MARINE TECHNOLOGY REPORTER

June 2017

www.marinetechnologynews.com

Autonomy & Seabed Mapping

Interview

Professor Ed Hill

Executive Director, NOC

Data Processing

Seamless Hydrographic Workflow

Volume 60 Number 5

A great addition to your cast.

The updated RBR*concerto* C.T.D|fast12, with streamlined CT cell for dynamic performances.

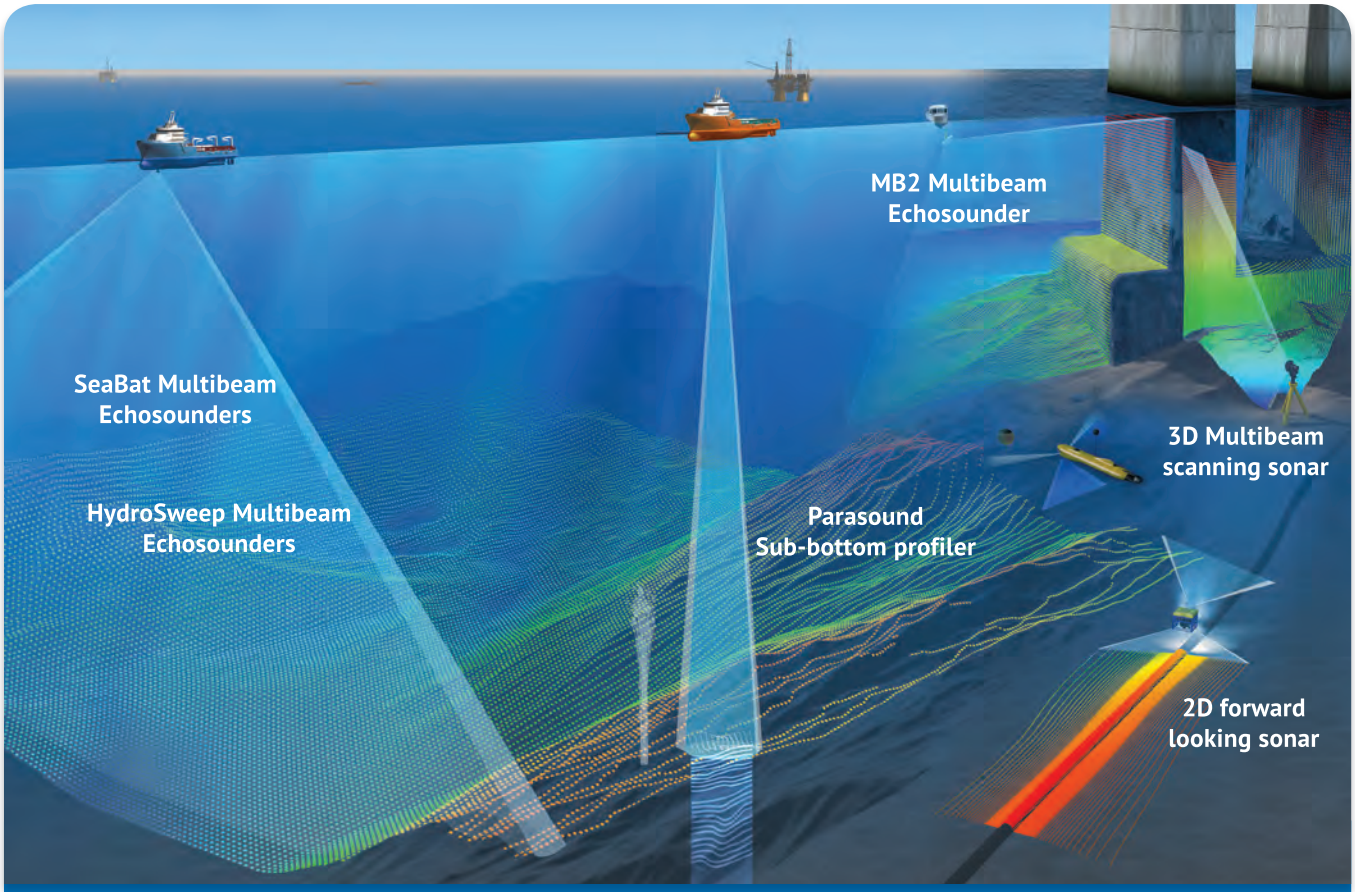
Up to 12Hz profiling, USB download, and twist-activated WiFi options.

RBR

rbr-global.com

Teledyne Marine

All the sonars you need, in one place



Hydrography
Seafloor mapping
Sub bottom profiling
Marine research

Defense & security
Terrain mapping
MCM and Obstacle Avoidance
Diver detection

Civil engineering & dredge
Dredge guidance
Construction support
Bridge, Dam and Harbor inspection

Offshore
Pipeline surveying
Leakage detection
Obstacle avoidance

Take advantage of the collective expertise of how our combined underwater acoustic imaging technologies deliver far-reaching support for your business. We operate out of six worldwide locations and are closer to you than ever before supported by a global network of service partners. Contact our skilled team for an in-depth look at our pioneering products and customized solutions.

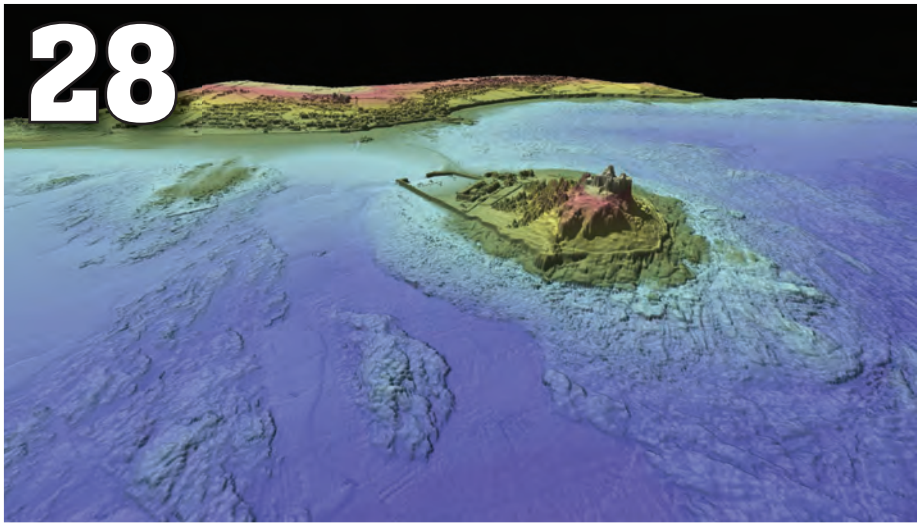
To know more, contact us at:

www.teledynemarine.com

TELEDYNE MARINE
Everywhereyoulook™
RESON • BlueView • Odom Hydrographic

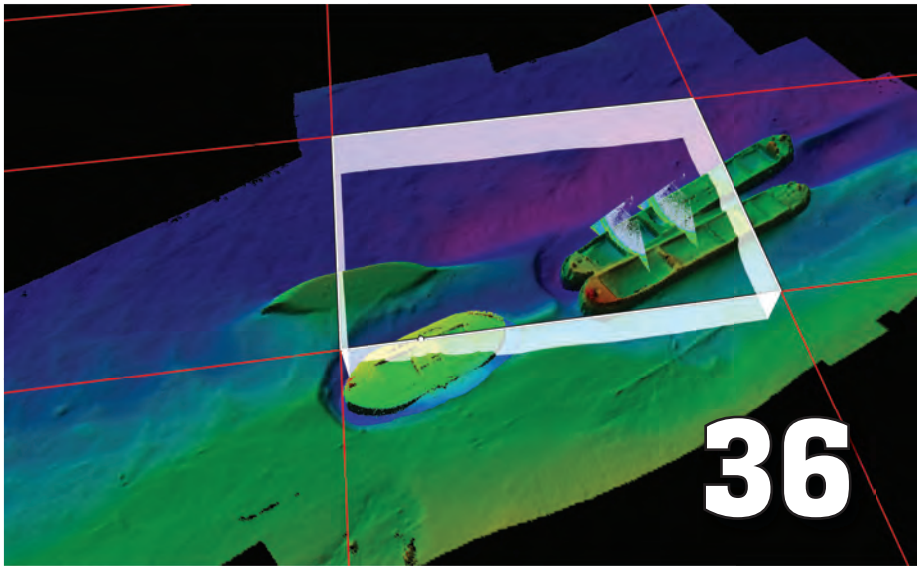
June 2017
Volume 60 • Number 5

Contents



Courtesy of Channel Coastal Observatory

NOC



QPS

On the Cover
Seabed Mapping

Voices

Data Processing

I FIND WRECKS. I SOLVE MYSTERIES.

I AM REMUS

HYDROID
A KONGSBERG COMPANY

Intelligent Marine Robots You Can Rely On

OUR REMUS VEHICLES
work for you to complete your mission –autonomously– whether solving underwater mysteries, performing site investigations or studying the ocean floor.

To learn more, visit **HYDROID.COM/IAMREMUS**

Courtesy of Channel Coastal Observatory

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

Managing Editor
Eric Haun
haun@marinelink.com

Contributing Writers
Kira Coley, United Kingdom
Capt. Edward Lundquist, USN (Ret.)
Tom Mulligan, Ireland
Claudio Paschoa, Brazil
William Stoichevski, Norway

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

Editorial

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

Ever since launching our *Marine Technology TV* brand earlier this year at Oceanology International North America in San Diego, I literally have been kicking myself for not starting this video interview journey even sooner. I have been in the business of B2B publishing for more than 27 years, including 24 years at the helm of *MTR* sister-publication *Maritime Reporter & Engineering News*, which launched its own *Maritime Reporter TV* brand in 2016. In this short time frame – at exhibitions and in our studio in New York City, I have had the unique opportunity to sit with dozens of CEOs and thought leaders in the collective maritime, offshore and subsea industries.

This month I am particularly pleased to take our video interview with **Professor Ed Hill**, the Executive Director of the National Oceanography Center (NOC) in Southampton, U.K., and deliver it to the pages of Marine Technology Reporter, starting on page 20. As many of you know better than I, the elite universities, institutions and institutes of the world are true thought and technology leaders, the breeding ground for the people and the products that will propel the subsea industry's future. Professor Hill provided to MTR an insightful overview of the highlights and priorities of NOC.

In this month's cover feature on subsea mapping, Kira Coley once again delivers in prose and pictures with a look at the autonomous future of seabed mapping, starting on page 28. In particular we focus on the launch of 4D Ocean, which could mean the breaking down of barriers and the start of an autonomous, low-cost future in seabed mapping.

MARINE TECHNOLOGY REPORTER
www.marinetechnologynews.com
Vol. 60 *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.

Subscription:
To subscribe please visit
www.marinetechnologynews.com

NAVIGATOR

A one man navigation and sonar reconnaissance unit

SHARK MARINE TECHNOLOGIES INC.

The Navigator, a second generation Sonar Imaging and Navigation system, designed by Shark Marine primarily for MCM and SAR use.

Proven

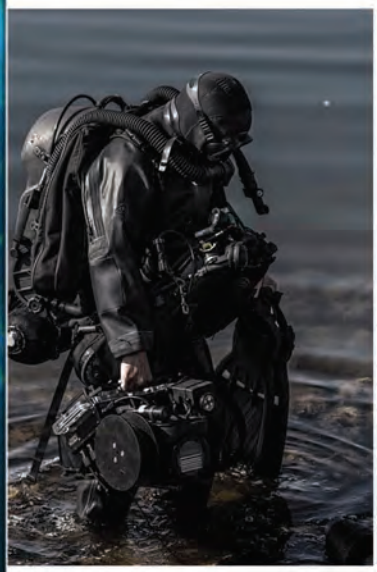
Tested and proven, the Navigator is the trusted choice of 17 Navies, as well as Law Enforcement, Search and Rescue Teams and Scientific Researchers spanning the globe. The Navigator has become a critical part of the Standard Kit and has reshaped SOPs. The modularity of the system and numerous advanced sensors available allow the Navigator be to become a force multiplier, enabling smaller groups to cover more ground efficiently with increased safety.

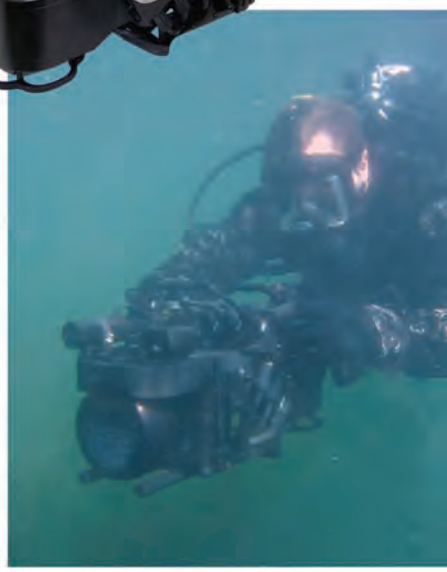
Mission Ready

The Navigator is the most modular system of its kind, enabling it to be quickly configured for any application.

Intuitive

Shark Marine's DiveLog software controls all operations of the navigator and its accessories, operators need only learn one software to master all their equipment.





www.sharkmarine.com sales@sharkmarine.com Ph: (905) 687 6672

... In case you missed it, highlights from marinetechnologynews.com and the Marine Technology Reporter ENews ...

