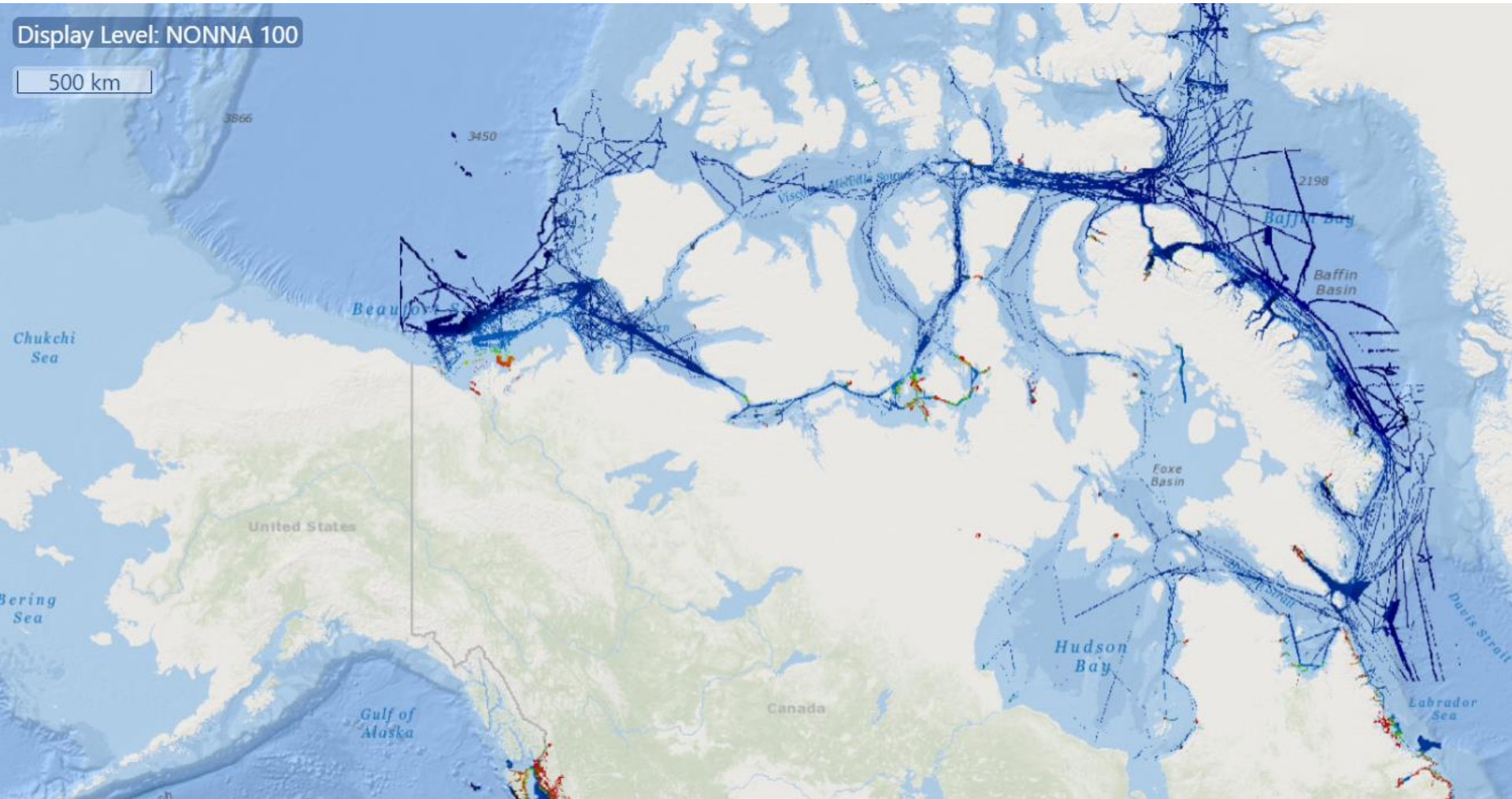


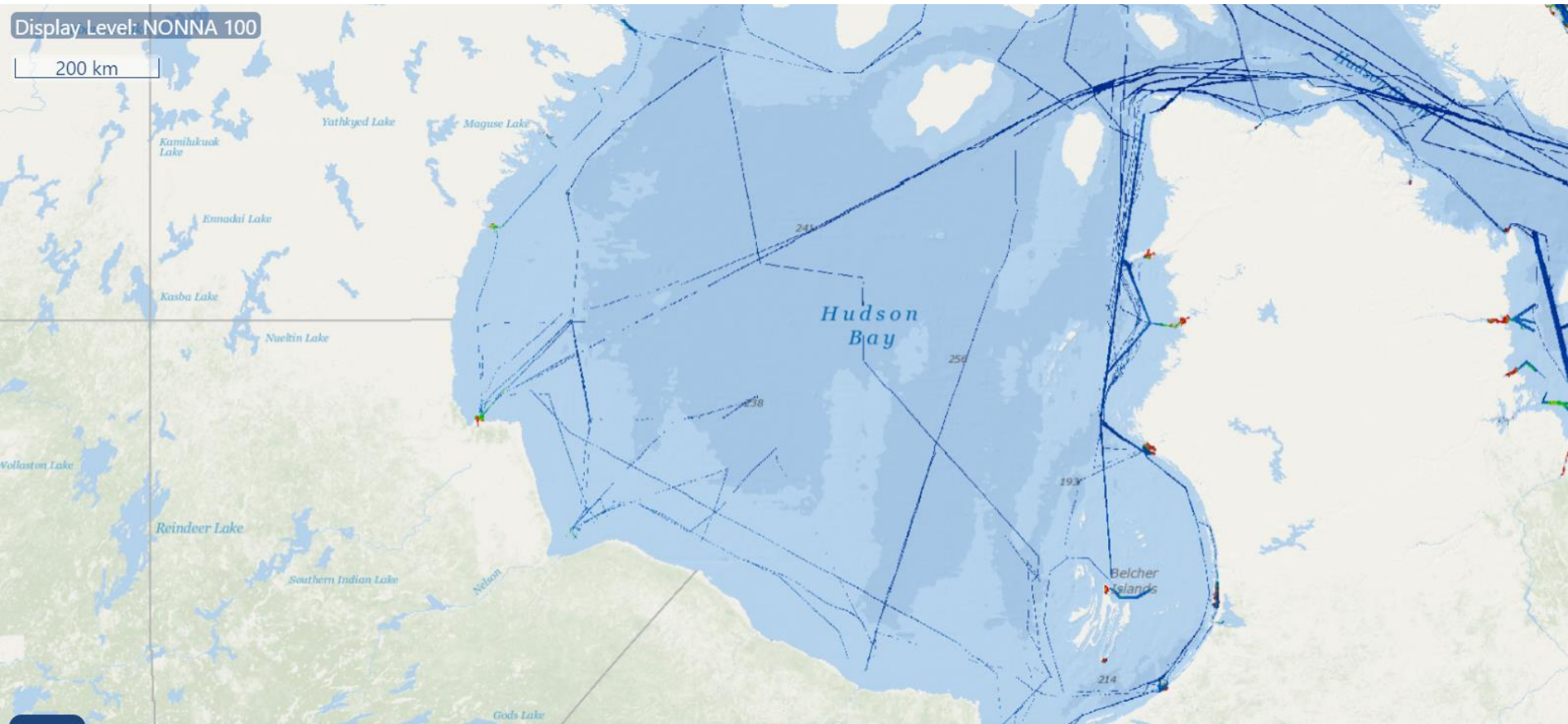


# CHS NONNA (Arctic)

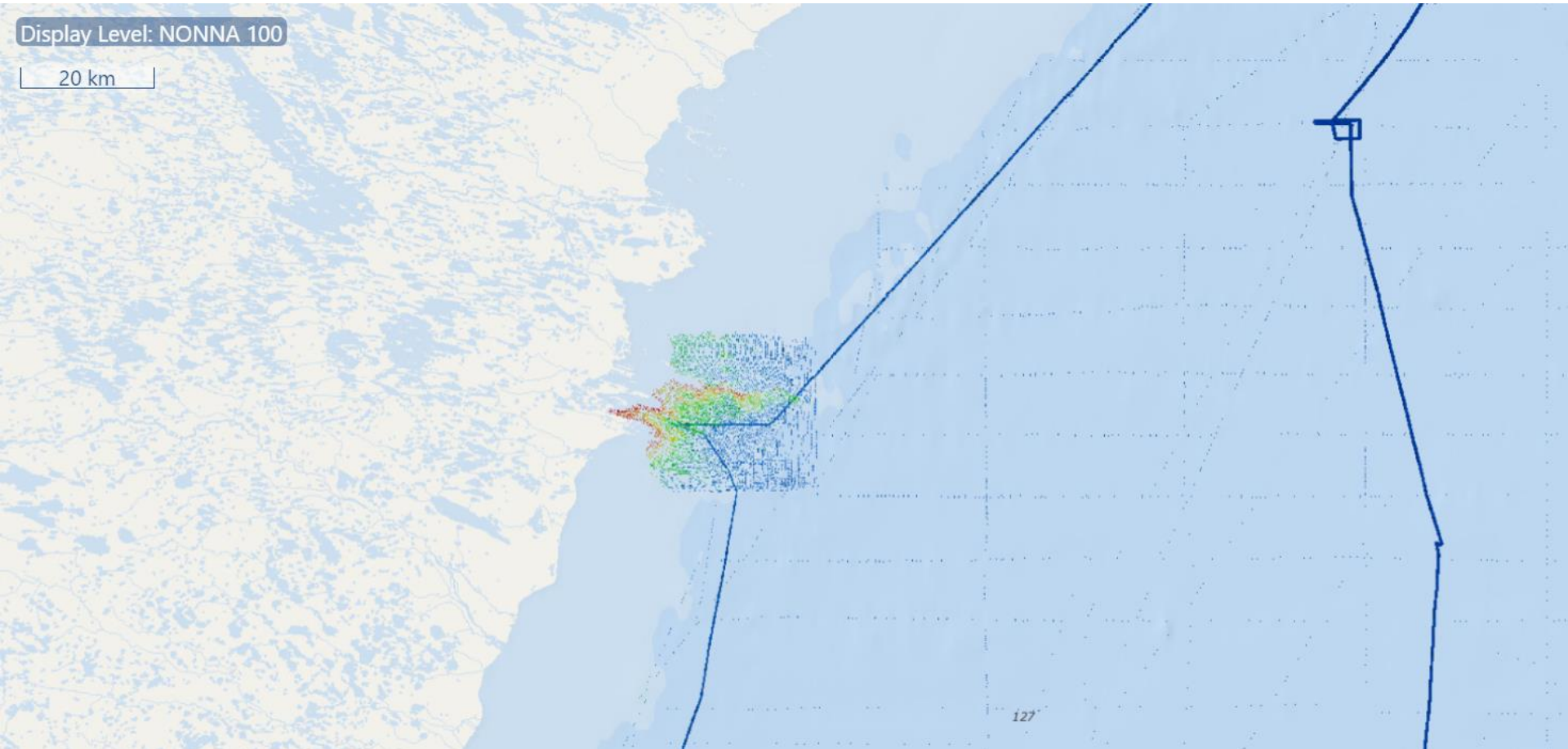


Approximately **14% of Canadian Arctic waters** have been **surveyed to either modern or adequate standards**, approximately 40% of the combined draft Primary and Secondary Low Impact Shipping Corridors in the Arctic have been surveyed to either modern or adequate standards. Source: CHS (2021)

