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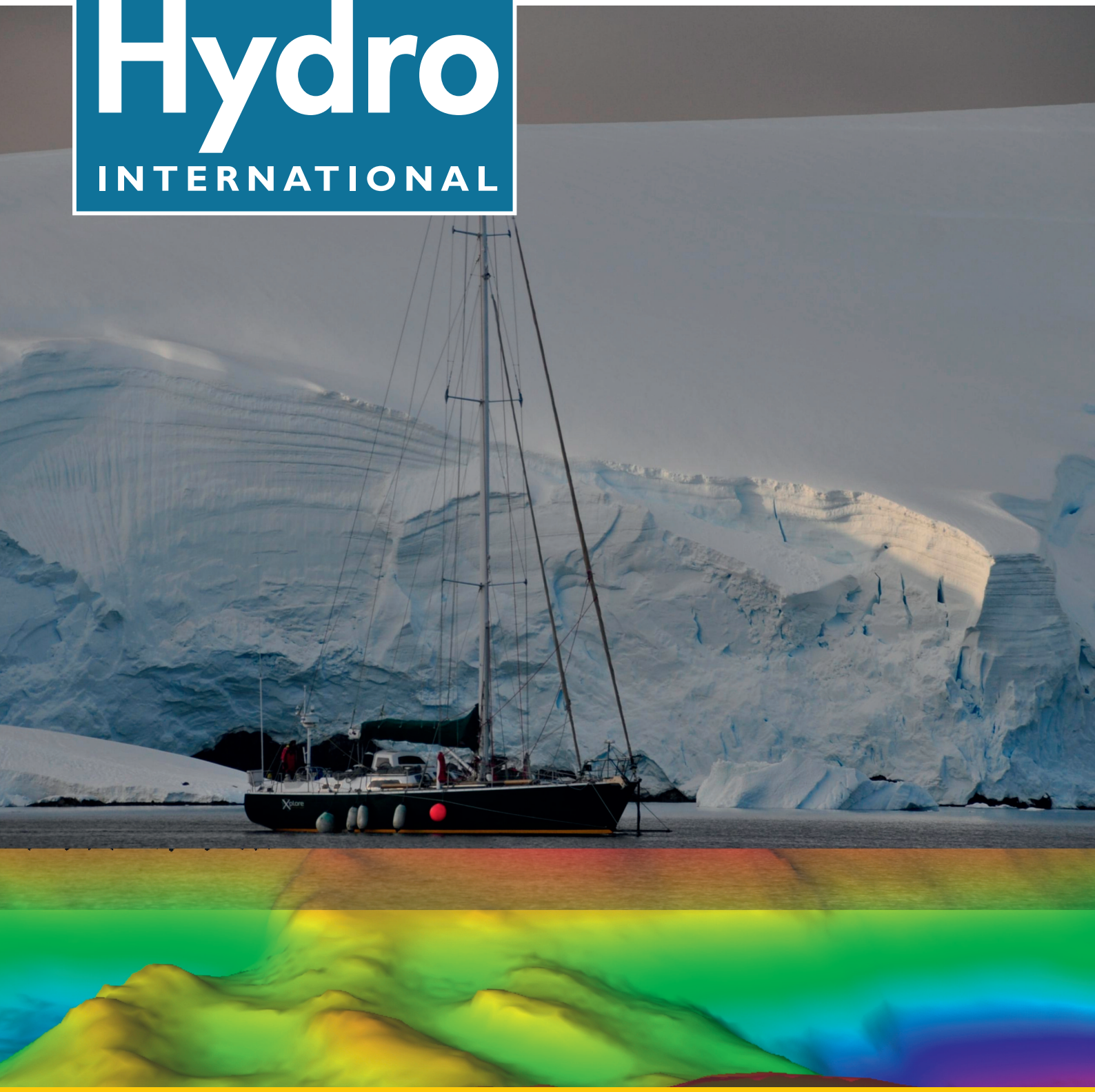
Hydro INTERNATIONAL



Measuring the Uncertainty of a Swath Bathymetry Sonar

A Statistical Analysis for System Performance and IHO Compliance

Open Standards for Interoperable Maritime Data Exchange

What Can We Learn from the Aviation and Defence Domains?

A Different Approach to Surveying Antarctica

'Operation Rock Bottom'

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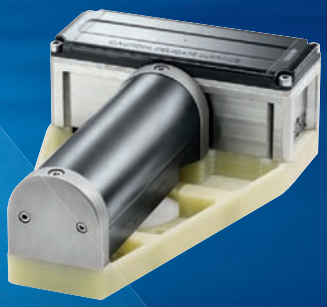
WHERE PORTABILITY MEETS PERFORMANCE



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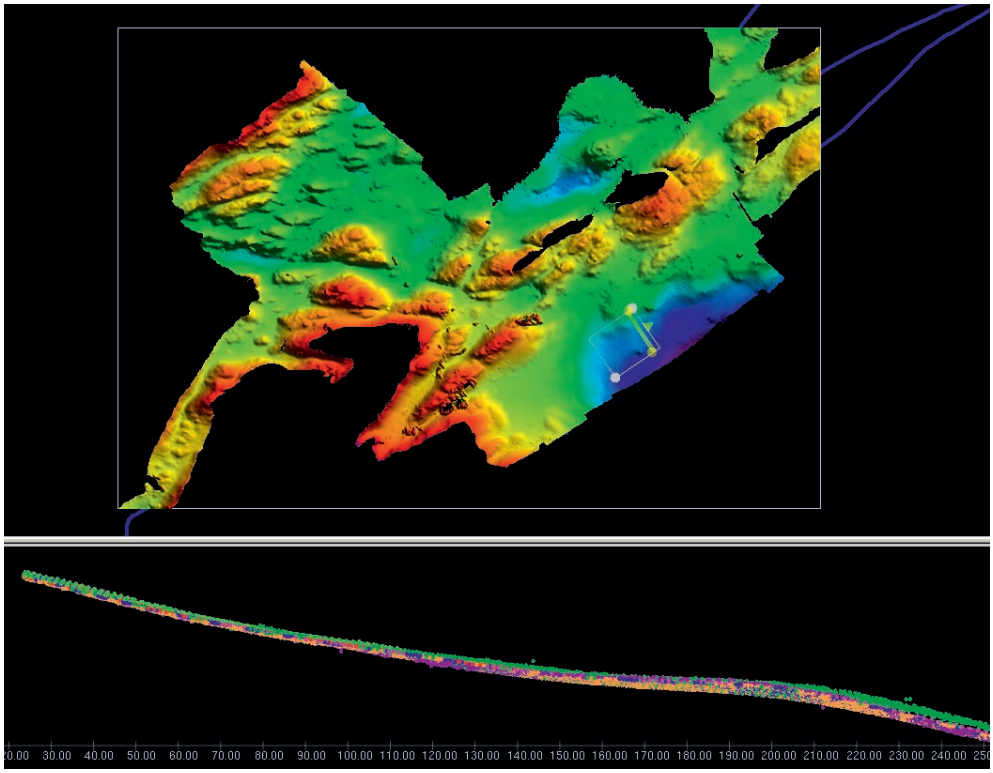

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Navigation data is poorly available in Antarctica. If navigational data is available it often dates back to the early 1900s with many lead line surveys. An initiative was undertaken by Stephen Wilkins of Xplore Expeditions to collect bathymetry with a multi-beam survey system making use of the sailing vessel *Xplore*. Also read the feature 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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Momentum

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At some point all things come together: this might be what some call momentum. Over the past years, there have already been discussions, in small conference rooms, between professionals and policy makers about targeting a broader audience for hydrographic data. This would indeed provide for a better business model underlining surveying companies and hydrographic offices, and in the end provide better prospects for the whole industry. FIG Commission 4 and IHO organised a seminar with the title 'The Blue Economy' during the last Ocean Business conference in Southampton, UK. At this one-off event, high-level delegates spoke about the necessity to reach out to other adjacent fields like coastal zone management, fisheries, environmental and sustainability and offshore energy. Many of those attending felt that the time was right to disseminate this message to all levels of the profession.

In the meantime, the industry is exploring its options in its own way, with the search for new markets, sometimes driven by economic reasons, but often by mere entrepreneurship , and with new applications for hydrographic data well on its way. Many surveying companies, working solely for hydrographic offices in the past, are now already in action for principals in offshore energy and wind parks, coastal zone management and fisheries.

An effort, led by the International Hydrographic Organization, but supported by the industry and policymakers, to develop the S-100 as data exchange standard, is now coming along very fast. S-100 will be the interoperability stimulus that makes it easier for other fields to join in, share and benefit from bathymetry data, illustrates Alexis Brooker in his article 'Open Standards for Interoperable Maritime Data Exchange' in this Hydro INTERNATIONAL on page 23. Peter Harris of Geoscience Australia, interviewed for the recent January/February issue of this magazine, puts hydrography in the middle, when he says 'hydrography provides an essential framework for marine science'. Evert Flier, director of the Norwegian Hydrographic Service says in the April issue of Hydro INTERNATIONAL that '[...]S-100 means a paradigm shift in hydrography. It will enable us to make our data available for other purposes more easily.' And in this issue, Dr. Nikolay Lebedev, president of Transas, says in an interview on page 10 that 'Hydrographic Offices should also consider that their data are not only used by SOLAS vessels'. He points to the different users in the private sector and other fields.

As I mentioned earlier, it appears that all parties are beginning to realise that hydrography involves much more than just bathymetry for nautical charts. Needless to say there are many problems to overcome, including business models, funding, restriction on data etc., but the tone has been set. Only the future will tell whether the momentum was maintained and whether 2013 was a turning point in the focus of hydrography.

Some things are complicated

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US Nation Ocean Service Budget Request

The 2014 President's Budget Request for NOS is USD 529.2M. This request represents a critical step toward re-establishing balance across investments in NOAA's missions. Examples of supported new projects are Coastal Lidar data collection, innovation in marine sensors and the use of gravity to establish a new vertical datum.
http://su.pr/1RZW3z

Sonardyne Aids NOC with Deepest Undersea Vent Discovery

Sonardyne International Ltd's Ranger 2 USBL acoustic positioning system has played an important role in the recent discovery of the world's deepest known undersea volcanic vents by a team from the National Oceanography Centre (NOC) in Southampton, UK. The expedition used Ranger 2 to track the Remotely Operated Vehicle (ROV) Isis from the RRS *James Cook*, 5,000 metres beneath the surface, as it recorded video and imagery whilst collecting samples from the newly discovered vents in the Cayman Trough.
http://su.pr/2lsdNO

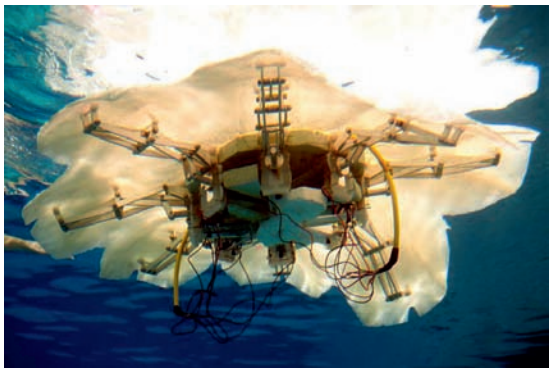
The ROV Isis.

Gardline and OceanPact Brazilian Joint Venture

Gardline Marine Sciences, headquartered in the UK, and OceanPact, a leading oil spill response company in Brazil, have entered into a joint venture. The new company is to be called Gardline Marine Sciences do Brasil S.A, and is a 50/50 joint venture between Gardline Marine Sciences (South America) Ltd and OceanPact Serviços Marítimos Ltda. This strategic alliance will see the two companies sharing their marine expertise and resources in order to pursue marine survey projects in Brazilian waters.
http://su.pr/1ZjSRA

Large Robotic Jellyfish to Patrol Oceans

As part of a US Navy-funded project, researchers from Virginia Tech College of Engineering have unveiled a lifelike, autonomous robotic jellyfish the size and weight of a grown man: 1.70m in length and weighing 77kg. The goal is to place self-powering, autonomous machines in waters for the purposes of surveillance and monitoring the environment, in addition to other uses such as studying aquatic life, mapping ocean floors and monitoring ocean currents. The prototype robot, nicknamed Cyro, is a larger model of a robotic jellyfish the same team – headed by Shashank Priya, professor of mechanical engineering at Virginia Tech – unveiled in 2012. The earlier robot, dubbed RoboJelly, is roughly the size of a man's hand, and typical of jellyfish found along beaches.
http://tw.gs/PZvcA2



A view inside the robotic jellyfish. Image courtesy: Amanda Loman / Virginia Tech.

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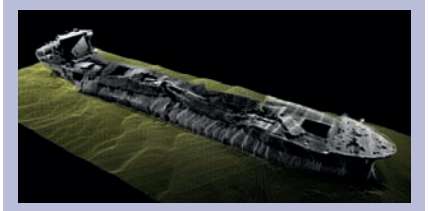
2. Two New Hydrographic Survey Boats for the Congo River - http://su.pr/2SqFFS
3. Salinity and Soil Moisture Measurement from Space - http://su.pr/2Lbp3q
4. Osiris Opts for CodaOctopus GEO - http://su.pr/4xlcHN
5. EM2040 Multi-beam Goes Compact - http://su.pr/1ap4ze

Chart Shows Antarctic Seafloor Topography

Reliable information on the depth and floor structure of the Southern Ocean has so far been available for only a few coastal regions of the Antarctic. An international team of scientists under the leadership of the German Alfred Wegener Institute, Helmholtz Centre for Polar and Marine Research, has succeeded in creating a digital map of the entire Antarctic seafloor. The International Bathymetric Chart of the Southern Ocean (IBCSO) shows for the first time the detailed topography of the seafloor for the entire area south of 60°S. An article presented to the scientific world by IBCSO has now appeared online in the scientific journal *Geophysical Research Letters*.
http://su.pr/1aHjTn

DeepOcean Owns 50% Interest in ADUS

DeepOcean UK now owns a 50% interest in the leading 3D sonar visualisation company ADUS to form ADUS DeepOcean Ltd. Originally a spin-out from the University of St Andrews and Dundee University, ADUS has rapidly gained a global reputation in the marine salvage market for its subsea 3D visualisations.
http://su.pr/1ffvyM



A sample of the imagery created by using the ADUS technology.

Satellite-based Bathymetric Mapping in Ireland

UK-based Proteus has been awarded a major contract by the Geological Survey of Ireland (GSI) to deliver complete bathymetric surveys of five Irish bays. In addition to operational mapping, Proteus will use satellite data to create a seabed classification map and perform water quality monitoring on one of the bays for proof-of-concept purposes. The five bays included in the operational contract are among Ireland's most commercially valuable and environmentally important: Cork, Shannon, Dingle, Dundalk and Carlingford. They include turbulent bays fed by fast-flowing rivers that frequently shift submerged sandbars and significant areas of shallows. As a result, bathymetric surveying can be particularly challenging and expensive using marine sonar or airborne Lidar. To date, airborne bathymetric Lidar has failed to achieve coverage in these particular bays.
http://su.pr/1IZDR1

More news
www.hydro-international.com/news/news.php

A View on Hydrography From an ECDIS Manufacturer

Hydro International Interviews Dr Nikolay Lebedev, president of Transas.

Since the introduction of the IMO resolution on having ECDIS systems on board Solas vessels the demand on technological advancements on ECDIS systems has grown. Dr. Nikolay Lebedev from Transas, a long-standing ECDIS manufacturer, explains how the ECDIS industry currently uses the available hydrographic information and what future improvements could be made in order to allow marine electronic navigation to further evolve.

Rear Admiral (Italian Navy retired) Giuseppe Angrisano
contributing editor, Hydro International

As the President of Transas can you tell our readers about your background, how Transas was created and how you joined it?

I started my career at sea back in 1980 at the Baltic Shipping Company, and by 1990 I was a sea captain at that company, with significant experience in international sea trade and a lot of ideas on how to improve marine electronic systems and make them more readily available.

In the late 1980s, I gathered a small team of very energetic and entrepreneur-minded seamen and engineers, and we decided to take this idea forward, making it a business case. This is how Transas was born in 1990. By the way, historically, Transas stands for 'TRansport SAfety Systems', however, we hope that nowadays it is already perceived as a proper name.

Today, Transas is a large international hi-tech corporation successfully working in over 130 countries, employing some 2,000 people and generating roughly USD 350 mln in annual sales, and I am happy and proud to be one of the founders of this business and its president.

What is the balance between Transas efforts dedicated to air and those devoted to water navigation?

Marine and aviation industries are currently the two biggest markets for Transas, probably accounting for 40% of our annual revenue each, with the

There is an issue with different sounding datums

remaining 20% coming from other areas, such as defence solutions, satellite technologies, oil and gas industry, etc.

In what way does industry (and in particular Transas) co-operate to develop IMO's e-navigation?
This initiative is well supported by Transas. Transas takes part in the IHO working groups and this is important so that we can share our knowledge and experience to change things for a better future, cleaner environment, increased safety at sea, etc.

To date, most ECDIS manufacturers have developed their own formats for data used in their systems such as route files, track files, add info etc but in the future a common maritime data structure is needed making it possible to share data from various brands of ECDIS with, for instance, a VTS operator ashore who can then have a complete overview of an area or to verify that a route is safe for the specific vessel.

