9th Meeting of the ARCTIC REGIONAL HYDROGRAPHIC COMMISSION

Murmansk, Russia

17-19 September 2019

National Report of CANADA

Executive Summary

This report to ARHC9 provides a summary of Canadian activities and points of interest since the previous ARHC meeting which was held in September 2018.

1. Hydrographic Office

1.1. In October 2018 the Minister of Fisheries, Oceans, and the Canadian Coast Guard (CCG) announced the creation of the DFO and Coast Guard Arctic Region. This new region is part of the Government of Canada's commitment to re-enforce a policy in the North that is driven by the peoples and stakeholders in that region. Consultations with Indigenous governments and organizations, Northern communities, provincial and territorial governments, academics, environmental non-government organizations, and the public on the boundaries and priorities of the Arctic Region have been ongoing.

1.2 Mr. Chris Marshall was appointed indeterminate Director of the CHS Central & Arctic Office in December 2018. The Central & Arctic office is responsible for the CHS Arctic programme. Chris had been acting in that position for the previous year. With this role, Chris has become the CA rep for the Arctic MSDI Working Group (ARMSDWG).

1.3 CHS is in year 3 of the 5-year Ocean Protection Plan (OPP) which is providing extra funding for Arctic surveying, ENC production, vertical datum enhancements, and the upgrading of the permanent water level gauge system in the region. OPP funding for the Arctic for 1 April 2019 to 31 March 2020 [CHS/GOC fiscal year] is approximately $5.8M CAD (of the $26.6M CAD over the entire five years). Organizationally, OPP is providing the means and opportunity for CHS to transform into an all-digital, data-centric hydrographic office capable of delivering timely and up-to-date modern hydrographic products and services.

1.4 OPP has had a positive impact on CHS recruitment. This growth, taking place at the same time as CHS transformation, is provoking a re-evaluation of new employees' qualifications and CHS's internal multi-disciplinary hydrographer training. The challenge is to balance the requirements for today's operations with future requirements under a transformed organization. In any case, CHS will maintain a close alignment with both current and developing IHO standards and best practices.

1.5 Some minor P-5 updates were provided to the IHO in August 2019, including an updated list of survey vessels. The IHO online form system was used for the updates (as it was for C-55 and for CL responses) and the experience using this system has been positive, so far.

2. Surveys

2.1 CHS has planned 7 Arctic surveys for 2019. Early indications are that ice conditions have been favourable and there has been no serious interruptions to surveying due to ice. Figure 1 indicates the planned surveying areas for 2019.

