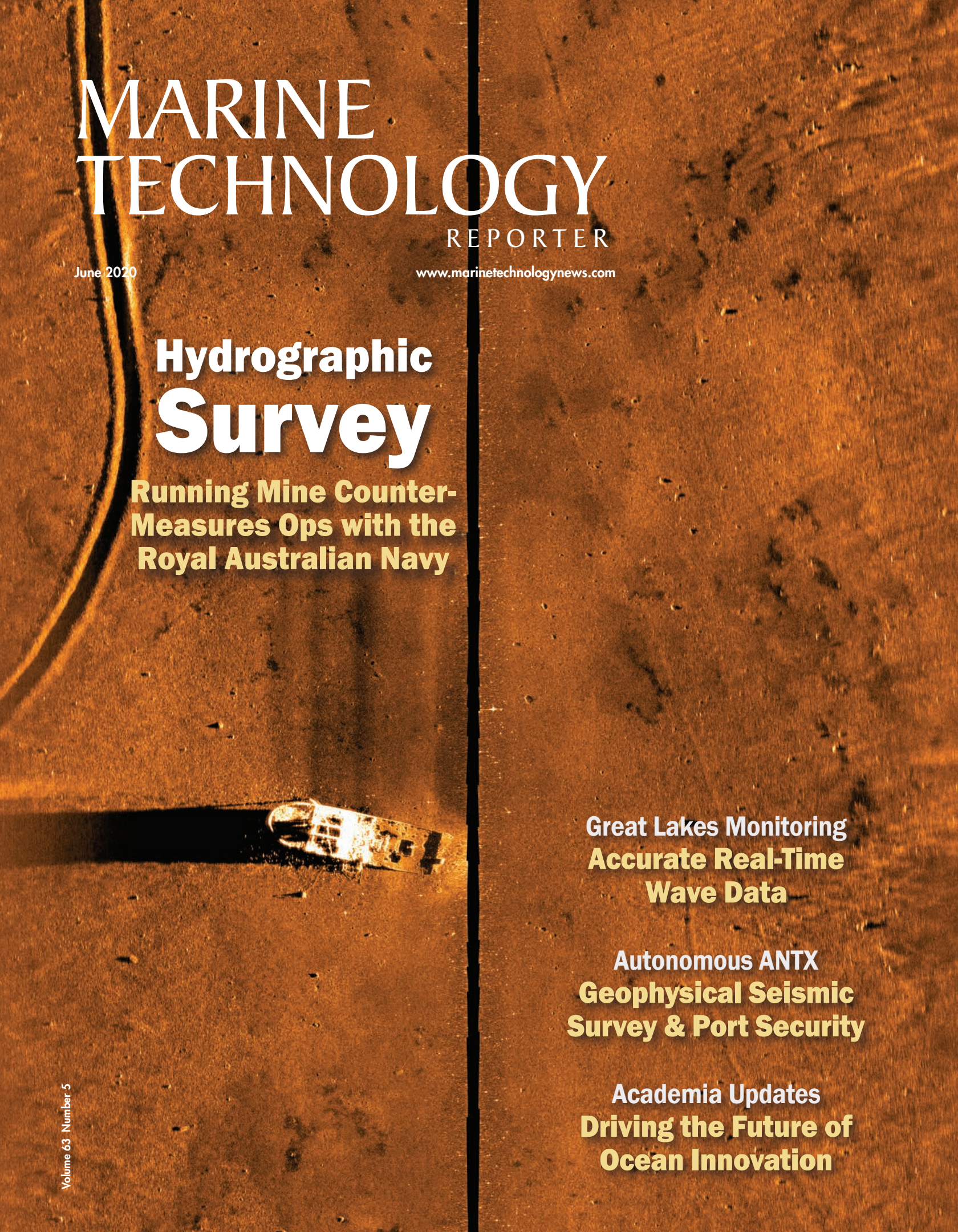
MARINE TECHNOLOGY REPORTER

June 2020

www.marinetechnologynews.com

Hydrographic Survey

Running Mine Counter-Measures Ops with the Royal Australian Navy



Great Lakes Monitoring Accurate Real-Time Wave Data

Autonomous ANTX Geophysical Seismic Survey & Port Security

Academia Updates Driving the Future of Ocean Innovation

Volume 63 Number 5

AVAILABLE NOW

Autonomous Command | Remote-Helm Control

- Reduce manual operations
- Lower risk of fatigue-related incidents
- Increases Safety at Sea
- Enable force multiplication
- Facilitate shoreside visibility

Survey | Spill Response | Search-and-Rescue | Fire | Security | Offshore Wind | Aquaculture

Sea Machines' innovation and advanced technology gives vessel owners an operational advantage. Contact us to schedule a live demonstration and learn how Sea Machines can solve your most persistent challenges on the water.

Sea Machines

Request a live demo at
sea-machines.com/contact

Qinertia

The Next-generation INS/GNSS Post-processing Software

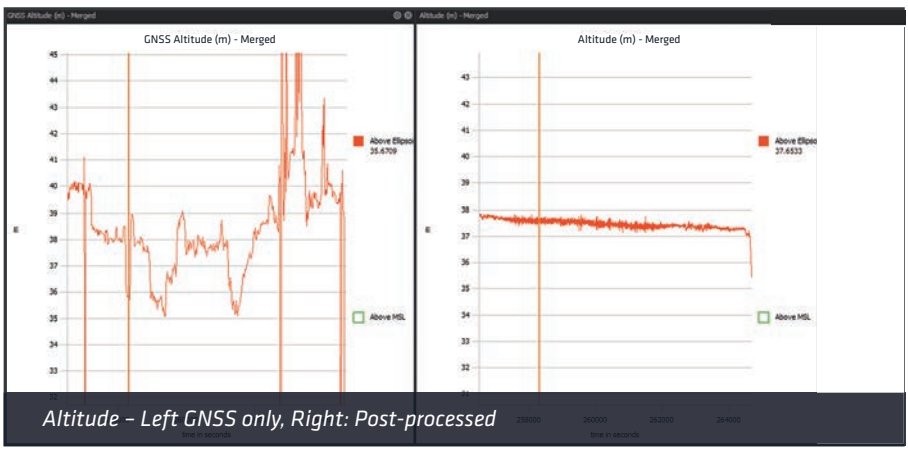
Quality: *Green -> centimetric position; Blue -> decimetric < 30cms; Red -> Raw GNSS data*

SURVEYING UNDER BRIDGES MADE EASY

This survey has been done with an APOGEE INS under very challenging conditions for the GNSS receiver (red dots).

The boat is crossing multiple times three large bridges including one made of steel.

With Qinertia and its unique 100% in-house GNSS/INS tightly coupled forward / backward processing, data collected under the bridges are fully exploitable (blue / green trajectory).



Altitude – Left GNSS only, Right: Post-processed

The Fastest PPK Software

Log duration: 2h15
Processing Time: < 2 mins

Long GNSS Outages Handling

Example: up to 80 seconds *outages and multi-path effects*
95% positions < 2 cms
Max error < 30 cms

Easy & Powerful Exporter

Easy export to third party software (SBET/ ASCII)

Many thanks to Hydro Systems Development (HSD Japan) for their kind collaboration.

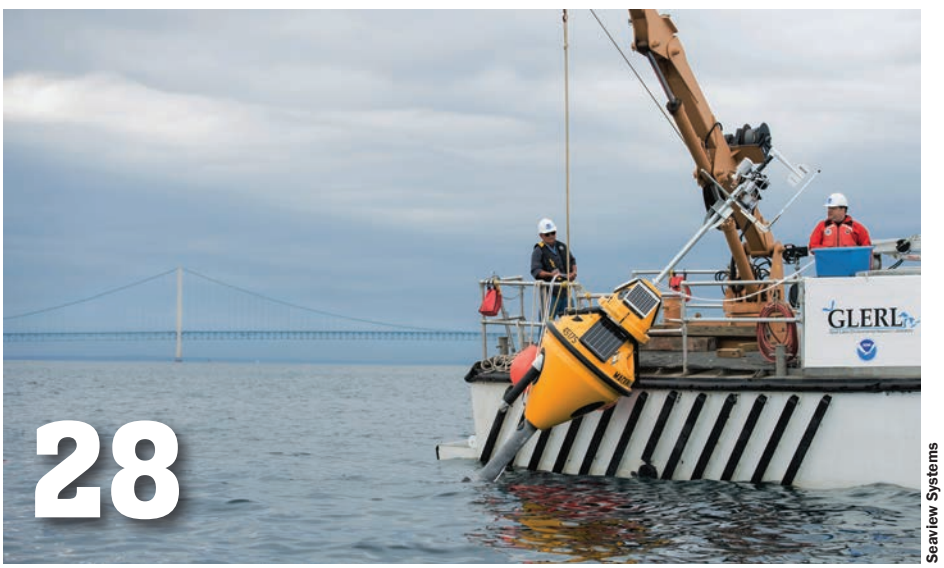
Full data available upon request at marketing@sbg-systems.com
www.sbg-systems.com

SBG SYSTEMS

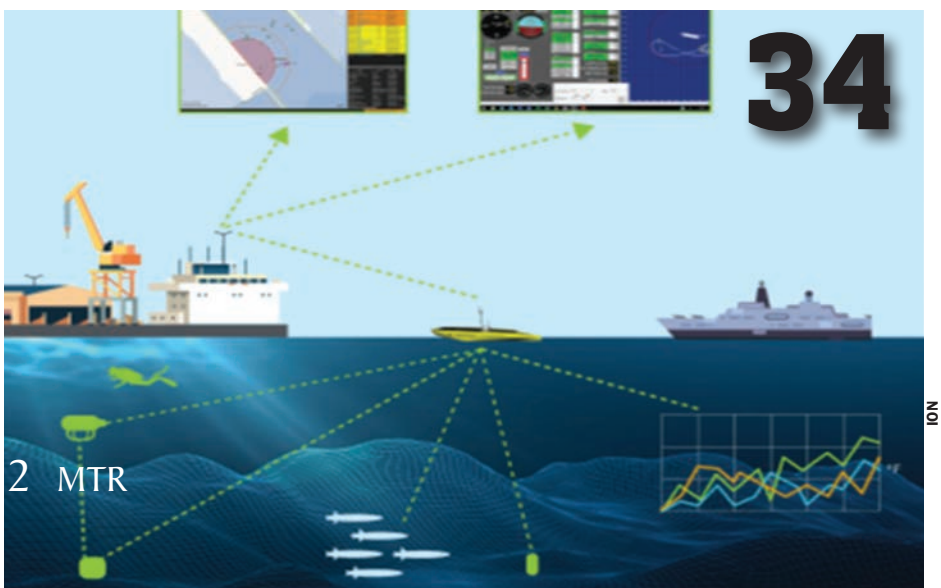
June 2020
Volume 63 • Number 5

Contents

Rotinor



Seaview Systems



ION

On the Cover

(Credit: General Dynamics Mission Systems Bluefin Robotics)

Royal Australian Navy's SEA 1778 Phase I deployable mine warfare system uses the General Dynamics Mission Systems Bluefin Robotics Bluefin-9 and Bluefin-12 unmanned underwater vehicles (UUVs) with Sonardyne Solstice multi-aperture sonar to find mines.
See story starting on page 18.

Built for Speed

9+Gb/s Data Rates for 6km-rated Subsea Cable Assemblies

Get groundbreaking new ultra-high speed data transfer rates of up to 9.4+/- 0.1 gigabits per second with BIRNS Millennium™ cable assemblies in a range of pin configurations, with our exclusive 52A-278 cable constucted for Cat 8.2 use.

Perfect for high definition video, monitoring and sonar digital data downloads, or any subsea application requiring incredibly high bandwidth data delivery.

Testing for this revolutionary subsea connectivity solution has data consistently transmitted at this rate over the entire range of pressures from 0 to 8700 PSI/600 bar (6,000m equivalent depth).

Ask our team for an exciting solution for your system to get your data delivered when and how you need it!

BIRNS®

High Performance . . .
Under Pressure®

www.birns.com

www.marinetechnologynews.com

NEW YORK
118 E. 25th St., New York, NY 10010
Tel: (212) 477-6700; Fax: (212) 254-6271

FLORIDA
215 NW 3rd St., Boynton Beach, FL 33435
Tel: (561) 732-4368; Fax: (561) 732-6984

PUBLISHER
John C. O'Malley
jomalley@marinelink.com

Associate Publisher & Editor
Gregory R. Trauthwein
trauthwein@marinelink.com

Contributing Writers
Justin Manley, U.S.
Elaine Maslin, Aberdeen
Tom Mulligan, Ireland
Claudio Paschoa, Brazil
William Stoichevski, Oslo

Production Manager
Irina Vasilets
vasilets@marinelink.com

Production & Graphic Design
Nicole Ventimiglia
nicole@marinelink.com

Corporate Staff
Manager, Marketing
Mark O'Malley
momalley@marinelink.com

Accounting
Esther Rothenberger
rothenberger@marinelink.com

Manager, Information Technology Services
Vladimir Bibik
bibik@marinelink.com

Circulation
Kathleen Hickey
mtrcirc@marinelink.com

Advertising
Vice President, Sales and Marketing
Rob Howard
howard@marinelink.com
Tel: (561) 732-4368 • Fax: (561) 732-6984

Advertising Sales Manager
Mike Kozlowski
kozlowski@marinelink.com
Tel: (561) 733-2477 • Fax: (561) 732-9670

Editor's Note

As we plod forward through the new world defined by pandemic, the days, weeks and months seemingly meld together, and from this seat, are flying by fast. It's hard to conceive that I have not been into my New York City office for more than three months, but the staff here at MTR, much like of the rest of the world, has become quite adept at working remotely. To most of you reading these pages though, the notion of 'working remotely' is standard fare, as the very nature of your work means that you either have, are or will 'work remotely' in some of the most fascinating, fast-changing and naturally hostile parts of the planet.

Working efficiently, effectively and safely on and under the world's waterways is the aim for all, whether you're collecting data for scientific research, installing a piling for an offshore wind farm or deploying a subsea network for national defense.

This month **Edward Lundquist** travels Down Under to deliver an insightful article on the Royal Australian Navy's efforts to protect task groups from the ever-present threat of sea mines. The Royal Australian Navy's (RAN) SEA 1778 deployable Mine Counter-Measures (MCM) capability is both a small step forward in the spiral development process and a "technological leap" into autonomy." The story starts on page 18.

Elaine Maslin's article "Autonomous ANTX" melds two markets, as at a glance geophysical seismic surveys and port security may appear to have little in-common. However, it turns out that managing complex marine seismic operations isn't that dissimilar to managing – and protecting – port facilities. Her story starts on page 34.

Finally, I'd like to officially welcome **Celia Konowe**, *Marine Technology Reporter's* summer intern, to our pages (see profile on page 6). Celia will become a regular name to many of you, as she takes on the gargantuan task of helping to organize the annual **"MTR100"** for the July/August edition – our 15th annual look at innovative companies, people and technologies in the subsea space. This year's internship is a bit different than past years, as first and foremost I have not personally met Celia except through our regular Zoom chats. But she was able to jump in immediately, researching, writing and delivering insight on the latest projects in Academia, starting on page 46.

Gregory R. Trauthwein
Associate Publisher & Editor

MARINE TECHNOLOGY REPORTER
www.marinetechnologynews.com
Vol. 63 *No. 5*
ISSN 1559-7415
USPS# 023-276
118 East 25th Street,
New York, NY 10010
tel: (212) 477-6700
fax: (212) 254-6271

Marine Technology Reporter (ISSN 1559-7415) is published monthly except for February, August, and December by New Wave Media, 118 E. 25th St., New York, NY 10010-1062. Periodicals Postage Paid at New York, NY and additional mailing offices.

POSTMASTER: Send all UAA to CFS. NON-POSTAL AND MILITARY FACILITIES send address corrections to Marine Technology Reporter, 850 Montauk Hwy., #867, Bayport, NY 11705.

The publisher assumes no responsibility for any misprints or claims or actions taken by advertisers. The publisher reserves the right to refuse any advertising. Contents of the publication either in whole or part may not be produced without the express permission of the publisher.

Member
BPA WORLDWIDE BUSINESS

Subscription:
To subscribe please visit
www.marinetechnologynews.com

High Resolution Without Compromise

AquaPix®

Kraken's family of commercial off the shelf AquaPix® sensors provide the industry's highest resolution imagery, while simultaneously collecting bathymetry at the lowest cost per pixel.

KRAKEN

Canada's Ocean Company™ www.KrakenRobotics.com

Authors & Contributors

Celia Konowe: Marine Technology Reporter's 2020 Summer Intern

Konowe

Celia Konowe is a rising college senior from Reston, Virginia, majoring in environmental studies at the University of Rochester with minors in French and theatre. This past semester, prior to the COVID-19 lockdown, she studied abroad in Ecuador through the Universidad de San Francisco Quito as part of its GAIAS (Galápagos Institute for the Arts and Sciences) program. Her time abroad was split between Quito and the Galápagos Islands while studying evolution, ecology and conservation. Her main environmental interests include hydrology, ecology conservation, marine ecosystem threats and food systems. She covered the 2019 Paris Air Show, aviation's largest industry event, by working for an on-site show daily and is a student member of the National Press Club.

Neville

Maslin

Lundquist

Hill

Hill

William Hill is the Executive Group Vice President – Oil & Gas for GAC. Hill joined the group in 1984 and has served in several senior leadership roles.

Lundquist

Edward Lundquist is a retired naval officer who writes on naval, maritime, defense and security issues. He is a regular contributor to Maritime Reporter and MTR.

Maslin

Elaine Maslin is an offshore upstream and renewables focused journalist, based in Scotland, covering technologies, from well intervention to subsea robotics.

Neville

Danny Neville completed a Bachelors of Computers Science from the University of New Brunswick (Canada) in 2000 and is currently the Fledermaus Product Manager at QPS.

EMPOWERING

our new generation of electric work robots

more **powerful** more **intelligent** more **future-flexible**

world leader in electric underwater robotics

SAAB

SAAB SEAEYE

AI Deployed to Map Marine Environs

Researchers at the University of Bath have developed an AI model that can automatically classify underwater environments directly from sonar measurements.

Sonar is commonly used to map the ocean floor, and seabed composition (e.g. mud, clay or rock) affects the way the sound is reflected back. Salinity, depth and water temperature also affect how sound waves are propagated through water.

This means that sonar measurements at different depths and distances can give accurate soundings of the ocean's properties, for example how underwater currents propagate, how the deeper ocean changes with the climate or where best to listen to whales.

Working with Systems Engineering & Assessment Ltd. (SEA), scientists at the University's Institute for Mathematical Innovation (IMI) have developed an Artificial Intelligence (AI) algorithm which could improve underwater mapping by making sense of incomplete data and working out how many measurements are needed to give an accurate survey.

The research was part of a project contracted by The Defense and Security Accelerator (DASA), a part of the Ministry of Defence, to improve monitoring of the UK's vast marine territories using high tech sonar. SEA led the project and provided simulated sonar data to train and test the AI algorithms developed by the IMI.

The technology could also be potentially used for ocean tomography across entire ocean basins, like the Arctic, to study the effects of climate change on the oceans and better enable the sustainability of human activities in fragile environments and ecosystems.

Senior Lecturer Dr Philippe Blondel, from the University's Centre for Space, Atmospheric and Oceanic Science, worked on the project alongside Machine Learning expert Professor Mike Tipping from the IMI.

Dr Blondel said: "There are lots of different variables that affect how sound waves are propagated in water, as some frequencies of sound can travel further than others.

"If you think about the sound of an orchestra, as you move further away, you might lose the high frequency sound of the violins but still be able to hear the lower frequency notes of the cellos. The beating of drums would be felt even further.

"This is the same with ocean sounds, which come from the weather, like rain and storms, the animals, like whales and fish, but also humans, with ships and offshore activities.

"For this project we wanted to model how sonar echoes were changed by depth, salinity and temperature so we could use sound to measure these variables in the ocean."

The researchers first analysed the many characteristics of underwater environments and classified them into different types.

They used Probabilistic Generative Modelling to develop several AI algorithms for identifying underwater environments.

After developing the AI algorithm, the researchers tested its performance on a wide range of simulated acoustic data representing a broad spectrum of underwater environments.

The tests demonstrated that their Probabilistic Principal Component Analysis (PPCA) algorithm could classify underwater environments from simulated sonar measurements with an average accuracy of 93%.

For more insights on work being done throughout Academia, turn to page 46

Acoustic Transducers and Arrays

CUSTOMIZATION Ultrasonic Collaboration **DESIGN** **Solutions**
Manufacture **TEST** Innovation **Prototype** Quality **Production**

From prototype to production, AIRMAR and MSI push the boundaries of sonar technology. Whether you need a simple single element sensor or a large multi-element array, we have the solution. We specialize in partnerships providing strong engineering support, innovative technology, advanced manufacturing capabilities and exceptional customer service.

AIRMAR® TECHNOLOGY CORPORATION

AIRMAR.COM

MSI® TRANSDUCERS

MSITRANSDUCERS.COM

Deploying Science for Oil Spill Containment

An innovative sub surface oil containment and recovery system, installed in April 2019 over a damaged oil platform in the Gulf of Mexico, is successfully preventing more than 1,000 gallons of oil per day from entering the environment. Scientific research and lessons learned following the Deepwater Horizon oil spill have allowed the development of unique oil spill response systems such as this to help protect the maritime environment from future threats.

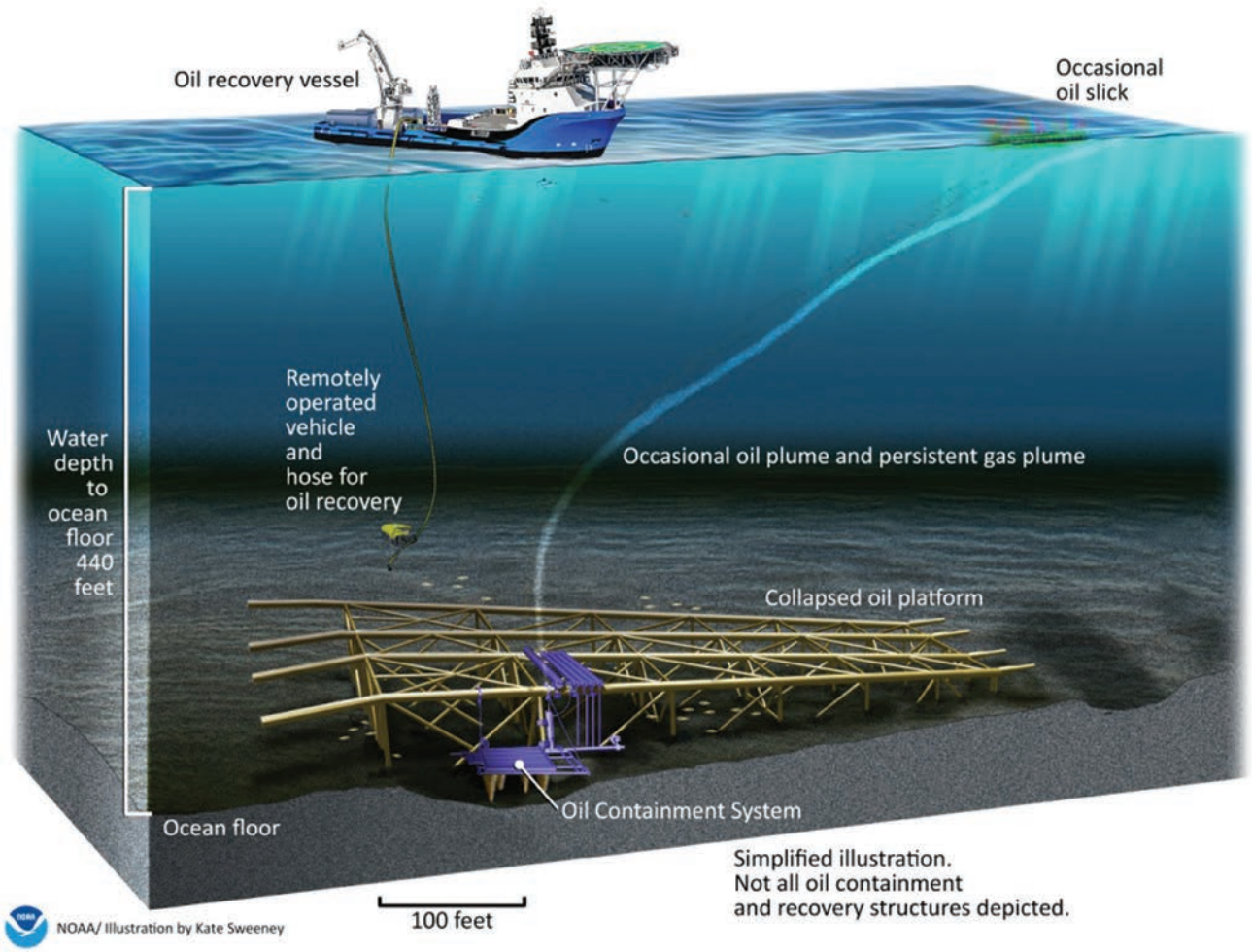
In 2004 during Hurricane Ivan the Taylor Energy Mississippi Canyon 20 (MC20) oil platform toppled creating an ongoing flow of oil into the Northern Gulf of Mexico. Scientists from multiple government agencies and academic institutions, conducted cutting-edge studies that determined the location, source, and amount of oil and gas emitting from the site. Utilizing remote sensing technologies such as drones, satellites, and underwater vehicles in combination with on-site in-situ sampling and chemical analysis, scientists were better able to characterize the oil release.

