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Virtual Agents
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2021

JANUARY

Annual Review & Forecast

FEBRUARY

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MARCH

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**AUVSI XPONENTIAL 2021 (Part 1), May 4-6, Virtual

MAY

Communications, Telemetry, Data Processing

**CLEAN PACIFIC, June 28-30, Seattle, WA

**UDT, dates TBD, Rostock, Germany

JUNE

Seafloor Mapping/Sonar Systems/Vessels

JULY

Deck Gear, Cable, Connectors, Power Systems & Salvage

**Offshore Technology Conference, August 16-19, Houston, TX

**AUVSI XPONENTIAL 2021 (Part 2), August 16-19, Atlanta, GA

AUGUST

Ocean Resources Development

**Global OCEANS 2021 San Diego – Porto, September 20-23,
San Diego, CA (Hybrid)

**SEG 2021, September 26-October 1, Denver, CO

SEPTEMBER

Geophysical Exploration

**Ocean Business, October 12-14, Southampton, UK

**Offshore Energy, October 26-27, Amsterdam, The Netherlands

OCTOBER

Environmental Monitoring, Remote Sensing & Pollution Control

**CLEAN GULF 2021, November 16-18, San Antonio, TX

NOVEMBER

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DECEMBER

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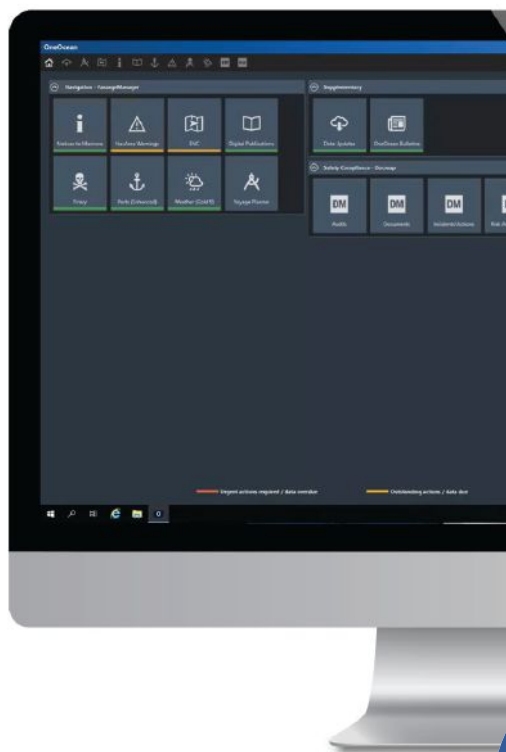
COVER IMAGE

KONGSBERG's C-Scope, seen here at Horten VTS, is widely used for vessel traffic management, surveillance, security and situational awareness.

NEXT MONTH

Multi-phase decom in Gulf of Mexico ... Riserless well intervention ... Poseidon: alarm, monitoring and control system for offshore vessels ... RAMMS airborne LiDAR bathymetry for coastal mapping ... OCTOPUS vessel optimization software from ports to wind farms.

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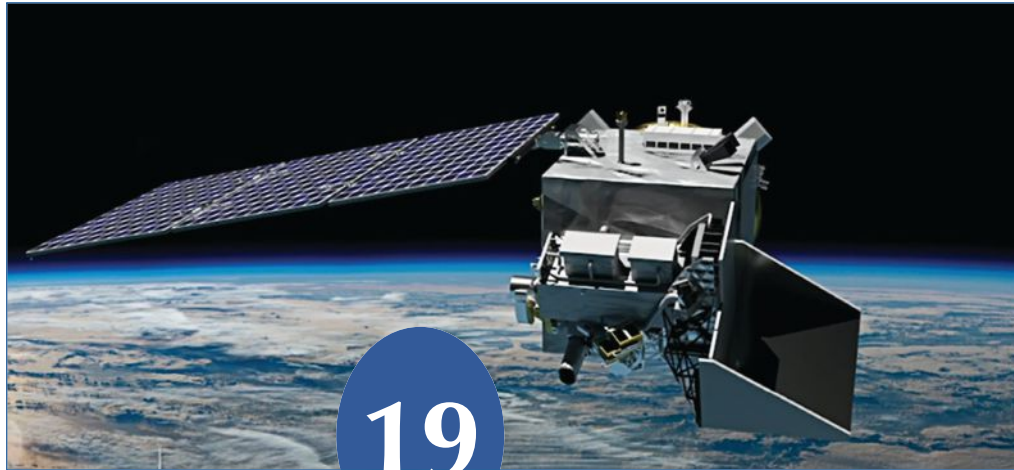




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)) Biden Pushes Climate Agenda. U.S. President Joe Biden has taken executive action to tackle the climate crisis at home and abroad, including re-establishing the President's Council of Advisors on Science and Technology. These executive orders follow through on Biden's promise to take aggressive action to tackle climate change and build on the executive actions that he took on his first day in office, including rejoining the Paris Agreement and immediate review of rollbacks of standards that protect U.S. air, water and communities. The orders include a freeze on new oil and gas leases on public lands and a doubling of offshore wind-produced energy by 2030. Biden aims for a clean energy revolution that achieves a carbon-pollution-free power sector by 2035 and puts the U.S. on a path to a net-zero economy by 2050. He has also signed a presidential memorandum on scientific integrity to protect scientists from political interference and ensure they can think, research and speak freely to provide valuable information and insights to the public.

)) Oil and Gas Industry Shifts Priorities, Report Finds. New research published by DNV finds that the oil and gas industry expects to boost investment in the energy systems of the future this year as companies seek to transform for the long term. A record two-thirds (66 percent) of senior oil and gas professionals report that their organization is actively adapting to a less carbon-intensive energy mix in 2021, up from just 44 percent in 2018. Some 57 percent plan to increase investment in renewables, up from 44 percent last year; half (48 percent) expect to increase investment in green or decarbonized gas. Just a fifth (21 percent) say they will increase investment in oil projects in 2021, as the sector increasingly comes to terms with the notion that the world's demand for oil has peaked or will peak in the short to medium term. Expectations for an increase in natural gas investment remain steady at 37 percent. The majority of senior oil and gas professionals expect these shifts in investment will lead to a wider reshaping of the industry. Eight-in-ten (78 percent) believe there will be increased consolidation in the year ahead, up from 64 percent one year ago. Strategic reorientation may also involve asset and business sales, with 63 percent expecting more demergers, divestments and spin-offs; up from 46 percent last year. Transformational investments come despite a crash in confidence for industry growth following the COVID-19 pandemic and subsequent oil and gas market crash. Only 39 percent of senior oil and gas professionals are confident about industry growth in 2021, down from 66 percent last year. "Turmoil and Transformation," DNV's outlook for the oil and gas industry in 2021, suggests priorities are shifting as investors reassess the risks of financing oil and gas projects, and as governments and industry pour billions into green recovery strategies following the COVID-19 pandemic.

)) Global Framework to Evaluate Ocean Energy Tech. The IEA-OES has released "An International Evaluation and Guidance Framework for Ocean Energy Technology" to respond to a need to have a completely objective evaluation of how a technology performs against key criteria. The information required to carry out a fully objective, quantitative evaluation is not always available, especially at the early stages of the development process. This means that the evaluation approach must evolve, taking into account the development stage, activities completed and the available information. International acceptance of a common approach to technology development and evaluation brings the following benefits: clarity in the expectations from different stakeholders during each stage of development, bringing clearer communication; consistency in the use of terminology, and the process to evaluate technology, ensuring a level playing field; stakeholders working together to build confidence and transparency in the sector; efficient decision-making processes promoting direction of funding to the technologies with the highest chances of commercial success; and technology development processes consistent around the world, leading to more international collaboration and more globally transferable technology. This document is applicable to subsystems (e.g., power take-off, mooring and connection systems); devices (wave energy converters and tidal stream energy converters); and arrays of devices, and is intended to be used by developers, research organizations, standard institutions, and private and public funding organizations. The report is available at: www.ocean-energy-systems.org/publications/oes-documents.

)) McLane Founder, Research Pioneer Passes. McLane Research Labs' founder, Dr. Susumu "Sus" Honjo, has passed. He died peacefully at home, surrounded by his family. His pioneering work as a scientist at Woods Hole Oceanographic Institution (WHOI) contributed to the understanding and observations of marine particle compositions and fluxes and of the oceanic biological pump. Honjo was a 2019 recipient of the first ever WHOI Distinguished Emeritus Award for his lifetime achievements. Along with his pioneering research in biogeochemical particle flux studies, Honjo also led the development of several notable oceanographic instruments over four decades, including the sediment trap, moored profiler and ice-tethered Arctic environmental buoys. In 1983, he founded McLane Research Laboratories Inc. in Falmouth, Massachusetts, to make his instruments commercially available to the global scientific community. Hundreds of the instruments he developed have been deployed in every ocean of the world and remain a significant tool for biological pump studies today. The company continues to thrive and was recently awarded Massachusetts SBA Exporter of the Year (2017). **ST**

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Supply Chain Must Be At Heart of UK's Energy Plan

It's bold, it's ambitious, and it's been warmly received by most stakeholders, from industry to environmental groups. The U.K. government's new 10-point plan covers clean energy, transport, nature and innovative technologies in its quest to create jobs and achieve net-zero greenhouse gas emissions by 2050.

The £4 billion investment plan aims to leverage three times as much private sector investment over the next 10 years. The key to unlocking that investment to create gross value added (GVA) and jobs is genuine engagement with the supply chain. The supply chain needs to fully understand what the opportunities are, so businesses know where to invest to be well positioned to capitalize.

If the aim is to develop U.K. capability and an environment in which overseas energy companies want to invest, then we need a clear supply chain strategy. And that strategy, with the supply chain shaping it, must provide a clear plan for how we will develop a specialist engineering, manufacturing, services and technology sector that can support the 10-point plan. Only then can we achieve the energy transition and cement the U.K. as a global exporter of expertise in net-zero activities. Only then will we treble the public sector investment, create and safeguard jobs, and generate additional GVA.

There needs to be a tripartite approach involving government, industrial corporate investment and the supply chain. The government needs to engage the supply chain and define strategies at the earliest opportunity. Leaving it too late could be disastrous and lead to lost opportunities in the development of competitive U.K. content, which could see us lose out to overseas capability. Take for example the missed opportunities in offshore wind, from which we need to learn the lessons.

In the early days of North Sea oil and gas, the U.K. set about building and promoting capability through a clear strategy. It wasn't perfect, but there was a focal point for the fledgling supply chain to morph into U.K. capability that has enabled the recovery of hydrocarbon reserves for several decades with a supply chain that is globally sought after.

The U.K. supply chain needs a platform within government to ensure strategies are in place to create the technologies, skills and opportunities for exporting around the world. This requires a genuine focus on sovereign capability that is developed and maintained in the U.K., with a priority on energy transition projects.

There are three points in the U.K. net-zero plan which are of major interest to the underwater engineering industry and its supply chain. These are: offshore wind, hydrogen and carbon capture (CCUS)—all of which will, in some form or other, rely on the subsea expertise that has been honed in the North Sea oil and gas sector and now leads the way around the world.

For example, the recent advances in floating offshore wind will benefit immensely through subsea know-how in key areas, such as floating structures, anchor and mooring systems, seabed fastenings, and dynamic cables.

As projects emerge related to hydrogen and CCUS, they will require subsea systems, technologies, knowledge and experience in the construction, installation, repair and maintenance of underwater pipelines for transportation through to the subsea injection systems and processes currently used to boost production in reservoirs.

When these pilot projects get underway, it's crucial that the subsea supply chain is involved from the outset in order for it to develop the disruptive technology, innovation and skills that will be needed to make these pilots successful and, once proven, export-ready around the world. **ST**

Virtual Personal Assistance at Sea

Digital ‘Agents’ Use Big Data Insights to Aid Decision Making

By Mike Konstantinidis

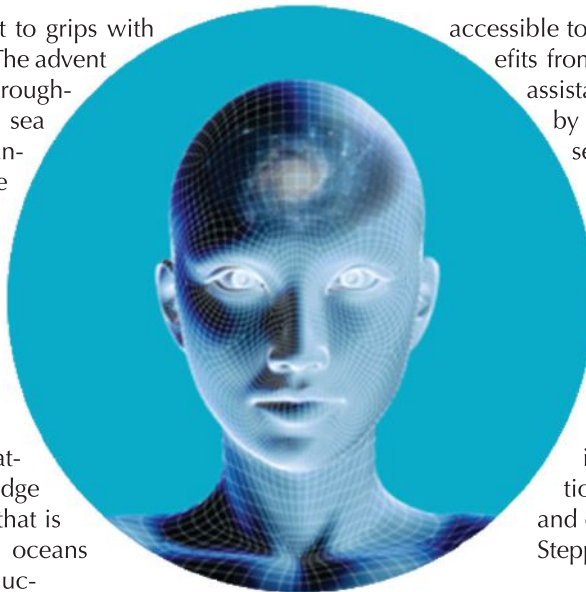
Shipping has struggled to get to grips with data, but the tide is turning. The advent of reliable, high-speed, high-throughput satellite connectivity at sea means transferring the vast quantities of data generated by the various equipment and systems on a modern container ship or tanker is no longer a problem. The challenge today is sifting those data for insights that can make vessels safer, more fuel efficient and better managed.

For vessel owners, these attributes can add competitive edge in a commercial environment that is often as unpredictable as the oceans themselves. Buffeted by daily fluctuations in commodity prices and freight rates, as well as longer-term shifts in the global economy, a reliable advantage can be used to maximize profits or minimize losses.

Shipowners and managers are also contending with a rapidly evolving regulatory landscape—particularly in terms of environmental performance—and vetting requirements from charters and cargo owners that are ever more demanding.

Data are increasingly regarded as holding the key to navigating these turbulent waters. Fortunately, the advances seen in artificial intelligence, machine learning and related analytic techniques are now as available to shipping as any other industry.

At METIS, these technologies have been deployed to create a platform for capturing, processing and analyzing data, with particular attention paid to making the outcomes of these analyses most relevant and easily



The METIS virtual personal assistant (VPA) serves as an “agent” to help with human decision making.

accessible to those using them. The user benefits from shipping’s first virtual personal assistant (VPA), an “agent” powered by artificial intelligence that, like a seafaring Siri or Alexa, can help seafarers, shore-side technical colleagues and boardroom executives alike to perform day-to-day tasks.

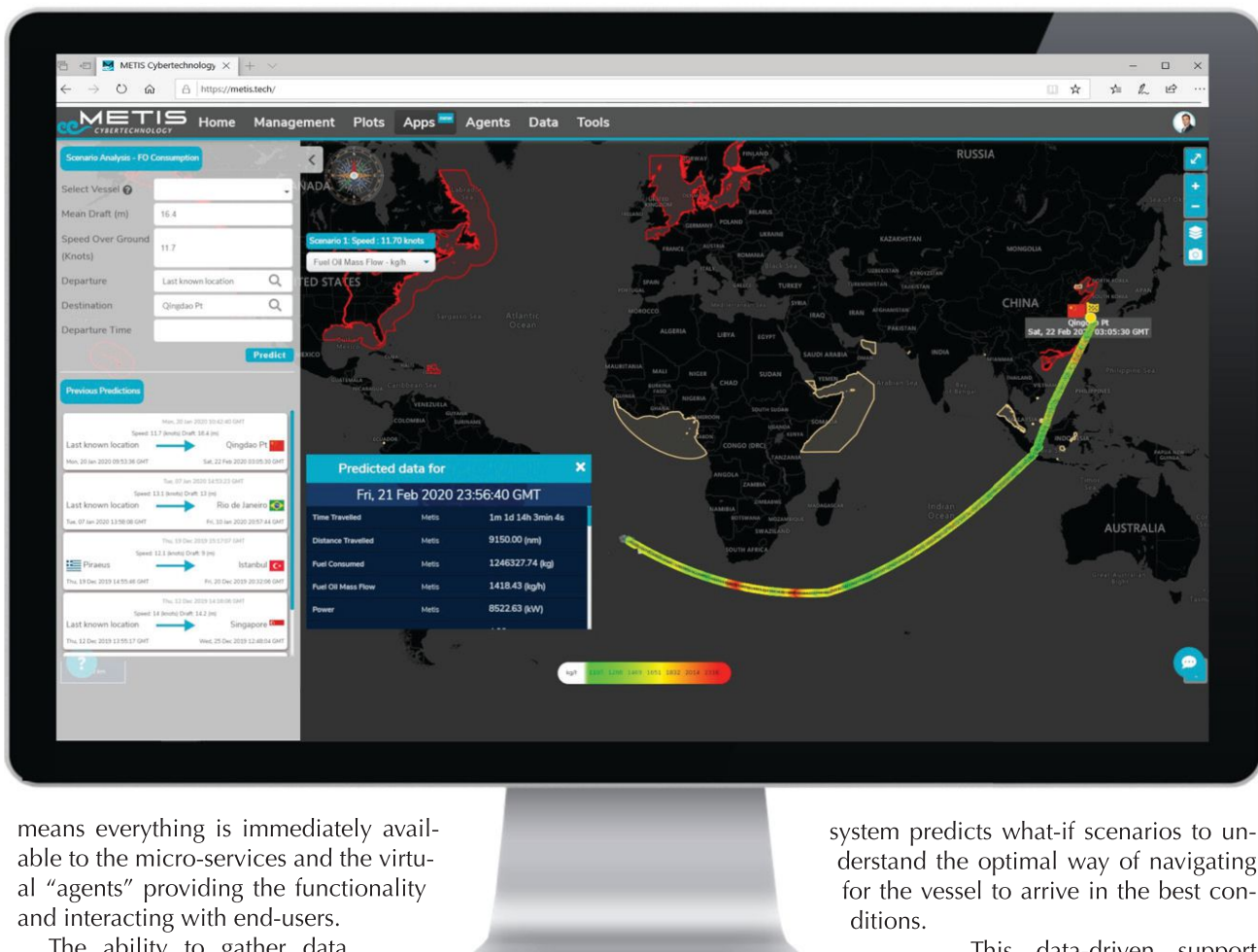
Data Capture

Creating such a powerful solution relies on addressing a major obstacle to digitalization in shipping: lack of standardization for equipment specifications and configurations on board.

