

Seabed 2030 Arctic – Antarctic – North Pacific Mapping Meeting 2018
October 8-10, 2018 Stockholm

OCEAN MAPPING & DATA MANAGEMENT

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Canadian Hydrographic Service (CHS)



Topics

- Description of current and planned MB systems for CHS
- Techniques employed during acquisition of MB bathymetry in ice covered waters
- Oceans Protection Plan & Data Sources
- Data Coverage and availability



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- **Description of current and planned MB systems for CHS**
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Surveying in Arctic Waters – The Assets

Multi-beam sonars in icebreakers

- 2014 - First deep water MB system was installed on *CCGS Louis S. ST-Laurent* for MB data acquisition in the Arctic in support of Canada's Law of The Sea Program.



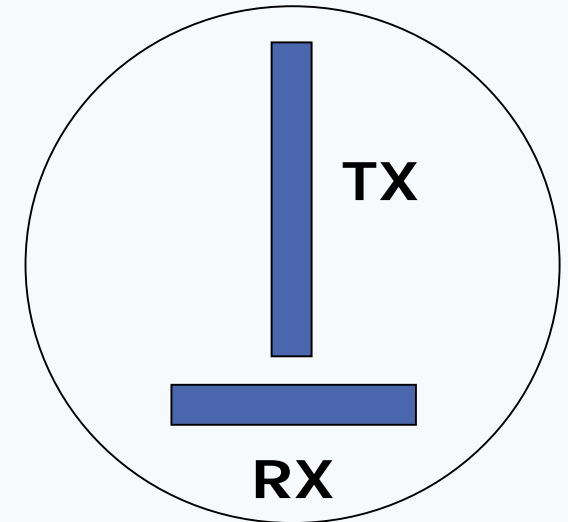
Technical specifications for multibeam systems

System	EM 2040	EM 2040 with Dual RX	EM 3002S	EM 3002D	EM 710	EM 302	EM 122
Operating frequency (kHz)	200 to 400	200 to 400	300	300	70 to 100	30	12
Range (m)	0.5 to 500	0.5 to 500	0.5 to 250	0.5 to 250	3 to 2000	10 to 7000	50 to 11000
Maximum coverage (cold sea, gravel)	>700m 140dg 5.5x water depth	>800m 200 dg 10x water depth	300m 130 dg 4x water depth	>300m 200 dg 10x water depth	2500m 140 dg 5.5x water depth	>8km 150dg 5.5x water depth	>30km 150dg 6x water depth
Beamwidths (degrees)	TX: 0.5, 1 RX: 1 (at 300kHz)	TX: 0.5, 1 RX: 1 (at 300kHz)	TX: 1.5 RX: 1.5	TX: 1.5 RX: 1.5	TX: 0.5, 1, 2 RX: 1, 2 (at 100kHz)	TX: 0.5, 1, 2, 4 RX: 1, 2, 4	TX: 0.5, 1, 2 RX: 1, 2, 4
System accuracy	>2cm	>2cm	~ 5-10 cm	~ 5- 10 cm	0.2 % x water depth	0.2 % x water depth	0.2 % x water depth
Maximum number of soundings per ping	Up to 800	Up to 1600	254	508	Up to 800	Up to 864	Up to 864
Pulse form	CW & FM	CW & FM	CW	CW	CW & FM	CW & FM	CW & FM
Pulse length	25us-12ms	25us-12ms	50us-400us	150us-400us	150us-120ms	0.7ms - 200ms	2ms - 100ms
Max pingrate (Hz)	50	50	40	40	>30	>10	>5
Transducer depth rating	6000m	6000m	500m, 1500m	500m, 1500m	250m	NA	NA
Ice protection	N/A	N/A	N/A	N/A	Yes	Yes	Yes

Surveying in Arctic Waters – The Assets (con't)

Multi-beam sonars in icebreakers

- EM122 TX and Rx Arrays in Mills Cross configuration.



Mills cross

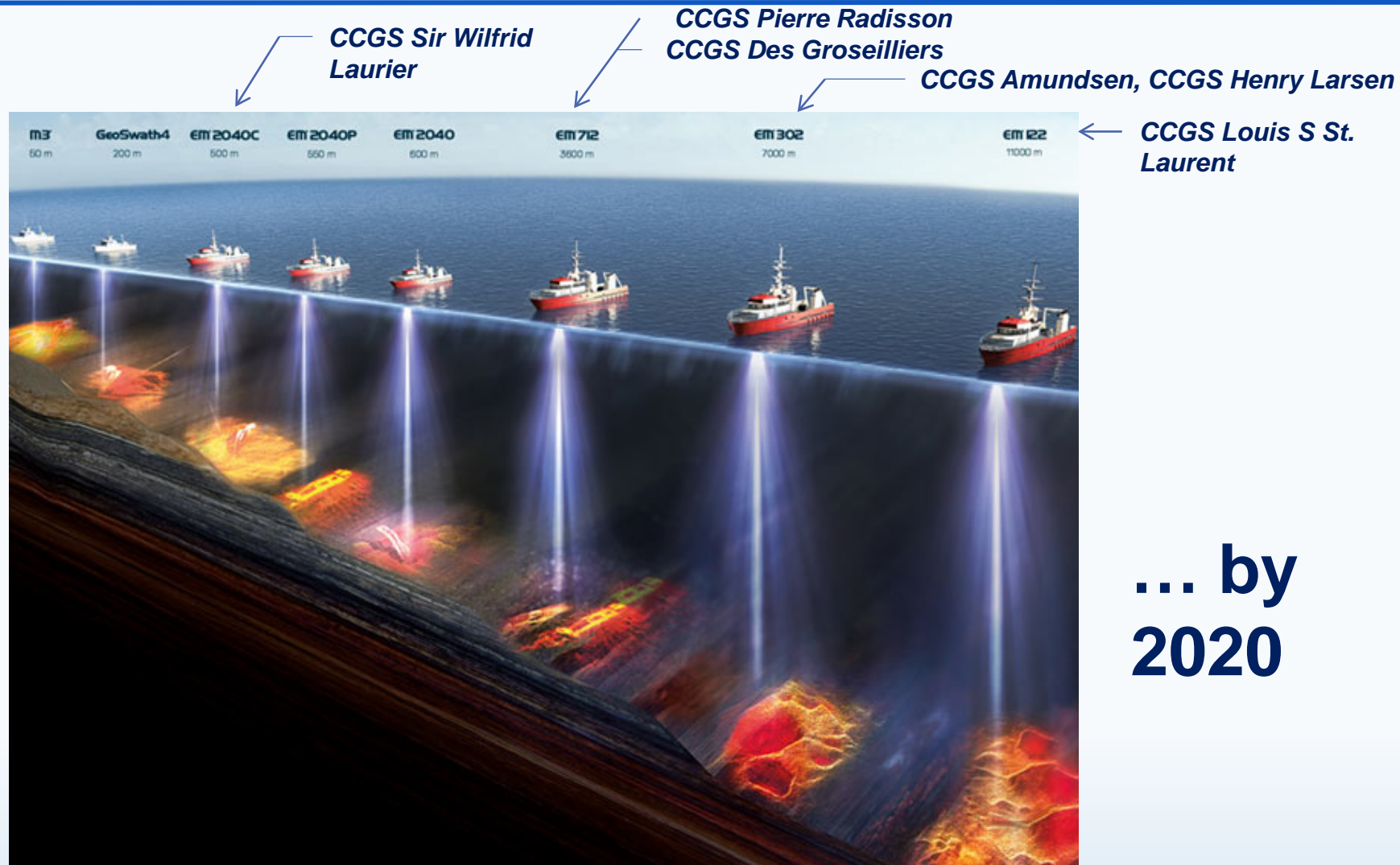
Surveying in Arctic Waters –The Assets (con't)

Multi-beam sonars in icebreakers

- Equipping the remaining icebreaking fleet with state-of-the-art multi-beam sonar systems will significantly accelerate the government's capacity to collect much needed hydrographic data in key areas.
- 2017/2018 – MBES for *CCGS Des Groseilliers*, *Pierre Radisson* and *Henry Larsen* procured
- 2018/2019 – *CCGS Des Groseilliers*, MBES installed during dry-dock period May – July
- 2018/2019 – MBES install *CCGS Henry Larsen* operational for 2018 field season
- 2019/2020 – first operation field season for *CCGS Des Groseilliers*
- 2020 – MBES install on *CCGS Pierre Radisson*
- 2020/2021 field season: all three ships operational