Two separate studies conducted in 2017 determined that the oil and gas were discharging from multiple plumes in a discrete location rather than over a wide area. In 2018, the Bureau of Safety and Environmental Enforcement and the National Oceanic and Atmospheric Administration undertook a follow-up study to determine the chemical characterization of the release, and to generate a flowrate (amount of oil and gas spilling in a given period of time) estimate for the site.

These studies helped determine that oil was leaking from the damaged infrastructure and could be contained, and that more than 1,000 gallons of oil per day was being released, versus previous estimates of 3-5 gallons per day.

The United States Coast Guard assumed partial control of the Taylor Energy oil spill response after repeated past attempts failed to stop, or contain, the flow of oil in the years since the platform with 25

United States Coast Guard directed the installation of an oil containment system (pictured in purple) which is designed to contain and recover as much oil as possible. An oil recovery vessel connects to the oil containment system periodically to remove oil collected in the system and transport the oil to shore.



producing wells were toppled and buried in sediment. The Coast Guard, with support from NOAA and the BSEE, oversaw the design, installation and operation of a Rapid Response Solution (RRS) subsurface system designed by the Louisiana based Couvillon Group.

The containment and collection system was developed and implemented in five months to quickly stem the flow of oil. The system has recovered more than 375,000 gallons of oil since it was installed. Environmental protection continues, with the Coast Guard overseeing continuous oil collection and containment system maintenance. These scientific successes are made possible through the collaborative efforts of the interagency team of oil spill responders and scientific experts. The Coast Guard and National Oceanic and Atmospheric Administration will continue to support the Bureau of Safety and Environmental Enforcement efforts to use sound science to ensure that the Taylor Energy wells are properly plugged and a permanent solution is reached.

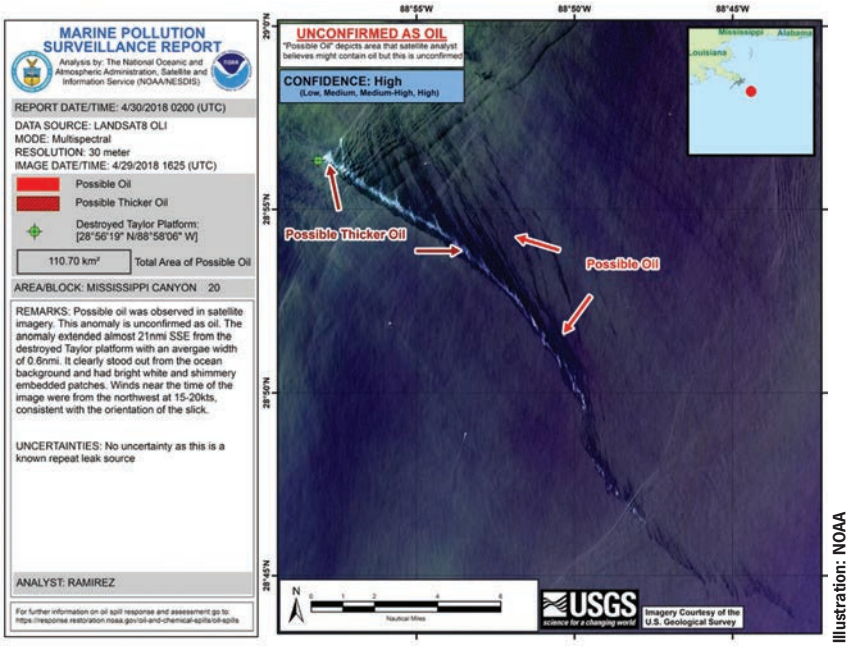


Illustration: NOAA

A National Oceanographic and Atmospheric Administration National Environmental Satellite evaluation of the MC20 well site conducted April 30, 2018. The oil platform collapsed after Hurricane Ivan in 2004.

Tech Files

Innovative products, technologies and concepts

Remotely Operated Vehicles

New Concept from Depro, VideoRay

Depro AS and VideoRay LLC have developed a new, compact and, flexible ROV concept, designed to be easy-to-use and quick to mobilize.

BLUEROC is a remotely operated container solution, designed to control and operate an inspection ROV. The container consists of equipment required to run the operation (operation room, winch, LARS, TMS and the ROV).

BLUEROC is quick to mobilize and install on the vessel. All parts needed to run the operation are delivered in one 20 feet container. The system is ready to be operated within one hour.

BLUEROC is designed to operate in water depths down to 2000 meters.

The compact system can be used on all type of vessels that have available space for a 20 feet container. This gives the opportunity to use vessel with low day rates, which contributes to lower cost for the operator.

This product is comprehensive, has direct sales, rental alternatives, and operational support offshore or onshore.

Customers buying the ROV-concept will be offered a training program on how to operate BLUEROC. BLUEROC is delivered with standard setup for 4G and Wi-Fi connection.

"This product is a part of a long term Depro strategy, where we want to offer innovative, remote operational concepts which generates high customer value. Depro has a strong global position.

To strengthen our position, we believe it is important to drive the technology towards more cost efficient and environmentally beneficial concepts and products," said Kenneth Olsen who is the CMO of Depro.

"The concept and our vision has been well received by customers. The first system is ordered and will be delivered by the end of this year."

Image: Depro AS

Vietnam Navy Puts Forum XLX-C ROV to the Test

Photo: Forum

Forum Energy Technologies' ROV, the Perry XLX-C, reportedly completed harbor trials for the Vietnam Navy. The vehicle is the compact derivative of the XLX work class ROV, and is a heavy-duty work class hydraulic ROV with a depth rating of 4000m, outfitted with cameras, lights, altimeters and sonars.

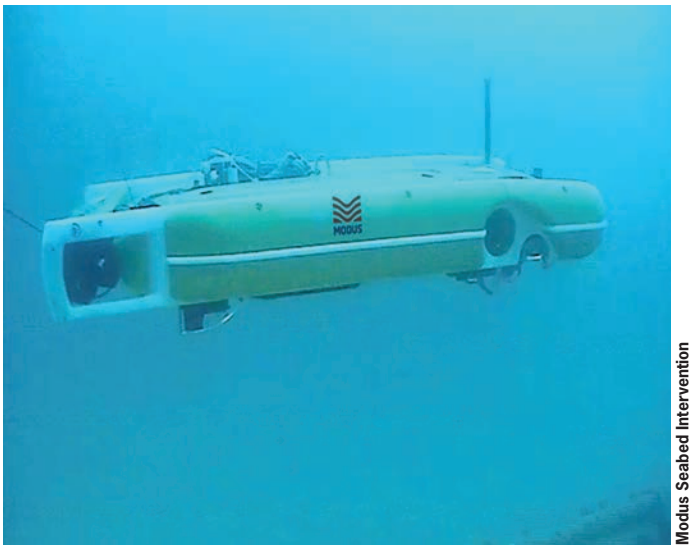
The Perry XLX-C will be used to support the Vietnamese' submarine rescue vehicle in its operations during assessment and preparation of a site for a submersible rescue. The XLX-C is fitted with Forum's latest technology and can deliver specialized equipment, including an Emergency Life Support System, to a distressed submarine. It was supplied with an Emergency Life Support Stores (ELSS) underslung ROV skid which allows the transport and deployment of up to three ELSS pods at once to a distressed submarine (DISSUB). fThe XLX-C is coupled with a Forum Dynacon Launch and Recovery System (LARS) manufactured in the U.S. The Houston team also supplied a VMAX ROV training simulator for the XLX-C as a training aid for the ROV pilots. Forum's software developers designed a new scenario to instruct pilots on how to latch the ROV with a distressed submarine using a 'sticky foot' tool in order to deliver emergency supply pods.

Forum has also provided the Vietnam Navy with a VisualSoft, four Channel VisualDVR, system. This is a multichannel digital video recorder with dynamic overlay and was supplied by Forum's VisualSoft team in Aberdeen, UK.

Hybrid AUV Completes Project for Offshore Wind Farm

Modus Seabed Intervention completed a high speed bathymetric and depth of burial survey of the inter array cable routes on the innogy operated Gwynt-y-Môr offshore wind farm, using the Modus HAUV-2 (Hybrid Autonomous Underwater Vehicle). The Gwynt-y-Môr Offshore Wind Farm comprises 160 Siemens 3.6MW WTGs located approximately eight miles from the North Wales coast in Liverpool Bay in water depths ranging between 12 to 28m. The WTG's are connected by 161 inter array cables which total circa 147km in length. The worksite is known for high subsea currents, so any solution had to cope with current up to 2 knots.

Modus mobilized its HAUV-2 system, equipped with Optimal Ranging Orion Cable Tracking System and dual head R2Sonic 2024 Multibeam Echosounder, on the chartered DP2 vessel "Noordhoek Path-finder." Having already performed numerous oil and gas scopes, Gwynt-y-Môr was the first complete OWF inter array survey performed by HAUV-2. As well as the high current capability, the HAUV can hover and can interchange sensors on the vehicle, which ensures system flexibility to change tasks, for example the HAUV can combine depth of burial survey with structure inspection activities to offer further synergy savings in these challenging environments.



Modus Seabed Intervention

Column

Renewables

A New Role for Service Providers Amidst Energy Upheaval

By William Hill, Executive Group Vice President, GAC Energy

In today's energy industry, things are moving fast. The upheaval brought about by COVID-19 and exacerbated by the Russia-Saudi Arabia oil price war has been so profound that the International Energy Agency (IEA) has described the situation as "a once in a century event for energy demand". This is supported by current IEA predictions which suggest a 6% drop in global energy demand in 2020 – seven times worse than the plunge in demand that followed the 2008 recession.

Amid what the IEA has dubbed a "dismal" year for fossil fuels, the one bright spot is the performance of renewables sector, which is still expected to grow by 1% this year. That is a serious downgrade on the sector's record performance last year, when global wind power capacity grew by almost a fifth. Nonetheless, the current modest growth figures for this year are fuelling speculation that renewables will emerge as a new paradigm winner once the COVID-19 pandemic abates. If that happens, renewables will attract investment, drive growth, bring jobs and energy security in the future – all while supporting the global battle against climate change.

Confidence in the long-term future of renewables is further buoyed by the growing number of oil majors that have signed up to ambitious green targets. In the last month, for example, Shell has committed to a net-zero emissions goal by 2050, with CEO Ben van Beurden saying "society, and our customers, expect nothing less".

The success of the renewables industry so far is supported by the progressive work done to date by companies including Shell, BP and Equinor to diversify into other means of power generation. As the global energy industry continues to navigate an era of unprecedented transition with renewables at its heart, the sector needs to be prepared to adapt and change.

As those who operate in the energy sector know, change has been a basic factor of the business over the last decade. Today, more than ever, the industry's experts will be called upon to provide the resources and expertise necessary to help make sense of the new lay of the land after COVID-19.

Redeploying resources

History teaches us that pandemics constrain what industries can do with the scarce resources at their disposal. Overcoming such constraints demands the highest levels of human ingenuity and effective use of the latest technologies. For offshore service providers, now is the time to take a clear and systematic view of all the issues – COVID-19 related and beyond – to take decisive action and update their approach as necessary and when further information is available.

While the current situation is singular, service providers are not in altogether uncharted waters. For years, they have managed heightened customer expectations, primarily motivated by a constant pursuit of cost reductions on the part of major operators. And for years, the response of the service providers has been a mantra of value adding; stretching to meet the demands of the market and remaining flexible to its ongoing change. This mantra must continue as service providers play their part in helping the market navigate the after-effects of the COVID-19 crisis.

The value of providers' transferrable skills and knowledge is brought into sharp new focus. Their knowledge takes on new significance as a vital piece in the energy market's COVID-19 response puzzle, particularly with respect to its persistent challenges of project management, knowledge bleed and technology.

Solving such perennial challenges helps make the overall shared response to the current market conditions more robust.

A faster pace of innovation

A knee-jerk reaction to the pandemic may be the assumption that a lack of resources will trigger the death of innovation within the sector. However, as we have seen, the demand for renewable electricity continues to grow, and the world has precious little time left to meet societal and regulatory pressures to decarbonise.

Some argue that COVID-19 may accelerate some of the innovations the energy market has already been adopting. Again, service providers find themselves at the cutting edge, driving and responding to increasing innovation within the markets they serve.

Data-driven decisions

In the same spirit, the value of data is likely to skyrocket. The previously observable shift from retrospective reporting to a requirement for real-time analytics will accelerate as cost concerns take centre stage once again.

As decisions are made about key projects, customers want in-depth insight into the exact cost and time taken for

OFFSHORE WIND
POWER

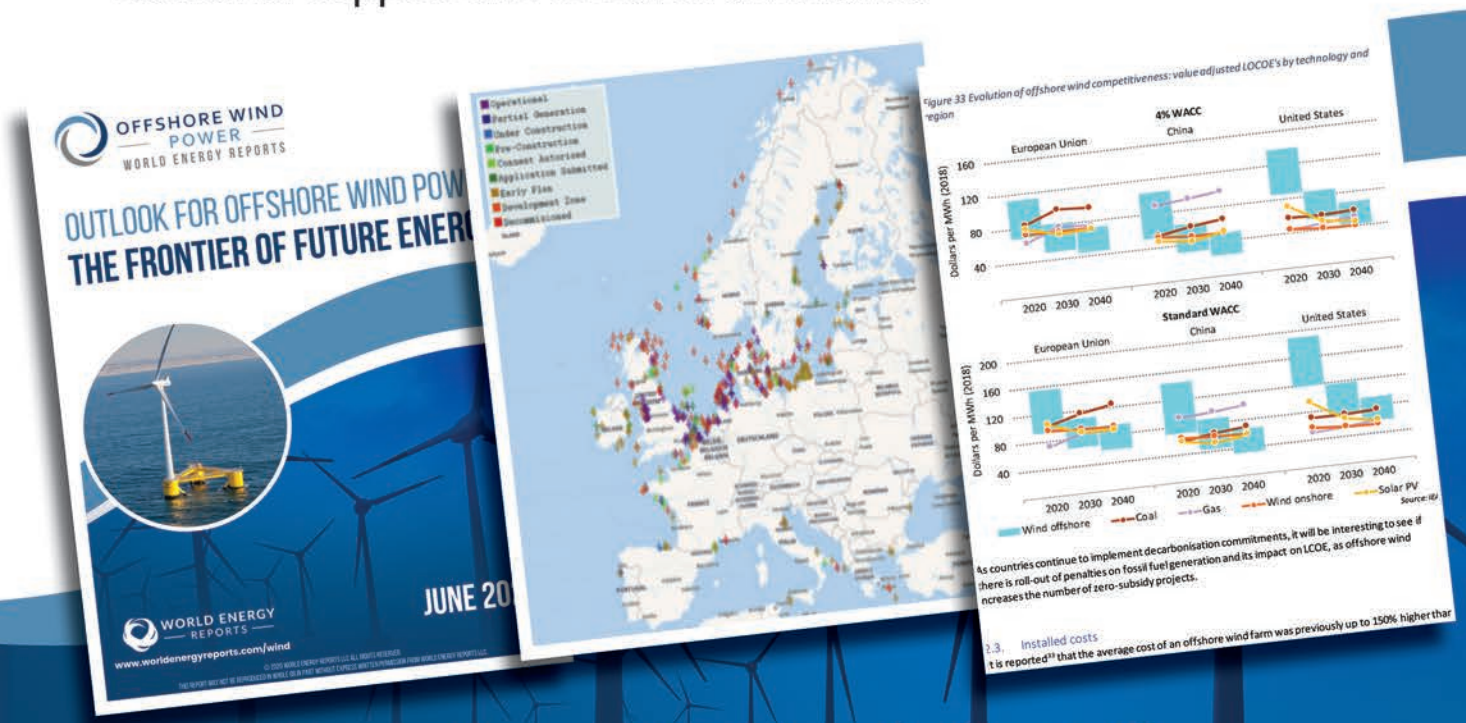
OUTLOOK FOR OFFSHORE WIND POWER

THE FRONTIER OF FUTURE ENERGY

OFFSHORE WIND MARKET INTELLIGENCE PACAKGE

The Offshore Wind Market Intelligence Package from World Energy Reports is a turn-key solution to analytics, forecasts and industry data for the offshore wind market. Each intelligence pacakge includes:

- A comprehensive and in-depth market research report
- Interactive on-line database
- Customer support and research assistance



To Learn More or for Subscribtion Options

Call +1-212-477-6700 xt 6920
or email: info@worldenergyreports.com
www.worldenergyreports.com/wind

every job or development. Real-time analytics enable service providers to supply customers with the constant data that facilitates more informed decision-making and forecasting.

Critically, such insight requires both the service provider and the customer to have the digital infrastructure in place, heightening the requirement for innovation to continue, rather than stall.

Growing data utilisation reveals that the costs of gathering this intelligence can be outweighed by the efficiency and operational benefits it brings, setting a challenge for every service provider to move in tandem, as data gains new prominence as an operational resource.

Human Capital in the Spotlight

By its very nature, the offshore economy has seen vast swathes of talent leave the sector as demand ebbs and flows. Sadly, the current economics will accelerate this trend further, leaving the market in an interesting position, particularly if we believe that there will be a continued uptick in renewable energy demand.

Historically, offshore energy projects have been hindered by organizations having to recruit and train individuals to successfully manage often complicated projects. This pressure is particularly heightened where projects have to navigate complex local regulatory and legal requirements, or are taking place in difficult environmental operating conditions.

Service providers will continue to fill this gap. Indeed, it could be argued that project management capabilities and market knowledge will be the defining factors of success both for providers, and the projects they work on, in the coming years.

Increasingly, contracts now stipulate a requirement for greater levels of knowledge sharing – at times including the outright secondment and embedding of experienced staff in a customer's operations. As the offshore sector adjust to the new balance of oil & gas and renewables projects, the knowledge needed to manage the transition will have to come from somewhere. More than ever, operators will be looking externally for these answers.

Finding the Right Approach

The energy sector is facing some vast challenges. As it works to juggle ongoing issues such as project and data management, along with the wild card of COVID-19 and its economic impact, the market must not become blinkered in its response.

The right blend of human capital and data insights will take on new prominence. While every operator and service provider wishes they have a crystal ball to foresee the future of the market, we can instead build a robust and resilient approach that will allow us to be proactive.

As service providers take on new roles in the market, we must remember that change is a constant for this sector. Finding the right approach to navigate the challenges is a difficult task, but not unsurmountable. The same values that made for success in the last ten years will make for success in the next decade: collaboration, strong partnership and flexibility.

Federico Rostagno/AdobeStock

For the Royal Australian Navy, Technological Leap Starts Small

Driven by the need to organically protect maritime Task Groups from the threat of sea mines, the Royal Australian Navy is introducing a deployable Mine Counter-Measures (MCM) capability under the first phase of Project SEA 1778.

By Edward Lundquist

Images: Rotinor

The Rotinor Black Shadow diver delivery system can be used to place detonating charges near mines.

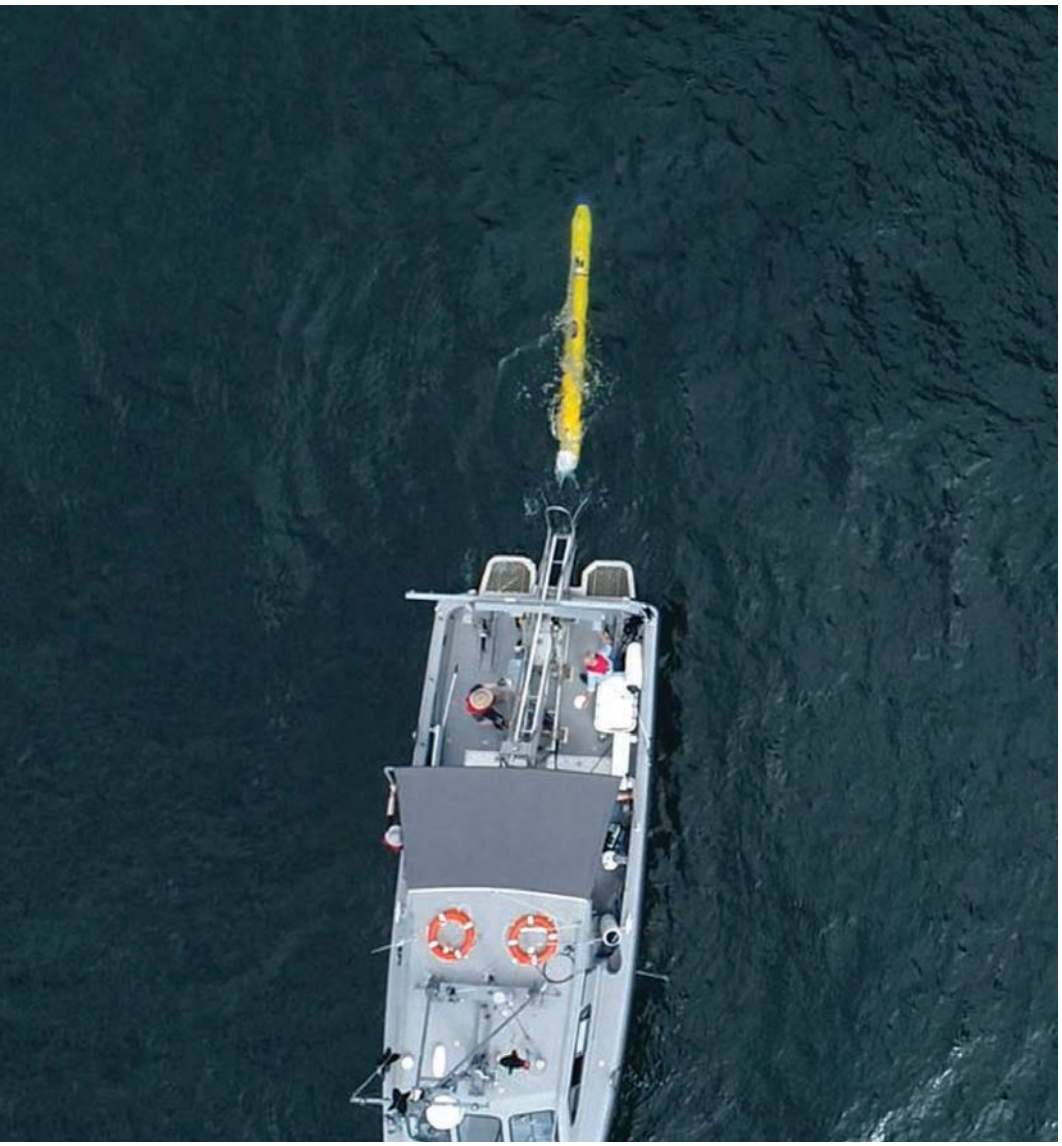


Photo: Thales Australia

The Royal Australian Navy's (RAN) SEA 1778 deployable Mine Counter-Measures (MCM) capability is both a small step forward in the spiral development process and a "technological leap" into autonomy."

The RAN is looking to replace its four legacy Huon-class minehunter coastal ships (MHCs) with a new deployable MCM capability. The lead ship in the class, HMAS Huon (M 82) will be 21 years old this May. The MHCs are slow and are not always available where and when they are needed. Furthermore, they need to enter mined areas to find the mines.

Captain Bryan Parker, the RAN's Commander Mine Warfare, Clearance Diving, Hydrographic, Meteorological, Oceanographic and Patrol Force (COMMHP), said the Task Group MCM capability aimed to provide a tactical capability essential to reducing the hazard of mines in the littoral maritime domain for Navy's deployed Fleet, while also minimizing direct exposure of its personnel to dangerous sea mines.

"By its very nature, MCM operations are a time-consuming task and conventional minehunters have a relatively slow speed of advance compared to our other warships. We are aiming to provide an MCM capability in-stride with, or in some cases ahead of, deploying maritime task groups to effectively speed up the time taken on this important function and enabling maritime maneuver," Parker said.

"We need an organic MCM capability that's designed to burst out of the back of the Landing Helicopter Dock (LHD) and clear a lane to the beach so the landing force can go ashore," said Cmdr. Mick Parker, the operational requirements sponsor for mine warfare at the Navy Strategic Command. "SEA 1778 provides an initial interim MCM effect for a single task group."

The SEA 1778 package is relatively

Royal Australian Navy photo by ABIS Jarrod Mulvihill

Australian Mine Warfare Team 16, MCDGRP and DSTG staff operating the Bluefin 9 Autonomous Underwater Vehicle (AUV) from a Mine Countermeasure Support Boat (MCMSB) during a Project Sea 1778 equipment application course at Pittwater, NSW.

small. The entire system can be containerized, shipped to a task group such as the RAN's amphibious ships, the new Arafura-class OPV or the Hunter-class future frigate. It can then be dispatched to another location if necessary.

It uses manned and unmanned surface vessels and autonomous underwater vehicles that can search an area from a safe distance.

The procurement is also relatively modest, so the RAN can take gradual steps towards using autonomous systems.

"It's a small buy so we can test the water, form our concepts, understand our rate of effort, the workforce requirement, conduct the integration, and springboard into the strategy," Parker said. "It's a toe-in-the-water of autonomy."

