MACHC 22nd Conference
November 30-December 03, 2021

Industry Support for Capacity Building Challenges
December 1st 2021 12:15 and 13:00 US-EST.

Bowden Harbour Project & the Caribbean Geoportal

Presentation Outline

1. TCarta -Who we are
2. Introduction to Satellite Derived Bathymetry (SDB)
3. TCarta's SDB software Trident
4. Case study of Bowden Harbour-Multiple Approaches
5. TCarta & Capacity Building

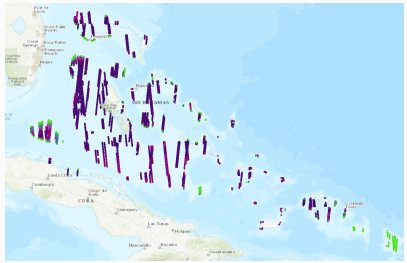
Carol Fisher - Program Manager/Lead Hydrographer

TCarta Caribe -Kingston

TCarta Caribe - Who we are

- Established in 2019 in Kingston Jamaica
- Subsidiary of TCarta Marine, Denver, Colorado established in 2014

Core Capabilities: Remote Sensing, GIS, Hydrographic services, Programming, Geospatial software and Web services development

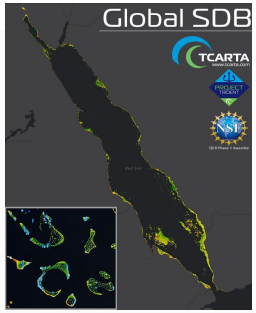


Recent Major Satellite Derived Bathymetry Past Projects:

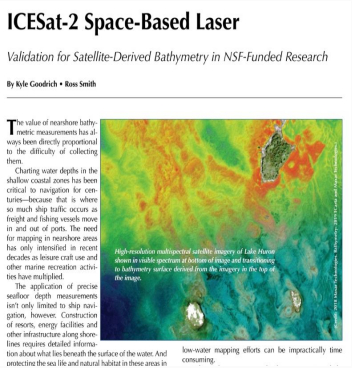
- 2019-2021 - National Science Foundation- SBIR Grant Phase 2: *Project Trident - Automated, AI-driven, integration of multiple SDB methods & ICESat-2*
- Large Scale Production for recreational boating; 130,000 sq km 10m SDB from 500+ images; 6 million+ ICESat-2 point

Recent Developments:

TCarta Leverages AI Technology and ICESat-2 Data to Create a G-SDB Product



OceanNews.com



ICESat-2 Space-Based Laser

Validation for Satellite-Derived Bathymetry in NSF-Funded Research

By Kyle Goodrich • Ross Smith

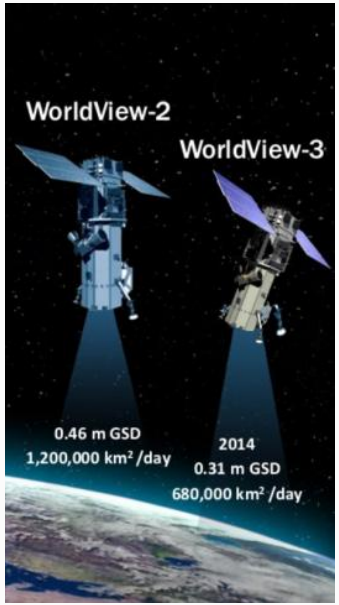
The value of nearshore bathymetric measurements has always been directly proportional to the difficulty of collecting them.

Charting water depths in the shallow coastal zones has been critical to navigation for centuries—because that is where so much ship traffic occurs as freight and fishing vessels move in and out of ports. The need for mapping in nearshore areas has only intensified in recent decades as leisure craft use and other marine recreation activities have multiplied.

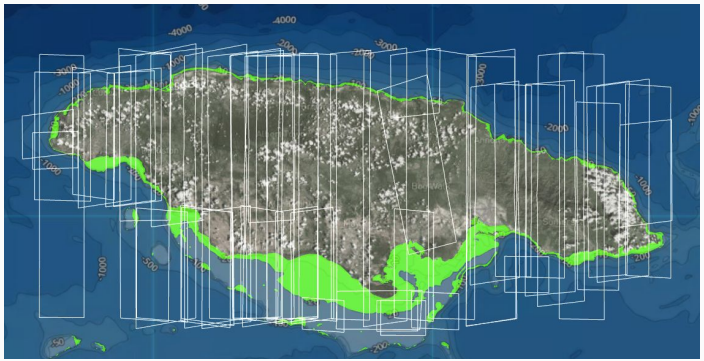
The application of precise seafloor depth measurements isn't only limited to ship navigation, however. Construction of resorts, energy facilities and other infrastructure along shorelines requires detailed information about what lies beneath the surface of the water. And protecting the sea life and natural habitat in these areas in low-water mapping efforts can be impractically time consuming.