Stepping on board any modern vessel offers a chance to find equipment from innumerable manufacturers, most of which opt for proprietary interfaces. The situation contrasts starkly with aviation, where airlines largely choose between just two manufacturers. Shipping’s apparent abundance of choice has, in reality, hampered efforts to achieve integration.

Finding a way to deliver data that can be pooled as “big data,” accessed and manipulated for multiple purposes has therefore become something of a “Holy Grail” for maritime digitalization.

The METIS solution is to deploy a collection of smart devices, called wireless intelligent collectors (WICs), which are meshed in a robust wireless network. The data collected are transmitted back to a cloud-based hub, where they are stored securely alongside information from other sources, like weather providers and traffic monitoring services, including AIS, as well as corporate resource and maintenance planning systems. This



means everything is immediately available to the micro-services and the virtual “agents” providing the functionality and interacting with end-users.

The ability to gather data around the clock provides a much richer, high-resolution picture of vessel performance than would be possible through trying to join the dots using incomplete, patchy data sets obtained from daily noon reports or ad-hoc manual reading.

WICs don’t just function as a dumb relay, forwarding data unchanged as they arrive. They contain enough embedded processing power to carry out local pre-processing, cleansing and preliminary analysis of incoming data, analog or digital, before they are transmitted back to the hub. By intelligently removing unimportant background noise and focusing only on the salient signal, the architecture reduces the load on the hub and improves the system’s overall resilience and reliability.

The system can also support data-driven decision making by helping staff to generate various operational scenarios quickly and easily. Based on the current condition of the vessel and dynamic parameters such as speed, ETA, draft, destination, etc., METIS can help shipping companies decide on the optimal course of action, without captains or superintendents having to resort to hunches or guesswork.

Through machine learning, data are analyzed to extract actionable information about route options, weather conditions, speed profile, fuel oil consumption and other navigational parameters. Based on all these, the

The system can support data-driven decision making by helping staff to generate various operational scenarios quickly and easily.

system predicts what-if scenarios to understand the optimal way of navigating for the vessel to arrive in the best conditions.

This data-driven support translates into tangible customer gains. Using the system’s predictive powers, we have seen an average reduction in fuel oil consumption of 11.25 percent; in a specific case, it reached up to 27.5 percent. Our customers have achieved significant savings while optimizing voyage operational performance, cutting voyage times and reducing their environmental footprint.

Recently, we had a case of a real vessel faced with heavy weather on a passage from Malaga, Spain, to Rotterdam, the Netherlands. The typical course of action would have been to slow the vessel down and let the storm pass before proceeding. But when we ran multiple scenarios on METIS, a counterintuitive result emerged: Less fuel would be burned by speeding up and outrunning the weather.

Intelligent Agents

METIS’s system allows for the creation of virtual agents to perform specific tasks. They can carry out weather analysis, monitor hull fouling, measure fuel oil consumption, track onboard energy usage, or keep an eye on the main engine’s operating efficiency, for example. In a nod to the design of smartphones, agents can also adapt intelligently to their immediate environment, selecting the best available data source for the job at hand, whether that comes from sensors built into equipment, manual

“The METIS solution is to deploy a collection of smart devices, called wireless intelligent collectors (WICs), which are meshed in a robust wireless network.”

readings keyed in by ship personnel or external information.

Because no two ships are identical, agents are also highly configurable and can be set up to detect and act on significant events based on thresholds specific to an individual vessel. They have both diagnostic capabilities that can help engineers pin down the likely cause of a deviation from expected behavior or other problem and prognostic capabilities for predicting future outcomes so that corrective actions can be planned in advance.

Thanks to their predictive capabilities, agents can raise alerts and forewarn crew of potential impacts on vessel operation caused by variations in equipment status or expected changes in the external environment. They help in the investigation of unusual behavior, assist in scheduling maintenance tasks, aid voyage planning, and monitor and evaluate machinery performance for optimization.

The ability to intervene before an issue escalates not only benefits vessel operators financially; more importantly, it enhances safety by reducing the risk of catastrophic machinery failure.

In exceptional cases where more rigorous investigative work is necessary to diagnose the root cause of a problem or make a decision, METIS can prepare and provide data in a format suitable for tools like Tableau, Power BI and MATLAB.

Virtual Assistance

The way in which agents convey information to vessel crew and shore-based staff also represents a sharp break with traditional industry norms. Instead of vessels and shore facilities installing another standalone application that complicates existing workflows, the default output channel for METIS is through the shipping company's existing collaboration platform—think Microsoft Teams, Skype or Slack.

If necessary, the virtual personal assistant can reach personnel more directly by sending text messages to alert them to critical events. Such updates and alerts are presented in plain English, as opposed to indecipherable error codes. Crucially, METIS won't spam everyone in the organization about, say, a broken fuel pump. It knows who needs to know what and, depending on the event's seriousness, when they need to know.

What's more, communication with the agent is interactive: Recipients can respond, requesting more information or selecting a course of action—again in natural English, in much the same way they would chat with a

human colleague. This lowers the learning curve, allowing anyone in the company to utilize the system and take advantage of data in their work, without having to undergo training on how to code or query a database directly. A side benefit of this ease of access is that it opens up the possibility of far greater collaboration between different teams or departments within a shipping company.

In this way, agents assume the role of an extra pair of eyes for personnel in the engine room or PA for staff tasked with preparing regular performance reports. Against a backdrop of shrinking crews and growing administrative burden on those who are left, the value of such additional “helpers” quietly and tirelessly supporting seafarers is immense.

Virtual agents are primed to assist in the field. Neptune Lines has signed a deal with METIS that entails utilization of IoT (Internet of Things) devices and NLP (natural language processing) technology to improve monitoring of fleet operational efficiency, optimize bunker consumption patterns and improve overall fleet performance, according to Neptune Lines' sustainability principles.

StarBulk Carriers Corp. is already benefiting from METIS's virtual solutions. “METIS provides an elegant human interface to the users in our offices, which allows anyone to find the answers to technical and operational questions by simply asking the question in more or less plain English,” Hamish Norton, president of StarBulk Carriers, said. “METIS has also demonstrated that they can analyze the data and determine the relationship between vessel speed and consumption up to, and probably somewhat beyond, sea conditions of Beaufort 4. The speed/consumption analysis they demonstrated is sufficiently precise that the increase in consumption due to normal hull fouling can be measured over a period as short as six months. Vessel monitoring is still in its infancy, but the METIS human interface is unmatched by any other so far.” **ST**

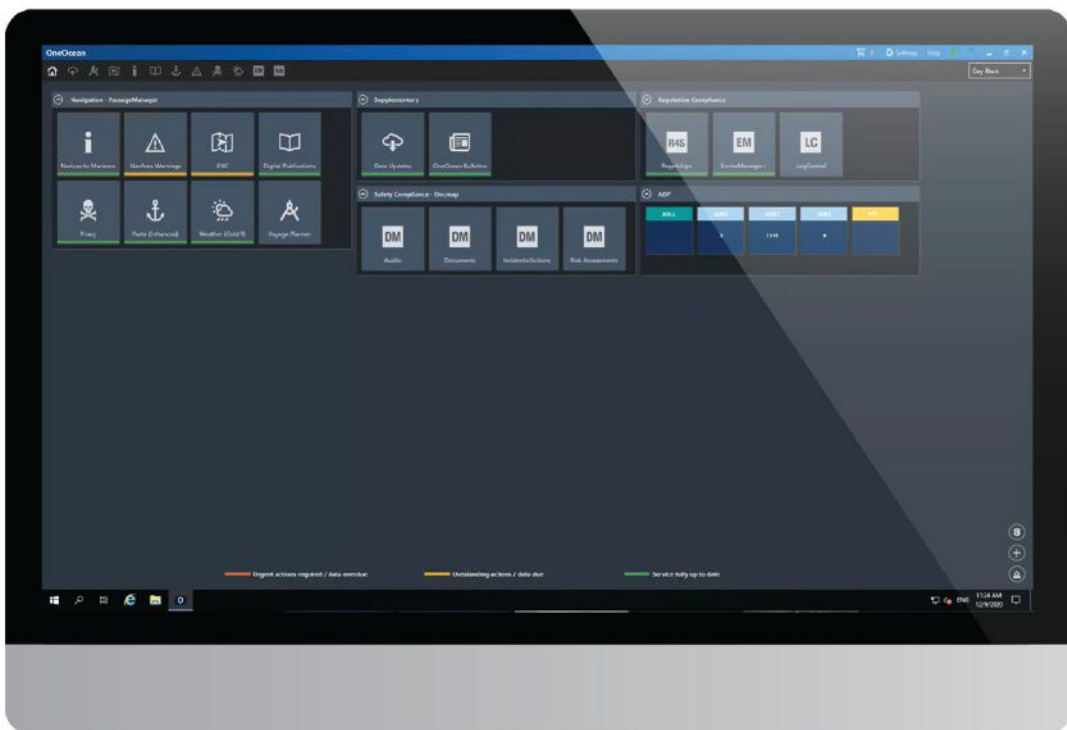
Mike Konstantinidis, co-founder and CEO at METIS Cyberspace Technology S.A., is a senior mechanical engineer (B.S., M.S.) with more than 25 years of insightful experience in leading organizations, most recently in the maritime sector. He is currently making a significant contribution to digitalization concepts and the introduction of artificial intelligence and machine learning technologies in the shipping industry. His main aim is the effective design and execution of operational and business strategy plans, ensuring competitiveness and profitability growth of the global maritime industry.



Intelligent Voyaging

A Platform to Manage Voyage Planning, Environmental Compliance

By Nicholas Bourque



The OneOcean platform has gained widespread industry recognition for allowing shipping companies to seamlessly plan passages, manage navigational risk and ensure widespread compliance with maritime regulations across their fleets. The newly launched next-generation OneOcean advances the platform as an intelligent voyage planning solution that automates mundane tasks, focuses users on high-priority actions and provides a digital workflow that is standardized and dynamically updated. It does this by integrating several variables, such as navigational elements, voyage optimization and operational events (e.g., environmental compliance) into one simplified, artificial intelligence

(AI)-powered voyage planner. The ultimate goal is to reduce workload and enable intelligent decision making across users and stakeholders. The end result is that users make smarter use of data so that voyage planning can be carried out more efficiently and effectively.

The company concentrated on four objectives: visually integrate data for better decision making; structure processes and data through a fully digital workflow; enhance decision making through AI; and reduce risk through customization.

Visually Integrate Data

The first core aspect is guided by the principle that,

The new user interface was conceived to make OneOcean even simpler to use.

(tom) All aspects of a compliant voyage plan on a single screen. Visual cues direct users on what needs to be taken. The simple interface enables easy adoption and reduces the training required.

The image shows a laptop screen with the EvriX Manager software. The interface is divided into several sections:

- Top Bar:** Contains the application name "EvriX Manager" and a "Try Now" button.
- Left Sidebar:** A vertical menu with icons for various functions such as "Map", "Layers", "Tools", and "Settings".
- Central Map:** A large map area showing a geographical region with a highlighted area in green and red. The map includes a scale bar and a compass.
- Bottom Panel:** A table displaying data points with columns for "Name", "Latitude", "Longitude", "Easting", "Northing", "Altitude", "Speed", "Time", "Distance", "Fuel", "Cost", "Status", and "Action". The table contains one row of data. Below the table is a "Route Planner" button.

As a result, users can visualize unique data sets in context to each other and see how decisions made in the planning process impact other areas. Mariners can better see the large-scale impacts of decisions and flag potential problems before they affect interconnected processes.

includes the ability to connect to a wide range of data sources, including databases, spreadsheets, and APIs. This allows users to pull in data from various sources and analyze it in a unified environment. The platform also offers a variety of visualization options, including charts, tables, and dashboards, making it easy to present data in a clear and concise manner.

Ocean even simpler to use. All aspects of a compliant voyage plan are now visible on a single screen, so officers have no need to jump back and forth between modules to make changes to a plan.

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users on what actions need to be taken to maintain compliance. If there is an area of concern along the journey, color coding is used to quickly determine problems.

To prevent overwhelming users with too much information, the user interface (UI) has been cleaned up to show only task- and workflow-specific data. The simple interface ensures an intuitive solution that enables easy familiarization and reduces the training required. For example, during the planning stage, navigators need to toggle between multiple information sources in order to understand their impact on the route. While navigating, however, the focus is more on the chart elements and events ahead. For the same reason, three viewing modes were created: standard, planning and live. These views each show different levels of detail depending on user needs.

Fully Digital Workflows

The second central aspect of OneOcean is the task of accelerating decision making by facilitating the creation and execution of automated workflows. This frees the staff aboard to focus on the vessel's operation instead of frittering away valuable time on paperwork.

Disconnected processes have traditionally caused confusion, conflicting information and consequent problems. A standardized digital workflow solves this by ensuring everyone is working the same way.

Through the single-view concept, decision makers can collaborate and see all sections of a voyage plan, allowing them to quickly understand risks and operations of the upcoming voyage. By unifying workflows, OneOcean now enables full, end-to-end passage planning, incorporating route generation, safety checks, optimizations and scenario evaluation. They can decide what portion they want to keep as part of the official passage plan and perform their approval process directly in the software.

Traditionally, operational events were added to the navigation waypoints sheets to list activities in a chronological timeline. OneOcean Group has introduced the concept of a waypoints table specifically for operational events as a way to separate these two blocks of activities. All events are then integrated into one time line that are clearly distinguished using color coding to show navigation and operational event waypoints.

Event waypoints can easily be added into the event route, providing users with a complete, holistic, single-screen view of the entire planning and voyage management process. As these waypoints are readily customizable, operators can include as much information as they like. Even though they are separate, they are still managed in the software as interdependent parts, meaning if changes are made to one block, the other table will be updated automatically.

Artificial Intelligence

A critical feature of OneOcean is that it has been designed to work dynamically. As navigation officers plan voyages, the system will notify them if changes to one factor would affect other elements of the voyage plan,

then suggest a course of action to rectify problems. This allows mariners to evaluate the impact of any changes and approve any suggested updates or alternatives that are recommended.

As an example, users do not have to manually search and reconfigure each element revision in the passage plan in the event of a change in circumstances, such as a delay in the departure time. Merely adjusting the start time updates the entire route, plan and schedules.

Additionally, as the vessel receives regular data updates such as charts, weather and regulations, the "Update Review" function shows users the impact of this new information. If, say, a voyage had been planned three weeks before the departure date, the charts could change significantly in that short time. If users turn on "Update Review" and select the time frame between planning and departure, zooming into each element reveals any revisions that may have occurred.

