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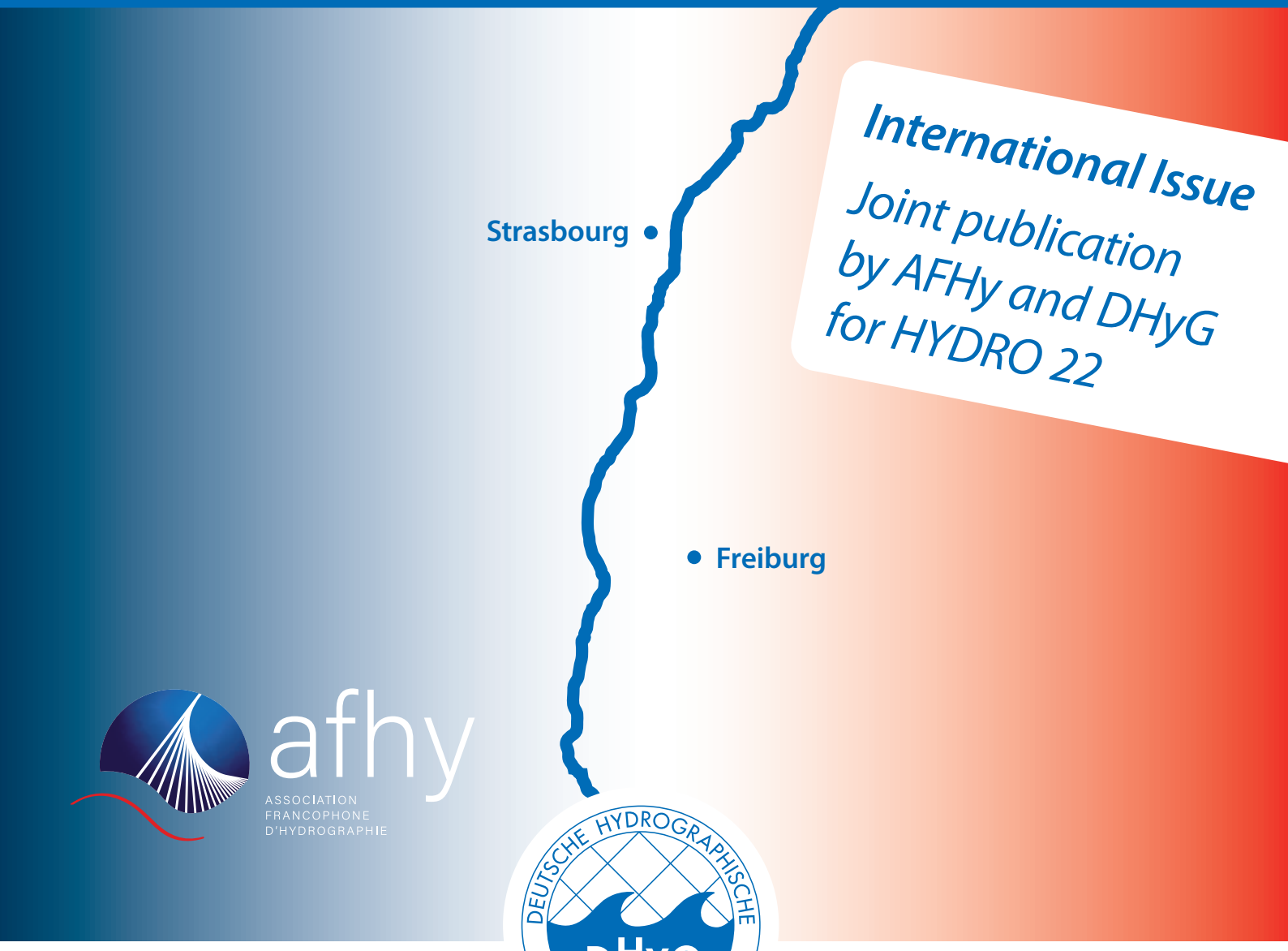

International Issue

Joint publication by AFHy and DHyG for HYDRO 22

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Dear readers,

This International Issue is the result of an experiment. The DHyG (Deutsche Hydrographische Gesellschaft) and the AFHy (Association Francophone pour l'Hydrographie) joined forces to create an issue of *Hydrographische Nachrichten (Journal of Applied Hydrography)*. The idea was to highlight similarities and differences in hydrography between the two countries, France and Germany.

We had planned a lot, but not everything worked out. For example, we had the wish to print an article on the surveying of the Rhine as our common border river. But unfortunately we could not get any authors, neither on the French nor on the German side. So this remains almost the only mention of the Rhine in this issue.

To get you in the mood, you will read an essay in which the statements on the differences between hydrography in France and that in Germany are deliberately pointed; at the same time the authors promote cross-border cooperation (page 6).

Then you will learn how hydrographic education is organised at no less than three training institutions in France (page 10) and how it is organised in Germany (page 20). Hydrographic education and applied research in French-speaking Canada is also included (page 28). These articles on hydrographic education are complemented by the enthusiastic report of an Erasmus student (page 26).

For the article on capacity building of the IHO, authors from Germany and France have joined forces. They report on France's exemplary engagement in several Coastal States to enable them to survey their waters themselves (page 36).

Last year, the International Federation of Hydrographic Societies (IFHS) and its member societies developed the Hydrographic Professional Accreditation Scheme (HPAS). With HPAS, hydrographers can have their knowledge and experience certified. A French-German author duo reports on this – both were significantly involved in the development of HPAS (page 44).

Another duo of authors from Germany and France reports on the recent activities of the Backscatter Working Group, a group of several researchers who want to improve seafloor and habitat mapping using multibeam backscatter data (page 57).

I think what international cooperation can achieve becomes very clear in this issue – especially in the three articles mentioned before. It is precisely this, the need for international cooperation, that Eric Langlois underlines in the interview you can read starting on page 50. Eric Langlois is French and works for an international organisation based in Germany, he is acting Chairman of the IFHS and he is a member of the Board of AFHy, which is now hosting HYDRO 22 in Monaco. We could not have found a better interview partner for this issue of *Hydrographische Nachrichten*. Of his impressive answers, I like the quote best that gives the title of the interview: »Hydrography is probably one of the best jobs ever in terms of versatility and diversity«. There is hardly a better way to put into words what our profession is all about.

Lars Schiller

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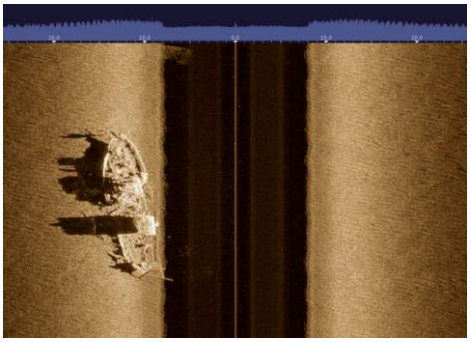

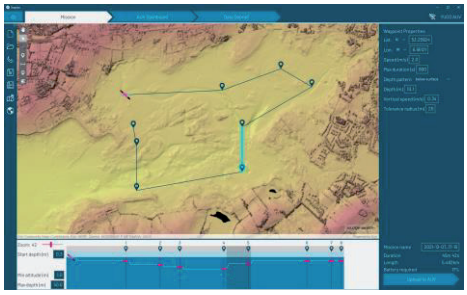

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International Issue

The next focus themes

HN 124 (March 2023)	**Crowdsourcing**
HN 125 (June 2023)	**3D Positioning at Sea**
HN 126 (October 2023)	**BIM and Digital Twins**

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French and German hydrography in a changing world

An analysis calling for intensifying French-German cooperation

An essay by FABIENNE VALLÉE AND GUNNAR TIETZE

This journal is devoted to French-German cooperation in hydrography. The topic is worth an introduction. The paper starts from the origin and history of the French and German hydrographic services to consider their specificities and thus the bases of cooperation. In a second step it analyses the current opportunities for hydrography in general, considering the increasing demand for hydrographic data and the digitalisation of maritime activities. This context has led IHO and IALA to develop a new standard for data (S-100) and data exchange (MCP). Hydrography is basic. S-100 is a chance to seize. Implementing new standards requires multinational cooperation and pilot actions. Is the French-German hydrographic community ready to contribute their joint strengths?

history of science | hydrographic education | S-100 family | Maritime Connectivity Platform
histoire des sciences | éducation hydrographique | famille S-100 | plateforme de connectivité maritime
Wissenschaftsgeschichte | Hydrographieausbildung | S-100-Familie | Maritime Connectivity Platform

Cette édition du journal *Hydrographische Nachrichten* est consacré à la coopération franco-allemands apporte une vision de l'hydrographie. Le sujet mérite une introduction. L'article part de l'origine et de l'histoire des services hydrographiques français et allemands pour comprendre leurs spécificités et donc les bases d'une coopération. Dans un deuxième temps, il analyse les opportunités actuelles pour l'hydrographie en général, considérant la demande croissante de données hydrographiques et la numérisation des activités maritimes. Ce contexte a conduit l'OHI et l'AISM à développer une nouvelle norme pour les données (S-100) et l'échange de données (MCP). L'hydrographie en est la base. La norme S-100 est une chance à saisir. La mise en œuvre d'un nouveau standard nécessite une coopération multinationale et des actions pilotes. La communauté hydrographique franco-allemande est-elle prête à apporter ses forces ?

Diese HN-Ausgabe ist der deutsch-französischen Zusammenarbeit in der Hydrographie gewidmet. Das Thema ist eine Einführung wert. Ausgehend von Entstehung und Geschichte der französischen und deutschen Hydrographischen Dienste werden deren Besonderheiten betrachtet, um damit die Grundlagen einer Zusammenarbeit besser zu verstehen. In einem zweiten Schritt werden die aktuellen Möglichkeiten für die Hydrographie im Allgemeinen analysiert, wobei der Beitrag die steigende Nachfrage nach hydrographischen Daten und die Digitalisierung maritimer Aktivitäten betrachtet. In diesem Kontext haben IHO und IALA veranlasst, einen neuen Standard für Daten (S-100) und Datenaustausch (MCP) zu entwickeln. Hydrographie ist grundlegend. Der S-100-Standard ist eine Chance, die es zu ergreifen gilt. Die Umsetzung neuer Standards erfordert multinationale Zusammenarbeit und Pilotprojekte. Ist die deutsch-französische hydrographische Community bereit, ihre Stärken gemeinsam einzubringen?

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1 Introduction

This edition of *Hydrographische Nachrichten* is special. Being written by German and French contributors somewhere it calls for further bilateral collaboration. The hydrographic community is small. We know each other at least on a national level. However, it is more like an exception between French and German hydrographers. Nevertheless, any cooperation requires a common topic, willing partners, financial resources and coordination teams. We hope that this *HN* edition might provide some ideas, as hydrography is entering a new era.

With the fast digitalisation process, of all marine sectors, hydrography finds itself in the middle of the stage. It is a chance to seize. The challenge to be met speaking of new data formats only (Chapter 3) requires intense, international cooperation. The French-German couple could be at least a

strong player in this process. To better understand the potential of such collaboration let's go back in time a little bit.

2 Historical insights into French and German hydrography

Let's start from the beginning of hydrography in the two countries in modern times to better understand the current particularities. Of course hydrography is as old as men set out sailing. In Europe, while neglecting the Arab world, Asia and Polynesia, hydrography was a by-product of basically merchant shipping like the Hanseatic. This changed with modern times.

2.1 France

In 2020, the Shom (Service hydrographique et océanographique de la marine; English: hydrographic and oceanographic service of the navy) celebrated the 300 years of French hydrography, that is to say the history of the Shom itself (1720 to 2020, 300 years of French hydrography; https://youtu.be/n0-BxWZev6Q).

With the powerful rise of the French kingdom after the Thirty Years' War and increasing rivalry with the United Kingdom, the military importance of nautical charts and thus hydrography was recognised. Thus, in 1720, more than 300 years ago, a national authority directly affiliated to the navy was created.

Its task was to create and maintain a central archive of all nautical charts. This involved collecting all knowledge from geography and bathymetry and making it available as official nautical charts and accompanying nautical books, first and foremost to the navy but also to civil maritime shipping.

Based on this heritage Shom's missions have largely evolved since its very beginning, but it remains a regalian institution that federates developments in the field of knowledge and modelling of the oceans. Shom either supports public policies on maritime and coastal areas but also naval operations with its expertise in the hydro-oceanographic and meteorological domains.

In 2007, the Shom became a public administrative establishment (EPA). It remains part of the navy, while performing many civilian tasks including research.

In addition to its regalian character, Shom has a strong historical involvement in all international issues concerning hydrography in the broad sense. Shom is one of the fathers to establish the International Hydrographic Bureau (IHB) in 1921. In 1970, IHB became the International Hydrographic Organization (IHO).

Training and education of hydrographers was also centralised, not at Shom but at a Grand Ecole: ENSTA Bretagne (École Nationale Supérieure de Techniques Avancées). Since 2010, ENSTA has been hosting students from École Polytechnique and the French Navy following courses in hydrography or maritime engineering fields. The ENSTA Bretagne hydrography courses have become one of the most important in Europe and are most renowned in the world.

Finally a word on the AFHy (Association Francophone d'Hydrographie): Initially made up of public actors only, the association opened itself to all French-speaking stakeholders in hydrography. The AFHy has the vocation to develop the relations, or indeed the cooperation between the academic, private and public sectors, an initiative highly appreciated in the francophone hydrography landscape (note the important commitment of the Quebecers).

2.2 Germany

In the days of the Hanseatic League, hydrography was a private matter for ship-owners. This did not change with its decline when, after the Thirty Years' War, Hamburg and Bremen clearly outstripped the Baltic ports from Lübeck to Danzig with the new overseas trades.

After the Congress of Vienna the interest in nautical charts and hydrography arose with the flourishing maritime trade. This gradually led, decades later thanks to the commitment of Hanseatic shipowners of Bremen and Hamburg, to the establishment of the Seewarte (maritime observatory) in Hamburg for the benefit of merchant shipping. With the establishment of a German navy from the middle of the 19th century, the military aspect came to the fore, especially from the founding of the German Empire in 1871. The Seewarte, which became the DHI (German Hydrographic Institute) after the end of the war in 1945, was now established as a civil authority placed under the Ministry of Transport. The reunification brought the merger with the corresponding service of the German Democratic Republic and the renaming to BSH (Bundesamt für Seeschifffahrt und Hydrographie).

Hydrographic training and education was and is somewhat neglected in Germany. The traditional nautical colleges in Elsfleth and elsewhere essentially serve training of seafarers. Hydrography is occasionally offered as a special course by university institutes close to the subject (oceanography, geophysics, cartography). Genuine hydrographic training has only been established since a few decades in Hamburg, today at the HafenCity University (HCU). But even there it is affiliated or subordinate to geodesy and land surveying and was repeatedly on the verge of being completely dissolved.

DHyG (Deutsche Hydrographische Gesellschaft, since 1984, near 200 members) is the professional

association of German-speaking hydrographers. Whether they work in teaching, for government agencies and authorities, in industry or as service providers, the DHyG unites their professional interests. Finally, hydrographers worldwide have joined forces through the International Federation of Hydrographic Societies (IFHS).

2.3 Commonalities

Furthermore, there are many similarities. On both sides of the Rhine there are supreme authorities that take care of the maintenance and navigability of inland waterways and inland waters in general. These are partly set up nation-wide, partly separated according to catchment areas, Elbe, Loire, Rhône, etc. These authorities are responsible for safety of shipping, buoyage and beaconing, sounding surveys, etc. and at the same time for the environmental protection of waters and banks. In Germany, these are primarily the WSV (Wasserstraßen- und Schifffahrtsverwaltung des Bundes, Generaldirektion in Bonn), the BAW (Bundesanstalt für Wasserbau, Karlsruhe) and the BfG (Bundesanstalt für Gewässerkunde, Koblenz) as well as the Havariekommando in Cuxhaven.

In France, these tasks are carried out by CEREMA (Centre d'études et d'expertise sur les risques, l'environnement, la mobilité et l'aménagement) which is based in Compiegne and has numerous branches throughout the country and in the overseas departments. In addition, there are supreme authorities such as the CNR (Compagnie National du Rhône, Lyon), which are responsible for research, environmental protection, water protection and hydraulic engineering. Furthermore, there are three so-called »Prefecture Maritime« in France, each responsible for the Channel coast (Cherbourg), the coast of the Bay of Biscay (Brest) and the Mediterranean coast (Toulon). They are responsible for safety and order as well as environmental protection, fisheries supervision, accident and disaster response, etc. in all the coastal waters under French jurisdiction (12-mile zone to EEZ).

Both countries have a technologically well-positioned industry, many innovative start-ups and small to medium-sized service providers. The situation of the private sector is comparatively better in France. With its overseas territories and correspondingly large EEZ, France offers a significant home market in the Francophone world. Industry finds more favourable framework conditions with the large offshore companies Elf, Total, Saipem, iXblue and others, accompanied by the high significance of the navy.

The enormous technological progress of the last decades has given hydrography a tremendous boost in both countries. The development has been similar and will therefore not be discussed further. However, in our opinion, digitalisation leads to a special challenge with great economic potential. Hydrography is big data, the data itself is very dynamic. So, digitisation can be of great benefit. To exploit this treasure in a global context requires cooperation on a larger scale than before.

3 Is a new era for hydrography rising?

Digitisation is permeating all maritime activities. It is all about data, data exchange chains and data processing. Hydrography as foundation of knowledge and exploitation of rivers and oceans, is living its own revolution, obliged to anticipate the needs of all communities it serves. What will hydrography be tomorrow?

Navigation became more and will become much more than just plotting sailed routes on paper charts. Route optimisation, visualisation of metocean data, currents, sea state, etc. shall be integrated on the now electronic chart. A battle has been waged in the background over standards. Who would win between OGC (Open Geospatial Consortium) standards used for geographic information systems (GIS) and S-57? With S-57, the representation of hydrographic data was fixed in a static ENC. With OGC open architecture, all data can be exchanged and used by any actor in the data production/operations chain. For example, bathymetric data are publicly available from EMODNET (European Marine Observation and Data Network) – however, these charts cannot be used for navigation.

All this »new« data, and it is Big Data, is usually visualised in thematic maps via GIS tools. However, to make them available for mariners requires an integration into their workhorse platform ECDIS.

IHO and IALA and IMO have developed new standards (S-100 family) and a new data exchange model (MCP, Maritime Connectivity Platform), a service to assure the transfer of good »quasi approved« data to unlock the exchange of data within and outside the maritime community, on land or at sea. The electronic navigational chart is »alive«, able to incorporate potentially real-time data (e.g. currents, water level/under-keel clearance, etc.) or even forecast. This navigation surrounding context can be shared with VTS stations on land. Thus, the vessels can be remote controlled or even autonomous in future.

What will be the next generation of navigational charts and ENC display terminals (ECDIS, VTS, PPU), designed for humans? Who will certify the quality of the ENCs and hydrographic data potentially calculated in real time? With real-time data or forecast (same data structure with just a future time stamp but requiring reliable ocean models and simulation) there is no way to officially validate the map after some months of processing as in the past. Probably the hydrographic services as

state agencies will redefine their role and procedures.

The hydrographic community is also exploring remotely operated and even autonomous survey vessels to produce more data and to allow its exploitation more rapidly, at lower cost but with enhanced quality. What will be the next generation of data production/processing/exploitation chains?

Hydrography is thus undergoing a challenging but exciting revolution. The S-100 model coupled with the MCP is a powerful data (flow) structure. Still, it leaves many questions open. But let's also see the open door for French-German cooperation. The initiative will move away from Europe if we do not strengthen up cooperation. This goes in line with numerous opportunities for private enterprise to offer data and data-based services to the mariners and the maritime world.

Thus ECDIS may become a safe platform for manifold applications like the smartphone. However, if necessary regulations and harmonisation enforced by IMO, IHO and IALA do not evolve fast enough, there is a threat that an unofficial parallel world on tablets with a zoo of heterogeneous proprietary solutions would pop up.

4 French and German assets for cooperation

As common sense, implementing these new models requires transnational cooperation. Digitalisation is a fact. International security and interoperability remain *the* criteria.

Trans-national physical test beds are necessary to validate the technical implementation of IHO/IALA models. Countries like Korea, Norway, Denmark or Singapore are pioneers. They are providing the hot spots for the implementation of S-100/MCP and propelling their industry to the forefront of development. The Korean KHOA S-100 test bed is one main example. Together with the ship handling simulator S-100 test system, it has already supported a pilot implementation of S-100 data models, a prototype shore-based ECDIS, supporting also the co-development of the MCP (Maritime Connectivity Platform) with European e-Navigation Project teams.

Considering only hydrography, it is worth mentioning the work achieved by the Canadian Hydrographic Service with PRIMAR and Norway on the production of hydrographical data using the St Laurent and the lakes as test bed. They have implemented and tested the data and chart production chain and demonstrated the capabilities of S-100 model for safety of navigation.

With their respective organisation and specificities, the French and German hydrographic communities are well positioned to take an active part in the development. However, this requires pulling financial resources and competencies when the determining factor is time. The market expects solutions now (e.g. remotely controlled navigation). Technologies progress at a faster speed than the theoretical standards themselves with the risk to open doors to »standards of fact«. Well known in standardisation processes such product can catch important market shares by creating solutions.

Could a stronger French-German cooperation be a way to favour the involvement of the two communities in this work and contribute to the international effort to speed up the implementation of S-100?

5 Conclusions

The conclusion is yours. We hope having excited the interest of the lectors with this essay. Ideas are welcome. //

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The study of Hydrography at French institutes ENSTA Bretagne, Cnam/Intechmer and Shom/UBO

An article by ROMAIN SCHWAB, RONAN LE ROY, CLAIRE MARION, NATHALIE DEBESE and FRANCE FLOC'H

Every year, around 60 highly-qualified hydrographers graduate from the French institutions ENSTA Bretagne, Cnam Intechmer and Shom/UBO. These complementary teachings address both civilian and military demands. The survey practice is a key part of the training which ensure students' ability to be quickly operational in the professional world. This paper outlines major fieldwork conducted by each school, where trainees acquire technical skills. To face these growing needs in terms of staff and equipment, French facilities actively cooperate. In particular, there are some bridges between educational programmes and also more global expertise and materials sharing.

hydrography education | practical training | ISBlue | Hydro3 | Category A | Category B
enseignement de l'hydrographie | formation pratique | ISBlue | Hydro3 | Catégorie A | Catégorie B
Hydrographieausbildung | praktische Übungen | ISBlue | Hydro3 | Kategorie A | Kategorie B

Les établissements français à savoir l'ENSTA Bretagne, Cnam Intechmer et le Shom/UBO forment chaque année une soixantaine d'hydrographes. Ces formations complémentaires répondent à la fois aux besoins civils et militaires. La composante pratique de la formation est fondamentale pour rendre ces futurs diplômés rapidement opérationnels dans le monde du travail. Ce papier présente un projet terrain d'envergure propre à chaque école dans lequel les étudiants développent leurs expertises techniques. Pour faire face aux besoins importants tant en termes d'encadrement que de matériel, les instituts collaborent activement entre eux. Il existe ainsi des passerelles inter-établissements sur la formation, et des partages de compétence sur les enjeux actuels et futurs de l'hydrographie.

