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COVER—Vertical base surface overlaid on a combined RESON A/S (Slangerup, Denmark) Seabat 7125 multi-beam and Terrapoint (Hamilton, Canada) ALMIS-350 lidar 3D point cloud scene showing a quay wall section for an inspection survey for the Port of Quebec, Canada, in June 2011. The color scale's range is 3 meters. A good condition sheet pile section is visible on the left, a concrete delamination of about 1-meter thickness is in the middle, and an undermining of about 1.5-meter thickness is on the right. The no-data strip is due to a tidal shift between the multibeam and lidar acquisition times. (Photo Credit: CIDCO / Mosaic 3D, Canada)

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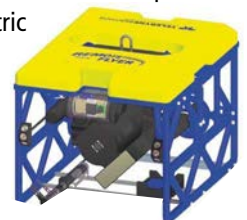
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Troubled US Waters Magnify Investment Needs

This past summer's drought, which has continued into winter, has reduced water levels throughout the Mississippi River Basin and its tributaries to historic lows and severely impacted commercial shipping traffic on the river—the main cost-effective transportation artery extending from the Great Lakes, through America's heartland to the Gulf of Mexico.

The 2012 drought has impacted shipping on the Mississippi River Basin by restricting vessel traffic, creating longer transit times, reducing vessel load carrying capacity, increasing vessel groundings, and creating impassable waterways and vessel logistics problems. Shipping rates have fluctuated widely as a result; other reasons being greater fuel needs, additional barges and increased labor to move the same amount of goods.

The typical tow on the Mississippi or Ohio rivers has 15 barges; a 1-foot loss of draft decreases the capacity of the tow by 3,000 tons. On the lower Mississippi, tows are larger, with 30 to 45 barges, and a 1-foot loss of draft results in a decreased capacity exceeding 9,000 tons, which is the equivalent of adding 130 tractor-trailer trucks to the highways or 570 rail cars to the train system. To maintain barge traffic on the river and its prime tributaries, the U.S. Army Corps of Engineers has taken extraordinary measures to deepen and widen areas of immediate concern by additional dredging and, in some cases, blasting rock river bottom.

Traffic on the Mississippi is just one example of how the system of inland waterways and marine ports plays a vital role in moving imported and exported goods through the U.S. In 2010, the cargo transported on the national system was valued at \$152 billion. More than 566 million tons of goods move through the system annually, more than half of which is coal and petroleum products.

Furthermore, more than 70 million metric tons of grain, soybeans and other food are transported within the U.S. each year via the system. With this amount of goods moving on the 12,000 miles of inland waterways, the impact of the 2012 drought is severe. According to the American Waterways Operators (AWO) association, a 1-inch drop in water level decreases the carrying capacity of a single barge by 17 tons of cargo. Losing 1 foot of a barge's draft results in the loss of 204 tons of cargo capacity per barge. Normally loaded 12-foot draft barges reduced to a 7.5-foot draft equates to losing about 54 trailers of goods per barge, according to AWO.

In addition to drought, the performance of the inland waterway system is threatened by scheduled and unscheduled delays caused by insufficient funding for operation and maintenance needs of the locks that govern traffic flow. A total of 90 percent of the system's locks and dams experienced unscheduled delays in 2009. According to the Army Corps of Engineers, maintaining existing levels of unscheduled delays on inland waterways, and not further exacerbating delays, will require almost \$13 billion in cumulative investment by 2020.

To remain competitive, U.S. marine ports and inland waterways will require investment beyond the \$14.4 billion expected over the next seven years. The American Society of Civil Engineers (ASCE) reports that with an additional investment of \$15.8 billion between now and 2020, the U.S. can protect \$270 billion in U.S. exports, \$697 billion in GDP, 738,000 jobs annually, \$872 billion in personal income and \$770 per year per household.

ASCE said that traffic on U.S. inland waterways is expected to increase by 51 million tons of freight from 2012, an 11 percent increase. By 2040, it is expected to exceed 118 million tons above 2012 levels, a 25 percent increase. To meet this anticipated growth, total public investment would have to exceed \$30 billion by 2020. This includes navigational waterway-harbors dredging and operations, and maintenance dredging for inland waterways and marine ports.

Inadequate and unbalanced investments in essential transportation infrastructure have serious implications. It is necessary to do the work and make available the funds to keep U.S. vital waterways and harbors open for commerce. The productivity and competitiveness of the U.S. economy depends on it. ■

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)) DNV, PSE Create Concept Design for Carbon Capture. Det Norske Veritas (DNV) of Høvik, Norway, and Process Systems Enterprise Ltd. (PSE) of London, England, have successfully developed a concept design for onboard chemical CO₂ capture as part of the Maritime CCS (carbon capture and storage) research and development project. Ship emissions are concentrated, unlike in other forms of transport, which allows for potential to capture CO₂ at the source. The system consists of a chemical absorption plant that separates CO₂ from flue gases, a liquefaction unit where the captured CO₂ is compressed and condensed using a refrigerant, and two storage tanks where the liquid CO₂ product is temporarily stored until discharge into transmission and storage infrastructures at the next suitable port. The results show that the concept is technically feasible and capable of reducing ship CO₂ emissions by up to 65 percent. For a very large crude carrier, this could correspond to capturing more than 70,000 tonnes of CO₂ per year, transforming them from emissions to a tradable product.

)) Belgium to Build Island to Store Energy. Belgium will try to decrease its reliance on nuclear power by building a doughnut-shaped island in the North Sea to store wind energy, *Reuters* reported. Electricity is difficult to store: "We have a lot of energy from the wind mills and sometimes it just gets lost because there isn't enough demand for the electricity," said a spokeswoman for Belgium's North Sea minister Johan Vande Lanotte. Water at the island's center would be pumped out using excess energy, and the water would reenter via turbines when demand outruns supply. The island could take five or more years to plan and build, and will be built out of sand 3 kilometers off the Belgian coast near the town of Wenduine. The island would also be an offshore substation for wind turbines. Before the project gets final approval, Belgium's power grid operator must strengthen the power lines leading out to the coast. Belgium plans to end its use of nuclear power when it amasses enough alternative energy. The country's North Sea wind farms are expected to eventually generate 2,300 megawatts.

)) Deepwater Capex Forecast at \$223 Billion for 2013 to 2017. As deepwater projects become more capital-intensive, there is an economic challenge for exploration and production companies but a significant potential prize for oilfield service and equipment vendors, according to a new report by Douglas-Westwood (Canterbury, England). A capex of \$223 billion is forecast for 2013 to 2017, and spending is to double, compared to the preceding five-year period. The "Golden Triangle" of Latin America, the Gulf of Mexico and West Africa will dominate deepwater expenditure over the next five years, and African developments, mainly in Angola, Ghana and Nigeria, and Brazilian projects dominate the forecast spending. Brazil is likely to experience substantial growth, exceeding Africa's deepwater expenditure towards the end of the forecast period, with activity driven by Petrobras' (Rio de Janeiro, Brazil) development of its pre-salt Campos and Santos fields. The viability of future prospects depends on continuing technological advances and increased cost-efficiency.

)) Upper Mississippi River Nears Record Lows. As a result of last year's drought, stretches of the Upper Mississippi River have approached record lows, the U.S. Energy Information Administration said. These low water levels have jeopardized commercial barge traffic shipping agricultural and energy commodities. Rock blasting and dredging by the U.S. Army Corps of Engineers, and expected rainfall should provide some relief. Key energy commodities transported via Mississippi River barges are coal and, increasingly, crude oil and distillate fuel oil. Large stretches of the Upper Mississippi have seen low water levels, although for the most part the Lower Mississippi River Basin has remained at normal water levels. Crude oil movements by barge and tanker between the Midwest and Gulf Coast in both directions averaged 55,000 barrels per day (bbl/d) during January through October 2012, up 14,000 bbl/d from the same period last year.

)) Lubchenco Looks Back at NOAA Career. Before Dr. Jane Lubchenco stepped down from her post as NOAA administrator at the end of February, she spoke with *Sea Technology* about her time at the U.S. agency. "We've been able to tackle some big issues and have accomplished a tremendous amount," Lubchenco said. She cited ending overfishing and rebuilding depleted fish stocks, helping create the National Ocean Policy and working toward a weather-ready nation among her proudest accomplishments at NOAA. Among her greatest frustrations was the economic battle against extreme weather events, each of which have caused at least \$1 billion in losses and strained national infrastructure during her time as the head of NOAA. Satellites are crucial to forecasting such events, but the tough economic climate has put pressure on their funding. As for her as yet unnamed successor, she would give this advice: "Respect, patience and determination are keys to success. The men and women of NOAA represent the nation's finest and most passionate scientists and professionals in their fields," so it is important to recognize their achievements and foster a sense of community and partnerships. Lubchenco is moving on to be the 2013 Mimi and Peter E. Haas Distinguished Visitor at Stanford University's Center for Public Service.

)) 2013 Declared the Year of OceanSTEM. The Maritime Alliance and the County of San Diego's Board of Supervisors in California have declared 2013 the year of OceanSTEM (science, technology, engineering and mathematics education). They hope to raise awareness and foster innovation in OceanSTEM teaching, learning and outreach. The initiative calls for numerous events throughout the year at various locations in San Diego County to celebrate the importance of science, technology, engineering and mathematics to the maritime community and the public at large. ■

A Pathway to Multithreat Assessment Through Integrated Multibeam Sonar

Combining Lidar and Bathymetric Data to Monitor Ports and Harbors

By Chris Malzone • Danny Wake • Jeff Bartkowski

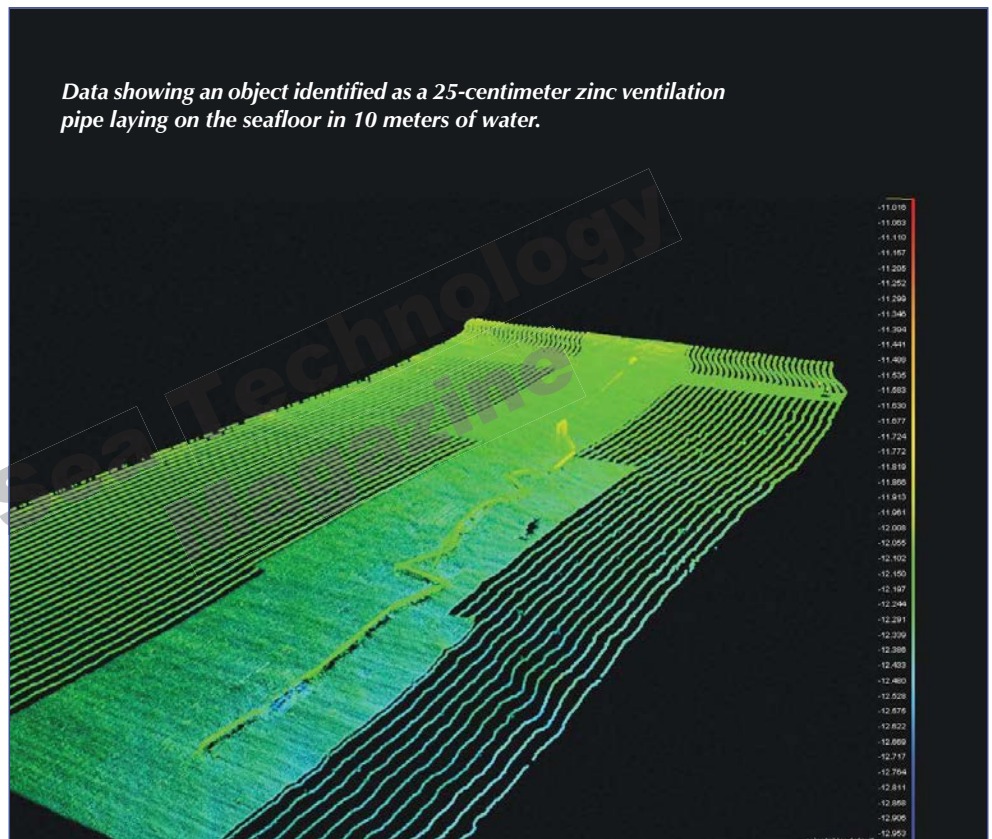
The use of multibeam echosounders for hydrographic applications is well-documented and has been widely accepted for decades. Improvements in resolution, accuracy, sampling rates, signal processing and software enhancements have further expanded the number of requirements that these sensors can address.

For instance, for Q-route applications, which ensure that navigable routes to and from ports are clear of dangers and obstructions, surveyors are now able to simultaneously collect the full water column information along with the bathymetry and seafloor imagery data (e.g., backscatter, snippets, side scan) to identify dangers on and above the seafloor. In ports and harbors, a single sonar can produce 512 soundings per transmission up to 50 times per second while also electronically steering the entire swath within 5 degrees of horizontal without having to physically remount the head.

Improvements in software have paved the road for vessel-mounted lidar systems to interface with multibeam systems and provide real-time 3D imagery above and beneath the water surface. Such innovations are providing valuable decision-making data for ports and harbors to better assess conditions within their infrastructure to enhance threat prevention and promote safety.

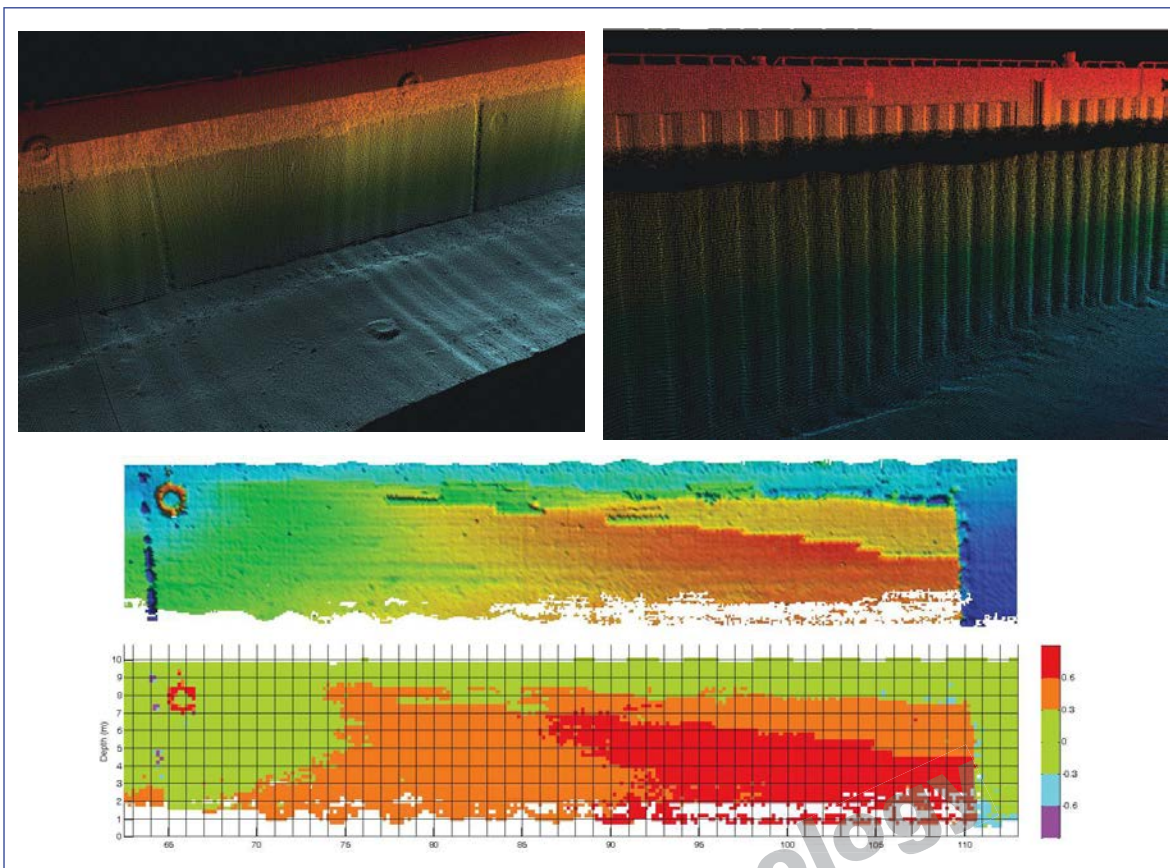
Applications and Solutions

The first commercial multibeam echosounder put into service provided 60 soundings per ping over a swath that was twice the water depth. These systems have evolved to provide more than 500 soundings per ping, with a swath more than 6.5 times the water depth, can acquire the quali-



tative backscatter data (seafloor and water column) and have doubled in resolution. To address the needs within a port or harbor infrastructure, multibeam technology needed to evolve beyond simply providing the geomorphology but to allow users to identify discrete targets both on and above the seafloor.

Since 2010, RESON (Slangerup, Denmark) has worked with local survey companies and port authorities to demonstrate how surveyors can collect full data-rate water column backscatter data while also obtaining the bathymetric and seafloor backscatter information with the 7000 series of its SeaBat multibeam echosounders. This feature was achieved through improvements to the sonar's electronic architecture, which combined the sonar-processing electronics with computing electronics. This increased the sonar's signal-processing capability to take advantage of



(Top) CIDCO quay wall survey in the Port of Quebec, showing integrated laser and multibeam information, as well as detection of object on the seafloor within short proximity. Beneath is a deformation map of the quay wall where green is zero deformation, purple is 0.6 meters of gouging, and orange is 0.6 meters of protrusion. (Credits: CIDCO)

(Right) Wedge display of the RESON SeaBat 7125 multibeam echosounder with Tracer activated. The screen shows overlay of intensity vales and color coded uncertainty information while using Flex Mode to track debris near the Port of Savannah. (Credit: EMC Surveys Inc.)

standard personal computer components, such as central processing units, video-card graphics processing units and RAM.

To address route survey requirements, including those for Q-route surveys, RESON introduced a programmable beamformer in 2010 that utilizes equiangular (EA) and equidistant (ED) bottom detection modes, separately or combined.

The use of EA and ED has been well-documented in literature, however, combining the two detection methods into a single swath is just now being implemented. A programmable beamformer allows the user to define the density of three sectors within the swath: two low-density ED and one high-density EA.

The density of each sector is user-defined and allows the operator to focus on obtaining the highest resolution over the primary route while also obtaining information in the secondary outer section of the corridor. This feature is called Flex Mode.

In a demonstration near the Port of Oslo in Norway in 2011, the operator detected 25-centimeter-diameter circular debris on the seafloor and, utilizing Flex Mode, obtained 155 soundings per ping within a 25-centimeter diameter while maintaining a 140-degree swath. Further, the operator can also implement beam steering of the entire sector, the high density sector or both to ensure the region of interest is always properly resolved.

At the Port of Savannah, Georgia, in January 2013, RESON implemented automation routines to further improve the efficacy of Q-route surveys. At the core of RESON's sonar automation is Tracker, which allows the surveyor to get high-quality data, regardless of seafloor substrate, without the need of constant supervision. It dynamically adapts sonar settings to the environment, ensuring the system is not oversaturated and bottom detection is optimized.

In addition to Tracker, RESON will introduce in 2013 real-time feature tracking that is activated when targets show a continuous trend (i.e., pipelines, cables, trenches, debris fields). This tracking algorithm is also designed to work the beam steering such that the sonar automatically maintains

the high-density Flex Mode sector over targets.

Combining Laser

First implemented for terrestrial mapping purposes in the early 1980s, lidar mapping has quickly expanded as a tool for morphological mapping from a variety of mounting platforms. Hardware advancements have led to lidar being mounted on small vessels, and software advancements have made it possible to integrate this high-resolution terrestrial data with multibeam bathymetric data.

RESON has demonstrated this combination at the Port of Constanta in Romania in 2010 with Shark Subsea Services (Constanta), the Port of Quebec in Canada in 2012 with the Centre Interdisciplinaire de Développement en Cartographie des Océans (CIDCO) and the Port of Savannah in January 2013 with EMC Survey Inc. (Grenada, Mississippi).

These projects inspected the ports' infrastructure, such as quay walls, bridge abutments, pilings and jetties, to assess their condition after continuous exposure to the elements and check they were clear of any addition-

“The combined use of lidar and multibeam allows for surveyors to view the condition of the quay wall in real time and also acquire quantitative information.”

al threat to port security. The surveys also monitored scour and detected debris entanglement. Another purpose of the projects was change detection for natural deterioration of infrastructure (i.e., quay walls), debris entanglement and threat identification.

Survey Setup, Calibration, Acquisition

The survey setup is straightforward consisting of a SeaBat 7125 multibeam echosounder either pole- or hull-mounted to the vessel, with the lidar mounted at a high point on the vessel, allowing it to scan to port or starboard.

Due to the high data rates and high resolution of the multibeam sonar (up to 50 hertz) and the lidar (10,000 hertz), it is critical that a high-precision motion sensor (0.025 degrees perfor-

mance or better) and inertial navigation system be integrated to ensure precise georeferencing.

RESON PDS2000 data acquisition and processing software provides calibration tools for all RESON multibeam systems and most lidar systems, including Applanix (Richmond Hill, Canada), Reigl (Horn, Austria), Optec (Vaughan, Canada) and Dynascan (Irvine, California). Once calibrated, the PDS2000 software is ready to acquire, display and store the corrected georeferenced topographic and bathymetric information while also displaying the bottom backscatter information in real time. It can acquire, calibrate and visualize lidar and multibeam data simultaneously.

Results

The most common use of this setup is for infrastructure inspection of quay walls and jetties. Quay walls are subject to two primary erosive factors: natural deterioration above and beneath the waterline due to constant exposure to saltwater and repeated contact with vessels during docking and disembarkment. The combined use of lidar and multibeam allows for surveyors to view the condition of the quay wall in real time and also acquire quantitative information.

Furthermore, the RESON SeaBat 7125 is capable of electronically steering the swath within 5 degrees of horizontal, i.e., within 1.85 meters of the surface at 1.5 meters transducer depth, such that the surveyor can obtain 100 percent coverage of the quay wall within one tidal cycle. For example, in the Port of Quebec, CIDCO performed an inspection survey of 6 kilometers of docks in eight hours, during which they ran two lines, simultaneously obtaining 100 percent coverage, and identifying cracks and bulges along the walls together with several seabed targets.

Upon completion of the survey, CIDCO then quantified the condition of

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the quay walls by comparing the measured surface to a vertical reference surface. The result provided information on protrusions and gouges in the seawall, as well as temporal markers for deterioration that can be used for scheduling maintenance and repair intervals.

Since the installation and calibration of the entire system is capable of centimeter-level precision, this same methodology can also be utilized to verify the presence of potential threats to vessel traffic along the wall prior to scuba inspection.

Pathways Forward

In Feature Pack 3, RESON implemented Tracer, an adaptation of the standard 3D waterfall display found in most data acquisition systems. However, with Tracer, the user is no longer required to initiate the data acquisition software since the display is built directly into the SeaBat user interface and can be overlain with the standard sonar wedge display.

Further, the backscatter intensity information (seen glowing around each bottom detection point) is retained within the wedge display while the user has the option to color code the detection points themselves based on depth, uncertainty (standard deviation quantification), quality or detection method (i.e., phase, amplitude or both). The color-coding is also present in the waterfall imagery, providing the user real-time 3D information of the morphology of the structure and variations in uncertainty that are often found as data either become less reliable or as materials change in composition.

As demonstrated at the Port of Savannah with EMC Survey Inc., implementation of the Tracer display allows system operators to utilize the acoustic response on materials as well as morphology changes along a structure to determine if a threat to overall integrity of port infrastructure is present.

