INTERNATIONAL HYDROGRAPHIC ORGANIZATION

NATIONAL REPORT FROM UNITED STATES

ARHC-09

Submitted by:

National Oceanographic & Atmospheric Administration
http://www.nauticalcharts.noaa.gov

National Geospatial-Intelligence Agency
http://msi.nga.mil/NGAPortal/MSI.portal

United States Navy
http://www.navmetoccom.navy.mil

Contents[1]

[1] Based on "Structure for National Reports to Regional Hydrographic Commissions": http://iho.int/mtg_docs/rhc/templates/Struct_NationalReports_Eng.pdf

1. HYDROGRAPHIC OFFICE/SERVICE

This National Report provides specific information pertaining to individual products and services of primary interest to the Arctic Regional Hydrographic Commission (ARHC). Four government agencies are responsible for the management of U.S. domestic and international hydrographic products, services, and maintenance.

1.1 Government Agencies with hydrographic responsibilities in the Arctic Region

1.1.1 National Oceanic and Atmospheric Administration's (NOAA)[2] conducts hydrographic surveys and produces nautical charts and related hydrographic information within the nation's Economic Exclusion Zone (EEZ).

1.1.2 National Geospatial-Intelligence Agency (NGA)[3] provides nautical charts and related hydrographic information and is the mapping and charting authority for the U.S. Department of Defense (DOD) and commercial mariners in areas outside the U.S. where the U.S. is the designated charting authority.

1.1.3 The U.S. Navy[4] conducts oceanographic, bathymetric, and hydrographic surveys worldwide to satisfy DOD and national security requirements.

1.1.4 The United States Coast Guard (USCG)[5] provides multifaceted SOLAS support with the responsibility of care and maintenance of maritime aids to navigation used for nautical charting, publishing Local Notice to Marines for hazard avoidance, search and rescue, security, and ice operations in the Arctic. Coast Guard District 17 serves the US Arctic.[6]

For more information on NOAA, NGA, and Navy hydrographic activities, see:
IHO Publication 5

1.2 United States Strategies for the Arctic

The U.S. envisions an Arctic that is stable and free of conflict, where nations act responsibly in a spirit of trust and cooperation. We have implemented a strategic approach to the Arctic Region, outlined by a national strategy that focuses on three lines of effort: advance U.S. security interest, pursue responsible Arctic region stewardship, and strengthen international cooperation. The Implementation Plan for the National Strategy for the Arctic Region[7], the Department of Defense Arctic Strategy[8], the U.S. Coast Guard Arctic Strategy[9], the U.S. Navy Arctic Roadmap (2014-2030)[10], and the National Oceanic and Atmospheric Administration Arctic Action Plan[11] are the primary guidelines for the regional strategy. These documents acknowledge the importance of international partnerships in addressing common challenges.

1.3 United States Open Data Policy – Managing Information as an Asset

[2] Primarily the Office of Coast Survey
[3] Primarily Source Operations and Management Directorate, Foundation Group, Maritime Safety Office (MSO).
[4] Primarily, Commander, Naval Meteorology and Oceanography Command (COMNAVMETOCCOM) and the Hydrographer of the Navy
[5] Primarily, United States Coast Guard, District 17
[6] https://www.pacificarea.uscg.mil/Our-Organization/District-17/
[7] National Strategy for the Arctic Region. (2013). Retrieved from https://obamawhitehouse.archives.gov/sites/default/files/docs/nat_arctic_strategy.pdf
[8] Department of Defense Arctic Strategy. (2013). Retrieved from http://www.defense.gov/Portals/1/Documents/pubs/2013_Arctic_Strategy.pdf
[9] U.S. Coast Guard Arctic Strategy. (2013). Retrieved from https://www.uscg.mil/Portals/0/Strategy/cg_arctic_strategy.pdf
[10] U.S. Navy Arctic Roadmap (2014 – 2030). (2014) Retrieved from http://www.navy.mil/docs/USN_arctic_roadmap.pdf
[11] National Oceanic and Atmospheric Administration Arctic Action Plan. (2014). https://www.afsc.noaa.gov/Publications/misc_pdf/NOAAarcticactionplan2014.pdf

Access to data and services, usable to the public, can help fuel entrepreneurship, innovation, and scientific discovery – all of which improve lives and contribute significantly to job creation[12] – is the foundation of the U.S. Open data policy. The open data policy has led to the public availability of hydrographic data, products, and services produced by U.S. Hydrographic Offices (HO's), which may be downloaded at no cost.

2. SURVEYS

2.1 Surveys in U.S. Waters

NOAA provides nautical charts and related hydrographic information for the safe and efficient navigation of maritime commerce as well as providing basic data for engineering, scientific, and other commercial and industrial activities within the nation's 3.4 million square nautical mile EEZ (US EEZ) and along its 95,000 miles of shoreline.

NOAA is in the process of re-defining how hydrographic survey plans are generated to and survey priorities are identified in federal waters. NOAA hydrographic in-house field units or external contractors then conduct surveys to meet these priorities. Data acquired from these surveys must meet the NOS Hydrographic Surveys Specifications and Deliverables13, an annually updated data specification guide.

The main component of the new hydrographic survey priorities method is the hydrographic health model. The hydrographic health model is a model based on the idea of navigational risk. Navigational risk is the product of the likelihood of an adverse event and the consequence of that event occurring. The model incorporates likelihood parameters such as traffic density, known hazards to navigation, and reported ship groundings to estimate the likelihood of an adverse event. To estimate the consequence of an adverse event, the model incorporates parameters such as proximity to search and rescue stations, proximity to reefs or marine sanctuaries. The model also considers the necessary quality of data to support modern traffic relative to what is currently available, explicitly recognizing that the seafloor changes over time. Seafloor changeability takes into account the frequency of storms, current speed, and accumulation of marine debris, where the quality of data in highly changeable areas decreases faster than the quality of data in less changeable areas. Using historic knowledge of seafloor changeability, the model can also approximate the future quality of survey data and assess how often an area needs resurveying.

[12] Open Data Policy-Managing Information as an Asset. (2013). Retrieved from https://www.whitehouse.gov/sites/whitehouse.gov/files/omb/memoranda/2013/m-13-13.pdf

[13] Current version is 2018, https://nauticalcharts.noaa.gov/publications/docs/standards-and-requirements/specs/hssd-2018.pdf

