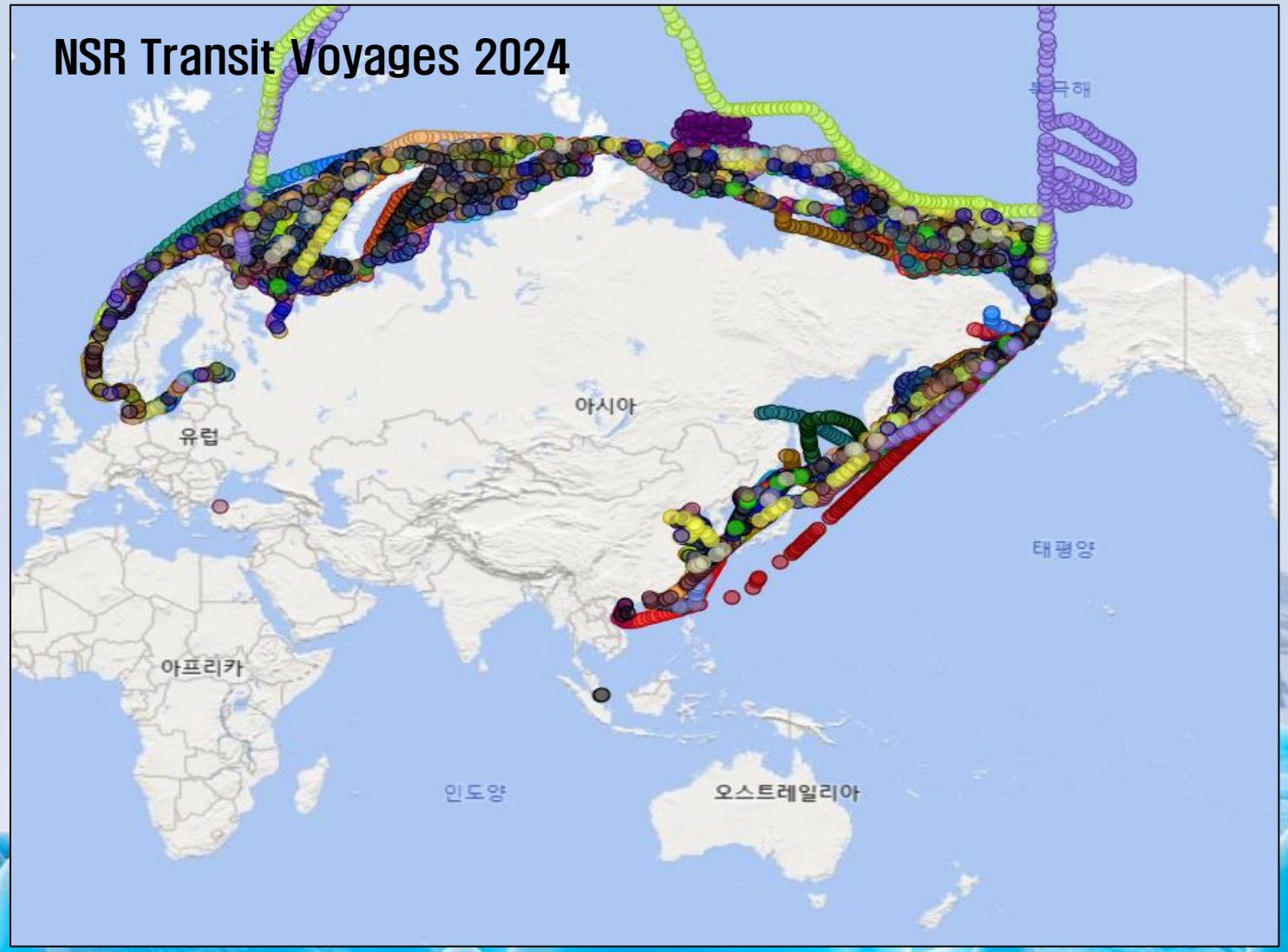
Proposals for the Development of the Digital Navigation Aid System of the Northern Sea Route