# NONNA-100 (Hudson Bay)



# NONNA-100 (◀<sup>9</sup>Δ◀<sup>9</sup>)



# Collaborative Bathymetry in

**Aqqiumavvik Society:** Who are they?

**Environment is changing:** What can be done?

**Proposed solution:** Let's map the seafloor!

**Capacity building + surveying (2020-2021)**

**Bathymetric data analysis + results**

**Products**

**Conclusion**

**What's next?**



# Aqqiumavvik's Goals

## Healthy Community

- **healthy community** that **builds capacity**;

## Individual Wellbeing

- We will promote simplicity and unity where **people come first and are responsible and accountable for their own wellbeing**

## Skills Development

- **promote continued learning**

## Community Based

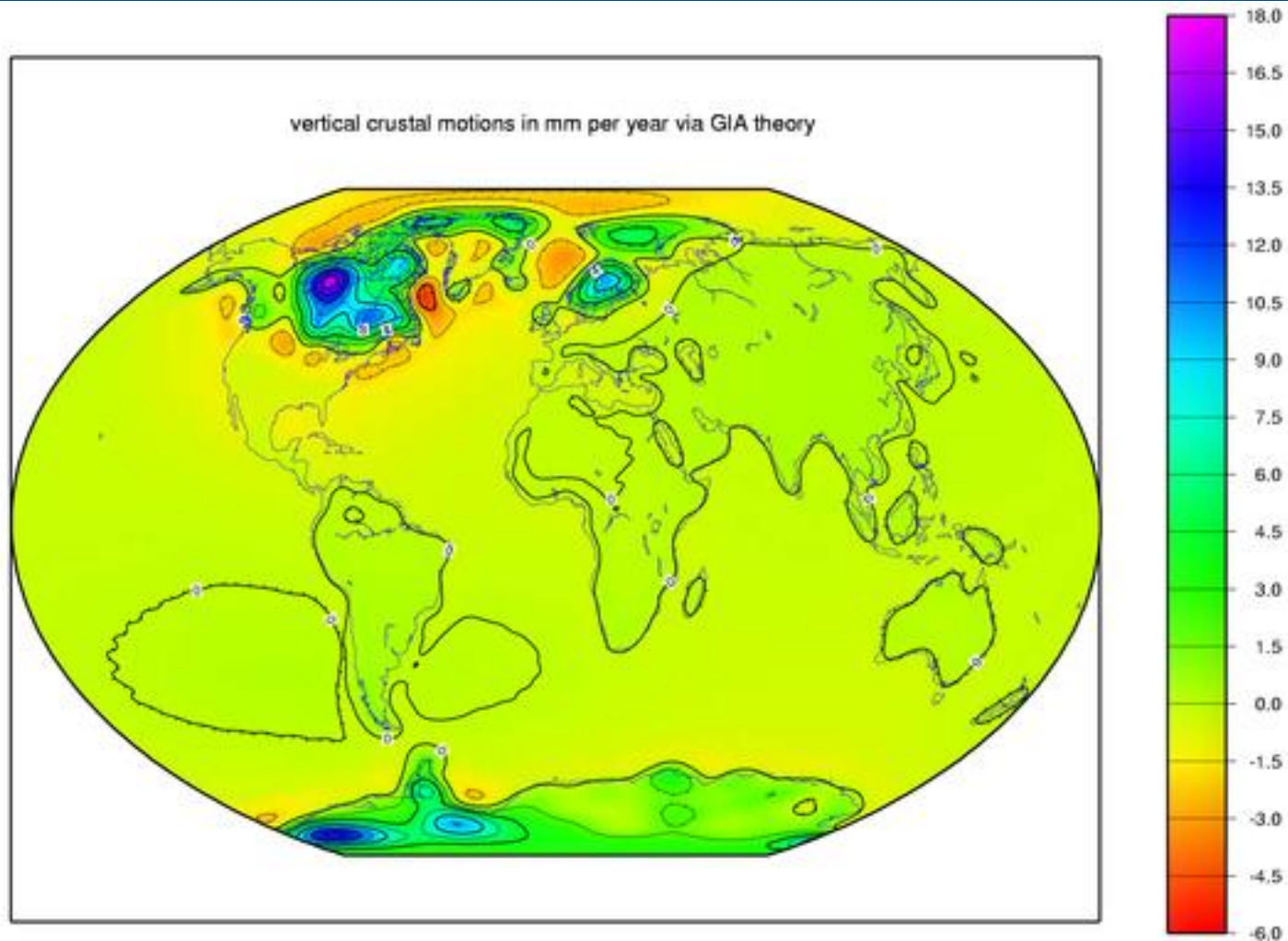
We will **promote self-reliance** through facilitating community processes that are dedicated to **directing our own destiny by working together, co-operating**