Transas takes part in the Mona Lisa 2 project, confirming our interest in struggling for a better environment at sea and a safer environment for seafarers.

In what way do you think that the development of training for navigation simulators under the IMO STCW rules could be further improved?
The major driving force for simulation applications within the maritime community is official requirements set by IMO. The current level of technologies allows simulators to ultimately deliver unlimited training of almost any processes and disciplines within the maritime skills set, and considering this, the next generation of simulators will be able to deliver anything a user can imagine. However, the regulations should remain in order to discipline the manufacturers and to limit access to the market for suppliers who cannot deliver products which are fit for purpose. At the same time it should be a two-fold process where IMO experts consider new technologies, customers' requirements and general trends in the shipping market to define the new rules.

We clearly see the development of new niches where simulation training becomes more popular. Among those we could name are the offshore training sector (almost all DP simulators), dedicated ECDIS simulators and tug simulators. As you may see the training solutions are focused on mastering those individual specific skill sets within the simulator. At Transas, however, we believe that the future training solutions will provide a tool with which the entire ship crew could master the broad range of skills and, in particular, co-operation and communication. We call these solutions 'total ship simulator' and so far it is a popular product and in some cases it has even been adopted within the Naval training segment.

HOs should also consider that their data are not only used by SOLAS vessels

Eleven years on, what do you think of the implementation of the rule, as defined in IMO SOLAS Chapter V, that only a government can produce a nautical chart?
If we look at it over a 10 year period, it has not been successful due to the lack of coverage of the official ENC. Here Transas and C-MAP have filled the gaps and supplied the industry with high-quality chart data allowing a smooth transition towards ECDIS navigation.

Today, private charts are the most commonly used but with the implementation of and requirement for ECDIS we see a weekly increase in the number of vessels subscribing to official ENC charts. So in the end it was a good decision that will enhance safety of navigation with all the benefits.

In which way will Transas adopt the S-100?
We permanently monitor the development of the S-100 Standards family. Transas' biggest interest as an ECDIS manufacturer is the development of the S-101 that is going to replace IHO S-57 and IHO S-52 standards. The ENC portrayal section is the most important for ECDIS, however, currently this part of S-101 is still under development and we expect to have the first draft ready by end of this year. As soon as we have a solid version of S-101 we can start implementing it in our new generation of navigational products. We see implementation of S-101 in ECDIS as an interactive process where standards are to be tested in prototype versions of ENC viewer and changed where required due to results of the tests.

How do you see the S-102 (bathymetric surface product specification) standard being used for navigation systems?
We see huge demand from our customers for additional informational overlays in ECDIS. We have already implemented the UKHO AIO overlay and we are in the process of collecting data for new auxiliary overlays. We believe the S-100 concept will be a great help to the maritime industry and mariners if it includes specifications for auxiliary overlays like nautical publications, sailing directions, weather forecasts and others. We also think that a data distribution chain is to be established allowing all additional data to be delivered from data owner

Nikolay Lebedev graduated from Admiral Makarov State Maritime Academy in Leningrad, navigation faculty. After the graduation N. Lebedev has worked onboard the Baltic Shipping Company vessels for 10 years as a navigator. In the mid 1980s, he gathered a group of associates from among the programmers and marine officers of Baltic Shipping Company, who made developments in the field of software for maritime transport and aviation. In 1992, the first Transas representative offices emerged abroad, and N.Lebedev became president of Transas Group.

A ship's navigation console.

(hydrographic office) to mariner in a most efficient and smart way.

S-102 specification for bathymetry overlay is a great step forward as it could help the mariner in areas where ENC information is insufficient and where very exact calculations of UKC in shoal water and channels are needed. But again, availability and distribution of bathymetry data may be an issue. Transas is ready to participate in the process of data delivery and present it to its customer.

From a technical perspective, there is an issue with different sounding datums that may be used in an ENC and in bathymetry overlay. There is currently no standardisation for sounding datums used in ENCs and it may cause problems if we combine bathymetry from a number of ENCs with S-102 bathymetry and apply, for example, tidal water level. The datum issue must be considered and resolved in co-operation between hydrographic offices and industry.

We need a common approach with regard to the provision of hydrographic data

What new geomatics technology could assist the mariner further in navigating even more safely?
As mentioned above, additional bathymetry data could assist mariners in planning and navigating their voyage. It must be advanced and comprehensive technologies that correctly process hydrographic survey data and present it to the mariner in a convenient and comprehensive form. We have implemented such technologies in our Draught Information System (DIS) running on board vessels sailing in the St. Lawrence Seaway in Canada. The project has been running in co-operation with the St. Lawrence Seaway Management Corporation and Canadian Hydrographic Service. Our DIS system combines high density bathymetry charts with real-time water level and calculates vessel's squat and under keel clearance and is presented to the mariner in the most comprehensive way.

Nowadays, ice-melting makes it easier to carry out hydrographic surveys in the Arctic and to produce a more reliable nautical cartography. In which way has Transas contributed to this production?
As a company born on the Baltic shore, Transas is historically actively involved in developing products and solutions for the marine industry that facilitate safe and efficient navigation in ice conditions. One very important element here is seamless integration of ice conditions data into the ECDIS. Until relatively recently, mariners navigating in ice-infested waters had to deal with two types of information systems simultaneously, which may not always be safe. A safe route identified on the ice chart may not be a valid navigation route on the ECDIS as a result of a shallow-water depth, for example. This suggests that a greater, more time-consuming effort should be put in by mariners in order to reach the correct navigation decision in a critical time. Even if it could provide safe navigation, this approach is absolutely not efficient.

A better approach to support safe and efficient navigation is to have the ice objects integrated within ECDIS. This enables the mariners to use only one system that is capable of alerting them in case of hazards and ensure advanced route planning. This helped mariners to make correct and informed decisions regarding the selection of the best possible navigation routes.

Transas co-operated with the Canadian Ice Service and Arctic and Antarctic Research Institute (AARI) of Russia to provide full integration, presentation and update of ice charts in its Navi-Sailor ECDIS.

In Transas' Navi-Sailor ECDIS an ice chart contains information regarding the distribution of ice of different age, concentration and forms and is displayed in a number of formats. Our system provides actual charts of ice allocation in S-57 format, based on information from NOAA, Terra, Radarsat, and data from hydro weather stations and vessels. Other options include forecast Ice charts in S-57 format, recommended routes for ice navigation presented also in S-57 format, and even raster satellite images, or Geo TIFF. And of course, the system allows for real-time online updates of ice data, which is crucial for safe planning of routes in icy waters.

In what way you think the voice of the industry can be better heard at IHO Conferences?
Besides participation in the IHO

work groups, the industry as a whole and Transas in particular participate in IEC and CIRM working groups related to ECDIS standardisation. Both organisations are present at IHO Hydrographic Standards and Services Committee (CIRM) and at IHO conferences. We also work in close co-operation with some governmental institutions such as the Russian Hydrographic Office, UKHO, NOAA and others. We believe our voice and argumentation will be heard if it comes from both directions - as an agreed industry position and as arguments provided via national HOs.

Finally, do you have a message for Hydrographic Offices and the IHO?
It is a fact that the Hydrographic Offices apply different policies related to licensing of their hydrographic data. At the same time, companies like Transas, who have proven their ability to provide comprehensive chart data service to mariners, is the only gate to process and integrate data from different HOs and deliver it to the mariner in the most convenient way. We need a common approach with regard to the provision of hydrographic data - this relates to the data availability and commercial terms applied to the data licensing.

The hydrographic offices should also consider that their data are not only used by SOLAS vessels that must comply with IMO regulations. There are a lot of private users and various institutions at sea and ashore that require hydrographic data for a number of purposes. The data licensing policy should provide maximum flexibility to allow industry to satisfy the needs of various users groups.

Transas is also active in the avaiation market.

'Operation Rock Bottom'

A Different Approach to Surveying Antarctica

Navigation data is poorly available in Antarctica. If navigational data is available it often dates back to the early 1900s with many lead line surveys. An initiative was undertaken by Stephen Wilkins of Xplore Expeditions to collect bathymetry with a multi-beam survey system making use of the sailing vessel *Xplore*. Together with Yoann Boulaire from SHOM, France and Fernando Landeta, hydrographic technician from Skyring Marine Chile, an IHO qualified survey was performed in Antarctica on an expedition sailing yacht.

Stephen Wilkins, Xplore Expeditions, Australia

Yoann Boulaire, hydrographic surveyor, France

Fernando Landeta, Sky Ring Marine, Chile

AS ALL MARINERS NAVIGATING in Antarctica know, one must use a combination of all available means to enable safe travel in this region. The international collision regulations state that one should use all facilities. In this age of very accurate technology many mariners around the world are too easily swayed by the ease of electronic systems. In Antarctica sailors must use everything, including depth soundings, ranges and bearings by any means and radar, GPS and currently available electronic charts are more a last resort due to offsets in old survey datums and poor quality.

Antarctica Waters

Only 2% of the Antarctic coastline inside the 200 metre depth contour has been surveyed . More has been done for the Antarctic Peninsula, but much of the available charting for this area dates back to the early and mid 1900s and are presented in fathoms and feet on black and white hand-drawn charts. The soundings on many charts would have been done with lead line soundings; using a weighted line to check the water depth. Certainly not what we would call high tech nowadays, but to date it is the best that there is in Antarctica.

Antarctica is an international territory, meaning that it is not owned by any country, though many countries have an interest in it. These countries have come together in what is referred to as the Antarctic Treaty Commission (ATCM) and they are the stakeholders and caretakers of Antarctica.

The ATCM and the International Hydrographic Office (IHO) decided to form a joint members commission with the task of collaborating hydrographic efforts between nations that have survey vessels and staff to continue the growing need to survey Antarctica. This new group has been called the Hydrographic Commission of Antarctica (HCA) and their mandate is to produce better navigation information and charts for the frozen south.

The same questions and issues kept being raised at the HCA meetings and other hydrographic forums. However, we are now pleased to be able to say that there are some very pro-active people who are equally hamstrung and frustrated by the processes and speed at which these glaring issues would ideally need to be addressed. The reality is that for all vessels to travel in the safer south we need to move forward.

Mud Maps

The pure waters of Antarctica may be clear, but the tasks of surveying and allocating funds and resources are very 'muddy'. Many navigation charts and electronic navigation charts that are currently available for Antarctica are quite inadequate for mariners; not all, but surprisingly many. Islands and land masses are frequently out of position, some by over one nautical mile in some locations and bathymetry and shore outlines have changed or are incorrect. There is so little useable navigation data for charts, and much of the available material is very old and inaccurate, that there are large areas of white paper areas in which there are no details.

Multi-beam sonar fastest way to accurately survey seafloor areas

This is well known to those who regularly ply these southern waters, but being an international territory it is not clear under whose responsibility this falls. Mariners sailing in the region are therefore drawing so-called 'Mud Maps'. Mud

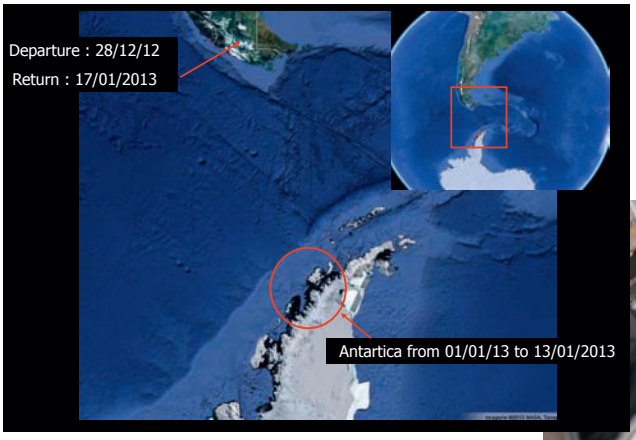


Figure 1: Expedition start and destination locations from South America to Antarctica.

Figure 2: Custom designed bow mount arrangement of the MBES on *Xplore*.

maps are small detailed charts of locations and anchorages that are often not even shown on the available charts. Hand drawn, using a zodiac with depth sounders, note books, a hand compass and a GPS, we soon learnt how to put together some very credible images that make it easier to navigate into these locations.

Challenges in Seafloor Mapping

The Mud book created over the last 10 years by the skipper of Xplore Expeditions, Stephen Wilkins, grew quite large. The fastest way to accurately survey seafloor areas was by using a multi-beam sonar. The challenges of using a multi-beam sonar for someone not having experience with such sophisticated equipment are numerous.

Besides the large costs, the technical skills needed to run these systems can take years to learn and the additional equipment that is needed for a proper survey is extensive. Moreover, if you want the data collected by these systems to be really useful then one requires a hydrographer on board to plan, collect, analyse and certify the collected multi-beam data and make sure that the survey is being conducted properly.

After lengthy negotiations of nearly a year with a prominent hydrographic equipment company the multi-beam equipment was almost made available. Unfortunately, it was believed that it would be impossible for a sailing vessel to perform a multi-beam project.

'Operation Rock Bottom'

Stephen Wilkins came across a young hydrographer, Fernando Landeta, from Sky Ring Marine in Chile. Within 7 weeks they mobilised and prepared *Xplore* for a IHO standard survey in Antarctica.

For the endeavour of survey perfection a qualified hydrographic surveyor was needed on board. Our Chilean technology provider is qualified but not to IHO standards. After contacting many countries around the world (Australia, New Zealand, UK, Chile and France) SHOM, France finally confirmed that they would be able to release one of their hydrographers to join the mission. This was a major step forward as the data could now be officially qualified and it could be demonstrated that a leisure sailing vessel is capable of performing official surveys.

The multi-beam sensor, 512 beam dual frequency 200Khz and 400Khz with attached Sound Velocity Profiler (SVP) maximum depth capability 500 metres, was installed on the bow of the *Xplore*. Taking the vessel's motion into the consideration this was the most suitable location. The motion sensor was mounted directly above the transducer and the GNSS correction came via Fugro Marine Star.

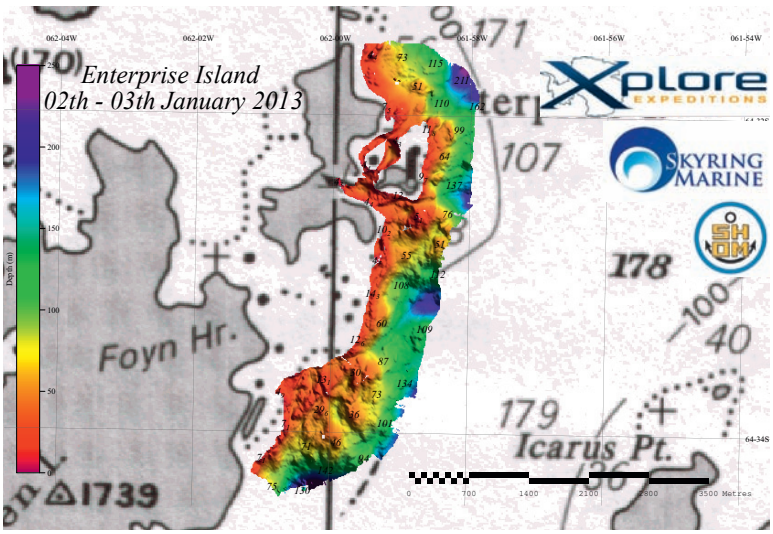


Figure 3: Enterprise Island MBES data overlaid on the only available navigation chart which dates back to the early 1900s.

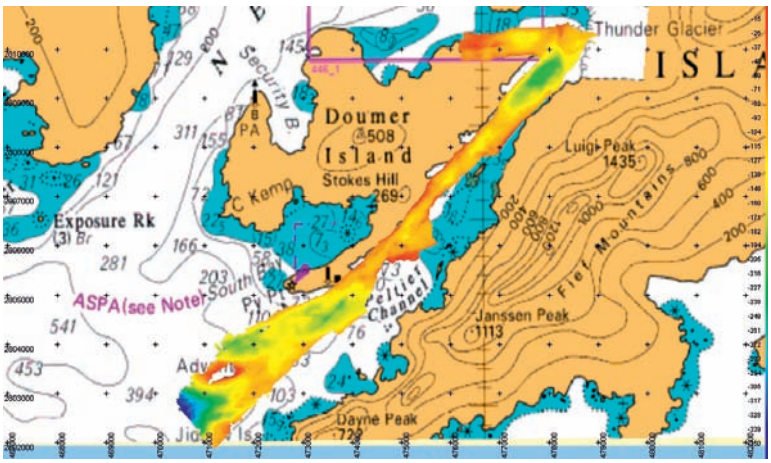


Figure 4: Peltier channel MBES data collected overlaid on the best scale and data chart currently available.

Three tide pressure sensors were used to gather tide data at each location. These sensors were cross referenced to the permanent tide gauge at the Ukrainian scientific base of Vernadsky and reduced from atmospheric pressure, this allowed the data to be corrected to chart datum. Meteorological data was also gathered by us each day and also cross referenced against the science station of Vernadsky. This was relevant to the overall quality of data collected as the effects of temperature, atmospheric pressure and wind strength have a real bearing.

Islands and land masses are frequently out of position

During the 7 days of the survey, the *Xplore* and its team surveyed 15.2 square miles. Three different locations were surveyed, namely, Enterprise Island, Booth Island and Peltier Channel. All the collected data fell in the IHO category 1 and 2 standards.