North Sea Route (NSR) Transit Voyages increasing



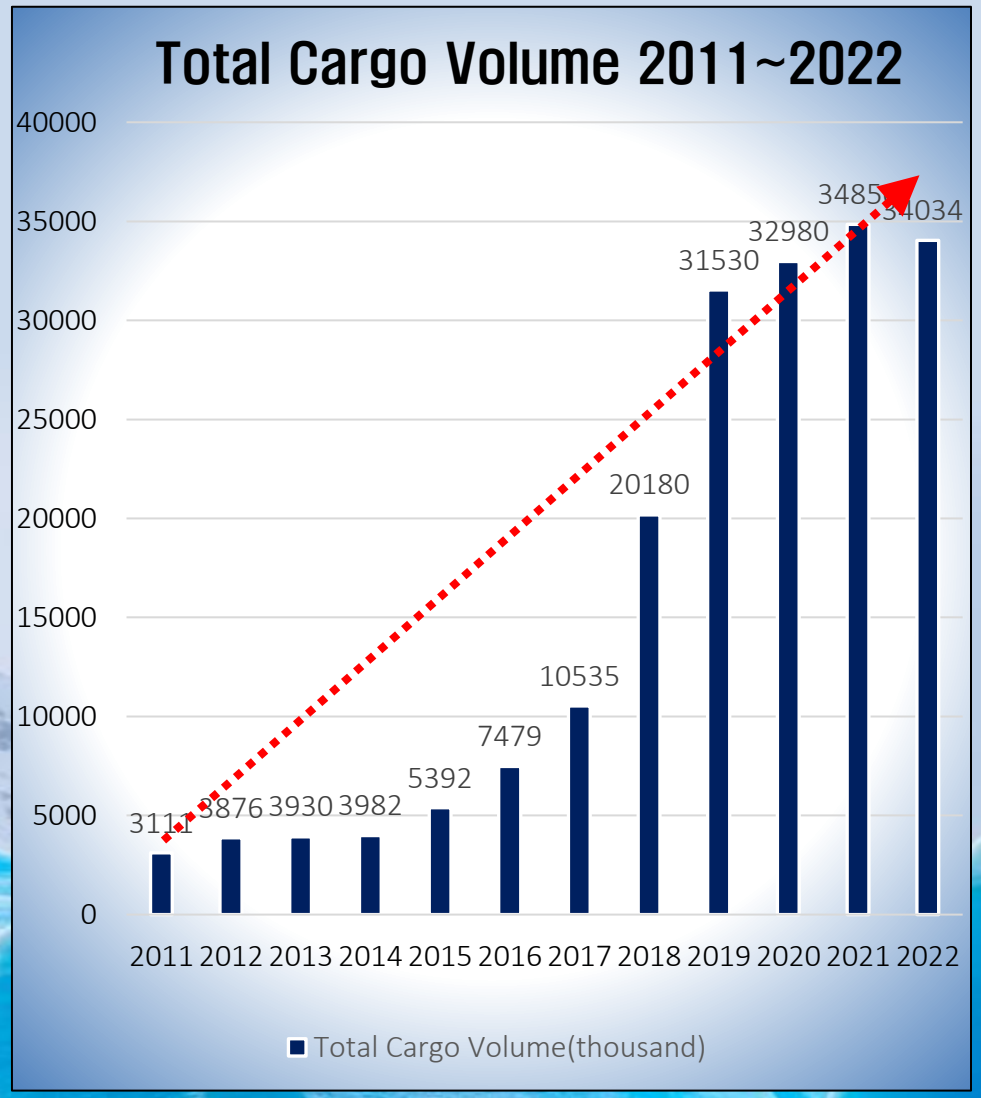


Table of Contents

1. Introduction

2. Problem Analysis

3. Solution

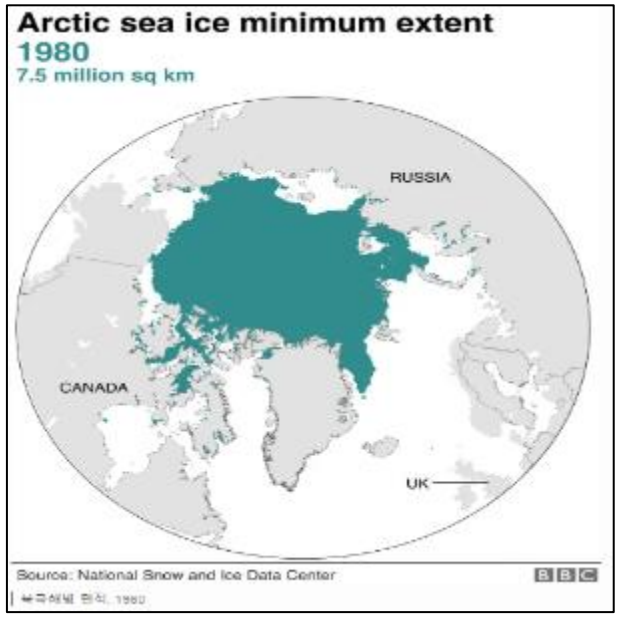
4. Conclusion

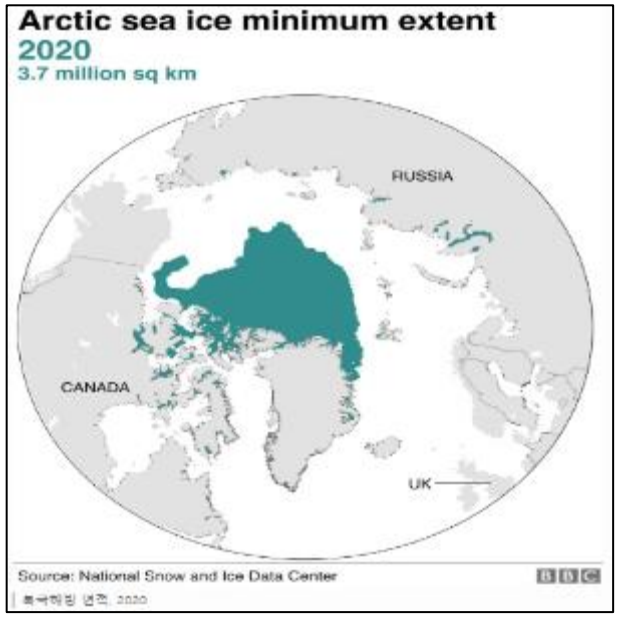
1. Introduction

The importance of the Northern Sea Route and its risks

1. Increasing interest to the Northern Sea route

① Decrease in Arctic sea ice





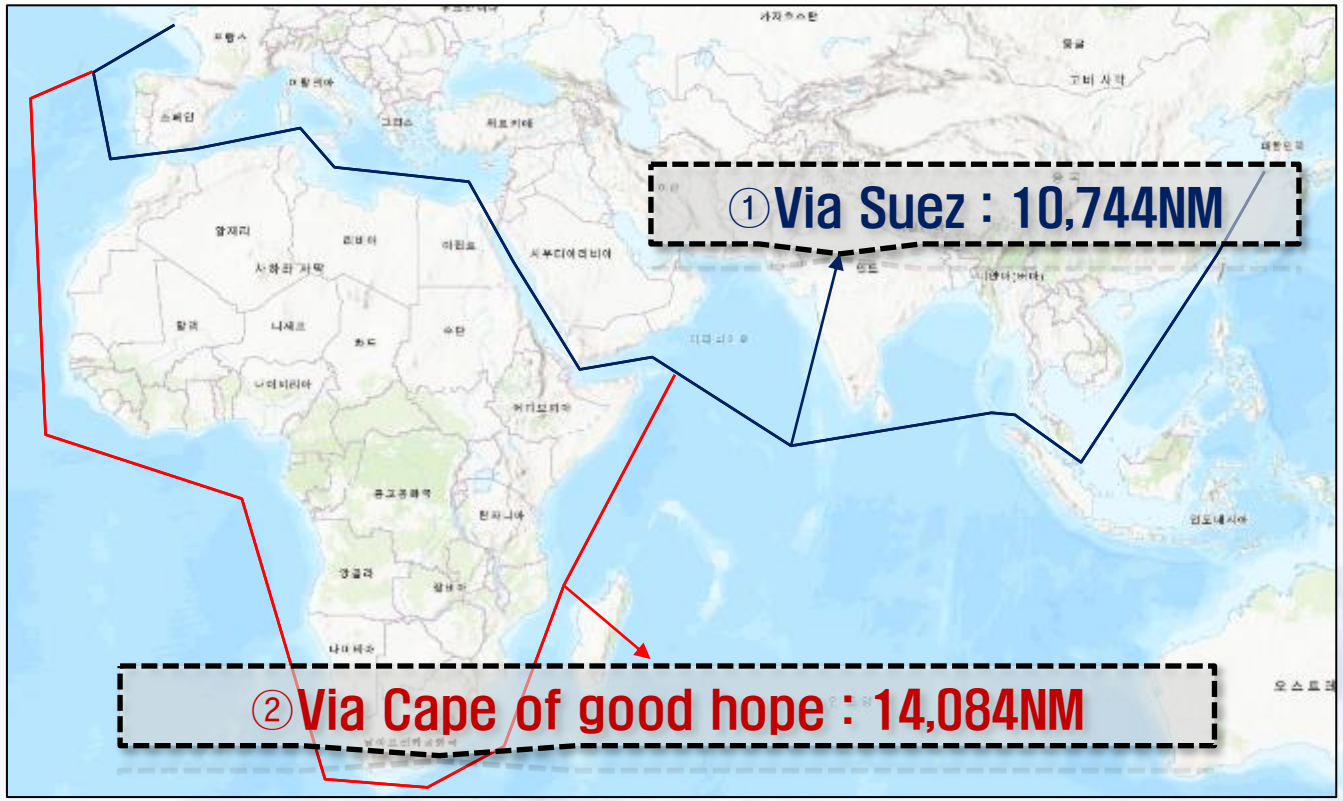
Arctic sea ice extent **decreases 51%**
Compared to 1980 as of 2020

② Advances in Icebreaking

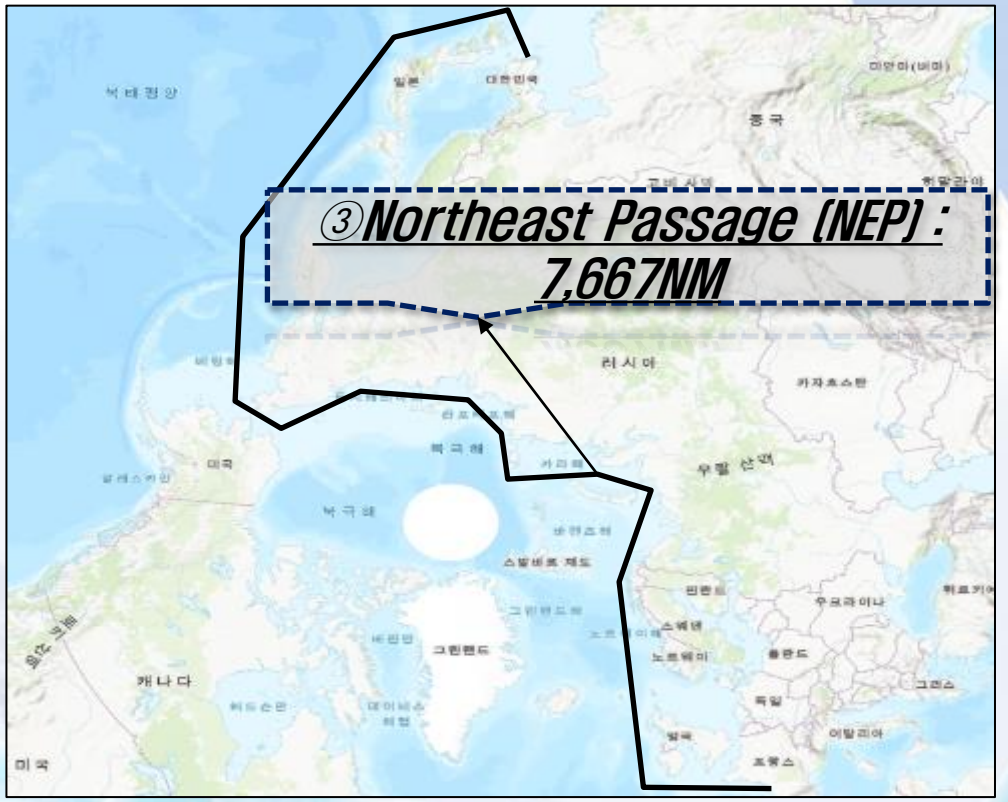
① Decreases in Arctic sea ice and ② Advances in Icebreaking brings increasing interest to the Northern Sea route

2. Advantage – ① Shortened Trade Route)

① Traditional Route (Busan, ROK-Notredame, France)



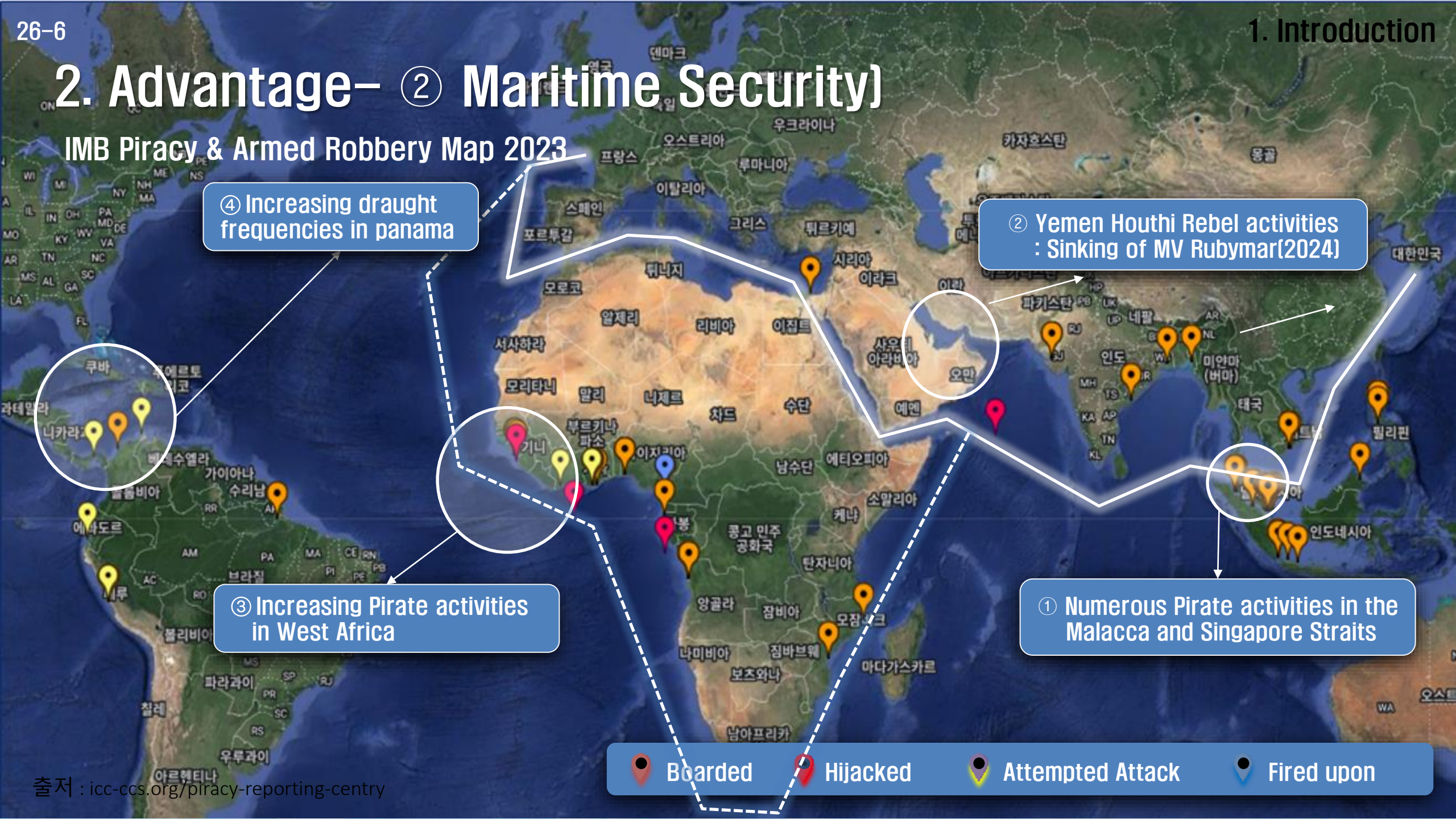
② Northern Sea Route (Northeast Passage)



Northeast Passage(NEP) can reduce the distance by 29% compared to ①, 46% compared to ②