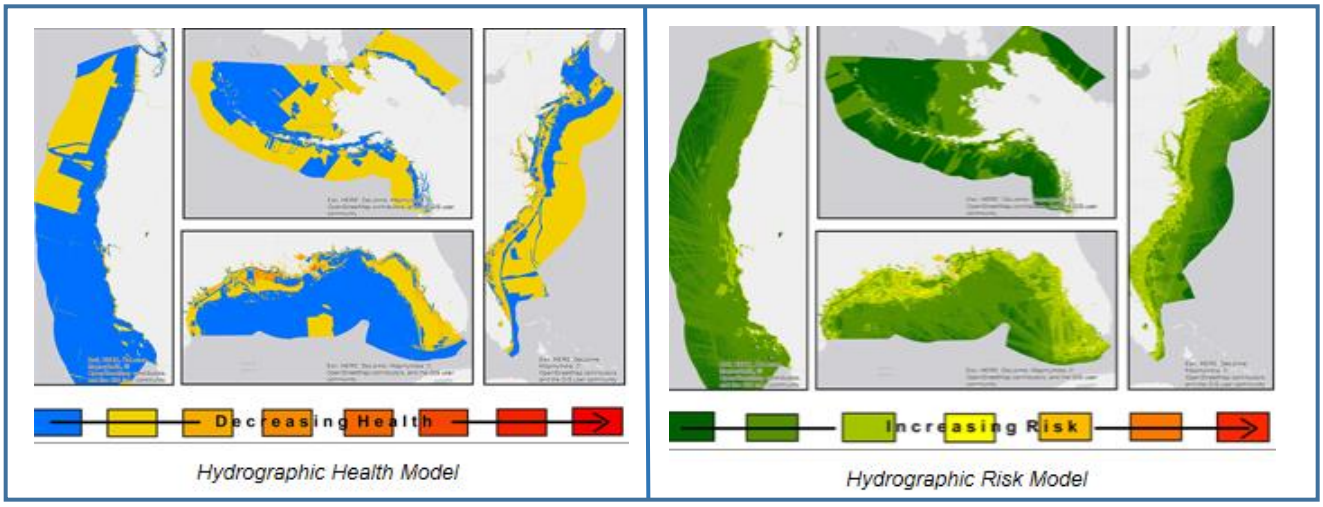

Figure 1: Hydrographic Health and Risk Conceptualization

The results of this model are available online in a geographic information system (GIS) interface and summarized in an annual report made available on the internet in FY18. Current information about the model and survey prioritization can be found at: https://nauticalcharts.noaa.gov/publications/national-hydrographic-survey-priorities.html

FY 19 Survey Plan Highlights for ARHC region

OPR-R341-KR-19, Kuskokwim Bay, AK & Vicinity (TerraSond Ltd.)

Planned project dates: June 01, 2019- February 28, 2020

Planned days at sea: 56

Area: 5,762 square nautical miles

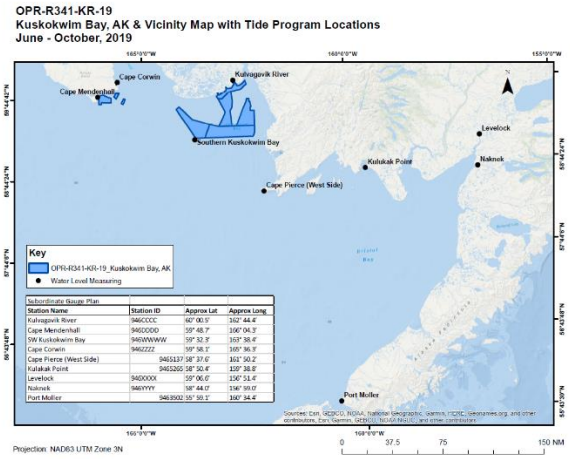

Figure 2: Kuskokwim Bay, AK and Vicinity (shown in the vicinity of 59.745N, 160.000W)

OPR-R320-FA-19, Vicinity of Cape Newenham, Alaska (NOAA)
Planned project dates: May 22, 2019 to August 8, 2019
Planned days at sea: 57
Area: approx. 315 square nautical miles

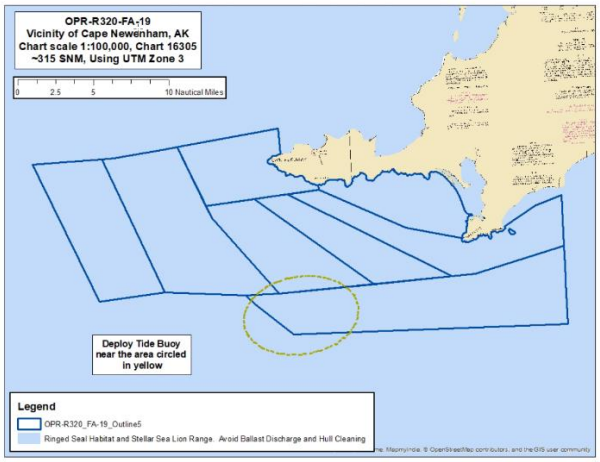

Figure 3: Vicinity of Cape Newenham (shown in the vicinity of 58.755184N,162.680935W)

2.2 Surveys outside U.S. Waters

The U.S. Navy conducts hydrographic surveys outside the United States in international waters as well as in the territorial waters of partner nations through diplomatic channels and international agreements to enhance maritime commerce and security while supporting relationship and capacity building initiatives.

By U.S. Navy, Commander, Naval Meteorology and Oceanography Command (COMNAVMETOCCOM) Instruction 5510.1, "Disclosure of Information to Foreign Governments and International Organizations", it is USN's policy to treat all data collected through bi-lateral agreements as restricted from public release. Accordingly, Hydrographic Service or Port Authority of the respective country is the appropriate point of contact for inquiries or requests for data regarding any of these surveys.

2.3 U.S. Hydrographic Survey Platforms

National Oceanic and Atmospheric Administration (NOAA)

NOAA survey platforms include six 28-foot survey boats, a research vessel, a LIDAR-capable aircraft, and private contractors and the following ships: NOAA ship *Fairweather*, NOAA Ship *Rainier*, NOAA Ship *Thomas Jefferson*, and NOAA Ship *Ferdinand R. Hassler*.

Additional information on NOAA's hydrographic vessels can be found online at: https://nauticalcharts.noaa.gov/about/survey-vessels.html

U.S. Navy

The Naval Oceanographic Office (NAVOCEANO), a subordinate command of COMNAVMETOCCOM, currently employs six Pathfinder Class 100-meter multi-purpose survey ships to conduct oceanographic, bathymetric, and hydrographic surveys in deep-ocean and coastal waters. Each ship carries two 10-meter hydrographic survey launches (HSLs).

NAVOCEANO also maintains the Airborne Coastal Survey (ACS) capability with the Optech, Inc., "Coastal Zone Mapping and Imaging" LIDAR (CZMIL) system. A Basler BT-67, a refurbished DC-3, serves as the

airborne system that carries the CZMIL system. NAVOCEANO's subordinate command, Fleet Survey Team (FST), employs various survey vehicles for survey including two 9 meter Workskiff with amidships transducer moon pools; four Teledyne Z-Boat 1800 Unmanned Surface Vessels (USV) equipped with multi-beam; two Iver3 580 Unmanned Underwater Vehicles fixed with Bathymetric Interferometric Side Scan Sonar; and rapid littoral survey vehicles (RLSVs) (personal water craft fitted with a single beam echo sounder and side scan sonar). C-130 aircraft provide rapid deployment transportation capability for all FST craft. FST also maintains a year round stand by "Fly-Away Team" consisting of four personnel and survey gear to outfit boats of opportunity. This capability enhances standard Navy survey requirements and provides capacity to maintain navigable approach corridors in support of humanitarian aid and disaster relief.

