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Télédétection des environnements aquatiques
& veille environnementale

Training Space-Based Bathymetry Models Using Community-Acquired Data in Eeyou Istchee Coastal Waters

Colloque CIDCO 2025

Bathymétrie collaborative

Arctus

Miskamoon Corporation

UQAR
Université du Québec
à Rimouski

University of Manitoba

INTRODUCTION

Fisheries and Oceans Canada | Pêches et Océans Canada

Canadian Hydrographic Service - NONNA - Service Hydrographique du Canada

EN

Layers | Attributes

- CHS NONNA - 10m
  - CHS NONNA - 10m Bathymetry
    - Transparency 0
    - -100 0 10 15 30 100 1000 6000 (m)
  - CHS NONNA - 10m Cell Limits
    - Transparency 0
- CHS NONNA - 100m
  - CHS NONNA - 100m Bathymetry
    - Transparency 0
    - -100 0 10 15 30 100 1000 6000 (m)
  - CHS NONNA - 100m Cell Limits
    - Transparency 0
- CHS NONNA - Packages
  - CHS NONNA - 10m Package Limits
    - Transparency 0
- CHS NONNA - Intensity
  - CHS NONNA - Backscatter
    - Transparency 0

20 km

lat: 54.037, lon: -82.836

James Bay

Robert-Bourassa Reservoir

Sakami Lake

Canada

Disclaimer
© Fisheries and Oceans Canada / Pêches et Océans Canada - NOT TO BE USED FOR NAVIGATION / NE PAS UTILISER POUR LA NAVIGATION Horizontal Reference : World Geodetic System 1984 (WGS84) / Référence horizontale : Système géodésique mondial 1984 (WGS84) Vertical Reference : Chart Datum (CD) / Référence verticale : Zéro des cartes (ZC)

Attributions
- World Ocean Base: Esri, Garmin, GEBCO, NOAA NGDC, and other contributors
- World Ocean Reference: Sources: Esri, GEBCO, NOAA, National Geographic, Garmin, HERE, Geonames.org, and other contributors
- Powered by Teledyne Geospatial
- Powered by Teledyne Geospatial

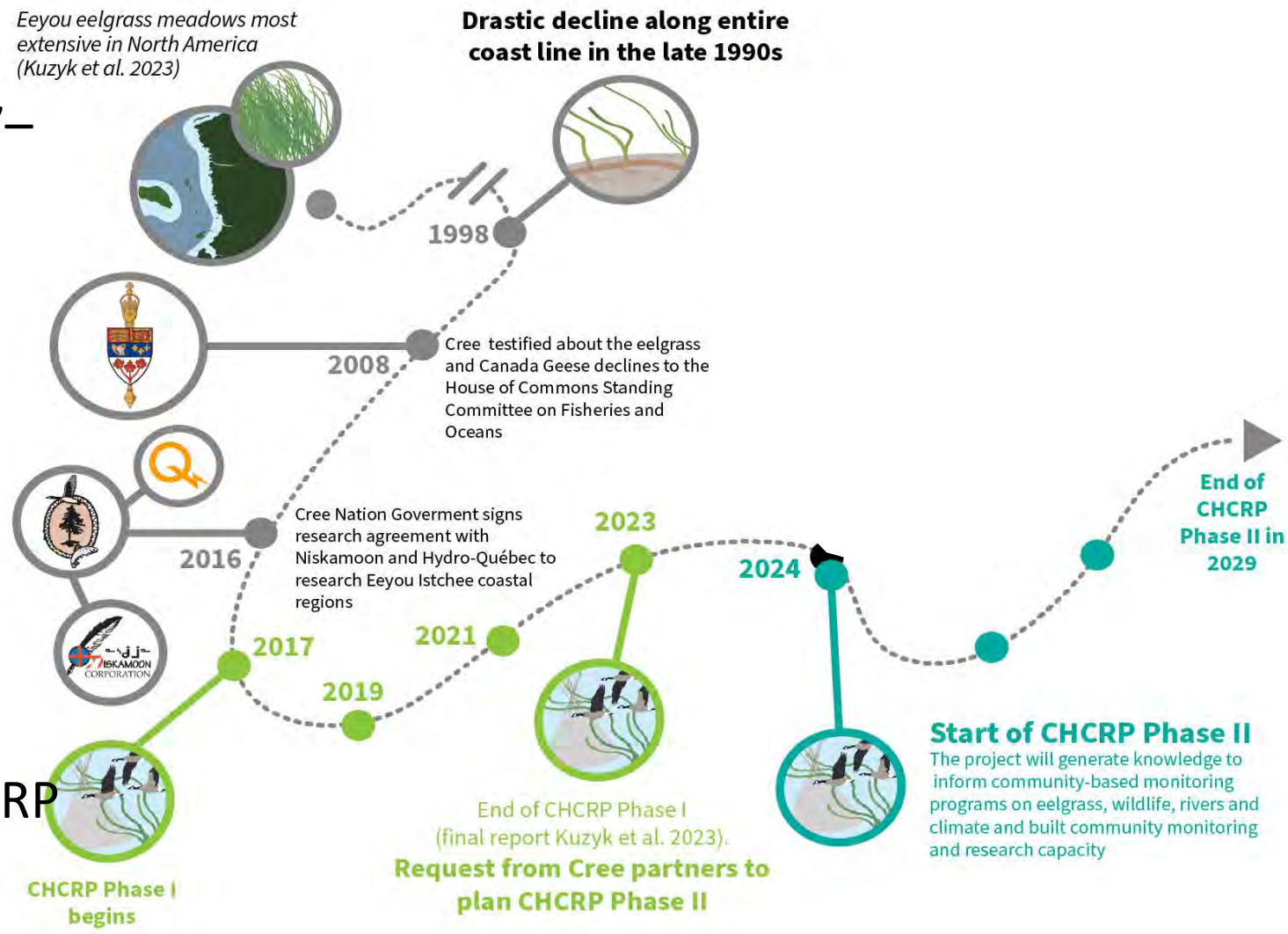
www.mozilla.org/firefox/central/

Nonna 100 and Nonna 10)

PROJECT HISTORY

CHCRP BACKGROUND

- Origins in CHCRP I (2017–2022)
- Community-academic partnership
- Eelgrass and goose population shifts
- Call for action from communities led to CHCRP II (2024–2029)

