

Hydro INTERNATIONAL

THE GLOBAL MAGAZINE FOR HYDROGRAPHY

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Preparing Research
Vessels for the Future

Securing Offshore Oil
and Gas Infrastructure
with USVs

GPS Trackers and
Drones Help Locate
Floating Debris

Maximizing performance by providing



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Hydro International is an independent international magazine published 6 times a year by Geomares. The magazine and related e-newsletter inform worldwide professional, industrial and governmental readers of the latest news and developments in the hydrographic, surveying, marine cartographic and geomatics world. Hydro International encompasses all aspects, activities and equipment related to the acquisition, processing, presentation, control and management of hydrographic and surveying-related activities.



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P. 13 Interview with Mark Heine, CEO of Fugro

Fugro is the leading and largest specialized survey company in the world, serving the full lifecycle of assets, and calls itself a geodata specialist. We talked to Mark Heine about leadership style, strategies for finding new employees, and Seabed 2030.



Sponsored article by Teledyne Caris

P. 18 AI Making Waves in the Maritime Field

P. 21 GPS Trackers and Drones Help Locate Floating Debris

An estimated 600,000 tons of abandoned fishing gear ends up in the oceans every year. According to the United Nations, some 380,000 marine mammals are killed each year, either by ingesting it or being caught in it. Mary T Crowley of the Ocean Voyages Institute describes how GPS trackers are being used to mark the ghost nets.



P. 29 Preparing the European Fleet of Research Vessels for the Future

Recently, the European Marine Board published a report on the current status of the European fleet of research vessels. This so-called Position Paper describes how the fleet will need to develop in the future to ensure that it will continue to provide the same high level of support to science and hydrography globally, as well as highlighting ways in which management could be made more efficient. This article is an extract of the report.



P. 32 Real-time 3D Mapping and Bathymetry Sonar for High-precision Marine Works

P. 35 Securing Offshore Oil and Gas Infrastructure with Unmanned Surface Vehicles

Employing commercial-off-the-shelf USVs that can be rapidly reconfigured with a diverse range of sensors can enhance the ability to deliver energy to America and the world. This is a win-win for the energy industry, says George Caldorisi when he describes the securing of oil and gas infrastructure with Unmanned Surface Vehicles.



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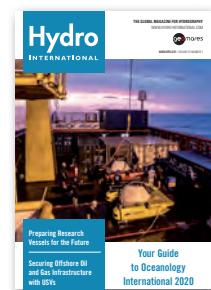
P. 25 Hydrographic Mapping for the Caribbean Islands

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Front Cover

The Seychelles and Maldives are undertaking a major joint marine research expedition to explore and conserve the Indian Ocean, called 'First Descent: Midnight Zone'. It is a 35-day mission to support the sustainable governance of the Seychelles and Maldivian ocean including the protection of 629,000 km². A team of 50 international scientists, technicians, media and crew will be carrying out research to gather critical data to define conservation and management priorities and the designation of Marine Protected Areas. Research is focussed on seamounts in the Midnight Zone (ocean depths between 1000m and 4000m). The expedition starts in the Seychelles on March 16th 2020. (Courtesy www.nektonmission.org)





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▲ Durk Haarsma.

We had prepared an extra thick edition of *Hydro International* for you, full of feature articles, columns, an interview and news from and a preview of Oceanology International 2020. However, this biannual top event for hydrography and oceanography, held at ExCeL in London, which always attracts thousands of people from all corners of the globe to visit the showcase of everything that is new or proven in our industries, has been postponed due to the coronavirus. As our aim is to serve the hydrographic community in the best way we can, we therefore changed – as much as possible – the focus of this issue. Before you lies a new, completely up-to-date, diverse and thick issue of *Hydro International*, updating you on all that is new in the industry. Please also visit www.hydro-international.com and our partner website www.geo-matching.com regularly to keep track of the very latest developments.

For this issue, I had the pleasure of interviewing Mark Heine, CEO of Fugro since October 2018. Heine talks about the transition the company is in, from a mainly oil- and gas-driven company to one that is relying on renewable energies such as offshore wind as a big source of revenue. As Heine points out, a shift is taking place in surveying companies like Fugro; formerly dependent on the fossil energy boom, they are now jumping on the bandwagon of greener sources of energy, in response to the negative impact of climate change.

Somewhat more hidden in Fugro's recent figures is the increase in the company's revenue from hydrography in the segment that Fugro calls 'nautical'. Water and flood protection are some of the factors behind the rise in this area of business for the Dutch surveying company. Factors that show, once again, a shift in the focus of the business that is heavily linked to climate change and the need to switch from fossil to other, more sustainable forms of energy. Another factor is the fast pace at which technology is changing. It is difficult for governments to keep up with these changes, so that consultation with and outsourcing to private parties is increasing.

Last but not least, more and more charting projects are being undertaken by philanthropists, and private parties such as Fugro are taking a lot of the day-to-day work out of their hands or are consulting with the philanthropists. The shift in the business towards a greener, more sustainable future for our globe and, moreover, for our oceans is inevitable, challenging and exciting at the same time. I wish you happy reading!

Durk Haarsma,
director strategy & business development
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Postponed, Not Cancelled

More than thirty years ago, I had just accepted a new position within the government organization where I worked and I was instructed to organize our participation in a trade show. For me, that was a totally new experience.



▲ Cees van Dijk.

I had visited many trade fairs as a visitor, but I had no idea what was needed to produce a professional and well-organized presentation. I also had no idea of all the advertising and marketing opportunities that a scholarship offers. Fortunately, I was surrounded by professionals who knew how to approach such a project. Nevertheless, it was still a surprise to see how many sleepless nights were involved in ensuring that our presence at the fair went smoothly.

Opportunities to promote our participation were limited to a few advertisements in some related magazines, a short interview in a newspaper and a minute of broadcasting time at a local radio station. I was constantly wondering how we could ever reach the people who, I hoped, would be interested in attending the show and, more importantly, coming to our booth.

When the doors of the exhibition complex opened, visitors flocked in for three days. This was understandable, because for many it was the only way to keep abreast of the latest innovations, remarkable products and services that had never been offered before. Making new contacts and maintaining existing contacts were also inextricably linked to visiting a trade fair.

With the dawn of the digital age, numerous opportunities have emerged to establish contacts with suppliers and other companies in the sector, and to become acquainted with innovations, without having to travel to an exhibition building with all the associated hassle. Is it actually still useful to invest time, money and energy in what some call an outdated concept?

My answer to that question is a resounding yes! It certainly is. No matter how advanced the current technical communication options are, they do not provide an alternative to making personal contact. This is possible in every way at a fair like Oceanology International. Let us seize this opportunity with both hands.

Shortly before this issue of *Hydro International* was printed, Oceanology International 2020 announced that the exhibition is to be postponed until December, following the escalation of COVID-19 in Europe. Our team will produce a show special with the latest updates of the trade show and we'll be publishing the Show Daily. Don't miss out on these excellent opportunities to inform your customers. In the meantime, keep sending us your news updates.

Cees van Dijk, content manager
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Founder of the Five Deeps Expedition Launches New 2020 Voyage



Through collaboration between investor and explorer, Victor Vescovo, Triton Submarines and EYOS Expeditions, the 2020 Caladan Oceanic expeditions will yet again visit never-before-seen ocean depths and famed historic sites. A first of its kind two-person research submersible, designed and manufactured by Triton specifically for extreme deep-sea exploration endeavours, will bring its stories of the voyage to the world in near real-time between February and July of 2020.

The vessel, the Deep Submergence Vehicle (DSV) Limiting Factor, is the first commercially certified full-ocean-depth submersible. It will be transported and deployed into the ocean depths by the Deep Submergence Support Vessel (DSSV) Pressure Drop, a former US Navy ship specially retrofitted for the expedition. Vescovo will pilot the submersible on almost all of its dives.

"Following up on the success of our mission last year to dive to the bottom of all five of the world's oceans, we look forward to diving two seas and two oceans in the recently enhanced Limiting Factor on a new series of 'first' manned dives," Vescovo said from Toulon, France, where he had just completed the first phase of the voyage.

After completing sea trials off the coast of Spain on 31 January, the Caladan Oceanic team sailed to the southern coast of France where on February 1-2 they twice dived on the tragic wreck of the French submarine, Minerve. Caladan worked closely with French authorities and the family of its crew to organize the expedition. On the first dive, Vescovo was accompanied by retired French Rear Admiral Jean-Louis Barbier, a submarine expert who conducted a detailed investigation of the wreck to gather new evidence on what might have caused the vessel's unexpected sinking in 1968.

Herve Fauve, the son of the submarine's captain, accompanied Vescovo on the second dive, when a memorial plaque was placed on the remains of the sunken vessel at a depth of over 2,250 metres. This was the first manned visit to the site since the Minerve's sinking in 1968, which was only discovered last summer. Vescovo later said: "It was very moving to be with the son of the Minerve's Captain, at the actual wreck, and to pay our respects to the brave sailors who gave their lives in the defence of France. As a former naval officer myself, I was very honoured to partner with our French allies to do this."

Researchers Link Greenhouse Gases to Ocean Circulation

A research team from the Institute of Oceanology of the Chinese Academy of Sciences has found that greenhouse gas emissions have played an important role in the acceleration of global ocean circulation, Xinhua, a Chinese news agency, reported. The study found that the global average ocean circulation has accelerated significantly in the past 20-plus years, which may lead to the reshaping of the global marine environment, the report said. A paper on the findings has been published in *Science Advances*, a subsidiary publication of the journal *Science*, the report said.

The researchers made the findings by integrating various data of ocean circulation and sea surface wind speed, and analyzing changes in ocean circulation on a global scale, the report said. "Wind is the main power source of ocean circulation," said Hu Shijian, a researcher with the institute and the first author of the paper. "The speeding-up of sea surface wind has given rise to the acceleration of global average ocean circulation."

Delta Areas Have Gained Land in the Past 30 Years

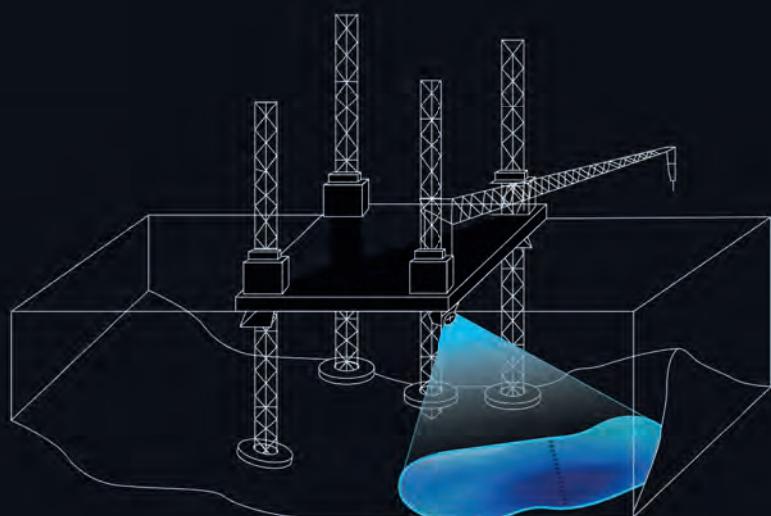
Researchers from Utrecht University in the Netherlands, Woods Hole Oceanographic Institution (WHOI) in the US, and colleagues found that delta areas worldwide have actually gained land in the past 30 years, despite river damming. However, recent land gains are unlikely to last throughout the 21st century due to expected, accelerated sea-level rise. The researchers published their findings in the journal *Nature*.

River deltas rank among the most economically and ecologically valuable environments on Earth. People living on deltas are increasingly vulnerable to sea-level rise and coastal hazards such as major storms, extremely high tides, and tsunamis. Many deltas experience a decline in sediment supply due to upstream damming, making them even more vulnerable. However, the new study found that long-term, large-scale, upstream deforestation has resulted in soil erosion that increased the amount of sediment transported to many deltas.

"A large driver of these gains turned out to be human action," says lead author Jaap Nienhuis, a geoscientist at Utrecht University and a graduate of the MIT-WHOI Joint Programme. "Twenty-five per cent of delta growth can be attributed to upstream deforestation, which results in soil erosion and increased sediment delivery to the coast. Human activities such as damming which causes sediment starvation, and the increased importance of wave- and tide-driven transport, can also change delta shape." The relationship between the sediment deposited by rivers, oceanographic forces of waves and tides, and delta shape has remained poorly understood. To address this, the international team of researchers developed and applied a novel theory that can quantify how waves and tides influence delta shape. The availability of global satellite imagery allowed them to test their new model on over 10,000 deltas worldwide, ranging from small to mega-deltas.