Thales Australia is the prime contractor for SEA 1778 PH I, and has assembled a world-class team, starting with the five 38-foot support boats made by Steber International of Taree, New South Wales.

The boats are the same, all though two of them will also have be equipped with a control system from ECA of La Garde, France so they can be operated remotely. "The unmanned boats (USVs) can tow the Australian Minesweeping System (AMAS) sweep, made by Thales, which is a towed magnetic and acoustic multi-influence sweep for detonating influence mines. If you know there's a mine out there, you can send out one of the unmanned boats and trigger the mine using the AMAS," said Troy Stephen who is the Director of the Underwater Systems Business for Thales Australia. "The AMAS is a proven capability used by many navies around the world."

General Dynamics Mission Systems Bluefin Robotics General Dynamics Mission Systems Bluefin Robotics of Quincy, Massachusetts, has delivered

Photo: General Dynamics Mission Systems Bluefin Robotics/Royal UK Navy

both 9-inch and 12-inch diameter Bluefin unmanned underwater vehicles (UUVs) for the program.

According to Stephen, both the Bluefin-9 and Bluefin-12 vehicles have good endurance, Stephen said, and yet are small enough to handle with relative ease. The Bluefin-9 is 2-man portable, and can be placed into the water from the boats and retrieved over the transom. The larger AUV uses a stern launch and recovery system on the Steber support boat that has been developed by Thales. Both UUVs are fully autonomous, and feature Sonardyne Solstice high-resolution Multi-Aperture Sonar (MAS); the same Removable Data Storage Module (RDSM); and the same 1.9 kWh Li-ion batteries (the Bluefin-9 has one; the Bluefin-12 has four, so the Bluefin-12 can conduct missions of up to 24 hours or longer).

The Bluefin vehicles have the ability to be configured with automatic target recognition using software from SeeByte of Edinburgh, Scotland, so they can identify mine-like objects onboard the vehicle to create an image of the target, and can return with the data for post processing right on the surface boat.

"We can start looking at the data straight away," Stephen said. "When we get the vehicle alongside, we can take the hot-swappable hard disk and the battery out, put a new one in, and launch it again to search a new area," said Stephen. "Not too many other vehicles that can do that. That's one of the key differentiators of the Bluefin vehicle, and why we chose it."

Both the Bluefin-9 and Bluefin-12 use commercial off-the-shelf sensors to collect bathymetric and environmental data, including data on water currents, temperature, salinity and turbidity; the

The Bluefin-9 and Bluefiun-12 vehicles use the same removable 1.9 KWh Lithium-Ion Battery

The removable 1.9 kWh Li-ion battery can be easily accessed, removed and replaced in-field in minutes. The battery provides 8 hours of in-water operation, and is fully recharged in 6 hours. The batteries, common across numerous Bluefin UUVs, and are also shippable under UN 38.3. 1

Nortek Doppler Velocity Log (DVLs) for current measurements; and the Sonardyne Solstice Multi-Aperture Sonar (MAS) for high-resolution imagery even in murky littoral waters.

"Solstice uses multiple elements to generate an image, and in doing that, we improve the signal to noise ratio, and in doing that we extend the range," said Ioseba Tena, the global business manager for defence and robotics at Yateley, UK-based Sonardyne International Ltd. "We're extending the range by virtue of doing a better job of how we process and dynamically focus the data, to ensure the best performance in real-time."

Tena said the Solstice and Bluefin vehicles can "fly" at speeds up to 6 knots, although most UUVs don't operate that fast. "The beauty with a synthetic aperture sonar is that you get a constant area coverage rate. If you go faster, the range comes down, just by virtue of how the system processes the data. And if you go slower, the range goes up."

"It's all about the data," said Andy Rogers, vice president of undersea systems at General Dynamics Mission Systems. "The Bluefin-9 and Bluefin-12 are able to collect high-resolution data, process that data on-board the vehicle, and deliver actionable information to vehicle operators and decision-makers both during and immediately after a mission."

Rogers said the vehicles – by design – can be adapted to new missions as they are identified.

Stephen said the Bluefin UUVs can also do underwater surveys for harbor clearance or to map out a lane for an amphibious force beach landing. "We've tested the Bluefin vehicle with the RAN up in Pittwater, an area to the north of Sydney on the Hawkesbury River, and we've had tremendous success. We used the Bluefin to map the bottom, and we found wrecks that nobody knew about. We're doing experimentation with that data to develop 3D models of the bottom of the ocean. The system also allows for change detection. If we found two objects on the bottom every week for a month, and then a third object shows up, maybe we need to check that out," said Stephen.

When mines are found and are to be destroyed, the SEA 1778 kit includes the

Photo: General Dynamics Mission Systems Bluefin Robotics

Atlas Elektronik SeaFox (Bremen, Germany) expendable mine neutralization system, as well as the Rotinor (Stuttgart, Germany) Black Shadow diver delivery vehicle to transport divers to place detonation charges near mines, depending on the environment and tactical situation. The MAS Zengrange (Wellington, New Zealand) Command Initiated Detonation Systems (CIDS) is used to initiate the detonation.

In the first phase, the unmanned boats won't be able to self-deploy the underwater vehicles, but in future phases it is anticipated that the USVs will be enhanced to become fully autonomous and capable of deploying and recovering the UUVs, Stephen said.

As part of the first phase of SEA 1778, the RAN stood up Mine Warfare Team 16 (MWT 16) to operate the four Bluefin-9 UUVs, three Bluefin-12 UUVs, two USVs, three manned MCM Support Boats, and the Seafox Expendable Mine Neutralization System. The team is training on select elements of the system now. MWT 16 will receive the all of its gear later this year. The initial roll-out of the equipment will be the man-portable 'Bluefin-9' AUV, for which MWT 16 is undergoing pilot training at Sydney's Pittwater area.

Stephen said the Bluefin-12 has now also completed acceptance trials at Pittwater.

Lt. Cmdr. John Sutherland, who command s MWT 16, said RAN's joint commitment to training with Defence Science and Technology Group (DSTG)

The Bluefin-9's Removable Data Storage Module (RDSM) (General Dynamics Mission Systems)

The Removable Data Storage Module (RDSM) is a field-swappable module that processes and stores data collected by integrated sonar, camera and environmental sensors. An operator is able to recover and redeploy their vehicle in 30 minutes or less and have reviewable or actionable data in-hand immediately. Bluefin-9's RDSM acts as an independent data processor, generating and storing post-processed data with a simple interface to an operator's workstation. The RDSM contains a high-definition, machine-vision-grade monochrome camera that captures still images and video. Imagery is geotagged for easy review during post-mission analysis.

and industry partners such as the Australian Maritime College, is bolstering the team's capacity to hit the Initial Operating Capability milestone.

"We've been working with partners to upskill our people in the operation of AUV technology and provide them with invaluable underpinning AUV knowledge required to execute activities," Sutherland said.

According to Sutherland, the new autonomous and unmanned technologies will allow the RAN to search for, classify, identify and dispose of sea mines more safely and efficiently and limit the danger factor presented when personnel are directly involving in mine removal and destruction. "There's a lot of training, testing and trialing involved, but we're all aware of the significance of this new generation of technology, the team are making an important contribution to Navy's leading-edge capability and mission to fight and win at sea."

"We've conducted several rounds of training in operations and maintenance for Thales and RAN operators," said Rogers. "Our modular systems allow operators to replace components themselves which increases operational

General Dynamics Mission Systems Bluefin Robotics

SCOUTING WITH THE BLUEFIN-12

Testing conducted for the Royal Australian Navy's SEA 1778 Phase I deployable mine warfare system has been very revealing.

Cmdr. Paul Hornsby is the RAN lead for Autonomous Warfare Systems and is responsible for SEA 1778 PH I, the RAN's new deployable mine warfare system. Hornsby said Australia has harsh conditions – strong currents and dynamic sea floor conditions—which is especially challenging in mine warfare. "We need systems optimized for our requirement,"

SEA 1778 PH I uses the General Dynamics Mission Systems Bluefin Robotics Bluefin-9 and Bluefin-12 unmanned underwater vehicles (UUVs) with Sonardyne Solstice multi-aperture sonar to find mines. "We've tested the Bluefin vehicle with the RAN up in Pittwater, an area to the north of Sydney on the Hawkesbury River, and we've had tremendous success," said Troy Stephen, the director of the Underwater Systems Business for Thales Australia, which is the prime contractor for SEA 1778 PH i. "We used the Bluefin to map the bottom, and we found wrecks that nobody knew about."

Additional testing was conducted in November 2019 by General Dynamics Mission Systems Bluefin Robotics conducting sea trials of a Bluefin-12 UUV near their facility in Quincy, Massachusetts, captured detailed images of a Navy ship, USS YF-415, lost during World War II. The 132'-foot YF-415 with a crew of 31 was carrying explosives from the Naval Ammunition Depot in Hingham, Mass., on May 10, 1944, when an accidental ignition occurred. The ship was lost with 17 of her crew killed or missing.

"In addition to the shipwrecks our Bluefin UUVs found in Australia, our Bluefin-12 UUV captured detailed images of the USS YF-415 shipwreck during sea trials off the coast near Boston," said Andy Rogers, vice president of undersea systems at General Dynamics Mission Systems. "Technology advancements for both autonomous underwater vehicles and sensors are allowing new and more detailed surveying of the sea floor in challenging environments. We are better able to locate and image sunken ships, and provide details that can solve mysteries about what happened to them."

availability."

Advantages for naval applications of autonomous platforms and systems are many. But deciding which systems to use, and how to share the capabilities between men and machines, can be daunting. This is especially true in the area of naval mine warfare. The more machines can do, while keeping Sailors safely out of a minefield, the better. But the technology is still evolving. For the RAN, the move towards autonomous MCM is being conducted with a modest and incremental low-risk approach.

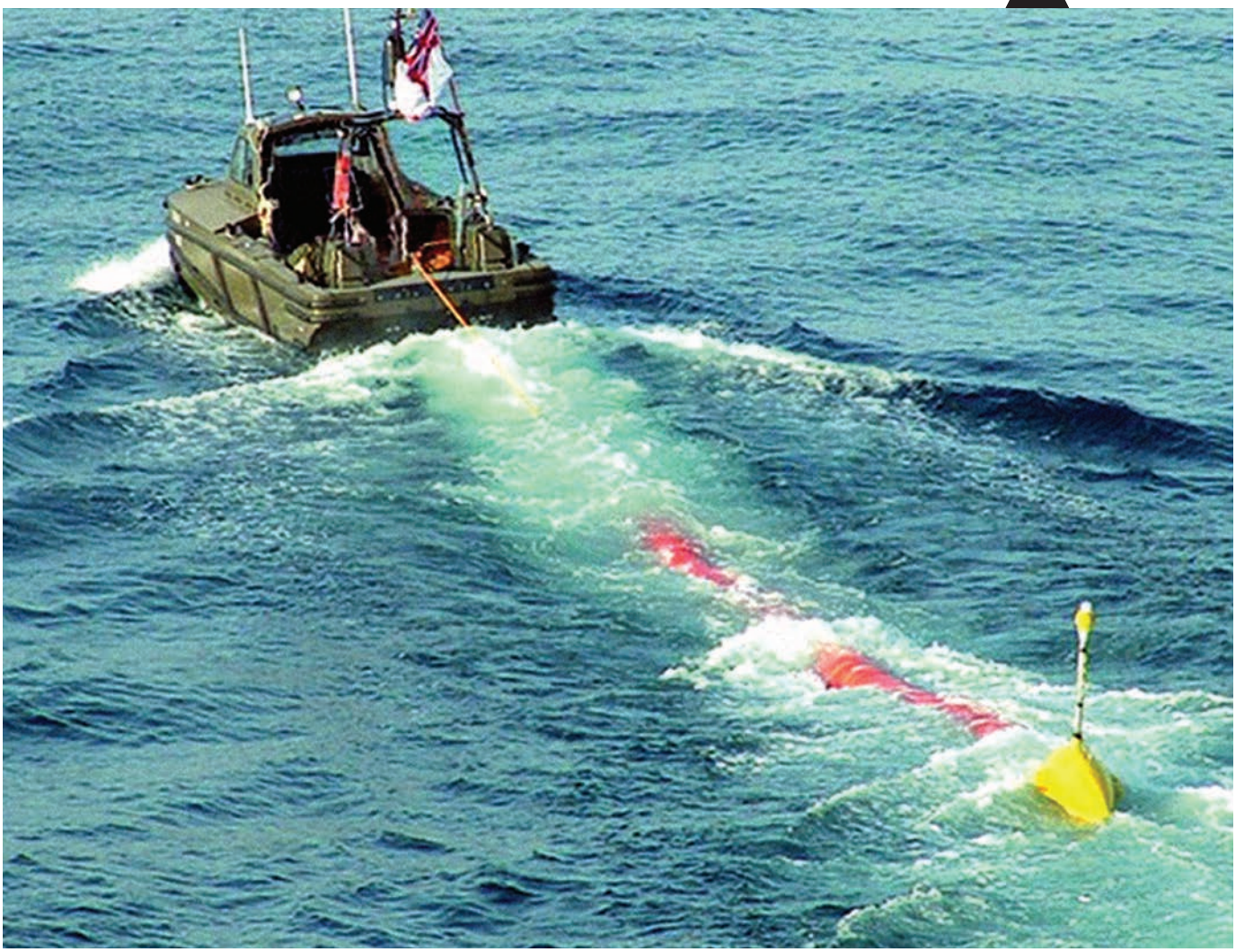
Cmdr. Parker, the SEA 1778 PH I program manager, said Phase I will be a learning experience. "It's a small buy so we can test the water, form our concepts, understand our rate of effort the workforce requirement, conduct the integration, and springboard into the strategy."

"In the modern warfare space, the speed and multiplicity of what will be occurring, such as swarms and counter swarms, means it's going to be a busy place. And that busy place may rise to what is beyond human capability in many of these terms," said Cmdr. Paul Hornsby, the Navy lead for Autonomous Warfare Systems, which includes the platforms, payloads, people and doctrine for the RAN.

"Technology is changing so quickly, and we don't want to commit to a great deal of investment and buy enough systems to last us 30 years when the technology will be obsolete in three years," said Hornsby.

"That's why we want to buy small, and buy often," Hornsby said.

Thales Australia's Australian Minesweeping System was developed with the assistance of the Australian Defence Science & Technology Organisation (DSTO) and the Royal Australian Navy.



Thales Australia

MICHIGAN TECH DEPLOYS SEAVIEW WAVE SENSOR FOR CHALLENGING GREAT LAKES MONITORING

Although land-locked, the Great Lakes are no strangers to large waves: the largest waves ever recorded approached 29 feet (8.8m) in Lake Superior in 2017. The Great Lakes Shipwreck Museum conservatively estimates 6000 ships and 30,000 lives have been lost on the Great Lakes since the 17th century. It is no wonder that accurate real-time wave data is crucial for the safety of commercial ships, recreational aquatic vehicles, fishing boats and ferries throughout the Great Lakes. Also crucial is weather prediction and prediction of phenomenon such as harmful algal blooms (HABs) In addition, the National Weather Service (NWS) reports its forecasts of over water winds, wave and storm surge are greatly enhanced during the Great Lakes navigation season when the buoys are in place and operational. During the harsh northern winters, all buoys are removed from the Lakes to survive the thick freshwater ice. Much of the wave statistics and water quality data such as temperature, dissolved oxygen and a host of other parameters are measured by a network of buoys that is maintained by a variety of organizations, university laboratories, government agencies, local municipalities, and private industries throughout the Great Lakes region.

Figure 3: MTU Deploying Buoy with SVS-603 in the Straits of Mackinac

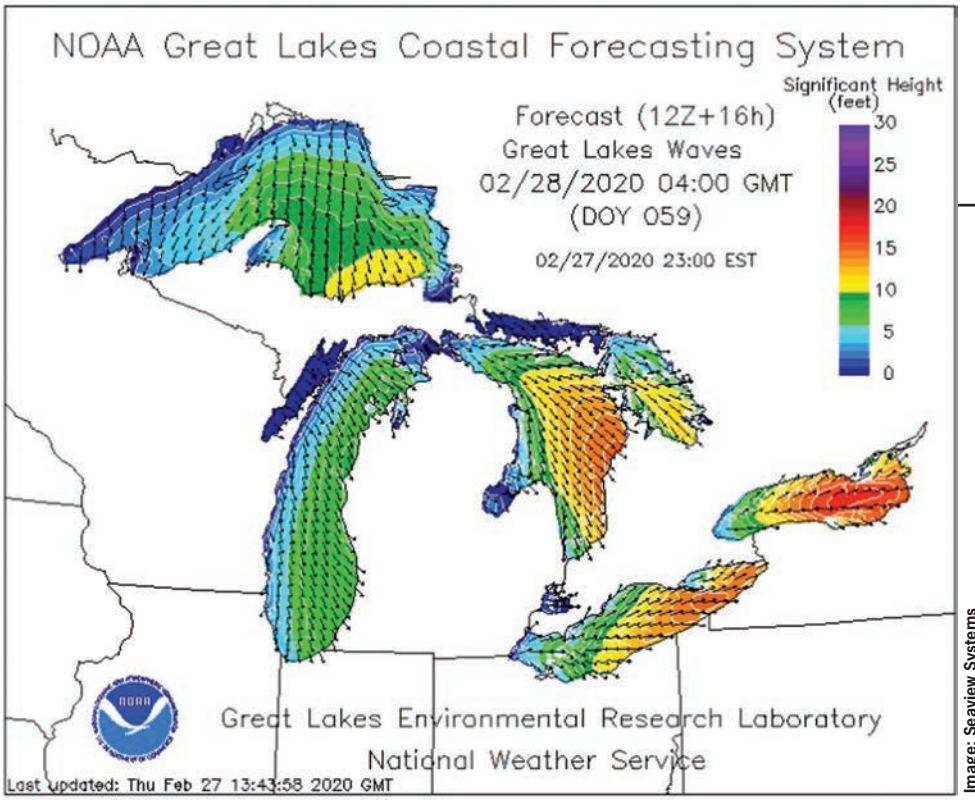


Image: Seaview Systems

Figure 1: NWS Great Lakes Significant Wave Height Forecast Map

Great Lakes Observing System and the Great Lakes Research Center

The Great Lakes Observing System (GLOS) is one of eleven regional associations of the Integrated Ocean Observing System (IOOS), working to enhance the ability to collect, deliver, and use ocean and Great Lakes information. GLOS is a consortium of academic, private and governmental bodies that provide real-time wave and water quality data at over seventy locations throughout the Great Lakes.

The Marine Engineering Lab of the Great Lakes Research Center (GLRC), directed by Dr Guy Meadows at Michigan Technological University in Houghton, MI, is one GLOS organization providing vital wave observations using SeaView's SVS-603 wave sensor. "The Straits of Mackinac is a dynamic and complex location within which to make accurate wave measurements," explained Dr Meadows.

Prior Solutions for Wave Measurement

For decades, the standard approach to wave measurement has been the use of dedicated buoys that have been developed around an electro-mechanical system. These systems have become something of a standard with their hull behavior well-documented but they suffer from several shortcomings. Because they are built around a spherical buoy hull that is designed to accurately follow the surface of the water as waves pass beneath it, they are not well suited to the addition of other sensors such as anemometers that are desirable to have co-located with wave measurements. The electro-me-

chanical system used in these buoys is large, heavy, and consumes power at a rate that requires larger battery banks, large solar panels (not well suited to the spherical hull shape) or both which limits deployment periods. This makes them challenging for use in smaller buoys that are typical in Great Lakes sites. And the cost of these systems generally means that fewer buoys are deployed than might be desirable in order to develop a complete system model for water conditions in the Great Lakes or elsewhere.

MEMS Sensors: A New Era for Wave Sensing Buoys

The field of micro-electro-mechanical systems has been an area of rich development for many decades. First proposed in the 1960s and commercialized in the 1980s, MEMS are some the smallest machines ever made and used in a variety of industries from inkjet printers to automobile airbags. While much of the drive behind these devices has been for land-based applications, the benefits of vast investment for applications such as smart phones, smart cars, airborne drones, and game controllers, for example, have provided capabilities that are spilling over into the area of marine electronics. The result of these technologies is a MEMS sensor that requires a minuscule fraction of the size, weight, and power of prior systems. One such example is the SVS-603 wave sensor from SeaView Systems. The SVS-603 wave sensor is a highly accurate MEMS-based sensor that reports wave height, wave period, wave direction and more via RS-232 and/or logs to its on-board data storage. The SVS-603 represents a new generation in accuracy and completeness for wave sensing electronic and it includes the possibility for significant data processing in situ on the buoy (or other) platform on which it is deployed.

Algorithms, Emulator and More:

Seaview's Dr. Timothy Crandle has seen MEMS transform from early days in the semiconductor lab at the University of Michigan through decades in silicon valley and on to the present where he works with the SeaView team to devise new models for the range of buoy hulls, legacy and new, that could be used as wave sensing platforms given the benefit of the SVS-603's rich model set and on-board computing power.

"One of the biggest advantages of a dedicated buoy hull for wave sensing is the known behavior of the hull," said Crandle. "But such buoys also suffer from significant disadvantages. This is where the 603's processing power and algorithm capabilities come into play. By using known information about the physical characteristics of the hull, a growing library of data from similar hulls from prior deployments, a sophisticated set of algorithms and some basic ingenuity, we can get quality wave data from buoys of opportunity that would otherwise not be capable of such service."

In addition to developing algorithms, SeaView also recognized the need to be able to take advantage of prior deployment data when testing out new algorithms. This led to the development of their emulator capability.

SeaView Systems has developed the capability to take empirical acceleration data, essentially the raw sensor readings from a full deployment of days, months, or in some cases years, saved to the SD card on the SVS-603 and back-test using their emulator to recalculate wave statistics. For example, the emulator affords the opportunity to change parameter inputs, apply a different low-frequency noise filter (from the industry standard) or apply a response amplitude operator (RAO) and recalculate wave outputs. Fine-tuning with the emulator allows for hull specific settings to be determined.

"Using SeaView's SVS-603 emulator, we can take literally decades of deployment data from a range of buoy hulls and run all of this data as a back-test for a

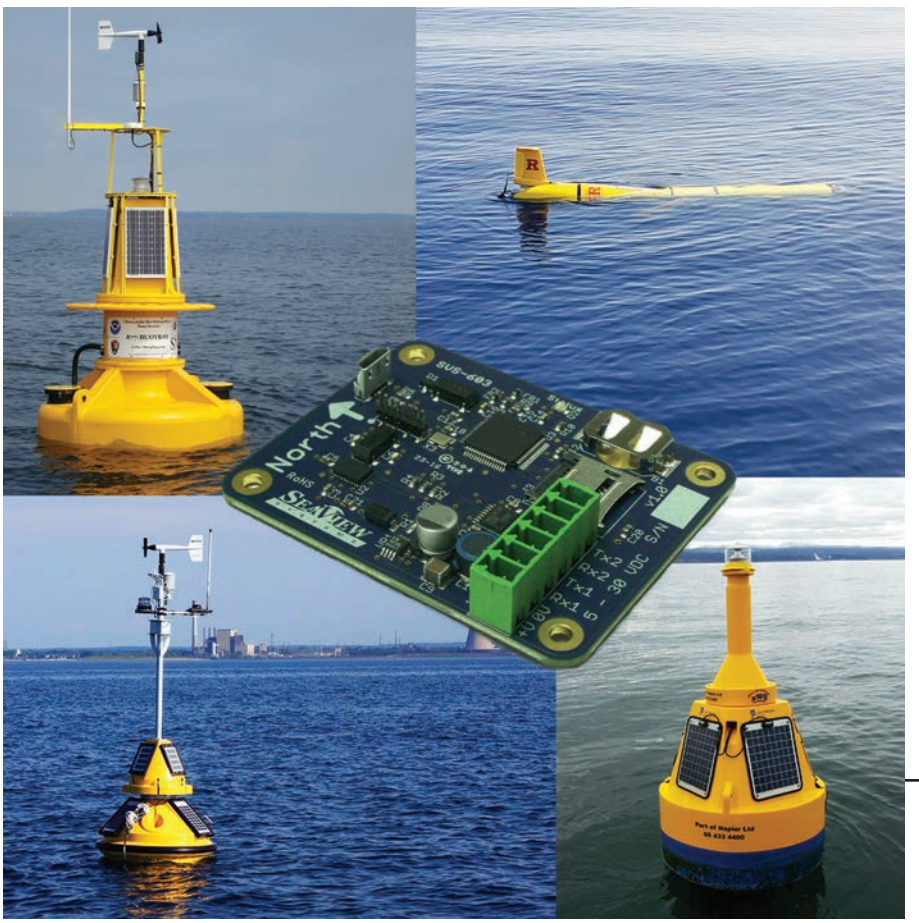


Image: Seaview Systems

Figure 2:
SeaView Systems SVS-603 Wave Sensor

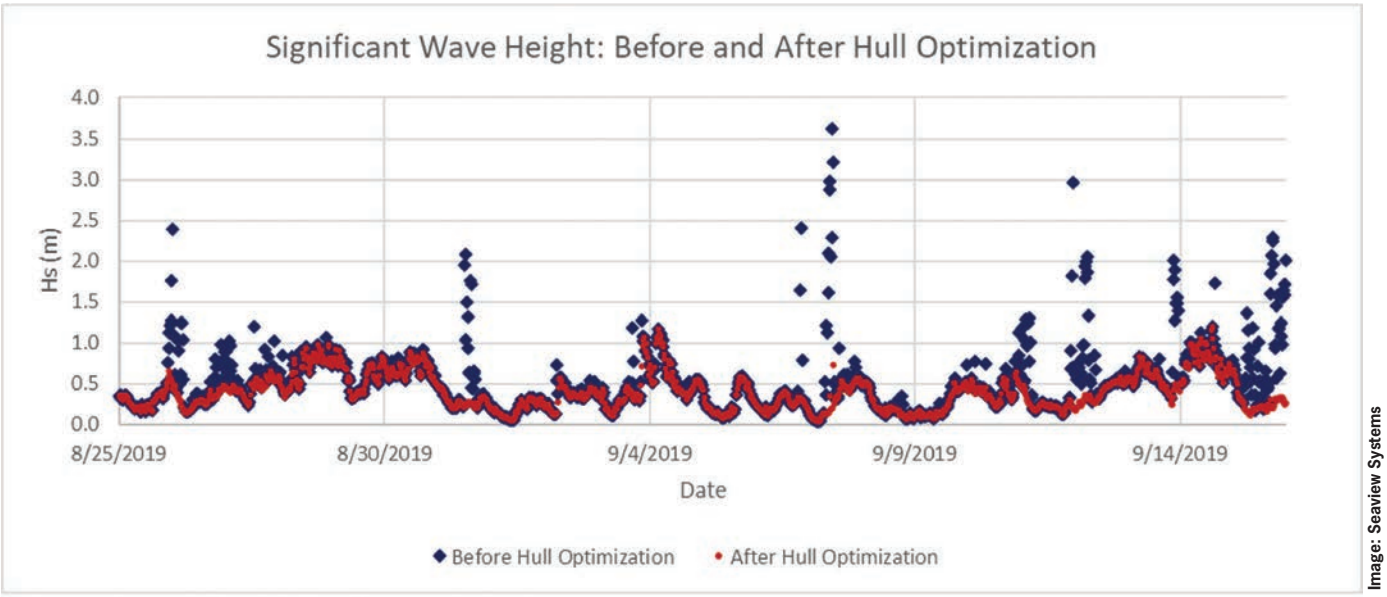


Image: Seaview Systems

Data courtesy of Great Lakes Research Center

new model," said Ed Celkis, SeaView's Systems Development Manager. "This ability gives tremendous power as a research tool."

