

Arctic Regional Hydrographic Commission (ARHC)

Status of Arctic Hydrography and Nautical Charting

Mr. Denis Hains

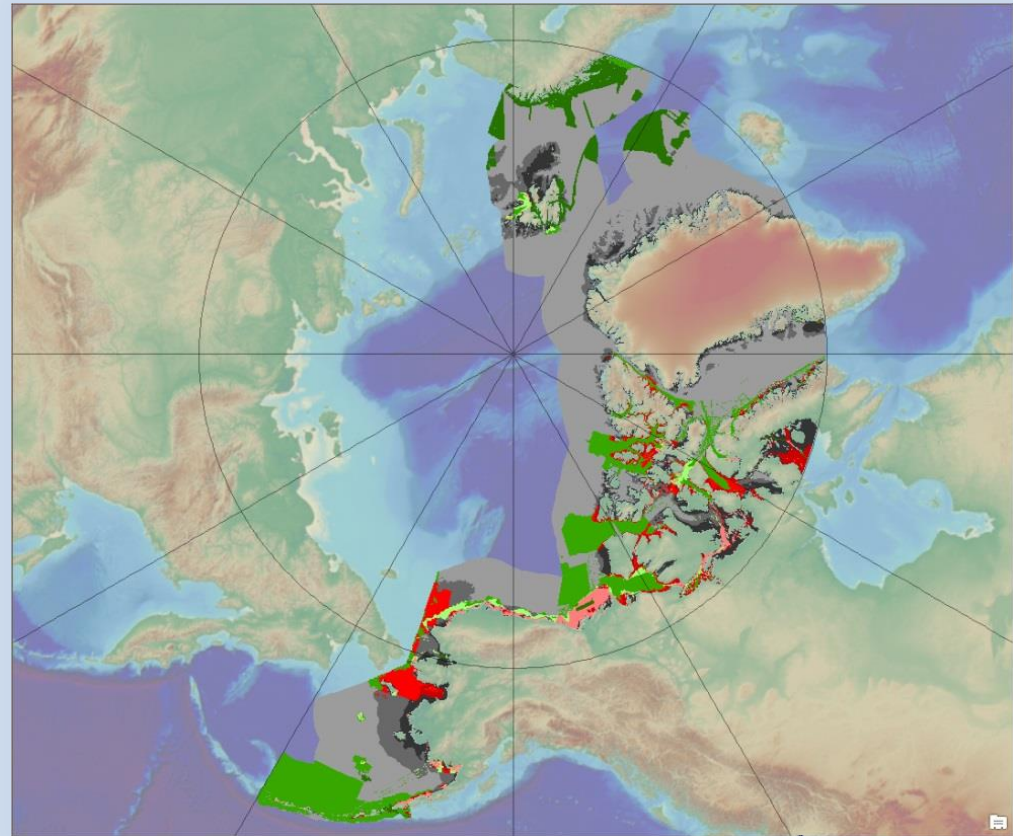
Director General, Canadian Hydrographic Service
Hydrographer General of Canada
Fisheries and Oceans Canada

2014 Vice Chair,
Arctic Regional Hydrographic Commission (ARHC)

PAME II-2014

Whitehorse Yukon Territory, Canada

September 16, 2014



Presentation to PAME II 2014



Arctic Regional Hydrographic Commission (ARHC)

Purpose

- PAME's request of the ARHC
- What is the ARHC?
- The results of this initial evaluation
- Continued partnership to build a safer Arctic



To: Evert Flier, Chair, ARHC and Director Norwegian Hydrographic Service,
Email: evert.flier@kartverket.no
Cc: Robert Ward, President, IHO; Email: robert.ward@iho.int

April 24, 2014

I am following up with you on our previous communications with respect to the possibility of a representative from the Arctic Regional Hydrographic Commission (ARHC) attending the next PAME meeting (PAME II-2014 meeting) which will be convened during the 3rd week of September (15-19 Sep) in Whitehorse, Yukon, Canada.

PAME has been implementing many of the 17 recommendations set forth in the Arctic Marine Shipping Assessment (AMSA) Report which was endorsed by the Arctic Council Ministers in 2009. Of particular relevance are [AMSA Recommendations I\(A\)](#) and [III\(A\)](#) which encourage PAME to identify areas of common interest and develop unified positions and approaches with respect to international organizations like the International Hydrographic Organization, and recognize that critical infrastructure improvements in the Arctic are needed with respect to navigational charts.

At PAME's February 2014 meeting, member governments adopted the following Record of Decision (RoD):

*PAME thanks the Arctic Regional Hydrographic Commission (ARHC) for their letter of 7 February responding to **PAME's invitation for information on the currency and accuracy of hydrography and nautical charting in the Arctic**. PAME is very interested in further dialogue and cooperation with the ARHC. PAME requests the Secretariat to invite the ARHC to attend PAME II-2014, present a more comprehensive Arctic hydrography and nautical charting status report, and identify opportunities for further collaboration between the ARHC and PAME.*

Soffia Gudmundsdottir
PAME Executive Secretary



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Arctic Regional Hydrographic Commission (ARHC)



Background

- Independent and voluntary group, established in 2010
- Canada, Denmark, Norway, Russian Federation, United States of America; Finland and Iceland are Associate Members
- One of 15 Regional Hydrographic Commissions (RHCs) delivering International Hydrographic Organization (IHO) objectives

Strategic Directions

- Facilitate international collaboration and discussion of Arctic hydrography
- Promote technical cooperation and enhance data collection
- Improve Arctic Marine Spatial Data Infrastructure (MSDI)
- Strengthen cooperation to support navigational safety, economic development and protect the environment
- Raise awareness of needs of hydrography in the Arctic

Goals consistent with recommendations of Arctic Marine Shipping Assessment (AMSA), 2013

