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Status Report of the Arctic Regional Marine Spatial Data Infrastructures Working Group (ARMSDIWG)

Submitted by:	Chair ARMSDIWG, United States
Executive Summary:	This report contains the current status and planned actions of the ARMSDIWG. Additionally, relevant information on related working groups (e.g., Arctic SDI, IHO MSDIWG, and OGC Marine DWG) is provided.
Related Documents:	ARHC 5: Draft List of Actions ARHC 6: Proposal for the Arctic Regional Marine Spatial Data Infrastructures Working Group (ARMSDIWG) (DRAFT) IHO Publication C-17, Spatial Data Infrastructures: "The Marine Dimension" - Guidance for Hydrographic Offices, Ed 2.0, April 2016 Open Geospatial Consortium (OGC) Concept Development Study Proposal Defining the Future for the Marine Spatial Data Infrastructure (MSDI)
Related Projects:	Arctic Regional Marine Spatial Data Infrastructures (MSDI) Working Group (ARMSDIWG) Terms Of Reference https://www.iho.int/mtg_docs/rhc/ArHC/ArHC_Misc/ToR_ARMSDIWG.pdf Arctic Spatial Data Infrastructure (Arctic SDI) http://arctic-sdi.org/ Open Geospatial Consortium (OGC) Marine Domain Working Group (Marine DWG) http://external.opengeospatial.org/twiki_public/MarineDWG/WebHome IHO Marine Spatial Data Infrastructures Working Group (MSDIWG) https://www.iho.int/srv1/index.php?option=com_content&view=article&id=483&Itemid=370&lang=en Protection of the Arctic Marine Environment (PAME) Arctic Marine Shipping Assessment (AMSA) https://www.pame.is/index.php/projects/arctic-marine-shipping/amsa

Introduction

Among the Hydrographic Office (HO) community, establishment of a Marine Spatial Data Infrastructure (MSDI) is generally regarded as the solution for discoverability, accessibility, and interoperability of marine geospatial data among the broader user base. A MSDI is the marine dimension to the broader Spatial Data Infrastructure (SDI) which is comprised of policies & governance, information systems, and technical standards working in harmony to provide geospatial data. The ARMSDIWG has been established as the key coordinating body for the deliverability of marine geospatial data from Arctic HOs to this broader user base.

Arctic Regional MSDI Approach

During its 5th meeting, the ARHC tasked Denmark and the United States to propose "how to proceed with MSDI from an ARHC perspective." Denmark and the United States returned to the 6th ARHC meeting with a proposal "to consider the establishment of an Arctic Regional MSDI Working Group (ARMSDIWG) in order to move forward with MSDI activities in the region and contribute to the Arctic Voyage Planning Guide (AVPG)."

The ARMSDIWG was formally established at the 6th ARHC meeting and, under the supervision of the ARHC, should function in the following ways:

- section continued on next page -

- Identify and assess the statuses of individual MS (Member State) MSDI implementation.
- Consider MSDI policies in related international projects and cooperate specifically with the Arctic SDI.
- Analyze how maritime authorities can contribute their spatial information and the necessary updates, so information can easily be collated with other information to create a current overall picture for the region.
- Focus on how ARHC in the future can benefit from a regional approach.
- Monitor the development of SDI (specifically the Arctic SDI) that could be relevant for the region.
- Monitor the development of relevant and applicable OGC standards and activities through association with the OGC Marine DWG.
- To present a yearly report to the ARHC at their meeting. This report should include a description on the current status, recommendations on how to proceed with the MSDI implementation, and if deemed necessary, an action plan with specified time schedule for future ARMSDI actions.

ARMSDIWG Workshop No. 1 and Joint Meeting of the Arctic SDI and the ARMSDIWG

The Arctic Regional Marine Spatial Data Infrastructures Working Group Workshop No. 1 (ARMSDIWG1) was held in Copenhagen, Denmark 04-05 April, 2017. ARMSDIWG1 was attended by representatives from the following ARHC Member States and Associate Members: Canada, Denmark, Finland, Norway, and United States. The primary outcomes from this meeting were the following:

- Completion of ARMSDIWG White Paper.
  - *Submitted to ARHC Special Meeting at IHO-A1.*
- Completion of ARMSDIWG Consolidated Work Plan 2017-2020.
  - *Submitted to ARHC Special Meeting at IHO-A1.*
- Note to ARHC Special Meeting at IHO-A1 about close working relationship with Arctic SDI.
  - *Continued yearly meetings.*
  - *Organized web presence (e.g., marine.arctic-sdi.org).*
  - *Combined White Papers and coordinated outreach.*
  - *Consistent reference of each group's existence and activities, regardless of our respective progress.*
- Decision not to create a Pan-Arctic Bathymetric Database, which is already being addressed by other initiatives, but to explore best practices for Arctic Bathymetry sharing.
  - *So many other organizations are already addressing this sort of initiative (e.g., IBCAO, GEBCO, EMODnet, NOAA National Centers for Environmental Information (NCEI) - IHO Data Centre for Digital Bathymetry (DCDB)).*
  - *Rather than create a new separate database, ARMSDIWG would seek to leverage something like the OGC Concept Development Study Proposal Defining the Future for the Marine Spatial Data Infrastructure (MSDI) to address "cross community bathymetric information sharing for the Arctic" in a potential follow on "OGC innovation pilot project or testbed".*
  - *It was determined that a pilot or testbed could provide some best practices to serving and sharing bathymetry and that other existing initiatives could benefit from seeing a modern and open standards approach (i.e. state-of-the-art, network-based services with open technical standards)*
  - *Also, the OGC Marine DWG is aware of the need to explore bathymetry sharing for various uses in the region and has integrated this in to their work plan (see "OGC Marine DWG" section below).*
  - *Going forward, ARMSDIWG would seek to invite representatives from other initiatives to participate in the studies/developments/demonstrations of cutting-edge approaches to bathymetry sharing.*
- Take a MSDI Approach for the Arctic Voyage Planning Guide (AVPG).
  - *Canada will lead (Norway and Denmark to support) a concept paper/implementation plan for Arctic Voyage Planning Guide (AVPG) that builds on previous AVPG framework with a MSDI perspective – ultimately to be approved by ARHC.*
  - *Finland and United States will investigate work in IALA that may align with this Voyage Planning approach.*
  - *With the AVPG, the ARMSDIWG could support the Arctic Marine Shipping Assessment (AMSA) within the Protection of the Arctic Marine Environment (PAME). Potentially, the ARMSDIWG could offer the hydrographic component to the PAME's Expert Groups (https://www.pame.is/index.php/shortcode/about-us) and support AMSA recommendation III.D: Building the Arctic Marine Infrastructure – Investing in Hydrographic, Meteorological and Oceanographic Data.*

Figure 1 *Participants of ARMSDIWG1 - Copenhagen, Denmark*

On 06 April, 2017, the representatives from the ARMSDIWG met with the National Contact Points from the Arctic SDI – the cooperation between the eight National Mapping Agencies (NMAs) listed in the table below:

Arctic SDI NMAs	
Canada	Natural Resources Canada
Denmark	Danish Agency for Data Supply and Efficiency
Finland	National Land Survey of Finland
Iceland	National Land Survey of Iceland
Norway	Norwegian Mapping Authority
Russian Federation	The Federal Service for State Registration, Cadastre and Mapping
Sweden	Swedish Mapping, Cadastre and Land Registration Authority
United States	U. S. Geological Survey

This Joint Meeting of the Arctic SDI and the ARMSDIWG was attended by all eight Arctic SDI National Contact Points (representing the eight NMAs above) and the HO representatives from Canada, Denmark, Finland, Norway, and United States.

This was an extremely aligned and cooperative meeting of the two organizations. Initially, both were introduced and their projects and priorities were explained/demonstrated to each other. The next half of the meeting consisted of discussion to find opportunities for collaboration. The primary topics discussed:

- Identifying the major datasets between domains – to provide the reference land/sea data for the foundation context of other datasets in a SDI.
- Further coordinated outreach to include a joint white paper and presentations.
- Build a joint conceptual architecture.
- Possibility of running pilots under the SDI framework involving stakeholders.
- Continuous reference of each group under the common SDI to mitigate confusion.
- Contact with the Marine domain representatives was a big milestone for Arctic SDI, which was a regularly occurring topic of discussion for Arctic SDI.
- Solutions to remain organized moving forward: web-sharing (e.g., Google Docs) and a common web presence under arctic-sdi.org domain (e.g., marine.arctic-sdi.org), continued joint meetings, etc.
- Possibility of an OGC Arctic Domain Working Group.

