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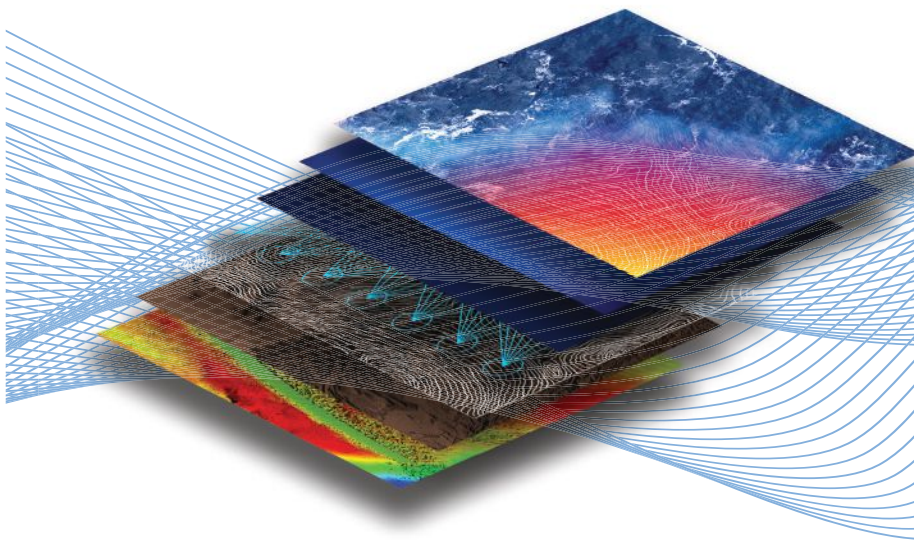
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Remote Crew Management Evolves in COVID Era

The COVID-19 pandemic has made us rethink the way we work. Technology is leading this change. Even companies that were wary of technology have found themselves conducting business via technological solutions and, having gained confidence in these new ways of working, are now likely to continue to embrace technology as we move forward from this global crisis.

Crew training is one area where we expect that online methods will take over from classroom-based learning. Crew learning has transferred almost exclusively to online methods due to worldwide travel bans and quarantine restrictions. The coronavirus outbreak forced us all to implement distance learning, and as a result the maritime training sector has taken a big step forward in embracing the digital evolution—which they should have taken five years ago to stay ahead of the curve.

The pandemic has accelerated this evolution. There should be no difference in the standard of a seafarer who qualifies online and one who does so in person, and the cost savings for employers and seafarers are important at this difficult time.

Seafarers are finding the digital revolution in maritime training to be beneficial. Online methods, properly supported by mentoring or one-to-one digital support, enable students to learn in their own time and environment, which can improve concentration, confidence and commitment.

Online training is often more flexible. It combines a mix of online tutorials, self-work and one-to-one teaching, backed up by verification processes. There are, of course, still training courses that need to be transited from the classroom format to the digital platform, but it is inevitably going to happen. Even training for the development of hands-on skills, such as welding and bridge and engine simulation where the physical equipment is necessary, may become a blended format between the online platform and a simulator.

Training providers will become more globally spread as the reliance on classroom training, which often incurs travel and accommodation costs, subsides. Danica is working with partner companies to produce a series of online training resources to meet the new needs in this area. The development costs are high for many courses, and a large throughput of students is needed to cover costs. With digital and online training methods, it's possible for a teacher in the Philippines or India to easily train seafarers in Ukraine and Russia, for example. This will open up the training marketplace to new competition.

In addition, the way crew are recruited and deployed has changed, thanks to the greater use of online technology. For example, pre-joining briefings between owners and seafarers are now being done online rather than in person.

Flag states have begun to allow many of their regulatory processes to be conducted electronically, such as applications and issuance for flag state endorsement. The pandemic has seen hundreds of thousands of seafarers at sea for many months beyond their contracts, and flexibility has been necessary on the part of employers, regulators and crew members. As a result, we have all discovered ways of updating required documents electronically.

Recruitment is also moving online. Some flag states have lifted the rule requiring crew employment contracts to be signed in person. This is now being done electronically, which cuts traveling times—particularly important when travel restrictions and flight cancellations have been a barrier to crew changes.

Meetings, too, have moved online, and international travel will remain low in the coming years as the world continues to adapt to the coronavirus era. COVID-19 hasn't stopped business; it's spurring a digital evolution. **ST**

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)) MTS Compass Award Winners. The Marine Technology Society (MTS) has announced its 2020 award winners. The awards were to be presented on October 8, 2020 at the virtual Global OCEANS 2020: Singapore – U.S. Gulf Coast conference. Compass Publications Inc. (publisher of *Sea Technology*) co-sponsors some of these awards, and this year's recipients of the Compass Awards are: Capt. (retired) Craig McLean, NOAA acting chief scientist and assistant administrator for Oceanic and Atmospheric Research—Compass Distinguished Achievement Award; Dr. Vladimir Ryabinin, executive secretary of United Nations Education Scientific and Cultural Organization (UNESCO) - Intergovernmental Oceanographic Commission (IOC) and assistant director general of UNESCO—Compass International Award; CODAR Ocean Sensors Ltd.—Compass Industrial Award. Nominations for next year's awards will be accepted from January 1 to May 31, 2021. For eligibility and nomination instructions, visit www.mtsociety.org/awards-honors.

)) SEA-KIT USV Maps Northeast Atlantic Seafloor. Woods Hole Group Inc. supported SEA-KIT with ocean current forecasting services for the 22-day voyage of the USV “Maxlimer” in the northeast Atlantic Ocean. The 12-m Maxlimer USV safely returned to Plymouth, U.K., in August after successfully completing remote survey operations on Europe's Atlantic margin. The ocean current forecasts aided SEA-KIT's pilots in their conservation of energy to ensure mission duration while surveying at speeds that provided quality bathymetric data. USV Maxlimer mapped over 1,000 sq. km of ocean floor, controlled around-the-clock by SEA-KIT via satellite communications from its remote operation center in Tollesbury, Essex. Notably, the uncrewed vessel also returned to Plymouth with its fuel tank still around a third full. This voyage clearly demonstrated the capabilities of the remotely controlled USV design in terms of over-the-horizon operation, endurance and ocean-going ability. The UTAS (Uncrewed Trans-Atlantic Survey) project, co-funded by the European Space Agency, was originally planned to be trans-ocean. However, due to COVID-19, this was ultimately not possible. SEA-KIT worked collaboratively with Fugro, Global Marine Group, Map the Gaps, Teledyne CARIS, Woods Hole Group and The Nippon Foundation-GEBCO Seabed 2030 project, contributing toward Seabed 2030's mission to have 100 percent of the ocean floor mapped by 2030.

)) DNV GL Steps Up Remote Surveys in Pandemic Era. The world's first in-water remote ship surveys using an ROV have been completed by DNV GL. In-water bottom surveys using ROVs have now been carried out on three separate Wilson ASA-managed vessels, with the first having been completed in December 2019 by a surveyor from Høvik. The surveys were conducted in collaboration with VUVI AS, a Norwegian inspection company certified by DNV GL to perform underwater inspections for ships and offshore platforms using ROVs. Survey planning and review of hull drawings were completed the day prior to the survey, thereby optimizing the degree of survey assurance. During the inspection, the surveyor used VUVI's sonar technology to scan the vessel's bottom in order to locate the hull equipment, such as echosounder sensors, speed log sensors and sea chests, while simultaneously assessing the general condition of the hull. DNV GL has recorded a 33 percent rise in the weekly number of remote surveys conducted compared to pre-pandemic levels. In total, DNV GL has conducted an estimated 17,400 remote surveys worldwide since 2018, with an average of 300 remote surveys being carried out every week.

)) Documentary Series on Autonomous *Mayflower* Ship. The Navy League of the United States, a nonprofit, is rolling out a multipart documentary highlighting the *Mayflower Autonomous Ship* Project, which includes IBM cloud, AI and edge computing technology. The series, which debuted in September, details the pioneering project led by marine research organization ProMare and unmanned submersible experts MSubs, with IBM as the lead technology partner. The goal is to build and sail a *Mayflower* for the 21st century, capable of traversing oceans autonomously and collecting data that will help protect the future of the world's most important resource. Unlike many robotic vessels that have been brought to market in the naval defense and oceanography spaces, the AI *Mayflower* leverages machine learning, edge computing and cloud technologies to make intelligent decisions without human intervention but with human oversight, enabling it to dynamically adapt to new situations, much like a human crew would. The ship was slated to take to the water for the first time in September 2020, ahead of a transatlantic voyage from Plymouth, U.K., to Plymouth, Massachusetts, in spring 2021. For more information on how to watch, go to: tinyurl.com/y4d9enyg.

)) \$10 Million for Coronavirus Tech Response. The U.S. Department of the Navy is offering more than \$10 million in funding opportunities to attract new small business partners and identify technology advances in the areas of autonomy, artificial intelligence, microelectronics, and command and control networks. This effort is being carried out by the Navy's Small Business Innovation Research (SBIR) and Small Business Technology Transfer (STTR) programs at the Office of Naval Research (ONR). It is part of a broader Navy initiative to support the national response to the coronavirus pandemic by leveraging and sustaining its own research-and-development industrial base. Proposal submissions will close on October 22. **ST**

Value-Added AIS Applications

exactEarth Partners with UP42 to Expand Earth Observation Market

By Nikita Marwaha • Elizabeth Duffy

The 2002 Safety of Life at Sea Convention provided innovative protections for ocean-going vessels by mandating that all ships over 300 gross tonnage (GT) be equipped with onboard transceivers for continuous data communication via the then new Automatic Identification System (AIS). These autonomous signals deliver location, heading, speed and other details to nearby vessels and onshore receiving stations within their lines of sight.

Although collision avoidance was considered the primary use of ship-to-ship AIS, maritime organizations also began using the information-rich data transmissions to enhance ship navigation and improve traffic management at ports.

Only eight years later, these AIS applications assumed a valuable new dimension when small satellites (small-

sats) successfully demonstrated how the VHF signals transmitted from vessels could be received in low Earth orbit (LEO). Almost overnight, the potential uses of AIS evolved from localized line of sight to continuous global tracking. Several organizations launched AIS-receiving satellites to offer a variety of maritime services, many of them commercial, based on the data broadcast from the ships.

One of these companies, exactEarth Ltd. of Canada, became the first to offer near-real-time and historic AIS vessel tracking data on a global basis. Through direct launches and partnerships, the Cambridge, Ontario, firm established a gap-free constellation comprised of dedicated AIS smallsats, as well as AIS receivers attached as secondary payloads on 65 Iridium communications satellites. Together, these LEO platforms offer nonstop vis-





Satellite AIS data complete the picture. (Credit: Airbus Defence and Space) (Below) UP42 currently offers two algorithms that use machine learning to detect ships in optical satellite imagery. (Credit: Airbus Defence and Space)

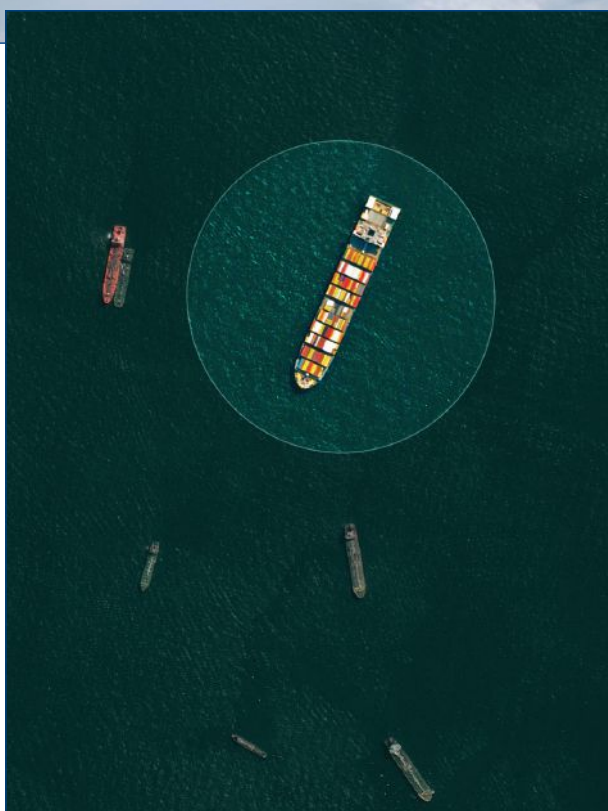
ibility into AIS-activated vessels anywhere in the world.

exactEarth enhanced the usability of AIS data by developing a patented technology that “untangles” the transmissions in crowded ports and shipping lanes to ensure the right signal is attributed to the correct vessel. Otherwise, the Canadian firm has focused primarily on selling relatively raw AIS data sets with filtering options for geography and time periods. exactEarth has provided its data to third-party companies and end-users in order for them to create value-added AIS-related services.

Value-added businesses have indeed been built on the AIS data, but a substantial roadblock to its use has hampered development of some applications, explained Bruce Winter, director of product management at exactEarth.

“One of the challenges is dealing with the volume of data. Even a single month’s worth might be a terabyte or two,” said Winter, adding that it takes organizations with sophisticated data-mining tools and massive computing power to process the data sets.

With a goal of expanding access to AIS data, exactEarth signed a partnership agreement this year with UP42 of Berlin, Germany. UP42 has built a developer platform and Earth observation marketplace where customers can buy geospatial data sets and information extraction algorithms to create custom solutions and products. The platform itself provides cloud-computing horsepower ca-



pable of processing enormous data sets.