Surveying in Arctic Waters –The Assets (con't)



... by
2020



Topics

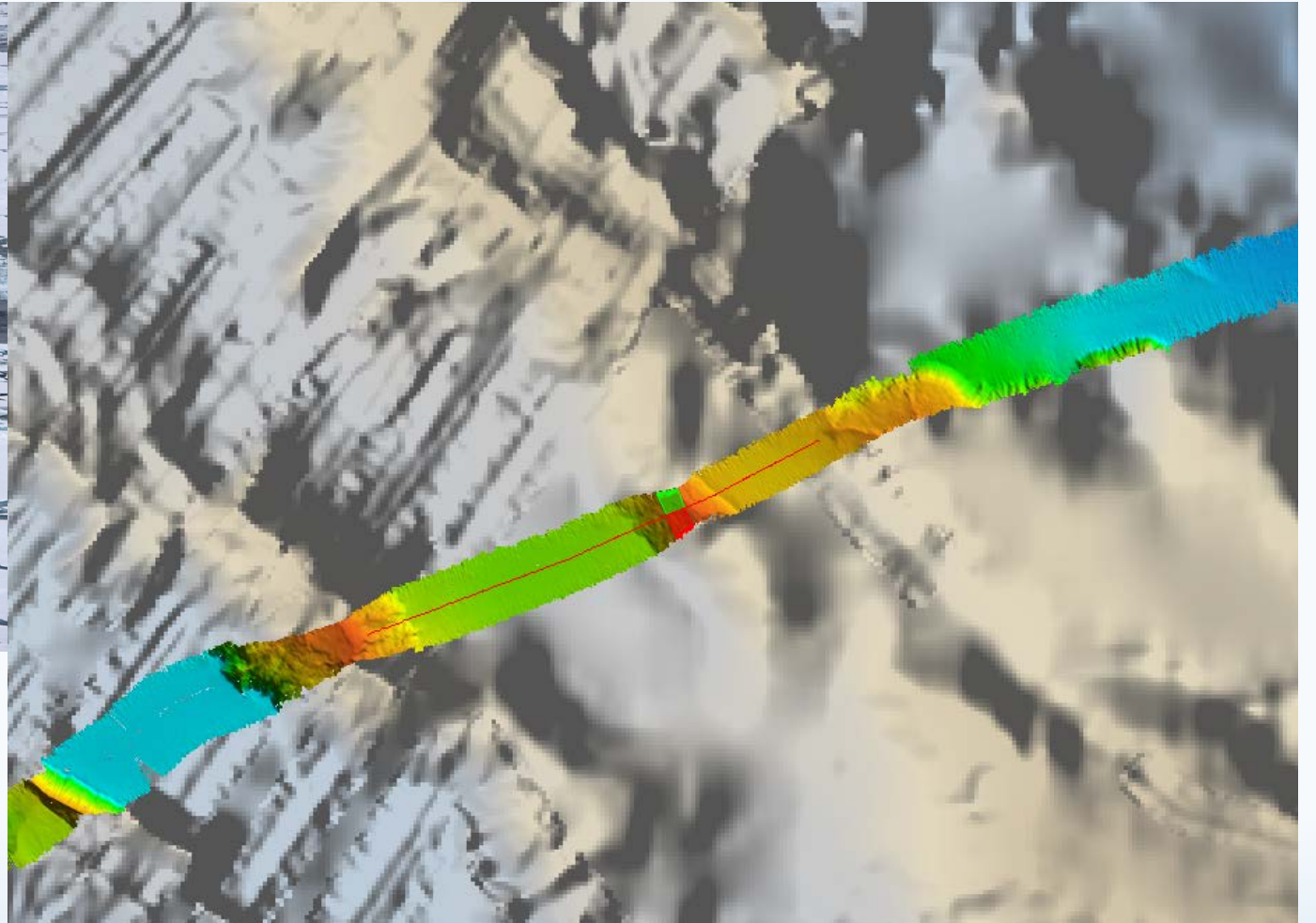
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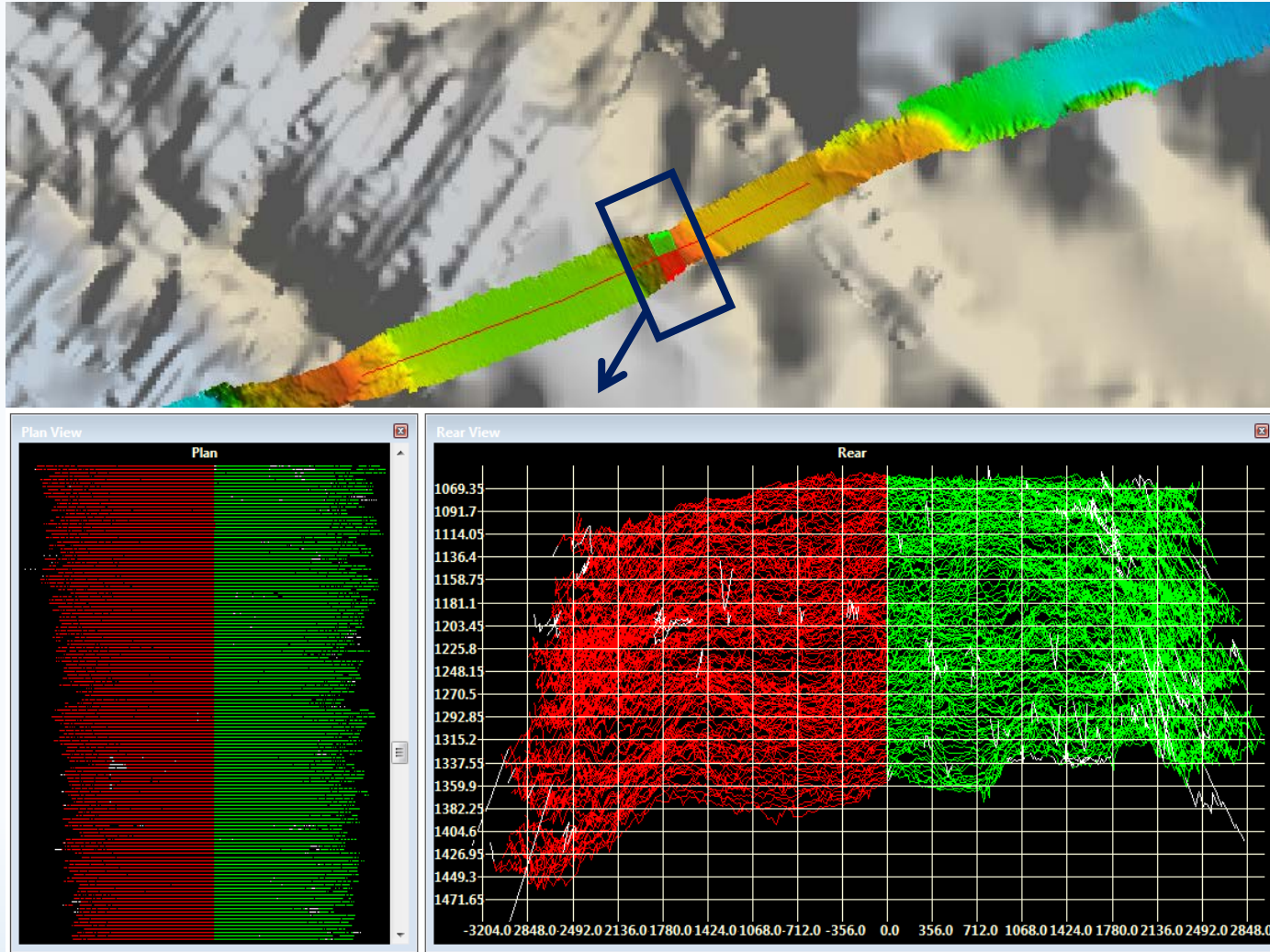
Surveying in Arctic Waters – A Technique



Example of data quality in
light to no ice conditions



Surveying in Arctic Waters – A Technique (con't)



We see a full gridded data set and minimal noise in the data during MB acquisition in light ice conditions

CARIS HIPS/SIPS used to process MB data



Surveying in Arctic Waters – A Technique (con't)