OneOcean allows route recommendations during the voyage based on factors such as navigational safety, weather forecasts, operational events and fuel performance parameters. The algorithms combine the various data sets in order to recommend an optimal route. This part of the software has been completely redesigned to integrate seamlessly with other voyage plan elements.

Additionally, users can set ship-specific safety thresholds for variables such as wave heights and wind speeds. In turning the weather layer on, they may see that the default route would take them through an area with high winds and waves and choose to adjust accordingly.

Furthermore, turning on an additional layer, such as EnviroManager, might reveal that the default route also takes the vessel through a zone requiring it to use more expensive, lower-sulphur fuel than would be necessary on a different route.

Customization

As OneOcean Group increased the number of automated calculations, it quickly became apparent that customizing voyage parameters by vessel would significantly increase the precision of recommendations.

Within the voyage plan workflow, users can enter information about their vessel, including equipment features, voyage instructions and ship characteristics, in order to ensure that calculations and risk recommendations are more accurate.

For ship managers, ensuring that ships are surpassing minimum compliance standards is important. It is difficult to ensure that both compliance and company standards are adhered to without a mechanism in place that supports users and enables enforcement.

OneOcean has initially targeted three key areas where functionality has been built in to enable both compliance and company standards to be clearly in view through a common and understandable format. The three areas focus on navigational safety, environmental compliance and weather risk. For example, company-wide under-keel clearance calculation thresholds can be pre-defined at the fleet level, published to the vessels and then become the default setting for each ship. When combined with

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***“The ultimate goal is
to reduce workload and
enable intelligent decision making
across users and stakeholders.”***

the ability to personalize voyage parameters, the result is stringent navigational risk mitigation.

Another example is the display of waypoint tables and passage plan sections, which can be defined to suit the safety management systems of each vessel, making it simple to create and view while ensuring consistency of methodology during passage plan creation.

Positive Feedback

Throughout the development, OneOcean collaborated with customers to create a solution that enables quick, informed decision making, utilizing smarter, connected processes to provide greater levels of standardization across fleets.

“The passage plan creation process is far simpler now that everything is in one screen,” said Dan Pearson of 2/O Sand Fulmar. “Making adjustments to the route and then being able to regenerate the passage plan immediately is a massive time-saver for us.”

“The new waste streams and new equipment settings make EnviroManager+ so much better for the crew,” added Capt. Piotr Rusinek of Intership Navigation. “It is much quicker and easier for them to understand what is allowed and prohibited.”

The feedback has been overwhelmingly positive. Beta trials have been very successful, and users emphasize the value that has been realized in the new version of the OneOcean platform.

The approach to this new version, using defined focal areas and customer partnerships to aid development, has laid strong foundations for the continued evolution of the OneOcean portfolio. This works in line with the company mission to deliver maritime solutions that remove the boundaries between ship and shore, helping customers benefit from more efficient, cleaner and safer practices.

The latest version of the product launched in February 2021. To learn more, visit: oneocean.com. **ST**

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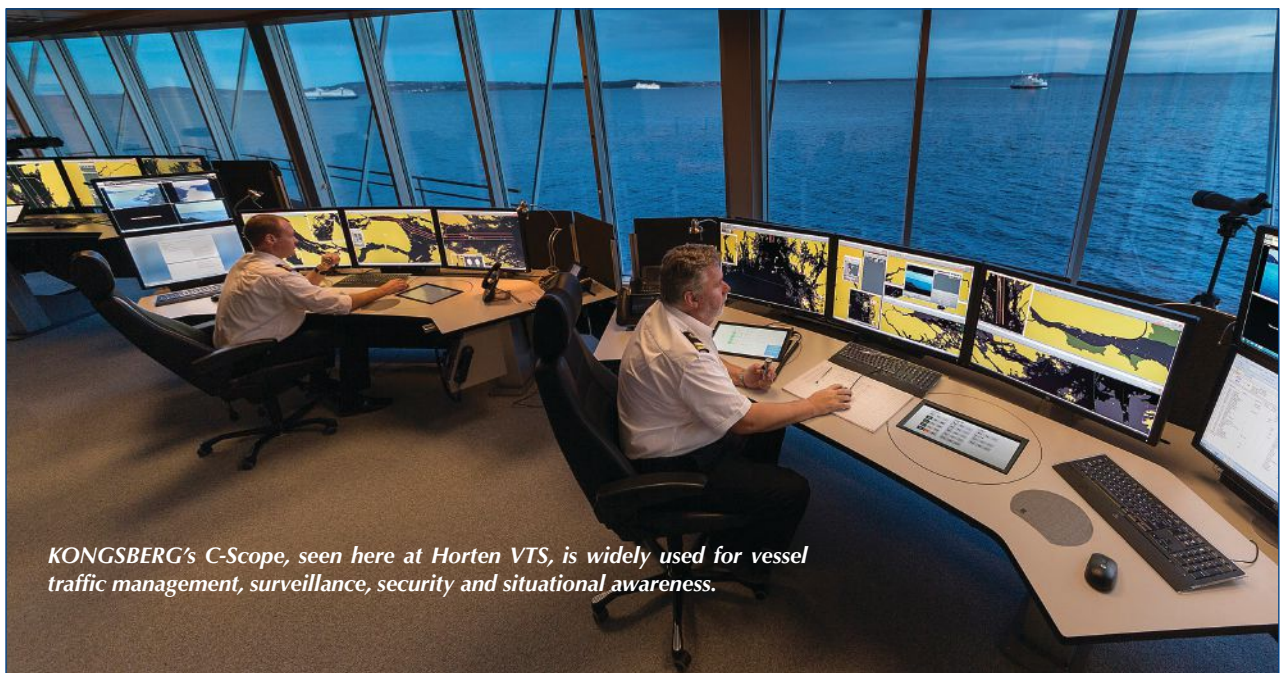
Nicholas Bourque is the chief strategy officer of OneOcean. Based in Montreal, Canada, he pilots a strategic initiative that oversees the review of current products and marketing strategies in order to structure future technology development, increase brand awareness and reinforce OneOcean's product portfolio through R&D and strategic partnerships.



The Greening of Maritime

Digital Solutions Advance Sustainability in Port, Shipping Operations

By Ketil Olaf Paulsen • Todd Schuett



KONGSBERG's C-Scope, seen here at Horten VTS, is widely used for vessel traffic management, surveillance, security and situational awareness.

The principle of working sustainably is driving a major transformation of activities and operations in international ports and harbors. The urgent necessity to radically reduce greenhouse gas emissions is pushing an across-the-board implementation of digital strategies that will also allow users to stimulate efficiencies, satisfy environmental compliance regulations, enhance personnel safety and generate considerable savings in both money and time.

Modern ports and harbors have duly become a focus for initiatives such as the European Green Deal. This envisages “green ports” as potentially crucial influencers in the industry’s evolution toward zero-emission shipping, a goal intended to be incrementally accomplished with achievable milestones in 2030, 2040 and 2050.

Such ports would ideally act as innovation showcases

for integrated, low-emission energy storage, supply, recovery and production systems. With smart, door-to-door logistics chains and all port operations overseen from renovated and/or energy-efficient dockside buildings, green ports could act as scalable hubs, providing an appropriate infrastructure for the refueling and/or recharging of vessels, freight trains and goods vehicles.

In the short and medium term, pilot activities would serve to demonstrate the environmental, technical and socioeconomic advantages conferred by digitalization in a port context. These activities could encompass everything from the integrated deployment of automated cranes and dock vehicles to the application of dynamic vessel traffic flow solutions for optimal scheduling and routing, minimizing the amount of time ships need to spend in port.



VTS systems are key to facilitating sustainable port operations. The C-Scope system is used along the entire Norwegian coast, including Kvitsøy VTS. (Credit: Norwegian Coastal Administration)

Situational Awareness

Looking ahead, design concepts for green ports must clearly embrace this holistic approach, accommodating sustainable solutions for demolition, construction and dredging activities. Such incentives will make a substantial contribution in port communities toward reducing noise, improving biodiversity and protecting the marine environment, as will a concerted push to hasten electromobility and the use of sustainable alternative fuel sources such as green hydrogen, ammonia and advanced biofuels.

Encouragingly, given that energy efficiency is the cornerstone of any environmentally responsible transport concept, certain solutions to counter ecological and literal vessel impacts in ports and harbors have been in operation for quite some time.

One such solution is KONGSBERG's C-Scope VTS (vessel traffic services) system, which has long established itself as an indispensable surveillance and situational awareness solution in some of the world's largest coastal and harbor areas, including the entire Norwegian coast, the busy ports of Singapore and Los Angeles, and the English Channel. The C-Scope system, developed by Kongsberg Norcontrol, helps port authorities to effectively manage vessel traffic and mitigate marine risk: Maintaining an efficient vessel traffic flow reduces emissions, protects the environment from oil spills and prevents ships from running aground.

Adhering to the International Association of Marine Aids to Navigation and Lighthouse Authorities' (IALA) VTS recommendations, the system also assists in tightening maritime security by detecting unusual and/or illegal activity. It enables maritime authorities to visualize the traffic picture in both 2D and 3D, rapidly pinpoint hotspots and bottlenecks, and utilize resources to their best advantage. Capable of supporting bespoke and spe-

cialized applications, the system is sometimes called upon to monitor and report upon factors such as speed limit compliance, as in the voluntary environmental requirement for vessel emissions within the Port of Los Angeles, which rewards ships for voluntarily reducing their speed. The system's daily reports can then be used by vessels in compliance as evidence to secure discounts on port fees.

Updates to the C-Scope VTS system reflect the fact that vessels are getting larger, traffic is getting heavier and port congestion is consequently intensifying, and the advent of autonomous shipping is poised to introduce an entirely new consideration for port authorities. Safe, coherent and consistent decision making is therefore reliant on all operators working from an identical situational image, so the system continues to evolve according to this basic but all-important precept.

Just-in-Time

Traditionally, anchored vessels waiting to enter ports are major contributors to maritime pollution. As their engines need to be running in readiness, they will be emitting cumulatively significant amounts of CO₂, SO_x, NO_x and particulate matter into the atmosphere. The obvious solution is to coordinate their arrival to avoid waiting: a so-called just-in-time arrival system. This approach not only reduces idle running time, it also permits vessels to approach their destination more slowly and economically if the port is not immediately ready to receive them.

KONGSBERG's SESAME Solution II e-navigation project offers a means to radically improve vessel traffic flows. The system aims to cut waiting times or eradicate them altogether by presenting a slot management solution for arriving vessels, which also coordinates ship interaction with port service providers, including feeder vessels, tugs, pilot boats, crane operators and land transportation



agents. Echoing developments within the C-Scope VTS system, the just-in-time arrival solution seeks to enhance and rationalize cooperative situational awareness between ship and shore operators. With the use of open APIs and standardized protocols where possible, it ensures that all parties will have uninterrupted access to the data and documentation required to promote a shared understanding of key factors, such as port resource availability, local traffic conditions and potential weather disruptions. It achieves this via comprehensive integration between shore-side VTS systems and onboard management information systems.

Additionally, vessels equipped with a digital voyage planning and chart management tool—such as Kongsberg Maritime's K-Nav Planning Station—that offers full ECDIS functionality can receive updates of scheduled arrival times, notices to mariners and anti-piracy information, along with best-route recommendations using real-time weather and tide prediction data from port operations centers. As a solution devised to optimize vessel traffic flow into ports, the just-in-time arrival system introduces the possibility of reducing vessel emissions underway, as well as at anchor, by enabling ships to proceed slowly but directly into their berth or bunker.

Automated Ship Reporting Service

November 2020 saw another arm of the SESAME Solution II venture achieve a major milestone when the Norwegian Coastal Administration (NCA) launched the first version of an automated ship reporting service, developed as a part of the project.

Hosted on a test environment in the NCA's maritime single window, SafeSeaNet Norway, the new service can be accessed by vessel planning stations either as "GetMrsReportingFormalities," which is an RRS (request and respond service), or as "PostMrsMessage," a TRS (transmit and receive service).

Both services, which are currently only available in SafeSeaNet Norway, are examples of mandatory ship reporting systems that require ships to report specific data via VHF at given points in International Maritime Organi-



Autonomous vessels, such as those commissioned by ASKO, offer a means to reduce congestion on land-based transport. ASKO expects to reach 150 trailer crossings per day by 2030 as part of a plan to save 5,000 tonnes of CO₂ per year.

zation-adopted traffic separation schemes. Forthcoming iterations of the NCA's automated ship reporting service will support other forms of reporting, including pre-arrival and facilitation (FAL) reporting.

K-Fleet Voyage/MRV Module

Credible sources of voyage reporting and environmental accounting from vessels approaching ports are becoming increasingly imperative as regulations tighten and unilateral pressure grows to prove that operations are being carried out sustainably, in line with EU MRV and IMO DCS mandates. To further address this issue, Kongsberg Maritime has also introduced a K-Fleet Voyage/MRV (monitoring, reporting and verification) module.

Designed as a straightforward means of recording the necessary data and relaying it to shore management teams, the module calculates all consumed chemicals and emissions to air, plus releases to sea and land, from a vessel or fleet perspective. It will also calculate and report a ship's fuel performance against benchmarks including EEOI (the Energy Efficiency Operational Index), the voluntary monitoring tool that measures vessels' CO₂ emissions to the environment per ton-mile of transportation.

With the capacity to be customized for particular types of releases as specified by head offices and the appropriate authorities, the module will also record all data relating to departure and arrival, noon reporting, condition, stoppages and so on.



Milestone Project

Another recently announced scheme with KONGSBERG's direct involvement exemplifies the growing commitment to sustainable operations that is steadily transforming the maritime industry. The milestone project in question will see Kongsberg Maritime and Massterly, a Kongsberg Wilhelmsen joint venture and the world's first company set up to operate autonomous vessels, equipping two new fully electric barges with autonomous technology for the leading Norwegian grocery wholesaler and distributor, ASKO.

ASKO deploys more than 800 trucks per day to transport its cargo; road haulage is currently the only available means of linking the company's warehouses on the western side of the Oslo Fjord with its distribution center on the eastern side. However, the new Ro-Ro vessels are at the heart of an alternative, zero-emissions solution, which, by replacing an estimated 2 million km of truck transport, will save 5,000 tonnes of CO₂ every year.

ASKO's planned zero-emissions logistics chain will see the battery-powered barges, or "sea drones," transporting shipments of 16 29-tonne trailers at a time across the fjord, and fully electric terminal tractors and trucks will transfer the cargo to and from the warehouses and ports. The vessels will initially feature a permanent bridge to enable manual operation, but this will be excluded in subsequent builds once the autonomous concept has been confirmed.

It is anticipated that 150 trailer crossings per day will be achievable by 2030: Both the westward and eastward sailing routes have been tested and verified beforehand in a variety of weather and traffic conditions with a Kongsberg Digital hydrodynamic and visual simulator model. Extensive testing of the virtual vessel is a fundamental element in cultivating the collision avoidance algorithms that will inform the barges' autonomous operation in real life. Kongsberg Maritime's responsibilities, meanwhile, extend to providing safe and secure connectivity between the ships and the shore-based remote operations center via MBR (maritime broadband radio) and 4G and 5G mobile broadband.

ASKO has set itself the objective of becoming a climate-neutral, self-sufficient provider of clean energy,

with 100 percent emission-free transport by 2026, and has been commendably quick off the mark in positioning itself as a standard bearer of what can be accomplished with a comprehensive adoption of digital technologies.

Connecting Port and Hinterland

A number of ports have shown interest in the ASKO concept. Struggling with onshore infrastructure like congested roads and with limited access to rail transport, they are now turning toward the sea to explore how small autonomous vessels could be used to connect the port with piers and logistical hubs in the hinterland. A container carrier version of the ASKO barge is under evaluation to fulfill this potential demand.

Ethical Stance

As the above example demonstrates, KONGSBERG's ethical stance on sustainability, facilitated through the application of digital solutions, is simultaneously influencing and enabling companies and authorities to make their own principled stand. The more it can be shown that exercising a profound degree of corporate, legislative or supervisory responsibility not only benefits marine environments and enhances operational safety but also creates value and generates appreciable financial dividends, the more mainstream sustainable thinking will become; and the better for everything and everyone. The time can't be far off when evidence of sustainable operation will be a legal precondition for all port areas and maritime business ventures. **ST**

Ketil Olaf Paulsen is the general manager for product development and a technical director at Kongsberg Maritime. Educated at the Trondheim Ingeniørhøyskole, he has worked at Kongsberg Maritime for over 30 years, more than 10 of which were spent managing the R&D team. He is now engaged in researching new technologies, including autonomy and energy storage/utilization.