Jedes Jahr schließen rund 60 hochqualifizierte Hydrographen ihre Ausbildung an den französischen Institutionen ENSTA Bretagne, Cnam Intechmer und Shom/UBO ab. Diese sich ergänzenden Ausbildungen decken sowohl den zivilen als auch den militärischen Bedarf ab. Die Vermessungspraxis ist ein zentraler Bestandteil der Ausbildung, um die Studierenden schnell in der Berufswelt einsetzen zu können. In diesem Paper werden die wichtigsten von den einzelnen Schulen durchgeführten Feldarbeiten beschrieben, bei denen die Studierenden technische Fähigkeiten erwerben. Um den hohen Bedarf an Personal und Ausrüstung zu decken, arbeiten die französischen Einrichtungen aktiv zusammen. Insbesondere gibt es einige Brücken zwischen Bildungsprogrammen und auch einen globaleren Austausch von Fachwissen und Materialien.

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Introduction

Training capacity

For years now, feedbacks from industry show a discrepancy between the strong demand of high-qualified hydrographers and the limited annual number of graduates. Marine activities, especially in energy and civil engineering sectors, are growing and changing fast. In fact, new technologies are redesigning the traditional ways of surveying by increasing the degree of technical skills. As a consequence, teaching facilities must keep high and up-to-date standards of education, so the young graduates would not be reliant to black-box solutions but able to face complex hydrographic surveys.

Sadly, the instruction capacity is not indefinitely extendable. It is driven by the ability to deliver high-quality practical trainings, which imply significant resources, both human and financial. In France, by regrouping the three main institutions, namely ENSTA Bretagne, Shom/UBO and Cnam Intechmer, the annual number of graduates is about 65. Among them, 17 are servicemen. So roughly 50 students would be professionals available for civilian needs.

Keep in mind that this number hides a wide range of career possibilities as further detailed later. Part of this diversity is explained by slightly different status, schooling goals and areas of expertise of the French academies. This paper will show how these trainings are complementary.

Practical training: A mandatory but challenging task

As a lecturer of the »Standards of Competence for Hydrographic Surveyors« (IHO 2018, 2017) would notice, the overall teaching in hydrography surveying contains a solid multidisciplinary scientific background, with hundreds of hours of theoretical courses.

However, a meaningful part of the job cannot be learnt by reading manuals and only a regular practice achieves a good understanding of some prerequisites. So, it is absolutely compulsory to provide a progressive practical training simultaneously. Being a surveyor implies the use of advanced sensors and survey technics in changing environments or applications. The adaptability is a key criterion. The hydrographer must therefore embrace the hydrographic system as a whole in order to choose and configure the adequate sensors considering the targeted performances. He must also have a good knowledge and understanding of calibration procedures designed to ensure that the expected data quality is reached. All these skills call for an extensive survey experience to be mastered. The practical training must provide enough tools and fieldwork projects, so that the graduate students will be quickly autonomous and efficient in the professional world.

As a consequence, education institutions have to invest in sufficient material means to achieve these training goals, including survey platforms, software and high-end sensors. So, contrary to other field of study like computer sciences, hydrography courses involve substantial budgets and staff. Another consequence is the limitation of the maximum number of students. Indeed, to guarantee high level of practical skills of their postgraduate students, the institutions must ensure that every trainee spend enough time on practice. An efficient format consists of keeping small groups of students working on fieldwork projects. The number of sensors, platforms and teachers being limited, it leads to class with modest capacity (around 30 students). But despite these expensive equipment and capped class size, for now the academies have found a way to keep moderate admission fees.

Part 1: Overall picture of French institutes ENSTA Bretagne, Intechmer and Shom

The institutes

Built on a legacy of training on its Brest campus since 1819, ENSTA Bretagne (ex-ENSIETA) has become in 1971 a multidisciplinary graduate and postgraduate engineering school, under the auspices of the French Government defence procurement and technology agency (DGA). Since the 1990s, ENSTA Bretagne has grown into both a public engineering school and a research institute with almost 300 new graduates each year in defence, high-tech and maritime sectors. Even if originally only military students could be admitted, nowadays the majority of applicants are civilians. Research and training activities are allocated between high-level departments with a wide-range expertise: Autonomous Robotics, Hydrography, Pyrotechnic Systems, Human Sciences, Naval Architecture, and so on.

The Conservatoire National des Arts et Métiers (Cnam) is a French public higher education institution, national research centre and a Grand Etablissement/Grande Ecole of Engineering under the supervision of the Ministry of Higher Education. Founded in 1794 by the French bishop Grégoire, Cnam's core mission is dedicated to provide training throughout life (lifelong education) and conduct research for the promotion of sciences and industry. Created in 1981 in Cherbourg (Normandy), the Cnam Intechmer is dedicated to marine sciences and technologies and hold the same missions in these specialities.

Shom is a public administrative establishment (EPA) under the supervision of the Ministry of the Armed Forces, with three missions:

- national hydrography, to ensure the security of surface navigation in the waters under the cartographic responsibility of France;
- defence support, characterised by hydro-oceanographic expertise provided to the French Government Defence procurement and technology agency and Operational Support of Naval Forces;
- support for public policies on the sea and coastline, by making its heritage data and expertise available to public authorities.

As the Shom's responsibility can be engaged, it is imperative to master the entire data production chain; this cannot be done without integrating the very specific skills and training of the staff. Since hydrography for nautical safety purposes and marine cartography, at the technician level, are not taught in any school in France, Shom has created its own school with its own training resources in its fields of competence. In order to open its training to civilians, Shom and UBO have signed a partnership agreement since 2017, making it possible to deliver an Earth Sciences Bachelor diploma (BSc) to civilians and military personnel in addition to the Category B certificate. Since 2017, the course has been attended in average by one third military personnel and two third civilians, with gender parity respected.

The available trainings in hydrography

ENSTA Bretagne

ENSTA Bretagne provides an educational programme in hydrography recognised at »Category

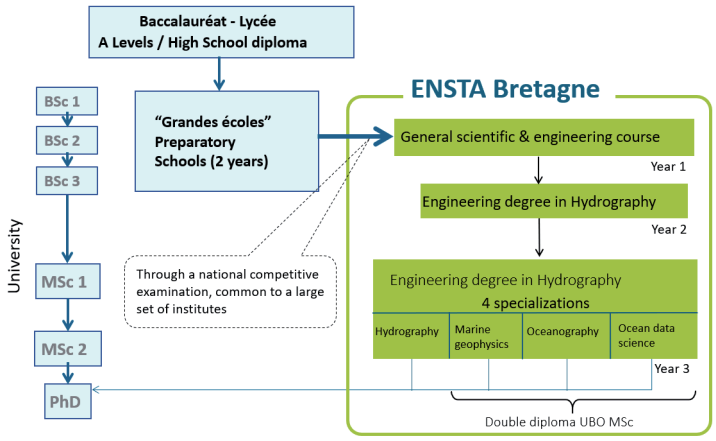

Fig. 1: ENSTA Bretagne application process for hydrography Cat. A programme

A level« by the International Hydrographic Organization (ENSTA 2022).

The classical way to get into a French engineering school requires to spend two years in a preparatory programme giving intensive education in basic sciences (i.e. Mathematics, Physics …). These preparatory years are followed by a national competitive examination, giving the opportunity to join a graduate and postgraduate engineering school for a three years engineering training programme. At ENSTA Bretagne, the core scientific training is completed by specialisation in the 2nd and 3rd years. Indeed, at the end of the 1st year, the students have to choose between different paths: Hydrography, Autonomous robotics, Vehicle Architecture, etc. After completion of this total amount of five years of study, ENSTA Bretagne delivers an engineering degree in Hydrography Cat. A.

External students, including international ones, holding a BSc or a 1-year MSc in a relevant discipline are welcomed to apply to ENSTA Bretagne course in Hydrography. The admission process consists of a selective examination of candidates' scientific background (Fig. 1).

Inside the hydrography cursus, ENSTA Bretagne and the University of Western Brittany (UBO) offer to 3rd-year ENSTA students the possibility of a double diploma (MSc from UBO) in marine geophysics or oceanography (Fig. 1).

Each year, up to 32 students graduate from ENSTA Bretagne »Hydrography« specialisation and start their career in a wide range of fields: applied research world, survey/dredging/offshore companies, hydrographic offices, equipment resellers or sensor manufacturers. The two military students become officers for the French Navy's Hydrographic and Oceanographic Service (Shom).

Cnam Intechmer

Cnam Intechmer provides three diplomas in marine sciences open to students with a scientific, technological or professional baccalaureate or with an equivalent scientific level for the deliverance of 180 ECTS. Among them, the Bachelor Océanographe-Prospecteur (BSc OP) is a three-year programme more focused in marine geology and geophysics (Fig. 2).

Cnam Intechmer Bachelor Océanographe – Prospecteur
3 YEARS / 180 ECTS / HYDROGRAPHY FIG OHI ACI CatB

FR le cnam intechmer

Bachelor OP – YEAR 1	ECTS
BCP001 OUTILS POUR LA PHYSIQUE	6
BCP002 GEOLOGIE GENERALE	6
BCP003 GEOLOGIE ET CHIMIE DES OCEANS	6
BCP004 OCEANOGRAPHIE GENERALE	6
BCP005 OCEANOGRAPHIE DYNAMIQUE	6
USTM16 INTERFACAGE ET LOGICIEL	6
USTM17 TRAITEMENT DES DONNEES	4
USTM18 GEOMATIQUE	6
USTM19 GEOLOGIE APPLIQUEE	6
USTM1A OCEANOGRAPHIE APPLIQUEE	6
USTM1B INSERTION PROFESSIONNELLE MARITIME ET INTERNATIONALE	2

Bachelor OP – YEAR 2	ECTS
BCP006 POSITIONNEMENT	5
BCP007 GEOPHYSIQUE MARINE APPLIQUEE	4
BCP008 DYNAMIQUE DES OCEANS	5
BCP009 GEOLOGIE ECONOMIQUE - AMENAGEMENT DU LITTORAL	4
BCP010: SEDIMENTOLOGIE	3
BCP011 ACTIVITES LIEES AU SURVEY	4
USTM1C ELECTRONIQUE EMBARQUEE ET INTERFACAGE	6
USTM1D : ANALYSES DE DONNEES OCEANOGRAPHIQUES	6
USTM1E MISSIONS EN MER	5
USTM1F PROJET PROFESSIONNALISANT	8
UA412S STAGE PROFESSIONNEL	10

OCEANOGRAPHY – MARINE SURVEY

EN HZS GHENT UNIVERSITY

Bachelor OP – YEAR 3	ECTS
HB300 INFORMATION AND COMMUNICATION TECHNOLOGY	3
HB310 NAVIGATION	6
HB320 INTRODUCTION TO SAFETY	3
HB330 SEAMANSHIP	3
HB340 WATER LEVELS AND FLOW	3
HB350 GEODESY & CARTOGRAPHIC SYSTEMS	3
HB360 HYDROGRAPHIC SURVEYING	6
HB370 DATA MANAGEMENT	3
HB380 GEOLOGY & GEOPHYSICS	3
HB390 LEGAL ASPECTS	3
HB500 HYDROGRAPHIC PRACTICE	24

HYDROGRAPHY

Fig. 2: Cnam Intechmer BSc OP's structure of course and certification in Hydrography FIG/IHO/ICA Cat. B. Note that learning units in pink are theoretical units – UE – and in blue practical units – US/UA – for a distribution of 50/50 of the ECTS credits each year

Since its creation in 2004, the Cnam Intechmer BSc OP propose two years on Cherbourg site to become a polyvalent technician/surveyor and a year on another site in English language in partnership with a foreign university to bring a speciality. Previously co-leaded with South Wales University (UK) until 2020 with a focus on Marine Renewable Energy, the collaboration is now shared with Ecole Supérieure de Navigation d'Anvers and Ghent University (Belgium) for hydrographic speciality with the recognition of FIG/IHO/ICA Cat. B level.

Each year, up to 18 students are graduated and find easily and quickly a position in industries, survey companies, ports and scientific institutions in a wide international context. They can also continue in Master degrees and Engineering Schools such as ENSTA Bretagne.

Shom

Shom provides a one-year programme in hydrography and a one-year programme in marine cartography (Fig. 3), both of them recognised at »Category B level« by the International Hydrographic Organization (Shom 2022).

The programme in hydrography is the third year of Earth Sciences BSc of UBO.

Military students following the Cat. B hydrography programme are selected by internal recruitment (within the French Navy) or external recruitment, at baccalaureate +2 level, as for the civilians. Each year, up to 15 students graduate from Shom hydrographic programme.

At the end of the course, the military students are assigned on the French hydrographic fleet at Shom. The best civilian students can enter a Master's degree or even one of the Cat. A programme in hydrography at ENSTA Bretagne. Civilian students enter professional life very easily (100 % of permanent position at the end of the year).

The students of the Cat. B marine cartography course are selected through a competitive examination by the Ministry of Defence. At the end of their training they become civil servants and are assigned to the cartography department at Shom.

After completion of their training, Shom delivers a degree in Hydrography Cat. B and a degree in marine cartography Cat. B, according to the programme followed.

External students, including international ones, with required scientific level (usually scientific baccalaureate + 2 years) are welcomed to apply to those Shom certified curriculums. Foreign students are admitted to the Shom school either as part of the French cooperation programme or through bilateral partnerships with foreign hydrographic services (Fig. 3).

In addition to its long courses approved by the IHO, the Shom's catalogue of continuing education courses also offers a wide range of short courses to improve the skills of personnel in particular fields of hydrography, marine cartography, oceanography or marine geophysics.

Educational means

ENSTA Bretagne teaching staff consists of eight teachers sharing complementary qualifications in

Fig. 3: Shom training courses

Morpin and Debese (2019)

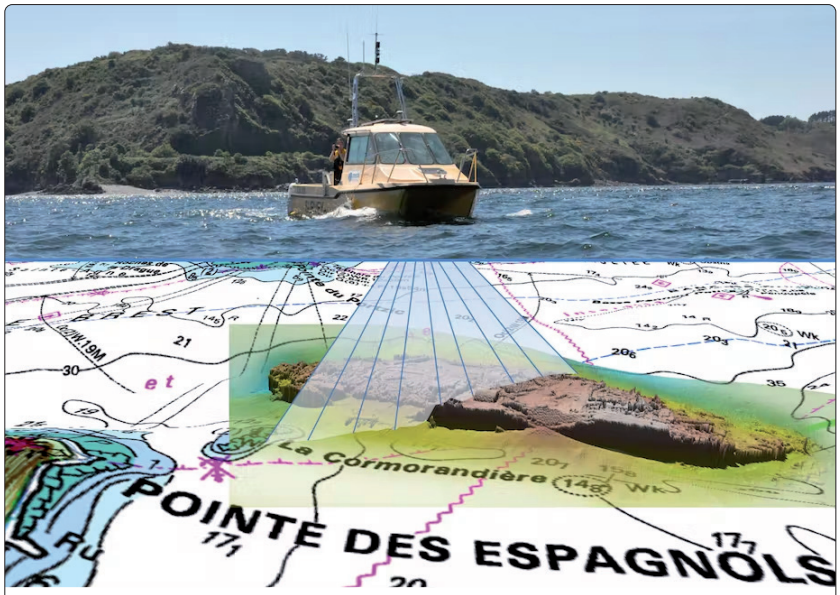

Fig. 4: ENSTA Bretagne survey vessel *Panopée*

data processing, inertial navigation, geodesy and underwater acoustics and so on. On top of this, external guest lecturers regularly give classes, and are mainly recruited from among French marine science institutes located within the Institute's vicinity: Shom, Ifremer, UBO, IUEM or from the industry. A noticeable amount of the training is about practical skills and requires students to achieve some experiments and surveys.

For that purpose, ENSTA Bretagne owes multiple platforms and sensors. The main platform is a 7 metre long survey vessel called *Panopée,* with a maximum speed of 15 knots and a short draught of only 40 cm, making very shallow waters survey possible (Fig. 4). The maximum capacity of six crew members allows training sessions for up to four students. The launch carries high-end hydrographic sensors mounted inside a moon pool: an inertial navigation system SBG Navsight and a multibeam echo sounder Kongsberg EM2040C lent by Shom. If necessary, additional SBES or ADCP sensors can be set up simultaneously on side poles. In addition, an amphibious vehicle named *ARGO* provides the ability to achieve coastline surveys with a 3D laser scanner Leica HDS6200 and a motion unit iXBlue Octans IV. For some years, these means are completed with autonomous vehicles, the most noticeable being a 3 metre long catamaran combining LiDAR and sonar.

Thanks to partnerships with QPS and Caris companies, ENSTA Bretagne trains its students on professional survey and data processing software solutions.

The Cnam Intechmer BSc OP course relies on ten permanent teachers at Cherbourg (France) and in Belgium, most of them are university lecturers and professors, but also more than thirty professionals from French or foreign companies and institutions delivering an up-to-date teaching at the nearest of the needs of the professional area.

The Cnam Intechmer is ideally located on the seaside, near Cherbourg's harbour. The sheltering position given by the Cherbourg artificial roadstead allows all-weather navigation (Fig. 5). Coastal vessels are made available each year by the French Oceanographic Fleet (Cherbourg site) or by survey companies (Ostende site) for our educational purpose. The O/V *Côtes de la Manche* is a 24.50 metre oceanographic vessel frequently assigned for pedagogic missions and designed for multi-purpose missions such as mapping with various equipment (Fig. 5): shallow-water multibeam echo sounders, hydrological measurements, underwater video, sampling by grab and dredge, acoustic and seismic trials.

The Cnam Intechmer is already well equipped for operational missions but the continuous technological evolution drives us to rent or use up-to-date equipment with industrial or academic collaborations, like sensors (Boskalis, Cadden, Aquatopo, Cnam ESGT, UBO, UniCaen …) or professional software solutions (QPS, IXBlue, Ifremer).

Shom school pedagogical team consists of three permanent teachers, one Cat. A hydrographic engineer and Cat. B hydrographic surveyors and around eighty temporary Shom staff who deliver courses in their field of expertise. This staff is complemented by university teachers. For practical training, Shom school uses one of the Shom hydrographic

Fig. 5: Cnam Intechmer location in front of the sea (left) and O/V *Côtes de la Manche* (right)

Fig. 6: Shom's school and Shom training facilities location

launch (Fig. 12), equipped with a multibeam echo sounder or the *Albert Lucas* launch (Fig. 13) from the UBO/IUEM for the civilian students, equipped with multibeam echo sounder from instrumental service »Pole Image et Instrumentation« of IUEM. French military students are also trained (during their complementary training) to operate French navy compact military hydrographic system (SDHM) used for rapid hydrographic assessment before beaching operations (Fig. 6).

Part 2: The practical training

ENSTA Bretagne CMFP in Lake of Guerlédan

ENSTA Bretagne practicals aim to gradually increase the level of autonomy and expertise throughout the hydrography programme. In their 2nd year, students are tasked to calibrate sensors, then to survey some dedicated areas close to Brest harbour with three different systems: a single-beam echo sounder, a multibeam echo sounder and a side-scan sonar. Based on their theoretical knowledge, trainees are responsible to establish a methodology for survey planning, data processing and quality assessment. In their 3rd year, students are in charge of a more complex and innovative project described below.

Since 2016, ENSTA Bretagne teaching staff has built a common practical training for last year students in hydrography and in mobile robotics. This complex multidisciplinary field project (CMFP) takes place at the artificial Lake of Guerlédan, centre of Brittany, France. The lake dam and its turbines are exploited by EDF, the France's main energy company, to produce electricity. With a depth up to 40 metre, significant slopes and underwater old structures (houses, trees, wrecks, lock), the area is quite challenging for surveys and robots' navigation.

The overall project lasts 132 hours over a period of six months. There are two practical sessions of intensive fieldwork at the lake: one week in October, one week in February (Fig. 7). The remaining time consists of preparation of experiments and data analysis at ENSTA Bretagne. It involves around 75 students and up to 25 teachers.

Thanks to funds from ISBlue (The interdisciplinary graduate school for the blue planet), some MSc students from IUEM (The European Institute for Marine Studies) joins the training on an annual basis. Scholars from other institutes are also welcomed.

Students are divided into small teams from three to five members, working on a wide range of topics, often suggested by companies or research institutes. The teaching staff encourage the submission of subjects merging hydrography and robotics advanced problems. A large amount of survey equip-

Fig. 7: *Panopée* survey vessel with the Guerlédan dam in the background

Fig. 8: Multiple platforms, some of them autonomous, for surveying the lake

Fig. 9: Amphibious vehicle *ARGO* surveying Guerlédan lake's dam

ment and robots are available on site (Fig. 8, Fig. 9) and students enjoy a high level of autonomy.

The local environment being quite tricky, students deal with complex situations:

- some very shallow water areas;
- low reflectivity seabed (soft mud) combined with significant slopes;
- GNSS multipath issues;
- varying water levels.

An equally important challenge is to learn how to work with people from other scientific communities. Indeed, because of their various scientific background, trainees share heterogeneous knowledge and have to learn to work efficiently as a team. During field experiments, some constraints stimulate synergy between groups:

- the number of platforms being limited, students have to share them;
- some tasks are interdependent (e.g., a group is in charge of a GNSS base station establishment);
- students deliver a daily oral report about their activities (Fig. 10).

Fig. 10: Recording of a daily podcast on students' fieldwork progress

All this acts to build up essential skills for team working: planning, organisation and communication.

The overall project come to an end in March, where all students give a restitution of their work in the form of a full day of presentations open to the public.