Case Study: Straits of Mackinac

Among many users of the SVS-603 in the Great Lakes is MTU-GLRC. The GLRC operates four data buoys in the Great Lakes. "At the confluence of Lakes Michigan and Huron, strong and ever-changing currents produce intense wave-current interactions, coupled with complex wave fields approaching from both Lakes," said Dr Meadows. "The multi-dimensional SVS-603 wave sensor is a requirement in this environment."

At the end of the 2019 season, SVS-603 SD card data was collected to determine if there were more optimal sensor settings to achieve improved wave statistics. For the 2019 season, the low-frequency noise filter employed by GLRC's SVS-603 sensors was the widely accepted Lang filter (N. Lang, "The Empirical Determination of a Noise Function for NDBC Buoys with Strapped-Down Accelerometers," OCEANS '87, Halifax, NS, Canada, 1987, pp. 225-228). However, an unidentified low-frequency noise source still produced anomalous spikes in the significant wave height and period data of the Straits Buoy. SeaView took the acceleration data saved on board the sensor and using their emulator honed in on the best sensor settings to recommend to GLRC for future deployments. The following graph show significant wave height before and after hull optimization: "We needed to be sure we'd have accurate wave measurements and have done a lot of testing to verify the SVS-603" said Dr. Guy Meadows. "SeaView's emulation capability provided us a tailored hull model to use for our Great Lakes Buoys to provide accurate and essential wave and water quality data to the community for the upcoming season based on the physically measured data."

SeaView Systems Buoy Library

The information gained from optimizing sensor outputs with the emulator in combination with the physical details about the platform (e.g. buoy hull or AUV/ASV) yields itself to the establishment of SeaView's buoy library. The library provides reasonable recommendations for sensor settings when no other information or reference data is available.

"The emulator gives us the capabilities to establish a buoy hull library from data shared by our clients," said Dr Crandle. "When a client deploys the SVS-603, we can suggest sensor settings based on their hull design to achieve optimal wave outputs."

Summary

SeaView's SVS-603 wave sensor is enabling a new generation of smaller, smarter wave buoys that exploit its small size, low power, and sophisticated onboard algorithms. In addition, the onboard SD card capability enables easy accumulation of raw deployment data. This data can be exploited using the emulator capabilities that are part of the complete software/hardware ecosystem that allows exploration of model parameters tailored to individual buoy hulls.

By working closely with partners such as Michigan Tech's Great Lakes Research Center, SeaView is able to create custom hull models using standard and proprietary

algorithms based on measured data. These capabilities were applied to data produced by MTU-GLRC in their 2019 season as a means for reducing low frequency hull/mooring noise that produced spurious spikes in significant wave height and period. In addition, the characteristics and model parameters for individual buoy hulls can be added to SeaView's growing hull library for use on similar buoys in other locations.

Figure 4: The Straits see traffic from both commercial shipping and recreational boating.

MARINE TECHNOLOGY REPORTER

Nominate Your Business for an MTR100 Award

Marine Technology Reporter's annual MTR100 awards edition is the industry's most awaited annual ranking of the leading companies serving the global underwater and subsea industry. Participants annually come from every corner of the globe and every sector of the industry.

Deadline is July 10, 2020 - The 15th Annual MTR100 set to publish in the July/August 2020 edition of *Marine Technology Reporter* the industry's largest circulating publication. Your nomination may be seen by the world's largest subsea and underwater technology audience.

www.mtr100.marinetechnologynews.com

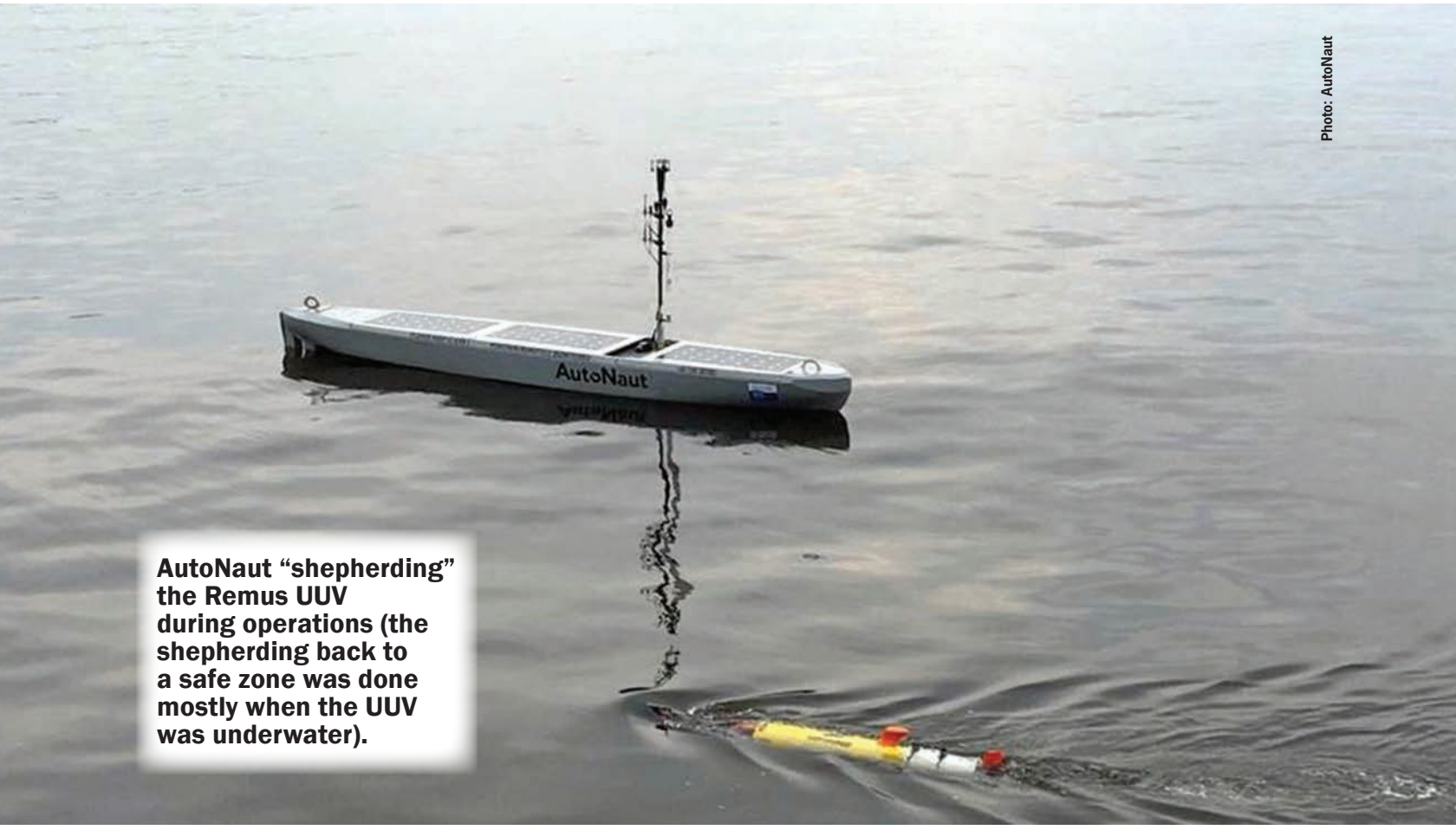


Photo: AutoNaut

AutoNaut "shepherding" the Remus UUV during operations (the shepherding back to a safe zone was done mostly when the UUV was underwater).

Autonomous ANTX

By Elaine Maslin

Geophysical seismic surveys and port security may appear to have little in-common. However, it turns out that managing complex marine seismic operations, where 10km-long seismic streamers have to be deployed harmoniously alongside other offshore marine assets, isn't that dissimilar to managing – and protecting – port facilities.

It's an area that ION Geophysical, more known for seismic data acquisition technology, has recently been proving its expertise in, using its Marlin system for marine operations management. Dave Gentle, Vice President of Business Development, spoke about the firm's involvement in last year's ANTX (Advanced Naval Technology Exercise) in the US – a project which involved detecting and managing a diverse array of assets, including potential security threats.

He says underwater threats are increasingly dynamic and diverse and therefore increasingly challenging. Gentle recalls the use of an early submarine, the Turtle, in the American revolutionary war in 1775, as an example of a new threat – and how metal hulls were a counter measure. "While threats to harbors have evolved at a slow pace, we're now in a period where there's a rapid advance in autonomous systems, underwater vehicles, where technology is improving and is more easily available to people around the world," he told the Marine and Autonomous Technology Showcase event in Southampton late last year. "It's not a giant leap to imagine these vehicles can be repurposed to make explosive devices or be used for other devious ends."

Photo: ION

To that end, focus on naval security has increased.

SHIFTING FOCUS

Similarly, ION has been shifting its focus. While the company's core business is seismic operations, it's recently been looking at how its capabilities could be relevant to other markets. The idea that it could support naval assets came up within the last couple of years and resulted in ION getting involved in ANTX. The event is run every year by the Naval Undersea Warfare Center (NUWC) out of Newport, Rhode Island, and CNMOC (Naval Meteorology and Oceanography Command), based at Stennis, MS.

For ANTX 2019, ION proposed a joint exercise with AutoNaut, a UK based wave propelled unmanned surface vessel (USV) developer, part of the Seiche group of companies, to address the ANTX Marine Security theme. An AutoNaut USV would provide environmental monitoring and be hooked in to Marlin, ION's marine operations management platform.

"However, as we progressed through the planning stages the CNMOC group teamed us up with Atlas Elektronik, who provided the Cerberus Diver Detection Sonar, and Marine Arresting Technologies, who have a non-lethal counter measure device in the form of their Stingray capture net," said Gentle. "This then became an exercise in integrating all of the separate systems into a port security solution."

OPERATIONS MANAGEMENT

Marlin is a rule-based software solution for operations management. It combines temporal planning with spatial awareness, primarily using real-time ships' AIS (automatic identification system), as well as radar and other tracked target feeds to improve operational efficiency.

ION has been using Marlin and other command and control software platforms for more than three decades in the offshore oil and gas industry. There, it's mostly used in managing seismic survey operations, involving towed streamer surveys comprising up to 14 hydrophone arrays each reaching up to 10km long or seabed surveys with multiple surface vessels and assets deployed on the seafloor.

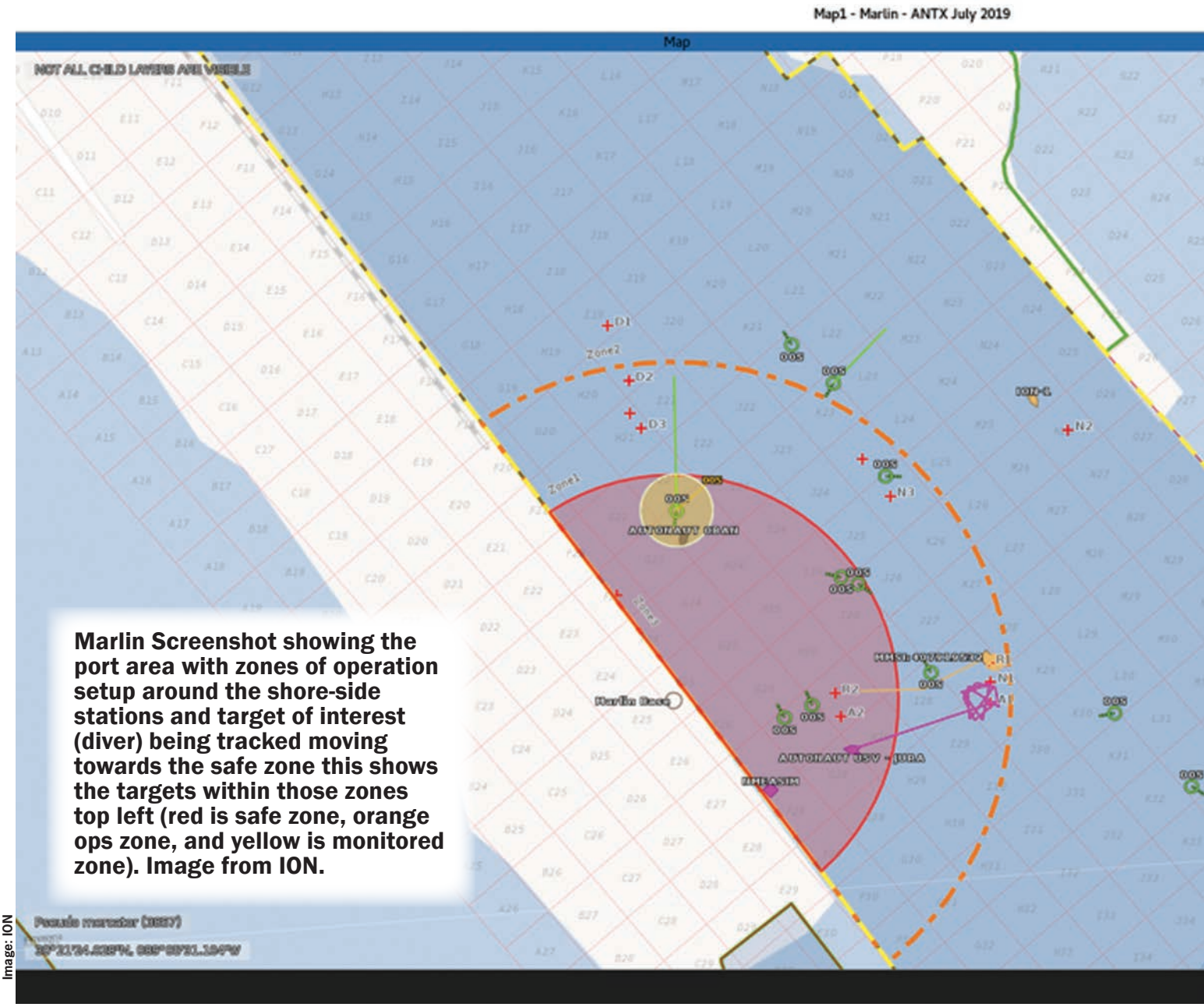
"In later years, we found that, as these surveys were increasingly needed around and in the middle of busy offshore oilfields, the seismic survey operations were in conflict with other oilfield operations," said Gentle. "At this point we turned our attention to simultaneous operations management (simops) enabling the seismic surveys and the oilfield operations to run in harmony with each other and avoiding costly downtime." Marlin could marry the

operational plans with a powerful geographic information system (GIS) engine with built-in archiving and look-forward analysis – helping to prevent asset conflicts.

PORT SECURITY

For the ANTX exercises, ION wanted to demonstrate that it could integrate third-party systems quickly into Marlin and then use it to provide the necessary information to enable decision optimisation in port security scenarios. This is what it got to do during the CNMOC exercises, which were also supported by the University of Southern Mississippi at their Marine Research Center at the Port of Gulfport.

During a week-long exercise, ION was tasked with working with AutoNaut, Atlas Electronik and Marine Arresting Technologies to provide an integrated system that would detect surface and underwater threats and coordinate a non-lethal mitigation against them. The threats were divers (real and mechanical/dummy) and unmanned underwater vehicles (UUVs), including Remus and Riptide UUVs. Atlas Electronik's Cerberus was used to detect the threats, while their SeaFox fiber optic guided mine countermeasure tool was used to intercept and inspect them and a Stingray capture net from Marine Arresting Technologies from Florida was also deployed. Approximately twenty people from com-



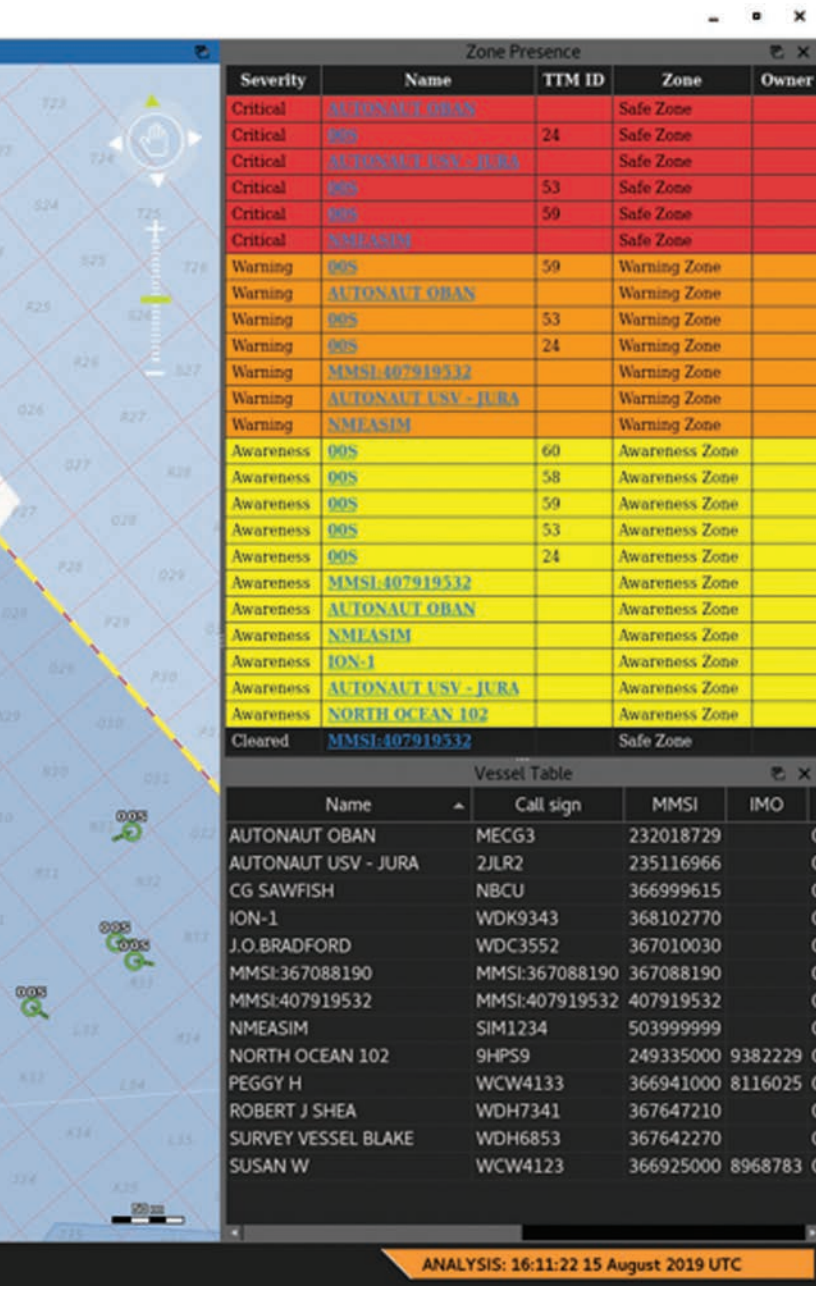
Marlin Screenshot showing the port area with zones of operation setup around the shore-side stations and target of interest (diver) being tracked moving towards the safe zone this shows the targets within those zones top left (red is safe zone, orange ops zone, and yellow is monitored zone). Image from ION.

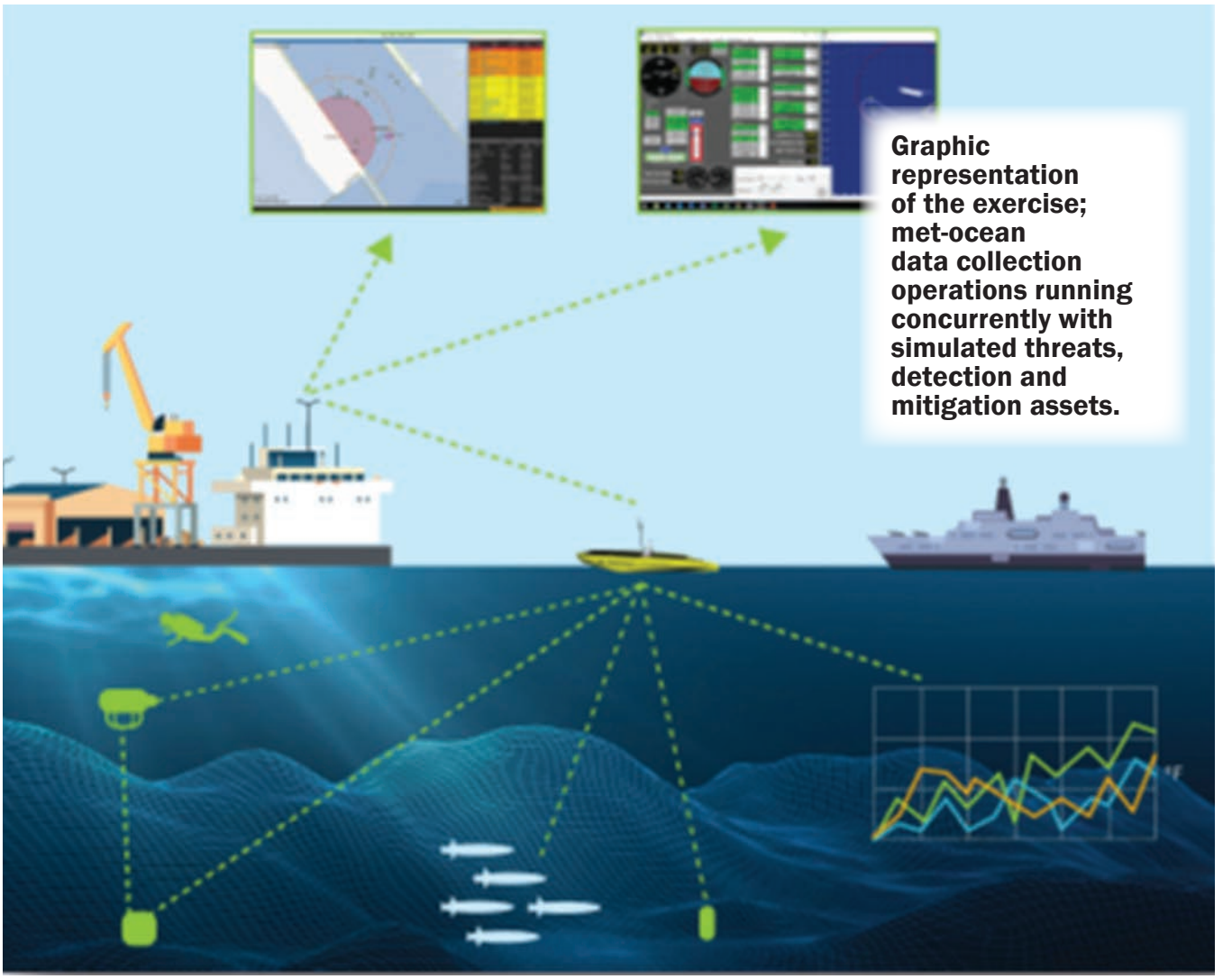
Image: ION

panies and Navy groups took part. A CONOPS (concept of operations) plan was decided and setup in Marlin which also monitored assets and threats in the operations zones.