2. Advantage- ② Maritime Security)

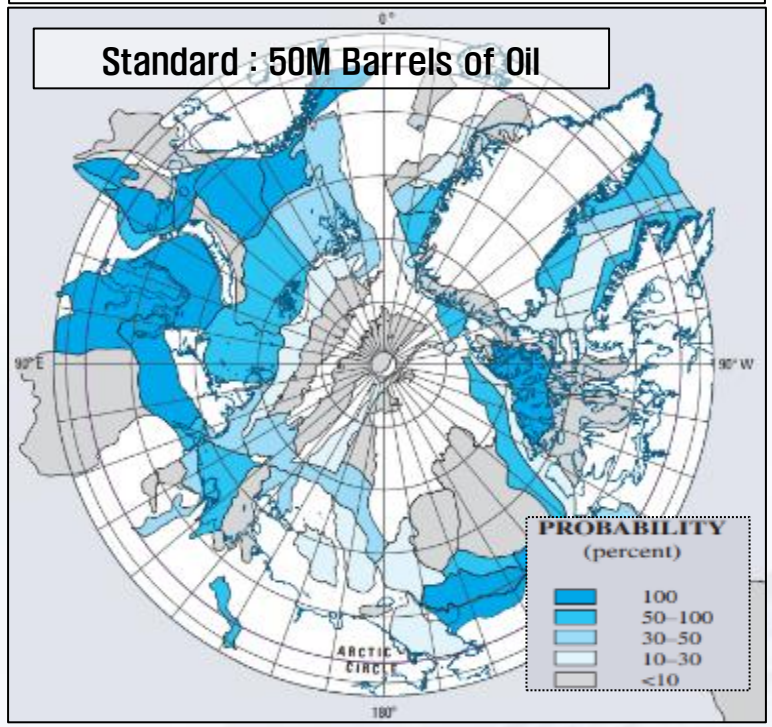
IMB Piracy & Armed Robbery Map 2023



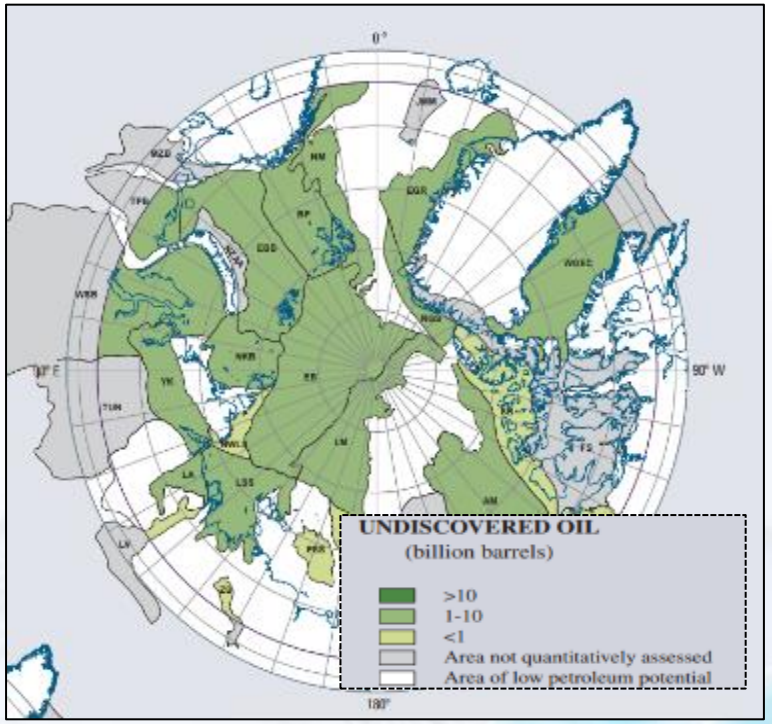
출저 : icc-ccs.org/piracy-reporting-centry

2. Advantage- ③ Rich Natural Resources)

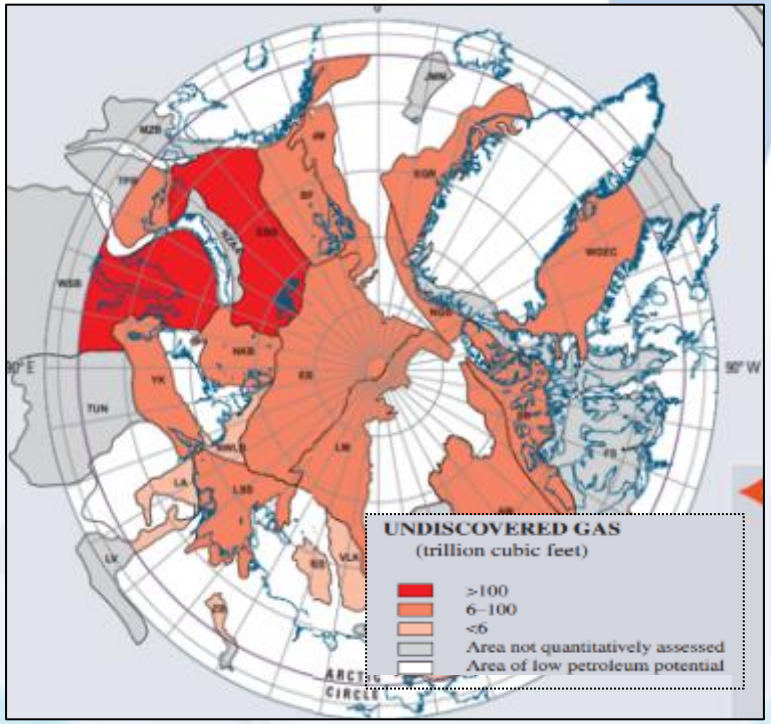
Assessment Probability of Recoverable Resources



Undiscovered Oil



Undiscovered Gas

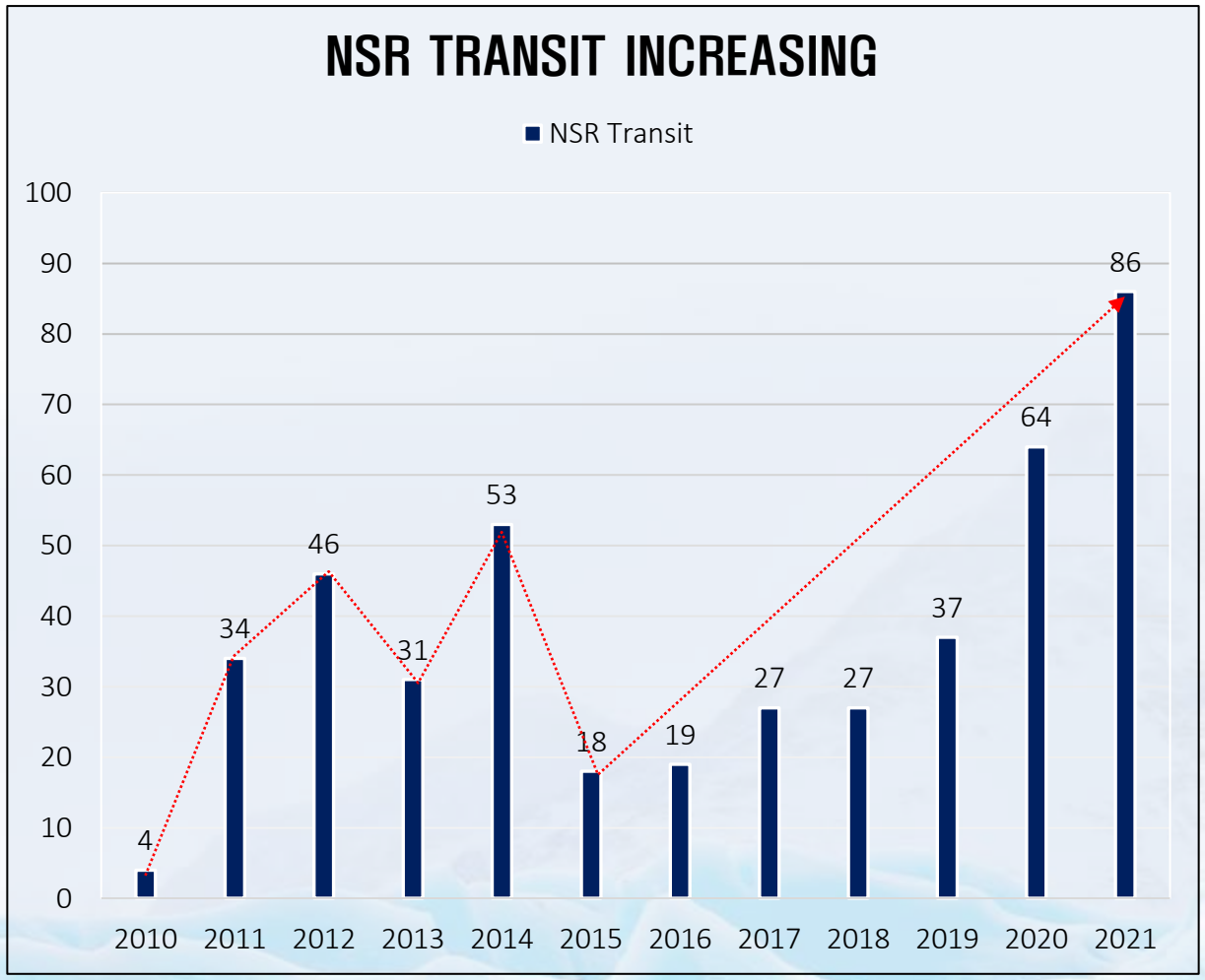


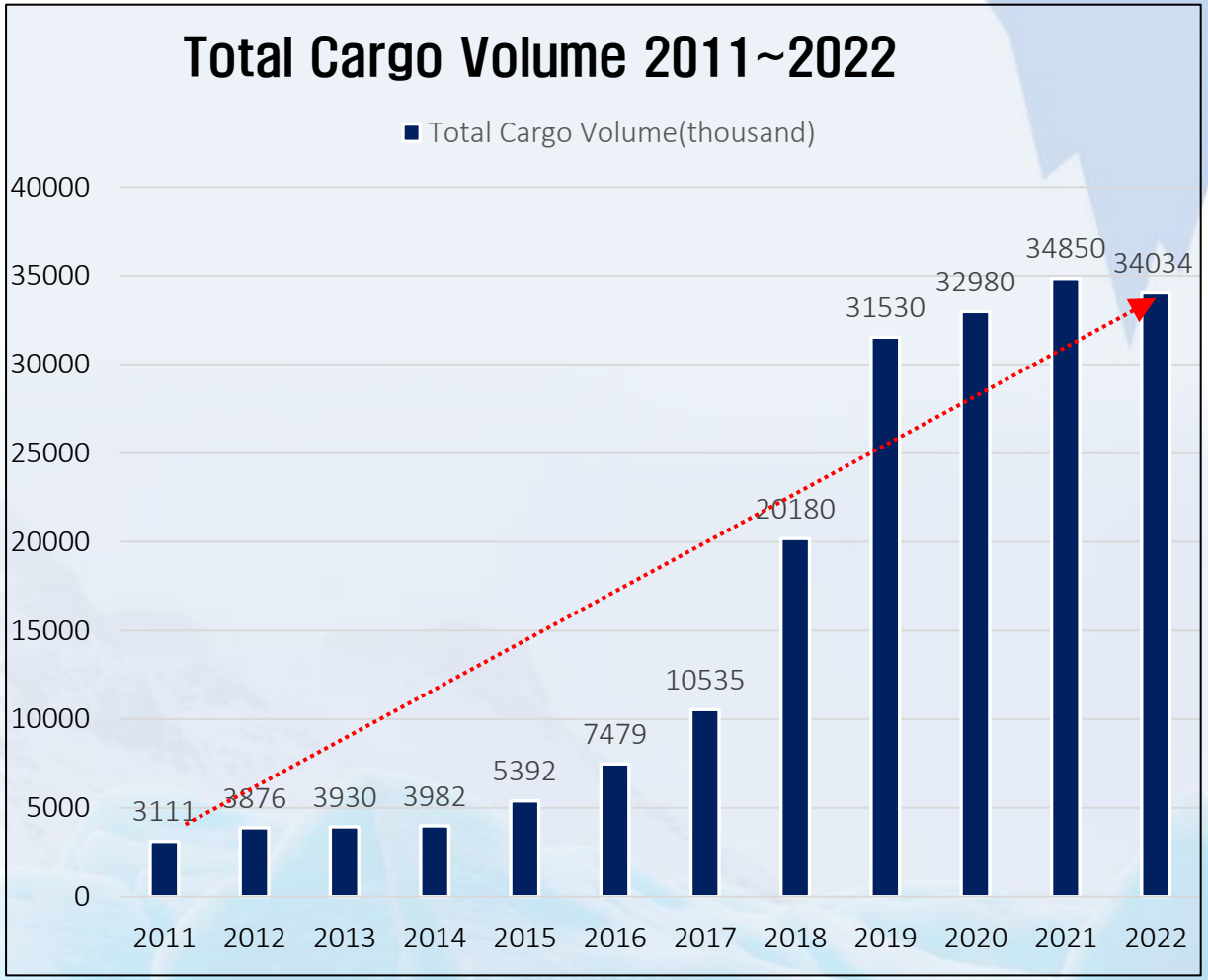
출처 : USGS Circum Arctic Resource Appraisal Estimates of Undiscoved Oil and Gas North of the Arctic Circle

