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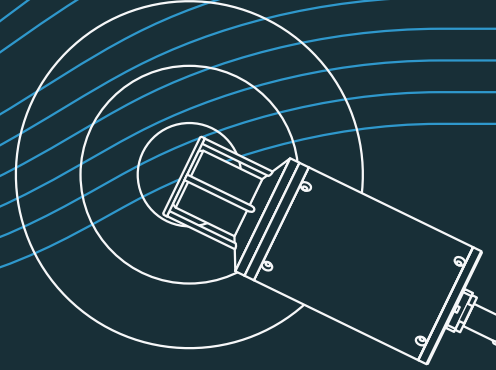
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CONTENTS

JANUARY 2024
Volume 65, No. 1

FEATURES

- 11** **ARCTIC AMOS: US NAVY ADVANCES POLAR UNDERWATER MONITORING**
By Warren Duffie Jr., U.S. Office of Naval Research
- 15** **NOT OUR PARENTS' NOAA: PREPARING A CLIMATE-READY NATION**
By Dr. Rick Spinrad, NOAA
- 17** **EQUITY, INNOVATION AND PROGRESS FOR OUR OCEAN**
By Dr. Amelia-Juliette Demery, U.S. National Science Foundation
- 18** **TECHNICAL WARFIGHTING READINESS AND STRATEGIC PARTNERSHIPS**
By Christian Schumacher, U.S. Naval Undersea Warfare Center
- 20** **NATO'S CC&S EFFORTS: WHEN SCIENCE DRIVES POLICY DEVELOPMENTS**
By Dr. Sandro Carniel, Aniello Russo and Alvaro Martin Blanco, NATO
- 23** **PREPARING FOR AN ERA OF GREATER CONNECTIVITY**
By Svante Einarsson, DNV
- 26** **THE NAUTILOS PROJECT: ADVANCEMENTS IN MARINE OBSERVATION AND TECHNOLOGY**
By Sandra Sá, EurOcean
- 28** **ADVANCING MARINE SCIENCE TECH FOR A CLEANER, SUSTAINABLE FUTURE**
By Professor Icarus Allen, Plymouth Marine Laboratory (PML) and PML Applications Ltd.
- 29** **MOMENTUM BUILDS FOR BETTER OCEAN GOVERNANCE**
By Liz Karan, The Pew Charitable Trusts
- 30** **THE FLOATING FUTURE OF CITIES**
By Olaf Waals and Joep van der Zanden, Maritime Research Institute Netherlands
- 34** **DELAYED LEASE SALES, DELAYED PROGRESS: OUR OFFSHORE ENERGY PREDICAMENT**
By Erik Milito, National Ocean Industries Association
- 35** **WORKING TOGETHER TO MAP THE SEAFLOOR**
By Cassie Stetkiewicz, FarSounder Inc.
- 38** **ADVANCED ACOUSTICS TECH SAFEGUARDS MARINE MAMMALS**
By Brian Hernacki, Saildrone

DEPARTMENTS

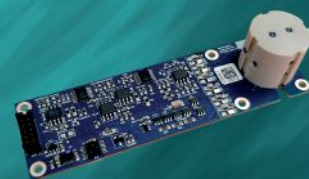
- | | |
|-------------------------------|--|
| 6 Soundings | 47 Environmental Monitoring |
| 7 Editorial | 48 Offshore Oil & Ocean Engineering |
| 40 International | 49 Contracts/Meetings |
| 42 Capital Report | 50 Soapbox |
| 43 Navy Currents | 51 Professional Services Directory |
| 44 Product Development | 52 Advertiser Index |
| 46 Marine Electronics | |

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)) Togo Branch Deployment of Google Subsea Cable. Pioneer Consulting, the full-service submarine fiber-optic telecommunications consulting and project management company, has completed deployment of the Togolese branch of Google's Equiano Cable on behalf of CSquared Woezon. The subsea cable branch offers advanced connectivity to Togo and additional diversification of the nation's digital infrastructure. Having been awarded a comprehensive technical and strategic consulting contract by CSquared Woezon in March 2022, Pioneer has managed the overall design, procurement, and implementation of the cable landing station and the system's transmission equipment. The Togo branch of Google's subsea cable system can provide up to 3 terabits per second of capacity between Togo and Portugal, with additional connectivity to Nigeria and South Africa planned. As the second submarine fiber-optic cable in Togo, the branch provides a redundant connection to ensure reliable broadband access. Last year, CSquared and the Société d'Infrastructures Numériques (SIN), a Togolese state-owned telecommunications asset company, formed the CSquared Woezon joint venture to oversee development of the branch of Google's Equiano cable. Aided by Pioneer, the joint enterprise has streamlined development of the branch to help achieve the Togo Digital 2025 Strategy and further strengthen and diversify the country's digital infrastructure.

)) Coastal Virginia Offshore Wind Gets Green Light. The U.S. federal government has approved the Coastal Virginia Offshore Wind (CVOW) commercial project. This follows the approval of the Vineyard Wind 1, South Fork Wind, Ocean Wind 1 and Revolution Wind projects. When completed, these five projects will collectively add more than 5 GW of clean, renewable energy to the nation's grid, enough to power more than 1.75 million homes. Located approximately 23.5 nautical mi. offshore Virginia Beach, the CVOW commercial project is the largest yet and would provide about 2,600 MW of clean, reliable offshore wind energy, capable of powering over 900,000 homes. The project is expected to provide about 900 jobs each year during the construction phase and support an estimated 1,100 annual jobs during the operations phase, generating vital economic development for Virginia's Hampton Roads area and supporting investments in the Virginia coastal region as a hub for offshore wind development and support.

)) Report on Underwater Autonomy Market. PreScouter, a Chicago-based research intelligence firm, has partnered with a global defense company to explore the future of underwater autonomy. The research is entitled "Navigating the Deep: The Path to Underwater Autonomy by 2030." While autonomous underwater platforms (AUPs) are advancing, the journey toward complete autonomy is far from complete. PreScouter sees this report as a holistic overview of the space and a valuable resource for defense, automotive and military organizations. The report looks at the limitations of today's AI engines for underwater applications, the tools and data sets to support the development and training of a functional AI engine, relevant advancements in the space, and a 20-year patent landscape analysis (revealing that NVIDIA has filed the most patents in the past four years in the field of autonomous underwater platforms). A significant financial investment between \$5 million and \$10 million is necessary for updating training data specific to underwater conditions, such as labeled image and sonar data sets. To evolve the current best-performing platforms to full autonomy, an estimated \$100 million investment is required. The handling of "noisy" data and the need to boost system latencies by 30X for efficient processing and decision-making capabilities are among the challenges. Achieving real-time communication protocols, enhancing bandwidth and robust signal transmission are pinpointed as vital improvements for underwater AI systems. Despite current advancements in AI models and deep-learning algorithms, a minimum of 7 Technology Readiness Levels (TRLs) improvement is necessary to achieve continuous autonomy.

)) Massive New Seamount Discovered off Guatemala. Seafloor mapping during a Schmidt Ocean Institute expedition has revealed an underwater mountain twice as high as the Burj Khalifa, the world's tallest building, in international waters off Guatemala. The 1,600-m (5,249-ft.) seamount covers 14 km² and sits 2,400 m below sea level. Using the EM124 multibeam echosounder on Schmidt Ocean Institute's RV *Falkor (too)*, the seafloor feature was discovered 84 nautical mi. outside the Guatemalan Exclusive Economic Zone during a six-day crossing this summer from Puntarenas, Costa Rica, toward the East Pacific Rise. The Schmidt Ocean Institute onboard crew included a GEBCO-trained hydrographic expert, who confirmed that this seamount is not included in any seafloor bathymetric database. This marks the ninth seafloor discovery since *Falkor (too)* was launched in March 2023. Discoveries have included two additional uncharted seamounts in the Galápagos Islands Marine Reserve, three new hydrothermal vent fields, a new ecosystem underneath hydrothermal vents, and two pristine cold-water coral reefs. Schmidt Ocean Institute is a partner in the Seabed 2030 initiative, led by the Nippon Foundation and the General Bathymetric Chart of the Ocean (GEBCO). Seabed 2030 and partners are accelerating ocean mapping efforts and working toward the ambitious goal of mapping the entire seafloor by 2030. The absence of detailed underwater topography, or bathymetric data, hinders the ability to navigate vessels safely at sea, manage marine resources sustainably and safeguard coastal communities. **ST**

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Encourage Learning to Prepare for the Future

In this last year, we've seen further evidence of the enormity of change the maritime sector is undergoing. From our own research at the Institute of Marine Engineering, Science and Technology (IMarEST), among our special interest groups, we have identified disruptive technologies that are set to transform the sector. These range from the continued introduction of artificial intelligence and autonomous vessels to technologies that will enable us to manage the required energy transition and help reduce emissions. As a result, the sector looks set to benefit from increased efficiency, improved safety, greater interconnectivity, and being better able to meet the environmental goals our biosphere needs, including the regulations to achieve net-zero carbon.

However, there are challenges to overcome. We are going to need not only technological, engineering and scientific advances, but also the skills to deliver the transformation, so it's no surprise that our last membership survey highlighted that training and continuous professional development (CPD) are among many organizations' top personnel concerns for the next three years.

Highly skilled employees are at the heart of marine businesses. As employers, we need to ensure that our employees are part of the technological transformation process. We need to consider how best to recruit, retrain and retain employees to ensure we have the expert and talented workforce to take us into the future. This includes providing opportunities for those whose roles may be affected by these disruptive technologies so they can continue to flourish within our businesses and our businesses do not lose their specialist knowledge and skills.

This year, we've seen an increased interest by employers who want to put CPD at the center of their employees' career progression. They see employees who have a self-development mindset as a vital element in introducing innovation and ensuring future growth and success in changing times.

Doing this creates a culture where learning and development are encouraged and valued. This has the knock-on effect of boosting productivity. Having highly trained employees who are keeping pace with developments in the sector is central to maintaining a competitive edge. A clear career progression and a good CPD program also improve retention because they enable employees to feel valued. In all, CPD can help organizations become an employer of choice among potential new recruits in the sector, and in these times of skills shortage, this is a very real benefit.

For individuals, CPD can help introduce new skills, polish existing ones, offer opportunities to share knowledge, build confidence, provide insight into different ways of working, and ultimately problem solve by seeing challenges from various perspectives.

CPD can also help organizations and individuals adapt to change more easily. Change can be exciting and challenging, or it can be destabilizing. The more we understand what is going on in our industry and what that means for our professions, the better we can see the implications of new developments and how to prepare for change. Understanding can help us feel more in control when change happens; it can boost confidence and build resilience. CPD can equip individuals with the tools to adapt, which can mitigate stress and related illness and loss of productivity.

For both employers and employees, being open to learning, remaining adaptable, improving problem solving, building skills for the future, developing curious minds, and recognizing that we're never too old to learn help build resilience so that when we face a challenge, we can meet it head on. **ST**

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****EUROMARITIME 2024**, January 30-February 1, Marseille, France

FEBRUARY

Instrumentation: Measurement, Processing & Analysis

****Oceanology International 2024**, March 12-14, ExCel, London, U.K.

MARCH

Electronic Charting/Vessel Management/ Ports & Harbors/Dredging/Homeland Security

****UDT 2024**, April 9-11, ExCel, London, U.K.

****OCEANS 2024 Singapore**, April 14-18, Singapore

****XPONENTIAL 2024**, April 22-25, San Diego, CA

APRIL

Offshore Technology/Alternative Energy & Ocean Engineering

****Offshore Technology Conference**, May 6-9, Houston, TX

MAY

Communications, Telemetry, Data Processing

JUNE

Seafloor Mapping/Sonar Systems/Vessels

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****OCEANS 2024 Halifax**, September 23-26, Halifax, Canada

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Geophysical Exploration/Seafloor Engineering

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Review&Forecast

Arctic AMOS: US Navy Advances Polar Underwater Monitoring

By Warren Duffie Jr.
Writer and Editor
U.S. Office of Naval Research

Working with crew members from the U.S. Coast Guard icebreaker *Healy*, scientists traversed a large Arctic ice floe, drilled and cut a hole in it, and placed a “light” gateway buoy into the opening. The yellow, barrel-sized buoy weighed more than 100 lb. and possessed a long spar-like attachment extending into the bone-chilling water below.

From there, the scientific adventurers traveled to another predetermined set of ice floes and identified a large crack, called a lead, between the two of them. The *Healy* crew used a powerful crane to hoist a cylindrical “heavy” gateway buoy—standing more than 20 ft. high and weighing approximately a ton—and slide it into the lead.

Both gateway buoys would spend a year in the Arctic serving as communication channels for multiple floats, buoys and UUVs, such as gliders, already present in the ocean. All were connected via a sophisticated suite of sensors and software for rapid data sharing and transmission, providing greater access to areas of the Arctic choked by pack ice and insurmountable by most research vessels.

This system is called the Arctic Mobile Observing System, or AMOS.

Sponsored by the U.S. Office of Naval Research (ONR)—and developed in partnership with Woods Hole Oceanographic Institution, the University of Washington Applied Physics Laboratory, Naval Undersea Warfare Center, and other academic and commercial partners—AMOS’s mission is to provide continuous, near-real-time observations of the Arctic environment underneath the water’s surface.

Such knowledge would enable entities such as the Naval Oceanographic Office to create more accurate computer-forecasting models of the Arctic environment, including wind and wave conditions, water temperature, and sea ice characteristics (e.g., thickness, volume, area, movement), and result in safer, more effective naval operations in the Arctic. This is especially important as diminishing sea ice in the summer months is providing greater access to this frigid region.

“A lot of the Arctic data gathered over the past 30, 40, 50 years isn’t relevant anymore because the Arctic looks completely different,” said Dr. Scott Harper, who

leads ONR’s Arctic and Global Prediction Program. “It’s a new Arctic, and the Navy needs new systems and capabilities to understand these changing processes and their potential impact on our presence out there—systems like AMOS.”

An Environment of Obstacles and Opportunities

For centuries, the thick ice encasing the Arctic provided seafarers with limited access each summer. That’s changing, however, as sea and air temperatures rise, and summer sea ice melts and doesn’t refreeze as fast.

As this frozen cover decreases, it seasonally opens previously inaccessible waterways for extended periods of time yearly.

Since 1979, when satellite monitoring of sea ice began, the Arctic has lost a substantial amount of its summer ice volume, which has shrunk in both overall area and thickness. Less of the ocean is covered in ice, which now tends to be thinner, seasonal ice rather than thick, older floes (known as multi-year ice). As sea ice melts and gives way to dark ocean water, which absorbs more sunlight, the water heats further—accelerating the melt.

This thaw provides once unimaginable summertime access to the Arctic—a body of water with territorial claims by multiple coastal nations, including the United States. It also opens up commercial shipping lanes; increases opportunities for oil and natural gas exploration, fishing, and tourism; and raises potential security concerns.

The state of Alaska has thousands of miles of Arctic coastline, and the U.S. claims around 889,000 sq. mi. of Exclusive Economic Zone waters. Future accessibility may call for a larger naval presence to protect our Arctic assets.

Despite the diminished ice, the Arctic remains a dangerous environment for naval operations and the safety of our fleet demands that we have a good understanding of that environment.

“AMOS is another example of how ONR is investing in research that will enable the Navy to prepare for, and respond to, future Arctic missions and concerns in recognition of the emerging interest in the region,” said Dr. Tom Drake, head of ONR’s Ocean Battlespace Sensing Department. “AMOS is part of a new generation of technologies allowing for persistent observational capabilities in the Arctic.”

US Naval Interest in the Arctic

In 2021, the Department of the Navy released “A Blue Arctic: A Strategic Blueprint for the Arctic” to outline the most pressing challenges facing the U.S. Navy in the polar regions. While the blueprint focuses on cooperation, it also provides the framework to prepare naval forces to “compete effectively and efficiently to maintain favorable regional balances of power.”

Furthermore, the document “stresses an approach that integrates American naval power with our joint forces, interagency teammates, allies, and partners to preserve peace and protect this northern maritime crossroads and gateway to our shores.”

U.S. Coast Guard Cutter Healy (WAGB-20) crew and researchers install equipment on a floe of multi-year ice in the Beaufort Sea, August 2023. Healy is the Coast Guard's only icebreaker specifically designed for Arctic research, as well as the nation's sole surface presence routinely operating in the Arctic Ocean. (Credit: U.S. Coast Guard, Briana Carter) (Inset) Ensign Natalie Wong assists Dr. Craig Lee, from the University of Washington's Applied Physics Laboratory, in the installation of the Dynamic Ocean Topography device in the Beaufort Sea, August 2023. The Office of Naval Research Arctic Mobile Observing System program focuses on developing technologies for making continuous, long-term scientific observations of the Arctic marine environment. (Credit: U.S. Coast Guard, Briana Carter)



According to “A Blue Arctic,” U.S. naval interest and strategy involving the Arctic go back more than 150 years, when the USS *Jamestown* stood northern watch as the U.S. flag was raised over Alaska, after that state was purchased from Russia in 1867.

During World War II, the Navy fielded eight icebreakers to clear the path for convoys of resupply ships from North America, the United Kingdom and Iceland, which sailed through the Arctic to aid Allied Soviet Union forces.

And during the 1950s, 1960s, and 1970s—the height of the Cold War—the Department of the Navy partnered with ONR to create and expand the High Latitude Dynamics Program devoted to research on the Arctic environment.

Once the Cold War ended in the early 1990s, however, Navy funding of Arctic research steadily waned until the High Latitude Dynamics Program was disbanded in 2003.

The break didn’t last long, though, as climate change emerged as a potentially problematic national security issue. Consequently, the Navy established the Task Force Climate Change in 2007 to foster public, strategic and policy discussions on how climate shifts could possibly affect naval operations.

This effort resulted in the creation of the 2009 Navy Arctic Roadmap, which assigned tasks to various naval

organizations to prepare for future Arctic operations. This document was followed by the Arctic Roadmap 2014 to 2030, the 2019 Strategic Outlook for the Arctic and 2021’s “A Blue Arctic.”

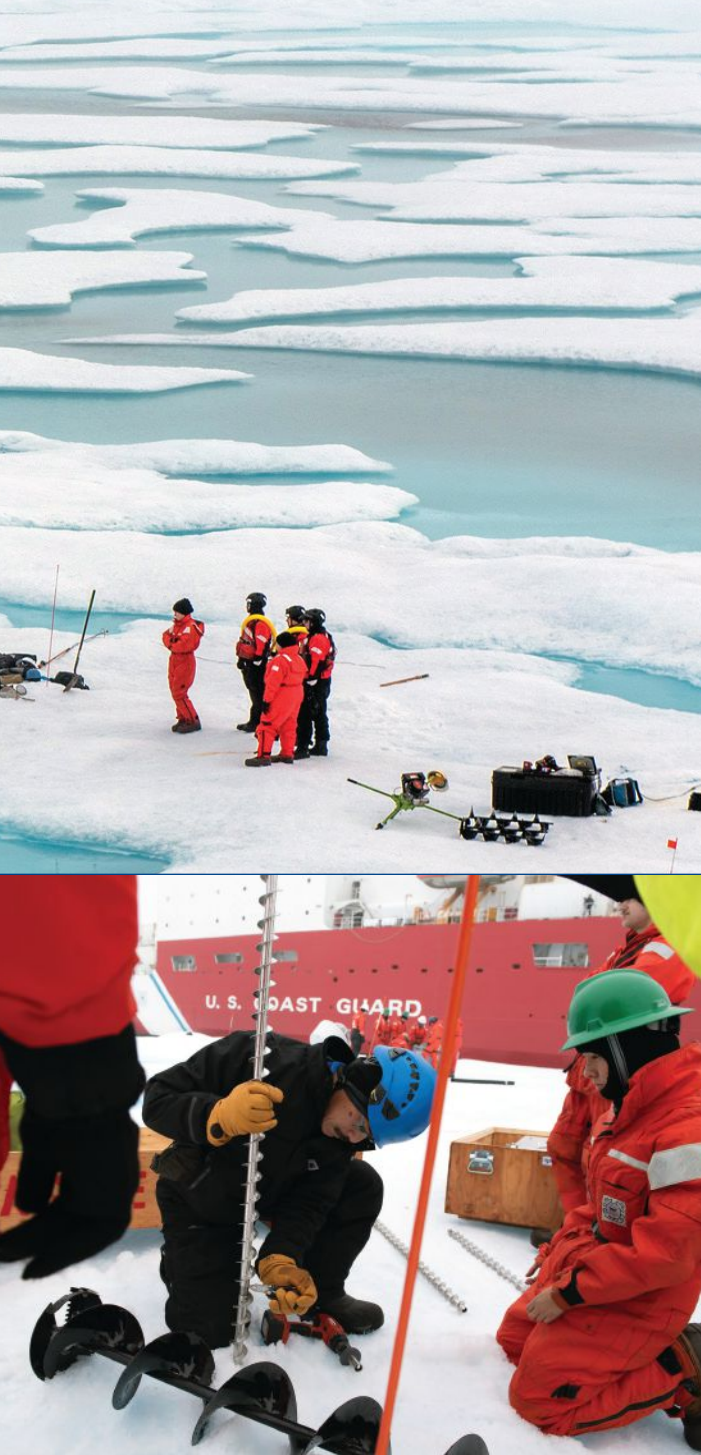
In 2011, the Navy again began funding Arctic research through ONR, leading to the creation of the command’s Arctic and Global Prediction Program, which sponsors research efforts, such as AMOS, studying the properties and processes of the Arctic.