Furthermore, valuable passage sounding data was collected at all times on route to and from each location and at a safe water surround of the Cape Anna shoal where the cruise ship *Ushuaia* ran aground.

To confirm and substantiate the quality of data collection and the stability of the survey platform 3, separate calibrations were conducted, at the start, halfway and at the end of the surveying period including the critical horizontal and vertical offset checks.

The instrumentation was interfaced to the PDS2000 software, which also recorded the collected data. Processing of all gathered data was then carried out using CARIS software.

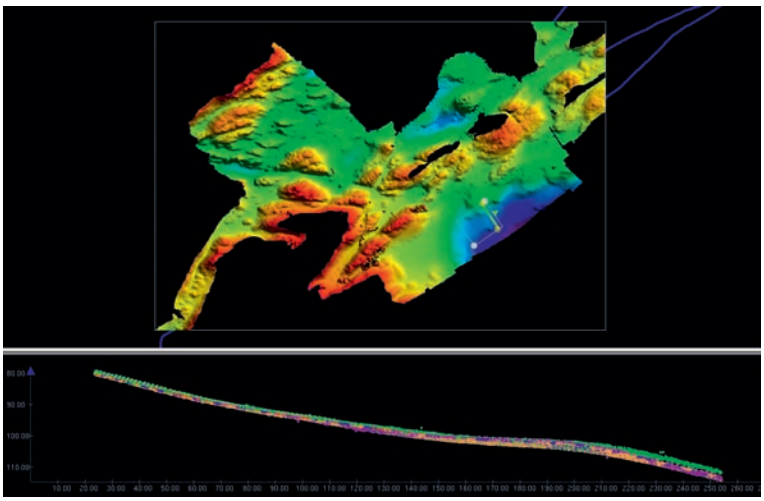


Figure 5: Post-processed MBES data at the historic French Port Charcot survey location showing accuracy trail.

Conclusion

A major reason for doing this project using a multi-beam sonar mounted on a sailing boat was not only to be able to prove that it could be done, but also to show that a hydrographic survey could be performed to a standard that meets all of the requirements set down by the IHO.

The future of this type of surveying is very much in the formative stage, and there were many lessons learnt. This experience has shown that yacht owners are not recommended to go out and purchase a multi-beam system to bolt on to their yachts, as there are many variables and additional parameters to take into account even before being able to make the data suitable for chart production.

But in this modern world where technology is moving so fast, there are still remote and unexplored locations where adventure and new discoveries are possible, Dream the Dream, then do it.

Acknowledgement

We would also like to thank John Clark, Australia, Alesia Ramanenka, Belaurus, Ugo Angelelli, Italy for their assistance and support and the crew of the *Xplore*, Debbi Smith, Scotland, and Meghann Jones Australia.

The Authors

Stephen Wilkins, a qualified merchant mariner and professional sailor, Stephen Wilkins has been conducting expeditions to the polar regions of the south and Antarctica since 2003. He was a lecturer at the Australian Maritime University AMC for 3 years. His involvement in the marine and safety committee of IAATO (International Association of Antarctic Tourism Operators) showed that continued hydrographic works by the IHO are necessary for continued safe navigation .

Yoann Boulaire, Hydrographer IHO Category B and diver, embarked on SHOM hydrographic and oceanographic vessels since 2008. Passionate about new experiences and human adventures, he volunteered to put his skills and expertise to the benefit of the *Xplore* project to validate multi-beam data according to IHO standards.

Fernando Landeta, Hydrographic technician with Sky Ring Marine Chile, is a civil engineer and a professional and technical diver from Chile. He did his Master's in Coastal Engineering in Kiel, Germany and formed the Oceanographic, ROV and Diving company, Sky Ring Marine Ltd. He currently works as multi-beam echo sounder operator and processor from the company he created.

Measuring the Uncertainty of a Swath Bathymetric Sonar

A Statistical Analysis for System Performance and IHO Compliance

In the last few decades, substantial efforts have been made to improve and facilitate the way hydrographic data is obtained. One technology is the EdgeTech 4600, an interferometric phase difference sonar. Unlike traditional interferometers, the EdgeTech 4600 is the first of its kind to offer complete swath coverage of the seafloor, even at nadir. Combining this kind of coverage with a vertical accuracy that exceeds IHO Special Order requirements in depths less than 30 metres, results in a sonar with superior area coverage rates, especially in shallow water.

Lisa N. Brisson, Edgetech, USA

Steven Wright, Edgetech, USA

IN THE SUMMER OF 2012, bathymetric survey data was collected using an EdgeTech 4600 540kHz system deployed on a bow mounted pole aboard the *Ocean Research II*. Repeat surveys were performed over a navigational channel (~5m) within the Intracoastal Waterway just south of Port Everglades, FL, USA, with the aim of generating reference bathymetric surfaces and test lines. The reference surface along with the acquired test lines were compared and used to assess the performance of the system. This article explains the procedure undertaken and presents the results.

Acquisition Tool

High frequency (100kHz to 600kHz) sonar interferometers (phase measuring bathymetric sonars or bathymetric side scans) have recently become a popular tool for shallow-water swath surveys, and now form an integral part of the surveyor's toolkit. The interferometric sonar is a multi-stave side-scan sonar, collecting a wide swath of bathymetry and sonar amplitude data, with the angle of arrival of the seabed returns determined by phase comparisons between the multiple receive staves. The problem with these traditional interferometers is that they are susceptible to multipath interference and have very poor or non-existent bathymetry data over a swath width at nadir.

The EdgeTech 4600 is a new kind of interferometer engineered specifically to solve some of these interferometer shortcomings. It uses eight receive element transducers and one discrete transmit element in a pair of transducer heads, instead of the two to four receive channels found on other systems. The high number of channels enables enhanced rejection of multi-path effects, reverberation and acoustic noise. In addition, the 4600 uses EdgeTech's Full Spectrum® processing techniques that results in a dense dataset in the nadir region.

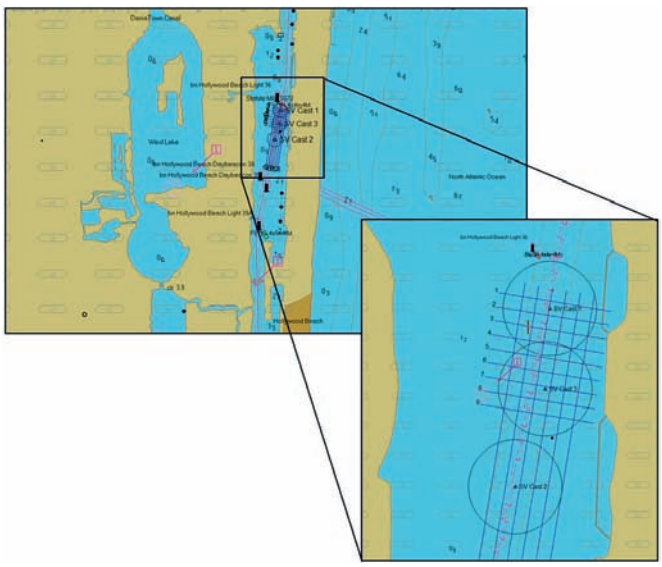
Error Models

A-priori theoretical error models of interferometric systems are complex and have been difficult to reconcile with observed system performance. A reliable system error model is required in order to apply sophisticated post-processing techniques, for example the CUBE algorithms developed at University of New Hampshire (UNH), to determine the uncertainty indications to use on datasets and charts. Direct empirical measurements of system uncertainty can be used to refine and verify the sonar models and ensure that the Total Propagated Uncertainty (TPU) applied in the data processing is consistent with real data as collected.

The Alternative Approach

Statistical techniques for analysing and optimising the performance of swath bathymetry systems have been used for several decades, especially in the analysis of multi-beam systems. A well-used technique is to compare a single line of test data against a reference surface to determine the sonar depth repeatability and consistency across the bathymetric swath. While an independently surveyed reference surface with a higher accuracy than the system under test would be desirable, this is not often available and in practice is difficult to obtain when testing sophisticated survey systems.

It has become accepted practice to test a system against itself, creating a reference surface using multiple passes in different directions, with tight data filtering, to create a very high data density which will average out errors. While this has limitations with regard to systematic offsets, the two effects of (1) tight filtering to limit the reference surface data to the most accurate part of the swath and (2) the averaging of errors from multiple passes, will create a reference surface



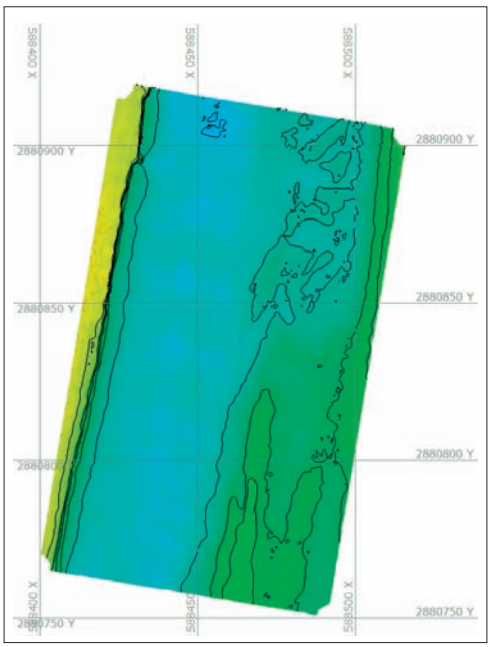


Figure 1: Reference surface lines (15m spacing) and SV dips. Map centre: 26 02 37.67N, 80 06 57.06W.

Figure 2: Reference surface (150m x 95m), 0.5m bins (0.5m contours shown).

with a significantly higher precision than obtainable from a single pass of the sonar.

Once a reference surface has been generated a separate survey line is recorded over the test area and the two datasets can be compared. Statistical analysis of the difference will give a good indication of the precision of the sonar system in a single pass as a function of position across the swath.

Survey Day

In the summer of 2012, the 'Alternative Approach' was applied to analyse the performance of a boat-mounted EdgeTech 4600 540kHz sonar system. Repeat surveys were run over a navigational channel (~5m) in the Intracoastal Waterway just south of Port Everglades, with the aim of generating reference bathymetric surfaces and reference test lines. The area chosen was the nominally flat channel south of the Port Everglades Turning Basin. This area was sheltered from swell and weather and was of sufficient size to allow orthogonal sets of 150m lines by 95m lines at 15m spacing as illustrated in Figure 1. A patch test area to the north of the survey area was identified and had a relatively flat dredged area and large boulders to enable roll, pitch, yaw and latency calibrations.

When setting up the data collection for the reference surface it is important to pay meticulous attention to detail. Accurate equipment offsets and system calibrations were measured. Frequent sound velocity profiles were also collected to minimise ray bending errors in the final surface (Figure 1), and repeated patch tests were carried out to check the consistency of the system calibrations.

Equipment Setup

The sonar electronics and arrays for the 4600 were mounted onto a streamlined body that was deployed over the bow of the survey vessel via a pole. The standard configuration for the 4600 includes an integrated sound velocity sensor and has interfaces for standard Global Positioning Systems (GPS), Motion Reference Units (MRU), Sound Velocity Profilers (SVP), Conductivity Temperature and Depth Sensors (CTDs), Altimeters and Gyros. Data acquired at the transducer was transferred from the transceiver at the sonar head to the processing unit in the survey cabin via Ethernet. In the Port Everglades tests, a complete NovAtel SPAN INS and Dual Headed GPS solution was used to measure attitude, position and heading. The height control in the final processing was achieved using manual tide inputs from the NOAA website.

Data Acquisition and Post-processing

The data were collected using EdgeTech's Discover 4600 software and Hypack Hysweep Multi-beam software, which has a real-time interface for collecting 4600 inteferometric data. Post-processing was carried out in the office using Hypack Hysweep Editor (also known as MBMax). Note that the 4600 also

Faster survey times and safer navigation with the same quality bathymetry data

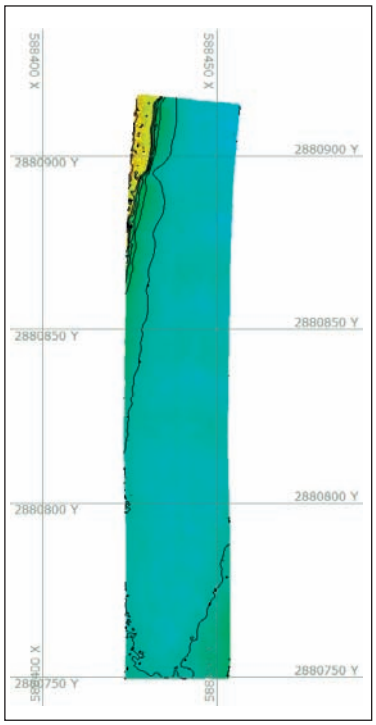


Figure 3: Test line, 150m long, filtered to 30m swath.

interfaces to a number of other 3rd party bathymetric acquisition and processing software packages.

The data from each survey line was processed and filtered separately to remove outliers and water column hits (for example wakes and fish). Although the system is capable of collecting data from a swath of over 12 times water depth, the total swath width for the reference surface was trimmed to 4 times water depth in order to retain only the cleanest data. Care was taken to visually inspect the lines to check for outliers, blunders and bad data, and cross-check lines against each other to identify and eliminate calibration and offset errors. The full filtered data from all the reference lines were then combined to create a cleaned reference surface. This was binned by averaging to a cell size of 0.5 metre x 0.5 metre for export as a final digital terrain model (DTM). (Figure 2)

The same data collection and processing was carried out for the individual test lines and again these were binned to 0.5 metre x 0.5 metre (Figure 3) for comparison with the reference surface. A grid of the differences between the reference surface depths and the test line depths was created, and multiple cross profiles were taken orthogonal to the boat heading along this line. Over 60 cross profiles were taken in order to generate the statistics for analysis.

Discussion

The depth residuals shown in both Figure 4 and Figure 5 are considered to represent systematic errors or biases in the depth results. The standard deviations are caused by random error sources from the sonar combined with other dynamic error sources which change rapidly over the time taken to collect the test line (~100 seconds).

The mean depth residuals were plotted against the swath in metres (Figure 4) and then plotted again vs. swath in degrees (Figure 5). The depth residuals vs. angle can be used to compare the system's results with that of a traditional single head multi-beam. The standard of measure for this discussion is the IHO Special Order Requirement (shown by the red lines), which states that the Total Vertical Uncertainty (TVU) equals +/- 25cm at the 95% Confidence Level. Using this, several features are apparent from these plots:

1. As demonstrated by Figure 4, the depth consistency of the test line is within IHO Special Order Standards out to a 30 metre swath, or 6 times water depth.
2. This coverage corresponds to an angle of about 72° per side, or a total of 144° in an area with an average depth of about 5 metres (Figure 5). The total useful angle for a traditional multi-beam is approximately 90° for IHO Special Order surveys.
3. This leads to faster survey completion times and safer navigation as the surveyor does not have to venture as close to the channel's edge.
4. The plots in Figures 4 and 5 also illustrate that the centre of the swath exhibits a distinct trough at nadir. This is suspected to be an effect of multipath as the sea was calm during the survey and the transducers were mounted near the surface. Nonetheless, the data at nadir is real and is well within the IHO Special Order requirement.
5. The data used to generate Figures 4 and 5 will have many sources of error included, both from the sonar and the ancillary equipment, so this can be considered as a reasonable proxy for the total propagated errors of the survey system.
6. These plots will be expected to overestimate the TVU contribution from the sonar alone. However, some static and slowly varying errors will be common to both the reference surface and the test line; these will be invisible to the above analysis. These will include errors in the static vertical offset from the GPS antenna to transducers and slowly varying GPS height and position errors. Comparison with reference surfaces collected using different equipment would be useful in estimating these errors.

Conclusion

The Edgetech 4600 sonar system was tested in 5m of water and the data consistency between a reference surface and a test line was within

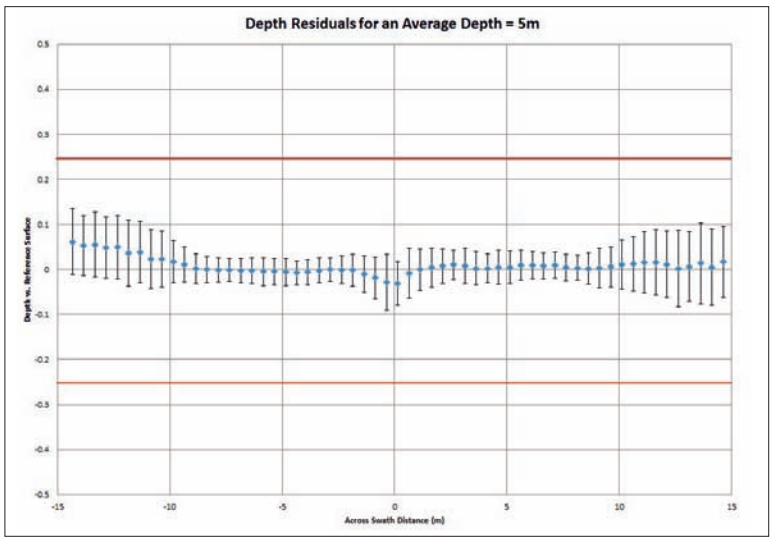


Figure 4: Error Bars: 95% confidence. IHO Special Order limits shown by red lines.