3 NEW CHARTS AND UPDATES

3.1 National Charting Plan (NCP)

On November 1, 2017, NOAA released the National Charting Plan[14], a strategy to improve NOAA nautical chart coverage, products, and distribution. It describes the evolving state of marine navigation and nautical chart production, and outlines actions that will provide the customer with a suite of products that are more useful, up-to-date, and safer for navigation. It is not a plan for the maintenance of individual charts, but a strategy to improve all charts.

The implementation of the National Charting Plan, which is focusing on improving the quality and coverage of NOAA's ENC products, will ultimately fulfil the chart requirements first identified in the U.S. Arctic Nautical Charting Plan, which it supersedes. New, larger scale, U.S. Arctic ENC coverage is being developed, but no new raster or paper nautical charts are planned in the Arctic or anywhere else in U.S. waters.

3.2 Rescheming NOAA ENC Coverage

NOAA has started to rescheme its suite of 1266 ENCs into a regular gridded set of rectangular cells. The current ENC scheme is based on the extents of the paper nautical charts from which ENCs were originally digitized. Rescheming will replace this puzzle-piece layout with a rectangular grid of ENCs, often providing larger scale, more detailed coverage than the existing paper charts. The final product suite is expected to exceed 9,000 ENCs. The current status of the creation of the new gridded ENC product layout is available online at:
https://noaa.maps.arcgis.com/apps/webappviewer/index.html?id=ab6ad790ac3f411f8ef96cb26d0c4868

[14] National Charting Plan (2017). https://www.nauticalcharts.noaa.gov/mcd/docs/NationalChartingPlan.pdf

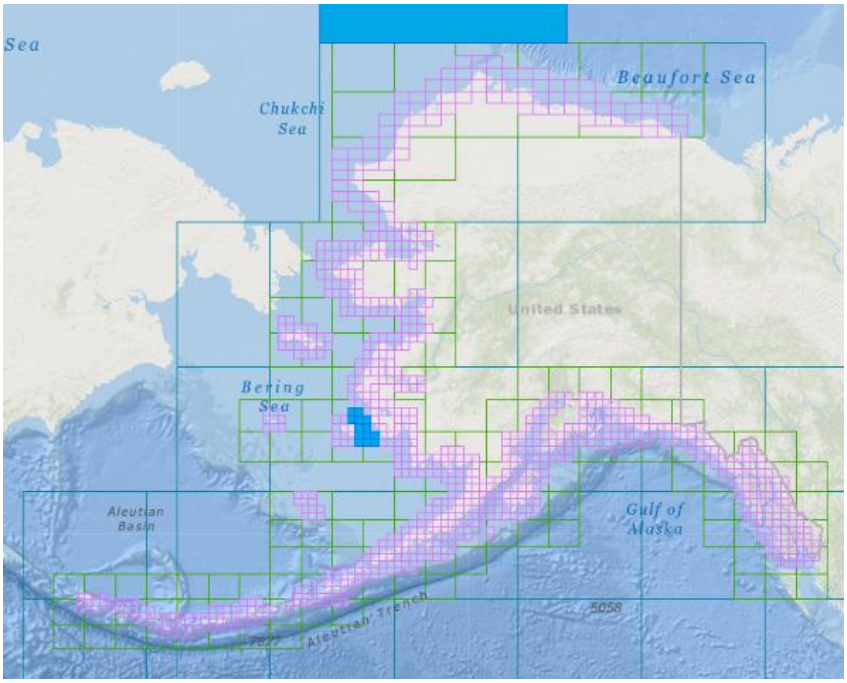

Figure 4: Planned New ENC Scheme for Usage Bands 1-4. ENCs already created are shown in blue.

3.3 Raster Navigational Charts (RNC) & Electronic Navigational Charts (ENC) Distribution

NOAA provides nautical products, services, and web deliveries of digital versions of most data, which are available free to the public.

For access to survey data: https://nauticalcharts.noaa.gov/data/hydrographic-survey-data.html
For access to RNC Charts: https://nauticalcharts.noaa.gov/charts/noaa-raster-charts.html
For access to ENC Charts: https://nauticalcharts.noaa.gov/charts/noaa-enc.html
For access to the Coast Pilot: https://nauticalcharts.noaa.gov/publications/coast-pilot/index.html

NOAA produces about 250 RNC and ENC charts over Alaskan waters. All charts are updated weekly with the latest Notice to Mariners and new dangers to navigation information. Raster charts are available for download from the NOAA website for free. Paper copies of Print-on-Demand (POD) products may be purchased from one of nearly three dozen NOAA certified chart printing agents.

U.S. ENCs are available as free downloads from the internet. Mariners who wish to download NOAA ENCs directly and use the data to fuel ECDIS or ECS may do so. ENCs, including newly created NGA ENCs, are distributed directly from NOAA on the web at www.nauticalcharts.noaa.gov. They are also available through the International Center for ENC's Distributors, http://www.ic-enc.org/Distribution.html.

3.4 Digital Nautical Chart (DNC)

The U.S. produces many DNCs in the ARHC waters. The DNC, produced by the National Geospatial-Intelligence Agency (NGA), is an unclassified, vector-based, digital database containing maritime significant features essential for safe marine navigation.

The DNC uses the Vector Product Format, which is a NATO standard for digital military map and chart data. Additional details can be located at http://msi.nga.mil/NGAPortal/DNC.portal.

DNC consists of libraries in a variety of scales for complete worldwide coverage. Arctic data is included in DNC regions 19, 20, 21, 22, 27, and 28. See coverage below.

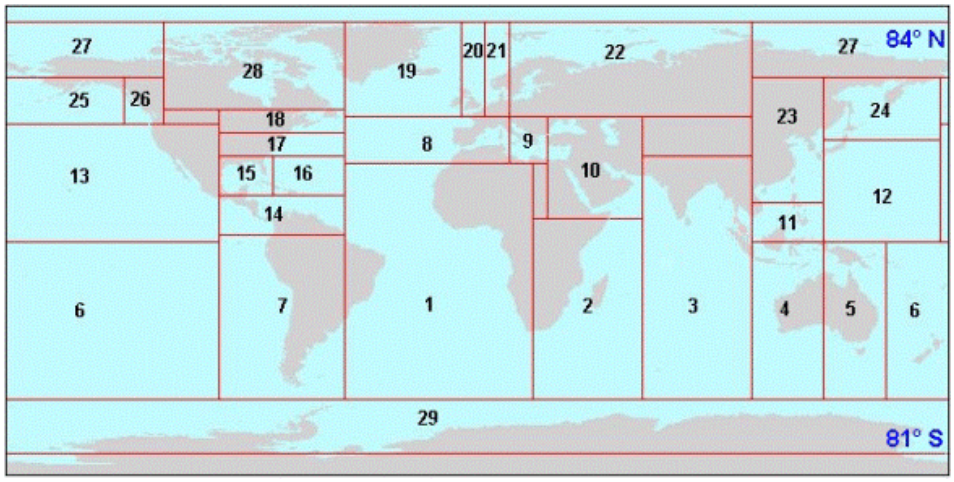

Figure 5: DNC Worldwide Coverage

DNC libraries are maintained with new source information from the U.S. and primary charting authorities (host nations). DNC libraries are considered Limited Distribution products and are not available for public sale or download except for those that are within U.S. territorial waters or in areas where source data restrictions allow them to be released. However, DNC data is shared with host nations for coverage in their territorial waters through formal bilateral exchange agreements.
For requests regarding DNC data, please contact maritime.international@nga.mil

3.5 Raster Navigational Charts (RNC)

The NOAA RNC® are geo-referenced, digital images of NOAA navigational charts. Because the images are geo-referenced, the end user can display a vessel's position on the chart image if a computer-based navigation system is connected to a global positioning system (GPS). RNCs, developed under the IHO S-61 product specification, are unique to NOAA. NGA does not produce RNCs.