AMOS Attributes

AMOS is designed as a network of oceanographic instruments and UUVs for making long-term, undersea scientific observations of the Arctic marine environment. This encompasses phenomena such as waves; atmospheric and water circulation; sea ice thickness and cover; the water column (physical and chemical characteristics of seawater); and the Marginal Ice Zone, a dense patchwork of ice floes sitting between solid sea ice and the open ocean.

The Navy currently uses UUVs to gather underwater Arctic data that surface and transmit information via GPS. But that’s only effective a few months out of the year.

“When people talk about diminished Arctic ice, they’re really talking about the summer months—July, August, September—when you have open water in the Beaufort and Chukchi regions, north of the Bering Strait,”



said Harper. “But then ice begins to grow back in the latter half of September and then all winter, until everything is covered in ice.”

That frozen blanket presents multiple problems for standard UUVs. The harsh temperatures often ruin sensors, ice slabs could batter and crush the vehicles, and GPS and other satellite communications don’t work under the ice.

AMOS addresses these issues in various ways. The system comprises the light and heavy gateway buoys placed in and amid the sea ice, smaller buoys and floats that drift with ocean currents, buoyancy-driven undersea gliders (Seaglider), and propeller-driven UUVs (REMUS 600) capable of performing diverse data gathering missions.

All of the external hardware and casings of these components have been ruggedized and strengthened to withstand Arctic rigors and protect the dynamic payloads inside. These include advanced acoustic sensors that function well under the ice—collecting and sharing data with the gateway buoys through the sections located underwater. Specialized software then filters the information upward through the gateway buoys to the sections jutting above the ice, which send data to satellites. This process also enables scientists to send instructions and coordinates to UUVs to carry out data gathering missions.

The AMOS system is built to survive 12 months in the Arctic before extraction and evaluation, and its coverage area extends more than 60 mi. The components also boast two-way communication capabilities with each other. In addition, the gateway buoys are equipped with cables that can serve as docking and charging stations for the UUVs.

Speaking of power, Dr. Sarah Webster from the University of Washington’s Applied Physics Laboratory said future versions of AMOS will include gateway buoys with a thermal energy-harvesting system that could create wintertime energy using the temperature difference between the extremely cold air and relatively warm ocean water.

“This would complement solar panels used during the summer months,” said Webster. “Both sources would provide power in perpetuity, a kind of power plant for summer and winter.”

Dr. Craig Lee, also from the University of Washington’s Applied Physics Laboratory, who serves as chief scientist of the AMOS project, takes inspiration from the Argo network, an international fleet of more than 4,000 robotic instruments scattered across the world’s non-ice-covered oceans that drifts with the currents and measures water properties.

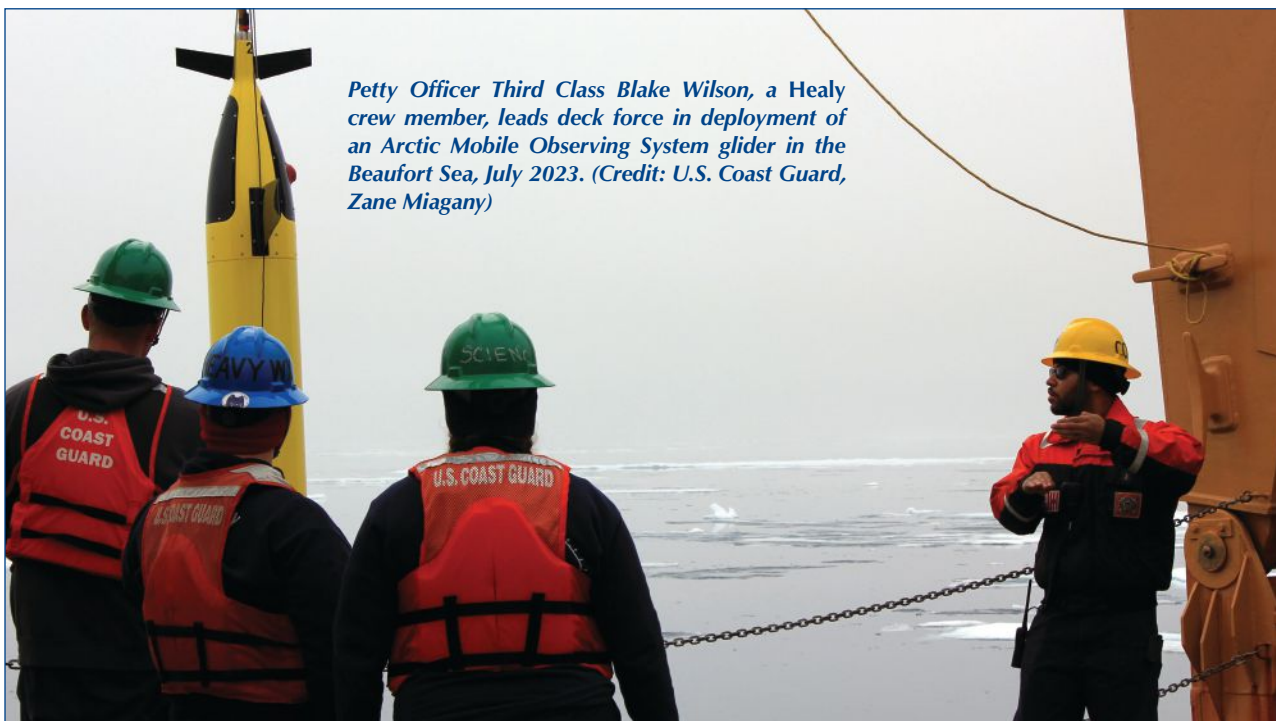
“Argo changed the way we do science in oceanography because it gives us a detailed map of the deep ocean every few days,” he said. “We want to extend this to the Arctic Ocean, and AMOS could be helpful in achieving that.”

Cultivating Collaboration

AMOS is not only an innovative tool for measuring underwater conditions, it’s also a powerful example of how ONR fosters strong collaboration and cooperation among its government, academic, and commercial research partners.

ONR sponsors three main types of research: fundamental (basic) research, which is the study of various phenomena and observable facts to improve understanding and develop scientific theories; applied research, which is the gathering of knowledge toward solving a problem or meeting a recognized and specific need; and advanced technology development, which is the application of knowledge toward development of prototypes.

Beyond these three categories are additional research designations based on the needs of the U.S. Navy. One of these is ONR’s Innovative Naval Prototype (INP) portfolio. Also called leap-ahead innovations, and usually



Petty Officer Third Class Blake Wilson, a Healy crew member, leads deck force in deployment of an Arctic Mobile Observing System glider in the Beaufort Sea, July 2023. (Credit: U.S. Coast Guard, Zane Miagany)

funded over four to five years, INPs comprise potentially game-changing or disruptive technologies intended to significantly alter the way naval forces conduct operations. INPs are developed around anticipated naval needs rather than in response to established requirements.

According to Harper from ONR's Arctic and Global Prediction Program, many of AMOS's components originally were part of multiple basic research efforts sponsored by the command since its Arctic focus was re-established in 2011.

"A lot of inspiration was taken from the Argo drifters that are now ubiquitous throughout the world's oceans and which ONR helped sponsor during the early development of those platforms," said Harper. "We wanted to find a way to use sensors and autonomous systems to study the Arctic Ocean."

"During the 2010s, we saw a lot of progress being done with sensors, particularly drifting sensors, and UUVs in the Arctic, and decided it was time to try and create a system for monitoring that region's underwater environment," he continued. "So, in 2018, we established an INP for AMOS."

Future Plans

Since its inception, AMOS has undergone several successful data-gathering missions, being placed in Arctic waters for yearlong intervals by the icebreaker *Healy*, as well as the research vessel *Sikuliaq*, which is owned by the National Science Foundation (NSF) and operated by the University of Alaska Fairbanks. AMOS was most recently deployed in October 2023 and will be retrieved in fall 2024.

"I'm very excited about the future of AMOS because we've had a lot of success using gliders, floats and autonomous systems to collect environmental data everywhere else, but we didn't have that capability for the

Arctic due to the extreme conditions there," said Harper. "Now we do."

Meanwhile, as AMOS comes to the end of its INP funding, Harper is reaching out to various naval systems command and warfare centers to gauge interest and find a home where the AMOS prototype could be refined and possibly transitioned for use in the Navy's fleet.

Harper also wants to share information gathered by AMOS with partner U.S. agencies, such as NSF, NASA and NOAA.

He also said AMOS will receive further testing and expansion during U.S. Navy's Ice Exercise (ICEX) 2024, to be held in February and March. This five-week exercise, held every two years, is conducted in the Beaufort Sea in order to maintain expertise in Arctic-specific skills, knowledge, equipment, and procedures to enable the U.S. submarine force to safely and effectively operate in the polar regions.

"We plan on putting in a light gateway buoy and repopulating the AMOS network with additional gliders and floats," said Harper. "We want to demonstrate that as long as you have the backbone—the communications system, acoustic sensors and gateway buoys—you can repopulate AMOS as much as you need to. It's a great opportunity to work with other federal agencies and our allies in the Arctic to flesh out a full Arctic observing system."

Lee Freitag, a principal engineer at Woods Hole Oceanographic Institution, said, "Military and civilian science in the Arctic are very much aligned. The needs of the Navy to understand day-to-day conditions and predict weather and ice cover are similar to the interests of scientists who are studying short-term changes and the long-term evolution of the Arctic environment. AMOS could be a game-changer by providing a more detailed window into Arctic processes." **ST**

Review&Forecast

Not Our Parents' NOAA: Preparing a Climate-Ready Nation

By Dr. Rick Spinrad
Under Secretary of Commerce for Oceans and
Atmosphere and NOAA Administrator

As we finish 2023 here at NOAA, I can say: This is not your parents' NOAA. We've upped our game, and the reasons for this are clear: Climate change is affecting every community in our country, making NOAA's climate, weather, ocean and fisheries services in higher demand than ever.

Here's the evidence: We saw record-high air temperatures causing unprecedented land and ocean heat waves, increased flooding, and a series of damaging hurricanes. In the 1980s, our nation averaged one weather- and climate-related billion-dollar disaster, adjusted for inflation, every four months: Now we see one every three weeks.

Here's what we're doing about it: NOAA received an additional \$6.3 billion, the largest new investment in our history, to accelerate NOAA's mission to help communities build resilience to climate change. With this funding provided over five years through the Bipartisan Infrastructure Law (BIL) and Inflation Reduction Act (IRA), NOAA is investing in high-impact projects that build resilience to coastal hazards, such as sea level rise and extreme weather events, and reduce pollution and marine debris; restore coastal habitats that help wildlife and humans thrive; build the capacity of underserved communities to support community-driven restoration; create climate solutions by storing carbon; support economic development in environmental products and services; and provide employment opportunities. We are also improving supercomputing capacity for research on weather and climate events, strengthening our fleet of ships and hurricane hunter aircrafts, and replacing aging facilities.

This new funding is enabling projects that will transform communities for generations, including helping to restore Chinook salmon populations on the West Coast; removing obsolete dams to restore fish passage and reduce flooding hazards; creating new technologies to reduce, remove and prevent marine debris from degrading coastal waters; and advancing new climate models to predict hurricanes, heat waves and ocean changes that drive global weather.

Enhancing the Blue Economy While Advancing Environmental Stewardship

We've made significant progress to advance President's Biden's America the Beautiful goal of conserving and restoring at least 30 percent of U.S. lands and waters

by 2030. We are in the process of designating six new national marine sanctuaries that, if implemented, would more than double the size of the National Marine Sanctuary System. Using BIL and IRA funding, we are upgrading sanctuary visitor centers and infrastructure and investing in climate resilience planning at these marine parks that conserve species diversity and maritime history.

We are building four new ships, nearly a quarter of our fleet, each one designed with the latest energy efficient technology. We are building new, and renovating existing, port facilities. Joining with our Alaska state, tribal and industry partners in Ketchikan, we unveiled a renovated port facility constructed by a Native Alaskan and shareholder-owned local corporation in 2023. The renovations build in climate resilience, green technology and a state-of-the-art floating pier to accommodate tidal flux and sea level changes. We are moving the NOAA Atlantic fleet homebase to Naval Station Newport in Rhode Island. With funding from IRA and other appropriations, we are building a new pier, administration building and warehouse. Four of our research ships will be homeported in Newport, bringing jobs to the region and strengthening our partnerships with the Navy, Coast Guard, our nearby NOAA fisheries science labs and NOAA's Cooperative Institute for Ocean Exploration. We just awarded a contract to add a new pier, warehouse, seawall and living seashore at our homeport for NOAA Ship *Ronald H. Brown* in North Charleston, South Carolina.

"Climate change is affecting every community in our country, making NOAA's climate, weather, ocean and fisheries services in higher demand than ever."

Supporting Climate Action with State-of-the-Art Science

Scientists from across NOAA are among the 500 authors of the Fifth National Climate Assessment, released this fall, which provides authoritative science data, information, and examples of successful resilience projects for states, tribes and all communities. The report outlines the challenges and urgency of addressing climate change and also notes progress made reducing greenhouse gases and building more resilient communities.

This year, we also saw remarkable advancements in the use of uncrewed systems to gather oceanic and atmospheric data to improve climate, weather and ocean forecasting, as well as explore and map our Exclusive Economic Zone. Guinness World Records 2024 calls out





President Biden (middle), NOAA Administrator Rick Spinrad (right) and U.S. Coast Guard Commandant Admiral Linda Fagan (left) at the 2022 NOAA Hurricane Outlook briefing at Joint Base Andrews, Maryland. (Credit: U.S. Air Force, Spencer Slocum)

NOAA and our private industry partners for records using uncrewed surface vehicles and uncrewed aircraft during major hurricanes to collect life-saving data. By teaming up with ocean technology companies, NOAA is advancing our mission and supporting the growth of the new blue economy.

Environmental Justice

NOAA also accelerated efforts to provide greater equity in the delivery of weather, climate and coastal resilience services to underserved communities who face some of the greatest climate change impacts. Our work with the Alaska Native Communities Health Consortium is bringing together NOAA's climate data and tools with the equity, health and service delivery expertise of the consortium to ensure Alaska Native communities have resources to make informed decisions in the face of climate risks.

What's in Store for 2024

In the new year, we look forward to seeing a number of initiatives take off, including a project to accelerate

training and education for a new generation, who will help transform our economy with growth in green energy and climate resilient infrastructure and dramatic reduction of carbon emissions.

We expect new research on climate mitigation through the ocean. The ocean is the world's largest store of carbon and has the potential to play a role in helping the world avoid the worst impacts of climate change. NOAA is supporting research on enhancing the ability of the ocean to remove carbon dioxide from the atmosphere, involving coastal communities in the process to carefully assess the benefits and risks of various strategies.

We are also excited about the new program to foster public-private partnerships to develop and support sustainable businesses around ocean, coastal, and Great Lakes observation technologies, products and services that address climate resilience needs.

The common theme of all these initiatives is that climate action is both the challenge of our time and a profound opportunity to transform our communities and industries to be more resilient, equitable and sustainable. **ST**

“We expect new research on climate mitigation through the ocean.”

Review&Forecast

Equity, Innovation and Progress For Our Ocean

By Dr. Amelia-Juliette Demery
Sea Grant John A. Knauss Fellow, Ocean Sciences Policy
Division of Ocean Sciences
U.S. National Science Foundation

The U.S. National Science Foundation (NSF) is forging a path forward for the nation's understanding of processes affecting the ocean, coastlines and the Great Lakes. NSF's investments come at a critical time for unlocking the ocean's potential as an essential tool in mitigating the effects of climate change. By supporting research, infrastructure and education, NSF can help advance researchers' current knowledge of the ocean—including its interactions with people and integrated Earth systems. Last year, NSF's Division of Ocean Sciences distributed \$418 million via 364 awards that leverage the efforts of both ocean science researchers and coastal communities.

Investing in the STEM Workforce of the Future

Investing in a STEM workforce that can tap into the potential of the nation's waters to address climate change can help to realize a more resilient and sustainable future. NSF remains committed to advancing the ocean STEM workforce and talent across generations. For example, NSF's Broadening Participation initiative targets the "missing millions"—individuals from underrepresented groups whose inclusion is crucial to enrich the scientific workforce and mirror the nation's demographic and geographic diversity. This initiative is designed to bolster the nation's scientific enterprise by ensuring that the science, technology, engineering and mathematics workforce reflects the demographic diversity of the nation and its territories.

NSF provides funding that launches the careers of many early professionals in the ocean science community. These individuals form exciting cross-sector partnerships to realize new technologies, unearth novel discoveries, and connect exploration of U.S. waters with the communities that depend on them for their health, prosperity, and well-being. In 2023, NSF partnered with the Kaleta A. Doolin Foundation (KADF) to amplify the work of select women leaders in ocean sciences, naming them NSF-KADF Ocean Decade Champions. This initiative provides half a million dollars in supplemental funding to women leaders from NSF's Coastlines and People Hubs for Research and Broadening Participation (CoPe). The Coastal Research Hubs support interdisciplinary teams studying regional, ecological and social ecosystems key to fostering more resilient coastlines.

Harnessing the Power of the Ocean In Engineering Technologies

One example of NSF's efforts to foster a next-generation ocean STEM workforce is the recent Engineering Technologies to Advance Underwater Sciences (ETAUS) program solicitation. This solicitation facilitates a rich STEM ecosystem of different minds, skills and ideas to solve challenges faced in aquatic systems. In 2023, four NSF directorates awarded a cumulative \$8.2 million to fund interdisciplinary workshops focused on developing solutions to challenges facing underwater research. Collaborative efforts such as ETAUS are critical for addressing complex problems such as climate change that require equally complex solutions. Projects in this solicitation aspire to create technologies to better map and observe the ocean. These include technological innovations to better study how microbe-rich sediment contributes to the ocean's carbon cycle, comprehensive observation systems to "smell and hear" marine communities in their entirety, and remote robots that work collectively to map out underwater ice shelves.

NSF also funds cutting-edge research that studies ways to bolster the ocean as a carbon sink and reverse greenhouse gases in the atmosphere. NSF is a proud member of the newly founded National Science and Technology Council Fast-Track Action Committee on Marine Carbon Dioxide Removal (MCDR-FTAC). Situated under the Ocean Science and Technology Subcommittee, MCDR-FTAC is tasked with creating an implementation plan for national priorities associated with marine carbon dioxide removal research, as outlined in the White House's Ocean Climate Action Plan. The race to innovate marine carbon dioxide removal requires a broad multisector approach that works in tandem with stakeholder engagement to assess promising technologies, design regulatory roadmaps for equitable and responsible implementation, and foster partnerships necessary to address and integrate social intersections with scaled-up deployment.

Looking Forward

NSF will continue to invest in research that advances ocean technology and innovation. NSF Director Dr. Sethuraman Panchanathan reiterated this mission at the House Committee on Science, Space, and Technology: "We are already investing in the technologies of tomorrow, but the technologies of tomorrow have been made possible not just because of investment of today, but decades of investment for tomorrow."

NSF has funded the National Academies of Science, Engineering, and Medicine to conduct the next Decadal Survey of Ocean Sciences. The survey provides recommendations for investments in research, infrastructure, and workforce development between 2025 and 2035, focused on a better understanding of the ocean's role in global challenges and national priorities.



