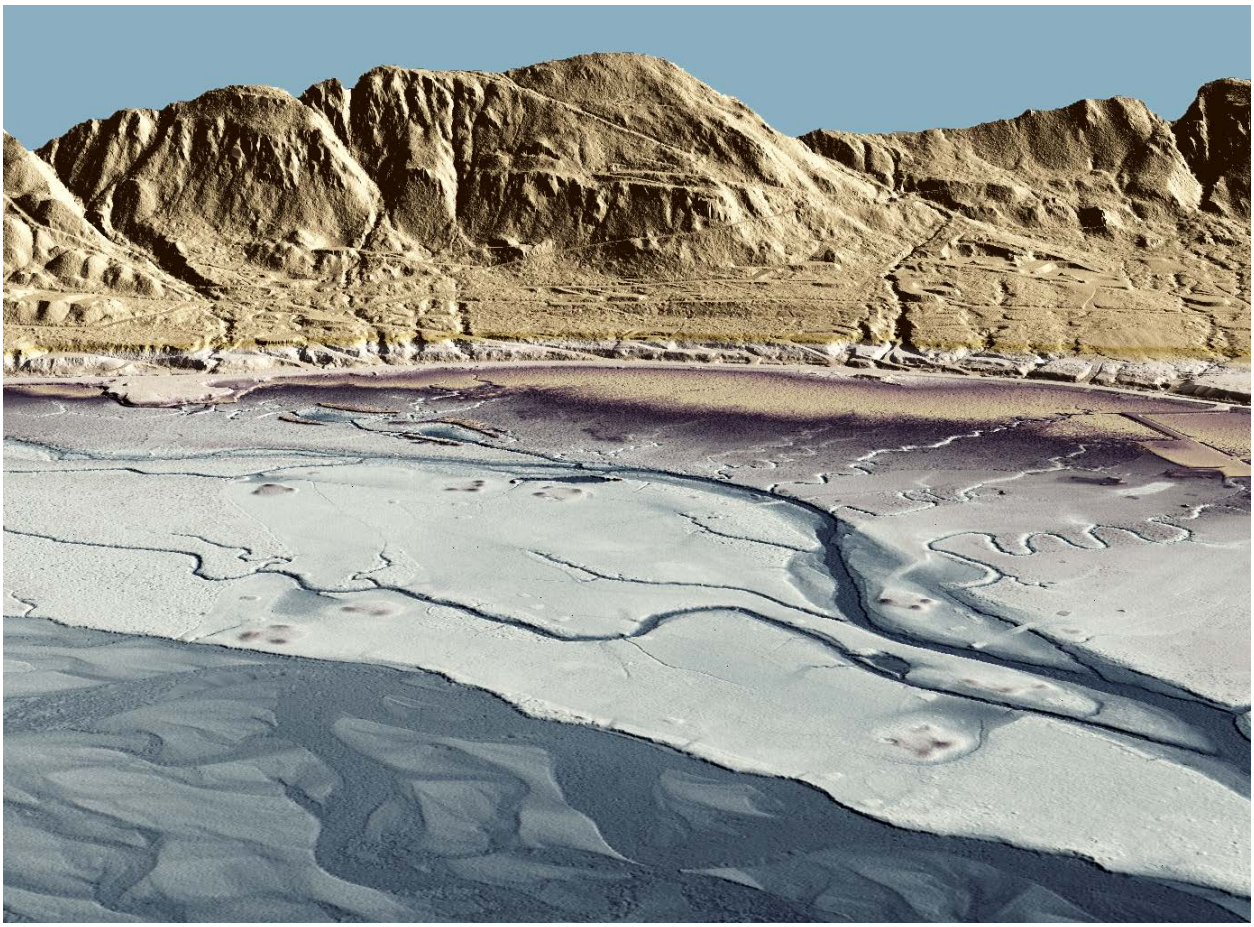
2018 ALASKA COASTAL MAPPING SUMMIT SUMMARY REPORT



Haines, Alaska. A look at the intricate braiding of tidal flats, looking north at the shoreline west of McClellan Flats. The image was created from the gridded LiDAR surface colored by elevation. Quantum Spatial

Final
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Prepared by Marta Kumle, Coastal Mapping Strategist
Alaska Ocean Observing System and State of Alaska Department of Natural Resources
Anchorage, Alaska

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I. EXECUTIVE SUMMARY

On February 9, 2018 over one hundred subject matter experts gathered in Anchorage for the second Alaska Coastal Mapping Summit. This event, hosted by the Alaska Ocean Observing System (AOOS), the State of Alaska Department of Natural Resources (AK DNR), and the federal Interagency Working Group on Ocean and Coastal Mapping (IWG-OCM), provided a forum to discuss the next steps for a coordinated approach to coastal mapping in Alaska.

Numerous real-world stories and planning scenarios made it apparent that reliable geospatial data underpins all responsible and economical decision-making for Alaska's coastal environments. Examples illustrated how coastal mapping is critical to the safety and livelihoods of residents, responsible resource extraction (mining, oil, gas, and timber), tourism, commercial fishing, subsistence, land and habitat management, and the development of local and international marine shipping routes. More than 30 of these detailed examples are included in the body and appendices of this summit report and the specific applications identified at the summit will drive development of the State's Coastal Mapping Strategic Plan.

Summit participants worked together to discuss strategies for identification and realistic prioritization of gaps in baseline geospatial data, namely imagery and seamless elevation surfaces that extend from inland areas to nearshore water and require auxiliary coastal mapping data, like tide station products or ground control. Meeting participants agreed that investments in Alaska coastal mapping should promote publicly accessible and authoritative products that address gaps critical to the safe navigation of vessels, infrastructure planning, flood and erosion mapping, emergency response, and environmental change detection.

Discussions throughout the day recognized that approaches, priorities, and objectives for mapping in Alaska's coastal zone require unique consideration of its extremely varied geomorphology, active earth processes, and remote setting. However, past success stories (e.g. 3D Elevation Program lidar project on the Yukon Delta), opportunities to pioneer new methods and technologies (e.g. advanced photogrammetric techniques or crowd-sourced bathymetry), and the existence of successful inter-agency bodies that recognize the importance of coastal mapping (e.g. the Alaska Mapping Executive Committee (AMEC), the Alaska Geospatial Council (AGC), and the ShoreZone Program) set a tone of optimism and opportunity about what can be achieved with this renewed commitment to statewide coordination.

To ensure that the substantive discussion from this meeting becomes a roadmap for coastal data acquisition in Alaska, the National Oceanic and Atmospheric Administration (NOAA), AOOS and the AGC have jointly funded a one-year Coastal Mapping Strategist position to spearhead compilation of an Alaska Coastal Mapping Strategic Plan. This Plan will incorporate many of the more than two dozen recommendations from this summit provided in the appendices to this report including; priorities and refresh rates for bathymetry, terrestrial elevation and imagery data; tiered, technology-neutral data specifications for different coastal environments; a data inventory with appropriate metrics; and an emphasis on demonstrated region-specific applications and anticipated future uses. Widespread and continued participation in the development of the Alaska Coastal Mapping Strategic Plan -- scheduled for draft release by December 2018 -- will be required to achieve an executable strategy that will include Alaska's many coastal mapping needs.

II. PARTICIPANTS

Approximately 100 individuals attended the summit, with 80 attending in person. Participants represented federal, state, and local governments; native corporations; non-governmental organizations; academia; and private sector organizations. The conference registration list with affiliations and contact information is available in the appendix of this report.

Figure 1: Alaska Coastal Mapping Summit, February 9, 2018, Anchorage, Alaska.

III. SUMMIT FORMAT & OBJECTIVES

The summit's broad purpose was to gather knowledge and strengthen Alaska's coastal mapping community as a follow up to the inaugural Alaska Coastal Mapping Summit held in June 2016. Three specific summit objectives were to: (1) distribute state and federal updates, (2) provide a forum for coastal mapping experts to present relevant work, and (3) host group discussions for exchange of ideas. One significant update was the introduction of a new **Coastal Mapping Strategist position**, funded by NOAA, AOOS, and AGC. This position is tasked with developing a feasible statewide Coastal Mapping Strategic Plan (CMSP) based on broad stakeholder input.

Twenty-two presentations were given in the morning, the majority as brief seven-minute lightning talks. In the afternoon, participants worked in small groups to address three discussion areas: (1) Stories that Speak, (2) Technologies and Specifications, and (3) Coordination and Collaboration. The full agenda, presentation PDFs and a digest of all group discussion notes organized by topic are available in the appendix of this report.

1. STATE AND FEDERAL UPDATE PRESENTATIONS

A. INTERAGENCY WORKING GROUP ON OCEAN AND COASTAL MAPPING (ASHLEY CHAPPELL, NOAA)

Chappell delivered a keynote speech on federal mandates and ongoing coordination strategies for coastal and ocean data acquisition, data management, and accessibility. She emphasized enabling as many applications as possible for each dataset: "**Map Once Use Many Times**."

The **3D Nation Study**, an effort to inventory national elevation data requirements and benefits, will be releasing a formal survey in 2018 and Alaska stakeholders are encouraged to participate. Chappell also introduced the **Alaska Coastal Mapping Strategist** part-time term position and the

intent to develop a **Coastal Mapping Strategic Plan**. Lastly, Chappell conducted a brief tour of **SeaSketch**, an online mapping collaboration space, and highlighted some known upcoming plans and activities in Alaska.

B. ALASKA GEOSPATIAL COUNCIL (KEN WOODS, STATE OF ALASKA)

Woods provided an update on Alaska Geospatial Council (AGC) activities. Council members are senior executives from federal, state, local and tribal governments and academia working together to make current and accurate digital base maps widely accessible for Alaska. Several **technical working groups,** composed of local and regional representatives as well as subject matter experts from diverse governmental and nongovernmental entities, focus on datasets central to effective coastal mapping such as imagery, elevation, terrestrial hydrography, administrative boundaries, and wetlands. AGC is developing the **statewide geoportal** that will act as a data clearinghouse, metadata catalog, and central database for Alaska geospatial information.

C. DIVISION OF GEOLOGICAL & GEOPHYSICAL SURVEYS (JACQUELYN OVERBECK, STATE OF ALASKA)

Overbeck presented an in-progress report: **Alaska Coastal Mapping Data Gaps and Priorities for the Assessment of Coastal Flood and Erosion Hazards**. The report will be available at DGGS's Coastal Hazard Website (http://dggs.alaska.gov/sections/engineering/profiles/coastalhazards.html).

Changing ocean processes, permafrost thaw, reductions in sea ice concentration and extent, and relative sea level change contribute to coastal flooding and coastal erosion in Alaska. The report focuses on gaps in baseline datasets such as orthoimagery, topography, sea ice, bathymetry, waves, water levels, and tectonic motion models which are necessary elements to enable the forecasting and long-term modeling of coastal flooding and erosion.

D. FEDERAL CONTRACTING VEHICLES

UNITED STATES GEOLOGICAL SURVEY, NATIONAL MAP PROGRAM (BRIAN WRIGHT)
Wright gave an update on statewide activities to refresh the national elevation datasets in Alaska with Lidar and IfSAR data acquisition. Under annual United States Geological Survey **(USGS) Broad Agency Announcements (BAA)** for the **3D Elevation Program (3DEP)**, the USGS assists in coordinating partnerships that leverage USGS matching funds to update the **National Elevation Dataset Plan** for projects that typically begin one year in advance to identify as many partnerships as possible. The BAA contracting vehicle is open to any type of partner including private, public, government or non-profit entities. The **USGS Geospatial Products and Services Contract (GPSC)** suite of contracting services is available for use by both BAA and non-BAA projects. GPSC works with pre-approved small and large business vendors in a competitive qualification-based selection for elevation, remote sensing, and GIS services; this program charges 5% to cover project management and technical quality control services.

NOAA OFFICE FOR COASTAL MANAGEMENT (DAVE STEIN)
Stein described how the **Office for Coastal Management (OCM)** partners with many local, state, federal and other partners to collaboratively fund coastal geospatial projects that address coastal management issues. OCM offers a contracting vehicle for coastal geospatial data acquisition, GIS services, and thematic mapping by competitively-selected business vendors. Contracting services include project management, quality assurance and quality control; this program charges 2%, which includes technical support from NOAA staff. No OCM liaison is physically located in Alaska, and partnerships to date are primarily outside of Alaska, but remote projects are possible and a memorandum of understanding can typically be established in two to three months. More information on this contracting mechanism can be found on the OCM website (coast.noaa.gov/idiq/geospatial.html).

2. ALASKA COASTAL MAPPING PRESENTATIONS

The summit included 15 additional presentations from public and private entities with different types of expertise relevant to mapping Alaska's coastal areas. Presentation themes included recent and upcoming coastal and nearshore data acquisition projects; the utility of using a variety of technologies and sensors including satellites, topo-bathymetric lidar and aerial photos for coastal projects; and data collection challenges associated with Alaska's remoteness and short weather windows. The summit's full agenda and PDF versions of all presentations are available in the appendix of this report.

Presentations and Speakers:

- Hydrographic Charting Activities in Alaska (Bart Buesseler, NOAA)
- NOAA's Coastal Mapping Program (Mike Aslaksen, NOAA)
- National Park Service Coastal Mapping Operations 2017-2018 (Tahzy Jones, NPS)
- Statewide Threat Assessment (Wendy Shaw, Denali Commission)
- Wave and Hydrodynamic Modeling within the Nearshore Beaufort Sea (Warren Horowitz, BOEM)
- U.S. Coast Guard Seventeenth District Brief (Dave Seris, USCG)
- Coastal Resilience and Adaptation Workshops (Karen Murphy, USFWS)
- Lidar Data Collection in the Yukon-Kuskokwim Delta, Alaska (John Gerhard, Woolpert)
- Shoreline Verification with Unmanned Aerial Systems (Tim Smith, TerraSond)
- Topo-Bathymetric Lidar - Flash Talk (Russ Faux, Quantum)
- Coastal Water Clarity in Alaska (Rick Stumpf, NOAA)
- Technology Integrations for Coastal Mapping Success (Rada Khadjinova, Fugro)
- Satellite Imagery for Coastal Mapping (Drew Hopwood, GeoNorth Information Systems)
- ShoreZone Coastal Imaging and Habitat Mapping in Alaska (Sarah Cook, Coastal and Ocean Resources)
- Two Hundred Billion Pixels of Digital Coastal Paradise: Mapping a Mile Wide Swath of Alaska's West Coast at 10-20 CM GSD with Fodar (Matt Nolan, Fairbanks Fodar)

3. GROUP DISCUSSIONS FOR EXCHANGE OF IDEAS

The summit's afternoon schedule was dedicated to small (4-15 person) group discussions in order to strengthen the collaborative community and gather knowledge to inform Alaska's upcoming Coastal Mapping Strategic Plan. Each discussion session began with a brief introduction by an experienced member of Alaska's coastal mapping community. Every group had a dedicated note-taker and addressed the same set of questions over the course of three themed discussion sessions: (1) Stories that Speak, (2) Technologies and Specifications, and (3) Coordination and Collaboration. Groups were invited to pick specific questions for discussion or branch into other conversations related to the session theme. A complete list of the discussion questions that were distributed to participants in advance of the summit is included in the appendix of this report.

(1) **Stories that Speak** focused on the value of coastal geospatial data in Alaska. This session allowed participants to meet one another and to identify specific, contemporary stories that illustrate the real-world need for coastal geospatial data products.
(2) **Technologies and Specifications** explored the potential for testing and using emerging technologies in Alaska in conjunction with technology-neutral discussions about data quality specifications and requirements such as refresh rates and tide coordination.
(3) **Coordination and Collaboration** concentrated on strategies for working between agencies and across sectors, strategies for working with existing State and Federal coordination programs, and required next steps to achieve coastal mapping objectives.

IV. DISCUSSION SESSION HIGHLIGHTS

Selected highlights from each of the three discussion sessions are described below. These excerpts are representative of the broad scope of topics and ideas that were exchanged in the discussion portion of the summit; a comprehensive digest compiled from notes taken by each group is available in the appendix of this report.

1. STORIES THAT SPEAK

This theme centered on stories in which geospatial data, or lack of geospatial data, makes an impact on real life situations. Most group conversations focused on specific instances, locations or stories that reflect the benefits of good geospatial data and examples of harm or loss attributed to a lack of data. In the complete digest, content is organized into the following categories:

- Successes
- Examples of Under-Mapped Area Issues
- Applied Data Uses
- Known Barriers
- Strategies for Success
- Opportunities for Success

A. SUCCESSES

Successful geospatial data acquisition projects occur regularly in Alaska, ranging in size from Statewide IfSAR collection to small aerial Imagery in Anchorage community parks. During the

summit, the Yukon-Kuskokwim Lidar data collection was highlighted as a successful project funded by a variety of partners.

3DEP LIDAR COLLECTION ON THE YUKON-KUSKOKWIM DELTA

The collaborative 2016 Yukon-Kuskokwim area lidar project is addressed in multiple sections of this report.

Lidar data collection across a large swath of the coastal zone was conducted through a **USGS 3DEP** contract with Woolpert and Kodiak Mapping with regional partners (**USFWS, AOOS, NRCS, FEMA, AKDNR**) represented through the **Western Alaska LCC**. The data are publicly available through the **DGGS Elevation Data Portal** (http://elevation.alaska.gov) and will also be available on the USGS site soon.

These data benefit multiple applications, including change studies, resource management, trail planning, and assistance in the potential move of the community of Newtok to its new location Mertarvik.

EMMONAK

Lidar data were used near Emmonak for a channel migration study conducted by **DGGS** and funded by the **Federal Emergency Management Agency (FEMA) Cooperative Technical Partners** program. The study produced rates of shoreline change that show where channel migration has impacted the area surrounding Emmonak since 1950. Shoreline positions were also projected to 2020, 2025, and 2030 for near-term community and state planning. The written report is available at http://doi.org/10.14509/29858 and data can be viewed in the Alaska Shoreline Change Tool http://maps.dggs.alaska.gov/shoreline/.

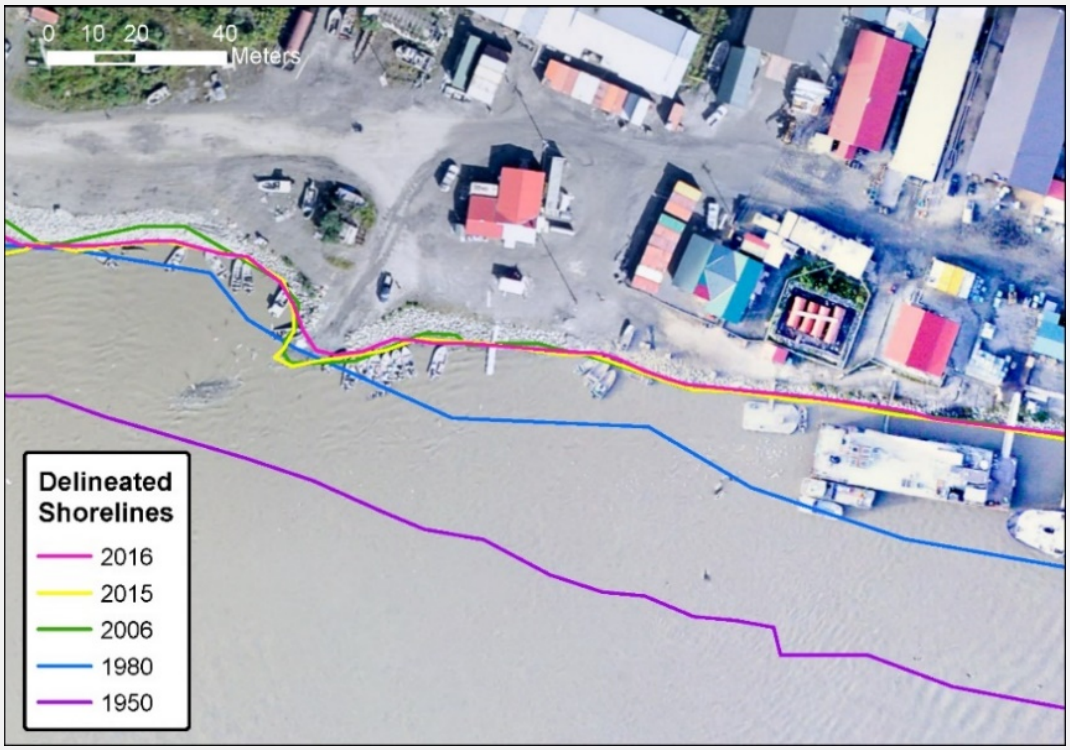

Figure 2: Emmonak delineated shorelines, including shoreline derived from 2016 Lidar data. Image courtesy of J. Overbeck, State of Alaska DGGS.

MERTARVIK

The **Alaska Native Tribal Health Consortium** and the **Denali Commission** were early users of the lidar data in order to assist the community of Newtok, an Alaska Native village experiencing rapid erosion. Data were used for siting, community planning, and engineering design of Mertarvik, for community relocation.

Figure 3: Heavy equipment loading the last seasonal barge in Mertarvik, after completion of the beach road to the barge landing. Photo taken by Robert Lundell, Alaska Department of Transportation, 2009.

HOOPER BAY

Near Hooper Bay, lidar data were compared to 2015 photogrammetric digital surface models (DSMs) in a research poster presented by **DGGS** at the **2016 American Geophysical Union Fall Meeting**. Differences in the two elevation datasets were compared based on vegetation and surface type. This type of research and comparison leads to greater understanding of how elevation from photogrammetric DSMs can be utilized.

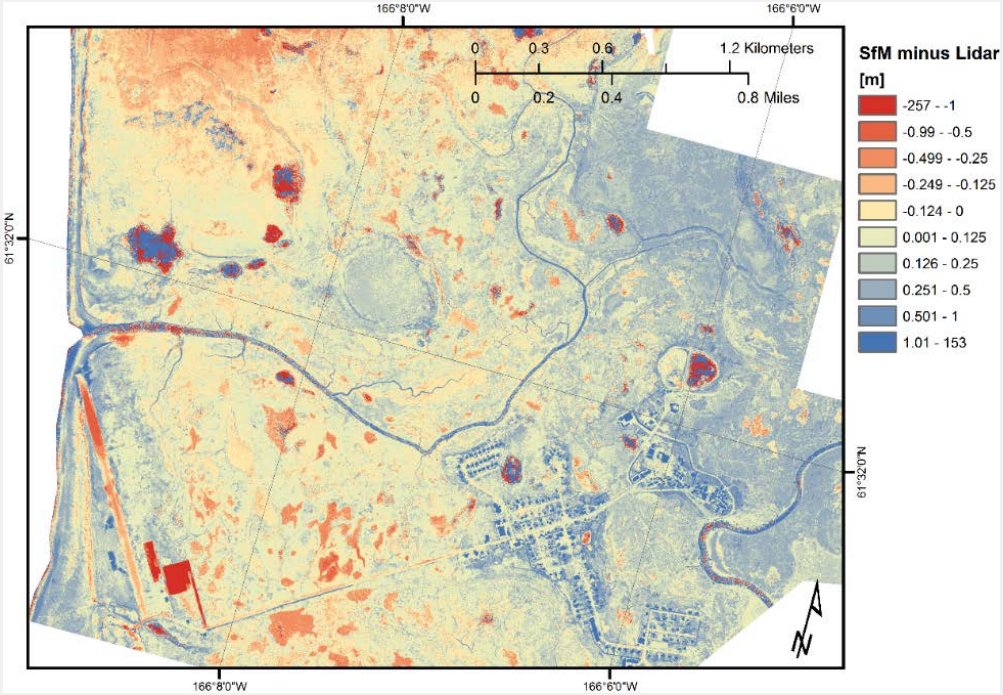

Figure 4: Difference in photogrammetrically-derived (SfM; 2015) and Lidar (2016) elevations near Hooper Bay, AK. Image courtesy of J. Overbeck, State of Alaska DGGS.

B. EXAMPLES OF UNDER-MAPPED AREA ISSUES: MARITIME OPERATIONS

The safe navigation of maritime vessels is dependent on accurate nautical charts created from modern bathymetry. In Alaska, however, many charts need updating. This is particularly true in the Arctic region where some soundings date back to the work of Captain Cook in the 18th century.

WESTERN ALASKA BARGE OPERATIONS

As most communities in Western Alaska are not connected to the road system, nearly all goods and supplies, including fuel, are distributed by barges. Due to dynamic shoaling on coastal deltas, rivers, and inland lakes in Western Alaska, some vessel operators experience "bump and go" groundings while transiting these poorly charted waterways. As the sandbars in these regions are soft and forgiving, the U.S. Coast Guard can exclude certain groundings from the casualty reporting requirements in 46 CFR 4.05, however, the potential for any type of grounding affects operational costs in the form of delays, heavier design criteria, and additional maintenance for vessels. Delays arise from padding operational windows with extra time to account for uncertainty in water levels, deployment of smaller scouting skiffs, and waiting for favorable winds, tides, or currents.

Figure 5: Cargo barge operations on the Kuskokwim River. Photo taken by M. Kumle, 2010.

RECENT LARGE VESSEL GROUNDINGS

In contrast to the soft bottom groundings described above, two recent reported groundings referenced in the **USCG Port Access Route Study Report** (https://www.regulations.gov/document?D=USCG-2014-0941-0040) highlight the risks of navigating inadequately charted areas and are summarized below. While these incidents did not result in any pollution or injuries, considering the limited response capabilities in the region any grounding could rapidly escalate to a potentially catastrophic situation. Appendix H of the USCG Port Access Route Study analyzes USCG reported marine casualties in the Bering Sea from 2005-2016 and is included in the of this report.

- **Report Casualty #132:** In 2015, the M/V Fenica, with a draft of 27 feet, grounded near Dutch Harbor while operating in a nearshore area most recently surveyed in 1935. NOAA was able to rapidly conduct a response survey in the area using modern technology and found the shallowest depth to be 22.5 feet rather than the previously charted 31.5 feet. This discrepancy was due to the limitations of the survey equipment in use at the time, and similar discrepancies can be expected in other survey areas of this vintage.
- **Report Casualty #142:** In 2016, the oil tanker Ebony grounded near Nunivak Island while carrying 11 million gallons of fuel. The vessel's maximum draft at the time was 37.3 feet, and well within the charted depth of 54 feet. Following the grounding, examination into the source data for the area revealed an "unknown" source, indicating the data was likely part of the Alaska Purchase in 1867 and represented the best data Russia had available at the time.

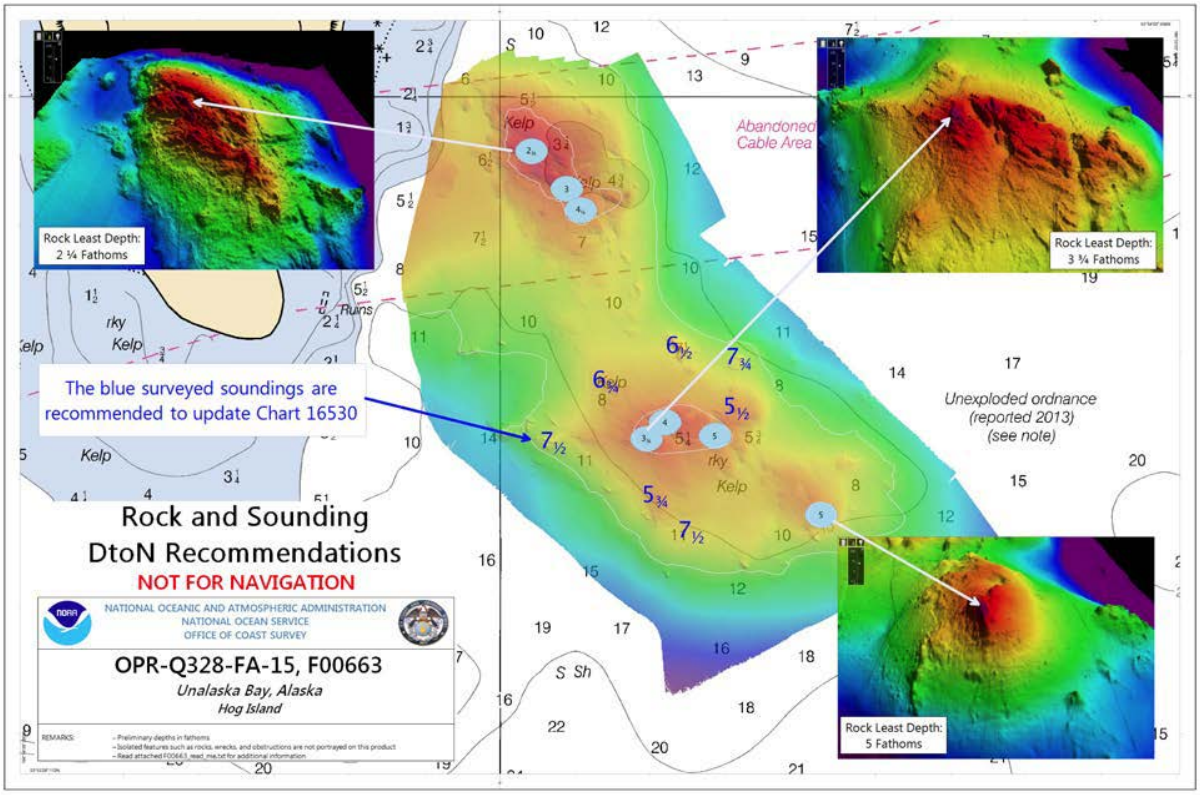

Figure 6: Example of modern multi-beam survey report finding previously uncharted dangers to navigation. From USCG Port Access Route Study Report.

LIMITED UNITED STATES COAST GUARD PRESENCE IN BRISTOL BAY

Bristol Bay is one of Alaska's most productive commercial fishing grounds, with millions of salmon harvested every year and yet this area is not patrolled regularly by the United States Coast Guard (USCG) due to a complex mix of challenges including the quality of current hydrographic data and charting information. The USCG is concerned about the safety of mariners operating in the area, and the congestion caused by a highly competitive seasonal fishery. The limited availability of soundings, tides, currents, and charting information increases the risk of operating USCG vessels in Bristol Bay, and hinders their capability to establish an enforcement presence to ensure the safety of all vessels operating in the area.

Figure 7: 2009 Egegik, Bristol Bay fishing vessels, photo credit Warner Lew, Icicle Seafoods. Note the muddy wakes from fishing in such shallow water.

C. APPLIED DATA USES: ONSHORE EXAMPLES

Moving onshore, geospatial data at the transition from sea to land is necessary for assessing coastal flood and erosion hazards, designing mitigation structures for coastal geohazards, and defining land use and ownership boundaries. As Overbeck's opening presentation stated; accurate topography/bathymetry; current and historical imagery; and vertical datums, all essential for flood and erosion mapping, forecasting, and mitigation; are not available for many communities in Western Alaska.

EROSION HAZARDS - SHISHMAREF

Coastal erosion is occurring in many Western Alaska communities with widespread consequences. Erosion is impacting community infrastructure such as buildings, schools, water treatment plants, landfills, and private homes, as well as traditional and cultural resources. Recent reductions in the duration of offshore and shorefast ice allow coastal storm water surges and waves to develop. The shorter shorefast ice season leaves coastal areas unprotected from fall and winter storms that can erode large portions of shoreline. Permafrost near the coast is especially susceptible to erosion with increased exposure to above freezing temperatures and wave action.

In 2017, the community of Shishmaref (approximately 600 people) experienced a coastal storm during ice-free conditions which eroded the only access road to the landfill.

Figure 8: Erosion at the landfill access road, photo taken by the Native Village of Shishmaref after November 2017 storm.

FLOOD HAZARDS - GOLOVIN

Communities in western Alaska are subject to coastal flooding from storms originating in the Bering Sea. **NOAA National Weather Service (NWS)** provides coastal flood forecasts for this region. Since of the NWS began incorporating DGGS color-indexed maps for flood-vulnerable communities (http://www.dggs.alaska.gov/pubs/id/29719) into forecast decision support and forecast language has become localized in communities where maps are available. At Golovin local community leaders, the NWS, and DGGS have been using color-indexed maps to give advance notice of the timing and potential impact of flooding in the community. The community has responded by building a temporary flood berm each time a storm is forecast to exceed local elevations. The community also provides feedback on the observed flood level, so that the accuracy of the flood forecast model can be assessed.

These color-indexed maps require (1) high resolution elevation data (< 2 m ground sample distance), (2) vertical datum transformations from tidal to land-based datums (e.g. mean lower low water to NAVD88), (3) local community infrastructure names and locations, (4) elevations of past flood events, and (5) elevations of modelled flood events based on return interval. Maps are publicly available where these data exist, however this only covers 13 of 60 coastal communities.

Figure 9: Schematic of color-indexed elevations as they relate to local topography, beaches, and coastal infrastructure. Image courtesy of J. Overbeck, State of Alaska DGGS.

FLOOD HAZARDS - CAPE LISBURNE

Many areas in Alaska, especially in northern and western Alaska, are low lying and subject to inundation by coastal flooding.

The Cape Lisburne airstrip in Northwest Alaska on the **Chukchi Sea** is known to completely flood during storm events. A local survey company, JOA Surveys, LLC, was involved in the response to re-establish airport survey control benchmarks after a flood event completely covered the airstrip.

Figure 10: Cape Lisburne airstrip during flood event in 2002 or 2003, photo courtesy of Cape Lisburne staff. Runway light near the bow of the skiff is three feet in height.

RELOCATION PLANNING - MERTARVIK

Coastal communities are already responding to erosion by relocations, selective expansion locations, building mitigation structures, and monitoring; however, without adequate data, efforts are delayed or conducted with inadequate data which limits their resilience to future events. Due to erosion, the community of Newtok has selected to relocate to a site that is under development, Mertarvik. During site development, a barge landing was chosen and developed without collecting bathymetry. Upon completion, the site was found to be too shallow for barge traffic, and a new site was constructed. By constructing the barge landing without adequate coastal mapping, the project incurred an additional $400,000 in costs and was delayed by three months.

Beyond the economic costs of community relocations there are greater losses to culture through the loss of individuals properties and archeological sites due to erosion and/or flooding. Communities need data to sustain planning on a greater than 50-year time scale.

Figure 11: Mertarvik original barge ramp sinking in the mudflats. Photo taken in 2009 by R. Lundell, State of Alaska Department of Transportation.

2. TECHNOLOGIES & SPECIFICATIONS

This topic focused on current and emerging technologies that could be used in Alaska to fill coastal mapping data gaps. Alaska's wide range of environmental conditions and remoteness allow for the testing of technologies under a variety of extreme conditions. Technology-neutral discussions about data specifications were also a central discussion topic. Several of the topics that were most prominent in the group discussions are summarized below. In the complete digest, content is organized into the following categories:

- Specifications
- Types of Elevation Data Needed
- Data Formats and Standards Coordination
- Water Levels and Tide Coordinated Data
- Emerging Technologies
- Test Locations
- Community Needs/Priority Locations
- Refresh Rates
- Elements of the Coastal Mapping Strategy

A. NATIONAL STANDARDS

Summit participants discussed how meeting national data standards can be more expensive in Alaska than in other areas of the U.S. due to remoteness, lack of ground control, lack of water level infrastructure, and unpredictable weather patterns. Participants indicated that data use considerations should drive data quality specifications, while remaining technology-neutral. This approach will maximize the opportunity for project managers to select the most appropriate or economic approach and allow emerging technologies to compete with traditional geospatial data collection techniques. Additionally, participants recognized that tighter specifications are required in some locations due to population, area use, economics, and ecological significance.

GPS CHECKPOINT REQUIREMENTS IN REMOTE AREAS

In the Yukon-Kuskokwim lidar project summarized in the 'Stories that Speak' Section, a slight adjustment of the checkpoint specification from "regular" to "reasonable" spacing was key to this project's success and feasibility in both costs and timeline. The adjustment enabled checkpoints to be distributed in accessible areas rather than in a rigid grid pattern, thus eliminating the need for excessive helicopter use and delays arising from special access permitting. The change is estimated to have saved the project well over $100K in the final budget and significantly increased the feasibility of project completion in a single season. Data that were assessed for quality control, were not degraded from QL2 requirements and have sufficiently met stakeholder needs for all known uses.

Figure 12: Footprint of 2016 Yukon-Kuskokwim Delta Lidar Project. Image courtesy of Woolpert.

ONSHORE DATA COLLECTION WINDOWS: LEAF FREE AND SNOW COVER

Standards for aerial imagery and lidar typically include seasonal stipulations such as "no snow cover" and "leaves to be absent from deciduous trees." While there are data quality justifications for these standards, the snow free and leaf free spring or fall periods in Alaska are short and collection at these times is further complicated by rapidly changing daylight hours and complex weather windows. It can be very costly to get equipment and people on site to wait for optimal conditions. While data coverage and quality may be marginally impacted, extending data collection further into shoulder seasons could reduce project costs.

B. EMERGING TECHNOLOGIES

Summit participants discussed the potential for using and testing emerging technologies in Alaska.

SATELLITE-DERIVED BATHYMETRY

Satellite-derived bathymetry (SDB) has the potential to provide shallow water bathymetric data over large coastal regions. Multiple forms of this technological approach have advanced in the past decade, however, there are still limitations in resolution, absolute vertical accuracy, and lack of effectiveness in turbid water. In 2015 NOAA created provisional Electronic Navigational Charts (ENCs) using satellite data for the turbid Yukon River and Yukon Delta, an area known for its changing shoals and coastline. The charts do not include bathymetric soundings, rather they contain shoreline and approximate shoals derived from satellite data. NOAA is aiming to update these products annually. This approach provides mariners and barges that frequent this area more up-to-date information than previously available at a fraction of the cost of a traditional ship-based sonar hydrographic survey. More information on this project can be found at https://landsat.gsfc.nasa.gov/satellite-images-are-source-for-first-of-its-kind-charts-of-alaskas-yukon-river/ and http://ccom.unh.edu/publications/yukon-river-prototype-electronic-charts-using-satellite-derived-bathymetry. Continued experimentation with SDB by NOAA and others, including evaluating new SDB technologies, experimenting with successful methodologies in different environments and comparison testing with ship-based sonar surveys may yield new options for Alaska coastal mapping.

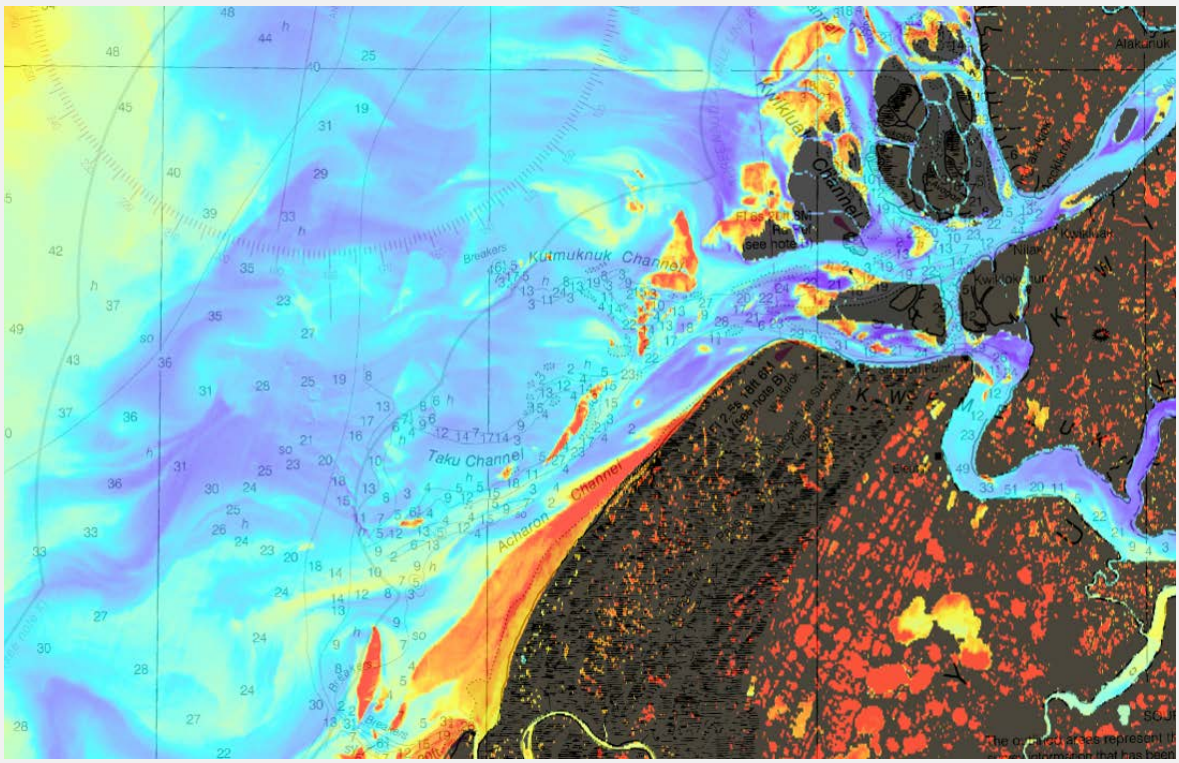

Figure 13: Experimental satellite derived bathymetry product on the Yukon Delta overlaid onto Chart 16240. Image courtesy of NOAA Coast Survey.

PHOTOGRAMMETRICALLY DERIVED DIGITAL SURFACE MODELS

Lidar is the primary technology presently used in the Continental United States (CONUS) for the collection of elevation data to support production of high resolution digital terrain models (DTMs) and DSMs. DSMs are elevation models that include above-ground features like vegetation or houses; whereas DTMs represent the bare earth.

DSMs can also be produced using modern photogrammetric techniques, such as Structure-from-Motion (SfM). DSMs generated with photogrammetry over unvegetated and undeveloped terrain, such as beaches, are equivalent to DTMs, and DTM algorithms may be used on photogrammetric point clouds to remove large structures from built environments. However, photogrammetric point clouds do not possess the same multi-return characteristics of lidar point clouds in vegetated areas or where small discrete features like power lines are present.

SfM is becoming a popular and relatively inexpensive method for producing DSMs for projects when lidar is cost-prohibitive due to project size, location or other factors. An increasing number of projects in Alaska are utilizing this methodology, but to ensure the data can be correctly geospatially referenced and have multiple uses, accuracy and data quality should be recorded by the data producer in a standard fashion. Existing elevation data standards, such as those used for lidar and IfSAR, are not directly transferable and could be modernized. Participants brainstormed methods to better communicate data quality/accuracy by separating elevation datasets into categories based on how they were collected, when they were served to the public and with more consistent and descriptive metadata. It was noted that without adequate metadata and outreach, users accustomed to elevation data from lidar may misinterpret this data type and its associated use limitations, such as reduced potential for descriptive point cloud classification.

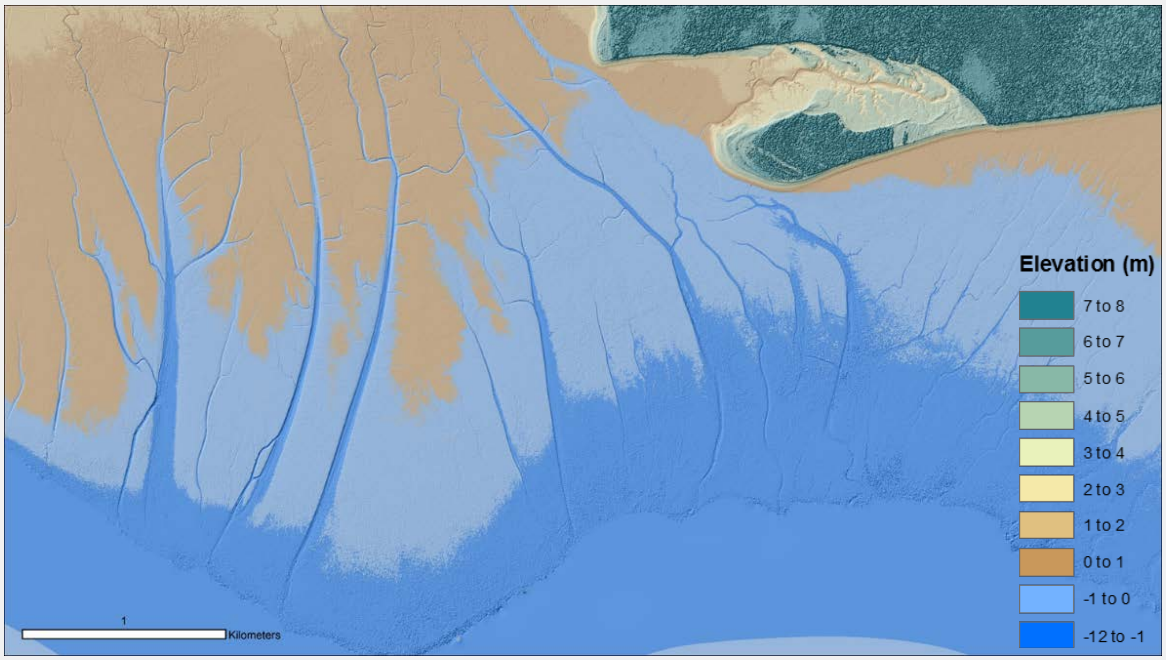

Figure 14: SfM elevation map of Cook Inlet tidal mudflat area. Image courtesy of T. Jones, National Park Service.

DRONES
The use of drones for mapping has been increasing as both platforms and mapping technologies evolve. Drones have advantages over traditional methods (manned ships or aircraft) including being more portable for use in remote areas and more cost effective for smaller areas that require high resolution data. There is also the potential to train local or regional personnel in the operation of drones for areas that need frequent re-survey. In these cases, resulting product accuracy can be controlled by establishing local control checkpoints which are included in each data collection effort. Battery life limitations are especially challenging for drone use in Alaska during very cold temperatures. Airspace restrictions, including around national parks and protected areas, further limit some aerial drone use. Projects using drones must still be evaluated for cost efficiency against the ready availability of marine vessels and aircraft in Alaska which often make traditional collection platforms more affordable. As drones establish their place in the mapping toolbox, we anticipate Alaska serving as an important test-bed; for example, the lack of man-made features in Alaska's Aleutian Islands served as a useful NASA field site for developing vision-based localization and navigation algorithms for Unmanned Aerial Vehicles.

3. COORDINATION & COLLABORATION

This topic focused on the opportunities to enhance coordination and collaboration across government agencies and with non-government entities. Several of the topics that were most prominent in the group discussions are summarized below. In the complete digest, content is organized into the following categories:

- Coordination
- Communications
- Working with the Private Sector
- Crowdsourcing Data
- Potential Leveraging of Coastal Mapping Activities for Other States
- Next Steps/Road Map Strategy Document
- 3D Nation Survey

A. SUCCESSFUL DATA ACQUISITION PROGRAM EXAMPLES

Participants discussed different programs and program models which have been successful for data acquisition in Alaska.

3DEP
The 3DEP program was noted as a highly successful model in Alaska due to the initial cost-benefit analysis, economy of scale, the Federal USGS matching funds for selected projects, and the interagency leadership of the Alaska Mapping Executive Council. 3DEP has resulted in the near-completion of replacing decades old, 60-meter resolution elevation data with contemporary 5-meter resolution IfSAR data statewide through ongoing and opportunistic partnerships. Areas still in need of data acquisition include Kodiak, areas around the Yukon-Kuskokwim Delta, parts of the Alaska Peninsula, the Aleutians and other remote islands. More recently, 3DEP has also supported some lidar projects around the state. The focus on identifying as many partners as prudent for any particular project has resulted in larger areas of data acquisition reducing the relative cost of project mobilization and decreasing the data acquisition cost per area. Matching funds from the USGS are a key incentive for partners to work with the 3DEP program. Additionally, the 3DEP competition period enables advanced project planning, which greatly enhances project success within Alaska's limited field season. Lastly, having a dedicated USGS liaison in Alaska familiar with local and federal agencies promotes program participation through personal connections with interested parties, ensuring the continued success of this program.

SHOREZONE
Another program with success garnering ongoing financial support specifically related to coastal mapping is ShoreZone. Like the 3DEP program, ShoreZone has been flexible enough to accept funds from a variety of partners. The flexibility to receive funds as they become available and more independently plan data acquisition missions based on an overarching plan to cover the state, has proven to be a successful model. Public availability of data and name recognition also encourages participation and funding of new acquisitions through this program.

B. CROWDSOURCING DATA

Participants discussed the potential for crowdsourcing and community-led projects as mapping technologies become more portable and digital connectivity increases. Most importantly, for crowdsourced geospatial data to be usable by others, it needs to adhere to base standards and undergo some type of control. Implementing methods or programs to provide data acquisition and metadata documentation guidelines, provide standardized quality control on datasets, and the identification of a data hosting platform are keys to successful crowdsourced data integration. Additionally, community relationships and reliable communication must be established and maintained for crowdsourcing data acquisition programs to be successful. In one example Olex, a company out of Norway, has created a model for crowdsourcing bathymetric data collection. Olex operates as a global bathymetry database in which users submit their data and in exchange they gain access to the contents of the shared database. For this type of system to be successful it must have significant consumer participation, standardized equipment, a tested methodology, and a desirable data-hosting service.

C. ACCESS, QUALITY CONTROL, UNIFORMITY AND METADATA

Summit participants discussed how data sharing can be enhanced with published guidelines, standardized access, quality control, and data uniformity. Published guidelines for data acquisition that cross federal and state agencies can make it easier for project collaboration and the collection of additional items that increase data applications. Many summit participants said that a regulated data access point with data standards and quality control measures would be useful for evaluating where data is already available. Reliability and consistency in data format, something often set at the contracting phase, was also cited as important, particularly for authoritative data. Lastly, standardized quality control measures for metadata will greatly enhance the usability and application of datasets.

ELEVATION DATA PORTAL
The State of Alaska Elevation Portal (https://elevation.alaska.gov/) is an example of data hosting specific to Alaska.

ALASKA GEOSPATIAL COUNCIL GEOPORTAL
The AGC Portal technical working group is tasked with developing a geoportal that will provide a statewide data access point for geospatial data. The geoportal will serve as a catalog for geospatial data holdings throughout the state, providing links to current datasets hosted by various agencies, as well as, hosting capabilities for data not hosted elsewhere. Datasets will include elevation, imagery, and many other thematic layers indexed and searchable with a standardized metadata library for easy data discovery and access. For updated information on the geoportal and to learn more about the AGC Portal technical working group, visit the AGC website: http://agc.dnr.alaska.gov/geoportal.html.

V. CONCLUSION

The 2018 Alaska Coastal Mapping Summit met all stated objectives of the meeting through highly-targeted presentations with numerous updates and in-depth discussions of coastal mapping in Alaska that laid the groundwork for the next step of developing a Coastal Mapping Strategic Plan under the guidance of the new Coastal Mapping Strategist.

The tables below contain notable feedback from the 2016 Alaska Coastal Mapping Summit, the corresponding actions implemented to improve the 2018 summit, and solicited participant feedback from the 2018 summit.

Table 1: 2016 summit participant feedback and corresponding 2018 summit actions.

2016 Suggestions	2018 Implementation Actions
Keep presentations short, less than 15 min.	Most talks were limited to 7 minutes, with the exceptions of the keynote speaker in the morning and the closing remarks speaker.
Provide coffee and snacks and social mixer after the event	Private industry partners were successfully solicited for food, beverage, and social mixer sponsorships.
Make agenda available in advance	Draft agenda emailed to registrants nearly two weeks before summit. Updated agenda emailed before the conference.
Have presentations in the morning and discussions in the afternoon	Implemented.
Provide discussion session questions in advance	Discussion session questions emailed to registrants nearly two weeks before summit.
Pre-designate discussion group moderators/notetakers	Online registration included a question for in-person participants to volunteer to be a group discussion moderator/notetaker. Selected moderators/notetakers were emailed instructions ahead of the summit.
Keep discussion groups small, 8-10 people	Registrants were assigned to groups ahead of the summit that dispersed participants from the same agencies/companies into different groups. During the summit, groups were combined to maintain adequate group size and account for participants who were not able to attend the entire summit.
Longer discussion periods	Discussion periods were scheduled for one hour, inclusive of a short (5-10 min) topic introduction and a short (10 min) large group discussion that shared one or two notable items from willing groups with the entire audience.
More specific questions for discussion periods	Discussion sessions were organized by topic and a list of 7-8 specific questions were formulated for each. Groups were not required to address all questions and were free to select a few questions and/or were encouraged to discuss additional related questions as the group deemed fit. The goal was to provide adequate brain teaser questions while allowing for discussions to evolve naturally. Additionally, during summit planning, some interested parties from past summits were solicited for discussion topics and questions. Lastly, online summit registration asked participants to enter any questions or topics they wanted included in the discussion sessions.
Compile a summit report with executive summary to sustain and facilitate continued discussion.	This summit report generation was included in summit budget/planning.

Table 2: 2018 summit participant feedback.

2018 Summit Feedback
Positive Feedback: • The location was perfect. • The agenda/schedule were kept on track the entire time. • The distribution of lightning rounds and breakout sessions worked well, as it kept participants more engaged. • There was a good mix of user perspectives and technology overviews. • Selection of beverages and healthy snacks was good.
Areas for Improvements: • Ask group leaders to bring laptops or tablets to record notes and email notes to summit organizers. • Put a short break between each 'round' of lightning talks. • Host an "icebreaker" social event the night before the conference. • Each summit should also report on the previous year's efforts.

Next Steps Recommendations:
• Formal in-state stakeholder survey
  o Identify user groups of coastal datasets
  o Document how these groups use coastal datasets
  o Determine where and at what refresh rate data is most urgently needed
  o Provide clarity on available budgets in order to develop funding framework
• Technology focused survey to data providers
  o Understand what technologies are available and under development
  o Determine advantages/disadvantages of each
• Develop working groups for
  o Acquisition needs & opportunities
  o Data availability for use in coastal planning & resiliency
• Create timelines and completion dates that are assigned to identified goals/actions discussed during the summit, to keep the momentum going.
• Make this summit an annual event.

VI. CRITICAL ELEMENTS FOR MOVING FORWARD

Over the remainder of 2018, several elements and milestones exist to keep the coastal mapping agenda moving forward. Upcoming activity will focus on the development of specific actions to support the development of the Coastal Mapping Strategic Plan; these concrete next steps will be based on the recommendations from summit participants.

1. ENCOURAGE RIGOROUS RESPONSE TO 3D NATION SURVEY

3D Nation Survey, sponsored by the National Oceanic and Atmospheric Administration (NOAA) Office of Coast Survey (OCS) and the U.S. Geological Survey (USGS), will be coming out soon. Responses from identified Alaska native, state, and local agencies will be solicited and compiled to access Alaska's identified need and desired base specifications for seamless topographic and bathymetric data that are in line with demonstrated business uses and associated benefits. Additional federal, not-for-profit, and private sector survey participants will also be selected at the national level. Additional information is available at:

https://my.usgs.gov/confluence/display/3DNationStudy/3D+Nation+Requirements+and+Benefits+Study

2. SUPPORT COASTAL MAPPING STRATEGIST POSITION

The Coastal Mapping Strategist is a part time, term position that will take the lead role in preparing the Coastal Mapping Strategic Plan; this position is presently funded to remain active until the end of the calendar year. In the coming months, the strategist will work to define and execute the actions necessary to act upon the recommendations from summit participants. Stakeholders are encouraged to remain in contact with, continue to provide input and feedback to, and respond to questions from the Coastal Mapping Strategist to ensure that a comprehensive strategy is developed.

3. COORDINATE WITH OTHER REGIONS

Other states and regions are also prioritizing coastal mapping and developing strategic data acquisition plans independently and in coordination with the 3D Nation survey. Communications and coordination with other states such as Florida, which is at approximately the same stage in the process as Alaska, is anticipated to be particularly beneficial to both states.

4. REPORT AT UPCOMING FEDERAL MEETINGS IN ALASKA

Participation and presentation of the summit outcomes at several upcoming federal meetings will raise awareness about Alaska's specific data needs and the increased in-state coordination now focused on coastal mapping.

A. NOAA HYDROGRAPHIC SERVICE REVIEW PANEL (HSRP)

NOAA's Hydrographic Service Review Panel (HSRP) will hold a meeting on August 28-30, 2018 (2.5 days) in Juneau, AK. This external panel advises the NOAA Administrator on matters pertaining to safe, efficient and environmentally sound maritime transportation and navigation products, data, and services. The HSRP also has a working group on "Emerging Arctic Priorities." Among probable discussion at the Summer 2018 meeting will be items pertaining to the Arctic maritime frontier, Alaska observational data gaps, and the 3D Nation Survey. The meeting will be open to the public and public comments are encouraged in person or in writing in advance of the meeting. There will be a webinar for remote attendees where pre-registration is requested at https://attendee.gotowebinar.com/register/3898703691780313857. Additional information will be available at: https://www.nauticalcharts.noaa.gov/hsrp/hsrp.htm.

B. ALASKA MAPPING EXECUTIVE COMMITTEE (AMEC)

In August 2018, the Alaska Mapping Executive Committee (AMEC) will meet in closed session the same week as the HSRP in Juneau, Alaska. AMEC Members are executive level managers from nearly two dozen federal and state agencies. Members serve to coordinate critical mapping activities in Alaska and collaborate with the AGC to provide accurate, current and accessible statewide base map products. AMEC has worked in the past to secure financial resources to complete Alaska topographic mapping, and a newly broadened tactical plan now supports the expansion of this effort to compile coastal and nearshore mapping requirements and

ongoing activities in Alaska by location, quality-level, partner, capacity, feasibility, and refresh-rate. These will be used to develop a long-term strategy for prioritizing coastal mapping activities and acquiring high-resolution lidar elevation datasets for select areas. AMEC forms yearly plans for data acquisition in Alaska.

5. DEVELOP COASTAL MAPPING STRATEGIC PLAN

Most importantly, the development of a feasible statewide coastal mapping strategy will be key to defining shared goals, improving coordination, and gaining support and funds. The Coastal Mapping Strategist, supported through AOOS, NOAA and AKDNR, will be primarily responsible for strategic plan development. The involvement of as many stakeholders as possible (AGC, AMEC, federal and state liaisons, native corporations, NGOs, the private sector, and academia) is an important goal in ensuring that the defined strategy reflects all user needs. Recommendations from summit participants will be used to define next steps for making this coordination occur.

The strategy will include bathymetry, terrestrial elevation data, and imagery priorities extending from approximately 30m in water depth to land subject to flooding within 1 km of tidally influenced water (an initial focus zone that may be further refined as the plan develops). This long-term strategy is intended to present an achievable, statewide roadmap for data collection over the next ten years with inclusion of additional considerations such as defining refresh rates according to rate of change and/or land use. A selective or tiered data specification matrix will be technology neutral, customized to specific physical environments, and reflective of current and future area uses. Recommended mapping activities will benefit a variety of user groups in the spirit of "map once, use many times". The strategy will outline specific recommendations and next step action items. Lastly, the document will be a 'living document' to facilitate updates as Alaska coastal mapping needs evolve.

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I. AGENDA

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- Map Once, Use Many Times -

2018 IWG-OCM Alaska Coastal Mapping Summit

Friday February 9, 2018, 8am-5pm AKDT

Room K'enakatnu 6 at Dena'ina Center, Anchorage, Alaska

Held Friday before 2018 Alaska Surveying & Mapping Conference

Time	Item	Speaker
8:00 – 8:15	*Arrival: Coffee/Tea Sponsored by Fugro*	
8:15 – 8:20	Introduction & Objectives	Nic Kinsman, NOAA NGS
8:20 – 8:40	Interagency Working Group on Ocean and Coastal Mapping (IWG-OCM), 3D Nation Survey, Seabed 2030	Ashley Chappell, NOAA OCS
8:40 – 9:00	SeaSketch Tour: Collaboration Opportunity Highlights	
9:00 – 9:50	**Lightning Talks I** (7 minutes each):	
	A. Alaska Geospatial Council	Ken Woods, DGGS
	B. Hydrographic Charting Activities in Alaska	LT Bart Buesseler, NOAA OCS
	C. Alaska Coastal Imaging	Mike Aslaksen, NOAA RSD
	D. 2017-18 Coastal Mapping Activities	Tahzay Jones, NPS
	E. Alaska Coastal Hazards Program	Jacquelyn Overbeck, DGGS
	F. Statewide Threat Assessment Project	Wendy Shaw, USACE Alaska
9:50 – 10:10	*Break: Coffee/Tea Sponsored by Frontier Precision* *Snacks Sponsored by Woolpert*	
10:10 – 11:00	**Lightning Talks II** (7 minutes each):	
	G. North Slope Nearshore Ocean Modelling	Warren Horowitz, BOEM
	H. Shallow Water Operations and Data Priorities	Dave Seris, US Coast Guard
	I. Alaska Coastal Resilience Workshops	Karen Murphy, FWS
	J. USGS 3DEP/GPSC Contracting	Brian Wright, USGS NMP
	K. NOAA's Coastal Geospatial Services Contract	Dave Stein, NOAA OCM
	L. 2017 Yukon Delta QL2 Lidar; JALBTCX	John Gerhard, Woolpert
11:00 – 12:00	**Lightning Talks III** (7 minutes each):	
	M. Shoreline Verification with UAS for Charting	Tim Smith, TerraSond
	N. Shallow Water Topo-bathymetric LiDAR	Russ Faux, QSI
	O. Coastal Water Clarity in Alaska	Rick Stumpf, NOAA NCCOS
	P. Approaches for Technology Integration	Rada Khadjinova, Fugro
	Q. Satellite Imagery for Coastal Mapping	Drew Hopwood, GeoNorth
	R. Alaska's ShoreZone Program	Sarah Cook, CORI
	S. 2015-16 Coastal Mapping of AK's West Coast	Matt Nolan, Fairbanks Fodar
12:00 – 1:00	*On-site Lunch Sponsored by the Alaska Ocean Observing System*	
1:00 – 2:00	**Discussion Session I: "Stories that Speak"** The value of coastal geospatial data in Alaska	Kick-off: 2017 Storm Season Jacquelyn Overbeck, DGGS
2:00 – 3:00	**Discussion Session II: Technologies & Specifications** Opportunities by technology category, test beds, and technology-neutral data specifications	Kick-off: Realistic Requirements Nic Kinsman, NOAA NGS
3:00 – 3:20	*Break: Coffee/Tea Sponsored by Fairbanks Fodar* *Snacks Sponsored by GeoNorth Information Systems*	
3:20 – 4:30	**Discussion Session III: Coordination & Collaboration** Strategies for working together	Kick-off: AMEC Successes Brian Wright, USGS
4:30 – 5:00	Closing Remarks and Next Steps	Marta Kumle, SOA/AOOS
5:15 – 7:00	*Coastal Mapping Mixer at Sullivan's Steakhouse - 320 W 5th Ave, Anchorage, AK 99501* *Sponsored by Quantum Spatial*	

2018 IWG-OCM Alaska Coastal Mapping Summit

Friday February 9, 2018, 8am-5pm AKDT

Special Thanks to our 2018 Alaska Coastal Mapping Summit Sponsors!

II. REGISTRATION CONTACT LIST

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Name (Last, First)	Job Title	Affiliation	Email Address
Allard, Chris	Program Manager	Denali Commission	callard@denali.gov
Anderson, Becci	National Hydrography Co-Lead	U.S. Geological Survey	rdanderson@usgs.gov
Anderson, Whitney	Chief, Bathymetry Branch (C/SFHMD)	National Geospatial-Intellegence Agency - Maritime Safety Office	Whitney.E.Anderson@nga.mil
Aslaksen, Michael	Chief, Remote Sensing Division	National Oceanic and Atmospheric Administration National Geodetic Survey	mike.aslaksen@noaa.gov
Bean, John	Assistant Professor	University of Alaska Anchorage - Geomatics	jbean6@alaska.edu
Biles, Frances	Geographer	U.S. Forest Service	fbiles@fs.fed.us
Bower, Bradford	Student	Unity College	bradfordbower@gmail.com
Brady, Michael	NGA, Maritime Safety Office	National Geospatial-Intellegence Agency - Maritime Safety Office	Michael.B.Brady@nga.mil
Buesseler, Bart	Navigation Manager	National Oceanic and Atmospheric Administration Coast Survey	Bart.O.Buesseler@noaa.gov
Catalano, Vinnie	Director of Operations	Cook Inlet Regional Citizens Advisory Council	SteveCatalano@circac.org
Causey, Douglas	Professor and PI	University of Alaska Anchorage Arctic Domain Awareness Center	dcausey@alaska.edu
Chappell, Ashley	IOCM, IWG-OCM Coordinator	National Oceanic and Atmospheric Administration	ashley.chappell@noaa.gov
Cody, Ryan	GIS Analyst	Univeristy of Texas at El Paso	rpcody@utep.edu
Colonell, Jack	Not Quite Retired	None	jmcolonell@gmail.com
Cook, Sarah	General Manager	Coastal and Ocean Resources	sarah@coastalandoceans.com
Coon, Catherine	Chief Environmental Sciences Management	Bureau of Ocean Energy Management	catherine.coon@boem.gov
Cox, Sally Russell	Local Government Planner/ State of Alaska Risk MAP Coordinator	Alaska Division of Community and Regional Affairs	sally.cox@alaska.gov
Danielson, Jeff	CoNED Project Chief	U.S. Geological Survey	daniels@usgs.gov
Devaris, Aimee	Regional Director	U.S. Geological Survey	adevaris@usgs.gov
Ditmer, Isaiah	Lead LiDAR Analyst	Kodiak Mapping, Inc.	kodmaps@mtaonline.net
Dixon, Gregtory	IT Manger	Prince William Sound RCAC	gregory.dixon@pwsrcac.org
Earl, Shannon	Marketing Manager, Alaska	Fugro	SEarl@fugro.com
Ellanna, Mischa	Geologist/GIS Analyst	Bristol Bay Native Corporation	mellanna@bbnc.net
Escarzaga, Stephen	PhD Fellow	University of Texas at El Paso/NOAA-Crest	smescarzaga@utep.edu
Eytalis, Rachel	Survey Technitian	Alaska Department of Transportation & Public Facilities	rmeytalis@gmail.com
Fanning, Tyler	Natural Resource Specialist	Alaska Department of Natural Resources	tyler.fanning@alaska.gov
Faux, Russ	Senior Vice President	Quantum Spatial	faux@quantumspatial.com
Faw, Melinna	GIS Graduate Student/AK Bio Tech	Unity College	melinnafaw@gmail.com
Feliciano, Melanie	GIS Specialist	National Oceanic and Atmospheric Administration (ERT)	Melanie.Feliciano@noaa.gov
Fuller, Tracy	USGS Alaska Mapping Program Manager	U.S. Geological Survey	tfuller@usgs.gov
Gaylord, Allison	GIS Specialist	Nuna Technologies	nunatech@usa.net
Gerhard, John	Vice President, Program Director	Woolpert, Inc.	john.Gerhard@Woolpert.com
Gibbs, Ann	Geologist	U.S. Geological Survey - Pacific Coastal and Marine Science Center	agibbs@usgs.gov
Gienko, Gennady	Professor of Geomatics	University of Alaska Anchorage - Geomatics	ggienko@alaska.edu
Grabacki, Stephen	President	Fisheye Consulting	fisheyecon@gmail.com
Hapke, Cheryl	St Petersburg Coastal and Marine Science Center	U.S. Geological Survey	chapke@usgs.gov
Heim, Becki	Regional Program Manager	National Weather Service Alaska Region	rebecca.heim@noaa.gov
Heiner, Daniel	GIS	North Slope Borough	daniel.heiner@north-slope.org
Heinsius, Jonathan	Director, Geospatial Programs	GeoNorth Information Systems	jheinsius@geonorthis.com
Henspeter, Mark	Natural Resource Specialist	Alaska Department of Natural Resources	mark.henspeter@alaska.gov
Hickman, Pete	GIS Project Manager	University of Alaska Fairbanks - Geographic Information Network of Alaska	pete@gina.alaska.edu
Hingada, Charmaine	GIS Programmer	North Slope Borough	Charmaine.Hingada@north-slope.org
Hoffman, Hans	ASRC Energy Services Alaska, Inc.	Geological Engineer	Hans.Hoffman@asrcenergy.com
Holderied, Kris	Director	National Oceanic and Atmospheric Administration Kasitsna Bay Laboratory	kris.holderied@noaa.gov
Holman, Amy	Regional Coordinator	National Oceanic and Atmospheric Administration	amy.holman@noaa.gov

Name (Last, First)	Job Title	Affiliation	Email Address
Homan, Kim	Geospatial Program Manager	U.S. Forest Service, Alaska Region	kimhoman@fs.fed.us
Hopwood, Drew	Technical Director	GeoNorth Information Systems	dhopwood@geonorthis.com
Horowitz, Warren	Oceanographer	Bureau of Ocean Energy Management	Warren.Horowitz@boem.gov
Hughes, Brenna	Environmental Scientist	PND Engineers, Inc.	BHughes@pndengineers.com
Ingram Pierson, Kelly	Conservation Coordinator	The Nature Conservancy	kelly.ingram@tnc.org
Jacobs, Justin	Chief of Prevention	U.S. Coast Guard – Sector Anchorage	Justin.W.Jacobs@uscg.mil
Jeong, Inseong		National Oceanic and Atmospheric Administration	inseong.jeong@noaa.gov
John, Johnson	VP cultural	Chugach Alaska Corporation	jjohnson@Chugach.com
Johnson, Anne	Geographic Information Officer	Alaska Department of Natural Resources	anne.johnson@alaska.gov
Johnson, Crane	Service Coordination Hydrologist	National Weather Service Alaska Pacific River Forecast Center	benjamin.johnson@noaa.gov
Jones, Tahzay	Oceans and Coastal Programs Coordinator	National Park Service	tahzay_jones@nps.gov
Kee, Randy (Church)	Executive Director	University of Alaska Anchorage Arctic Domain Awareness Center	rakee@uaa.alaska.edu
Kening, Erik	Director, Land Management and Enforcement	Arctic Slope Regional Corporation	ekenning@asrc.com
Kennedy, David	NOAA Arctic Advisor	National Oceanic and Atmospheric Administration	Bianca.terry@noaa.gov
Khadjinova, Rada	General Manager	Fugro USA, Inc.- Alaska	rkhadjinova@fugro.com
Kinsman, Nic	Alaska Regional Advisor	National Oceanic and Atmospheric Administration National Geodetic Survey	nicole.kinsman@noaa.gov
Krieger, Kacy	Alaska Hydrography Coordinator	University of Alaska Anchorage	kekrieger2@alaska.edu
Kumle, Marta	Coastal Mapping Strategist	Alaska Ocean Observing System & Alaska Department of Natural Resources	marta.kumle@alaska.gov
Maio, Chris	Assistant Professor	University of Alaska Fairbanks	cvmaio@alaska.edu
Manley, William	Research Scientist	University of Colorado, INSTAAR	william.manley@colorado.edu
Marlow, Ryan	UAS Mapping Scientist	Alaska Aerial Media	Ryan@akaerialmedia.com
Martyn, Parker	Regional Inventory Program Manager	National Park Service	parker_martyn@nps.gov
Marvel, Carrie	DPM I	Alaska Department of Natural Resources	carrie.marvel@alaska.gov
Maune, David	Senior Project Manager	Dewberry Engineers Inc.	DMaune@dewberry.com
McCammon, Molly	Executive Director	Alaska Ocean Observing System	mccammon@aoos.org
McCullough, Adam	Alaska Geospatial Program Manager	Quantum Spatial	amccullough@quantumspatial.com
McPherson, Ronny	Coastal Engineer	HDR	ronald.mcpherson@hdrinc.com
Metzger, Jennifer	GIT Specialist	Michael Baker International	jennifer.gross@mbakerintl.com
Moore, Cindy Hartmann	Fish Biologist	National Oceanic and Atmospheric Administration, NMFS, Alaska Region	cindy.hartmann@noaa.gov
Morrow, Kalen	ShoreZone Project Manager	Coastal and Ocean Resources	kalen@coastalandoceans.com
Murphy, Karen	Western Alaska LLC Coordinator	U.S. Fish and Wildlife Service	karen_a_murphy@fws.gov
Newman, Thomas S	President	TerraSond Limited	tnewman@terrasond.com
Nolan, Matt	Alaska Coastal Mapping Expert	Fairbanks Fodar	matt2013@drmattnolan.org
Orange-Posma, Amy	Land Surveyor	Alaska Department of Natural Resources Division of Mining, Land, and Water	amy.orange@alaska.gov
Overbeck, Jacquelyn	Coastal Hazards Program Manager	Alaska Department of Natural Resources, Division of Geological & Geophysical Surveys	jacquelyn.overbeck@alaska.gov
Palmer, Erin	GIS Analyst	Alaska Department of Natural Resources	erin.palmer@alaska.gov
Parker, David	Waterways Management Division Chief	U.S. Coast Guard	David.N.Parker@uscg.mil
Parrish, Christopher		Oregon State	Christopher.Parrish@oregonstate.edu
Perkins, Rick	GIS Manager	Sealaska Corporation	rick.perkins@sealaska.com
Plivelich, Mike	Alaska NHD Steward	U.S. Forest Service	mtplivelich@alaska.edu
Ravens, Tom	Professor of Civil Engineering	University of Alaska Anchorage	tmravens@alaska.edu
Raynes, Brian	Land Surveyor II	Alaska Department of Natural Resources	brian.raynes@alaska.gov
Reiske, Henry	Educator	Center for Alaskan Coastal Studies	Henry@akcoastalstudies.org
Ridge, David	Director, Marine Operations	Crowley	david.ridge@crowley.com
Robicheau, Neil	Geospatial Technical Sales	Frontier Precision	neilr@frontierprecision.com

Name (Last, First)	Job Title	Affiliation	Email Address
Robinson, Nikita	Natural Resource Specialist	Alaska Department of Natural Resources Division of Mining, Land, and Water	nikita.robinson@alaska.gov
Sanchez, Stuart	GIS Analyst	BP Exploration Alaska	stuart.sanchez@bp.com
Schaefer, Janet	Volcanology Section Chief	Alaska Division of Geological & Geophysical Surveys - Alaska Volcano Observatory	janet.schaefer@alaska.gov
Seitz, Robert	Electrical Engineer	Artech Engineering, IEEE, MTS	rseitzak@aol.com
Seris, David	Waterways Management	U.S. Coast Guard District 17	David.m.seris@uscg.mil
Shaw, Wendy	Civil Engineer - Hydraulics	U.S. Army Corps of Engineers	wendy.l.shaw@usace.army.mil
Silagi, Michael	LT	National Oceanic and Atmospheric Administration	michael.silagi@noaa.gov
Silva, John		Moran Environmental	jsilva@moranenvironmental.com
Smith, Brittany	Natural Resource Specialist	Alaska Department of Natural Resources	brittany.smith@alaska.gov
Smith, Jeremy	Project Manager	Kodiak Mapping, Inc	jsmith@kodiakmapping.com
Smith, Tim	Survey Technician	Terrasond Limited	tsmith@terrasond.com
Stein, Dave	Geographer, COR	National Oceanic and Atmospheric Administration Office for Coastal Management	dave.stein@noaa.gov
Stoll, Willie		Dowl	wstoll@dowl.com
Stumpf, Rick	Oceanographer	National Oceanic and Atmospheric Administration NCCOS	richard.stumpf@noaa.gov
Sweeney, Con	GIS & Remote Sensing Manager	Michael Baker International	CSweeney@MBakerIntl.com
Thiel, Phillip	Senior Vice President	Dewberry	pthiel@dewberry.com
Unger, Mike	Natural Resources Specialist III	Alaska Department of Natural Resources/DMLW/Planning	mike.unger@alaska.gov
Venator, Sarah	Geologist	National Park Service	Sarah_Venator@nps.gov
Vernlund, Caitlin	Alaska Operations Coordinator	Quantum Spatial	cvernlund@quantumspatial.com
Wander, Jaclyn	Civil Engineer II	Bristol Engineering Services Corporation	jwander@bristol-companies.com
Wang, Caixia	Assistant Professor	University of Alaska Anchorage	cwang12@alaska.edu
Wardwell, Nathan	Managing Partner	JOA Surveys, LLC	nathan@joasurveys.com
Wawrzonek, Rich	Sr. GIS Programmer/Analyst	Resource Data, Inc.	richw@resourcedata.com
Weaver, Anne	Environmental Program Specialist	Alaska Department of Environmental Conservation	anne.weaver@alaska.gov
Westcoast, Lucy	Land Administrator	Cook Inlet Region Inc.	lwestcoast@ciri.com
Wilcox, Laura	Port Engineer	Vitus Marine	laura.wilcox@vitusmarine.com
Williams, Dee	AK Region Deputy Director	U.S. Geological Survey	dmwilliams@usgs.gov
Wilson, Susan	President	Sustainable Futures	Susan.Wilson@SustainableFuturesAK.org
Woods, Ken	System Admin	Alaska Division of Geological & Geophysical Surveys	ken.woods@alaska.gov
Wozencraft, Jennifer	JALBTCX Director and National Coastal Mapping Program Manager	U.S. Army Corps of Engineers	jennifer.m.wozencraft@usace.army.mil
Wright, Brian	National Map Liaison	U.S. Geological Survey National Geospatial Program	bwright@usgs.gov
Xiao, Ming	Associate Professor of Civil Engineering	Pennsylvania State University	mxiao@engr.psu.edu

III. PRESENTATION PDFS

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AOOS
Alaska Ocean Observing System

NOAA
NATIONAL OCEANIC AND ATMOSPHERIC ADMINISTRATION
U.S. DEPARTMENT OF COMMERCE

ALASKA DEPARTMENT OF NATURAL RESOURCES

Alaska Coastal Mapping Summit

Dena'ina Center
Anchorage, Alaska
February 9, 2018

FAIRBANKS FODAR
If your topography is changing, we can measure it. Affordably.
www.fairbanksfodar.com

FUGRO

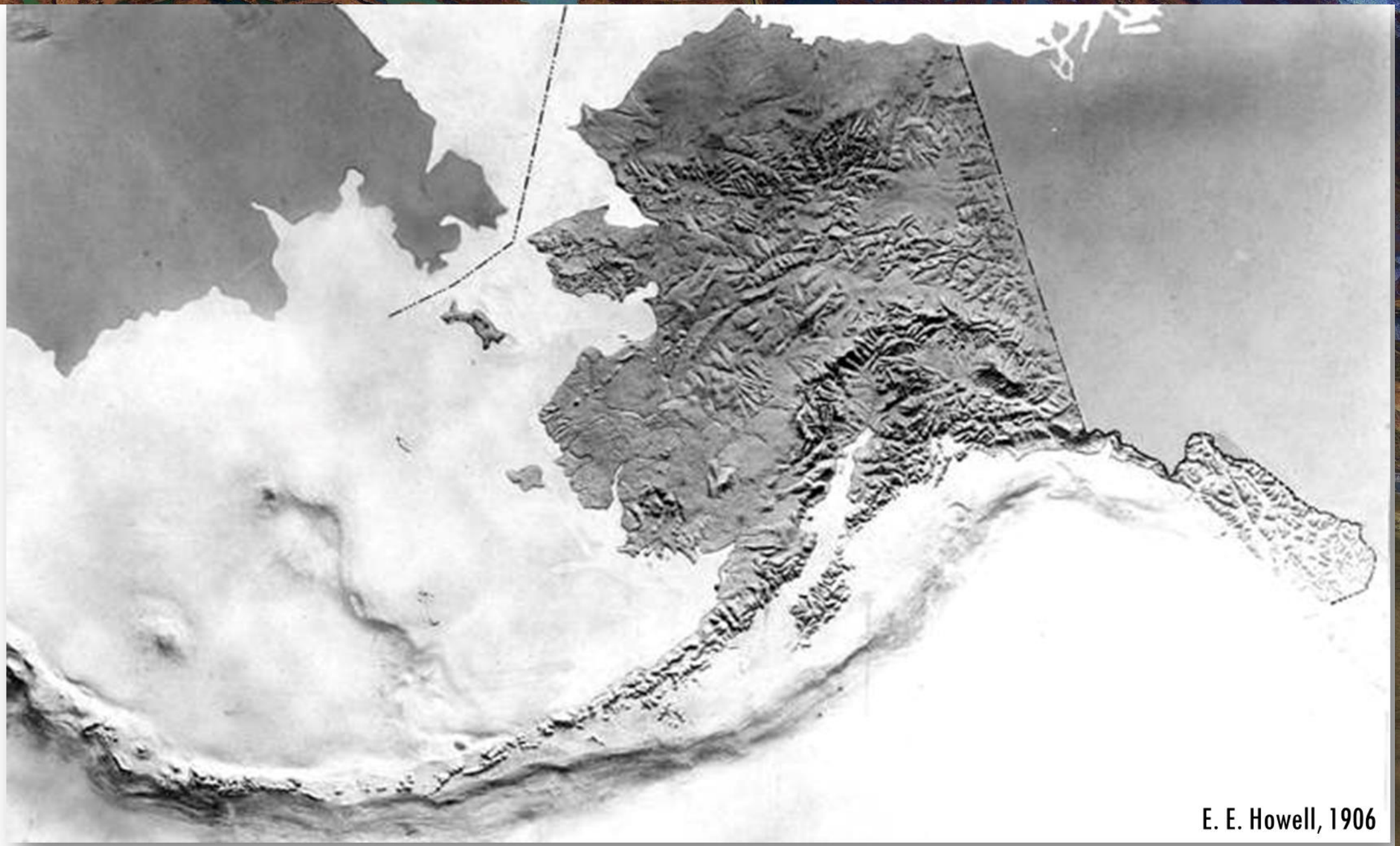
WOOLPERT
ARCHITECTURE | ENGINEERING | GEOSPATIAL

quantum SPATIAL

GeoNorth
Information Systems

FRONTIER PRECISION

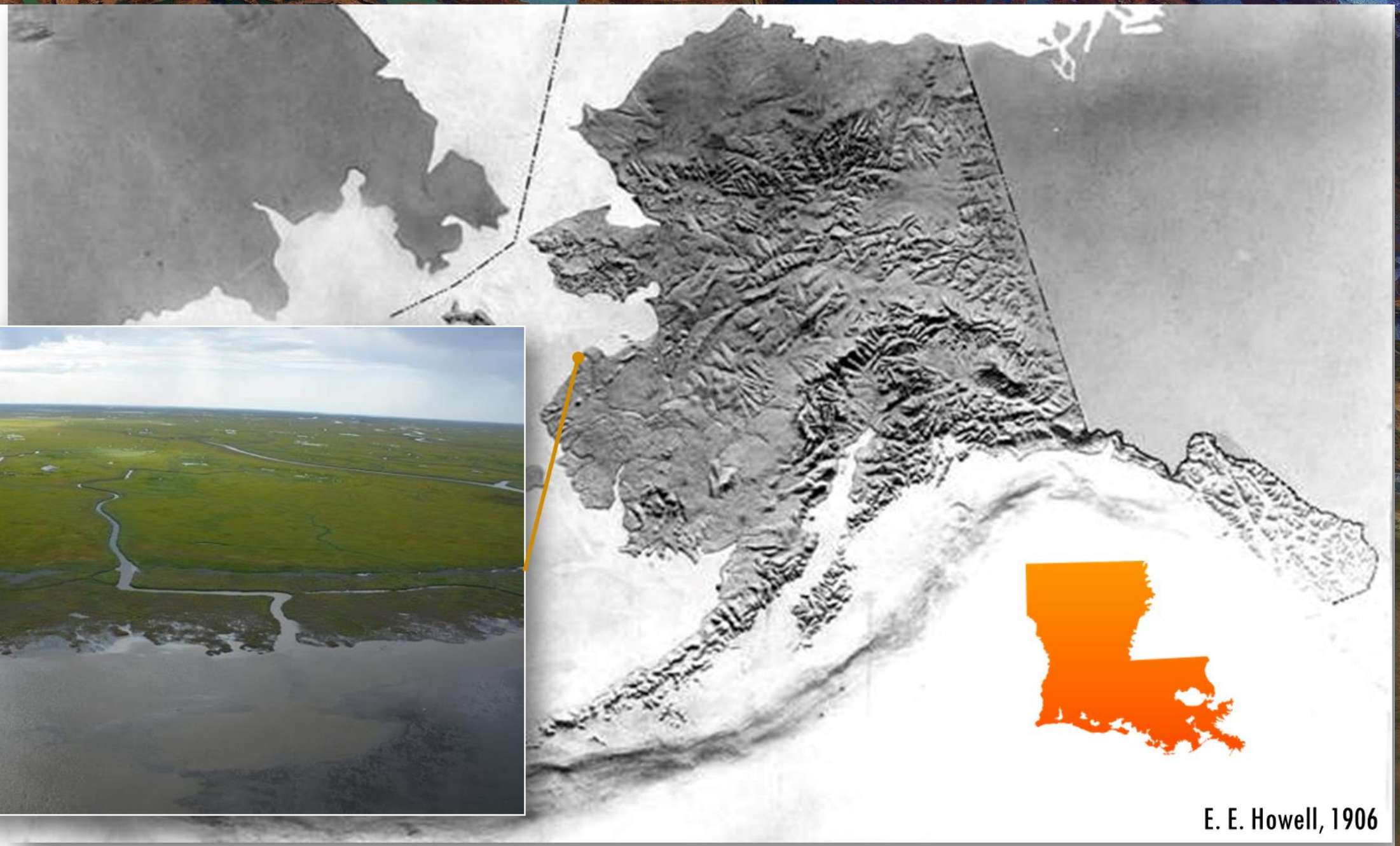
WELCOME



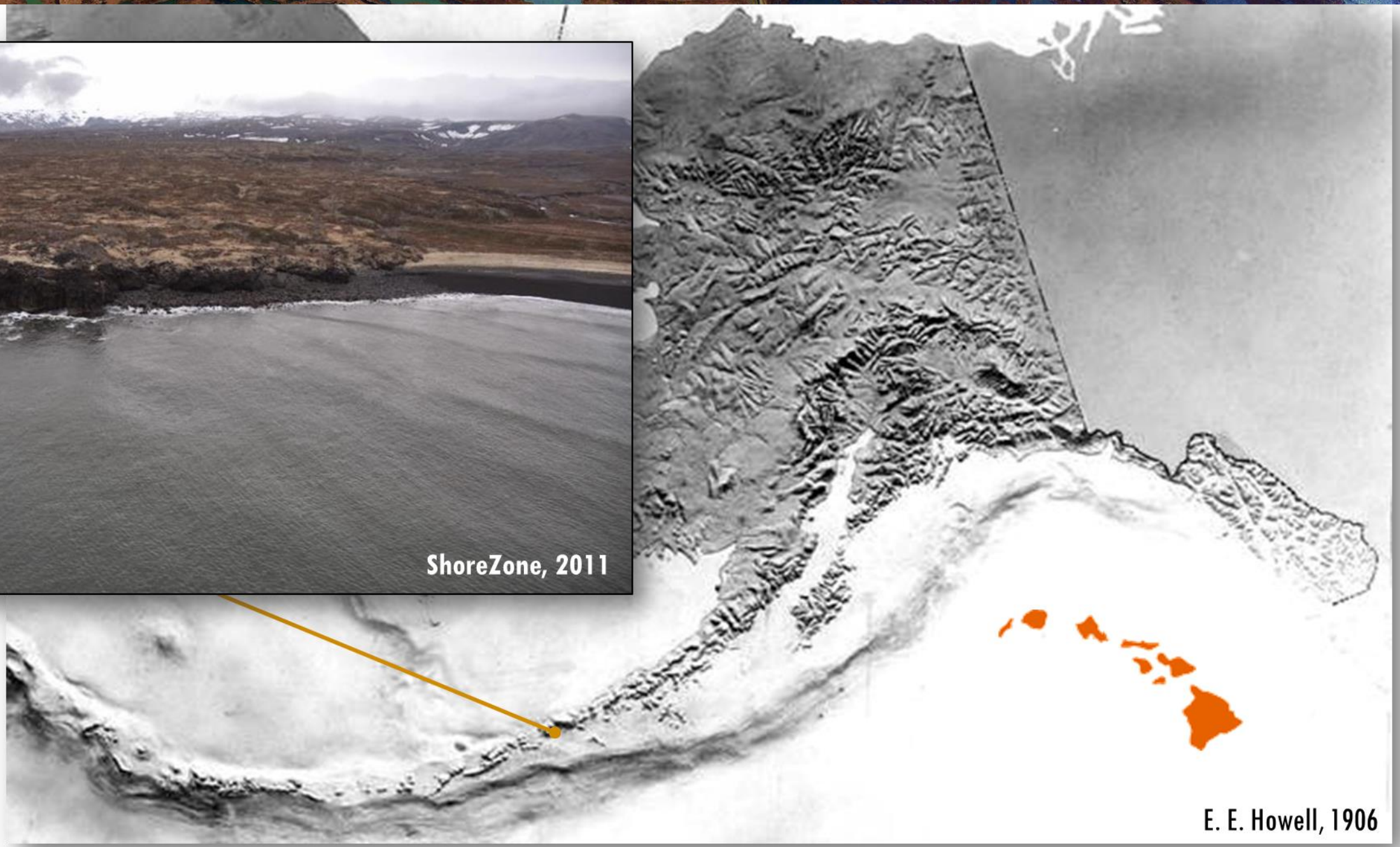
ShoreZone, 2012

E. E. Howell, 1906

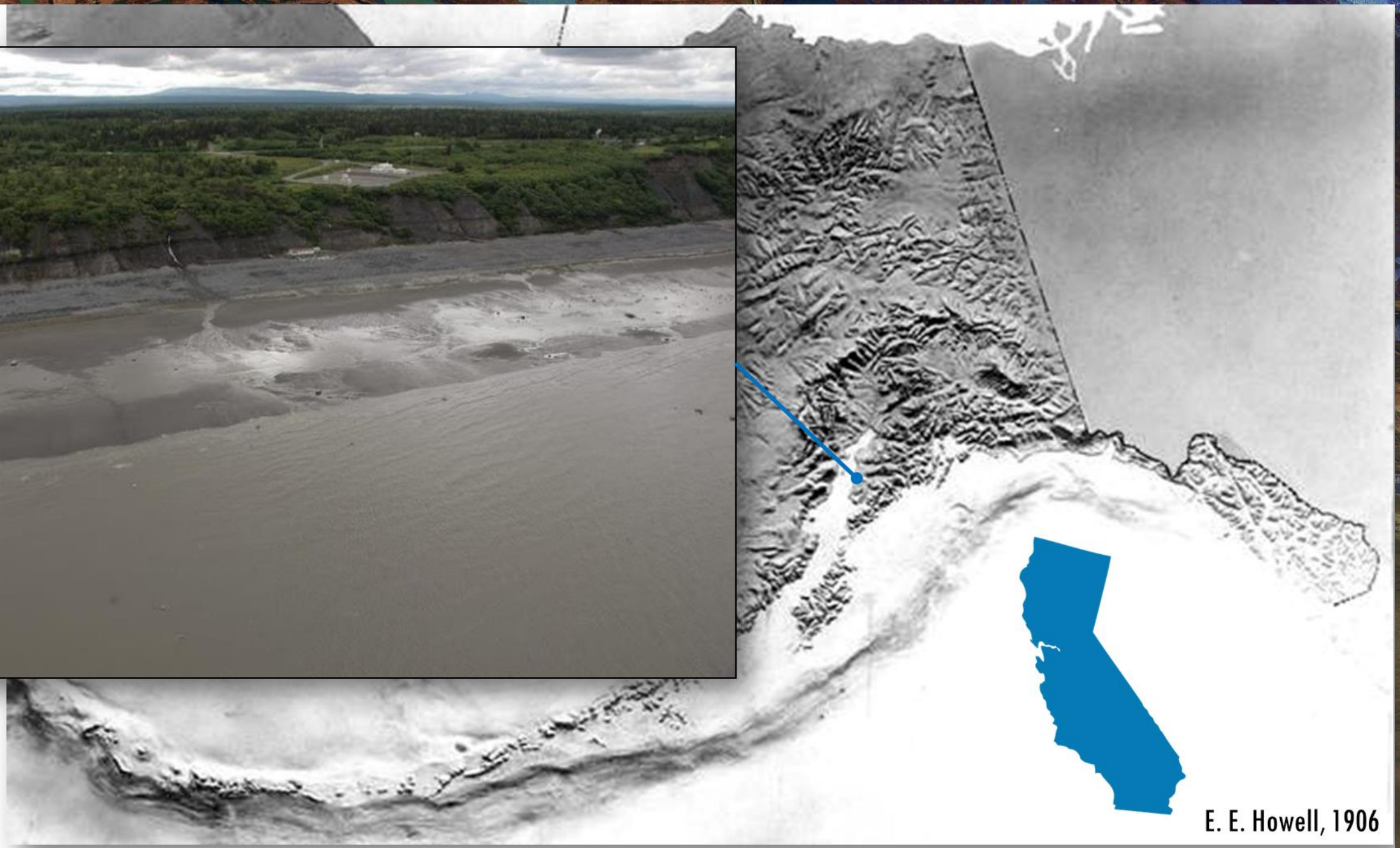
ShoreZone, 2014


E. E. Howell, 1906

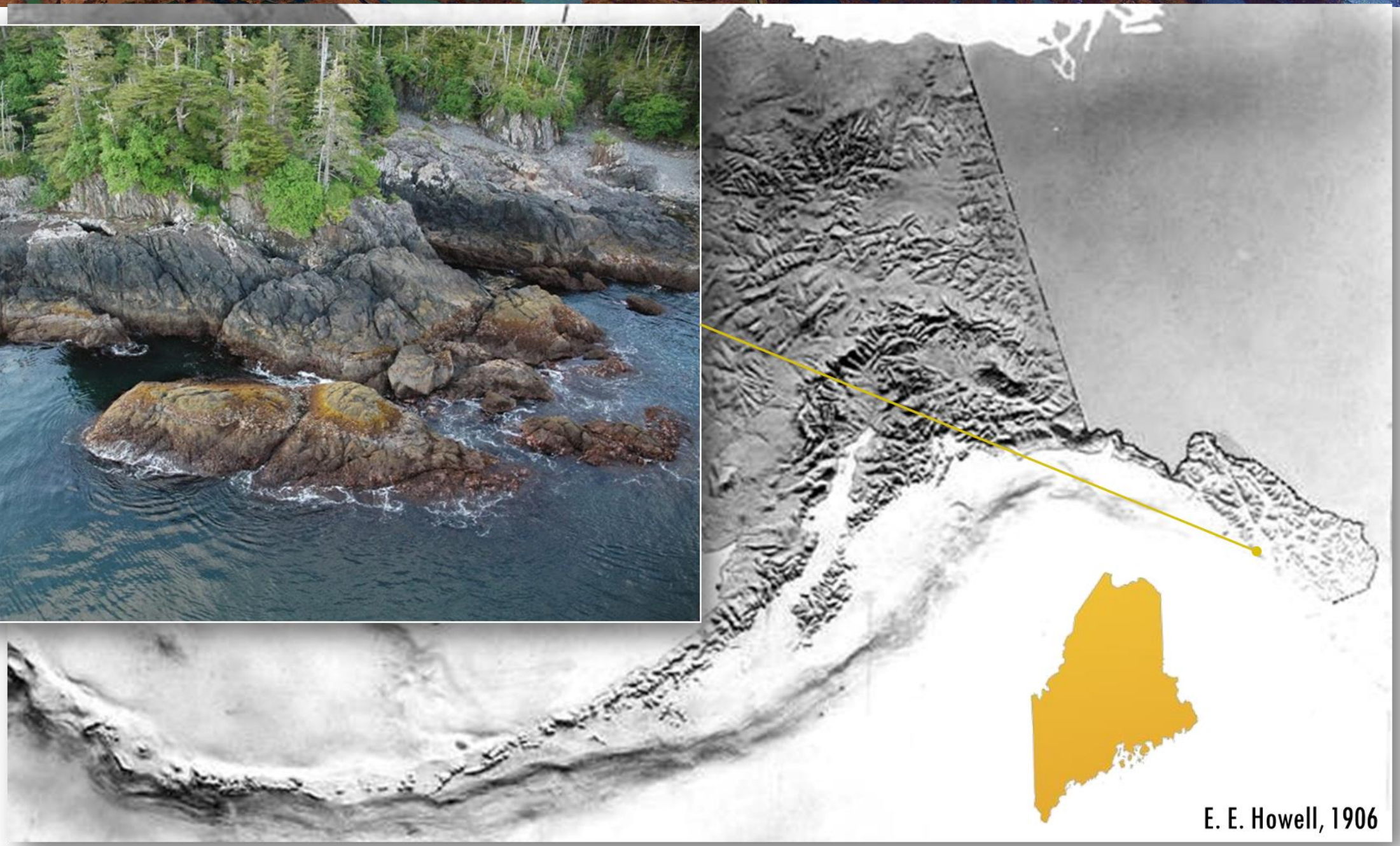
ShoreZone, 2011


E. E. Howell, 1906

ShoreZone, 2009


E. E. Howell, 1906

ShoreZone, 2007


E. E. Howell, 1906

FORMAT

National Coordination Overview

Three Rounds of Lightning Talks

Three Discussion Group Sessions

GOALS

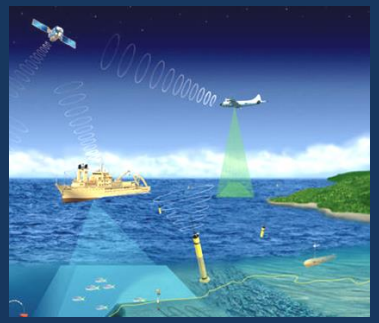
Share Knowledge

Discuss New Ideas

Groundwork for a Tangible Roadmap & Strategy

INTERAGENCY WORKING GROUP ON
Ocean and Coastal Mapping

Alaska Coastal Mapping Summit 2.0



Data Supporting Science
and Sound Decision-Making

Ashley Chappell

February 9, 2018

Alaska Coastal Mapping Summit 2016

June 14, 2016
Girdwood Alaska

- 4 hour inaugural coordination meeting
- Over 75 attendees from over 50 stakeholder entities

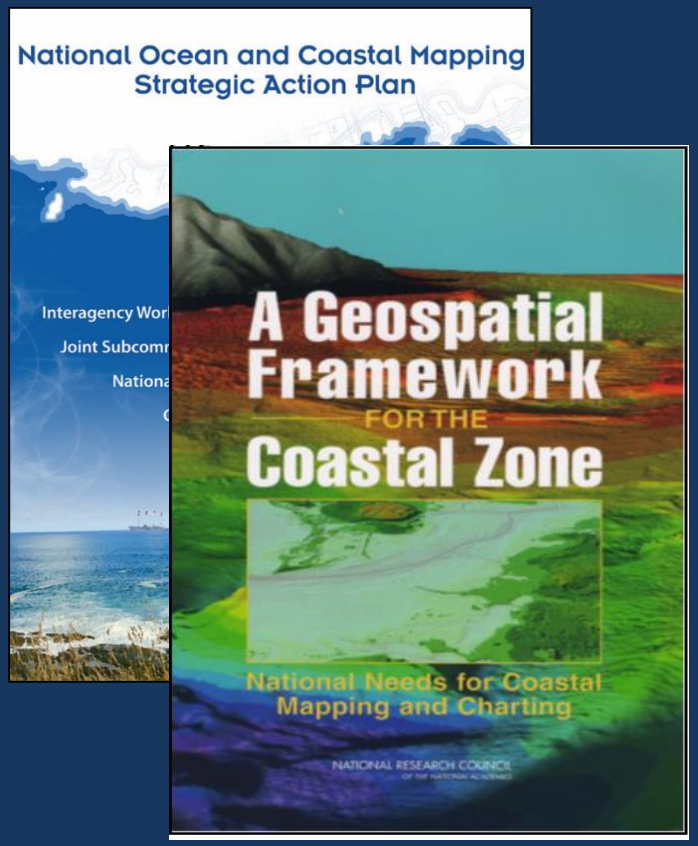
2016 Alaska Coastal Mapping Summit

NOAA
USGS science for a changing world
Western Alaska LCC
National Park Service
National Geospatial-Intelligence Agency
Alaska Department of Natural Resources
Federal Emergency Management Agency
United States Coast Guard
Arctic Domain Awareness Center
NSF
The Nature Conservancy — Protecting nature. Preserving life.
NRCS Natural Resources Conservation Service
NUNA TECHNOLOGIES
Coastal and Ocean Resources — a MER company
U.S. Fish & Wildlife Service
Sea Grant Alaska
State of Alaska — Division of Geological & Geophysical Surveys
quantum SPATIAL
AK Hydro
Michael Baker INTERNATIONAL
JOA Surveys, LLC — At the boundary between land and sea
KODIAK MAPPING
BSEE — Bureau of Safety and Environmental Enforcement
Resource Data Inc. — PEOPLE • TECHNOLOGY • RESULTS
The University of Texas at El Paso
State of Alaska
U.S. ARMY
TERRASOND — PRECISION GEOSPATIAL SOLUTIONS
FishEye Real-Time
Virginia Tech
FAIRBANKS FODAR — If your topography is changing, we can measure it.
Department of Commerce, Community, and Economic Development — State of Alaska
Canadian Hydrographic Service — Service hydrographique du Canada
AECOM
Dewberry
GEONORTH — A Wholly Owned Subsidiary of The Tatitlek Corporation
ASHSC Alaska Seismic Hazards Safety Commission
FUGRO
UAA University of Alaska Anchorage
BOEM — Bureau of Ocean Energy Management
Northern Land Use
UAF University of Alaska Fairbanks
Illinois State Geological Survey — Prairie Research Institute

The Interagency Working Group on Ocean and Coastal Mapping (IWG-OCM)

WHO:

- NOAA
- USGS
- USACE
- NAVO
- BOEM
- NSF
- NGA
- USCG
- EPA
- FEMA
- NASA
- USDA
- *and other appropriate Federal agencies involved in ocean and coastal mapping.*



- **Co-chaired by NOAA, USGS, and USACE**
- **Charged with facilitating "the coordination of ocean and coastal mapping activities and avoid[ing] duplicating mapping activities…"**

Recent Mandates

Ocean and Coastal Mapping Integration Act, 2009:

- Validated NOAA's vision for IOCM
- Provided focus for interagency coordination
- Authorized previously ad-hoc efforts

SOST implementation plans (stemming from NOP)

- Identifies mapping actions to meet OCMIA
- Provides long term road map
- Coordinates across mapping agencies

National Strategy for the Arctic Region

- Identifies charting as an objective
- Coordination role

The term "ocean and coastal mapping" means the acquisition, processing, and management of physical, biological, geological, chemical, and archaeological characteristics and boundaries of ocean and coastal areas, resources, and sea beds through the use of acoustics, satellites, aerial photogrammetry, light and imaging, direct sampling, and other mapping technologies.