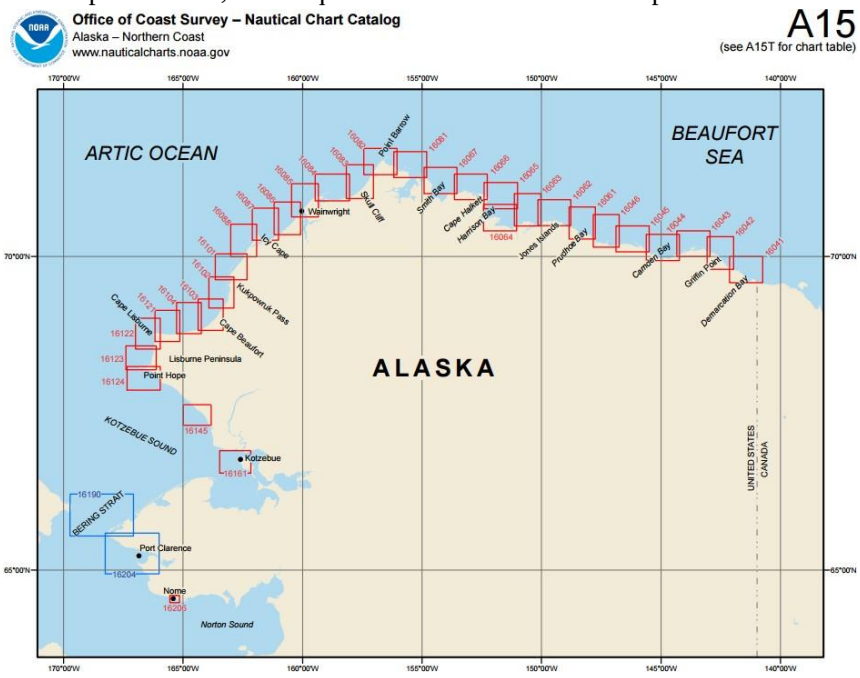

Figure 6: Alaskan RNC Catalog

Shown above is a graphic of the Alaskan RNC catalog, a printer friendly version of the Alaska RNC

catalog is at: http://charts.noaa.gov/ChartCatalog/webimages/pdf/AlaskaCatalog.pdf
U.S. RNCs are downloadable from a list at http://www.charts.noaa.gov/RNCs/RNCs.shtml or through the Coast Survey's Nautical Products Catalog at:
http://www.charts.noaa.gov/InteractiveCatalog/nrnc.shtml

3.6 International (INT) Charts

The U.S. does not produce INT charts but does offer "INT Chart Equivalents." Contributions to the S-11 Region N (Edition 2.0.0 September 2013) coordinated with and provided to Norway as the ARHC INT Chart Coordinator. NGA does not share INT chart responsibility within the ARHC region. However, NGA does build its chart schemes and DNC library limits from these INT schemes, if practical.

4 NEW PUBLICATIONS AND UPDATES

4.1 New Publications

None for comment.

4.2 Updated Publications

The American Practical Navigator, first published in 1802 describes in detail the principles and factors of navigation, including piloting, electronic navigation, celestial navigation, mathematics, safety, oceanography and meteorology. It also contains various tables used in typical navigational calculations and solutions, including the formulas used to derive the tabular data. The 2019 edition of the American Practical Navigator is published in two volumes, which can be downloaded as complete PDF documents from the following website:
https://msi.nga.mil/NGAPortal/MSI.portal?_nfpb=true&_pageLabel=msi_portal_page_62&pubCode=0002

The following publications are continuously updated in accordance with SOLAS:

- The **United States Coast Pilot** consists of a series of nine regionally- focused nautical books that over a variety of useful information important to navigators for coastal and intra-coastal waters and the U.S. Great Lakes. For the ARHC region, Coast Pilot 9 covers Alaska (35th ed., 2017). U.S. Coast Pilot now offers completely updated publications every week. U.S. Coast Pilots can be downloaded at: https://nauticalcharts.noaa.gov/publications/coast-pilot/index.html
- Produced and maintained by NGA, **Sailing Directions** consists of useful information important to navigators of coastal waters. Information for the ARHC region is contained in Publications 145 – Nova Scotia and the St. Lawrence, 146 – Newfoundland, Labrador, and Hudson Bay, 181 – Greenland and Iceland, 182 – North and West Coasts of Norway, and 183 – North Coast of Russia. Digital updates can be downloaded from NGA at http://msi.nga.mil/NGAPortal/MSI.portal .
- ***World Port Index*** **(Pub150)** is a publication maintained by NGA. It contains the location and physical characteristics as well as the facilities and services offered by major ports and terminals worldwide. Digital updates are available to the public and posted at the NGA Maritime Safety website, at http://msi.nga.mil/NGAPortal/MSI.portal.
- The **NGA *List of Lights, Radio Aids and Fog Signals*** and their digital updates are available to the public and posted at the NGA Maritime Safety website, at http://msi.nga.mil/NGAPortal/MSI.portal.
- Publications 110 – Greenland, the East Coasts of North and South America, 111 – The West Coasts of North and South America, and 115– Norway, Iceland, and Arctic Ocean cover the ARHC region.

5 MARITIME SAFETY INFORMATION (MSI)

5.1 Existing infrastructure for transmission

Maritime Safety Information (MSI) is navigational and meteorological warnings, meteorological forecasts and other urgent safety-related messages broadcast to ships in accordance with the International Convention for the Safety of Life at Sea, 1974, as amended. One component of MSI is the U.S. Notice to Mariners, which provides timely information for the correction of all U.S. Government navigation charts and publications from a wide variety of sources, both foreign and domestic. Information published in Notice to Mariners provides for the correction of unclassified nautical charts, the unclassified NGA/DLIS Catalog of Hydrographic Products, United States Coast Pilots, NGA List of Lights, U.S. Coast Guard (USCG) Light Lists, and other related nautical publications produced by NGA, National Ocean Service (NOS), and the USCG.

5.2 Notice to Mariners

The U.S. Coast Guard issues Local Notices to Mariners for NOAA charts, while NGA issues Notices to Mariners for NGA charts in the ARHC region.

Local Notice to Mariners are updated weekly and available for download in several formats. U.S. Coast Guard District 17 is responsible for publishing Notice to Mariners in the Arctic Region and notices are available at: https://www.navcen.uscg.gov/?pageName=lnmDistrict&region=17 .

Additional information about U.S. Coast Guard District 17 can be found at: https://www.pacificarea.uscg.mil/Our-Organization/District-17/.

