

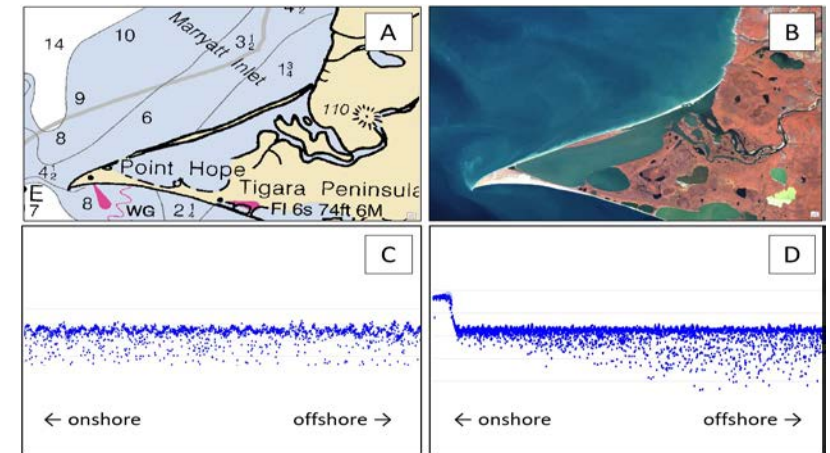
Coastal Geomorphology Questions

High level question:

How are coasts changing by natural and human influences and what are the impacts?

Sub questions

- What are the current and predicted threats to marine ecosystems and coastal/benthic habitats (e.g. coral reef, saltmarsh, mangroves, seagrass, oyster reef, etc.)?
- How will coasts change by rising seas, erosion, subsidence, accretion and anthropogenic influences?
- What are the predicted impacts of coastal storms and surge on coasts?
- How can we locate shoals, reefs and other hazards to marine navigation and how are they changing with time?
- How can we quantify the flows of energy, water, carbon, and nutrients?
- What are the structure, function and biodiversity of Earth's marine ecosystem, and how and why is it changing in time and space?

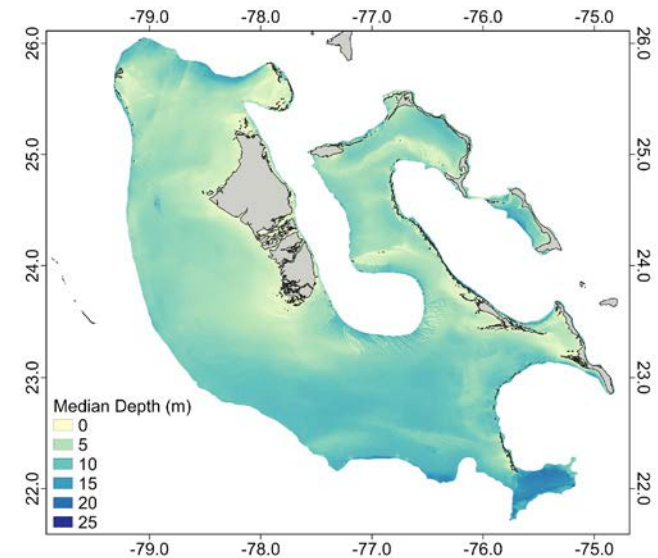


Coastal Geomorphology Goals

Overarching goal: Assess, model and predict inundation, coastal erosion and coastal vulnerability using seamless data across the land-water interface

Sub goals

- Quantify the increasing vulnerability of coastal communities to water inundation and erosion from growing fetch, sea level rise and permafrost thaw as weather events become more intense.
- Assess and model the processes that drive the predicted impacts of sediment transport, erosion and deposition?
- Accurately forecast large-scale geological hazards in a socially relevant timeframe.
- Quantify the impact of land cover change, modification and soil disturbances on water, carbon, sediment and energy fluxes at the land-sea continuum.
- Support safety of marine navigation in nearshore environments.