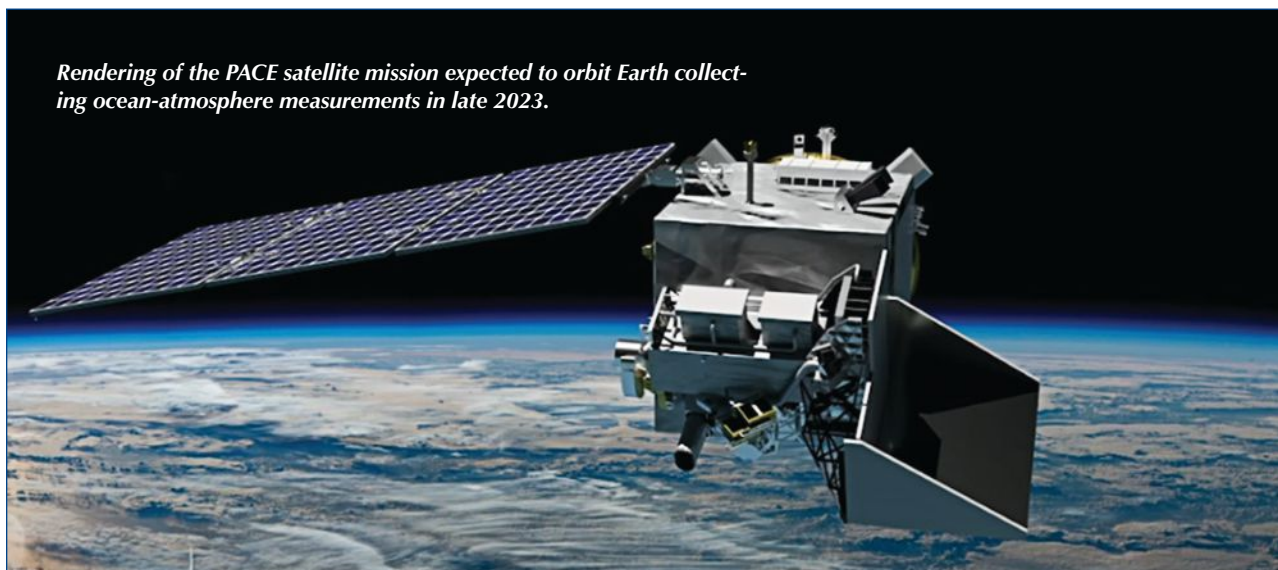
Todd Schuett is the innovation projects manager at Kongsberg Norcontrol. A graduate of the University of Chicago, he joined Kongsberg Norcontrol in 2000 and, for several years, managed the VTS training programs. In 2012, he began managing innovation projects, which have included the SESAME e-navigation projects in Norway and the Next Generation VTMS Lab in Singapore.

Sensing a More Colorful Ocean

NASA's PACE Mission Will Improve Monitoring of Coasts and Harbors

By Dr. Heidi Dierssen • Dr. Jeremy Werdell • Dr. Lorraine Remer

Rendering of the PACE satellite mission expected to orbit Earth collecting ocean-atmosphere measurements in late 2023.

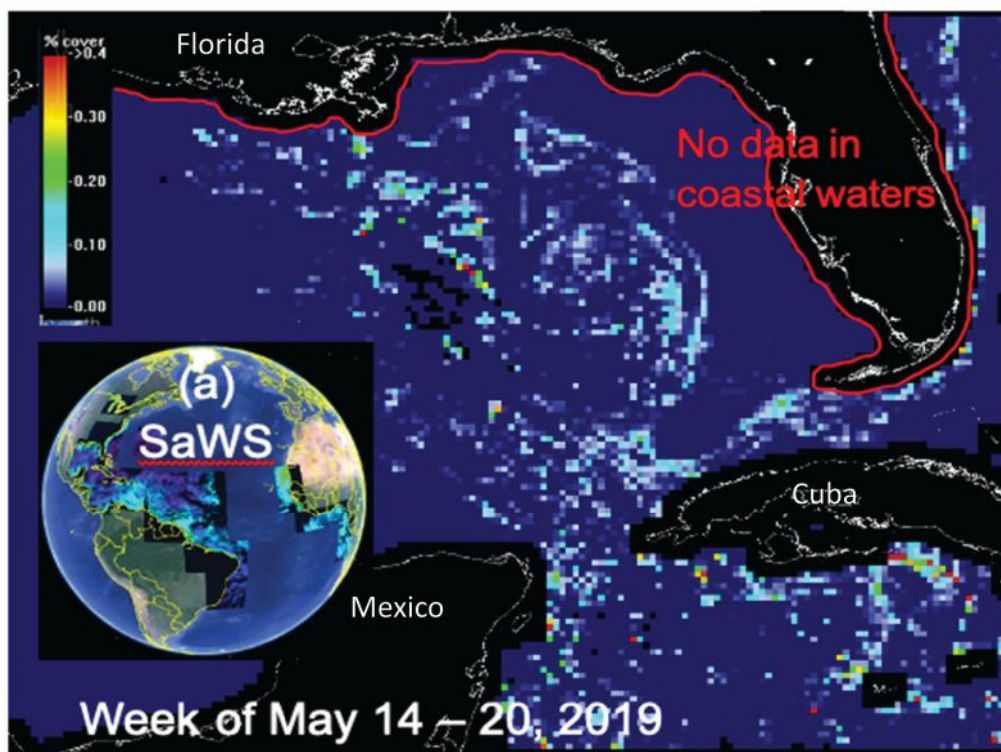
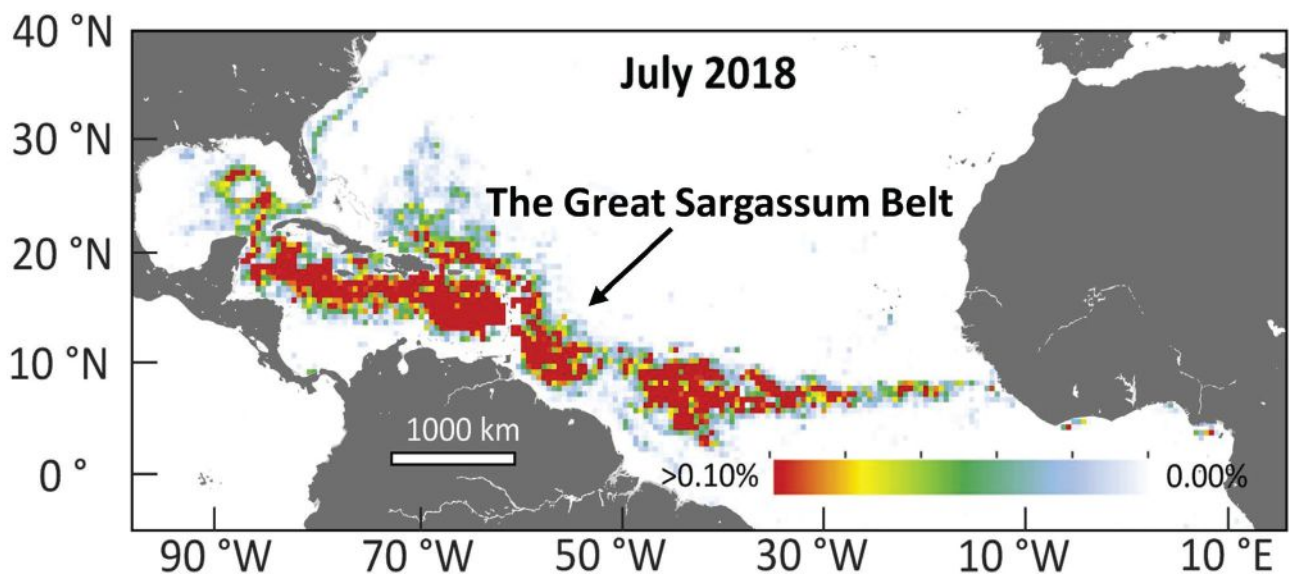


Satellites provide unprecedented views of the swirling, dynamic patterns of ocean life. Even though we cannot directly see the microscopic phytoplankton that fuel the ocean food web from space, we can see how they absorb light as they photosynthesize. The sea changes from blue to green, brown or even red as pigments like chlorophyll-*a* harvest light in different parts of the electromagnetic spectrum. The evolution of chlorophyll-*a* derived from satellites over the last 20 years has outlined fronts where fish congregate, intense algal blooms that can be toxic, and changes in productivity in the center of ocean gyres. This colorful view of the oceans is about to get even more colorful with the launch of the next generation of “hyperspectral” ocean color satellites. NASA’s upcoming Plankton Aerosol Cloud and ocean Ecosystem (PACE) mission will be the first of its kind, featuring a suite of cutting-edge optical sensors to monitor the atmosphere and ocean.

Sensor technology has improved considerably over the last few decades, and space-borne radiometers that

provided only three to eight channels of information in visible wavelengths are now “hyperspectral,” with 60 channels across the same visible spectrum of light. The PACE mission, expected to launch in late 2023, will host the Ocean Color Instrument (OCI), consisting of two spectrometers spanning the ultraviolet, visible and near-infrared spectral regions at 5-nm resolution and 2.5-nm sampling, as well as seven additional detectors to collect measurements at longer shortwave infrared, useful for monitoring the atmosphere and turbid harbor waters. The entire globe will be imaged every one to two days with a pixel size around 1 km², depending on scan angle.

The mission will simultaneously measure the polarization state of the reflected light with the Hyper Angular Rainbow Polarimeter (HARP 2), built by the University of Maryland, Baltimore County, and the Spectropolarimeter for Planetary Exploration (SPeXone), contributed by a consortium in the Netherlands. Together, these sensors will provide insights into the functioning of atmospheric



(Top) The Great Atlantic Sargassum Belt can extend nearly 9,000 km in length, containing upward of 20 million metric tons of wet biomass of Sargassum. Some of this biomass can wash ashore as mass strandings that can block harbors and beaches and cost millions to clean up (adapted from Wang et al. 2019). (Bottom) Dr. Chuanmin Hu and his team at University of South Florida produces the Sargassum Watch System (SaWS). Measurements from the PACE mission will fill the gap closer to land and help detect submerged Sargassum.

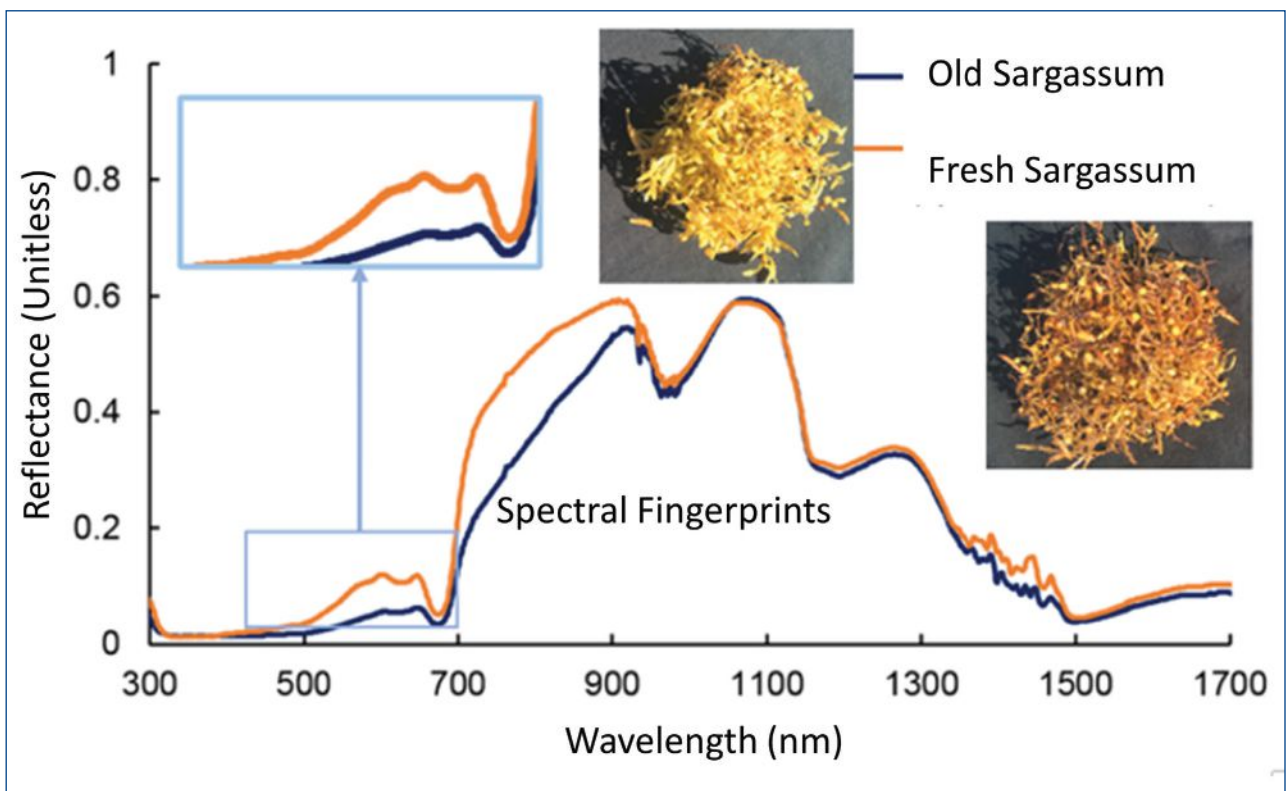
aerosols, clouds and ocean biology and are poised to make significant breakthroughs on ocean-atmosphere interaction. Indeed, sailors have long recognized the importance of quantifying color with the adage: “Red sky at night, sailor’s delight. Red sky in the morning, sailor’s warning.”

What makes the hyperspectral sensor unique is that it can provide a spectral “fingerprint” for monitoring the biodiversity of photosynthesizing flora and fauna in the water column, on the seafloor and floating on the sea surface. Merging hyperspectral and polarimetric imagery will provide many additional benefits, such as better characterizations of clouds and aerosols needed to interpret ocean imagery, as well as reducing uncertainties in many of the current products produced by ocean color

satellites. Combining the optical imagery with models can provide even more predictive capabilities, such as finding the location of the endangered Atlantic sturgeon in order to guide resource managers in protection efforts.

Exploiting the vast technological advances of the mission, the team of PACE Early Adopters aims to integrate PACE data into policy, business and management activities, from quantifying air pollutants to prospecting for aquaculture sites. By incorporating data users into the mission well before launch, NASA will provide the necessary training and sample products so that PACE imagery can be rapidly assimilated into programs that benefit society and inform decision making.