The U.S. Notice to Mariners are posted at the NGA Maritime Safety website at: http://msi.nga.mil/NGAPortal/MSI.portal

5.3 Navigation Warnings

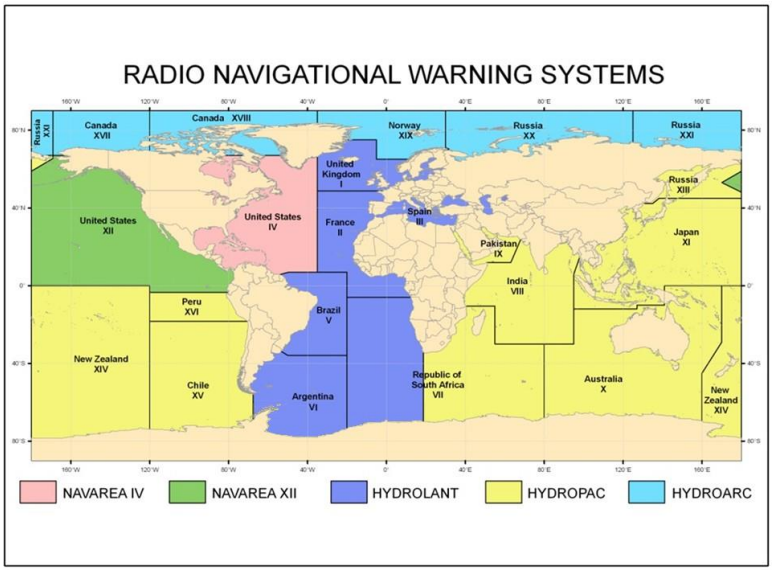

Figure 7: Radio Navigational Warning Systems

As the NAVAREA IV and XII Coordinator, NGA issues the navigational warnings for these areas and are broadcast and uploaded to http://msi.nga.mil/NGAPortal/MSI.portal. NGA requests the assistance of all member states within these two NAVAREA regions to relay pertinent maritime safety information for promulgation to navsafety@nga.mil.

The International Maritime Organization has designated NAVTEX as the primary means for transmitting coastal urgent marine safety for instantly distributing maritime navigational warnings,

weather forecasts and warnings, search and rescue notices and similar information to ships worldwide. Eleven NAVTEX stations are operational in NAVAREA IV and XII and is broadcasted from Coast Guard facilities in Cape Cod, Chesapeake VA, Savannah GA, Miami FL, New Orleans LA, San Juan PR, Cambria CA, Pt. Reyes CA, Astoria OR, Kodiak AK, Honolulu HI, and Guam. The broadcast coverage area for NAVTEX stations vary between 200 and 500 nautical miles from shore.
The NAVAREA coordinator is the authority charged with coordinating, collating and issuing navigational warnings for a designated NAVAREA within the IMO/IHO World-Wide Navigational Warning Service (WWNWS) (see figure below).

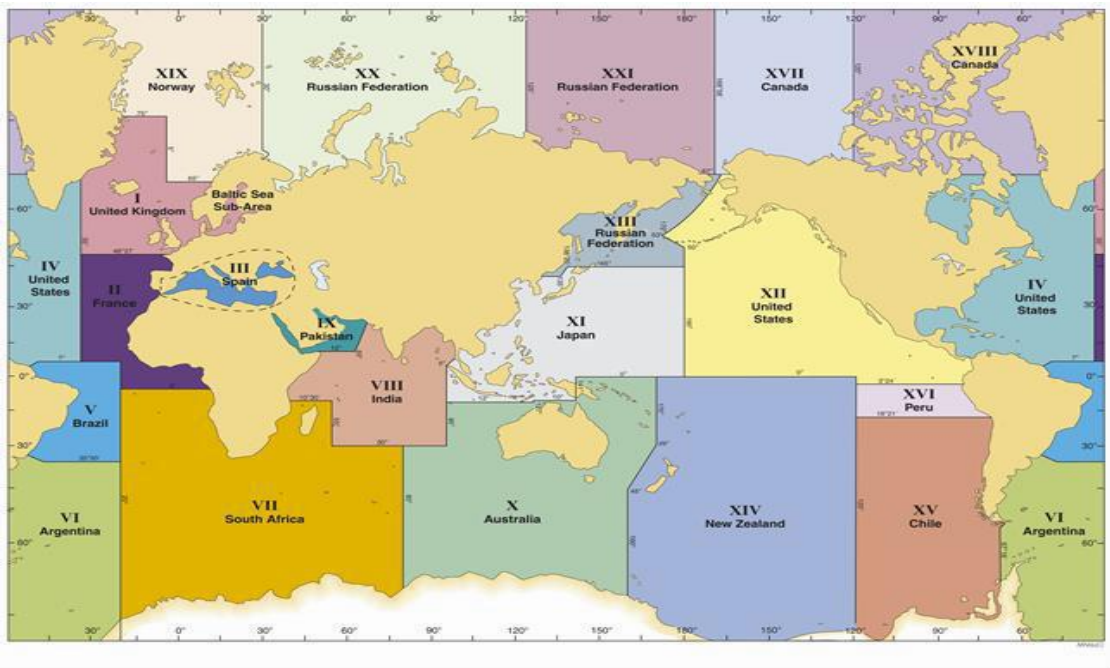

Figure 8: NAVAREAS for coordinating and promulgating navigational warnings under the World-Wide Navigational Warning Service

6. C-55[15]

The aim of IHO Publication C-55 is to present a clear picture of the worldwide coverage of surveys and nautical charts and of the extent of effective organizations for the timely promulgation of navigational safety information. The following tables outline the survey and nautical chart coverage in the U.S.

6.1 Hydrographic Coverage Available:

Area: U.S INT Region N – Alaska and Arctic (including Aleutian Islands) (N)[16]

	A	B	C
Depths < 200m	18%	28%	54%
Depths > 200m	0%	0%	100%

Table 1: Hydrographic Coverage, Area U.S. INT Region N

6.2 Nautical Chart Coverage Available:

U.S. INT Region N – Alaska and Arctic (including Aleutian Islands) (N)[17]

	A*	B*	C*
Offshore Passage	100%	100%	100%
Landfall and Coastal Passage	100%	100%	97%
Approaches and Ports	100%	100%	100%

Table 2: Nautical Chart Coverage, U.S. INT Region

[15] Source: March 2018 IHO U.S. C-55. https://www.iho.int/iho_pubs/CB/C-55/c55.pdf

[16] Ibid. page 491. Area is defined by the total hydrographic survey coverage available where A = adequately surveyed, B = Re-survey required, and C = never systematically surveyed.

[17] Ibid. page 492.

7. CAPACITY BUILDING

7.1 Offer of and/or Demand for Capacity Building

The United States is an active participant in the IHO Capacity Building Sub-Committee (CBSC). The U.S. (NGA) directly supports the IHO Maritime Safety Information (MSI) training course as well as provides support to nations through on site and remote guidance and advice as they grow their hydrographic capacity.