The project received sponsorship from ISBlue, AFHy (Francophone Association of Hydrography) and private sector (EDF, QPS, iXBlue, Kopadia …). ENSTA Bretagne is very grateful to all these contributors. More information about the project can be found on a dedicated website: guerledan.ensta-bretagne.fr.

Cnam Intechmer practical at sea aboard coastal missions

The practicals are the core of Cnam Intechmer BSc OP's training, with different practice learning sequences placed within the three years of the course:

- practical works in laboratory/computing/fieldwork;
- personal professional project in 2nd year;
- practicals at the sea in supported by French Oceanographic Fleet (FOF) in France and survey companies in Belgium;
- internship period (20 weeks in 2nd year, 6 × 5 weeks possible – at least 90 days needed in 3rd year).

The study of the marine domain requires technical skills in instrumentation (multibeam echo sounder, sonar, current meter, sensors), sampling methods (water column, sediment) and in analysis of georeferenced data (SIG, CAD/DAO). These techniques must be acquired during the training, and the practical works at sea are a key moment to integrate both knowledge and savoir faire. During the course, Cnam Intechmer organises two coastal missions supported by the French Oceanographic Fleet (FOF). Each academic year, the FOF affects us

Fig. 11: Cnam Intechmer 2021 teaching missions supported by the French Oceanographic Fleet (FOF)

two campaigns, classically December and March, for a total of approximately 20 days including mobilisation/demobilisation (Fig. 11). We can work during one week with six students and two teachers (night and day shift) or with ten students and two teachers for the daily operations. This allows students to work in real conditions they will encounter in their future professional position.

For the period dedicated to bathymetric acquisition, the task is to set up a complete acquisition with a MBES: from the material mobilisation to data storage. More than looking to data quality, we pay attention to the way the future technician deal with problems and solve it in an operational context. For our bathymetric mission, we work with a R2Sonic 2020 – SBG Systems *Apogée* solution. The students install, connect and configure all the equipment themselves in the ship. They monitor offsets measurements and apply patch test. A collaboration with QPS enables students to carry out the database for the acquisition with Qinsy and, during and after the survey, the data processing with Qimera.

Shom practical training

Practical works and field projects are performed in Brest surroundings and in the Brest roadstead. This sea area is appropriated for training: it is a nearly closed basin, which waters are protected from average winds by the local topography.

The Cat. B hydrographic programme includes a eight-week final project. The objective of the final year project is to allow each student to apply a large part of the theoretical courses and to gain experience in the realisation of the tasks entrusted to the hydrographer.

The project consists in a complete hydrographic survey that includes different types of surveys, among them a bathymetric survey using one hydrographic launch made available to the military students by Shom hydrographic fleet (Fig. 12) and

Fig. 12: Fassmer hydrographic launch, operated by the military students during the Final project

Fig. 13: N/O *Albert Lucas* of CNRS and Flotte Océanographique Française

the *Albert Lucas* launch (Fig. 13) from the UBO/IUEM for the civilian students.

For the acquisition work (bathymetric survey and topographic fieldwork), students are divided into small groups responsible for carrying out a number of defined tasks. In the data processing phase, each student works alone and prepares the final documents, data sets and reports corresponding to the surveys carried out. In the final phase, each student is responsible for producing a report and defend his/her work to the jury.

On top of the bathymetric survey, the students are asked to perform levelling of tide markers and geodetic positioning of geodetic points and remote landmarks (Fig. 14).

One major practical work during this Cat. B hydrographic curriculum is a two-week field project, called RADEC. It consists in a campaign of oceanographic measurements in the roadstead of Brest on *Albert Lucas* launch (Fig. 15). The students are asked to prepare the campaign, plan the data acquisition, perform the survey on board a small vessel, study the water samples in the chemistry lab, post-process the CTD measurements, interpret the results, provide an overview of the hydrological dynamics in the Brest roadstead. A report and an oral presentation of the results are provided and assessed.

As far as the Cat. B cartographic course is concerned, the objective of the final year project is to produce a complete nautical chart, applying the Shom procedure and provide to future cartographers a »leading line« for the first charts they will have to produce in their future positions. The final cartographic is performed over a time period of twelve weeks.

Fig. 14: Shom levelling exercises

All the Shom production means can be operated by trainees during this project. The main available tools and systems are Shom databases and archived data, computing and drawing tools and software, available nautical documentation.

The project evaluation is based on produced documents (preparation file, survey sheets and produced chart) in terms of rigor, completeness and accuracy, regulation, standards and procedure application and quality.

Part 3: Educational collaboration and interaction

Existing partnerships between ENSTA Bretagne, Cnam/Intechmer and Shom/UBO

The three French institutions are involved in the »Training in Hydrography – Hydro3 level« of the Francophone Association of Hydrography (AFHy). The »Hydro3 level« means the surveyor is able to perform independently a hydrographic survey by following a standard methodology. This four-weeks teaching is designed to increase knowledge about current measurements, positioning, echo sounders and practical multibeam survey. At the end, the trainees get a »Hydro3 level« certificate from AFHy.

Last years, part of graduates from ENSTA hydrography have come from »bridges« with other French education programmes. One can mention the students from Ecole Nationale des Sciences Géographiques (ENSG) who have the opportunity to gain a double degree ENSTA/ENSG by spending two years in each school. Also, after graduate from Shom or Intechmer, scholars can apply to ENSTA MSc.

Not only the students, but also the teaching staff, is shared between institutes. For example, the engineering degree of ENSTA Bretagne in Hydrography, and especially the double diplomas ENSTA/UBO MSc (Fig. 1) involves both teachers from ENSTA Bretagne and Shom.

Hydrographic equipment being costly, some agreements have been signed for sharing platforms and sensors. For example, Shom is lending a multibeam echo sounder to ENSTA Bretagne for 2016. ENSTA got also some depreciated equipment from Shom. By contrast, ENSTA Bretagne can provide its survey vessel for some Shom courses or experiments. Regional funds ensure the maintenance and sustainability of the systems (CPER).

ENSTA and IUEM/UBO are involved in ISBlue project: a 10-year project promoting common research and education programmes. Both Hydrography courses in Earth Sciences BSc and MSc are partly supported by this project, mainly for practi-

Fig. 15: RADEC oceanographic survey

cal aspects. All these institutions having close research and operational interests, students have opportunities to apply for summer internship or PhD.

International collaborations

From 2012 to 2014, ENSTA Bretagne co-organised a European Union Erasmus Intensive Programme in Hydrography and Geomatics with Ghent University (Belgium), HCU University (Germany) and the CIDCO (Canada). Students were in charge of surveying the lake of Vassivière (France) during two weeks, both with topographic and bathymetric sensors. The Erasmus funds made three annual sessions possible. This international collaboration was a success but has not been reconducted due to the consequential administrative workload induced. However, it shows that such international training camps are possible.

To renew such educational project at an international scale, two major issues are raised. Firstly, there is the question of funds. Some facilities exist like Erasmus or ISBlue, but it brings the critical question of time. Indeed, almost full-time equivalent persons are required to manage such a huge upstream workload. Today, ENSTA Bretagne has some experience with its CMFP but the organisation is kept quite simple with only a single host, the few external students coming as guests.

For its part, the Cnam Intechmer BSc OP is co-leaded with Belgian partners, thus it provides a relevant abroad experience in the course itself in order to enhance international employability after the diploma.

Finally, the Shom school annually welcomes international students. Most of them are admitted either as part of the French cooperation programme or through bilateral partnerships with foreign hydrographic services. Other trainees are also admitted to follow tailor-made courses, requested by their home organisation.

Prospects

These last years, the French educational facilities have been working on how to fit the teaching of hydrography with the new reality of the job. Indeed, unmanned vehicles are now a reality and the transition to autonomous operations is in process. Moreover, the amount of data, often heterogeneous both in terms of type and quality, is exponentially growing. All of these ongoing and future changes are considering in the trainings.

Firstly, changes have been made on the substance of the lectures. Now students have to master new knowledge such as marine robotics basics, big data or deep learning methods which are well suited for data processing tasks. These new expertises entail a strengthening of collaboration between teaching teams by demanding interconnected specialists.

Secondly, changes have been made on the form of the courses. For example, the Shom school has undertaken to develop distance learning in order to facilitate access to its training courses for external students, but also for its own personnel, within the framework of continuing professional training; thus, the Shom's on-board hydrographers, who are not very available to attend face-to-face courses, could benefit from this development. To this end, the Shom is recruiting an educational engineer and is going to equip itself with a Learning Management System that can be interoperable with the platforms of its partners, like ENSTA Bretagne.

Thus, the Shom school wants to engage in a digital transformation of its training apparatus, in order to offer hybrid training programmes. The AFHy Hydro3 training cycle, intended for staff members of AFHy, is one of the training courses to be adapted to this training method.

To achieve these goals, synergies are being sought between partners for sharing material resources and developing common educational teaching. //

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Hydrographic education and research at the HafenCity University Hamburg

An article by MONA LÜTJENS and HARALD STERNBERG

With more than 30 years of experience in hydrographic education, the HafenCity University Hamburg (HCU) provides a sophisticated study programme specialised in the field of hydrography which has been certified as a Category A programme by the FIG/IHO/ICA International Board on Standards of Competence for Hydrographic Surveyors and Nautical Cartographers. The programme is completely taught in English and can be completed within two years. Next to profound theoretical courses, the HCU's hydrography programme offers plenty of practical exercises on board of its own shallow-water research vessel *DVocean*. Apart from educational modules, several hydrographic research projects are conducted at HCU to further contribute to the ever rising research interest of the hydrographic sector.

hydrography education | practical training | Category A
enseignement de l'hydrographie | formation pratique | Catégorie A
Hydrographieausbildung | praktische Übungen | Kategorie A

Avec plus de 30 ans d'expérience dans la formation hydrographique, l'Université HafenCity de Hambourg (HCU) propose un programme d'études exigeant, spécialisé dans le domaine de l'hydrographie et certifié comme programme de catégorie A par le FIG/IHO/ICA International Board on Standards of Competence for Hydrographic Surveyors and Nautical Cartographers. Le programme est entièrement enseigné en anglais et peut être terminé en deux ans. En plus de cours théoriques approfondis, le programme d'hydrographie de la HCU propose de nombreux exercices pratiques à bord de son propre navire de recherche en eaux peu profondes, le *DVocean*. Outre les modules de formation, différents projets de recherche hydrographique sont menés à la HCU, contribuant ainsi à l'intérêt toujours croissant de la recherche en hydrographie.

Mit mehr als 30 Jahren Erfahrung in der hydrographischen Ausbildung bietet die HafenCity Universität Hamburg (HCU) ein anspruchsvolles, auf den Bereich der Hydrographie spezialisiertes Studienprogramm an, das vom FIG/IHO/ICA International Board on Standards of Competence for Hydrographic Surveyors and Nautical Cartographers als Kategorie-A-Programm zertifiziert wurde. Das Programm wird komplett in Englisch unterrichtet und kann innerhalb von zwei Jahren abgeschlossen werden. Zusätzlich zu fundierten theoretischen Kursen bietet das Hydrographie-Programm der HCU zahlreiche praktische Übungen an Bord des eigenen Flachwasser-Forschungsschiffs *DVocean* an. Neben den Ausbildungsmodulen werden an der HCU verschiedene hydrographische Forschungsprojekte durchgeführt, die zum stetig wachsenden Forschungsinteresse der Hydrographie beitragen.

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Introduction

The HafenCity University Hamburg (HCU) is the University of Built Environment and Metropolitan Development and combines all aspects of building and design as well as engineering and natural sciences. The overall research agenda prioritises climate, sustainability and digitisation and is implemented in the following degree programmes: Architecture, Civil Engineering, Geodesy and Geoinformatics, Urban Planning, Metropolitan Culture, Urban Design and REAP (Resource Efficiency in Architecture and Planning). For around 2,400 students and approximately 160 research and teaching staff, the HafenCity location, as Europe's largest inner-city urban development project, provides special attraction to the built environment and metropolitan theme of the university. Especially for hydrographic students, the university's site next to the river Elbe and close to the Port of Hamburg, offers an excellent educational and scientific setting on its own doorstep (Fig. 1).

Hydrographic education is taught in the Master's programme in Geodesy and Geoinformatics which extends over four semesters and is completed with the »Master of Science (MSc)«. Within the scope of the education three specialisations can be chosen: Geodetic Measurement Technology, Geoinformation Technology or Hydrography. All

specialisations are accredited by ASIIN (Akkreditierungsagentur für Studiengänge der Ingenieurwissenschaften, der Informatik, der Naturwissenschaften und der Mathematik e. V.) which is a non-profit association that works nationally and internationally for the recognition, comparability and quality assessment (accreditation) of Bachelor's and Master's degree programmes within the fields of engineering and natural sciences, mathematics and computer science as well as in medicine and economics (ASIIN 2022). To further seal the quality of the English taught specialisation in Hydrography, it has been additionally internationally certified as Category A programme (the highest level) by the FIG/IHO/ICA International Board on Standards of Competence for Hydrographic Surveyors and Nautical Cartographers (IBSC). The specialisation in Hydrography thus obtains a distinctive feature which is unique in Germany.

Academic hydrographic training in Hamburg dates back 35 years to 1985 when the first consecutive degree programme in hydrography was introduced at the Hamburg University of Applied Sciences (HAW). After completion of the six-semester degree programme in surveying, students could attend three additional theoretical semesters of hydrography and one practical semester to receive a double diploma in surveying and hydrography (Böder and Egge 2007). The course was first recognised by the FIG/IHO International Advisory Board on Standards of Competence for Hydrographic Surveyors in 1990 with Category A with »Specialization in Nautical Charting« and was followed by a Master of Science degree in 2000. After the HafenCity University Hamburg was founded by the Free and Hanseatic City of Hamburg in 2006, Hydrography has been integrated as a specialisation in the two-year Master of Science »Geodesy and Geoinformatics« (until 2017 »Geomatics«). In 2017, the programme was recertified by the FIG/IHO/ICA IBSC as a Category A course and has been approved under the new Standard S-5A (First Edition, August 2016) and the corresponding Guidelines for the Implementation of the Standards of Competence for Hydrographic Surveyors (First Edition, July 2016) (Sternberg and Dufek 2018).

While the university can look back on many years of experience in hydrographic education, current research should not be neglected. Recent research activities cover autonomous subsea monitoring, deep sea massive sulphide investigations, automatic object detection and habitat mapping. All in all, the university offers comprehensive hydrographic education and attracts many students every year from all over the world.

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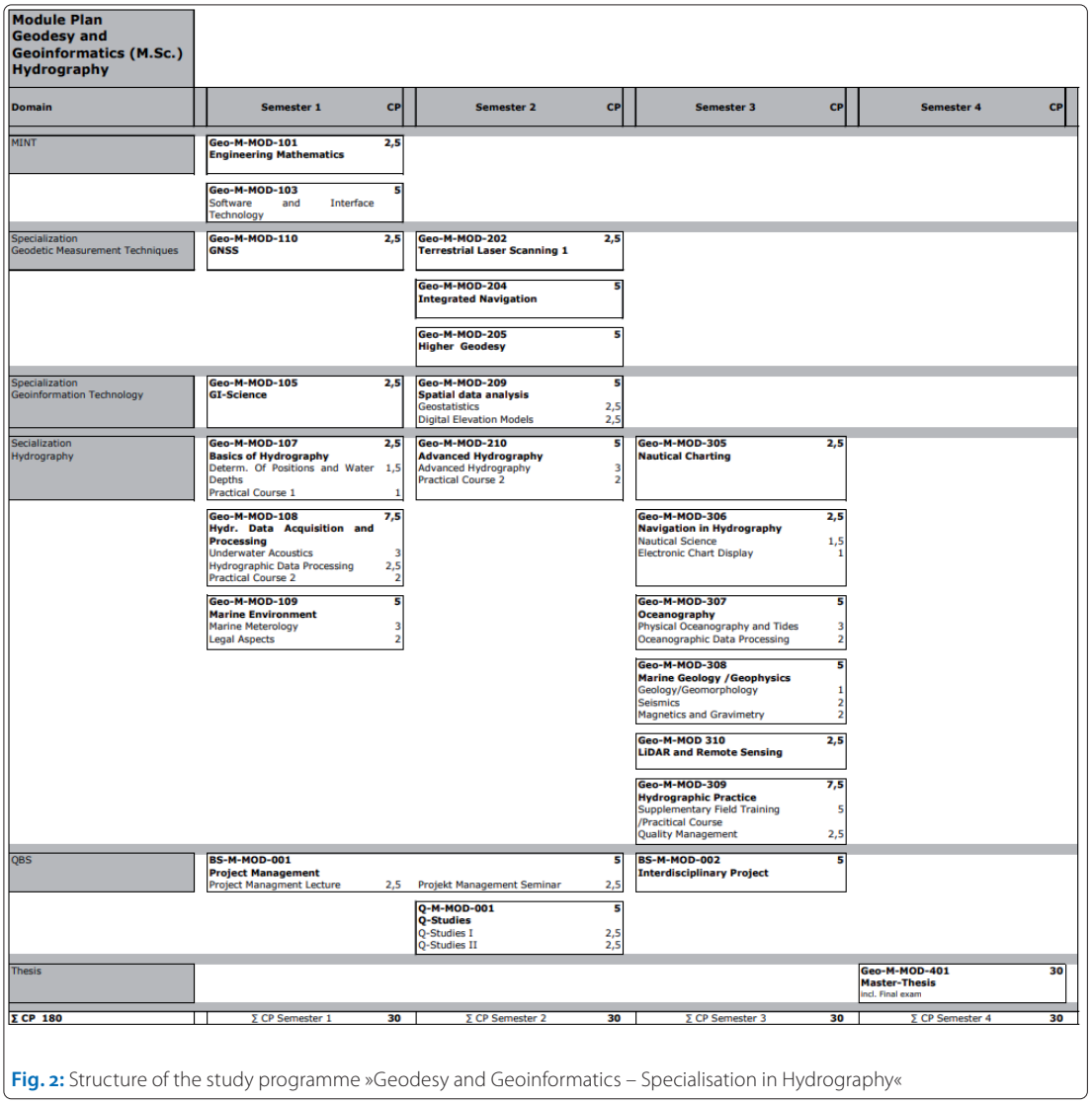
Fig. 1: Location of HafenCity University Hamburg on the river Elbe (top) and its interior (bottom)

Programme structure

The discipline of »Geodesy and Geoinformatics« at HCU does not have an ordinary structure compared to other universities as there are no specific departments or institutes. Instead, the discipline is integrated into the interdisciplinary Bachelor and Master school for teaching, the research school and some interdisciplinary research groups. The Master programmes are led by a dean of studies who is supported by a programme coordinator and a secretary. Currently, there are four professors teaching in »Geodesy and Geoinformatics« with additional help of about 20 scientific and technical staff.

In the Master's specialisation in Hydrography students are progressively introduced to complex problems in order to solve them using scientific approaches. Special emphasis is given to develop methodological and analytical skills that are needed to independently integrate scientific techniques from various disciplines. The programme is completely taught in English and the programme structure can be seen in Fig. 2.

To successfully finish and graduate with a Mas-



Module Plan Geodesy and Geoinformatics (M.Sc.) Hydrography

Domain	Semester 1	CP	Semester 2	CP	Semester 3	CP	Semester 4	CP
MINT	**Geo-M-MOD-101** Engineering Mathematics	2,5						
	Geo-M-MOD-103 Software and Interface Technology	5						
Specialization Geodetic Measurement Techniques	**Geo-M-MOD-110** GNSS	2,5	**Geo-M-MOD-202** Terrestrial Laser Scanning 1	2,5				
			Geo-M-MOD-204 Integrated Navigation	5				
			Geo-M-MOD-205 Higher Geodesy	5				
Specialization Geoinformation Technology	**Geo-M-MOD-105** GI-Science	2,5	**Geo-M-MOD-209** Spatial data analysis Geostatistics Digital Elevation Models	5 2,5 2,5				
Secialization Hydrography	**Geo-M-MOD-107** Basics of Hydrography Determ. Of Positions and Water Depths Practical Course 1	2,5 1,5 1	**Geo-M-MOD-210** Advanced Hydrography Advanced Hydrography Practical Course 2	5 3 2	**Geo-M-MOD-305** Nautical Charting	2,5		
	Geo-M-MOD-108 Hydr. Data Acquisition and Processing Underwater Acoustics Hydrographic Data Processing Practical Course 2	7,5 3 2,5 2			**Geo-M-MOD-306** Navigation in Hydrography Nautical Science Electronic Chart Display	2,5 1,5 1		
	Geo-M-MOD-109 Marine Environment Marine Meterology Legal Aspects	5 3 2			**Geo-M-MOD-307** Oceanography Physical Oceanography and Tides Oceanographic Data Processing	5 3 2		
					Geo-M-MOD-308 Marine Geology /Geophysics Geology/Geomorphology Seismics Magnetics and Gravimetry	5 1 2 2		
					Geo-M-MOD 310 LiDAR and Remote Sensing	2,5		
					Geo-M-MOD-309 Hydrographic Practice Supplementary Field Training /Pracitical Course Quality Management	7,5 5 2,5		
QBS	**BS-M-MOD-001** Project Management Project Managment Lecture	5 2,5	Projekt Management Seminar	2,5	**BS-M-MOD-002** Interdisciplinary Project	5		
			Q-M-MOD-001 Q-Studies Q-Studies I Q-Studies II	5 2,5 2,5				
Thesis							**Geo-M-MOD-401** Master-Thesis incl. Final exam	30
Σ CP 180	Σ CP Semester 1	30	Σ CP Semester 2	30	Σ CP Semester 3	30	Σ CP Semester 4	30

Fig. 2: Structure of the study programme »Geodesy and Geoinformatics – Specialisation in Hydrography«

ter of Science, students are required to complete a workload of 30 credit points (CP) per semester, resulting in a total of 120 CP for the entire study. After completing three regular semesters of lectures and practicals, students write their final thesis in the fourth semester over a period of five months. As the Master's programme in »Geodesy and Geoinformatics« is divided into three specialisations, modules can be both compulsory and elective and are taught in conjunction with each other. Consequently, all students will attend an introductory hydrography lecture in their first semester to gain basic understanding in this field. Having this close linkage within the »Geodesy and Geoinformatics« programme, students learn and work together which emphasises on scientific exchange. Moreover, all professors are equally involved in the hydrography specialisation.