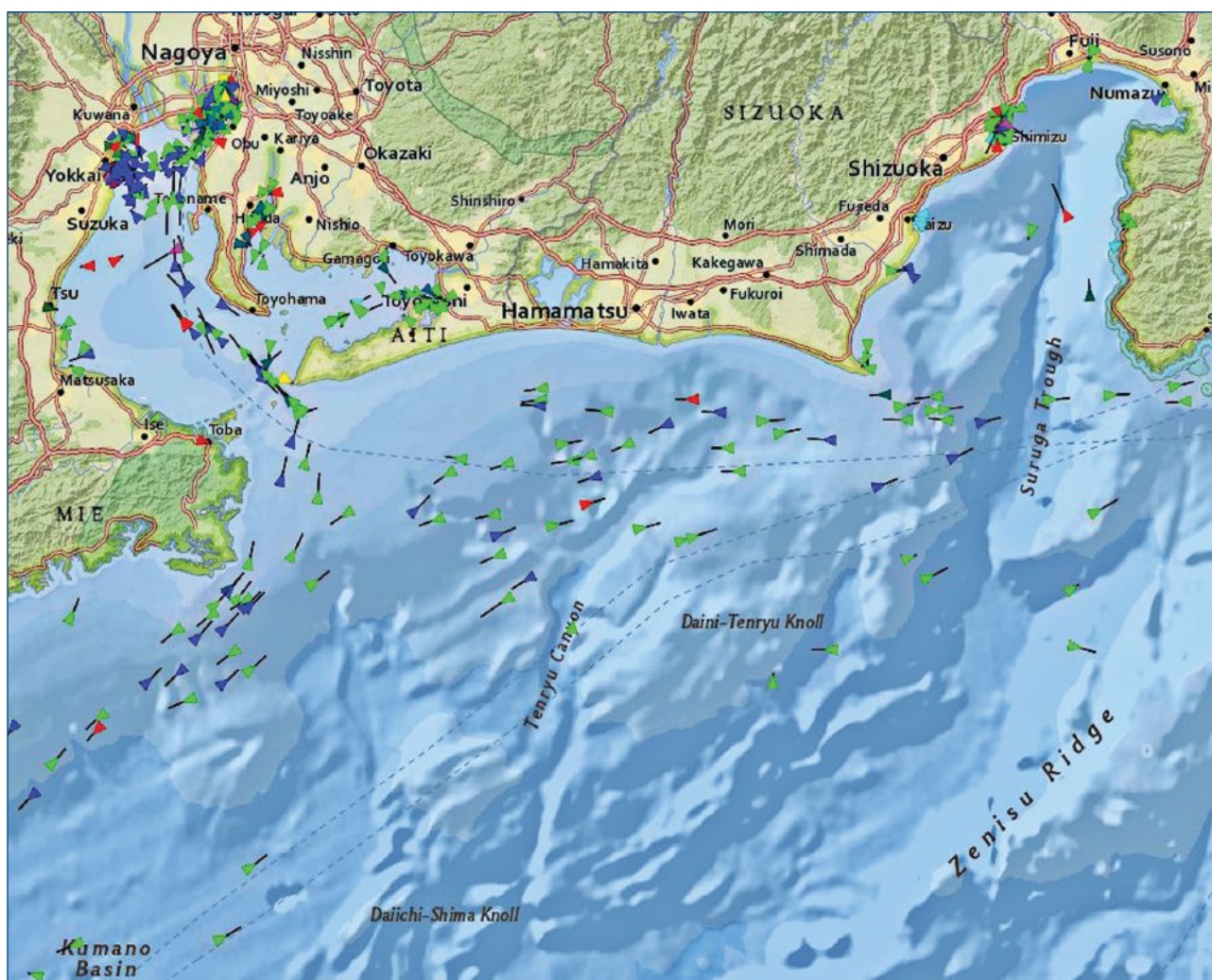
“We built the UP42 platform to democratize the development of geospatial solutions,” said Sean Wiid, CEO. “Organizations of any size can fuse and process large data sets using advanced machine learning technology without the expense of buying and maintaining their own computing infrastructure.”

exactEarth’s Winter predicts availability of AIS data on the UP42 platform will yield at least two benefits to the maritime community. First, there will be a proliferation of value-added AIS products similar to ones already on the market—thanks to smaller companies being able to compete. And second, entirely new maritime products and services will be created

by merging the AIS data with other geospatial data sets and applying new algorithms.

The Benefits of AIS

More than 600,000 vessels are equipped with AIS transceivers. Large 300-GT-plus ships utilize what are called Class A devices, while smaller vessels have more affordable Class B units. In either case, the direct signals allow the ships to “see” the position of others on digital map displays to a range of nearly 80 km. Even before satellite AIS, ports with receiving stations could begin staging incoming traffic when vessels were still several hours out.



(Top) AIS vessel positions in the vicinity of Nagoya Port and the Port of Shimizu, Japan. (Credit: exactEarth) (Right) Vessels are classified based on their purpose, size and type of cargo. This legend illustrates the colors assigned to each vessel type. (Credit: exactEarth)

The most important information in the AIS signal is the position data, which are typically reported from a GPS receiver on board the vessel. However, the data sets transmitted from the ships are a treasure trove of other valuable information transmitted every 6 min. or with major course alterations. The data are divided as static, dynamic or voyage information.

Static info comprises: identity, International Maritime Organization (IMO) number, length and beam, vessel type, and location of position-fixing antenna. Dynamic info comprises: position, speed over ground, course over ground, navigational status and rate of turn. Voyage info comprises: cargo type, destination, estimated time of arrival (ETA), route plan and safety-related information. The advent of satellite AIS dramatically enhanced the value of



this information, whether purchased from exactEarth in near real time or as historical records, because end-users no longer had to be within line of sight to access the data. Governments and commercial entities, such as fleet operators and commodity traders, have become regular customers of the data sets, according to exactEarth.

Safety remains a primary consideration. AIS data gives search-and-rescue teams unparalleled situational awareness when a ship broadcasts a distress signal. And in the event an accident does occur, historical data can be reviewed by investigators to determine what happened so the mishap is not repeated in the future.

"Vessels can even add a note to their AIS information that armed guards are on board as a warning to potential pirates," said Winter.

Numerous fleet operators now track their ships and cargoes in near real time with AIS, Winter added. And some are integrating the vessel routes with live weather data so that they can compute and transmit course corrections in order to keep the ship away from storms or to guide them toward the most favorable navigation currents.

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“UP42 has built a developer platform and Earth observation marketplace where customers can buy geospatial data sets and information extraction algorithms to create custom solutions and products.”

For government agencies, the most common applications of the satellite AIS are marine protection and maritime security. Nations now know when and where a specific ship has entered their Exclusive Economic Zones, and they can also monitor if a vessel has strayed into a protected environmental area.

A significant drawback to AIS with regards to these latter applications is that onboard transponders can be manually turned off from on board the ship. This makes the vessel go dark to other ships, onshore receivers and orbiting AIS satellites. Even more disturbing, a vessel can intentionally “spoof” its position by altering the GPS location reported in its AIS broadcast. Integration of AIS with other geospatial data, however, is a potential solution to these issues.

Integrating and Processing AIS Data

The UP42 online platform facilitates the correlation and integration of AIS data by offering a marketplace of geospatial data sets for purchase by the square kilometer and direct download. Near-real-time and historical exactEarth AIS data dating back a decade are sold on the site along with aerial and satellite imagery from numerous sources, including Airbus Pléiades and SPOT, U.S. Landsat 8, European Sentinel-2, NASA MODIS and other missions.

“Streaming weather and ocean current data from Meteomatics of Switzerland are also available,” said UP42’s Wiid. “Our customers can readily merge this information with the exactEarth AIS data to plan safer and more efficient navigation routes for ships at sea.”

Entirely new maritime monitoring applications are expected to be developed by fusing AIS data with optical satellite imagery. For example, a national government could overlay the AIS signals on an image that visually shows the positions of vessels in its Economic Zone. If 12 ships are present in an area where only 11 AIS signals exist, the agency knows an incursion has occurred and can take steps to investigate.

For organizations with the capabilities to merge or overlay two geographic data sets, UP42 offers an API where a workflow can be created by the customer for its own use. But for those without geospatial skills, the platform also provides dozens of analysis processes—including machine-learning algorithms—that can be accessed in a pay-per-click mode. These tools automate the extraction of information from data sets, including detecting and counting objects, assessing change over time, and uncovering patterns of repetition.

The platform currently offers two algorithms that use machine learning to detect ships in optical satellite imagery. Airbus of France has created one of these tools,

which find even small ships in very high-resolution imagery—ideal for monitoring fisheries, protected habitats or ports. The other, developed by Osir.io of Germany, has a similar automated detection tool that counts vessels in coarser-resolution, less expensive satellite imagery, making it a solution for ongoing analysis of marine traffic globally and in specific geographic areas.

“Port operators can analyze vessel arrivals and departures over time to improve the efficiency of their facilities,” said Wiid.

With ongoing geographic monitoring in mind, UP42 has built direct tasking into the platform so customers can schedule certain Earth observation satellites to capture imagery over their area of interest one or more times in the future. With tasking, workflows are built in the API to automate the integration and analysis of the data sets on a continuous basis. Alerts can be set so that specific activities observed through the integrated AIS-imagery data analysis can trigger a notification.

“In developing the platform, we have focused on making it accessible to the most advanced geospatial end-users, as well as customers with little or no experience in image processing, machine learning or GIS,” said Wiid.

Wiid expects some marine organizations will utilize the platform strictly for its cloud-computing power to mine the immense AIS data sets to pinpoint specific pieces of information. But he also predicts the availability of exactEarth data along with numerous other sources of geospatial data—and the tools to process and exploit them—will lead to creation of new maritime applications that were previously impossible. **ST**

Nikita Marwaha is the content and social media marketing manager at UP42, where she produces content about geospatial data, its world-changing applications, and the people who create them.



Elizabeth Duffy is the product marketing specialist at UP42, where she integrates and promotes new partners onto the UP42 platform, as well as educates UP42 users on the product.



Remote Metrology

Unmanned Capabilities Come into Focus for Offshore Operations

By Aidan Thirsk

Over the last three to four years, we have heard from many operators about the need for remote operations in the offshore industry. BP has declared that by 2025 all inspections will be performed by unmanned systems. Shell has made similar statements about moving to autonomous operations. AUVs are already deployed for extended periods, with remote data download and charging stations in development. Many drill floors are being monitored remotely with oversight from the beach.

Basically, the industry is looking to keep subject matter experts from having to be mobilized to offshore vessels and platforms. The expectation is to only have essential workers offshore, with remote support from onshore subject experts.

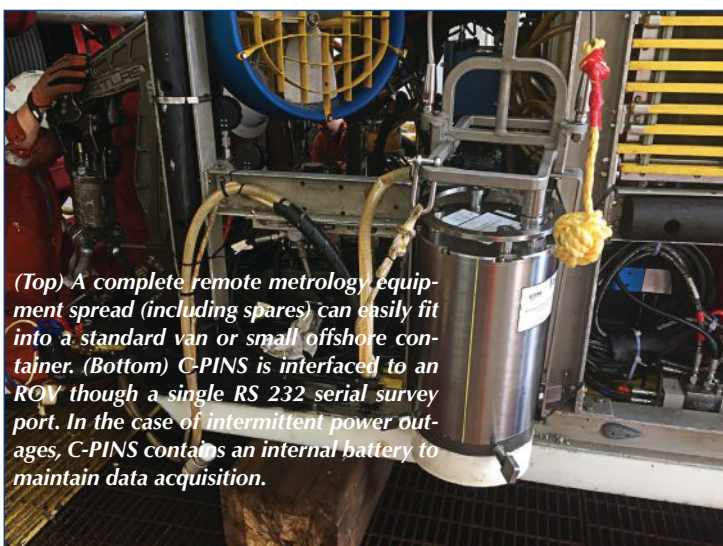
Metrology

Very briefly, when we talk about metrology, we are talking about the ability to measure the distance, attitude and bathymetry between two hubs/connectors subsea. These measurements will provide data for the fabrication of an interconnecting jumper or spool (basically, a pipe) between the two structures subsea.

The jumper can connect between a large variety of subsea structures (for example, pipeline end termination/PLET, pipeline end manifold/PLEM, permanent guide base/PGB, well, manifold, etc.), and the jumper is usually used in order to export from a well to a transmission system and onto an offshore floating production system or to shore.



Gio, one of Zupt's offshore engineers, quality controlling metrology data in real time onshore.



(Top) A complete remote metrology equipment spread (including spares) can easily fit into a standard van or small offshore container. (Bottom) C-PINS is interfaced to an ROV though a single RS 232 serial survey port. In the case of intermittent power outages, C-PINS contains an internal battery to maintain data acquisition.

At Zupt, we complete metrologies a little differently than the industry norm of using acoustic transponders for data collection. We use an inertial navigation tool, called C-PINS. To date, Zupt has completed approximately 250 inertial metrologies globally. A significant portion of this work has been completed in West Africa (Ghana, Nigeria, Angola, Congo) and the Gulf of Mexico. We have worked with ROVs and divers, and from barges, rigs and many vessels of opportunity. We have also been involved with the dimensional control of subsea structures being installed prior to deployment. A small number of the metrologies that we are completing these days are when there is a jumper in place, meaning the tooling required must be custom designed to work around an existing installation subsea.

We start any new project by gaining as much information as possible from the client for our planning and job preparation prior to heading offshore. We generate task

plans and procedures before mobilizing our equipment and surveyors to the field. Once the equipment is delivered offshore, the surveyors will check our communications to C-PINS via the ROV early. When the client wants to complete the metrology, we sequence through a series of tasks involving alignment of C-PINS subsea, measuring the attitude (heading, pitch and roll/HPR) of the two hubs, and collecting our position loop data. Performing position loops involves traveling from hub A to hub B, back to hub A; this would be considered one position loop. C-PINS is then turned off and stored on the ROV. With a pressure transducer, we determine the difference in height/depth between the two hubs, from the hub to the mudline, and the bathymetric profile along the jumper route. If we have a "classic" jumper, we need to be sure the jumper is clear of the mudline underneath the connector at each hub, or any obstructions along the route. When we have completed the metrology data collection, most clients will want the deliverable within 24 hr. (some want the deliverable in 12 hr.).

A typical survey contractor will deliver horizontal and vertical distance, attitude for each hub, and perhaps an AutoCAD file for the bathymetry survey. In most instances, a separate engineering company will create the isometric fabrication drawings based on this survey deliverable.

Remote Capability

Three years ago, we started offering fully remote metrology services. By "remote" we mean absolutely no survey personnel offshore; just our equipment to be deployed by the ROV personnel. When we offer clients remote survey as an option, a common response is: "Hang on, bandwidth does not work offshore. When I want to check an email, it takes hours to download a 500 kb attachment." We compare our capability to Netflix: You cannot watch a show over a dial-up or limited DSL connection. Nowadays, we expect a high level of bandwidth at home.

There is a limit on the amount of satellite bandwidth offshore, but the available bandwidth on a vessel is usually an artificial limit because the client or vessel operator is not paying for the bandwidth (or the bandwidth is being throttled down). In that case, yes, bandwidth is an issue. But in nearly all cases, there is an opportunity to open additional bandwidth.

One of the other issues is that the bandwidth on a vessel is managed by the IT department, which focuses on the security of the networks and not on adding operational efficiency by expanding bandwidth for the third-party contractors on board.