While the applications for PACE are diverse, several examples are highlighted below that have relevance to



(Top) Example of spectral reflectance, or “spectral fingerprints,” that will be measured by the PACE mission to detect subtle changes in color related to different age and/or nutrient conditions of floating Sargassum. (Bottom) Sargassum accumulates along Bathsheba Beach on the east coast of Barbados, March 24, 2015. (Credit: Romel Hall/Barbados Today)

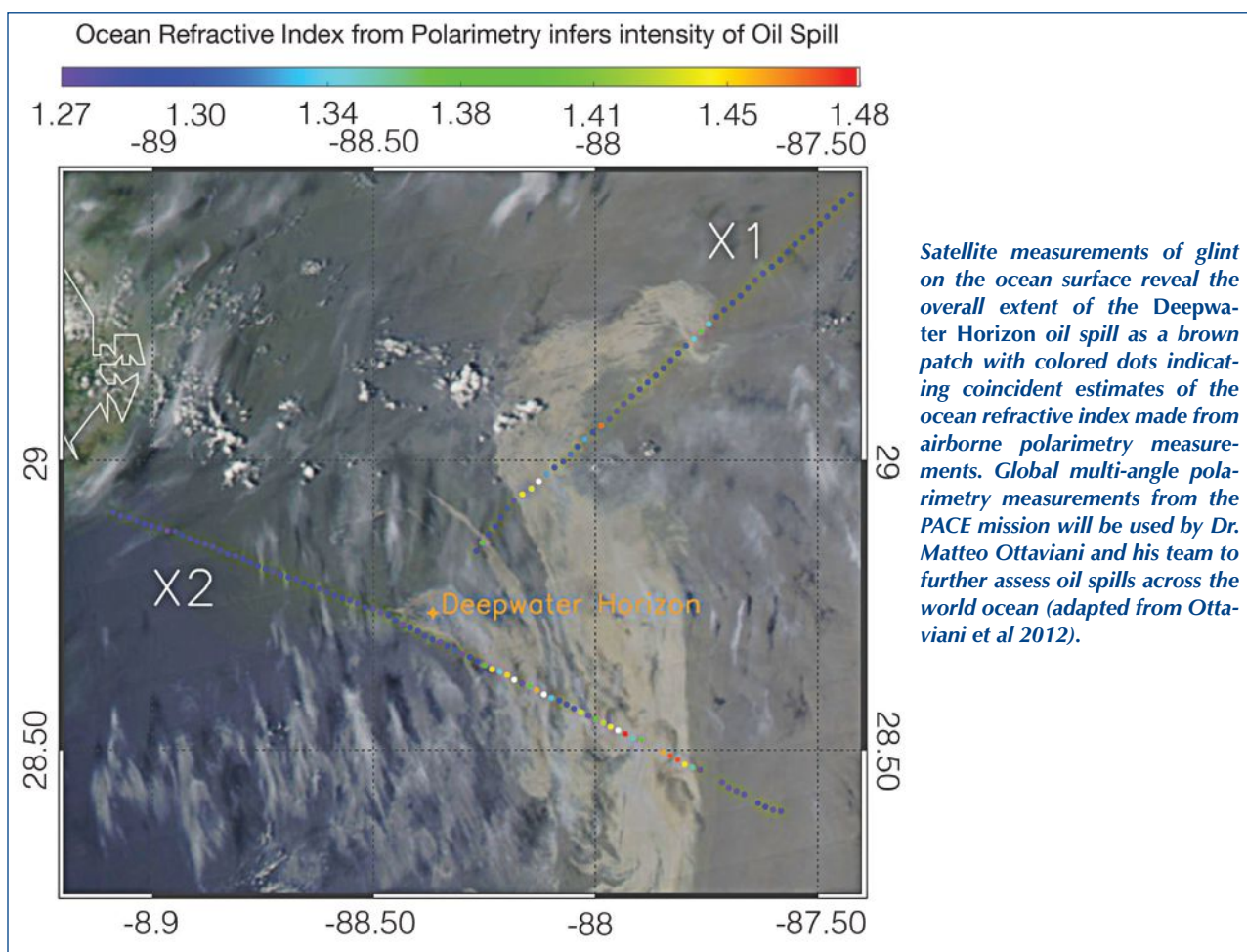
and serves as a refugia for migratory fish, turtles, crabs and a diverse array of smaller organisms. Sargassum does not always stay offshore and with the proper winds and tides can be beached in excessive amounts called mass strandings. In small amounts, stranded Sargassum may serve as fertilizers for sand dunes and, thus, protects shoreline stability. As large mats of Sargassum decompose on the shore, however, Sargassum becomes a nuisance as these mats create a pungent stench due to release of hydrogen sulfide, attract large amounts of insects, and can cause damage to important coastal ecosystems like seagrass and mangrove habitat. Sargassum can also be problematic by blocking important access

management of ports and harbors in particular. Specifically, better quantification and forecasting of the seaweed Sargassum will be possible to aid in harbor management. PACE will also provide new ways to assess oil spills in terms of the types of oil and the extent of spills.

Tracking the Increase in Nuisance Seaweed

Sargassum is a buoyant brown seaweed with berry-like air bladders that floats on the surface of tropical waters

to and from harbors and preventing the deployment of fishing vessels and other ships. The cost for cleanup of Sargassum mass strandings can be staggering, with the need for heavy machinery and intensive labor. The unprecedented levels of Sargassum that washed up on Caribbean beaches in 2018, for example, resulted in estimates of cleanup costs of \$120 million for that year alone, according to government officials. Likewise, Miami-Dade County of Florida has spent an estimated \$45



million a year in removing Sargassum from the shore in the past few years.

“Sargassum in the tropical Atlantic has flourished in recent years due to transport from the Sargasso Sea and nutrient supplies from several sources,” Dr. Chuanmin Hu, a professor at University of South Florida and member of the PACE Science Team, noted. Hu and his research group used satellites to first identify the Great Atlantic Sargassum Belt, which can extend nearly 9,000 km in length from West Africa to the Caribbean Sea and Gulf of Mexico and weigh upward of 20 million metric tons. Hu produces monthly bulletins through the satellite-based Sargassum Watch System (SaWS), providing current bloom conditions and future bloom probability for the Caribbean Sea and Gulf of Mexico. A sample map from SaWS in this article shows Sargassum abundance in the eastern Gulf of Mexico, a result of transport from the Caribbean Sea that indicates the potential for future strandings along the Florida Keys and east coast of Florida.

The present Sargassum bulletins do not extend into coastal waters less than 30 km from shore due to a lack of reliable satellite algorithms and products in these waters. “I am excited for the launch of PACE to use more spectral bands to fill this spatial gap that will produce products closer to the coastline, where it will be of use to environmental managers,” Hu said. Certainly, managers cannot effectively plan for mitigation of mass strandings

without additional information and projections that can identify masses of Sargassum in waters near harbors and ports.

Additionally, the spectral fingerprints provided by the PACE sensors will enhance the Sargassum monitoring capabilities by enhancing the ability to differentiate Sargassum from other floating vegetation like floating seagrass leaves, or “wrack,” and dense phytoplankton blooms. The fronds of Sargassum also can have different coloration ranging, from yellow to brown and red hues. Such subtle differences in color should be detectable from PACE and allow for further assessments of plant age and nutrient status. In addition, satellites can significantly underestimate the amount of Sargassum in the environment when it is submerged below the sea surface. Hu and his team are working on building more sophisticated models that can detect Sargassum even when it is several meters beneath the sea surface.

Oil Spill Detection

Near coasts and harbors, oil spills can come from oil platforms, ship discharge, oil pipeline leaks, unexpected disasters and land-based runoff, with the oil type ranging from crude, lubricating oil, diesel, gasoline, kerosene and condensate. Rapid and accurate detection of spilled oil can not only guide mitigation efforts but also assist in post-spill damage assessment. Among the various satellite remote-sensing techniques, synthetic aperture radar

“Nearly 10 to 20 times the amount of data will be produced per pixel compared to present multichannel ocean color satellites.”

(SAR) and optical sensors are the two most often used for both near-real-time and post-spill assessments. While SAR measurements can “penetrate” clouds, the limited spectral information makes it difficult to differentiate oil from other features that are also commonly found in coastal waters, such as phytoplankton surfactant, fresh-water slicks, current shears and floating algae. Under clear-sky conditions, optical sensors can provide additional spectral information to differentiate and quantify spilled oil. Indeed, the use of optical sensors to assess oil spills can be traced back to the early 1980s, when multiple sensors were used to observe oil distributions after the toxic oil spill off of Mexico in 1979.

PACE can help address the challenge in a novel way by exploiting the measurements from its two multi-angle polarimeters to detect oil spills. Dr. Matteo Ottaviani, a new investigator on the PACE science team, will be using PACE polarimetric data collected from regions affected by sun glint to evaluate anomalies in the polarization state of the reflected light that may be related to oil spills on the sea surface. “My team plans to create a novel ocean surface refractive index product using parts of the imagery that are usually discarded as ‘contaminated’ by sun glint,” Ottaviani said. “A nice aspect of this work is that an effect normally regarded as a nuisance will be turned into a useful resource for a new application like oil spill detection.” Assessing the index of refraction of sea surfaces globally will provide information not just on oil but on the chemical composition of other floating material, such as marine plastics and debris.

A complementary method that Dr. Chuanmin Hu will pilot is to evaluate the differences in spectral information from the PACE OCI instrument to classify the oil emulsion state. Oil spreads rapidly over the sea surface as soon as it is spilled, and waves and turbulence at the sea surface can cause the slick to break up into fragments and droplets of varying sizes. With physical mixing, seawater droplets become suspended in the oil to form water-in-oil emulsions, and oil becomes suspended in seawater to form oil-in-water emulsions. Determining the emulsion state is an important factor in mounting a response to oil spills because emulsions can increase the volume of pollutant and slow oil weathering processes. Hyperspectral measurements from PACE will provide the spectral information necessary to classify different emulsion states of the oil to assist with cleanup efforts. Just such an approach was demonstrated using hyperspectral imagery from the AVIRIS sensor flown from aircraft over the Deepwater Horizon (DWH) oil spill in the Gulf of Mexico in 2010. Unlike targeted aircraft campaigns, the PACE sensor will be able to detect and monitor such oil spills from

space in remote locations throughout the world ocean, with near daily coverage under clear-sky conditions.

Looking Forward

The applications highlighted above are just some of the many compelling new science products that will be produced by the PACE mission. The novel coupling of hyperspectral imagery and polarimetry will undoubtedly lead to other applications that can only be imagined. As a start, the mission team is working hard to have a selection of new products ready for users by the time the mission launches. This is no small feat given the enormous amount of data that will be retrieved from the instruments. Nearly 10 to 20 times the amount of data will be produced per pixel compared to present multichannel ocean color satellites. Given the large data requirements, the few existing hyperspectral satellites have all been targeted to image only select locations primarily optimized for land applications. When launched, PACE’s satellite will produce daily hyperspectral imagery over the entire watery globe with the sensitivity and capability to greatly expand how we see the vast ocean and our relationship with it.

References

For a list of references, contact: heidi.dierssen@ucornn.edu. **ST**

Dr. Heidi Dierssen is a professor of marine sciences and geography at the University of Connecticut and international expert in optical oceanography. A Fulbright scholar, she leads the Science and Applications Team for the NASA PACE mission and serves an international advisory role in advancing hyperspectral remote sensing through the International Ocean Colour Coordinating Group, Scientific Committee on Ocean Research, Australian Aquawatch Program, Belgian Science Policy Office and the Alliance for Coastal Technology. She holds an M.S. in biological sciences from Stanford University and a Ph.D. in geography from the University of California, Santa Barbara, and was a postdoctoral scholar at the Monterey Bay Aquarium Research Institute and Moss Landing Marine Laboratory.

Dr. Jeremy Werdell is an oceanographer at NASA Goddard Space Flight Center in the Ocean Ecology Laboratory and the NASA PACE project scientist. He is responsible for ensuring that PACE achieves its mission science objectives and meets the needs of its user community, inclusive of overseeing instrument calibrations, scientific output and performance assessments. He holds an M.S. in oceanography from the University of Connecticut and a Ph.D. in oceanography from the University of Maine.

Dr. Lorraine Remer is an atmospheric scientist with the Joint Center for Earth system Technology (JCET) at the University of Maryland, Baltimore County (UMBC). She focuses on aerosol remote sensing and different facets of the global aerosol system. She is developing an aerosol retrieval for the broad-spectrum Ocean Color Instrument (OCI) for the PACE mission, while serving as deputy team lead for the PACE Science and Applications Team, and serves as the manager of the UMBC Earth Space Institute’s project to build a multi-angle polarimeter that will fly on NASA’s PACE mission.

Autonomy for Homeland Security

Autonomous Systems As Force Multiplier for Maritime Domain

By Phil Bourque • Amelia Smith

As the third-largest department of the U.S. government, the Department of Homeland Security (DHS) encompasses border protection and the U.S. Coast Guard (USCG), among other missions and entities. Using land, air and marine resources, DHS is responsible for counterterrorism; border, port and maritime security; protection of critical infrastructure; protection against chemical, biological and nuclear threats to the home-

land; response to disasters; and more. The challenges for DHS are amplified in the maritime domain. According to the National Institute for Occupational Safety and Health, marine workers face a higher risk of fatality and injury than the average American worker. In addition to typical hazards such as fatigue and use of heavy equipment, our industry faces additional risks of vessel collisions, allisions, groundings, severe weather and more.



Enabled by Sea Machines' remote-helm control system, an operator commands the company's autonomous boat from a second vessel at sea. (Credit: David Shopper/Sea Machines Robotics)



Alex Venetiou, director of engineering, commands Sea Machines' autonomous vessel Lightning from the company's remote command station in Boston. (Credit: David Shopper/Sea Machines Robotics)

Since even before DHS's inception in 2002, marine industry challenges have simply become widely accepted as risks inherent to the job. But that is now changing with the introduction of advanced perception and autonomous command vessel technologies that mitigate many of these risks while empowering mariners to conduct missions more productively, predictably and safely.

Marine Autonomy Explained

Autonomous control of a vessel is a highly practical technology that aids navigation and improves the productivity and safety of mariners on the water today.

Lloyd's Register defines autonomy for commercial marine operations across six categories, ranging from "low automation" (all actions are taken by human operators, but a decision support tool can present options or influence decision making, with data provided by systems on board) all the way to "unmanned operations" (unsupervised operation where decisions are entirely made and actioned by a system).

Today's commercially available systems, such as those offered by Boston-based Sea Machines Robotics, tend to fall in the middle, between "conditional automation" (decisions and actions are performed autonomously, with human supervision and authorization) and "high automation" (decisions and actions are performed autonomously, with human supervision, and human operators can intervene and over-ride in high-impact decisions).

Sea Machines is designed as a human-on-the-loop system. Most current use cases involve supervised autonomy for locally controlled or remotely operated missions, with unmanned configurations primarily being conducted in controlled domains. The technology enables opera-

tors to work with less risk and greater redundancy while leveraging manpower.

Using Modern Technology to Solve Age-Old Challenges

Autonomous command and remote-helm control systems offer solutions to marine operators in several ways. For on-water incidents caused by fatigue, they offer obstacle detection and collision avoidance capabilities. Commercially available Sea Machines systems use continuous data from sensors such as computer vision, radar, AIS and IMU, and offer 24/7 watch redundancy. When fused, these technologies are more accurate than the human eye, especially in times of low light or poor sea conditions. This can reduce operator fatigue and risk of operational incidents.

Patrol, disaster response, or search and rescue (SAR) missions may be conducted in extreme environments. Autonomous systems increase safety by reducing or eliminating the need for humans to be on board vessels during missions. Today's tech also uniquely executes with human-like behavior, intelligently factoring environmental and sea conditions (including wave height, pitch, heave and roll) and making controlled speed changes between waypoints for added crew comfort.

Another hurdle operators face is manual operations. Across all industries, autonomy automates tedious, redundant and dangerous tasks, allowing workers to focus on higher-level operations. Mariners now can program vessels to autonomously deploy pre-established routes and can remotely command workboats to follow paths in unmanned or autonomous modes. Offering greater predictability and higher performance, these autonomous missions can be saved and reused for future efficiency.

Yet another challenge solved by today's autonomous marine systems is the limited shore-side visibility humans have into at-sea vessel operations. Sea Machines enables crews to remotely monitor operations of working vessels in real time from a shore-side location or second vessel. Remote management and watch redundancy can prevent operational incidents and make operations safer. For DHS, remote vessel monitoring capabilities could also foster interagency sharing of pooled autonomous assets for even greater efficiency.

Another significant challenge the marine industry faces is vision obstruction due to vessel structure or cargo. In traditional operations, crews are confined to a wheelhouse to operate the vessel and onboard payloads. This fixed location doesn't always offer the best vantage point for operators and, in some cases, requires the use of signals to be relayed from another mariner to the wheelhouse. Replacing this conventional system are wireless and remote-helm control technologies that free crew from the wheelhouse to conduct operations from any location that offers the greatest visibility and safety. Systems like Sea Machines' SM200 enable wireless helm and propulsion control, as well as remote control of auxiliaries and payload equipment. Last year, the USCG and American Bureau of Shipping (ABS) approved the SM200 for installation aboard a class of U.S.-flag tugboats that support articulated tug-barge sets.

An example of a DHS application for shore-based remote operations is in port security, where patrol vessels are used for surveillance and monitoring of vessel traffic, as well as searching for potential malicious or suspicious behaviors. Using autonomy, port security authorities can remotely operate and monitor navigation and remotely access a vessel's situational awareness data via sensors and cameras. This empowers shore-based crew to be virtually present with the vessel and make informed decisions about any needed action or vessel response.