With increasing urgency, the advancement of science and technology is demanding multiple perspectives, voices, and experiences to address challenges. NSF recognizes that interdisciplinary teams are required to broaden understanding of the ocean and to develop resilient solutions.

"The fusion of disciplines is where the future of innovations lies," said Panchanathan.

This fusion includes an intersection of scientific advancement and societal impacts. The work of efforts such as the decadal survey, ETAUS, CoPe, and the MC-DR-FTAC can only reflect a strong vision for ocean research if it is complemented by a vision for how that work strengthens the health and well-being of all who are affected. That is why NSF is a proud agency partner in developing the Ocean Policy Committee's Ocean Justice Strategy (OJS), a key cross-cutting action of the Ocean Climate Action Plan. The OJS will provide a comprehensive whole-of-government framework for federal activities in communities disproportionately affected by ocean climate impacts.

With its success stories, momentum and resilience through 2023, NSF is excited for the forthcoming year's initiatives.

The agency looks forward to funding ongoing and future projects that advance research on the ocean, coastlines and the Great Lakes, and the communities who call them home. **ST**

Review&Forecast

Technical Warfighting Readiness And Strategic Partnerships

*By Christian Schumacher
Chief Development Officer
U.S. Naval Undersea Warfare Center*

The United States Navy is committed to accelerating our warfighting advantage. In an era of strategic power competition, as global challenges rise to threaten U.S. interests, maintaining technical superiority and fostering collaboration with defense partners is of paramount importance. For the Naval Sea Systems Command (NAVSEA) Naval Undersea Warfare Center (NUWC) and Naval Surface Warfare Center (NSWC), the Navy's primary research, development, test, and evaluation organizations for undersea and surface ship systems, enabling maritime supremacy hinges on readiness today and a vision for tomorrow. While 2023 saw significant progress on both fronts through wartime preparations and expanded partnerships, even greater challenges lie ahead.



Potential adversaries are actively enhancing their naval capabilities, with the aim of challenging U.S. supremacy at sea, especially in the undersea domain. Their assertiveness serves as a clear indication that conflict could escalate with little warning. Being combat-ready is not only essential for deterrence but also for a swift response in case deterrence fails. The escalating geopolitical turbulence places a premium on the crisis support roles played by NAVSEA warfare centers.

The naval warfare centers (WCs) are busier than ever, ensuring that the fleet possesses the necessary technologies and expertise to contribute to the nations integrated deterrence strategy. They focus on two primary objectives: wartime readiness and cultivating partnerships with academia, industry, and allied partners.

Readiness

In the short term, enhancing real-time readiness is vital. The naval warfare centers make indispensable contributions to integrated deterrence by ensuring the success of technical programs and sharing knowledge with industry partners across various domains, including science and technology, research and development, acquisition, and in-service support. They also play a pivotal role in determining and developing the capabilities required by the Navy and Marine Corps. Additionally, they verify the quality, safety, and effectiveness of platforms and systems; help design, develop and field solutions for urgent operational fleet needs; and serve as a critical bridge between warfighters and the technical community. By fulfilling this broad spectrum of responsibilities, the naval warfare centers contribute to the continued evolution and readiness of the fleet.

In 2023, the labs rapidly delivered multiple at-sea solutions to address urgent warfighter capability gaps. For example, NUWC played a crucial role in brainstorming ideas, developing solutions and conducting at-sea testing of Heavyweight Torpedo (HWT) lethality upgrades. This effort progressed from the whiteboard to at-sea testing in just 12 months. In addition, in support of in-service engineering and assessment (ISEA), NUWC and industry partners provided the necessary components for the at-sea testing.

Collaborating with industry, the centers brought weapons, procedures and subject matter experts out of deep storage after more than 15 years to test technology that could enhance HWT capacity. For example, the WCs, in partnership with industry, integrated Virginia Payload Tubes into the fleet. During strike operations, this collaborative team addressed mechanical and electrical issues in real time to ensure that all weapons were ready for use by combatant commanders.

NUWC played a pivotal role in delivering, training, and troubleshooting new command and control systems essential for transmitting the common tactical picture to our forward-deployed submarines. This encompasses

“Potential adversaries are actively enhancing their naval capabilities, with the aim of challenging U.S. supremacy at sea, especially in the undersea domain.”

both shoreside and platform-side capabilities, ensuring the submarine’s connectivity and enabling future missions. Engineers adeptly handled complex technical issues in real time, allowing damaged vessels to return safely to their home port.

As threats emerge, the ability to restore critical systems within 24 hr. or less can prove decisive. Enhancements in data sharing, logistics coordination and planning can help achieve this accelerated speed. To fulfill this mission, the warfare centers are evaluating their crisis response roles, planning improvements in data sharing, and enhancing contracting agility. WCs’ leadership is also working closely with public shipyards to address workforce proficiency.

Strategic Partnerships

In the long term, maintaining an advantage requires a relentless expansion of the boundaries of innovation and the development of new capabilities through research. Progress in this regard was achieved in 2023 through new academic research partnerships and increased collaboration with the industry.

The warfare centers are expanding their partnerships throughout the innovation ecosystem to increase our warfighting advantage. These partnerships serve as invaluable connections between warfighters, engineers, academia and industry, fostering the development of new technologies. The WCs take the Secretary of the Navy’s challenge to expand the marketplace seriously and support these efforts through prize challenges, tech bridges, other transaction authority (OTA) contracting, and different innovative contracting approaches.

Crucial partners in this role include the Office of Naval Research (ONR), Defense Advanced Research Projects Agency (DARPA), Strategic Capabilities Office (SCO), University Affiliated Research Centers (UARCs), Federally Funded Research and Development Centers (FFRDCs), and international partners.

Supporting naval readiness and innovation demands integrated partnership efforts across the ecosystem comprising academia, industry, small businesses, FFRDCs/UARCs and international partners. The objectives are to: expand naval research partnerships in science and engineering to advance discoveries in critical capability areas, such as autonomy, hypersonics and cyber; develop cutting-edge curriculum, mentoring and experiential learning to nurture world-class talent; foster earlier engagement with contractors beyond the mere execution of requirements; explore collaborative technology roadmapping at earlier stages of capability life cycles; engage

emerging technology companies aligned with naval needs through appropriate incubators and accelerators; provide mentorship on worksopes and contracting approaches; enhance collaboration with advanced R&D organizations to address complex system challenges that require deep expertise; and expand cooperative R&D efforts, leveraging complementary expertise, as multilateral collaboration can enhance innovation.

Five priorities can guide future collective action. The first is to enhance cross-organizational crisis coordination to a razor’s edge, sharpening the naval labs’ ability to swiftly share expertise, data and physical assets across sites when novel threats suddenly arise. These readiness exercises, including tabletop simulations and live drills, are critical for seamless coordination.

The second priority is to foster even tighter integration between academic, industry and uniformed naval research partners. Deeply collaborative discovery projects can accelerate the translation of innovative ideas into operational capabilities. Utilizing advanced computer modeling can facilitate rapid concept design evaluation.

The third priority is to significantly expand and deepen the talent pipeline in critical technical areas, such as hypersonics, directed energy, cyber-physical systems, quantum sensing, autonomy and artificial intelligence. Actively scouting emerging research frontiers and recruiting rising early-career engineers and scientists are part of this priority.

The fourth priority is to upgrade physical facilities infrastructure, simulation capabilities, and computing capacity to support rapid design, advanced prototyping, and rigorous testing of cutting-edge naval systems. Technical excellence demands state-of-the-art tools and environments.

The fifth priority is to pursue technology scouting programs at naval incubators, academic labs, and industry events to identify high-potential innovations for capability enhancement. Identifying promising ideas early allows for efficient maturation.

In the face of the rising urgency posed by potential global adversaries in this “decisive decade” for global stability of power, the Navy recognizes that partnerships between warfare centers, academia, industry and international partners are indispensable for undersea dominance.

By balancing near-term warfighting readiness and long-term technical strength, the NAVSEA warfare centers, as part of the wider naval research community, will continue to advance the asymmetric edge to counter aggression both above and beneath the waves. **ST**

Review&Forecast

NATO's CC&S Efforts: When Science Drives Policy Developments

By Dr. Sandro Carniel
Head of Research Division

Aniello Russo
Head of Climate Change and Security Analysis Project

Alvaro Martin Blanco
S&T Analyst, Program Manager
Science and Technology Organization
Centre for Maritime Research and Experimentation
NATO

Since its inception, the North Atlantic Treaty Organization (NATO) has held an enduring purpose to safeguard the freedom and security of all its members by political and military means. Today, as global climate change threatens the world's security, it becomes imperative for NATO to adapt its strategic approach and address climate change as a significant security challenge.

This policy paper aims to outline NATO's role in tackling climate change and security by drawing upon recent developments, such as the 2022 NATO Strategic Concept, new specific funding from the Science and Technology Organization (STO) Office of Chief Scientist (OCS) in Brussels, and the work of the STO Centre for Maritime Research and Experimentation (CMRE), based in La Spezia, Italy, including the "Climate Change & Security" international workshop held in Lerici, Italy, October 2023.

NATO's Strategic Concept and Climate Change

NATO's current approach to address climate-related security risks is defined by its 2021 Climate Change and Security Action Plan, which sets out the framework for delivering on NATO's Agenda on Climate Change and Security to contribute to the organization's three core tasks and guarantee the security of the Alliance.

As part of this action plan, NATO's work related to climate change is defined by four pillars: to increase Allies' awareness; adapt to climate change; contribute to

the mitigation of climate change; and enhance outreach.

In addition, NATO's 2022 Strategic Concept—the Alliance's core policy document, which guides its strategy over the coming years—also highlights climate change as a defining challenge of our time, with a profound impact on Allied security. It states that NATO should become the leading international organization when it comes to understanding and adapting to the impact of climate change on security.

In response to these policy developments, the STO has been a pioneer in seeking Allied support to set up a unique and forward-looking Science and Technology (S&T) Programme of Work (PoW) that focuses specifically on Climate Change and Security (CC&S). Since 2023, specific funding was made available to the OCS, who commissioned CMRE to conduct scientific research activities as a vital instrument to address climate change impacts on NATO's maritime capabilities, help define foresight scenarios of CC&S, provide quantitative data to support defense planning, and inform new technology evolutions to preserve the maritime capability of the Alliance.

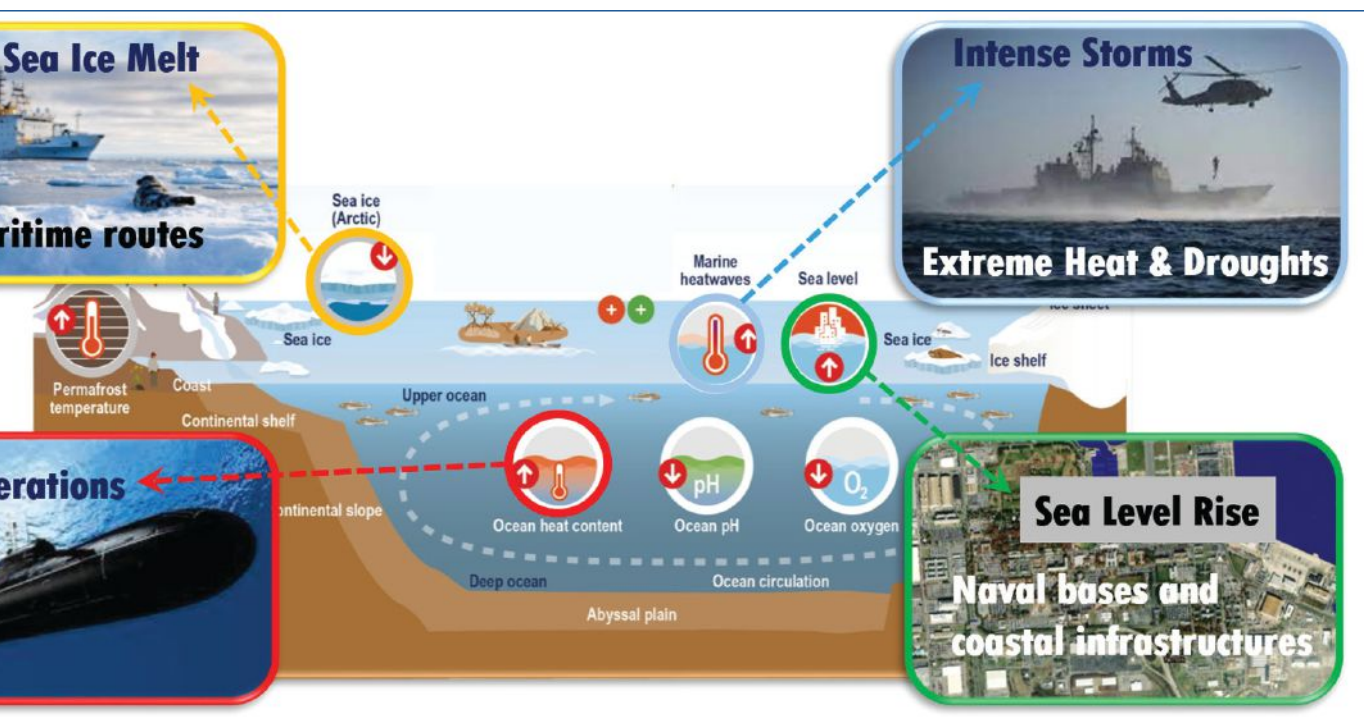
The new revenue stream has allowed CMRE to create a new CC&S Department, addressing climate change impacts on maritime regions spanning across all of NATO's CC&S pillars.

Awareness and Adaptation

The development of adaption strategies for climate change can't be done without solid scientific evidence. In this direction, the new CC&S Department is conducting research on numerous topics that touch upon the CC&S nexus.

Concerning field activities, a critical area (from both climatic and geopolitical perspectives) is the Arctic, which is being investigated under the new PoW with the creation of the NATO Arctic Climate Observatory (NACO). In July 2023, the NATO RV (NRV) *Alliance* deployed deep moorings (i.e., moored vertical lines with several oceanographic and acoustic recorders distributed along the water column) for long-term monitoring of ocean-





(Top) Examples of CC&S nexus in the maritime domain. (Right) ROV operations to map scattered sea ice floes during CMRE sea trial in the Fram Strait Marginal Ice Zone.

ographic properties and acoustic ambient noise evolution in the Fram Strait and the northern Norwegian Sea.

There are currently several research projects based on publicly available climate data and projections to study climate change effects and impacts related to NATO. One study focuses on NATO naval bases' resilience, specifically exploring hydro-climatological extremes' effects on training and readiness of NATO military forces. This study also assesses how bases might be simultaneously impacted by extreme events.

Another study concentrates on sea level rise and associated flooding of coastal bases to help NATO understand how to plan for sea level rise effects, using already available tools to protect critical infrastructures.

Wave climate and sea state research is being conducted in the Mediterranean Sea and High North regions from a naval perspective, aiming at exploring the possible changes in the occurrence of specific sea states and how they will impact operations (search and rescue, antisubmarine warfare, etc.). The design of future naval platforms might also benefit from the results.

A study of the evolution of "hot days" frequency at a global scale focuses on possible consequences for naval helicopter operations, e.g., their lifting or take-off capacity. It also contributes to assessing possible impacts on training and readiness.

Naval radar and electromagnetic communications performance research is examining the evolution of a



surface evaporative duct and how it might improve or limit the performance of current radar and communication systems.

Work on the performance of sonar and underwater acoustic communications is also being done, and the results from this research will enable decision makers to prepare for different future detection and communication ranges in specific regions, and to orient necessary technological steps to cope with them.

In order to support the tailored climate data and projection analyses of all these studies and efficiently share results with stakeholders, CMRE tested cloud-based tools available within the NATO Software Factory (NSF) environment. By deploying an open-source framework,



ROV operations to map scattered sea ice floes during CMRE sea trial in the Fram Strait Marginal Ice Zone.

CMRE demonstrated how to access, retrieve, analyze and visualize large climate model outputs within hours, rather than weeks, exploiting high-speed internet connection and the scalability of cloud resources within a NATO-accredited environment.

Mitigation

The provision of additional resources in 2024 will enable CMRE researchers to enhance their research into the study of CC mitigation. Future research activities will expand support for ongoing initiatives, such as the study of carbon storage in the oceans, removing carbon dioxide from the atmosphere using carbonates (inspired by the LIMENET tech concept, <https://limenet.tech/en>), and renewable energy.

Outreach

The CMRE CC&S Department is actively setting up mechanisms to increase the knowledge base of the Alliance through an enhanced collaboration with civil society, academia and industry on climate change and security issues. Part of this effort will be the establishment of dedicated academic courses on the subject of CC&S with prestigious academic institutions, with the objective to forge new curricula and support the training of the next generation of leaders capable of responding to climate change impacts.

The international workshop held in Lercici on Climate Change & Security (www.climatechangesecurity.org), organized by CMRE, highlighted NATO's commitment

to building a comprehensive understanding of the complex relationship between climate change and security challenges. The workshop facilitated discussions among experts, policy makers, and practitioners to identify best practices, share knowledge, and develop actionable recommendations, focusing on the maritime domain and on building networks among stakeholders.

Conclusion

Given the entanglement between climate change and security, it is imperative for NATO to proactively address this global challenge and its threat multiplier dimension. By aligning its efforts with the recently approved Strategic Concept, using funding from the OCS, collaborating with world-class organizations and leveraging the expertise of NATO stakeholders (i.e., NATO's Emerging Security Challenges and Defence Investment Divisions), CMRE is enabling NATO to strengthen its ability to understand, anticipate and respond to climate-related security risks effectively.

NATO's role in addressing climate change and security extends beyond the military realm. By engaging political leaders, scientists and civil society, NATO can harness collective intelligence and facilitate knowledge sharing.

Through robust partnerships and cooperation, NATO can foster a comprehensive approach that integrates climate change considerations into security policy making, enhances resilience, and contributes to global efforts to combat climate change. **ST**

Review&Forecast

Preparing for an Era Of Greater Connectivity

By Svante Einarsson
Head of Maritime Cyber Security Advisory
DNV

Advances in digital and connected technologies are enabling a greener, safer and more efficient global shipping network, representing a major opportunity for maritime companies to gain a competitive advantage, according to DNV's recent Maritime Cyber Priority research: www.dnv.com/maritimecyberpriority. Of the 800 maritime professionals surveyed by DNV for the research, 87 percent say the future of the industry relies on an increase in connected networks. Eighty-five percent of maritime professionals believe that connected technologies are helping the industry reduce emissions through fleet and route optimization, for example.

Many have already embarked on this journey, with digital technology being a key enabler of decarbonization plans. As well as improving sustainability and performance, digital technologies provide safety advantages by automating and streamlining complex processes, which help to enhance safety at ports and at sea. Because of these developments, maritime businesses today face a choice between connecting their assets and infrastruc-

ture at pace or potentially underperforming relative to their peers.

However, from a security perspective, as the maritime industry becomes increasingly reliant on connected networks and infrastructure, the issue of cybersecurity becomes more pressing.

This is particularly the case for the security of operational technology, or OT, which manages, monitors, controls and automates physical assets, such as sensors, switches, safety and navigation systems, and vessels.

Simply put, the more connections that a system has, the likelier it is that a breach will occur. And when it does occur, the breach spreads further, wider and quicker than ever before.

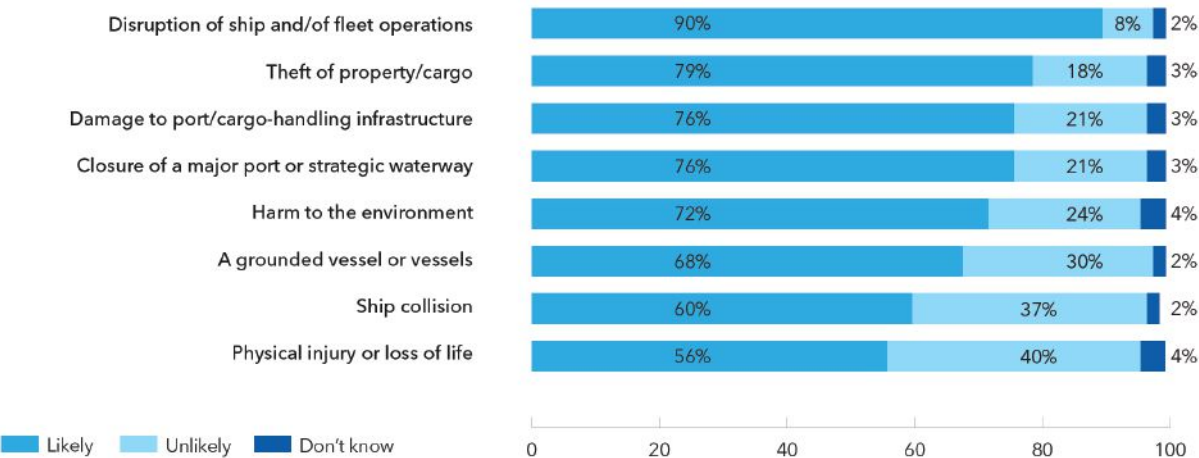
There is an almost universal expectation among maritime professionals that cyberattacks will disrupt ship operations in the coming years.