2.2 The breakdown on the operations is as follows:

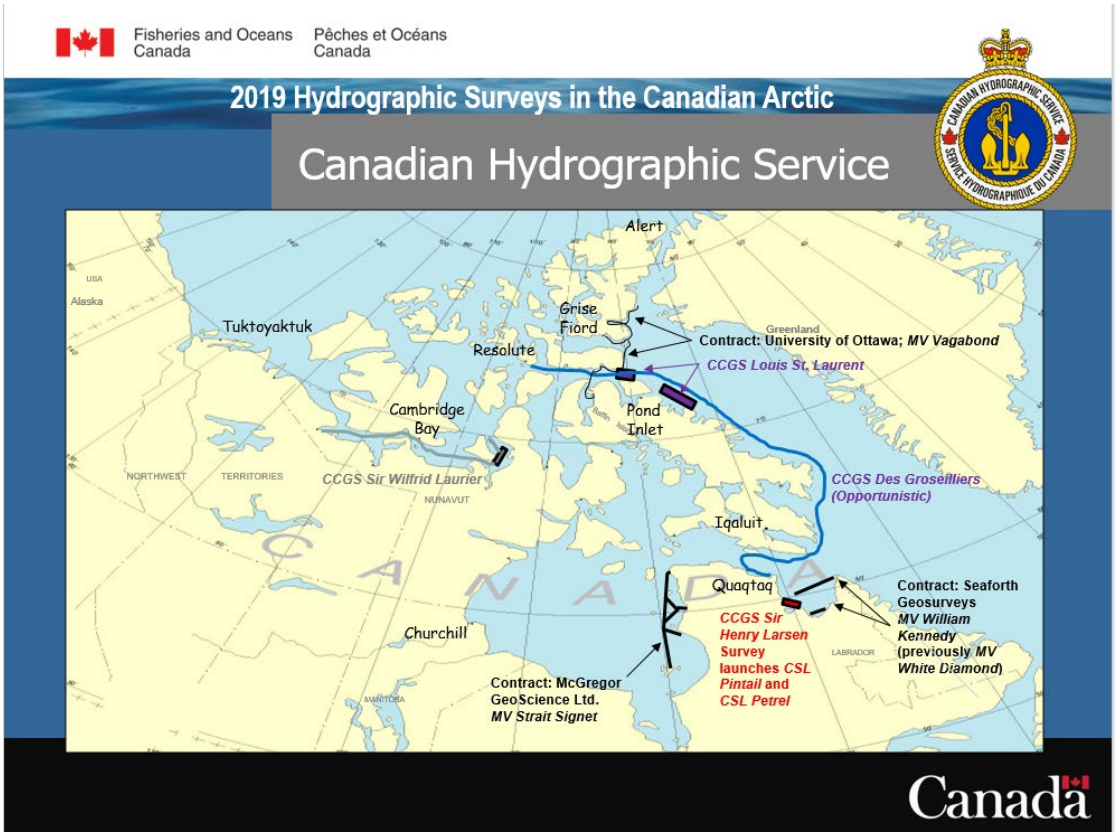
.1 Three areas are to be specifically surveyed by using MBES on CCG icebreakers (*CCGS Louis St Laurent* (2); *CCGS Sir Wilfred Laurier* (1)).

.2 One survey in Ungava Bay is to be run off the *CCGS Henry Larson* using two CHS launches, the *CSL Pintail* and the *CSL Petrel*.

.3 Three surveys are to be contracted out: eastern Hudson Bay by MacGregor GeoScience Ltd. using the *MV Strait Signet*; Ungava Bay by Seaforth Geosurveys off the *MV William Kennedy*; and, in western Baffin Bay by the University of Ottawa using the *MV Vagabond*.

.4 In addition, the CCGC Des Groseilliers will be deploying its MBES on an opportunistic basis during its northern activities.

Figure 1. Planned CHS Arctic survey in 2019.



2.3 A 2014 report by the Office of the Auditor General (OAG) of Canada recommended that CHS "should identify the areas of the Arctic region that need to be surveyed and charted, and prioritize them on the

basis of needs across the country". Client consultations remain an important part of the process for establishing priorities.

As part of this prioritization most recent surveying activities have focused on primary and secondary low impact shipping corridors.

.1 CATZOC A1 and A2 coverage in Canada's overall NORDREG area has increased from 6.38% in 2018 to 7.38% in 2019.

.2 Modern and adequate bathymetric coverage (CATZOC A1 and A2 plus CATZOC B) for the coverage of corridors has increased from 26.97% in 2018 to 30.63% in 2019.

