



INTERNATIONAL HYDROGRAPHIC ORGANIZATION

UNITED STATES OF AMERICA
National Report

**21st Mediterranean and Black Sea
Hydrographic Commission (MBSHC)
Cadíz, Spain
11 June – 13 June 2019**



Office of Coast Survey
National Oceanographic & Atmospheric Administration
<http://www.nauticalcharts.noaa.gov>



Maritime Safety Office
National Geospatial-Intelligence Agency
<http://msi.nga.mil/NGAPortal/MSI.portal>
<https://www.nga.mil/Pages/Default.aspx>



Naval Meteorology and Oceanography Command
United States Navy
<http://www.navmetocom.navy.mil>
<https://www.facebook.com/NavalOceanography/>

1. HYDROGRAPHIC OFFICE/SERVICE

This National Report provides specific information pertaining to individual products and services of primary interest to the Mediterranean and Black Sea Hydrographic Commission (MBSHC) Region. Five 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 MBSHC Region

- 1.1.1 National Oceanic and Atmospheric Administration's (NOAA)¹ 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)² 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. Navy³ conducts oceanographic, bathymetric, and hydrographic surveys worldwide to satisfy DOD and national security requirements.

For more information on NOAA, NGA, and NAVY hydrographic activities, see [IHO Publication 5](#).

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

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 creation⁴ is the foundation of the [U.S. Open data policy](#). With the exception of some data collected and/or obtained by the U.S. Navy through bilateral agreements, the open data policy has led to the public availability of most hydrographic data, products, and services produced by U.S. Hydrographic Offices (HO's) for data downloads at no cost. Further information on U.S. Navy collected data is provided in Section 2.2, below.

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.

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 Instruction 5510.1, Disclosure of

¹ Primarily the Office of Coast Survey

² Primarily Source Operations and Management Directorate, Foundation Group, Maritime Safety Office (MSO).

³ Primarily, Commander, Naval Meteorology and Oceanography Command (COMNAVMETOCCOM) and the Hydrographer of the Navy

⁴ 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>

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. Any further inquiries or requests for data regarding any of these surveys should be directed to the Hydrographic Service or Port Authority of the respective country.

2.3 U.S Hydrographic Survey Platforms

2.3.1 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>

2.3.2 U.S. Navy (USN)

The Naval Oceanographic Office (NAVOCEANO), a subordinate command of the Naval Meteorology and Oceanography Command (COMNAVMETOCOM), 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 Plan⁵, 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.

3.2 Electronic Navigational Chart (ENC)

NGA produces ENCs in areas where the U.S. functions as the Prime Charting Authority outside U.S waters. NGA maintains these ENCs by updating them with new source information from obtained from U.S. and foreign partners as it becomes available.

NGA produces ENCs in areas where the U.S. functions as the Prime Charting Authority outside U.S. domestic waters. These ENCs are maintained by NGA with new source information from the U.S., and our foreign partners as it becomes available.

⁵National Charting Plan. (2017). <https://nauticalcharts.noaa.gov/publications/docs/national-charting-plan.pdf>

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

Company	Distributor Type*
Baker Lyman and Co, Inc	CED
C-MAP Norway A/S	CEVAD
ChartWorld	CEVAD
National Geospatial-Intelligence Agency (NGA)	CED
Creative Map Corp.	CED
Maris AS	CED
Primar	CED
Transas Ltd.	CEVAD
Titafin LLC (Subsidiary of Baker Lyman and Co, Inc)	CED
United Kingdom Hydrographic Office	CED
CherSoft	CED

Table 3-2 ENC Distributors and type

* **CED** - Certified NOAA ENC® Distributor - Provides NOAA ENC® data.

***CEVAD** - Certified NOAA ENC® Value Added Distributor - Provides NOAA ENC® data and reformatted System ENC (SENC) data.

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

The U.S. 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>

As of April 2014, NOAA no longer produces lithographic paper charts with traditional print cycles for new editions. All paper charts are updated weekly and available for download as Print-on-Demand (POD) products, or in paper form from one of 17 NOAA-certified chart-printing agents. (See Annex A for NOAA certified chart printing agents).

U.S. ENC's are available as free downloads from the internet. Mariners who wish to download NOAA ENC's directly and use the data to fuel ECDIS or ECS may do so. ENC's, including newly created NGA ENC's, 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 MBSHC 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. MBSHC data is included in DNC regions 08, 09, and 10. See coverage below.

DNC is maintained with new source information from the U.S. and foreign primary charting authorities. The DNC product is Limited Distribution 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 can be shared with host nations for coverage in their territorial waters through formal bilateral exchange agreements.

