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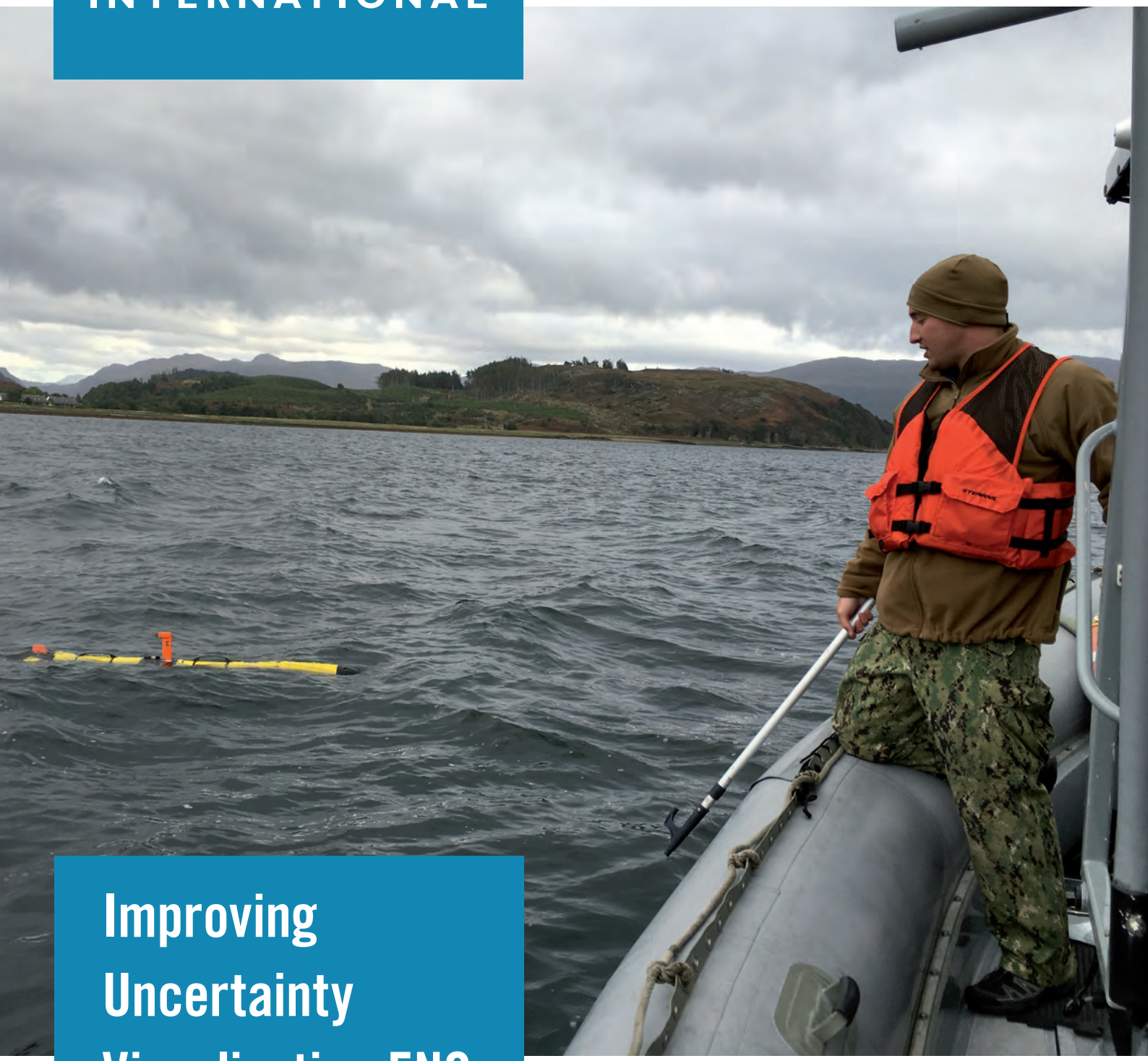
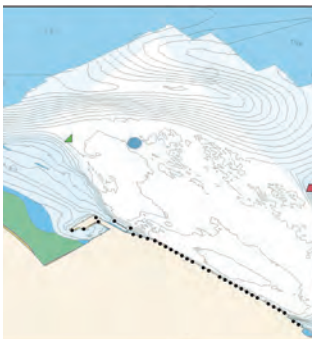
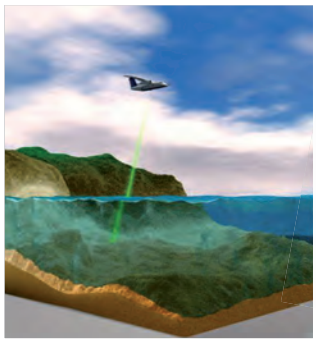


Improving Uncertainty Visualisation ENCs

CANDIDATES PRESENTING FOR IHO OFFICE

Ocean Business 2017 Preview





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Volume 21 #2

An OceanServer Technologies Iver AUV being retrieved from the water after a survey. AUVs are some of the technologies that are presented during Ocean Business in Southampton, UK from 4-6 April 2017. Image courtesy: OceanServer Technologies.

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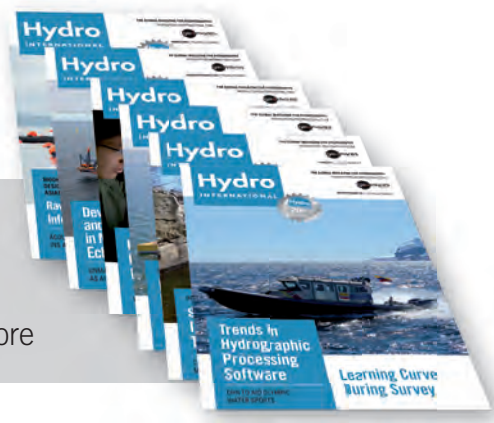

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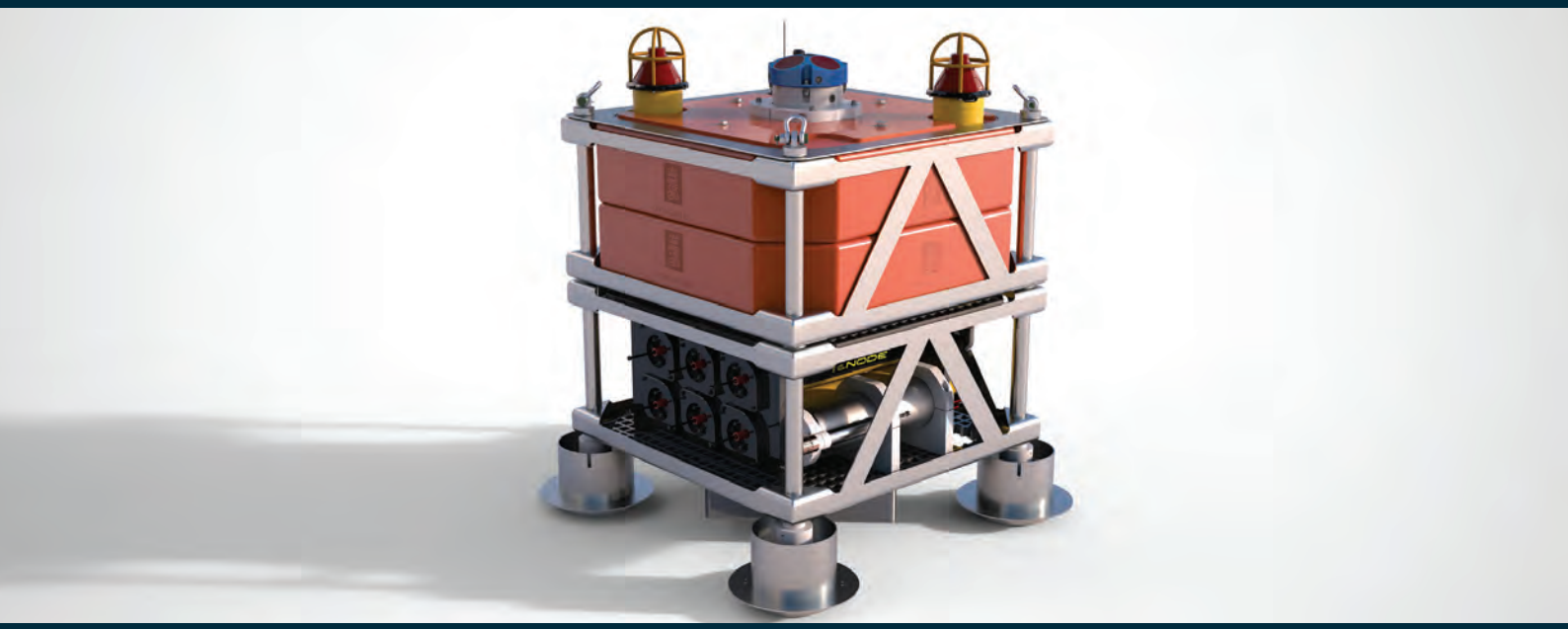

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Hydro INTERNATIONAL

Hydro International is an independent international magazine published 6 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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Fever

Election fever reaches boiling point more often these days, it seems, than in earlier days. Maybe because we've seen such crucial elections recently with a substantial impact in the world of politics as well as in global economics. For example, Brexit (not a real election, but a referendum) and the presidential election in the United States, but also elections in Europe: in the Netherlands, France and later this year in Germany. Without discussing the outcomes of all these elections and any related consequences, I only want to say that I always enjoy the election fever that precedes the final election day. The debates, live and on television, the long background features on the internet, in the newspapers and magazines, and the short messages on social media, I soak it all up.

As luck would have it, the hydrographic community is facing its own election this year. During the first IHO Assembly, taking place from 24-28 April in 2017 in Monaco, represented Member Sates will elect the new Secretary-General and Directors for the International Hydrographic Organization. There are nine candidates (at the moment of preparing this magazine as nominations still could be submitted): Mr. Gilles Bessero (France), Rear Admiral Carrasco (Chile), Commodore Mir Imdadul Haque (Bangladesh), Rear Admiral Mustafa Iptes (Turkey), Dr Mathias Jonas (Germany), Captain Abraham Kampfer (South Africa), Admiral (ret) Luiz Fernanndo Palmer Fonseca (Brazil), Captain (ret) Rafael Ponce Urbina (Mexico) and Captain Luigi Sinapi (Italy). Looking at the background of the candidates and their regions of origin, their experience and ideas, there's really something to choose. In this issue of *Hydro International* on page 10 and on our website www.hydro-international.com the candidates are all presented to you. They share their views on a number of hot topics within hydrography like expansion of the IHO, cooperation with private industry, developments in the field of the Marine Spatial Data Industry and more, brought together by our contributing editors Giuseppe Angrisano and Joost Boers. I really hope this article will contribute to the election fever and ultimately the election of the best candidate to serve hydrography and the worldwide community of hydrography professionals in the years to come. Good luck to all candidates!

A fever that feels a bit like election fever is one that the hydrography world suffers from when Ocean Business approaches. This biannual event will be taking place from April 4-6 at the National Oceanography Centre in Southampton, United Kingdom, and is this year's hub for the industry with more than 300 exhibitors and an expanded training and demonstration programme. Visitors will be treated to the traditional wine trail and there will be plenty of opportunity to meet up with each other and get familiar with all the new innovations in our business. The *Hydro International* and Geo-matching.com teams will be there to interact and catch up with you. You can find them at stand R4.

I am really looking forward to both events - the election of the new Secretary-General and Directors of the IHO and Ocean Business - and I am planning to suffer or rather enjoy the harmless fever that comes with them both. I hope you will as well.

Durk Haarsma durk.haarsma@geomares.nl

ALB Operations, Standards, Specifications and Stuff.

I commend the 'Technology in Focus: Bathymetric Lidar' article in this edition; it is right on the money. Amongst other things, it describes the crucial factors leading to a successful ALB survey as being water clarity management and the knowledge and experience of the operator. I wholeheartedly agree. Without doubt, one of the key success factors is an effective 'Turbidity Management Plan', as poor water clarity management is highly detrimental to effective ALB operations. Regarding the experience of the operators, it is now possible for almost anyone to lease an ALB system on a project by project basis, however this ad hoc approach creates significant project risk due to inexperience.

Later in the article, the term 'full insonification' is used with reference to the ALB coverage of the seabed. I think this acoustic terminology should be replaced with 'full illumination'. Confusion between electromagnetic and acoustic technology also occurs in specifications; for example, reference to 3 pings in an along-track and across-track direction. I remember this input was used to determine the speed to tow a side-scan sonar based on the acoustic horizontal beam-width and distance of the target. Apart from water clarity, the next most significant factor affecting the performance of an ALB system is the laser power; increasing ALB data density can be a poor trade-off when it comes at the expense of laser power, which is mostly due to the requirement of maintaining eye safety.

Another factor to consider is the data density required for target detection. Under suitable conditions (i.e. clear water), deepwater ALB systems can reliably detect 2m cubes (i.e. for IHO Order 1a surveys) to depths exceeding 20 metres using 2.5 x 2.5m laser spot spacing. Noting that ALB performance is highly dependent on laser power, and over specifying the data density for target detection can also be counterproductive.

The selection of the appropriate standard is also worthy of discussion. IHO Order 1a is designed for areas where under keel clearance and the existence of man-made or natural features is of a concern, however this standard often seems to be specified over general areas where under keel clearance is not a concern. Although for most MBES systems there is little difference between conducting IHO Order 1a and 1b surveys in shallow water, standards should be selected and specifications designed to meet the survey requirement and be independent of specific technology.

Coming back again to the Technology in Focus article, it also discusses deploying multiple ALB sensors in an aircraft, which is an increasing and beneficial trend. Deploying high-density shallow and high-power deepwater systems in combination enables the shoreline and shallow water to be captured in great detail and also provides continuous coverage extending to the deeper water. When high-density imagery is also captured, this

configuration is ideal for many applications in the coastal zone. Although these ALB systems are very capable tools in themselves, the ultimate solution is to combine these systems with MBES. The optimum approach is to deploy a combined shallow / deep ALB capability first to survey the coast and shallow water and identify all the dangers, and then employ MBES to survey the adjacent deeper waters, fill in any gaps in the ALB coverage, investigate critical shoals where required and collect data to higher standards in critical navigation channels and berthing areas. Vessels can also conduct the in-situ measurements, including geodesy, tides, tidal streams, navigation aids and seabed samples, and make observations to update the pilot. Now this approach is what our standards and specifications should encourage!

Mark Sinclair works for Fugro as the Service Line director Hydrographic Services Asia-Pacific. He is also a competitor in the 2018 Golden Globe Race.

Malaysian Hydrographic Society Holds First AGM

The Malaysian Hydrographic Society (MyHS) was officially registered on 26 February 2016. A pro-temp committee comprising seven people was elected during the first MyHS meet on 14 November 2015, which was attended by approximately 50 participants. The first annual general meeting (AGM) has recently been held at Universiti Teknologi MARA (UiTM), Shah Alam. At this AGM, which took place on 18 February 2017, 44 participants registered and cast their votes.

▸ *bit.ly/2m58Z2W*

▲ *The participants of the first AGM of the Malaysian Hydrographic Society.*

Most Shared

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

1. Pushing Lidar to the Limits - bit.ly/2m5bLoV
2. Video Footage of Robotic Subsea Snake - bit.ly/2m56CwY
3. High-resolution Structural Inspection of a Flooded Tunnel - bit.ly/2m58Ufs
4. Multi-purpose ENCs for Ports - bit.ly/2m59DgM
5. Technology in Focus: Acoustic Doppler Current Profiler (ADCP) - bit.ly/2m5s4le

21 Semi-finalist Teams Advancing in Shell Ocean Discovery XPRIZE

XPRIZE has announced the 21 teams representing 13 countries advancing in the USD7M Shell Ocean Discovery XPRIZE. This three-year global competition challenges teams to advance ocean technologies for rapid, unmanned and high-resolution ocean exploration and discovery. Their innovative approaches run the gamut: gliders and drones, underwater robotic swarms, autonomous underwater vehicles, robotics, artificial intelligence and massive computing platforms.

▸ *bit.ly/2m5lX0z*

Water Level Monitoring System for Dominica

OceanWise (UK) has been awarded a contract by the Government of Dominica for the supply, installation and maintenance of a water level monitoring system comprising two coastal sites, with potential expansion to a third site at a later date. The data is required to establish a vertical datum for Mean Sea Level (MSL) in the short term and to enable the refinement of this datum value in order to provide data for operational, planning and climatological purposes in the longer term.

▸ *bit.ly/2m5njYW*

Video Footage of Robotic Subsea 'Snake'

Eelume AS has released live video footage of its underwater intervention vehicles. With the support of Kongsberg Maritime as a development partner, the Eelume robot has presented itself as a snake-like vehicle designed to live permanently underwater and carry out underwater intervention tasks that would normally require the mobilisation of expensive surface vehicles for divers or launch and retrieve remotely operated vehicles (ROVs) or autonomous underwater vehicles (AUVs).

▸ *bit.ly/2m56CwY*

▲ *The Eelume robotic snake.*

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Teledyne RDI Citadel CTD-NV	http://bit.ly/TeledyneCitadel
Sea-Bird Scientific SBE 911plus CTD	http://bit.ly/Sea-BirdSBE
AML Oceanographic Minos•X CTD / SVP	http://bit.ly/AMLMinos
Sontek CastAway-CTD	http://bit.ly/SontekCastAway

Scripps Scientists Collaborate with Icelandic Coast Guard on Wave Study

Scripps Institution of Oceanography at the University of California San Diego, USA, is collaborating with the Icelandic Coast Guard (ICG) on a study of the extreme ocean surface conditions that characterise the waters off Iceland's coast. Scripps' physical oceanographer Eric Terrill and other scientists from Scripps first approached Icelandic officials with the concept of deploying a suite of marine instruments because of the unique ocean conditions that are found there.

▸ *bit.ly/2m5heM8*

Tugs to Be Equipped for Dredging and Surveying

Baggerbedrijf De Boer B.V. (Dutch Dredging B.V.) has ordered two custom-made, special-purpose tugs to be built at Damen Shipyards Hardinxveld in the Netherlands through the subsidiary De Boer Remorquage SARL. The larger of the two, the *WID 2915*, will be configured for a variety of roles including dredging using the Air and Water Injection Dredging (AIRSET) method. The smaller *ASD 2310 SD* (Shallow Draught) tug will be fitted out to operate the equipment needed for bed-levelling and will also carry out surveying activities.

▸ *bit.ly/2m5gW85*

▲ *The new tugs will also be used for surveying.*

First IHO Assembly to Elect Secretary-General and Directors

Candidates Presenting for IHO Office

During the first IHO Assembly taking place from 24 to 28 April 2017 in Monaco, the represented Member States will elect the new Secretary-General and Directors. At the time of preparing this issue of *Hydro International*, there were nine candidates. They will present themselves here by answering the same 5 questions. In this multi-interview, you find summaries of their answers – the full interviews are available at www.hydro-international.com/iho-2017. Any candidates nominated after closing of this publication for print will also be added there.

Some coastal states are not yet members of the IHO. How do you envisage improving the number of the IHO Member States?

Bessero I would continue to focus on raising awareness of governments and other decision-makers on the importance of hydrographic services in relation to their role in supporting the sustainable development of the blue economy (through MSDI) and in accordance with international obligations (SOLAS and UNCLOS) or commitments (UN 2030 Agenda).