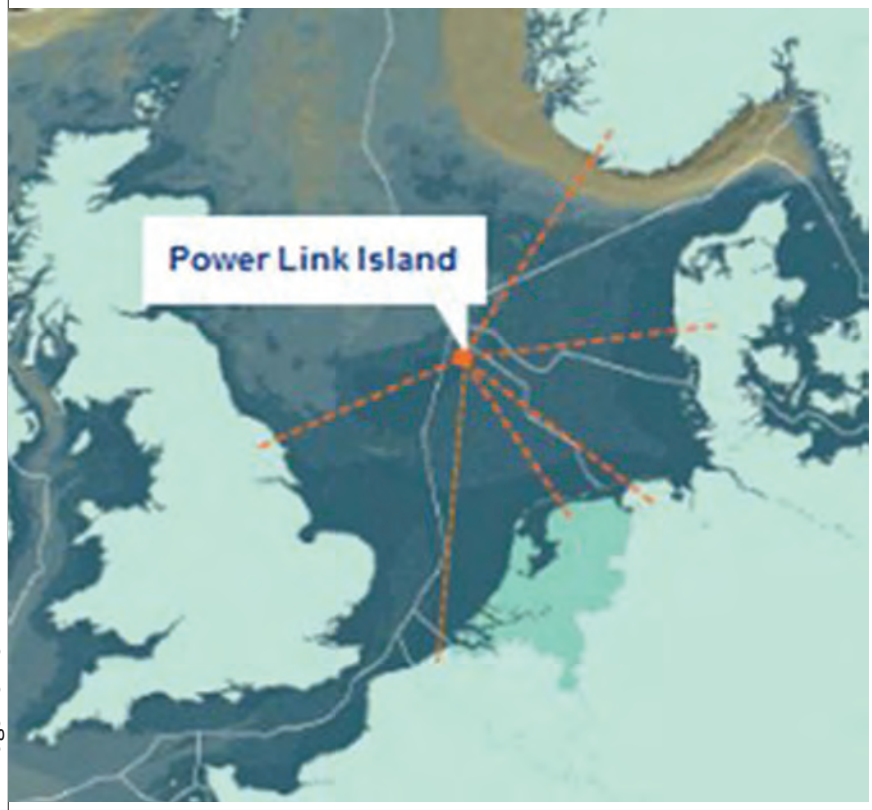


Image: TenneT

Energy Island: Europeans Mull North Sea Hub

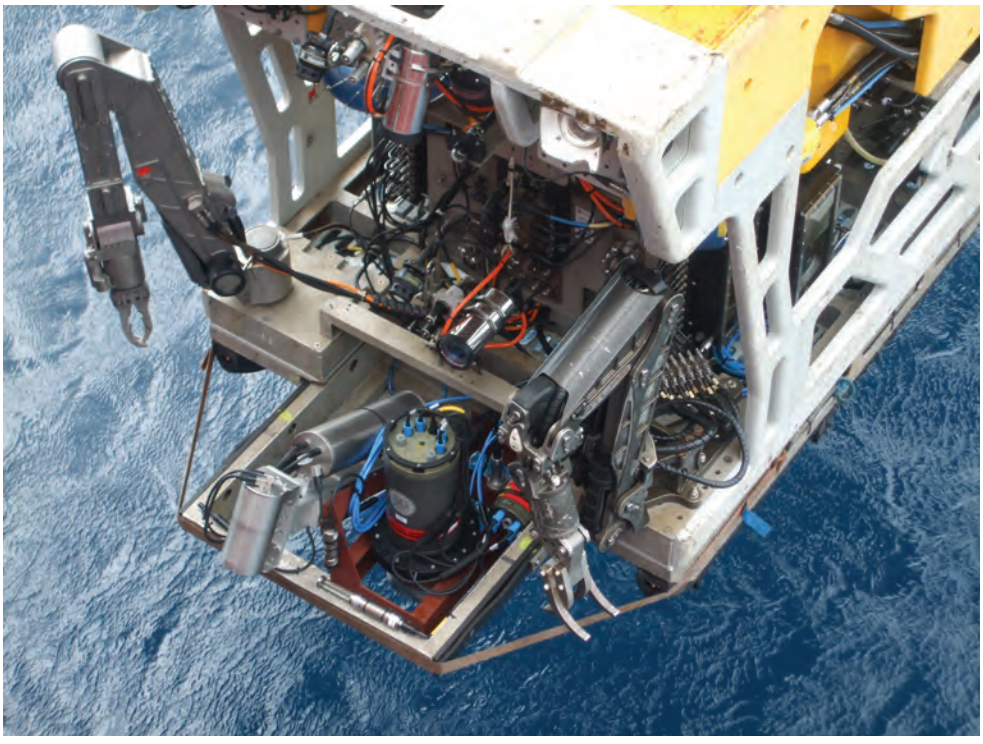
A plan set in motion by three European transmission system operators from the Netherlands, Denmark and Germany aims to develop mammoth offshore wind farm infrastructure in the North Sea supported by at least one manmade island.

http://www.marinetechnologynews.com/news/energy-island-europeans-north-548184

Dynamic Subsea Laser Mapping

A collaboration agreement between 2G Robotics Inc. and Sonardyne International Ltd, UK. will see the two subsea technology companies work together on the development and promotion of a dynamic underwater laser mapping solution which reduces the time needed to survey seafloor sites and offshore structures.

http://www.marinetechnologynews.com/news/partners-developing-dynamic-subsea-548189



(Photo: Sonardyne)

Best choice ever

for underwater tasks everywhere
the future is electric

WORLD LEADER IN UNDERWATER e-ROBOTIC SYSTEMS

SAAB

SAAB SEAEYE

THE FUTURE IS ELECTRIC

... In case you missed it, highlights from marinetechnologynews.com and the Marine Technology Reporter ENews ...

U.S. Navy photo courtesy Huntington Ingalls Industries by Ashley Major

USN Christens Indiana

The U.S. Navy christened its newest Virginia-class fast attack submarine, the future USS Indiana (SSN 789), during an April 29 ceremony at Huntington Ingalls Shipyard in Newport News, Va. Vice President Mike Pence, who previously served as the 50th governor of Indiana, delivered the ceremony's principal address.

http://www.marinetechnologynews.com/news/christens-submarine-indiana-547881

Invasive Seaweed

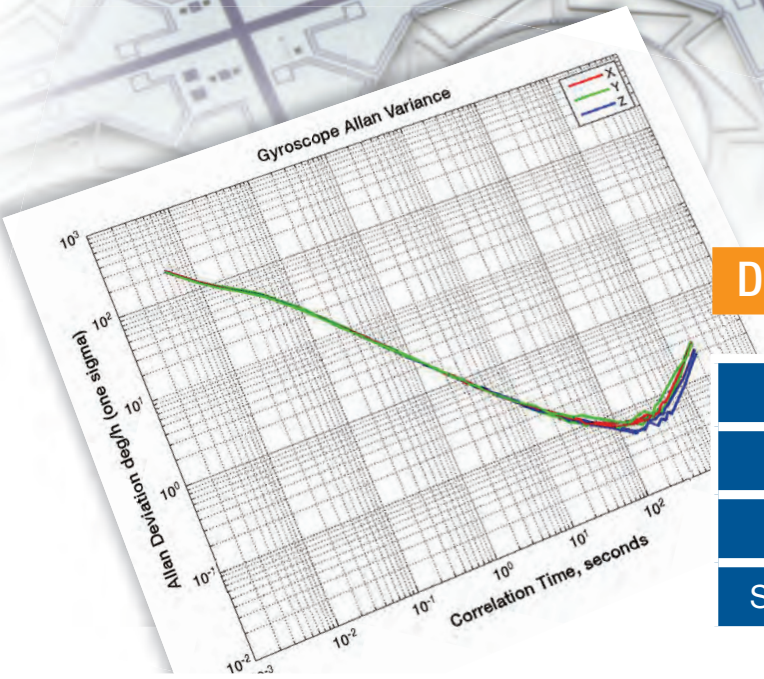
Researchers at the University of New Hampshire looked at seaweed populations over the last 30 years in the Southwestern Gulf of Maine and found the once predominant and towering kelp seaweed beds are declining and more invasive, shrub-like species have taken their place, altering the look of the ocean floor and the base of the marine food chain.
http://www.marinetechnology-news.com/news/habitats-altered-invasive-seaweed-548039

(Photo: Kristen Mello/UNH)

DMU30 Precision MEMS IMU

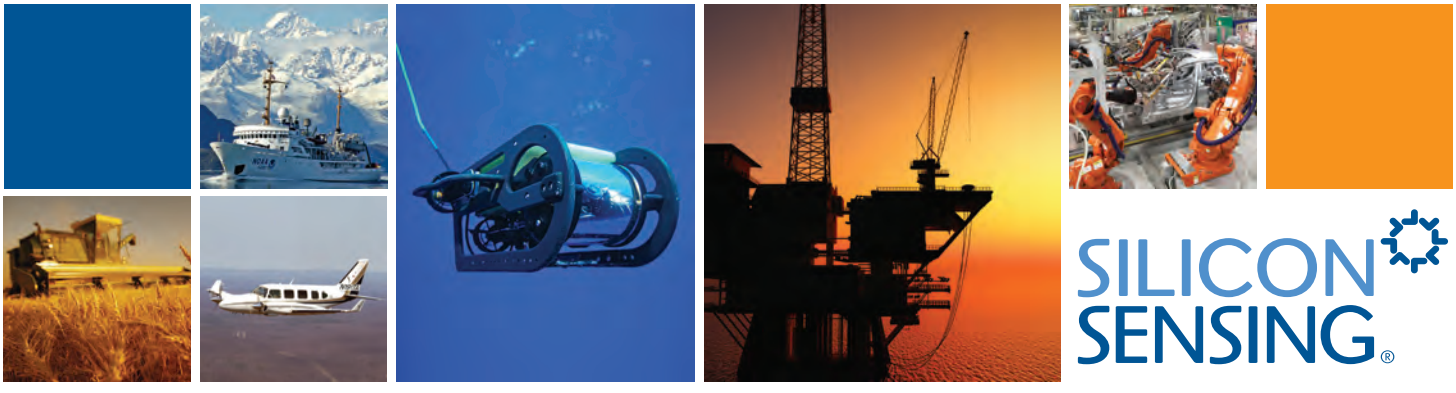
...FOG IMU performance, not price

- Proven MEMS Technology
- Non-ITAR
- Multi-MEMS Blending
- OEM & Custom Solutions
- 'Tactical Grade' Precision



DMU30

Bias Instability	0.1°/hr	15µg
Random Walk	0.02°/√hr	0.05m/s/√hr
Scale Factor	250ppm	250ppm
Size - Mass - Power	270cm³ - 300g - 3W	



SILICON SENSING®

www.siliconsensing.com sales@siliconsensing.com

People & Companies


Halliburton

Jeff Miller


Halliburton

Dave Lesar


Bibby Offshore

Dorothy Shepherd

Halliburton Taps Miller as CEO

Halliburton Company has promoted president and board member Jeff Miller to the position of president and CEO, succeeding Dave Lesar, who has led Halliburton as chairman and CEO since 2000. Lesar will stay with the company as executive chairman.

Angelle New Director of BSEE

Former Louisiana state official Scott A. Angelle will head-up the U.S. Bureau of Safety and Environmental Enforcement (BSEE), part of the Department of the Interior. He assumed his new position May 23, becoming the fourth director in BSEE's history. Angelle, who most recently served as Vice Chairman of the Louisiana Public Service Commission, has held numerous positions in Louisiana State and Parish governments, including Interim Lieutenant Governor, Secretary of the Louisiana Department of Natural Resources and St. Martin Parish President.

Shepherd Joins Bibby Offshore

Bibby Offshore has appointed Dorothy Shepherd as general manager, renewables. The position includes supporting new and existing business development and tendering efforts, while collaborating with Bibby Offshore's sister companies Bibby Marine Services and Bibby HydroMap. Shepherd brings more than 15 years' experience in the energy industry, having spent a significant time at The Crown Estate.

FairfieldNodal Hire Two

Brian Adams and Andrew Lewis have joined FairfieldNodal as the company continues to focus on growing its data processing technology portfolio and service offerings. Adams assumes the role of technical sales manager, Fairfield Seismic Technologies, tasked with growing FairfieldNodal's data processing business with an expanded technical portfolio in the Permian Basin and Gulf of Mexico. Lewis joins FairfieldNodal as manager of reservoir services, Fairfield Seismic Technologies. Reservoir characterization will be a new service offered to FairfieldNodal customers.

Mathewson Joins FarSounder

FarSounder, Inc. has hired Michael Mathewson in a newly-created position of director of global sales. Mathewson, a mechanical engineer by training with expertise in marine science, technology and engineering, is charged with continuing the company's growth in the global market.

ThunderFish AUV Program Gets $745,000 Boost

Kraken Sonar Inc. wholly-owned subsidiary Kraken Sonar Systems Inc. received a $745,950 contribution from the Research & Development Corporation (RDC) of Newfoundland and Labrador to support development of its ThunderFish autonomous underwater vehicle (AUV) program.

The ThunderFish program will combine smart sonar, laser and optical sensors, advanced pressure tolerant battery and thruster technologies and artificial intelligence algorithms integrated onboard a 6,000 meter depth rated AUV.

RDC is a provincial Crown corporation responsible for improving Newfoundland and Labrador's research and development (R&D) performance. RDC works with R&D stakeholders


Kraken Sonar

Kraken ThunderFish

including business, academia and government agencies and departments to make strategic investments in highly qualified people, R&D infrastructure and innovative research.

Kraken Invests in German Subsea Components Firm

Kraken Sonar Inc. acquired a minority interest in ENITECH Subsea GmbH, renamed Kraken Power GmbH, a provider of specialized deep sea components for underwater robotics based in Rostock, Germany.

Kraken Power GmbH, led by Dr. Carl Thiede, has been working on pressure tolerant technology and products for the subsea market for the past 10 years and is a specialist in deep-sea components for autonomous underwater vehicles (AUVs) and remotely operated vehicles (ROVs).

Under the agreement, Kraken has taken a 19.9 percent equity interest and provided a $124,000 convertible loan. The loan pays interest at five percent per annum and has a term of three years. Through the conversion of the loan to equity and a further investment capped at $225,000, Kraken can choose to increase its ownership stake to 75 percent of the common shares of Kraken Power GmbH.

"Kraken Power represents our third significant German technology partnership in 2017. With the establishment of Kraken Robotik GmbH and a strategic partnering and licensing agreement with Fraunhofer, Kraken Power represents key additional component capabilities," said Karl Kenny, CEO. "As we execute our 'Sensors to Systems' strategy, Kraken now has key sensor, software and component technologies in place to be a vertically integrated supplier of high performance, differentiated AUVs and other underwater vehicles."

Klein Hires Dentzman

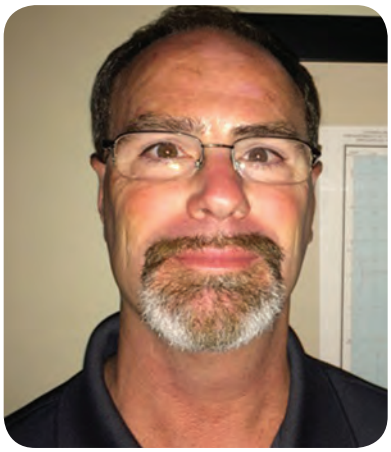
Richard Dentzman has joined Klein Marine Systems, Inc. as regional sales manager, contributing to Klein's market share expansion and new product introduction, as well as strengthening cooperation with customers.

Dentzman is a U.S. submarine veteran and has experience with sonar manufacturers. He has more than 20 years of surveying experience and his background includes work in numerous offshore research diving, acoustic subsea mapping and maritime security programs. Throughout his career, Dentzman has developed markets for a variety of underwater mapping and navigation systems.

Guo Joins AML Oceanographic

AML Oceanographic has hired Jackie Guo as sales manager for the Asia Pacific region. Working out of AML's

People & Companies



Klein Marine Systems

Richard Dentzman

AML Oceanographic

Jackie Guo

BIRNS

Rayna Kanapuram & Eric Birns

Nova Scotia location, Guo brings to the role over 10 years' experience working with private, government and higher education sectors in China and Canada.