3.5 Raster Navigational Charts (RNC) and Paper Charts

The NOAA RNC® is a geo-referenced, digital image 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 and a global positioning system (GPS) are connected. RNCs, developed under the IHO S-61 product specification, are unique to NOAA. NGA does not produce RNCs. There are no NOAA RNC® products in MBSHC waters.

NGA produces approximately 530 paper or “Standard Nautical Charts” (SNC) for the MBSHC region. Most of these charts are not available via public sale. However, partners may request these charts as outlined in the associated bilateral agreement. The only charts that NGA distributes to the public are those where NGA serves as the primary charting authority. These charts are in areas where the U.S. conducts the surveys, compiles, and issues charts, and there is no fully functioning national authority or NGA has specific authority (e.g. Trust Territory of the Pacific).

4. NEW PUBLICATIONS AND UPDATES

4.1 New Publications

None for comment.

4.2 Updated Publications

4.2.1 Bowditch Vol. 1

The American Practical Navigator, or as most mariners refer to it, “Bowditch” was first published in 1802. It 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 publication of the updated 2017 edition of the American Practical Navigator returned this publication to a two-volume format.

4.2.2 Bowditch Vol. 2

Over the past year, NGA analysts expended considerable efforts on post-publication proof reviews that generated more than 300 corrections and updates to the 2017 edition. NGA made the decision to “rebrand” the publication as a new edition. NGA plans to issue this new 2019 edition of the **American Practical Navigator** in the first quarter of 2019.

The new 2019 edition will be available for download 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:

4.2.3 U.S. Coast Pilot – none exist within MBSHC region

4.2.4 U.S. Sailing Directions

NGA publishes a 42-volume set that contains 37 Enroute volumes, 4 Planning Guide volumes, and 1 volume combining both types. Planning Guides describe general features of ocean basins and country-specific information such as firing areas, pilotage requirements, regulations, search and rescue information, ship reporting systems, and time zones; routes describe features of coastlines, ports, and harbors. NGA updates the Sailing Directions with new data obtained from sources such as pilots and Sailing Directions from other countries. Sailing Directions (Planning Guide) and Sailing Directions (Enroute) receive frequently updates. In early 2005, NGA discontinued production of these publications in printed form; now editions exist in digital form only. NGA issues new editions after source data requires extensive revision of an existing text. Between editions, NGA updates Sailing Directions via a binary patch process referred to as Publication Data Update (PDU).

The NGA Sailing Directions are available for free download at:

<http://msi.nga.mil/NGAPortal/MSI.portal>

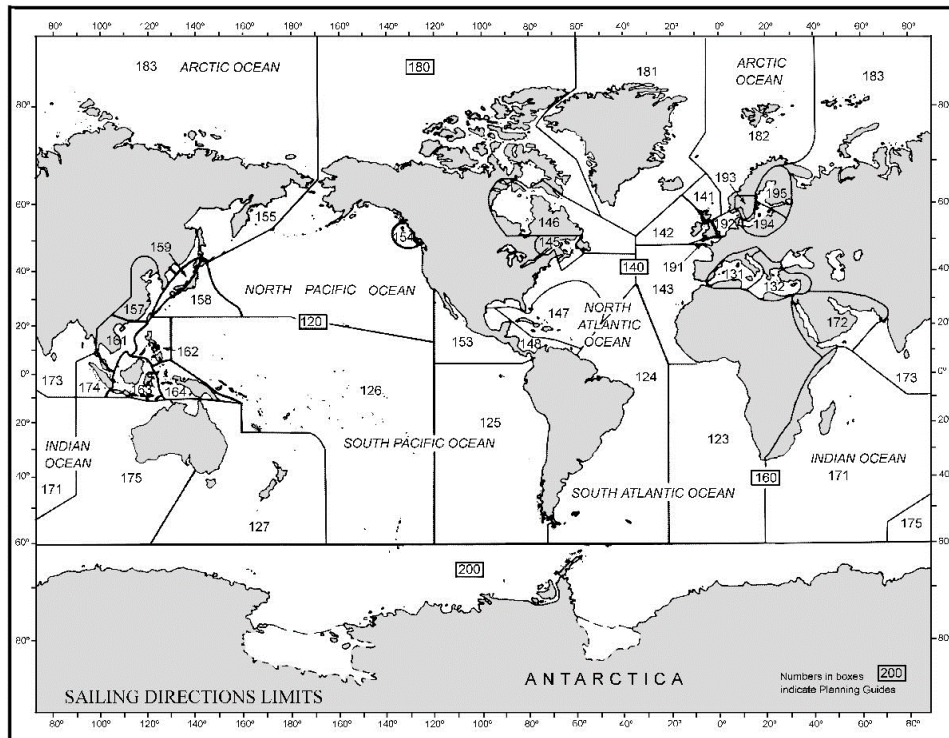


Figure 4-2-2:

Limits

Sailing Directions

Information for the MBSHC region is contained in following Publications:

Publication	Edition Date
Sailing Directions 131 – Western Mediterranean (Enroute)	2017 Edition

Publication	Edition Date
<i>Sailing Directions 132 – Eastern Mediterranean (Enroute)</i>	2017 Edition

4.2.5 World Port Index

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. The data is available as a Web Mapping Service, and is currently utilized within the IHO INTogIS system.

