LIGHTHOUSE

JOURNAL OF THE CANADIAN HYDROGRAPHIC ASSOCIATION
REVUE DE L'ASSOCIATION CANADIENNE D'HYDROGRAPHIE

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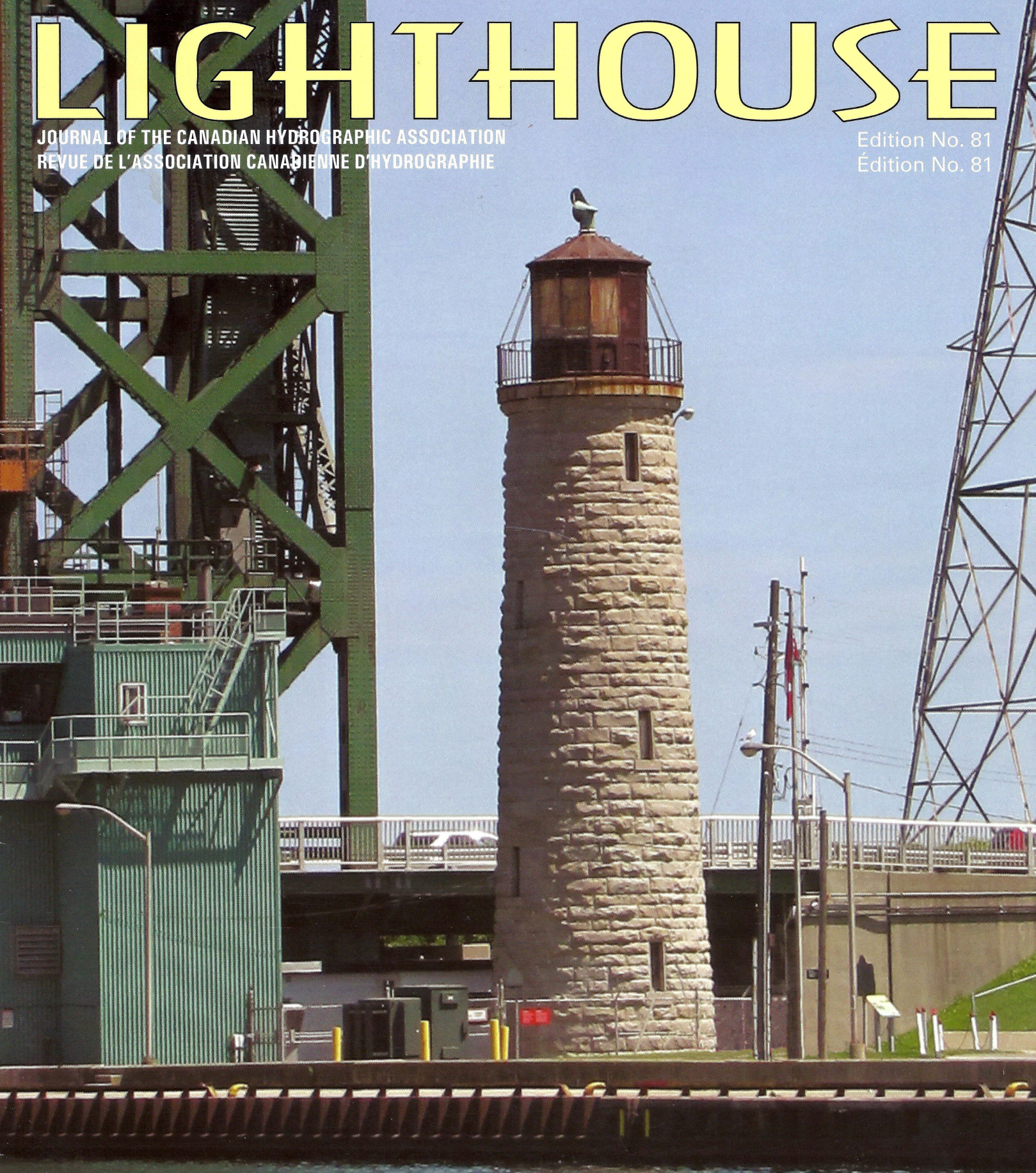

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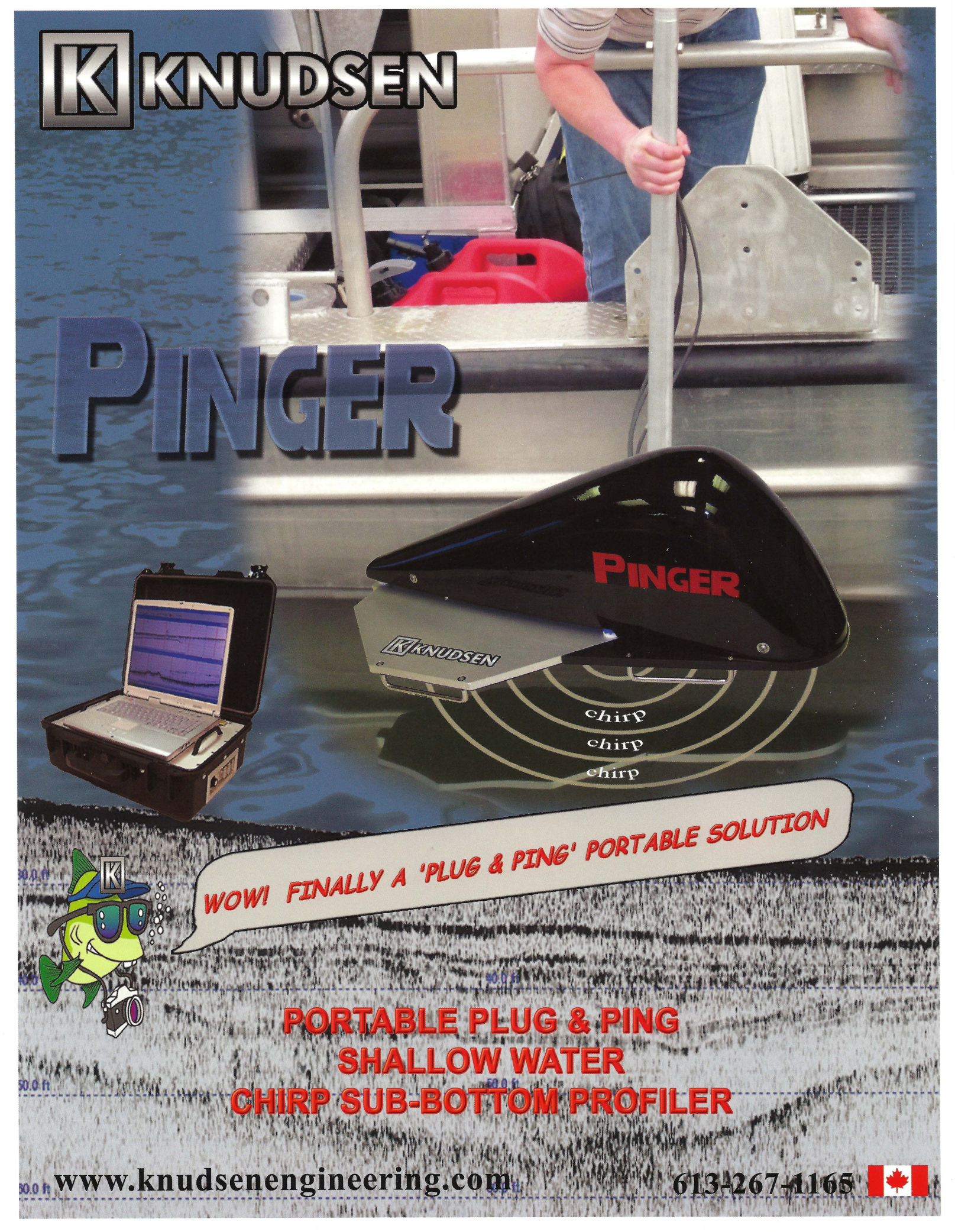
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contents contenu

LIGHTHOUSE

Edition 81 • Édition 81

5 **Seafloor Classification: The Use of Hydrographic Data for Seabed Analysis** - S. Finnis
8 **Canadian Institute of Geomatics News** - CIG
9 **Association of Canada Lands Surveyors News** - J-C Tétreault
9 **Nouvelles de L'Association des Arpenteurs des Terres du Canada** - J-C Tétreault
10 **170 Delegates Attend FEMME 2013** - Kongsberg
15 **Russian Leader Awards Medal to Saanich Man for Wartime Valour** - R. Watts
17 **Hydrographic Efficiencies of Operating a 19m Research Platform in the Eastern Canadian Arctic** - S. Brucker, J. Muggah, I. Church, J. Hughes Clarke, T. Hamilton, A. Hiroji, W. Renoud
27 **Coastal Zone Mapping and Imaging LIDAR (CZMIL) Validation** - D. Dodd, K. Barbor
38 **BCIT Students Map English Bay** - D. Rutherford

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regular features / chroniques

2 Cover photo / Photographie en couverture
2 CHA Directors / Directeurs de l'ACH
3 Message from the National President / Mot du Président national
4 Editor's Note / Note du rédacteur
7 Go F.I.G.ure
11 CHA Corporate Members/ Membres corporatifs de l'ACH
37 Calendar of Events
39 CHA Corporate Member Profiles / Profils de l'ACH Membres corporatifs
51 CHA News / Nouvelles de l'ACH
52 CHS News / Nouvelles de l'SHC
55 CHA Award / Bourse de l'ACH
56 Rates / Tarifs

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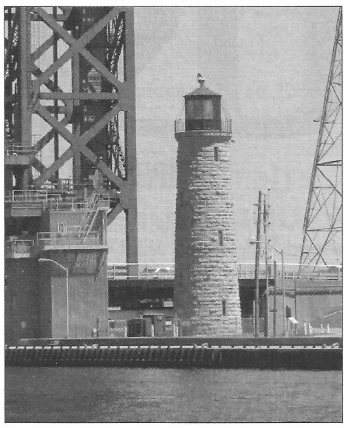
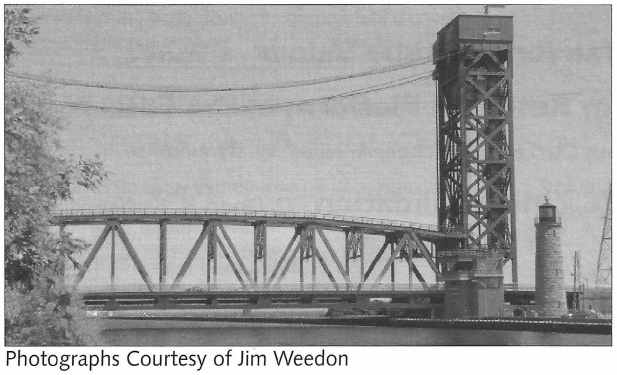


Burlington Canal Lighthouse

Burlington (Beach) Canal Lighthouse

The Burlington Canal Lighthouse has stood in its present location since it was completed in 1858. It replaced an original wooden structure that burned down in 1856 due to sparks from a passing steamer igniting wooden piers. The lighthouse is 55 feet tall, constructed of white dolomite limestone and tapers slightly as it rises. It is topped with a lantern room and cap and originally housed a pair of oil-burning lamps with reflectors. It is similar in appearance to several Imperial Tower lighthouses constructed around Lake Huron and Georgian Bay. The lighthouse on Christian Island in Georgian Bay bears the closest resemblance.

In 1961 the light was decommissioned and electrified at which time a third order Fresnel lens was installed. The lighthouse was deactivated in 1968 and has sat slowly decaying since it's light was turned off.



Photographs Courtesy of Jim Weedon

During the past 155 years the lighthouse has been witness to several changes along the beach strip. It now sits nestled next to the towering steel structure of the Burlington Lift Bridge to the east and dwarfed by the Skyway Bridges to the west.

Efforts of those interested in saving the lighthouse from eventual deterioration have been ongoing for several years. Thoughts of restoring it in it's present location, to moving it elsewhere along the beach strip or other areas of the harbour have been suggested. A group called the Beach Canal Lighthouse Group (www.bclg.ca) has been working to preserve the lighthouse.

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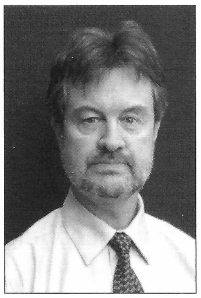
Message from the National President
Mot du Président national



tran•si•tion. /tran ziSH n/. Noun. The process or a period of changing from one state or condition to another.

As the mantle of leadership is passed from my predecessor to me, I reflect on life's little, and sometimes not so little transitions. Less than a year ago, I was employed by the Canadian Hydrographic Service: today I am retired - sort of. Retirement is not about doing less, but about doing the things you want to do, when you want to do them.

One of the things that I have wanted to do (on my bucket list, as it were) is an Ironman triathlon. A wise coach once said: "Work; marriage; Ironman - pick 2." His meaning: if you try all three, one is doomed to failure. So I chose to drop the first, rather than risk wrecking the second. And so I transitioned from a working person to a retired person, a very busy retired person.

In triathlon, the first discipline is swimming, followed by biking and ending with running. Between each discipline is a transition: transition from the swim to the bike is called T1; transition from the bike to the run is called T2. Many refer to these transitions as the fourth discipline. One must be accomplished at all four disciplines to truly do well in the sport of triathlon.

And so as the CHA transitions its national president, I'd like to thank George for his two terms, his hard work and dedication and the many things he accomplished as our leader. He briefed me well on the items that I must now take up and move forward. Like keeping our journal, *Lighthouse*, fresh, relevant and timely - for our readers, for our advertisers and for potential new members to our association.

If you have ideas for how to make *Lighthouse*, or even the CHA more relevant, please drop me a line.

Rob Hare
wabbit@shaw.ca

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tran si tion / tr zi sj /. n.f. Processus ou période de passage d'un état ou d'une condition à un autre.

Je réfléchis aux petites et parfois pas si petites transitions de la vie depuis que mon prédécesseur m'a remis le bâton de commande. Il y a moins d'un an, je travaillais au Service hydrographique du Canada; aujourd'hui, je suis à la retraite en quelque sorte. La retraite n'est pas de faire moins, mais de faire ce que vous voulez quand vous le voulez.

Une des choses que je veux faire (sur ma liste d'objectifs personnels) est un triathlon Ironman. Un entraîneur avisé a dit un jour: «travail, mariage, Ironman – choix douteux». Il voulait dire que vous êtes voué à l'échec si vous essayez de concilier les trois. J'ai donc choisi de laisser tomber le premier plutôt que de risquer de ruiner le second. Je suis donc passé de travailleur à retraité, un retraité très occupé.

En triathlon, la première discipline est la natation, le vélo suit et on termine par la course. Chaque transition porte un nom, la transition entre la natation et le vélo s'appelle T1, celle entre le vélo et la course s'appelle T2. Plusieurs font référence à ces transitions comme la quatrième discipline. Il faut être accompli dans les quatre disciplines pour vraiment bien faire dans le sport du triathlon.

Il en est de même dans la transition des présidents nationaux de l'ACH, je tiens à remercier George pour ses deux mandats, son travail acharné, son dévouement et ses réalisations pendant qu'il était notre leader. Il m'a bien informé sur les points que je dois maintenant relever et faire progresser comme garder notre revue *Lighthouse* renouvelée, pertinente et opportune pour nos lecteurs, nos annonceurs et les nouveaux membres potentiels de notre association.

N'hésitez pas à m'écrire si vous avez des idées dans la réalisation de la revue *Lighthouse* ou même pour rendre l'ACH plus pertinente.

Rob Hare
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Editor's Note
Note du rédacteur

Taking on any new task forces one to revisit how the task has been accomplished by others before you. Sure, I've received and read *Lighthouse* in the past, mostly the articles, but now I find myself re-reading it through a different lens. What are all the content elements that go into each edition? Are they still all useful and relevant? What can be done differently to make *Lighthouse* better (more relevant, more timely, more accessible) for CHA members, for our advertisers, for potential new CHA members that we might wish to attract?

But this is only my first edition as Editor (hopefully an interim position only - I'm seeking volunteers to help, if not to take over the role), so I'm learning the ropes and hoping to get out this edition in a timely manner, with very little in the way of changes to the way it's been for the last several years.

The real meat of *Lighthouse* is in its high-quality articles, and this edition is no different. The article by David Dodd (USM), which is an update to a paper presented at US Hydro 2013, gives us a look at the many tools required to evaluate a coastal topographic/hydrographic lidar system (CZMIL) effectively. When a depth/height measurement system transitions through the surf zone, comparison to multibeam echosounder depths alone will not be able to evaluate its full performance thoroughly enough, and other measurement techniques must be employed.

Steve Brucker et al. (UNB) also provide an updated version of a paper originally presented at US Hydro 2013, on the operations and successes of a hydrographic program from a small autonomous vessel in the Eastern Arctic.

Meanwhile, Stephen Finnis (CHS-Pacific) gives us a look at what Pacific Region has been able to accomplish in their attempts to classify the seabed type over the BC Coast, and the challenges they still face.

Finally, an article on Tom McCulloch's recent medal award, is reprinted with kind permission of the Victoria Times-Colonist newspaper.

As always, we have news from our sustaining members, updates from related organisations: the ACLS, the CIG, FIG Commission 4, Friends of Hydrography; and from the CHS regions and CHA branches.

If you have ideas for how to make *Lighthouse* more relevant and useful, please drop me a line.

Rob Hare
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Seafloor Classification: The Use of Hydrographic Data for Seabed Analysis

By: Stephen Finnis, CHS Pacific Co-Op Student, University of Victoria, BC, Canada

Introduction

In recent years, there has been an increased interest in understanding seabed composition. Fields of study which require seafloor data, such as benthic habitat mapping and resource exploration are expanding, in part, due to technological advances in GIS and remote sensing (i.e. acoustic backscatter). Due to this growing interest in the seabed, the Pacific Region of the Canadian Hydrographic Service (CHS) is currently in the preliminary stages of documenting their bottom quality data and assessing its usefulness for these purposes. As part of my co-op term from January to April 2013, I have been working to collect, update and store available bottom quality data collected by CHS. Although the primary goal of CHS has typically been to collect bathymetric data for safe navigation, CHS has recorded a large volume of bottom quality data (over 140,000 samples) from their surveys since 1911. Although most of the data lack the rigorous sediment analysis performed by biologists and geologists, compiling the data into an available product is a useful starting place for developing CHS' role in seafloor classification.

Data

The majority of seabed data gathered by CHS has been specifically collected for navigation purposes. Data collection has therefore focused on purposes such as finding safe anchorage sites and locating rocky shoals. Bottom quality information has been collected and recorded on hardcopy field sheets as point data classified to Chart 1 standards.

For this project, bottom quality data was extracted from validated, digitized field sheets and from digital copies of charts stored in CARIS Bathy Database into a geodatabase in ArcGIS. Over 110,000 bottom quality data points from digitized field sheets and roughly 30,000 point data samples from charts were compiled. Supplemental data, such as survey year, chart number and chart edition date were added as additional attribute fields.

Despite the large number of samples, seafloor data collected by CHS have several limitations. Similar to sounding data from early surveys, positional accuracy of the samples is often low due to deriving coordinate positions by triangulation. As well, collection methods initially involved obtaining seafloor samples by putting tallow on the bottom of a leadline before deployment and looking at the returning sediments after contact with the seafloor. Fine grain sediments such as silt often washed off and were incorrectly classified as bedrock since no sediment was returned. Furthermore, classifications were performed in the field which led to largely subjective analysis. Chart 1 lists classes in decreasing order of composition (e.g. sand and gravel contains more sand than gravel) which resulted in many classes being developed for sediments with a mix of grain sizes. With no strict standards for classification, over 200 bottom quality classes exist from various combinations of Chart 1 sediment types.

In addition to charting data, CHS has also collected grab samples with the specific goal of studying seabed composition (referred to as "video grab samples" in Figures 1 and 2). From 1998 to 2008, a team from CHS collected 814 samples in southern Vancouver Island (primarily the Strait of Georgia) which were analyzed by grain size analysis at the Pacific Geoscience Centre in Sidney, B.C. Samples were classified using a modified Folk (1954) classification system, which is based off of gravel, sand and mud percent composition. The scale was adjusted to include bedrock and shell fragments. As well, a video system was deployed with the grab sampler to obtain a more detailed view of the seafloor. If the sample was deemed unrepresentative of the seafloor from the video, the classification was adjusted to match the true seafloor substrate best. Images of most samples were also taken for a comprehensive data record.

Analysis and Potential for Mapping

Despite the data limitations, data from CHS give an important first glimpse of seafloor composition. When all data sources are combined, there is very dense coverage of sample points for the entire BC coast, which is especially valuable in remote, poorly studied locations.

Figure 1 shows the density of data collection in Northern Haida Gwaii, Saanich Inlet and Haro Strait and Barkley Sound. The data sources of the point samples (charts, field sheets and video grab samples) are represented using different symbology.

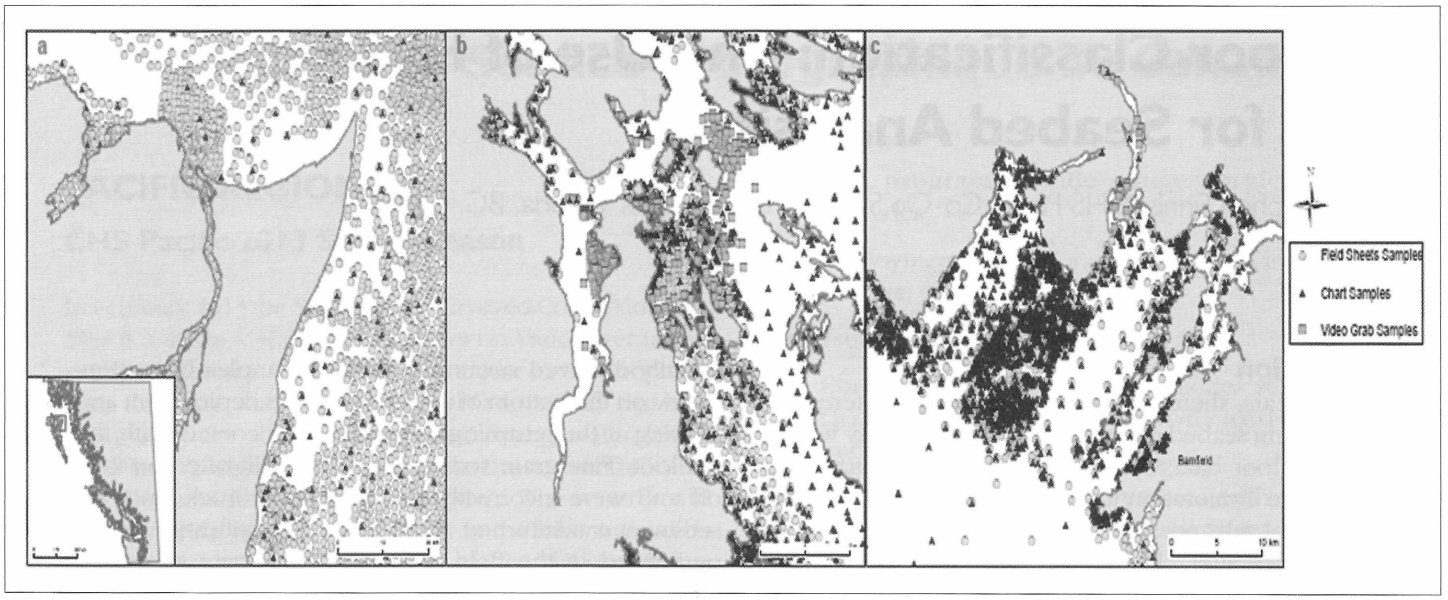

Figure 1: Bottom quality data extracted from field sheets (circles), charts (triangles) and video grabs (squares) collected by the Pacific Region of the Canadian Hydrographic Service in (a) Northern Haida Gwaii, (b) Saanich Inlet and Haro Strait and (c) Barkley Sound.

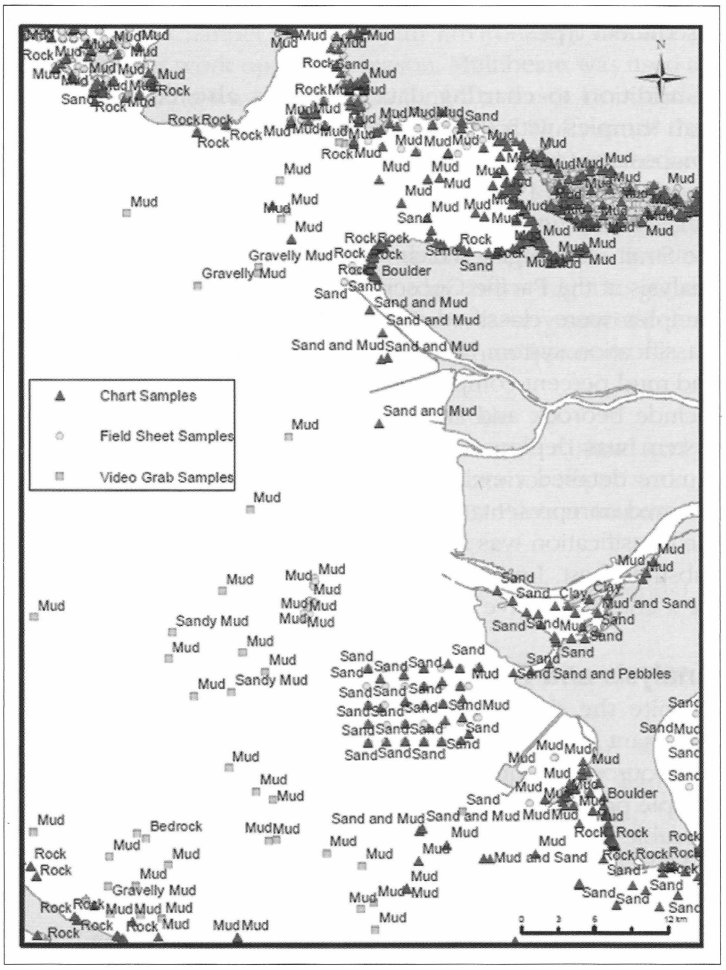

Figure 2: Bottom quality samples in the Greater Vancouver Area extracted from field sheets (circles), charts (triangles) and video grab samples (squares) collected by the Pacific Region of the Canadian Hydrographic Service.

