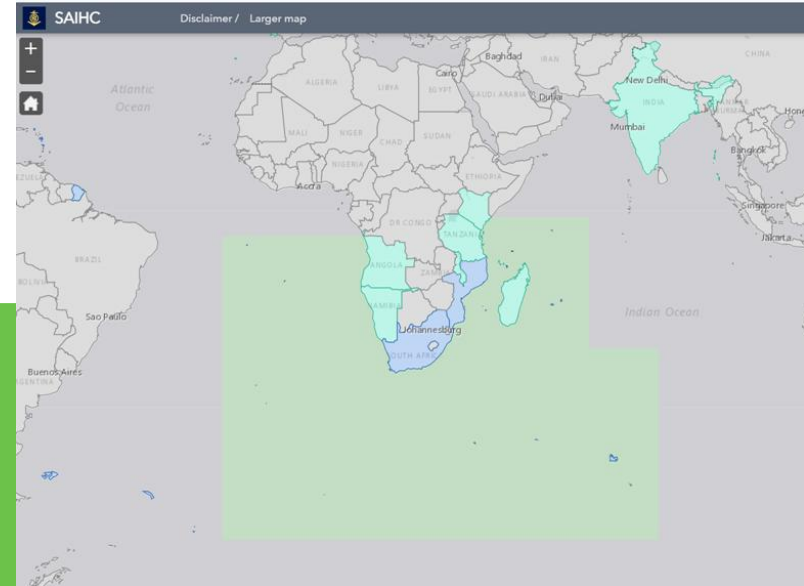


# Collaborative Satellite Derived Bathymetry Mapping Projects for Seabed 2030



Southern African and Islands Hydrographic Commission 19  
31 August 2023

Kyle Goodrich, *President & Founder*  
kg@tcarta.com



# Team TCarta

Denver | Kingston | Vancouver

## 18 person team

- USA (12)
- Canada (5)
- Jamaica (1)