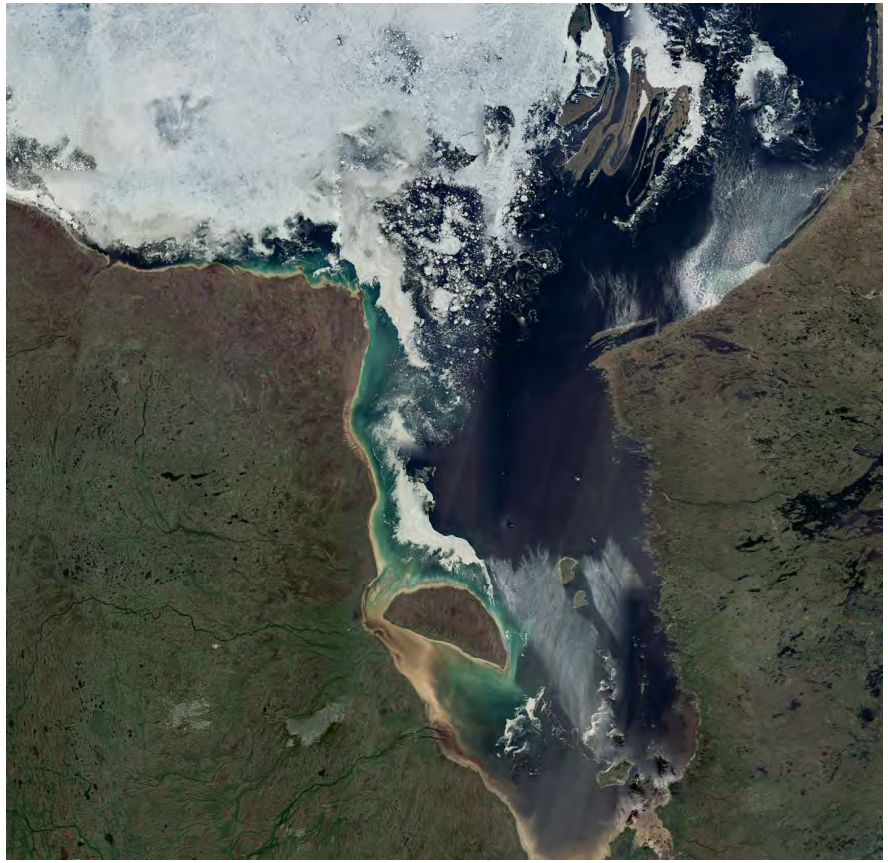


PROJECT GOALS

OBJECTIVE

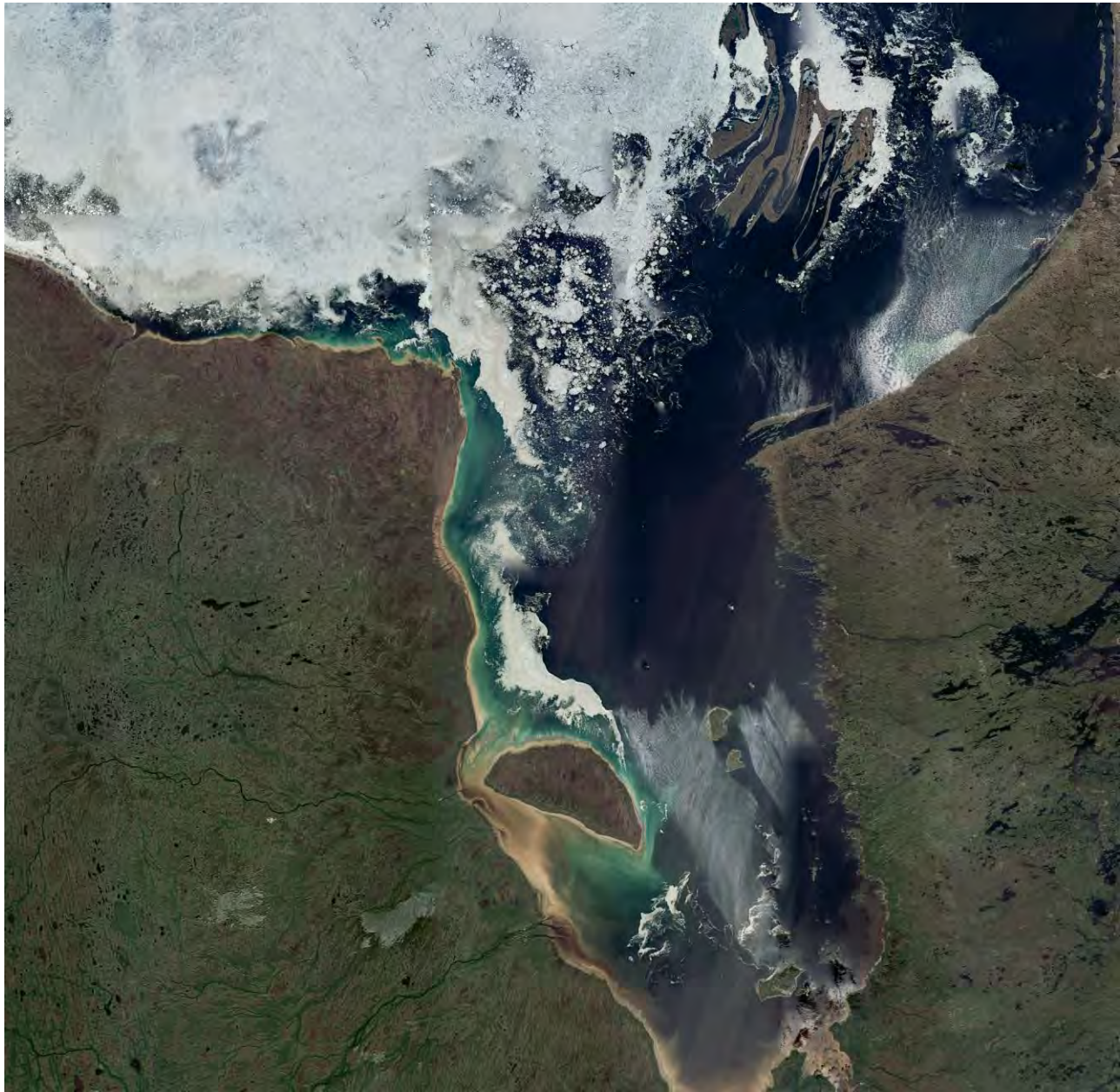
- Develop and train satellite-based bathymetry models using in-situ data collected by Cree land users.

- Identify and survey shallow waters
- Build AI models to scale bathymetry using satellite data
- Transfer knowledge and capacity to communities



IMPACT AND BENEFITS

- Empowerment of Cree land users
- Training and employment
- Contribution to bathymetry map (increase coverage)
- Path toward full James Bay coverage



IN-SITU DATA COLLECTION CAMPAIGN

APPROACH

- Two boats per site with trained Cree land users

- GPS + single-beam sonar setup

- Over 14 field days in Chisasibi, Wemindji and Eastmain traplines

Tools Used:

•Cruise Pro sonar
•Garmin GPS
•Tide gauges (RBR)
•CTD casts for water properties

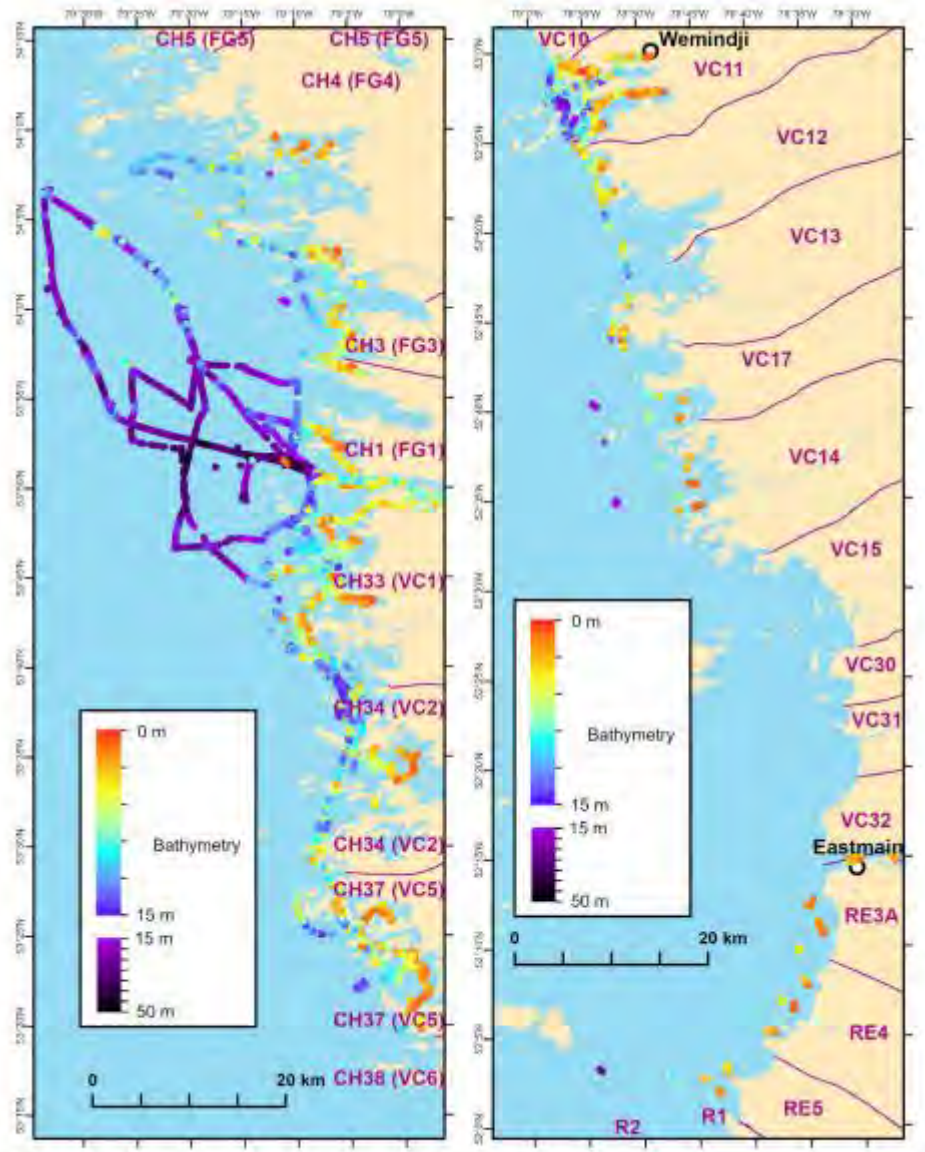
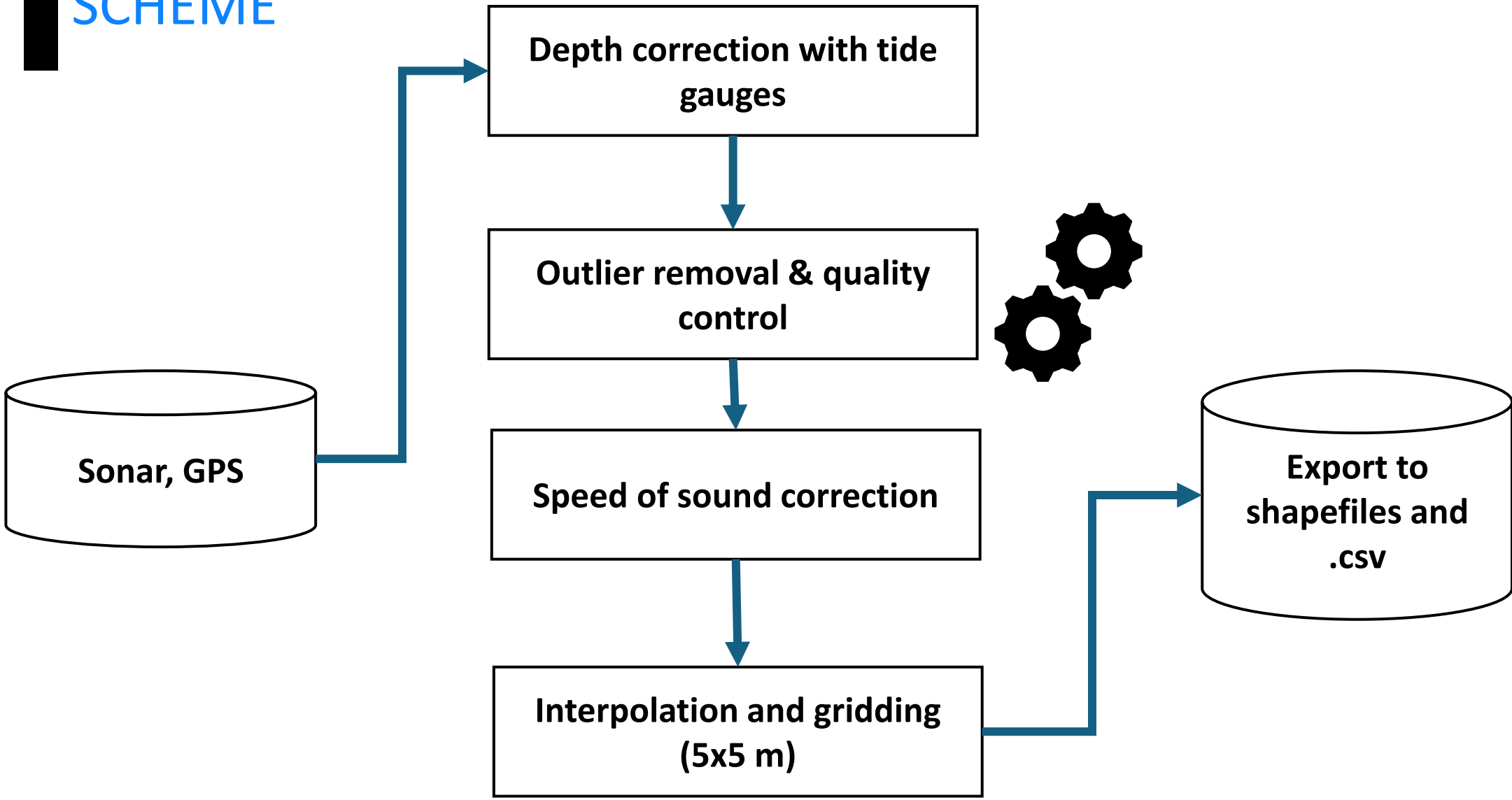


Figure 52. Overview of the bathymetry data collected between 2017 and 2021. Depths are in meters below mean sea level.

Neumeier, U.,et al., 2023. Coastal oceanography of eastern James Bay. Final report of the COast-JB Project prepared for the Niskamoon Corporation.