Carrasco Today with the changes to the Convention, any United Nation Member State that is not an IHO member can become a member in a much less bureaucratic and faster way than in the past.

Haque The willingness of individual states is the key factor for applying the membership of IHO. Thus, I believe in increasing the number of IHO members through motivation / awareness. Thus, growing government eagerness of non-member states is the prime factor here. We should identify the causes of the non responsive attitude of the states. In this regard, information about unwillingness may be sought from local or regional UN offices, NGOs, IMOs, etc. Besides, IHO could take a diplomatic approach to get that information. A dedicated action plan is to be followed to convince the non willing coastal states to join.

Iptes I have a goal to reach 100 Member States for the centennial celebrations of the IHO in 2021. I will be proactive and visit decision makers of coastal states that are potential new members and also invite them to become full members of the IHO considering the simple and fast application process under the new IHO structure. I will mainly focus on Significant IMO Flag States that are not a member of the IHO (Panama, Liberia and other big Flag States).

Jonas Hydrography is an obligation of coastal states and the IHO is the competent organisation to assist here. This should be brought to the attention of the countries that are not yet a member. The request for marine data information beyond safety and efficiency of navigation is rapidly growing and IHO membership can help to set up such a marine SDI environment nationally as well as to associate regionally. Becoming an IHO member helps to improve national visibility within this framework and opens options of fundraising for capacity building measures via the well formatted IHO paths.

Kampfer The benefits of being a member should continuously be communicated during high level visits and technical advisory visits and that SOLAS obligations are best met through membership and active participation in the workings of the IHO. It is possible that the economic circumstances of a prospective Member State could be the major factor in the reluctance to commit to full membership and it should therefore be clearly communicated that the benefits gained through the capacity building programme will outweigh the membership contribution. Consideration should also be given to provide some assistance with the application process.

Palmer Fonseca Becoming IHO member coastal states will have a voice in the decisions of an organisation that deals with matters concerning their own interests at sea. Developing countries will be given special attention to receive support to improve their hydrographic capacities.

Ponce I am proposing to proactively engage and educate higher levels of government about the relevance of hydrography for their economic development. My commitment is to work with all, and particularly those considered 'smaller HOs' within their administrations, to elevate the hydrographic matters to the highest level of government possible, and unlock the hydrographic data potential to the benefit of their national economy and interests, and to build the bridges between well-developed HOs and those that require support to grow.

Sinapi Involve not just coastal states, because the sea is a crucial resource for us all. Promotional campaign led by the Secretary-General also through diplomatic channels. The UN Assembly, where the IHO is a permanent observer, has proved useful in promoting the organisation. Invite non members to attend the IHO Assembly and Regional Hydrographic Commissions (RHCs).

One of the main objectives of the IHO has, for a number of years, been to foster the hydrographic capabilities of developing countries. How do you envisage continuing and possibly improving the IHO's actions in this field?

Bessero The revised IHO Capacity Building (CB) Strategy adopted in 2014 provides clear directions. Increasing the resources (both in-kind and financial) allocated to the CB Work Programme (hence the importance of increasing IHO membership) and further developing the 'Deliver as one' approach with other international organisations are key factors. Assisting recipient governments in taking full ownership of the CB concept in their national interest is also essential.

Carrasco The Capacity Building Sub Committee and the IHO Capacity Building Fund, that started in 2002 and 2003, respectively, have

both initially had a very slow but strong development, aiming to fill strategic gaps with different mechanisms of great value to the IHO. The IHO Capacity Building Fund is an equation that involves potential donors and recipients with the IHO, and particularly the Capacity Building Sub Committee, acting as a bridge between both, to support and facilitate this action.

Haque The actions in fostering Hydrographic capabilities that would be taken are: highlighting the capacity building measures by managing more funds for hands-on training; developed countries may be requested to host hydrography-related training, symposium and seminars to developing countries. Pursue regional hydrographic bodies to foster more cooperation and encourage hydrographic equipment manufacturers to interact with the developing countries for enhancing their capabilities.

Iptes I have worked particularly hard to promote the IHO Capacity Building (CB) programme, the main asset to support the developing countries. I have worked intensively on increasing the level of external CB funds and CB budget. I will continue to improve the level of collaboration and cooperation within CB activities in order to meet training needs of developing states. I wish to enhance the good relationships of the IHO with donor States and funding institutions. I will also encourage and coordinate the large scale regional hydrographic projects which generally include developing states. In addition, I will improve the institutional relationship with global funding organisations, such as the World Bank and UN Agencies.

Jonas I propose to approach the Global Environment Facility, an international financial mechanism with a partnership of 183 countries, international institutions, civil society organisations, and the private sector for additional funding. Equally important to the educational aspect, are the technology and knowledge transfer element of capacity building. Joint activity of the public sector, academia and private industry might convince local politicians to become more supportive for hydrographic subjects on the whole. And there is another path to raise the general attention for hydrography: A series of lectures about the nature of our science and their applications to be held at IMO´s World Maritime University in Malmö, Sweden would directly address the world´s maritime leaders of tomorrow.

Kampfer Capacity building should be considered holistically. Awareness at high levels of government should generate support for the in-country officials. Strict adherence to the IHO Capacity Building Strategy to develop hydrographic capability in accordance with the three phases of Hydrographic Development is required. The provision of support and training should consider the current levels of development and be escalated only to the next phase once the required capacity and competence are established and maintained. Long-term progress could be achieved if IHO Member States consider including in-country support to fledgling Hydrographic Offices through attachment of survey and cartographic experts as a capacity building strategy. Such support does occur currently as bi-lateral activities.

Palmer Fonseca First by supporting developing countries to gain access to already available opportunities in well-established Hydrographic Services. A good example of such an initiative is scholarships for Category 'A' and Category 'B' hydrographic programmes for the South American and African countries at the Brazilian Hydrographic Service (DHN). Secondly, to enable the IHO to secure sustainable funds from donor agencies to regional projects in priority areas.

Ponce I will work to get people committed to fully engaging and developing their hydrographic capabilities from the conscience and knowledge perspective first and technology second, ensuring there would be commitment and continuity in their hydrographic programmes.

Sinapi Carry out the promotion of Maritime Capacity Building as a key element of a sustainable Blue Economy. This starts with education, from basic training to highly specialised skills. Develop an effective and financially sustainable strategic plan to be implemented also by the private industry and individual governments. I think that the IHO should encourage such projects.

In which way will you coordinate the relations with Organisations, Associations and Institutions and the UN Assembly in order to obtain support in meeting the IHO objectives?

Bessero I would be attentive to maintaining close personal contacts with the leaders of our partner Organisations, Associations and Institutions and to implementing actively, on behalf of the IHO, the relevant provisions agreed in the various MoUs, in particular when a periodic review is called for. I would also ensure that the Secretariat continues to be actively involved in relevant UN-led initiatives and fora.

Carrasco It is very important that the objective of each MOU is reached. A permanent follow-up of the relationship between IHO and the other relevant organisations must exist permanently. If occasionally the Secretariat cannot attend regular meetings, IHO representatives of each country can be invited to represent it.

Haque Best option is to highlight the achievements of the IHO in maritime affairs since its inception by presenting the facts and figures. At the same time existing limitations/ shortfalls/hurdles are to be brought forward so

▲ *Mr Gilles Bessero (France). Nominated for Secretary General and Director.*

▲ *Rear Admiral Carrasco (Chile). Nominated for Secretary-General and Director.*

▲ *Commodore Mir Imdadul Haque (Bangladesh). Nominated for Director*

as to obtain their assistance in this regard.
Iptes I will concentrate on outreach activities and raising awareness on the importance of hydrography and cartography and the role of the IHO at all international platforms. I will work on improving relationships with relevant international organisations (UN, IMO, IALA, IOC, ISA, WMO, GEO, OGC, etc.) in order to have better cooperation and obtain support based on common interest.
Jonas The new IHO council could serve as a forum where partnered organisations will regularly express their expectations towards IHO. IHO should form alliances with its allies to move it to the forefront of the global agenda and UN is the natural partner for it.
Kampfer The initiative to establish MOUs with Organizations, Associations and Institutions is welcomed and this practice should continue as this is an excellent method of creating awareness of the objectives of the IHO and obtain support in meeting those. It will also ensure that there is no duplication in efforts with similar capacity building initiatives. The IHO should however examine and re-prioritise from time to time to ensure that the efforts to be an active participant can be met within the limited resources available
Palmer Fonseca The IHO is instrumental in putting Hydrography in the agenda of all organisations related to the oceans, seas and waterways. The principle 'UN delivering as one' has been applied by the IHO with the IMO, WMO, IOC, IALA, IAEA and FIG when developing Capacity Building activities. Increase engagement with those key elements related to the UN Sustainable Development Goals (SDG), specially to the SDG 14 related to the oceans.
Ponce The IHO objectives need to be aligned and connected with the UN vision and strategy. The IHO's approach to the matters of ocean affairs and marine science activities has to be in harmony with the UN Sustainable Development Goals (UN SDG). If the IHO goals are aligned with the SDG14 (conserve and sustainably use the oceans, seas and marine resources), we would look at the risk assessment of navigation using the whole stack of information at our disposal, leveraging our relationships and agreements.
Sinapi It is fundamental for the IHO to take part in their most important meetings creating suitable Working Groups (i.e. IENWG – IHO-EU Network Working Group with the EU). Super-national organisations can directly contribute to the enhancement of the Hydrographic Offices in developing countries.

How would you deal with the private industry to optimise its contribution to the IHO?

Bessero I am convinced that the active participation of industry is key to implementing IHO objectives, including CB. I am all in favour of proactive interaction with industry at all levels of the IHO, while ensuring an even playing field in terms of contracting opportunities. Close partnership with international organisations representing the various industry sectors is essential, in particular, to develop suitable IHO standards.
Carrasco There is always room for improving relationships and also to speed up processes, keeping a permanent, transparent, responsible and loyal relationship, observing the best conduct codes, allowing a professional and confident interaction. Both, IHO and the Private Industry should feel proud and honoured by this joint work, each in its own field of competence, avoiding any misunderstandings between them, in order to fulfil the user requirements and expectations.
Haque I would prefer to request private industries to increase publicity through effective demonstration of their products to earn the confidence of the hydrographic community. They will be advised to provide some products 'on a test' basis. Later on, feedback reports from the users will to be published in international fora for better understanding and confidence building of their products.
Iptes I will encourage the invitation of the expert contributors to the relevant technical working groups. Regional Hydrographic Commission meetings and also appropriate platforms in which industry representatives provide valuable contributions to regional capacity building initiatives and have the opportunity for direct relations with the local hydrographers. I will also support Industry Sessions and informative briefings at relevant IHO meetings and also industry exhibitions in regional and global hydrographic conferences.
Jonas IHO is challenged to attract global providers of geoinformation by bespoke work items in standardisation and technology transfer as an element of capacity building. IHO´s contemporary offer is the cross sectorial standardisation of maritime data streams of all kinds based on one coherent technical concept. The second track is the acquisition of and access to the data itself: crowdsourcing by humans, means of flying, swimming and diving autonomous working measurement devices and information re-use – all are topics of commercial relevance. Geoinformation PI and IHO should federate their efforts on these fields.
Kampfer The participation by private industry in the various working groups of the IHO should be encouraged to continue. The participation by industry in Regional Hydrographic Commission meetings as observers will benefit delegates as they can be exposed to new developments and technologies. Noting the limited resources available in many regions to conduct hydrographic surveys and to produce the necessary products, available private industry data will greatly assist in improving safety of navigation in these regions if such data could be made available, especially in shallow navigable waters.
Palmer Fonseca. I support the continuous engagement with industry at all levels, from development of standards to promotion of best practices, support to Capacity Building, use and

▲ *Rear Admiral (Ret) Mustafa Iptes (Turkey). Nominated for Secretary General and Director.*

▲ *Dr Mathias Jonas (Germany). Nominated for Secretary General.*

▲ *Captain Abraham Kampfer (South Africa). Nominated for Secretary General and Director.*

re-use of hydrographic data and the broad relationship with all sectors of society. The IHO Secretariat will be the facilitator of this engagement that will benefit all stakeholders.

Ponce The private industry (PI) provides training and excellent capacity building programmes, plus their valuable contribution to technical working groups in developing new standards. The PI is a critical component to make the S-100 series of standards a reality. PIs have former HO employees in their staff, and these are the people that work with our organisation. I think is very important that Member States and the PI understand their interdependence; I would work with our members and the entire PI to exploit our synergies to its maximum potential for our mutual benefit.

Sinapi The private industry is a fundamental resource. The IHO – through the Secretary-General and the Directors – must use it wisely and for the best. Develop a proper framework to make data available to all stakeholders, for a variety of applications. An active presence of the private industry in the IHO working groups and conferences, benefits the data standardisation process and the development and employment of digital products.

How do you see the use of hydrographic data in a Marine Spatial Data Infrastructure by the general public beyond their use for ENCs?

Bessero The IHO encourages HOs to evolve towards a data-centric concept and connect their data to SDIs. In my view, the beneficiaries are all maritime stakeholders -including, but not limited to, mariners- who need the data to plan or conduct any activity on, in and under the sea.

Carrasco The main contribution of the IHO shall be the standardisation for the collection, compilation, processing, analysis and validation of the Hydrographic Data. Once all these steps are followed and achieved with high priority, IHO Member States would be in conditions to establish the best way to increase the wider use of its Hydrographic Data.

Haque The general public can use marine spatial data in the following ways: for harnessing Blue Economy; connected with the national spatial data infrastructures for having seamless use of the data; for economic benefit as well as amateur uses of the seas like tourism; conservation of marine life; pollution control operations at sea; coastal zone management and for disaster forecast, prevention and management.

Iptes Marine Spatial Data Infrastructures (MSDI) is the future of the hydrographic community. Many Hydrographic Offices are growing very slowly. I think MSDI activities should be emphasised at all platforms. Collected data should be used for multiple purposes in addition to chart production. In this regard, the collect data once, and use many times policy should be well understood and implemented broadly by the Member States. The MSDI Working Group has an important role to develop required capacity and I will closely observe and support all MSDI related activities.

Jonas Some Hydrographic Offices have already started their transition from a chart oriented approach towards a data-centric approach striving to become the leading marine geospatial service of their nation. They are encouraged to create new products by the demands of an emerging group of new stakeholders who have uses for maritime information far beyond travelling the seas. The future will see cloud-based data provision, smart presentation customised to specific themes of various user groups and autonomous shipping supervised by automated algorithms. We all are called up to meet the expectations of these groups to get easy and digital access to our engineer's knowledge of the seas and the IHO has to cope with this for the proof of their necessity.

Kampfer Hydrography is far more than making and distributing colourfully prepared charts, it is the core essential in the provision of Maritime Safety Information. Hydrographic Offices are involved in measuring most of the parameters of the oceans and seas, advising and servicing those that utilise these areas in so many other fields related to maritime transport, exploitation of maritime resources and environment protection. The lack of hydrographic data in various parts of the world and particularly in developing countries will become more evident and may encourage coastal states to invest more in improving their hydrographic services.

Palmer Fonseca Making data discoverable and available will enable the public to re-use data in all possible ways. It can be for oceanographic and meteorological modelling, tsunami alerts, coastal planning and management but also for products and services not envisioned by the Hydrographer. The IHO is also a key element to provide stimulus to a balanced development of regional and international MSDI initiatives working with other bodies.

Ponce The natural evolution of an HO is headed from a chart making agency to a true geo-spatial agency. The uses and number of hydrographic data users are growing exponentially and our organisation needs to be prepared to address them in a new 'seaconomics' era. Soon, the general public will have access to all this data, either through paid services or for free. As IHO Director, I would work tirelessly in evolving our organisation into the 21st century, fully embracing the geospatial world.

Sinapi An efficient Marine Spatial Data Infrastructure, supervised by the IHO and shared by Member States, ensures a wider use of data and a more efficient use of resources. It promotes knowledge of the marine environment, with a collective benefit. Copyright, cost recovery and data integrity should be carefully considered. ◀

▲ *Admiral (ret) Luiz Fernando Palmer Fonseca (Brazil). Nominated for Secretary General and Director.*

▲ *Captain (ret) Rafael Ponce Urbina (Mexico). Nominated for Director.*

▲ *Captain Luigi Sinapi (Italy). Nominated for Secretary-General and Director.*

Towards a Better Portrayal of Bathymetric Data Quality For Mariners

Improving Uncertainty Visualisation in ENCs

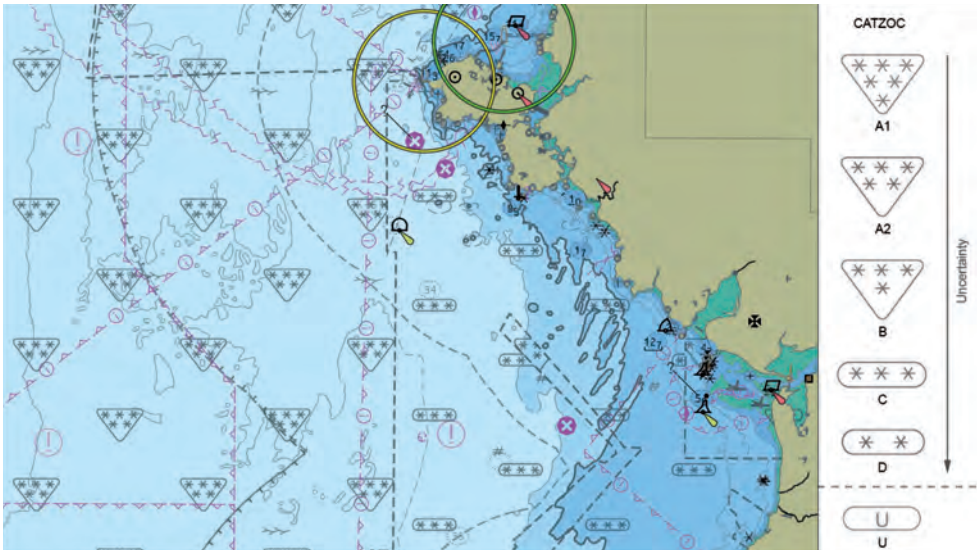
The visualisation of bathymetric data and associated uncertainty in electronic nautical charts is important when it comes to planning and monitoring a ship's route safely. However, a study confirmed that the current uncertainty representation is not very intuitive and does not provide clear orientation for mariners. To improve this situation, Fraunhofer IGD proposed novel visualisation solutions for the next generation S-101 ENC standard, which are summarised in this article.

Electronic nautical charts (ENCs) are common tools for safe navigation at sea. By providing information concerning water as depth zones, contours and spot soundings, they support mariners in planning routes, which maintain under keel clearance during the entire voyage. However, considering charted depths figures only for this task is not sufficient. Known or presumed uncertainties associated with the underlying bathymetric data must be taken into account too, as this may lead to critical deviations of the charted depths and the real depth at a certain position and point in time. The sources contributing to such uncertainty are well known. They include limited accuracy, resolution and precision of sensors, environmental influences like tides, wind, wave height or dynamic seabeds, as well as incomplete surveys of marine areas. To make mariners aware of the data imperfections and to increase the credibility and expressiveness of the ENC, a dedicated uncertainty visualisation is useful. This can facilitate informed decision-making and avoid running aground in the worst case.