Conclusion

The use of integrated multibeam and laser-based solutions for port and harbor applications can quickly obtain quantitative and qualitative information on infrastructures. The resulting information not only provides stunning imagery in real time, but also provides critical information for decision makers on the physical condition and presence of threats both above and below the water's surface.

Since multibeam sonars are widely accepted hydrographic tools, the same installation may be deployed for Q-route surveys as well as standard bathymetric surveys. ■

Chris Malzone is the vice president of sales for RESON Inc. His prior positions at RESON include field engineer, test and verification engineer, and scientific and autonomous applications manager. Malzone holds a master's in oceanography and geology and has more than 20 years of experience in the academic and private sectors.

Danny Wake is a senior product manager at RESON Inc. After graduating from the University of Glasgow with a degree in geomatics, he worked in the offshore survey industry prior to joining RESON in 2005, where he commissioned fully integrated multibeam hydrographic solutions. He lectures in hydrographic surveying at the University of Glasgow.

Jeff Bartkowski is the RESON Inc. sales manager responsible for the defense, homeland security and autonomous vehicle market sectors. After graduating with a master's in biology from Rensselaer Polytechnic Institute in 2005, he began his career in the marine technology industry focusing on the navigation and acoustic positioning of subsea vehicles.

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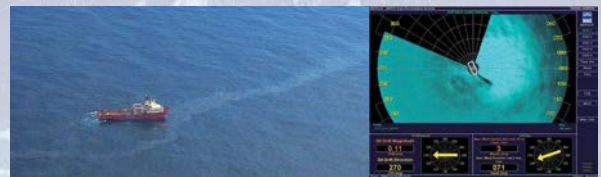
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Material Selection For Seawater Sensors

Nickel Superalloys Offer Optimal Corrosion-Resistance

By Karmjit Sidhu

Seawater attacks metals at varying water depths, resulting in corrosion accelerated by the different levels of oxygen, temperature, pH, salinity, chlorinity, biological activity, electrical conductivity and velocity flow rates present in seawater at various depths.

Sensors, including pressure and linear position sensors, are widely used for control and safety functions at various depth levels for applications in offshore platforms, desalination systems, mooring cables, seafloor wellheads, and oil and gas gathering systems. During operation, sensors can be submerged in seawater at varying depths, based on tides, up to 1,000 feet. To operate in these environments, sensors must be constructed from corrosion-resistant materials so that units can provide continuous information under hostile conditions.

As demand for sensors to be in contact with seawater and sea fog increases for applications such as loading systems, subsea mooring cables, control valves, chokes, desalination plants and platform stability, specifying sensor materials depends upon the proper selection of alloys suitable for the subsea application and service environment. Whether corrosion comes from varying seawater depth levels, galvanic effects or biological attack, matching the proper materials for service application is the top priority for good sensor performance over a long period of time. Material selection is also often affected by system-reliability requirements, availability, cost and manufacturability.

Seawater Characteristics Leading to Corrosion

Containing high levels of salts, dissolved oxygen, carbon dioxide and micro-organisms, seawater environments are highly corrosive. Corrosion rates vary by the combination of location, temperature and micro-organism activity. Stagnant or polluted waters are additional triggers that often promote sulfate-reducing bacteria (SRB) that can affect sensor materials' performance. The major constituents of seawater containing negative ions are chloride, sulfate, bromine and bicarbonate, while positive ions are sodium, magnesium, calcium and potassium.

Seawater increases localized corrosion of stainless steels and other active-passive materials as a result of dissolved chlorides and other salts. This type of corrosion occurs in the form of pitting, crevice or intergranular. The high electrical conductivity of seawater promotes macro cell corrosion and increases galvanic corrosion, which accelerates temperature rise as well, further promoting corrosion.



The pitting of a 316L pressure-sensor diaphragm 0.030 inches thick with less than one-month service near the Great Barrier Reef in Australia.

For instance, pitting occurred in an American Sensor Technologies Inc. (Mount Olive, New Jersey) 316L 0.03-inch-thick pressure-sensor diaphragm, with less than one-month service near the Great Barrier Reef in Australia. This was part of a desalination application where seawater was pressurized to approximately 1,500 pounds per square inch before being converted to drinking water. The unit was replaced with another product from American Sensor Technologies constructed of a nickel superalloy, Inconel 625, that was much more corrosion-resistant than 316L stainless steel in warm, shallow seawater.

Corrosion by Micro-Organisms in Seawater

Microbially induced corrosion (MIC) is a very serious problem that affects sensor operation based on different service conditions and materials used in sensor construction, especially low-grade austenitic stainless steels. It is a corrosion process involving material degradation that normally occurs on welded joints and leads to weld failure if not checked and treated in time.

In oxygen-rich environments, aerobic bacteria are active, while anaerobic bacteria can be found in low-oxygen environments. Bacteria can be described as slime-forming, acid-

“Matching the proper materials for service application is the top priority for good sensor performance over a long period of time.”

producing, iron-oxidizing, sulfate-reducing, and iron- and nitrate-reducing. There are hundreds of individual species of bacteria that form MIC. Colonies of MIC bacteria typically form local clusters on a sensor, with the location identifiable as a rough spot, inclusion site, corrosion site or cut on the material surface. These colonies, feeding on oxygen, iron and manganese, produce a sticky paste that lures a host of other biological and nonbiological species that, in turn, attack the sensor surface leading to crevices, oxygen- and ion-concentration cells to form, which results in corrosion.

SRB can be very corrosive and aggressive when environmental conditions are right for its growth, stimulating it to convert sulfate to harmful sulfide. To grow, SRB relies on acid-producing bacteria (APB), the main initiator of MIC. APB consumes oxygen and produces low molecular weight, organic acid and alcohol. It is this organic acid that SRB eat, which starts the process of producing hydrogen sulfide. The sulfide, acting as a cathode to steel, attacks the steel surface of a sensor in an electrochemical corrosion process and starts to consume anodic iron. This results in the pitting and creation of crusty tops or flakes on the surface of the sensor material. The process accelerates as seawater temperature ranges between 25° and 41° C, subject to location.

Titanium and nickel-based superalloys offer much better protection for sensors against localized corrosion. In some cases, Monel 400 and Monel K materials have been used successfully in shallow, warm waters, particularly in the Middle East and Africa.

Stainless Steels and Nickel Superalloys

Many common stainless steels, such as 304 and 316, should not be used for sensors that will operate in direct contact with seawater. Duplex steels with higher alloy con-

tent and pitting resistance equivalent factor (PREN) value greater than 40 have to be used as an alternative to stainless steel. However, this alloy does not guarantee long reliable sensor life in new deep-sea and Arctic applications.

For PREN calculations, the key elements of chromium (Cr), molybdenum (Mo) and nitrogen (N) are used as the weighted factor, with its multiplier to determine the overall value. The common formula used is: $PREN = \% Cr + (3.3 \times \% Mo) + (16 \times \% N)$.

Inconel 625 and Hastelloy C-276 are two primary alloys within the nickel superalloy family that offer excellent protection against corrosion due to higher content of nickel, chromium and molybdenum. These superalloys are the optimal choice for sensors, as well as all other critical components, when it comes to reliability and trouble-free operation for many years.

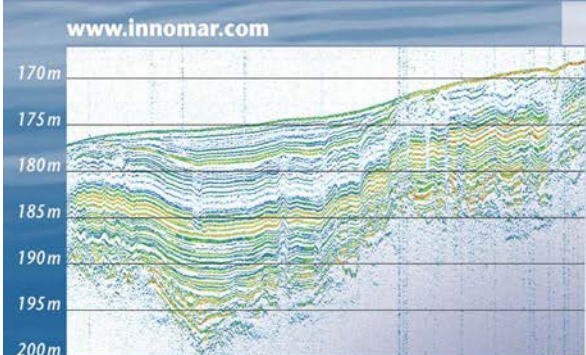
In comparison to stainless steels and duplex steels, these alloys cost more. However, they offer total immunity against localized corrosion, as well as oxidizing and reducing elements.

Conclusion

When specifying a sensor, it is important to consider the seawater environment, the location and the conditions in which a unit must operate. Materials must be carefully selected to withstand variable corrosion properties to ensure trouble-free operation. The long-term cost of ownership should be taken into account as some locations, particularly on the seabed, are not easy to access to replace failing sensors without spending a lot of money and downtime.

Choosing Inconel 625 or Hastelloy C-276 materials for sensors as an alternative to stainless steels and nickel alloys is best when working in seawater environments. ■

Karmjit Sidhu is the vice president of business development for American Sensor Technologies. He is responsible for business and product development for global markets for pressure, level and position sensor products utilizing cutting-edge technologies. He holds a bachelor's in electrical and electronics engineering, and a master's in industrial measurement systems from Brunel University, England. He is conducting his Ph.D. in material science at New Jersey Institute of Technology.



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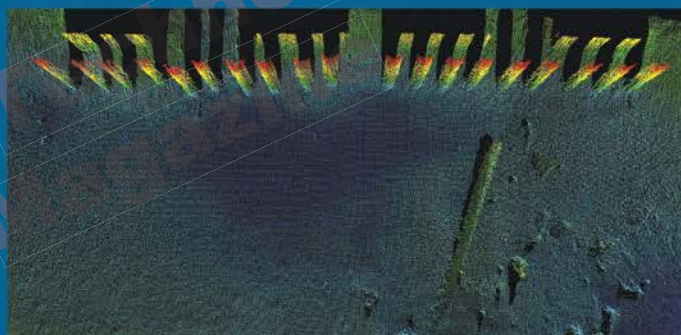
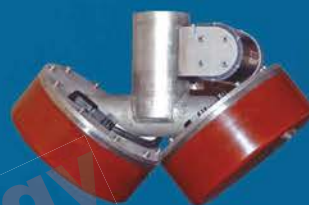
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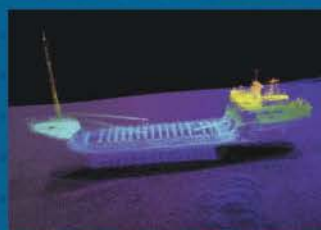
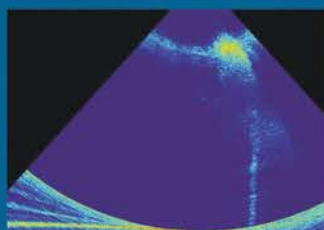
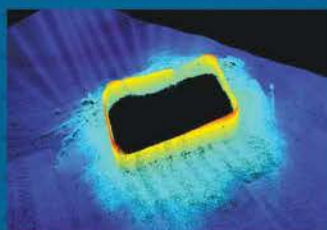
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WQM upon recovery;
significant bio-fouling along instrument but
clear optical window from use of Bio-wiper™



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SBE 16plus V2 SeaCAT CTDs
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Successful Capture of Ultradeep Sea Animals From the Puerto Rico Trench

Amphipods Recovered From 8,000 Meters With Robotic Vehicle System

By Nichola C. Lacey • Dr. Alan J. Jamieson • Dr. Fredrik Sørreide

On a deployment last year to more than 8,000 meters depth in the Puerto Rico Trench, a prototype robotic vehicle system, the 11k, recovered several samples of deep-sea animals (*Sea Technology* magazine, December 2012). The 11k, developed by Promare (Chester, Connecticut), also recorded HD video of the seafloor. The most conspicuous aspect of the footage was the swarm of benthic amphipods (crustaceans commonly known as hoppers), which rapidly accumulated at the bait tied to the vehicle. These amphipods, collected by small nets mounted on the 11k, are now being studied to further understand the fauna of deep trenches.

Amphipods are prolific scavengers in the deep sea, dominating the deepest trench communities. While the diversity of amphipods decreases with depth in each trench, their abundance increases exponentially. Therefore, at the

deepest points, large swarms of amphipods rapidly consume bait and are comprised almost exclusively of one species.

Exactly what species dominate any given trench appears to be trench-specific. Their survival at extreme depths is thought to be due to a combination of diet plasticity, rapid consumption of relatively large food parcels, incredible pressure tolerance and the ability to survive long periods of starvation, as they are very reliant on infrequent food falls descending from overlying waters.

Frame grab from the HD video recorded by the 11k, showing the amphipods on the bottom of the Puerto Rico Trench. (Photo Credit: Promare)



One of the recovered *Scopelocheirus schellenbergi* amphipods from more than 8,000 meters in the Puerto Rico Trench. (Photo Credit: Toyonobu Fujii)



Amphipod Location

The samples recovered by 11k were *Scopelocheirus schellenbergi*, a species of lysianassoid amphipod that have so far only been found in ultradeep trenches. They are typically found in the deep subduction trenches of the Pacific Ocean from the Aleutian Trench in the north Pacific and the Kuril-Kamchatka, Japan, New Hebrides and the Tonga-Kermadec trenches, which run down the western Pacific Rim. In these trenches *S. schellenbergi* has been found between 6,000 and 9,104 meters, the deepest of which came from the Kermadec Trench.

The interesting point concerning the presence of this species in the Puerto Rico Trench is that there is no direct corridor of equivalent depth between the north and western Pacific Trenches and the Puerto Rico Trench. This level of isolation offers a tantalizing question as to how the same species came to be in multiple trenches that are isolated from one another. Furthermore, the closest trench to the Puerto Rico Trench is the Peru-Chile Trench. Although thousands of amphipods were captured from 4,000 to 8,000 meters in 2010 by the Hadal Environmental Science Education Program (HADEEP), not a single *S. schellenbergi* was found.

Extending the Reach of Amphipod Research

S. schellenbergi was first discovered in the Puerto Rico Trench in 1948 when the Swedish vessel *Albatross*, under the leadership of Hans Pettersson, successfully bottom trawled between depths of 7,625 and 7,900 meters. Among other benthic fauna, the recovered amphipods were later described as *S. schellenbergi* by Russian scientists J.A. Birstein and M.E. Vinogradov in 1958.

In the mid-1970s, a deep trawl was conducted in the trench to 8,800 meters, whereby six amphipods were collected but unfortunately were not identified to species level. Similarly, two box cores from 8,560 meters were also obtained, recovering more than 30 unidentified amphipod samples. Given the abundance of this species from the 11k deployment, it is likely that many of these samples were also *S. schellenbergi*.

Technology capable of sampling at such depths is limited with two ROVs (Nereus at the

Woods Hole Oceanographic Institution and Abismo at the Japan Agency for Marine-Earth Science and Technology, or JAMSTEC), one submersible (James Cameron's Deepsea Challenger) and seven landers (four at Aberdeen University, two at the Scripps Institution of Oceanography and one at JAMSTEC). The 11k, particularly in its role as both AUV and ROV, adds to the global capability at these depths.

Future Research

The samples obtained by the 11k are of immense value to an ongoing sample archive. The HADEEP project has sampled multiple trenches around the Pacific Rim over the past six years and has successfully performed nearly 40 deployments of cameras and traps in five trenches from 4,000 to 10,000 meters (more than 30 of which are greater than 6,000 meters).

Among these data is now the largest collection of amphipod samples from the ultradeep trenches. These samples are now available for genetic sequencing, allowing scientists to examine the genetic connectivity between these incredibly deep and isolated habitats.

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“Technology capable of sampling at such depths is limited. The 11k, particularly in its role as both AUV and ROV, adds to the global capability at these depths.”

The species found in the Puerto Rico Trench has in recent years been again sampled from the Tonga-Kermadec and Japan trenches. The Puerto Rico 11k samples will help scientists to investigate the genetic and evolutionary connectivity between these isolated ultradeep communities.

The 11k will be deployed again in 2013. There are plans to begin production of a commercial version of the 11k system. A low-cost, easy-to-deploy, full ocean depth robotic vehicle system will allow for an increased exploration tempo in the deepest parts of the world's oceans.

Acknowledgments

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References

For a list of references, contact Dr. Fredrik Søreide at fredrik@promare.org. ■

Nichola Lacey is a Marine Alliance for Science & Technology for Scotland-funded Ph.D. student based at the University of Aberdeen's Oceanlab under the supervision of Dr. Alan Jamieson. Lacey's research is focused on understanding the ecology and physiology of amphipods inhabiting hadal depths at 6 to 11 kilometers deep.

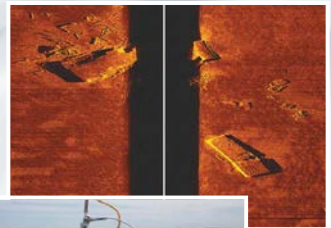
Dr. Alan Jamieson is a lecturer in marine biology at the University of Aberdeen, based at Oceanlab. His research focuses on the development of novel deep-sea technology for biological research at abyssal and particularly hadal depths.

Dr. Fredrik Søreide is the vice president of Promare and is responsible for its new deepwater exploration initiative. He is also a professor of marine engineering at the Norwegian University of Science and Technology. He has been involved in numerous marine scientific and exploration projects around the world.

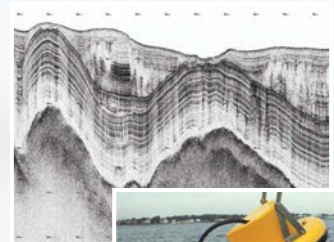
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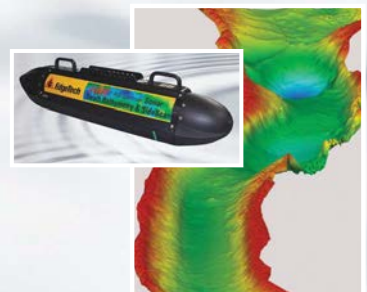
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AUV Designed For Marine Measurements

Small, Low-Cost Platform With ADCP, CTD for Water Profiling

By Liu Jie • Liang Jie



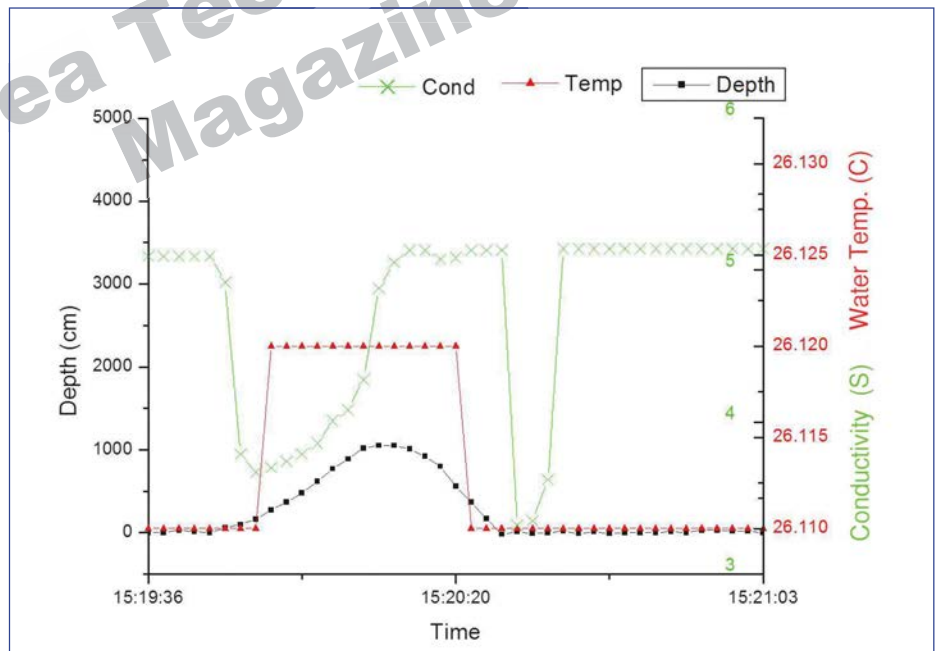
Designed to measure dynamic ocean environmental elements, a new AUV developed by the National Ocean Technology Center (NOTC) of China is a low-cost, small observation platform capable of underwater autonomous navigation and positioning. To measure current profile, CTD profile, water level and water depth, the AUV carries instruments such as an upward-looking acoustic Doppler current profiler (ADCP), down-looking ADCP and CTD.

Upon reaching a desired location, the AUV will sink and remain fixed in place on the seafloor to conduct continuous bottom-supported measurements. The AUV will then automatically ascend after a preset period and also conduct measurements during the return process.

When navigating on the surface, the AUV will transmit the acquired data to users via satellite. Users can obtain raw data from the AUV through a cable connection and process the data via NOTC software.

AUV Design

The AUV platform is 3.8 meters long and 0.6 meters high, with a diameter of 250 millimeters. There is a 100-millimeter-diameter, coupled ancillary chamber on each side of the torpedo-shaped main chamber. For stable bottom-supported



(Top) The AUV during testing in the South China Sea in December 2011.

(Bottom) CTD measurements during descent and ascent of the AUV in December 2011.

measurement, the AUV adopts a tri-body structure of a main chamber and two slender ballast tanks, all connected by four support legs. The main chamber of the AUV consists of compartments for oceanographic measurements, a battery,



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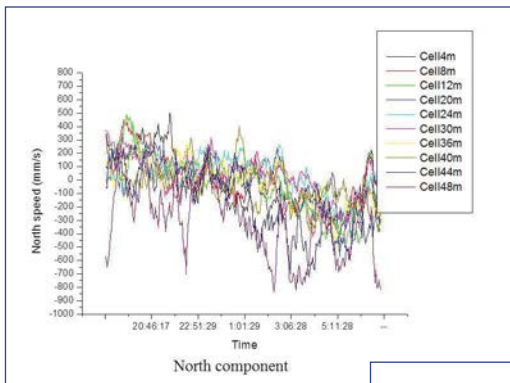
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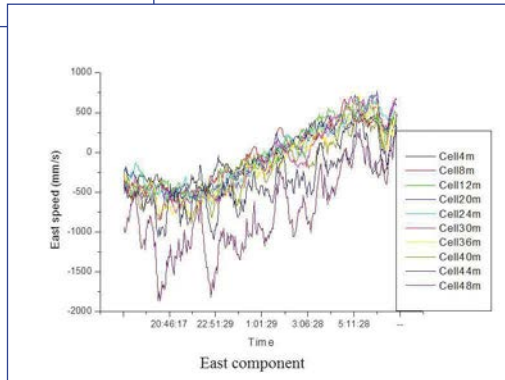
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The North and East components of the speed-time curve during December 2011 testing.



communications and propulsion. For reliable connections and sealing, these compartments are connected and sealed by clamps and reinforcing ribs.

Upon reaching the preset observation position, the AUV's water tank will be injected with seawater and then sink. When the preset rising time is met, the AUV can automatically rise from the seafloor through take-off-and-ejection-type load discarding.

Design factors such as the sensors' structure, layout, line shape and flow field analysis were taken into account. The design includes two main aspects. First, the CTD must be able to measure freshwater (if it cannot, the accuracy of measurement data could be affected) and have the ability to avoid bubbles caused by the vehicle's movement. However, simply installing the CTD on the AUV body would destroy the laminar flow field and increase the water resistance of the vehicle, so this had to be compensated in the design. A hydrokinetic fairwater cone was designed for the CTD, which was adapted to the nose shell of the AUV. Through this method, the effect of the CTD on the flow field is minimized.

Second, an ADCP needs a low-noise environment and immunity from the vehicle's navigation posture and movement-created bubbles. Like the CTD, the ADCP array would also increase the water resistance of the vehicle. To solve this problem, two fairwater cones were designed and installed around the upward and downward ADCPs; a design that proved to be effective in later experiments.