Teledyne Marine Technology Workshop: Call for Speakers

Teledyne Marine has issued a call for speakers for its joint Teledyne Marine Technology Workshop (TMTW) to be hosted in San Diego, October 15-18, 2017. Building upon the group's 2015 inaugural event, Teledyne Marine's 23 brands will once again join forces to host an expanded users' conference in which users from around the globe will converge to explore, learn and share their experience on a broad range of applications and technologies.

BIRNS Awards Scholarship

BIRNS, Inc. has awarded its annual Debra K. Geist Memorial Scholarship to Rayna Kanapuram, a senior at Newbury Park High School in California. Kanapurum is a National AP Scholar and a National Merit Scholar finalist, with a black belt from the International Shotokan Karate Federation in Japan. She is the cofounder of the Girls Who Code Club, teaching high school girls computer programming with her own curriculum. She will attend University of California, Berkeley as a Regents' and Chancellor's Scholar in the fall.

Side Scan Sonar Training

Klein Marine Systems will host a three-day side scan sonar training course, June 20-22 at the Seacoast Science Center in Rye Beach, N.H., with practical sessions on UNH Gulf Challenger, based in Newcastle, N.H. Participants will develop a thorough understanding of sonar image analysis as well as get hands-on experience with single beam sonars such as the dual-frequency Klein 4900 and the high-speed, Multi-Beam Klein 5000 V2.

Sonardyne Nav for Thai AUVs

A new autonomous underwater vehicle (AUV) being developed by a joint-research program between PTT Exploration and Production Public Company Limited (PTTEP) and Kasetsart University (KU), Bangkok, Thailand will feature marine robotics navigation technology supplied by

Teledyne Marine

Call for Speakers

Klein Marine Systems

SSS Training

Sonardyne

Sonardyne Thai AUV Program

Sonardyne Asia Pte. Ltd, of Singapore. The order for Sonardyne's SPRINT inertial navigation system (INS) and Syrinx Doppler Velocity Log (DVL) was placed by the PTTEP-KU and will be integrated on a 4,000-m rated, long endurance AUV being built for applications including pipeline maintenance and oil-spill detection.

Syrinx DVL is designed to provide tightly integrated beam-level aiding for SPRINT, even if one or two DVL beams are unavailable. It is able to operate at altitudes up to 50 percent higher than conventional 600 kHz DVLs with the high resolution performance of a 1,200 kHz DVL, all while navigating over undulating and challenging terrain of any type, Sonardyne said.

MMT Wins Pipeline Inspection

MMT Sweden won a three-year contract from Nord Stream AG to inspect both lines of the Nord Stream Pipeline running through the Baltic Sea from Russia to Germany. The external inspection will be executed in 2017 by a joint venture between MMT Sweden and Reach Subsea.

The scope of the 150-day project includes visual and instrumental inspection of the pipelines with remotely operated vehicles (ROV) over the entire length of the route. The trenched sections and cable crossings of the pipeline will also be inspected. The survey will mainly be conducted from the vessel Stril Explorer.

Roan Joins IMCA

The International Marine Contractors Association (IMCA) has appointed Eric Roan as its regulatory representative in North America. Based in Houston, Roan has worked in a variety of regulatory compliance and advocacy roles for several oil companies and drilling contractors in the U.S. Gulf of Mexico, and has over 20 years of marine and offshore oil and gas industry experience.

Axel Schmidt / Nord Stream

Stril Explorer with ROV

Subsea Consultancy: 1CS1

A newly formed subsea integrity consultancy, 1CSI (1 Consulting Subsea Integrity) has marked the launch of its business with a move into premises at the James Gregory Center in the Aberdeen Innovation Park. The company was established in April by CEO Matthew Kennedy and COO


IMCA

Eric Roan


1CS1

Aleksandra Tomaszek & Matthew Kennedy


Heriot-Watt University

Professor John Underhill

Aleksandra Tomaszek. Kennedy holds over 30 years of experience within the nuclear, renewable and subsea integrity industries, and Tomaszek has worked in the oil and gas sector since 2011.

Industry Funding to Boost UK Offshore O&G Research

A major funding package for the Institute of Petroleum Engineering (IPE) at Heriot-Watt University will support research and training for the future of the U.K. offshore industry. Heriot-Watt's chief scientist Professor John Underhill has secured $537,000 in funding from Verus Petroleum, an oil company active on the U.K. Continental Shelf (UKCS). The award will support a number of oil and gas related training and applied geoscience research activities in IPE including the NERC Center for Doctoral Training (CDT), the Ogilvie-Gordon 3D Audio-Visualization Center (OGAVC) and UKCS and Frontier Basins PhD research activities.

Fugro Begins Survey

Fugro has commenced a hydrographic survey encompassing an area of Norwegian waters of approximately 15,000 square kilometers.

The $4 million contract awarded by the Norwegian Hydrographic Service is part of the MAREANO program, for which Fugro has completed a number of surveys since 2006. The program maps depth and topography, sediment composition, contaminants, biotopes and habitats. It takes place in the Barents Sea with various areas located above the 78th parallel and typical water depths ranging from 80 to 3,500 meters. The main workscope comprises the collection of high resolution and density multibeam echo sounder data meeting standards set by the International Hydrographic Organization. Fugro will acquire a range of data including bathymetry, backscatter and water column imaging, together with sub-bottom and gravimetry data.

STR Doubles Order

Having recently ordered its first Nexus 2 USBL system, Subsea Technology and Rentals Ltd (STR) has subsequently presented Applied Acoustics with a


Fugro

MV Fugro Helmert

Nexus 2


Applied Acoustics

Photo: Teledyne Webb Research

Slocum Glider

second order, doubling its requirement for the tracking systems.

Nexus 2 is the second generation two-way digital system designed and produced by the U.K. headquartered company.

M² Subsea, Frontera Join Forces in the GoM

M² Subsea has joined forces with Frontera Offshore to deliver remedial pipeline work for Permaducto, a subsidiary of Grupo Protexa, in the Ku-Maloob-Zaap (KMZ) oilfield in the Bay of Campeche, 65 miles north east of Cuidad del Carmen, Mexico. This contract also marks the first award for M² Subsea in the Gulf of Mexico region. The project will see personnel from M² Subsea's Houston base on-board Frontera Offshore's chartered multi-purpose support vessel (MPSV) Tehuana, to facilitate pre and post lay surveys for Frontera Offshore.

Slocum Glider Delivered

Teledyne Webb Research recently sold and delivered a Slocum Glider to The University of California, Davis.

After its maiden flight in Antarctica, where the vehicle was initially used to examine physical processes of ice shelves in the Western Ross Sea, the glider has now been delivered to Davis where plans are underway for its new deployment in Lake Tahoe. The glider shipped to UC Davis is equipped with a Seabird SBE pumped CTD, Wetlabs FLBBCD sensor and two customer supplied sensors including an Aanderraa oxygen optode and a sonotronics fish pinger.

M² Subsea

The MPSV Tehuana

Ocean Infinity Buys Two HUGIN 6000 AUVs

Ocean Infinity has purchased two more autonomous underwater vehicles (AUV) from Kongsberg Maritime, expanding its fleet of HUGIN 6000 AUVs from six to eight vehicles.

The AUVs will be used worldwide to collect high resolution seabed data for clients. The fleet of AUVs will be operated simultaneously, each AUV programmed with an independent mission plan.

STATOIL

Digitalization is Driving Value Creation

Eldar Sætre, CEO, Statoil

While there is much chatter in the maritime, offshore energy and subsea worlds regarding the move toward "digitalization," Norway's oil major Statoil is moving full speed ahead, recently announcing its plans to establish a digital center of excellence and launching a roadmap with seven specific programs for digitalization in the company toward 2020. In total the company expects to invest $120 to $240 million in new digital technologies, accelerating the digital roadmap work.

"Aiming to be a global digital leader within our core areas, we are now stepping up our efforts to capture opportunities provided by the rapid development within digital technologies," said Eldar Sætre, Statoil's CEO.

The oil industry is already extensively using IT technology and digitalization, but the rapid technological development creates new opportunities, particularly within the following areas:

- **Digitalization of Work Processes**
- **Advanced Data Analytics:** Improving the understanding of extensive and complex data for better decision-making by means of advanced data analytics and machine learning.
- **Robotics and Remote Control:** Increasing the operational regularity, reducing costs and improving safety and security by reducing human activity in physically intensive activities. Examples of this are robotic drilling and automated installations.

Digital Center of Excellence

Statoil is establishing a digital center of excellence that will coordinate and manage the digitalization efforts across the company. The center of excellence will collaborate with external specialist communities, have dedicated units for data analytics, machine learning and artificial intelligence, as well as leaders for digital programs. Statoil will recruit candidates for the center of excellence both internally and externally, and the leader will report to Statoil's chief operating officer.

Photo: Ole Jørgen Bratland

7 Programs for Digitalization

1. **Digital safety, security and sustainability:** Using data to reduce safety risks, improve learning from historical incidents, strengthen security and reduce the carbon footprint of our operations.
2. **Process digitalization:** Streamlining of work processes and reduction of manual input across the value chain.
3. **Subsurface analytics:** Improving data accessibility and analytical tools for subsurface data, enabling better decision-making.
4. **Next generation well delivery:** Enhancing utilization of well and subsurface data for planning, real-time analytics and increased automation.
5. **Field of the future:** Smart design and concept selection by maximizing the use of available data, and integrating digital technologies in future fields.
6. **Data-driven operations:** Using data to maximize asset value through production optimization and maintenance improvements.
7. **Commercial insights:** Improving analytical tools and data accessibility within our commercial areas to enable better decision-making.

Photo: Apium

The Apium Data Diver

The Data Diver is a new type of vehicle: a hand launched gps enabled boat that doubles as a motorized profiling system. With only two moving parts, the vehicles travel at up to 4 knots, reversing motor direction to dive vertically up to 100 meters. Apium developed these vehicles to study swarm control algorithms to perfect the simple and intuitive control of groups. With this swarming ability and the company's rugged "drive and dive" vehicle architecture, new types of distributed data collection are possible. Apium is currently developing a product based upon this technology, with standard versions integrating commercial sensors to potentially include depth, temperature, conductivity, sound velocity and dissolved oxygen, as well as fluorometers, hydrophones and sonars.

The prototype vehicles last 1-2 hours on a typical deployment, and measure temperature and depth. Their low profile and high speed let them station keep in surf-zone environments. The version currently in development is targeting an operational endurance in the range of 8-12 hours, with top speeds of 6-8 knots and a maximum depth rating of 250 meters – all in a package that weighs less than 10 lbs and is easy to ship or carry-on when traveling. Apium transports the current prototype in boxes of 10 units, which double as launching containers for rapid deployment.

The unique size and low cost of the vehicle is made possible by the motor technology developed and supplied by Blue Robotics. Additionally, the vehicles use a wireless inductive charging system provided by WiBotic that lets them charge at a rate of 50 watts. The advent of such inexpensive and capable technologies is fostering a revolution in low cost marine systems. As the company continues to refine its prototype for commercial usage, Apium said it is open to considering application ideas and associated requirements. Partnering for system use-case demonstrations is also possible. Additionally, Apium's work on swarm control is available for licensing on third party vehicle platforms, enabling unique applications with on-the-fly behavioral planning at sea and in the air.

Photo: Riegl

Meet the BathyCopter

The BathyCopter is a sUAV-based LiDAR surveying system for bathymetric applications, suited for generating profiles of inland water bodies. The platform design of Riegl's remotely piloted RiCopter integrates the new Riegl BDF-1, a bathymetric depth finder comprising a tilt compensation, an IMU/GNSS unit with antenna, a control unit and up to two external digital cameras. The Riegl BDF-1 can be supplemented, as an option, with a miniVUX-1UAV. Typical applications include the generation of profiles of inland water bodies, repeated survey of water reservoirs, canal surveying, landscaping and surveys for planning and hydraulic engineering work. The Riegle BDF-1 is a laser range finder specifically designed for bathymetric surveying tasks. The compact device is suited for generating profiles of inland water bodies when operated from a UAV. The topo-bathymetric depth finder is comprised of a tilt compensator, an IMU/GNSS unit with antenna and a control unit. In addition, it can be equipped with up to two external digital cameras.

BathyCopter Specifications

Laser class:	Class 2M
Operating flight altitude:	10-40m AWSL (above water surface level)
Flight endurance:	up to 30 minutes
Measurement direction:	Downward looking, 15 degrees off nadir
Active pitch compensation:	24 degrees range
Achievable Secchi Depth vs. Measurement Rate:	1.0 @ 4,000 meas./sec (single pulse), 1.2 @ 400 meas./sec. (10 pulses averaged), 1.5 @ 40 meas./sec. (100 pulses averaged)
Integrated camera:	Sony Alpha 6000
IMU/GNSS unit:	Applanix APX-15 UAV
Operation Temperature:	+10C up to +40C
Transportation case:	1,220 x 810 x 540 mm

www.riegl.com / www.ricopter.com

Topaz Resolve Goes to Work

Photo: Topaz Energy & Marine

Topaz Energy and Marine said its MPSV Topaz Resolve has commenced a charter in support of geophysical and geotechnical survey operations in the Mediterranean Sea for a European oil major. Topaz Resolve is operating from Limassol, Cyprus for an initial period of one month.

The vessel is a multifunctional ROV, dive and survey vessel and is equipped for deep and shallow water operations, in DP2 or by four-point mooring. The 50-meter vessel was built in late 2015 and is equipped with a 25-metric-ton offshore subsea crane.

Photo: NOC

Hill

At the National Oceanography Center (NOC) in Southampton, U.K. for Ocean Business 2017, Marine Technology Reporter *was able to sit down with Professor Ed Hill, NOC Executive Director, to discuss the science and technologies moving ocean studies forward.*

By Greg Trauthwein

Please give an overview of your activities here at the National Oceanography Center.

The National Oceanography Center is part of the Natural Environment Research Council which is the main body that funds environmental science, including oceanography, in the U.K. We are a national facility. We undertake research in large-scale oceanography, everything from physics and climate through to ocean biology through to sea floor processes, with a big program in marine technology development and innovation. We also run major national infrastructure like our global class research ships, the Discovery and James Cook, as well as the National Oceanographic Data Center. So we're an asset here to do great science but also to enable the whole of the U.K science community based in universities to be able to do big ocean science, as well.

Obviously, the ocean is very near and dear to your heart. But from your point of view, why study the oceans?

There are really three big challenges facing society. By 2050 there are going to be 9 billion people living on earth, and 70 percent of them will be living within 70 km of the coast in low-lying coastal regions and megacities around the world. And so that sparks three big issues: first, how are we going to feed 9 billion people, where are we going to get clean supplies of energy to power our economies, where are we going to get the strategic minerals that we need in the future, and the new medicines that we're going to need to combat disease? We are looking to the ocean for the solution to many of those questions, and we need to be able to exploit those resources in a sustainable way such that the oceans' future productive capacity and the ability to continue to supply resources is as good tomorrow as it is today. So that's the first big challenge.