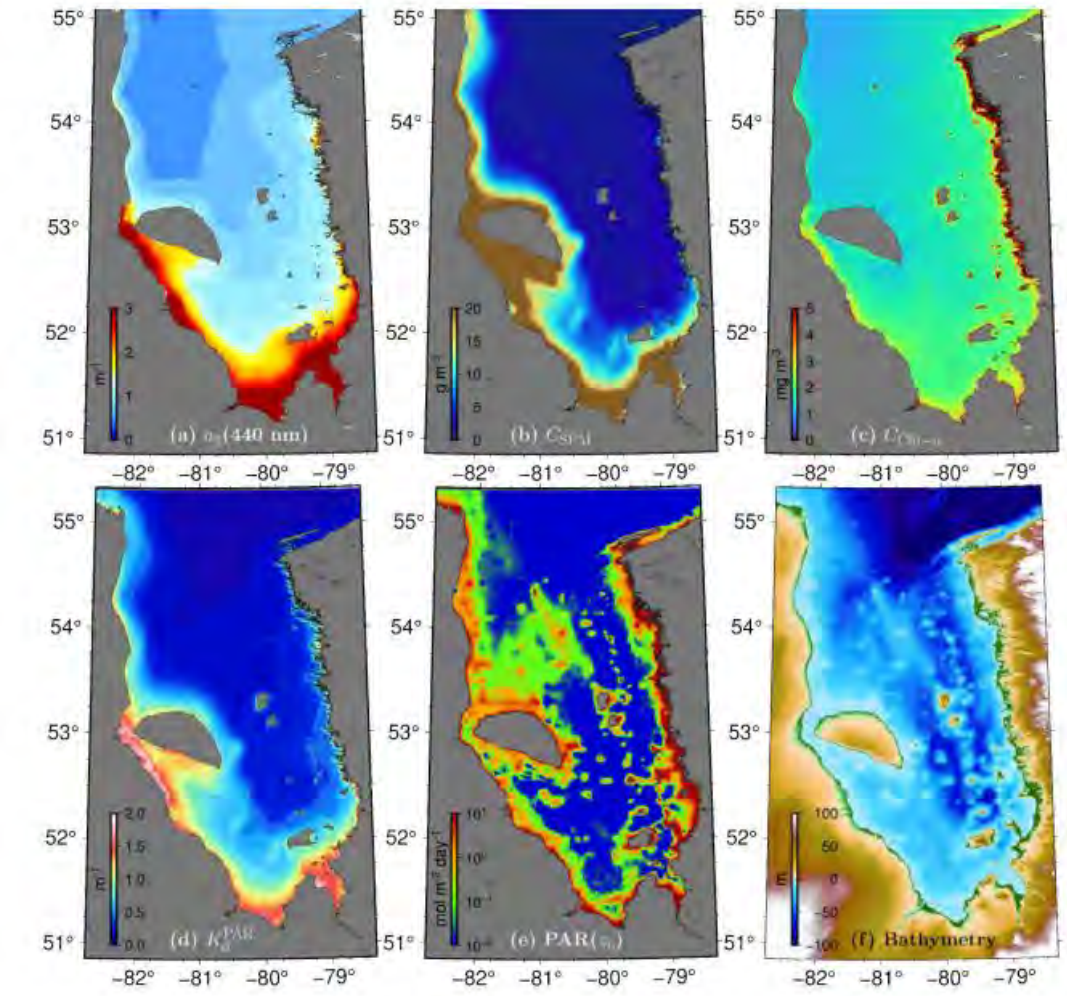
SAMPLE FIELD

SCHEME



INTRODUCING
SATELLITE-DERIVED BATHYMETRY (SDB)

- Definition: Estimating water depth from satellite imagery
- Why SDB? Large spatial coverage, low cost, regular updates
- Challenges in James Bay: turbid waters, organic matter



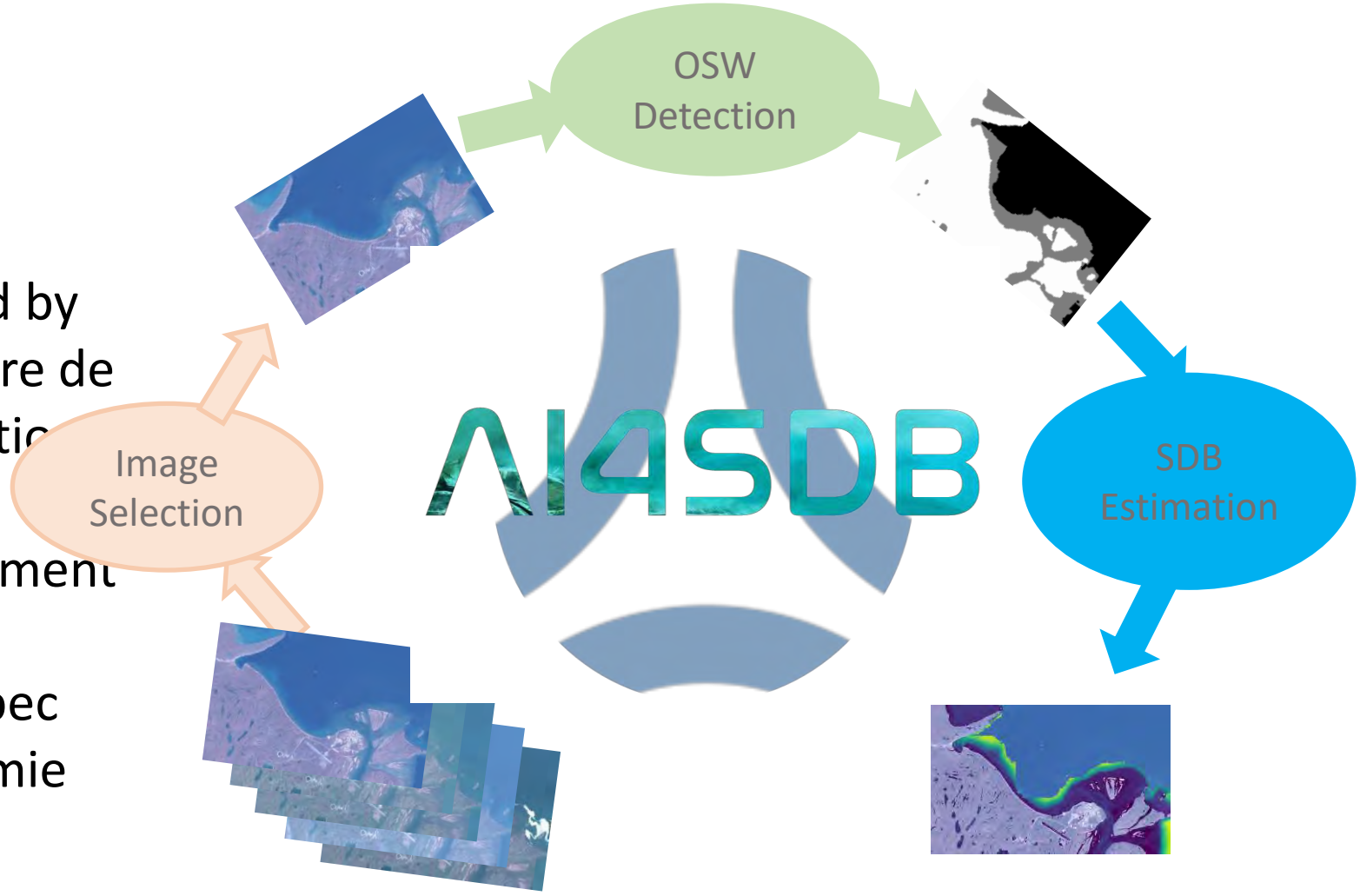
Neumeier, U.,et al., 2023. Coastal oceanography of eastern James Bay. Final report of the COast-JB Project prepared for the Niskamoon Corporation.