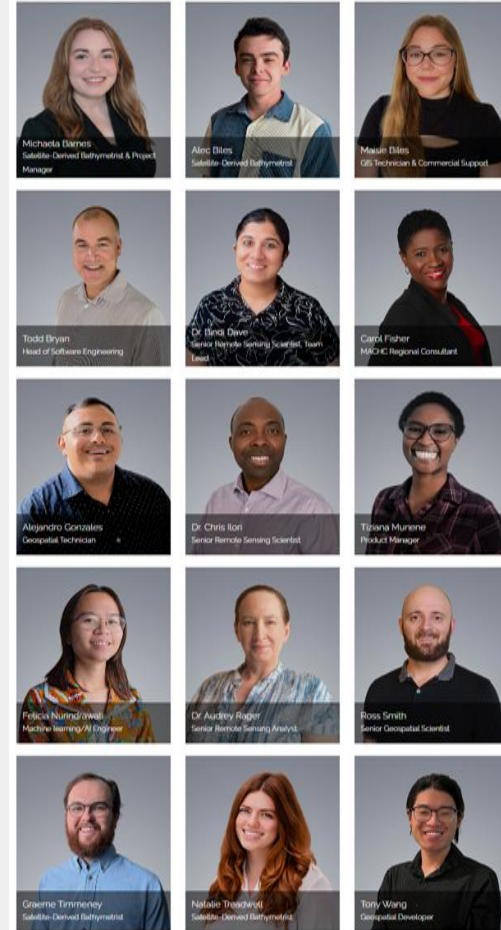
## 8 Women in Hydrospatial

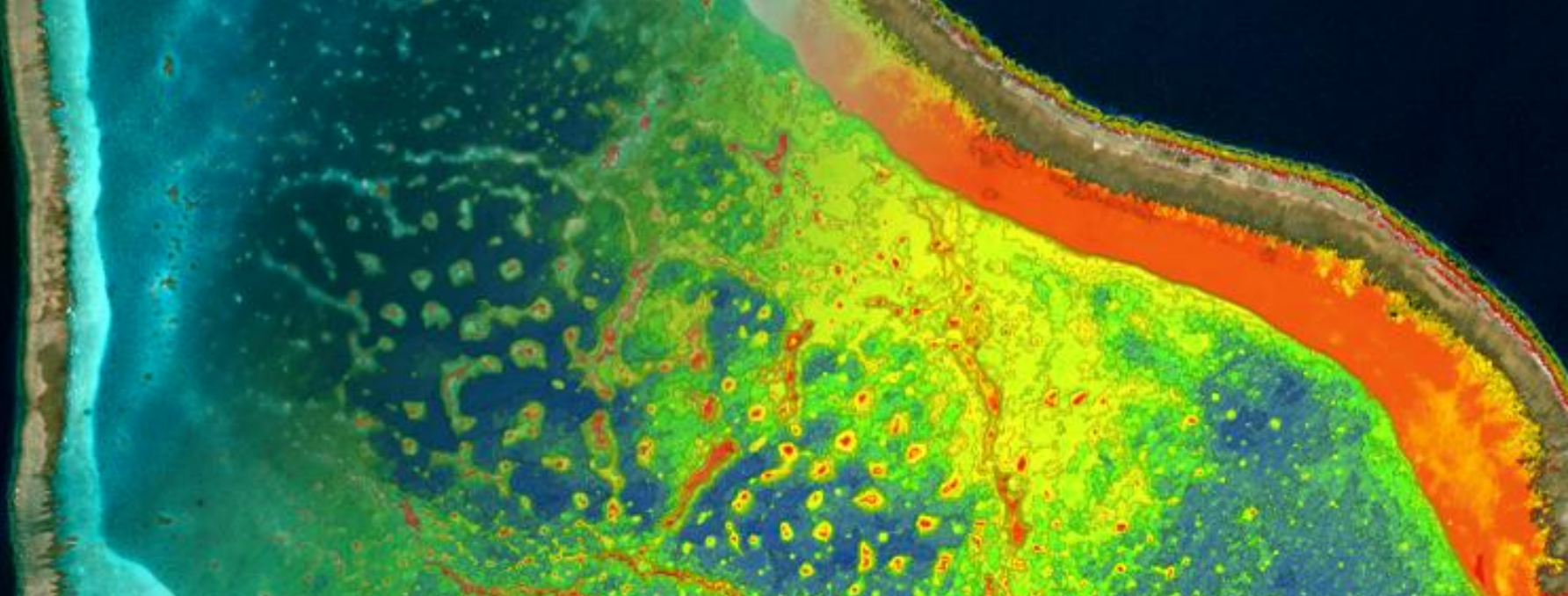


Kyle Goodrich  
Owner, President &  
Founder

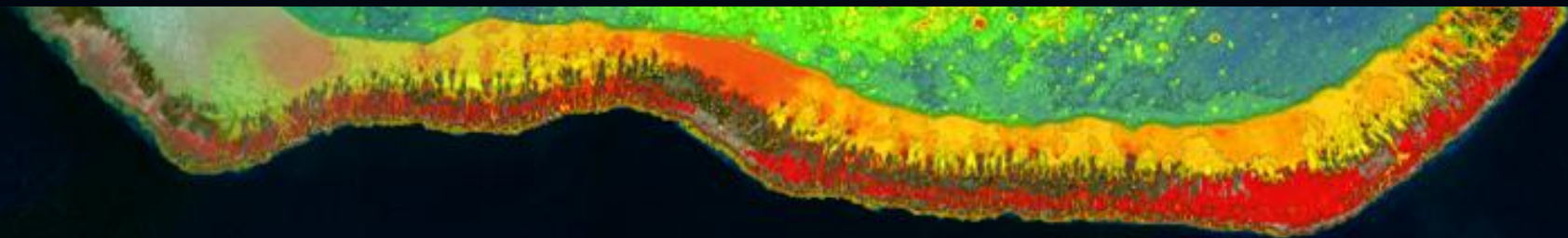


Corey Goodrich  
Owner,  
Managing Partner





Satellite Derived Bathymetry



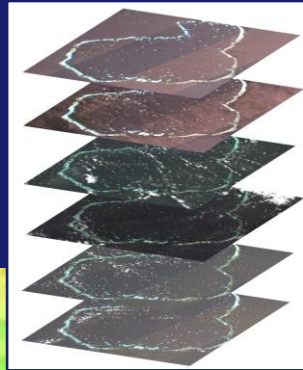
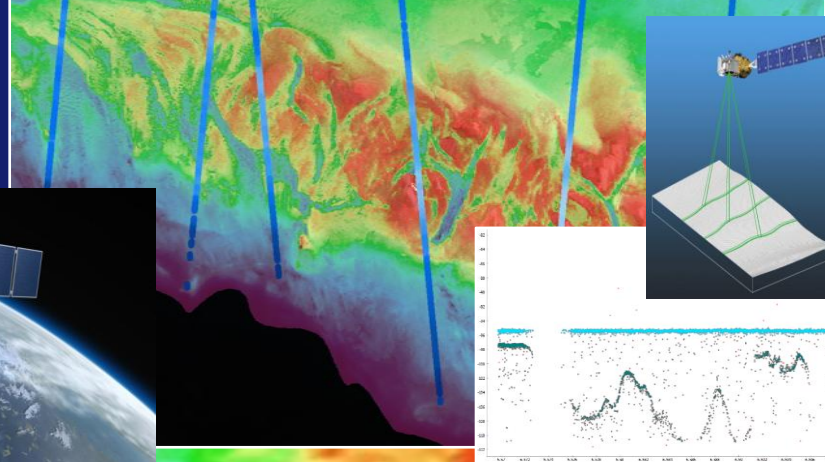
# Technology to Facilitate Regional Mapping



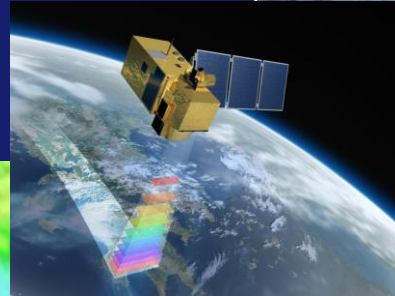
National Science Foundation Small Business Innovation  
Research Grant Phase II: Oct 2019 -December 2021

Trident Bathymetry Mapping System: A Multi-Pronged Automated  
Solution to Satellite Derived Shallow Seafloor Surveying. Award No:  
1927058

