Coastal Mapping Programs Supporting Resilience at the Local Level in Alaska

Jeff Lovin, Sr. Vice President, Woolpert
Alaska: the only Arctic State in the Nation

- Warming 4 times faster than the global average.
- Alaska Native communities are being severely impacted.
- In jeopardy are not just buildings, but entire communities and cultures.
- Tribes and tribal organizations are disadvantaged in many ways.
Filling Information Gaps in Alaska

**RISK ASSESSMENT**
- Collect baseline data on erosion, flood, and permafrost thaw using community-based observations and scientific data
- Erosion, flood, and permafrost modeling and engineering analyses
- Data compiled into risk assessment report for review by community members and leaders

**RESULT**
Community understanding of risk

**PLANNING**
- Community solutions to mitigate risk are developed based on technical feasibility and benefits and costs of actions
- Community decides to protect in-place, retreat or relocate, and permits related actions, resources, and timelines
- Community develops Resilience Mitigation Plan (RMP) and resilience/adaptation plan with prioritization of fundable projects

**RESULT**
Written plan summarizing hazards and priority projects to reduce risk

**IMPLEMENTATION**
- Community drives project design
- Community secures and manages project funding
- Community manages construction project implementation by working with local or outside project management contractors
- Construction using local workforce

**RESULT**
Reduced risk to environmental threats
The Road to Mapping the Coast of Alaska

• 2019 Presidential Memorandum called for NOAA, SOA and Alaska Mapping Executive Committee to develop Alaska Coastal Mapping Strategy
All Hands-On Deck Approach to Mapping in Alaska

ALASKA MAPPING EXECUTIVE COMMITTEE

- U.S. Geological Survey and National Oceanic and Atmospheric Administration Co-chair

- Bureau of Indian Affairs
- Bureau of Land Management
- Bureau of Ocean Energy Management
- Department of Defense
- Department of the Interior
- Environmental Protection Agency
- Federal Aviation Administration
- Federal Emergency Management Agency
- National Geospatial Intelligence Agency
- National Park Service
- National Reconnaissance Office
- Natural Resources Conservation Service
- Office of Management and Budget
- State of Alaska
- U.S. Army Corps of Engineers
- U.S. Fish and Wildlife Service
- U.S. Forest Service
- U.S. Senate
Mapping the Land-Sea Interface: Envisioning seamless topobathy by 2030
The Road to Seamless Topobathy

- Lidar
- Imagery
- Sonar
- Shoreline delineation
- Topobathymetric Lidar
- Satellite Derived Bathymetry
Federal Coastal Mapping Programs

- Joint Airborne Lidar Bathymetry Technical Center of Expertise – National Coastal Mapping Program

- NOAA National Geodetic Survey – Coastal Mapping Program
National Coastal Mapping Program in Alaska

Jennifer M. Wozencraft

Director, Joint Airborne Lidar Bathymetry Technical Center of Expertise
Manager, US Army Corps of Engineers National Coastal Mapping Program
Research Physical Scientist, US Army Engineer Research and Development Center, Coastal and Hydraulics Laboratory

Port of Nome, Alaska, 2022
National Coastal Mapping Program

- Develops regional, repetitive, high-resolution, high-accuracy elevation and imagery data
- To build an understanding of how the coastal zone is changing
- Facilitates management of sediment and projects at a regional, or watershed scale

Progress-to-Date

Per year:
- 2500 square miles
- @ 25 navigation channels
- @ 50 navigation structures
- 18 billion points
- 4500 digital elevation models
- 3000 air photo tiles
- 3000 hyperspectral image tiles

Lidar bathymetry and topography Port of Nome, Alaska, 2022

5 cm resolution imagery
JALBTCX surveys supporting military resilience efforts
- Palau 2021
- Kwajalein 2023
- Wake Island 2023

Jennifer.M.Wozencraft@usace.army.mil
NOAA NGS Alaska Merbok Topographic/Bathymetric Lidar
Motivation: Extratropical Typhoon Merbok

Track of Merbok, September 11-18, 2022
August 2022 Sea Surface Temperature Ranks Relative to 1900-2021

Source: Thoman - ACCAP and Brettschneider - NWS

Source: AOOS
Motivation: Measuring High Water Marks

Social Media Post, original source unknown

Source: USGS
Motivation: High Water Marks

High Water Mark Elevations

Problem: How to differentiate the storm surge effects from tides, wind waves, and other ocean processes?

Data Source: USGS
Results: Station Highlight - Unalakleet

- All constituents have temporal variability
Results: Merbok Storm Surge Height

Graph showing non-tidal residual storm surge height in meters from September 16 to September 21, 2022, for different locations such as Red Dog Dock, Kotzebue (Hotham Inlet), Nome, Unalakleet, Bethel, Goodnews Bay, St. George Island, and Port Moller.
Discussion: Kuskokwim Estuary Surge and Tides

- Landward amplitude change is frequency dependent
- Storm surge amplified more than tides

Goodnews to Bethel: ~230km

<table>
<thead>
<tr>
<th>Tides</th>
<th>Amplitude (m)</th>
</tr>
</thead>
<tbody>
<tr>
<td>M2 (12.4 h)</td>
<td>0.23</td>
</tr>
<tr>
<td>K1 (23.9 h)</td>
<td>0.34</td>
</tr>
<tr>
<td>O1 (25.8 h)</td>
<td>0.43</td>
</tr>
<tr>
<td>Merbok (2 days)</td>
<td>1.33</td>
</tr>
</tbody>
</table>

Bethel/Good News:

- Good News Bay
  - Bethel
  - Good News
  - M2 (12.4 h): 0.23
  - K1 (23.9 h): 0.34
  - O1 (25.8 h): 0.43
  - Merbok (2 days): 1.33

![Map of Kuskokwim Bay with locations of Bethel and Goodnews Bay]
• Water levels are controlled by multiple drivers which have strong temporal and spatial variability in western Alaska.

• Tides and storm surges may amplify or attenuate in a landward direction depending on the basin geometry and the wave period.

• For a local water level, resolving the effect of each driver and predicting total water levels requires:
  o Non-stationary methods (e.g., tidal analysis)
  o High-quality year-round water level observations
  o Accounting for frequency dependent basin effects
Unalakleet, AK – JALBTCX Data Coverage
USGS Application

We use the topobathy data to make computer models of wave and floodwater movement along the coast and over land.
Need for Enhanced Accessibility

Current barriers include limited data availability, training opportunities and need for workforce development
Workforce Development: AK Coastal Mapping

1. Research leadership
   Support post-doctoral fellowships to create future research leaders

2. Project fellows
   Host Sea Grant Alaska fellows supported by cohort program to refine technical skills and leadership ** CURRENT **

3. Graduate students
   Tackle specific research topics and techniques while including professional development ** CURRENT **

4. Undergraduate interns
   Develop interest in coastal applications. Exposure to data, processing and applications ** CURRENT **

5. Foundational education
   Host technical workshops, create processing manuals, knowledge transfer of techniques for applications ** CURRENT **
Norton Sound Regional Technical Workshop

• Held in Unalakleet
February 26 – 28, 2024
Norton Sound Regional Technical Workshop
Thank You

• Steven Dykstra, PhD - Assistant Professor | Oceanography Dept. | College of Fisheries and Ocean Sciences | University of Alaska Fairbanks

• Leslie Jones, PhD - Geospatial Information Officer | Alaska Geospatial Office

• Erin Trochim, PhD - Research Assistant Professor | Institute of Northern Engineering | University of Alaska Fairbanks

• Jennifer M. Wozencraft - Director, Joint Airborne Lidar Bathymetry Technical Center of Expertise