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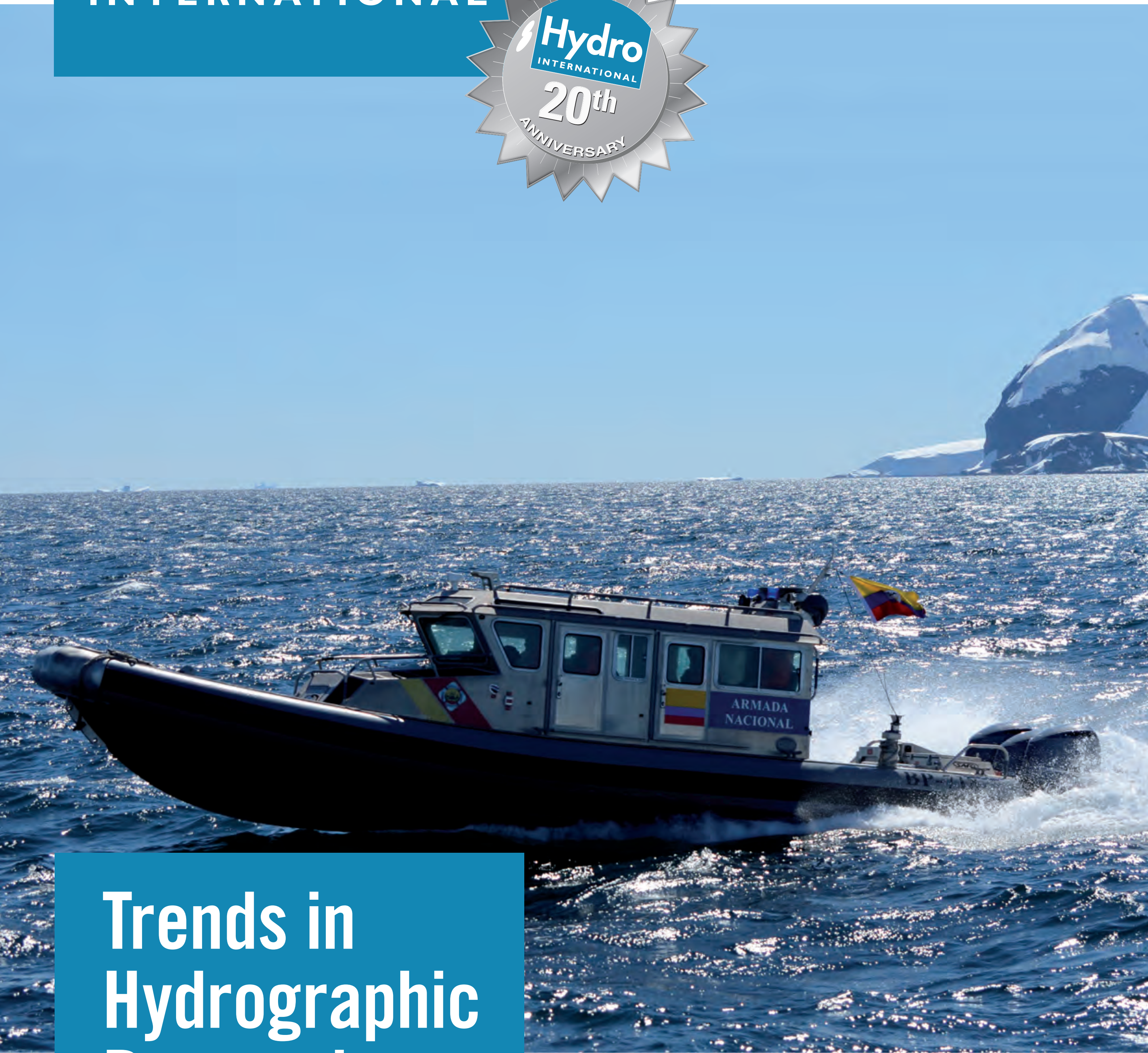
Hydro INTERNATIONAL

20th ANNIVERSARY



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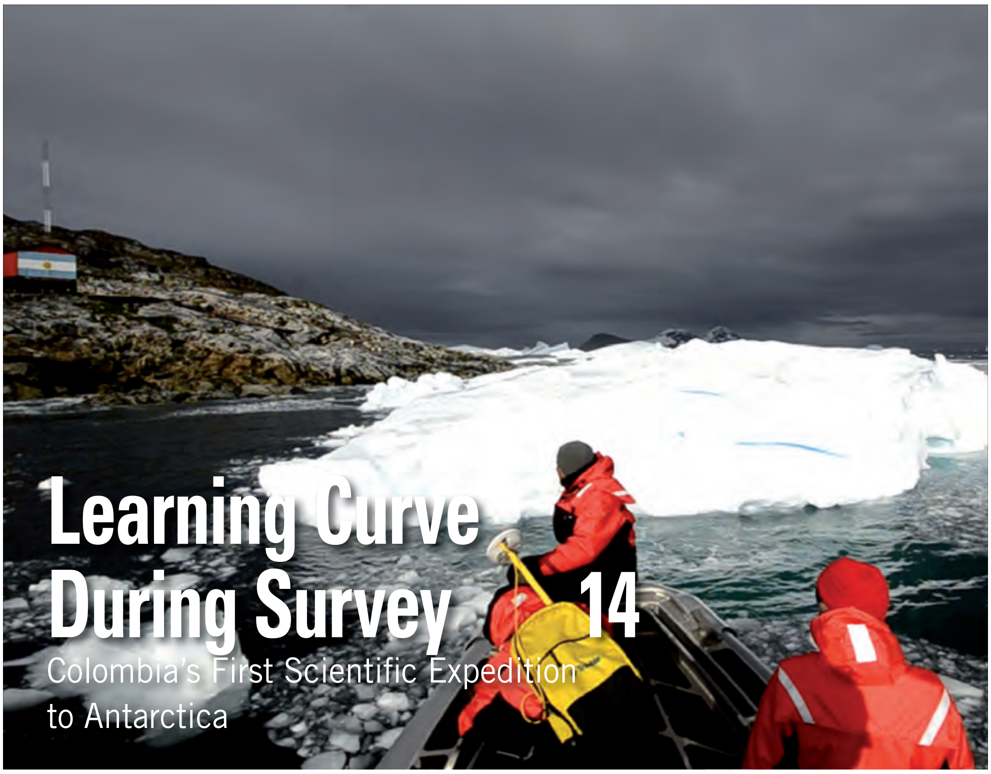

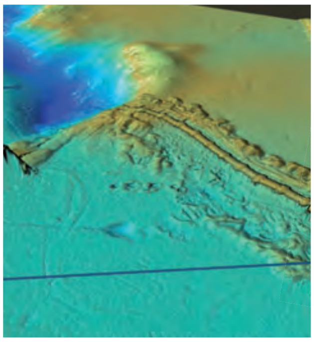

November-December 2016
Volume 20 #8

Surveying in the Arctic has its presents own challenges. This issue carries a couple several of articles focussing on this area. Richard Guzmán Martínez shares the experiences of Colombia's first scientific expedition to Antarctica from page 14.

Hydro INTERNATIONAL

Hydro International is an independent international magazine published 8 times a year by Geomares Publishing. The magazine and related e-newsletter inform worldwide professional, industrial and governmental readers of the latest news and developments in the hydrographic, surveying, marine cartographic and geomatics world. Hydro International encompasses all aspects, activities and equipment related to the acquisition, processing, presentation, control and management of hydrographic and surveying-related activities.

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PHOTOGRAPHY: ARIE BRUINSMA (WWW.ARIEBRUINSMA.NL)

Invitation

Who do we invite to the next edition of Oceans? That intriguing question was posed during the Future of OCEANS Panel Discussion at Oceans '16 MTS/IEEE, held from 19 to 23 September in Monterey, California. The Panel Discussion, moderated by Dr Rick Spinrad, chief scientist at NOAA, was the second one, the first one being held last year during Oceans '15 in Washington, DC. The discussion circled around future needs, trends and likely accomplishments in ocean science, technology and engineering. It was not just looking for the actual answer to the question, who do we send an invite to for next years edition of our conference, but it was also looking at it in a broader sense: who do we need to tie up and partner with, who are going to be colleagues of the ocean scientists in the years to come. The participants in the discussion were drawn from different corners of the ocean community – academia, government and private sector, global partnerships and investments. A lively discussion between the delegates and the panelists first of all tried to ascertain why the invitation needs to be sent out in the first place: it was quite clear that a lot of the people in the room felt that new technology was so encompassing, and developing at such a fast pace that the ocean community needs to find partnerships to implement these technological possibilities as soon as possible to solve the problem of not being able to understand the ocean more quickly on a bigger scale. Therefore, transfer of technology from land to sea, because boundaries between the two are disappearing, is necessary as is making use of the Internet of Things and crowdsourcing. These both need to be high on the agenda, as do visualisation and video imagery.

Taking the discussion further, these trends will result in invitations to a bunch a professionals that are never present at an Oceans conference, and to be honest, nor at any other conference in oceanography or hydrography. Groups that were mentioned were, of course, programmers, computer scientists and other IT professionals ('if we can gather a terabyte of data, we need the guy that knows how to handle that terabyte'), filmmakers (to talk about visualisation so as to show the outside world what the ocean community finds), kids and amateurs (aren't they the best ones to show us how intuitive crowdsourcing should work?), biologists and environmentalists (if they are not already involved) and Google (what would Google do?).

Let's see if the invites are indeed sent; it will be a very refreshing and highly educational experience to hear what all these invited guests come up with. It might give new energy to the ocean community and indeed speed up developments to reach that goal even faster: map the ocean in all possible ways for the betterment of our planet.

This is already this year's last issue of *Hydro International*. 2016 is almost over and will surely not go into history as one of the best years for hydrography and adjacent fields. It's good to start a fresh new year and see 2017 as a blank new page that offers new opportunities!

Durk Haarsma durk.haarsma@geomares.nl

HYPACK Enters UAV Data Collection Era

HYPACK, USA, has partnered with Infinite Jib, Velodyne and SBG to provide a mapping solution that represents a next evolution in the unmanned aerial vehicle (UAV) market: NEXUS 800 UAV. This solution, powered by HYPACK, represents a full end-to-end solution, seamlessly harmonising Lidar data with photogrammetry. The NEXUS 800 is a turnkey system that integrates hardware and software to provide an advanced and seamless solution for Lidar survey planning, data acquisition, post-processing and analysis and product creation.
▸ *bit.ly/2eBkEXv*

Honour to AUV UXO Team

Tim Taylor of Tiburon Subsea and Christine Dennison of OceanOutreach.org have been awarded the Brazilian Navy League Medal of Honour, 'Grande Benemérito do Parimõnio Marítimo', for their exploration, discovery and dedication to preserving the legacy of the lost WWII Submarine R-12 and her 42 entombed sailors. They were presented with the league's highest honour at a private reception at the Explorers Club in New York City, USA, on 14 October 2016.
▸ *http://bit.ly/2eBlvaK*

'Small Satcom' for Storm Waves on Sea Ice Research

With the growing need to secure new data from remote and inhospitable areas of scientific interest balanced against commercial challenges and tough competition for academic budgets as a background, the UK's Rock Seven is reporting an upsurge in its Iridium satellite communication products being used for environmental science applications in both the Arctic and Antarctic.
▸ *bit.ly/2ffvwWI*

Real-time Measurement of Oil in Arctic Area Conditions

A smart navigation ice buoy system was installed for test use near the Neste Refinery in Porvoo, in the Arctic area of Finland, in October 2016. The aim is to develop a system to deliver real-time data on oil in water, especially in cold climate conditions. It will help environmental and oil response authorities to monitor marine environments more effectively. In the future, buoys placed along fairways could also reveal and confirm illegal oil discharges.
▸ *bit.ly/2ffBCpK*

Oil spill monitoring can take place using smart navigation buoys.

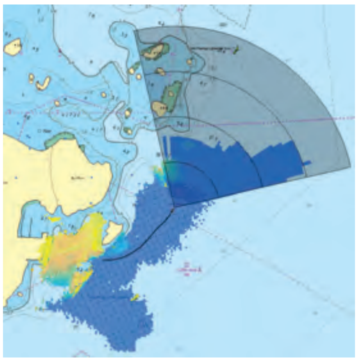
CEDA Introduces Dredging Management Commission

CEDA has added a new Commission to its ranks: the Dredging Management Commission (DMC). This commission was set up to provide for initiating and facilitating discussions, innovations and questions from the dredging community on the management of dredging works in the broadest sense. The Dredging Management Commission had its inaugural meeting at the CEDA headquarters in Delft, the Netherlands, in September 2016. An enthusiastic group of international experts got together to further define the scope (mandate) and identify and agree on topics and their priorities.
▸ *bit.ly/2ffDE9v*

Local History Mapping for 3D FLS

FarSounder is announcing Local History Mapping (LHM). This feature offers users the ability to build a 3D map of the seafloor over which they have recently sailed. This map is updated with every ping and is displayed as an overlay on top of the system's nautical chart display. This new overlay is displayed in conjunction with the real-time sonar overlay. When used together, one can quickly see what lies ahead and what they've recently passed over. LHM capabilities will be included as part of its standard navigation sonar software starting with SonaSoft 3.3.