If you ask major providers of bandwidth to open up the connection on a vessel, it is incredibly inexpensive. The cost for a satellite bandwidth provider to widen the diameter of the bandwidth "pipe" by 512 kilobits per second (kbps) offshore-to-onshore and 128 kbps onshore-to-offshore for one month is approximately equivalent to the cost of having one Zupt surveyor offshore

for one day. Satellite bandwidth providers are very well structured to switch on/off this additional bandwidth by the day and, thus, for a week or month. However, for a third-party contractor, such as Zupt, it can be incredibly difficult to find the correct point of contact within the client or vessel operator organization to get that bandwidth switched on.

Remote Metrology Process

We completed our first remote metrology in June 2017, and since then we have completed 12 remote metrologies and three remote buoy pattern set placements. Our most recent remote metrology was in May of this year and was especially interesting as the client was originally planning on using a different vendor before personnel issues arose because of the COVID-19 pandemic.

Again, when we say remote, we have absolutely no survey personnel offshore. What we do is ship the equipment out in a slightly different configuration than a conventional manned metrology to make it easy for the ROV team to assemble and deploy. Our lump sum pricing allows us to ship the equipment earlier so that the client has the equipment available, and the ROV team will then connect the equipment and run a communications check at their convenience. We will perform loop-back communications tests and power test to ensure we have communications and the correct power/polarity to the C-PINS. Once fully tested, the equipment will remain on standby until the client or vessel schedule is ready for

the metrology to begin. Our surveyors will then arrive to Zupt's Houston-based office and bring up communications early to ensure correct operation. Our surveyors log into C-PINS and bring up video and phone connections when the metrology is ready to start.

The software we use onshore is the same as we would use offshore to collect data. We review and quality control the data in real time onshore during data collection and before final data and report delivery.

Equipment

A complete remote metrology system comprises six packing cases and a very small pallet with C-PINS lifting hardware. The equipment spread contains two C-PINS systems, fully assembled tooling stabs, pressure-balanced oil-filled (PBOF) cabling, PCs, CTD sensor, altimeter, barometers and sound velocity sensor (SVS), if necessary. All these components easily fit in a typical rental cargo van with room to spare. The spread is very similar for each specific metrology, and the equipment footprint that would be on a vessel's back deck is compact (easily fits into a 6-ft. container).

We connect to C-PINS through the ROV (38,400 baud rate, 24 V, 3 A, 75 W) via a conventional serial survey port. C-PINS is connected through the ROV's MUX system up to the ROV control room. This serial connection will be interfaced with a compact 19-in. "rack" that is placed in the ROV control room for onshore data delivery. In this 19-in. "rack" is a Moxa serial-to-Ethernet

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server, video encoding device (we use H.265), IP phone, managed switch, and managed power supply to allow the onshore team to turn the instruments on/off over an internet connection.

From offshore to onshore, there are three options for the minimum bandwidth speed needed for operation: 512 kbps if Zupt is transmitting C-PINS serial data, IP phone link and video link to onshore; 256 kbps if the video is multicast to onshore by the client and Zupt is responsible for the C-PINS serial data and IP phone link delivery to onshore; and 128 kbps if voice communications and the video link are available from the client onshore (in this instance, Zupt is only sending serial data from C-PINS over the satellite bandwidth connection).

These numbers provide an idea of the relatively minimal bandwidth requirements that we need to complete a remote metrology. Again, the cost of adding 512 kbps additional bandwidth to the existing bandwidth on an offshore vessel for one month is approximately the same cost as an inertial surveyor for one day.

Satellite bandwidth is slightly different than your residential bandwidth provider due to satellite bandwidth being sold per bit. These providers are interested in the number of bits per second that are required from offshore to onshore—and onshore to offshore. Zupt would ask a satellite bandwidth provider for 512 kbps uplink (offshore to onshore) and 128 kbps (onshore to offshore) connection, with a guaranteed quality of service or confirmed information rate (CIR, a guarantee of available bandwidth rate at any point during the service).

Satellite Bandwidth and Through-Space Communications

All the current major vendors in this space (RigNet, SpeedCast, Marlink, Inmarsat, ITC Global, etc.) are dramatically changing their method of selling bandwidth. A recent satellite industry newsletter mentioned that in the near-term, satellite bandwidth pricing at the wholesale level will tumble to as low as \$200 per megabit per second (mbps) per month. Even more interesting was that the actual cost to the provider of providing this level of additional bandwidth for an entire month would be in the realm of \$5; incredible margins with room to reduce pricing further.

Starlink, Elon Musk's SpaceX subsidiary, is launching 60 satellites at a time on its Falcon 9 rockets and currently has a total of 530 satellites in its constellation, with the target number of 1,600 satellites orbiting by the end of 2021. SpaceX has the approval from the FCC for 30,000 low Earth orbiting (LEO) satellites.

The current array of geostationary satellites has communications latency in the uplink and downlink of approximately 650 to 700 milliseconds (ms); this level of latency means that control of an ROV manipulator is a huge issue, for example.

Because LEO satellites are within short proximity to the Earth, the latency in the communication bandwidth is in the order of 20 to 30 ms; max 50 ms. LEO satellites will provide next to no bandwidth latency at a margin of the price of today's bandwidth services.

Offshore satellite hardware components are also radically changing. There is a plethora of flat-panel, low-profile antenna assemblies that contain an antenna, a modem to a switch, RF transceiver, block up converter (BUC), and down converter known as a low noise block (LNB). Today, we see systems that have packaged all of these components into an assembly that fits on top of a standard SUV. The typical domes you see today for primary, secondary and perhaps TV communications on a vessel will soon be replaced by four flat-panel antenna assemblies separated by the superstructure of a vessel. These assemblies are currently more expensive than the competing conventional domes (\$70,000 to \$90,000) but the dependence on flat-panel antennas for LEO satellite communications will dramatically lower their cost (targeted below \$2,000) in the next one to three years. The offshore industry will be able to take serious advantage of this.

We believe in the next six to 24 months, multiple short-term providers of offshore services will provide remote service capability with their own external bandwidth link. Kymeta already offers a dual redundancy solution that shares a flat-panel antenna assembly and is available in a standard shipping case, for example.

Conclusion

While this article focuses on remote metrology, we would like to emphasize that similar technology and methodology can be used for other remote operations. Inertial metrologies are Zupt's line of business, but the method to deliver offshore data onshore for data collection, quality control and processing can be used for numerous other applications. In addition to the safety benefits of eliminating the need for offshore personnel, remote operations reduce visa/travel logistics, eliminate the extra day rates charged for personnel/equipment that are in country or offshore before/after the specific task, and allow for much more project flexibility in scheduling. Commercially, it facilitates lump sum operational pricing.

In Zupt's most recent remote metrology, which took place May 2020, the intention was for another vendor to complete the metrology for a jumper in the Gulf of Mexico. The complications involved with mobilizing personnel during the COVID-19 pandemic meant that the vendor was not be able to safely fulfill the work required, and Zupt was asked to complete the work remotely at short notice. All that was necessary to bring the ROV team up to speed was a short video call and a handful of training videos, and the ROV team comfortably completed the offshore metrology using Zupt's remote metrology equipment without any prior experience. The project was completed on time, despite the pandemic.

We look forward to continuing to push remote services as a safer, more flexible alternative to conventional offshore operations. **ST**

Aidan Thirsk is a sales engineer at Zupt.

Autonomous Vehicles for Research

Saildrones Gather Data on Pollock in Bering Sea

By Don Nester

There is a sea change happening in ocean exploration. Autonomous surface vehicles and subsurface vehicles are being used more frequently to capture data all around the world. The COVID-19 pandemic exacerbated the trend, as many research cruise activities came to a halt.

"With many research cruises suspended or delayed due to the COVID-19 pandemic, oceanographers will now rely more than ever on these robotic eyes in our oceans," *Nature Geoscience* reported in a June article.

While autonomous vehicles are being used more frequently to collect ocean data, one recent project took on an even more complex assignment: assessing the quality of the data gathered from a noise-reduced research vessel

compared to data gathered by autonomous vehicles. The results were noteworthy.

In the project for NOAA, two autonomous vehicles called Saildrones were deployed in the Bering Sea, a waterway close to Canada's western border, for 103 days, from May through early August 2019. They were equipped with echosounders to look deep into the water underneath the autonomous vehicles and measure everything that reflects the sound waves.

The data from the Saildrones show evidence of depth-dependent avoidance reactions to the noise-reduced ship by walleye pollock in depths from 30 to 100 m. But at depths greater than 90 m, the behavior was not evident. Comparisons of data from the ship and the

This Saildrone was employed in a 103-day project in the Bering Sea. Saildrones can endure missions up to 12 months and sail an average of 100 km per day. They include data cables and energy chains from igus. The igus components withstand the harmful effects of saltwater, and because they are made with highly technical plastics, they have an extended life cycle compared to steel components. (Credit: igus)





Saildrones indicate that backscatter where the ship and USVs crossed paths show similar results.

"This study demonstrates that it is now practical to make routine long-term measurements of acoustic backscatter over a wide area with an ASV equipped with an echosounder equivalent to those used in fisheries surveys," the NOAA team wrote in the *ICES Journal of Marine Science*.

Cost-Friendly Research

One of the primary reasons more ocean research is being conducted with autonomous vehicles is cost. The costs of chartering a ship can range up to \$35,000 per day.

"Ships are very expensive to build, crew and operate," said Noah Lawrence-Slavas, an engineer with NOAA. "The NOAA fleet is shrinking while demand is increasing. In 2017, the NOAA fleet was meeting less than 50 percent of the demand for days at sea. The discrepancy has become greater as we continue to lose capability due to attrition from aging ships."

Ships can also only collect data along the path of the vessel. Autonomous vehicles expand the range of the area that can be observed. That's especially critical in ocean discovery, as more than 80 percent of the world's oceans remain unmapped and unobserved.

"The United States has vast areas of unsurveyed waters, particularly in the Western Pacific, the Arctic and the Great Lakes," said RAdm. Shepard Smith, director of NOAA's Office of Coast Survey. "We cannot afford to conduct these surveys using traditional methods and are seeking technology that will allow us to increase our capacity for surveying over the coming decade."

Limitations of Conventional Methods

Buoys and satellite observations have also been used to collect ocean data, but they have some limitations. Lawrence-Slavas said buoys provide excellent time-series information to look at long-term trends. "But they do a poor job of resolving spatial changes in the ocean, particularly in highly variable coastal regions where you can see significant changes in the ocean over short distances," he said. Buoys also require ships, which increases costs and contributes to limited ship resources.

While satellite observations are expanding, this method cannot see below the molecular skin of the ocean. They also do not have the resolution needed to resolve many important fine-scale processes and lack the accuracy needed for many measurements.

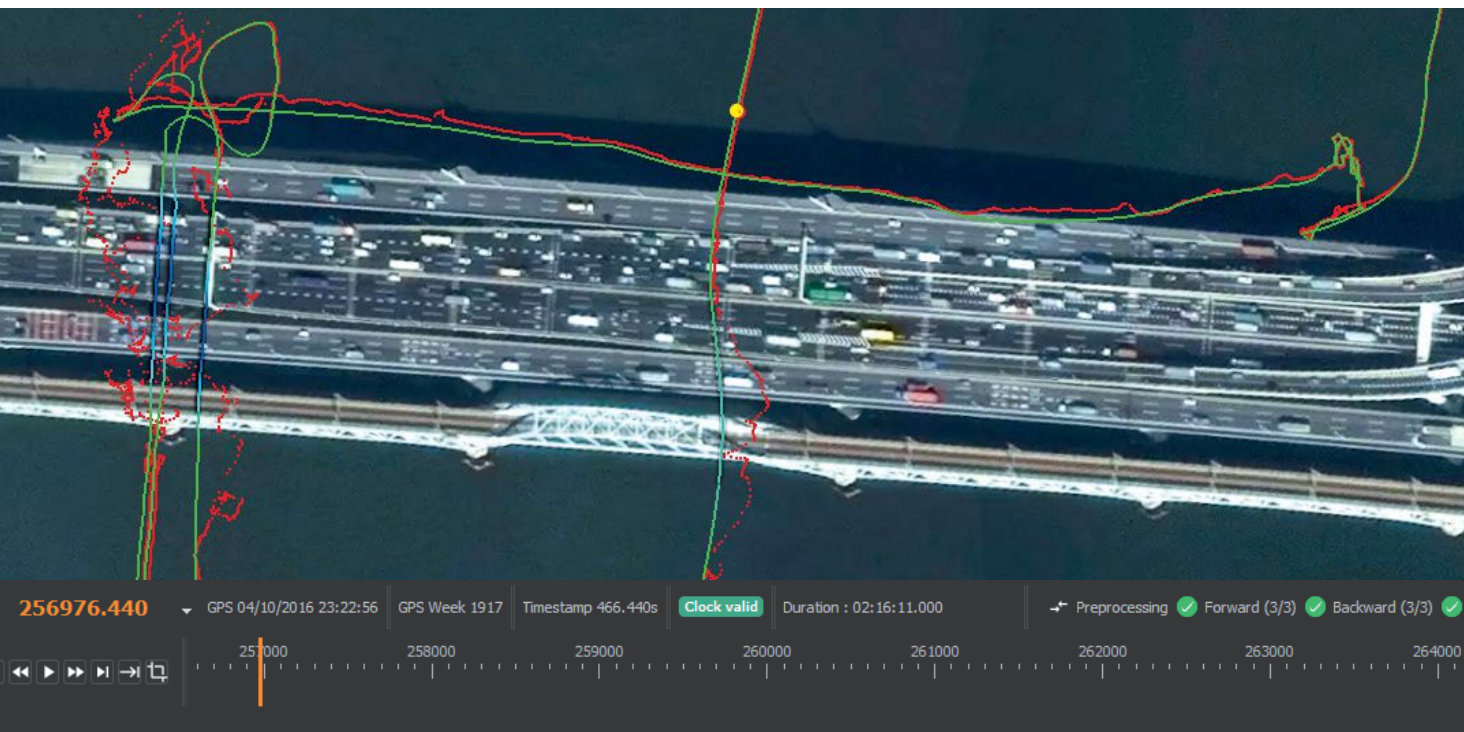
"The ocean science community has a real problem," Lawrence-Slavas explained. "The oceans are vast, difficult to observe, and in many places, particularly high-latitude regions, are rapidly changing."

While autonomous vehicles have some limitations, their reduced costs and more extensive range are quickly gaining in appeal for oceanographers.