Figure 2 *Joint Meeting of the Arctic SDI and the ARMSDIWG participants - Copenhagen, Denmark*

Upcoming ARMSDIWG Meetings

The next, half-year virtual meeting, ARMSDIWG1.5, will take place via Skype to continue progress of items from ARMSDIWG1. ARMSDIWG2 will be an in-person meeting with the intent to be combined with another Joint Meeting of the Arctic SDI and the ARMSDIWG, but the date and location is still to be decided.

ARMSDIWG Outreach and Awareness

Since its inception, the ARMSDIWG, including its cooperation with Arctic SDI, has been presented to approximately 300+ individuals at many conferences and meetings of both similar working groups and the broader geospatial community. Some of the notable presentations are below:

- Ocean Innovation 2016, OCT 2016 – Iqaluit, NU, Canada
- BS-NSMSDIWG5, DEC 2016 – Rostock, Germany
- MSDIWG8, FEB2017 – Vancouver, BC, Canada
- U.S. HYDRO 2017, MAR 2017 – Galveston, TX, USA
- 103rd OGC Technical Committee Meeting, JUN 2017 – St. John's, NL, Canada
- International Cartographic Conference 2017, JUL 2017 – Washington, DC, USA
- NOAA Open House on Nautical Cartography, JUL 2017 – Silver Spring, MD, USA
- 7th Symposium on the Impacts of an Ice-Diminishing Arctic on Naval and Maritime Operations, JUL 2017 – Washington, DC, USA

ARMSDIWG Work Plan Tasks

During ARMSDIWG1, the representatives drafted a consolidated work plan for the 2017-2020 period. The wok plan consists of tasks deemed important to the working group and aligned with the functions of the working group as outlined in the Terms of Reference:

- Common Understanding of MSDI in Arctic
- Spatial Data Interoperability, Sharing and Display
- Liaise with External Users of MSDI
- ARMSDIWG / Arctic SDI Collaboration
- Geospatial-enablement of Arctic Voyage Planning Guide (AVPG)
- Pan-Arctic Bathymetry Database
- Annual Meetings

IHO MSDIWG

From an HO perspective, it is important that the IHO take the lead in addressing MSDI matters for the maritime sphere through its MS; the IHO MSDIWG is seen as an appropriate WG to take advantage of these opportunities from an international perspective. The MSDIWG has many functions, but in particular, it is responsible for monitoring "national, regional, and international SDI activities and trends" and supplying information up to the organizational structure of the IHO to the IRCC.

8th MSDIWG Meeting

The 8th meeting of the IHO MSDIWG (MSDIWG8) took place in Vancouver, Canada from 31 January to 02 February 2017. The Chair ARMSDIWG and other ARMSDIWG representatives were in attendance. The primary outcomes from this meeting were the following:

- Redeveloped 2017-2020 Work Plan (see below).
- Revised draft new edition 2.0.0 of C-17 and submitted to IRCC9.
- Revised and submitted MSDI White Paper to the IRCC Chair as part of the MSDIWG report.
- Produced a compilation of best practices and a list of standards related to SDI/MSDI.
- ESRI presented the concept of Ecological Marine Units and the MSDIWG discussed the concept.
- Discussed the importance of considering making MSDI a Regional Hydrographic Commission (RHC) agenda item in the hopes of seeing a National MSDI report prepared by each Member State for submission to every RHC incorporating the status of MSDI, plans for involvement in MSDI and challenges facing the HO.
- OGC Marine DWG meeting was arranged as a back-to-back meeting with the MSDIWG8 and relevant geospatial research topics were passed to the OGC Marine DWG during the redevelopment of the 2017-2020 Work Plan. The MSDIWG has established close cooperation with the OGC Marine DWG, with several of the same participants contributing to both working groups.
- Discussed the possibility to create an OGC concept development study that could establish the framework for future development of MSDI. The initiative will emphasize the rapid evolution of technologies and methodologies for generating non-navigational location-based information of value to a broad range of users (see "OGC Concept Development Study Proposal" section below).

Upcoming MSDIWG Meetings

The next meeting of the MSDIWG (MSDIWG9) is planned to take place in Niteroi, RJ, Brazil (29 January-02 February 2018) preceded by a MSDI Open Forum and followed by a meeting of the OGC Marine DWG. MSDIWG10 is planned to be held in the Republic of Korea (2019) with exact dates and venue to be decided.