Digital updates are available to the public and posted at the NGA Maritime Safety website, at: <http://msi.nga.mil/NGAPortal/MSI.portal>.

4.2.6 List of Lights, Radio Aids and Fog Signals

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>.

One volume of the NGA List of Lights covers the MBSHC region:

Publication	Edition Date
List of Lights Pub. 113 (The West Coasts of Europe and Africa, the Mediterranean Sea, Black Sea, and Azovskoye More (Sea of Azov))	2018 Edition

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. Another 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/DLA 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, NOAA, 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 MBSHC region.

Local Notice to Mariners are updated weekly and available for download in several formats.

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

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).

MBSHC waters primarily lie within NAVAREA III (Spain is Regional Coordinator).

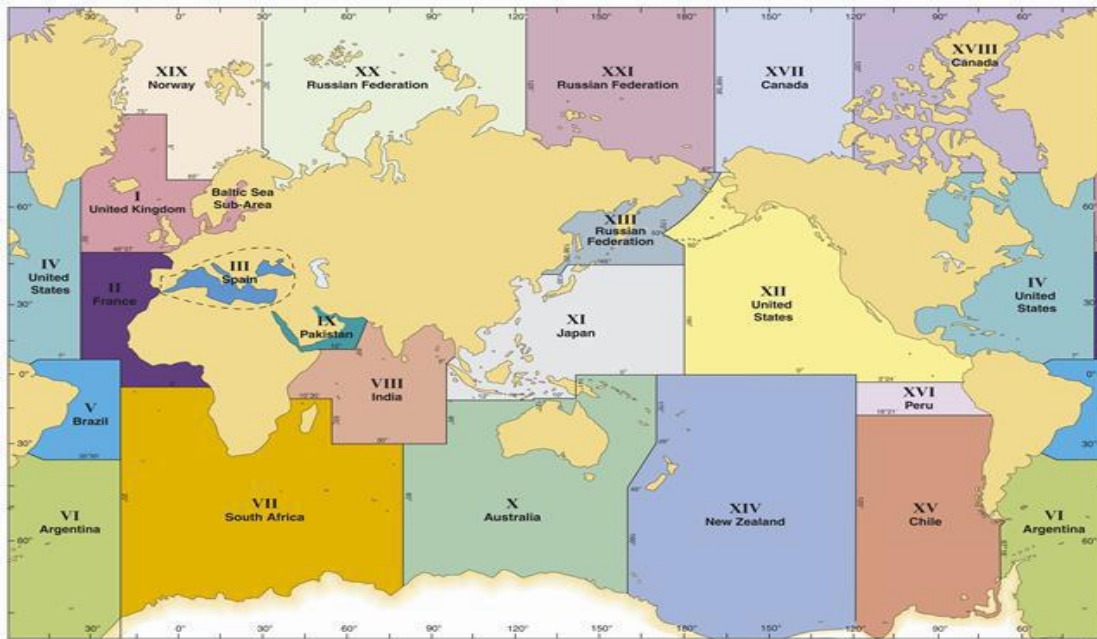


Figure 5-3: NAVAREAS for coordinating and promulgating navigational warnings under the WWNWS program

6. C-55⁶

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:

None for comment.

6.2 Nautical Chart Coverage Available:

None for comment.

6.3 Maritime Safety Information Available:

None for comment.

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 US (NGA) directly supports the IHO Maritime Safety Information (MSI) training course as well as

⁶ Source: March 2018 IHO U.S. C-55. https://www.iho.int/iho_pubs/CB/C-55/c55.pdf

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 United States. Two “Category A” certified hydrographic programs are available through:

- The University of Southern Mississippi (USM)⁷
- The University of New Hampshire (UNH)⁸

7.3 NGA

Category-B Competence Training for Nautical Cartography at 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 to add several additional sessions throughout the next several years.