Current Situation

Despite the fact that uncertainty visualisation is a well-researched area within information visualisation and cartography, visualising uncertainty associated with bathymetric data in ENCs has not been addressed sufficiently yet. Although a standardised solution for visualising the composite quality indicator 'Category of Zone of Confidence' (attribute CATZOC) exists in IHO's ENC standard S-52 (see Figure 1 for an example), a study by Harper et al. confirmed, that this kind of representation is difficult to understand for mariners and thus is rarely used. Moreover, it has been indicated that CATZOC itself has limited expressiveness. Consequently, the development of better quality indicators and visualisation techniques have been an issue for many years within the respective standardisation committee and working groups of the International Hydrographic Organization (IHO). After several iterations, IHO's Data Quality Working Group introduced a more comprehensive composite quality indicator called 'Quality of Bathymetric Data' (QOBD), which is going to become a standardised attribute in the next generation ENC specification S-101. QOBD categorises surveyed areas in one of the following classes: Quality_1 – Quality_5 (from low to high uncertainty), Oceanic (areas far offshore which are considered as adequately safe for navigation) and Unassessed.

The efficient visual representation of uncertainty including QOBD in ENCs is still an open research question. A major difficulty are ENCs themselves. They already represent a multitude of information in a complex way and utilise a large number of different visual communication channels. This does not only limit the possibilities of visualising uncertainty, it also makes it difficult to meet representation requirements like intuitive



▲ *Figure 1: Visualisation of CATZOC for a part of the Irish Sea according to IHO's ENC standard S-52.*

readability, consistency of the visual encoding and prevention of visual clutter as well as ambiguities. Fraunhofer IGD conducted a study concerning this issue in 2016 and proposed novel solutions in this regard, which are summarised below.

New ways of visualising uncertainty

Based on an in-depth literature review in the research areas of information visualisation and cartography, a large variety of existing techniques for visualising uncertainty were identified. To check their applicability, a list of requirements for representing uncertainty of bathymetric data in ENCs was compiled. For doing so, the ENC representation standard S-52 as well as previous work on this topic by IHO's working groups were examined. Important requirements are:

- Simultaneous representation of depths and associated uncertainty
- Avoidance of visual clutter
- Intuitive and unambiguous visual encoding
- Matching colours for the ECDIS modes day, dusk and night

By taking these and further requirements into account, Fraunhofer IGD made proposals with regard to three aspects.

It is not possible to visualise all individual aspects of uncertainty at the same time

Data pre-processing

In order to avoid visual clutter and information overload it is not possible to visualise all individual aspects of uncertainty at the same time. Instead, the representation of a quantitative or qualitative aggregation of aspects of uncertainty is proposed.

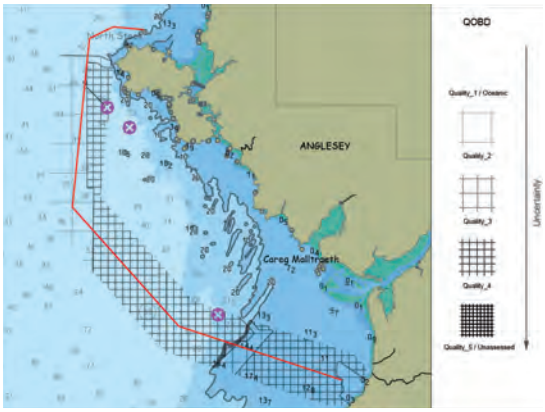
With a quantitative aggregation, the maximal deviation of a measured depth at a specific location (e.g., +/- 2m) can be described for a certain point in time. This deviation could then be visualised either in combination with the depths themselves, or in the form of corrected minimal depths. Although this approach would provide valuable information to mariners, it is still difficult to realize, especially the quantification of potential changes over time. This requires suitable and complex forecast models for dynamic seabeds, tides and wave heights which may not exist for many sea areas. When it comes to aggregate uncertainty in a qualitative way, there are many possibilities. However, it is not entirely clear, which information should be included and how they should be weighted. CATZOC and QOBD are two existing examples. Visualising such composite, qualitative indicators enable mariners to get a rough overview of existing uncertainty, but do not provide precise information. This can still be enough to decide in favour of or against a certain route.

Area of interest

Information concerning uncertainty of bathymetric data are typically required for certain areas of interest, not the entire map. This makes it possible to restrict the uncertainty visualisation locally, which in turn helps to avoid visual clutter. The area of interest depends on the use case. For route planning, it is a corridor along potential routes. In monitoring scenarios, nearby waters are of interest, for instance when a planned route must be left in case of an emergency. Thus, the visualisation should be confined locally to a circular region around the ship's position. The radius of this area should be calculated based on a reaction time set by the mariner and the current speed of the ship. Assuming a ship is travelling with 20kn and the reaction time is set to 30min, the radius of the circular area should be 10nm.

Visual Encoding

In the study by Fraunhofer IGD, novel concepts for visualising the qualitative indicator QOBD as well as an aggregated quantification of uncertainty have been developed.

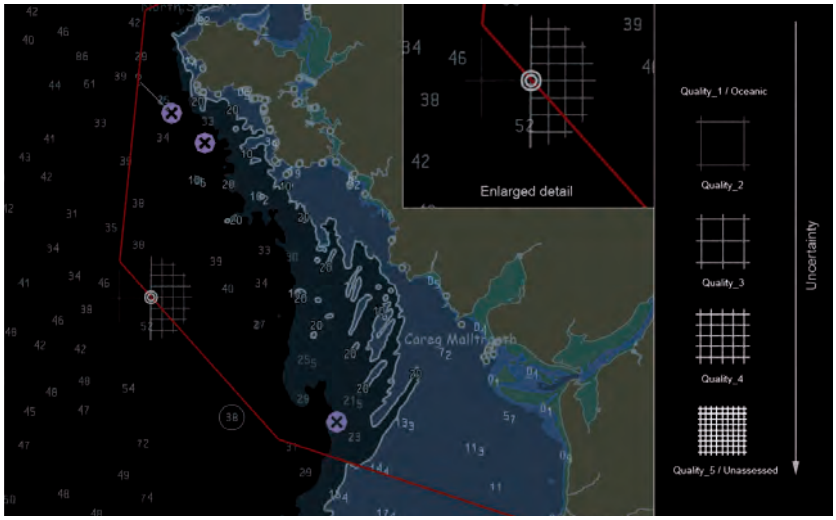


▲ *Figure 2: Visualising QOBD in a route planning scenario and ECDIS day mode via hierarchical texture overlay.*

For visualising QOBD, an optional ENC layer is added, so that bathymetric data, geo-spatial reference and uncertainty can be viewed together. For encoding individual QOBD classes, a hierarchical texture overlay with varying hierarchy level and transparency is proposed:

- Quality_1/Oceanic: 100% transparency, hierarchy level 0
- Quality_2: 75% transparency, hierarchy level 1
- Quality_3: 50% transparency, hierarchy level 2
- Quality_4: 25% transparency, hierarchy level 3
- Quality_5/Unassessed: 0% transparency, hierarchy level 4

As a basic assumption, Quality_1 and Oceanic as well as Quality_5 and Unassessed are



▲ *Figure 3: Visualising QOBD in a monitoring scenario and ECDIS dusk mode via hierarchical texture overlay.*

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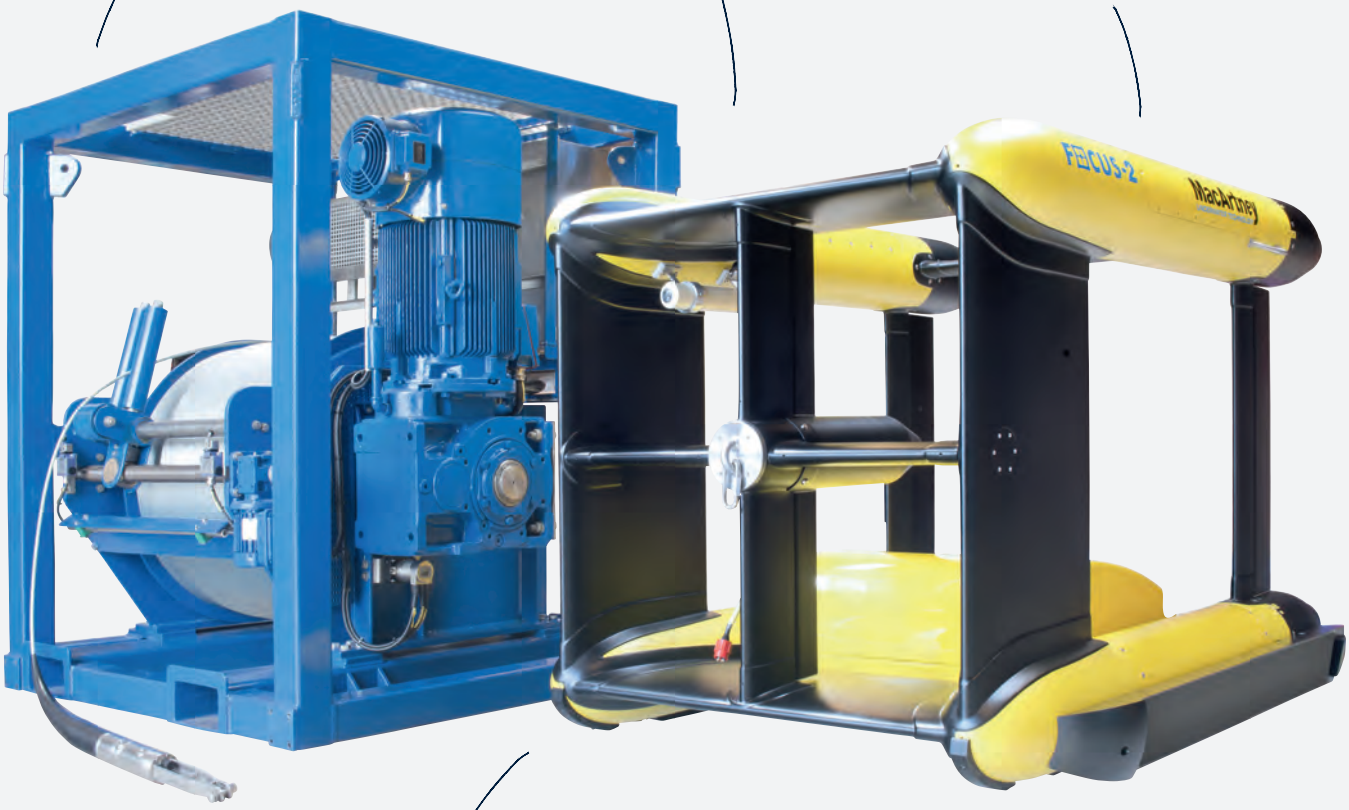

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visualised identically as they provide semantically similar information. The colour of the texture is selected depending on the current ECDIS mode. In day mode, black is used, whereas two different shades of grey are utilised in dusk or night mode. As a suitable type of texture, a regular grid is recommended. For further support of the visual separation of areas with different QOBD class, outlines are added. The overall impression produced by this kind of visual encoding is: the clearer the depth representation, the better the data quality. Figures 2 and 3 exemplify the visualisation for a fictitious route planning and monitoring scenario in ECDIS modes day and dusk. Since a classification of waters according to QOBD does not exist yet, the CATZOC classification was used as a basis for these images.

Assuming that the uncertainty can be quantified appropriately, the researchers propose to compute areas that are potentially unsafe for navigation (i.e., areas where the depth plus uncertainty may fall below the safety contour threshold) and to add a respective visualisation. The adaption of the safety contour to an area representation would be a suitable example. This would communicate additional information and increase the ENC's expressiveness. The thick grey line (area) on the bottom part of the route's corridor in Figure 2 gives an example.

With these solutions, Fraunhofer IGD aims to increase the safety when navigating at sea. For further details, the interested reader is referred to the original study. ◂

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Dr. **Mathias Jonas** is the National Hydrographer of Germany. Holding the chair of IHO´s Hydrographic Standards and Services Committee, he oversees the work of a total of nine technical standardisation working groups – including those responsible for the maintenance of ECDIS standards. mathias.
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How to Create and Maintain Them

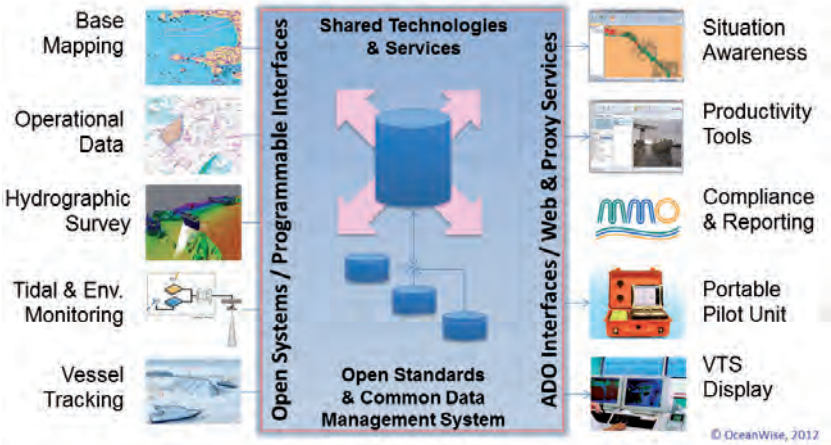
Multi-purpose ENCs for Ports

Ports require access to a wide range of data and information to function safely and efficiently, some acquired from external stakeholders but most generated internally within the port but very often managed and held within a single software application, department or business function. Streamlining how a port manages its data; by adopting a more data-centric approach, can bring major benefits. OceanWise has been working with ports for over five years and has pioneered the concept of a port, when considered more widely, as being a maritime information infrastructure.

There is nothing inherently wrong with managing and holding data within a single software application as long as processes are in place to control, quality assure and manage the life-cycle of this data. However, this often results in the creation of data 'silos' or 'stovepipes', which characteristically makes the sharing and exchange of data between departments and with external bodies difficult. As a consequence, port personnel spend more time than is necessary requesting, sending, reworking and reformatting data as well as running the risk of using data which is out of date or otherwise unfit for its intended purpose.

A maritime infrastructure is based on best practice data management principles and because much of the data that a port handles has a spatial context, it can be referred to as a Spatial Data Infrastructure (SDI), operating at an enterprise level. The key elements that underpin an effective SDI are data and metadata (data about the data), conformance to standards and specifications, Information Computer Technology (ICT) and governance of the data but also the people and organisations responsible for its development. Of these, data must be considered a key asset. The ability to share data between different applications is a key benefit of this approach. This SDI would typically encompass land and marine assets, as well as commercial and logistical components. By standardising how the data is structured and encoded and by making 'machine readable' the information it contains it will be more accessible and more easily understood by all users.

By developing this SDI, a port can consider its data and information as a centralised and valued asset, connecting disparate sources of data (e.g. sensors) thus making data processing and information exchange more effective whilst delivering business improvements to its stakeholders. This also means having a data policy and data management system in place which sits alongside and supplements other business management systems, such as for Quality, Environment, and Health and Safety. Whilst it is feasible to improve how ports manage their data and information without a data policy and management system in place, it does encourage high level buy-in and managerial commitment that is necessary for long-term success. Whilst there is presently no international standard for data management, similar to ISO 9001 for Quality Management, there is plenty of reference material and examples of best practice, including within maritime based organisations, to draw on (Figure 2).



▲ *Figure 1: Typical Port or Maritime Information Infrastructure (aka Enterprise SDI).*

Safety of Navigation

A very important role of a port is to ensure that safety of navigation within its area of jurisdiction is undertaken as effectively as possible by creating charts and other documents e.g. passage plans. These documents are then made available to key people, such as pilots and VTS operators but can also support wider maritime operations. They utilise the same or similar data sources that are used to undertake planning and other administrative tasks, and to comply with legislation. By extending the concept of the information infrastructure, selected documents can be made available to vessels entering the port and, for example, can be provided to pilots to use onboard vessels. One of the more difficult aspects of creating and maintaining safety of navigation documents is being able to locate and collate the input data

and then convert it into a form required by the target system e.g. Portable Pilot Units (PPUs). All this is achievable, with minimal investment, using existing open standards and systems and by adopting a data-centric approach.

Port and Bathymetry ENCs

Much of the data used in the creation of ENCs – and Marine Information Overlays (MIOs) or Dynamic Overlays – that can be ingested into off-the-shelf software, already exists within a port and is used daily for other purposes. This data includes the location and properties of coastal infrastructure, the location of dredged channels, including their target and surveyed depths, Aids to Navigation (AtoNs), and clearance, passage and berthing lines (Table 1). These are just a few examples where data are collated and maintained by a particular department e.g. estates, engineering and navigational systems and are used elsewhere for other purposes e.g. asset and facilities management. Initially, some of this data may need to be migrated from legacy systems e.g. CAD, spreadsheets and paper formats, but this is a one-off task, and should be part of an IT Systems modernisation programme.

Centrally Managed Type	ENC Object Class Feature Description
Bollard	Mooring/Warping facility
Obstruction	Obstruction
Berth	Berth
Aid to Navigation	Buoy, …; Beacon, …; etc.
Dredged Box	Dredged area

Table 1: Typical data stored centrally mapped onto ENC object classes.

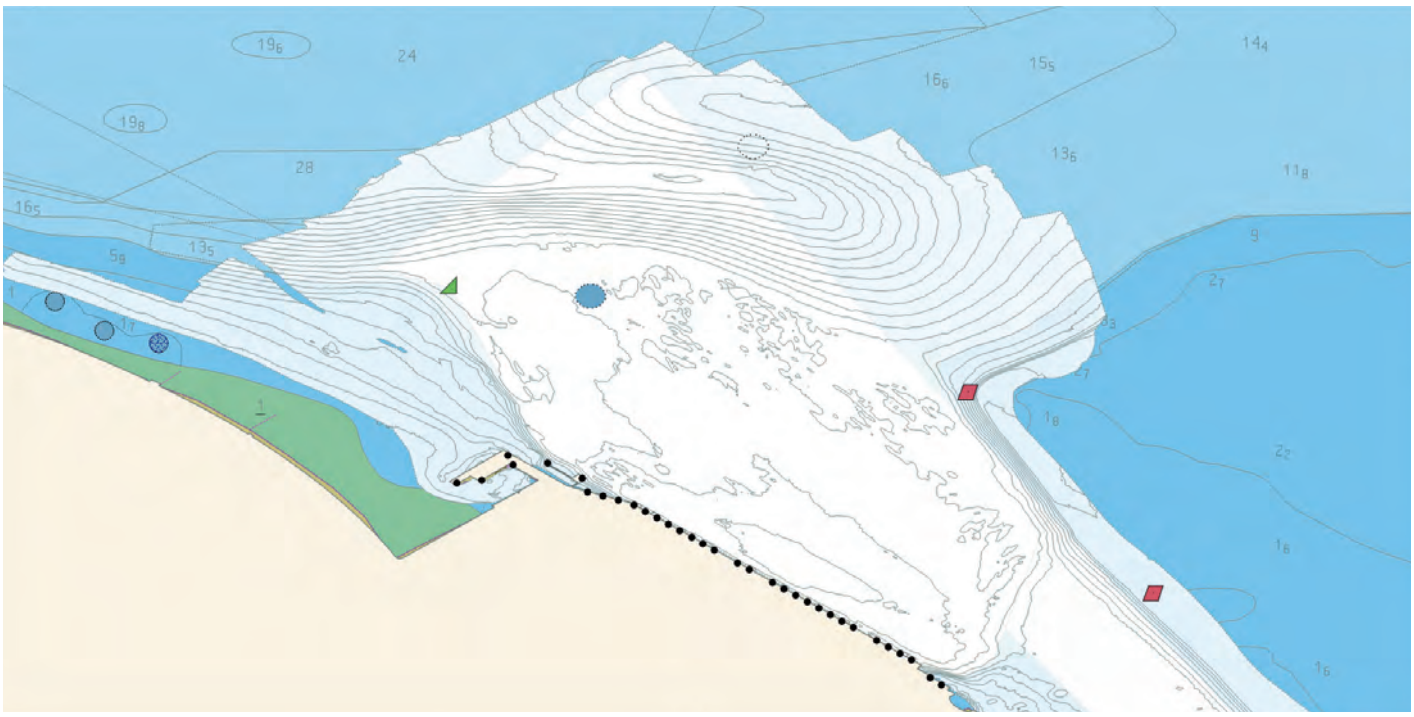
Internal to Official ENCs

By managing data centrally and ensuring the required characteristics (or attributes) and metadata are maintained and remain accessible, means that the actual generation and validation of Bathymetry and Port ENCs becomes straightforward using readily available software tools such as OceanWise' Maritime Toolbar ENC Writer Extension (Figure 3) to easily create the ENC. But why stop there? It is often the case that official ENCs for safety of navigation within the port environment lag behind or contain insufficient information to be of use to anyone other than the casual or recreational user. Even where the HO has invested in developing dedicated procedures to update official charts from hydrographic surveys provided by the port, the whole process – from survey to ENC update - takes several weeks. This is too long for a modern port requiring a 24-hour turnaround, and arguably too long for most other users too.