Hydrography underpins

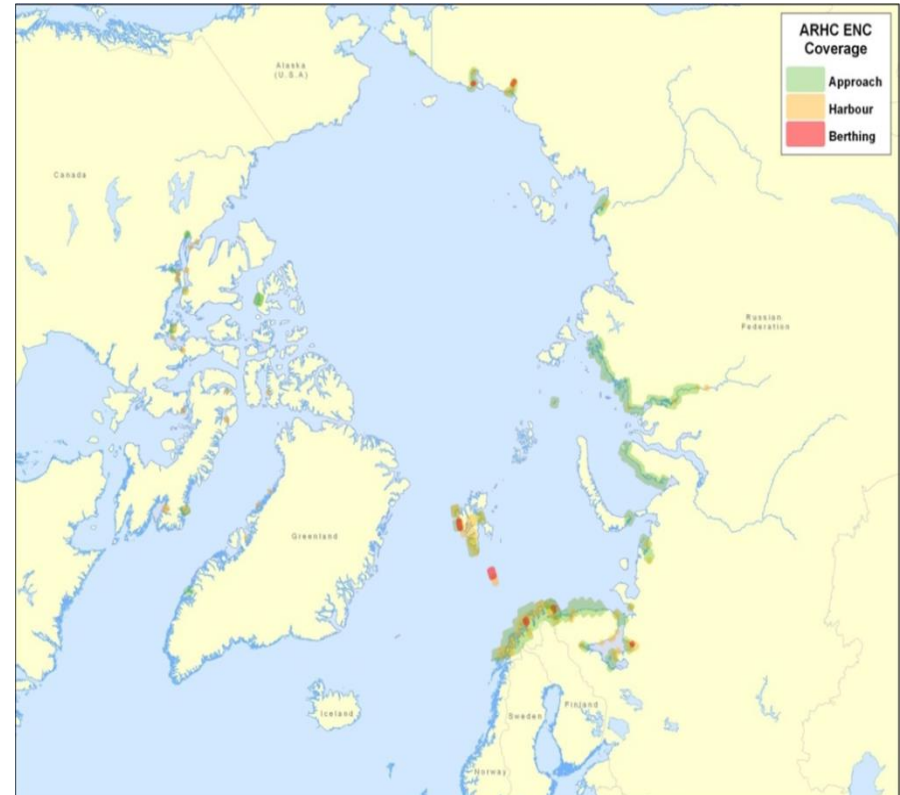
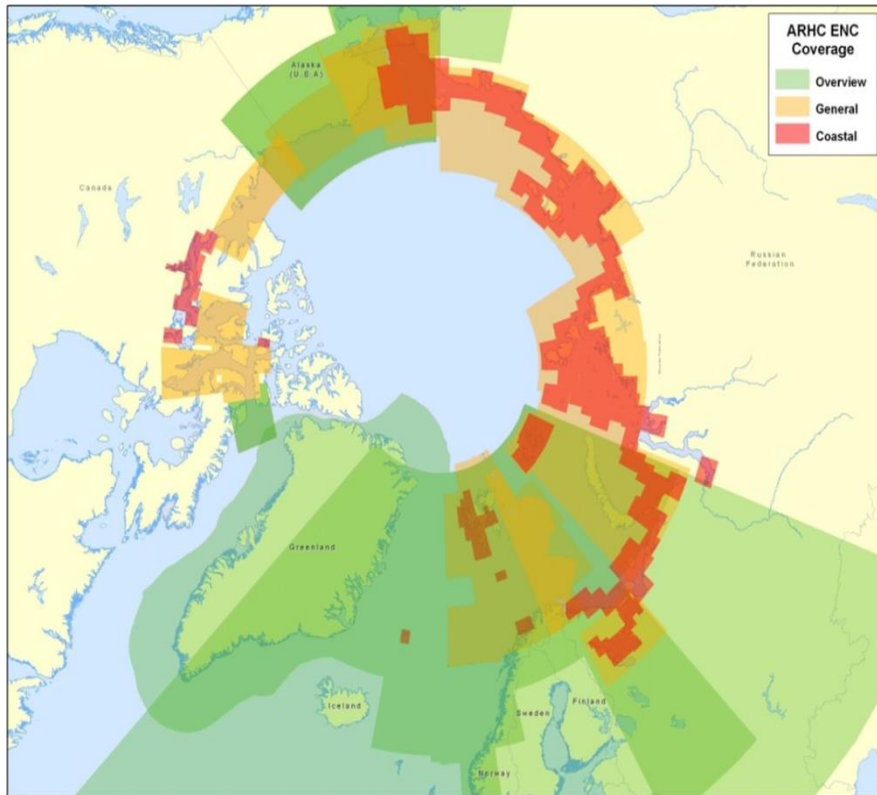
- Navigation and safety at sea
- Resource exploitation - fishing, minerals, ...
- Marine environmental protection and management
- Maritime boundary delimitation
- National and Arctic marine spatial data infrastructures
- Recreational boating
- Search and rescue; maritime defense and security
- Oceanography; tsunami flood and inundation modelling
- Coastal zone management
- Tourism; eco-tourism and cruise ships
- Marine science
- Efficient marine transportation



Arctic Regional Hydrographic Commission (ARHC)

Isn't the Arctic already charted?