## Active & Passive Sensor Integration



Multi-Image SDB



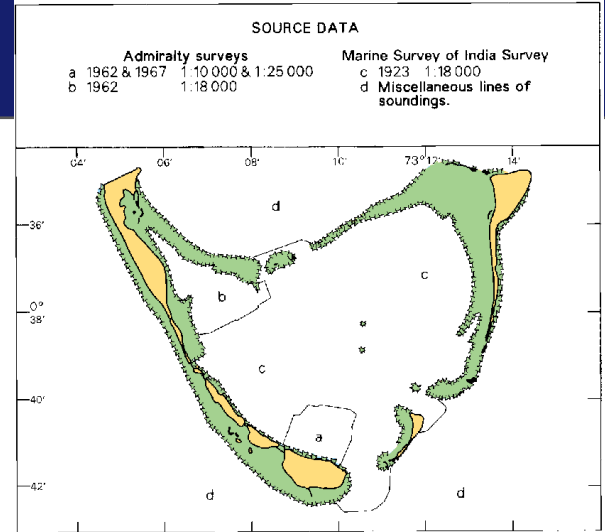
"Passive" - Earth Observation

"Active" - laser pulse



# Regional Demonstration Project

## Maldives - 2021



# Whole Country | Regional SDB

## Demonstration Tally

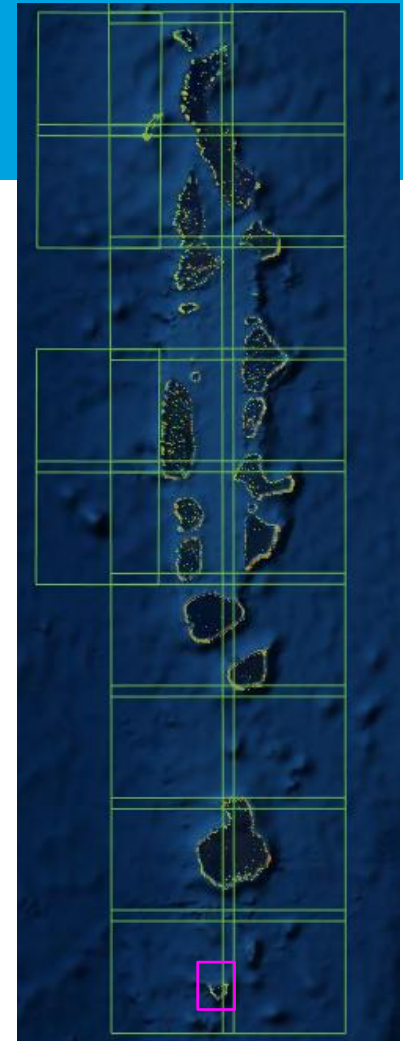
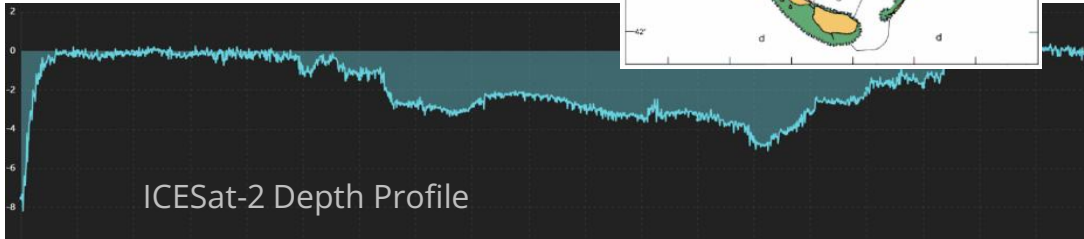
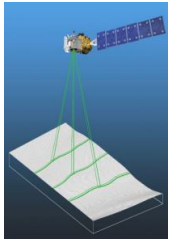
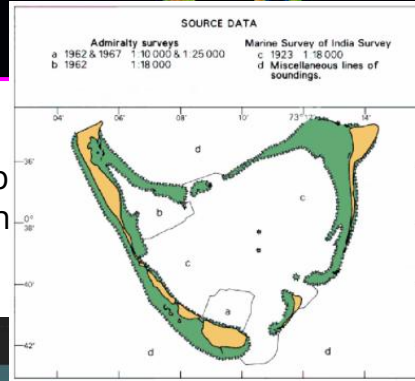
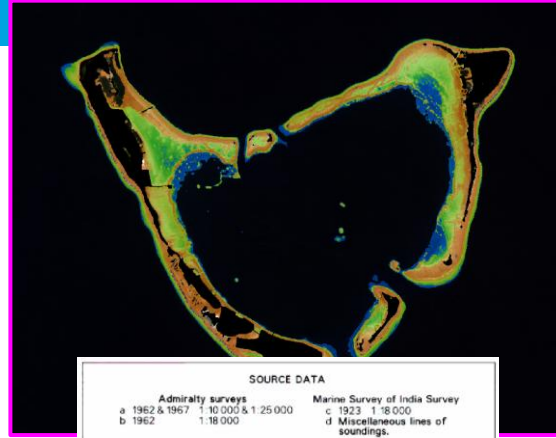
3200+ Sentinel Images Assessed  
- 509 Images Processes

~4,200 sq km of 10m SDB produced

1,136,608 ICESat-2 points.