Sea Technology Magazine

Satellite Derived Bathymetry



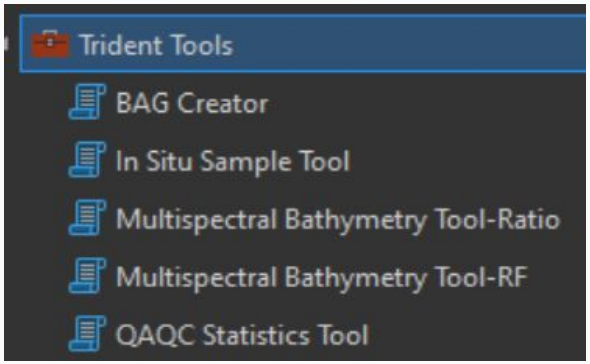
"SDB relates the surface reflectance of shallow coastal waters to the depth of the water column"



TCarta has developed novel approaches to SDB by integrating multiple methods, sensors and utilization of machine learning and developed scalable approaches to surveying broad areas

1. Imagery collection
   a. Have to consider cloud cover, haze, turbidity, and sun glint
2. Image pre-processing
   a. Atmospheric correction, land masking, de-glinting
3. Bathymetric creation
   a. Exponential decay, random forest, linear regression (physics-based algorithms)
4. Post-processing
   a. Smoothing, PCE
5. QA/ QC
   a. Compare SDB product to NASA's ICESat-2 data & assign uncertainty level

TCarta SDB Software-Trident



- TCarta proprietary software as result of grant research for automation of the SDB method
- Trident MBT tool is add-on tool in Esri ArcPro software
- Software enables user to produced their own bathymetric model using a systematic workflow

Download & pre-process multispectral satellite imagery

Step 1

Collect ground truth points (SBL), and split the points into calibration & validation datasets

Step 2

SDB calculation: log ratio & random forest

Step 3

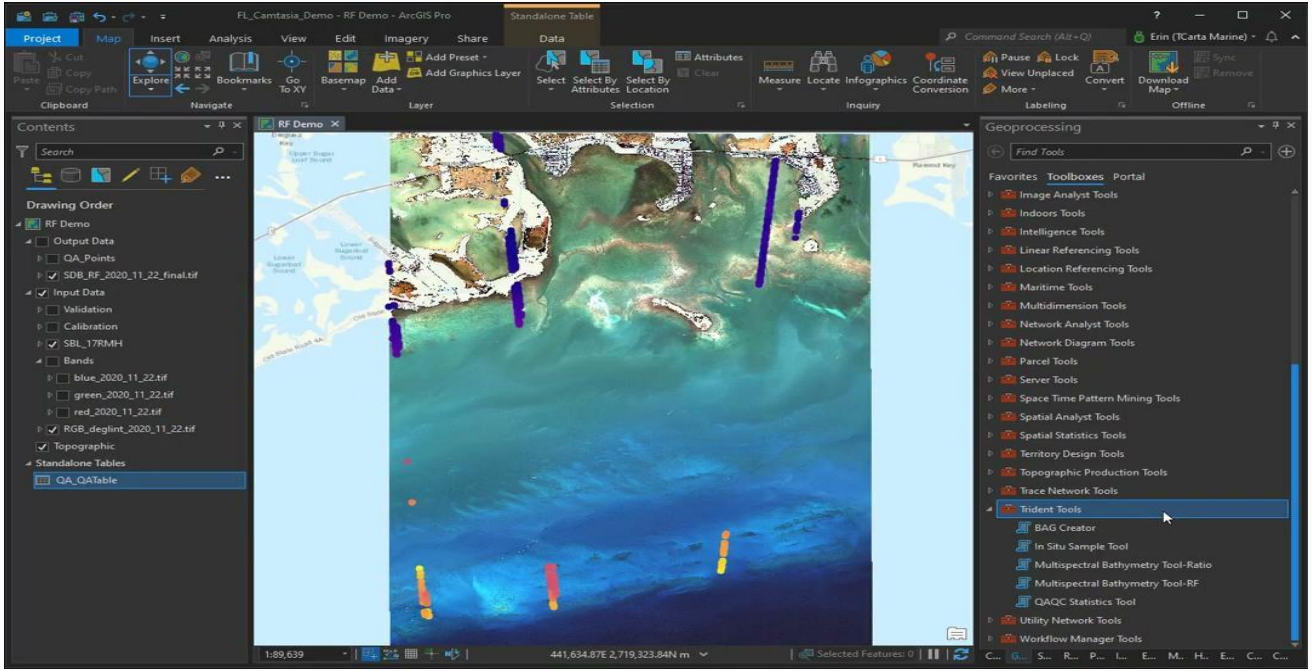
QA/ QC & accuracy assessment

Step 4

Export SDB to the Bathymetric Attributed Grid (BAG)