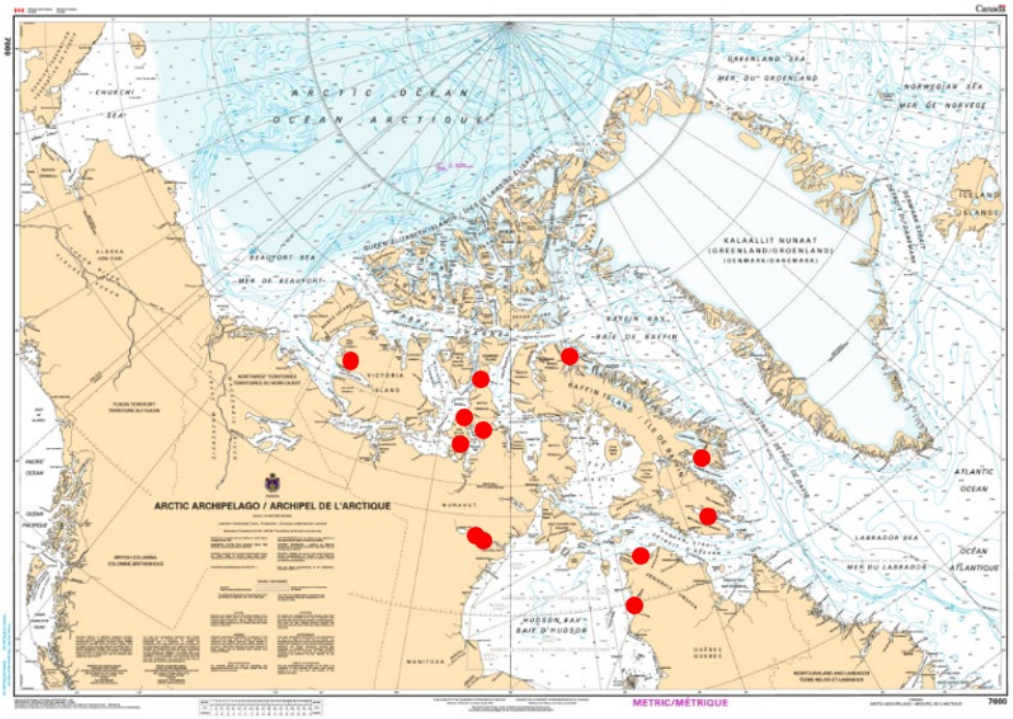
3. New charts and updates

3.1 In the 2018-2019 business year (1 April 2018 to 31 March 2019) CHS released 10 ENCs, 6 paper charts, and one patch. There were 24 notice to mariners (NOTMARs) published and 18 navigation warnings (NAVWARNs) issued related to reported depth or uncharted rocks dangers.

3.2 For the fiscal year 1 April 2019 to 31 March 2020 the planned releases are 11 ENCs and 10 paper charts (see Figure 2). RNCs will also be produced. ENCs are produced first, followed by the paper chart and then the RNC. The release of the ENC prior to the paper chart or RNC is a new approach for CHS ("ENC first") and represents CHS's commitment to getting the latest available information into the hands of mariners as soon as possible.

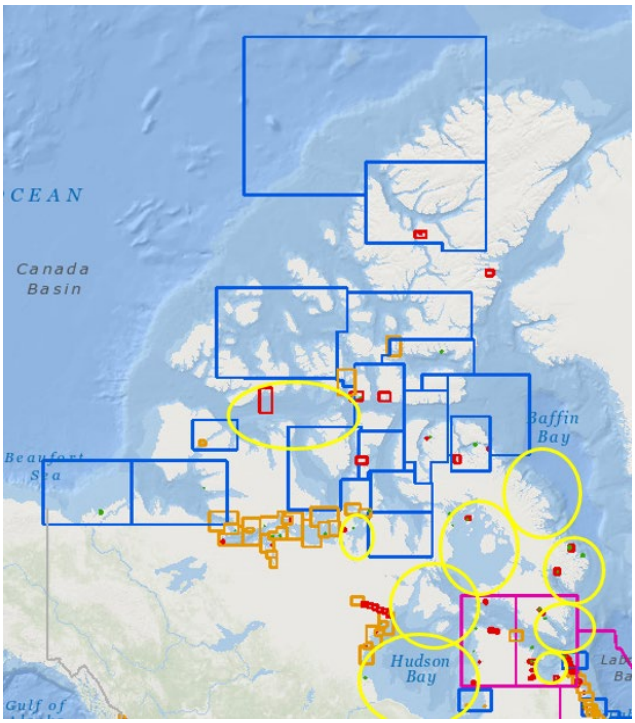
So far in 2019, there have been 14 NOTMARs and 2 NAVWARNS.