The *Arctic has estimated 90 B barrels of Oil, 44 B barrels of Gas reserves,*

with over 84% located offshore(USGS), leading to extensive maritime exploration

3. NSR transits increasing





Sources : Centre for High North Logistics (https://arctic-lio.com/category/statistics/)

3. NSR transits increasing

CENTRE FOR HIGH NORTH LOGISTICS

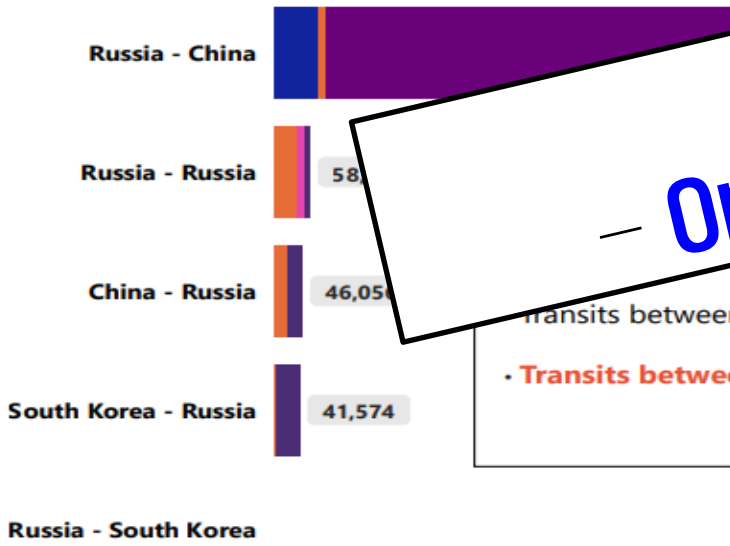
NSR Transits in 2023

NORD University

Total № transit voyages	Transit Cargo Approx (tons)
79	2,104,201

Cargo Volume (tons) & Type by Country Directions

Ballast Coal Containers Crude oil Fish General cargo Iron ore



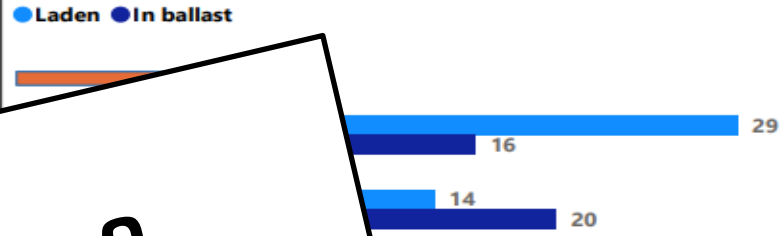
– Russian ports – 36

Transits between Russian port and non-Russian port – 43

• Transits between non-Russian Ports - 0

cargo quantity collected from varioues sources and does not represent official statistics data.

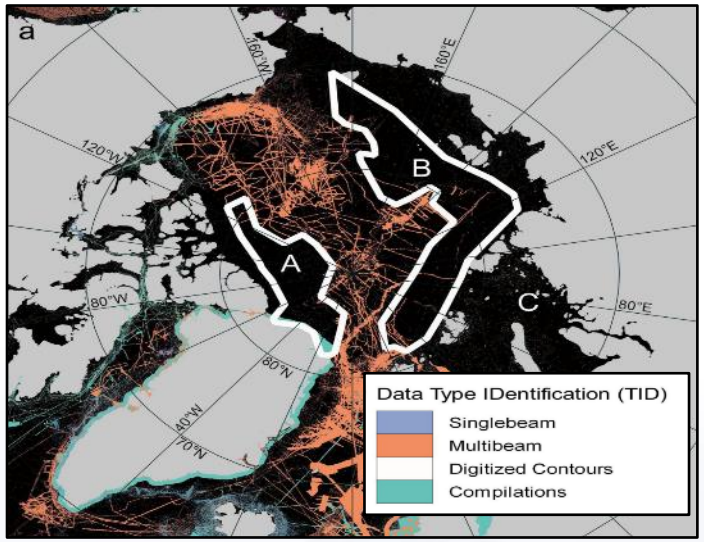
Voy Directions / Laden or Ballast

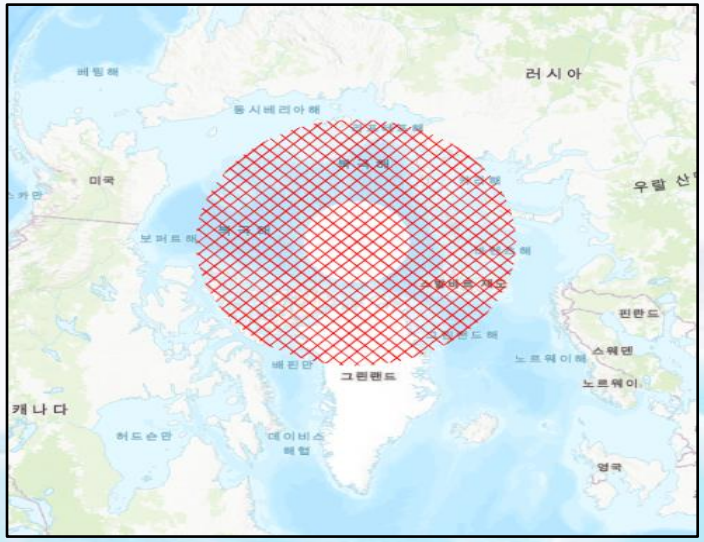


West or East 2	voy N	vsl N	Cargo	%
EASTWARD	**45**	**40**	**1,989,317**	**94.54%**
Crude oil	14	12	1,465,924	69.67%
Iron ore	2	2	324,500	15.42%
Coal	1	1	72,320	3.44%
LNG	1	1	71,500	3.40%
Containers	4	3	35,098	1.67%
General cargo	3	3	19,181	0.91%
Fish	5	5	793	0.04%
Ballast	15	14	0	0.00%
WESTWARD	**34**	**30**	**114,884**	**5.46%**
General cargo	5	4	60,331	2.87%
Containers	6	5	43,575	2.07%
Fish	3	3	10,978	0.52%
Ballast	20	19	0	0.00%
Total	**79**	**50**	**2,104,201**	**100.00%**

Northern Sea Route
– Opportunity of the Next Era?

4. The Risks of voyaging NSR





① Constantly shifting ice cover and floes

② Lack of depth and navigation data

③ Satellite Communication equipment (EPIRB) Blind Spot

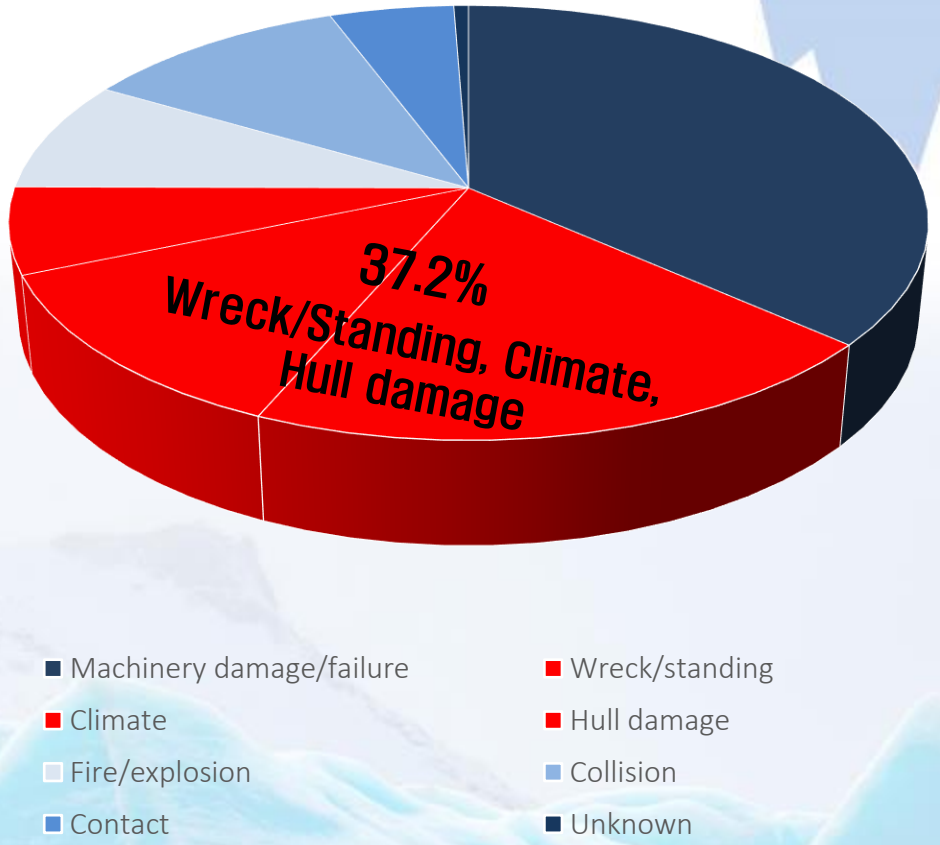
④ Inability to access real-time information on nearby ports

5. NSR maritime accidents 2000-2020

TABLE 5 Overview of the total distribution of marine accidents/incidents 2000-2020