Beyond the ports are remote regions, such as the Arctic, where DHS must have a greater focus in the future. Drivers for this include fisheries, tourism and commercial shipping, which are all seeing increased activity in remote areas.

DHS groups can leverage marine autonomy to patrol and survey remote areas with reduced crew or USVs that collaborate to create a force-multiplier effect with less resources required. A single shore-side operator can command multiple autonomous boats with full situational awareness. With their long endurance, USVs can provide persistent domain awareness in remote regions.

An often overlooked but critical challenge of our industry involves the massive size of our oceans and waterways contrasted with our limited resources available for managing them. Whether the missions are border patrol or security for ports and other critical infrastructure, autonomous vessels can follow grid patterns and perform other coordinated tasks along the same paths at set distances apart. These capabilities can be particularly useful in protecting seafood fraud and preventing illegal, unreported and unregulated (IUU) fishing. This is a high-priority focus for DHS, as it is currently placing authorities

at the border to inspect and seize fraudulent or illegally imported seafood.

USCG Sea Machines Trials

In October 2020, the USCG's Research and Development Center (RDC) kicked off an evaluation of USVs' ability to provide persistent maritime domain awareness in remote areas. Supporting these efforts, Sea Machines partnered with Metal Shark Boats to supply an autonomous Sharktech 29 Defiant vessel offering a full range of advanced capabilities.

The USCG said the purpose of the testing was to examine "the operational utility of the USV, including feasibility, costs and benefits. While potentially applicable to many Coast Guard missions, there is potential these technologies will help enable the Coast Guard to better protect critical natural living marine resources from IUU fishing and other illicit activities."

During the event, the RDC operated Sea Machines' autonomy system in real time. Planned exercises included transit and grid autonomy missions, use of the wireless belt-pack from the vessel and shore, and an observance of the system's obstacle detection and collision avoidance feature. Operators saw how the technology enabled optionally manned or autonomous-assist (reduced crew) modes that can reduce mission delays and maximize effort—a critical feature for time-sensitive operations, such as on-water SAR and other expeditious missions.

"It's clear that autonomous technology is a growing industry and has great potential to enhance USCG operations," Cmdr. Blair Sweigart, the RDC demonstration's director, said in MyCG (www.mycg.uscg.mil). "Combined with AI [artificial intelligence] algorithms, unmanned systems could be a game changer."

"The first application that was immediately apparent was the utilization of the USV as a force multiplier from a cutter or shore unit. Having another asset on scene to assist as a show of force or presence is invaluable to the CG's law enforcement missions," said BM1 Houston Riley, also in MyCG. "During an event like the Fourth of July, you can leave it unmanned or have someone operate the vessel remotely, to keep people at bay or create an atmosphere of safety. It has video cameras on it, so the operator or someone back on shore could have visual input. What I really found interesting was using the USV as a manned vessel for SAR ops. As the USV 'self-operates' on a search pattern, the operators are freed to keep a lookout for a person in the water or vessel."

The Sharktech vessel is now home at the RDC's New London, Connecticut, facility, where it is being used for additional testing and operations.

First Autonomous Search-and-Rescue Vessel

The use of autonomy for searching large domains is an ideal use case, and the technology is quickly being put to work. An example is Sea Machines' partnership with Hike Metal, a manufacturer of workboats in Ontario. In what will mark the world's first autonomous and unmanned SAR vessel, Hike Metal will integrate Sea Machines' autonomous vessel control system aboard a

patrol boat to develop and demonstrate the capabilities of autonomous marine technology in increasing the productivity and safety of SAR operations. Demonstrations will be conducted alongside the Canadian Coast Guard in mid-2021.

"We see the need to increase response capabilities and reduce the risk to first responders. We feel this technology and platform will be a valuable tool to all Coast Guard Societies around the world," said Hike Metal's Roger Stanton, senior project manager.

Autonomy in Beyond-Line-of-Sight Applications

Sea Machines, in collaboration with Viasat, a global communications company, has made beyond-line-of-sight autonomous operations attainable for vessel operators. Leveraging Viasat's highly secure, high-speed maritime broadband services on expansive satellite networks, operators can now conduct autonomous missions across North America, Central America, the Caribbean and Europe without signal disruption. This capability is ideal for government operators executing global, offshore and long-distance missions that may utilize reduced-crew or unmanned daughter craft, with full situational awareness provided to operators located aboard a crewed mother-ship or on land.

What's Next: Computer Vision

The next wave of progress will include AI-powered perception systems (computer vision) for autonomous vessels—including ships, tankers, cruise ships and ferries—that will provide advanced situational awareness for piloting. Computer vision allows for increased situational awareness beyond capabilities of radar through identification, tracking, geolocation and classification of targets of interest via proprietary Sea Machines' software and AI-models built from the companies' catalog of digitized data from operational vessels. This library includes routes, positions, attitudes, domain imagery and machinery conditions in varying seasons, locations, and atmospheric and oceanic states.

Sea Machines is releasing this capability to work with its flagship autonomous control system, the SM300. With computer vision as an added sensor, the autonomous capability for vessels to track targets and avoid collisions is greatly increased.

The company is also developing a product that uses computer vision for traditionally controlled ships as a crew-assist tool, which will display these data feeds in a user-friendly way on wide-angle panoramic screens located in the wheelhouse and other areas of the ship. The system is "always on watch" and supports navigation 24/7, even in poor visibility and challenging weather conditions.

Sea Machines is now trialling a computer vision system aboard an A.P. Moeller - Maersk ice-class container ship in Denmark. The product will be commercially available this year.

The main advantages of advanced perception and situational awareness technologies are the reduced risk of uncontrolled incidents, accidents and delays that impact cargo schedules and reduce operators' bottom lines. These incidents are traditionally caused by limitations in conventional shipboard instruments and the perception limitations of human operators.

The Future Is Now

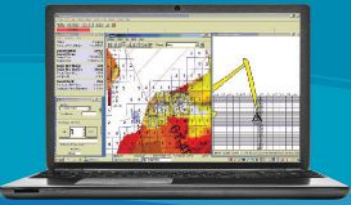
Autonomous technology is available now, and many early adopters in the marine industry have already begun leveraging autonomous and remote-helm control technologies to increase their capability and improve operational vessel safety, productivity and predictability. The result will be the start of an unprecedented era and the introduction of a myriad of new skill sets for mariners. DHS and other operators must lean into modern technologies to keep our nation and economy strong and protected. **ST**

Phil Bourque is the director of sales at Sea Machines Robotics.

Amelia Smith manages communications and marketing for Sea Machines Robotics.

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Energy Solutions Partnership

Industrial energy storage experts Sterling PlanB (SP-BES) and technical sales and service company MJR Power & Automation have a new partnership agreement to expand access to purpose-designed energy storage solutions to U.K.-based customers in marine markets. MJR Power & Automation will provide customers in the U.K. with Sterling PlanB energy storage solutions for offshore and short-sea vessels.

The partnership comes as increasing pressure from the International Maritime Organization (IMO) to achieve regulations targets means that many marine companies are rapidly adjusting their operations to reduce Tier 1, 2 and 3 emissions.

Hydrography, Oceanography Combo Portfolio

Subsea Europe Services GmbH and Cyprus Subsea Consulting and Services C.S.C.S. Ltd. have entered a new strategic cooperation to share knowledge and services that will simplify the acquisition of high-quality marine data for clients across Europe. A harmonized hydrography and oceanography portfolio will be available from a single, Europe-wide source. Both companies will also share knowledge on the continuing development of autonomous solutions for marine surveying.

DNV GL Changes Name, Combines Businesses

DNV GL, the assurance and risk management company, is now named DNV after a comprehensive review of the company's strategy as it positions itself for a world in which many of DNV's markets are undergoing fundamental change. The name DNV GL has been in place since the 2013 merger between DNV (Det Norske Veritas) and GL (Germanischer Lloyd). The name simplification is a natural consequence of a successfully completed merger and of having operated as a fully integrated company for several years now.

The company will also combine its Oil & Gas and Power & Renewables businesses into one new business area called Energy Systems to better reflect the emerging energy future.

Independent Maritime Testing Company

Maritec Pte Ltd., the fuel and oil testing services company acquired by certification company Centre Testing International Group (CTI), is now fully integrated into CTI's marine division to create a purely maritime-focused independent testing services company.

The June 2020 acquisition forms part of CTI's strategy to expand its marine division to meet the bunkering, emissions and environmental challenges shipowners are set to face over coming months and years.

MacArtney Toolkit for Danish Water Monitoring

MacArtney Group has supplied a 12-unit solution for the Danish Environmental Protection Agency with three different water sampler configurations in dedicated

frames to help document marine conditions in Danish waters. The solution will help measure CTD, fluorescence, yellow matter (CDOM), dissolved oxygen and photosynthetically active radiation.

UK Supply Chain Survey

Subsea UK's snapshot surveys of the U.K.'s supply chain in July and November 2020 show an improved outlook for the industry, with less anticipated redundancies, greater optimism and new geographical markets.

Half of the respondents' target markets had changed between surveys as a result of the pandemic. Europe remains the top market among 54 percent of respondents, a rise of 8 percent since July, followed by the Gulf of Mexico, Asia Pacific, South America and the Middle East.

While oil and gas is still the dominant market for the subsea industry, activity in offshore wind has increased, and 28 percent of firms are now prioritizing this market, compared to 21 percent in July.

Vessel Notation for Infectious Disease Mitigation

The Thome Group's diving support vessel, *Southern Star*, has achieved a world's first Infectious Disease Mitigation-Arrangement (IDM-A) notation by ABS. The inspectors were satisfied with all the measures in place to mitigate the spread of any infectious diseases on board, in light of the current pandemic.

MAC to Become BVS

Bureau Veritas (BV) has announced that MAC (Maritime Assurance & Consulting), acquired in 2016, will officially become Bureau Veritas Solutions Marine & Offshore (BVS). BVS specializes in advisory, asset management and assurance solutions dedicated to the marine and offshore energy markets.

Dredging Acquisition

Encore Dredging Partners LLC has acquired Inland Dredging Company LLC. EDP completed the transaction with the support of AV Capital, which is the sole financial sponsor of EDP and will continue to support future growth and provide oversight.

USCG Issues Ballast Management Type Approval

The U.S. Coast Guard (USCG) has issued type approval for Alfa Laval PureBallast 2. Most owners of Alfa Laval's second-generation ballast water treatment systems can now opt to continue operating in U.S. waters, even when their alternate management system (AMS) approval expires.

Oil and Gas Major Pivots

Following a detailed analysis of the climate positions of the American Petroleum Institute (API), Total has decided not to renew its membership for 2021. The company is shifting focus to the energy transition.

Shop More BIRNS Products Online

BIRNS Inc. has a new e-commerce offering for NPT (National Pipe Thread) penetrators on its website: www.birns.com. Customers now have an online one-stop shop

for BIRNS's ABS Product Design Assessment (PDA)-certified penetrators. Available configurations on the site include sizes P25N-16-RA-LS, P25N-12-RA-LS, P13N-4-RA-LS and P19N-12-RA-LS, which come with four, 12 or 16 conductors.

Phoenix Builds New Test Tank

Phoenix International Holdings Inc. will construct a new test tank at its Bayou Vista, Louisiana, facility. The one-atmosphere dive tank will hold 39,700 gallons and be utilized for subsea applications such as underwater weld testing (both wet and dry habitat conditions), underwater nondestructive testing (NDT) applications, and performance trials including underwater welding certifications and underwater tooling calibration and testing.

G&G Campaign off Equatorial Guinea

TDI-Brooks International Inc. has completed a geophysical and geotechnical (G&G) campaign for Trident Equatorial Guinea off the coast of Equatorial Guinea in the Elon Field. The site survey work was performed off TDI-Brooks' RV *Proteus* to assess seabed conditions prior to the emplacement of a drilling rig at three proposed locations (previously drilled), together with reconnaissance survey work at two additional platforms and along a number of proposed cable/pipeline routes.

Centek Expands

Delta "T" Systems, manufacturer of advanced engineered marine ventilation systems, has joined the Centek Industries family of companies. The move expands the breadth of marine solutions offered by Centek and provides additional opportunities and resources to Delta "T" Systems. Riviera Beach, Florida-based Delta "T" Systems will retain its location, manufacturing and personnel.

FOAM System for Dredge Monitoring

Sequoia Scientific Inc., Ocean Instruments and Sequoia's Dutch distributor, Geometius, have delivered a Fast Oceanographic Automated Measurement (FOAM) system for dredge monitoring. It comprises a pump and winch with a fluid rotary joint, 100-m hybrid cable with hose and conductors, a tow sled with an RBR CTD and a Sequoia LISST-ABS, and a topside-mounted Sequoia LISST-200X running in flow-through mode. The sled is towed through the dredge plume as water is continuously pumped through the hybrid cable and winch to the LISST-200X. This setup delivers particle size, concentration and other parameters from the CTD in real time and allows for co-located water samples to be collected on deck for ground-truthing sensor data.

First NOIA ESG Annual Report

The National Ocean Industries Association (NOIA) has released "Year One: NOIA ESG Annual Report," highlighting work by the NOIA Environmental, Social & Governance (ESG) Network and NOIA members to share and develop the best ESG practices across the offshore industry. The report is available at: <https://tinyurl.com/yxadz9e4>. **ST**

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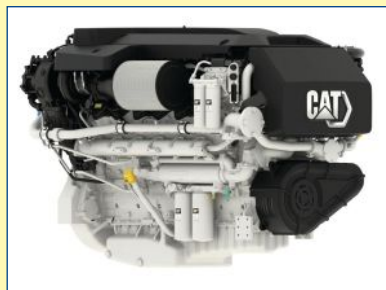
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Triple-Turbo Marine Engine



Cat C32B 2433 MHP (2400BHP) has a rated engine speed of 2,300 rpm. With a 20% increase in power output, the C32B leverages the same core engine upgrades as the C32B 2025 MHP rating while offering additional features and benefits. It is ideal for yachting, sportfishing and governmental applications. Caterpillar Marine.

Underwater Laser Scanner

With built-in high-resolution radiation-tolerant color cameras and lighting, the 3D CAD NM200EVT-1 scanner can quickly and accurately perform VT-3, VT-1 and EVT-1 inspections required by MRP/BWRVIP and ASME Section XI. It supports in-vessel inspection campaigns. Newton Labs.

Ultracompact Modem

Sized at just 60 x 50 mm and weighing in at just 55 g, the UCM provides reliable wireless underwater acoustic communications on board the growing number of autonomous microvehicles and other subsea instruments. It is rated to 700 m. Teledyne Benthos.

Semiautonomous Sailing

SmartMove Suite features advanced sensors and high-accuracy ship control systems. It can be retrofitted to soup up existing vessels with next-generation capabilities to improve safety, efficiency and productivity on the water. The technology enables navigation officers to perform at a higher level. Wärtsilä Voyage.

Ocean Learning Platform

Drawing on the resources of Seagull and Videotel, as well as sister learning brands Marlins and MTS, the platform is an enterprise-level maritime learning management system designed to unite shore-based and onboard training initiatives, online and across mobile devices. Microlearning and gamified content are included. Ocean Technologies Group.

CTD Profiler

SWiFT CTD is the next generation of the SWiFT profiler range and delivers enhanced accuracy and versatility for those requiring CTD measurements. It provides survey-grade sensor technology coupled with the convenience of Bluetooth connectivity, rechargeable battery and an integral GPS module to geolocate each profile. Valeport Ltd.

Large USV



Rated to 7,000 m, the 72-ft. Sailerone Surveyor puts comprehensive ocean-floor mapping within reach. It is an uncrewed, autonomous surface vehicle designed for deep-ocean mapping. It operates with almost zero carbon footprint and at a fraction of the cost of traditional manned ships. Sailerone Inc.

Towing, Mooring Connection

Lankoloop uses a simple knot and eye connection to complete the connection in seconds. No shackle or other hardware is needed for the Lankoloop; feeding it through any smooth strongpoint will complete the connection. Lankhorst Ropes.

Fleet Management

A new port information module has been added to the FLEET INSIGHT service, which combines IHS Markit's Ports and Terminals data and other information to provide a comprehensive directory of port facility information, previous port calls, live port occupancy, berth availability and inbound marine traffic, all within a single online service. Voyager Worldwide.

Sustainable Shipping Tool



Carbon Intensity Monitoring (CIM) is a new service for reliable CO₂ reporting and regulatory compliance. CIM collects all required data via interactive reporting tools and provides multi-layered data verification for accurate calculation of a vessel's Energy Efficiency Operational Indicator (EEOI) and CO₂. Weathernews Inc.