▶ *bit.ly/2eBmvf1*



FarSounder 3D local history mapping.

Most Shared

Most shared during the past month from www.hydro-international.com

Underwater Electromagnetic Propagation - http://bit.ly/2fjyYjs
40 Wrecks Found During Black Sea Maritime Archaeology Project - http://bit.ly/2fYwoj8
Technology in Focus: Bathymetric Lidar - http://bit.ly/2f79qIS
Safe Navigation with Uncertain Hydrographic Data - http://bit.ly/2fYkXZU
Communications to the Deepest Point of Earth - http://bit.ly/2fziJ51

MoU to Build First Unmanned Automated Vessel

The UK's Automated Ships and Norway's Kongsberg Maritime have signed a Memorandum of Understanding (MoU) to build the world's first unmanned and fully automated vessel for offshore operations. In January 2017, Automated Ships Ltd will contract the *Hrönn*, which will be designed and built in Norway in cooperation with Kongsberg. Sea trials will take place in Norway's newly designated automated vessel test bed in the Trondheim fjord and will be conducted under the auspices of DNV GL and the Norwegian Maritime Authority (NMA). The *Hrönn* will later be classed and then flagged.

Hrönn *in an artist's impression.*

▶ *bit.ly/2eBhJ0Z*

Underwater Noise around UK Coast Analysed

The Centre for Environment, Fisheries and Aquaculture Science (Cefas) has teamed up with Marine Scotland Science and the University of Exeter to analyse underwater noise data from subsea sound recorders located around the UK coast. The results of the Defra-funded study have now been published in an article titled *Underwater noise levels in UK waters* in the Nature journal Scientific Reports.

▶ *bit.ly/2eBIRxL*

Cefas has created a report on underwater noise.

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Hydrographic Processing Software	
1. EIVA - NaviSuite Post-Processing	geo-matching.com/products/id2584-eiva-navisuite-post-processing.html
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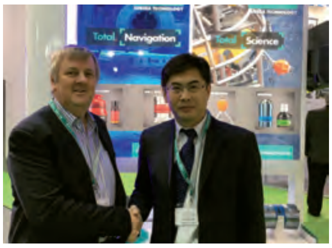
3. QPS – Qimera	geo-matching.com/products/id2623-qps-qimera.html
4. Eye4Software – Hydromagic	geo-matching.com/products/id2541-hydromagic.html
5. HYPACK – MAX	www.geo-matching.com/products/id2571-hypack-max.html

Acoustics Selected for Six Chinese Research Vessels



(Left to right) Geraint West of Sonardyne, Qi Zhengyu, director of China ORE and Anthony Gleeson, vice president of Sonardyne in Singapore announced the contract during OI China.

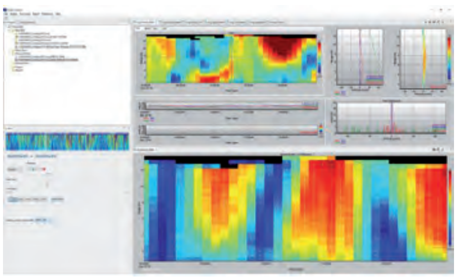
Ocean science technology company Sonardyne Asia Pte. Ltd., Singapore, has announced that its Ranger 2 underwater acoustic positioning technology has been selected for six new Chinese scientific research vessels. The order, announced during the OI China exhibition and conference in Shanghai, follows news last month that the Polar Research Institute of China has also purchased Ranger 2 for its new 122 metre polar exploration vessel.

▸ ***bit.ly/2eBmRCn***

Simplifying Oceanographic Data Interpretation

Oceanographic instruments measuring currents and other aspects of ocean behaviour collect vast amounts of data. Processing and interpreting these data volumes has traditionally been the preserve of highly specialised scientists working with their own custom-built programmes. Now the field is opening up to a wider range of users with the advent of unique software designed to simplify data interpretation.

▸ ***bit.ly/2eBpnbr***



Signature500 data averaged and saved in a processed data file.

Theme of WHD 2017: Mapping Seas, Oceans and Waterways

The next World Hydrography Day (WHD), to be held on 21 June 2017, will be based around the theme of 'Mapping our seas, oceans and waterways - more important than ever'. The IHO takes care of a dedicated page on the IHO website, where papers and other materials relevant to the celebration and reflecting the variety of activities supported by hydrography will be posted and which Member States and other IHO stakeholders may use as appropriate.

▸ ***bit.ly/2eBhVNG***

USVs Autonomously Detected and Tracked a Live Submarine

Liquid Robotics and Boeing have for the first time used a network of persistent unmanned surface vehicles (USVs) to detect, report and track a live submarine in a naval demonstration. Four sensor hosting autonomous remote craft (SHARCs) were deployed off the coast of Northern Scotland during the British Royal Navy's Unmanned Warrior 2016 demonstration. The autonomous surface vehicles used Boeing acoustic sensors in the live anti-submarine warfare (ASW) mission.

▸ ***bit.ly/2eBmA2I***

Support for 'Mayflower' Autonomous Ship Project

To mark the 400th anniversary of the *Mayflower* setting sail to America with 102 intrepid early settlers on board, a team has a plan to design and build a fully autonomous ship to make the same Atlantic crossing, completely unmanned, in 2020. The team is led by US-owned but UK-based (Plymouth) firm MSubs and includes Plymouth University and ProMare (a charitable research foundation). Silicon Sensing is to provide a package of support to help turn the MAS400 concept into reality.

▸ ***bit.ly/2fcwHqc***

MAS400 and Mayflower DMU30. Image courtesy: Prof Bob Stone, Birmingham University.

Report from Semi-annual Marine Technician Conference in Bergen, Norway

Inmartech 2016

The International Marine Technician (INMARTECH) group was established in 1995 by the global network for operators of oceangoing research vessels formerly known as International Ship Operator Meeting (ISOM), now named International Research Operators (IRSO). See www.irso.info for more details. INMARTECH is a sub-committee for marine technicians and users of marine research instruments and equipment. The most recent INMARTECH Conference in Bergen, Norway, was visited by 200 participants, including approximately 30 delegates from sponsors.

The Norwegian Institute of Marine Research (IMR) was the convener for INMARTECH 2016 and the venue was the main concert hall in Bergen, Norway, called 'Grieghallen'. The conference attracted approximately 200 delegates and sponsor representatives from 16 different countries spread across Asia, Australia, Europe and North America.

A total of 52 presentations were given during the main conference and, in addition, several side sessions were held by sponsors on specific equipment and topics. A poster wall and stands for the 14 sponsors and IMR as the host were located outside the main conference hall. Lunch was also served here during the conference.

▸ *http://bit.ly/2eIWYk3*

More information

All presentations, the conference handbook

inmartech2016.imr.no

▲ *Dr Ole Arve Misund, keynote speaker at INMARTECH 2016.*

Hydrography is about Geospatial Data Availability

The Hydro16 event took place in Rostock-Warnemünde, Germany, from 8 to 10 November 2016. About 400 professionals joined the conference and the trade show to update their knowledge and skills and to meet fellow professionals. Geospatial data is becoming an increasingly important issue on the agenda and there is a strong call for making the collected data available.

▸ *bit.ly/2eBhpil*

Robert Ward emphasised the importance of available hydrographic data.

Hydro International interviews Peter Ehlers, World Maritime University

Hydrography is the Leading Marine Geospatial Service

Looking at the programme of the Hydro16 Conference, that was held in Rostock-Warnemünde, Germany, one of the keynote speakers was remarkable, namely the legal specialist Peter Ehlers, who talked about maritime governance. What do maritime law and the rather 'practical' discipline of hydrography have in common related to this subject? *Hydro International* interviewed Peter Ehlers on this aspect and discovered that hydrography plays a prominent role.

From law to hydrography – what brought you into the profession?
I am a lawyer and I have learned to ask questions until you know what you are talking about. I started during my study at the Federal Ministry of Transport and once I finished my dissertation on the IMO, I stayed there. I got into the hydrographic organisation and established the German Hydrographic Service BSH. At the beginning, it felt like working in a scientific organisation while we should have been working like an authority. I have had the opportunity to shape the organisation and bring it forward. I always loved the economic aspects of the work, but there are actually three dimensions to hydrography: legal, technical and scientific. We tend to divide questions into sectors, but in reality, they are interlinked. You can't divide them.

What links maritime governance and hydrography?
Actually, I would rather talk about ocean governance, whatever it means. You can't translate it in the German language, it's about controlling and managing maritime affairs aimed at sustainable development. One of the prerequisites is that we don't know enough of the seas. Hydrography is providing data that

is complimentary to oceanography, it goes further than just safety for navigation. There are more aspects of the sea and ocean. Hydrographic data is the main geospatial data service.

When thinking of 'governance', the relationship with the environment is close. What do you think of that relationship?

The marine biodiversity goes beyond national jurisdiction and it takes time before people see the consequences on what's happening. In the eighties, the UNCLOS discussions started but no one discussed this issue. The polluter pays, seemed to be the status quo. We have to develop this further, the environment is more important. That's where geospatial data comes into play.

How do you think these geospatial data can best be collected?

There are three aspects on the collection of maritime data: oceanography, hydrography and marine environmentalists. Currently, it seems that they operate as different pillars – there should be more cooperation between them as their interests are interlinked. For example, traditionally when oceanographers go out for their measurements, they don't include the hydrographic data. And with the current increased possibilities, a hydrographic survey can have oceanographic measurements as 'by-product'. I'm convinced we can achieve more by collecting and exchanging the data more intensively. We can collect more data. This is both an advantage and a difficulty: we have to select the right data.

How do you think data should be made available?

One has to start the discussion about this subject. For example, many research vessels are publicly funded. So why not provide the data for public use? Of course, especially regarding the commercially collected hydrographic data, there's an issue about property rights. In Germany, we always followed the line not to give the data away. This is in contrast to the USA. It's worth thinking of making the data available free of charge, especially when it's been collected using public money. But we don't have to solve it at this very moment.

What is your message to the younger generation of hydrographers?

I am under the impression that they are very interested and that the education is good as well. We have the disadvantage that little is known about hydrography outside the community. The profession has changed a lot: cartographers in earlier times were true artists. Now we are information technologists, which is a good development. As I mentioned before, the profession is becoming more data driven and the geospatial information of hydrography is the linking pin of maritime data. When we decided to move the BSH department from Hamburg to Rostock, we attracted a new generation of young professionals and were able to develop towards ECDIS and electronic charting. However, when working on the technical aspects of these developments, we should still focus on the service we deliver. In the end, that's what we're here for. ◂

Geospatial information of hydrography is the linking pin of maritime data

Peter Ehlers, officer of the German Federal Order of Merit, is a member of the Board of Governors and guest lecturer of law of the sea and marine environment law at the World Maritime University in Malmö, Sweden. He studied law at the German Marburg and Kiel universities. After having written his doctoral (PhD) dissertation about IMO he joined the German maritime administration in 1970. He worked for many years in the Maritime Transport Department of the Federal Ministry of Transport where he became Deputy Director General. From 1989 to 2008, he was the president of the Federal Maritime and Hydrographic Agency. He represented Germany in maritime organisations, e. g. IMO, IHO, UNESCO-IOC, Helsinki-Commission and he was a member of numerous German maritime institutions and organisations. Until its closure in 2014 he was a member of the Board of Directors of the International Max-Planck Research School for Maritime Affairs, Hamburg. He retired in 2008, after which he was appointed chairman of EUROGOOS, until 2013. He is a guest lecturer at International Law Institute, Malta. He performs consultancy functions concerning law of the sea, hydrography, marine research and offshore activities and has published more than 170 papers and articles on maritime, environmental, legal and administrative measures.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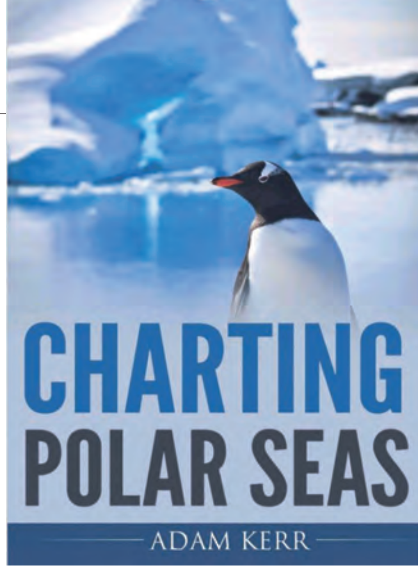


Adam Kerr

Charting Polar Seas

This book reached HI's reviewer in July 2016 and, sadly, it was while reading of Adam's life, careers and interests that we learned of his death.