The AUV's control system adopts a field bus-based distributed structure and consists of a general control unit, a navigation control unit, a measuring and communication unit, a navigation and positioning unit, and a system-

monitoring unit (black box). Each one controls and manages corresponding instruments, equipment and parts, and cooperates with each other to realize respective functions under the control of the general control unit.

The AUV has wired, wireless and satellite communications. Safety measures include forward-looking sonar to detect and avoid obstacles, an acoustic beacon to send sound signals for vehicle tracing in case of an accident and a black box to record work processes and states.

Workflow

To meet the measurement requirements, the AUV adopts the trapezoid profile measurement mode and the bottom-supported measurement mode. The former is named after the shape the AUV creates relative to the sea surface when cruising. A whole profile includes water surface navigation, descending operation, underwater horizontal navigation and ascending operation.

The tracking, mission and other information will be input through the deck unit before deployment. The AUV will then carry out both the trapezoid profile measurements and bottom-supported measurements according to the information.

The AUV will make several vertical trapezoid profiles along the route for cruising measurements. When floating in the water, it will conduct GPS po-

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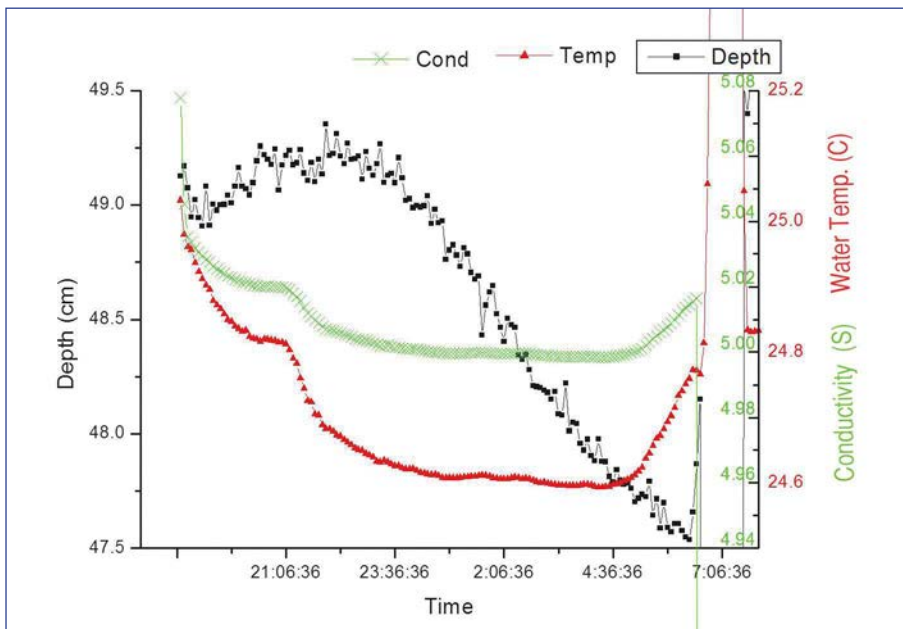
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The CTD curve during the bottom-supported measurement in December 2011.

site, the AUV will float on the surface and send the position information to users for recovery.

According to the designed measuring modes, the following information during cruising would be acquired: several CTD trapezoid data profiles within a depth of 100 meters along the route, with a minimum space interval of the profiles (maximum 400) up to 1 kilometer (much higher than the measuring line density of a research vessel), 100 layers of current profiles with the maximum range of 200 meters and a depth variation curve within

sitioning and pressure modification, and send the data via satellite. Upon reaching a preset position underwater, the water chamber will be injected and then sink to the bottom, where GPS positioning will be conducted again. Continuous bottom-supported measurement will begin when the AUV reaches the seabed.

At the preset rising time, the load will be released, and the AUV will ascend and make a return voyage. During the return, the platform will make cruising profile measurements along the original route. Upon reaching the recovery

200 meters.

In the bottom-supported measurement mode, continuous data at 100 meters depth for 72 hours can be obtained, including about 50 layers of current profiles, average depth of water, seabed temperature, conductivity and water level.

The variation characteristics of local tides and currents can be analyzed based on the data. Moreover, the water carried in the ballast tank of the AUV could be used as a sample for local water quality analysis.



Image courtesy of School of Ocean Sciences, Bangor



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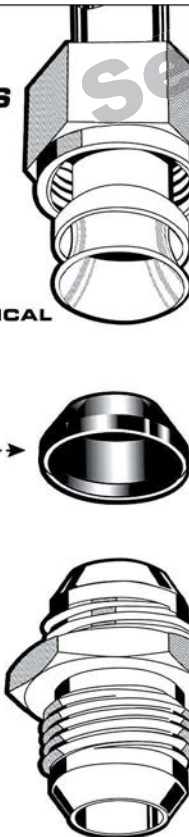


South China Sea Testing

The AUV was deployed for full-function testing in the South China Sea in December 2011, as a follow up to the first testing conducted in the Yellow Sea in September 2011. The AUV carried the following instruments: LinkQuest Inc.'s (San Diego, California) FlowQuest 300 upward-looking and down-looking ADCP, Sea-Bird Electronics Inc.'s (Bellevue, Washington) SBE 49 CTD, Imagenex Technology Corp.'s (Port Coquitlam, Canada) Model 881A digital profiling sonar and LinkQuest's TrackLink 1500 ultrashort baseline acoustic tracking system.

During the December 2011 testing, the AUV took 14 hours to complete the bottom-supported measurement stage, according to the preset time. The AUV adopted the trapezoid profile measurement and bottom-supported measurement modes, and finished all tests, such as water surface navigation, descent, submarine navigation, bottom-supported observation, rising at the set time, ascent and auto-return. The navigation posture was stable, and the platform traveled a total of 60 kilometers, with the maximum single voyage up to 32 kilometers.

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Underwater fixed-depth navigation measurements were conducted at 30 meters, with the duration of a single profile measurement at more than one hour. The bottom-supported observation at 49 meters lasted for 13 hours.

The current measurements at 4 to 48 meters depth (the surface layer) were obtained by the ADCP. The temperature and conductivity descended with the rise of the tide and reached the minimum when the tide was at its highest. With the ebbing of the tide, temperature and conductivity rose slightly, then increased rapidly.

From September to October 2012, the AUV underwent more sea trials in the northern waters of the South China Sea to further validate its design features. Conditions were six on the Beaufort wind scale, with a maximum wave height of 4 to 5 meters. The AUV, using the same instruments as during the previous testing, spent 74 hours conducting bottom-supported measurement at 105-meters maximum depth on a 103-kilometer course. Data were measured every 5 minutes, and a total of 886 data sets were obtained.

Conclusion

Testing demonstrated that the AUV developed by NOTC functions as a bottom-supported continuous-measurement vehicle, with variable buoyancy, self-localization and trapezoidal cross-section profile measurement. It can obtain data on ocean current velocity, CTD, water level and other environmental parameters.

Improving the applicability of the AUV and using higher-capacity batteries to increase its operational distance will be done in the future, if plans are approved by NOTC. The AUV will be used to observe marine environmental emergencies, such as oil spills. ■

Liu Jie is a senior engineer at the National Ocean Technology Center of China. He received his bachelor's degree in computer application from Tianjin Normal University in 1994.



Liang Jie is a professor at the National Ocean Technology Center of China. He received a bachelor's degree in oceanography physics from Ocean University of China in 1984.



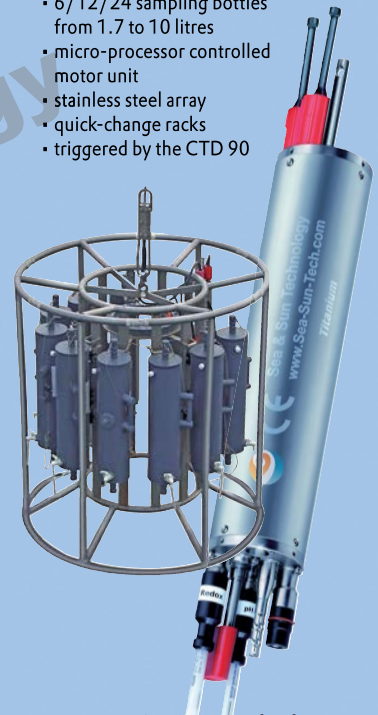
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Global Marine Renewable Energy Conference

The sixth Global Marine Renewable Energy Conference, or GMREC VI, is slated for April 10 and 11 at the Almas Temple in Washington, D.C. Last year's conference, at the same venue, attracted participants from more than 20 countries and brought together policy, regulatory and technology leaders.

GMREC will include updates from the Implementing Agreement on Ocean Energy Systems (OES-IA), the U.S. Department of Energy, U.S. National Labs, chief executives of global marine and hydrokinetic (MHK) renewable energy companies, major technology developers and MHK consulting firms from around the world.

Expected to attend GMREC this year are engineers and researchers; environmental analysts, scientists and biologists; attorneys and regulatory specialists; technology developers and innovators; investors and venture capitalists; federal, state, and local government policymakers and regulators; and nongovernmental organizations.

Marine Energy Technical Symposium

This year's conference will host the inaugural Marine Energy Technical Symposium (METS), which comprises 40 technical presentations by U.S. and international authors from academia, industry and national laboratories.

METS presentations will detail aspects of wave energy converter and water current turbine design, analysis and measurement techniques that have the potential to advance the scientific understanding of the technologies.

Panels and Conference Topics

At GMREC VI, attendees can expect to learn about updates on deployed projects, and lessons learned from deployments and other marine-based industries, including offshore wind, marine architecture, offshore safety and construction, advanced materials, metals fabrication and international standards development.

The first day of technical panels will discuss the state of water power research and development, and feature CEOs from companies that have won awards from the U.S. De-

partment of Energy. Other sessions will cover permitting, MHK in the northwest, the development of the U.S. and international MHK markets, reducing the cost of energy, and wave energy opportunities with the U.S. Navy and Department of Energy.

The second day of talks will examine technology and projects around the world, opportunities in other markets, capturing Gulf Stream energy in Florida, wave and tidal energy in New England, financing and supporting MHK in the U.K. and Ireland, projects in New Zealand, Australia and Canada, and investment opportunities in new technologies.

Speakers

Confirmed speakers include OES-IA Chairman Jose Luis Vilate from Tecnalia (Derio, Spain), a private technology center that is one of the main organizations devoted to applied research in Europe. Also confirmed is Jochen Bard from the Fraunhofer-Gesellschaft Institute, Europe's largest application-oriented research organization, and Henry Jeffrey from the University of Edinburgh.

The CEOs of U.S. tidal companies Ocean Renewable Power Co. (Portland, Maine) and Verdant Power (New York City, New York), along with the U.S. wave energy companies Columbia Power Technologies (Charlottesville, Virginia), Neptune Wave Power (Dallas, Texas) and Resolute Marine Energy (Boston, Massachusetts), will provide updates on their early deployments, commercial progress and lessons learned.

Another standout is John Huckerby, director of Power Projects Ltd. (Wellington, New Zealand), which collaborated on the Wave Energy Technology-New Zealand program (WET-NZ) that served as the first wave technology to be deployed at the Northwest National Marine Renewable Energy Center in Oregon.

Registration

For more information on the conference, visit www.globalmarinerenewable.com. ■



A Real Time Synoptic View Of Ocean Currents

Using Satellite Data to Compute Near-Real-Time Sea Surface Velocities

By Dr. Marc Lucas • Dr. Hélène Etienne • Dr. Eric Greiner

Getting an accurate picture of oceanic surface conditions is crucial for most seagoing activities. Traditional observing methods often only provide single-point data (i.e., a rotor current meter) or, at best, one-dimensional profiles (i.e., an acoustic Doppler current profiler, or ADCP) and require considerable effort to install and maintain, making it difficult to get a synoptic view of the ocean. This is a significant drawback as a synoptic vision is fundamental if the user is to get a feel and an understanding of the oceanic conditions in his area of interest, in a similar way to what has been achieved in meteorology.

Satellite data have gone a long way in providing this synoptic vision, with the introduction of very high-resolution infrared sea surface temperature and ocean color data. However, satellites do not provide direct measurement of ocean currents, which is the variable that is of greatest interest. In recent years, numerical models have been developed to answer this need, but, in spite of advances in data assimilation techniques and resolution, the scientific complexity and numerical cost often mean that they fall short of the end user's expectations.

Therefore, there is a need to develop a method where satellite data can provide an operational delivery of current data in a given region. To this end, CLS (Ramonville-St.-Agne, France) created the Hybrid Current System (HCS), which incorporates relevant and available satellite data in a way that is made to be easily deployable, relocatable and computationally inexpensive. This system is designed to answer the need for ocean surface currents in hindcast as well as in forecast situations.

Hybrid Current System Design

The HCS combines fluid dynamic equations with near-real-time satellite observations and 3D ocean general circulation model (OGCM) analysis to provide the user with a three-day forecast. Data are introduced into the model using spectral nudging techniques and damping coefficients. Depending on the available data, each model's variables (e.g., velocity, meridional velocity, model layer depth) are damped on different spatial scales. The high-resolution velocity of the model comes from satellite

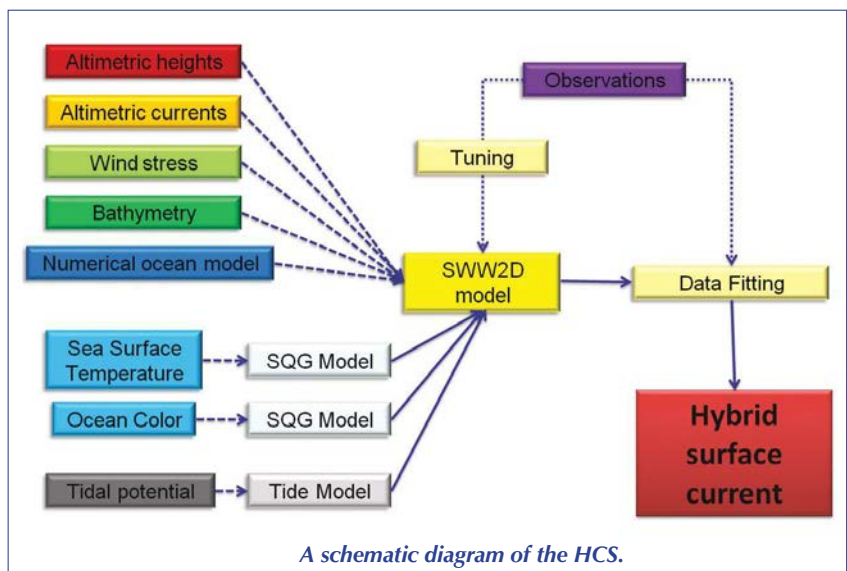
measurements, and the mesoscale is derived from a combination of OGCM and satellite altimetry data. A global tide model is used to add the tidal component. To calibrate the model parameters, in-situ data are drawn from drifting floats and ADCPs, which, in this case, included CLS's MAR-GE/T drifters and the Teledyne RD Instruments (Poway, California) 300-kilohertz Workhorse Monitor ADCPs. Data from tidal gauges can also be used to improve the tidal model.

The HCS is fully dependant on the quality of the input data used to constrain and force the model. Drifters or any current measurement data can be used in order to correct the produced current forecast in an a-posterior treatment. The final field is often more realistic and closer to the observations, with a more accurate positioning of dominant features, such as eddies.

Data Sources

An important feature of the HCS is the access to multiple sources of data. Depending on the specific area chosen, different products will be used to represent specific scales of the dynamics.

Satellite data offer numerous advantages over traditional ocean observing techniques, such as offering 2D spatial coverage, being nearly global and remaining unaffected by issues such as the remoteness of the location or the local



A schematic diagram of the HCS.

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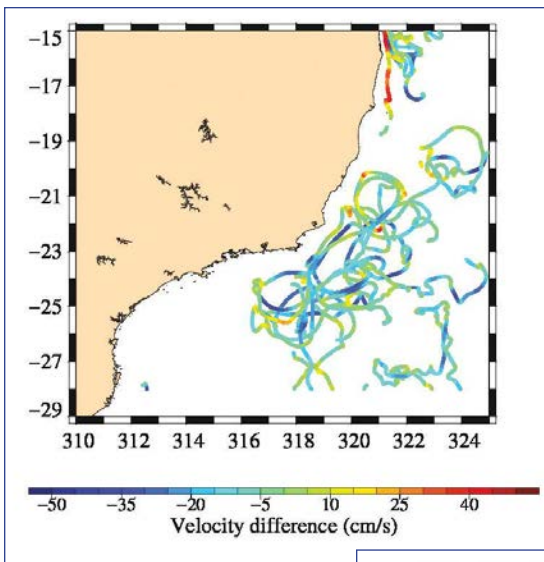
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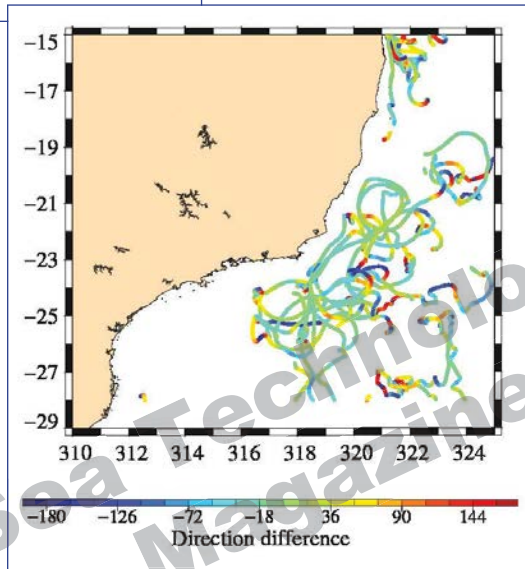
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The Campos configuration comparison with drifter data and current module (top) and direction (bottom).



weather conditions (although cloud cover can be an issue). Satellite data time coverage is also better, as the data are often continuous, with time series going back as far as 20 years. In addition, the resolution of satellite data is very high and able to reach down to a few meters for synthetic aperture radar imagery, although it is often in the range of a few kilometers for most products. Furthermore, the near-real-time delivery of the data takes a few hours, which is quicker than the characteristic time scales of many ocean phenomena.

Two aspects of the data determine its suitability for use by the HCS: quality and availability in real and near-real time, and in forecast modes. Hence, if consistent with the HCS's needs, priority is given to these data sets in operational mode. There are three types of data used in the production of the HCS currents.

Satellite Data. Satellite data are used to provide information on the large-scale circulation (altimetry data, often from CLS's Aviso Web server) through the geostrophy calculation. It is also used to give information on the small-scale features, such as sea surface temperature and ocean color data, through the surface quasigeostrophic approach. Sea surface temperature and ocean color data are operationally produced at CLS.

Model Data. Three types of model data are used in the HCS: Ocean, atmospheric and tidal. Ocean model data provide boundary conditions and information on the large-scale veloc-

ity intensity distribution, often from the Mercator Ocean (Ramonville-St.-Agne) model but also from regional models when available. These operational models use in-situ observation and along-track satellite data, such as altimetry.

Atmospheric data are used to calculate the wind-driven part of the flow, often from the European Centre for Medium-Range Weather Forecasts (ECMWF) model and from available local configurations.

Tidal model data from a global CLS-run tidal model gives the tidal currents.

In-Situ Data. Ocean in-situ data from ADCPs, rotor current meters or drifting floats are used to configure and validate an HCS configuration. CLS has developed and maintains a database of all available drifters' data from France's Coriolis data center or Argo float program.

Atmospheric in-situ data can be used by the HCS to determine the wind-driven part of the circulation.

Campos Configuration

The Campos configuration, extends from 29 to 14 degrees south and from 50 to 35 degrees east along the Brazilian coast. The bathymetry of the Campos configuration comes from a one-sixtieth-of-a-degree CLS database. The time step is 600 seconds. For storage reasons, the output frequency was set to one hour (in theory, it could be set to 10 minutes). The Campos configuration is run from March 2010 to March 2011.

Inside the Campos domain, the wind-driven part of the circulation is calculated from ECMWF six hourly fields. The large-scale and coastal circulation are altered through a restoring to the daily Mercator Ocean (St.-Agne) PSY4V1 velocity fields. Ocean color data from the CLS-generated fields provide information on the smaller-scale features such as eddies and plumes.

Validation Results. The HCS Campos outputs are compared to drifter's observations. Comparisons are made along the drifter's tracks and at the drifter's time step. In the following validation, prior to any comparison, the HCS model outputs are interpolated at the drifter's hourly positions, averaged over three days and compared to the three days filtered drifter data at these positions. This is necessary to remove from the drifter data inertial oscillations due to the Earth's rotation (and, hence, not the result of oceanic currents).

Statistics are computed along the drifter's tracks and at the drifter's time step. Thirty-six drifting buoys have trajectories passing through the area during the one-year period from the beginning of March 2011 to the end of February 2012.

The mean speed difference is about -2.8 centimeters per second, indicating that the HCS slightly underestimates

the surface current strength. The RMS difference is 13 centimeters per second. Considering the current direction, the mean difference with drifters is about -3.4 degrees with a root mean square difference equal to 73 degrees.

In one area, the direction differences were greater than 45 degrees, which corresponds mainly to the northern open boundary. The same differences can be found in the input data set used to specify the surface current through the open boundary. In other words, the difference with the drifter data is not only due to the HCS but also to the boundary forcing data used. In the interior, the features showing greater direction differences with drifters correspond to mesoscale pattern, mostly eddies. They are in most cases slightly shifted from their observed positions.

The maximum speed of the drifters is about 0.7 centimeters per second, whereas the HCS reaches 0.68 centimeters per second. Generally, the underestimation is not very important for the higher speed range. It can reach 16 percent of the drifter's velocity for HCS velocities between 0.2 and 0.4 centimeters per second, which is a reasonable result.

Conclusions

Recent developments in the area of satellite technology, data processing and delivery mean that high-quality information on oceanic surface features is now routinely available. Crucially, velocity data is not directly available. However, it can be easily calculated from oceanic surface fields. With this in mind, CLS has developed a method to obtain surface currents data based mainly on satellite observations and combining shallow-water equations with restoring to observed velocity fields. Initial results show a significant im-

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provement to the traditional modeling method, particularly in coastal areas.

The flexibility of the method means that the HCS can easily incorporate tailored data for a given area, such as regional altimetry data, regional OGCM data and regional atmospheric model data. New satellite data products, such as sea surface salinity, can also easily be incorporated in the system and improve the representation of currents, particularly in the vicinity of river plumes. Finally, in-situ data from ADCPs, rotor current meters and drifting buoys can either be used in hindcast mode to tune the HCS or in forecast mode for data fitting.

One of the principal strengths of this approach is the low numerical cost. The simulations can be performed quickly in view of the reduced number of grid points. This opens up the possibility of performing stochastic experiments (ensembles) on an operational basis, thus providing users with probability-based forecasts for surface currents, a fundamental requirement for any drift model forecast.

Acknowledgments

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References

For a list of references, contact Dr. M. Lucas at mlucas@cls.fr. ■

Dr. Marc Lucas oversees CLS's operational modeling as a project and research engineer. He develops, sets up and runs numerical models and data-processing tools. He also regularly conducts metocean studies, and research and development involving satellite data. He completed his Ph.D. in numerical modeling in 2005.

Dr. Hélène Etienne completed her Ph.D. in data assimilation in 2003. Since then, she has worked in collaboration with Mercator Ocean in the field of operational oceanography. In the last few years, she has developed and implemented numerical modeling in surface and 3D configurations at CLS, where she works as a research engineer.