Figure 2 shows the point data displayed with classification labels from the Lower Mainland. Density and distribution of data sampling is often variable. There are typically numerous samples in important navigation areas, such as Burrard Inlet.

Attempts were made during the co-op term to reduce the number of bottom quality classifications. Ultimately it was decided that reclassifications should be up to the user depending on their need. Users likely require data from one specific region and will not deal with the all 213 bottom quality classes. Generalizing data and removing details is useful for cartographic purposes, but for now, keeping the original data seems to be the best option.

Conclusion

Although the data has important limitations that need to be recognized, CHS has a large inventory of data which can provide very useful information depending on the application. All seafloor analysis is subject to error, but these samples are better than no data at all. Compiling all bottom quality datasets is a necessary first step in the preliminary stages of seafloor classification. Ultimately, an online interactive map to display the point on the CHS website would provide the greatest utility.

References

Folk, R.L. 1954. The distinction between grain size and mineral composition in sedimentary rock nomenclature. J. Geol. 62(4), 344-359.

This regular feature provides information and current news from the International Federation of Surveyors (FIG) with emphasis on FIG Commission 4 (Hydrography).

Commission 4 Newsletter

Dr. Michael Sutherland (Canada, and Trinidad and Tobago)
Chair (2011-2014), Commission 4, International Federation of Surveyors (FIG)
March 15, 2013

In 2012, Commission 4 participated in a number of conferences of importance to hydrography:

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

2013 is the penultimate year of the current 2011-2014 term, and Commission 4 remains committed to all things hydrographic. Below are two main events in which the Commission participated in 2013:

FIG Working Week 2013, Abuja, Nigeria

FIG Working Week 2013 was held in Abuja, Nigeria between May 6th and 10th 2013 at the International Conference Centre and Nicon Luxury Hotel. There were two planned Commission 4 technical sessions: Hydrographic Education and Standards, and Hydrography in Practice. Both sessions comprised nine papers. Abuja is a beautiful and modern city, but FIG was aware that some anxieties existed among potential conference participants because of recent unfortunate incidents involving foreigners. The conference went on as planned. More than 2000 Nigerian and regional participants and almost 250 international participants, from around 40 countries, attended. The Working Week was a success and was also the largest Working Week ever in FIG history.

Joint FIG-IHO Conference – The Blue Economy

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

Web References

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

CANADIAN INSTITUTE OF GEOMATICS NEWS

NOUVELLES DE L'ASSOCIATION CANADIENNE DES SCIENCES GÉOMATIQUES

SPRING is just around the corner, heralding new beginnings and much work to do.

Congratulations go out to: Rob Hare on being elected President of the Canadian Hydrographic Association; CIG Past President, Tom McCulloch on being awarded the *Ushakov Medal* by H.E. Vladimir Putin, President of the Russian Federation; Professor Dr. Ayman Habib, head of the Department of Geomatics Engineering at the University of Calgary for the ISPRS President's Citation for Technical Commission 1; and Professor Dr. Ahmed El-Rabbany of Ryerson University on joining the Canadian Institute of Geomatics (CIG) Executive as Vice President...Welcome Ahmed! CIG also welcomes Intergraph Canada Ltd., as the newest Platinum Sustaining Member.

Since the last CIG News in *Lighthouse* Edition No. 80, the CIG National Executive has been busy representing the association in several forums and promoting cooperation with several of its colleagues. In December, CIG was represented at the ISPRS meeting by the President of Technical Commission II, Dr. Songnian Li. In January, at the Canadian Geomatics Community Round Table (CGCRT) in Ottawa by the President and Immediate Past President Anthony (Tony) Sani, where the latter was named to the Standing Committee of the CGCRT, which is tasked with developing a draft Pan Canadian Geomatics Strategy. CIG was also represented at the Annual General Meetings of the New Brunswick and Ontario Land Surveyors Associations. CIG Vancouver Branch presented a Technical Workshop in Vancouver, on "How to Search the Indian Land Registry". CIG looks forward to being represented at the Annual World Bank Conference on Land and Poverty, and at the FIG Working Week in Abuja, Nigeria, where the Chair of Commission 4-Hydrography Dr. Michael Sutherland will lead the CIG Official Delegation.

Planning is well underway for the Earth Observation Conference on Global Changes (EOGC 2013) and CIG is inviting you to attend the National Conference to be held in conjunction with EOGC 2013 at Ryerson University June 4-7. Please visit the CIG website at http://www.conferences.cig-acsg.ca/ and come out and support your Geomatics community. Planning has also commenced for the CIG Annual General Meeting in conjunction with the CIG Montreal Branch Geomatics Symposium 2013, October 3-4. Please set the date aside and plan to attend.

To improve cooperation with our colleagues, CIG has initiated discussions with GIAC, PSC and the Alberta Geomatics Group and is exploring ways of participating in the Pathways Project being undertaken by York University and the Association of Ontario Land Surveyors. CIG is also collaborating with Four Point Learning as a means of providing increased services to CIG Members. CIG is seeking discussions with the Federal Government to promote the CIG *New Business Model* for the Geomatics Certification Program.

The President looks forward to meeting many of you at *The 2013 Canadian Institute of Geomatics Annual Conference and the 2013 International Conference on Earth Observation for Global Changes* (EOGC'2013) June 4-7, 2013 in Toronto. Please visit the CIG website for details http://www.conferences.cig-acsg.ca

ACLS·AATC
Association of Canada Lands Surveyors
Association des Arpenteurs des Terres du Canada

Use of the CLS Professional Designation

The title "CLS", or "Canada Lands Surveyor" is reserved to individuals who hold a CLS commission and who are members in good standing of the Association of Canada Lands Surveyors (ACLS).

Until recently, the only pre-requisite to being able to use the title "CLS" officially was the possession of a CLS commission. However, section 25 (1) of the Canada Lands Surveyors Regulations was amended on December 6, 2011 to say that the right to use the title "CLS" is possessed only by those who both hold a CLS commission and are current members of the ACLS.

Many will be surprised to learn that, unlike other professions, in the past CLS's did not have to be members of the ACLS to be able to use the professional title. However since December 2011 this is no longer the case.

If you have any questions about the process of becoming a Canada Lands Surveyor, please see the information here: http://www.acls-aatc.ca , or contact me at 613-723-9200 (Ottawa) or jctetreault@acls-aatc.ca .

Jean-Claude Tétreault, CLS, a.-g., P. Eng., MBA
Executive Director

Utilisation du titre professionnel d'a.t.C.

Le titre « a.t.C. », ou « arpenteur des terres du Canada » est réservée aux personnes qui détiennent un brevet d'a.t.C. et qui sont membres en règle de l'Association des arpenteurs des terres du Canada (A.A.T.C.). Anciennement, le titre était « a.f. » ou « arpenteur fédéral » (avant 1999).

Jusqu'à récemment, le seul prérequis pour être en mesure d'utiliser le titre d'a.t.C. a officiellement été la possession d'un brevet d'a.t.C. Toutefois, l'article 25 (1) du Règlement sur les arpenteurs des terres du Canada a été modifié le 6 décembre 2011 pour stipuler que le droit d'utiliser le titre d'a.t.C. n'est dorénavant détenu que par ceux qui, à la fois, détiennent un brevet d'a.t.C. et sont actuellement membres de l'A.A.T.C.

Beaucoup seront surpris d'apprendre que, contrairement à d'autres professions, dans le passé les détenteurs de brevet d'a.t.C. n'avaient pas besoin d'être membres de l'A. A.T.C. pour être en mesure d'utiliser le titre professionnel. Toutefois, depuis décembre 2011, ce n'est plus le cas.

Si vous avez des questions sur le processus qui mène à l'obtention d'un brevet pour d'arpenteur des terres du Canada, veuillez consulter les informations disponibles à : http://www.acls-aatc.ca , ou communiquez avec le soussigné au 613-723-9200 (Ottawa) ou jctetreault@ acls-aatc.ca.

Jean-Claude Tétreault, A.T.C., a.-g., ing., M.B.A.
Directeur exécutif

170 Delegates Attend FEMME 2013

By: Kongsberg, SUBSEA NEWS

FEMME is the Forum for Exchange of Mutual Multibeam Experiences. This biennial conference, Organised by Kongsberg Maritime, brings together a diverse delegation of Kongsberg Maritime multibeam users, who regard it as one of the most rewarding events of its kind on the calendar. FEMME is a truly global affair – this year 170 people attended from 27 countries.

The main conference was opened by Arnt-Helge Olsen, Vice President Subsea Sales at Kongsberg Maritime on Wednesday 17th April and the audience was treated to an interesting opening address by Larry Mayer, Professor and Director of the Center for Coastal and Ocean Mapping/ NOAA-UNH Joint Hydrographic Center at the University of New Hampshire.

His presentation, titled An 'Almost Old' Man's Look at from Whence We've Come and Where We May be Going, looked in-depth at the area of bathymetry and improving data quality. Other topics covered include the growth of ocean mapping applications and how this is tied to backscatter, and water column measurements, whilst asking; "Why can't we map our own planet as completely as we've mapped the moon and mars?"

A big question certainly, and a presentation that really engaged the audience. Larry also played a part, as one of several joint authors, in the presentation that followed his opening address, when J. Beaudoin from the University of New Hampshire looked at Multibeam Echosounder System Optimization for Water Column Mapping of Undersea Gas Seeps.

Papers with topics from different applications, both traditional and new were presented during the conference and all were at a very high technical level. Topics covered included logging, displaying and processing water column data, also referred to as mid-water column data, and seabed backscatter data. With new more powerful systems and technology the potential and the usage of these data are increasing rapidly, which was highlighted in papers throughout the conference.

A lot of interest was also taken on how to ensure that the quality of the bathymetric survey was in compliance with the IHO S-44 standards, especially on target detections. To achieve this, the importance of good alignment and calibration of all systems was highlighted. This is especially important since the Kongsberg Maritime EM 2040 produces very clean and high resolution data, displaying more and smaller features on the seabed.

Regardless of topic, several key aspects tied all presentations together; they were presented by experts to experts, and featured real technical detail that the audience could openly discuss and take away with them to help them in their own work.

The next FEMME will take place in Autumn 2015 in Singapore.

"More data and better data quality will have a great impact on the data flow and the production line from logging to finished products," explains Helge Uhlen, Product Sales Manager, Kongsberg Maritime. "Amazing results were presented, from pipeline inspection and shallow waters surveys to deep waters survey from different research projects."

"We were delighted with the quality of presentations from our users and Kongsberg Maritime staff during FEMME," comments Arnt Helge Olsen, Kongsberg Maritime. It gave us the opportunity to update our customers on new developments with Kongsberg Maritime technology but most importantly, it provided our user community with an open forum for discussing the use of multibeam technology and how as an industry, we can continue to improve our use of this vital technology."

In addition to the many customer papers, Kongsberg Maritime presented several new products including the new EM 2040 Compact, which is a small version of the EM 2040. Throughout the conference, Kongsberg Maritime took many requests for new features and improvements to its products, which it considers a key part of events like this. On FEMME 2013 itself, feedback from delegates was overwhelmingly positive:

"FEMME is an impressively well-organized conference, with an amazing technical level of users' presentations." – Commander Aluizio Oliveira, BRAZILIAN NAVY

"It has been a great experience. We have learned a great deal and would recommend that other hydrographic users in Latin America come to the next FEMME." – Mr. Rodrigo Torres, PERUVIAN NAVY

"Very good conference overall. The level of expertise and the organization of this event is great." – Karen Hart, CARIS

"I want to thank everyone involved for an excellent week, well managed under difficult circumstances. Your speakers were of a high level, the hospitality excellent and the whole event left a very good impression."- Rich Lear, DOF Subsea A/S

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Russian Leader Awards Medal to Saanich Man for Wartime Valour

By: Richard Watts, Times-Colonist Newspaper, Victoria, BC

Article reprinted with permission from the Victoria Times-Colonist newspaper, April 2, 2013.

Saanich man was awarded the Ushakov Medal on behalf of Putin.

Christmas, 1943, and a deadly game of cat and rat was underway in heavy seas atop Norway — the Royal Navy as cat and Nazi warship *Scharnhorst* the rat.

Unaware, however, of this pursuit were the sailors of 19 merchant vessels in Convoy JW55B. These ships, loaded with war supplies bound for Murmansk, Russia, were the cheese meant to lure the Nazi battle cruiser, *Scharnhorst*, into a fight.

"We kept on wondering 'What on earth is happening?'" he said. "What we didn't realize was our convoy, JW55B, was bait."

"The Royal Navy was trying to keep us out there to entice the *Scharnhorst* into making an attack," McCulloch said.

And the Nazi battle cruiser bit. What followed was an engagement that has since become known as the Battle of the North Cape. It ended on Dec. 26 about 8 p.m. with the *Scharnhorst* capsized and sunk under gunfire and torpedoes. Of the 1,968 crew members, only 36 were rescued and taken prisoner.

Tom McCulloch has received a medal for valour from the Russian government. Although honoured, McCulloch said the award brought back memories of the war's hardships. (Photos by Adrian Lam, Times Colonist)

Following that engagement, McCulloch went on to earn his credentials as a master mariner. He enjoyed a long career captaining a variety of vessels and immigrating to Canada, with wife, Doreen, in 1948.

Eventually, he became a hydrographer, measuring depths, tides and currents for shipping maps, first for Canada, but later for a variety of developing countries before retiring, finally, in 2002.

So it was a bolt from a place long forgotten when he received a message, in November, from the Russian Embassy in Ottawa.

"We were in very heavy seas and we were ordered to throttle back to eight knots," said Tom McCulloch, 88, of Saanich, then an 18-year-old cadet aboard the merchant ship *Ocean Viceroy*.

"These were big, heavy cargo ships, and in a heavy gale when you are only going eight knots, you can't control them," said McCulloch, born in Greenock, Scotland, and now living in Gordon Head.

"By decree of Vladimir Putin, President of the Russian Federation, of Sept. 30, 2012, you are awarded the Ushakov Medal," read the letter.

The letter said the award was proof of President Putin's high respect and gratitude for the courage and bravery shown on the Murmansk convoy during a difficult time in his nation's history.

McCulloch was presented the medal on Feb. 1 in Vancouver. He learned 19 others in B.C. were awarded the Ushakov Medal, as well as 62 others living in Canada.

McCulloch said when he first received word, the memories of that time were nearly forgotten. But they came flooding back: the terror, the winds, big seas and the freezing, freezing conditions.

His own vessel was loaded with tanks, artillery pieces and shells. Ready for assembly were planes, carried in crates on deck. As a cadet, it was his job to routinely inspect the deck cargo to make sure it was secure in the pitching seas.

It was also his job to report the state of the ice build-up to the mate on duty. And if it was getting dangerously thick, its weight threatening to make the ship topheavy, it was his job to lead a small party of sailors to break it up with chipping hammers.

McCulloch remembers that only days after departing Scotland, Convoy JW55B had already come under attack from German planes. Shortly after, McCulloch said it lost two ships to U-Boat sinkings. Seeing the flashes of guns on the horizon during the night of the battle, Boxing Day, 1943, the merchant sailors were more glad to be safe than interested in the fight.

The battleship *Duke of York*, cruisers *Jamaica* and *Belfast*, and destroyers *Oppurtune*, *Virago*, *Musketeer* and *Matchless* were all in on the *Scharnhorst's* sinking.

McCulloch's own ship, and the others, continued on to Murmansk safely. The port had suffered heavy damage from nightly bombings, so it took more than a month before his ship was unloaded and he was back in the U.K.

He said his wartime and career experiences have earned him several medals, including the Atlantic Star and the Queen's Jubilee Medal. But the Ushakov Medal is something special.

"This is a real one," he said. "This is for valour and bravery in the face of the enemy."

"Russians only give it out to people who have undergone that," said McCulloch. "So, it's a very great honour."

Tom McCulloch received the Ushakov Medal. (Photos by Adrian Lam,Times Colonist)

Hydrographic Efficiencies of Operating a 19m Research Platform in the Eastern Canadian Arctic

By: Brucker S., Muggah J., Church I., Hughes Clarke J., Hamilton T., Hiroji A., and Renoud W., Ocean Mapping Group, Department of Geodesy and Geomatics Engineering, University of New Brunswick, Fredericton, NB, Canada

A new research mapping program has been initiated as a partnership between the ArcticNet consortium and the Government of Nunavut (GN). GN owns and operates a 19m fisheries research vessel with a mandate to conduct fisheries resource investigations in Nunavut waters. The geographic focus is the heavily ice-impacted eastern coast of Baffin Island.

With only three hamlets over a 600nm coastline and the compounded difficulty of access due to ice, the only significant prior charting activity has been specific corridors in support of the Distant Early Warning (DEW) Line and North Warning Systems. In order to fulfill the new fisheries mandate, the vessel has to predominantly operate in uncharted waters. In doing so, there is the opportunity to compile new seabed mapping corridors that serve charting, ArcticNet geoscience and GN fisheries science objectives simultaneously.

Traditionally, charting and science programs in the Arctic Archipelago have been supported from major icebreaker assets (with ancillary launches) with commensurate associated costs. An independently operating 19m platform is an order of magnitude cheaper to operate, but must work safely within the constraints of the ice and weather windows.

Introduction

In 2012 a collaborative partnership was undertaken between the Government of Nunavut, the ArcticNet NCE and the Canadian Hydrographic Service (CHS) to implement a seabed mapping capability on a 19m research vessel for operations in the eastern Canadian Arctic.

At the present time, there is no dedicated federal hydrographic survey vessel operational in Canada's Arctic waters. Federal hydrographic operations are conducted on an opportunity basis using launches aboard non-dedicated Canadian Coastguard icebreakers. Charting priorities are driven by the core shipping access requirements of the communities. As such seabed mapping activity in areas outside these core priority corridors is not routinely addressed.

This paper reports on the development of an alternative seabed mapping capability which meets the differing, yet complementary, needs of the collaborating partners.

Political Framework

In 1993, the Nunavut Lands Claims Agreement was signed. That agreement obliges the federal government to recognize the principles of adjacency and economic dependence of Nunavut communities on marine resources. Until recently, however, that obligation had not been met as offshore living resource development was predominantly being undertaken by foreign and non-Nunavut commercial organizations. Furthermore, that development has had only limited oversight to ensure the sustainable development of this emerging resource. As a result a Nunavut Fisheries Strategy was devised.

In 2005, the Nunavut Fisheries Strategy (GN and NTI, 2005) clearly identified that there was a lack of scientific knowledge behind the development of Nunavut living marine resources. Comparable research in this field in other areas of Canada's waters is far more developed through a long history of publicly-funded programs. The current federal model, however, has been to defer to "user pay" approaches which have proven inadequate.

As a result *"emerging fisheries such as flounder and clams are subject to virtually no scientific research upon which to make management decisions"* (GN and NTI, 2005). As such, a recommendation was made in 2005 to establish a Nunavut Fisheries Science Agenda that would address: *"fundamental marine ecosystem and hydrographical research, regulatory requirements, climate change impact assessment and modeling, research in support of inshore and offshore industry development"*

This has lead to the implementation of the Nunavut Fisheries Science and Research Agenda (Lynch, 2010) with a commitment of C$7.5 million over 4 years (2010-2013). A dedicated new fisheries research vessel, the *MV Nuliajuk*, has been the prime tool for the implementation of that Agenda for the 2011-2013 years.

Implementing that Agenda requires significant improvement in marine infrastructure in Nunavut. This includes harbour and port facilities, marine service centres, processing plants and cold storage facilities, and also significantly, ocean research capability. Examples of improvements in this infrastructure include the dredging of the Pangnirtung port (AMEC, 2010), feasibility studies for a deep water berth in Qikiqtarjuaq (Bridger Design Associates, 2010) and, most significantly for this paper, the construction of the *MV Nuliajuk* (Bollivar, 2010) to meet the mandate for fisheries research.

It should be noted that the impact of this infrastructure development extends well beyond the fisheries needs. Such infrastructure will also play a key role in improving maritime safety, and in facilitating the improvement of other important activities such as hunting, sea-lift re-supply, and tourism (GN and NTI, 2005).

With the implementation of a seabed mapping capability as an extension to the *Nuliajuk*, there are a wider group of users that can now utilize the platform collaboratively. This paper reports on the implementation of this capability and demonstrates its applications for fisheries habitat, nautical charting, dredge spoil disposal, port development and palaeo-sea level history.

History of Charting off Eastern Baffin Island

The first dedicated hydrographic operations off eastern Baffin Island were undertaken in 1955 by the *USS Tanner* (AGS-15) in support of the Distant Early Warning (DEW) line of radar stations. This involved single beam operations from four survey launches (Figure 1). As the DEW line stations were downgraded in 1963, there was no subsequent requirement for further surveying. Only very localized work was done by private contractors in the late 1980's to support the North Warning System.

During the DEW line period, Canada undertook delivery of the *CSS Baffin* in 1958 which provided a dedicated hydrographic survey capability in the north. With six hydrographic launches, the *CSS Baffin* represented an extremely efficient means of undertaking coastal surveys. Those surveys, however, from 1960 to 1989 were focused primarily on perceived shipping needs for the Northwest Passage and thus other areas were not addressed. For example Exeter Sound and Merchants Bay (Figure 1) which are now of interest to emerging fisheries and scientific studies (Siferd, 2005 and Cowan et al., 2012) remain uncharted.

In 1989, the *Baffin* was withdrawn from service without replacement. Since that time, no regional-scale hydrographic charting operations have taken place in the eastern Arctic. Only localized charting activities around communities have continued through the use of non-exclusive time on coastguard icebreakers. More extensive work is precluded due to the high cost and limited availability of these icebreaker assets.

As a result, areas that are now of interest to the emerging fisheries and scientific communities are often completely uncharted. Therefore there is a pressing need to find an alternate way to undertake coastal seabed mapping surveys. One model, pioneered by the Royal Danish Administration of Navigation and Hydrography (RDANH) has been to utilize groups of much smaller vessels during the short ice-free windows. Since 1958, the RDANH have operated the SKA boats in west Greenland waters (RDANH 2004). Because of the longer ice-free season, viable operations extend from late May to October. The original four vessels were 15m long and were operational until 1980 utilizing single beam sounder technology. In 1989 they were replaced with two 20m long vessels and as of 2002 they now utilize multibeam sounders. Because of well developed coastal infrastructure, these vessels are pulled out of the water and stored ashore in a dedicated building in Grønnedal.

As long as the local ice-free window is clearly understood, the SKA boat model could be extended to the Canadian side of Baffin Bay. This paper reports upon the trial implementation of multibeam sonar seabed mapping technology on the *MV Nuliajuk*, a solitary, 19m long, vessel. Because no comparable port and harbour infrastructure exists in Nunavut, the vessel has to transit from Newfoundland annually.

Core Fisheries Research Mandate

As originally delivered, the *MV Nuliajuk* was designed to undertake research in support of the emerging offshore and inshore fisheries. The offshore fisheries are focused around two species: The Turbot or Greenland Halibut (Reinhardtius hippoglossoides) and the Northern shrimp (Pandalus borealis).

These species are currently harvested in Northwest Atlantic Fisheries Organization (NAFO) geographic Divisions 0A and 0B. Division 0B (off SE Baffin Island) has the longest record of development, dating from about 1981 involving mainly foreign organizations. Division 0A (Eastern Baffin Island Shelf) has had more recent development, with exploratory fisheries starting in the early 1990's. The 2006 Turbot quota was 8,500 metric tonnes and worth about C$37.1 million (including C$5.1 Million in royalties to Nunavut Industry). Of that quota, 500 metric tonnes is designated for an emerging inshore fishery in Cumberland Sound.