AIS, Weather Data

Optimise ensures that a tramp operator's vessels are always sailing at optimal speed. The calculation is informed by Spire's AIS and weather forecasts. This improves decision making to reduce emissions and fuel consumption and increase revenue. ZeroNorth and Spire Maritime.

Seafloor Measurements

Global Satellite Derived Bathymetry (G-SDB) has been developed with a new seafloor depth measurement technique that leverages machine learning and NASA ICESat-2 laser data. The first G-SDB offering covers the entire Red Sea. Additional data sets will roll out through 2021. TCarta Marine.

Engine Management App

Coxswain enables customers to access after-sales support for Cox

diesel outboards at the touch of a button. The app is the first of its kind in the marine industry. Cox Powertrain Ltd.

Dredging Support

SUPER SHREDDER SS2400 is an in-line disintegrator that reduces a variety of liquid-borne solids with a unique, low headloss design. It reduces clogging and downtime. Franklin Miller Inc.

Emission Monitoring

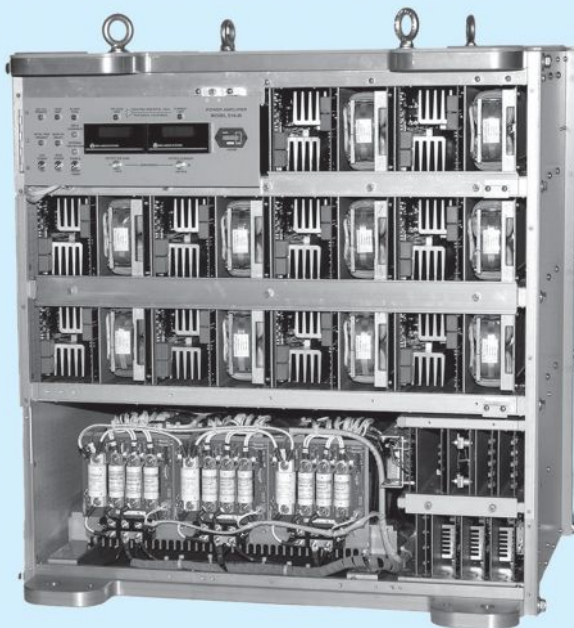
CEMcaptain is a multicomponent analyzer system that continuously provides real-time data. It measures SO₂ and CO₂ in line with regulation requirements. ABB.

Anti-Foulant Coating

ClearSignal is clear and nontoxic. It is designed to last as long as the equipment it is protecting. Severn Marine Technologies LLC. **ST**

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Biden Administration Appointments

Lloyd Austin is the new defense secretary. He is the first African-American to serve in the position. Kathleen Hicks is the new deputy defense secretary. She is the first woman in this role.

Alejandro Mayorkas is the new secretary of the Department of Homeland Security, which includes the Coast Guard. Mayorkas is the first immigrant to serve as DHS secretary.

Amanda Lefton is the new director of the U.S. Bureau of Ocean Energy Management (BOEM). She most recently served as the first assistant secretary for energy and environment for New York.

Pete Buttigieg is the new secretary of the Department of Transportation, which includes the Maritime Administration (MARAD). He is a former mayor of South Bend, Indiana.

Gina McCarthy is the new national climate adviser. She will head the newly formed White House Office of Domestic Climate Policy.

Funding for FY 2021

The U.S. Congress has passed legislation providing \$1.4 trillion in federal funding for fiscal year (FY) 2021, with approximately \$900 billion for COVID-19 relief. The Consolidated Appropriations Act, 2021, includes sweeping provisions that span clean energy research and development, programs focused on climate policy, energy tax extenders, pipeline safety reauthorization and water infrastructure. At a total cost of \$2.3 trillion, the package is the second-largest bill ever passed by Congress.

Legislation for Ports

The American Association of Port Authorities (AAPA) has championed many port-related programs that are included in the FY 2021 Omnibus appropriation package and in the FY 2021 National Defense Authorization Act (NDAA).

The omnibus spending bill includes the Water Resources Development Act (WRDA) of 2020, which includes critical Harbor Maintenance Tax spending reforms long advocated by AAPA, together with the first-ever drawdowns from the \$9.3 billion balance in the Harbor Maintenance Trust Fund.

The FY 2021 NDAA includes the authorization of the Maritime Transportation System Emergency Relief Program for ports to access federal relief following disasters, including pandemics such as COVID-19.

Congress Reauthorizes NOAA Sea Grant Through 2025

The National Sea Grant College Act has been reauthorized with updates that include: direct-hire opportunities for Knauss fellows by participating federal agencies following their fellowship year; a change in the frequency of the National Sea Grant Advisory Board's report to Congress from biennial to periodic and at least every four

years; updated authorization of appropriations levels; affirmation of several key topical areas of Sea Grant's work, including language on strengthening the requirement for Sea Grant to support a program of fellowships; and an increase in the administrative allowance from 5 to 5.5 percent of the total federal appropriations.

Sea Grant is a national network of 34 university-based programs with a mission to enhance the practical use and conservation of coastal, marine and Great Lakes resources to create a sustainable economy and environment.

NOIA Successfully Lobbies for Expansion of Safe Harbor Provisions for Offshore Wind Projects

The U.S. Department of the Treasury and the Internal Revenue Service said that federal tax credits can be claimed on offshore wind projects and renewable energy projects on federal land that are completed within 10 years after the year construction starts.

Until now, most renewable energy projects have had to be completed within four years after the year construction starts for tax purposes. Under the new guidance, there is a 10-year safe harbor compliance period for all projects otherwise qualifying for the Investment Tax Credit.

This has been a major lobbying priority for NOIA; the flexibility the updated guidance provides is vital for offshore wind as it makes use of existing federal support.

2020 Had Record Temps

NASA and NOAA have released their annual assessment of global temperatures and climate conditions. NASA's analysis found that 2020 tied with 2016 as the hottest year on record, while NOAA's analysis identified 2020 as the second hottest year by .04° F.

This follows the release of new data from Copernicus Climate Change Service, a program of the European Commission, that also said 2020 tied with 2016 for the world's hottest year on record and that the past decade was the warmest ever observed.

Report to Congress on Complementary PNT, GPS Backup Tech

The U.S. Department of Transportation (DOT) has released the Complementary Positioning, Navigation, and Timing (PNT) and GPS Backup Technologies Demonstration Report to Congress. DOT's Volpe National Transportation Systems Center conducted field demonstrations of candidate PNT technologies that could offer complementary service in the event of GPS disruptions. The purpose was to gather information on PNT technologies at a high Technology Readiness Level that can work in the absence of GPS. The results indicate that there are suitable, mature and commercially available technologies to back up or complement the timing services provided by GPS. However, the demonstration also indicates that none of the systems alone can universally back up the positioning and navigation capabilities provided by GPS and its augmentations. This necessitates a diverse universe of positioning and navigation technologies. **ST**

offshore oil & ocean engineering

OBN North Sea Project

iSURVEY has completed its largest project to date, involving 6,300 km of survey since mobilization in July. The contract, which consisted of two workscopes, was awarded by Norwegian ocean-bottom seismic experts Magseis Fairfield ASA.

The two surveys, using multi-beam echosounder, side scan sonar and magnetometers, have contributed to Magseis Fairfield's ocean bottom node (OBN) exploration project within the Cornerstone area, one of the most challenging locations in the North Sea.

Motive Offshore Acquisition

Motive Offshore Group, specializing in marine equipment fabrication and rental for the back deck and beyond, has acquired subsea equipment experts Flowline Specialists. The deal is the latest development in Motive's growth trajectory, bringing its headcount to approximately 200 and bolstering existing capabilities in the U.K., Norway and United Arab Emirates, while further increasing its European footprint.

Established in 2001, Flowline designs, engineers and manufactures its own equipment, supplying experienced technicians and support services for the handling and deployment of flexible pipes, umbilicals and cables to the offshore energy market.

The acquisition will enable Motive to further implement its strategic vision of market diversification into offshore wind, power and utilities via the introduction of complementary products, services and expertise to existing and prospective clients.

Record-Breaking Subsea Flowline Cleanout

SBS Energy Services has successfully completed a multi-phase project to decommission approximately 29,000 ft. of 10-by-6-in. insulated pipeline in the Gulf of Mexico in partnership with Helix Energy Solutions, setting a new offshore snubbing unit/hydraulic workover world record, according to the company.

The previous snubbing record depth of 23,800 ft. was set in 2006 by Helix (then Cal Dive).

The SBS project, which was completed successfully in 22 days, ahead of schedule, involved retrieving and removing a pipeline end termination (PLET) to the surface of a DP3 drilling intervention vessel. A 340K snubbing unit was used to rig up and intervene inside the pipeline with an optimized drill pipe string to perform washing/flushing operations until reaching the second PLET. A cap was then installed on the first end of the pipeline and placed back in the original trench on the seafloor with the deployment rigging and drill string for permanent abandonment in situ. The final task was to record the final pipeline position on the seafloor.

Data-Driven Decarbonization

Norwegian energy major Equinor has signed a deal with Yxney to roll out the Maress software for data-driven decarbonization for Equinor's chartered offshore service fleet operating in Norway.

The new contract is a timely fit with Equinor's expressed ambition to halve its maritime emissions in Norway by 2030 compared with 2005, and globally by 2050 compared with 2008. These ambitions are embedded in the company's climate roadmap launched in 2020.

Using Maress to facilitate close cooperation with the vessel owners and suppliers of innovative technology will unlock significant fuel and emissions savings.

Oceaneering Connectors for Tieback in US GOM

Oceaneering International Inc. has been awarded a connector supply contract from TechnipFMC to provide 2-in. M5 connectors and chemical throttle valves (CTV) for the Khaleesi/Mormont and Samurai tieback project in the U.S. Gulf of Mexico (GOM). The M5 connector provides an easy-to-install, fly-to-place connection solution that enables injection of gas or chemicals

into subsea infrastructure and serves as an access point for future subsea field intervention activities, such as gas lift, chemical injection, well stimulation, hydrate remediation, flooding and venting operations, acid injection, and scale squeeze.

3D Survey off Ghana

TG-GEOPARTNERS has signed an agreement with the Petroleum Commission of Ghana to conduct a major multi-client 3D geophysical survey in the Keta Basin, offshore Ghana. The project will comprise the acquisition of 14,000 sq. km of 3D long-offset broadband multi-client seismic over open blocks that will be available for application.

Safety Software

Wärtsilä Voyage has successfully completed its first commercial installation of the Wärtsilä Navi-Harbour WebVTS 5.0 software application. The system was ordered by Netherlands-based Wintershall Noordzee B.V. to provide greater safety for offshore installations in the North Sea. The software features an early-warning system to avoid collisions between the offshore platforms and vessels. It provides remote access to AIS or vessel traffic service (VTS) data sources to maintain constant and full situational awareness, using a standard internet browser.

Report Says Industry Collaboration Key to Growth

Enhancing collaborative culture within the offshore oil and gas industry is not only key to maximizing the potential of its existing supply chain but could also unlock future activity in the U.K. Continental Shelf (UKCS) and be key to delivering a successful Net-Zero future.

Improving commercial models that support cost reduction while incentivizing the supply chain could re-energize collaboration, according to the annual Deloitte and OGUK Collaboration Report.

Deloitte and OGUK's industry-wide Collaboration Index showed a slight increase in collaboration during 2020 compared to 2019. **ST**

Sonardyne Tech for AUV Program

Dive Technologies has chosen Sonardyne technologies for navigation, tracking and control of its large displacement DIVE-LD AUV program.

The DIVE-LD AUV is being developed to meet a wide range of long-endurance mission requirements across the commercial, research and defense sectors. The vehicle is fitted with Sonardyne's hybrid navigator SPRINT-Nav. For underwater positioning and acoustic communications, the DIVE-LD is fitted with Sonardyne's AvTrak 6, a combined transponder, modem and emergency relocater beacon. To cover all its concepts of operations (CONOPS), including tracking and communication during development and testing, Dive Technologies has also acquired Sonardyne's ultrashort baseline (USBL) system, Ranger 2.

The DIVE-LD AUV, measuring 48 in. in diameter and 19 ft. long, is designed for operations down to 6,000-m water depth. It is currently in production in the U.S.

Remote In-Water Survey

Bureau Veritas (BV) has successfully completed the proof-of-concept project for underwater remote surveys using the Seasam technology ecosystem from Notilo Plus on the Corsica Linea ship *Méditerranée*. An in-water survey of the ship in Marseilles was supervised from BV's head office in Paris.

The Seasam drone, sensors and control system with Notilo Plus software has successfully demonstrated an alternative to the traditional diver in-water survey.

ROVs for In-Situ Inspection

Global Drone Inspection (GDI), the new subsidiary company of robotic inspection specialists RIMS BV, has introduced the use of ROVs for the inspection of in-water ship assets. Building on the experience of RIMS BV, GDI can now offer customers fast, flexible and safe inspec-

tions of stern tube seals, bow thrusters, hull land markings and in-use tanks, which are often unable to be emptied for inspections.

The condition of the coatings, anti-fouling, deformations, damages, leaking seals, rudders and propellers require regular inspections, so there is a need for fast, real-time, safe and cost-effective inspections of floating assets and internals of tanks.

Using technology from Blueye Robotics, a small ROV provides high-definition video recordings and images to clients, enabling real-time decision making on repairs and maintenance.

ELWAVE Raises Capital

ELWAVE, an industrial designer and manufacturer of innovative electromagnetics sensors for underwater and industrial robotics, has completed its first capital raise. The funds will support the company's global growth, industrialization and commercialization of its first products for underwater robotics.

The funding round was led by SOFIMAC Innovation, with co-investors Litto Invest Fund and Atlantique Vendée Innovation Fund. Bpifrance and other banks have completed this capital raise, with other financial support. This equity financing comes as ELWAVE scales to meet strong demand in underwater robotics, especially for the offshore wind and AUV markets.

Cloud-Based Simulator Training

Columbia Shipmanagement (CSM) has partnered with Wärtsilä Voyage to launch cloud-based simulator training for its maritime training centers worldwide (including in Russia, Latvia, Ukraine, Georgia, Korea, Croatia and the Philippines).

The agreement with Wärtsilä's distributor in Manila, AWA Marine, will enable cloud-based simulators to be used for navigation, engineering and liquid cargo handling simulator-based training.

Columbia Shipmanagement has over 40 years of experience in the

industry and currently employs over 15,000 people worldwide and manages 380 vessels.

Engine Makes World Record

WinGD's 12X92DF engine series has been awarded the Guinness World Record for the most powerful Otto-cycle engine ever built.

In tests carried out at engine builder CSSC-MES Diesel Co. (CSSC-CMD) and verified by Guinness World Records for the official record title "Most powerful marine internal combustion engine (Otto cycle) commercially available," the 2,140-tonne engine demonstrated a power of 63,840 kW at a speed of 80 rpm.

The X-DF range of dual-fuel engines enables the use of LNG as a marine fuel. They are ready for use, with no modifications required, once carbon-neutral fuels, including methane produced from biomass, or renewable electricity become available.

ABB to Power Busan Port's Electric Ferries

ABB has secured a contract with Haemin Heavy Industries shipyard to provide a complete power and propulsion solution for Busan Port Authority's first all-electric passenger ferry.

The new ferry represents the first commitment by South Korean authorities to a plan that will see 140 state-owned conventionally powered vessels replaced with those operating on cleaner alternatives by 2030, in line with environmental legislation. Sustainable transportation, including marine vessels, will play an important role in South Korea's plan to achieve net-zero emissions by 2050, set out in the country's Green New Deal.

As the first system integrator chosen to support this initiative, ABB will deliver an end-to-end electric power and propulsion solution for the twin-hulled ferry, which is due for delivery in 2022. The 40-m catamaran ferry will have the capacity to carry up to 100 passengers and five crew members and will operate between Busan's North and South ports. **ST**

RJE to Recover SURTASS in Case of Loss at Sea

The U.S. Navy has chosen RJE International Inc.'s ATT-400 underwater acoustic transponder for subsea relocation to ensure the recovery of the AN/UQQ-2 surveillance towed sensor system (SURTASS) in case of loss at sea.