A maritime infrastructure is based on best practice data management principles

▲ *Figure 2: International Data Management Association (DAMA) Wheel modified by OceanWise.*

The first step for a port therefore is to streamline the exchange of data with the HO. This may mean providing the elements of the official ENC that the port is best placed to manage at source - a fundamental principle of good data management - to the national HO. This could include port maintained objects such charted depths, controlled areas, AtoNs, and passage-related objects such as passage lines. The exact list of objects, timing and other details, and how these objects relate to similar



▲ *Figure 3: Example of a Port ENC created using the Maritime Toolbar ENC Writer Extension.*

objects within adjacent and smaller scale ENCs can be agreed and documented in a data protocol between the port and national HO.

There is no technical reason why a port cannot create, maintain and publish its own 'official' ENCs. Many ports have their own producer codes issued by the International Hydrographic Organization (IHO) and, for those that do not, a straightforward application process exists. Indeed, a code is mandatory to publish any specification of ENC and therefore can also form the basis of publishing uniquely named ENCs via the Regional ENC centres. However, it would not at the present time be sensible for a port to publish official ENCs that replicates the function of the national HO. It is suggested that an agreement is reached for a port to work with the national HO to streamline this important function.

Conclusion

Improving how data is managed and being able to access it for multi-purposes becomes an integral part of how a modern or 'smart' port should operate in the future. This includes using the same sets of data for multiple purposes, including the creation of ENCs for internal use by pilots and VTS centres, and exchanging data easily and efficiently internally and externally. The step to publishing official ENCs is now within the grasp of most modern ports.

However, this step should be undertaken with care and by working with national HOs, so the strengths of both organisations are presented to mariners and other users in innovative and fit-for-purpose products and services. ◂

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Dr **Mike Osborne**, managing director of OceanWise, is an oceanographer and marine data specialist. He worked in the oil & gas sector as a consultant across the world before heading up the informatics operation at Metoc Ltd. He set up OceanWise in 2010 as an independent marine data management company providing specialised data products and services and data management advice and training.

John Pepper is marketing director at OceanWise. He trained as both a land and hydrographic surveyor and has 40 years' geospatial experience working in the UK and overseas with Ordnance Survey, DOS and UKHO. He specialises in data collection and management, planning, policy and strategy, training and marketing. He joined OceanWise in 2011.

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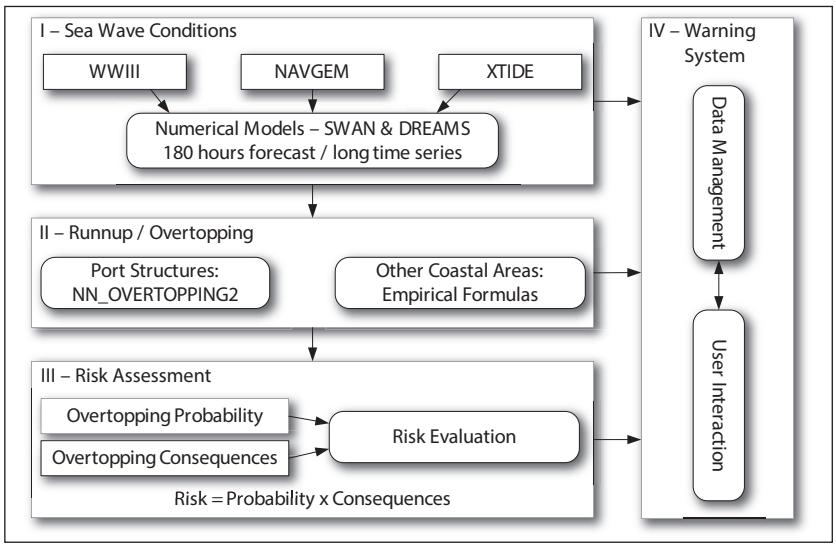
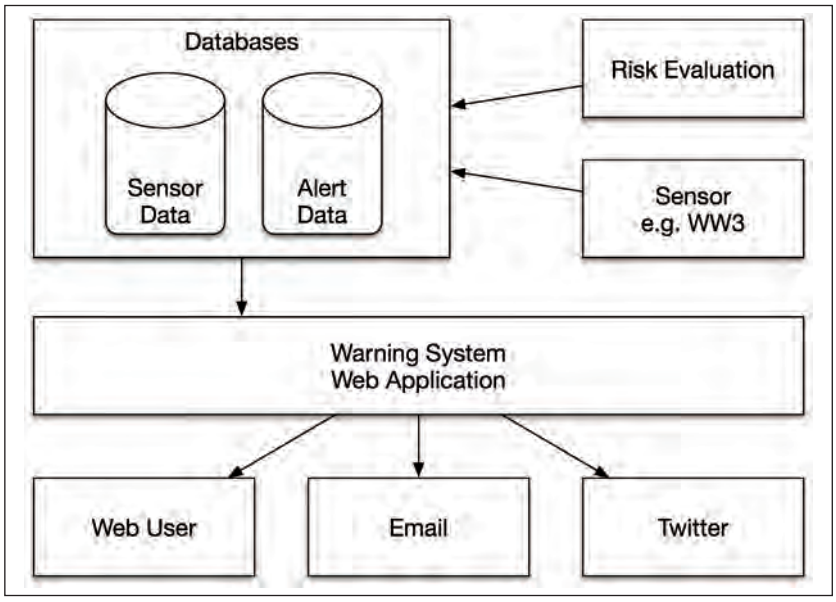
Coastal and Port Risk Forecast and Warning Platform

HIDRALERTA

In Portugal, emergency situations caused by sea waves are common, and usually have serious consequences for the economy and society. It is thus crucial to implement an early warning system to forecast the occurrence of these situations in relation to wave overtopping and flooding events in coastal/port areas. The European Framework Directive 2007/60/EC of 23 October 2007 recommended the development of risk maps and flood risk management plans, including the establishment of systems of forecasting and early warning. The national and local authorities need to implement short-term/emergency measures to prevent the loss of lives and reduce economic and environmental damage.



▲ *Figure 1: Overview of the HIDRALERTA System.*



▲ *Figure 2: The HIDRALERTA Web Architecture.*

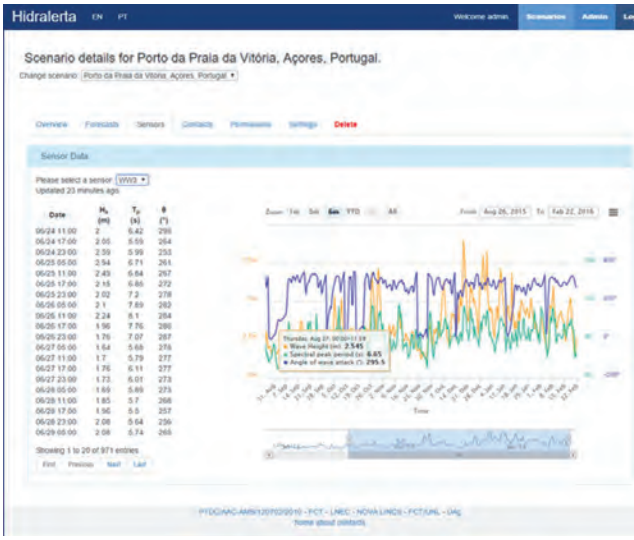
HIDRALERTA is a forecast and early warning system for coastal and port regions capable of predicting emergency situations, as well as carrying out risk assessment. The system concentrates on evaluating wave overtopping and flooding scenarios. It uses offshore sea wave and wind forecast data, as well as tide data, as input to determine wave overtopping at specific locations. This is done through the use of numerical models, artificial neural networks and empirical/semi-empirical formulas.
The values of the mean overtopping discharges per metre length of the overtopped structure are at a later stage compared with pre-established admissible maximums, enabling:

a) Real-time evaluation of emergency situations and issue of warnings addressed to the relevant coastal/port authorities, whenever the safety and/or integrity of people, property or activities are at stake;
b) Risk map production, considering long sea wave forecasting time series or pre-established scenarios associated with climate change and/or extreme events.

The HIDRALERTA system is composed of four modules developed in Open Source Web Technology, mainly using the Python Language. These modules are briefly described below (see Figure 1):

1. Sea wave characterisation, obtains the sea wave conditions from numerical models for sea wave propagation;
2. Wave overtopping determination, where, based on the wave characteristics and structure geometry, either an artificial neural network tool predicts mean wave overtopping discharges, or empirical formulas are used to evaluate wave run-up/overtopping;

▲ *Figure 3: HIDRALERTA warning system - mapping interface.*



▲ *Figure 4: HIDRALERTA warning system – analysis interface.*

3. Risk assessment, defines a risk level for the predicted mean overtopping discharges;
4. Warning system, integrates all the information and is responsible for early warning dissemination.

The Warning System (Figure 2) can be configured and adapted for specific scenarios and is made available via the Web. The design of the system considered the following adaptability conditions:

- Flexibility in evolving data sources: the system may need to generate results from different data sources, as availability conditions change;
- Automatic integration with the risk assessment component;
- Semi-automatic scenario generation and availability: each case study can be made available as a particular configuration;
- Dissemination strategy: Actors/stakeholders are profiled and the granularity of the configuration takes into account the hierarchical importance of the actor, as well as the region he/she represents (e.g. national, regional or local stakeholder).

The warning system persistently stores all data; mainly sensor data and risk assessment results. These data can be analysed in several media, using mapping or graphical support (Figures 3 and 4, respectively). Moreover, all emergency occurrences are logged and can be reviewed whenever required (Figure 3).

Case Study: Port of Praia da Vitória, Azores

The HIDRALERTA platform has been successfully tested for the Port and Bay of Praia da Vitória, Terceira Island, Azores, Portugal. The port is the second largest in terms of ships and goods movement and is located on the east coast of Terceira Island (Figure 5), one of the nine islands of the Azores Archipelago. The protection of the bay is supported by the northern breakwater, built to protect the port facilities of the Lajes airbase, and the southern breakwater, intended to protect the commercial sector and fishing port facilities. A marina was built at the location of the former fishing harbour taking advantage of the shelter provided by these breakwaters. The port basin is approximately 1km by 2km.

Given the forecast complexity of some of the phenomena studied in the HIDRALERTA project and the requirement to calibrate the numerical models, a validation tool was developed and integrated into the platform. This tool enabled the visualisation and comparison of data measured by the Praia da Vitória buoy with the HIDRALERTA forecast for the same location. Furthermore, the tool allows the comparison of historical data through a dynamic graph (Figure 6).

The system was tested during the winter of 2015/16. During this period, the HIDRALERTA team monitored the North Atlantic Sea and analysed the system's response in terms of wave forecasting, wave propagation to Terceira Island, wave adaptation to shallow waters and wave propagation to the bay, and finally, wave

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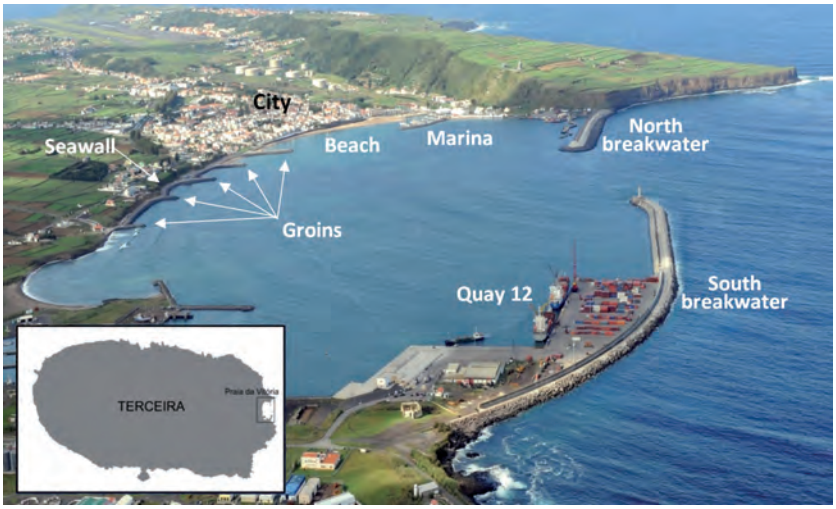

▲ *Figure 5: Aerial view of Praia da Vitória port and bay.*

overtopping occurrences. Each 24-hour period the system automatically generated a new 24-hour forecast as well as a 72-hour forecast.

Conclusion

The HIDRALERTA team was able to provide effective support to local authorities during the passage of Hurricane Alex in the Azores on 15 January 2016 (Figure 7). The daily reports sent to the authorities in Praia da Vitória enabled the following:

- To predict the possible occurrence of storms with overtopping potential 72 hours in advance;
- To identify computational system problems which could delay or invalidate forecasting;
- To validate the system in terms of overtopping occurrence and magnitude through the feedback given by local authorities;
- To develop communication channels and to establish an active bridge between science, government and society.

HIDRALERTA identified the low pressure system that originated the hurricane as early as 7 January. The system is now also being deployed on the beach of S. João da Caparica, in Costa da Caparica (south Lisbon area), also in Portugal.

Acknowledgements

The authors acknowledge the financial support of the research projects HIDRALERTA (PTDC/AAC-AMB/120702/2010) and M&M Ships (PTDC/EMSTRA/5628/2014), funded by the Portuguese Foundation for Science and Technology (FCT). Pedro Poseiro PhD studies are also supported by FCT, research grant SFRH/BD/97193/2013. ◀

▲ *Figure 6: HIDRALERTA warning system – validation tool.*

▲ *Figure 7: Praia da Vitória port during Hurricane Alex (15 January 2016)*

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✉ jfortes@lnec.pt

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✉ treis@lnec.pt

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✉ pposeiro@lnec.pt

Hands-on Update on Ocean Technology – Science and Business

Ocean Business
Ready for Business

The bi-annual event Ocean Business is coming to the NOC, Southampton from 4-6 April 2017. Three days of ocean technology engineering and science, knowledge sharing, hands-on training and demos as well as networking. The exhibition space is completely sold out, including more than 340 exhibitors. A selection of the businesses represented give a taster of their innovations in this preview. Better still, of course, is to come and see and experience for yourself!

Ocean Business is more than just a trade show. There will also be seminars, workshops by suppliers, a general conference as well as a conference organised by the NOC. A B2B Matchmaking event is scheduled for Wednesday 5 April. For the younger generation, the Ocean Careers Programme is another 'not to be missed' part of the exhibition. Side events are being organised by IMarEST & MLA, the Marine Alliance and Jerico Next. The Hydrographic Society UK will be organising its AGM during the days. For additional information and free registration, go to *www.oceanbusiness.com.*

▲ *Ocean Business has a reputation for building relations and exchanging hands-on information.*

Applanix

Applanix Corporation, a wholly-owned subsidiary of Trimble, designs, builds, delivers and supports products and solutions designed specifically for the hydrographic survey industry. Even in the harshest marine environments, our products and solutions provide robust, reliable and repeatable positioning and motion compensation solutions from moving boats and vessels. Marine-based mobile mapping and positioning with Applanix technology cuts costs associated with marine surveys and it also delivers tremendous accuracy.
www.applanix.com, K13

Appanix POS MV Surfmaster SFF.

Applied Acoustics

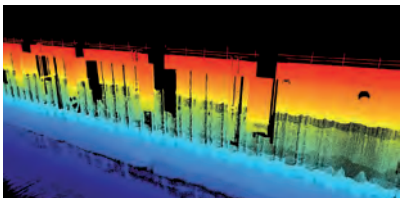
Applied Acoustics will be introducing its latest USBL positioning system the Nexus Lite in Southampton alongside its big sister, Nexus 2, that was launched in London only last year. As with all systems designed by Applied Acoustics, the highly advanced positioning and tracking system is quick to deploy with easy set up procedures and can be used with a variety of Applied Acoustics' positioning beacons, legacy products and transponders from third party manufacturers. It has bi-directional Sigma spread spectrum acoustics, 8 target tracking and a small surface console mounted within just a 1U enclosure for connection to a laptop or tablet PC.
www.appliedacoustics.com, Q1.

Applied Acoustics Nexus Lite with Transceiver.

Bibby Hydromap

Established 20 years ago, in 2017 Bibby HydroMap are celebrating their anniversary at Ocean Business and will be hosting a range of

events, activities, and competitions to mark the occasion. Firstly, they will be introducing their new Teledyne Blueview BV5000 and describing their experience in using the system for port, harbour and inland waterway inspection, along with data examples. Secondly, BD manager Michael King will be presenting on our advances in the field of ferrous and non-ferrous UXO surveying using a range of survey sensors and deployment techniques. Their 20th Anniversary drinks and nibbles reception event will be held on Wednesday 5 April, before the Gala Dinner, on their stand Q8. For further information on any of these events and registration information please email heather.carrigher@bibbyhydromap.com.
www.bibbyhydromap.com, Q8



Bibby HydroMap offers a wide range of survey and offshore services.

develogic

develogic developed a new ECB.PopUp System – an expendable communication buoy. These popup data ferries are ideal for transporting data from subsea installations to the customer's data network without the need of installing a surface relay system or paying regular visits in order to download data. One launcher holds up to 6 units. The launchers are also daisy-chainable. The release of popups can be triggered based on a programmable schedule or by threshold violations in the logged data itself. As the ECBs are equipped with GPS and LED strobe light, they can also be easily recovered at the surface. The ECBs are available with 2,000m or 6,000m depth rating. develogic will show these and other systems at the Ocean Business 2017. During four training and demonstration sessions visitors will be able to have an insight on the ECB.PopUps as well as modular seafloor landers and a compact gateway buoy.
www.develogic.com, E2

CSL Lander Deployment.