"They are not a 1:1 replacement for ships or buoys, but are more of an augmentation to these traditional technologies in order to expand our understanding of the ocean and to make more cost-efficient measurements," Lawrence-Slavas said.

A Look at Saildrones

Saildrone, a company based in California, designs, manufactures and operates a global fleet of wind and solar-powered ocean drones that monitor the state of the planet in real time. The drones are powered with a pro-



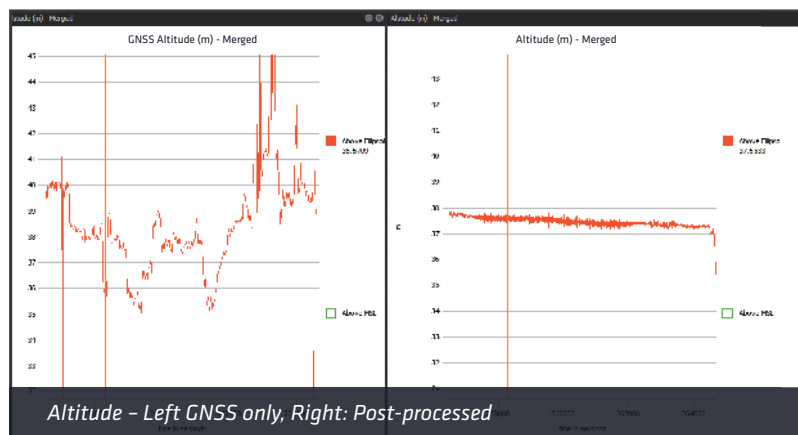
Quality: Green -> centimetric position; Blue -> decimetric < 30cms; Red -> Raw GNSS data

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“The reality of self-driving cars is on the horizon, and we have autonomous surface vehicles, like the Saildrone, that are doing amazing things,” Lawrence-Slavas said.

pulsion system and include a tall, hard wing; a longitudinal spar; and a vertical tail. A trim tab on the tail adjusts the wing angle to the wind, similar to the way an elevator trim tab controls the pitch of an aircraft.

The wing technology enables mission duration up to 12 months. Each vehicle consists of a 7-m hull, a 5-m-tall wing and a keel with a 2.5-m draft. Each unit weighs about 750 kg and can be launched and recovered from a dock. They have an average speed of 2 to 3 kt., sail an average of 100 km per day, and can reach top speeds above 8 kt.

Each unit also includes a sensor package that measures key atmospheric and oceanographic environmental variables in real time. The package measures solar irradiance, long-wave radiation, atmospheric pressure, air temperature, humidity, wind speed and direction, ocean skin temperature, bulk water temperature, and chlorophyll and colored dissolved organic matter.

“The Saildrone is a very capable autonomous surface vehicle,” Lawrence-Slavas said. “It can carry a large science payload, has solar panels to provide higher power to instruments than most buoys, and can cover lots of ground.”

Unique Components

Saildrones include data cables and energy chains made by igus, a Germany-based manufacturer of motion plastics. The company, whose U.S. headquarters is in Providence, Rhode Island, produces highly technical, engineered plastic components that help reduce costs in a wide range of applications. The igus components in the Saildrone withstand the harmful effects of saltwater and have an extended life cycle compared to components made with steel.

The data cables are typically used in heavy-duty applications in indoor and outdoor environments. When supported, they have gliding travel distances up to 40 m, and are typically used in high-bay warehouses, machining units and machine tools, semiconductor insertion, outdoor cranes, and low-temperature applications.

Essential to the NOAA project is a thermoplastic elastomer cable jacket that withstands the effects of saltwater. “The power and data cable attaching to echosounder electronics needed to not degrade over the more than five million bend cycles the cable would see in a typical one-year long deployment,” Lawrence-Slavas said.

The energy chains played a critical role in stabilizing the Saildrone. Waves cause a lot of movement of the vehicle, which can impact the data collection essential to the experiment. The energy chains have a high tensile strength and are completely enclosed. They are frequently used in applications that move within two or three axes.

“The Saildrone acts like a sailboat, so when the wind blows, it heels over. To get high-quality echosounder data, the transducer, which generates and then receives the acoustic pulses, must be on average pointing straight down,” Lawrence-Slavas said. “We needed to remove the Saildrone’s heel from the echosounder’s transducer, so we built a hinged mount. The two-foot-long energy chains and chainflex cables allowed us to reliably transmit power and receive data through the moving mount.”

Why the Walleye

The data collected were critical to capture the movement of walleye pollock, which is considered the world’s second most important fish species in terms of total catch. The species is found throughout the North Pacific and is most common in the Bering Sea.

Other fish species, ranging from humpback whales to sea lions to seals, eat walleye pollock to sustain themselves. Since it is a milder taste, pollock is also frequently used in the fast food industry and for the raw material for breaded and battered fish products that are found on supermarket shelves. Also called Alaska pollock, the species has been the top fish catch in the world for the past four years. In 2016, pollock made up 67 percent of the total groundfish catch off Alaska.

While the data regarding the movement of fish are valuable, engineers also proved the effectiveness of autonomous vehicles in collecting data that lie hidden under the ocean surface. There is a wealth of information to be discovered in the world’s oceans. The Saildrone experiment revealed that when autonomous vehicles include the right equipment to withstand the ocean environment, they open the door for a whole new world of ocean discovery.

“The reality of self-driving cars is on the horizon, and we have autonomous surface vehicles, like the Saildrone, that are doing amazing things,” Lawrence-Slavas said. “These vehicles are crossing oceans by themselves, operating in the worst ocean environments. They have the potential to revolutionize both how and what we are able to learn about the ocean.” **ST**

Don Nester is the chainflex cables product manager for igus North America. He has 12 years of experience in the wire and cable industry, specializing in manufacturing, design and applications. He is responsible for all aspects of the chainflex continuous flex cable product line, including sales and product development.



Automatic Emission Monitoring

Sniffer Buoy Detects Emissions Before a Vessel Enters Port

By Nina Savijoki • Saija Sariola



The first Sniffer Buoy pilot is currently ongoing in the Finnish west coast archipelago.

Finnish companies Meritaito Ltd., which is part of the Arctia group, and KINE Robot Solutions Ltd. have jointly developed the Sniffer Buoy, a fully automated air quality monitoring station placed inside a rigid solar-powered navigation buoy. It offers cost-effective vessel emission monitoring with minimal maintenance to support authorities and ports striving to improve air quality. It also facilitates responsible and fair conditions for the entire shipping industry.

Meritaito—internationally known for its brand Seahow—manufactures durable polyethylene buoys that are widely used in the Nordic and Baltic countries, Russia, and Canada. KINE Robot Solutions specializes in integration, automation and air emission monitoring and has several years of experience in automated air quality monitoring stations and vessel emission analysis. Both companies aim to be trailblazers in sustainability and digitalization.

The Sniffer Buoy, which is connected to the cloud-based program AirNow by KINE Robot Solutions, monitors and detects all changes in air quality, including the fumes of passing vessels. The AirNow algorithm couples the collected data (AIS, weather, humidity, wind, temperature, ambient pressure, etc.) and emission fume analysis to calculate the fuel sulphur content of a passing vessel. The analysis results are made available to the port authority before the vessel enters the port. The authorities can then concentrate on collecting fuel samples and

other necessary actions focused on vessels suspected of regulatory noncompliance.

Emission Monitoring and the Regulatory Framework

The automated Sniffer Buoy can be deployed along shipping routes or in remote sea locations without any additional infrastructure, and it is designed to operate for years with minimal maintenance and human interaction. The Sniffer Buoy enables large ports and coastal nations to develop emission monitoring networks for spot checks at desired areas.

Initially, the Sniffer Buoy analyzes sulfur oxides (SO_x), but the service is expandable to nitrogen oxides (NO_x) and carbon dioxide (CO₂) emissions monitoring. Shipping contributes an estimated 13 percent of global SO_x emissions and 15 percent of global NO_x emissions. Nearly 70 percent of these emissions occur in coastal areas, contributing to air quality degradation and human health problems.

Global shipping operators are obliged to comply with the International Maritime Organization's (IMO) sulphur cap at 0.5 percent of fuel. This regulation has been in effect since January 2020. Certain areas have even stricter local regulations.

AirNow Service and Sniffer Technology

AirNow is a full coverage service that includes all hardware and software required to acquire remote emis-



users through a web interface. On the web interface, the user can set triggers for email or SMS notifications as desired. The user can adapt the system to produce customized report formats with various filter options (over limit FSC, station-based reports, vessel ID, etc.).

Buoy Development

The AirNow service (developed by KINE Robot Solutions) has provided Sniffer-type emission monitoring systems since 2015 in Finland's coastal areas, adapting to the harsh sea environment and intense seasonal changes in weather. The experience and robust solutions developed over this period were utilized when developing the Sniffer Buoy. KINE's roots in designing and building industrial robot systems proved useful in developing robust components and equipment for monitoring systems adapted to marine environments.

Developing the Sniffer Buoy wasn't an easy task, but KINE's team together with Meritaito's buoy factory development team were up for the challenge to design a compact solution that had never been made before. The main concern was the provision of sufficient energy for running the complex analysis process without compromising the

quality of measurements. Precision air quality measuring equipment is typically used in laboratory environments where the availability of electricity and stable clinical conditions do not pose a challenge. The buoy, with a diameter of only 800 mm, offered a very challenging environment for the sensitive equipment. KINE had to carry out persistent research and innovation to find solutions suitable to be placed inside the buoy while paying attention to

autonomy and energy consumption.

Meritaito's navigation buoys are made of high-density polyethylene that does not emit heat in the same way as iron buoys. The durable plastic surface requires neither sandblasting nor painting. The polyethylene buoys have successfully served for up to four decades, withstanding all weather conditions and forces of nature, from complete ice cover in the winter to exposure to midnight sun in the summer to the rough seas of the North Sea.

The cylindrical shape of the buoy and the draft of 8 m create a stable floating body, which is ideal to hamper wave-induced movement and provide sufficient space

(From top to bottom) A summary of IMO's Sulphur 2020 regulation. A vessel passing the pilot buoy; the exhaust plume is analyzed and coupled to other data in the AirNow service before the vessel enters a port. The installation of the first Sniffer Buoy took place in May 2020 in Finland.



sion results from passing vessels. The program collects air quality data, analyzes regulatory compliance and reports the results to the end-user. Usually the end-user is an authority that inspects the vessel based on an indication of possible noncompliance. AirNow is offered as SaaS (software as a service) by KINE Robot Solutions to ensure high quality and uptime of monitoring.

The Sniffer Buoy's analysis equipment includes: sampling equipment that ensures the air samples reach the gas sensors; gas sensors to analyze the varieties and quantities of gases from the samples; AIS receiver to monitor the passing vessels (ship identity, position, course and speed); weather station comprising meteorological sensors to monitor and log weather, wind speed and direction; data loggers; and remote control equipment to upload all collected data to cloud servers and to monitor the status and condition of the equipment.

All the data monitored and logged by the station are uploaded to AirNow servers, where the analysis and compliance calculations are conducted. Some of the data collected by the station are cross-checked with public databases of weather and AIS data to ensure the validity of the data. The analysis results are available to



for the AirNow equipment and a power source.

The prototype power unit, consisting of solar panels covering the buoy body to charge a built-in battery unit, is the largest power unit placed within a Meritaito buoy so far. The batteries are placed below the water level to guarantee relatively stable external temperature conditions throughout the year and contribute to buoy stability.

Sniffer Buoy is one more solution based on Meritaito's Smart Buoy concept. The Smart Buoys are manufactured at Meritaito's buoy factory in Finland and are exported to some 20 countries. The selection of Smart Buoys include a variety of alternatives fitted with sensors for current, water height and water quality (related to algae or oil spill) measurements, all with remote control capability. Smart Buoys are available in all color combinations according to the guidelines of the International Association of Marine Aids to Navigation and Lighthouse Authorities (IALA).

The lightweight plastic buoys allow handling and maintenance with small, environmentally friendly vessels. As all required components have been integrated inside the robust buoy body, the installation of the system is fast and cost-effective, and the instrumentation is sheltered against physical damage. The buoy leaves a lean ecological footprint at the end of its lifetime due to the recyclability of all the product's components.

Sniffer Buoy Pilot

The Sniffer Buoy pilot is part of the EU-funded Intelligent Sea project, headed by Meritaito. In the project, various digitalized navigational aids were piloted in the Port of Naantali, Finland, and Ports of Stockholm, Sweden.

The Sniffer Buoy pilot has two phases. The first phase is currently ongoing from May to October, with the Sniffer Buoy monitoring the west coast archipelago of Finland. After an adjustment and development break, the second phase will be carried out in the Ports of Stockholm starting summer 2021 for half a year. The first experiences from the pilot are encouraging as they have proved that

the combination of the buoy and air quality sensors is an excellent fit.

Solar panels are the only energy-supplying unit for the Sniffer Buoy, and the energy is reserved in four batteries. Charging to full capacity (640 Ah) with solar panels takes about 1.5 days. At full charge, the Sniffer Buoy is capable of functioning for five days. In case of connection failure, the data-logging system reserves all data and uploads to the cloud as soon as the connection is regained. During the first month of the pilot, battery charge didn't drop

The Sniffer Buoy.

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below 80 percent. There were six out of 50 days when the solar panels didn't charge because of weather conditions; even during cloudy days, the charge rate was high enough to provide power to all the equipment inside the Sniffer Buoy.

During the first month of the pilot, the weather conditions varied widely, from heat waves to severe gales. During severe gales, all equipment was shut down because

of the vibration caused by the wind and stormy weather. Remote control of the Sniffer Buoy worked as intended, and all equipment restarts were performed remotely and frequently for test purposes, and major updates were also conducted fully remotely.

KINE Robot Solutions has deployed another fixed emission monitoring station in the vicinity of the Finland pilot location to enable cal-

ibrating the results from the buoy against reliable reference results.