Adam Kerr's life was both charmed and charming, and, by his own account, he was very fortunate. He modestly says that he "moved through life without having had to experience any great traumas … a life story based on fortuitous circumstances and perhaps luck". The book gives an insight into what we may judge a calmer and more ordered life quite distant from our present times. This is not to say that Adam's life was easy: boarding school aged four and then HMS *Conway* as a cadet at 13, followed by several year-long sea voyages.

Adam was the grandson of a well-known painter, his mother was a talented painter, and his father a sailor, trout fisherman and writer of 50-odd books – this genealogy becomes evident throughout his life. A first sea-going adventure, aged three, was exploring the lochs and inlets of the Clyde on a 29-foot converted ship's lifeboat with parents, grandparents and occasionally a nanny, together with fishing and painting paraphernalia. These events alone can be imagined being made into a modern TV drama, along with alcoholic shipwrights and the background threat of war in the late 1930s.

The author relates with affection his early days and shows a great affinity for place – in this case Cornwall and West Scotland, rather regretting that he was in fact born in Chelsea. Latterly, he returned to Cornwall where he recounts occasionally bumping into his near neighbour (and fellow author!) John LeCarre, walking the coastal path.

This autobiography is a more-or-less chronological account starting in childhood and his schooling. There is a formal cadetship with Blue Funnel, followed by a freer, more adventurous time as second mate on RSS *Shackleton* in the Falklands and visiting Antarctic research stations before settling to a 30 years' career with the Canadian Hydrographic Service. Adam was appointed as a director of the International Hydrographic Bureau, in Monaco, in 1987, where he remained for 10 years before returning to his native Cornwall. Adam continued working into the 21st century as a hydrographic and cartographic expert … and keen sailor, fisherman, painter and author.

Adam appears to have had a good 'eye' for upcoming navigation and cartographic technologies that he promoted, as well as sound judgment in spotting some of the best career opportunities.

Although the historical accounts are of sextants, station pointers and inking-in of fair sheets, it's the skiing, sailing, trout fishing, painting and sketching that stir the imagination. Even quite late in his career, while a director at IHB in Monaco, we hear of intrigues in Rosie's Bar and a new office, which gave trackside views of the Grand Prix motor races. There are many notable references to pretty young women, beer, champagne and caviar.

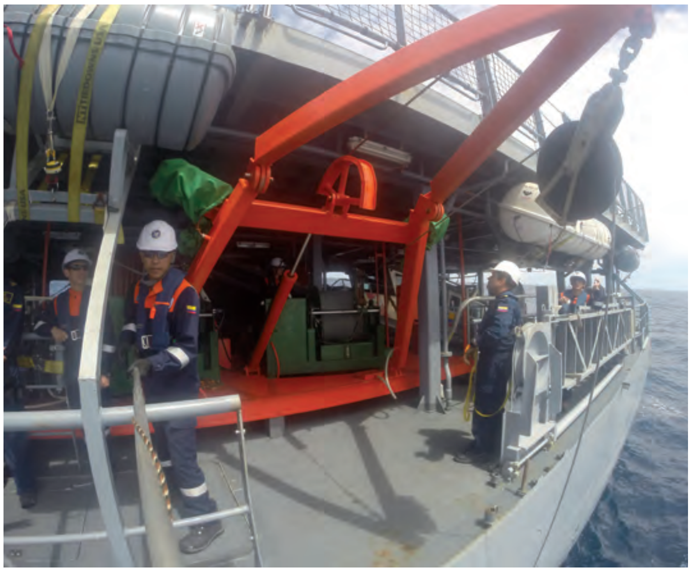
While almost all of this story is very good natured and sanguine, it was amusing to read Adam Kerr's occasional acid remark regarding some undeserving individuals and one organisation was described as being overbearingly arrogant. ◂

Colombia's First Scientific Expedition To Antarctica

Learning Curve During Survey

The first Colombian scientific expedition to Antarctica was a major challenge for the country and the Colombian Hydrographic Survey because of the extreme conditions in which the investigations had to be carried out. It is Columbia's vision to contribute to the preservation of the white continent. The preparation and the professionalism of the scientists and crew were critical to achieving the objective of the cruise: to become part of Antarctic Treaty. This objective has been set out in document 104 to the member countries of the 'Antarctic Treaty'.

▲ *Patrol Ship* ARC 20 de Julio.



Design of the oceanographic Mobile Platform.

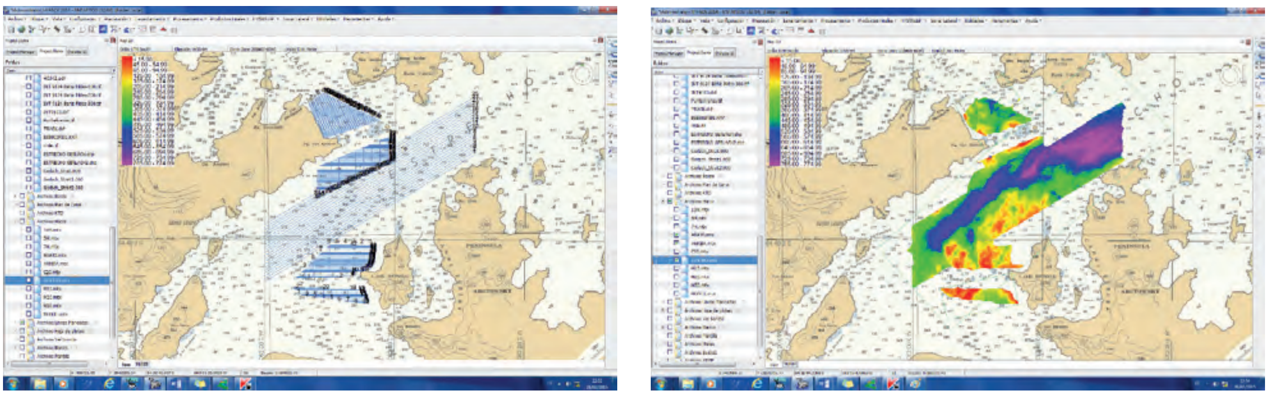
Within the Antarctic Treaty Colombia intends to change its status, from an observer country to a consultative treaty country. This resulted in the preparation of the first Colombian expedition to Antarctica.
During the preparatory meetings of the expedition, we listened and took note of the recommendations made by the Hydrographic Services of Ecuador, the Hydrographic Service of Chile and the Chilean Antarctic Institute INACH, institutions with extensive experience in research in these latitudes. Each meeting and each recommendation increased our anxiety and fears to explore the unknown, but at the same time, we were encouraged to ultimately prepare ourselves for this challenge.
The hydrographic research was coordinated by the Chilean Hydrographic Service and was to result in the delivery of bathymetric information in four areas in the Gerlache Strait, specifically to the nautical chart INT 9103 SHOA / CHILE Bay Markmann to Andrvord Bay.
Only 10% of the Antarctic waters are mapped, so this hydrographic survey will be an important contribution to the maritime security in this region, which can be used by all countries practicing tourism or conducting research in this area.

Only 10% of the Antarctic waters are mapped

The Colombian Navy originally commissioned the oceanographic research vessel *ARC Malpelo* to carry out this cruise. However, after several meetings and recommendations from countries with experience in operating in Antarctic waters, it was decided to commission the EEZ patrol boat *ARC 20 de Julio* as the platform for research. The vessel was built in the shipyards of COTECMAR in Cartagena, Colombia, and is one of the largest and most modern units built in our country and gave more prominence to the project. Now a vessel, built in Colombia, was to be used with 107 Colombians doing research in the white continent.
This pride also became a great challenge for the crew and scientists, since the patrol ship initially did not have the capabilities to fulfil the mission, so that a search for solutions began to adapt the vessel for this purpose.

First Challenge: Hydrographic Survey in Deep Waters

The research centre CIOH proposed the installation of a single beam echo sounder for deepwater using a dual frequency. With the strong support of the Colombian Navy and the capabilities of our shipyard, the installation could be executed in less than a month.
The dual frequency single beam echo sounder, a Kongsberg EA600, was installed onboard the *ARC 20 de Julio*.



Planned area and surveyed area.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▲ *Geodetic control and levelling for installation of the tide gauge.*

Second Challenge: Sound Velocity Profile Collection Data

A mobile oceanographic winch platform (MPO) was built to collect the data of different oceanographic devices, such as a SVP, a multi bottle rosette sampler, a bottom grab or a piston corer. The initial design was made by the Hydrographic service and the system was built by an engineering firm.

Using this system, we were able to collect 17 sound velocity profiles geographically distributed in the study area, resulting in an average sound velocity of 1,446 m/s.

Third Challenge: Hydrographic Survey in Shallow Waters

For surveying in shallow waters it was necessary to adapt the intervention boat (built as a unit for the Colombian coast guard) into a hydrographic boat. It had the basic features to operate in this harsh environment, with a heated cabin, for instance. A portable dual frequency echo sounder was adapted, with the transducer installed on one side and the GPS antenna installed on the top post, in order to gain accuracy in the measurement and to reduce any 'off set' events.

Fourth challenge: Geodetic Control and Sounding Corrections

The geodetic control points at the Chilean Gonzalez Videla station were used for geodetic control and a portable tidal gauge was installed before the start of the survey for taking water level data, which could subsequently be imported and processed in the survey data.

A 'satellite navigation system Trimble brand model R-7 was used for positioning during the survey. The data were collected in the differential mode signal FLOAT RTK satellite OMINISTAR XP. Some Latin American countries had not used this kind of positioning, with their positioning only being based on differential correction or simply in a standalone mode.

Having overcome the challenges during the installation of the equipment, we sailed to the study area to start the survey in the designated area allocated by SHOA in the Gerlache Strait zone, to collect hydrographic data for the Chart INT 9103, Bay Markmann Bahia Andvord.

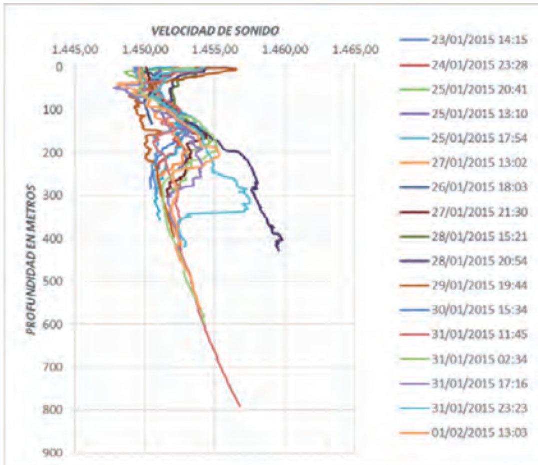
During the execution of the survey we found the oddest atmospheric ocean conditions that had ever been experienced in a hydrographic survey: ice, snow, low visibility and surveying the seabed only 300 metres from the rugged coastline with depths up to 80 metres below the keel.

A steep learning curve for the crew in navigating the vessel in polar waters resulted in rapid familiarisation with the Antarctic conditions, resulting in a larger hydrographic area being covered than initially planned.

The expedition spent 30 days in the Antarctic where 9 research lines were performed. One of these was the hydrographic survey campaign that lasted 11 days using both platforms simultaneously. It was planned to survey four zones with a total of 680 nautical miles linear, in an area totally lacking any bathymetric information. In the end, we managed to survey a total of 1002 nautical miles.

The results of this campaign were delivered to the Chilean Hydrographic Service as a contribution to chart INT 9103 Markmann Bay Andvord Bay.

Finally, Colombia showed that they have the technical and professional capacity to continue providing data for maritime safety, preservation of life at sea, research, preservation and conservation of Antarctica. ◀



▲ *Overview of the sound velocity profiles.*

Master Chief Petty Officer Richard Guzmán Martínez is head of hydrographic surveys at the Centre for Oceanographic and Hydrographic Research Caribbean (CIOH) and was designated as lead supervisor and coordinator of the installation of hydrographic equipment on board the *ARC 20 de Julio* and enlistment, planning and implementation of bathymetry in the Gerlache Strait, within the framework of the Colombian First Scientific Expedition to Antarctica. He graduated from Naval Petty Officer School ARC Barranquilla in 1991. He was a pioneer in the implementation of multibeam systems in Colombia and Commander of the first river hydrographic boat that had this system, which first conducted surveys in the majority of Colombian ports. He is instructor on the hydrography course for completion of the Naval Officer School 'Almirante Padilla' and Naval Petty Officer on *ARC Barranquilla*.