7.4 NOAA

Category-B Competence Training for Nautical Cartography -- the IBSC approved the NOAA program or Category B in Cartography in March of 2017. Eleven students graduated from the first class during the period of August 2017 through August 2018. The second class began in August 2018 with 12 students, including foreign national student from the Nigerian Navy that is now participating in this one-year competence-training program. An announcement for the third class (August 2019 until August 2020) will be in early 2019.

Capt. Andrew Armstrong, NOAA (ret.), NOAA co-director of the Joint Hydrographic Center at UNH, is a member of the FIG/IHO/ICA International Board on Standards of Competence for Hydrographic Surveyors and Nautical Cartographers. As a member of the board, Capt. Armstrong is available to advise institutions on establishing hydrographic training curricula and preparing submissions to the International Board for Category A or Category B recognition.

NOAA’s Office of Coast Survey hosts an annual three-day long workshop on nautical chart adequacy assessment for approximately a dozen students from around the world. The participants receive training in techniques to evaluate the suitability of nautical chart products using chart quality assessment techniques with publicly available information.

NOAA is coordinating the scheduling of the fifth annual Chart Adequacy Workshop anticipating a July-August 2019 time-period in Silver Spring, MD.

7.5 U.S. NAVY

COMNAVMETOCOM and USM are partners in their Category A program. COMNAVMETOCOM 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. COMNAVMETOCOM’s Category A and B programs and mobile training also qualify for Security Cooperation assistance.

8. OCEANOGRAPHIC ACTIVITIES

⁷ <https://www.usm.edu/marine/hydrographic-science>

⁸ <https://marine.unh.edu/program/center-coastal-and-ocean-mappingjoint-hydrographic-center>

8.1 General Bathymetric Chart of the Oceans and Seabed 2030

The United States Subject Matter Experts participate on the IOC-IHO Guiding Committee for GEBCO. The U.S. hosts the IHO Data Centre for Digital Bathymetry at NOAA's National Centers for Environmental Information (NCEI).

The GEBCO Seabed 2030 effort aims to bring together available bathymetric data to produce the definitive map of the world ocean floor, at the best possible resolution within practical limits, by 2030 and make it available to all. It builds on more than 100 years of GEBCO's history in global seafloor mapping. The project seeks to encourage both data collectors and data managers of governmental, academic and private interests to work together to improve the quality of publicly available data and grids of the ocean floor.

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.

8.2 Crowdsourced Bathymetry

Crowdsourced bathymetric data is another tool that enables the identification of areas where nautical charts are inadequate and highlights the need to conduct proper hydrographic surveys. Through effective program parameters on data gathering, collection, and dissemination, the collected data can fill gaps on charts nautical charts. 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 U.S. 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 database's web address is: https://maps.ngdc.noaa.gov/viewers/iho_dcdb/.

Designed to tap into the enthusiasm for mapping the ocean floor, this program enables trusted mariners a means to contribute data they collect while underway which will ultimately 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 have written a CSB Guidance Document for nonprofessional mariners who wish to collect and contribute CSB 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 Marine Spatial Data Infrastructures (MSDI) Progress

9.1.1 International

The International Hydrographic Organization Data Centre for Digital Bathymetry (IHO DCDB), established in 1988, was designed 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. Further information is available 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 Marine Geospatial Information Working Group (MGIWG)

- Open Geospatial Consortium Marine Domain Working Group (Marine DWG)

9.1.2 National Marine Spatial Data Infrastructures (MSDI) Progress

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, 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/>.

Related to MSDI is the U.S., “MarineCadastr.gov. This is an integrated marine information system that provides data, tools, and technical support for ocean planning.” The team for MarineCadastr.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.” MarineCadastr.gov supports complementary efforts: Digital Coast, Data.gov, and Geoplatform.gov (a FGDC initiative). For more information: <https://marinecadastre.gov/>.

The U.S. Hydrographic Offices contribute to these larger initiatives by supplying chart data in GIS formats via an application called ENC Direct to GIS. This application allows users to request chart data in shapefile format through a geospatially-enabled viewer. In addition, OGC distributes Theme Layers via compliant Web Services. Theme Layer development accounts for suggestions from the IHO MSDIWG on core MSDI data layers. In order to ensure consistency across products and increase application stability, redevelopment efforts for this application and its applicable Theme Layers ensue with a delivery date planned for 2019. For more information: <https://nauticalcharts.noaa.gov/data/gis-data-and-services.html>.