Attacks on IT environments can and do disrupt normal shipping operations. But perhaps more concerning, it is through direct attacks on operational technology that the greatest threat to physical safety and infrastructure becomes possible.

Most maritime professionals believe a cyber incident will likely force the closure of a strategic waterway in the coming years, and more than half expect cyberattacks to cause ship collisions, groundings, and even result in physical injury or death.

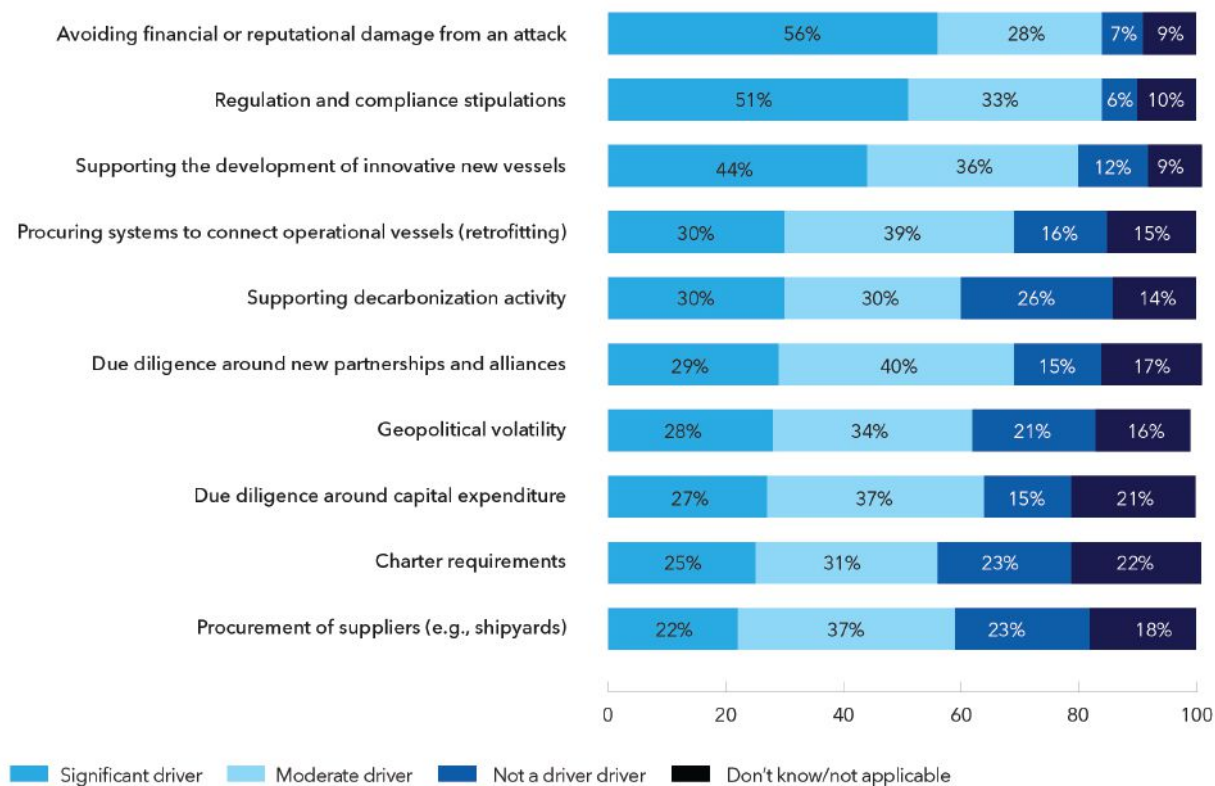


Maritime professionals expect serious outcomes from cyber in the near future



Q: How likely is it that cyber-attacks in the maritime industry, within the next one or two years, could result in the following outcomes?
Percentages reflect likely/unlikely (i.e. moderately + highly likely, and moderately + highly unlikely).

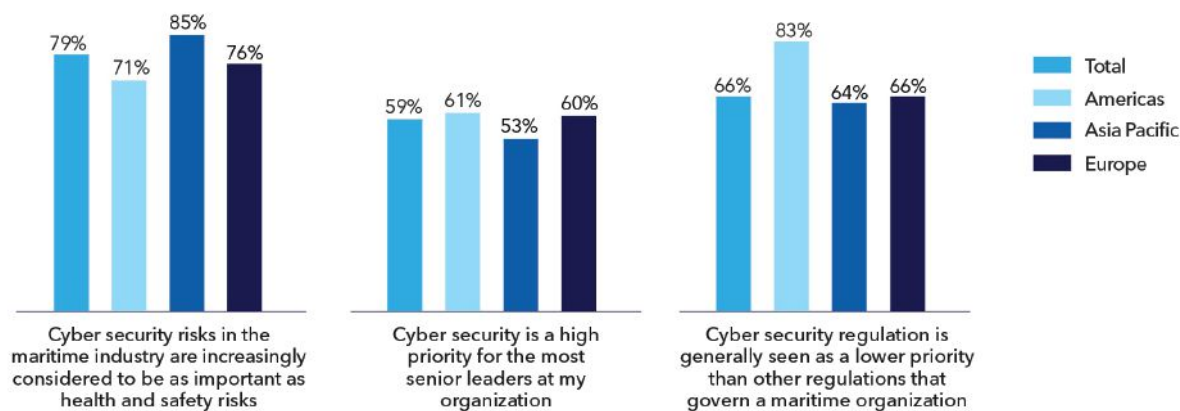
Regulation and reputation leading drivers of cyber security investment



Q: Which of the following factors are currently driving cyber security investment and activity within your organization?

DNV Maritime Cyber Priority 2023

Cyber security a rising business concern, but cyber regulation is a lower priority



Q: To what extent do you agree or disagree with the following? Percentages reflect net agreement (i.e. moderately + strongly agree)

OT Is Vulnerable

A third of maritime professionals say their organization has experienced negative outcomes as a result of IT-targeted cyberattacks, and a quarter say their organization has been negatively impacted by attacks on OT. Despite the relatively high incidence of attacks, few in the industry are fully confident in their organization's ability to prevent OT (or IT) attacks, and there is a view that OT is not as well protected as IT systems in the maritime industry.

More generally, we find that OT lags IT security in maturity by around 15 years because OT systems have been developed without cybersecurity in mind and they are now being connected to IT systems and the internet. In many ways, the maritime industry is still focused on IT security, even though we are in an era of connected operational systems and assets.

Tighter Regulation Is on the Way

Cyber regulation is becoming stricter across all sectors, particularly those managing critical infrastructure. In maritime, tighter regulation is on the horizon as industry bodies seek to encourage the sector to improve its security posture. The IMO published its Guidelines on Maritime Cyber Risk Management in 2017, issuing an update in 2021 aimed at improving cybersecurity across the industry. These are more than guidelines: They make it practically mandatory to include cyber risk management into the safety management of vessels.

The reality is that ship managers and owners have handled these requirements differently. Some only do the bare minimum and only include a few references to cybersecurity in their risk management and undertake limited training for crew. Others have updated their integrated management systems and sought certification against standards, such as ISO 27001 and DNV's cyber secure class notation.

New IACS Requirements

The International Association of Classification Societies (IACS) has adopted new universal requirements for cybersecurity. The requirements will make verification of cybersecurity aligned to recognized IEC standards part of the mandatory verification scope for new vessels contracted from July 2024.

This will increase the focus of ship classification societies on the topic of cybersecurity. It will ensure that technical cyber resilience is built into important onboard systems and a vessel's overall network, for example, addressing the integration of IT and OT, and the systemic integrity of third-party suppliers. And it will lead to follow-up on cybersecurity, with surveyors visiting vessels in operation.

For many in the maritime industry, regulation provides a strong motivator to unlock much needed cyber security funding from their business.

And there are plenty of other benefits to a regulatory approach, for example, the building of trust so that part-



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ners across the industry have a base level of security.

Strengthening Collective Cybersecurity in 2024

As we pursue greener, safer and more efficient global shipping, the digital transformation of the industry is deeply dependent on securing interconnected assets. This makes it vital that we work collaboratively to strengthen our collective cybersecurity. Only by sharing information and experience will the industry create standards and best practices for cybersecurity. The maritime industry needs to take big steps forward in openly sharing cybersecurity experiences—the good, the bad and the ugly—to collectively create security best practice guidance for a safer, more sustainable maritime sector.

Cyber professionals should use upcoming, tighter regulation to build stronger security postures. The instinct of many in the past has been to focus narrowly on what needs to be achieved now to satisfy the essential requirements of regulation. However, regulation is evolving at pace, illustrated by the new requirements and recommendations set out by IACS and the IMO. Organizations with a “just keep up with regulation” mindset risk falling behind.

Maritime organizations have set clear priorities around digital transformation to enable commercial advantage and decarbonization. Cybersecurity leaders should be part of these wider strategic conversations. Maritime organizations should consider investment in cybersecurity not just a cost of business, but an investment in confidence, competitiveness, compliance and innovation. **ST**

Review&Forecast

The NAUTILOS Project: Advancements In Marine Observation and Technology

By Sandra Sá
Information Manager
EurOcean

The European Union (EU) Horizon 2020 NAUTILOS project is on a mission to revolutionize marine observation and technology: www.nautilus-h2020.eu. It aims to bridge significant gaps in our understanding of the world's oceans, which comprise elaborate and dynamic ecosystems. The project's core objective is to develop a new generation of sensors and samplers capable of measuring a wide range of essential ocean variables. These technological innovations are designed to be both cost-effective and highly adaptable, ensuring their continuous deployment across various observing platforms. By enhancing our capacity to monitor the oceans with a much higher degree of precision, frequency

and duration, the project promises to greatly improve our comprehension of environmental fluctuations and the impact of human activities, while facilitating innovative solutions that serve a wide spectrum of data users.

Understanding the ocean and its ecosystems has been a long-standing challenge. The NAUTILOS project focuses on physical, chemical and biological variables essential to our understanding. These variables include: salinity, temperature, inorganic carbon, nutrients, oxygen, phytoplankton, zooplankton, and even micro- and nano-plastics. What sets the project apart is its vision of deploying cutting-edge technologies across a diverse array of observing platforms, ranging from commercial vessels and aquaculture facilities to AUVs. This wide-reaching deployment enables comprehensive monitoring, extending from nearshore environments to the abysses of the deep sea, supporting various applications aligned with European Union policies.

Sensor Development

NAUTILOS is committed to studying biogeochemistry and ocean physics. Additionally, the project aligns with the principles set out by the EU's Marine Strategy Framework Directive. One of the significant milestones in the NAUTILOS project was the successful completion of sensor and instrument prototypes emphasizing biogeochemistry and biology. A remarkable breakthrough was the development of a precision miniaturized dissolved oxygen (DO) sensor, boasting both precision and portability for field deployment. The project has also introduced advancements in WiSens sensors tailored for chlorophyll-a and dissolved oxygen, opening new avenues for deployment, notably on fishing vessels. These achievements are pivotal in advancing marine observation capabilities.

In tandem with these accomplishments, NAUTILOS has achieved another milestone by delivering a second batch of sensors with a primary focus on enhancing carbonate system and ocean acidification measurements. These measurements are critical for understanding the present state of the ocean and predicting the potential consequences of climate change. The project's approach centers on enhancing off-the-shelf technologies and brand-new sensors to make them more modular, user-friendly and cost-effective. Their reduced size, lower costs and enhanced usability make them a valuable addition to the marine observation toolkit.

Furthermore, NAUTILOS focuses on rapid silicate detection, significantly improving response times compared to previous versions. The project's development of innovative mechanical design streamlines the production of essential reagents, thereby reducing the sampling time to under 10 sec., making it compatible with integration onto Argo floats.

The project also concentrates on the development of an underwater microplastics sampler capable



“The project’s core objective is to develop a new generation of sensors and samplers capable of measuring a wide range of essential ocean variables.”

of sampling at depths down to 600 m. This system employs cascade filters, a pump and a flow meter to quantify the number of microplastic particles per unit of water mass. This critical development contributes significantly to our understanding of ocean plastic pollution.

NAUTILOS’s pursuit of autonomous microplastic detection represents the final frontier in the project’s quest for marine research breakthroughs. Designed for real-time, on-site analysis of microplastics collected from marine water, this system has the potential to transform how we study microplastics. Although it requires further refinement, particularly in terms of integration with the FerryBox, which measures physical, chemical and biological parameters on board of ships of opportunity, this innovative technology holds great potential for automating the monitoring of microplastics, leading to a new era in marine research.

Democratizing Data

As the project continues, the focus turns toward integration, calibration, validation and controlled scenario testing of the developed instruments. These advancements promise to significantly enhance marine observation and understanding, extending the scope of data collection to unprecedented levels. Concurrently, the project is dedicated to improving data management. With the successful deployment of the NAUTILOS data infrastructure, which offers both private and public data access areas, the project ensures that stakeholders have efficient access to NAUTILOS’s public products. Additionally, the development of the graphical user interface on the NAUTILOS website enhances the visualization and accessibility of data through a data portal, fostering greater engagement.

Lastly, the NAUTILOS project places a strong emphasis on citizen science initiatives, acknowledging the vital role of public engagement in marine data collection. To achieve this, the project has developed a series of tools integrated with common smartphones, such as an app for citizen science partners, a near-infrared (NIR) scanner for identifying plastic fragments, and a portable microscope for analyzing water samples. This inclusive approach seeks to broaden the project’s reach, empowering a wider audience to participate in marine monitoring and environmental stewardship.

In essence, NAUTILOS is not just revolutionizing marine observation; it is democratizing access for the public to actively contribute to the understanding and safeguarding of our precious marine environments. **ST**

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Review&Forecast

Advancing Marine Science Tech For a Cleaner, Sustainable Future

By Professor Icarus Allen
Chief Executive
Plymouth Marine Laboratory (PML), PML Applications Ltd.

The ocean plays a critical role in health, wealth and prosperity around the globe and it has been a particularly hot topic in recent news. Between marine heat waves, ocean litter, tragic incidents and landmark international partnerships aimed at protecting this incredible environment, to name just a few, the ocean has rarely been out of the headlines.

2023 has also been a big year at Plymouth Marine Laboratory (PML), and here we reflect on some of the achievements in 2023, as well as highlight some exciting activities ahead in 2024.

Plankton Analysis

This year saw the delivery of a remarkable new plankton analysis technology, the Imaging FlowCytobot (IFCB), to automatically image and classify plankton that range in size from 0.01 to 0.15 mm. PML scientists were part of the team that developed the new equipment, which benefits from artificial intelligence (AI) capabilities, offers a radically more sustainable sampling solution compared to traditional direct sampling, and enables the collection of a vastly increased range and frequency of data.

This will allow our experts to observe what plankton species are present in the local waters in much finer detail, which is crucial in gaining a better understanding of how the system functions and how environmental changes may impact those functions and the organisms living within. The ultimate aim is for multiple systems to be deployed around the globe to create a worldwide network of plankton observatories.

Marine Plastics

It was an impressive year for PML's world-class marine plastics research. PML's Head of Science for Marine Ecology and Biodiversity Professor Pennie Lindeque was part of an internationally recognized trio awarded the Volvo Environment Prize and the Blue Planet Prize for pioneering research into the extent and impact of marine plastic litter. Back at the lab, research continued by using satellites and machine learning to help detect and monitor marine plastics, including research using water quality proxies to help determine microplastic concentrations in certain water systems.

Another area of microplastic research highlighted the need for motorists to maintain the correct tire pressure to reduce the amount of microplastics from tire wear en-

tering our waterways. Tire wear stands out as a major source of microplastic pollution: Per year, an average of 1 kg of microplastic pollution from tire wear is produced per person on the planet.

Carbon Initiatives

Also in 2023, an innovative €1.5 million project, funded through Amazon's Right Now Climate Fund, was launched to explore the carbon capture capabilities of seaweed living in the available space between offshore wind turbines. Seaweed habitats have long been heralded as having high carbon dioxide removal potential; however, the extent of their viability for carbon removal at industrial scales is yet to be determined. Marine space is also at a premium, so it is important to find large-scale, accessible spaces for seaweed farms to enhance their feasibility as carbon removal businesses. This first-of-its-kind research project of co-locating a seaweed and offshore wind farm will enable researchers to determine whether this type of co-location could be practical. It will also provide the opportunity to gain a far greater understanding of the natural processes involved in the seaweed carbon cycle and the ability to track detritus and locate where carbon may be stored in the long term.

Always investigating ways in which to reduce the lab's own carbon footprint, PML has been investing heavily into low-carbon technologies in recent years. This year, a state-of-the-art solar photovoltaic carport was built and has already been helping offset the energy required to run experimental equipment and high-performance computing facilities. It is estimated that the carport will save approximately 65 tonnes of carbon dioxide a year, adding to the 14 tonnes of saved carbon dioxide from the roof solar panels, installed in May 2021.

Looking ahead, PML has ambitious low-carbon goals for its sampling operations. Having been highly successful in attracting funding for an autonomous fleet of marine sampling technologies, including data buoys, an uncrewed surface vessel and underwater robots as part of Smart Sound Plymouth, the team is now investigating the development of the world's first long-range autonomous research vessel. The proposed 24-m *Oceanus* has been designed, with funding support from the Natural Environment Research Council (NERC), as a self-righting, lightweight, monohulled autonomous vessel capable of carrying an array of monitoring sensors to collect data for research into critical areas, such as climate change, biodiversity, fisheries and biogeochemistry. Designed by Plymouth-based M SUBS Ltd., it will make the transatlantic sampling voyage from the U.K. to the Falklands, which is currently performed in the annual six-week Atlantic Meridional Transect (AMT) research expedition. The *Oceanus* will carry an advanced scientific payload and use the latest AI navigation technology. An autono-



mous AMT could lead to multiple data collection missions a year to enable a much better understanding of the dynamics of the ocean environment while allowing a significant reduction in the carbon footprint of data collection.

Supporting Society, Industry

Extending beyond the lab's autonomous activities, PML is a founding member of the National Centre for Coastal Autonomy, the U.K.'s first fully integrated autonomous coastal observing and monitoring network. The lab also hosts the Centre for Coastal Technologies through its commercial arm, PML Applications Ltd., which offers access to a team of highly experienced marine operations experts for the safe and secure testing of new sea-going technologies within its existing high-specification marine infrastructure.

Another rapidly advancing research area at the lab is digital twins. PML is a world leader in marine ecosystem and biogeochemical model development, and its models and outputs are used around the globe by a wide range of environmental scientists. However, these models are complex, computationally expensive and require advanced training to generate the output and interpret the information. With this in mind, PML's expert team has turned its attention to developing environmental digital twins to make ecosystem

"... the team is now investigating the development of the world's first long-range autonomous research vessel."

modeling capabilities more accessible for specific purposes outside of academia, such as aquaculture, blue carbon initiatives and coastal development. Significant progress has already been made in this area, with the latest study demonstrating the successful prediction of low oxygen levels for aquaculture sites and the accurate estimation of oxygen levels from marine observations. The vision is that digital twins of the ocean would eventually democratize access to modeling, enabling end-users without access to high-performance computing facilities to investigate a range of real-world scenarios for management and policy-making decisions.

Overall, it is an inspiring and fascinating time to be working within the marine sector, and the whole of PML looks forward to more exciting ocean opportunities. **ST**

Review & Forecast

Momentum Builds for Better Ocean Governance

By Liz Karan
Director of Ocean Governance
The Pew Charitable Trusts



Major international conservation events were planned in 2020 for what was called the “super year” for the ocean. But the onset of the COVID-19 pandemic disrupted numerous meetings and delayed critical policy decisions. However, as we approach the end of 2023, many of these postponed decisions are coming to fruition, leading to positive developments for the ocean and the people and local economies that depend on it.