~1 month production time

Imagery sourced from existing archives of freely available European government sources - no new collection of an mobilization of equipment for this project



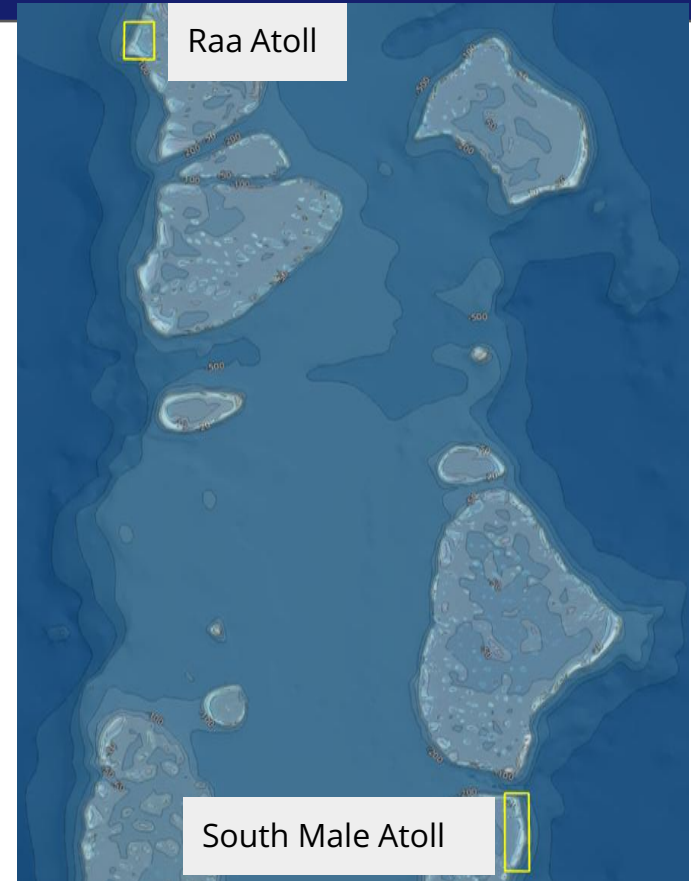
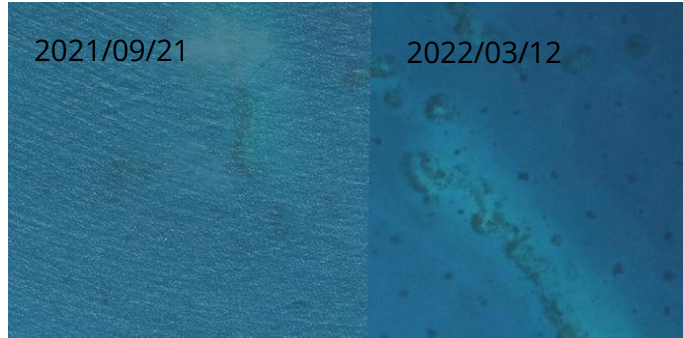
# Follow-On Collaboration Project

3 Day in-person training: 10-12 September, 2023

## Satellite Derived Bathymetry Multibeam Echosounder

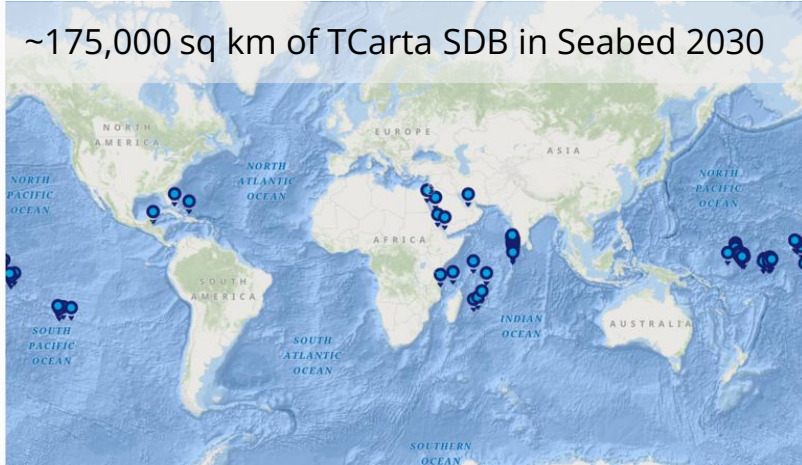


Maldives Land and Survey Authority  
Republic of Maldives

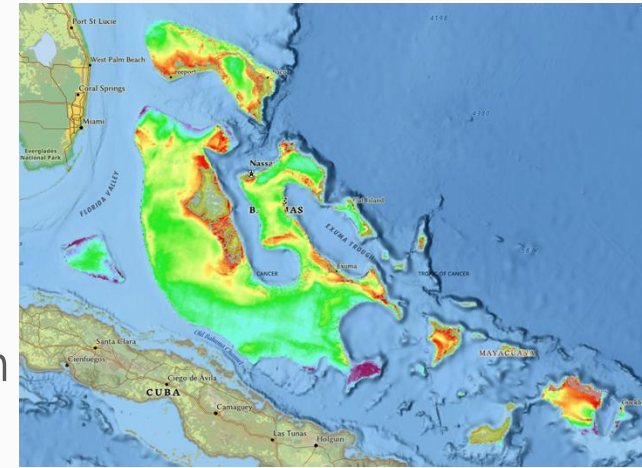


# TCarta SDB in Seabed 2030

~175,000 sq km of TCarta SDB in Seabed 2030



- Bahamas
- Belize
- Red Sea
- UAE
- Reunion
- Mauritius
- St. Brandon
- Seychelles



