volume) was also implemented to optimize the monitored area.”

Tests were thus conducted for 2 weeks, off the west coast of the island to assess the efficiency of the SeapiX sonar for such an application. Installed in a forward-looking position on a tripod, 100 meters away from the shores, the SeapiX sonar was able, after a few days, to detect a young 2.7 meters long tiger shark at a distance of 160 meters. A record for the sonar detection of those sharks that do not usually exceeds a few tens of meters.

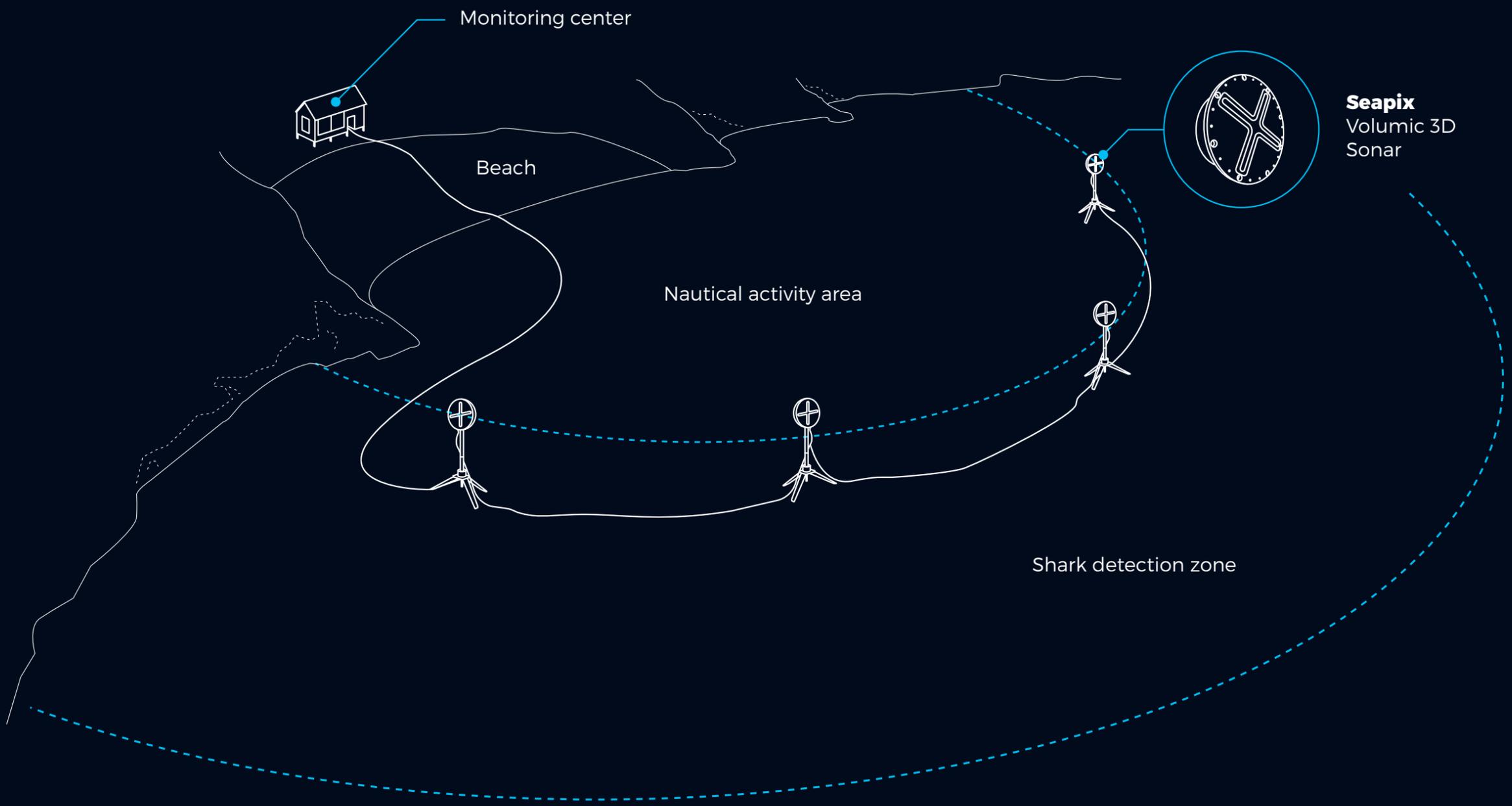
“We are very satisfied by the first results of these tests conducted in partnership with the CRA,” states Olivier. “Being able to confirm the sharks’ acoustic signature at a distance as important as 160 meters, opens up great possibilities for SeapiX. The next step for us is to confirm these capabilities in complex reef areas with very low water levels, chaotic bathymetry with highly reverberant bottom obstacles, and strong surface agitation. We are also looking forward to validating the performance of our new automatic detection algorithm!”