Momentum began in late 2022 when the Convention on Biological Diversity established the Kunming-Montreal Global Biodiversity Framework, a key component of which is a commitment to safeguard at least 30 percent of the world's oceans and lands by 2030, also known as 30 by 30. Scientists say reaching this goal is necessary to protect biodiversity and restore ocean health. According to the United Nations Environment Programme, only about 8 percent of the ocean is currently protected. So, the framework reflects the growing recognition that the environment needs much greater protection, especially in the face of climate change.

An important step toward that goal was the successful adoption this summer of a new UN treaty to address the conservation and sustainable use of marine biodiversity of areas beyond national jurisdiction (BBNJ). By establishing a legal mechanism for facilitating the creation of marine protected areas in more than two-thirds of the ocean that make up the high seas, the BBNJ Treaty, also known as the High Seas Treaty, represents a significant opportunity to reach the goal of protecting 30 percent of our global ocean by 2030. However, for the treaty to be implemented as quickly as possible, it must first be ratified by 60 countries.

Another notable achievement is the World Trade Organization's (WTO) Agreement on Fisheries Subsidies, which was adopted in June 2022. Currently, 43 WTO members have ratified this agreement. This signals progress toward reducing harmful subsidies linked to fishing activities and enhancing the sustainability of our ocean resources. But the treaty will only come into force when it's formally accepted by at least 110 countries—two-thirds of the WTO membership. Although the fisheries subsidies agreement is historic, its current form leaves

important issues unaddressed. However, ongoing negotiations—ahead of the WTO’s February 2024 ministerial meeting—aim to resolve these remaining concerns, which relate to overfishing and overcapacity, and are a crucial step toward curbing overfishing on a global scale.

One area of concern is deep-seabed mining, where uncertainties persist regarding the effect of large-scale industrial operations on the ocean environment. The International Seabed Authority, the body mandated to govern deep-seabed mining, should it take place, has been unable to establish regulations for these activities. In light of the potentially devastating impacts this industry could have on the fragile deep-sea ecosystem, a growing number of countries have publicly called for a precautionary pause or moratorium on seabed mining until scientists have a deeper understanding of the potential environmental damage this industry could cause to the ocean.

Looking ahead, we anticipate significant progress in the coming year. Achieving widespread acceptance of the High Seas Treaty, which requires the involvement of 60 countries, will be a key milestone. Several nations have expressed their desire to see the treaty come into force by the UN Ocean Conference in 2025, making 2024 pivotal for securing ratifications.

“The real catalyst for change lies in multilateral agreements and policy changes at the national, regional, and international levels.”

Additionally, tangible progress toward the 30 by 30 goal is essential. This includes not only national actions but also commitments to protect the Southern Ocean by the Commission for the Conservation of Antarctic Marine Living Resources. Several proposals for marine protected areas in this region have languished for years, so progress is long overdue.

The real catalyst for change lies in multilateral agreements and policy changes at the national, regional, and international levels. Governments must drive these agreements and, building on the victories of the past year, move toward effective implementation of forward-looking policies and commitments. **ST**

Review & Forecast

The Floating Future of Cities

By Olaf Waals
Manager Offshore

Joep van der Zanden
Senior Project Manager Offshore
Maritime Research Institute Netherlands (MARIN)

Many cities situated in coastal areas are vulnerable to sea level rise while also suffering from a scarcity of space. Extreme weather events may result in high or low water levels in rivers, and more space is consequently needed to accommodate large water flows or to store water for periods of drought. In the Netherlands (and other deltas around the world), the space for housing and industry is becoming limited due to these developments.



Together with a group of partners, we at MARIN have initiated the Floating Future project to better understand the pros and cons of developing floating cities and infrastructure at a larger scale.

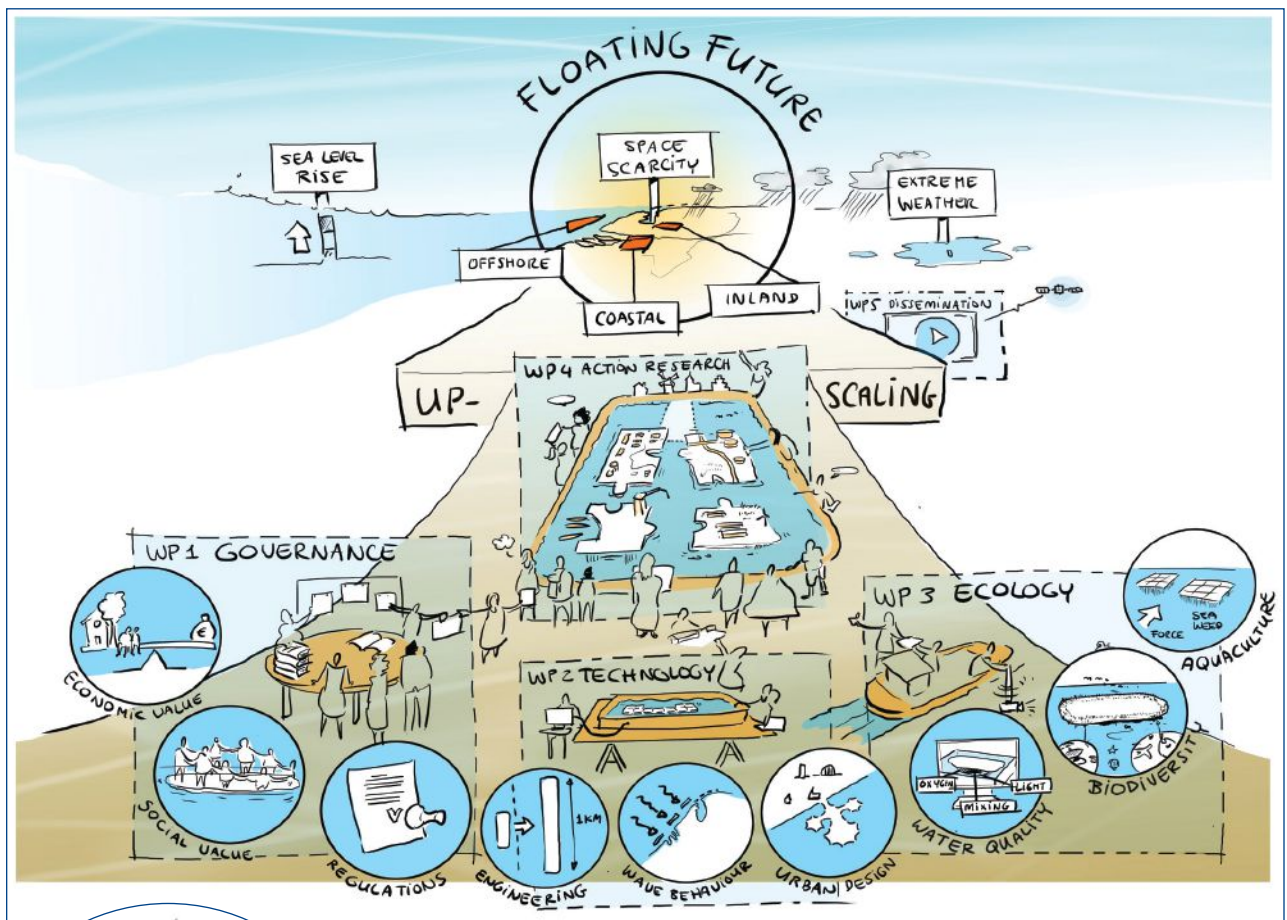
For centuries, the motto of the Dutch approach to water safety has been: “Luctor et Emergo,” which means: “I struggle and emerge.” This new project aims to take the next step: “I struggle, emerge and ... float!”

The Floating Future project is investigating the possibilities of large-scale floating developments as an addition to the present-day toolbox of civil and maritime engineering. Floating settlements provide space, while the water at the foundation can be used for other purposes. A floating foundation adapts to the changing water level, making it resilient to sea level rise, and it can be relocated if needed.

We already see an increase in the number of floating houses in the Netherlands. The next step would be to go from single houses to housing blocks, public spaces (such as parks), and floating industry and ports. The Floating Future project was awarded a €5.3 million subsidy by the Dutch government to research the upscaling of floating developments.

Stakeholders

This unique project is supported by more than 40 public and private stakeholder organizations and combines interdisciplinary research with industry and societal partners. With this project, we are building a knowledge base as the foundation for the large-scale floating



developments of the future. The core of the project is founded on 10 Ph.D. researchers that will study the possibility of floating settlements from the perspective of different disciplines, including social sciences, economics, legislation, technology, coastal safety and ecology.

Both technical and societal breakthroughs are required to achieve the upscaling of floating infrastructure. A technical breakthrough is needed to come up with an offshore engineering solution capable of withstanding environmental conditions and providing floating space with minimal ecological impact. Societal breakthroughs are needed to create governance arrangements for floating islands in inland water and coastal areas, and for societal acceptance of living and working on water.

The work will be divided in three clusters addressing governance, technology and ecology, which relate to interdisciplinary questions. Researchers will collaborate with experienced societal partners to tackle the chal-

lenges. As well as scientific output, this will deliver an integrated vision, policy guidelines, design guidelines, project proposals, and an inventory of the required resources and milestones to implement the Floating Future in the Dutch delta. Consequently, this project will deliver key insights into the required governance, financial and economic capabilities to realize climate-proof floating islands.

Work Package (WP) 1: Governance

To create sustainable, inclusive and multifunctional living space on water, insight is required into the societal acceptance of large-scale floating concepts and the governance challenges related to upscaling. The first governance project is studying the social value of floating communities, and how citizens can be enabled, motivated and mobilized to participate in these developments. Arts-based, co-creation methods will be used to develop and visualize shared narratives on floating futures.

The second project zooms in on the economic value of floating concepts, focusing on the development of sustainable business models for floating ports. To this end, soft systems methodology and multi-actor, multi-criteria analysis will be used.

The third project focuses on the legal embodiment of large-scale floating structures and studies the rules and regulations that are required to incorporate floating objects into the existing legal system.

Together, the three projects will develop novel floating



urban and port concepts, and propose social, economic and legal conditions and principles for the future governance arrangements of large-scale floating structures.

WP 2: Technology

The forces and motions of extremely large structures in waves will be studied. The challenge is to find designs that lead to acceptable forces and motions in open-water environments. This will be studied for inland and offshore environments, scaling up the engineering complexity from smaller scale developments to large floaters at sea.

Additionally, the effect that these very large structures have on the local wave climate and coastal processes will be studied. It will be interesting to see if floating structures can play a role in coastal flood safety. This also links to the ecology work package, where we will investigate the effects of wave and light shielding on biodiversity and opportunities for aquaculture.

Finally, for urban developments, it is likely that float-

ing parts will be added to existing cities. We will research the architecture and urban design methods needed to enable the floating parts to become integrated into the city through case studies in Rotterdam and Amsterdam.

WP 3: Ecology

Large floating structures will not only cause shading but will also affect water mixing by currents and waves, resuspension of fine sediment and many other factors. Additionally, such structures will become potential habitat for organisms that settle on hard substrate, which eat phytoplankton and use nutrients, thereby affecting a more extensive area around the structure. The ecological effects are, hence, extremely hard to predict, especially because the magnitude of these effects depend on the scale of the floating structure relative to the size and other specific characteristics of the relevant water body.

Beyond potential negative impacts on the environment, there may also be opportunities to create positive impacts by making biodiversity-enhancing designs for



the edges of the man-made islands (both above and below water) and utilizing specific areas for economic activities, such as aquaculture, that may also have favorable effects on biodiversity. We will develop design rules to maximize floating space in an environmentally friendly way. The design rules will include how to scale floating structures relative to the receiving system, how to create biodiversity-supporting island edges, and how to spatially integrate the cultivation of seaweeds.

WP 4: Action Research

Participatory Action Research (PAR) is the unique central “integration engine” of Floating Future, where the scientific disciplines of Governance (WP 1), Technology (WP 2), and Ecology (WP 3) and the societal stakeholders come together to co-create innovative knowledge with the researchers.

PAR is a method not only to advance scientific knowledge with societal stakeholders, but also to achieve prac-

tical objectives by participating in concrete case studies around the three research focus areas: Inland, Coastal Port City and Offshore.

One of the Action Research methods that is applied in Floating Future is Climate Café, a unique and proven platform for collaborative learning and co-creation at case study field locations. Other WP 4 co-creation instruments include: governance think tank meetings, interactive design workshops, VR simulations and investor roundtables.

The Floating Future project officially launches January 2024: www.floating-future.nl. MARIN is involved in the technical evaluation of large floating structures, and we will also use the new Seven Ocean Simulator center to enable people to experience how it is to live and work on water. We are looking forward to a very inspiring project with the consortium.

You can follow us on LinkedIn: www.linkedin.com/company/floating-future-research-project. **ST**

Review&Forecast

Delayed Lease Sales, Delayed Progress: Our Offshore Energy Predicament

By Erik Milito
President
National Ocean Industries Association (NOIA)

As 2023 comes to a close, the offshore energy industry finds itself at a critical juncture, grappling with the uncertain fate of the federal offshore oil and gas leasing program. Our industry is no stranger to challenges, but the current situation is bewildering and carries profound implications for our nation's energy security, economic prosperity and environmental responsibility.

For too long, we've anxiously awaited the launch of the much-anticipated federal offshore oil and gas leasing program, a legal requirement. Remarkably, when the previous program expired in June 2022, there was no replacement in sight.

In late September, the administration unveiled the new leasing program (<https://shorturl.at/ftzPR>), which can be aptly described in one word: a failure (www.noia.org/federal-offshore-oil-gas-leasing-program). It offers only three offshore oil and gas lease sales in the Gulf of Mexico, scheduled for 2025, 2027 and 2029. This is a far cry from the historical norm, where the Department of the Interior (DOI) typically conducted at least 10 sales in the Gulf over the period of the program.

Compounding this policy misstep, the Department of the Interior decided to delay the necessary lease-sale-specific environmental reviews. These reviews usually take one to two years to complete, and they've traditionally run concurrently with the program's development. Previous administrations, irrespective of their political affiliations, followed this process diligently to ensure uninterrupted leasing activities.

Incredibly, the administration's decision to include only three sales in the next oil and gas leasing program will hamper momentum behind offshore wind development. To issue offshore wind leases while adhering to the Inflation Reduction Act, the DOI must offer at least 60 million acres annually for offshore oil and gas leasing and grant leases to "acceptable bids." With only three potential sales spread across five years, it's impossible for the DOI to legally conduct offshore wind lease sales annually through 2029. Annual offshore wind lease sales are crucial for supporting the growth of offshore renewables along America's coastlines.

But there's more to this predicament. In July 2023, the Biden Administration reached a voluntary settlement with activist groups regarding protections for the Rice's whale, a species already safeguarded under the Endan-

gered Species Act and the Marine Mammal Protection Act.

This agreement allowed the administration to sidestep Congress, the public and established regulatory processes. It disregarded scientific input and imposed extensive restrictions while removing millions of prime acres from Gulf of Mexico Oil and Gas Lease Sale 261. These restrictions significantly deviated from established best practices, introducing vessel speed limits, as well as constraints on night travel and travel during periods of low visibility across a vast area encompassing the entire Gulf of Mexico. The new restrictions were imposed in a massive channel where there has been little to no presence of the whale.

In a fortunate turn of events, a last-minute preliminary injunction was issued just days before Gulf of Mexico Lease Sale 261 was scheduled. It nullified these restrictions, restoring the acreage for lease sale. The U.S. District Court for the Western District of Louisiana found the actions procedurally invalid and the DOI's decision arbitrary and capricious.

This decision prompted the U.S. Court of Appeals for the Fifth Circuit to grant an emergency stay in response to the preliminary injunction. Subsequently, the Bureau of Ocean Energy Management (BOEM) decided to delay Lease Sale 261 until a ruling on merits was issued for the case. It's essential to emphasize that there were no legal or operational constraints preventing the DOI from proceeding with Lease Sale 261. This delay raises concerns, particularly in the face of geopolitical instability and oil market fragility due to ongoing armed conflicts in multiple oil-producing regions.

The implications of these actions go far beyond our industry. They affect the broader economy, energy security and environmental stewardship. The overwhelming uncertainty in the offshore energy sector hinders companies' ability to make investment decisions and plan for future projects.

This lack of clarity stifles innovation, restrains economic growth and risks diverting investments to other regions worldwide. Despite the Gulf of Mexico's abundant reserves, skilled workforce and robust infrastructure, the region's attractiveness for energy development is in peril without access to new acreage and energy projects.

The Gulf of Mexico is a lifeline that supports hundreds of thousands of jobs, attracts billions in investments and generates substantial government revenue. The Gulf of Mexico also produces among the lowest carbon barrels of oil in the world. As energy demand continues to rise through the foreseeable future, the Gulf of Mexico clearly represents an environmentally advantageous asset when compared to other options around the world.

All these benefits are jeopardized without a firm commitment to ongoing energy development.

As inflation soars, particularly in energy prices, and global instability looms, the U.S. and our allies face stra-



tegic disadvantages if Gulf of Mexico production dwindles. Moreover, emerging offshore energy sectors such as offshore wind and carbon sequestration depend on the expertise of companies integral to the offshore oil and gas industry. Many of these companies play a pivotal role in these nascent U.S. sectors, as they all involve marine construction and engineering, making their success instrumental for the growth of American offshore wind farms and Gulf of Mexico carbon sequestration projects.

The current state of the offshore oil and gas leasing program is not merely a missed opportunity; it's a step backward. It threatens our energy future and weakens our position on the global stage.

The encouraging aspect is the substantial bipartisan interest in Congress to address this issue. Notably, when every Democrat in Congress voted in favor of the Inflation Reduction Act, this underscored their support for mandated Gulf of Mexico oil and gas lease sales. Moreover, earlier in 2023, H.R. 1, the Lower Energy Costs Act, which also mandated Gulf of Mexico oil and gas leasing, garnered bipartisan support as it passed the House of Representatives.

Given that the benefits of the Gulf of Mexico extend beyond party lines and regional boundaries, it's imperative that we collaborate on a course correction to ensure that our offshore energy resources remain a source of strength for our nation. **ST**

Review&Forecast

Working Together to Map the Seafloor

*By Cassie Stetkiewicz
Director of Operations
FarSounder Inc.*

Imagine if protecting the fragile underwater ecosystems and reaching business goals were simultaneously achievable. At FarSounder, we have discovered that these ideals are actually a reality, and they support a third dream.

Imagine if a vessel operator could make valuable contributions to global initiatives without changing its daily operations. Imagine if our map of the seafloor here on Earth was as detailed as our map of the surface of Mars. FarSounder is helping to actualize these concepts with contributions to global initiatives.

Leading by example is an effective way to bring the community together toward a common goal. We have found that taking the initiative to align our company with like-minded nonprofit organizations is the best way to make the strongest impact.

At FarSounder, we develop 3D forward-looking sonars for real-time navigation. We are able to take what we do every day and work together with The Nippon Foundation-GEBCO Seabed 2030 Project, NOAA and the International Hydrographic Organization (IHO) to contribute to their objectives.

As you may know, less than 25 percent of the world's ocean has been mapped, and some of the data are very old. The goal is to complete a global map of the seafloor by leveraging depth measurements from the wider maritime community, not just the hydrographic survey community.

It is clear that mapping our oceans is an important step to better understanding our world. The more we talk about our goals for mapping the seafloor, the more interest we find in our greater community. As our customers sail, they are continually accumulating real-time, high-quality seafloor data. We have found that many FarSounder Argos users want to contribute to global mapping initiatives, and we're happy to make it as easy as possible to enable them. Unlike other mapping products that focus on generating a private database only for their paying customers, FarSounder is committed to facilitating publicly accessible contributions.