# Post-Glacial Rebound



GM7 2010 Oct 26 18:37:27 deg ord 79 Paulson GIA appx. uplift rates in mm per yr

# Solution?

What can be done? Find a way to map the sea floor!

Contract a private company?



Wait for someone else to do it?



Let's take the matter into our own hands?



# Technology to use: HydroBlock™

An easy-to-use hydrographic system developed by CIDCO allowing the collection of TCSB (Trusted Crowd Sourced Bathymetry)

TCSB: <https://www.dfo-mpo.gc.ca/science/documents/hydrography-hydrographie/Trusted-Crowd-Sourced-Bathymetry.pdf>



Installation on opportunity vessels:

- Prequalified system (known offsets)
- Easy to configure sonar
- Accurate vertical positioning to the ellipsoid (GNSS: L1/L2)
- Attitude measurements (roll + pitch)



# Training

**M2Ocean** provided **distance (2020) and face-to-face training (2021)** and **made themselves available** for any **needed support**.

Training and support provided for:

**Survey planning** for SBES surveys

**Installing** hydrographic system on opportunity vessel

**Operating** hydrographic system, following survey lines

**Good survey practices:** survey speed, line spacing, sonar adjustment, realtime QC

**Equipment maintenance**

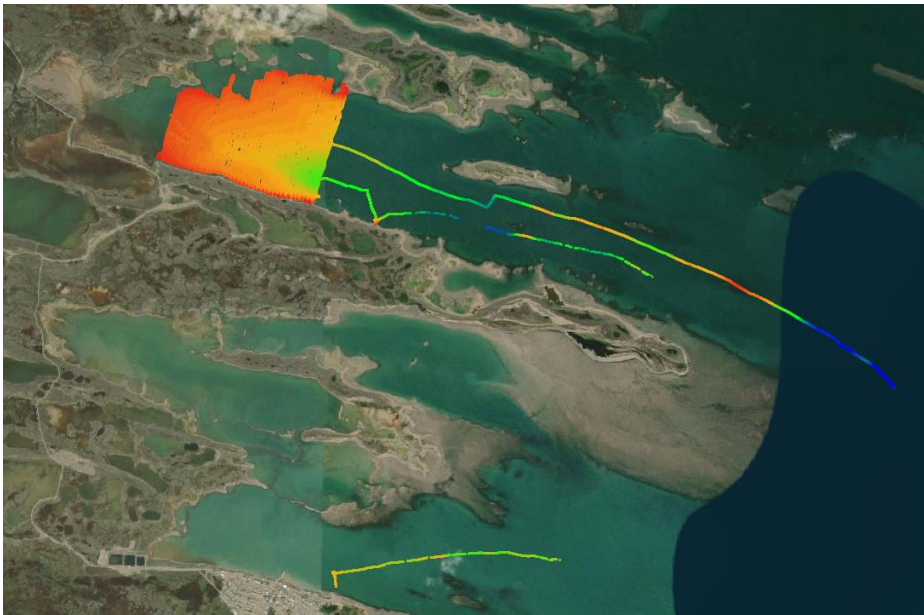
**Troubleshooting**

Introduction to **data processing**

# Summer 2020 Surveying

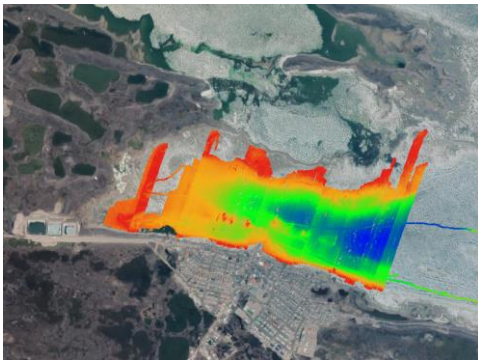
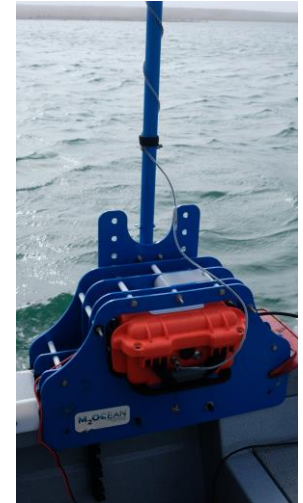
6 days of surveys completed between August and September