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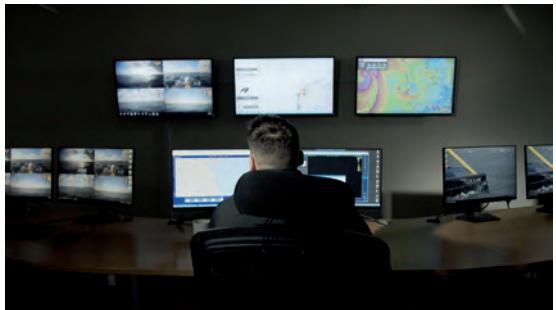
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Remotely Controlled USV Undertakes Survey Work for Wind Farm



In a first for the offshore wind sector, a vessel remotely controlled from shore recently took to the sea off Suffolk to undertake survey work for Greater Gabbard Offshore Wind Farm, a joint venture between SSE Renewables and innogy. The XO-450 Unmanned Surface Vessel (USV), owned and operated by XOCEAN, carried out seabed surveys on seven of the turbines at the 140-turbine

wind farm, located 23 kilometres off the UK coast. The vessel is around the size of an average car (4.5 metres) and half its weight (750kg), and can be monitored and controlled 24/7 via a satellite connection by a team at an onshore control centre. Throughout the survey, the data collected was monitored from shore in real-time by experts located in the UK, to validate data collection before the vessel departed the work locations. This demonstrates the highly flexible and collaborative nature of this new technology, enabling industry experts to have direct access to real-time data, from any location. Commenting on the project, James Ives, CEO of XOCEAN said: "Our USV platform has demonstrated itself to be a safe, reliable and low carbon solution for the collection of ocean data. We are delighted to be working with SSE and innogy on this groundbreaking project." The 500MW offshore wind farm has been in operation since 2012, generating enough low-carbon renewable energy each year to power the equivalent of over 400,000 UK homes.

Two New Oceanographic Vessels Will Join the NOAA Fleet



The first ship, to be named Oceanographer, will be homeported in Honolulu. The second ship, to be named Discoverer, will be assigned a homeport at a future date. Both ships will continue the legacies of their namesakes, the first Oceanographer having served in the agency's fleet from 1966 to 1996 and her sister ship, Discoverer, from 1967 to 1996. Design of the vessels is currently underway and NOAA expects to award contracts for the construction of the ships by the end of the year. Both will be built in the United States and construction timelines and target launch dates for the vessels will be determined after the shipbuilding contracts have been awarded. "The acquisition represents a major step forward in the recapitalization of NOAA's ship fleet and will help ensure that the agency has the seagoing capability to collect the best information possible about the marine environment," said Rear Adm. Michael J. Silah, director of the NOAA Commissioned Officer Corps and NOAA Office of Marine and Aviation Operations (OMAO). NOAA currently has a fleet of 15 active research and survey ships, which are operated by OMAO and crewed by NOAA Corps officers and civilian professional mariners. Each year, NOAA ships conduct more than 100 missions to collect data critical for nautical charts, fishery quotas, exploration of the nation's 4.3-million-square-mile Exclusive Economic Zone, storm surge modelling and climate research.

NOAA is in the process of acquiring two new oceanographic ships as part of the agency's fleet rebuilding effort. Once in service, the new ships will support a wide variety of missions, ranging from general oceanographic research and exploration to marine life, climate and ocean ecosystem studies.



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Arctic Ice Melt: Faster Ocean Currents

A major ocean current in the Arctic is faster and more turbulent as a result of rapid sea ice melt, a new study from NASA shows. The current is part of a delicate Arctic environment that is now flooded with freshwater, an effect of human-caused climate change. Using 12 years of satellite data, scientists have measured how this circular current, called the Beaufort Gyre, has precariously balanced an influx of unprecedented amounts of cold, freshwater — a change that could alter the currents in the Atlantic Ocean and cool the climate of Western Europe.

The Beaufort Gyre keeps the polar environment in equilibrium by storing freshwater near the surface of the ocean. Wind blows the gyre in a clockwise direction around the western Arctic Ocean, north of Canada and Alaska, where it naturally collects freshwater from glacial melt, river runoff and precipitation. This freshwater is important in the Arctic in part because it floats above the warmer, salty water and helps to protect the sea ice from melting, which in turn helps regulate Earth's climate. The gyre then slowly releases this freshwater into the Atlantic Ocean over a period of decades, allowing the Atlantic Ocean currents to carry it away in small amounts. But since the 1990s, the gyre has accumulated a large amount of freshwater, 1,920 cubic miles (8,000 cubic kilometres).



Hydrographic Survey Along the Drake Passage



RRS Discovery has started a hydrographic survey along the Drake Passage. As part of the ORCHESTRA programme, the expedition team will take measurements of ocean temperature, salinity, oxygen isotopes, and currents to help them quantify how the Southern Ocean stores and transports heat. They will also be taking measurements of nutrient cycles and of microplastic pollution.

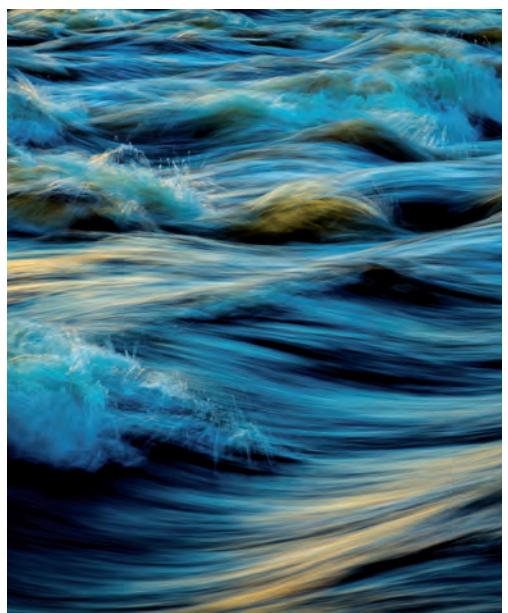
ORCHESTRA is a NERC-funded Long Term Science programme that involves scientists from many NERC Centres. This ambitious 5-year project began in spring 2016 and will use a combination of data collection, analyses and computer simulations to radically improve our ability to understand and predict the circulation of the Southern Ocean and its role in the global climate, with particular emphasis on the way that the Southern Ocean absorbs and stores heat and carbon.

ORCHESTRA is led by BAS (British Antarctic Survey) with NOC (British National Oceanography Centre) playing a major role, particularly in the measurement and modelling aspects of the project. The intensive 5-year observational programme will involve ORCHESTRA scientists undertaking 12 expeditions on research ships in the Southern Ocean, with US collaborators performing a 13th.

Ten of these expeditions will be annual north/south transects across the Antarctic Circumpolar Current, to evaluate how the ocean changes from one year to the next. The other three will form 'boxes' around the Atlantic sector of the Southern Ocean so that budgets can be performed. All this data, along with historical measurements, will be combined and analysed together. The observations will be used to inform and test a range of models.

Average Sea Surface Wind Speed

"With increasing greenhouse gas emissions, more than 20 sets of numerical simulations show that the global average sea surface wind speed has significantly increased, indicating that greenhouse gas emissions are the main reason for the acceleration of ocean circulation," Hu added. Wang Fan, director of the institute, said the acceleration of ocean circulation will lead to greater material and energy transport, potentially reshaping the global marine environment and exerting a significant impact on marine ecology and the Earth's biochemical system.



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Hydro International Interviews Mark Heine, CEO of Fugro

Working for a Safer and More Sustainable World

Mark Heine is chairman of the board and CEO of Fugro, which has its headquarters in the Netherlands. Fugro is the leading and largest specialized survey company in the world, serving the full lifecycle of assets, and calls itself a geodata specialist. For the avid mountaineer Heine, challenges are never too high to take on, not even heading up a multinational in transition, from a company largely dependent on the oil and gas industry to one that wants to co-create a sustainable and liveable world. We talked to Mark Heine about leadership style, strategies for finding new employees, and Seabed 2030. About this ambitious project, Heine says “Commercial companies need to work together with NGOs and academia to make this happen.”

FUGRO CLAIMS TO SUPPORT A SAFER AND MORE SUSTAINABLE WORLD. HOW?

“Through the nature of our work, we provide information about the Earth and structures built upon it to help design, build and operate our client’s assets in a safe, sustainable and efficient manner. We are therefore experts in understanding the risks of overusing the Earth. Also, we are a company that gets half of its revenue from the oil and gas industry but now also has 50% of its activities in offshore wind, infrastructure and nautical. Climate change is therefore a topic of daily discussion.

Hydrography plays an increasingly large role for Fugro, also because of climate change, as we map coastlines and coastal zones to learn more about tsunami hazards or rising sea levels.

“Much of Fugro’s land business has a direct impact on sustainable infrastructure development. Fugro is increasingly involved in projects that map and mitigate the impact of climate change. Growth in renewable energy is strong and has global reach. We’ve chosen five Sustainable Development Goals, namely 7, 9, 11, 14 and 15 and their sub-goals, as focal points of our policy, we now have to work towards meeting these goals.”

“Our expertise has always contributed to our purpose by creating a safe, liveable and sustainable world, but as a company we may be a bit modest in promoting it more widely.”

HOW DOES A COMPANY THAT IS ACTIVE IN OVER 60 COUNTRIES AND HAS ALMOST 10,000 EMPLOYEES PRACTISE WHAT IT PREACHES?

“An extra dimension to our purpose is that we are able to deploy our technology and expertise – that inherently contributes to a more

emissions from our vessels and other measures mean that we carry out our services for our clients with a reduced carbon footprint. I dare to say that people, planet, profit are incorporated in Fugro.”

IS DEVELOPING TECHNOLOGY A PART OF THAT PROCESS?

“Very much so. We incorporate innovations in technology into integrated digital solutions for our clients. We make full use of technological developments in visualization, robotics,

‘We are growing very fast in the offshore wind sector, which now accounts for around 14% of our revenue. That was close to zero in 2016 and only 7% in 2017’

sustainable world – in more efficient ways these days. We don’t need to send as many people offshore as we used to, so less health and safety exposure, fewer flights, lower

connectivity and advanced analytics to provide safer, faster, more efficient and better quality services; all in a more sustainable way. As an example, we are sending fewer people offshore



▲ Mark Heine, CEO of Fugro.

due to the possibilities to do a lot of work from our seven remote control centres, where we process and analyse data onshore. The actual surveying can be done using unmanned technology, such as AUVs or ROVs."

CAN YOU TELL ME A LITTLE MORE ABOUT THE BREAKDOWN OF CLIENTS PER SECTOR FOR FUGRO? DOES THIS BREAKDOWN REFLECT A SHIFT FROM FOSSIL TO RENEWABLE ENERGY?

"As I mentioned, we are growing very fast in the offshore wind sector, which now accounts for around 14% of our revenue. That was close to zero in 2016 and only 7% in 2017. Oil and gas have come down from 76% in 2014 to 51% last year. In nautical, although traditional hydrography for charting is falling, water and flood protection and general charting is growing and made up 7% of our revenue in 2019, from 4% in 2017."

WHERE DOES THE INCREASE IN NAUTICAL STEM FROM?

"Firstly, parties such as NOAA and UKHO, who have always outsourced, have increased this outsourcing in recent years. Countries like Sweden and Australia are also looking at outsourcing. Australia is a particularly good example, as it is surveying vast amounts of sea around the continent and is asking commercial parties to take care of that, at least in part. This is a logical step, because it is getting harder to keep up with technology every year; not just buying new and updated hardware and software, but also keeping employee's skills up-to-date. Governments are looking closely at how to manage this process, because they don't want to get out of touch completely of course. This is why some governments are even asking commercial parties like Fugro to educate staff, for example at hydrographic offices. Secondly, there are quite a few philanthropists who are putting a lot of money into charting the seabed and the ocean, sometimes just out of a spirit of adventure and competition to get to a remote and often deep spot in the ocean for the first time. Despite the competition, we see more and more consultation and discussion taking place between these parties. Fugro also takes part in this, for example by making our data available."