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Arctic Hydrographic Survey Achieves Production Gains by Utilising ASV Technology

Bering Sea ASV **Force Multiplier**

TerraSond, a hydrographic services company based in Palmer, Alaska (USA), used a C-Worker 5 (CW5) unmanned Autonomous Surface Vessel (ASV) in conjunction with a 105' (32m) research vessel from June through August 2016 on a major hydrographic survey in the Bering Sea region of Alaska. The ASV served as a force-multiplier, collecting multibeam and towed side-scan data alongside the larger vessel, which surveyed adjacent lines simultaneously. The 18' (5.5m) ASV collected 2,275 nautical line miles (4,213km) – 44% of the project total -- and achieved an industry-first in terms of data production rates utilising ASV technology in the Arctic.

Based in an Arctic region, TerraSond has long seen the potential benefits of using ASV technology on hydrographic survey projects. Much of the Alaska coastline is far from ports and requires expensive mobilisations of relatively large vessels and time-consuming transits to reach. Once the effort and expense of reaching a remote site is recognised, the potential benefits of deploying one (or more) unmanned vessels from the larger vessel to increase production is clear -- especially when work needs to be completed during the limited ice-free season.

Along these lines in 2015, TerraSond deployed an ASV on a survey undertaken for the US National Oceanic and Atmospheric Administration (NOAA) in the northern Bering Strait. That effort involved a 12' (3.7m) C-Target 3 ASV (CT3) military target drone, chartered from ASV, LLC of Broussard, Louisiana (USA) and retrofit for hydrographic data collection with a modest suite of survey instrumentation. Production was less than planned, largely due to the inability to safely deploy and recover the ASV in the highly exposed, inclement area.

However, the experience brought lessons which were incorporated in the 2016 effort when NOAA again contracted TerraSond to perform a major survey in the Bering Sea region of Alaska, near Nunivak Island in Etolin Strait.

Etolin Strait Project

Etolin Strait is located east of Nunivak Island in Alaska's Bering Sea. Located near the southern edge of the Arctic ice pack's maximum annual extents, the area is either covered by sea ice or experiences ice flows for the majority of the year. The area is therefore reliably navigable only from June through October.

During the ice-free season the area experiences a flurry of navigation activity from barges, freighters, and other vessels as they transit through, bringing goods and fuel to locations further north along Alaska's west and north coasts. The area also offers limited protection from the frequent storms of the region, where protection is scarce along Alaska's exposed southwest coast.

Existing charts here are incomplete or inaccurate, based on limited surveys dating to 1951 or older—a trait common of Arctic charts. This, as well as requests from mariners, led NOAA to prioritise Etolin Strait for a modern hydrographic survey. In fact, in June of 2016 the necessity of updating charts in the area was underscored when a 595' chemical tanker grounded in the survey area on an uncharted shoal, just weeks before survey operations were scheduled to commence.

▲ *Q105 and ASV survey simultaneously in Etolin Strait, with both vessels collecting multibeam and towed side-scan data.*

Area Logistics

Like much of Alaska's Arctic coast, the area is remote, with fuel and supplies days away by water. The 105' research vessel, the RV *Q105*, would need to be mobilised in Homer, Alaska – the 'closest' port to the survey area on the road system – and transit 900 nautical miles (1,667km) for four days to reach the survey area. The closest source of fuel and supplies was Bethel, a roundtrip transit of 600 nautical miles (1,111km), or about three days.

Given the size and remoteness of the survey area, limited ice-free season, and inclement nature of weather of the region, it was important to maximise production for every operational day on-site. Utilising an ASV to effectively double production for relatively small additional cost made sense.

▲ *ASV collecting multibeam and towed side-scan data.*

▲ *ASV is deployed from the* Q105 *using the LARS.*

C-Worker 5 ASV

A C-Worker 5 (CW5-ASV) was chartered from ASV, LLC (USA). The CW5-ASV was developed from the ground-up as a hydrographic force multiplier. At 18' (5.5m) the vessel is large enough to handle marginal weather conditions and support a variety of survey instrumentation but small enough to fit on the deck of small to mid-sized support vessels like the *Q105*. Other features which made it well-suited for this project include 4-5 days of continuous survey endurance and 6 to 7 knot survey speeds

To address the deployment issues experienced on the 2015 survey, ASV designed a custom Launch and Recovery System (LARS) for the CW5. The LARS is a dual-lift point davit system which allows the ASV to be deployed and recovered safely in conditions beyond that possible with a single-point lift, such as by vessel crane.

Project requirements called for simultaneous multibeam and side-scan data collection. Therefore, ASV installed a multibeam-hull mount as well as a side-scan winch with a custom track/trolley system capable of deploying the side-scan tow fish and pulling it from the water again to be cradled and stowed on the CW5 deck when not in use.

Existing charts here are incomplete or inaccurate – a trait common of Arctic charts

Mobilisation

Following suitability testing and integration of TerraSond's survey equipment into the ASV in Broussard, Louisiana, the ASV was trucked to Alaska. Arriving dockside in Homer – the 'end of the road' for the North American road system in Alaska – the vessel was craned aboard the *Q105*, along with its supporting infrastructure and spares. The LARS system was welded to the *Q105* deck and load-tested while the *Q105* was mobilised simultaneously with survey and IT systems.

Both the ASV and *Q105* were configured with identical survey systems. Major components consisted of Reson 7101 multibeams, Edgetech 4200 side-scans, and Applanix POSMVs. Although the relatively large multibeam sonar head and side-scan tow fish were a challenge to integrate onto the small unmanned vessel, consistency across the two survey platforms utilised proven, familiar, and owned equipment, and more importantly allowed spares to be transferrable to either vessel if needed.

Following sea trials of both vessels in Homer, the *Q105* commenced the four-day transit to Bethel, where the survey crew would fly in to join it, and then an additional 1 ½ days to the Etolin Strait survey area, where operations would commence.

Communications and Control

Controlling and monitoring the ASV required an additional four dedicated personnel aboard the *Q105* for 24 hour operations. This consisted (per 12-hour shift) of one ASV personnel to monitor the CW5-ASV and one TerraSond personnel to monitor the survey equipment suite. A fifth person from ASV was also aboard to assist with issues if needed, especially since the CW5 was a new survey platform for 2016.

ASV's proprietary 'ASView' software served as the command and control interface with the CW5-ASV, which maintained a telemetry link to the vessel at all times via IP radio with antennas mounted on the *Q105* mast. ASView was used to send commands to the vessel, including what line to track, and monitor and control onboard systems. A streaming camera view was also monitored for obstacle avoidance and docking with the larger vessel.

Survey systems were monitored by remote desktop methods over an independent IP radio system. Two survey PCs running on the CW5-ASV were monitored simultaneously over the radio link to monitor and control a combination of software packages including QPS Qinsy, Edgetech Discover, Reson 7k Center, and CARIS OnBoard.

Operations

The CW5-ASV was operated in an 'unmanned but monitored' mode. In this mode the vessel was kept within visual range at all times while

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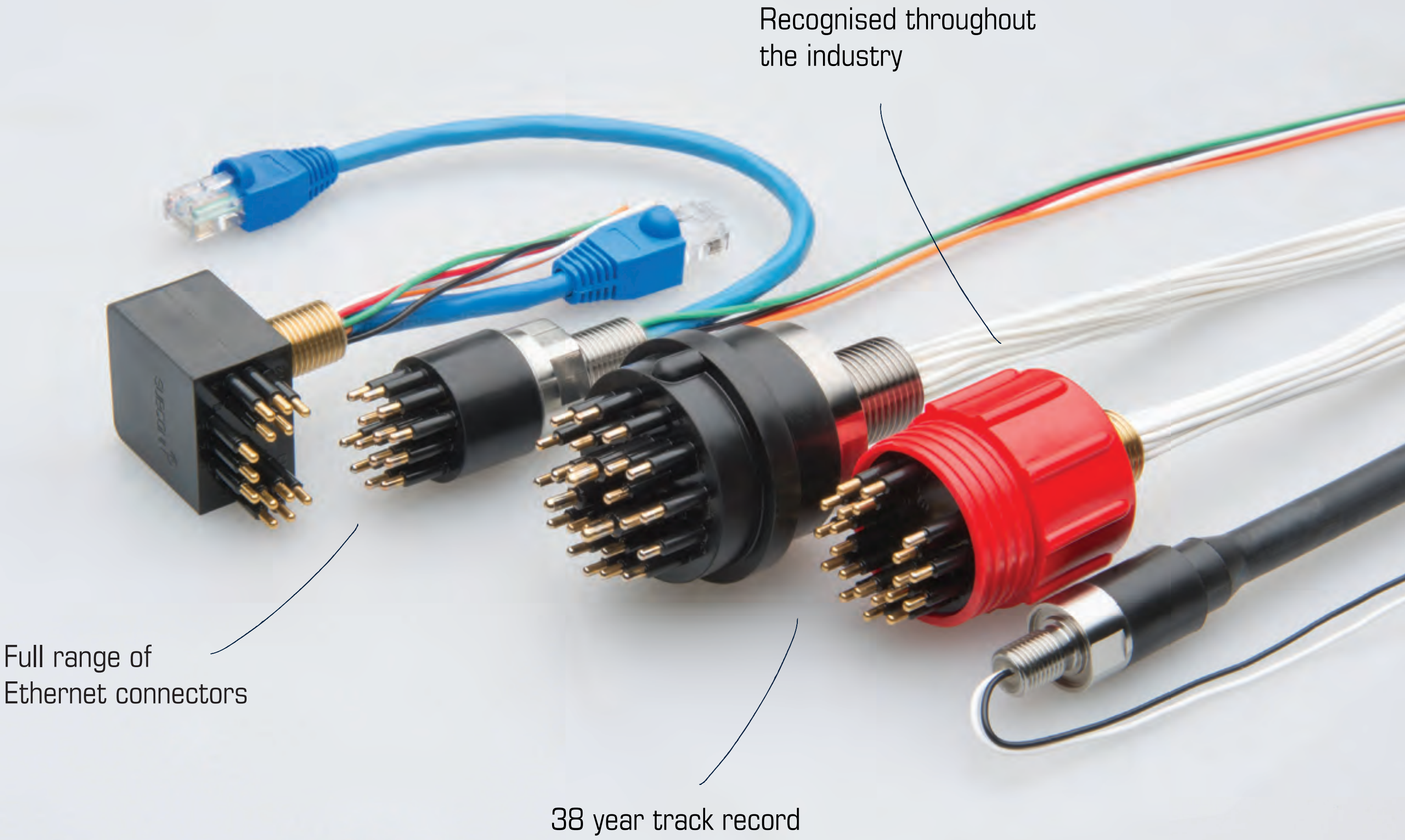

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▲ *ASV acquisition station on the* Q105; *ASV monitoring on the left, survey equipment monitoring on the right.*

▲ *Project area overview (shown in red).*

running a survey line adjacent to the line being surveyed by the *Q105*. Line tracking was automated, with the vessel able to maintain a distance off-track of 1 metre or better, even in poor sea states. Speeds were adjusted manually as necessary to keep the CW5-ASV at an optimum distance from the *Q105*, normally 500 – 800 metres forward to keep good visibility from the *Q105* bridge. Line turns were completed by manual remote control and coordinated with the *Q105* bridge. The ASV-CW5 side-scan tow fish was manually commanded to cable-in or cable-out as necessary to maintain an optimum height above the seafloor.

Data quality compared well between the two vessels

Radio bandwidth was adequate for real-time monitoring and tuning of the acquisition systems but insufficient to transfer raw data, which could be as great as 50 – 100GB/day. Therefore, data was downloaded whenever the ASV was recovered aboard the *Q105*, which on one occasion was 3½ days after deployment. In fact, the need to fully QC and process the data was more of a limiting factor on deployment endurance than fuel consumption, which was estimated at 4-5 days.

Though the CW5-ASV was primarily used to increase production, it was also used as the sole survey platform in particularly shallow (4-5m depth) portions of the area where it was deemed unsafe or impractical to survey with the larger vessel, which had a draft of 2m. In these cases the *Q105* would follow the unmanned vessel to monitor it and keep it within radio range.

Results

Despite a relatively complex survey instrumentation suite that included towed side-scan, the CW5-ASV acquired 2,275 nautical miles (4,213km) of the project total of 5,200 nautical miles (9,630km) of side-scan and multibeam data, or 44% -- with the *Q105* collecting the remainder. This production rate was much higher than the anticipated 30% and resulted in an on-site time savings of almost 25 days, allowing the project to be completed well ahead of schedule and during the optimal part of the Arctic summer.

The LARS system was a large part of the success, allowing the ASV to be recovered and deployed safely in marginal sea conditions, with some recoveries taking place in seas of 6' (1.8 m).

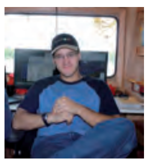
Data quality compared well between the two vessels, with slightly more motion artifact apparent in the ASV-CW5 data due to the increased motion from its relatively small size. Line handling abilities were actually superior to the larger vessel even in marginal sea states.