- Chart coverage vs data coverage vs waterway usage



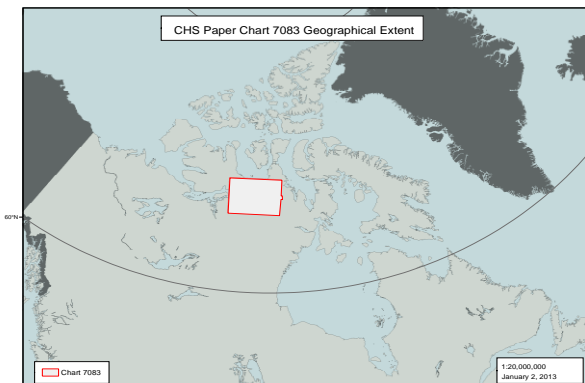
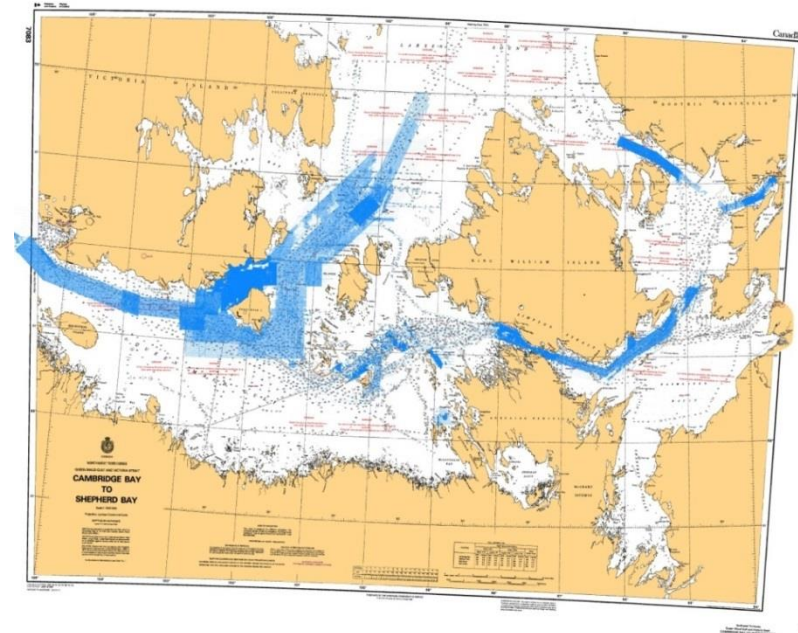
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...Only a fraction of the data in this chart is “adequate”...

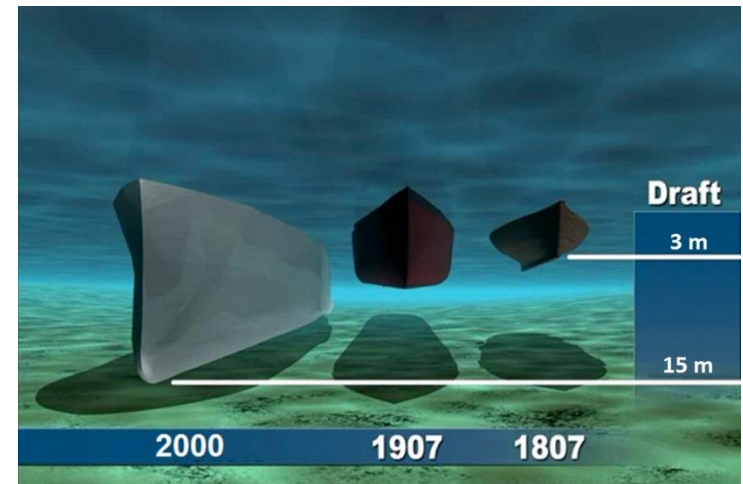
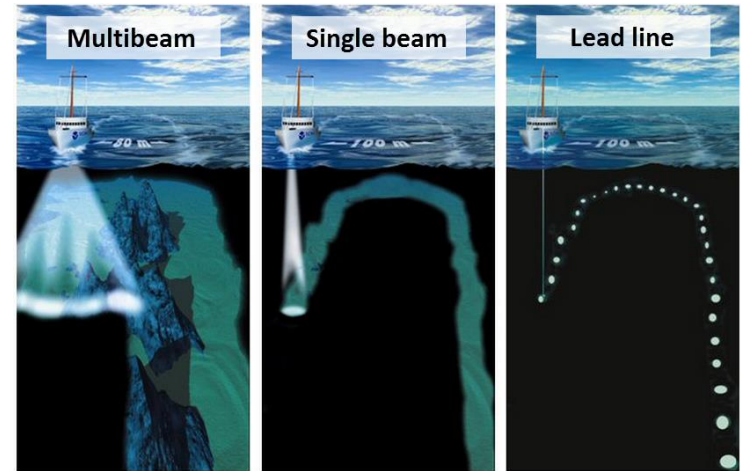
- Arctic **challenges** include:
 - Precise positioning
 - Harsh environment (limited survey window; ice-capable platforms and support)
 - Telecommunications
 - Complex seafloor
- Areas of existing adequate data may not correspond with areas of current and future risk.
- Proper analysis of hydrographic and navigational information is a key tool for pragmatic prioritization of the hydrographic challenges in the vast Arctic region.



Arctic Regional Hydrographic Commission (ARHC)

Higher resolution is required

- Ships are getting bigger
- Marine transportation still cost-effective
 - Remote communities
 - Production sites
- Arctic is getting more accessible
 - Commercial shipping
 - Cruise Industry
 - Private pleasure craft
 - Commercial fishing industry
 - Maritime boundary and mineral rights claims



ARHC's methodology to addressing charting adequacy:

1. Assess confidence of the present hydrographic holdings (Age of data, Type of coverage, etc.).
2. Divide ocean into general depth categories (shallow, mid-depth, deep) factoring in seafloor complexity .
3. Intersect confidence (#1) with depth bands (#2) to develop potential areas of concern.
4. Assess historic traffic patterns as they relate to the areas of concern (#3).
5. Generate maps and statistics which can guide decision-making processes.