The second one is most of those 9 billion people are going to be living in low-lying coastal regions and vulnerable to coastal flooding, which is the biggest natural disaster risk that faces most people across the world. Here in Britain, our biggest natural disaster risk is storm surge flooding and our capital city, which is very low-lying and very vulnerable to coastal flooding.

And then the final challenge is how do we make sense of

The OECD produced a report in 2016 that forecast the ocean economy would grow from $1.5 trillion a year to **$3 trillion a year by 2030**

a lot of really big changes that are happening across the globe, whether that be the change in variability in our weather and climate, right through to there is a major loss of biodiversity happening across the planet, both on land and in the ocean.

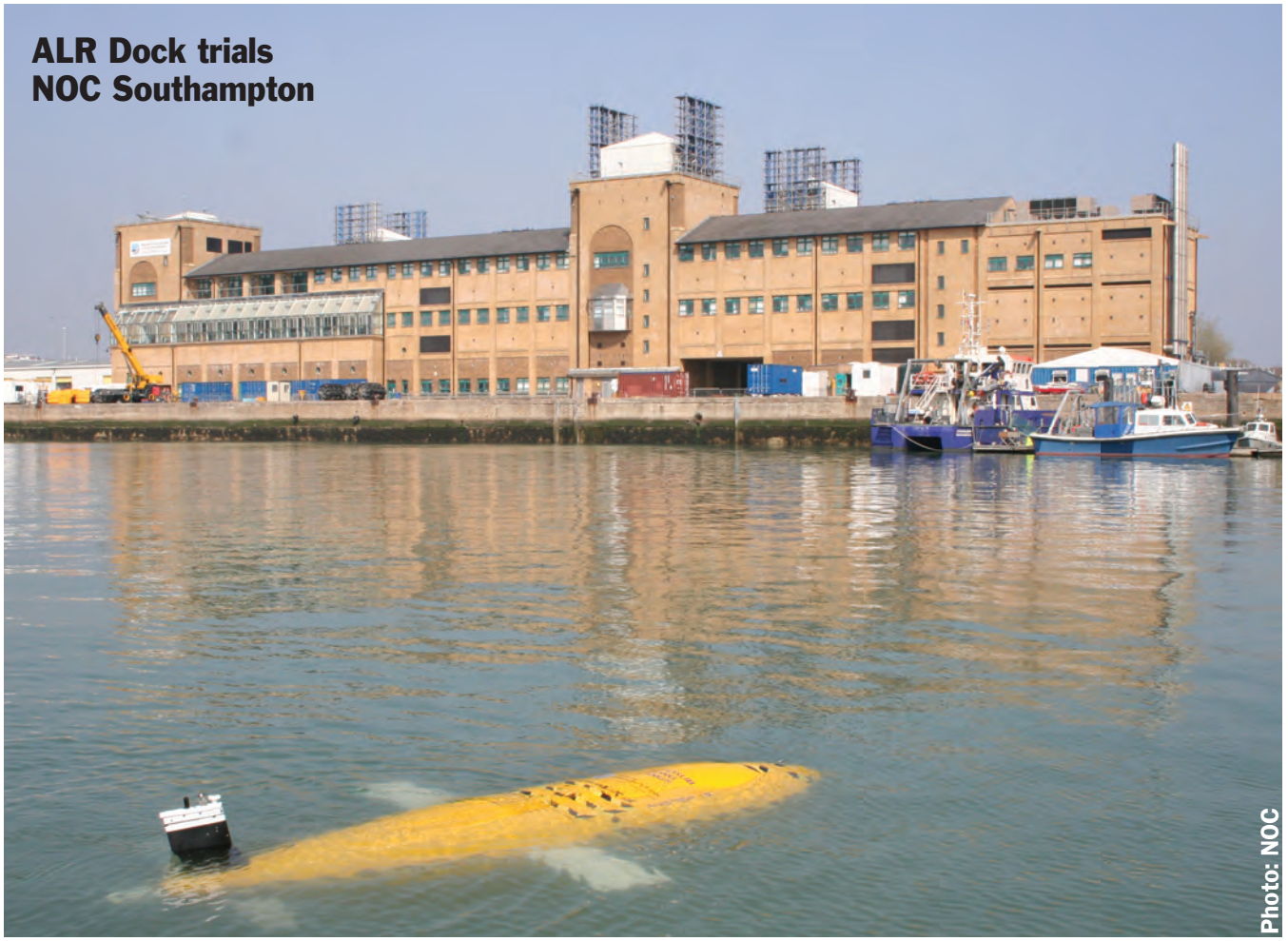
If we want to make sense of any of this global change, we've got to make sense of the ocean. And despite all of this and its importance, we know more about the surface of the moon and Mars and even the planet Pluto, it has to be said, than we do about our own ocean. So there's a lot to find out.

How long have you been involved in this industry, and what got you interested in the oceans to begin with?

I started off like many oceanographers: in a completely different discipline. I'm an applied mathematician and that's how I started. I was always interested in the sea since I was brought up by the sea when I was a kid. I became interested in fluid dynamics and then realized the ocean was a great place for that. I've been running research institutes for nearly 20 years, first a small institution, and then I had the privilege to be in charge of the U.K.'s National Oceanography Center.

What do you consider to be your greatest challenge in keeping the activities of the NOC moving forward?

Well, like every oceanographic institution in the world,



everyone will tell you they don't have enough money or resources. The challenges in front of us are enormous, and that means we are continually looking for resources. Here in the National Oceanography Center we're certainly looking to diversify the opportunities to maintain the capability that you need to do really big science. And there are half a dozen institutes around the world with this scale and capable of doing it. So that's a big issue.

The ways of going about that, though, are common because we have huge opportunities. For example, the OECD produced a report in 2016 that forecast the ocean economy would grow from $1.5 trillion a year to $3 trillion a year by 2030. That's a doubling and it's certainly a much higher growth rate than the average growth rate of the global economy. There are huge opportunities in the ocean, an we are moving ever deeper into the ocean to meet these challenges. So, actually, there is a much wider range of customers and users interested in the science that we are doing and the technologies that we are generating. So I think that's the first challenge, is to engage in the right way with those people.

The other big challenge that we have is that no one institute, no one country can do this science on their own. International cooperation is the name of the game. We are working with big institutes across the world to try to understand how we can share out the load of measuring the ocean to understand its processes and change.

We talk regularly about big data – the amount of data that is being collected, and turning that data into useable information. Can you put in perspective the challenge that you see surrounding big data?

Historically oceanography's problem is that it didn't have enough data. Since 2000, with the advent of the Argo Float Program, we've been on the journey of being able to make more measurements in the ocean. Last year, I think we completed the millionth Argo Float profile. More data has been collected in the last 10 years than in the whole history of oceanography beforehand. So that presents new challenges and new opportunities.

Such as?

The first thing I think that is really important is to recognize that we actually are on the cusp of a technological revolution in being able to measure the ocean: a continuous presence and a much more diverse range of parameters that we're measuring. We're on the journey, and transformative

We are going to have to be much more adept at handling real-time data ... ***the whole data management problem is starting with the design of the sensor***

technologies are making that happen. I am convinced that in 10 and certainly 20 years' time the way in which we are collecting data from the ocean will be very different from today and we will have a vast volume of data. Which then brings me to the challenge that you've identified is how to manage that data and to turn it into actionable products. We are going to have to be much more adept at handling real-time data. And the sensors that we develop need to have the data management problem recognized at the outset so that they're actually collecting the metadata that goes with it and stamping it and so that the whole data management problem is starting with the design of the sensor. Then the issue is about making sure that we can put this data together from across the world's ocean. Increasingly the problems that we're dealing with are not just about the ocean itself – it's the way it couples with the atmosphere, with water coming off from the land. So we need to make data much more interoperable across the whole of the earth system.

ecoSUBm AUV developed in partnership with Planet Ocean and NOC.

Photo: NOC

How do you see this data structured for maximum impact?

This is not about taking all this data and putting it in one massive data center where we could pick it out. It's about being able to access, and discover, and search this data using Semantic Web type technologies such that we can suck out these data from the disparate places where it's held and then fuse them together. And then there's the issue of how is that data actually turned into the things that people want to use, which is about engaging and finding common languages with the users – whether they be in the business sector or in government – as to what is really needed so that we can turn those raw data into really usable products. The real secret of this is actually not about pushing data out. It's about enabling the relevant users to access, to be able to discover and pull out the data they want, and that's a different kind of growth because many of the products that are needed will come from the users themselves, provided that they can have access to the data in ways that are searchable, which they are not at the moment in ways that they need to be. So it's turning this whole data challenge on its head in many ways.

Marine Technology TV

Photo: NOC

The previous is excerpted from a video interview recorded with Professor Hill at the National Oceanography Center in Southampton. See the full video at:
www.marinetechnologynews.com/videos/video/marine-technology-tv-interviews-noc-executive-director-ed-hill-100020

Ballast tank facilities at NOC

Photo: NOC

From the standpoint of the NOC, what are you doing to help scientists and technologists take their ideas so that they can be out in the world to "make a difference?"

Absolutely right, Greg, this is really important, to turn great science into great business innovation, to create jobs and create great businesses that can work effectively in the ocean. We have been working very hard at this in the National Oceanography Center.

The area of technology that we're particularly interested in and have great capability in is autonomous and robotic systems, both in terms of their vehicles. We started in this game about 25 years ago making deep-sea submersibles that were all autonomous, and we've done some great science with it. Many of those science and advances now have practical applications in much more mundane but very useful applications.

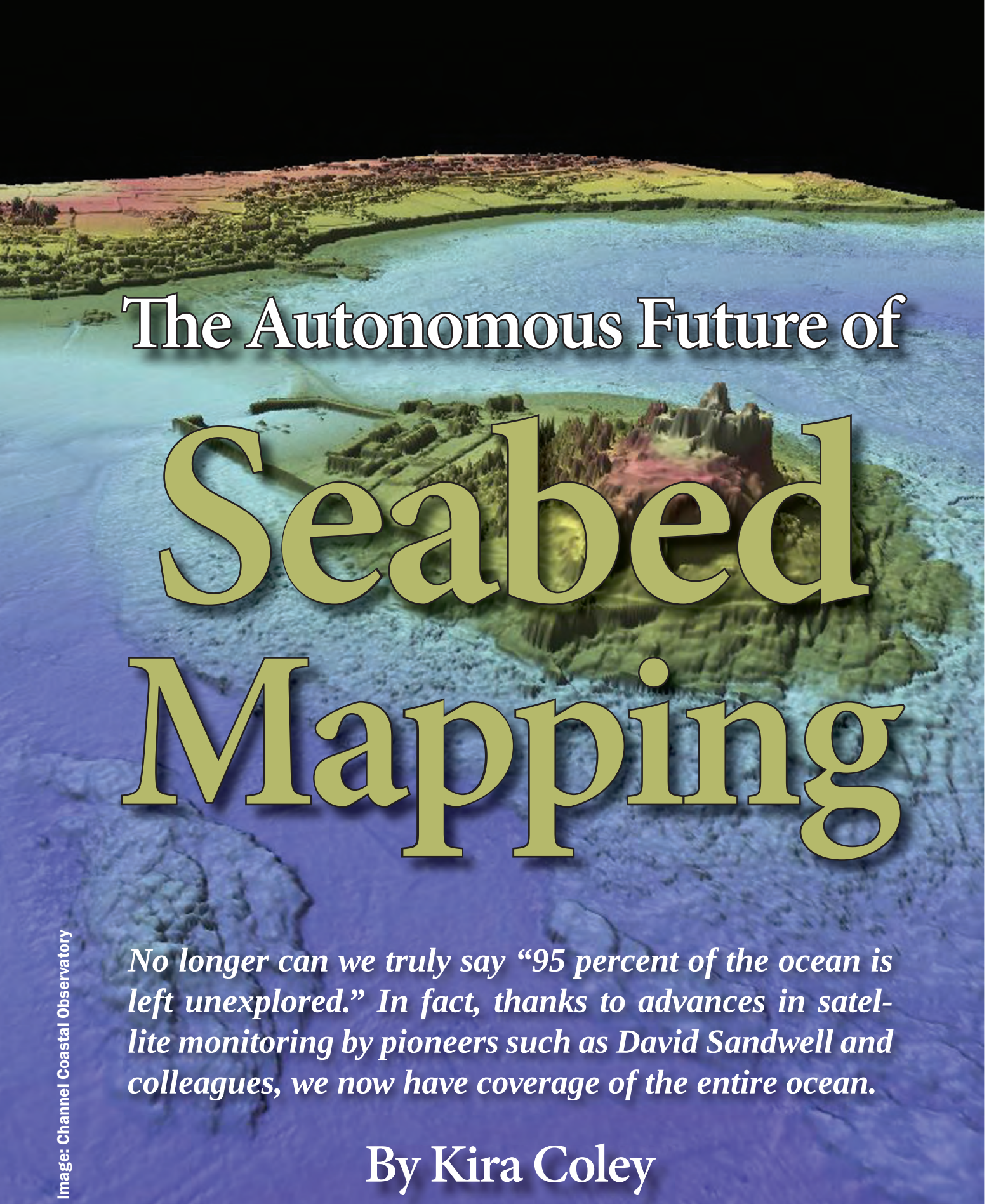
For example, we discovered the world's deepest, hottest, hydrothermal vents by sniffing out their plumes with chemical sensors on an autonomous vehicle. The same technology has got applications for sniffing out precursor chemicals from carbon-capturing storage sites subsea. Some of the technologies that we used for exploring underneath Antarctic ice shelves – where you are completely remote from the ship and you need a truly autonomous capability – are now being used in things like pipeline survey. So what we've been doing here is trying to bring small technology companies to work alongside us, companies that are interested in developing these systems and the micro sensors that you put aboard them, as well as bring in companies who are not so interested in developing the technology but want to shape the way that it evolves and are interested in using it; primarily oil and gas majors and defense companies at the moment.

Are there any tangible manifestations of this effort at the National Oceanography Center?

Eighteen months ago we opened here in Southampton a Marine Robotics Innovation Center, and we are working now with about 20 companies – large ones who are users and small companies who are working alongside us in a number of projects to develop innovative autonomous systems. It has been successful and growing, and we have many projects underway; it is a real hub for bringing all of us together: academics, the users, technology companies, as well as engaging with some of the public regulators of how this technology will be used in the ocean. We are trying to play the role of a hub to be a bridge in this innovation landscape, and we've certainly grown our engagement with small companies, actually taking some of those products to global markets right now. It's a success story, but we believe there's a lot more to be done in this space and we are very excited about it.

I can only imagine that a center of this magnitude requires continuous investment. Looking at the NOC and at investments going forward, what are your priorities? Where are you investing today for tomorrow?