Causes	Share of causes	MI	SC	VSC
Machinery damage/failure	36.5%	4	51	2
Wreck/stranding	19.9%	0	26	5
Climate	12.2%	3	13	3
Collision	10.9%	0	16	1
Fire/explosion	8.3%	0	10	3
Hull damage	6.4%	2	3	5
Contact	5.1%	0	8	0
Unknown	0.6%	0	0	1
TOTAL	**100%**	**9**	**128**	**19**

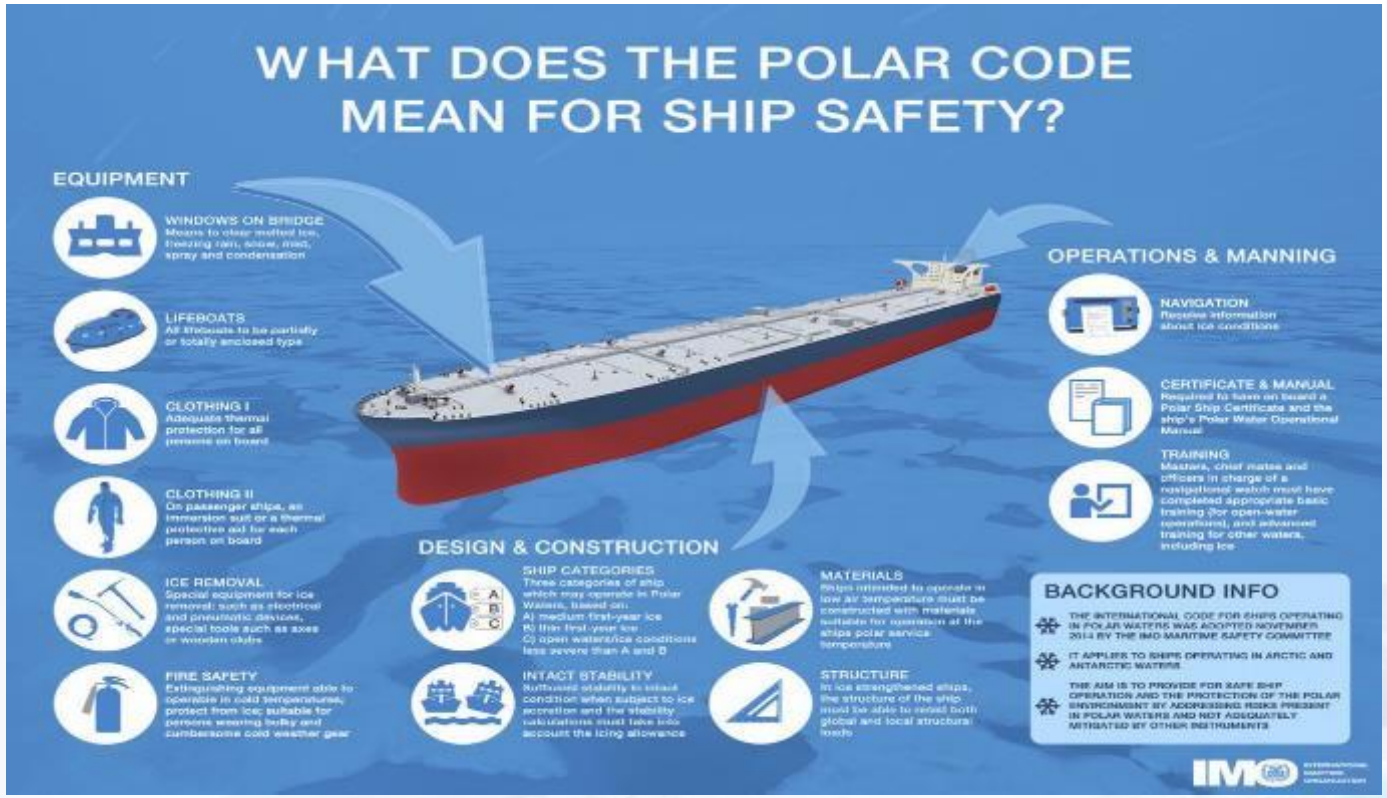
Accidents in Arctic sea



Sources : Application of the IMO taxonomy on casualty investigation: Analysis of 20 years of marine accidents along the North-East Passage (https://hal.science/hal-04483233/document)

6. IMO's POLAR CODE

IMO Polar Code



Polar Operational Limit Assessment Risk Indexing System (POLARIS)

IMO INTERNATIONAL MARITIME ORGANIZATION

E

MARITIME SAFETY COMMITTEE
94th session
Agenda item 3

MSC 94/3/7
12 September 2014
Original: ENGLISH

CONSIDERATION AND ADOPTION OF AMENDMENTS TO MANDATORY INSTRUMENTS

POLARIS – proposed system for determining operational limitations in ice

Submitted by the International Association of Classification Societies (IACS)

Since 2017, the Polar Code has been in effect, enhancing safety and environmental protection for ships operating in polar waters, including requirements for equipment, structural integrity, and crew

7. IMO's E-Navigation Strategy Implementation Plan

INTERNATIONAL MARITIME ORGANIZATION

E

4 ALBERT EMBANKMENT
LONDON SE1 7SR
Telephone: +44 (0)20 7735 7611 Fax: +44 (0)20 7587 3210

MSC.1/Circ.1595
25 May 2018

E-NAVIGATION STRATEGY IMPLEMENTATION PLAN – UPDATE 1

1 The Maritime Safety Committee, at its eighty-first session, recognizing the technological advancement in shipping, agreed on the process of developing a regulatory framework for e-navigation.

2 At its ninety-fourth session, the Committee approved the e-navigation Strategy Implementation Plan (SIP), finalized by the Sub-Committee on Navigation, Communications and Search and Rescue (NCSR), at its first session.

3 At its ninety-ninth session, the Committee, recognizing the need to regularly update the e-navigation SIP to allow for prioritized tasks to be included in the work programme of the NCSR Sub-Committee, approved the *E-navigation Strategy Implementation Plan – Update 1*, prepared by NCSR 5, as set out in the annex.

4 Member States and international organizations are invited to bring the updated e-navigation SIP to the attention of all parties concerned.

***

Table 6

List of proposed Maritime Services for use in MSP

Service No	Identified services	Domain coordinating body	Identified responsible service provider
1	VTS Information Service (INS)	IALA	VTS Authority
2	Navigational Assistance Service (NAS)	IALA	VTS Authority
3	Traffic Organization Service (TOS)	IALA	VTS Authority
4	Local Port Service (LPS)	IHMA	Local Port/Harbour Authority
5	Maritime Safety Information Service (MSI)	IHO	National Competent Authority
6	Pilotage service	IMPA	Pilotage Authority/Pilot Organization
7	Tug service	TBD	Tug Authority
8	Vessel Shore Reporting	TBD	National Competent Authority and appointed service providers
9	Telemedical Assistance Service (TMAS)	TBD	National Health Organization/dedicated health Organization
10	Maritime Assistance Service (MAS)	TBD	Coastal/Port Authority/Organization
11	Nautical Chart Service	IHO	National Hydrographic Authority/ Organization
12	Nautical Publications Service	IHO	National Hydrographic Authority/ Organization
13	Ice Navigation Service	WMO	National Competent Authority/Organization

13	Ice Navigation Service	National Competent Authority Organization	The ice navigation service is critical to safeguard the ship navigation in ice-infested waters, given how quickly the ice maps become outdated in the rapid changing conditions of ice-covered navigational regions. Such services include: • ice condition information and operational recommendations/advice; • ice condition around a vessel; • vessel routeing; • vessel escort and ice breaking; • ice drift load and momentum; and • ice patrol.

IMO intends to enhance *safety* of life at sea, *maritime security* and *protection* of the *marine environment*, as well as having *global remit*

8. Maritime Accident Cases

'21 21 Russian cargo ship run aground on icebergs

'19 cargo ship loses containers due to storm

'18 Research vessel run aground and oil leakage

Constantly shifting ice cover and floes

Lack of depth and navigation data

Satellite Communication equipment (EPIRB) Blind Spot

Inability to access real-time information on nearby ports

Accidents keep occurring due to *Lack of Shared Information* and *Information Sharing Capability*