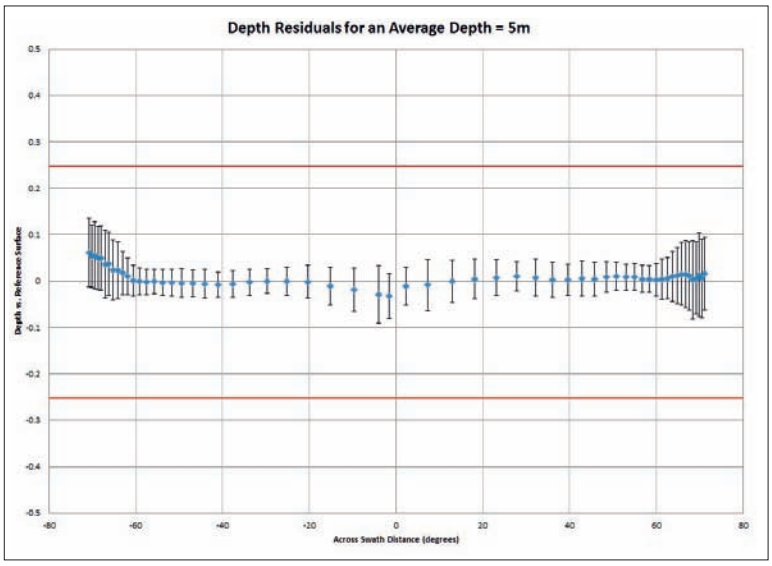


Figure 5: Error Bars: 95% confidence. IHO Special Order limits shown by red lines.

IHO Special Order specifications to at least a swath width of 6 times water depth. The total useful angle of the EdgeTech 4600 system was shown to be 1.6 times greater than that of a traditional single head multi-beam system, leading to faster survey times and safer navigation while producing the same high quality bathymetry data.

The statistical analysis techniques applied here provided valuable information about the sonar's performance and helped measure the data quality that can be obtained from the sonar system. The TVU values obtained will help inform sonar users and aid in the use of advanced post-processing algorithms with this data.

Acknowledgements
The authors would like to thank Mr. Thomas Hiller and Thurne Hydro for their valuable contributions during the investigation of the EdgeTech 4600's system performance.

Further Reading

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The Authors

After completing her MSc in Ocean Engineering in 2010, **Lisa N. Brisson** has spent the last 3 years working at EdgeTech as a project engineer installing, testing, and providing training for hydrographic systems. She is now involved in the design and development of interferometric and side-scan systems.

Steven Wright has been working at EdgeTech for the last 12 years as the director of Technology Development and has over 28 years of technical management experience in both small and large companies. Most recently, he has been involved in the development of compact sonar systems electronics, transducer arrays and swath bathymetry sonar.

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Open Standards for Interoperable Maritime Data Exchange

What Can We Learn from the Aviation and Defence Domains?

The adoption of open standards for Maritime data exchange is just the start of a long journey. With increased vendor support, a potential reduction in costs, as well as enabling innovation as some of the benefits, implementing open standards such as S-100 and Geography Markup Language (GML) within the Maritime domain is bringing the industry a step closer to truly interoperable data exchange.

Alexis Brooker, Snowflake Software, UK

WHEN IT COMES TO DATA exchange for the Maritime industry, S-100 is shaping up to be the interoperability stimulus, but it is just the start. S-100 is intended to support a wide variety of hydrographic-related digital data sources, products and customers. This includes, but is not limited to, imagery and gridded data, 3D and time-varying data (x, y, z, and time) and new applications that go beyond the scope of traditional hydrography into value added services such as voyage efficiency management and exploitation via fusion with other data sources and feeds.

S-100 conformance with the International Organization for Standardization Technical Committee 211 (ISO/TC211) geomatics standards, including GML (XML grammar defined by the Open Geospatial Consortium (OGC) to express geographical features) will enable the greater use of commercial-off-the-shelf IT and software applications (without plugins) and provide basic interoperability at the open standards level for marine data and web services.

However, as has been discovered in other domains such as Aviation and Defence, the adoption of open standards for data and web services is just the start of a long journey towards total interoperability. Complete semantic and end to end process interoperability at all levels, in all languages, may not actually even be achievable. However, clear and consistent marine data exchange at the semantic and business process level, via well designed marine Application Programming Interfaces (APIs) and S-100 derived products, will encourage the development of new services and enable the more rapid development of new value-added products. But how can this 'higher level' of exchange be achieved?

> No motivating tool like a public demonstration

The IHO and S100

Within the International Hydrographic Organization (IHO), according to their website, the Transfer Standard Maintenance and Applications Development Working Group (TSMAD DWG), a subsidiary of the IHO Hydrographic Services and Standards Committee (HSSC) has been working towards:

a. Maintaining, developing and extending:
   1. the S-57 IHO transfer standard for digital hydrographic data;
   2. the S-100 IHO Geospatial Standard for hydrographic data;
   3. the S-101 IHO ENC Product Specification;

b. Monitoring the development of other related international standards.

To this end, the TSMAD and Snowflake Software in support of the UKHO, have developed draft product specifications and an S-100 GML profile. Other TSMAD contributors have worked on metadata schemas, portrayal, impact studies, test data and more. More details are available on the IHO website (1).

But Why S-100, What was Wrong with S-57?

Rewinding back to 1996, with updates for temporality and new

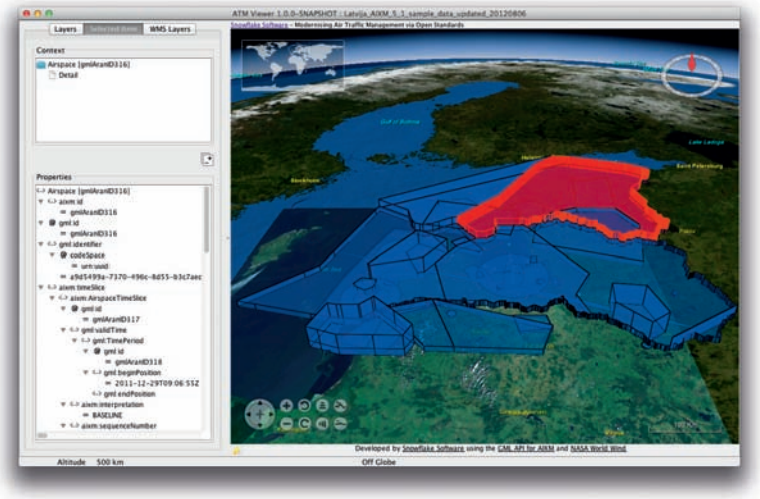

Figure 1: AIXM-5-1 Airspace.

Open standards for information exchange increases vendor support and competition

features up to 2009, S-57 is a decent data exchange and delivery carrier format. Indeed, from a geospatial data exchange perspective it is a heavyweight. S-57 supports version control and Change Only Updates (COU), it is compressed binary, it re-uses geometry constructs between features and it is an Open Standard. On the downside, S-57 has a data encoding that is too tightly coupled with the content model – it is too restrictive. S-100, however, separates the content model from the encoding. S-100 was developed primarily to meet the Electronic Navigational Charts (ENC) requirement for an International Maritime Organisation (IMO) compliant Electronic Chart Display and Information Systems (ECDIS). In addition, for S-100 each digital product specification can have its own feature catalogue – enabling rapid realisation for new composite products and compatible value added services.

S-100 also has the constructs to support imagery, gridded bathymetric data as well as time varying information – a neat gridded model with temporality.

Specific use cases for S-100 are:

- Seafloor classification
- 3D and time varying data
- Marine vector information overlays
- Event Driven Architecture for updates and alerts
- Web-based services for exchange, dissemination and automated exploitation.

Conformance with the ISO/TC211 standards will enable the use of commercial-off-the-shelf IT and software applications and provide basic interoperability at the open standards level; however, as mentioned above, other domains such as Aviation and Defence have recognised the need for usage profiles of exchange standards as well as domain specific extensions. The development of these profiles and extensions has, to some extent, reintroduced the complexity that hampered interoperability in the first place, resulting in varying vendor support and understanding.

It is important to understand interoperability at the business process level. Identifying how the information provided within a digital product is validated and used is a vital part of the process of verifying and improving a digital exchange product – overcoming the complexity. The questions to ask the Maritime S-100 stakeholders are:

- How do users and systems actually align with and make the most of this information?
- What is the process by which new products can be tested in an operational or real world context?
- How can the new digital products be validated, their integrity known and be made available to the system and end-user in a form that can be understood?
- Is there a vehicle that can be used to bring together industry, standards bodies, Hydrographic Offices, which also has a track record built around exchange model validation?

Gaining Wide Stakeholder Engagement and Support

Digital information and intelligence products can only be judged as fit for purpose when they have been assessed and validated as part of a real world business process – including domain specific use cases with software vendors, standards stakeholders, as well as the national and international domain bodies involved. While there are clear benefits from basic standards interoperability through S-100 utilising the ISO/TC211 family, this is not enough to provide the business process level interoperability, reliability and flexibility required for the added value services and

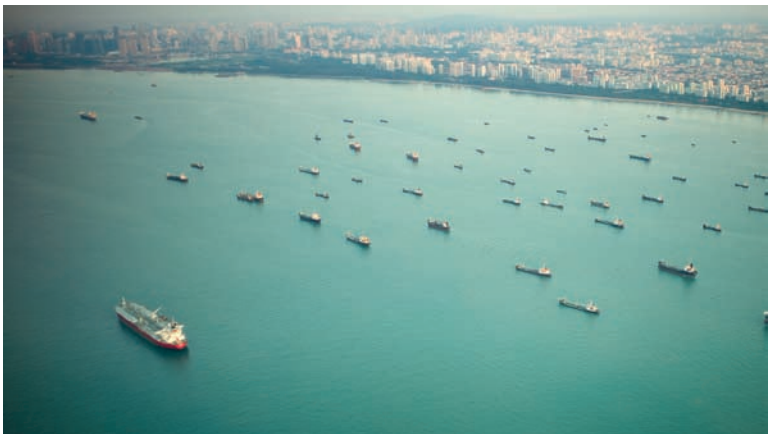

Figure 2: Singapore Harbour.

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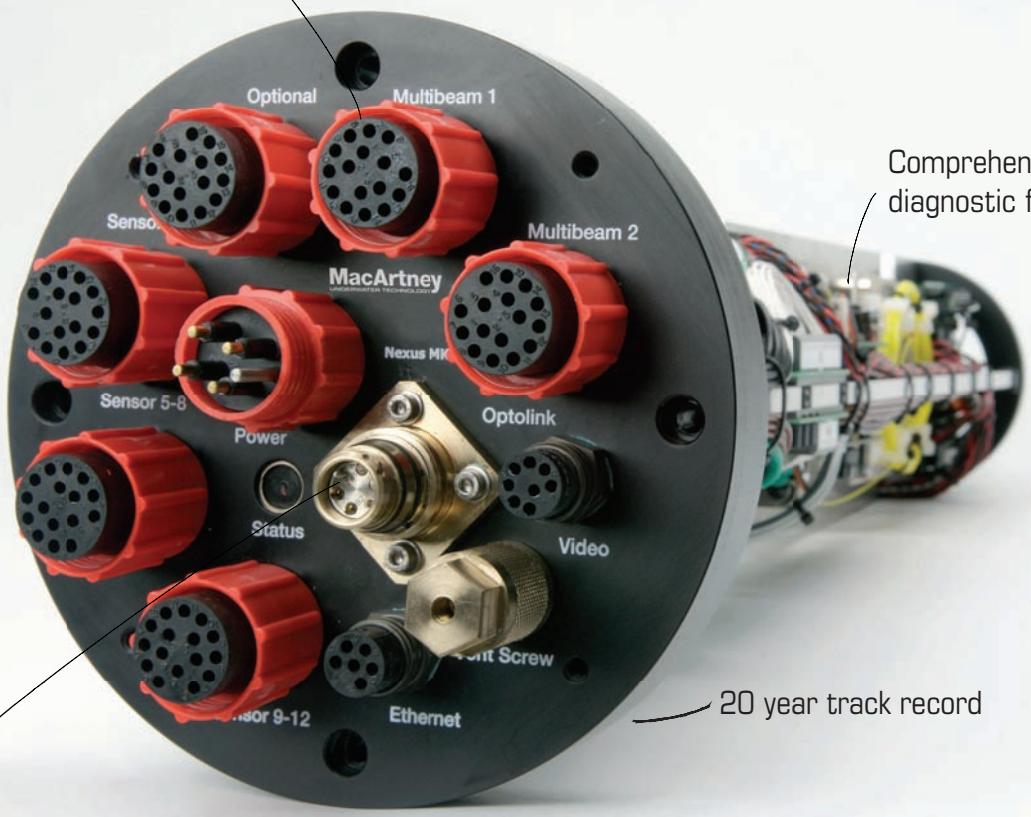

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high level interoperability described previously.

In order to achieve this, a co-ordinated group of stakeholders is required. This group needs to include those who can provide funding, requirements, domain and operational expertise, technology experience from a systems and software perspective, information modelling experts and standards experts. Someone to actually do the co-ordinating and facilitate a strong collaborative working environment is also essential. This facilitating body probably has the hardest role, remaining an independent co-ordinating body in order to run a programme of requirements gathering and prioritisation, experimentation and tangible delivery back to the sponsors. And at the same time ensuring that every stakeholder gets a return, whether financial, PR, networking or technical in nature.

So, what motivates the industry stakeholders? Is it purely funding? One method that works particularly well for Open Geospatial Consortium experiments is the allocation of two suppliers for each component implementation within the architecture. This, combined with a public demonstration and access to the sponsoring stakeholders and wider industry, fosters a collaborative but also highly competitive environment. There is nothing quite like a public demonstration as a motivating tool for project teams! The public profile and exposure is hugely valuable to small and large industrial players alike - and hence more effort is expended to make the most of the opportunity.

Drawing upon lessons and inspiration from the Aviation domain, where this approach has worked particularly well, Aeronautical information and intelligence products are encoded using exchange models such as AIXM (Aeronautical Information Exchange Model), WXXM (Weather information Exchange Model) and FIXM (Flight Information Exchange Model). These models were developed along with GML profiles and best practice, specific extensions and business rules-based information validation and interoperability test beds. The models have all been used to prepare the ground and support the development of next generation air traffic management systems in Europe and the US, alongside the SESAR and NextGEN programmes respectively. Open Geospatial Consortium (OGC) working groups such as the Aviation Domain Working Group have facilitated and enabled a healthy constructive engagement process between the leading (sponsoring) stakeholders such as EUROCONTROL and the FAA with academia and industry since 2006. Not surprisingly, some of the problems and challenges in the Aviation domain are similar to those in the Maritime – increasing traffic and rising fuel costs in the context of a safety critical and strict national and international legal construct provide a more challenging operating environment in both domains. Adopting open standards for information exchange increases the likelihood of vendor support and therefore increases competition, reducing costs to the industry as well as adding opportunity for greater innovation.

Conformance with ISO/TC211 standards enables use of commercial-off-the-shelf IT

Prototyping Future Maritime Information and Intelligence Exchange

The lessons, processes adopted and methods exploited in the Aviation domain to date represent an excellent opportunity that could be copied and exploited for S-100 derived products in the Maritime domain. The OGC Web Services initiatives have also been shown to provide a 3:1 ratio of research bang to sponsor provided buck. The OGC Meteorology & Oceanography Domain Working Group, the TSMAD and government bodies such as the UK and other Hydrographic Offices have an opportunity to get more involved and co-ordinate, run and sponsor respective OGC initiative threads (or adopt an equivalent model) within the OGC Interoperability Programme to more efficiently realise the benefits of validated product designs, exchange patterns and real world usage of Maritime digital information and intelligence.

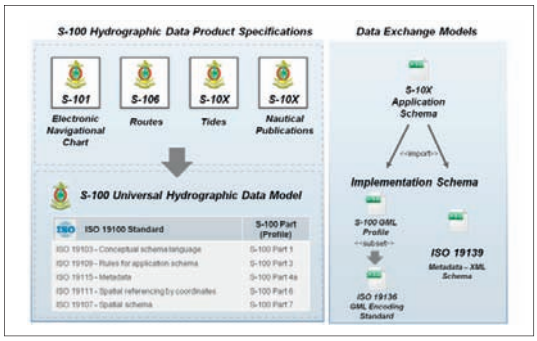

Figure 3: Marine Data Exchange Standards.

As a software supplier and a UK-based SME (small and medium enterprise), Snowflake Software has participated in every OGC Web Services test bed run to date, and has witnessed the transformation first hand from early aeronautical data services interoperability testing to a mature data exchange and dynamic event-based platform, that has developed and strengthened the exchange models to the extent that they are now mandated in the US and EU for aeronautical data exchange. This is a scenario that, if repeated for maritime data exchange and used to build on the development of S-100 based products, could benefit the marine data provider, industry and enable as yet unknown innovations and value added services.

The Author
Alexis James Brooker, principal consultant and head of Professional Services with Snowflake Software, based in the UK, has extensive experience of technical delivery, business development and consulting related to enterprise software and open standard web services - specifically for systems development in the Maritime, Defence and Aviation domains.

