Coastal Processes

Chris Parrish, Oregon State Univ.

• Storm surge and tsunami inundation hazards
• Shoreline erosion and sediment transport
• Benthic habitat and marine ecosystems
• Tidal interaction with mangroves and salt marshes
• Shallow water navigation and hazards
Coastal Science & Application Needs

Benthic habitat mapping

Marine navigation & hazards

Tsunami inundation modeling

Marine ecological assessment

Coastal management

Sediment transport/management

Image credits: OSU, NOAA NCCOS, and USACE
Coastal Processes Scope of Study for STV

- Topics within scope
  - Coastal geomorphology and geologic hazards
  - Inundation (e.g., storm surge and tsunami)
  - Marine ecosystems
  - Sediment erosion, transport, and deposition
  - Marine archaeology
  - Marine navigation
  - Relative sea level rise (subsidence + eustatic SLR)
## SATM – Draft Goals, Objectives, and Targeted Observables

<table>
<thead>
<tr>
<th>Goals</th>
<th>Objectives</th>
<th>Targeted Observable(s)</th>
<th>Physical Parameter(s) Required</th>
</tr>
</thead>
<tbody>
<tr>
<td>(S-1) How can large-scale geological hazards be accurately forecast in a socially relevant timeframe?</td>
<td>(S-1d) Forecast, model, and measure tsunami generation, propagation, and run-up for major seafloor events.</td>
<td>Shallow Bathymetry, Vegetation (mangroves &amp; submerged aquatic veg)</td>
<td>A) Seafloor height, relative to a known vertical datum (orthometric or tidal)</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Land topography</td>
<td>B) Seafloor rugosity</td>
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From Decadal Survey
SATM – Draft Goals, Objectives, and Targeted Observables

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<td>(E-1) What are the structure, function, and biodiversity of Earth’s ecosystems, and how and why are they changing in time and space?</td>
<td>(STV) What are current and predicted threats to marine ecosystems and coastal/benthic habitats (e.g., coral reef, saltmarsh, mangroves, seagrass, oyster reefs, etc.)?</td>
<td>Shallow Bathymetry Vegetation (mangroves, submerged aquatic veg)</td>
<td>A) Time series of shallow bathymetry</td>
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B) Time series of rugosity and seafloor structure
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| (C-8i) Quantify how increased fetch, sea level rise and permafrost thaw increase **vulnerability of coastal communities** to increased coastal inundation and erosion as winds and storms intensify. | A) How will coasts change by **rising seas, erosion, subsidence, accretion, and anthropogenic influences**?  
B) What are the predicted impacts of **coastal storms** and surge on coasts? | Shallow Bathymetry  
Vegetation (mangroves and submerged aquatic veg)  
Land topography | A) Time series of shallow bathymetry  
B) Time Series of rugosity and seafloor structure |
**SATM – Draft Goals, Objectives, and Targeted Observables**

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<td>Support <strong>safety of marine navigation</strong> in nearshore areas</td>
<td>Where are shoals, reefs and other <strong>hazards to marine navigation</strong>, and how are they changing with time?</td>
<td>Shallow bathymetry</td>
<td>Time series of shallow bathymetry</td>
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Space-based Shallow Bathymetric Mapping

- Growing interest since 1970s; estimate bathymetry from spectral image bands
- Based on wavelength-dependent, exponential attenuation of downwelling irradiance with depth (Beer-Lambert Law)
- Dozens of approaches in published literature
- Requires reference bathymetry (“seed depths”)

\[
L_{obs} = (L_b - L_w) \cdot e^{-2K(\lambda)z} + L_w
\]

\[
D = \frac{\ln(R_{blue})}{\ln(R_{green})}
\]

\[
Z = m_1 D - m_0
\]
ICESat-2 ATLAS Bathymetry

Active-Passive Fusion Based Approaches

Gaps/Data Needs

- Data lacking in many coastal areas
  - Nautical charts obsolete in many areas (IHO)
  - Shore-adjacent areas (0-5 m) generally the most critical gap
- Spatial accuracies and resolutions don't meet all science and application needs
Existing Standards Docs

IHO Standards for Hydrographic Surveys
Special Publication N° 44

MAPPING THE COAST OF ALASKA
A 10-Year Strategy in Support of the United States Economy, Security, and Environment

NATIONAL COASTAL MAPPING STRATEGY 1.0:
COASTAL LIDAR ELEVATION FOR A 3D NATION
DRAFT FOR PUBLIC REVIEW AND COMMENT

PRODUCT OF THE
National Science and Technology Council
Science Data Requirements

- Not as well documented as those of mapping/hydrographic surveying community

Need input from community!
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<th>Goals</th>
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<th>Physical Parameter(s) Required</th>
<th>Level 3 or 4 Product</th>
<th>Area of Interest</th>
<th>Coverage (%)</th>
<th>Smallest Feature Resolution (m)</th>
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<td>Shallow Bathymetry, Vegetation (mangroves &amp; submerged aquatic veg), Land topography</td>
<td>A) Time series of shallow bathymetry</td>
<td>Time series of bathymetry DEMs (2D grid)</td>
<td>Coral reefs, saltmarsh, mangroves, seagrass beds, oyster reefs and other priority habitat areas worldwide</td>
<td>30% 100%</td>
<td>5 m 0.5 m 1 m 0.25 m</td>
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<td></td>
<td>B) Time series of rugosity and seafloor structure</td>
<td>Time series of gridded seafloor rugosity</td>
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**Aspiration Threshold**
Coastal Processes

• Charge to Community:
  • Come prepared to discuss your product gaps/needs
  • If possible, please identify published papers, reports that we can cite in justifying the needs
    • “T” in SATM = Traceability
      • Need references!