**ONE OF THE MOST AMBITIOUS
PROJECTS IN THIS RESPECT MIGHT
WELL BE THE GEBCO SEABED 2030
INITIATIVE, TO MAP THE ENTIRE
SEABED BY 2030. FUGRO IS LARGEMLY
INVOLVED IN THIS. WHAT DOES
YOUR INVOLVEMENT ENTAIL?**

"Seabed 2030 is in a phase in which cooperation between the commercial sector, the Nippon-Foundation and GEBCO academia is crucial to take the project to the next level. If we really want to map the entire seabed by 2030, we need to take big steps. For this purpose, we have already provided Seabed 2030 with data for hundreds of thousands of square kilometres. Technology, for example unmanned surface vehicles, will play a crucial role. In all honesty, 2030 is impossible, because we would need a hundred years of continued surveying to reach the goal, which would mean ten vessels out there every day of the year for the next ten years."

**CROWDSOURCED BATHYMETRY
IS OFTEN SPOKEN OF AS A SOLUTION
TO GET AS CLOSE AS POSSIBLE
TO THE END GOAL IN 2030.
DO YOU FEEL THE SAME WAY?**

"Crowdsourced bathymetry is reality and is happening. For example, we have deployed a

"I completely understand the trend. A lot of manufacturers of survey equipment are dealing with a market that expects lower prices for products. Equipment is therefore being manufactured in cheaper countries. These companies often see it as a good strategy to offer services as well. However, that is not always easy because they are almost obliged to use their own hardware, while it may not always be the best for the job. Buying a services or software company is a good way of buying some market share. It could lead to conflicts, when traditional service providers like us see suppliers turning into competitors, but so far we haven't seen any real threats entering the market."

**FUGRO IS A COMPANY WITH A VERY
SPECIALIZED FOCUS, OTHER THAN
A LOT OF ENGINEERING COMPANIES
WITH A BROADER SCOPE. DOES
THAT MAKE YOU VULNERABLE?**

"Not at all, geo is in everything and the fact that we are focusing on geodata and that we call ourselves geodata specialists makes our services interesting to all kinds of industries. We are the specialist that you want to hire if you want to know if the site you are about to develop is the right one, if you want to construct safe

and we educate them further in-house in our Fugro Academy. We recently launched a special programme called U.Gro, in which we pitch for master's students to train further. This is active now in Europe and Africa, and we will soon roll it out in the Americas and Asia-Pacific as well. We are a very culturally diverse company with many different nationalities. We combine our global reach with a local presence. This ensures that we understand local business procedures, cultures and traditions and allows us to compete against local participants. Also, we like to focus on gender balance, and we are therefore specifically looking for women to come and work with Fugro. Currently, 20% of our management is female, and we want to bring that up to 25% as soon as possible."

WHAT IS YOUR LEADERSHIP STYLE?

"I am fervent believer in team work. I am not an authoritarian leader. I believe that a good team will reach higher goals than an individual. That is how I try to manage as well. In my first full year of being a CEO, it was very important to shape a team around me that works well together. We have adapted the organization at the top level and we now have a much more dynamic and diverse team, although with a lot of experience, that works closer to the business. It's the enthusiasm and energy that we want to bring over to all levels of our organization, and I think we are succeeding in that."

**YOU ARE KNOWN TO BE AN AVID
MOUNTAIN CLIMBER. CAN
YOU STILL MAKE TIME FOR THAT?**

"Yes, sure. I try to make time every now and then to climb, although it may not be as long and as high as in earlier years, but certainly I am still fit and like to take part in a short expedition!" ▲

**'I am fervent believer in team work.
I believe that a good team will reach
higher goals than an individual'**

lot of our vessels with survey equipment for continuous surveying, as have other commercial parties. There are hundreds of systems out there. But the complicating factor is of course that we are all sailing the same shipping routes. This has a reason: taking a more inefficient route is unsustainable and therefore counterproductive, so this is a difficult one to crack."

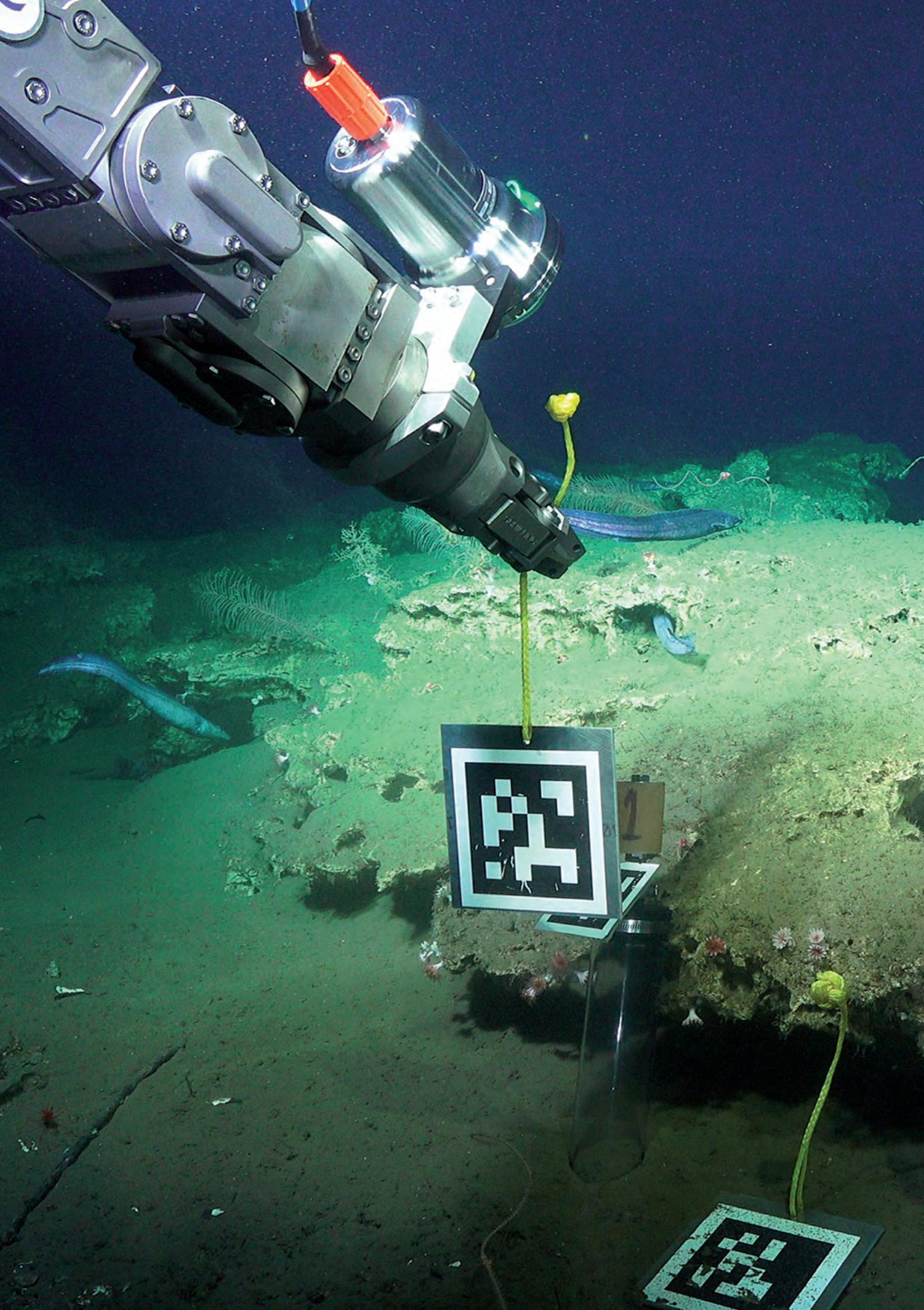
**NOWADAYS, LOTS OF HARDWARE
MANUFACTURERS ARE BUYING
SOFTWARE COMPANIES TO BE
ABLE TO PROVIDE SERVICES AS
WELL. DO YOU SEE THIS TREND
AS A DANGER TO FUGRO?**

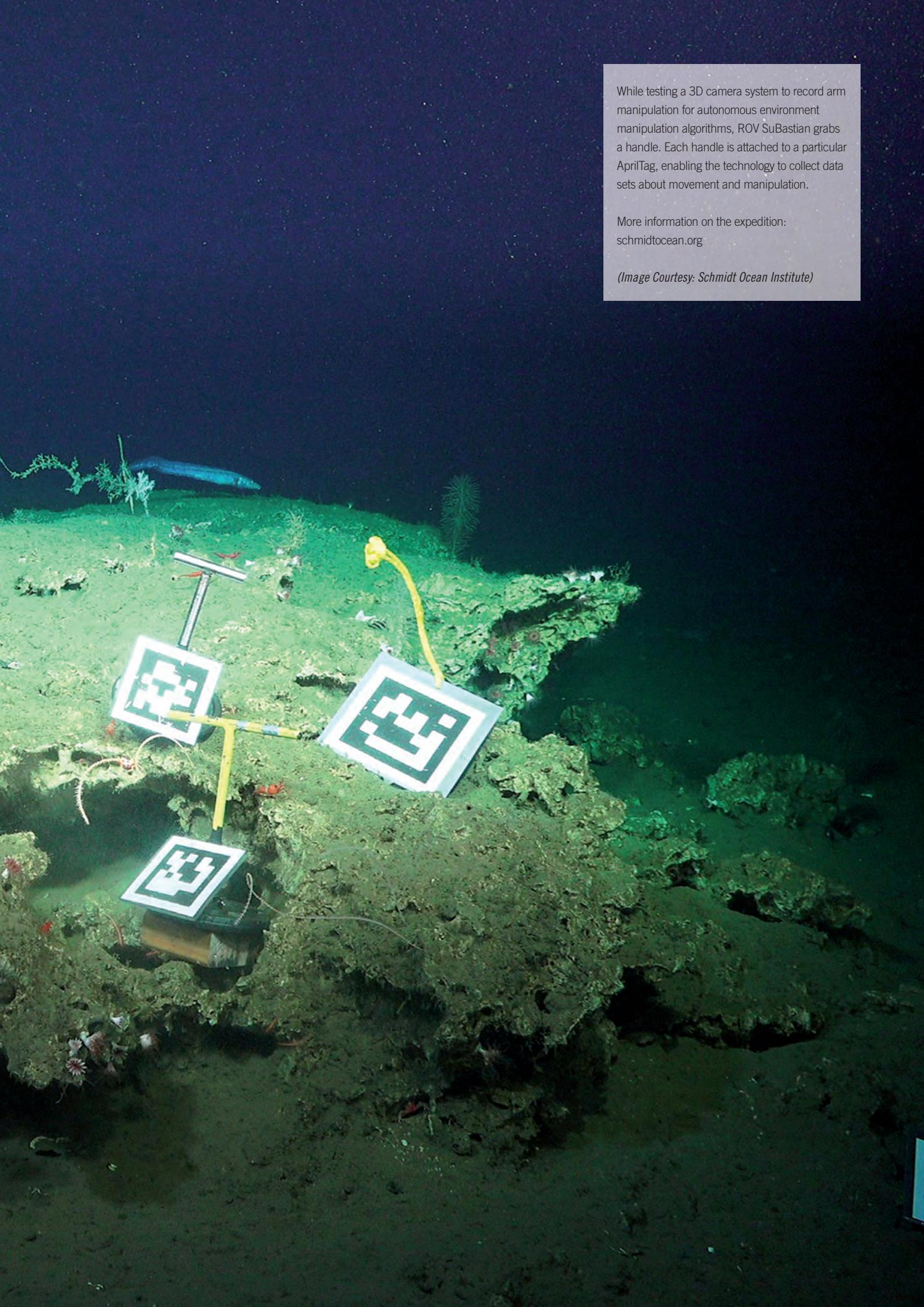
buildings or wind parks on that site, and if you want to monitor the site afterwards. As a company, we are crucial in multiple stages and that puts us in a very good position."

**FUGRO HAS A LOT OF VACANCIES.
ARE YOU ABLE TO FILL
THESE EASILY THESE DAYS?**

"We are looking for a lot of specialized people, such as geodesists, data analysts and specialists in for example site characterization, but we also see many new positions appear through innovation and technology like C# software developers and C++ developers. So it is obviously more challenging to find these people. Candidates that apply often have the right basis,

Mark Heine is chairman of the board and CEO of Fugro. He graduated from the Technical University of Delft in the Netherlands as a geodesist in 2002, having joined Fugro in 2000 as a data management manager. He went on to climb the ranks in the Dutch survey and geodata specialist company and became managing director in 2008. In 2012, he became regional director of Europe and Africa, and in 2015 a member of the executive committee. Ten years later, he was appointed chairman of the board and CEO. Mark Heine is vice-chair of IRO.