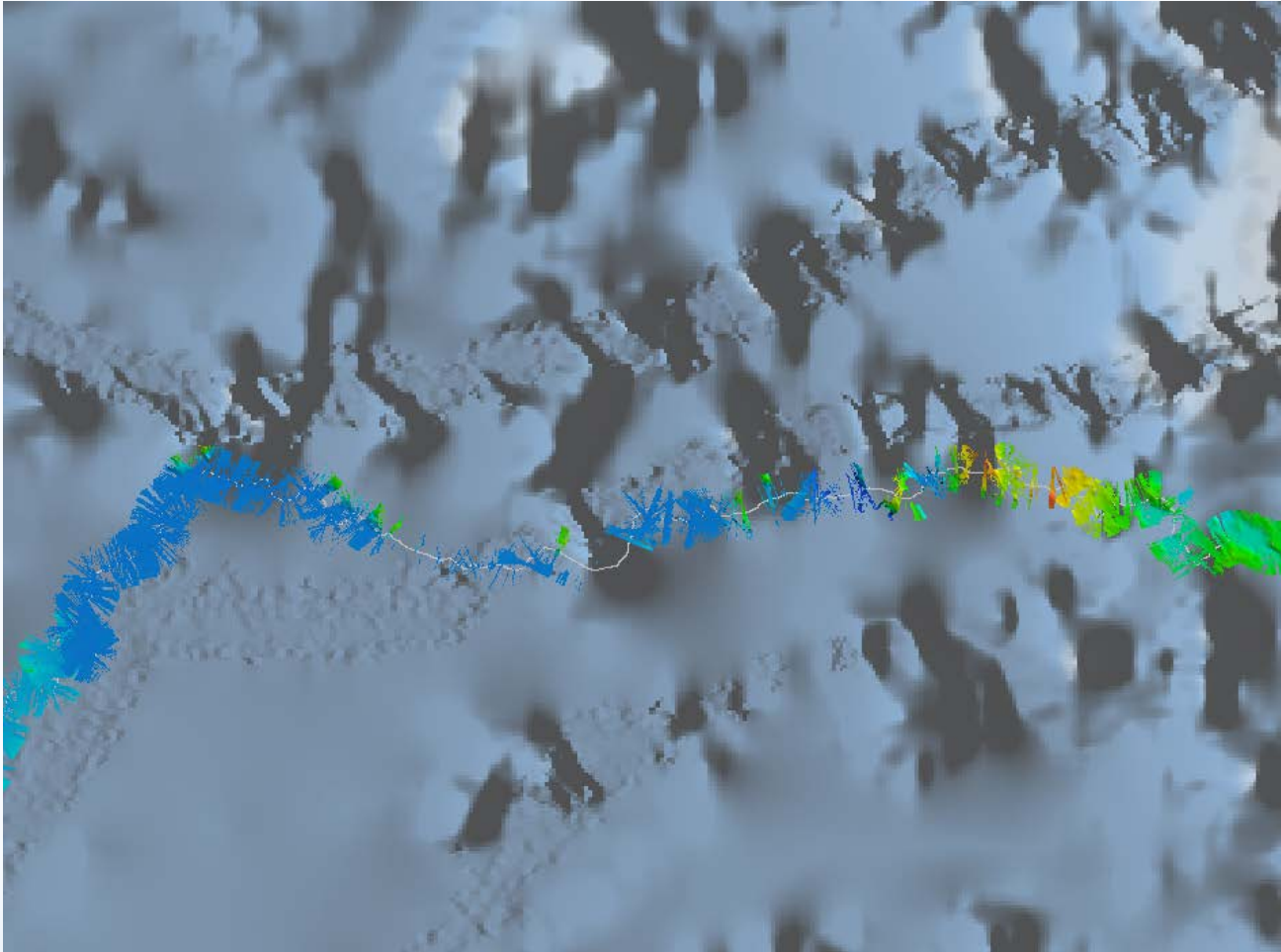
What happens
when we get
into multi-year
ice?



Surveying in Arctic Waters – A Technique (con't)

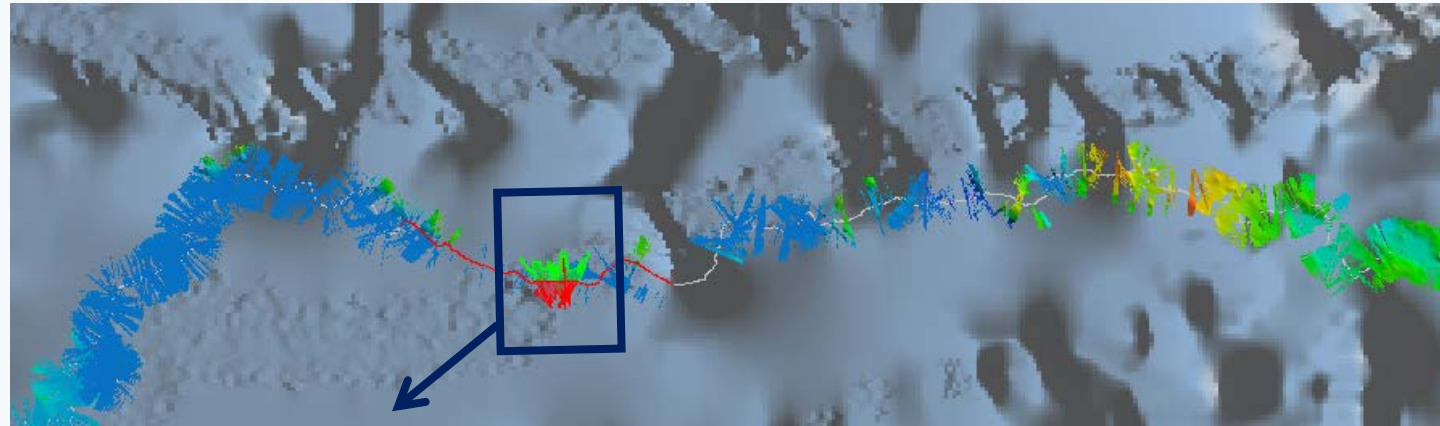


Surveying in Arctic Waters – A Technique (con't)



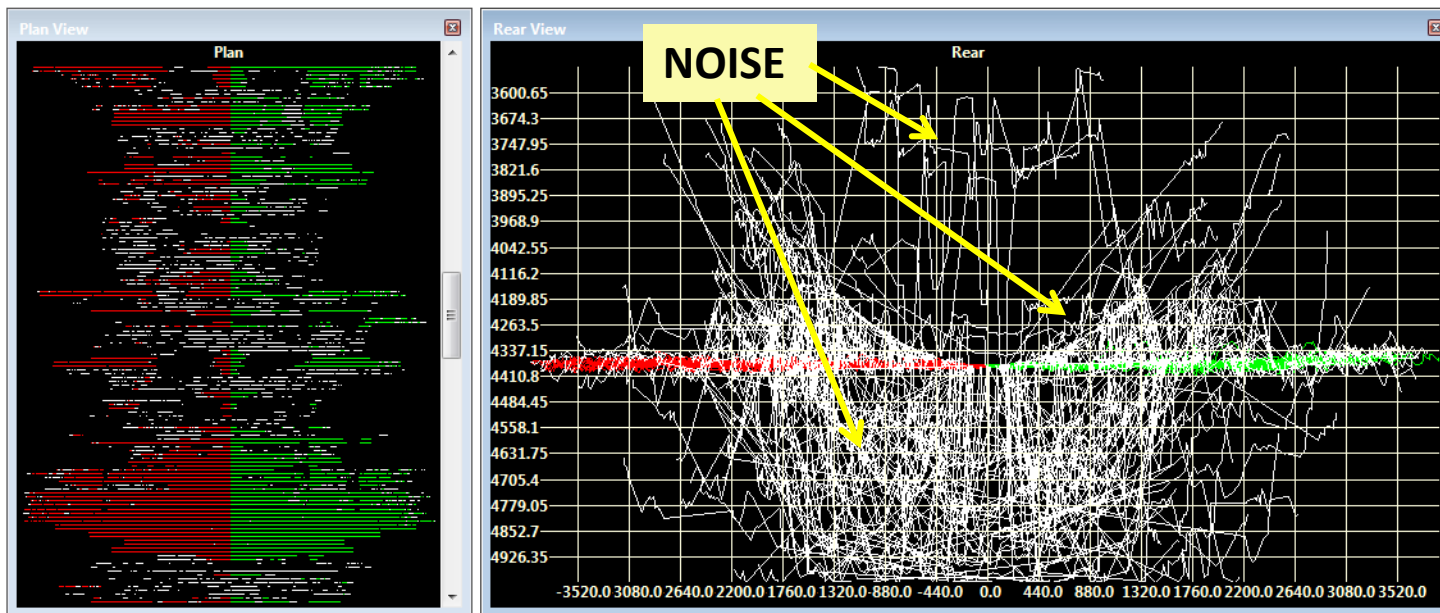
Gridded data of MB acquisition when navigating through multi-year ice