Figure 2. 1 April 2019- 31 March 2020 Areas of planned production.



3.3 While there have be significant improvements to ENC coverage, there are still some gaps. Figure 3 indicates the ENC gaps in primary and secondary corridors that will be continued to be addressed via the production plan. The goal is to have these gaps covered by 2025. The expansive area to be brought up to modern hydrographic coverage remains the largest challenge for CHS.

Figure 3. ENC Gaps in primary and secondary corridors (in yellow).



3.4 There are no plans to provide special products for recreational craft in the Arctic.

4.0 New publications, updates, and other developments

4.1 Paper Chart 2.0. CHS is moving forward with an implementation of a PC 2.0 solution which is the automatic generation of a paper chart from an ENC. This development is being done with ESRI and the goal is a paper chart output that is 100% automatic. CHS wants to focus on ENC production and leverage industry hydrographic/cartographic artificial intelligence to automate the creation of paper/POD products. CA and UK presented a paper on this subject at HSSC11 and it was received with great interest. CHS has also generated test paper charts from several other countries' ENCs for their analysis.

The use of IHO S-52 and/or IHO S-4 symbology and variations of these standards are allowed in order to enable the automation and eliminate the requirements for traditional manual editing. The product needs to fulfill IMO SOLAS 5 requirements and Canada's Charts and Nautical Publications Regulations, 1995.

As of September 1st 2019, for each new CHS ENC a PC 2.0 version will be generated and evaluated to see if it is fit-for-purpose. The Arctic is an excellent proving area as the ENCs in the region are generally not that complex. CHS is willing to share its experiences and to work with any other hydrographic office interested in developing this ENC-derived product.

4.2 Grid-based ENCs. Another initiative in the CHS transformation process is to move to a grid-based ENC scheme. The goal is to have this grid in place for the implementation of S-101 (if not before) and this scheme will be applicable to all CHS S-100 products depending on purpose. CA would welcome a discussion on how a grid could be applied in the Arctic.

4.3 Charting adequacy. CHS has developed measures for charting adequacy in the Arctic in response to the Auditor General of Canada report mentioned in Sec. 2.3. This GIS-based tool contains many different layers that are to be used for planning and progress tracking. The methodology used is similar to that used by the tool developed by the OTWG, though with more parameters and a greater focus on the shipping corridors. See also Sec. 6.3.

4.4 Bathymetric Data in the Cloud as a Service project.

.1 This is a CHS-Norwegian Hydrographic Service (NHS) project with TeledyneCARIS, PRIMAR, and the Electronic Chart Centre (ECC) which seeks to operationalize the delivery of S-100 data by way of a cloud-based service. Initially the project is focusing on S-102 data, but in later stages it hopes to expand the application to S-104 (water levels) and S-111 (surface currents) data. The first year of the project (1 April 2018 to 31 March 2019) successfully tested the proof of concept and the set-up of the component parts of the service. This project has been introduced at both the HSSC and IRCC level.

.2 The current phase includes sea trials with various partners and using portable pilot units (PPUs). There are 3 pilots on the St. Lawrence River testing the data (currently just flat files) on PPUs.

.3 Testing of the full chain (CHS bathy server – CARIS Cloud – Primar Service) is scheduled to start end of October with both Canadian and Norwegian pilots participating.

.4 It is hoped that early sea trial results can be available for the S-100 showcase planned for the 3rd meeting of the IHO Council (C3) and further outreach may be possible at A2.

.5 At the end of the project there will be at least four geographic areas in Canada with this service, which will all be in southern waters. There are no immediate plans for this type of service in the Arctic region. CHS is open to discussing regional solutions for certain types of data, e.g. surface currents (S-111).