Dr. Eric Greiner, a research engineer at CLS, completed his Ph.D. in numerical analysis in 1993 and has worked in the field of numerical modeling since. For the past 10 years, he has been in charge of scientific innovation in operational modeling and validation. He collaborates with research institutions around Europe.



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Public-Private Partnership on In-Situ Measurements in the Gulf of Guinea

By Dr. Rémi Estival • Valérie Quiniou • Christophe Messenger

In-situ measurements are crucial for remote-sensing observations, and hindcast and forecast modeling. Hence, in-situ data are often used to calibrate and correct satellite data, or they are merged and processed with other in-situ data and remote-sensing observations to improve the quality and coverage of environmental monitoring. These data are also used to improve global Earth modeling. For instance, the National Centers for Environmental Prediction and the National Center for Atmospheric Research (NCEP/NCAR) Reanalysis 1 project incorporates observations and model outputs to provide a gridded data set of atmosphere parameters over large regions.

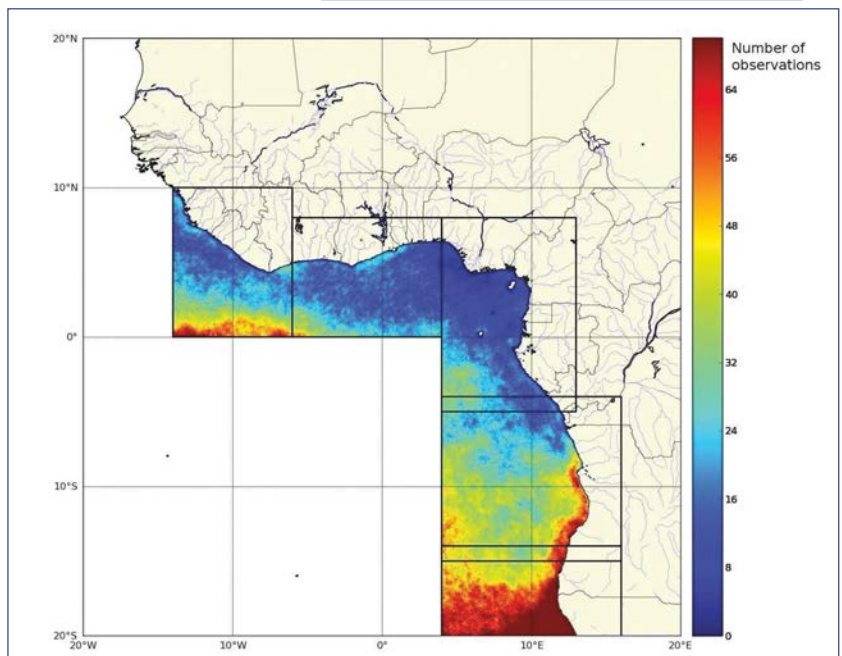
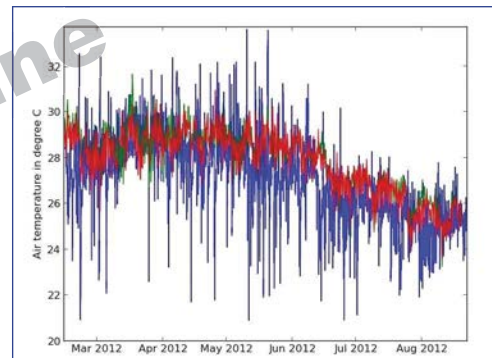
For modeling, in-situ data are used to analyze or validate ocean and meteorological model outputs. They can also be assimilated to correct the model locally (as for the NCEP/NCAR reanalysis) and serve as initial and boundary conditions. Therefore, the reliability of the simulations or reanalysis products often depends on the quality and amount of data in the monitored area. However, access to these data as soon as they are collected is a real issue when it comes to forecast quality.

Lack of In-Situ Measurements in the Gulf of Guinea

The Gulf of Guinea is located in the equatorial East Atlantic Ocean, between Cape Lopez in Gabon and Cape Palmas in Liberia. In this instance, it is considered also to include Congo and northern Angola. This tropical region benefits from a high level of incoming solar radiation with an important meridional

gradient of temperature, enhanced between the ocean and the continent. These irregular surface energy distributions induce regional and subregional low-level atmospheric circulations.

Moreover, the ocean gains heat from solar flux, which is released mainly through latent heat (evaporation) fluxes to the atmosphere. This contributes to high cloud coverage in the area, which is the major limiting factor to the use of remote sensing. In 2011, between Guinea and Angola, around 90 percent of NASA's Moderate Resolution Imaging



(Top) NCEP/NCAR reanalysis of Total's Usan platform air temperature at 2.5 degrees north 5 degrees east (green), 2.5 degrees north 7.5 degrees east (red) and 3.17 degrees north 6.83 degrees east (blue).

(Bottom) A map of the number of sea surface temperature observations from the MODIS satellite in 2011.

Spectroradiometer (MODIS) data were obscured by clouds. The MODIS satellite has provided on average less than one observation every two weeks in 2011 because the area has cloud cover most of the time.

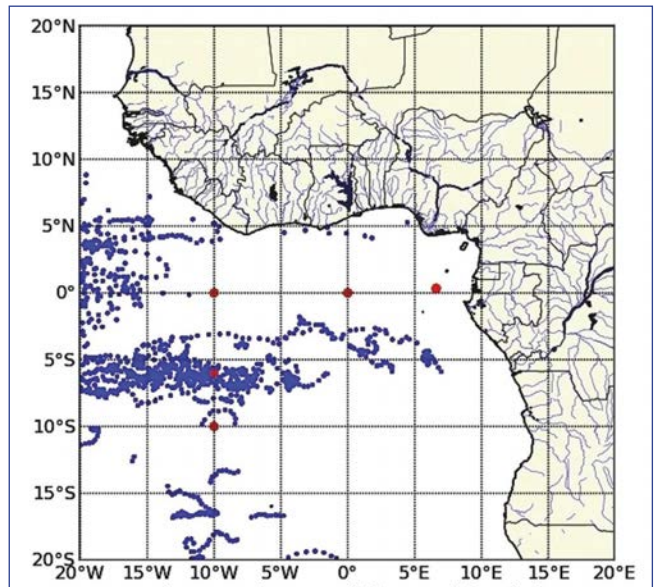
Additionally, intense precipitation and strong freshwater discharges from the Congo and Niger rivers modify the velocity field in the ocean and tend to flush drifting buoys offshore away from the river plume. Hence, very few drifters can be seen along the coast between Nigeria and Congo.

Consequently, NASA's Autonomous Temperature Line Acquisition System (ATLAS) buoys from the Pilot Research Moored Array in the Tropical Atlantic (PIRATA) programs provide the main sustainable observations in the Gulf of Guinea. Four buoys have been installed in the equatorial East Atlantic Ocean, and a weather station has been placed in Sao Tomé. Thus, over a typical year, few observations are available in the coastal region of Western Africa.

In-Situ Measurements on Oil and Gas Platforms

The Gulf of Guinea and, more generally, Western Africa have many oil and gas resources, and major industry players are present in the region. When in production, platforms are surrounded by vessels or helicopters that require ocean and weather monitoring to secure operations. For safety, most of the platforms with a helideck have an operational weather station; those equipped with an oil offloading system to tankers often have instruments to measure sea state and near-surface currents.

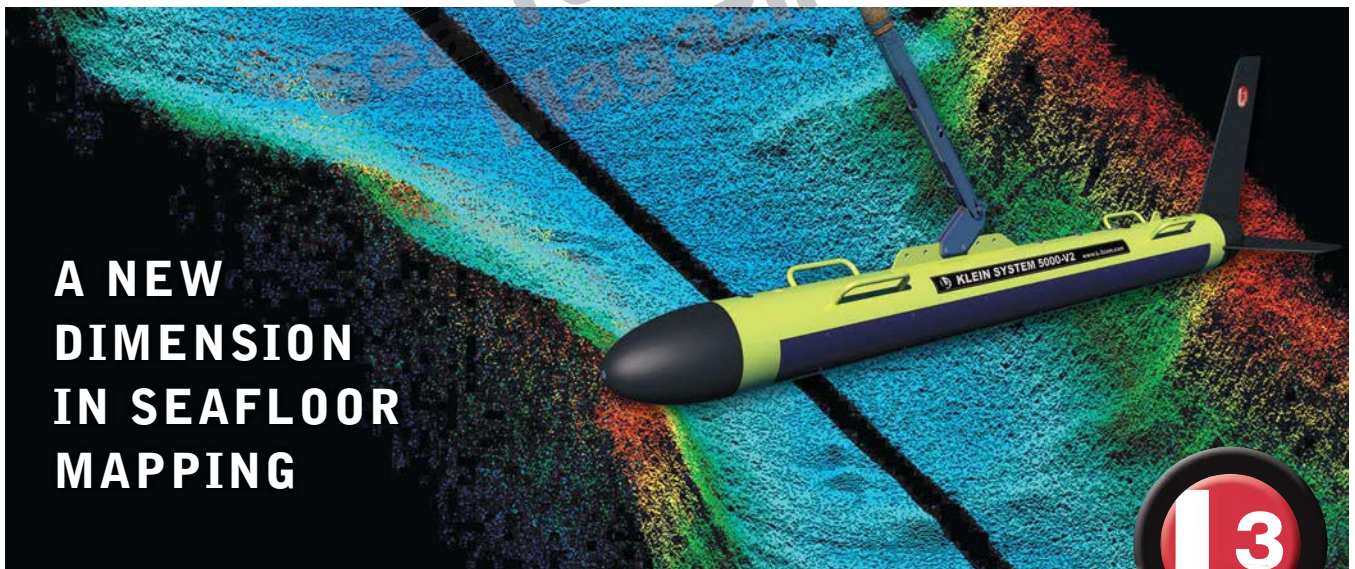
However, most of the time, these monitoring systems have no remote connection, and data are not available in real time or, in the best case, only available within the com-



PIRATA buoys' and Argos drifters' positions in 2011.

pany network. Remote access to real-time data would improve the safety and the organization of marine and air logistics operations, provide valuable modeling information and help predict drift in case of oil spills. It would also secure data by simplifying archiving and sensor maintenance. The archived data could then be used to improve design criteria for new platforms in the area.

Most of the oil and gas resources are localized on the continental shelf, which has been divided into blocks where



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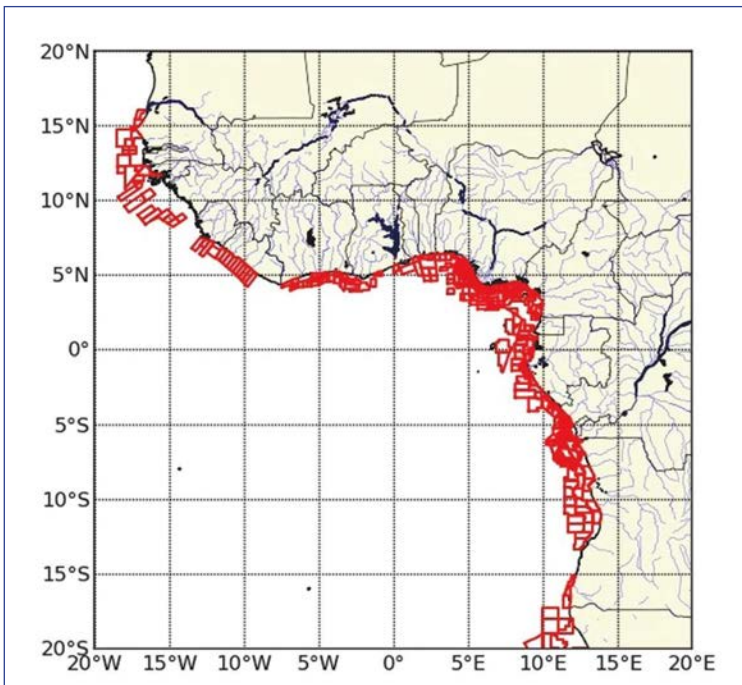


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A map of oil and gas exploration and production blocks in the Gulf of Guinea.

companies conduct exploration and production. Measurements in those areas would complement existing ocean and weather observations. Introducing these data in a global system, such as the World Meteorological Organization's (WMO) Global Telecommunication System (GTS), and providing free access to the scientific community would improve weather and ocean forecasts to the benefit of civilians as well as the oil and gas industry.

Monitoring Network in the Gulf of Guinea

The International Centre for Education, Marine and Atmospheric Sciences over Africa (ICEMASA) and Total S.A. (Paris, France) have developed a joint project to provide public, real-time and remote access to the ocean and weather data measured on platforms operated by Total in

the Gulf of Guinea. The project started in September 2010 and should be fully operational by 2013.

A prototype network of five existing platforms—Akpo, Usan, Tchibouela, N'Kossa and Dalia—is sending data to the French meteorological agency Météo-France, and five to 10 more platforms should be added before 2014. The platforms are primarily in Nigeria, Congo and Angola, plus those in the Anguille Marine field in Gabon.

Sensors. Offshore production platforms are often equipped with a helideck, which has to comply with the regulations of the International Civil Aviation Organization and Total's specifications. To that extent, platforms are usually equipped with a weather station comprising at least an anemometer, e.g., Vaisala (Vantaa, Finland) WAA151; barometer, e.g., Endress+Hauser Consult AG (Reinach, Switzerland) PMC 731; and hygrometer, e.g., Vaisala PTU200 HMP45D. Some platforms have a more complete weather system, with sensors for temperature, cloud, visibility and precipitation. Most of the sensors directly measure from a helideck height 20 to 35 meters above sea level, but the anemometers are often

placed higher, typically on the telecom mast approximately 40 meters above sea level, to limit wind turbulence.

Some of the platforms are anchored FPSOs whose drafts change according to their tanks' fillings. The elevation of the structure can change up to 12 meters. Although most parameters are not sensitive to these variations, the bias in pressure data is corrected using the function:

$$P = 1013.25 [1 - \{1 - (E/44307.69321)\}^{5.253283}]$$

E is the elevation of the pressure sensor in meters above sea level, and P is the additional pressure if the sensor were to be repositioned to mean sea level.

Some platforms require current and wave monitoring to support marine operations such as oil off-loading, and they could be equipped with a buoy moored a few kilometers from the platform with a current meter, current profiler or wave sensor. Examples of current meters being used are the

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- Free Fall Cone Penetrometer (FFCPT)
- Laser Optical Particle Counter (LOPC)

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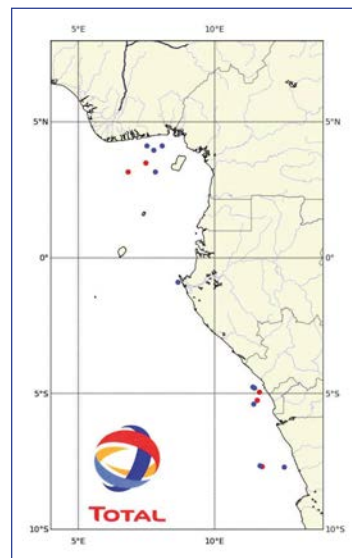
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Aanderaa DCS4100R and InterOcean Systems Inc. (San Diego, California) S4A. Current profilers employed in the project include the Teledyne RD Instruments (Poway, California) 600-kilohertz Sentinel ADCP and NortekUSA (Boston, Massachusetts) Aquadopp. One of the wave sensors in use is the Fugro OCEANOR (Trondheim, Norway) WaveSense 3. Current meters and profilers are used to measure near-surface current up to 50 meters below sea level, and the upward-looking current profiler data are sometimes processed to measure waves.

Some other platforms have a marine radar to monitor waves, such as the Saab Rosemount (Gothenburg, Sweden) WaveRadar Rex, OceanWaveS GmbH (Lüneburg, Germany) WaMoS or Miros AS (Asker, Norway) WAVEX. Alternatively, the platforms might have a dedicated wave buoy, such as the Fugro OCEANOR Wavescan buoy with Wavesense sensor. Most data are sampled every minute, except wind data, which are sampled every second.

System Architecture. The IT architecture comprises triple archiving, with near-real-time access within 5 to 10 minutes of data collection. The weather and ocean systems of each platform are connected to the plant information (PI) server. Using OSIsoft's PI System, data are then replicated at Total's affiliate offices and headquarters. Complementary information on the data are stored in a separate database, processed and converted into a defined format, then sent to an FTP server provided by Météo-France, which transfers to them to WMO GTS. The data are available on this FTP server for 15 days, during which the British Oceanographic Data Centre (BODC) performs quality control before archiving in the System of Industry Metocean data for the Offshore and

Total's metocean platforms in the Gulf of Guinea. Connected platforms are in red, and platforms that are connected are in blue.



Research Communities (SIMORC) database.

Users that require real-time data access can connect directly to the GTS or, after receiving Total's approval, to the FTP server. The GTS is only available to weather services and their associates, but data can be requested from weather services or the European Centre for Medium-Range Weather Forecasts.

Metadata and Data Format

All the metadata, including unit, processing, altitude, sampling and position, are documented and made available. The metadata designated for the GTS respect the WMO Binary Universal Form for the Representation of meteorological data (BUFR), and others are in a format close to the BODC template for SIMORC. The data are sent in two sets as GTS cannot assimilate some of the data. For example, some places have both a current meter and profiler; the BUFR tem-

G-882 TVG - TransVerse Gradiometer Marine Magnetic Survey System

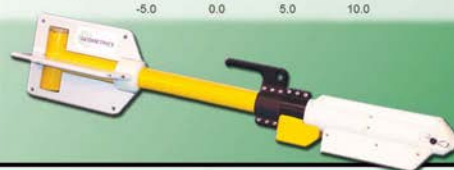
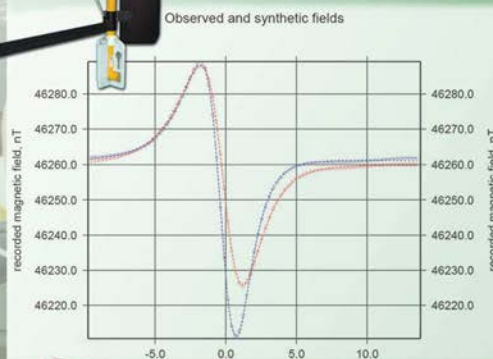
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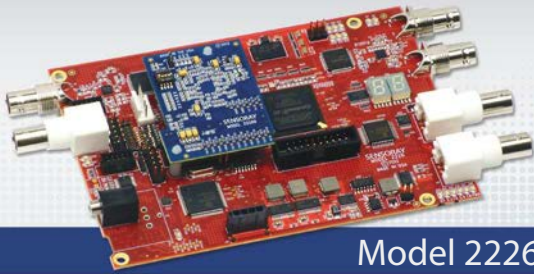
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plate cannot take two values of the same parameter from a unique platform. Also, the GTS will assimilate only one data per parameter per hour where Total data can be sampled every minute or second.

The data are sent to Météo-France in two different sets for each platform. The first set is dedicated to the GTS and comprises two ASCII files: one containing the first data of the present hour of each parameter, which is sent every hour, and the other containing the sensors' metadata, which is sent every day. Both files are used to convert the data in BUFR before being sent to the GTS.

The second set contains all data at their original sampling rates. Two ASCII files are sent: one containing the data sampled every minute and the other containing those sampled every second. These files are transferred to the FTP server every six minutes and comprise the data measured during the past six minutes.

One metadata file per platform is transferred every day. Those files are retrieved weekly and stored by the BODC in the SIMORC database, where they will be available to the scientific community.

Conclusions

In-situ data are key to understanding and forecasting weather and ocean status. Oil and gas companies operating in Western Africa conduct in-situ measurements that satellites cannot, and sharing those data with weather services and the scientific community will benefit both industry and civilians.

Total and ICEMASA launched the MetOcean Data Acquisition network to provide public, remote, real-time access to the data monitored on platforms operated by Total in the Gulf of Guinea. Five platforms are now connected and transferring their data to Météo-France. Soon, a few other platforms will be connected, and Météo-France will set the transfer to the GTS. Total hopes other companies will be encouraged to join the project and thus contribute to better regional environmental monitoring.

Acknowledgments

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References

For a list of references, contact Valérie Quiniou at Valerie.Quiniou@total.com. ■

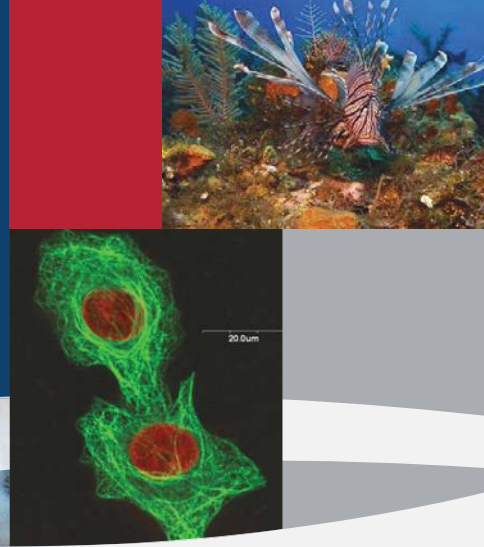
Dr. Rémi Estival has a Ph.D. in submarine acoustics and a master's degree in mechanics. He was employed by Total to set up a real-time network of ocean and weather stations. His work is hosted by ICEMASA (International Centre for Education, Marine and Atmospheric Sciences over Africa) and University of Cape Town.

Valérie Quiniou is the head of Total's survey technologies department for geophysics, geotechnics, metocean and geomatics applied to development and operations. She joined Total in 2002 as a metocean advisor, after working with Noble Denton and Bouygues Offshore (now Saipem). She graduated as an engineer from École Polytechnique and ENSTA (École nationale supérieure de Techniques Avancées).

Christophe Messager founded ICEMASA (International Centre for Education Marine and Atmospheric Sciences over Africa) in 2008 and led it until 2011. He is one of the promoters of the Guinea Gulf data collection project. He presently researches ocean-atmosphere interaction and is involved in international climate and meteorological modeling programs, as well as in-situ data collections.

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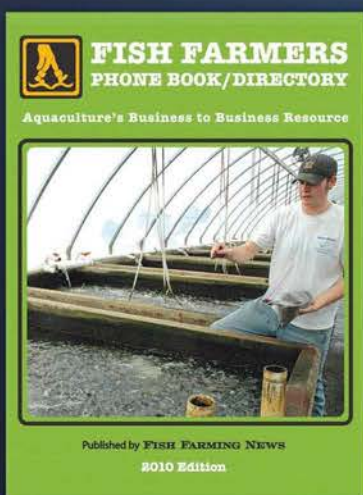
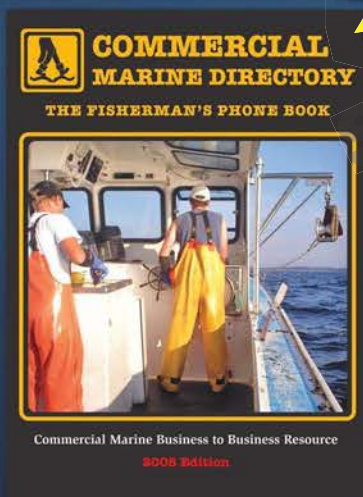
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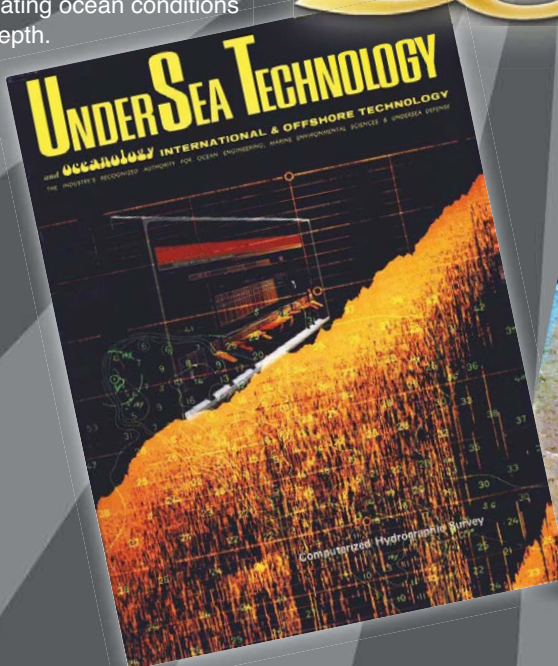
1971

One of the control stations for the six-chamber complex at the Institute for Environmental Medicine at the University of Pennsylvania. One of the six pressure units is a wet diving chamber simulating ocean conditions at 1,800 feet depth.