DETECTING DIVERS & UUVS

The idea was to have a diver or UUV enter the area and make their way to the controlled zone. There, Cerberus, mounted off a dock, would pick them up, which Marlin would then see, track and predict when and where the diver would go and send the SeaFox to investigate. The exercise then presumed that the diver/UUV would continue to move into the controlled zone, so then the Stingray net would be deployed, on this occasion from





Graphic representation of the exercise; met-ocean data collection operations running concurrently with simulated threats, detection and mitigation assets.

Photo: ION

the Port Police Patrol boat. AIS transmitters were used to track 'friendly' assets. But, because the update rates during the exercise were slow, ION switched to using GPS tracking, where it was available, through some "on the fly" integration.

"There was a silty bottom (in the area) and high turbidity," said Gentle, "the conditions were challenging. But the system detected real and dummy divers. Atlas Elektronik's SeaFox was used to investigate the intruders and we also used the Stringray net to capture the Remus 100 and Riptide."

All of this was coordinated through Marlin, with the AutoNaut USV being used as a communications gateway to the UUVs, with control via a Woods Hole Oceanographic Institute Acomm unit. In addition, the AutoNaut also collected a metocean dataset, which offered some additional interesting data to analyse.

"We were able to do this very quickly during the exercise, leaning on our decades of sensor and data fusion experience in the oil and gas industry," said Gentle. "The end result is that the team were able to successfully detect threats, monitor their tracks and deploy countermeasures, all coordinated through Marlin."

"For this exercise, Seiche's engineers built a prototype PAM (passive acoustic monitoring) array that was housed on the AutoNaut USV," said Gentle. "As AutoNaut is capable of very quiet wave propulsion and is able to maintain station and listen as we performed the port security operations, they picked up some very interesting results in later post processing."

ONGOING CHALLENGES

It seems there's more to come, and not just from ION. "Underwater security threat detection and mitigation still has a number of challenges to solve in order to provide a seamless and reliable solution to the growing potential threats that are out there," said Gentle. "A number of companies are working on this area and ION hope to be able to contribute using the Marlin platform as the glue to tie it all together." ION specifically is doing more work in this area, including providing a Marlin variant, called Marlin SmartPort, in ports for vessel tracking and port operations management. "This is a fairly new area for us, but we are gaining traction working with our partners at the Port of Montrose (in the UK) and we working with AWS on this cloud native version of the Marlin platform," said Gentle.

The Maritime Industry's Largest Social Media Presence

Maritime Reporter is a member of the Maritime Media Network of websites, publications, and social media sources for news, editorial and information including the Maritime Network, the commercial marine industry's largest dedicated Linkedin group.

61,049
Facebook Page Likes

137,725
Linkedin Group Members
(Industry's Largest)

39,243
Twitter Followers

MARITIME REPORTER AND ENGINEERING NEWS

THE MARITIME NETWORK

@ShipNews

All stats from 01/31/2020

Also part of the Maritime Media Network:

Page	Likes
Marine Electronics	31,944
Marine Technology Reporter	52,612
Maritime Global News	24,857
Maritime Jobs	44,532
Maritime Logistics Professional	29,548
Maritime Propulsion	21,298
Maritime Reporter & Engineering News	61,049
World Energy News	47,050

Using high resolution 3D MESHES *for improved shape reconstuction of marine survey data*

By Danny Neville, Fledermaus Product Manager, QPS

When using dense, high-precision survey data, the method for management and visualization of the data can have a large impact on the final decision making process. This is an important factor when accurate shape reconstruction is required, as there are significant trade-offs with traditional approaches. For applications where it is critical to know exactly the shape and size of surveyed objects, a high-resolution 3D mesh is likely the best option.

Gridded surfaces, even with variable resolution, cannot adequately model complex overlapping or vertical structures. Though we think of grids as 3D objects, they are referred to as having 2.5 dimensions because of this limitation of being able to only represent a single vertical value per grid cell. Alternatively, point clouds can represent any shape or structure, but by themselves pose challenges for visualization and quantitative analysis. To address these limitations and bridge the benefits of both point clouds and gridded surfaces, QPS has created tools for creating and working with high resolution 3D meshes, directly in the QPS Fledermaus software package. The new techniques can be used with the majority of common survey formats, with data coming from photogrammetry, LiDAR, or multibeam. The primary requirement is that the data is dense enough to support the 3D reconstruction process.

Supporting Structure From Motion

Before adding functionality for creat-

Figure 1

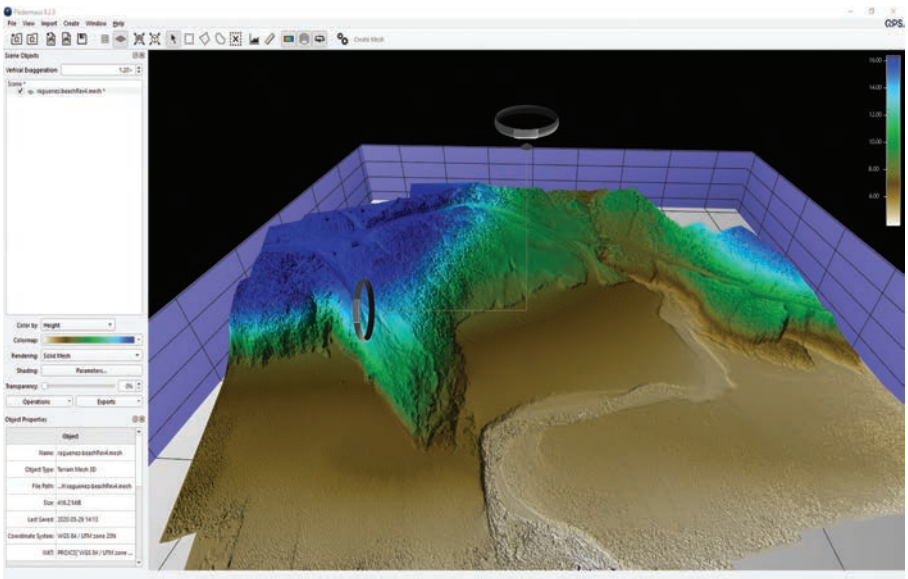
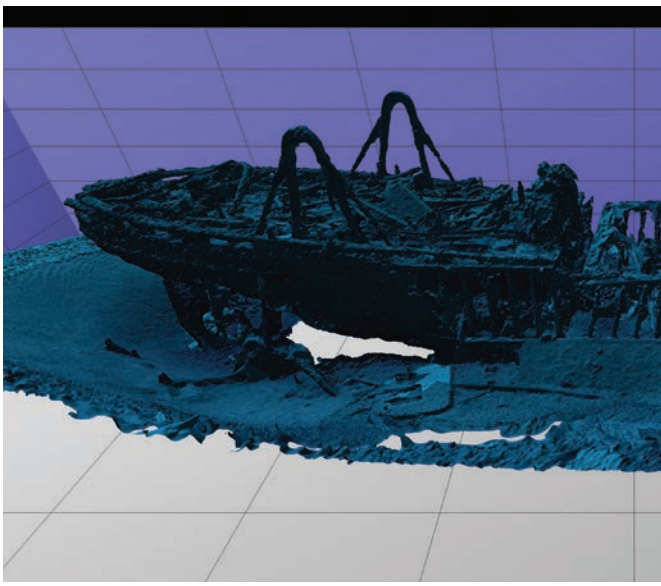


Figure 2



ing new meshes, Fledermaus supported the importing of meshes created using Structure From Motion (SfM) techniques in 3rd party software, such as Agisoft Metashape and Pix4D. Users desired improvements for better handling of large meshes, and wanted the same functionality they were used to when working with gridded surface. This included operations such as applying color maps, measurement tools, and interactive profiling.

Initial applications for these tools were coastal and near shore mapping and analysis, with data acquired from aerial drones. **Figure 1** illustrates an example of an inter-tidal area represented as a mesh in Fledermaus. With rapid advancements in lighting and camera technology, SfM tools were also applied underwater, with impressive high density point cloud produced from ROV and AUV video, as shown in **Figure 2** (Data source: USS YP-389 NOAA/Project Baseline). One of the key benefits of a 3D mesh can be seen in the overlapping and protruding structures of the wreck. These features would be averaged out when using a grid, and would be more difficult to see in a point cloud.

After adding support for meshes created in 3rd party software, the next major step was adding the ability to create new meshes from point clouds. This ability was first introduced in Fledermaus 8.0, and the process has been improved in each follow up release. To maximize the benefits of adding a new data structure to your workflow, the creation process needs to be accessible, and well integrated. To achieve these goals, the Fledermaus mesh creation tools were designed to be almost as simple as creating a standard gridded surface.

In addition to opening up the mesh creation process to both multibeam and LiDAR data, this also allows SfM derived point clouds to be improved before mesh creation. There are often times when SfM data requires further processing, because of deficiencies in the original pre-built mesh. By using the point editing and QC tools in Qimera software, the point cloud data can be improved, and a more accurate mesh created in Fledermaus. There are also specialized tools, such as the SfM add-on for Qimera, which can be used to correct for refraction errors in submerged data acquired from airborne photogrammetry, as shown in **Figure 3** (Data courtesy 4DOcean). The image shows a beach profile running from land to underwater with the original terrestrial and bathymetric SfM points, and the refraction corrected SfM terrain model derived from the same source, but after the correction. The original terrain model's profile is colored in Red and the corrected one in Green. Within Fledermaus, the mesh tools use the Poisson surface reconstruction algorithm (Kazhdan et al. 2006) for creating a best-fit surface of a dense point cloud. A key part of the mesh construction is determining the orientation, or shape from the point cloud. By using a data source with recorded navigation and orientation data, Fledermaus can make an improved mesh compared to generic mesh creation algorithms.

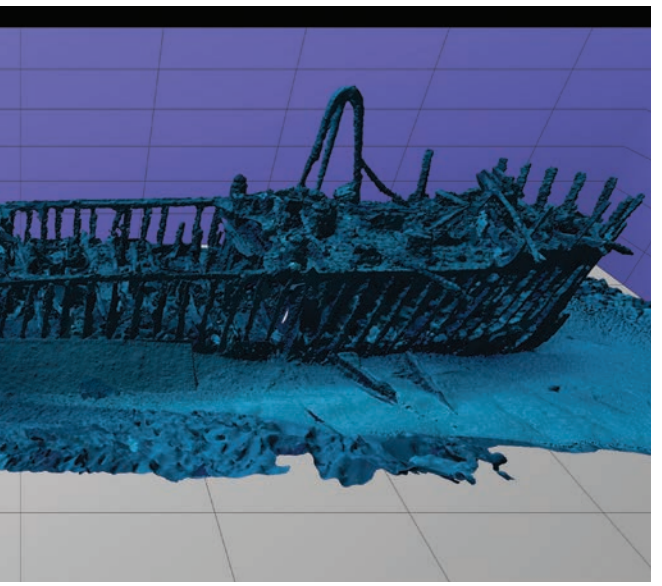
Applications of a 3D Mesh

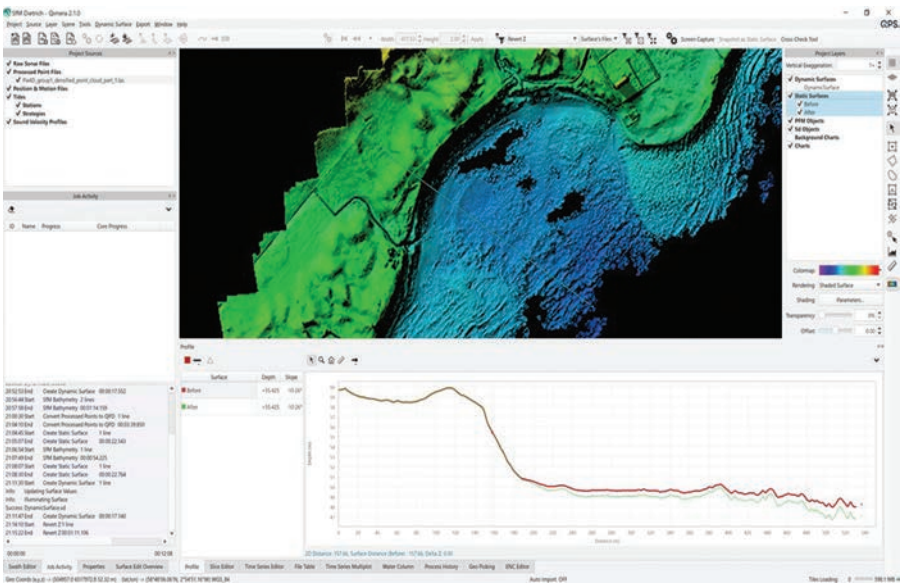
In terms of applications, this technology is beneficial anywhere that accurate shape reconstruction is of utmost importance. This can apply when proper identification and measurement of features is critical to risk management, and to a greater extent in situations where there will be close interaction with the surveyed objects. When performing marine salvage, construction, or asset inspection, it is critical to have the most comprehensible and accurate representation of the data.

These applications highlight the differences between historical usages of mesh structures, and the new techniques now being introduced. Representations such as triangulated irregular networks (TIN) have been a common part of surveying for many decades. However, there have been major changes driving a completely new approach to how meshes are created and used. Instead of using a mesh as a way to create an interpolated shape from a sparse set of points, the abundance of dense point data now allows for the most

All images QPS

Figure 3





accurate representation possible from the source point cloud. In addition, there has also been the transition from 2.5D meshes, to true 3D structures.

The change to high resolution 3D meshes has been enabled by three factors:

- *Growth in CPU and GPU capacity, especially in regards to multi-core processing*
- *Advancement in shape reconstruction algorithms*
- *Increased availability of dense, high precision point cloud data*

Multibeam Sonar

Applying the mesh tools to a traditional multibeam survey, **Figure 4** shows an example in shallow water of data collected with a Kongsberg EM2040D of 4 shipwrecks. At this scale, there is no discernible difference between the 10cm mesh and the 10cm grid.

Looking closer at the data, **Figure 5** can better highlight the differences between data structures. The grid still provides some details, but comparing it to the original point cloud, there are missing details and the overall dimensions are distorted. The mesh provides a much better preservation of the shape, and full dimensions of the object.

The most immediately visible benefit of a 3D mesh is the ability to model areas with overlapping z values, such as

Figure 4

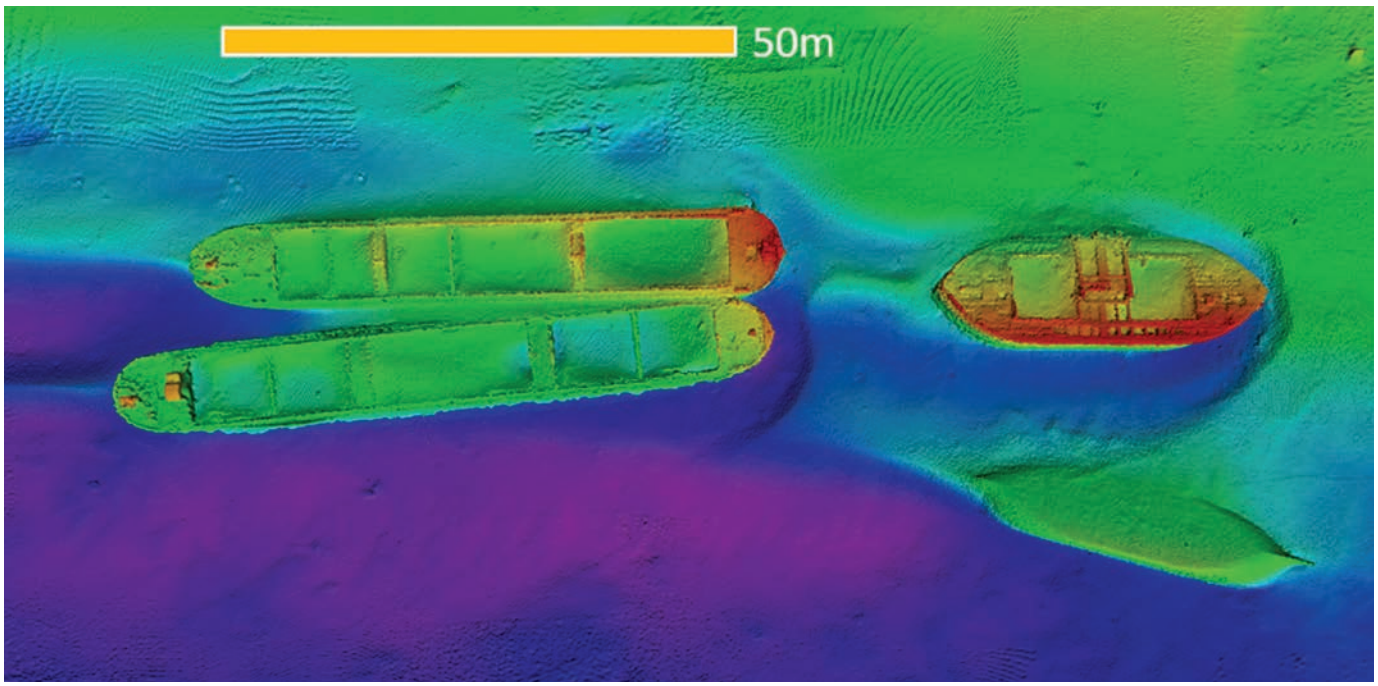
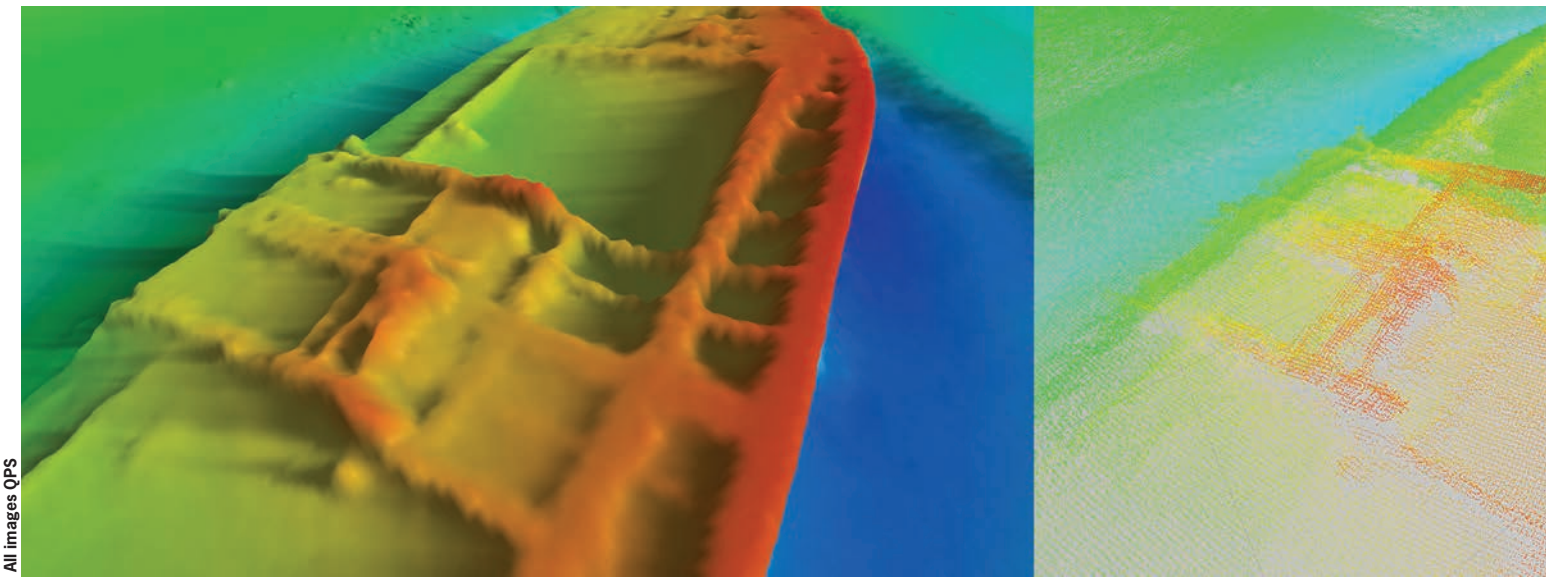


Figure 5



All images QPS

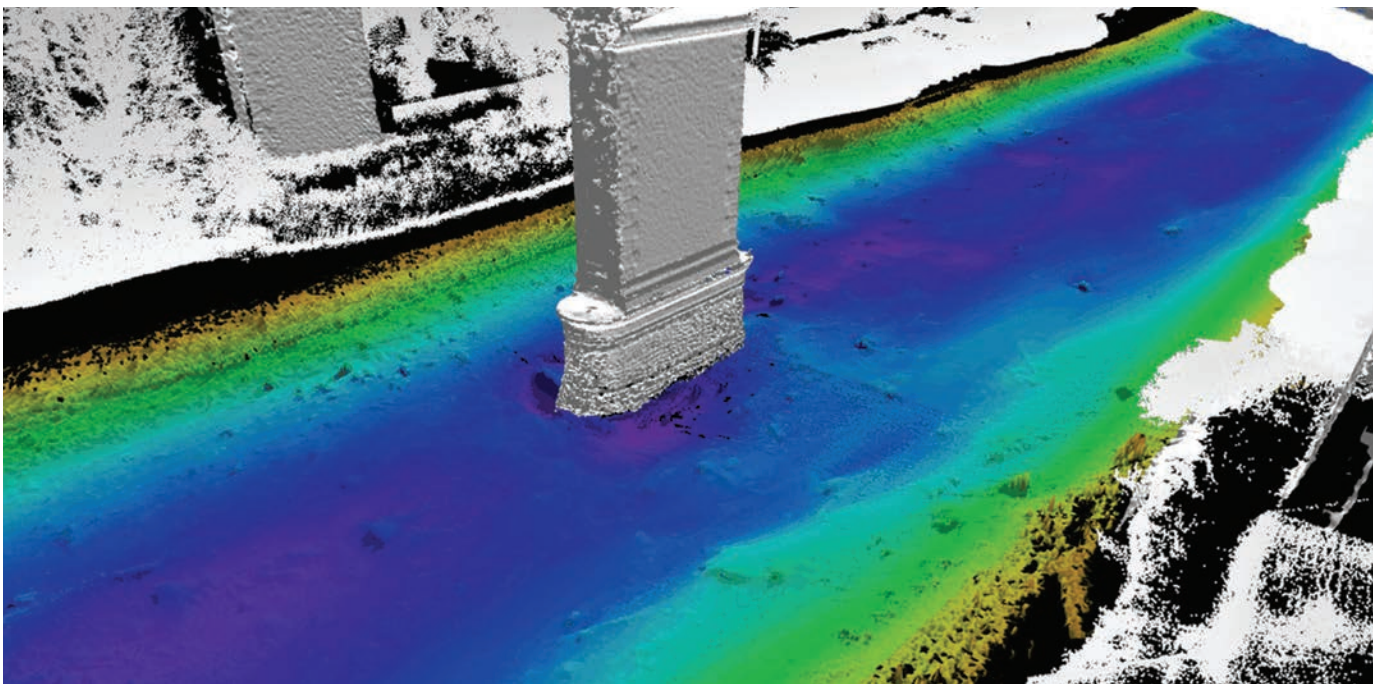
slopped walls, or protruding structures. This is easily visible in the wreck show in **Figure 2**. A complimentary benefit is that the mesh is a variable resolution structure. When creating a mesh, you provide a minimum resolution, and the creation algorithm will adapt the resolution as needed based on point density and the shape itself. Lastly, mesh creation can also reduce the data volume while still preserving shapes and structures. In the example from **Figure 4 & 5,** the original point cloud had just under 8 million points, but the mesh was able to reduce that to 2.5 million vertices, while also helping to improve visual analysis.