What is IOCM?

IOCM is *planning, acquiring, integrating, and managing* ocean and coastal geospatial data and derivative products for easy access and use by the greatest range of users.

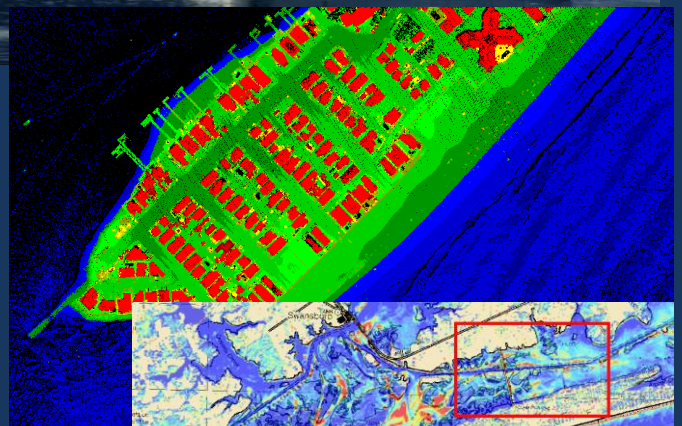
Three primary tasks:

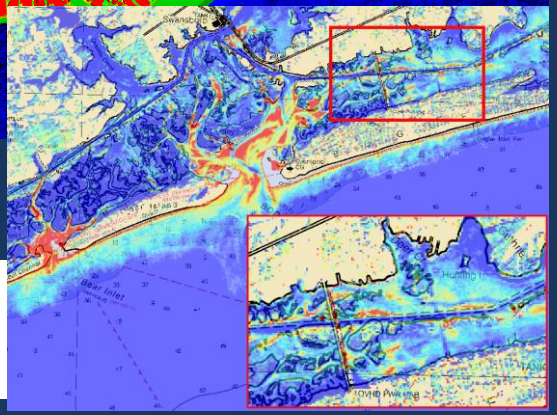
1. Data Acquisition
2. End-to-End Data Management
3. Maximum Use and Re-Use of data

Ocean and Coastal Mapping Integration Act of 2009

Why coordinate & collaborate on Data Acquisition?

- Avoid costly duplication of effort
- Maximize survey time
- Meet science & mission requirements
- R&D on technology, techniques





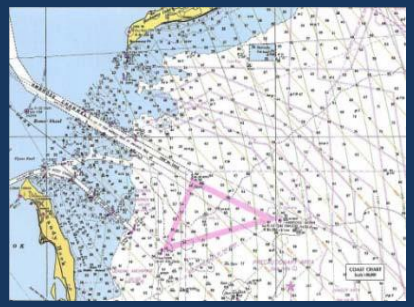
IOCM:

- Identifies mapped areas
- Improves planning
- Enables cross-agency collaboration

NOAA INTEGRATED OCEAN AND COASTAL MAPPING (IOCM)
UNITED STATES DEPARTMENT OF COMMERCE

Why manage data?

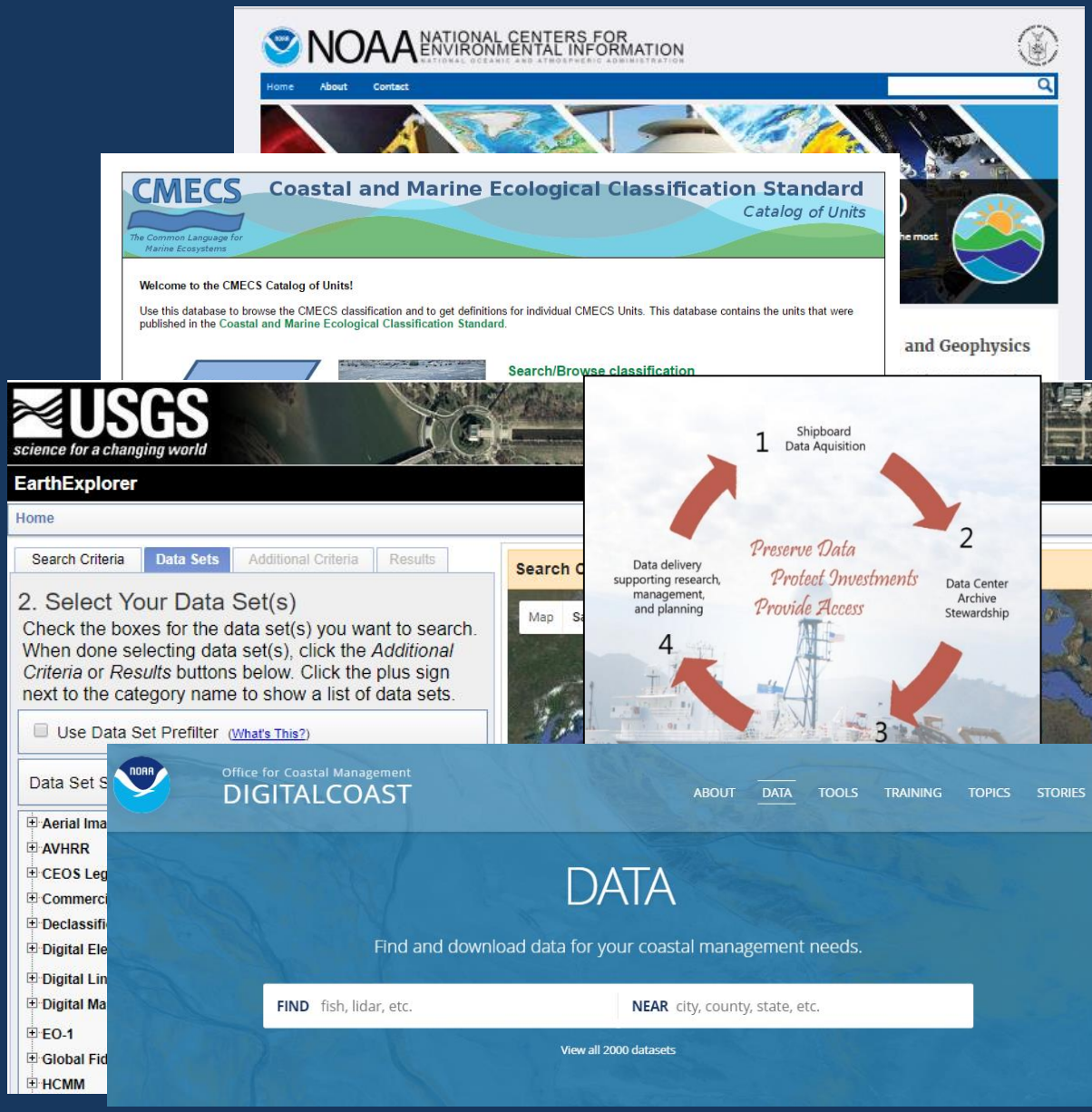
- Enable Agency missions requiring scientific data
- Maximize use of data for multiple purposes
- Avoid costly data loss



- IOCM:
  - Ensures data collected are available for use
  - Processes data for multiple uses
  - Delivers bang for the buck

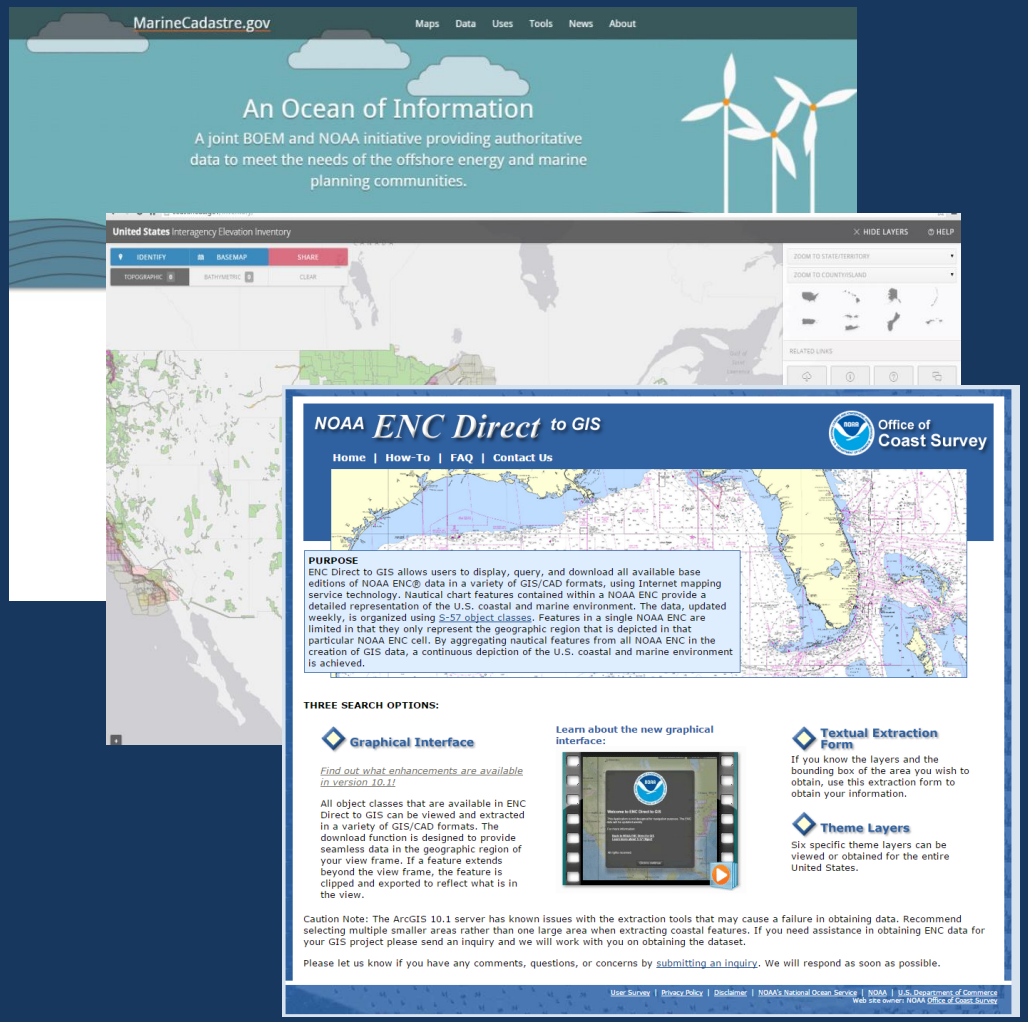
Data Stewardship, Access

- National Centers for Environmental Information
- Digital Coast
- Earth Explorer
- Rolling Deck to Repository
- Coastal and Marine Ecological Classification Standard
- Crowd-sourced Bathymetric Database



Why re-use data?

- Scientifically sound decisions require data
- Data expensive to collect
- Scientific data management is cost-effective
  - 3-month study, 2000% return on investment
- IOCM:
  - Ensures data are available
  - Enables use/re-use of data
  - Supports scientific and management missions



NOAA INTEGRATED OCEAN AND COASTAL MAPPING (IOCM)
UNITED STATES DEPARTMENT OF COMMERCE

"Map Once, Use Many Times"

National Coastal Mapping Strategy 1.0

Coastal Lidar Elevation for a 3D Nation

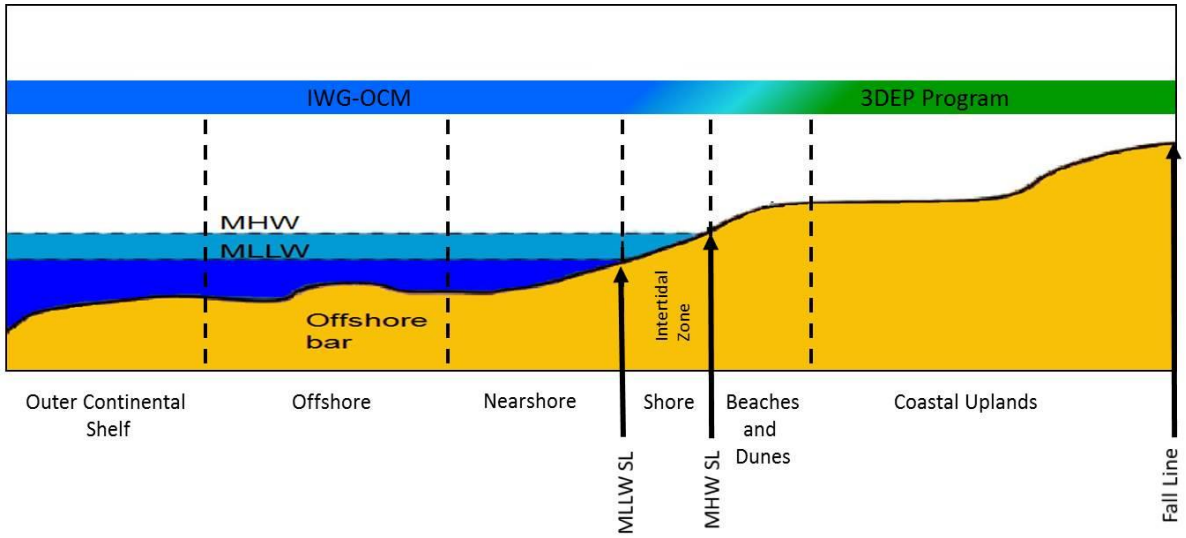
Components:

Regional Coastal Mapping Summits for coordination

Common standards – Bathy Quality Levels aka 3DEP topo QL's

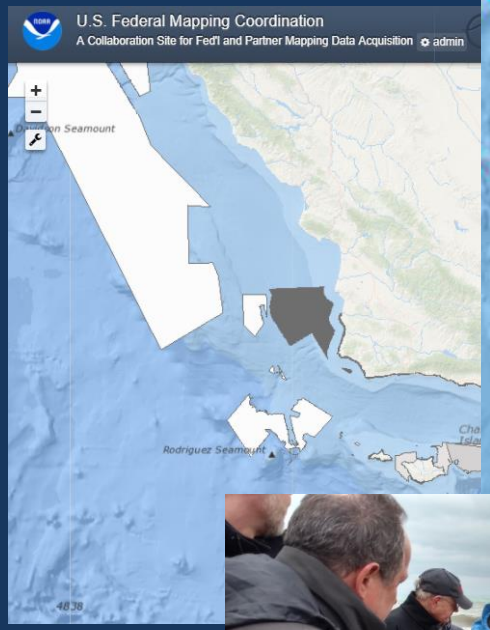
Whole life cycle approach to data

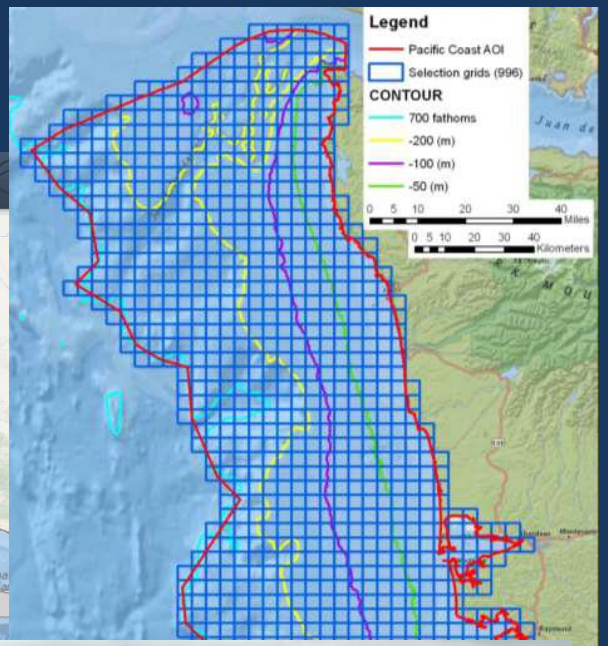
R&D on new tools/techniques for data collection and use.



Regional/State Summits

JALBTCX meetings -- national (Mobile 2014, Corvallis 2015)
California 2014
Washington 2014, 2016, *2018*
Northeast 2015, 2016, *2018*
Alaska 2016, 2018
Great Lakes 2017
Southeast 2016, *2018*
Florida 2018
Gulf *2018*





Florida Coastal Mapping Program

Vision

Accessible, high resolution seafloor data of Florida's coastal waters to support infrastructure, benthic habitat mapping, restoration projects, resource management, emergency response, and coastal resiliency and hazard studies for the citizens of Florida.

Mission

Coordinate across Federal and FL State agencies, academics, NGOs, and other stakeholders to evaluate the state and quality of existing data, establish and implement a prioritization for new data collection, and develop and implement a strategy to create a seamless, modern, high resolution topo-bathymetric map for Florida's coastal waters from the shoreline to 200m water depth within 10 years.

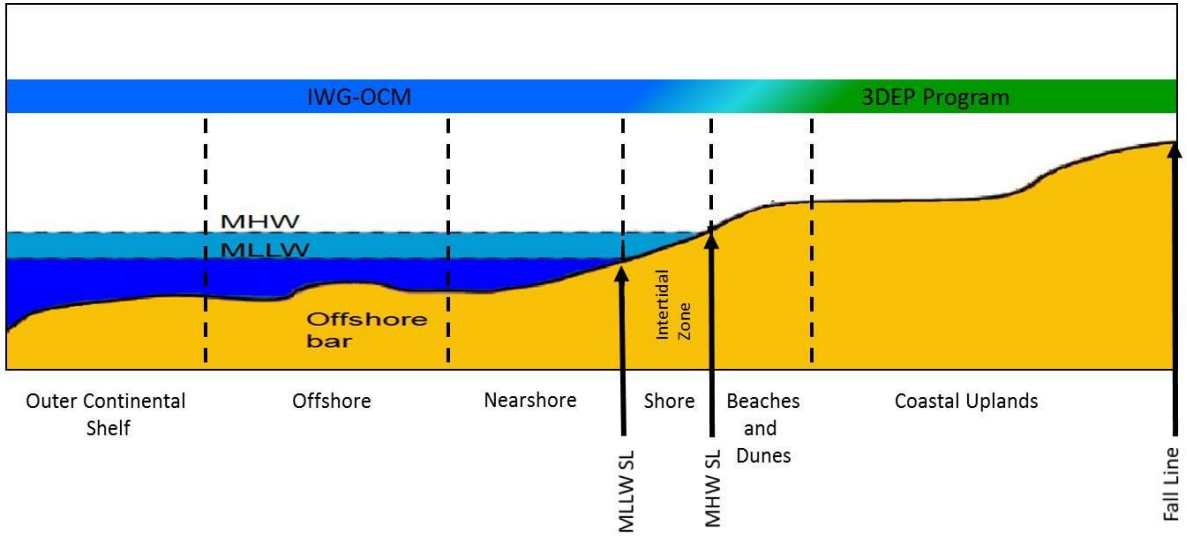
COORDINATOR

National Coastal Mapping Strategy 1.0

Coastal Lidar Elevation for a 3D Nation

Components:

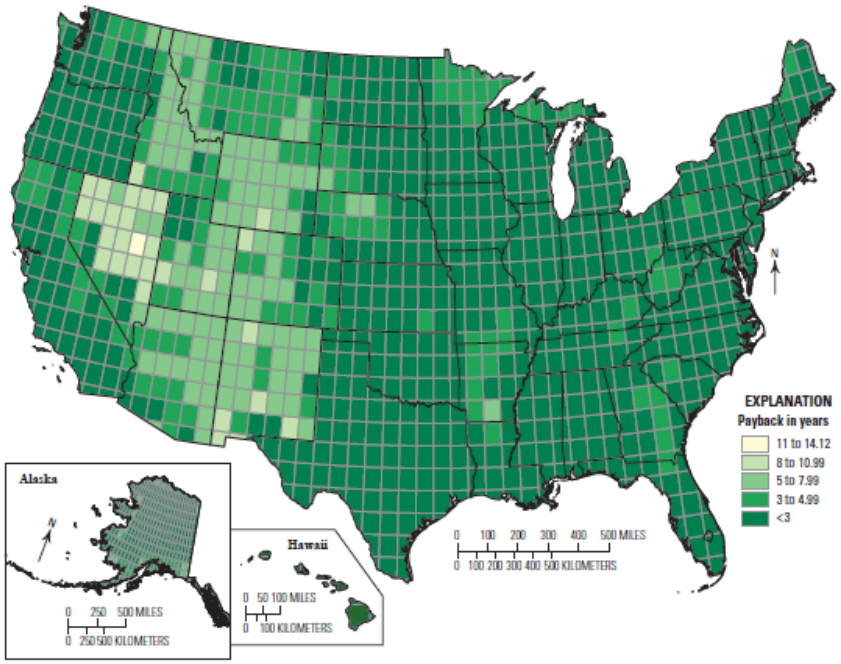
Regional Coastal Mapping Summits for coordination
Common standards – Bathy Quality Levels aka 3DEP topo QL's
Whole life cycle approach to data
R&D on new tools/techniques for data collection and use.



3D Nation?
Refresh cycle?
ROI?
NEEA-like study?

National Enhanced Elevation Assessment (NEEA)

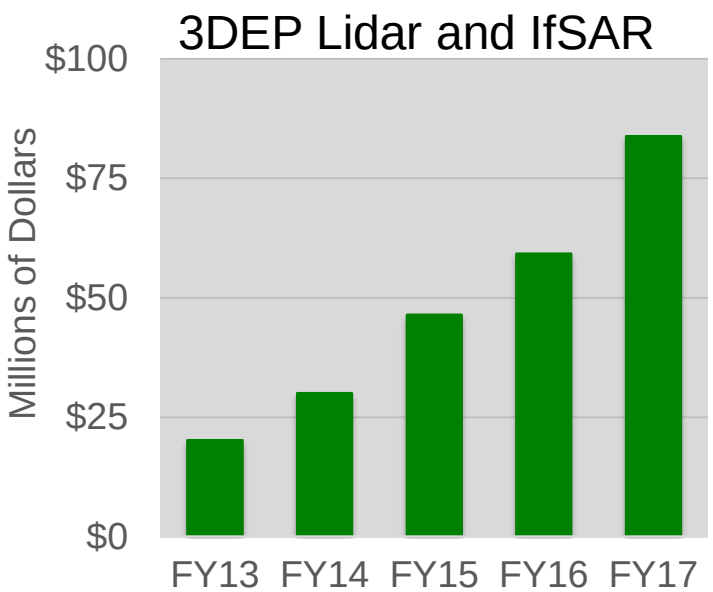
A comprehensive inventory of user requirements and benefits for elevation data



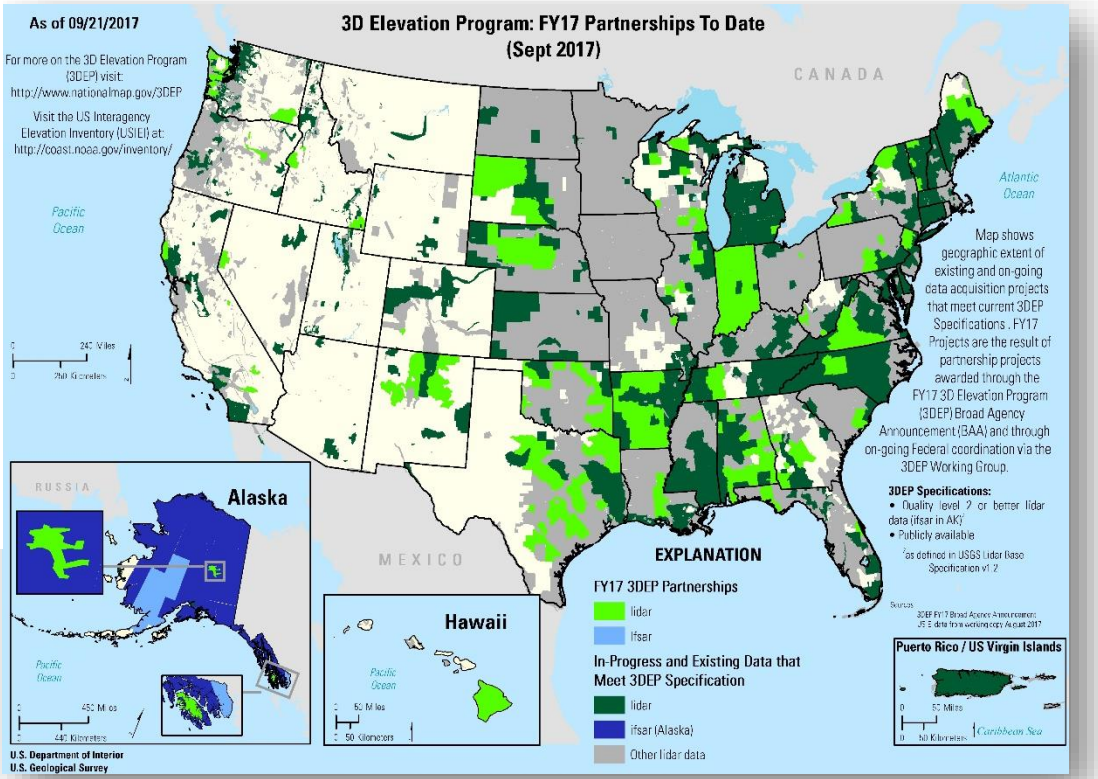
- Conducted in 2010 – 2012
- Data collection
  - 34 Federal Agencies
  - 50 States
  - Local Government, tribal, private, not-for-profits
- Results
  - 602 Mission critical activities that need significantly better data than are currently available
  - Between $1.2 billion and $13 billion in benefits annually
  - Increases in President's budget in FY14-17
  - http://nationalmap.gov/3dep

3DEP Growth - Partnerships To Date

Strong coordination and increasing investments (FY13-17)



Map shows lidar from FY13 – FY17



- Between FY13 and F17, 3DEP data (lidar and IfSAR) have been contracted for 37% of the entire US
- Alaska IfSAR – 92% of state available or in work to date in FY17

In FY17, 3DEP data have been contracted for 11.4% of the Nation

Updating User Requirements and Benefits for 3DEP

- Be able to assess new technologies against user requirements and identify the tradeoffs between different approaches
- Plan for the next round of 3DEP after nationwide coverage has been completed
- Improve our understanding and data about requirements and benefits at the state level for the existing and future program
- Improve our understanding of needs to guide development of the next generation of 3DEP Products and Services

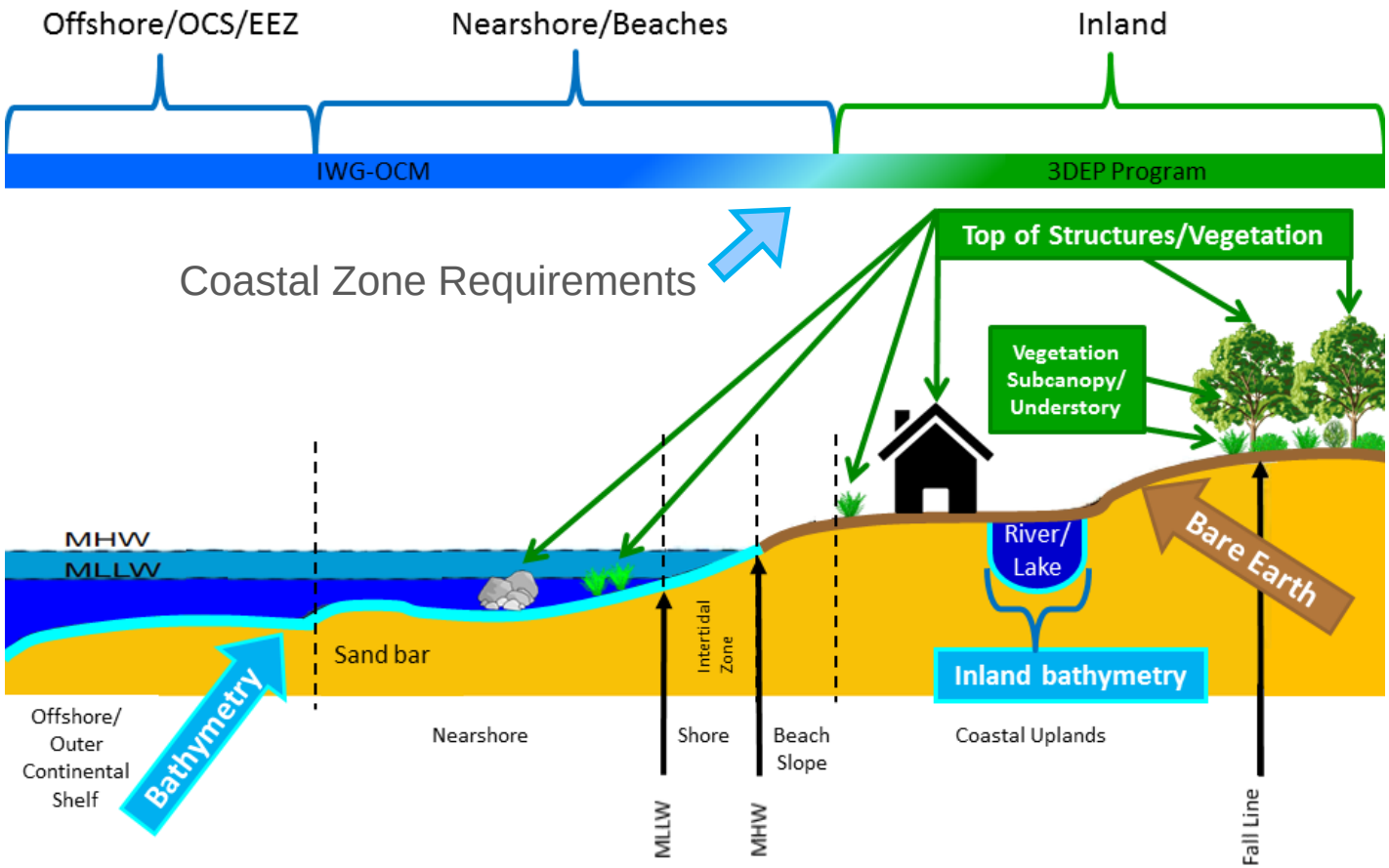
Mapping a 3D Nation: Requirements and Benefits Study Goals

Understand 3D Data Requirements

- Refresh NEEA for the years beyond the initial 8-year acquisition program
- Understand inland, nearshore, and offshore bathymetric data requirements and benefits
- Understand how requirements and benefits dovetail in the coastal zone
- Sensor agnostic/Technology Neutral
  - Focused on need for, and value of, elevation data

3D Nation Study Context

Inland, Nearshore, Offshore and Topo, Bathy, Topo/Bathy



Technology Neutral Approach

Study Phases Timeline

Information Gathering Phase → Follow on Study Tasks

Study Preparation
(7 months)

- Study Design
- Questionnaire Development
- OMB Approval

9/2017 – 3/2018

Initial Data Collection
(6 months)

- Identify Fed POCs/ State Champions
- Questionnaire Open
- Summary Reports for Interviews

1/2018 – 6/2018

Data Validation
(6 months)

- Conduct Interviews
- Validate Interview Results (Reports & Geodatabase)

7/2018 – 12/2018

Aggregate/ Report
(3 months)

- Aggregate Benefits by Business Use
- Final Report & Geodatabase

1/2019 – 3/2019

Analysis/ Development
(6 months)

- Develop Program Scenarios
- Analyze Benefit/Cost and ROI
- Determine Program Direction

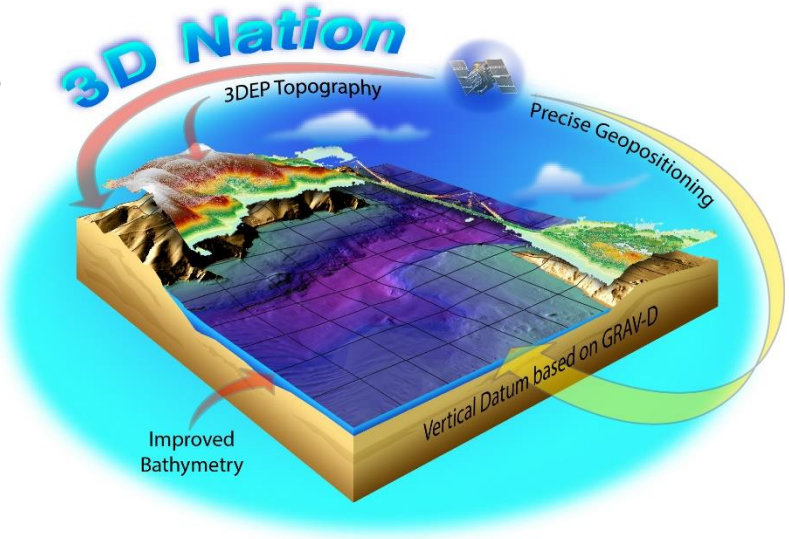
4/2019 – 9/2019

2017 — 2018 — 2019

3D Nation Stakeholders

Federal, State, Local, Non-Profit, Private, & Academia

- Federal departments and agencies
- Federal commissions or committees
- 50 states plus D.C. and territories
- Local, regional, and Tribal stakeholders
- Non-profits
- Private/commercial
- Academia



USGS science for a changing world | The National Map Your Source for Topographic Information | Dewberry | Interagency Working Group on Ocean and Coastal Mapping | NOAA

State Agency Participant Types

- Archaeology/cultural heritage
- Biological survey
- Coastal resource management/Coastal zone management
- Economic and community development
- Emergency management
- Energy
- Environmental protection/management
- Fisheries management/aquaculture
- Forestry/rangeland management
- Geology
- GIS
- Habitat management
- Mining
- Natural resources/conservation
- Oil and gas
- Permitting/planning
- Recreation
- Regulatory
- State university
- Transportation
- Water management/resources
- Water quality
- Wildlife management

State Champions will help identify participants

Local and Regional Participant Types

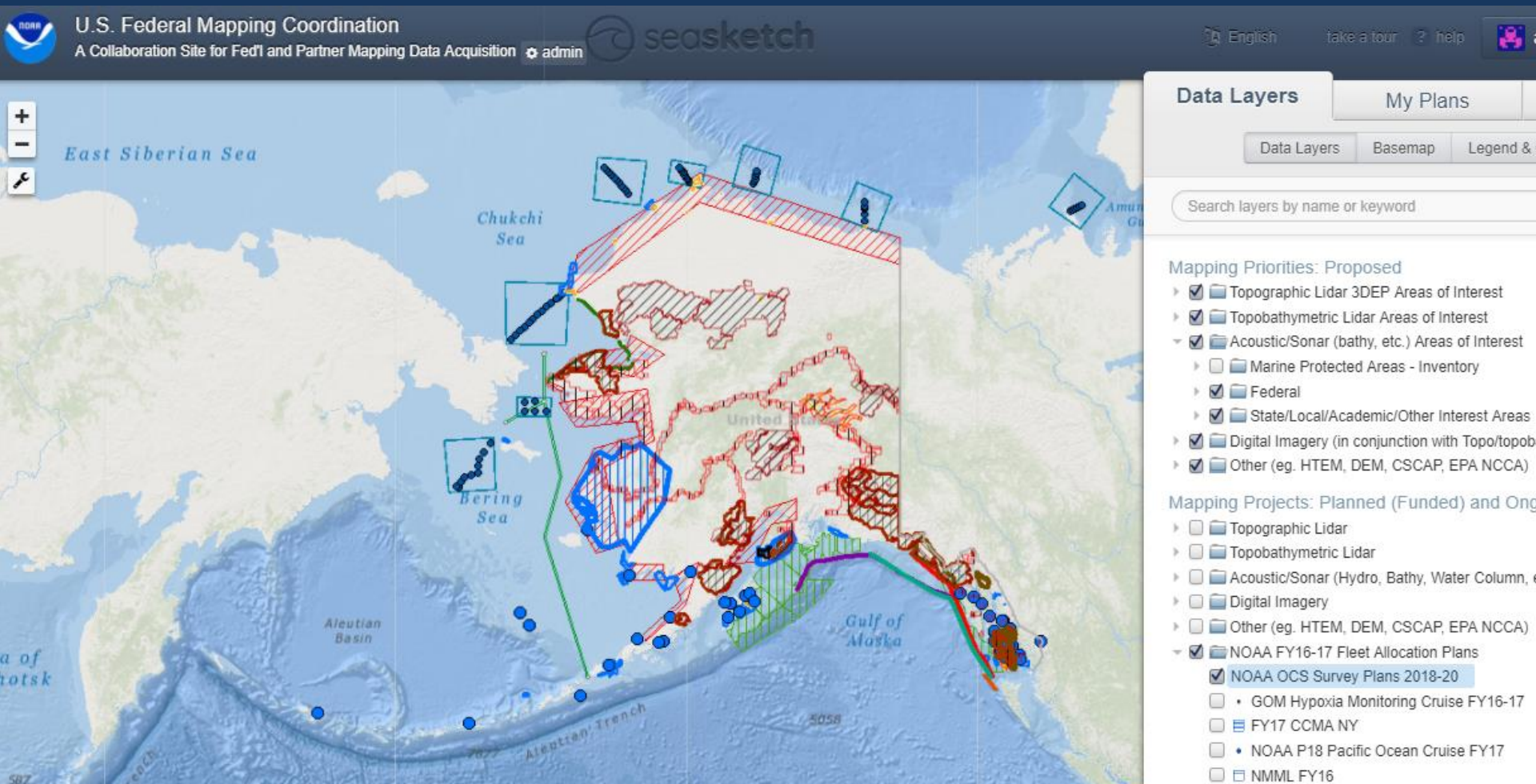
- Tribal entities
- Local government agencies
- Integrated Ocean Observing System (IOOS) regional associations
- Metropolitan and/or regional councils/districts
- Port authorities
- Regional commissions or councils
- Scientific and research organizations
- Non-profits

What We Need Your Help With

- Take the survey
- Get the word out to your colleagues and associates
- Identify study participants and their contact information
- Help with questionnaire – invitations and follow ups with non-respondents if needed
- Participate in follow up interviews/workshops
- Help gain consensus on responses
- Review and sign off on validated responses

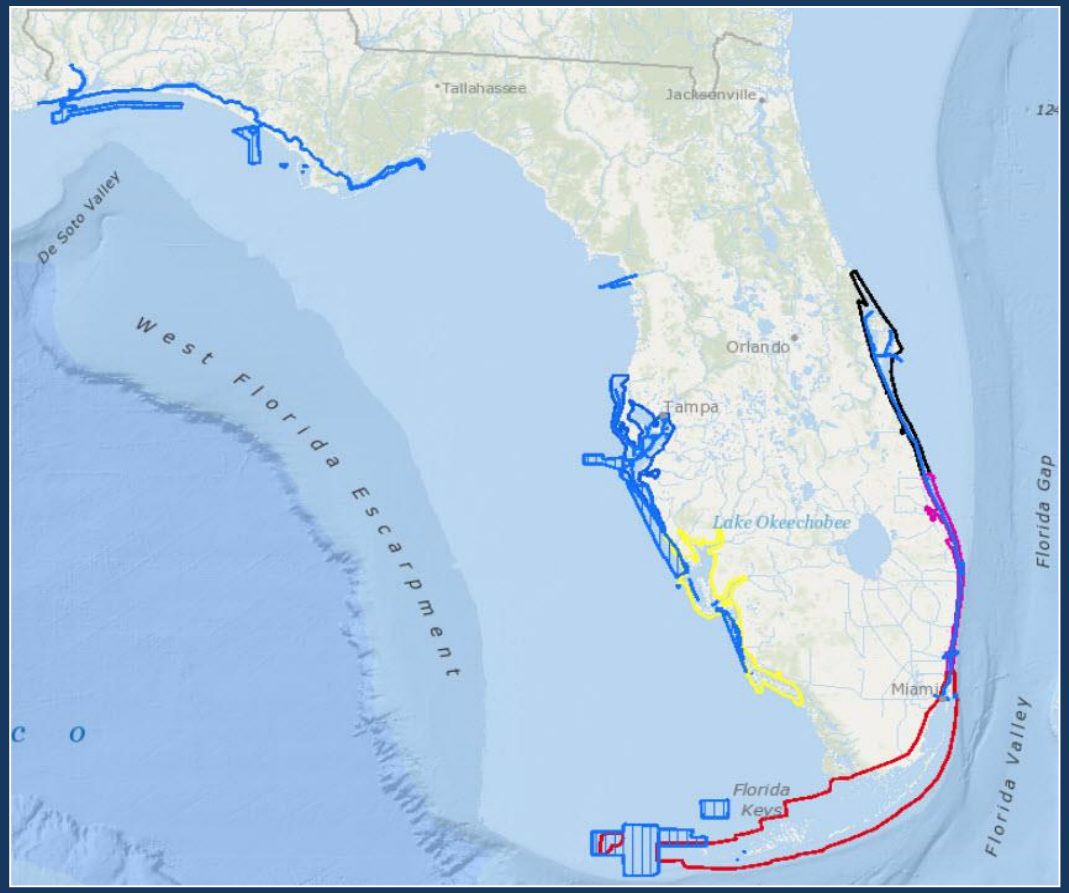
U.S. Federal Mapping Coordination Site

- IWG-OCM and 3DEP agencies are using Seasketch tool to share info on acquisition plans, data needs, coordination
- Additional tools available for use – forums, sketching



Hurricane Season 2017
Hurricane Supplemental Funding Request-- *Pending*

- NOAA Hurricane Supplemental Funding Request pending approval through Congress
  - $20M Pres Request
  - $40M House Mark
- Outlined/highlighted areas in graphic represent impacted areas from Hurricane Irma and interagency priorities for mapping
- Collaborative effort involving NOAA's OCS, NGS, CO-OPS, IOOS and other partner agencies and stakeholders
- Coordinated recovery mapping effort that brings the full suite of NOAA navigation, observation and positioning capabilities to impacted areas



SEABED 2030

Seabed 2030 is a global initiative led by the General Bathymetric Chart of Oceans (GEBCO) Guiding Committee and The Nippon Foundation with the aim to facilitate *the complete mapping of the ocean floor by the year 2030*.

GEBCO

UNESCO
United Nations Educational, Scientific and Cultural Organization

Intergovernmental Oceanographic Commission

THE NIPPON FOUNDATION

TARGET RESOLUTIONS

Depth range	Grid-cell size	% of World Ocean
0-1500 m	100 x 100 m	13.7
1500-3000 m	200 x 200 m	11
3000-5750 m	400 x 400 m	72.6
5750-11000 m	800 x 800 m	2.7

Feasible resolution based on state-of-the-art 2 deg x2 deg deep water multibeam installed in surface vessels, calculated at 60 degree from nadir

Bathymetric Gap Analysis

HOW CAN YOU CONTRIBUTE

U.S. Mapping Agencies and Partners will be KEY:

- U.S. is responsible for U.S. waters – EEZ, shelf
- U.S. leadership recognized: Will continue mapping international unknown ocean to explore & discover
- 24 govt/research institutions, universities, businesses already participating, and this number is growing
- First big step – Discovery, sharing of existing data to fill gaps
  - Anything not already at NCEI or other accessible site
  - Agency, partner, stakeholder data with good metadata
- Agreement on, and use of, common standards
- Sharing of plans at FEDMAP and collaborative mapping campaigns to fill more gaps
- IHO Crowdsourced Bathymetry initiative

Alaska Mapping Executive Committee

Updated AMEC Charter:

New AMEC charter runs 2018 through 2022

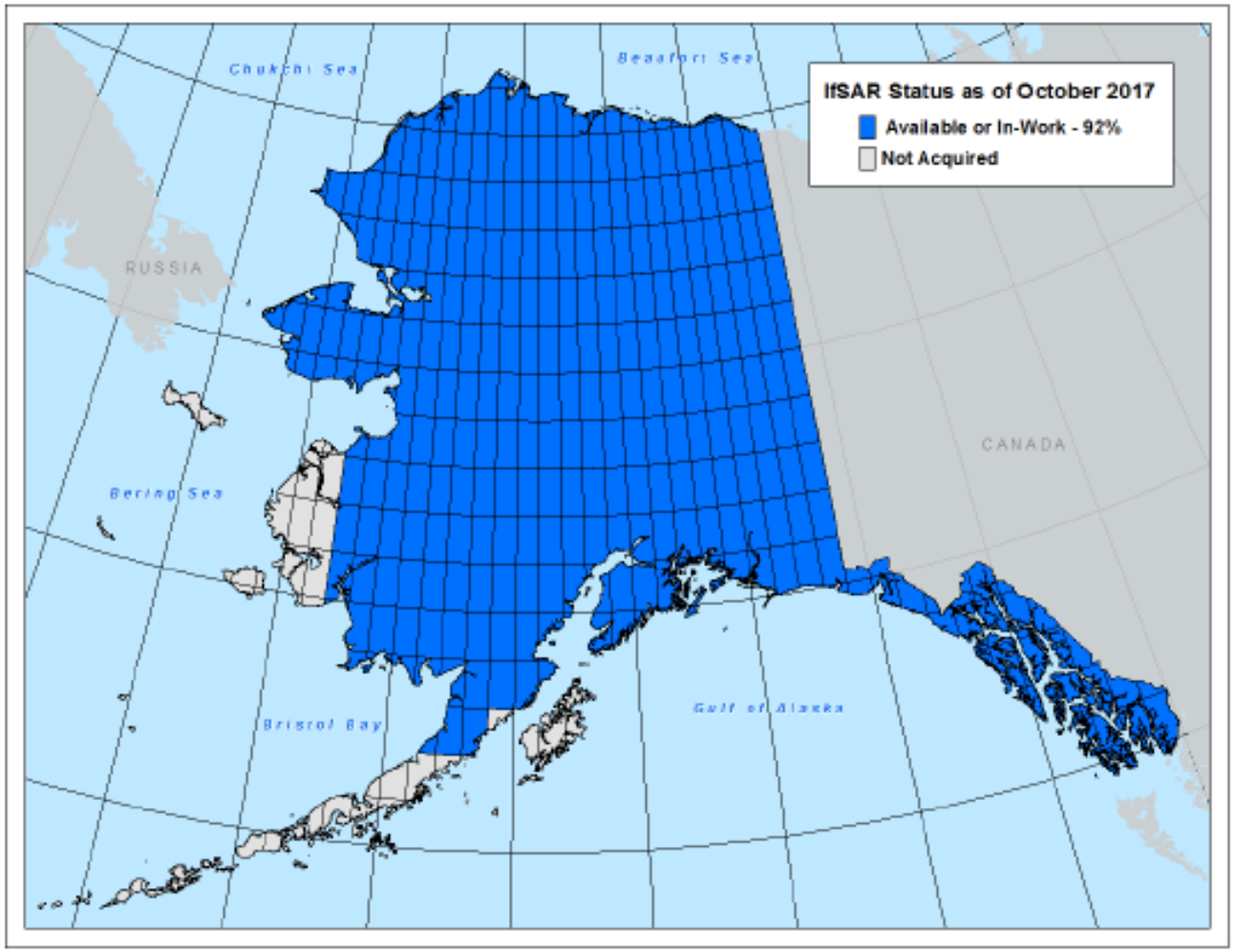
Language expanded to note additional Alaska mapping requirements that AMEC can consider in the future:

- imagery
- bathymetric mapping
- targeted lidar acquisitions
- continued improvements to hydrography
- geologic mapping
- geophysical surveys
- land classification

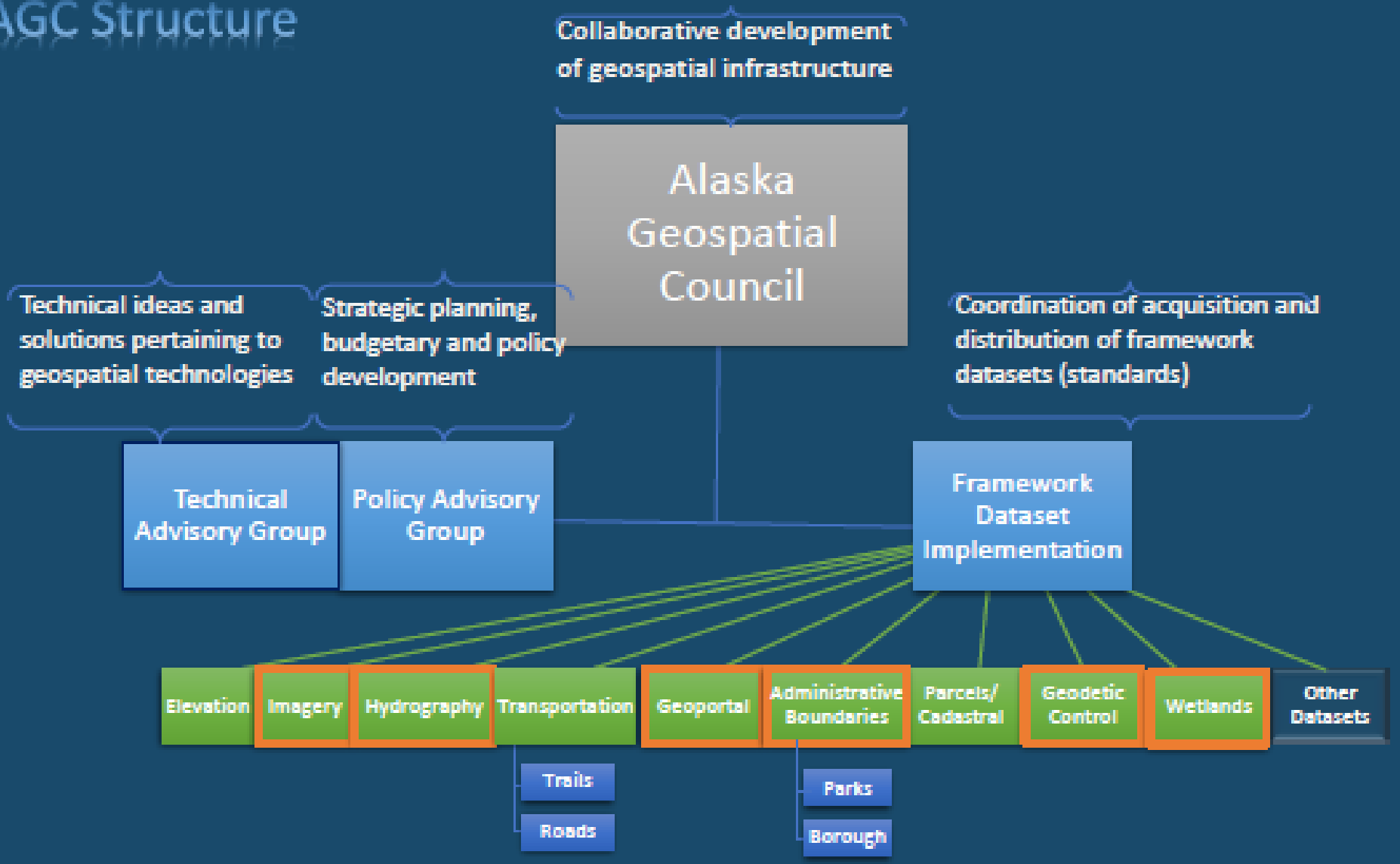
Theme	Metric	2013 Goal	October 2017 Status
Elevation	% IFSAR acquired	Complete in 4 years	92% statewide coverage achieved
Hydrography	% NHD updated	Complete in 6 years	20% updated
Transportation	% of State completed and publicly available	Complete in 5 years	Baseline AK DOT roads dataset 100% complete; ongoing maintenance
GRAV-D	% GRAV-D acquired	Complete in 2019	78.4%
Coastal Mapping	% AK shoreline updated	Complete in 5 years with budget increase, longer term if no budget increase	48.5%

Alaska IfSAR Status EOY FY2017

- 15% Statewide coverage acquired in FY2017
- 92% of the State Available or In-Work at end of FY2017



AGC Structure



Working Groups: develop strategic plans and implementation plans for data acquisition, maintenance and distribution, set data standards, and define data models. Additional working groups and subgroups can be deployed as needed. Orange border indicates groups with approved charters.

TODAY – Set Some Goals for Alaska Coastal Mapping

- 2016 Alaska Coastal Mapping Summit
- Strategist position jointly funded by State of Alaska and NOAA – Marta Kumle
- 2nd Alaska Coastal Mapping Summit (Feb 9, 2018)
- Alaska Coastal Mapping Roadmap, Strategy, Prioritization, Standards, Leveraging -- ACTION

Questions?

Ashley.Chappell@noaa.gov
240.429.0293

Alaska Geospatial Council

2018 Alaska Coastal Mapping Summit

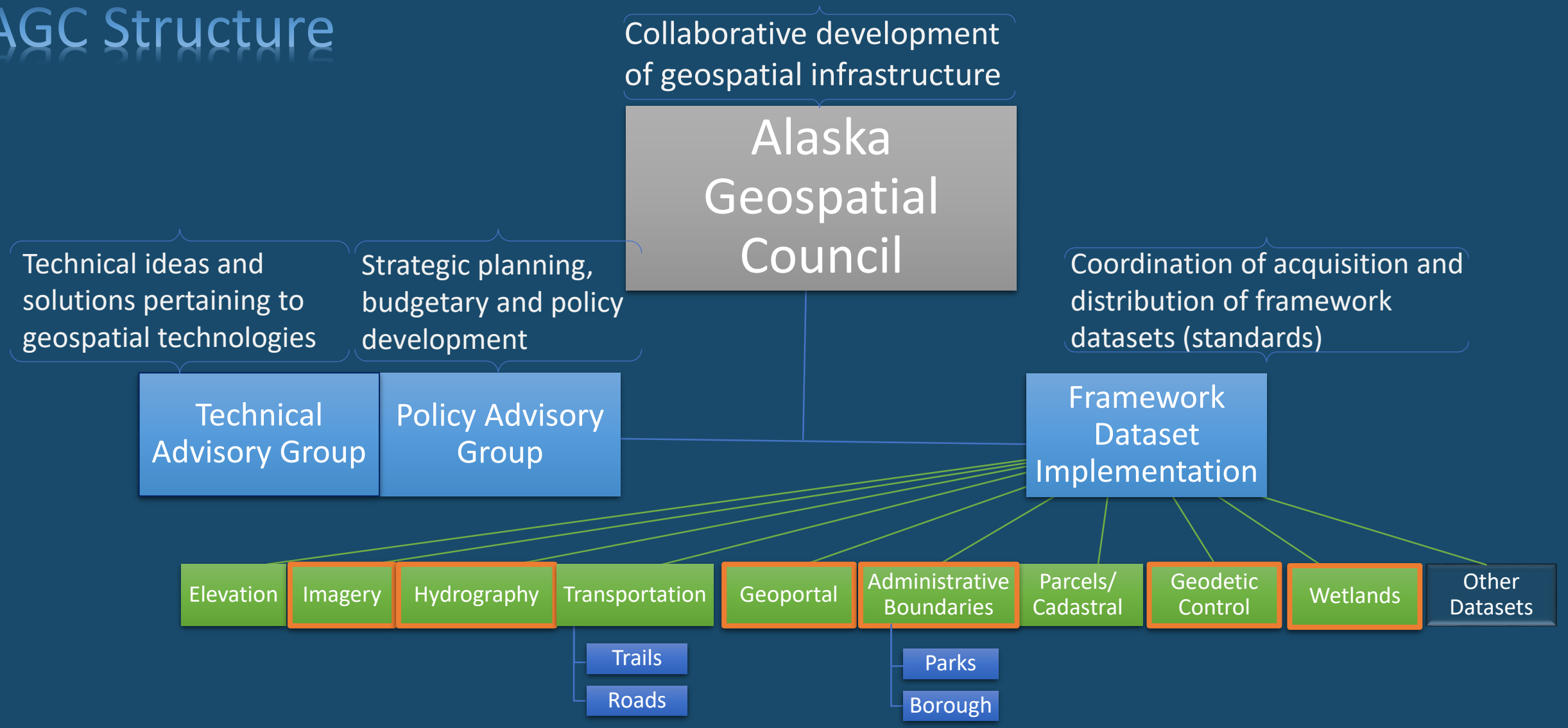
February 9, 2018

Ken Woods, System Administrator, SOA/DNR/DGGS

AGC Members and Technical Representatives

Agency	Delegate/Alternate	Technical Advisor(s)
Alaska Dept. of Natural Resources	Steve Masterman, State Geologist	Anne Johnson
Alaska Dept. of Transportation and Public Facilities	Commissioner Marc Luiken	Gerry Remsberg
Dept. of Military and Veteran's Affairs	Commissioner Brig. Gen. Laurel Hummel; Mike O'Hare alternate	Dave Caplan
Dept. of Fish & Game	Commissioner Sam Cotton; David Rogers alternate	Jason Graham
Dept. of Commerce, Community & Economic Development	Commissioner Chris Hladick; Fred Parady alternate	George Plumley
Dept. of Environmental Conservation	Commissioner Larry Hartig; Alice Edwards alternate	Jason Seifert
University of Alaska Geophysical Institute	Director Robert McCoy	Lisa Wirth
USGS	Steve Wackowski, Alaska DOI liaison	Brian Wright
NOAA	Amy Homan	Nicole Kinsman
USDA-NRCS	Bob Jones	Sydney Thielke
ANCSA Regional Association	Mischa Ellanna	
Alaska Municipal League	Eric Wyatt	Matt Rykazewski

AGC Structure



Working Groups: develop strategic plans and implementation plans for data acquisition, maintenance and distribution, set data standards, and define data models. Additional working groups and subgroups can be deployed as needed. Orange border indicates groups with approved charters.

2017 Accomplishments

- Active, chartered technical working groups identifying existing data and authoritative data sources for framework themes
- Coastal Strategist position NOAA/DNR/AOOS jointly funded (and filled!) for 2018
- Data Distribution & Access
  - Elevation

    http://elevation.alaska.gov 259.71GB downloaded per day. **94.794TB total**
    539,425 square miles of ifsar, lidar, and SfM data available for download via map interface
  - AK hydro

    State hydrography layer used to inform the National Hydrographic Dataset with high-resolution updates hosted at AK DNR
  - Imagery

    14M data requests from 1,487 unique users for the first 6 months of service starting in April 2017--Demand is growing exponentially

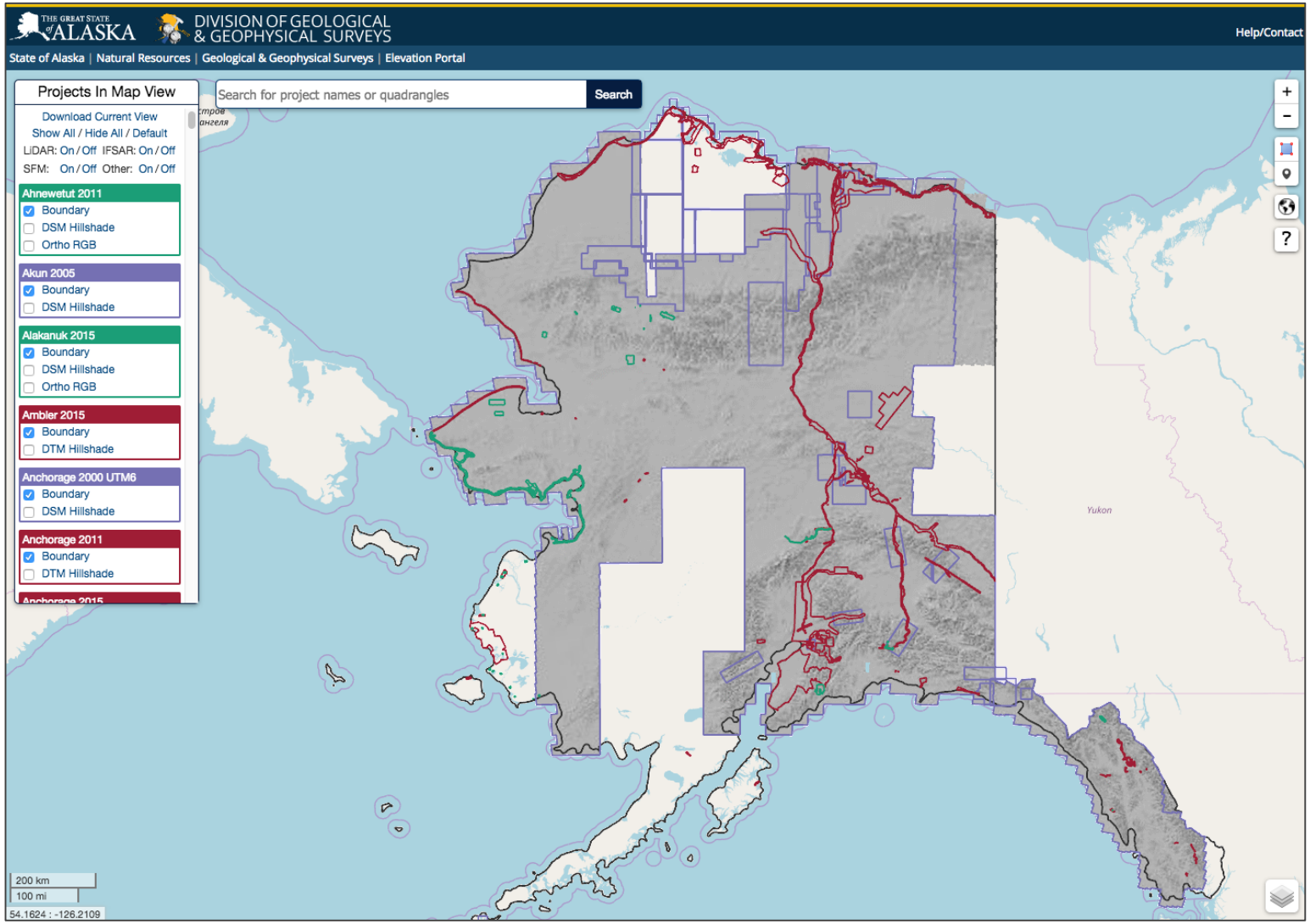
1. Elevation

~92%

(funded)

Chris Noyles, BLM

Ken Woods, DNR/DGGS



http://elevation.alaska.gov

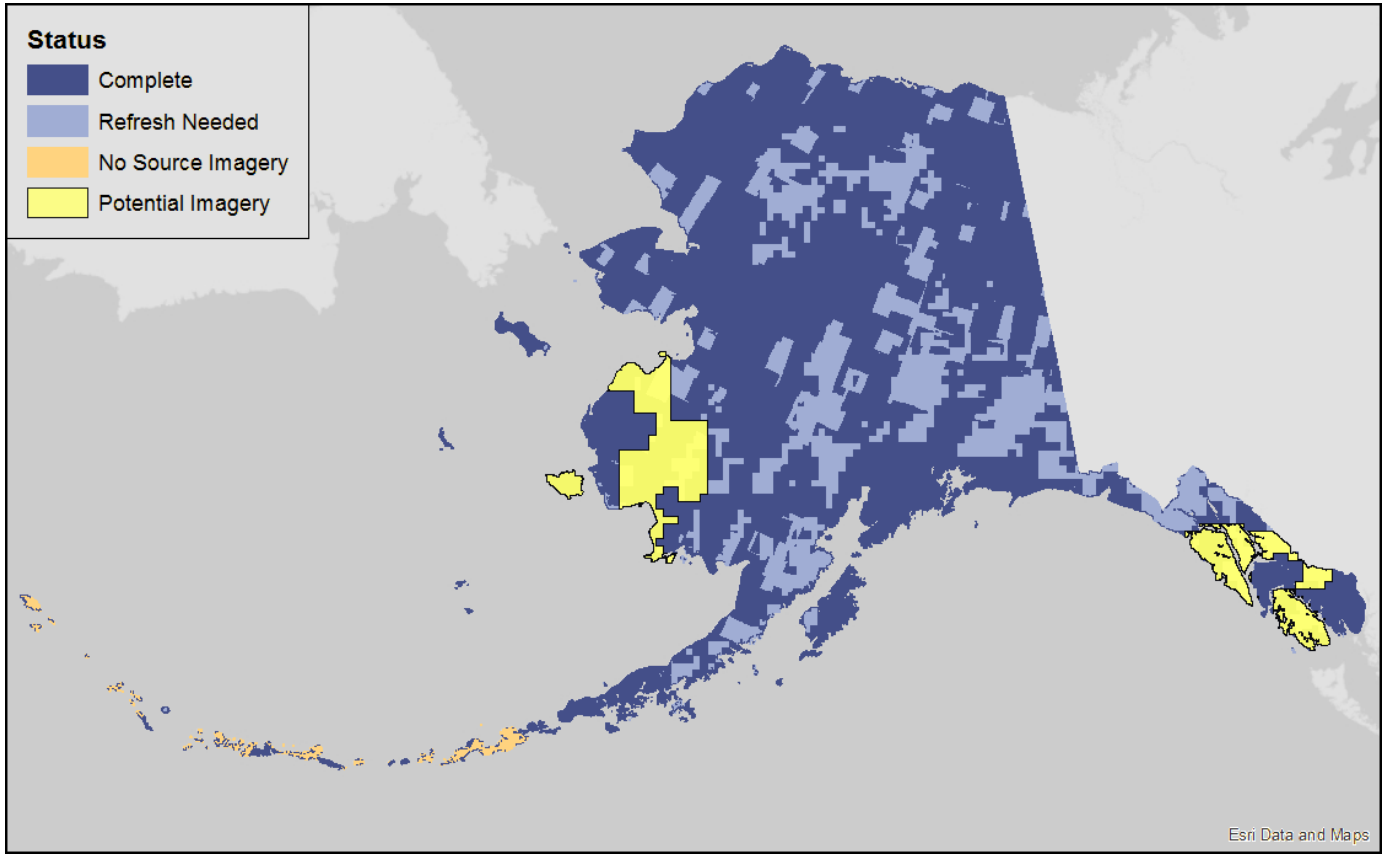
2. Imagery

72%

Sydney Thielke, USDA-NRCS

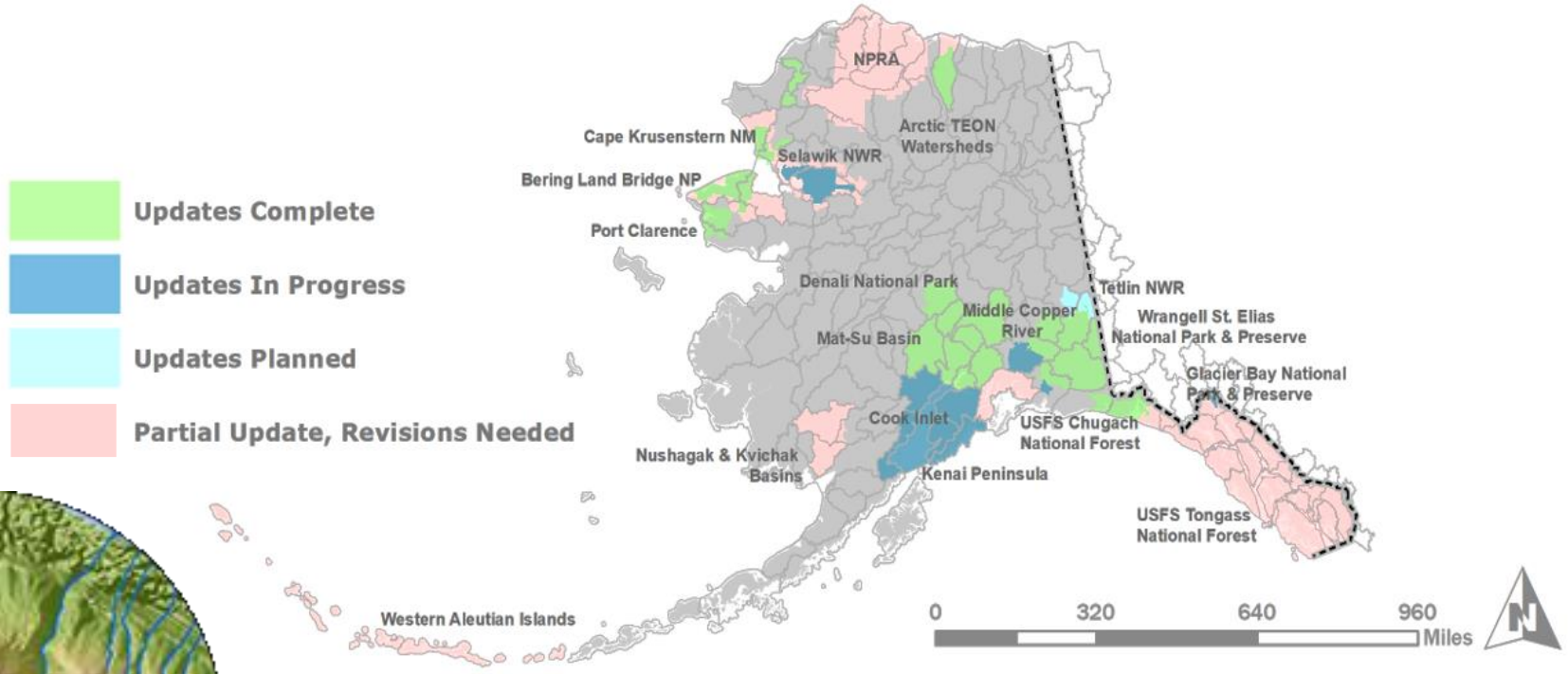
Parker Martyn, NPS

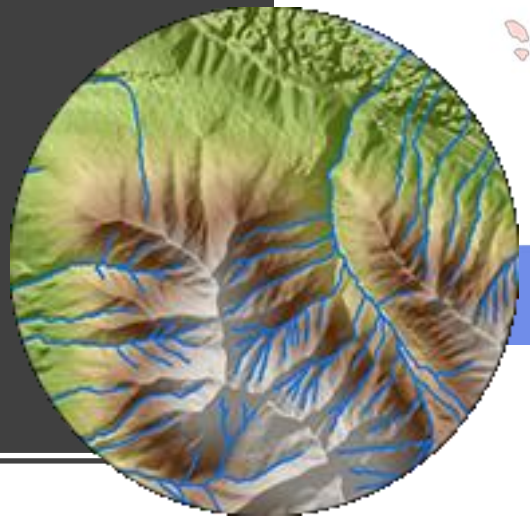
Dayne Broderson, UA



3. Hydrography

22%





4. Wetlands

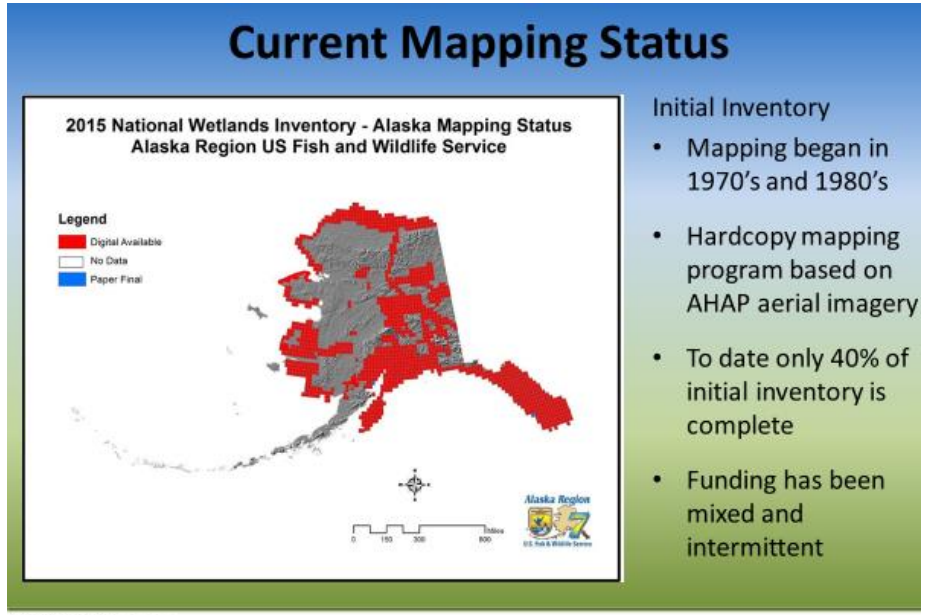
5%

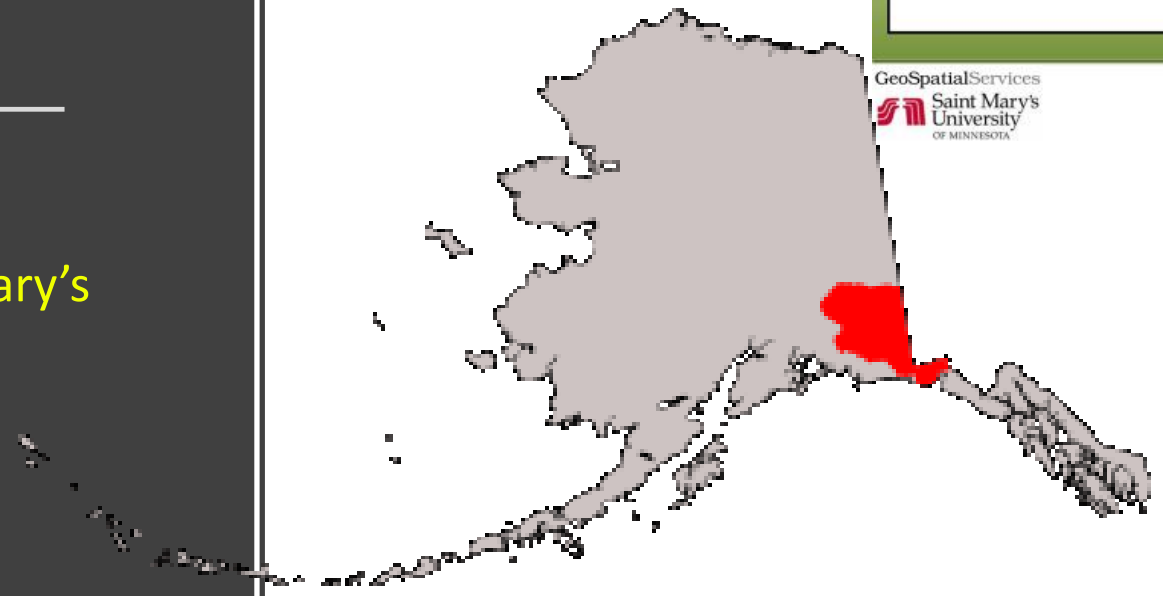
Jason Seifert, DEC

Andy Robertson, St. Mary's University

Inventory of existing data: 40% complete

High-resolution updates complete for Wrangell-St. Elias National Park



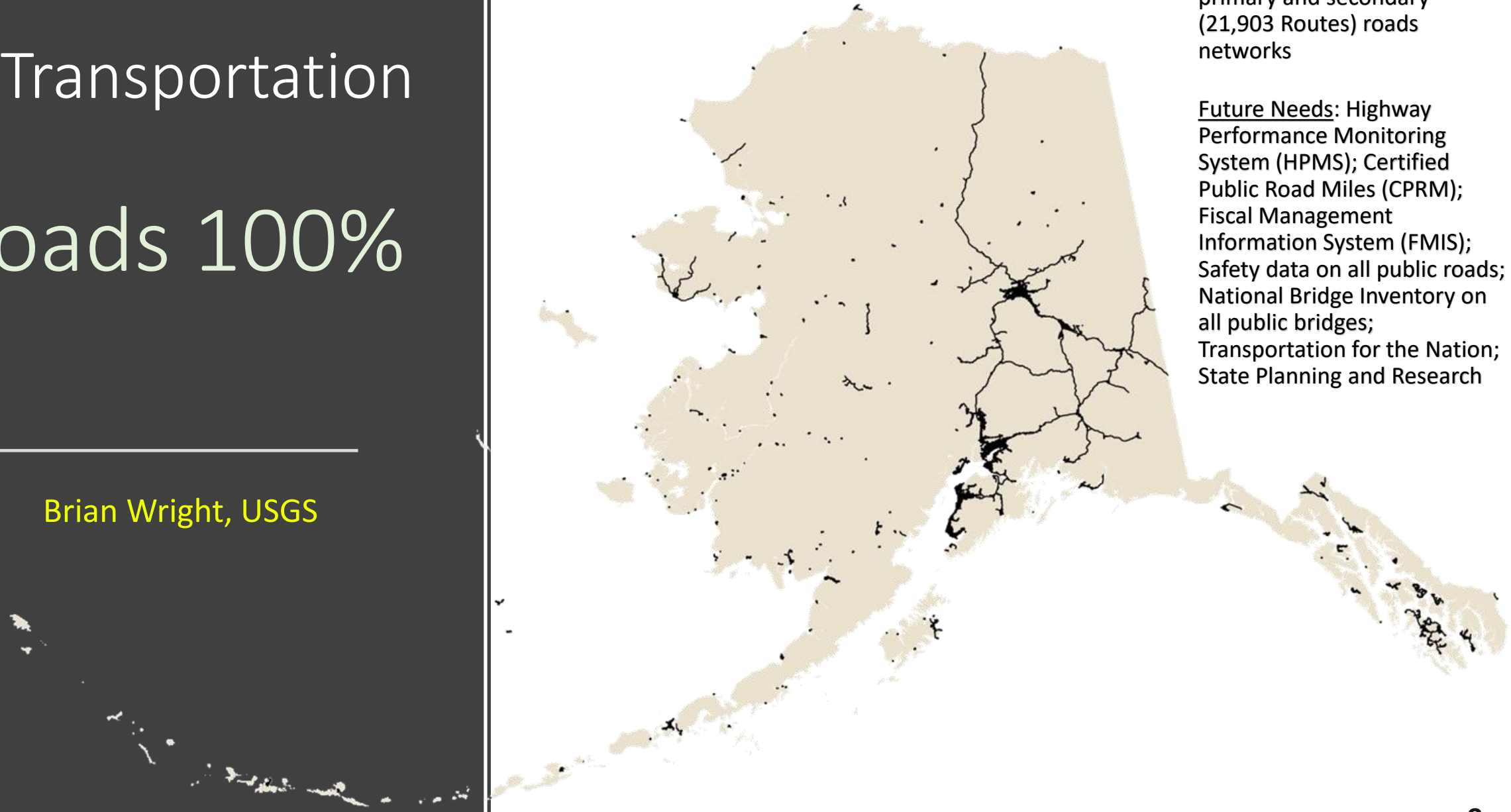


GeoSpatialServices
Saint Mary's University OF MINNESOTA

5. Transportation

Roads 100%

Brian Wright, USGS



Completed to date: 100% primary and secondary (21,903 Routes) roads networks

Future Needs: Highway Performance Monitoring System (HPMS); Certified Public Road Miles (CPRM); Fiscal Management Information System (FMIS); Safety data on all public roads; National Bridge Inventory on all public bridges; Transportation for the Nation; State Planning and Research

6. Administrative Boundaries

unknown %

Carrie Marvel, AKDNR

Examples:

ANCSA boundaries

city limits

coastal zone boundary

designated scenic areas

drinking water protection areas

election districts

emergency communications districts

federal agency organizational boundaries

fire management zones

fish management districts

forest protection districts

health districts

highway lighting districts

national memorials, parks, scenic areas, etc.

national forest boundaries

natural hazard regions

neighborhood associations

oil spill geographic response areas

park and recreation districts

places

rural fire protection districts

sanitary districts

school districts

service districts

shellfish management program areas

soil & water conservation districts

soil water conservation district zones

special road districts

state agency administrative subdivisions

state boundary

state forest boundaries

state park boundaries

transportation districts

voting precincts

wilderness areas

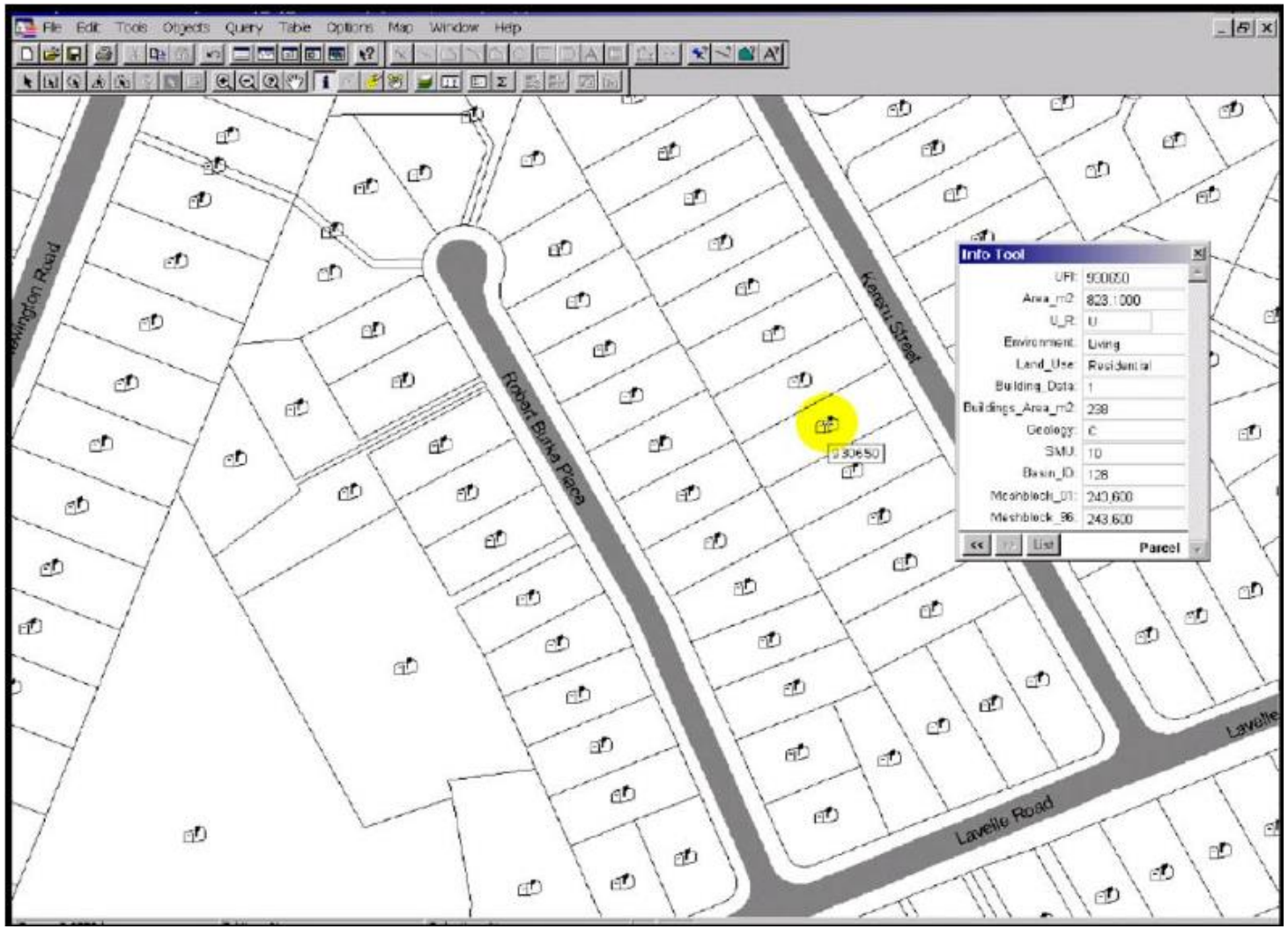
wildlife management units

zoning (all lands)

7. Cadastral

unknown %

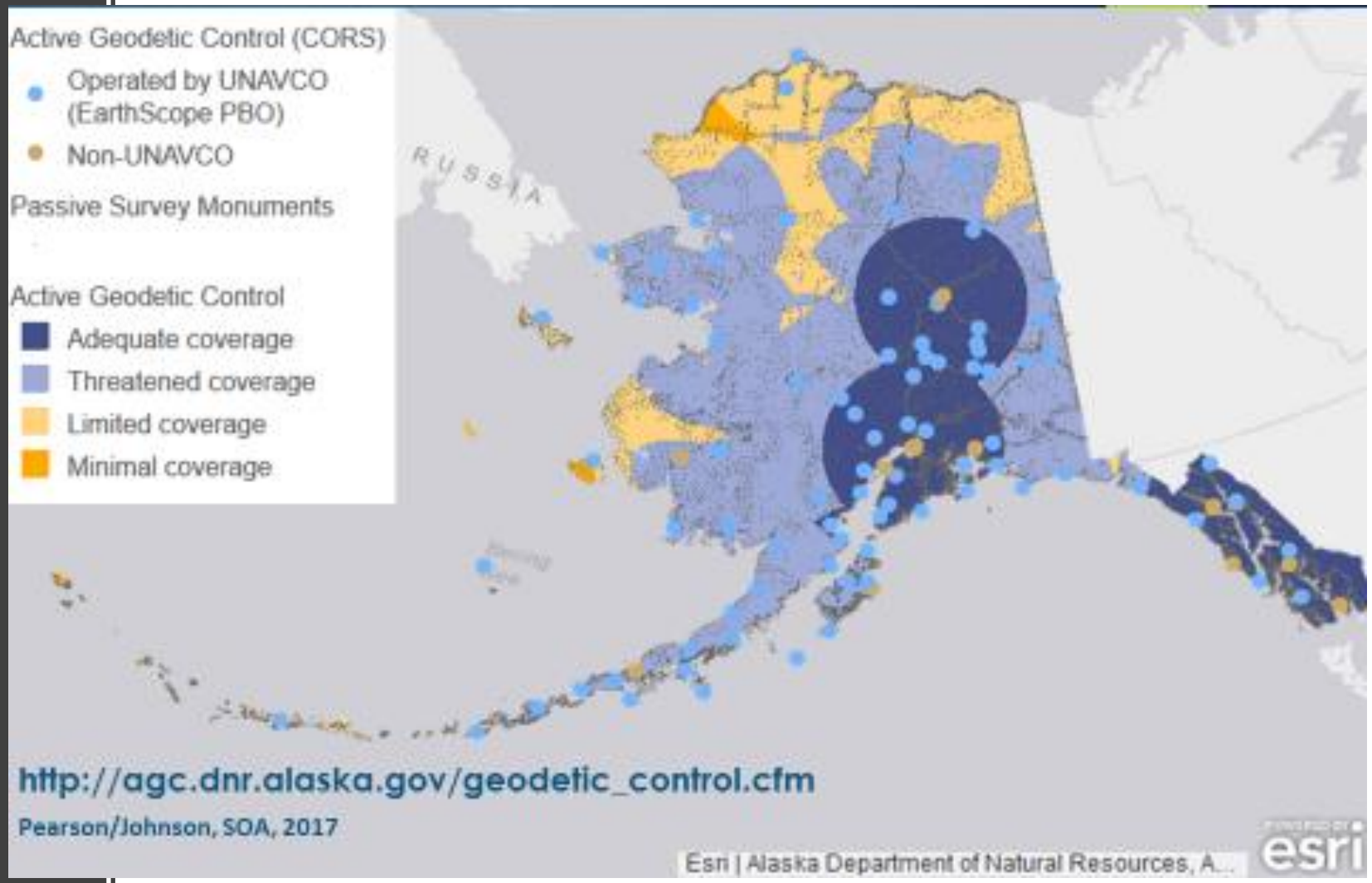
Gwen Gervelis, AKDNR



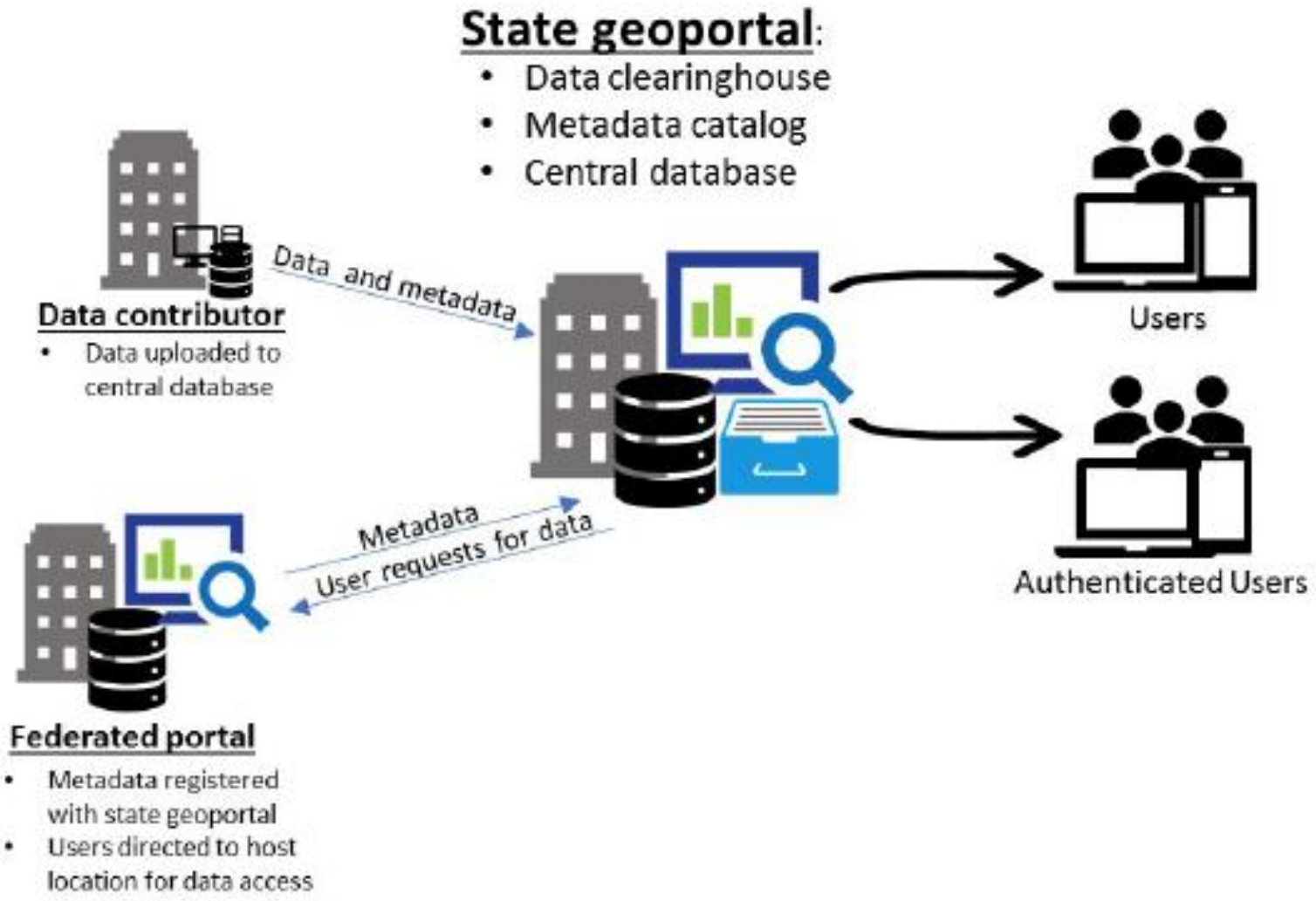
8. Geodetic Control

74%

- Nicole Kinsman, NOAA
- Jeffrey Freymueller, UA



Geoportal


State geoportal:
Data clearinghouse
Metadata catalog
Central database
Data contributor
Data uploaded to central database
Data and metadata
Users
Authenticated Users
Metadata
User requests for data
Federated portal
Metadata registered with state geoportal
Users directed to host location for data access

Top State Priorities for 2018, in order:

1. Continue IfSAR elevation collection for the state

2. Fund sustainable imagery refresh program
   - Leaf-on
   - 1-meter pixel resolution or better
   - Refresh every 3-5 years (collect 1/3 to 1/5 state annually)

3. Continue to update hydrography and wetlands framework datasets

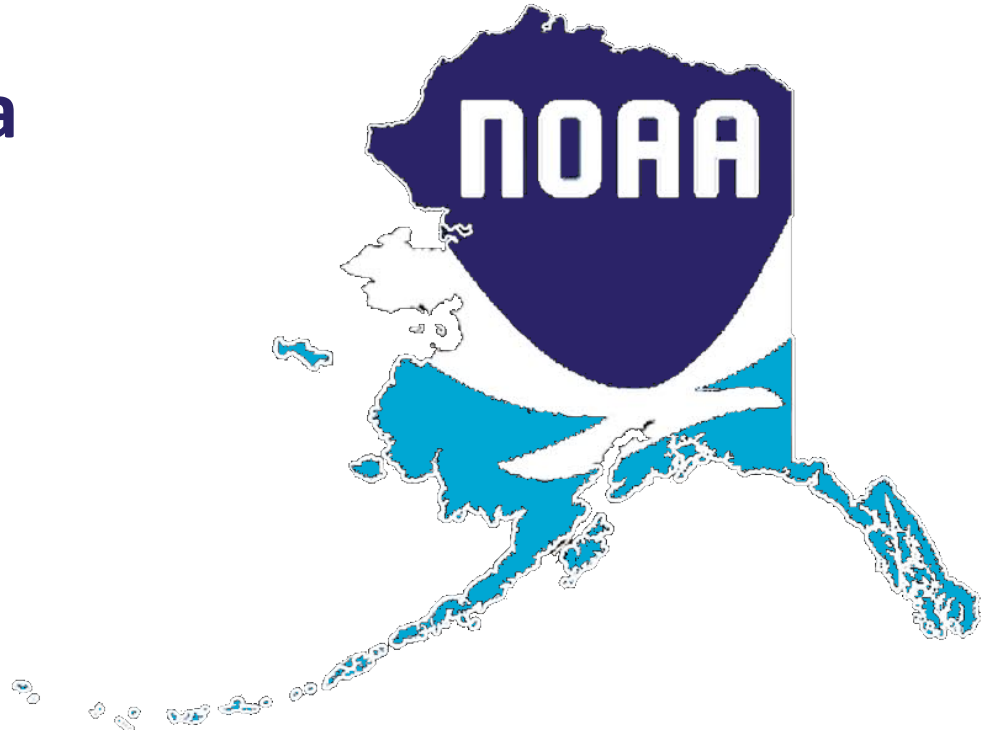
The Alaska Geospatial Council

- AK Dept. of Natural Resources
- AK Dept. of Transportation
- AK Dept. of Military and Veterans Affairs
- AK Dept. of Commerce, Community and Economic Development
- AK Dept. of Fish and Game
- AK Dept. of Environmental Conservation
- University of Alaska
- Dept. of the Interior Alaska Liaison
- National Oceanic and Atmospheric Administration
- Natural Resources Conservation Service
- ANCSA Regional Association
- Alaska Municipal League

Questions?

Hydrographic Charting Activities in Alaska

Alaska Coastal Mapping Summit 2018



LT Bart Buesseler, NOAA
Navigation Manager, Alaska
NOAA's Office of Coast Survey

O: 907.271.3327
C: 907.231.7112
Bart.O.Buesseler@noaa.gov

Overview of 2017 Survey Activities:

- 2017 Office of Coast Survey Story Map
  - http://noaa.maps.arcgis.com/apps/MapSeries/index.html?appid=84f1127b56d7464c8deaae9d88f5ac94

Preview of planned 2018 Survey Activities:

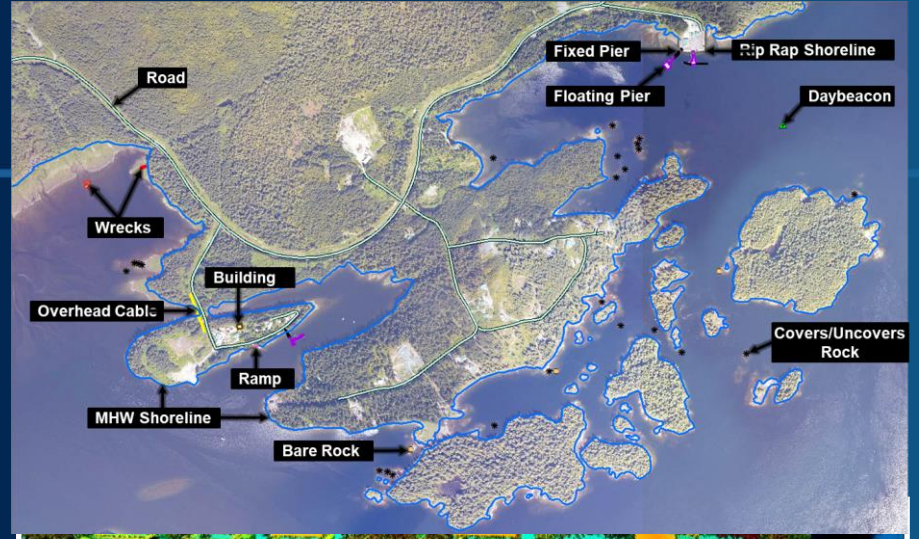
- Future survey plans as a layer of SeaSketch
  - https://www.seasketch.org/#projecthomepage/5272840f6ec5f42d210016e4
- 2018 Office of Coast Survey Story Map – **NEW!**
  - http://noaa.maps.arcgis.com/apps/MapJournal/index.html?appid=7007abd6aa81440f9a360d9e71f8cbca

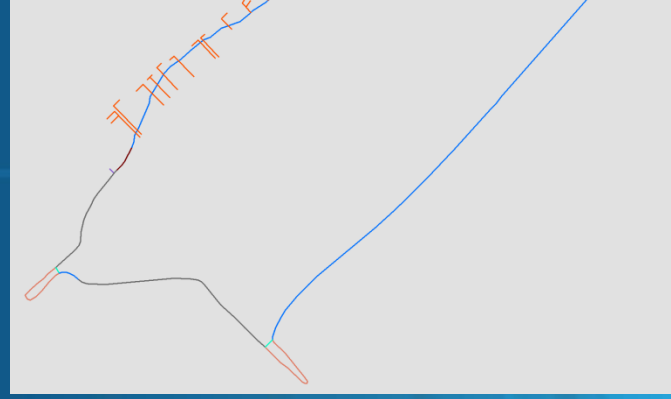
Note: Survey plans are always subject to change due to federal funding and other operational factors.