1972

Aerial view of the New York Ocean Science Laboratory (NYOSL) on Fort Pond Bay at Montauk, New York, and students learning to use Beckman Environmental oceanographic instruments on the NYOSL dock.



1973

Photographic rendition relating the application of digital computers to automated hydrographic data collection processing and compilation for production of nautical charts.



1974

Brown and Root's derrick-lay barge BAR-323 laying pipe in the North Sea.

ST50

1971 - 1974

As *Sea Technology* magazine celebrates its 50th year, we take a look back at major events in the oceanographic industry and the world.

1971

The Harbor Branch Oceanographic Institute was founded by J. Seward Johnson Sr. and Edwin A. Link.

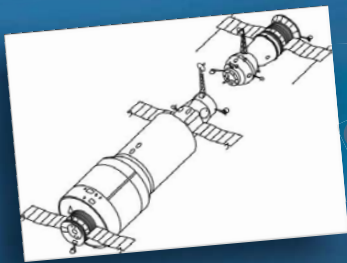


1971

The International Decade of Ocean Exploration (IDOE) began. The goal of the 10-year program was to achieve more comprehensive knowledge of oceanic characteristics and oceanic processes.

1971

The Geochemical Ocean Section Study (GEOSECS), coordinated by Scripps Institution of Oceanography, was established to form a baseline database for assessing future chemical changes in the oceans and attaining a better understanding of large-scale oceanic transport and mixing processes. More than 2,200 water samples were collected.



1971

Salyut 1, the world's first space station, was launched by the Soviet Union April 19, 1971. (Credit: NASA, David S. F. Portree)

1971

- Dr. Fred. N. Spiess - Compass Distinguished Achievement Award
- Perry Oceanographics Inc. - Compass Industrial Award

1972

The National Ocean Industries Association was founded with 33 members to represent U.S. offshore energy and related industries.



1972

The Department of the Interior stopped issuing whaling licenses and banned the importation of whale products—even foreign cars with whale oil in the transmission. (Photo Credit: Shari Smith, Channel Islands Naturalist Corps)

1972

NOAA launched its first data buoy, one of six 100-ton General Dynamics Engineering Experimental Phase prototypes, at Gulfport, Mississippi.

1972

- Butler King Couper - Compass Distinguished Achievement Award
- Hydronautics Inc. - Compass Industrial Award

1973

The first successful U.S. ocean fish culture operation was reported. Domsea Farms Inc. raised salable, 12-ounce Coho salmon in pens along Puget Sound, Washington. (Photo Credit: NOAA Fisheries)



1973

U.S. direct involvement in the Vietnam War effectively ended January 27, 1973 with the signing of the Paris Peace Accords. (Photo Credit: U.S. Army)

1973

- Dr. Warren S. Wooster - Compass Distinguished Achievement Award
- International Nickel Co. - Compass Industrial Award

1974

Astronaut-aquanaut Dr. John Anthony Llewellyn, of the University of South Florida, began working on a \$1,200 automatic diver decompression system, including a depth gauge, timer and small computer that were packaged in a case small enough to fit on the diver's arm. (Photo Credit: NASA)



1974

Deepsea Ventures Inc., developer of mining manganese nodules from the seabed and processing them, filed the first deep-sea mining claim with the U.S. Secretary of State. (Photo Credit: Woods Hole Oceanographic Institution)

1974

- Dr. Kenneth O. Emery - Compass Distinguished Achievement Award
- Western Geophysical Co. of America - Compass Industrial Award

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First Congressional Maritime Congress Established

Reps. Cedric Richmond (D-La.) and Michael Grimm (R-N.Y.) formed in February the first-ever U.S. Congressional Maritime Caucus. It will operate as a forum and information distribution center in the U.S. House of Representatives where members of Congress can turn for material on maritime issues, legislation and initiatives.

Reps. Richmond and Grimm expect to welcome a host of representatives to the caucus who understand the importance of a strong U.S. Merchant Marine.

"The Congressional Maritime Caucus represents a huge step forward for the maritime industry giving us a unified and concentrated voice on Capitol Hill," said Mike Jewell, president of the Marine Engineers' Beneficial Association. "This important initiative will work hand-in-glove with the grassroots maritime action committees that are already in place in numerous congressional districts across the country to spread the maritime message."

Hurricane Sandy Relief Aid Signed Into Law Without Funding for Coastal Marine Spatial Planning

U.S. President Barack Obama has signed into law the Disaster Relief Appropriations Act, which provides \$50.7 billion in federal aid for recovery from Hurricane Sandy.

An amendment from Rep. Bill Flores (R-Texas), agreed to with a 221-197 vote, removed \$150 million in funding for NOAA's Regional Ocean Partnership grants, which would

support regional ocean partnerships and the development of coastal marine spatial plans.

Those opposing Flores' amendment argued that funding the Regional Ocean Partnership's grants would help states affected by Hurricane Sandy recover faster and enable them to better prepare for and mitigate extreme weather events and risks.

Under the law, NOAA will receive up to \$476 million: \$290 million for operations, research and facilities, and \$186 million for procurement, acquisition and construction for its damaged facilities and repairs and upgrades to its hurricane reconnaissance aircraft. Included is \$50 million for mapping, charting and geodesy services and marine debris surveys in states impacted by Hurricane Sandy. The agency's weather satellite data mitigation gap reserve fund will receive \$111 million.

With the \$9.7 billion aid package signed into law in January, federal aid for Hurricane Sandy totals \$60.4 billion.

Begich Introduces Bills to Halt FDA Approval Of Genetically Engineered Salmon

As the U.S. Food and Drug Administration (FDA) considers the approval of genetically modified salmon, U.S. Sen. Mark Begich (D-Alaska) introduced two pieces of legislation banning the fish in February.

The FDA is examining an application from AquaBounty Technologies' (Maynard, Massachusetts) to sell its genetically modified AquAdvantage salmon. The agency extended the comment period on the application, originally slated to end in February, until April 26. Begich's Prevention of Escapement of Genetically Altered Salmon in the United States

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(PEGASUS) would make it illegal to produce, sell or ship genetically engineered salmon in the U.S., unless NOAA finds it would have no significant impact. Begich's second bill would require any genetically engineered salmon product to be labeled as such, a proposal the FDA has rebuffed.

Late last year, the FDA found no significant impact on the proposal from AquaBounty Technologies to produce a hybrid Atlantic salmon modified with a Chinook salmon growth gene and an antifreeze gene from an eel-like fish, the ocean pout. The FDA reviewed the AquaBounty proposal not as a food product but as a veterinary drug. If approved, the salmon would be the first genetically modified animal to be sold for consumption.

Opponents of genetically modified salmon are concerned about the potential impacts on human health and the environment, especially if the salmon are accidentally released into the wild.

Murkowski Unveils Long-Term US Energy Plan

Sen. Lisa Murkowski (D-Alaska), ranking member of the U.S. Senate Energy and Natural Resources Committee, published her plan for U.S. energy sources and policies in February, outlining several goals with deadlines in 2020.

One of these goals is for the U.S. to achieve independence from the Organization of the Petroleum Exporting Countries (OPEC). Murkowski's report finds this goal feasible since over the past decade the U.S. has seen its reserve portfolio grow substantially (largely in part due to previously subeconomic resources, like shale oil) and domestic energy production has increased.

To become independent from OPEC, the U.S. government would need to permit the construction of the Keystone XL and other domestic pipelines, streamline the offshore leasing processes (specifically repealing the recent additional requirements on shallow-water Gulf of Mexico drillers) and expand leasing to the eastern Gulf of Mexico and parts of the Atlantic Outer Continental Shelf.

Additionally, Murkowski's plan calls for a share of revenues to participating offshore energy-producing states—including offshore wind, tidal and wave generation. It also calls for the establishment of permanent revenue sharing (as is established for onshore development) from leasing, bonus bids, rents and royalty receipts at 27.5 percent, with provision for direct partial payments to affected coastal communities.

The report also calls for an amendment to provide for an updated liability regime so all oil spill victims would be compensated.

The plan briefly touched on marine hydrokinetic (MHK) energy, encouraging more research into MHK devices and grid integration, and developing a thematic environmental impact statement for MHK projects. It also suggests establishing up to four MHK testing facilities.

Bills to Prevent Illegal Fishing Introduced

Sen. John D. Rockefeller (D-W.Va.) introduced in February the International Fisheries Stewardship and Enforcement Act and the Pirate Fishing Elimination Act.

If enacted, the bills would aim to curb and end illegal, unregulated and unreported fishing. The late Sen. Daniel Inouye of Hawaii had sponsored this legislation in previous congresses. ■

international

Seatronics Invests in iXBlue Equipment

Seatronics Ltd. (Aberdeen, Scotland) has expanded its equipment rental pool to include more iXBlue (Marly-le-Roi, France) inertial and acoustic products. The purchase comes in response to increasing market demand for inertial navigation technology to provide positioning for deepwater projects in West Africa and Brazil, where Seatronics' new Rio de Janeiro office became operational in February.

The systems include five more iXBlue PHINS 6000 systems, upgrades to 12 existing iXBlue OCTANS Gen 4 subsea gyros and 12 additional OCTANS Gen 4 industry-standard subsea survey gyrocompasses.

Applied Acoustics Adds Australian Agent

Applied Acoustic Engineering (Great Yarmouth, England) has appointed a new distributor, Western Advance Pty Ltd. (Perth, Australia). The independent supplier deals with oil and gas, defense and security industries.

As well as providing project design, equipment supply, installation, commissioning and field support to Australian companies, Western Advance is a distributor to the offshore survey and construction industry.

Astrium Services Extends Agreement With Intelsat for Connectivity to Offshore Customers

Astrium Services (Paris, France) and Intelsat S.A. (Luxembourg) have signed a multiyear renewal agreement for

C-band capacity to be used by Astrium Services' maritime customers in the Mediterranean, Atlantic Ocean, North Sea and Gulf of Mexico.

Astrium Services will use C-band capacity on Intelsat 907 at 332.5 degrees East. The capacity will improve passenger communication, ensuring that multiple simultaneous users can access the Internet.

Intertek to Undertake Cable Risk Studies in Qatar

Intertek's (London, England) Energy & Water consultancy services, formerly Intertek METOC, has won a new marine power cable assignment in Qatar for LS Cable & System (Anyang, South Korea).

Under the contract, Intertek began last year an underwater cable burial risk assessment study for two high-voltage AC (HVAC) submarine cables from Ras Laffan, Qatar, to Halul Island, approximately 100 kilometers off the country's coast. The study should be wrapping up in March.

The HVAC link will supply power to meet the electrical demand of Halul Island, a major international oil and gas terminal. The assessment includes hazard identification, fishing gear and anchor penetration studies, shipping intensity study, geological assessment, cable burial technology and tool evaluation, and burial depth recommendations.

Transas Marine Completes AIS-Based VTS Installation for EU's SafeMed II Project

Transas Middle East (Dubai, United Arab Emirates) has installed and commissioned its AIS Base station T214 at the Port of Aqaba, Jordan. Funded by the European Union's SafeMed II Project, the base station will track maritime traf-

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fic in and around Aqaba Port to help forecast risks related to marine pollution. In addition, Transas supplied and commissioned AIS VTS Server, Web server and related hardware equipment to the Jordan Maritime Authority, also financed under SafeMed II.

WASSP Appoints Imtech Marine as Distributor

WASSP Ltd. (Auckland, New Zealand) signed in February a distribution agreement that will see its multibeam sonar systems distributed by Imtech Marine (Rotterdam, Netherlands) through the Netherlands, Belgium and China. The agreement covers all WASSP's commercial fishing and commercial multibeam sonar systems.

Ibercisa Breaks into the Norwegian Market

Ibercisa (Vigo, Spain) will supply naval and fishing machinery to the Norwegian companies Volstad Maritime AS (Ålesund, Norway), REM (Fosnavåg, Norway) and Andenesfiske (Andenes, Norway).

The machinery will be installed on board Volstad's trawler, which is being built in Tersan's (Yalova, Turkey) shipyard; on the REM trawler, under construction at the shipyard STX OSV (Ålesund); and on another trawler, which Andenesfiske is building in Tersan.

ABB Acquires APS Technology Group

ABB (Zurich, Switzerland) will acquire San Diego, California-based APS Technology Group (APS) to add optical character recognition and gate automation capabilities.

APS will join ABB's Crane and Harbor automation business. No major changes to staffing, product offerings or marketing efforts are planned. ABB estimates that the global terminal automation market will double in five years.

"As containerized shipping grows, container handling in ports and terminals is quickly moving away from manual controls to fully automated systems," said Fred Hoonard, head of Crane and Harbor Center of Excellence.

Triton Imaging, Kraken Announce OEM Agreement

Triton Imaging Inc. (Capitola, California) and Kraken Sonar Systems Inc. (St. John's, Newfoundland) have signed an original equipment manufacturer (OEM) agreement under which Kraken will offer Triton Perspective software bundled with their AquaPix Synthetic Aperture Sonar (SAS).

AquaPix users can use the Perspective software to process high-resolution SAS and associated interferometric bathymetric data to create seabed imagery, mosaics and bathymetric 3D digital terrain models. The Perspective GIS-based software provides the multisensor processing functions that can enhance the fusion of the co-registered imagery and bathymetry produced by the AquaPix system.

SMD, SeeByte Successfully Integrate SeeTrack CoPilot Software and ROV

Soil Machine Dynamics Ltd. (SMD), based in Tyne and Wear, England, and SeeByte Ltd. (Edinburgh, Scotland) have successfully integrated SeeTrack CoPilot to SMD's work-class ROV system. This pairing makes the ROV better equipped for surveys, field development and pre- and post-lay operations. The software features a point-and-click interface, flight modes, a map that moves in real time, chart overlay and the ability to track specific structures in the water column. ■

Teledyne Acquires RESON

Teledyne Technologies Inc. (Thousand Oaks, California) has entered into an agreement to acquire RESON A/S (Slangerup, Denmark), the companies announced in February. RESON, which has 185 employees, will become part of Teledyne's marine instrumentation group.

"With RESON, Teledyne will possess the ability to provide detailed 3D imaging solutions, ranging from full ocean depth survey, shallow water and coastal zone imaging, terrestrial and airborne mapping, and even deep space science applications," said Robert Mehrabian, president and CEO of Teledyne.

Ocean Exchange Competition Open For Sustainable Sea Technology Solutions

The Ocean Exchange has launched its third annual global competition for the Gulfstream Navigator Award (\$100,000) and the Wallenius Wilhelmsen Logistics Orcele Award (\$100,000). The theme for the 2013 competition is Leap to Zero+, which refers to generating economic growth and increased productivity while reducing the use of natural resources and waste.

Entries must be registered by 11:59 p.m. (GMT) on May 1. A prescreening application is available at www.oceanexchange.org. Submission reviews will begin May 2.

Previous winners include Liquid Robotics' (Sunnyvale, California) Wave Glider, the Protei_Open Source Sailing Drone and Nonox Ltd.'s (Nassau, Bahamas) Emulsion Combustion System.

Seatronics Opens Brazil Office

Seatronics Ltd. (Aberdeen, Scotland) has completed the start-up phase of its new office, workshop and warehouse facility in Macaé in Rio de Janeiro, Brazil. It will support sales, rental, engineering and cable molding. Staff there will handle the complete range of Seatronics equipment, including inspection-class ROVs, cables and connectors.

The opening of the new facility coincides with the appointment of Fabio D'Agostino as Seatronics' vice president in Brazil.

ACL to Transport Petroleum for SeaRiver Maritime

Jeffersonville, Indiana-based American Commercial Lines (ACL) has entered into a multiyear agreement with SeaRiver Maritime Inc. to provide petroleum barge transportation services on U.S. inland waterways via its mainline service and in unit tows.

ACL is diversifying its business mix, with a focus on liquid cargoes, the company said.

Universidade de São Paulo Gets First Slocum

Teledyne Webb Research (East Falmouth, Massachusetts) has delivered the first Slocum G2 glider to the Coastal Hydrodynamics Laboratory at the Oceanographic Institute of the Universidade de São Paulo. It will be used for sustained monitoring over the continental shelf of São Paulo State.

The glider is outfitted with a CTD, an altimeter, and a sensor to measure colored dissolved organic matter, chlo-

rophyll and backscatter. It is a 200-meter-rated coastal version of the Slocum. Subsequent gliders will be optimized for deeper operation up to 1,000 meters.

Two additional gliders are expected to ship to the university later this year.

Jewell Acquires Applied Geomechanics' Products

Jewell Instruments LLC (Manchester, New Hampshire) has acquired the product lines of Applied Geomechanics Inc. (San Francisco, California), which comprise tilt meters and clinometers, and include full signal conditioning electronics. Jewell has started full production in its facility.

PolyShield Enters Share Purchase Agreement for Ecolutions

PolyShield Technologies Inc. (Boca Raton, Florida) has entered into a share purchase agreement with Rasmus Norling, formerly of Royal Caribbean International, for the purchase and sale of all of the issued and outstanding shares of Ecolutions Inc. for the aggregate purchase price of \$53,000, payable by the issuance of 100,000 restricted shares of PolyShield's common stock. Norling became PolyShield's president and CEO in February.

PolyShield has acquired all of Ecolutions' rights under collaboration, master distributor and license agreements with Green Tech Marine AS (Farsund, Norway). PolyShield will market the Green Tech Marine GTM R15 gas scrubber technology.

World's Second-Largest Ocean Cargo Line Puts More Money Into Long Beach Port

Mediterranean Shipping Co. S.A. (MSC) of Geneva, Switzerland, has increased its investments at the Port of Long Beach in California, its biggest West Coast hub of operations.

This comes at a time when the port sees potential challenges from ports in Canada and Mexico, as well as the expansion of the Panama Canal. The Port of Long Beach has been rebuilding and modernizing as part of a 10-year, \$4.5 billion effort.

exactEarth Creates On-Demand Satellite AIS Access with GWS

exactEarth Ltd. (Cambridge, Canada) announced the release of new geospatial web services (GWS), allowing users to access satellite AIS data on request. Data can now be integrated with other geospatial data sets dynamically, and can be immediately consumed and displayed in any Open Geospatial Consortium-compliant geospatial system, such as Esri (Redlands, California) and Google Earth platforms. Users get access to daily live tracking of more than 90,000 ships globally.

Spurs Marine Sold to Internal Managers

Donald Govan, owner and chief design engineer of Spurs Marine Manufacturing Inc. (Ft. Lauderdale, Florida), has sold the company to Pablo Sosa, Spurs' vice president and general manager, and Chris Jones, Spurs' sales application engineer.

Sosa has been with Spurs more than 15 years, and has created computerized and technical systems for product manufacturing. Jones joined the company two years ago, and is responsible for product design and installation.

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Hemisphere GNSS Buys Part of Hemisphere GPS

Hemisphere GNSS Inc. has purchased the Precision Products business, and related GNSS technology and intellectual property from Hemisphere GPS Inc. (Calgary, Canada). Hemisphere GNSS will operate its headquarters out of Scottsdale, Arizona, and will maintain its operations in Calgary.

Hemisphere GPS Inc. intends to change its company name to Agjunction.

As part of the agreement, Hemisphere and Agjunction have formed a strategic alliance and a collaborative business relationship that covers supply chain management, customer support, technology development and cross-licensing.

Drew Marine Acquires Alexander/Ryan

Drew Marine (Whippany, New Jersey) has completed the acquisition of Alexander/Ryan Marine & Safety and Sea Technology (Houston, Texas). Alexander/Ryan is a manufacturer, distributor and safety certification provider for the offshore and marine industries.

Labor Contract Rejected for California Ports

Negotiations broke down in February between the International Longshore and Warehouse Union's Local 63 Office Clerical Unit and the Harbor Employers Association with the rejection by union members of a labor contract.

An eight-day strike in November and December 2012 shut down most terminals at the Ports of Los Angeles and Long Beach in California before the parties agreed on a tentative new contract, now rejected.

Crowley Christens Florida Tanker

Crowley Maritime Corp. (Jacksonville, Florida) has christened its newest tanker, *Florida*, at the Aker Philadelphia Shipyard in Pennsylvania. The *Florida* will be placed into service delivering domestic oil to U.S.-based refineries. It can carry 330,000 barrels of petroleum products and chemicals.

ESNE Becomes BIRNS Sales Rep

BIRNS Inc. (Oxnard, California) has announced Old Saybrook, Connecticut-based Electronic Sales of New England (ESNE) as the company's newest sales representative. The agreement includes sales and support of BIRNS' electrical, coaxial, optical, electrocoax, electro-optical and electro-optomechanical hybrid connectors.

The territory for ESNE's sales efforts on behalf of BIRNS includes Connecticut, Maine, New Hampshire, Vermont, Massachusetts, Rhode Island, New York, New Jersey and Pennsylvania.

OMM Completes Fiber-Optic Work For Telecom Company in Mexico

Offshore Marine Management (OMM), based in Bristol, England, has completed a contract for Telmex to supervise and assist with repairs to the shore-end section of a fiber-optic connection between the Mexican mainland and the island of Cozumel.

OMM installed protective pipe onto the submarine cable section to provide protection and prolong its operational lifespan. ■

SMIT Singapore Wins Contract for Salvage Operations After USS *Guardian* Crashes Into Reef

Salvaging operations began in February for the USS *Guardian*, a U.S. mine countermeasure vessel that crashed in January into the Tubbataha Reef, a United Nations' World Heritage site in the Philippines, *International Business Times* reported. The U.S. Navy plans to dismantle the ship into three sections and decommission it, *DefenseNews* reported.

SMIT Singapore Pte Ltd. (Singapore) won a U.S. Defense Security Cooperation Agency contract for \$24.9 million to provide emergency response and recovery operations support. This includes personnel, vessels and equipment for assessment, planning, stabilization, oil removal and vessel recovery. Seventy-two percent of the work will be done in the vicinity of the Tubbataha Reef and 15 percent will be done at Palawan, Philippines.

Operations began with the *SMIT Borneo*, a crane ship, anchoring into the Sulu Sea. It was to drop four anchors 10 meters away from the reef: two at the bow at 800 meters depth and two at the stern at 300 meters depth.

Work will be completed by December.