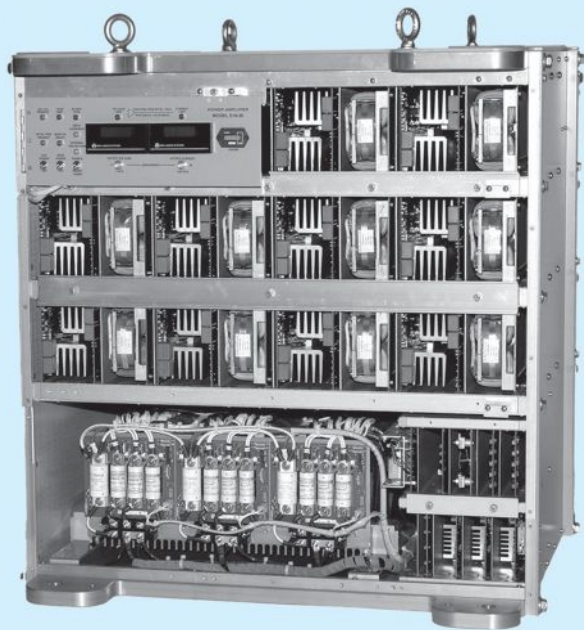
Conclusion

The need for vessel emission monitoring is indisputable. With a global fleet of more than 50,000 merchant vessels, automated pre-selection of possibly noncompliant ships would help authorities to concentrate their efforts in the right place.

Most shipping companies recognize the need to comply with international and local emission regulations and have invested vast sums in the required technology and onboard compliance procedures, such as crew awareness and training. However, the competition for freight and passengers is fierce, and the prices per transport unit are low. Public awareness and concerns regarding the health implications of emissions exposure force authorities to act and measure the air quality of coastal communities, too. An emission monitoring solution such as the Sniffer Buoy represents a cost-effective tool to address air quality concerns. **ST**

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Nina Savijoki is the project manager of the EU-funded development project Intelligent Sea – exploring digital solutions for sea buoys (www.arctia.fi/en/arctia-ltd./intelligent-sea-project.html). The project is coordinated by



Meritaito Ltd., a part of the Arctia Group that specializes in fairway development and construction, polyethylene buoys and underwater survey services. Savijoki is a naval architect (B.S.) with 20 years of experience in vessel concept development and ship design.

Saija Sariola is the project leader for R&D projects at KINE Robot Solutions Ltd. She has 15 years of experience in automation and integration projects and works together with the AirNow team leaders (<https://airnow.fi>). KINE Robot Solutions Ltd. has been the supplier of SO₂ emissions remote monitoring in Finnish seas since 2015.



Brazil's Underwater Acoustic Recorder

Equipment Challenges of an Acoustic Landscape Monitoring Project

By Rafael Mazza Buchmann • Eduardo Bernsmüller

The Brazilian Navy has over 35 years of experience in pioneering acoustic systems in the country. The demand for an autonomous system for the acquisition of underwater acoustic signals is relatively new.

In 2016, the Brazilian Navy Research Institute (IPqM – Instituto de Pesquisas da Marinha, Rio de Janeiro, Brazil) signed a partnership with Petrobras (Rio de Janeiro, Brazil) to develop part of the Santos Basin Underwater Acoustic Landscape Monitoring Project (PMPAS-BS - Projeto de Monitoramento da Paisagem Acústica Submarina na Bacia de Santos), which was demanded by IBAMA (the Brazilian Institute for the Environment and Renewable Natural Resources) in the federal environmental licensing of Petrobras's pre-salt pole of oil and gas exploration, aiming to characterize the marine soundscape.

This partnership made it possible for IPqM to work with autonomous acoustic recorders, which began development in 2017 and have been proving to be a high-value tool for the Brazilian Navy and research community.

Subsea observatories are one of the PMPAS's methods of data acquisition, and they were installed in three coastal locations in the Santos Basin. They were developed by the IPqM, consisting of a block of 1 cubic meter of concrete, housing up to five sensors, with at least one being an acoustic recorder and another being an ADCP.

This article aims to present a brief history of the progress and challenges of IPqM's research and development of the Autonomous System for the Acquisition of Underwater Signals (SAASS - Sistema Autônomo de Aquisição



de Sinais Submarinos). The objective of these acoustic recorders is to measure ambient noise to help characterize the acoustic landscape.

Why Not Just Buy An Acoustic Recorder?

At first, in early 2016, the obvious and easiest solution was to just specify and buy the recorders, as was done with the other measuring devices used in the PMPAS (ADCPs, acoustic profiling floats and gliders). However, since there are no recorders made in Brazil, to import them

would entail a huge amount of taxes, fees and delivery time, not to mention the maintenance costs. Also, unlike the other devices, developing an autonomous recorder is simpler and more familiar to IPqM's engineers due to the successful development of underwater sound data acquisition projects in the past.

Joining Forces, to No Avail

At the same time, it was discovered that a Brazilian university laboratory was finishing the development of its own recorder. IPqM signed a partnership with this laboratory, since the equipment met most of the requirements and initially had a low overall price. Three units were purchased.

As they were being used, all the units showed themselves unreliable, with failed recordings, real-time clock issues and low data quality.

Even so, they were used for about the whole year of 2017. By March 2018, the last one was damaged due to battery leakage.



(Above) Another observatory, with five housings, about to be placed underwater. (Right) SAASS Mk2.

Despite the improvements that would take place through our field tests and recorded data analysis, the new version of the university's recorders was overpriced, and acquiring new ones was not an option anymore.

Developing SAASS

Considering all the possibilities and the project deadlines, early in 2017, the decision was made to import a recorder. This procedure took almost 10 months to be completed.

We decided that it was time to develop our own acoustic recorder. Since the PMPAS was already running, and requiring underwater records, and since there was no such equipment available in the country, the fastest solution to the problem was to employ an ordinary interview recorder and plug a hydrophone in it. With some adaptations, a pre-amplifier and proper housing, the SAASS Mk1 was born. After six months of hard work, the IPqM engineering staff developed a custom microcontroller board with its own firmware.

Another goal of the project was to design, manufacture and test a hydrophone using national technology. Improvements in mechanical characteristics were made, resulting in a fully functional autonomous underwater acoustic recorder, the SAASS Mk2. The first tests with the SAASS Mk2 were conducted in March 2018. After

the system's capabilities check and hydrophone calibration, the equipment was used on the subsea observatories. With little tune-ups, the SAASS Mk2 has proved itself through more than 50 successful launches so far.

In the meantime, the imported recorders arrived in December 2017. Unfortunately, it was no easy task to set them to work, confirming the soundness of our decision to develop our own recorders. After many e-mails exchanged with the support staff, long tests and many configuration setups, the company had to send one engineer to Brazil to spend one entire week updating the hardware and firmware. After that, some more weeks of testing and configuration passed until we finally had the three recorders ready to work on site.

Thirty-three months had passed from the purchase of these recorders to the end of a 60-day successful launch in December 2019. Due to the long delay, the recorders served more as a comparative to validate the SAASS Mk2 data than as a reference to aim for during the development of SAASS.



Results: Operations Appraisal, And What's to Come

As mentioned previously, the SAASS Mk2 has had over 50 successful launches, recording for 60 days per launch and being recovered to change the batteries, get the data and check for possible damages. These maintenance routines give us the opportunity to acquire knowledge in various areas, including fouling and how it disturbs sound capture, and how to brush the equipment without damaging it.

The data collected have good quality, specially concerning naval acoustic signatures, since the equipment was deployed in coastal areas with intense naval activities. The data will support present and future research related to the acoustic landscape, animal and naval acoustic signatures, and how they affect each other, among other topics.

Meanwhile, many improvements in the Mk2 have been made to overcome challenges that have cropped up. Since October 2019, the IPqM project manager has been developing the next generation of sound recorder, the SAASS Mk3. It will achieve better sound quality, with more days of data acquisition in deeper waters.

The development of the SAASS recorders allowed the IPqM engineers to obtain the know-how that is now in use in other projects. The first one is the Virtual Shooting Range to tune the aim of naval cannons. The mechanical structure will be used to build a national acoustic release with pop-up buoy and, maybe in the future, a profiling float. Today, the IPqM staff has the knowledge to develop

	University's Recorder	Imported Commercial Recorder	SAASS Mk1 (prototype)	SAASS Mk2 (in use)	SAASS Mk3 (in development)
Main module	Proprietary custom PCB	Proprietary custom PCB	Retail interview recorder	ARM Cortex M3 based custom PCB	ARM Cortex M4 based custom PCB
Max sample rate (kHz)	48	96	96	48	192
Resolution (bits)	16	24	24	16	24
Autonomy (days)	45	60	15	60	90
Max depth (meters)	70	2,000	30	30	1,000
Memory cards	4 μ SD	16 SD	1 SD	5 μ SD	16 μ SD
Supervision sensors	-	Battery voltage, battery current	-	Battery and MCU voltage	Battery and MCU voltage, battery current, internal temperature and humidity
Antifouling	-	-	-	Hydrophone with antifouling painting	Hydrophone with antifouling painting and UV LEDs
Estimate cost (USD)	2,000-4,000	30,000	400	3,000	3,500

many underwater data acquisition systems, thanks to the development work on SAASS.

Conclusion

In the span of four years, the engineers from IPqM achieved remarkable progress, developing national technology in firmware, mechanical and hydrophone areas. All of this work was conducted in an environment with many financial and bureaucratic setbacks.

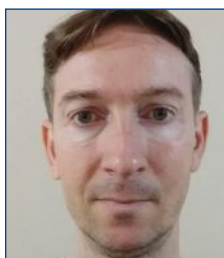
The IPqM achieved the goal of developing an autonomous underwater acoustic recorder, tested more than 50 times, in 60-day operations, through three different sites. Many improvements are to come: advancing the project to a new observatory, which will expand the reach to four sites, and further developing the SAASS Mk3, which will increase quality, autonomy and depth to our recordings.

We wish to improve our equipment for formal qualification, with the possible goal of the IPqM becoming a player in the worldwide market of acoustic recorders and subsea devices. **ST**

Rafael Mazza Buchmann is an electronic engineer, with a master's degree in oceanographic instrumentation and underwater acoustics. He is currently developing and maintaining underwater equipment for the Underwater Acoustic Landscape Monitoring Project in the Santos Basin, at the Brazilian Navy Research Institute.



Eduardo Bernsmüller is an electrical engineer, with a master's degree in power electronics. He is currently developing an underwater recorder for the Underwater Acoustic Landscape Monitoring Project in the Santos Basin and the Virtual Shooting Range at the Brazilian Navy Research Institute.



international

Lightning Prevention Distributor in Middle East

Elcome International has been appointed exclusive distributor for the CMCE Sertec Marine deionizing lightning prevention systems in several Middle East countries. Elcome will have responsibility for sales, engineering, consulting, installation, commissioning, maintenance, service and technical support for CMCE Sertec Marine in the United Arab Emirates, Oman, Kuwait, Saudi Arabia, Bahrain and Qatar.

The CMCE Sertec Marine lightning suppressor, derived from discoveries of Nikola Tesla in 1916, practically eliminates direct lightning impacts on protected structures by 99 percent through the deionization of electrostatic charge. Unlike a conventional lightning rod, it works by preventing the formation of lightning.

THURN Buys USV

THURN Group in the U.K. has purchased a new SL40 autonomous survey vessel from OceanAlpha in Hong Kong. The 32-kg, 1.6-m vessel will be equipped with 40 Ah of lithium-polymer batteries for up to 10 hr. of endurance at survey speeds, with waterjet propulsion, data and control telemetry, a video monitoring system, collision avoidance sensors, and USV mission planning software.

Food Insecurity in Pacific as Global Warning

The COVID-19 pandemic exposes weaknesses in the supply chain when countries go into lockdown. UC Santa Barbara marine conservationist Jacob Eurich and collaborators watched food security become vulnerable in the island nations in the middle of the Pacific Ocean, from New Zealand to French Polynesia, including the Marshall Islands to Papua New Guinea. While infection with SARS-CoV-2 has been slow there relative to other parts of the world, the global lockdown can have outsized effects on their food systems. One of the key messages from the research is to rely less on global food supply chains.

Report Calls for More Fisheries Transparency

In a new report commissioned by the High Level Panel for a Sustainable Ocean Economy—a unique initiative of 14 serving world leaders building momentum toward a sustainable ocean economy—leading experts highlight the threat of organized crime in the fisheries sector and its growing economic, social and environmental impacts. “Organised Crime in the Fisheries Sector” outlines clear steps that must be taken in order to achieve greater transparency at sea to help fight organized crime.

BV Expands in North America

Bureau Veritas (BV) has taken a number of steps in North America to broaden and deepen its marine and offshore client services and customer focus. The opening of a new remote survey center in Miami is the latest step in the delivery of digital services. Complementing BV’s digital ambitions, a new physical survey center has been

opened in Seattle to provide additional surveyor coverage in the immediate Washington state area and in-depth strength along the West Coast.

Sat Images Monitor Fish Spill

Chile is the world’s second largest producer of salmon. In June, there was a complete collapse of a marine harvesting site that contained a total biomass of 2,900 tons of fish. The site sank on June 27 at 295- to 310-m depth in the eastern area of Reloncaví Bay in southern Chile.

Six days after the event, Sentinel-1 satellites of the European Copernicus program revealed the first signs of fish oil on the sea surface, at 740-m distance from the sunken module. On July 5, the slick measured more than 7 km in a southwest direction. The plume was still visible and more extensive in August.

The fish oil can be detected on the radar images because it affects sea surface roughness. It has not been previously documented that SAR technology has been applied to marine harvesting sites or fish farming in lakes.

New Distributor for SubSeaSail

SubSeaSail LLC has appointed BlueZone Group as its exclusive distributor for Australia and New Zealand. Based in San Diego, California, SubSeaSail designs and manufactures unmanned semisubmersible vessels that are wind-propelled and solar-powered.

Digital Ocean Brand

KONGSBERG plans to increase investment in maritime digital solutions, focus on building strong partnerships and combine Kongsberg Digital’s two maritime divisions into one brand: Digital Ocean. Digital Ocean will be headed up by former SVP Energy and digital twin expert Andreas Jagtøyen.

Intelligent Vessel Systems in MMA Curriculum

Boston-based Sea Machines Robotics has partnered with Maine Maritime Academy (MMA) and representatives of the U.S. Maritime Administration (MARAD)’s Maritime Environmental and Technical Assistance (META) Program to bring valuable, hands-on education about autonomous marine systems into the MMA curriculum. The academy will provide instruction to cadets using MMA’s 41-ft. Coast Guard cutter-class workboat RV *Quickwater*, which is being outfitted with Sea Machines’ SM300 autonomous control system, and a shore-side command station located on campus.

MIND Technology Shift

MIND Technology Inc., formerly Mitcham Industries Inc., has completed the reincorporation of the company from the state of Texas to the state of Delaware. This includes a name change to MIND Technology Inc., as well as the rebranding of the company’s operations to MIND Technology. No changes have been made to the board of directors, management, business or operations of the company as a result of the reincorporation. The corporate headquarters will remain in Texas.