NOAA's Coastal Mapping Program

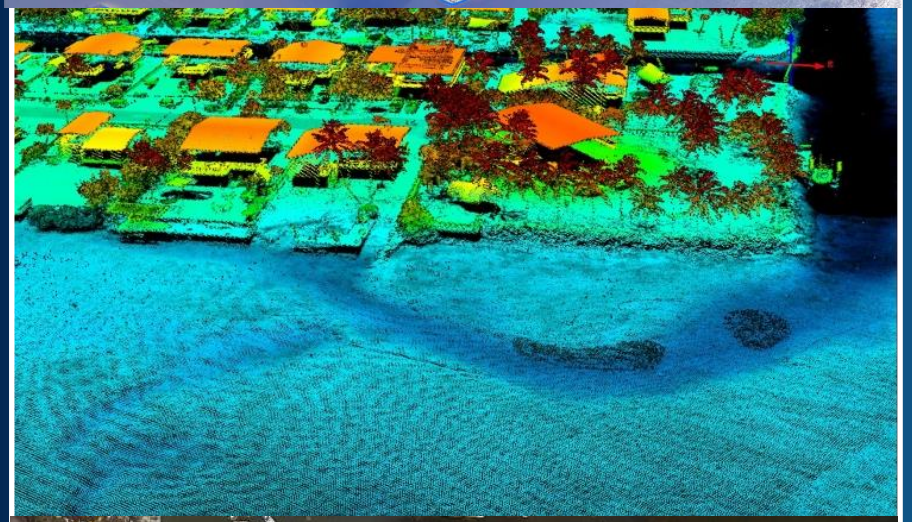
- Define the National Shoreline and nearshore elevation data
- NOAA nautical charts
- Other important applications:
  - Used in defining the United States' territorial limits
  - Coastal resource management
  - Storm surge and coastal flooding modeling
  - GIS analysis
  - Benthic habitat mapping
- Coastal Intelligence and Resiliency…

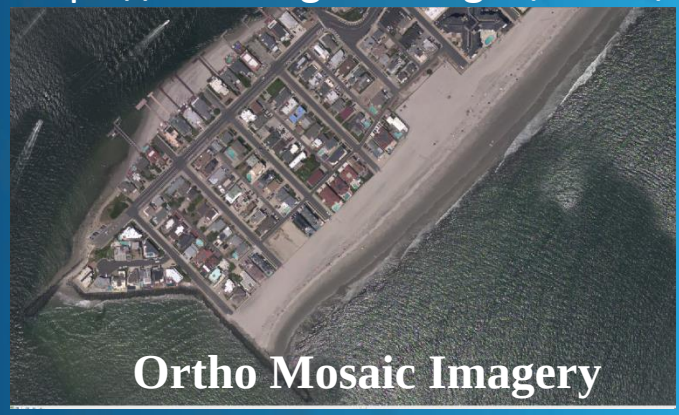
  Map once use many times!
- Emergency Response Imagery





Shoreline
https://www.ngs.noaa.gov/NSDE/

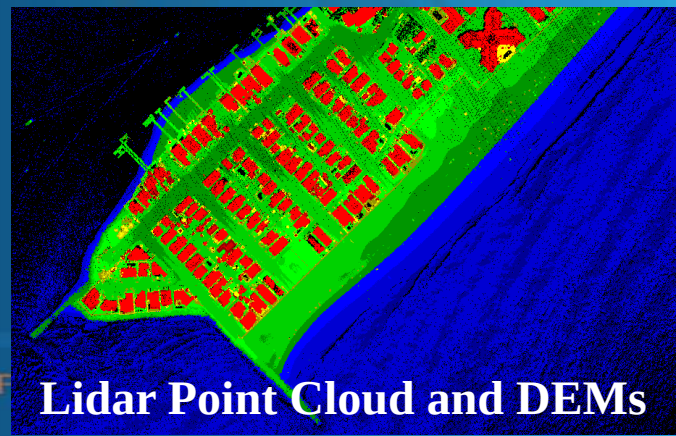




Ortho Mosaic Imagery

https://coast.noaa.gov/digitalcoast/

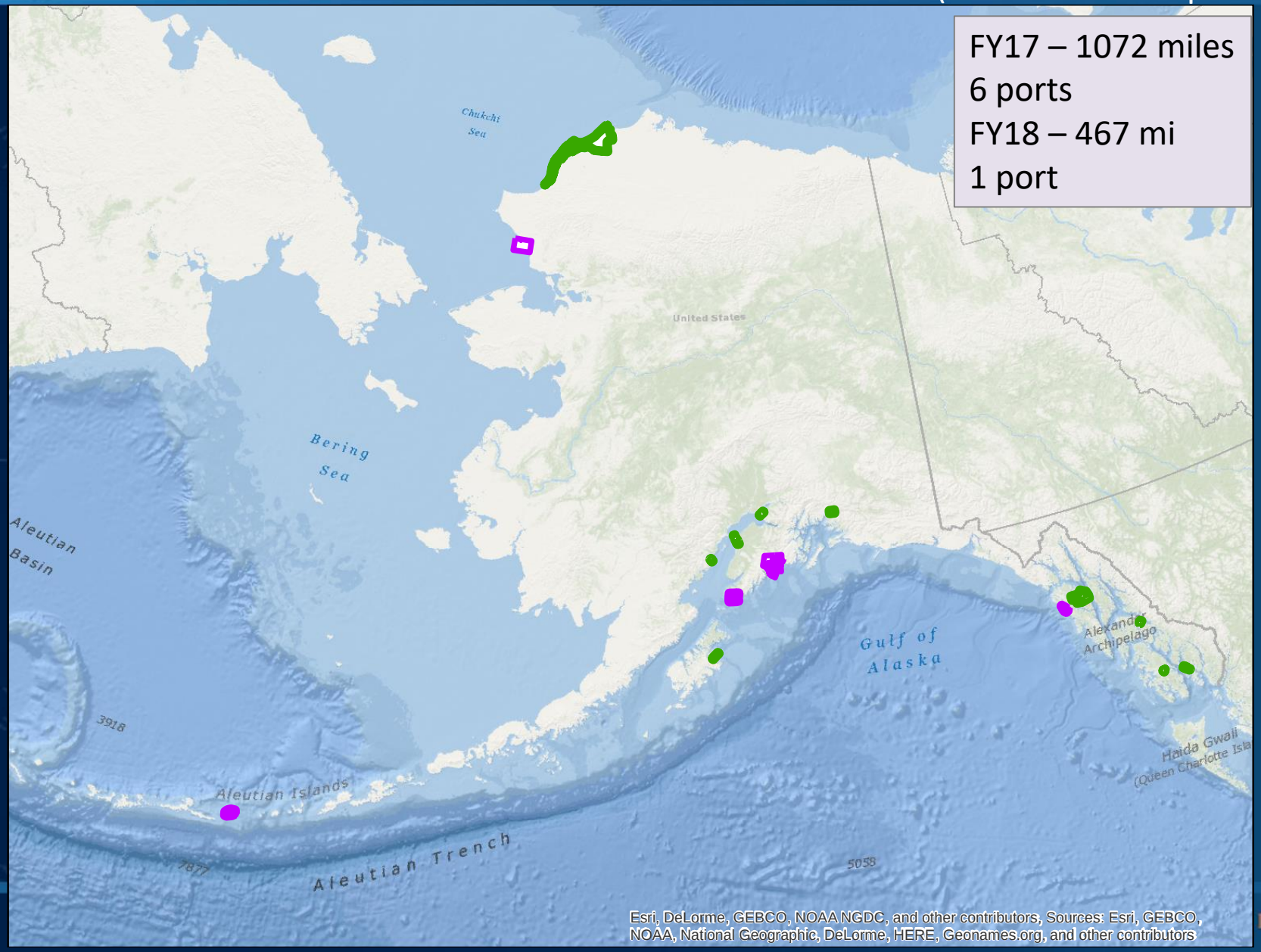
https://storms.ngs.noaa.gov/



Lidar Point Cloud and DEMs

NOAA Shoreline Update

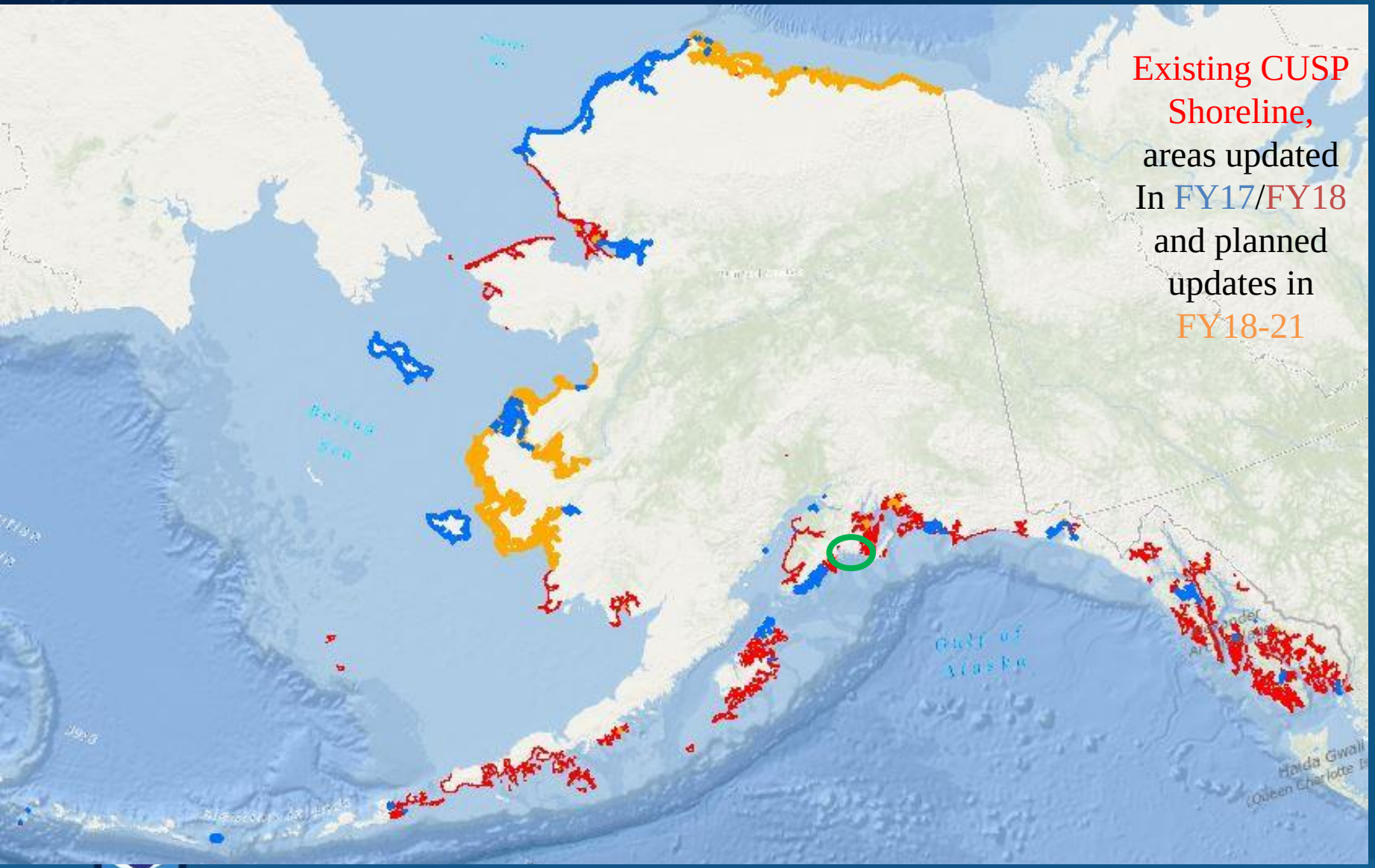
National Shoreline (CMP for Chart Update)



National Shoreline updates focus on navigational-significant areas (harbors, ports, approaches, etc.) primarily for nautical charting applications – each year NOAA/NGS maps 3-5 % of U.S. National Shoreline (equivalent to <500 mi/year in Alaska).

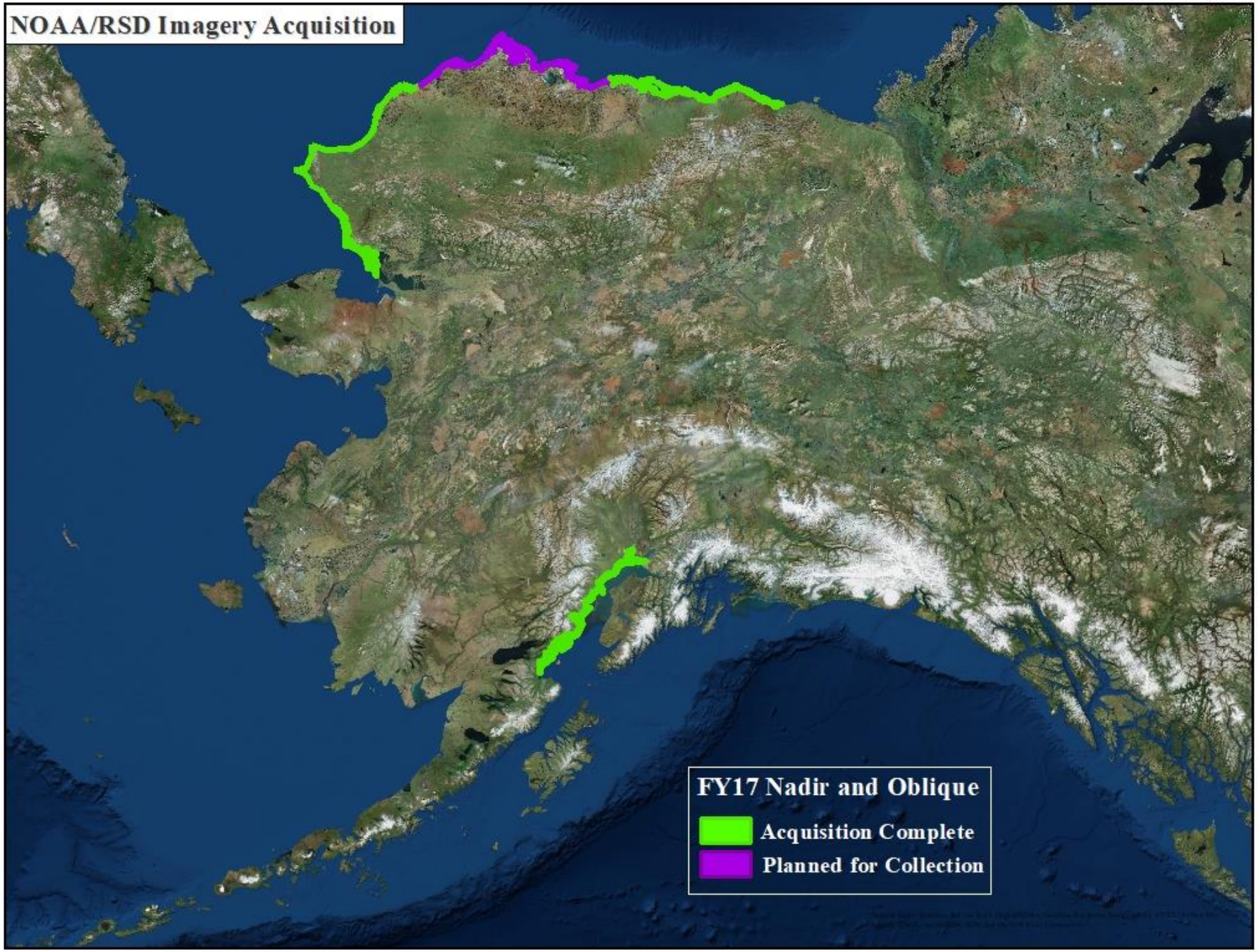
Primary sources to derive shoreline and features are stereo imagery from aircraft and satellite.

Continually Updated Shoreline Product (CUSP)



CUSP benefits/purpose:
To provide the most current shoreline representation
Designed to deliver continuous shoreline with frequent updates (available via WMS and online at NOAA Shoreline Data Explorer)
Referenced to Mean High Water datum (where applicable)
Includes NOAA and non-NOAA contemporary sources

NGS is presently working with partners in the region such as AK Hydro, The State of Alaska, USGS, NPS, BLM, and US Forestry to identify improved mechanisms for delivering MHW shoreline vectors to NOAA for validation and considered inclusion into CUSP.



Coastal Nadir imagery 2017

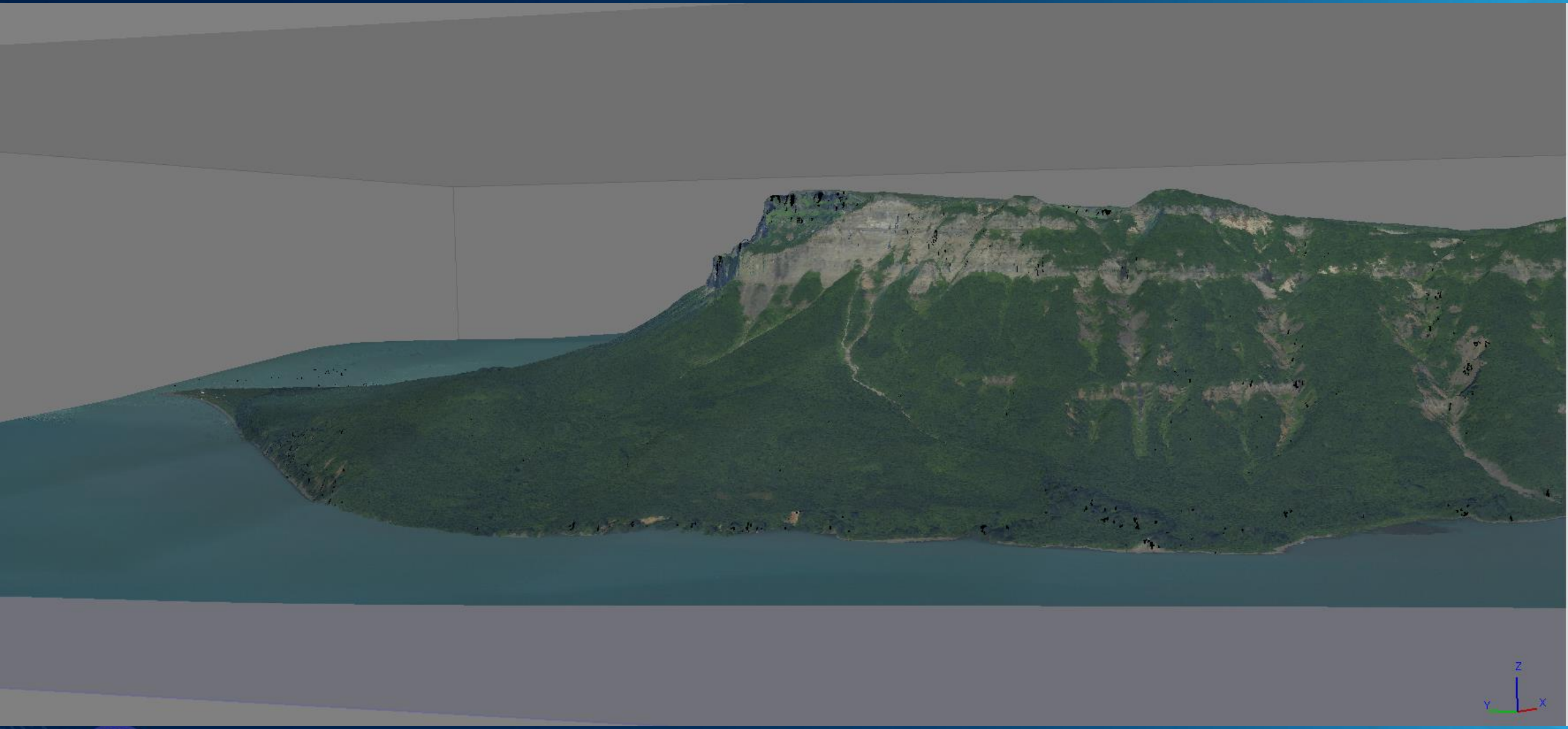
https://geodesy.noaa.gov/storm_archive/alaska/index.html

2017 imagery was collected to support SfM analysis and available for download

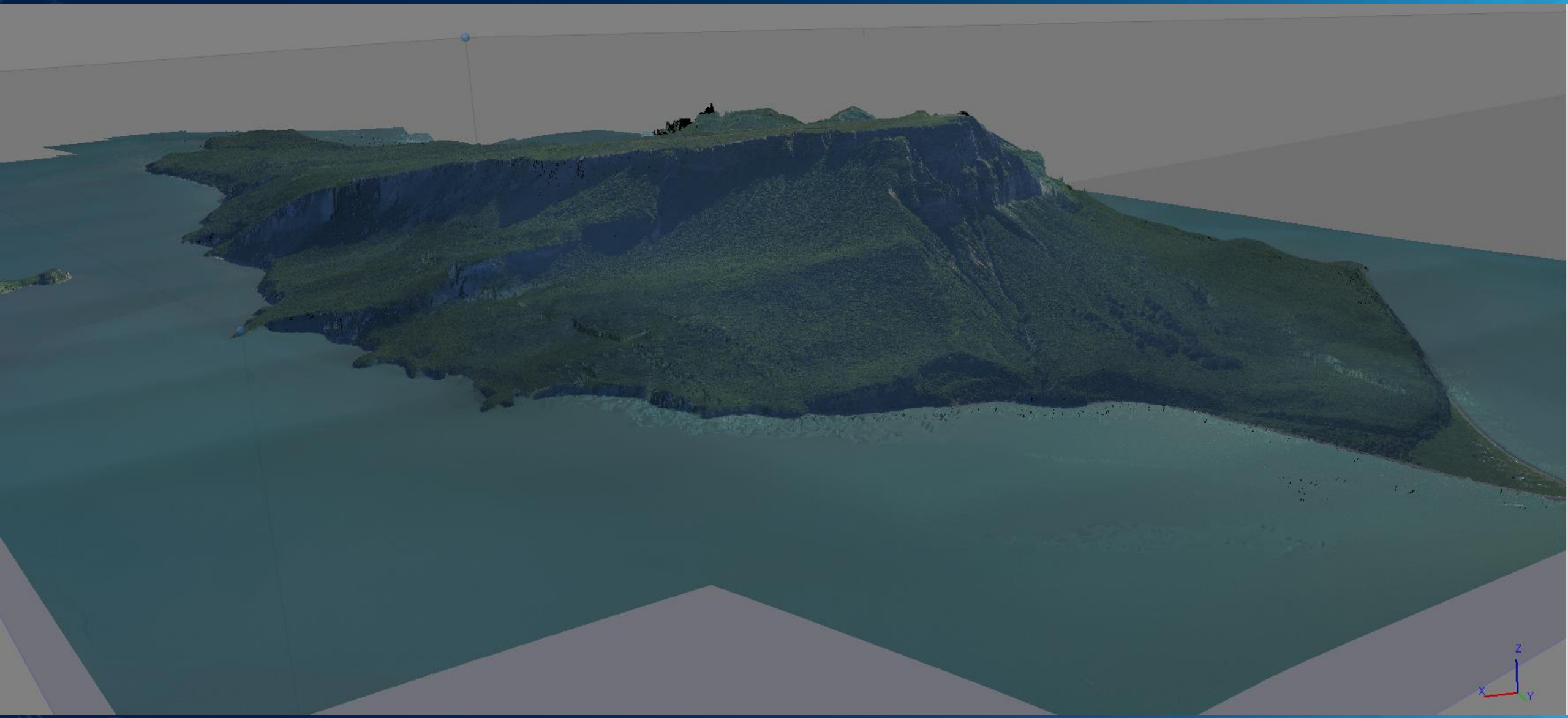
Coastal Oblique imagery 2016

https://geodesy.noaa.gov/storm_archive/coastal/viewer/index.html

Chisik Island



Chisik Island



Contacts

Mike Aslaksen

Chief, Remote Sensing Division

NOAA National Geodetic Survey

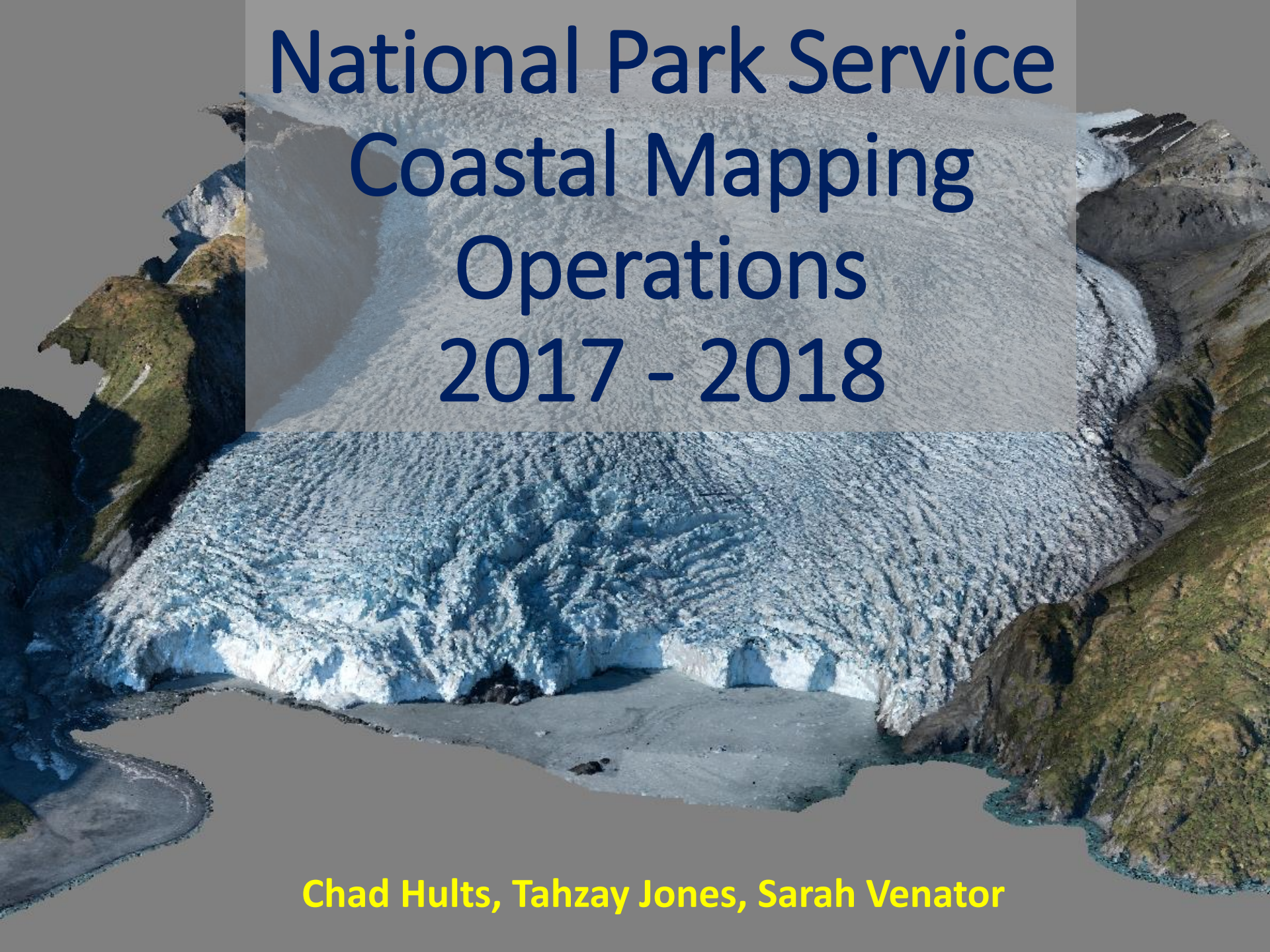
Mike.Aslaksen@noaa.gov

301-801-9024 mobile

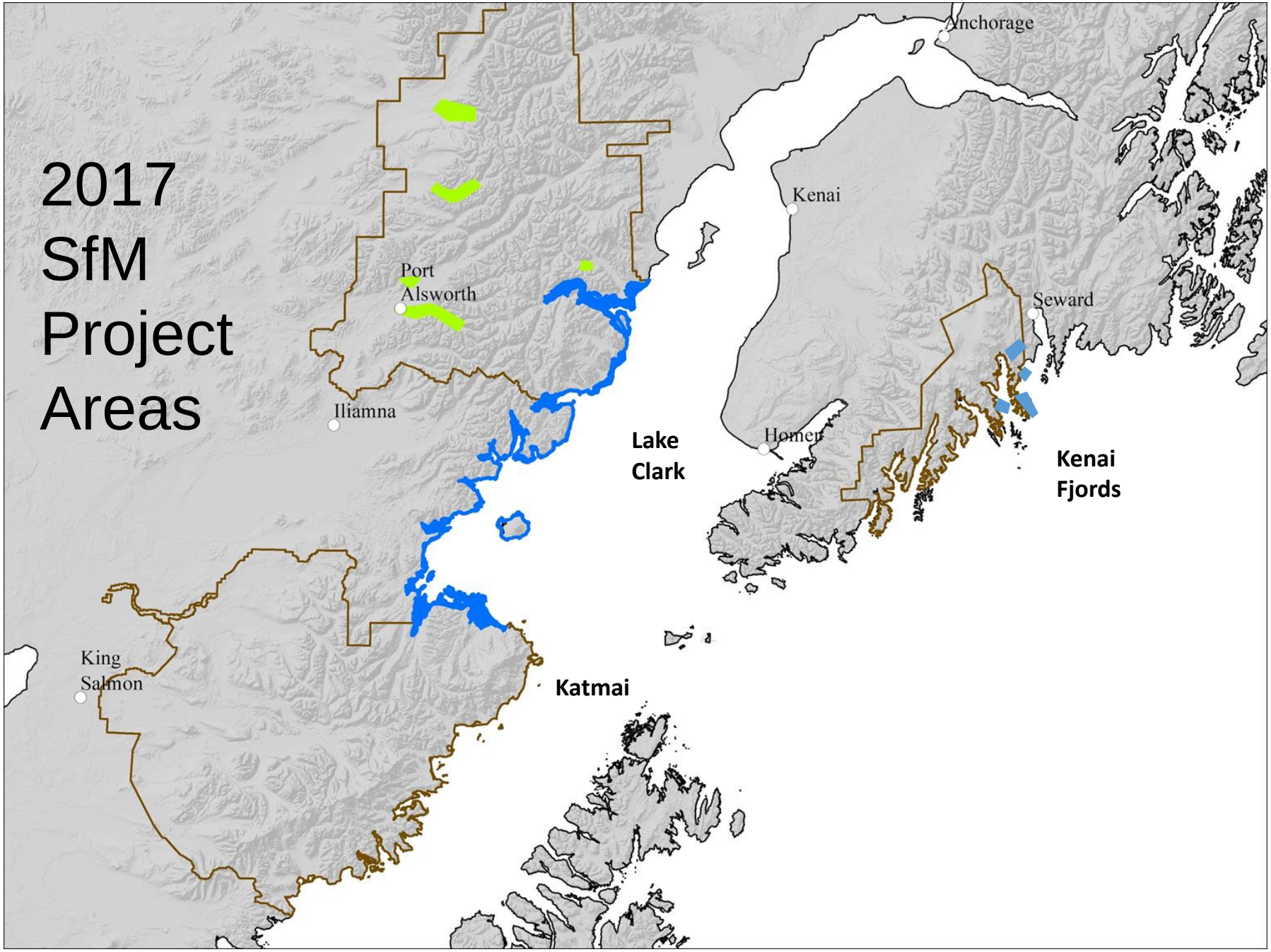
240-533-9576 office

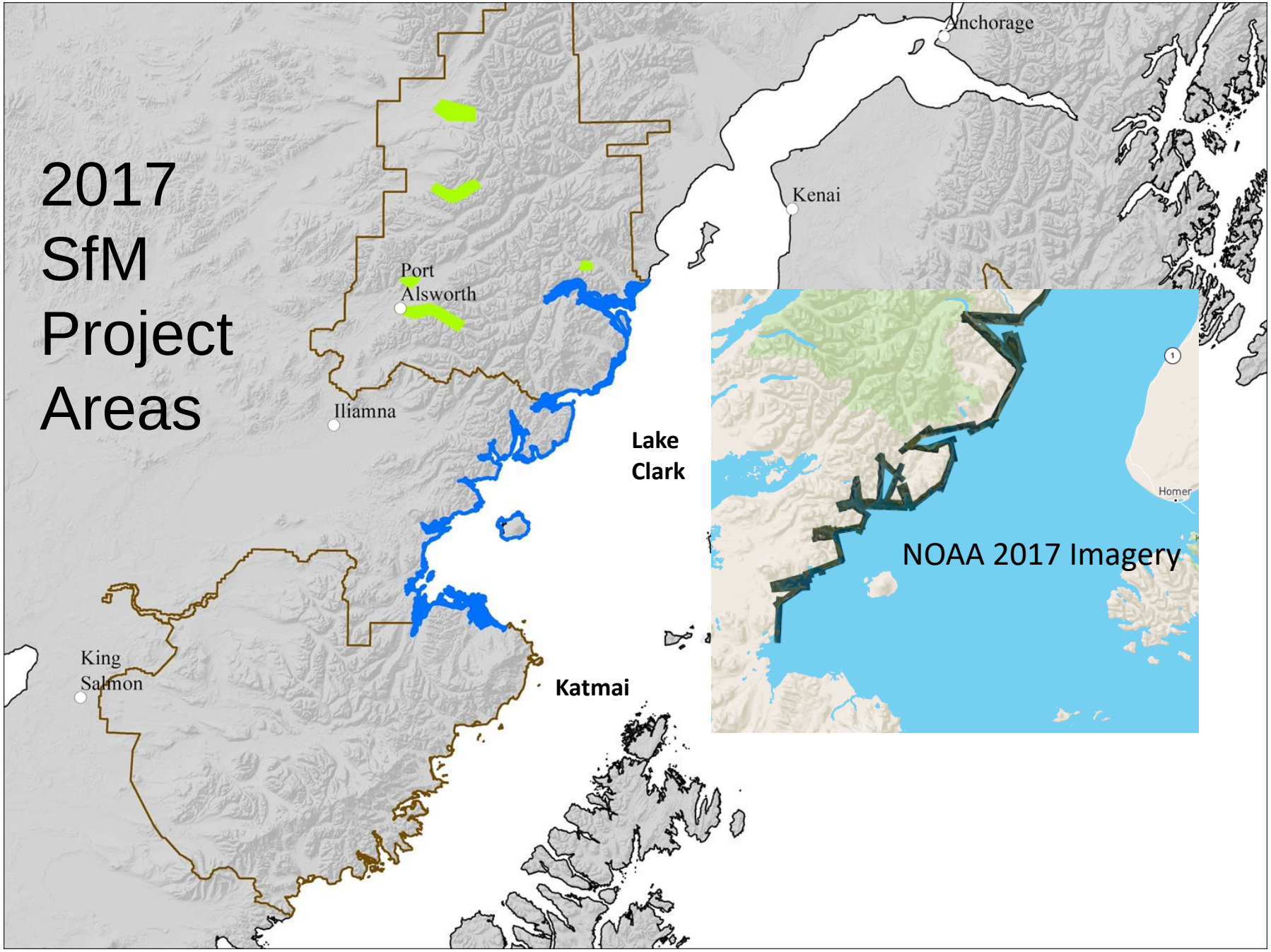
Nicole Kinsman
Alaska Regional Advisor
NOAA National Geodetic Survey
nicole.kinsman@noaa.gov
Telephone (mobile): 202-306-5736

National Park Service Coastal Mapping Operations 2017 - 2018



Chad Hults, Tahzay Jones, Sarah Venator


2017
SfM
Project
Areas
Anchorage
Kenai
Port
Alsworth
Seward
Iliamna
Homer
Lake
Clark
Kenai
Fjords
King
Salmon
Katmai


2017
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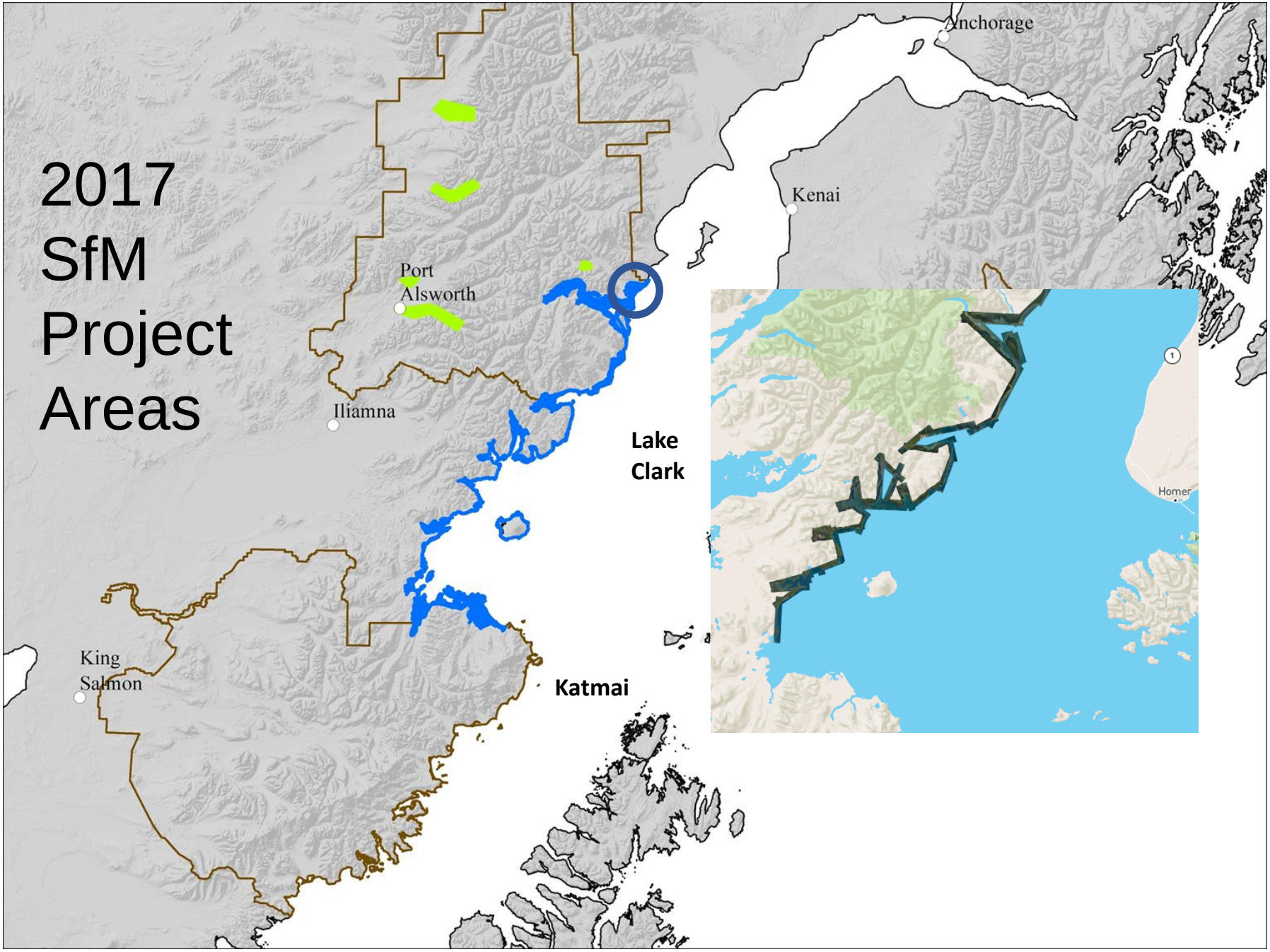
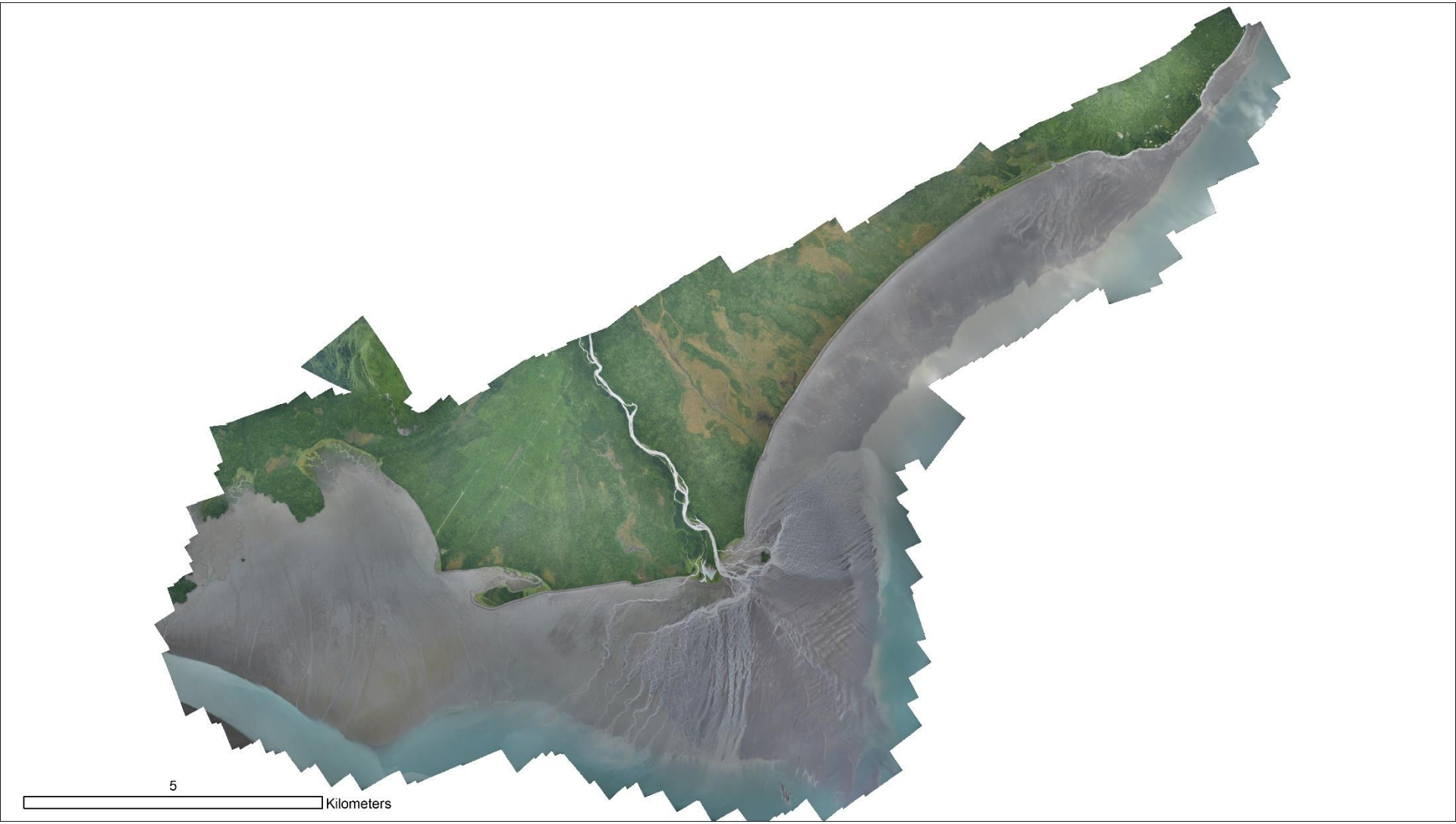
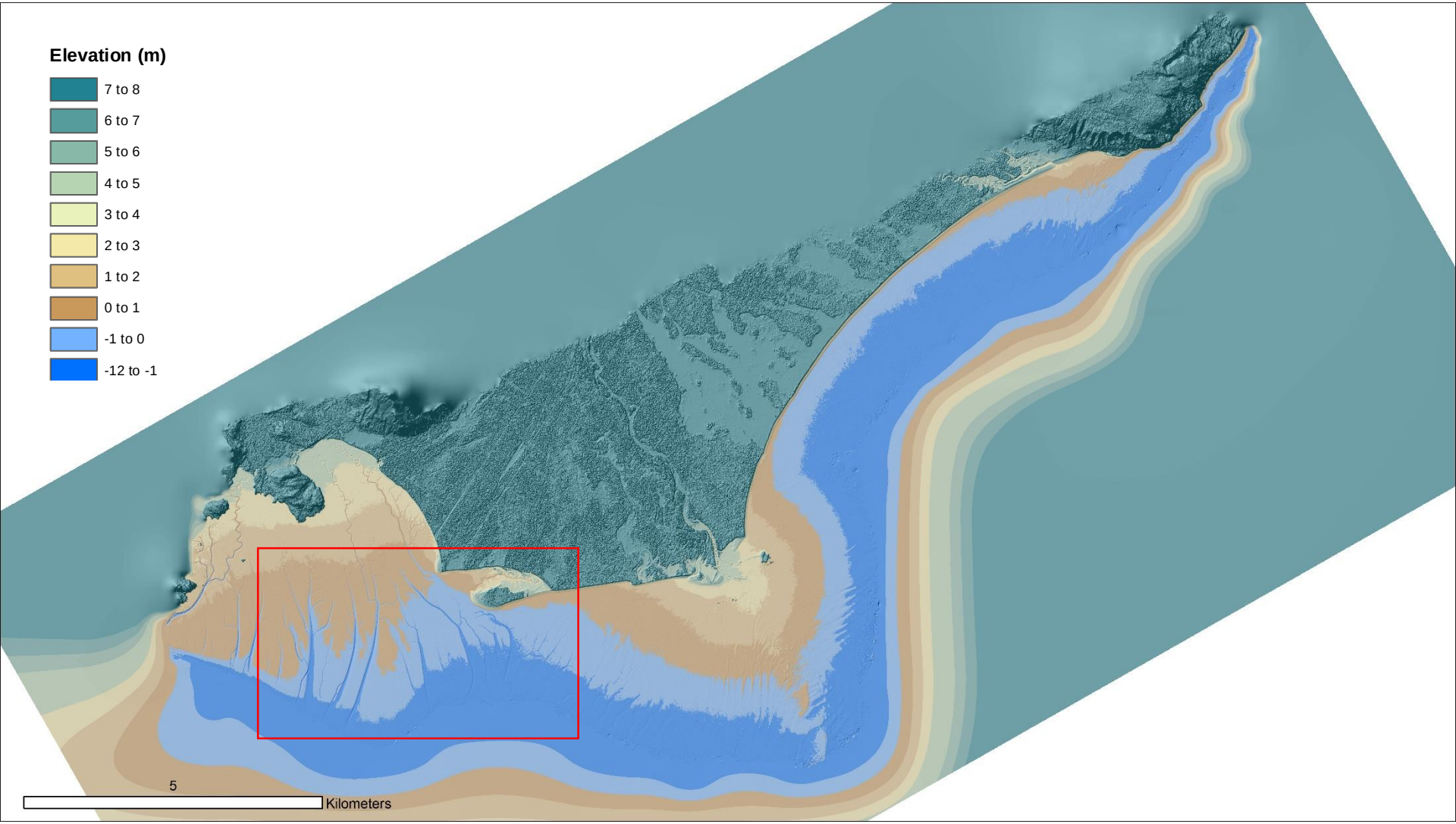
Project
Areas
Anchorage
Kenai
Port
Alsworth
Iliamna
Lake
Clark
King
Salmon
Katmai
NOAA 2017 Imagery
Homer

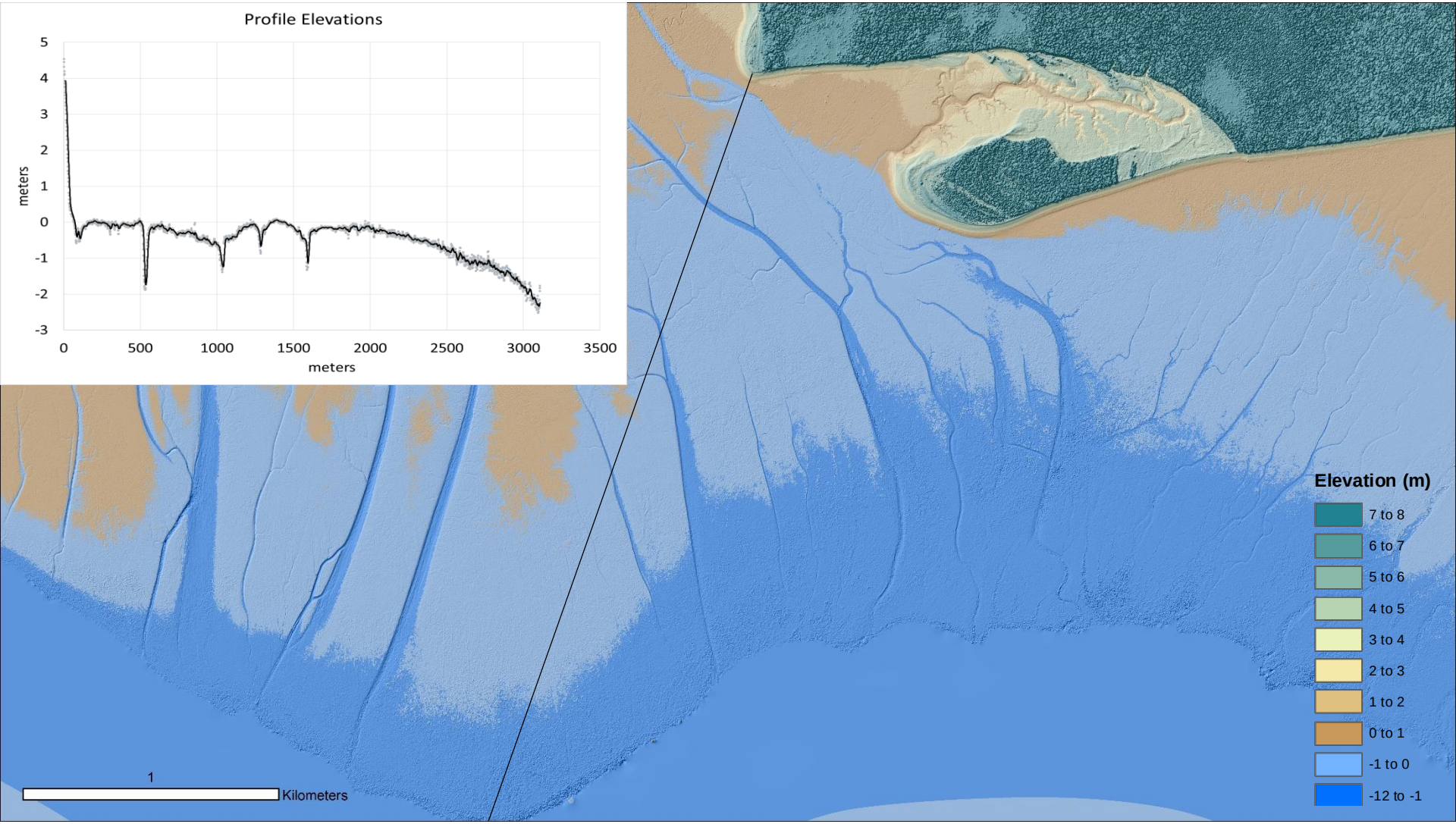
2017 SfM Project Areas

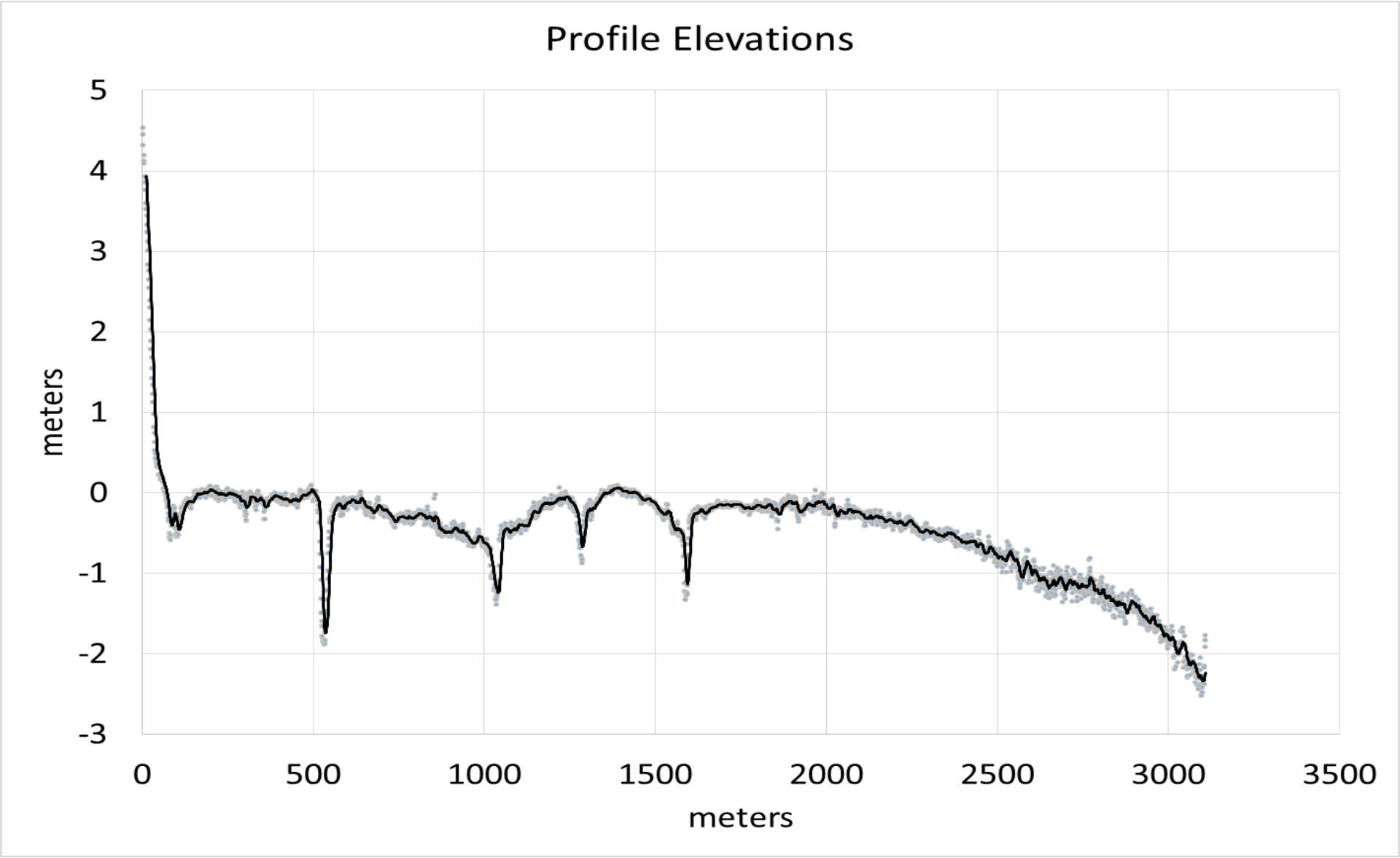


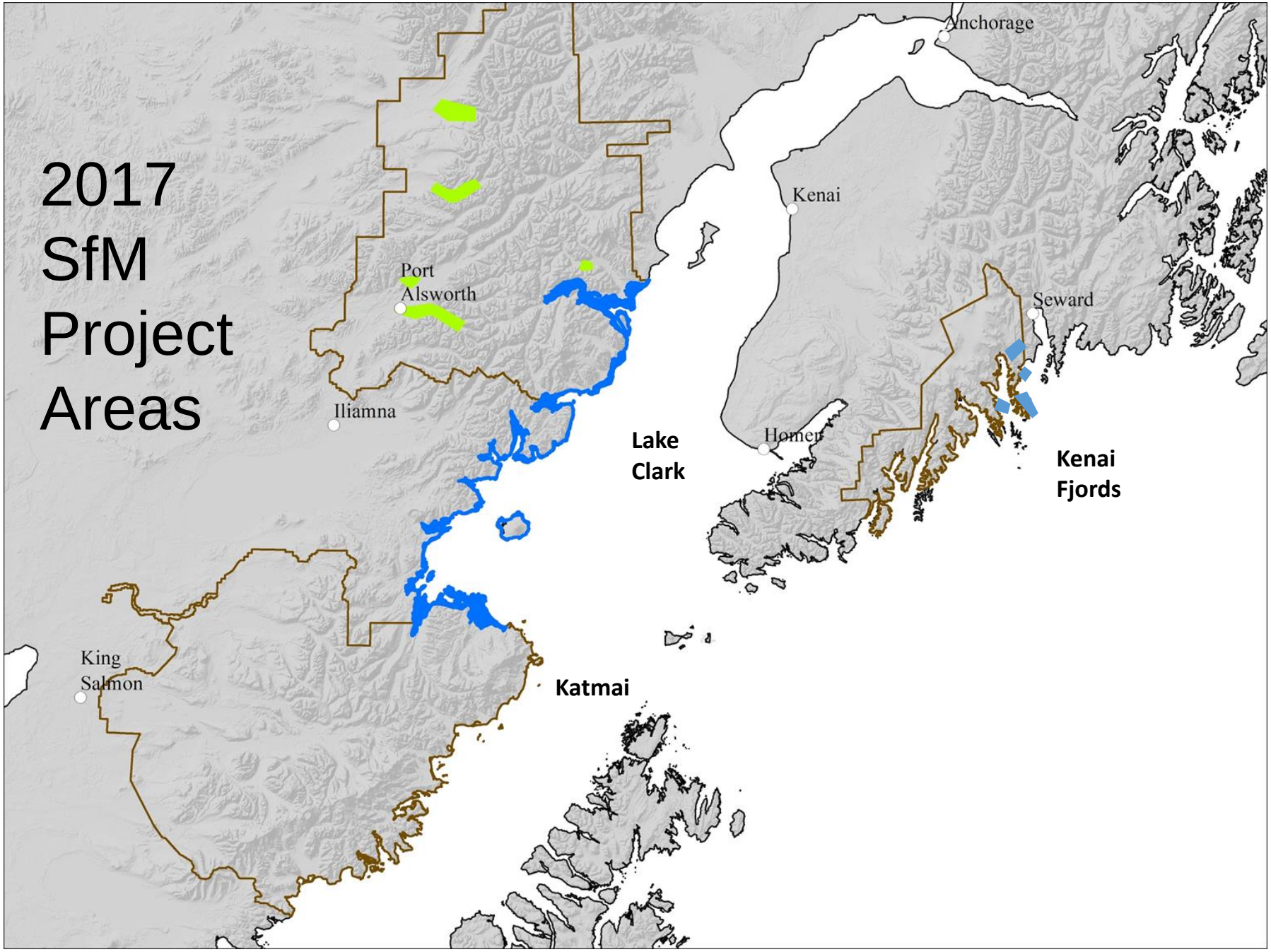

5
Kilometers


Elevation (m)
7 to 8
6 to 7
5 to 6
4 to 5
3 to 4
2 to 3
1 to 2
0 to 1
-1 to 0
-12 to -1
5
Kilometers

1
Kilometers


Profile Elevations
meters
5
4
3
2
1
0
-1
-2
-3
0
500
1000
1500
2000
2500
3000
3500
meters
Elevation (m)
7 to 8
6 to 7
5 to 6
4 to 5
3 to 4
2 to 3
1 to 2
0 to 1
-1 to 0
-12 to -1
1
Kilometers


Profile Elevations
5
4
3
2
1
0
-1
-2
-3
meters
0
500
1000
1500
2000
2500
3000
3500
meters


2017
SfM
Project
Areas
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Port
Alsworth
Seward
Iliamna
Homer
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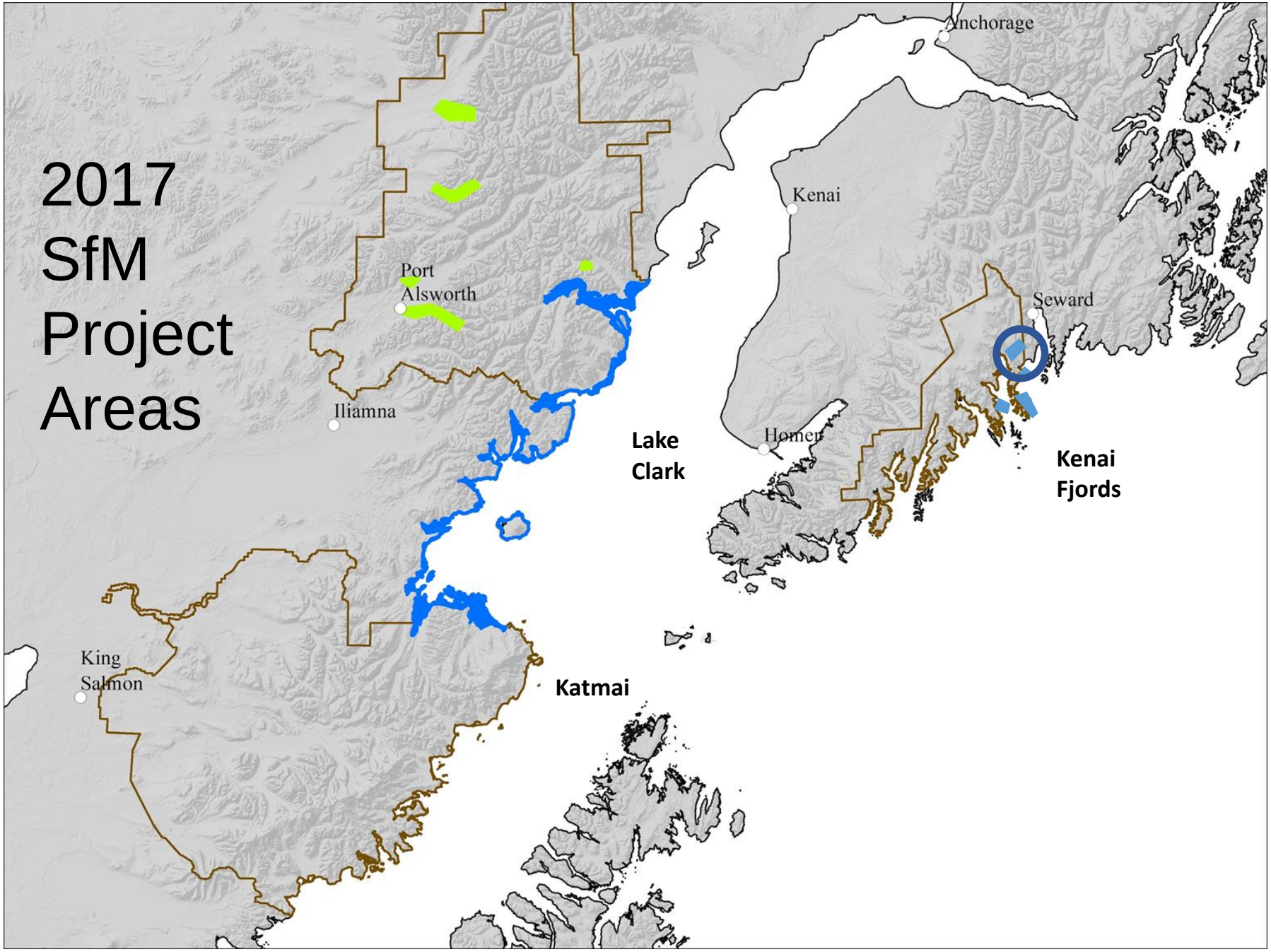
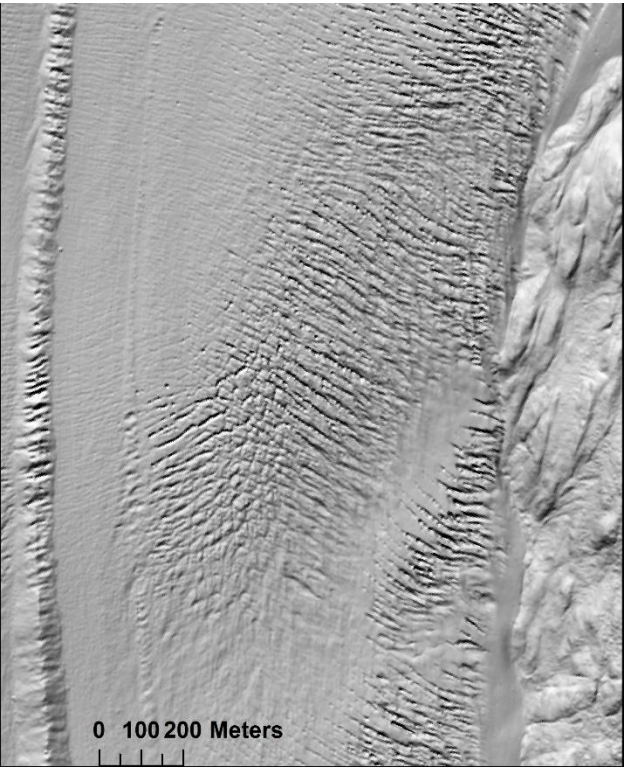
Clark
Kenai
Fjords
King
Salmon
Katmai

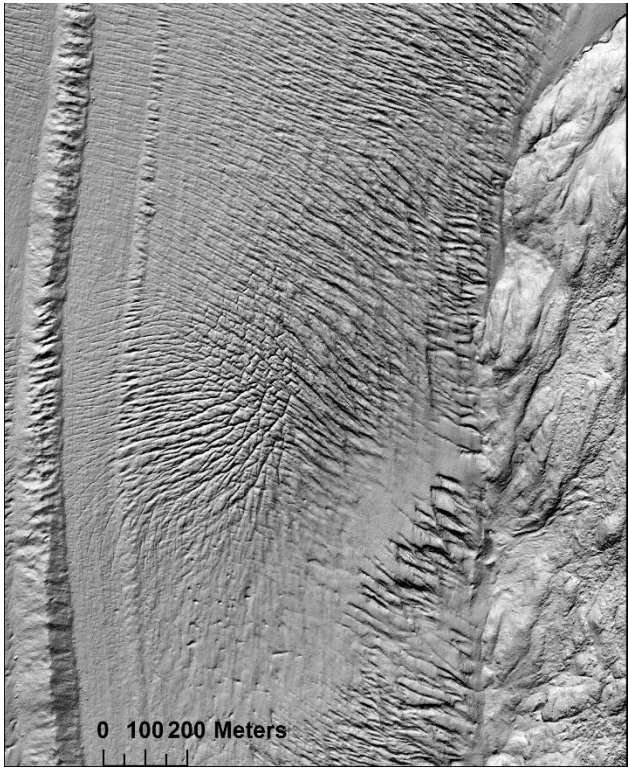

2017
SfM
Project
Areas
Anchorage
Kenai
Port
Alsworth
Seward
Iliamna
Homer
Lake
Clark
Kenai
Fjords
King
Salmon
Katmai

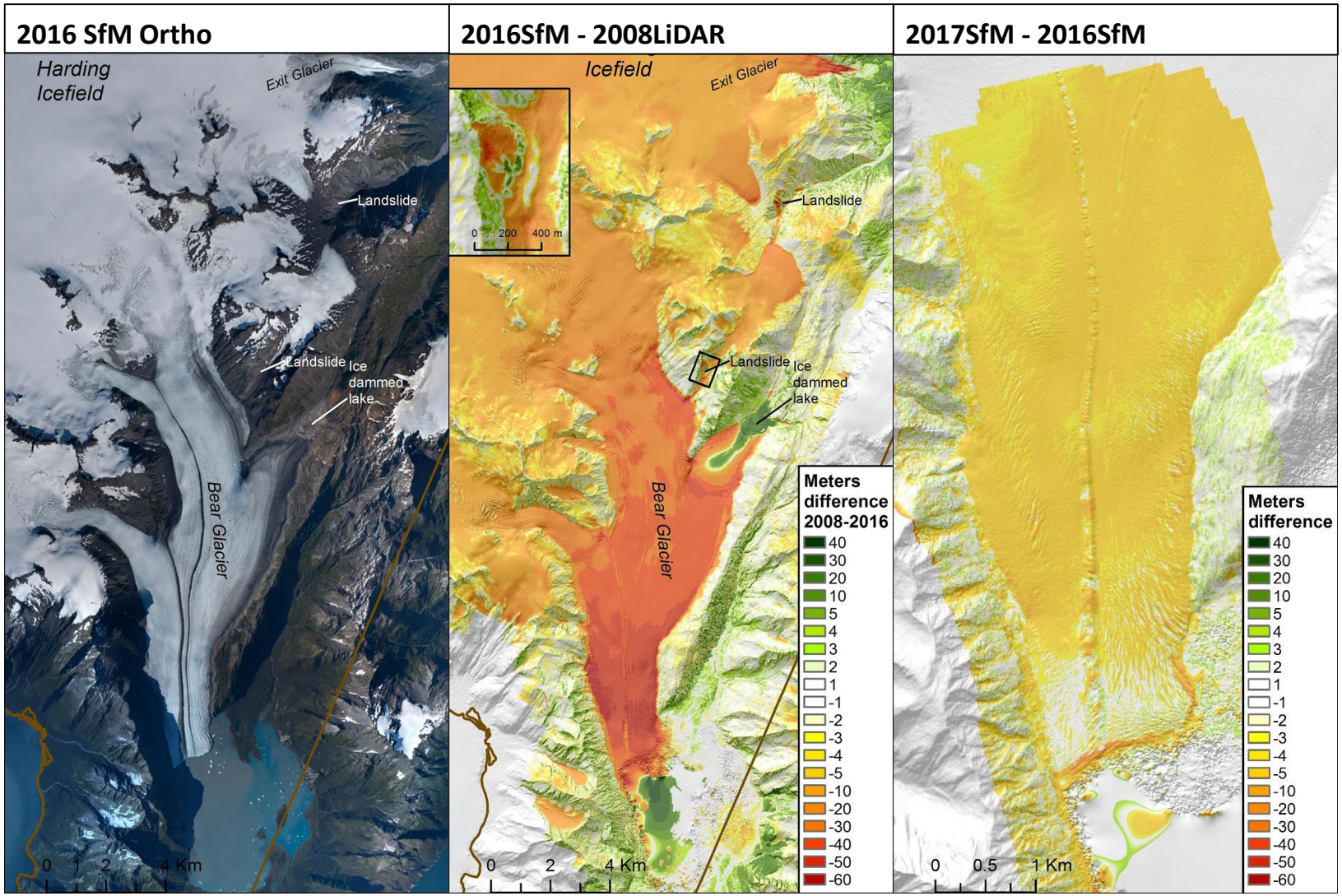
2008 LiDAR 1m



2016 SfM 2m

2017 SfM 0.2m




2016 SfM Ortho
2016SfM - 2008LiDAR
2017SfM - 2016SfM
Harding Icefield
Exit Glacier
Landslide
Landslide
Ice dammed lake
Bear Glacier
0 1 2 4 Km
Icefield
Exit Glacier
0 200 400 m
Landslide
Landslide
Ice dammed lake
Bear Glacier
0 2 4 Km
Meters difference 2008-2016
40
30
20
10
5
4
3
2
1
-1
-2
-3
-4
-5
-10
-20
-30
-40
-50
-60
0 0.5 1 Km
Meters difference
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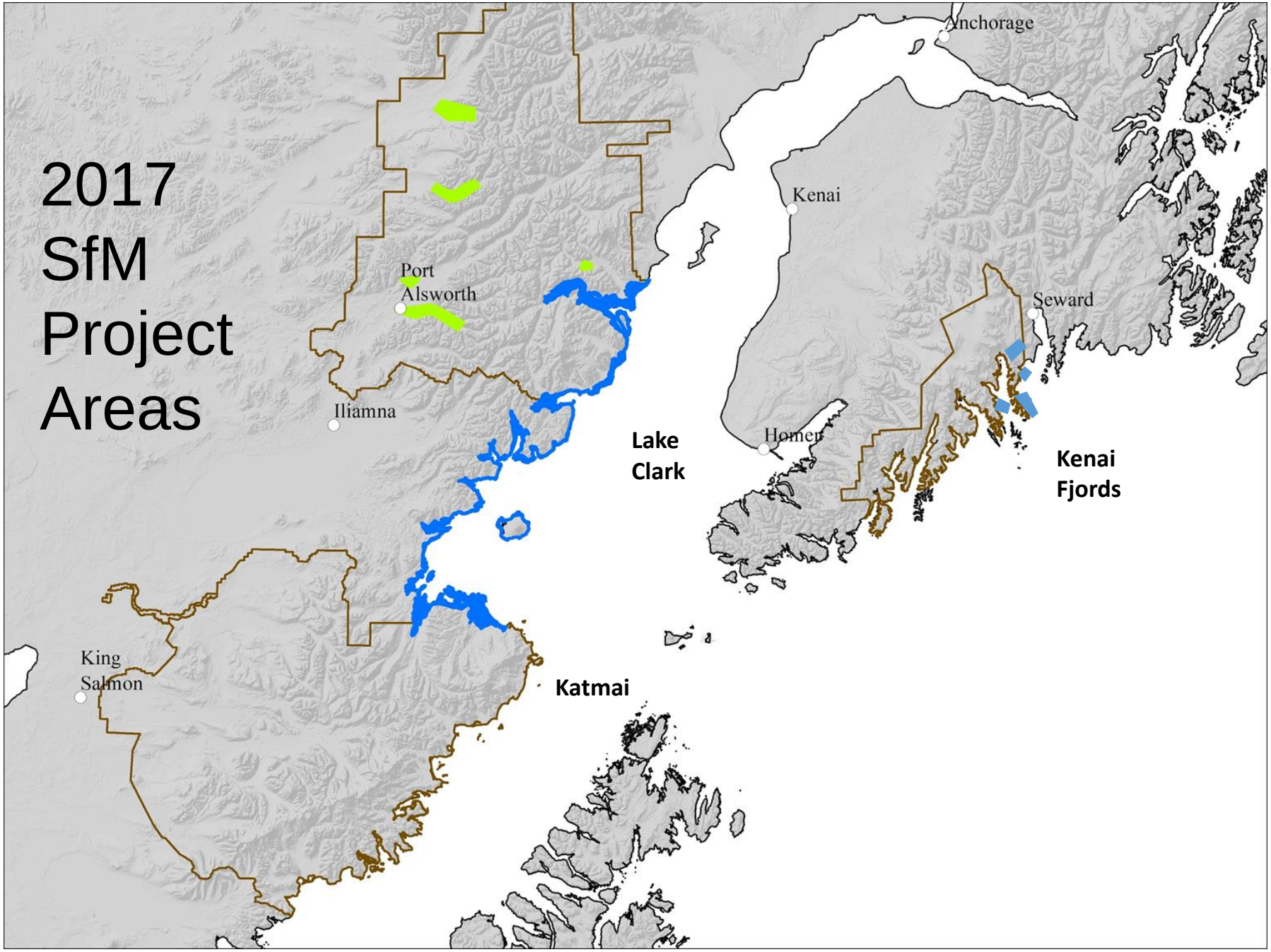
-60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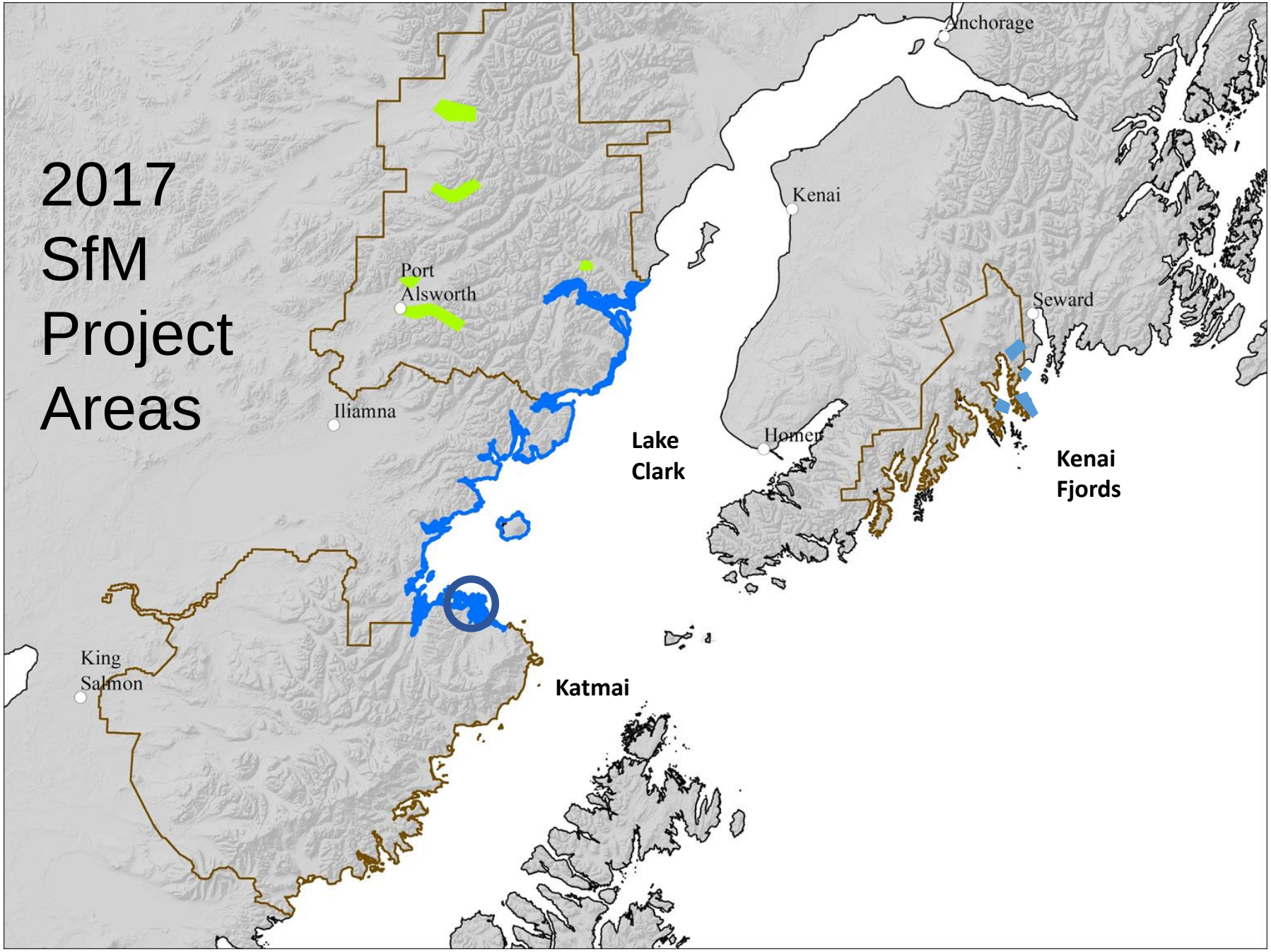
Salmon
Katmai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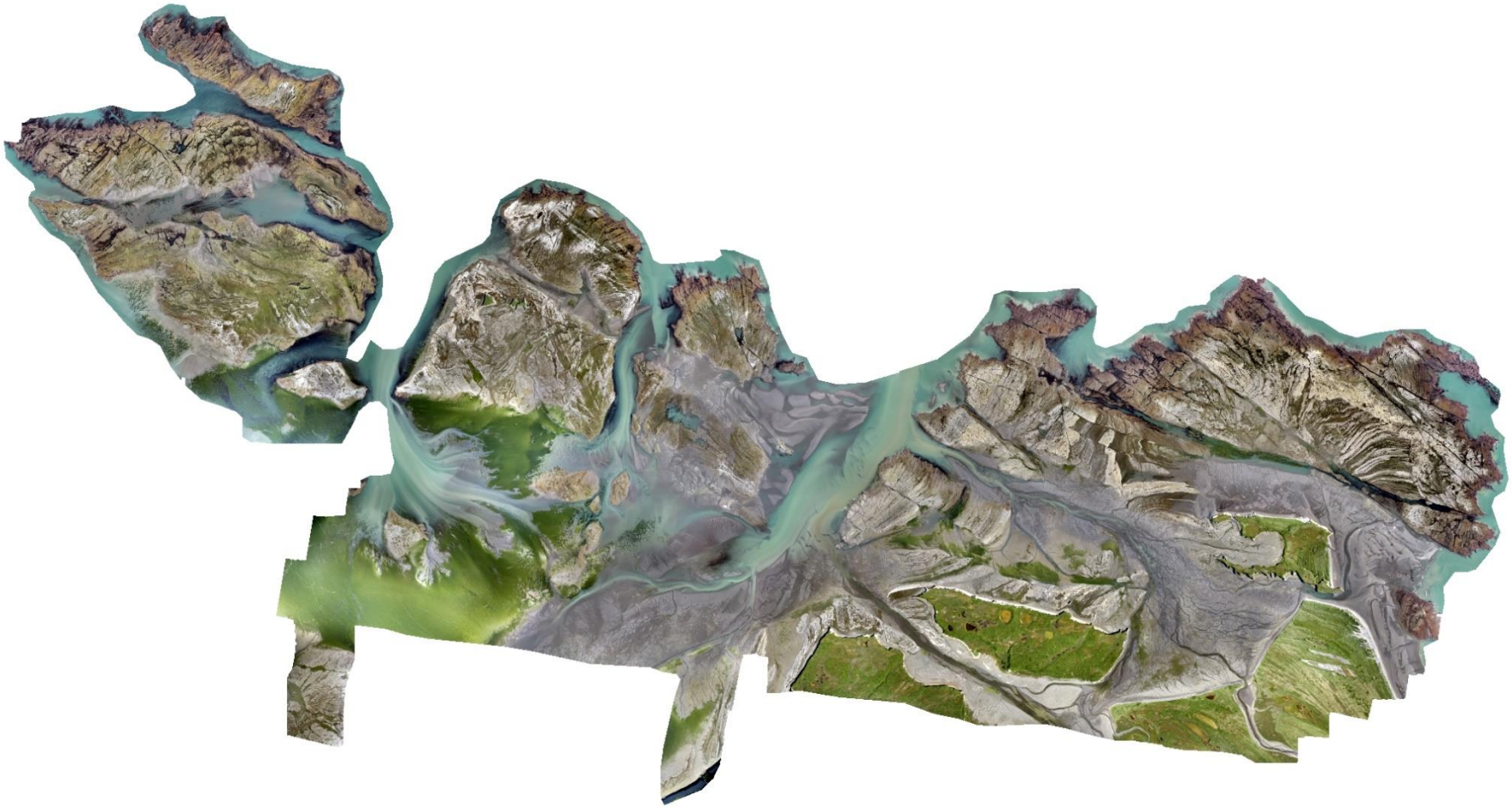
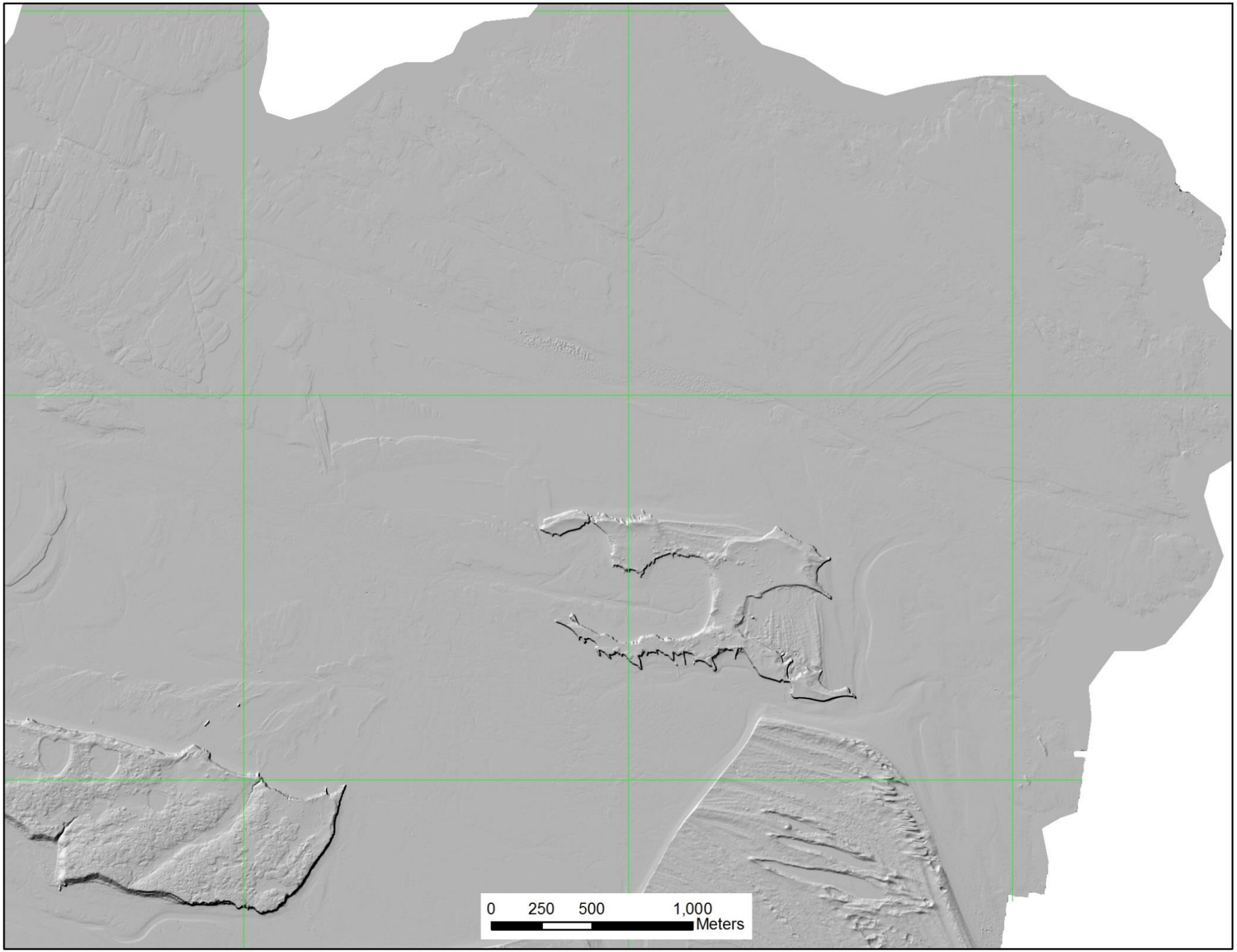
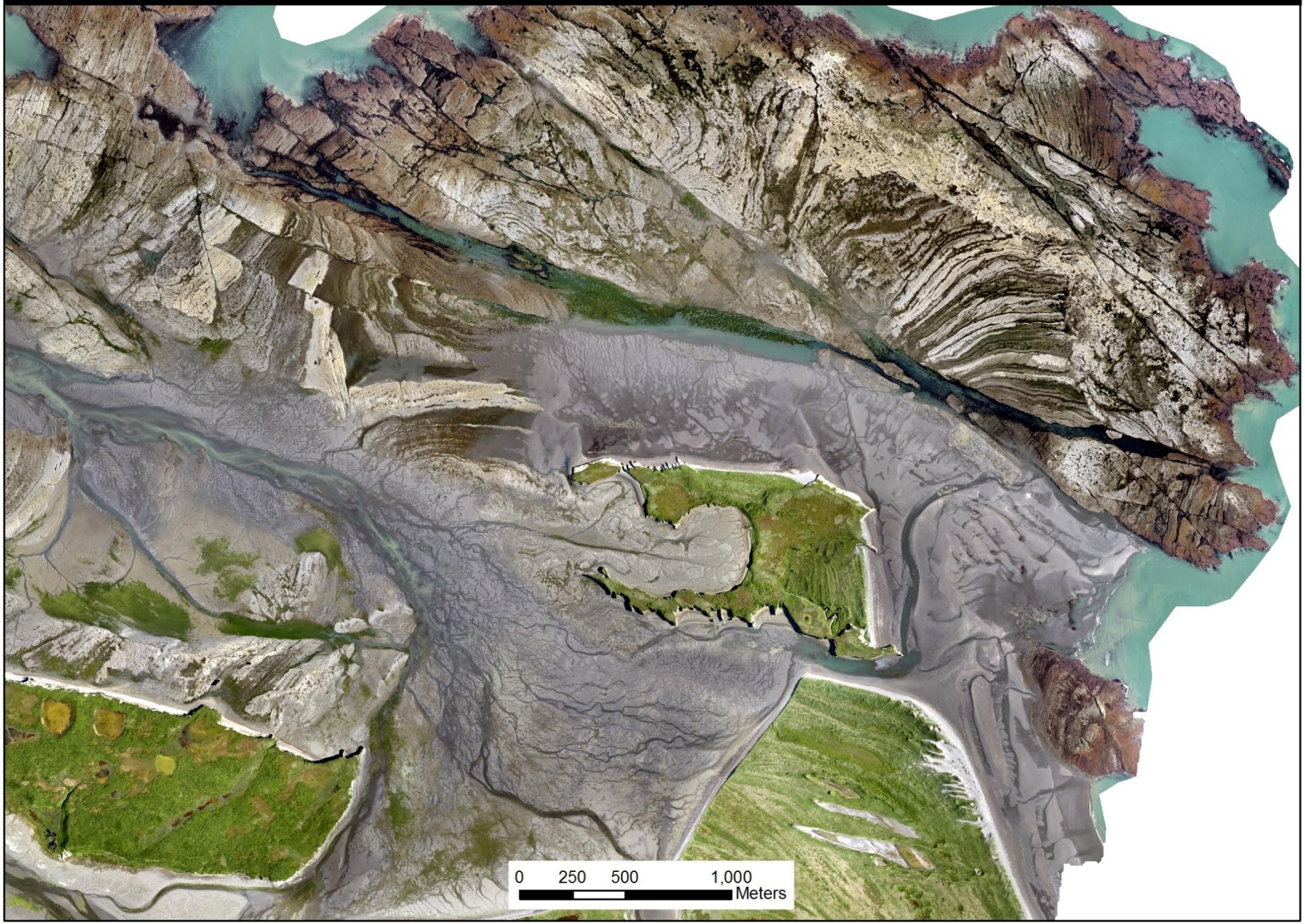


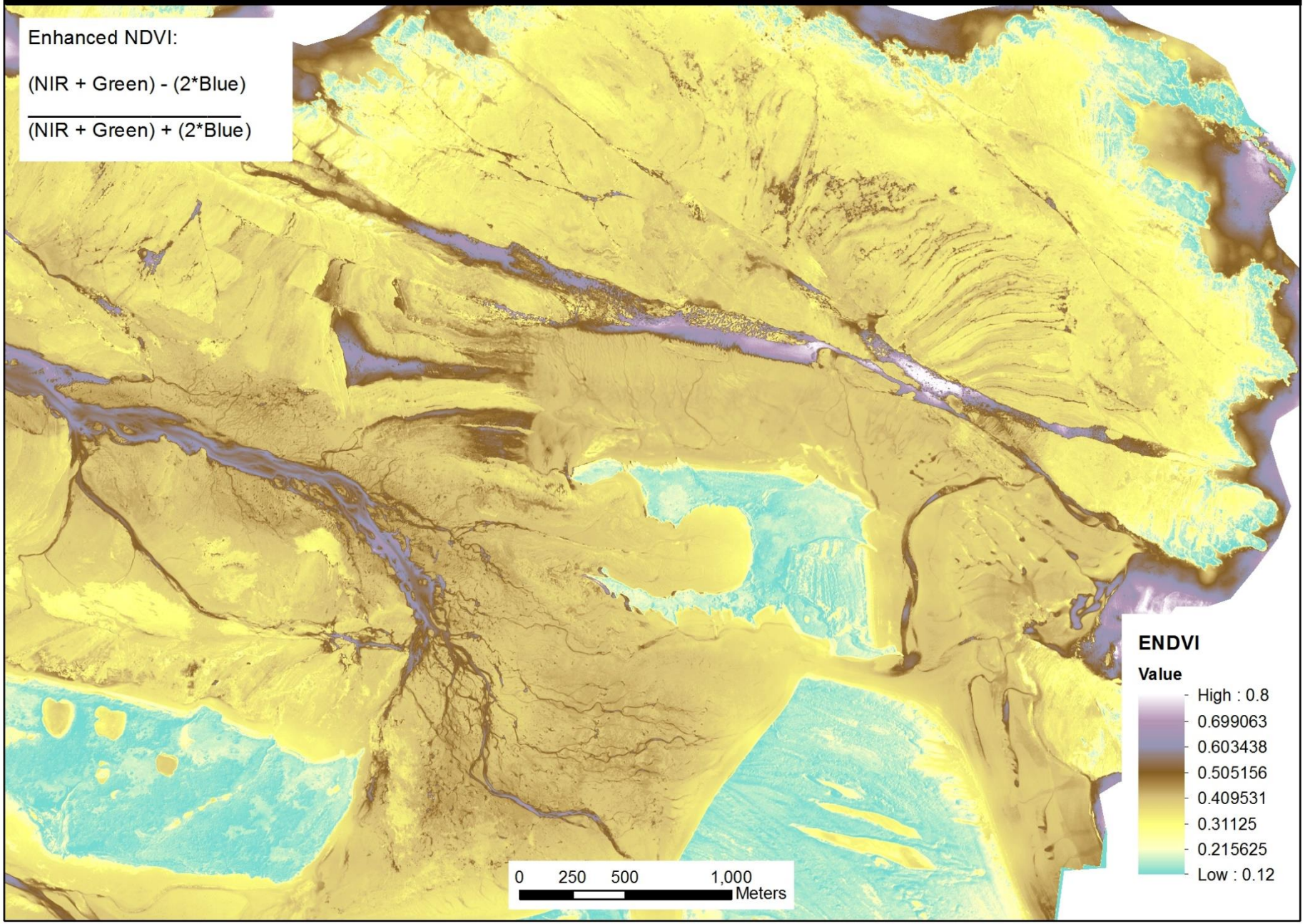
0 750 1,500 3,000
Meters


0 250 500 1,000
Meters

Douglas Reef, Kamishak Bay, Alaska



Douglas Reef, Kamishak Bay, Alaska



LIDAR for 2018

Katmai NP

- Hallo Bay
- Takli Island
- Katmai Bay

Lake Clark NP

- Silver Salmon
- Chinitna Bay

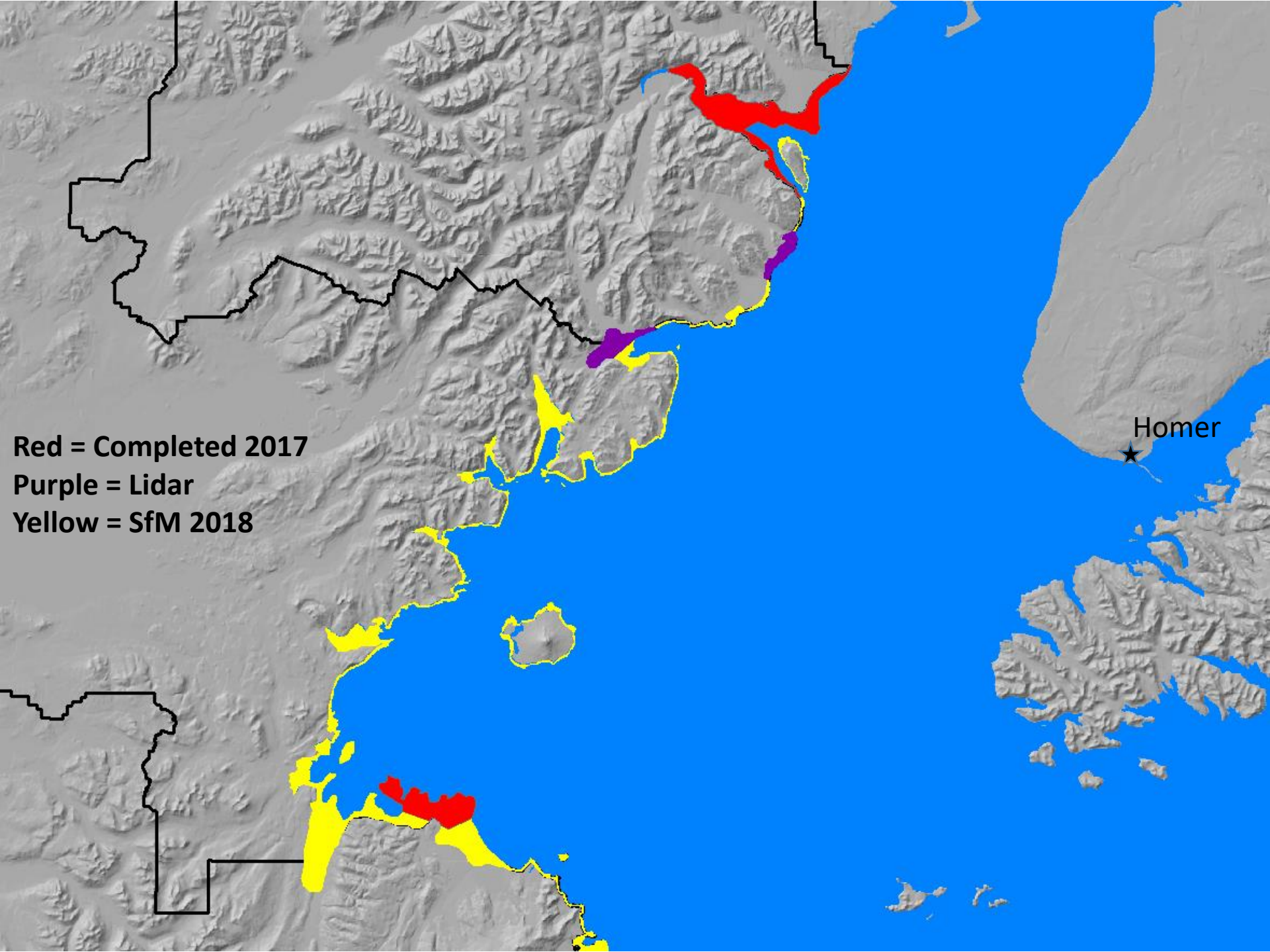
SfM for 2018

Katmai & Lake ClarkNP

- Salt Marshes
- I&M Coastal Monitoring Plots
- Complete Lower Cook Inlet

Northwest Arctic

- Seward Peninsula Outer Coasts, Lagoons, and River Mouths


Red = Completed 2017
Purple = Lidar
Yellow = SfM 2018
Homer

New SfM Acquistion Areas NW AK

2004 NOAA Lidar

2018 SfM Collection AOI

Thank You

Chad Hults, Tahzay Jones, Sarah Venator

Alaska Coastal Mapping Gaps & Priorities

For the assessment of coastal flood & erosion hazards

State of Alaska
Department of Natural Resources
Jacquelyn Overbeck

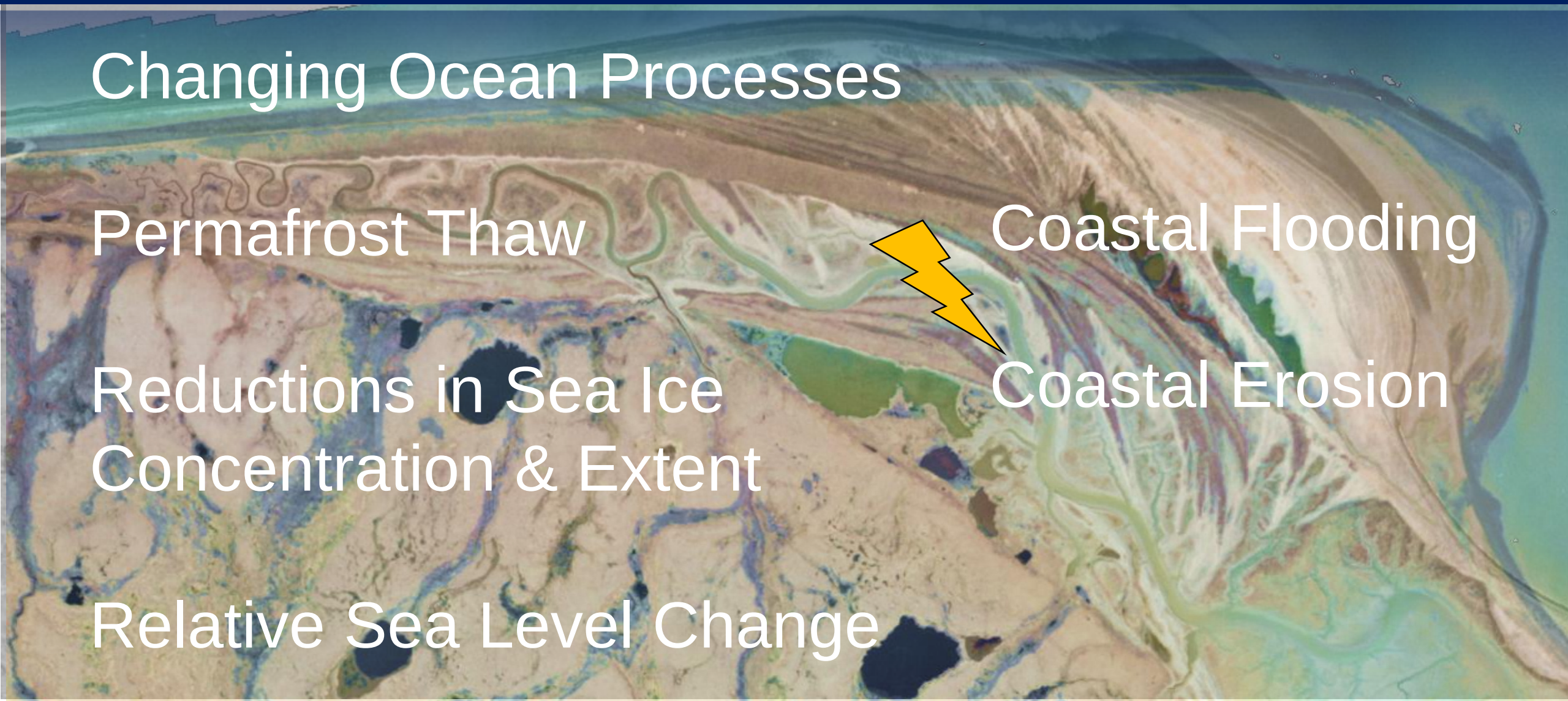
Lightning Talk

State of Alaska Coastal Hazards Program

The State of Alaska established the Division of Geological & Geophysical Surveys (DGGS) to carry out Alaska Statute 41.08.020

> "Determine the potential of Alaskan land for production of metals, minerals, fuels, and geothermal resources, the locations and supplies of groundwater and construction material, and the **potential geologic hazards to buildings, roads, bridges and other installations and structures**"

Coastal Hazards



Changing Ocean Processes

Permafrost Thaw

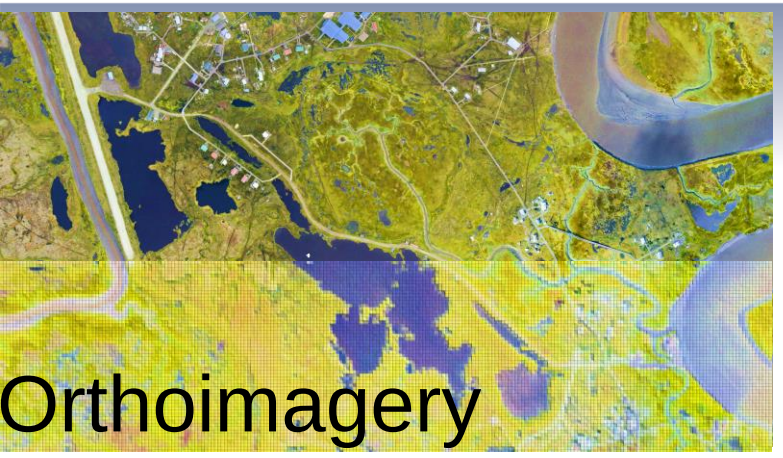
Reductions in Sea Ice Concentration & Extent

Relative Sea Level Change

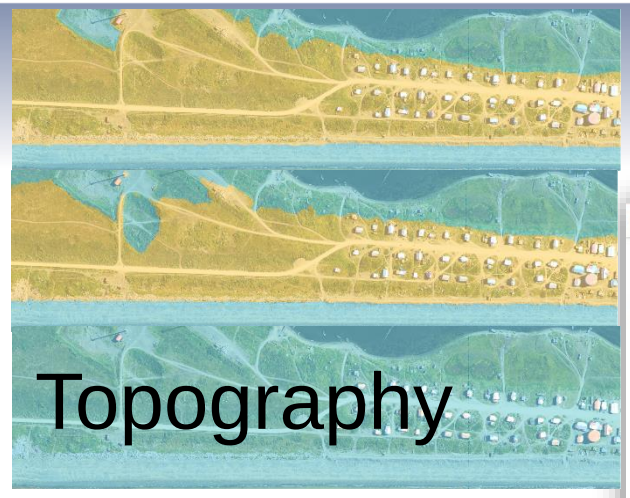
Coastal Flooding

Coastal Erosion

Coastal Mapping Baseline Datasets

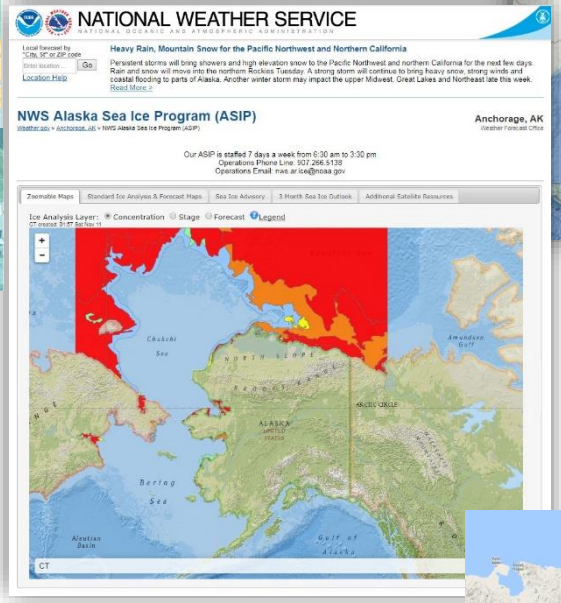


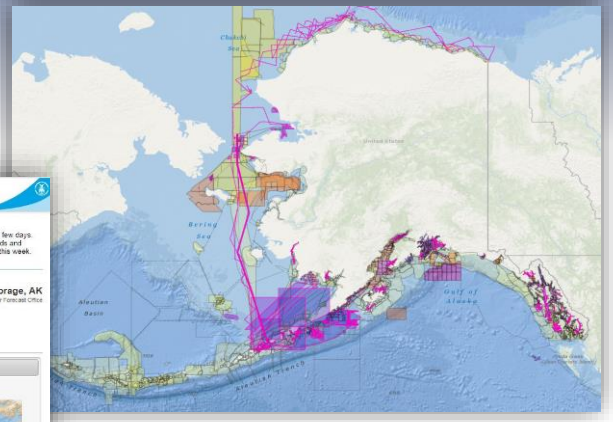
Orthoimagery



Topography

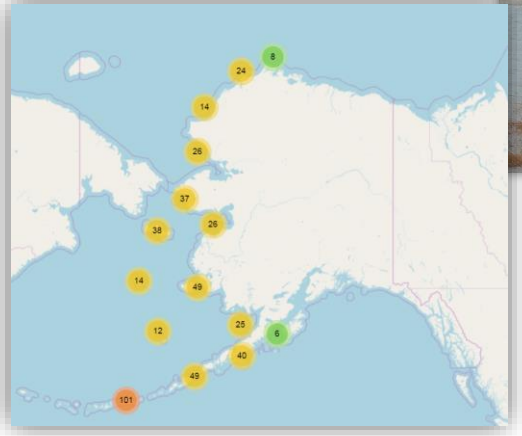
Sea Ice

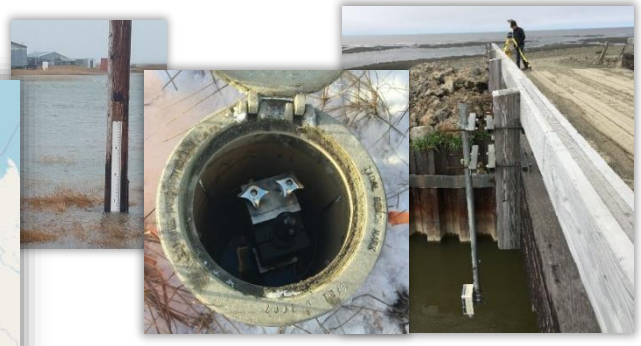




Bathymetry

Waves



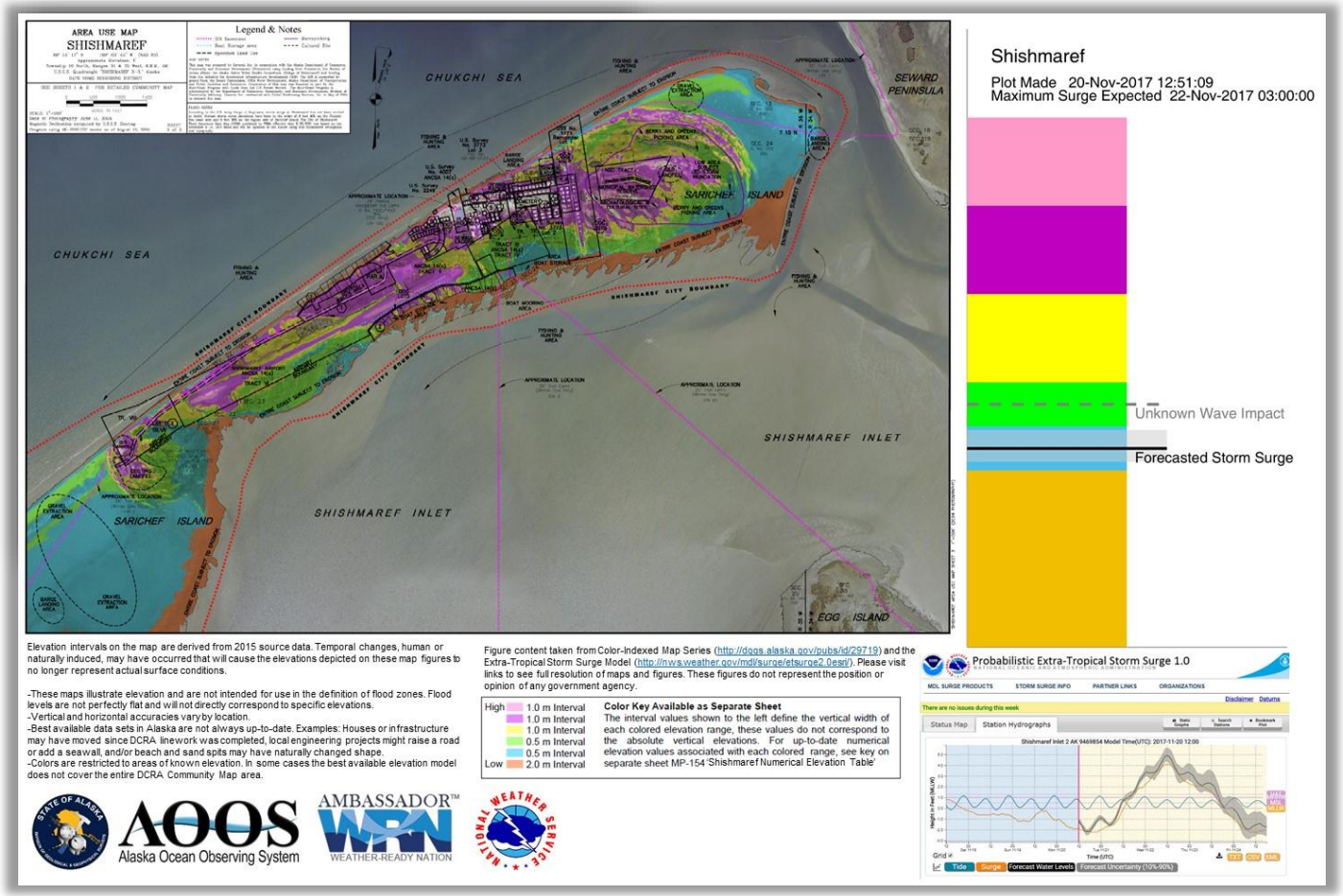


Water levels

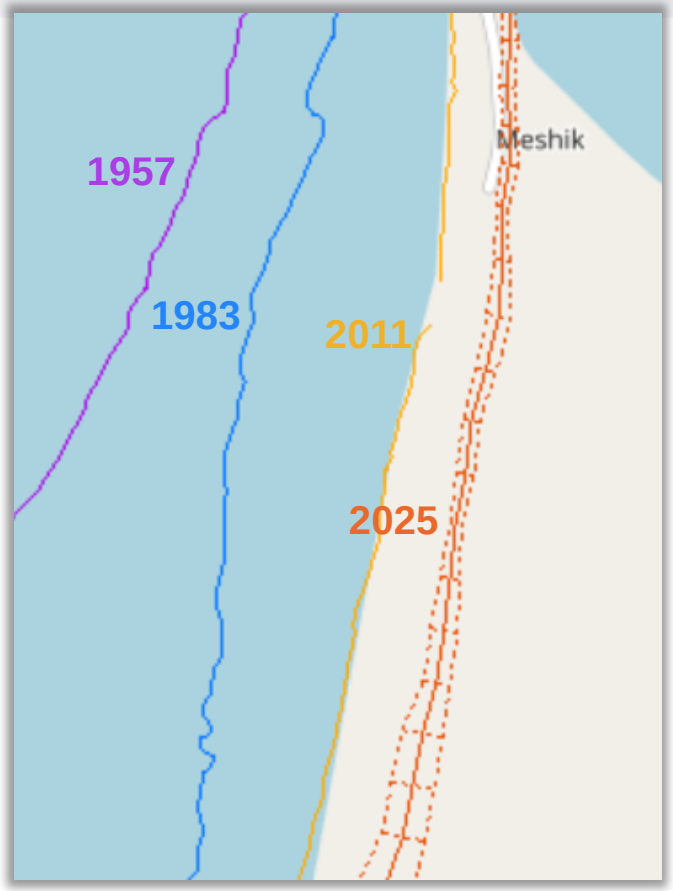
Continually Operating Reference Systems (CORS)

Coastal Hazards Mapping & Forecasting

Coastal Flooding



Coastal Erosion

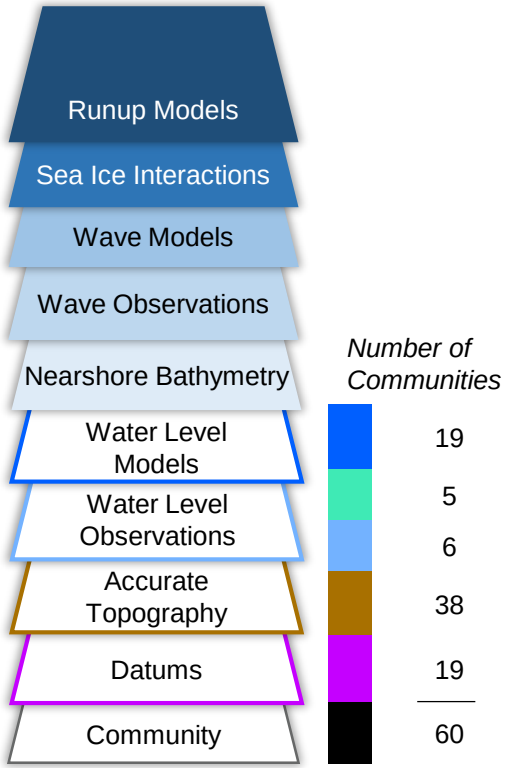


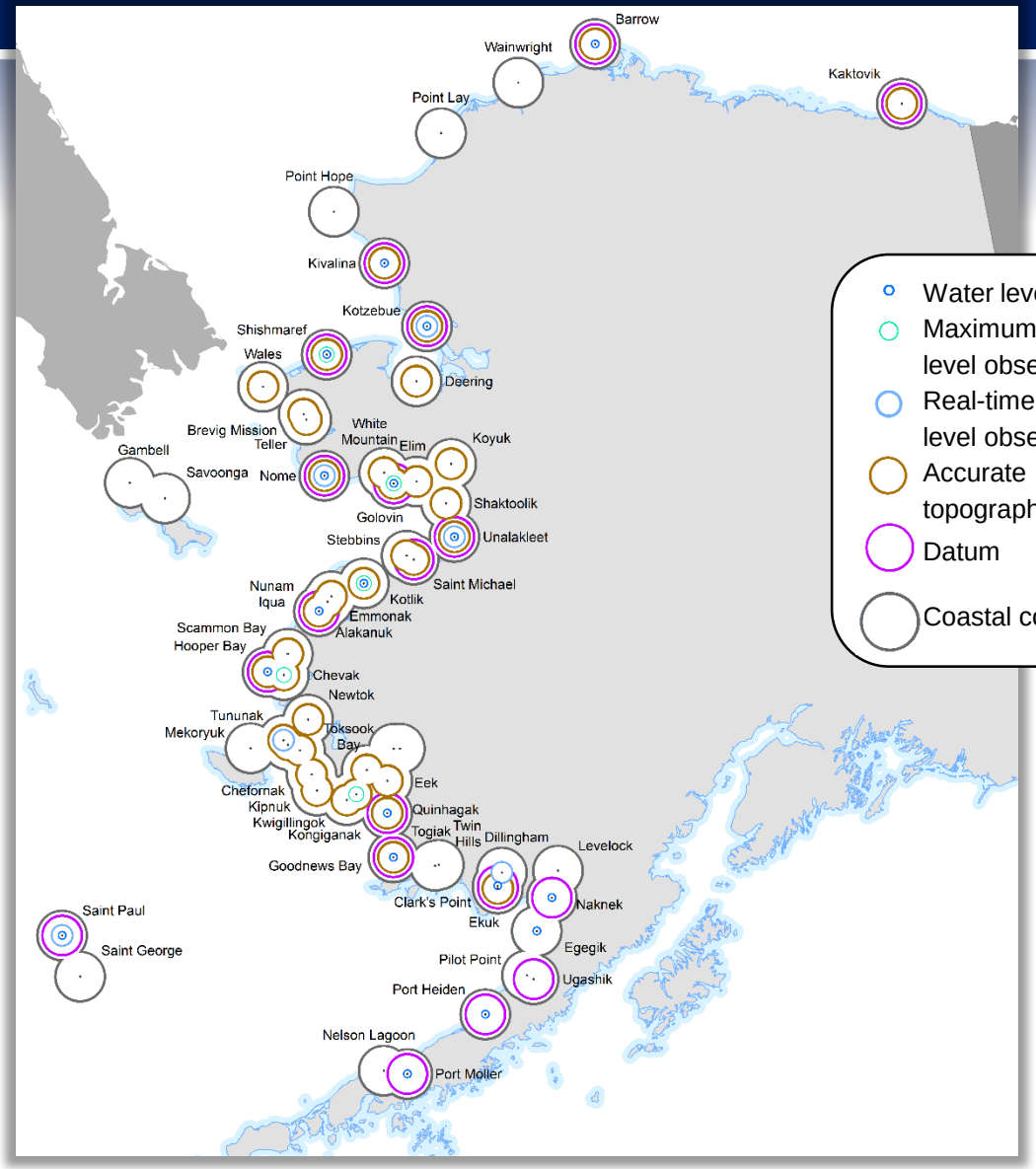
http://maps.dggs.alaska.gov/shoreline/

Flood Mapping & Forecasting

Baseline data layers used for coastal flood modeling and forecasting in northern and western Alaska communities.