Bluefin to Give NRL Modified Knifefish for LFBB Development, Reliant UUV Work Continues

Bluefin Robotics Corp. (Quincy, Massachusetts) will produce a variation of the Knifefish UUV for the U.S. Naval Research Laboratory (NRL). Knifefish is a specialized Bluefin-21 UUV being developed for the Surface Mine Countermeasure UUV program, for which Bluefin is under subcontract to General Dynamics Advanced Information Systems (Fairfax, Virginia).

Bluefin completed the Knifefish preliminary design review earlier this year. The vehicle will be used to advance NRL's low-frequency broadband (LFBB) payload technology and support its broader mission to move forward with basic and applied research in undersea warfare.

For the past 10 years, Bluefin and NRL have been working to develop and field the Reliant vehicle, a Bluefin-21 used as a science and technology system for the original LFBB development. In addition to Knifefish features, Reliant will be equipped with two-way Iridium communications, specialized sensors, a reacquisition capability and accommodation for an acoustic payload, including a towed receiver array. Bluefin will also deliver topside support equipment and graphical user interface software.

LCS-5 to Get Four New High-Powered Waterjets Designed to Lower Maintenance Costs

The U.S. Navy's fifth littoral combat ship (LCS-5), *Milwaukee*, will be the first to have the Axial-Flow Waterjet Mk-1, the new high-power-density waterjets aimed at staving off rudder and propeller damage on high-speed ships. The waterjets, produced by the U.S. Office of Naval Research (ONR) Future Naval Capabilities program, have arrived at the Marinette Marine Corp. (Marinette, Wisconsin) shipyard, where LCS-5 is under construction.

Four of the waterjets will propel the LCS-5 to speeds exceeding 40 knots. Developed by Rolls-Royce Naval Marine

Inc. (Walpole, Massachusetts), ONR and U.S. Naval Surface Warfare Center, Carderock Division, the Mk-1 can move nearly half a million gallons of seawater per minute, with more thrust per unit than existing commercial waterjets. The smaller, more efficient waterjets will also help avoid excessive maintenance costs associated with cavitation.

Full-scale sea trials for the waterjets on LCS-5 are expected to occur in the next 24 months.

Indian Navy Commissions INS *Saryu* For Heightened Surveillance Effort

The Indian Navy has commissioned the first of four domestically built offshore patrol vessels, INS *Saryu* (P57), at Goa Shipyard in Vasco, India, *naval-technology.com* reported. The 105-meter-long vessel, which can operate offshore on its own for a month, is intended to patrol the exclusive economic zone around the Andaman and Nicobar islands in response to increased maritime surveillance needs.

The vessel will conduct surface warfare missions, monitor sea communication and protect offshore assets. It has two SEMT Pielstick (Villepinte, France) diesel engines, and its weaponry includes a 76-millimeter Oto Melara gun, two 30-millimeter close-in weapon system guns and six chaff launchers. It also has a helicopter landing deck and hangar, and two rigid inflatable fast motor boats.

Delivery of the INS *Sunayna*, the second of the *Saryu*-class ships, to the Indian Navy is scheduled for May 2013. The remaining two ships, INS *Sumitra* and INS *Sumedha* will be delivered in the next year and a half.

The 2,300-ton *Saryu*-class ships can cruise at more than 25 knots and have a range of 6,000 nautical miles. ■

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For more information on any of these products, visit our website at www.sea-technology.com/products

Pressure Sensor and Data Logger



With up to 64 GB in storage on a compact flash card, the Wave Gauge Blue can operate for months of continuous or years of burst data logging. Standard pressure ranges are 1, 3 and 10 bars. It is accurate to 2 ppm and has a real-time clock for time-tagging the data. Ocean Sensor Systems Inc.

Military-Spec VSAT

Designed with a rotating polarizer, the SuperTrack X10Mk3 operates at Rx 7.25 to 7.75 GHz and Tx 7.9 to 8.4 GHz. It includes a brake system, shock absorbers and high-torque mo-

tors, and is anodized to eliminate corrosion. The Mk3 platform meets or exceeds military vibration, shock and EMI/RFI standards. KNS Inc.

Wide-Angle Lens

Depth-rated to 50 m, the BigEye Lens M67 Mark II has a 67-mm thread mount that fits over the housing's port, and can be installed and removed during the course of the dive. It features a multilayered anti-reflection coating on both sides of the lens. Its diameter measures 118 mm. Fantasea Line Ltd.

MEMS-Based Inertial System

At 0.05° 3D attitude accuracy, Ekinox Inertial Systems offers tactical-grade MEMS. This series consists of two ITAR-free models: the Ekinox AHRS provides 5-cm heave, surge and sway, and the Ekinox INS delivers 2-cm position. Both accept aiding data from marine external equipment, including DVL, dual-antenna GPS, USBL and EM log. SBG Systems S.A.S.

Dual Wideband Frequency Transducer

Made for applications such as depth-sounding, fish finding or guidance and Doppler speed metering, the 09222/000 piezo-composite transducer has dual ranges of 55 to 89 kHz and 150 to 220 kHz, with a side lobe level of less than -25 dB, compared to -20 dB. Morgan Technical Ceramics.

Iridium Signal Detector



Capable of detecting an Iridium transmission to within 3 ft. of its origin, the iON - Iridium Transmission Detector can last up to 100 hrs. in search mode or 50 hrs. in detected mode on a single, user-replaceable 9-V alkaline battery. The unit is a self-contained, handheld device. JouBeh Technologies Inc.

ECDIS Familiarization Course

Using the Navi-Sailor software running in real time, this training package for the Transas Navi-Sailor 4000 follows the requirements set by flag states and provides 16 to 18 hrs. of study followed by an online test. IMO 1.27 generic training is a prerequisite. SafeBridge GmbH.

Wet Differential Pressure Transducer

Featuring 316L and Inconel X750 material, the AST5300 is made for use in explosion-proof and nonincendive areas. It is suitable for various liquids and gases requiring high line pressure (1,500 psi) and low differential pressure (10 PSID) measurements. American Sensor Technologies Inc.

3D, 4D Visualization Software

Version 1.2 of Makai Voyager geospatial software enables users to import and visualize their scientific and GIS data. Users can now preprocess lidar, GIS and volumetric data from common formats into streamable files. Volume rendering for large 4D data, such as NetCDF, added. It is available on Windows, Linux and Mac OS X. Makai Ocean Engineering Inc.

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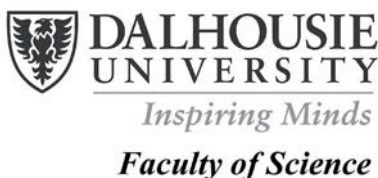
Canada Research Chair (Tier II) in Ocean Technology Systems

The Department of Oceanography at Dalhousie University in Halifax, Canada (www.oceanography.dal.ca) is respected internationally for its strong interdisciplinary training and research in ocean science. Together with partners from government research, academia and industry, the Department now plays a leading role within the newly formed Halifax Marine Research Institute which seeks to maximize the potential of the region's vibrant and growing ocean research and technology sector. Since 2011, the Department has hosted the Canada Excellence Research Chair in Ocean Science and Technology, which is developing new approaches to observe the changing ocean and to study ocean processes. In association with this CERC group, Dalhousie University is seeking a motivated individual to fill a new ocean research chair:

Dalhousie University invites applications for a Tier II Canada Research Chair in the field of Ocean Technology Systems. The position is associated with Dalhousie's Canada Excellence Research Chair in Ocean Science and Technology and will be held in the Department of Oceanography of the Faculty of Science with potential for joint appointment with the Faculty of Engineering. The candidate will be expected to establish and maintain an active research program addressing new, practical approaches to at-sea sensing and measurement of physical, chemical, atmospheric and/or biological processes. Potential areas of research include development and application of robotics, novel platforms, power and communication systems, sensors and/or instruments.

The candidate will have obtained a PhD degree within the last ten years, have post doctoral research experience, and a research track record that demonstrates particular research creativity and the potential to achieve international recognition in the next five to ten years. It is anticipated that the appointment will be tenure-stream and made at the Assistant or Associate Professor level. The successful candidate will be expected to teach undergraduate and graduate classes in ocean science and/or engineering, and to develop a vigorous and creative research program with external funding. The candidate will have opportunities to interact with a wide range of researchers at the University, nearby government laboratories and a broad range of companies working in the ocean technology sector.

Applications should consist of a Curriculum Vitae, a list of publications and patents, a summary of research interests, a research proposal (no more than 3 pages), a statement of teaching interests and experience, and the names and contact information for at least three referees.



The completed application should be sent to:

Chair, Ocean Technology Systems Search
Oceanography Department
Dalhousie University
1355 Oxford Street
PO Box 15000
Halifax, Nova Scotia B3H 4R2
Canada

Email: oceanography@dal.ca

Appointment is subject to approval by the Canada Research Chair program. Consideration of candidates will begin in April 2013 and continue until the position is filled. Dalhousie University is an Employment Equity/Affirmative Action employer. The University encourages applications from qualified Aboriginal people, persons with a disability, racially visible persons and women.

Watertight Integrity Testing

A semifixed system for monitoring seals for watertight or weathertight degradation, the Permascanner Dynamic can check the seals of doors, holds and hatchcovers while at sea. The main generator is placed inside the hold, attached by magnets. Its battery provides up to 10 days of testing. Coltraco Ltd.

Thickness Gauge



Based on the original Multigauge 5600, this upgraded version includes a large color display and a new graphic menu. The gauge utilizes the multiple echo technique to ignore coatings up to 6 mm thick and measure only the metal substrate. Tritex NDT Ltd.

Radar Level Sensor

Designed to work with Valeport's Tide-Master tide logger or as a standalone device with optional integrated GPRS telemetry, the VRS20 uses 25 GHz pulsed K-band radar to measure water level to ± 10 mm accuracy. Alternatively, it can interface with a third-party data logger. Valeport Ltd.

Echosounder for Fishery Surveys

With upgrades to the ME70 multibeam echosounder's hardware and software

(version 1.2.5), beamforming can be carried out on a single computer, rather than six. The update also introduces Windows 7 compatibility and increases the absolute maximum range from 1,000 m to 2,000 m. Simrad.

Nano-Ceramic Lubricating Grease

With a lower coefficient of friction than traditional PTFE greases, DAY-Lube operates in temperatures from -40° F to 800° F. Lasting for more than 100,000 production strokes, it is ideal for workboats, as well as port-side material handling equipment like cranes, lift trucks and conveyors. Dayton Progress Corp.

Monochrome CCD Camera

Ideal for very low light level, underwater viewing and navigation, the EXPLORER LITE is fitted with a wide-angle, high-speed, aspherical lens, giving a 103° diagonal field of view. Its housing options are hard anodized aluminum (rated to 1,500 m) or titanium (rated to 6,000 m). Bowtech Products Ltd.

Analog, Digital Data Acquisition Card

The Model 826, a PCI Express I/O board, features six encoder/timer/counter interfaces, 16 differential analog inputs (16-bit, 300 kS/s), 8 analog outputs (16-bit, 900 kS/s), 48 bidirectional digital I/Os with edge capture, three-stage watchdog timer and output fail-safe controller. Sensoray Co. Inc.

Full Environmental Sealing Boot

Resistant to salt spray, sunlight, ozone, weather, and most acids and lubricat-

ing oils, the HEXSEAL 1131/60 inverted bellow toggle switch boot can be attached to avoid unintentionally tripping a sensitive breaker/switch on or off. It operates in temperatures from -94° F to 400° F and pressures to 15 psi internal and 1,500 psi external. APM HEXSEAL.

Instrument With Field-Swappable Sensors

A real-time, single-parameter instrument, the Micro•X comes in two configurations: one compatible with sound velocity or conductivity Xchange sensors, and another compatible with temperature, pressure, dissolved oxygen and turbidity Xchange sensors. It offers 25-Hz sampling. AML Oceanographic.

Dual-Port USB Charger

Compatible with any USB 1.1, 2.0 or 3.0 electronic devices, the Hubbell USB Charger Receptacle provides 3 amps of power via two USB ports. It can recharge one tablet computer from 0% to 100% in 5 to 6 hrs. It installs in a standard electrical box deeper than 1.5-in. with internal AC/MC clamps. The faceplate is 2.62-in. high by 1.3-in. wide. Hubbell Marine Electrical Products.

Interceptor System

Humphree Control System 5 (HCS-5) features a new control panel with a high-resolution color screen readable in bright sunlight. Other features are an intuitive user interface, night mode, and actual trim and list data in real time. A control unit with state-of-the-art motion sensors provides power distribution to the servo motors. Humphree. ■

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Total Enters Deep Offshore Exploration in Cyprus

Total SA (Paris, France) signed in February two production sharing contracts (PSCs) for blocks 10 and 11 with the Republic of Cyprus. The PSCs were awarded as part of the second offshore exploration licensing round, launched by the Cypriot government in 2012.

The licenses extend more than 2,572 square kilometers in block 10 and 2,958 square kilometers in block 11, southwest of Cyprus, in water depths ranging from 1,000 to 2,500 meters. The exploration program will begin with 3D seismic surveys in block 11 and 2D seismic surveys in block 10.

Shell's Arctic Rigs En Route to Asian Shipyards for Repairs

The two rigs intended for Royal Dutch Shell plc's (The Hague, Netherlands) drilling program offshore Alaska will undergo repairs at shipyards in Asia, *Reuters* reported in February. Shell has not confirmed whether it will drill offshore Alaska in 2013, but the ships' repairs and previous issues have cast further doubt on whether such plans would be feasible.

Shell has yet to name the shipyards, but the *Kulluk* will be dry-docked and the *Noble Discoverer* will go to South Korea. The ships were scheduled to depart Alaska in March for a two-to-four-week-long trip to their destinations.

At the end of last year, the *Kulluk* had run aground near Kodiak Island after slipping its tow lines. Government regulations and testing had further slowed Shell's progress, as problems were identified with the company's support vessels and *Noble Discoverer* rig. In October, a fire broke out on the *Discoverer*. These mishaps culminated with the U.S. Department of the Interior launching a review of Shell's program in January 2013.

Shell has spent \$4.5 billion on its efforts in the Chukchi and Beaufort seas, according to *Reuters*. The *Noble Discoverer*, under contract from owner Noble Corp. (Baar, Switzerland), is costing Shell \$244,000 per day, while it is docked in Seward, Alaska, where U.S. Coast Guard inspections revealed deficiencies in its environmental and safety systems.

Oceaneering Awarded Subsea BOP Control Systems Contracts

Oceaneering International Inc. (Houston, Texas) has secured contracts worth more than \$40 million with a subsidiary of Transocean Ltd. (Houston) to provide three subsea blowout preventer (BOP) control systems.

The contracts are for discrete hydraulic systems that will be used on existing semi-submersible drilling rigs that Transocean is modifying to comply with the American Petroleum Institute's recently issued standard API 53, which requires subsea BOPs with a single shear ram to be upgraded or replaced.

These systems will be manufactured at the Oceaneering Intervention Engineering facility in Houston, with deliveries anticipated in the fourth quarter of 2013 and the first quarter of 2014.

DPS Offshore Renamed Forum Subsea Rentals

Forum Energy Technologies Inc. (Houston, Texas) recently announced the rebrand of its DPS Offshore (Aberdeen, Scotland) product line to be known as Forum Subsea Rentals.

Forum Subsea Rentals services operates from locations in Aberdeen; Great Yarmouth, England; Houston; Dubai, United Arab Emirates; and Singapore.

38 Million Acres Offered In Central Gulf of Mexico Lease Sale

The Central Gulf of Mexico Lease Sale 227, planned for mid-March, will offer 38.6 million acres offshore Louisiana, Mississippi and Alabama for oil and gas exploration and development, the U.S. Bureau of Ocean Energy Management (BOEM) said in February.

The sale encompasses 7,299 blocks located from 3 to 230 miles offshore, in water depths ranging from 3 to 3,400 meters. BOEM estimates the lease sale could result in the production of 0.46 billion to 0.89 billion barrels of oil, and 1.9 trillion cubic feet to 3.9 trillion cubic feet of natural gas.

The sale, which includes all unleased areas in the Central Gulf of Mexico planning area, will be the second sale under the Outer Continental Shelf Oil and Gas Leasing Program for 2012 to 2017. It is the first of five Cen-

tral Gulf of Mexico lease sales that will be held under the program.

Variable Bore Rams to Provide BOP Rams to Weatherford Asia

Variable Bore Rams Inc. (Lafayette, Louisiana) has entered into an agreement with Weatherford Asia Pacific Pte Ltd. (Singapore) to provide blowout preventer (BOP) rams.

Equipment stocking began in February to allow for the quicker deployment of rams in the Asia Pacific region. The range of stock will include rams in 7 1/16 inch, 3 to 15M; 11 inch, 3 to 10M; 13 5/8 inch, 3 to 10M; 18 3/4 inch, 10 to 15M; and 21 1/4 inch, 2M.

The venture will be headed by the Weatherford Pressure Control Business unit and Variable Bore Rams Inc.'s International Operations department. Both will oversee all operational activity involved with the contract.

UK Subsea Companies See Bright Future for Industry, Survey Says

Subsea companies in the U.K. are very optimistic for business in 2013 after the industry had a profitable 2012, according to a survey of Subsea UK members.

The survey results, released in February, found that all firms are predicting significant growth in the next 12 months. Almost half expect to grow by 30 percent and a third by more than 50 percent.

Almost 90 percent of those surveyed saw turnover and profits rise in 2012, with more than half reporting growth of 20 percent and a fifth reporting more than 50 percent growth.

The main drivers for growth were a sustained high oil price, an increase in global demand, and new technology and innovation that are leading to more developments becoming viable. The fastest growing subsea segments are inspection, repair and maintenance, integrity and reliability, decommissioning and offshore wind.

The biggest challenge facing the sector is recruiting and retaining skilled people, with 88 percent citing this as their foremost constraint.

Other challenges reported by 15 percent or more respondents were access to finance and working capital in particular, finding suitable premises, controlling costs and managing growth. ■

AUV, ROV Uncover Hidden Underwater Faults

Monterey Bay Aquarium Research Institute (MBARI) and U.S. Geological Survey geologists have brought underwater faults offshore California, hidden by ocean waves and masked by sand and mud on the seafloor, into view for the first time.

These faults are notoriously difficult to see and even more difficult to study. As a result, geologists struggle to evaluate the risks associated with these faults and often cannot include them in seismic hazard assessments. The team's methods were very similar to those used to study faults on land, but this was among the first studies to take similar measurements underwater, said MBARI geologist Charlie Paull.

The team conducted its studies off the coast of Southern California in the California Borderland. The researchers collected ultrahigh-resolution images of the seafloor using one of MBARI's AUVs, which also measured the thickness of the muddy layers of sediment.

They then used these images to measure the slip rate within the San Diego Trough Fault Zone, the first slip rate that has ever been recorded for an offshore fault within the California Borderland.

To calculate the fault's slip rate, the researchers first used data from MBARI's Dorado-class, seafloor-mapping AUV to measure how far the fault had shifted the seafloor and found a shift of about 18 meters. To estimate how long this 18-meter shift took to form, the team used sub-bottom profiles and collected samples of sediment using MBARI's ROV Doc Ricketts.

Using the new sonar data, the team also discovered that this fault extends 60 kilometers further north than previously mapped. It may even be linked to the San Pedro Basin Fault Zone, which extends an additional 90 kilometers to the northwest. If this is the case, this fault zone would be one of the longest in the California Borderland and could produce some of the largest earthquakes in the region.

PharmaSea Hunts for Potential Antibiotics in Deep-Sea Trenches

In an effort to uncover bacteria that can produce new antibiotics, the PharmaSea project will plunge up to 2 kilometers below sea level to retrieve samples this autumn in the Atacama Trench in the Eastern Pacific Ocean about 100 miles off the coast of Chile and Peru. The four-year project is backed by £8 million of European Union funding.

The team will also search the Arctic waters off Norway and the Antarctic via Italian and South African partners. Deep trenches will also be accessed off New Zealand.

Using fishing vessels, the team will drop a sampler on a reel of cables to the trench bed to collect sediment. Scientists will then attempt to grow unique bacteria and fungi from the sediment, which can be extracted and refined to discover new antibiotics.

Most experts agree over-reliance and inappropriate prescribing of antibiotics has led to an increase in drug-resistant bugs. Medical experts fear effective antibiotics might soon run out completely, leaving no means to treat seriously ill patients in the future. "There hasn't been a completely new



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antibiotic registered since 2003. This is partially because of a lack of interest by drug companies as antibiotics are not particularly profitable," said project leader Marcel Jaspars, a professor of chemistry at the University of Aberdeen. "The average person uses an antibiotic for only for a few weeks and the drug itself only has around a five-to-10-year lifespan—so the firms don't see much return on their investment."

Only a handful of samples have ever been taken from deep trenches and investigated. The results of the project could be available to treat patients within a decade.

Scientists Prototype Titanium Fish Trackers With 3D Printing

The Commonwealth Scientific and Industrial Research Organisation (CSIRO) scientists are using 3D printing to build a new generation of titanium fish tags. The aim is to use the tags to track big fish such as marlin, tuna, swordfish, trevally and sharks for longer periods.

CSIRO is printing the tags at its 3D printing facility in Melbourne, Australia. The tags are printed overnight and then shipped to Tasmania where

marine scientists are trialing them. Tags are made of titanium for several reasons: the metal is strong, resists the salty corrosiveness of the marine environment and is biocompatible (non-toxic to living tissues).

One of the advantages of 3D printing is that it enables rapid manufacture of multiple design variations, which can then be tested simultaneously, in as little as a week. CSIRO's 3D printing facility prints metal items layer by layer out of fused metal powder. Had the scientists been using conventional tags, which are machined out of metal blocks, it would have taken a couple of months to design, manufacture and receive the new designs for testing.

Scientists from a number of agencies, including CSIRO Marine and Atmospheric Research, use fish tags to track movements of individual marine species and increase understanding of their behavior.

IOOS Publishes Guide for Ocean Data Standardization

The U.S. Integrated Ocean Observing System (IOOS) has issued the first in a series of IOOS manuals designed to improve standardized collection of

ocean data, "A Guide to Quality Control and Quality Assurance for Dissolved Oxygen Observations in Coastal Oceans." This standardization of 26 different oceanographic data variables should enhance accuracy of tools, models and forecasts.

The manual, available at www.ioos.gov/qartod, focuses on best practices for quality assurance and control tests of dissolved oxygen measurements taken by commonly used sensors in all coastal regions, including the Great Lakes. The next manuals, expected out this spring, will feature best practices for wave and current data.

Developed with observing experts and sensor vendors, the manual provides a checklist that each IOOS region, as well as others who operate data collection centers, can use to begin quality assurance and control procedures while still addressing specific regional needs.

The effort behind the manuals began in 2003, looking at then-existing community-based quality assurance/quality control efforts and standards across federal agencies and in the development of U.S. IOOS Regional Coastal Ocean Observing Systems. ■

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More Rain From Climate Change Could Strengthen Marshes

Rising sea levels from a warming climate are predicted to threaten many coastal sea marshes around the world in the coming decades. Global climate change is also predicted to increase the frequency and severity of storms. A research study in the *Journal of Geophysical Research: Earth Surface* takes into account how increased storminess could affect the ability of coastal marshes to withstand sea level rise.