Surveying in Arctic Waters – A Technique (con't)



- We see a minimal gridded data set and an abundance of noise in the data during MB acquisition in heavy ice conditions
- By being vigilant and ***forcing the depth*** during pinging, less beams are dropped and the system is able to recover in a more timely fashion

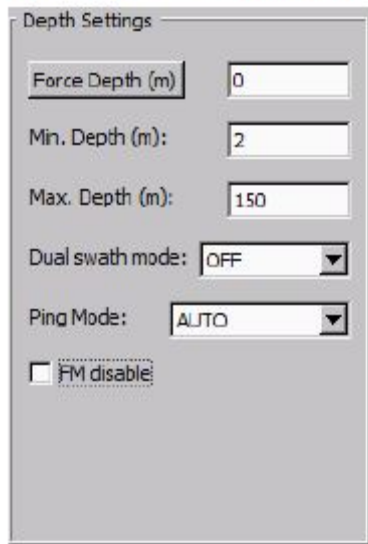
CARIS HIPS/SIPS used to process MB data



Surveying in Arctic Waters – A Technique (con't)

Observations during acquisition :

Parameters – Depth settings



Depth Settings

Force Depth (m): 0

Min. Depth (m): 2

Max. Depth (m): 150

Dual swath mode: OFF

Ping Mode: AUTO

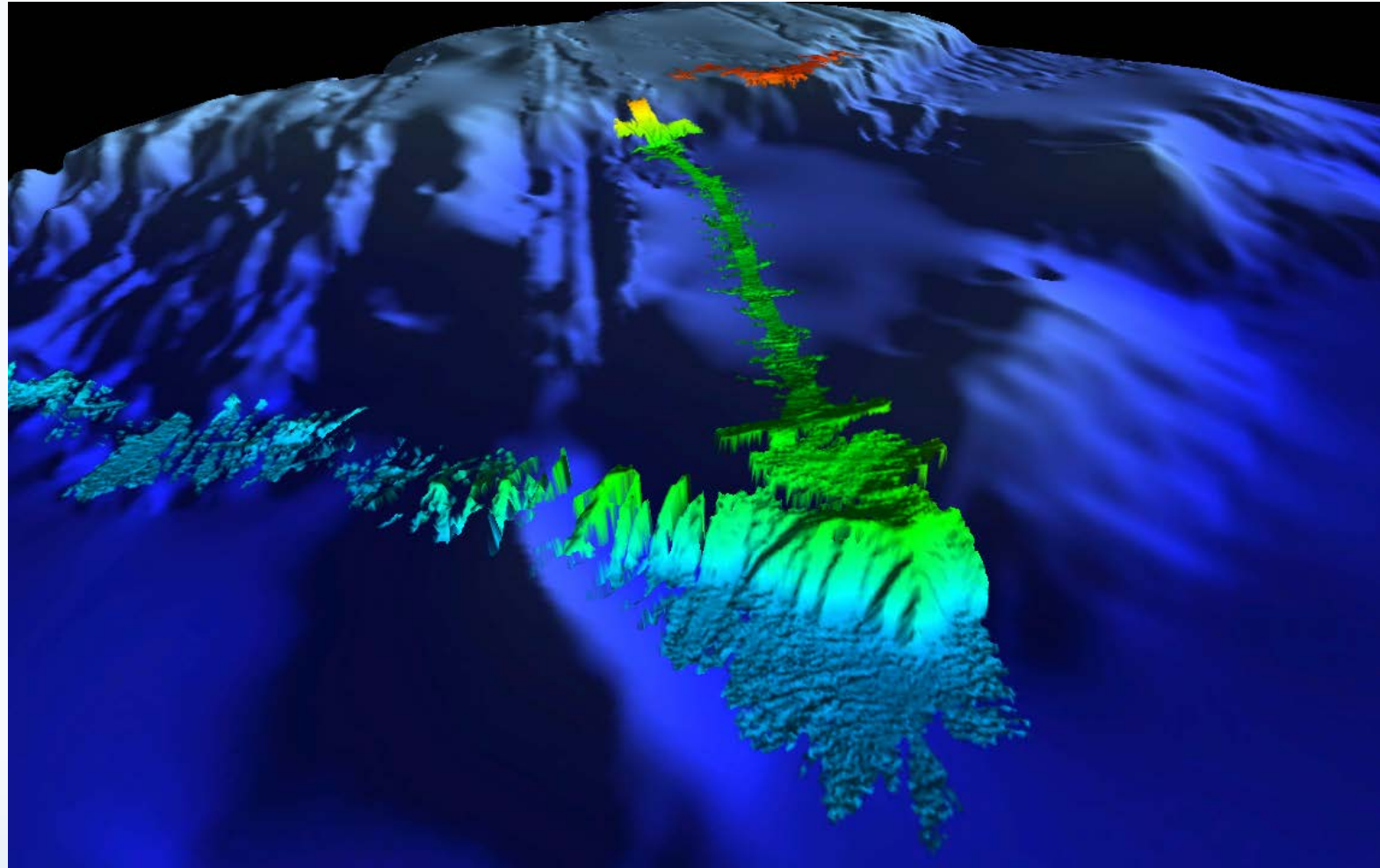
☐ FM disable

Kongsberg
SIS

- As the vessel moves through heavy ice the MB system can easily loose bottom tracking as ice strikes the hull.
- **Setting a narrow Min Max Depth range** will also help the system in bottom tracking under difficult conditions.
- **Forcing the depth** will cause the system to set its gain and range windows accordingly, and ignore its own findings about where the bottom is.
- In both cases, the operator must then monitor the actual depth closely, and adjust the depth window as often as required.



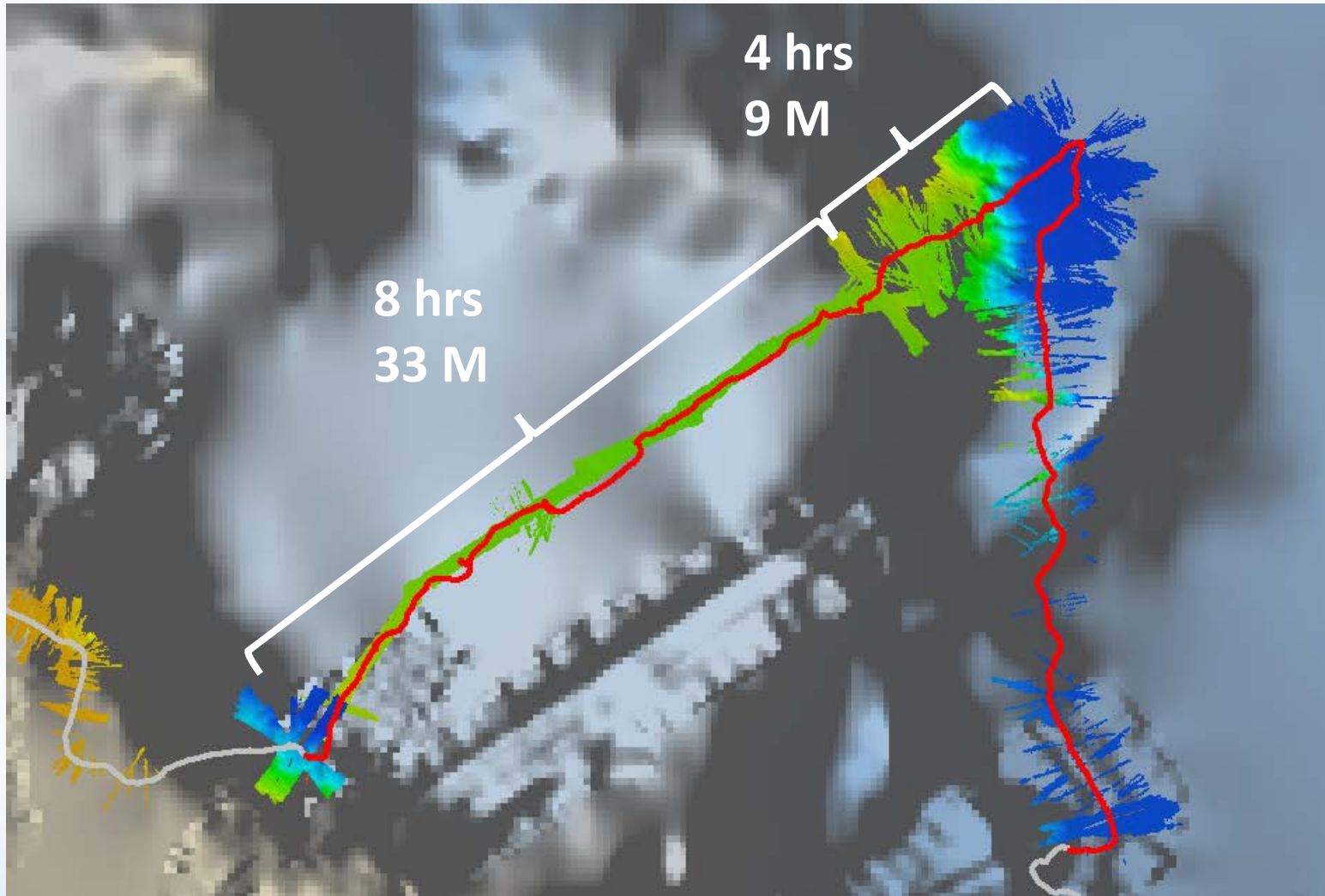
Surveying in Arctic Waters – A Technique (con't)