INTRODUCING
AI4SDB

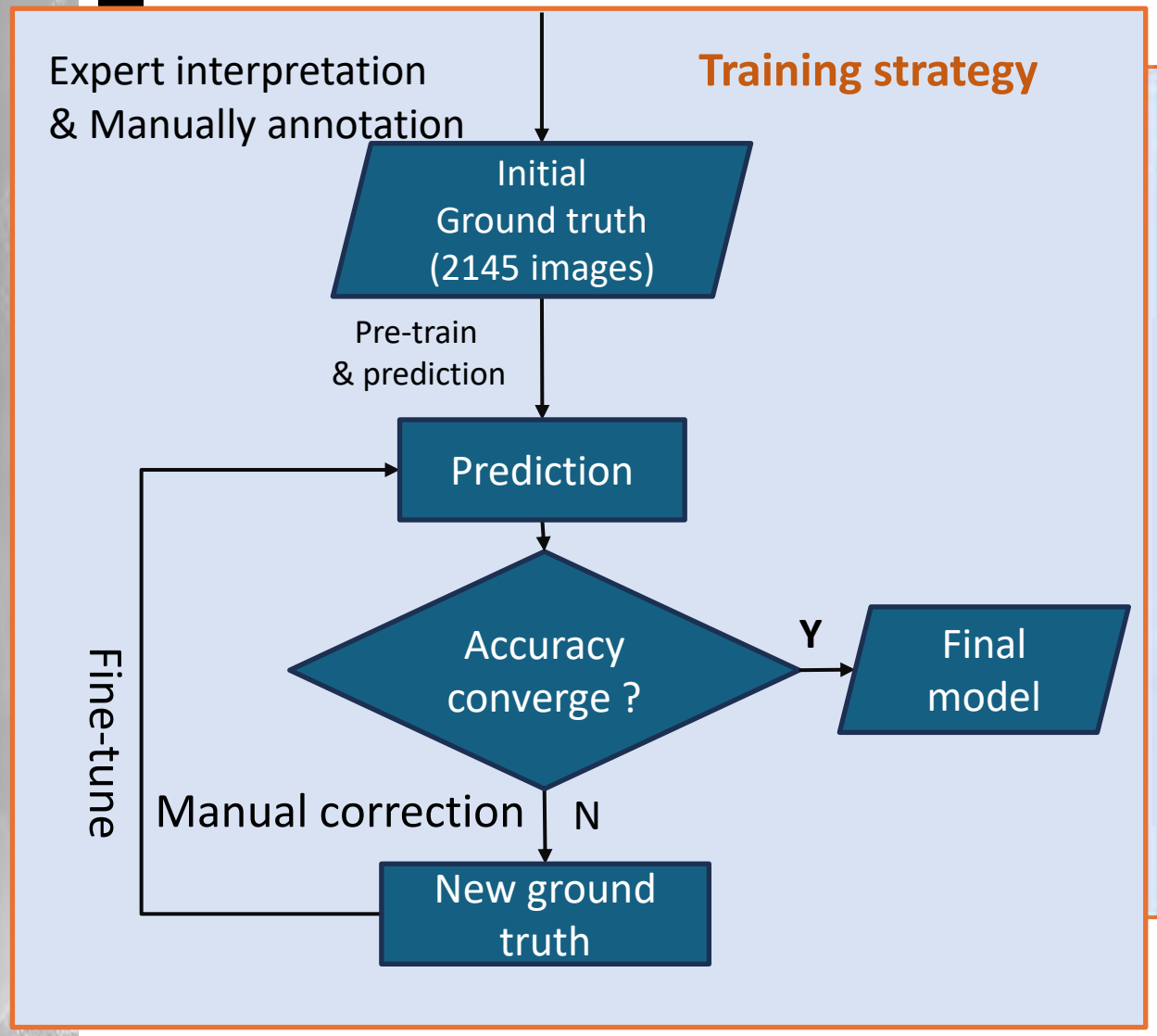
R&D history

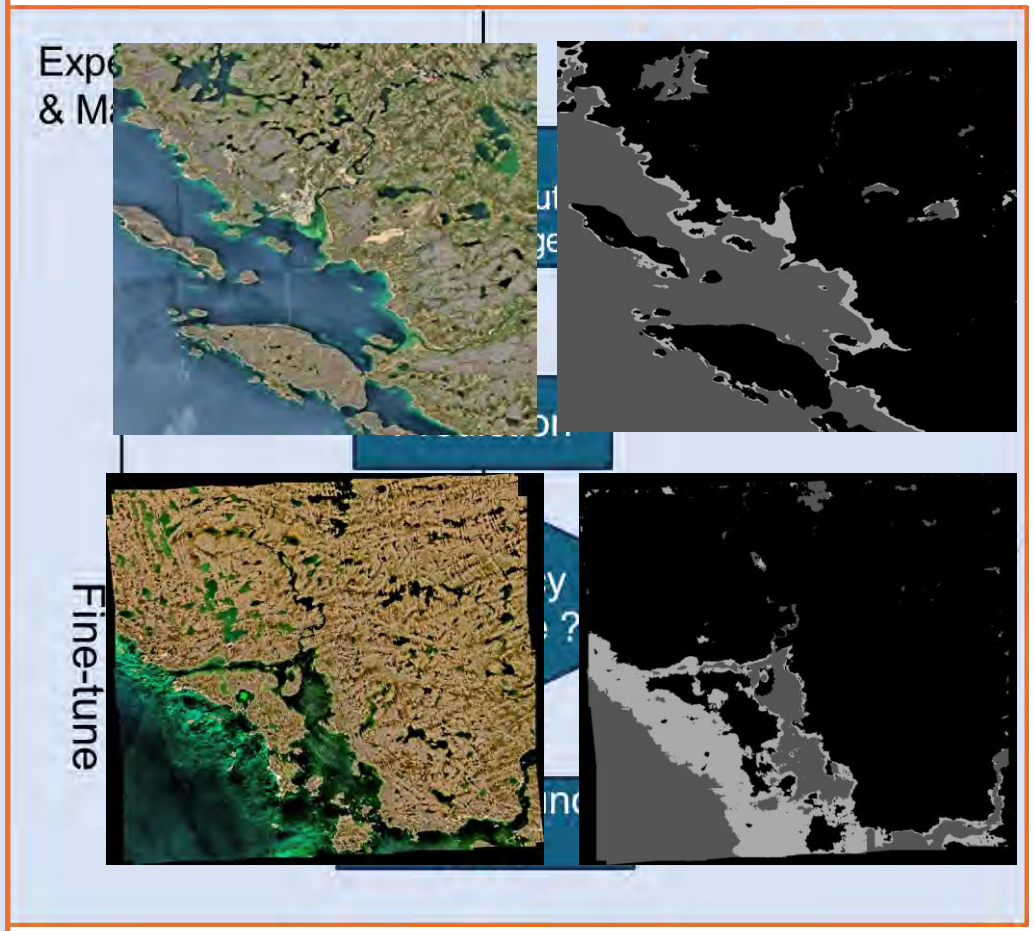
2020 – 2022 protype development (funded by from Quebec Ministère de l'Economie et Innovatio

2022 – 2024 improvement & application (part funded by from Quebec Ministère de l'Economie et Innovation)