The areas that we're investing in is in the technology space for two reasons. One is that will enable us to work with businesses. It's a way of diversifying our income and it's a way of demonstrating to government, who is the primary funder of oceanographic sciences, that it's worth putting public money into oceanographic sciences because we do make a real difference to businesses. Also we are investigating technologies because this is going to transform the science – the things that we need to be doing scientifically are going to be transformed by new technologies. And all the greatest discoveries in oceanography have been enabled by new technologies, so we're putting a huge emphasis on this. But our big challenge is to try to understand the way in which the earth system functions, the way in which the ocean is changing, and its variability which is causing enormous challenges and opportunities to human society – the carbon cycle, the way ecosystems are changing and the way in which the ocean processes are affecting sea level and weather. That's the science that's motivating us, but it's the technology that's enabling it, and that's where we're putting our big focus right now.



The Autonomous Future of Seabed Mapping

Image: Channel Coastal Observatory

No longer can we truly say "95 percent of the ocean is left unexplored." In fact, thanks to advances in satellite monitoring by pioneers such as David Sandwell and colleagues, we now have coverage of the entire ocean.

By Kira Coley

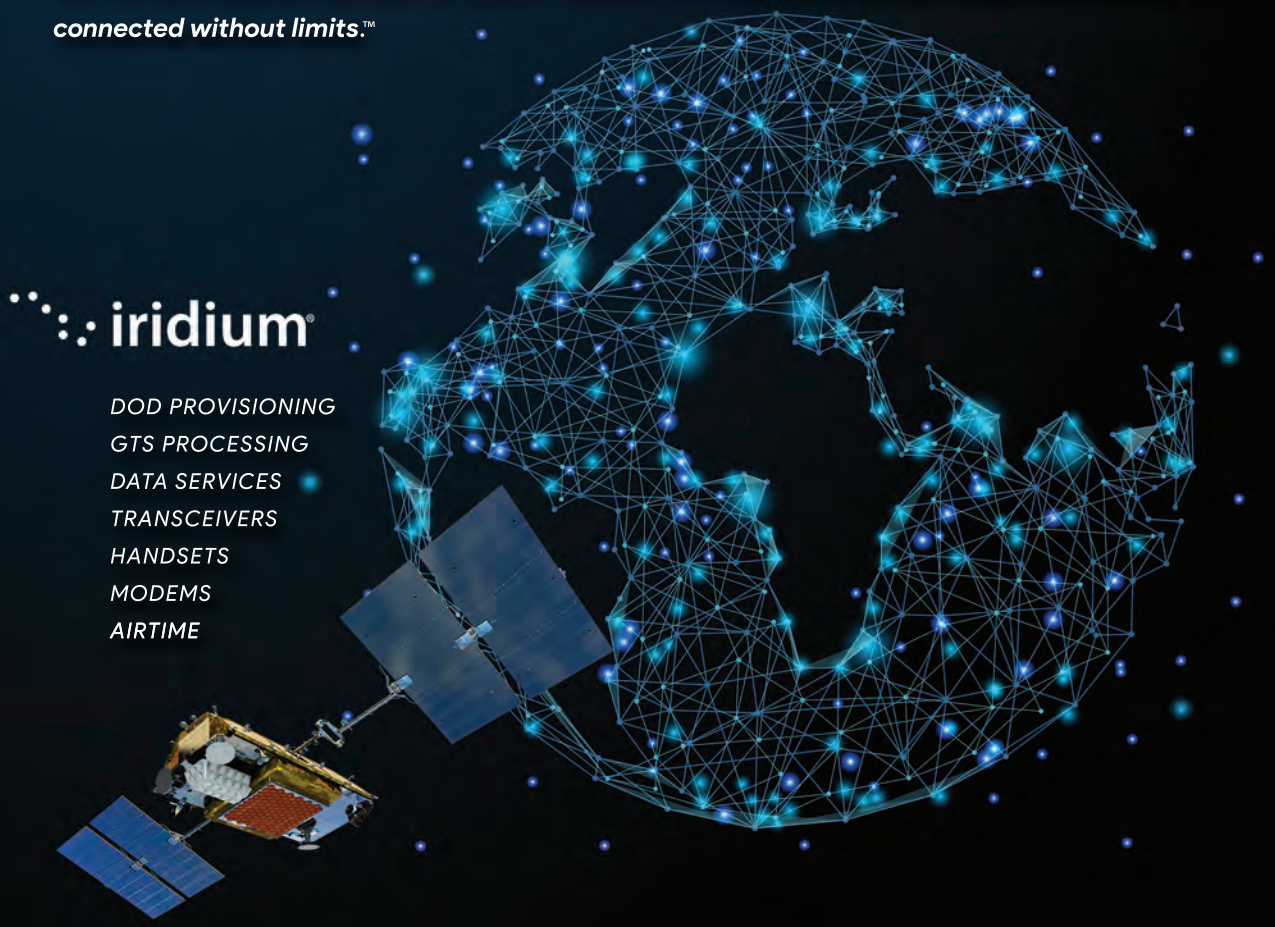
metOcean™ telematics

Connecting the oceans.
All 361,419,000 km² of them.

Only one name can connect them all—**metOcean telematics**.

Our team understands the challenges you face when integrating and deploying your device. With our broad portfolio of Iridium® products and services, we offer innovative solutions for applications ranging from AUV's and Unmanned Surface Vehicles to buoys, profilers and everything in between.

We are leading the global effort to better understand, assess, monitor and connect our planet. That's why we are the leading global provider of Iridium® satellite communications products and services that keep you ***connected without limits***.™



iridium®

DOD PROVISIONING
GTS PROCESSING
DATA SERVICES
TRANSCEIVERS
HANDSETS
MODEMS
AIRTIME

Your Worldwide Iridium® Partner of Choice iridium®

metocean.com

SeaRobotics ASV 2.5m with R2Sonic 2020 and Applanix POS MV.

While these maps are only at a resolution of around 5 kilometers – less than current global maps of Mars and Venus – it has given us submarine topography data in locations we weren't able to access previously. For us to really understand what lies under the surface, scientists must travel to the site and use acoustic techniques such as sonar and multibeam bathymetry to produce detailed maps. But, the financial and logistical obstacles to achieving this across the entire ocean have meant only around 0.5 percent of the seafloor has been mapped to the highest resolution achievable today. Now, the launch of 4D Ocean could mean the end of these barriers and the start of an autonomous, low-cost future in seabed mapping. Autonomous platforms will allow more people to access the technology and together, the opportunity to map Earth's largest ecosystem in more detail than ever before.

Over the last 15 years, the transition from the single beam to multibeam echosounders has been instrumental in the broader use of bathymetry. And, along with its associated products, backscatter and water column data, this technology has helped to drive the Blue Economy. The rapid pace of developments in this field has not only been pushed by advancements in mapping techniques but also the surge in seabed mapping projects in areas such as oil and gas exploitation, dredging, maritime construction and marine conservation.

Traditionally, small survey vessels less than 16 meters long have been used to collect multibeam data in the inshore and coastal waters, with the larger vessels operating further out. Sometimes a multi-vessel approach is used whereby a field office is a setup for the inshore vessel while the offshore vessel works 24/7. The efficiency of shallow water surveys is reduced because the swath width becomes smaller in size and, because of potential hazards, surveys are nearly always daylight operations. The inshore vessels also have to transit from the local port, sometimes adding hours each way for remote locations.

The innovative U.K. based company NetSurvey Limited helped push the boundaries of multibeam technology from its infancy to the defacto tool for seabed mapping that it is today. In 2011, the company merged with MMT Group. Now this year, NetSurvey's founder Duncan Mallace has launched 4D Ocean, an industry first company he hopes will pave the way for a next big thing in seabed mapping techniques. 4D Ocean aims to make autonomous survey the new norm for conducting seabed surveys and will provide services for hydrographic survey, coastal engineering, habitat mapping, as well as pipeline and cable surveys.

Mallace said, "I get really excited about new technology for seabed mapping. What I love most about it is taking something new and making something exceptional from it. We are unique. We don't own vessels or have a marine crew, yet operate a full hydrographic survey capability.

"The systems we use are entirely autonomous, not remote controlled, and that includes the data collection capability too, not just the guidance.

"We are passionate about all aspects of seabed mapping and about using the very best technology."

Photo: SeaRobotics

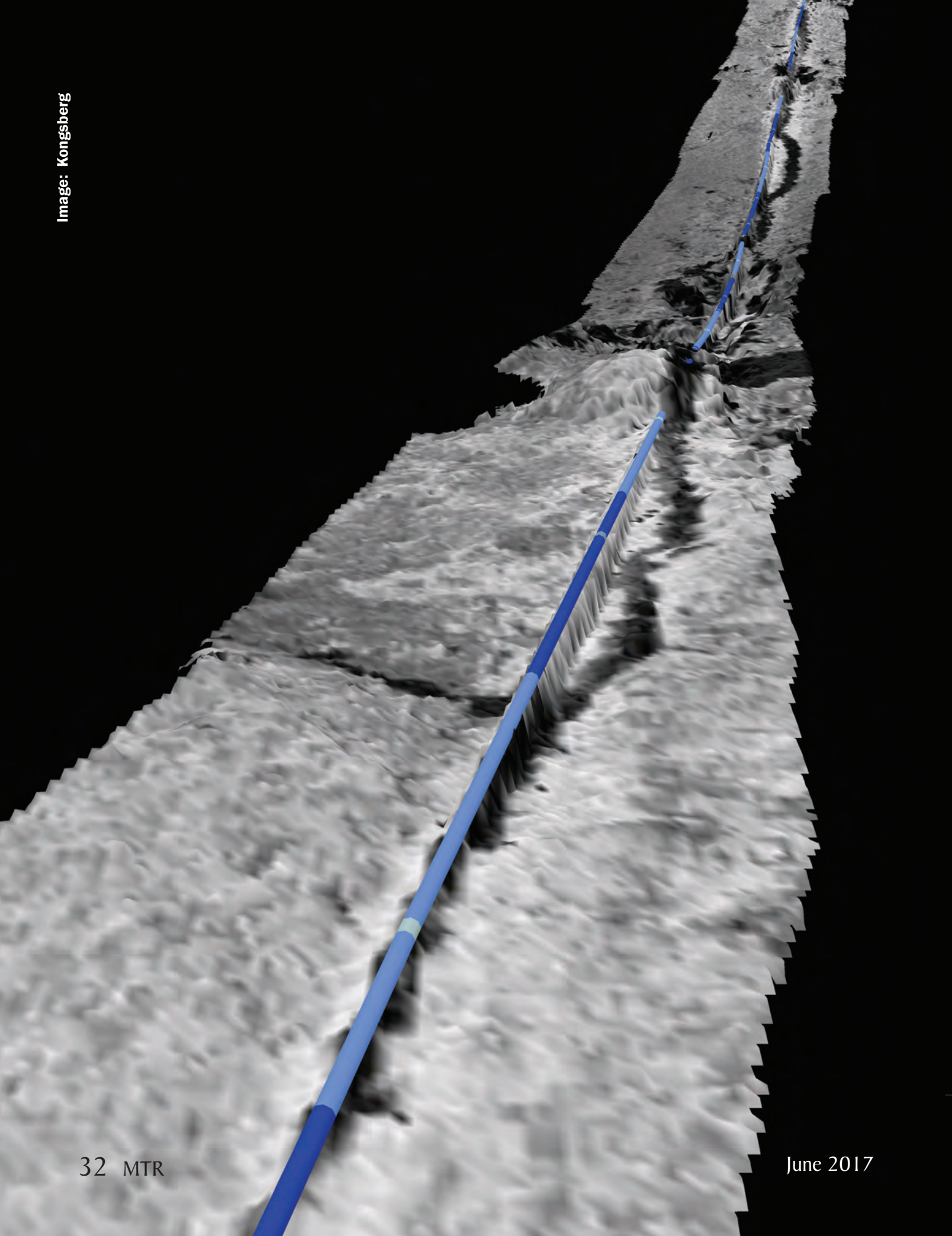


Image: Kongsberg

Autonomy in Seabed Mapping

4D Ocean believes that autonomous solutions are far more efficient than traditional methods of mapping. Autonomous surface vehicles (ASVs), unmanned aerial vehicles (UAVs) and autonomous underwater vehicles (AUVs) can be deployed from almost anywhere, with state-of-the-art guidance systems which make for better survey progress, and fewer infill lines. ASVs are not constrained by harbors, so transit times are much reduced, and all systems are battery powered, using clean and green energy.

Autonomous systems do not require ports and can also access areas which are either too hazardous or too difficult to get to, making for better coverage and safer operations. The technology is also quiet – so not only is the environment protected but the data quality is far better. As well as improvements in safety and data quality, the data can also be processed immediately, thereby spotting issues early in the project and raising the efficiency of the survey process.

"We use UAVs to map the drying areas and also to identify potential hazards for the ASV. In the future, we will also be able to use the technology in larger surveys where an offshore vessel mothership launches ASVs to survey specific areas. I believe that the swarm approach, adopted by some at the moment, isn't the one that will ultimately be used, but we are not quite there yet for giving ASVs specific areas. It won't be far off though," Mallace said.

4D Ocean will work closely with its ASV supplier SeaRobotics, multibeam sonar supplier R2Sonic, AUV and sonar supplier Kongsberg and its software providers QPS and Hypack to push the technology forward for the benefit of the seabed mapping community. The company is using the SeaRobotics USV 2.5, which is equipped with an R2Sonic 2020 multibeam sonar, Applanix Wavemaster inertial system and an autonomous SVP winch.

For coastal zones, the 4D Ocean has chosen the senseFly eBee Plus RTK. Mallace has chosen the best mapping drones in the industry which can survey for almost an hour to cover 12 square kilometers. This allows the operators to see where not to go with the ASV and also capture high-resolution imagery and topography of the land areas.

Mallace explained, "Very technical pieces of oceanographic or hydrographic equipment take a while to be adopted. First, the technology needs to develop a track record and prove that they fulfill the promise they have and show, economically, that it makes sense to adopt them. The technology has literally just arrived for full autonomous capability but it is the first stage, and I'm sure that there will be many improvements and features required. Collision avoidance and regulations need to be implemented before anyone can even think of not requiring a vessel further offshore or out of sight."

"At the early stages, companies and organizations are willing to subcontract a new technology as it de-risks them. Therefore, there is now a need for an autonomous specialist company that can provide the technology to the industry. We can combine bathymetry data collected by the ASVs with topographic data and photography compiled by the UAVs to produce stunningly accurate and complete data sets."

An Autonomous Mapping Future

Recent advancements in technology have opened the autonomous survey capability to the industry. While the technology will continue to evolve, and improve over the coming years, there will still be some challenges to overcome before 4D Ocean's new approach can be fully adopted. Mallace said, "Local regulations may slow or stop the adoption of autonomous systems at different times around the world. For instance, the FAA in the U.S., only as recently as last year, allowed commercial UAV operations. In the Middle East being able to easily use the extended Wi-Fi on the ASVs is not yet possible. So, the biggest challenges are going to be governments and their adoption of autonomous technology. We are lucky in the U.K. that the chair of the autonomous committee

is also the Deputy Director of the Navigation and Safety Branch of the MCA and is forward thinking, so I think here things will progress smoothly."