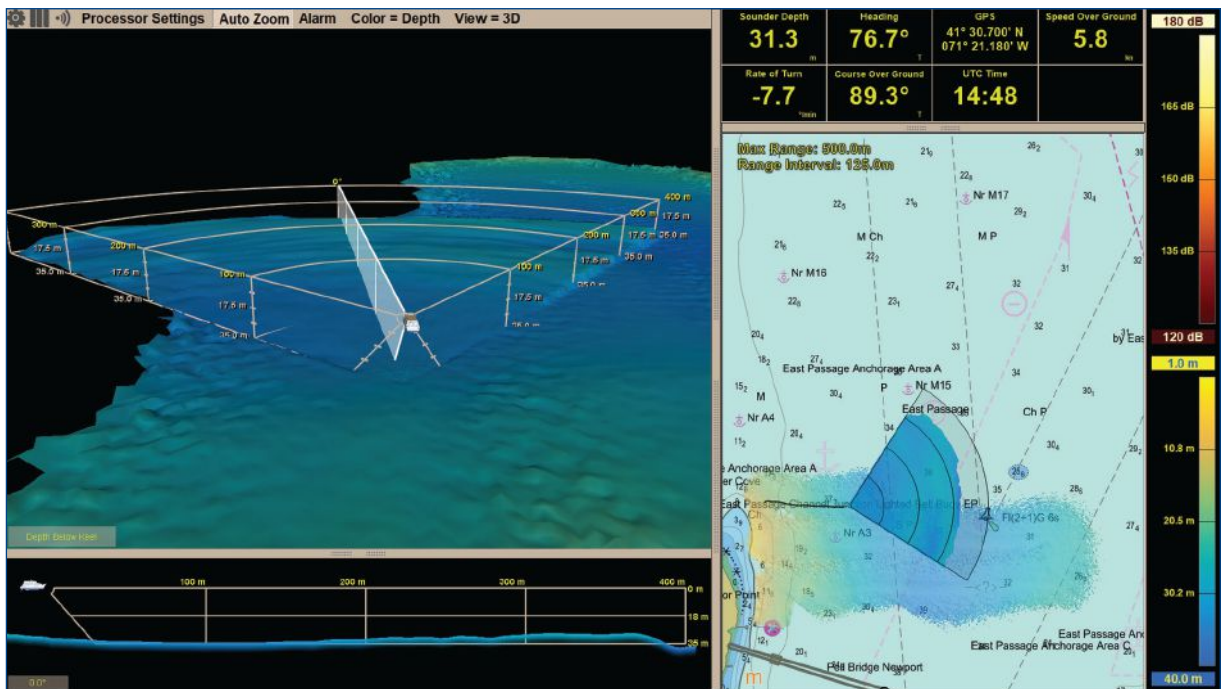
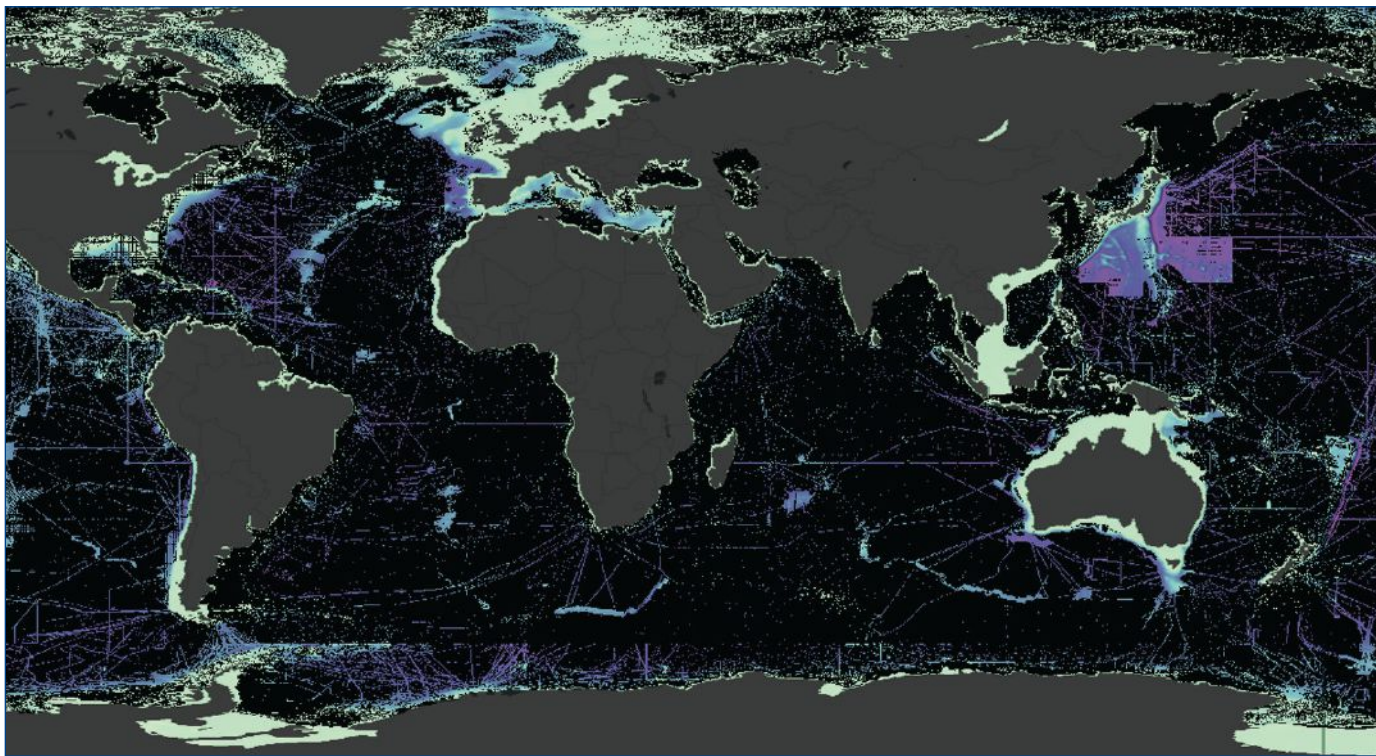
A key facilitator of crowdsourced bathymetry (CSB) data is the IHO, an intergovernmental organization based in Monaco that works to ensure all the world's seas, oceans and navigable waters are surveyed and charted. It coordinates the activities of national hydrographic offices; promotes uniformity in nautical charts and documents; issues survey best practices; provides guidelines to maximize the use of hydrographic survey data; and develops hydrographic capabilities in member states.

The IHO organizes a number of working groups, including the Crowdsourced Bathymetry Working Group (CSBWG). The mission of CSBWG is to develop the standards and practices for CSB data and enable participation by the global community to contribute depth measurements from around the world. The working group spearheaded the effort to create an IHO database for these crowdsourced measurements called the Data Center for Digital Bathymetry (DCDB). FarSounder has been an active member of the CSBWG since 2018. We're also a Trusted Node of the DCDB, which means that we are one of the conduits for uploading contributions to the database. All contributions distributed via the DCDB are available to anyone to access at no charge.

Most coastal countries are member states of the IHO. The United States is an active member of the IHO, with participation primarily via NOAA (part of the U.S. Department of Commerce and the primary U.S. agency in charge of hydrographic activities in U.S. waters). NOAA is a world leader in the development of hydrographic technologies, and it hosts the DCDB at its Colorado campus.

Seabed 2030 is a joint project of the Nippon Foundation and GEBCO, with the goal of mapping the world's



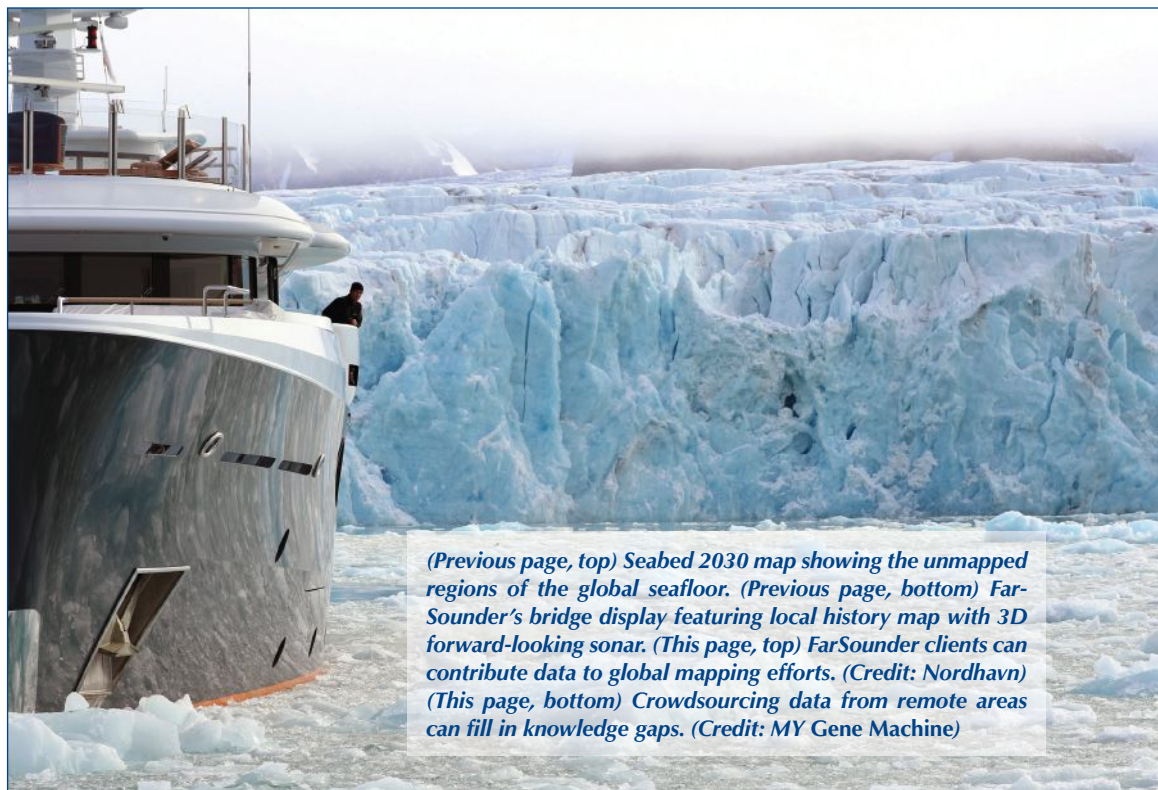


oceans by 2030. Seabed 2030 has done a fantastic job of rallying the global community with its outreach and has become a “household name” in the maritime industry. It is endorsed by the UN and collaborates closely with the IHO. GEBCO’s aim is to provide the most authoritative publicly available bathymetry of the world’s oceans. It operates under the auspices of the IHO and the Intergovernmental Oceanographic Commission of UNESCO. The GEBCO map (the Seabed 2030 map) is built from a variety of survey data, including CSB contributions.

All contributions to the IHO’s DCDB are included in Seabed 2030’s efforts and are sources for the GEBCO

map. Our customers are able to contribute to these efforts by uploading anonymous submissions for them to the DCDB, which are then passed on to Seabed 2030 for the GEBCO map. Plus, all of our customers’ contributions are available directly from the DCDB. All contributions to the DCDB are under Creative Commons Zero universal public domain dedication (CC0 1.0) and are not considered hydrographic surveys for navigational use.

In recognition of FarSounder’s efforts to facilitate contributions and promote the Seabed 2030 message, we’ve recently become an official partner of Seabed 2030.



(Previous page, top) Seabed 2030 map showing the unmapped regions of the global seafloor. (Previous page, bottom) FarSounder's bridge display featuring local history map with 3D forward-looking sonar. (This page, top) FarSounder clients can contribute data to global mapping efforts. (Credit: Nordhavn) (This page, bottom) Crowdsourcing data from remote areas can fill in knowledge gaps. (Credit: MY Gene Machine)

As part of our fleet sharing service, we will continually submit FarSounder user-generated contributions to the DCDB at resolutions meeting or exceeding the needs of Seabed 2030. FarSounder's new pilot program to share data across the FarSounder fleet is partially sponsored by NOAA (as part of a Phase I Small Business Innovation Research grant we recently received), and the goal is to make it easy for our users to contribute their local history mapping data and access the contributions of all other participants while also contributing to global efforts to map the oceans. The gist of the program is to automatically share your measurements with a FarSounder cloud service, which will then compile contributions and relay them back to your software. From this cloud service, contributions will also be shared with the global community via the IHO's crowdsourced bathymetry database and Seabed 2030.

FarSounder also invites select customers to participate in its Expedition Sourced Ocean Data Collection Program, which supplies participants with an external

USB drive that can record raw sonar data. Once full, the drive is sent back to FarSounder, where we then import the sonar data into our engineering database. The quantity of data collected under this program is much higher than with our fleet sharing program and requires considerable time to process and analyze. For this reason, we focus on recruiting participants who have interesting itineraries well off the beaten path and in a wide range of environments. The data help improve existing processing methods and algorithms and develop new ones. Users reap the benefits of these engineering efforts, fed by their contributions, through no-cost software updates that FarSounder releases multiple times per year.

Investing in these data collection programs and partnering with like-minded nonprofits aligns with the core value of our company to provide safety at sea. We want to ensure vessels and the ecosystem are safe from preventable accidents. Accidents occur partly because of lack of knowledge. We are doing what we can to help fill the knowledge gap with extensive, detailed mapping. **ST**

Review&Forecast

Advanced Acoustics Tech Safeguards Marine Mammals

By Brian Hernacki
Chief Technology Officer
Saildrone

Commercial energy activities such as offshore wind and oil and gas require persistent monitoring and mitigation for protected species, including dolphins, turtles and endangered whales. As the global demand for energy continues to grow, there has been a corresponding increase in the development of offshore solutions to help meet energy needs. However, it is important that the construction and operation of these sites don't negatively impact marine ecosystems. Marine mammals are highly dependent on acoustics to conduct important life functions, which also makes them sensitive to underwater noise.

Survey activities and construction produce potentially harmful underwater noise that requires continuous monitoring. Traditional visual and acoustic methods for monitoring marine mammals require protected species observers (PSOs) and passive acoustic monitoring (PAM) operators to be deployed offshore on vessels, increasing

the cost of operations and risk to personnel. The noise inherent to these vessels, and the activities being conducted, increases the challenges to detecting some marine mammal species. Alternatively, acoustic sensors are mounted on moored buoys, spatially limiting areas monitored. The buoys are also low to the water and, therefore, ineffective for visual monitoring.

Saildrone is working with RPS, a Tetra Tech company and leading provider of protected species monitoring and mitigation compliance services, to create a monitoring network using cutting-edge acoustic technology, uncrewed vehicles, and machine learning to detect, classify, and localize marine mammals.

Passive Acoustics Array

Designed for the Saildrone Voyager, Saildrone's passive acoustics package is a multi-frequency, multipurpose commercial sensing array to detect underwater acoustic phenomena. The hydrophone design, including frequency selection and spatial arrangement, has been specially configured to listen for whales, dolphins and other marine mammals. The advanced acoustic arrays Saildrone has developed, combined with RPS's machine learning, will detect and monitor the presence of marine mammals in real time to mitigate impacts on those species from human activities.

Saildrone and RPS began testing passive acoustics capabilities in summer 2023, with the first of four demonstrations, using the smaller Saildrone Explorer. Two vehicles were stationed in an area where several species of whales are known to be present. During the two-week





deployment, numerous marine mammal vocalizations were recorded, including a North Atlantic right whale, humpback whales, dolphins and others. Acoustic data were processed post-mission.

Two more demonstrations are planned for 2024, which will integrate the passive acoustics array onto the Saildrone Voyager. The ultimate goal is to integrate RPS's machine learning with the passive acoustics array to provide real-time alerts of marine mammal presence.

Saildrone's three USV models have been developed to balance mission payload flexibility and endurance. Saildrone vehicles are mobile and can be deployed anywhere, for unparalleled range and efficiency. From its origins in science and fisheries, Saildrone has expanded its capabilities to include ocean mapping, maritime security and defense applications.

Saildrone Voyager

The 10-m (33-ft.) Voyager carries an impressive payload for coastal mapping missions and an ISR sensor suite for defense applications, including a smart camera array and digital radar combined with onboard machine learning.

Saildrone vehicles leverage renewable wind power for propulsion, making them virtually silent, with a minimal or zero operational carbon footprint. The vehicle, combined with passive acoustic technology, allows users to gather vital information in a noninvasive and cost-effective manner. The mobility and endurance of Saildrone's

uncrewed platforms provide unprecedented monitoring capability, facilitating research, conservation and commercial enterprise.

The capabilities of Saildrone's vehicles have been demonstrated over the past decade, with more than 1,000,000 nautical mi. sailed and more than 32,000 days at sea for the combined fleet.

In fall 2023, the American Bureau of Shipping (ABS) issued the first-ever class certificate for a commercial USV to the Saildrone Voyager. One of the world's leading classification organizations at the forefront of marine and offshore innovation, ABS granted classification after an extensive review and evaluation process. The Voyager is the first autonomous asset built to ABS Class using the ABS Requirements for Autonomous and Remote Control Functions.

Classification is a major milestone for Saildrone, allowing the Voyager to operate in the ports and waters of countries that require vessels to be classed by organizations such as ABS. The achievement demonstrates Saildrone's commitment to safety, standardization, and reliability in its technology and operations.

By harnessing the power of renewable energy and autonomous technology, Saildrone is revolutionizing the way ocean data are collected and utilized for science, commercial, and defense applications worldwide. Saildrone's innovative solutions will play a crucial role in ensuring a responsible, sustainable, and environmentally conscious approach to expanding the blue economy. **ST**

international

Seabed 2030 Continues to Grow Network

The Nippon Foundation-GEBCO Seabed 2030 Project, the initiative leading the global effort to map the world's ocean floor by 2030, has added GeoAcoustics as a partner. Based in the U.K., GeoAcoustics has been a prominent provider of subsea sensors and equipment for over four decades. With the integration of powerful artificial intelligence (AI), its GeoSwath 4 bathymetric sonar offers real-time, quality-controlled data acquisition, reducing costs and survey time. The resulting streamlined workflows make it easier for organizations to share high-quality bathymetric data with the Seabed 2030 Project.

FarSounder has also become a partner of Seabed 2030 (see story in this issue). The company manufactures 3D forward-looking sonar (FLS) technologies and enables data sharing via the International Hydrographic Organization's Data Center for Digital Bathymetry, which archives over 30 terabytes of oceanic depth soundings and serves as the long-term archive for Seabed 2030.

Seabird Technologies is another new Seabed 2030 partner. This start-up is driving the development and adoption of electric foiling vessels. Through an exclusive partnership with the E1 World Championship, Seabird has developed the world's first electric foiling race boat.

Seabird Technologies' next generation of boats will be equipped to collect valuable data for the global seabed mapping project. The first E1 World Championship will take place February 2024 and will showcase the Racebird: the world's first all-electric race boat, capable of speeds up to 50 kt.

Danelec Acquisition

Danish company Danelec, a producer of electronic equipment for the maritime industry, has consolidated its market position in the voyage data recorders (VDR) sector with the acquisition of MacGregor's business in this field, including MacGregor's Maritime Data Engine (MDE) software. Danelec now has an installed base of about 16,000 units across its business areas of VDR, ship performance monitoring and IoT data collection.

ANB Adds Distributor in Singapore

ANB Sensors, the creator and manufacturer of revolutionary pH sensor technology that requires no calibration, has created a distributor agreement with Seraya Engineering Pte Ltd., a solutions provider for the petrochemical, wastewater, pharmaceutical, environmental, aerospace and semiconductor industries.

ANB's sensors are ideally suited for use in freshwater, saltwater and aquaculture applications.

Cable Protection Manufacturing Expansion

CRP Subsea, an AIS company, has made a significant

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53

investment to expand its polyurethane molding manufacturing facility to meet the increasing demand for high-quality cable protection solutions and enhance its capabilities to serve the offshore wind, oil and gas, seismic and telecom industries effectively. The investment involves the addition of two state-of-the-art semiautomatic molding presses to CRP Subsea's manufacturing facility.

The facility primarily supports the production of the Uraduct cable protection system and engineered moldings that play a crucial role in protecting cables used in demanding offshore environments.

Partnership to Tackle Plastic Waste

Aquapak Polymers Ltd., based in Birmingham, U.K., and specializing in polymer-based material technologies at scale, has established a Prosperity Partnership with the University of Birmingham to help tackle the plastic waste crisis. The three-year project, which brings together world leaders in their fields, is being funded by the Engineering and Physical Sciences Research Council, Aquapak, Siemens and the University of Birmingham, with a combined value of £1.7 million.

Most end-of-life plastics are either landfilled, dumped or incinerated, leading to the pollution of soil and waterways and the release of significant volumes of CO₂ into the atmosphere, thereby exacerbating the wider climate crisis. There exist two main alternatives to these environmentally damaging end-of-life options: replacing conventional plastics with alternative, biodegradable polymers, or increasing the recyclability of plastics. The Prosperity Partnership aims to bring both possibilities closer to widespread adoption.