Future Plans

The successful deployment of the CW5-ASV on this project demonstrates the potential of ASVs to increase efficiency and productivity by operating concurrently with a larger survey vessel. TerraSond intends to continue to explore and deploy ASV technology whenever feasible, especially on its remote Arctic projects where increased production efficiencies are critical to decrease cost per nautical mile surveyed and make cost-effective mapping of the expansive, poorly charted Arctic region possible. Future plans may include deployment of multiple ASV platforms like the CW5-ASV off a single larger vessel to realise even greater production capacity.

Acknowledgements

Thanks are due to NOAA for funding this work, ASV, LLC for providing, outfitting and managing the CW5-ASV, and Support Vessels of Alaska (SVA) for field deployment support on the RV *Q105*. ◀



Andrew Orthmann manages NOAA charting work for TerraSond. He has 16 years of experience in the field of hydrographic survey, consisting of 9 years for Fugro-Pelagos and 7 years for TerraSond. He holds a BSc in Geography (2000) from the University of Alaska Fairbanks and is a NSPS-THSOA Certified Hydrographer (#225).

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DHN Chosen to Aid Olympic Water Sports

DHN Presence at **Olympic** and **Paralympic Games** Rio 2016

Hosting the Olympic Games includes supporting water sports competitions like Sailing, Swimming Marathons and Triathlons. The Brazilian Directorate of Hydrography and Navigation (DHN) has been supporting Olympic sailing and other international yachting races since Athens 2004, in addition to being the accredited organisation to provide safety at the Brazilian waters and a large portion of the South Atlantic Ocean. As a result, the Rio 2016 Organizing Committee selected DHN to add expert weather forecasting and to deploy metocean buoys to collect data to support water sports during the Olympic Games.

▲ *DHN Navy Meteorologists.*

The Directorate of Hydrography and Navigation (DHN) is accredited in Brazil to run the Hydrographic Service and the Marine Meteorological Service (SMM). The SMM is operated by the DHN's Navy Hydrographic Center (CHM), which is located at Ponta da Armação Naval Complex (CNPA), Niterói, Rio de Janeiro. Following the adoption of the International Convention for the Safety of Life at Sea (SOLAS, 1974), the Brazilian government assigned SMM with the responsibility of issuing daily weather bulletins, and severe weather warnings when appropriate, for the whole maritime area under the responsibility of Brazil.

▲ *The seven sailing races and four deployed buoys at Guanabara Bay. Races (in green): 01 – Ponte, 02 – Aeroporto, 03 – Escola Naval, 04 – Pão de Açucar, 05 – Copacabana, 06 – Niterói, 07 – Pai. Buoys: B1, B2, B3 (in red): SiMCosta, B4 (blue anchor): DHN.*

SMM in Previous Olympic Games

Besides its duty for the safety at sea, SMM has been developing experience with weather forecasting for the Brazilian sailing teams since Athens 2004. SMM's debut followed an unofficial invitation by the Olympic Sailing Team to assist their strategies with weather forecasting. Navy experts added specific runs to Navy operational numerical weather prediction models to focus on the Eastern Mediterranean region with a denser grid with a 20km resolution. Navy Meteorologists issued weather bulletins and warnings based on those model outputs and all available measurements of winds and currents. They were added to the ensemble of forecasts available for the sailors. Brazilian athletes Torben Grael, Marcelo Ferreira and Robert Scheidt performed so well in 2004 that they won two out of the five Brazilian gold medals that year.

The esteemed 2004 contribution fostered further participation. After aiding a series of international sailing competitions, SMM was officially requested to provide weather forecasts for the XV Pan-American games in 2007 that took place in Rio de Janeiro. Further contributions during the Olympic Games in Beijing 2008 and London 2012 vouched for the request to join the Rio 2016 weather forecasting team.

'Nowcasting' depends upon observational data

Preparations for the Olympic Games Rio 2016

Following the selection of Rio de Janeiro in 2009 to host the Games in 2016, the Olympic Public Authority (APO), a public consortium constituted by the Brazilian federal government, sent part of its Board to review the available resources at the DHN facilities in 2012. SMM would be assigned to help monitor weather and tide events in the Guanabara Bay as a result of the Olympic candidature process commitments. To comply with the International Olympic Committee (IOC) requirements, SMM conducted personnel qualifications and specifications of equipment, expected costs and delivery times.

The last two years were challenging. In 2014, SMM weather forecasting started during the first official test event concerning the Olympic Games, the International Sailing Regatta 2014, the largest held in Brazil ever. A Memorandum of Understanding was signed in March 2015 between the Organizing Committee of the Olympic and Paralympic Games Rio 2016 and all the requested institutions for weather forecasting: the Instituto Nacional de Meteorologia (INMET), the Instituto Nacional de Pesquisas Espaciais (INPE), the CHM, the Departamento de Controle de Espaço Aéreo da Força Aérea Brasileira (DECEA), the Sistema de Monitoramento da Costa Brasileira (SiMCosta), the Instituto Estadual de Ambiente (INEA), the Secretaria Municipal de Meio Ambiente (SMAC), and the Sistema Alerta Rio/Fundação Instituto de Geotécnica do Município do Rio de Janeiro (Geo-Rio). The appendix of the agreement was the Matrix of Responsibilities in Meteorological Data and defined what each institution was to deliver. Yet, a final official test was promoted during the International Sailing Regatta 2015.

Let the Games Begin

The effort put into providing accurate and timely forecasts during the Olympic Games was truly great. SMM predicted weather to all offshore sports, and DHN nautical charts and tide tables were available. Sailing was hosted at seven different race areas inside and outside the Guanabara Bay. It involved 380 sailors from 66 countries in 13 competitions. The swimming Marathon was held at the Copacabana beach, which involved a 10km track for 51 swimmers from 29 countries. The triathlon had a much shorter 1.5km water track, but for 110 athletes from 42 countries. Add to that all Paralympic competitions. These are such different scenarios that a team of two Navy Meteorologists was assigned by DHN to work exclusively for the Games, and the other two assigned by CPTEC and CEMADEN, dealt with providing bulletins and warnings, as well as two daily briefings for the event organisation and all delegations that could change races or postpone competitions.

'Nowcasting' and Improved Observational Data

Weather forecasting of synoptic scale features such as cold fronts is routine for SMM along the Brazilian coast, but tracks within Guanabara Bay required better spatial and temporal resolutions.

Mesoscale features such as breezes and katabatic winds, as well as local scale features such as cumulonimbus clouds that develop sparsely at the end of a warmer day, could mislead forecasts. The best-suited approach was to conduct ‘nowcasting’. This is defined by the World Meteorological Organization (WMO) as the detailed description of the current weather along with forecasts obtained by extrapolation for a period of 0 to 6 hours ahead.

The effort put into providing accurate and timely forecasts during the Olympic Games was truly great

’Nowcasting’ depends upon observational data, so sensors dedicated to the Olympic Games were needed. Cold and warm fronts, highs and lows, tides, and currents are distinguishable large-scale features in current weather products. However, ’nowcasting’ relies on observing relevant smaller-scale features. Buoys and weather stations play key roles in acquiring such data. DHN deployed four buoys for collecting environmental data, one under Navy management, and three under SiMCosta management. The buoy under Navy management, a.k.a. Guanabara, is already attached to the National Program of Buoys (PNBOIA) observational network. The PNBOIA is an almost 30-year cooperation between several partners coordinated by the DHN that has already deployed and maintained nine moored buoys and 296 drifting buoys along the Brazilian coast and the South Atlantic region. All buoys were able to measure air pressure, temperature and humidity, wind and ocean currents, water temperature, and wave properties. In addition to the buoys, three new surface weather stations were installed by the CEMADEN. One of them was installed at DHN.

Brazilian Gold Medal at the Last Sailing Competition

DHN contributions to the Olympic and Paralympic Games Rio 2016 demonstrated that Hydrographic and Marine Meteorological Services could perform tasks that are collateral to its regular responsibilities with proper planning and joint efforts with other government institutions and the private sector. The participation of Navy Meteorologists performing ’nowcasting’, deployment of buoys, and weather station data resulted in remarkable contributions such as was the Skiff 49er class gold medal of the Brazilian sailors and Navy Sergeants Martine Grael and Kahena Kunze. They were sailing at home and had a strategy supported by weather forecasts, but four boats had nearly equal chances up to the last regatta. The winning decision of the girls was to sail away from the beach right before the last leg. It was based on their personal ’nowcasting’. Competitors were not allowed to receive observational data during the race, but in an interview later, they mentioned that gale wind information was provided by the visual observation of the Brazilian flag movements on the Fort Urca mast. In the end, it seems that the lasting professional experience obtained by the DHN is the most rewarding part of its Olympic legacy.

Acknowledgements

Many thanks are due to Capt Emma Giada Matschinske and CDR Cesar Reinert Bulhões de Morais for their ideas and dedicated review, as well as to LT Alana de Lima Pontes Gadelha and LT Alexandre Augusto Lopes Gadelha for their service at the Olympic and Paralympic Games.

More information

- Brazilian Navy monitors climatic conditions to competitions at Guanabara Bay, available at http://www.defesa.gov.br/noticias/23493-rio-2016-marinha-monitora-as-condicoes-climaticas-para-as-competicoes-na-bahia-de-guanabara.
- Read about the meteorological system essential for outdoor events, available at http://www.brasil2016.gov.br/en/news/read-about-the-meteorological-system-essential-for-outdoor-events.

Surface weather observation station installed at DHN.

LCDR Daniel Peixoto de Carvalho graduated from the Brazilian Naval Academy in 2000, became a Hydrographer in 2004 and earned an MSc in Meteorology and Physical Oceanography from the United States Naval Postgraduate School in 2013. He is currently working at the Brazilian Navy Hydrographic Center.

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A View on Trends in Hydrographic Processing Software

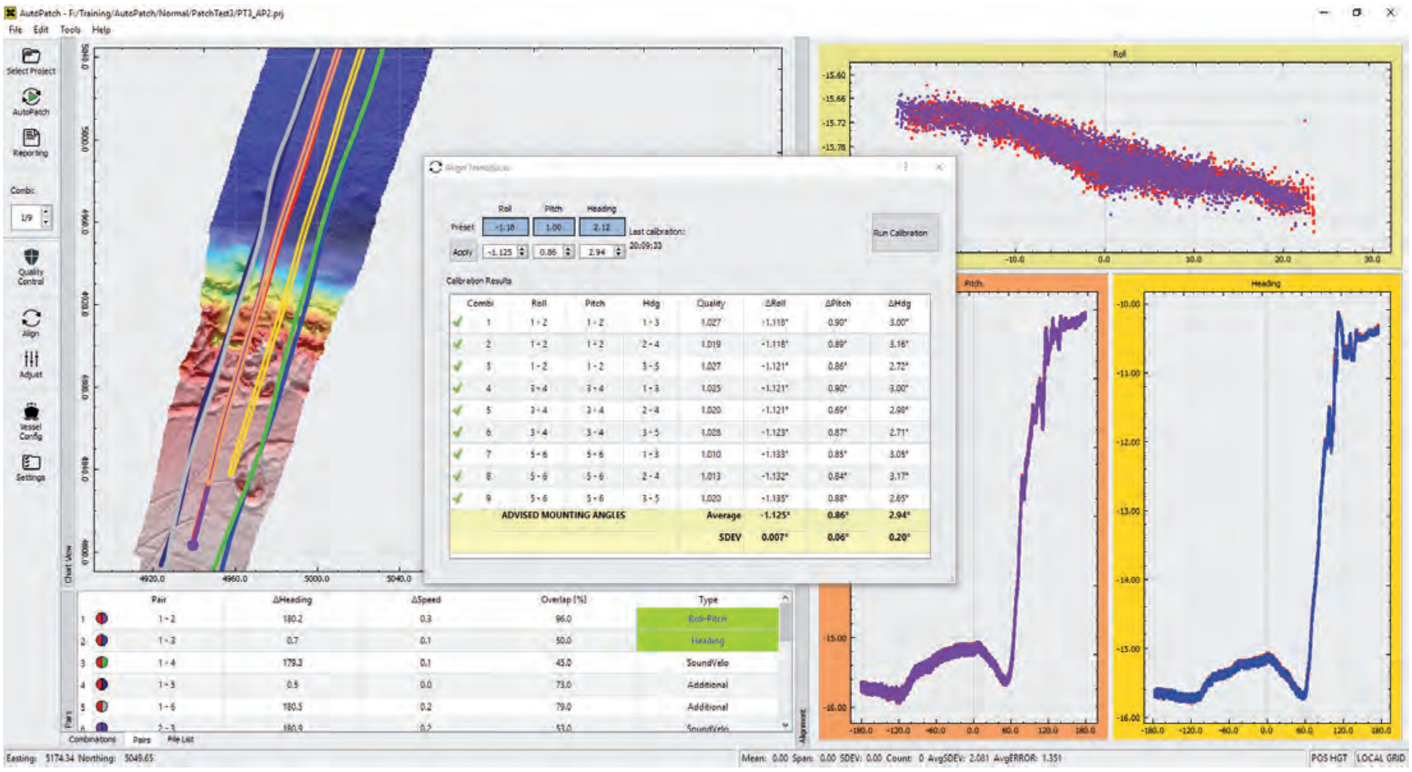
In What Direction is **Progress Headed?**

Discussing and comparing software has often been tricky in *Hydro International* as it is difficult to put the packages together and see clear differences. In this overview of hydrographic processing software, we will highlight trends and movements as indicated by the responses from software suppliers to our questions. In addition, we have added to this our own observations. All in all, this makes for interesting reading as there are movements in the industry that also tell us where the profession is headed.