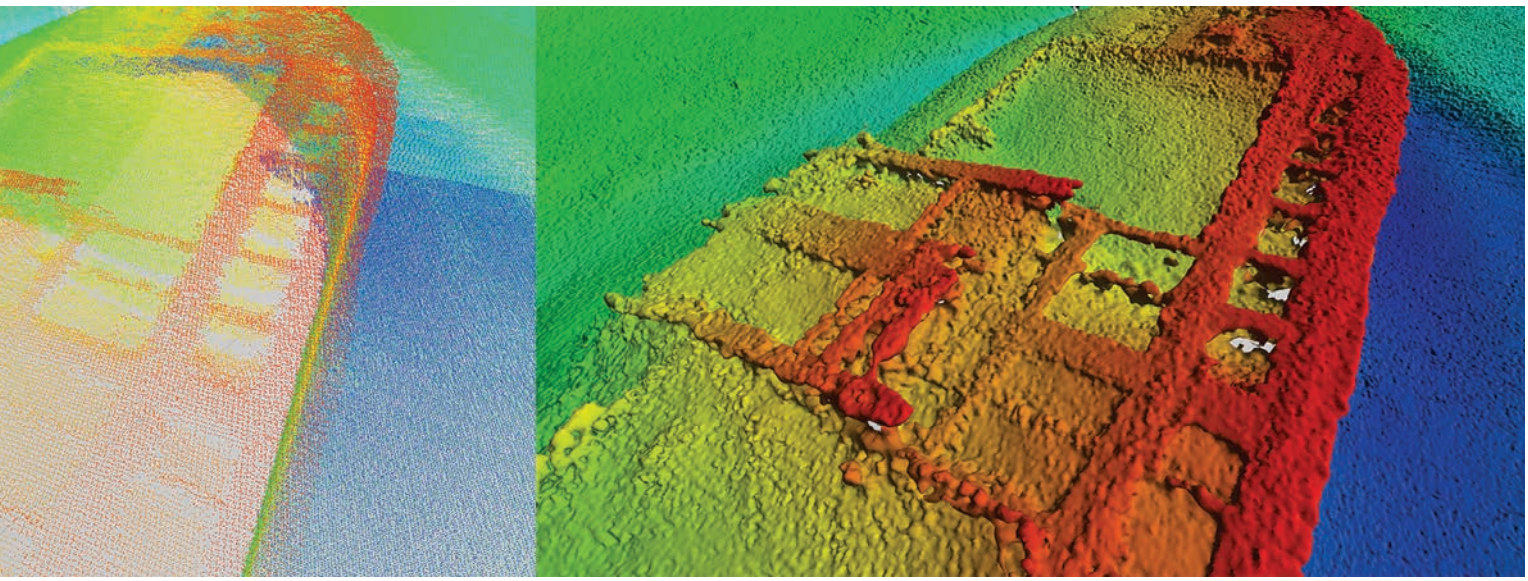
Revisiting the comparison of a 3D mesh with a standard grid, the downside is that a grid is limited as a 2.5D surface, which can only represent one Z value or depth, for each grid cell. This prevents accurately representing quickly changing slopes, overhangs, or any protruding structures. The advantage is that grids are quick to build, and easy to understand. A variable resolution grid can address some of the limitations of a standard grid, but ultimately it is still restricted by it being a 2.5D surface that cannot accurately represent certain shapes. In situations where accurate reconstruction is required, a grid should not be used for detailed planning or measurements.

Comparison with Point Clouds

In a similar comparison for point

Figure 6





clouds, we can see that points have the advantage of no additional building time, compared to grids and meshes. As your point density and resolution increases, mesh construction can be resource intensive. However a modern multi-core machine can help offset this, with a close to linear reduction in build times with each additional CPU core. Points naturally represent objects at the full resolution of the sensor, with 3D meshes usually coming close to the same.

The largest potential downsides of a point cloud are that it is not a connected shape, which complicates quantified analysis, such as slope or volume calculations. Also point clouds can be challenging for visual perception, as you are seeing either too many points at once, or obstructing fine details.

What is best?

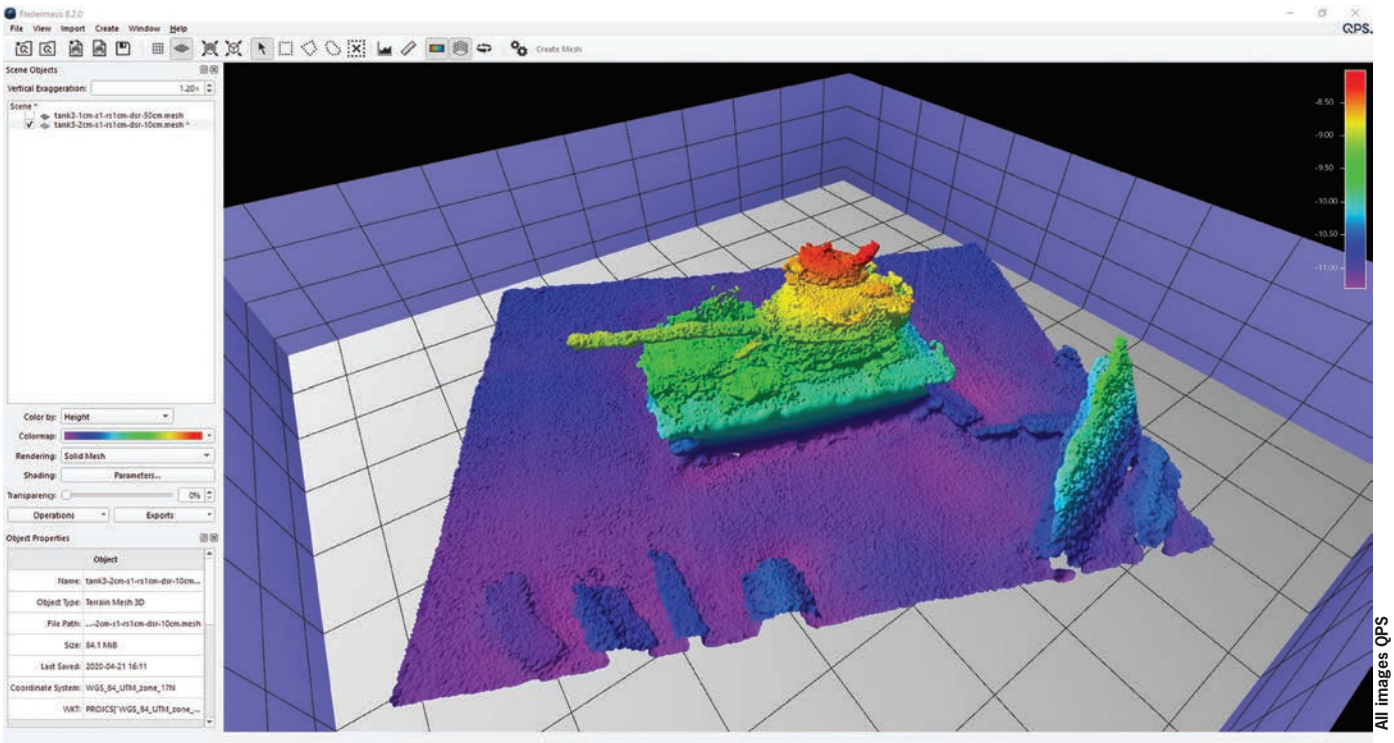
Considering the complimentary benefits and trade-offs, the best approach is to work with a combination of data structures, to best fit the situation and data. There can also be complementary applications between data structures, such as combining a medium resolution mesh with a point cloud to help create structure, and occlude points on the backside of the point cloud. This improves the visual perception of the points, without needing the time to create a high resolution mesh. A more complex example is when working with a large multi-sensor survey. This can be examined using a sample data set from Bibby Hydromap, a former survey company based in the UK. The asset inspection survey combined data from a Reson SeaBat T20-P multibeam, a Blueview scanning sonar, a Carlson Merlin laser scanner, and also airborne LiDAR. **Figure 6** is an example of one area of the survey, and shows multiple different data structures used together in one scene.

The multibeam data of the riverbed is represented with a regular grid, as that is quick to produce and is a good match for the bathymetry. Areas of interest on the riverbed can be selected and 3d meshes created as needed. To best identify problems, the bridge is a 3d mesh combining the laser scanner, the scanning sonar, and the aerial LIDAR points. Additional laser points, such as the surrounding vegetation, are left as a point cloud, as direct analysis is not needed for those points.

Maximizing your Point Clouds

There are significant costs associated with collecting and processing dense, high-resolution point cloud data. To maximize the return on those costs, it is important to have a set of tools that can best leverage the investment in collecting the data. The QPS suite of tools can support a workflow focused on creating the highest quality 3d data possible. For example, using the new 3D point filter in Qimera 2.2 with the latest mesh technology in Fledermaus 8.2, is a powerful combination. Applying these tools to a data set collected with an R2Sonic Sonic 2024 multibeam operated in UHR (700kHZ) mode, provides a great example of what can be achieved, as shown in **Figure 7**. In future versions the technology and capabilities for 3D meshes will only improve as more tools are developed to integrate this new data type into various workflows.

Figure 7



All images QPS

Woods Hole Oceanographic Institution

WHOI: Ocean "Pumped" to Capture More Atmospheric Carbon

While scientists have long known the essential role that the ocean plays in capturing atmospheric carbon, a new study from Woods Hole Oceanographic Institution (WHOI) shows the efficiency of this natural pump has been underestimated.

The ocean's "biological pump" is a critical part of the global carbon cycle and relies on phytoplankton, single-cell organisms that use photosynthesis to turn light into energy—consuming carbon dioxide and releasing oxygen in the process. When phytoplankton die or are eaten by zooplankton, carbon-rich fragments sink into the ocean, then consumed by other creatures or buried in sediments. In a paper published on April 6, 2020 in Proceedings of the National Academy of Science, WHOI geochemist Ken Buesseler and colleagues showed that the depth of euphotic, or sunlit, zones vary throughout the ocean.

This matters since the phytoplankton's ability to take up carbon depends on the amount of sunlight that is able to penetrate the ocean's upper layer.

By using chlorophyll sensors, which indicate the presence of phytoplankton, to assess the depth of the euphotic region, it was found that about twice as much carbon sinks into the ocean per year than previously thought.

Buesseler, a principal investigator with WHOI's Ocean Twilight Zone Project that focuses on the important mid-ocean region, explains this new information holds implications for not just today's ocean, but that of the future, too.

"Is the amount of carbon sinking in the ocean going up or down? That number affects the climate of the world we live in," he added.

Marine chemist Ken Buesseler (right) deploys a sediment trap during a 2018 expedition in the Gulf of Alaska.

Researched & Written by ***Celia Konowe***

Scripps Institution of Oceanography (UC San Diego)

3D-printed Coral Are Natural Producers of Biofuels

Researchers at the Scripps Institution of Oceanography and the Jacobs School of Engineering at UC San Diego, alongside the University of Cambridge, UK, have 3D printed coral-like structures capable of growing dense microscopic algae populations. The work is aimed at the development of compact, efficient bioreactors for producing algae-based biofuels and could lead to a better understanding of the coral-algae relationship, with the hopes of establishing techniques to repair and restore reefs.

Author Daniel Wangpraseurt, whose work was published April 9, 2020 in Nature Communications, explained, "Corals are one of the most efficient organisms at using, capturing, and converting light to generate energy," even in extreme environments with light fluctuation and limited space to grow. Inspired by corals, the goal was to develop productive techniques for growing microalgae as a form of sustainable energy.

Wangspraseurt and his team measured photosynthetic activity of corals in both liquid cultures and models and examined how algae grows on the structures. In laboratory settings, the printed coral structures were used to grow two different types of microalgae—Marinichlorella kaistiae and Symbiodinium sp.—which grew to achieve up to 100 times a greater density than in liquid cultures.

The structures themselves were developed with Shaochen Chen, a nanoengineering professor in the School of Engineering, whose lab specializes in rapid 3D bioprinting. The printed corals are built to capture and scatter light more efficiently than in nature, with tiny cylindrical structures on the surface that act as coral tentacles, increasing the surface area for light absorption. Nanocrystals embedded in the skeleton and coral tissue, which are made up of polymer gel (PEGDA) and gelatin-based polymer hydrogel (GelMA), respectively, further improve the efficiency of photosynthesis.

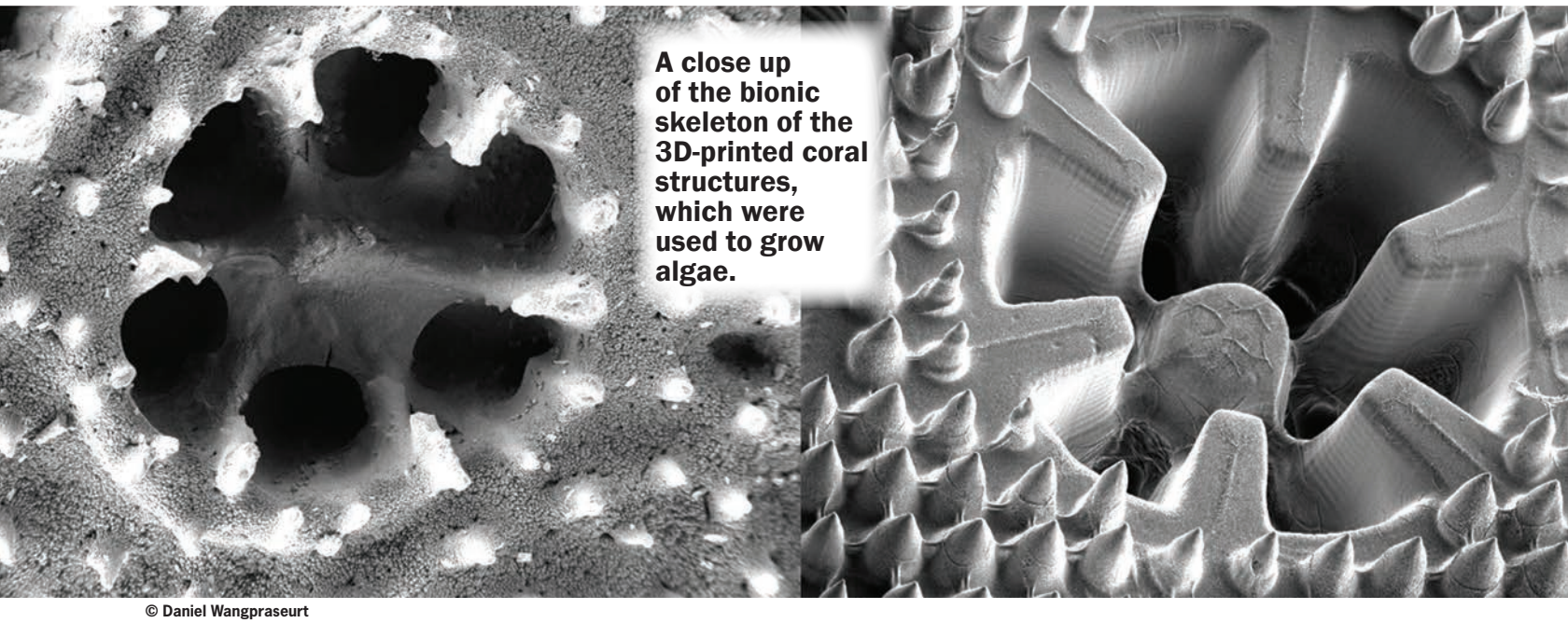
Since bionic corals have superior productivity compared to current systems, this technology holds implications for further research, looking beyond biofuel production and towards reef restoration.

New Course to "Hack" Ocean and Coastal Issues

Hacking for Oceans, a new class offered at the Scripps Institution of Oceanography at UC San Diego (UCSD) and UC Santa Cruz (UCSC) is the first of its kind to focus entirely on ocean and coastal issues. The course is designed to teach young technologists how to solve environmental crises at startup speed.

Hacking for Oceans students use tools and processes, such as the Lean Startup methodology and problem-curation techniques, to solve ocean and coastal challenges. The series of classes was created by Steve Blank, founder of the Lean Startup movement; U.S. Army Col. (Ret.) Joe Felter (former Deputy Assistant Secretary of Defense for South and Southeast Asia); and BMNT Inc. CEO Pete Newell, another retired colonel and former director of the Army's Rapid Equipping Force.

Offered for the first time in Spring 2020, Hacking for Oceans teams consist of four or five interdisciplinary graduate and undergraduate students. Example projects pursed at UCSD include making shipping routes safer and quicker by employing satellite data to detect routes in sea ice, improving the transparency of the fishing supply chain, and developing a cost-effective technique to monitor water levels and provide flood data for vulnerable coastal communities.



A close up of the bionic skeleton of the 3D-printed coral structures, which were used to grow algae.

Dalhousie University

Dalhousie University: Quiet Oceans Speak Volumes During Shutdown

Research at Dalhousie University shows that a quieter ocean—courtesy of the current COVID-19 pandemic lockdown—can benefit marine life, particularly those listed on the endangered species list, like killer whales.

David Barclay, an assistant professor in the Department of Oceanography, and researchers in his lab took advantage of the current lockdown to explore how the underwater soundscape has changed during the pandemic. Oceans Network Canada, a University of Victoria initiative that operates ocean observatories in the northeast Pacific Ocean and the Salish Sea, provided hydrophones that allowed Barclay and his team to analyse the noise environment of British Columbia's coastal waters.

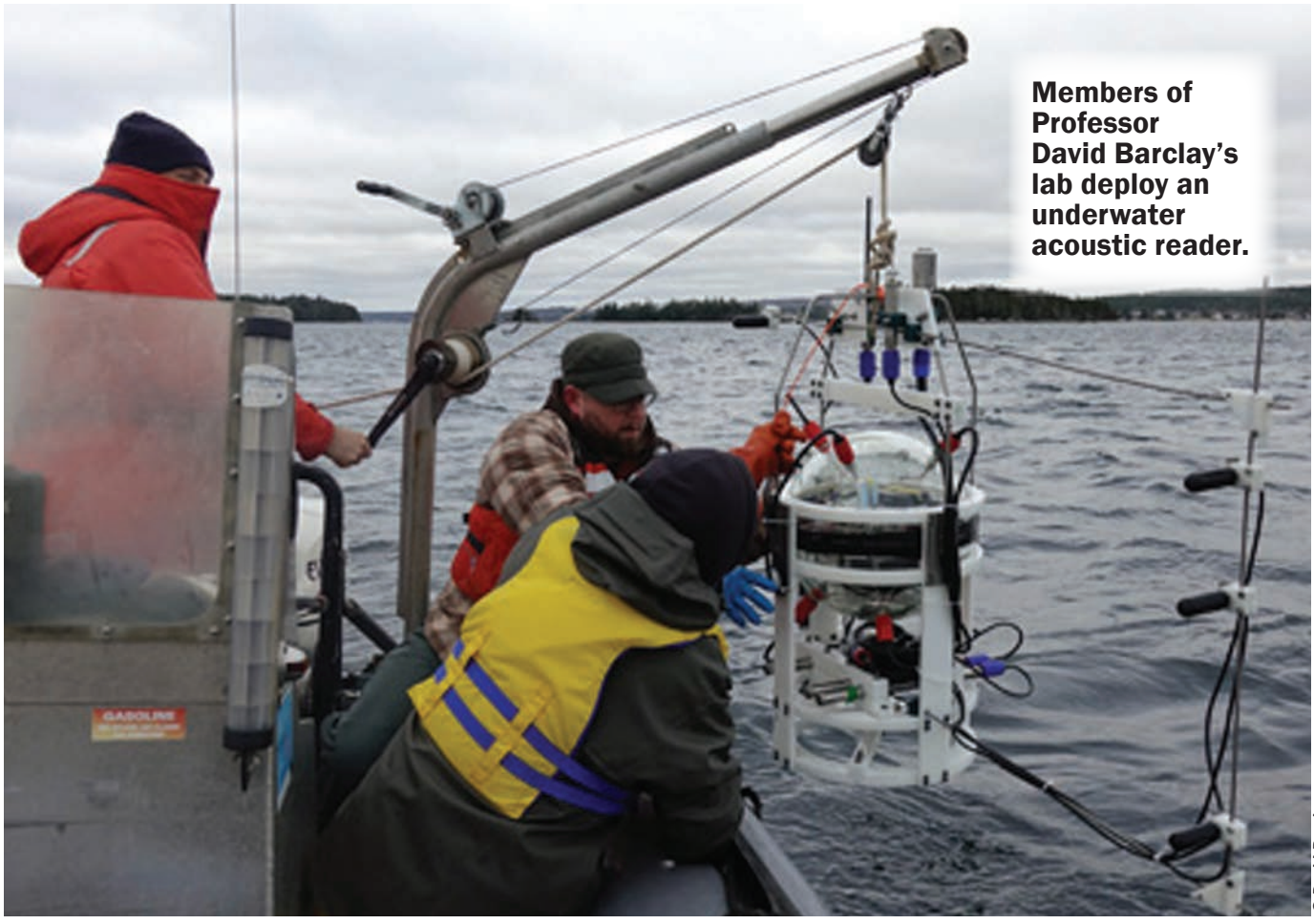
The paper, recently accepted for publication in the Journal of the Acoustical Society of America, reported measurable reductions in low-frequency sounds near major shipping routes between Canada and the U.S. Between January and April of this year, a hydrophone west of Vancouver Island recorded a 16% (1.5 decibels) decrease in noise power compared to the same time last year.

And, in the usually busy Strait of Georgia, Barclay noticed that not only is the ocean getting quieter, but at a faster rate, too.

The full effects of a quieter ocean are unknown, but they may lead to healthier marine mammal populations. "Free from the distraction and stress we cause, hunting would become easier, mating more convenient, and wayfinding more obvious.

Sound is for some whales and marine mammals what sight is for humans," Dr. Barclay emphasizes.

PhD student and Royal Canadian Air Force Major Dugald Thomson points out that observing the ocean soundscape during "this unique time may provide opportunities to better understand the impact human activity is having on the ocean." By analyzing this data over the entirety of the pandemic, Barclay adds, scientists can begin to understand "what exactly happens when we turn down the noise in the marine environment."



Members of Professor David Barclay's lab deploy an underwater acoustic reader.

© David Barclay

Researched & Written by ***Celia Konowe***

Monterey Bay Aquarium Research Institute

MBARI: Hydrothermal Mapping is Heating Up

A recent paper by Monterey Bay Aquarium Research Institute (MBARI) has revealed almost 600 hydrothermal chimneys around the Endeavour Segment of the Juan de Fuca Ridge, about 350 kilometres (220 miles) northwest of Washington State. The vents, located in a valley about 14 kilometres (8.6 miles) long and 1.5 kilometres (0.9 miles) wide, has been studied previously, but never mapped until now because of difficult access.

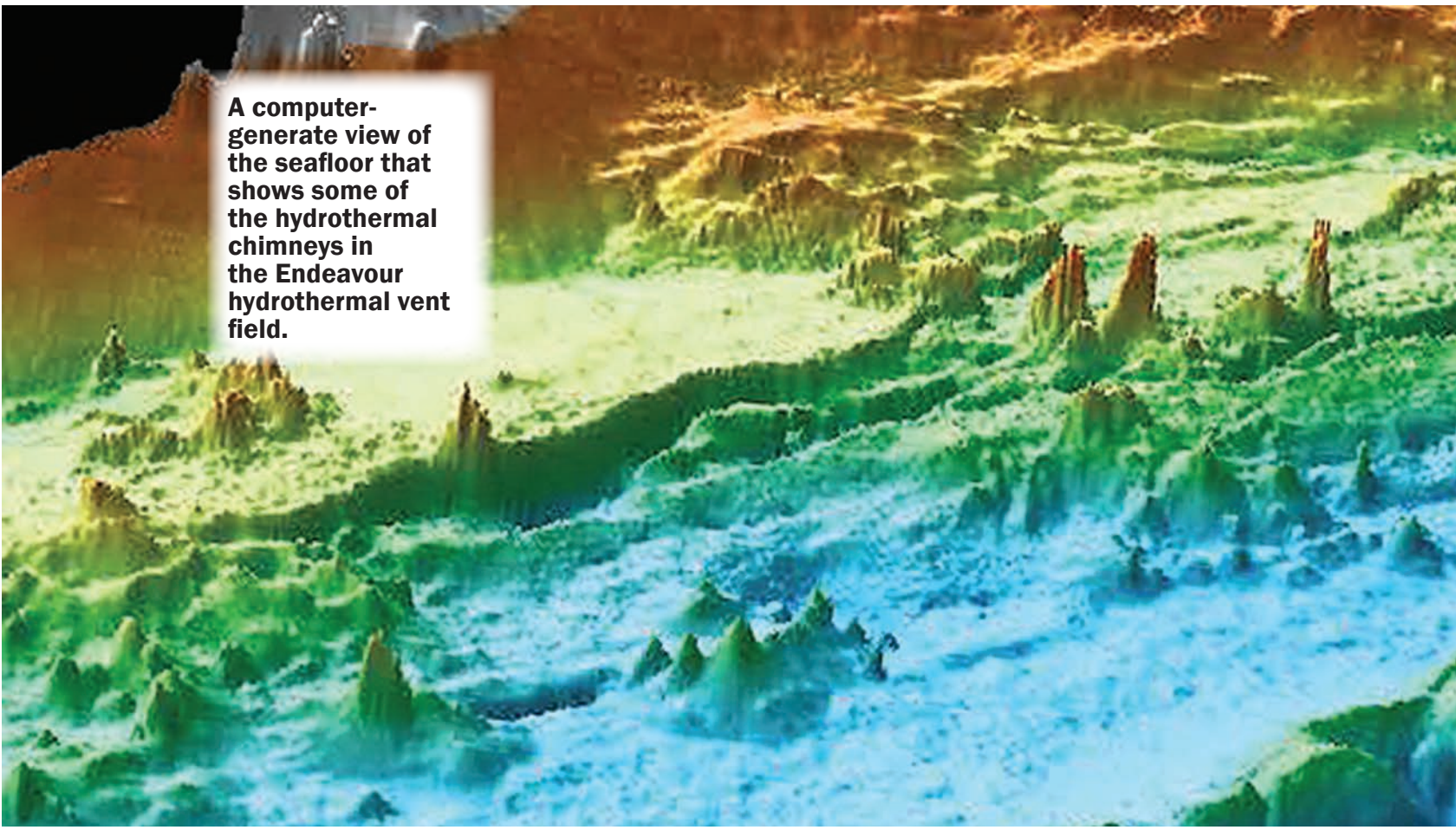
Hydrothermal vents are created by magma beneath the seafloor that heats water within the surrounding bedrock, emerging from the seafloor in the form of underwater seeps and geysers. When this heated mineral water meets freezing seawater, the dissolved minerals crystallise, creating spires and chimneys up to 25 metres (80 feet) tall.