MSDIWG Work Plan (2017-2020) Tasks

The MSDIWG Work Plan 2017-2020 was redeveloped at MSDIWG8 based on recent changes and change in focus on MSDI from regional and national perspectives. In order to deliver this Work Plan, eight MSDI Tasks have been established:

A. Communication and dissemination
B. Operational - Data sharing and management
C. Policies and governance – RHC. (Ensure that MSDI is a standing agenda item for RHCs' meetings (IHO Res 2/1997, as amended, refers))
D. Standards (OGC and HSSC)
E. Innovation – Future perspectives (2021 - 2023)
F. Training and education
G. Maintain and extend the publication IHO MSDI C-17 (IHO Task 3.9.2.1 refers)
H. Conduct annual meetings of MSDIWG, arranged back to back with 1-day MSDI Open Forum (IHO Task 3.9.1 refers)

Figure 3 *Participants of MSDIWG8 - Vancouver, Canada*

OGC Marine DWG

From the OGC Marine DWG web page: "The Marine DWG has been established to address the gap in the OGC baseline with regards to marine geospatial data and to ensure knowledge is exchanged effectively between the relevant standards organizations, the OGC membership and the broader geospatial community. Although this group will not be the platform for creating new standards, it will be the platform to discuss and understand any issues, concerns, or barriers to interoperability to ensure that marine data can be used effectively by the wider community. . . . The group will facilitate discussion of the requirements that define different exchange methods and formats to ensure that data used for navigation can also be used within the broader realm of MSDI for non-navigational purposes."

Currently, the Marine DWG's draft work plan includes the following items defined during its Vancouver 2017 meeting and is focused on several overlapping areas with the IHO MSDIWG and the ARMSDIWG:

0. [Standing Items] Address action items output from MSDIWG meetings. A list of ongoing items. These are reproduced from the MSDIWG workplan. See [*] below.
1. Create White Paper on the MSDIWG top issues for consideration.
2. Explore and document the most appropriate/usable formats for bathymetry dissemination to the broader user base.
3. Begin structured OGC Project.
4. Develop primary use case document with a focus on a Pan Arctic bathymetry database (joint actions for - ARMSDIWG, MSDIWG, OGC Marine DWG)
5. Develop a proposal for an OGC concept development study (CDS) for MSDI and identify funding requirements and sources (RHC's, IHO stakeholders, OPP, NGA). One outcome from the CDS would be to develop a follow-on proposal for a full OGC pilot or a testbed, with cross-organisation/country/community data sharing (i.e. Bathymetric Data) as the key use case.
6. Implement an Interoperability testbed for Pan Arctic bathymetry database

**MSDIWG – work items*

B.3 Identify wider user requirements for bathymetry data.

D.1 Identify relevant standards to support MSDI implementation and operation.

D.2 Assess the suitability and shortcomings of standards in supporting data interoperability.

Upcoming Marine DWG Meetings

The next meeting of the Marine DWG will occur in September 2017 at the 104th OGC Technical Committee meeting in Southampton, United Kingdom. The Marine DWG will also meet on 02 February 2018 in Niteroi, RJ, Brazil immediately following the MSDIWG9 meeting.

OGC Concept Development Study Proposal

During the MSDIWG8 meeting in Vancouver 2017, the idea was formed to create an OGC study that could establish the framework for future development of MSDI. OGC has developed the OGC Concept Development Study Proposal Defining the Future for the Marine Spatial Data Infrastructure (MSDI). It has the following objectives:

- Document the current state of MSDIs
- Document the needs for a MSDI based on current emerging technologies
- Document strategies to interoperate with other Spatial Data Infrastructures
- Develop a common interoperability reference architecture
- Engage with experts from across the user community as well as from the community of technology / information and services providers, including hydrographic offices, industry, government, research, and other SDOs.

As mentioned previously, while this concept development study proposal was written for a broader scope, “cross community bathymetric information sharing for the Arctic” is mentioned as use case and could be addressed in a potential follow on “OGC innovation pilot project or testbed”.

Invited Actions of ARHC

The ARHC members are invited to:

- Take note of the report.
- Take note of the ARMSDIWG White Paper provided under separate cover.
- Confirm ARHC Special Meeting at IHO-A1 approval of the ARMSDIWG Consolidated Work Plan 2017 - 2020 provided under separate cover.
- Discuss the ARMSDIWG approach for Pan-Arctic Bathymetry.
- Discuss the ARMSDIWG approach for the AVPG.
- Consider the Note to ARHC Special Meeting at IHO-A1 about the cooperation with Arctic SDI and the topics discussed during the Joint Meeting of the Arctic SDI and the ARMSDIWG, and approve these types of cooperative functions with Arctic SDI to contribute to the broader SDI for the region.
- Take action as seen appropriate.