UK Hydrographic  
Office

- Kiribati
- Pitcairn Islands



- Maldives





# Collaborations Within the MACHC Region

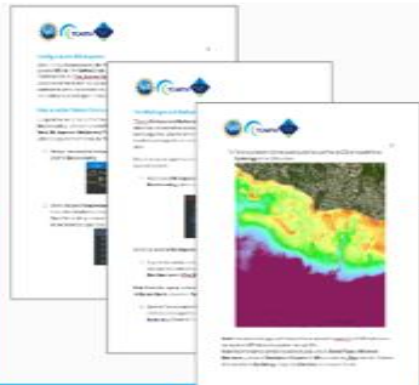
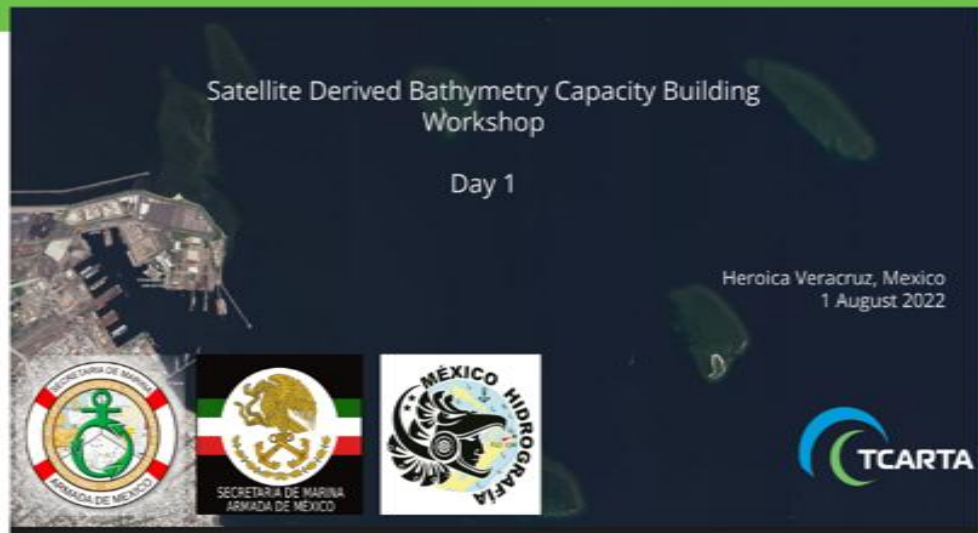


# Capacity Building - Vera Cruz, Mexico

Mexican Navy Hydrography Dept.

5 Day in person SDB Capacity Building - dual language

Goals: Training for Mex Navy to produce SDB for Charting, survey planning and Seabed 2030

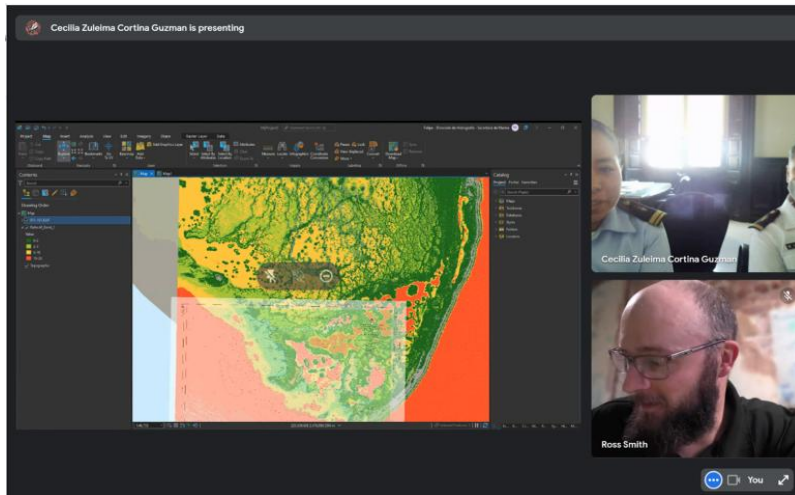


# Virtual, Web-Based Training & Pilot Project

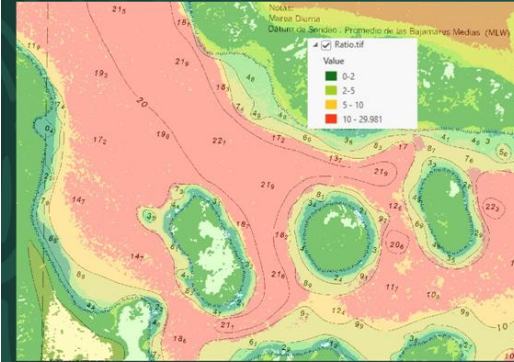
Web-Based Workrooms and Troubleshooting

MBES survey data used to extend coverage in shallow areas

Nautical Chart Produced!



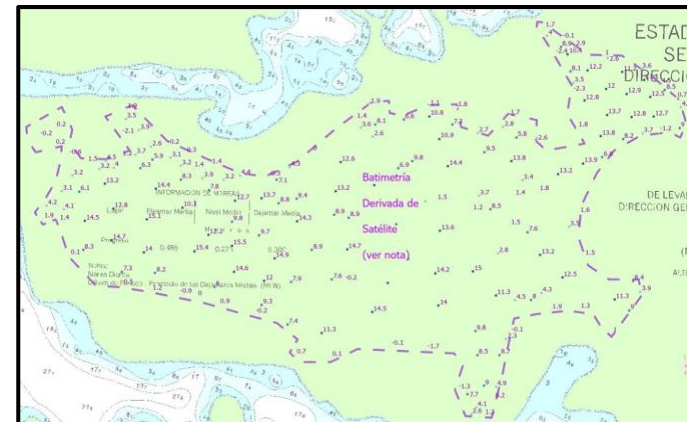
## Metodología para la generación de Batimetría Derivada por Satélite:



El modelo batimétrico obtenido se clasificó de la misma forma que los rangos de profundidad con sus respectivas isóbatas son representadas en la carta:

- 0-2 m
- 2-5 m
- 5-10 m
- 10-20 m

En la imagen se muestra que el compartimiento de las áreas entre el modelo batimétrico y la carta es semejante (datos en color negro).