Ecochlor Receives IMO BWMS Type Approval

Ecochlor has received type approval from the Norwegian Maritime Authority for the IMO BWMS Code (MEPC.300(72)/revised 2016 G8) standards. The new certification applies to the entire range of Ecochlor ballast water management systems (BWMS), with flow rates between 500 and 16,200 m³/hr., meaning that vessel owners may continue to install Ecochlor's BWMS after the IMO BWMS Code October 28, 2020 deadline.

Tracking Cables on Land and Underwater

Commercial Diving & Marine Services Inc. has used its JW Fishers CT-1 cable tracker and Pulse 8X for two projects that required locating a 6-in. steel gas main. In the first project, the main was located on the shoreline of the river, but the exact location was unknown. In the second project, the general area of the pipe was known but the exact location was needed to allow for a bridge contractor to drive sheet pile.

Mapping of Liberty Ship off Texas

TDI-Brooks recently mapped the Liberty ship *George Vancouver* off Freeport, Texas, while out on a seabed survey project with the RV *Brooks McCall*. The multiple multi-phase geophysical and geotechnical site surveys program consisted of pipeline routing and subsea structures to facilitate route and project design for offshore developers.

Equipment used to map the ship was a Teledyne RESON SeaBat T-20 multibeam sonar with integrated Applanix POS MV.

DMO Partners with SouthernTech

Del Mar Oceanographic (DMO) and SouthernTech have partnered to cover Chile and other select parts of South America.

SouthernTech is led by enthusiastic native Chilean aquaculture specialists and located in the heart of the Southern Hemisphere's aquaculture industry. With ties to academia and representing ocean-sensing technologies in the region, SouthernTech is well positioned to provide a broad range of environmental and technology solutions to both industry and academia. The addition of the DMO Wirewalker to its portfolio will support Chilean ocean sciences by bringing unprecedented vertical resolution and autonomy through rapid wave-powered profiling.

New Water-Taxi Docks on the Nile

For 3,000 years, people have plied the Nile River for travel and commerce. In Mansoura, Egypt, the tradition continues, albeit far more modernized. Home to nearly 1 million residents, the metropolitan city recently opened a series of new water-taxi docks.

Built by SF Marina, the project is the first of two phases. The first consists of four stations; the second phase will add two additional stations and is scheduled for delivery later this year.

The Mansoura water-taxi docks are built using SF Marina's floating concrete pontoons, which are steel-reinforced to guard against sinking. **ST**

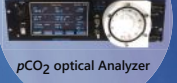
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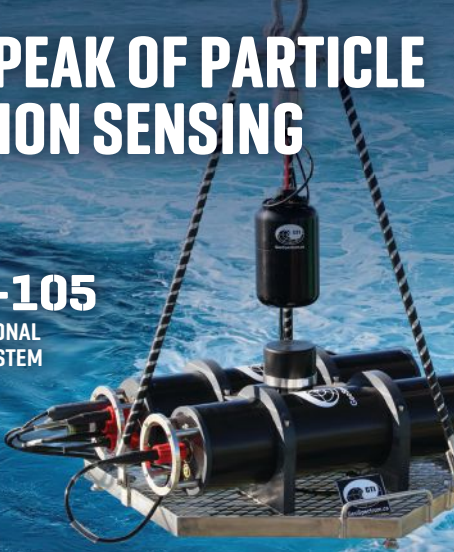
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Oyster Aquaculture Could Improve Potomac River Estuary
Oyster aquaculture in the Potomac River estuary could result in significant improvements to water quality, according to a new NOAA and U.S. Geological Survey study published in *Aquatic Geochemistry*. All of the nitrogen currently polluting the Potomac River estuary could be removed if 40 percent of its live oysters were used removed to the joint study. [2-23-SeaTech.com](#)

Navy's Laser Weapon Ready For Summer Deployment
Navy engineers are making final adjustments to a laser weapon prototype that will be the first of its kind to deploy aboard a ship late this summer. The prototype, an improved version of the laser weapon system, will be installed on the USS Zumwalt (DDG 1000) in the Persian Gulf. Navy leaders have made dramatic threats, weapons a top priority to counter what they call asymmetric threats, including unmanned and light aircraft and small attack boats that could be used to deny U.S. forces access to certain areas. [2-23-SeaTech.com](#)

Ferry Sinks Off Coast of South Korea
With 462 passengers onboard, a ferry sailing from Incheon, South Korea, to the island Jido sank near the southern tip of South Korea Wednesday, near the southern tip of South Korea. Most of the more than 400 people on the ship were high school students headed for a school trip to the tourist island. In the rescue effort, more than 80 vessels and at least 18 aircraft sought in the pull passengers from the water to safety. [2-23-SeaTech.com](#)

Pay Increase for Sailors Soon to Come
Sailors working for the U.S. Navy could see a pay raise in the coming weeks, reported the Virginia Pilot. On May 1, sailors serving aboard ships will receive a pay raise. The increase in pay comes as an effort by the Navy to increase the attractiveness of the job to those who work in jobs involving long deployments. Currently, the pay is between \$10 and \$700 a year. [2-23-SeaTech.com](#)

US Senate Reviews DOE Budget Request
For fiscal year 2015, the Department of Energy requested \$20.1 billion. The U.S. Senate Appropriations Committee, Subcommittee on Energy and Water Development, held a hearing last week to review the funding request and discuss financial priorities. According to Lamar Alexander (R-Tenn.), research should be a focus of spending. [2-23-SeaTech.com](#)

US Technology Helps in Search for Flight 370
More than a month after Malaysia Airlines Flight 370 went missing, crews are hard at work trying to uncover what happened to the Boeing 777. Acoustic signals emitted from the plane's black box, which houses records from the flight, provide a lead to the location of the plane, and right now, countries are participating in the effort to scan the waters off the coast of Northwest Australia. Crews believe the U.S. Navy is helping in the search. [2-23-SeaTech.com](#)

2014 Sea Technology Buyers Guide Now Available
Published annually by Compass Publications, the 2014 edition of the *Sea Technology Buyers Guide* is now available. The Buyers Guide features a market analysis and sector sub-directories, including industrial firms, services, federal government organizations, educational institutions, oceanographic research vessels and specialty survey vessels.

Featuring the government and industry news you need to know, *Sea Tech e-News* delivers timely information straight to your inbox, with details on recent product releases, updates on new hires and promotion, and workshops. We send out the newsletter every other week, so you'll get a steady stream of news edited down to what matters most.

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Portable Communications Kit



Weighing approximately 20 kg, the lightweight kit is simple to operate and offers fast mobility by forces in the field, helping to prevent their exposure to hostile elements. The single-pack kit enables communication by small ground units with a range of platforms, including unmanned systems with line-of-sight of up to 45 km, loitering munition, and OPVs within 15 km of the shoreline. Commtact Ltd.

Autonomous Landing

Landing systems transfer people and essential items between a vessel and oil/gas platform or wind turbine generator, compensating for the movement of the ship and the sea for safe use in adverse conditions. This new solution eliminates the need for manual control. It is available on newbuilds and for retrofit later this year on Barge Master motion-compensated gangways. Bosch Rexroth AG and Barge Master B.V.

Bridge Safety Update

eGlobeG2 ECDIS now has DNV GL type-approval revision. In an industry first, eGlobeG2 has been certified compliant with IEC62923-1 and IEC62923-2 standard alert and cluster identifier for bridge alarm management (BAM). ChartWorld GmbH.

Compass for Rough Water

The 4.5" SS-2000 SuperSport Navigator is suitable for offshore harsh conditions. Featuring PowerDamp technology and DirectiveForce magnets, the high-visibility blue

card is smooth and quick to respond to course changes. Ritchie Navigation.

FLS for Survey

FarSounder's Argos forward-looking sonars (FLS) have been integrated into the Qinsy survey software package. Argos sonar users are now able to display their FLS bathymetric data in the Qinsy platform along with other survey data. Quality Positioning Services B.V.

Underwater Imaging

Ivanoff-inspired LiquidOptics is a new feature for SubC's smart cameras with water correction and a sapphire construction for durability and impact resistance. UltraOptics provides an ultrawide field of view. SubC Imaging.

LED Light



SeaStar is a compact, high-powered and lightweight LED light that delivers 10,000 lumens output with full-range dimming capability. The SeaStar is completely field serviceable and available with flood or spot reflector options. It is depth-rated to 6,000 m. Remote Ocean Systems.

ROV Management

The REVOLUTION NAV package provides the ability to monitor an ROV's trail as it moves through the water on a Google Map while allowing waypoints to be set and data to be tracked over time. It also offers autonomous capabilities such as station-holding in current and altitude-holding, and will eventually pave the way to a hybrid auton-

omous vehicle with waypoint navigation capabilities. Deep Trekker Inc.

Software Update

SonarWiz 7.6.5 is now available, featuring: faster loading of side scan projects; improved color palette displays and options; new SEG-Y option to compute depth from fathometer and altitude; values to shaded relief sliders and other user interface enhancements; and improvements for handling Klein MAX-600 and Norbit WH sensors. Chesapeake Technology Inc.

Marine Engine



Cat C32B 2000 HP (2025 MHP) has a rated engine speed of 2,300 rpm. This engine meets emerging market demands and expands the power capability of the C32 high-performance product line, delivering a 5 percent power increase over existing C32 ratings. Caterpillar Marine.

Coronavirus Containment

IND-HL-HDB-BX55-120V-15C is a powerful UV-C handheld surface sanitizer that disinfects 99 percent of bacteria, viruses (including coronavirus) and other contaminants safely, effectively and fast. This unit operates in the germicidal UV range of 200 to 280 nm (254 nm). Larson Electronics.

Satellite Messenger

SPOT Gen4, the new generation of the SPOT Satellite GPS Messenger, is now available in EMEA. New features include a more detailed mapping interface with more display options, improved product specifications for water resistance, and geofencing capability. Globalstar Europe Satellite Services Ltd.

Turnkey Lay-Up Services

CO₂ LP, developed in collabora-

tion with a leading European-based shipowner, simplifies decommissioning and recommissioning procedures by ensuring CO₂ low-pressure (LP) firefighting systems are correctly deactivated when ships enter lay-up. Survitec Group Ltd.

Underwater Hydraulic Tool

BHT-2000 Brocoda can be used for grinding, polishing, drilling and cleaning with a variety of wheels, brushes and other attachments. Applications include construction, cleaning of ship hulls and propellers, underwater cutting, salvage, demolition, welding preparation, and cold cutting concrete and steel. Broco Rankin.

Raw Water Engine Cooling Pumps

Replacement pumps for Cummins Onan generators are ISO-9001 certified, with heavy-duty cast bronze bodies and corrosion-resistant fittings, mechanical seals, stainless-steel wear plates and marine-grade nonmagnetic shafts. JMP Marine LLC.

Reservoir Analysis Software

RockProp combines mud log and drilling data with physical properties measured from cuttings to output reservoir parameters. It provides an assessment along vertical or horizontal wellbores that is independent of log models, which can be used to refine 2D and 3D reservoir models, improve geosteering, optimize completion designs and better characterize well potential. Cuttings Alliance.

Sonar Frequency Combo

Ideal for shallow-water USVs and UUVs, the 850- and 1,600-kHz dual-frequency combination provides high-resolution side scan sonar imagery and optional bathymetry at 850 kHz. EdgeTech.

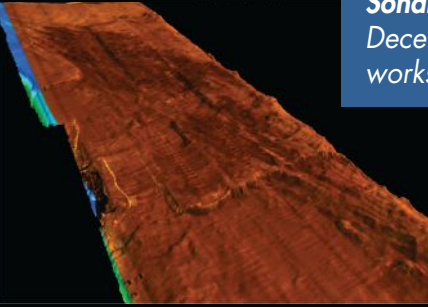
Low-Drag Bionic AUV

PingGuin was developed as part of the MUM (Modifiable Underwater Mothership) collaborative R&D project. It is inspired by the hydrodynamic properties of a penguin's body. EvoLogics GmbH. **ST**



SonarWiz 7.7 Coming Soon

- ◆ Cloud Licensing – run DFLs on AWS & Azure
- ◆ Auto-trace & identify multiples in SBP
- ◆ CDF file split - by mouse, time, ping, feature
- ◆ Single import function for multiple data sets
- ◆ XTF file split by sensor for greater convenience
- ◆ New Klein MA-X 600 and Dolphin Seaview drivers



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Mutual Support by Canada, US For Offshore Wind

Marine Renewables Canada and the Business Network for Offshore Wind have entered into an affiliation agreement to share knowledge and support the development of offshore wind. The two organizations have been key drivers for offshore wind in their respective countries, and the agreement will increase collaboration to benefit industry in Canada and the U.S.

Offshore wind in the U.S. is a fast-growing market, presenting new economic opportunities and a clean energy resource.

While Canada does not have active offshore wind development yet, many suppliers have decades of experience from working in related marine and offshore industries that could contribute to helping the U.S. meet its offshore wind goals.

Ongoing Site Characterization For Atlantic Shores

Fugro has mobilized three additional vessels off the coast of New Jersey to support ongoing site characterization work for Atlantic Shores Offshore Wind, a joint venture between Shell New Energies US LLC and EDF Renewables North America. Operating in the Atlantic Shores lease area since May, Fugro now has four vessels on site.

The project involves collection of high-resolution geophysical, benthic and shallow geotechnical data within the lease area and along two proposed export cable routes. These data will be processed and analyzed to characterize site conditions, including bathymetry, seafloor morphology, subsurface geology, environmental and biological sites, seafloor obstructions, soil conditions, and archaeological resources.

Atlantic Shores could generate up to 2,500 MW of renewable energy for residents of the Mid-Atlantic.

Carbon Capture, Reuse

Nine Japanese companies have started the Ship Carbon Recycling

Working Group (WG), formed within Japan's Carbon Capture & Reuse (CCR) Study Group, and held its first meeting. The participating members are: EX Research Institute Ltd., Hitachi Zosen Corp., Japan Marine United Corp., JFE Steel Corp., JGC Corp., Mitsui O.S.K. Lines Ltd., Nippon Kaiji Kyokai (ClassNK), Nippon Steel Corp., and Sanoyas Shipbuilding Corp.

As the effects of climate change become apparent, carbon recycling, a method used to capture and reuse emitted carbon dioxide, is attracting attention as one of the paths to a decarbonized society.