New Member of One Sea

MAHI (*Sea Technology*, August 2022) has joined One Sea, an association whose mission is to advance maritime autonomous surface ships. MAHI is the fifth new member in the past 12 months. MAHI also becomes One Sea's first member from Belgium, adding to a list that now includes representation from eight countries across three continents.

MAHI is a spin-off of Project Mahi, a private initiative that began in 2015 and culminated in March 2022 with Mahi Two, the USV that became the world's first solar-powered autonomous vessel to cross the Atlantic Ocean. Following the success, members of the Project Mahi team founded MAHI to develop crucial components for unmanned and reduced crew vessels. The company's flagship product, MAHI Sense, provides full situational awareness and collision avoidance.

Methanol Retrofit UK Project

Cummins Inc. will jointly develop a methanol kit for its QSK60 engine as part of the Zero Emission Vessels and Infrastructure (ZEVl) competition, funded by the U.K. government and delivered in partnership with Innovate UK.

The £4.4 million in total funding will be leveraged by Cummins and its fellow project stakeholders—Ocean Infinity, the Aberdeen Harbour Board and Proman AG—in

the deployment of a U.K.-designed and -built methanol conversion kit for a high-horsepower marine internal combustion engine, offering the U.K. an important foothold in enabling the transition to cleaner maritime fuels.

Upon completion in the second quarter of 2025, the project targets a 50 percent reduction in CO₂ emissions for offshore operations of the vessel, with NO_x, SO_x and PM at levels considerably below those emitted by conventional fuel.

All retrofitted dual-fuel engines will achieve compliance with IMO Tier III emission standards.

Dredge Delivery for Philippines

The Philippines Department of Public Works and Highways has taken delivery of a 2023 IMS Model 5012 LP Versi-Dredge with WeedMaster cutterhead. The dredge will be used to cut and pump water hyacinths and other vegetation several hundred meters away to a remote discharge area in the Tulaoc River. This dredge will clear dense aquatic vegetation in urban environments without needing to rehandle it with multiple excavators or transport boats.

Water hyacinths' rapid growth traps debris and obstructs river flow, resulting in heightened flood risks that threaten aquatic biodiversity and foster disease-carrying vector breeding, a public health risk.

Intellian Expands in MEA

Intellian Technologies, a global provider of resilient multi-constellation, feature-rich satellite user terminals and communications solutions, has established a new Intellian entity in Dubai, covering all Middle East and Africa (MEA) regions. This entity is strategically positioned to cater to the rapidly growing needs of Intellian's distribution partners, gain insights into their evolving needs, and strengthen the brand in key areas across maritime and enterprise markets.

Seed Funding to Advance Hybrid Workboats

Glas Ocean Electric, a Canada-based company that designs and builds battery electric-hybrid drives for workboats, has received \$2 million in seed round funding from Ocean Zero LLC. The investment will support scaling up Glas Ocean's electric hybrid drive system that dramatically reduces CO₂ emissions, makes any boat more efficient and improves the marine environment.

Winner of NOIA ESG Award

The National Ocean Industries Association (NOIA) has named TechnipFMC as the winner of the second annual NOIA Environmental, Social, & Governance (ESG) Excellence Award.

The award recognizes those who, by their actions, design or influence, are contributing to the advancement of the ideals embodied by the NOIA ESG Principles.

From the integration of an ESG scorecard to the adoption of governance structures and the implementation of advanced management systems and standards to ensuring industry-wide adoption, TechnipFMC has demonstrated significant progress across all ESG segments. **ST**

NSF Grant to Develop Robot Swarm To Explore Beneath Ice Shelves

Oregon State University researchers will lead a team of scientists and engineers on a three-year, \$1.5 million project to develop and test a team of robots that could travel under ice shelves and collect critical measurements about the extent of ice cavities and surrounding ocean properties. The effort, funded by the U.S. National Science Foundation's Office of Polar Programs, is designed to help advance underwater exploration in confined and hard-to-reach environments.

Warming ocean conditions are causing polar ice sheets and ice shelves, which are floating extensions of ice sheets, to melt rapidly and contribute to global sea level rise, but studying the impact of this phenomenon poses a significant challenge for researchers who have limited tools to physically reach dangerous and deep, distant cavities beneath ice using existing tools.

The research team's goal is to develop a system with a large "mothership" robot that will carry and deploy a swarm of smaller passenger robots that could spread out and explore the waters under a melting ice shelf or other hard-to-access locations. The robots would operate autonomously and be programmed with decision-making ability based on conditions.

The proof-of-concept project includes building the deployment and recovery system for the parent robot and the swarm of passenger robots; developing hardware and protocols for communication and localization underwater; and navigation and decision-making algorithms that would allow the robots to adapt their behavior and data collection efforts based on the conditions they encounter. During the three-year project, the researchers plan to conduct a series of tests in water, including a frozen lake in Oregon.

The project resulted from a National Science Foundation-sponsored Ideas Lab workshop that brought together scientists from several disciplines, including robotics, polar science, oceanography and engineering, to brainstorm innovative solutions to advance underwater science.

Humanitarian Action Partnership

USAID and the U.S. Coast Guard (USCG) have a new partnership for coordinated disaster response operations and pre-disaster planning, activities, training, and exercises.

USAID and USCG have worked together to respond to international humanitarian disasters in the past, including in Haiti following the catastrophic earthquake in 2021. This new partnership will expand upon those prior successes, amplifying the U.S. government's ability to provide critical, life-saving assistance to vulnerable populations worldwide.

As the lead federal coordinator for international disaster assistance, USAID is committed to saving lives and alleviating suffering of people affected by crises and natural disasters around the world.

USCG's unique capabilities, including search and rescue, will prove vital in supporting USAID-led humanitarian responses.

This partnership will help ensure that U.S. humanitarian responses can continue to effectively and quickly meet the needs of the most vulnerable.

MARAD Funds Port Infrastructure

The U.S. Department of Transportation's Maritime Administration (MARAD) has granted \$653 million in Port Infrastructure Development Program (PIDP) awards, funding 41 projects in 26 states and one territory, according to the American Association of Port Authorities (AAPA). These grants range in size from more than \$54 million for a terminal expansion project in Port of Tacoma, Washington, to \$415,000 for the development plan of a 40-acre deepwater port in Wrangell, Alaska.

As awardees begin the necessary paperwork, AAPA urges Congress to streamline outdated and burdensome permitting processes by advocating for the introduction of AAPA's proposal, the Port Infrastructure Permitting Empowerment (PIPE) Act.

Grants Support Coastal Resilience Projects

NOAA and the National Fish and Wildlife Foundation (NFWF) have announced \$144 million in new grants to support natural infrastructure projects in 31 coastal states and U.S. territories. These grants will support design and implementation of projects to enhance the resilience of coastal communities and improve habitat for fish and wildlife. The 109 grants will generate more than \$97 million in matching contributions for a total conservation impact of \$242 million.

The projects supported by these grants will restore and create important coastal habitats, including salt marshes in New England and restored tidal wetlands in California, and will help Alaskan coastal communities prepare for a changing climate.

The grants were awarded through the National Coastal Resilience Fund (NCRF), a partnership between NOAA, NFWF, the Department of Defense, Shell USA, TransRe, Salesforce and Oxy. The NCRF supports capacity building and larger-scale planning, design, and implementation projects to help improve community and coastal habitat resilience and reduce risks and devastating impacts of rising seas, coastal flooding, and more intense storms.

Funding for this year's grants includes \$144 million for 109 projects provided through the Bipartisan Infrastructure Law, Congressional appropriations and private partnerships. These grants are in addition to the 27 projects totaling \$44.7 million announced in October, funded through the Inflation Reduction Act.

NFWF launched the NCRF with NOAA in 2018 at Congress's direction, joined initially by Shell and TransRe. The program supports projects to engage communities and reduce their vulnerability to growing risks from extreme weather, rising sea levels, flooding, and other coastal hazards through strengthening coastal ecosystems that benefit both people and wildlife. **ST**

3D Printing Advances in Shipbuilding

HII's Newport News Shipbuilding (NNS) division and General Dynamics Electric Boat (GDEB) have advanced efforts to integrate additive manufacturing technology, also known as 3D printing, into the shipbuilding process for nuclear-powered submarines. The use of certified 3D-printed parts has the potential to accelerate construction and delivery of submarines to the U.S. Navy by cutting lead times for critical components.

The companies have focused on the availability and deployment of marine-based alloys, such as copper-nickel, to provide an alternative to traditional copper-nickel castings. Recently, a copper-nickel deck drain assembly was identified as a candidate for the 3D printing solution. Working with shipbuilding partner GDEB, and supplier AMMCON on the model and proof of concept, NNS successfully created a copper-nickel deck drain part using additive manufacturing. AMMCON is providing final machining and assembly of the part before it is installed on *Virginia*-class submarine *Oklahoma* (SSN-802), to be delivered by NNS.

HVAC-R, CBRN Filter Systems For Dutch ASW Frigates

With Heinen & Hopman, Dutch shipbuilder Damen Naval has again found a Dutch supplier for anti-submarine warfare frigates. The company, based in Spakenburg, will supply the climate and filtration systems for the four new frigates being built for the Netherlands and Belgium. Following Thales and RH Marine, Heinen & Hopman is the third "home-grown" supplier for the project.

The scope of the contract includes a complete heating, ventilation, air conditioning, refrigeration system (HVAC-R). In addition, Heinen & Hopman will supply a chemical, biological, radiological and nuclear filtration system (CBRN) to protect the ship, and especially the crew, from chemical, biological or nuclear attacks.

Serco Continues US Anti-Terrorism Support

Naval Information Warfare Center (NIWC) Pacific has selected Serco Inc. for the Physical Security System-Enterprise Architecture (PS2-EA) contract to provide technology support services in support of anti-terrorism. Under the contract, Serco will continue to provide life-cycle sustainment of physical security/access control and command, control communications, and computers and intelligence (C4I) systems to ensure the continuous operation and advancement of the PS2-EA, previously known as the Anti-Terrorism/Force Protection (AT/FP) Electronic Surveillance Systems (ESS). Serco will also provide these services globally for the Pentagon at naval bases. The workscope covers installation, integration, testing and evaluation, maintenance, and supply/logistics support.

Riverine Patrol Boats in US Foreign Military Sale

Silver Ships has completed the construction of six riverine patrol boats (RPB) under a contract award from the

U.S. Naval Sea Systems Command. The vessels were designed and constructed as a part of the U.S. Navy Foreign Military Sale (FMS) program and will benefit a Pacific region ally. Each RPB was inspected and accepted by the Navy.

The six custom-designed riverine patrol boats are engineered to operate in shallow and hazardous waters. The rugged, 40-ft. center-console patrol boats are powered by twin Yanmar 440-hp engines and Hamilton waterjets. Traveling at more than 30 kt., the boats reach necessary speeds with limited operating noise in order to remain stealthy. The boats are armed and armored and can carry 20 personnel, or a typical crew of six with 14 additional troops and cargo. Riverine patrol boats are used for foreign and joint force operations on river, coastal and open-ocean patrol and interdiction duties.

Advancing Underwater Acoustic Communication

delResearch LLC, the creator behind the Popoto Modem brand of acoustic modems, has been selected by the U.S. Office of Naval Research (ONR) to contribute to the Physical and Networking Layer Prototype (PNLP) project.

The company's expertise in acoustic modem technology will play a crucial role in enhancing the U.S. Navy's capabilities underwater. The partnership with ONR is also expected to push the boundaries of what's possible for delResearch LLC, fostering innovation and elevating the state of the art in the field. **ST**

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Synthetic Rope

Defender Fuse complements standard mooring systems with an advanced overload warning system engineered to mitigate snapback situations. It can be added to any mooring system without line replacement. Defender Fuse absorbs energy within the entire mooring system, including the stiff, high-performance mooring lines common in the industry and their elastic tails. Samson Rope Technologies.

Intelligent Edge Automation

The ABS-certified FlexEdge platform, including controllers, sleds and modules, is the ideal industrial automation solution for marine and offshore applications, such as vessel water management and offshore oil rigs. It powers performance through real-time data access, visualization and remote access. Red Lion Controls Inc.

Underwater Welding Stinger

Broco BR-20 holds the welding electrode at the optimum angle to deliver quality welds and reduce diver fatigue. The movable jaw design allows for use with a wide range of electrode diameters. The BR-20 meets Mil-H-865D and is

approved for Navy use. BrocoRankin Inc.

Multibeam Echosounders

The PicoMB13X range features low SWaP-C for hydrographic survey on board man-portable USVs and small survey vessels, delivering superior quality survey data from ultracompact units. The range comprises the PicoMB131, PicoMB132 and PicoMB133. PicoMB132 and PicoMB133 come with an integrated INS. All systems are supported by industry standard acquisition and processing software: BeamworX, EIVA NaviSuite, Xylem HYPACK, Teledyne PDS and QPS QINSy. Picootech Ltd.

High-Pressure LNG Pump



HPP Triplex Unit is designed for two-stroke engines with three combined cold ends to enable lower fuel consumption and significantly reduced methane slips. Operational design pressure is 350 bar, and maximum working pressure is 380 bar. Minimum operating temperature is -163°C. Svanehøj Danmark A/S.

Coastal Mapping System

The next-generation Rapid Airborne Multibeam Mapping System, RAMMS 2.0, is the world's only airborne LiDAR that can deliver both full water column imaging and high-resolution bathymetry, making it ideal for accurately mapping, monitoring and modeling coastal environments. This information is critical for coastal hazard assessment and mitigation, marine re-

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Oyster Aquaculture Could Improve Potomac River Estuary
Oyster aquaculture in the Potomac River estuary could result in significant improvements to water quality, according to a new NOAA and U.S. Geological Survey study published in *Aquatic Geochemistry*. All of the nitrogen currently polluting the Potomac River estuary could be removed if 40 percent of its riverbed were used for shellfish cultivation, according to the study. [3-28/2015](#)

Navy's Laser Weapon Ready For Summer Deployment
Navy engineers are making final adjustments to a laser weapon prototype that will be the first of its kind to deploy aboard a ship late this summer. The prototype, an improved version of the laser weapon system, will be installed on the USS Ponce for a test in the Persian Gulf. Navy leaders have made direct-energy weapons a top priority to counter what they call asymmetric threats. [3-28/2015](#)

Ferry Sinks Off Coast of South Korea
With 463 passengers onboard, a ferry sailing from Incheon, South Korea, to the island Jeju sank near the southern tip of South Korea Wednesday, near the southern tip of South Korea. Most of the more than 400 people on the ship were high school students and people on the ship were high school students and people on the ship were high school students. [3-28/2015](#)

Pay Increase for Sailors Soon to Come
Sailors serving for the U.S. Navy could see a pay raise in the coming weeks, reported the Virginia Pilot. On May 1, sailors serving on the Virginia-class submarines will receive a pay raise. The increase in pay comes as an effort by the Navy to attract and retain sailors. [3-28/2015](#)

US Senate Reviews DOE Budget Request
For fiscal year 2015, the Department of Energy requested \$2.8 billion. The U.S. Senate Appropriations Committee, Subcommittee on Energy and Water Development, held a hearing last week to review the funding request and discuss financial priorities. [3-28/2015](#)

US Technology Helps in Search for Flight 370
More than a month after Malaysia Airlines Flight 370 went missing, crews are hard at work trying to uncover what happened to the Boeing 777. Acoustic signals emitted from the right, private jet, which crashed in the Indian Ocean, and other signals are being used to help find the plane. [3-28/2015](#)

2014 Sea Technology Buyers Guide Now Available
Published annually by Compass Publications, the 2014 edition of the Sea Technology Buyers Guide is now available. The Buyers Guide/Directory features a market analysis and seven sub-directories, including industrial firms, services, federal government organizations, educational institutions, oceanographic research vessels and geophysical survey vessels. [3-28/2015](#)

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source management, coastal engineering and navigation safety. Fugro.

Fleet Management Software

Updates to Nautical Systems will enable all maintenance-related processes to be managed from a single source. Procurement is simplified with easy price and lead time comparison. Compliance management features meet upcoming regulations. ABS Wavesight.

Marine Battery System



SEAGEN 11 is a Bureau Veritas type-approved modularized marine propulsion battery module system. The modularized system allows for flexibility of installation on board various marine platforms and in confined spaces, as well as ease of stringing up battery modules to meet different battery voltage requirements. Sea Forrest Technologies.

Fully Electric Offshore Vessel

SOV 7017 E is the first large offshore vessel to operate fully electrically. Equipped to charge offshore from turbines and substations, SOV 7017 E paves the way for zero-emissions offshore wind operations. Damen Offshore & Specialized Vessels.

Ship-Based Education, Training

KR-Real360, a 360° XR (eXtended Reality) program, has been developed to provide users with the educational information necessary for ship operation and maintenance

using the latest XR technology. Users can effortlessly locate educational resources, such as operation manuals, survey data and checklists, available in diverse formats, including images, text, PDFs and videos within the ship's virtual reality environment, crafted using 360° panoramic images. Korean Register.

Deepwater Coax Assemblies

Recent stringent testing has led to coax "1C" contact configurations of the popular Millennium connector series receiving certification for open-face pressure to 6 km. The new 40-cycle, open-face hydrostatic testing protocols yielded lower insertion losses at 8,800 psi and losses of only -0.35 dB at 3.0 GHz with a VSWR of 1.2. BIRNS Inc.

GNSS Receiver

MPS566 Modular GNSS heading receiver has applications for marine construction and drilling and piling operations. With built-in dual GNSS antenna ports and constellation-agnostic ProPoint technology, the

MPS566 delivers highly accurate positions and orientation for work that demands precise heading. With a ruggedized and compact form factor, the MPS566 consumes low power and has minimal cabling, all benefits when installation space is at a premium. Trimble Inc.

Internet-of-Things Router

SurfGate is a cloud communication and power-saving gateway router compatible with all types of IoT needs. In addition to conventional Ethernet, RS485/232 serial ports and wireless LAN, it can support EnOcean and BLE (Bluetooth low energy), providing a rich interface for connecting various types of sensors and actuators. Eco Marine Power Co. Ltd. and Surfwave Inc.

Hydroacoustic Software

Echoview 14 is the latest release that performs analysis and processing of data recorded from an array of echosounders and sonars in marine and freshwater environments. Echoview Software Pty Ltd. **ST**

Kongsberg Partner in Turkey

Kongsberg Maritime and BMA Technology have formed an alliance to support the supply of low-voltage electrical products and engineering services to Turkish shipyards.

BMA Technology will manufacture, assemble and test Kongsberg Maritime low-voltage electrical products in its facility in Turkey. The company will also provide engineering support and perform commissioning work on the products at local shipyards, working alongside the Kongsberg Maritime team in Istanbul.

NOx Reduction Solution

Damen Maaskant has delivered another pioneering technical solution for reducing nitrogen oxide (NOx) emissions. The 43-m *YE118*, owned by Yerseke 118 Noordland B.V., will now fish for razor shells with an electric propulsion motor; a second step toward the full electrification of this vessel.

Following the long-standing cooperation and successful technical modifications offered in 2015 for safety and catch quality, the two companies resumed working together two years ago on the challenge of reducing NOx emissions.

Autonomous Ships JV

Samsung Heavy Industries (SHI) and DNV have inked a memorandum of understanding to establish SHI's state-of-the-art Remote Operation Centre (ROC) for real-time monitoring and control of Maritime Autonomous Surface Ships (MASS). The collaboration will drive innovation and redefine the future of marine transportation. The joint venture (JV) will harness cutting-edge technology, including the Internet of Things (IoT) and cybersecurity platforms, and ensure safe and smooth operations. It will also explore remote assistance technologies.

First USV Classification

Saildrone has received the world's first marine classification for a commercial USV for the Saildrone

Voyager from the American Bureau of Shipping (ABS).

Classification is a major milestone for Saildrone, allowing the Voyager to operate in the ports and waters of countries that require vessels to be classed by organizations such as ABS.

Hydrogen Fuel Cell Approval

Nedstack Fuel Cell Technology, a provider of hydrogen fuel cell solutions, has received an approval in principle from Bureau Veritas (BV) for its revolutionary PemGen 600 containerized fuel cell system. This approval advances clean and sustainable power generation in the maritime industry.

The PemGen 600, powered by hydrogen, is specifically engineered to deliver efficient and reliable power generation while operating without emissions. The system generates a high power output and provides a robust and sustainable energy solution for marine vessels, ensuring a reliable power supply.