Area of  $2.4\text{km}^2$



# Summer 2021 Surveying

Surveying in the inlet near community:  
- Still ongoing



# Data Processing

Geo-referencing equation:

$$X_n = P_n + C_{bI}^n (C_{bS}^{bI} r_{bS} + a_{bI})$$

↑  
Sounding position

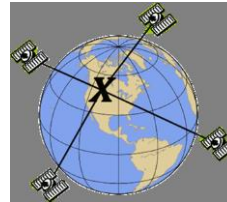
↑  
Navigation

↑  
Attitude

↑  
Depth

↑  
Lever arm

Processing done with:



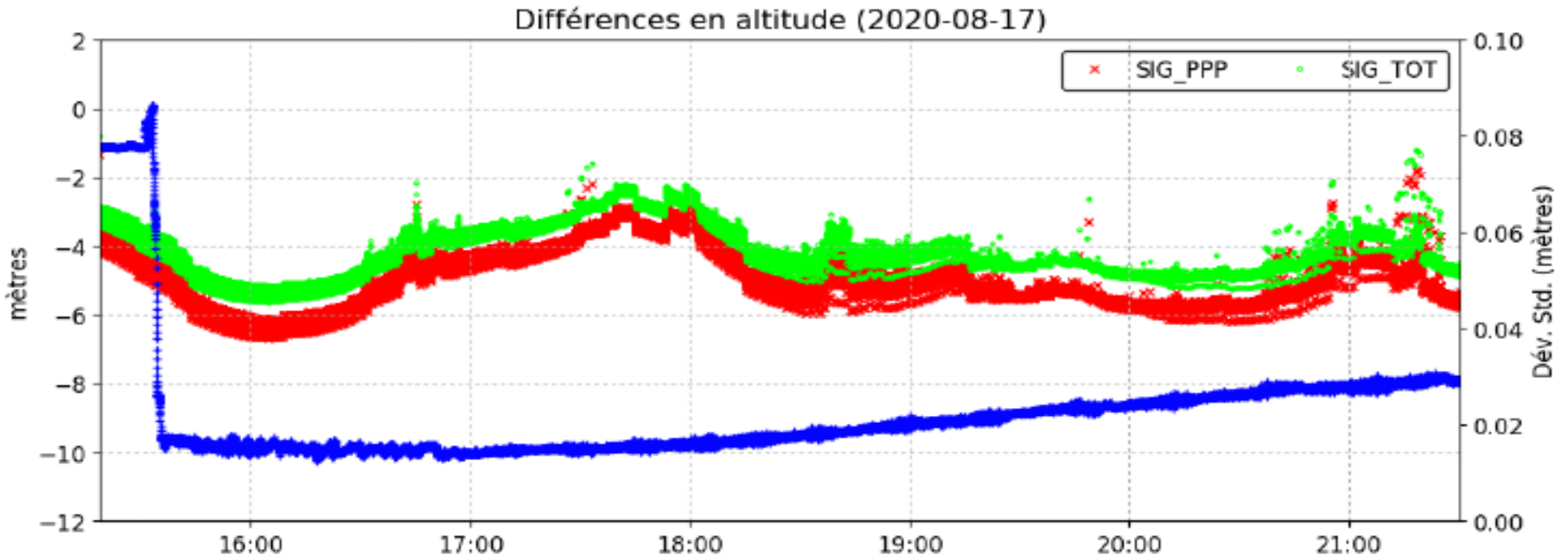
+



# GNSS Processing

## CSRS-PPP NRCAN GNSS processing:

Send raw RINEX observation files to CSRS-PPP online service  
Receive processed GNSS navigation data at an accuracy better than 0.10m:





# Data Cleaning

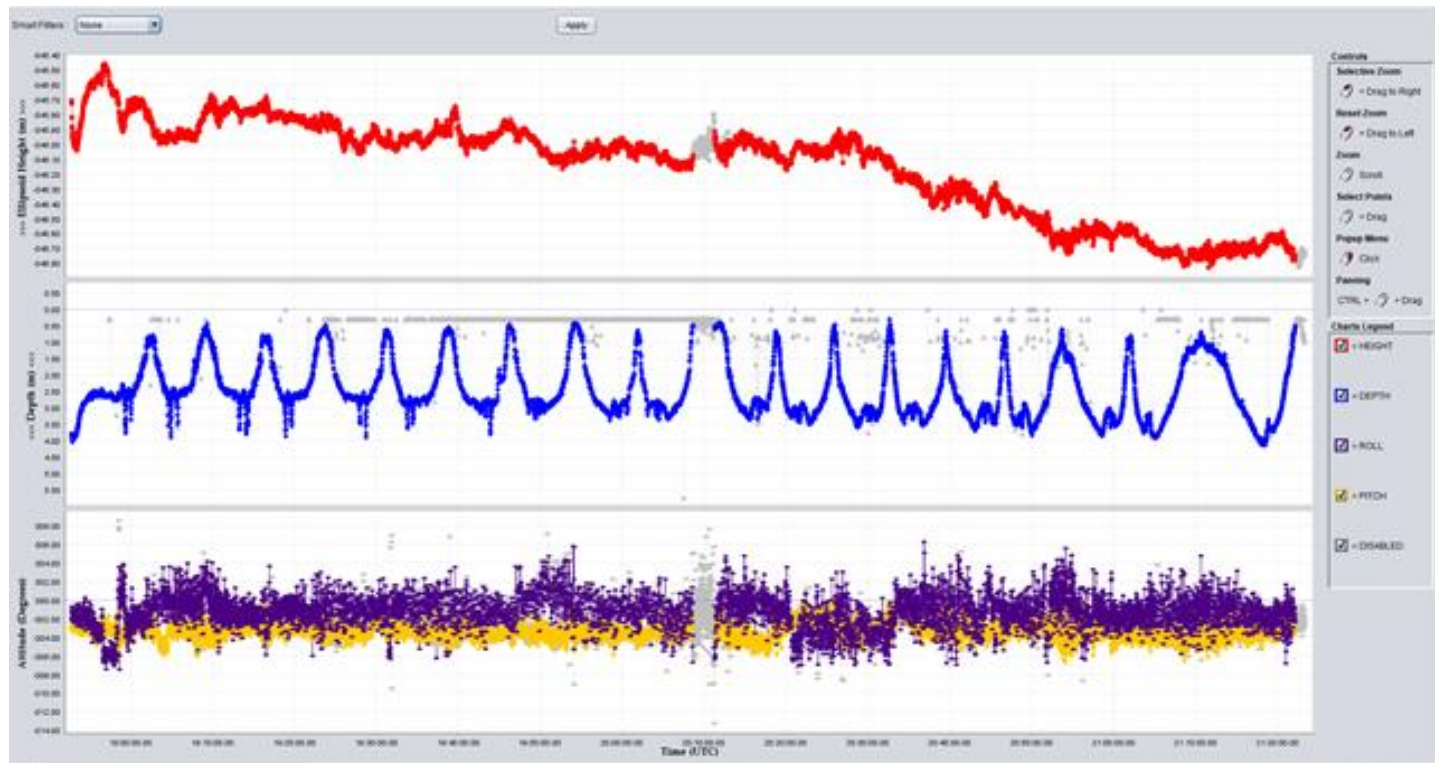
Data cleaning performed with DepthStar™ developed by CIDCO:

Automatic filter settings:

sonar threshold: 0.1m

moving average threshold: 0.5

+ manual filtering to remove remaining outliers



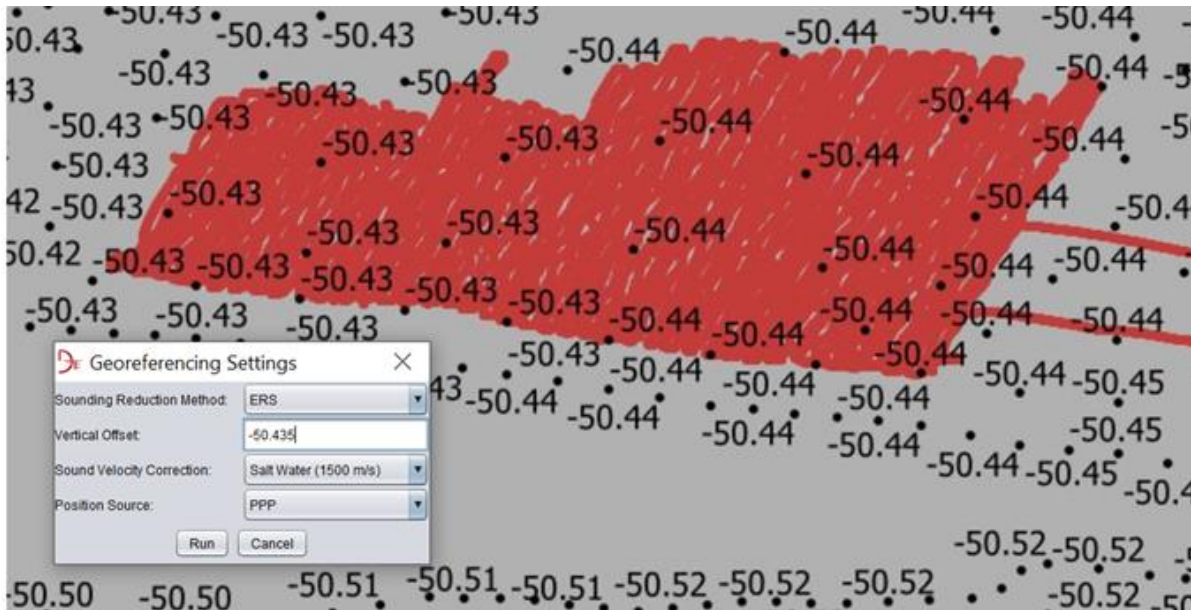
# Geo-referencing

Reduction method: **ERS** (Ellipsoid reference survey)