The HCU's interdisciplinary and transdisciplinary approach is also reflected beyond the individual study fields as modules such as [Q]-Studies and BASICS are offered across all degree programmes. Within these modules, the university educates students not only to be confident in their own discipline but to have an understanding and appreciation of neighbouring disciplines, thereby promoting creative collaboration and receptiveness to different ways of seeing and thinking. While the [Q]-Studies are a set of elective courses where students choose from a variety of changing topics, BASICS courses teach competencies and soft skills that enable students to use and examine classic project management tools.

Beyond the interdisciplinary approach of the HCU, the professional identity of geodesy and geoinformatics is maintained on the one hand by a common, regular meeting »Plenum Geodesy and Geoinformatics«, on the other hand by four disciplinary laboratories: »Geodesy«, »Geoinformation and Geovisualization«, »Hydrography« and »Photogrammetry and Laserscanning«.

Research vessel *DVocean*

The *DVocean* (Fig. 3) is the new survey vessel of the HCU which can be used for both teaching and research projects. It was designed for the use

Fig. 3: Research vessel *DVocean*

in shallow waters to explore and monitor primary inland waterways and their built-up banks. Moreover, areas of application include the investigation of new approaches for position determination and bottom structure analyses to determine the stability of buildings and underwater structures. Initial measurements to create test fields for hydrographic sensors will be further acquired and analysed.

The survey equipment for the *DVocean* comprises of state-of-the-art sonars such as multibeam echo sounder and sub-bottom profiler in addition to a positioning and inertial measurement system. These instruments will be used in conjunction with low-cost equipment such as a two-frequency single-beam echo sounder, fish finder and an open-source ROV. Special or further borrowed sensors may be mounted on the vessel for detailed surveys or specific tasks. With three poles of which one is located at the bow and one on each side of the vessel, sensors are able to record data simultaneously. Additionally, the vessel can be equipped with a laser scanner on its roof to map the surrounding environment both below and above the water line. As the assembly of sensors is modular, they can be easily installed and replaced depending on the application question.

With a length of about 8 metres, the aluminium vessel can be towed with a trailer making it accessible to more distant and secluded survey areas. In addition to the skipper, the cabin can accommodate six people with sufficient free working space. Further details can be seen in Table 1.

DVocean
Total length: 8.8 m
Total width: 2.6 m
Maximum draft: 0.9 m
Height of the boat above the waterline: 2.8 m
Propulsion: 2 outboards and bow thruster
Maximum number of persons on board: 10
Shipyard: Lübeck Yacht Trave Schiff GmbH
Launched: 2019

Table 1: Key specifications of the *DVocean*

The name *DVocean* was chosen in memory of the professors Delf Egge and Volker Böder, who were very committed to the HCU's Hydrography specialisation and contributed significantly to its development. The letter D is the initial letter of Prof. Delf Egge and the letter V is the initial letter of Prof. Volker Böder. The pronunciation shall further remind of the English word »devotion«.

Measurement exercises

The hydrography lectures are accompanied by a variety of exercises and tutorials and these training phases provide necessary practical experience. In the third semester, a final field project will be executed which is a multidisciplinary exercise that builds on the knowledge acquired in previously attended courses. In this final project, a complex hydrographic scenario has to be planned, prepared, conducted, documented and evaluated by all students from scratch. The project also enables the formulation of research questions leading to individual elaborations of the practical by each student. Apart from the timeline, available instrumentation and facilities, students have to plan and prepare everything by themselves. Fig. 4 gives impressions of the measurement exercises. To gain insights into the professional world, HCU is in close cooperation with various institutes and authorities. The students have the possibility to apply for

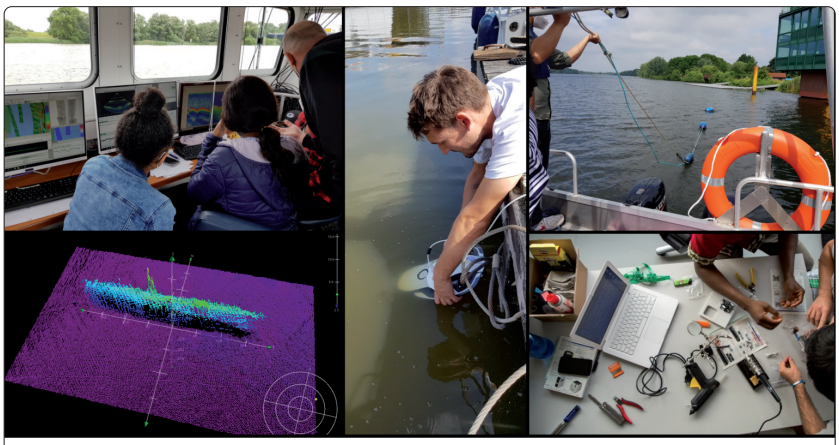


Fig. 4: Students during the exercises and the final project

internships or write their final thesis in collaboration with these partners.

Research projects

As a leading academic institution in hydrography, HCU's research projects cover multiple topics. Within the INDEX project (INDian ocean EXploration), the Federal Institute for Geosciences and Natural Resources (BGR) is supported by the HCU in the acquisition and analysis of multibeam echo sounder data from ship-based and deep-towed platforms (BGR 2022). In the face of ever rising prices for raw materials, potential deposits of polymetallic seafloor massive sulphides are being explored. With licences issued from the International Seabed Authority, annual exploration campaigns have been undertaken using different available research vessels. The aim is to identify massive sulphide deposits that have been formed at the outflow points of formerly active hydrothermal vents on the seabed. With the use of a deep-towed sled, bathymetry, backscatter and water column data are acquired. HCU is involved in the analysis and evaluation of such data sets to identify and characterise hydrothermal vent sites, corresponding sulphide deposits and their extent. The results will be implemented into a general exploration concept.

Another current research project is investing in the development of a novel autonomous underwater vehicle (AUV) that is able to autonomously monitor underwater installations and infrastructure such as pipelines or cables in the deep sea. The CIAM project (Comprehensive Integrated and fully Autonomous subsea Monitoring) was funded by the German Federal Ministry for Economic Affairs and Energy as a joint project (ROSEN Group 2022). HCU's contribution lies in the development of adaptive navigation filters and automated object detection from hydrographic data for autonomous underwater docking of the AUV to a mother ship or harbour. Additionally, HCU is developing methods for the detection and automated tracking of pipelines and overseas cables.

Research regarding object detection and instance segmentation is further addressed in the field of benthic habitat mapping in the Southern Ocean. Underwater images were collected during the expedition PS118 conducted by the Alfred Wegener Institute, Helmholtz Centre for Polar and Marine Research (AWI). The focus rests on the development of an automatic object detection and segmentation algorithm (Lütjens and Sternberg 2021). Findings of this work will contribute to the estimation of distribution and abundances of encountered species revealing relationships with the environment for predictive habitat mapping. //

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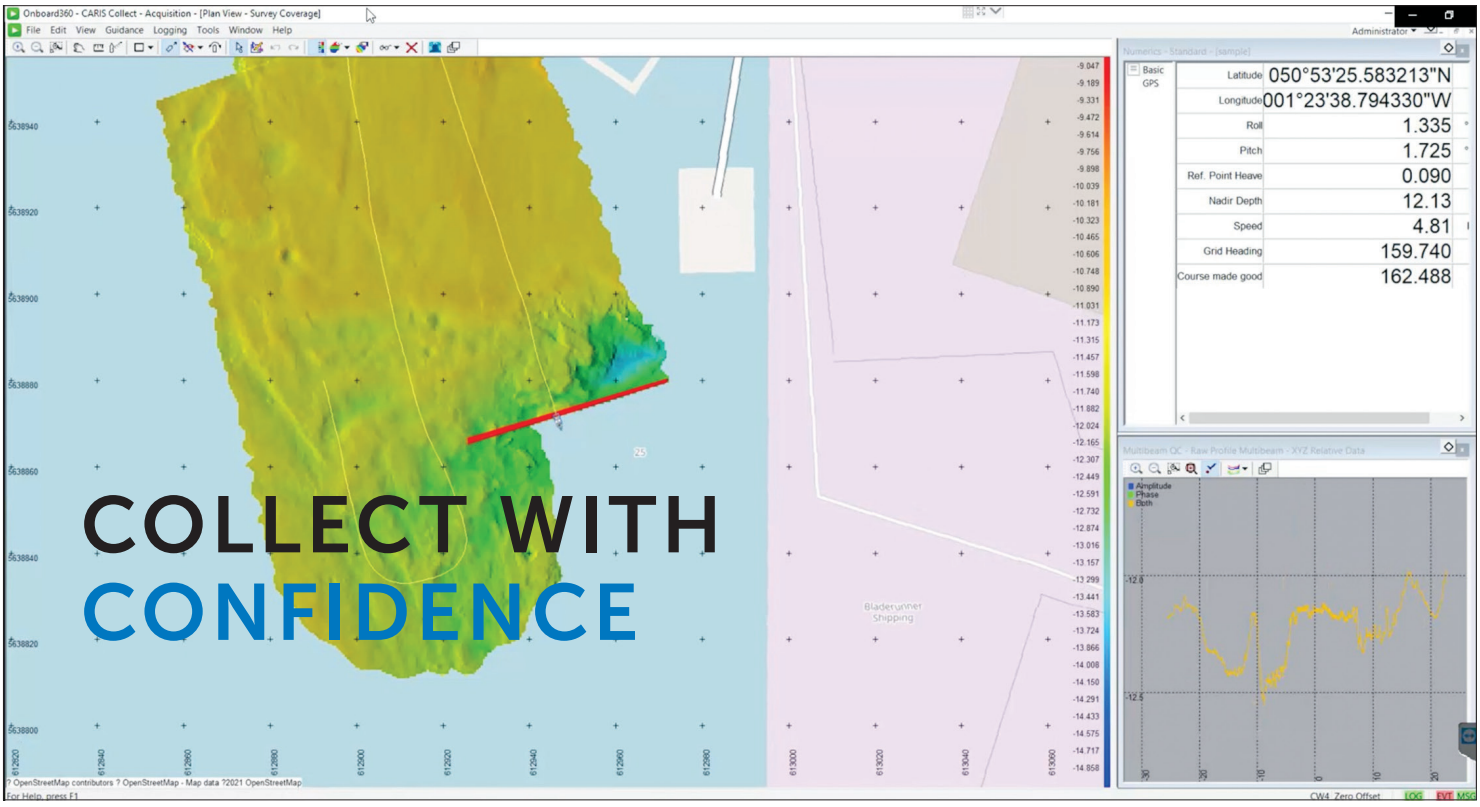

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Hydrography in Hamburg: like a fish to water

An article by CÉLINE VAN MIGERODE

Céline Van Migerode is a Belgian student who just graduated the Master Geography and Geomatics at Ghent University. In her final Master year, she participated in an exchange programme and studied for one semester at the HafenCity University in Hamburg. Currently, she is a PhD candidate in Social Geography at KU Leuven doing research about uncertainty related with urbanisation. In this article, she reports on her Erasmus experience in Hamburg.

hydrography education | practical training | Erasmus semester
enseignement de l'hydrographie | formation pratique | semestre Erasmus
Hydrographieausbildung | praktische Übungen | Erasmussemester

Céline Van Migerode est une étudiante belge qui vient d'obtenir le master Géographie et Géomatique de l'Université de Gand. Lors de sa dernière année de master, elle a participé à un programme d'échange et a étudié pendant un semestre à l'université HafenCity de Hambourg. Actuellement, elle est candidate au doctorat en géographie sociale à la KU Leuven et mène des recherches sur l'incertitude liée à l'urbanisation. Dans cet article, elle parle de son expérience Erasmus à Hambourg.

Céline Van Migerode ist eine belgische Studentin, die gerade ihr Masterstudium in Geografie und Geomatik an der Universität Gent abgeschlossen hat. In ihrem letzten Masterjahr machte sie ein Auslandssemester an der HafenCity Universität in Hamburg. Derzeit ist sie Doktorandin in Sozialgeografie an der KU Leuven und forscht über Unsicherheit im Zusammenhang mit der Urbanisierung. In diesem Artikel berichtet sie über ihre Erasmus-Erfahrung in Hamburg.

Author
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No better place to immerge in the fascinating world of hydrography than Hamburg, the city on the banks of the Elbe river, home to the most important port in Germany (Fig. 1). From August 2021 to March 2022, I moved to Hamburg to get a taste of the German life, study hydrography and gather practical experience on board of a survey vessel.

During my first month in Hamburg, I got the opportunity to follow an internship in the Federal Maritime and Hydrographic Agency in Hamburg (Bundesamt für Seeschifffahrt und Hydrographie, BSH). Guided by the expertise of Birgit Klein and Ingrid Angel, I contributed to the EURO-ARGO RISE project by performing simulations with Virtual floats in boundary currents in the Nordic Seas. I learned about the Argo project – an international programme with the aim of monitoring and studying the oceans dynamics and the processes –, gained insight in oceanographic models and experimented with optimisation algorithms.

After the interesting period at the BSH, I started as an exchange student in the Master Geodesy and Geoinformatics at the HafenCity University Hamburg. The majority of my courses were taught within the specialisation Hydrography. I followed some basic courses to strengthen my elementary foundation in hydrographic science: I gained knowledge in common hydrographic terminology, in the principles of underwater acoustics, and got insight into the working in principles of popular underwater sonar systems such as the multibeam echo sounder and the side-scan sonar. In more advanced classes, I was taught how to adequately prepare and realise the complex multisensory procedure that is a hydrographic survey, and during practical fieldwork, I put the theoretical knowledge into practice and gained experience on board of a survey vessel.

The most specialised and intrusive course in my curriculum was an advanced training that guided me through every step of a hydrographic survey: from a ship alignment survey and cruise planning to data acquisition and processing. Under supervision of Mona Lütjens and Friederike Köpke, I conducted a survey on board of the *Ludwig Prandtl* in which we acquired data with advanced hydrographic instruments such as an Acoustic Doppler Current Profiler, a side-scan sonar and a sub-bottom profiler. With the acquired data, I solved a self-chosen research question; I investigated the relation between the flow velocity and the

Fig. 1: Céline Van Migerode in the port of Hamburg

micro-bathymetry. During the field training, I really gained theoretical and practical expertise as a hydrographer.

Apart from the in-depth hydrographic courses, I also followed German-taught courses from the specialisation »Geodätische Messtechnik« (Geodetic Measurement Technology) within the Master in Geodesy and Geoinformatics. The courses not only allowed me to expand my knowledge in other subdisciplines of geomatics, but also to improve my German speaking and writing skills. In one of the courses, 3D-visualisation, I learned how to build a game in Unreal Engine. I developed a game in Virtual Reality with as key feature one of the most stunning buildings in Hamburg: the Planetarium (Fig. 2).

In addition to the high-quality educational experience in Hamburg, I also experienced a lot of unforgettable moments with my friends and roommates. Accommodated in the Gustav-Radbruch-Haus, home to a large international community of students from all over the world, I learned from different cultures and met a lot of interesting people. The semester abroad as a whole was thus an important and valuable experience both on a personal and education level.

The exchange semester was an immersive experience in hydrography by the combination of both the internship at the BSH and the specialised courses at HCU. And even though at the moment I am not working in the hydrographic sector, the semester in Hamburg was a valuable experience and taught me a lot of relevant insights in performing fieldwork, analysing data and modelling principles in general. I would certainly recommend a semester abroad in Hamburg at the HafenCity University, especially for students interested in hydrography. //

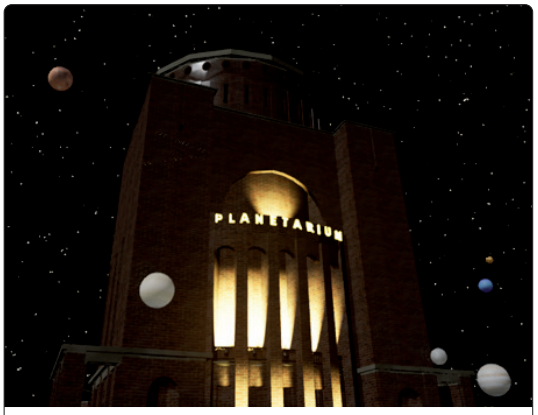

Fig. 2: The Planetarium in a Virtual Reality game

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A hydrospatial research centre with an international scope

An article by MOHAMED ALI CHOUAER and GUILLAUME LABBÉ-MORISSETTE

CIDCO, a non-profit organisation created in 2002, is at the forefront of marine, hydrographic and hydrospatial sciences. For the past 20 years, the CIDCO team has allowed the only French-speaking hydrography research centre in America to work on numerous projects (international and local) for ministries, municipalities, industries, private companies, educational institutions and many other renowned partners. We also developed hydrographic equipment and software to facilitate the acquisition and interpretation of underwater data. Our mission is to modernise hydrography. You will learn how we offer an internationally certified S-5 Category B training programme, how we use LiDAR and sonar for autonomous navigation and infrastructure inspection, and how crowdsourced bathymetry (CSB) contributes to the global seabed mapping effort.

CIDCO | distance learning | Category B | crowdsourced bathymetry | MASS | habitat map
CIDCO | enseignement à distance | Catégorie B | bathymétrie participative | MASS | carte des habitats
CIDCO | Fernstudium | Category B | Crowdsourced Bathymetry | MASS | Habitatkarte

CIDCO, une organisation à but non lucratif créée en 2002, est à la fine pointe des sciences marines, hydrographiques et hydrospatiales. Depuis 20 ans, l'équipe du CIDCO a permis au seul centre de recherche francophone en hydrographie d'Amérique de travailler sur de nombreux projets (internationaux et locaux) pour des ministères, des municipalités, des industries, des entreprises privées, des institutions d'enseignement et bien d'autres partenaires de renom. Nous avons également développé des équipements et des logiciels hydrographiques pour faciliter l'acquisition et l'interprétation des données marines. Notre mission est de moderniser l'hydrographie. Vous apprendrez comment nous offrons une formation S-5 catégorie B certifiée, comment nous utilisons le LiDAR et le sonar pour la navigation autonome et l'inspection des infrastructures, et comment la bathymétrie participative (CSB) contribue à l'effort global de cartographie des fonds marins.

CIDCO, eine 2002 gegründete gemeinnützige Organisation, steht an der Spitze der Gewässerwissenschaften sowie der Hydrographie. In den letzten 20 Jahren hat das Team des CIDCO als einziges französischsprachiges Forschungszentrum für Hydrographie in Amerika an zahlreichen (internationalen und lokalen) Projekten für Ministerien, Gemeinden, Industrie, Privatunternehmen, Bildungseinrichtungen und viele andere renommierte Partner gearbeitet. Wir haben hydrographische Geräte und Software entwickelt, um die Erfassung und Auswertung von Unterwasserdaten zu erleichtern. Unser Ziel ist es, die Hydrographie zu modernisieren. Sie erfahren, wie wir ein international zertifiziertes Trainingsprogramm nach S-5 Kategorie B anbieten, wie wir LiDAR und Sonar für die autonome Navigation und die Inspektion von Infrastrukturen einsetzen und wie die Crowd-Sourced Bathymetry (CSB) zur globalen Kartierung beitragen kann.

Authors
Mohamed-Ali Chouaer is Marine geomatics specialist, Guillaume Labbé-Morissette is Director of Research and Development at CIDCO in Quebec, Canada.

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CIDCO presentation

The Centre for Interdisciplinary Ocean Mapping Development (CIDCO), located in Quebec (Canada), is a hydrospatial R&D organisation working on the development of technologies for the acquisition, management and graphic representation of marine spatial data. CIDCO is a non-profit organisation (established in 2002) at the forefront of marine, hydrographic and hydrospatial sciences, serving the R&D needs of institutions and industry.

CIDCO has developed an international partnership network (particularly with France: ENSTA Bretagne, Shom, Ifremer, iXblue, Hytech Imaging, Compagnie National du Rhône CNR, Énergie de France EDF, etc.) and is an active member of the Canadian Coastal Ocean Mapping Research and Education Network (COMREN) in addition to being recognised by Fisheries and Oceans Canada as a Canadian Champion for the United Nations Decade of Ocean Sciences for Sustainable Development (2021–2030).

Over the past 20 years, the CIDCO team, in addition to offering world-renowned S-5 Category-B training, has enabled the operational research and development centre to work on numerous projects for ministries, municipalities, industries, pri-

vate companies, educational institutions and many other renowned partners. The team also develops and transfers hydrographic equipment and software such as HydroBall®, HydroBlock®, HydroTom, Depthstar and OpenSideScan to facilitate the acquisition and interpretation of underwater data with institutional and commercial partners.

Among its many achievements, CIDCO has proposed to integrate new inspection methods combining sonars and laser scanners into autonomous navigation technologies in order to carry out the inspection of all types of partially submerged infrastructure at lower costs, in complete safety and in a sustainable manner. In recent years, CIDCO developed high-precision calibration algorithms, which have solidified its reputation as a leader in automated metrological solutions. These include the auto-calibration of boresight angles, of inter-sensor latency and of lever arms. Currently, CIDCO is developing intelligent algorithms allowing either autonomous or semi-supervised navigation in complex environments, such as ports and harbours. This will allow survey vehicles to maintain optimal coverage while avoiding static and dynamic obstacles within the active port dynamics, increasing both the safety and efficiency of the survey work.

A certified S-5 Category-B training

Parallel to the excellence of its applied research, CIDCO is also known for its vocational training in hydrographic sciences, with a unique feature: the possibility to follow a Category-B training at distance. It is the only institution in North America offering a recognised course in hydrographic surveying in both French and English languages. This course aims to provide theoretical foundations and practical field experience that enables future hydrographers to execute hydrographic surveys, monitor and evaluate survey data quality in accordance with the latest IHO standards. The targeted audience for this course constitutes people with at least a technical diploma in geomatics, surveying, civil engineering, or related fields. Many of these people are those with a significant experience in hydrography with no certification or recognition who now see the need to follow a certified training. The training allows graduated students to work as hydrographers on large survey operations such as nautical charting surveys, offshore surveys or on small survey units, utilised for ports, coastal engineering, inland waters and surveys launches in support of a large-scale survey operation.

CIDCO is committed to capacity building, not only in Canada but also worldwide. It is with this in mind that CIDCO has been developing its expertise in distance learning since 2016. Indeed, well before the Covid-19 pandemic, CIDCO's online training course »Course in Hydrographic Surveying« has been offered as e-learning modules, making this course accessible to students from all around the world. Over the past six years, 33 students from 18 different countries have completed the online programme (Fig. 1), with the constant support of the CIDCO's tutors that can be found with a few clicks on the other end of the mouse.