Researchers flew MBARI's autonomous underwater vehicle (AUV), D. Allan B., over the seafloor during seven surveys in 2008 and 2011, mapping the area at about 1.25-metre (4-foot) resolution. Overall, the AUV completed 140 hours of dives and mapped about 62 square kilometres (24 square miles).

Based on their work at Endeavour and other mid-ocean ridges, researchers propose that these ridges may go through three phases of evolution: magmatic (lasting up to tens of thousands of years, when magma erupts and covers the seafloor); tectonic (lasting 5,000 years, when the seafloor cools and contracts, forming cracks and faults); and hydrothermal (last a few thousand years, when resurgent magma heats fluids that percolate up through the cracks, forming vents).

Further implications for this work include using MBARI's new maps to plan research dives and the location of monitoring equipment.

Additionally, data can be used to estimate the volume and mass of hydrothermal deposits in the chimneys, which is critical for understanding the distribution of metal-rich rocks around vents, some of which have been targeted for deep-sea mining.



A computer-generate view of the seafloor that shows some of the hydrothermal chimneys in the Endeavour hydrothermal vent field.

National Institute of Water and Atmospheric Research

NIWA: Slow-slip Earthquake Research Gains Momentum

Two international scientific expeditions, undertaken in 2017 and 2018, have allowed scientists to study New Zealand's largest earthquake fault in hopes of learning more about slow-slip earthquakes in subduction zones worldwide.

The International Ocean Discovery Program (IODP) expeditions to the Hikurangi subduction zone off the east coast of the North Island were jointly led by researchers from the National Institute of Water and Atmospheric Research (NIWA), GNS Science, the University of Texas, and the University of Auckland. This research marks the first time scientists have studied and directly sampled rocks from the source region of slow-slip events by drilling into the ocean floor.

Slow-slip events resemble regular earthquakes, but instead of energy released suddenly and catastrophically, slow quakes take place in increments that may last from days to months and can recur every year or two. NIWA principal scientist Dr. Philip Barnes explains that these events are important not only as a new type of seismic behavior, but because they occur in areas prone to large earthquakes and tsunamis. "As slow-slip earthquakes are still only newly discovered, we don't yet understand their relationship to large damaging earthquakes," he added.

New Zealand was identified as one of the best places to study such events because they occur close to the sea floor, making drilling to collect geophysical information and rock samples a viable option. A transect across the plate boundary was drilled off the coast of Gisborne to analyze the properties of rocks where slip events occur. "What we believe is that shallow slow-slip events occur on fault zones made up of a mash-up of different rock at different scales that are hugely variable in composition," Barnes says.

The study indicates that contrasting rock types in fault zones may lead to both the slow-slip movements observed, and perhaps others at subduction boundaries around the world. Barnes notes that the research is not only relevant to New Zealand, but to other areas prone to seismic behavior, like those along the Ring of Fire.

Drillers working on the rig floor of IODP Expedition 372.

© Phil Barnes, NIWA

Researched & Written by ***Celia Konowe***

Bermuda Institute of Ocean Sciences

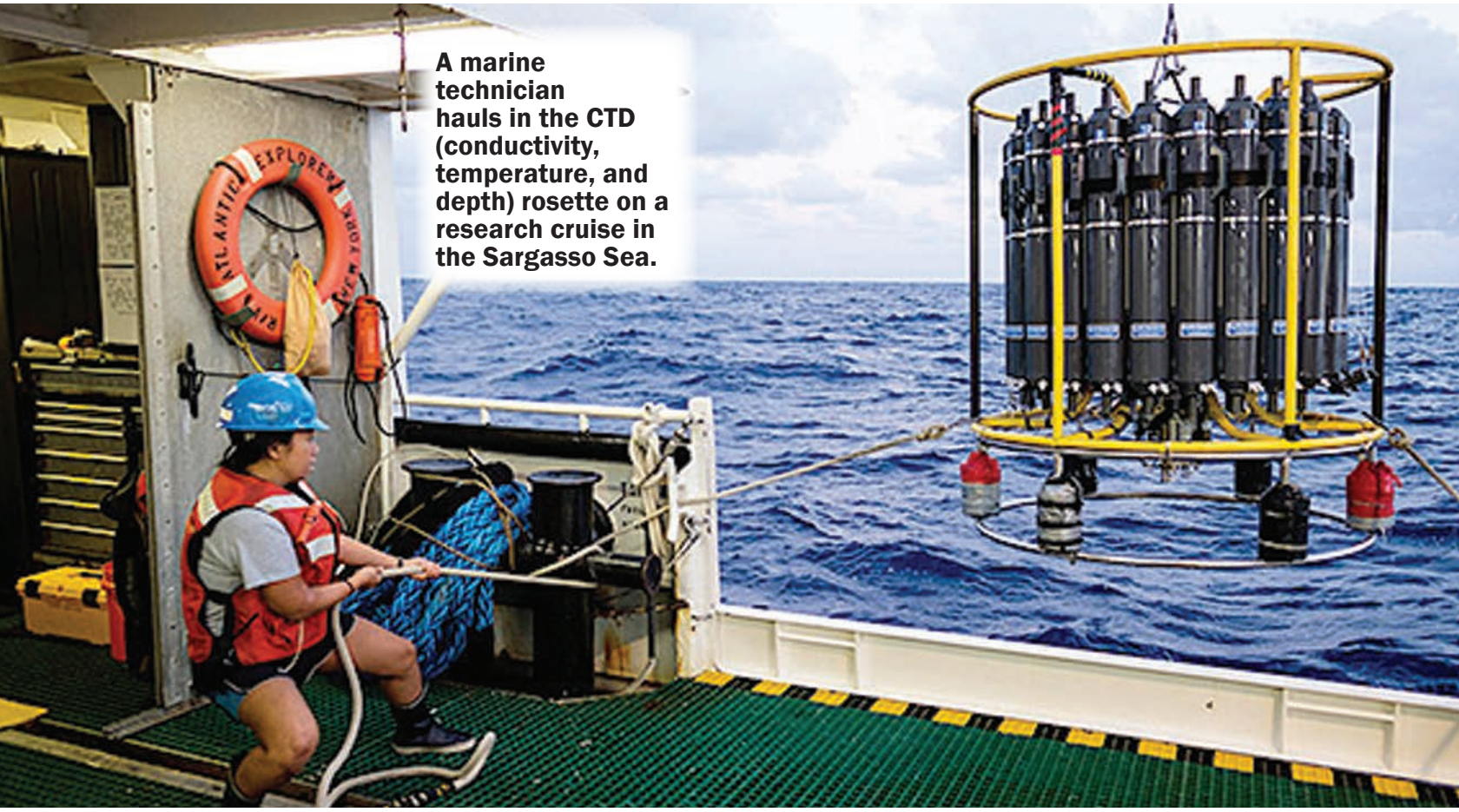
BIOS: North Atlantic Carbon Sink Shrinking Due to Warming

An analysis of North Atlantic Ocean water masses has made it clear that the effects of a warming planet extend beyond biology—they impact the physics of ocean circulation, too. The research, recently published in Nature Climate Change, was conducted by scientists from the University of British Colombia, the Bermuda Institute of Ocean Sciences (BIOS), the French Institute for Ocean Science at the University of Brest, and the University of Southampton.

One particular layer in the North Atlantic Ocean, a water mass called the North Atlantic Subtropical Mode Water (STMW), represents around 20% of the entire carbon dioxide uptake in the mid-latitude North Atlantic and is an important nutrient reservoir for phytoplankton—the base of the marine food chain. "The oceans play a vital role in buffering the Earth from climate change by absorbing carbon dioxide and heat at the surface and transporting it in the deep ocean," said Sam Stevens, doctoral candidate at the University of British Columbia and lead author on the study. "Studying changes in the structure of the world's oceans can provide us with vital insight into this process and how the ocean is responding to climate change."

Using data from two open-ocean research programs, the Bermuda Atlantic Time-series Study (BATS) Program and Hydration S, scientists found that as much as 93% of the STMW has been lost in the past decade. This loss, coupled with significant warming of the STMW, has culminated in the weakest, warmest SMTW ever recorded. "We find that the loss is correlated with different climate change indicators, such as increased surface ocean heat content, suggesting that ocean warming may have played a role in the reduced STMW formation of the past decade," explained Professor Nick Bates of BIOS and principal investigator of the BATS Program.

These findings outline a future relationship where ocean warming restricts STMW formation and changes the anatomy of the North Atlantic, making it a less efficient sink for heat and carbon dioxide.



A marine technician hauls in the CTD (conductivity, temperature, and depth) rosette on a research cruise in the Sargasso Sea.

Plymouth Marine Lab

PML: Invasive Seaweed Finds New Role as Coastal Cleanup Hero

A research team, led by the University of Exeter and the University of Bath, has developed a cheap and simple way of creating biofuel and fertilizer from seaweed, aiding in its cleanup and the removal of plastic from tourist beaches in the Caribbean and Central America.

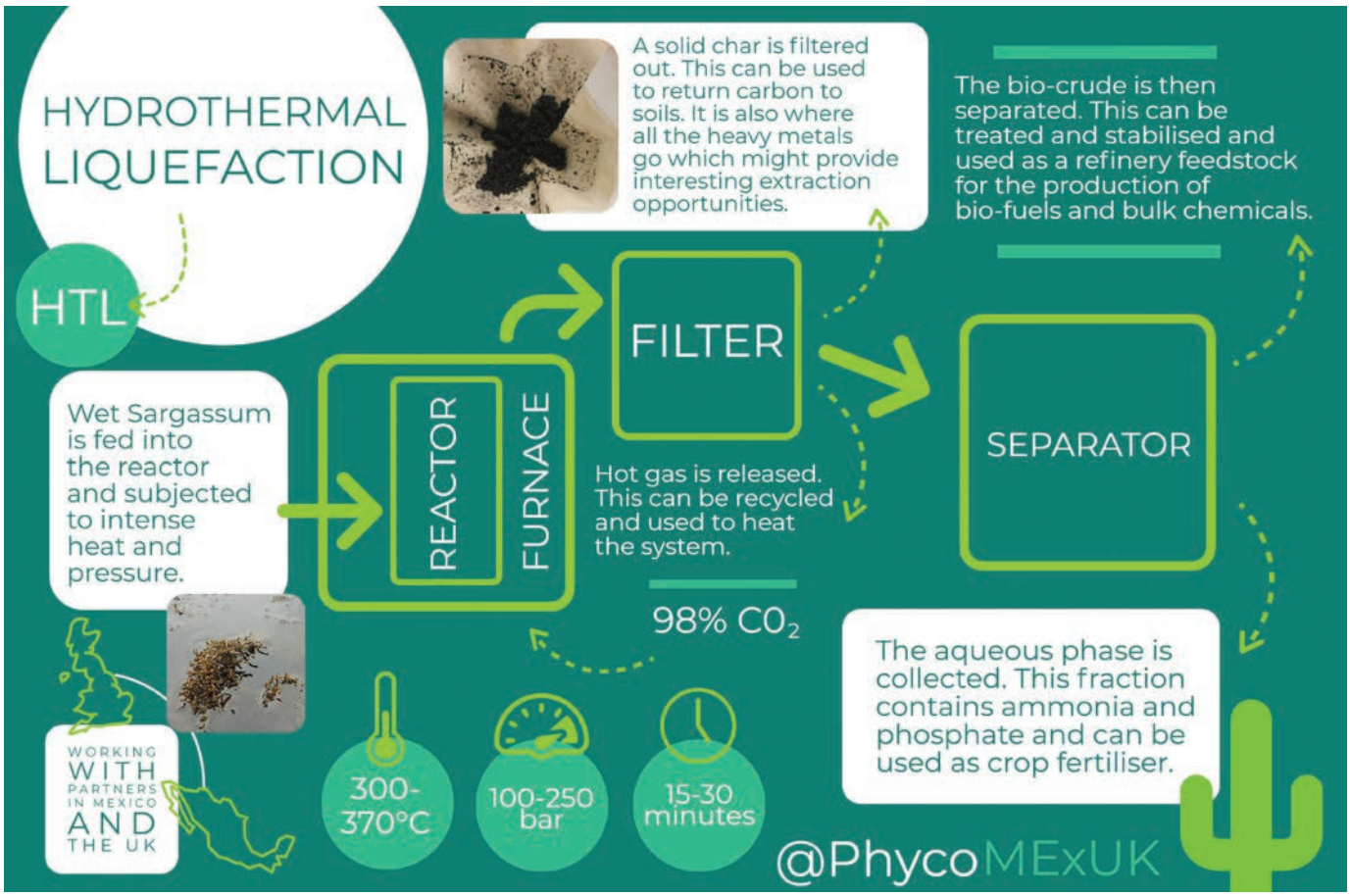
The study, recently published in the Journal of Chemical Technology and Biotechnology, aims to remove invasive seaweed, like Sargassum, which is costly to cleanup and deters tourists, while also producing biofuel in a sustainable way. Professor Mike Allen of the University of Exeter and Plymouth Marine Lab explained the need for an economically and environmentally viable method: "Processing marine biomass like seaweed usually requires removing it from the saltwater, washing it in fresh water and drying it. The costs of these processes can be prohibitively high."

As a solution, the team devised a process that, using acidic and basic catalysts, releases sugars that can be fed to a yeast that produces a palm oil substitute. This method also prepares the residual seaweed for the next stage of processing, called hydrothermal liquefaction. The organic material is subjected to high temperature and pressure, turning the seaweed into bio-oil that can be processed further into fuels and high-quality, low-cost fertiliser.

"For the first time this study demonstrates that, rather than a hindrance, the presence of saltwater can be helpful," noted Ed Jones of the University of Bath and lead author on the paper.

Additional implications include plastic conversion, an idea inspired by Allen's children as they helped to collect samples; any plastic found on the beaches will be converted alongside the seaweed.

The process of hydrothermal liquefaction, a method of converting seaweed into useful products including fertilisers, biofuels, and stock chemicals.



© Amy Pilsbury, PhycoMExUK

Researched & Written by ***Celia Konowe***

King Abdullah University of Science & Technology

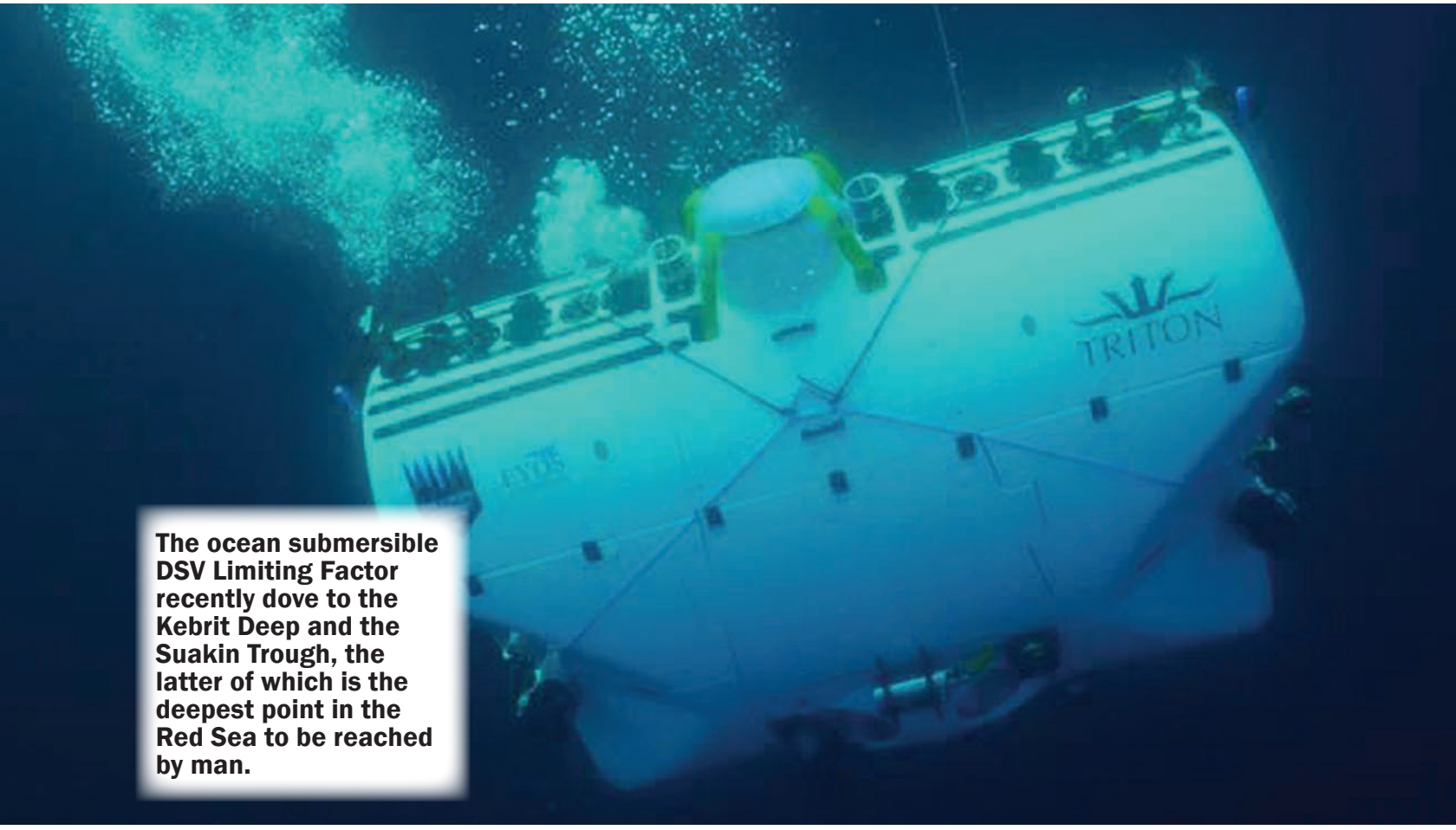
KAUST and Others Conduct Deepest Manned Red Sea Dive

In cooperation with the King Abdullah University of Science and Technology (KAUST), an expedition performed by the Caladan Oceanic crew and Victor Vescovo, renowned explorer, investor, and retired naval officer, reached the deepest point achieved by man in the Red Sea—the Suakin Trough.

Using the DSV Limiting Factor submersible from Triton Submarines, manned dives were completed to the Suakin Trough (2,777 m/9,111 ft) and the Kebrit Deep (1,470 m/4,823 ft), making Vescovo the first person to physically reach these points in the Red Sea. Accompanying him on the dive at the Kebrit Deep was Dr. Alan Jamieson from Newcastle University; with him on the dive to the Suakin Trough was Mohammed A. Aljahdli from the KAUST Coastal and Marine Resources Core Lab.

Both points exhibit unique traits, as they have "brine lakes" on the seafloor that differ in character from the seawater above them. Averaging about 10 metres in depth, the ultra-dense pools settle in the centres of the Deeps and create underwater "shorelines" between the highly saline brine below and regular sea water on top. Mineral and sponge-encrusted "chimneys" were observed along these shorelines of the Kebrit Deep, and in the Suakin Trough, the team dove into the caldera of an extinct underwater volcano to study its geology.

This expedition has created opportunities for protecting the Red Sea and its resources. "As we continue this year's expedition into the Indian and Pacific Oceans, we hope to explore as many new areas as possible with this, the deepest diving system on the planet, and investigate the 90 percent of the ocean that remains unexplored," said Vescovo. The next phase in the 2020 Caladan Oceanic Expeditions is in partnership with the Nekton organisation in the Indian Ocean to explore the Seychelles and Maldives.



The ocean submersible DSV Limiting Factor recently dove to the Kebrit Deep and the Suakin Trough, the latter of which is the deepest point in the Red Sea to be reached by man.

Khaled bin Sultan Living Oceans Foundation

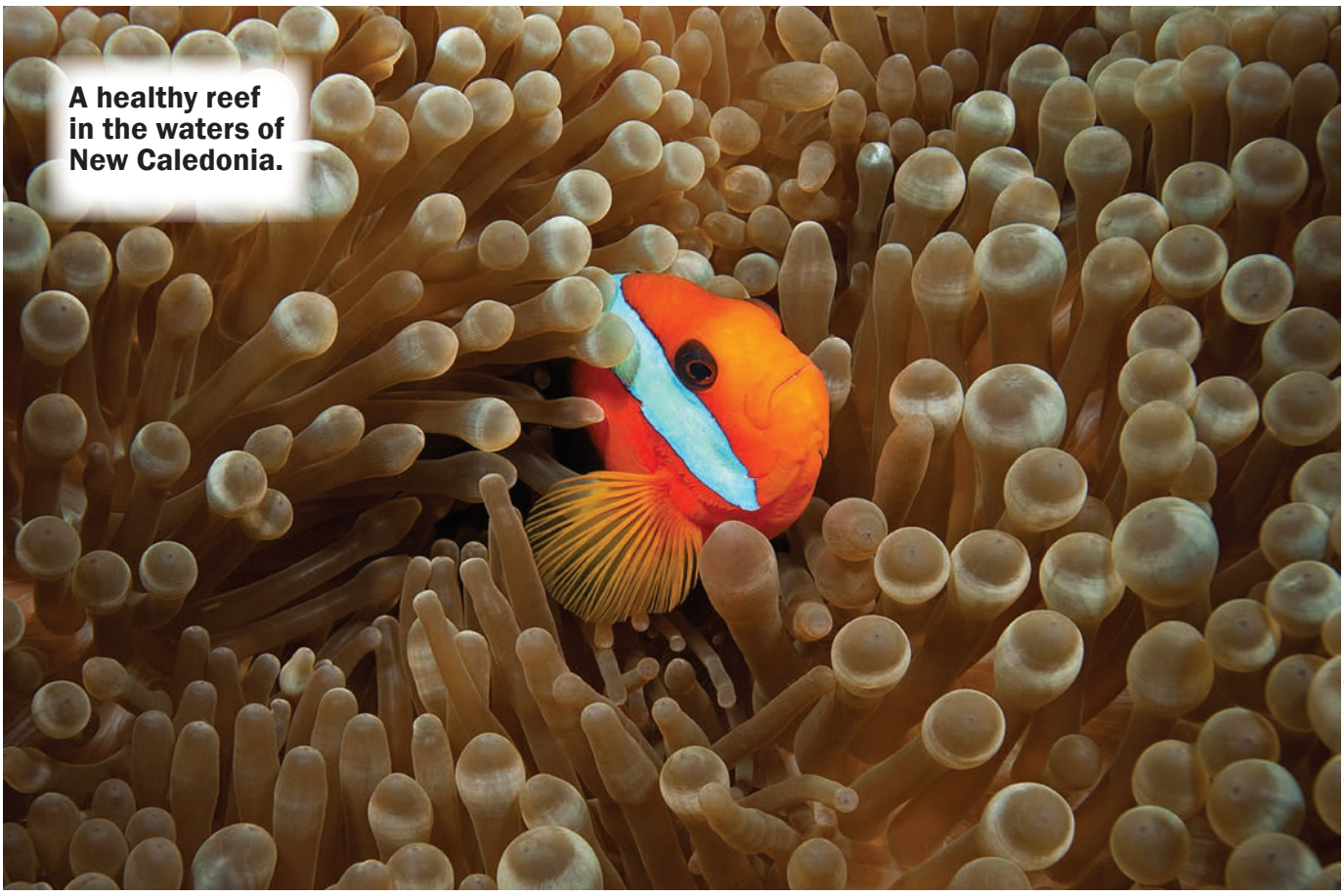
KSLOF: Some Reefs Are Tougher Than We Think

A recent report from the Khaled bin Sultan Living Oceans Foundation (KSLOF) provides an assessment of the status of coral reefs in New Caledonia thanks to a research mission aimed to study their health and resiliency around the world. Surprisingly, many coral reefs were found in to be in good health, even in unexpected places.

New Caledonia, a leader in global marine conservation, is home to the second largest marine protected area in the world and has already made strides to protect local reefs and coastal marine resources. This research initiative was conducted as part of the Global Reef Expedition, a five-year mission that circumnavigated the globe to collect baseline data on the state of reefs and the threats they face. Scientists from KSLOF, the Institut de Recherche pour le Développement, and other organizations spent more than a month at sea, satellite mapping many remote reefs and collecting data as a baseline for future reef analysis.

"The reefs of New Caledonia are simply spectacular. Incredible diversity. Remarkable morphology," said Dr. Sam Purkis, KSLOF's Chief Scientist. "But in New Caledonia, as elsewhere, the reefs are gravely threatened by local impacts and climate change." One exception, despite its close proximity to the shoreline, was Prony Bay, which had the highest live coral cover observed in New Caledonia. Alexandra Dempsey, the Director of Science Management at KSLOF, explained, "Corals were surprisingly abundant in what would normally be sub-optimal conditions for coral growth. This gives us hope for the future of coral reefs. More research is needed, but this finding shows us that at least some corals can adapt to survive in high-stress environments."

"This report provides government officials, marine park managers, and the people of New Caledonia with relevant information and recommendations they can use to effectively manage their reefs and coastal marine resources," said Renée Carlton, a marine ecologist with KSLOF. With hope, the data will help inform ongoing and future marine conservation efforts.



A healthy reef in the waters of New Caledonia.