Technique
employed in
heavy ice
conditions and
when full
detection is
required



Surveying in Arctic Waters – A Technique (con't)



Turn and Scan
technique:

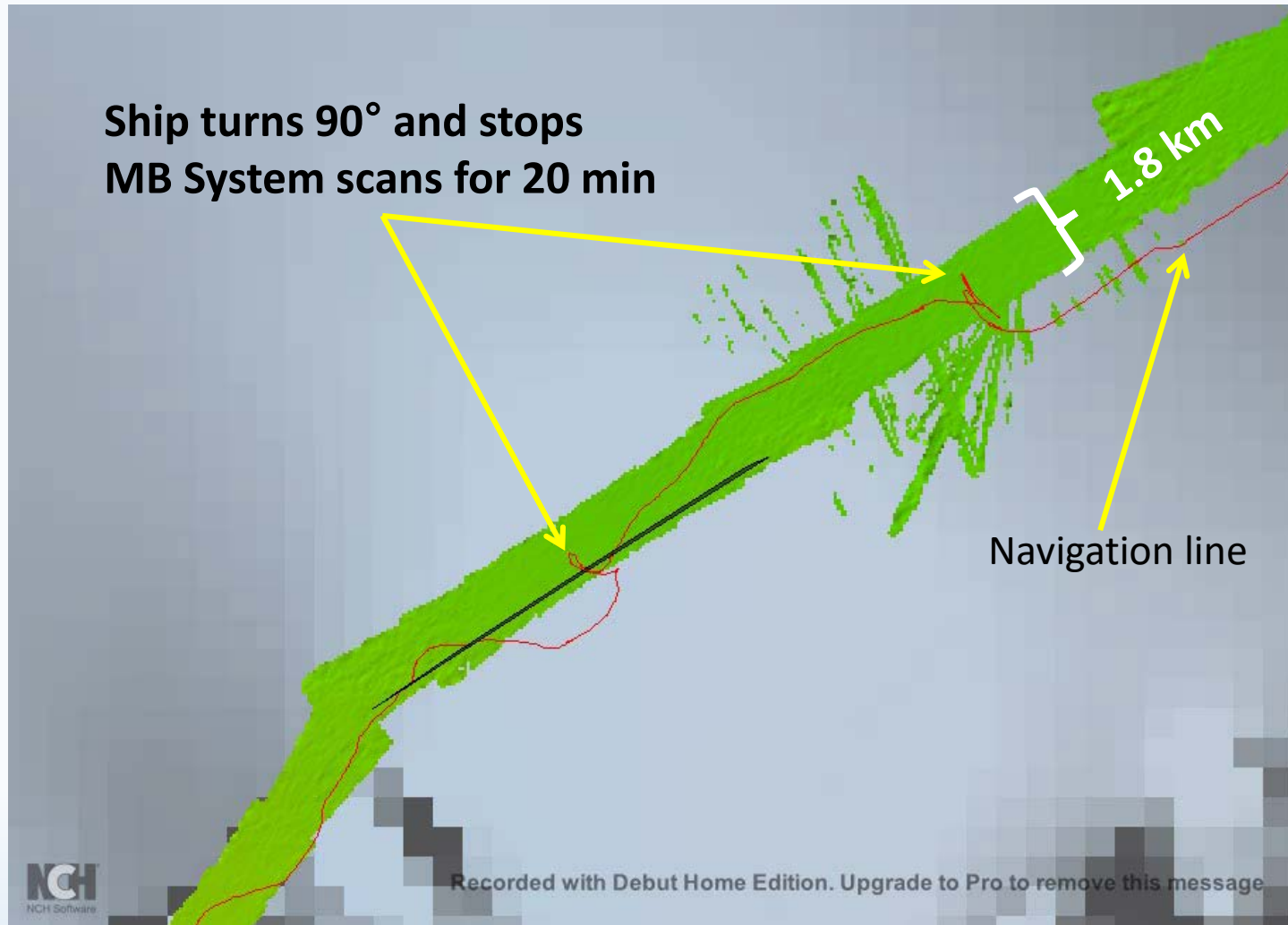
4 hrs 9M of MB

vs

8 hrs 33M of MB



Surveying in Arctic Waters – A Technique (con't)



Example of MB fore/aft beam scanning

Limited to
 ± 10 degrees

Parameters – Transmit Control

Transmit Control	
<input checked="" type="checkbox"/> Pitch stabilization	
Along Direction (deg.):	0.0
Auto tilt	OFF
Yaw Stabilization	
Mode:	REL. MEAN HEADING
Heading:	0.0
Heading filter:	MEDIUM
Min. Swath Dist. (m)	0.0
<input type="checkbox"/> External Trigger	
3D Scanning	
<input type="checkbox"/> Enable scanning	
Min. (deg.):	-5
Max. (deg.):	5
Step (deg.):	0.0



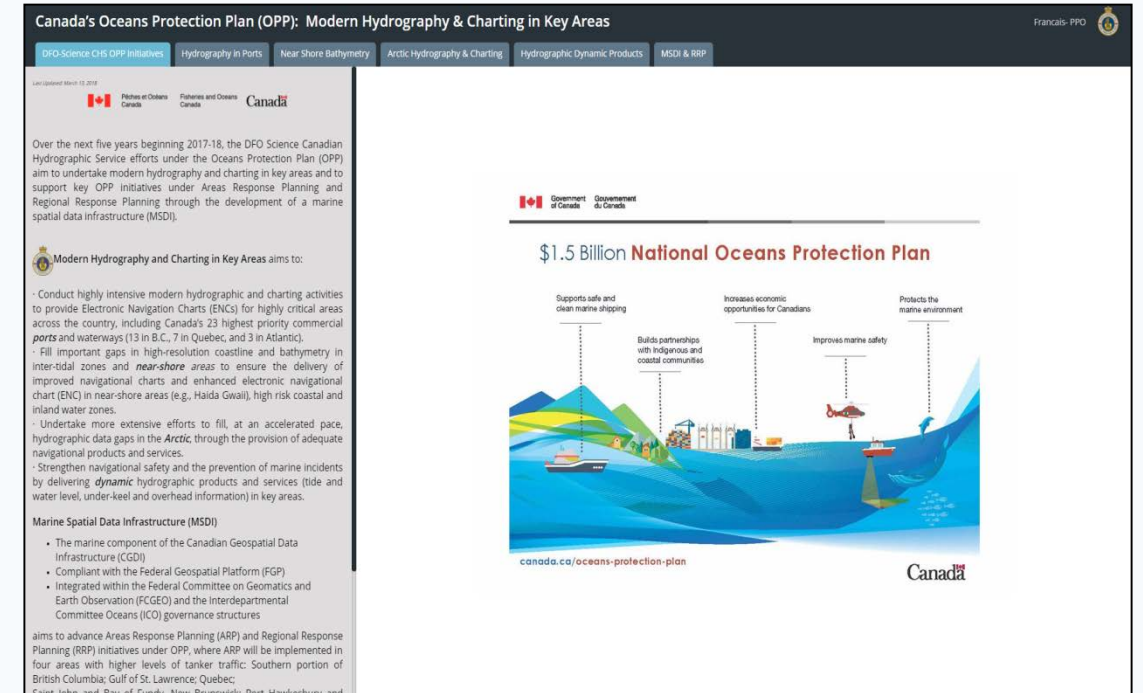
Topics

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Canada's Oceans Protection Plan