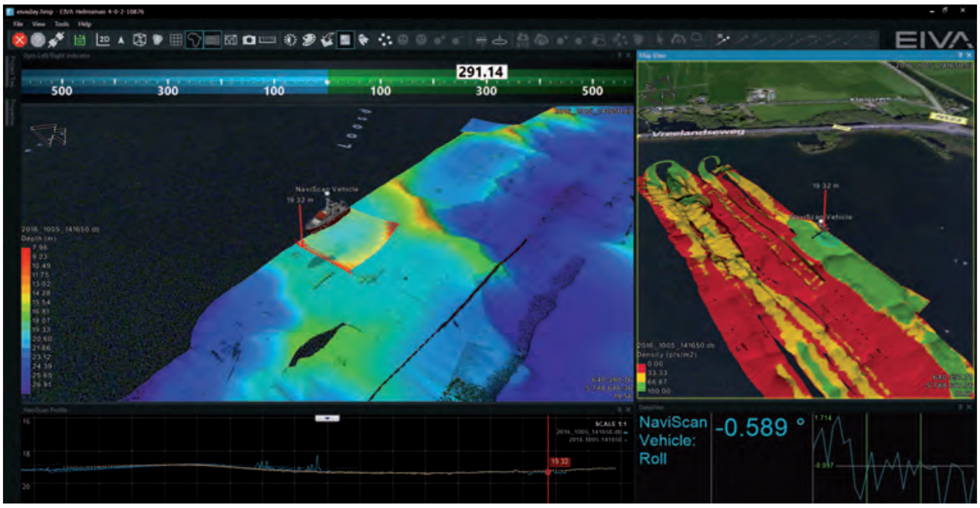
Firstly, we would like to establish what ‘hydrographic processing software’ is. Where does ‘processing’ start and end? Most suppliers start with the acquired data; in most cases the raw data are the starting points for the surveyors working on the set. This may even be live data. Beamworx defines the time that the data is released by the acquisition software as starting point for its specific data patch and data cleaning software.
The ‘processing’ terminates at the time that the georeferenced data is ready to create deliverables like 2/3D models, volume calculations for dredging, contour maps, habitat maps, etc. Most packages can be tailored to fit the workflow of the end-user.

Typical Users

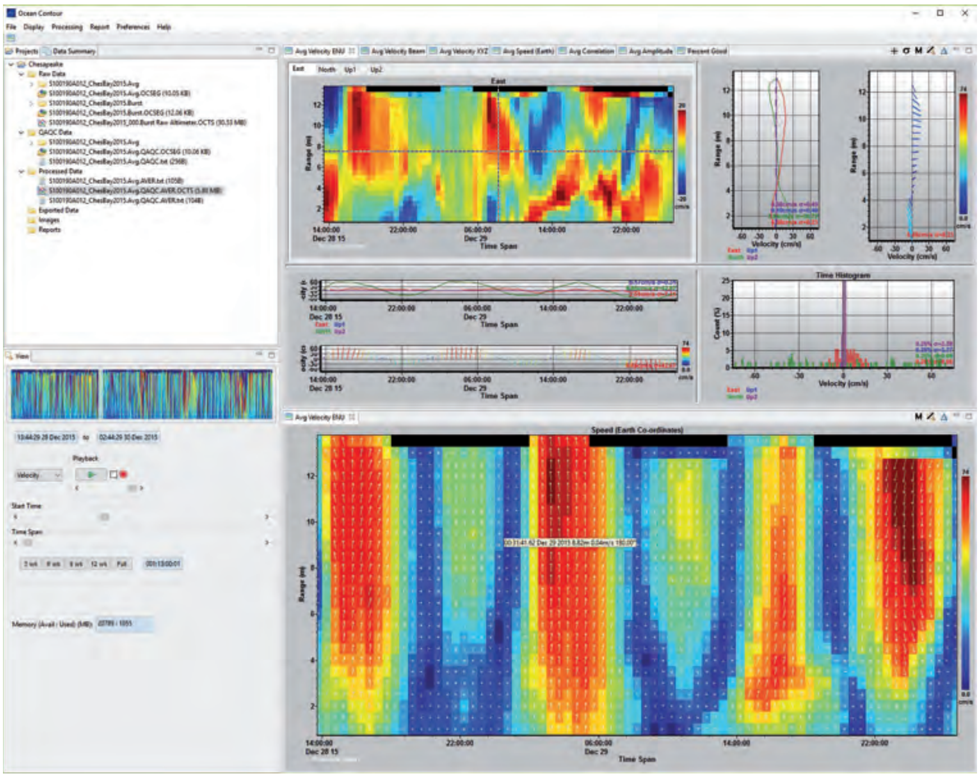
Who uses the packages? According to the suppliers the packages are extensively used in nautical charting and Oil & Gas. Dredging is also an application that was mentioned often. QPS mentioned an extension of the application towards terrestrial data: highway profiling surveys and terrestrial laser scanning surveys.



▲ *Beamworkx AP2 ScreenShot With align dialogue.*



▲ *Eiva's 3D real-time QC tools reduce need of re-survey.*



▲ *Ocean Contour example of a processed Signature 500 datafile.*

This may sound new and surprising, but a multibeam echo sounder also creates a point cloud. HYPACK has also taken a step towards the 'terrestrial' having launched a version for processing Unmanned Aerial Vehicles (UAV) data. Eiva allows the user to add any type of point cloud, such as those derived from terrestrial laser scanning or photogrammetric surveys and display those together with the typical multibeam survey data.

More Data Sources

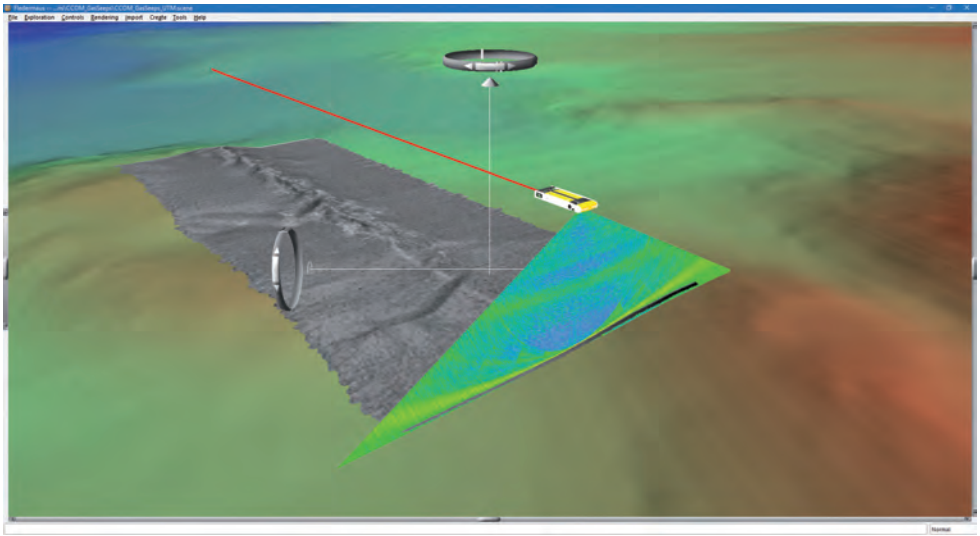
Most packages facilitate live data monitoring and processing and strive to minimise the lag between logging of a survey line and the start of the post-processing of the same. This is becoming more important as the additional data is collected by either the same sensor or by additional sensors, often working simultaneously. While more data is logged per time unit, a typical turnaround time from acquisition to a preliminary dataset at the clients disposal is not seldom around 24-48 hrs. This puts a significant strain on the operator of the processing software. Sensors are not placed uniquely on a vessel anymore, the number of possible platforms has been increased over the course of time. Think of AUVs, USVs, or ROVs. One of the trends visible is a greater number of data sources that need to be 'handled'. More data is available from one source. Think of water column data and backscatter that can be analysed for further information. Coming to this point, most packages are suited to process the data from different sensors. Only Kongsberg SIS QA and, at the moment, Ocean Contour from Ocean Illumination are dedicated to Kongsberg sensors and Nortek Signature series acoustic Doppler Profilers respectively. The latter is designed to open up for more instruments. Being able to process the data from more than one kind of sensor or various types of data from the same sensor (such as backscatter and water column data) in one software suite is judged to be an advantage on most occasions. Also from the perspective of the operators, this preference is present: they just need to be familiar with one package to work with all incoming data. Keeping the software generic towards sensors ensures the optimal adaption towards applications and requirements from the business or science on the one hand and technical developments such as the introduction of new sensors on the other hand. Organisations that work on a project basis can keep the same software and use the sensors that are best for that job.

Most packages are suited to process the data from different sensors

Operational Aspects

From an operators perspective, there are significant differences between the packages, with the most prominent difference being that some packages comes bundled with an acquisition part and others do not. Some advantages of such a solution is the transfer of

online settings such as lever arm and angular offsets without requiring additional user input, thereby removing one plausible source of error. It also allows the user to move back and forth in the workflow with less time delay, and so helping to increase the efficiency of the processing.
This brings us to the workflow. Most packages allow the user to define the workflow and the solution wraps around this. Most of them can work with the raw data and allow live (real-time) monitoring and near real-time processing, putting efforts to even optimise this further. Teledyne Caris Onboard has been developed with real-time processing in mind - especially when using autonomous survey platforms.



▲ *AUV survey in Fledermaus.*

Looking to the Future

As we are talking trends, it is interesting to see where everything is heading. Some aspects have already been touched on. The main trends we see in the development of hydrographic processing software are mentioned below.

Most packages facilitate live data monitoring and processing

- More data. The data comes from more than the traditional sources (single beam, multibeam echo sounders, SVPs, ADCPs…) and it will become more data-intensive. Multi-head echo sounders, integration of (underwater) laser scanning, photo, and video are multiplying the amounts of data. Increased survey speed as a result of improved sensor performance further increases the amount of data being acquired per time unit. Processing power of the hardware will increase as well.
- Big data. With an increasing demand for cost efficiency there is an obvious market for automated tasks in a bigger picture than what is seen today. If methods that allow machine learning to take place are made available for the service providers, not only the processing time can be trimmed but also the repeatability may be improved, reducing costly rework.
- Storage and accessibility of the data. The amount of data is increasing, the cost of data storage (in the cloud) is decreasing. More data will be created and stored in the 'cloud': an online data storage that is available from various parts of the world. As the (satellite) communication costs are also decreasing, real-time access of data from around the world is facilitated. This means that an operator can work with the data collected somewhere completely different in a short period of time after acquisition. And after processing, the data is made available to the end-user much more quickly.
- Autonomy. An AUV or USV (or even more!) can be operated from one vessel, all collecting data that needs monitoring and quality checking, then needs to be put together and processed towards the same standard. The human intervention will be reduced and especially routine jobs in data processing should be made automated, possibly already in the vehicle (in case of an AUV or USV).
- Visualisation is already important for the judgement of the data quality. This aspect is to gain additional interest among hydrographic (and oceanographic) professionals. From some of the packages we notice a distinct focus on improving the visualisation experience for the end-user. The 3D (and sometimes 4D) environment that is the workplace of a hydrographic processor constitutes a large part of that persons working environment.
- The software, especially the user interface, will be simplified and will even get an app approach, making it user friendly even for people who are not familiar with a particular package.

Another challenge that will have an impact on the processing of hydrographic (and oceanographic) survey data is, for example, crowdsourcing. This will enable more seafloor surface to be mapped, but it results in varying data quality and other issues may potentially need to be overcome before they can be matched with existing or adjacent surveyed areas by other organisations. ◂

More information

Geo-matching.com

For an overview of characteristics of hydrographic processing software see Geo-Matching.com: http://bit.ly/HydrographicProcessingSoftware

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CIRM

An Industry View

As the principal international association for marine electronics companies, CIRM brings individual companies together into a powerful collective body with an influential voice. As a non-profit organisation we are totally dedicated to the needs of our members. In respect of hydrography, CIRM not only represents the industry utilising the digital products generated by hydrographers around the world, but our members also produce tools and equipment that help the hydrographic community to do their job.