While testing a 3D camera system to record arm manipulation for autonomous environment manipulation algorithms, ROV SuBastian grabs a handle. Each handle is attached to a particular AprilTag, enabling the technology to collect data sets about movement and manipulation.

More information on the expedition:
schmidtocean.org

(Image Courtesy: Schmidt Ocean Institute)

Future of Hydrography, Marine Geomatics and Ocean Science

AI Making Waves in the Maritime Field

Andy Hoggarth's role at the helm of BD at CARIS is to understand trends in the business space industry as it evolves and to translate these from ideas to products. Given the spectrum of his expertise, he reflects on the current state of play and future possibilities for the fields of hydrography, marine geomatics and ocean science. He shares his insights on current and future trends in the field, articulating the value of artificial intelligence (AI) in reducing costs and processing time whilst increasing data accuracy and quality.

HOW AI CAN HELP BUSINESSES CUT THROUGH THE DATA DELUGE

Everyone is inundated with data these days, and the data deluge continues to flow. Data is generated from myriad internal and external sources including satellites and citizen-sourced. Hoggarth's strategic work at CARIS looks at how hydro enterprises can better manage and process their data, and he suggests that AI can certainly help. Hoggarth says that "AI is one of the main trends people need to be aware of. One trend that we're seeing is using AI to perform some of the tasks that were manually intensive and potentially subjective, such as multi-beam sonar technology for seafloor mapping: AI means we can make decisions so much more quickly".

AI is an emerging technology that can and is being leveraged to meet the challenges of the global hydrographic community. The introduction of AI and ML capabilities will

enable maritime enterprises to shift from being product-centric to data-centric, introducing possibilities for enterprises to expand their product and service portfolios. This could give rise to new business opportunities and greater client satisfaction due to faster delivery, contributing to growth.

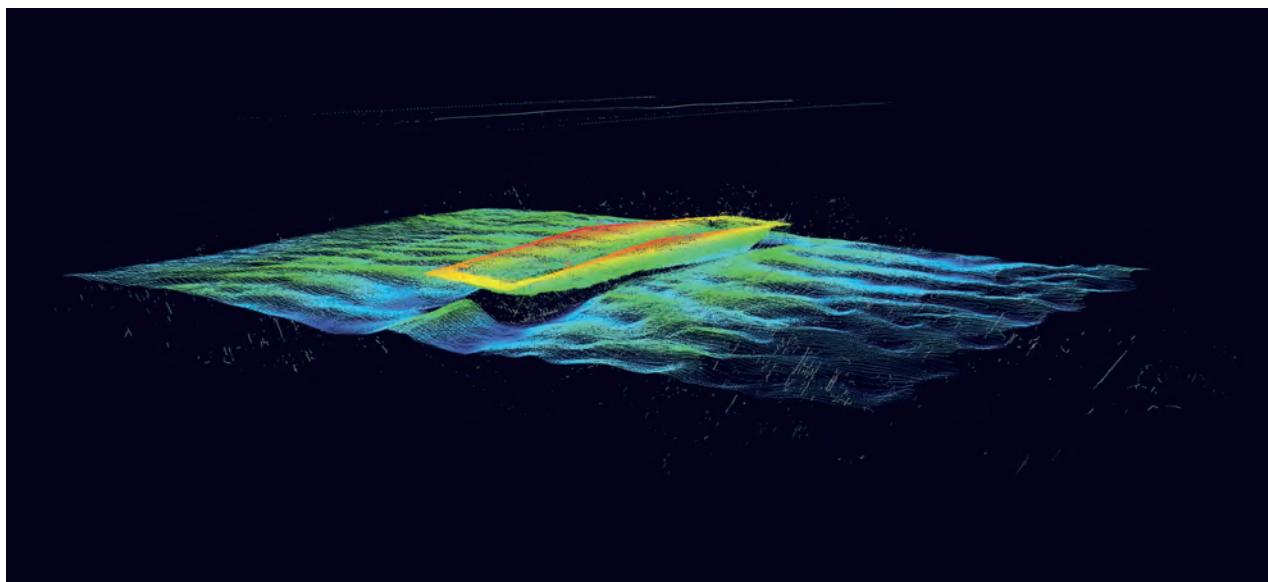
Hoggarth goes on to explain that "some agencies are at the cutting edge, experimenting with some of the new AI tools available, and reaping the rewards. AI tools have been implemented across multiple sectors within the maritime industries, with entities like navy and government proving to be especially interested in emerging technologies like AI, although the private sector tend to be very early adopters in this space".

Hoggarth is clear that whilst AI and ML are powerful tools for the field, they are just

tools, and they cannot replace human expertise required to plan and oversee the application of AI in hydrography. In fact, the most effective setup is for employees to gain new, valued expertise in working with and overseeing AI, using it as a secret weapon to achieve business objectives via more accurate, faster data processing with oversight from trained expert employees. This will increase efficiency and speed of output, enable employees to obtain new, valuable expertise and develop their professional prowess in ways that grow the business. "This is game changing", he says, noting the unprecedented ability AI offers to handle new sources of data and obtain better quality results faster.

AI OPPORTUNITIES IN THE MARITIME INDUSTRIES: HARNESSING THE POSSIBILITIES

The current standard for data cleaning involves time-consuming and labour-



intensive manual work like dot-killing, as well as simple filters, statistical filters plus terrain model binning and filtering.

Regardless of the method or filter type, everyone faces processing challenges. Complex features and steep slopes, for example, pose problems for the professional tasked with cleaning the data. Hoggarth explains how CARIS has just launched pioneering sonar noise classification software that detects all the following types of noise: cavitation/bubble sweep, loss of bottom on outer beams, loss of bottom lock and false returns from the water column.

Hoggarth's company, Teledyne CARIS, has been making software for the marine GIS community for 40 years and is renowned in the field for its products and client service. CARIS Mira-AI is their new, robust, secure cloud-based platform that hosts their AI solutions. The platform has undergone years of considerable beta-testing by a group of public and private sector companies. Hoggarth says that this major initiative has been "a community driven collaboration", pointing out that when it comes to machine learning (ML) and AI, "you must train the algorithm, you want data that has been trained, processed, so we can learn from how the human did it in their operations".

During development, Hoggarth's teams taught the algorithm numerous use cases, drawing on real-world data, so that the algorithm recognises real features on the seafloor, and that noise signatures are errors. This deep ML approach has resulted in an extraordinarily precise tool, the Sonar Noise Classifier, the first offering available out of the CARIS Mira-AI portfolio. The Sonar Noise Classifier, launched in early February 2020, reduces the need for manual cleaning, enabling employees to focus their expertise on the other important aspects of the work that machines cannot do.

Hoggarth believes that "the availability of training datasets is always a challenge

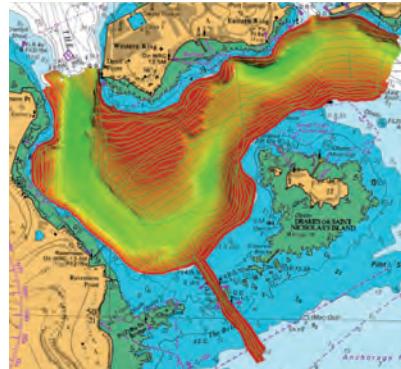
across the geospatial realm: the algorithm is only ever as good as the data you have access to, and partnerships are critical". He goes on to explain that the work of his company is unique, because CARIS wanted to create the ability to classify high density point cloud 3D data sets, whereas most of the work in this space to date has been related to analysing flat, one-dimensional images.

This is pioneering work, and it's very challenging. CARIS software responds to these kinds of challenges, enabling the professional to analyse data with an incomparably high level of accuracy. The software provides insights regarding a multitude of data, allowing the hydro professional to determine with precision things like what is noise and what is real; characteristics like where the seafloor is sandy or where the shipwreck is. Thinking about where the future is headed, Hoggarth predicts that "classification at the object level is the next step".

HOW AI CAN HELP ADDRESS SOME OF THE MOST ENDURING CHALLENGES IN THE FIELD

Another important element of the equation, Hoggarth says, is computer power, stating that "it's critical, cloud power specifically". Computing hardware is particularly key. The CARIS process is to "make use of their [client] server arrays, take the data, anonymise it, send it to the cloud. Then, our algorithm runs, results are generated and passed back to the local machine". Making use of the cloud in such a way is ideal for enterprises, who don't have to purchase computer power, train multiple employees in how to use it and then ensure expensive hardware is kept up to date.

Going forward, businesses need to explore the possibilities for introducing cloud computing capabilities into their data processing workflows. There are two models that CARIS offers, firstly "enterprises could use our software and connect to the cloud, it's less bandwidth



than you imagine it to be. The software runs it through, then brings it back locally".

Hoggarth's tip is that most are likely to be better off with the cloud, because "it provides greater benefits with regard to scalability, security and responsiveness" to the end user. In some contexts, he agrees that option two, going 'on premises' with high-end computing, might be preferable or necessary, such as in certain government contexts where all data must remain on-site or in settings without an internet connection but, in general, the cloud option is ideal. AI can be applied to legacy data as well as embedded as part of project design for new projects, enabling businesses to seamlessly transition to incorporating the technology where possible. ▲



Andy Hoggarth, Director of Business Development at Teledyne CARIS, has been with the company for over seventeen years. Beginning his geospatial career as a multi-beam sonar processor using CARIS software at sea, he transitioned from working on the technical side to the business side, and is considered an expert in ocean mapping.

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WHO DO YOU TRUST?

Cleaning the Ocean Through Innovative Instruments

How GPS Trackers and Drones Help Locate Floating Debris

An estimated 600,000 tons of abandoned fishing gear ends up in the oceans every year. According to the United Nations, some 380,000 marine mammals are killed each year, either by ingesting it or being caught in it.

Mary T Crowley of the Ocean Voyages Institute describes how GPS trackers are being used to mark the ghost nets.

The Ocean Voyages Institute is a non-profit organization based in Sausalito, California (US). It leads the way in utilizing and adapting existing maritime equipment with innovative approaches to ocean cleanup. For the past 40 years, the Ocean Voyages Institute has devoted its efforts to ocean conservation and preservation and has worked in conjunction with global sail-training education and the international maritime industry. As it works internationally, it is well positioned to continue cleaning the North Pacific Gyre (considered the most polluted gyre) as well as areas such as Indonesia, the Mediterranean and Polynesia.

The first research expedition and cleanup mission was conducted in 2009 on the 151'

Brigantine Kaisei, working in tandem with the Scripps Institute of Oceanography R/V New Horizon. Since 2009, the Ocean Voyages Institute has continued research on the North Pacific Subtropical Convergence Zone and done testing of cleanup methods and additional expeditions.

MARINE DEBRIS COLLECTION THINK TANK

Formed in 2010 by William Hurley, former President of Seattle-based Glosten Associates and Mary T Crowley of the Ocean Voyages Institute, this collection of naval architects, marine engineers, oceanographers, marine biologists, fishermen and maritime industry professionals from around the world focused on

analysing the problem of marine debris, mainly plastic trash, in our ocean and determining the best methods to remove these toxic materials from the ocean environment.

Having already conducted two month-long expeditions to the gyre, we were in a good position to discuss and examine the most efficient cleanup methods for different types of plastics. It has been and is our belief, based on the significant experience and expertise within our team that professional maritime equipment can be adapted for successful ocean cleanup missions. Using professional ships and yachts (proven equipment) is the most effective, efficient and economical manner to achieve significant cleanup in our global ocean now.





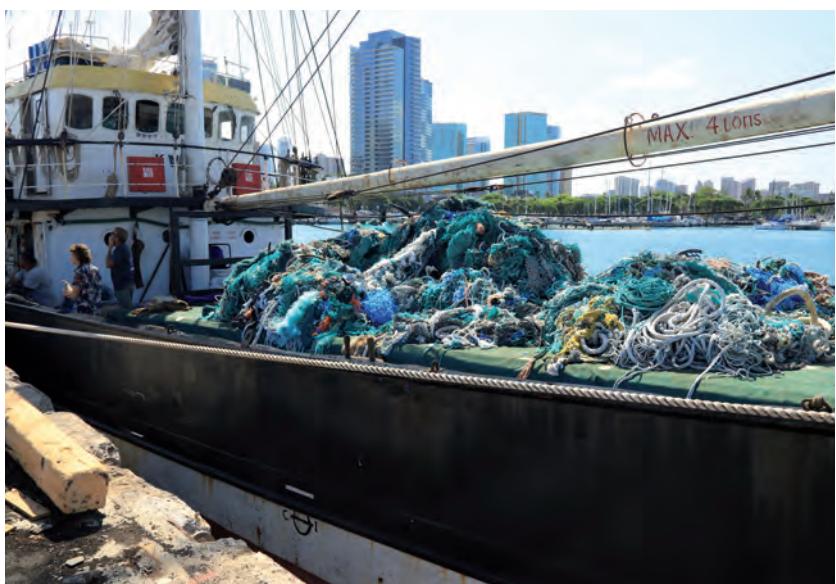
These ships, combined with our innovative GPS Satellite trackers and use of drones, have proven to be effective for cleanup expeditions.