PROPOSED APPROACH 1:
SHALLOW WATER DETECTION





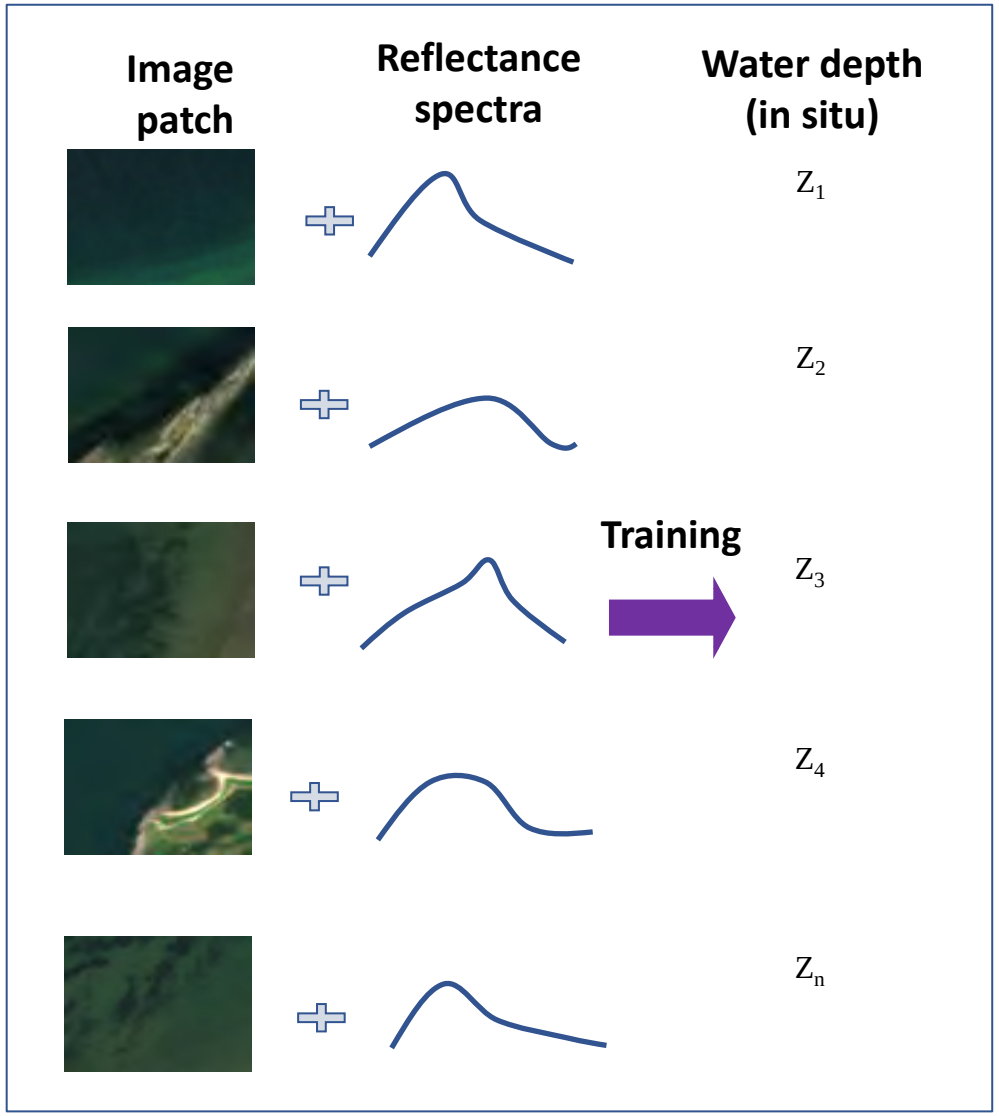
UNET-based model (OSWNETV1.1) are trained. Accuracy: 94%

PROPOSED APPROACH 1:

TRAINING THE NEURAL NETWORK FOR DEPTH

- Match reflectance (S2) with in-situ depth
- Use Empirical Neural Network to model SDB
- Model trained only in shallow water (< 5 m)

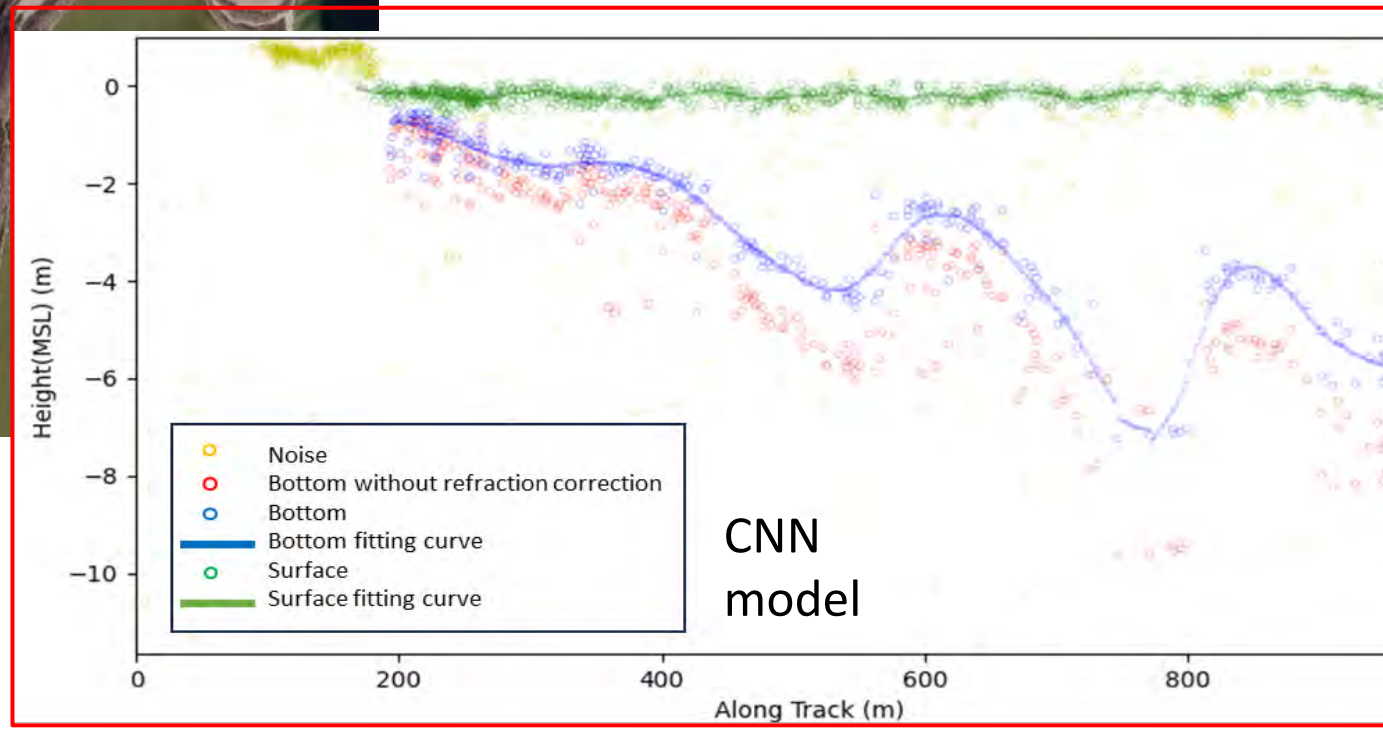
Empirical method (CNN model)



PROPOSED APPROACH 2:
INTEGRATING ICESAT-2 DATA

- Satellite LiDAR altimetry from ICESat-2
- Direct detection of seabed when water is clear
- Used to validate or supplement Sentinel-based SDB
- Paths known in advance and integrated into survey