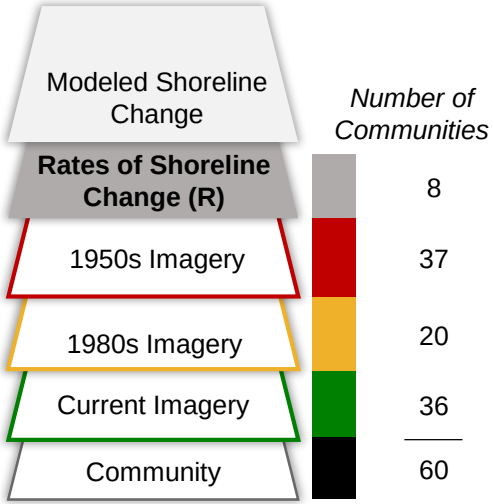
Requiring research or needed at all locations.

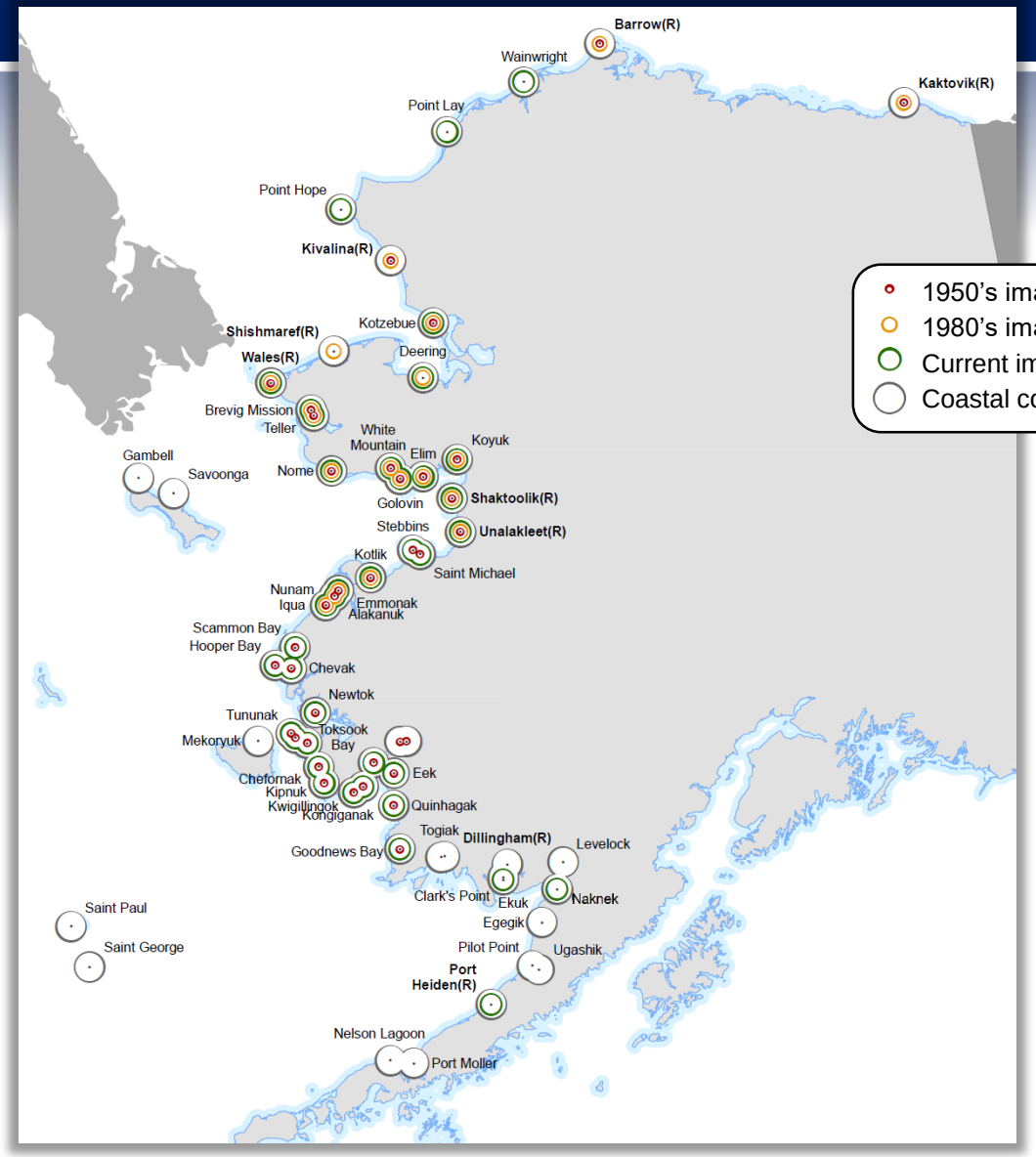




Erosion Mapping & Forecasting

Baseline data layers used for coastal erosion modeling and forecasting in northern and western Alaska communities.





Impacts on Alaskans

- Effective flood and erosion **mapping**
- Continuous and consistent flood and erosion **forecasting**
- Accurate flood and erosion **long-term modeling** and prediction

- Informed state, regional, and local community and climate adaptation planning
- Effective engineering in the coastal zone
- Disaster preparation and mitigation

For More Information

This has been a lightning version of:
Overbeck, J.R. [ed], 2018, **Alaska Coastal Mapping Gaps and Priorities for the assessment of coastal flood and erosion hazards** [in prep]: Alaska Division of Geological & Geophysical Surveys.

Jacquelyn Overbeck
State of Alaska
Division of Geological & Geophysical Surveys
Coastal Hazards Program
907-451-5026
Jacquelyn.overbeck@Alaska.gov

DENALI COMMISSION

Statewide Threat Assessment

Coastal Mapping Summit
February 9, 2018

Village Infrastructure Protection (VIP) Program

- Coordination and Facilitation vs. Implementation
- Threats: Coastal Erosion, Flooding, and Permafrost Degradation
- Impacts to Infrastructure
- GAO Report 551—2009

Photos Courtesy of Lemay Engineering

Statewide Threat Assessment Project

- Rural Communities with Population > 20
- Evaluate Erosion, Flood, and Permafrost Data
- Assign Risk Index for Each Threat
- Establish Aggregate Risk Index

US Army Corps of Engineers

CRREL

UAF UNIVERSITY OF ALASKA FAIRBANKS

Photos Courtesy of Romy Cadiente

Assessment

Criteria & Ranking	Erosion Ranking										Flood Ranking									
	Critical Infrastructure	Health & Safety	Subsistence & Shoreline Use	Geographic Location	Population Affected	Housing in Parallel	Environmental Hazard	Cultural Importance	Commercial/ Non-Residential	Baseline Erosion Ranking Score	Critical Infrastructure	Health & Safety	Subsistence & Shoreline Use	Land Use/Geographic Location	Population Affected	Housing Distribution	Environmental Hazard	Cultural Importance	Commercial Infrastructure	Flood Ranking Score
Akhiok, Native Village of	Low	Low	Low	Low	Low	Low	Low	Low	Low	32	Low	Low	Med	Low	Low	Low	Low	Low	Low	21
Akiak, Native Community	Low	Low	Low	Low	Med	Low	High	High	Med	93	Med	Low	Low	Low	Med	Low	High	High	Med	68
Akutan, Native Village of	Low	Low	Low	Low	Low	Low	Low	Low	Low	19	Med	Low	Low	High	High	Low	Med	Med	Med	68
Alakanuk, Village of	Med	Low	Low	Low	Med	Med	Med	Low	Med	93	High	Med	Low	Med	High	Med	High	Med	Med	132
Alatna Village	Low	Low	Med	Low	Low	Low	Med	Low	Low	48	Med	Low	High	Low	Low	Low	Med	Med	Low	30
Barrow, Native Village of	High	Low	Low	Med	Low	Low	Low	High	Low	84	Med	Low	Low	High	Med	Low	High	Med	High	74
Dillingham, Curyung Tribal Council (for	High	Low	Low	High	Low	Low	High	Low	Med	105	Med	Low	Low	Med	Low	Low	Med	Med	Med	29
Huslia Village	High	Low	Med	High	Low	Low	High	Low	Med	111	Med	Med	Low	Med	Med	Low	Low	Low	Low	84
Kivalina, Native Village of	High	Med	High	High	High	High	Med	High	High	153	Med	Med	Med	High	High	Med	Med	Med	Med	82
Port Heiden, Native Village of	Med	Med	Low	Med	High	Med	High	Med	Low	117	Med	Med	Low	Low	Med	Low	Low	Low	Low	27

Criteria & Ranking	Permafrost Ranking												
	Critical Infrastructure	Health & Safety	Access to Subsistence	Land Use/Geographic Location	Population Affected	Housing Distribution	Environmental Hazard	Cultural Importance	Commercial Infrastructure	Weighted Criteria Total	Confidence	Permafrost Ranking Score
Akhiok, Native Village of	None	None	None	None	None	None	None	None	None	0	***	0
Akiak, Native Community	None	None	None	None	None	None	None	None	None	0	***	0
Akutan, Native Village of	None	None	None	None	None	None	None	None	None	0	***	0
Alakanuk, Village of	Med	Low	Low	Low	Low	Med	Low	Low	Low	24	**	24
Alatna Village	Med	Low	Low	Med	Med	High	Med	Low	Low	32	**	32
Barrow, Native Village of	Med	Low	Med	High	High	High	Med	High	Med	41	***	41
Dillingham, Curyung Tribal Council (for	Low	Low	Low	Low	Low	Low	Low	Low	Low	19	***	19
Huslia Village	Med	Low	Med	Med	Med	Med	Med	Low	Low	32	**	32
Kivalina, Native Village of	Low	Low	Low	Med	Med	Med	Low	Low	Low	24	**	24
Port Heiden, Native Village of	None	None	None	None	None	None	None	None	None	0	***	0

- Erosion, Flood and Permafrost evaluated by similar criteria
- Individual condition score and certainty of evaluation determined

Objectives and Uses

- Consolidated Data
- Better Understanding of Environmental Vulnerabilities and Threats
- State and Federal Prioritization of Resources
- Scoring Criteria
- Quantify and Communicate Needs
- Inform Agency Investment Decisions

Next Steps

- Finalize evaluation criteria and determine composite indices
- Conduct public meetings in communities to “ground truth” assessment methodology
- Develop public-facing static display (ex. Google Earth kml) of assessment results
- Participate in Silver Jackets Yukon-Kuskokwim Delta Resiliency Workshop in cooperation with Western Alaska LCC.
- Determine where and how dataset will be housed and updated

Feedback / Questions

Wave and Hydrodynamic Modeling within the Nearshore Beaufort Sea

5-Year BOEM Funded Study (2017-2022)

BOEM
Bureau of Ocean Energy Management

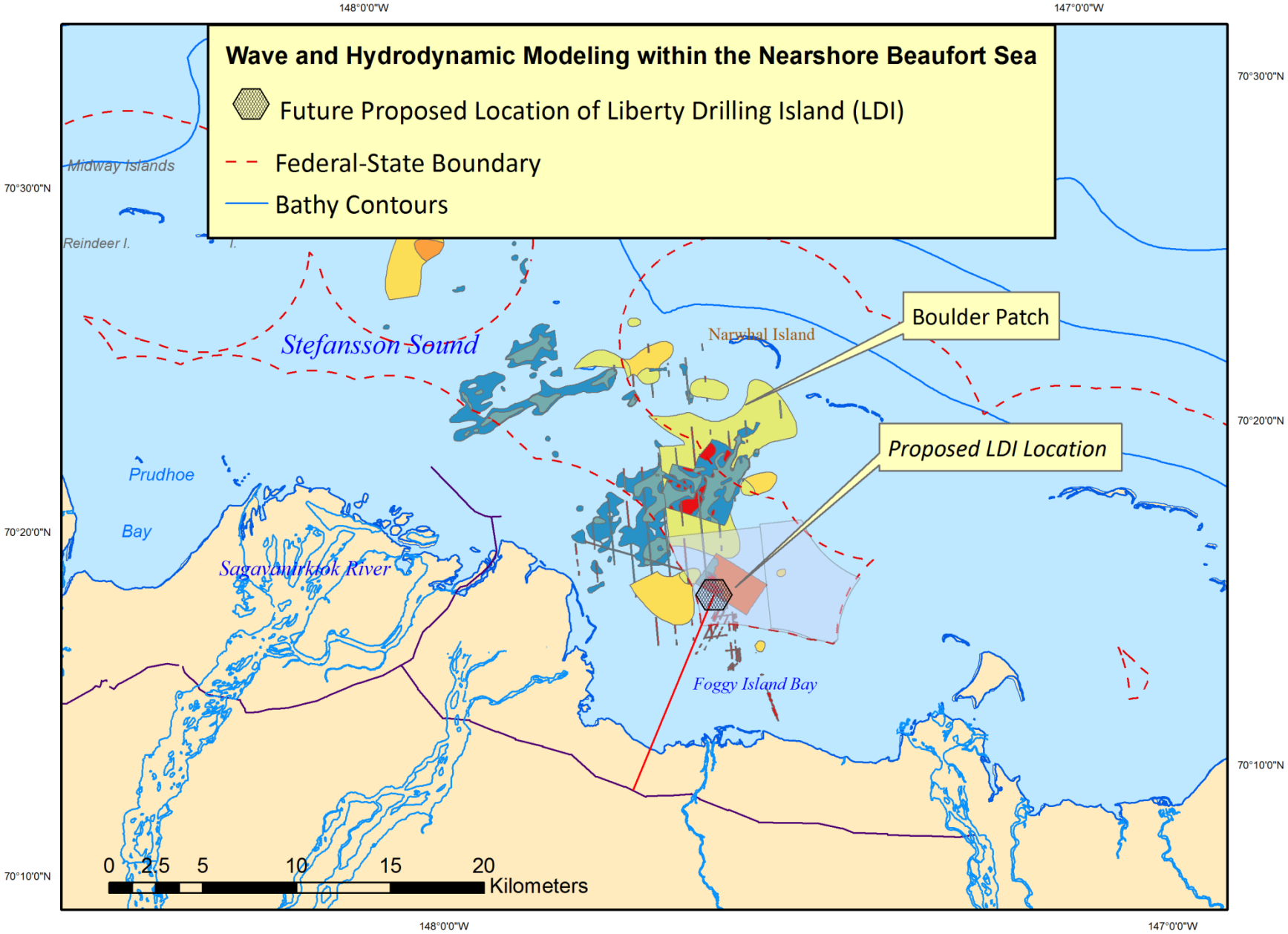
By Warren Horowitz
Project Officer

UAF University of Alaska Fairbanks

USGS science for a changing world

UAA University of Alaska Anchorage

AOOS Alaska Ocean Observing System


Wave and Hydrodynamic Modeling within the Nearshore Beaufort Sea
Future Proposed Location of Liberty Drilling Island (LDI)
Federal-State Boundary
Bathy Contours
148°0'0"W
147°0'0"W
70°30'0"N
70°20'0"N
70°10'0"N
Midway Islands
Reindeer I.
Stefansson Sound
Narwhal Island
Boulder Patch
Proposed LDI Location
Prudhoe
Bay
Sagavanirktok River
Foggy Island Bay
0 2.5 5 10 15 20
Kilometers

Why BOEM is Funding this Study?

- Hilcorp, Alaska plans to develop an offshore Oil Field in Foggy Island Bay called the Liberty Development Project.
- During the winter months, Hilcorp, Alaska will construct the offshore Liberty Development Island (LDI) in Foggy Island Bay and excavate a pipeline trench from the LDI to shore.
- Once production begins, oil will be transported to shore via a sub-seabed pipeline connecting to existing onshore infrastructure.
- The LDI will be maintained for the life of the proposed production, which is approximately 20-30 years.

What Information is BOEM going to Obtain from this Study?

- Past, present, wind, wave and storm surge conditions and outputs (1979-2019).
- Similar forecast products as ice recedes in the area (2020-2049).
- Changes in coastal erosion and sediment impacts.
- Validated wave, hydrodynamic, and sediment transport models.
- Model outputs of sediment transport and concentrations from construction activities associated with proposed Liberty Development Project and long term trends (outputs) due to expected changes in region-wide environmental conditions.

Expected Environmental Changes

Warmer Air and Water Temperatures

Diminishing Sea Ice Cover

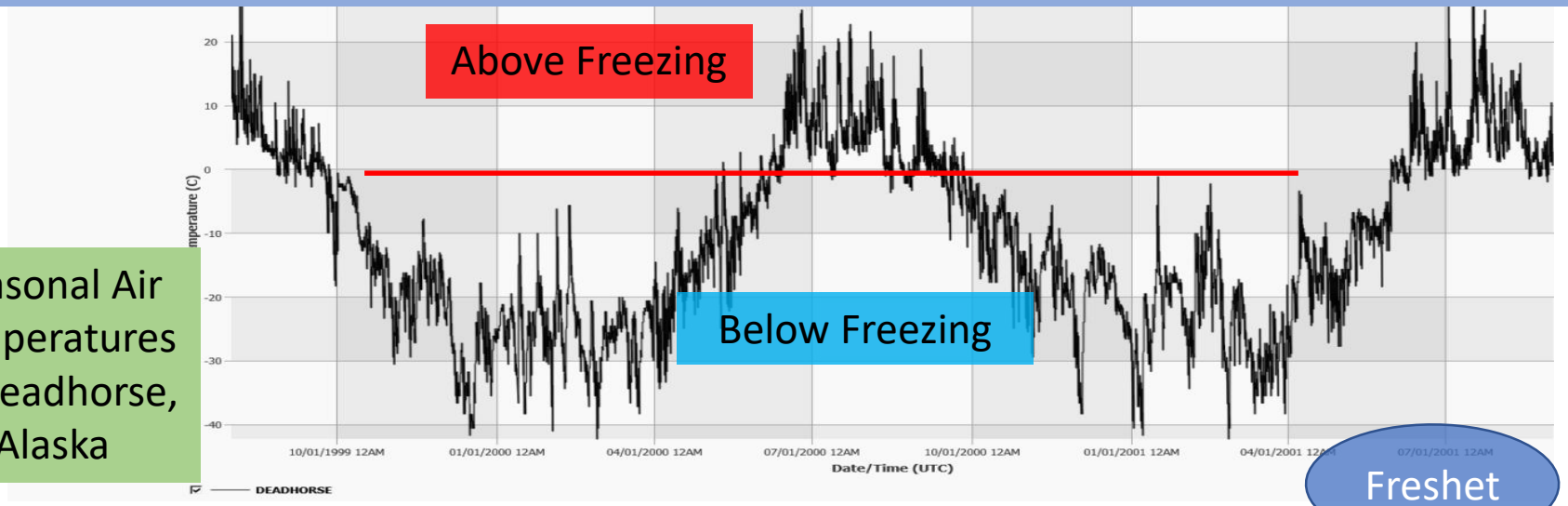
Increased Precipitation?

May lead over time to:

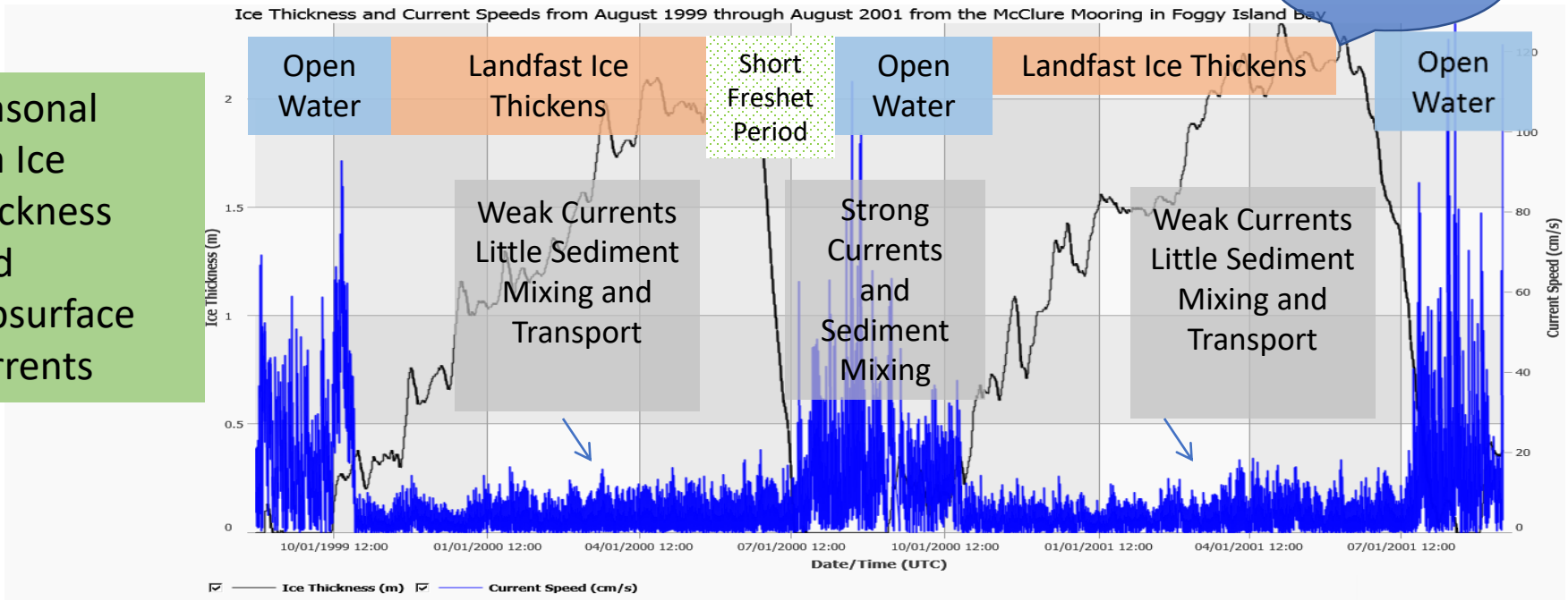
- Longer periods of open water
- Increased wave intensity and duration
- Increased storm surge extents
- Increased coastal erosion of permafrost cliffs
- Increases in fresh water and sediment flux into the coastal lagoons.

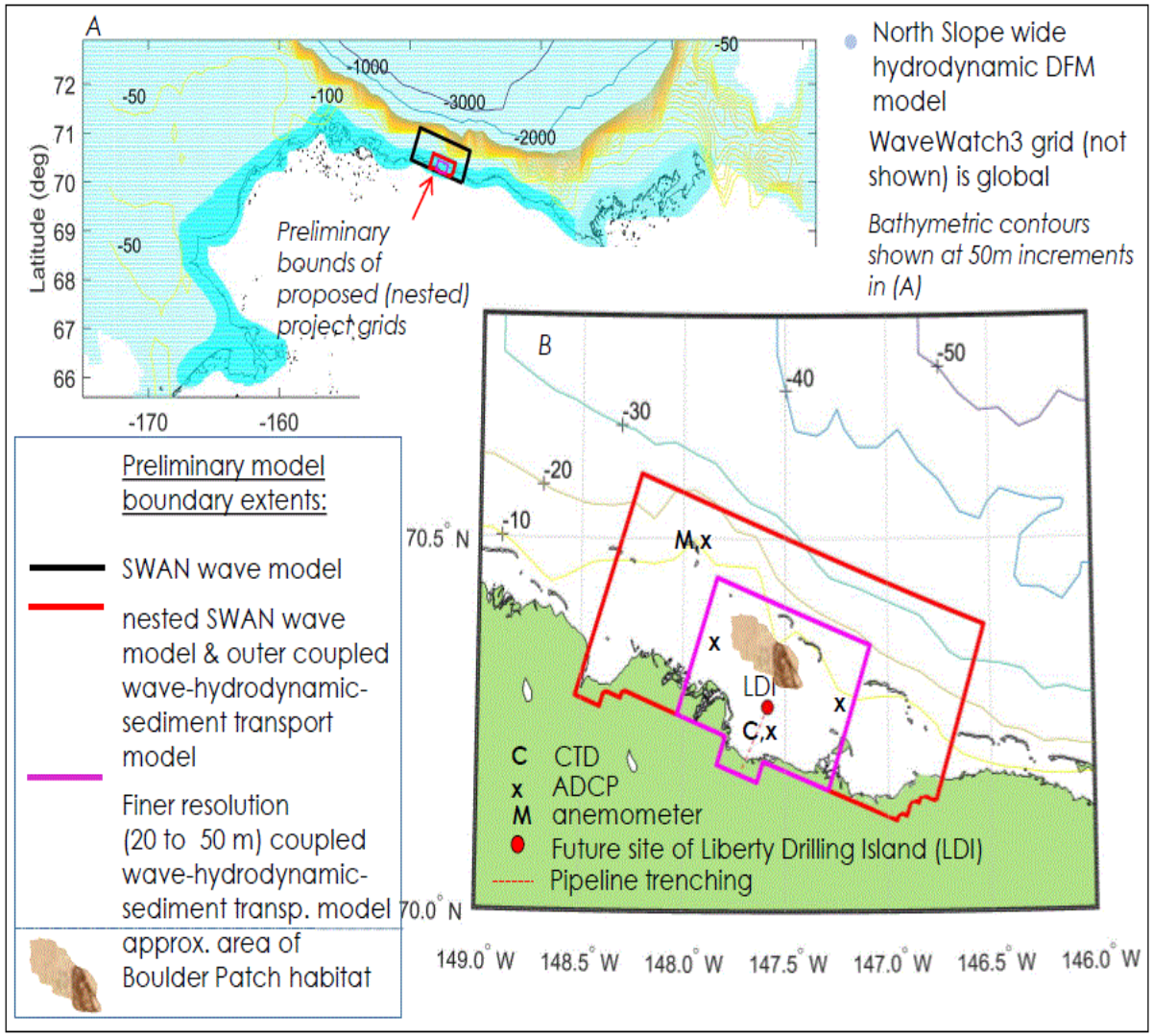
Seasonal Cycles of Landfast Ice Growth and Ablation within Foggy Island Bay 1999-2001

Seasonal Air Temperatures at Deadhorse, Alaska



Seasonal Sea Ice Thickness And Subsurface Currents





GOAL

to characterize and quantify

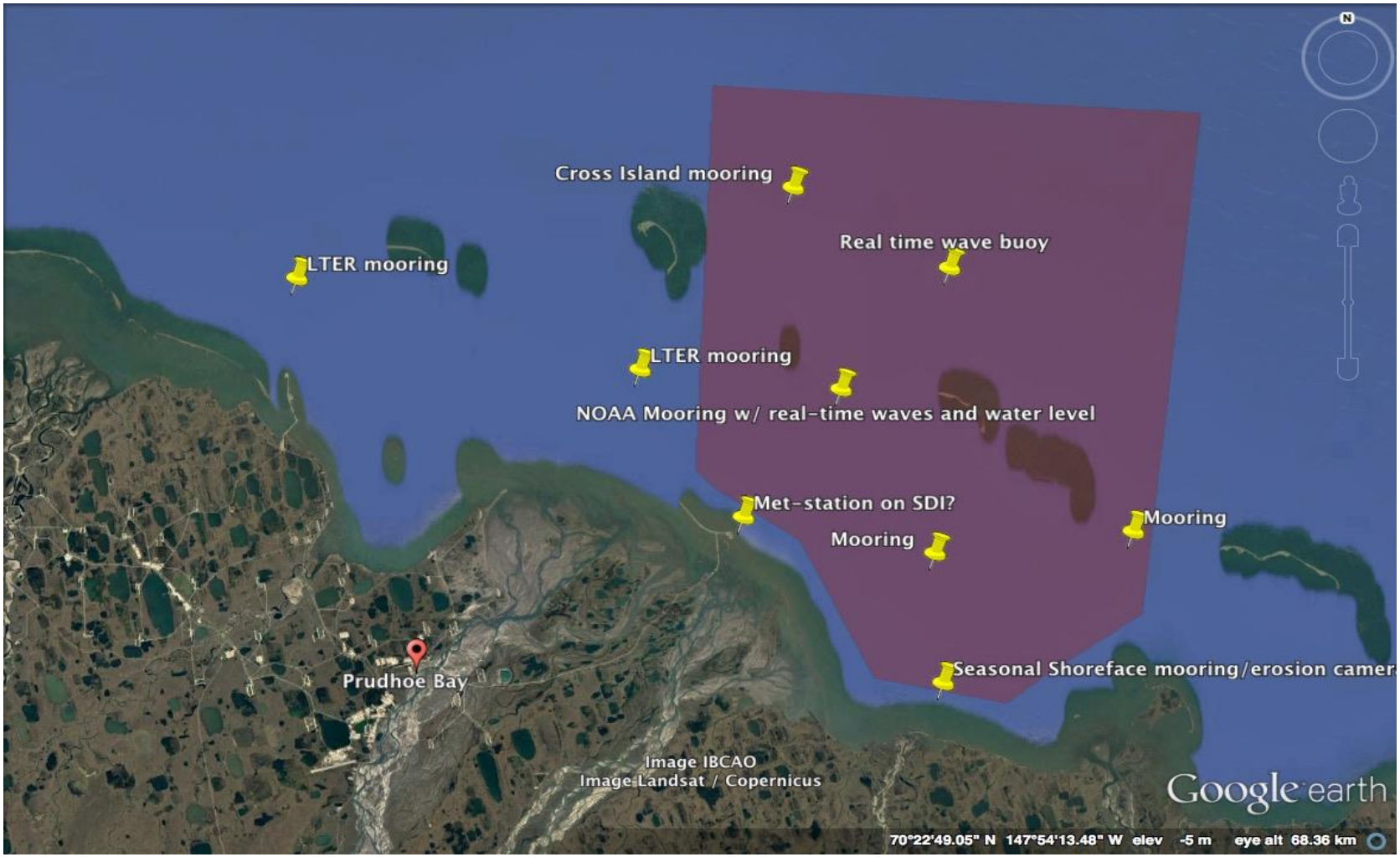
- **wave conditions, storm surge**, and **currents** (Stefansson Sound and surrounding coastline)
- **sediment transport** (Foggy Island Bay)

- ❑ **hindcast 40 years** (1979 – 2019)
- ❑ **project 30 years** into the future (2020–2049) (using projected changes in atmospheric conditions and sea ice)

Modeling

- WaveWatch (Deep Water) forced SWAN (Shallow Water) simulations.
- North Slope Wide DFM (Hydrodynamic) and WaveWatch models (40-year hindcast (1979 – 2019)
- Arctic Xbeach modeling of coastal change and the supply of sediment to the nearshore via erosion (hindcast and forecast)
- Higher resolution coupled wave-sediment-hydrodynamics simulations for select *seasonal scenarios* (**open water**, **landfast ice**, **spring freshet** and **no island(LDI)**, **artificial island (LDI**), **pipeline trenching** etc.)
- Two 30-year projections using calibrated and validated hydrodynamic, wave and sediment transport models

Planned Observations for Model Validation

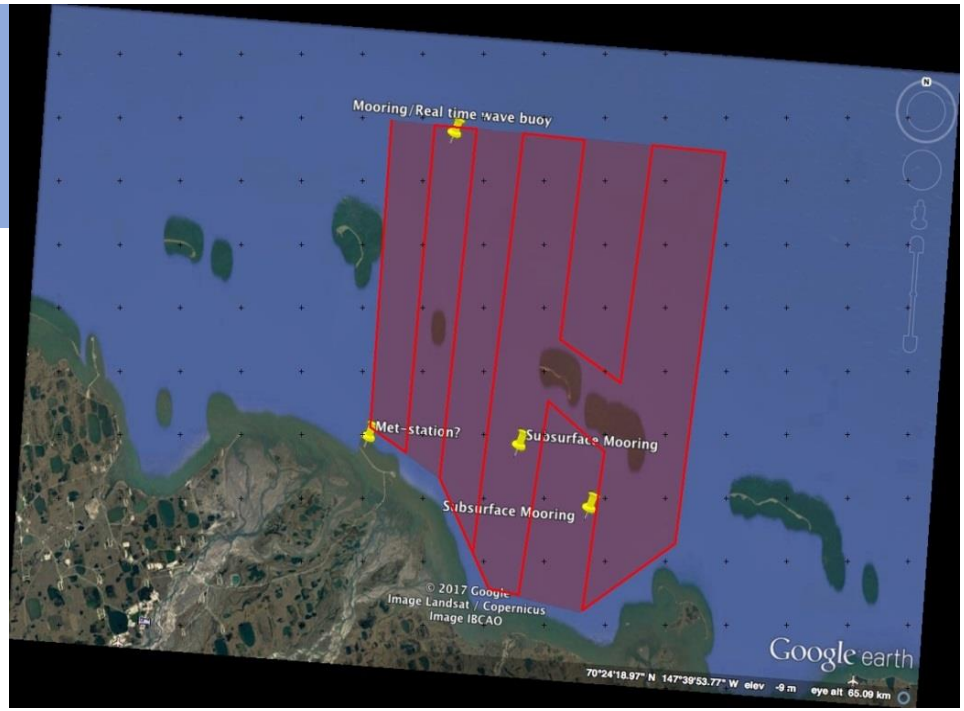


Observations for Model Validation

- **Historical data collection** *plus* **new observations** to include:
- Repeat **bathymetric surveys** to estimate bedload transport and bed elevation changes.
- **Hydrographic surveys** to map fronts, hydrography, suspended sediment and transport.
- 4 year-round **oceanographic moorings** (ADCP, CTD etc..).
- Seasonal shore face mooring to measure sediment flux.
- **Met-station**, time-lapse camera to assess coastal erosion.
- 2 **real-time wave buoys (Offshore and Nearshore)**
- **Coastal elevation** transects to quantify coastal change
- **Seasonal** through **ice measurements. (water column)**
- **(Partnering) L**ong**T**erm**E**cological**R**esearch **LTER "Beaufort Sea Lagoons: An Arctic Coastal Ecosystem in Transition"**

Tentative Field Schedule

- ~9 days of CTD, multi-beam sonar surveys and mooring deployments in 2018, 2019 from the R/V Ukpik.
- Most of the vessel-based work concentrated in- and around- Foggy Island Bay (red shaded area)
- Final mooring recoveries in 2020
- Real-time wave data Summer/Fall 2018 and 2019
- Real-time met station (location TBD)



Multiple Collaborators

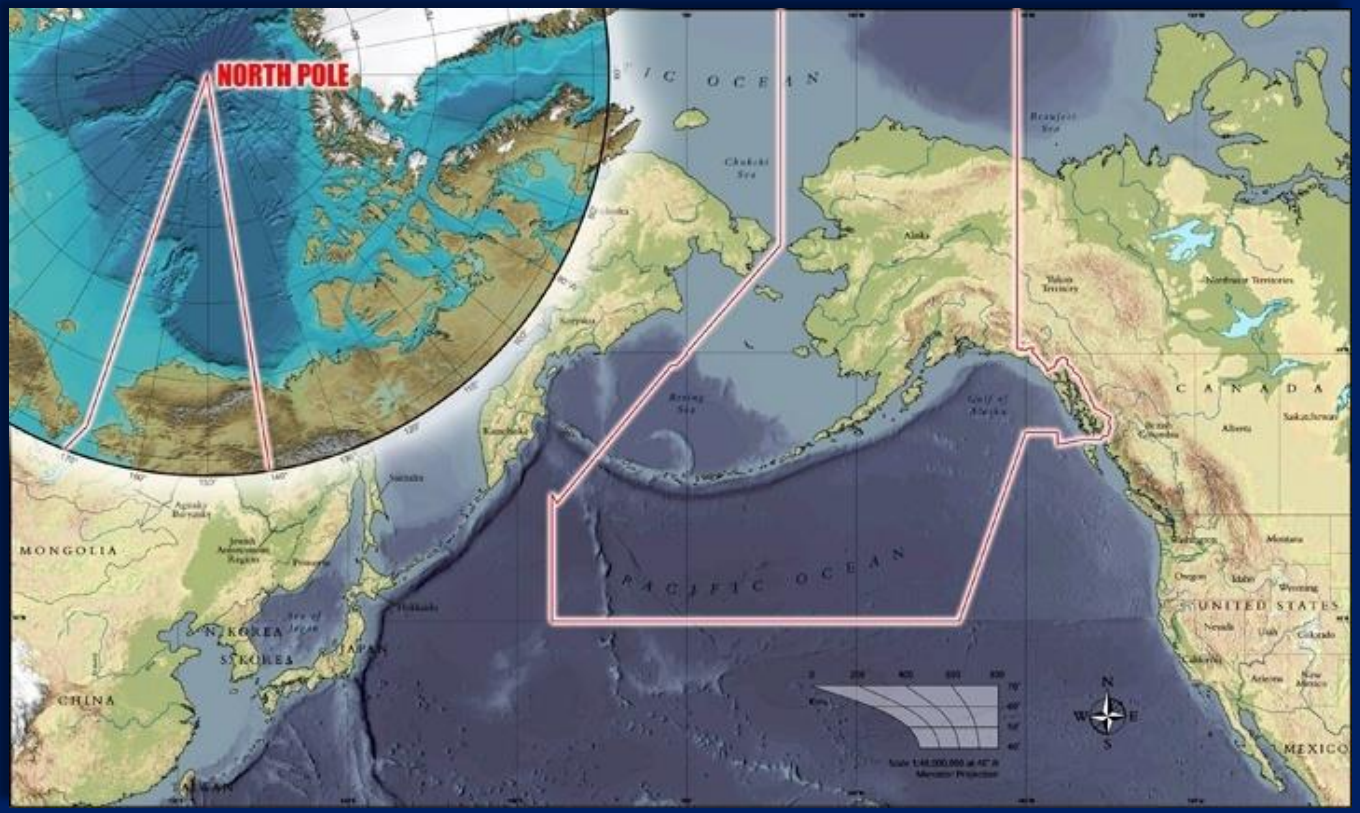
- **University of Alaska Fairbanks (INE and IARC)**
  - UAF: Project Management, Observations of waves, sediment transport and hydrography, model validation
  - IARC: Dynamical downscaling of hindcast and forecast GCM output
- **USGS Pacific Coastal and Marine Science Center**
  - Wave, sediment transport, surge and hydrodynamic modeling (hindcast and forecast), Model validation
- **University of Alaska Anchorage**
  - Modeling of coastal erosion, sediment characterization and sediment transport observations
- **Alaska Ocean Observing System and Axiom Data Science**
  - Project Website, Data Compilation and Management and Outreach

U. S. Coast Guard Seventeenth District Brief

IWG-OCM Alaska Coastal Mapping Summit, Feb 2017

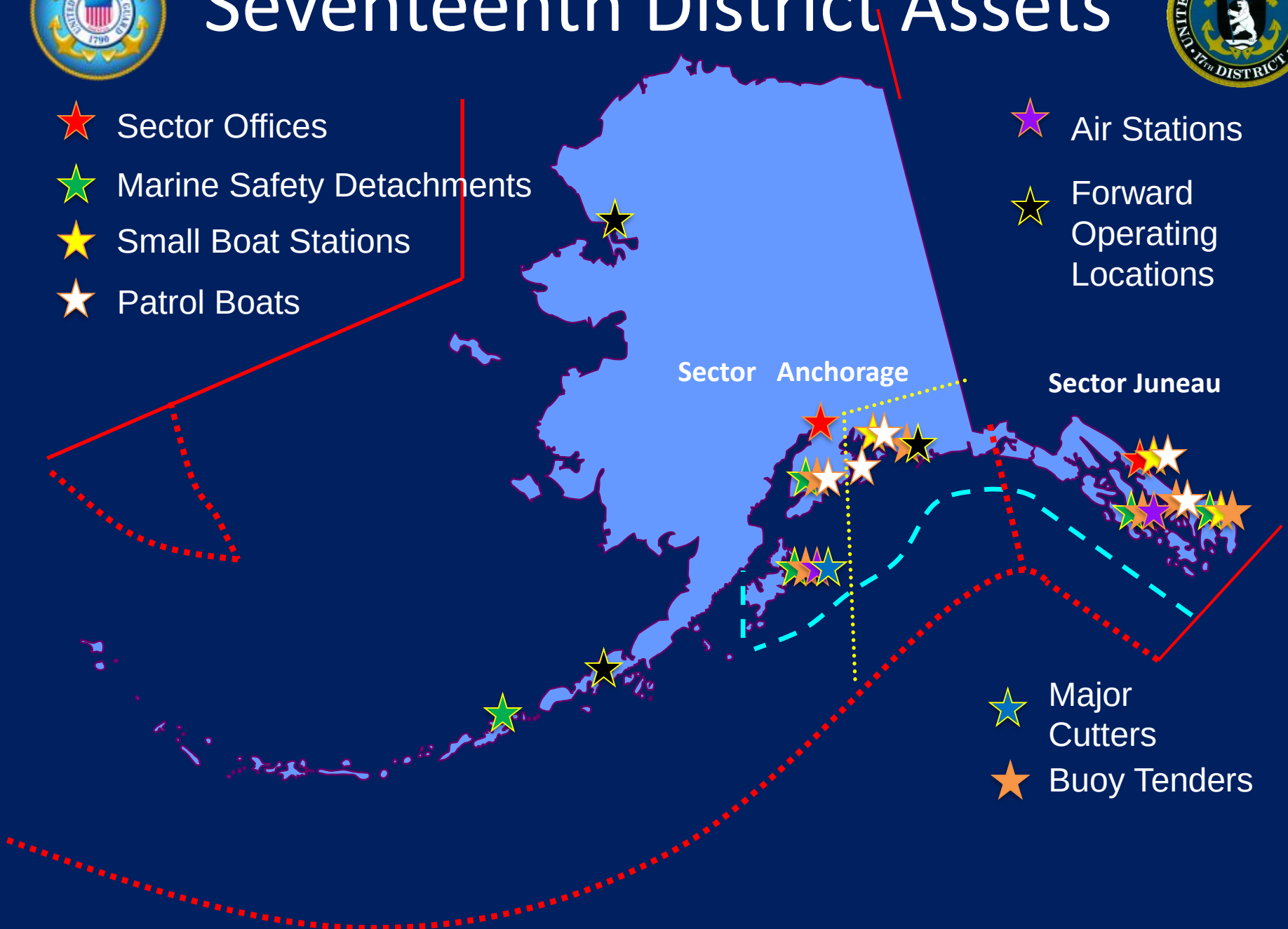
We Stand the Watch
on the Last Frontier

Seventeenth District



2,500 active duty, reserves, auxiliarists & civilians support operations in Alaska encompassing 3,853,500 sq. miles and more than 44,000 miles of coastline.

Seventeenth District Assets



Coast Guard Arctic Strategy

D17 Supporting Operational Activities

– **Improving Awareness**

- D17 Arctic Fusion Center
- Arctic Domain Awareness Center
- Information sharing with Canada/DoD

– **Modernizing Governance**

- Port Access Route Study
- Polar Code outreach
- Arctic Waterways Safety Committee

– **Broadening Partnerships**

- International Coordination (oil spills, search and rescue, fisheries)
- Tribal engagement
- Federal/State/local coordination
- Support to Arctic commissions, councils, etc.

- ***Perform Coast Guard missions in the Arctic – SAR, environmental protection, aids to navigation, science support, marine safety***

Typical Arctic Shield Force Lay-Down

Cutter/Air Ops

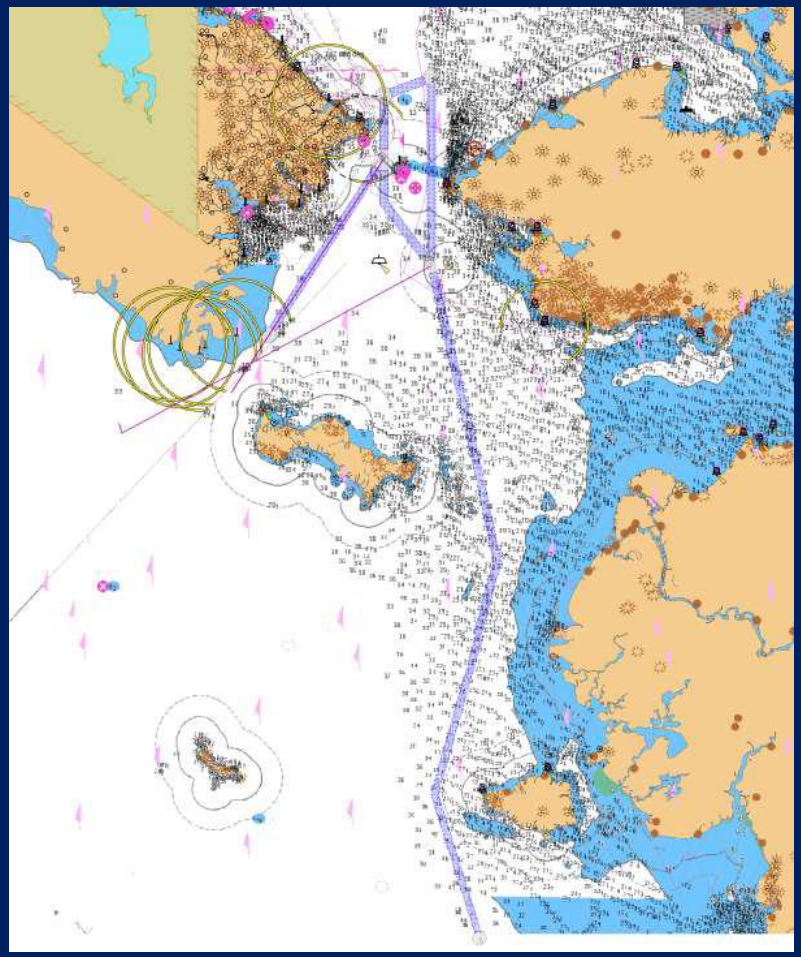
- High Endurance Cutter
- Medium Endurance Cutter
- Sea Going Buoy Tender
- Polar Ice breaker
- Rotary/Fixed Wing Aircraft

Multiple Missions

- Law Enforcement
- Response Operations
- Sovereignty Presence
- Command/Control
- Defense Support
- Community Relations
- Aids To Navigation
- Scientific Support

Port Access Route Studies

- Bering Strait PARS:
  - Four-mile-wide two-way route from Unimak Pass through Bering Strait.
  - "Areas to Be Avoided" established around areas of heightened environmental concern.
  - Russian Participation led to joint proposal to IMO for adoption.
  - Extensive assistance from NOAA OCS to survey proposed route.

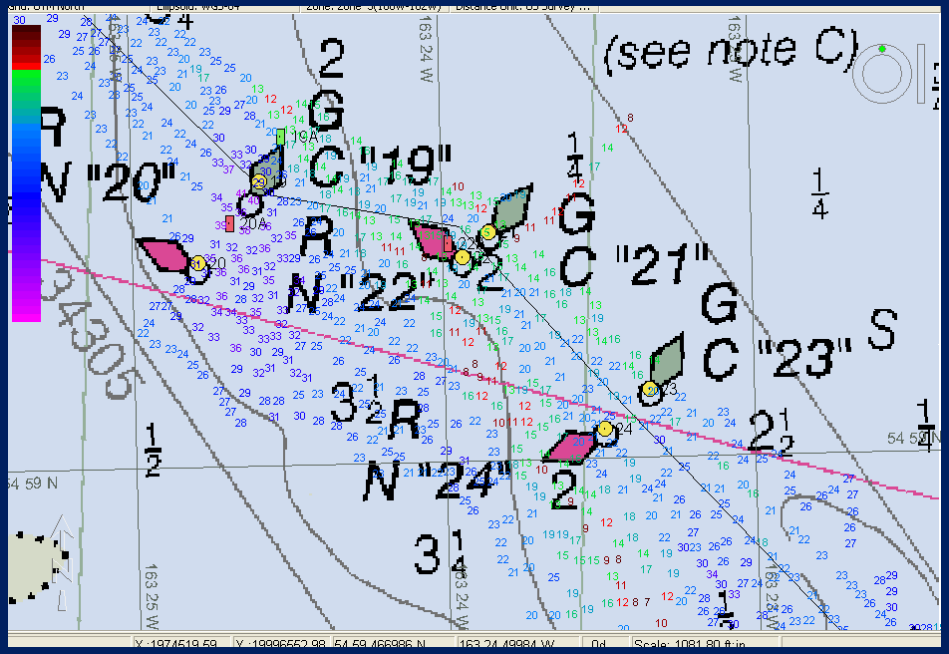


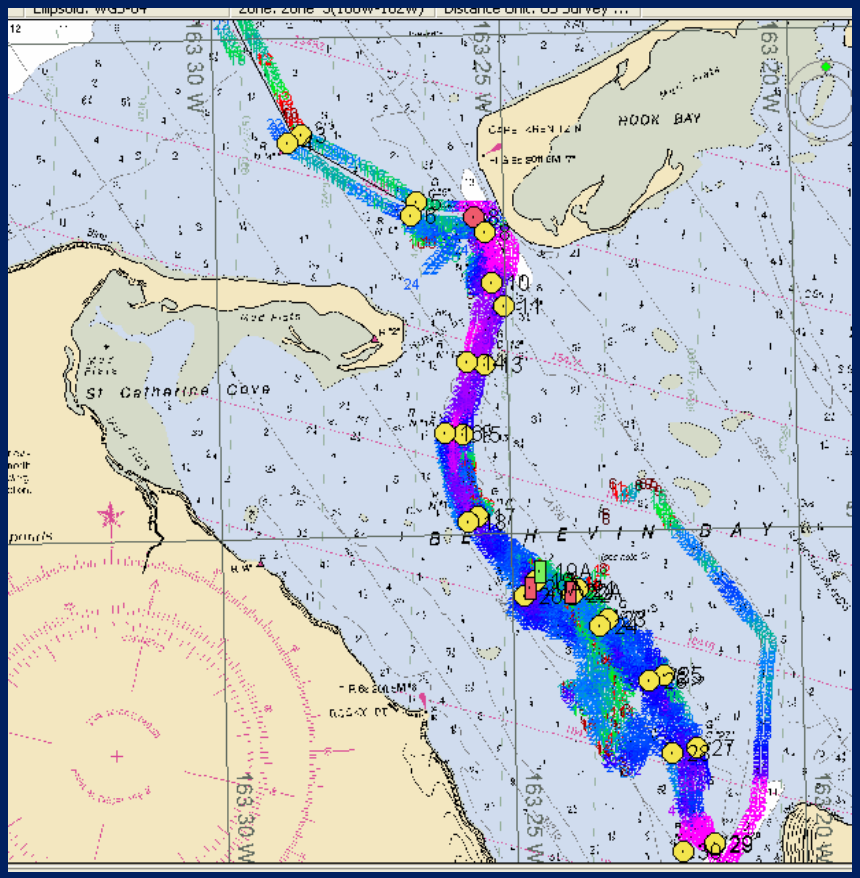
Shallow Water Aids to Navigation Ops

- USCG Maintains seasonal buoys in shallow draft waterways:
  - Local areas surveyed by boat using HYPAC.
  - Data files exported to cutter navigation suite to prevent grounding.

Shallow Water Aids to Navigation Ops

- Example from False Pass & Bechevin Bay:
  - Composite representation from ~2 days of boat surveys.
  - Data is used to reposition buoys depending on shoaling.





- 3 buoys relocated to mark deepest water, about 165 yards wide.

Questions?

Seventeenth Coast Guard District

Standing the watch on the last frontier yesterday, today and tomorrow

COASTAL RESILIENCE AND ADAPTATION WORKSHOPS

Identified needs linked with mapping

Karen Murphy
Western Alaska LCC & USFWS
On behalf of the primary organizing and funding partners:

2016 Coastal Resilience & Adaptation Workshops

- Four western Alaska regions
  - Northwest Arctic
  - Bering Straits
  - Bristol Bay
  - Aleutians/lower AK Peninsula
- Southeast AK

- Over 300 participants
- Product highlights
  - Posters
  - Reference document of 'tools'
  - Database of science, management and policy needs

Jointly assess relevant issues

Profound Changes in Alaska's Coastline "Our Homes, Our Way of Life"

Coastlines provide Alaska's most life-filled environments. From shallow near shore waters, to tidelands, beaches, bluffs, bays, lagoons, estuaries and deltas, this thin slice of Alaska supports a disproportionately large share of our state's fish and wildlife as well as most of our communities. These fantastically rich coastal environments – the places where the land meets the ocean – are particularly vulnerable to climate change.

Much Warmer Temperatures! (from mostly below to more & more often above freezing)

- THAWING PERMAFROST
- MELTING SEA ICE & more "fetch" - increasing expanses of open ocean
- STRONGER STORMS
- MELTING GLACIERS + WARMER OCEAN = RISING SEAS

→ MORE WAVES & FLOOD WATERS HITTING THAWING SHORELINES

→ **BIG IMPACTS ON PEOPLE, COMMUNITIES, HABITATS:** Shoreline & stream erosion; silting up rivers, changes in lagoons, & estuaries, challenges for subsistence species, & travel

PHASE CHANGE:
Welcome to a New World

- From 1970–2015, northwestern Alaska **warmed two and a half times faster** than the global average (+7.3 °F/ vs. +3.0 °F / century).
- Future average regional temperature is likely to **increase by +7° F by the 2040s and +13° F by the 2080s**.
- These changes are enormous, **equal to or greater than the magnitude of change from the ice ages to our current climate**.
- **The Bottom Line:** These changes mean a transition from an environment with average temperature 10°F below freezing, no trees, where humans and wildlife rely on predictable sea ice, to one where **the average annual temperature is above freezing**, trees can grow, and spring and fall sea ice is rare, if it exists at all.

MELTING SEA ICE
"If I can't hunt for walrus I lose the heart of what I teach my grandchildren" *Nome Participant*

- **What's Changing?** The shift in temperatures from mostly below to often above freezing is driving dramatic changes in sea ice.
- **Impacts?** Sea ice is critical to life in the Arctic. The lives of walrus, seals, and whales are directly linked to sea ice, and sea ice gives people a safe platform for hunting and fishing. Declining sea ice will require new subsistence strategies to keep food on the table and sustain traditional practices at the heart of Alaska Native cultures.

COMMUNITY LIFE AT THE MELTING EDGE OF CLIMATE CHANGE
"Shishmaref is our home, it's where our heart is" *(Shishmaref resident quoted in New York Times)*

- **What's Changing?** Shishmaref is one of many Alaska coastal villages hit by a climate change quadruple threat: thawing permafrost; intensifying storms; rising sea levels, and less shorefast sea ice to buffer shorelines from storm waves.
- **Impacts?** These changes are combining to wash away land, buildings, roads, fuel storage tanks, airports and other infrastructure, forcing communities to try to defend in place or relocate.

ROCKY ISLANDS
"Animals are migrating different and we need to change the hunting seasons and practices so that we can get our fish and game" *King Salmon*

- **What's Changing?** Coastal erosion is not only a problem in low lying communities underlain by permafrost, like Shishmaref or Shaktoolik. Islands in the Aleutians and St Paul Island in the central Bering Sea are also seeing accelerating coastal erosion, driven by intensifying storms and changes in the direction of wind and storm driven waves.
- **Impacts?** Erosion in Unalaska has removed traditional clamming beaches. Storm waves are threatening the locations of two St Paul roads, the community health center and a graveyard. To track these changes, St Paul is a leader in using locally based monitoring – the Bering Watch program – where local residents monitor and quantify change using low cost, but scientifically valid methods.

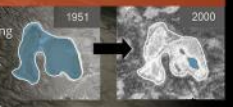
"We're seeing more deaths every year as people risk travel for food and fall through the ice" Nome participant

"For the first time ever we have beavers, and they're polluting our village water supply" Kotzebue participant

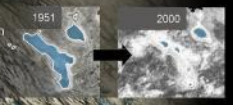
"Most of our communities are based on edge of highly productive estuaries – and they're really changing" Nome participant

"Historic and archaeological sites are being eroded; barrier islands and spits are being eroded" Unalaska participant

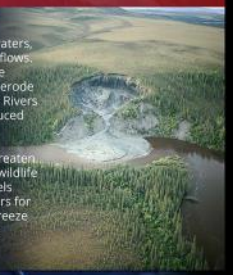
SHRINKING LAKES, DRYING WETLANDS
"The tundra is so dry – now it crunches when you walk" *Kotzebue Participant*



- **What's changing?** Coastal lakes and adjoining wetlands are drying, due to higher temperatures, smaller winter snowpacks, and thawing permafrost.
- **Impacts?** Shrinking lakes impact, fish, birds, wildlife and people. In Kotzebue, the city's water comes from a shallow lake normally replenished by melting snow. With precipitation switching from snow to rain the lake dries in early summer and the city now must find and fund a costly new water source.



CHANGING RIVERS, COASTAL LAGOONS, & ESTUARIES
"Lagoons, coastal rivers are incredibly rich and productive – and they're being hammered by climate change" *Kotzebue participant*



- **What's Changing?** Estuary and lagoon productivity is being disrupted by rising sea waters, storm surge, new vegetation, and freshwater flows. Rivers – the highways for people and fish – are changing as warmer temps thaw permafrost, erode banks, and spill silt and gravel into riverbeds. Rivers are warming and water levels falling with reduced snowpacks and changing rainfall.
- **Impacts?** Changes in coastal waterways threaten rearing habitats for the rich array of fish and wildlife using these unique resources. Low water levels harm coastal communities dependent on rivers for barge resupply and travel. Rivers also don't freeze as they have in the past, making winter travel dangerous or impossible.

RISING WATERS & FLOODING COASTLINES: WE NEED BETTER DATA!
"There are more tidal data stations in Chesapeake Bay than all of Alaska" *King Salmon Participant*

- **What's Changing?** As glaciers melt and warmer marine waters expand, ocean levels are projected to rise 1-3 feet by 2100. But the ocean doesn't rise uniformly like a bathtub, with local variations driven by topography, erosion rates, isostatic rebound, tides and storms. To be prepared for rising waters, Alaska needs vastly improved data, including storm and wave patterns, bathymetry, current sea levels, and coastal topography.

This project was a collaborative effort of many partners, led by Aleutian Pribilof Islands Association, Inc and the Aleutian Bering Sea Islands and Western AK Landscape Conservation Cooperatives, working with Agnew::Beck Inc. and the U. of Washington Center for Environmental Visualization. Funding was provided by the Bureau of Indian Affairs and U.S Fish and Wildlife Service. To get involved, citations or more information, see adaptalaska.org. Thanks to over the 200 people who contributed to these posters! Sept 2017

Connections to 'mapping'

- Ocean to Land Connections
  - Nearshore bathymetry, high resolution topography, tidal benchmarks/water levels
- Biological/ecological baseline information
- Projections of potential changes of distribution/abundance for species/ecological communities
- Ice (nearshore, thickness, patterns)
- ShoreZone
- Scalable and locally refined

"Land is not only part of our soul; it's what literally feeds us: berries, caribou, fish. We must maintain the environment so we have those things. Our goal is to still be here. We eat the berries, the caribou, the moose, the fish – being able to conserve those resources, maintain clean water for fish habitat – that's what we talk about is that we are still here. That's our goal."
(King Salmon workshop)

Questions?

Contact information:

Karen Murphy
karen_a_murphy@fws.gov
907-786-3501

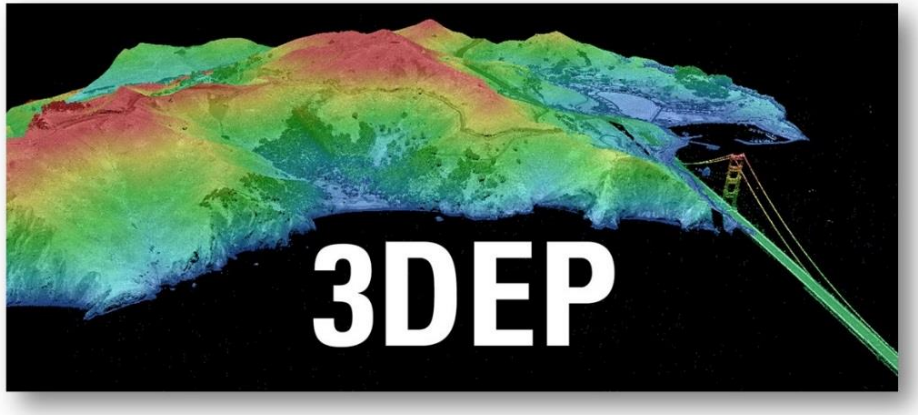
Information about Landscape Conservation Cooperatives in Alaska/NW Canada:

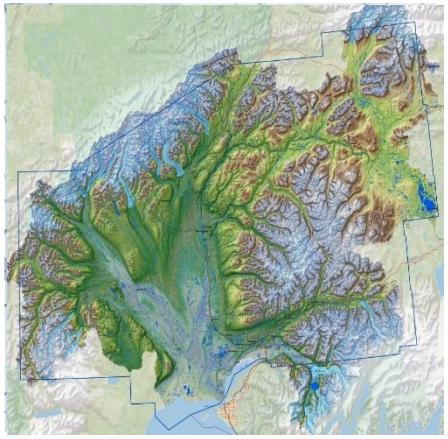
http://www.northernlatitudes.org/

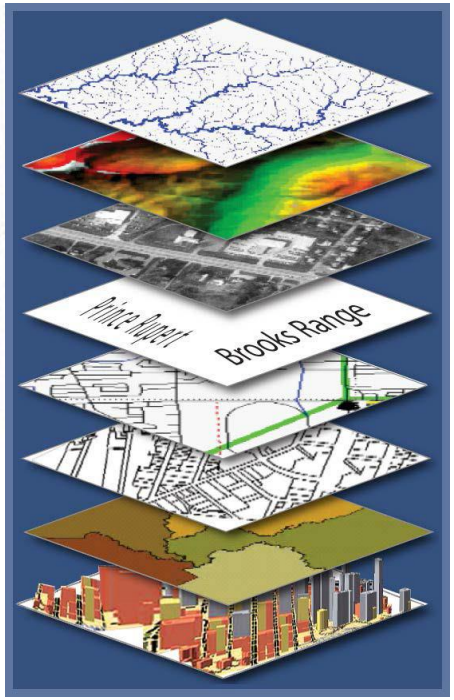
Information from the workshops

http://adaptalaska.org/

US Geological Survey Partnerships for Elevation Data







National Geospatial Program

USGS science for a changing world

The National Map
Your Source for Topographic Information

Brian Wright
National Map Liaison – Alaska
February 9, 2018

+ National Map Liaison Roles

- Engage partners to produce consistent and accurate data and services
- Network to create and maintain long-term partnerships
- Leverage funding across organizations cost savings and
- Reduce redundancy
- Assist with the availability of common base data to a broad range of users and applications
- Representation of Alaska Mapping needs via Alaska Mapping Executive Council (AMEC) and Alaska Geospatial Council (AGC)

Alaska Mapping Initiative - goal is to acquire and enhance foundational digital map layers such as elevation and hydrography used to produce new US Topo maps for Alaska.

+ 3D Elevation Program

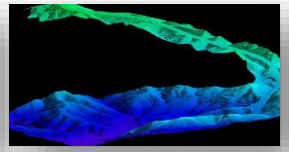
- Proceeds the National Elevation Dataset – NED
- Leverage collaboration among Federal, states, local, and tribal partners to systematically complete national 3D data coverage in 8 years
- Address the mission-critical requirements of 34 Federal agencies, 50 states, and a sampling of local governments, tribes, private and not-for profit organizations documented in the **National Enhanced Elevation Assessment (NEEA)**
- *Leverage the capability of private industry mapping firms and create jobs*
- Refresh national elevation data holdings with new lidar and IfSAR (Alaska) elevation data products and services **Alaska Mapping Initiative (AMI)**

Natural Resource Conservation

Infrastructure Management

Flood Risk Mitigation

Precision Farming


Land Navigation and Safety

Geologic Resources and Hazards Mitigation

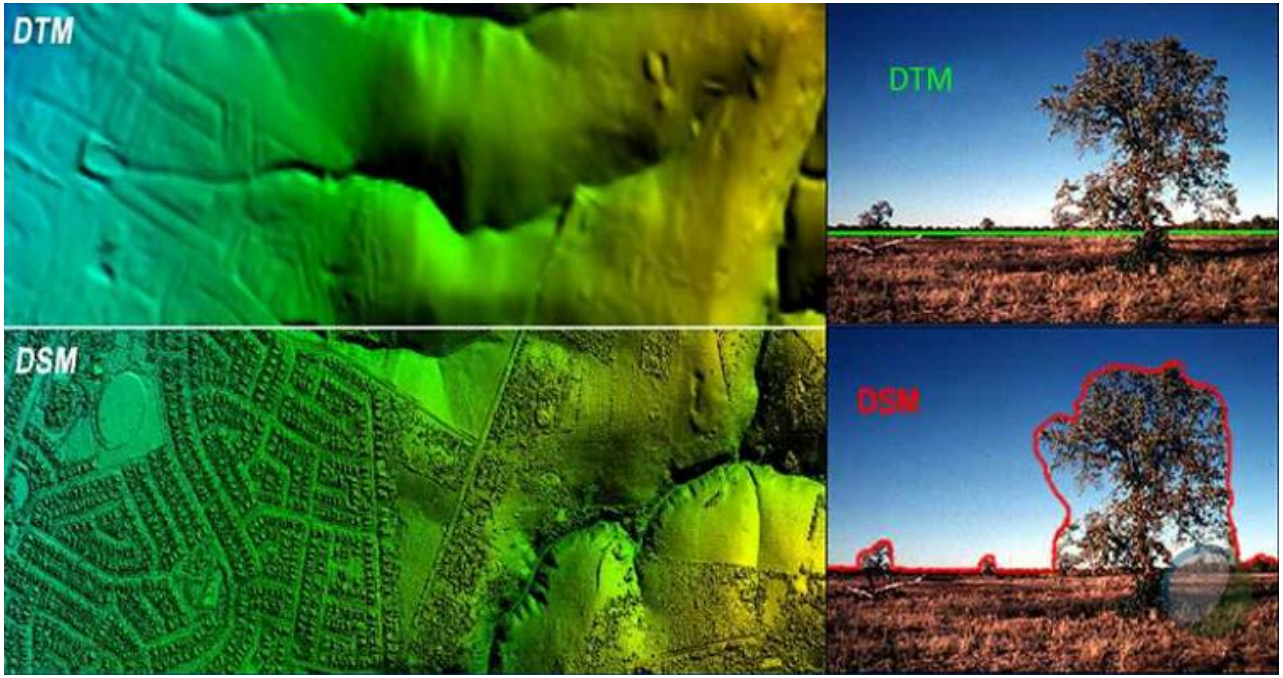
USGS science for a changing world

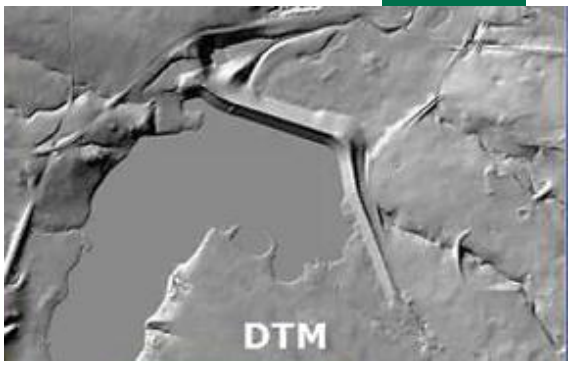
The National Map Your Source for Topographic Information

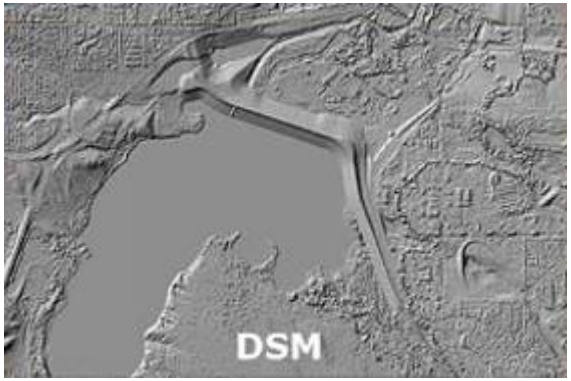
+ Interferometric Synthetic Aperture Radar

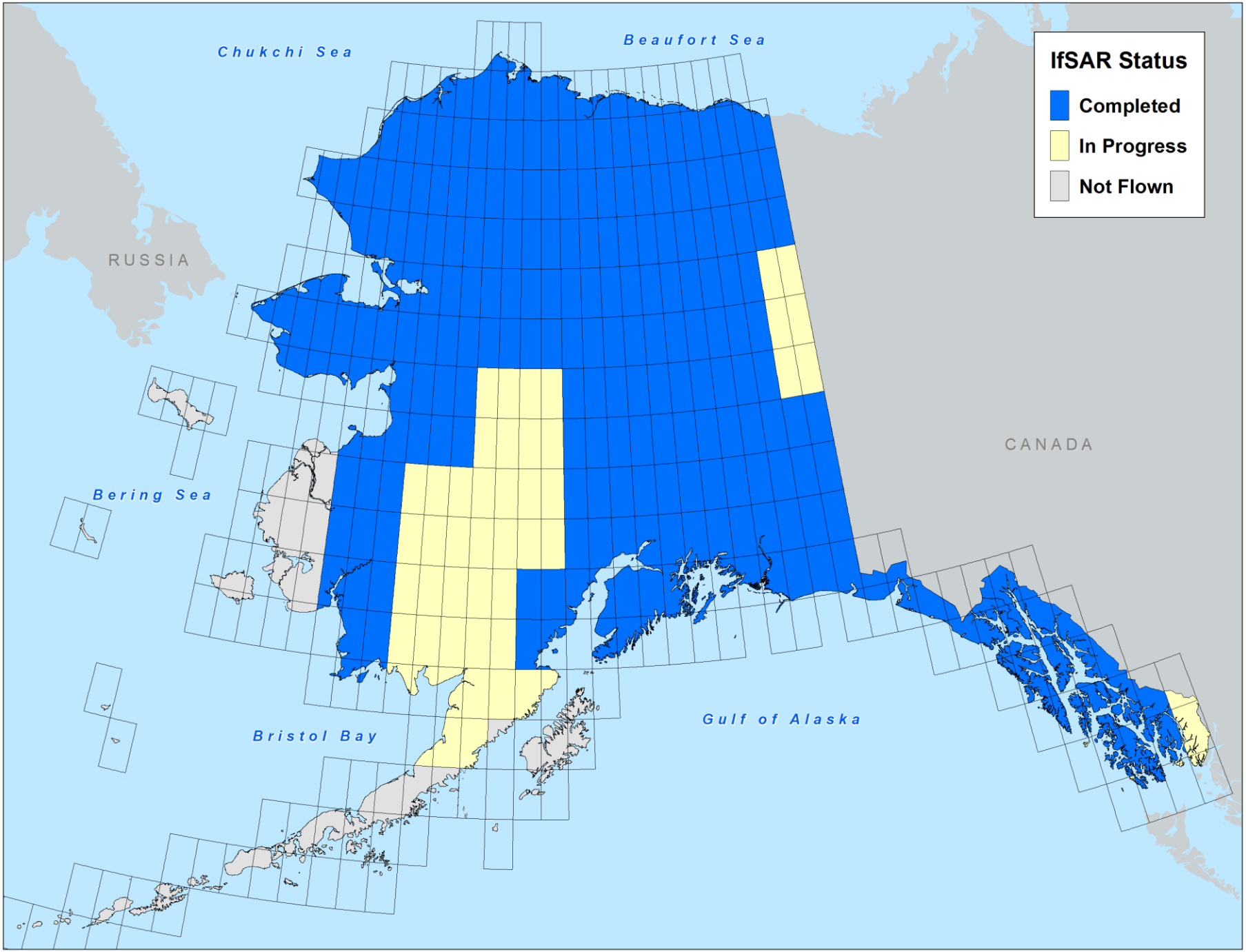
The 5-meter elevation data replaces decades old 60 meter elevation data.

IfSAR uses two radar images taken at the same time but from two different places in space.








IfSAR Status
Completed
In Progress
Not Flown
Chukchi Sea
Beaufort Sea
RUSSIA
CANADA
Bering Sea
Bristol Bay
Gulf of Alaska

v2.2018

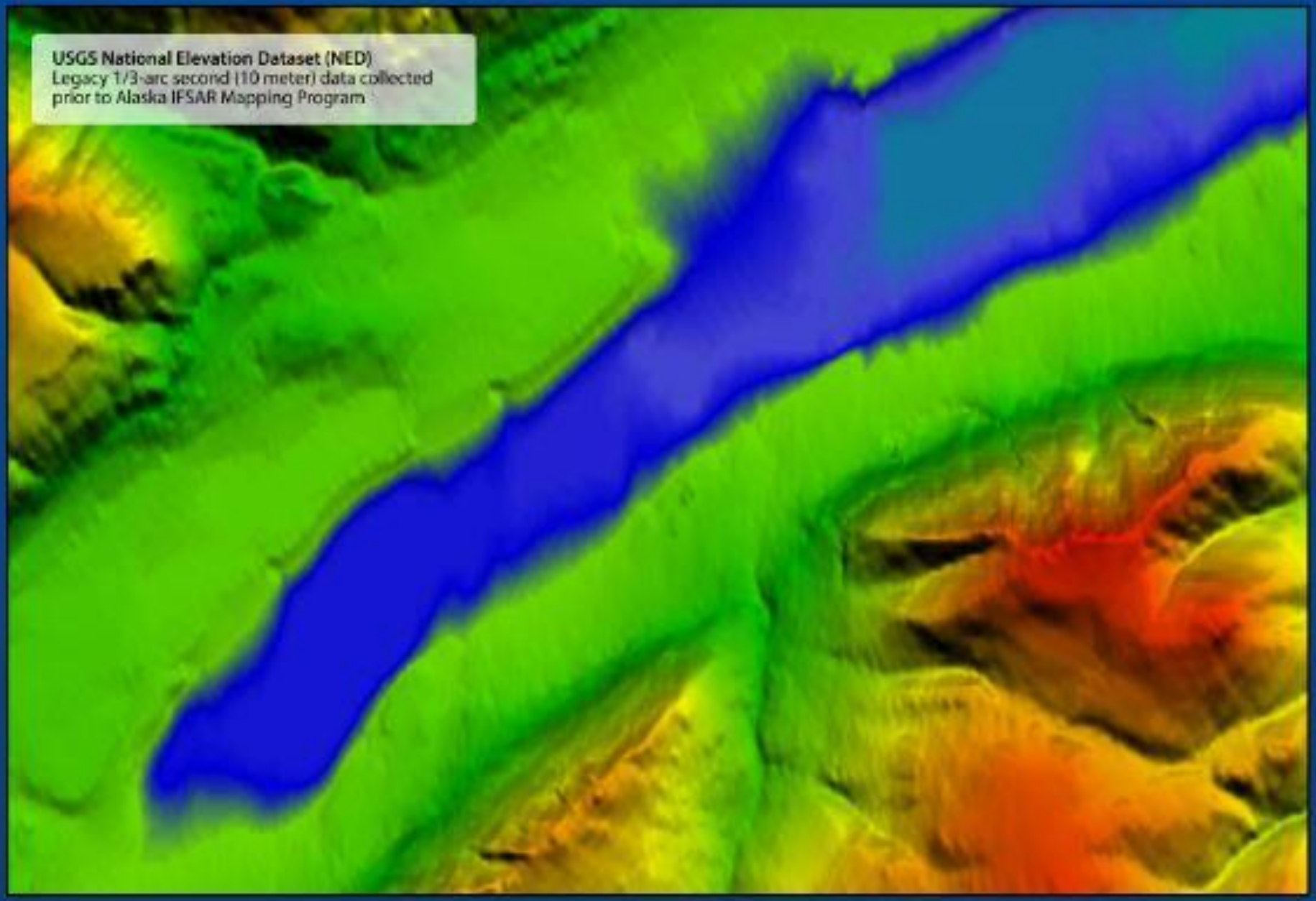
+ Partner Contribution Summary

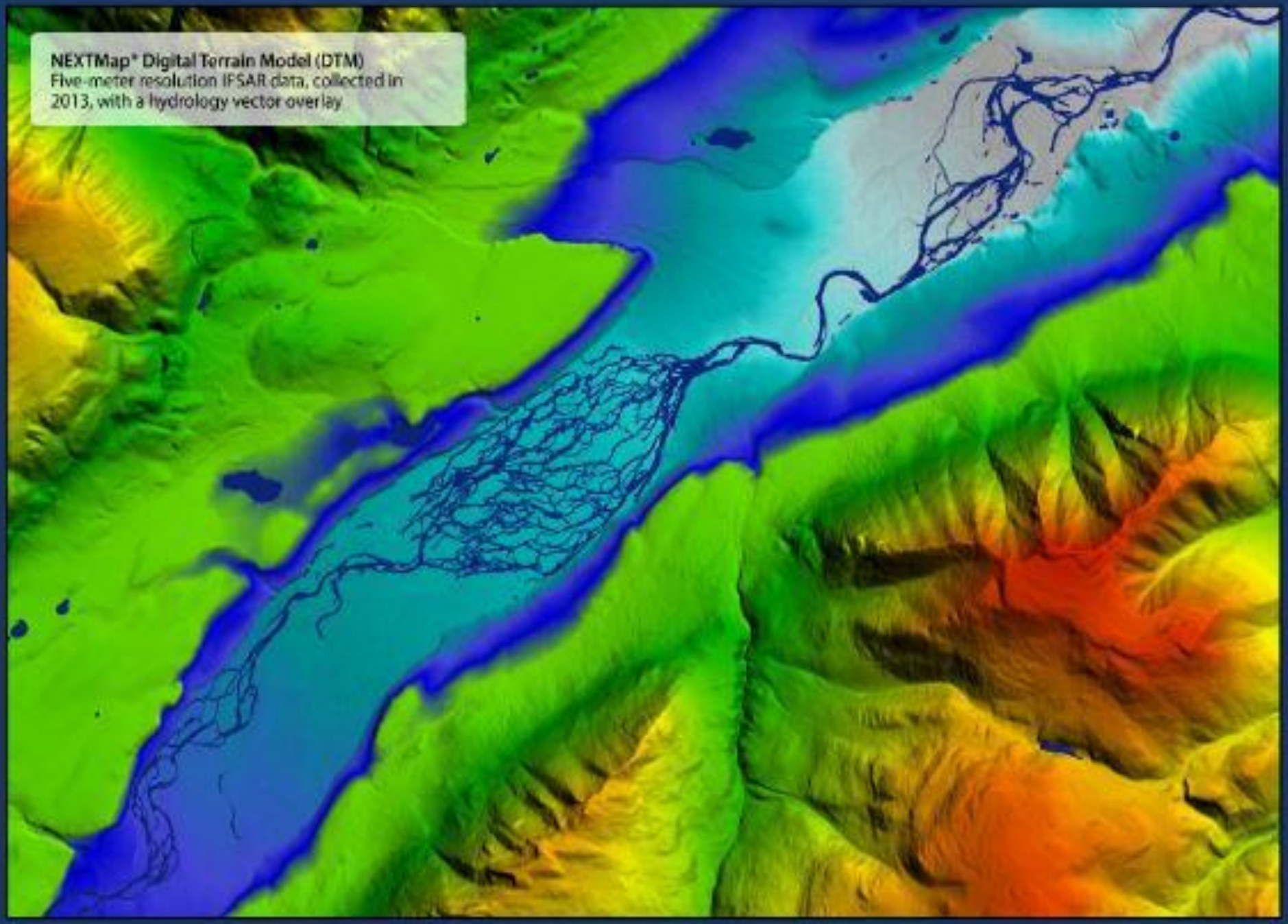
Partner	2017 Contribution	2010-2017 Contributions
BLM	$50,000	$3,267,355
USFWS	$0	$950,000
NGA	$0	$2,399,895
NPS	$975,000	$3,050,348
NRCS	$700,000	$3,703,472
USFS	$150,000	$1,786,842
USGS	$7,212,088	$27,074,156
Alaska	$0	$13,340,591
Total	$9,087,088	$55,572,659

Dewberry

Killick River, Gates of the Arctic National Park and Preserve, North Slope Borough

INTERMAP




NEXTMap® Digital Terrain Model (DTM)
Five-meter resolution IFSAR data, collected in 2013, with a hydrology vector overlay

BAA in Nutshell

- Think lidar
- Competitive process
- Federal funding to acquire lidar at QL2 level – minimum
- Proposal covers cost for above base deliverables and QL1
- Need to identify why IfSAR does not meet your needs
- Have matching funding
- Begin planning process one-year in advance to identify partnerships
- Contractors can work with partners to develop projects
- Geiger Mode and Single Photon lidar

2015 - Anchorage Municipality	765 sq/mi	QL2
2016 - Yukon and Kuskokwim Delta	1700 sq/mi	QL2
2017 - Prince of Wales Island	1600 sq/mi	QL1
2017 - Fairbanks North Star Borough	2500 sq/mi	QL/QL2

BAA Eligible Applicants

Individuals

Small businesses

For profit organizations other than small businesses

Nonprofits having a 501(c) (3) status with the IRS, other than institutions of higher education

City or township governments

Special district governments

County governments - Boroughs (Anchorage and Fairbanks)

State governments (AK DNR, Division of Geological and Geophysical Surveys)

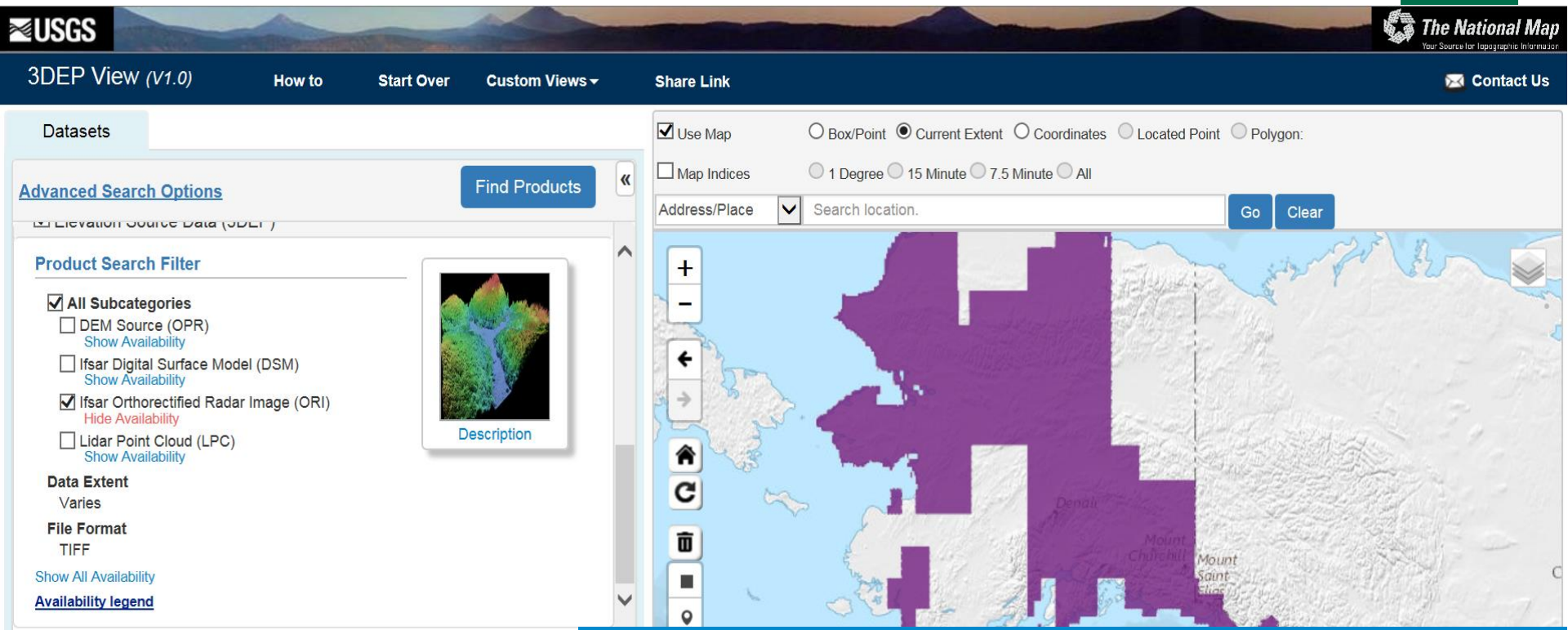
Native American tribal governments (Federally recognized)

Native American tribal organizations (other than federally recognized tribal governments)

Federal agencies

The Nature Conservancy, Anchorage Municipality, Fairbanks North Star Borough, Sealaska, NRCS, US Forest Service, Golden Valley Electric Association, NOAA, Alaska Department of Natural Resources.

+ The National Map



How to Find and Download Products

Users can find products in the following steps. (Tutorial Videos)

A. Find Products

B. Review Products

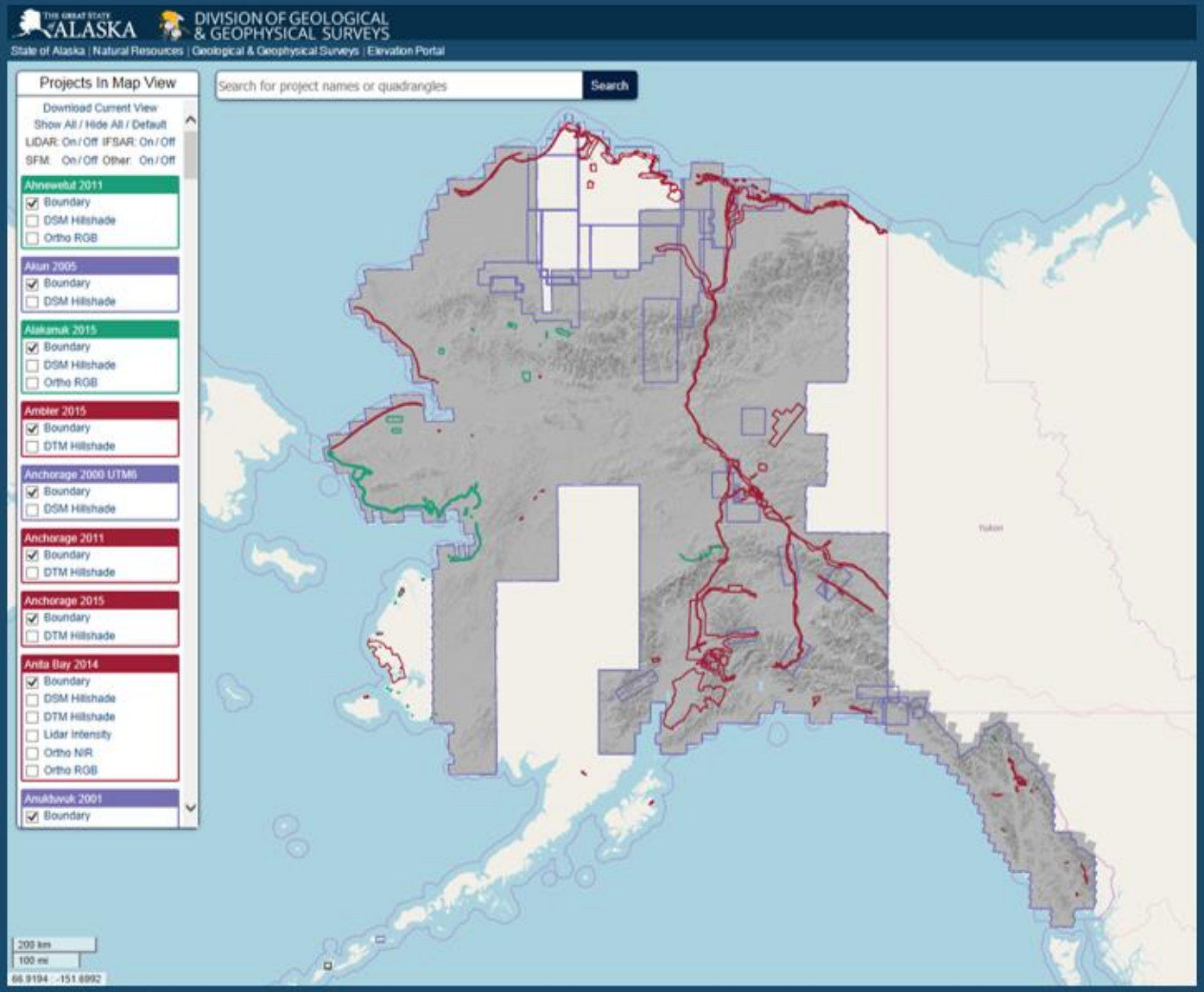
C. Use Cart (Optional)

USGS science for a changing world

The National Map Your Source for Topographic Information

Alaska Elevation Distribution & Archive

- 371# IfSAR, lidar, and SfM data products available.
- Covering a total of 540,137 square miles.
- All available for download via an easy to use map interface.



Map interface:
http://elevation.alaska.gov

REST endpoint for hillshade service used in application:
http://elevation.alaska.gov/arcgis/rest/services/apps/elevation_app_prod/MapServ

For more information:
Ken Woods
907-388-0999
ken.woods@alaska.gov

Geospatial Products and Services Contract

- Architecture and Engineering (A&E) Indefinite Delivery/Indefinite Quantity (IDIQ) Contract
- $750 Million delegated procurement authority for 5 years
- Perform professional mapping services
- Over 18 years old – on version 3
- Competitive qualification based selection (QBS) process for contractors
- Remote sensing and GIS services impervious surface mapping
- Elevation Lidar acquisition and processing; topographic and bathymetric
    - Charge a 5% assessment rate
        - Used to cover staff time to manage contracts and projects

GPSC Project Types

- Remote sensing and GIS services
  - Impervious surface mapping
- Elevation
  - Lidar acquisition and processing
    - Topographic and bathymetric
  - IfSAR
- Hyperspectral imagery acquisition
- Orthoimagery acquisition and processing
- Alaska Example: AK DOT UAV Proof of Concept
  - Looking at Airport Obstruction Survey for 1-2 rural artic airstrips/airports

What is GPSC?

- 10 contracts
  - Each has a base year plus four option years
  - Valid from 2016 – 2022, if all option years are executed

Large Business Firms

- Dewberry
- Fugro Earthdata
- Merrick-Surdex JV
- Quantum Spatial
- Sanborn
- Woolpert

Small Business Firms

- Aerial Services
- Atlantic
- Digital Aerial Solutions
- Precision Aerial Reconnaissance

Subcontractors in AK

- JOA Surveys
- Kodiak Mapping
- e-Terra
- And others….