Step 5

The Secret Sauce: Random Forest



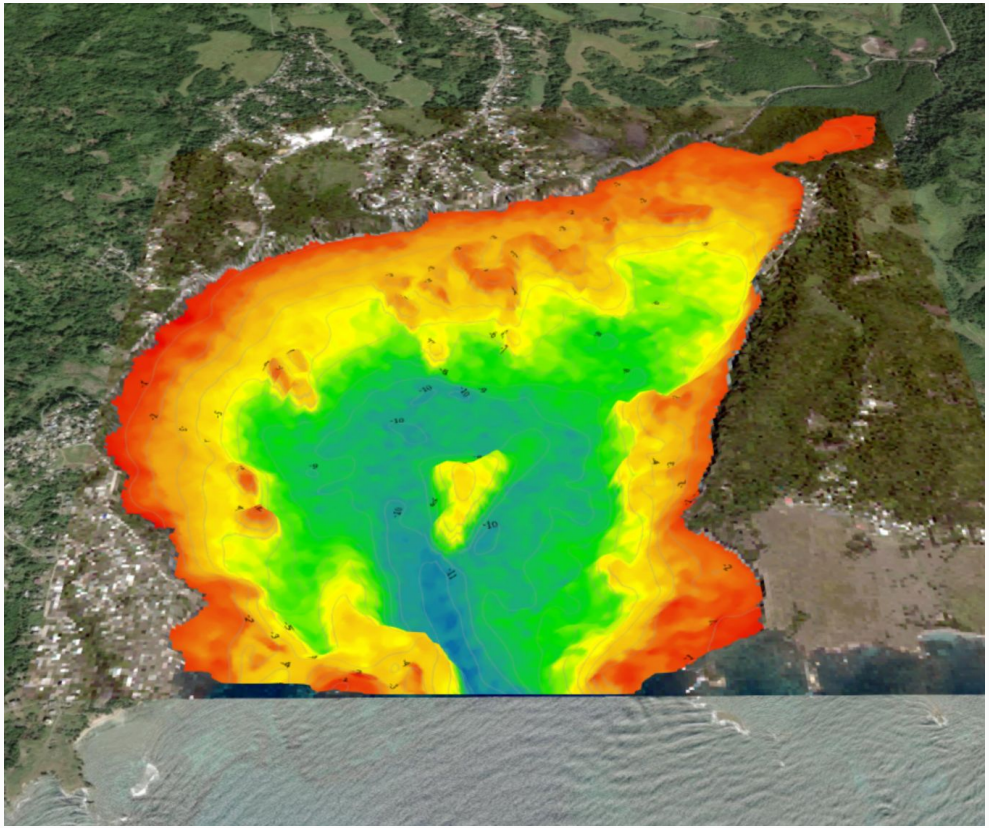
1. https://drive.google.com/file/d/1M5IvJ72uBPgDAQk8o5DzVX6iTUT-oBN3/view?usp=sharing

Case study of Bowden Harbour

Joint MOU with National Land Agency (NLA)