Turbot are generally only caught in water depths greater than 400 fathoms (Young and Treble 2010). Thus most of the fisheries locales are along the shelf break or in the cross-shelf, glacially-excavated troughs, such as off Sam

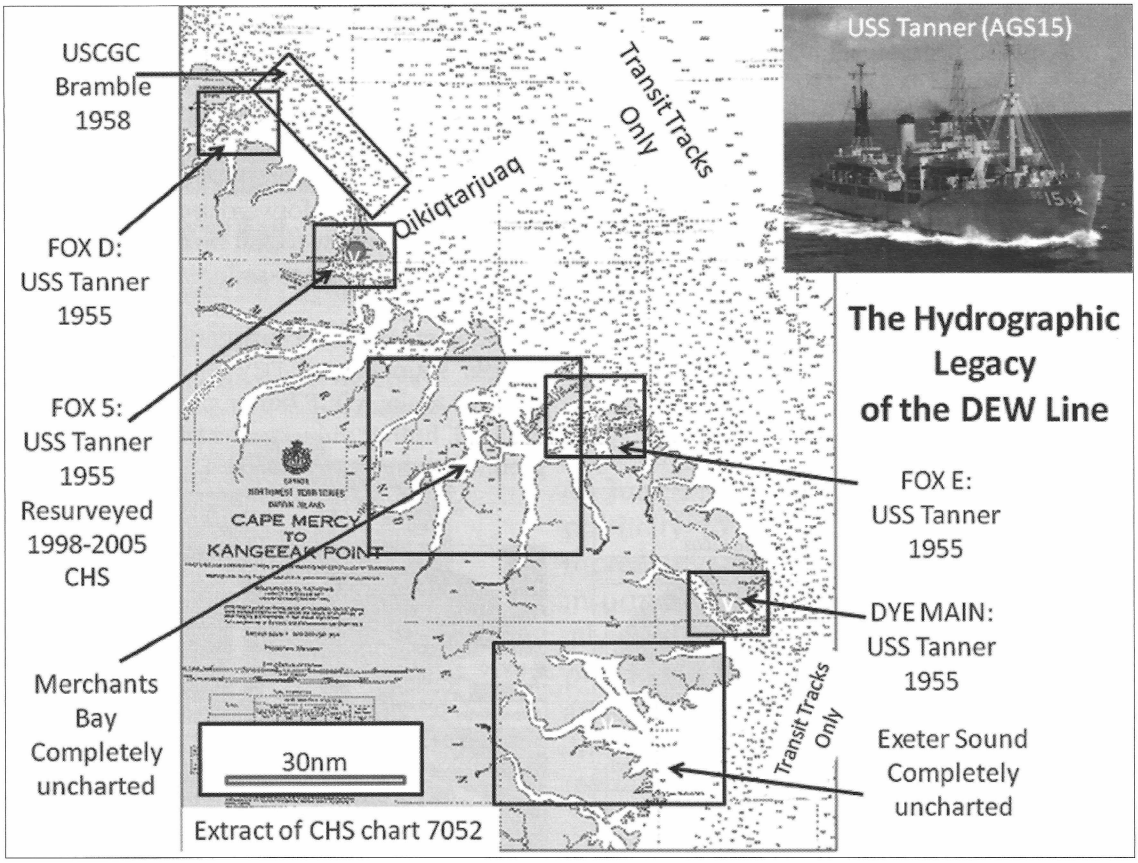

Figure 1: State of hydrographic charting in early 2012 along eastern Baffin Island. Note that the offshore regions are almost entirely covered only by transit ship tracks and that much of the inshore region does not even have reconnaissance data.

Ford Fjord and Scott Inlet, (Walsh et al., 2008) and the >1000m deep basin in Cumberland Sound (Young and Treble, 2010). Note that the offshore extension of the Nunavut Land Claims Agreement only extends out to the limit of the territorial sea (12nm) and thus excludes most of the offshore fishery with the exception of the Cumberland Sound and other glacial trough locations.

The inshore fishery of interest off eastern Baffin Island is the possible exploitation of soft shelled clams (Mya Truncata). A preliminary study of the density and distribution of this species was carried out by Siferd (2005). That study utilized bottom photography referenced to depth measurements along a series of transects. Notably that study did not have the ability to delineate the substrate to assess any correlation. Acoustic backscatter from multibeam sonar can provide that capability.

Identification of Opportunity and Implementation

Since 2003, the Ocean Mapping Group at the University of New Brunswick (UNB) has collected multibeam sonar data throughout the Canadian Arctic from the Canadian Coast Guard Ship (CCGS) *Amundsen* and ancillary survey launches (Bartlett, 2006). The CCGS *Amundsen* is a 1200 Class icebreaker owned and operated by the Government of Canada. It is made available to scientific researchers primarily through ArcticNet, a Canadian Network of Centres of Excellence (Laval, 2013).

Over the winter of 2011/2012, the CCGS *Amundsen's* engines underwent detailed testing. It was found that several of the six diesel engines aboard were failing and needed replacement. This meant that the regular home for the Ocean Mapping Group's Arctic operations was to be out of service for the 2012 mapping season. As a result, talks began in January 2012 with personnel from the Nunavut government to gauge both the feasibility and interest that existed in adding seabed mapping capability to the *Nuliajuk*.

The Ocean Mapping Group at UNB assisted with the design of the transducer blister that was to be installed on the *Nuliajuk*. The installation of the remainder of the systems necessary for multibeam and sub-bottom survey were also designed and carried out by various members of the Ocean Mapping Group. The full sounder suites and additional support equipment were either already available at UNB or borrowed from participating groups.

Costs for the design, construction, installation, and testing of the mapping sonars were shared by UNB, the CHS, Memorial University, and the Government of Nunavut. Costs were also divided between the multibeam echosounder (MBES), sub-bottom sounder, and the Furuno FCV-30 fisheries sounder, which was installed at the same time on a new blister.

A Kongsberg EM3002 multibeam was chosen for installation on the *Nuliajuk* due to its compact installation size and availability due to the cancellation of the 2012 *Amundsen* barge program. The deep fjords of eastern Baffin Island, however, presented some operational challenges for the system, as the 300kHz EM3002 MBES system normally reaches its operational limit in about 150m of water. The cold and brackish waters of the Arctic, however, allowed for an additional 50 to 100m of quality data to be collected. The system tracked as deep as 300m in the summer of 2012 aboard the *Nuliajuk*, but the data coverage and quality are reduced. A reliable 300 to 400m wide swath was produced in 200m of water depth (Figure 2).

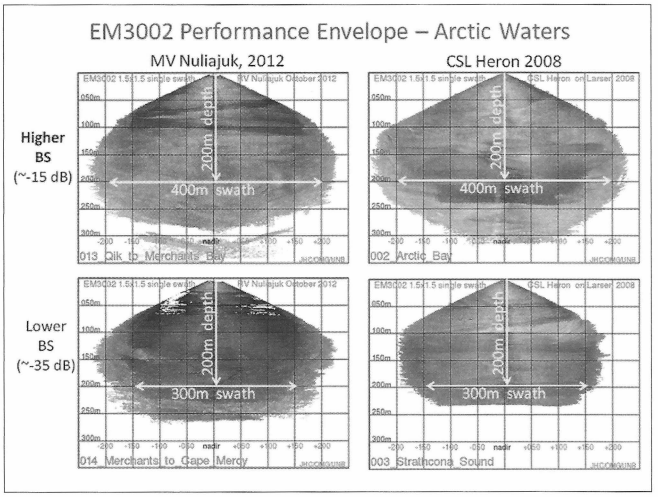

Figure 2: EM3002 Performance Envelopes on two platforms operating in eastern Arctic waters.

The fjords and bays of Baffin Island where the *Nuliajuk* worked during the 2012 season have many areas that exceed the functional depth limit of the installed MBES. For example the depths at which data is required for turbot habitat mapping are beyond the operational depths achieved by a 300kHz system, but it was ideally suited to mapping potential clam habitats, undertaking exploratory charting surveys and monitoring sea level history.

Nuliajuk Mapping Hardware and Design Specifications

The *Nuliajuk* has a length of 19.4m, a beam of 6.4m and a draft of 3.5m. The vessel is constructed of steel with an aluminum wheelhouse. Normal operation in Arctic waters requires four crew members. Additionally there are six berths in a single forward cabin for crew trainees and scientists. The *Nuliajuk* is a well equipped vessel for autonomous operations in the Arctic, having dual engines, twin screws, two independent generators and redundant water makers.

One of the requirements originally laid out during the design phase was that the vessel be capable of resting out of the water on its keel. This characteristic would be put into use when in ports such as Iqaluit which have large tidal ranges and a 'high tide only' wharf. It could also be skidded ashore for work or storage in remote areas. The *Nuliajuk* was specifically delivered with a strengthened central keel and two side skegs to meet this requirement (Bollivar, 2010). After the initial construction, however, a 150kHz acoustic doppler current profiler (ADCP) was flush mounted next to the forward section of the keel, negating the *Nuliajuk's* ability to rest on the seabed except in case of emergency, as the transducer would be destroyed.

The face of the blister that contains the multibeam, sub-bottom sounder and FCV-30 transducer (Figure 3) is adjacent to the ADCP blister and is just above the base of the keel, further reducing the practicality of intentionally grounding the vessel.

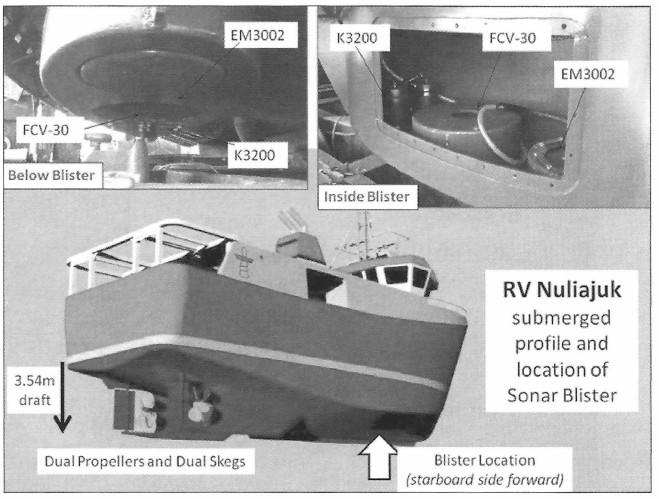

Figure 3: Rendering of Nuliajuk stern submerged profile and detail on blister construction. Note dual propellers and skegs. (CAD drawing from Bollivar, 2010).

As described earlier, a Kongsberg EM3002 was immediately available for quick installation on the *Nuliajuk*. Also available for use was the Coda Octopus F185 motion sensor and C&C Technologies CNav 3050 GPS systems that normally accompany the 3002 (Figure 4).

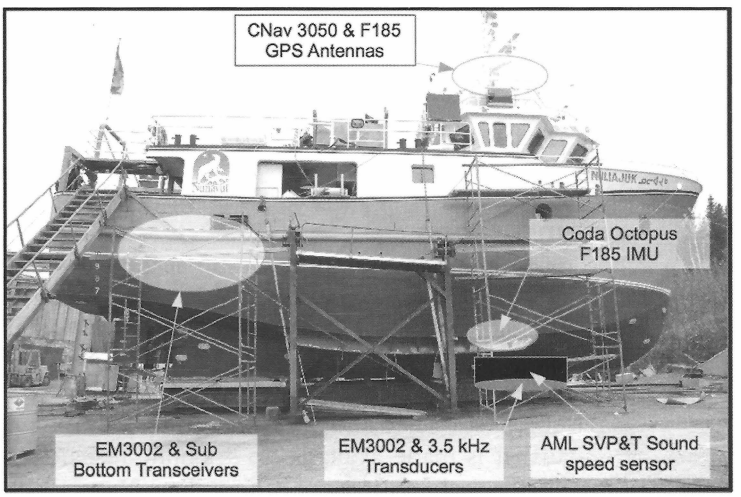

Figure 4: Mapping System Components.

Vertical Datum Reduction

The east coast of Baffin Island is a tidally complex region. The semi-diurnal (M2) component of the tide varies between macro-tidal in southern areas of Baffin Island to micro-tidal in the central region around Clyde River, as illustrated in Figure 5. The presence of an amphidrome for the semi-diurnal tides in the centre of Baffin Bay, shown in the left hand image of Figure 5, significantly decreases the amplitude of that component of the tide between the areas of Qikiqtarjuaq and Clyde River. The diurnal component (K1), shown in the right hand image of Figure 5, is negligible in the areas of Frobisher Bay and Cumberland Sound, but becomes significant further north along the coast. The variability in the tidal regime complicates vertical reduction of hydrographic survey data as existing tidal predictions at sparse historic stations along the coast do not account for the propagation of the tides throughout the long narrow fjords. There was no operational tide gauge in the region for the 2012 season. To overcome these limitations, two solutions were pursued. The first, and ultimately preferred implementation, was the method used aboard the CCGS *Amundsen* of employing national tidal models to apply predictions of the spatially varying tides. The second was the use of ellipsoidally referenced surveys (ERS).

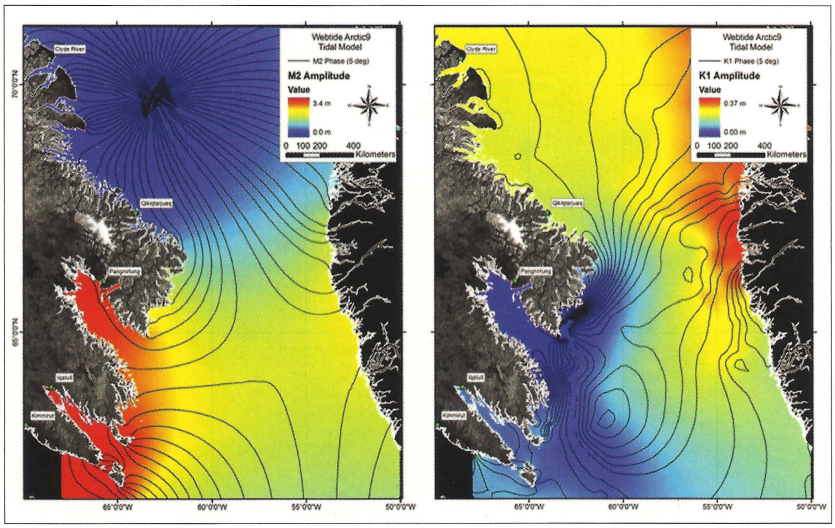

Figure 5: Semi-Diurnal and Diurnal Tidal Range and Phase of southeastern Baffin Island.

Application of ERS has a number of challenges in the eastern Canadian Arctic. Vertical accuracies will initially be limited by the quality of the GPS data available. While the CNav corrections provide the vessel with decimetre level vertical uncertainty in real-time, they are often obstructed at high latitudes in steep walled fjords. The collection of raw GNSS pseudoranges allowed for the post-processing of Precise Point Positioning (PPP) solutions, but the results were heavily degraded by radio-frequency interference with the original GPS signal, which is still under investigation. With tolerable vertical trajectories, depth measurements must be referenced to a more meaningful datum than the ellipsoid. To accomplish this, the vertical position of the vessel needs to be reduced to a local Geoid, such as the Canadian Geoid model CGG2010 or the global EGM08. The area of southeastern Baffin Island exhibits a strong gradient in the Geoid-Ellipsoid separation, as shown in the left hand image of Figure 6, and many Geoid models differ in this area. As shown in the right hand image of Figure 6, differencing the CGG2010 and EGM08 Geoid-Ellipsoid separation models demonstrates the impact of choosing one model over the other, with discrepancies on the order of half a metre.

The arctic9 tidal model was ultimately used to reduce the hydrographic survey data to mean sea level for the 2012 season. The model, as described in Collins, et al. (2010) and partially shown in Figure 5, accounts for the propagation of the tide throughout the complex region of southeastern Baffin Island. It is tuned to reproduce predictions at coastal gauges and provides a smoothly varying reference to mean sea level. At present, the models are not without their complications and deficiencies. Unlike the previously mentioned ERS, the model predictions still require the inclusion of dynamic and static draft adjustments and do not account for spatially varying sea-surface topography, which can be difficult to measure in the Arctic. The model domain also only covers a limited area and a different model must be used for work along the Labrador Coast.

Analysis of Ice Regime

As the *Nuliajuk* has no icebreaking capability, she must operate in predominantly ice-free waters. As such her area of operations and time window are limited by the departure and return of significant ice.

Crane (1978) published an analysis of the spatial and temporal variability in retreat and advance of ice in the

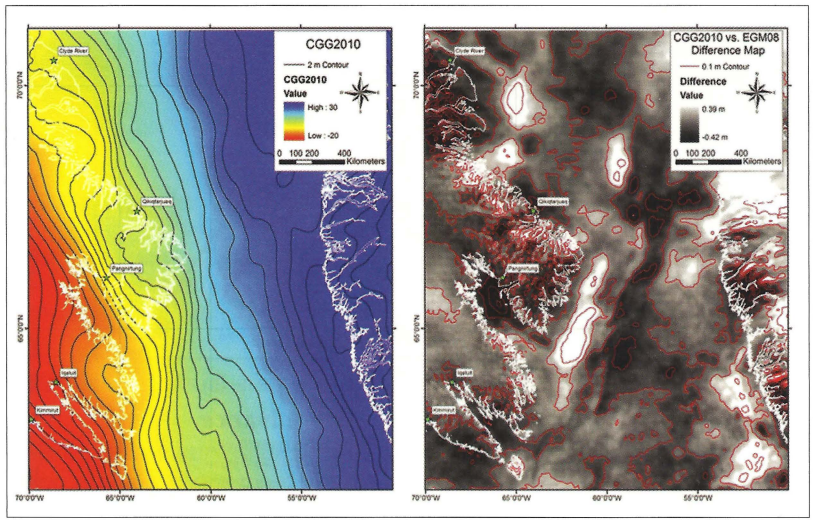

Figure 6: CGG2010 Geoid-Ellipsoid Separation and Difference with EGM08.

Labrador Sea and Davis Strait area based on available 1964-1974 ice records. On average, he found that sea ice is present for up to 40 weeks per year in the Davis Strait and for 30 weeks off the northern Labrador Coast. He demonstrated that there is significant variability in early and late advance and retreat of ice (Figures 7 and 8) which could be linked to meteorological forcing. The prime factor was wind direction with southerly flows promoting early ice retreat and northern flows promoting early ice advance.

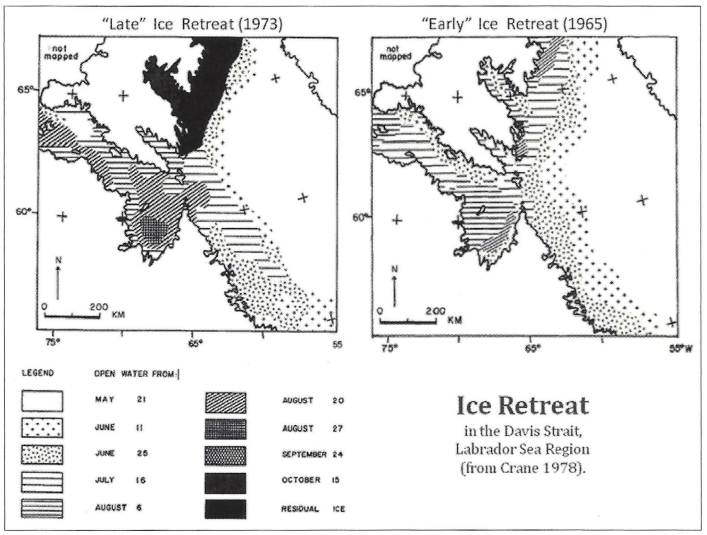

Figure 7: Variability in the retreat of Ice in the Davis Strait/ Hudson Strait region (adapted from Crane (1978).

Notably, Crane's work illustrates that the first viable use of the *Nuliajuk*, on leaving Glovertown, along the Labrador Coast may not occur until mid to late June (Figure 7). Note also that access into Hudson Strait could be possible along the northern side as early as late June but might still be blocked in mid August. In the 1960's there were years in which residual ice prevented access to Cumberland Sound all year. Given the recent changes in Arctic ice regimes, these 50 year old analyses must now be reassessed in the light of climate change.

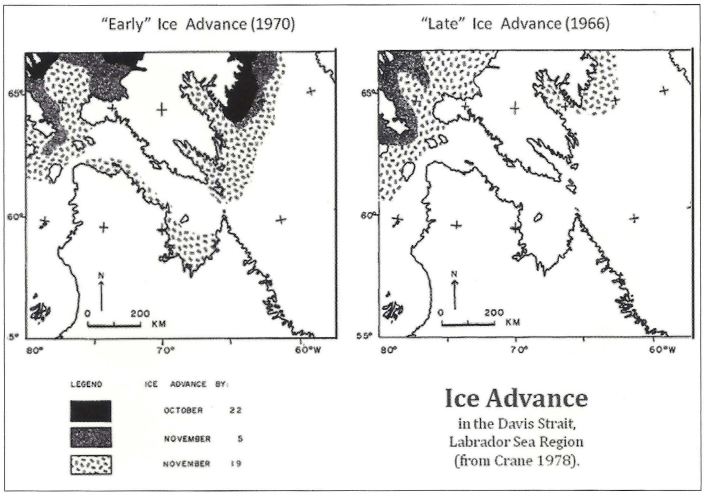

Figure 8: Variability in the readvance of Ice in the Davis Strait/ Hudson Strait region (adapted from Crane (1978).

Crane's analysis of the ice readvances (Figure 8) demonstrated that mapping within Hudson Strait could be undertaken as late as early November. It also illustrated that in some years, however, the ice could be past Cape Dyer before the end of October. Again, these extreme ice events need to be reassessed given the changing ice regimes due to climate change.

More recent analysis conducted herein has compiled Canadian Ice Service weekly synopses for the past 9 years (2004-2012). This examines the more northerly potential operating area of the *Nuliajuk* from Cumberland Sound up to the Lancaster Sound (Figures 9 and 10). Ice retreat is highly variable and depends on the penetration of the West Greenland current up the east side of Baffin Bay (Figure 9). The northern end of Baffin Island may well open up before the section by Cape Dyer. Notably, while the open shelf opens up more predictably, the presence of ice in Cumberland Sound can be accelerated (e.g. 2011) or retarded (e.g. 2012). This presumably reflects the meteorological forcing demonstrated by Crane (1978).

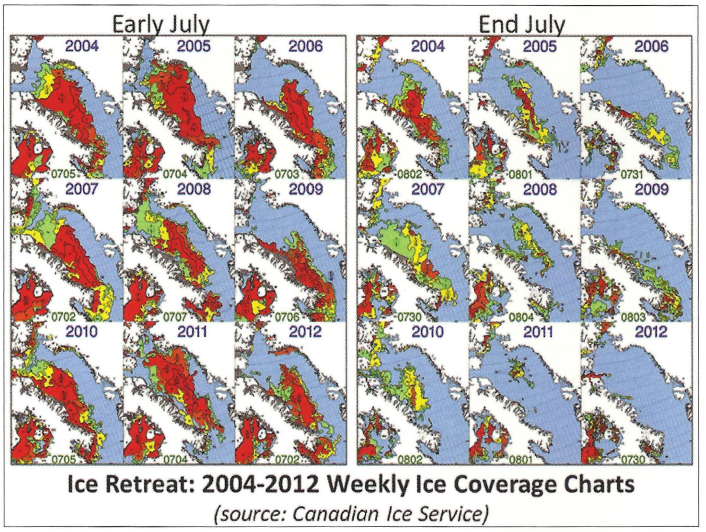

Figure 9: Ice retreat in Baffin Bay over the past nine years.

In contrast to the retreat of ice, the return of the ice is strongly dependent on latitude, advancing from the north along the east coast of Baffin Island (Figure 10). The variability in arrival time from year to year is significant however, with open water still present at the end of October at Pond Inlet in 2012 and 2006 whereas at the same period the ice extended down to Clyde River in 2008 and 2009.

Discussion of Operations, Cost, and Logistics

The *Nuliajuk* is very cost effective for both research institutions and governmental departments. Crewing demands and operating costs are small compared to a large vessel with ancillary launches. As long as the ship is already near the area where the work is to be conducted, transit costs are kept to a minimum.

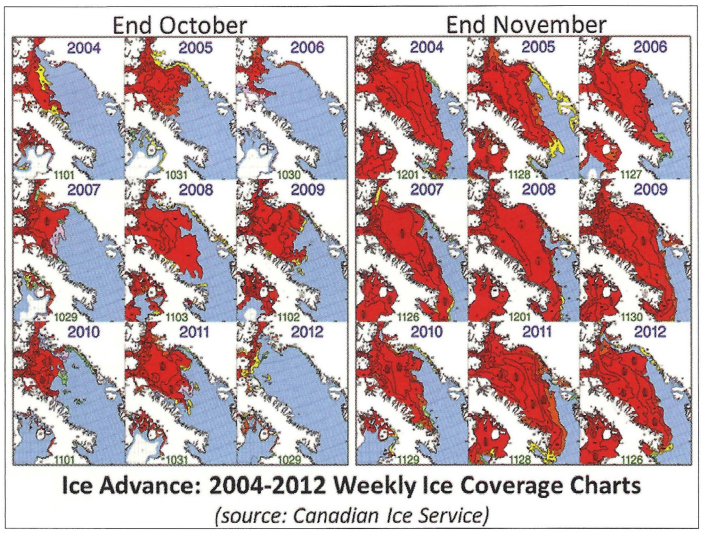

Figure 10: Ice advance in Baffin Bay over the past nine years.

The charge for a research group to conduct sampling or mapping from the *Amundsen* under the ArcticNet banner is currently $50,000 to $60,000 CDN per day (Montreal Gazette, 2011). A vessel of similar size to the *Nuliajuk* under contract to conduct hydrographic surveying would cost in the area of $15,000 to $20,000 per day. The current cost per day for non-commercial research use of the *Nuliajuk* is ~$5500. This covers both vessel operations and crewing.

To date, support for fisheries research from the vessel came from Fisheries and Oceans Canada, the Canadian Northern Economic Development Agency, the University of Windsor, University of Victoria, Dalhousie University, the Sir Alistair Hardy Foundation for Ocean Science, the community of Pangnirtung and the Nunavut Department of Development (Government of Nunavut, 2012). The mapping campaign in 2012 saw additional support from Memorial University, University of New Brunswick, ArcticNet and the Canadian Hydrographic Service.