Fig. 1: Origin of students who have participated in the CIDCO Cat-B programme since 2016

The theoretical part of the course is given as an e-learning formula (Fig. 2). The online platform is among the best Learning Management System (LMS) on the market. It enables the management of course activities, post course materials and electronic documents. This type of format makes the teaching resources and materials accessible to students any time from any computer anywhere in the world. In addition, this gives students the opportunity to complete the online activities at their

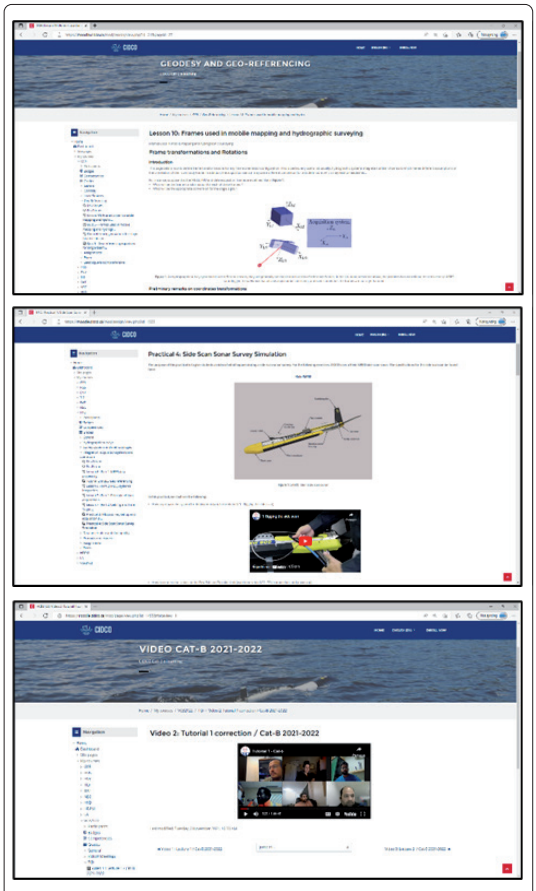

Fig. 2: CIDCO e-learning platform

Fig. 3: Cat-B students performing different hydrographic tasks

own pace without the same pressures as in-class activities.

The theoretical part is followed by an in-person practical session (Fig. 3), a seven-week field session on site, in Rimouski, Canada, to put into practice the theory and knowledge all through a well-defined hydrographic survey project. This part is critical and important not only to put in practice learning and ensure qualification before graduation, but also to establish great invaluable relationships between participants from around the world, creating a rich international professional and personal network for the future.

Applied research projects

CIDCO is incorporated as a non-profit organisation, which gives it a great deal of independence and flexibility in its action plan. Among the many projects on which it has succeeded in distinguishing itself, four are summarised below.

First Nations – Trusted crowdsourced bathymetry and capacity building in British Columbia

The International Hydrographic Organization (IHO) defines crowdsourced bathymetry (CSB) as depth measurements from vessels, collected using standard navigation instruments, while engaged in routine maritime operations (https://iho.int/en/csbwg). Canada has been looking at developing a reliable approach, based on collaborative data collection, to address the enormous challenge of collecting hydrographic data in all remote areas of the country where bathymetric data are lacking.

As part of a previous crowdsourced bathymetry (CSB) pilot project in the northern region of Canada, participatory bathymetry systems (HydroBall® and HydroBlock®) were developed by some COMREN members for data acquisition, processing and dissemination. These systems were specifically developed for use by non-specialists.

The project that CIDCO with COMREN partners have been working on focuses on building the capacity of First Nations communities to engage, involve and participate in the collection of hydrographic data to ensure safe and efficient navigation in remote areas of the central coast of British Columbia. The data can also be used to characterise the marine environment. Training and knowledge transfer to the Nanwakolas Council and its member First Nations communities was provided in the summer of 2022 in order to collect the data according to national and international standards.

As a result of the lessons learned from this innovative project, the CIDCO team upgraded the participatory bathymetry systems, expanded its

Fig. 4: Hydroball® on the field

capacity for CSB and facilitated data dissemination to the Nanwakolas Council and its members in First Nations communities in British Columbia. This was an opportunity to co-design new models involving stakeholders in all its operations with the intention of integrating, not replacing, the knowledge of the Nanwakolas Council and its First Nations members about hydrospatial conditions and safety at sea in their regions.

Given that only 23.4 % of the world's oceans have been surveyed to date and to meet the challenges of initiatives such as Seabed 2030, several technologies have been developed and used. The technology proposed by CIDCO and its partner M2Ocean® to meet this challenge was a low-cost system that allows for the recording of depth and position data on any type of vessel. In the spring of 2021, a project to develop this type of system was completed by the CIDCO team. The project developed a prototype of an improved version of the HydroBall® (Fig. 4). The original HydroBall® is a compact tractable bathymetric survey system. The main benefit of the HydroBall® is its capacity of being deployable without having to adapt the supporting vessel. The objectives of this project were to improve the technological capabilities of the HydroBall® in order to increase its number of applications, to add intelligent functions and to use artificial intelligence for the classification of seabed substrates.

CIDCO and M2Ocean are already part of the CSB expert committees and have already been approached by three national hydrographic services (Canada, the United States and Denmark) to request an intelligent and robust product that they can put in the hands of operators in their jurisdictions.

The HydroBall® and HydroBlock® are compact systems that integrate GNSS, an inclinometer and a single-beam echo sounder. Bathymetric soundings taken with these systems meet IHO standards (S-44 Order 1b).

Enabling MASS technologies

The emergence of Maritime Autonomous Surface Ships (MASS) represents a unique opportunity in terms of instrumentation and collaborative hydrospatial data acquisition techniques. This project aims to exploit Trusted Collaborative Bathymetric Acquisition (TCSB) techniques to build an operational framework to facilitate the implementation of MASS technologies.

CIDCO is building on the concept of participatory bathymetric data collection, using the opportunity of commercial vessels, by equipping large vessels with bathymetric data loggers (Hy-

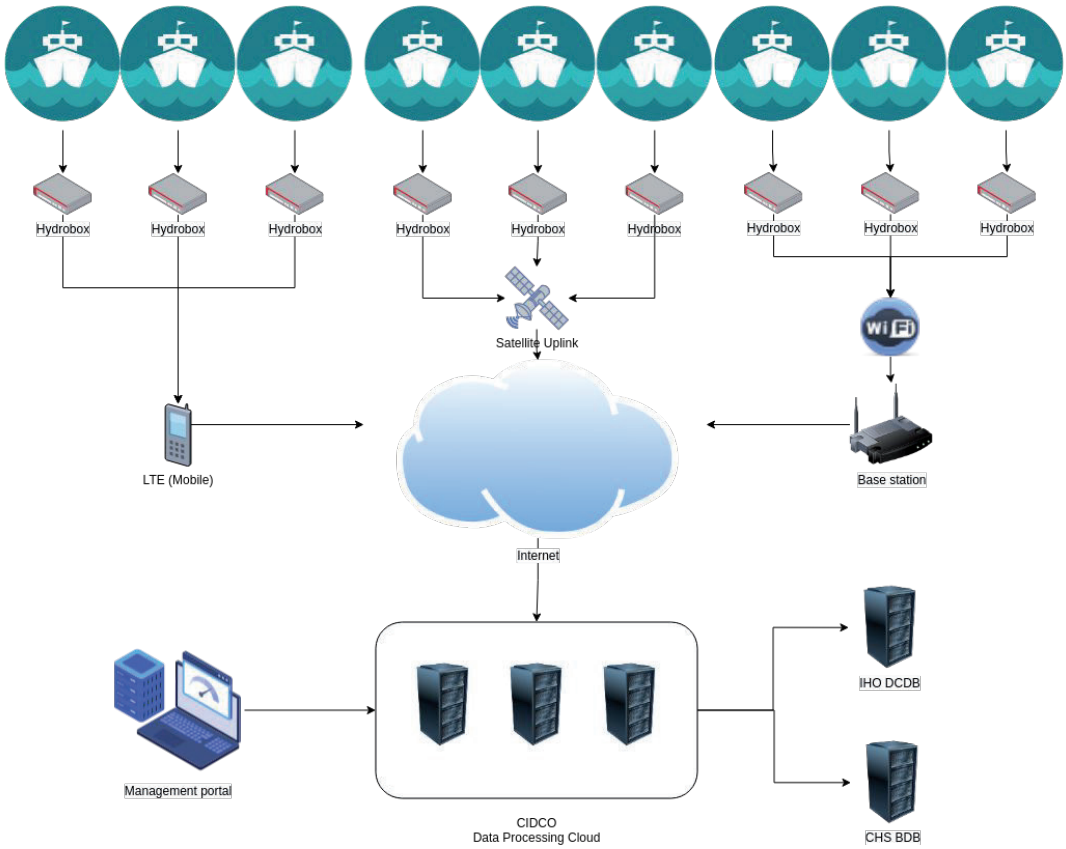

Fig. 5: CIDCO Trusted Collaborative Bathymetric Acquisition (TCSB) system

droBlock®) and installing data transfer stations at strategic locations (Fig. 5). A prime example of the use of such technologies is in the St. Lawrence Seaway. The requirement of up-to-date safe navigable depth in the St. Lawrence Seaway can be fulfilled by allowing raw data to be automatically collected from ships and sent to a data processing cloud that transforms raw bathymetric data into quality products suitable for active monitoring of the St. Lawrence Seaway. This data can also further be integrated into Canadian Hydrographic Service (CHS) data products and services. The first vessel to be equipped with this system is the *Bella Desgagnés*, a passenger transport and supply ship for the lower North Shore owned and operated by Relais Nordik inc. (Fig. 6). This system makes it possible, in real time when the ship is in areas covered by a cellular network, to retrieve the ship's bathymetric data and send it to the cloud.

Fig. 6: The *Bella Desgagnés* with Hydroblock®

Reducing the threat of ghost fishing in snow crab fishing areas by retrieving abandoned traps from the seafloor

For the last four years, CIDCO in collaboration with Merinov, an R&D centre in fisheries and aquaculture, has been working to find a solution to reduce the threat of entanglement and bycatch of species at risk by conducting a recovery campaign of lost snow crab traps in the Gulf of St. Lawrence in the areas prioritised by the project team. CIDCO developed a solution using multibeam data and artificial intelligence (AI).

CIDCO aims to consolidate the evolution of the technological tools developed within the project (Fig. 7) and to validate them in the field. Thus, a second generation of AI algorithms has been programmed in order to make the most of the data collected during the sea trips to train an artificial neural network in order to detect the fishing gears (Fig. 8). New partnerships were established in order to augment the database of acoustic images of lost traps. For example, a collaboration with the CERMIM (Centre de recherche sur les milieux insulaires et maritimes) has allowed the

Fig. 7: Echoboat and AUV for automatics crab traps detection

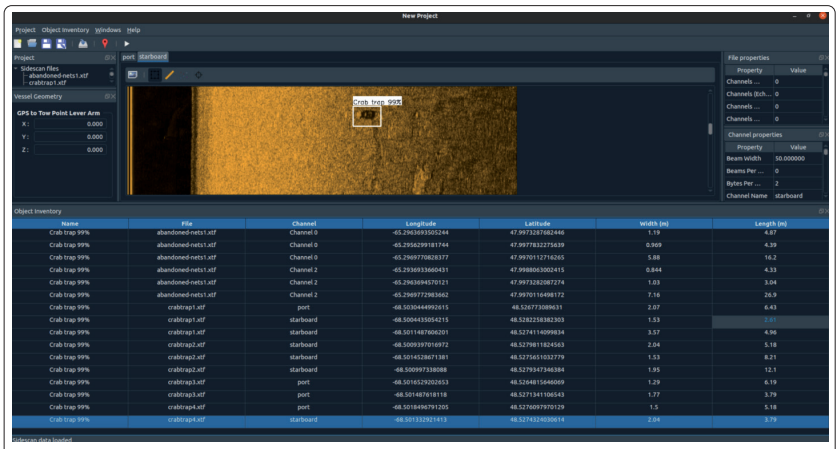

Fig. 8: Crab trap detected by the CIDCO algorithms

addition of nearly 3392 new images and 601 new traps.

This improvement has produced a detection technology that is more robust and less vulnerable to the calibration parameters of the devices, in comparison with the method using computer vision. In addition, the integration of additional data sets to the CrabNet (Compositionally-Restricted Attention-Based Network) system has allowed us to improve the queries performed and to optimise the selection of search areas according to strategic parameters: mammalian frequentation, density of spatial distribution of lost fishing gear, matching lost fishing gear, match lost and recovered gear and generate optimal recovery routes.

Particular attention was paid to validate the process with end users through a test trip with the ACPG (Association des capitaines-propriétaires de la Gaspésie), an association of fishermen and partner in the project. This allowed further customisation of the tool to meet the needs and fulfil the specifications dictated by the end-users.

Automatic classification of benthic habitats using machine learning over sparse 3D point clouds on the North Shore of the Saint-Lawrence Seaway, Canada

According to the Organisation for Economic Co-operation and Development (OECD), the ocean economy will reach 3 trillion dollars by 2030. Ironically, almost 90 % of the world's oceans are not mapped to modern standards. In the spirit of increasing our knowledge of the oceans, benthic habitat mapping has become a necessity with very high stakes, with many countries, notably Canada, engaging in massive benthic mapping campaigns (Proudfoot et al. 2020).

While the world requires more data-driven decision-making to ensure proper sustainable stewardship of natural resources on one end, the efficiency requirements of commercial and industrial ventures have never been higher. As such, efficient technologies are required to adequately map out the benthic zones. Of particular economic interest are geomorphometric methods such as the ones described in a land survey context by Hackel et al. (2016), and shown to be applicable in a hydrographic context by Lecours et al. (2016). With the knowledge that the methods can be applied in a hydrographic context, CIDCO improved on the random-forest methods described in Hackel et al. (2016) and provided a comparative analysis of several machine-learning algorithms applied on several multibeam echo sounder surveys conducted on the North Shore of the Saint-Lawrence River.

The method relies on classifying each sounding based on geomorphometric features computed on its neighbourhood. Using ground-truthing data from Fisheries and Oceans Canada (DFO), a training set of soundings was obtained that can be used to train various machine learning models which can subsequently be used to classify out-of-band data. The bulk 80 % was used to train the models, and the remaining 20 % to assess the quality of the models. Fisheries and Oceans Canada (DFO) has developed a dictionary of underwater habitats, with data acquired at 1000 ground truthing stations (Fig. 9). Available for each station are longitude and latitude, the dominant three bottom substrates, and vegetation type if applicable.

Fig. 9: DFO ground truthing stations in the Saint-Lawrence River

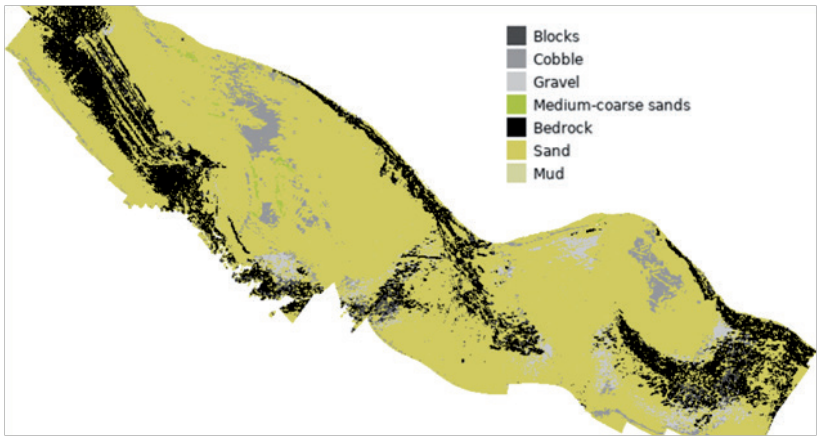

Fig. 10: Distribution of habitat classes in Baie-des-Anglais

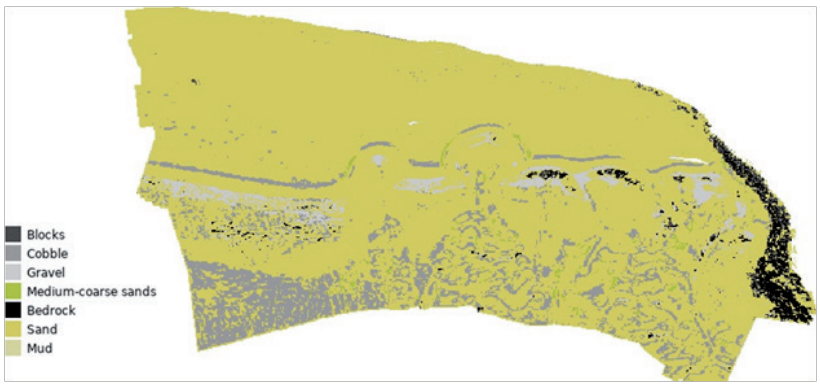

Fig. 11: Distribution of habitat classes in Franquelin

While the categorisation could be optimised to improve precision, it was decided to preserve the domain-specific information and format that the employees of the Government of Canada are used to in order to generate directly transferable results.

In order to generate the training data, the ground truthing stations' data has been cross-referenced with the MBES data in order to get a neighbourhood large enough to compute the feature vector for every ground station point. Habitat classes were derived from substrate particle size nomenclature provided by DFO in order to generate products meant to be helpful to biologists. Namely, bedrock, blocks, cobble, gravel, medium-coarse sands, sand and mud classes were found.

By running the model on each MBES data set, a fully classified data set was obtained which can be readily plugged into any GIS software, in this case QGIS, to generate habitat maps. Fig. 10 and Fig. 11 show model-generated maps.

As such, the technique is quite useful to instantly map out a geological phenomenon that would require many hours by an expert. This information can be leveraged in process automation in many fields, by providing bottom type information to a superior logic layer. This could open doors in improving resource monitoring in biology, searching for specific geological formations in oil and mining industries, and many more. The use of a sparse DTM implies that the technique can be readily generalised to data coming from a large variety of sensors such as multibeam echo sounders, aerial bathymetric lidar, satellite-derived bathymetry, and many more. Further research could easily leverage more than one remote sensing method to improve this technique.

Conclusion

As long as we have not succeeded in mapping all the rivers and oceans of the planet, innovation in hydrography and the hydrospatial domain will always be necessary in order to accelerate and simplify the processes. The existence of research centres is therefore essential in this field. By helping or participating in the development of projects for institutions, ministries, private companies, governments and all other research centres around the world, CIDCO has succeeded in building its credibility and reputation over the past 20 years. Whether it is for the creation of autonomous vehicles with collision avoidance, LiDAR autocalibration, hydrographer training, collective bathymetry or any other challenge, our team's reactivity and taste for innovation allow us to respond to any challenge. //

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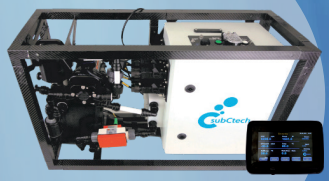

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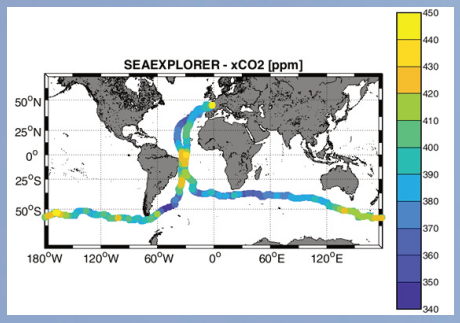

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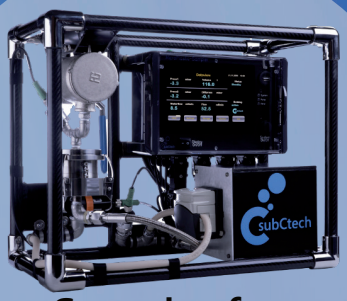

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Improving the capacity in hydrography

An article by THOMAS DEHLING, JULIEN SMEECKAERT, RONAN LE ROY, SÉBASTIEN BEUCHARD, GABIN SOGORB and SALOMÉ LARSONNEAU

Capacity building (CB) is a highly important part of the strategy of the International Hydrographic Organization (IHO). It provides an extremely valuable opportunity for Coastal States to get support for their development in hydrography and improves the cooperation with other countries. It makes use of the experiences gained to a wider community. It is a vital component of the efforts of intergovernmental technical organisations to support the development goals of the United Nations (UN). The IHO is committed to support its Member States and to a certain extend also other Coastal States, to improve their capacity in hydrography. As the resources are limited, the IHO CB is giving priority to those States that are not capable to fulfil this task completely on their own. This paper describes the way CB is done at the IHO, what challenges it is facing and it gives examples especially from the French national approach.

capacity building | Shom | Category B | vessel construction | funding | e-learning
renforcement des capacités | Shom | Catégorie B | construction de navires | financement | e-learning
Kapazitätsaufbau | Shom | Kategorie B | Schiffbau | Finanzierung | E-Learning

Le renforcement des capacités (CB) est une partie très importante de la stratégie de l'Organisation hydrographique internationale (OHI). Il offre aux États côtiers une occasion extrêmement précieuse d'obtenir un soutien pour leur développement en hydrographie et améliore la coopération avec d'autres pays. Il permet de faire profiter une communauté plus large de l'expérience acquise. Il s'agit d'une composante essentielle des efforts des organisations techniques intergouvernementales pour soutenir les objectifs de développement des Nations Unies (ONU). L'OHI s'engage à soutenir ses États membres et, dans une certaine mesure, d'autres États côtiers, afin d'améliorer leurs capacités en matière d'hydrographie. Comme les ressources sont limitées, le CB de l'OHI donne la priorité aux Etats qui ne sont pas capables de remplir cette tâche complètement par eux-mêmes. Ce document décrit la manière dont le CB est réalisé à l'OHI, les défis auxquels il est confronté et donne des exemples, notamment de l'approche nationale française.