The Ocean Voyages Institute is a member of the multi-disciplinary FloatEco Project, which studies physical and biological processes maintaining the pelagic ecosystem, associated with floating marine debris accumulating in the North Pacific Subtropical Convergence Zone. Currently, FloatEco is sponsored by NASA and includes teams from the University of Hawaii, Washington, California – San Diego, Smithsonian Environmental Research Center, Williams College, the Ocean Voyages Institute, and Ocean and Fisheries Canada. The project uses a variety of drifting buoys, a mixed-layer float and actual debris items, tagged with the OVI's GPS satellite trackers, to understand how different types of floating marine debris respond to various oceanic and atmospheric processes. Settlement panels and a camera mounted on these instruments monitor the species colonizing marine debris and help to investigate the impact of man-made long-living debris as a new vector for invasive species and a global change in the marine ecosystem.

LAST YEAR'S CLEANUP EXPEDITION

On 25 May 2019, the S/V Kwai, a sailing cargo ship left Hawaii on a 25-day voyage. They headed for the various tagged ghost nets, planning a route that would provide them with the best sailing conditions to retrieve the trackers, nets, and other plastic garbage. They succeeded in retrieving the nets tagged by our specially designed GPS Satellite Trackers. Our thesis held true; each net led us to areas where there were other nets to be retrieved and, in most instances, significant amounts of consumer plastics. The 42 tons of debris removed in this 25-day expedition was the largest cleanup of trash in the North Pacific Gyre region to date. The success of this project can be scaled up and replicated throughout our ocean.

The Ocean Voyages Institute's goal is to continue scaled up expeditions in this region of the North Pacific Subtropical Convergence Zone and, over the next four years, inspire and facilitate cleanups in other polluted ocean regions. The heaviest areas of litter distribution move around, based on currents and weather conditions, but are generally located about mid-way between California and Hawaii. Unfortunately, this debris field stretches for



thousands of square miles. The GPS Satellite technology played a very important role in the recovery effort, enabling the ship to be efficient in finding the heavy debris distributions. This innovative approach is leading the way to our 2020 expedition which will be scaled up ten times.

Our 2020 expeditions will be conducted over a three-month period, rather than the 25-day programme we operated in 2019. Besides utilizing our great sailing cargo ship, we will be adding three additional vessels: another sailing cargo ship, a fishing vessel to fish for consumer plastics and a large work ship with lots of space.

We will also be conducting various experiments around the retrieval of microplastics.

More and more people understand that the combination of industrial fishing gear and cargo nets, plus other plastic debris, ends up with ghost nets that grow larger over time, one net picking up other nets and amassing plastic debris. These killers ensnarl wildlife. An estimated 600,000 tons of this abandoned gear ends up in the oceans every year. According to the United Nations, some 380,000 marine mammals are killed each year, either by ingesting it or being caught in it.

FUTURE UPDATES

We will keep you posted as full plans for our 2020 expanded recovery mission are finalized. It is clear from the success of our 2019 expedition that we will retrieve very significant amounts of toxic plastic from the North Pacific Gyre in 2020. We want to spread our methods and knowledge and help others throughout the world dealing with this urgent issue, so we can be inspiring successful ocean cleanups globally. ▲



Mary T Crowley is the founder and executive director of the Ocean Voyages Institute, established in 1979 as a public charity based in Sausalito, California (US), with the goal of preserving the maritime arts and sciences, the ocean environment and island cultures. Mary is one of the founders and project directors of the environmental mission Project Kaisei. She previously served as Executive Director of the Oceanic Society, publisher of Oceans magazine and on the board of Directors of Project Jonah, the Maritime Museum of San Diego, Sail San Francisco and many other organizations.

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FACTS AND FIGURES

The Ocean Voyages Institute (OVI) is a non-profit organization founded in 1979 by a group of international sailors, educators, and conservationists with a mission of teaching maritime arts and sciences and preserving the world's oceans. In 2009, Project Kaisei was launched to focus on major ocean cleanup and to raise awareness regarding the global problem of marine debris and ocean trash. The OVI's Board of Directors and volunteers have extensive experience designing and conducting ocean research projects. It has 34 years of experience which includes the creation of marine biology courses for high school students, three scientific expeditions to the North Pacific Gyre, the convening of a Marine Debris Collection Equipment Think Tank and raising global awareness of this marine debris problem.

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Hydrographic Mapping: a Service Provided Inconsistently by the Developed Nations

Hydrographic Mapping is Critical for the Caribbean Islands

Considered paradise by the legions of tourists who visit each year, the Caribbean islands are developing states that struggle to maintain a delicate balance between economic expansion and environmental preservation. Hydrographic mapping, a critical element in achieving this equilibrium, has been a service provided inconsistently by the developed nations upon which many of the islands are still dependent. Affordable new geospatial technologies, however, offer Caribbean islands the opportunity to reduce their traditional reliance and assume greater control over their economies and natural resources.

The islands of the Caribbean, collectively known as the West Indies, were colonized for centuries by seafaring powers of the world, including the United Kingdom, Spain, and the Netherlands. In the 20th century, many individual islands and island groups – such as Jamaica, Cuba, Haiti, and Bahamas – achieved independence. Others, including Puerto Rico, Saint Martin and Virgin Islands, remain territories of developed nations.

Regardless of their varied political status, languages and locations, these islands share a common characteristic – tourism drives their

economies. Although the Caribbean is known worldwide for the friendliness of its people, the natural environment, which is dominated by marine ecosystems, remains the primary attraction. Sandy beaches, coral reefs and shallow lagoons serve as playgrounds to the several million visitors who arrive annually by sea and air.

MINERAL RESOURCES

Even with tourism growing steadily, Caribbean governments are involved in diversifying their economies by developing other industries to employ their people and produce export goods.

Agriculture, once dominated by bananas and sugar cane, is expanding into a variety of crops that are shipped globally.

Mining is another industry seeing rapid growth in the region. The mineral resources of some larger islands, like Jamaica, are believed to be enormous, yet relatively untapped. Even hydrocarbon production has become a major source of revenue for some Caribbean nations, such as Trinidad & Tobago.

The island governments understand the opportunities and challenges presented to them





by their wealth of natural resources. Enlarging existing harbours and building new ports to accommodate a greater number of larger ships can deliver more tourists to the seaside resorts and transport valuable minerals and crops to countries around the world. These sorts of development are appealing for the money they can inject into the economy in the near term.

The International Hydrographic Organization, headquartered in Monaco and composed of 93 member nations, has calculated that for every \$1 spent on hydrography, \$10 in value is returned to the local economy in foreign investment, development and other resources.

NATURAL ENVIRONMENT

The Caribbean people, however, are inherently protective of their natural environment. They have witnessed firsthand the destructive impacts natural disasters, such as hurricanes, can have on their beaches, fisheries, and wildlife habitats. They understand that rampant construction of waterfront hotels and cruise ship piers can produce even worse devastation, in

the long term, by wiping out the natural sights the tourists come to enjoy in the first place.

Striking a balance between economic development and environmental preservation is particularly challenging for governments in the Caribbean where most of the nations and territories are underdeveloped. Their limited financial resources must first be spent on infrastructure, health care, and other basics. Everyone understands that tourist dollars help pay for these.

Until recently, spending money on hydrographic mapping occurred, but mainly when absolutely necessary. However, an increased global awareness of environmental concerns has aroused the Caribbean people's innate sense of protectiveness toward their natural surroundings. This in turn has led to a broader appreciation of the connection between preserving island ecosystems and maintaining the tourist trade. As a result, mapping and other technologies that can play a role in environmental conservation and responsible development are prime topics of consideration.

TRADITIONAL TECH

The applications of marine mapping in the Caribbean are many, but the collection of hydrographic information – water depth and ocean floor classification data – has traditionally been performed primarily for the safety of cruise and container vessels. In accordance with the International Convention for the Safety of Life at Sea (SOLAS), the deep waters around the continental shelf and approaches to ports are surveyed periodically, and usually by single- or multibeam sonar devices mounted on ships.

As cruise liners and merchant vessels get bigger, their drafts get deeper. Sonar sensing will continue to provide the extremely accurate deep-water bathymetry to ensure these ships don't run aground on the seafloor or scrape their hulls on the delicate reefs as they approach commercial harbours.

Due to the expense of sonar mapping systems, these surveys have traditionally been conducted on behalf of the Caribbean governments by hydrographic survey organizations operated by the





developed nations on which many of the islands still have reliance. Even the islands that have declared their sovereignty maintain some economic ties to the US, UK, the Netherlands, Spain or France.

COLLABORATIVE SONAR MAPPING

In a recent example of collaborative sonar mapping, the UK Hydrographic Office has performed surveys in Antigua and Barbuda, Anguilla, Montserrat and Jamaica. These offshore surveys are vital for SOLAS compliance; however, most do not include the nearshore coastal zones. In fact, formal shallow-water surveys have not been performed around some Caribbean islands in more than a century. From both a public safety and environmental protection perspective, this is troubling because it is in these nearshore areas where the 'blue economy' lives. This is where sightseeing and fishing boats trawl and splendid wildlife and coral reefs thrive.

Some of the shallow-water challenges already facing Caribbean islands include:

- Port development and polluted ballast water from ships are stressing mangroves on the shoreline;
- Rising sea levels and jetty construction are eroding beaches;
- Inaccurately charted coral reefs near the shore are being damaged by vessels.

Managing these diverse marine ecosystems requires accurate and up-to-date seafloor depth and habitat data. Fortunately, numerous geospatial technologies are able to collect this coastal information effectively and more cost-effectively than sonar systems. With these affordable mapping methods now within their own reach, Caribbean nations are beginning to

perform marine mapping on their own. Jamaica, for example, was among the first to form an official hydrographic office.

TURNING TO HIGH-TECH GEOSPATIAL SOLUTIONS

While sonar will continue to be used in critical navigation channels, where the utmost precision is required, and beyond the continental shelf and in waters deeper than 30 metres, Caribbean officials are deploying the newer technologies closer to shore and in combination with airborne and marine surveys to cut costs and expand geographic coverage. Airborne LiDAR, which can penetrate shallow water and collect bathymetric data, is seeing increased deployment in the region. And hydrographic data derived from Earth observation satellites has significant appeal for application in many areas due to its lower cost and decades of archived datasets.

A relatively new geospatial processing technique called Satellite Derived Bathymetry (SDB) extracts water depth measurements from multispectral Maxar WorldView satellite data. In the clear waters of the Caribbean, SDB products have been created to depths of 28 metres with accuracies. The SDB process also generates remarkably detailed seafloor classification maps that can differentiate reefs from rock and identify seagrass species.

This information is proving vital to Caribbean government agencies as they consider proposals for new development. Knowing what lies beneath the waves and at what depth allows them to decide precisely where infrastructure should – and should not – be built to minimize impact on fragile marine ecosystems.

The value of satellite imagery extends onto dry land as well. Years' worth of coastline images are enabling Caribbean officials to see how the placement of something as seemingly simple as a jetty in the past has affected the nearby beach or mangrove stand. Seeing what happened in the past, through archived imagery, guides their plans for the future.

Farther inland away from the beaches, geospatial information extracted from satellite images has applications too. Jamaica has already turned to multispectral imagery to see the impacts its renewed development of bauxite mines is having on the soils and vegetation in the vicinity of those operations. These images are helping to regulate how the mining is carried out so its impact on the natural surroundings can be minimized.

CONCLUSION

The value of geospatial technology in the Caribbean can be measured by hectares of mangroves and underwater corals it helps to save, as well as the responsible development it enables. But the most important contribution might be harder to quantify. The affordability of geospatial mapping techniques is empowering the Caribbean people to reduce their dependency on developed nations by enabling them to monitor their environment, make better informed decisions, and establish policies with their own best interests in mind. ▲

Carol Fisher is a partner in TCarta Caribe and serves as Programme Manager and Lead Hydrographer in the Kingston office. Born and raised in Jamaica, she worked most recently as a Senior Hydrographer at the Jamaican National Land Agency. She holds a degree in Land Surveying/GIS and is a Certified Hydrographer at Category B level, and has over 19 years' extensive experience working on hydrographic programmes in Jamaica.