7.2 Training offered

Training opportunities are available at various institutions in the U.S.. Two Category A certified hydrographic programs are available through:

The University of Southern Mississippi (USM)[18]
The University of New Hampshire (UNH)[19]

- NGA
  Category-B Competence Training for Nautical Cartography. The National Geospatial-Intelligence Agency (NGA) commenced training with an IHO/ICA/FIG IBSC approved portable S-8 Category B Nautical Cartography class in 2017. NGA teamed up with IIC Technologies to provide training to analysts with a comprehensive 20-week instructor led course and a six-week final project. Each session will run for one to three weeks at a time over the course of two years. The pilot session started in June 2017 in Springfield, VA and consists of 10 students. The second session started in St. Louis, MO in January 2018, also with 10 students. A combination of lectures, hands-on compilation techniques, and homework assignments will prepare the students for the final project, the creation of a finished ENC product for NGA users. NGA plans on adding several additional sessions throughout the next several years.
- NOAA
  Category-B Competence Training for Nautical Cartography – In March, 2017 the FIG/IHO/ICA International Board on Standards of Competence (IBSC) for Hydrographic Surveyors and Nautical Cartographers approved the NOAA program for Category B in Nautical Cartography. The year-long program has graduated 24 students in its first two classes, including its first foreign national student last year. The third class of a dozen students started in late August.
  Capt. Andrew Armstrong, NOAA (ret.), NOAA co-director of the Joint Hydrographic Center at the University of New Hampshire, is a member of the IBSC and he available to advise institutions on establishing hydrographic training curricula and preparing submissions to the International Board for Category A or Category B recognition. (andy.armstrong@noaa.gov).
  Chart Adequacy Workshop:
  NOAA held its fifth annual Chart Adequacy Workshop July 25, 2019. The workshop trains professional cartographers from international offices on techniques for assessing nautical chart adequacy using publicly available information such as satellite images and maritime automatic identification system (AIS) data. This is an important technique for hydrographic offices around the world, particularly for developing countries, who may be resource constrained.
  As in the previous years, the workshop covered an overview of Coast Survey's datasets, processes, requirements for nautical charts, and preprocessing hydrographic data. The 2019

[18] https://www.usm.edu/marine/hydrographic-science
[19] https://marine.unh.edu/program/center-coastal-and-ocean-mappingjoint-hydrographic-center

participants hailed from over a dozen countries including Angola, Denmark, France, Japan, Kenya, Malaysia, Mauritius, Mexico, Nigeria, St. Vincent and the Grenadines, Thailand, South Korea, and the United Kingdom. The international nature of the workshop allows the participants to meet and learn from cartographers from a variety of backgrounds and expertise. The individuals were nominated by their home hydrographic offices and their travel was sponsored by the General Bathymetric Chart of the Oceans (GEBCO). For more information, please contact Dr. Shachak Peeri (shachak.peeri@noaa.gov).

- U.S. Navy
  COMNAVMETOCCOM and USM are partners in their Category A program and NOAA has a similar arrangement with UNH for their Category A program. COMNAVMETOCCOM also offers a six-month Category B International Hydrographic Management and Engineering Program and mobile training via the Information Warfare Training Group in Gulfport, Mississippi . COMNAVMETOCCOM's Category A and B programs and mobile training also qualify for Security Cooperation assistance.

8. OCEANOGRAPHIC ACTIVITIES

8.1 General Bathymetric Chart of the Oceans and Seabed 2030

The United States participates on the IOC-IHO Guiding Committee for GEBCO, and hosts the IHO Data Centre for Digital Bathymetry at NOAA's National Centers for Environmental Information (NCEI) (formerly the National Geophysical Data Center, NGDC).

NOAA distributes the International Bathymetric Chart of the Arctic Ocean (IBCAO) digital grid at http://www.ibcao.org/. The goal of this initiative is to develop a digital database that contains all available bathymetric data north of 64° north, for use by mapmakers, researchers, institutions, and others whose work requires a detailed and accurate knowledge of the depth and the shape of the Arctic seabed. Initiated in 1997, this undertaking has so far engaged the volunteer efforts of investigators who are affiliated with 24 institutions in 10 countries. ARHC members (Canada, Denmark, Norway, Russia, and the U.S.A) contribute to this initiative, as does the ARHC observer member state Iceland.

At the 33rd meeting of the GEBCO Guiding Committee, the Seabed 2030 Project was approved. Seabed 2030 sets the goal of collecting, using and sharing, data of the world's oceans. The project seeks to encourage the data collectors and data managers of governmental, academic and private interests to work together to improve the quality of publicly available grids of the ocean floor.

This project is focused on the goal of compiling a high-resolution, openly available, Digital Bathymetric Model (DBM). This DBM should efficiently provide bathymetric information to end users and leave no features of the World Ocean floor smaller than 100 m unmapped by the completion of the program. The Seabed 2030 project has great potential to create partnerships and cooperation between interested parties, significantly improving our understanding of the sea floor and empower sustainable ocean management in the coming century.

Crowdsourced Bathymetry

Crowdsourced bathymetric data can be used to identify areas where nautical charts are inadequate and proper hydrographic surveys are needed or can be applied to nautical charts when the source and uncertainties of the data are well understood. The key to successful CSB efforts are volunteer observers who operate vessels-of-opportunity in places where charts are poor or where the seafloor is changeable and hydrographic assets are not easily available.

The NOAA provides financial support for the IHO-initiated project to develop a global database for crowdsourced bathymetry hosted by the IHO Data Centre for Digital Bathymetry (IHO DCDB). The IHO DCDB, co-located with NOAA's National Centers for Environmental Information (NCEI), is

building the infrastructure necessary to provide archiving, discovery, display and retrieval of global crowdsourced bathymetry data from mariners around the world. The online database can be found at https://maps.ngdc.noaa.gov/viewers/iho_dcdb/.

NOAA is also coordinating with the Association of Arctic Expedition Cruise Operators (AECO) to ingest Arctic data to test the new system. The vision is to tap into the enthusiasm for mapping the ocean floor by enabling trusted mariners to easily contribute data to fill the gaps in our current bathymetric coverage. NOAA and NGA are active participants in the IHO Crowd-Sourced Bathymetry Working Group (CSBWG), and together, with other CSBWG members, they are compiling a CSB Guidance Document for layman mariners who wish to contribute data to the IHO DCDB. This document will provide volunteer collectors with information about CSB, the installation and use of CSB data loggers, data quality issues, and instructions for submitting the data to the IHO data repository.

9. OTHER ACTIVITIES

9.1 Native Outreach: Alaska Region

NOAA's Office of Coast Survey has been in years past and continues to build relationships with local communities and subsistence hunting groups to ensure that traditional knowledge is harnessed and conflict avoidance is ensured. NOAA recognizes that native Alaskans contribute a wealth of hunting, fishing and gathering knowledge to the region as well as key information about navigable waters in local areas. Below is a map that outlines some of the native entities in Alaska.