1. http://www.iho.int/mtg_docs/com_wg/TSMAD/TSMAD25/TSMAD25Docs.htm

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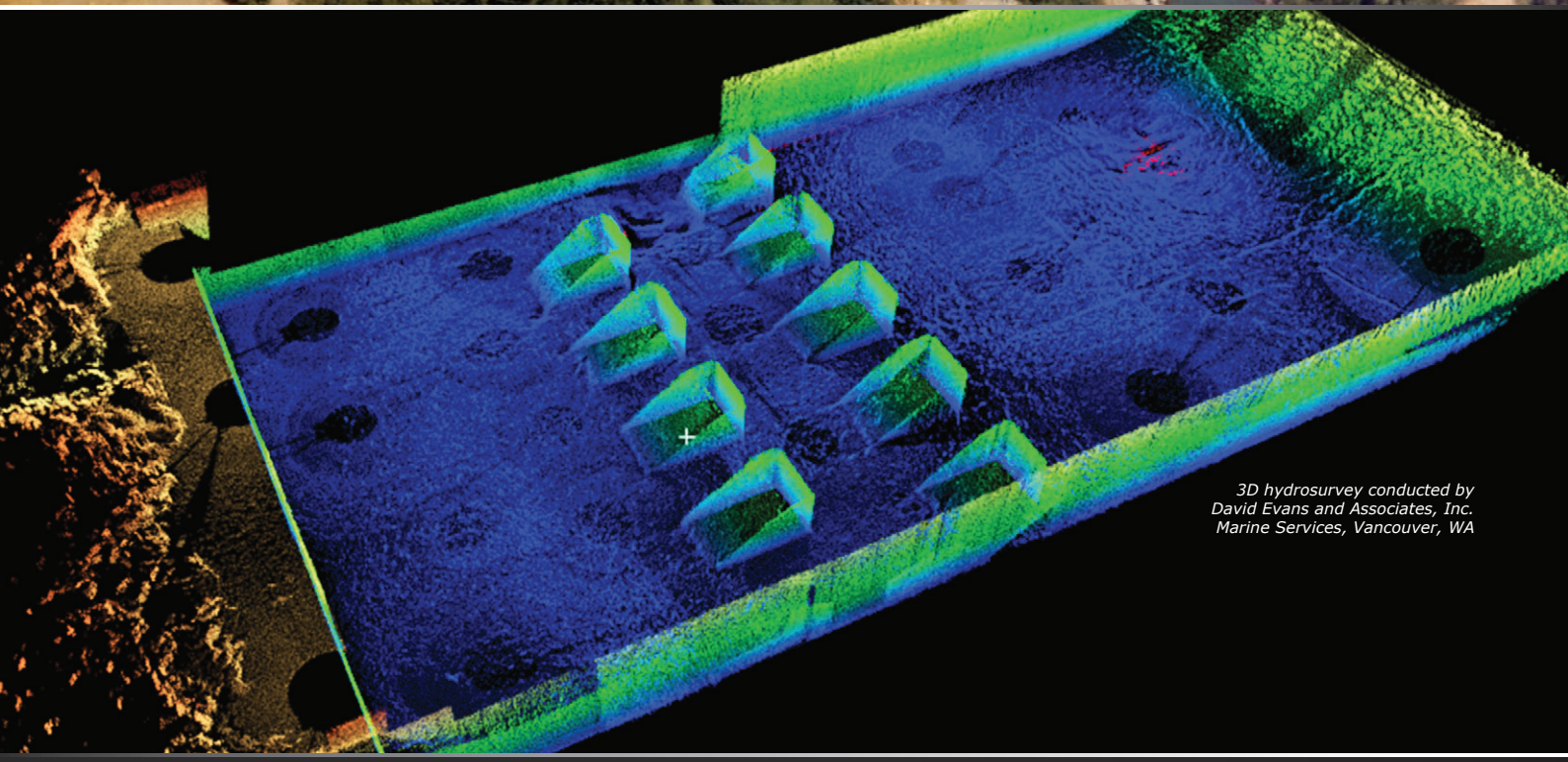

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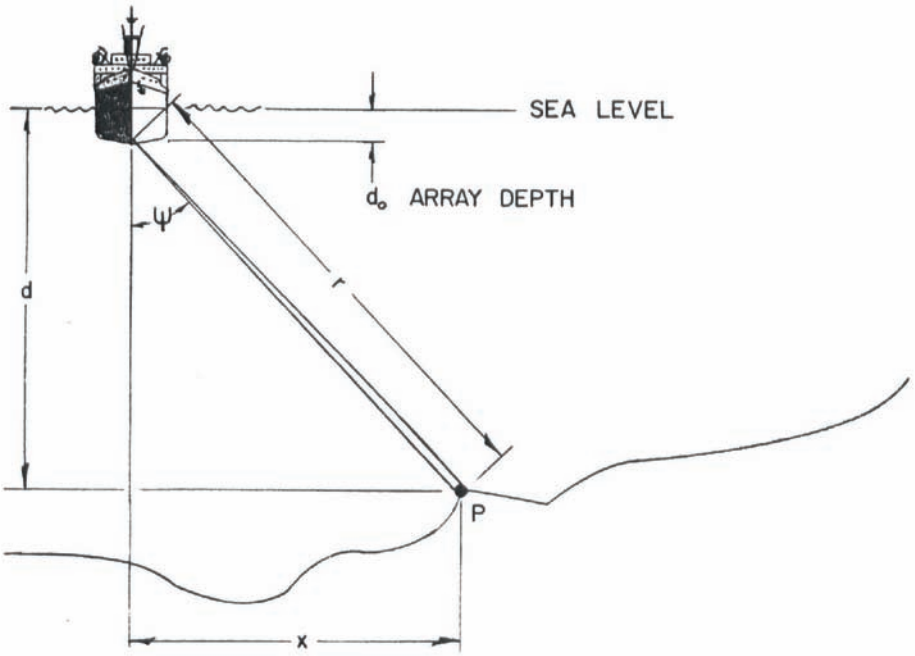

Figure 1: BOMAS-1 First conceptual diagram of slant range and accompanying insonified area in GI BOMAS proposal to Navy.

A Note on Fifty Years of Multi-beam

The Early Years

Albert E. Theberge Jr., Contributing editor, Hydro INTERNATIONAL

Norman Z. Cherkis, Five Oceans Consultants, LLC.

The year 2013 marks the Fiftieth Anniversary of the first installation of a multi-beam sonar sounding system. A review of the early development of multi-beam sonar systems follows.

ON 1 MAY 1960, A UNITED STATES U-2 spy plane flown by Francis Gary Powers was shot down over the USSR by a Russian Dvina surface to air missile. This event, although it would seem not to be related, led directly to the development of multi-beam sonar according to the autobiographical memoir, Lazarus: From Seven to Seventy by Eugene Weisberger, then general manager at General Instrument.

The U-2 had flown spy missions over the USSR since 1956, but because of its extreme flight altitude of 70,000 feet, it was able to enter hostile airspace with impunity as Russian surface to air missiles were not able to reach that altitude. That all changed on 1 May 1960, with the improvement of technology and the downing of the U-2 spy plane flown by Powers. The U-2 had been doing photo reconnaissance for the past four years but a new mission was in the planning stage at the time of the downing. That mission was radar mapping of the USSR by a system being developed by engineers of General Instrument Corporation. The system, as envisioned by engineers Howard Lustig and Arthur Rossoff, would use a technique known as the Mills Cross technique. This method was named for Bernard Mills, an Australian radio astronomer who devised an array of radio telescopes that through a beam-forming technique was able to resolve the sky into individual 49-arc-minute sectors.

The concept of beam-forming was adopted by General Instrument (GI) in the design of a mapping radar that was to be installed on the U-2. With the shooting down of the aircraft, the concept almost died except that those involved in the project contacted engineers Harold Farr, Paul Froelich, and Don White of Harris ASW, GI's newly-formed sonar group, to inquire if they had any use for the concept. Don White was the general manager of Harris ASW at the time. Within a

Navy bureaucracy responded with lightning speed to this unsolicited proposal

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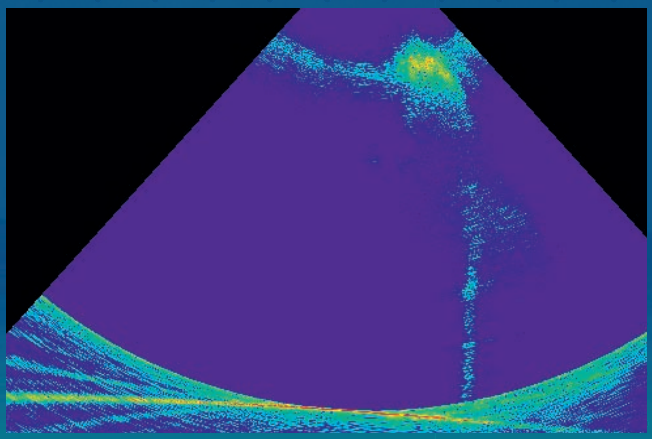

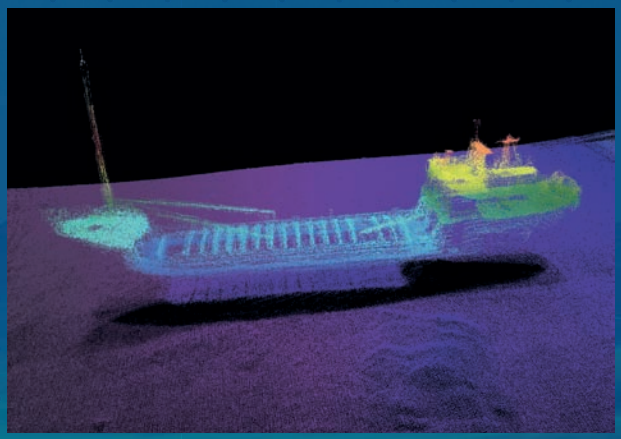

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No. 3324

year, these engineers had put forward a concept to the Navy which they gave the acronym BOMAS which stood for Bottom Mapping Sonar.

The definition of BOMAS in the proposal was that it was 'a ship or submarine-borne sonar system, designed to map the bottom by generating a strip map containing selected depth contours.' The original designers also recognised that 'for special applications, a strip map that displays bottom return intensity can be included in the BOMAS system.' Furthermore, 'BOMAS derives bottom profile information from the intersection of the ocean bottom with a vertical plane perpendicular to the heading of the ship.' As conceived, the sonar data from each ping would be processed automatically, but because high-capacity digital data storage was not yet available, the data would be transformed into a depth contour strip map in real-time that was recorded on a continuous film record. In addition, theoretically the strip map was geo-referenced and 'undistorted in the presence of variations in ship's speed, attitude, course, heading and, for submarine application, depth.' Standard sound velocity corrections and refraction effects could also be applied.

The United States Navy bureaucracy responded with lightning speed (relative to most major procurement actions) to this unsolicited proposal. In 1963, the first test system, now dubbed SASS, for Sonar Array Sounding System, was installed on the USS *Compass Island*, a Navy test ship for various electronic systems. The 12kHz sounding swath was ultimately composed of 61 1 degree beams stabilised for roll and pitch that generated a fan width of approximately 1.15 times water depth. Within another two years, SASS was fully operational and installed on three US Navy vessels that became the backbone of the Naval Oceanographic Office Ocean Survey Program. These were the USNS *Bowditch*, USNS *Dutton*, and USNS *Michelson*. However, the data was classified and few outside the naval community were aware of either its existence or the power of multi-beam systems to define seafloor features.

In parallel with SASS development, a Narrow Beam Echo Sounder (NBES) was produced by Harris ASW and installed on the Coast and Geodetic Survey Ships *Surveyor*, *Discoverer* and *Researcher*. The NBES was composed of the same technology that ultimately became Sea Beam and formed 16 beams of 2 2/3 degree width. However, only the vertical centre beam was recorded and used during surveying operations.

Decade 1980-1990 was one of intense seafloor feature discovery

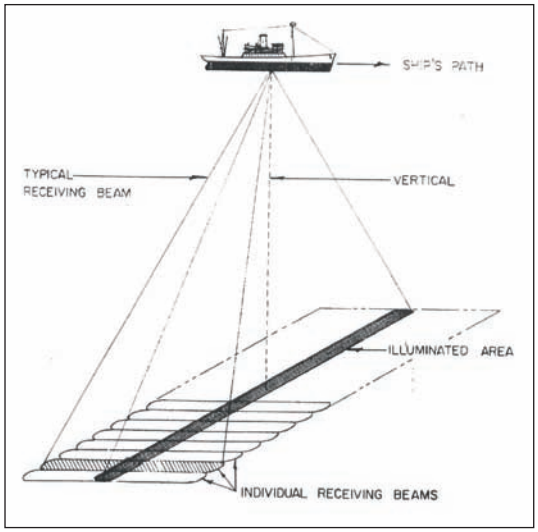


Figure 2: BOMAS-2 First conceptual diagram of how a multi-beam system would function as seen in GI proposal to Navy in 1961.

Following the success of SASS, General Instrument's Harris ASW Division developed a mid-water multi-beam sounding system for civil use. The first of these, called BO'SUN, was described by Don White at the 3rd Offshore Technology Conference in 1971. BO'SUN could be configured for either eleven or twenty-one 5 degree beams. This system was designed for use between 150-600 metres depth. Perhaps because it was limited to use on the continental shelf and continental slope, the BO'SUN system did not attract the attention from civil interests that its later deep water successor did. As installed and configured on the NOAA Ship *Davidson* in 1978, it became known as, "BS cubed", the Bathymetric Swath Survey System.

The data from the naval survey ships was classified (and much of it still is) but the Navy released SASS data for the 1974 Project FAMOUS (French-American Mid-Ocean Undersea Study). Following the release of this

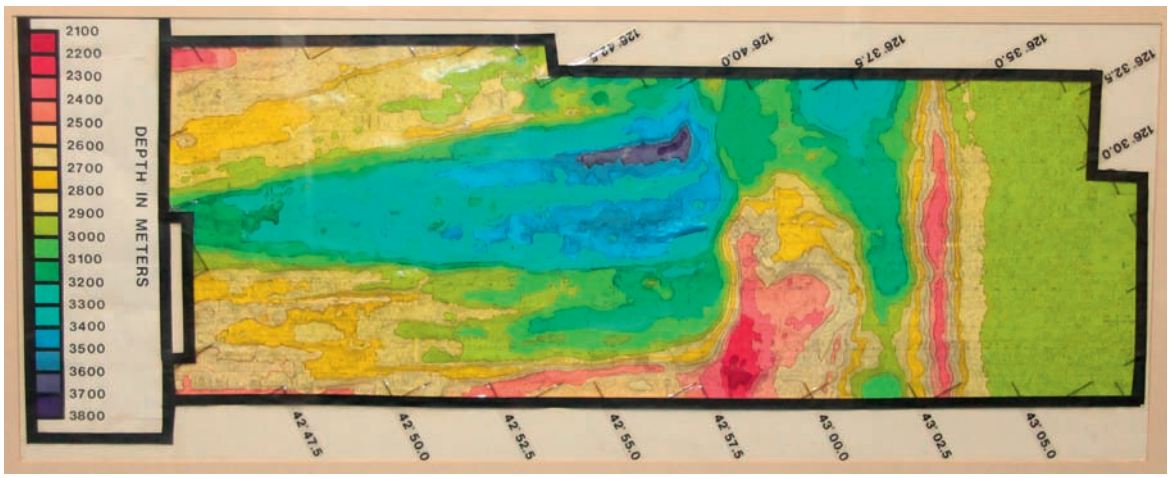


Figure 3: Hand-coloured first NOAA Sea Beam map of Gorda Ridge area off the Oregon coast of the United States produced in February1980.

data, a demand arose in the civil community for access to multi-beam technology. This was further fueled by General Instrument discussions with the navy concerning allowing full use of the NBES system with its sixteen 2 and 2/3 degree beams versus the classified higher-resolution SASS system. Ultimately, access to the lower-resolution system was allowed to proceed. In order to differentiate between this system and the higher-resolution Navy system, Eugene Weisberger needed a new name. He enlisted the aid of his children in this endeavor and, as related in his autobiography, his then nine-year-old son suggested the name Sea Beam.