Der Kapazitätsaufbau (Capacity Building) ist ein äußerst wichtiger Teil der Strategie der Internationalen Hydrographischen Organisation (IHO). Er bietet den Küstenstaaten eine extrem wertvolle Möglichkeit, Unterstützung für ihre Entwicklung in der Hydrographie zu erhalten und die Zusammenarbeit mit anderen Ländern zu verbessern. Er macht die gewonnenen Erfahrungen einem größeren Kreis zugänglich. Er ist ein wesentlicher Bestandteil der Bemühungen zwischenstaatlicher technischer Organisationen, die Entwicklungsziele der Vereinten Nationen (UN) zu unterstützen. Die IHO ist bestrebt, ihre Mitgliedstaaten und in gewissem Umfang auch andere Küstenstaaten bei der Verbesserung ihrer Kapazitäten im Bereich der Hydrographie zu unterstützen. Da die Ressourcen begrenzt sind, bevorzugt der Kapazitätsaufbau der IHO diejenigen Staaten, die nicht in der Lage sind, diese Aufgabe vollständig selbst zu erfüllen. Dieser Artikel beschreibt, wie der Kapazitätsaufbau bei der IHO durchgeführt wird, welche Herausforderungen es zu bewältigen gilt, und er nennt Beispiele, insbesondere aus dem französischen Ansatz.

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1 Capacity building organisation among IHO

1.1 Strategy

The vision of the IHO CB as stated in its policy paper is to provide strategic guidance for IHO capacity building to ensure the optimum contribution to safety of life at sea, to the protection of the environment and to national economic development.

In the IHO, capacity building is defined as the process by which the organisation assesses the status of current arrangements and assists States to achieve sustainable development and improvement in their ability to meet hydrographic, cartographic and maritime safety obligations with particular reference to recommendations in UNCLOS, SOLAS and other international instruments. The scope encompasses all hydrographic needs as it

Fig. 1: Technical visit in Congo funded by IHO and carried out by Shom in November 2021

underpins every other activity associated with the sea, including safety of navigation, protection of the marine environment, national infrastructure development, coastal zone management, marine exploration, marine resource exploitation (minerals, fishing, etc.), maritime boundary delimitation, maritime defence and security, and coastal disaster management.

1.2 Organisation

The IHO established a Capacity Building Sub-Committee (CBSC), the current Chair is Evert Flier from Norway. The tasks are in close cooperation with the IHO Secretariat to:

- continuously assess the hydrographic surveying, nautical charting and hydrographic information status in nations and regions where hydrography is developing;
- establish and maintain close relationships with national and international organisations, which may provide funding or other support;
- operate the Capacity Building Fund;
- develop, manage and coordinate the assessment and provision of CB in close cooperation with the Regional Hydrographic Commissions.

The CB at the IHO is relying on the contributions from Member States and a rather small fund from the IHO budget. Major contributions are being provided by the Republic of Korea and the Nippon Foundation with funds earmarked for certain projects. Other countries, namely France, provide direct support like trainings and technical visits (Fig. 1). The support goes far beyond the funded projects. This can as well be the provision of equipment, facilities, trainers or direct support to certain participants. Allocated funds sometimes exceed 1 Million €, but funding technical equipment is not included. The projects are mainly:

- raising awareness in countries, where hydrography is not sufficiently implemented, especially through high level visits;
- technical visits to assess the status and needs and to propose recommendations at technical but also institutional levels;
- workshops and seminars;
- onboard and on-the-job training;
- education like Category A and B courses.

Funding is provided partially or fully for travel expenses, per diems, trainers and/or training facilities.

The proposals as well as the development and execution of projects is mainly based on the Regional Hydrographic Commissions (RHC). Each RHC installed a Capacity Building Coordinator, which are members of the CBSC.

One excellent example for the success of the CB is the Suriname. This rather small country has been supported some years ago to improve its capacity in hydrography and is now in a position to support other countries in the region.

Proposals for support and the inclusion into the CB programme have to be forwarded to the CBSC by IHO Member States usually via an RHC.

Two important current developments should be mentioned especially. Both are, to a large extent by Republic of Korea. One is the e-learning platform and the other one is the Training-for-Trainers (TFT) project. The latter one is at this stage limited to the East Asia Hydrographic Commission (EAHC) and enables States to build up their own training capabilities by multiplying the capacity and bringing it into the countries. This also reduces travel expenses. The e-learning platform will make better use of online trainings and is seeking for more in-kind contributions of training material.

The IHO CB is not working in isolation, it cooperates with other CB initiatives, namely IMO, IOC, WMO, but also liaises with the RENCs.

A potential conflict has always been the prioritisation between projects that are more basic (and thus important for many developing States) and the more fashionable ones like S-100 development or MSDI. The CB Strategy and the related procedures forms the basis for the decisions. Neediness, importance, contributions and the potential for success.

Another good example is the project »Empowering Women in Hydrography«. Women are still significantly underrepresented in leadership positions in hydrography. To try and change this, the

IHO has launched a new project to »Empower Women in Hydrography« with the goal of raising awareness about career opportunities in hydrography and to increase the number of women in leadership positions.

2 An example of a national approach: capacity building activities of the French hydrographic and oceanographic service (Shom) in third countries

Although capacity building knows an important dynamic at the multinational level in bodies such as the IHO with the activities mentioned above, most of the hydrographic, oceanographic and cartographic capacity building activities are carried out in a bilateral framework. In that respect, the hydrographic and oceanographic service of France develops actions for the benefit of other States which enable them to acquire or strengthen the necessary skills and tools to ensure their sovereign mission of safety of navigation in their waters, but also to broaden their scope of work/field of activity to associated areas.

2. 1 Setting up partnerships in the SOLAS Convention framework

By ratifying the International Convention on the Safety of Life at Sea (SOLAS), a country undertakes to arrange for the collection and compilation of hydrographic data and the publication, dissemination and keeping up to date of all nautical information necessary for safe navigation [in its waters] (SOLAS Convention, Chapter V – Regulation 9). The same regulation offers the possibility for States without the capacity to delegate this role to another State to do so. This delegation of authority, commonly named »Primary Chart Authority« (PCA), is also framed in the IHO resolutions. It requires a good coordination between the Coastal State and its PCA to generate efficient and relevant nautical information feedback and to ensure that nautical documents, on which the maritime traffic of the coastal country depends, are properly updated.

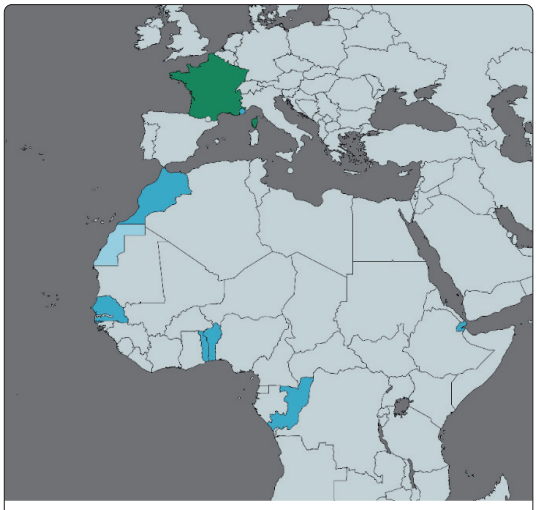

Fig. 2: Coastal States which have signed an Administrative Arrangement with France in the frame of SOLAS Convention

In the case of France, this assumption of responsibility as PCA is formalised and framed with the Coastal State through the signature of an Administrative Arrangement for cooperation in hydrography and marine cartography signed at ministerial level (Fig. 2).

These Administrative Arrangements, in addition to enabling Coastal States to meet their SOLAS commitments, also define a support from the PCA to progressively develop their capacities in the dedicated fields. The ultimate aim is for Coastal States to have developed their hydrographic services, to be able to identify navigational needs and to specify and carry out hydrographic surveys, and to produce, disseminate and maintain nautical products. This process can last several years and is to be realised step by step by adapting the training to the specific situation of each country.

Following a fruitful partnership since the signing of such an Arrangement between France and Morocco in 2008 (cooperation having started long before the Arrangement), the Moroccan Hydrographic Service (DHOC) is now in a position to carry out its own surveys and to produce the nautical charts and structures in its waters. Morocco's cartographic autonomy is underway with a transitional period for the latter to ensure cartography on all its coasts.

2.2 Visits by experts from Shom

Within the framework of bilateral relations with Coastal States, it is possible for Shom to set up cross-expert visits. Those allow both the visit of a local expert delegation to France, in order to discover the associated French theme and procedures, and the visit of Shom experts to the Coastal States to present their methods and tools. This expertise allows the identification of needs in terms of training and resources as well as the sharing of knowledge and experience. Bilateral action plans can thus be set up in targeted areas according to the country's needs.

Repeating these visits makes it possible to evaluate the effectiveness of the actions carried out and to update the action plan according to the progress made. The reliability and relevance of the analysis is guaranteed by the high level of qualification of the experts, coming from the Shom's production or research teams.

2.3 Training of foreign students at Shom

Because of its high-stake missions, Shom's responsibility can be engaged. As a consequence, it is

imperative to master the entire data production chain; this cannot be done without integrating the very specific skills and training of the personnel. Since hydrography for nautical safety purposes and marine cartography at the technician level, are not taught in any school in France, Shom has created its own school with its own training resources in its fields of competence (Fig. 3).

Shom school provides a one-year programme in hydrography and a one-year programme in marine cartography, both of them recognised at Category B level by the International Hydrographic Organization (IHO).

These two courses are primarily intended to train the future hydrographic technicians and cartographers of the Shom.

But these courses are also open to external students. A partnership was concluded in 2017 with the UBO to allow civilian students to follow the hydrography programme. This opening allows us to meet a growing need for qualified manpower in the civil hydrography industry.

Moreover, international students, with required scientific level (usually scientific baccalaureate + 2 years) are welcomed to apply to those Shom certified curriculums. Usually one or two foreign students on average are admitted to the Shom school either as part of the French cooperation programme or through bilateral partnerships with foreign hydrographic services. These foreign trainees are most often military officers or naval officers from very different countries: Morocco, Lebanon, Indonesia, Ivory Coast, etc.

After completion of their training, Shom delivers a degree in hydrography Category B and a degree in marine cartography Category B, according to the training followed.

At the end of the course in hydrography, the military students are usually assigned on the hydrographic fleet of their country. The best civilian students can enter a Master's degree or even one of the Category A programme in hydrography at ENSTA Bretagne.

At the end of the course in marine cartography, the students are assigned to the cartography department of the hydrographic service in their country.

In addition to its long courses approved by the IHO, the Shom's catalogue of continuing education courses also offers a wide range of short courses to improve the skills of personnel in particular fields of hydrography, marine cartography, oceanography or marine geophysics. Any students, including foreign ones, may apply for these courses.

Finally, Shom offers tailor-made courses. These courses are particularly aimed at foreign trainees, who need in-depth training or specialisation in a specific field. For example, two or three times since 2018 to the benefit of Morocco or Tunisia, Shom has set up a training course on the marine chart data validation. These are three-week immersion courses in the »marine cartography« department to learn the validation procedures of the Shom's cartographic controllers. These internships can be adapted and targeted to specific aspects according to the request.

Fig. 3: Training courses provided by Shom school

Shom is also called upon to provide advice and expertise to foreign countries for the choice of hydro-oceanographic measurement equipment to be integrated on board a new hydrographic vessel. In this context, the Shom school is involved in training scientific and technical teams in the integration and use of measurement equipment, so that the hydrographic service of the foreign navy can carry out surveys and products in accordance with the standards of the IHO.

Shom school pedagogical team consists of three permanent teachers, one Category A hydrographic engineer and Category B hydrographic surveyors. This staff is complemented by university teachers and around 80 temporary Shom staff who deliver courses in their field of expertise. A noticeable amount of the training is about practical skills and requires students to achieve some experiments and surveys. For that purpose, Shom school uses one of the Shom hydrographic launch, equipped with a multibeam echo sounder. French military students are also trained (during their complementary training) to operate French navy compact military hydrographic system (SDHM) used for rapid hydrographic assessment before beaching operations.

2.4 Support to project management for the construction of hydro-oceanographic vessels

Shom has recognised expertise in the construction of hydro-oceanographic vessels (from eight-metre launches to 100-metre ships). It has technical experts in the field of acoustic equipment (e.g. multibeam echo sounders, side-scan sonars, current profilers), oceanography (e.g. CTD, sampling), sedimentology (e.g. sediment sounders, corers), geosciences (e.g. magnetometers, gravimeters), positioning and attitude (e.g. GNSS, reference stations, inertial units, USBL systems) who are in charge of the entire process, from the expression of need to the implementation of systems. The multitude of systems that Shom implements and its active and permanent work of technological watch make it a particularly advanced player in the field of hydro-oceanographic equipment.

Shom has a deep expertise in capacity building by assisting shipyards to the construction of hydrographic and oceanographic vessels:

- studies, in order to define, on the basis of an expression of need, the complete specifications in terms of hydro-oceanographic equipment (including IT), but also in terms of fitting out the premises and scientific areas of a hydro-oceanographic vessel. Shom provides intellectual services such as definition of the metrology survey for proper integration and control of the systems, specification of spare parts batches adapted to the ship's missions, the interface file, the acceptance booklet and the ship's log (in its field of competence);
- equipment acceptance and integration: supervision of equipment integration (e.g. mechanical, interfacing, metrology), factory, dockside and sea acceptance;
- training and assistance: training (both on land and at sea) of the crew who will be implementing the equipment, but also of personnel ensuring the maintenance of the systems, transfer of skills, handling of warranty calls after delivery of the vessel to the end customer. Shom's school in Brest (France) is also able to deliver dedicated training sessions in English for specific projects. This training can be focused on hydrography, oceanography, cartography or any other field related to Shom's activities (Fig. 4).

After delivering of the vessel Shom can participate in the crew training in the country and assist the client with a technical assistance in hydrography and oceanography.

This work has been done in the past years for Indonesia (Fig. 5), Morocco, Algeria and Nigeria (Fig. 6) with different French shipyards.

Since 2018 Shom is working with French shipyard OCEA on OSV190 *NNS Lana* for Nigeria (Fig. 6): after the studies, construction took place in Les Sables d'Olonne with a dedicated

Fig. 4: Training of Nigerian navy hydrographers at Shom (Brest, France)

Fig. 5: *Rigel*, hydrographic and oceanographic vessel (Indonesia)

Fig. 6: *NNS Lana* before launching in Les Sables d'Olonne

Fig. 7: *NNS Lana* in Lagos (Nigeria)

full-time engineer. In 2021, a Nigerian team was trained both theoretically and practically during four weeks in Shom's school in Brest (France). They learned about the equipment of their new ship *NNS Lana* and participated in several practical sessions for using GNSS equipment and other related tools. Training also took place onboard the ship in France and on site in Nigeria (Fig. 7). The technical assistance phase in Lagos started end 2021 and will continue until 2023, with the support of a Category A hydrographic engineer full time for more than a year. During this technical assistance period Shom will help the Nigerian Navy to solve issues that can happen on the hydrographic and oceanographic vessel, assist in the configuration and use of the equipment and provide advice on how to make different types of survey. Once the surveys are made, guidance is provided on data processing, data validation and how to elaborate survey reports complying with IHO standards.

This partnership is meant to help the Nigerian navy hydrographic office to train its personnel and ensure that they are able to complete hydrographic and oceanographic surveys up to the IHO standards. The main purpose for *NNS Lana* at this time is to survey the approaches to Lagos in order for Nigerian authorities to make their own nautical chart of this area. Many uncharted wrecks have been already discovered proving that this work is critical for safety of navigation in these waters. For shallow area the *NNS Lana* has its own hydrographic launch, also equipped with multibeam echo sounder, allowing the Nigerian navy to survey in places where the main vessel can't.

In addition, advice and expertise have been provided in the framework of exchanges with prospects in other countries. These partnerships contribute to develop Shom's expertise in hydrographic and oceanographic capacity building as well as they are also helping to develop the hydrographic cooperation and technical exchanges between the countries involved.

3 Challenges related to capacity building

The ever-increasing need for building capacity in Coastal States, as well as technological and societal developments (including the recent Covid-19 pandemic), pose challenges to the various contributors in order to carry out this essential process.

3.1 Search for funding

The IHO CB is trying to retrieve additional funds from donor organisations, but this is depending on decent and usually more complex proposals. The funds can be used for consulting expenses in this regard, but success has been depending so far on the lead by a Member State.

3.2 Adapting to e-learning and innovative tools

Distance learning, which can be accessed from anywhere provided there is an internet connection, is flexible in time and adaptable to the needs of students, has developed in recent years and underwent unprecedented expansion in response to the Covid-19 pandemic. This practice has become as much a part of modern society as teleworking, and needs to be further developed in the field of hydrography and related sciences in order to increase the efficiency of capacity building.

At the international level, IHO is developing e-learning opportunities. Several IHO Members raised the need for e-learning to support IHO CB initiative at the 1st Session of the IHO Assembly in 2017. Following that proposal (Pro 3.3 of A-2) the CBSC established the e-learning project team (PT) to start preparing for the establishment of the IHO e-learning centre by the Republic of Korea. This centre is now close to be operational and will host the first Shom MOOC on Maritime Safety Information from a range of courses and teaching materials in different languages that are accessible to a wide range of people. Shom school is an active member of the e-learning project team to move forward this IHO e-learning centre.

E-learning is also developed at national levels. For instance, Shom school has undertaken to develop distance learning in order to facilitate access to its training courses for certain personnel, such as on-board hydrographers, who are not always available for face-to-face training, but also for foreign trainees who are far from the training site. To achieve this aim, Shom school has started a digital transformation of its training system, in order to offer hybrid training programmes, with educational qualities equivalent to those of face-to-face training, or even improved thanks to the multiple possibilities offered by digital technologies of teaching. To this end, Shom is recruiting an educational engineer and is going to equip itself with a Learning Management System (LMS) that will improve access to the training offer by making the courses permanently accessible, with or without an internet connection, without waiting for the organisation of sessions that are necessarily limited in volume (number of participants) and frequency. Synergies will be sought with its partners, to share resources on common platforms or to develop resources in common, notably the IHO e-learning platform.

4 Conclusion

In closing, capacity building is multi-faceted: it embraces cooperative activities at different scales with the ultimate goal of ensuring safe navigation around the world by strengthening each of its actors.

This policy must be based on three pillars in order to be effective and have a lasting effect. Firstly, high skills are required which implies well trained and qualified personnel. Secondly, high standard material is necessary to enable staff to put in practice their practical knowledge. Last but not least, the structure, whether decision-making or functional, must not be forgotten. Coastal States must have governance bodies that bring together the various maritime safety stakeholders to identify and prioritise needs, to give a national dynamic ranging from the acquisition of data at sea to the dissemination of nautical products and their maintenance and to the management of maritime safety information. Nonetheless, there is obviously a need for a functional structure like a national hydrographic service capable of implementing these directives in the waters under the responsibility of the Coastal State.

This policy requires long-term efforts but also substantial funding without which no action can be taken. It is therefore necessary to look for funding outside the IHO, which requires networking and a good knowledge of the various regional players and issues.

The duration of capacity building also makes it sensitive to changes in society, especially those with the greatest impact such as reducing the carbon footprint and new distance learning methods. It is therefore necessary to continuously adapt and modern practices in terms of training.

For many Coastal States, capacity building in hydrography, oceanography and marine cartography often represents the first link in a chain enabling them to ensure the safety of navigation in their waters, thus reinforcing and increasing maritime traffic in their ports and consequently their economy. But much more than that, in the longer term, this chain also enables the development of a blue economy in a sustainable manner and helps States to adapt to coastal evolutions due to natural phenomena and also to climate change. //

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HPAS – The hydrographic professional accreditation scheme by the IFHS

An article by DAVID VINCENTELLI and TANJA DUFEK

In such an international branch as hydrography, the need for standards – especially in certification of personnel – is of great importance. The recently introduced multinational hydrographic professional accreditation scheme (HPAS) by the IFHS (International Federation of Hydrographic Societies) including its member societies AFHy and DHyG, allows individuals to gain a professional accreditation not only based on educational qualification, but also on their practical experience and continuing professional development (CPD). The HPAS has received recognition by the IBSC (FIG/IHO/ICA International Board on Standards of Competence) earlier this year, which increases the likelihood that such personal accreditation will become more established in the professional field of hydrography.

HPAS | personal accreditation | IFHS | IBSC | CPD
HPAS | accréditation personnelle | IFHS | IBSC | développement professionnel continu
HPAS | persönliche Akkreditierung | IFHS | IBSC | kontinuierliche Weiterbildung

Dans un secteur d'activité aussi international que l'hydrographie, le besoin de standards – tout particulièrement en ce qui concerne la qualification des individus et son suivi – est crucial. Le schéma d'accréditation (HPAS) récemment mis en place par l'IFHS (Fédération internationale des sociétés hydrographiques), dont sont membres l'AFHy et le DHyG, permet à tout professionnel du secteur d'obtenir une accréditation ne reposant pas uniquement sur son cursus universitaire mais également sur les acquis de son expérience professionnelle. Courant 2022, le schéma d'accréditation HPAS a été reconnu par l'IBSC (comité international FIG/OHI/ACI sur les normes de compétence pour les hydrographes et les spécialistes en cartographie marine), l'asseyant davantage comme un standard de qualification des personnels employés au service de l'hydrographie au sens large.

In einer so international agierenden Disziplin wie der Hydrographie sind Standards wichtig – insbesondere für die berufliche Qualifikation. Vor Kurzem wurde das HPAS – das »Hydrographic Professional Accreditation Scheme« – von der IFHS (International Federation of Hydrographic Societies), darunter auch die AFHy und die DHyG, eingeführt. Das HPAS erlaubt es Einzelpersonen, sich neben ihren Studienabschlüssen auch basierend auf ihren praktischen Berufserfahrungen und kontinuierlichen Weiterbildungen akkreditieren zu lassen. Anfang des Jahres 2022 hat das IBSC (FIG/IHO/ICA International Board on Standards of Competence) das HPAS anerkannt, was die Wahrscheinlichkeit erhöht, dass sich die persönliche Akkreditierung im Berufsfeld der Hydrographie stärker etabliert.

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Towards a standardised, follow-up and international recognition of hydrographic skills

HPAS is the IFHS certification scheme, certified by the IBSC (FIG/IHO/ICA International Board on Standards of Competence), created to follow and certify professional hydrographers.

In regard to HPAS multiple questions may arise: Why this need for a new certification scheme? What are the differences between HPAS and the famous Cat. A and Cat. B?