✉ cf@tcarta.com

Kyle Goodrich, President, TCarta Marine, Denver, Colorado, US, has had a 19-year career in geospatial services. Since founding TCarta in 2008, Kyle has led numerous global geospatial product research and development plans, including the development and commercialization of satellite derived bathymetry, shoreline classification and global bathymetric products. Under Kyle's direction, TCarta has successfully delivered hundreds of projects worldwide to wide-ranging industries and applications.

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Greater Use of Autonomy Will Influence the Numbers of Personnel Required on Board

Preparing the European Fleet of Research Vessels for the Future

Recently, the European Marine Board published a report on the current status of the European fleet of research vessels. This so-called Position Paper describes how the fleet will need to develop in the future to ensure that it will continue to provide the same high level of support to science and hydrography globally, as well as highlighting ways in which management could be made more efficient. This article is an extract of the report.

Many of the global challenges facing the world today - climate change, food and water security, health and well-being, sea-level rise and economic development - are driving the ever-greater need for science to help understand and ultimately address these challenges. The natural and, in particular, the marine sciences, have a significant role to play, and the research vessel fleet is called upon to deliver data and support globally important scientific research, says Gilles Lericolais, Chair, European Marine Board, in his foreword.

RESEARCH SUPPORT PLATFORMS

Science has used ships as instruments for research since at least the 1700s, and the evolution of usage from instrument to laboratory

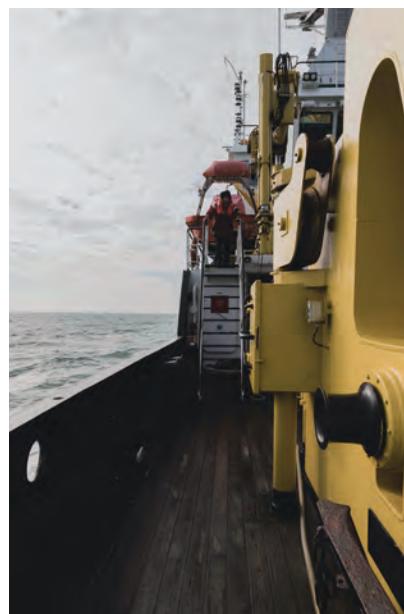
can be traced through history. Today's research vessels have been shaped to become complete research support platforms by the demand for scientific knowledge, fast-paced technological development and the increasing need for new ocean observations.

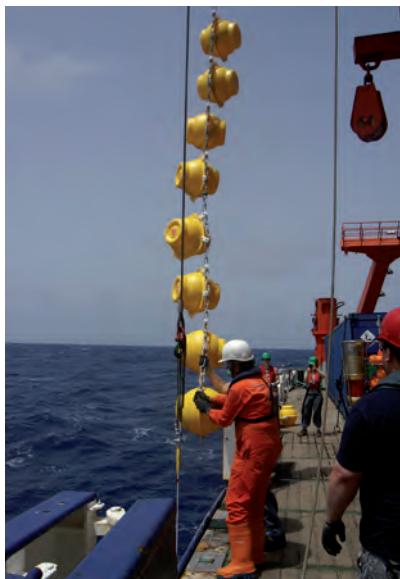
Given the context in which Europe's research vessel fleet is now operating, and the rapid developments in technology such as smart sensors and autonomy seen in recent years, it was timely to review the current status of the fleet and its ability to deliver the data that is needed. It is more than ten years since the first EMB Position Paper on research vessels was published, and a lot has changed in that time. In particular, new research frontiers have arisen,

especially in the deep sea and Polar regions, placing a new set of demands on the capabilities of vessels.

DEVELOPMENT OF THE FLEET

The recently published Position Paper provides a review of the current European research vessel fleet, its capabilities and equipment, assessing its ability to support science across the globe, now and into the future. It also takes a wider vision, assessing the importance of these vessels in the ocean and earth observing landscape. This review includes not only technological but also human capabilities, looking at training needs for crew and technicians to ensure they can continue to deliver on critical science needs. Last but not





least, the report describes the ways in which the current European fleet is managed.

It contributes formulated recommendations for how the fleet will need to develop in the future to ensure that it will continue to provide the same high level of support to science globally, as well as highlighting ways in which management could be made more efficient. It is aimed at national- and European-level policy makers and funders, as well as the marine science community and the research vessel operator community.

SCIENTIFIC RESEARCH

The European research vessel fleet plays a vital role in supporting scientific research and

development, not just in Europe but also across the globe, the authors say. In their document they explore how the fleet has developed since the publication of the European Marine Board Position Paper 10 (EMB PP 10) 'European

equipment and capabilities, the deep sea and Polar regions as study areas of ever-increasing importance for science and for the vessels that explore them, the role that research vessels play in the wider ocean observing landscape, the

'I hope that this publication will help carry the European research vessel fleet into an exciting era of exploration'

Ocean Research Fleets – Towards a Common Strategy and Enhanced Use' (Binet et al., 2007). It looks at the current fleet and its

importance of training personnel for research vessels, and considers management of the European research vessel fleet. It also considers what has changed since 2007, what the status is in 2019, and future directions for the European fleet, with a 10-year horizon to 2030.

AGEING FLEET

The current European research vessel fleet is highly capable, and is able to provide excellent support to European marine science and wider scientific research and can lead on the world stage. However, with a typical life expectancy of 30 years for a research vessel, the fleet is ageing and urgently requires further investment and reinvestment to continue to be as efficient and capable as the scientific community expects and requires. The capabilities of the fleet have increased considerably since 2007, and vessels have kept up with fast-paced technological developments.

Contributors to the report expect the demand for complex and highly capable vessels to continue.



Research vessel designs and the fleet as a whole will need to keep pace in order to remain fit-for-purpose and continue to be a key player globally. There is huge diversity in vessel types and designs in terms of capabilities and equipment, management structures and processes, and training possibilities.

While it would not be possible or appropriate to highlight any one approach as the only one to use, a growing trend in collaboration through community groups, agreements, legal entities and funded projects now enables more strategic thinking in the development of these vital infrastructures. However, some issues remain in enabling equal access to research vessel time for all researchers across Europe, regardless of country and regardless of whether or not that country owns a suitable research vessel for their scientific needs.

NAVIGATING THE FUTURE

Marine research and monitoring of the oceans is, and will for the foreseeable future (i.e. for the 10-year horizon to 2030) be based on collecting data and physical samples from the water column, the seabed, the ground below the seabed and the atmosphere above. Beyond that, we cannot yet fully envision what the future will bring. The development pace of new technology for marine data collection and physical sampling is extremely high and we expect to see major innovations in this field in the coming years. One forecast for this can be found in the epilogue of EMB's latest marine science foresight document, Navigating the Future V (European Marine Board, 2019), which proposes the concept of a virtual ocean based on actual, real-time and historical data.

This would enable people to explore the ocean in a way they have never been able to before, developing knowledge of how it functions and understanding the implications of management and policy decisions and approaches. Such a vision cannot be realized without research vessels carrying many of the data collection and physical sampling instruments. Research vessels will also for the foreseeable future continue to deploy, service and recover stationary autonomous instruments on the ocean floor, in the water column or on the surface, in addition to deploying and recovering autonomous vehicles which are drifting or being self-propelled on the surface and/or in the water column. Research vessels will therefore remain a vital component of the Earth and ocean observation and monitoring system.

ARTIFICIAL INTELLIGENCE

Technological developments in automation and artificial intelligence will undoubtedly change the way in which marine research is conducted in the future, and ever-greater focus on a carbon-neutral and sustainable society will require development of new energy carriers (e.g. batteries and fuel cells) and new types of propulsion systems for vessels of all kinds, including research vessels. This will have a significant impact on the way in which future research vessels are designed and operated in the longer term beyond the 2030 time horizon of this publication. Some innovations may render existing techniques and equipment redundant, and trends towards greater use of autonomy (e.g. using fleets of autonomous vehicles) and digital technology (e.g. livestreaming of science) will most likely influence the numbers of personnel required on board research vessels.

PUSH THE BOUNDARIES

Other innovations will produce smaller, lighter and more powerful sensors. All of this will affect how future research vessels and indeed fleets look, creating a new balance in vessel sizes, categories and capabilities. The key will be to work together and be ready to adapt to change in order to ensure that the European research vessel fleet remains capable and fit-for-purpose for addressing the scientific and societal challenges to come, while continuing to strive for efficiency. Scientific needs and the demands of the scientific community will drive technology advancements, but at the same time, technological developments will also continually push the boundaries of what is possible.

Closer collaboration between research vessel owners and operators will support more efficient operations and increase both the availability and accessibility of ship time. Most importantly, the whole research vessel and marine community will need to engage with the wider society to foster understanding of the importance of Earth and ocean observations, and the role that research vessels play. Without a clear justification for the contribution and growth in funding, and ultimately, without societal support, the research vessel fleet in Europe will not be able to continue

Acknowledgement: this article is based on the European Marine Board's report 'Next Generation European Research Vessels: Current Status and Foreseeable Evolution, EMB Position Paper 2'.

to underpin globally relevant marine research.

Without it, the vision of a sustainably managed and globally valued ocean will remain just that: a vision, the report concludes. ▲

HIGHLIGHTED RECOMMENDATIONS

Greater collaboration and ongoing communication are vital for the future of the European Research Fleet. Some other recommendations are:

- Information and data on the capabilities and equipment of the European research vessel fleet should be kept up to date and continue to be made available through the EurOcean Research Infrastructure Database¹ (EurOcean RID).
- For the European research vessel fleet to remain capable and fit-for-purpose, both the fleet and its scientific equipment and instruments should be renewed and developed as a matter of urgency.
- The research vessel community should continue on its path towards greater collaboration in order to aim for equal access to research vessel time, based on excellent science.
- Funding agencies should engage in discussions with the research vessel and marine science communities, as well as other relevant stakeholders to identify key funding needs.
- The research vessel operators community should continue to look forward to the emerging science and technological developments and work together with relevant parties to ensure that the fleet is ready to support these.

ABOUT THE EUROPEAN MARINE BOARD

The European Marine Board provides a pan-European platform for its member organizations to develop common priorities, to advance marine research, and to bridge the gap between science and policy in order to meet future marine science challenges and opportunities. The Board was established in 1995 to facilitate enhanced cooperation between European marine science organizations towards the development of a common vision on the strategic research priorities for marine science in Europe.

Members are either major national marine or oceanographic institutes, research funding agencies, or national consortia of universities with a strong marine research focus. (33 Member Organizations from 18 countries). The Board provides the essential components for transferring knowledge for leadership in marine research in Europe.

Adopting a strategic role, the European Marine Board serves its member organizations by providing a forum within which marine research policy advice to national agencies and to the European Commission is developed, with the objective of promoting the establishment of the European Research Area. www.marineboard.eu

SeapiX-C Will Increase Efficiency and Reduce Vessel-time

Real-time 3D Mapping and Bathymetry Sonar for High-precision Marine Works

Increasing efficiency and reducing vessel-time has been a key focus for all companies working in the offshore industry for several years now. As a major provider of advanced navigation, subsea positioning and imagery solutions dedicated to the offshore market, iXblue is striving to bring new innovative solutions to support operators in their daily operations. It is with this in mind that the company has developed a seabed mapping solution, dedicated to marine works: the new SeapiX-C sonar.

Based on iXblue's SeapiX 3D volume sonar, a proven solution originally developed for the fishing industry, the new SeapiX-C offers wide coverage (up to 10,000m² at 30m range) and real-time georeferenced static bathymetry capabilities to marine works operators for instant monitoring and decision-making.