+ Resources

3D Elevation Program (3DEP) FY17/18Broad Agency Announcement (BAA) Information Sharing Site https://cms.geoplatform.gov/elevation/3DEP

FY18 BAA Reference Materials Page
http://nationalmap.gov/3DEP/BAAReferenceMaterials.html

NOAA sponsored Seasketch site: U.S. Federal Mapping Coordination, *A Demonstration Site for Federal Mapping Data Acquisition*

http://fedmap.seasketch.org

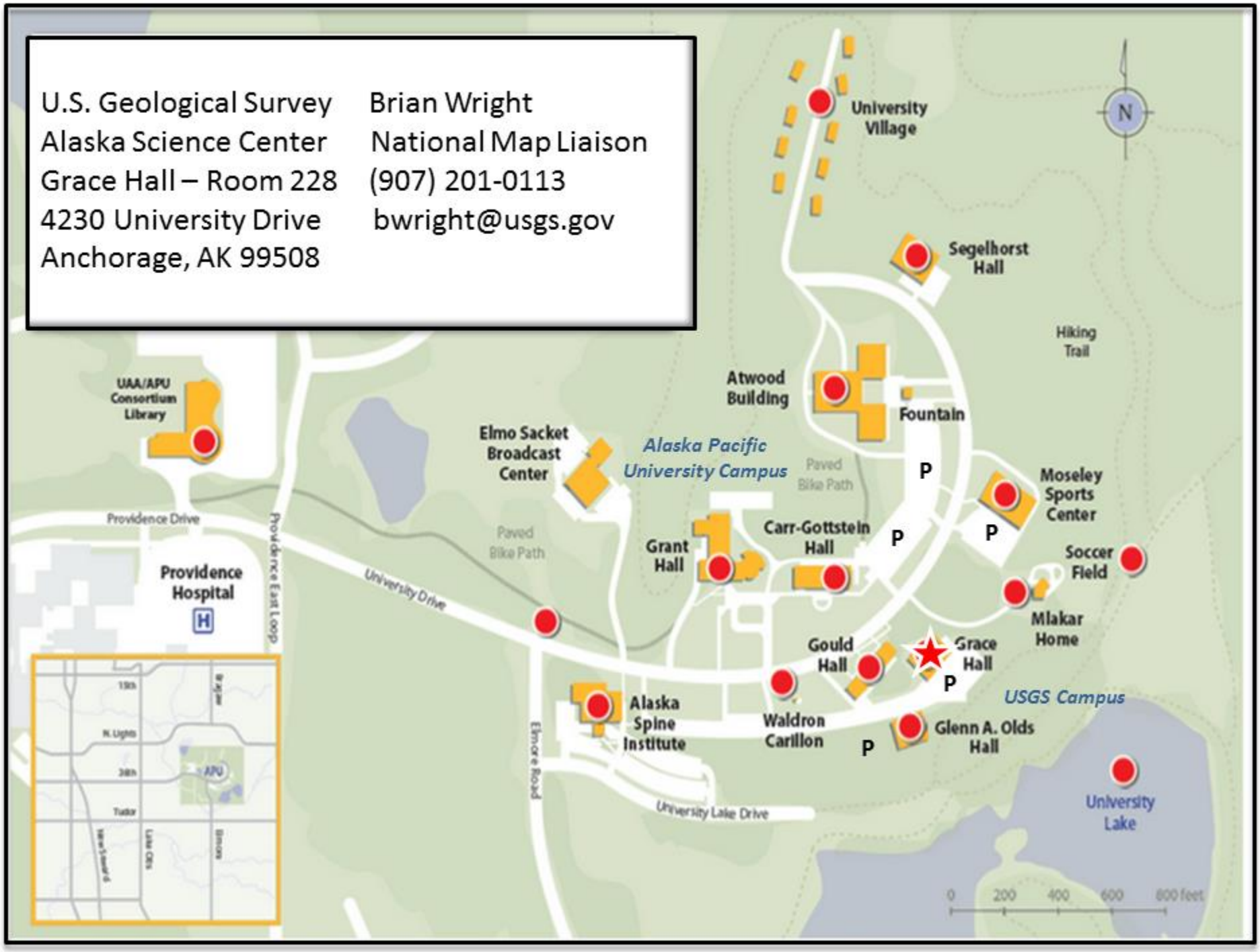
The 3D Elevation Program Initiative – A call for Action
http://pubs.usgs.gov/circ/1399/

USGS NGP Lidar Base Specification V1.2
http://pubs.usgs.gov/tm/11b4/pdf/tm11-B4.pdf

Where can you find me?

U.S. Geological Survey
Alaska Science Center
Grace Hall – Room 228
4230 University Drive
Anchorage, AK 99508

Brian Wright
National Map Liaison
(907) 201-0113
bwright@usgs.gov



Coastal Geospatial Services Contract

Alaska Coastal Mapping Summit

February 9th, 2018

Dave Stein

Geographer, Contracting Officer's Representative

Coastal Geospatial Services Contract III

- Brooks Act, Architecture and Engineering, Federal Acquisition Regulation Part 36 – Indefinite Delivery, Indefinite Quantity
- As of August 2016, five prime contractors (Dewberry, Fugro, Quantum Spatial, Tetra Tech, and Woolpert) with more than 75 subcontractors
- Awarded August 2016, ends August 2021
- $49 million ceiling (shared among the primes)
- Contract III follows successful implementation of two previous Coastal Geospatial Services Contract Awards: 2006 to 2011 and 2011 to 2016

History

Contract I 2006 - 2011	Contract II 2011 - 2016	Contract III 2016 - 2021
Task Orders: 128 Total Dollars: $23M Contractors: • Dewberry • Fugro • Photo Science • Sanborn	Task Orders: 156 Total Dollars: $47M Contractors: • Dewberry • Fugro • Photo Science • Woolpert	Task Orders: 20 Total Dollars: ~$3M Contractors: • Dewberry • Fugro • Photo Science • Tetra Tech • Woolpert

Contract Services

- **Data Acquisition:** Collection of Lidar, imagery, and bathymetry using a variety of platforms and sensors.
- **GIS Services:** Spatial data development, data management, application development, cartographic product development, and GIS consultation in support of coastal management applications.
- **Thematic Mapping:** Using source data to delineate and derive data products. Creating thematic classes for land cover, environmental sensitivity, benthic habitat, and hazards vulnerability mapping.

Contract Services

- **Quality Assurance and Quality Control:** Third-party review of data deliverables.
- **Technical Support:** Could include scanning of historical imagery, curriculum development, website development, expert consultation, white paper development, and specialized software development

coast.noaa.gov/idiq/geospatial.html

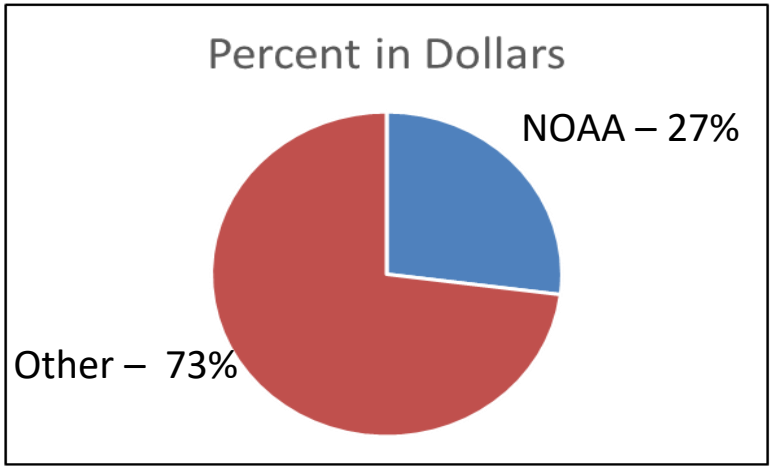
Active Partnerships

Federal:

- Bureau of Ocean Energy Management
- Environmental Protection Agency
- Housing and Urban Development
- National Park Service
- National Oceanic and Atmospheric Administration
- United States Geological Survey

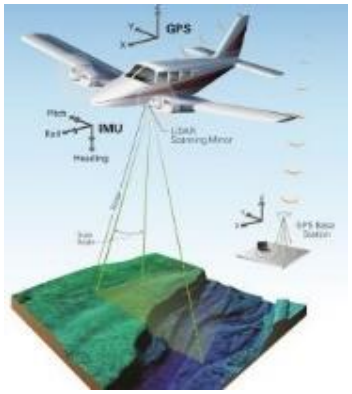
States: California, Connecticut, Georgia, Massachusetts, and New York

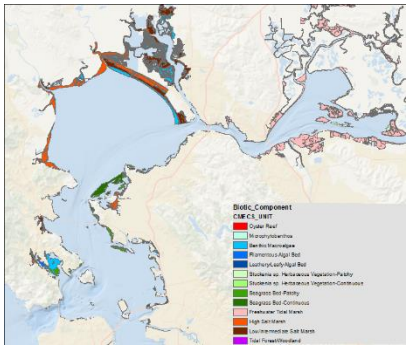
Others: Multiple Georgia counties and regional commissions, County of Hawaii

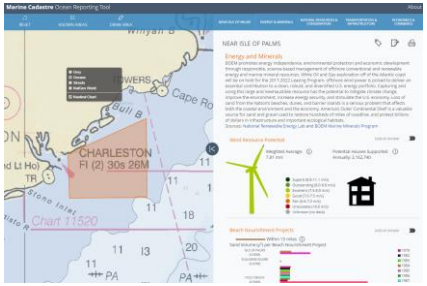


Project Examples FY17-18

- Coastal Imagery – GA Coastal Resources Commission
- Imagery for Seagrass Mapping – State of New York
- Imagery for Seagrass Mapping – State of Massachusetts
- Wild rice Mapping in Lake Superior using Hyperspectral Imagery – EPA/NOAA
- Lidar for Big Island, Hawaii – USGS/NOAA
- Lidar for GA Watersheds – GA DNR
- Benthic Habitat Mapping Lake Michigan – NOAA/EPA/NPS
- Marine Minerals GIS – BOEM
- AIS – Vessel Traffic – BOEM/NOAA/USCG
- Data Development to support Ocean Reporting for Aquaculture - NOAA/BOEM







How Can You Use the Coastal Geospatial Services Contract?

- Meet the requirements
  - Coastal
  - Address a Coastal management issue
  - Available capacity
- Enter into Memorandum of Understanding

Memorandum Process

Phase I – Establish (Two to Three Months)

** All financial transactions outside of NOAA require a Memorandum of Understanding

- Requesting agency contacts our office to start the process
- OCM sends a template
- Requesting agency fills in MOU template and returns
- Department of Commerce attorneys review, approve, and clear
- Requesting agency approves and signs
- If there's funding involved, an invoice is sent to requesting agency by NOAA Finance
- Upon receipt of funds, contracting can begin!

Contract Benefits

1. Competition is already done
2. Streamlined process
3. Access to industry leaders with proven capabilities
4. Contract management provided at small percentage of total cost (2%)
5. NOAA Office for Coastal Management technical expertise provided at no cost

Questions?

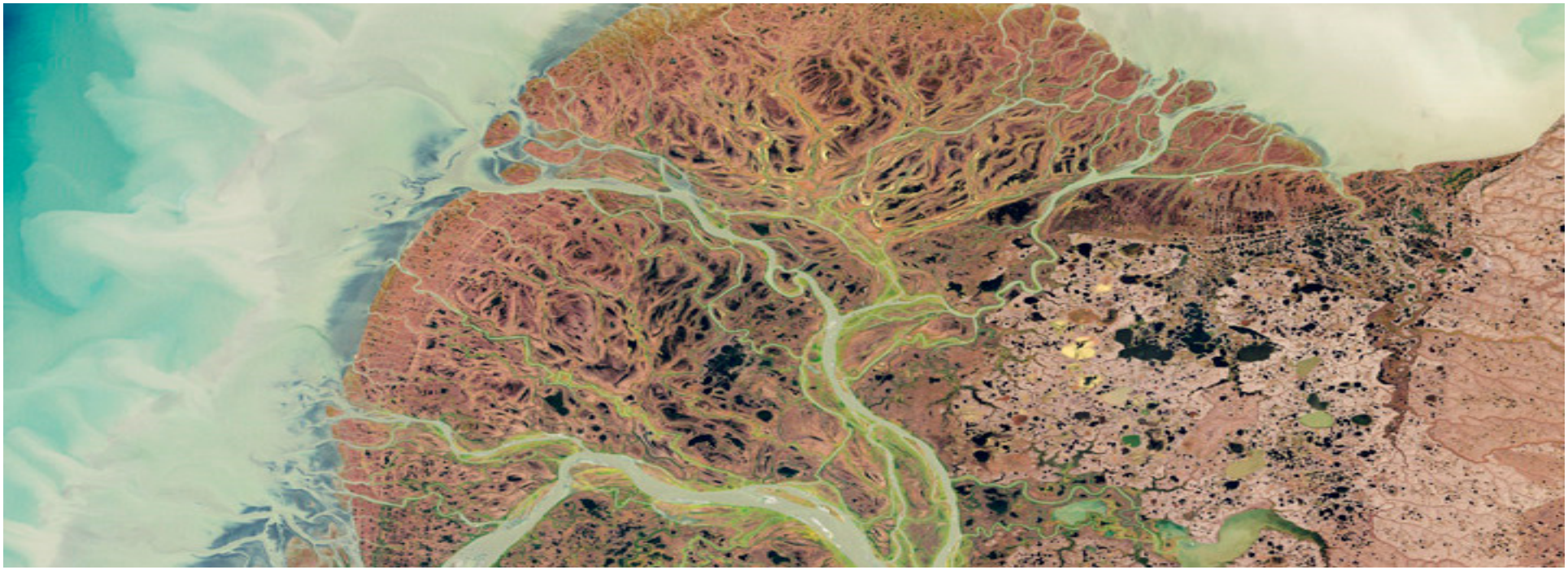
Dave.Stein@noaa.gov

(843) 740-1310

coast.noaa.gov/idiq/geospatial.html

Credit: Mark Sullivan, NOAA

Lidar Data Collection in the Yukon-Kuskokwim Delta, Alaska



WOOLPERT

ARCHITECTURE | ENGINEERING | GEOSPATIAL

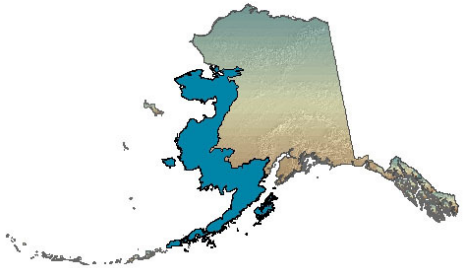
John Gerhard, CP
Vice President
Program Director
Woolpert

Yukon-Kuskokwim Delta Lidar

U.S. FISH & WILDLIFE SERVICE

FEDERAL EMERGENCY MANAGEMENT AGENCY

Western Alaska LCC



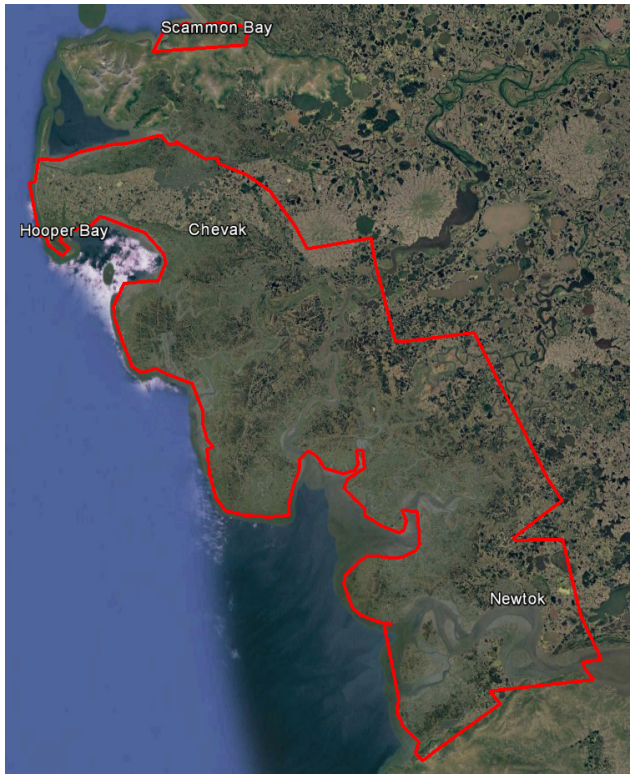
ALASKA DEPARTMENT OF NATURAL RESOURCES

NRCS Natural Resources Conservation Service

AOOS Alaska Ocean Observing System

USGS

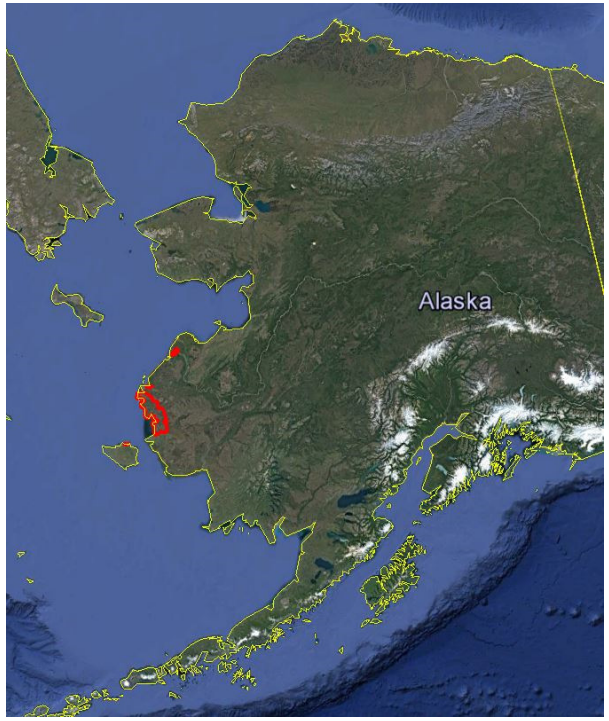
Yukon-Kuskokwim Delta Lidar



Yukon-Kuskokwim Delta Lidar

Data Collection by Kodiak Mapping

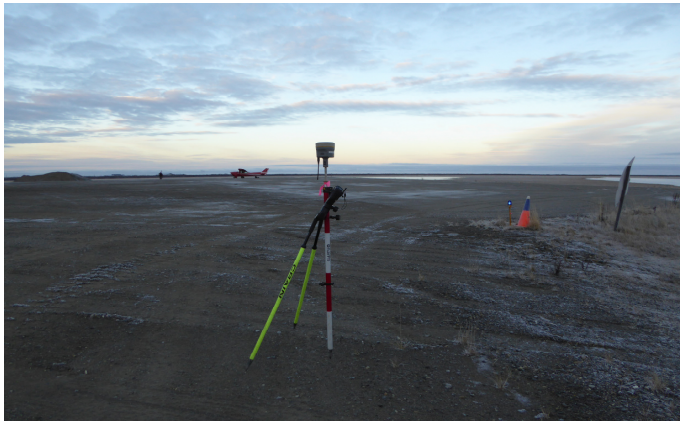
- August 30, 2016 – October 16, 2016
- C-182 Katmai Aircraft
- Riegl LMS-Q780
- RCD30 Digital Camera



Yukon-Kuskokwim Delta Lidar

Survey Effort

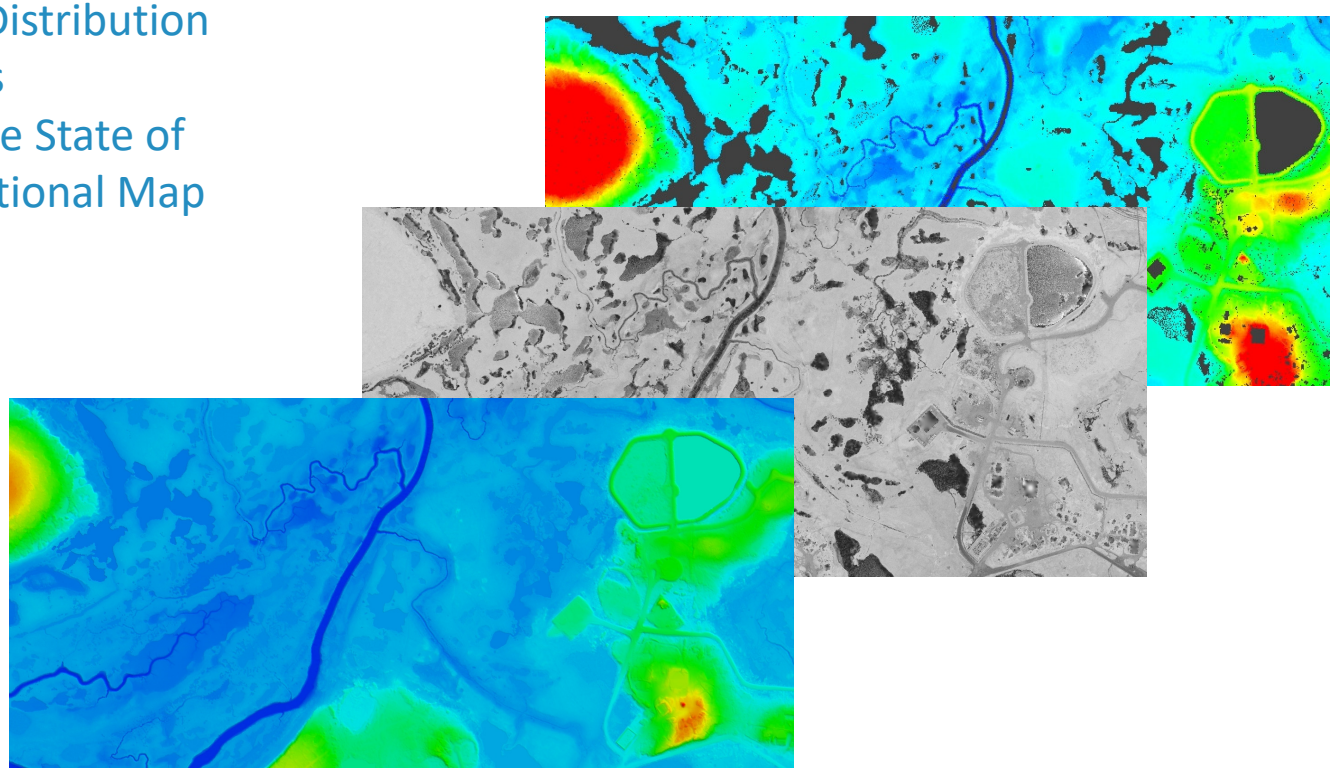
- November 2, 2016 – November 6, 2016
- Kodiak Mapping
- Control and checkpoints
- Accessibility difficulties
- Community outreach



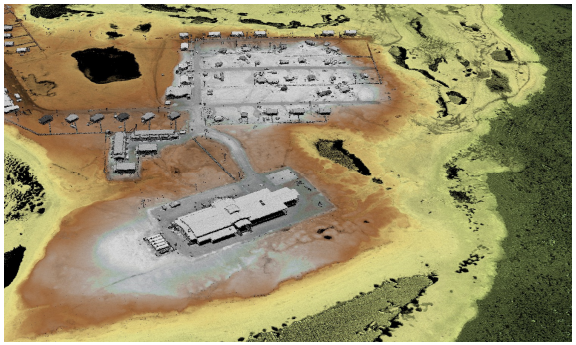
Yukon-Kuskokwim Delta Lidar

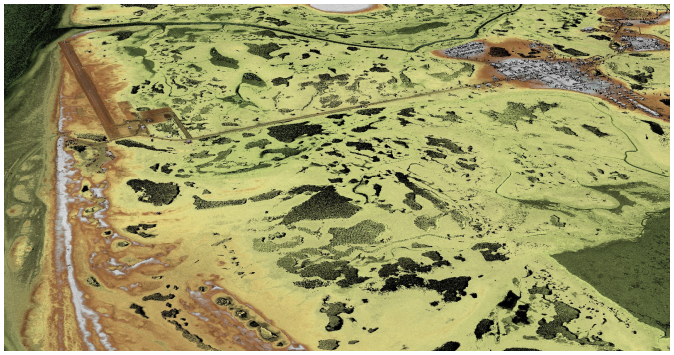
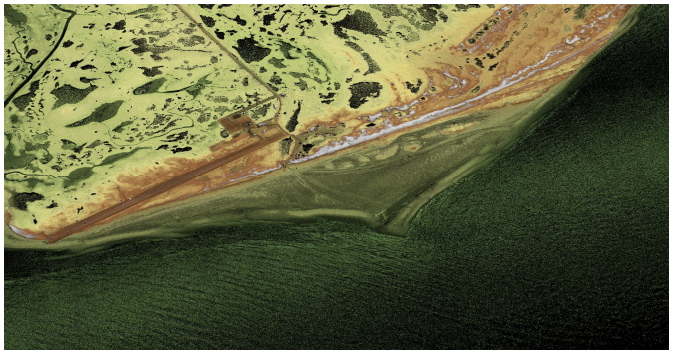
Data Deliverables and Distribution

- USGS 3DEP Products
- Available through the State of Alaska and USGS National Map Viewer



Yukon-Kuskokwim Delta Lidar

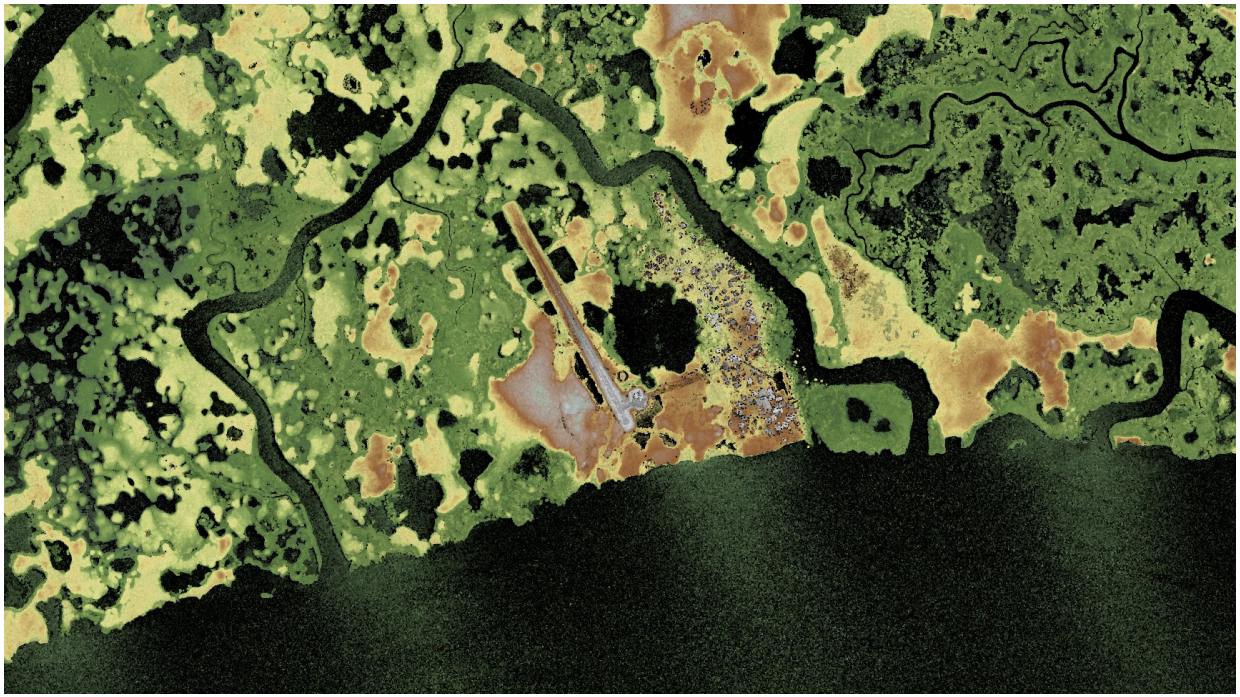


Hooper Bay, AK

Yukon-Kuskokwim Delta Lidar

2007

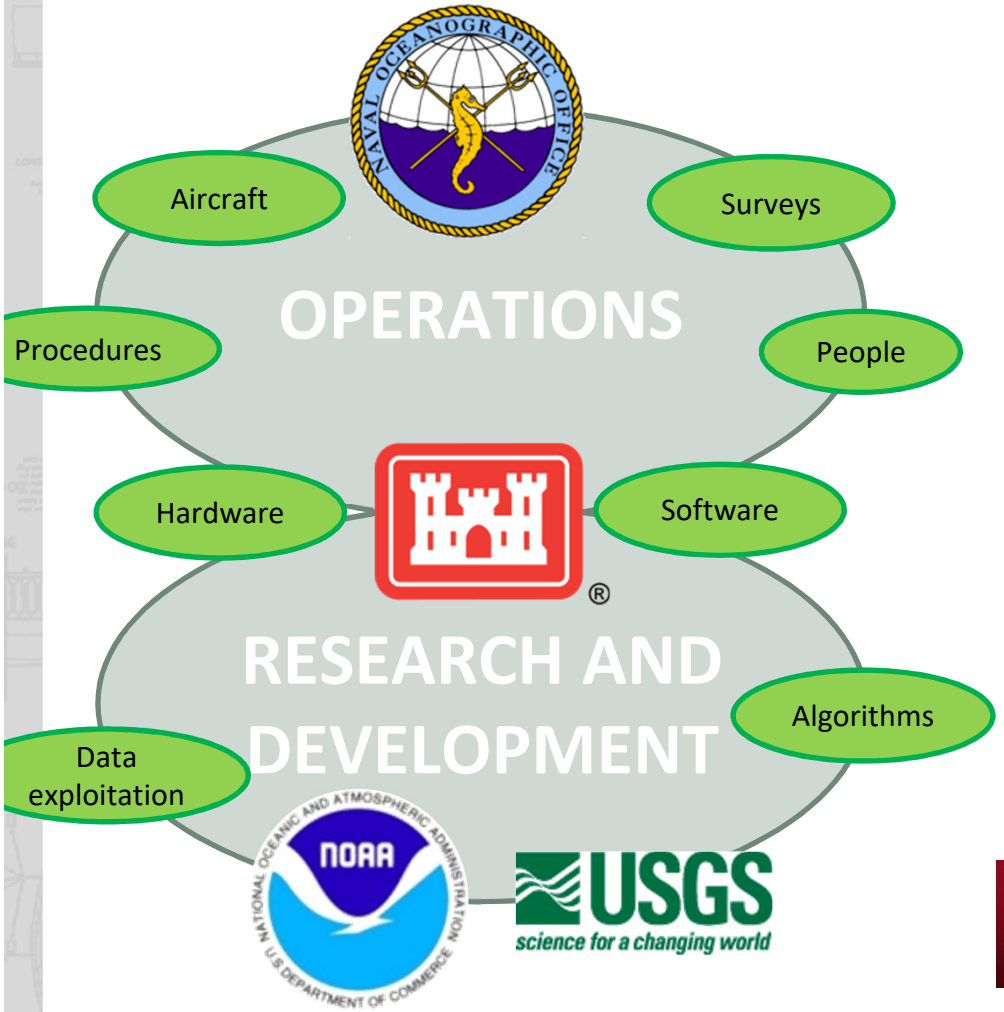


2016

Yukon-Kuskokwim Delta Lidar

- Storm surge and inundation research
- Emergency response planning
- Wildlife conservation
- Community planning
- Relocation planning
- Source of improved elevation data

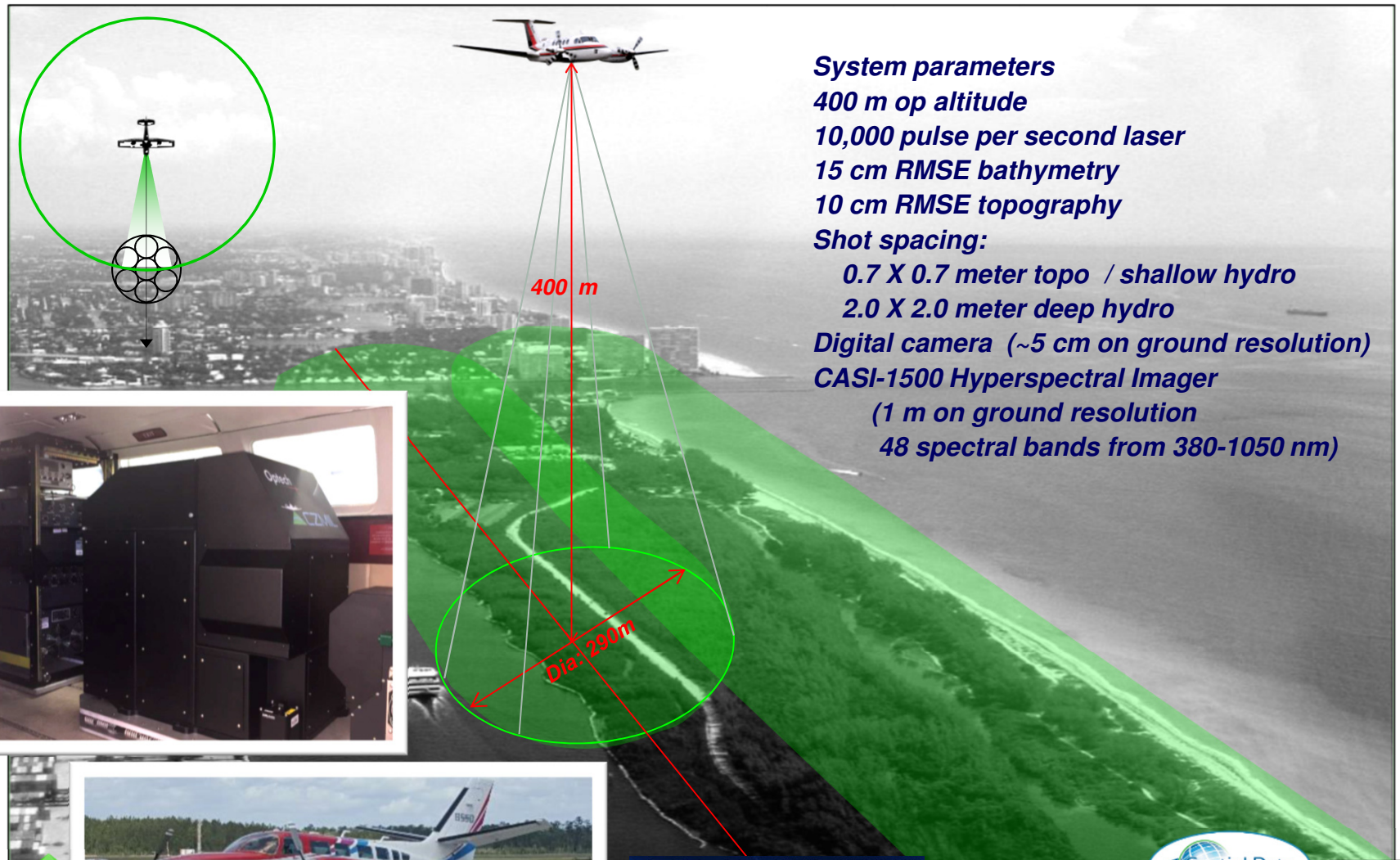
JOINT AIRBORNE LIDAR BATHYMETRY TECHNICAL CENTER OF EXPERTISE



@Stennis International Airport
Kiln, MS

Jennifer.M.Wozencraft@usace.army.mil 228-806-6044

CZMIL Coastal Zone Mapping and Imaging Lidar



System parameters
400 m op altitude
10,000 pulse per second laser
15 cm RMSE bathymetry
10 cm RMSE topography
Shot spacing:
0.7 X 0.7 meter topo / shallow hydro
2.0 X 2.0 meter deep hydro
Digital camera (~5 cm on ground resolution)
CASI-1500 Hyperspectral Imager
(1 m on ground resolution
48 spectral bands from 380-1050 nm)

JALBTCX

TELEDYNE OPTECH Everywhereyoulook™

WMR 532 Wood pot | Magnolia River Joint Venture

THE UNIVERSITY OF SOUTHERN MISSISSIPPI 1910

US Army Corps of Engineers

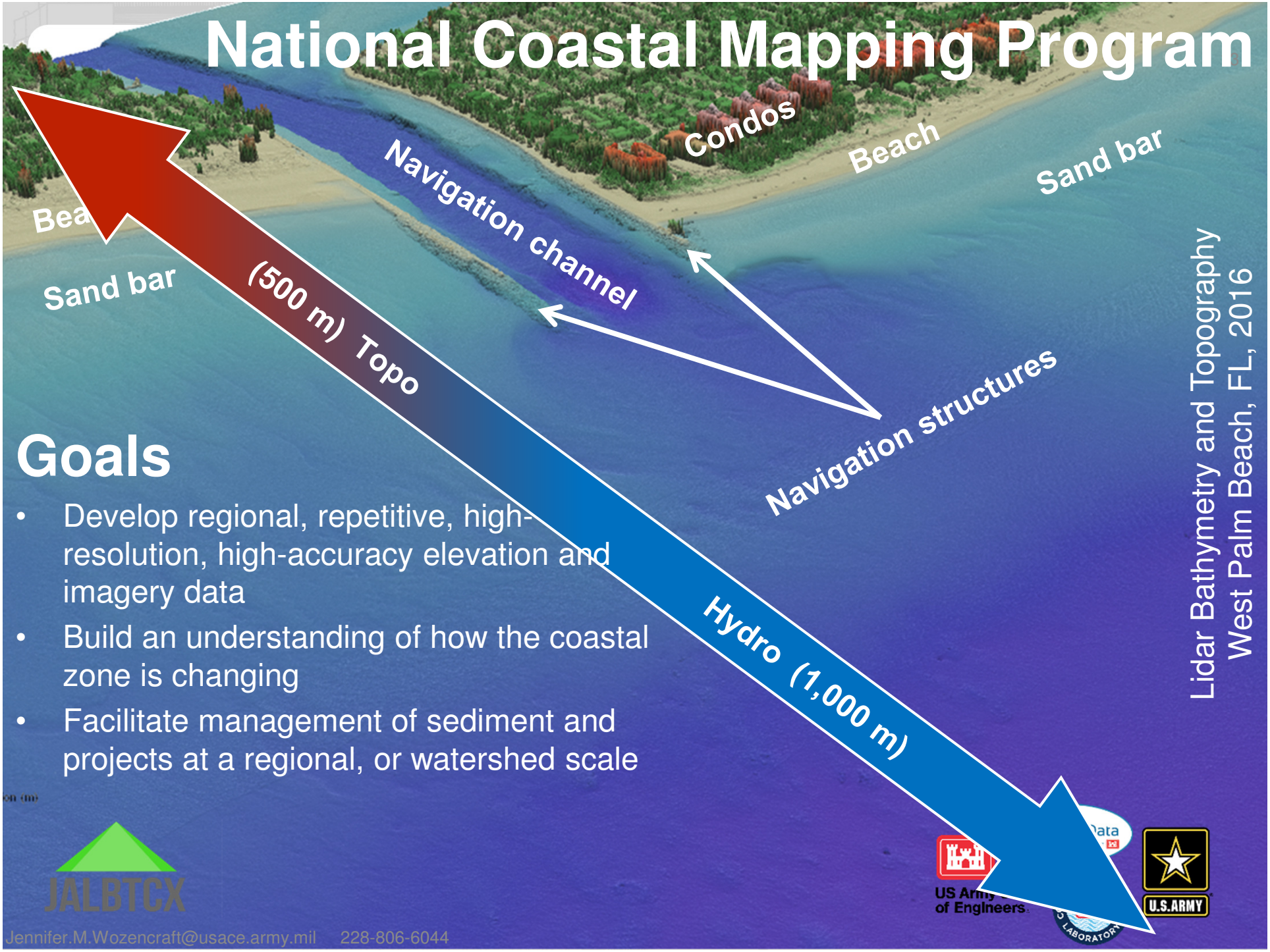
Spatial Data MOBILE DISTRICT

COASTAL AND HYDRAULICS LABORATORY

U.S.ARMY

Jennifer.M.Wozencraft@usace.army.mil 228-806-6044

National Coastal Mapping Program



Goals

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

Lidar Bathymetry and Topography
West Palm Beach, FL, 2016

JALBTCX

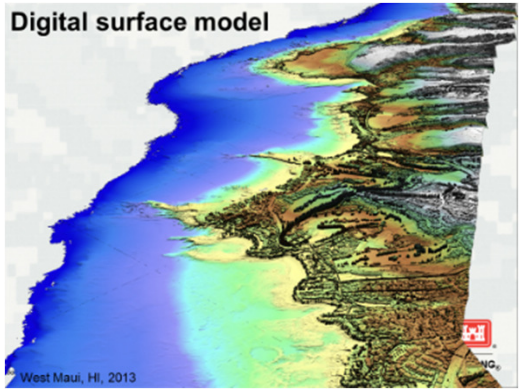
US Army of Engineers

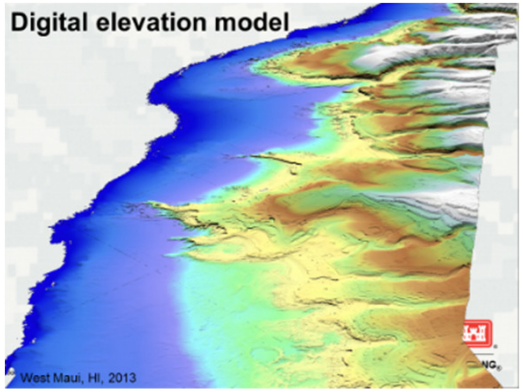
U.S.ARMY

Jennifer.M.Wozencraft@usace.army.mil 228-806-6044

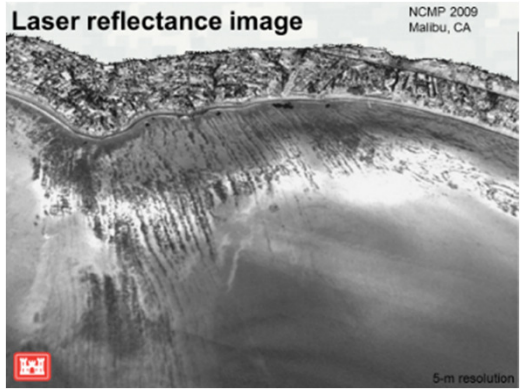
JALBTCX PRODUCTS FOR COASTAL ENGINEERS

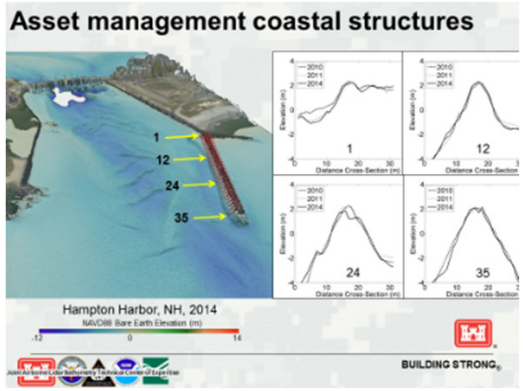
Basic lidar and imagery products





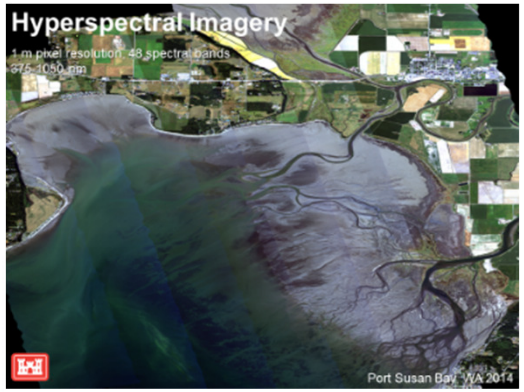
Advanced lidar products*

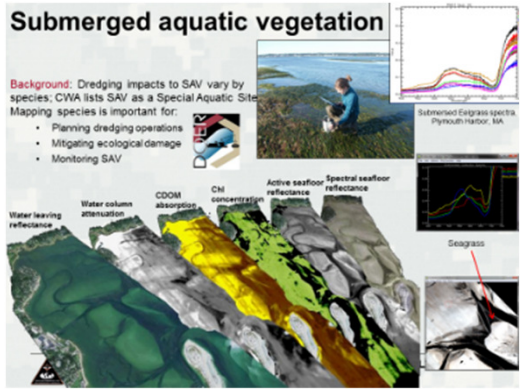


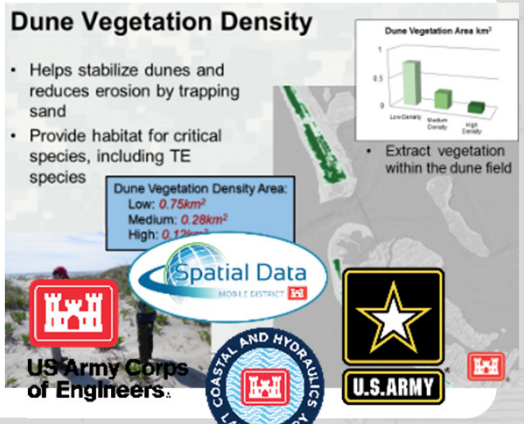


Fusion products*

**Leveraging ERDC CHL and EL R&D*







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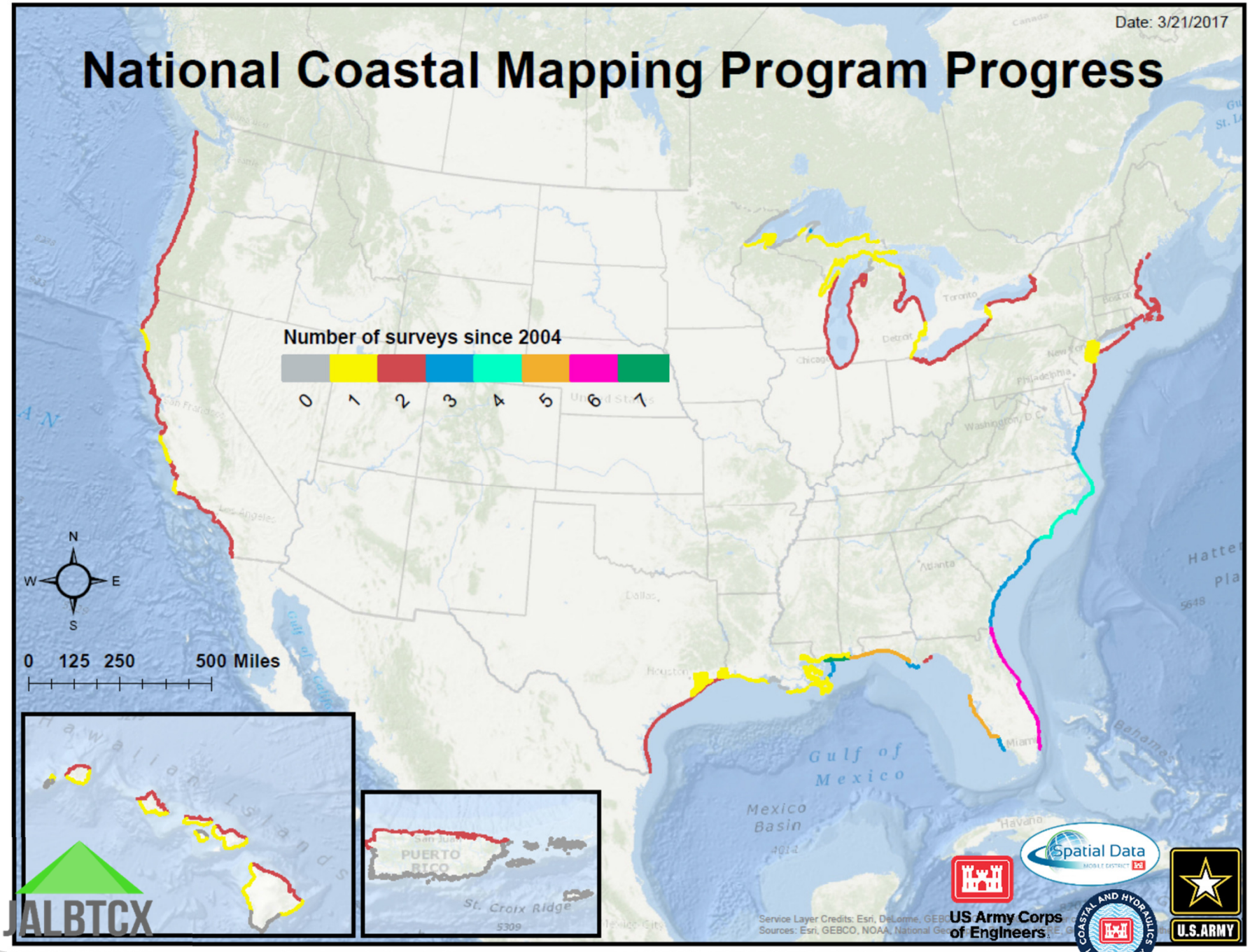
National Coastal Mapping Program Progress



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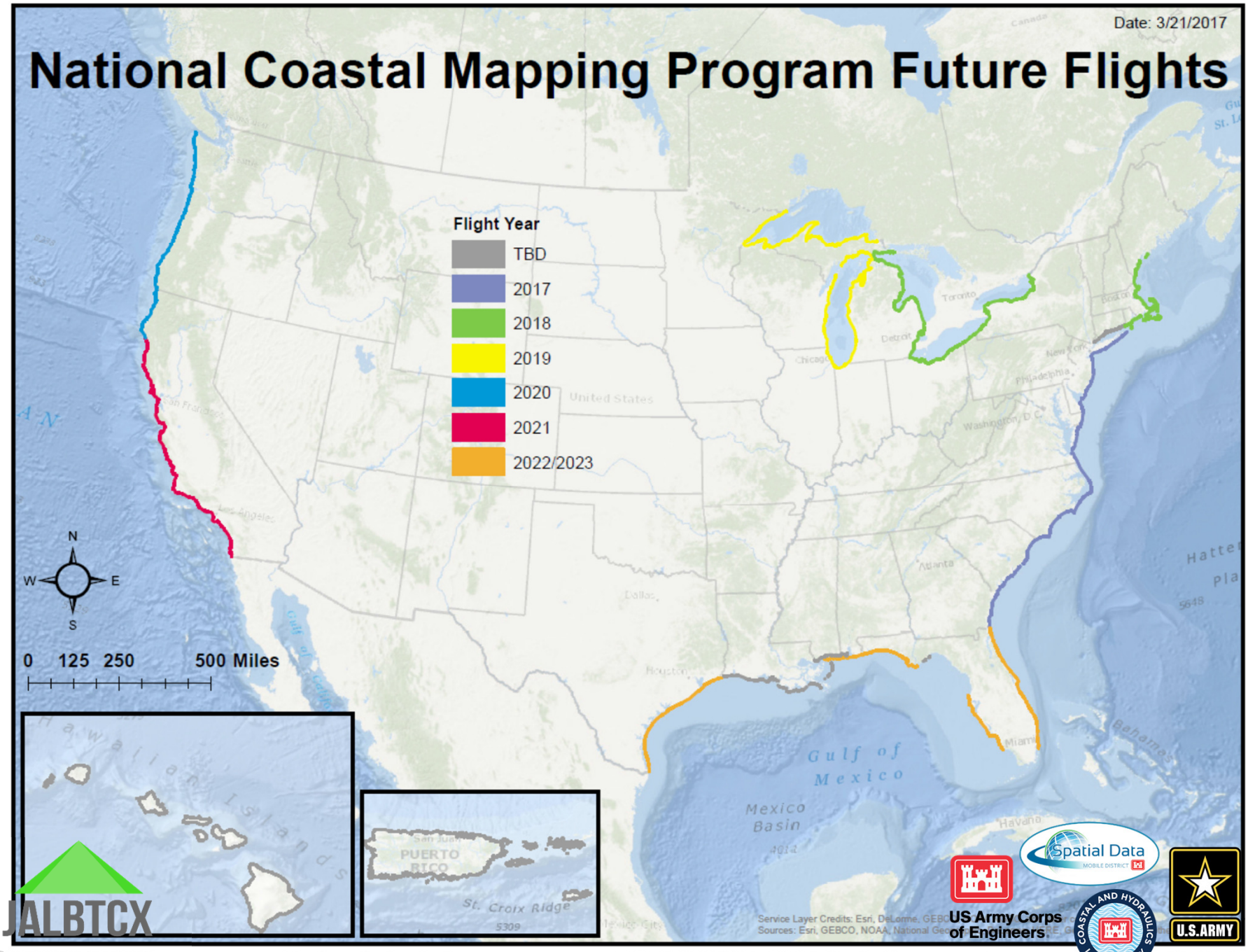


Jennifer.M.Wozencraft@usace.army.mil 228-806-6044

- Long endurance aircraft, ~11 hours.
- Transits annually through AK at the completion of the NAVO mission.
- Very experienced operating in remote and challenging locations.

JALBTCX

US Army Corps of Engineers

Spatial Data

U.S.ARMY

Jennifer.M.Wozencraft@usace.army.mil 228-806-6044

MULTI-MISSION SURVEY AIRCRAFT

- Enhanced global reach
- Carry survey equipment & aircraft parts
- Multi-mission capable with space, power, and additional bottom ports for additional sensors as needed

BT-67 Specifications (with options)

Range	2,140 nm
Max Cruise	215 kts
Standard Cruise	205 kts
Fuel Capacity	1,542 gal
Endurance	~11 hrs
Max take-off wt.	28,750 lbs
Survey Altitude	1200 ft
Survey Speed	140 knots

Approved for public release: Distribution unlimited

JALBTCX

US Army Corps of Engineers

Spatial Data

U.S.ARMY

Jennifer.M.Wozencraft@usace.army.mil 228-806-6044

COASTAL ZONE MAPPING & IMAGING

LIDAR (CZMIL) SYSTEM

The right tool for safe and efficient shallow-water hydrographic and near-shore topographic data collection in support of Navy requirements

Hydro/Topo Lidar

Hyperspectral

RGB Imagery

- 10,000 Hz Pulse Rate Laser for Hydro / Topo
- 25 Megapixel Digital camera (~20 cm pixel)
- CASI-1500 Hyperspectral Imager
  - 1500 pixels
  - 380 – 1050 nm wavelength
  - 288 possible bands

Shot spacing:
- 0.7 X 0.7 meter topo / shallow hydro
- 2.0 X 2.0 meter deep hydro

Approved for public release: Distribution unlimited

JALBTCX

US Army Corps of Engineers

Spatial Data

U.S.ARMY

Jennifer.M.Wozencraft@usace.army.mil 228-806-6044

Shoreline Verification with Unmanned Aerial Systems

Tim Smith, TerraSond Limited

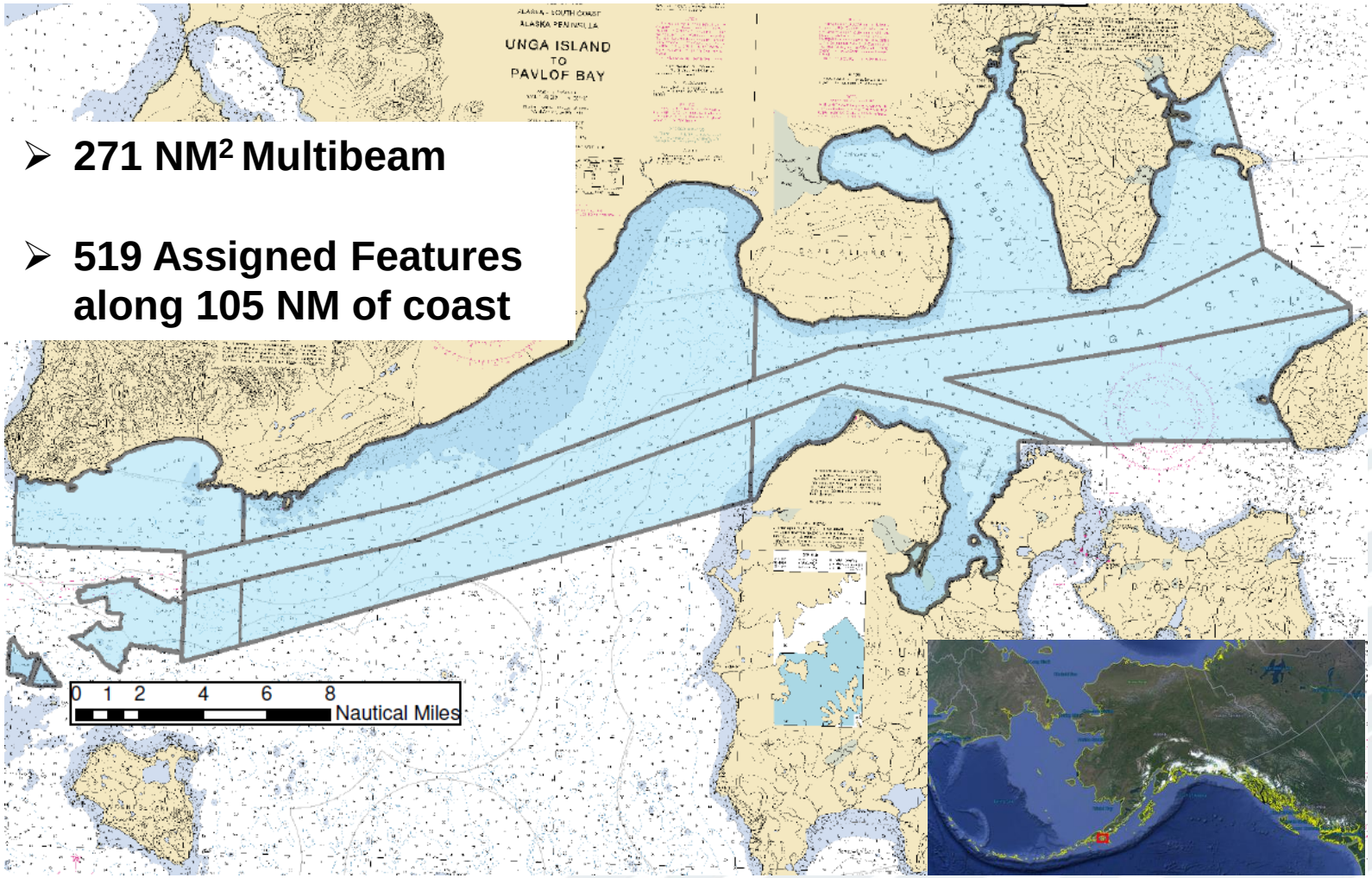
Alaska Coastal Mapping Summit

February, 2018

TERRASOND

Pavlof Islands and Vicinity Project Area

- 271 NM^2 Multibeam
- 519 Assigned Features along 105 NM of coast



TERRASOND

Common Shoreline Features

- Rocks & Islets
- Ledges & Reefs
- Foul Areas & Kelp

Photos from this project via UAS

TERRASOND

Vessel-based Investigation Methodology

Investigation via Skiff:

- Navigate to assigned features
- Ranges and bearings
- Visually estimate heights

TERRASOND

Vessel-based Investigation Methodology

Some problems with skiff-based approach:

- Can’t approach features
- Low-confidence measurements
- What is NOT seen?
- Low efficiency
- Safety concerns

TERRASOND

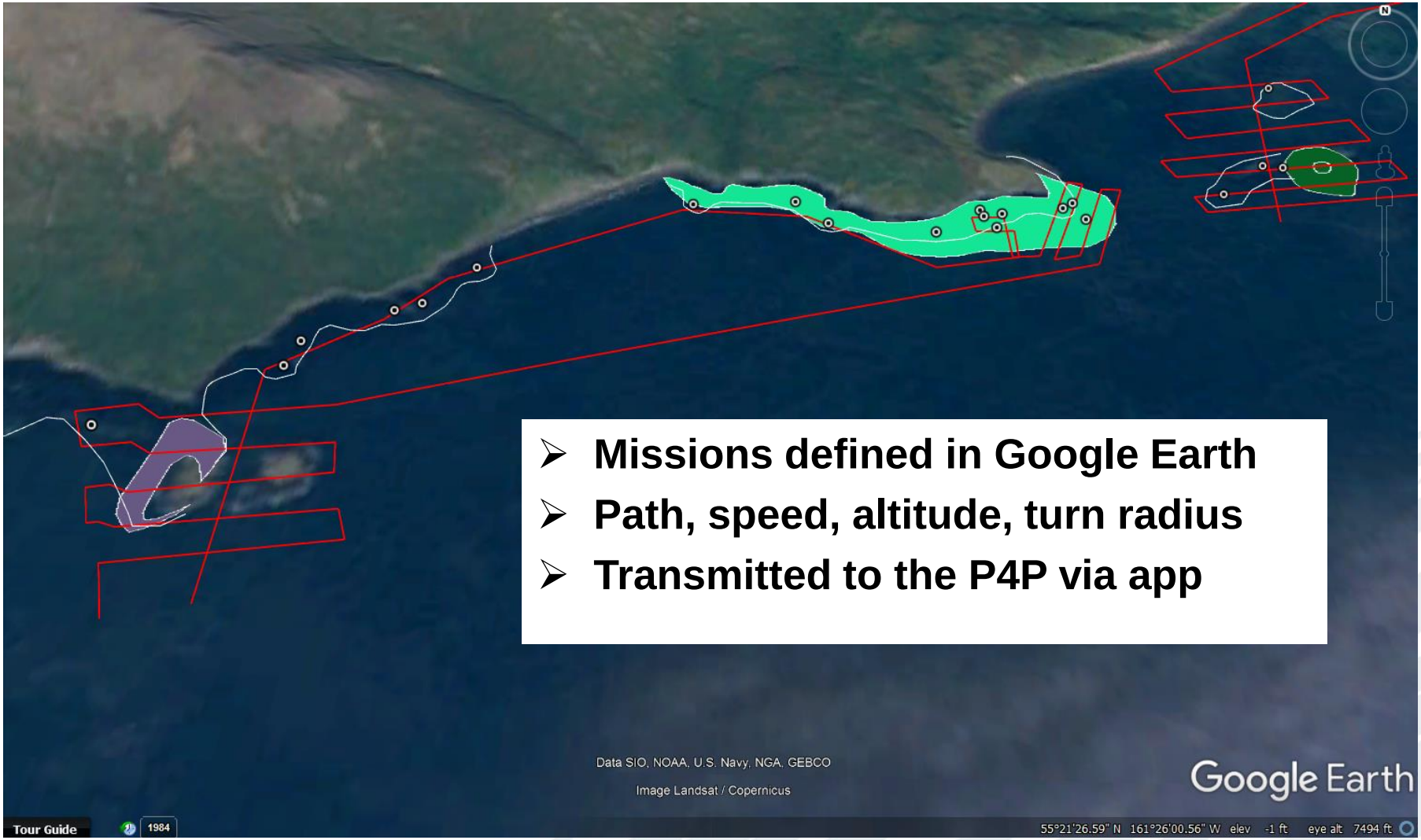
UAS (Drone) Equipment

DJI Phantom 4 Professional (P4P):

- 3 lbs
- GNSS positioning
- ~ 20 minute flight time (real-world)
- Camera – 20 megapixel, gimbal stabilized
- Affordable, simple

TERRASOND

Mission Planning

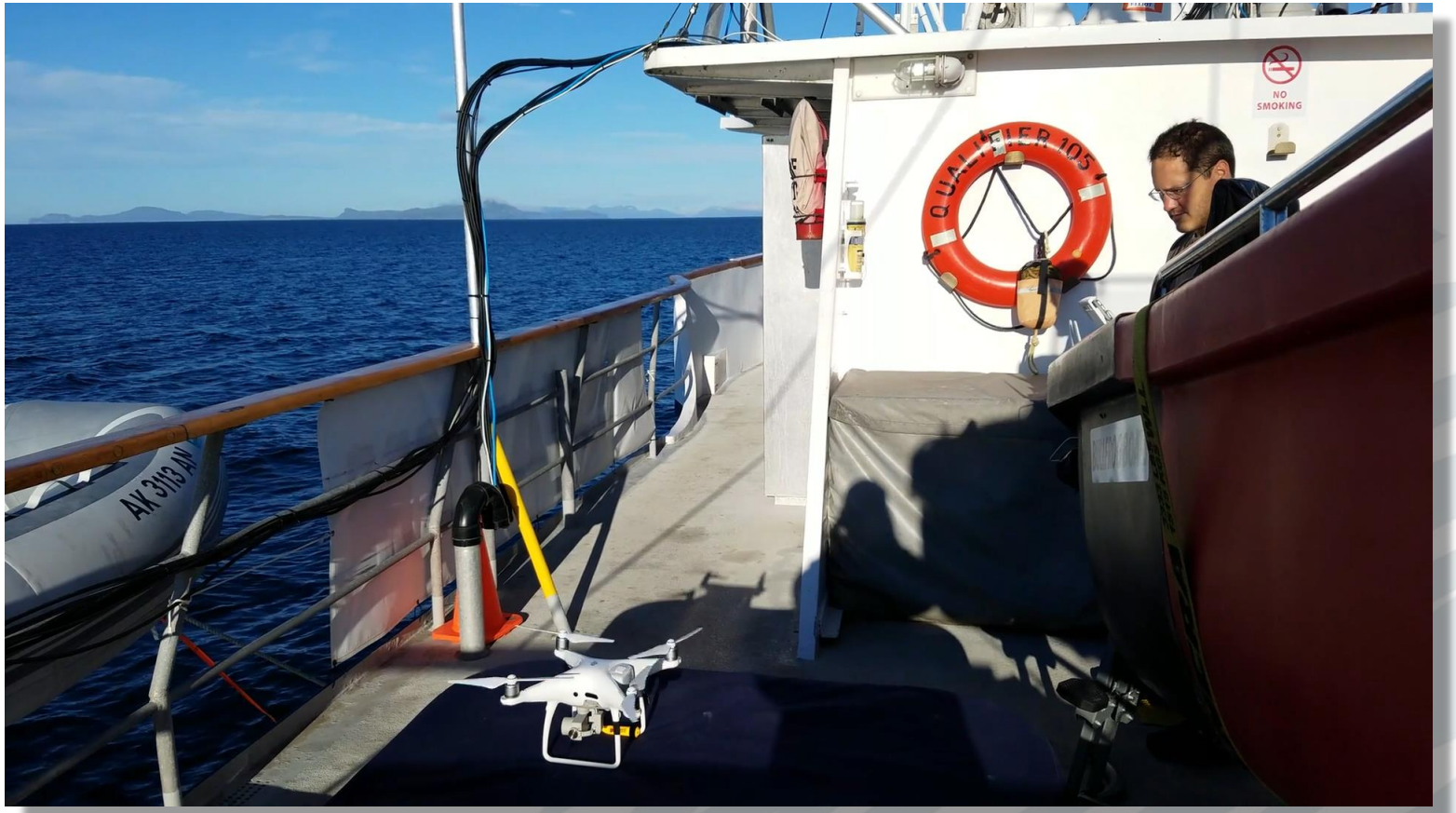


- **Missions defined in Google Earth**
- **Path, speed, altitude, turn radius**
- **Transmitted to the P4P via app**

TERRASOND

Launch

- **Manually-controlled launch**
- **After clear of vessel, initiate pre-planned mission**



TERRASOND

Automatic Photo-taking

- 2-second photo interval
- 45 km/hr normal flight speed
- 120 m (~ 400’) altitude
- At least 3 photos per object
- Average 375 photos per mission

TERRASOND

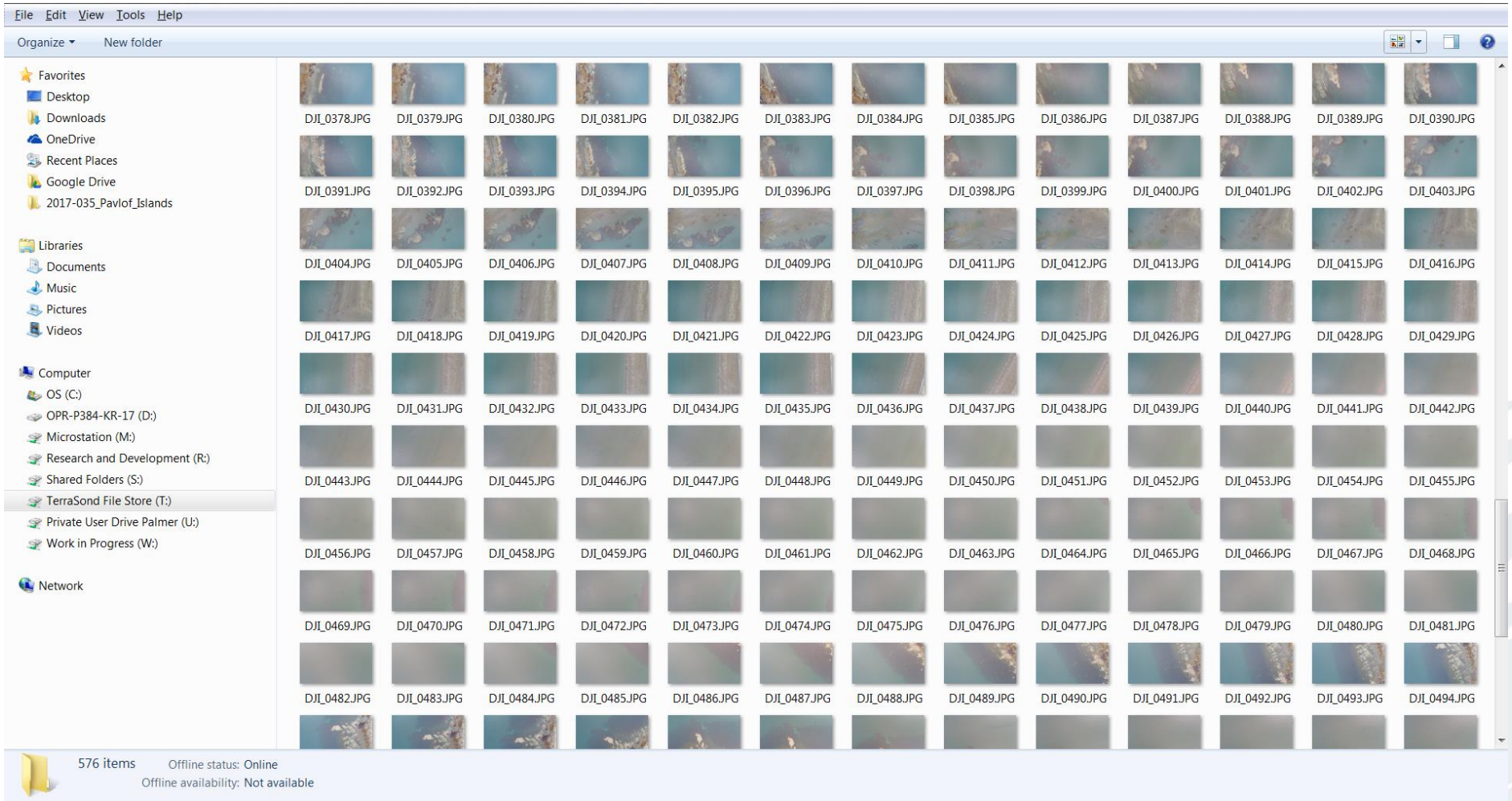
Recovery

- **Manually-controlled recovery**

TERRASOND

Processing

Examining hundreds of photos individually not an option…

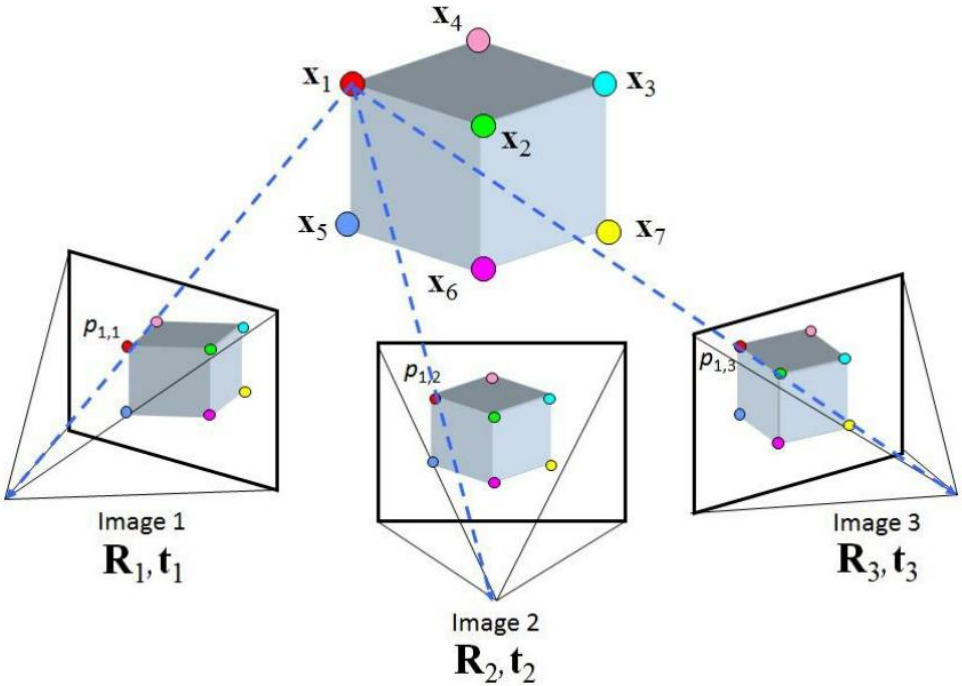


TERRASOND

Processing

- **Agisoft PhotoScan Professional**
- **Ortho-rectified photomosaics AND 3D-point clouds via SfM**

"Structure from motion (SfM) is a photogrammetric range imaging technique for estimating three-dimensional structures from two-dimensional image sequences" - Wikipedia



Important elements:

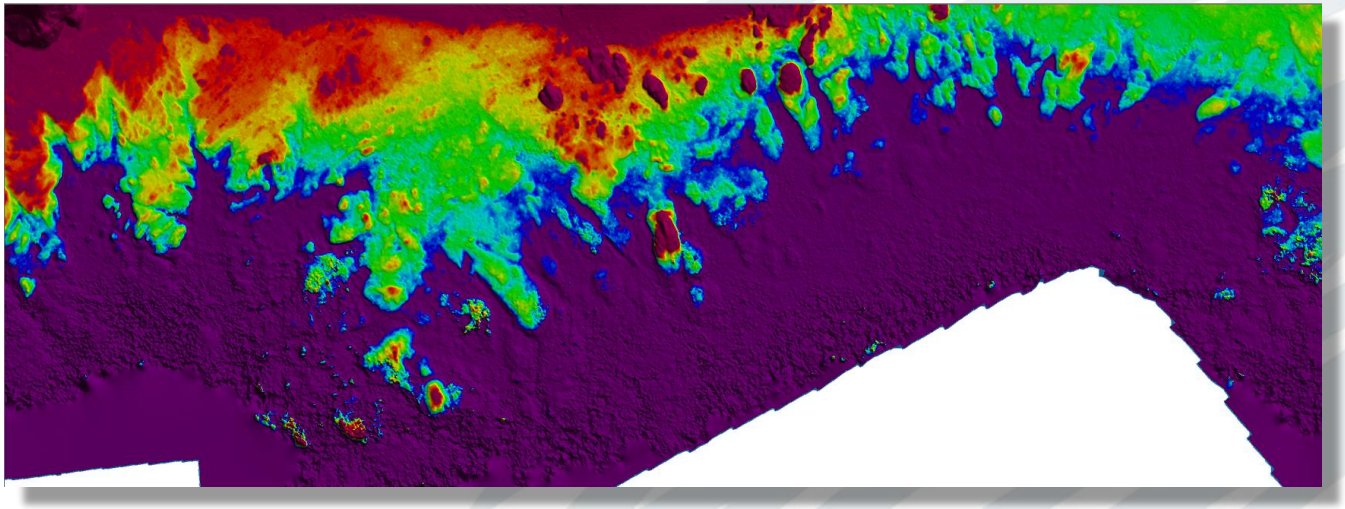
- Minimum 3 photos per object
- Common tie points
- Photo position (geotag) for absolute positioning
- Perspective (nadir to oblique)

TERRASOND

Processing Products

Ortho

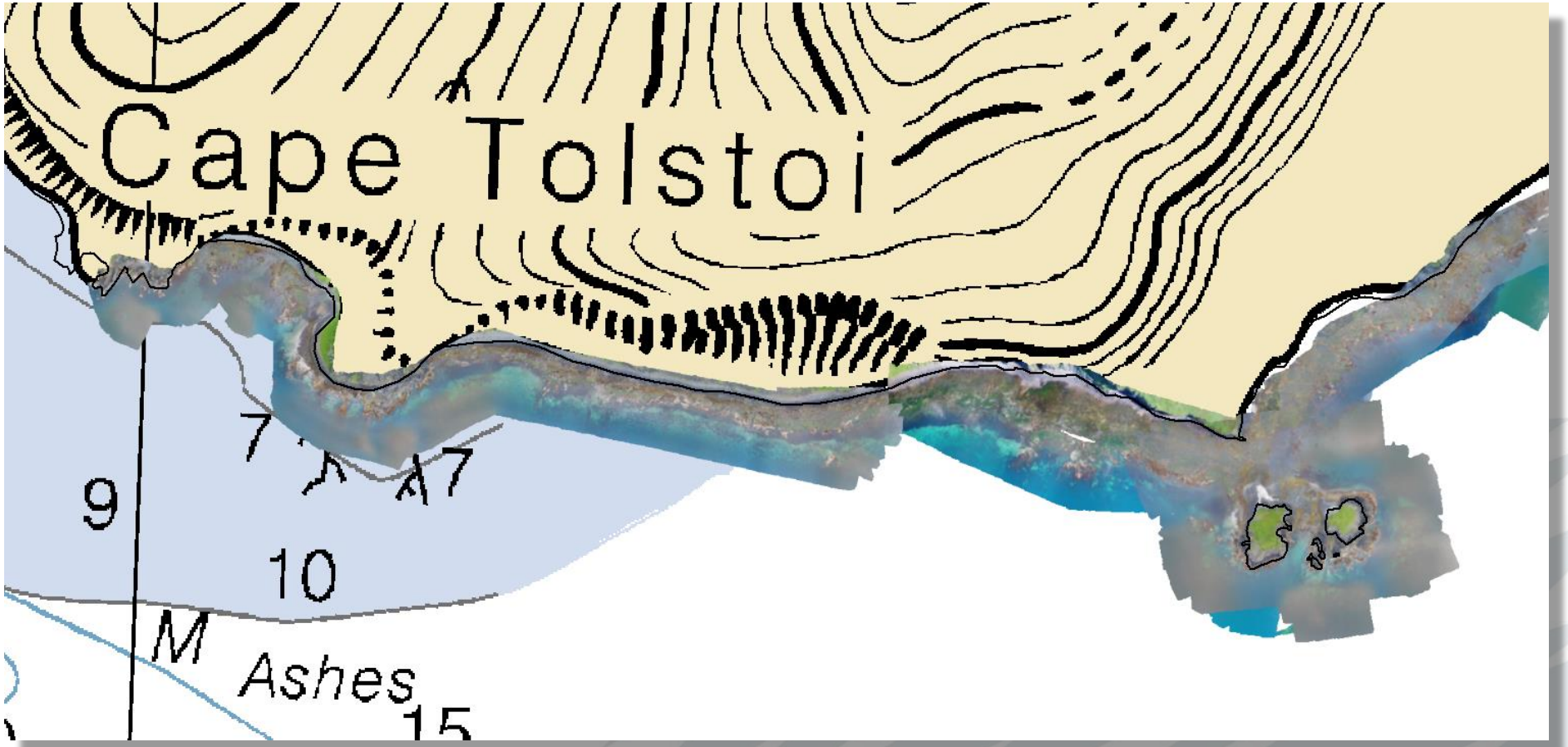
DEM



Purple = 0 m MLLW and deeper

TERRASOND

Ortho-photomosaics

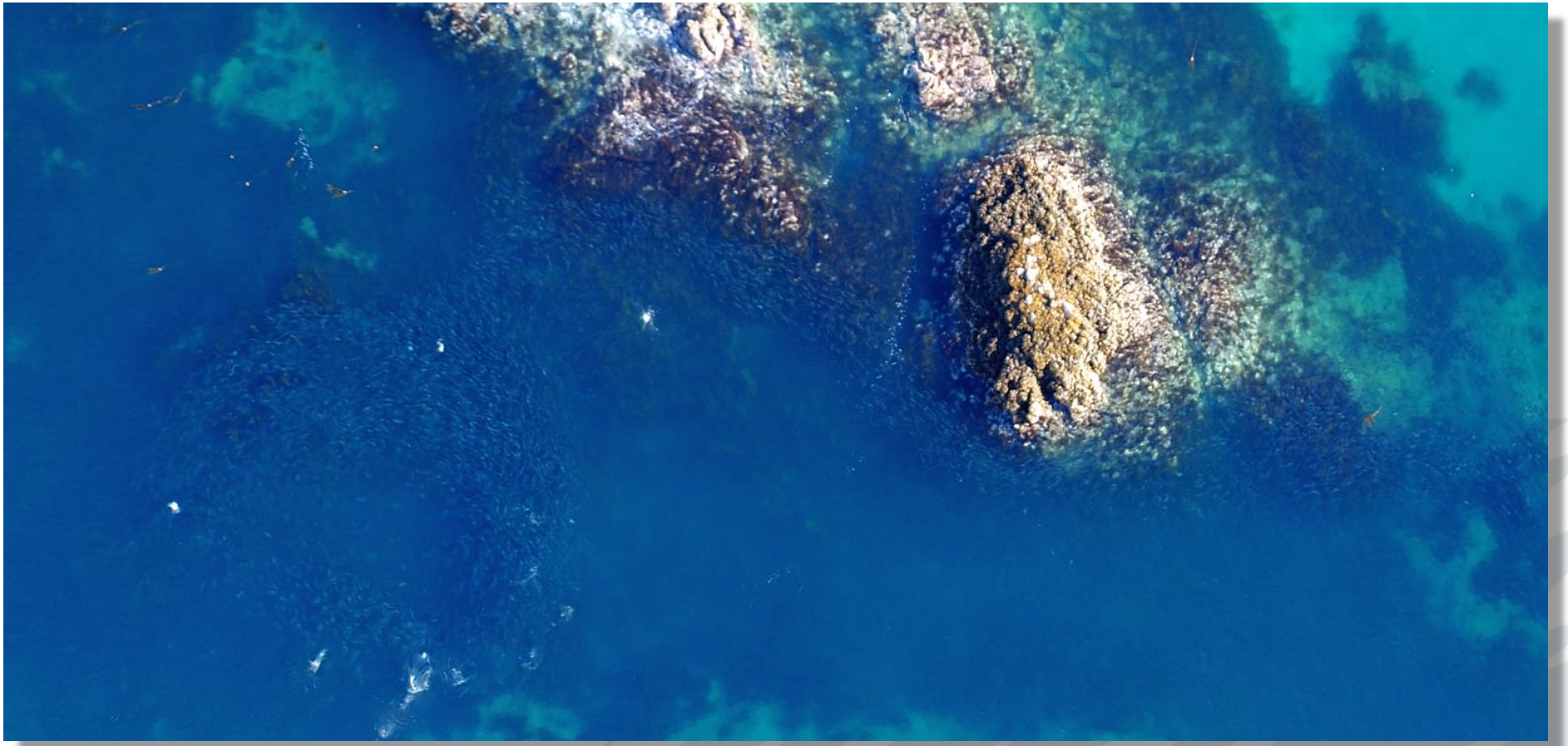


TERRASOND

Ortho-photomosaics

TERRASOND

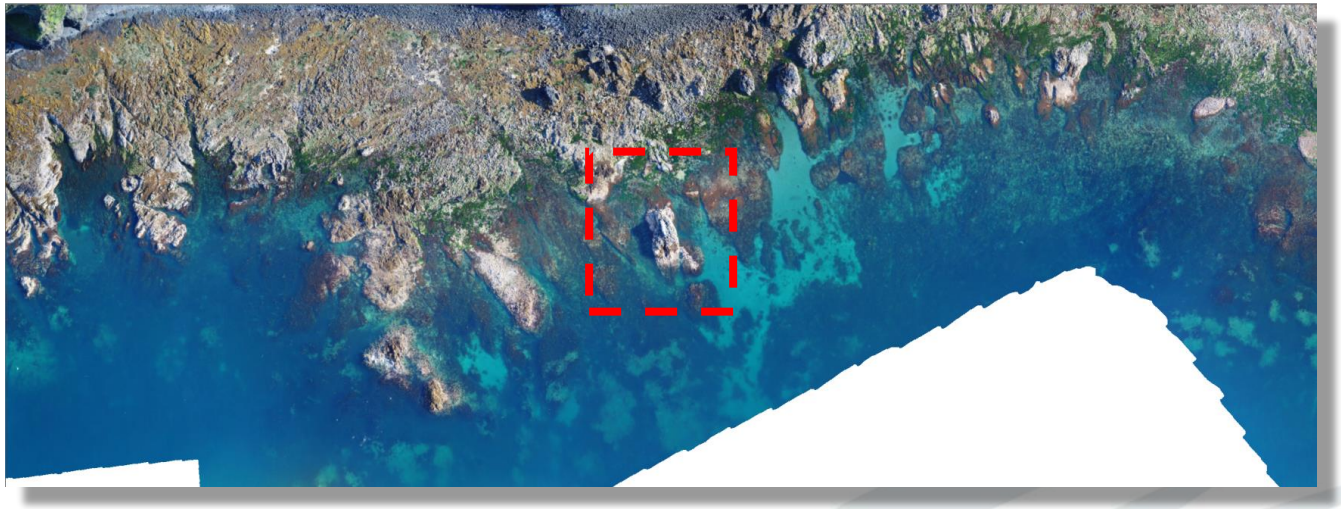
Ortho-photomosaics



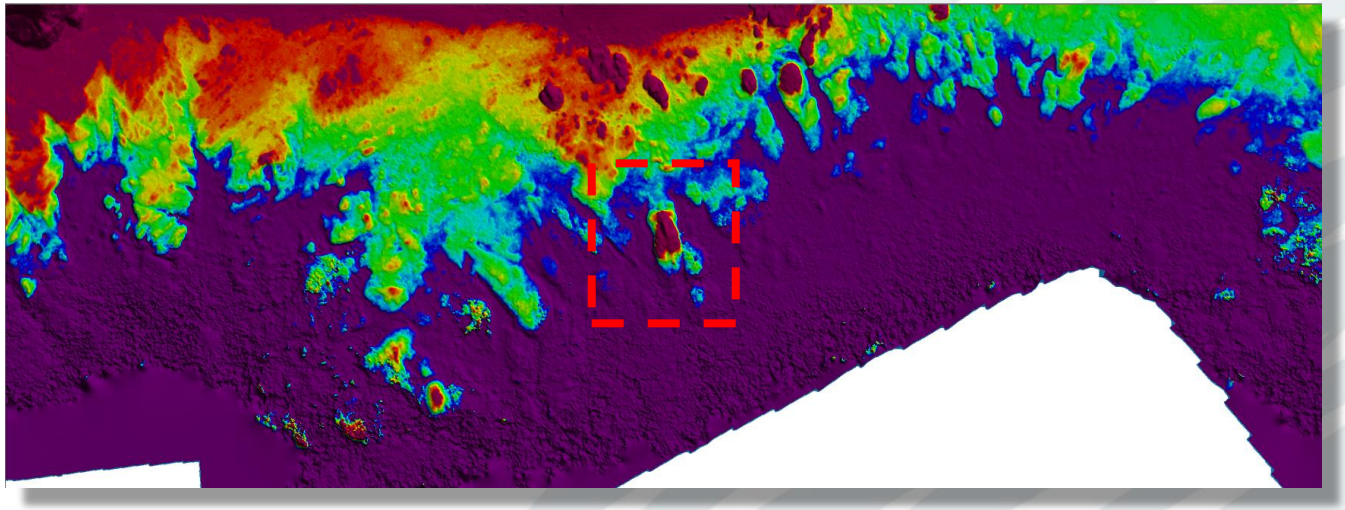
TERRASOND

SfM Derived DEMs

Ortho



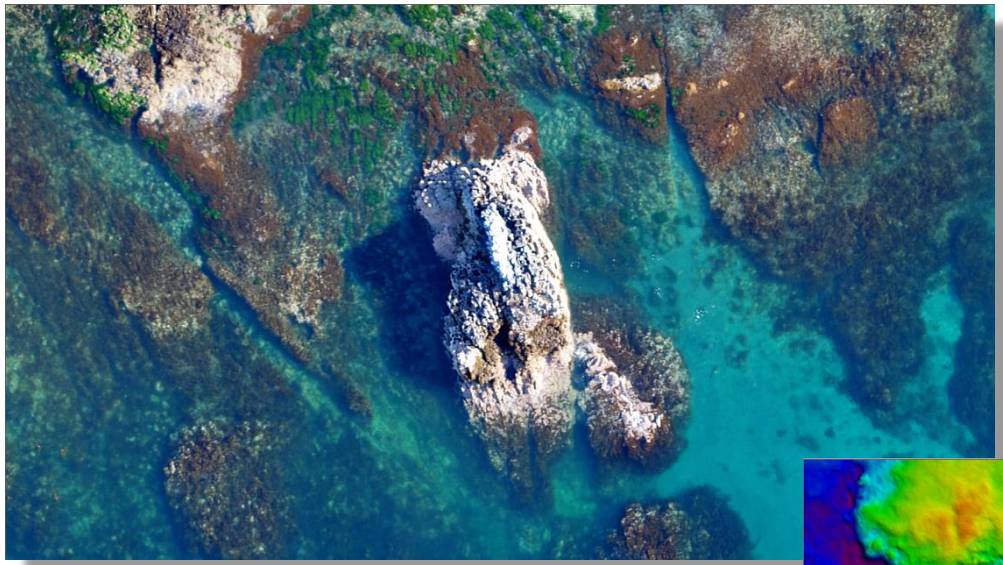
DEM

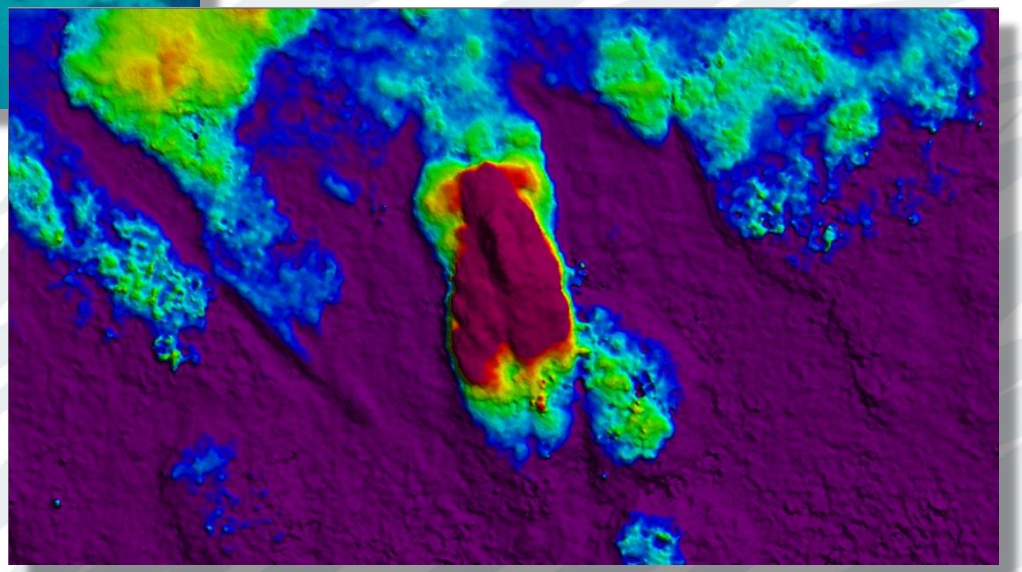


Purple = 0 m MLLW and deeper

TERRASOND

SfM Derived DEMs

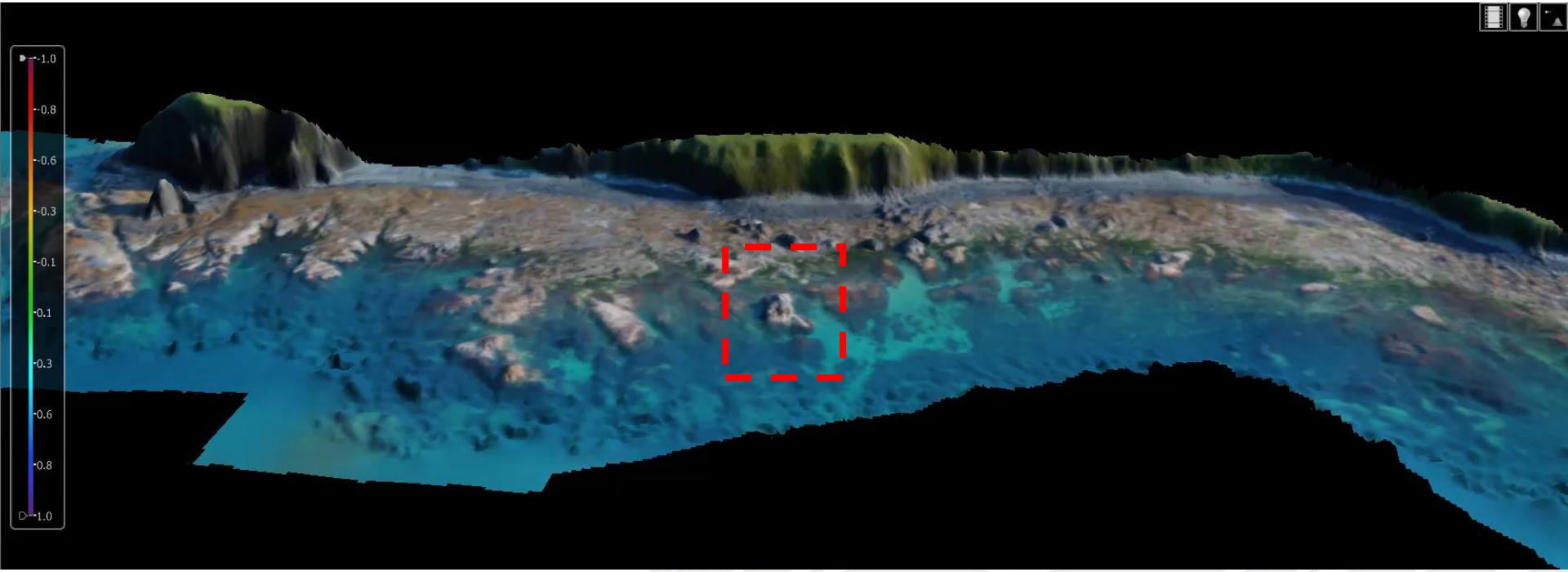




Purple = 0 m MLLW and deeper

TERRASOND

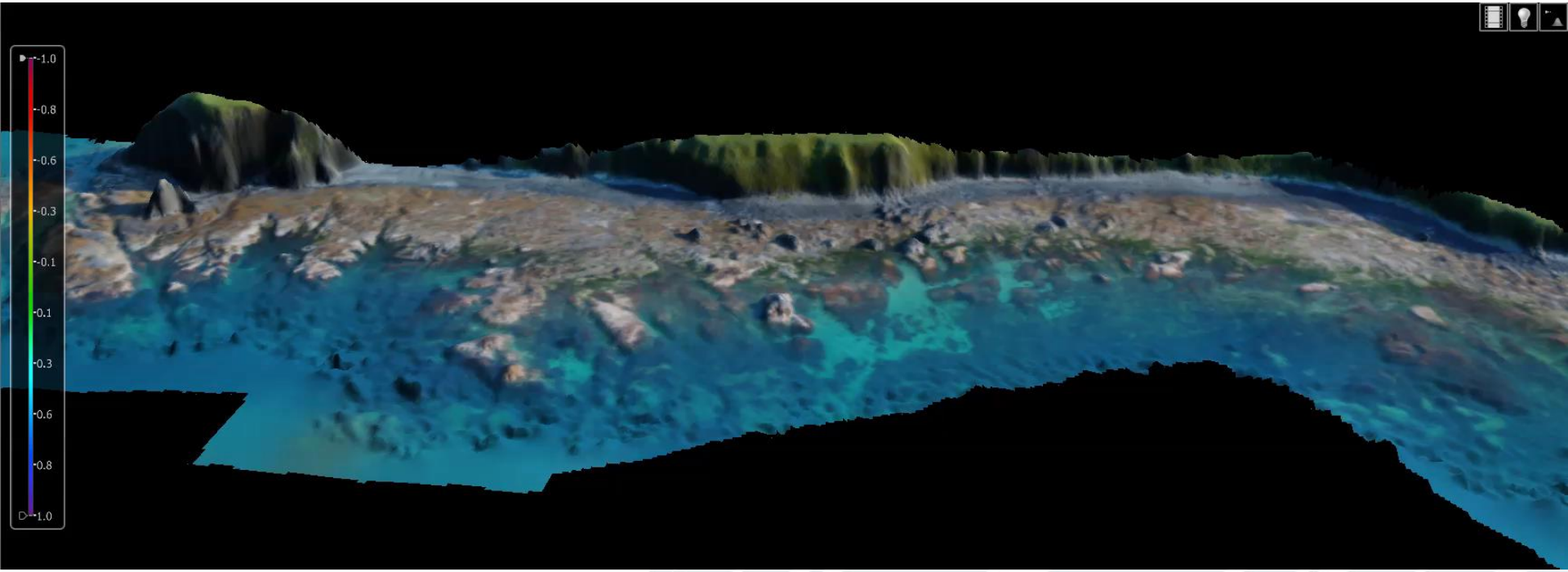
Ortho-DEM Drape (in CARIS HIPS)



Purple = 0 m MLLW and deeper

TERRASOND

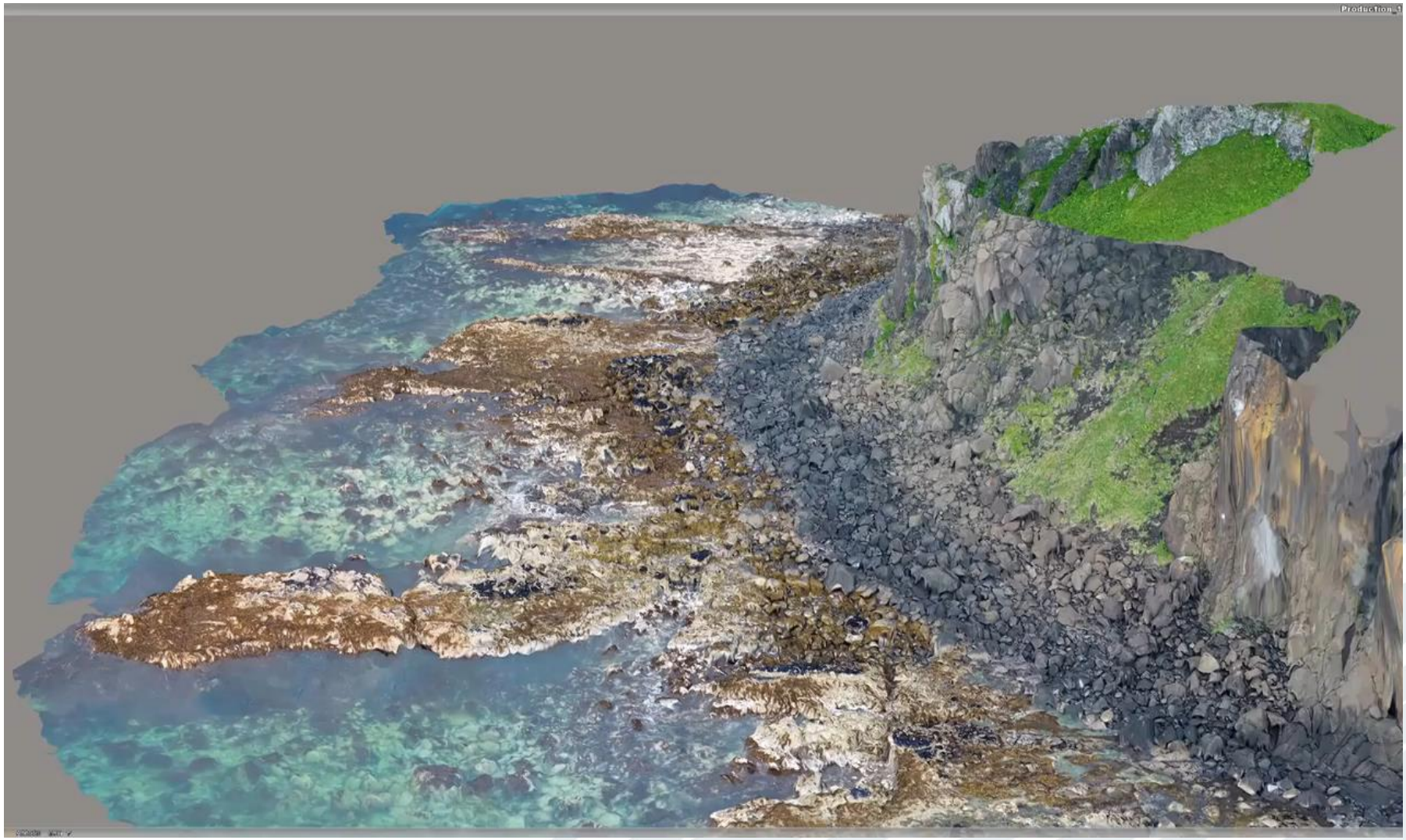
Ortho-DEM Drape (in CARIS HIPS)