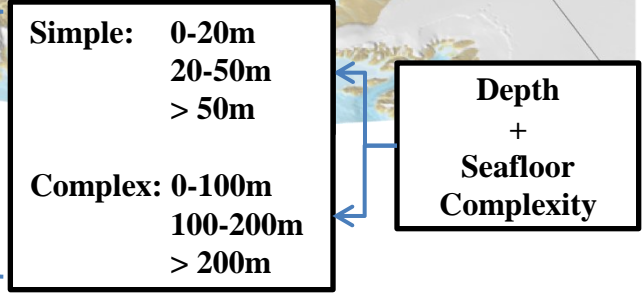
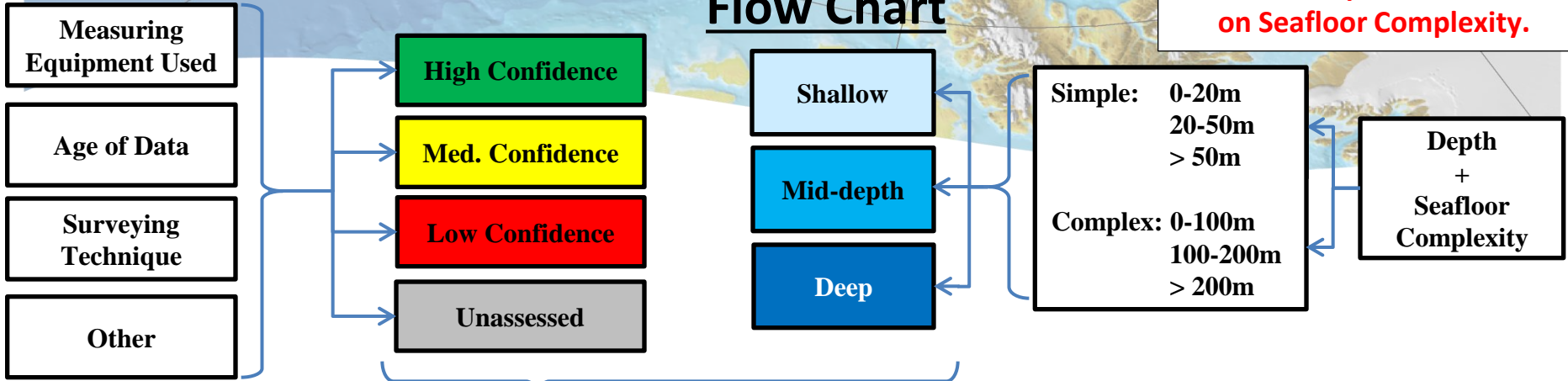


Assessing Arctic Survey Adequacy Methodology

Flow Chart

1. Determine Confidence of Hydrographic Holdings.

2. Define Depth Bands based on Seafloor Complexity.



3. Intersect Areas of Confidence with Depth Areas to determine Potential Areas of Concern.

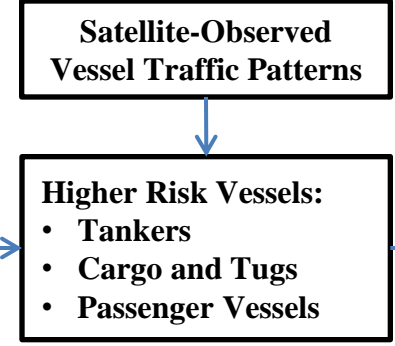
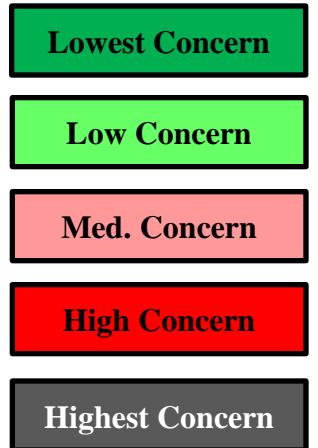
4. Extract "High Risk" Vessel Traffic Tracklines and Intersect with Potential Areas of Concern.

(e.g. Higher Confidence and/or Deeper Depths)

↑

↓

(e.g. Lower Confidence and/or Shallower Depths)



Output:

- Frequency of Vessels transiting within Areas of Higher/Lower Concern...
- ... thus quantifying whether region is adequately charted.

5. Compute Area Geometry of Potential Areas of Concern and Linear Distance Traversed by Vessel Traffic within each Area type.

Demonstration of Methodology

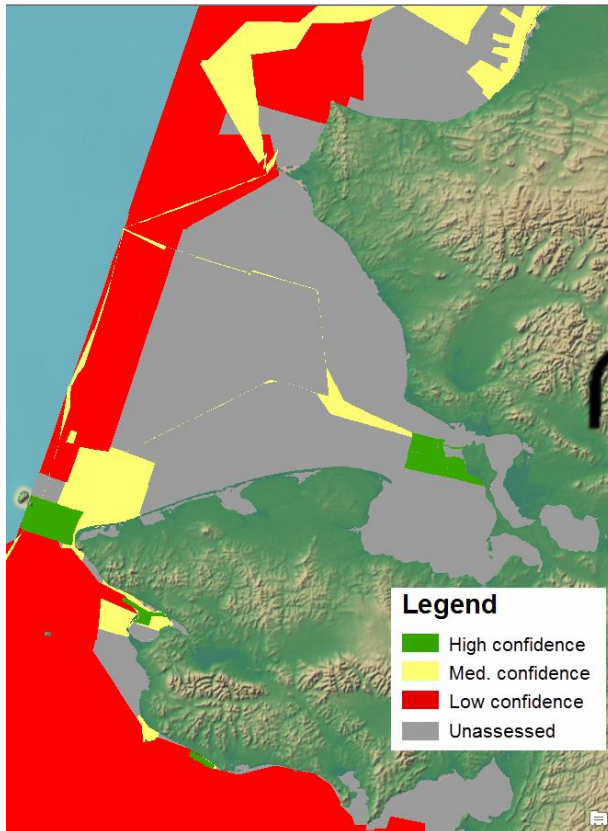


- Demonstrate the process via example...
- Iterate through steps for a sample region (Eastern side of Bering Strait, *USA vicinity)...