EdgeTech

EdgeTech designs, manufactures and sells industry-leading side-scan sonar, sub-bottom profilers, bathymetry systems and combined sonar systems. Additionally, the company produces world-class underwater actuated and transponding solutions including deep-sea acoustic releases, shallow-water and long life acoustic releases, transponders, reliable USBL acoustic tracking and positioning systems, and custom-engineered acoustic products. From 4-6 April 2017 at Ocean Business in Southampton, UK, EdgeTech will be showcasing the new 2300 mid-to-deep water combined sub-bottom profiler and side-scan sonar system (with optional bathymetry). The 2300 will be on display at the EdgeTech stand.
www.edgetech.com, B9.

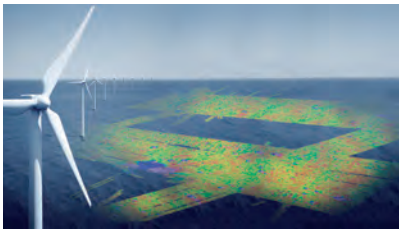
The EdgeTech 2300.

Geo-matching.com

Geo-matching.com offers a complete overview of sonar and echosounders, positioning and navigation solutions, subsea and surface vessels, hydrographic software and more. With direct access to accurate and up-to-date technical specification lists, manuals, videos and case studies, Geo-matching.com should be your first port of call when gathering technical product information. The search filters make it easy for you to select products that fit your requirements. You can compare up to 4 products at a time and export the data in PDF format if you wish. This significantly reduces the time spent on preparing product surveys for your projects. Moreover, Geo-matching.com connects you with manufacturers and suppliers worldwide to further support your project needs.
www.geo-matching.com, R4

Geosoft

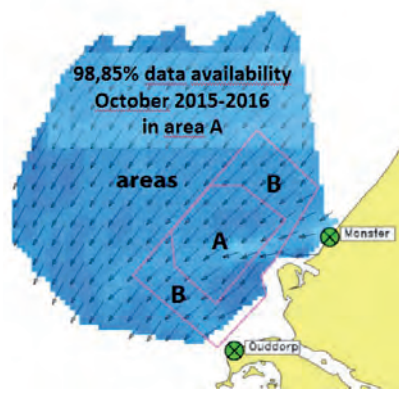
Geosoft provides state of the art mapping and data visualisation software for the analysis and interpretation of subsurface geoscientific data. In the underwater environment, Geosoft Oasis montaj is widely used as a platform for handling large volumes of magnetic data in the geophysical survey and investigation phase of marine construction projects. Application of the software can help to detect and locate UXO, buried cables and pipelines, and offer clearer insight to new archaeological sites and ocean contamination. Geosoft will host a demonstration session to showcase the latest UXO Marine tools and workflows with some case studies presenting the wider uses of Oasis montaj. Geosoft is also hosting an introductory level Oasis montaj and UXO Marine training course in Southampton from 2-3 April. For full details on these events and how to register, please contact Lorraine Godwin, Global Business Director, at Lorraine.Godwin@geosoft.com.
www.geosoft.com, G8



UXO surveys are required when establishing wind farms.

HELZEL's WERA HF Ocean Radar

HELZEL Messtechnik's ocean radar 'WERA' provides high-quality ocean current maps for ranges of >200km offshore. WERA provides maps of significant wave height as well as directional wave spectra within 50% of the current mapping range. Why rely on single point measurements (buoys) when you can have access to area-wide data with the convenience of land-based instruments? The high-resolution current maps resolve even sub-mesoscale surface current structures. Diverse comparisons of surface currents measured by WERA with subsurface currents (ADCPs) as well as drifters show an excellent correlation. Combination of the real-time WERA data with numerical ocean models offer opportunities to improve the accuracy for oil spill drift prediction and search & rescue operations. This shore-based technique offers the best price performance ratio compared to other ocean sensing instruments.
www.helzel.com, W36

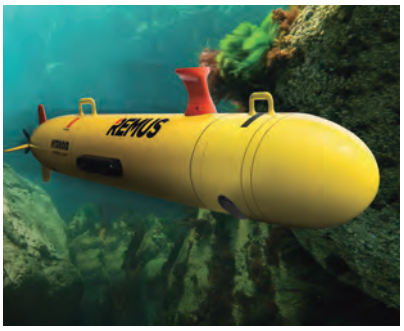


WERA Data availability.

Hydroid

Located in the US and a subsidiary of Kongsberg Maritime, Hydroid is the world's most trusted manufacturer of advanced Autonomous Underwater Vehicles (AUVs). Our Marine Robotics systems provide innovative and reliable full-picture solutions for the marine research, defence, hydrographic and offshore/energy markets. Our products represent the most advanced, diversified and field-proven family of AUVs and AUV support systems in the world.

www.hydroid.com, P1



Hydroid Remus AUV.

Hydro International

Hydro International started out as a print magazine in 1996 and soon developed into a the multimedia platform it is today, featuring a successful website and respected weekly e-newsletter. The magazine is international in scope and focuses on bringing to its readership topical overviews and the latest news and developments in the technology and management of hydrographic activities. *Hydro International* seeks and publishes the opinion of leading hydrographers on the state of the market, technical issues and national and international policies.

www.hydro-international.com, R4

Kongsberg Maritime

Kongsberg Maritime will showcase the innovative 'Eelume' swimming robot on its stand. With its slender and flexible body, the Eelume robot provides access to confined areas that are difficult to inspect with existing technology. Eelume robots will be permanently installed on the seabed and will perform planned and on-demand inspections and interventions. The solution can be installed on both existing and new fields where typical jobs include: visual inspection, cleaning, and adjusting valves and chokes. These jobs account for a large part of the total subsea inspection and intervention spend. Alongside the ground-breaking, disruptive Eelume technology, Kongsberg Maritime will also show a cross-section of its diverse subsea technology portfolio. De facto industry standard systems from the company's camera, subsea transponder, sonar & echo sounder and AUV product lines will all be on show, making Kongsberg Maritime's stand a must-see for visitors.

www.km.kongsberg.com, N1-P2

Eelume underwater robot on the shore.

Leica Geosystems

Leica Geosystems airborne Lidar sensors for hydrographic survey collect combined data for bathymetry and topography. For nearshore surveys, the Leica Chiroptera II collects seamless data from water to land with up to 25 metres water penetration. When fitted with the Leica HawkEye III deep bathymetric module, the survey water penetration can be increased up to 50m with the highest possible efficiency. The airborne Lidar sensors are equipped with the Leica RCD30 high-resolution 80-MP camera, enabling RGBN colouring of Lidar point clouds, as well as production of ortho image mosaics in RGB or CIR. The turnkey Leica Lidar Survey Studio software allows simultaneous processing and quality assurance of all sensor data. Users can quickly create coverage plots, check accuracy, check point density, 3D visualise the data as well as review and extract Q/A reports.

www.leica-geosystems.com, V19

Leica Geosystems Hawkeye.

Marinestar GNSS

Marinestar high performance positioning products and services delivered to you by Fugro Satellite Positioning are able to meet a varied range of applications in dredging & marine construction, wind farm installation, cable lay, naval and hydrographic/oceanographic surveys. Marinestar services deliver up to 8cm (vertical, sigma 2) accuracy in high availability using eight overlapping L-band satellite beams. With GPS, GLONASS, Beidou and Galileo constellations (at customer choice to combine) redundancies as well as precision gains are made available. Our most recent development is the fixing of ambiguities of the GPS constellation leading to the G2+ or G4+ L-band service. Our redundant infrastructure and 7x24 global customer service makes this precise positioning service the tool you need.

www.fugromarinestar.com, V13.

Marinestar is using multiple constellations.

Meet MMT

MMT is exhibiting at Ocean Business. You will have an opportunity to listen to their presentation at the Ocean Business 2017 training and demonstration programme on Wednesday 5 April at 12 noon on the topic: 'Geophysical, geotechnical, environmental, UXO and advanced ROV surveying'. Pop by MMT's stand and do not miss out on the wine trail that MMT are sponsoring. With their innovative and high-speed Surveyor Interceptor SROV on the market MMT have new information to release onsite in their stand. And important information to all visitors of MMT stand: Greet MMT by saying SROV ROCKS and receive a fun freebie.

www.mmt.se, K1

MMT staff conduct environmental survey on board MMT's survey vessel IceBeam. Image courtesy: MMT.

Nautikaris

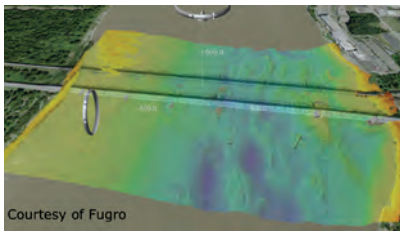
Nautikaris will be presenting the latest developments of their product portfolio. They are specialised in hydrographic, oceanographic and meteorological systems and sensors, integrated subsea communication systems,

inertial navigation and GNSS positioning products, wireless Small band radio telemetry networks, underwater connectors, rugged data collectors, Solar Marine Led navigation lights and professional lightweight inspection ROVs. Additionally, Nautikaris have acoustic real-time 3D Imaging systems for rental with experienced operators. Nautikaris has become a Videoray ROV certified service centre and holds their European distribution centre. Their customers count on them for their high-quality products combined with ease of use and a flexible and professional support team.
www.nautikaris.com, S1

Nautikaris represents several brands.

NORBIT

Experience multibeam survey proficiency as NORBIT Subsea demonstrates speedy high-resolution bathymetric multibeam surveying from any platform. At this event, we release firmware/software 10.2 - this includes a concise interface for single/dual head multibeam and GNSS-INS. Bridging the gap of parallel technologies, the WBMS family is the most compact, high-resolution, wide swath and cost-effective system to date.
norbit.com/subsea, V27



Bridge survey. Image courtesy: Fugro.

NovAtel

NovAtel's high-precision GNSS receiver technology and correction services are trusted by marine integrators around the world. Our expansive OEM product line, which includes our SPAN deeply-coupled GNSS + Inertial Navigation System (INS) technology, delivers robust position, heading and attitude solutions for the most challenging hydrographic survey requirements. Our Oceanix Nearshore Correction Service utilises Precise Point Positioning (PPP) corrections, from our proprietary corrections network, to provide high-accuracy positioning, delivered via satellite 24/7, complementing nearshore network and local RTK networks. The flexibility of our world-leading GNSS receiver platform ensures easy integration into a wide variety of marine products and applications. Our team of highly skilled customer support personnel is on hand to provide full engineering support to our marine customers whenever assistance is required with the integration process.
www.novatel.com/marine, V24

NovAtel SPAN-CPT.

OceanWise

Data is the most important resource of any organisation after the people it employs but is often taken for granted. As a result, this vital resource is often misunderstood, misused or worse still, just ignored! OceanWise specialises in all aspects of marine environmental data acquisition, data management, GIS and other services and can help you modernise your approach to data management. We provide tools and expertise, developed in conjunction with our customers, to better manage marine and coastal assets. By streamlining operational workflows associated with compliance and conservancy, asset management, chart production, tidal and weather monitoring and publishing, improved situational awareness and decision making will be gained. We will be showcasing the very latest developments in our Port-Log online real-time services and our Enterprise GIS productivity tools. So don't let poor data management put your operations at risk; work with Marine Data experts…"where your data matters!"
www.oceanwise.eu, R5.

PortLog screen in Totnes.

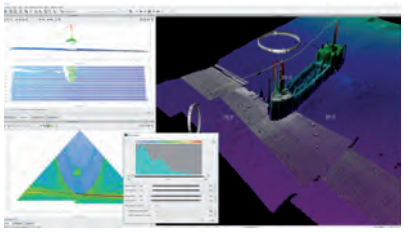
OceanServer Technology

Ocean Server builds the first commercially developed family of low cost Autonomous Underwater Vehicles (AUVs), Iver, ideal for coastal applications such as sensor development, general survey work, subsurface security, research and environmental monitoring. These modern AUVs are single man-portable and feature simple point and click mission planning.
www.ocean-server.com, B4

Ocean Server presents the Iver AUV series.

QPS

QPS BV (Quality Positioning Services) makes industry leading software for collection, post-processing and visualisation of maritime geomatic data. Our products QPS QINSy, QPS Qimera and QPS Fledermaus seamlessly partner with third parties, to solve problems and gain efficiencies for maritime-related business. QPS QINSy is a software suite used for many types of maritime geomatic surveys, ranging from simple single beam surveys up to very complex offshore construction works. QPS Qimera is an evolution in hydrographic data-processing, and it combines the core technologies of QINSy and Fledermaus. QPS Fledermaus is a powerful tool used by commercial, academic and government clients worldwide to interact in 4D with geographical datasets. QPS is an independent software company that has been headquartered in the Netherlands since 1986, and now with subsidiary offices in the USA, Canada and the UK. In 2012, QPS became a member of the SAAB (Sweden) group of companies (Traffic Management division).
www.qps.nl, U1



Screen image of QPS Qimera.

RIEGL

RIEGL will present their high performance airborne and UAV-based Waveform-Lidar solutions in hydrography. The VQ-880-G, a fully integrated airborne laser scanning system, is the

high-end solution for combined hydrographic and topographic surveying of coastlines, shallow waters and river beds. The system is offered with integrated and factory-calibrated high-end IMU/GNSS systems and cameras. An optionally integrated infrared laser scanner complements the data from the green laser scanner and supports the detection of the water surface. The design allows flexible adaption and straightforward installation on various platforms. The BathyCopter is a sUAV-based Lidar surveying system for generating profiles of inland waterbodies, equipped with RIEGL's BDF-1, a compact and lightweight bathymetric depth finder including tilt compensation, IMU/GNSS unit, control unit, and up to two digital cameras. For safe water landing and take-off from water bodies a floating support is provided.
www.riegl.com, W17

RIEGL Bathycopter.

SBG Systems

SBG Systems, leading supplier of inertial navigation systems, will release new generations of its two popular product lines: the Ellipse and the Ekinox Series. Both product lines' performances have improved by a factor of two! Ellipse 2 Series is a product line of miniature inertial systems. This new version now delivers 0.1° roll and pitch with an exceptional 5cm heave accuracy for this size and price. With brand new accelerometers and gyroscopes, Ekinox 2 now provides 0.02° roll and pitch accuracy, meeting the IHO standards. This new generation of inertial navigation systems offers the best performance/price ratio with a light and easy to install package. The embedded web interface simulating all installation parameters is a significant benefit. The Apogee Series completes the previous product lines offering the best accuracy for a MEMS INS/GNSS, with a 0.08° roll and pitch in real-time.
www.sbg-systems.com, E5c

The family of SBG Systems.

Seabed

Seabed will release the new GNSS Receiver SGR7 at the end of the second quarter of 2017. The SGR7 is a robust, high-precision receiver, with RTK that delivers centimetre level real-time positioning or go base free with centimetre and decimetre PPP solutions using Terrastar and Veripos corrections. Capable of tracking all current and upcoming GNSS constellations including GPS, GLONASS, Galileo, Beidou, QZSS and IRNSS. It is software upgradeable to track upcoming signals as they become available. Some new features are: web interface; modem; 555 channel, all-constellation, multi-frequency heading and positioning solution; advanced interference visualisation and mitigation features; double ethernet port; multiple serial and event outputs; IP67 and 16GB internal storage. Possible features: display; WiFi; triple antenna; RTK Assist; align; span; INS Enabled; Terrastar L-band; Veripos and upgradeable internal storage.
www.seabed.nl, V18.

Silicon Sensing

Two all-new inertial measurement units from Silicon Sensing Systems Limited, which are enhancing their successful range of MEMS inertial products, are to be featured at Ocean Business 2017. DMU11, like its predecessor DMU10, combines MEMS angular rate and linear acceleration sensors to create a precision, low-cost, six-degrees-of-freedom (6-DOF) IMU for a complete motion sensing solution. DMU11 features a redesigned layout for applications where space is at a premium and is calibrated over the full rated temperature range. Also the first of a family of High Performance IMUs, DMU30 creates a ground-breaking, non-ITAR, MEMS IMU alternative to more costly 'FOG-grade' equivalent for use in exacting marine motion sensing applications.
www.siliconsensing.com, V30

Sonardyne International Ltd

Visit Sonardyne on Stand E1 to learn how you can now access your subsea data when you want, where you want, by equipping your marine robotic platforms, vehicles and vessels with their acoustic positioning, optical communications, inertial navigation and sonar imaging technologies. Sonardyne's trials vessel *Echo Explorer* will once again be at the show, giving visitors the opportunity to see some of the products on display inside, in action out on the water. These will include a Mini-Ranger 2 tracking system, Nano transponder, Syrinx DVL and SPRINT INS. The company will also be hosting three classroom sessions, one of which will be presenting recent advances in underwater dynamic mobile mapping.
www.sonardyne.com, E1

Sonardyne SPRINT-Syrinx.

Teledyne CARIS

Introducing the HIPS 'Essential' application, tailored for use by Ports and Waterways and small survey companies. HIPS 'Essential' will meet your standard multibeam processing workflow requirements with quality assured and a cost-effective price. As part of the HIPS and SIPS family, HIPS 'Essential' maintains the robust nature you have come to expect from CARIS products and is easily expanded to meet your growing needs.
www.caris.com, N10

Teledyne CARIS introduces HIPS 'Essential'.

Teledyne Marine

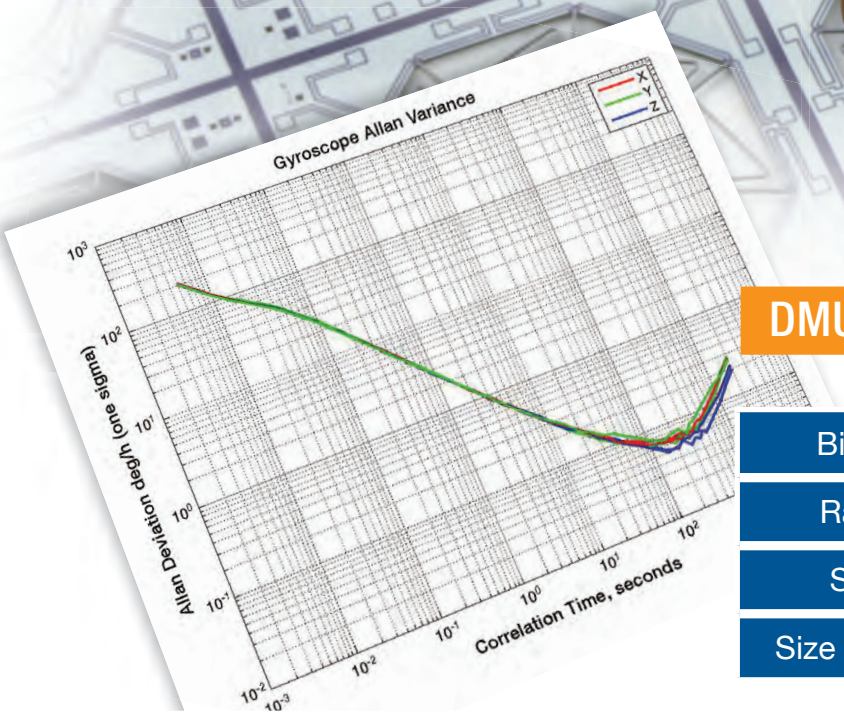
Make Teledyne Marine your first stop on stands T5 and U12 where you'll discover the largest breadth of technology in the marine industry. Whether you're looking for interconnect, instruments, vehicles, or imaging solutions, Teledyne Marine can assist you with stand-alone products or fully integrated custom systems – all from one supplier. Our OneTeam of professionals will be ready and waiting to help

Stand V30 at Ocean Business 2017

DMU30 Precision MEMS IMU

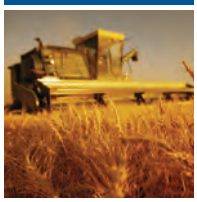
...FOG IMU performance, not price

- Proven MEMS Technology
- Non-ITAR
- Multi-MEMS Blending
- OEM & Custom Solutions
- 'Tactical Grade' Precision



DMU30

Bias Instability	0.1°/hr	15µg
Random Walk	0.02°/√hr	0.05m/s/√hr
Scale Factor	250ppm	250ppm
Size - Mass - Power	270cm³ - 300g - 3W	



SILICON SENSING®

www.siliconsensing.com sales@siliconsensing.com

you solve your biggest marine challenges. Teledyne Marine will be previewing several new and exciting technologies at this event. Be sure to stop by our booths for full details. Teledyne Marine will also be hosting +20 classroom training sessions, dockside, test tank and on-water demos throughout this 3-day event. Contact us if you'd like to pre-register for any of these events.
www.teledynemarine.com, T5,U12

Teledyne Marine OneTeam.