5. Maritime Safety Information (MSI).

5.1 Information on marine communications and traffic services (MCTS) in Canada is available at:

http://www.ccg-gcc.gc.ca/Marine-Communications/Home

5.2 Canadian Coast Guard (CCG) has stood up a new Navigational Warnings (NAVWARNs) web site and subscription service to replace the domestic Notice to Shipping (NOTSHIP) services. For further information visit:

http://nis.ccg-gcc.gc.ca/

6. C-55 for INT Region - N; Country – Canada –Arctic Region

6.1 CHS submitted updates to C-55 in August 2019 based on analysis performed in April 2019.

6.2 Status of Surveys.

.1 Regional Boundaries (Canada-Atlantic, Canada-Pacific, Canada-Arctic and Canada-Inland Waters) have been divided based on the regional boundaries used for the production of ENC, RNC and INT charts.

.2 Canadian shoreline and depths were derived from GEBCO 2014 30 arc-second grid retrieved on January 22, 2019.

.3 Status of survey classifications were based on the C-55 CATZOC conversion table found in Annex A of the document *CBSC16-08.3B Proposal for Review of C-55: Status of Hydrographic Surveying and Nautical Charting Worldwide,* submitted by the United Kingdom and France (2016). It is available from: http://iho.int/mtg_docs/com_wg/CBC/CBSC16/CBSC16-08.3B-Review_of_C-55_UK_FR.pdf

.4 Due to the change in the status of survey classifications noted above from the previous year, differences in statistics were detected.

.5 "Adequate", "Resurvey" and "No Survey" areas were classified using CATZOC survey data extracted from Canadian Hydrographic Service database on April 11, 2019.

Status of surveys	Adequate (%)	Resurvey (%)	No survey (%)
0-200m	7.86	60.13	32.01
> 200m	36.61	13.88	49.51

6.2 Status of Nautical Charting.

.1 Regional Boundaries (Canada-Atlantic, Canada-Pacific, Canada-Arctic and Canada-Inland Waters) have been divided based on the regional boundaries used for the production of ENC, RNC and INT charts.

.2 Chart Coverages were divided based on the minimum scale of each chart.

.3 "Passage" comprised of charts from 1:150 001 and above, "Coastal" comprised of charts ranging from 1:50 001 – 1:150 000, "Port" comprised of charts 1:50,000 and below.

.4 RNC, ENC and INT chart coverages were extracted April 11, 2018.

.5 The high proportion of inadequately surveyed waters is predominately due to the large area of Arctic waters that are un-surveyed or covered by frontier surveys only.

.6 Ecotourism, climate change and resource development are increasing demand for surveys in Arctic and frontier areas.

.7 Satellite datums were assumed to be WGS 84 and NAD83 in the calculation of paper charts referenced to a satellite datum.

Chart coverage	Passage (%)	Coastal (%)	Port (%)
INT	100	10.46	0.86
RNC	29.46	2.91	0.34
ENC	36.34	3.84	0.51
Status of Paper Charts			
Paper charts with depths in meters (%)			68.91

Paper charts referenced to a satellite datum (%)	62.82

6.3 Comparing results. Due to the varying methodologies, definitions/terminologies, and selection of input data, there are obvious differences in the results given by the analyses for C-55, OTWG, and CHS (internal) regarding adequacy. On the positive side, with GIS being employed to do each of this spatial analyses, there are opportunities to continually improve the approaches. CA would like to see a convergence of these approaches toward single GIS-based method for indicating the status of surveying and nautical charting. Ideally, C-55 and INToGIS would fulfill this requirement.

7. Capacity Building

7.1 In 2019 CHS accepted the gracious offer from NOAA Office of Coast Survey (OCS) to have three CHS hydrographers participate in some legs of its Alaska cruises. The CHS hydrographers were thrilled to have this opportunity and all agreed this was an exceptional and valuable experience. CHS would like reciprocate in 2020 and plan to have OCS staff on selected Arctic operations.

7.2 As the lead for the development and implementation of marine spatial data infrastructure (MSDI) for the Department of Fisheries and Oceans, CHS continues to conduct education and outreach both within the Department and to other agencies. The rollout of the MSDI is a significant milestone that has been recognized across the Government of Canada (GoC) as improving and accelerating science data management, discovery, and access.