We shall first outline the differences between diploma and certification. Both Cat. A and Cat. B diplomas are well known and accepted within the industry and beyond. This certification is given by the IBSC to educational programmes to award the completion of such IBSC certified »scholar« path, including a minimum list of course contents.

Certification schemes, such as the HPAS, certify the capacity of an individual to be a recognised hydrographer, not only thanks to the education qualification of that individual but also thanks to the experience gained during their career, the technics applied in the field, their management skills, their research, their lecture …

The main objectives of a certification scheme compared to a diploma are:

- to keep certifying the capabilities of individuals all along their career;

- to allow personnel with academic or non-academic background in related science to be recognised as an hydrographer to a certain level, thanks to the experience gained (in its position, in the field, in office or based to additional courses taken).

To develop this multinational HPAS scheme by the IFHS – a federation gathering six hydrographic societies: THS:UKI for UK and Ireland, DHyG for Germany, HSB for Benelux, IHS for Italy, AFHy for francophone countries and HSSA for South Africa – has been a long process. It was expedited by the THS:UKI and driven by the general need for such an accreditation scheme in industry, governmental and educational/research institutions. All of them unite the demand for qualified people.

HPAS is not the first scheme to become certified by the IBSC. It follows the path of Canada, Australasia and recently America in that way, with the early goal to bridge the interest of the six associated societies, becoming a cross country standard, and the ambition to be recognised by all other IBSC approved schemes, helping the employment of professional hydrographers worldwide and increasing the confidence of the employers and clients of hydrographic professionals.

How to apply?

HPAS offers three levels of accreditation. For each level multiple pathways are possible (Fig. 1). Level 2 (AH-L2) is a practical hydrographic surveyor who can execute various survey tasks and instructions. A level 1 (AH-L1) surveyor has progressed in their career to a supervisory/senior level and is able to plan and lead complex multidisciplinary field projects. Level 0 (AH-L0) is the highest level given to professionals who have not only advanced their knowledge but also developed management and leadership skills and become people of repute in the profession.

The minimum duration of work experience given in Fig. 1 have to be understood as an absolute minimum. The variety of tasks and types of executed projects as well as the assigned responsibilities and roles are of greater importance.

The affiliate is not a level and therefore does not provide an accredited professional status but addresses students/trainees who want to show commitment to the profession during their education/training.

To apply for a certain HPAS level, the proof of the educational qualification and work experience have to be provided. The particular required documentation varies according to the level sought and the preconditions of the applicant and might include:

- a CV with two referees,
- a logbook of hydrographic survey activities,
- two recent survey reports with a critique providing detailed information about the ap-

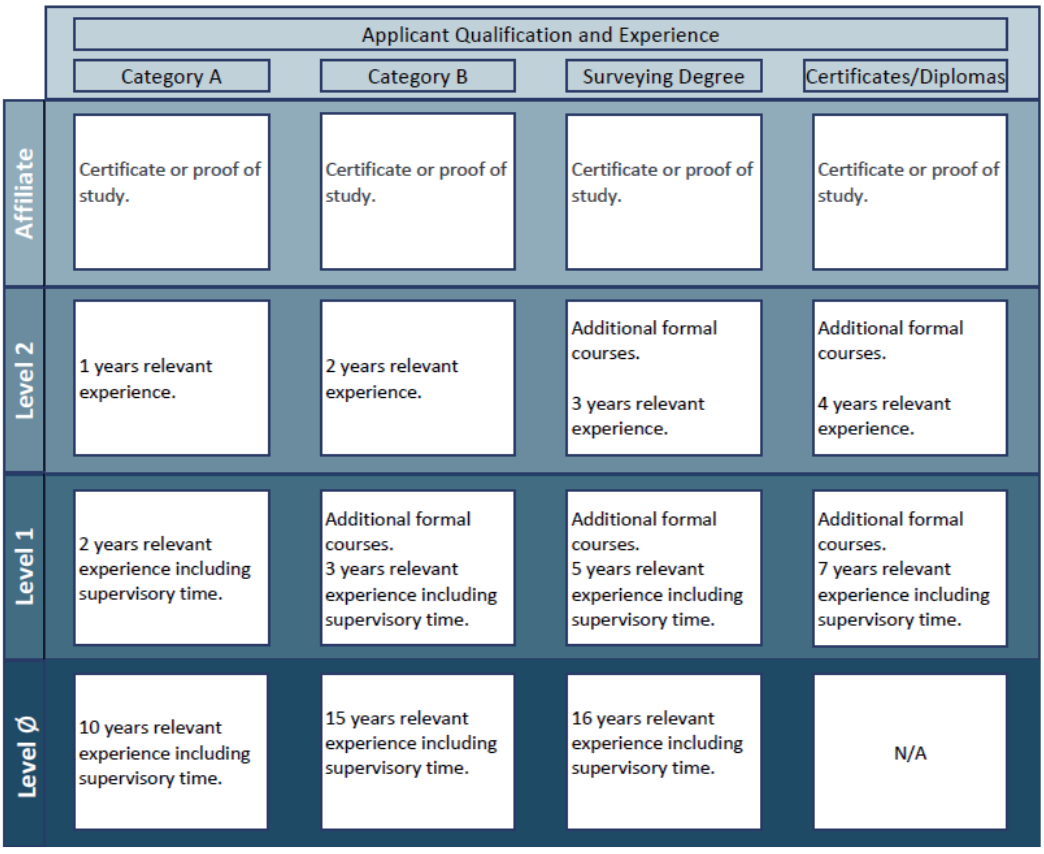

Fig. 1: HPAS levels and pathways

plicant's role in the provided projects as well as an evaluation,
- an experience matrix, which lists different survey types and tasks according to the subjects of the IHO standard S-5 (these S-5 subjects need to be covered by IBSC certified Cat. A or B programmes).

The applicants have to indicate which kind of projects and in which responsibilities they have been involved. Depending on the level applied for, a certain number of tasks and types as well as roles are expected to be accomplished.

A qualification mapping is necessary for the applicants who have not completed a Cat. A or B programme. The mandatory theoretical competencies required by the IHO S-5 for the IBSC recognised Cat. A or B programmes need to be covered by the applicants by other formal courses or trainings.

A level-specific overview of necessary documents, examples of filled forms and a detailed explanation of them for each level are given in the HPAS applicant guide published online (https://hydrography.earth/hpas).

The submitted applications are reviewed by the HPAS panel. In case certain aspects in regard to the accreditation level cannot be clarified based on the provided documentation, the applicant can be invited to an interview.

The panel consists of at least eight members from IFHS societies coming from industry, academia or government and are in office for three years. IFHS will advertise the vacant panel seats annually and nominations are then received by the HPAS steering committee, which selects the panel member. The steering committee consists of representatives of the IFHS societies and gives strategic direction and guidance to the HPAS.

There are two HPAS application deadlines per year: 31st of March and 31st of October. The time between application deadline and being informed about the decision might take about 15 weeks. The regular accreditation fee of 140 to 200 € (depending on the level sought) is reduced to 70 to 100 € for members of the IFHS societies. The annual renewal is about 30 to 50 € for members.

How to maintain an HPAS level?

To maintain an HPAS level, members have to show annually that they have been employed in the hydrographic field for at least six months of the last twelve and submit a record of at least 40 hours CPD from that year. The CPD log ensures HPAS members currency of knowledge and practical experience as well as the enhancement of skills. For the CPD record different professional, educational or volunteering activities related to hydrography are supported. They also include non-technical skills to improve personal qualities as well as formal and informal time. The minimum required time of formal CPD is 20 hours per year and includes activities of structured learning that have a clear learning objective like a professional course, technical authorship or a learning activity with assessment measures. Informal CPDs are self-managed learning like private study, on-the-job practical training, attendance at informal seminars or events focusing on knowledge sharing. HPAS accredits can also transition from one level to the next higher one after gaining more experience and educational or other qualification. Depending on the transition level, the applicant has to hand in some or all of the documents listed above for the regular application.

Conclusion

The first two sessions of HPAS have well demonstrated the interest of public and private sector professionals lacking standard hydrographic background to apply for HPAS accreditation, indeed a large majority of applicants were missing Cat. A or Cat. B recognised courses. However, this success needs to be confirmed by a larger interest from the Cat. A/Cat. B hydrographer community.

As within the area of IFHS such personal accreditation is new, the scheme needs to be advertised and introduced and acquainted in the community. Its successful establishment in such an international operating branch like hydrography has a lot of benefits. It facilitates, for example, the staff recruitment, tenders, company-internal CPD or general administration. If the CPD keeping becomes a larger focus, a greater and international training industry offering e-learning and online trainings might develop further.

HPAS is not the only personal accreditation scheme in hydrography: in Canada, Australasia and America similar schemes – also with IBSC-recognition – are in place. Succeeding to obtain a mutual recognition between them would be of great importance for the overall international establishment and implementation of these schemes. They constitute the foundation for a new international standard in the hydrographic profession. //

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Are the clichés true?

We wanted to know: How does the food on offer differ between French and German research vessels? On board a German ship, are there the Königsberger Klopse (meatballs) and Rouladen (roulades), which are considered typically German? Or does the chef take into account the Germans' love of Italian cuisine by regularly serving lasagne and spaghetti? Is the crew of a French ship spoiled with Mediterranean specialities, is there foie gras, stuffed snails and quiche? We compare the menu on RV *Meteor* with that on RV *Thalassa* from 2nd to 5th November.

Nous voulions savoir : Quelles sont les différences entre les plats proposés sur les bateaux de recherche français et allemands ? Est-ce que l'on trouve à bord d'un navire allemand les boulettes de Königsberg et les roulades qui ont la réputation d'être typiquement allemandes ? Ou le cuisinier tient-il compte de l'amour des Allemands pour la cuisine italienne en servant régulièrement des lasagnes et des spaghettis ? L'équipage d'un navire français est-il gâté par des spécialités méditerranéennes, y a-t-il du foie gras, des escargots farcis et des quiches ? Nous comparons le menu du RV *Meteor* avec celui du RV *Thalassa* du 2 au 5 novembre.

Wir wollten wissen: Wie unterscheidet sich das Speisenangebot auf französischen und deutschen Forschungsschiffen? Gibt es an Bord eines deutschen Schiffs die als typisch deutsch verschrieenen Königsberger Klopse und Rouladen? Oder berücksichtigt der Koch die Liebe der Deutschen zur italienischen Küche, indem er regelmäßig Lasagne und Spaghetti auftischt? Wird die Besatzung eines französischen Schiffs mit mediterranen Spezialitäten verwöhnt, gibt es Gänseleberpastete, gefüllte Schnecken und Quiche? Wir vergleichen das Menü auf RV *Meteor* mit dem auf RV *Thalassa* vom 2. bis zum 5. November.

RV *Thalassa*

RV *Meteor*

Authors
Jens Schneider von Deimling (idea and recherche), Herve Bisquay (recherche), Lars Schiller (text).

2 Novembre 2022

DÉJEUNER :
Betteraves râpées aux framboises
(shredded beetroot with raspberries)
Croissant au jambon *(ham croissant)*
Bœuf bourguignon *(beef bourguignon)*
Torsades *(twists)*
Salade *(salad)*
Fromages *(cheese)*
Fruits *(fruit and vegetables)*

DÎNER :
Crème de courgettes *(cream of courgette soup)*
Emincée de choux rouges *(sliced red cabbage)*
Maquereaux rôtis sauce moutarde
(roasted mackerel with mustard sauce)
Ecrasé de pommes de terre et carottes
(mashed potatoes and carrots)
Salade *(salad)*
Fromages *(cheese)*
Fruits *(fruit and vegetables)*

2. November 2022

MITTAGESSEN:
Graupensuppe *(barley soup)*
Königsberger Klopse in Kapernsoße, Reis, Kartoffeln, Rote Beete *(Königsberger meatballs in caper sauce, rice, potatoes, beetroot)*
Gemüsebällchen, Kartoffeln, Reis, Kapernsoße
(vegetable balls, potatoes, rice, caper sauce)
Obstplatte *(fresh fruits)*

ABENDESSEN:
Spinat, Spiegelei, Kartoffeln
(spinach, fried eggs, potatoes)
Wurst- und Käseplatte
(cold cuts and cheese platter)
Salat *(salads)*

3 Novembre 2022

DÉJEUNER :
Guacamole *(guacamole)*
Paëlla *(paella)*
Fromages *(cheese)*
Crumble aux pommes *(apple crumble)*

DÎNER :
Potage au potiron *(pumpkin soup)*
Salade chinoise *(chinese salad)*
Spaghetti Bolognaise *(spaghetti Bolognese)*
Fromages *(cheese)*
Fruits *(fruit and vegetables)*

3. November 2022

MITTAGESSEN:
Blumenkohlcremesuppe *(cauliflower soup)*
Entrecotè-Steak, Kräuterbutter, Backkartoffel mit Schmand, Country Potatoes, bunter Salat
(entrecotè steak, herbs butter, baked potato with creme fraiche, mixed salad)
Gemischtes Eis *(mixed ice cream)*

ABENDESSEN:
Bauernomelett *(farmers breakfast)*
Wurst- und Käseplatte
(cold cuts and cheese platter)
Salat *(salads)*

4 Novembre 2022

DÉJEUNER :
Tzatziki *(tzatziki)*
Tacos *(tacos)*
Coquelet au cidre *(coquelet with cider)*
Pommes de terre rôties *(roasted potatoes)*
Fromages *(cheese)*
Fruits *(fruit and vegetables)*

DÎNER :
Crème de légumes *(cream of vegetable soup)*
Œufs mimosas *(mimosa eggs)*
Poivrons farcis sauce diable
(stuffed peppers in devil's sauce)
Pâtes chinoises *(chinese pasta)*
Fromages *(cheese)*
Fruits *(fruit and vegetables)*

4. November 2022

MITTAGESSEN:
Asiasuppe *(Asiasoup)*
Schollenfilet gebraten, Dillsoße, Kartoffeln, Reis, Salat *(plaice filet, dill sauce, potatoes, rice, salad)*
Spätzlepfanne *(Bavarian noodles pot)*
Frisches Obst (fresh fruits)

ABENDESSEN:
Spare Rips, Knoblauch-Kräuter-Baguette
(spare rips, garlic-herbs baguette)
Gemüsespieß *(vegetable skewer)*
Wurst- und Käseplatte
(cold cuts and cheese platter)
Salat *(salads)*

5 Novembre 2022

DÉJEUNER :
Houmous *(hummus)*
Pissaladière *(pissaladière)*
Blanquette de veau *(blanquette of veal)*
Riz pilaff *(rice pilaff)*
Fromages *(cheese)*
Fruits *(fruit and vegetables)*

DÎNER :
Potage cultivateur
Poireaux ravigote
Lieu jaune
Choucroute de fenouil à l'orange
Fromages *(cheese)*
Fruits *(fruit and vegetables)*

5. November 2022

MITTAGESSEN:
Hühner-Nudel-Eintopf, Wiener Würstchen, Baguette
(chicken-pasta stew, Frankfurters, baguette)
Gemüse-Nudel-Eintopf, Baguette
(vegetable- pasta pot)
Germknödel mit Vanillesoße
(dumplings with sauce vanilla)

ABENDESSEN:
Döner Kebab mit Kalb-Putenfleisch
(Döner Kebab with veal turkey meat)
Döner Kebab mit Tofu *(Döner Kebab with tofu)*
Wurst- und Käseplatte
(cold cuts and cheese platter)
Salat *(salads)*

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»Hydrography is probably one of the best jobs ever in terms of versatility and diversity«

An interview with ERIC LANGLOIS

Eric Langlois is French, he works in Germany for an international organisation in Bonn, he is Chairman of the IFHS, a member of the board of the AFHy, which is organising the HYDRO conference in Monaco this year on behalf of the IFHS – we could not have found a more suitable interview partner for this international edition of HN, which is jointly produced by the AFHy and the DHyG.

hydrography in France | HYDRO conference | IFHS Student Award | HPAS | Sustainable Development Goals
hydrographie en France | conférence HYDRO | IFHS Student Award | HPAS | objectifs de développement durable
Hydrographie in Frankreich | HYDRO-Konferenz | IFHS Student Award | HPAS | Ziele für nachhaltige Entwicklung

Eric Langlois est français, il travaille en Allemagne dans une organisation internationale, il est président de l'IFHS, membre du conseil d'administration de l'AFHy, qui organise cette année la conférence HYDRO à Monaco au nom de l'IFHS - nous n'aurions pas pu trouver un interlocuteur plus approprié pour cette édition internationale des HN, réalisée conjointement par l'AFHy et la DHyG.

Eric Langlois ist Franzose, er arbeitet in Deutschland bei einer internationalen Organisation in Bonn, er ist Präsident der IFHS, Mitglied im Vorstand der AFHy, die in diesem Jahr im Namen der IFHS die HYDRO-Konferenz in Monaco organisiert – einen besser geeigneten Interviewpartner hätten wir für diese internationale Ausgabe der HN, die von der AFHy und der DHyG gemeinsam gestaltet wird, nicht finden können.

Interviewer
The interview with Eric Langlois was conducted by Lars Schiller and Holger Klindt via email in November.

You work in Bonn at an organisation named OCCAR. This acronym stands for »Organisation for Joint Armament Co-operation«. What is the mission of this organisation and what is your personal role here?

OCCAR is an international centre of excellence in armament programme management. It aims to facilitate and manage such programmes through their life cycle while improving efficiency and reducing costs. The main strength of OCCAR is that, beyond its six Member States (Belgium, France, Germany, Italy, Spain, United Kingdom), non-Member States are also able to participate in programmes they find an interest in.

For the record, the concept of OCCAR first came with the French-German Principles of Baden-Baden signed in December 1995.

Today, OCCAR is responsible of 13 important programmes with a total operational budget of about 4 billion Euros. One of them, the European Secured SOftware Radio (ESSOR) Programme involves six Participating States (Finland, France, Germany, Italy, Poland, Spain). ESSOR addresses military communication interoperability by developing common secured software radio waveforms to be ported on national radio platforms. My current position stands within the ESSOR Programme Division as Head of the Programme Control, Commercial and Financial Section.

What does your current occupation have to do with hydrography?

My current position does not have anything to do with hydrography. However, being involved in IFHS has been a way to maintain a link with our community and to contribute to its development.

Speaking about your background, how did you originally get involved in hydrography and which experience have you gained in the field of hydrography?

When I first heard about hydrography and marine environment, it seemed to be so much in line with my personal professional expectations: high technical benefit, nonprofit activity, and the remote office space (while being at sea). A balanced mix of adventure and purpose. After being graduated (Hydrography and Marine Cartography) from ENSTA Bretagne school in France, I worked for 13 years at Shom, the French Hydrographic Office, where I gathered most of my experience in hydrography.

My first assignment lasted three years on board French Navy survey vessels. There, I learned the

»on the field« job, gaining experience from experienced teammates and trying to adapt to every survey sites and weather conditions, taking into consideration the singularity of the mission, especially in remote locations. Besides, long period on board a ship puts you into so many human related situations that you are equipped to deal with a number of different future scenarios and eventualities.

After this first assignment, I studied for one year at the École Nationale de Meteorologie (French National Meteorology School) in Toulouse. After this academic break, I was in charge of designing bespoke wave modelling for the amphibious units, using accurate bathymetric and tidal data combined with refined weather modelling forecasts. It contributed to capture the broad range of application of hydrographic data.

Another turnover in my career happened when I joined Shom's Parisian Office as Head of the External Relations Division. Five years in this position gave me the taste for international cooperation, from the International Hydrographic Organization (IHO) to UNESCO's International Oceanographic Commission (IOC) and the various bilateral cooperation France has in the field of hydrography and cartography. What I enjoyed the most during those years was the capacity building projects we managed to raise awareness of hydrography, especially in Western Africa.

You are a board member of AFHy, the French hydrographic association. Please tell us more about AFHy. Which are the aims and objectives of your society and how many members does AFHy have?

AFHy actually stands for »Association Francophone pour l'Hydrographie«. It aims at promoting hydrographic expertise in France and francophone countries. It is a forum of exchange and dissemination of information between researchers, manufacturers and private/public hydrographic surveyors.

AFHy has 60 corporate members including both public administration and private companies and 20 individual members.

Do you only accept members from central France or can other French-speaking nationals from your overseas territories also become an active member?

Initially, AFHy was exclusively dedicated to French public administration, including French overseas territories. In 2012, AFHy changed its statutes to include a private corporate college of members and to open to francophone individuals and entities. Today, AFHy counts in francophone members from Canada, Western Africa and Indian Ocean regions.

Please share with us your view on the different roles and relevance of hydrographic work in France.

The relevance of the French hydrographic expertise takes its root in three aspects:

Eric Langlois

- The legacy of French hydrography, as France was the first Coastal State to create, in 1720, a national entity entitled to safeguard the marine knowledge related to navigation charts;
- The multiplicity of the uses of the French maritime space raising economic, environmental and governance needs for marine knowledge and therefore hydrographic data;
- The extent of the France's National Waters, which is the second largest maritime territory with 11 millions square kilometres spread all over the globe.

These three aspects have been the reasons why French hydrographic expertise is now one of the richest ones, based on a strong legacy: the discovering and cartography of new overseas territories, the invention of the hydrographic circle, the first use of satellite-derived bathymetry in the Pacific atolls. Today, the French industrial base is one of the most dynamic and innovative in the field of hydrography.

»Hydrography offers a balanced mix of adventure and purpose«

Eric Langlois

Where and how are French hydrographers also involved in hydrographic activities abroad?

Every survey area comes with its own challenges, which is why the hydrographic expertise has to be versatile in order to adapt to all circumstances.

With a maritime »playground« of 11 millions square kilometres spread over five continents, French hydrographers are accustomed to dealing with one of the most various range of conditions and environmental factors: Tracking sand dunes in the British Channel, achieving precise positioning and levelling in the middle of the Pacific or setting up a tide gauge in Antarctica, this is why French hydrographers are keen to adapt to every maritime situation.

Training and education of hydrographic knowledge is key to any successful professional development. How is it organised in France and who are the key institutions here?

France disposes of several academic entities able to provide accredited courses recognised by the IBSC (FIG/IHO/ICA International Board on Standards of Competence):

- ENSTA Bretagne, a pluri-disciplinary engineering school that delivers Category A certified Master degree,
- Intechmer, an academic institute that delivers a Category B certified Degree in Hydrography,
- Shom's School of Hydrographers, initially created to train French Navy's Hydrographic personnel, delivers Category B certified in both hydrography and cartography.