Researchers ran simulations of marshes on the German island of Sylt in the Wadden Sea for the period from 2010 to 2100. They analyzed simulations of 48 sea level-rise scenarios and 13 storm scenarios to identify the critical rate of sea level rise that would allow marshes to survive just until 2100.

They found that with no increase in storminess and with constant sea level rise, the maximum rate of sea level rise the marshes could withstand was 19 to 21 millimeters per year. But when they took into account storminess, the marshes' ability to withstand sea level rise increased: Marshes survived an additional 3 millimeters per year of sea level rise with increasing frequency of storms, though only an additional 1 millimeter per year if storm intensity, but not frequency, increased.

Flooding from storms tends to transport sediment to the marshes from adjacent areas, helping to build up the marshes. Thus, the effects of increased storminess on a particular marsh's ability to withstand sea level rise will depend on the availability of erodible fine-grained material near the marsh, the researchers said.

Public Can Weigh in on Gulf Coast Restoration

The Gulf Coast Ecosystem Restoration Council, established by the U.S. Congress' Resources and Ecosystem Sustainability, Tourism Opportunities and Revived Economies of the Gulf Coast States (RESTORE) Act of 2012, held public engagement sessions in February in Mississippi, Louisiana and Florida to allow for initial input into the comprehensive plan for Gulf Coast restoration. The council will announce additional dates and locations for

public sessions as they become available. In January, the council released *The Path Forward to Restoring the Gulf Coast*, a report describing how it will develop an initial comprehensive plan. A draft plan will be released for public comment in the spring.

The plan's goals are to restore and conserve habitat, restore water quality, replenish and protect living coastal and marine resources, enhance community resilience, and restore and revitalize the gulf economy.

Indonesia Government Promotes National Blue Economy

Indonesia's Maritime Affairs and Fisheries Ministry has chosen Nusa Penida, Lombok and Batam islands for a national pilot project to develop a blue, sustainable economy, *The Jakarta Post* reported. Development potential and investment costs are currently being calculated.

To improve infrastructure in the eastern parts of the country to support the project, the ministry plans to provide incentives on sea transportation to ease access and facilitate connectivity between islands. The ministry will also improve fishery commodity-processing plants in eastern Indonesia.

In 2013, the maritime and fishery sector is expected to contribute \$6.8 billion to the GDP. The ministry is targeting a 2013 export value from the sector of \$5 billion, compared to \$4 billion in 2012.

Exports of marine and fishery products constituted 86 percent of total trade in 2012, while imports accounted for only 14 percent.

Fish Discovered at Record Depths In Kermadec Trench

Scientists from the University of Aberdeen's Oceanlab, New Zealand's National Institute of Water and Atmospheric Research (NIWA), and Museum of New Zealand Te Papa Tongarewa have discovered a new species of fish and gained new knowledge of life at previously unexplored depths during seven days of ocean sampling on the edge of the Kermadec Trench at 1 to 6.5 kilometers depth. They took more than 6,500 photographs of deep-sea fish and caught about 100 fish.

Among the discoveries were a new species of eelpout at 4,250 meters depth, a new depth record of 5,500 meters for a rattail fish, another rattail fish at 2,000 to 4,500 meters depth and a new depth record of 3,500 meters for large, deep-sea cusk eels.

On board the RV *Kaharoa*, the scientists used landers with cameras attached that free fall to the seafloor, as well as baited fish traps to attract the animals.

The amount of data recovered adds to the information collected on three previous voyages to the Kermadec Trench by the Aberdeen-NIWA collaboration aboard the *Kahora*.

All the equipment used in these research cruises was designed and constructed at Oceanlab.

The results are improving understanding of biodiversity in the deep sea around New Zealand, and assessment of potential risks to the ecosystem from future climate change and human activities, such as seabed mining.

EU Could Limit Fish Catches For Sustainability

The European Parliament approved in February a plan to reform the European Union's (EU) Common Fisheries Policy, *ScienceInsider* reported. The plan will limit catches, ban discards of unwanted species and improve the use of scientific data for long-term planning.

The European Commission said 68 percent of the EU's stocks are overfished. If the new rules are fully adopted, fish stocks should "recover by 2020, enabling us to take 15 million tons more fish, and create 37,000 new jobs," said Ulrike Rodust, a German member of the parliament.

Starting in 2015, regulators would set catch limits according to a maximum sustainable yield (MSY), preventing fishermen from catching more than a fish stock can reproduce in a given year. MSY is common in the U.S.

Europêche, a European fishing lobby, thinks MSY should be postponed to 2020.

The reform plan must be discussed with governments from the EU's 27 member states. If an agreement is reached by the end of June, the plan could be enacted next year.

Spain and France, two of the EU's top fishing nations, oppose the reform, according to Greenpeace. ■

SeaRobotics Delivers First HullBUG for Testing

SeaRobotics Corp. (Stuart, Florida) has delivered the first Hull Bio-inspired Underwater Grooming (HullBUG) System to the Center for Corrosion and Biofouling Control at Florida Institute of Technology. It will be tested and further developed at the newly commissioned large-scale seawater facility located at Port Canaveral in Florida and funded by the U.S. Office of Naval Research.

The HullBUG system is an AUV designed to crawl on ship hulls or other underwater structures to groom their surfaces to keep them clean of marine growth. It weighs 30 to 40 kilograms, attaches to the hull and performs a gentle cleaning function. Numerous embedded computers perform navigation and sensing tasks to facilitate grooming the ship hull.

"The highly automated proactive grooming, or light cleaning ... will revolutionize hull maintenance allowing it to remain in a clean state at all times," said Geoffrey Swain, a Florida Tech professor of ocean engineering.

The AUV can attach to ferrous, non-ferrous and fiberglass hulls. Opportunities are being explored in commercial shipping, oil and gas, and nuclear and conventional power generation markets.

The HullBUG is being tested on an 8-foot by 30-foot steel plate, coated with U.S. Navy-qualified antifouling coatings, which simulates a ship's hull.

The estimated 5 percent improvement in fuel efficiency achieved through proactive grooming translates into a savings of \$15 billion a year for the global shipping industry, SeaRobotics said. Additionally, this grooming will achieve a proportional reduction in the 1 billion tons of greenhouse gases a year emitted by the fleet.

Great Barrier Reef Pilots to Get Touchscreen Devices for Safety

SevenCs (Hamburg, Germany) has partnered with VoyageBank (Cairns, Australia) to deliver Portable Pilot Unit (PPU) technology to 50 marine pilots responsible for keeping the Great Barrier Reef free of shipping disasters.

The three-year deal, signed with the Australian Reef Pilots industry group,

will bring navigation, real-time monitoring and centralized management of pilotage activities as part of a pilotage safety management system.

The new PPUs are touchscreen devices that run the SevenCs Orca Pilot G2 pilotage software, and they were customized by SevenCs for pilotage within the reef.

SeeTrack Now Compatible With Sea Scan HDS

SeeByte Ltd. (Edinburgh, Scotland) announced in February the compatibility of its SeeTrack Military software systems with the Marine Sonic Technology Ltd. (White Marsh, Virginia) high-resolution Sea Scan HDS side scan sonar system.

SeeTrack Military is an open-architecture platform solution for rapid on-site analysis and data fusion that can be adapted for specific user needs. It was developed as a mission-planning, monitoring, post-processing and reporting tool, and can be used on surveys, military and security operations, and scientific experiments.

Sea Scan HDS has a small top-side processor (8 by 4.5 by 1.75 inches) and is lightweight, shock-resistant, and designed to provide a telemetry interface between the tow fish and a Windows PC. The top-side processor design provides for a tow-cable connector, USB 2.0 connector, fuse holder, power connector, LED power indicator and power switch. The system can be powered from a 12-to-24-volt DC or 90-to-240-volt AC, 50-to-60-hertz power source.

Space, Deep-Sea Scientists Will Jointly Develop Autonomous Tech

Several German space and marine research institutions under the leadership of the Alfred Wegener Institute (AWI) Helmholtz Centre for Polar and Marine Research have joined forces for the Robotic Exploration under Extreme Conditions (ROBEX) project. They will share research and develop robot technologies to explore the moon and the deep sea independently over long periods.

"We are faced with the same technical challenges in the exploration of both regions. Neither for the deep sea nor for the moon has a solution so far

been found, for example, as to how robot systems can move and conduct measurements a year long on their own and independently without exhausting their batteries," said Professor Karin Lochte, scientific director of AWI.

One of the goals is to develop a control unit for new autonomous deep-sea robot systems that recognizes and avoids any object lying in its path, such as stones. Future robots would also be able to independently take soil samples from deep-sea volcanoes and help to minimize the risks of deep-sea exploration. Furthermore, technologies would be developed to reliably monitor pipelines on the seafloor or the foundations of offshore structures over long periods of time.

The Helmholtz Association is supporting the five-year project with €15 million. The same sum is being contributed by the scientific institutions involved: AWI, five institutes of the German Aerospace Center, GEOMAR – Helmholtz Centre for Ocean Research Kiel, German Research Center for Artificial Intelligence, Center for Marine Environmental Sciences at the University of Bremen, Jacobs University, Technical University of Munich, Technical University of Dresden, Technical University of Berlin and Technical University of Kaiserslautern.

C-Stat 2 Buoy to Monitor Japanese Coast for Earthquakes

ASV Ltd. (Portchester, England) has delivered a C-Stat 2, an autonomous mobile station-keeping buoy, to Tohoku University in Japan. It will be used to help predict earthquakes off the Japanese coast.

The C-Stat hull is made of aluminium with a polyurethane-coated closed-cell foam fender and is powered by a hybrid diesel-electric drive system. An integral fuel tank provides an endurance of four and a half days in currents up to 3.5 knots and more than 20 days in lower speed currents such as 1.5 to 2 knots.

The vessel can be controlled by a UHF data link for line-of-site control or a satellite link for global control. The portable control console comes with a handheld controller for close-quarters maneuvering when launching and retrieving alongside a ship or harbor wall.

The buoy will also be developed for the oil and gas, and military markets. ■

Wave Energy Project Gets Go-Ahead in Yakutat, Alaska

Resolute Marine Energy (RME) of Boston, Massachusetts, announced in February that its preliminary permit application to the U.S. Federal Energy Regulatory Commission (FERC) has been approved for the Yakutat Wave Energy Project in Alaska.

In July 2012, RME filed an application for a preliminary permit to study the feasibility of the project, which involves a 25-square-mile area within submerged lands off Yakutat, a remote community in southeast Alaska. The project will consist of an array of RME's SurgeWEC wave energy converters for a total installed capacity of 750 kilowatts. The estimated annual generation exceeds 3,000 megawatt-hours.

"Today we're totally at the mercy of the price of diesel fuel," said Scott Newlun, general manager of Yakutat Power. "We see a huge energy resource going to waste over on Cannon Beach and hope this project brings sustainable power to Yakutat and eases

the cost of energy on our rate payers, which is currently 55 cents per kilowatt-hour for most residential customers."

Studies and planning will now start for the design of the project and preparation for a FERC operation license application.

In December 2012, RME successfully tested its latest SurgeWEC device off the Outer Banks in Duck, North Carolina. The tests were the final phase of work under an award from the U.S. Department of Energy.

Maine Approves Statoil Hywind Demonstration Project

Maine's Public Utilities Commission has approved support for the Statoil (Stavanger, Norway) Hywind Maine demonstration project, which means utility customers will have to pay about 75 cents more a month on average, *Portland Press Herald* reported.

Hywind could become the first floating wind turbine park in the United States.

Statoil's proposal won a \$4 million grant from the U.S. Department of Energy. The company is now competing for final awards up to \$47 million. But if Statoil doesn't win a second grant installment or Congress does not renew a key tax credit for renewable energy, the company might not move forward with Hywind.

If Statoil does proceed, the project, which would cost \$120 million, would put four 3-megawatt wind turbines on floating spar-buoy structures tethered to the seabed at 460 feet depth. Power could be moving through undersea cable into the grid by 2016.

Norway's Hywind project has exceeded performance goals by generating power 50 percent of the time and surviving 50-foot waves and hurricane-force winds. The success, however, came at a high price tag: \$62 million for the single 2.3-megawatt turbine. The company aims to reduce the technology's cost, which the Maine Hywind project could facilitate.

The Maine Hywind would help Statoil reach its goal for this decade of producing power at 10 to 15 cents per kilowatt-hour in a commercial wind park.



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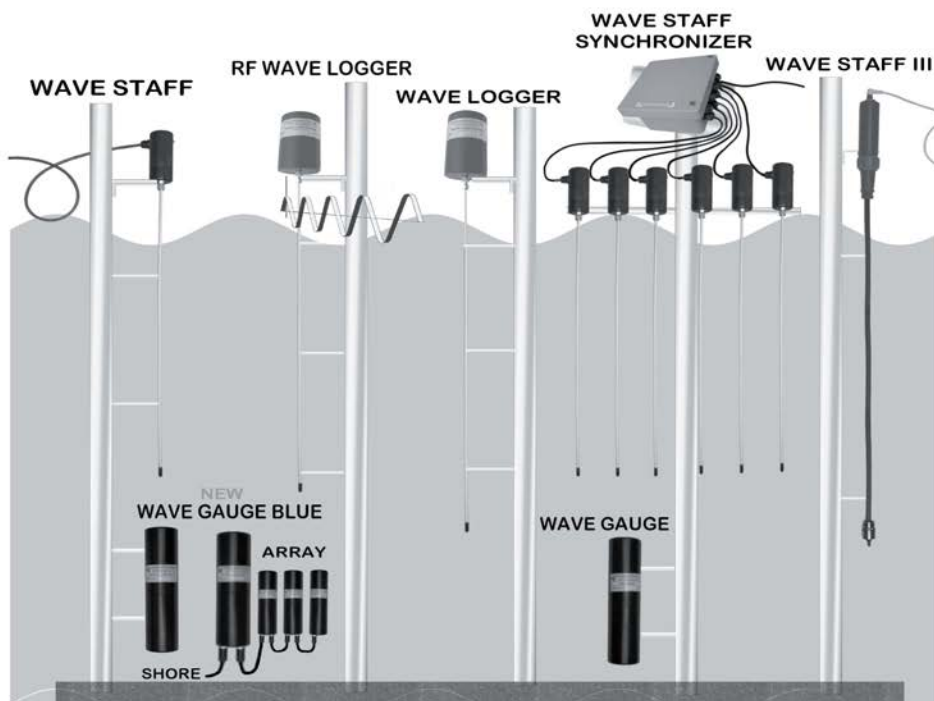
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EMP Teams With Solbian To Bring Solar Panels to Ships

Eco Marine Power Co. Ltd. (EMP) of Fukuoka, Japan, will collaborate with Solbian Energie Alternative Srl of Avigliana, Italy, to develop applications for Solbian's solar-cell technology across a variety of marine renewable energy projects for shipping, including EMP's Aquarius MRE System, which comprises rigid sails, solar panels and energy storage modules.

Initially, lab testing activities in Osaka, Japan, will focus on incorporating

Solbian's technology into EMP's EnergySail, which can be configured with solar panels or wind power devices. Later this year, sea trials are planned, as well as the application of Solbian technology to other projects, such as EMP's AquariusUSV and Aquarius Eco Ship.

Solbian's light, flexible and impact-resistant photovoltaic modules, or SOLBIANFLEX panels, use lightweight polymer films instead of traditional glass, which allows for new applications for the proven technology of

crystalline silicon cells. The polymers are also highly resistant to weathering, even under extreme conditions.

WindSentinel Buoy to Aid Taiwan's Offshore Wind Projects

AXYS Technologies Inc. (Sidney, Canada) will supply the National Cheng Kung University (NCKU) in Taiwan with the WindSentinel wind resource assessment buoy.

The purchase has been funded by a National Science Council grant. The system will be used to support Taiwan's development of 3 gigawatts of offshore wind projects.

At this first stage, the WindSentinel will be deployed in the Super Tank at NCKU's Tainan Hydraulics Lab.

New O&M Base for Sheringham Shoal Wind Farm

Scira Offshore Energy Ltd. (Walsingham, England), which runs Sheringham Shoal Offshore Wind Farm, moved in February to a new operation and maintenance (O&M) base at Wind Farm Place in Egmere, England.

The facility is a low-energy consumption building, with low-energy lighting, highly insulated walls, a green roof to reduce rainwater run off and gray-water recycling of rainwater to flush toilets. With 900 square feet of office accommodation and 400 square feet of warehousing, the facility will house Scira's management and administration staff, and serve as the base for the wind turbine technicians.

MTU's Series 2000 Engines Power Wind Farm Support Vessels

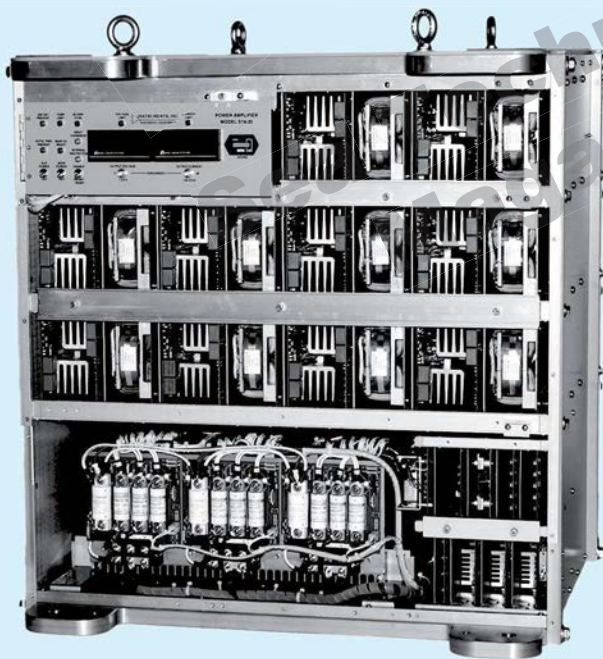
VEKA Group (Werkendam, Netherlands) has launched its first wind farm support vessel series, called *Animal*. Each ship in the series is equipped with twin 8V 2000 M72 engines from MTU Friedrichshafen GmbH (Friedrichshafen, Germany). The catamaran is about 20 meters in length and has a service speed of 23 knots, with a top speed of 27 knots. The support vessel can carry 12 passengers and a three-man crew.

MTU has also delivered twin 8V 2000 M72 engines for the first of eight wind farm support vessels by shipbuilder Strategic Marine Pty Ltd. (Henderson, Australia). The 21-meter catamaran, which is capable of speeds up to 25 knots, was built for the European market in the Singapore shipyard of Strategic Marine. ■

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environmental monitoring

NASA to Launch Ocean Wind Monitor to Space Station

Reusing hardware originally built to test parts of NASA's QuikScat satellite, the agency will launch the ISS-RapidScat instrument to the International Space Station in 2014 to measure ocean-surface wind speed and direction.

The ISS-RapidScat instrument will help improve weather forecasts, including hurricane monitoring, and understanding of how ocean-atmosphere interactions influence Earth's climate.

ISS-RapidScat will fill the data gap created when QuikScat, which was designed to last two years but operated for 10, stopped collecting ocean wind data in late 2009. NASA and NOAA have studied next-generation replacements for QuikScat, but a successor will not be available soon. NASA's Jet Propulsion Laboratory and the agency's station program proposed adapting leftover QuikScat hardware in combination with new hardware for use on the space station.

ISS-RapidScat will have measurement accuracy similar to QuikScat's and will survey all regions of Earth accessible from the space station's orbit. The instrument will be launched to the space station aboard a SpaceX Dragon cargo spacecraft. It is expected to operate autonomously aboard the station for two years.

Present scatterometer orbits pass the same point on Earth at approximately the same time every day. Since the space station's orbit intersects the orbits of each of these satellites about once every hour, ISS-RapidScat can serve as a calibration standard and help scientists stitch together the data from multiple sources into a long-term record.

Unique System FZE Installs First Permanent Tidal Station in Dubai

Unique System FZE (Sharjah, United Arab Emirates), along with The Geodesy and Hydrographic Survey Section of Dubai Municipality, established a permanent tidal station at Al

Mamzaar. The station will collect precise tide data continuously for 19 years to calculate the mean sea level and annual sea-level rise, provide precise tide and meteorological data, and define and update a precise vertical datum for Dubai Emirate.

There is no such permanent tidal station elsewhere in the Gulf region, and this is first time such a project is being undertaken in the Middle East, Unique System FZE said. As a result of significant dredging and construction in the nearshore and offshore area of Dubai, the sea level has risen. Also, due to global warming, the Geodesy and Hydrographic Survey Section of the Survey Department felt the need for a permanent tide gauge station in the Gulf Sea.

The Survey Department of Dubai Municipality already has a network of five coastal and offshore tide and meteorological stations that have been continuously monitoring and recording data since 2004.

Seafloor Boreholes Illuminate Stress Change in Tohoku Quake

The magnitude-9.0 Tohoku earthquake in March 2011 produced the

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largest slip ever recorded in an earthquake, more than 50 meters. Such huge fault movement on the shallow portion of the megathrust boundary came as a surprise to seismologists because this portion of the subduction zone was not thought to be accumulating stress prior to the earthquake.

These large slips are the results of a complete stress drop during the earthquake, Integrated Ocean Drilling Program (IODP) reported in a study published in *Science*, which sheds light on the stress state on the fault that controls the very large slip.

The expedition, mobilized by the Japan Agency for Marine-Earth Science and Technology (JAMSTEC) in April 2012, is the first time that "rapid-response drilling" (within 13 months after the earthquake) has been attempted to measure the temperature across a subduction fault zone.

The team investigated the large displacement by drilling from the ocean floor to the plate boundary, reaching a maximum depth of more than 850 meters below seafloor (mbsf).

Drill sites were located approximately 220 kilometers from the east-

ern coast of Honshu, Japan, in nearly 7,000 meters of water.

An important finding of the paper is that the present shear stress on the fault is nearly zero, indicating that there was a nearly complete stress change during the earthquake. Usually, earthquakes are thought to release only a portion of the stress on the fault.

The expedition set new milestones in scientific ocean drilling by drilling a borehole to 854.81 mbsf in water depths of 6,897.5 meters. Deep core was obtained and analyzed from this depth. The Japan Trench plate boundary was sampled and a parallel borehole was instrumented with a borehole observatory system.

The expedition is conducting further investigations of core samples and borehole logging data.

Scientists Identify Which El Niño Events Impact US Winters

By examining sharp dips in heat radiating from the tops of deep convective clouds, or outgoing long-wave radiation (OLR), during El Niño, forecasters could more accurately predict the unusual, highly unpredictable weather caused during these events.

This new method, found by scientists from NOAA and the University of Washington, could allow meteorologists to forecast outlooks for the winter season more accurately. The study was published in the February issue of the *Journal of Climate*.

A network of buoys that spans the Pacific, the TAO-Triton array, observes conditions in the upper ocean and helps forecast El Niño months in advance.

Scientists looked at all El Niño events that were identified by sea surface temperature measurements since 1979. They then examined satellite imagery and found that a subset of the events showed a sharp dip in OLR.

When comparing the El Niño events to historical weather records, they found that the El Niño events with drops in OLR were the ones most likely to play havoc with winter weather.

El Niño events with no corresponding drop in OLR did not produce statistically significant anomalies in weather patterns.