Purple = 0 m MLLW and deeper

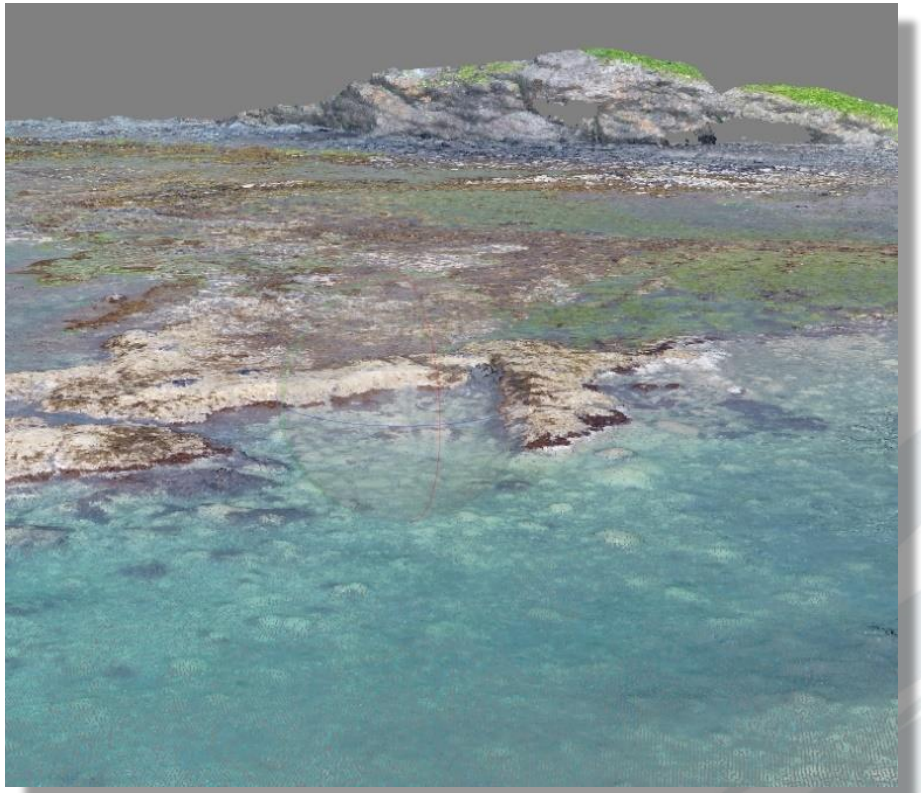
TERRASOND

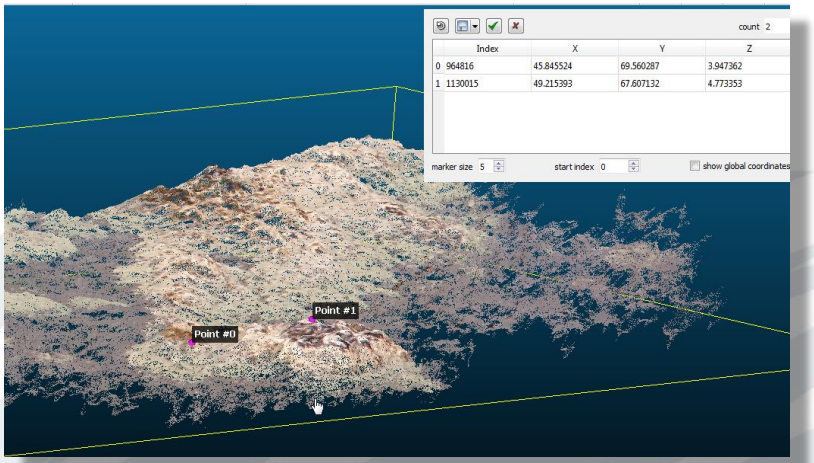
Ortho-DEM Drape



TERRASOND

Point Cloud Adjustment to MLLW





TERRASOND

Point Cloud Adjustment to MLLW

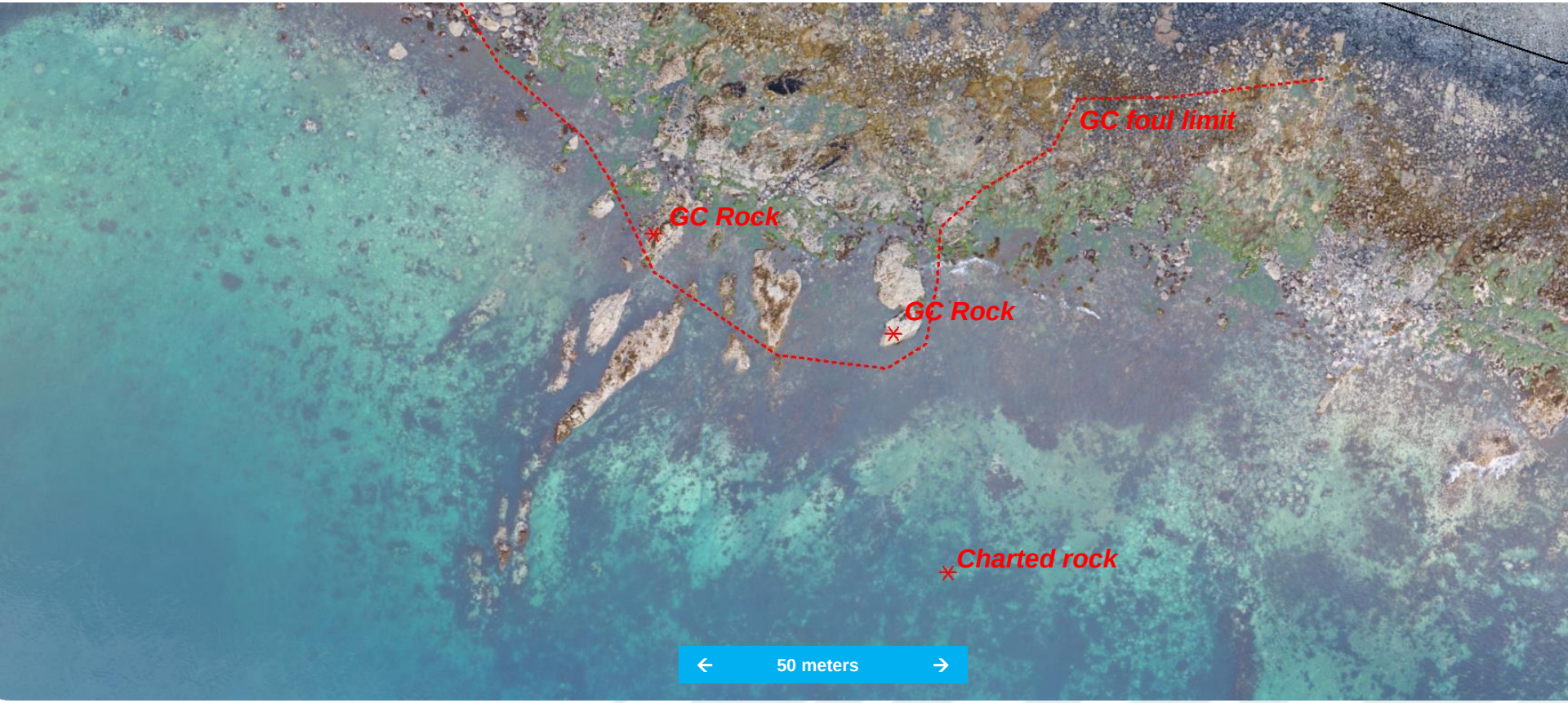
TERRASOND

Using the Data / S57 Encoding

Verification of Assigned Features

- SfM products overlaid with assigned features
- Features verified and deconflicted

Assigned features



TERRASOND

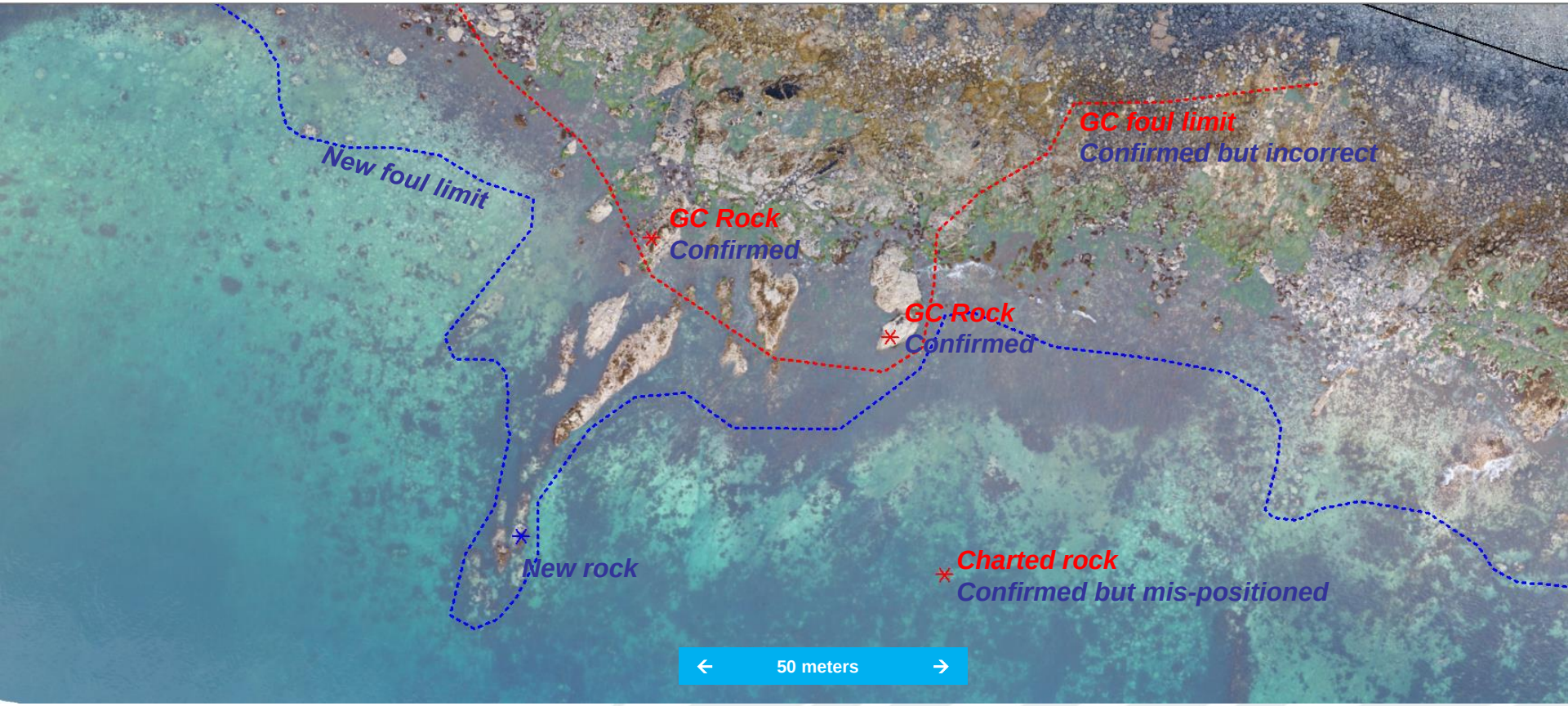
Using the Data / S57 Encoding

Verification of Assigned Features

- SfM products overlaid with assigned features
- Features verified and deconflicted

Assigned features

Verification results



TERRASOND

Using the Data / S57 Encoding

Verification of Assigned Features

- SfM products overlaid with assigned features
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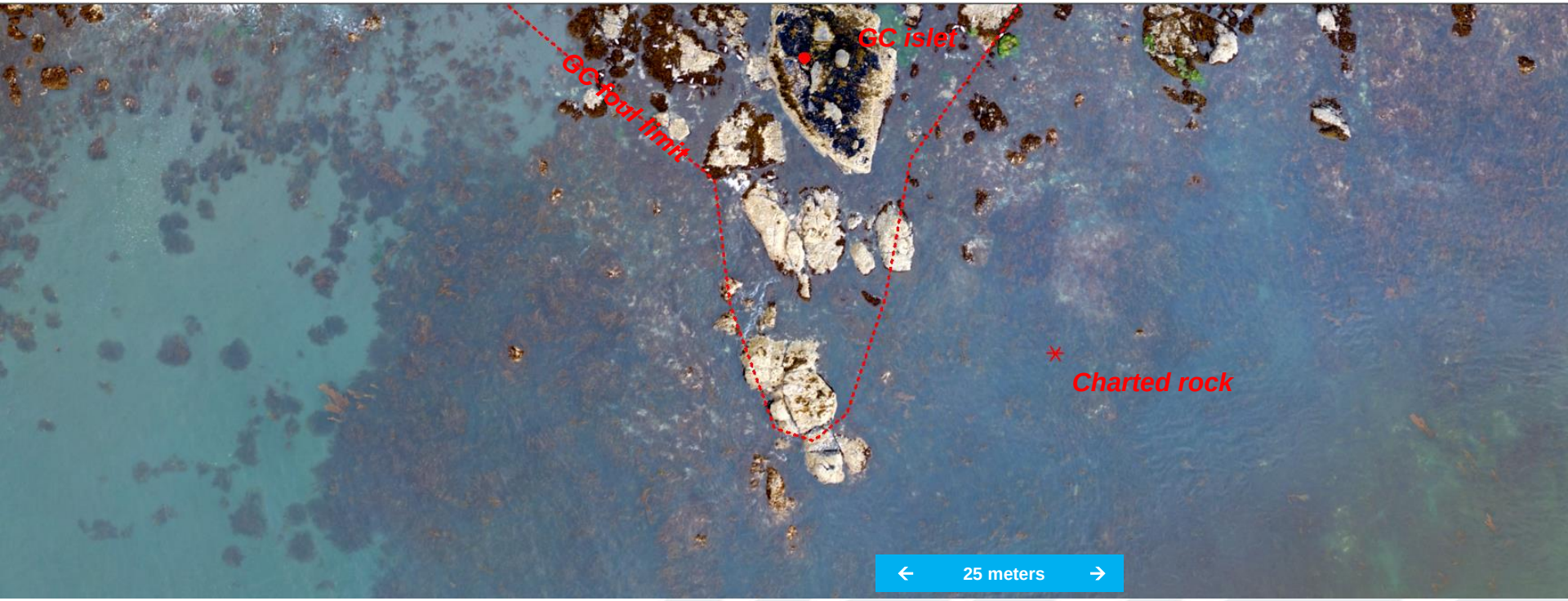
Assigned features



TERRASOND

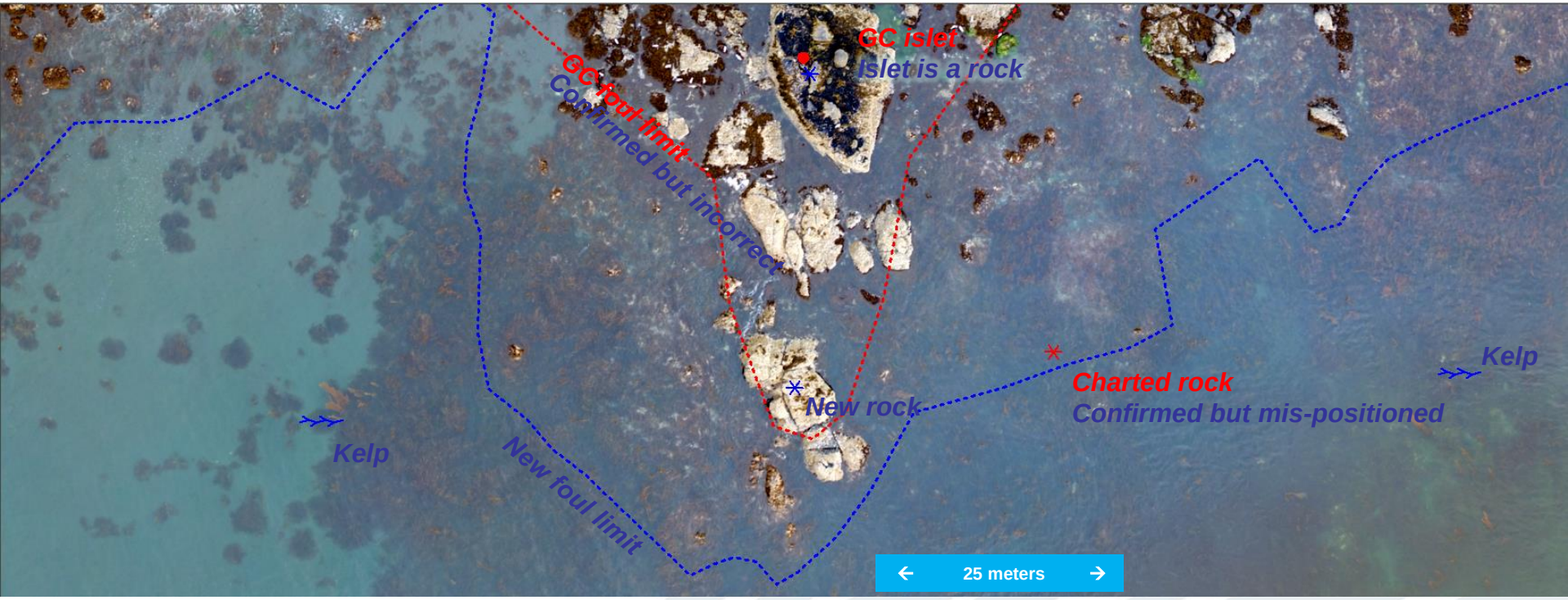
Using the Data / S57 Encoding

Verification of Assigned Features

- SfM products overlaid with assigned features
- Features verified and deconflicted

Assigned features

Verification results



TERRASOND

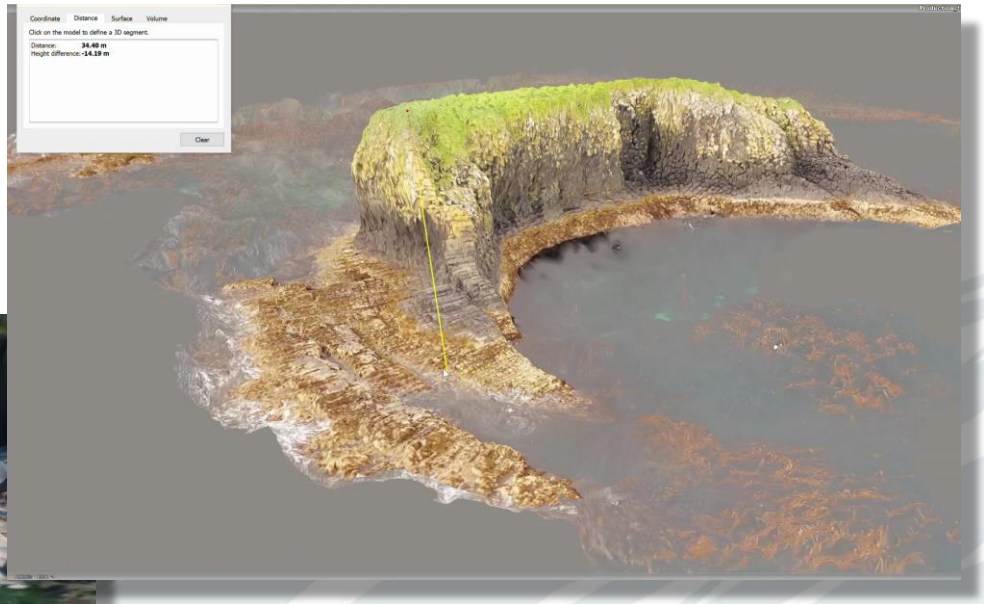
Results

Compared to traditional, vessel-based investigation:

PROS:

Quantitative – not estimated / interpolated

✓ **Quality**



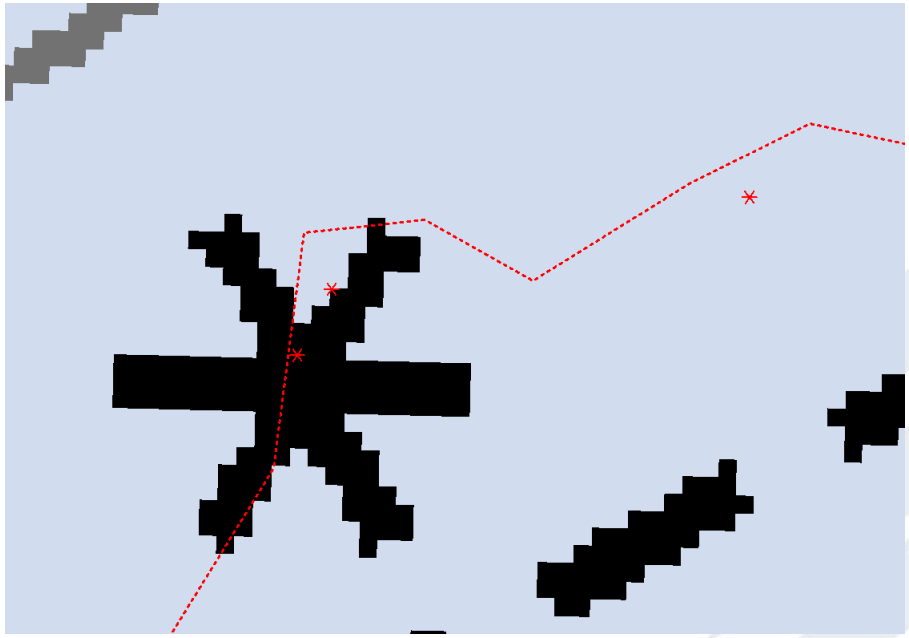
TERRASOND

Results

Compared to traditional, vessel-based investigation:

PROS:

Comprehensive – wholistic view of the shoreline area



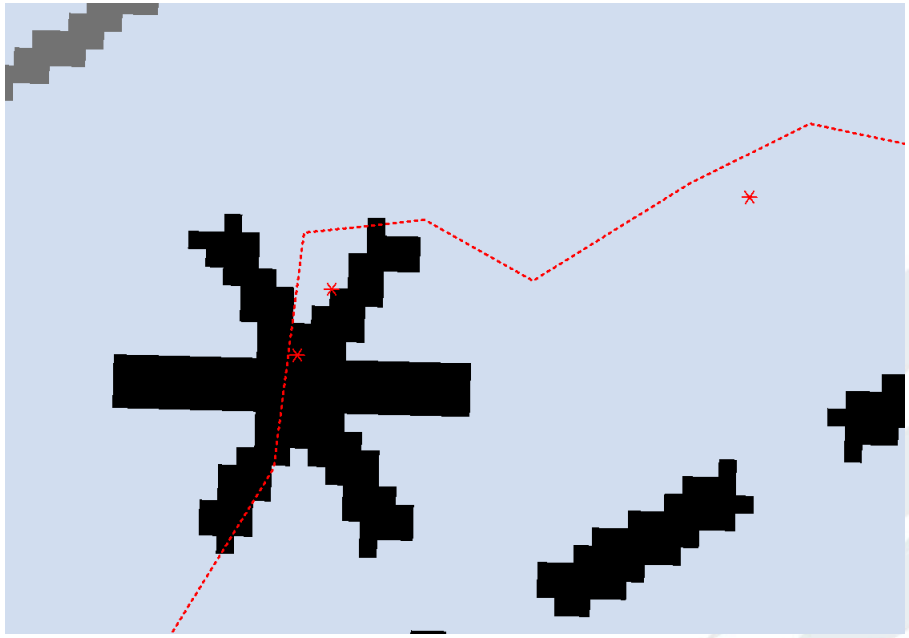
TERRASOND

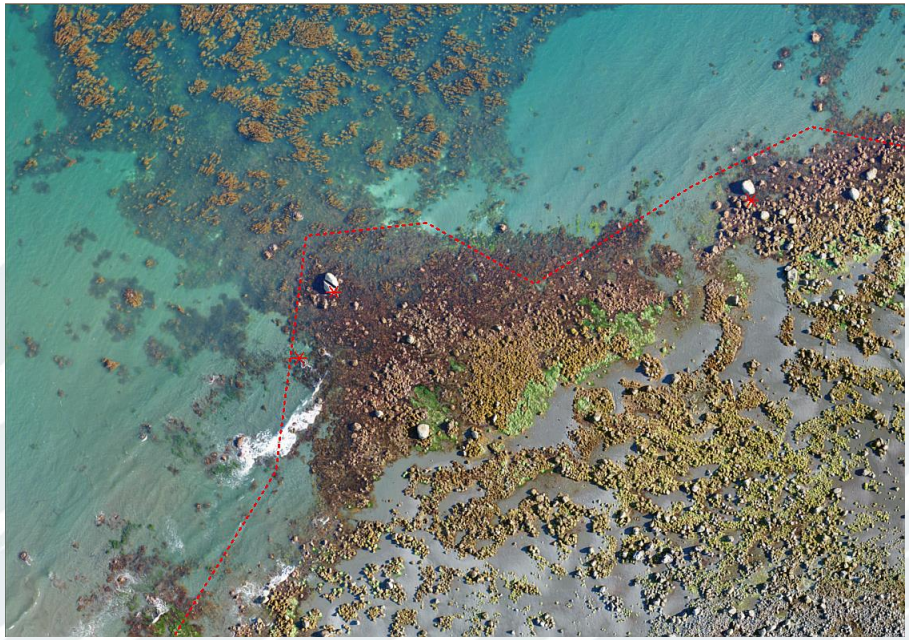
Results

Compared to traditional, vessel-based investigation:

PROS:

Comprehensive – wholistic view of the shoreline area





TERRASOND

Results

Compared to traditional, vessel-based investigation:

PROS:

- ✓ Quality
- ✓ **Efficiency**

- About 2 NM per 15-20 minute flight
- No skiff deployment
- Reposition larger vessel between flights
- Two drones airborne at once

TERRASOND

Results

Compared to traditional, vessel-based investigation:

PROS:

- ✓ Quality
- ✓ Efficiency
- ✓ **Simplicity**

- Simple, off-the-shelf
- Fits in a small case
- Easy to learn

TERRASOND

Results

Compared to traditional, vessel-based investigation:

PROS:

- ✓ Quality
- ✓ Efficiency
- ✓ Simplicity
- ✓ **SAFETY**

STAY ON THE BIG BOAT,
DRINK COFFEE,
INVESTIGATE SHORELINE!

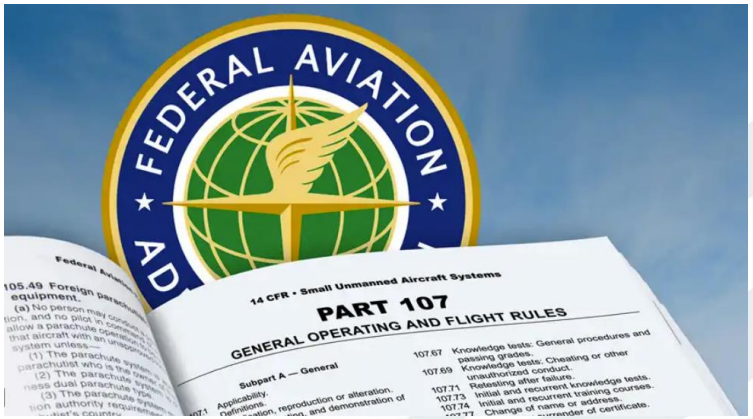
TERRASOND

Results

Compared to traditional, vessel-based investigation:

PROS:

- ✓ Quality
- ✓ Efficiency
- ✓ Simplicity
- ✓ SAFETY



CONS:

- ✓ **FAA Licensure**

TERRASOND

Results

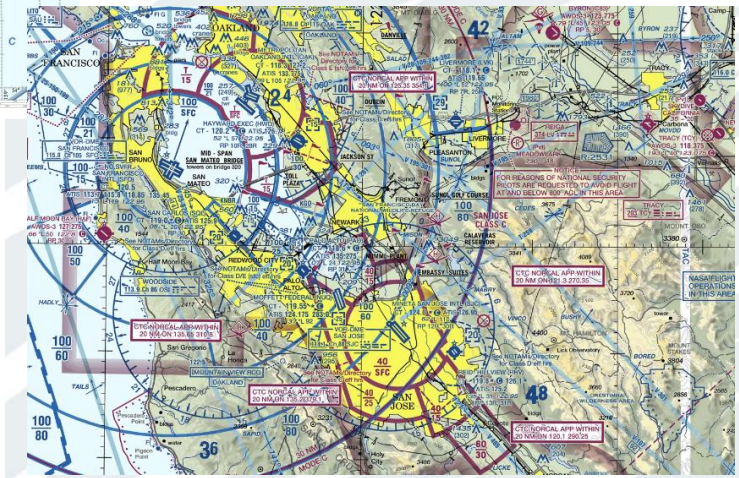
Compared to traditional, vessel-based investigation:

PROS:

- ✓ Quality
- ✓ Efficiency
- ✓ Simplicity
- ✓ SAFETY

CONS:

- ✓ FAA Licensure
- ✓ **FAA Regulations**



TERRASOND

Results

Compared to traditional, vessel-based investigation:

PROS:

- ✓ Quality
- ✓ Efficiency
- ✓ Simplicity
- ✓ SAFETY

- Probably MORE wind-capable
- But, precipitation & visibility are concerns

CONS:

- ✓ FAA Licensure
- ✓ FAA Regulations
- ✓ **Different Wx Windows**

TERRASOND

Results

Compared to traditional, vessel-based investigation:

PROS:

- ✓ Quality
- ✓ Efficiency
- ✓ Simplicity
- ✓ SAFETY

CONS:

- ✓ FAA Licensure
- ✓ FAA Regulations
- ✓ Different Wx Windows
- ✓ **Training & Procedures**

TERRASOND

Results

Compared to traditional, vessel-based investigation:

PROS:

- ✓ Quality
- ✓ Efficiency
- ✓ Simplicity
- ✓ SAFETY

CONS:

- ✓ FAA Licensure
- ✓ FAA Regulations
- ✓ Different Wx Windows
- ✓ Training & Procedures
- ✓ **More Data**

- ~ 200 GB raw
- ~ 1 TB processed (larger than the CARIS dataset)

TERRASOND

Summary / Looking Forward

- Took over 25,000 photos
- 200 km of coastline
- 700 features

- Will continue to use!
- Shoreline, scouting, documentation
- New technology

Other Possibilities:

- Full shoreline verification (with ground control)
- Bathymetry from SfM…

TERRASOND

Questions?

3D rendering from SfM of Unga Point ATON

TERRASOND

quantum
SPATIAL

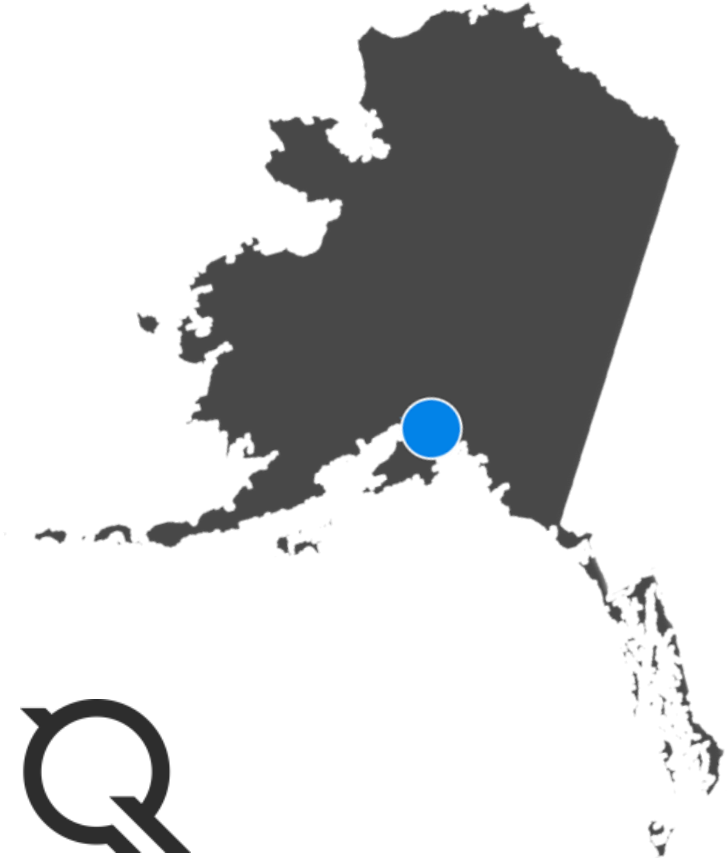
Topo-Bathymetric LiDAR – Flash Talk

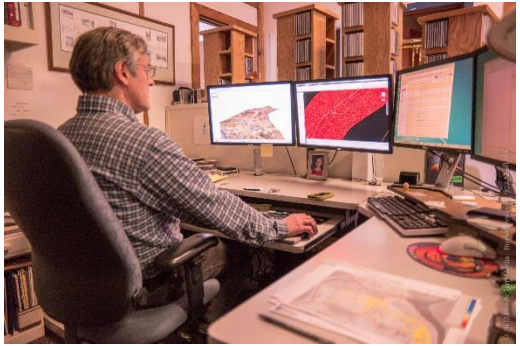
Alaska Coastal Mapping Summit

Russell Faux
faux@quantumspatial.com
Friday, Feb 9, 2018

Who We Are

Mission: **Deliver actionable intelligence & geospatial analytics to those who want to map, model and manage their world.**



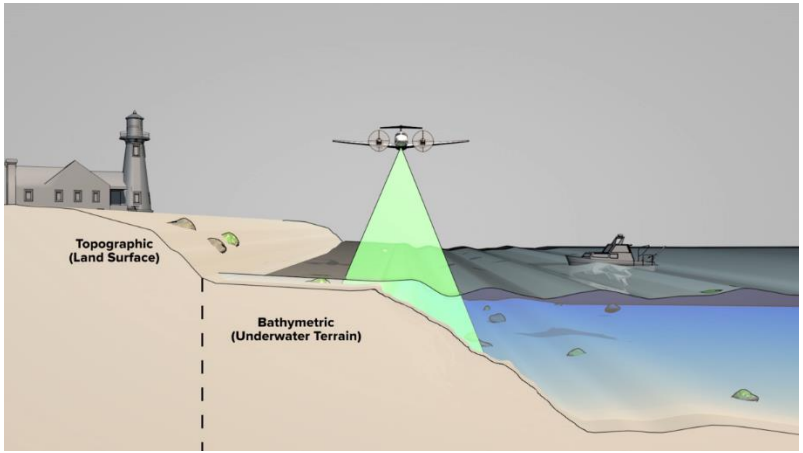


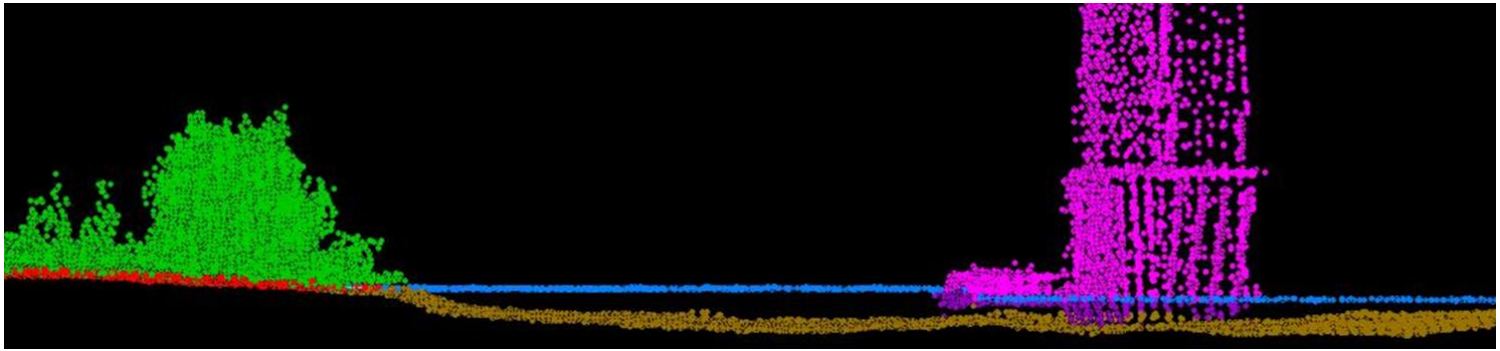
Topo-bathymetric LiDAR

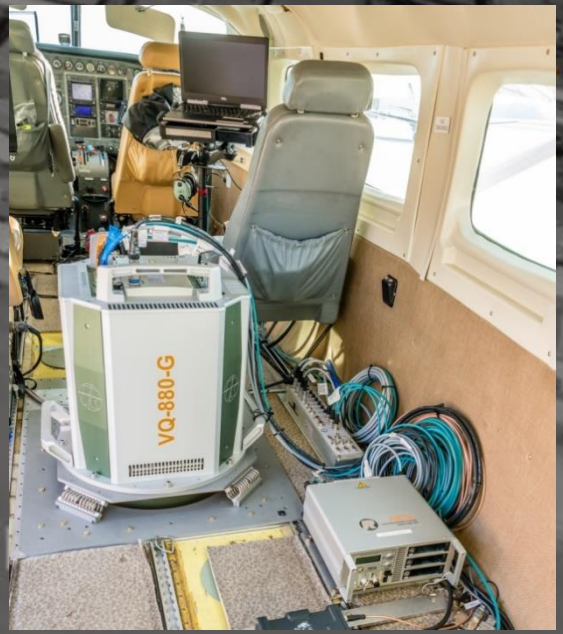
Extending the Survey Under Water

Green wavelength LiDAR

Captures both near shore terrain and shallow water environments



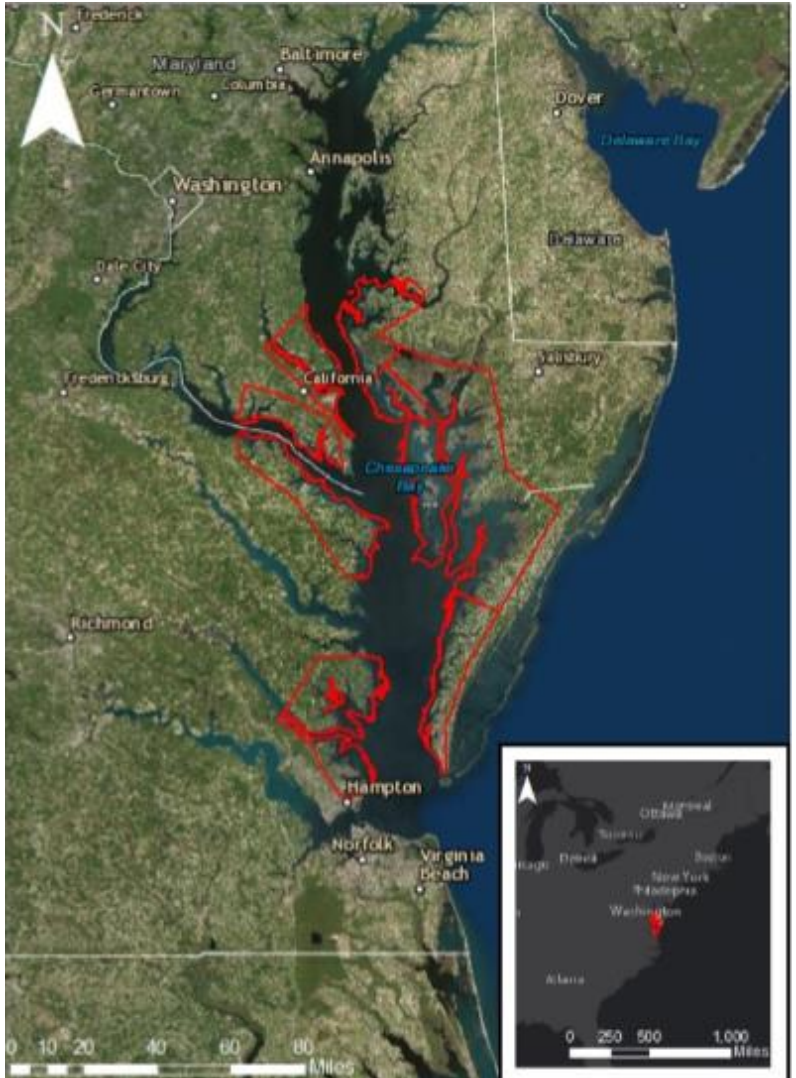




- **High Pulse Rate (up to 550 kHz)**
- **Full waveform w/ every pulse**
- **Online waveform digitizing**
- **1.5 Secchi Depth “depth rating”**
- **Selectable beam divergence**
- **Short pulse length**

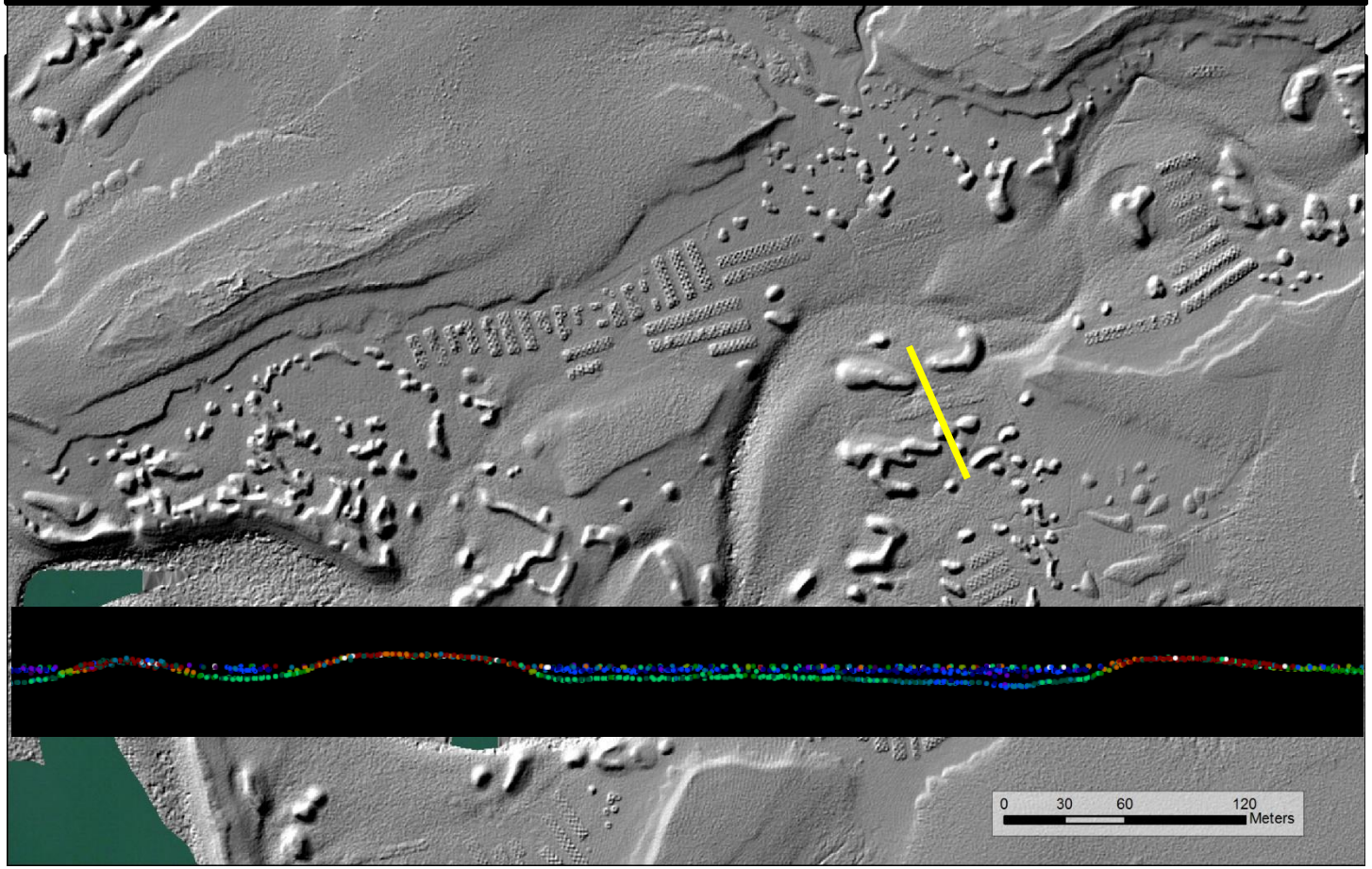
Coastal Mapping with Topo-bathymetric LiDAR

- Chesapeake Bay, MD - 450 sq. miles
  (NOAA 2018 – Phase I)
- Willamette River, OR – 170 sq. miles
  (JABLTCX 2017)
- Kootenai River, ID – 34 sq. miles
  (USGS CONED, 2017)
- Coastal South Carolina – 800 sq. miles
  (NOAA 2016/2017)
- Hurricane Sandy – 2,773 sq. miles
  (NOAA 2013/2014)



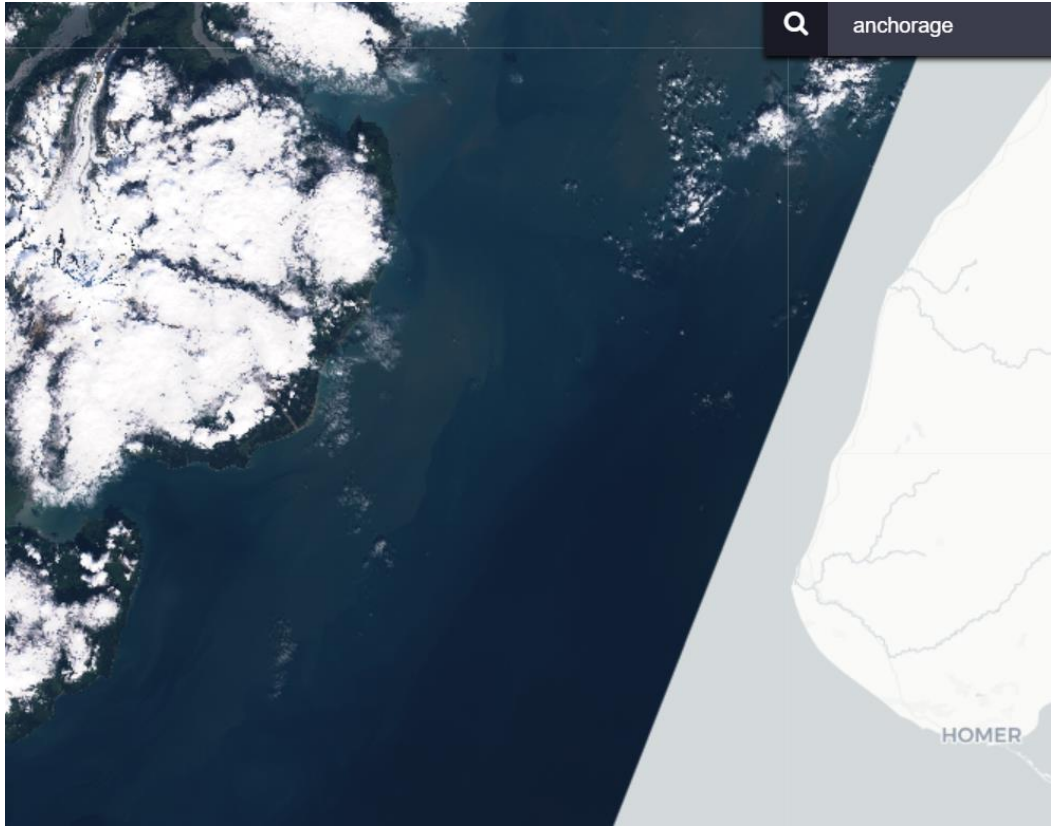
Back bay marshes and mudflats behind Kiawah Island, SC : **2016 NOAA NGS topobathy lidar**

Back bay marshes and mudflats behind Kiawah Island, SC : **2016 NOAA NGS topobathy lidar**



Alaska Considerations

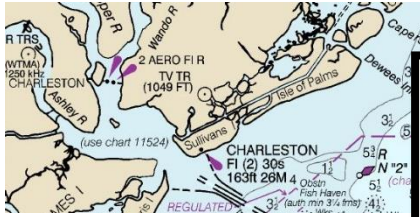
- 33,904 miles of diverse shoreline
- Short data collection season
- Variable water clarity conditions
- Fewer monitoring resources – including satellite data
- Remote locations and bad weather



How it helps

Safety of Navigation &

Foundation for sound decision making



Safety of Navigation

Up-to-date Nautical Charts

Contributing Partners

NOAA NGS, NOAA OCS

Riverine Flood Inundation Maps

View riverine flood forecasts in a visual format

Contributing Partners

FEMA, NOAA NWS, NOAA OCM, USACE, USGS

Sea Level Rise Viewer

View potential impacts of sea level rise along the coast

Contributing Partners

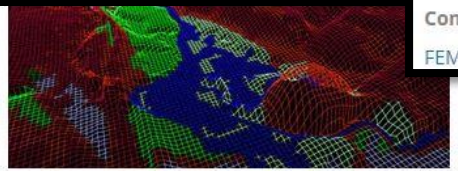
NOAA OCM

Digital Shoreline Analysis System

Computes the rate of shoreline change using multiple historical shoreline positions

Contributing Partners

USGS

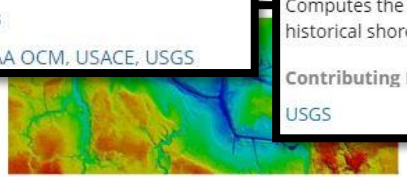


Sea Level Affecting Marshes Model

Simulates potential impacts on wetlands and shorelines from long-term sea level rise

Contributing Partners

EPA, Warren Pinnacle Consulting



VDatum

Vertically transforms geospatial data between a variety of tidal, orthometric, and ellipsoidal datums

Contributing Partners

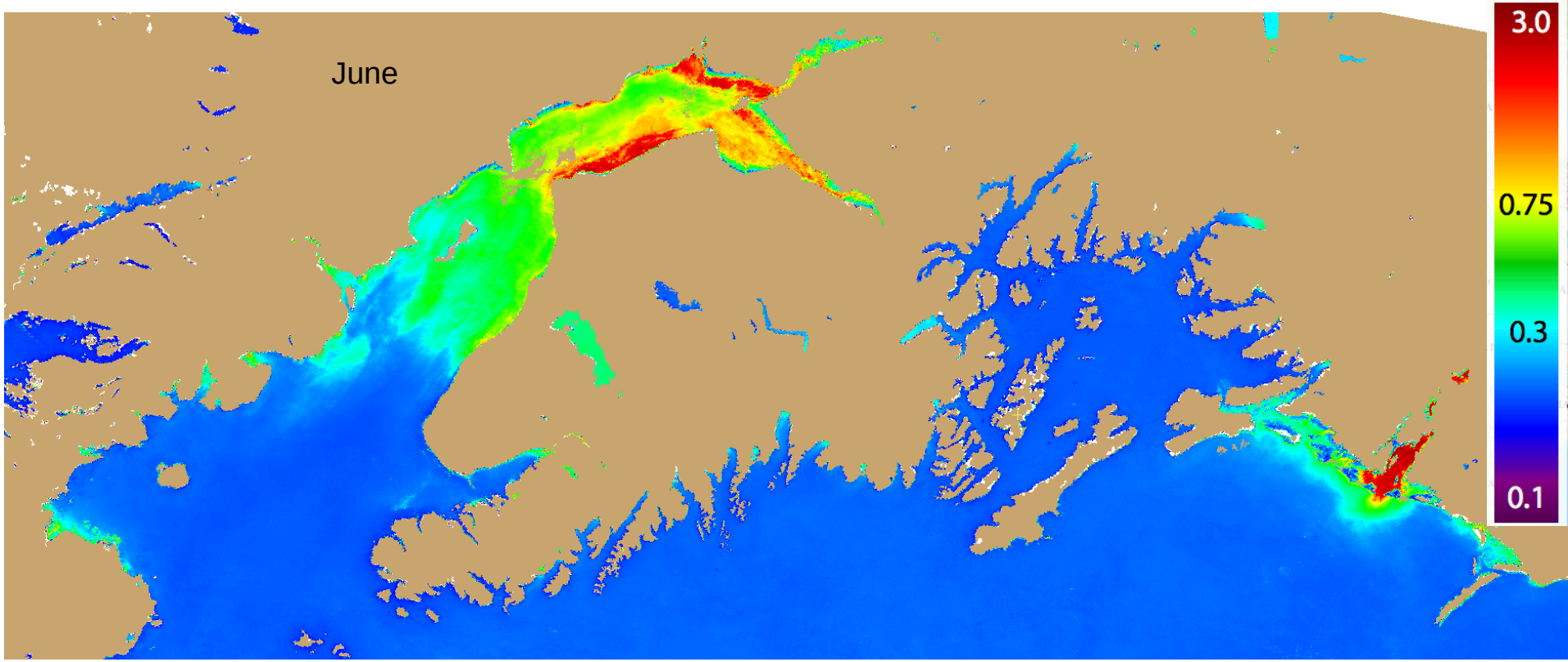
NOAA CO-OPS, NOAA NGS, NOAA OCS

Thank You

faux@quantumspatial.com

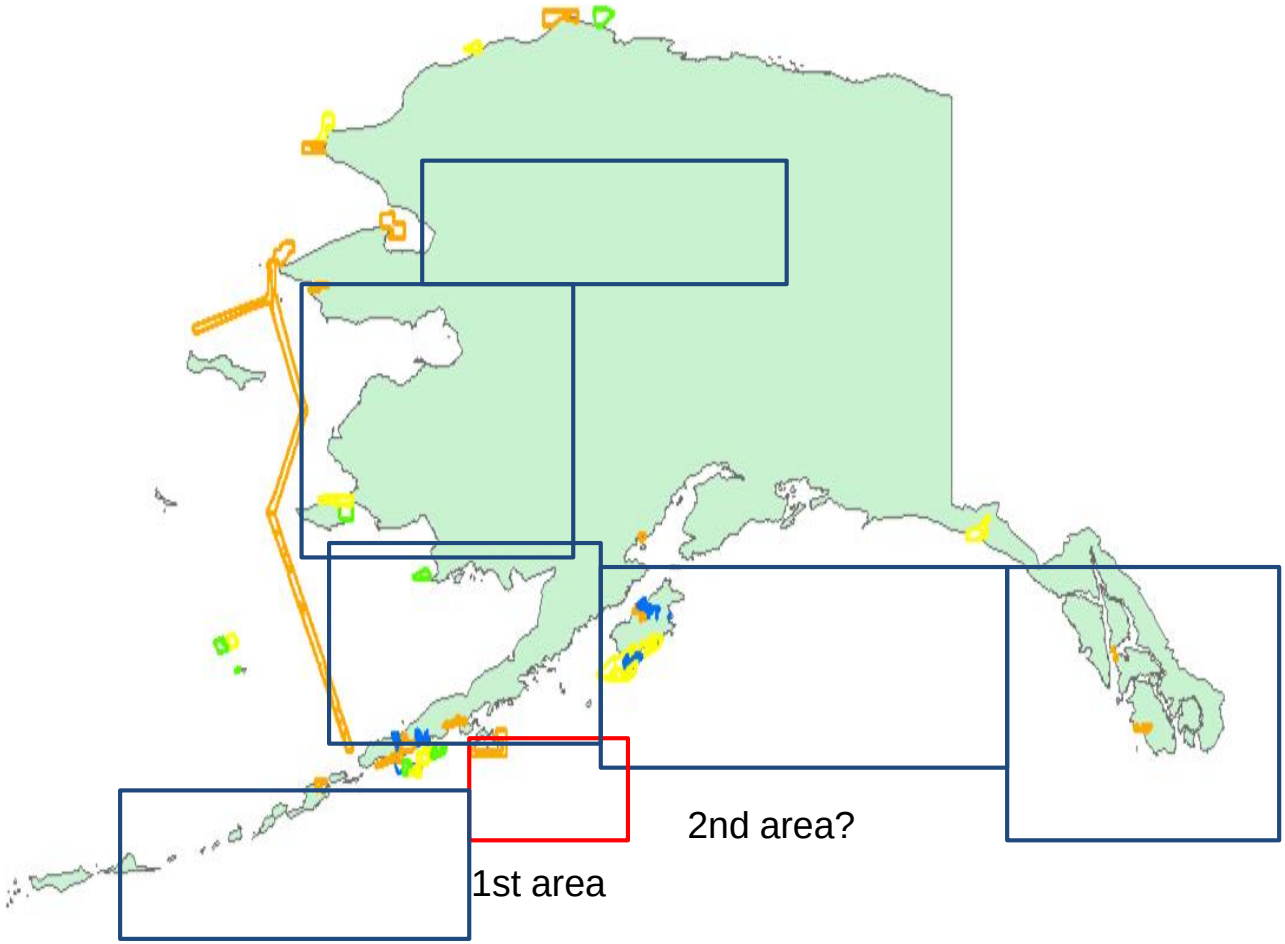
Coastal Water Clarity in Alaska

Rick Stumpf, NOAA National Ocean Service
Natl Centers for Coastal Ocean Science, Maryland

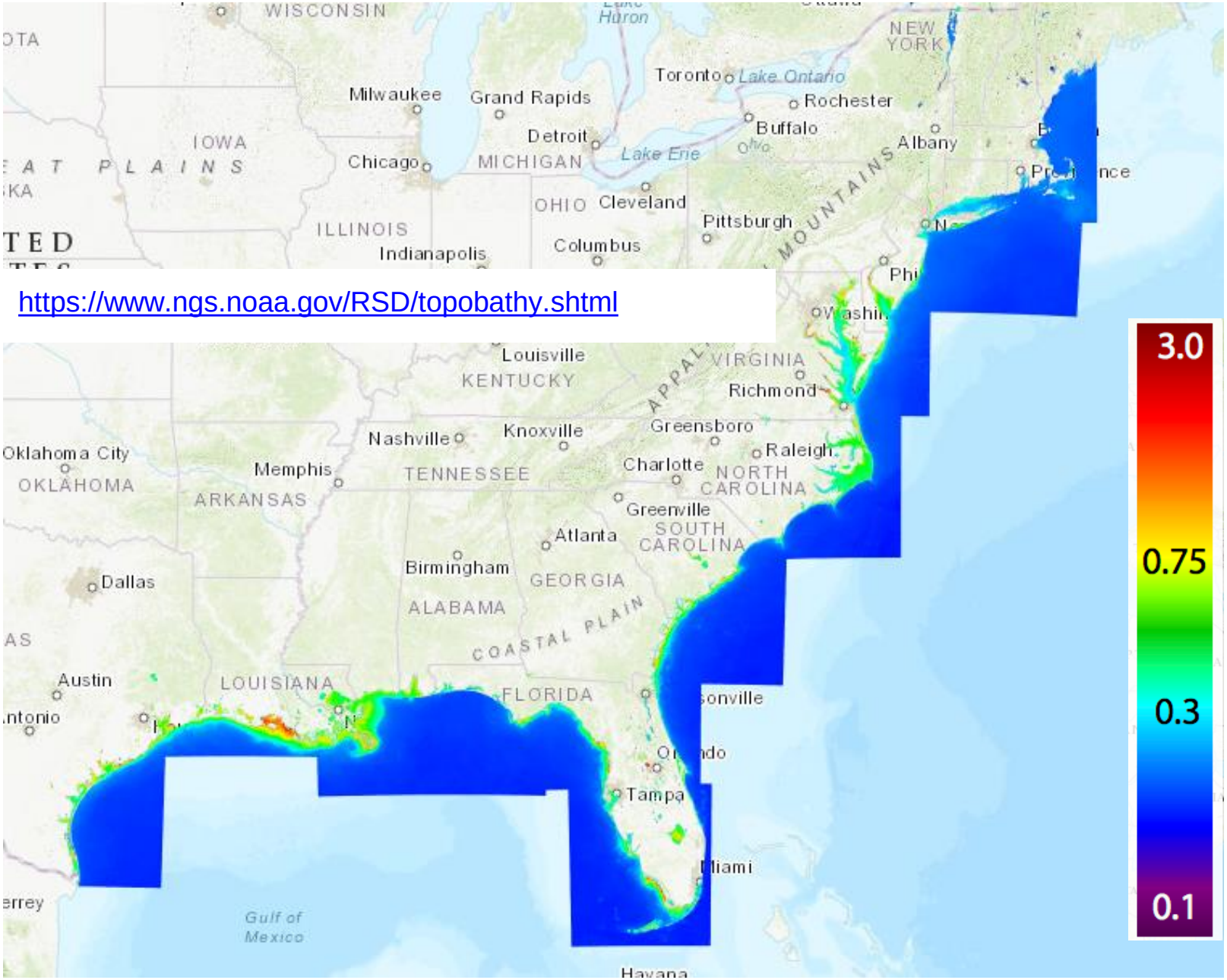


What are NGS/OCS's needs?

- Barrow
- Point Hope
- Etolin Strait
- Pribilof
- Aleutians
- Kodiak

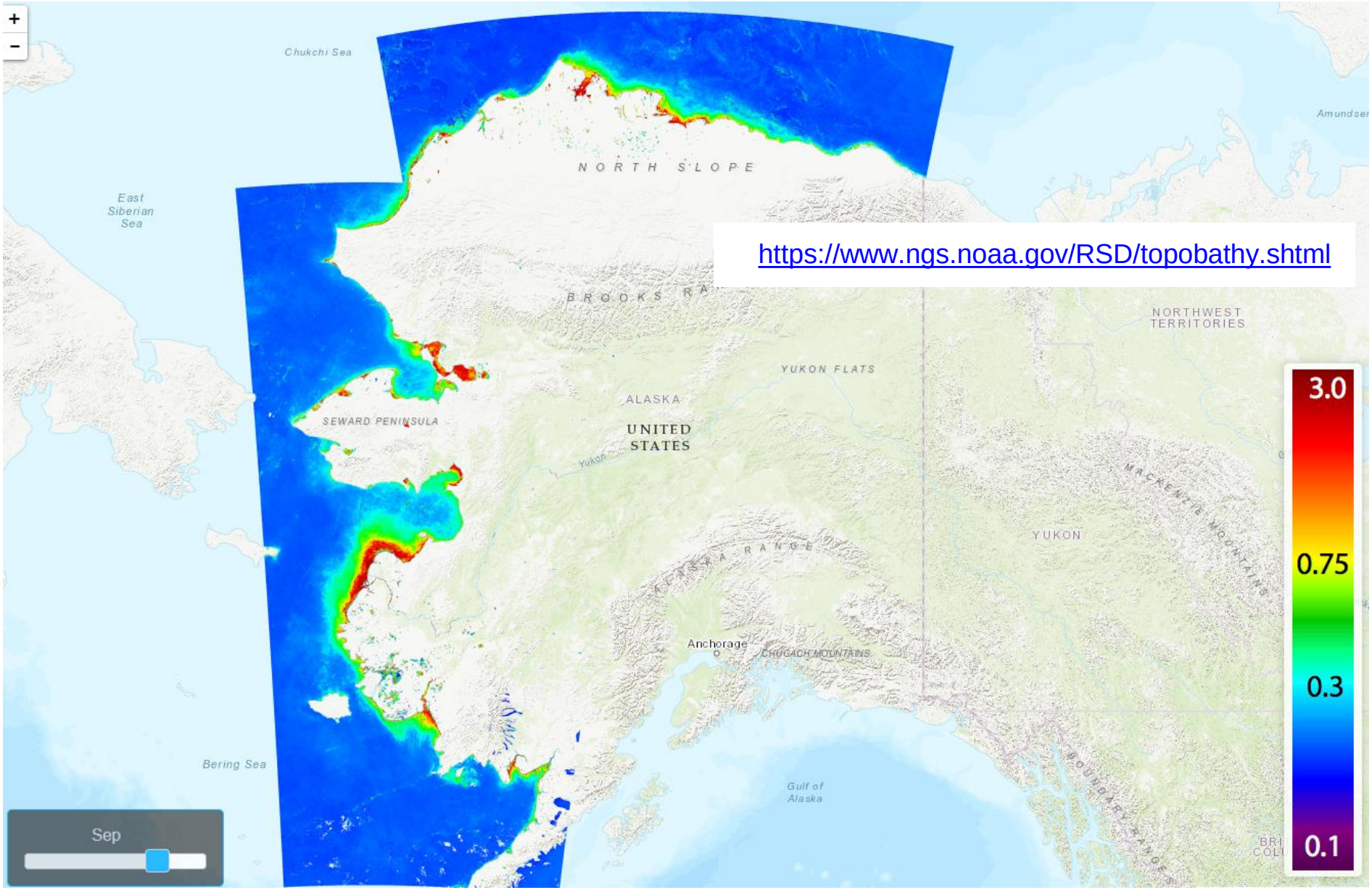


Light Attenuation Climatology for US



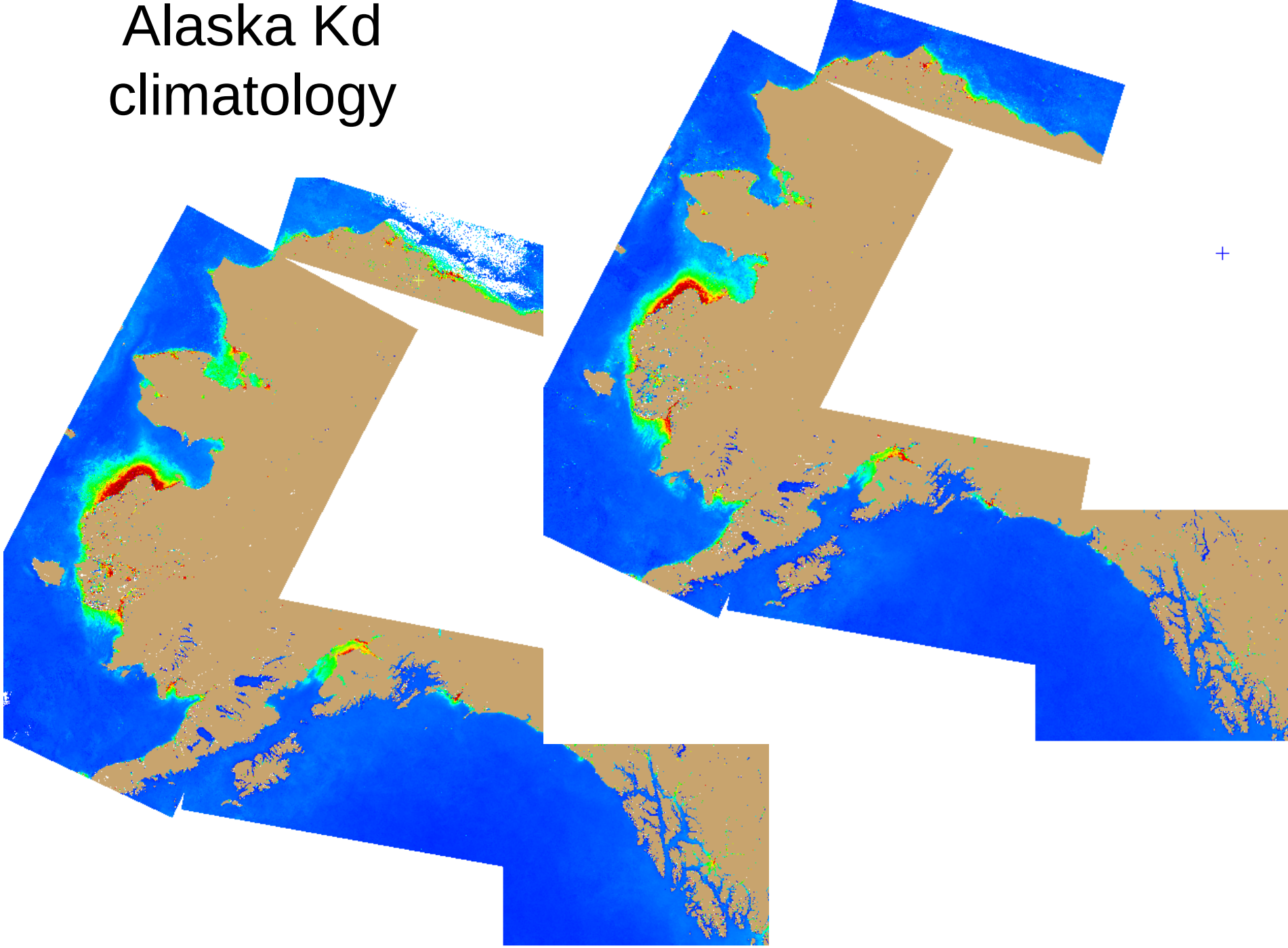
https://www.ngs.noaa.gov/RSD/topobathy.shtml

Climatology for U.S. and Alaska

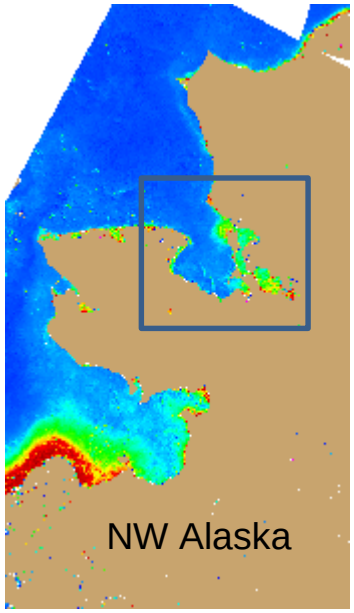


https://www.ngs.noaa.gov/RSD/topobathy.shtml

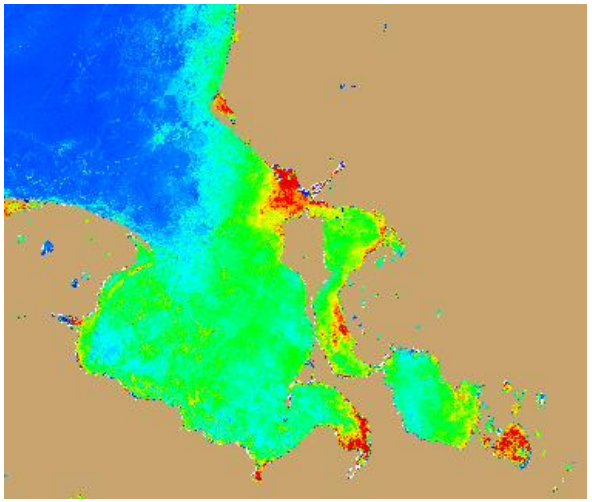
Alaska Kd climatology



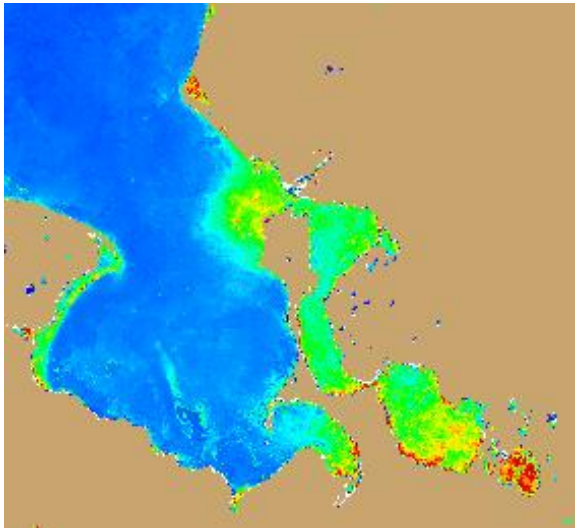
Changes over season, multi-year climatology



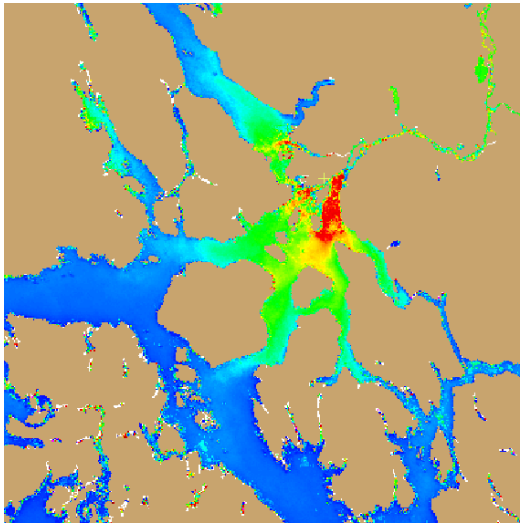
Kotzebue Bay June



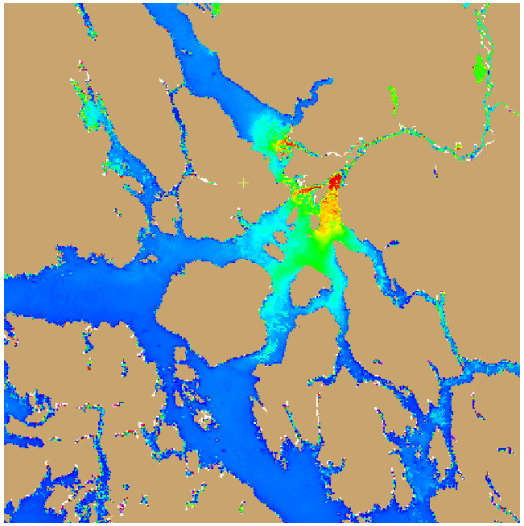
August



Wrangell June



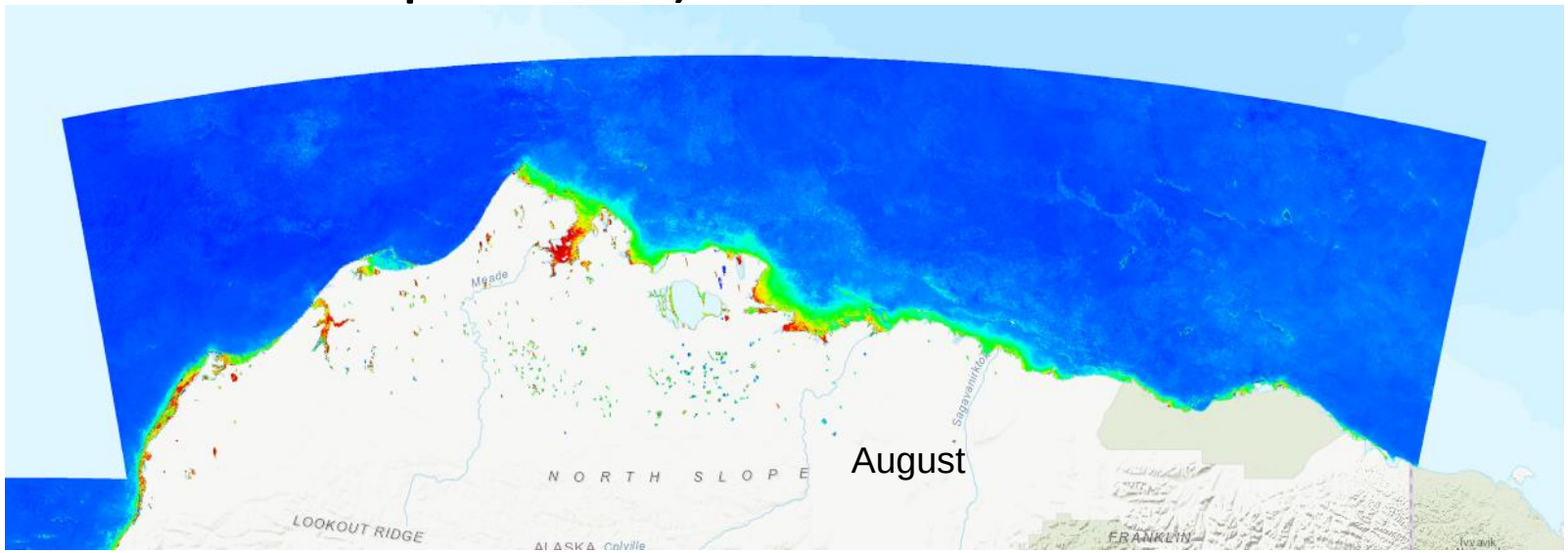
August



What are the products?

- Georeferenced products
  - 300m resolution
  - UTM projection
  - light attenuation (estimate of water turbidity)
  - Grand means/medians for each month
    - Also each year (although clouds/ice can be a problem)

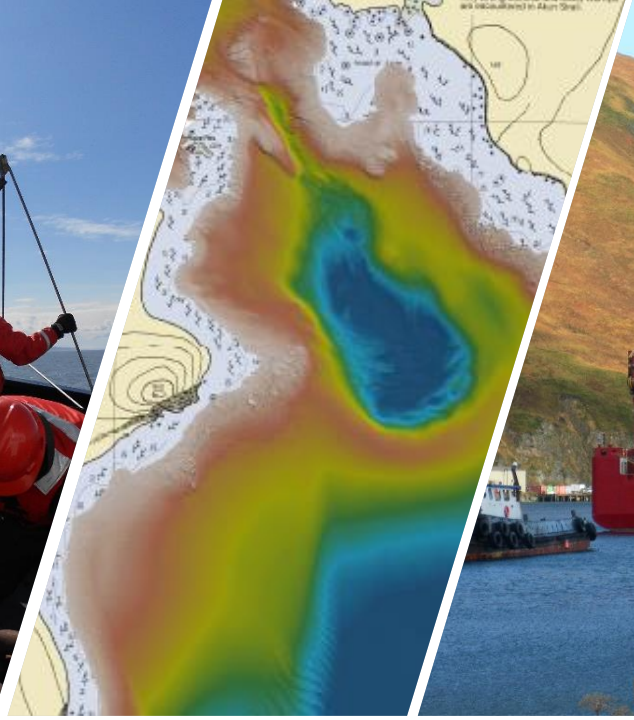
https://www.ngs.noaa.gov/RSD/topobathy.shtml



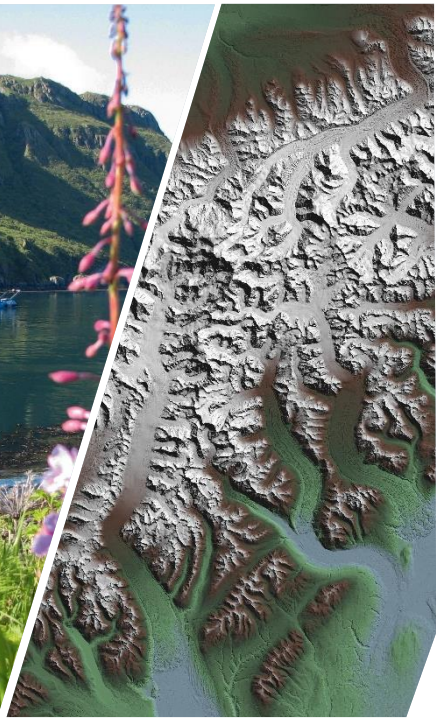
Technology Integration for Coastal Mapping Success

2018 Alaska Coastal Mapping Summit

We are Fugro



We collect data on topography, soil composition and environmental conditions, both on and offshore. We organize the acquired data and add value through processing, interpretation and visualization.



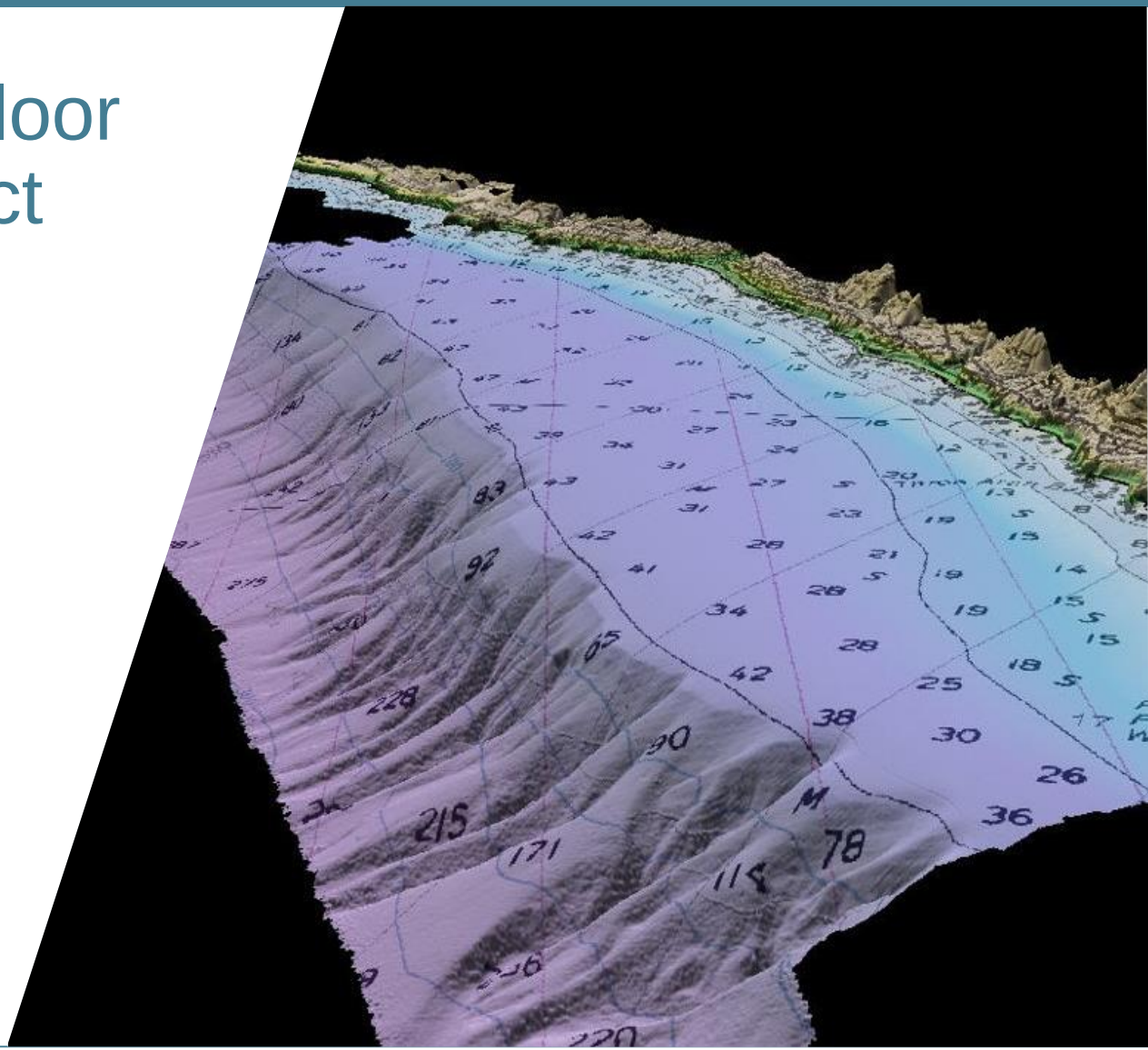
33,904 miles of shoreline

Coastal mapping requires multiple types of data:

- Nearshore
- Shoreline
- Coastal elevation

California Seafloor Mapping Project

- Multi-year effort made possible through a partnership model
- Dedicated to producing high-resolution geologic and habitat base maps for all CA waters while also updating nautical charts
- Benefitted multiple stakeholder groups



Largely uncharted territory

- Extreme weather
- Remote locations
- Short field season
- Limited tide/base stations

Integrated technologies offer time, cost, and safety benefits

- **Vessel:** multibeam echosounder (MBES)
- **Aircraft:** airborne lidar bathymetry (ALB)
- **Satellite:** satellite-derived bathymetry (SDB)

Multibeam echosounder (MBES)

Overview

Data resolution is dependent on the distance from the sensor to the seafloor. Coverage is typically 3-5 times the water depth. Works in turbid water.

Applications

- Nautical charting
- Infrastructure planning and inspections
- Dredging and volume computations
- Habitat classification
- Rate of change tracking

Experience

- Recently collected more than 1 million km² of high resolution bathymetry data per year in shallow and deep waters globally
- Extensive AK experience for public- and private-sector clients; NOAA charting projects dating back to 1999
- First company to deliver high-resolution seabed imagery from MBES backscatter for NOAA

Airborne lidar bathymetry (ALB)

Overview

Depending on water clarity, seabed type, and weather conditions, ALB maps in water depths of up to 70 meters.

Applications

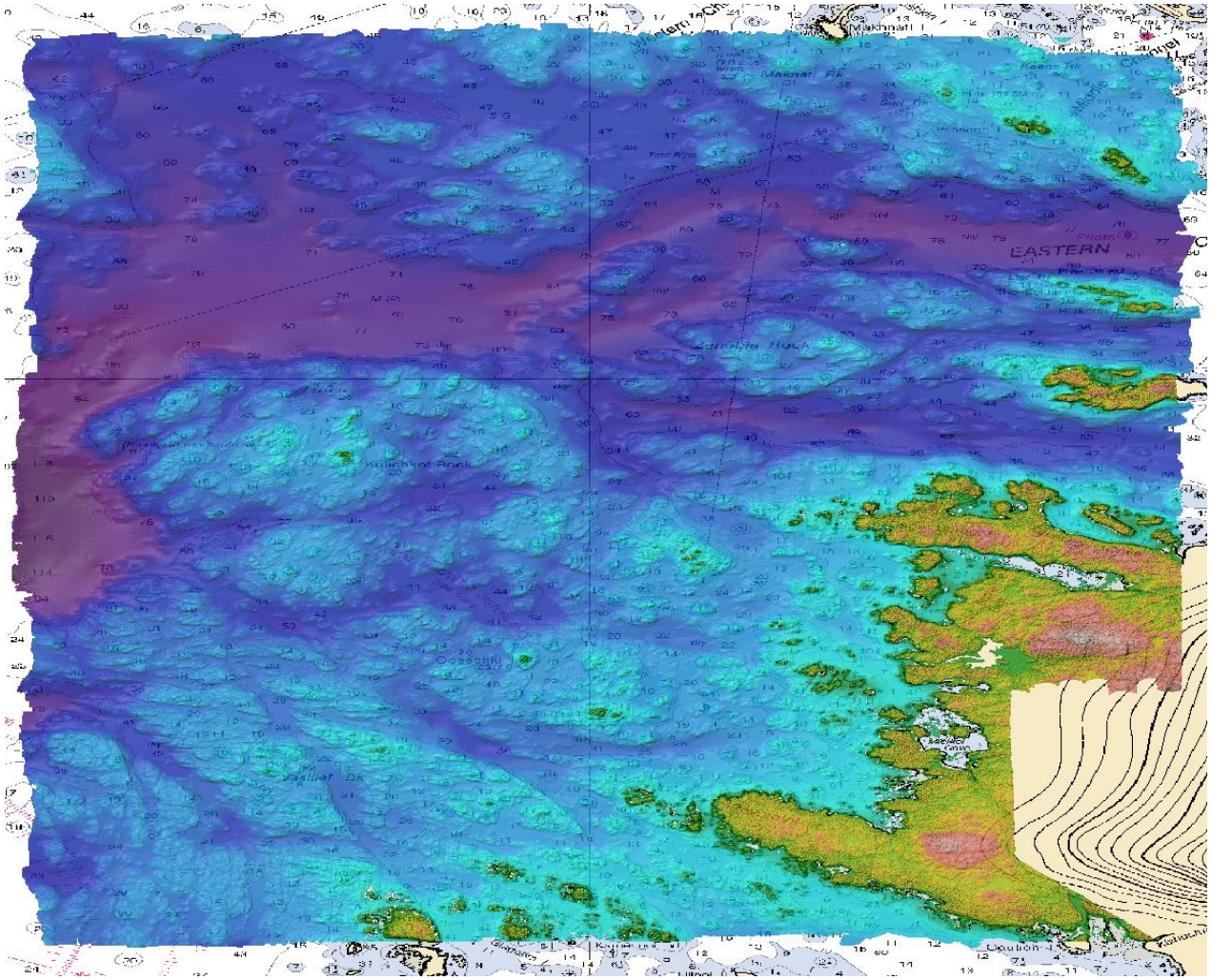
- Nautical charting
- Coastal zone management
- LOS/EEZ mapping
- Infrastructure planning and inspections
- Habitat mapping
- Rate of change tracking

Experience

- 25 years experience; 500+ ALB projects worldwide
- Multiple ALB projects in Alaska for NOAA
- First company to deliver ALB services to USACE, NOAA, and NAVO
- First company to use ALB for charting in the US
- First company to deliver ALB reflectance imagery
- First company to integrate ALB with MBES and topo lidar

Example: Combined topo lidar, ALB, and MBES

Sitka, Alaska
2004



Satellite derived bathymetry (SDB)

Overview

In optimal conditions, our SDB capabilities offer a vertical accuracy of 10-15% water depth, in depths up to 35 meters. Offers fast delivery of large, homogenous datasets.

Applications

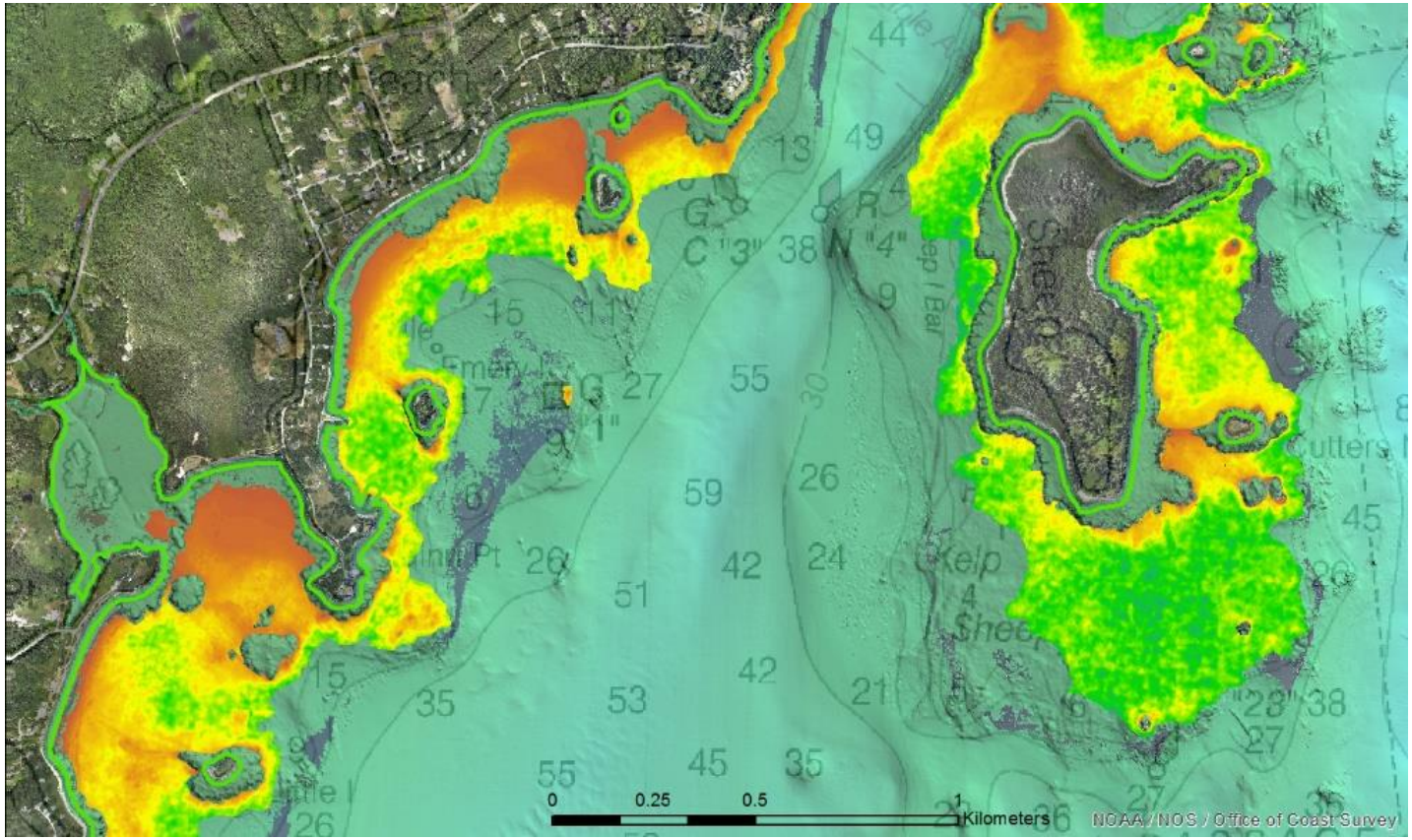
- Coastal zone mapping
- Reconnaissance for high-resolution surveys
- Environmental assessments
- Environmental impact statements
- Seabed classification
- Change detection (erosion/accretion)

Experience

- 2015 teaming agreement with EOMAP, the leading global service provider of satellite-derived aquatic information in maritime and inland waters

Example: Combined SDB, ALB, and MBES

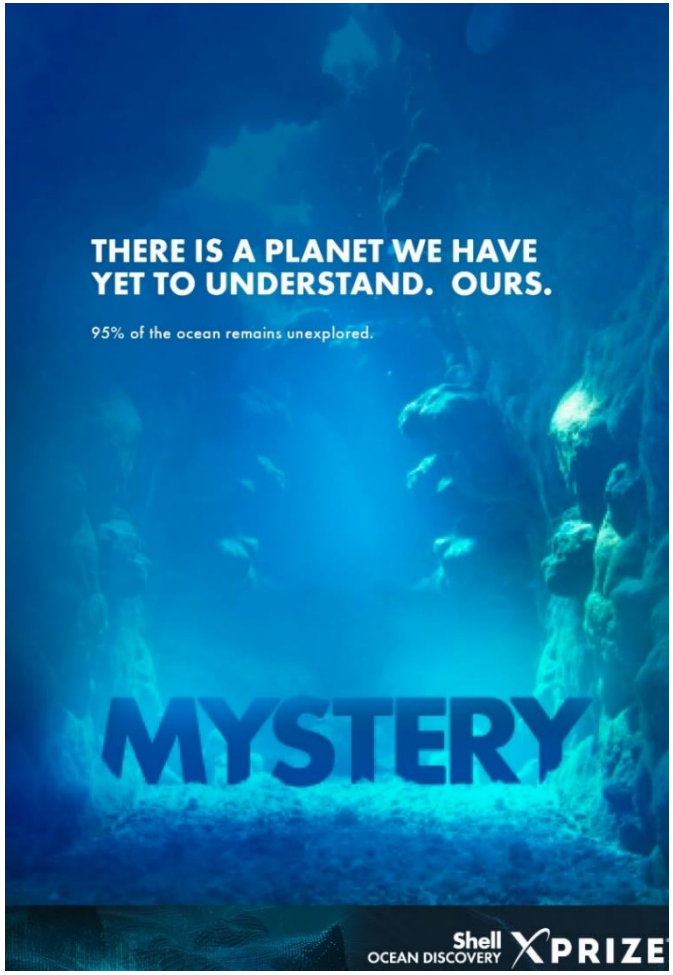
Penobscot Bay, Maine



What’s next: faster, better, cheaper

Seabed 2030

Shell Ocean Discovery XPRIZE



FUGRO

5761 Silverado Way, Suite O
Anchorage, AK 99518
907 561 3478 / akprojects@fugro.com
www.fugro.com
Rada Khadjinova, Alaska General Manager

Satellite Imagery for Coastal Mapping

2018 IWG-OCM Alaska Coastal Mapping Summit
Lighting Talk
February 9, 2018

Drew Hopwood
GeoNorth Information Systems (GNIS)

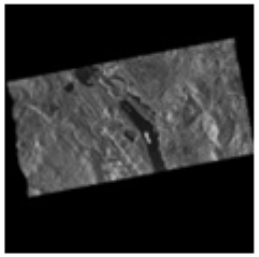
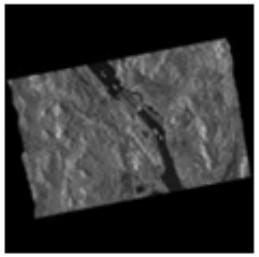
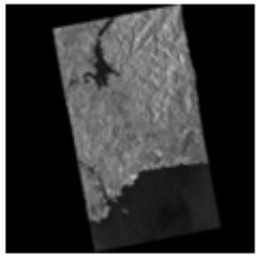
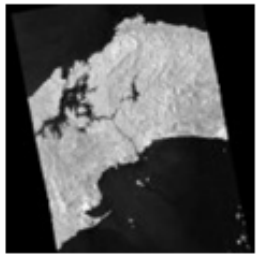
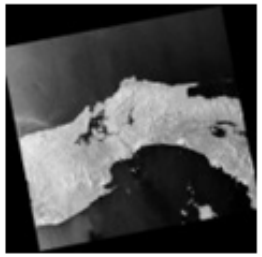
Why Use Satellite Imagery for Coastal Mapping?

- Easy access remote locations
- Regular monitoring and repeat collections
- Year round data collection
- Weather independent
- Broad area collections
- Rapid response (emergencies, storms, etc.)