- In November 2016, the Prime Minister launched the \$1.5-billion Oceans Protection Plan, the largest investment ever made to protect Canada's coasts and waterways, while also growing Canada's economy.
- The Government announced an investment of close to \$20 million over five years for modern and improved hydrography and charting in areas of high traffic, commercial ports and waterways, to make navigation safer.



Canada's Oceans Protection Plan (con't)

OPP sub-initiative ***Modern Hydrography and Charting in Key Areas*** is directed at CHS specifically

- 5 inter-related pillars:
 - 23 Ports and waterways
 - **Arctic**
 - Near-shore bathymetry – filling gaps
 - Dynamic hydrographic products and services
 - Regional response planning / MSDI
- Success hinges on the rapid processing and throughput of high volumes data into accessible information, services, and products (to a lesser extent).
- Opportunity for CHS to transform to a data-centric organization and to prepare for S-100 implementation

Canada's Oceans Protection Plan (OPP): Modern Hydrography & Charting in Key Areas

Over the next five years beginning 2017-18, the DFO Science Canadian Hydrographic Service efforts under the Oceans Protection Plan (OPP) aim to undertake modern hydrography and charting in key areas and to support key OPP initiatives under Areas Response Planning and Regional Response Planning through the development of a marine spatial data infrastructure (MSDI).

Modern Hydrography and Charting in Key Areas aims to:

- Conduct highly intensive modern hydrographic and charting activities to provide Electronic Navigation Charts (ENCs) for highly critical areas across the country, including Canada's 23 highest priority commercial ports and waterways (13 in B.C., 7 in Quebec, and 3 in Atlantic).
- Fill important gaps in high-resolution coastline and bathymetry in inter-tidal zones and near-shore areas to ensure the delivery of improved navigational charts and enhanced electronic navigational chart (ENC) in near-shore areas (e.g., Haida Gwaii), high risk coastal and inland water zones.
- Undertake more extensive efforts to fill, at an accelerated pace, hydrographic data gaps in the Arctic through the provision of adequate navigational products and services.
- Strengthen navigational safety and the prevention of marine incidents by delivering dynamic hydrographic products and services (tide and water level, under-keel and overhead information) in key areas.

Marine Spatial Data Infrastructure (MSDI)

- The marine component of the Canadian Geospatial Data Infrastructure (CGDI)
- Compliant with the Federal Geospatial Platform (FGP)
- Integrated within the Federal Committee on Geomatics and Earth Observation (FCGEO) and the Interdepartmental Committee Oceans (ICO) governance structures

aims to advance Areas Response Planning (ARP) and Regional Response Planning (RRP) initiatives under OPP, where ARP will be implemented in four areas with higher levels of tanker traffic: Southern portion of British Columbia; Gulf of St. Lawrence; Quebec; Saint John and Bay of Fundy; New Brunswick; Port Hawkesbury and