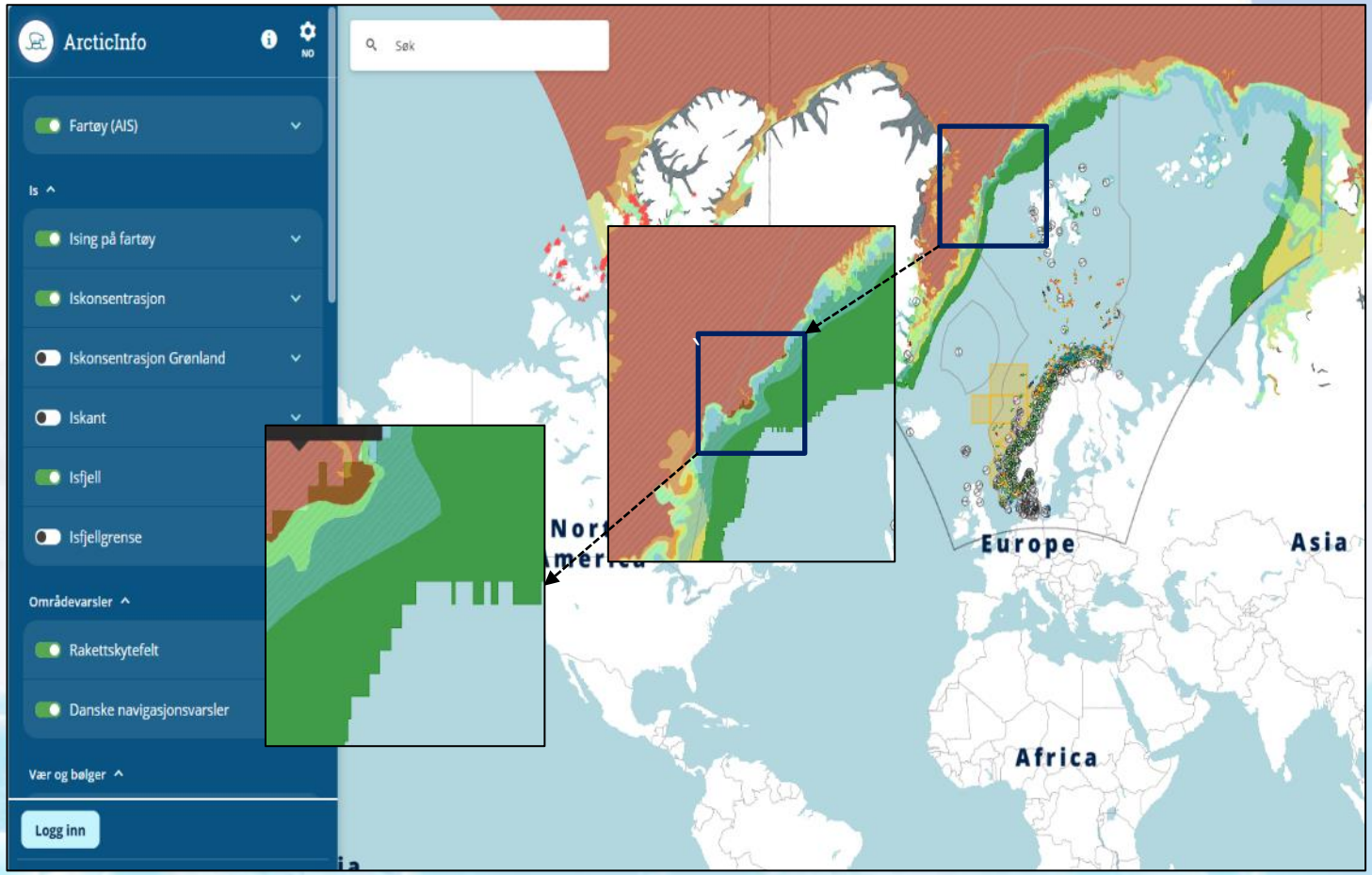
2. Problem analysis

Lack of information

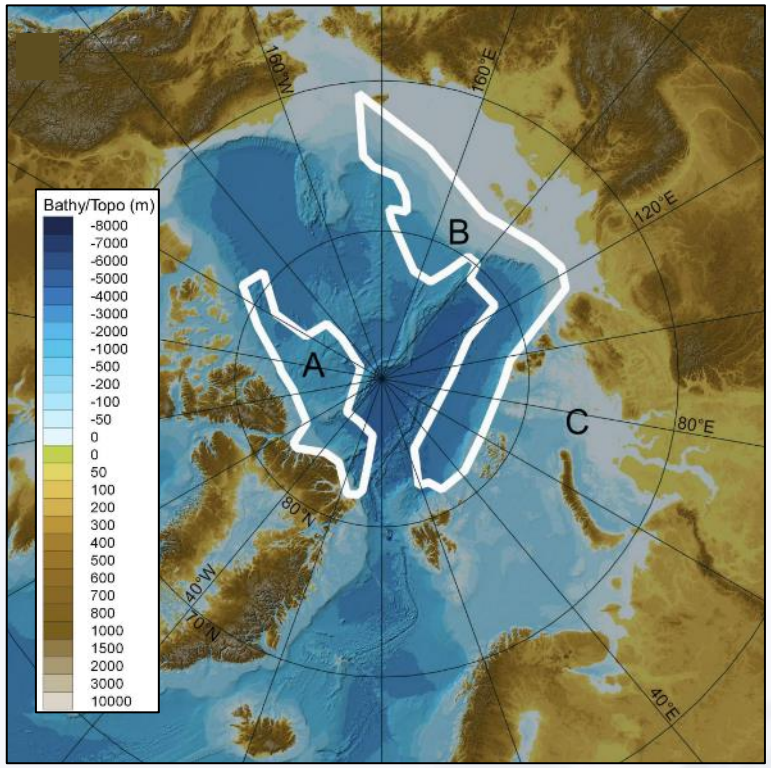
1. Limitations in gathering Ice Data

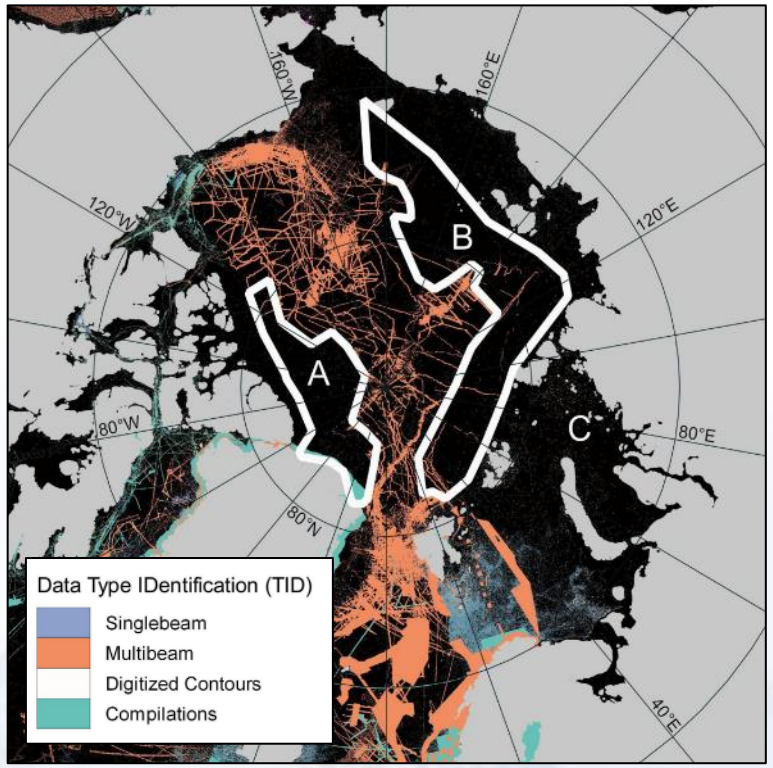
IceSAT-II(NASA) Ice thickness info : 25km grid, 24hour update, No drift Ice data

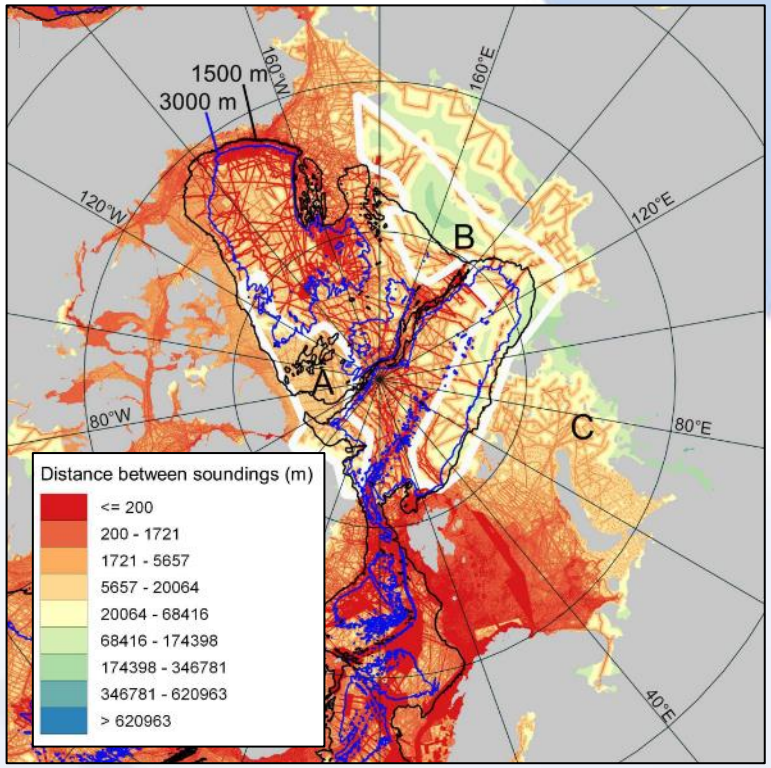
Barentswatch(Norway) App Ice info : 20km Grid, 6hour update, No drift Ice data



2. Limitations in gathering Sea depth Information







① Limited Data

② 400m resolution

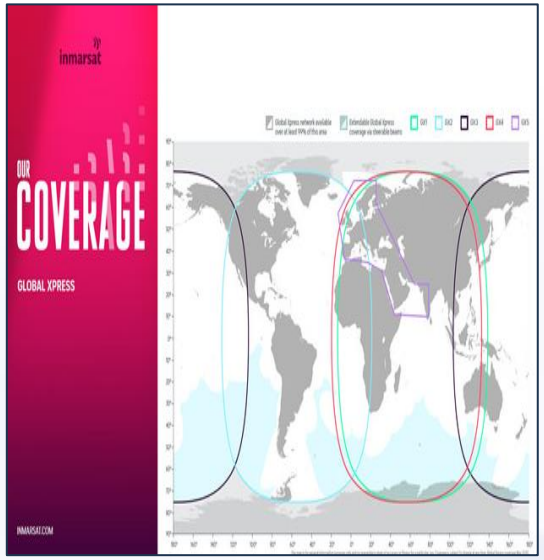
③ Infrequent updates

④ Inconsistent

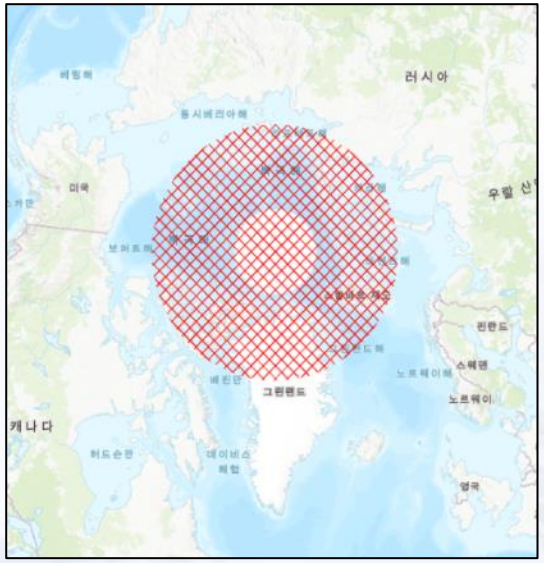
Limited depth information, low resolution, infrequent updates, and a lack of consistency make it unsuitable for use as navigational data

3. Challenges in obtaining Satellite/Infrastructure information

SATCOM(INMARSAT)
Service Coverage

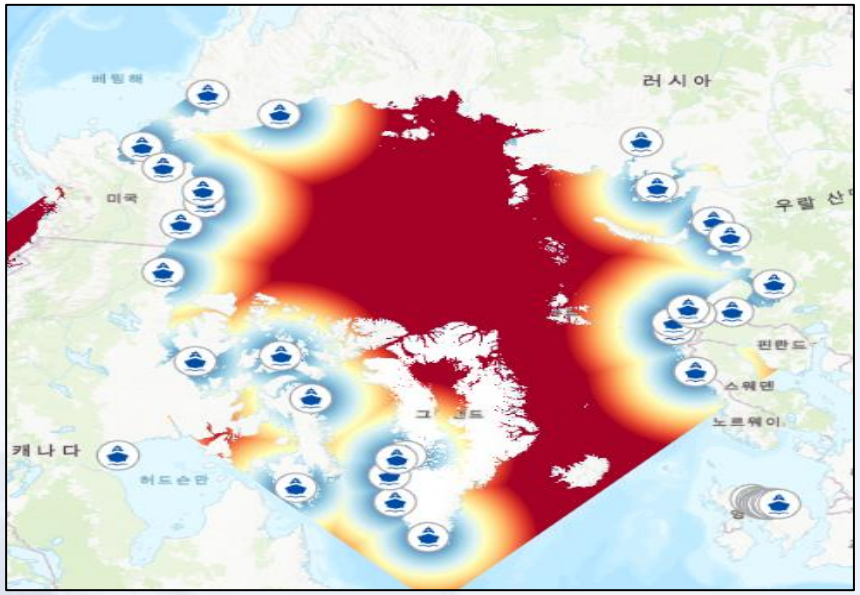


Blind Spot : Latitude
Exceeding 75 degrees



Unable to request rescue using satellite communication

Refuge Port



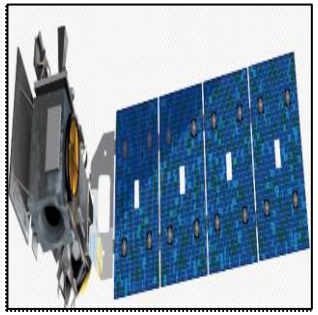
Unable to obtain information on the availability of refuge ports