The dip in heat from deep convective clouds usually occurred before winter, so the timing of the signal could help forecasters improve winter seasonal outlooks. ■

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contracts

McDermott International Inc., Houston, Texas, contract to develop offshore surface facilities and an infield flowline for the Kepodang Field in water depths up to 70 meters, including procurement, construction, installation and commissioning of a central processing platform, a well-head platform, an infield flowline and installation of remote control facilities onshore. Completion is expected in 2014. Petronas Carigali Muriah Ltd.

Navis Engineering Oy, Vantaa, Finland, contract to supply six DP2 systems for the series of Fast Support Intervention Vessels being built at the Piriou SEAS shipyard in Vietnam. Bourbon.

General Dynamics NASSCO, San Diego, California, contract to design the conversion of two 839-foot *Orca*-class diesel-electric trailerships, which operate between Tacoma, Washington, and Anchorage, Alaska, to LNG propulsion. Totem Ocean Trailer Express Inc.

Intelsat Global S.A., Luxembourg, multiyear agreements to enable provision of broadband service in the Indian Ocean. Capacity will be used on Intelsat 22 at 72° East, Intelsat 702 at 33° East, and the IntelsatOneSM terrestrial network. GLOBAL IP.

Aquatec Group Ltd., Hartley Wintney, England, 1.6 million Norwegian krone contract to supply HYDROlog, AQUAmodem and AQUAswitch technology to equip subsea hydrotest data-logger spreads. IKM Subsea AS.

US Fab, Portland, Oregon, contract to build an Alaskan deck barge, *Iliuliuk Bay*, which is designed to house a 230-ton lift capacity Manitowoc 4100 crawler crane and other heavy machinery. Harley Marine Services Inc.

Kraken Sonar Systems Inc., St. John's, Canada, contribution agreement that

will provide funding in order to develop AquaTrak, a correlation velocity log for underwater navigation. It will be used to measure the speed over ground of UUVs and can also be used for high-resolution current profiling. National Research Council of Canada Industrial Research Assistance Program.

Parker Hannifin Corp., Cleveland, Ohio, contract to supply the ParkerRPMS (remote position monitoring system) for the *Goliat* FPSO. The ParkerPMS and ParkerRPMS will be modified for *Goliat*, and they will also play a role in safety during crude-oil loading in the Arctic. The order also includes delivery of two ParkerPMS systems to two Knutsen OAS Shipping shuttle tankers. Eni Norge.

Centre for Environment, Fisheries & Aquaculture Science, Lowestoft, England, contract to provide met-ocean data to support the development of the East Anglia Zone in the North Sea. The three-year project will involve the deployment, operation and servicing of directional waverider buoys and seabed mini-landers across the zone. East Anglia Offshore Wind Ltd.

Atwood Oceanics Inc., Houston, Texas, two-year drilling services contract for the *Atwood Orca*, which will mobilize after delivery in May for approximately 10 days to its first location offshore Thailand. Mubadala Petroleum.

Subsea 7, London, England, \$135 million contract for work on the Fram oil and gas development in the Central North Sea, including engineering, procurement, fabrication and installation of a 4.5-kilometer, 44-inch-diameter infield pipeline bundle, with integrated manifolds and tie-in structures. Offshore activities are scheduled to start and complete in 2014. Shell UK.

Pulse Structural Monitoring, Woking, England, contract to provide an integrated monitoring system, using the INTEGRi range, for the Big Foot extended tension leg platform in the Gulf of Mexico. Chevron U.S.A. Inc.

GE Oil & Gas, Florence, Italy, \$500 million contract to supply turboma-

chinery equipment and services for FPSOs P-74, P-75, P-76 and P-77 in the Cessão Onerosa region of the Santos Basin pre-salt fields. Petrobras.

FoundOcean, Marlow, England, grouting contract for 108 monopiles at West of Duddon Sands Offshore Wind Farm in the east Irish Sea. The turbine foundations will be grouted May to November, using BASF's Masterflow 9500 ExagROUT. Offshore Wind Force.

Beam Communications Pty Ltd., Mulgrave, Australia, an agreement for the supply of an initial \$1 million of Beam Inmarsat marine satellite terminals. This initial order follows the successful trial and acceptance of the Beam terminals after MCN committed in July 2012 to undertake a trial deploying 200 Beam Oceana 400 and Oceana 800 marine communication terminals on fishing vessels in China, using the Inmarsat FleetPhone Service. Delivery of the initial order will commence this quarter and be completed by May. Beijing Marine Communication & Navigation Co. (MCN).

Unique Hydrographic Systems, Navi Mumbai, India, contract to supply Seaflex Air Lift bags. The total value of the project is approximately \$70,000. The Air Lift bags range from 250 to 5,000 kilograms for a project worth \$251.2 million for the replacement of production and transportation infrastructure installed in the 1980s, extending the Mumbai High project's potential field life under pipeline replacement project PRP3. Leighton Welspun Contractors Pvt. Ltd.

Dron & Dickson, Stirling, Scotland, contract for a project involving electrical inspection and maintenance on SBM Offshore's assets. Dron & Dickson will provide a team of 60 to service the operation, including a rope access team for high-level maintenance. The firm will also provide a dedicated engineering manager to oversee work being done in all regions. In addition to providing maintenance, the frame agreement with SBM Offshore also allows for the provision of additional services, such as condition monitoring and trace heating maintenance. SBM Offshore. ■

meetings

APRIL

April 8-10—Aquatech India, Delhi, India. +31 (0) 20 549 1212, h.vd.meer@rai.nl or www.aquatechtrade.com/india.

April 8-10—CANADA-INDIA Matchmaking Mission in Water Technologies, New Delhi, India. 613-729-3069 ext. 224, Water-India@istpcanada.ca or <http://bit.ly/Y34Sns>.

April 8-10—Sea-Air-Space, National Harbor, Maryland. 203-491-2400, tom.mapes@clarionevents.com or www.seaairspace.org.

April 9-11—Ocean Business, Southampton, England. +44 (0) 1453 8363 63, info@intelligentexhibitions.com or www.oceanbusiness.com.

April 10-11—Global Marine Renewable Energy Conference, Washington, D.C. (301) 869-3790 or sean@foroceanenergy.org.

April 10-11—Offshore Survey, Southampton, England. +44 (0) 1453 836363 or www.oceanbusiness.com/en/conference.

April 10-11—Thetis MRE, Brest, France. +33 1 49 54 73 45, c.peseux@thetis-emr.com or www.thetis-emr.com.

April 10-11—Wind Farm Development: European Offshore 2013, Edinburgh, Scotland. +44 207 981 2503 or www.wplgroup.com/aci/conferences/eu-ewp3.asp.

April 12—SonarWiz 5 Training, Southampton, England. 650-967-2045, info@chesapeaketech.com or www.chesapeaketech.com/support/training-calendar.php.

April 15-19—Bilbao Marine Energy Week, Bilbao, Spain. +34 94 40 40 000 or <http://bit.ly/Uxgg7>.

April 16-18—SINAVAL Elite, Bilbao, Spain. 206-553-5615, ext. 234, karen.taylor@trade.gov or www.sinaval.eu.

April 17-18—Subsea Vessel Operations, Oslo, Norway. +44 (0)20 7017

5511, maritimecustserv@informa.com or <http://bit.ly/ZdH9Qj>.

April 22-24—Sustainable Ocean Summit, Washington, D.C. 808-277-9008, paul.holthus@oceancouncil.org or www.oceancouncil.org/site/summit_2013.

April 23-26—TransRussia, Moscow, Russia. +44 207 596 5188 or www.transrussia.ru.

April 30-May 1—Newport Ocean Observing Conference, Newport, Oregon. yaquinabayooi@gmail.com or www.ybooi.org.

MAY

May 6-9—Offshore Technology Conference, Houston, Texas. 972-952-9494, meetings@otcnet.org or www.otcnet.org/2013.

May 9-10—IMarEST Ballast Water Technology Conference, London, England. +44 (0)20 7382 2617, events@imarest.org or www.imarest.org/events.

May 9-10—Uganda & COMESA: Oil, Gas and Mining Summit, Kampala, Uganda. +44 (0) 207 127 4501, info@oliverkinross.com and www.comesaogm.com.

May 13-14—Offshore Wind Farm Planning, London, England. +44 (0)20 7017 5518, energycustserv@informa.com or <http://bit.ly/W1HuZf>.

May 13-16—Blue Vision Summit, Washington, D.C. info@bluefront.org or <http://bit.ly/W2SPWo>.

May 13-16—Geospatial World Forum, Rotterdam, Netherlands. +31 684 427 822, yogesh@geospatialmedia.net or www.geospatialworldforum.org.

May 14-16—IMDEX ASIA, Singapore. +65 6542 8660, sales@imdexasia.com or www.imdexasia.com.

May 22-23—All-Energy, Aberdeen, Scotland. +44 (0) 20 8241 1912, judithpatten@jppr.uk.com or www.all-energy.co.uk.

May 29-31—Fórum do Mar, Leça da Palmeira, Portugal. forumdomar@exponor.pt or www.forumdomar.exponor.pt.

JUNE

June 4-6—Capitol Hill Ocean Week, Washington, D.C. 301-608-3040 or allison@nmsfocean.org.

June 10-12—EnergyOcean International, Providence/Warwick, Rhode Island. 240-654-7761, PEphraim@tradefairgroup.com or www.energyocean.com.

June 10-13—OCEANS '13 MTS/IEEE, Bergen, Norway. info@oceans13mtsieeebergen.org or www.oceans13mtsieeebergen.org.

June 12-13—Commercial Marine Expo, Hampton, Virginia. 888-849-8586, ssamuels@HighlinerEvents.com or www.comarexpo.com.

June 12-13—Wind Farm Development: European Onshore 2013, Istanbul, Turkey. +48 (0) 616 469 780, agrabowska@acieu.net or www.wplgroup.com/aci/conferences/eu-ewo1.asp.

June 17-18—Myanmar Oil & Gas Summit, Yangon, Myanmar. +44 (0) 20 7127 4501, laura@oliverkinross.co.uk or www.myanmarsummit2013.com.

June 18-20—Undersea Defence Technology, Hamburg, Germany. +44 (0) 20 7384 7787, anna.campagnoli@clarionevents.com or www.udt-global.com.

June 19-21—TransNav, Gdynia, Poland. +48 58 6901136, transnav@am.gdynia.pl or <http://transnav2013.am.gdynia.pl>.

June 23-28—Underwater Acoustics, Corfu, Greece. +30 2810 391803, johnsp@iacm.forth.gr or www.uam-conferences.org.

June 24-28—International Submarine Races, Carderock, Maryland. 207-729-7873, c.brancart@ieee.org or www.isrsubrace.org.

June 25-27—Imaging and Lidar Solutions Conference, Toronto, Canada. 905-660 0808, inquiries@optech.com or www.optech.ca/ilsc2013.

June 25-27—RIEGL International Airborne, Mobile, Terrestrial and Industrial Conference, Vienna, Austria. 407-248-9927 or userconference2013@rieglusa.com. ■

people

Simon Hird was appointed general manager of UTEC Survey Australia Pty Ltd. (Welshpool, Australia) in February. He has more than 30 years of experience, gained primarily in the North Sea. He has held senior management positions at engineering and subsea construction companies in Australia since 2008.



Kathy Forrester has joined Hydroid Inc. (Pocasset, Massachusetts) as marketing coordinator. She will assist in planning, developing and executing Hydroid's marketing plan. Over the past 20 years, she has worked at firms including Sotheby's International, AMA Nantucket, Talbots and Walt Disney World.

ITF (Aberdeen, Scotland) appointed **Patrick O'Brien** to be its CEO, effective April 1. O'Brien, who is currently the group director of strategic business and marketing with Wood Group Kenny, will take over from managing director **Neil Poxon**, who resigned in July 2012.

Hawkes Ocean Technologies (San Francisco, California) has named **Adam Wright** as president. He began at the company in 2000 and has been principal mechanical engineer since 2010. He will retain this position. **Graham Hawkes** will remain chairman, CEO and chief technology officer.

Rod Trafford has joined Florida Atlantic University Harbor Branch in the role of specialty license plate (SLP) marketing manager. He was most recently with Xenith LLC. His focus will be to market and increase sales of the SLPs while raising awareness in support of Harbor Branch research.

North Sea Energy Inc. (Toronto, Canada) has appointed **Peter Rhys-Davies** as exploration manager. He is now director of the subsidiaries: North Sea Energy (UK) Ltd., North Sea Energy (UK NO2) Ltd. and Echo Exploration Ltd., replacing **Ian Lisseter**, who was to retire in March. Upon Lisseter's retirement, Rhys-Davies will become chief exploration officer.

Nessco Group (Westhill, Scotland) has hired **Phil Goodall** as business development manager to grow its international offshore weather monitoring business. Goodall has more than 30 years experience and worked before at StormGeo, where he established an Aberdeen, Scotland, weather-forecasting office.

L-3 Communications Klein Associates Inc. (Salem, New Hampshire) has added **Straud J. Armstrong** to its marketing and technical sales group. He will initially focus on supporting Klein's shallow-water bathymetry product line.

Scott Allen, appointed as items sales manager at MacArtney Inc. (Houston, Texas), will be heading a dedicated SubConn underwater connector support team. **Jacobo Aguilar**, who has been with MacArtney for several years, will bring technical knowledge to the sales team. ■

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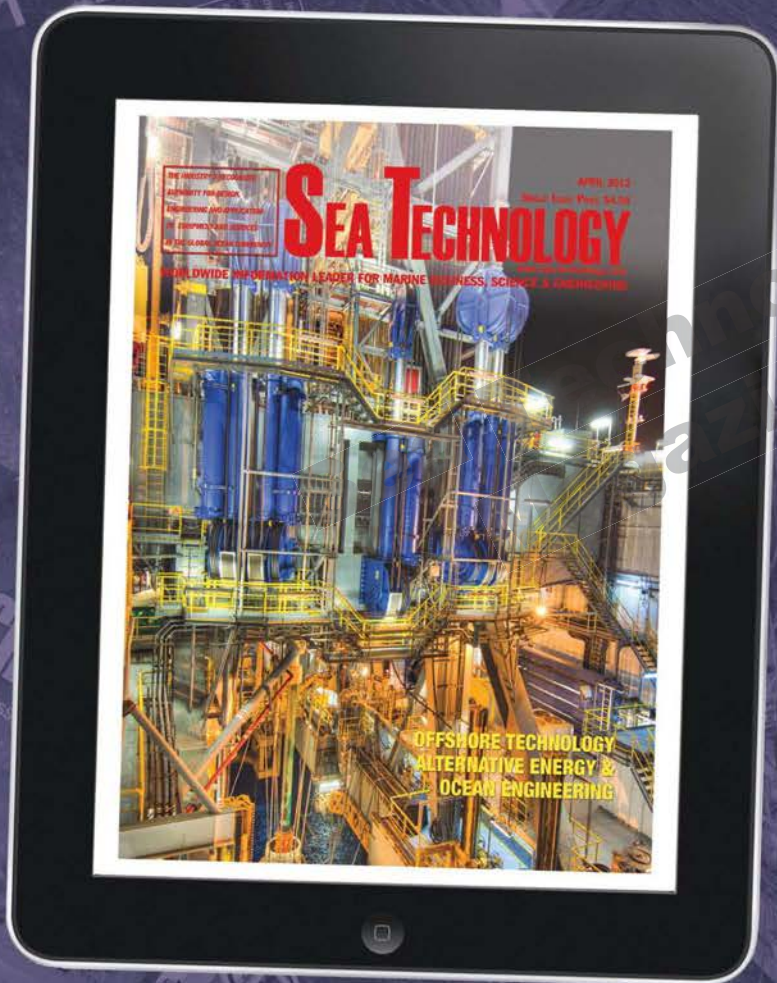
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st looksback

March Issue

25 Years Ago

1988. The U.S. Navy budget proposal called for retiring 16 frigates, leaving 589 ships available for deployment in 1990, rather than the projected 605. ... Under a \$650,000 award from Canada's Department of National Defence, MacDonald Dettwiler began to develop a motion compensation system for a new radar that would allow accurate differentiation between commercial and combatant ships. ... Researchers from the Harbor Branch Oceanographic Institute spent five weeks studying jellyfish by diving through Antarctic sea ice. The jellyfish ranged in size from 1 inch across to 8 feet or more.

15 Years Ago

1998. The Association for Unmanned Vehicle Systems International (AUVSI) announced the first International Autonomous Underwater Vehicle Competition. Students designed and built AUVs to navigate through a body of water and gates. ... An El Niño-related drought and high ocean temperatures in the Pacific Ocean off Australia resulted in coral bleaching around the Great Barrier Reef, raising concern among experts. ... Sonatech Inc. reported it received a call from a fisherman in Puerto Rico, who said he had found one of its transponders. The nine-year-life unit had been installed in 1986 at 6,000 meters depth.

10 Years Ago

2003. NOAA announced plans to establish a National Weather Radar Testbed to provide the meteorological research community with the first phased array radar facility available on a full-time basis. ... More than 170 U.S. coast Guard sailors from the Pacific Area Command departed for the Persian Gulf in support of Operation Enduring Freedom in Afghanistan. ... Episodes in which dolphins and whales beached themselves while human-generated sounds were deployed in nearby waters began to prompt concern about the impact of ocean noise. A report by the National Academies' National Research Council recommended setting up a single federal agency for monitoring marine noise and its effects. ■

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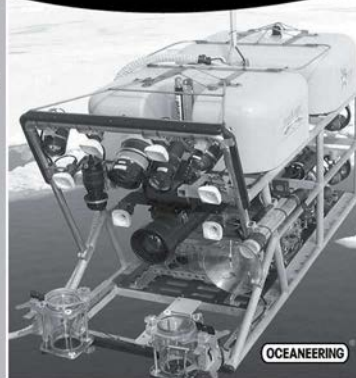
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Mark Miller is the CEO of Terresolve Technologies, a company based in Mentor, Ohio, that provides nontoxic, biodegradable lubricating products. Miller received his bachelor's in chemical engineering from Tufts University and has an MBA from Manhattan College. He has engineered, sold and marketed lubricants and lubricant additives for more than 20 years.



Under the Draft 2013 Vessel General Permit (VGP) and Small VGP, EPA will require vessel owners and operators to adopt environmentally acceptable lubricants (EALs) into their operations to further reduce their environmental impact starting in December 2013. This regulation brings a two-fold benefit to the industry by boosting the bottom line of both small and large vessel operations, while engendering positive change that ensures the preservation of ecosystems in which these vessels operate.

The wording of the 2013 VGP is purposefully broad. Vessels, as referenced in the 2013 VGP, cover “every description of watercraft or other artificial contrivance used as a means of transportation” on U.S. waters. The 2013 VGP affects any vessel owner or operator whose business depends on traveling through U.S. waters. The language of the regulation points specifically to “oil-to-sea” interfaces, which includes mechanisms such as thrusters, stern tubes, azipods, ramps, watertight doors and many others.

Every vessel that does not currently use EALs in all oil-to-water interfaces will experience incremental costs associated with phasing in environmentally acceptable products, but in the scope of yearly vessel operations, the increase is negligible.

EPA upper-bound projections estimate a 120 percent cost increase and their lower-bound projections estimate an increase of 50 percent for an average annual increase of \$555 to \$1,111 per vessel. Of course, depending on a vessel's lubricant consumption rate and the type of EAL selected, costs will vary.

To put these cost increases into perspective, Nordic American Tankers (Hamilton, Bermuda), a major international tanker company, announced net voyage revenue per vessel per day of \$16,200 in its second-quarter 2012 report. Using the high-end estimate from EPA of the annual costs of phasing in EALs to tank barges and tank ships, it would take slightly more than one hour of voyage time per vessel to recoup these costs.

For a lubricant to be considered an EAL, it must be biodegradable and nontoxic. Technically, all lubricants are inherently biodegradable, meaning they will biodegrade eventually, but they can be toxic and persist much longer in the environment than their readily biodegradable counterparts.

Readily biodegradable lubricants meet the Organisation for Economic Co-operation and Development's guidelines for biodegradability, breaking down at least 60 percent within the first 28 days and reaching the 60 percent level within 10 days of reaching the 10 percent level (10-day window criterion).

Currently, there are four categories of EALs that vessel owners and operators can choose from: triglycerides, polyglycols (PAGs), synthetic esters and synthetic biopolyolefins.

EPA estimates that EALs from vegetable sources are 10 percent to 50 percent more expensive than conventional lubricants and also noted that synthetic-based lubricants tend to be significantly more expensive than mineral-based lubricants (two to four times more expensive).

In terms of application, vegetable-based EALs demonstrate lower performance metrics and usable life spans when compared to synthetic alternatives. Vegetable-based EALs have an upper temperature threshold of only 180° F and tend to break down when mixed with water. Perhaps most importantly, the expected change-out time for vegetable-based EALs is 1,000 to 2,000 hours.

PAGs tend to be highly toxic and demonstrate less effective performance than other EALs. In addition, PAGs take years to biodegrade, which makes for

a poor investment compared to readily biodegradable fluids.

Biopolyolefin synthetics have an upper temperature threshold of 400° F, are water-resistant and last 10,000 to 15,000 hours or more. Even though synthetic products can cost up to four times more than vegetable-based products, they last 10 times longer, while performing at the same level as conventional, mineral-based lubricants.

Overall, biopolyolefin fluids are the optimal choice for complying with the 2013 VGP regulations, maintaining peak performance of vessel systems. In addition, these lubricants are readily biodegradable, which helps to mitigate cleanup and remediation costs following leaks and spills.

Based on the low capital requirements needed to phase in EALs to oil-to-water interfaces, the use of environmentally acceptable lubricants produces significant returns by reducing cleanup and remediation costs on fluid spills and leaks. Initial cleanup and containment efforts will always be costly to extract as much of the leaked fluid as possible.

However, long-term remediation (continuing action to control lingering environmental effects like chemical toxicity and sheening) represents about 60 to 70 percent of spill containment costs that involve conventional lubricants and oils. The remediation schedule of EALs as compared to conventional lubricants is a matter of weeks versus a number of years.

Noncompliance will bring penalties and fines that vary depending on the severity of the case. EPA grants enforcement authority to the U.S. Coast Guard (USCG), which will assist EPA in upholding the statutes in the 2013 VGP.

The Draft 2013 VGP's focus on proliferating environmentally acceptable lubricants across the industry helps preserve fragile ecosystems in American waters and offers vessel owners and operators a significant return on a marginal up-front investment. EPA is still reviewing public comments regarding the Draft 2013 VGP and will take them into consideration before finalizing the 2013 VGP. The full draft is available at <http://1.usa.gov/WoUNg1>. ■

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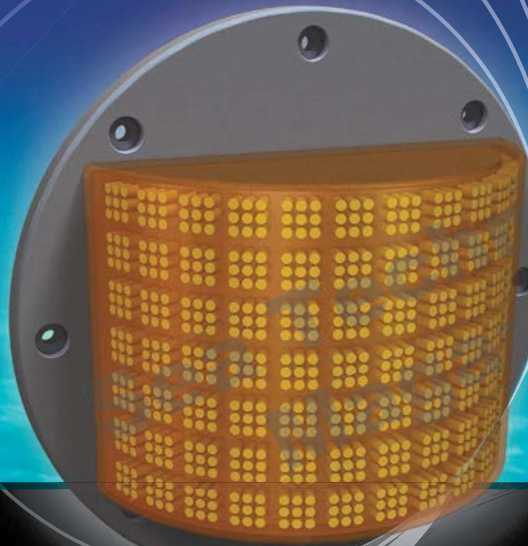
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