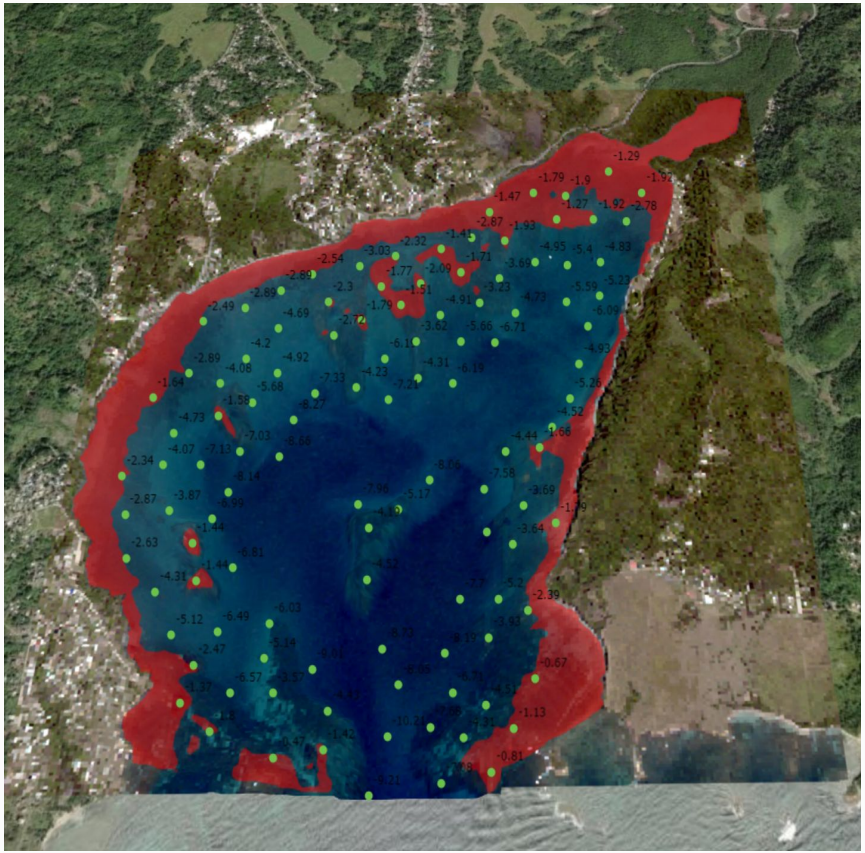
- TCarta provide initial Satellite Derived Bathymetry dataset to NLA for reconnaissance and planning of sonar survey
- NLA provide TCarta with sonar dataset for merging of both dataset to produce final surface
- Final surface produced to include more details of shoal areas plus a more seamless and detailed dataset

Satellite Derived Bathymetry of Bowden Harbour



- One satellite imagery ID 1003001008DSF2300 downsampled to 10m resolution
- Imagery date 21 March 2019
- 7015 depths derived from SDB
- Depths range from 0.5m- 17m
- Remotely produced
- No safety concern for team members or equipment
- No boat so no carbon footprint

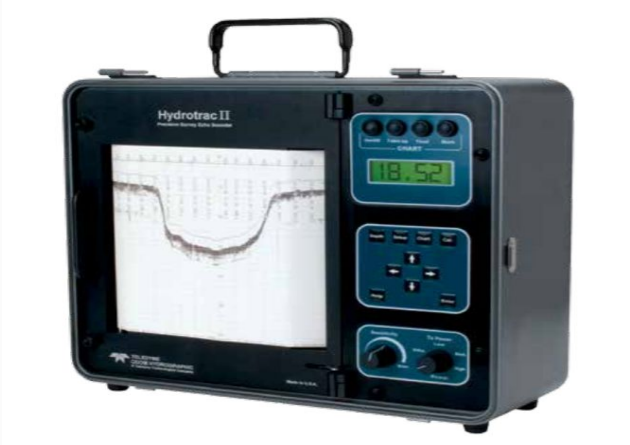
SDB Derived Dataset



Two derived dataset produced

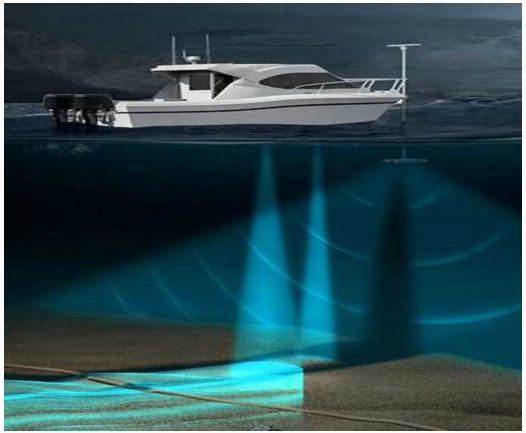
- No-go area inform survey team to exercise caution/avoid
- Shoal points identified can be investigated
- Both dataset provide a current picture of that will serve for more efficient planned lines for sounding