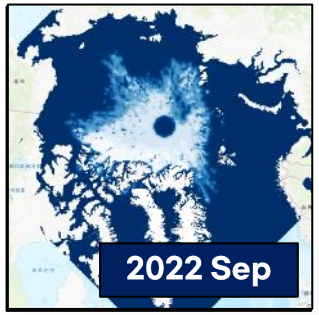
3. Solution

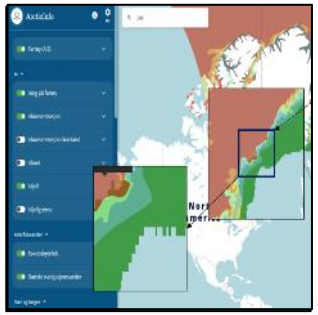
Technical advancement of e-navigation

1. E-navigation. Global mapping and information sharing system

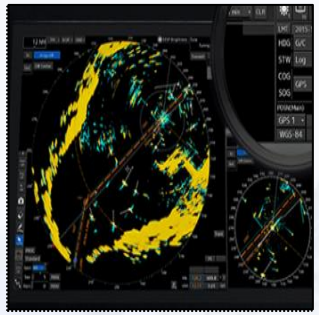
Ice data from satelite

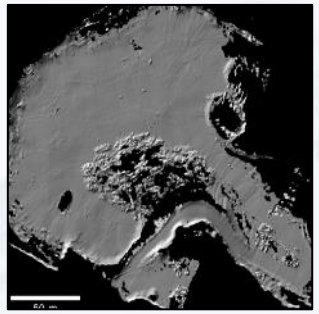




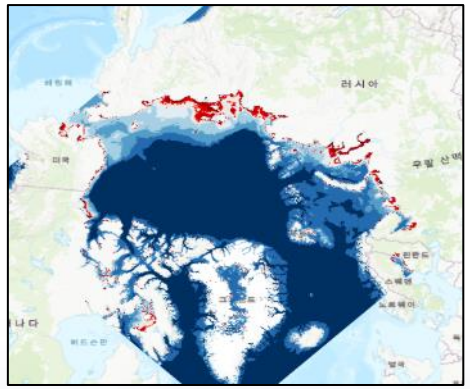


Radar Mobile Mapping System



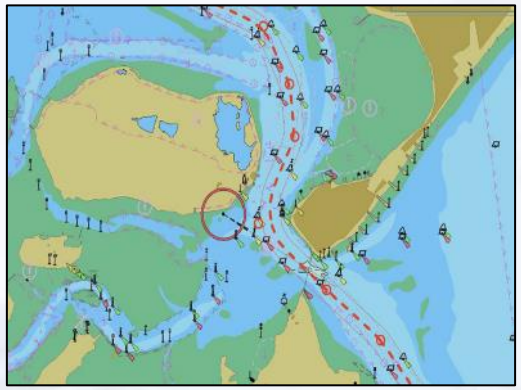


Integration of ice data from satelite
and on-site radar geo file data

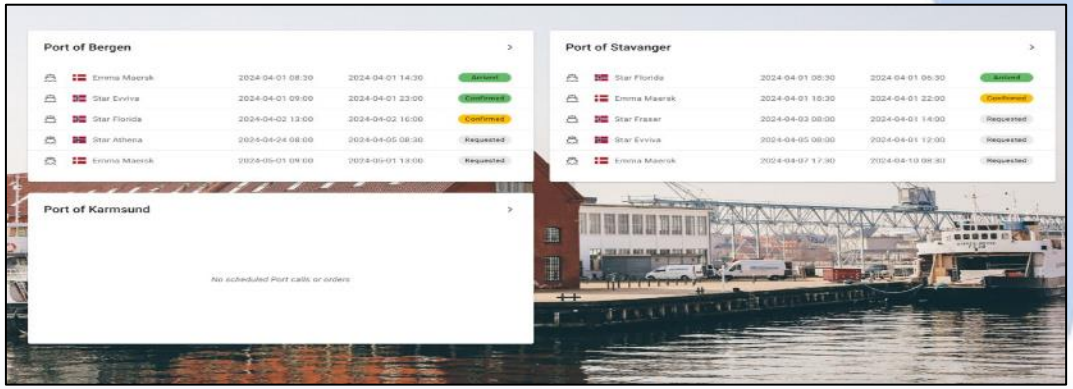


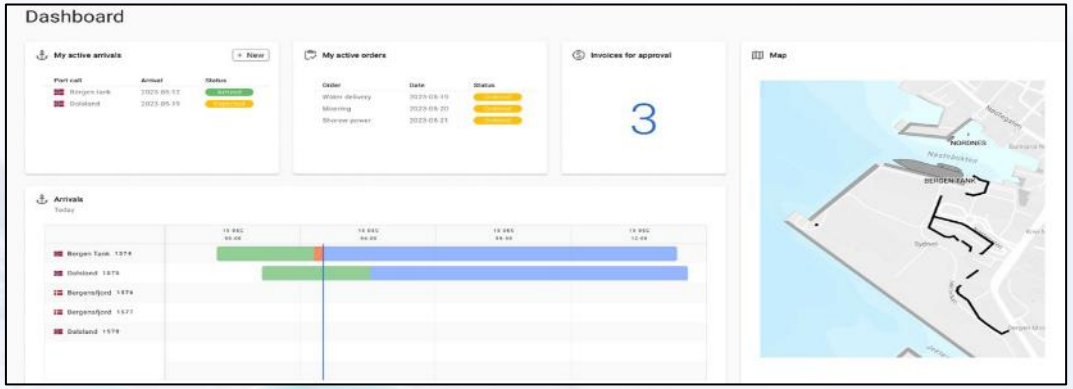
Integrate and display Data on reefs and hazards
detected by ships and sensors.

2. E-navigation. Integration with new technologies and information



Integration of ASBM and GMDSS
with e-navigation systems





Port management information system
on e-navigation

3. Importance of Continuous Updates in E-Navigation [MSC.1-Circ.1595]

MSC.1 / Circ.1595

E-navigation Strategy Implementation Plan (SIP)

Introduction

1 As shipping moves into the digital world, e-navigation is expected to provide digital information and infrastructure for the benefit of maritime safety, security and protection of the marine environment, reducing the administrative burden and increasing the efficiency of maritime trade and transport.

2 The Organization defines e-navigation as *the harmonized collection, integration, exchange, presentation and analysis of marine information on board and ashore by electronic means to enhance berth to berth navigation and related services for safety and security at sea and protection of the marine environment* (as defined in the Strategy for the development and implementation of e-navigation (MSC 85/26/Add.1, annex 20)). E-navigation is intended to meet present and future user needs through harmonization of marine navigation systems and supporting shore services. Hence, the implementation of e-navigation should be based on user needs and not be technology-driven. The user needs were agreed upon by the Sub-Committee on Safety of Navigation,[1] at its fifty-sixth session (NAV 56/WP.5/Rev.1, annexes 2 to 4), and are reproduced in annex 4 of this document.

3 The Strategy for the development and implementation of e-navigation assigns the governance of the e-navigation concept to IMO as the organization responsible for establishing mandatory standards for enhancing the safety of life at sea, maritime security and protection of the marine environment, as well as having global remit. In accordance with the strategy, the implementation of e-navigation is a phased iterative process of continuous development taking into account the evolution of user needs and the lessons learned from the previous phase.

4 It is important to understand that e-navigation is not a static concept and that the development of logical implementation phases will be ongoing as user requirements evolve and as technology develops, enabling more efficient and effective systems. If sufficient progress is made in the implementation, an e-navigation-enabling Performance Standard may be envisaged (see also sub-solution S4.1.10), providing a single-reference for e-navigation solutions.

⋮

7 According to paragraph 14 of the original SIP (NCSR 1/28, annex 7), which is also reproduced as paragraph 19 below, the SIP requires periodic updates.

8 The implementation strategy elements should, therefore, remain under review, and in light of recent technological developments, evolved user needs, new trends in the industry and progress made in the implementation of the SIP, NCSR 4 agreed to an update of the plan, including prioritization of the outputs and their reorganization so as to avoid duplication.

9 Consequently, the work to update the SIP was undertaken and completed by NCSR 5 in February 2018 and the updated SIP was approved by MSC 99 in May 2018.

10 Although the need to use existing equipment in a more holistic way was identified early on, some onboard equipment may need modifications to interfaces and controls. However, in the future, the need for new equipment for the deployment of future e-navigation solutions and applications cannot be disregarded.

11 The tasks listed in table 7 should be incorporated as outputs, taking into account the provisions of the *Organization and method of work of the Maritime Safety Committee and the Marine Environment Protection Committee and their subsidiary bodies*, as set out in MSC-MEPC.1/Circ.5, as may be revised (Organization and method of work).

12 In line with the provisions of the Organization and method of work, proposals to undertake e-navigation-related tasks by the Organization will need to be submitted to the Committee for approval and inclusion as output(s).

2 The Organization defines e-navigation as *the harmonized collection, integration, exchange, presentation and analysis of marine information on board and ashore by electronic means to enhance berth to berth navigation and related services for safety and security at sea and protection of the marine environment* (as defined in the Strategy for the development and implementation of e-navigation (MSC 85/26/Add.1, annex 20)). E-navigation is intended to meet present and future user needs through harmonization of marine navigation systems and supporting shore services. Hence, the implementation of e-navigation should be based on user needs and not be technology-driven. The user needs were agreed upon by the Sub-Committee on Safety of Navigation,[1] at its fifty-sixth session (NAV 56/WP.5/Rev.1, annexes 2 to 4), and are reproduced in annex 4 of this document.

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7 According to paragraph 14 of the original SIP (NCSR 1/28, annex 7), which is also reproduced as paragraph 19 below, the SIP requires periodic updates.

8 The implementation strategy elements should, therefore, remain under review, and in light of recent technological developments, evolved user needs, new trends in the industry and progress made in the implementation of the SIP, NCSR 4 agreed to an update of the plan, including prioritization of the outputs and their reorganization so as to avoid duplication.