The *Nuliajuk* has a top cruising speed of approximately 8 knots. While this is generally fine for hydrographic surveys where data quality is the main concern, it reduces the potential to increase the area covered per day. It also increases the cost and time that needs to be allocated to transiting between work sites, anchorages and resupply ports. The benefit to this speed limitation is that there is almost no data degradation from speed related effects while collecting valuable transit survey data in uncharted regions.

With the base four man crew, only 12 hour per day operations are currently supported. With an additional two crew members, 24 hour operations are possible, but the survey staff berths are correspondingly reduced.

The *Nuliajuk* is quite manoeuvrable, having twin screws, each on its own skeg. While it would not be considered a shallow draft vessel for inshore work, 3.5 metres is reasonable for working in depths up to ~10 metres. Slow, methodical investigations of shoals are possible, accepting that the least depth will not necessarily be found by this vessel.

The operation of the *Nuliajuk* in the remote, mostly uncharted inshore waters of southeast Baffin Island would not have been possible without the aid of the Furuno CH-300 Searchlight Sonar. Having the ability to scan 360° around the vessel at various tilt angles provides a preliminary view through the uncharted waters. One example that highlights the use of this sonar was in the previously uncharted Boas Fjord in Merchant's Bay (Figure 1). Steaming towards the head of the fjord, the searchlight sonar detected a shoal extending across the centre of fjord. The shoal was subsequently mapped, with the least depth still unknown (less than 7m).

The endurance of the vessel depends on specific operations but is generally a maximum of 2 weeks. Refuelling in many of the small communities was challenging, as there are only two wharves in the region capable of handling the *Nuliajuk*. In the remote communities, drums of diesel are ferried in small craft to the *Nuliajuk* and it is then pumped into the main tanks.

Although the *Nuliajuk* operates in remote areas, the nearby communities are of sufficient size to support crew changeovers with commercial airports and limited restocking of ship supplies. As operations dictated, the mapping and fisheries research groups, as well as crew, swapped in and out over the summer and fall, maximizing use of the available time.

2012 Season Overview

The 2012 season consisted of 3 main segments. Dedicated mapping in Labrador was followed by shared research time in southern Baffin Island and more dedicated mapping time in various locations across the southeastern shores of Baffin Island.

Mapping in Labrador was conducted for Memorial University as part of their research in Lake Melville. Due to a later than anticipated sailing date, the window of opportunity in Labrador was thought to be lost but the 2012 ice retreat along southern Baffin Island proved to be later than average and much later than 2011 (Figure 9). The intended work zones for July in Baffin Island were inaccessible so the *Nuliajuk* continued to work in the ice free region of Lake Melville.

Once the ice began to dissipate in Frobisher Bay and Cumberland Sound, the *Nuliajuk* headed north to begin work near Iqaluit. The ice proved, however, to be persistent and the *Nuliajuk* and supply ships alike were forced to wait outside the bay. The second segment of mapping aboard the *Nuliajuk* was intended to be shared time (and cost) between active fisheries research and seabed mapping. The fishing activities were to take place during the days and transit lines to and from anchorage, as well as some dedicated mapping in the afternoons, was expected for hydrography.

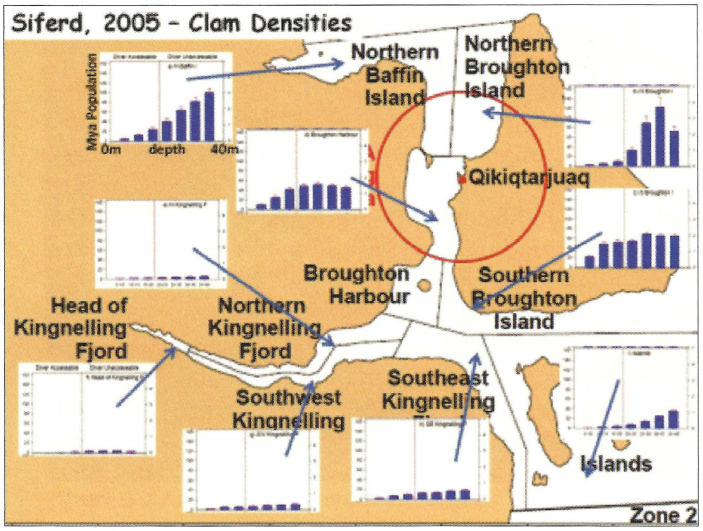

Figure 11: Assessment of a clam fishery near Qikiqtarjuaq, Nunavut. Canada. From Siferd (2005).

Subsequent to the 2012 field campaign, the CHS compared the *Nuliajuk* data to their existing database of archived sounding data in the SE Baffin Island area. From this, locations that were significantly shallower than previously reported were identified. In all, 292 locations, in less than 50m of water were identified with depths more than 10% shallower than charted.

One of the major lessons learned in 2012 was that operations need be scheduled around traditional ice retreat times more than any other events. In addition alternate plans need to be made in advance so they can be implemented when ice-conditions dictate.

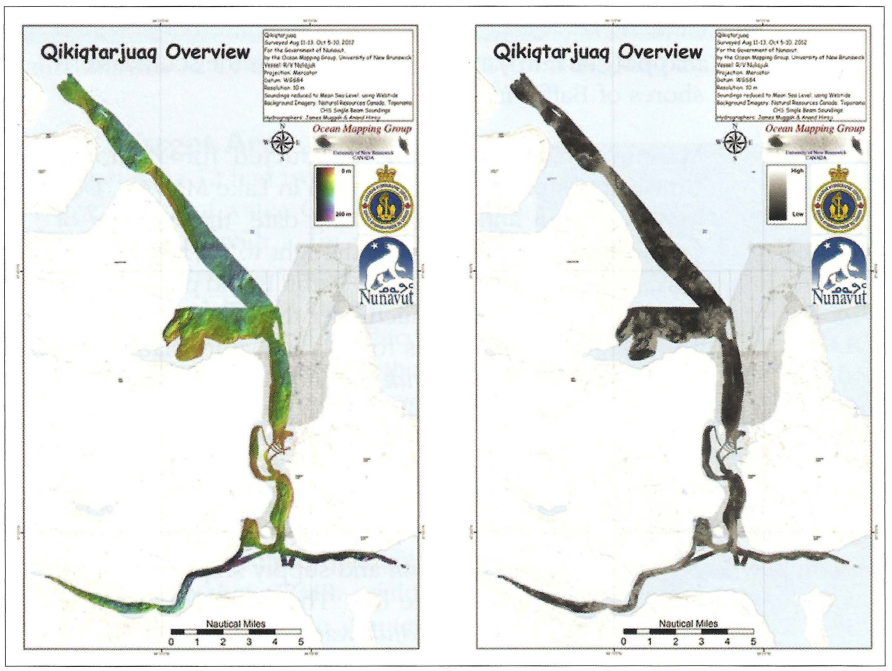

Figure 12: Bathymetry and Backscatter maps of the Qikiqtarjuaq vicinity acquired for the purpose of delineating seabed habitat for potential clam fisheries. Extent of previous CHS single beam charting is indicated as grey mesh. All other areas were previously unsurveyed.

Example Seabed Mapping Projects

Clam Habitat Mapping around Qikiqtarjuaq

Siferd (2005) had illustrated significant variations in the total density and depth dependence of the clam comminutes along the coastlines around the community of Qikiqtarjuaq (Figure 11). An experimental fishery for these species had already been undertaken in that region but baseline mapping was lacking to adequately define the areal extent of the available resource.

The *Nuliajuk* mapping deliberately overlapped the survey areas of Siferd (2005) (Figure 12) to determine if the seabed sediment type (as identified from backscatter) could be used to explain the variability in densities reported by Siferd. The multibeam surveys were then extended along the coastlines into other areas of less than 100m water depth in which potential clam habitats might be expected. It is hoped that correlation between measured clam density and acoustically-defined surficial sediment type can be demonstrated.

Palaeo Sea-Level History of Eastern Baffin Island.

Relative Sea level models of the Canadian Arctic combine the global record of eustatic sea level history with the local predicted level of isostatic crustal motion. Such models require validation through the recognition of raised fossil coastlines (visible on land as emergent beaches) and submerged fossil coastlines (only resolvable through multibeam mapping). Palaeo-sea level research provides important baseline data to support projections of future sea levels under various climate-change scenarios. These local sea-level projections provide important guidance for the management of coastal hazards, erosion, and development within coastal Arctic communities (Cowan et al. 2012).

The ArcticNet component of the 2012 *Nuliajuk* mapping program was specifically aimed at identifying potential drowned shorelines along the Cumberland Peninsula off the SE coast of Baffin Island (Cowan et al., 2012). Locales with high sedimentation rates are required to develop and preserve a sea level record. The Exeter Sound region was chosen for this work. The Sound previously had never been surveyed (Figure 1) and thus access corridors had to be established prior to undertaking detailed surveys of potential submerged terrace sites (Figure 13).

Subsequent to this work, piston coring will need to be undertaken from the CCGS *Amundsen* to date these terraces. The *Amundsen* can only enter these areas using the access corridors established by the *MV Nuliajuk*.

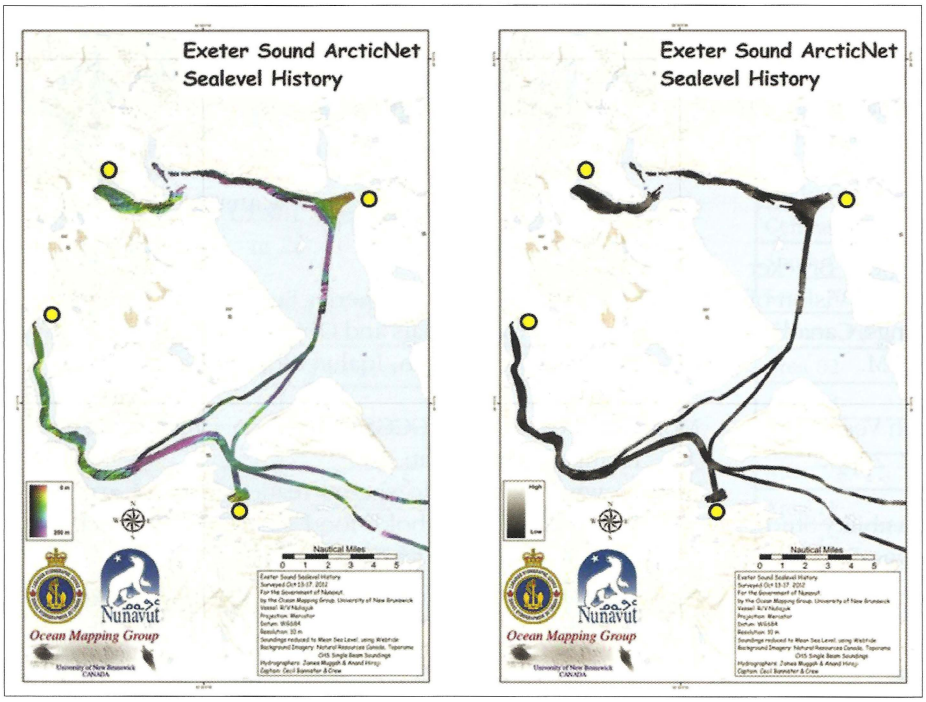

Figure 13:Access corridors and sea level terrace search locations (yellow) in Exeter Sound.

New Shipping Corridors

A combined interest of the Government of Nunavut and the CHS was to improve the shipping access to sites routinely visited in the Cumberland Sound area. Kekerton Island is a historic site, regularly visited by tourist vessels, and a potential safe anchorage for vessels seeking refuge. The approaches and the anchorages within the Kikistan Island Group had never been surveyed. Thus a reconnaissance survey was requested to establish safe access to this area (Figure 14).

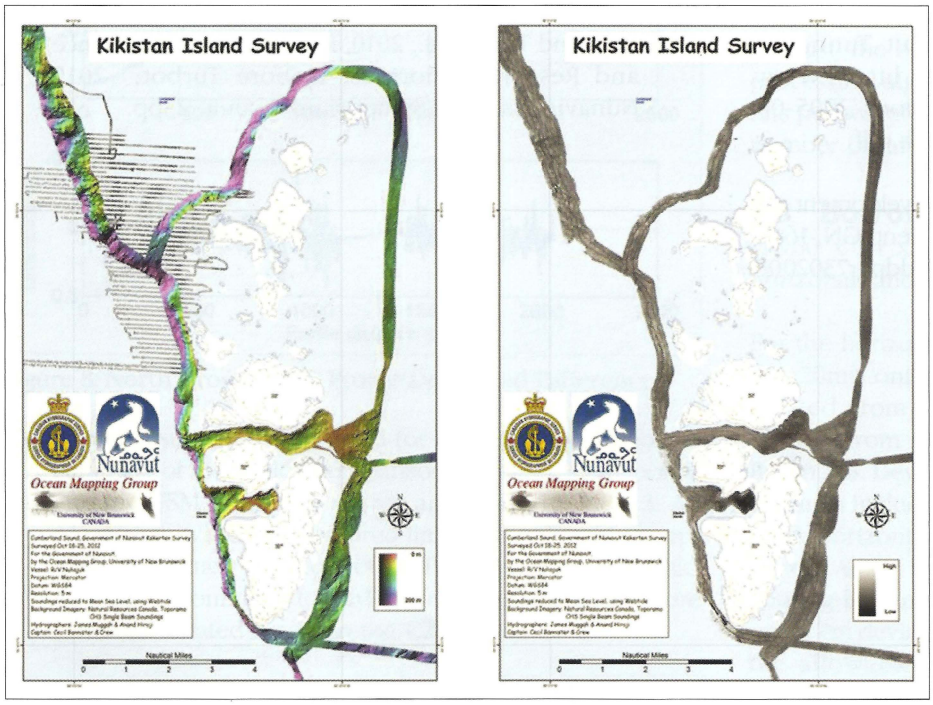

Figure 14: Nuliajuk multibeam access corridors around Kikistan Island Group. Left: bathymetry, Right: backscatter.

Summary

The 2012 *Nuliajuk* program has demonstrated the viability of undertaking coastal seabed mapping in the eastern Arctic from a small yet autonomous, non-icebreaking platform. As long as the constraints imposed by the ice retreat and advance (including its variability) are well understood, safe and efficient mapping operations can be planned. The vessel has the endurance, shoal draft, and obstacle avoidance equipment to operate independently in these predominantly uncharted waters.

2012 operations were able to address the specific needs of the collaborating parties including fisheries habitat, nautical charting and scientific seabed surveys. All data collected in the 2012 field season will be collated and integrated with the growing ArcticNet multibeam dataset, all of which is available online through the use of a Google maps portal (Muggah et al., 2010). All data is provided to the Canadian Hydrographic Service for incorporation into their bathymetric database to aid in chart updating.

Based on the ice regime analyses presented above, 2013 operations are currently being planned for both the SE Baffin Island and Hudson Strait areas. Exact locales will depend on the needs of various funding agencies (e.g. GN, 2008 AANDC, 2013).

Acknowledgements:

The success of this program was dependent on the expert seamanship of Captain Cecil Bannister and the crew of *MV Nuliajuk*. Funding for the 2012 hydrographic field program was obtained from Fisheries and Sealing Division of the Department of the Environment within the Government of Nunavut, the Canadian Hydrographic Service, Memorial University, University of New Brunswick and the ArcticNet consortium.

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Coastal Zone Mapping and Imaging LIDAR (CZMIL) Validation

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Optech, Inc. in a partnership with the University of Southern Mississippi (USM) has developed a new shallow water bathymetic LIDAR and imaging system known as the Coastal Zone Mapping and Imaging LIDAR (CZMIL). This system tightly integrates a digital camera and hyper-spectral imager with a new combined bathymetric and topographic LIDAR, into a single platform designed to map all features of the coastal zone, including the water surface, water column, seabed (depth and makeup), and land (height and makeup). The LIDAR component is a completely new design that enables the green laser to collect height/depth data on both land and at sea. This will enable it to seamlessly bridge the land/sea interface. In the spring of 2012 the system went through validation trials in Mississippi Sound and off the coast of Ft. Lauderdale. The Hydrographic Science Research Center (HSRC) of USM collected baseline data and performed the validation comparisons. Acoustic sounding data were collected using the USM research vessel and hydrographic survey suite with the resulting bathymetry referenced to the ellipsoid. This paper gives an overview of the CZMIL system, describes the procedures used to validate the CZMIL bathymetry, and presents the results of the validation.

1 INTRODUCTION

The Hydrographic Science Research Center of the University of Southern Mississippi was tasked to validate Optech's new CZMIL system designed and built for the US Army Corps of Engineers (USACE). This paper discusses the bathymetric evaluation.

The bathymetric validation was performed near Cat Island, in the Mississippi Sound, and off the coast of Ft. Lauderdale, Florida. The Cat Island site was selected for its proximity to Optech, Inc. and USM facilities. The acoustic bathymetric data were collected between March 15 and April 19, 2012 and the CZMIL data used for evaluation were collected on April 25, 2012. Ft. Lauderdale area was selected for its clear waters, depth range and abundance of targets. The acoustic bathymetric data were collected between May 09 and 15, 2012 and the CZMIL data were collected on May 07 and 08, 2012.

2 BACKGROUND

The CZMIL system is a new design that uses a rotating Fresnel Prism to deflect the laser beams unlike the pivoting mirrors of the Shoals system. The result is a circular pattern with high density spot spacing on the sides and two looks at the surface, one on the forward side of the arc and one on the rear side of the arc. Under nominal conditions, the bathymetric spot size will be approximately 2.6m with a spot spacing no greater than 2m, and an average density of approximately 0.42m (Fuchs and Mather, 2010). The system is designed to measure bathymetry and topography with the same laser. This is accomplished through the use of three field of view (FOV) states (Figure 1):

1. One large FOV for deep water
2. Seven small FOVs for topographic surveys
3. One intermediate bathymetric depth FOV resulting from a combination of the seven topographic FOVs

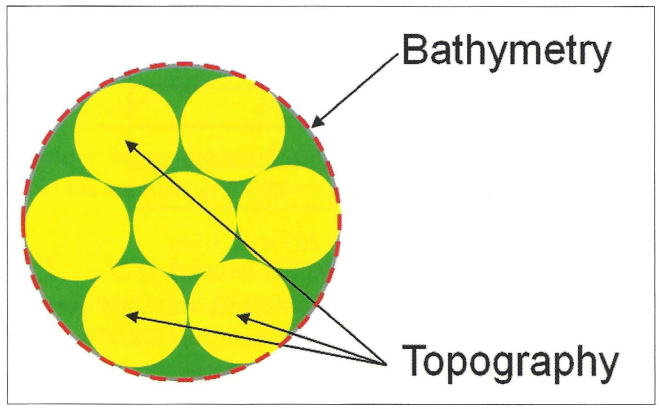


Figure 1: CZMIL Fields of View, taken from Fuchs and Mather, 2010

The system is designed to measure bathymetry through at least 30m of water, as well as through the shallows and onto the beach.

The USM hydrographic suite used for validation is comprised of:

- Reson 7125 beam forming multibeam
- Edgetech 4600 phase differencing multibeam and side scan sonar
- Applanix POS MV Wavemaster motion and heading sensor
- C-Nav 3050 real-time GIPSY (RTG) GNSS positioning system
- TopCon NetG3A GNSS receiver

The survey suite was mounted on the 28ft USM research vessel *LeMoyne*, which was used for both Cat Island and Ft. Lauderdale surveys. It was not possible to cover the same amount of area with the ship borne system as the airborne system; therefore, survey lines were designed to cover a variety of depths, bottom types and bottom features.

It was necessary to validate the USM systems in order to ensure that it was suitable for validating the CZMIL system. This was achieved by comparing the two multibeam systems (Reson and EdgeTech), as well as comparing observations from different platforms. This USM system validation was performed near Cat Island using GNSS on wheeled poles onshore and in the shallows, and a single beam survey platform near shore. The results of this evaluation are included in the next section.

All data were positioned using high-accuracy GNSS techniques, including heights and depths. This eliminated the need for tide observations and removed the uncertainty associated vertical datums.

The allowable CZMIL data vertical uncertainty was $\sqrt{0.3^2+(0.013d)^2}$ m 2σ

This translated to a vertical uncertainty limit of (2σ):

Depth (m)	2σ Uncertainty Limit (cm)
10	33
15	36
20	40
30	49

Horizontal uncertainty limit (2σ) was 3.5m

Vertical uncertainty between the CZMIL and USM derived depths were determined by comparing CZMIL point clouds to depth surfaces generated from the USM data. Horizontal uncertainty was evaluated by comparing depth contours generated from both data sets. The CZMIL target detection capabilities were also evaluated.

3 CAT ISLAND

The Mississippi Sound is very shallow and turbid. The survey area, located to the east of Cat Island and due south of Gulfport (Figure 2), had depths from 0 to 5m. The Secchi depths were usually ~1m.

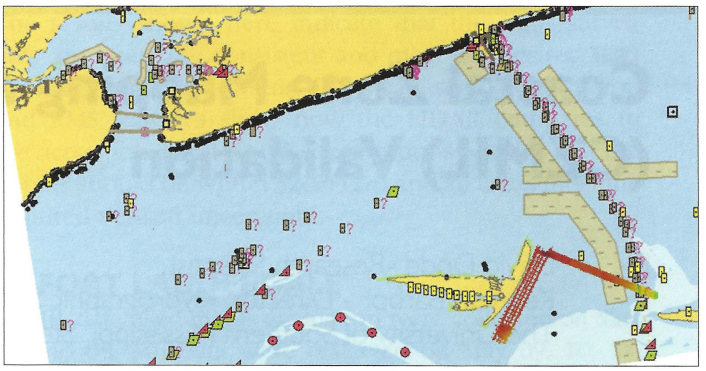


Figure 2: Mississippi Sound and Cat Island

Multibeam (MB) survey lines were run parallel and perpendicular to the Island (Figure 3). GPS wheel transects were run on the island and into the near-shore shallows. Single beam (SB) lines were run connecting the MB perpendicular lines to the GPS wheel transects, thus ensuring a continuous connection between land and sea observations. All data were collected using high-accuracy GPS positioning equipment and methods and all height/depth results were related to the WGS84 (IGS08) reference frame.

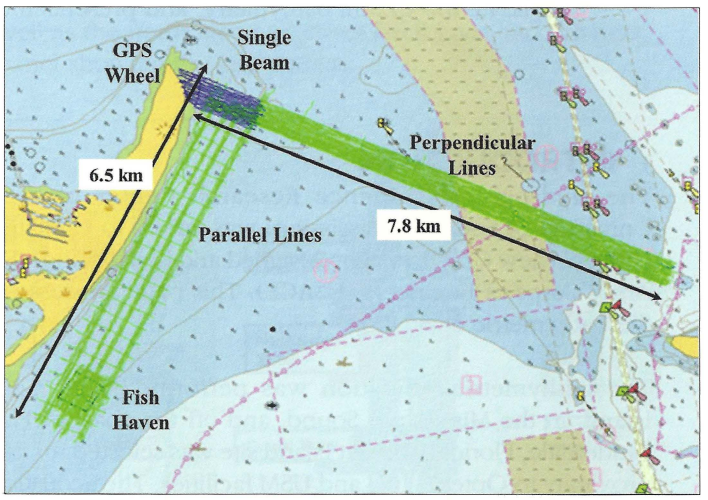


Figure 3: Cat Island Survey Lines.

3.1 USM Acoustic System Evaluation

In order to use the USM acoustic data to validate CZMIL data, it must first be evaluated. GNSS Wheel observations, land and shallow water (< 1.5m) at 25m line spacing, were collected on the north tip of Cat Island (Figure 4A). SB data were collected in shallow water (0.5 to 2m), overlapping the GNSS wheel transects and MB data (Figure 4A, B, and C). MB data were collected in water greater than 2m (Figure 4B, C, and D). Wherever there was data overlap, evaluations were conducted. MB crosscheck lines were surveyed at regular intervals over all MB main production lines. Each beam from the crosscheck lines was compared to the surfaces developed from the main productions lines. All 512 Reson beams from all cross check lines passed IHO special order criteria to greater than 95% (2σ).