\$1.5 Billion National Oceans Protection Plan

Supports safe and clean marine shipping

Increases economic opportunities for Canadians

Improves marine safety

Protects the marine environment

canada.ca/oceans-protection-plan

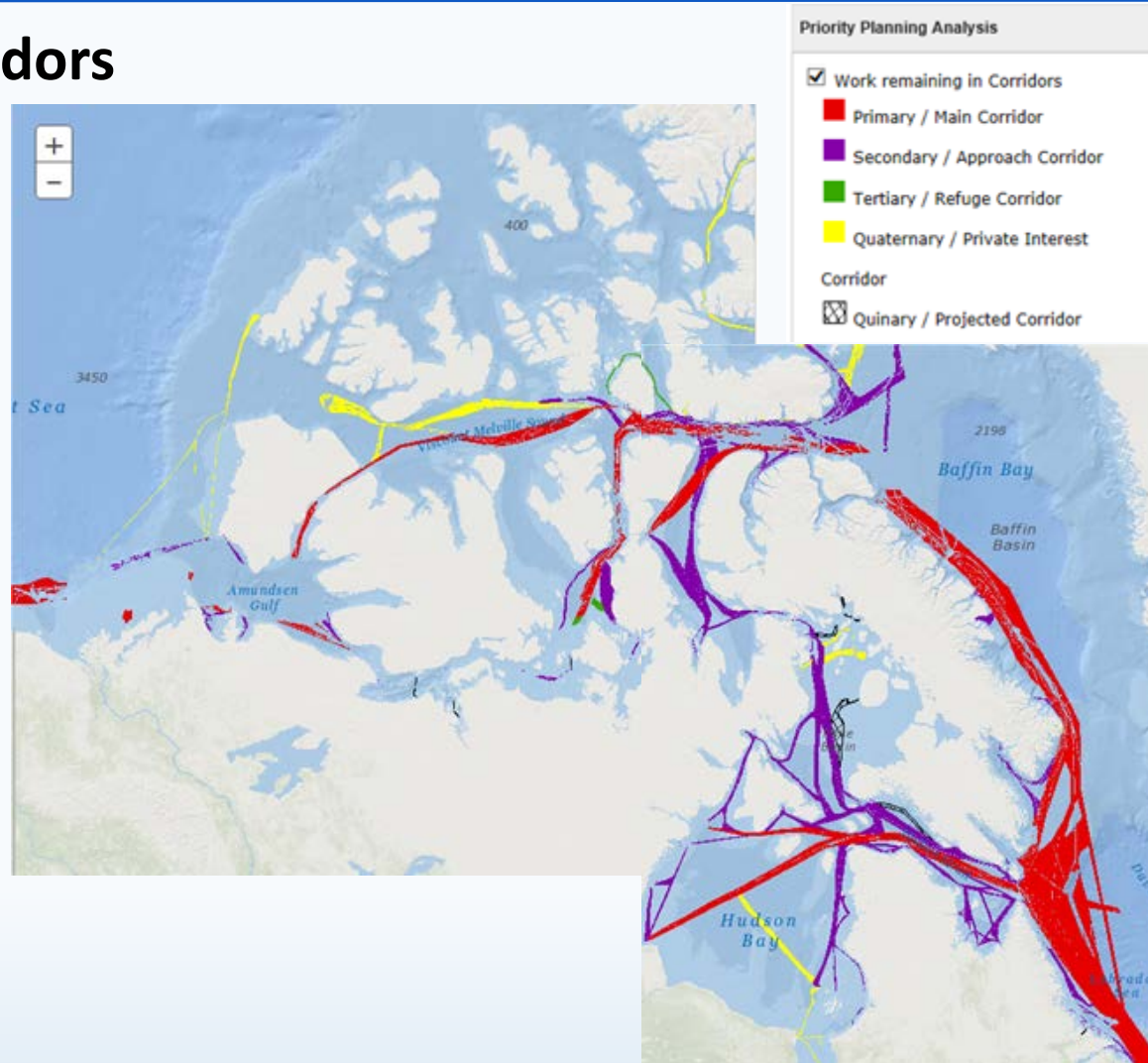
Canada



Surveying in Arctic Waters – The Plan

Proposed Low Impact Shipping Corridors

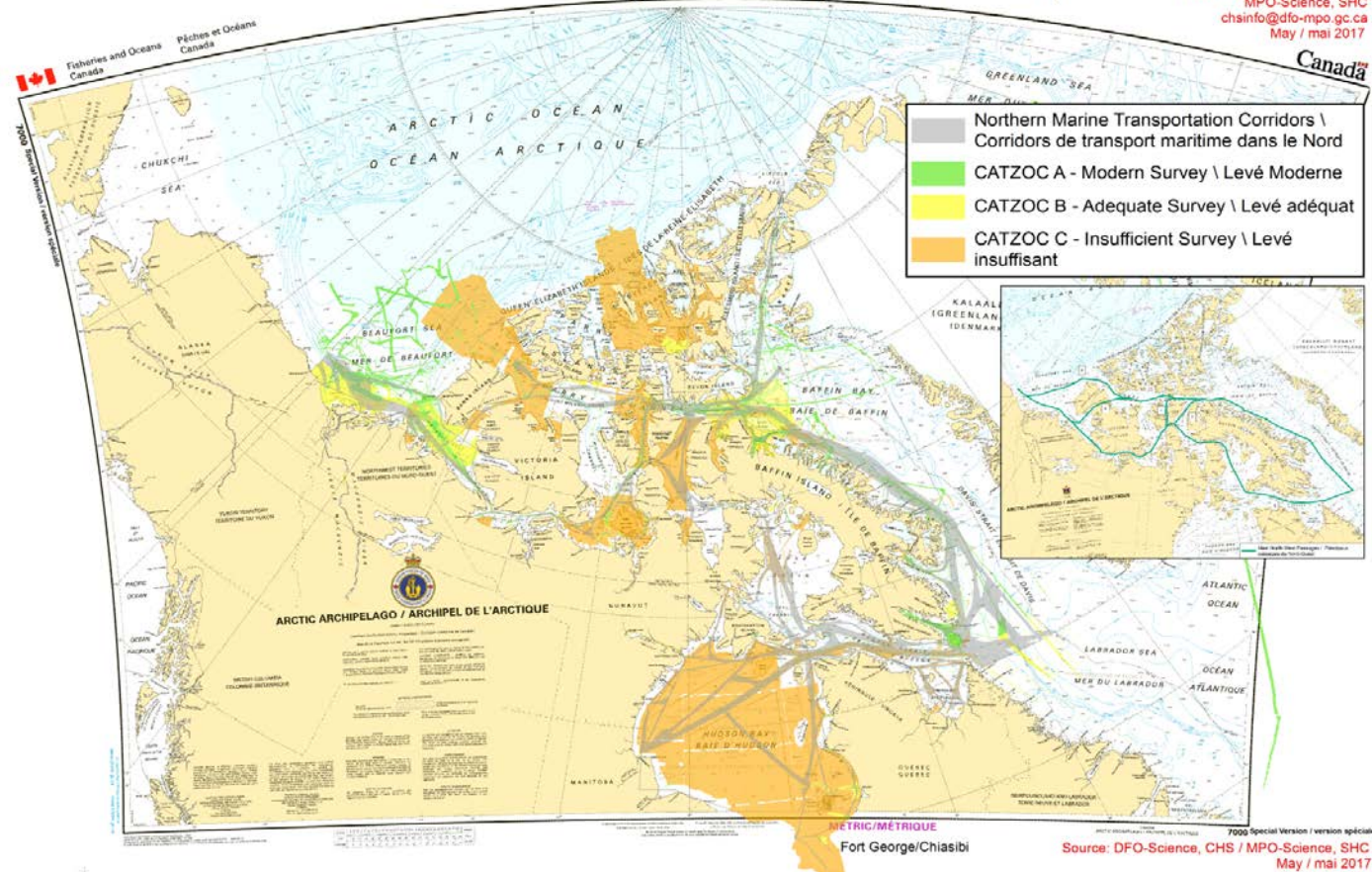
- Graphic illustrates areas in corridors that are not surveyed to modern standards
- At present, 28% of the combined areas of the Primary and Secondary Draft Low Impact Shipping Corridors¹ are adequately surveyed (surveyed to '*adequate*' or '*modern*' standards).
- Many areas within corridors are covered with either spot soundings, track lines (recon.), or unsurveyed.
- Client consultations are a significant driver



Surveying in Arctic Waters –The Plan

Category Zone of Confidence (CATZOC) of Hydrographic Survey
with Northern Low Impact Shipping Corridors
Qualité générale des données bathymétriques (CATZOC)
avec Corridors de navigation nordiques à faible impact

Source: DFO-Science, CHS /
MPO-Science, SHC
chinfo@dfo-mpo.gc.ca
May / mai 2017



- Category of Zone of Confidence for Chart Data Quality



Surveying in Arctic Waters –The Plan (con't)

CHS Survey Plan for the Arctic during the 2018 Season

General Location	Data Acquisition Agency	Rationale for Survey
SW King William Is.	DFO (CHS) Completed	<ul style="list-style-type: none"> - Priority areas per CCGS-industry led Arctic Marine Advisory Board meetings - expansion of Secondary Low Impact Shipping Corridor - coincident area with CCG Aids Maintenance operations - Alignment with CHS Priority Planning Tool
Approaches to Repulse Bay and Kangirsuk	DFO (CHS) Ongoing	<ul style="list-style-type: none"> - Priority areas per CCGS-industry led Arctic Marine Advisory Board meetings - Repulse Bay chart poor quality – requires new bathymetry - Alignment with regional production plan - Kangirsuk priority area #7 for CCG Aids to Navigation Unit
NE / SE Baffin Is.	DFO (CHS) Completed	<ul style="list-style-type: none"> - Alignment with CHS Priority Planning Tool - expansion of Primary Low Impact Shipping Corridor - depths best utility of sonar on CCGS LSSL - data for NE Baffin Island will support DFO's Oceans agenda (MPA)
Ungava Bay Corridors - 2017 contract extension	McGregor Geoscience Ltd. Ongoing	<ul style="list-style-type: none"> - Priority for ship operators (supports community resupply) - Priority areas per CCGS-industry led Arctic Marine Advisory Board meetings - Alignment with regional production plan
Ungava Bay Corridors	Seaforth Geosurveys Inc. Ongoing	<ul style="list-style-type: none"> - Priority for ship operators (supports community resupply) - Priority areas per CCGS-industry led Arctic Marine Advisory Board meetings - Alignment with regional production plan



Surveying in Arctic Waters – Sources (con't)

- CCGS *Amundsen* MBES operational since 2003, CHS has been a partner with Arctic Net (Amundsen Science) since the beginning.
- Data from CCGS *Amundsen* represents ~65% of all of CHS' modern hydrography in the Arctic.
- Data from CCGS *Amundsen* has been incorporated on 83 charts to date.
- MBES is an EM302, mid-water mapping system.
- *Amundsen's* success established a blueprint for the rest of the icebreaking fleet.

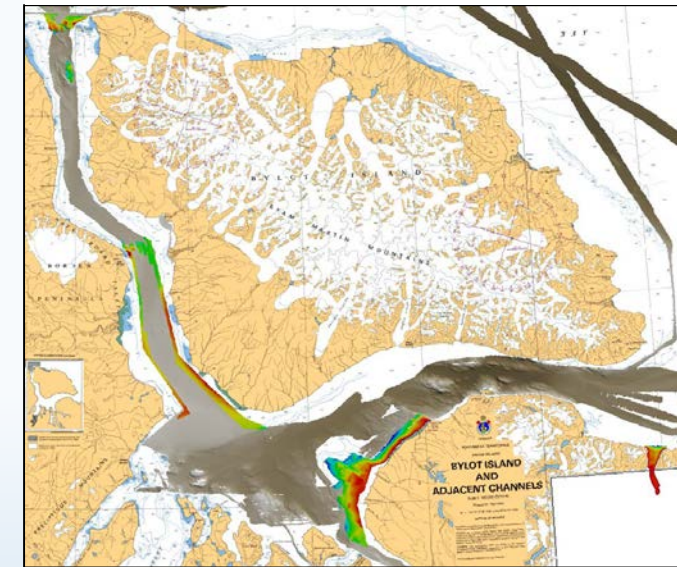


Surveying in Arctic Waters – Sources (con't)