4. Proposal for Specific Maritime Services (using the template in appendix 1)

RESOLUTION MSC.467(101) (adopted on 14 June 2019)
GUIDANCE ON THE DEFINITION AND HARMONIZATION OF THE FORMAT AND STRUCTURE OF MARITIME SERVICES IN THE CONTEXT OF E-NAVIGATION

APPENDIX 1

TEMPLATE FOR DRAFT DESCRIPTIONS OF MARITIME SERVICES IN THE CONTEXT OF E-NAVIGATION

This template should be used to describe Maritime Services. Descriptions of Maritime Services provided to IMO using this template will enable IMO to exercise leadership and overarching oversight and to provide a globally harmonized list of recognized Maritime Services.

To ensure a standardized approach in the development and implementation of Maritime Services, the content should include a general description of the operational services, and a reference to associated technical services that will enable the exchange of information in digital format.

1 **Title of the Maritime Service (Maritime Service number)**

2 **Submitting organization**

3 **Coordinating body**

4 **Description of the Maritime Service**

Stating the exact nature and scope of the Maritime Service in accordance, if applicable, with existing IMO instruments. Additional details might be added for clarity as required.

5 **Purpose**

What is the purpose of the Maritime Service?

What value does it bring to its intended stakeholders?

Is the Maritime Service compliant with regulatory requirements, if applicable?

In the case that the Maritime Service covers existing services, a description of the steps required to transition from analogue to digital information promulgation must be included.

6 **Operational approach**

How is the purpose of the Maritime Service achieved, taking into account existing guidance of the Organization and other international bodies?

7 **User needs**

Describe the user needs the Maritime Service addresses. In so doing make reference to any relevant IMO instruments and, where applicable, include one or more use cases.

8 **Information to be provided**

List the information elements the Maritime Service provides. The information elements will be the starting point for data modelling, as part of the technical services to access, promulgate or exchange the information.

9 **Associated technical services**

Using the table below list existing or potential technical services associated with this Maritime Service.

Name	ID (MRN) [1]	Description *(incl. measure for quality assurance[2])*	Standardization body

10 **Relation to other Maritime Services**

Describe any relationships between this and other Maritime Services such as interdependencies or areas of overlap. This section should clarify the nature of interdependencies, overlaps and provide recommendations for their resolution.

User needs & Information to be provided	
Crowd Sourcing of Ice Information	Display data that combines Arctic sea ice data measured by satellites with drifting ice data collected through radar mobile mapping by vessels navigating in the field
Hazard zone	Features for sharing and displaying the locations of reefs, shallow waters, and hazardous materials
Distress Signal Relay	Integration with ASBM, GMDSS system and e-navigation for distress signal relay and display functions within the e-navigation framework
Real time Pilotage, port information	A real-time information provision system for port availability and pilotage support times
Meteorological Information	Service to facilitate the efficient, uniform, streamlining of information.

5. Providing Data in Alignment with the S-100 Framework

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GUIDANCE ON THE DEFINITION AND HARMONIZATION OF THE FORMAT AND STRUCTURE OF MARITIME SERVICES IN THE CONTEXT OF E-NAVIGATION

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Annex 19, page 6

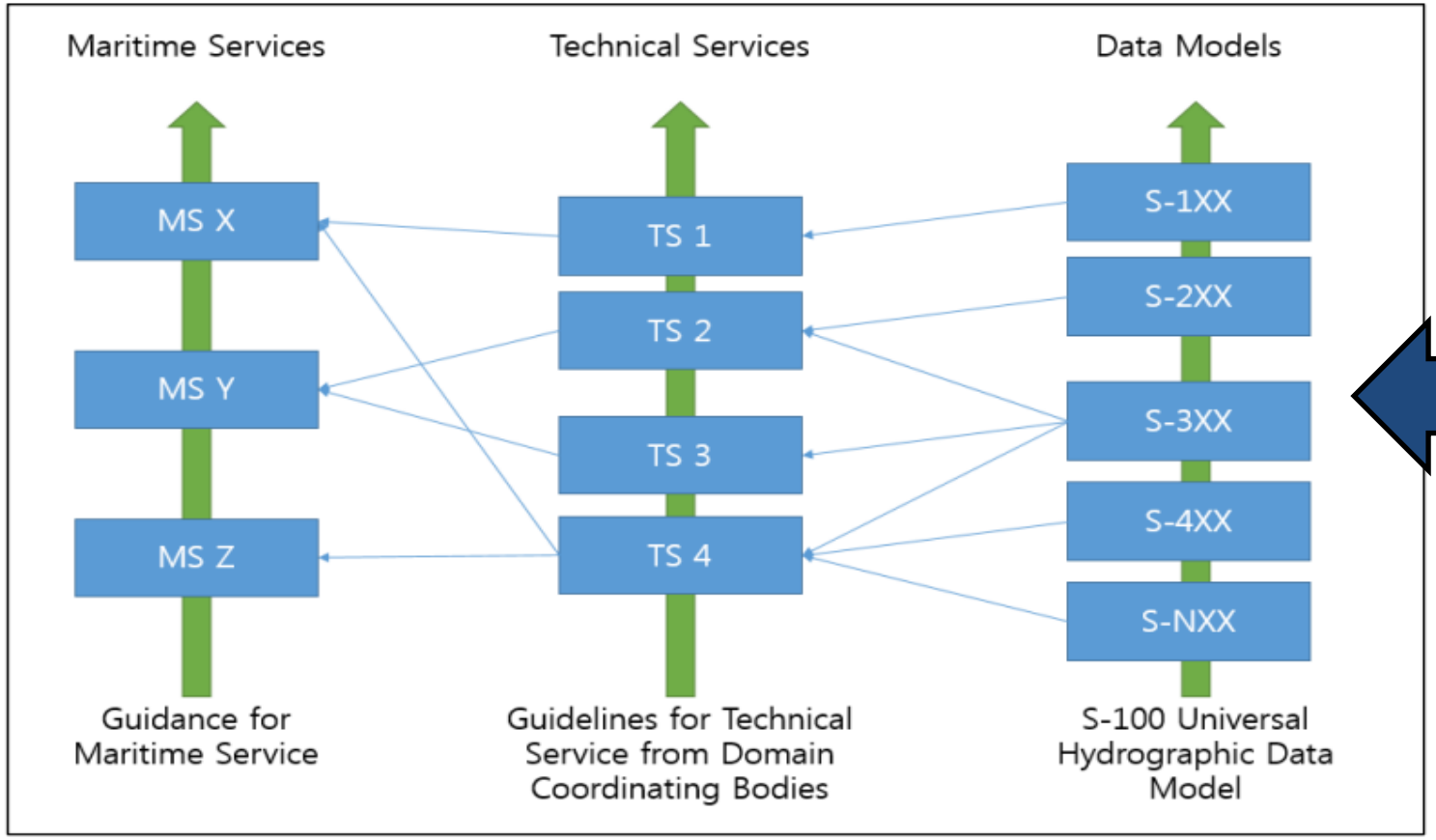
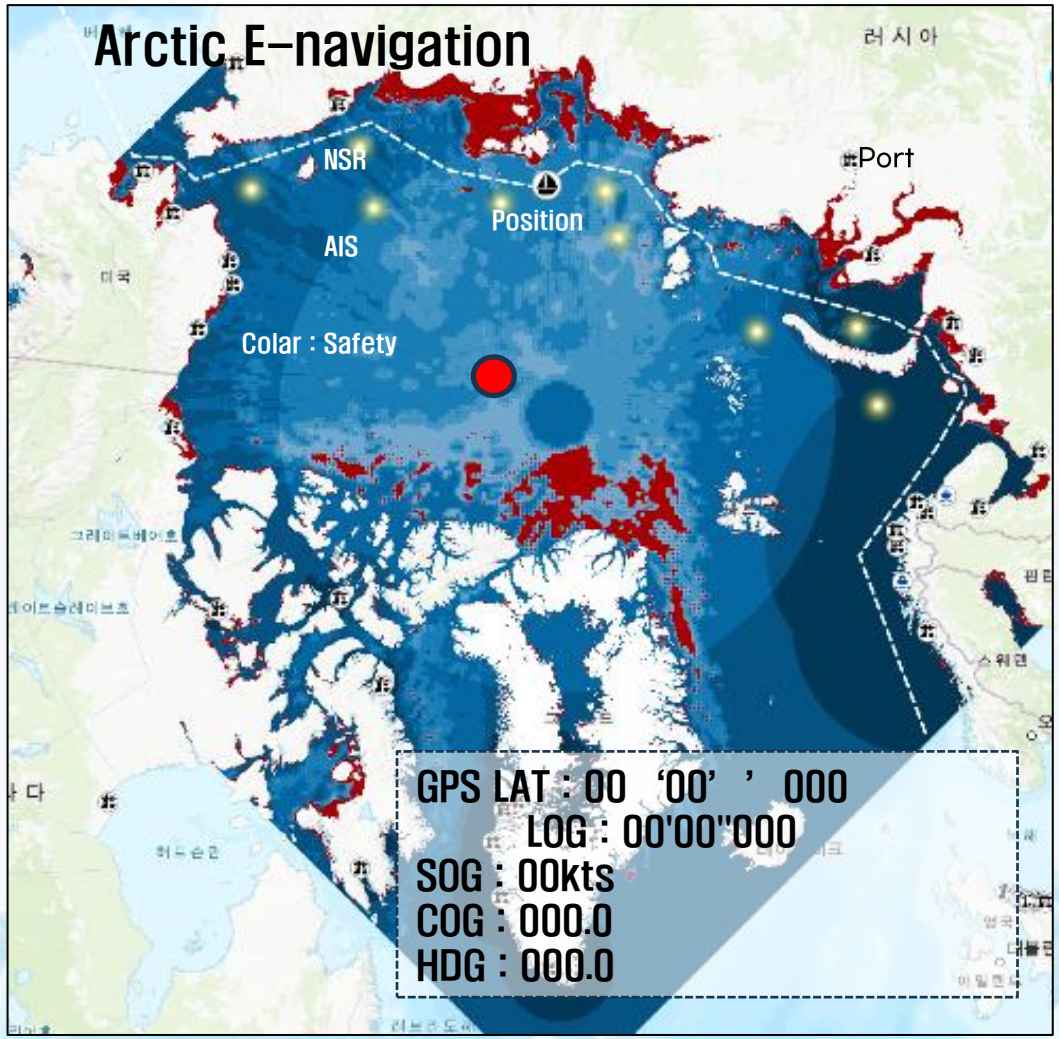


Figure 2: Interaction between different service levels

WORLD METEOROLOGICAL ORGANIZATION
IHO
IALA
BIMCO
NSIDC
National Snow and Ice Data Center
University of Colorado at Boulder
KYSTVERKET

4. Conclusion

Conclusion


Arctic E-navigation
NSR
Position
Port
AIS
Colar : Safety
GPS LAT : 00 '00' ' 000
LOG : 00'00"000
SOG : 00kts
COG : 000.0
HDG : 000.0


Opportunity
risk
E-navigation
IMO Mission
Safety

Thank you for Your Attention