The SURTASS system is a passive surveillance system that consists of long acoustic arrays towed by the T-AGOS-class naval ships. At the end of each acoustic array, an ATT-400 is mounted to provide range and bearing for subsea recovery.

In support of the Navy's ASW mission, SURTASS provides long-range detection, tracking and classification of both diesel- and nuclear-powered submarines.

Toward Next-Gen European Naval Platforms

Damen Shipyards Group, as coordinator of the SEA Defence (Survivability, Electrification, Automation, Detectability, Enabling Foresight of European Naval Capabilities in Extreme conditions) project, has announced that the European Commission has selected this proposal within the European Defence Industrial Development Programme (EDIDP 2019). The EDIDP, which paves the way for the European Defence Fund, focuses on the promotion of a strong and innovative defense industry and raising the EU's autonomy and technological leadership in defense. SEA Defence's proposal will now enter the next phase toward award of the project, which is likely to be effective later this year. Unique in this project is that the leading European naval yards, brought together within SEA Naval, a working group of SEA Europe association, have joined efforts to identify future technological challenges and opportunities in the research and capability domains for the next generation of naval platforms.

REMUS 100 UUVs for German Navy

Huntington Ingalls Industries has delivered new REMUS 100 UUVs to the German Navy. The vehicles will be used to expand the German Navy's current fleet of REMUS 100 UUVs for mine countermeasure (MCM) operations. The new REMUS 100 UUVs have advanced

core electronics and endurance of up to 12 hr. The vehicles are open architecture and have enhanced modularity. The German Navy previously acquired legacy REMUS 100 UUVs after extensive trials. For the past seven years, the German Navy has been using these successfully for area search, debris field mapping and topographic ocean-floor mapping in water down to 100 m. The UUVs are outfitted with side scan sonar.

General Dynamics to Support Knifefish UUVs

The U.S. Navy has contracted General Dynamics to deliver engineering support for the development, testing and production of the Knifefish UUVs, based on the Bluefin-21 deepwater UUV. Currently, General Dynamics is contracted to deliver five Knifefish systems for the low-rate initial production of the surface mine-countermeasure UUV program.

Greensea SBIR Grant for Robotic EOD Ops

Greensea Systems Inc., creator of OPENSEA, the open-architecture robotics platform for the marine industry, has been awarded a Phase II Small Business Innovation Research (SBIR) ASAP grant totaling \$1,100,000, with option for additional funding, for the continued development of standoff command and control of ROVs.

The Phase II award will further the development of a capability to conduct water-borne explosive ordnance disposal (EOD) operations with marine robotics from a safe standoff distance. The standoff system is hardware, transmission and vehicle agnostic, and provides high levels of autonomy for the ROV, as well as coordination of launch and recovery, vehicle tether and host USV.

SeaBat Sonar for Mine-Hunting Newbuilds

Teddyne RESON will supply SeaBat 7123-MkII forward-looking sonar systems for obstacle identification and avoidance for two newbuild naval mine-hunting vessels. SeaBat 7123-MkII is suitable for use in a wide range of applications and platforms, including both surface vessels and underwater vehicles. It can deliver super-high-resolution imaging for underwater inspection tasks, such as long-range detection of objects in the water column or on the seabed, and it can be a platform for scientific and oceanographic research applications. **ST**



SAAB SEAEYE



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environmental monitoring

Xodus Adds Experts On Emissions Reductions

Global energy consultancy Xodus Group has invested in expanding its emissions team to support clients and the wider energy industry in achieving its Net Zero goals.

Xodus has added atmospheric expert Natasha Howlett to lead an in-house emissions management division, which will support clients' emissions reduction initiatives around the world. This new offering will build on Xodus' existing services by including offshore energy assessments, exhaust stack sampling, emissions management and forecasting, ESOS compliance, BAT assessments, gas turbine and compressor performance testing, and training packages.

Howlett will be joined by Christopher Smith and Vicky Milne, who join from energy and emissions consultancy PI, and have more than 15 years of dedicated emissions experience combined. Throughout that time, the team has built an extensive international database of emissions data compiled from hundreds of global offshore tests and assessments.

Creating an Anthropogenic Vulnerability Index

Sindhujha Kasthala was studying land use and land cover in the coastal regions of India when she noticed an alarming trend. "I found that although we have coastal rules, the land use kept changing very fast," said Kasthala on eos.org. "I thought, instead of just studying the existing vulnerability types, I would come up with a new type of vulnerability—anthropogenic vulnerability—and link it to these policies."

Kasthala is a Ph.D. student at the Indian Institute of Technology Bombay, where researchers are working to understand the vulnerability of India's coastal communities and ecosystems to extreme weather events such as tropical storms. As the climate warms and extreme weather becomes more common, this understanding will become crit-

ical in protecting coastal populations and livelihoods. Vulnerability assessments help identify geographical areas of most concern.

Researchers begin by using interviews and a literature review to create a list of factors that are generally agreed to affect vulnerability. For the anthropogenic index, Kasthala identified habitat and land use changes, resource exploitation, pollution, the introduction of nonindigenous species, development and tourism as the key factors. Each of these factors has one or more corresponding indicators. For example, loss of wetlands and aquaculture expansion are both indicators of land use change.

Mangroves are particularly at risk from coastal development associated with tourism, shipping and aquaculture. Kasthala will evaluate changes in mangrove cover as a leading indicator of habitat loss.

Kasthala hopes the anthropogenic vulnerability index will become part of a comprehensive rubric that can help inform policy decisions for sustainable coastal development.

Short-Term Warming From Less Aerosol Pollution

The lockdowns and reduced societal activity related to the COVID-19 pandemic affected emissions of pollutants in ways that slightly warmed the planet for several months last year, new research finds. The new study in AGU's journal *Geophysical Research Letters*, highlights the influence of airborne particles, or aerosols, that block incoming sunlight. When emissions of aerosols dropped in the spring of 2020, more of the Sun's warmth reached the planet, especially in heavily industrialized nations such as the U.S. and Russia that normally pump high amounts of aerosols into the atmosphere.

"There was a big decline in emissions from the most polluting industries, and that had immediate, short-term effects on temperatures," said Andrew Gettelman, a senior scientist at the National Center for Atmo-

spheric Research and lead author of the new study.

The research highlights the complex and often conflicting influences of different types of emissions from power plants, motor vehicles, industrial facilities and other sources. While aerosols tend to brighten clouds and reflect heat from the Sun back into space, carbon dioxide and other greenhouse gases have the opposite effect, trapping heat near the planet's surface and elevating temperatures.

Gettelman emphasized that the long-term impact of the pandemic may be to slightly slow climate change because of reduced emissions of carbon dioxide, which lingers in the atmosphere for decades and has a more gradual influence on climate. In contrast, aerosols have a more immediate impact that fades within a few years.

Landmark Study: Climate Change Causes 'Critical Threat'

For the first time, researchers have proved human-caused global warming is directly responsible for creating a "critical threat" of a devastating outburst flood, putting a city of some 120,000 people in the path of potential floodwaters, according to new research from the University of Oxford and the University of Washington, published in *Nature Geoscience*.

As the planet warms, retreating glaciers contribute to the formation of unstable lakes, prone to hazardous outburst floods. This study provides evidence for a ground-breaking lawsuit seeking compensation from an energy company, RWE, for climate change impacts. It establishes a "full set" of links from human-made greenhouse gas emissions to the substantial risk of a dangerous outburst flood from Lake Palcacocha, high in the Peruvian Andes. This flood threatens to inundate the city of Huaraz.

"We found that human influence on climate—through greenhouse gas emissions—is responsible for virtually all of the warming that has been observed in the region," Rupert Stuart-Smith, lead author of the study said. **ST**

contracts

Independent Data Services (IDS), Aberdeen, Scotland, has been awarded a fleet-wide deal for fully integrated online reporting and analytics services. Stena Drilling.

Allseas, Châtel-Saint-Denis, Switzerland, has awarded a contract for the delivery of the complete electrical, hydraulic and control system for its deep-sea mining nodule collector. The project is part of Allseas' development program to gather polymetallic nodules from the ocean floor in a responsible way. Seatools.

Cashman Dredging and Marine Contracting Co. LLC, Quincy, Massachusetts, has executed a design contract for a new 6,500-cubic-yard trailing suction hopper dredge. The new vessel will complement Cashman Dredging's current fleet of specialized dredging equipment and will primarily service the coastal protection and navigation maintenance markets when it enters service in 2024. IHC America Inc.

The Panama Canal, Panama City, Panama, has signed memorandums of understanding to help optimize supply routes for the distribution of the COVID-19 vaccine and supplies to Latin America. Panama Ports Company and PSA Panama International Terminal.

Fugro, Leidschendam, Netherlands, has chosen the Mini-Ranger 2 USBL positioning system for its new 12-m-long Blue Essence USV to enable the USV to deploy, track, command and control the Blue Volta electric ROVs and AUVs as part of inspection, survey and data harvesting projects, all controlled from Fugro's onshore remote operations centers. Sonardyne.

Alfa Laval, Lund, Sweden, has formalized a strategic collaboration on the development of zero-carbon solutions for the maritime industry by signing a strategic corporate partnership agreement. Systems will

be developed to handle new green fuels or solutions to improve overall energy efficiency. Mærsk Mc-Kinney Møller Center for Zero Carbon Shipping.

Wallem, Hong Kong, China, will implement the OCEAN Learning Platform, designed to deliver blended learning, assessment and competency management solutions to improve knowledge, skills and behavioral development. Ocean Technologies Group. **ST**

meetings

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

APRIL

April 28-30—Waterpower Week (WPW) 2021 and the International Conference on Ocean Energy (ICOE) 2021, Virtual. <https://waterpowerweek.com> and <https://icoe2021.org>.

MAY

May 4-6—AUVSI XPONENTIAL, Virtual. www.xponential.org.

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

JUNE

June 1-4—Nor-Shipping, Oslo, Norway. www.nor-shipping.com.

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

June 28-29—Floating Wind Solutions, Houston, Texas. <https://floatwindwindsolutions.com>.

June 29-July 1—UDT, Rostock, Germany. www.udt-global.com.

AUGUST

August 16-19—AUVSI XPONENTIAL, Atlanta, Georgia. www.xponential.org.

August 16-19—Offshore Technology Conference, Houston, Texas. www.otcnet.org.

August 23-27—World Water Week, Virtual. www.worldwaterweek.org.

August 31-September 2—MAST Europe, Toulon, France. <https://mastconfex.com/europe2021>.

SEPTEMBER

September 7-10—SPE Offshore Europe, Aberdeen, Scotland. +44 (0) 1224 253807, gillian.george@bigpartnership.co.uk or www.offshore-europe.co.uk.

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

September 20-22—Oi Middle East, Abu Dhabi, United Arab Emirates. www.oceanologyinternationalmiddleeast.com.

September 20-23—OCEANS 2021 San Diego – Porto, California and Virtual. <https://sandiego21.oceansconference.org/global-oceans-2021-san-diego-porto>.

September 20-24—NMEA/RTCM Conference & Expo, Anaheim, California. 410-975-9425, enauer@nmea.org or www.expo.nmea.org.

OCTOBER

October 12-14—Ocean Business, Southampton, U.K. +44 (0)1273 645 110, info@oceanbusiness.com or www.oceanbusiness.com.

October 26-27—Offshore Energy, Amsterdam, Netherlands. <https://www.offshore-energy.biz>.

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

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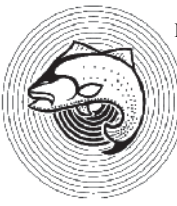
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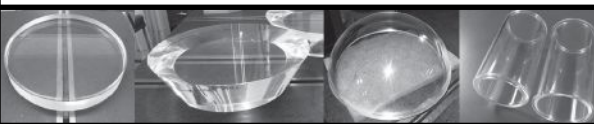
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How to Prevent Collisions Between Whales and Ships—Callie Steffen

Callie Steffen is a project scientist at the Benioff Ocean Initiative, University of California, Santa Barbara, a marine research group that supports cre-



ative collaboration between leaders in marine science, technology and the ocean community. Steffen helps to develop science- and technology-based solutions to ocean problems. Her background is in conservation planning, particularly with marine mammals.

Over the past 200 years, whale populations worldwide were hunted to the brink of extinction, until a moratorium on commercial whaling in 1986. Many species have not fully recovered; they remain threatened or endangered and now face multiple anthropogenic threats.

Whale-vessel collisions are a leading cause of death for large whales. Scientists estimate that over 80 endangered whales are killed from vessel collisions each year off the West Coast of the U.S. The problem seems to be increasing: 2018 and 2019 were the worst years on record for whale-ship collisions off the coast of California. In Southern California, the Santa Barbara Channel is a high-risk area for vessel collisions. International shipping lanes leading to and from the Ports of Los Angeles and Long Beach are transited by thousands of vessels each year and overlap with important feeding grounds for endangered fin, blue and humpback whales.

To help address this growing problem, the Benioff Ocean Initiative, a marine research group at University of California, Santa Barbara, organized a coalition of leading ocean scientists to design, engineer and launch a new online tool, Whale Safe (<https://whalesafe.com>). The platform is a near-real-time whale detection system that uses state-of-the-art technology, includ-

ing big data models and an acoustic monitoring system, along with direct whale sightings, to alert mariners of whale activity in the Santa Barbara Channel. This is the first time these three complementary data sources have been combined to assess whale presence, serving as California's first automated, near-real-time, actionable whale notification system.

The acoustic monitoring system was developed by scientists at Woods Hole Oceanographic Institution and Texas A&M University at Galveston. It comprises a moored buoy with a hydrophone and a digital acoustic monitoring (DMON) instrument programmed with an algorithm to identify vocalizations of blue, fin and humpback whales. The surface buoy contains a platform computer that stores and transmits data via satellite to scientists who review and confirm whale calls.

The dynamic blue whale habitat model was developed by scientists at NOAA's Southwest Fisheries Science Center, University of Washington, and University of California, Santa Cruz, and it integrates data from 104 satellite-tagged blue whales and daily 3D oceanographic data into statistical models to understand the relationship between blue whale presence and oceanographic conditions. The model predicts and displays where blue whales are likely to be each day, similar to a weather forecast where certain oceanographic conditions indicate high likelihood of blue whales being present.

Whale sighting data are also integrated into the daily assessment of whale presence using direct sightings from trained observers and community scientists aboard whale-watch and tourism boats, who record the sightings with the mobile applications Whale Alert and Spotter Pro.

The three data streams—acoustic, model and sightings—are val-

idated, integrated and visualized as a daily Whale Presence Rating, which can range from low to very high. The rating provides commercial mariners, government officials, boaters and other stakeholders with a streamlined, data-driven assessment of whale activity in the Santa Barbara Channel. Mariners and ship operators can receive the data through various methods, including text message, email, web interface or application programming interface (API).

Whale Safe data can improve mariner situational awareness and inform actions, such as posting additional lookouts or reducing speeds. Studies have shown that slower ships are less likely to fatally strike whales. Thus, NOAA and the U.S. Coast Guard establish voluntary 10-kt. speed limits in the Santa Barbara Channel and surrounding waters during months when whales are known to be feeding in the region. Whale Safe also uses AIS data to track vessel speeds and calculate cooperation rates with this vessel speed reduction zone. Each commercial ship operator receives a cooperation rate and letter grade, detailing their performance with the voluntary measures as their ships transited the vessel speed reduction zone in Southern California.

Healthy ocean ecosystems and a strong economy depend on sustainable practices from the maritime shipping industry. No one wants to hit a whale, but whales and ships often overlap in busy coastal areas, which can result in fatal collisions and the risk of species extinction.

As global maritime trade continues to increase, mitigation measures and solutions must be implemented to help protect whales, in balance with maritime commerce. The most effective solutions will leverage the latest technology and best-available science to improve data-driven decisions for the benefit of whales and people. **ST**

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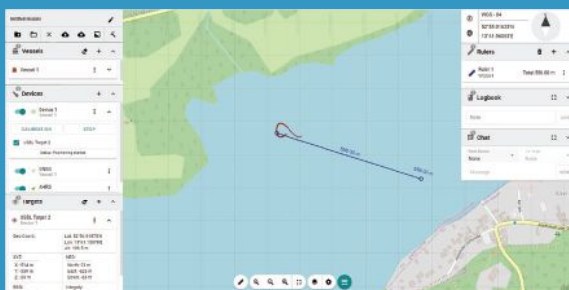
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