Formed within the CCR Study Group in August 2019, the WG aims to explore the feasibility of the concept of utilizing methanation technology for zero-emission ship fuels. Through its activities, the WG aims to reduce greenhouse gas emissions to zero in sea transportation, which accounts for 99.6 percent of Japanese imports and exports, and thereby contribute to the formation of a sustainable society.

Specifically, the nine companies listed above plan to assume carbon recycling supply chain of methanation fuel that involves the supply of feedstock CO₂, transportation of the feedstock, methanation, and conversion into marine fuel. They will calculate the estimated amount of CO₂ emissions in the supply chain, and based on these results, identify technical challenges and develop a roadmap for realization.

Partnership to Advise, Service Japan Offshore Wind

Global energy consultancy Xodus Group has agreed on a partnership with Japanese consultancy E&E Solutions to deliver in-depth advice and analysis for the fast-developing offshore wind market in Japan. The collaboration will bring together Xodus Group's international track record in helping clients address industry challenges to enable offshore wind, alongside E&E Solutions' extensive experience of providing environmental and renewable en-

ergy consulting services across Japan. The partnership will provide integrated advisory and technical services to deliver value to offshore wind developers, owners, operators and lenders.

As consultants for wind projects in Japan, E&E Solutions has significant local market knowledge, including an extensive understanding of Japanese environmental laws and the country's leasing and consenting system.

Xodus's expertise in offshore wind includes techno-commercial advisory capabilities, subsea infrastructure, pipelines and cables engineering, offshore engineering, risk management, environmental, supply chain analysis and project development planning. Xodus has a track record in the European and Asian offshore wind, cables and interconnectors market.

International Status for EMEC

The European Marine Energy Centre (EMEC) has been designated with Renewable Energy Testing Laboratory (RETL) status, the highest international designation for marine energy test laboratories.

EMEC is the first RETL for ocean energy in the world.

RETL designation is awarded by the International Electrotechnical Commission – Renewable Energy System (IECRE), which operates a global certification system addressing three renewable energy sectors: solar photovoltaic (PV), wind energy and marine energy.

Up until now, EMEC could perform accredited performance assessments within the U.K. RETL designation enables EMEC to perform tests to assess the power performance of tidal energy converters anywhere in the world in compliance with IEC TC 114 Technical Specifications (precursors to international standards).

For now, the RETL designation only covers the power performance assessment of tidal energy converters. However, the IECRE System is in the process of expanding such a designation to cover wave energy converters and additional competence areas. **ST**

HYPACK Max Supports Surveys During Pandemic

Cornwall Inshore Fisheries and Conservation Authority has invested in sonar technology for its survey works throughout its district. The HYPACK Max technology, supplied by Hayle-based survey support company Swathe Services, can be operated remotely and has been essential for performing surveys under COVID-19 restrictions.

It has been used for logging seabed surveys, including subsea camera surveys and side scan sonar surveys, which are used to describe seabed texture and feature locations. It has been operated off-site and remotely.

Damen Partners with Echandia

Damen Shipyards and Echandia have cemented a global partnership, combining Echandia's DNV-certified E-LTO energy systems and battery expertise and Damen's tugboat experience.

The first project will be a fully electric ship-handling tug, the first of its kind in the world, to service New Zealand's largest container and international trade terminal, the Ports of Auckland Ltd. This port manages over half of New Zealand's imports and exports, as well as servicing hundreds of thousands of cruise ship voyagers each year.

The RSD-E Tug 2513 will be a zero-emissions derivation of the IMO Tier III-ready RSD Tug 2513, introduced by Damen in 2018.

Echandia's E-LTO energy storage system (ESS) is a smart, highly scalable, air-cooled modular design system based on Toshiba LTO cells. The 2.8-MWh ESS is optimized for the RSD-E tug application and will be type-certified by Bureau Veritas.

Ricardo's First Remote Certification Engine Testing

To continue to enable marine sector customers to check their products' compliance with upcoming international regulations to prevent air pollution from ships, Ricardo has implemented a vir-

tual certification test service. This enables the witnessing agent, customer and its subsystem supplier to observe tests and validate quality checks safely and remotely.

With travel restrictions, quarantine procedures and social distancing measures in effect to try to control the COVID-19 pandemic, Ricardo's digital-first strategy is enabling the company to offer customers in the marine sector an advanced, virtual emissions testing and certification service.

IMO Marpol Tier III regulations, which relate to the prevention of air pollution from ships, will apply to shipping in the North Sea and Baltic Sea from January 2021. Ricardo worked with its Norwegian-based customer Bertel O. Steen Power Solutions to provide a virtual certification service to certify a large marine engine series. This was the first time Ricardo has undertaken an IMO Tier III virtual certification testing event for a maritime customer.

Bertel O. Steen Power Solutions arranged for the engine to be shipped to the test facility at Ricardo's Shoreham Technical Centre. The Ricardo team provided a suite of IT solutions to streamline the remote certification test process. These included fixed and portable camera technology to enable inspection of the test-cell and the emission measurement system checks, and a comprehensive connection of virtual network connectivity to consolidate multiple systems: the test automation system data display, test-cell live camera, engine management system and selective catalytic reduction control subsystem, all of which were orchestrated centrally by the test engineer to continually adapt the presentation display securely via Microsoft Teams to suit the witnesses requirements, while operating an efficient compliance testing schedule.

The customer, the supplier and the independent witnessing agent (DNV GL) were able to observe the remotely performed emissions tests, validate quality checks, and par-

ticipate in the test and certification virtually, without the need for travel.

ROBOSHIP in Development

e5 Lab Inc. in Tokyo has started developing the ROBOSHIP, a standard model of electrically powered vessels to realize zero emissions, as well as an integrated system called the ROBOSHIP BOX, which brings together telecommunications, the Internet of Things (IoT) and software. This initiative addresses critical issues facing Japan's ocean shipping and maritime industries, including a shortage of seafarers, environmental concerns, safety and the sustainable growth of the shipbuilding/ship machinery sectors. With partners in Japan and overseas, the development project team targets the commercialization of electric-powered merchant vessels that adopt world-class propulsion systems at the most competitive price in the global market.

MKII USV for Tetra Tech

The Marine Services Division of Tetra Tech has taken delivery of an Unmanned Survey Solutions' Inception-class MKII USV with a bespoke cooling system and two additional survey instrumentation pods for harbor survey projects.

The first payload pod has been fitted with an R2Sonic 2020, SBG Ekinox-D, Valeport SVS and HYPACK HYSWEEP software for high-resolution multibeam data acquisition. A second pod will be fitted with an EdgeTech side scan sonar and the third with a single-beam echosounder, both for subsequent operation in the U.S.

ABB, Kongsberg Cooperation

ABB Turbocharging and Kongsberg Digital have signed a cooperation agreement on edge data collection and ship engine performance analysis. The agreement will enable ABB Turbocharging to use Kongsberg Digital's Vessel Insight as an additional data infrastructure service for ABB Turbocharging's digital solutions. Such exchange of data between cloud platforms is fundamental to enabling remote diagnostics on vessel engines. **ST**

Patent for Sub Rescue System

Global Aerospace Corp. (GAC) has patented (US 10,683,071) a passive system to decompress the air within a crew compartment of a disabled submarine (DISSUB) thousands of feet below the surface of the ocean. The patent addresses possible DISSUB scenarios that could lead to a crew suffering from nitrogen narcosis, oxygen toxicity or possible decompression sickness during rescue.

With a simple and passive Submarine Compartment Pressure Relief System (SCPRS) on board, a crew could reduce or stabilize the compartment air pressure without external assistance or submarine energy sources and significantly increase their own chances of a safe rescue.

SCPRS creates a physical atmospheric connection between the pressurized DISSUB compartment(s) and the ocean surface; enables venting and equalization of compartment overpressure directly to the sea surface atmosphere; accommodates a wide range of depths from hundreds to thousands of feet; and is a solution that does not require shipboard power or excessive crew exertion.

The inventors are Kim M. Aaron and Kerry T. Nock.

Reef Habitat Structures For Chesapeake Bay

The Coastal Conservation Association-Maryland Chapter has received 60 reef balls constructed by union apprentices in Gloucester City, New Jersey. The reef balls will be placed in the Chesapeake Bay to enhance critical fisheries habitat.

Earlier this year, a crew of apprentice plasterers and concrete finishers from the Operative Plasterers' and Cement Masons' International Association Local 592 training center set molds and poured concrete to construct the reef ball habitat structures.

Apprentices pursuing careers in a variety of skilled union trades are a potent source of volunteer labor

in conservation, public access and outreach projects organized by the Union Sportsmen's Alliance's Work Boots on the Ground (WBG) program. Launched in 2010, the program has completed 244 projects in 30 states, plus D.C. The value of volunteer labor donated through WBG exceeds \$1.6 million, and outreach events have engaged more than 13,000 participants.

Union apprentices—who spend the work week on the job earning a living while advancing their careers and trade skills—play a vital role in these efforts.

eAcademy Technical Courses Accessible Worldwide

Bureau Veritas (BV) has launched the BVS eAcademy to provide online learning to a global audience. The eAcademy is led by BV Solutions Marine & Offshore, the technical advisory, asset management and assurance solutions provider dedicated to marine and offshore energy markets.

Offering more than 25 maritime courses, BVS eAcademy was developed from BV's own internal training academy, which, since 2016, has delivered more than 20,000 training sessions to over 1,500 BV staff.

All courses are delivered online and on demand. The e-learning modules allow students to set their own pace and manage their own learning experience in a carefully structured, engaging format. Suitable for maritime professionals, or students looking to develop their awareness and understanding of specific areas of expertise, the courses address technical areas in: naval architecture; materials, welding and nondestructive testing (NDT); rules and regulations; and classification and statutory matters.

Joint Venture for Digital, Flexible Recruitment

ETPM, an Aberdeen-based sub-sea and marine recruitment specialist, has a new joint venture with Glasgow-based start-up Nudge Ex-

change. Nudge Exchange has developed a platform to connect agile companies with a flexible workforce. The company is a resource for employers that have a resourcing requirement for a project that they need to fill efficiently and in line with current IR-35 legislation.

The technology being developed digitalizes the process from engagement through payment by using artificial intelligence to enhance efficiency and user experience. Nudge Exchange's concept is currently going through the Oil & Gas Technology Centre's TechX accelerator, a 16-week commercialization program to ensure it is ready for launch early next year.

The use of contracted staff is predicted to grow substantially by 2023 to 2024.

Smart Ship Guidelines

ClassNK has released its Guidelines for Digital Smart Ship, which stipulates the procedures for class notations for ships with advanced digital technology.

The guidelines are part of the society's new initiative, Innovation Endorsement, the goal of which is to certify innovations utilizing digital technology.

The Digital Smart Ship Guidelines set out the requirements to grant class notations for ships that are equipped with systems utilizing digital technology, such as energy-efficiency analysis, hull or machinery monitoring, sloshing detection and prediction, onboard data processing and data transmission to shore, routing/speed optimization, and remote monitoring/operation.

ClassNK will add and update the guidelines in response to future industry needs and advances in digital technology so that the society continuously supports the industry's efforts to promote and develop innovative technology.

The guidelines are available to download free of charge via ClassNK's website, www.classnk.com, for those who have registered for the ClassNK "My Page" service. To register, go to www.classnk.com and click on the "My Page Login" button. **ST**

Study Suggests Ocean Ion Ratios Are Not Constant

Ocean chemistry is a complex mixture of particles, ions and nutrients. For over a century, scientists believed that certain ion ratios held relatively constant over space and time. But now, following a decade of research, a multinational study has refuted this assumption. Debora Iglesias-Rodriguez, professor and vice chair of UC Santa Barbara's Department of Ecology, Evolution, and Marine Biology, and her colleagues discovered that the seawater ratios of three key elements vary across the ocean, which means scientists will have to re-examine many of their hypotheses and models.

Calcium, magnesium and strontium (Ca, Mg and Sr) are important elements in ocean chemistry, involved in a number of biologic and geologic processes. For instance, a host of different animals and microbes use calcium to build their skeletons and shells. These elements enter the ocean via rivers and tectonic features, such as hydrothermal vents. They're taken up by organisms like coral and plankton, as well as by ocean sediment.

The first approximation of modern seawater composition took place over 130 years ago. The scientists who conducted the study concluded that, despite minor variations, the ratios between the major ions in the waters of the open ocean are nearly constant. Researchers have since generally accepted this idea, based on the slow turnover of these elements in the ocean—on the order of millions of years.

Seawater ratios of Mg to Ca affect the composition of animal shells. For example, a higher magnesium content tends to make shells more vulnerable to dissolution, which is an ongoing issue as increasing carbon dioxide levels gradually make the ocean more acidic.

Mussels Inspire Adhesives

Jonathan Wilker, a Purdue professor of chemistry and materials engineering, is studying the chang-

ing chemistry of seawater to see how it may affect the ability of animals to stick. His team will use these insights to design adhesives for consumer products.

Wilker has spent years investigating how marine mussels secrete sticky plaques for attaching themselves to wet surfaces. His research group uses these discoveries to create new, biomimetic adhesives for everything from electronics and vehicles to construction structures and cosmetics.

They found that the strength of the mussels' adhesive tracked with iron levels in the surrounding seawater. When there was less iron, the glue was weaker. More iron than normal brought about the strongest bonding. But at an extreme excess of iron, performance dropped.

There is also a link for this work to ongoing climate change. Most iron in seawater is particulate. Mussels are filter feeders, and they collect their food, including iron, by filtering the water. As the oceans become more acidic, iron transitions from solid to more dissolved forms. In the years to come, if less iron is in solid forms, mussels will have difficulty capturing the iron that they need for making their adhesive.

Ocean Acidification Web Tool

A new scientific model and associated web tool will help scientists, resource managers, fishermen and decision makers understand ocean acidification in the Gulf of Alaska.

Ocean acidification occurs when human-made carbon dioxide building up in the air is absorbed by the ocean, lowering its pH and often creating poor conditions for crabs, mollusks and other marine organisms.

Despite its relevance to commercial and subsistence fishing, ocean acidification is poorly understood in Alaska. University of Alaska Fairbanks (UAF) researcher Claudine Hauri is working to change that by providing a way to identify ocean acidification hotspots, seasonal patterns and long-term trends.

Hauri, a chemical oceanographer at UAF's International Arctic Research Center, and her team developed a user-friendly web tool: <https://portal.aooos.org/gulf-of-alaska.php>. With it, people can create maps, plot data and view statistics for over 100 ocean variables, including temperature, salinity, pH and carbon dioxide in the water. Many of the variables are linked to ocean acidification and climate change.