Canadian Ocean Mapping Research and Education Network



2014 – HMCS Kingston

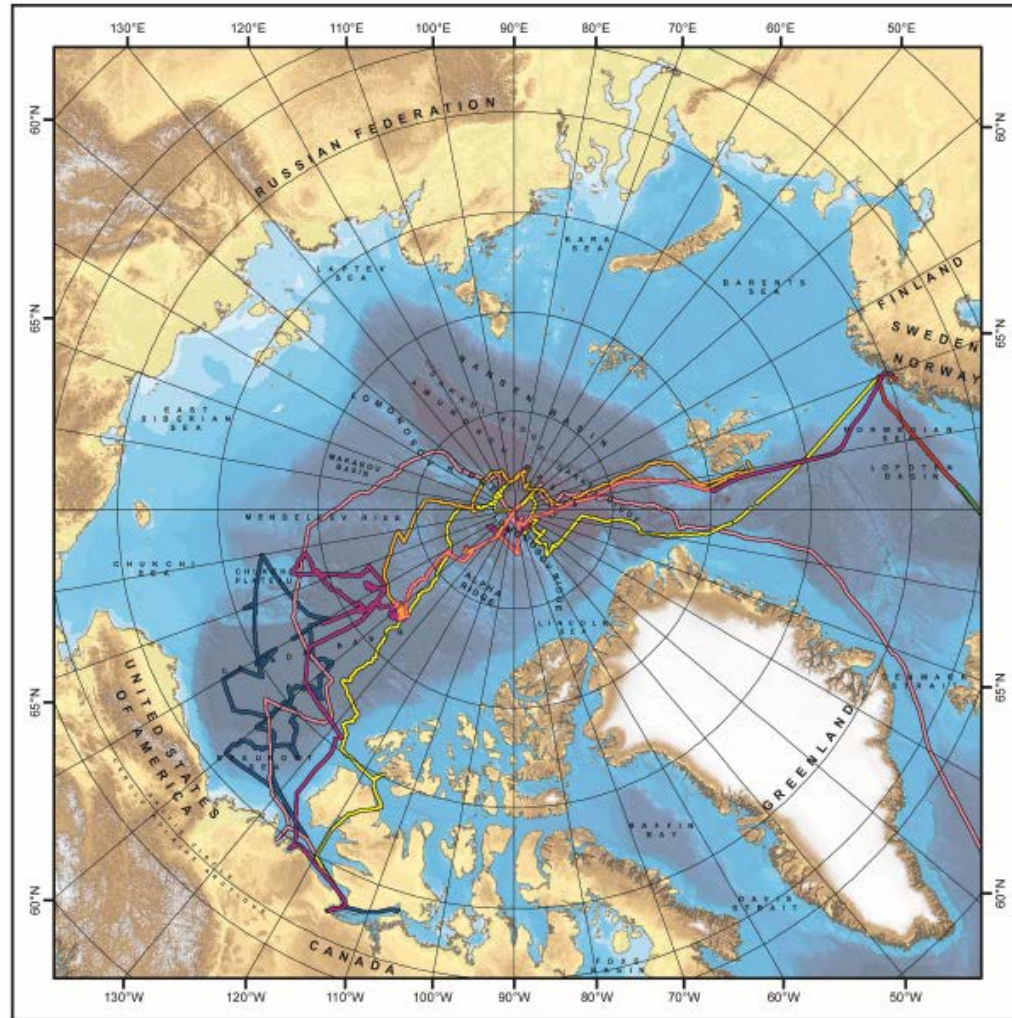


Topics

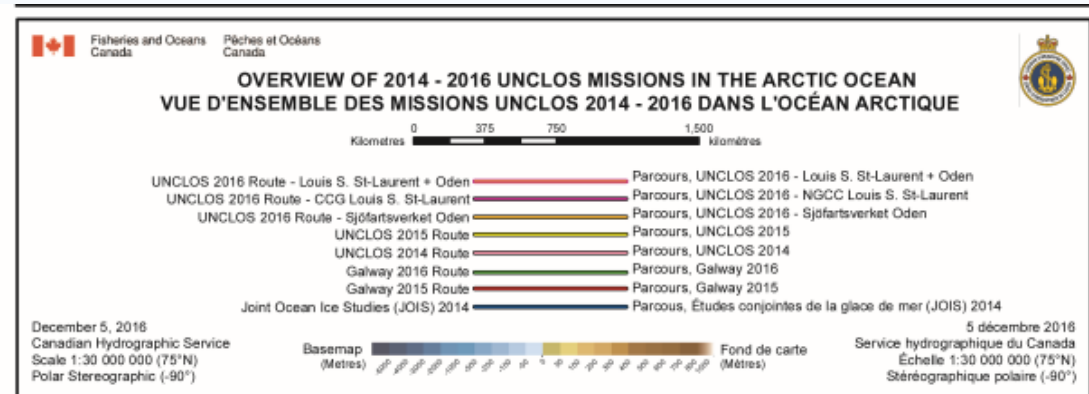
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Canadian Multibeam contributed to IBCAO

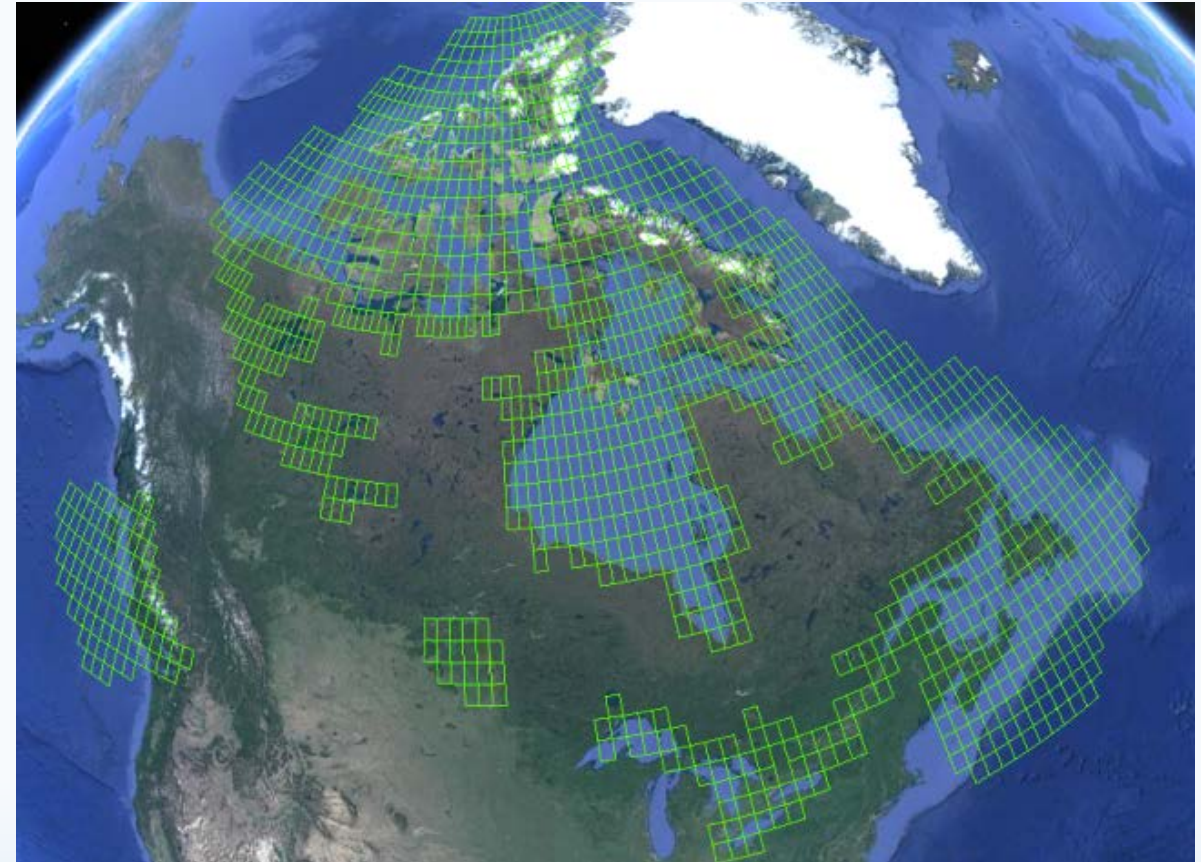


- Collected 2014-2016
- 90 000 line-km of MB contributed to IBCAO
- 100m grid resolution provided



NONNA - 100

- **NON N**avigational products follows S-102 grid schema for the level 2 of S-102
- 100m gridded bathymetry cells available for free on the Canadian Federal Geospatial Platform (FGP) as Open Maps and Open Data
- Will be released through the Canadian Federal Geospatial platform before the end of 2018 calendar year





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