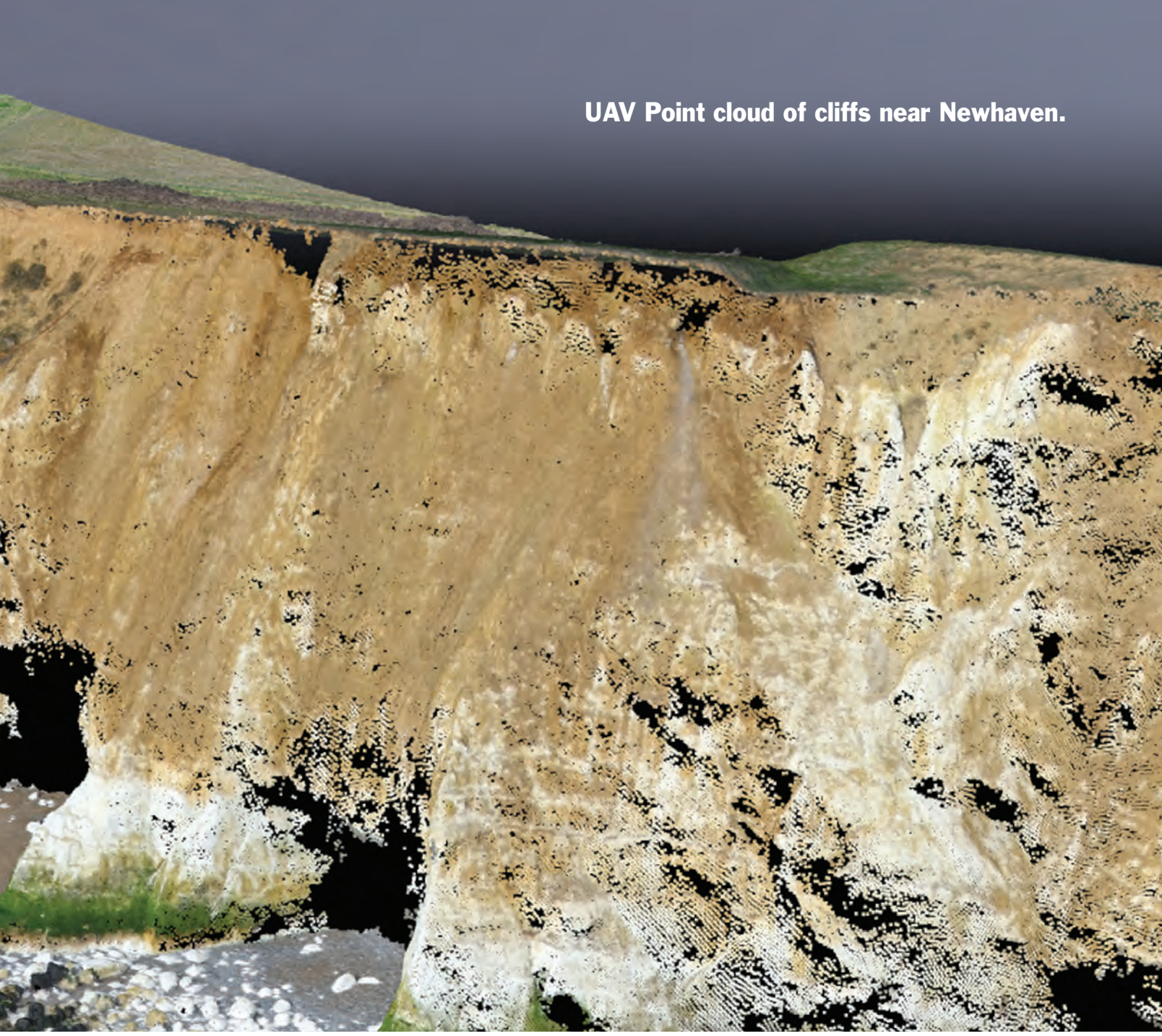
"I'm taking this year very much as a learning exercise to find the limits of the technology and to start to introduce the autonomous systems as a natural choice. Initially, the ASV usage will be in coastal, lake and river surveys, complemented by the UAVs to ensure a seamless sea and land final product. The MUNIN AUV will be tasked with pipeline and cable inspection surveys.

"It is more about using the same survey methods but with a new platform – like getting used to using an electric car instead of a petrol one."

Over the next year, 4D Ocean will test the performance of the ASV in different sea states, currents and surface winds, and have plans to map two coastal strips of England, some unchartered waters in Scotland and kelp habitats in South Africa. Mallace also intends to see if he can extract bathymetry from multi-spectral cameras mounted on the UAV in a similar way to satellite-derived bathymetry - a method which, if achievable, promises far greater resolution than satellites current capabilities.

"In five years' time, I think the coastal and inshore market will be mostly surveyed by ASVs, with larger ASVs for specific tasks offshore. In 10 years' time, we may well have serious offshore capable autonomous survey vessels for all seabed mapping tasks. The time it takes for technology to move from infancy to ubiquitous adoption is becoming smaller and smaller. I believe it won't be long until we have an autonomous future in seabed mapping, offering low-cost, economically viable solutions. This could mean even more people can access the technology and get closer to the ultimate goal: detailed maps on the world's oceans."

Acknowledgements
Duncan Mallace, Founder of 4D Ocean.



UAV Point cloud of cliffs near Newhaven.

The Introduction of the Seamless Hydrographic Workflow: Processing Evolved

By Chris Malzone & Jonathan Beaudoin, QPS Inc.

Multibeam sonar technology has seen steady advancements leading to higher quality, cleaner data. To capitalize on this technology, hydrographers are consistently adjusting their workflows to deliver detailed and accurate information in an efficient manner. Issues arise due the incorporation of a variety of software solutions within a single non-seamless (acquisition through deliverable) workflow. This often results in an accumulation of human error which leads to inaccurate final products and/or poor decisions with undesirable consequences (Beaudoin, 2017). Advancements in the hydrographic workflow by researchers and engineers at Quality Positioning Systems (QPS) have automated the mundane, human-error prone tasks and guide users through the hydrographic workflow. This workflow removes redundancy, capitalizes on advanced computing technology to provide a dynamic multidimensional user interface that allows those even with a low knowledge threshold to deliver high-quality final products.

Introduction

Beginning in the 1990s, sonar technology evolved from the analog to digital allowing users to utilize multiple datagrams inherent within multibeam mapping solutions. For example, seafloor interpretation evolved from hand-pasted sidescan mosaics with hand-contoured mylar overlays to semi-automated processing incorporating sophisticated algorithms such as CUBE (Calder, 2003) and Geocoder (Fonseca, 2005). While hydrographic hardware advancements are exponentially improving, hydrographic software data processing and their associated workflows still provide challenges for even the most experienced users. While software generally keeps pace with the advancements in hardware and processing methods, many of the frustrations are present because human operators must connect all the pieces together to come up with a final processing solution (Beaudoin, 2017). A paradigm shift is currently underway to isolate the human error in the modern day hydrographic workflow while maximizing advancements in computing technology to automate the mundane, error prone tasks.

Uncertainty

To obtain a single, accurate data point on the seafloor, you must account for: position (XY), draft, squat, load, tide, geoid model, bathy depth, node offsets, timing offsets, speed, gyro heading, vessel motion (HPR), mounting offsets, beam range, beam angle, beam width, beam steering, sound velocity at transducer head and sound velocity profile. Within the installation, uncertainty accumulates which is known as Total Propagated Uncertainty or TPU (Calder, 2007) (Fig 1). The TPU of a point is a measure for the accuracy to be expected for such a point, when all uncertainty sources are considered. The TPU can be computed statistically using the well-known Law of Uncertainty Propagation. Hence the indication propagated. The TPU value thus results from the combination of all contributing uncertainties. Hence the indication uncertainty.

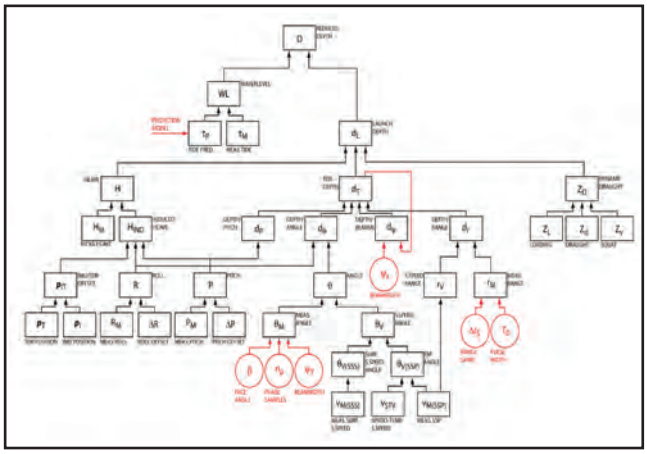


Figure 1: Data flow diagram for vertical uncertainty component of the Hare-Godin- Mayer MBES uncertainty model (Calder, 2007).

What is not considered is the human uncertainty in any given workflow. Quality controls are imposed that minimize error; however errors do occur, and their cumulative totals result in what is now referred to as human induced TPU. During acquisition, we utilize survey logs to note line

names, positions, start/stop times, features (shoals, wrecks) and unique observations that may pertain to any line. During data processing, we incorporate checklists to ensure proper application of such things as tides, sound velocity, post-processed heave, etc. The common denominator with survey logs and checklists is that they require manual (analog) input with cognitive feedback to ensure quality. Unlike systematic TPU which can be calculated human TPU is unpredictable and cannot be measured. Typical areas for Human TPU are:

- **Transcription:** There may be up to three different coordinate frame conventions that exist within a single installation spread across a minimum of eight software interfaces (Fig. 2).
- **Processing:** Failing to apply imported ancillary data
- **Reprocessing:**
  - o Changing configurations and then not triggering the appropriate reprocessing
  - o Not triggering the appropriate reprocessing for the files that need it
- **Folder Configuration**

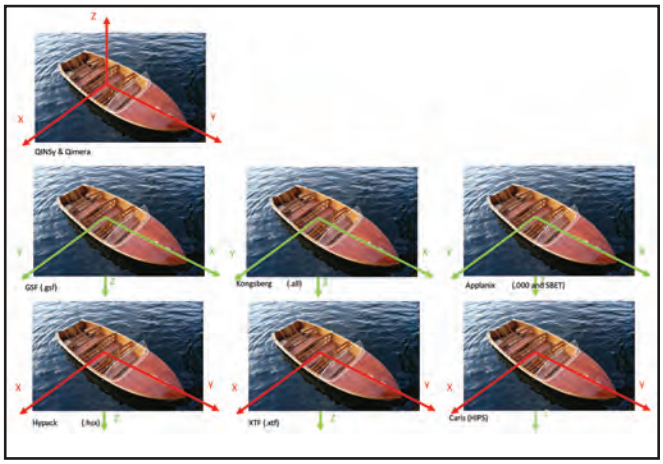


Figure 2: Sample of the variation in coordinate frames found within any given hydrographic workflow

Minimizing TPU, both systematic and human represent a logical evolution in the ocean mapping workflow.

Guiding the User

Real-Time Improvements

Standard software hydrographic software solutions are governed by menu-driven Graphical User Interface (GUI) that reference files structured through a folder organization within the computer hard drive. Current practice requires users to self-navigate themselves to construct a very specific folder structure (eg Windows Explorer) while manually linking the logging and/or processing software to these folders.

In the year 2000, QPS introduced the guided workflow to the QINSy software to assist their users in the setup process. The process includes a guided wizard based setup for project preparation, including automated folder creation; template database creation (guided geodesy, vessel setup, hardware interfacing); and online preparation, including data recording setup, pre-data filtering, calibrations and field checks.

Paradigm Shift

The production of high quality products from high-resolution data is a difficult task even for the experienced hydrographer. Despite field procedure improvements, the hydrographic workflow is complex since it requires a human to connect all the pieces to produce a final product. Following in suite with the QINSy model, QPS has evolved the guided workflow into the processing portion of the workflow. The solution is known as Qimera and represents a paradigm shift in hydrographic processing. Qimera incorporates the QINSy hydrographic engine with the Fledermaus 4D visualization and multicore processing engines to provide users with a seamless, dynamic and pleasant work environment. It performs complete hydrographic processing for most modern sonar formats (.db, .all, .s7k, .hsx, .jsf, .gsf, etc), support many ancillary formats (SBET, PosPac, most tides and SVP) and exports to a variety of formats (GSF, FAU, BAG, Arc and other image formats).

The Qimera paradigm shift is the reduction of human induced TPU. This is accomplished through automation of mundane and error prone tasks (transcription automation and processing state management) to isolate the stages for which the hydrographer is best suited. Examples of such stages include data validation, processing configuration management and trouble-shooting. To accomplish this, two types of workflows are incorporated: guided and dynamic. The guided workflow allows for non-expert users to arrive at typical bathymetric deliverables with little training or expert knowledge. The dynamic workflow is processing state management which codifies and manages the relationships between the observations and the results. You don't need to remember what processing need to be done, but rather that some processing must be done. Everybody, regardless or knowledge or experience should be able to walk away with a product.

Using What's Already There

The guided workflow within Qimera is simply a series of prompts that step the user from one stage to the next. However, the innovation lies in the background. Upon opening Qimera, a minimum of seven functions are automated. For example, creating a project establishes the file structure, organizes by file type (processed, grid, image, SVP, tide, SBET) and structures where all raw and soon-to-be processed data will be stored. Most modern file formats (.dB, .all, .s7k, .gsf)

contain all the necessary information required for processing as setup prior and during acquisition. Qimera utilizes all available information to guide the user thus eliminating the necessity of manual checklists. File import searches each format for what information exists (range, angle, motion, dynamic heave, SV, SVP, etc), catalogs it, transcribes all vessel configuration information, processing configuration and then performs the initial processing such ray tracing based on the all raw data (bathy and ancillary), etc. Following the initial automated processing, Qimera prompts you as to how you wish to create your surface. Resolution, CUBE settings and color map are presented in a simplified interface. Within five-clicks and in under 60 seconds, the user has a map and is now ready to utilize one or many of Qimera's data editing tools to clean and validate your data, apply SBET's or edit and validate both the assembled bathymetric data and the ancillary data used to calculate them.

Data validation consists of creating a loop between the observed surface and calculated results to expose errors immediately. This is referred to as live processing state management. In Qimera it is very easy to make processing configuration adjustments or to perform data validation and to immediately asses the impacts of changes. Near immediate feedback shortens the time between cause and effect while promoting causal reasoning which is a key ingredient for natural cognitive evolution. In short, it allows users to train themselves through something as simple as immediately recalculating the dynamic surface and showing the user they have accidentally deleted good data or applied the wrong SVP, etc (Fig 3). Visual feedback on cause and effect.