Apply a constant offset to reference to **Chart datum**  
(CANNORTH2016v1HyVSEP\_NAD83v6\_CD)

Sound speed correction: apply a constant for salt water

Position source: **CSRS-PPP** NRCan post-processed navigation data



# Data Quality Analysis (2020 survey)

## Cross-line validation of survey data:

Cross-lines on different survey days and different survey conditions

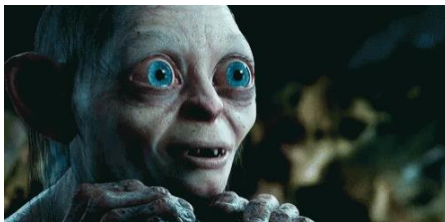
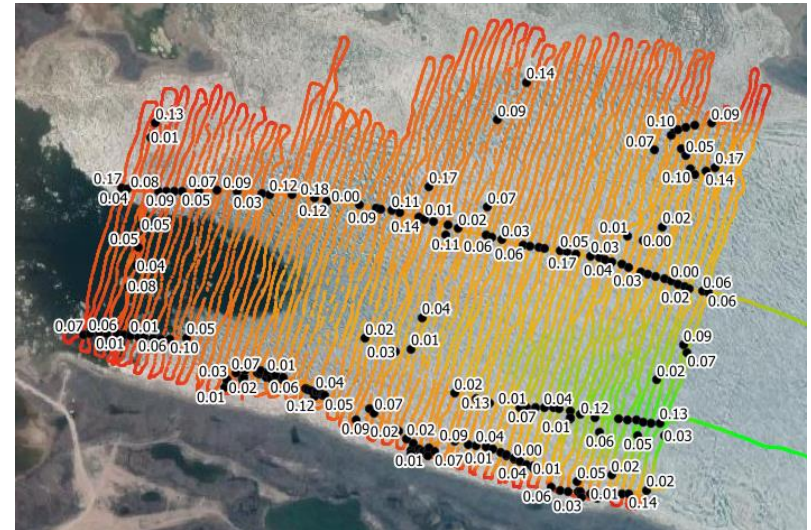
Number of intersections: 228

All intersections diff:  $< 0.20m$

$$\bar{x} = 0.058 m$$

$$\sigma = 0.044 m$$

Consistent reliable results!!!!