CIRM exists to promote the application of electronic technology to the safety of life and efficient conduct of vessels at sea. We strive to foster relations between all organisations concerned with electronic aids to marine navigation, communications and information systems.

CIRM was originally founded in Spain in 1928 by 8 companies engaged in the application of radio to the maritime service. It was reconstituted in Belgium in 1947 and subsequently moved to London. It is now the principal international association for companies engaged in maritime electronics, with current membership of some 100 companies from 29 nations worldwide.

Defining hydrographic products by agreeing on and utilising international standards is only one aspect

CIRM is one of the nine original international bodies accredited in 1961 as a non-governmental organisation in consultative status to the International Maritime Organization (IMO).

CIRM is a Sector Member of the International Telecommunication Union (ITU-R and ITU-T), and is a Liaison Member both of the International Organization for Standardization (ISO) and of the International Electrotechnical Commission (IEC).
CIRM also enjoys mutual observer status with all the other relevant international and regional organisations, including the International Hydrographic Organization (IHO), the International Association of Lighthouse Authorities (IALA), the International Chamber of Shipping (ICS), and the US Radio Technical Commission for Maritime (RTCM).
Given all of that, how does CIRM now support the hydrographic community?
There are two major aspects of the work of hydrographers that we should look at.

1. The work to define the necessary hydrographic products to support the maritime community

CIRM is deeply involved in the development of standards, like IHO S-57 or now the IHO S-100 series of standards, but also standards developed by IALA, which influence the hydrographic community. We actively participate in relevant working groups to ensure the standards developed by those organisations meet the needs of our customers' sailing ships around the world or working in organisations on shore to support maritime trade, safety and security. With the direct link to end-users we are in a position to help improve the hydrographic products.
In addition, we test draft standards to ensure the desired results are produced. We validate that theoretical thoughts are implementable and have the necessary cost-benefit structure to be marketable to our members' customers.

2. Producing and distributing hydrographic products so they can be used.

Defining hydrographic products by agreeing on and utilising international standards is only one aspect to be taken into consideration. Bringing those standards to life by creating the so defined products, keeping them up to date and making them available for use is equally

▲ *The CIRM headquarters.*

important. Here the CIRM members take on the different roles of industry. Tools to conduct surveys are developed and improved by CIRM members. Our members also work together directly with Hydrographic Offices to create tools to produce, validate and update, for example, ENCs. But CIRM members also service the community by distributing hydrographic products, licensing them to navigators and ensuring access to hydrographic products of different nations is easy and that they are continuously updated. In the different organisations, CIRM helps to ensure the full supply chain for hydrographic products meets the demands of the end-users.

As such, CIRM works with the hydrographic community so that products can be generated and distributed. But the work of hydrographers needs the necessary electronic equipment to display, for example, ENCs in a way that increases situational awareness for the mariner and helps them ensure safe and efficient journeys. This is where the onboard electronic products of CIRM members are kicking in. Contributing to IMO's ECDIS Performance standard, developing the associated testing standards with IEC, and contributing to new developments like e-Navigation are some of the activities in this arena that CIRM is involved in. These standards help CIRM members to develop the equipment to fully utilise the hydrographic data products and integrate them with data streams from other communities, like oceanography or sea traffic management.

CIRM helps to ensure the full supply chain for hydrographic products meets the demands of the end-users

▲ *Michael Bergmann, president, CIRM*

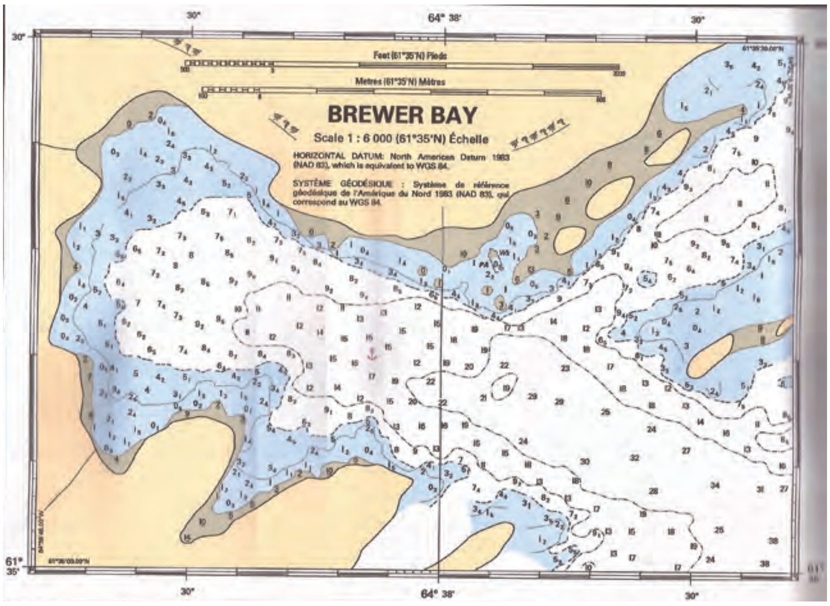
Covering the full cycle of hydrographic data, from survey to use, CIRM is dedicated through its members and its office, to help expand the utilisation of this data as the maritime industry, both military as well as civil, needs it. ◀

More information
www.cirm.org

The Grounding and Sinking of MV *Minna*

The high cost of exploration in subarctic, often uncharted, waters was demonstrated in an unorthodox but convincing way by the 1974 grounding and sinking of the MV *Minna* off Resolution Island (Canada) while conducting a combined hydrographic-geophysical survey in the northern Labrador Sea.

Minna was an 83.6m long (274ft), ice-strengthened freighter built in 1960 at Arendel, Norway, as MV *Varla Dan* and subsequently sold to the Karlsen Shipping Company of Halifax who changed her name. Bedford Institute of Oceanography (BIO) in Dartmouth, Nova Scotia, Canada, chartered her in 1972, 1973, and 1974 for deep-sea hydrographic and geophysical surveys in the Labrador Sea. Given that she was only carrying survey equipment, 300 tons of concrete ballast, and was light on fuel, her displacement at the time of the grounding would have been about 3000 tons.



▲ *Figure 1: The inset of Brewer Bay on CHS Chart 5340 (Approaches to Sorry Harbour) showing Minna at 61° 35° 17.5°N, 64° 37° 53.5°W. Soundings are in fathoms and feet, heights above chart datum (low water) are underlined and are in feet. NOT TO BE USED FOR NAVIGATION.*

The Survey Equipment

Navigation for hydrographic and geophysical surveys on the *Minna* was obtained from:

a) Two range DECCA-LAMBDA 12-f, with Master transmitter on the *Minna*. The slave stations were on Spotted Island east of Cartwright, Labrador, and on Resolution Island.

b) Rho-rho LORAN-C, which used an Austrom 5000 LORAN-C receiver and an atomic clock to predict the instant of transmission from the LORAN-C stations at Cape Race, Newfoundland, and from Angissoq, Greenland.

c) A Marconi Doppler satellite receiver to establish a position every few hours to verify the DECCA 'lane count' and to determine the clock rate (microseconds/day) of the atomic clock on the *Minna* versus the ones at Cape Race and Angissoq. Doppler satellite positioning needed accurate ship's velocity during the 20 minutes of the satellite passing overhead, which was provided by DECCA and/or LORAN-C.

Most of the survey equipment was in a purpose-built unit

The geophysical survey equipment included a magnetometer, three marine gravity meters, and one land gravity meter. Two sizes of air guns and a 100-foot (30m) towed streamer with acoustic microphones connected to receivers were used for collecting seismic reflection data.

Most of this equipment was in a purpose-built unit designed and built at Bedford Institute and lowered into #2 Hold, which became the 'survey office'.

Before the Grounding

The *Minna* visited Godthåb (now Nuuk), Greenland, for engine repairs and to verify the marine gravimeters against land-based gravity readings. Departing Godthåb on 16 August, she ran a line of soundings towards Saglek, Labrador, then, at 08:00 on 18 August 1974, she entered Brewer Bay near the Northeast

▲ *Figure 2: CCGS* Griffon *maneuvering to attempt to pull MV* Minna *off the rock. Image courtesy: Steve Grant.*

▲ *Figure3: In the left-hand rack of equipment, from the top are: 2 pieces covered by paper (one is probably the cesium beam frequency counter), Austron 5000 LORAN-C receiver (with visor over the oscilloscope), PDP-8 computer, and paper tape reader. In the right-hand rack, third and fourth pieces from the top are the Doppler satellite receiver and another paper tape reader. George Yeaton, chief scientist, is typing at a teletype – the keyboard to the computer. Image courtesy: Steve Grant.*

corner of Resolution Island to pick up electronic technicians who had installed a DECCA Slave transmitter on the island and then to establish the lane count. The wind was from the Southeast to South-Southeast at Force 4 creating a swell of 1.3m.

The Bay

The navigable portion of Brewer Bay is about 240 metres wide by 600 metres with a maximum depth of 22 fathoms (40m). The bay is surrounded by high hills providing little shelter and it experiences heavy ground swell and a circular tidal stream when near high water. A landing beach is located in a cove on the south shore of the bay where supplies are landed annually and temporarily stored for the radar station on Cape Warwick just north of the bay.

The Tide

Because *Minna* had a single propeller and no bow thruster, her normal turning radius was large. The ship was riding high due to low fuel and light load and was adversely affected by the SE wind causing her to have an even larger turning radius. Accordingly, she went outside of the surveyed area while turning. Because of forward motion and being blown sideways, she grounded on a rock pinnacle at 09:34. At the time of grounding, the tide was dropping but still 3.1m above datum. A sounding by lead line on the ship's starboard (seaward) side, just aft of where the pinnacle pierced the ship's outer hull, found no bottom; however, the ship's sounder showed a depth of 25 fathoms.

The Re-floating Attempts

Having assessed the situation, the captain ordered full astern at 11:00 (height of tide now 1.8m above datum), but the stern of the ship merely turned to port, thus coming closer to being parallel to the cliff, and failed to come off the pinnacle. To return the ship to the original heading, the captain ordered full port rudder and went forward, driving the ship farther onto the rock. By 13:00, CCGS *Griffon*, a buoy tender & light icebreaker, was proceeding to Brewer Bay to provide assistance. At 19:30 (height of tide 5.5m above datum) and again at 20:20 (height of tide now 4.8m) the *Griffon* tried to pull while the *Minna* applied full reverse, but at both times the lines parted. On the second attempt, the broken end of the hawser fouled *Minna*'s propeller, thereby reducing later attempts by the *Griffon* acting alone. The *Griffon* tried a third time at 21:15. Only at 21:30, did the crew begin lifting some of the concrete blocks from #1 Hold. Around 23:00, it was reported in the deck log that #2 Hold was dry but #1 Hold was flooded – an indication that the ship was becoming more damaged.

Insurers declared the ship abandoned as no salvage company was interested in rescuing her

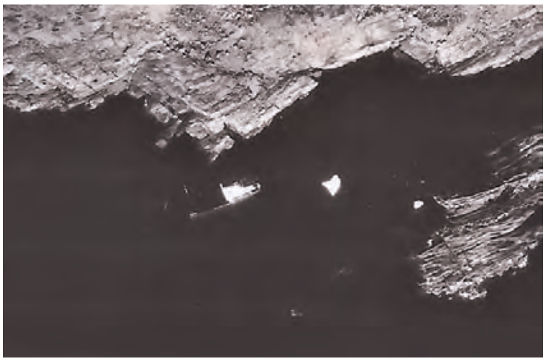
Lightening the Load

The removal of cement blocks ceased at 06:00 on 19 August owing to water rising in #1 Hold, so the hatch was covered and the booms lowered. Three more times *Griffon* attempted to pull *Minna* off the rocks; all attempts failed. The heavy sea and swell and the wind from the Southeast (i.e., directly from the open ocean) caused the ship to keep striking heavily on the rocks. At 13:00, they attempted to take the hatch-cover off #2 Hold to hoist the survey equipment from the Hold, but the hinges gave out, negating that course of action – another indication that the ship was breaking apart. The crew and the BIO staff were transferred to shore and were not particularly welcome guests at the radar site, at least until some of the ship's provisions (especially the duty-free alcohol) were brought up from the landing beach. Between 18 and 20 August, the BIO staff returned to the ship during periods of high tide and man-handled all the moveable equipment through the ship, up the gangways, onto the deck, and then lowered it down into the BIO barge for transfer to shore. Nine personnel were flown to Frobisher Bay (now Iqaluit) by chartered aircraft on 20 August and to Halifax by commercial airlines the next day. CCGS *Norman McLeod Rogers* (buoy tender/light icebreaker) arrived to take nine of the ship's personnel to Frobisher Bay on 21 August to get flights to Halifax.