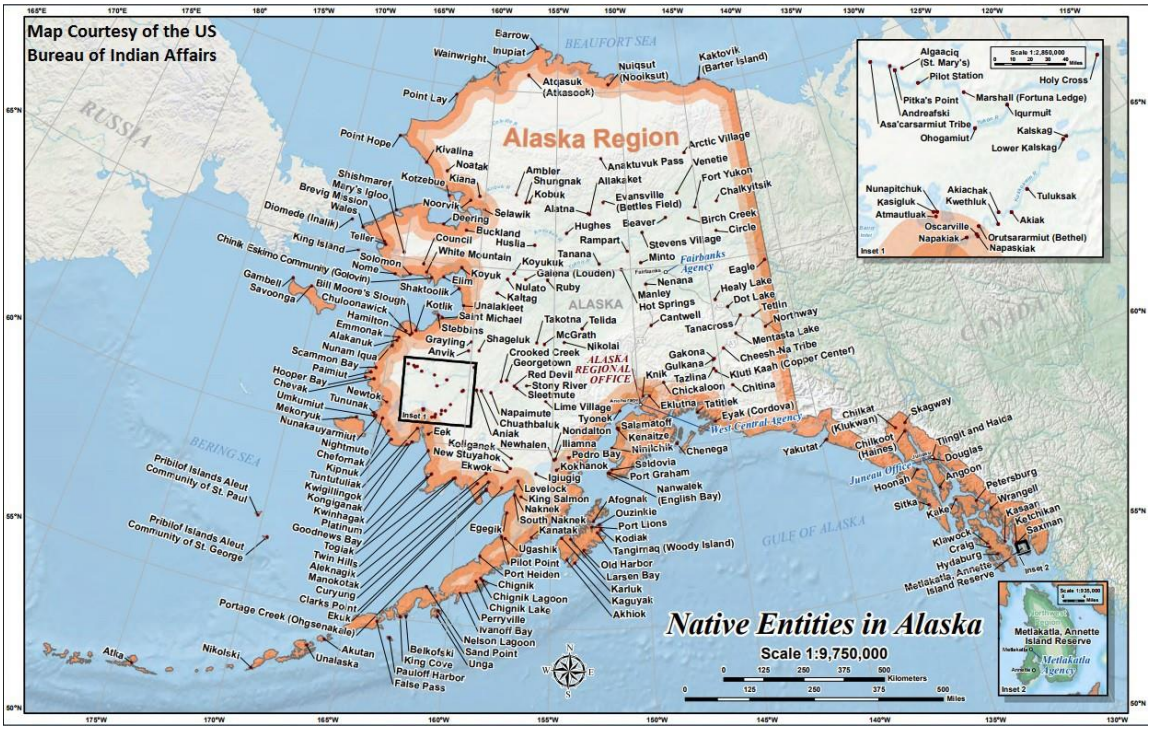

Figure 9: Native Entities in Alaska

In 2010, NOAA Ship *Fairweather* conducted a bathymetric survey on the eastern side of the International Dateline. This survey was preceded by extensive outreach to the village located on Little Diomede Island. The outreach included contacting the village elders, the native corporation, the village government, and the borough government. Prior to beginning any work in the area, representatives from the ship went to the village and provided a brief of the anticipated activities. During the operations, ship personnel continually updated the village representatives of anticipated

schedules. One evening the village hosted the shipboard personnel to visit the island of Little Diomede and had a celebration with traditional song and dance. Prior to departure from the area, the ship reciprocated and hosted 12 representatives from the village for lunch and a tour of the vessel. This model carried on through subsequent years of high arctic operations for bathymetric surveying activities.

In following years, additional outreach and communications were sought. During the winter, the Alaska Eskimo Whaling Commission meets regularly to discuss best practices and policies associated with subsistence hunting of the Bowhead Whales that migrate through the Chukchi and Beaufort Seas in Spring and Fall. NOAA has been reaching out to this community to ensure a transparent plan of operations and planning so de-confliction of the waterways is made possible for all users.

In 2015, the Arctic Waterways Safety Committee (formerly the Alaska Marine Mammal Coalition) was formed to bring all maritime operators, subsistence hunters, and oil and gas companies to a discussion about operations and hunting activities. The purpose of this meeting is to identify voluntary programs that all users can agree on to de-conflict the arctic waterways of the Chukchi and Beaufort Seas. This group has come up with a draft Standard of Care[20] for Research Vessels. This document is a notification plan for the vessel operators to maintain a transparent plan for conducting operations in the US high arctic. The Standard of Care calls for a brief to occur at the Alaska Eskimo Whaling commission advising the planned operations one year prior to commencing. Additionally, this plan would be communicated at that Arctic Waterways Safety Committee. Prior to entering within 30 nautical miles of a whaling village, 50 nautical miles of Barrow, and 12 nautical miles of the rest of the coast, notification would take place to village and regional leaders to ensure conflict avoidance. Finally, research results and findings would then be shared with the local communities at the following Alaska Eskimo Whaling Commission mini convention in the winter.

This model of communication and notification is dynamic and continues to be refined through trust and commitment from our agency and the other research groups operating in the US arctic Region.

9.2 Proposed Route through the Bering Strait and Bering Sea

At the 99th Session of the IMO Maritime Safety Committee in London in 2018, the IMO approved a joint proposal by the Russian Federation and the United States, with concurrence from Italy and Finland. The proposal[21] establishes six two-way routes and six precautionary areas in the Bering Sean and Bering Strait off the coast of Chukotskiy Peninsula and Alaska. The joint proposal derived from the U.S. Coast Guard's Bering Strait Port Access Route Study[22], which assessed the need to create new vessel routing measures in the Arctic Region. The application of this approval is set for December 1, 2018 and is the first internationally recognized measure for navigation in the Arctic Region.

The U.S. and Russian proposal adopted by the IMO divides the route into a system of 6 two-way routes separated by precautionary areas (a precautionary area is a place along the route where ships should navigate with caution).

[20] Arctic Waterways Safety Committee, Standard of Care, 2017. http://nebula.wsimg.com/3f6e3c7518e6de0f4b323a47884e6748?AccessKeyId=4913A243119CE1325FB9&dispositi on=0&alloworigin=1

[21] https://www.navcen.uscg.gov/pdf/IMO/NCSR_5_3_7.pdf

[22] https://www.navcen.uscg.gov/pdf/PARS/Bering_Strait_PARS_General.pdf

Figure 10: Bering Sea and Bering Strait Routing Measures

Arctic's First Routing Measures Will Improve Safety, Environmental Protection (Image credit: Pew Charitable Trusts)