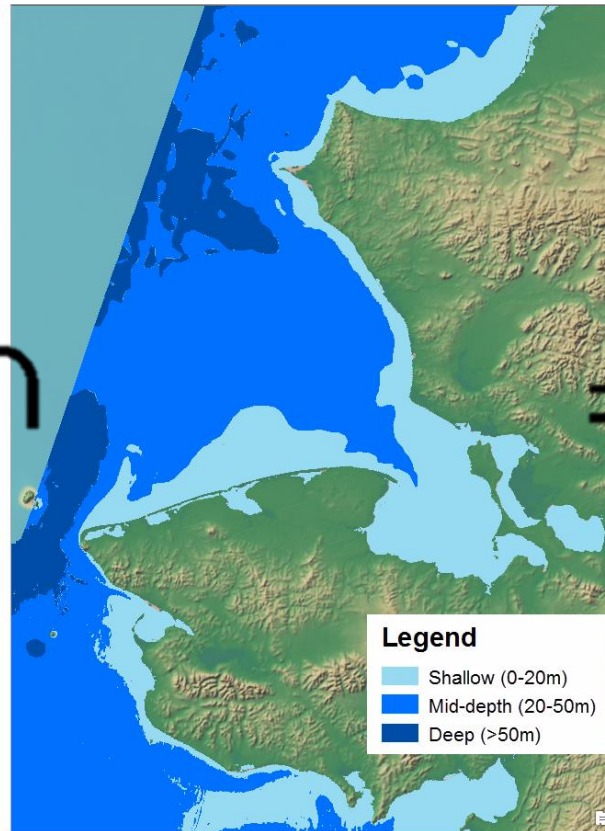
** NB The area depicted on all next slides (and throughout this analysis and project) is in no way representative of any cadastral claims by any nation.*