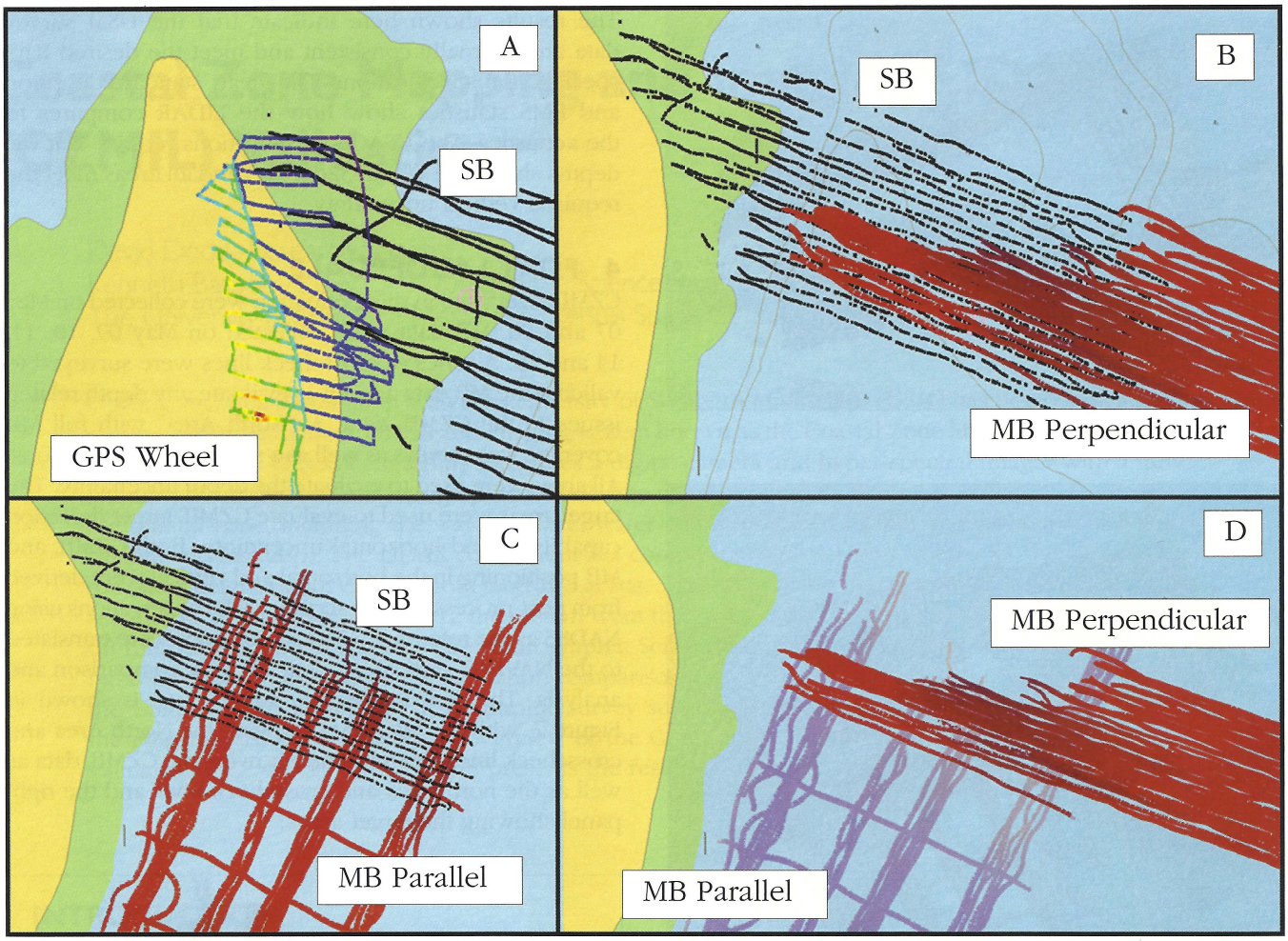


Figure 4: USM Data Validation near Cat Island

IHO Special Order vertical uncertainty is;

$\sqrt{0.25^2 + (0.0075d)^2}$ m 2σ

Which is effectively < 0.25m at 2σ for the waters in Mississippi Sound.

The IHO Special Order horizontal uncertainty of 3.5m was considered trivial using high-accuracy GNSS, and therefore not addressed in this evaluation.

The MB surfaces were generated primarily from the Reson data, with the EdgeTech data used to fill any gaps. Separate surfaces were developed from the parallel and perpendicular lines, each at 0.5m resolution.

A 0.25m resolution surface was created in the area of a fish haven at the south end of the survey area. As a check, separate surfaces from this area were developed from the Reson and EdgeTech data sets. When compared there was no bias, and the standard deviation was 1cm. The comparison results shown in Table 1 indicate that all systems are well below the IHO special order of 0.25m.

Comparison	Mean difference	St dev (1σ)	RMS (2σ)
Wheel/Wheel	-2	3	7
Wheel/SB	-5	5	14
SB/Parallel MB	-5	10	23
SB/Perpendicular MB	-6	10	23
Perp/Paral	1	8	17

Table 1: Mean, Standard Deviation and 2σ RMS values (in cm) for each of the USM comparison

3.2 Cat Island CZMIL Validation

CZMIL data from April 25, 2012 were used for this evaluation. Data were delivered in LAS format, with horizontal positions in UTM zone 16, relative to NAD83. Heights were relative to the ellipsoid, and positive up. The height difference between NAD 83 and WGS84, for Cat Island, was 1.40m. Translation from NAD83 heights to NAVD88 (N) was -27.60m. See Figure 5 for overall coverage and Figure 6 for GNSS wheel, SB and MB coverage in the north area.

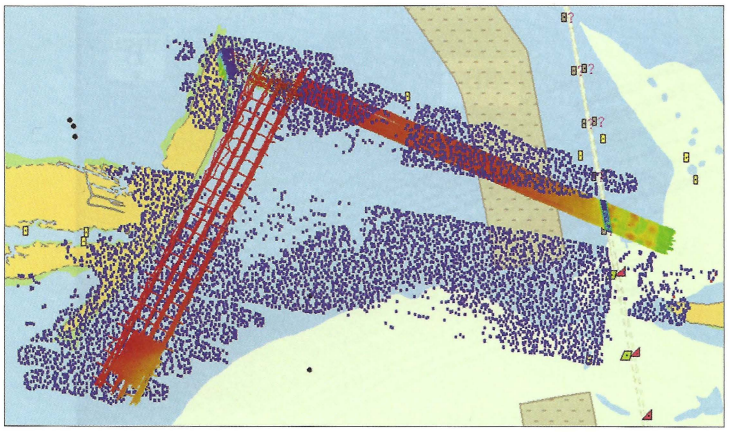


Figure 5: CZMIL and MB coverage

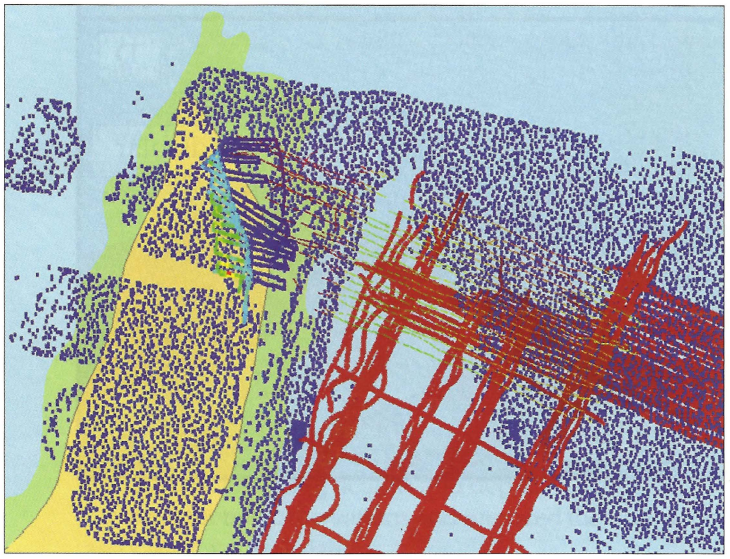


Figure 6: CZMIL, MB, SB and GPS transect coverage, North End of Cat Island

The two systems were compared by differencing the results in CARIS BaseEditor. When comparing the MB to the CZMIL, the MB surfaces were subtracted from the CZMIL point clouds. MB surface values were interpolated from the CZMIL point locations.

Table 2 shows the differences between USM observations and CZMIL for the GNSS wheel on land, GNSS wheel in water, SB, and the three MB areas (perpendicular, parallel and fish haven).

Area	Mean difference	St dev (1σ)	RMS (2σ)
Wheel Topo	1.3	11.0	22.2
Wheel Bathy	6.0	4.5	15.0
SB	2.2	8.2	16.0
Parallel MB	4.1	13.7	28.6
Perpendicular MB	1.1	9.6	19.3
Fish Haven	6.7	9.1	22.6

Table 2: Mean, Standard Deviation and 2σ RMS values (in cm) for each area. Optech data received in late October, 2012. In all instances CZMIL is Deeper

The results shown here indicate that the USM survey data are internally consistent and meet the desired IHO special order specifications. The mean, standard deviation and RMS statistics show how the LIDAR compares to the acoustics. The USACE specifications require that the depths should be within 32cm (2σ) and all areas meet the required vertical uncertainty.

4 FORT LAUDERDALE

CZMIL data used in this evaluation were collected on May 07 and 08. MB data were collected on May 09, 10, 11, 14 and 15. A series of crosscheck lines were surveyed to validate the MB data as well as evaluate any depth related issues in the CZMIL data. A "North Area" with full MB coverage was surveys as well as a series of target locations. All areas were used to evaluate the depth uncertainty. The target areas were used to evaluate CZMIL target detection capabilities and horizontal uncertainty. Both CZMIL and MB positioning in the horizontal and vertical were derived from post-processed high-accuracy GPS observations using NAD83 as the reference. Vertical positions were translated to the NAVD88 vertical geodetic data for comparison and analysis. The Fort Lauderdale survey area is shown in Figure 7, with the left panel showing the North Area and crosscheck lines, center panel showing the CZMIL data as well as the north area and crosscheck lines and the right panel showing the target areas.

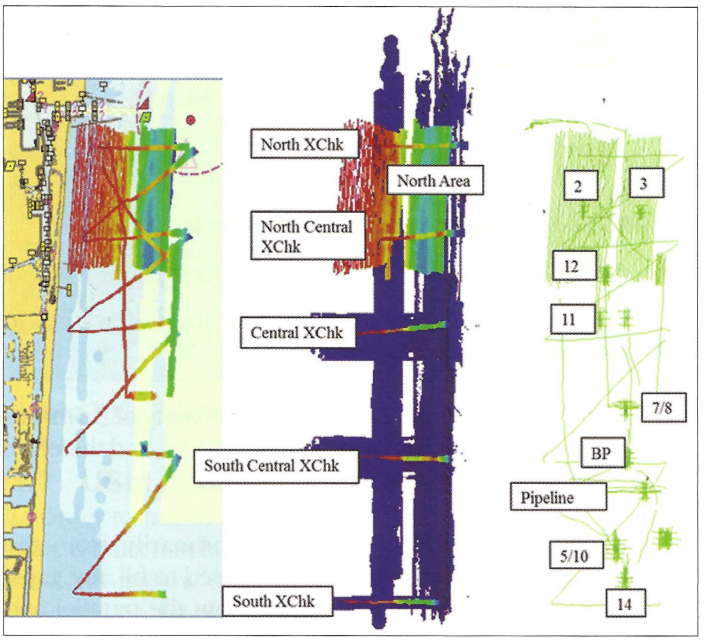


Figure 7: Fort Lauderdale Survey Area. Left panel shows North Area and crosscheck lines. Center panel shows the CZMIL data as well as the North Area and crosscheck lines. Right panel shows the target areas.

CZMIL data were delivered in LAS format, with horizontal positions in UTM zone 17, relative to NAD83. Heights were relative to the ellipsoid, and positive up. The height difference between NAD 83 and NAVD88, for Fort Lauderdale, was -25.744m. See Figure 7 for the CZMIL data extents and the USM MB crosscheck lines and North

Area. Validation was performed by subtracting the MB derived surfaces (25, 50 or 100cm resolution) from the CZMIL point clouds. The MB surfaces were generated in CARIS HIPS 7.1 using the CUBE (Combined Uncertainty and Bathymetry Estimator) algorithm.

The allowable CZMIL data vertical uncertainty was

$\sqrt{0.3^2 + (0.013d)^2}$ m 2σ

Vertical uncertainty limit (2σ)

Depth (m)	2σ Uncertainty Limit (cm)
10	33
15	36
20	40
30	49

Horizontal uncertainty limit (2σ) = 3.5m

All areas met the uncertainty criteria and the crosscheck profiles show that there were no depth related trends.

4.1 CZMIL Depth Evaluation

The crosscheck lines were used to assess CZMIL depth dependent issues. Figure 8 shows the results of the North Profile evaluation. The upper graph plots the depth versus distance and the lower graph plots the CZMIL, MB difference versus distance. Figure 8 indicates that there are no depth dependent trends, which is the same for all profiles.

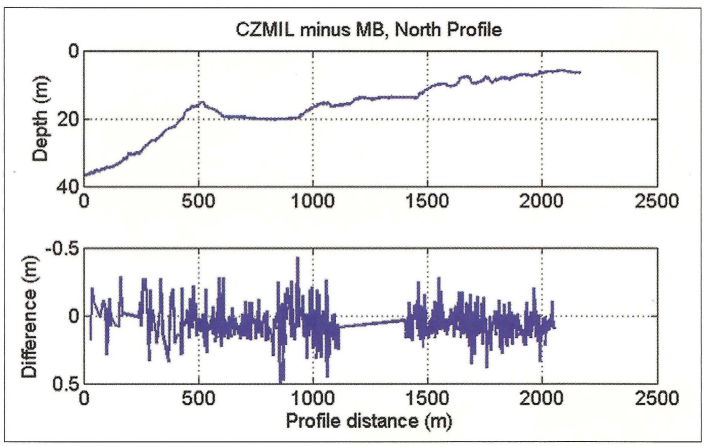


Figure 8: North Cross Check Profile Depth and Difference

All areas surveyed were used for the depth evaluation. A summary of the vertical comparison between CZMIL points and the USM Reson MB survey are shown in Table 3. All areas were within the required limit (last column), except area 7/8, which was 1cm over. The profile lines (XChk) extending from deep to shallow indicated that there were no depth related biases in the CZMIL data.

Area	Mean Difference (cm)	1σ St dev (cm)	2σ RMS (cm)	Requirement (cm)
North Area	5.3	15.3	32.6	40
North XChk	5.2	15.0	31.6	40
North-Central XChk	5.9	17.6	37.2	40
Central XChk	4.2	15.4	31.8	40
South-Central XChk	4.4	15.5	31.1	40
South XChk	1.6	14.8	29.8	40
Borrow Pit	-2.8	20.0	40.3	45
Area 02	-2.9	9.7	20.2	30
Area 03	3.2	14.3	29.3	40
Area 5/10	6.3	13.8	30.4	45
Area 7/8	2.8	20.8	42.0	41
Area 11	7.1	14.9	33.0	34
Area 12	-14.7	8.9	34.4	34
Area 14	12.6	12.7	35.8	45

Table 3: Summary of vertical uncertainty evaluation

4.2 CZMIL Horizontal Position and Target Detection Evaluation

The horizontal positions were evaluated by comparing contour lines created from the CZMIL data and the MB data. This evaluation was performed using the Borrow Pit (BP) area. Target detection analysis was performed in Target Areas 02, 5/10, 7/8, 11, 12 and 14 (Figure 7). CZMIL data from either May 07 or May 08 were used for this evaluation.

Target detection evaluation was performed by comparing a 1m CZMIL grid with a 50cm Reson grid over significant features. Initially, the CZMIL processor reported only the deepest return from each waveform. Given that the spot size was approximatley 3m, it was likely that, even though a target was detected in the waveform, it was not reported because the bottom was also detected. A revision of the processing algorithm enabled the reporting of multiple hits per waveform resulting in a significant increase in the number of targets detectable in the CZMIL point cloud.

4.3 Borrow Pit

A 160 x 94 x 5m deep borrow pit was used for both horizontal and vertical evaluations (Figure 9).

For the horizontal evaluation, the 20m contour lines were created from 2.0m surfaces derived from the CZMIL and Reson MB. Deviations between the lines include the effects of both horizontal and vertical offsets. As see in Figure 10, the contour lines match except for one 2.7m deviation. Given that the allowable 2σ horizontal uncertainty was 3.5m, it is concluded that the horizontal criteria were met.

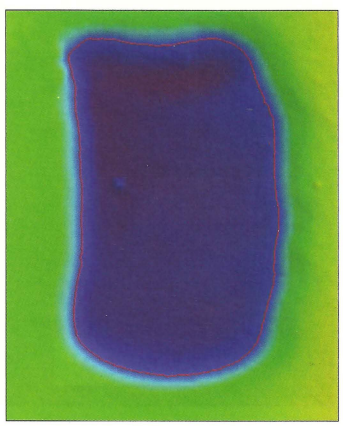


Figure 9: Borrow Pit

Vertical comparison, CZMIL Points minus Reson 25cm surface:

- Mean: -2.8cm
- Standard Deviation: 20.0cm
- 2σ RMS: 40.3cm

Depth range was 20 to 30m, allowable vertical 2σ RMS of 40 to 50cm.

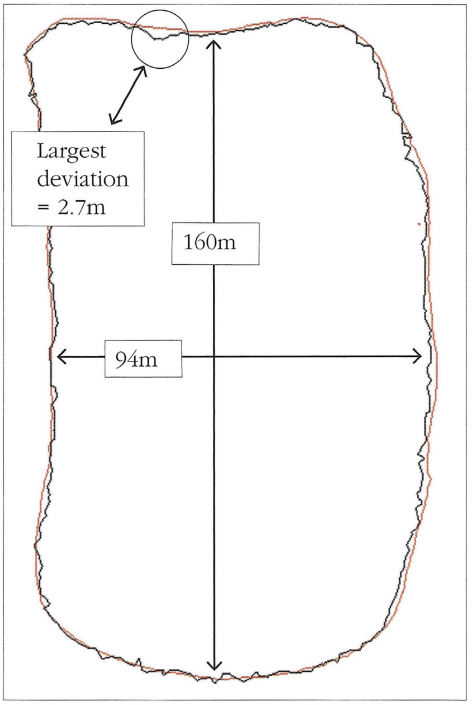


Figure 10: 25m Borrow Pit contour lines created from CZMIL and Reson 2m grids. Red is Reson, Black is CZMIL

4.4 Target Area 02

Five significant objects were detected in the MB (Figure 11). Object 1 (Figure 11 and Figure 12) is in 7m of water and appears to be conical in shaped, with the base approximately 2.5m long and 1.5m wide. It sits approximately 1m proud of the bottom and is located at: 26° 04' 35.31" N, 80° 06' 03.47" W.

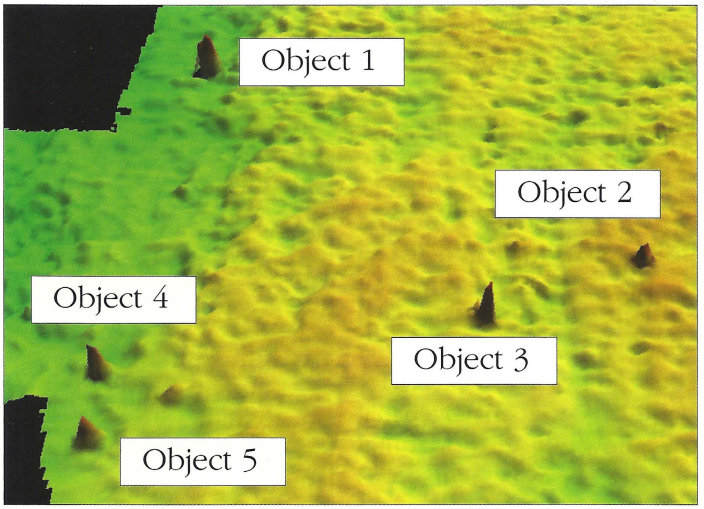


Figure 11:Area 02 objects in MB surface

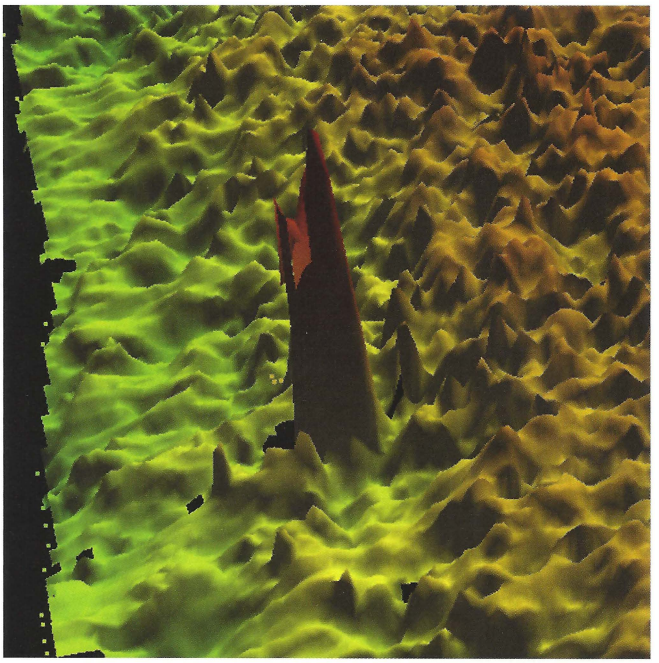


Figure 12:Area 02 Significant Object 1 in MB surface

The CZMIL 1m gridded surface shows objects 1 and 3, but not 2, 4 or 5 (Figure 13).

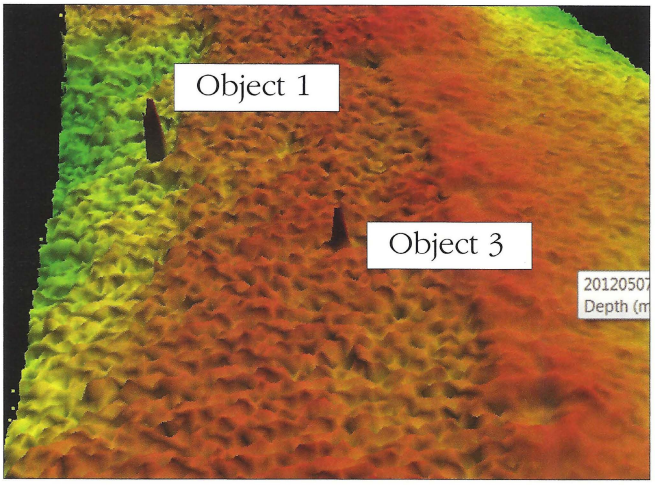


Figure 13:Area 02 objects in CZMIL 1m grid surface

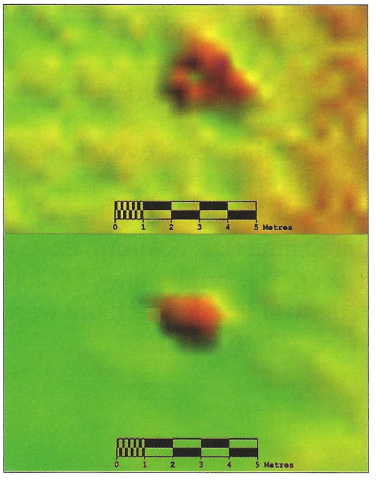


Figure 14 displays 2D images from CZMIL and MB gridded surfaces in the area of object 1. Both systems show the feature clearly.

Figure 14: 2D images of Object 1. Top is from CZMIL and bottom is from MB. Both were gridded at 50cm

The three dimensional image in Figure 15 shows both the CZMIL (greyscale) and MB (color). Objects 1 and 3 are co-located and objects 2, 4 and 5 only appear in the MB data.

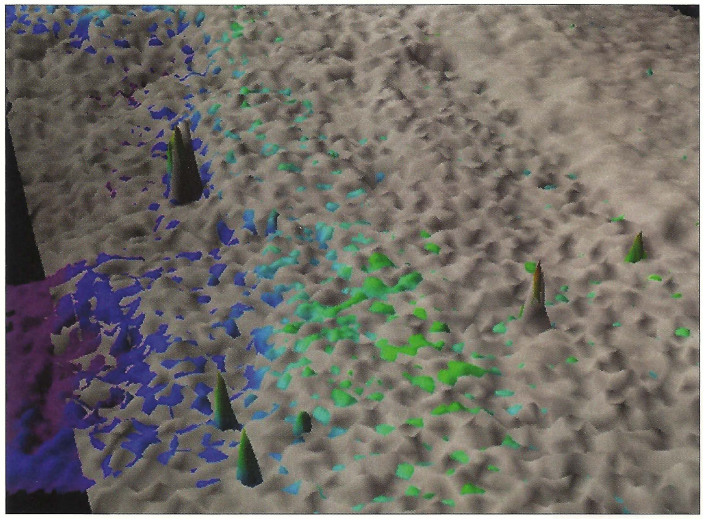


Figure 15: 3D depiction of Area 02 objects as seen by CZMIL (greyscale) and MB (colour)

A close-up of object 1 (Figure 16) shows that the CZMIL grid envelopes the MB grid surface, which is a testament to both target detection capability and horizontal positioning correlation between the LIDAR and acoustics systems.

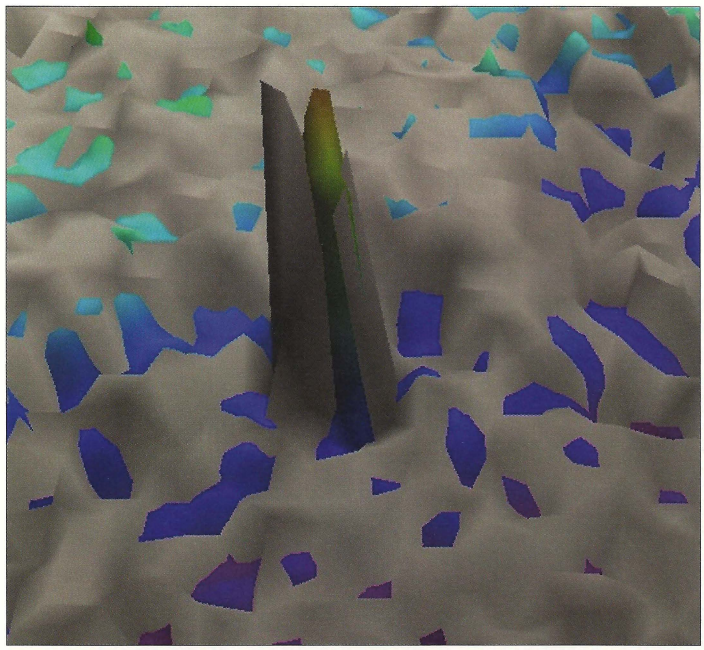


Figure 16: 3D depiction of Area 02 Object 01 as seen by CZMIL (greyscale) and MB (colour)

4.5 Target Area 7&8

There is a significant object in Target area 7/8. It is rectangular and rises ~2m off the bottom. It is approximately 30m long by 6m wide (Figure 17 and Figure 18). The Navy Test Site designation is MT9 (SFTF). It is in 22m of water.