YGT Invests More In ESS Company

Yinson GreenTech (YGT) has increased its stake in marine industry energy storage solution (ESS) provider Shift Clean Solutions through the acquisition of all outstanding shares from TTB Holding, held by Shift's founders, Brent Perry and Paul Hughes.

Following the acquisition, YGT will become the single largest shareholder of Shift, with the remaining shares held by Shapoorji Pallonji and Delsys FZCO.

This acquisition will drive further innovation and commercialization of Shift's battery storage technology and accelerate Shift's ongoing expansion into new markets and geographies, solidifying YGT's commitment to drive decarbonization efforts across the industry.

YGT first collaborated with Shift in early 2021 on the electric passenger craft *Hydroglyder*, followed by the electric cargo harbor craft *Hydromover* later that year. In October

2021, YGT made an initial investment in Shift, and since then both parties have been collaboratively working to accelerate the large-scale rollout of Shift solutions in selected regions. YGT's continued investment in Shift is in line with its strategic plans to further strengthen its capabilities in energy storage solutions to create a holistic ecosystem of green transportation across land and sea.

Simulator for Finnish Maritime Training Facility

Wärtsilä will supply its latest simulator technology for a new maritime training center in Finland. The order has been placed by the South-Eastern Finland University of Applied Sciences (Xamk) and the Joint Authority of Education of Kotka-Hamina Region (Ekami). The simulator will be installed in Xamk's new campus in Kotka, Finland, where part of Ekami's maritime training will take place in the future.

The simulator will feature the latest versions of Wärtsilä's Navi-Trainer professional and Techsim simulation software, as well as the latest Navi Sailor and NACOS Platinum bridge systems. These include multi-pilot workstations for ECDIS, radar and conning applications.

The Wärtsilä equipment is scheduled for delivery in August 2024.

Danelec Expands AI Tech

Danelec has acquired Nautilus Labs' AI technology platform. Combining Danelec's onboard data-capturing ship performance capabilities with the AI-based analytics platform of New York-based Nautilus Labs, Danelec will be able to offer a comprehensive solution to accelerate the maritime industry's transition to high-quality, high-frequency data to support and accelerate the green agenda.

The combined suite will enable fleet efficiency, incorporating shaft power meters, digital data capturing and Nautilus Labs' AI platform, providing customers with valuable insight to optimize operations, realize savings and ensure compliance.

The acquisition is Danelec's third in two years. **ST**

environmental monitoring

Proposed LNG Site Study

ASL has completed a two-year wave and current study for Ksi Lisims LNG at a proposed LNG terminal site in northern British Columbia, Canada. The project is being conducted in cooperation with the Nisga'a First Nation.

A bottom-mounted TRDI ADCP was used to collect full water column current profiles, as well as hourly directional wave data. The pressure sensor on the ADCP provided water level measurements. A Seabird CT logger measured near-bottom temperature and salinity. Challenges included steep and rocky bathymetry, large tides, and adverse winter weather.

Servicing of the mooring was done every three months, and full data sets were collected, except for a few hours during each turnaround.

The data are being analyzed for seasonal variations, tidal currents, large wave events, wind forcing and extremal analyses.

Data Buoy for AI Modeling

A multidisciplinary data buoy platform manufactured by OSIL has been installed in Dublin Bay as part of the PREDICT multidisciplinary project. This project will provide a coordinated program of coastal ocean observations that will be used to validate, calibrate and extract as much information as possible from satellite Earth observation data as an experimental proof of concept, with the aim of generating AI models that can be used to predict environmental change in a range of environments.

The 1.9-m OSIL Fulmar buoy is recording and transmitting a variety of environmental parameters, including salinity, temperature, pH, partial pressure of CO₂, turbidity, dissolved oxygen and chlorophyll, in addition to a full suite of meteorological measurements.

Data from the buoy are relayed via GSM, with an Iridium satellite Short Burst Data backup. The data are immediately available to the public via a web portal, and data

from all sources will soon be publicly available on the easy to use PREDICT Data Portal. The environmental data are cataloged, mapped and displayed in an interactive web environment, facilitating collaboration and partnership planning.

The intention is to predict and assess coastal vulnerability by systematic and sustained monitoring of physical, chemical, and biological processes occurring in coastal zones by integrating mathematical modeling, remote and in-situ sensing, physical and chemical oceanography, and seabed mapping from various sources, including the Dublin Bay buoy. These models will then contribute to future planning in a diversity of applications, such as coastal mapping, flooding prediction, marine habitats and fisheries, climate change, environmental protection and policy.

The scheme has been funded by Science Foundation of Ireland, the Geological Survey of Ireland (GSI) and the Marine Institute.

The project is coordinated at Dublin City University, with principal investigators in Maynooth University, University College Cork and the GSI.

HAB Tech Among Winners of Collegiate Innovation Contest

An ocean technology solution has been chosen as one of the winners of the 2023 Collegiate Inventors Competition, an annual contest for college and university students and their advisers. The judges comprise U.S. National Inventors Hall of Fame inductees and U.S. Patent and Trademark Office officials.

The Arrow Electronics People's Choice Award, which comes with a \$2,000 prize, was given to NucleoTide of Duke University. Daniel Collins, with adviser Peter Nguyen, created this solution to efficiently monitor ocean health.

Over the past several decades, a combination of natural and human-caused factors has led to an increase in the frequency, duration, size and impact of harmful algal

blooms (HABs), with a global economic impact estimated at more than \$8 billion annually.

NucleoTide is a molecular diagnostic platform that uses CRISPR-based biosensors to rapidly identify marine pathogens and HABs.

With a low-cost, handheld device that filters and processes water samples, it enables lab-free, on-site ocean health monitoring and provides results in less than an hour, offering both economic and environmental benefits.

Citizen Science Uses FlowCam To Monitor Phytoplankton

Documenting ecological changes in Antarctica is critical, as the continent is experiencing some of the fastest rates of warming on the planet.

Because polar regions are, historically, the least-visited parts of the Earth, they are logistically challenging to monitor.

With polar tourism on the rise, one team of scientists is trying to overcome this challenge by enlisting the help of nonacademic travelers to document changes to phytoplankton communities over time.

Fjord Phyto is a citizen science project that brings together researchers interested in studying the relationship between melting glaciers and phytoplankton with tour operators who bring thousands of travelers to Antarctica each summer.

The program was born from a spontaneous meeting between researchers from Scripps Institution of Oceanography and polar expedition guides in Antarctica in 2015. Since then, it has grown into a NASA-funded plankton powerhouse that has engaged more than 4,000 Antarctic travelers in phytoplankton observation since the program's inception in 2016.

The project utilizes Fluid Imaging Technologies' FlowCam for Antarctic phytoplankton research. FlowCam is a precision instrument that rapidly acquires high-resolution digital images of particles, capturing data on particle count, size and morphology with flow imaging microscopy. **ST**

offshore oil & ocean engineering

Reimaging Tano Basin

CGG has started a major new multi-client 3D PSDM reimaging program in the Tano Basin offshore Côte d'Ivoire in association with the country's Direction Générale des Hydrocarbures (DGH) and national oil company PETROCI Holding.

The 6,400 sq. km reimaged seismic data set near the recent Baleine field will give interested industry operators unique insight into this high-potential new play. The project is supported by industry funding and expected to be completed by the end of 2024, with a fast-track volume available in the first quarter of 2024.

CGG will draw on its two decades of geoscience experience in Côte d'Ivoire to reimagine the 3D seismic data with its latest proprietary technologies, including time-lag FWI, QFWI and the potential application of targeted FWI imaging. The team will also conduct a regional interpretation of the project area to provide a better understanding of the distribution of the highly prospective clastic and carbonate plays in the Tano basin.

SENSFIB for FPSOs

Light Structures AS, a supplier of fiber-optic condition monitoring systems based on Fiber Bragg Grating (FBG) technology, has been awarded two contracts with YANTAI CIMC Raffles Offshore for the delivery of extensive SENSFIB hull stress monitoring systems for two Petrobras-commissioned floating production, storage and offloading (FPSO) units.

Representing the most extensive SENSFIB technology configuration available, the contracts for Petrobras P-80 and P-83 were secured via Light Structures' agent China Merchants Hoi Tung company, following another recent order of SENSFIB systems for eight LNG carriers. With production capacity of 225,000 barrels of oil per day, the FPSO units will be among the largest in the world when completed and deployed at the Búzios offshore

oil field in Brazil. The first SENSFIB system is scheduled to be delivered to the yard by the end of November 2023, with the second arriving in April 2024.

Identical in design and execution, the P-80 and P-83 FPSOs will feature innovations including carbon reduction technologies and digital twins that will provide Petrobras with high-fidelity virtual duplicates of the FPSOs to allow for remote simulation and testing that will secure operational safety, reliability and efficiency. The digital twins will be connected to live data from diverse sensors on the FPSOs, including the SENSFIB hull monitoring system, ensuring that any pre-operation checkouts provide accurate data for Petrobras engineering teams.

Offshore Substation Standards For Floating Wind

DNV has successfully concluded phase one of its joint industry project (JIP) aimed at establishing offshore substation standards for the growing floating wind sector. The collaborative industry effort has brought together 38 participating companies (including transmission operators; developers; component suppliers; engineering, procurement, construction and installation contractors; and yards) to tackle the distinctive challenges associated with floating offshore substations.

Floating offshore wind capacity is projected to exceed 260 GW by 2050, as per DNV's 2023 Energy Transition Outlook (ETO) research. Offshore substations play a crucial role in the scaling of floating offshore wind, serving as hubs to connect multiple wind turbines and transmit renewable energy to markets. Designing and implementing these substations present distinct challenges, including the need for high-voltage dynamic cables and electrical equipment that can withstand the movements of floating structures. With a focus on closing gaps in existing technology and standards applicable to floating sub-

stations, the JIP will help the wind industry meet its potential and contribute to the ongoing evolution of the global energy system.

The JIP's phase one primary outcomes include: affirming the feasibility of floating offshore substations and export cables, identifying technology gaps requiring attention, and highlighting the maturity of AC solutions compared to DC. The project also carried out a feasibility analysis for generic floater types and dynamic export cable concepts. Emphasizing a robust design process for optimized integrated floating substations, DNV plans to incorporate the JIP's findings in the next update of DNV-ST-0145 for floating substations and of DNV-ST-0359 for dynamic cables, both scheduled for 2024.

DNV is now initiating phase two of this JIP, where phase one participants and new participants will be invited to join. Phase two will build on phase one deliverables and input received from the contributors.

Geodata Survey off Namibia

Galp, a Portuguese energy corporation, has chosen Fugro to conduct an environmental and geophysical survey offshore Namibia. Known for its remote location, challenging conditions and ultradeep water, this site is key to future energy operations in the region.

Fieldwork has been completed, with the survey reaching depths of 2,000 m. The *Fugro Venturer*, a geophysical vessel, has collected sediment samples for environmental and chemical analysis before an AUV captured seabed video footage. Additionally, Fugro acquired in-situ, full ocean depth water profiles and water samples to measure the current biodiversity. The geodata collected through this survey will support the identification of potentially sensitive habitats, advance knowledge of remote seamounts, and contribute to informed project planning and resource management. The survey will also provide insights into the underwater landscape, ensuring the safe movement and operation of offshore assets in the designated area. **ST**

contracts

ANB Sensors, Cambridge, U.K., the creator and manufacturer of a revolutionary and ground-breaking pH sensor technology that requires no calibration, has signed a reseller agreement with a specialist in environmental monitoring systems. An-Hydre.

KVH Industries Inc., Middletown, Rhode Island, will integrate Cognitive's suite of enterprise-grade network and bandwidth management tools into KVH's mobile communication service offerings. Cognitive's software will become an integral element of KVH's multi-orbit, multi-channel marine communication solutions. Cognitive Networks Inc.

Kongsberg Maritime, Kongsberg, Norway, has entered into a collaboration agreement to identify and trial decarbonization technologies across Solstad's fleet. The agreement will also investigate the use of other new, digital technologies to drive operational efficiency. Solstad Offshore.

Maersk Supply Service, Lyngby, Denmark, has selected Fleet Data IoT platform to help optimize the performance of its first vessel battery installation onboard Maersk Minder Offshore Supply Ship in a solution which will also allow the owner to evaluate how best to optimize the use of zero-emission energy storage systems across its fleet. Inmarsat Maritime, a Viasat business.

BIO-UV Group, Lunel, France, has received an order to supply its BIO-SEA ballast water treatment system (BWTS) to a pair of drill ships by a United Arab Emirates-based offshore drilling contractor, a returning customer for BIO-UV Group. Undisclosed.

RMK Marine, Istanbul, Turkey, has begun construction of its very first sailing Ro-Ro vessel. The ship is due to enter into service in June 2025. Neoline Armateur.

Intellian Technologies, Paris, France, has renewed an existing strategic partnership. This agreement will continue to support the connectivity landscape across maritime, land and military sectors, delivering cutting-edge network solutions over the next five years. Marlink.

Hill's Ingalls Shipbuilding division, Pascagoula, Mississippi, has received a contract for follow yard support of the *Arleigh Burke*-class (DDG-51) destroyer program. This contract allows for the continuation of key technical management and support functions that enable coordinated production of DDGs under existing construction contracts. U.S. Navy.

SAFE Boats International, Bremerton, Washington, is collaborating on a fully electric patrol boat. The zero-emission 223e concept will enable working long hours at lower speeds. Vita Power. **ST**

meetings

FEBRUARY

February 5-7—Floating Wind Solutions, Houston, Texas. <https://float ingwindsolutions.com>.

February 11-13—Geo Week, Denver, Colorado. www.geo-week.com.

February 18-23—Ocean Sciences Meeting, New Orleans, Louisiana. www.agu.org/ocean-sciences-meeting.

February 26-29—Blue Innovation Symposium, Middletown, Rhode Island. <https://blueinnovationsymposium.com>.

MARCH

March 12-14—Oceanology International, London, U.K. <https://www.oceanologyinternational.com>.

March 24-26—Canadian Underwater Conference & Exhibition, Toronto, Canada. www.cuce.ca.

APRIL

April 9-11—Undersea Defence Technology, London, U.K. www.udt-global.com.

April 14-18—OCEANS 2024 Singapore, Singapore. <https://singapore24.oceansconference.org>.

April 16-18—Subsea Technology Eastern Mediterranean, Limassol, Cyprus. www.subseatechnologyconference.com.

April 17-19—NOIA Annual Meeting, Washington, D.C. www.noia.org.

MAY

May 6-9—Offshore Technology Conference, Houston, Texas. 2024.otcnet.org.

May 20-23—MTS Buoy Workshop, Sequim, Washington. www.mtsociety.org/buoy-workshop.

JUNE

June 10—Speed@Seawork, Cowes, U.K. <https://seawork.com/about/speed>.

June 11-13—Seawork, Southampton, U.K. www.seawork.com.

SEPTEMBER

September 17-19—South America Offshore Wind, Rio de Janeiro, Brazil.

NOVEMBER

November 4-7—EURONAVAL, Paris-Nord Villepinte, France. www.euronaval.fr.

November 7-10—Europort, Rotterdam, Netherlands. www.europort.nl.

November 19-21—MAST Australia, Adelaide, Australia. Mastconfex.org.

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

Ocean Census: Charting New Depths in the Era of Discovery—Kira Coley

Kira Coley is the head of communications for Ocean Census. For over a decade, she's been telling stories about human-kind's relationship with the ocean,



covering everything from underwater innovation to deep-sea exploration. She is a communications adviser and a member of the UN Ocean Decade Strategic Communications Group. Coley seeks to bridge the gap between the scientific community and the wider world.

Our planet's life forms a complex web within a grand, interdependent system. Human existence is not just a part of this dynamic biosphere; we depend on it for critical resources. Yet, we are witnessing an alarming decline in biodiversity.

The 2022 Living Planet Index report reveals an average decline of 69 percent in monitored wildlife populations since 1970, indicating the accelerating crises of biodiversity loss and climate change, driven by unsustainable human activity.

This decline highlights a striking gap in our knowledge: We have a better grasp of the galaxy's stars than the number of species on our own planet, estimated to be somewhere from a few million up to 100 million. The current species extinction rate is 1,000 to 10,000 times higher than the natural rate. If Earth indeed hosts 100 million species, we could lose 10,000 to 100,000 species every year.

An estimated 1 million to 2 million species inhabit our seas, yet up to 90 percent are undescribed, a glaring deficiency that exacerbates the biodiversity crisis.

Launched in April 2023 by The Nippon Foundation and Nekton, Ocean Census embarks on a mission to uncover the hidden biodiversity in the ocean. This groundbreaking initiative aims to identify 100,000 new species over the next decade: the most comprehensive

marine life survey to date. Building upon the historical achievements of the Challenger Expeditions (1872 to 1876) and the Census of Marine Life (2000 to 2010), Ocean Census's strategy includes global expeditions to collect specimens and gain new insights into marine ecosystems.

Central to this initiative is the cyber-taxonomy approach, which merges traditional taxonomy with contemporary techniques, such as DNA sequencing, digital imaging and machine learning. A "digital life form" is created for each specimen, facilitating and accelerating the classification and description of species by an expanding network of global taxonomists.

"Revolutions in technologies such as digital imaging, sequencing, and machine learning now make it possible to discover ocean life at speed and at scale," said Professor Alex Rogers, Ocean Census science director. "It currently takes one to two years to several decades to describe a new species after it is collected by scientists, but by utilizing new technologies and sharing the knowledge gained using cloud-based approaches, it now can take only a few months."

The program, with partners, will establish a comprehensive baseline of ocean life to advance scientific understanding and stewardship of our marine resources. Early achievements include pioneering expeditions to the Barents Sea, Johnston Atoll and Tenerife, which are only the beginning of a much larger journey of discovery.

The Ocean Census initiative is crafting a worldwide alliance uniting science, technology, and expedition partners with governments, philanthropy, and civil society from high-, middle-, and low-income nations, fostering a seamless exchange of knowledge and ensuring the equitable distribution of data, significantly enriching the global comprehension of biodiversity. By

digitizing data from specimen collections and constructing a sophisticated cyber-biodiversity system for data distribution, Ocean Census democratizes access to crucial biodiversity knowledge. This accelerates the discovery of species and invigorates global conservation initiatives, setting a new standard for collaborative scientific efforts, emphasizing knowledge transfer and skill enhancement, particularly in regions with limited resources. This ensures that local communities have the necessary tools for long-term research and biomonitoring.

The initiative is bolstering a global knowledge base to promote a culture of inclusivity, with open-source information. Reshaping the field of taxonomy by integrating digital imaging, sequencing and AI will quicken the pace of species identification to help us confront climate change and biodiversity loss.

"The beauty and diversity of marine life in the ocean is still beyond human comprehension, but as we explore and uncover what lies beneath the sea surface, we are constantly awed and delighted by new life forms," said Dr. Jyotika Virmani, Schmidt Ocean Institute's executive director. "Schmidt Ocean Institute is proud to be partnering with Ocean Census to accelerate our understanding of the incredible creatures that inhabit our marine world."

Ocean Census invites organizations and individual scientists to join this mission by co-developing and co-deploying technologies, contributing to the science network, and participating in expeditions and taxonomic workshops. Your involvement can protect the ocean's diversity, crucial for maintaining ecological balance and supporting human health and prosperity. By understanding marine life, we can harness its benefits, mitigate human impact and nurture resilient marine habitats for future generations: <https://oceancensus.org>. **ST**

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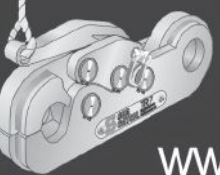
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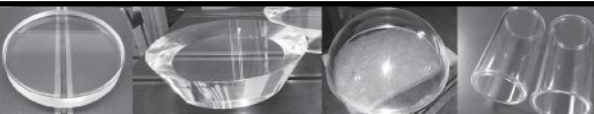
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OCEANS 2024 Singapore..... www.singapore24.oceansconference.org	53
SubCtech GmbH..... www.subCtech.com	43

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COVER IMAGE

U.S. Coast Guard Cutter *Healy* (WAGB-20) crew and researchers install equipment on a floe of multi-year ice in the Beaufort Sea, August 2023. *Healy* is the Coast Guard's only icebreaker specifically designed for Arctic research, as well as the nation's sole surface presence routinely operating in the Arctic Ocean. (Credit: U.S. Coast Guard, Briana Carter)

NEXT MONTH

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