"SeapiX-C being a solid-state '3D' multibeam sonar with no moving parts, it allows for each of the detected points on the seabed to be seen in two different ways, without requiring any movement of the sonar. To fully benefit from this

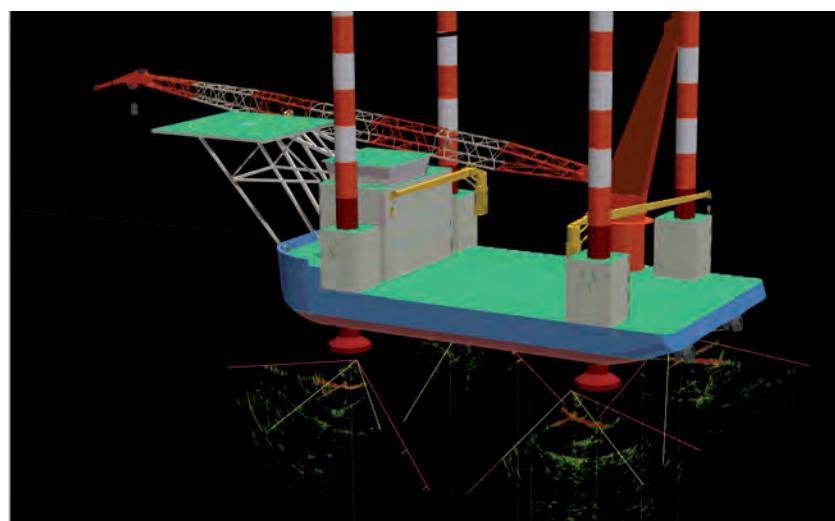
particular feature and offer a unique static bathymetry capability, we have developed a very specific algorithm so that the sonar is able to automatically choose, in real-time, the configuration that will offer the most accurate measurement possible," explains Maxence Rioblan, Software & Products Manager at iXblue. "Our algorithm has proven to be highly robust, as it was able to reject side lobes and multi-travel echoes, which usually limit the performance of standard MBES installed on rotators."

Providing highly accurate and robust station-based bathymetry, SeapiX-C is a

valuable seabed-mapping solution that will bring about more efficient and flexible operations, as well as increased safety to marine works, and which will be perfectly suited for challenging jack-up barge deployments and dredging operations.

INCREASING SAFETY AND EFFICIENCY FOR JACK-UP BARGE DEPLOYMENT

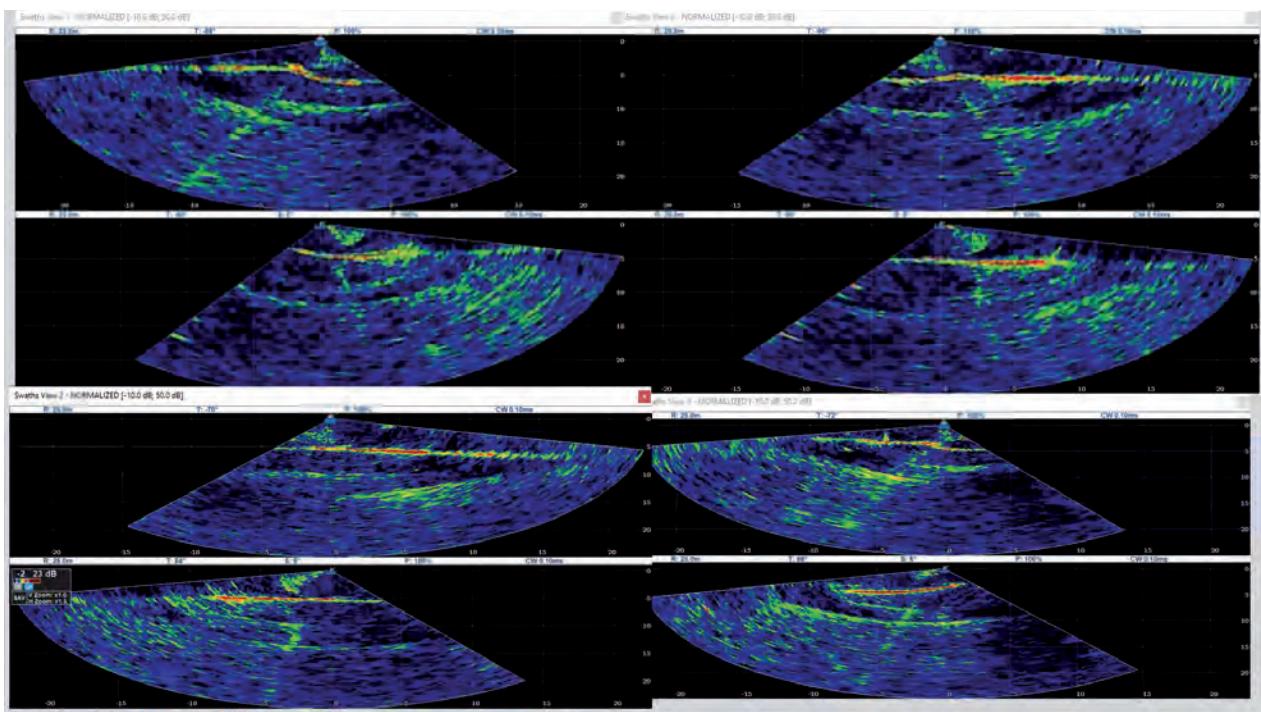
Jack-up barges are very large platforms that need to be securely positioned on an even seabed. As manoeuvrability is limited, it is of the utmost importance for operators to know exactly where they are positioning



▲ 3D view displayed within the dedicated software.



▲ SeapiX-C can be mounted on a jack-up barge for efficient and safe deployment.



▲ Swath view displaying across-track and along-track swaths during operation mode.

the legs of the platform. However, current operations remain challenging, with the jack-up barges' legs being deployed blindly, using seabed information found on pre-lay survey maps. A difficult exercise, as operators can never be entirely sure whether they are positioning the legs exactly where they should be, and as the bathymetry of the terrain displayed on those maps may have changed since the pre-lay surveys.

By providing a new station-based 3D imagery solution, able to display the seabed in real-time, and covering a wide area, the new SeapiX-C completely removes this challenge and enables operators to see directly where they are positioning the legs during the deployment. A highly efficient tool that increases the safety of deployment and brings higher efficiency to the operations by removing the need for time-consuming and costly pre-lay diver operations.

To make deployment operations even more straightforward, iXblue is also providing a new software dedicated to this solution. The real-time bathymetric results provided by the installed SeapiX-C (usually one per leg), along with the information coming from the platform itself (legs position, displacement, height when rising above the waterline...), are all displayed within a

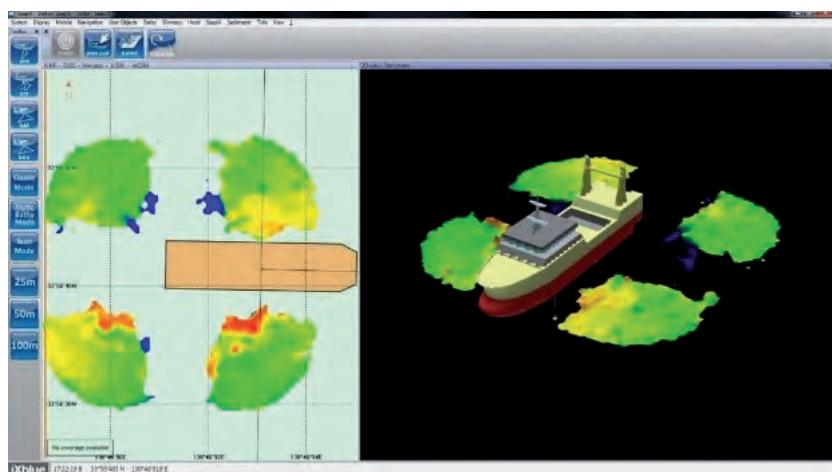
single user-friendly interface that also enables the operator to switch between three available modes (static bathymetry, standard bathymetry used during transit, and scanning to visualize the deployment of legs in the water column). Additional indicators displaying critical information, such as the distance between the legs and the seabed, are also available within the interface to facilitate the operation.

REDUCING DREDGING TIME THROUGH REAL-TIME OPERATION MONITORING

SeapiX-C sonar is also a valuable solution that increases operational efficiency for dredging works by enabling real-time

monitoring of construction or maintenance operations. SeapiX-C indeed provides real-time high-resolution and georeferenced static bathymetry of the seabed on a wide area (120° aperture), allowing operators to directly observe and monitor their work.

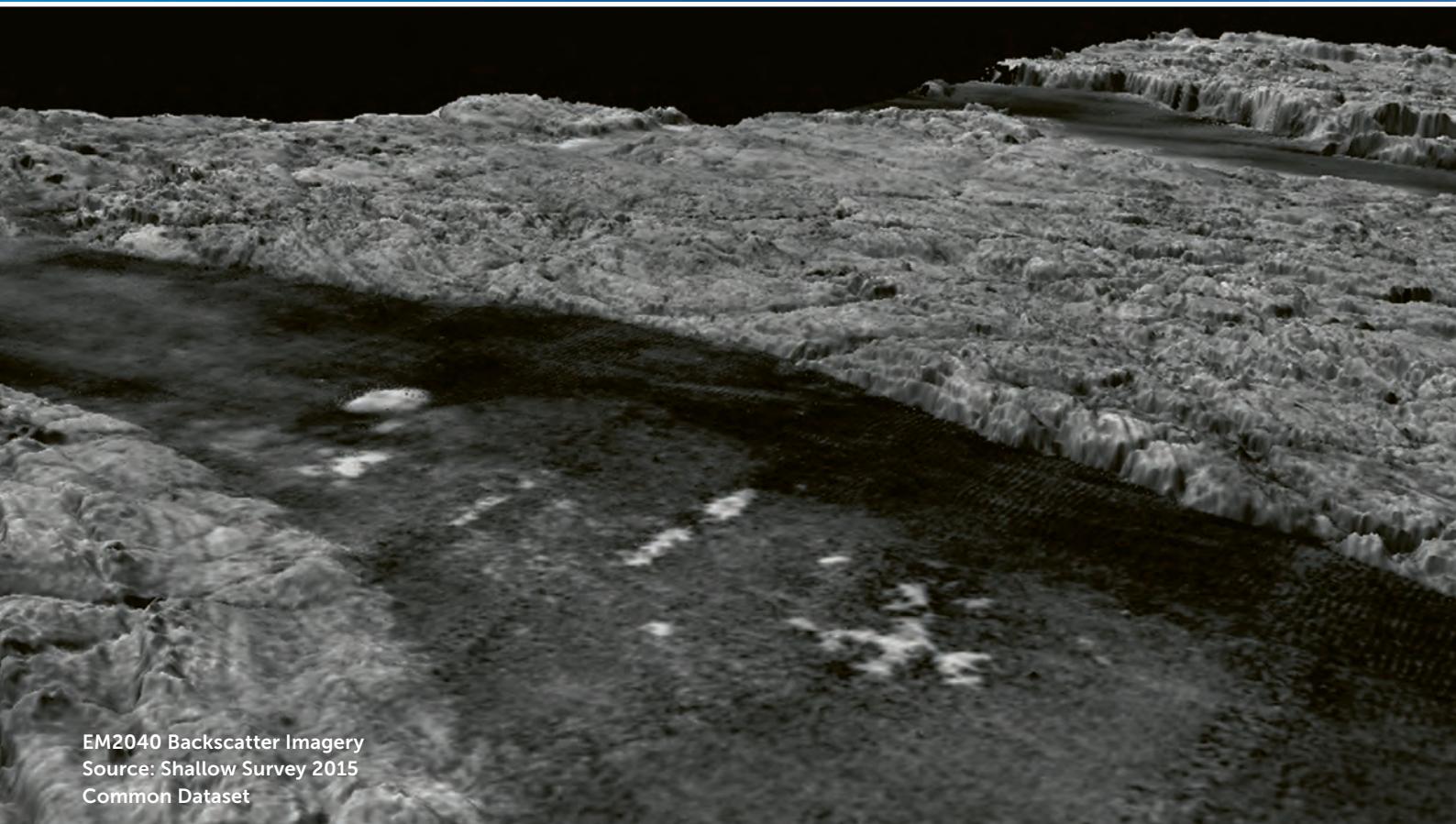
Preventing ineffective or out of specification dredging and reducing dredging-time, the new SeapiX-C can be easily operated by the end-user, without the need for a specialized surveyor. All acquired data is furthermore directly integrated and displayed into the existing dredging software for easier use of the system. ▲



▲ SeapiX-C provides reliable digital elevation model from a static point.



AUTOMATION FOR BACKSCATTER PROCESSING



EM2040 Backscatter Imagery
Source: Shallow Survey 2015
Common Dataset

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A View from the American Industry

Securing Offshore Oil and Gas Infrastructure with Unmanned Surface Vehicles

Employing commercial-off-the-shelf USVs that can be rapidly reconfigured with a diverse range of sensors can enhance the ability to deliver energy to America and the world. This is a win-win for the energy industry, says George Caldorisi when he describes the securing of oil and gas infrastructure with Unmanned Surface Vehicles.