Scalability: Collaboration & Production Line Processing

QPS provides workflows within Qimera to that scale to multiple users contributing to an overall processing effort through cooperative cleaning and production line processing. Cooperative cleaning allows multiple users to clean a large project by dividing it into smaller, more manageable projects while also maintaining data integrity. Data processors work within their subprojects and, once complete, introduce their efforts back into the main project. In parallel, the main project may have ancillary data processing completed (eg SBET, SVP, height corrections). The edits from the subprojects may be incorporated back into the main project without impacting the overall progress of the entire project but enormously increasing efficiency.

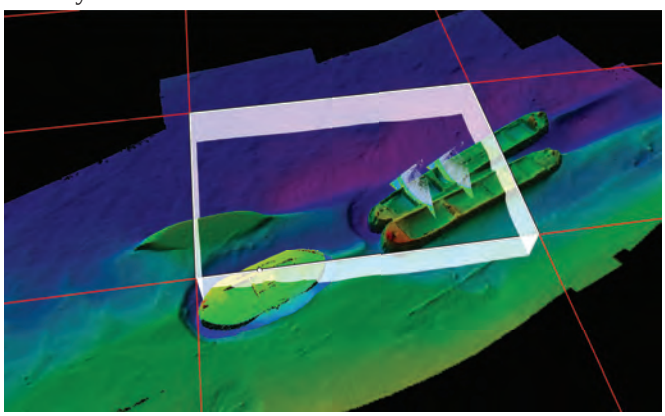


Figure 4: For cooperative multi-user cleaning, Qimera breaks up the project based on user-defined parameters. This example shows a simple grid of nine subprojects.

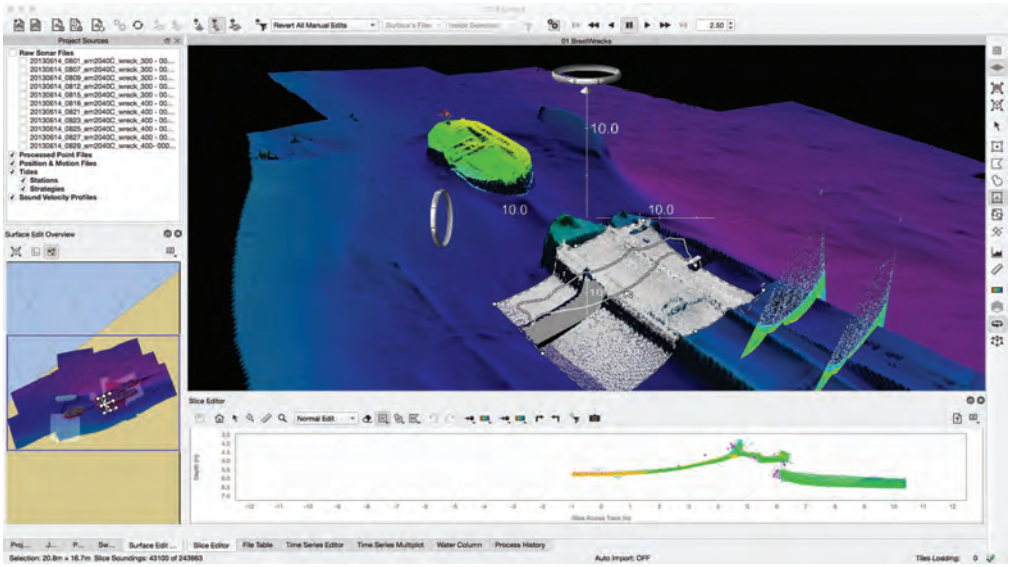


Figure 3: Typical Qimera Data Processing Environment showing a dynamic surface recently updated to show an inadvertent data edit completed within the Slice Editor.

Product line processing allows for projects to be broken down into stages. These stages can be done based on survey days, survey segments, survey vessels, etc. The processing for a stage (eg a day, vessel, segment) of data is handled in its own processing project. The processed outputs from this effort can be aggregated into a master project where it is evaluated by the senior hydrographer review. During review, the stage project may be accepted and immediately incorporated into the master projects or sent back for additional processing. This is done repeatedly and combined with other stages within the master project. The net result is the integration of multiple smaller projects processed in the exact same manner into a final deliverable.

The hydrographic workflow has evolved to provide a dynamic multi-dimensional user interface that allows those even with a low knowledge threshold to make good decisions that lead to high-end final products.

The critical component is the isolation of tasks within the workflow to capitalize on the technological advances in computing technology to automate the mundane error prone tasks to bring more value to the stages in which the human brain brings value. QPS through QINSy and Qimera innovate the user experience through several key design features including: guided workflow, transcription automation, processing state management, real-time QA, the dynamic workflow for validation, collaborative cleaning and production line processing. This reduces human error, the QA burden in general and lowers the knowledge barrier to entry.

For the hydrographic manager, the return on investment is found in lower trainings costs due to the guided workflow (easier to learn and retain knowledge), improved processing outcomes, scalability, reduced post-processing times and better results.

References

Beaudoin, Jonathan, Doucet, Moe, Advances in Hydrographic Data Processing: Time for a Paradigm Shift, U.S. Hydrographic Conference (HS Hydro), Galveston, TX, USA, March 2017.

Calder, Brian R, How to Run CUBE (with the Baseline CCOM/JHC Implementation), Internal Report, University of New Hampshire (UNH), Center for Coastal and Ocean Mapping (CCOM)/Joint Hydrographic Center (JHC), 2003.

Calder, Brian R, Wells, David, CUBE User's Manual, (Version 1.13), University of New Hampshire (UNH), Center for Coastal and Ocean Mapping (CCOM)/ Joint Hydrographic Center (JHC), 2007.

Fonseca. Luciano and Calder, Brian R, Geocoder: An Efficient Backscatter Map Constructor, U.S. Hydrographic Conference (US HYDRO). San Diego, CA, USA, pp. 0-0, 2005.

The Author

Chris Malzone is the General Manager for Quality Positioning Services, Inc. Chris has an MS in Oceanography/ Geology and has worked in hydrography and related ocean sciences since 1992 in a variety of roles ranging from Scientist to Hydrographer to General Manager.

Custom Cables from Novacavi

Novacavi released its new P_22SSA ruggedized custom cable to support marine environmental monitoring activity. This electro-optical-mechanical custom cable enriches the manufacturer's diverse production range of subsea armored cable for detection and instrumentation in defense and environmental monitoring applications. Key advantages of this armored halogen free low smoke cable are high working load performance, protection against electromagnetic interference, compactness and versatility.

www.novacavi.it

Novacavi

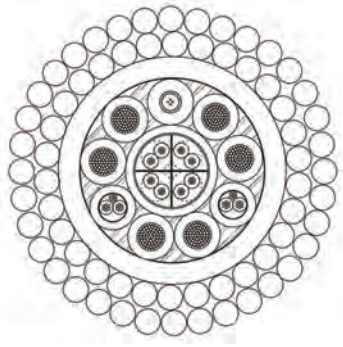


Photo: Novacavi

TE Debuts New Wet-mate Connector

TE Connectivity has launched its SEACON HydraElectric wet-mate connector, available in remotely operated vehicle (ROV), stab plate and manual modes. The connector's modular construction with 4, 7 or 12 electrical circuits enables many configurations for use in electrical, signal and distribution networks in subsea control systems. Qualified for both 1500 VDC and 1000 VAC pin to pin, the HydraElectric connector enables copper-based high speed Ethernet and supports the industry standards for Ethernet protocols, including CAN bus compatibility. Verified for use at 4,000 meters water depth, the connector includes oil-filled dual barriers to help maintain pressure balance. The connector is also corrosion resistant without cathodic protection.

www.te.com

TE Connectivity

Photo: TE Connectivity

BIRNS Upgrades Millennium Series

BIRNS, Inc. has introduced new features to its flagship high performance 6km-rated subsea connector line, the BIRNS Millennium series, including hex flats on its coupling rings to make the connectors even easier to loosen by hand or with a wrench, and allow a torque wrench to be used so that a specific mating torque can be applied for certain high-precision applications. BIRNS has also developed special wrenches for each connector size in the series. Each hard phosphor bronze coupling ring features Higbee threads – a special formation at the beginning of the thread providing positive identification to eliminate cross threading-and includes exclusive anti-rotation locking set screws.

www.birns.com

BIRNS

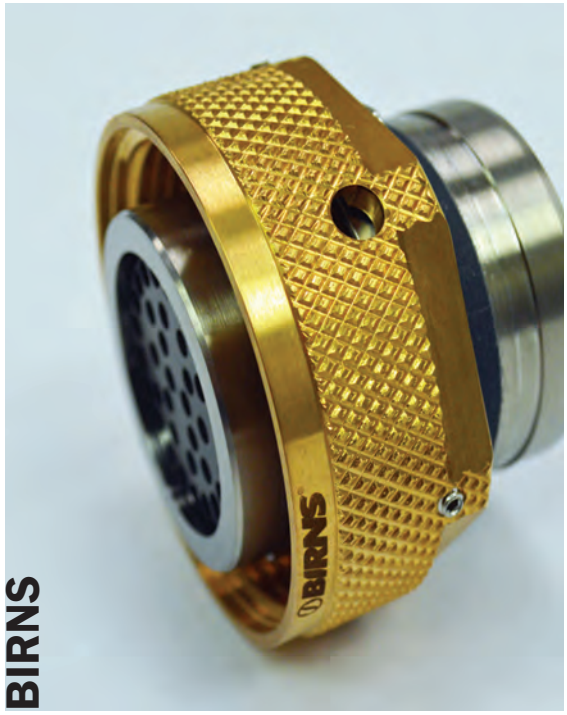


Photo: BIRNS

Hydro Cable Systems

Hydro Cable Systems designs and manufactures a range of electrical, fiber optic and composite cables to withstand the arduous subsea environment during operations. Recent innovations include its illuminated buoyant tether for nuclear operations. Following stringent regulations, the chosen material had to comply with nuclear specifications, combined with the electrical characteristics and buoyancy of previous tethers. As illuminated wire wrapped around cable can lead to small areas of contamination, the wire within this tether was encapsulated during the layup and extrusion processes to allow for light to emit whilst submersed in water with limited visibility.

www.hydro-cable-systems.com

Hydro Cable

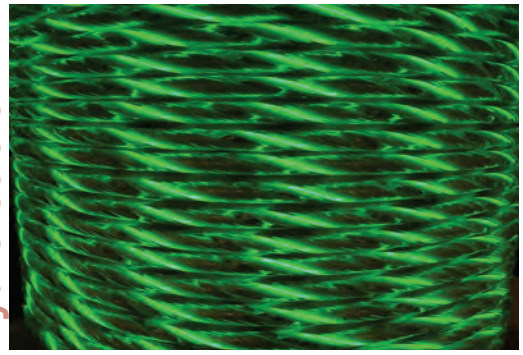


Photo: Hydro Group

Falmat

Photo: Falmat

Falmat

Building upon its extensive range of subsea cables, Falmat has launched its next-generation Xtreme Marine Subsea Video Cables, engineered to perform to 7 km depth with full water blocked video cable designs. High performance coax components for SD & HD video transmission are ideal for demanding applications including ROV, diver umbilical, overboard cameras, subsea monitoring, ocean observatories and fisheries. Falmat is certified to AS9100C / ISO-90001 Quality Management System.

www.falmat.com

SWIM Series

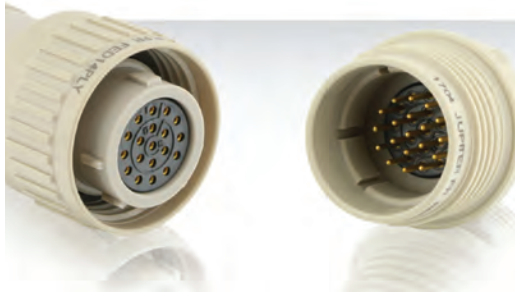


Photo: Souriau

SWIM Series

SOURIAU has launched a dedicated range of shallow water connectors designed for long immersion at low pressure. The dry mate SWIM (Shallow Water IMmersion) series connectors answer the needs for immersion to 300 meters/1,000ft, and bring reliability, durability and watertightness for applications such as buoys and unmanned surface vehicles. Their thermoplastic construction means they are neither subject to corrosion nor cathodic delamination.

www.esterline-connection-technologies.com

Linden Photonics

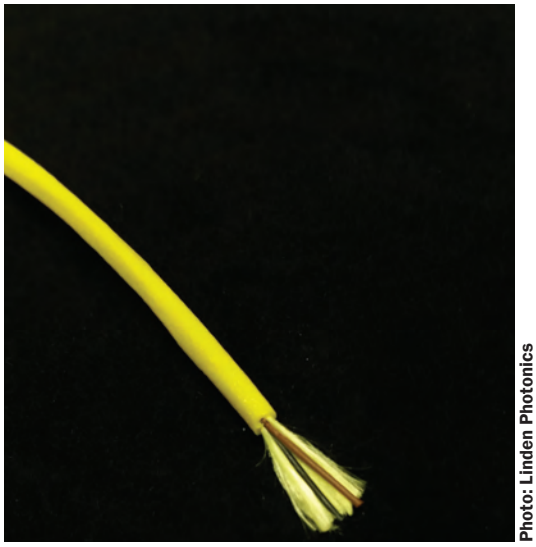


Photo: Linden Photonics

Linden Photonics

Providing more than fiber only products, Linden Photonics now provides high performance, buoyant copper cables. The manufacturer designs low weight, Kevlar reinforced, high-voltage cables to user specifications.

www.lindenphotonics.com

Photo: Teledyne Impulse

Optical 12,000 Meter Connector

New from Teledyne Impulse-PDM is a dry mate underwater 5135/5175 optical connector for ultra-deep water applications, utilizing standard ferrule technology and available for multi-mode or single-mode operation. The engaging nuts are also manufactured in the same grade of Titanium and the threads are coated with a Nickel/PTFE composite coating to prevent galling. The connectors have been qualified to 12,000 meter (17,500 psi) operating depth.

www.teledynemarine.com

Teledyne Impulse

Photo: Teledyne Impulse

NetG Ethernet Connector

Teledyne Impulse's standard NETG design uses rugged stainless steel connector bodies with a naval bronze engaging nut. Qualification testing performed on the assemblies verifed 1 Gbit/s transmission rates at pressures up to 10,000psi. The NETG connector is currently available as an 8 contact Ethernet only version, though additional configurations, including a combination of Ethernet and power contacts are being developed, and will be available in the near future.

www.teledynemarine.com

New Products

Turbidity Sensor With Wiper

Turner Designs has introduced Turbidity Plus, a new single-channel turbidity sensor including an integrated wiper which is triggered by the user to help keep the instrument optical face clear. Deployable to 200 meters and available with or without a plastic housing, the turbidity sensor is designed for integration with multiparameter systems and dataloggers from which it receives power and the wiper trigger.

www.turnerdesigns.com

Multiplexer Tech to Rental Market

Forum Energy Technologies business Forum Subsea Rentals has brought the DOMINO-7 Mk II and NANO-MUX multiplexers to its global rental market following investment in MacArtney's EMO range. The compact MacArtney DOMINO-7 Mk II multiplexer (MUX) can be installed on a range of work class ROVs. A fiber-optic system with a range of MUX channel and power supply configurations, it offers three videos with 10 bit data link in addition to two multi-beam ports, so that data can be communicated via a gigabit Ethernet link coupled with a 48 VDC supply voltage.

www.f-e-t.com

Seafloor Mining Tools

Canada based Nautilus Minerals Inc. said its Seafloor Production Tools have arrived in Papua New Guinea (PNG), and will shortly commence submerged trials. The submerged trials will take place in an existing facility on Motukea Island, near Port Moresby in PNG.

www.nautilusminerals.com

NOVATECH iBCN (Iridium Beacon)

MetOcean Telematics has released a new firmware update adding new capabilities to the iBCN (Iridium Beacon). The firmware updates build upon the iBCN's power efficiency and ability to be reconfigured via over the air commands. The update contains numerous improvements based on suggestions and feedback received from iBCN users. These include GPS status check, power up quick reports, transmission of current GPS location, LiNC integration and message format.

www.metocean.com

New Ultrasonic Anemometer

The R. M. Young Company has introduced the ResponseONE Ultrasonic Anemometer (Model 91000), fully wind tunnel tested and calibrated to provide accurate wind measurement over an operating range of up to 70 meters/second (156 mph). Wind speed and direction data is provided at up to 10 updates per second and made available via a variety of standard serial output formats including SDI-12, NMEA, RMYT and ASCII text.

www.youngusa.com

Turbidity Sensor

Photo: Turner Designs

Multiplexer Tech

Photo: Forum

Ultrasonic Anemometer

Photo:R.M. Young Company

Do you belong in the top 100?