8. Oceanographic activities

8.1 The release of a Canada-wide, 100-metre resolution bathymetry surface for non-navigation (NONNA-100) which was announced in October 2018 has been very well received. The data was submitted to the IHO Data Centre for Digital Bathymetry (DCDB) and is available there. The next step for CA will be to release a 10m surface.

8.2 Four temporary submerged tide gauges will be retrieved from the Arctic in 2019. The data collected over the past year will be analyzed and used to enhance the vertical datum knowledge and complement the data from the five permanent stations in the region.

8.2 Canadian tide, current, and water level information can be found at:

http://www.tides.gc.ca/eng

9. Other activities and points of interest

9.1 On May 23, 2019, Canada filed its submission with the Commission on the Limits of the Continental Shelf regarding its continental shelf in the Arctic Ocean. Canada collaborated with its Arctic neighbours in the scientific work, which included joint surveys and scientific collaboration with the Kingdom of Denmark, Sweden and the United States. The claim covers 1.2 million square kilometres. The data collected for the submission has exponentially increased the scientific knowledge of the Arctic Ocean and opened a new chapter in the understanding of its history, geology and geomorphology.

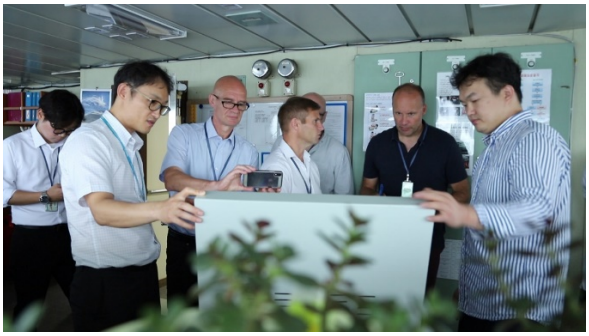
9.2 The HMCS *Harry DeWolf* was launched in September 2018. It is the first vessel launched under the Arctic and Offshore Patrol Ship (AOPS) project. This class of vessels are purpose built to support other

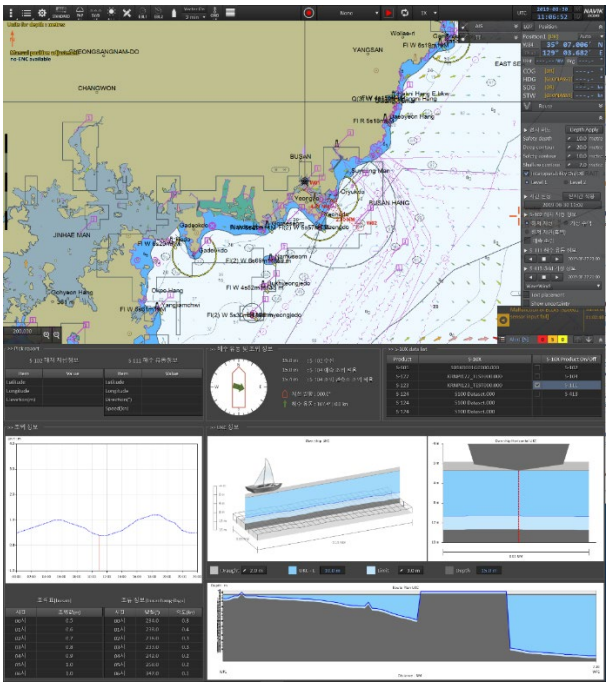
operations such as scientific research and potentially, hydrographic surveys. The first of its class, the *Harry DeWolf* is not currently fitted with a multi-beam echo sounder system (MBES), however, there are discussions on that possibility for other AOPS project vessels. Currently, the *Harry DeWolf* is in the process of completing outfitting, sea trials and other acceptance activities with the goal to deploy to the Canadian Arctic in July 2020.