The first operational Sea Beam was installed on the French vessel *Jean Charcot*, which began operations in 1977. This was followed two years later by upgrading the NBES on the United States NOAA ship *Surveyor* to a multi-beam Sea Beam. The *Jean Charcot*'s first operations, under the direction of Vincent Renard and Jean-Paul Allenou, of the Centre Oceanologique de Bretagne at Brest, were in the Bay of Biscay while the *Surveyor*'s first complete survey was conducted in the Pacific Ocean off the coast of Oregon on the Gorda Ridge under the direction of Alexander Malahoff, chief scientist of NOAA's National Ocean Survey as it was known at the time. These installations were followed by the Australian vessel HMAS *Cook* in 1981 (the *Cook* is often credited as having the first installed Sea Beam but the ship was plagued with mechanical problems and was not commissioned until early 1981) and then the first academic ship, the Scripps Institution of Oceanography vessel *Thomas G. Washington* in 1981. By the end of the decade, nearly 40 multi-beam systems had been installed on vessels of seven nations. Besides Sea Beam there were Simrad, Furuno and Hydrosweep systems as well as a Russian system called Ekhos XD. The decade 1980-1990 was one of intense seafloor feature discovery as every survey and expedition seemed to find new and sometimes surprising features. The ability to better define the shape of seamounts with the accompanying discovery of cratered volcanoes on the seafloor, the overlapping spreading centres of the East Pacific Rise, the characterisation of the great fracture zones such as the Garrett Fracture zone associated with one of the fastest spreading ridge segments on earth, great salt domes and basins of the Texas Louisiana slope, fields of mud waves at the mouth of canyons such as Pioneer Canyon on the US West Coast, and the ability to track canyons with all of their meanders and twists and turns - all led to a sense of wonder during this period. The increased resolution of these systems, as compared to wide-angle single beam echo sounders, also led to better targeting of both manned submersible exploration and robotic vehicle exploration. As the decade wore on, navigation systems experienced a quantum leap in absolute positioning capabilities with the Global Positioning system becoming increasingly available although not fully operational until the mid-1990s. This better navigation capability assured better final products as 'rubber-sheeting' (the adjustment of adjacent survey lines to assure matching of contours) in areas of poor to non-existent electronic control sometimes led to blunders and misinterpretations.

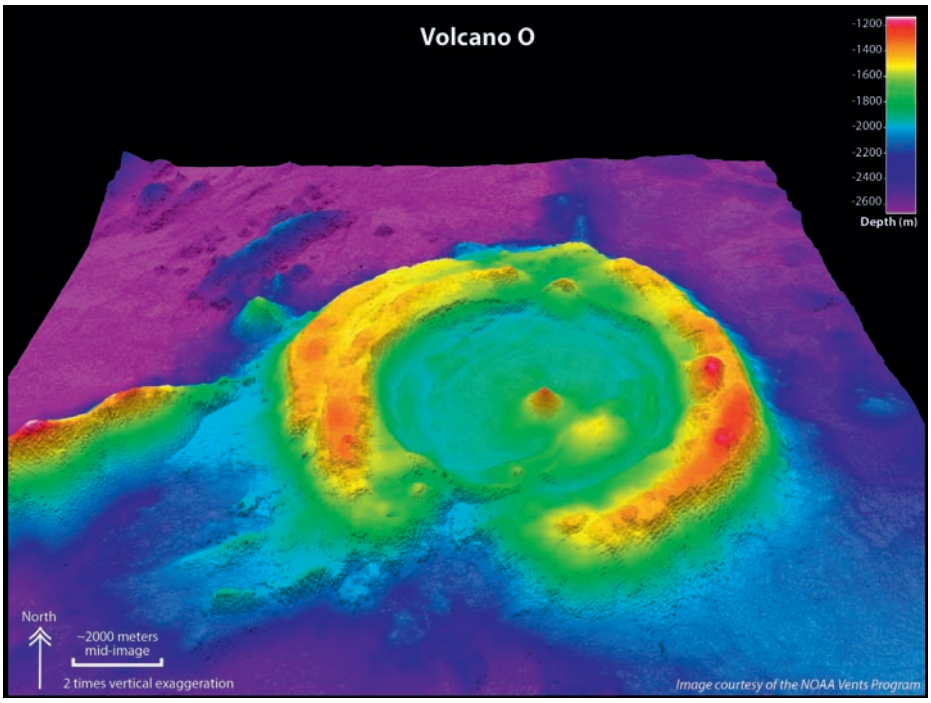


Figure 4: Volcano O, a huge caldera in the NE Lau basin. Image looks toward the north, 2 times vertically exaggerated. EM300 and EM122 multi-beam bathymetry grid cell size is 35 metres. Image courtesy of Susan Merle OSU, Submarine Ring of Fire 2012 Exploration, NOAA Vents Programme.

In the years since 1990, multi-beam systems have proliferated, have migrated into shallow water as well as increasing capabilities in deep water, have increased in swath width, and have decreased in beam width. They have been further enhanced by a number of enabling technologies including improved motion sensing with higher update rates, exponentially increased processing power of computers, and greatly improved visualisation tools for real but anomalous object identification and for non-existent artifact identification and removal. Today's systems are a far cry from the original SASS and Sea Beam systems. However, all modern systems owe their origin to the vision of a small group of engineers and the seemingly unrelated shooting down of a spy plane.

Shooting down of spy plane led directly to the development of multi-beam sonar

Ocean Business: AUVs, Cloud Technology and Many Visitors

This year's Ocean Business conference had a busy programme. The traditional programme of trade show, live demonstrations and workshops is gaining more popularity among the hydrographic community. Ocean Business welcomed 4111 visitors from 65 countries between 9 and 11 April 2013.

Figure 1: The Liquid Robotics WaveGlider represented the trend of autonomous vehicles capable of mapping the ocean. (Image Courtesy: 3 Men & a Suit).

THE FIG AND IHO organised a seminar on the Blue economy during Ocean Business. Government as well as non-governmental organisations discussed the various possibilities within Hydrography during the one-day seminar Blue Economy. Hydrography provides far more than just creating maps for the safety of navigation.

The Offshore Survey conference highlighted a wide range of topics. As was already apparent from the trade show, AUVs appear to be becoming increasingly popular and more are being used. Where the AUV was traditionally seen as being used in deeper waters and large scale surveys, nowadays the AUV is being used in a wide variety of survey projects. Smaller sized AUVs and low power systems allow the systems to endure longer and are they are more easily deployable. About 70% of the AUVs sold is meant for water depths up to 200 metres. Although the technology seems to be gaining popularity, there are still challenges ahead such as accurate positioning, on board processing, georeferencing, collision and recovery.

Related to the autonomous underwater vehicles, autonomous surface vessels are also becoming popular for hydrographic and oceanographic measurements. A relatively new and interesting vehicle presented at Ocean Business was the low-power and long endurance surface vehicle from Liquid Robotics. In the future, these kinds of systems might allow us to take ocean samples and measurements more cost efficiently, allowing us to better understand the unknowns of our oceans.

Another interesting development taking place is the increasing interest for GIS systems. Traditionally, offshore-related organisations produced fair sheets as an end-product. In an era where Google Maps can be found in everybody's daily life, the hydrographic industry is also moving towards GIS solutions. The GIS, however, should not serve as the repository of maps, but should be used for data storage of the spatial information and data. The OGP SSDM model could become an interesting standard for exchanging spatial hydrographic information.

Related to managing spatial information and data, two new companies also presented their new solutions. OneOcean and MarineExplore showcased for the first time the use of cloud technology by hydrographic and oceanographic organisations and by the commercial companies. OneOcean primarily offers their solution as a data storage provider for bathymetry. MarineExplore is a platform, collaborating the global oceanographic information available, which is traditionally stored in a wide variety of ways.

A wide range of new systems was also launched during Ocean Business. Both Kongsberg and Teledyne Reson introduced smaller and more compact models of their multi-beam systems. Sonardyne introduced their new Sonardyne Solstice, a small-scale side-scan sonar with integrated swath bathymetry and designed in such a way that the system can also be integrated on AUVs.

Diversified Business Communications UK has taken over Ocean Business organiser Intelligent Exhibitions Ltd. The next Ocean Business event is scheduled to take place in April 2015 at the NOC in Southampton, UK.

Mark Pronk
Technical editor, Hydro INTERNATIONAL

Figure 2: MacArtney presented Sensorbots. These are small nodes with water sensors that can optically form a flexible underwater data transmitting network.

Figure 3: Sonardyne launched the Solstice, a small-scale side-scan sonar.

www.oceanbusiness.com

MARID

Experts on marine and river dune dynamics gathered in the medieval city of Bruges, Belgium, for the fourth conference on this topic from 15 to 17 April 2013. Initiated in 2000 by the North Sea Hydrographic Commission, the conference takes place once every four years somewhere around the North Sea. About eighty people attended the conference, mostly from universities and government institutions.

THE HALL OF THE NEO-gothic Provincial Court provided the conference with a beautiful atmosphere. There were keynotes from Prof. Maarten Kleinhans (Utrecht University, NL), Prof. Suzanne Hulscher (University of Twente, NL), Prof. Peter Thorne (National Oceanography Centre, UK), and Prof. Ugo Piomelli (Queen's University, Canada). Topics ranged from laboratory studies to idealised morphological models to field measurements. There was considerable attention for biological influences on the observed rhythmic patterns, as well as for the grain size distribution of such patterns. In some cases, the coarse sediment is on the crests, while in others it is found in the troughs. Underwater life could either make the patterns firmer, or contribute to the suspension of sand.

There were presentations of different lengths: twenty minute presentations, seven minute 'pecha kucha' style presentations with a maximum of twenty seconds per slide, and one minute presentations to pitch the posters. Another special aspect was selecting the best picture of sand waves. The submitted pictures where shown on a TV screen during the breaks, and many participants voted.

In addition, there was a reception in the town hall, with plenty of the local beer, Brugse Zot, delicious but very strong. After the presentations, there was a conference dinner, and an excursion to the Western Scheldt and the 'Zwin' former tidal inlet — which was used by ships to reach Bruges. The siltation of the Zwin also meant the end of the prosperity of Bruges, according to the tour guide a city as large as London and Paris in the fifteenth century. At the end of the conference, the University of Bangor (Wales) announced that they will organise the next edition.

Leendert Dorst, contributing editor, Hydro INTERNATIONAL

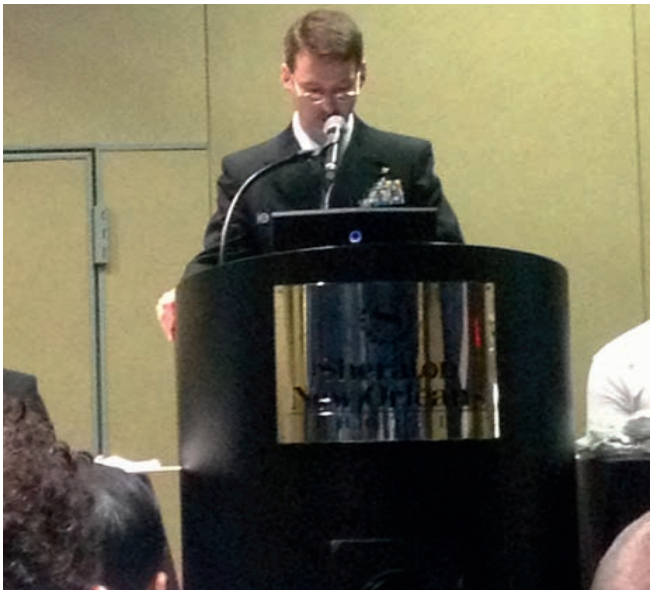
Figure 1: Visit to Hooge Platen.

Figure 2: One of the groups visiting Het Zwin. (Image courtesy: Vera Van Lancker).

US Hydro 2013 Enjoying New Orleans

From 26 to 28 March 2013, US Hydro 2013 took place in New Orleans, at the mouth of the Mississippi river, USA. Just a block away from the famous French Quarter, the venue provided the participants with lots of opportunities to meet up and enjoy themselves. The programme consisted of technical presentations, an extensive series of workshops, an exhibition with over 60 booths and a well-attended partner programme. At the end of each day, there was a happy hour with music, snacks and drinks.

THE KEYNOTE ADDRESS WAS delivered by two American Rear Admirals: NAVOCEANO Commander Brian Brown and NOAA's new director Gerd Glang. They provided overviews of their recent activities, and also spoke about the negative effects of the current financial situation of their government. One effect was obvious: only very few American government



NOAA director Rear Admiral Gerd Gland.

officials were allowed to attend. Although a couple of government presentations had to be cancelled, most government presenters were able to find a stand-in.

A new aspect was the organisation of lightning round presentations of only five minutes, without questions. This gave the audience an opportunity to get a first impression of a project, and contact the authors later. In addition, 23 students presented their work with posters. Their enthusiasm was sparked further by the selection of a poster for an award.

Three distinguished hydrographic professionals had the honour of being inducted into the new Hall Of Fame of The Hydrographic Society of America. Dr. Lloyd Huff, Doug Moore and Jack Wallace received this honour with short acceptance speeches, each of them looking back on their impressive careers.

As ever, the technical programme had several strong contributions from the NOAA/University of New Hampshire's Joint Hydrographic Center. Dr. Brian Calder was involved in a presentation about the CHRT algorithm, which improves the ideas of CUBE using grids with variable resolution. He also spoke about ways to estimate the deepest depth of the Challenger Deep in the Marianas Trench – the deepest point on Earth. This exercise is somewhat unusual, as hydrographers are used to always looking for the shallowest depth. Dr Jonathan Beaudoin spoke about optimal frequencies for water column variability measurements, and about forecasting water column variability using global oceanographic models. Dr. Shachak Pe'eri was involved in several presentations about remote sensing. Besides airborne Lidar, there is considerable progress in bathymetry using satellite remote sensing. This technique has the potential to give an impression of rather shallow areas that are seldom or never surveyed with other techniques.

President Mike Nitska of the Louisiana chapter welcomes the participants of USHydro2013.

There also was a strong Canadian presence, with contributions from CHS, CARIS and the port authorities. Access to the ports along the Saint Lawrence River remains a challenge, where technology could make a big difference. A shallow and narrow estuary with large tides and high-intensity shipping provides a need for complicated planning and accurate hydrographic information.

Leendert Dorst, contributing editor, Hydro INTERNATIONAL

1. www.hypack.com/ushydro/2013/

Seabed Mapping and Inspection 2013

The annual Seabed Mapping and Inspection conference took place from 6 to 8 February 2013 in Geilo, Norway. The conference had more than 150 participants, and included people working with technology development, survey and inspection in the marine segment of the oil and gas industry.

Figure 1: The technical committee did an excellent job in organising the conference. From left to right: Tor Arne Paulsen, Deep Ocean; Jan Arvid Ingulfsen, DOF Subsea; Fiona Stewart, BP; Egil Ingebretsen, Statoil; Anu Laakso, Tekna; Berit Plasstun, Fugro Survey.

THE CONFERENCE WAS held in Geilo, a beautiful winter paradise with 39 downhill slopes and 550km cross country tracks, more or less as far away from the ocean as you can get in Norway. With generous lunch breaks allowing for skiing, or just soaking in the spa, the conference had an informal atmosphere combined with a very high scientific and technical level.

Arctic Activity - Hype or Real?

The conference was opened by Egil Ingebretsen from Statoil, who was the chair of the Technical Committee. The first presentation started with some critical questions about the future activities in the Arctic from Jon Marsh Duesund of Rystad Energy, asking whether this was to be considered a hype or real. The expectations for this market have been high in Norway, and Duesund concluded that there will be great opportunities, but probably not as quickly as many had hoped for.

Once Upon a Time...

While most of the presentations focused on state of the art and upcoming technologies, some looked back. The multi-beam echo sounder technology has revolutionised the world of marine mapping, and the Norwegian company Kongsberg with its EM series has been at the forefront of this development. Eddy Lund from Kongsberg, soon to retire, gave a lively description of the early development of this industry. He emphasised the importance of the co-operation with and economic support from the oil company Statoil, which needed the technology for its field developments.

Natural and Man-made Gas Leakages

Acoustic and chemical sensors to detect natural gas leakages or leakages from man-made subsea constructions were presented by Terje Thorsnes from the Geological Survey of Norway, and Per Sparrevik from the Norwegian Geotechnical Institute. Thorsnes focused on large gas flares in the Barents Sea detected using the water column data from a hullborne EM710 multi-beam echo sounder, combined with AUV mounted methane sniffers, synthetic aperture sonar and optical systems. Sparrevik described how well-established techniques can be combined to provide an efficient monitoring system with online processing giving early warnings for conditions which may develop into critical leakage scenarios. Gas leaks from bubble trains to significant gas plumes are rapidly spotted by scanning sonar systems, and chemical sensors which are sensitive enough to detect changes from the normal background level.

Focus on AUVs and SAS

The use of autonomous underwater vehicles (AUVs) and synthetic aperture sonar (SAS) was addressed by several presenters. AUVs make it possible to perform very detailed mapping at a reasonable speed close to the seabed, and emerging technologies such as SAS give extremely detailed acoustic mapping. An interesting comparison was given by Ola Oskarsson from MMT Sweden. They compared results from hullborne multi-beam echo sounders with data from ROV and AUV mounted systems, and added a SAS system to the AUV.

Broad Spectrum

The conference had a broad spectrum of presentations, covering various aspects of technology and experience. Installation, operational performance and calibration operational experience were key words, but the conference also included the latest developments in environmental guidelines, positioning, geographic information systems and visualisation. Perhaps most important was the fact that the splendid setting and generous breaks provided excellent opportunities for ample informal discussions in between the presentations during the formal sessions.

By Terje Thorsnes, Norges Geologiske Undersøkelse

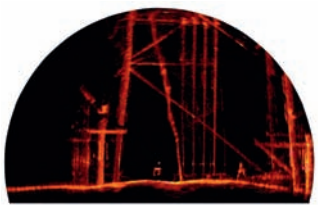


Figure 2: Confirmation of a simulated gas plume (50 l/min) by vertical sonar scan. Source: Norwegian Geotechnical Institute.