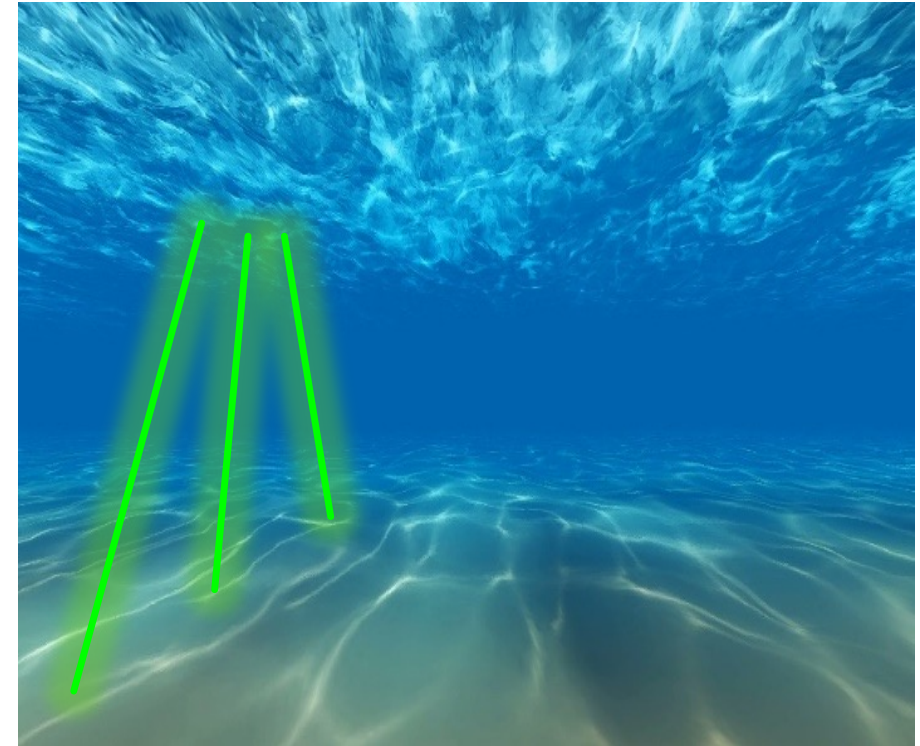


Coastal Geomorphology Science Gaps

Needed modeling/simulations/investigations

At the in situ, airborne and spaceborne level we need capacity to

- **Explore sensitivity studies to data product quality (vertical and temporal resolution) for:**
 - habitat classification
 - habitat variability
 - benthic community composition
 - habitat change estimation
- **Pursue bathymetric uncertainty propagation to benthic habitat maps/products and change estimates**
- **Understand topo-bathy data quality for forecasting long-term morphological change**
- **Ability to decouple long-term geomorphic change and habitat change from seasonal variation (erosion and accretion patterns, growth cycles)**

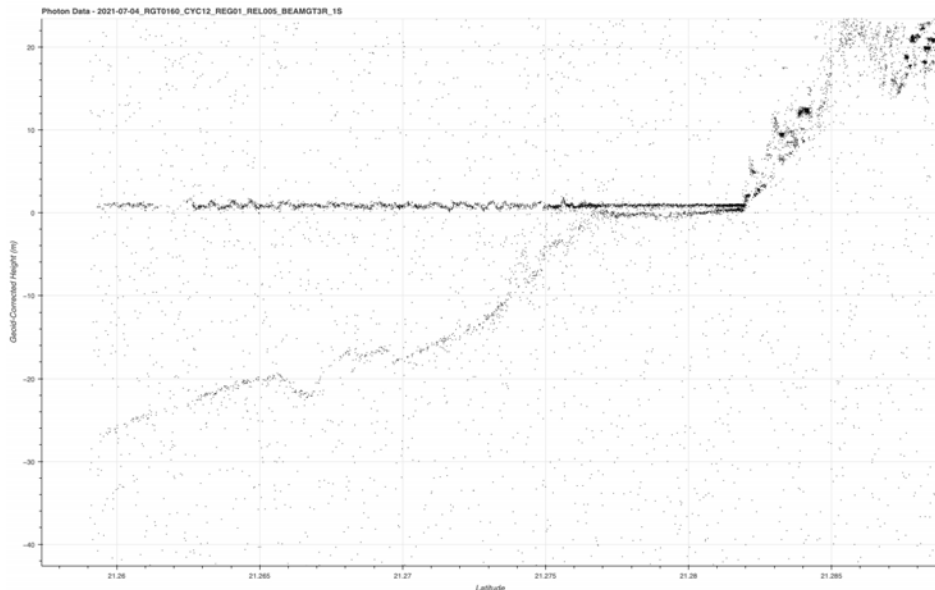


Coastal Geomorphology Measurement Needs

Most stringent requirements listed among specific coastal science objectives

Requirements associated with measurements of:

- Shallow bathymetry
- Vegetation structure
- Land topography
- Water surface heights



Last updated 11/07/23

Aspirational and Threshold

Duration (years) 8 years 3 year

Max Bathymetric depth: 30 m 10 m

Vertical resolution: 1 m 2 m

Coverage: 90% 60%

Latency: 30 days 90 days

Vertical Accuracy: 10 cm 20 cm

Geolocation Accuracy: 1 m 3 m

Rate of change accuracy: 20 cm/yr 40 cm/yr

Repeat Frequency: 1 month 5 months

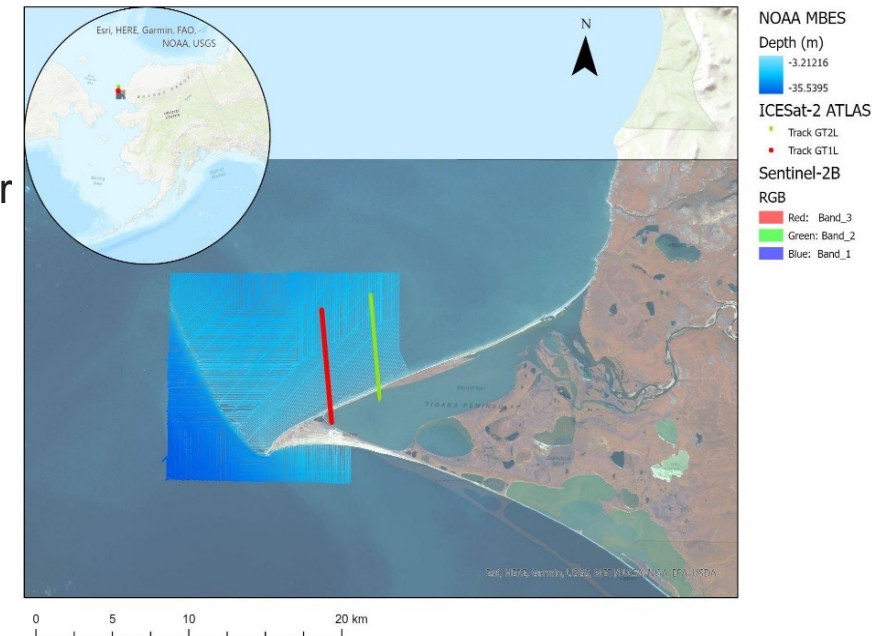


Coastal Geomorphology Needed Experiments

Existing and proposed:

Multi-temporal, variable-accuracy data collection campaigns to assess sensitivity to product quality and temporal resolution.

- In Situ:
 - Validation of higher altitude collections
- Airborne campaigns:
 - Determine optimal combination of sensors and explore algorithmic solutions for product development
- Satellite: Coverage analytics through simulations of performance capability/possibilities
 - Using existing optical imagery/SAR to infer bathymetry from sea surface/wave characterization
 - Explore uncertainties and uncertainty propagation using existing ICESat-2 bathymetry data
- Data sets: Topo-bathy DEMs,
- Overall:
 - Trade studies and algorithm development for product production:



Summary

- Key topics supported by topo-bathy measurements for coastal geomorphology
 - Storm surge and inundation hazards
 - Relative sea level rise
 - Shoreline erosion and sediment transport
 - Benthic habitat and marine ecosystems
 - Tidal interaction with mangroves and salt marshes
 - Marine archaeology
 - Marine navigation and hazards
- General measurement needs:
 - Coincident and combined optical imagery or radar with lidar for wide spatial coverage and high vertical accuracy
 - Shallow bathymetry
 - Vegetation Structure
 - Land topography (DEMs across land-water interface)
 - Water surface height (sediment transport, inundation modeling, discharge studies)
- Coverage and repeat frequency needs
 - Monthly measurements, global coastline coverage with ~30 m depth capability.
- Thoughts about future activities
 - Technology combinations and data fusion to achieve measurement needs
 - Stereoimaging/lidar, Spectral imaging/lidar, radar
 - Need simulation studies for distributed systems, airborne/spaceborne combinations, Airborne campaigns
 - Tasking and mapping capability investigations