Magdalen Island, QC



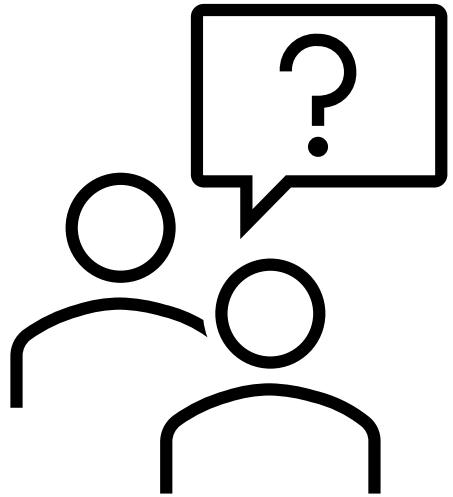
CNN model

UNCERTAINTY ASSESSMENT

- **In-situ uncertainty:**
  - ~15–30 cm due to tides, draft, sonar noise

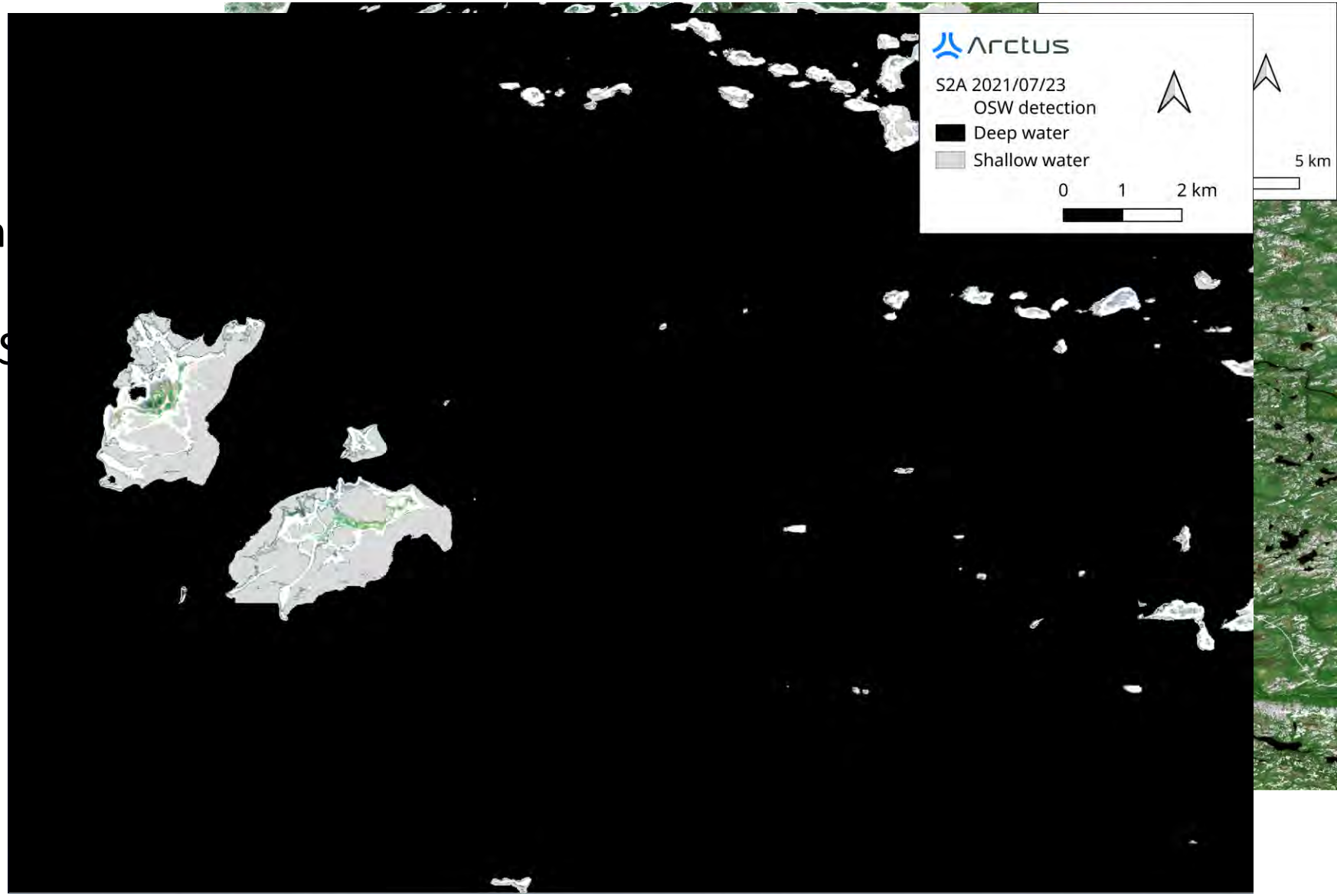
- **SDB uncertainty:**

  - Passive (Sentinel-2): varies with water depth (30 cm @ 0 m to 1m, 1 m @ 2 m to 4m)
  - Active (ICESat-2): RMSE ~0.35–0.71 m (Guo et al., 2022)



EARLY RESULTS
AND VALIDATION PLAN

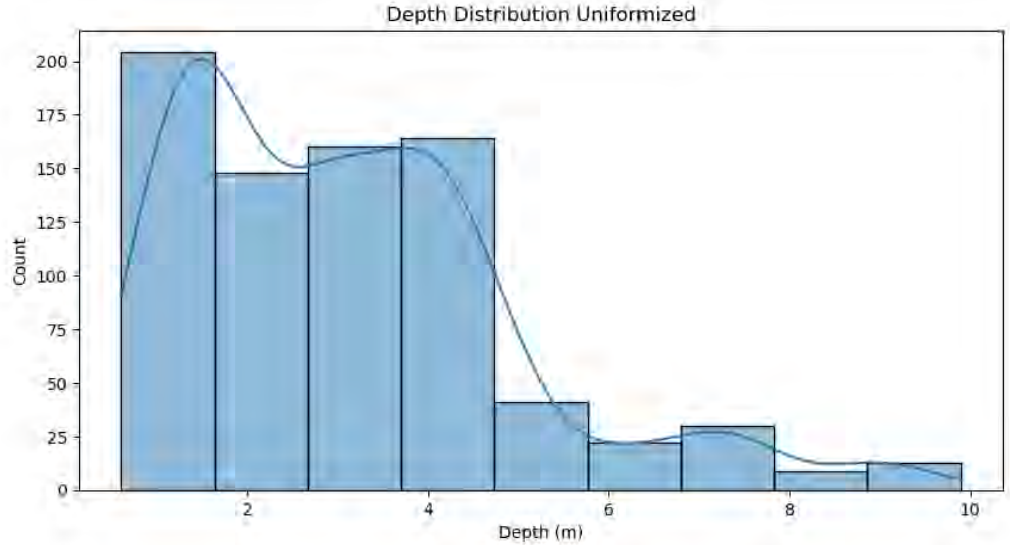
- Identification
  situ data in th
- Extraction of S
  data