Demonstration of Methodology

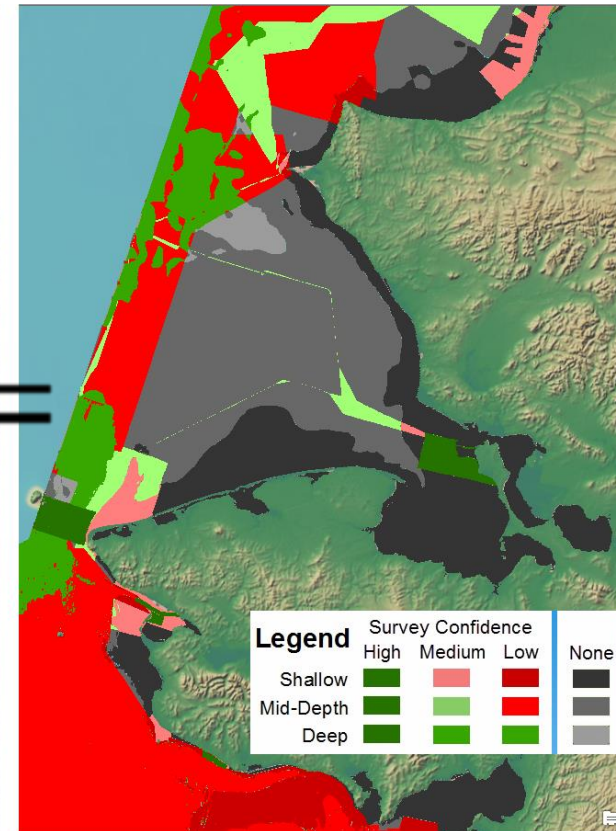
Areas of Confidence



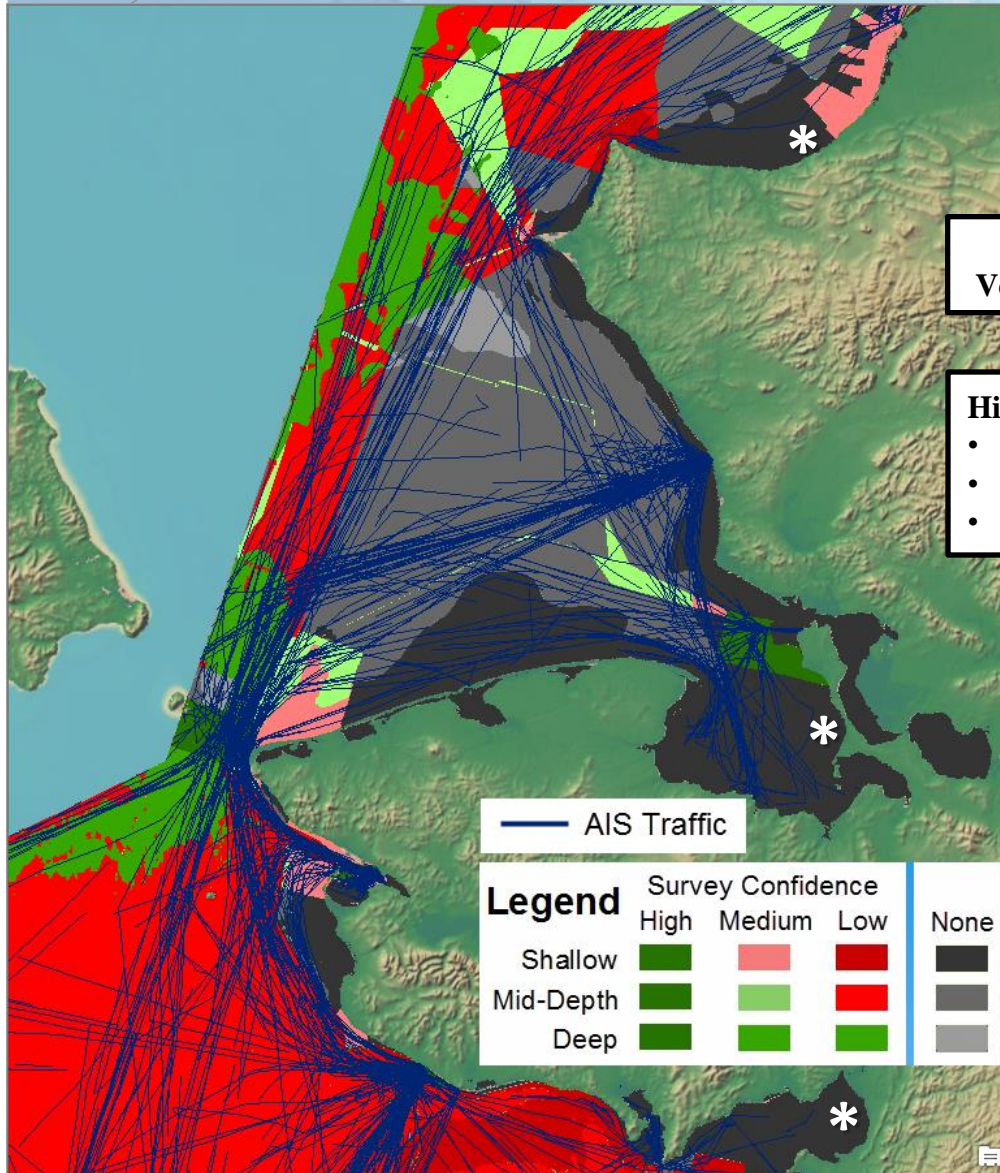
Depth/Complex Areas



Potential Areas of Concern



Demonstration of Methodology



4. Extract “High Risk” Vessel Traffic Tracklines and Intersect with Potential Areas of Concern.

Satellite-Observed Vessel Traffic Patterns

Higher Risk Vessels:

- Tankers
- Cargo and Tugs
- Passenger Vessels

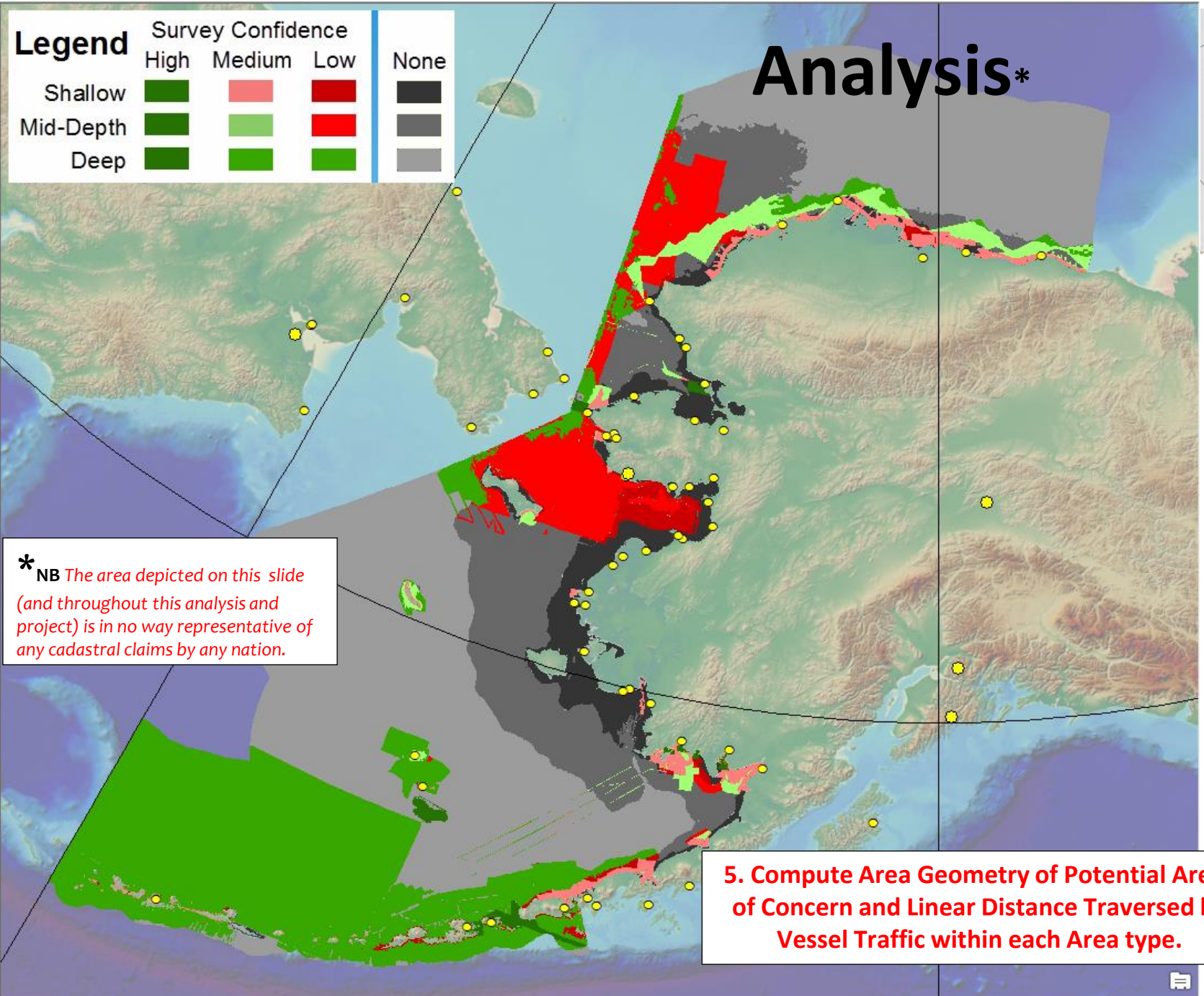
Output:

- Frequency of Vessels transiting within Areas of Higher/Lower Concern...
- ... thus quantifying whether region is adequately charted.

- Notice there are three shallow bays with an Unassessed confidence (marked with an *)...
- While all three were previously identified as potential areas of concern, only the center one experiences heavy traffic (thus, it could be increased in survey priority over the others).

Analysis*

Legend	Survey Confidence			None
	High	Medium	Low	
Shallow	Dark Green	Light Green	Red	Black
Mid-Depth	Dark Green	Light Green	Red	Grey
Deep	Dark Green	Light Green	Red	Grey















***NB** The area depicted on this slide (and throughout this analysis and project) is in no way representative of any cadastral claims by any nation.