Valeport

Valeport is using Ocean Business17 as the launch venue for a new sensor especially designed for the dredging community. Recognised as world leaders in sound velocity technology, Valeport's latest addition combines a new turbidity sensor with the SWiFT SVP (CTD) technology to create dredgeMATE - a very useful new profiler aimed at the dredging market. Valeport will also introduce Connect, a software platform for mobile and PC devices. Product Manager, Jim Gardner, will host a training session on Tuesday 4 April, 3.30pm at Ocean Business to present the software platform which is designed for Bluetooth connectivity to interface, configure and download data from both legacy and new products.
www.valeport.com, M1

The Valeport dredgeMATE profiler aimed for the dredging market.

Veripos

Veripos leverages the Global Navigation Satellite Network (GNSS) and our own fully redundant proprietary corrections network to deliver highly accurate, reliable GNSS augmentation services for survey, dynamic positioning and other marine applications. Focused on reliability, innovation and around the clock customer support, our services include our Apex5 multi-constellation service which provides corrections for GPS, GLONASS, BeiDou, Galileo and QZSS constellations as well as our Quantum quality control software. Veripos corrections are delivered via redundant delivery mechanisms on 7 satellite beams ensuring customers global availability. With regional offices in Houston, Singapore, Mexico, Brazil, Australia and China and support offices in South Africa, Egypt, Middle East and India, Veripos offers truly global installation support and calibration services for all its products and services.
www.veripos.com, C6

Veripos LD5 mobile unit.

Changes to Data Sourcing in Modern Times

The **New Data Paradigm**

Seaports, waterways and climate are inextricably linked. Weather anomalies change bottom contours and destroy aids to navigation compromising safe navigation. In the past decade, maritime applications, maturing marine technologies and crowdsourcing have given mariners access to near real-time hydrographic data. The 3D Forward-looking Sonar is one example of the technology navigators are using today to create their own 3D local chart database. Thousands of vessel operators are now contributing to online navigation safety databases. This article provides examples of how traditional hydrographic data sourcing continues to change in the wake of Apps, intra-vessel communication and 3D sonar hardware/software technology.

In the past decade, some 600 maritime and crowdsourcing Applications (Apps) have provided mariners access to critical post-storm hydrographic data resulting in fewer groundings. For example, in 2015 the author avoided grounding a 5.5' draft vessel in the Intracoastal Waterway in multiple inlets affected by winter storms based on just-in-time crowdsourced sounding data. This valuable information was accessed daily through the ActiveCaptain Application.

Hurricane Matthew provided the perfect backdrop to showcase the value of instantaneous crowdsourced navigation safety data. Jeff Siegel, CEO of 'ActiveCaptain', the US based online real-time interactive vessel guide, characterised the huge ActiveCaptain data stream in the aftermath of the hurricane as 'Crowd Sourcing's Finest Hour'. Hundreds of vessels cruising south and north along the Atlantic coast of the USA seek the calmer conditions of the Intracoastal Waterway (ICW).

Data Capture Before and After Hurricane Matthew

Just before and after the arrival of Hurricane Matthew, ICW vessel traffic multiplied. As a result, tech savvy mariners were entering large volumes of data on ActiveCaptain. The data included time stamped real-time water level information, defined inlet shoals, closures of waterways, bridges and marinas and missing aids to navigation (ATON). While commercial Florida ports were closed to the public and still conducting post-storm hydrographic surveys, cruisers armed with cell phones and iPads using the ActiveCaptain App were able to access real-time information to determine how to navigate safely in the shifting channels of the ICW and where they could still buy fuel. Thousands of vessel operators are now acting as sensors contributing to online hydrographic databases. The National Oceanic and

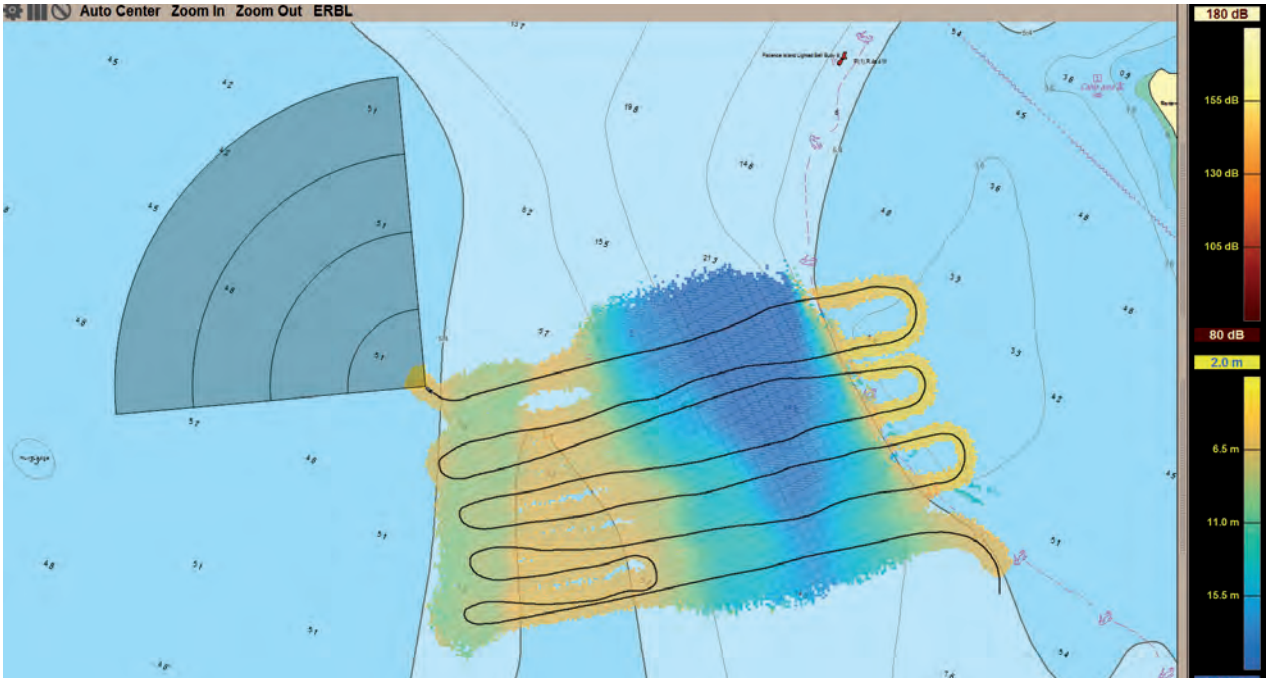
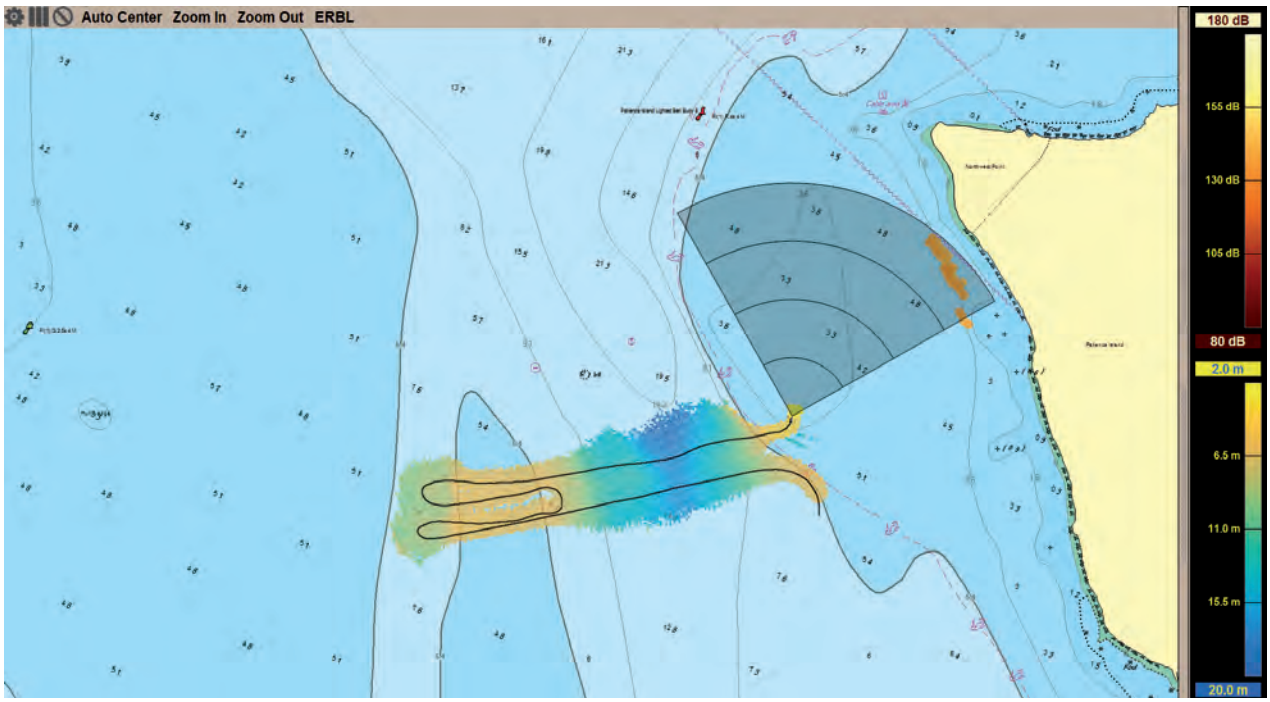


Figure 1: Local History Mapping™ Survey. Black line depicting GPS track. Lower colour scale indicates depth from 0 to 20 metres.



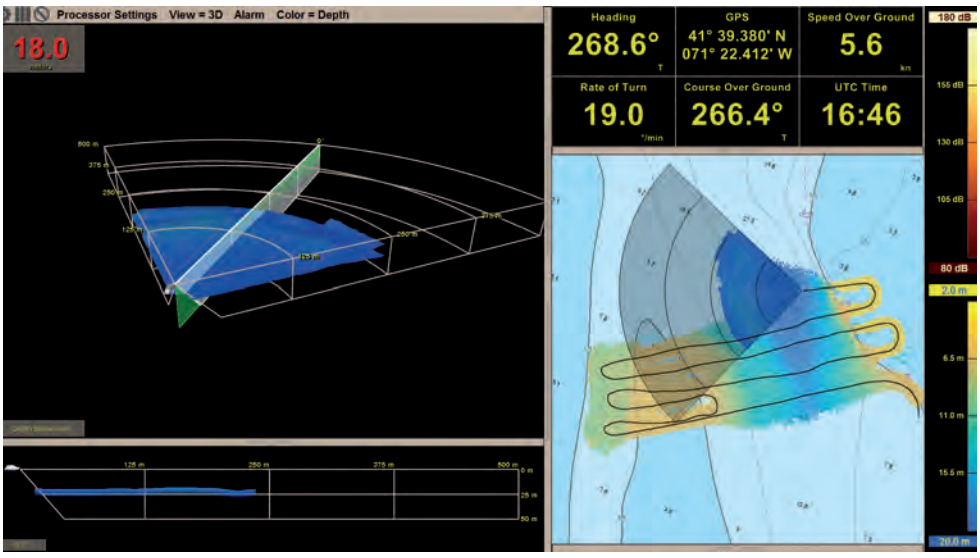
▲ *Figure 2: In-water Targets showing two distinct in-water targets outside bottom mapping range. Upper colour scale indicates signal strength (lower number indicates lower signal strength). Orange line within the sonar cone is a phantom reflection of the shoreline. Shorter, lighter line below it indicates the stronger reflection of the charted rock.*

Atmospheric Administration (NOAA) and US Coast Guard (USCG) tap into these databases to prioritise resources and anticipate chart updates. Both the USCG and NOAA review reports of shoaling and missing ATON data from cruisers while tracking ocean debris and hazards through crowdsourcing Apps.

When Charts Don't Measure Up

In addition to maritime Apps, the 3D Forward-looking Sonar (FLS) technology/software improvements provide a growing number of vessel operators with the ability to safely navigate 'skinny water' in dicey conditions. For example, marine traffic near the Poles has increased nearly four-fold to almost 700,000 cruise vessel movements in the past 15 years according to Midge Raymond. This has both US Coast Guard and NOAA's attention.

In August 2016, Exercise Arctic Chinook simulated the rescue response to a passenger ship casualty off Kotzebue, Alaska in the Bering Sea. Regions in the remote Bering Sea are described in the US Coast Pilot (chart 16006) as "only partially surveyed and the charts must not be relied upon too closely, especially near shore." Typically, vessel accidents near the Poles involve hull breaches due to ice or unexpected groundings. There has been a marked increase in purchases of 3D FLS by prudent operators of Arctic and Antarctic bound cruise ships and mega-yachts. This technology offers the navigator a means to view a detailed 3D forward look at the seafloor, uncharted rocks and potentially damaging submerged ice. When pushing the navigation safety envelope a 3D FLS adds a significant margin of safety. Shifting riverbeds, polar and glacial bottom contours and remote tropical islands are perfect environments where the use of FLS and crowd sharing of bathymetric data makes the most sense. The FLS 'ship centric' approach allows vessel operators to anticipate and avoid danger while simultaneously filling in the sounding voids left by early explorers.



▲ *Figure 3: FarSounder Navigation Display showing a slice of the sonar image with 18.0 metre depth below the vessel's sonar on the left-hand side.*

Ship-Centric Local History Mapping

In March 2017, FarSounder will officially release SonaSoft 3.3 software that creates a 3D chart (while underway). This Local History Mapping (LHM) capability allows the FLS navigator to 'paint' an intuitive 3D image of the bottom contour and potential obstructions ahead of their vessel in real-time. Future software

releases will add additional database functionality including storage, sharing and accessing each additional visit to the area. Sea trials were conducted by FarSounder in late 2016 using SonaSoft 3.3. Figure 1 captures the FarSounder sonar survey. FarSounder 500 and FarSounder 1000 products have a Bottom Mapping Range of 8 times the water depth below the transducer. For example, in-water depth of 20 metres has a Bottom Mapping Range of 8 X 20 or 160 metres (forward of the sonar). Depending on the local propagation conditions and the seafloor composition, this range may be longer or shorter.

All other targets that are outside the Bottom Mapping Range but appear on the sonar image are called 'In-water Targets' (Figure 2). The sonar cannot discriminate between in-water targets that are on the seafloor, in the water column or floating near the surface. The in-water target image will change colour and correct its position on the chart as the vessel gets within the sonar's Bottom Mapping Range. The standard FarSounder user interface software includes automated alarms, GPS compass, depth sounder display and vector-based chart plotting capabilities (Figure 3).

A gross quantitative analysis was made by FarSounder between the 2016 Local History Map and NOAA survey H11988 (2008/2009) multibeam data. In the analysis, FarSounder used a Furuno SC-30 GPS compass for position, course over ground, speed over ground and rate of turn. No compensations were made for heave. The orientations of the Transducer Module and SC-30 were eyeballed. An iso-velocity sound speed of 1,500 metres/second was assumed for all depths for simplicity. Since this was a location with relatively little tidal change, a single tide height was averaged over the time of the survey. When considering the entire survey, the depth measurements had an average depth difference of 3.31% relative to the NOAA data with a standard deviation of 2.40%. As the software continues to be developed to include more hydrographic parameters, such as tide height, the quality of the 3D surveys will also improve.

Game Changers

A data sharing revolution is taking place at sea. Whether it is the adventure cruise ship operator creating their own 3D survey of a secluded anchorage or the resource strapped government surveyor expanding the list of trusted sources of data, there is no question, the quality and quantity of hydrographic data that is being collected by mariners today is impressive. This all contributes to changing the hydrographic data paradigm. The days of using single point fathometers for depth soundings are fading. Whole area bottom contour maps are being produced by individual mariners in remote areas with the latest technology.

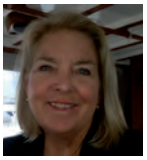
With the capabilities mentioned in this article, individuals could produce a survey that resembles the International Hydrographic Organization Order 1a/1b hydrographic survey with no extra specialised sonar system. Crowd sharing of this and other relevant navigation data allows mariners to help other mariners in time of need. The implications of this are endless. Post disaster humanitarian aid might have reached ports such as Port au Prince, Haiti much earlier and recovery operations in coastal areas near Fukushima, Japan might have resumed sooner, had there been assets in the area sharing 3D data. As sonar technology/software and crowdsourcing applications mature hydrographic data contributors have begun to multiply and contribute to the subsurface puzzle in the sea less travelled.

Acknowledgements

The author would like to thank Matthew Zimmerman (Vice President of Engineering at FarSounder) for the data, information and image contributions. ◂

More information

- 3D FarSounder sonar, www.farsounder.com
- ActiveCaptain, https://activecaptain.com/



Marianne Molchan is president of Molchan Marine Sciences LLC, a consulting business dedicated to promoting a safe and secure marine environment. Specialties include ship and underwater port security, marine technology development and navigation safety. Marianne is a retired Naval Commander, certified NOAA and Navy Hardhat Diver and former NOAA Corp Deck Officer who spent a decade performing hydrography, oceanography and installing tide/tsunami gauges primarily in Alaskan and Pacific Island waters. Marianne has a clear understanding and interest in the value of hydrography and the technological and software advances that are changing the hydrographic data paradigm.

✉ Marianne@Molchanmarine.com

Technology in Focus: Bathymetric Lidar

With sea level rise and increases in the severity of extreme natural events, there has been a renewed push to further our understanding of the coastal zone. Fundamental to understanding risk in areas of high vulnerability is capturing the near-shore land and sea surface. Bathymetric Lidar is the most effective and cost-efficient technology to capture both the land and seafloor simultaneously to provide a continuous, detailed 3D elevation model along the coastline. Its ability to successfully capture elevation on both sides of the coastline, over areas stretching more than 100km along the coast, has made it the 'gold standard' for coastal vulnerability and near-shore benthic habitat modelling.