Synthetic Aperture Radar (SAR)

- Multiple acquisition modes (resolution and coverage)
- All-weather, day/night data acquisition
- Predictable collection scheduling
  - Increased revisits in high latitudes
- Precise & accurate geolocation and measurement
  - TerraSAR-X up to 1m @ CE90

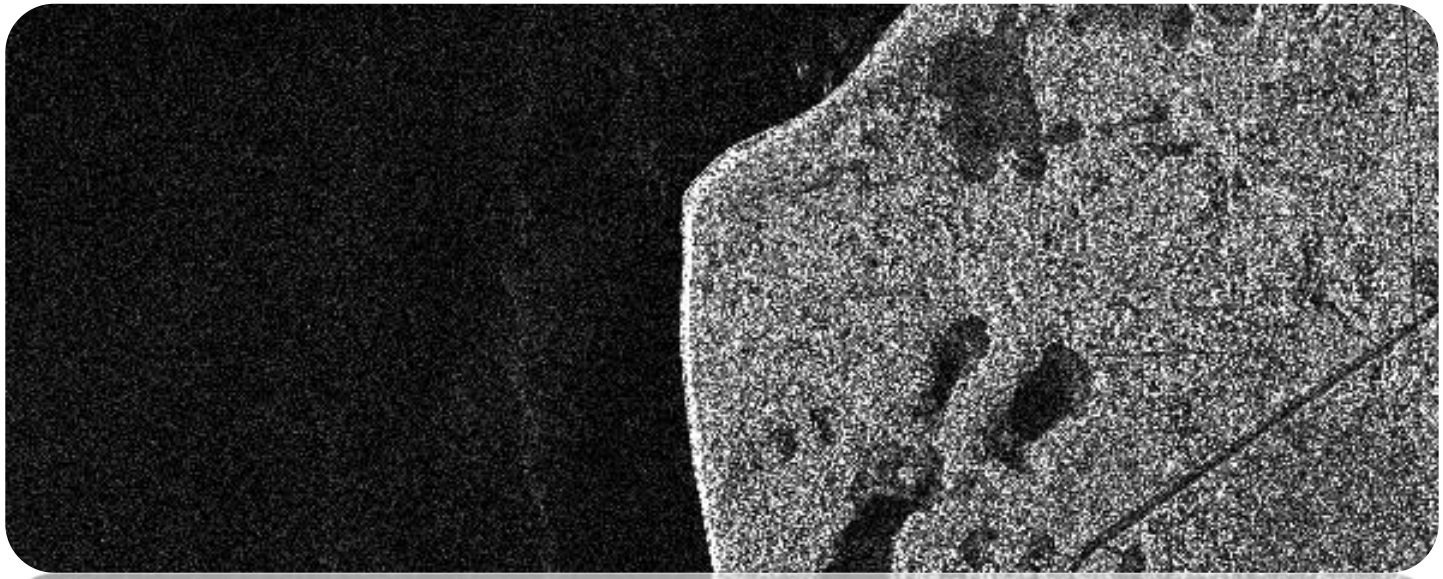
TerraSAR-X Collection Modes

Staring SpotLight	High Resolution SpotLight	StripMap	ScanSAR	Wide ScanSAR
				
Up to 25cm resolution	Up to 1m resolution	Up to 3m resolution	Up to 18.5m resolution	Up to 40m resolution
Scene size depending on incidence angle, for example ~ 4km (width) x 3.7km (length) at 60°	Scene size 5 to 10km (width) x 5km (length)	Scene size 30km (width) x 50km (length*)	Scene size 100km (width) x 150km (length*)	Scene size up to 270km (width) x 200km (length**)
Identification of objects	Recognition of objects (airplanes, hangars, vessels)	Detection & classification and monitoring of vessels and infrastructure Large scale mapping	Detailed maritime monitoring & detection Small scale mapping	Large area maritime monitoring of ship traffic, oil spills, sea ice

*StripMap and ScanSAR: acquisition length extendable to 1,650 km
**Wide ScanSAR: acquisition length extendable to 1,500 km

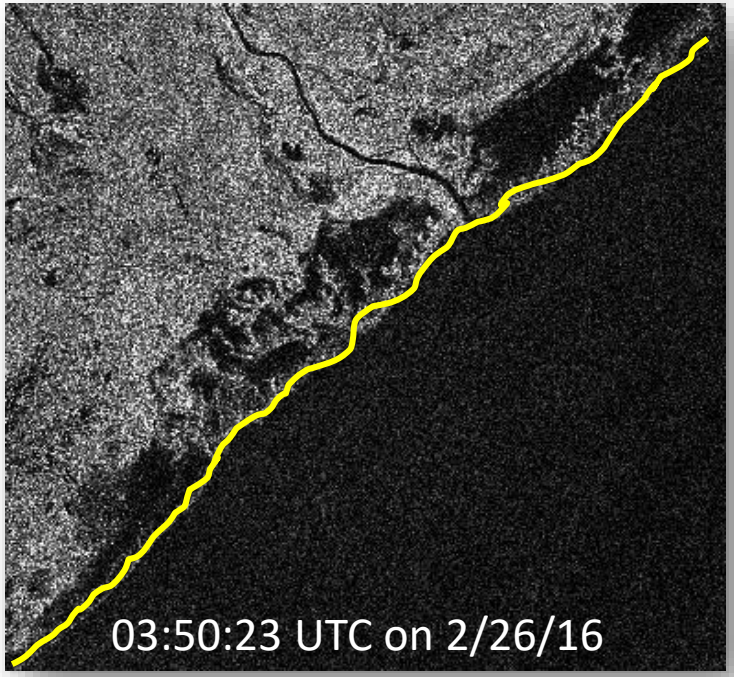
Using SAR for Coastal Mapping

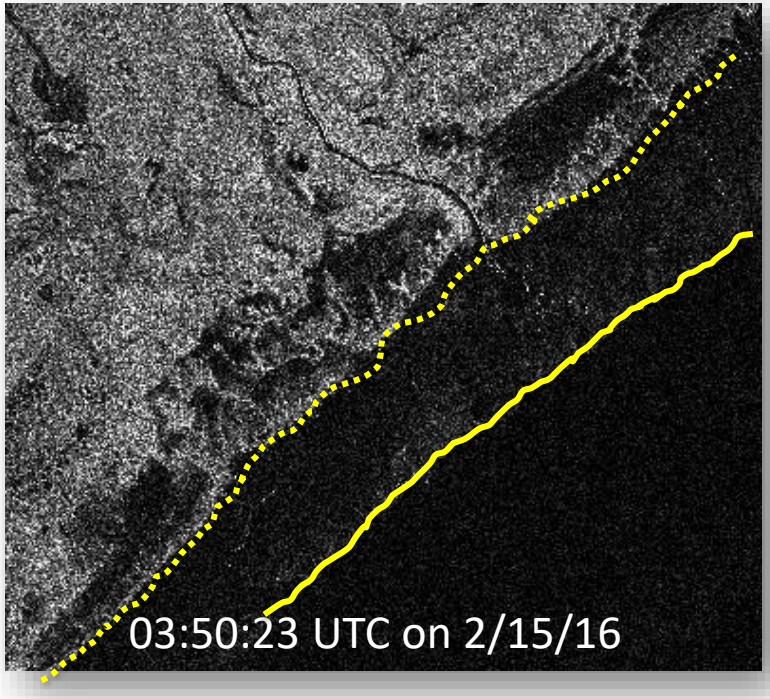
- Land/Water boundary identifiable
  - Automation is possible
- Precise & accurate geolocation and measurement
  - TerraSAR-X up to 1m (w/o GCPs)
- All season monitoring, emergency/event response



Using SAR for Coastal Mapping

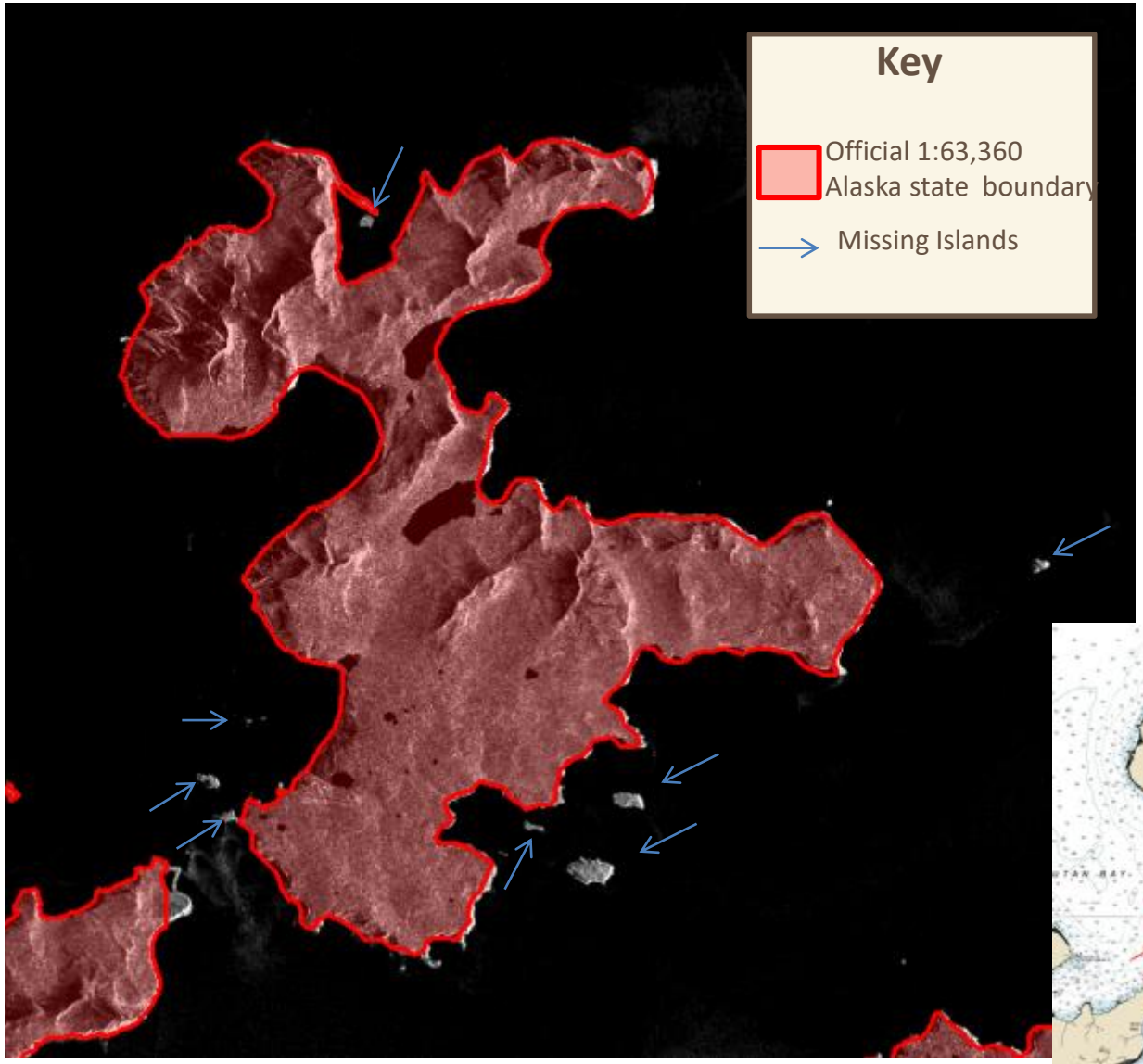
- Weather independence allows collection scheduling
  - Enabling tide coordinated collections
  - Aiding field work coordination
  - Guaranteed collections to meet project timelines





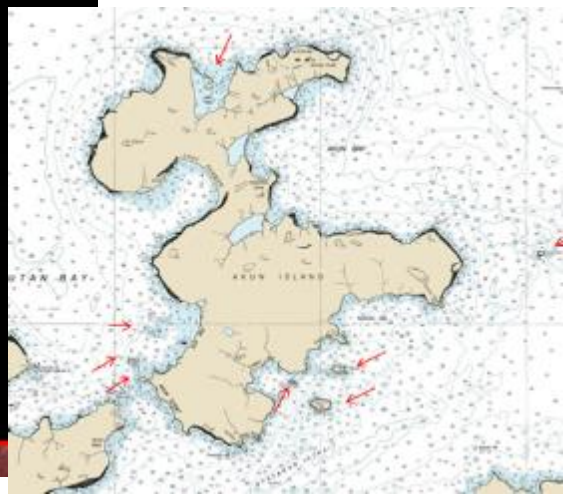
* Shoreline was traced in PPT to illustrate tidal impact on shoreline

Coastline Example



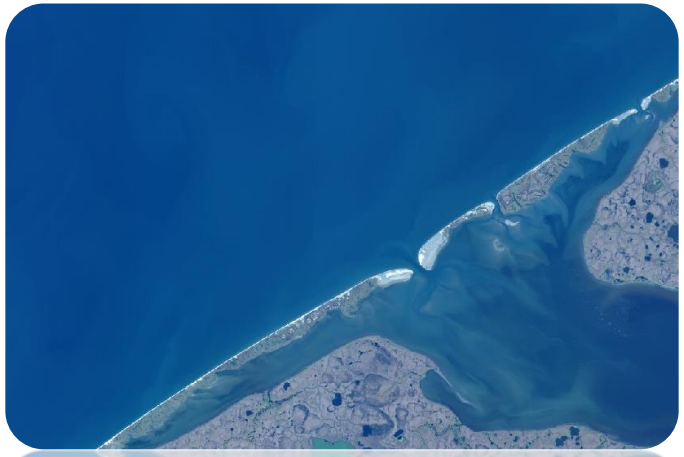
Akun Island

Several islands are missing from the 1:63k state boundary file

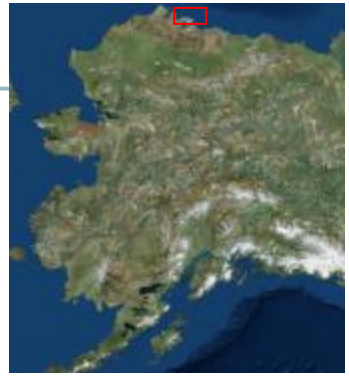


EO Advantages for Coastal Mapping

- Land/Water boundary identifiable using NIR band
- Collection of Stereo imagery
- Sub-surface capability for near shore bathymetric mapping
  - Subject to multiple environmental factors
- Source for land classification

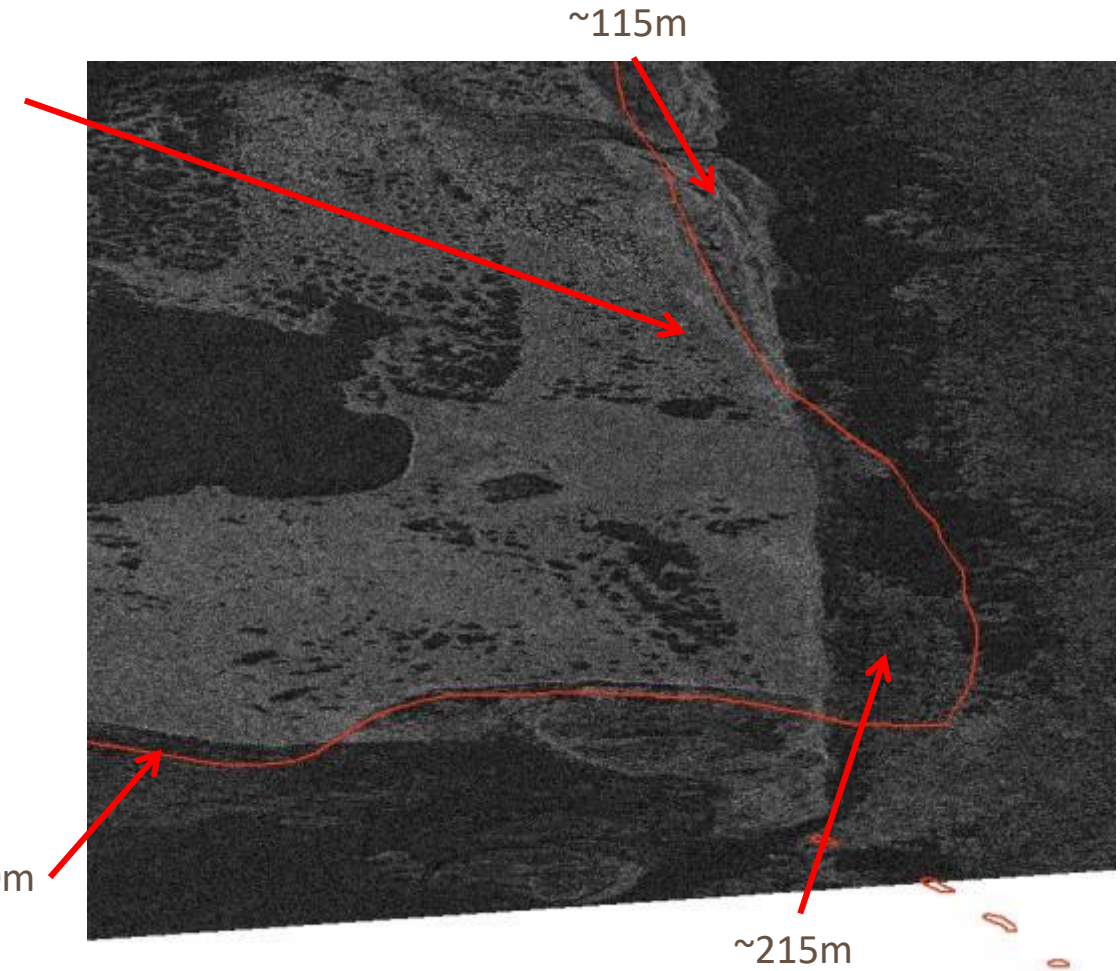


North Slope Coastline



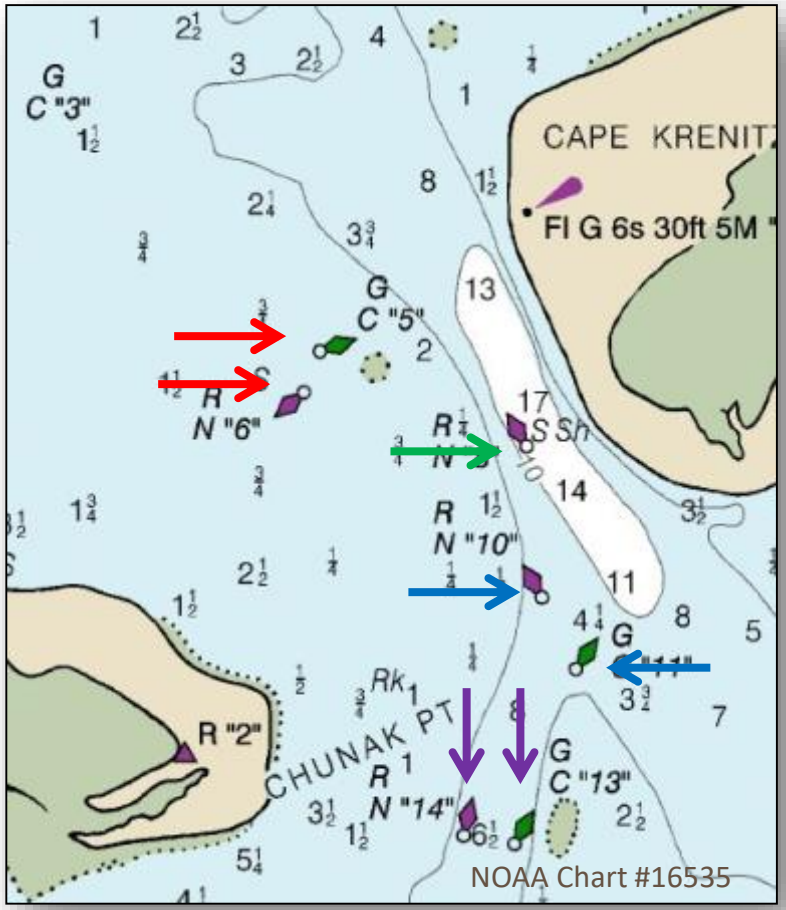
ENC Coastline – Chart US5AK9LM
- Scale – 1:48,767
- Edition 1.0
- Published – February 2012

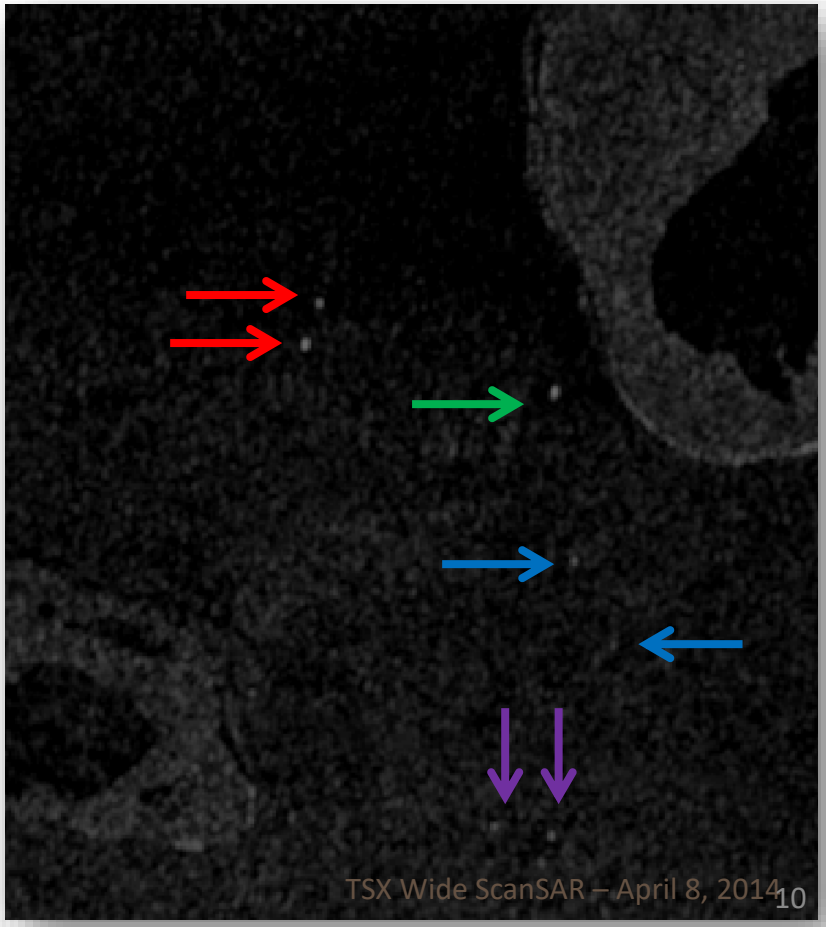
Landsat – Date Unknown
SDMI SPOT 5 – Date Unknown
Pleiades – July 2013
TerraSAR-X – June 2014
- High Resolution Mode
- VV Polarization



Using SAR for Monitoring Aids to Navigation

Bechevin Bay, Alaska
Locations known within 1 meters





Access to GNIS Services

- GNIS prime contract with Army Geospatial Center (AGC) – Imagery Office (IO)
  - Available to any USACE user
  - Includes both SAR & EO products, value-added products, DEMs, etc…
  - Responsive data collection, processing and delivery

Other Government-Wide Acquisition Contracts (GWACs)

- GSA Schedule 70: Schedule# GS-35F-0119Y
  - Term: December 20, 2011- December 19, 2021
- NASA SEWP: Schedule # NNG15SC03B (small) or NNG15SC27B (other than small)
  - *Term: May 1, 2015 - April 30, 2020*

About GNIS

- Founded in 1999
- Alaska Native-Owned Corporation (ANC) and SBA-certified 8(a)
  - A wholly-owned subsidiary of The Tatitlek Corporation
- Headquartered in Anchorage; Offices in Denver and Vienna, VA.
- 18 years IT and Geospatial Solutions
- Top Secret Facility Clearance
- Cleared Staff (TS/SCI, TS, Secret)
- USG Clients: AGC, HHS, NOAA, USGS

Questions?

Drew Hopwood
GeoNorth Information Systems (GNIS)

Tel: (907) 646-4529
Email: dhopwood@geonorthis.com

ShoreZone Coastal Imaging and Habitat Mapping in Alaska

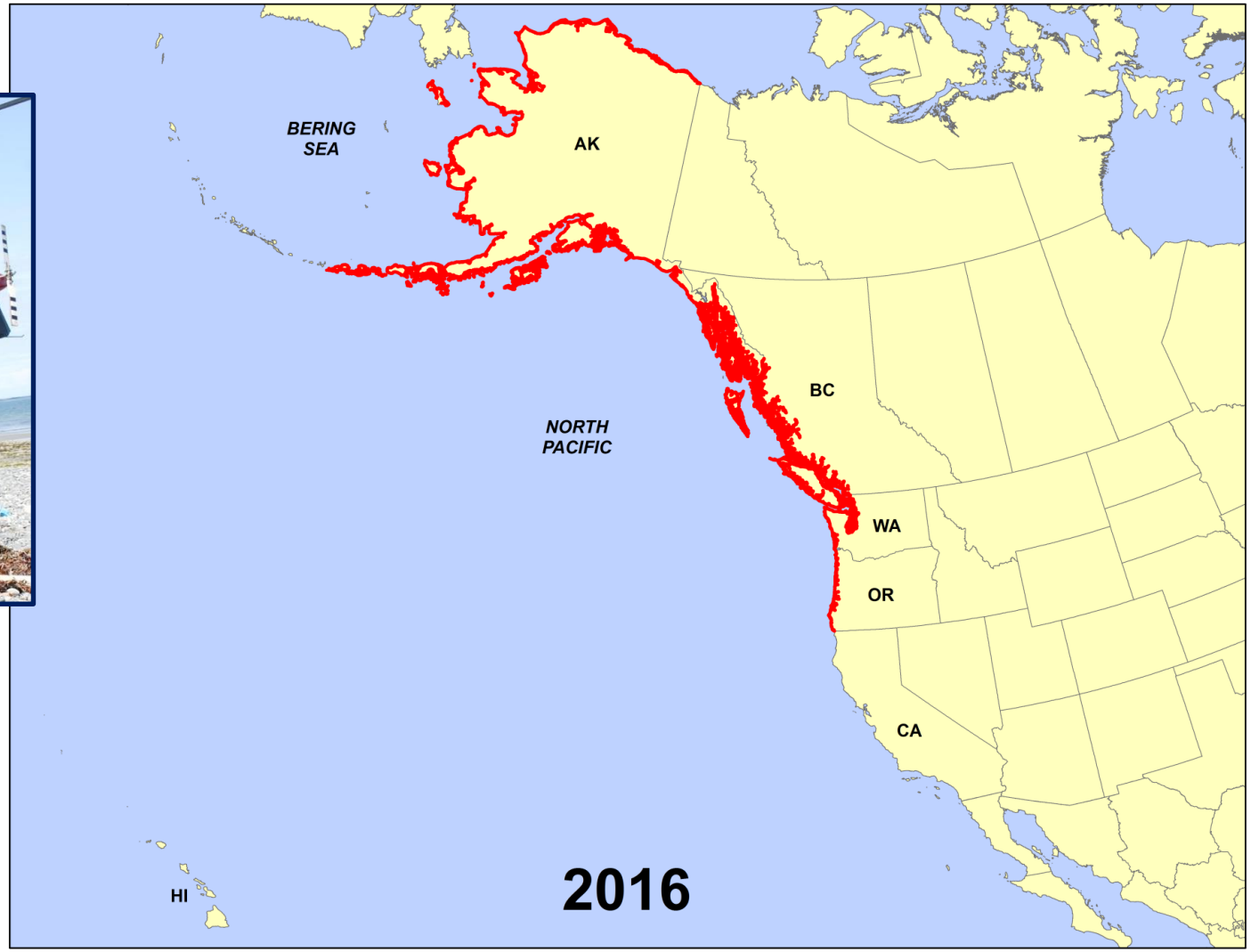
Sarah Cook RPBio
Coastal and Ocean Resources
sarah@coastalandoceans.com

Alaska Coastal Mapping Summit, February 9th, 2018

What is ShoreZone?

A standardized coastal imaging and habitat mapping system that characterizes physical and biological attributes of the shoreline in a searchable, georeferenced database.

Where is ShoreZone?



How to Access ShoreZone

NOAA ShoreZone Website
https://alaskafisheries.noaa.gov/habitat/shorezone

TNC ShoreZone Website
https://www.ShoreZone.org

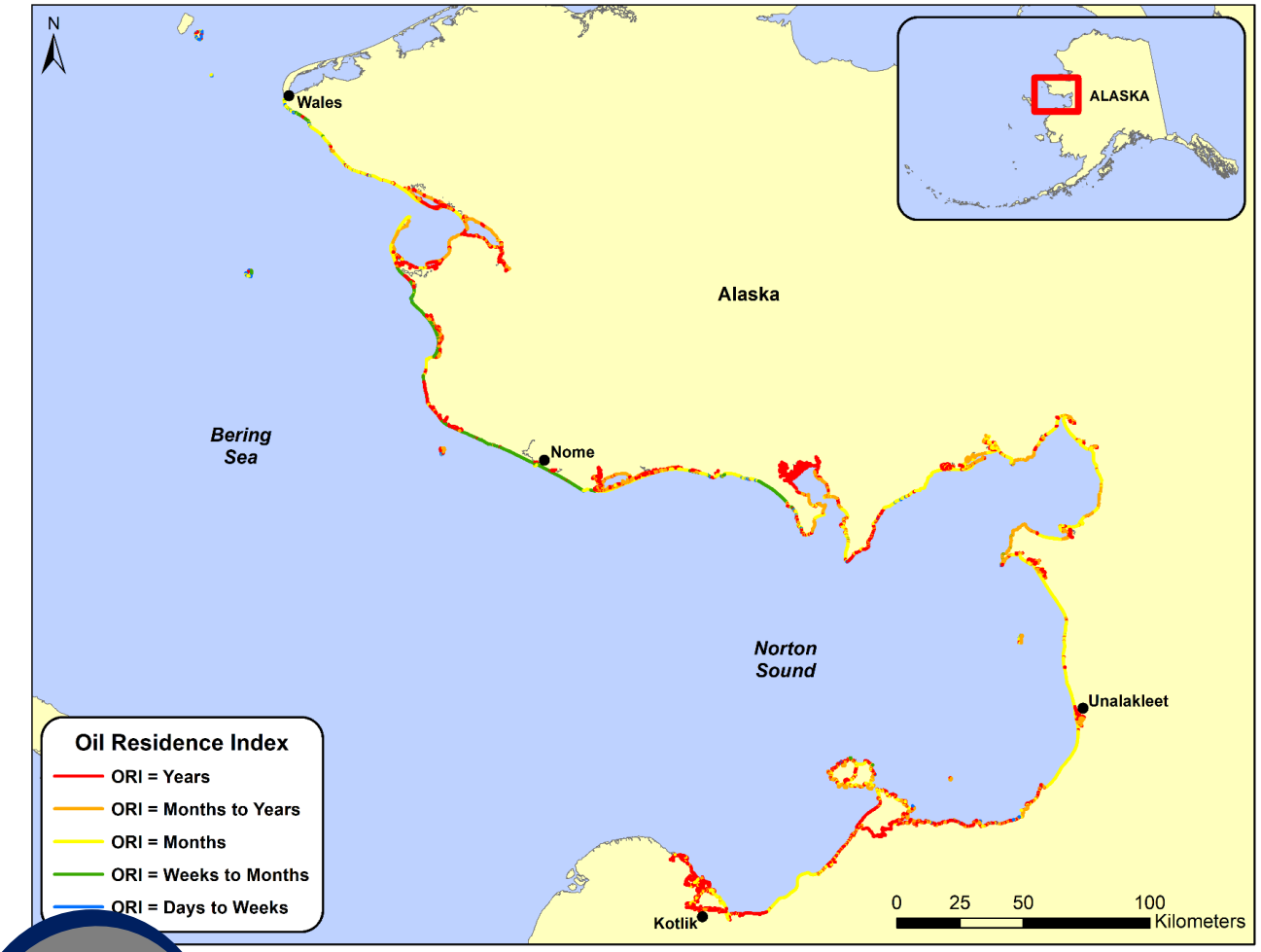
AOOS Portal
Arctic ERMA

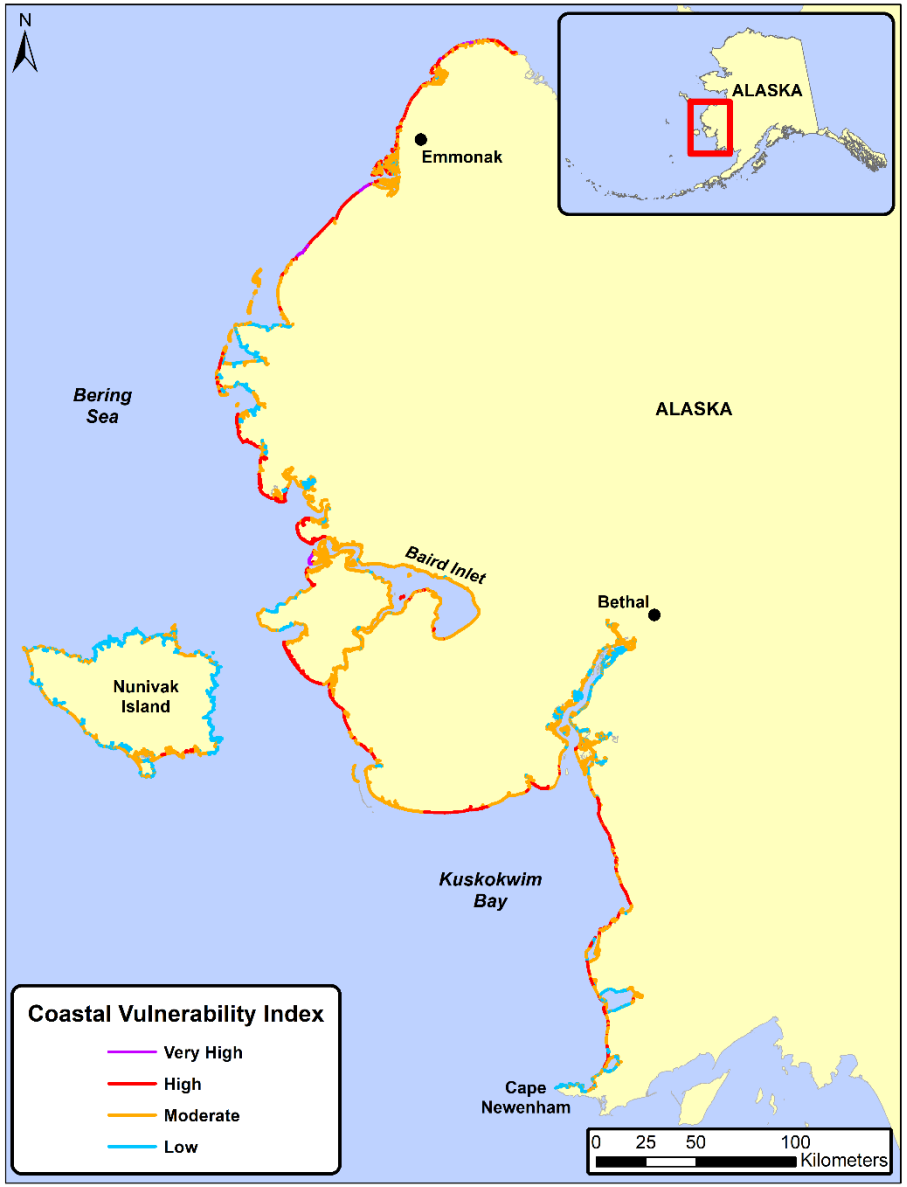
Collect Once, Use Many Times

~85% of the State of Alaska Imaged and Mapped (or Mapping in Progress)

Multiple Uses for both the Imagery and Habitat Mapping

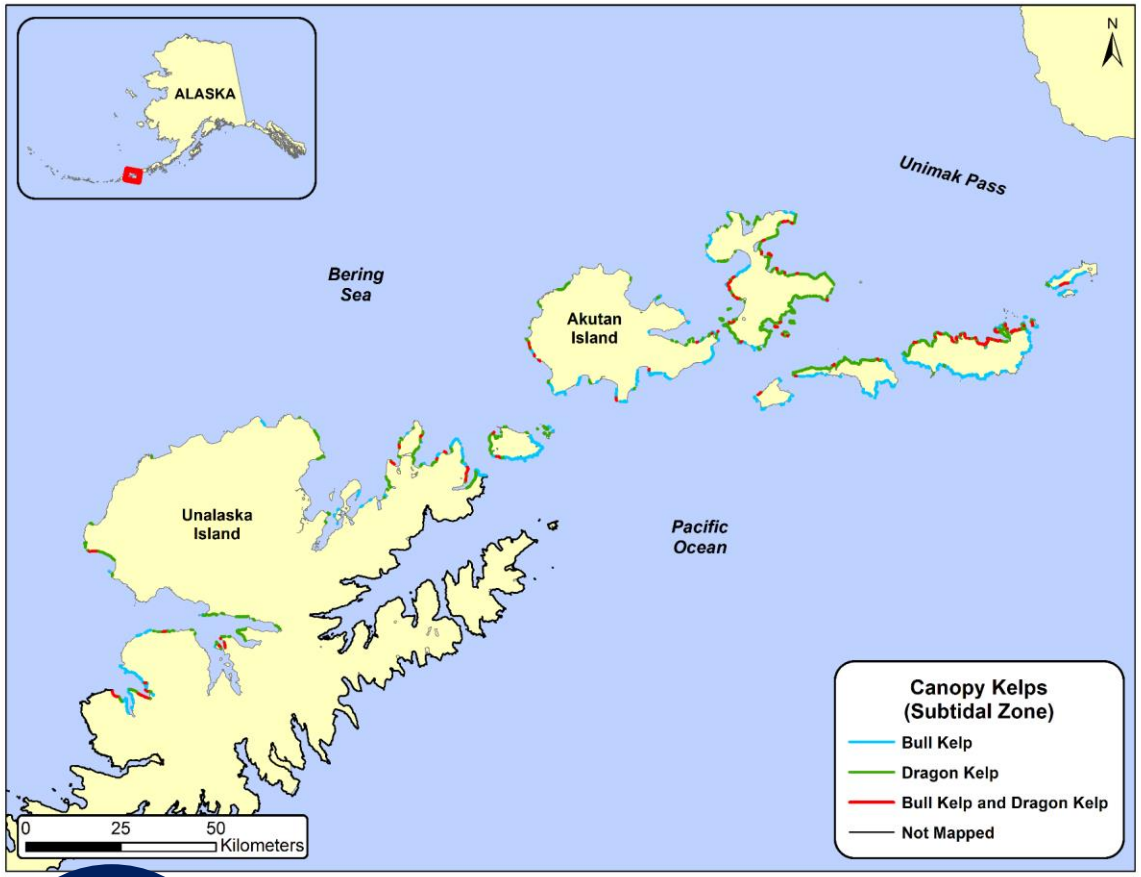
Uses for ShoreZone
Attribute Maps

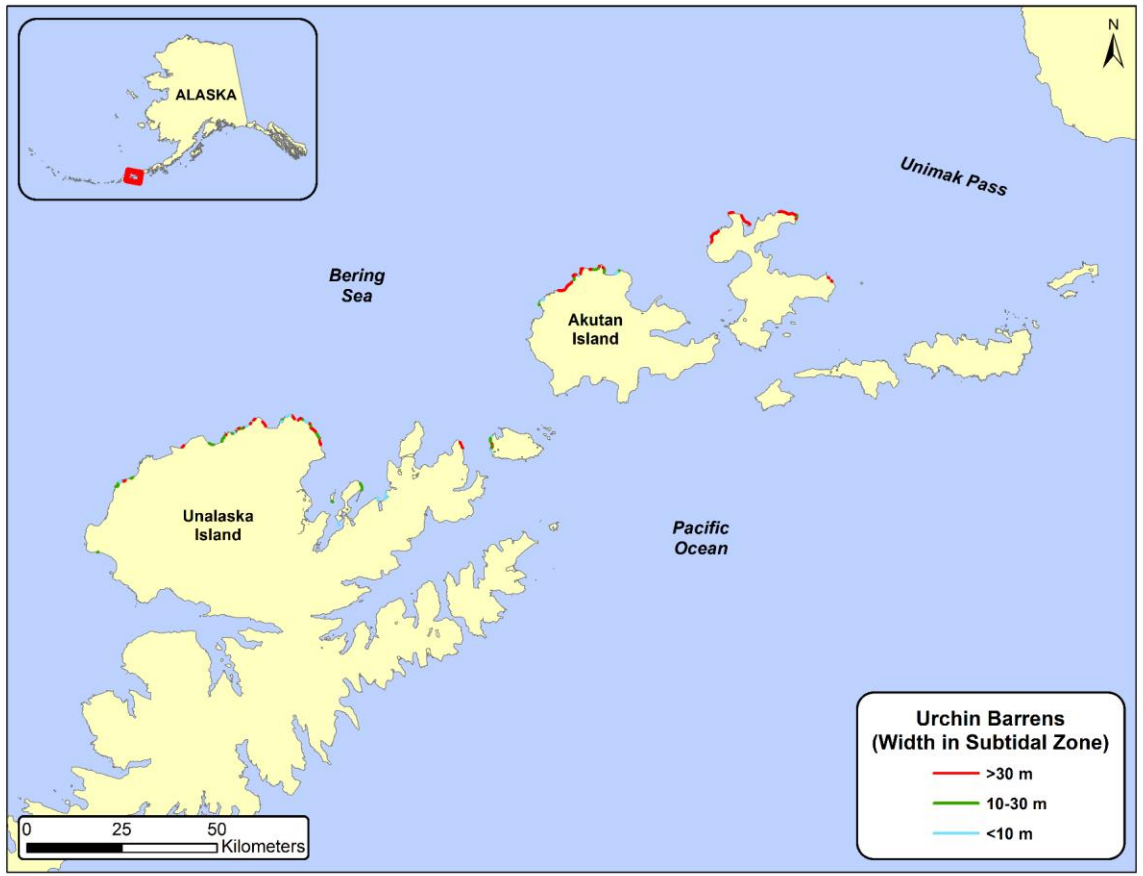




Uses for ShoreZone

Attribute Maps

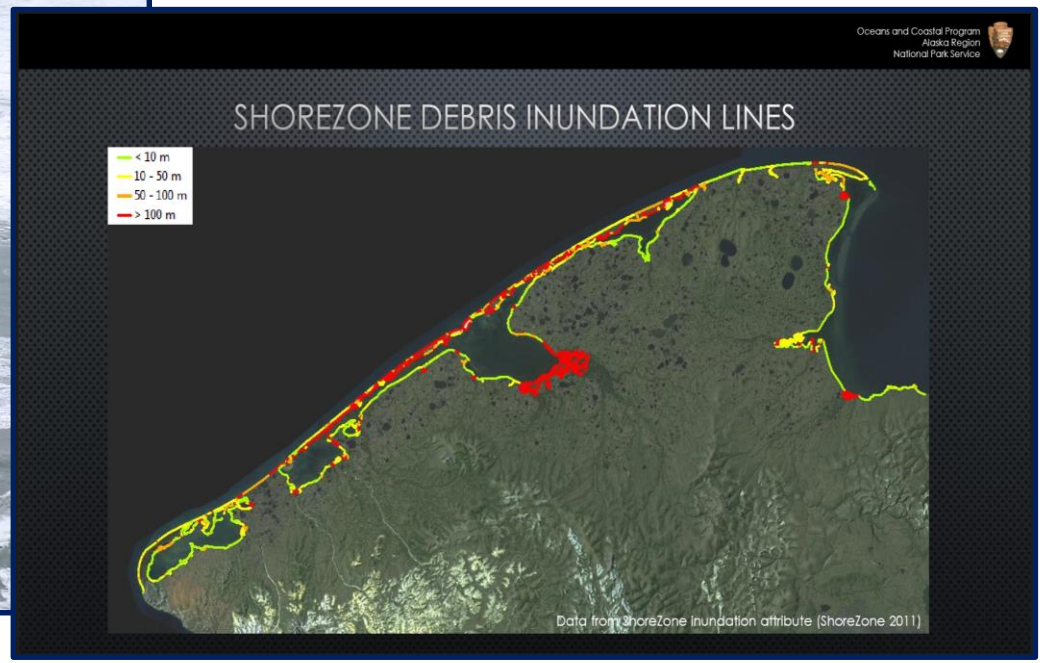




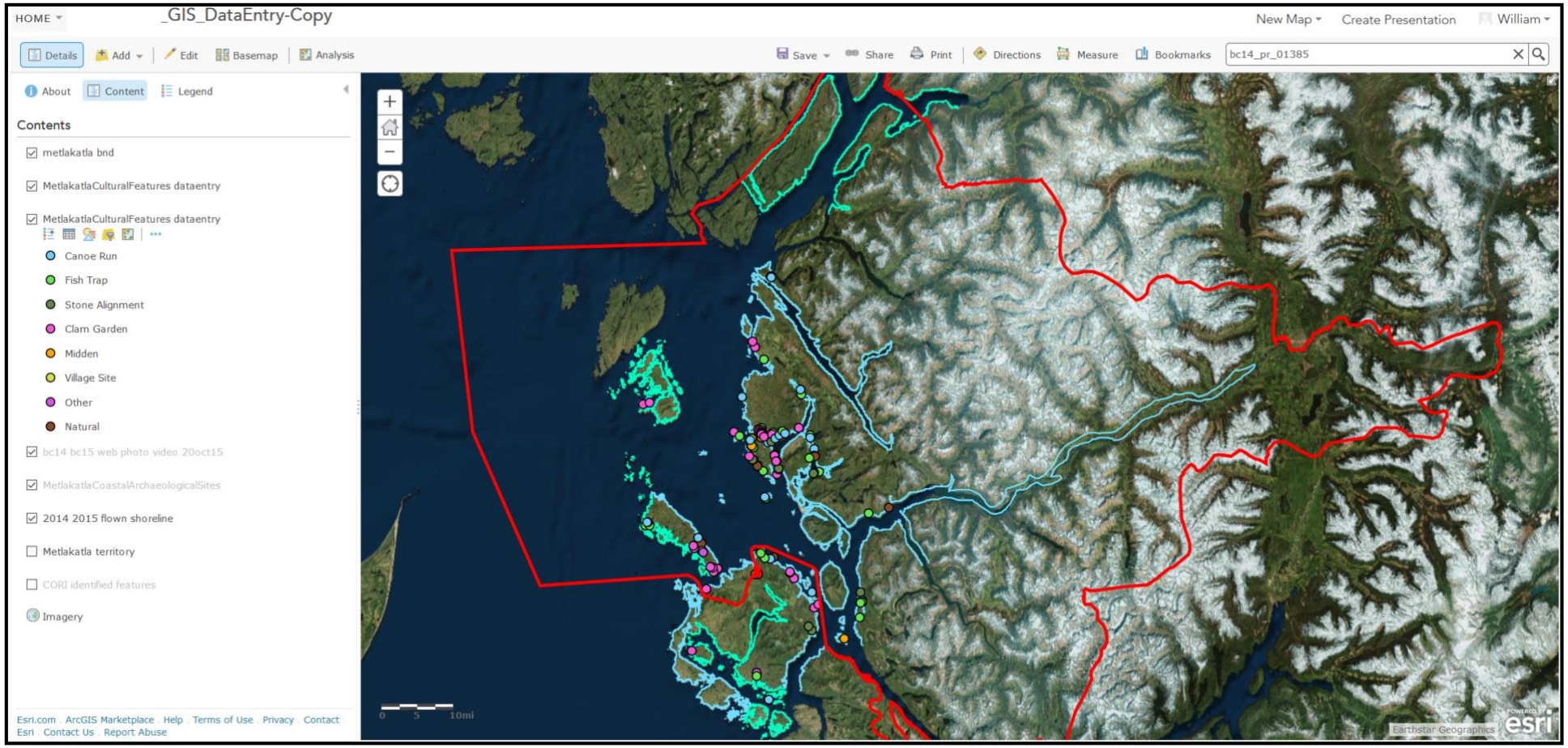
Uses for ShoreZone

Oil Spill Planning and Response

Marine Debris Mapping

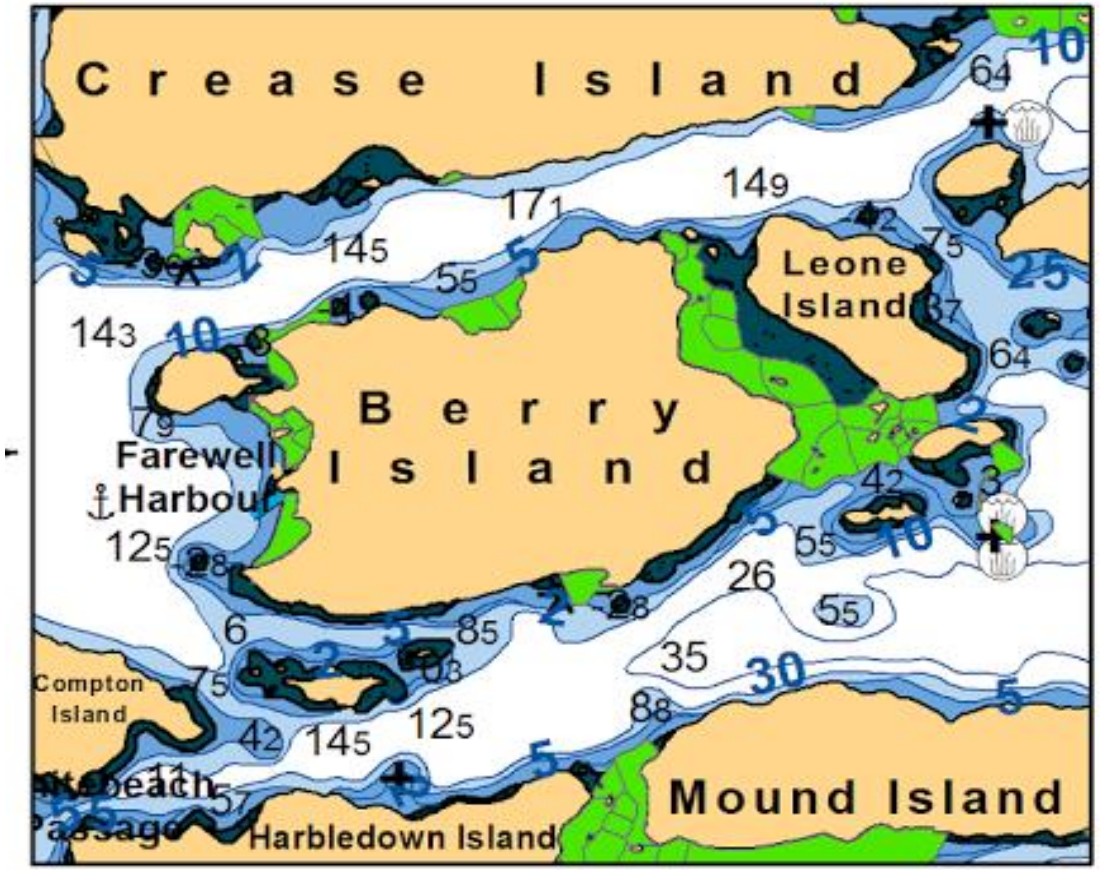


Uses for ShoreZone

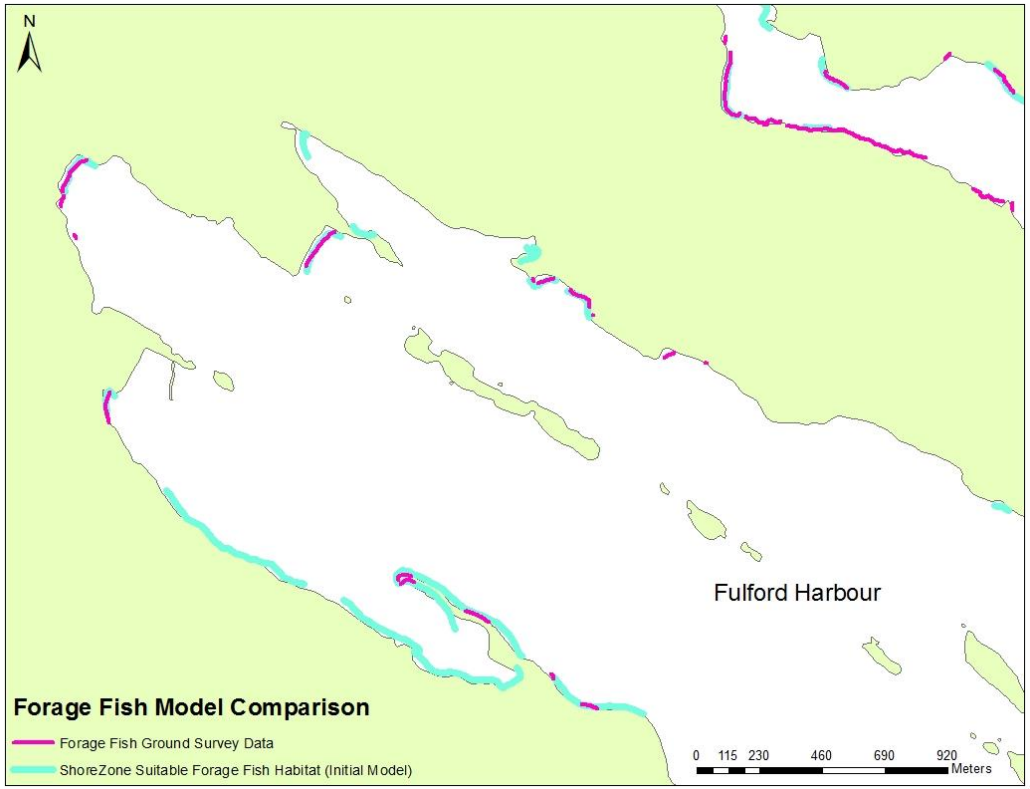


Cultural Features Mapping

Uses for ShoreZone

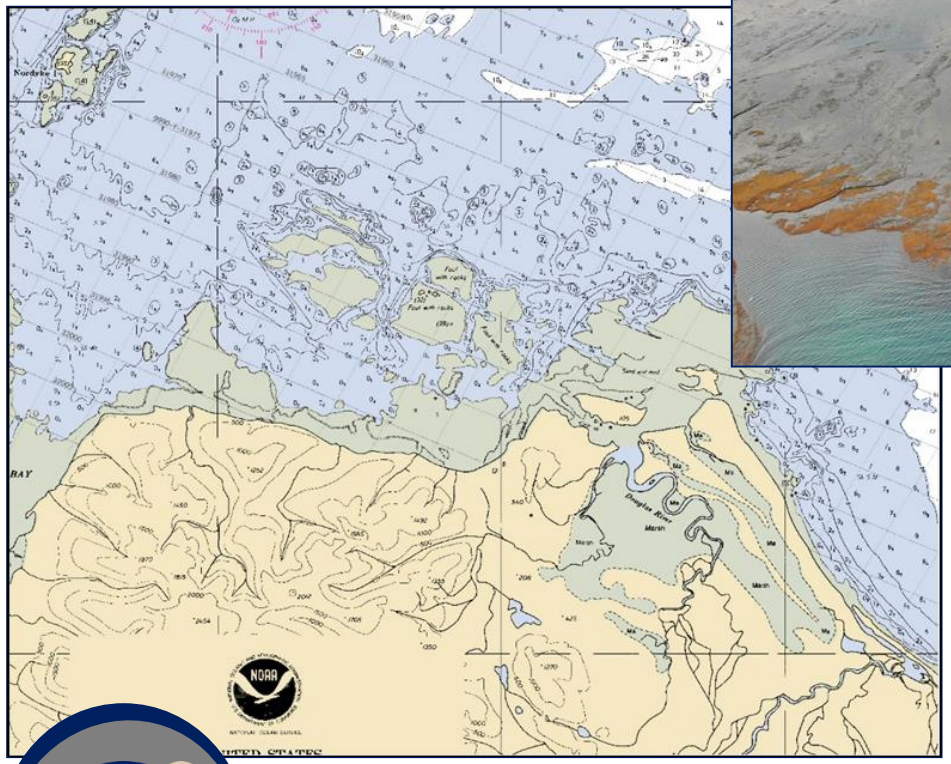


Habitat Modelling
Species Modelling



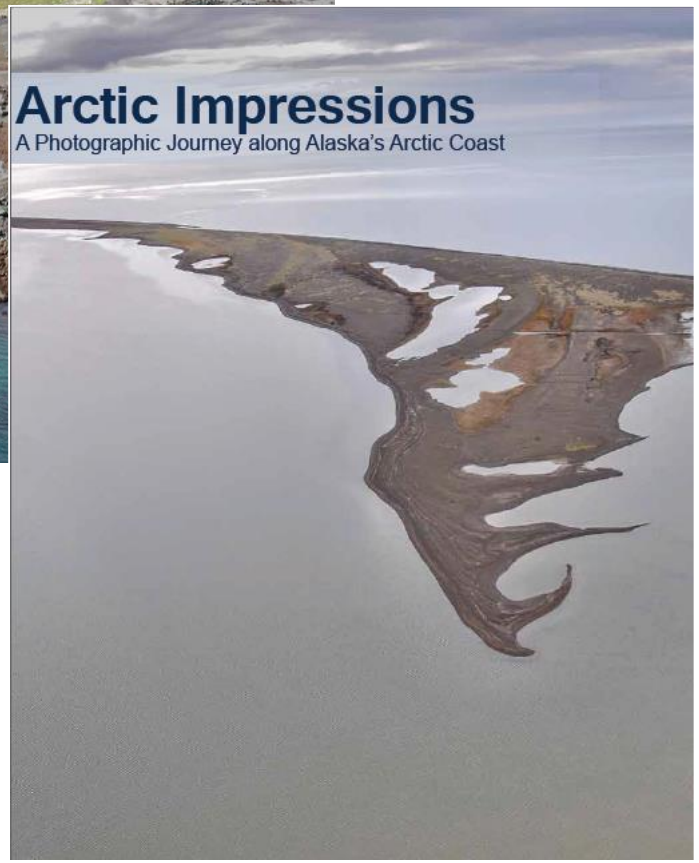
Uses for ShoreZone

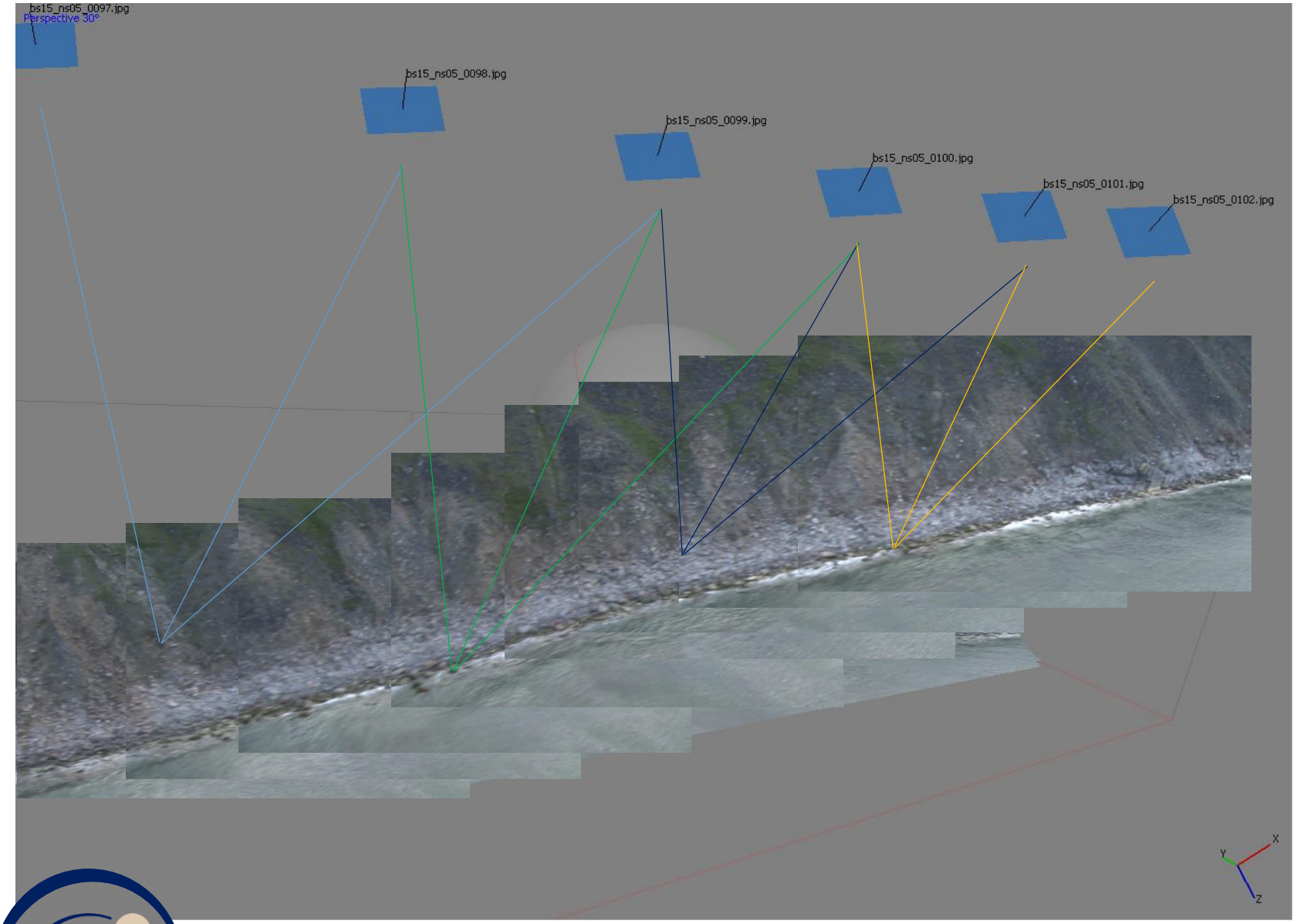
Kamishak Bay, Cook Inlet



Research Study Design

Uses for ShoreZone
Outreach and Education

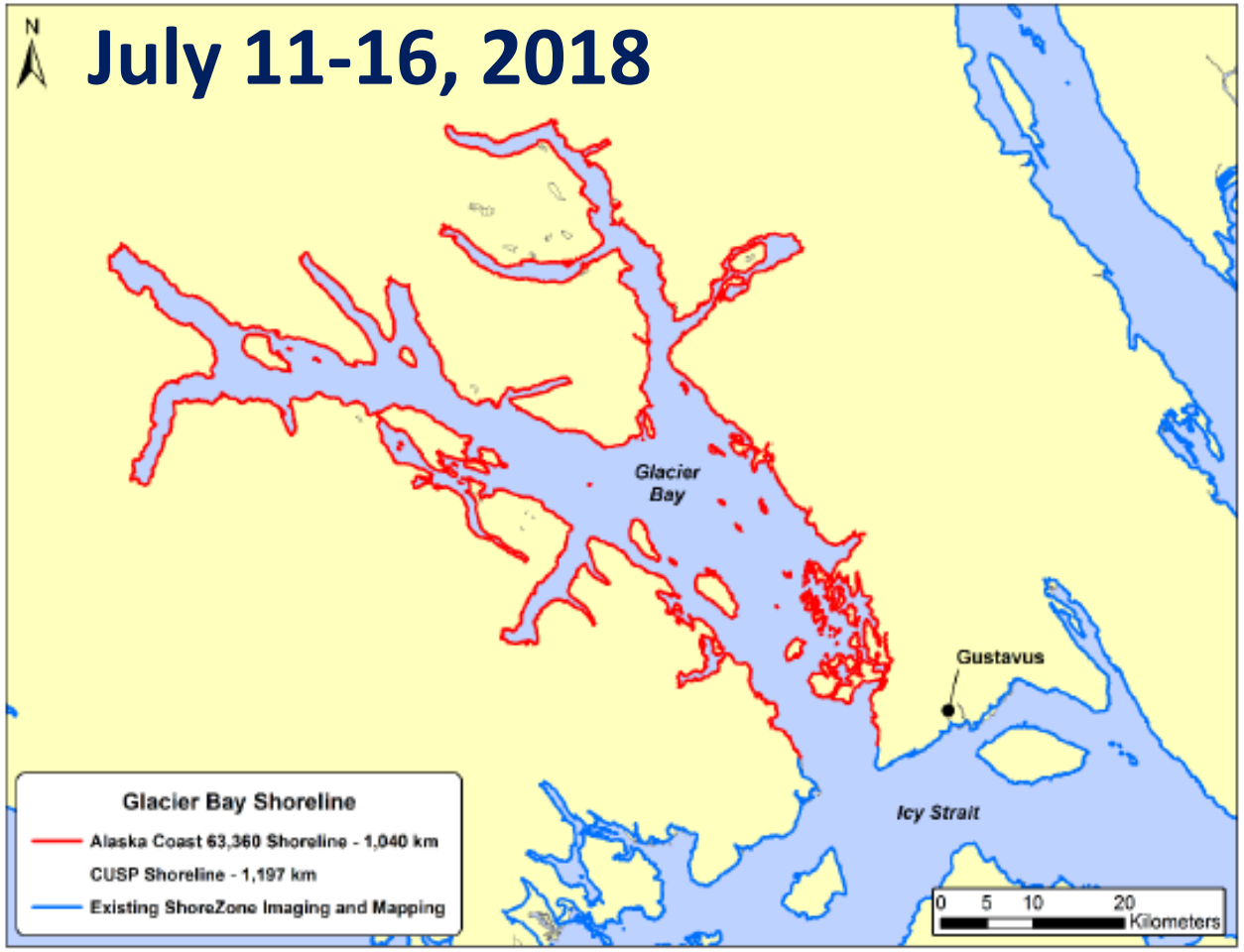


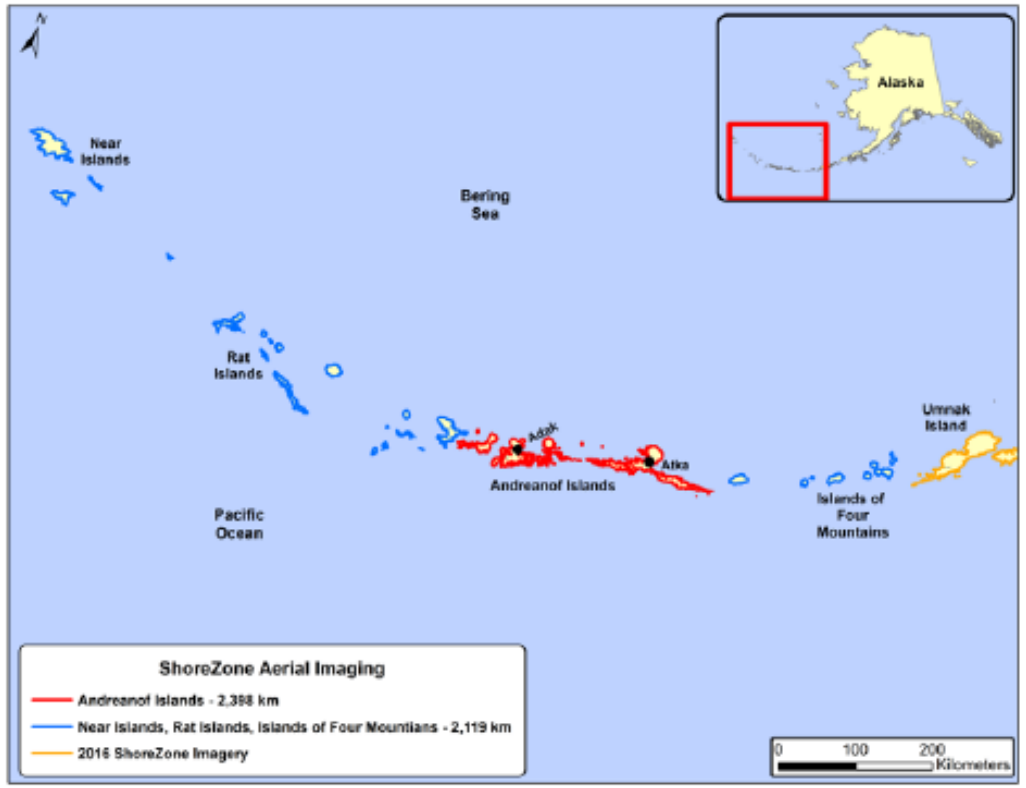


Developing ShoreZone for the Future

Structure From Motion

Future Projects in Alaska





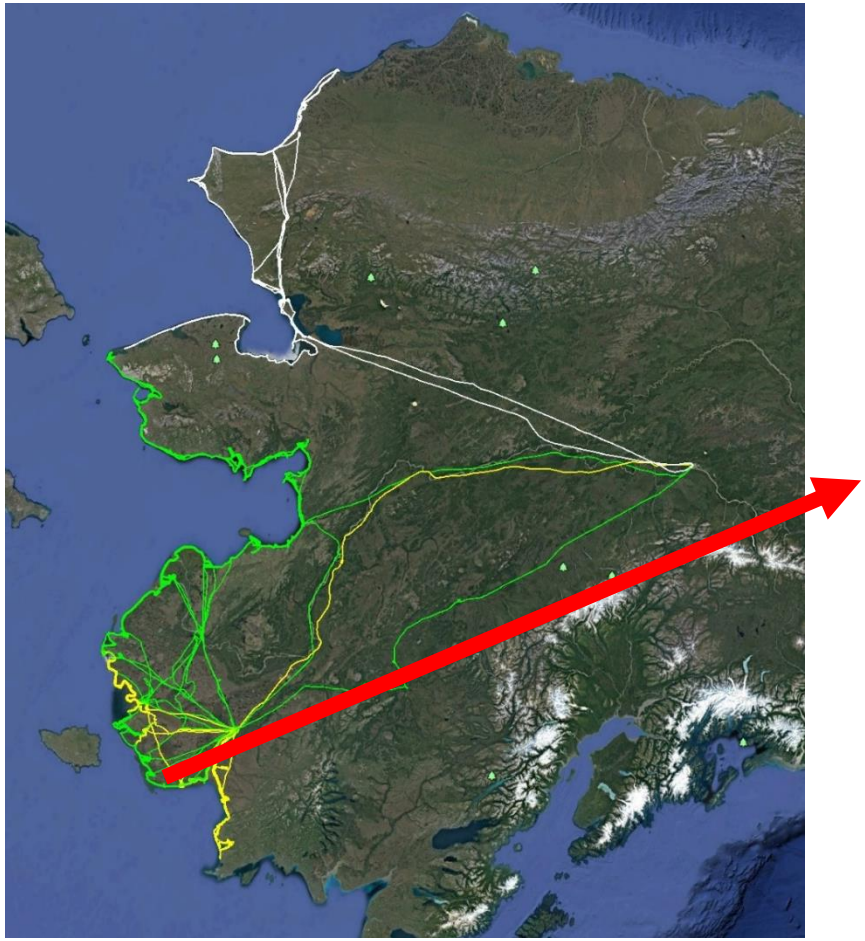
Looking for Funding

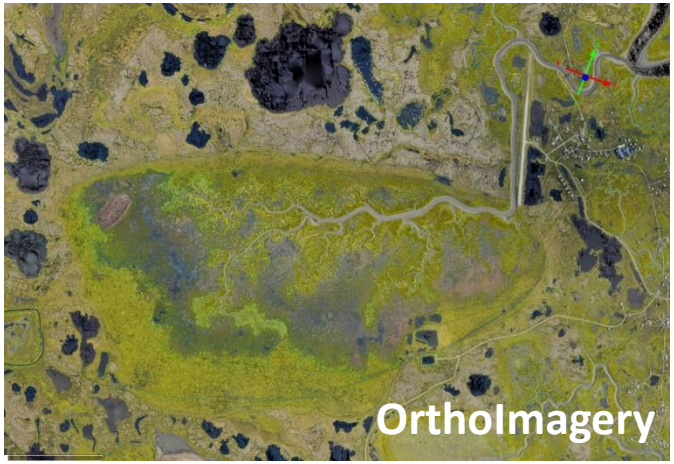
Thank-you!

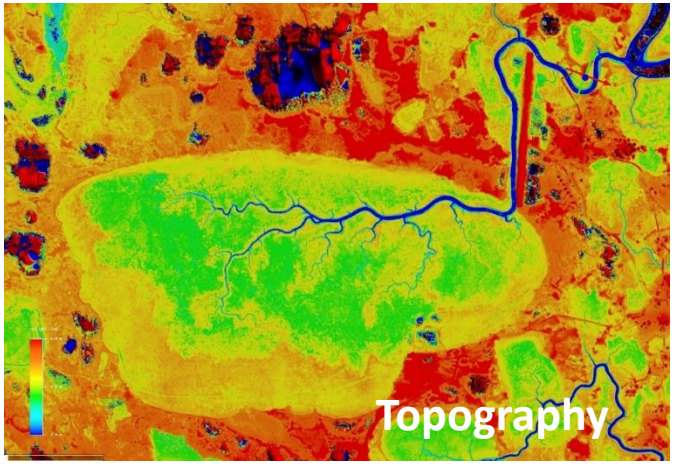
sarah@coastalandoceans.com

Two hundred billion pixels of digital coastal paradise: Mapping a mile wide swath of Alaska's west coast at 10-20 cm GSD with Fodar

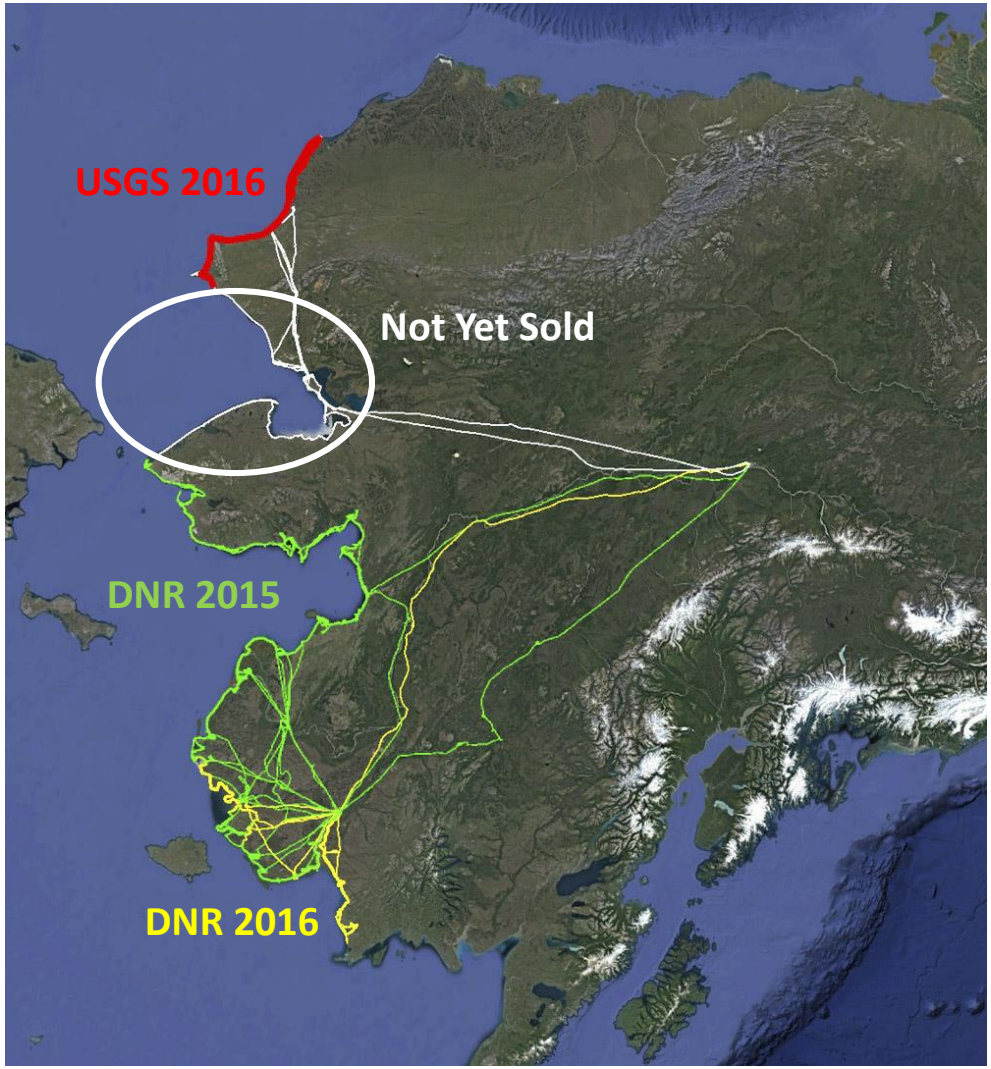
Matt Nolan
www.FairbanksFodar.com







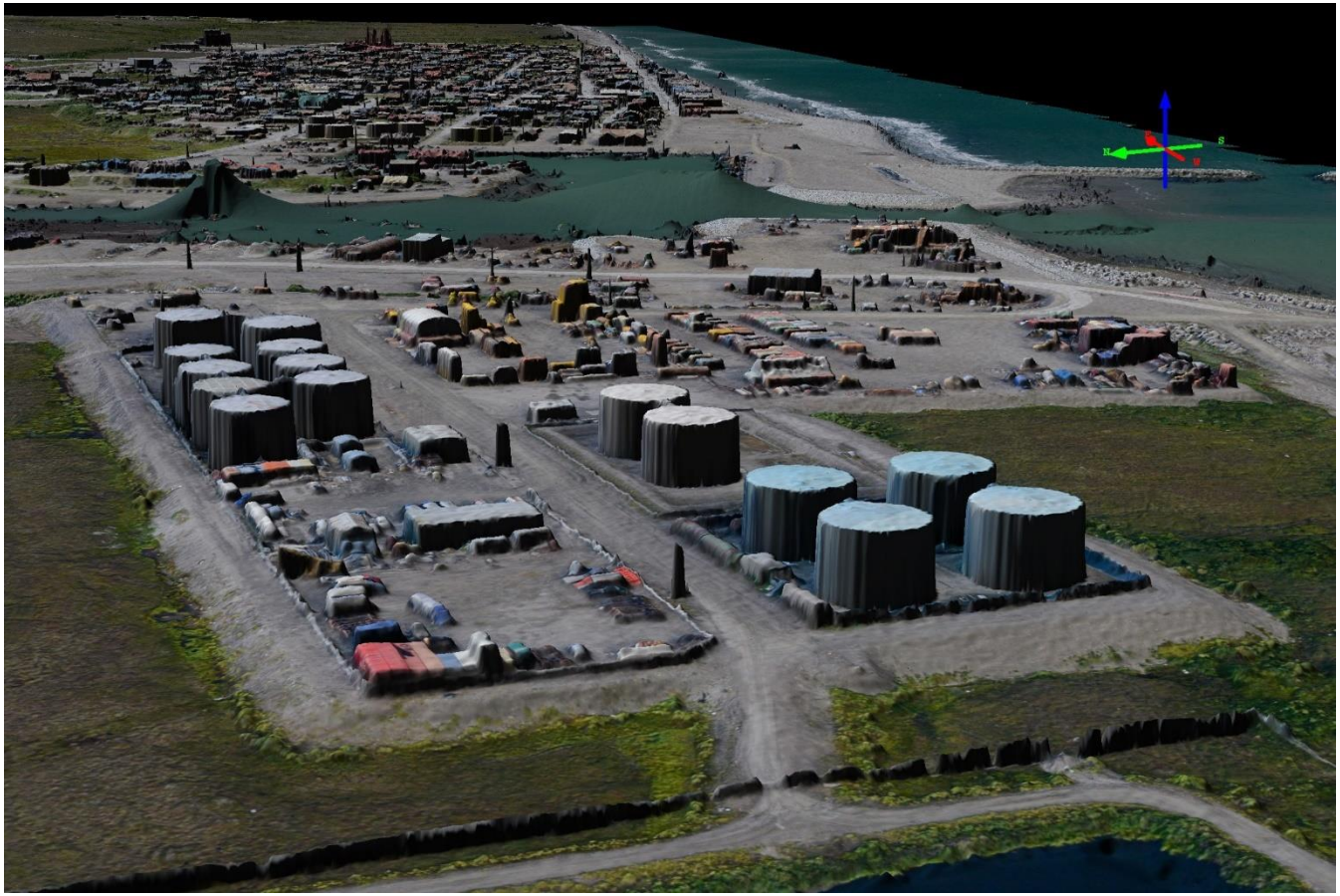
Data Coverage Overview



Fodar is a proprietary form of survey-grade SfM photogrammetry in development since 2010.

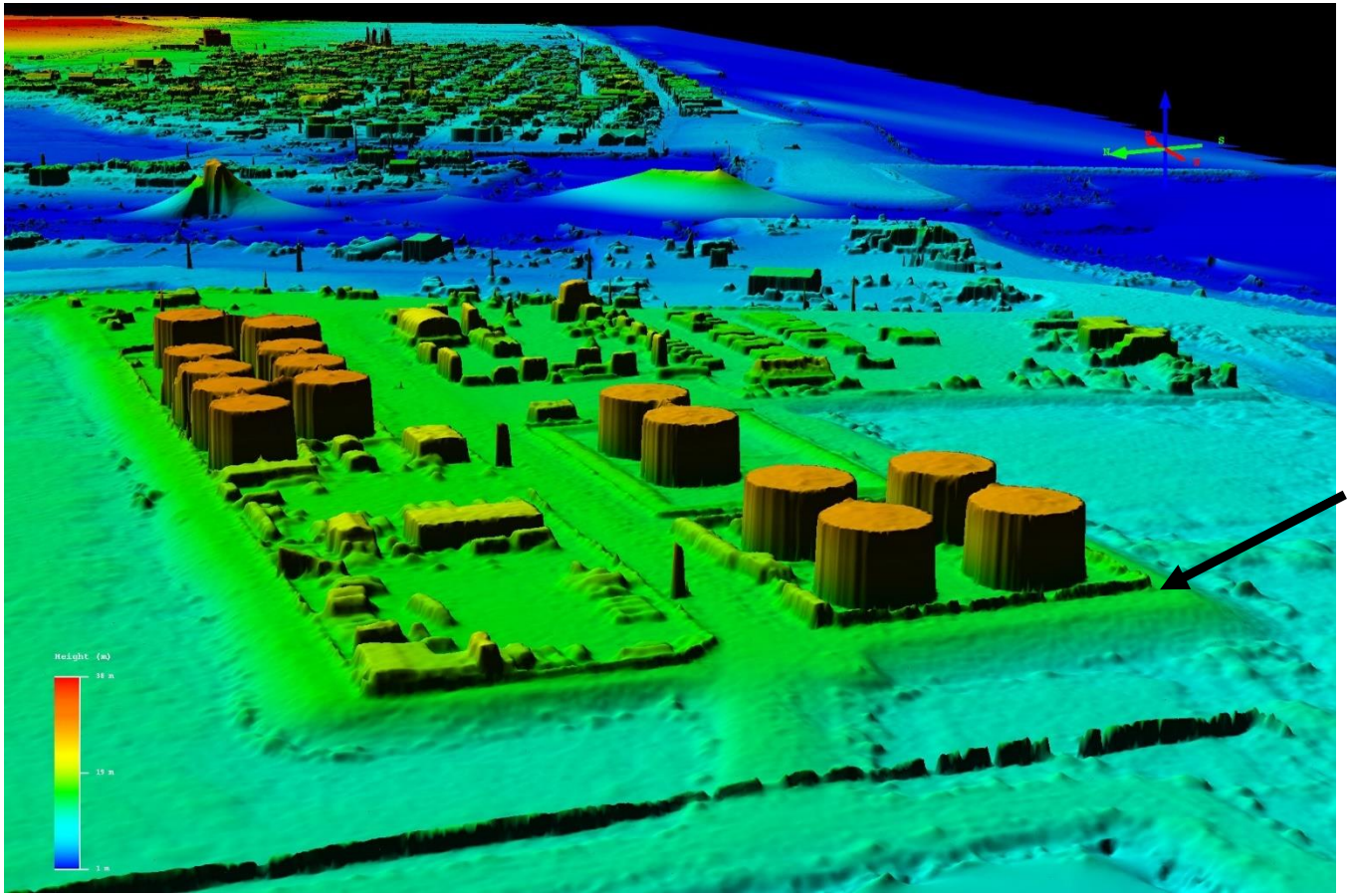
Fairbanks Fodar acquired ~2000 miles of coastline, to ~ 1 mile inland including 35 villages, at 10 - 20 cm GSD with an accuracy and precision of 10 - 20 cm @95%.

Sample Fodar Results



A primary goal for the data was to assess the vulnerability of coastal villages to storms and sea level rise and guide policy accordingly.

Sample Fodar Results



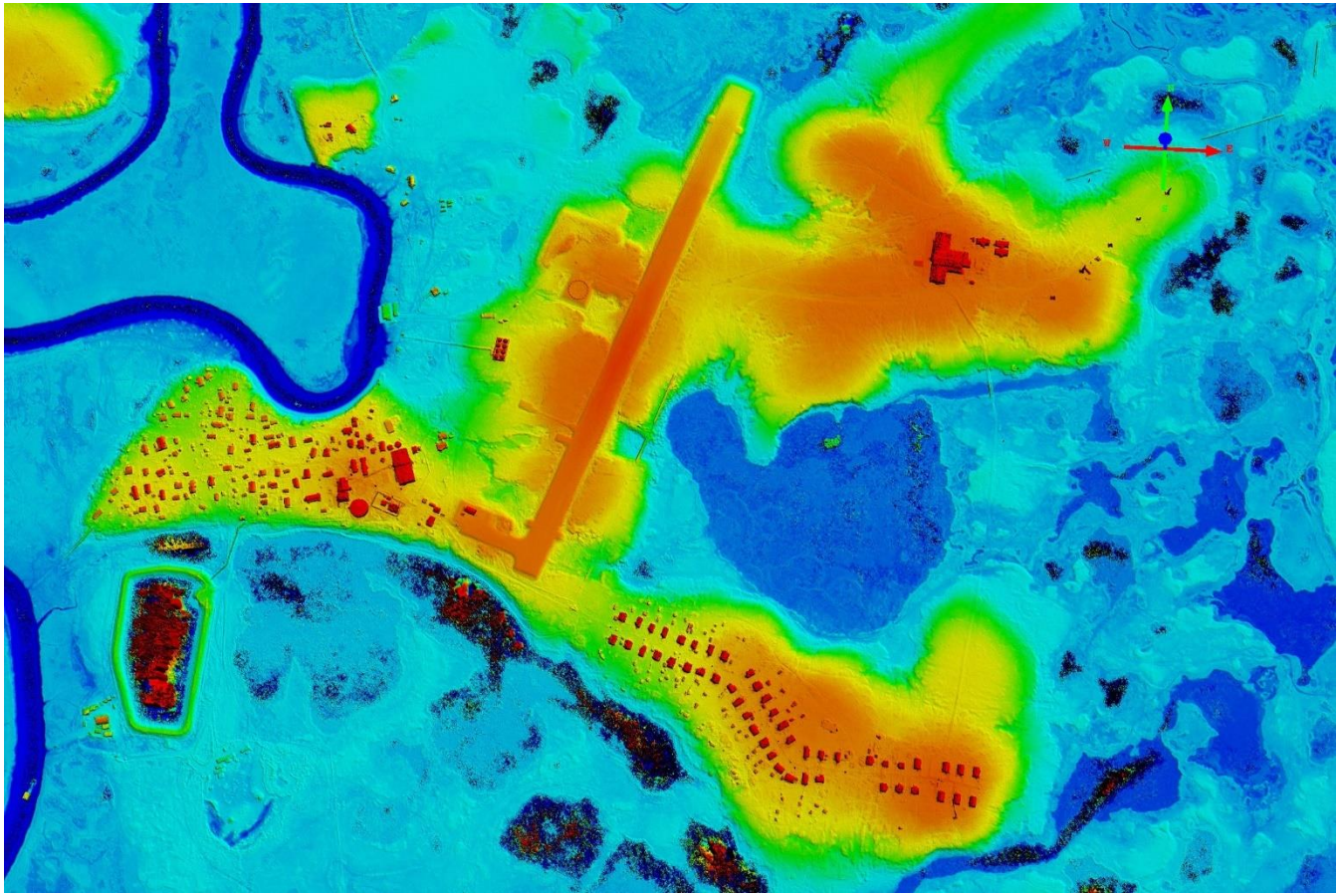
Is this embankment high enough?

These data are now being used by State and Federal stakeholders for exactly that purpose, as we've seen in this meeting.

Sample Fodar Results

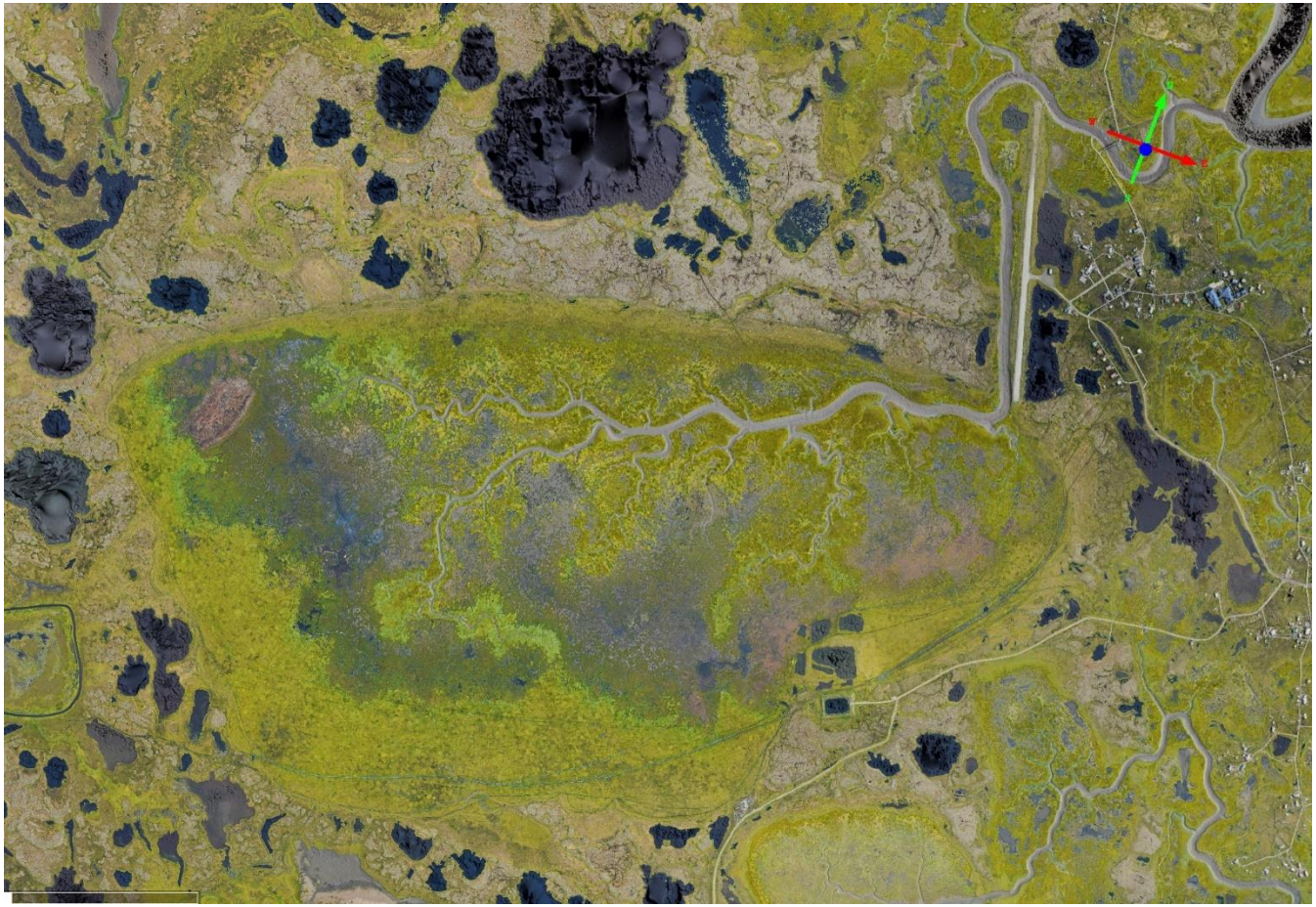
Kongiganak has a strange layout…

Sample Fodar Results



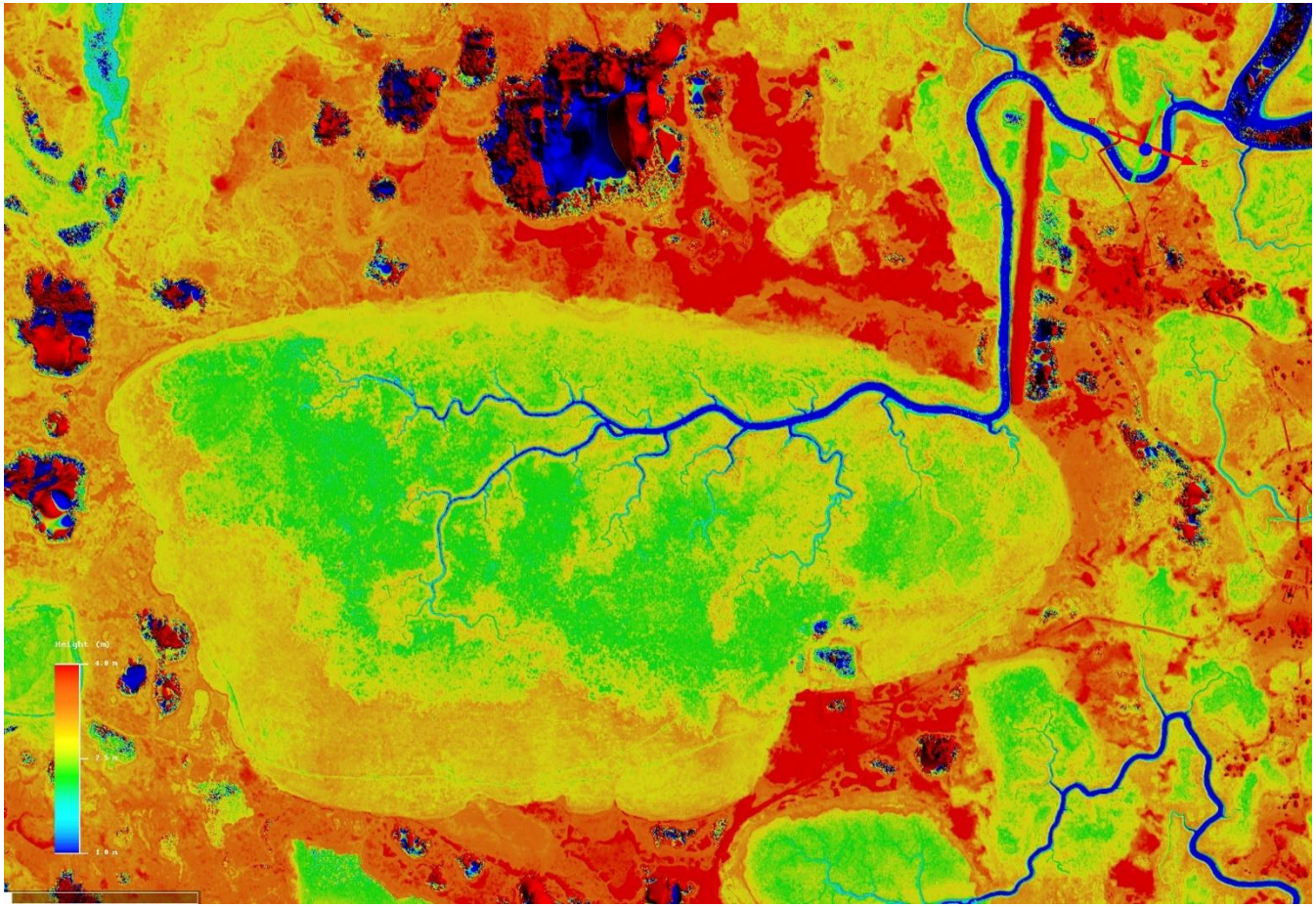
Kongiganak has a strange layout…
… until you realize its built on a island!
This is a serious problem for many villages.

Sample Fodar Results



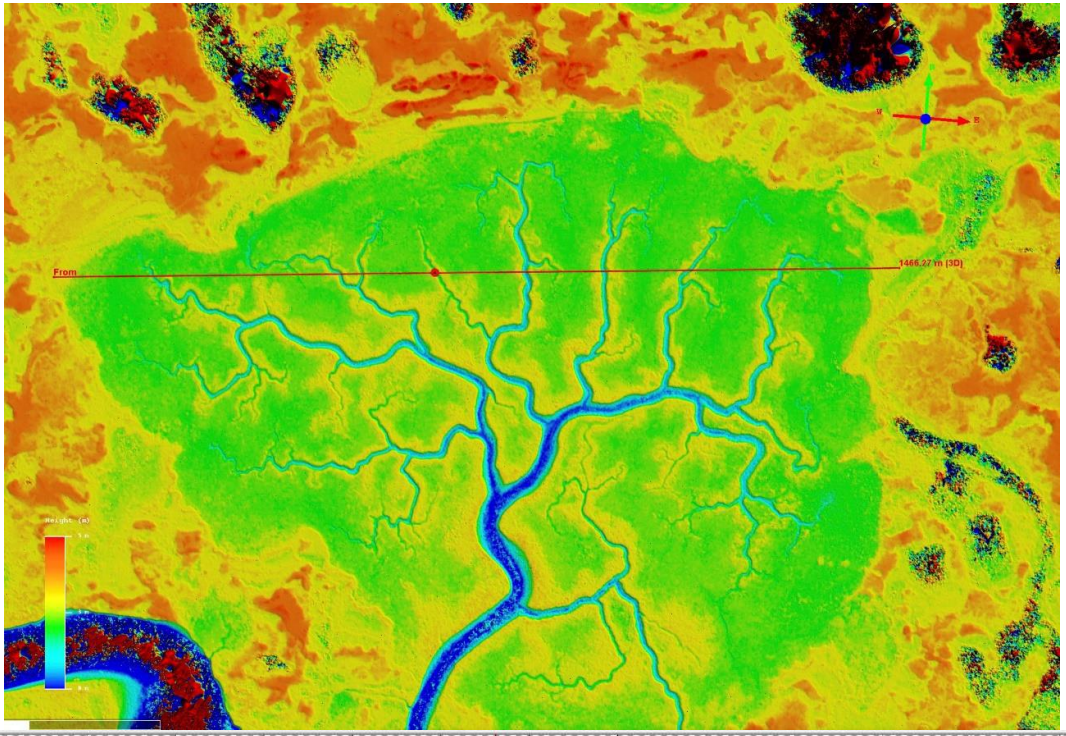
This tidally-filled lake at Kwigillingok is an excellent example of the detail derived from fodar. Note the size of the lake compared to the size of the village (upper right)

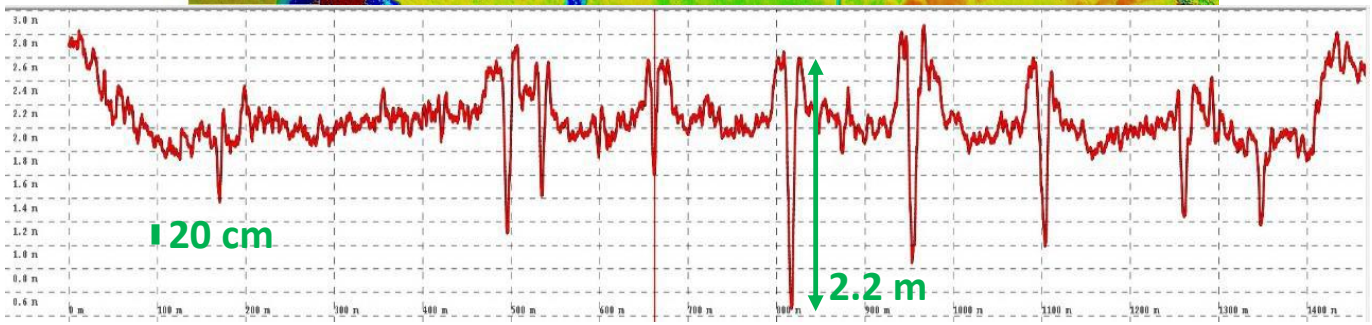
Sample Fodar Results



This tidally-filled lake at Kwigillingok is an excellent example of the detail derived from fodar. Note the size of the lake compared to the size of the village (upper right)

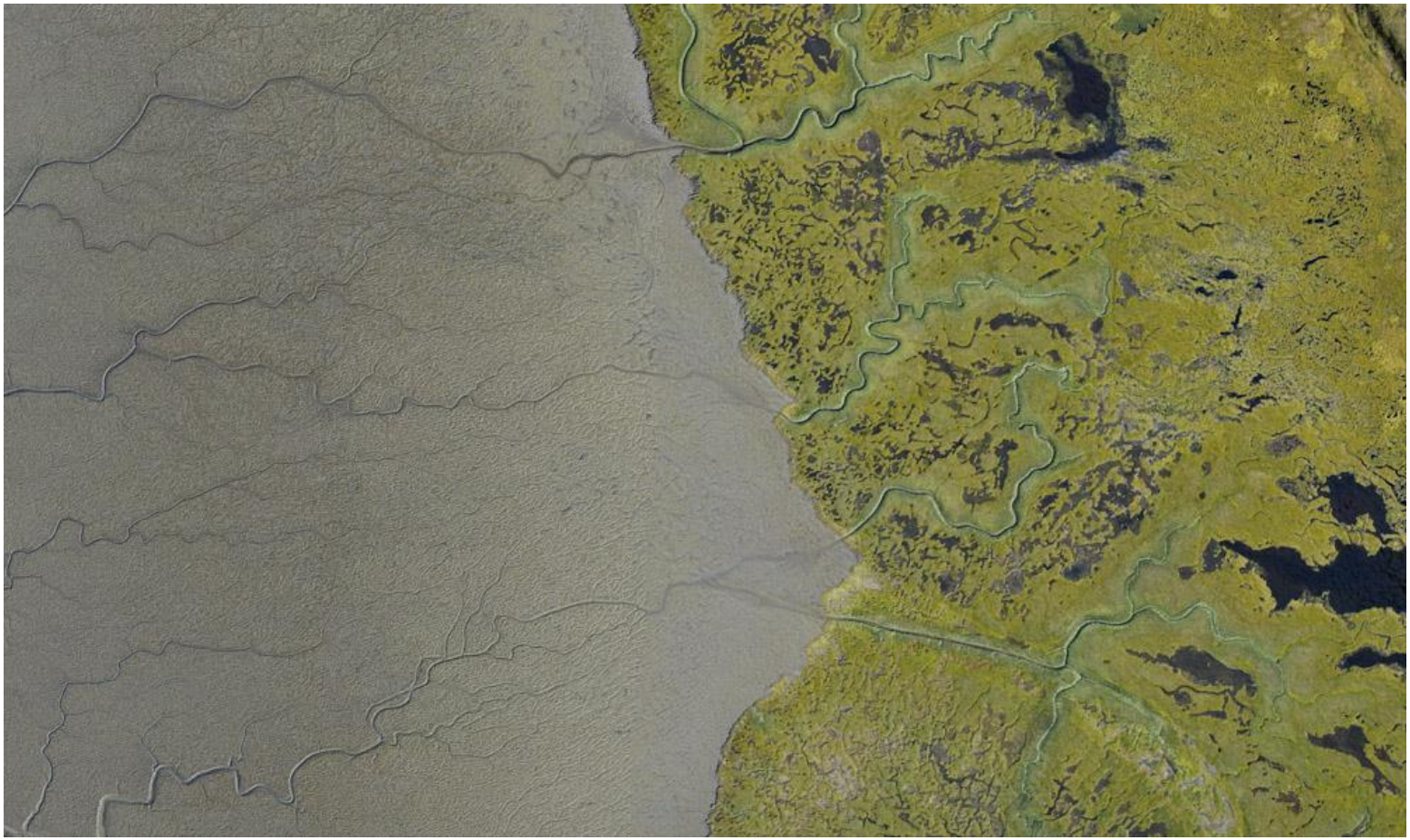
Sample Fodar Results





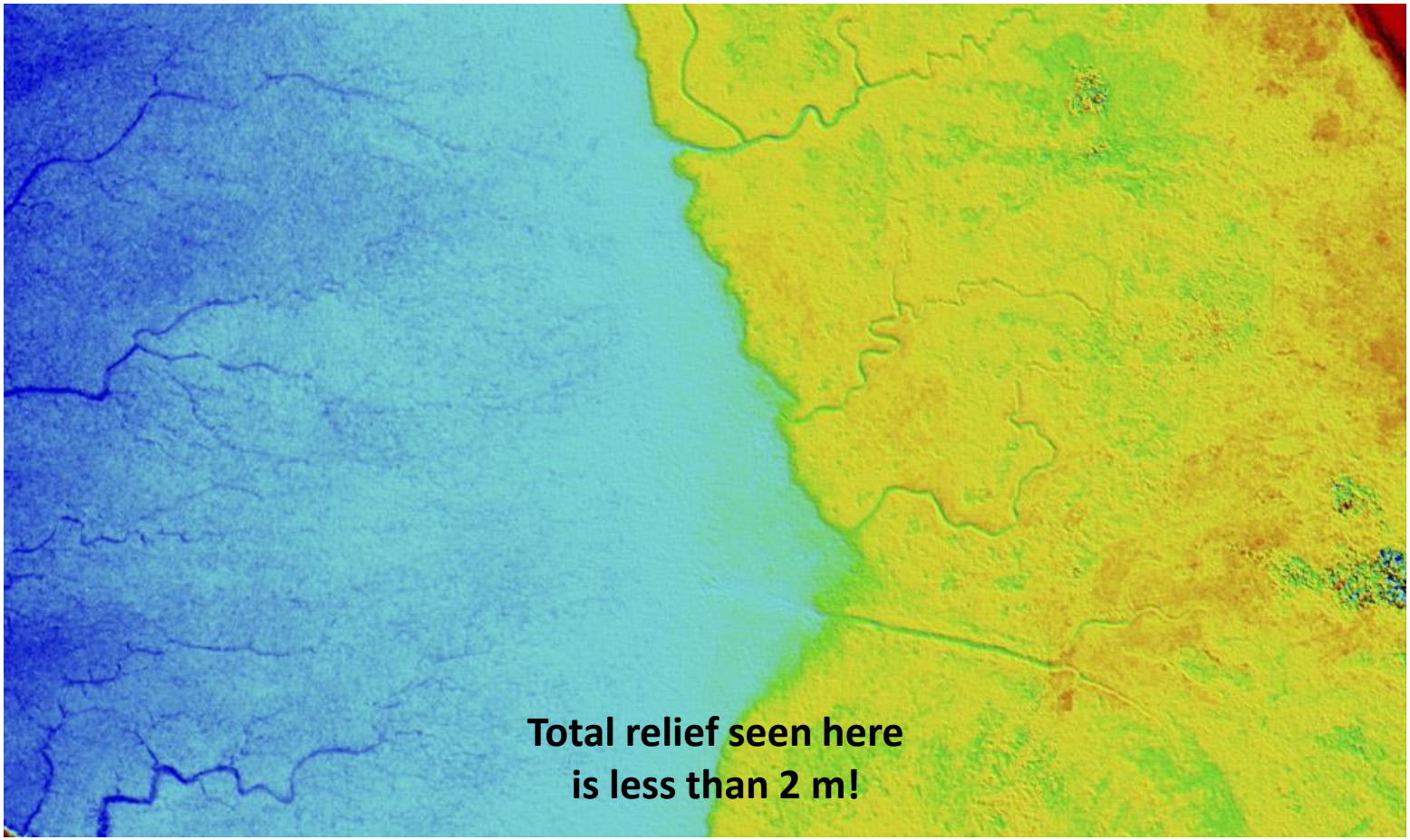
We can not only measure the depth of small stream channels, but the height of the vegetation growing along their edge.

Sample Fodar Results



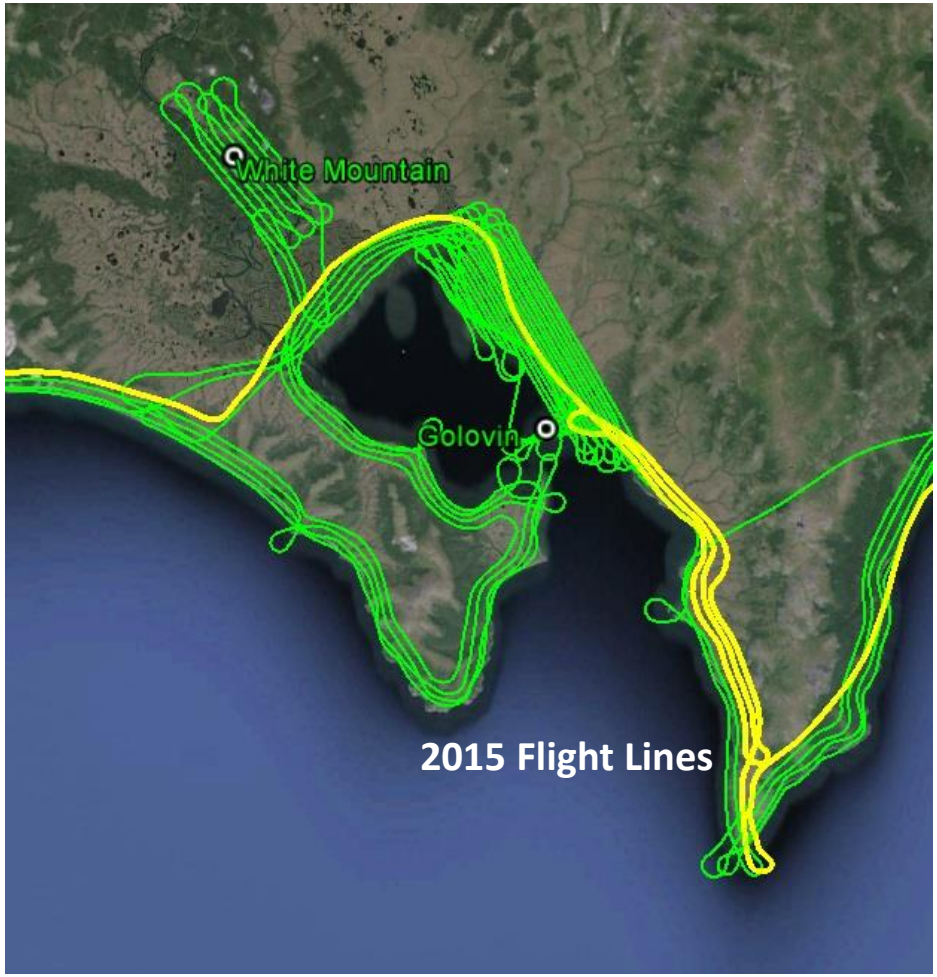
I acquired the entire coast with tide below MHW (and most of it below MLW I think). That is, acquisition dates and times were pinned to the tide predictions.