Sonar Hydrographic Survey



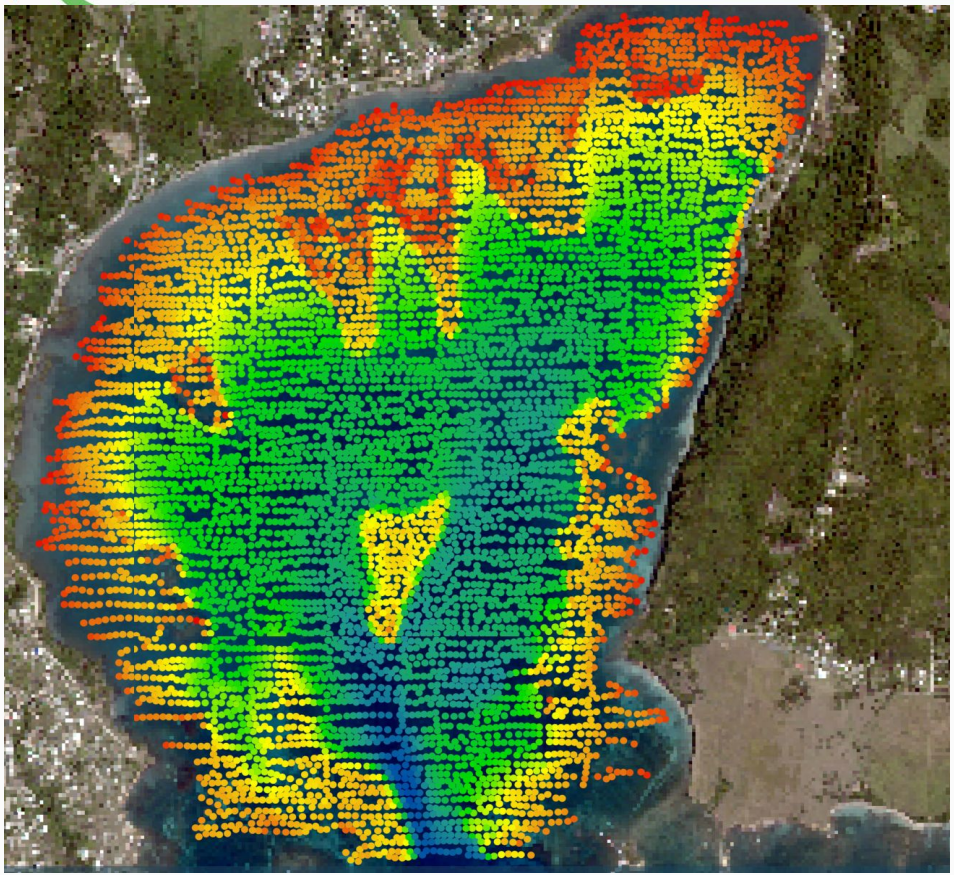
Teledyne Hydrotrac II Single Beam Echosounder

- Uses Echosounder
- Sonar equipment that uses soundwaves to map the profile of the seafloor
- Mounted on a vessel in navigable waters such as rivers, lakes, channels, ocean
- Labour intensive



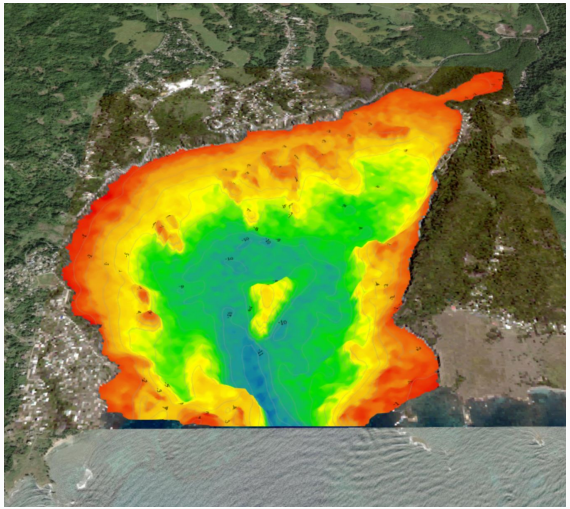
NLA Hydrographic Survey Crew

NLA Sonar Survey

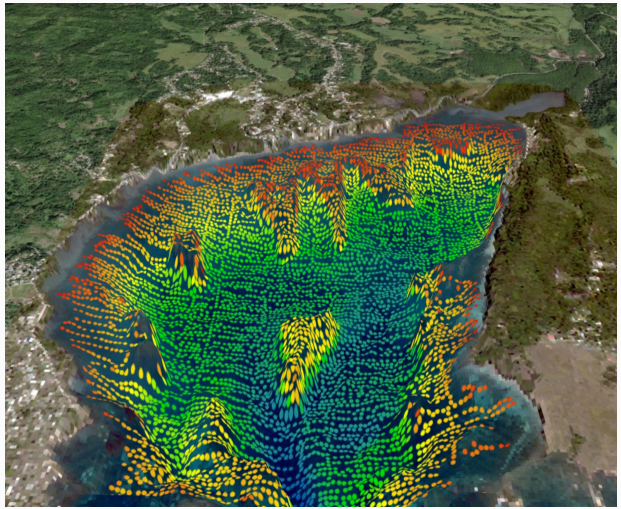


- Approximately 171 planned lines perpendicular to depth contours at 20m interval
- Depth Range 0.4m to 14m
- Depths at Mean Low Water (MLW) were converted to LAT
- Tides observed from Tide staff at 30 minutes interval
- Sounding days ~ 10 days