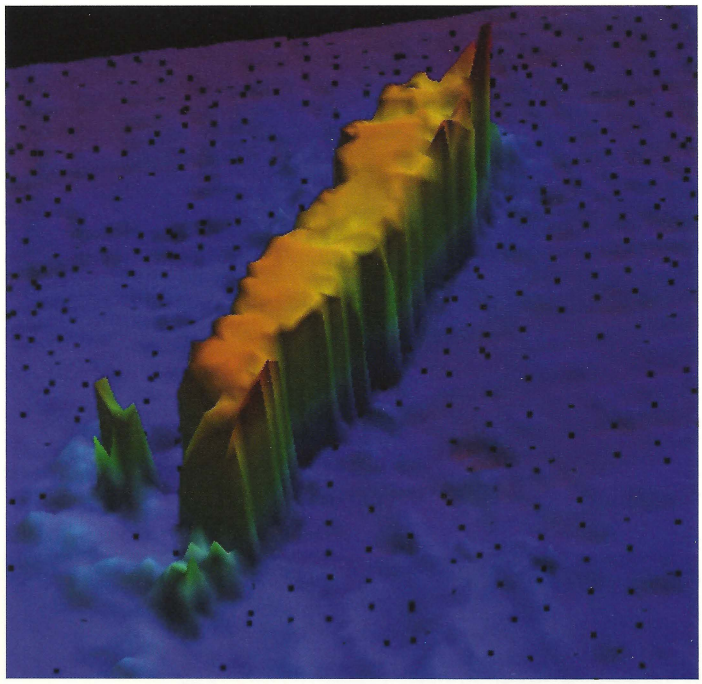


Figure 17: Area 7&8 Rectangular Target, 3D

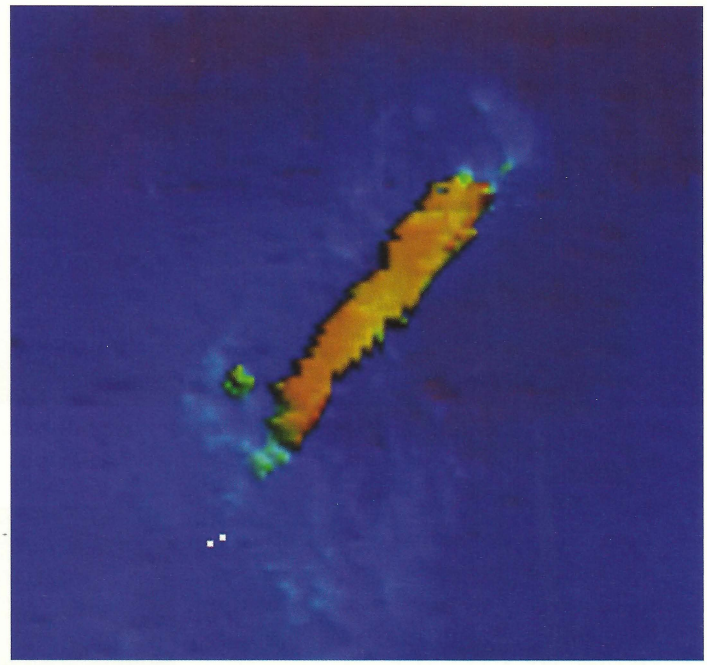


Figure 18: Area 7&8 Rectangular Target

CZMIL captures the basic outline of this target, but does not identify it as solid. As seen in Figure 19, CZMIL shows depths to the seafloor within the target area, whereas the MB data shows it as a solid feature. CZMIL reports two hits from a single waveform. In this case, because of the spot size, the waveform reports a hit on the target and on the seafloor; however, both are reported at essentially the same location.

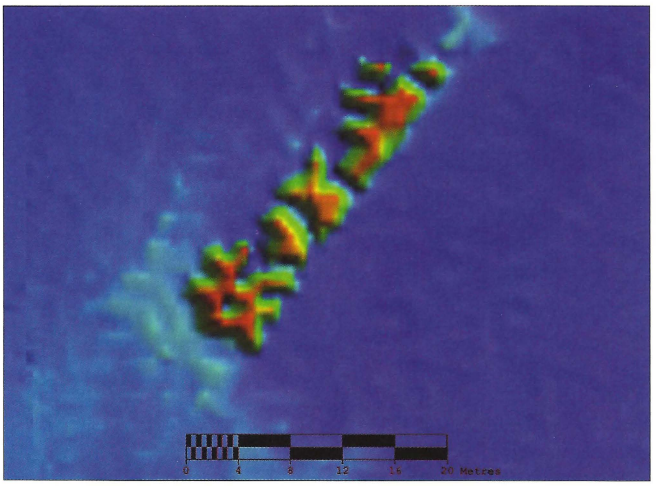


Figure 19:Area 7&8 Rectangular Target

However, it is sufficient for CZMIL to identify that an object exists, and it will be up to the processor to use other information, such as reflectance, or other observations, to verify and further evaluate that object.

5 CONCLUSIONS AND RECOMMENDATIONS

It was clear that CZMIL met the both horizontal and vertical uncertainty requirements of the USACE. Target detection capabilities were less well defined, except to say that most features were reported in the point cloud, but further investigation would be necessary to define those targets better. Perhaps a future modification to the processing code could include the ability to select the first return from the bottom, rather than both the first and last.

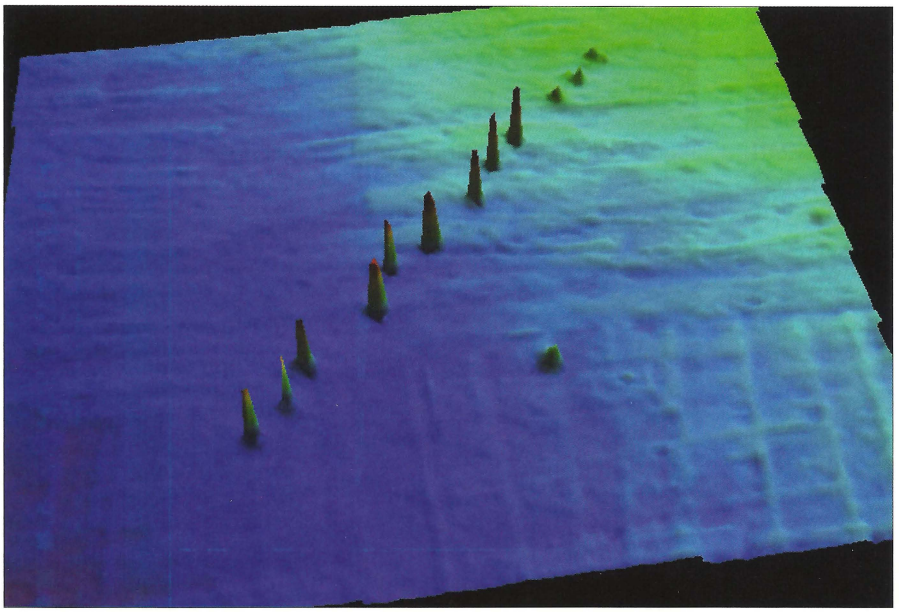


Figure 20:Area 12 Cylindrical objects in 3D (from the MB Data)

References

Fuchs, E., A. Mathur (2010). Utilizing Circular Scanning in the CZMIL System. Paper presented at the Algorithms and Technologies for Multispectral, Hyperspectral, and Ultraspectral Imagery XVI, Orlando, FL

4.6 Target Area 12

Target Area 12 had twelve objects in a row in 12m of water. Objects appeared to be conical with a 1m radius at the base and rise 1m above the bottom (Figure 20). A line of targets were also seen in the 50cm grid produced from CZMIL (Figure 21); however, the targets were not as well defined. It would be difficult to distinguish between features, but features were detected.

The target detection capability of CZMIL was difficult to quantify. It was shown here that CZMIL could detect targets as small as 1m diameter and 1m high (Area 2). CZMIL could identify significant objects, but due to the spot size and multiple reports from a single waveform, the shape of that object may not be entirely correct (Area 7/8).

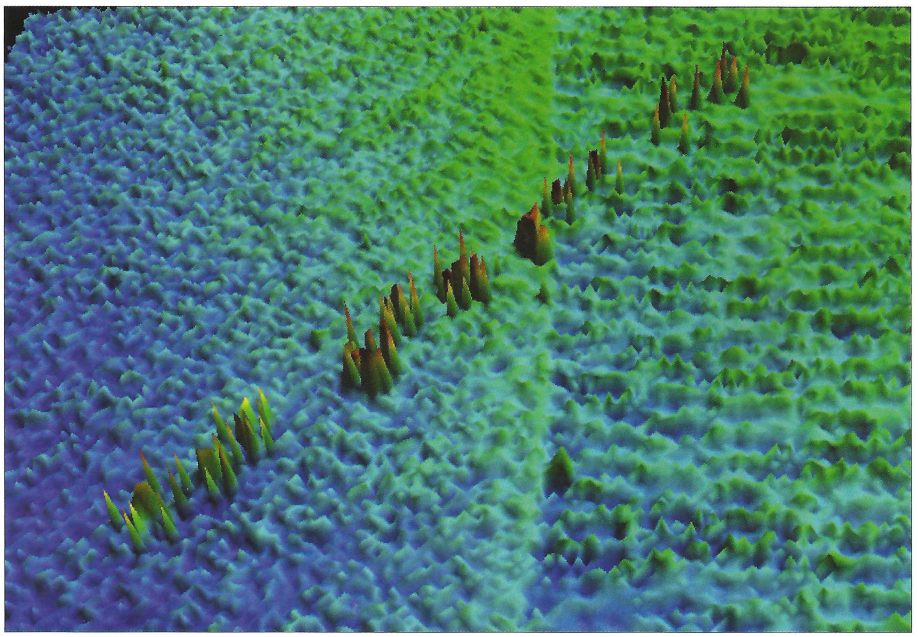
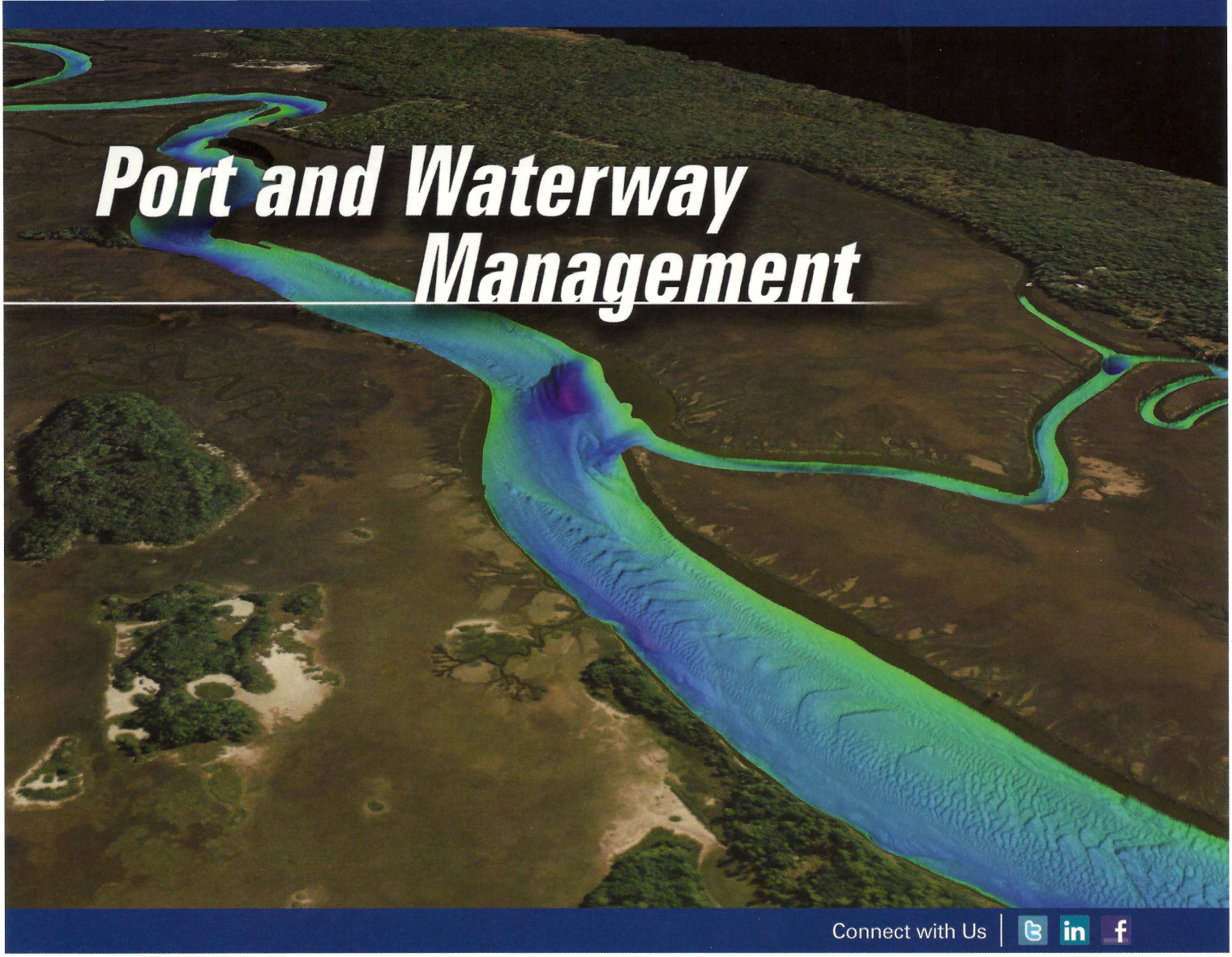


Figure 21:Area 12 CZMIL 50cm Surface



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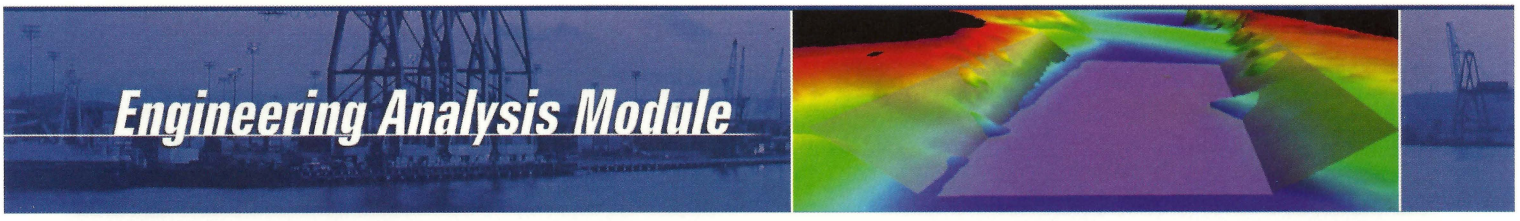

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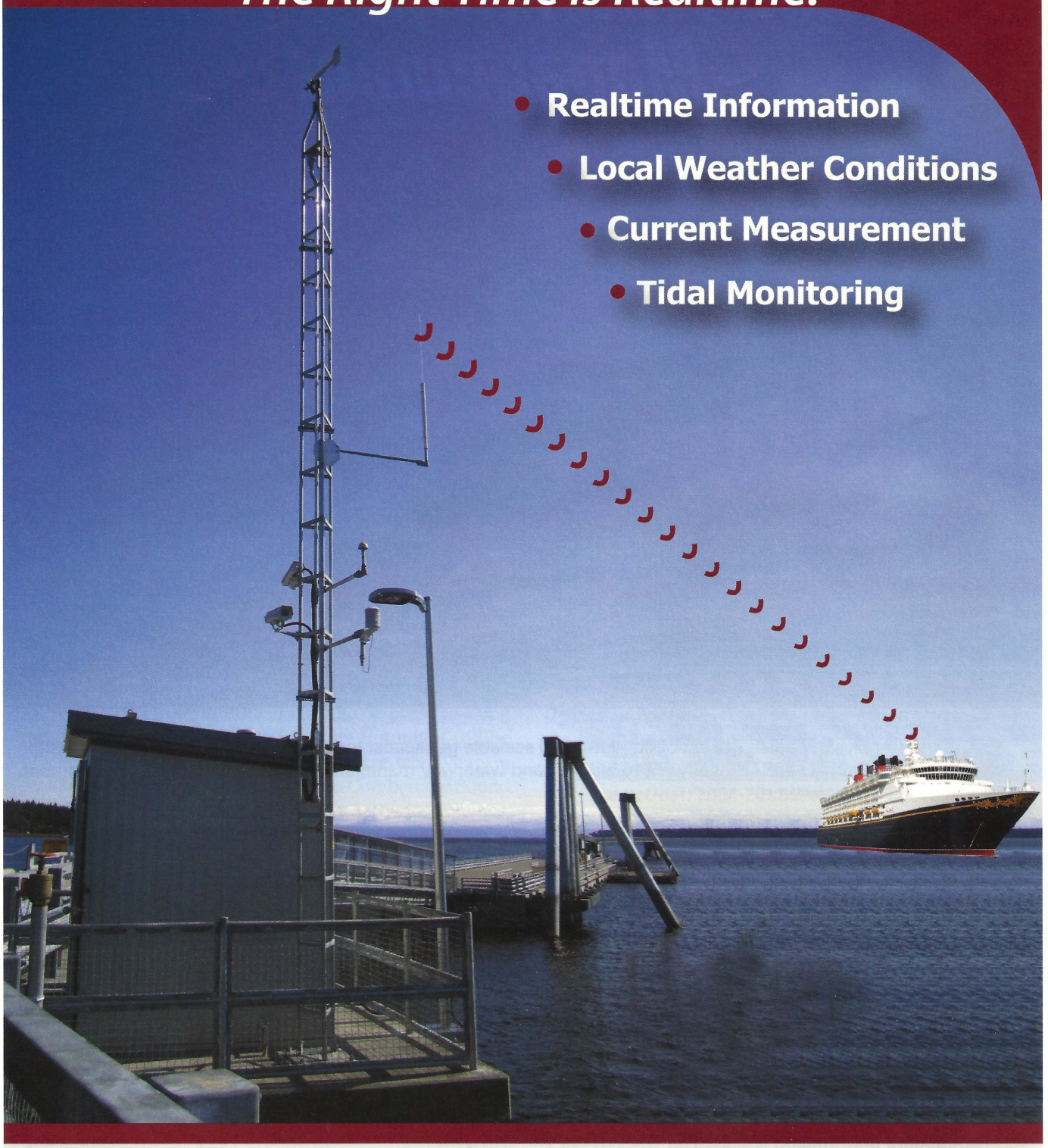

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- Local Weather Conditions
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SUTRON

Celebrate...

World Hydrography Day - June 21st

The United Nations, in its General Assembly Resolution A/60/30 of 29 November 2005, "Welcomes the adoption by the International Hydrographic Organization of the "World Hydrography Day", to be celebrated annually on June 21st, with the aim of giving suitable publicity to its work at all levels and of increasing the coverage of hydrographic information on a global basis, and urges all States to work with that organization to promote safe navigation, especially in the areas of international navigation, ports and and where there are vulnerable or protected marine areas."

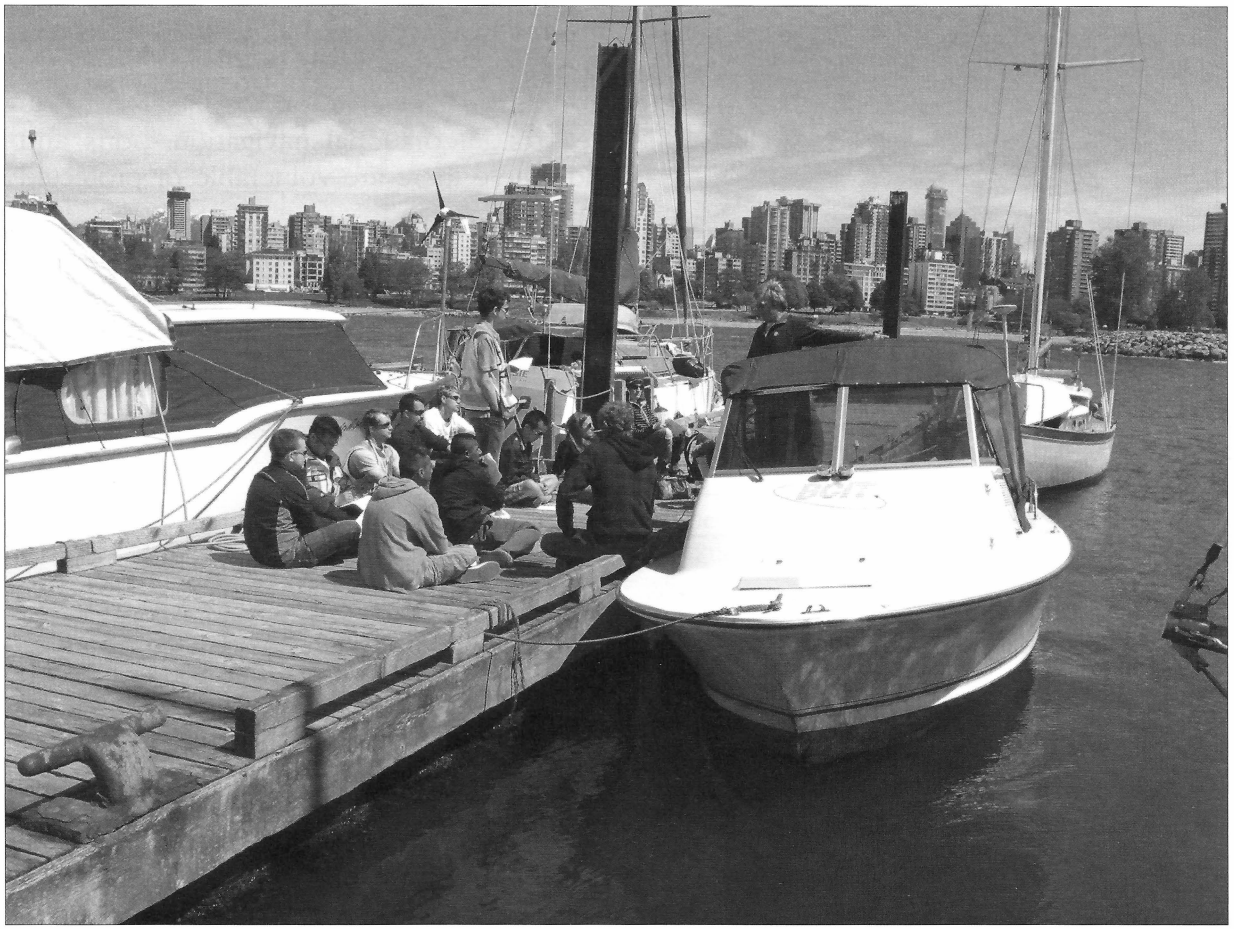
CALENDAR OF EVENTS

- International Maritime Organization's World Maritime Day - last week September 2013
- CIG Montréal Branch - Geomatics 2013 - Montréal, Québec, Canada, October 3-4, 2013
- CHC2014 - Sheraton Hotel - St. John's, Newfoundland and Labrador, April 15-17, 2014
- CIG - ISPRS Technical Commission 2 Symposium - Toronto, Ontario, Canada, September 2014

BCIT Students Map English Bay

By: Dave Rutherford, Geomatics, BCIT

As part of the BCIT Geomatics Diploma program, students spend 3 days on board the Geomatics survey launch mapping a portion of English Bay around False Creek in Vancouver. Students calibrate sounding gear, gyros, perform a bar check, calculate sounding line positions and operate the survey vessel using WinFrog software. The students are broken into groups, with each group responsible for several lines that will be later compiled into a complete chart of the area. Students use the Coast Guard differential GPS system for position, the sounding system and a fluxgate compass system for measurements. A shore survey is also undertaken which includes tide monitoring and feature location for both on shore and off-shore marine structures.



Peter Rontu, BCIT Assistant Instructor briefs students on Hydrographic survey procedures aboard the launch prior to departure.

Corporate Members
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We invite your organization to become a corporate member in our association. Consider the following benefits:

- ***Receive three copies of each issue of Lighthouse (published twice annually).***
- ***An invitation to participate in CHA seminars.***
- ***Listing and recognition in every edition of Lighthouse.***
- ***An annual 250 word description of your organization in Lighthouse.***
- ***10% off advertising rates in Lighthouse.***
- ***10% off exhibitor fees at CHA sponsored events.***
- ***Listing and link to your home page on each CHA Branch Web site.***
- ***News from corporate members in every edition of Lighthouse.***

The CHA, through *Lighthouse,* is active in promoting the strength and diversity of organizations and companies that support the hydrographic and related communities. Get onboard with us as a corporate member and we will help you reach potential customers throughout our worldwide distribution.

To join, please contact one of the Directors as listed on page 2. International applicants please remit to Central Branch. To obtain an application visit us at *www.hydrography.ca*

Annual dues for CHA Corporate Membership is $150.00 (CDN).

ASI Group Ltd

ASI Group provides a complete range of hydrographic, geophysical and visual inspection techniques to conduct underwater investigations. Lake bottom surface features and targets are located, measured and mapped with precision accuracy in real-time using a combination of geophysical mapping and charting tools. In-house cartographers and graphic specialists interpret geophysical data to produce quality technical reports in hardcopy and GIS compatible formats.