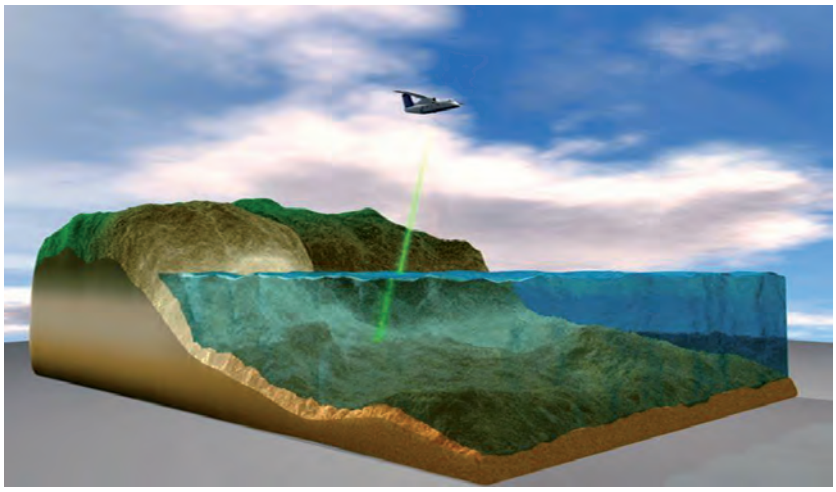
Bathymetric Lidar is an airborne acquisition technology. As opposed to airborne topographic Lidar, which uses an infrared wavelength of 1,064nm, bathymetric Lidar systems use a green wavelength of 532nm to penetrate the water column for measuring the seafloor. Bathymetric Lidar sensors can be simplified into four major components:

- the GPS receiver which gives the aircraft position
- the inertial measurement unit (IMU) which gives the roll, pitch and yaw of the aircraft
- the laser scanner which emits the signal in a particular pattern
- the sensor which reads the returning signal.

Knowing the position and orientation of all these components enables accurate measurements to be recorded by the Lidar system. Some of these sensors can now measure more than 100,000 points per second, resulting in surveys with over 10 points per m2 in shallow water. In a recent survey delivered for Samoa, over 1.8 billion points were captured in an area of just over 1,100km^2. The deepest of these measurements achieved a depth of just over 75m.

Environmental considerations

The addition of the water column in bathymetric Lidar surveys makes them more vulnerable than their topographic counterparts to the adverse impacts of environmental effects. These impacts can lead to data gaps, reduced data coverage and measurement quality. To minimise these impacts and achieve a successful bathymetric Lidar survey numerous factors need to be considered, such as weather for flying, air traffic controls, turbidity, tides, sea state, vegetation condition and ground control accessibility. Water clarity, or lack thereof, is a major hindrance for shallow-water penetration from bathymetric Lidar sensors. High turbidity, sea grasses and low-reflectance seafloors pose risks to the success of a survey. Understanding and managing these conditions can mean the difference between success and failure.



▲ *Figure 1: Bathymetric Lidar*

Individual characteristics of bathymetric Lidar sensors

Bathymetric Lidar sensors arguably tend to have more individual characteristics and differences than topographic Lidar sensors. Importantly, all modern bathymetric Lidar sensors can measure topography in addition to bathymetry. The most obvious split is between the shallow-water (<10m) and deep-water systems (>10m). The shallow-water systems tend to have less laser power per pulse, a higher measurement frequency (high resolution), smaller laser footprint diameter and a smaller receiver field of view, and can generally only measure water depths within the visible water column. The deep-water bathymetric Lidar systems use more laser power per pulse, a lower measurement frequency (low resolution), a larger laser footprint and receiver field-of-view. These deep-water bathymetric Lidar systems vary in depth penetration capability from between 2.0 to 3.0 times the Secchi depth measurement. To maximise detail and coverage, bathymetry survey operators are nowadays utilising both shallow-water and deep-water sensors simultaneously in twin optical port survey aircraft.

The scan patterns for sensors are composed of the shape, tilt and method. The scan shapes vary between rectilinear, elliptical arc, circular arc, elliptical and circular (see Figure). The circular and elliptical scanners are able to look forwards and backwards, increasing the number of times an area is sampled, although this can result in oversampling along the edges of the scan. The remaining shapes are usually tilted forward or backwards with respect to the aircraft. The scan methods vary between oscillating mirrors, rotating prisms, palmer scanners, rotating multi-facet mirrors and oscillating raster scanners. All of these methods result in subtle differences in the scan pattern and can be seen in the subsequent point cloud. A major consideration when employing bathymetric Lidar systems is laser energy per pulse. Although factors such as the receiver telescope area and field of view influence depth penetration, the laser power combined with the pulse duration is the strongest influence on depth penetration. High laser power and pulse duration tend to result in deeper water column penetration. The downside of higher laser energy per pulse is that the measurement frequency is lower, resulting in a lower point density. However, full insonification of the seabed is still possible.

Advances in bathymetric Lidar sensors

Recent advances in bathymetric Lidar sensors have been heading in a number of different directions. Some of these advances include multiple sensors in the aircraft, more integrated systems with additional sensors, faster throughput to data products, reflectance calibration between flight lines, greater point density, enhancements for fresh water capture, and enhanced classification of point clouds. Additionally, it is still early days for the use of bathymetric Lidar sensors in small unmanned aerial vehicles (UAVs), although this is likely to change in the next ten years. Advances in cloud computing and big data processing also hold a huge amount of promise for point cloud processing, and it will be fascinating to see how the industry utilises these advances to provide further value to the end users.

Concluding remarks

When selecting and employing a bathymetric Lidar sensor it is important to consider the environmental factors as well as the individual characteristics of the system. Even then, the success of a survey is often determined by the knowledge and experience of the operator. That aside, the decision about the best system for a survey will depend on the survey area, environment, project requirements and sensor availability. The aspects which commonly determine the choice of sensor relate to the maximum depth, point density, coverage, final product requirements and, not unimportantly, the intended purpose for the data.

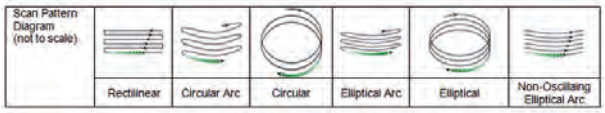


Figure 2: The scan shapes vary between rectilinear, elliptical arc, circular arc, elliptical and circular.

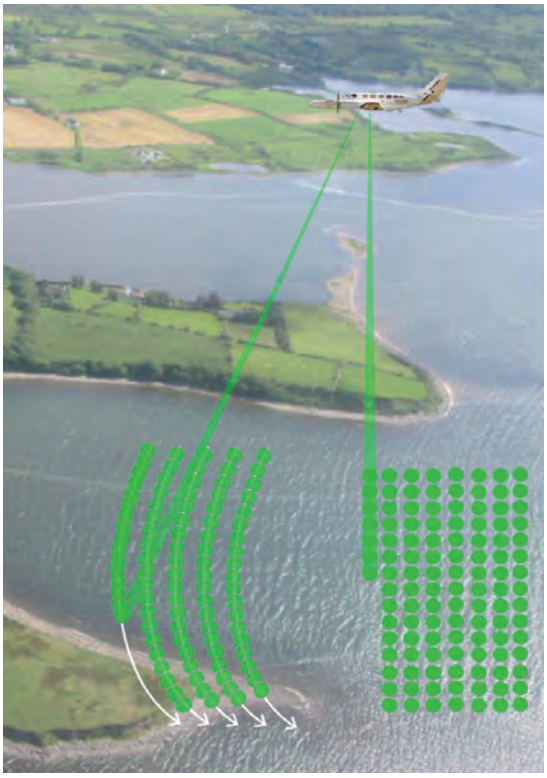


Figure 3: The Airborne Bathymetric Lidar principle. Image courtesy: Fugro LADS.

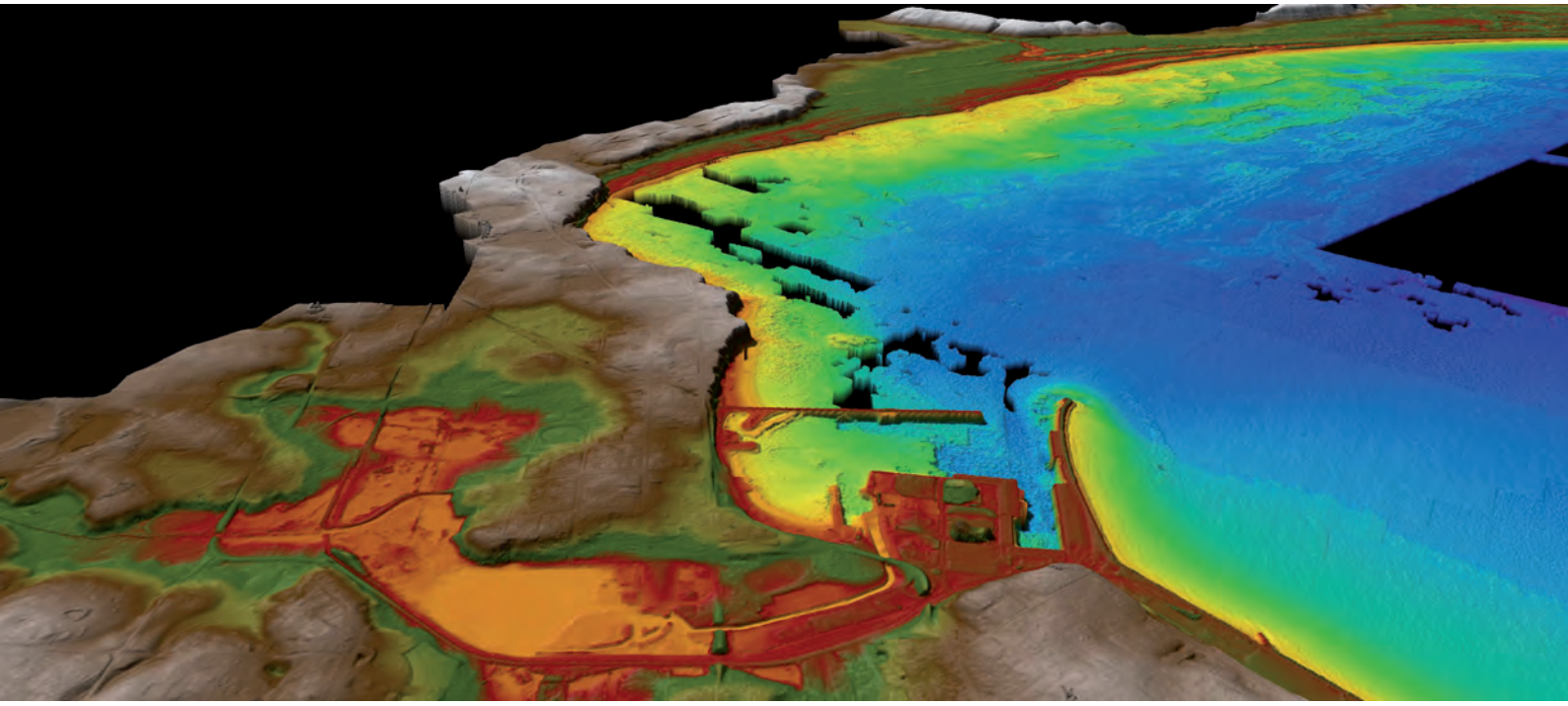


Figure 4: Portland Harbour surveyed.

100 Years of Service

This year marks the 100th Anniversary of the Commissioned Corps of the National Oceanic and Atmospheric Administration (NOAA Corps). The law forming the service was signed on 22 May 1917 and overnight made the field officers of the then United States Coast and Geodetic Survey uniformed commissioned officers. Literally hundreds of hydrographers, topographers and geodesists have since served in this uniformed service. As such, a look back at the origins and history of this organisation is in order.

Many elements of the National Oceanic and Atmospheric Administration (NOAA) and its commissioned officer service are direct descendants of the US Coast and Geodetic Survey (USC&GS), the oldest physical scientific agency in the US Federal Government. NOAA and the NOAA Corps can trace their lineage to 1807 when President Thomas Jefferson, among the most scientific of the United States presidents, signed a bill for the 'Survey of the Coast'. The first Superintendent of the Coast Survey was Ferdinand Rudolph Hassler, a Swiss immigrant whose scientific skill, strength of character, and indomitable nature guided the young science agency through many difficult times until his death in 1843. Hassler left a thriving organisation imbued with principles of accuracy, scientific standards, and integrity as his gift to science and the American people.
During the period before the American Civil War, the work force of the Survey was made up of a nucleus of civilians working hand-in-hand with Army and Navy officers. These men and women (the Coast Survey was the first United States Federal agency to hire female professionals) worked at charting the nation's waterways, producing topographic maps of our shorelines, and conducting geodetic surveys that were the backbone of all precise mapping efforts. Their efforts made the marine highways of the United States among the best charted in the world.

The Civil War Years

With the outbreak of the Civil War, all Army officers were withdrawn from the Survey and never returned; all naval officers but two were withdrawn from Survey duty. Consequently, the civilian officers of the Survey were called upon to serve in the field and provide mapping, hydrographic and engineering expertise for Union forces for the duration of the war. Curiously, the Army gave Coast Survey officers 'assimilated rank' which allowed them to wear Army uniforms while in the field. The Navy, on the other hand, retained them as civilians, putting coast surveyors in jeopardy of execution as spies if captured.
Whether Army or Navy, these coast surveyors served in virtually all theatres of the war including the defences of Washington, on the Peninsula with McClellan, with the Union blockading forces, with Farragut and Porter on the Mississippi and Red Rivers, with Grant at Vicksburg and in Virginia, and with Sherman in Georgia and the Carolinas. They were often in the front lines or in advance of the front lines conducting their mapping duties. For its part, the Coast Survey office force produced many of the coastal charts and interior maps used by Union forces throughout the war.

New Responsibilities

After the Civil War, the Coast Survey resumed its work of making the shores of our Nation safe for commerce. The area of responsibility continued to grow with the acquisition of Alaska in 1867 and the 1871 law requiring the Coast Survey to carry geodetic surveys into the interior of the United States. Naval officers returned to hydrographic duty on the Survey and remained until the Spanish-American War (1898) when all were withdrawn permanently.
With the acquisition of the Philippines and Puerto Rico, the Coast and Geodetic Survey's (C&GS) realm of responsibility increased again. Initial surveys in the Philippines were in support of defence needs as naval vessels and army transports grounded on uncharted shoals with distressing frequency.
During the years between the Spanish-American War and World War I, all C&GS work

▲ *Figure 1: Richard B. Derickson, one of the original commissioned officers of the C&GS.*

▲ *Figure 2: A 1923 sounding crew off Hawaii*

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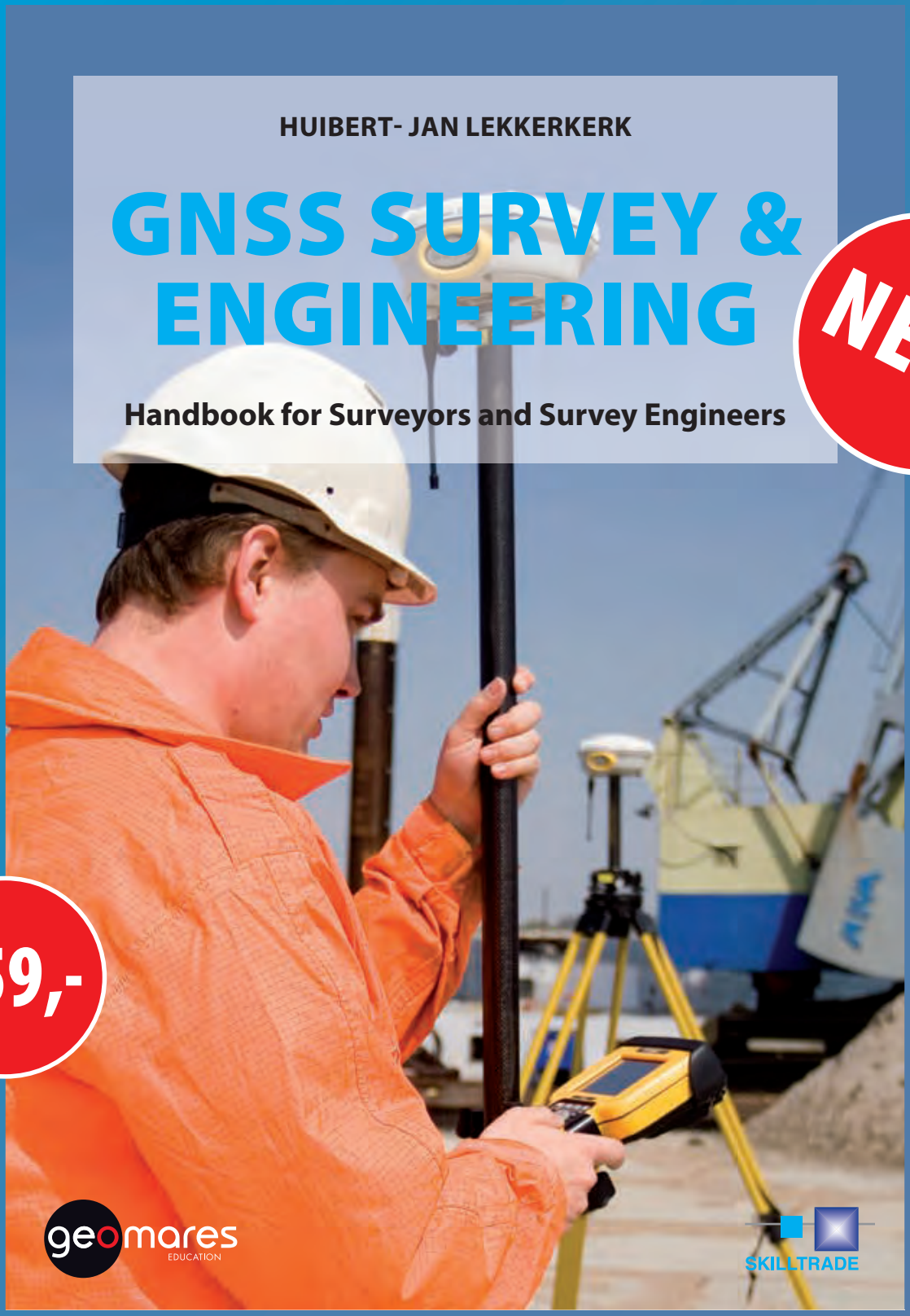

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▲ *Figure 3: 1945 The* Pathfinder*, the most illustrious of WW II hydrographic survey ships.*

▲ *Figure 4: NOAA Ship* Hassler*, modern twin-hulled hydrographic survey ship operated by NOAA Corps officers.*

was conducted by civilians even though shipboard personnel wore uniforms that were virtually indistinguishable from naval uniforms.

Civil War which placed civilian assistants accompanying armed forces in jeopardy of being considered spies.