9.3 Marine Spatial Data Infrastructures (MSDI) Progress

9.3.1 International

Beginning in July 2018, the OGC-IHO MSDI-CDS was supported by the United States, on behalf of the International Hydrographic Organization (IHO) and the IHO MSDI Working Group (MSDIWG), and executed by the Open Geospatial Consortium (OGC). The study included an open Request for Information (RFI) with the objective to gather additional information to better support governments, agencies, nongovernmental organizations and citizens, unlocking the full societal and economic potential of the wealth of marine data at local, national, regional or international levels. The RFI results also provide information and insight on the current state of the Marine SDI. In addition to the RFI, a MSDI workshop (hosted by the U.S. Committee on the Marine Transportation System at the U.S. Department of Transportation in Washington, D.C.) and roundtable were held to gather additional information from both expert panel members and the audience. The final engineering report presents an analysis of RFI, workshop and roundtable responses and interactions which provided in depth information on requirements and issues related to stakeholders, architecture, data, standards of current and a possible future Marine SDI. In addition, the report will serve as the basis for improvement of SDIs' to support the marine domain. The responses will also be discussed with potential sponsoring organizations that would provide funding opportunities for possible Marine SDI Pilot(s) initiatives proposed for later this year, and in subsequent

years. All RFI, workshop and roundtable responses will contribute to Marine SDI(s) moving forward. It will help to achieve greater interoperability, availability and usability of geospatial Web services and tools across different types of marine spatial data uses. In addition, these responses will provide identification of gaps, and definition of core components of an SDI to be referenced by IHO MSDIWG and used to define reference use-cases and scenarios for use in future pilot activities. The final engineering report can be found on OGC's website here: https://www.opengeospatial.org/docs/er
Direct link to download PDF here: https://portal.opengeospatial.org/files/?artifact_id=88037
The International Hydrographic Organization Data Centre for Digital Bathymetry (IHO DCDB) was established in 1988 to steward worldwide bathymetric data on behalf of the IHO Member States. The Centre provides long term archive of and access to single and multibeam deep and shallow water ocean depths contributed by a range of mariners. The IHO DCDB welcomes bathymetric data and metadata, accepts descriptions and spatial footprints of data that is already online and of data that are not publicly available to provide easy search and discovery. Information can be obtained at: https://www.ngdc.noaa.gov/iho/
The U.S. holds active roles in supporting the work of several international MSDI-focused working groups:

- IHO MSDIWG
- UN-GGIM Working Group on Marine Geospatial Information Working Group (WG-MGI)
- Open Geospatial Consortium Marine Domain Working Group (Marine DWG)

9.3.2 National

The Federal Geospatial Data Committee (FGDC) is an organized structure of federal geospatial professionals that provide executive, managerial, and advisory direction and oversight for geospatial decisions and initiatives across the United States federal government. FGDC works collaboratively with federal, state, tribal, and local governments, non-Federal collaborates, communities, constituents, and professional bodies providing the enabling foundation of standards, data catalogs, partnerships, and tools that make up the National SDI (NSDI). For more information visit: https://www.fgdc.gov/
Regarding the U.S. NSDI, on October 5, 2018, the Geospatial Data Act of 2018 (GDA) became law in the U.S. The GDA codifies the committees, processes, and tools used to develop, drive, and manage the National Spatial Data Infrastructure (NSDI) and recognizes responsibilities beyond the Federal government for its development. The GDA reflects growing recognition of the essential role of geospatial data and technology in understanding and managing our world and highlights the need to support their continuing development as critical investments for the Nation. For more information: https://www.fgdc.gov/gda
Related to MSDI in the U.S., "MarineCadastre.gov is an integrated marine information system that provides data, tools, and technical support for ocean and Great Lakes planning." The team for MarineCadastre.gov continually works "to increase access to data through data and map services. The services are designed to deliver data without replication and directly from the source." MarineCadastre.gov supports complementary efforts: Digital Coast, Data.gov, and Geoplatform.gov (a FGDC initiative). For more information: https://marinecadastre.gov/
The National Geospatial-Intelligence Agency (NGA) and its partners in academia and industry released the final planned 3-D digital elevation models (DEMs) of the Arctic in 2-meter resolution Sept. 28 2018. Release 7 of the ArcticDEM Project is a mosaic of time-stamped DEM strips that cover the entire Arctic and fills gaps from previous releases. The resolution is more than five times that of the original release and covers just over 10 percent of the Earth's surface. Enhancements also include improved filtering to preserve coastlines and better resolve densely-forested areas subject to seasonal variation, according to the University of Minnesota's Polar Geospatial Center. Analysis can be done on DEMs to determine or detect changes in topography

over time. Reduced-resolution versions of the mosaic are also available at 10 meters, 32 meters, 100 meters, 500 meters, and 1 kilometer for cartographic uses. ArcticDEM maps can be downloaded from http://maps.apps.pgc.umn.edu/id/2366 and http://maps.apps.pgc.umn.edu/id/2367

9.4 A Ten-Year Projection of Maritime Activity in the U.S. Arctic Region, 2020–2030

The U.S. Committee on the Marine Transportation System's Arctic Integrated Action Team is pleased to release the draft report, "A Ten-Year Projection of Maritime Activity in the U.S. Arctic Region, 2020–2030" for review and public comment on or before July 31, 2019. The draft report may be accessed as both a PDF and a Word Document from: https://www.cmts.gov/posts/790ca034-8429-421f-a708-c798c0213f40.

This report is an update to the CMTS's 2015 report, "The 10-Year Projection Study of Maritime Activity in the U.S. Arctic". The new report expands on the 2015 report, and provides an overview of vessel activities in the U.S. Arctic and surrounding waters north of 60°N and expands the original report's projection methodology. The report incorporates twenty-nine different sources of possible vessel activity growth, and extrapolates four different growth scenarios to 2030. This report aims to inform partners and stakeholders about potential changes in the U.S. Arctic's rapidly changing marine transportation system to support a safe Arctic marine transportation system.

ANNEX A US IHO Representation (2019)

Acronym	Name	NGA Rep.	NOAA Rep.	NAVY Rep.
IRCC	Inter-Regional Coordination Committee	Keith Dominic	John Nyberg	Matthew Borbash
HSSC	Hydrographic Services and Standards Committee	Albert Armstrong	Dr. Neil Weston	Rodney Ladner
S-100WG	S-100 Working Group	Josh Clayton	Julia Powell Janice Eisenberg	David Brazier
ENCWG	S-101 ENC (S-101) Working Group	Eric Lee	Megan Bartlett	
S-102 subWG	S-102 Sub Working Group	TBD	Janice Eisenberg	David Brazier
ENCWG (S- 101)	ENC	Albert Armstrong	Megan Bartlett	
NIPWG	Nautical Information Provision	Mike Kushla	Tom Loeper	
NCWG	Nautical Cartography	Jacqueline Barone	Colby Harmon	
DQWG	Data Quality	Chris Petrof	Sean Legeer	
MSDIWG	Marine Spatial Data Infrastructure	Sebastian Carisio	Patrick Keown	
TWLCWG	Tides & Water Levels and Surface Currents	Doug Roush	Kurt Hess Peter Stone	
HDWG	Hydrographic Dictionary	TBD	NA	
ABLOS	Advisory Board on Law of the Sea	John Lowell	Leyland Snyder	
WWNWS	World Wide Navigational Warning Service	Chris Janus	NA	
CBSC	Capacity Building Sub-Committee		TBD	Calvin Martin
WEND	World Wide ENC Database	Gerry Walter	John Nyberg	
IBSC	Int'l Board on Standards of Competence for Hydrographic Surveyors and Nautical Cartographers		Andy Armstrong	
GEBCO	General Bathymetric Charts of the Ocean	James Ford	Andy Armstrong	Ray Sawyer
CSBWG	Crowd Sourced Bathymetry Working Group		Jennifer Jencks	Ray Sawyer
SCRUM	GEBCO Sub Committee on regional undersea mapping	James Ford		
SCUFN	GEBCO Sub Committee on Undersea Feature Names	Trent Palmer		