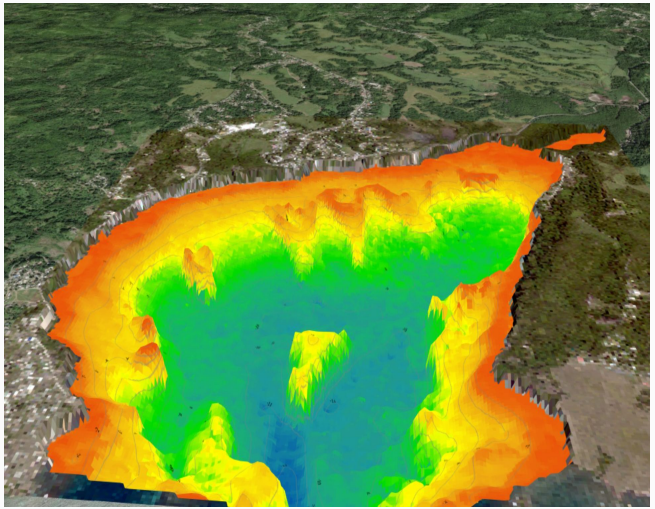
Merging both SDB and Sonar Dataset



SDB calibrated with NASA's Icesat-2 data

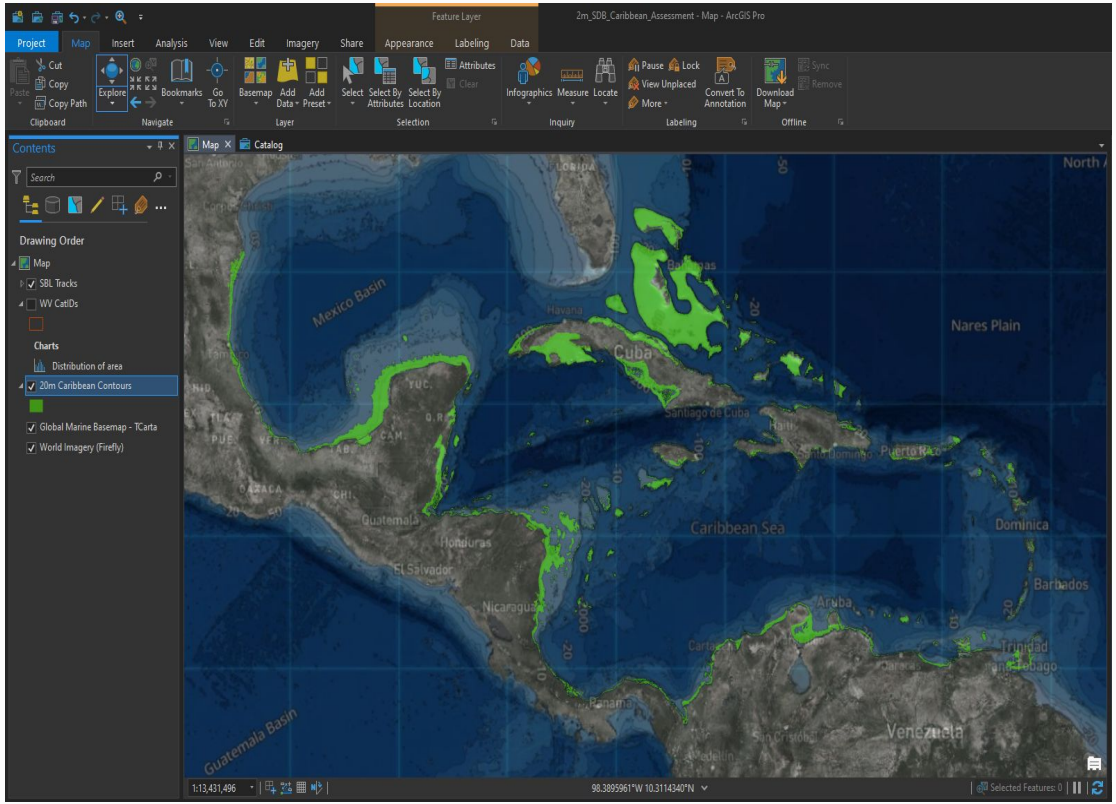


Gaps exist in sonar dataset



Infilling of Gaps producing a seamless dataset

TCarta Caribe LLC | TCarta Marine



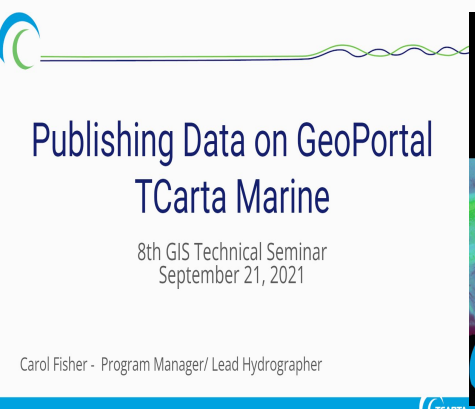
~330,000 km^2 of seafloor less than 20m deep, much of it previously unsurveyed.