AFHy also contributes, to an extent, in the sharing of the knowledge by organising workshops and dedicated courses for the benefit of its individual members. Some of its corporate members also offer courses or demos on survey equipment and tools.

Is there a close cooperation in France between hydrographic and other marine sciences?

I have two personal examples of close cooperation between national entities:

In 2005, I volunteered to take part to an international campaign on a Spanish Navy oceanographic vessel named *Hesperides*. The purpose of this campaign was to gather bathymetric and geologic evidence in the Bay of Biscay in order to submit a common request for an exclusive economic zone (EEZ) extension from France, Spain and Ireland. On board this vessel, I worked closely with one colleague from Ifremer. The campaign at sea lasted for one month and gathered critical pieces of evidence that contributed to the approval of this extension request by the United Nations.

In 2016, the French Ministry of Environment signed an MoU with the World Bank, enabling the sharing of French expertise on coastal areas. A working group was then created, with representatives from the national agencies involved in coastal areas. The underlying purpose was to find project ideas to support the empowerment of Western African States on their coastal areas management, strongly impacted by coastal erosion and water level rising. One of the project ideas submitted was to take advantage of Shom's archives in the region by digitalising old chart and using the data to monitor coastal erosion. This project came through, funded by the French Ministry of Environment with the participation of Shom for the data rescue part and CEREMA, a French agency specialised in the study of coastal dynamic and phenomenon.

Shom and Ifremer are two globally well-reputed institutions in marine sciences. How do they interact with each other; and are there further institutions contributing to this field?

Shom and Ifremer are two public entities placed under the authority of different Ministries. Shom depends on the French Ministry of Defence whereas Ifremer depends on the Ministries of Research, Environment and Agriculture.

Beyond these administrative differences, these two entities share expertise on common fields related to marine knowledge and research: Bathymetry, coastal and seafloor dynamics, wave modelling, sedimentology and several others.

Besides, Shom and Ifremer share their maritime assets in order to minimise the deployment costs. In that scope, both Hydro-oceanographic survey vessels *Beautemps-Beaupré*, launched in 2002, and *Pourquoi Pas?*, launched in 2005 have been co-financed by Ifremer and the French Navy (for the benefit of Shom). Moreover, all French survey vessel deployments are harmonised by a national

commission in charge of dispatching these vessels adequately to fulfil national needs on campaigns at sea.

Initially planned in December 2020, the HYDRO conference will take place in December in Monaco. AFHy is organising this event. Please allow us an early glimpse on what we should expect there.

I am very excited to attend this HYDRO conference, for various reasons:

- It is a kind of homecoming for HYDRO conference events after a three years break;
- It is the first edition hosted by AFHy, which chose Monaco to emphasise on the francophone scope as well as the symbol Monaco represents for worldwide hydrography;
- It is the first edition to be hosted on the coasts of the Mediterranean Sea, which is a maritime area subject to several challenges while involving more than 40 different Coastal States of different cultural background.

Therefore, I am expecting to see lots of familiar faces as well as new ones, especially from the students community. They suffered a lot over the past years from the worldwide situation, and I am more than grateful that they managed to persevere in that field, which is probably one of the best jobs ever in terms of versatility and diversity.

For this edition, we did not want to limit ourselves on a technical ground. So we agreed to focus on the responsibilities that lie on the shoulders of all hydrographic professionals, as maritime stakeholders and citizen of the world, in raising awareness on climate challenges affecting the ocean.

The International Federation of Hydrographic Societies (IFHS) is a unique partnership of learned national and regional hydrographic societies and acts as a kind of an international umbrella organisation for all hydrographic associations around the globe. You are the current Chairman of this organisation. What do you intend to achieve with your involvement in the IFHS and which are your strategic goals?

Today, we do have international coordination on charting schemes and on technical standardisation with the national hydrographic offices and the IHO. However, we are still missing coordination between the community of its professional individuals, who are the core constituent of the hydrographic community.

Even though individuals and national companies and administrations have managed to organise themselves with national societies, the leverage effect remains quite limited.

IFHS purpose is to join all these national communities, without duplicating their actions, more to bring initiative and concerns from their members to a higher level. IFHS can contribute to advocate these concerns on the international scene, especially on topics not properly addressed by other international forums: individual accreditation, recognition of the hydrographic expertise, promotion of hydrographic careers.

To reach this goal, IFHS needs to federate more national/regional societies from all over the world, increase the recognition of the hydrographic expertise worldwide, especially towards youth.

My dream is that youngsters wish to become hydrographers as much as some would like to become astronaut.

The IFHS has a new logo. What does it express?

When I took the chairmanship of the IFHS, I noticed the logo was very similar to national societies, which did not help in understanding which role IFHS has, particularly with the recurring use of the hippocampus in several national logos.

The new logo is a combination of several key symbols that are of crucial importance in our community today: the sea-sky interface to represent the hydrography-hydrospatial duality, the accoustic waves in the water as our technology still relies a lot on these technics. All these features are gathered in a rounded shape that symbolises the globe. We also wanted all these features to combine in order to symbolise an eye, as the human expertise is still the main driver of our community.

Please tell us more about the organisation. How does it work and how does it interact with its national member societies?

IFHS is a federation of national entities, registered a United Kingdom Charity, equivalent to a non-profit organisation. IFHS is managed through its Board of Directors, in which every society member is represented. The Board is consulted on every decisions taken by IFHS, from the budget to the hosting of the next edition of the HYDRO conference. In order to ensure its financial autonomy, every society member provides a per capita yearly subscription depending on their total membership.

Where do you see the added value of the organisation? Could you give us examples of a successful cooperation with and between national hydrographic societies and the IFHS?

The benefit of IFHS is beyond the value for money dimension for the sake of the professional individuals and the profession. The main example of successful cooperation lies with our individual accreditation scheme, HPAS. In 2020, the Board agreed to initiate the work on a common individual accreditation scheme. This idea had been discussed for years within the federation, but compromise seemed quite difficult to reach between the national communities. With the support of THS:UKI, we created a task force that managed to draft a scheme in a few months. With the help and support of all the societies, this scheme was tested and consolidated in order to be suitable for IBSC recognition. The Hydrographic Professional Accreditation Scheme (HPAS) was born. Our submission was endorsed by all the national hydrographic authorities related to our society members: France, United Kingdom, Belgium, the Netherlands, Germany, Italy and South Africa. Last spring, the IBSC decided to recognise HPAS as one of the individual accreditation scheme.

This success only lies on team work and a shared will to reach a common ground for the sake of our community.

You mentioned HPAS. The IFHS has developed HPAS to assist and support individual qualified and experienced hydrographic professionals in demonstrating their competency, capability and development of their careers. Would you please tell us about the idea behind HPAS. And where does the initiative stand today? Will HPAS one day will achieve global recognition by all relevant organisations?

The main idea beneath HPAS was to build a multinational accreditation scheme. Lately, the increase of national and regional schemes made us consider this idea in order to avoid a situation where hydrographic professionals would not be able to work worldwide, depending on how much accreditations they have.

The other underlying idea was to consolidate the legitimacy of the profession. Today, there are still many individuals whose strong expertise in the field of hydrography is based on a certified degree they gained several years/decades ago. It is so casual that most of hydrographic professionals tend to introduce themselves as a »IHO Category A/B hydrographer«. They should actually introduce themselves as »graduated from an IHO Category A/B certified course«. But the main issue is that hydrographic individuals cannot always claim with the same consistency when it comes to their »on-the-field« experience since their graduation.

So HPAS came in to bring a response to these two issues. First step was reached earlier this year with its recognition by the IBSC. The next step is to discuss and sign »mutual recognition agreements« with other IBSC recognised accreditation schemes (for example Canada and Australasia). In the meantime, we need to promote this multi-national recognition towards national/regional granting authorities that issue call/invitation to tender in the field of hydrography to enable all our accredited individuals to benefit from their status and then guaranty that these projects are managed by qualified and experienced individuals.

Under the motto »Younger generations in the forefront« IFHS is actively promoting hydrography

amongst young hydrographers. One of the most prominent and attractive activities here is the IFHS Student Award (ISA). Please tell us more about this award. How is it perceived amongst students and younger professionals? Which are the criteria for a successful application and what are the future plans for this scheme?

Every year, each IFHS society member nominates a candidate for this award. Each candidate is named by its academic tutor for a specific project/work/project/publication achieved by the nominee. Each candidate is then assessed independently by each IFHS Board Members. Based on these individual assessments, a common ranking is agreed in order to designate the winner.

The winner is awarded with a money prize and get to present its work during the next HYDRO conference.

To be successful, the candidate's work has to bring a real value to the hydrographic community and to demonstrate a real complexity in the making of the scientific response. Some national societies usually name the winner of their national award to represent them.

In 2020, due to the pandemic context, we declared all our ISA candidates as winners. This year, at the next HYDRO conference in Monaco, we will finally be able to introduce our winner after several years without any public event. This is a fair reward to these students and all the others.

Today, the IFHS Student Award could be more advertised among the student community. This could go through modifying the selection process, for example by setting up a public vote within the community.

Currently the IFHS only comprises of six member societies. Comparing this with the total membership of our partner organisation IHO, how would you rate the further growth potential of the IFHS – what e.g. about the Hydrographic Societies from the US, Denmark and Australasia?

Unlike the IHO, not all Coastal States have their own national society. Therefore, the potential growth is to extend the membership basis to new national societies: Brazil, Nigeria, USA, Canada …

As for Australasia, Denmark and South Korea, they have been member of IFHS in the past, so the challenge is more focused on bringing them back on board based on the growing profile gained by IFHS over the last years.

Do you follow a strategic acquisition plan to grow IFHS beyond its current extent and, if so, when can we expect to see new member societies joining this important work?

The main concerns shared by all potential new members are:

- What do I get from IFHS for my own members?
- The financial contribution to IFHS versus the subscription fees they charge their individual members.

To address the first concern, we are building some direct added-value to the attention of individuals like we are doing with HPAS. HPAS is a key enabler to increase to membership of national/regional societies. But we need other initiatives of that kind to bring new societies along with us.

As for the second concern, one possibility would be to allow candidate societies to join us as an observer in order to have a close look on the work and the challenges faced by the Federation. Today, IFHS only includes members and associated members with different voting rights, but no observer status yet.

»My dream is that youngsters wish to become hydrographers as much as some would like to become astronaut«

Eric Langlois

For many years the *Hydrographic Journal* had been a very attractive, regular publication of the IFHS. Unfortunately, it ceased to exist since a while now. Which are the reasons for this and are there any plans to revive the journal again?

When I took up the Chairmanship of IFHS, I took the decision to put this publication on hold. My intent was actually to rethink our communication channels and assets before taking the decision to publish the journal again. The limited human resources we dispose at IFHS forced us to prioritise the efforts towards the HPAS initiative. However, the intent is still to revive this famous publication into a formula in line with its time.

Today, the world is in a true turmoil. A multitude of simultaneous crisis, ranging from the global climate threat, the worldwide hunger for energy and commodities to the military conflict in Ukraine dominate the headlines. What is the role and potential contribution of hydrography to counter these challenges in future?

I strongly believe that hydrography has the ability to teach us how to become better individuals. Not every job has this power. It combines purpose, cooperation, innovation, discovery and mutual aid. Not to mention that it is very unlikely to be practiced alone. All these values, when experienced accordingly, contribute to set our individual bearings right.

On the other hand, I like to remember this quote that says that 80 percent of the success in any job or activity is based on your ability to deal with people. Well, the human experience is so rich within the hydrographic community that you are geared up to handle any kind of crisis that might come to your path.

The 2030 Agenda for Sustainable Development, adopted by all United Nations Member States in 2015, provides a shared blueprint for peace and prosperity for people and the planet. As the UN state: »They recognise that ending poverty and other deprivations must go hand-in-hand with strategies that improve health and education, reduce inequality, and spur economic growth – all while tackling climate change and working to preserve our oceans and forests.« To what extent is the hydrographic community involved in the ongoing implementation of these globally accepted goals?

Hydrography cannot strictly be related to »climate action« and »life below water« (respectively SDG #13 and #14). Hydrography is actually able to trigger a virtuous circle able to impact various aspects addressed with the SDGs: By gathering hydrographic data, the community contributes to improve maritime knowledge, improving the management of the maritime space between the different stakeholders: increased navigation safety, protection of the marine environment, enhanced management of natural resources. All the consequences contributes to strengthen the development of the Blue Economy. Besides, strong and sustainable governance of maritime areas contributes to the stability of a coastal region, particularly through its institutions and infrastructures (water, energy, transport). This stability is then a key enabler to population well-being, which contributes in the long-term to raising education standards and reducing gender inequality. The rise of education standards will then trigger innovation, setting the way to new technologies that will ensure a more comprehensive and consolidated knowledge of the whole maritime area. Eventually, this circle also contributes to enhancing the hydrographic and marine sciences communities.

In a nutshell, enabling the hydrographic expertise and data collection in a particular region means nothing less than opening a new chapter of its sustainable development.

You are IFHS Chairman until the end of the year. A new chairman is being sought for the time after that. Assuming that the HYDRO conference will be a success, with what feelings do you look back on the years?

My first thought goes to my fellow Board members who joined me during this three years journey. Although we haven't been able to see each other in face to face mode, I always felt confident by their ability to support new initiatives and ideas I proposed. The second feeling is the satisfaction to have contributed to the community on my personal time and no longer as part of my job. The last impression is that there is so much left to do for this community. To that extent, I wish a lot of success to my successor and I hope that he/she will be able to capitalise on a successful HYDRO conference in Monaco. //

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Towards better backscatter data products by multibeam echo sounder systems for improved seafloor mapping

An article by JENS SCHNEIDER VON DEIMLING and XAVIER LURTON

A three-day international workshop on multibeam sonar backscatter was held (October 25-27, 2022) at Dalhousie University (Halifax, Canada), coordinated by the Backscatter Working Group (BSWG), with 20 delegates attending on-site and 37 delegates attending online. The workshop served as a reviver for the BSWG activities which aim at supporting improvements in the quality and consistency of multibeam backscatter data products. The overall goal is to provide backscatter end-users with tools improving their use of backscatter for seafloor and habitat mapping. Several actions have been decided for the future, encompassing in particular the topics of at-sea acquisition, sonar calibration, data processing and collection of reference data.

multibeam echo sounder | backscatter data | BSWG
échosondeur multifaisceaux | données de rétrodiffusion | BSWG
Fächerecholot | Rückstreuinformation | BSWG

Un colloque international de trois jours sur la mesure de rétrodiffusion par sondeurs multifaisceaux a été organisé (25-27 octobre 2022) par le Backscatter Working Group (BSWG) à l'Université Dalhousie (Halifax, Canada), avec 20 participants sur place et 37 participants en ligne. Le colloque a donné une nouvelle impulsion aux activités du BSWG qui visent à améliorer la qualité et la cohérence des mesures de rétrodiffusion. Le but général est de fournir aux utilisateurs des outils améliorant leur utilisation de la rétrodiffusion pour la cartographie des fonds et des habitats. Plusieurs actions ont été décidées pour le futur, concernant en particulier l'acquisition des données en mer, la calibration des sonars, le traitement des données et la constitution d'un catalogue de données de référence.

Vom 25. bis 27. Oktober 2022 fand an der Dalhousie University, Kanada, ein dreitägiger internationaler Workshop statt, koordiniert von der Backscatter Working Group (BSWG), an dem 20 Personen vor Ort und bis zu 37 Personen online teilnahmen. Ziel des Workshops war es, die BSWG-Arbeiten hinsichtlich Verbesserung von Qualität und Konsistenz von Fächerecholotrückstreuinformation zu reaktivieren. Das übergeordnete Ziel hierbei ist es, in Zukunft eine verbesserte Meeresboden- und Habitatkartierung mit Hilfe der Rückstreustärke von Fächerecholoten für die Anwender zu erreichen. Für die Zukunft wurden mehrere Maßnahmen beschlossen, die insbesondere die Themen Datenaufnahme, Sonarkalibrierung, Datenverarbeitung und Sammlung von Referenzdaten umfassen.

Multibeam echo sounder systems (MBES) have become the standard swath-mapping sonar systems in hydrographic surveying. However, they not only provide accurate bathymetry, but also measure the seafloor's acoustic backscattering strength, which is useful for a range of applications including seafloor classification and habitat mapping. MBES backscatter data are conveniently acquired at the same time as MBES bathymetry data, and backscatter from MBES is an excellent proxy for mapping differences in seafloor properties (e.g. substrate and benthic habitat), and is therefore often used in the production of a variety of seafloor thematic maps. Such combined maps integrating bathymetry and backscatter information derived with modern MBES can partly outperform thematic maps derived from side-scan records, especially when it comes to quantitative analysis using algorithms.

To improve the quality and consistency of multibeam backscatter data, the Backscatter Working Group (BSWG) was formed in 2013 as an international group of experts on seafloor backscatter data acquired with multibeam sonar systems. The group includes researchers in acoustics, electrical engineering, geoscience and ecology, but also MBES hardware and software manufactures, surveyors, hydrographers and

Authors

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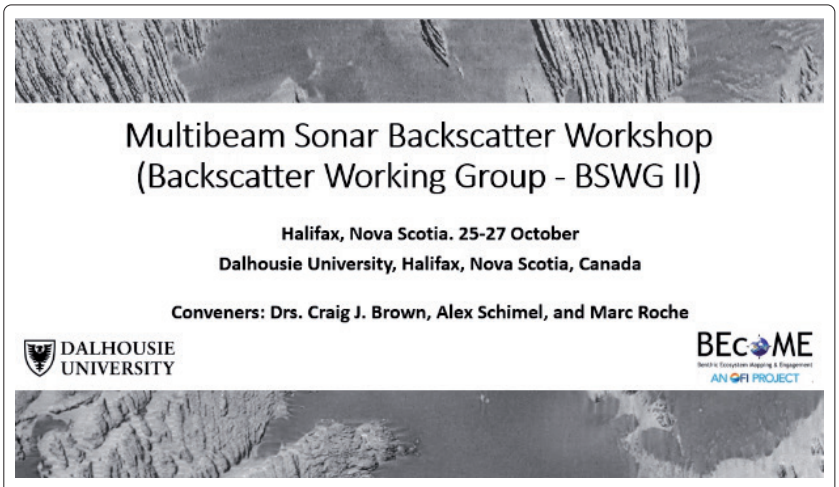

Fig. 1: Opening slide of the three-day workshop presented by the conveners

other end-users. The BSWG was formed in Rome in 2013 at the annual GeoHab conference, and to this day operates under the umbrella of the GeoHab association (https://geohab.org/backscatter-working-group). To date, the main output of the BSWG was a report published in 2015 providing comprehensive guidelines and recommendations on the nature, acquisition, processing and use of MBES backscatter data (Lurton et al. 2015), which is widely recognised today as the main resource on the topic of MBES backscatter data for all interested users. Subsequently, the group published a special issue on »Seafloor Backscatter Data from Swath Mapping Echosounders: from Technological Development to Novel Applications« in the journal *Marine Geophysical Research* (Lurton and Lamarche 2018), collating research articles on the topic of MBES backscatter data measurement, processing and applications.

In order to give a new impetus to the BSWG activities, the core members of the BSWG and active participants recently convened during a workshop held in Halifax, Canada, October 25 to 27 (Fig. 1). Thanks to the organisation and hosting of Craig Brown and the financial support from the Ocean Frontier Institute (OFI) BeCOME project (https://www.ofi.ca/research-projects/become), the hybrid event took place at Dalhousie University's Steele Ocean Science Building with 20 participants on-site and a total of 37 participants attending online. The workshop began with presentations from participants to outline the state-of-the-art and new developments regarding MBES backscatter data and its use (https://www.youtube.com/channel/UCxqsSrkihByHyVLzgp04-yg/videos), and which provided background for the subsequent discussions. Small break-out group discussions then took place where participants discussed current research gaps and priorities regarding the topic. The groups appeared unanimous in identifying a general lack of standards (in calibration, acquisition and processing) as a main issue to tackle. The group also discussed what solutions can be put forward to improve the education and training of backscatter users with this data type. Furthermore, it was agreed that new models and technical advances such as multispectral acoustic analyses and water-column data information deserve more attention and are offering tremendous potential for applications in environmental surveying. The workshop concluded with a synthesis of the topics discussed and an open discussion on updating the groups' mission, objectives, structure and roadmap. A major decision was to re-organise the BSWG into thematic sub-groups.

The workshop was brought together by host Craig Brown (Dalhousie University) and co-convened by Alexandre Schimel (Geological Survey of Norway) and Marc Roche (Federal Public Service Economy, Belgium), who worked together to revitalise the BSWG this year. The group actively looks for interested and active participants from the community of backscatter users. Further meetings of the group are expected online and in person at the next GeoHab conference to be held in May 2023. If you are interested in becoming an active participant in the future activities of BSWG or simply remaining informed about those future activities through the mailing list, contact the BSWG at bswg@geohab.org. //

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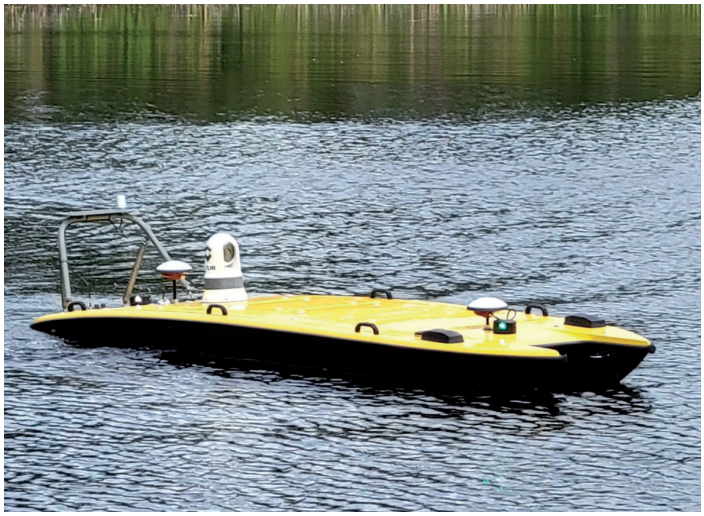

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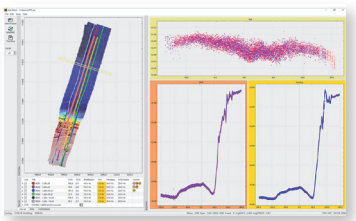

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