This first series of tests successfully conducted by the CRA and iXblue clears up a way to a new highly effective technology that could be used as an innovative, sustainable and reliable system for the early coastal detection and tracking of sharks on the Reunion Island (see next page). Installed on the seabed, far from the coast, SeapiX 3D volumic sonar could make a significant contribution to bringing back safety and peace of mind to the island and its population. ■

Tests were conducted
100 meters off the
West Coast of the island

Being able to confirm the sharks’ acoustic signature at a distance as important as 160 meters, opens up great possibilities for SeapiX.

Rendition of the potential use of the system





HIGH ACCURACY SUBSEA POSITIONING FOR SCIENTIFIC MISSION OFF THE COAST OF COLUMBIA

iXblue recently took part in a scientific mission to study marine ecosystems around the Malpelo Island, off the coast of Columbia. This mission was part of a three-year circumnavigation of the world's oceans and seas to study the overexploitation of marine resources, pollution, ocean warming and acidification, as well as the disappearance of marine species and coral reefs.

Onboard the Yersin, a vessel turned into a scientific boat by Monaco Explorations, iXblue's USBL (Ultra Short Base Line) positioning system, Gaps, provided accurate positioning of the ROV (Remotely Operated Vehicle) used to sample environmental DNA and film the seabed at depths reaching up to 1,000 meters during the three-week mission.

For this operation, Gaps was installed on a pole lowered into the water thanks to the crane of the vessel. This allowed the easy use of Gaps that did not need to be mounted on the vessel itself, an operation that would have proven challenging on this type of ship. Such a use of iXblue's USBL antenna was made possible thanks the INS (Inertial Navigation System) directly integrated within Gaps, and that provided permanent and accurate monitoring of the antenna's motion.

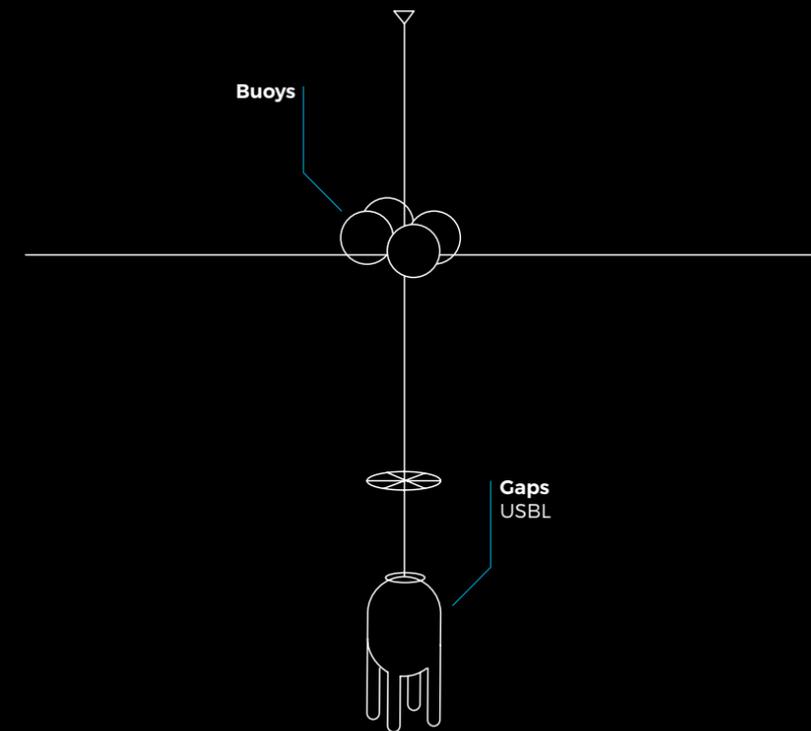
Gaps thus ensured accurate positioning of the ROV, whatever its conditions of use (vertical or horizontal positioning) and offered a nominal range of 4,000 meters and a positioning precision of 1 meter for a slant range of 1,000 meters.

Recent updates made to Gaps opened-up the way to new functional capabilities such as a bidirectional acoustic communication link between the vessel and the underwater vehicle thanks to the telemetry function. In addition to its positioning functionality, Gaps thus also acts as an acoustic modem, enabling various other features (recalibrating an INS while in position, retrieving sensors data, sending control command to a subsea vehicle, retrieving the subsea vehicle information). Gaps offers a robust acoustic communication link with a data transfer speed that can reach up to 500 bits/s even in harsh and noisy environments.