ASI's survey vessels are trailerable and equipped with a wide variety of survey equipment packages. In addition to surface vessels, ASI owns and operates a fleet of purpose-built remotely operated vehicles (ROVs) to deploy sonar and video imaging in open water, tunnels and pipelines.

ASI provides greater efficiency and accuracy in mapping rivers, estuaries, channels, lakes or harbour bottom surfaces for:

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- Underwater search, survey and recovery
- Dredging surveys and volumetric determination
- Sonar profiling/imaging surveys
- Remotely operated vehicle inspections
- Integrated navigation and positioning services
- Cable and pipeline inspections.

For further information please contact:

ASI Group Ltd
Tel: (905) 641-0941 E-mail: dkeyes@asi-group.com Website: *www.asi-group.com*

Association of Canada Lands Surveyors
Association des Arpenteurs des Terres du Canada

The ACLS is a national self-regulating professional association. It has 560 members located across Canada (and the world), who have expertise in surveying, photogrammetry, remote sensing, geodesy, hydrography and land information systems.

The ACLS is committed to raising awareness of the responsibilities and concerns of respective stakeholders in offshore Canada lands, and to find a common strategy to move this industry sector forward for the betterment of all. The following is a short list of the current main thrusts:

- Promotion of a Marine Cadastre for Canada
- Promotion of the ACLS national certification program for hydrographers
- Publication and promotion of the new book entitled "Canada's Offshore: Jurisdiction, Rights, and Management". Copies can be purchased from: www.acls-aatc.ca or www.trafford.com

L'A.A.T.C. est une association professionnelle de juridiction fédérale. Elle est composée de 560 membres répartis aux quatre coins du Canada (et du monde) qui ont une expertise en arpentage, en photogrammétrie, en télédétection, en géodésie, en hydrographie et en systèmes d'information foncière à référence spatiale.

L'A.A.T.C. est engagée à l'amélioration de la sensibilisation aux responsabilités et aux préoccupations des intervenants respectifs des terres extracôtières du Canada et de l'adoption d'une stratégie commune pour faire progresser ce secteur de l'industrie en vue de la plus-value pour tous. Voici la liste des activités principales en cours :

- Promotion d'un cadastre marin pour le Canada.
- Promotion du programme national de certification des hydrographes de l'AATC.
- La publication et la promotion du nouveau livre : *Zone extracôtière canadienne : juridiction, droits et gestion*. La version française sera disponible en novembre 2007. Vous pouvez faire l'acquisition de copies en visitant : www.acls-aatc.ca ou www.trafford.com

For further information please contact:

Association of Canada Lands Surveyors
Tel: (613) 723-9200 FAX: (613) 723-5558 E-mail: admin@acls-aatc.ca
Website: *www.acls-aatc.ca*

Blodgett-Hall Polar Presence LLC

The Blodgett-Hall Polar Presence LLC is a US registered non-profit non-commercial entity set up to promote geomarine research in the Arctic Ocean by combining modern technology with the advantages of working on the drifting sea ice cover. It has built and tested a research hovercraft, the R/H *SABVABAA*, which is based at UNIS, the University in Longyearbyen, Svalbard. The hovercraft, whose Inuit name means "flows swiftly over it", is equipped for work in marine geophysics, marine geology, and oceanography in the most inaccessible parts of the high Arctic. The program intends to put "boots on the ice" for extended periods, using a relatively inexpensive, very habitable platform with a minimum crew of two or three. Whether in motion along leads, or drifting on floes, it can carry out deep and shallow reflection and wide angle seismics, and home in on geological targets for direct coring, dredging, and bottom photography. Oceanographic instrumentation consists of electromagnetic ice thickness measurements every 2sec, CTD casts to 500m, and Acoustic Doppler Current Profiling. The hovercraft was especially designed to investigate the Alpha Ridge, in areas of thick multiyear ice presently inaccessible to icebreakers north of Ellesmere Island and Greenland. In preparation for this the hovercraft has undergone three summers of testing over the Yermak Plateau. More that 10,000nm of travel have been recorded, while dredging, making CTD casts, seismic profiles, and testing autonomous drifting buoys for unattended seismic profiling, echo-sounding, and shallow CHIRP.

For further information please contact:

Website at *www.polarhovercraft.no*

C & C Technologies

C & C Technologies, Inc. is a privately-owned international surveying and mapping company specializing in deepwater services. Our cutting-edge technologies, inspiring workplace and "can do" attitude endear our clients and attract the industry's leading innovators. C & C services include autonomous underwater vehicle surveys, C-Nav® globally corrected GNSS, marine construction surveys, geophysical surveys, geosciences services, government services, land and coastal surveys, a free GoM GIS viewer, and geotechnical services.

For more information regarding C & C Technologies services please contact:

Thomas Chance, CEO
at (337) 261-0000 email to marketing@cctech.us or
visit C & C's Website at *www.cctech.us*

CARIS

Established in 1979, CARIS is a leading developer of geospatial software designed for the hydrographic and marine industries. Developed in cooperation with hydrographic clients and universities worldwide, CARIS software is designed to cater specifically for the marine GIS community, and is built on decades of hydrographic experience.

No other single company can supply a software solution for your entire offline workflow. The CARIS Ping-to-Chart solution is designed to deliver an integrated and seamless solution for the entire workflow of hydrographic information from processing the echo-sounder ping to the production and distribution of the chart. This integrated software solution provides our clients with resource optimization and a true operational advantage.

The CARIS Ping-to-Chart solution includes products that address the need to manage bathymetric data sets containing billions of soundings, to support the development of multiple chart types from a single source and to be able to distribute and interrogate high density bathymetry over the internet.

CARIS software also offers peace of mind backed by a comprehensive level of industry leading support. CARIS offers training sessions, consulting and technical support services, as well as an extensive series of courses to make sure that its clients fully utilize the software's capabilities. Users can also gain swift access to qualified technical experts via on-line services, multilingual telephone support and email.

Find out why CARIS software is selected by national mapping and charting agencies, survey companies, port and waterway authorities, oil and gas companies and academic institutions around the world by visiting www.caris.com.

For more information regarding CARIS services please contact:

Sheri Flanagan
at (506) 458-8533 email to info@caris.com
visit CARIS's Website at *www.caris.com*

CIDCO

Le Centre Interdisciplinaire de Développement en Cartographie des Océans (CIDCO) est un organisme de R&D en géomatique marine. Dédié à la mise en valeur des technologies de pointe pour l'acquisition, la gestion et la représentation graphique de données spatiales marines, le CIDCO est un organisme sans but lucratif qui répond aux besoins en R&D de l'industrie et de la communauté scientifique.

Cartographie hute résolution

Les équipements du CIDCO permettent un niveau de précision allant du mètre à quelques centimètres selon le contexte. Cette précision permet d'identifier les objets se trouvant sur le fond marin, sous des couches sédimentaires ou flottant dans la colonne d'eau. De plus, les données acquises permettent la production d'images bathymétriques et d'images de réflectivité du fond marin.

Le CIDCO possède l'expertise en traitement de données (bathymétrie et imagerie) issues de sonars monofaisceau, multifaisceaux et interférométriques. De plus, il améliore continuellement le flux de travail du traitement de données afin de réduire le temps nécessaire à la réalisation de produits de géomatique marine.

Le CIDCO est continuellement en évolution par l'apprentissage de nouvelles méthodes et l'utilisation de nouveaux outils. L'organisme est au cœur du milieu de la géomatique marine par sa veille technologique et son positionnement stratégique ainsi que par l'organisation de formations et d'ateliers avec des scientifiques du milieu et les professionnels du CIDCO.

The Interdisciplinary Centre for the Development of Ocean Mapping (CIDCO) is a marine geomatics R&D organization. Dedicated to the enhancement of state-of-the-art technology for marine geospatial data acquisition, management and graphic representation, the CIDCO is a not for profit organization answering the R&D needs of the industry and the scientific community.

High-resolution Mapping

CIDCO's equipments allow for precision levels varying from meter to centimetre-level precision depending on the survey context. This precision enables identification of objects on the seabed, buried under sedimentary layers or suspended in the water column. Moreover, the survey data is used to produce both bathymetric and backscatter imagery of the seabed.

CIDCO possesses the expertise in data processing (bathymetry and imagery) acquired from singlebeam, multibeam and interferometric echo sounders. Moreover, it continuously strives to improve the data processing workflow in order to reduce the time required for production of marine geomatics products.

CIDCO is continually evolving through learning of new methods and uses of new tools. The organization is at the heart of the marine environment of the marine geomatics sector by its organization of courses, training and workshops with the scientific community and CIDCO employees.

For more information regarding CIDCO services please contact:

Jean Laflamme
at (418) 725-1732 email to Jean.Laflamme@cidco.ca
visit CIDCO's Website at *www.cidco.ca*

Fugro GeoSurveys Inc.

Fugro GeoSurveys Inc. (FGI) is Canadian-based and staffed, with offices in St. John's, NL and in Dartmouth, NS and has a large, locally based, inventory of hydrographic, geophysical, geotechnical and positioning equipment. With approximately 75 employees, FGI has established an impressive track record in Canada and on the international stage.

FGI has provided seabed mapping and construction support services for all of Eastern Canada's offshore oil and gas developments and is also actively involved in marine based non-oil and gas projects such as Canada's UNCLOS mapping, hydrographic charting in Canada's North, large area habitat mapping, pipeline and cable route surveys, ice scour studies, wharf investigations and a broad range of engineering and construction support surveys.

FGI's Hydrographic Group operates a wide range of multibeam equipment including Reson 8101, 8111 and 8125 systems. These systems are routinely mobilized by FGI on ocean going vessels, as well as our customized 26 foot inshore survey launch. Systems have also been mobilized on ROVs for detailed oil and gas related infield mapping projects.

Multibeam data are processed in the field and at bases in St. John's and Dartmouth using CARIS HIPS/SIPS, IVS' Fledermaus visualization tools, and Fugro's own Starfix software suite. The resultant multibeam data are commonly integrated with seabed sampling, underwater imagery, geotechnical, seismic, sidescan and sub-bottom profiler data to deliver superior data products for use in seafloor and sub-seafloor assessments.

Throughout each project, FGI is committed to the health and safety of its employees, partners and clients, and to the protection of the environment. This is accomplished through the company's comprehensive HSE policy and Safety Management System which is OHSAS 18001 certified.

If you would like to receive further information about Fugro GeoSurveys Inc. please contact:

Fugro GeoSurveys Inc.
Tel: (709) 726-4252 FAX: (709) 726-5007 E-mail: todd.ralph@fugro.com
Website: *www.fugro.com*

HYPACK, Inc.

HYPACK, Inc develops Windows-based software for the hydrographic and dredging industry. Founded in 1984, HYPACK, inc. (formerly Coastal Oceanographics, inc.) has evolved from a small hydrographic consultancy to one of the most successful worldwide providers of hydrographic and navigation software. HYPACK® is one of the most widely used hydrographic surveying packages in the world, with over 4,000 users. It provides the surveyor with all of the tools needed to design their survey, collect data, process it, reduce it, and generate final products.

Whether you are collecting hydrographic survey data or environmental data or just positioning your vessel in an engineering project, HYPACK® provides the tools needed to complete your job. With users spanning the range from small vessel surveys with just a GPS and single beam echosounder to large survey ships with networked sensors and systems, HYPACK® gives you the power needed to complete your task in a system your surveyors can master.

For more information regarding HYPACK, Inc. please contact:

HYPACK, Inc.
Tel: 1-860-635-1500 FAX: 1-860-635-1522 E-mail: sales@hypack.com
Website: *www.hypack.com*

L'Institut maritime du Québec

Fondé à Rimouski en 1944, l'Institut maritime du Québec (I.M.Q.) est le plus important centre de formation maritime au Canada et le seul francophone. Faisant partie des cinq écoles nationales du Québec, il offre des formations collégiales techniques de haut niveau comme Techniques de la logistique du transport et des spécialités qui lui sont exclusives : Technologie de l'architecture navale, Navigation, Techniques de génie mécanique de marine et Plongée professionnelle.

L'I.M.Q. jouit d'une réputation d'excellence à l'échelle internationale pour la qualité de la formation qu'il offre, pour son expertise très vaste dans les domaines maritimes et de la logistique du transport et pour la compétence reconnue de ses élèves diplômés. D'ailleurs, plusieurs d'entre eux occupent aujourd'hui des positions-clés dans l'industrie en Amérique et en Europe.

Afin de maximiser les apprentissages, l'I.M.Q. met à la disposition des élèves des équipements de pointe comprenant des laboratoires informatiques, des ateliers bien aménagés, un bassin de plongée, ainsi que des simulateurs de navigation, de salle des machines et de communication maritime. Son personnel hautement qualifié participe également à sa réputation et à son rayonnement au Canada et ailleurs dans le monde.

Bien branché sur les besoins du marché du travail, l'I.M.Q. propose des formations incluant des stages. Orchestrée en partenariat entre l'Institut maritime du Québec et l'industrie, la formule est gagnante pour tous les intervenants — entreprises, élèves et maison d'enseignement — car elle contribue à l'amélioration de la qualité des apprentissages tout en permettant à l'élève d'évoluer dans son futur milieu de travail.

Pour plus d'informations à propos de L'Institut maritime du Québec s'il vous plaît contactez:

L'Institut maritime du Québec
Tel: (418) 724-2822 FAX: (418) 724-0606 E-mail: infoscol@imq.qc.ca
Website: *www.imq.qc.ca*

Jeppesen Norway AS

Jeppesen is a leading provider of solutions that support decision-making in commercial maritime operations. Today we contribute to the smooth operation of thousands of commercial ships and shipping companies around the world.

As a natural extension of our commercial products, we have supported production of charts and publications at national hydrographic offices worldwide for over a decade. Jeppesen dKart Office technology organizes the production and maintenance of traditional paper charts and survey sheets, electronic charts such as ENCs, lists of lights, Notices to Mariners, sailing directions and print-on-demand products.

Our commercial clients rely on us for electronic charts, weather and met-ocean data, weather routing and voyage optimization. We were one of the first companies in the world to offer digital chart data to commercial shipping, and we are fast becoming one of the world's leading suppliers of official chart data (ENCs). In addition, we have developed a vast array of solutions that meet the operational needs of the shipping industry.

Both our national and commercial customers recognize our ability to meet their business needs, for quality assurance, rapid updating, user-friendly operation, flexible procurement, business integration and compatibility.

Recent major projects for national hydrographic offices include one recently concluded with Croatia, and another just underway for the Sultanate of Oman. For each, Jeppesen has been commissioned to supply the countries with its dKart Office suites, including tools, processes and training services. Production and maintenance of ENCs and paper charts and NtM processing have been key. Finally, Jeppesen is finalizing a print-on-demand extension for the Norwegian Hydrographic Service.

For further information please contact:

Egil O. Åarstad
Tel: +47 51 464960 FAX: +47 51 464701 E-mail: dkart@jeppesen.com
Website: *www.jeppesenmarine.com/National-Hydrographic-Services/*

Knudsen Engineering Limited (KEL)

Knudsen, a long-standing corporate member and familiar face to the Canadian hydrographic world, is recognized worldwide for its innovative high performance singlebeam echosounders used in numerous commercial/defence applications including survey, navigation, dredging, sub bottom profiling, and ocean research.

Known for advanced underwater acoustics technology, Knudsen introduced the first 'all-digital' echosounder with its 320M echosounder and followed with the industry's first "blackbox" echosounder, the 320BP. Product innovation has continued and today, a common set of technology components - embedded Digital Signal Processing firmware, Windows application software , and modular hardware design - are bases of the Sounder and Chirp Series of Echosounders that provide leading edge solutions for the world of today and into the future. Digital signal processing is again the key to the performance of these new product lines. Both Sounder and Chirp series systems digitize the entire incoming signal over an exceptionally wide bandwidth and extract the frequency of interest entirely with digital signal processing software. Knudsen Sounder and Chirp echosounders provide stability and selectivity simply not achievable with analog components and offer sufficient processing power to recover the signal from even the noisiest environments.

Knudsen, an ISO certified manufacturer, located in Perth, Ontario Canada, has a current customer base that spans more than 60 countries. Knudsen cornerstones - 'Meeting customer needs through ongoing product innovation and unparalleled customer support' - continue to identify Knudsen products as the established benchmark for performance and accuracy.

For additional information please contact:

Judith Knudsen
Tel: (613) 267-1165 FAX: (613) 267-7085 E-mail: judith@knudsenengineering.com
Website: *www.knudsenengineering.com*

Kongsberg Maritime

Kongsberg Maritime, a company in the Kongsberg Group, is a leading supplier of advanced multibeam and single beam echosounders and instrumentation systems.

With its strong application knowledge and trend-setting quality products, Kongsberg Maritime is able to offer unique and complete solutions for ROVs, AUVs, positioning systems and sea bed surveying and mapping.

Kongsberg Maritime has about 980 employees with subsidiaries world wide. Canadian operations include a sales office in Halifax and a factory in Port Coquitlam, British Colombia.The headquarters are located in Kongsberg, Norway. Kongsberg Maritime exports its products to all of the world's major markets.

For more information regarding Kongsberg Maritime please contact:

Mr. John Gillis
Survey & Underwater Vehicle Instrumentation
Tel: (902) 468-2268 FAX: (902) 468-2217 E-mail: john.gillis@kongsberg.com
or visit Offshore: *www.km.kongsberg.com* and Marine: *www.simrad.no*

Naval Meteorological and Oceanographic Office (NMOO)

R.O.C Naval Meteorological and Oceanographic Office, developed in 1922, is mainly responsible for the spatial environmental information of the naval operations, and strongly supports to all kinds of naval missions and other military exercises.

Missions

- To collect the whole spectrum of spatial environmental parameters (air, surface and under water).
- To predict weather, sea states, currents and trajectories.
- To integrate all spatial environmental parameters with GIS to clearly present spatial scenarios.
- To publish and distribute Nautical Charts, Notices to Mariners, Tide Tables, List of Lights, Sailing Directions and other Hydrographic Publications periodically.
- To operate oceanic survey for supporting national defense infrastructures, economic and communication developments.
- To do scientific studies to improve capabilities of forecasting, data processing and mapping techniques with higher accuracy.

Numerical Modeling

NMOO atmospheric and current/wave models generate results twice a day for 120-hour forecasting within the area of East Asia and Taiwan.

Atmospheric and Maritime Forecast

NMOO has capability on both observations and forecasting of atmosphere /meteorology and oceanography. The information is released every 6 hours to all naval units and other services.

Hydrographic and Oceanographic Survey

NMOO executes various tasks of hydrographic and oceanographic surveys around Taiwan waters annually. Therefore, the Office will update and publish nautical charts and relevant information for maritime safety.

Atmospheric & Oceanic Observations

The mobile and stationed surface and upper-air sensors and equipments are settled around Taiwan waters. All real-time observations will be sent to the naval commanders and other staff immediately to support decision making.

For more information regarding Naval Meteorological and Oceanographic Office please contact:

James Mau (Commanding Officer)
Tel: 886-07-5813141 ext784390 FAX: 886-07-9540149 E-mail: jamesmao@ms21.hinet.net

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Réformar

Reformar a pour principale mission de soutenir les chercheurs, les institutions de recherche et de formation et les organisations gouvernementales et privées, lors de la réalisation de leurs projets scientifiques en sciences et technologies de la mer, par le biais de ses infrastructures, dont le navire de recherche le Coriolis II. Par le biais de son réseau de partenaires publics et privés, Reformar a ainsi accès à un parc d'équipements d'une valeur d'une dizaine de millions de dollars, ce qui permet d'équiper le Coriolis II pour tous ses différents travaux de recherche.

Véritable laboratoire flottant, le Coriolis II dispose d'espaces dédiés exclusivement aux travaux de recherche. Ses laboratoires, dont l'espace totalise plus de 55 mètres carrés, permettent de former des équipes de recherche multidisciplinaires pouvant accueillir 14 personnes, en plus de l'équipage régulier du navire.

Le Coriolis II répond aux plus hautes normes de certification maritime internationale, dont la certification ISM et ISPS. Il est classé auprès de la société ABS et est conforme à la convention SOLAS. Il peut naviguer non seulement au Canada, mais partout dans le monde et ce, dans un cadre opérationnel des plus sécuritaire. Doté d'équipements de pointe, Le Coriolis II est maintenant équipé de deux systèmes de multifaisceaux dont un pouvant aller jusqu'à une profondeur de 7000 mètres, ce qui en fait un des 20 navires au monde équipé d'une telle technologie.

For more information regarding Réformar please contact:

Martial Savard
Réformar
Tel: (418) 723-1986 FAX: (418) 724-1842 E-mail: msavard@reformar.ca
or visit *www.reformar.ca*

Rolls-Royce Naval Undersea Systems (ODIM Brooke Ocean)

ODIM Brooke Ocean, Dartmouth, Nova Scotia, is a world leader in the development and supply of sensor platforms for moored and underway use. The company provides hardware, engineering, repair and overhaul, life cycle support and R&D services to the hydrographic and oceanographic communities as well as to the naval and oil & gas sectors. Products include advanced data collection platforms, instrumentation, cable-handling hardware and launch/recovery systems.

ODIM Brooke Ocean's Moving Vessel Profiler™ (MVP) collects real-time free fall data profiles from ships underway at speeds of up to 12 knots. In addition, the ODIM Free Fall Cone Penetrometer (FFCPT) was developed to collect geotechnical and geophysical data during route location surveys for seabed cable and pipeline installations, bottom classification and acoustic groundtruthing, mine countermeasures and geo-environmental studies.

The ODIM FFCPT can be used either on-station or from a vessel underway at speeds up to 6 knots, using an ODIM MVP. Deployment of the ODIM FFCPT from an ODIM MVP offers a rapid and reliable method for characterizing the seafloor sediment, as well as the sound velocity of the water column.

Another of ODIM Brooke Ocean's primary areas of specialization is in the development of shipboard Launch And Recovery Systems (LARS) to deploy and recover various payloads from a ship at sea. These payloads include Autonomous Underwater Vehicles (AUVs), Unmanned Surface Vehicles (USVs), offboard sensors, oceanographic equipment, and manned submersibles.

If you would like to receive further information about ODIM Brooke Ocean and its services please contact:

Arnold Furlong
Tel: (902) 468-2928 FAX: (902) 468-1388 E-mail: sales@brooke-ocean.com
Website: *www.brooke-ocean.com*

SANI-INTERNATIONAL TECHNOLOGY ADVISORS INC. (SANI-ITA)

SANI-INTERNATIONAL TECHNOLOGY ADVISORS INC. (SANI-ITA), an Ontario Corporation, provides services and consulting in geographic information systems, remote sensing, softcopy photogrammetry and hydrography. The Corporation is a Distributor for GeoEye (50 centimetre imagery) LizardTech (MrSID and LiDAR data compressors), Nuvision and TRUE3Di (softcopy photogrammetry hardware) and is also the Authorised Training Centre for the complete suite of ERDAS IMAGINE software products. SANI-ITA is a sister company to Spatial Geo-Link Limited, the sole distributor in for ERDAS softcopy photogrammetry, geographic imaging and enterprise solutions in Canada.

SANI-ITA committed to providing services that meet or exceed approved designs, specifications and accepted industry practices. Our Corporation is technology driven and provides innovative solutions, high quality services and timely deliveries in the field of geomatics. The Corporation is ISO 9001:2008 registered.

Services offered by SANI-ITA include:

- Project Consulting
- Project Management
- Management of airborne and spaceborne data acquisitions missions
- Control surveys in support of geodetic or photogrammetric projects
- Hydrographic surveys
- Aerial triangulation of airborne and satellite data
- Digital Elevation/Terrain collection – automatic or static mode
- Orthoimagery
- Digital topographic mapping
- Digital map revision
- GIS data structuring
- Map conversion and data translation services
- Image compression services - MrSID, ECW and JPEG2000
- Quality assurance services
- Third party audits of mapping and imagery
- 3D Visualisations

For additional information on the Corporation, please visit our website at:

www.sani-ita.com
or contact us at
Tel: (905) 943-7774 FAX: (905) 943-7775

Shark Marine Technologies Inc.

Shark Marine Technologies Inc. was founded in 1984 with a mandate to offer products and services that are innovative, high quality, dependable and cost effective.

Over the years, we have gained global respect for our developments in undersea technology, and the expertise we bring to on-site operations. As a manufacturer we have made significant advancements in underwater imaging equipment, remotely operated vehicles and other survey systems. In our services we have provided consultation, software development, custom manufacture, hydrostatic testing, equipment rentals and location operations.

Shark Marine Technologies Inc. is also a world leader in the development and manufacture of new technologies for maritime security and SAR organizations. Products such as diver detection and deterrent systems, remotely operated inspection and intercept vehicles; diver-held imaging sonar units and ship hull inspection devices, highlight our focus on security. Along with our own manufactured products we are also proud to be the North American representatives for Systems Engineering and Assessment (SEA) Ltd.of the U.K., for their line of SWATHplus bathymetric survey systems.

Our customer base has grown over the years to include gas and oil exploration, commercial diving, various governments, fisheries and undersea research facilties, search and rescue organizations, and survey firms. Our location services have taken us from warm waters to the frozen Arctic, where we have gained international recognition. These include pipeline surveys, locating of sunken vessels and other objects, search and recovery, as well as magnetic and sonar mapping.