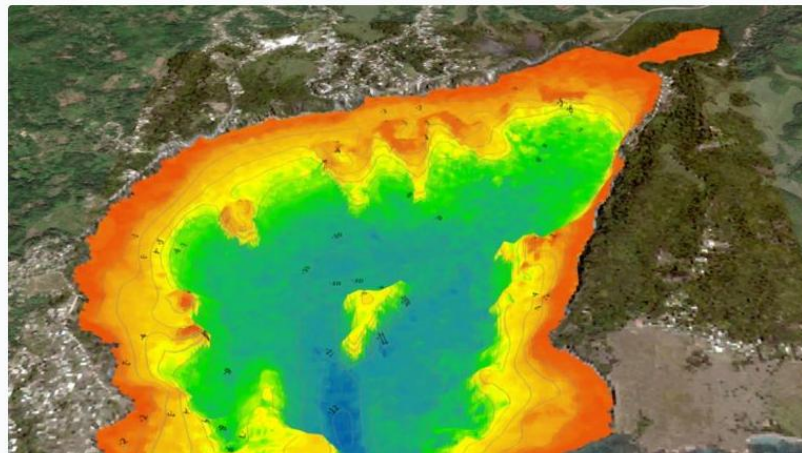


# First SDB Demonstration Project with Jamaica - 2021



## Bowden Harbour SBES & 10m SDB Integration

- Fully remote engagement due to Covid
- Didn't go as planned
- Healthy debate on SDB's potential to be used to fill in gaps from a hydrographic standpoint
- Results not as desired -both sides, still found success, next steps



ARTICLE

## Satellite-derived bathymetry for surveying Jamaica's coastal waters

Towards time efficiencies, cost savings and improved safety

By Carol Fisher, Antonio Williams • March 29, 2022

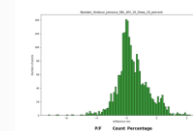
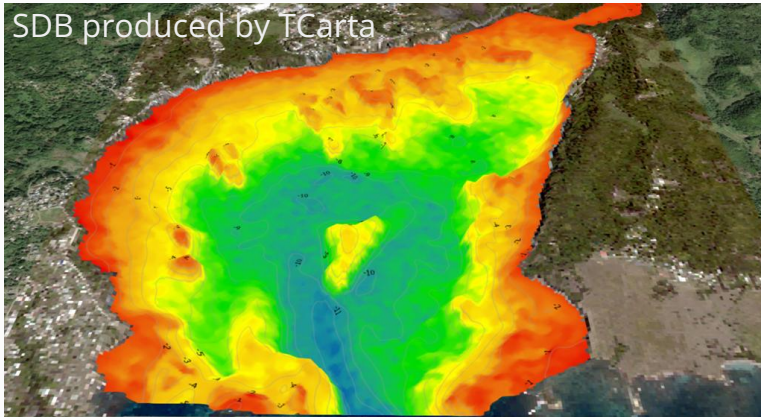
**T**he national land agency in Jamaica has integrated satellite-based hydrography to benefit from time efficiencies, cost savings and improved safety as part of its hydrographic programme in support of the nation's further economic development.