The data are 3D, so users can explore conditions at different depths. They also can compare over 30 years of simulations to see how ocean acidification is changing.

Methane Leakage Linked to Climate Change

Together with researchers from Brazil and France, professor Marcello Ketzer and his colleagues at Linnaeus University have discovered methane gas leakage from gas hydrate dissociation caused by climate change, something that has never been witnessed in the Southern Hemisphere before.

Gas hydrate is an ice-like substance formed by water and methane at depths of several hundred meters at the bottom of the oceans at high pressure and low temperatures. Methane is a potent greenhouse gas, roughly 25 times more potent than carbon dioxide, and it is estimated that methane frozen in these sediments constitute the largest organic carbon reservoir on Earth.

The fact that methane gas has now started leaking out through gas hydrate dissociation is not good news for the climate.

Methane leakage could lead to a feedback loop in which ocean warming melts gas hydrates, resulting in the release of methane from the ocean floor into the water. The warmer it gets, the more methane leaks out. The hydrate dissociation and related methane leakage is a long-term process that can last for several centuries, and it can lead to a significant amplification of climate change effects and changes in ocean chemistry, for instance, further acidification. **ST**

meetings

Note: The coronavirus (COVID-19) pandemic could affect event dates. Check event websites for the latest updates.

NOVEMBER

November 3-5—Marine Renewables Canada Conference, Halifax, Canada. amanda@marinerenewables.ca.

November 5—Marine Renewables Canada Fall Forum, Halifax, Canada. <https://marinerenewables.ca/marine-renewables-canada-2020-fall-forum-november-5-2020>.

November 5—North American Marine Environment Protection Association Annual Conference, New York City. <https://namepa.net/event/2020-annual-conference-and-awards-dinner>.

November 10-12—Marine Autonomy & Technology Showcase, Southampton, England. dcook@noc.ac.uk or <https://noc-events.co.uk/mats-showcase-2020>.

November 16-20—BlueTech Week, San Diego, California. www.tmatbluetech.org/bluetech-week.

DECEMBER

December 1-3—Oceanology International London, London, England. +44 (0)1202 669244, j.riegal@saltwater-stone.com or www.oceanologyinternational.com.

December 1-17—American Geophysical Union Fall Meeting, Virtual. 202-777-7396 or www.agu.org/fall-meeting.

December 2-3—LNG Latin America & the Caribbean, Buenos Aires, Argentina. <http://LNGlatinamerica.com>.

December 8-10—UDT, Rotterdam, Netherlands. www.udt-global.com.

December 16-17—West Coast Defense Contracting Summit, San

Diego, California. 202-552-0179 or marketing@defenseleadershipforum.org.

2021

JANUARY

January 5-9—NCSE & Drawdown: Research to Action Conference, Virtual. <https://tinyurl.com/yygp6o8>.

January 19-20—Floating Wind Solutions Conference & Exhibition, Houston, Texas. 832-862-3390 or <https://floatingwindsolutions.com>.

FEBRUARY

February 2-5—SMM (Shipbuilding, Machinery & Marine Technology), Hamburg, Germany. +49 40 3569 2445, nora.hirschfeld@hamburg-messe.de or www.smm-hamburg.com.

February 23-25—Subsea Expo, Aberdeen, Scotland. www.subseaexpo.com.

February 25-26—Floating Wind Solutions, Houston, Texas. <https://floatingwindsolutions.com>.

MARCH

March 2-4—World Ocean Summit & Expo, Lisbon, Portugal. <https://events.economist.com/events-conferences/emea/world-ocean-summit>.

MAY

May 18-20—Aquaculture UK, Aviemore, Scotland. +44 (0)1453 836363, www.aquacultureuk.com or carvonio@divcom.co.uk.

JUNE

June 15-17—Seawork and Marine & Coastal Civil Engineering Expo, Southampton, England. www.seawork.com and www.mcceexpo.com.

SEPTEMBER

September 13-17—London International Shipping Week, London, England. +44 1296 682104, ljacobs@elabor8.co.uk or <https://londoninternationalshippingweek.com>.

For more industry meetings, visit sea-technology.com/meetings. **ST**



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contracts

Art Anderson, Bremerton, Washington, will provide naval architecture and marine engineering services for the new hybrid-electric *Olympic*-class ferries for Washington State Ferries. Art Anderson is a team member of Elliott Bay Design Group, which was awarded the design by the shipbuilder. Vigor.

OceanTools, Aberdeen, Scotland, has an order to supply the newly launched PowerLOG combined data logger with integral battery packs. The packaged OceanTools order contains the PowerLOG units along with an OceanDISP subsea data display. Seatronics.

Fugro, Adelaide, Australia, will chart the waters of Gulf St. Vincent and Investigator Strait. The 998 km² survey is for the Australian Hydrographic Office to update nautical charts for safer navigation. Data will also be shared with scientific agencies, including Geoscience Australia and the AusSeabed community. Australian government.

Kongsberg Maritime, Kongsberg, Norway, has signed a contract to deliver its sonars to the Norwegian Coast Guard for use on three new craft planned for launch between 2022 and 2024, replacing the existing *Nordkapp*-class vessels. Vard.

SPI Servicios Portuarios Integrados for Mar del Plata port, Argentina, has acquired a DOP Dredger component package. The DOP Dredger 250 will be used to dredge underneath a floating dock to make it operational full time. Damen Shipyards Group.

ST Engineering iDirect, Herndon, Virginia, a company of ST Engineering North America, announced that a long-term customer has deployed its iDirect modems with marine antenna from manufacturer, integrator KNS Inc. to provide reliable, high-speed connectivity to mining ships in Guinea, West Africa. Paratus.

Oceaneering International Inc.'s, Houston, Texas, Space Systems business will develop mission-critical components for a submission to NASA Human Landing Systems for the Artemis Program. Oceaneering's scope of work involves crew systems engineering, including the integration of NASA's new space suit. Dynetics Inc.

Trelleborg's, Trelleborg, Sweden, offshore operation will be the agent for the Elastopipe flexible piping system, as well as a selection of Firestop Passive Fire Protection solutions in the Netherlands, Belgium and Germany. This partnership will enable development of business in Western Europe. Borbotech BV.

Remy InfoSource, Sydney, Australia, is partnering to offer port companies a combined service solution for easy establishment and oversight of a single capital expenditure budget for all equipment procurement, third-party

factory inspections and project management requirements. Trent Port Services.

StormGeo, Bergen, Norway, has expanded a partnership to combine a digital platform with StormGeo's ship-to-shore fleet and voyage management solutions, FleetDSS and ECO Insight. U-Ming Marine. **ST**

people

Tony Goldsmith, partner, master mariner and marine casualty specialist, has been appointed as head of Marine and Trade at Hill Dickinson in London. He will succeed **David Wareing**, who will retire in the fall, having held the position since 2017. **Andrew Lee**, a partner in Hill Dickinson's Marine and Trade team in Singapore, is the new head of that office, succeeding Goldsmith.



StormGeo has appointed **Kim Hedegaard Sørensen** as COO for StormGeo's shipping division. He has an extensive portfolio of global C-level leadership positions in shipping and transportation, including CEO of Nordics Nagel-Group, Blue Water Shipping and TransAtlantic Industrial Shipping. He also brings 17 years' experience with A.P. Møller – Mærsk Group.

Global energy consultancy Xodus Group has appointed a U.S. renewables vice president to head a new office in Boston as the company looks to grow its offshore wind services across North America. **Alexander Thillerup** joins Xodus from Aegir Wind Solutions, where he was director of project management.

Ocean Technologies Group has added **Caspar Atkinson** as chief product officer. He has over 20 years' experience in creating digital products and delivering technology solutions, successfully launching B2B and B2C products in a diverse range of companies.

Cheryl Hapke, Ph.D., is joining science and engineering firm Integral Consulting Inc. as a senior consultant to support its Marine Science and Engineering practice. She will help expand the firm's services in coastal resiliency, including assessment and modeling of coastal hazards and vulnerabilities, and planning and adaptation for sea level rise. Integral Consulting has also named **Patrick Friend**, Ph.D., P.G., the Estuarine and Coastal Sciences Association Ambassador for the United States. Friend is a coastal and marine strategic advisor based in Integral's Houston office. **ST**

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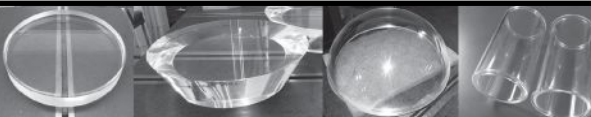
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Sverre Alvik is director of the Energy Transition Program and project director for DNV GL's Energy Transition Outlook. He has a master's in naval architecture and 20 years' experience working at DNV GL. His background is in the maritime and energy sectors, where he has worked on strategy and politics, marketing and sales, management, and research and innovation. Mark Irvine is a communications manager at DNV GL.



Mark Irvine is a communications manager at DNV GL.

The coronavirus pandemic will have a dramatic impact on energy supply and demand in the short term and will have lasting impacts once the pandemic dissipates. However, that will in itself do little to advance the world's progress toward the Paris climate ambitions.

Energy use is strongly linked to economic activity, which has, and will continue to be, significantly impacted by the novel coronavirus pandemic: Our energy forecast is predicated on IMF's longer outbreak scenario, where world GDP will shrink 6 percent in 2020 and 9 percent in 2050, relative to pre-pandemic forecasts. Even with slower growth, however, by mid-century the world economy will still be twice its size today.

In contrast, energy demand will not grow. Our modeling shows that the pandemic will reduce energy demand through 2050 by 8 percent, compared to 2018.

Improvements in energy intensity will remain the most important factor in reducing energy demand in the coming decades, and the contraction due to COVID-19 comes on top of this. Lasting changes linked to COVID-19 are mainly behavioral in nature and include the impact of the pandemic on the transport sector, especially aviation, and on less office work and changed commuting habits, which will result in transport energy use never again

reaching 2019 levels. Demand for manufactured goods globally will need almost four years to recover to 2019 levels, and the energy-intensive iron and steel industry, affected by lower demand for new office space, may never reach its pre-pandemic heights.

This seems to be good news for decarbonization. Transport remains heavily oil dependent, and iron and steel relies on hydrocarbons to supply high-heat processes. Declining demand in these sectors is one of the main reasons for the price weakness in hydrocarbons, with widespread write-downs in oil and gas assets. It appears likely that oil has already reached a supply plateau that we forecast to occur in 2022, prior to factoring in the effects of the pandemic.

It is certainly not game over for hydrocarbons or natural gas, which we forecast to take over from oil as the largest energy source in this decade. However, the reduced return on capital and the increased volatility in fossil fuel prices is making many investors look at these assets in the post-COVID world with a greater degree of caution; they may also now regard renewables assets more favorably, even though the pandemic is placing a temporary check on the expansion of renewable sources of energy. Renewables have first place in the merit order of the power mix due to their very low operating costs and short design and construction times.

With the earlier than anticipated plateauing of oil and the continued rapid decline of coal use, our forecast shows that CO₂ emissions most likely have already peaked (in 2019). Again, this appears to be good news from a climate goals perspective, but the longer-term decline in emissions is not significantly accelerated by the pandemic. Even with peak emissions behind us, and flat energy demand through 2050, the energy transition

we forecast is still nowhere near fast enough to deliver the Paris ambition of keeping global warming well below 2° C above pre-industrial levels. We would need to repeat the decline we're experiencing in 2020 every year from now on to reach the target. The COVID-19 impact on energy demand only buys humanity another year of "allowable" emissions before the 1.5° C target is exhausted (in 2029) and a couple of years before the 2° C warming carbon budget is exhausted (in 2050).

In our Energy Transition Outlook (2020), released in September, we explore many of the technology solutions that can help to close the gap between our forecast global warming outcome and the Paris ambitions. Our view remains firmly that humanity already possesses the technology and knowhow to deliver on Paris. We also have the capacity to modify our behaviors and habits, and in this year's outlook we cover energy-related behavioral change and explore where and how COVID-19 may permanently change our habits.

However, the key to reaching the Paris goals remains policy around the world that encourages the correct behavioral changes and enables the right technical solutions to scale. Policy also represents the main uncertainty as to whether the pandemic will speed up or slow down the energy transition. It is unclear whether the enormous COVID-19 economic stimulus packages being lined up by governments will be spent wisely on renewable energy sources, or expeditiously on fossil sources in the hope of bringing larger numbers of people back to employment more rapidly. There are signs now of both directions being pursued, with strong regional variations. We assume that the global sum of the stimulus packages will not significantly impact the energy mix—but that remains an assumption. Time will tell. **ST**

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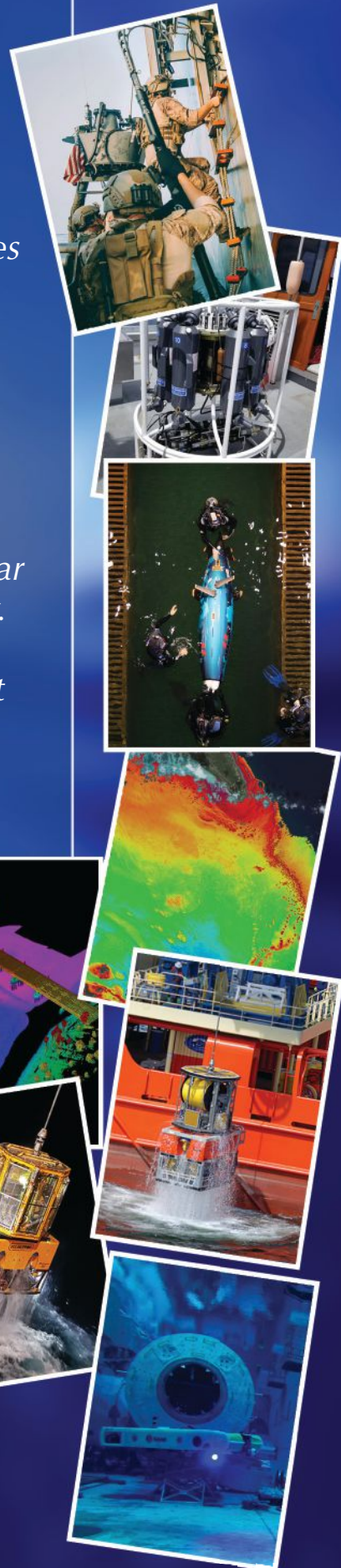
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