5. Compute Area Geometry of Potential Areas of Concern and Linear Distance Traversed by Vessel Traffic within each Area type.













Quantifying and Interpreting the data...

Area of each depth/confidence regime within the Arctic, in the vicinity of the United States, in square kilometers (sq.km).

		Vicinity of United States											
		Confidence Level											
		High		Medium		Low		Unassessed					
		sq. km	%Total	sq. km	%Total	sq. km	%Total	sq. km	%Total				
Depth (m)	Shallow		7,151	0.4%		46,340	2.4%		61,288	3.2%		101,443	5.3%
	Mid-Depth		2,280	0.1%		48,647	2.6%		150,830	7.9%		252,610	13.2%
	Deep		3,613	0.2%		26,111	1.4%		368,836	19.3%		838,347	44.0%
Total			13,044	0.7%		121,098	6.3%		580,954	30.5%		1,192,400	62.5%

* - Depth ranges (0-20m, 20-50m, >50m)

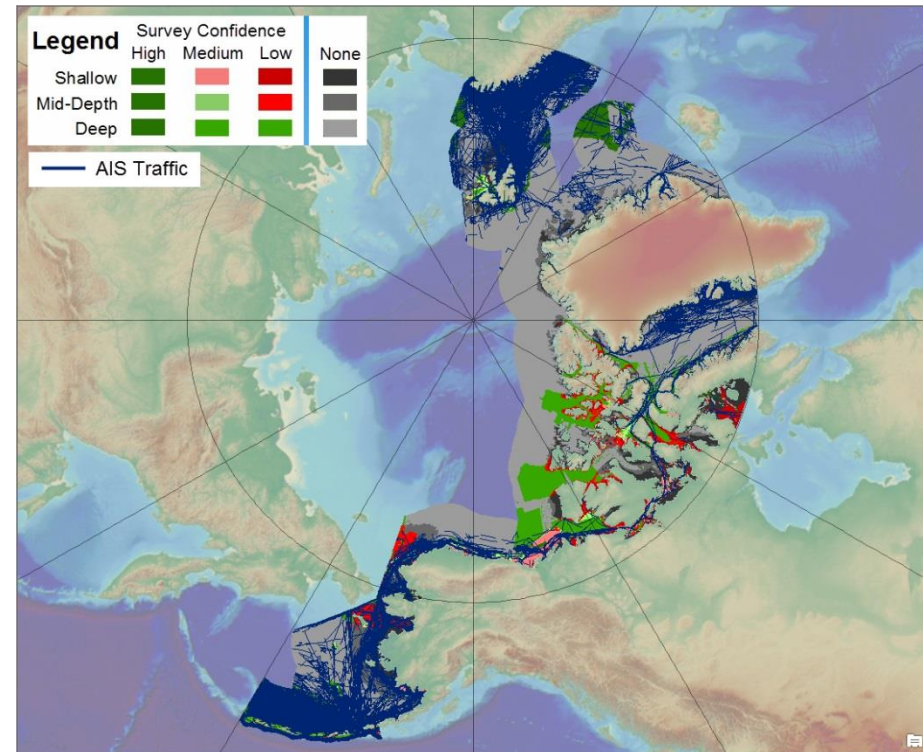
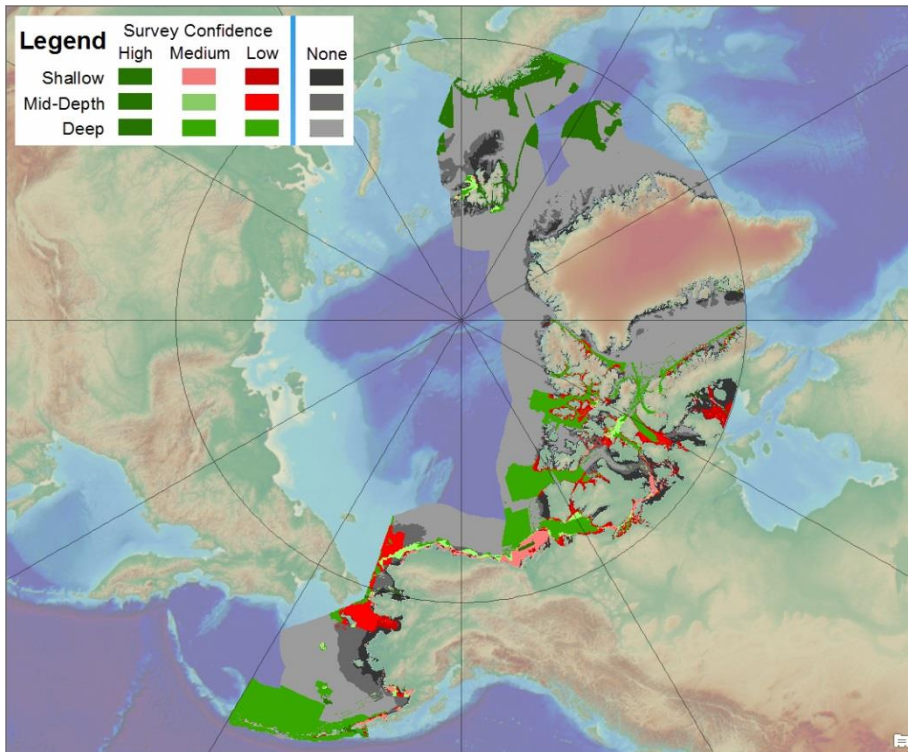
Transit lengths of “high risk” vessels within each depth/confidence regime within the Arctic, in the vicinity of the United States, in linear nautical miles (LNM).