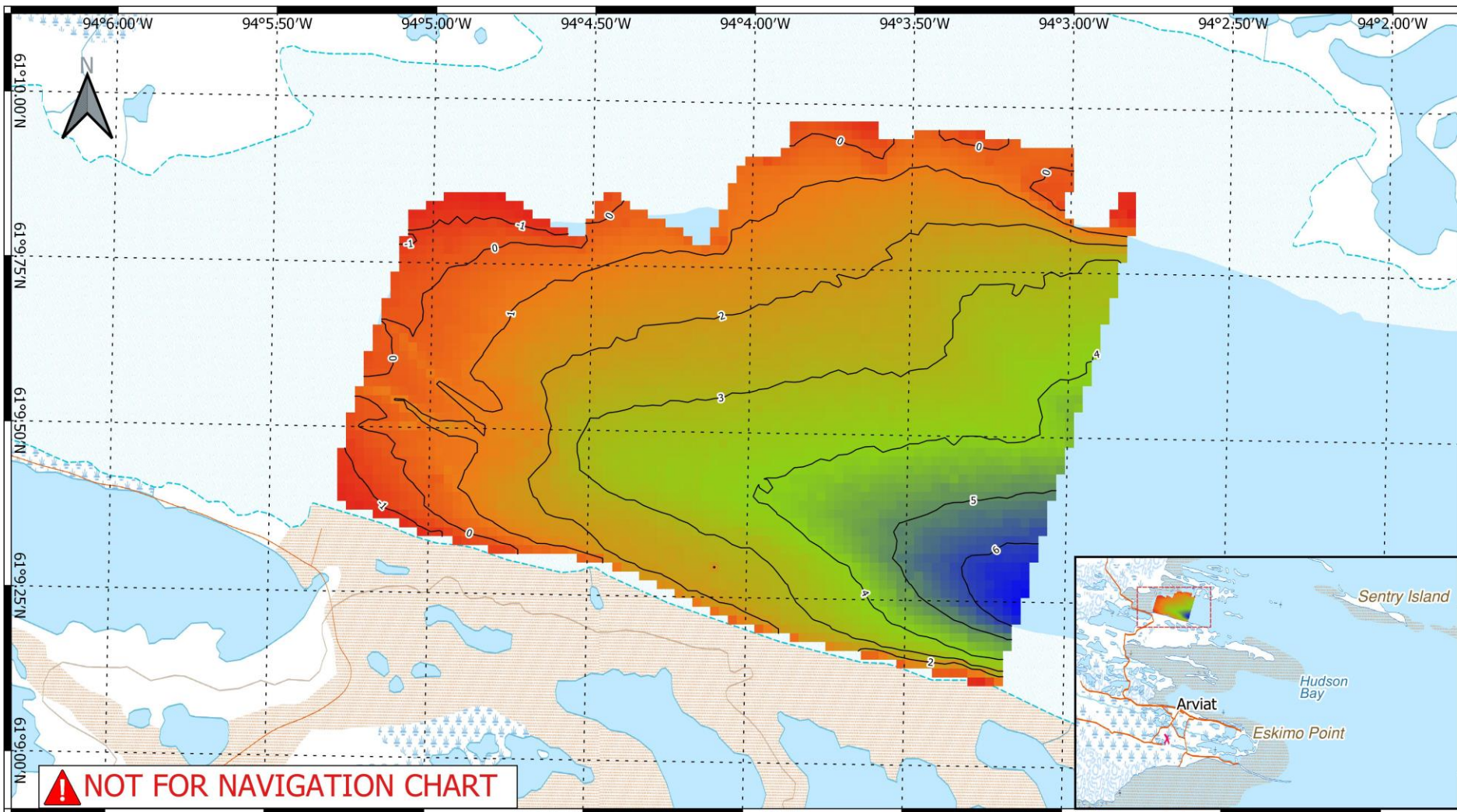
# Provided Products

To the Community:

- Bathymetric chart of survey area (not for navigation)

To the CHS:

- Processed soundings, data processing workflow + metadata

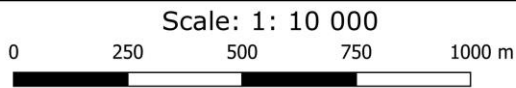


ᑱᐱᑦᑲᑦᑲᑦᑲᑦ (Qi'ngu'juaq) Inlet near Arviat, NU

BATHYMETRIC DATA ACQUISITION BY:  
 Aqquimavik HydroBlock Crew: Captain Andrew Balum Muckpah,  
 Aupaaq Irkok, Jacque John Ollie, Mikiyungiak, Nooks Keenan Lindell,  
 Muckpah Joe Shamee, Zack Owingayak, Darryl Baker  
 Young Hunters: Morgan Tookoome, Liam Arloo

BATHYMETRIC DATA ACQUISITION PERIOD:  
 2020/08 to 2020/09

DATA ACQUISITION SYSTEM:  
 HydroBlock



DEPTHS are in meters and referenced to Chart Datum  
 (lower low water, large tide or LLWLT)

HORIZONTAL DATUM: NAD83(CSRS) ep.2010

PROJECTION: UTM 15N

MAGNETIC DECLINATION: 3° 22.18' West (IGRF-12(2015))

Produced on December 23, 2020, by Julien Desrochers  
 (M2OCEAN)

**Legend**

- Contour
- Depth (CD)
  - -2.0
  - 1.0
  - 4.0
  - 7.0

# Conclusions

- Aqqiumavvik was able to **build capacity to measure the sea floor**.
- **Training + HydroBlock** provided by M2Ocean = developed **skills** to acquire **quality hydrographic data**
- **Aqqiumavvik** is now able to conduct hydrographic **surveys** with **minimal assistance**
- New skills will allow to verify **community knowledge** with **science** and ensure **safer navigation**
- Data could potential help to update charts after CHS evaluation

# What's Next???

## Aqqiumavik to **continue building capacity in ocean mapping**

- More data collection for 2021 season
- Learn new surveying skills

## Identify **valuable products for the community**

- Create intuitive maps for safe navigation around community?
  - \* cellphone app for navigation
- Data to appear on CHS NONNA grids (hopefully soon)
- Data to appear in the IHO DCDB (hopefully soon)
- Improve hydrographic systems and workflow
- Spread the word to have other communities worldwide to engage in collaborative bathymetry!!!!



# Project Participants



## Aqqiumavvik Society:

**Coordination:** Shirley Tagalik, Kukik Baker, Nooks Lindell, Aupaa Irkok

**Aqqiumavvik HydroBlock Crew:** Captain Andrew Balum Muckpah, Aupaa Irkok, Jacque John Ollie, Mikiyungiak, Nooks Keenan Lindell, Muckpah Joe Shamee, Zack Owingayak, Darryl Baker, Lucas Owljoot

**Young Hunters:** Morgan Tookoome, Liam Arloo

M2OCEAN: Julien Desrochers and Kevin Wilson





**M<sub>2</sub>OCEAN**  
THINKING OUTSIDE OF THE 

# Thank you!



Julien Desrochers  
[julien.Desrochers@m2ocean.com](mailto:julien.Desrochers@m2ocean.com)