Gaps thus provides both the positioning and the telemetry functionality within a single device, making it possible to save space and energy on the underwater vehicle which only has to use a single beacon. This makes the management of acoustic resources much more straightforward as the transmissions sequencing of positioning and telemetry signals are controlled by a single device, eliminating risks of interference.

Adopted by over 120 companies, institutes and navies worldwide, iXblue's flagship subsea positioning system, Gaps, rapidly established itself as the new standard product for operations requiring the precise positioning of an underwater vehicle. It is now used in various applications such as scientific missions, subsea construction, offshore energy exploitation or deep see mining. ■

Gaps mounted on a floating side pole ▶





IXBLUE BUILDS
NEXT GENERATION
OF PLANETARY SEISMOMETERS

IXBLUE'S BLUESEIS BUSINESS LINE, THAT OFFERS UNIQUE AND RELIABLE EARTH MONITORING SOLUTIONS, IN PARTNERSHIP WITH A EUROPEAN CONSORTIUM OF RESEARCH LABORATORIES (ISAE-SUPAERO, ETHZ, IPGP, ORB, LMU), HAS RECENTLY WON THE HORIZON 2020 CALL FOR PROPOSALS. FUNDED BY THE EUROPEAN COMMISSION, IT FOCUSES ON THE DEVELOPMENT OF A NEW GENERATION OF PLANETARY SEISMOMETERS.

Coordinated by ISAE-SUPAERO, the PIONEERS project (Planetary Instruments based on Optical technologies for an iNnovative European Exploration using Rotational Seismology), in which iXblue plays a key role, aims at developing a unique breakthrough technology which will make it possible to sense deformations 100 times weaker than with currently available sensors.

"We were looking for an industrial partner to support us in answering the H2020 program call and iXblue, being a leader in rotational seismology, was the most obvious choice for us," explains Raphael Garcia, Researcher at ISAE-SUPAERO. "Their strong implication in research and scientific instrumentation, combined to the advanced skilled of their engineers only confirmed this choice. Another key factor that convinced us also was iXblue's strong track-record of successful collaborations with research laboratories and academic partners."

The future space probes that will be developed by the consortium, whose mission will consist in characterizing the composition of planetary bodies by studying a range of parameters including their density, mass distribution, and elastic mechanical properties, are therefore going to be equipped with the Fiber-Optic Gyroscope (FOG) technology developed by iXblue. Optical interferometry techniques (involving measurement of a motion

using the interference between two light rays, whose difference in the path covered varies with the movement to be measured) will be used to measure, not only the translation movements, but also the rotational motions at the surface of the planetary bodies. This new dimension of rotational measurement will complement traditional seismometers which only measure translation, and hence open up the way to new methods for the exploration of planetary interiors.

«ISAE-SUPAERO came to us mainly thanks to our unique ability to measure what we commonly call the 6 DoF (or 6 Degrees of Freedom). To put it simple, a movement can only be fully described if we're able to measure both its translations and its rotations in the three directions of space," explains Frédéric Guattari, who leads the blueSeis business line. "Another important factor in winning this project has been our FOG technology. Being fully adaptive, it means we can provide a solution for sensors ranging from the ultra-compact to the very large. So the challenge ahead for the project will be to develop a single electronics package for the three gyroscopes and three accelerometers.»

An additional challenge for the iXblue teams involved in the project will be the requirement to deliver a «mock-up level» giant FOG, one meter in diameter, and therefore to develop specific

electronics that can be used both on small coils for observation of asteroids and larger coils for observation of the moon. The benefit for Europe being not to have to fund additional developments each time there is a new mission.

By bringing together cutting-edge skills including planetary instrumentation, geodesy, rotational seismology, electronics and spatial optics, iXblue and its partners will be able to develop a breakthrough technology to measure the translation and rotation of the surface of planetary bodies within a single probe.

Frédéric Guattari concludes: «This H2020 project opens up great opportunities for iXblue. The company's navigation, space and blueSeis teams will be able to work together in perfect synergy to deliver this exciting project. Thanks to this, we will be able to position ourselves in the emerging New Space market, along with our Motion Systems and Photonics divisions, as this is an extremely dynamic segment with lots of growth opportunities. Moreover, it's an incredible showcase for iXblue's expertise. This is true recognition for the quality of our technology.» ■