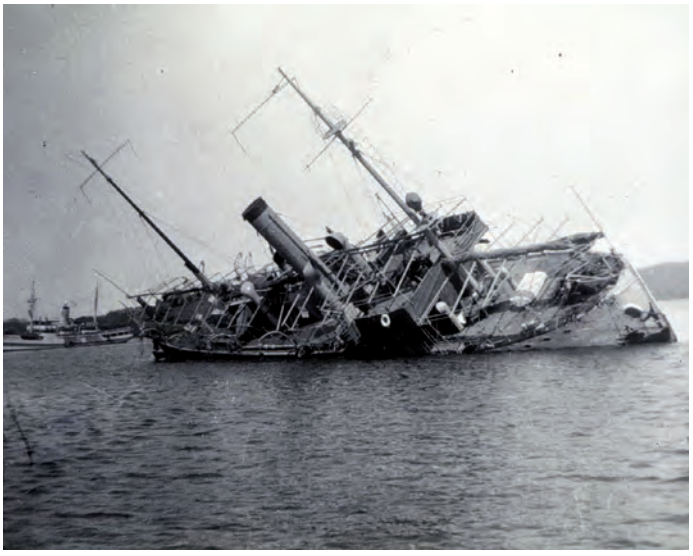
OMAO NOAA WP-3D Orion hurricane hunter aircraft piloted by NOAA Corps officers reflecting the expanded role of NOAA Corps officers since 1970.

With the entry of the United States into the war in 1917, the commissioned service of the C&GS was formed in order to eliminate the anomalous condition that arose during the

Also, by forming a uniformed commissioned service that could be rapidly transferred into the Armed Forces, the rapid assimilation of C&GS technical skills for defence purposes was assured. Even today, if a national emergency occurs, the NOAA Corps could be assimilated rapidly into the armed services by order of the President.

Serving During World War I

Over half the commissioned officers of the C&GS served with the Army, Navy, or Marine Corps during World War I. They served as artillery orienteering officers, mine-laying officers in the North Sea, troop transport navigators, intelligence officers, and even on the staff of General 'Black Jack' Pershing, the head of the American Expeditionary Force. Colonel E. Lester Jones, then director of the Coast and Geodetic Survey and 'father of the Commissioned Corps,' returned to the United



▲ *Figure 5: C&GS Ship* Fathomer *driven aground by typhoon at northern Luzon, 1936. The ship was salvaged and returned to survey duty.*

▲ *Figure 6: C&GS Ship* Discoverer *in the Gulf of Alaska circa 1925.*

States and was a founder of the American Legion and first president of the Pioneer Post. Following WWI, the commissioned officers and civilians of the C&GS reverted to their role of peaceful surveyors and chart makers of the United States. The young men who came into the commissioned service during this period spent years developing expertise in land surveying, sea floor and airways charting, coastline mapping, geophysics and oceanography. This expertise was combined with the hardships of a lifestyle that was characterised by years in survey field assignments or attached to survey vessels.

World War II

With the outbreak of World War II, once again over half of the commissioned officers of the C&GS were transferred to either the Army, Navy, or Marine Corps. Of the C&GS civilian workforce, approximately half, slightly over 1,000, joined the armed services. Those remaining on the home front were engaged almost exclusively in activities related to the prosecution of the war. Three officers who remained in the C&GS and eleven members of the agency who had joined other services were killed during the course of the war.

Officers and civilians of the Survey served in North Africa, Europe, and throughout the Pacific. These individuals served with distinction, earning the respect of the highest echelons of the armed services. Members of the Survey shared the danger, hardship and years of separation from loved ones that were common to all services.

As the C&GS officers were but a small portion of the men and women under arms during this period, there is no claim that C&GS men or ships were instrumental in turning the tide of any one battle or enemy engagement. But the claim is justly made that the Survey helped speed the movement of men and material, that it was instrumental in improving the efficiency of putting ordnance on target, and that their charts, field artillery surveys, and skill in developing new instrumentation and methods saved countless American and Allied lives. Much of this work was done at the front as the officers were subjected to all the hazards of land, air and naval warfare.

Providing Support in the Field

C&GS officers served as artillery surveyors, hydrographers, amphibious engineers, beach masters, reconnaissance surveyors for the worldwide aeronautical charting effort, instructors at service schools and in a plethora of technical positions. In Europe, the work of

C&GS artillery surveyors assured the success of the devastating tactic of 'time-on-target'. In the Pacific, C&GS ships often operated in advance of fleet units.

Of the USS *Pathfinder*, a C&GS ship taken over by the Navy for the duration of the war, it was said, "The road to Tokyo was paved with *Pathfinder* charts." Admiral Chester Nimitz, in praising this ship's work, referred to it as a C&GS ship, because the technical expertise was provided by C&GS officers transferred into the Navy. C&GS amphibious engineers were regimental navigators for Army engineer shore and boat regiments moving men and supplies during General Douglas MacArthur's leap-frog war up New Guinea and into the Philippines.

In the worldwide aeronautical charting effort of WWII, C&GS officers were reconnaissance surveyors with the Army Air Forces travelling throughout the world pioneering many of today's civil air routes. On the home front, C&GS chart makers provided close to 100 million charts and maps to the Allied forces. These included press runs of over 1,800 target charts of such areas as Ploesti and Hiroshima. Adding to the total contribution of the C&GS to the war charting efforts was the assignment of a C&GS officer as the first commanding officer of the Army Air Forces Aeronautical Chart Plant at St. Louis.

The Post-war Years

Following WWII, C&GS officers returned home to be immediately ordered to the business of surveying and charting the United States. Many men who had spent years overseas were immediately sent out on survey ships and mobile field survey parties. Defence projects were still prominent as the C&GS sent geodetic and hydrographic survey crews to Arctic Alaska for 10 years on Distant Early Warning Line surveys; conducted geodetic and geophysical surveys of various rocket ranges; and sailed on oceanographic cruises for the Navy. C&GS expertise was used in establishing seismic stations for monitoring nuclear testing.

In 1959, as it became increasingly evident that the United States' environment was intertwined with the world environment, C&GS was given the mandate to conduct worldwide oceanographic studies. In the 152 years since its inception, the Survey of the Coast had grown from a relatively small operation centered on the east coast of the United States to an agency working in all the oceans of the world.

Following two reorganisations in which many science agencies with related missions were brought together in one agency, NOAA and the NOAA Corps came into existence in 1970 following a short stint as the Environmental Science Services Administration and the ESSA Corps (1965-1970).

Serving NOAA and the Nation

Today, NOAA is comprised of the National Weather Service, National Marine Fisheries Service, Office of Oceanic and Atmospheric Research (NOAA Research), National Environmental Satellite, Data, and Information Service, National Ocean Service, and the Office of Marine and Aviation Operations. NOAA Corps officers serve on and command NOAA's fleet of research and survey vessels and aircraft, and also serve within each of NOAA's line offices. NOAA officers and civilians are equally at home under the sea, on the sea, surveying the land, charting the airways, flying into hurricanes and other dangerous weather phenomena, monitoring environmental spacecraft, and studying the most important star, our sun. They have served on all the oceans of the world and have represented the United States in many nations. One can only wonder what Ferdinand Hassler would think about the organisation that he helped found so many years ago. ◀

▲ *Figure 7: C&GS hydro launches on the North Slope of Alaska, 1951.*

▲ *Figure 8: Two NOAA Corps officers installing a tide gage at Castle Cape Alaska. Women have served in NOAA Corps since 1972 and comprise 30% of today's NOAA Corps.*

Cefas

115 Years of **World-class Science** and **Collaboration**

In 2017, the Centre for Environment, Fisheries and Aquaculture Science (Cefas) is celebrating its 20th year in its current form, as an executive agency for government. Cefas is recognised internationally for a breadth and depth of science capability in the marine and aquatic environment, helping the UK government monitor and manage the country's marine environment. However, the organisation's history extends much further, all the way back to 1902 when the Lowestoft laboratory was known as the Marine Biological Association (MBA).

In 1902, the organisation's remit was simply to collect and analyse data for the management of UK fisheries. Since then, Cefas have been tasked with providing marine expertise for many different users and their needs as part of the UK government's national and international commitments to sustainably manage the marine environment through evidence-based decision making. This has required a shift in the type of work Cefas undertakes, the equipment Cefas uses and the skills of Cefas scientists and technologists to carry out world-leading research to increase our understanding of the seas, as well as collecting and analysing evidence for specific programmes.

Predicting Future Science Needs

As new pressures and users of the marine space become evident, and new technologies and techniques emerge to enable more informed management, the organisation has evolved and developed its scientific and technical capabilities. This ensures that, despite changing needs and abilities, the marine and aquatic evidence and advice provided by Cefas to governments (domestic and overseas), academic collaborations and partnerships with the private sector remains world class.

Cefas combines these new innovations with 115 years of institutional memory and datasets. By analysing over a century of data and thanks to new equipment and in consideration of new scientific thinking it has been possible to spot long-term trends in fisheries, climate, and across other indicators of marine environmental health. Cefas is using modern technology and modelling capabilities to collect further data, and project the changes which may occur in the marine environment due to different pressures and stresses. Throughout its history, Cefas has played a central role in providing a robust evidence base to policy decisions, which remains as relevant in 2017 as in 1902.

▲ *Figure 1: 1907, Staff at the Marine Biology Laboratory, Lowestoft.*

Harnessing the Potential of Open Data

In recent years, Cefas have been enabling access to much of this data. In 2015, the organisation launched the Cefas Data Hub – a portal offering free access to a significant proportion of our historical and contemporary marine science datasets. In under two years, over 5400 datasets have been made freely

▲ *Figure 2: RV* Cefas Endeavour.

▲ *Figure 3: - 'Lyra' onboard RV* Cefas Endeavour *after successfully completing her first mission.*

available for industry, academic and public users to download and analyse.
Going forward, most of Cefas' 'new' datasets will be acquired using cutting-edge technology. The 74m research vessel RV *Cefas Endeavour* delivers surveys for domestic and international governments and Cefas continuously assesses future scientific needs to ensure that the vessel's capability remains appropriate for the wide range of data she collects for the assessments these inform. In the last year alone, RV *Cefas Endeavour* has been upgraded through the purchase of a state of the art water sampling rosette and profiling system, and a deepwater underwater imaging capability.
However, a 21st century marine monitoring programme needs to extend beyond vessel-based technology. Indeed, Cefas is leading proponents of integrated monitoring solutions – drawing together different technologies in collaboration with a range of partners to maximise the UK's collective evidence base, and to ensure that the UK remains a leader in marine monitoring systems and practices.

Strength in UK and International Partnerships

New technologies advance the field further, allowing Cefas to monitor more environmental indicators in more sites with greater accuracy and at a cheaper cost. Cefas scientists work closely with academic institutions and industry to share expertise on scientific needs, test technological advances (sometimes deployed on Cefas platforms) and enhance existing third party tools.
In the summer of 2016, Cefas collaborated with Liquid Robotics (USA) to install a Cefas water sampling system on a Liquid Robotics Wave Glider SV3. Together, the two organisations achieved what is believed to be a world first by remotely triggering water sample collection from an unmanned surface vehicle (USV). During the expedition, the platform was remotely piloted to areas of scientific interest, identified from satellite observations of ocean colour. These satellite observations could then be validated by onboard instrumentation, allowing Cefas scientists to sample harmful algal blooms (HABs) remotely.
From San Francisco, Liquid Robotics' operations team piloted the USV around the North Sea's oil terminals, ships, shallow-water and other offshore obstacles, transiting over 2,700km in the process. The partnership allowed each organisation to concentrate on their strengths and together develop a new application based on existing technologies and expertise.

Monitor more environmental indicators in more sites with greater accuracy and at a cheaper cost

Global Blue Economies

Cefas' global remit continues to develop, through work with local and regional partners across the world to share knowledge and to demonstrate the importance of developing marine economies for sustainable blue growth. Projects delivered by Cefas overseas include collaborations with other UK marine organisations (including the UKHO and the NOC), in which the three partners are delivering expertise, advice and capacity building across a range of specialisms, including seabed mapping for Caribbean governments, enabling navigation and evidence-based decisions to manage marine resources for sustainable development. Cefas is also included in the UK-Gulf Cooperation Council partnership, working with local partners to promote collaboration between the parties.
Over the last century, the organisation has evolved from its early origins and adapted significantly over the decades, but its core purpose remains constant, with a commitment to providing world-class marine and aquatic science in the UK and internationally. Cefas will continue to work to this commitment, with our partners across sectors, supporting economic, environmental and societal benefits for UK and international blue economies.
Cefas are exhibiting at Ocean Business 2017 (Stand K14). Please come along and speak to the team to learn more about the scientific services Cefas provides to national and international governments, industry and academia.

The Centre for Environment, Fisheries and Aquaculture Science developed across time to deliver different scopes of services to the government and academia under different names (MBA, BAF, MAF, MAFF, DFR). In 1997, Cefas was established as an executive agency of Defra. ◀

More information
www.cefas.co.uk
www.twitter.com/CefasGovUK

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The Challenge We Face

The oceans, covering seventy percent of the Earth's surface, are fundamental to sustaining life, controlling climate and a vast source of resources and economic wealth -- yet our understanding of ocean and seafloor processes is limited due to the technological and financial difficulties of operating in this environment.

▲ *We know more of the planet Mars than of the oceans.*

Foremost amongst the challenges of understanding the oceans and the seafloor is the fact that electromagnetic waves (e.g. light and radar) are highly attenuated in ocean water and previous optical and electromagnetic sensors designed to map, observe and better understand the Earth and planets were unable to penetrate more than a few metres in typical ocean waters. This is why we know the surfaces of the Moon and Mars in greater detail than that of the Earth, and why over 80% of our ocean floors remain unmapped, unobserved and unexplored.

Recent advances in technology mean such problems are surmountable. Multibeam sonar, for example, broadcasts an overlapping, fan-shaped series of beams, which dramatically increased the ease with which the seafloor can be mapped. Unfortunately, the adoption of these technologies requires large-scale international investment and political will. Experts estimate mapping the entire ocean floor could be achieved for USD3 billion, the cost of a single Mars mission; yet bathymetry remains a lower funding priority than space exploration.

Detailed bathymetric data is of vital importance for navigation and coastal management and for a growing variety of inter-related uses. Mapping the depths of the oceans yields the shape of the seabed that is a fundamental parameter for understanding ocean circulation, tides, tsunami forecasting, fishing resources, wave action, sediment transport, environmental change, underwater geo-hazards, cable and pipeline routing, mineral extraction and much more. Given the limitations of electromagnetic sensing in the ocean, bathymetric details must be obtained using acoustic mapping technologies deployed from surface or submerged vessels. This is both slow and expensive.

Broad coverage can be achieved through international coordination. The General Bathymetric Chart of the Oceans (GEBCO) project has two parent organisations: the International Hydrographic Organization (IHO) and the Intergovernmental Oceanographic Commission (IOC) of UNESCO, supported by The Nippon Foundation, a private foundation based in Japan with long experience in maritime matters. GEBCO was initiated more than 100 years ago with the vision of portraying the world's ocean floor. This followed from societal needs and scientific curiosity.

During the Forum for Future Ocean Floor Mapping, organised by GEBCO and The Nippon Foundation and held in Monaco in June 2016, Mr Yohei Sasakawa, chairman of The Nippon Foundation, proposed a partnership with GEBCO to map 100% of the world ocean floor topography. This ambitious challenge, as put by Mr Sasakawa, was to "leave no features of the world ocean floor larger than 100 metres unmapped by the year 2030".

The challenge will constitute the centrepiece of GEBCO's activities for the next 10 years. It builds on GEBCO's legacy and established regional connections to all corners of the world's oceans, as well as drawing on the platform of human capacity, built over 10 years through the GEBCO - Nippon Foundation training programme at the University of New Hampshire, which has so far produced over 70 graduates from 35 countries.

A mission statement for this new initiative would be to "empower the world to make policy decisions, use the oceans sustainably and undertake scientific research, based on bathymetric information of the Earth's seabed". A challenge indeed. ◀

More information
www.gebco.net

Hydrographic Society Benelux

Workshop 'Measuring Methods in Harbours with Silt'

The Hydrographic Society Benelux regularly meets up with the CEDA. They also met up on 31 January 2017 at the inspiring headquarters of Boskalis in Papendrecht, the Netherlands. On arrival, the office was surrounded by dredging vessels – creating a perfect environment for the lectures updating the 160 participants on measuring techniques in harbours with silt.

During the reception, the guests were ninvited to join the dinner buffet. This was greatly appreciated and brought the marine professionals in contact with each other.. However, the main part of the evening consisted of presentations on how best to manage 'navigable mud' or how deep should the seafloor be to accommodate vessels?

After welcoming words by Johan Pennekamp (CEDA) and chair of the day IJves Wesselman (Boskalis), Willem Snoek, Asset manager Hydrografie, Port of Rotterdam, introduced the audience to the way they are dealing with silt – an infinite job as he called it. Due to the tide and salinity of the water there is a regular programme of survey and dredging to keep the navigable bottom fit for the vessels calling into the harbour.

His presentation was followed by a talk by Leendert Bourgonjen, project manager & manager of the Dredging & Surveying Unit at Groningen Seaports NV who shared the results of trials of sailing through silt and reporting the effect of the stream caused by the tides and various levels of navigable silt and the 'sailability' of the channel floor accessing the harbour.

Styn Claeys, head of Instrumentation and Technology at the WL HIC presented the findings of research on sediments and nautical aspects showing that the terms 'nautical depth' and 'safe navigation' are inseparable and the consequences this should have on dredging programmes in harbours with silt.

Coen Werner, senior geologist and R&D manager at Stema Systems concluded the line-up updating everyone about the application of seismic technology to determine the nautical seafloor and object detection. He gave examples of pipelines and cables, but also the detection of boulders.

The last item of the programme was the social where the professionals took the opportunity to exchange their experiences and do a bit of networking.

▲ *Figure 1: Participants of the workshop 'Measuring techniques in harbours with silt'*

APRIL

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

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

International Robotics Week
The Hague, NL
→ 19-21 April
tusexpo.com

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

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

MAY

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

UDT
Bremen, DE
→ 30 May-1 June
www.udt-global.com

JUNE

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

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

MTS/IEEE OCEANS 2017 Aberdeen
Aberdeen, UK
→ 19-22 June
www.oceans17mtsieeeaberdeen.org

JULY

International Cartographic Conference (ICC)
Washington, DC, USA
→ 2-7 July
icc2017.org

RIO Acoustics
Rio de Janeiro, BR
→ 25-28 July
rioacoustics.org

SEPTEMBER

MTS/IEEE OCEANS 2017 Anchorage
Anchorage, US
→ 18-22 September
www.oceans17mtsieeeanchorage.org

OCTOBER

Offshore Energy
Amsterdam, NL
→ 9-11 October
offshore-energy.biz

Teledyne Marine Technology Workshop
Dan Diego, US
→ 15-18 October
www.teledynemarine.com/events/teledyne-marine-technology-workshop-2017

NOVEMBER

Oceanology International China
Qingdao, CN
→ 1-3 November
www.oichina.com.cn

PLOCAN Glider School
→ 6-11 November
Telde, ES
gliderschool.eu

Marine Autonomy and Technology Showcase
→ 13-17 November
Southampton, GB
conference.noc.ac.uk/matshowcase

Hydro17
Rotterdam, NL
→ 14-16 November
hydro17.com

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

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