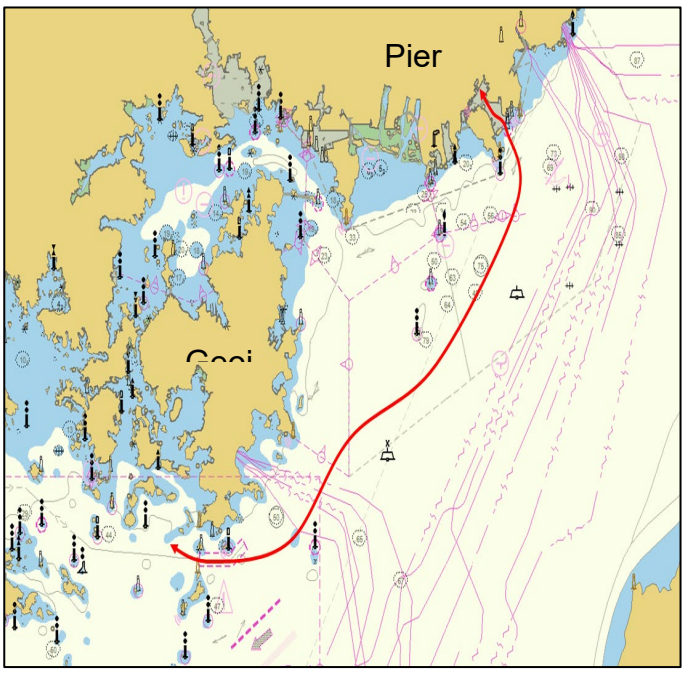
9.3 On 23 August 2019 a 47.7m (156.69ft) super yacht, the *Hanse Explorer* ran aground in Admiralty Inlet at 72 35.03N 085 39.89W. There were no reports of environmental damage or injuries and the vessel was re-floated safely. No other details of the incident are available at this time.
The ship, with a draft of 3.4m (14.11ft) was sailing in an area covered by a paper chart and ENC of a scale of 1:300 000, which carry the Caution "Much of the information shown on this files is of a reconnaissance nature and mariners should exercise caution when navigating these waters". Sounding measurements on the chart are spot soundings taken through the ice.
There are no navigation corridors in the area of the reported shoal and the AIS data in this area are all related to pleasure craft. Based on observed AIS data from 2017, another super yacht, the *Archimedes* (68m, 3.5m draught) passed very close to this location.
The nearest shipping corridor is approximately 50 km north with cargo ships and tankers with draught up to 9 metres going into and out of Arctic Bay.
This incident was similar to the grounding of the *Akademik Ioffe* which occurred in the Arctic on 24 August 2018 and highlights the risk to vessels venturing into poorly surveyed waters.
In June 2017, ARHC published a statement highlighting the need for caution when using nautical charts if Arctic waters. CA is interested in discussing further measures to re-enforce this message.

9.4 On the invitation of the Korea Hydrographic and Oceanographic Agency (KHOA), Michel Breton from the Canadian Hydrographic Service attended S-100 Sea Trials in Busan (Korea), August 27-29, 2019 along with Julia Powell (USA member and S-100WG Chair), Thomas Mellor (UKHO Member and ENCWG Chair), Jens Schröder-Fürstenberg (Germany member and NIPWG Chair), and Jonathan Pritchard (IIC Technologies, Inc.).
The sea trials successfully demonstrated the feasibility of S-100 at the bridge with effective portrayal of data. For CHS, the presence at sea trials in Busan was extremely beneficial in order to participate in the discussions around interoperability of data on bridge, navigational warnings, under-keel clearance, marine protected areas, and sea ice information in the context of navigation in Canadian waters.
CHS is grateful to the KHOA for organizing this important event.

Photographs from the S-100 Sea Trials







10. Conclusions

Canada continues to make advancements in improving the hydrographic knowledge and navigational products and services in the Arctic. It welcomes and looks forward to further collaboration with other ARHC members and associate members to continue this effort on a pan-Arctic scale.