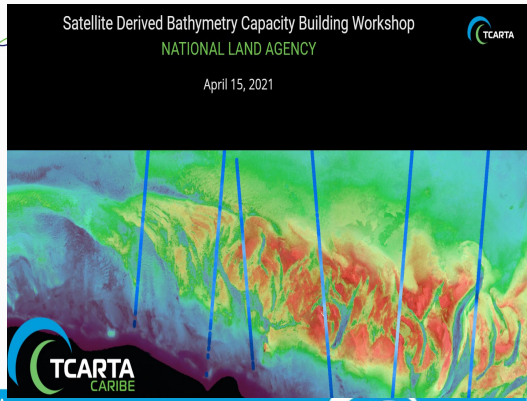
Takeaway

- Combination of SDB and Sonar Hydrography provide a seamless dataset and fill gaps
- To identify shoal areas for planned lines
- Identify no-go areas for safety of staff and equipment
- For environmental monitoring for change detection of the seafloor
- Wide geographic area can be mapped using both SDB and sonar in a shorter timespan

TCarta & Capacity Building

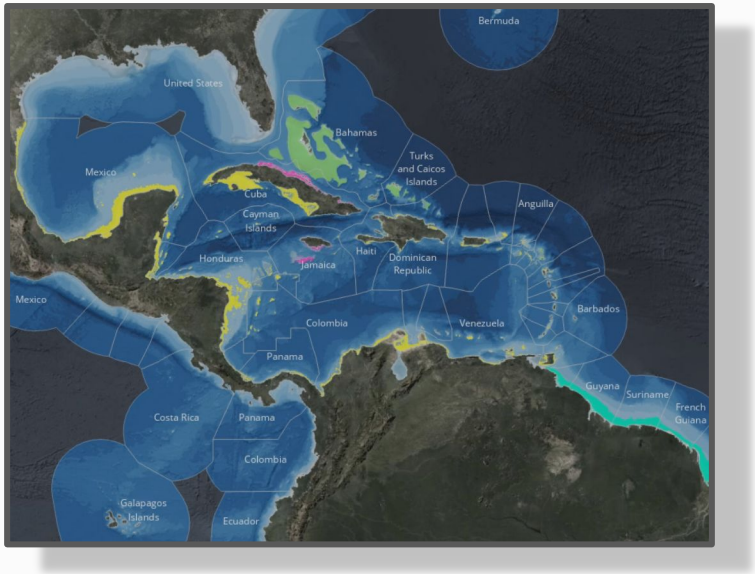
- TCarta provided capacity building training to NLA staff of Jamaica
- Training was focus on SDB production using Trident software
- TCarta presented at 8th Technical Summit for the Caribbean Geoportal
- TCarta hosted and presented at IHO 2021 Satellite-Derived Bathymetry webinar with presentations from NOAA, the Canadian Hydrographic Service, and ESRI
- TCarta presented at the 9th Technical Seminar 2021-Geography Awareness Week and GIS Day Jamaica