Our manufacturing and global sales facilities are located in St.Catharines, Ontario, Canada, with associated sales offices in North Liberty, Iowa, USA and Grenoble, France as well as various sales representatives throughout the world.

Our experience in the diverse aspects of this field allows us the ability to create innovative solutions to often difficult or costly tasks.

For further information about please contact Shark Marine Technologies Inc.:

Jim Garrington
Tel: (905) 687-6672 FAX: (905) 687-9742 E-mail: jim@sharkmarine.com
Website: *www.sharkmarine.com*

Technopole maritime du Québec

La mission de Technopole Maritime du Québec est de promouvoir et accélérer le développement du créneau des sciences, technologies et biotechnologies marines du Québec en assurant son rayonnement sur les scènes nationale et internationale, en offrant des services à valeur ajoutée aux membres du créneau et en soutenant l'avancement des projets prioritaires à long terme. De plus, Technopole Maritime du Québec a pour objectif de positionner son réseau comme leader au niveau québécois et canadien dans les secteurs d'excellence des sciences marines, des biotechnologies marines et des technologies maritimes afin d'y accélérer la création de richesse par la croissance et les nouveaux investissements dans les entreprises, institutions et organismes. Les actions de Technopole maritime s'inscrivent dans une volonté de mobiliser les forces vives du créneau des sciences et technologies marines, à savoir les institutions d'enseignement, les organismes de transfert, les installations et les laboratoires de recherche et, surtout, bon nombre d'entreprises qui vivent à l'heure de l'innovation technologique.

- Par ses actions de maillage et de réseautage, TMQ est l'animateur par excellence du domaine des sciences de la mer dans la région;
- Par ses actions de représentation, TMQ contribue au développement de liens d'affaires solides entre les acteurs de l'industrie des sciences de la mer au Québec et au Canada;
- Par ses actions de communication et de promotion, TMQ contribue au rayonnement et à la reconnaissance du domaine des sciences de la mer dans la région et à l'extérieure de celle-ci;
- Par son leadership, TMQ est à même d'identifier et de piloter des projets d'envergure qui sont rassembleurs pour la communauté des sciences de la mer de la région.

The mission of the Technopole Maritime du Québec (TMQ) is to promote and advance the development of marine sciences, technology and biotechnology in Quebec by increasing their visibility on both the Canadian and international stages, providing value-added services to the members of this niche sector, and supporting the progress of priority projects over the long term. Furthermore, the goal of the Technopole Maritime du Québec is to position its member network as the provincial and national leader in the marine sciences, biotechnology and technology sectors. Doing so will enhance wealth creation and attract new investments to the sector's industries, institutions and organizations. The Technopole's actions are driven by the will to mobilise the dynamic strength of the marine sciences and technology sector, namely the educational institutions, technology transfer organizations, research laboratories and facilities, and the numerous companies that are currently thriving through technological innovation.

- Through its communication and promotional strategies, TMQ contributes to the reach and recognition of marine sciences in the region, in Canada and around the world ;
- Through its representation work, TMQ contributes to the development of successful business relationships between actors in the marine science industry in Quebec and Canada ;
- Through its networking strategies, TMQ is an outstanding coordinator for the marine sciences sector in the region ;
- Through its leadership, TMQ is well-placed to identify and spearhead major projects that promote joint action in the regional marine sciences community.

For more information regarding technopol maritime du Québec please contact:

Laurent Bellavance
Tel: (418) 724-9616 / FAX: (418) 721-6127 E-mail: lbellavance@tmq.ca
Website: *www.tmq.ca*

Terra Remote Sensing Inc. (TRSI)

Terra Remote Sensing Inc. (TRSI) is a spatial data organization offering world-class expertise and technology for clients requiring fast, accurate, detailed and cost effective surveys. Our teams specialize in the acquisition and positioning of remotely sensed data in terrestrial and marine environments, and in the transformation of that data into a wide array of products to meet our client's needs.

TRSI was established in 1983 in Sidney, British Columbia as the West Coast subsidiary of Terra Surveys Ltd, based in Ottawa Canada. The company began by providing consulting, engineering, training and technical services in coastal and land-based resource studies, hydrography, marine geophysics and remote sensing. TRSI, a 100% employee-owned venture, was launched in 1999 to allow the company to further develop its technology and processes. Our new sensor technologies and associated applications are testaments to our innovation approach.

TRSI has over 50 dedicated full-time professionals that work on both national and international projects. Senior management is comprised of a core group of professional engineers and business specialists.

A highly qualified permanent staff of Geomatic Engineers, GIS Specialists, Mapping Technicians, Computer Programmers, Electronic Engineers, Hydrographers, Geophysicists and Surveyors comprise TRSI's multi-disciplinary team.

TRSI established a wholly owned subsidiary in Chile in late 2008. The Chile operation maintains a commercial office in Santiago and an operational office located in Carauma near Valpariso, in order to provide access to qualified staff.

Our wholly-owned US entity was established in 2009 as a sales office to provide a US base for our clients. Their focus is the Pacific Northwest region, which is a natural extension from our Sidney head office.

For more information regarding Terra Remote Sensing please contact:

Rick Quinn
Tel: (250) 656-0931 / (800) 814-4212 FAX: (250) 656-4604 E-mail: rick.quinn@terraremote.com
Website: *www.terraremote.com*

SECTION DU QUÉBEC

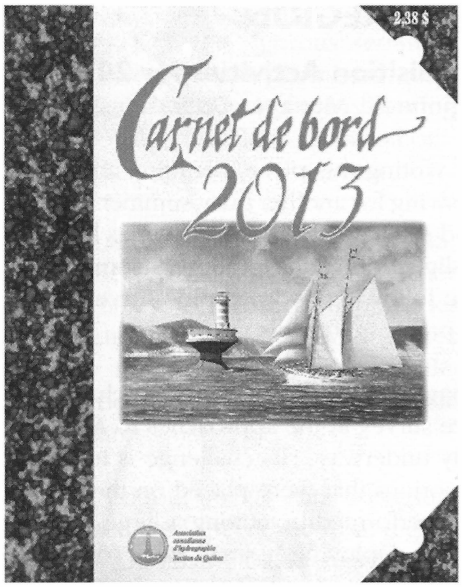
La Section du Québec a tenu sa réunion générale annuelle et tous les directeurs du conseil d'administration ont été réélus pour un autre mandat. Bernard Labrecque occupe le poste de vice-président pour l'année 2013, les postes de directeurs sont assurés par Robert Dorais et Jean Laflamme et Pierre Pagé fera la vérification comptable.

La Section du Québec a continué sa collaboration avec la revue « Québec Yachting » en publiant trois chroniques portant sur l'importance de suivre des cours de navigation et l'interprétation de la carte no 1, les 25 ans du personnel et des réalisations de l'institut Maurice-Lamontagne et finalement l'importance de mettre à jour les cartes et documents nautiques avant de reprendre une saison de navigation. Une nouvelle chronique est en préparation et portera sur le colloque organisé par le CIDCO sur une utilisation non-traditionnelle de l'hydrographie pour l'inspection des infrastructures sous-marines.

La Section du Québec a publié son Carnet de Bord en février 2013 dont une large distribution se fait dans les écoles de voiles ainsi que dans plusieurs points de vente au Québec et dans l'Est de l'Ontario. Elle offre toujours le service de vente de cartes et publications du Service hydrographique du Canada en plus des cartes topographiques.

Le membre corporatif CIDCO organise un colloque les 20 et 21 juin sur l'utilisation non traditionnelle de l'hydrographie. La Section du Québec profitera de l'occasion pour souligner la journée mondiale de l'hydrographie. Le format et la mise en forme ne sont pas encore arrêtés au moment de l'écriture des présentes nouvelles de la section.

La Section du Québec souhaite une bonne Fête nationale aux québécois le 24 juin et une bonne Fête du Canada le 1er juillet à tous les canadiens.



PACIFIC BRANCH

It has been a quiet winter for branch activities. We did hold our Annual General Meeting and would like to thank those who attended. We would like to congratulate the following for their election to the branch executive; Vice President - Craig Lessels, Secretary – Bodo de Lange Boom, Treasurer/Past Vice President – Ken Halcro. Thank you to those members for volunteering to be on the executive.

We look forward to a busy season with many of our members preparing for field surveys.

We look forward to World Hydrography Day and are currently planning a celebration for that. We will announce more detail as the date approaches.

PACIFIC REGION

CHS Pacific 2013 Survey Season

In February 2013 the *Shoal Seeker* surveyed Cowichan Lake. This is a 40km x 4km body of water on Vancouver Island north of Victoria. The survey was done in collaboration with the local water board and DFO to survey the lake completely for the first time. Decreasing water levels have had a significant impact on the survivability of juvenile salmon in the Cowichan River. The water board is considering raising water levels in the lake and needs to determine the possible impacts of this. The survey was completed in the four weeks assigned and the use of a borrowed POS/MV (thanks to CHS, Central and Arctic Region) produced a very clean data set. We did not find the train wreck that local legend describes.

In April 2013 the *Otter Bay* took part in a small survey in Cordova Channel working with Environment Canada as part of its work up for the season. Multibeam was used to look at sand waves and determine if acoustic backscatter could help identify the particular type of "fluffy sand" that is home to the Sand Lance, a small fish that, due to the lack of a swim bladder, can bury itself into the seabed at night. It is a very important part of the food chain, particularly for sea birds. In addition to the multibeam data, a video grab was deployed during the day and at night to gather images and bottom samples. This was very successful as one grab alone caught six of the fish in question.

Plans for further work in 2013 include:

- Ports on the West Coast of Vancouver Island and Strait of Georgia to capture data for super scale ENCs requested by the BC Coast Pilots to improve docking safety;
- SE coast of Haida Gwaii (Queen Charlotte Islands) in collaboration with Parks Canada;
- Central BC coast to extend multibeam coverage for navigation safety;
- NW Vancouver Island in collaboration with Environment Canada looking for Sand Lance habitat to help define protected area limits;
- Small craft Harbours in collaboration with DFO Real Property;
- Upgrading *Shoal Seeker* to allow ship based deployment;
- Later in the year installing and testing newly acquired Goeswath and EM2040 hardware;
- Full program of tide gauge servicing and upgrades;
- Deployment of temporary tide gauges to support surveys;
- Tsunami Warning Gauge servicing;
- Continuous Vertical Datum model refinement through data acquisition and model improvements;
- Investigating e-nav opportunities with Ports for real time, predicted and forecast water level and current data;
- Arctic tide gauge support; and
- Revisory, Sailing Directions & Aids to Navigation as required.

CENTRAL REGION

Data Acquisition Activities for 2013

(G. Schlagintweit, Manager Operations)

At time of writing this piece, planning and preparations are in full swing for another busy summer for CHS staff in Central and Arctic Region. Field activities have only been curtailed slightly in order to address some data backlog issues. The following hydrographic surveys are planned (or are in progress) for this year:

Alert, Nunavut: Andrew Leyzack is in charge of a small through-ice survey at the approaches to Alert. This work is presently underway. His challenge is to recover three current moorings that were placed on the seabed a year ago; a task performed by cutting a large hole in the 2m thick ice and deploying a small ROV for the recovery. Time permitting; Andrew will also collect spot soundings to expand on the work done in the area in 2012.

St. Clair, Detroit and St. Mary's Rivers, Ontario: Tim Janzen and his team will be responsible for the annual 'Waterways' surveys this summer. This work supports the Coast Guard's dredge maintenance program for these waterways.

Small Craft Harbours, Ontario (Great Lakes): Survey parties led by either Tim Janzen or Scott Youngblut will address some work requested by DFO Small Craft Harbours

Branch. Details are being worked out at time of writing. Revisory Surveys – Lake Huron and Lake Ontario: Scott Youngblut and his team will take some time this summer to conduct numerous hydrographic investigations in the Great Lakes including a small survey at South Baymouth (S.E. Manitoulin Island).

St. Lawrence River, Ontario: Upon completion of their Revisory work, Scott's team will be undertaking another hydrographic survey to expand on multibeam coverage in the St. Lawrence River. This work is critical for a time when water levels are at all-time lows and the Great Lakes carriers are attempting to maximize their cargo loads in an overly competitive shipping industry.

Sanikiluaq, Nunavut (S.E. Hudson's Bay): Scott Youngblut will be in charge of a two-launch survey in the fall that will expand on the corridor that Tim Janzen and his team started during the 2012 season. This work will be conducted from the Coast Guard icebreaker *Radisson*. The area has been identified as a top priority by the shipping companies that provide re-supply services to Arctic communities.

Tides Currents and Water Levels Activities: Terese Herron and her team are busier than ever preparing for another field season. TCWL activities for the upcoming field season will include the annual maintenance and calibration at each of the thirty-four water level gauges on the Great Lakes and St. Lawrence River. In the north, the tide gauge at Churchill will receive an annual maintenance and calibration check, underwater infrastructure is planned to be replaced for the tide gauge at Uluhaktok and Tuktoyaktuk and the building will also be replaced at Tuk. At the CFS Alert tide gauge, the submersible tide gauge will be swapped out and at Qikiqtarjuaq annual maintenance and calibration will be completed. Additional work in the north this year will include retrieval of submersible tide gauges at Gjoa Haven, Quaqtaq and Sanikiluaq, deployment of tide gauges at Frobisher Bay, Cumberland Sound, Foxe Basin, Kugluktuk and Bellot Strait.

In addition, plans are in place to support hydrographic surveys with temporary gauge installations at South Baymouth (Revisory Survey), the mouth of the St. Clair River (Waterways) and Cake Island (Eastern Arctic).

Frobisher Bay, Nunavut (S.E. Baffin Island): The manager is working closely with the University of New Brunswick's Ocean Mapping Group to coordinate data acquisition efforts with the Government of Nunavut vessel *MV Nuliajuk*. [See article by Brucker et al in this Edition. Ed.] An opportunity to conduct vertical control surveys in this area may also be realized in support of the Continuous Vertical Datum Project.

Production Activities for 2013
(L. Colombe, Manager Nautical Publications)

Production activities remain focussed primarily on Arctic charting. That being said, there is some work being done in the Great Lakes as well.

Work continues on updating the Electronic Navigation Charts (ENCs) for Coronation Gulf in order to support an update to the paper chart 7777. In addition, we will be updating the ENC and paper chart with the survey data from 2012 that extended the corridor in Sanikiluaq. We are also creating a new ENC of Iqaluit, Tasiujaq and Eureka. These were requested either by the Arctic communities or by the Canadian Coast Guard and we are incorporating new survey data. Last summer some survey work was done in Deception Bay as the wharf had been extended and we will be updating our products for this.

In the Great Lakes, we are completing some large scale ENCs that were requested by commercial shipping companies. We will have new ENCs in Serpent Harbour and Meldrum Bay. In addition, our goal is to finalize a number of our St. Lawrence paper charts. We've been working to ensure that all of our St. Lawrence paper charts are current and released from our new Hydrographic Production Database. This will allow for quick New Editions of paper charts to be released.

RÉGION DU QUÉBEC

Bonjour à toutes et tous,

Voici donc un bref aperçu des activités du Service hydrographique du Canada, région du Québec, tant celles de 2012-13, pour un petit bilan, que celles prévues en 2013-14. Le SHC-RQ termine sa transformation sous le nouveau modèle organisationnel suite aux réductions de l'examen stratégique de 2011. Les activités sont maintenant livrées par deux divisions, les opérations hydrographiques (levés et production cartographique) et la géomatique marine (incluant les marées, Instructions nautiques et les projets de développement).

En 2012-2013, des activités de levé ont été menées dans le chenal du Saint-Laurent (pour la Garde côtière canadienne), dans une vingtaine de havres (pour Ports pour petits bateaux) et, plus intensément, sur la basse Côte-Nord avec le soutien du navire Matthew (de la région des Maritimes) et d'un levé LiDAR. Les travaux sur la basse Côte-Nord vont servir à produire une nouvelle série de cartes pour ce secteur, qui en a bien besoin. Le nombre de cartes sera réduit, tout en gardant la même couverture géographique. Les échelles seront harmonisées, le trait de côte sera précisé, et des levés modernes permettront une mise-à-jour complète de ce secteur. Des consultations ont débutées auprès de la clientèle sur le nouveau schéma de cartes, et les commentaires initiaux sont encourageants.

Du côté de la production cartographique, une douzaine de nouvelles éditions ont été produites, en plus de 4 annexes graphiques, et on en prévoit un nombre similaire pour l'année courante. Les Tables des marées sont produites comme prévue, avec un changement de port de référence, Grondines étant remplacé par Deschaillons. La modélisation nous a permis de publier de nouvelles valeurs pour les corrections aux ports secondaires dans la table 3. Pour 2014, un nouveau modèle hydrodynamique sera utilisé dans la portion fluviale du fleuve Saint-Laurent, ce qui devrait encore améliorer les prédictions.

Finalement, nous continuerons à être présents pour la communauté maritime par notre présence au Salon des sports nautiques et aux différents comités consultatifs. Nous continuerons à promouvoir la sécurité de la navigation en appuyant la Garde côtière auxiliaire dans ses efforts de sensibilisation auprès des plaisanciers, de même qu'avec les Escadrilles canadiennes de plaisance. À tous, une excellente année de navigation!

THE CANADIAN HYDROGRAPHIC ASSOCIATION AWARD
LA BOURSE DE L'ASSOCIATION CANADIENNE D'HYDROGRAPHIE

(Established. 1992 / Établie en 1992)

Deserving Student $2,000 / 2000$ Pour un étudiant méritant

Application Criteria

1. The applicant must be a full time student in an accredited post secondary program in the field of Geomatics (the program must have a Hydrographic Survey or Ocean Science component) in a university or technological college anywhere in Canada. Other programs may be deemed eligible at the discretion of the Manager of this award.

2. The award will be available to undergraduate students in a degree or diploma program that conforms to the basic subject topic. The applicant will be required to submit a transcript of his/her most recent post secondary marks at the time of application. The marks must indicate an upper level standing in the class and under no condition less than 70%.

3. The award will be presented to an applicant who can demonstrate a bona fide financial need, coupled with an above average academic performance as stated above.

4. The applicant will be required to write a short paragraph explaining his/her financial need in a clear, concise manner on the application form or, if necessary, attached piece of paper. The importance of this aspect of the application is emphasized.

5. The award application will be submitted to the Canadian Hydrographic Association by June 30 each year and to the address in item 11 below.

6. The value of the award is $2,000. There is one award only each calendar year. Only the winner will be notified.

7. The successful applicant will be issued with a special Hydrographic Association Certificate, duly framed, at the time the award is made. He/she will also receive a medallion with the Hydrographic Association Crest and have his/her name mounted on a perpetual winner's plaque. A picture of the plaque, duly inscribed will be mailed to the winner along with the $2,000 cheque during the second week of July.

8. The applicant must submit one letter of reference from an official of the university or college where the applicant spent the previous year. This letter of reference must include the address and phone number of this official.

9. An individual student may receive the award once only.

10. The successful applicant's letter of appreciation will be published in the next issue of our professional journal "Lighthouse".

11. Application will be made on the form supplied or preferably down loaded from the official CHA web site at *www.hydrography.ca* and sent to:

Critères d'admissibilité:

1. Le candidat ou la candidate doit être inscrit à plein temps à un programme reconnu en sciences géomatiques (ce programme doit inclure l'hydrographie ou un contenu en sciences de la mer) par une université ou un collège situé au Canada. D'autres programmes peuvent être jugés éligibles à la discrétion de l'administrateur de cette bourse.

2. La bourse s'adresse aux étudiants et étudiantes inscrits dans un programme menant à un diplôme collégial ou de premier cycle universitaire conforme aux disciplines de base. Le candidat doit soumettre une copie de son dernier relevé de notes post-secondaire avec sa demande. Les notes doivent être au-dessus de la moyenne de sa classe et être obligatoirement supérieures à 70 %.

3. La bourse sera remise au candidat ou à la candidate qui, de bonne foi, peut démontrer ses besoins financiers et qui respecte les exigences académiques mentionnées ci-haut.

4. Le candidat ou à la candidate devra écrire un court texte clair et concis, démontrant ses besoins financiers sur le formulaire de la demande ou, si nécessaire, sur une lettre jointe. Une grande importance est accordée à cet aspect de la demande.

5. La demande doit être soumise à l'Association canadienne d'hydrographie au plus tard le 30 juin de chaque année à l'adresse mentionnée à l'article 11 ci-bas.

6. La valeur de la bourse est de 2000 $. Il n'y a qu'une seule bourse remise par année civile. Il n'y aura que le gagnant qui sera avisé.

7. Le récipiendaire recevra un certificat spécial de l'Association canadienne d'hydrographie, dûment encadré. Il ou elle recevra aussi un médaillon à l'effigie de l'Association canadienne d'hydrographie et verra son nom ajouté sur la plaque des gagnants. Une photo de la plaque, dûment gravée sera postée au gagnant avec un chèque de 2000 $ au cours de la deuxième semaine de juillet.

8. Le candidat ou la candidate doit soumettre une lettre de référence d'un représentant de l'université ou du collège où il a suivi son cours l'année précédente. Cette lettre de référence doit inclure l'adresse et le numéro de téléphone de ce représentant

9. Un étudiant ne peut recevoir la bourse qu'une seule fois.

10. Une lettre d'appréciation du récipiendaire sera publiée dans l'édition suivante de notre revue professionnelle « Lighthouse ».

11. La demande devra être faite en se servant du formulaire prescrit ou préférablement téléchargée à partir du site internet officiel de l'ACH « www.hydrography.ca » et envoyée à :

Manager / Administrateur
Canadian Hydrographic Association Award Program / Bourse de l'Association canadienne d'hydrographie
6420 Edenwood Drive, Mississauga, ON L5N 3H3
geomac66@sympatico.ca *www.hydrography.ca*

Rates / Tarifs

POSITIONING / EMPLACEMENTS

The acceptance and positioning of advertising material is under the sole jurisdiction of the publisher.

L'approbation et l'emplacement de l'annonce sont à la discrétion de l'éditeur.

DIGITAL REQUIREMENTS
EXIGENCES NUMÉRIQUES

Advertising material must be supplied by the closing dates as digital Tiff 600dpi files. Proofs should be furnished with all ads.

Single-page inserts will be charged at a full-page body rate. Material must be supplied by the client. Page size must conform to the single page insert trim size (below).

L'annonce publicitaire doit être fournie aux dates de tombée. Les épreuves devraient être fournies avec tous les suppléments.

Les insertions d'une page seront chargées au tarif d'une pleine page. Le matériel devra être fourni par le client.

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Internégatif tramé à 133 lignes au pouce.

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LIGHTHOUSE is published twice yearly, in Spring and Fall. The closing dates are March 15th and September 15th respectively.

LIGHTHOUSE est publiée deux fois par année, au printemps et à l'automne. Les dates de tombée sont le 15 mars et le 15 septembre respectivement.

RATES / TARIFS

All rates are quoted in Canadian Funds. Corporate Members receive a 10% discount.

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All advertising material should be directed to:
Tout le matériel publicitaire doit être acheminé à:

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Victoria, BC Canada V9B 5T5
Telephone/Téléphone: (250) 478-8688
E-mail: wabbit@shaw.ca

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LIGHTHOUSE publishes material covering all aspects of hydrography.

Authors submitting manuscripts should bear the following points in mind:

1. Submit a hardcopy complete with graphics including tables, figures, graphs and photos.
2. Submit digital files, one with text only and a separate file for each graphic (tables, figures, photos, graphs) in its original form or in .tif format (600 DPI). Photos may be submitted separately to be scanned. These may be submitted via E-mail or on CD ROM to the Editor.
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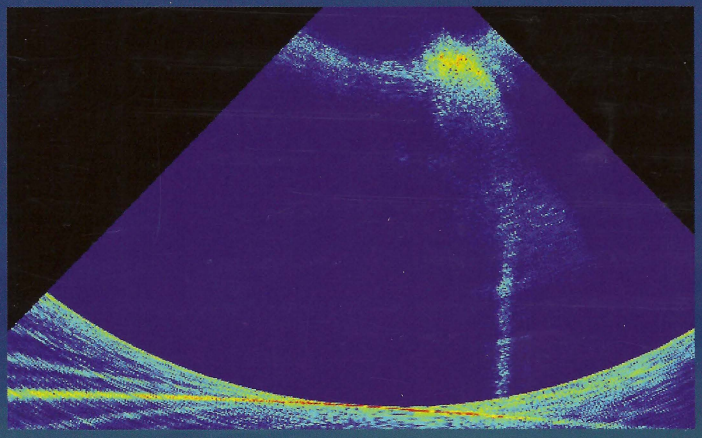

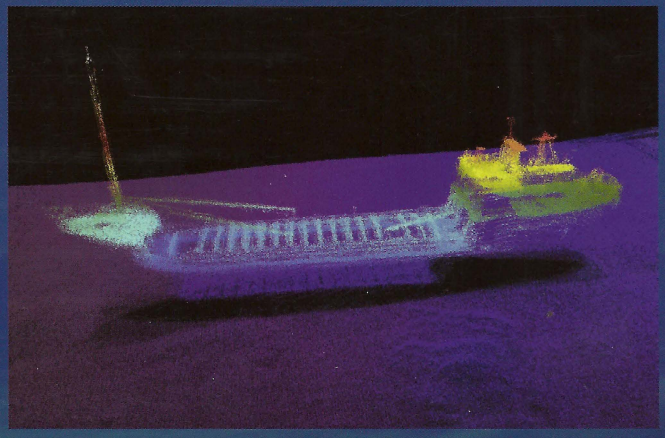

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