Every year *Marine Technology Reporter* selects the top 100 companies that have made significant contributions to the underwater technology community. Apply today and tell us why your company should be featured in July's *Marine Technology Reporter.*

APPLY TODAY:
http://mtr100.marinetechnologynews.com/

Deadline for Entries: July 7, 2017

MARINE TECHNOLOGY REPORTER

2017 EDITORI

	FEATURE	MARKET	TECH
JAN/FEB AD CLOSE 1/20	Underwater Vehicle Annual: ROV, AUV, and UUVs	HD Cameras & Sonar for Vehicles	Underwater N
	MTR White Papers: Oceanographic - February 2017 Bonus Electronic Edition Publication Date: February 27, 2017		
MAR AD CLOSE 2/28	Oceanographic Instrumentation: Measurement, Process & Analysis	Fiber Optic Connectors & Slip Rings	Ocean Bus Southampt
APR AD CLOSE 3/30	Offshore Energy Annual	Subsea Engineering: Subsea Field Architecture	Buoyancy Tec
MAY AD CLOSE 4/28	Underwater Defense	Offshore Renewable Energy: Wind, Wave & Tide	Magnetomete
JUN AD CLOSE 5/25	Hydrographic Survey	Comms, Telemetry & Data Processing	GPS, Gyro Co Motion Tracki
JUL/AUG AD CLOSE 7/28	THE MTR 100 - The 12th Annual Listing of 100 Leading Subsea		
	MTR White Papers: Hydrographic - July 2017 Bonus Electronic Edition Publication Date: July 15, 2017		
SEP AD CLOSE 8/25	Ocean Observation: Gliders, Buoys & Sub-Surface Networks	Research Vessels	Seafloor Engi Operations
OCT AD CLOSE 9/22	AUV Operations	Harsh Environment Systems for Arctic Ops	ROV Technolo Micro System
NOV/DEC AD CLOSE 12/1	Acoustic Doppler Sonar Technologies ADCPs & DVLs	Fresh Water Monitoring & Sensors	Offshore Insp Maintenance
	MTR White Papers: Unmanned Marine and Subsea Vehicles - November 2017 B Publication Date: November 7, 2017		

AL CALENDER

HNOLOGY	PRODUCT	SPECIAL	BONUS DISTRIBUTION
avigation	Scientific Deck Machinery	The Atlantic Canada Subsea Cluster	Oceanology Intl North America Feb 14-16 San Diego, CA Underwater Defence & Security March 6-8, 2017, Portsmouth, Uk TUSEXPO Amsterdam, Netherlands
			Delivered to Over 30,000 Recipients Worldwide
siness 2017 ton, UK	Sonar Systems & Seafloor Mapping	Southern California Subsea Cluster	Ocean Business Apr 4-6, Southampton,UK Sea-Air-Space Apr 3-5, National Harbor, MD
hnology	Work class ROV's & Seafloor Trenchers	The Norwegian Subsea Cluster	OTC May 2-5, Houston, TX AUVSI XPONENTIAL May 8-11 Dallas, TX USA
rs & Streamers	Subsea Housings	Subsea Mining: The Time is Now	UDT 30 May- 1 Jun, Bremen, Germany MAST Asia Jun 12-14, Tokyo,Japan
mpasses & MEMS ng	Interconnect: Underwater Cables & Connectors		Oceans 2017 Jun 19-22, Aberdeen, Scotland

n Companies

			Delivered to Over 30,000 Recipients Worldwide
neering & Remote	Geospatial Software Systems for Hydrography	The Northeast U.S. Subsea Cluster	Oceans 2017 Sept. 17-22, Anchorage, AK
gy: Workclass to s	Underwater Tools & Manipulators	The Southeast U.S. Subsea Cluster	OTC Brazil Oct 24-26 Rio De Janeiro,Brazil
ection, & Repair (IMR)	Underwater Imaging: Lights, Cameras & Sonar	The 2018 Subsea Market Planner	Underwater Intervention 2018

onus Electronic Edition

ANCHORAGE ALASKA

SEPTEMBER 18-21

Oceans 17

Paper submission and registration now open
General early registration opens June 1
Exhibitor space available

570+ abstracts, 20+ Panel discussions ▲ Tutorials, workships and special sessions
Dive event ▲ Gala – Alaska Native Heritage Center
Countless recreational opportunities in Alaska – The Great Land

marine technology SOCIETY

www.oceans17mtsieeeanchorage.org

IEEE Oceanic Engineering Society OES

MTR Marketplace

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

Advertiser Index

Page	Company	Website	Phone#
C3	EvoLogics GmbH	www.evologics.de	49 30 4679 862 0
3	Hydroid, Inc.	www.hydroid.com/IAMREMUS	(508) 563-6565
35	Hypack	www.hypack.com	(860) 635-1500
31	JW Fishers Mfg Inc.	www.jwfishers.com	(508) 822-7330
19	Klein Marine Systems, Inc.	www.KleinMarineSystems.com	(603) 893-6131
C4	Kraken Sonar Systems, Inc.	www.krakenrobotik.de	Please visit us online
29	MetOcean Telematics	www.metocean.com	Please visit us online
46	Oceans 17' Anchorage	www.oceans17mtsieeeanchorage.org	Please visit us online
15	QPS / Quality Positioning Services B.V.	www.qps.nl	(603) 431-1773
C2	RBR Limited	www.rbr-global.com	Please visit us online
11	Rowe Technologies, Inc.	www.rowetechinc.com	(858) 842-3020
7	Saab Seaeye Ltd.	www.seaeye.com	Please visit us online
23	SBG Systems	www.sbg-systems.com	Please visit us online
39	Seco Seals, Inc.	www.secoseals.com	(714) 546-3478
5	Shark Marine Technologies Inc.	www.sharkmarine.com	(905) 687-6672
27	Sidus Solutions LLC	www.sidus-solutions.com	(619) 275-5533
9	Silicon Sensing Systems Limited	www.siliconsensing.com	+44 (0) 1752 723368
17	Sonardyne International LTD	www.sonardyne.com	44 1252 872288
13	South Bay Cable	www.southbaycable.com	(951) 659-2183
33	SubCtech GmbH	www.subctech.com	+49 (0) 431-22039 884
1	Teledyne Marine	www.teledynemarine.com	Please visit us online
25	Valeport Limited	www.valeport.co.uk	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

UNDERWATER COMMUNICATION AND POSITIONING SOLUTIONS

S2C TECHNOLOGY: COMMUNICATION AND TRACKING COMBINED

- time, space and cost-saving solutions
- low power consumption for autonomous operations
- advanced data delivery algorithms, addressing and networking, remotely configurable settings
- extendable platform with multiple configuration options: power-saving Wake Up module, acoustic releaser, additional sensors, custom solutions, OEM versions availableh

USBL POSITIONING SYSTEMS

simultaneous positioning and communication - no need to switch between positioning mode and modem mode

- flexible SiNAPS positioning software
- reliable data transmissions
- range: up to 8000 m
- accuracy: up to 0.04 degrees

UNDERWATER ACOUSTIC MODEMS

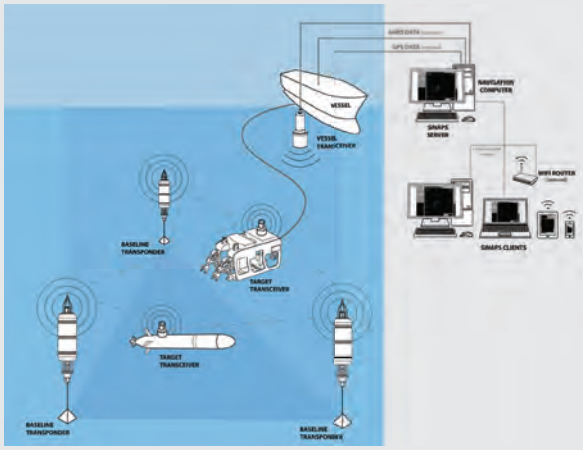
reliable data transmissions even in adverse conditions, customizable R-series modems, light and compact M-series "mini" modems, **new S2CM-HS high-speed modem**, special editions for developers, S2C communication and positioning emulator - remote access or standalone device

- range: up to 8000 m
- depth: up to 6000 m
- data rate: up to 62.5 kbps

LBL POSITIONING SYSTEMS

highly accurate, precise and stable performance, simultaneous positioning and data transmissions

- flexible SiNAPS positioning software
- reliable data transmissions
- range: up to 8000 m
- accuracy: better than 0.01 m



EvoLogics GmbH
Ackerstrasse 76,
13355 Berlin, Germany

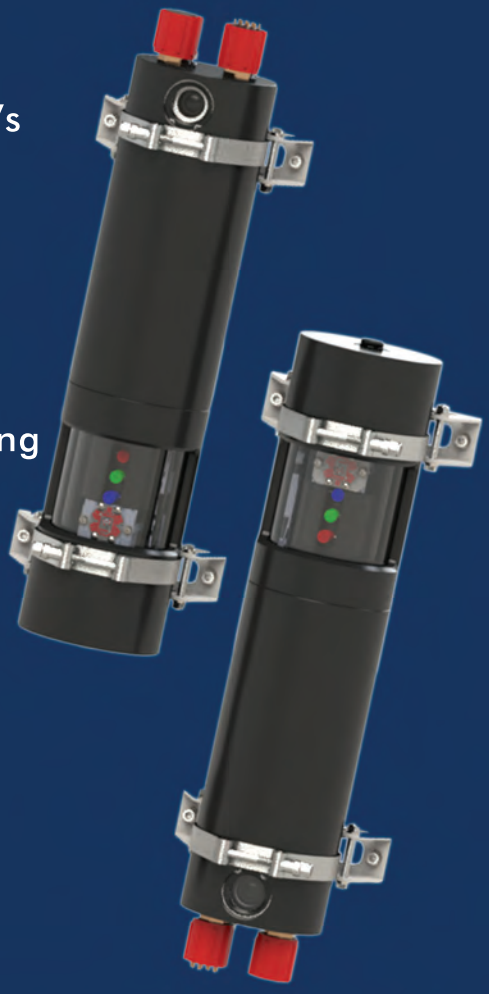
tel.: +49 30 4679 862-0
fax: +49 30 4679 862-01

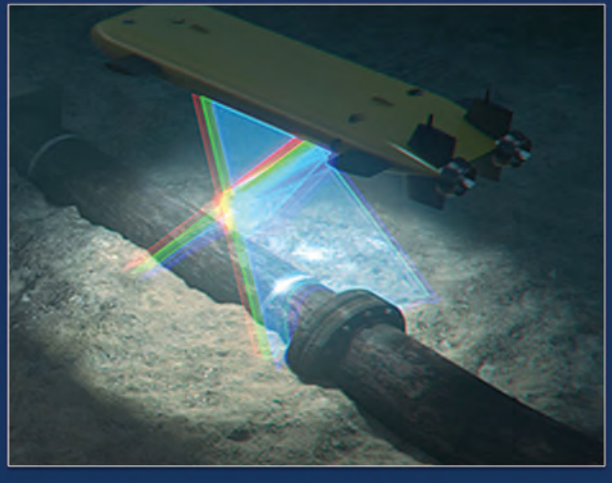
sales@evologics.de
evologics.de

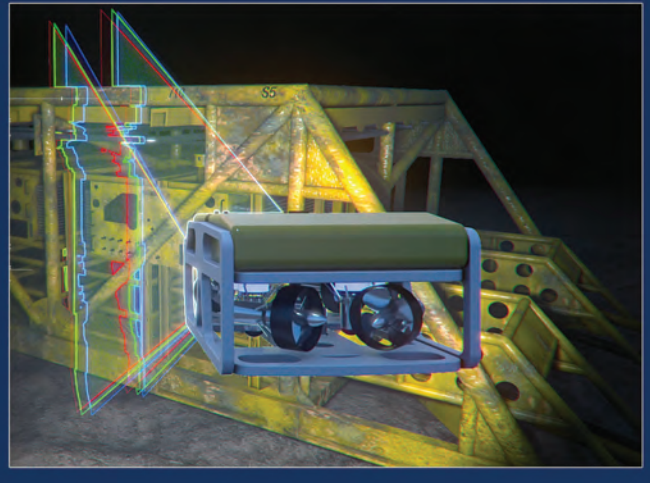
SEAVISION™

3D UNDERWATER IMAGING SYSTEM

- Ultra-high resolution
- Twin pods enable flexible mounting on ROVs and AUVs
- Dynamic (profiling) or static (scanning) operation
- Full colour 3D point clouds from RGB lasers
- Unprecedented scan speed (300,000 points/second)
- High-sensitivity colour camera with live video streaming
- No wet moving parts
- Real-time signal and image processing
- Embedded inertial navigation system
- Simple in-field, on-deck calibration
- Compact and lightweight
  (42 cm length x 11.4 cm diameter, 6 kg)
- Low captial cost







For more information:

seavision@krakenrobotik.de | www.krakenrobotik.de

KRAKEN