		Vicinity of United States											
		Confidence Level											
		High		Medium		Low		Unassessed					
		LNM	%Total	LNM	%Total	LNM	%Total	LNM	%Total				
Depth (m)	Shallow		5,595	0.3%		31,657	1.4%		11,598	0.5%		160,641	7.3%
	Mid-Depth		2,034	0.1%		40,244	1.8%		66,028	3.0%		24,854	1.1%
	Deep		320,822	14.5%		21,633	1.0%		1,393,156	62.9%		137,675	6.2%
Total			328,451	14.8%		93,534	4.2%		1,470,782	66.4%		323,170	14.6%

* - Depth ranges (0-20m, 20-50m, >50m)













Total Linear Nautical Miles of Traffic (USA): 2,214,721

Analysis on a regional scale...



Analysis on a regional scale...













Area of each depth/confidence regime within the Arctic (combination of Canada, Greenland, Norway and United States study areas), in linear nautical miles (LNM).

Combination of Canada, Greenland, Norway and United States study areas													
		Confidence Level											
		High		Medium		Low		Unassessed					
		sq. km	%Total	sq. km	%Total	sq. km	%Total	sq. km	%Total				
Depth (m)	Shallow		51,151	0.7%		154,062	2.2%		186,537	2.7%		562,359	8.0%
	Mid-Depth		53,158	0.8%		102,116	1.5%		241,096	3.4%		664,923	9.5%
	Deep		301,997	4.3%		166,100	2.4%		772,807	11.0%		3,762,086	53.6%
Total			406,306	5.8%		422,278	6.0%		1,200,440	17.1%		4,989,368	71.1%

Legend

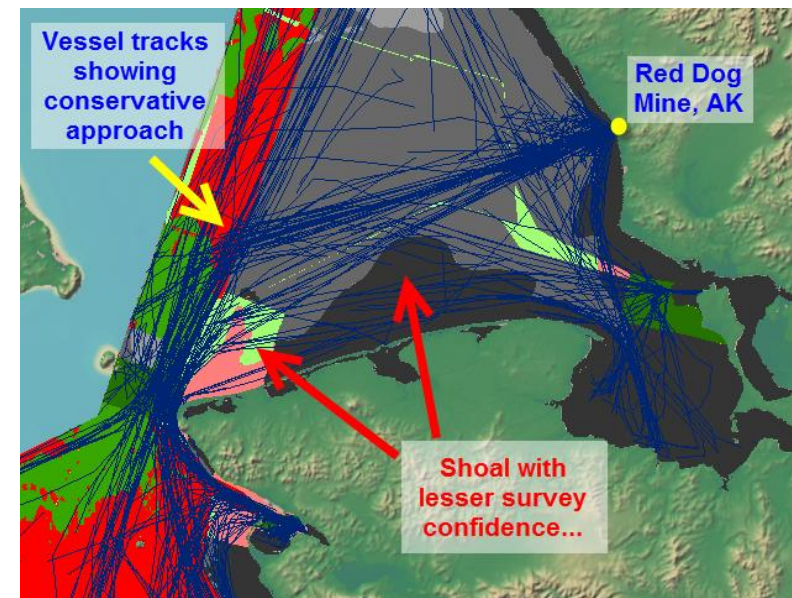
- Shallow
- Mid-Depth
- Deep

Transit lengths of “high risk” vessels within each depth/confidence regime in the Arctic (combination of Canada, Greenland, Norway, & U.S. study areas), in linear nautical miles (LNM).

Combination of Canada, Greenland, Norway and United States study areas													
		Confidence Level											
		High		Medium		Low		Unassessed					
		LNM	%Total	LNM	%Total	LNM	%Total	LNM	%Total				
Depth (m)	Shallow		477,412	9.1%		127,673	2.4%		17,800	0.3%		211,972	4.0%
	Mid-Depth		576,983	11.0%		71,396	1.4%		69,372	1.3%		70,048	1.3%
	Deep		1,419,646	27.1%		103,136	2.0%		1,399,784	26.7%		690,968	13.2%
Total			2,474,041	47.2%		302,205	5.8%		1,486,956	28.4%		972,988	18.6%

Caution should be used when interpreting the data...

- The vessel traffic was acquired over a span between June 2012 and July 2013; it is a snapshot of where vessels have transited in the past, which is not necessarily indicative of the emerging needs within the Arctic (e.g. establishment of new ports and terminals, increased trans-Arctic transits, etc.)
- While a disproportionate amount of vessel traffic occurs within areas of high confidence bathymetry; this may be a function of mariners performing their own risk analysis and sticking to the known “safe” waters, rather than risking the shorter routes through questionable waters.



The analysis tells us:

1. There are vast portions of the Arctic that are **not adequately surveyed** .
2. There is **navigation risk** and the risk is increasing.
3. Navigated routes may expand **beyond adequate chart coverage** (e.g. ice conditions may force vessels out of charted corridors).
4. **Collaboration and sharing of information is necessary.**



Key messages

1. Hydrography and charting matter!

- Critical foundation for the protection of the Arctic marine environment and economic development through safe navigation and better science which underpins:
 - Safe and efficient maritime commerce
 - Resilient coastal communities
 - Ecosystem management (e.g. sensitive areas, marine protected areas)

2. ARHC is the expert group actively conducting hydrography-related science and analysis in the Arctic.

- Independent, inter-governmental, open, and assessable
- Committed to long-term partnerships
- This work is just beginning



Arctic Regional Hydrographic Commission (ARHC)

Next Steps

1. ARHC will produce and publish a Paper of this first Analysis.
2. In what ways can ARHC assist PAME?
3. How can we increase data sharing throughout the region?
 - Local knowledge and community input
 - Crowd sourcing
 - Distill information on marine protected and sensitive areas
 - Ships/platforms of opportunity
 - Satellite and aerial derived information (e.g. bathymetry)
 - Marine spatial data infrastructure (MSDI)
4. ARHC special session in October to share PAME feedback and directions

ARHC is looking forward to update PAME



Presentation to PAME II 2014



Questions?

ARHC Website at IHO:

http://iho.int/srv1/index.php?option=com_content&view=article&id=435&Itemid=690

Thank you!



Presentation to PAME II 2014



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