Co-Authored Hydro International Article - Mar 2022

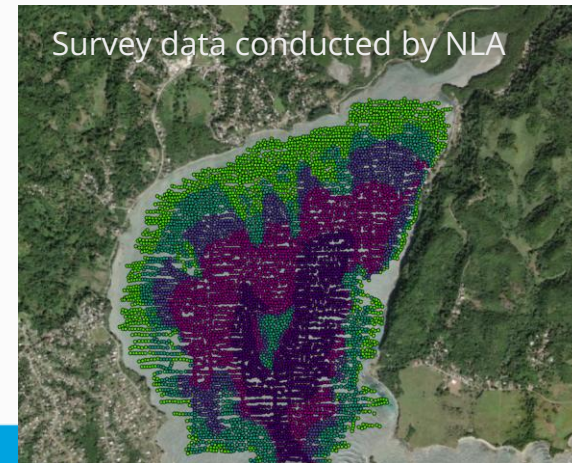


# Collaboration with Hydrographic Office - Combined Benefits of SDB and SBES Survey

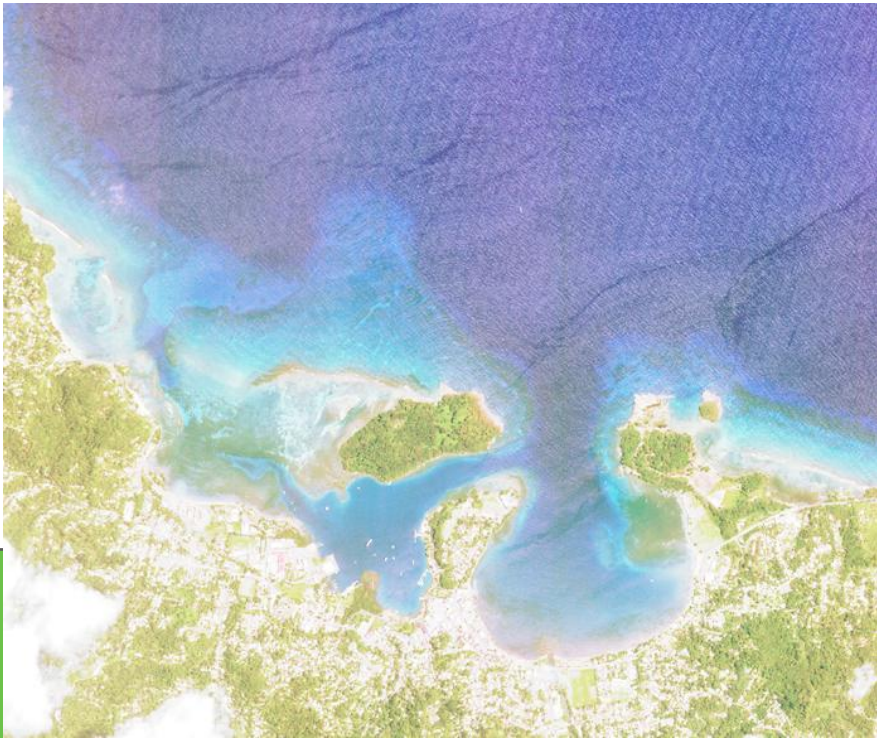
## Bowden Harbour, Jamaica



Data Collaboration and Capacity Building Workshop held in March 2021

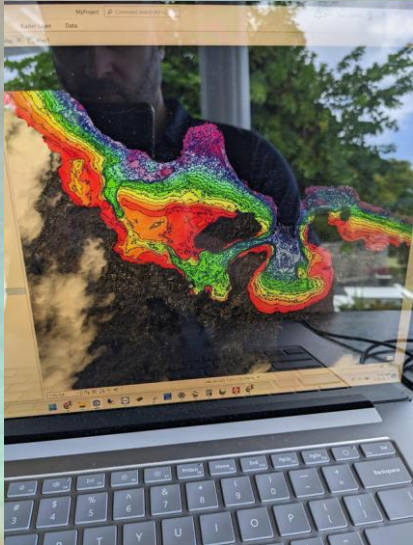


# Satellite Derived Bathymetry Capacity Building



March, 2023

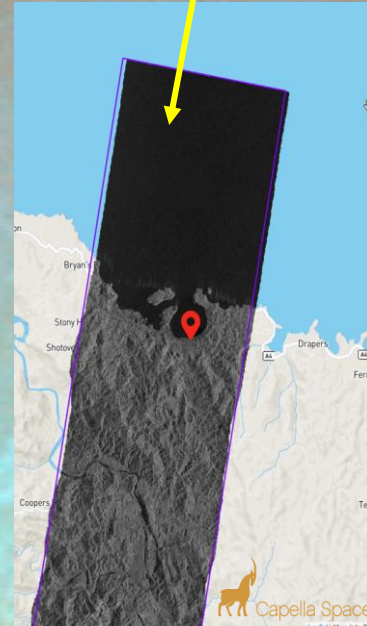
# Leads to Port Antonio MBES & SDB & UAV Integration Project



MBES | SDB | SAR | UAV



Imagery Tasked During Survey



1 Crewed Survey Vessel

1 UAV

4 Satellites

- WorldView
- Planet
- Satellogic
- Capella (SAR)

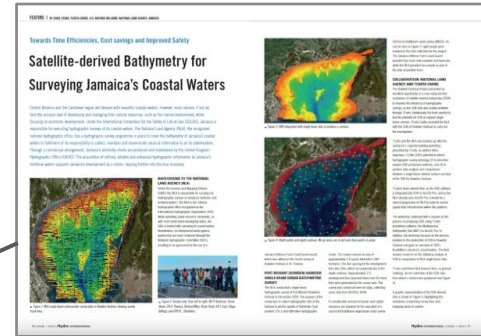


# National Land Agency (NLA), Jamaica SDB Integration

## *from a healthy skepticism to strategic planning*

2021

- April 2021 - TCarta provides a half-day virtual SDB intro, across NLA ranks, initiates proof of concept collaboration
- Integrated surveying of Bowden Harbour (TCarta SDB & NLA SBES)
- Co-authoring of Hydro International Article; debate over hydrographic applications of SDB
- Hydro International article receives a lot of positive attention; TCarta pursues further collaboration with NLA; Favorable leadership changes at NLA



2023

- Technical Exchange: TCarta learns MBES on the water & Drone Collection; NLA learns SDB in the Computer Lab
- May 2023 NLA / GEBCO Alumni Proposal to map all of Jamaica w/ combined technologies & team

NIPPON FOUNDATION / GEBCO  
TRAINING PROGRAM ALUMNI

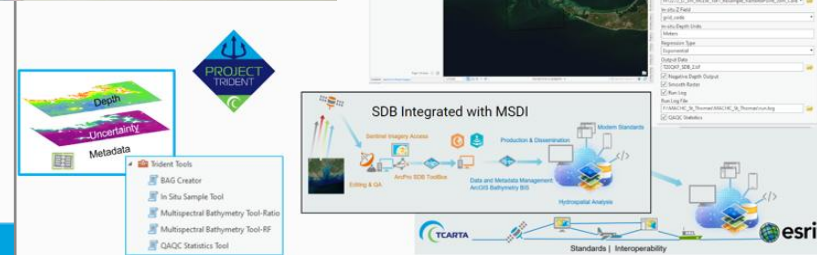
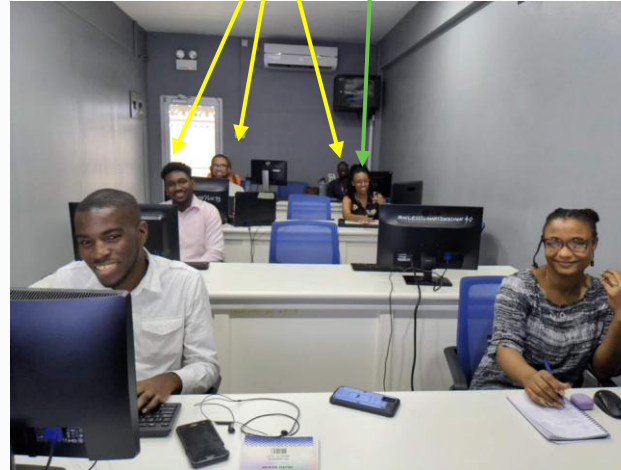