2020 Editorial Calendar

JAN/FEB

Ad Close: Dec 21

Underwater Vehicle Annual

Subsea Defense Tech

Manipulator Arms and Tools

Autonomous Navigation GNSS MEMS

Unmanned Vehicle Propulsion

Event Distribution

Subsea Expo 2020- Feb 11- 13, Aberdeen
Underwater Defense & Security - Mar 3-5, Southampton
Canadian Hydrograpic Conference- Feb 24-27, Quebec City
Oceans 2020 Singapore - Apr 6-9 Singapore

FEBRUARY

Ad Close: Jan 22

MTR White Papers: Oceanographic

White Paper Electronic Edition Publication Date: February 2020

MARCH

Ad Close: Feb 21

Oceanographic Instrumentation: Measurement, Process & Analysis

Oceanology International New Tech Gallery

Fiber Optic Cables, Connectors & Slip Rings

Marine Drones

Hydrographic Sonar & Software

Event Distribution

Oceanology International - Mar 17-19, London
Sea-Air-Space- Apr 6-8, Baltimore, MD

APRIL

Ad Close: Mar 21

Offshore Energy: Oil & Gas, Wind & Tide

Subsea Electrification

Lights, Cameras, Lasers, Multibeam Sonar

Buoyancy Technology

Scientific Deck Machinery / LARS

Event Distribution

Offshore Technology Conference- May 4-7, Houston, TX
AUVSI XPONENTIAL- May 4-7, Boston, MA

MAY

Ad Close: Apr 21

Underwater Defense Technology

Comms, Telemetry & Data Processing

Hydrophones

Magnetometers & Streamers

Beacons, Flashers & Tracking Systems

Event Distribution

UDT- May 12-14, Rotterdam
Underwater Technology Conference- Jun 16-18, Bergen

JUNE

Ad Close: May 21

Hydrographic Survey: Single & Multibeam Sonar

Research Institutions

USV Platforms

GPS, Gyro Compasses & MEMS Motion Tracking

Interconnect: Underwater Cables and Connectors

JULY

Ad Close: Jun 22

MTR White Papers: Hydrographic

White Paper Electronic Edition Publication Date: July 2020

JULY/AUGUST

Ad Close: Jul 21

MTR 100 - Edition

The 15th Annual Listing of 100 Leading Subsea Companies
MTR looks at 100 leading companies and executives in all subsea disciplines, defense, offshore energy and science.

Event Distribution

Offshore Northern Seas- Aug 31-Sep 1, Stavanger

SEPTEMBER

Ad Close: Aug 21

Autonomous Vehicle Operations

Subsea Residency

ROV Technology: Work Class to Micro Systems

Thruster Tech: Underwater Propulsion

Underwater Tools & Manipulators

Event Distribution

SNAME Sep 29- Oct 3,Houston, TX
Offshore Energy Europe- Oct 7- 10, Amsterdam

OCTOBER

Ad Close: Sep 21

Ocean Observation: Gliders, Buoys & Sub-Surface Networks

Instrumentation: Profilers, Samplers & Sediment Corers

Seafloor Mapping

Harsh Environment Systems for Arctic Ops

Geospatial Software Systems for Hydrography

Event Distribution

Oceans 2020- Oct 19- 22, Biloxi, MS
Blue Tech Week, San Diego, CA
MAST Japan Defense- Nov 2-4, Tokyo

NOVEMBER

Ad Close: Oct 22

MTR White Papers: Subsea Vehicles

White Paper Electronic Edition Publication Date: November 2020

NOVEMBER/DECEMBER

Ad Close: Nov 21

Acoustic Doppler Sonar Technologies ADCPs and DVLs

Fresh Water Monitoring & Sensors

Offshore Inspection, Maintenance & Repair (IMR)

Underwater Imaging: Lights, Cameras, Lasers & Multibeam Sonars

The 2021 Subsea Market Planner

Event Distribution

Underwater Intervention 2021

information may be subject to change

Algorithm Aims to Assist Ocean Search and Rescue

S&R algorithm identify hidden "traps" in ocean waters, helping to more quickly identify regions where objects — and missing people — may have converged.

By Jennifer Chu, MIT

The ocean is a messy and turbulent space, where winds and weather kick up waves in all directions. When an object or person goes missing at sea, the complex, constantly changing conditions of the ocean can confound and delay critical search-and-rescue operations.

Now researchers at MIT, the Swiss Federal Institute of Technology (ETH), the Woods Hole Oceanographic Institution (WHOI), and Virginia Tech have developed a technique that they hope will help first responders quickly zero in on regions of the sea where missing objects or people are likely to be.

The technique is a new algorithm that analyzes ocean conditions such as the strength and direction of ocean currents, surface winds, and waves , and identifies in real-time the most attracting regions of the ocean where floating objects are likely to converge.

The team demonstrated the technique in several field experiments in which they deployed drifters and human-shaped manikins in various locations in the ocean. They found that over the course of a few hours, the objects migrated to the regions that the algorithm predicted would be strongly attracting, based on the present ocean conditions.

The algorithm can be applied to existing models of ocean conditions in a way that allows rescue teams to quickly uncover hidden "traps" where the ocean may be steering missing people at a given time.

"This new tool we've provided can be run on various models to see where these traps are predicted to be, and thus the most likely locations for a stranded vessel or missing person," says Thomas Peacock, professor of mechanical engineering at MIT. "This method uses data in a way that it hasn't been used before, so it provides first responders with a new perspective."

Peacock and Pierre Lermusiaux, also a professor of mechanical engineering at MIT, who oversaw the project, and their colleagues report their results in a study published today in the journal Nature Communications. Their coauthors are lead author Mattia Serra and corresponding author George Haller of ETH Zurich, Irina Rypina and Anthony Kirincich of WHOI, Shane Ross of Virginia Tech, Arthur Allen of the U.S. Coast Guard, and Pratik Sathe of the University of California at Los Angeles.

A new MIT-developed search-and-rescue algorithm identifies hidden "traps" in ocean waters. The method may help quickly identify regions where objects — and missing people — may have converged.

Hidden traps

Today's search-and-rescue operations combine weather forecasts with models of both ocean dynamics and the ways in which objects can drift through the ocean, to map out a search plan, or regions where teams should concentrate their search.

But the ocean is a complicated space of unsteady, ever-changing flow patterns. Coupled with the fact that a missing person has likely been continuously floating through this unsteady flow field for some time, Peacock and his colleagues say that significant errors can accumulate in predicting where to look first, when using a simple approach that directly predicts the trajectories of a few drifting objects.

Instead, the team developed a method to interpret the ocean's complex flows using advanced, data-driven ocean modeling and prediction systems. They used a novel "Eulerian" approach, in contrast to more commonly used "Lagrangian" approaches — mathematical techniques that involve integrating snapshots of the ocean velocity due to waves and currents to slowly generate an uncertain trajectory for where a missing person or object may have been carried.

Image courtesy of the researchers/ http://news.mit.edu/

The new Eulerian approach uses the most reliable velocity forecast snapshots, close to the point where a missing person or object was last seen, and quickly uncovers the most attracting regions of the ocean at a given time. These Eulerian predictions are then continuously updated when the next batch of updated velocity information becomes available.

The team has named their approach TRAPS, for its goal of identifying TRansient Attracting Profiles, or short-lived regions where water may converge and be likely to pull objects or people. The method is based on a recent mathematical theory,

developed by Serra and Haller at ETH Zurich, to uncover hidden attracting structures in highly unsteady flow data.

"We were a bit skeptical whether a mathematical theory like this would work out on a ship, in real time," Haller says. "We were all pleasantly surprised to see how well it repeatedly did."

"We can think of these 'traps' as moving magnets, attracting a set of coins thrown on a table. The Lagrangian trajectories of coins are very uncertain, yet the strongest Eulerian magnets predict the coin positions over short times," Serra says.

"The key thing is, the traps may not have any signature in the ocean current field," Peacock adds. "If you do this processing for the traps, they might pop up in very different places from where you're seeing the ocean current projecting where you might go. So you have to do this other level of processing to pull out these structures. They're not immediately visible."

Out at sea

Led by WHOI sea-going experts, the researchers tested the TRAPS approach in several experiments out at sea. "As with any new theoretical technique, it is important to test how well it works in the real ocean," Rypina says.

In 2017 and 2018, the team sailed a small research vessel several hours out off the coast of Martha's Vineyard, where they deployed at various locations, an array of small round buoys, and manikins.

"These objects tend to travel differently relative to the ocean because different shapes feel the wind and currents differently," Peacock says. "Even so, the traps are so strongly attracting and robust to uncertainties that they should overcome these differences and pull everything onto them."

The team ran their modeling and prediction systems, forecasting the ocean's behavior and currents, and used the TRAPS algorithm to map out strongly attracting regions over the course of the experiment. The researchers let the objects drift freely with the currents for a few hours, and recorded their positions via GPS trackers, before retrieving the objects at the end of the day.

"With the GPS trackers, we could see where everything was going, in real-time," Peacock says. "So we laid out this initial, widespread pattern of the drifters, and saw that, in the end, they converged on these traps."

The researchers are planning to share the TRAPS method with first responders such as the U.S. Coast Guard, as a way to speed up search-and-rescue algorithms, and potentially save many more people lost at sea.

"People like Coast Guard are constantly running simulations and models of what the ocean currents are doing at any particular time and they're updating them with the best data that inform that model," Peacock says. "Using this method, they can have knowledge right now of where the traps currently are, with the data they have available. So if there's an accident in the last hour, they can immediately look and see where the sea traps are. That's important for when there's a limited time window in which they have to respond, in hopes of a successful outcome."

This research was primarily funded by the National Science Foundation's Hazards SEES program, with additional support from the Office of Naval Research and the German National Science Foundation.

Tech Files

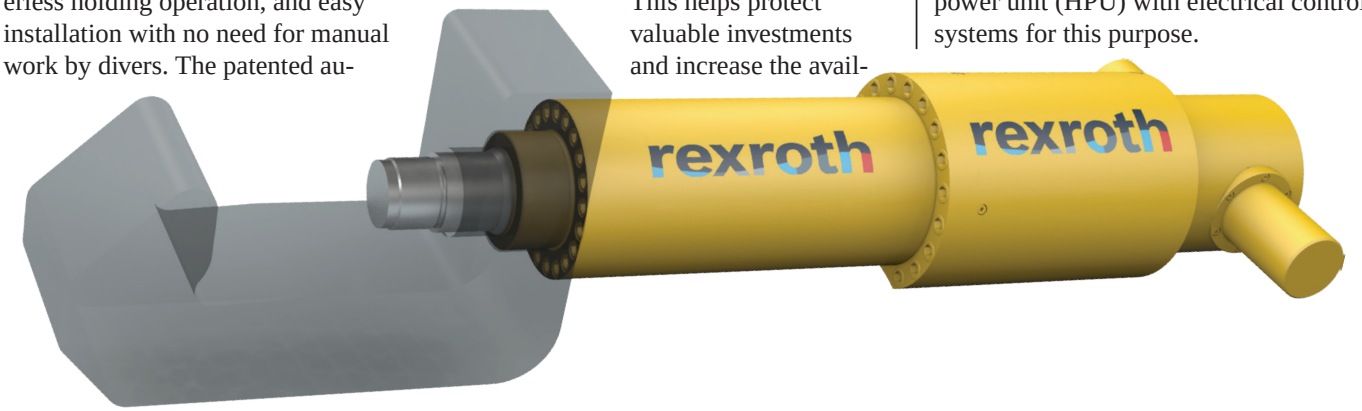
Innovative products, technologies and concepts

Subsea Clamping Cylinder

The new Subsea Clamping Cylinder from Rexroth takes into account the complete life cycle of riser systems: whether it be transport and storage on the seabed, commissioning and reliable use, or removal and reuse. Bosch Rexroth's new Subsea Clamping Cylinder protects valuable offshore systems against premature wear - with no diving work or power supply needed

With the Subsea Clamping Cylinder for fully automatic Bend Stiffener Connectors (BSCs), the system is designed for use for up to 25 years and is impressive with its high clamping forces, powerless holding operation, and easy installation with no need for manual work by divers. The patented automation solution withstands forces of up to 120 tons per clamping cylinder. A cushioning mechanism absorbs vibrations and distributes the load across a number of cylinders within the system. This prevents material fatigue and premature wear with a predefined clamping force. The integrated clamping unit allows straightforward, reliable actuation during commissioning and removal – even after long periods of use.

Bend Stiffener Connectors (BSCs) protect riser systems against premature material fatigue coming from movements such as those caused by waves. This helps protect valuable investments and increase the availability and productivity of the offshore equipment. In a fully automatic BSC, a number of Rexroth clamping cylinders are used as a system. The patented automation solution reliably protects riser systems against bending loads and allows a secure and economical holding operation. It is designed for use for up to 25 years and no manual diving work is necessary during installation and removal. Holding operation requires no power – a hydraulic supply is only required for the initial clamping and subsequent removal. Bosch Rexroth offers an optional integrated hydraulic power unit (HPU) with electrical control systems for this purpose.



Rexroth

Blue Trail Engineering: Cobalt Connectors

Blue Trail Engineering introduced its new Cobalt Series waterproof connectors. These dry-mate underwater connectors and cables set a new standard for miniature waterproof connectors. Cobalt connectors offer the same reliability as larger subsea connectors, but at a fraction of the cost.

Perfect for space-limited applications, Cobalt connectors take up significantly less volume than the industry-standard Micro-Circular connectors. With 316 stainless steel shells and PEEK inserts, they withstand long-term use in seawater at depths up to 600 meters. In spite of their compact size, Cobalt connectors carry up to 12 amps on 3 pins, 5 amps on 6 pins or 20 amps on 4 pins. Connector shells are keyed and feature a scoop-proof design, allowing them to be mated blind with no possibility of pin damage.

With its 10-mm thread size, Cobalt bulkhead connectors are drop-in replacements for Blue Robotics penetrators, making quick-connect and quick-disconnect possible with Blue Robotics enclosures, thrusters, lights, grippers, and other accessories. Blue Trail also offers Blue Robotics T200 thrusters with Cobalt connectors pre-installed, allowing the user to replace a thruster in a matter of seconds, without breaking the seal on the ROV's enclosure.

Photo: Blue Trail Engineering

Arctic Rays

Arctic Rays

Arctic Rays released a high torque version of its miniature Hammerhead pan and tilt for use on multiple platforms, including ROVs, HOVs, ASVs, landers and fixed platforms. In addition, the standard 316 SS unit can be supplied in 6061 Aluminum for weight critical applications. The original Hammerhead and the new Hammerhead XT are both available as single axis rotators. The new Hammerhead XT provides a rated torque of 13.6 N-m (10 ft-lbs) in a compact envelope measuring only 6.59" (167mm) tall x 5.02" (128mm) wide x 2.5" (64mm) deep.

Teledyne Lumenera

Teledyne Lumenera expands its Lt Series camera portfolio with new compact and lightweight USB3 cameras for use in diverse imaging applications.

Equipped with the latest rolling shutter Starvis CMOS sensors and global shutter Pregius CMOS sensors from Sony, and ranging in resolution from 2-20 megapixels, these new cameras perform in a wide variety of imaging applications such as aerial imaging, Intelligent Traffic Systems (ITS), robotic inspection solutions, and life sciences.

Teledyne Lumenera's Lt Series Cameras offer a smaller, lighter, and lower cost imaging solution and are designed specifically to meet the challenges of today's modern imaging systems that strive to provide advanced vision performance while using less power, less space, and fitting increasingly tight industry budgets.

RS Aqua

RS Aqua launched its next generation WaveRadar, the WaveRadar REX2. In been in development for several years, the WaveRadar REX2 is half the size and weight of the legacy REX, consuming 10 times less power while offering a 25% greater range and still maintaining its accuracy.

The WaveRadar REX2 is powered by a new Emerson microwave sensor, using the same Frequency Modulated Continuous Wave (FMCW) measurement technique that has been used by the WaveRadar REX over the past 20 years. This new higher frequency sampling unit enables a greater measurement range of up to 80 m, and the same high accuracy over this distance (3 - 6 mm, dependent on range).

Every WaveRadar REX2 will be supplied with a new software package called WaveConfigurator, enabling system set up and diagnostic monitoring by end users in the field. Unlike its predecessor, the WaveRadar REX2 incorporates an LCD screen for instantaneous sensor measurement display.

MetOcean

MetOcean Telematics will supply the Royal Navy with its new Maritime Acoustic Scoring and Simulation System (MASS), an over-the-horizon Naval Surface Fire Support (NSFS) and Naval Gunfire Scoring and Simulation (NGSS) system which is designed to eliminate the need for land bombardment ranges and the necessity to destroy physical targets on land or at sea. The free-floating system consists of a set of operation buoys, which report acoustic event data, point of impact, and precise time.

TE Connectivity

SEACON product lines from TE Connectivity (TE) are now available from TTI, Inc. Used extensively in the global oil and gas industries, the SEACON series of connectors includes electrical dry-mate, optical hybrid dry-mate, electrical underwater mateable, electrical wet-mate, optical underwater mateable connectors, downhole, field installable, underwater switches, penetrators and specialty products. The advantages of this strategic distribution partnership include the speed of the ordering process, shorter lead times and the additional flexibility to purchase in small quantities. TE's SEACON products are stocked at various TTI locations in the U.S., EMEA and Asia.

TTI also stocks DEUTSCH connectors, Raychem wire and cable products, AMP products and TE sensors.

People & Companies

The people and organizations that made news

Trowell Named CEO of Acteon

Acteon

Teledyne CARIS

Dean Joins Teledyne CARIS

3D Spacial Solutions

Scott Walters, 3D Spatial Solutions

Trowell Named CEO of Acteon
Offshore services group Acteon will appoint **Carl Trowell** as Group Chief Executive Officer, succeeding **Richard Higham**, effective June 1. Trowell, with 25 years of experience in a wide range of roles across the energy sector, joins Acteon from the offshore drilling contractor Valaris plc.

Dean Joins Teledyne CARIS
Teledyne CARIS welcomes Geoff Dean to the group as USA Sales Manager. I

Gullick to Lead NOC's Biz Dev
The National Oceanography Center (NOC) appointed Huw Gullick as Managing Director of NOC Innovations and Associate Director of Strategic Business Development starting in August 2020. NOC Innovations Ltd. is the wholly owned commercial trading subsidiary of NOC, the purpose of which is to generate revenue to support the advancement of the NOC's charitable purposes.

Planet Ocean, SIDUS Ink Deal
Planet Ocean signed an exclusive distribution agreement with SIDUS Solutions LLC for the UK and Ireland. SIDUS provides undersea situational awareness equipment. Its product offerings includes high-definition cameras, electric pan and/or tilt positioner systems, feature rich underwater lighting and projection lasers.

Greensea, 3D Spatial Solutions
Greensea Systems announced its sales partnership with 3D Spatial Solutions, LLC. "We believe that Greensea provides the crucial link between operator and machine. Their OPENSEA platform and user interface, Workspace, are the key to OEMs providing increased capability for their current vehicles, and enabling existing ROV owners and users to enhance their productivity by reducing workload for the operator," said Scott Walters, Principal of 3D Spatial Solutions.

CWind Taps Rovco for Offshore Wind
UK-based ROV provider Rovco has been awarded a long-term contract by CWind for subsea work on the East Anglia ONE offshore wind project. The Rovco team will carry out a campaign of subsea inspection and survey work on all subsea structures, informing the maintenance of the wind turbine and substation foundations.

ThayerMahan, Geo Subsea Sign MoU
Groton-based ThayerMahan, a leader in autonomous maritime security solutions, has executed a cooperative partnering agreement Geo SubSea, LLC, a market leader in marine geophysical surveying, data analysis and reporting. Partnering with Geo SubSea represents an important addition to ThayerMahan's expanding portfolio of seabed surveying capabilities.

GeoSpectrum Wins Comms Deal
GeoSpectrum was selected to deliver its Long-Range Acoustic Messaging system to another (unnamed) customer, following the recent delivery of LRAM equipment to the Canadian Government. The LRAM system is a through-water acoustic communications system optimized for robust operation over long range.

COVE Internship Project Begins

The Center for Ocean Ventures and Entrepreneurship (COVE) has announced the Internship Pilot Program, with 10 participants, is proceeding on time. The project has been revamped to be delivered using virtual means which allows the interns to help the participating companies transition through the COVID-19 pandemic.

EdgeTech Promotes Andella

EdgeTech has promoted Gene Andella to the role of Customer Service Manager. Andella has worked with EdgeTech for over seven years. He started on the factory floor building EdgeTech products and then moved into a Customer Support role six years ago.

Greensea Expands into Europe

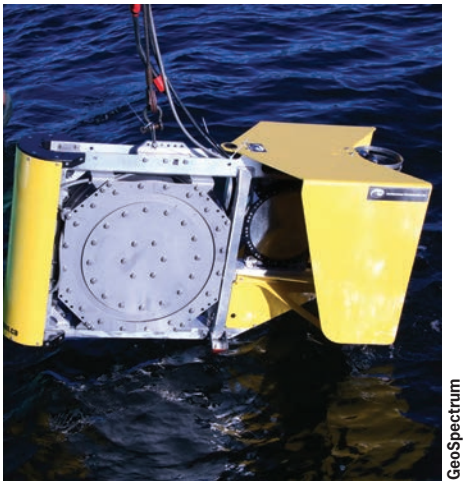
Greensea Systems, Inc. is expanding its international presence to meet increasing demand for its open architecture navigation, control, autonomy and human-machine interface technology. Wight Ocean, Ltd. will represent Greensea products to customers across Europe. This will include the Greensea INSpect GS inertial navigation system and the EOD Workspace software tool. "We are excited to collaborate with Greensea Systems, providing our customers with a robust technology framework and the building blocks that enable rapid development of integrated robotics solutions, helping operators accomplish their missions more efficiently and safely," said Graham Lester of Wight Ocean.
Wight Ocean will also market Greensea's recently introduces hull crawler designed to perform underwater ship inspections in lieu of dry-docking (UWILD) and naval vessel survey and inspection operations. The hull crawler is the first commercial product to come out of Greensea's hull robotics program, which is developing the advanced navigation and localization capabilities necessary for hull inspection, surveying, and non-destructive testing.

COVE Internship Project Begins

COVE

Graham Lester

Wight Ocean



GeoSpectrum

Towed Body Projector with LRAM.

ROVCO

CWind Taps Rovco for Offshore Wind

MTR Marketplace

PRODUCT, PROFESSIONAL, VESSELS, BARGES & REAL ESTATE FOR SALE

Advertiser Index

Page	Company	Website	Phone#
9	Airmar Technology Corporation	www.airmar.com	(603) 673-9570
3	BIRNS, Inc.	www.birns.com	Please visit us online
29	Blue Trail Engineering	www.BlueTrailEngineering.com	(720) 526-6388
19	Blueprint Subsea	www.blueprintsubsea.com	+44 (0) 1539 531536
23	Digital Edge Subsea Ltd	www.digitaledgesubsea.com	+44 (1229) 206456
C3	EvoLogics GmbH	www.evologics.de	49 30 4679 862 0
37	Falmouth Scientific, Inc.	www.falmouth.com	(508) 564-7640
17	JW Fishers Mfg Inc.	www.jwfishers.com	(508) 822-7330
11	Klein Marine Systems, Inc.	www.KleinMarineSystems.com	(603) 893-6131
5	Kraken Robotic Systems Inc.	www.krakenrobotics.com	Please visit us online
9	MSI Transducers	www.msitransuders.com	(978) 486-0404
25	QPS / Quality Positioning Services B.V.	www.qps.nl	(603) 431-1773
31	R.M. YOUNG COMPANY	www.youngusa.com	(231) 946-3980
7	Saab Seaeye Ltd.	www.seaeye.com	Please visit us online
1,17	SBG Systems	www.sbg-systems.com	Please visit us online
C2	Sea Machines	www.sea-machines/contact	Please visit us online
21	Silicon Sensing Systems Limited	www.siliconsensing.com	+44 (0) 1752 723330
37	SubCtech GmbH	www.subctech.com	+49 (0) 431-22039 884
C4	Teledyne CARIS, Inc.	www.teledynecaris.com	Please visit us online
13	Valeport Limited	www.valeport.eo.uk/swiftplus	44 (0) 1803869292

The listings above are an editorial service provided for the convenience of our readers.
If you are an advertiser and would like to update or modify any of the above information, please contact: productionmanager@marinelink.com

Evo Logics®

SMART SUBSEA SOLUTIONS

Delivering data in most adverse conditions: underwater acoustic modems with advanced communication technology and networking

Accurate USBL and LBL positioning of underwater assets

Modem emulator and other cost-saving developer tools

Autonomous surface vehicle for bathymetry, monitoring and AUV support

sales@evologics.de

EvoLogics.de

Introducing CARIS Mira AI

Bring the Noise

The Sonar Noise Classifier is a Gamechanger

Powered by the CARIS Mira AI engine and available now in CARIS HIPS and SIPS 11.3.

The Sonar Noise Classifier automatically identifies noise providing significant reductions in manual cleaning and quickly propels data from acquisition to review.

Reduce manual cleaning by up to 10× at an accuracy of 95%.

Try it now with a FREE 30-Day Trial!

LEARN MORE about the Sonar Noise Classifier
www.teledynecaris.com/caris-mira/

TELEDYNE CARIS
Everywhereyoulook™
Part of the Teledyne Imaging Group