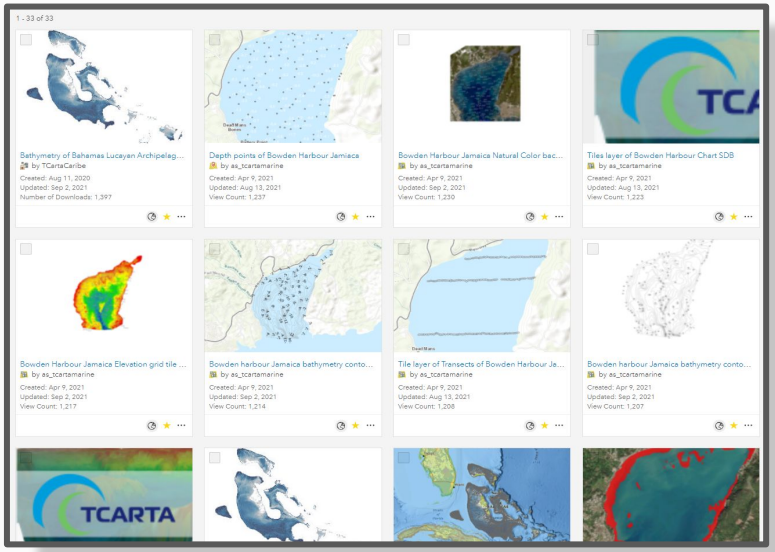


TCarta on Caribbean Geoportal

Bathymetry Status map:
https://arcg.is/1PLuO0

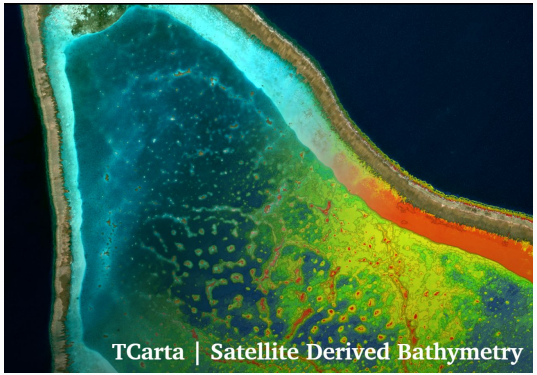


TCarta catalogue on Geoportal:
https://arcg.is/rO4PO

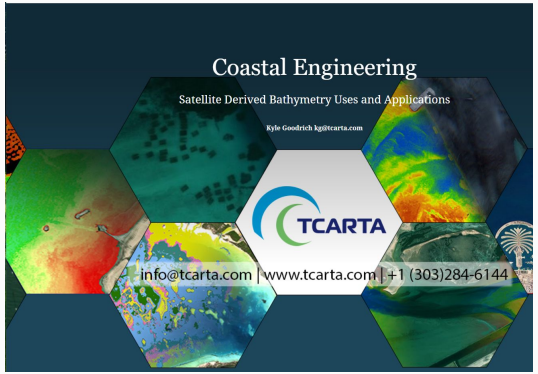


Additional Resources

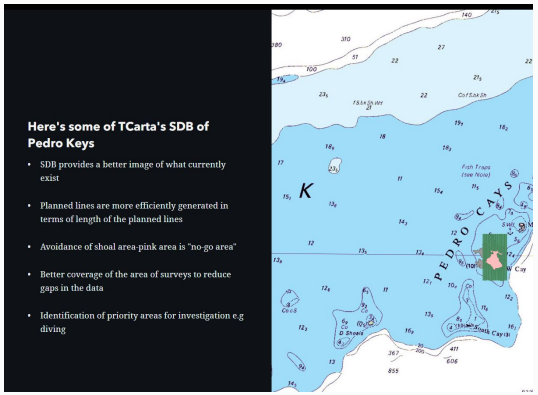
Share the value of remote sensing for bathymetry and water quality monitoring in the region



History of SDB
https://arcg.is/1HCSiy



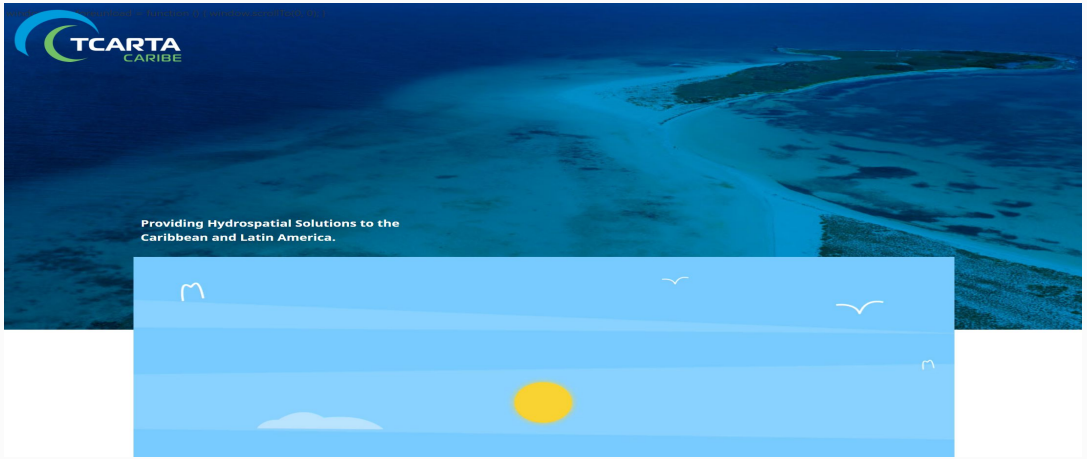
Use cases
https://arcg.is/1yDumG1



Survey planning
https://arcg.is/05L8uP

End of Presentation

THANK YOU



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