NIPPON FOUNDATION- GEBCO ALUMNI PROJECTS -  
CALL FOR PROPOSALS



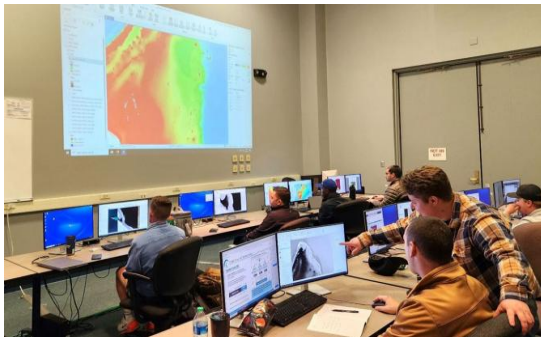
# In-Person and Remote SDB Capacity Building

Partnering to develop the next generation of SDB- Hydrographers  
Ready Hydrospatial Professionals  
**It's about people too!**



# University of Southern Mississippi, Stennis Space Center

## Future Hydrographers | Tech Integration | Tools & Workflows



Spring 2023

Instructing hydrographers of the future

# Marine Institute Summer Work Term Program



Co-funded by:



2 graduate students - ongoing

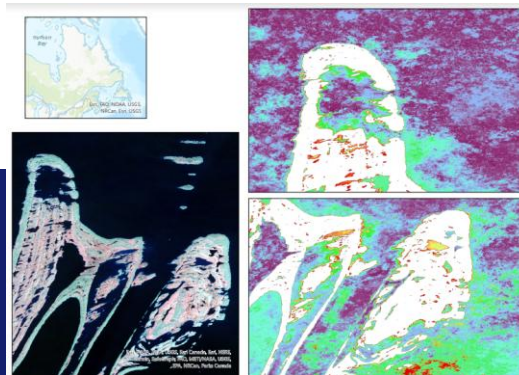
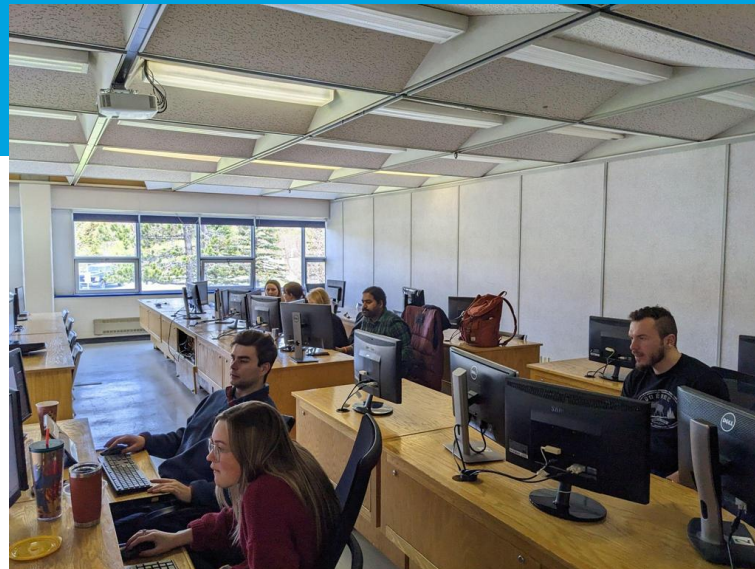
6 undergraduate - 12 week summer work term

Real World Satellite Derived Bathymetry Work

- In-person instruction and virtual workrooms
- Student-generated SDB
- Marine Institute Native Village Research Sites AOIs
- SDB produced contributed to Seabed 2030



# Summer Staff Producing SDB for Seabed 2030 Project



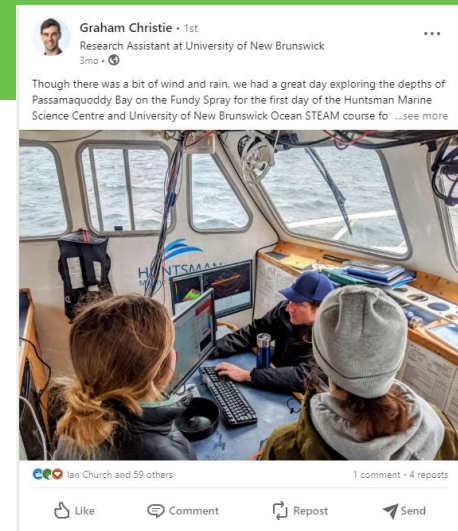
Before:  
"I hate science. This was your idea, Dad"

Dad: [says nothing - but it was not!]



After:  
"Dad, Geodesy is awesome"

Dad: [says nothing, tears of joy!]



# Collaborative Satellite Derived Bathymetry Mapping Projects for Seabed 2030



Southern African and Islands Hydrographic Commission 19  
31 August 2023

Kyle Goodrich, *President & Founder*

[kg@tcarta.com](mailto:kg@tcarta.com)

[www.tcarta.com](http://www.tcarta.com)