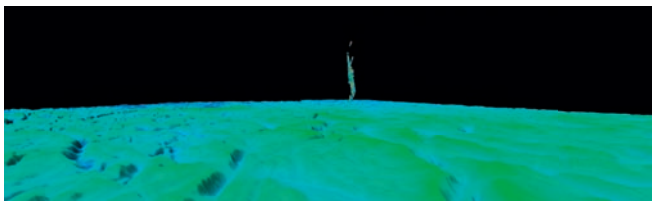


Figure 3: Natural gas leakage in the Barents Sea, detected with water column data from the EM710 multi-beam echo sounder. Source: Geological Survey of Norway/Lundin Norway/ Norwegian Defence Research Establishment.

www.bit.ly/10nC8qV

Figure 1: Chris Ransome, founder and president of CRA, Inc.

Figure 2: The *Seahawk*, CRA's biggest boat with full cabin used for multi-beam surveys.

Surveying The Coast

Chris Ransome & Associates, Inc. (CRA, Inc.)

Laci Theriot, sales and marketing, CRA, Inc.

Based out of Houston, Texas, USA, CRA is the specialist hydrographic survey company on the Gulf Coast. As a provider of hydrographic surveying solutions, CRA specialises in using the latest automated data acquisition systems and offering other technical marine-based services such as sediment sampling, hazard surveys and underwater inspections.

IN 1987, A TEAM OF FIVE experienced land and offshore surveyors who had spent several years working in the oil industry came together to form a company to provide survey services to the Gulf Coast civil engineering sector. Leading the venture was former ex-president of Wimpol, Inc. and Aquanav, Inc., Chris Ransome. CRA was put in business by a subsidiary of Boskalis, the world's largest dredging contractor. Using computer-based radio positioning systems, CRA developed a solid position in the dredging market. CRA has expanded into many different types of surveys, adding geophysical techniques such as side-scan sonar and sub-bottom profiling.

Hydrographic survey business becoming more competitive

Providing the Most Cost-effective Service using the Latest Technology

Since CRA was founded, their mission statement has not changed. The three elements contributing to the company's success has always been service, price and technology. The eleven employee firm consists of three departments: administration, marketing and operations. "Internally, CRA has a fun, dynamic culture. We thrive on working on projects that are out of the ordinary and require us to help clients decide which data, acquired by which technology is most appropriate for their needs," said Chris Ransome, president. In twenty-five years of business, CRA has completed over 2,300 jobs, including post-Hurricane Rita and Ike work.

A Global Perspective

CRA works with marine dock owners, civil engineering firms, pipeline companies, dredging and construction contractors and port authorities. Many marine-related projects along the coast and inland waterways require hydrographic surveying, and with the Port of Houston being one of the busiest ports in the United States,

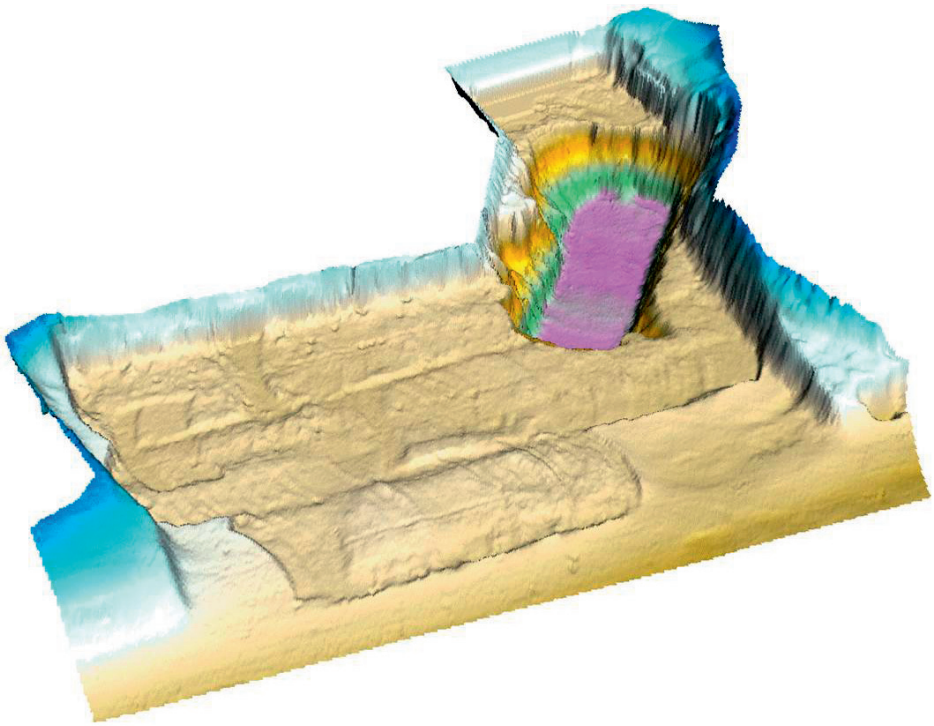


Figure 3: A 3D view of bottom floor, taken with a multi-beam system.

Continual drop in cost of equipment needed to perform survey work is challenging

there are a lot of opportunities. The majority of CRA's regular work is on the Texas and Louisiana coast, however, they have tackled many jobs throughout the lower 48 states and internationally in the Bahamas, Venezuela and the Caribbean. With four survey vessels, CRA has the capability to work in most rivers, lakes, bays, and channels, as well as nearshore coastal areas. In upcoming years, CRA plans to expand geographically towards the country's central inland market and diversify their services even further. "CRA wants to be the on and underwater data collection experts for all engineering solutions, measuring any environmental parameters that our clients may require," said Chris Ransome.

Preparing for the Future

The hydrographic survey industry is fast paced. To be successful, you have to keep up with the constant change in technology and techniques. Several years ago, multi-beam systems came into the picture, and being more sophisticated and complex than single beam systems, caused problems for surveyors who did not understand how to use them properly. Since that time, more survey companies have adapted to the methodology, taking surveying to a whole new level.

Activity in the oil and gas industry is starting to show a substantial increase. One of the challenges is the continual drop in cost of equipment needed to perform survey work. This trend is causing the hydrographic survey business to become more competitive as some small engineering and land surveying companies are now offering this service. Existing primary providers will have to improve their service by not only providing ever more sophisticated technology and solutions, but also with a higher standard of safety procedures and increased insurance.

The improving economic outlook is such that there will be a larger demand for water investigations. Coastal areas may be impacted by future rises in sea level. This, and other ecological impacts, will lead to increased surveying requirements in all marine environments, including more scientific studies and research. CRA plans to be on the forefront of developments in this industry for many years to come.

Laci Theriot: ltheriot@crahouston.com; Chris Ransome: cransome@crahouston.com

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International Hydrographic Organization

World Hydrography Day 2013: Underpinning the Blue Economy

The term 'blue economy' is becoming more frequently heard. It is an expression used to describe all the economic activity associated with the oceans, seas, harbours, ports, and coastal zones. Underpinning this activity is hydrography. Every human activity conducted in, on or under the sea depends on knowing the depth and the nature of the seafloor, the identification of any hazards that might exist and an understanding of the tides and the currents. Obtaining and disseminating this hydrographic knowledge is the role of the world's hydrographers. Their work is the most fundamental of all the enablers required to develop and sustain the Blue Economy.

The theme for this year's World Hydrography Day on 21 June, which is also the 92nd anniversary of the establishment of the IHO, is: 'Hydrography - underpinning the Blue Economy'.

IHO Celebrations

Many of the world's hydrographic offices will be organising awareness raising events focussing on the Blue Economy. They will be emphasising the vital contribution that hydrographers and related professions in both the government and the commercial sectors make to the Blue Economy.

The Potential of the Blue Economy

The seas and oceans, including the seabed and the sub-seabed, represent a vast resource for food, mineral and hydro-carbon reserves, energy generation, water, bio-medicines, and infrastructure that in turn create wealth for nations and for the population.

The Blue Economy is much more than the traditional core activities of fishing and shipping. It also includes, but is not limited to:

- Aquaculture
- Biomedicine
- Boats and Shipbuilding
- Cables and pipelines
- Coastal Zone management
- Defence and Security
- Desalination and water treatment
- Marine recreation
- Ocean energy and minerals
- Ocean science and observation
- Port operations
- Robotics and submarines
- Shoreline development
- Telecommunications
- Tourism
- Very large floating platforms
- Weather and climate science

Each of these important and growing maritime sectors provides jobs and creates wealth. Each depends, in some way or another, on hydrography as its enabler.

Some facts about the Blue Economy:

- The Oceans already provide at least 15% of animal protein for about 3 billion people, aquaculture (farming) of fish and aquatic plants is worth more than USD106 billion, the fishing industry provides livelihood to more than 540 million people.
- Cruise ship passengers spend at least USD100 each for each day ashore. That is over a quarter of a million dollars from a typical cruise ship for every day in a port.
- Well over 95% of the world's intercontinental data and telephone traffic passes through undersea cables.
- 75% of the world's oil supplies and 55% of the world's gas supplies are transported by sea.
- Offshore wind farms are increasingly becoming cost competitive with fossil fuel and nuclear sources.
- Port economic activity usually generates at least one other indirect job for each new job. For high tech industries this multiplier effect can reach up to 5 or 6.
- Economic studies show that the cost:benefit ratio for national investment in hydrography and nautical charting is always positive and can be better than 1:10.
- For most ships, 30cm extra depth of navigable water allows at least 2,000 tonnes more cargo to be carried.

More information is available on the IHO website.

Robert Ward
President, Directing Committee of the International Hydrographic Bureau

1. *www.iho.int*

International Federation of Surveyors
Fédération Internationale des Géomètres
Internationale Vereinigung der Vermessungsingenieure

FIG COMMISSION 4
Hydrography

Commission 4 Report

The FIG Working Week Conference Hotel in Abuja, Nigeria.

Commission 4 officers and members participated in a number of conferences of importance to hydrography during 2012.

In this article we present an overview of the activities and congresses where the FIG commission 4 has been represented during 2012:

- IEEE Transactions on Geoscience and Remote Sensing;
- CVRS2012, Xiamen, China, 16-18 December;
- ISPRS 2012 Congress, Melbourne, Australia, 25 August;
- ASPRS Annual Conference, Sacramento, California, 19 - 23 March;
- Canadian Hydrographic Conference (15 - 17 May) in Niagara Falls, Canada;
- Hydro12 conference, with the theme Taking Care of the Sea, Rotterdam, The Netherlands, 13 – 15 November;
- FIG 8th Regional Conference, Montevideo, Uruguay, 26 to 29 November.

Last year, due to a tragic accident, the Commission lost Professor Volker Böder of HafenCity University Hamburg (HCU) and former chair of Working Group Group 4.3 Multi-Sensor Systems for Hydrographic Applications. In 2011, Commission 4 lost David Neale, former vice-chair Administration and Communication due to illness. In spite of the loss of these once active members, Commission 4 remains vibrant and committed to all things hydrographic.

2013 represents the penultimate year of the current 2011-2014 term. Below are two main events in which the Commission has participated in 2013:

FIG Working Week 2013, Abuja, Nigeria

FIG Working Week 2013 was held in Abuja, Nigeria from 6 to 10 May 2013 at the International Conference Centre and Nicon Luxury Hotel. There were two Commission 4 technical sessions: Hydrographic Education and Standards, and Hydrography in Practice. Both sessions were comprised of nine papers. Abuja is a beautiful and modern city. However, FIG was aware that some anxieties existed among potential conference participants because of recent unfortunate incidents involving foreigners. The conference went on as planned.

Joint FIG-IHO Conference – The Blue Economy

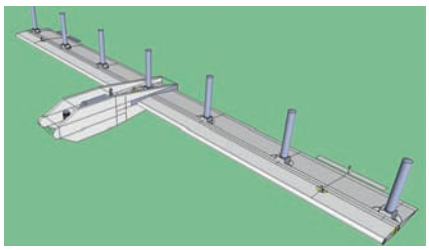
On Tuesday 9 April 2013, FIG (directly via Commission 4) and the International Hydrographic Organization (IHO) held a one-day conference titled 'The Blue Economy'. The Royal Institution of Chartered Surveyors was the local host. The conference was held at the National Oceanographic Centre (NOC) Southampton, England. Presentations were made by speakers from a number of organisations with interests in hydrography-related economic development. Organisations represented included FIG, IHO, The Maritime Alliance, International Association of Marine AtoN and Lighthouse Authorities (IALA), International Maritime Organization, United Kingdom Hydrographic Office, National Oceanography Centre, International Association of Oil & Gas Producers, International Marine Contractors Association, The Hydrographic Academy and University of Twente.

Dr. Michael Sutherland (Canada, and Trinidad and Tobago). Chair (2011-2014), Commission 4, International Federation of Surveyors (FIG)

1. www.fig.net/commission4/
2. www.fig.net/commission4/contactus/contactus.htm
3. www.fig.net/fig2013/

Area Survey System for Pipeline Tracking

UK-based Innovatum has developed an area survey system or 'Wing' as a new operating platform for the company's magnetic cable and pipeline tracking systems. Fewer personnel will be required for operations, and the Wing is more straightforward to operate than using an ROV or towed sled for depth of bury cable or pipeline survey.
http://su.pr/2OlOqK



The Area Survey System.

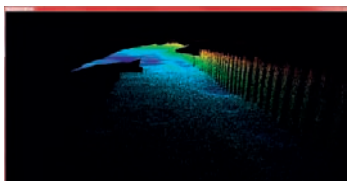
Portable SeaBat Launch at Ocean Business 2013

Teledyne RESON (Denmark) has released a new product designed from the ground up to meet the demands of the shallow-water market: the SeaBat T20. It is developed for users requiring ease of use and portability, while still demanding the highest-quality data and a powerful feature set. It is based on a new-generation sonar receiver, which is roughly half the size of the SeaBat 7125 array, and a new Teledyne RESON Portable Sonar Processor.
http://su.pr/19YzNJ

The SeaBat T20.

EM2040 Multi-beam Goes Compact

Kongsberg Maritime introduced the EM 2040 Compact, a multi-beam echo sounder for high-resolution mapping and inspection applications, during Ocean Business 2013, from 9 to 11 April 2013 in Southampton, UK. Based on the EM 2040 multi-beam, the EM 2040C makes detailed surveys of shallow water possible using small boats and launches. Kongsberg Maritime will also offer another variant, the EM2040CX for use on AUVs, ROVs and other vessels of opportunity.
http://su.pr/1ap4ze



An image created with the EM 2040 Compact.

New Profiling Instrument for Shallow Water

AML Oceanographic, Canada, introduced a new profiling instrument at Ocean Business 2013. The Base•X is an entry-level shallow-water logging instrument which offers performance at an attractive price. Designed for profiling in coastal waters, the instrument includes a shackle, a sensor cage and an LED status indicator to simplify deployment preparation. High-speed 25Hz sampling ensures data resolution.
http://su.pr/19fZJ1

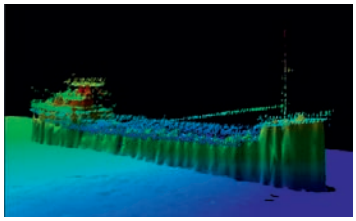
The AML Oceanographic Base•X Shallow-water logging instrument.

AUVs as Part of Growing Rental Service

Kongsberg Maritime announced at Ocean Business 2013 that it will add a number of Autonomous Underwater Vehicles (AUV) to its rental pool during 2013/2014. The addition of AUV capability will further enhance the existing rental equipment portfolio at Kongsberg Maritime Ltd, which supports customers within the offshore oil & gas, environmental and renewable energy markets.
http://su.pr/24N6UU

HIPS and SIPS 8.0 Featuring Water Column Data Supplementation

CARIS has released CARIS HIPS and SIPS 8.0. HIPS and SIPS offer a single solution for bathymetry, seafloor imagery and water column data processing. The new release includes some significant enhancements, such as the continued implementation of water column data processing allowing the data to be supplemented into the bathymetry, the redesigned calibration tools in Subset Editor and the new HIPS project database allowing for faster open times and multi-user access.
http://su.pr/2GOGju



Imagery demonstrating the new HIPS and SIPS features.

More product news
www.hydro-international.com/news/productnews.php

Australasian Hydrographic Society

AHS Awards
Nominations close 30 April 2013. This scheme celebrates hydrography and allows the AHS to recognise those who contribute to improving the profession and enhancing community understanding.

The schedule is:
- Awardees notified: 28 May 2013
- Awards presented: World Hydrography Day on 20 June 2013 or AHS AGM

Details about the awards as well as nomination forms are available from the AHS website: *http://www.ahs.asn.au/awards.html*

Hydrographic Society Russia

On a frosty spring day,11 March 2013, about ten people gathered in Smolensky orthodox cemetery in St. Petersburg at the family Vilkitsky grave. At the iniative of HSR they were gathered to participate in a remembrance event dedicated to the outstanding Russian hydrographer, geodesist, researcher of the Arctic regions, the general of the Corps of hydrographers, Andrey Ippolitovich Vilkitsky (1858-1913). The day marked the 100th anniversary of his death. HSR members, representatives of other public and state organisations, and pupils who are member of the historical-geographical club by the name of Boris Vilkitsky at St.Petersburg school 43 took part in the event.


General of Russian Corps of Hydrographers, Andrey Ippolitovitch Vilkitsky 1858-1913.