The U.S. is supporting and organizing a project – the Marine Spatial Data Infrastructures - Concept Development Study (MSDI-CDS) – along with the Open Geospatial Consortium (OGC) on behalf of the IHO and international marine communities. The aim of this project is to assess the current state of data/product management and exchange technologies used in the marine domain. A technical report capturing the knowledge gained from the CDS will provide the foundation for development of a potential future pilot that will in turn advance the state of Spatial Data Infrastructures (SDIs) supporting marine data across the globe. The first MSDI-CDS workshops took place in October 2018 with the intent to gather information and help focus the effort for the future.

9.2 Earth Gravity Model (EGM) Update

The U.S. is in the process of updating the Earth Gravity Model (EGM) to reflect the variance in gravity based on the uneven mass distributions found across the irregularly shaped Earth. This gravity difference can effect air, land, and sea navigation if there is no instrument compensation to account for the difference in gravity across the Earth’s surface. This model is also important in establishing Mean Sea Level (MSL), which is a component of the World Geodetic System (WGS) system. NGA plans to release the next EGM for release in 2020. After the 2020, subsequent releases will be on a 10-year development and release cycle.

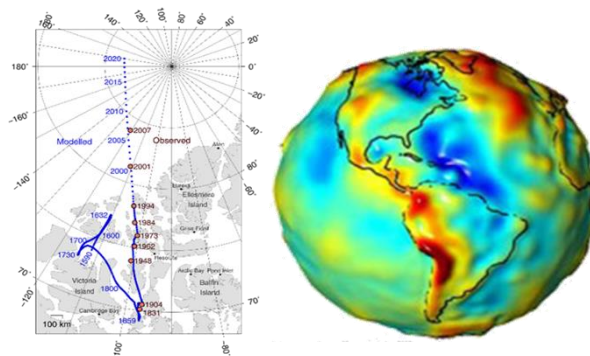


Figure 9-2: Magnetic North Pole movement and Earth Gravity Model

9.3 World Magnetic Model (WMM) Update

The World Magnetic Model (WMM) helps define the difference between true north and magnetic north. Safe navigation across the Earth's surface requires the application of this correction. This model changes over time because of magma changes in the Earth's molten iron core. Historically, the shift in the WMM has been consistent over time. However, in recent years the shift has accelerated leading to the need for NGA to create an out-of-cycle update to the WMM in 2019. This accelerated shift has the greatest effect on navigation in the northern latitudes of the Earth. Accurate compass headings are essential for a wide range of positioning and navigation system applications that use the Earth's geomagnetic field, including most aircraft, ships, submarines and GPS receivers. NGA also plans to release the regular 5-year release of the WMM in 2020 as well.

9.4 MagQuest



The U.S. has an innovation competition aimed at improving our magnetic data holdings. MagQuest, an open innovative competition to advance how we measure the Earth's magnetic field is funded at 1.2M USD for Phase 1, and 2.5M USD at Phase 2. The competition has been designed to attract new ideas to increase efficiency, reliability, and sustainability of geomagnetic data collection for the World Magnetic Model (WMM). With MagQuest, the U.S. aims to inspire domestic and international solvers to apply their expertise to space-borne, aerial, terrestrial, and other potential solution areas.

For more information: www.MagQuest.com

ANNEX A

NOAA CERTIFIED RASTER CHART (PAPER CHART) PRINTERS

Company	Phone Number	Additional Services*
The Copy Shop	770-682-6600	
Frugal Navigator	509-426-4472	FO
Weilbach A/S	+45 33 34 35 60	
Marine Press	514-866-8342	UO
Eagle Enterprises Safety Solutions	800-478-2331	
Bluewater Books & Charts	954-763-6533	WP
Richardson's Maptech (Edgewater Marine Ind., LLC)	508-990-9020	WP
East End Blueprint and Reprographics Services, LLC	631-726-2583	
Pacific Publishers	912-472-4373	WP
TrakMaps	1-877-861-8725	WP
My Nautical Chart	401-499-3842	
The Map Shop	800-532-6675	WP, BC, UO
OceanGrafix	877-562-4278	WP, UO, FO, BC
Map House	Coming Soon	
Maritime Services Ltd.	888-387-8667	
Stanfords	+44 (0)20 7836 1321	
Milwaukee Map Service, Inc. (Meacham Enterprises)	800-525-3822	
East View Geospatial	877-856-6705	BC, FO, UO, WP
William & Heintz Map Corporation	800-338-6228	FO
Captains Charts – Tiger Printing Group, LLC	215-799-0500	UO, WP
Hyannis Marina	508-790-4000 x 2	
Paradise Cay Publications	707-822-9063	WP, FO, BC
Datema Nautical Safety	+31 (0)596 63 52 52	
Granville Printing	203-254-3090	

Additional Services:

Book Chart (**BC**), Folio Charts (**FO**), User Overlays (**UO**), Waterproof Charts (**WP**)