While the exigencies of climate change have led to major strides in the development and fielding of renewable energy sources such as solar, wind and others, the world's energy needs will continue to be met primarily by oil and natural gas for the foreseeable future. As readers of Hydro International are well aware, the strategic implications of the United States' transition from energy dependence, to energy independence, to becoming a net oil and gas exporter, are being felt worldwide. While some saw this sea change coming, most did not, and the community of nations is still coming to grips with what this will mean to the energy market over the next several decades.

OFFSHORE OIL AND GAS INDUSTRY

While much of the reporting regarding America's increased energy production has focused on fracking – which has opened up billions of barrels of oil and trillions of cubic feet of natural

gas to production and transformed the global energy sector in a matter of a few years – it is the offshore oil and gas industry that still provides a huge amount of the United States' energy. According to Forbes Magazine, offshore energy production has been increasing over the past decade and now stands at over two-and-a-half million barrels of oil and almost three trillion cubic feet of gas a day.

This massive production effort is sustained by the hundreds of US offshore drilling rigs, primarily in the Gulf of Mexico. According to Forbes Magazine, the Trump Administration has directed the Department of the Interior to open up 25 regions in the outer continental shelf to oil and gas exploration. Indeed, in February 2019, Phase 3 of the Atlantis Project commenced in an effort to create a tie-back of eight new production wells. There is little question that the United States intends to accelerate its

harvesting of oil and gas in the Gulf of Mexico as part of the Trump Administration's America-First Offshore Energy Strategy.

INDUSTRY DISASTERS

However, environmental concerns – impelled by major events such as the 2010 Deepwater Horizon disaster in the Gulf of Mexico – have served as a brake on US offshore drilling. And it is worth noting that the second largest marine oil spill in history, the Ixtoc 1 spill, also occurred in the Gulf of Mexico. These – and other industry disasters – have resulted in ongoing environmental activism that has given some second thoughts about the viability of continuing to drill for oil and gas offshore.

Addressing these environmental worries has been a challenge for the oil and gas industry. And while offshore oil and gas companies have been proactive in ensuring the safety and viability of their platforms, more remains to be done. Using current technology, this is dull, dirty and dangerous work that impedes comprehensive inspections of these production rigs. Today, platform operators depend on divers and remotely operated vehicles (ROVs) of various types to perform these inspections. This methodology is good as far as it goes, but ROVs have a limited field of view, and putting divers in the water always involves substantial risk and increasingly high costs.

Industry has proposed technology-enabled solutions that can provide faster and more thorough inspections of these enormously expensive platforms and insure against not only catastrophic disasters like Deepwater Horizon, but also more common issues like wear and tear of underwater components – to say nothing of potential sabotage of these oil and gas rigs by terrorists or environmental activists. And much like an iceberg, what the eye can see above the water when viewing an oil or gas rig is only part of the story. There is a tremendous amount of the infrastructure that is below the surface and unseen.

CANAL AND DAM HYDROGRAPHY

Maritime Tactical Systems, Inc. (MARTAC), a Florida-based manufacturer of unmanned surface vehicles (USVs), has fielded a family of low-cost, rugged and adaptable MANTAS USVs built on a catamaran hull. Part of the attraction of using a USV such as these for offshore oil and gas platform inspections is that this unmanned surface vehicle has had extensive use in military exercises, experiments and





demonstrations in both near-shore and open-ocean operations, as well as hundreds of hours of use in a number of civilian missions, ranging from commercial canal and dam hydrography, to commercial power plant inspections, to port and harbour security.

The MANTAS T12 (12-foot) USV has already been equipped and tested with a wide variety of surface and below-surface sensors, such as the SeaFLIR-230 Gyro-stabilized High Definition EO/IR zoom camera with laser tracking, FLIR M232 thermal camera, Teledyne RESON T20 high resolution multi-beam sonar, Teledyne BlueView M900 single-beam echo-sounder and Norbit iWBMS STX multi-beam sonar, among others. MARTAC already has a T24 (24-foot) and T38 (38-foot) MANTAS in final design for fabrication. Later this year, MARTAC will introduce their first T38 as an operational USV in a major international military exercise.

OFF-THE-SHELF TECHNOLOGY

This off-the-shelf technology can be used today to effect faster and more complete inspections of offshore oil/gas platforms, along with their surrounding bottom mounted pipelines, valves and sensors, while dramatically decreasing the need for human divers. Under this concept, a MANTAS USV would be controlled by one operator in the Rig Command Centre. This

inspection of bottom valves, vertical pipes, fittings, pipelines and other rig components can be part of scheduled, routine checks or be done on-demand to investigate something out of the ordinary discovered by Rig Command Centre watchstanders.

Three primary missions where the Rig Command Centre would utilize this USV concept include:

- For underwater imaging, the MANTAS (T12, T24 or T38) could be equipped with Norbit

iWBMS STX multi-beam sonar, a forward-looking or side-scan sonar, or any of many other commercial-off-the-shelf underwater sensors.

- For surface investigation, which would include area security, external rig structure investigation and surface contact monitoring, among other missions that a MANTAS USV is ideally suited for, the MANTAS could be equipped with a SeaFLIR-230 or FLIR Cutlass-240 Gyro-stabilized High Definition



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Getting to the bottom of things

EO/IR zoom camera, or alternately, a simpler FLIR M400, M500 or M625CS.

- Since one of the early indicators of material failure of oil rig components involves oil and other material from the rig seeping into the surrounding water, the MANTAS USV can be equipped with water-monitoring sensors to include Acoustic Doppler Current Profilers (ADCP), Current-Temperature Depth (CTD) sensors, fluorometers and others to detect changes in the water quality in the immediate vicinity of the rig.

ON-STATION LOITERING ENDURANCE

While the size of the MANTAS T12 restricts its ability to carry multiple sensors (surface and subsurface), the T24 and T38 have that inherent capability and sensor-swap modularity. Additionally, the endurance of the T12 is currently restricted to batteries and solar panels. The T24 and T38 are diesel powered, thereby providing a significant extension to their missions and on-station loitering endurance. The selection of the T24 and/or the T38 for this mission would therefore be the optimal solution.

Depending on the mission, operators in the Rig Command Centre can control any of the mentioned USVs remotely and direct their missions manually, or use them in an autonomous or semi-autonomous mode to search along a pre-determined course, through the use of pre-programmed waypoints. Most significantly, the video and sonar imaging from the MANTAS can be sent directly to the Rig Command Centre in real-time, thereby providing immediate notification of what the USV discovers above or below the water surface, thus enabling operators and management to make time-sensitive decisions regarding rig operations.

Anticipating near-term demand from the offshore oil and gas industry, MARTAC is developing concepts of operations (CONOPS) for how MANTAS would be used to help ensure rig security. For example, an operator in the Rig Command Centre might have a MANTAS on patrol on a predictable pattern, inspecting the rig above and below water. If the USV discovers an anomaly and links the video back in real-time, the operator will be alerted, can switch to remote manual control, and can command the MANTAS to linger in a particular area for more granular analysis.

If this investigation uncovers an area of concern, then a diver can be deployed to make a repair.



Clearly, this CONOPS will secure the integrity of the rig, while also substantially reducing the false alarms generated by other methods. Conversely, if the investigation does not reveal an issue, the MANTAS can return to its previously programmed autonomous mission profile.

The same USV technology that is poised to assist the oil and gas industry is already being used to inspect critical infrastructure such as harbours, ports, inland waterways, dams, levees, canals, bridges and other infrastructure that cannot be safely or effectively inspected by humans. For example, a MANTAS USV was used to conduct inspections of the Keokuk dam and energy centre, the Bagnell energy centre, the Elkhart hydro dam, the Central Arizona Project canal and other infrastructure.

Oil and gas rigs in the Gulf of Mexico, while not necessarily bunched together, are in some areas close enough for several rigs to share a single MANTAS. With a cruise speed of 20 knots, burst speeds of up to 80 knots for the larger craft, and a cruise radius of 60-plus nautical miles, several rigs can share one MANTAS USV. This scheme can be particularly valuable as it could well result in sharing best-practices among various

oil and gas companies where, if a USV discovers that a valve, fitting or other gear on one rig is in need of repair or replacement, operators can perform more frequent inspections of that component on other rigs.

The enormous investment America's energy companies have made in their offshore oil and gas rigs is one that these companies must protect against failure, sabotage, or other hazards. Protecting these expensive and vulnerable rigs is a first order priority for the industry and one that is increasingly expensive. Current means of inspecting these rigs are slow, expensive and hazardous. Employing commercial-off-the-shelf USVs like the MANTAS T24 or T38 that can be rapidly reconfigured with a diverse range of sensors can enhance the ability to deliver energy to America and the world. This is a win-win for the energy industry. ▲

George Calderisi is a career naval aviator whose 30 years of active duty service have included four command tours and five years as a carrier strike group chief of staff. He began his writing career in 1978 with an article in the US Navy's professional magazine.

✉ george@georgecalderisi.com

Highlighted Products

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survey work, operating remotely around fixed offshore infrastructures for Sound Characterisation Services for a major oil and gas client and environmental monitoring with The Ocean Cleanup. Contact AutoNaut's team of experts to discuss the high-profile scientific project to Antarctica in which an AutoNaut was adapted to carry and release an underwater glider to measure sea ice. Upcoming missions will use the AutoNaut as a surface communications hub for subsea assets as well as noise monitoring and mitigation work. AutoNaut is propelled by the motion of the waves and a range of sensors onboard are powered by solar energy. Operating independently in hazardous marine environments, AutoNaut is overseen from the safety of shore. Data can be stored and analysed or sent in real-time to inform live projects, depending on client requirements.

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In Our Next Issue

In the June / July edition of Hydro International, we 'will be looking at' the combined powers of hydrographers and space researchers. Peter Sparks, the National Hydrographer of the UKHO, will present his vision of international cooperation and we will zoom in on a new project by 'deep-sea diver' Victor Vescovo. With a selection of novelties, we will look back on this year's Oceanology International. Our next issue will be available from 14th May.

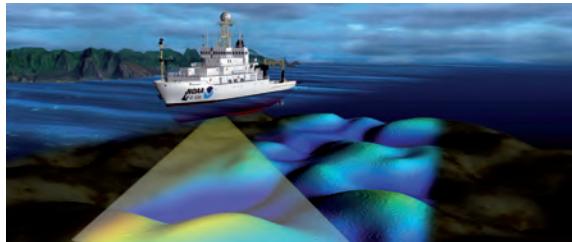
Interview Rear Admiral Peter Sparkes, National Hydrographer of the UKHO

In December 2019, the UK Hydrographic Office (UKHO) announced the appointment of Rear Admiral Peter Sparkes to the position of National Hydrographer and Deputy Chief Executive. Peter is the UK government's representative at the International Hydrographic Organization (IHO). In this

interview, he speaks about setting and maintaining standards that protect the safety of mariners around the world and he oversees key international partnerships with foreign navies, hydrographic offices, governments and commercial organizations to support the sharing of global marine geospatial data.



Collaboration Between Hydrographers and Space Researchers



Dr. David Amblas, a marine scientist at the University of Barcelona, is working on a research project on how multibeam echosounders can collect not only bathymetric data but also acoustic images of the water column. This will provide extraordinary new possibilities in ocean exploration. However, this water column

acoustic data generates huge amounts of data that poses obvious logistic, economic, and technical challenges. Dr. Amblas and his team are promoting a unique collaboration between hydrographers and space researchers to adapt a compression tool to solve the big data challenge posed by new multibeam echosounders.

Review Oceanology International 2020

Have you missed Oceanology International 2020? Read what Hydro International's editorial team discovered at the exhibition: innovative products, the latest technological developments and visionary opinions. Here is an overview of what is happening in the hydrographic and oceanographic arena.



Founder Five Deeps Expedition Launches New 2020 Voyage



Through collaboration between investor and explorer, Victor Vescovo, Triton Submarines and EYOS Expeditions, the 2020 Caladan Oceanic expeditions will yet again visit never-before-seen ocean depths and famed historic sites. A first of its kind two-person research submersible, designed and manufactured by Triton specifically

for extreme deep-sea exploration endeavours, will bring its stories of the voyage to the world in near real-time between February and July of 2020. This vessel, the Deep Submergence Vehicle (DSV) Limiting Factor, is the first commercially certified full-ocean-depth submersible. Vescovo will pilot the submersible on almost all of its dives.



PRODUCTS FOR POSSIBILITIES



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