HSR president Nikolay Neronov speaking.

The event started at noon and was opened by HSR president Nikolay Neronov. The other speakers were: HSR secretary Valentin Smirnov; great-granddaughter of Boris Vilkitsky, Irina Tikhomirova; the head of the historical-geographical club, Elena Nazarenko; the secretary of the St. Petersburg society of geodesy and cartography, Vitaly Kaptsjug; the secretary of the mathematical and geographical cartography branch of the Russian Geographical Society (RGS), Eduard Mozhenok.

They recalled that Andrey I. Vilkitsky showed outstanding abilities, knowledge and initiative from an early age. At the age of 29 he was already awarded two RGS small gold medals for work on Novaya Zemlya by defining gravity acceleration. He supervised over hydrographic and geodetic works in Arctic regions until 1907, and he was then appointed as chief of the Head Hydrographic Department of the Russian Sea ministry. Under his management the 30-year plan of hydrographic works in all seas of Russia and the ten

Wreaths and flowers placed on the grave of Andrey Vilkitsky .

year plan of beacons construction was developed.
In 1912, the Second International Sea Conference on Safety of Navigation took place in St. Petersburg under the direction of General Andrey I.Vilkitskogo. It should be emphasised that this conference became a first step in the creation of the International Hydrographic Organization.

In the same year, the special Corps of hydrographers was founded under his initiative. Since then the Russian Navy is known for its hydrographers and has promoted the improvement of the quality and efficiency of navigating maintenance of the Navy and transport fleet.

Under Andrey I. Vilkitsky's management the Hydrographic Expedition of Arctic Ocean (HEAO) was created and two special hydrographic icebreaking steamships, *Taimyr* and *Vaigach*, were constructed. Boris Vilkitsky became the HEAO chief on these vessels after the death of his father. On 3 September 1913, he made the last outstanding geographical opening, he opened the until then unknown land which was named *Zemlya of the Emperor Nikolay II* (now - *Severnaya Zemlya*).

In 1913, Andrey I. Vilkitsky was made full general in the Corps of hydrographers and was dismissed from service due to illness.

After the speeches a wreath and flowers were placed on the grave of Andrey I. Vilkitsky.

Hydrographic Society Benelux

Workshop on Dredging the River Vecht

The Annual General Meeting was held on 27 March, after a well-attended workshop on the dredging of the River Vecht. The main purpose of this work was removing pollution and debris from the river floor. Water-Net, Stema Survey and De Vries en Van de Wiel developed a new, more precise 3D dredging model, thereby saving money and the environment as a reduced amount of silt will need to be disposed of. Intensive surveying before, during and after the dredging job mapped the layer to be removed.

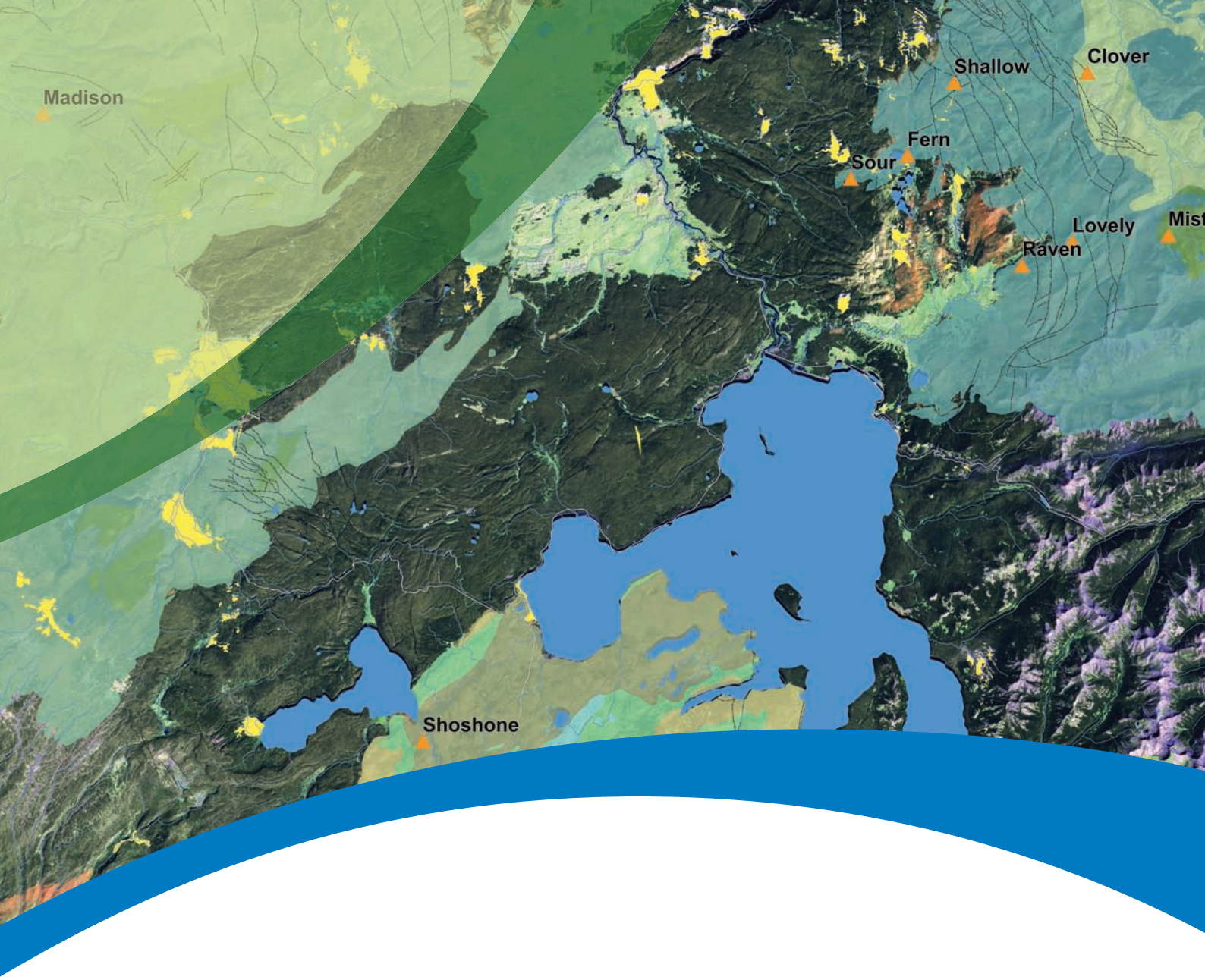
Periplus gave an insight into the archaeological aspects of the job. They gave an introduction on the various phases starting with an inventory pointing out potentially interesting features and areas, followed by a survey to find more detail. In doing so, wrecks, most of them small and recent, a couple of cars and the thresholds of a sea lock were found. In addition, a few old bombs from the Second World War and tools were secured.

Following these presentations, Auke van der Werf presented the awards for the best papers. Karel Epke (MIWB), graduated on a project commissioned by Allseas, presented 'Performance and Implementation of an INS for Pipeline Surveys', and Ravi Peters (Delft University of Technology) – graduated and now doing his PhD at the Delft University of Technology presented 'A Voronoi and surface-based approach for the automatic generation of depth contours for hydrographic charts'.

World Hydrography Day

The next workshop will be held on 21 June 2013, in Scheveningen, the Netherlands. The theme will connect with this year's theme of World Hydrography Day, namely, the Blue Economy. The programme is currently being established and will be available on the website of the Hydrographic Society Benelux in due course.

www.hydrographicsocietybenelux.eu



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Hydro Agenda

MAY

Hydrographentag 2013
Papenburg, Germany
→ 28-29 May
For more information:
W: www.dhyg.de/ht2013

SEE Congress & Exhibition on Energy Efficiency & Renewable Energy (EE&RE)
Sofia, Bulgaria
→ 29-31 May
For more information:
E: office@viaexpo.com
W: www.eeandres.viaexpo.com/en/exhibition

JUNE

WODCON XX
Brussels, Belgium
→ 03-07 June
For more information:
W: www.wodcon.org

MAST Europe
Gdansk, Poland
→ 04-06 June
For more information:
www.mastconfex.com

Energy Ocean International
Warwick, RI, USA
→ 10-12 June
For more information:
E: gsachs@accessintel.com
W: www.energyocean.com/attend/about/

OCEANS 13 MTS/IEEE BERGEN
Bergen, Norway
→ 10-13 June
For more information:
W: www.oceans13-mtsieeebergen.org/

EAGE
London, UK
→ 10-13 June
For more information:
W: www.eage.org/events/index.php?eventid=755

Brasil Offshore
Masaé, Brasil
→ 11-14 June
For more information:
W: www.brasiloffshore.com

Global Energy Career Expo
Aberdeen, UK
→ 12-13 June
For more information:
E: laurenceallen@dmgevents.com
W: www.globalenergy-careerexpo.com/aberdeen

TransNav 2013
Gdynia, Poland
→ 19-21 June
For more information:
E: transnav@am.gdynia.pl
W: http://transnav2013.am.gdynia.pl

Underwater Technology Conference
Bergen, Norway
→ 19-20 June
For more information:
E: stale.eiken@possibility.no
W: www.utc.no

Coastal Dynamics 2013
Arcachon, France
→ 24-28 June
For more information:
www.coastaldynamics2013.fr/

Seminar on Dredging and Reclamation
Delft, The Netherlands
→ 24-28 June
For more information:
W: http://www.iadc-dredging.com

Seawork International
Southampton, UK
→ 25-27 June
For more information:
W: www.seawork.com

JULY

Rio Acoustics 2013
Rio de Janeiro, Brasil
→ 24-26 July
For more information:
E: secretariat.rioacoustics@gmail.com
W: www.rioacoustics.org

AUGUST

33rd Annual Western Hemisphere Dredging Conference
Honolulu, HI, USA
→ 25-28 August
For more information:
E: weda@comcast.net
W: www.westerndredging.org

International Cartographic Conference
Dresden, Germany
→ 25-30 August 2013
For more information:
W: www.icc2013.org

International Seminar and Workshop on Hydrography
Batam Island, Indonesia
→ 27-29 August
For more information:
E: seminar@mhi.or.id
W: http://mhi.or.id/seminar

SEPTEMBER

RESON World Tour - Underwater Technology Seminar 2013
Shanghai, China
→ 01-03 September
For more information:
E: marketing@reson.com
W: www.reson.com/worldtour

Oceanology International China
Shanghai, China
→ 03-05 September
For more information:
W: www.oceanology-international.com/china

Offshore Europe 2013
Aberdeen, UK
→ 03-06 September
For more information:
E: natalie.booth@reedexpo.co.uk
W: www.offshore-europe.co.uk

Oceanology International China
Shanghai, China
→ 03-05 September
For more information:
W: www.oceanology-international.com/china

YOUMARES 4
Oldenburg, Germany
→ 11-13 September
E: info@youmares.net
W: www.youmares.net

OCEANS MTS/IEEE 2013 San Diego, CA, USA
→ 23-26 September
For more information:
W: www.oceans13-mtsieeesandiego.org

ADCPs in Action
San Diego, CA, USA
→ 29 September-02 October
For more information:
E: mnewcombe@teledyne.com
W: www.rdinstruments.com/aia2013.aspx

OCTOBER

Offshore Energy 2013
Amsterdam, The Netherlands
→ 15-16 October
For more information:
E: oe@offshore-energy.biz
W: www.offshore-energy.biz

Digital Hydrography on the Maritime Web
Southampton, UK
→ 29-30 October
For more information:
E: digitalhydro@ths.org.uk
W: www.digitalhydro.org.uk

NOVEMBER

RETECH 2013
Washington, DC, USA
→ 09-11 November
For more information:
E: smccollum@accessintel.com
W: www.retech2013.com

DECEMBER

IHO Hydrographic Commission on Antarctica (HCA)
Cadiz, Spain
→ 03-05 December
For more information:
W: http://bit.ly/UkkGOE

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

Hydro Alphabetical list of advertisers

Weaker without Hydrography

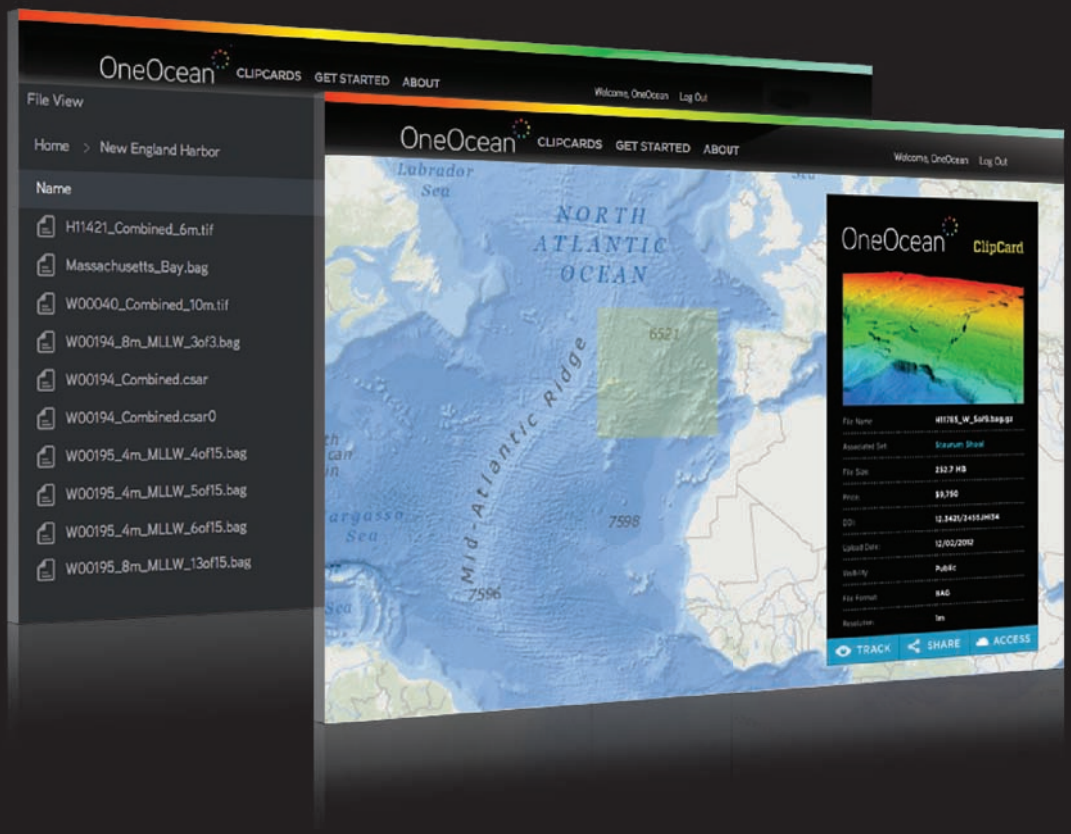
I've come to realise that explicit consciousness of hydrography's importance to the 21st century's world socioeconomic and environmental wellbeing resides with those involved professionally and academically with the discipline. This realisation is stark when, in discussions with the average person, the benefits of modern society are enjoyed without any awareness of hydrography's contribution, through safe navigation and support for ocean exploration and enjoyment, to the fulfilment of many of their needs. This is probably nothing new to many of you reading this article.

In developing and underdeveloped countries and regions, this lack of realisation can translate into under-funded hydrographic services, training and education. This is certainly the case in regions such as Africa and the Caribbean. In Western Africa, the International Federation of Surveyors' Commission 4 has taken steps, through its working group 4.5, Hydrography in Africa, to increase consciousness among government officials and decision makers so as to motivate increases of funding for hydrography and hydrography-related matters. The working group has engaged key stakeholders and decision makers in Nigeria and Ghana through a series of strategic meetings and workshops.

This lack of funding linked to the lack of realisation described above can hamper even the development of appropriate mitigation and adaptation strategies for climate change threats such as storm surges and Sea Level Rise (SLR), which are receiving much contemporary research attention. I'm part of a multi-million (Canadian) dollar socioeconomic vulnerability project, contributing GIS-based spatial SLR models to assessments of selected Caribbean coastal communities' vulnerabilities. For example, Bequia is a popular tourist destination with obvious links to the economic wellbeing of the island nation of St. Vincent and the Grenadines. Another project area, Grande Riviere (Trinidad and Tobago), hosts the densest nesting site of endangered leatherback turtles which directly impact the socioeconomic wellbeing of the community through tourism. Coastal topography at both sites makes them potentially vulnerable to SLR. Implemented socioeconomic impact assessments are enriched by the spatial impacts assessments. However, there is much difficulty in obtaining good quality long-term primary or secondary tidal data (used to input estimated mean sea levels into the models) for the project sites. The spatial impacts assessments are diminished by this lack of hydrographic data. Funding for obtaining additional hydrographic data is often contingent upon successful independent project proposals to international financial institutions or national governments. This can be a hard sell unless tied to other initiatives of more easily perceived national importance.

By implication, whether dealing with the adaptation and mitigation strategies that may be developed through the project, or in relation to the numerous 21st century benefits taken for granted, many hopes, plans and initiatives are weaker without hydrography. This consciousness ought to be continually impressed upon decision makers to ensure that hydrography-related activities receive adequate funding and recognition.

Dr. Michael Sutherland (Canada, and Trinidad and Tobago), chair (2011-2014), Commission 4, International Federation of Surveyors (FIG)



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