The wreck of the Minna had slipped into deeper water because of ice action

The Retrieval of the Equipment

The scientific equipment, which had been removed from the ship, was stored in a shed near the beach. Fortunately a squadron from the Royal Canadian Navy was exiting Hudson Strait and was called upon for assistance. HMCS *Assiniboine* and *Saguenay* (destroyers) arrived on 22 August and HMCS *Preserver* (supply ship) on 23 August, but the squadron commander was not going to risk his ships going into such a small bay. Nevertheless, the Navy retrieved the off-loaded equipment by sea-boat or Sikorsky Sea King helicopters to the *Preserver* and ultimately returned it to Bedford Institute. Three of the survey staff went to Newfoundland on the naval ships. The chief scientist and nine others stayed to dismantle the DECCA Slave station and on 26 August flew to Halifax via Frobisher Bay. On 19 September 1974, CSS *Baffin* (hydrographic ship) retrieved the DECCA equipment from the shore and more of the equipment from the *Minna*.



▲ *Figure 4: Air photo taken 18 August 1976 showing* Minna *lying on her starboard side, bow to the southwest, stern to the northeast. Image courtesy: National Air Photo Library, Roll A24530, Frame 9.*

David H. Gray worked for the Canadian Hydrographic Service from 1971 to 2005 and was involved in geodetic surveying computations, radio navigation systems and maritime boundaries. He authored chapters in *Mapping a Northern Land and Charting Northern Waters* concerning CHS post-war history.

The End

A Norwegian ocean-going tug arrived before 5 September, but waited until the next Spring High Tide on 15 September but the tug was not successful in freeing her. On September 19, the Karlsen Shipping Company and its insurers declared the ship abandoned as no salvage company was interested in rescuing her.

Notice to Mariners

The yearly sealift of goods to the Northern Warning System station on Cape Warwick reported in June 1998 that the wreck of the *Minna* had slipped into deeper water because of ice action. A Notice to Mariners was immediately issued instructing mariners to add a dangerous wreck symbol to the 1963 Edition of CHS chart 5430 and on its inset of Brewer Bay, at 61° 34° 56.0°N, 64° 38° 23.0°W (local datum). Also, a multibeam hydrographic survey with full bottom coverage positioned by GPS was carried out late that summer. The 2005 New Edition of the chart incorporates the 1998 survey both on the main chart (for the approaches to Brewer Bay) and for the entire inset of Brewer Bay. The main chart shows the more normal wreck symbol whereas the inset uses the wreck symbol appropriate for large-scale charts near the north shore of the bay at 61° 35° 17.5°N, 64° 37° 53.5°W (NAD-83) with the bow facing northwest and drying (i.e., visible) at low tide. The present Sailing Directions, published 2009, cautions mariners that "ice action has shifted the wreck; the exact position and depth over (the wreck) are not known."

The Chart

The 1963 Edition of Chart 5340 was based on a 1952-3 US Navy survey, where its geographic grid was based on an astronomically determined survey point. The topography on the chart was from aerial photography taken about the same time. A New Edition of the chart was required to incorporate the 1998 CHS survey and so the chart was converted to NAD-83 so that it would be compatible with GPS positioning. The shift in the geographic grid accounts for most of the 795 metres between the two positions quoted above. The magnitude of this shift is typical for charts that are based on exploratory quality astronomic positions.

Air Photos

Air photos taken in 1976 show the *Minna* lying on her starboard side, bow to the southwest and stern to the northeast. In the 1987 air photos, the ship is not visible above water, but the water tones suggest that the ship is submerged at its 1976 position, although the orientation may be reversed. In the 1993 air photos, the ship is not visible, although there may be something in the water at the 1976 position. Google Earth, which uses a July 2006 satellite imagery, shows shallow water at the wreck's charted location. These series of photographs pose two questions. 1) Was the ship moving or rotating between these various epochs? 2) Was the ship being naturally reduced to rubble by the action of wind, waves and ice? Perhaps the apparent movement in the air photos and the situation as found in the 1998 survey, are the reasons for the Sailing Directions' caution note and the continuance of the 'Position Approximate' on the inset of the chart.

Some Thoughts

Given modern capabilities of 100% bottom coverage and remotely controlled underwater vehicles, it would be interesting to evaluate the damage done by sea-ice on the hull of the *Minna* after 40-plus years. ◂

Hydrographic Society Benelux

Workshop On Board SS *Hydrograaf*

A workshop themed 'Hydrograaf' was held on board the SS *Hydrograaf* in Rotterdam on 23 September 2016. The afternoon opened with a sightseeing tour of the vintage vessel. Presentations highlighted various aspects of the profession, like developments on Inclinocam and 3D Direct for offshore positioning of monopoles; data management software and the shallow survey week with students from Maritiem Institute Willem Barentz, supported by the industry.
The meeting was attended by 60 members who enjoyed going back in history and hearing about different aspects of the profession.

HSB Prepares to Organise Hydro17

The International Federation of Hydrographic Societies has asked the Hydrographic Society Benelux (HSB) to organise next year's Hydro Conference Hydro17 from 14-16 November 2017. Although the members of the HSB must still formally approve, which will be discussed during the HSB's next workshop, an organising committee has already been assembled. The committee consists of the following people: Floor de Haan, Andrew Devlin, Rob van Ree and Matthieu Vrakking.
As the venue of Hydro12, which was also organised by the HSB, proved to be a very good location, it is the organising committee's intention to yet again hold the conference on board of the SS *Rotterdam*, which is permanently moored in the port of Rotterdam, the Netherlands.
▸ ***hydro17.com***

▲ SS Hydrograaf. *Image courtesy: Hollands Glorie.*

▲ SS Rotterdam *moored in the port of Rotterdam. Image courtesy: Iain Middleton-Duff.*

JANUARY 2017

HYPACK 2017 Training Event
New Orleans, USA
→ 9-12 January
hypack.com

Multibeam Sonar Training Course
New Orleans, USA
→ 9-14 January
hydrometrica.com/wp/mbc72

Least Squares Adjustment for Offshore Survey
Newcastle Upon Tyne, UK
→ 16-18 January
bit.ly/2aLJVJG

2nd Annual Marine Data Infrastructure GCC
Dubai, UAE
→ 30-31 January
marinedatainfrastructuregcc.com

FEBRUARY

North American Dredging Summit
Houston, USA
→ 8-9 February
wplgroup.com/aci/event/dredging-summit-america/

Oceanology International North America 2017
San Diego, USA
→ 14-16 February
oceanologyinternational-northamerica.com

MTS/Underwater Intervention
New Orleans, USA
→ 21-23 February
underwaterintervention.com

Underwater Technology
Busan, KR
→ 21-24 February
ut2017.org/ut/

Wave & Tidal 2017
London, UK
→ 23 February
events.renewableuk.com/wave-tidal-overview

MARCH

Arctic Shipping Summit
Montreal, CA
→ 8-9 March
wplgroup.com/aci/event/arctic-shipping-summit

US Hydro 2017
Galveston, USA
→ 20-23 March
ushydro2017.com

APRIL

Ocean Business
Southampton, UK
→ 4-6 April
oceanbusiness.com

Gastech
Chiba-City, JP
→ 4-7 April
gastechevent.com

IHO Assembly (A-1)
Monaco
→ 24-28 April
iho.int

SMI Annual Conference 2017
Dartmouth, UK
→ 26-27 April
maritimeindustries.org/SMI-Annual-Conference

MAY

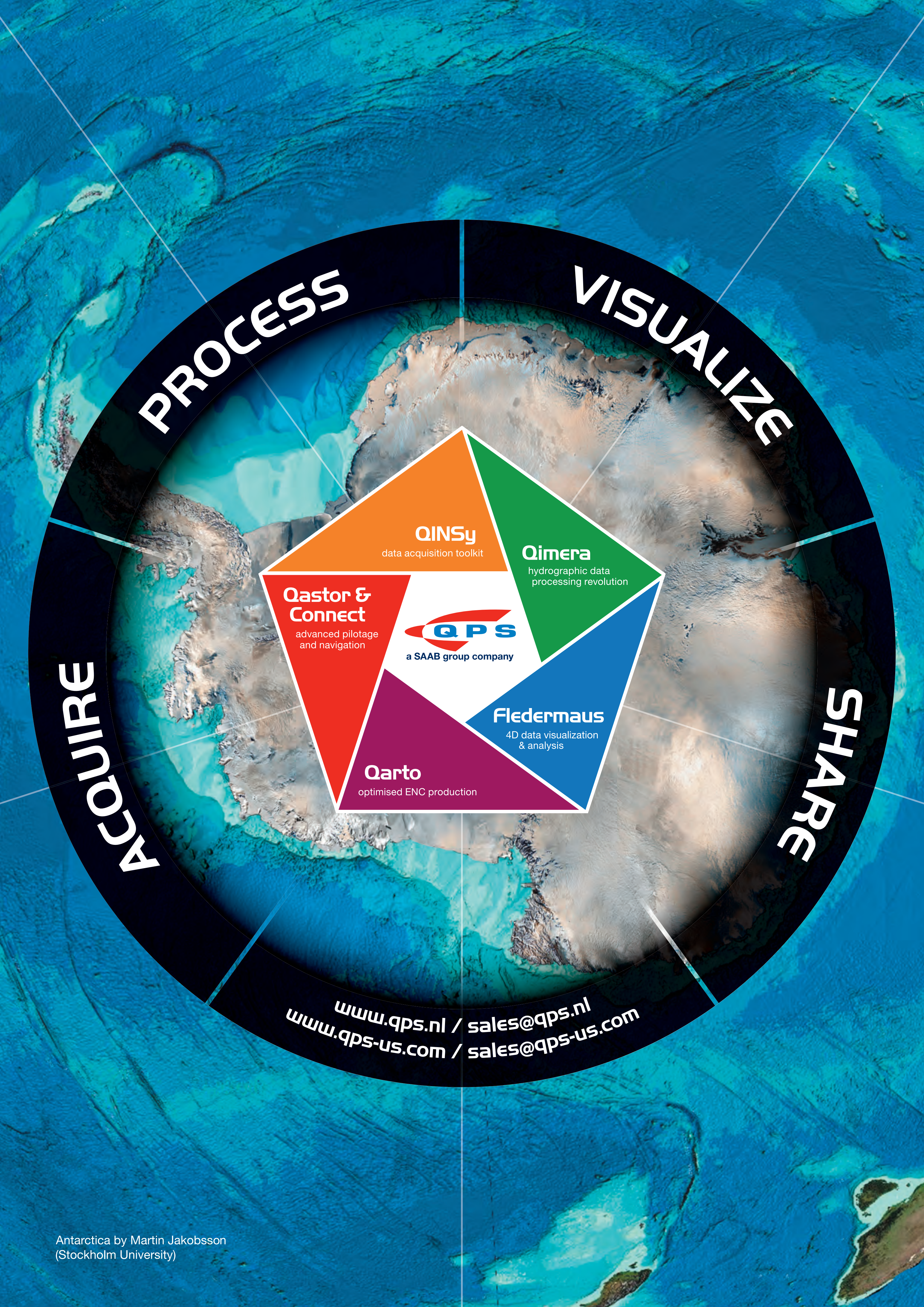
73rd Multibeam Sonar Training Course
Stockholm, SE
→ 15-20 May
bit.ly/2eAXK2i

JUNE

EWEA Offshore
London, UK
→ 6-8 June
ewea.org/events/ewea-offshore

CARIS 2017
Ottawa, CA
→ 19-22 June
caris.com/caris2017

Calendar Notices
For more events and additional information on the shows mentioned on this page, see www.hydro-international.com. Please send notices at least 3 months before the event date to: Trea Fledderus, marketing assistant, email: trea.fledderus@geomares.nl.



Antarctica by Martin Jakobsson
(Stockholm University)

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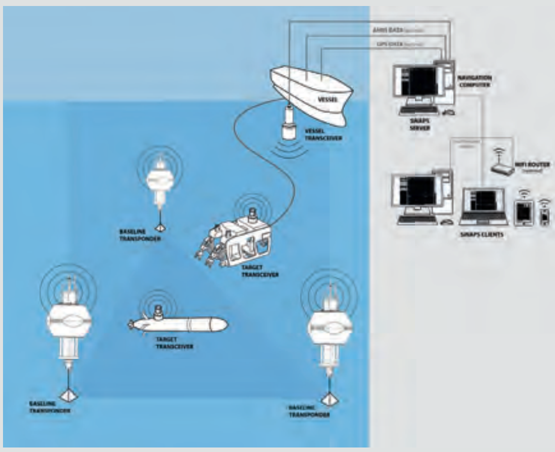

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