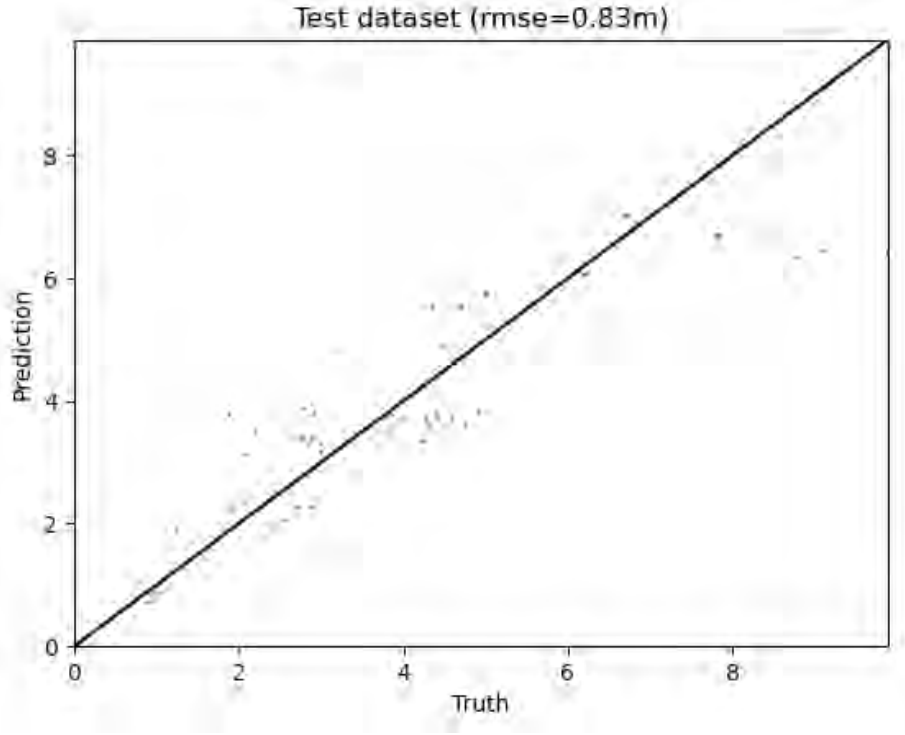


EARLY RESULTS
AND VALIDATION PLAN

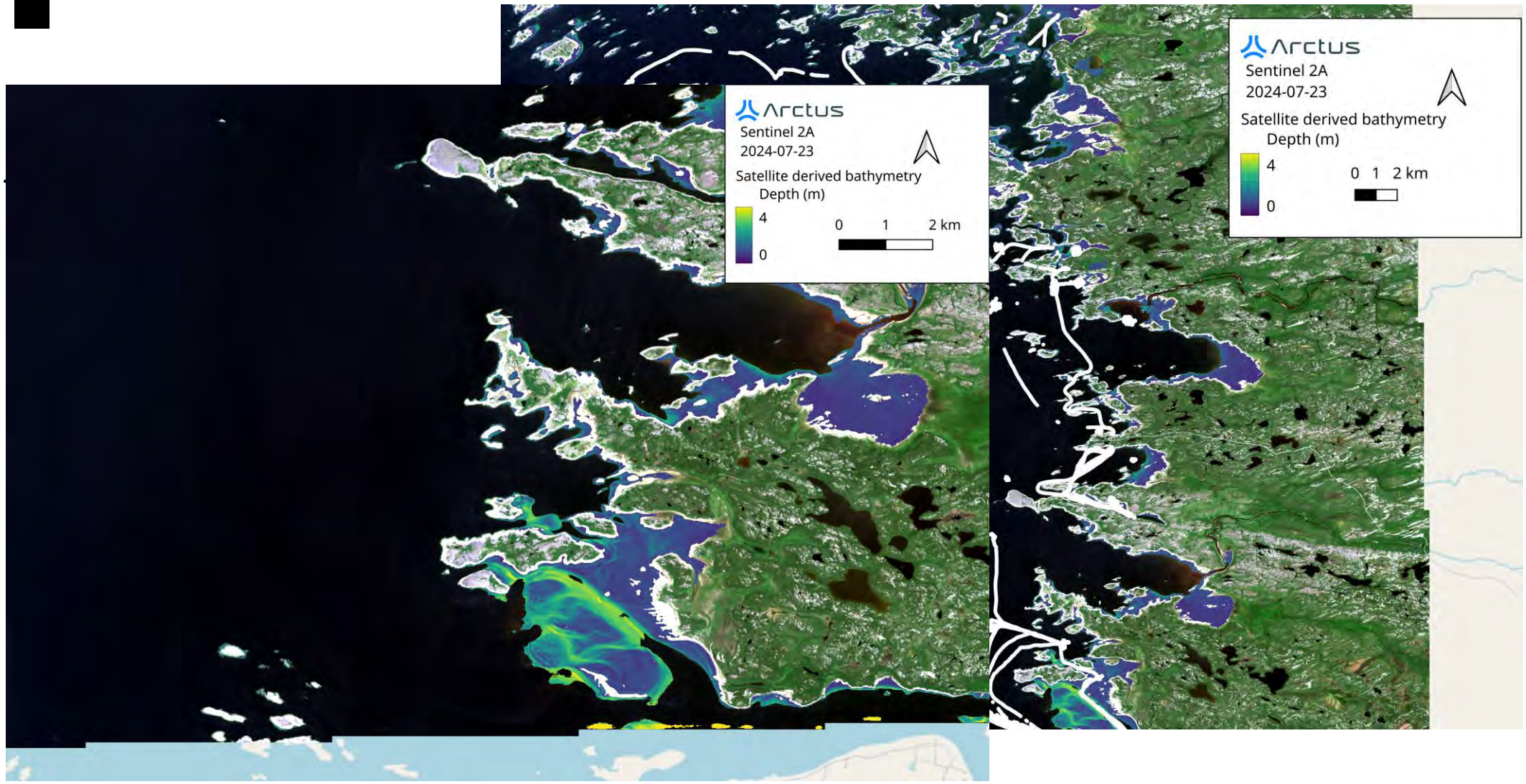
- Identification of the in-situ data in the OSW – filtering to have a homogenous representation of all depth

- Extraction of Sentinel 2 data for training and validation



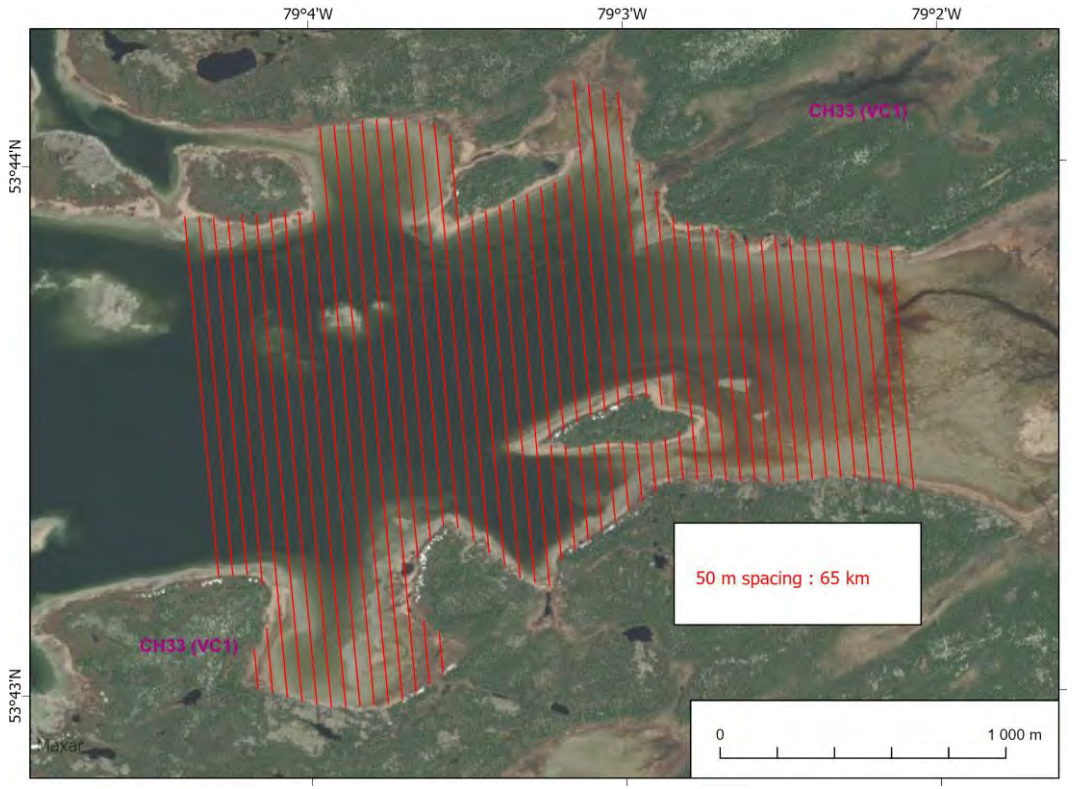


EARLY RESULTS
AND VALIDATION PLAN



NEXT STEPS

- 2025: Field measurement for validation and model training
- Explore deep learning models combining S2 + ICESat-2
- Deliver full-resolution maps to Cree communities and partners



ACKNOWLEDGMENTS

- Niskamoon Corporation
- Cree Nation of Chisasibi, Wemindji & Eastmain
- UQAR/ISMER, University of Manitoba
- SHC (Fisheries and Oceans Canada)

Merci

Directeur de projet: Simon Bélanger (sbe@arctus.ca)

Gestionnaire de projet : Thomas Jaegler (tj@arctus.ca)