Sample Fodar Results



I love mapping mud flats.

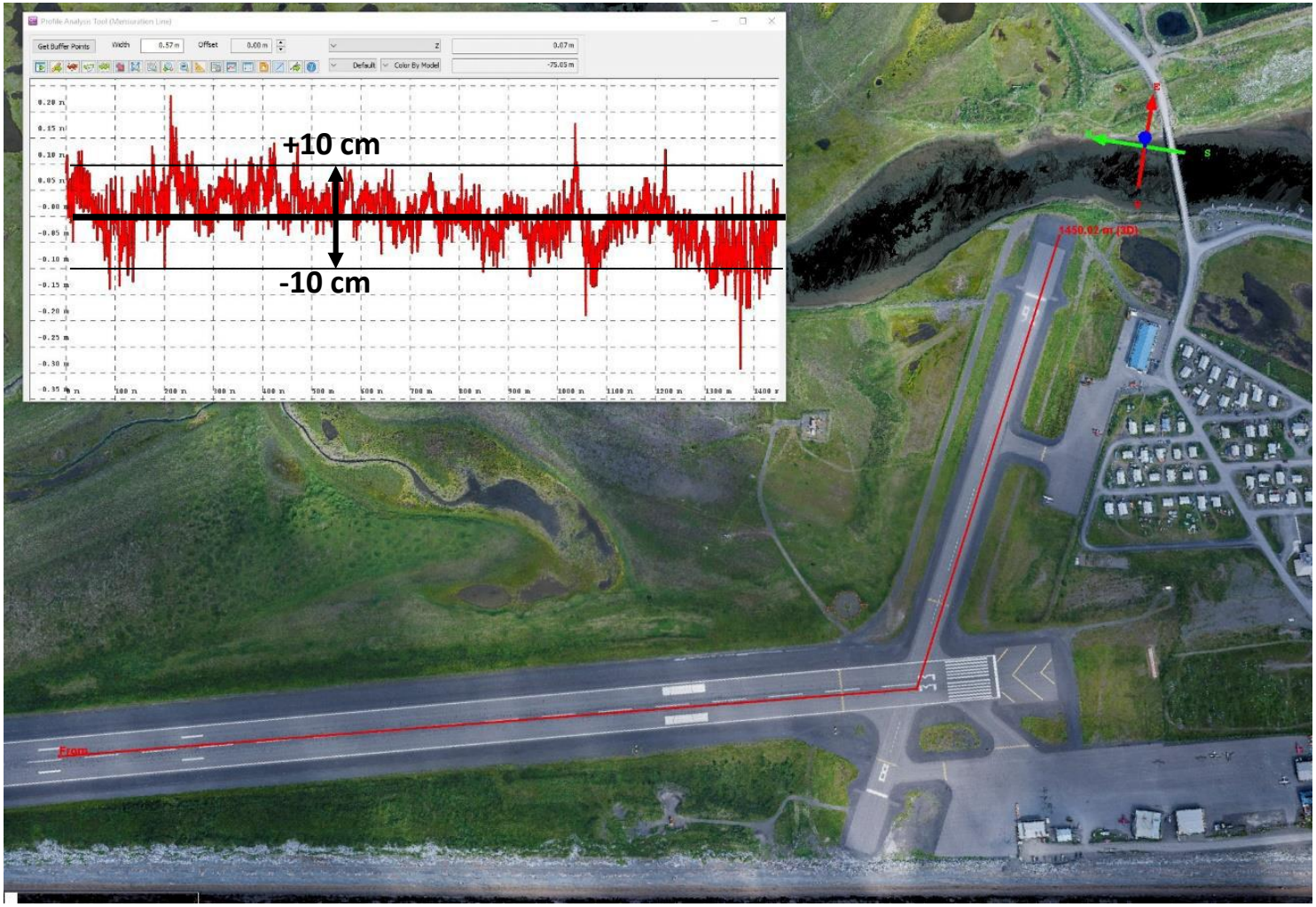
Methods



About 25,000 miles of flying, over 30 days in 3 campains.

Golovin Bay is beautiful. I'll offer deep discounts for more mapping there…

Data Validation



The best means of validating these huge raster data sets is by comparing to another. Here I assessed vertical precision by comparing fodar of Unalakleet from 2014 and 2015 and found that 95% of difference is less than 8 cm (~4 cm stdev).

Data Validation

The best means of validating these huge raster data sets is by comparing to another. Here the compass rose at an airport makes the horizontal accuracy crystal clear.

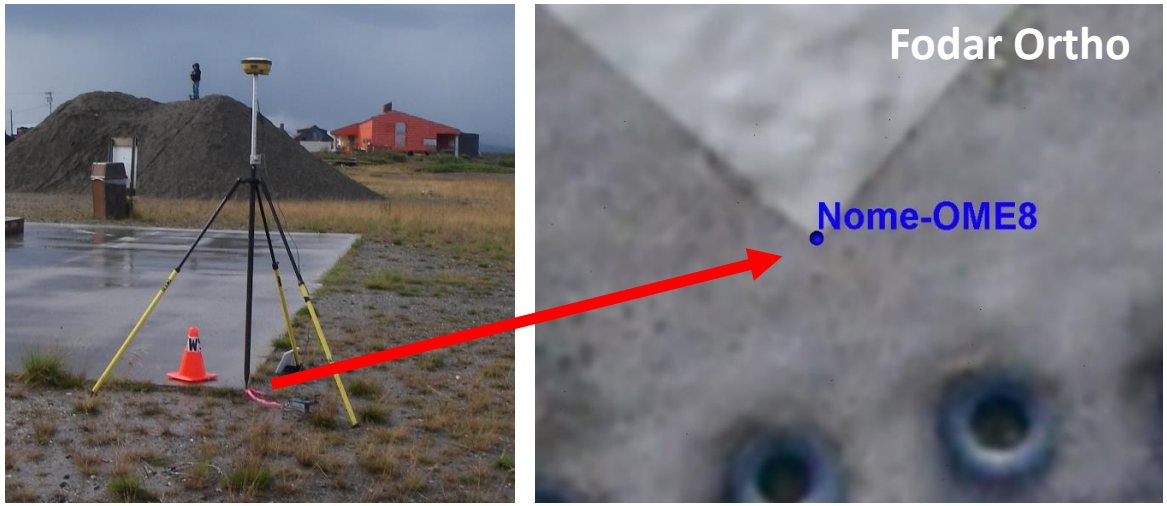
Data Validation

The best means of validating these huge raster data sets is by comparing to another. Here the compass rose at an airport makes the horizontal accuracy crystal clear.

Data Validation

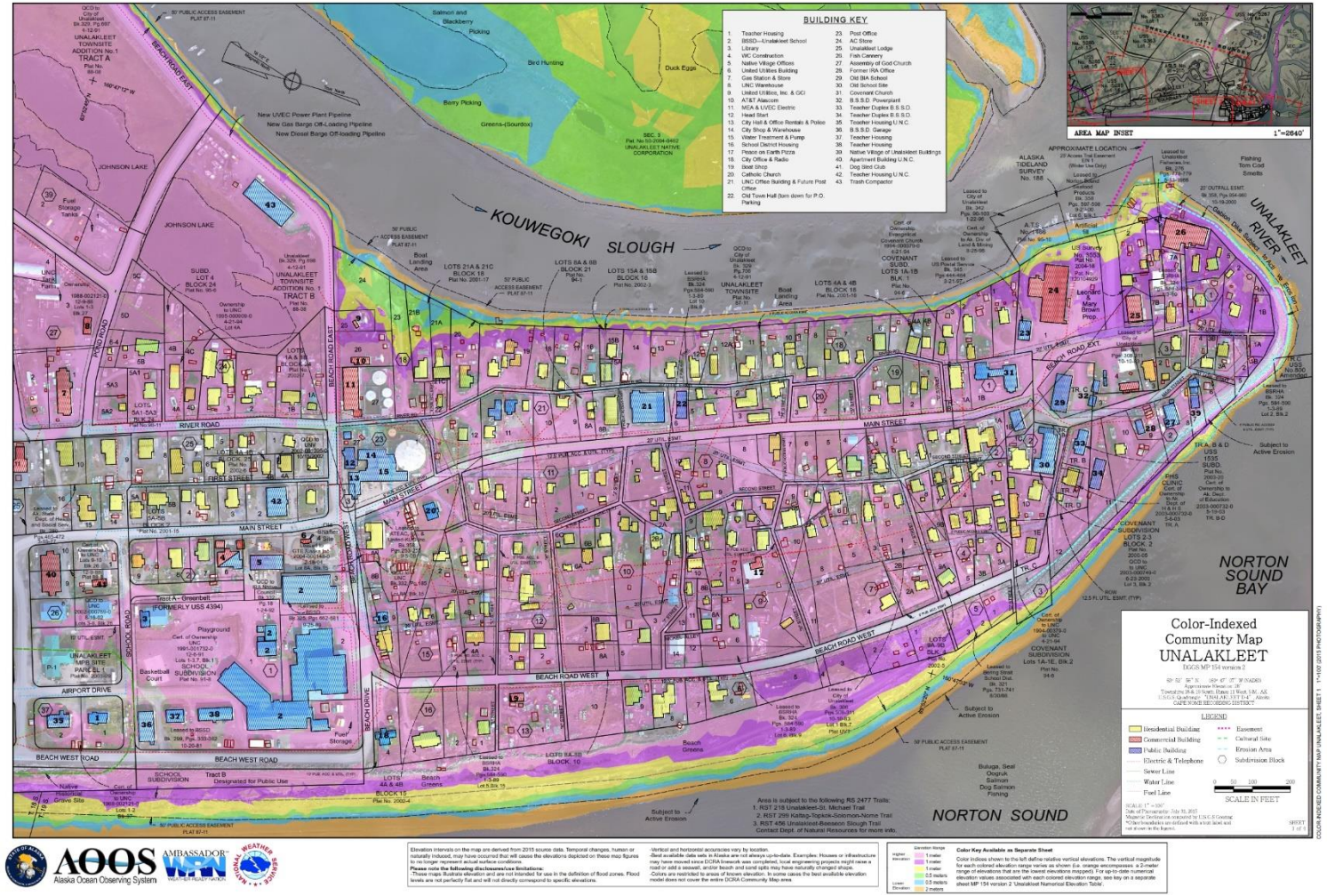
Some photo-identifiable targets are better than others; these are good ones. Regardless, comparing 120 GCPs to 120 billion pixels is an undersampling, though they are quite useful for blunder checking.

Data Validation



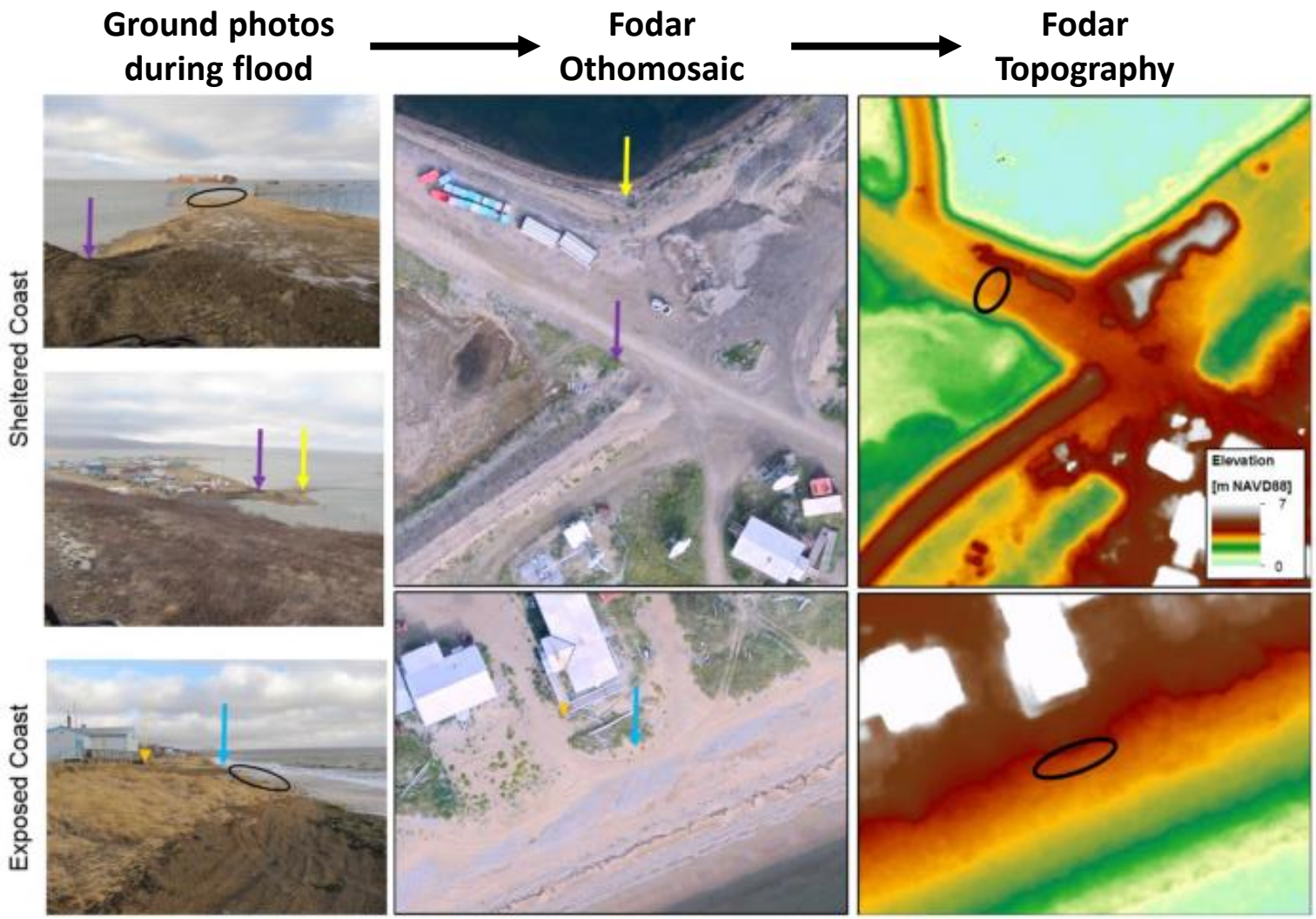
About 120 GCPs were collected by a professional land surveyor.
Horizontal accuracy was found to be perfect (subpixel).
Note that no ground control was used in fodar processing.

Applications: Policy Decision Facilitation



DGGS Conclusion: Fodar is suitable for creation of maps for land-use and emergency planning.

Applications: Flood Inundation Mapping



DGGS Conclusion: Fodar is suitable for determining flood inundation extents using suitable ground photographs.

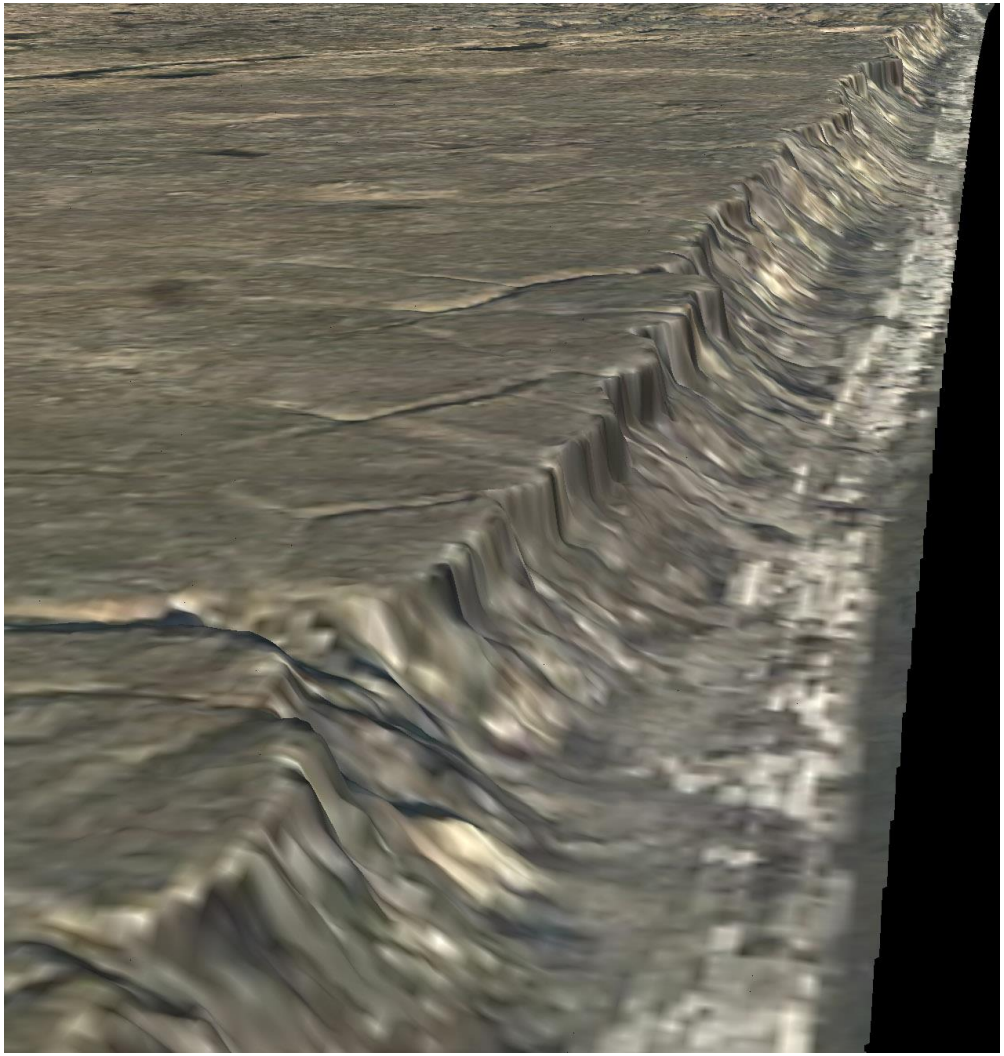
Applications: Coastline delineation

Nicole Kinsman, Ann Gibbs, and Matt Nolan, 2015.
EVALUATION OF VECTOR COASTLINE FEATURES EXTRACTED FROM 'STRUCTURE FROM MOTION'-DERIVED ELEVATION DATA.
In *The Proceedings of the Coastal Sediments 2015*.

Conclusion: Fodar is suitable for creating accurate shoreline vectors from both orthoimage and DSM.

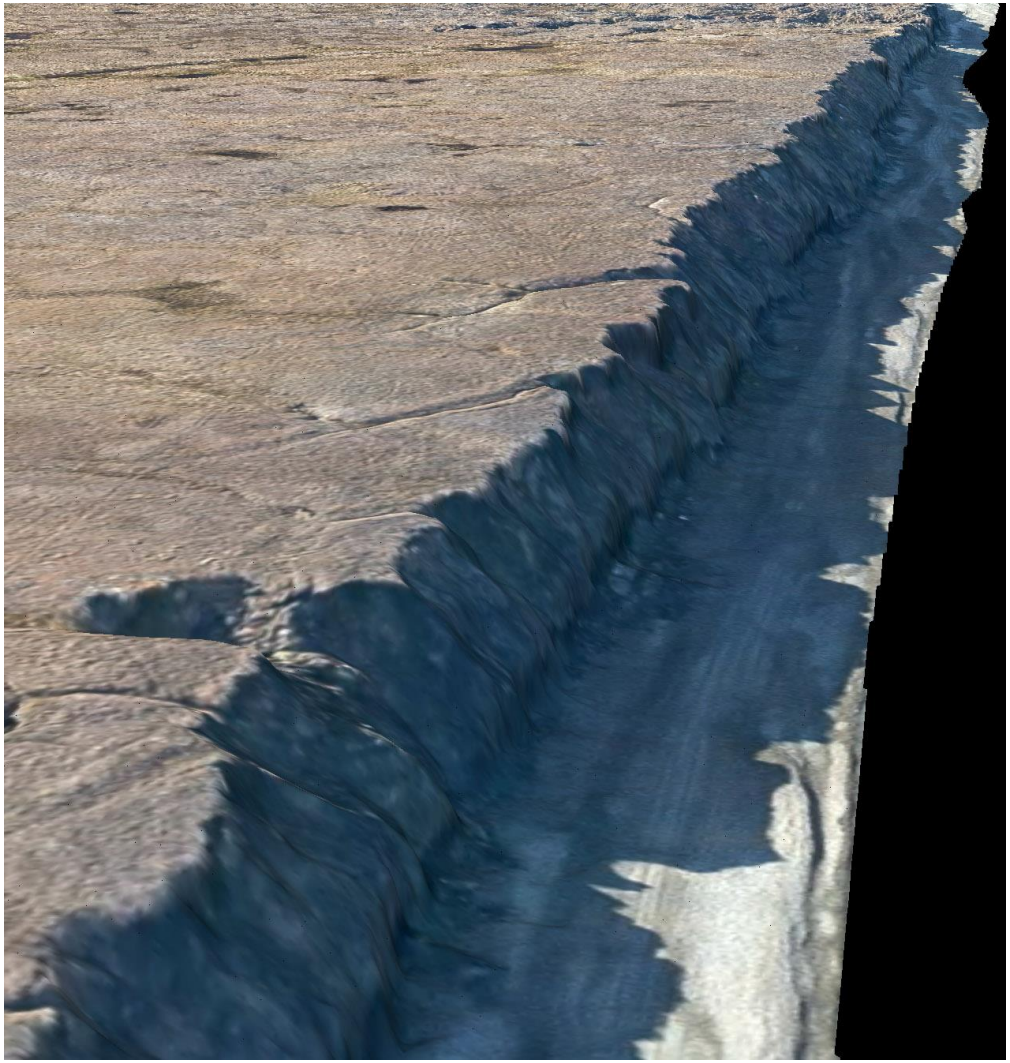
Indeed, DGGS is currently doing just that.

Applications: Coastal Erosion from Repeat Mapping



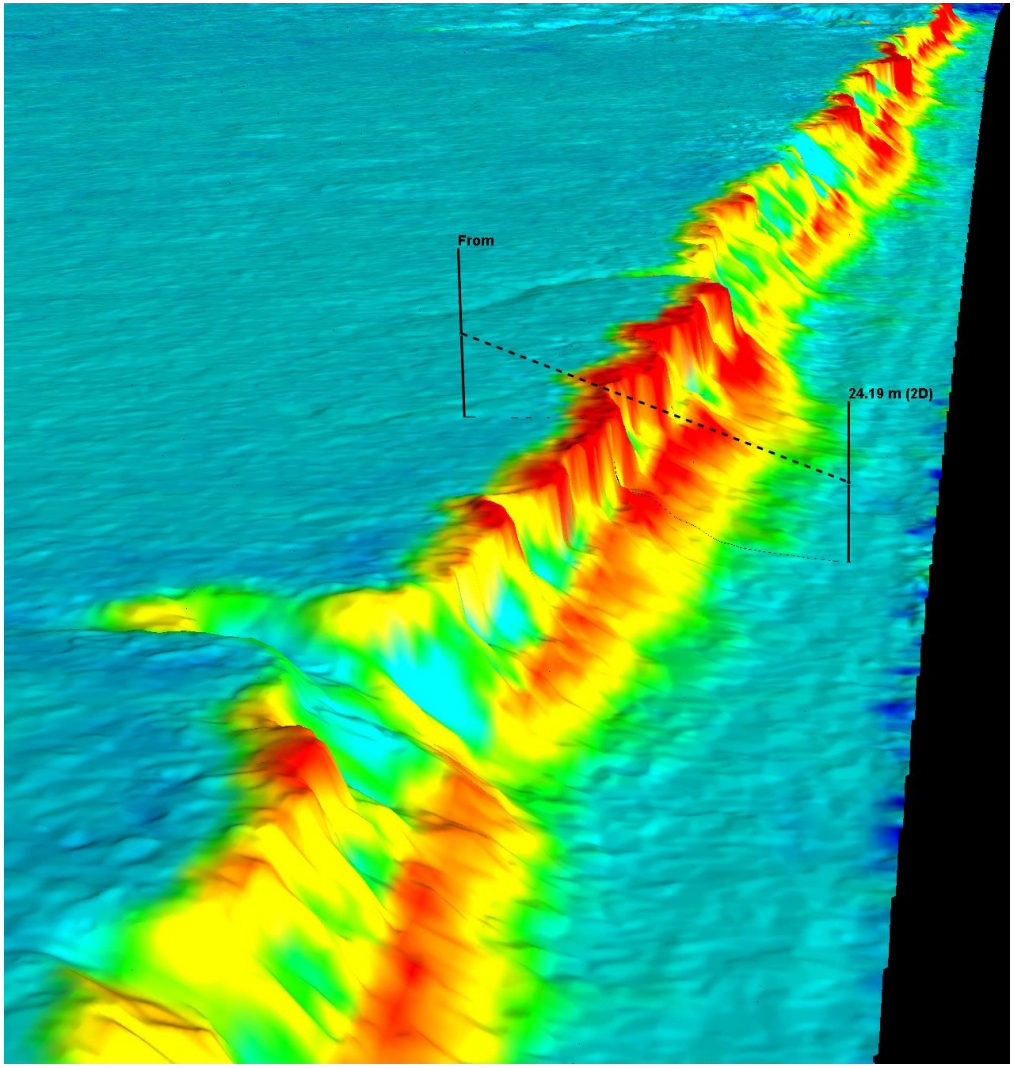
Here is some fodar data of a beach on Barter Island from July 2014.

Applications: Coastal Erosion from Repeat Mapping



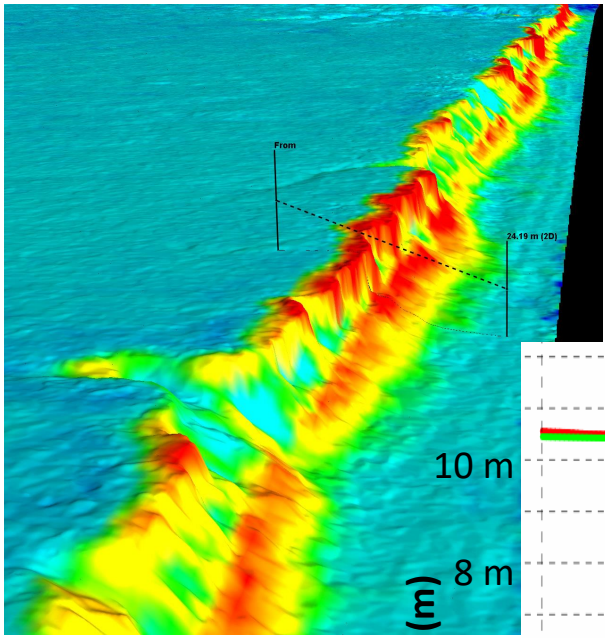
Here is the same stretch of beach from September 2014, two months later.

Applications: Coastal Erosion from Repeat Mapping

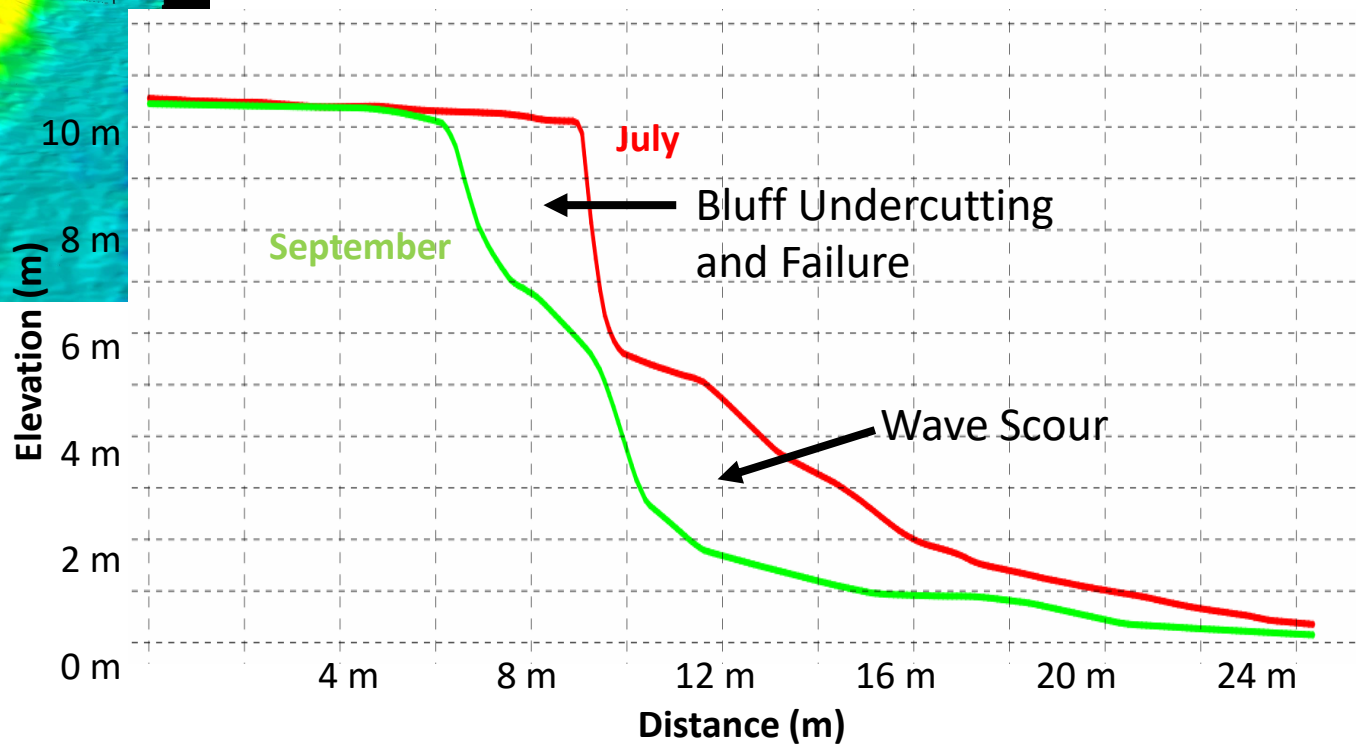


Here is the erosion that occurred in those two months, with reds, yellows, and greens showing loss.

Applications: Coastal Erosion from Repeat Mapping

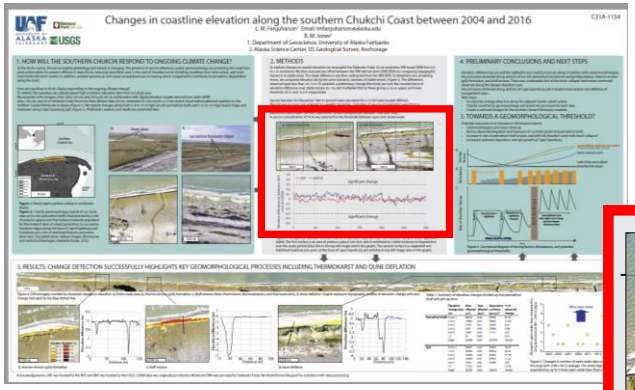


Ann Gibbs, Matt Nolan, and Bruce Richmond, 2015.
EVALUATING CHANGES TO ARCTIC COASTAL BLUFFS USING REPEAT AERIAL PHOTOGRAPHY AND STRUCTUREFROM-MOTION ELEVATION MODELS.
In *The Proceedings of the Coastal Sediments 2015*.



USGS Conclusion: Fodar is suitable for measuring coastal erosion at unprecedent accuracy.

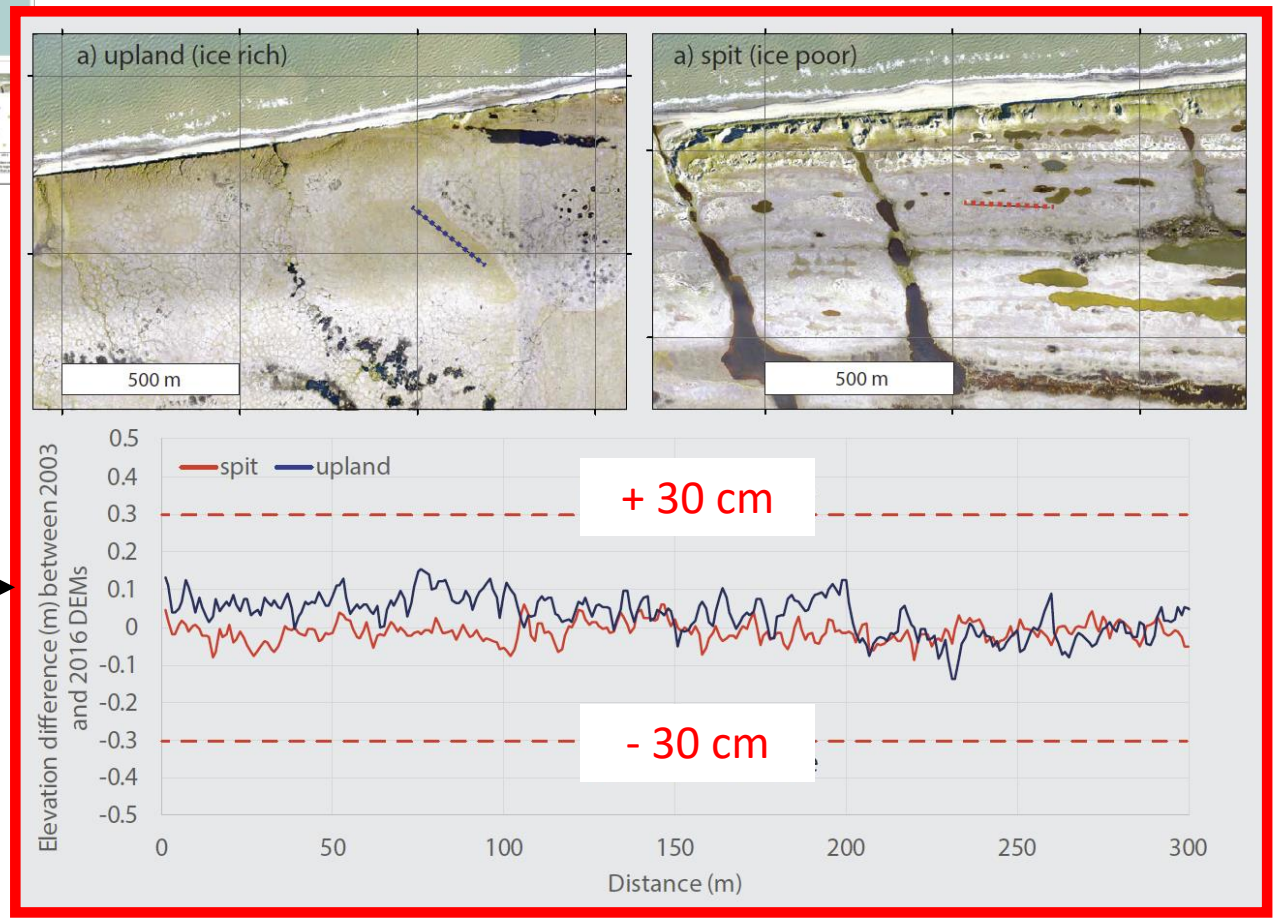
Applications: Coastal Erosion from Repeat Mapping



Louise Farquharson and Ben Jones,
Changes in coastline elevation along the southern Chukchi Coast between 2004 and 2016.
AGU Fall Meeting 2018, C31A-1154.

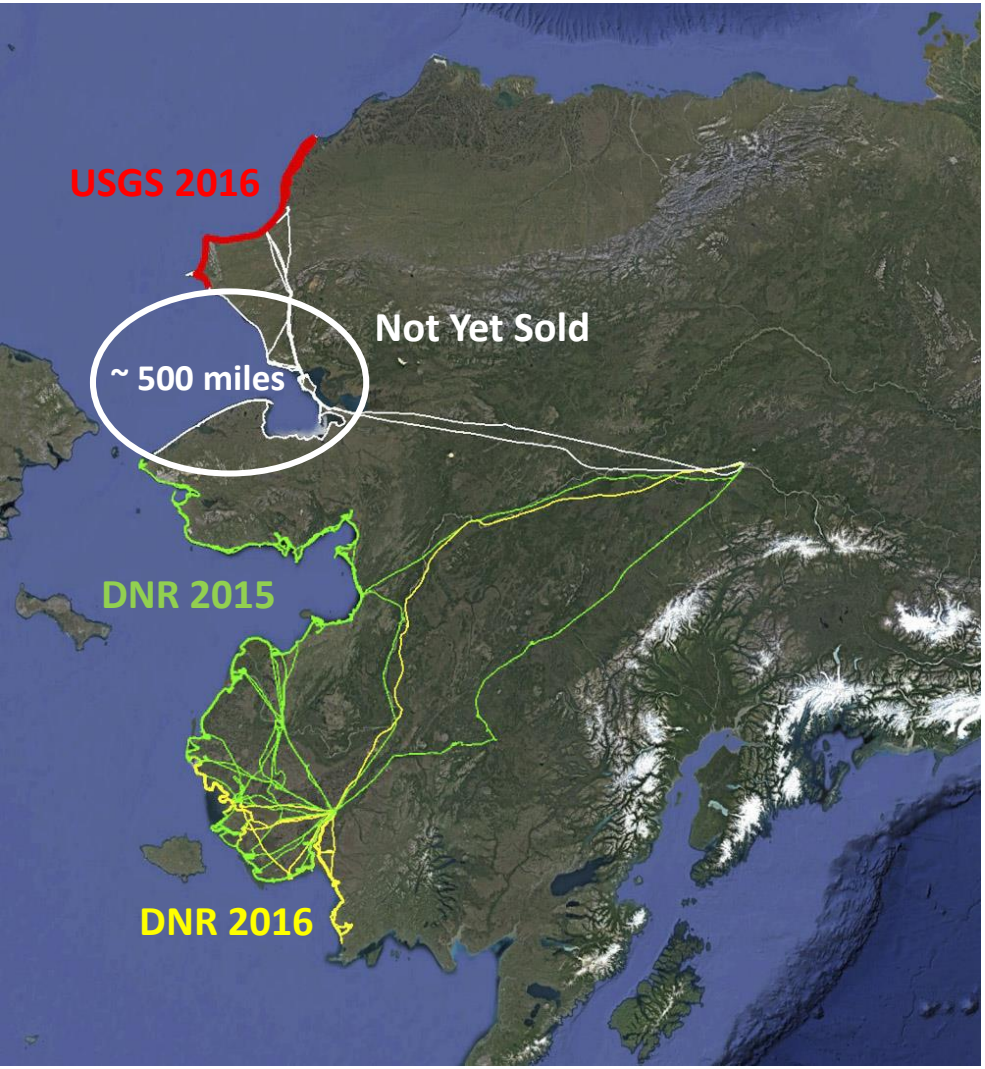
Between Shishmaref and Cape Espenberg

2004 Lidar
minus
2016 Fodar
near Shishmaref



UAF Conclusion: Fodar elevation values are within 10 cm of lidar and thus these data are suitable for coastal erosion measurements.

West Coast Overview



There has been some awesome work done with the existing data I don't want to hold up scientific and policy progress by waiting/hoping for an RFP for the missing data, but I can't release it for free either.

Total cost to date: $375,000.

Applying the DNR/USGS rates to these 500 miles, retail price should be $125,000, **and includes Shishmaref and Kivilina**. Data have the same specs as DNR/USGS, But are only 700-1000 m wide.

I'm willing to reduce the price to $36,000 if…

… the people at this summit are excited to crowd fund this purchase and work together to figure out a mechanism.

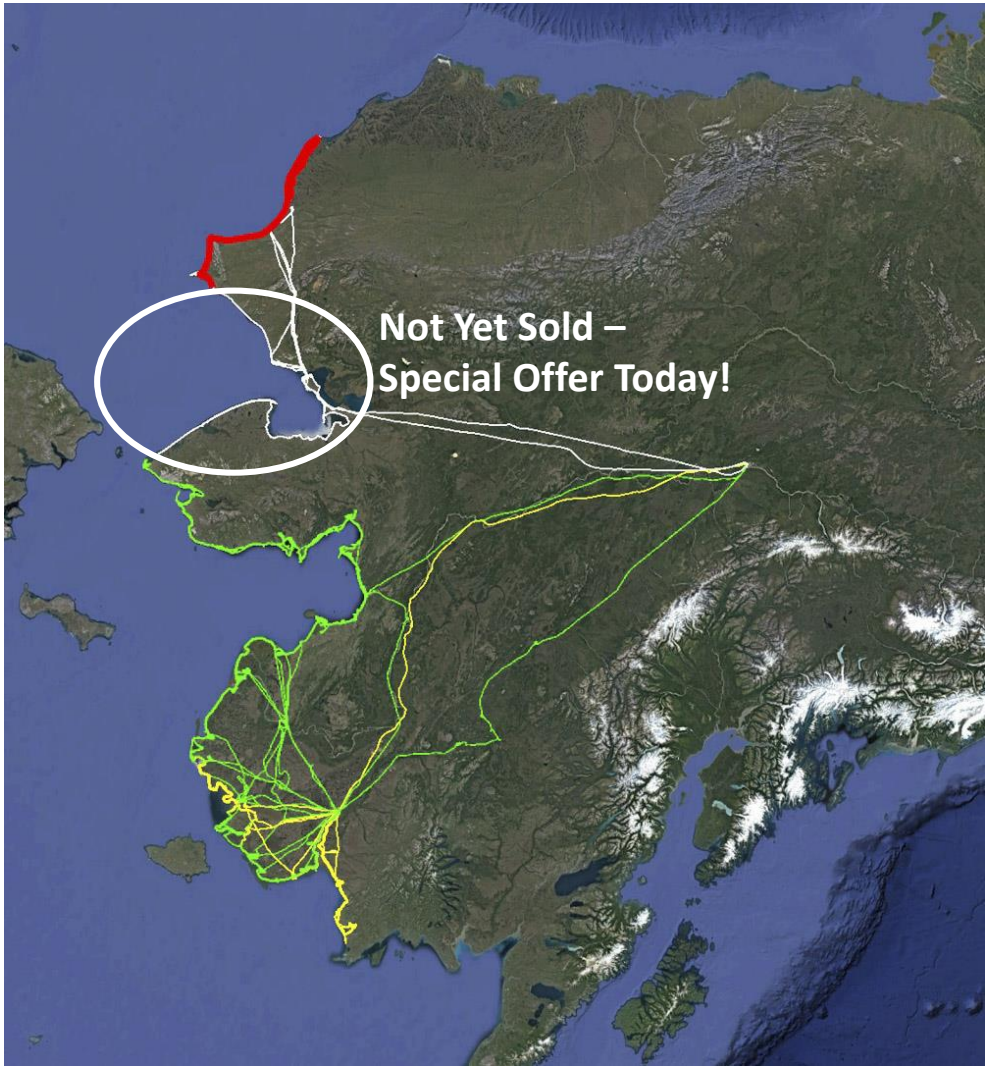
That's only $360/person attending!
Or 12 people @ $3000 each!

Take Home Messages

1) Fodar is awesome for coastal mapping and analysis. But don't just take my word for it…

2) I'm excited to map the rest of Alaska's coast!

3) COASTAL SUMMIT SPECIAL OFFER for WALES to PT HOPE Today: $36,000, but need a large expression of interest from this crowd and need to figure out the best mechanism to share costs.



Thank You!

Visit www.fairbanksfodar.com for more info!

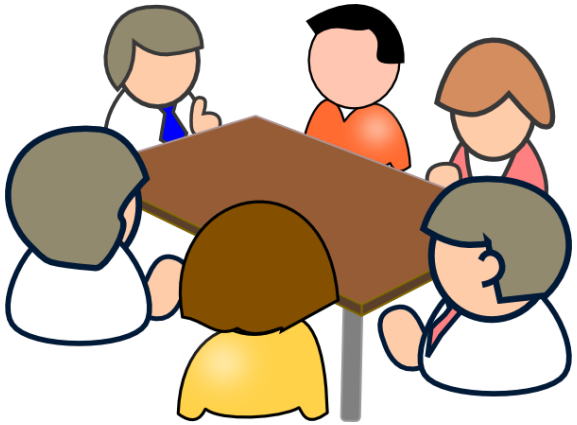
Closing Remarks

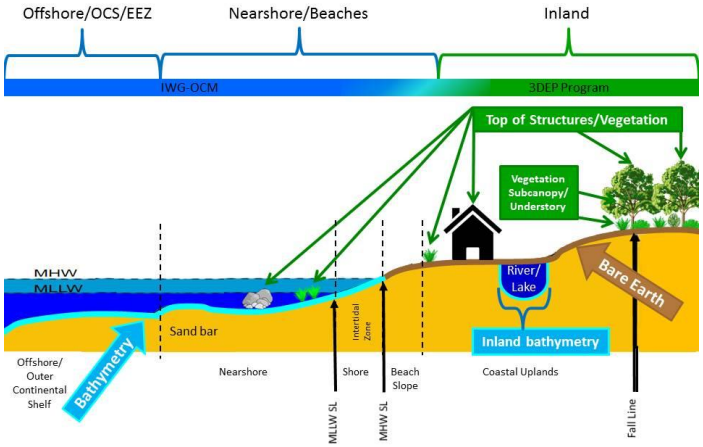
Alaska Coastal Mapping Summit

Marta Kumle, Coastal Mapping Strategist
Alaska Ocean Observing System
Alaska Department of Natural Resources
February 9, 2018

Coastal Mapping Strategy

Coastal Mapping Strategist





STRATEGY DOCUMENT

Goal:

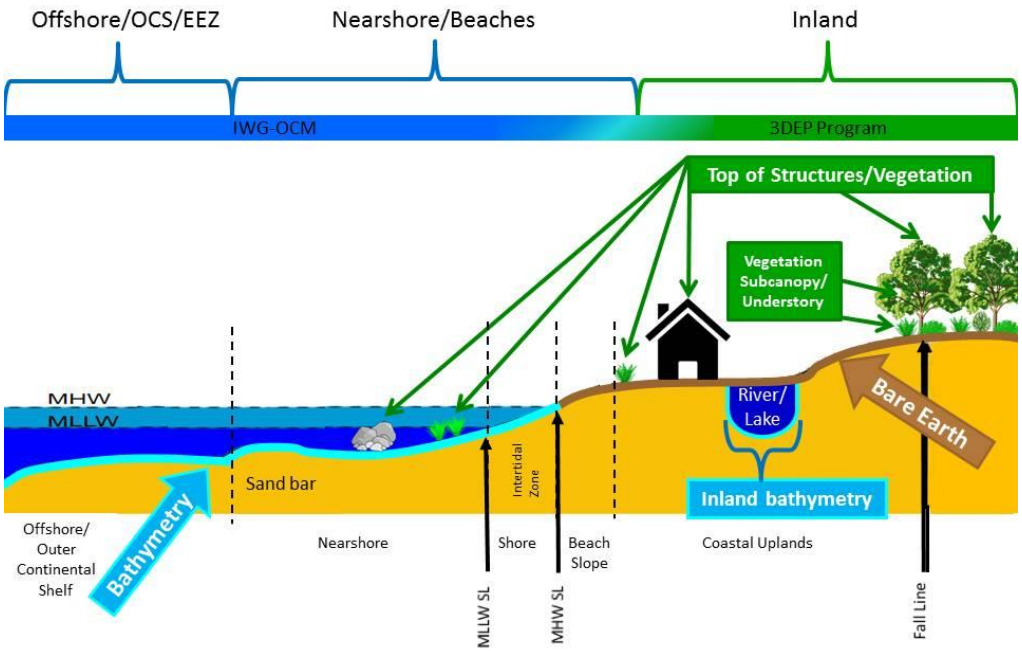
Create an <u>achievable</u> plan to map AK's Coastal Zone

(approx. from <30 m deep to 1 km inland)

- **Long term strategy for prioritizing coastal mapping activities**
- **Selective/tiered data specifications**
- **Appropriate to physical environment**
- **Current and future area uses**
- **Technological/logistical feasibility**
- **Versionable document**

MULTIDISCIPLINARY APPROACH

Data Types:
Bathymetry
Shoreline Delineation
Nadir/Oblique Imagery/Video
IFSAR Topography
Lidar
Photogrammetry
New Technologies



Multipurpose Approach

Products:
flood mapping
coastal navigation
coastal hazards
coastal change
habitat mapping

Enable Classifications:
vegetation
habitat
hazard
geomorphic

Industry Applications:
infrastructure
engineering
nearshore navigation
project planning

Image courtesy of Shorezone: Tigvariak Island, Beaufort Sea, North Slope.

Specifications Matrix

- **Data Acquisition (as technology neutral as possible)**
  - **leverage new technologies**
  - **resources already in Alaska**
- **Elevation, Bathymetry, Imagery**
- **DEM, DSM, Photomosaics, Land Cover**
- **Refresh Rates**
- **Horizontal & Vertical Control**
- **Water Levels, Tidal Fluctuations**

	IHO Bathy	Lidar: Q1, Q2, Q3	Imagery
IHO Bathymetry	✓✓✓	✓	✓✕
Lidar: Q1, Q2, Q3		✓✓✓	✓
Imagery			✓✓✓

LOCATION SPECIFIC

What specifications are needed where?

Match feasibility & capacity

Account for:

- **population/communities**
- **industry activity**
- **natural resources**
- **hunting/fishing**
- **habitat**
- **geomorphic processes**
- **storm surges & flooding**

2017 → 2030

what is feasible to accomplish?

User Groups

Alaska Geospatial Council (AGC)

Alaska Mapping Executive Committee (AMEC)

Agency Liaisons

Native Corporations

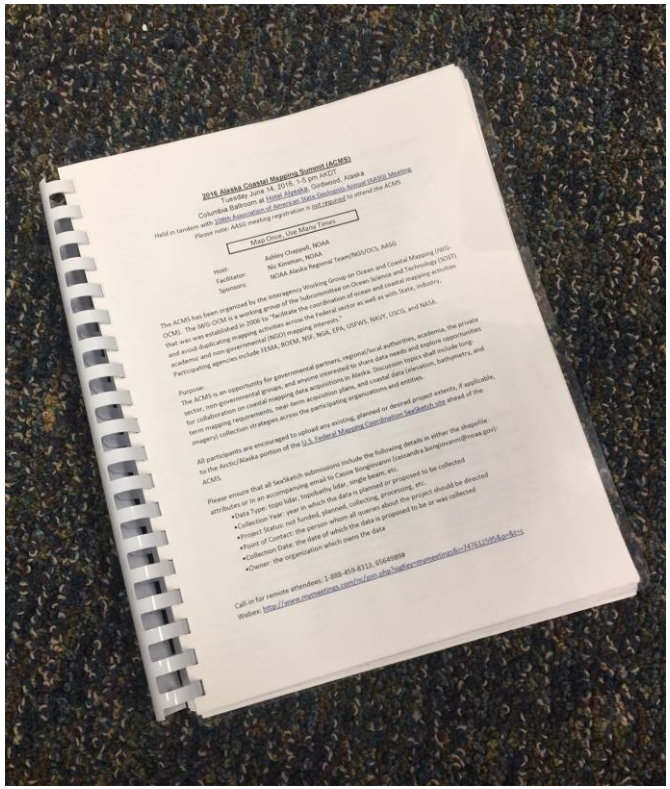
Non-Governmental Organizations

Private Sector

Academic Community

Suggestions?

Next Steps



Conference Report

- executive summary
- send me feedback

Hydrographic Service Review Panel (HSRP) & Alaska Mapping Executive Committee (AMEC)

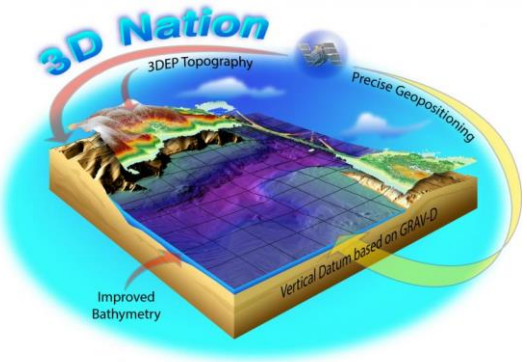
- Juneau, AK in August

STAY INVOLVED

Alaska Geospatial Council
Technical Working Groups:

- **Elevation**
- **Imagery**
- Geoportal
- **Terrestrial Hydrography**
- Transportation
- Administrative Boundaries
- Parcels/Cadastral
- Geodetic Control
- **Wetlands**

http://agc.dnr.alaska.gov/
Email: Ann.Johnson@alaska.gov



Volunteer to be a strategic plan contributor/reviewer

Contact me:
marta.kumle@alaska.gov

Thank You to our Sponsors

Coastal Mapping Mixer at Sullivan's Steakhouse!
320 W 5th Ave, Anchorage, AK 99501

IV. BREAKOUT GROUP DISCUSSION DIGEST

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1. DISTRIBUTED QUESTION LIST

- Map Once, Use Many Times -

2018 IWG-OCM Alaska Coastal Mapping Summit

2018 Alaska Coastal Mapping Summit Breakout Session Questions

- Participants are encouraged to review the topics below prior to the Summit.
- Each breakout group will be assigned a dedicated lead that is responsible for documenting the ideas, perspectives, and discussion of the group.
- The provided questions are just intended to seed dialog, so please do not feel compelled to answer every question; pick a few that capture the interest and expertise of your particular breakout group or pose new questions of your own.

ShoreZone Photo: North of Cape Sabine, Chukchi Sea, North Slope.

Discussion Session I: "Stories that Speak"

The value of coastal geospatial data in Alaska

1. When it comes to coastal mapping in Alaska, where have we been successful and where have we run into barriers? How can we put numbers to these successes and failures?
2. What are examples of how coastal geospatial data (bathymetry, topography, imagery, or other derivative map products) have been or are being used in Alaska?
3. What end products or projects have been created or enhanced as a result of these data? (example: engineered structures, vulnerability mapping, etc.)?
4. Where does a lack of existing geospatial data cost money or cause harm to residents, government, industry, or other users?
5. Are there known examples of projects with timelines that have been significantly slowed for lack of coastal geospatial data?
6. Are there any metrics that could be used to better quantify the benefits of baseline geospatial data in Alaska's coastal areas? (one example could be the cost per day of a grounded barge)
7. What types of strategies might we employ to best communicate the value, opportunities, and/or some of the barriers associated with coastal mapping in Alaska to a national audience?

- Map Once, Use Many Times -

2018 IWG-OCM Alaska Coastal Mapping Summit

Session II: Technologies & Specifications

Opportunities by technology category, test beds, and technology-neutral data specifications

1. What data or data quality specifications are most important to you and why? What specifications could be relaxed and still meet the data requirements of your industry/agency? How much does this vary by location (provide examples)?
2. What types of locations are the top priority for geospatial data with high resolution, absolute an/or relative positional accuracies? Are these priorities the same for topobathy data as they are for imagery? Include specific examples.
3. How important is it to have tide coordinated data?
4. What are desired refresh rates for various types of coastal geospatial data?
5. What environments or coastal conditions are unique to Alaska and what locations would be good candidates for testing new/emerging technologies?
6. Can we, as a group, make a list of representative test locations for Alaska environments?
7. What is needed to make crowd-sourced data more useable in the development of derivative products, and how can we ensure that crowd-sourced data are mutually beneficial?
8. Are there any specific national standards or specifications that pose a barrier to cost-effective geospatial data collection in the Alaska region?

Session III: Coordination & Collaboration

Strategies for working together

1. What are some success stories of past geospatial data collaborations in Alaska? What worked well and what did not?
2. What role should coastal mapping priorities play in guiding Alaska Geospatial Council and Alaska Mapping Executive Committee priorities over the next decade?
3. How can we better connect entities with overlapping/adjacent project locations or objectives?
4. How can we encourage/enable private industry to collect data of opportunity?
5. How can we encourage coordination with non-mapping projects that may be able to contribute value-added support such as ground control or tidal observations?
6. How can we work more effectively with university research/projects to foster products and deliverables that are of direct use to stakeholders or can be incorporated into non-research projects?
7. In what ways can Alaska leverage coastal mapping efforts (past or present) in other geographies (e.g. California Seafloor Mapping Program or Florida Coastal Mapping)?
8. What do you see as important next steps for the development of an Alaska coastal mapping roadmap? What types of content need to be included in a strategy document to outline next steps for transitioning today's dialog into action?

2. STORIES THAT SPEAK HIGHLIGHTS

A. INTRODUCTION BY JACQUELYN OVERBECK

Hello everyone, I'm here to introduce the next topic for discussion, and I'd like to do that by explaining a story that has spoken to me throughout my career, and has given me the feedback I've needed in order to continue doing my job and even feel good about doing that job. Within the DGGS Coastal Hazards Program, one of our primary objectives is to provide coastal residents of the state of Alaska with the tools they need to be prepared for flooding from coastal storms. This last storm season was very active, with 7 storms that DGGS was able to help respond to. Unfortunately, with reductions in sea ice during the storm season, the impacts of these storms are expected to increase. So today, I want to share a story with you that speaks to the need for baseline coastal mapping with very real and impactful results. A story that, although it only represents one community among many, sheds light on the state of weather forecasting and community response to coastal storms. A story that shows what progress in coastal mapping can do for individuals.

DGGS maintains relationships with local individuals throughout the state, but by far the most productive relationship has been with the Chinik Eskimo Community in Golovin, Alaska. Through the years we've worked together in preparing for, responding to, and measuring the impacts of coastal storms on this small western Alaska community. Golovin is located on a low-lying sand spit on the northern end of Norton Sound. They regularly experience coastal flooding, and in 2011 shared photos of flooding at the base of many homes, with people canoeing down the streets to get from place to another. During the 2011 flood, weather forecasters and emergency responders had no idea in advance what the impacts of the storm would be. They just knew it would be big.

Since then, storms have continued to impact Golovin, but coastal mapping has been conducted at the community to connect the forecasted storm water levels onto a local digital elevation model. The community has responded by building a temporary storm berm to protect low lying areas of the spit every time a storm is forecasted. So, when they get a forecast, they also get a map showing the potential elevations at which flooding could reach. The tribe then determines whether the storm berm should be built or not and works with the city and corporation to extract the gravel resources needed to build the berm. Over the last few years, they have even been able to provide feedback on how well the storm was forecasted. Allowing DGGS to catalog the resulting impacts of storms, and use that information to improve future forecasts. Residents of Golovin, working with DGGS have created a full circle communication loop which is so difficult to maintain in western Alaska. But is so important if the coastal mapping that is conducted in the state is truly going to benefit those who need it.

So today, I want to challenge you to think of your own stories that speak. Look at the questions that have been provided for this session to start thinking along these lines. But I can almost guarantee you that most people don't want to hear about vertical datums or the ground sample distance of your digital elevation model. They want to know what that data means in a real-life situation, and as group we have the opportunity to document these stories so that they

Group discussion digest is a compilation of handwritten or typed notes from all groups with limited opportunity for participant review. Efforts have been made to preserve the intent of each comment, however, it is possible that some facts and context may have been misconstrued in this process.

can benefit coastal mapping for the state. So, take this time to discuss and like the earlier session, we will report back the highlights of the group discussion.

B. SUCCESSES

Success is defined as productive collaborations, the acquisition of needed data, the access of that data so that it informs locals and all planners understanding of risks, and leads to actions that reduce risk.

- Bathymetric data acquisition in Southeast Alaska has been successful. Factors leading to this include relative accessibility of the areas, tourism as a driver, the nature of the steep and deep bathymetry that leads to more efficient mapping by multibeam, and relatively clearer waters that allow for bathymetric lidar data collection.
- The Statewide Digital Mapping Initiative (SDMI) is also a great example of widespread elevation data acquisition with a variety of funding sources and data collection over a number of years.
- The 3DEP program in general is a great success in Alaska, as we have been getting projects every year. This success can be attributed to the matching funds of the program and quality work of the local program coordinator, Brian Wright.
    - Second half of Prince of Wales Island will be mapped under this program this year.
    - North Slope Borough is seeking a USGS BAA award this year for Lidar mapping
    - Yukon-Kuskokwim area lidar data collection in 2016 was a great example of coordination of multiple partners to fund a large swath collection along the coast. This data collection was funded by a consortium of agencies and matched by the USGS 3DEP program. The complexity and remoteness of the area required adjustments of the standard QL2 requirements for field data to make the project feasible yet still retain the QL2 accuracy.
        - The adjustment of the checkpoint specification from "regular" to "reasonable" spacing enabled checkpoints to be distributed in accessible areas rather than a rigid grid pattern, thus, eliminating the need for massive amounts of helicopter charter time and special access permitting. This change is estimated to have saved the project well over six figures in budget, and also significantly increased the feasibility of project completion in a single season. Furthermore, special access permitting for regular grid spacing would have likely delayed the project a season.
        - These data are being used for multiple applications, including change studies, resource management, planning trails and to assist the potential move of the community of Newtok to its new location to Mertarvik.
        - The lidar data collection was funded by the USFWS National Wildlife Refuges Program, the Western Alaska Landscape Conservation Cooperative, AKDNR - Division of Geological & Geophysical Services, Natural Resource Conservation Service, Federal Emergency Management Agency and the Alaska Ocean Observing System (who sent money to DNR

Group discussion digest is a compilation of handwritten or typed notes from all groups with limited opportunity for participant review. Efforts have been made to preserve the intent of each comment, however, it is possible that some facts and context may have been misconstrued in this process.

to help fund the work). The funding from all of the previous partners was matched by the USGS's 3DEP program. NOAA contributed in-kind services and was integral in developing the funding proposal and providing the specifications to USGS.

- Lidar data has already been utilized near Emmonak for a soon to be published shoreline change study
- Lidar data over Hooper Bay was compared to photogrammetric DSMs acquired in 2015 in poster published by the AGU in 2017.
- The Alaska Native Tribal Health Consortium and the Denali Commission were early users of the data to help assist Newtok on its move to Mertarvik.
- This project was conducted through a USGS contract with Woolpert, Inc and Kodiak Mapping with regional partners (FWS, Western AK LCC, NRCS, FEMA, AKDNR) represented through the Western Alaska LCC.
- The data are publicly available through the DGGS Elevation Data Portal and will also be available on the USGS site soon.

- ShoreZone is an example of a successful program given its tie-in to the Cook Inlet Response Tool (CIRT) (http://portal.aoos.org/cirt). It gives access to daylight, low-tide imagery and allows responders to know what to expect in advance of a response and also provides a snapshot of space in time before a spill. The Kulluk incident was an example where ShoreZone data was used to provide a safe location where the drill rig could be towed to wait out the storm. Additionally, the images generated from the project improves awareness of coastal areas as they tour the state – this allows people to gain appreciation for a place they may not otherwise have access to or be aware of.
    - ShoreZone has been effective in passing the cup to chip away at imaging across the state. ShoreZone's goal is to provide a consistent imaging and mapping dataset for the whole state, asking partners to help meet the goal. Program has well-articulated goals and protocols (Cook et al., 2017). Since ShoreZone started an estimated $12M have gone into ShoreZone in Alaska. Annual meetings have been useful in keeping the ball rolling, but a single coverage of state is still not finished yet with central and western Aleutians yet to be completed. ShoreZone would have benefited by having a strategy from the beginning. Having an IDIQ with NOAA National Marine Fisheries Service (NMFS) was useful.
- Locally, a small project success story from the University of Alaska Anchorage (UAA) is the Point Woronzof bluff erosion study in Anchorage. The driver to this small project was actually the neighborhood community council that was concerned about the loss of public park land due to bluff erosion. The community brought the issue up to UAA, which was able to conduct the study using structure from motion.
- An innovative use of crowd sourced data was the Alaska State Department of Natural Resources study of a storm event in 2016. The DNR collected iPhone images taken by members of a coastal village during storm surge run-up. Those images were co-registered with a DEM to get the heights. This information was then compared to existing modeling to improve the database and future models. More information on this study can be found in this report: http://dggs.alaska.gov/pubs/id/29730.

Group discussion digest is a compilation of handwritten or typed notes from all groups with limited opportunity for participant review. Efforts have been made to preserve the intent of each comment, however, it is possible that some facts and context may have been misconstrued in this process.

- For the community of Shaktoolik, having the color-indexed elevation maps was hugely helpful in communicating to local individuals about flood vulnerabilities remaining after constructing a locally led flood berm. The map showed how ATV access points along the beach, were lower elevation, and provide access to flood waters from beach to Front Street. The 100 year storm, however, is still so high that individuals would not be able to see the ocean from their house anymore. Seems like an over design. How do we evaluate model results in AK, when so few models and comparative data exist?
- UAF/Alaska SeaGrant conducted coastal resiliency assessment project in Goodnews Bay. The project mapped the coastline and historical coastal erosion in the area and trained locals on how to measure coastal profiles.
    - It was challenging at first to get community support but with time, effort and engaging the community and elders (and listening to their stories), support and trust was gained to make this project successful.
    - More information on the project can be found below:
        - https://seagrant.uaf.edu/research/projects/summary.php?id=1019
        - http://annualreport.seagrant.uaf.edu/studying-erosion-with-local-students/
        - https://news.uaf.edu/two-year-project-on-coastal-resilience-wraps-up-in-goodnews-bay/
- The North Slope Borough
    - USACE will be doing a study near Barrow in the near future on coastal erosion and coastal hazards

C. EXAMPLES OF UNDER-MAPPED AREA ISSUES

- Compare the oil spill response efforts from Exxon Valdez and the Macondo Prospect Mississippi Canyon Block 252 (MC252), also known as Deepwater Horizon. There are many situational differences between to the two events, an important one to note is coastal data in the region of the oil spill. When Exxon Valdez occurred, there was very limited shoreline data available and that slowed and complicated the oil spill response.
- There is water that has not ever seen large ships before that is now opening up. These areas must be mapped for safety of navigation. One documented report is the USCG Port Access Route Study Report (https://www.regulations.gov/document?D=USCG-2014-0941-0040. Consider quantifying based on the value of the goods on the vessels, cost of salvage. Larger vessels that can carry more fuel equals more risk. What is the monetary value of cargo at risk?
- The United States Coast Guard Absent from Bristol Bay
    - Bristol Bay is one of Alaska's iconic fishing grounds, with millions of salmon harvested every year. However, this area is not patrolled regularly by the United State Coast Guard (USCG) due to a complex mix of challenges including the quality of current hydrographic data and charting information. The USCG is concerned about the

safety of mariners operating in the area, and the congestion caused by a highly competitive seasonal fishery. The current availability of soundings, tides and currents, and charting information increases the risk of operating USCG vessels in Bristol Bay, limiting their capability to establish an enforcement presence and ensure the safety of all vessels operating in the area.

- From the engineering perspective, rural Alaska projects (structural), depend on local hazard mitigation plans to plan/site new/updated infrastructure. For one particular case, the FEMA's Local Hazard Mitigation Plan (LHMP) stated that past erosion was imminent to the current water source. If the infrastructure is rebuilt at its current location, it won't be viable in the next 20-40 years, however, they would have to totally rebuild and site the infrastructure (including groundwater well) to avoid erosion. This decision is, however, based on information provided in the LHMP, which does not map out erosion at the site, or give information on other sites that might be more suitable for that infrastructure.
    - Currently, Alaska Coastal Hazards program is under contract with FEMA to perform coastal erosion mapping for communities along the coast from Wales to Platinum, and combine with existing datasets to show localized rates of erosion at individual communities.
- Old mapping on the North Slope is based on topographic quads from 1950s gets reused & recycled in things like critical habitat mapping. Decisions are being made on data that are no longer valid. This also translates to administrative boundaries which are no longer valid. This creates administrative risk and redundancy in not knowing where MHW line is. Shoreline vectors need to be maintained for permitting as well, however much of this data is nonexistent or out of date. For example, Section 10/404 wetland permitting for USACE dredging is relevant to many coastal areas. Additionally, if you have an emergency, how can you rapidly and reliably define the USCG-EPA jurisdiction line for response activities? Example Alaska Clean Seas procedures.
- As of January 2018, NOAA's Continually Updated Shoreline Product (CUSP) vector in Alaska is at 39.76% with an average age of 11.4 years old.
- The Cape Lisburne airstrip is known to completely flood. JOA surveys was involved in the response to re-establish airport survey control after a flood. The flood event completely covered the airstrip.
- Land area around the Kuskokwim River is extremely flat. During a spring tide water flooded all around tide stations while crews was working/camping out. Crews were establishing temporary tide stations for NOAA charting project of the Kuskokwim River. How much land floods because it is so low lying?
    - The Yukon-Kuskokwim Delta area is extremely flat and subject to flooding during coastal storms and high tides. While completing a NOAA hydrographic survey of the Kuskokwim River, spring tides inundated temporary tide stations while survey crew were working and camping on-site. The inundation made for hazardous work conditions and required specialized equipment and planning for continued operation. See figure below.

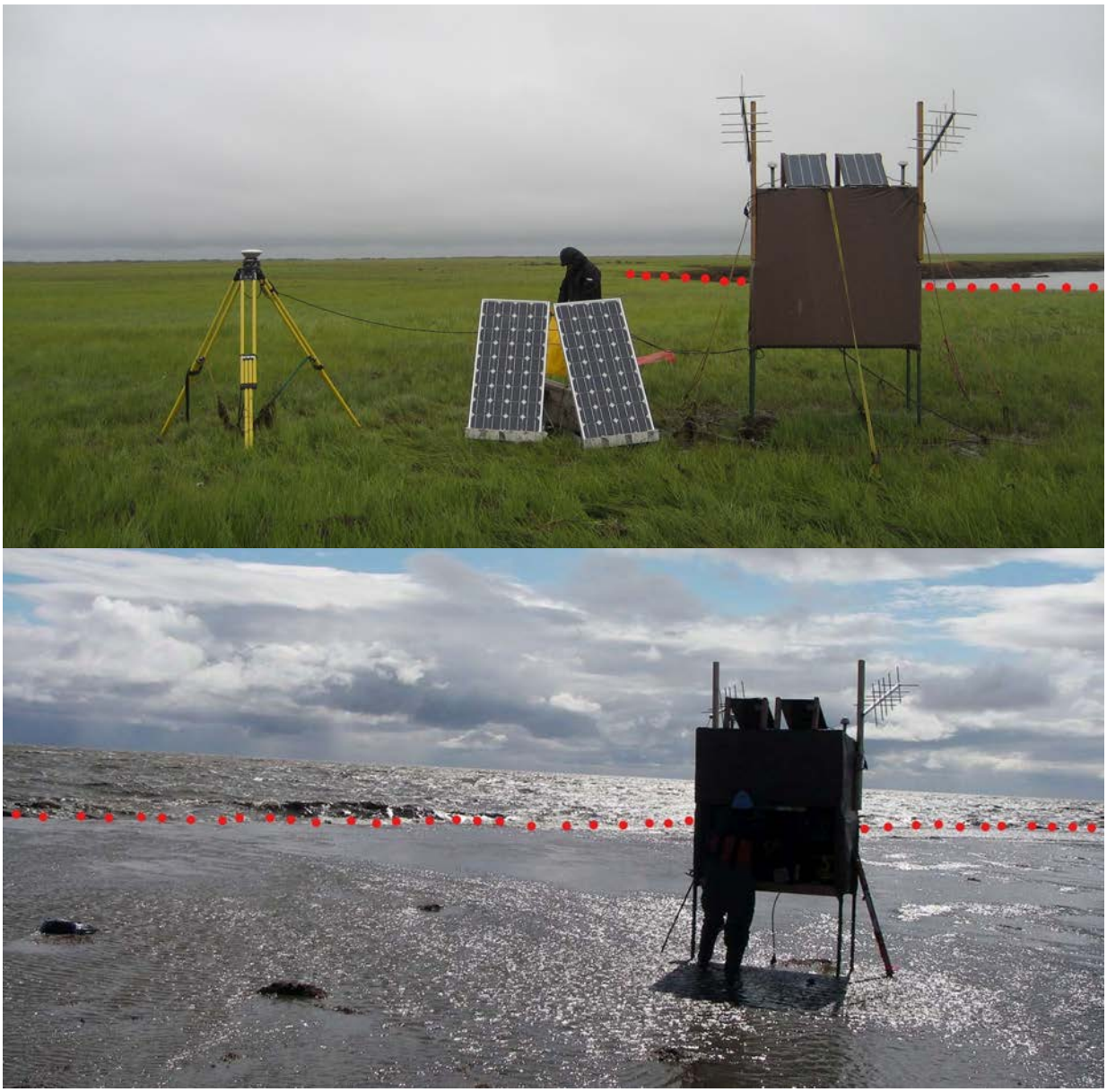

Figure 15: Popokamute tide station shack, photos taken approximately one month apart from different angles. Red dots indicate the bluff edge. Top photo was taken in July of 2011, courtesy of TerraSond Limited. Bottom photo was taken in June of 2011.

- The Alaska Coastal Hazards Program contracted the collection of photogrammetrically derived elevation models in this region, which show relative land elevations. There aren't, however, enough tidal datum conversions in the region to convert modelled water levels onto the land elevations. The Alaska Coastal Hazards Program established a flood monitoring staff at Kwigillingok, Alaska, near Kuskokwim Bay in 2017 and have recorded 2 storms so far by collaborating with the Native Village of Kwigillingok.

- The village of Newtok has a good example the cost of no bathymetry data. A large landing area was built in too shallow area. More money was needed to build second, deeper landing area. Bathymetry was acquired prior to building the second landing area.
- Lack of baseline data, particularly the lack of geotechnical information, prolonged the Shishmaref Relocation Site Feasibility Study. Three relocation sites were being considered. Study link can be found here: https://www.commerce.alaska.gov/web/Portals/4/pub/Shishmaref_Site_Selection_Feasibility_Study_FINAL_022316.pdf
- North Slope villages/communities must take into account eroding coastline, tundra subsidence and other environmental factors into account for developing infrastructure, moving homes and people out of hazardous situations, and for long term community planning. More frequent mapping is needed in these areas.
- What is the cost of moving a village? Often, the two reports below get cited for cost estimates, but there are several issues with using these values.
    - United States Government Accountability Office, Report to Congressional Requesters, Alaska Native Villages, Limited Progress Has Been Made on Relocating Villages Threatened by Flooding and Erosion: June 2009 - https://www.gao.gov/new.items/d09551.pdf
    - U.S. Army Corps of Engineers, Alaska Village Erosion Technical Assistance Program: An Examination of Erosion Issues in the Communities of Bethel, Dillingham, Kaktovik, Kivalina, Newtok, Shishmaref, and Unalakleet (Alaska District: April 2006). - http://66.160.145.48/coms/cli/AVETA_Report.pdf
    - Recognized issues with using values cited in these reports:
        - These estimates are more than 11 years old.
        - An adjustment of these values to the national rate of inflation would not be accurate, as shipping and logistics costs have likely risen higher in remote Alaska than the national average
        - The assumptions made for these calculations are not well known or understood.
        - These reports don't reflect any progress, construction, mitigation projects that has been made since these reports.
- What is the true cost of moving a village? Not just monetarily but also to culture, the individuals, and archeological sites lost to erosion. Communities need data to sustain planning on a 50+ year timeframe.
- Without accurate data, communities may develop infrastructure in areas where life and property are at risk.
    - The community of Unalakleet has experienced coastal erosion and selected to expand their community, by building infrastructure further inland and on higher ground. Entire residential neighborhoods and a housing facility for community elders are under development at "the Hills".

- There is a general lack of erosion vector map near communities, or risk assessment (similar to what the US has on the East Coast)
    - Include sea level rise, fault movement and horizontal & vertical control
- Western Alaska is where the most threatened communities are, but also has the most challenges, including remoteness and lack of vertical datum and control.
- Lack of continuous monitoring can have bad results. For example, earthquake and volcano monitoring in Bristol Bay. If there is no monitoring, there is not planning or warning.
- Is lidar enough for engineering planning? It's not available in most places. Engineers should conduct ground surveys for siting design.
- Slowed projects: Kivalina relocation, Liberty oil and gas hazard assessment and mitigation for coastal communities; baseline permafrost degradation info slows as well.
- Delays or inability to deliver fuel to communities (i.e. at the end of the navigation season)
- Operational costs due to groundings: time losses, vessel damage, insurance rates
- Under Mapped areas
    - General areas noted: everything north of the Aleutians, Bristol Bay, Y-K Delta
    - Between Kuskokwim and Etolin Point there are uncharted shoals, barges go around, way offshore, increases fuel costs to the communities
- One result of these navigational uncertainties is the potential impact on the developing fuel distribution model in Western Alaska. Since about 2012, companies supplying fuel to remote villages and communities in Western Alaska began the practice of lightering fuel from large tankers to barges to reduce barge transits. These lightering operations occur outside of the 3 nautical mile state waters boundary. Bathymetric mapping could help reduce the potential risk of an offshore oil spill and determine areas of higher and lower risk for lightering operations.

D. APPLIED DATA USES

Groups noted the below items as general uses for geospatial data.

- Vessel navigation: shipping/barges, fishing, tourism, local use, law enforcement (USCG)
- Infrastructure planning: docks/ports, barge docking, water treatment plants, sewage lagoons/water treatment areas, landfills
- Hazard mapping/mitigation locations
    - Tundra subsidence/permafrost thaw
    - Flood Hazards
        - Tsunami maps/modeling
        - Flood inundation maps

        - Flood insurance map rates
    - Infrastructure damage
    - Erosion Hazards
        - Shoreline change maps
- Emergency response
    - Oil spills
    - Search and rescue
- Environmental monitoring/habitat
    - Fisheries management
    - Vegetation
    - Erosion assessment
    - Change detection: riverine, storms, seasonal permafrost monitoring. There is also desire to be able to understand the relationship of land to estuaries and nutrient flux modeling to understand ocean acidification.

E. KNOWN BARRIERS

- Alaska has unique conditions: large distance between populated locations, lack of infrastructure, lack of established GPS control points, permafrost, ground temp monitoring, SAR, IR, distributed mapping, distributed communities across large areas of coast.
- Alaska is the only state that is excluded from the IWG-OCM's Joint Airborne Lidar Bathymetry Technical Center of Expertise (JALBTCX) program due to the size and remoteness of Alaska's coast. This which means limited federal funding for ongoing coastal mapping. There aren't enough people in Alaska to justify sending resources. We must pool resources. JALBTCX could have 2 platforms running, but needs funding to do so.
- Survey markers are eroding or sinking. Some have subsided multiple feet. This, along with the low density of CORS, means that surveyors must occupy benchmarks for much longer periods of time, increasing field costs even more.
- How will GEOID 2022 be updated in Alaska? How will accuracy be assessed? Will it suffer from a lack of observations in northern and western Alaska, like other models?
- No uniform coastal permitting process, every location is different and has a different process.
- State government is people limited. No longer any coastal engineers on staff at DOT&PF. Now projects must go out for contract every time. Will this increase costs since now projects must include the whole site assessment? Value of having data a priori grows.
- ShoreZone is regularly brought up as a useful tool in oil spill response, but the frequency of imagery is not keeping up with changes in the lagoon systems in places like the North

Slope. This area is very dynamic and rapid refresh rates are of high value. Other folks utilize ShoreZone for project planning. Refresh rates can affect efficiency of pre-project planning. Accurate imagery reduces extra costs by making field operations more efficient because conditions onsite are more accurately known.

- Some Native Corporations are utilizing ShoreZone images to evaluate real estate in the coastal zone. While ShoreZone is better than no data, it lacks significant details including actual elevation and erosion rates.
- ShoreZone is used by a lot of agencies, researches, by the public (e.g. kayakers). However, due to the online interface it is not always accessible to communities (hopefully changing via offline application soon).
- Hard to know if the data that is being collected and produced will actually be used by the communities or people that will need it
- Some communities are applying for grants but without baseline data they can't ask specific enough questions or demonstrate quantitative damages and the process of getting money is slowed down.
- For aerial drones, there are several non-technical limitations:
    - takeoff and landing locations are restricted from national parks and wildlife refuges
    - Some offshore Alaskan islands are part of parks and can't fly over them
- Biological permits take a long time to obtain
- On the North Slope and Western Alaska, village/community footprints are small, but separated by large areas of coastline.
- There are a lot of uncoordinated mapping activities and studies occurring near Barrow and on the North Slope by universities and oil/gas companies.
    - University studies often make data available but not always accessible or in an easy to digest fashion for community planners.
    - It is not required for data to be turned over to the state or borough. Datasets that the state has received from oil and gas companies have been few and far between.

F. STRATEGIES FOR SUCCESS

- Shoreline data is useful for response activities like oil spill cleanup- but the data need to be in a form where it is accessible and usable.
- We need to leverage Federal project funds in Alaska, where appropriate. Often, those in charge of nationwide funds are not familiar with Alaskan needs, so funds go to more familiar projects.
- Need to have a person on the ground in Alaska that reports to Office of Coastal Management on issues in the state. Office of Coastal Management is very unfamiliar with what is going on, and needs someone with a pulse on what is happening.

- Where else in the lower 48 does erosion play a key role… everywhere. Even small events, such as nor'easters travelling offshore can cause erosion of the outer banks beaches. Local city and community governments are constantly managing sand to avoid erosion and loss of tourism dollars.
- Look at Digital Coast (https://coast.noaa.gov/digitalcoast/) —stories from the field—this is how they show impact stories to funders (congress).
- Where do you get your geospatial data for engineering projects in the coastal zone? The first place to look is the AGC website. They are using all layers, and it is unfortunate when some layers aren't available, then they must collect those layers themselves.
- Disaster declarations happen almost every year from the coast of Alaska. It would make sense if the state invested in pre-storm surveys, so that when the state puts forward a disaster declaration, it has a better chance of bringing federal disaster relief dollars to the table. Local collaborators are interested in using UAS systems for post-storm documentation. Train citizen scientists, we don't need as accurate mapping for disaster situations.
- Interview community members, examples, viral video, convey struggles, impacts, hazards; put personal picture out to huge audience; most people don't realize. Also show value of culture and subsistence lifestyle
- Iditarod has brought awareness along coast. We need to leverage this more.
- Lobby mainstream media
- Focus discussions around environmental issues and impacts on people
- Make a GIS story map of these examples in "Stories that Speak" and or NY Times article
    - include images in a story map that show before and after difference in areas undergoing high rates of change to emphasize the importance of data refresh (with examples)
- Ukpeaġvik Iñupiat Corporation (UIC) has a website for distributing mapping and study information: http://barrowmapped.org/
- Michael Brady, a student from Rutgers University worked on developing web maps for the North Slope Borough community planner use and for building community involvement and understanding for coastal erosion data.
- Goal for 2018, is for the North Slope Borough to have a website for distributing GIS mapping and study information.
- Include/highlight stories of companies sharing data as examples, promote companies that share secondary data as a way of leading by example.
- Continue to break down silos of information by hosting summits like this.
- Get community involved before mapping takes place. Community consultations are often an afterthought which can affect how the data was used

- Include data access to rural communities: final data presentations, community involvement before a project takes place, line item in budget for community engagement

G. OPPORTUNITIES FOR SUCCESS

- Leverage what the parks are doing…. Partnership on the non-park sides of Park boundaries. If there is a project happening in a NP – check for partners!
    - Glacier Bay, Kenai Fjords – National Park Issues rules on how close they can get (set back distances). Passenger vessels for ecotourism. Glaciers are receding and we don't know what the seafloor is like in those areas.
- Nunivak Island southern side is wilderness. Would think we need some mapping there, USFWS land managers would have interest there too. Charting would support navigation and thereby protect wilderness land from incidents.
- Look for ways to work with ongoing research observation programs like National Science Foundation's National Ecological Observatory Network.
- Seek opportunities in coordination with Outer Continental Shelf 10-02 Area leasing as Alaska National Wildlife Refuge opening for petroleum exploration, increased shipping, ecotourism, and advances in horizontal and vertical equipment accuracy.
    - The industry has interests, but they are privately held. Are there things that could be done to work better together? Perhaps some way to start early in coordination process, like right at the start of a new lease?
    - Good project examples are cable routes: Quintillion, GCI mapping efforts for marine cable
- How can we extract more meaningful data out of ShoreZone imaging and mapping?
    - Add Structure from Motion (SfM), enhance by adding beacons, add metadata including info on cameras and equipment, lens angles, offsets, how it was mounted, flight log, for SfM 4K video minimum
    - What about ground control points?
    - Consider other derivative products
    - Refresh areas imaged and mapped farther in the past for repeat collection. Imaging technologies continue to improve and having those sections of coastline to the latest standards would ensure consistence in the overall dataset.

3. TECHNOLOGIES & SPECIFICATION HIGHLIGHTS

A. SPECIFICATIONS

- Specifications should be linked to data use and purpose, perhaps need a matrix of data applications. Ask ourselves, what is the impact of getting it wrong?
    - for permafrost change is more important to have higher vertical detail than horizontal detail
    - Fault line detection, subsidence, erosion
    - Property boundary determinations are directly linked to tidal fluctuations and how far those go upriver.
    - Infrastructure areas
    - Navigation
- For an area as large as Alaska we can relax standards to study larger area. General picture provides more bang for your buck
- Validation of data is extremely important. Specifications for lidar are based on hard surfaces. More focused on validating layer
- Communities going out bid on mapping projects often copy/paste specification from boiler plates that they don't understand and that may not be needed
    - Problem alleviated by going through NOAA or USGS contractor
- Tighter, well thought-out specifications are appreciated by contractors
    - With an understanding that the questions that need answering in some areas could be answered by something different
- Some contractors may not be familiar with what and why certain data standards are needed. Need to be able to communicate with private companies to update and make standards realistic, on a project-by-project basis. Having flexibility is a must.
- Being flexible on a project by project basis can be good but don't necessarily want to relax specifications to the point where to data isn't useful
- There are drawbacks to having specifications written that are tied to a specific technology. For instance, in some cases lidar and fodar (a type of SfM) could provide similar results at vastly different budgets. However, because projects are often written to an ASPRS specification, it is not possible to propose with the less expensive option (point density for ground control was provided as an example; as well as hydro-flattening). A technology neutral specification is something the group considered important.
- Nationally-derived standards are not always applicable to Alaska. We don't fit for a lot of reasons and we need the ability to work with those who are developing these national standards, as well as educate the enforcers of standards about unintended

consequences of the mandates. The group specifically discussed the ASPRS requirements for ground control as being inappropriate for many projects in Alaska.

- Many topographic or bathymetric surveys are geared toward the 'gold standards' of surveys rather than what is really needed
- Across Platform/Technology Shared Specification
    - Pixel size
    - Ground sample distance
    - Detection vs recognition
    - Accuracy specs
    - Vertical accuracy specs
    - Metadata
        - ISO metadata everything is optional so we're only getting name, phone, and org. Could save a lot of time and effort if metadata was robust. The problem is getting worse with drones and other ability to acquire large amounts of data. Example: DOT elevation data doesn't have any information. How can we foster and encourage good metadata practices so that less geospatial data goes to waste?
- Across Platform/Technology Specification Differences
    - Conditions on when you can collect
    - QL1 vs QL2 imagery/lidar are different
    - Satellite? Control of some sort?
    - NOAA: Formula vs. Depth
    - LIDAR - current USGS and other specifications are well written and give good guideline. It is not necessary to relax any standards <u>except</u> on a case-by case basis (like the YK Delta example)
    - Satellite imagery specifications work well although challenges exist in some areas
- Specification to relax
    - ASPRS standards for data collection are considered a suggestion, even to federal contracting agencies. Every project will need flexibility in data standards, and have similar issues in Hawaii, where regular ground control would require collecting on the side of volcanoes (not possible), private lands (not accessible), and other deltas such as Louisiana (spongy and difficult to access). So, changes are regularly made to alter ASPRS GCP standards.
    - For topo-bathymetric data, the 20% of LLW specification should be relaxed in favor of utilizing a weather window.

        - Topo-bathy - tide coordination with MLLW can be prohibitive with weather and low clouds
        - Some require slack currents
    - Keeping in mind the differences, control points shouldn't be relaxed but checkpoints could be
    - Land cover checkpoints for USGS need bare earth hard surfaces and land cover checkpoints. This will often require helicopter access.
        - Land cover checkpoints inhibit collection
            - "Reasonable" vs "regular"
            - Land cover checkpoints - add cost
            - Bare earth checkpoints - add cost
        - What to do about squishy surfaces? (tundra)
    - Technology advances have reduced the cost of meeting spec, except USGS number of checkpoints
    - 10% cloud cover not always feasible, 25-30% might be feasible
    - For Lidar, most specifications read 'no snow' and during leaf off. In Alaska, this window is typically in the spring, and is very short. Timing must be perfect to get it after the snow melts and before the trees leaves bud. (especially in spring between no snow and leaf budding)
    - Sun angle 30 or 20 degrees
    - Sometimes for SFM some shadows work better than full sun, as long as you can see in the shadows
    - Tide coordination in SE AK gets expensive due to low clouds & fog for aircraft
    - Slack currents are experienced differently for small boat vs large vessel due to draft
- Bathymetry
    - The USCG in many areas measures tides and storm surges in sub feet to measure under keel clearances to be barges into areas
        - The Port of Long Beach, CA even uses wave and swell to calculate how keep depth changes with vessel motion
    - Nome is a difficult port for larger vessels to get into
    - In Alaska, low draft barges are dependent on tides and time of year to get in
- Positioning
    - Aircraft specifications have been loosened
        - As technology advances that reduce the cost of accuracy

        - We may be able to meet specs without checkpoints
    - For Ships, Post Processing Kinematic (PPK) is good for about 20 miles
- People want the same things you can get in the lower 48 states, but Alaska doesn't have that kind of data. Since Alaskan data is different in resolution, quality, type and coverage, we can't use the same tools that are used in the rest of the states. When tools need to be redesigned or re-coded to Alaskan data it adds a large cost.
    - Example: People want sea level rise viewers for Alaska. People build them using IFSAR data and the results are not accurate, and folks must have a number of disclaimers explaining.
    - Example: Storm surge tools. Ken Woods (with the State of Alaska) is expending lots of time creating something from first principles something that exists in lower 48, but can't use it since we don't have the quality of data.
    - Example: AK's Shoreline profile tool must be built
    - Cost estimate from Surging Seas effort to change their tool to work in Alaska
    - What is the cost of difference for creating a new tool verses collecting better data?
    - Does it even make sense to apply these tools to Alaskan data?

B. TYPES OF ELEVATION DATA NEEDED

- For LIDAR, engineers typically ask for one foot contours. Other customers ask for recommendations on what needs to be done. Data companies then shows them the options based on desired data application. This process typically requires consultation. Takes more time, but makes an informed decision.
- USGS base specification document shows the difference in data levels.
- Quantum Spatial also has a power point that shows 2 vs 6 vs X point data.
- Alaska's strategic mapping plan should have something that matches typical uses to lidar standards with qualifiers on landscape types (vegetation cover). Landscape ecology plays a big part of it. It is hard to have a one size fits all.
- Some clients ask for QL1 (point density of 8 pixels per square meter) or better and ½ foot pixels. This maybe over kill for many projects. Typically, QL2 (point density of 2 pixels per square meter and the same accuracy as QL1) can be less expensive to acquire, as line spacing is wider and planes can fly higher.
- Floodplain Managers' conference showcased a decision-making tool that would take several parameters into consideration to determine what type of data was needed to achieve improved floodplain models. See below image, taken from Appendix E2: FEMA Report 100049589_FEMA_ASFPM_Inputs_Final2, Appendix E2, which is available in the appendices.
    - This type of tool/explanation would be great to have for lidar in AK.

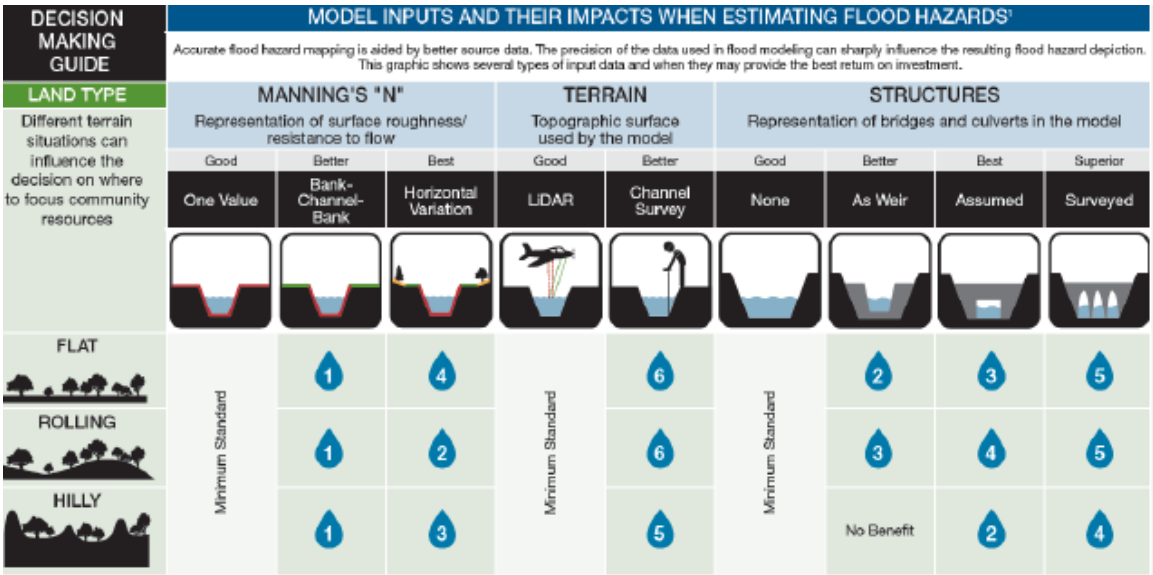

Figure 16: Image taken from FEMA Report 100049589_FEMA_ASFPM_Inputs_Final2, Appendix E2.

C. DATA FORMATS AND STANDARDS

- ESRI's .LASD format is not good for Alaska data distribution. Need just .LAS files. We need to tell customers to keep the .LAS files even though they are larger than the ESRI proprietary compressed format for point cloud.
- The parallel problem on geospatial side is hiring a licensed surveyor who pulls all that data through ESRI and someone later must reconstruct what occurred (if possible). Sloppy data transport is rampant in the state. It takes a week to reconstruct. This is not a unique problem to Alaska, but it speaks to the importance to the state's geoportal. We don't put enough stress on this.
- All large projects in the last two years are being delivered to the ellipsoid. NAVD88 is not a reliable vertical datum in Alaska unless you know how it was determined. New time-dependent NSRS will help with some of these issues, but only if people exercise good metadata habits.
- Academic datasets can be of great quality, but without metadata that can make them next to useless. People collect the data and the state must figure out how to fix it. Example: NEON data is combining geoid model with the wrong reference frame. Project areas have spots of lidar every year. Annual recollects, but they are not in a real reference frame. Having places (like a statewide geoportal) where data lives or where it must pass through is a benefit.
- Having someone with authority say it must be delivered with these minimum and some form of "metadata police". What options do we have to address this? Can AGC address this? If AGC had UL stamp of approval would that carry any weight/be of value. Is there any role that AELS could potentially play in this?
- There are AELS standards, but they are optional/not required.

- Standards do exist, but are sometimes ignored or some people/projects are not educated on them.
- Alaska climate change round table discussed data integration issue of this nature that could be a template – NWS demos data and determines what is/is not usable in broader products. This does have some drawbacks – limits incorporation of nimble, new, and emerging technologies.

D. WATER LEVELS AND TIDE COORDINATED DATA

- Generally, low tide is better for LIDAR or topo bathy because you get the most data
- High priority for ShoreZone
- NOAA needs to tide coordinate.
- Erosion precision modeling of bluffs is dependent on tidal heights and surges
- Tide coordinated data is very important—necessary.
- Always ask: "How important is that?" when a tide level is specified or else you may never acquire your data
- Don't need really clean water levels to get tidal datums. Example: Astra station, processing the data showed the Astra data RMS was 6mm. The cost savings for this station was huge, an order of magnitude in costs compared to NWLON. The Astra data is spiky, but when properly processed, it is good. Easier access to datums and tidal datum transformation tools improves coastal data quality. Biased water level does become an issue in places with only very short-term water level stations.
- State should take lead in developing its own water level monitoring if NOAA don't/won't meet Alaska mapping needs.
    - Are there methods other than the tide coordinated standard to achieving water level monitoring
    - Getting tidal information can be a barrier. There are places where there is only one hour of data you can collect to make the data requirements.

E. EMERGING TECHNOLOGIES

- NOAA is beginning to experiment with finding appropriate uses of satellite derived bathymetry. In 2015 NOAA created provisional Electronic Navigational Charts (ENC)s using satellite data. The turbid Yukon River and Yukon Delta are the locations of this new type of chart. This area is known for its changing shoals and coastline. The charts include shoreline and approximate shoals derived from satellites and NOAA is aiming to update them annually. This approach provides the mariner and barges that frequent this area more up to date information than previously available at a fraction of the cost of a ship based traditional sonar-based hydrographic survey. More information on this project can be found at https://landsat.gsfc.nasa.gov/satellite-images-are-source-for-first-of-its-kind-charts-of-alaskas-yukon-river/ and http://ccom.unh.edu/publications/yukon-river-

prototype-electronic-charts-using-satellite-derived-bathymetry. NOAA is continuing to experiment with satellite derived bathymetry in other areas, including planning ship based sonar surveys to test and validate the results of satellite data.

- It would be useful to have a comparison of new technologies with accepted technologies and to make available to contracting entities (and end-users) the pros and cons of each.
- It would also be useful to have quality rankings for different approaches to the same technology type (e.g., SFM or SDB). How do different methodologies measure up to others?
- It would be good to have a website dedicated to research on new technologies so published papers, articles, presentations, etc. can be co-located to the benefit of everyone (the USARC has something like this).
- Single-photon and Geiger-mode are two newer lidar systems that perform photon counting, but neither of them have full acceptance yet by USGS for the 3DEP. Both single-photon lidar and Geiger-mode lidar can fly higher and create higher point densities than conventional linear-mode lidar. While single-photon and Geiger-mode lidar consistently deliver higher point density, their vertical accuracy has not yet performed comparable to linear-mode lidar.
    - Alaska could be a potential test bed for these systems, if there was funding.
    - Some contractors agree to fly this type of data because it can shorten acquisition time.
    - Both single-photon and Geiger-mode systems are more expensive to operate per hour than conventional linear-mode lidar.
    - All lidar systems are limited by clouds, fog, haze and smoke. Thus, project cost savings in flight time could potentially be offset by extra costs in weather down time.
    - Already some projects in Alaska get flown at lower altitudes than planned due to lower cloud ceilings. It can be more cost efficient to fly at lower altitudes and acquire more data than necessary rather than wait for ideal weather and cloud conditions. Potential projects may need to be individually evaluated on a case by case basis for the most cost-efficient technology and seasonal timing.
- Differential INSAR
    - Space born SAR that is building a timeline
    - Using the wave information of radar to measure change
    - Challenge to use in areas without fixed structures
    - Could be useful to test in the Arctic
- Perhaps not enough existing satellite data in the Arctic to test, but could be looked into.
- ShoreZone testing out high resolution still photo SfM imagery collection in Glacier Bay National Park in July 2018

- Since 2001, the informal ShoreZone partnership has administered a successful program to collect coastal imagery along the Alaskan coast. Utilizing the video and still photos, ShoreZone has been able to classify the biological and physical attributes of the shoreline including biobands, coastal class, oil residence, wave exposure, shoreline modification, and coastal vulnerability including stability (erosion/accretion), flooding sensitivity, and thaw sensitivity. However, existing ShoreZone products fall short of the type of geospatial map products that many users require, including updated Mean High Water shoreline vectors. Photos and videos are geospatially referenced to airborne locations and are not orthorectified to ground, although all attributes are attached to the best available digital shoreline. New use of SfM techniques in combination with ShoreZone imaging and mapping protocols creates the potential for more quantitative map products.

- SfM is great because it's fast, cheap and easy but need to make sure it is being done properly.
- How can we get more standardized quality control of point clouds from SfM projects?
    - We have to have something to measure against
    - Even lidar is controlled by discrete points
    - Standardize quality & data accuracy so everyone can use the same
    - Include a quality map to make the data to earn more user trust
    - How can we communicate the data quality/accuracy in the metadata when downloading from the internet?
- Drones
    - Underwater & unmanned vehicles & aerial
        - Find control to go to every time
        - Train people in communities
    - Drones are great for focused sites to get high resolution data
    - Can be used anywhere you can get imagery
    - partnerships/education
    - Research, monitoring
    - Programs in place
    - New lidar technologies are smaller, can carry it for longer than 30 minutes. Are getting much better. Can use with unmanned systems. FAA has given opportunity to get RPIC to everyone. Point lay data took 7 min to collect.
    - UAV downsides: battery life and dependence of battery life on non-freezing temperatures

- Sometimes a plane is faster & quicker than a UAV
- Pacific Marine Environmental Lab
    - Has UAS deployed from ships in Dutch Harbor
    - Maybe able to engage in partnerships

F. TEST LOCATIONS

- Getting technology that works well in Alaska will work anywhere else
- Test locations should be easily accessible
- We want community and collaborator buy-in and support for test locations
- Test locations should also be challenging for the new technologies and be beneficial to large groups of people
- Satellite Data/Remote Sensing
    - Cook Inlet good spot due to access and lots of existing data
    - Whittier: close, Prince William Sound is clean for satellites
    - Kuskokwim - USCG maps regularly to put in buoys, I think with single beam
    - Kodiak and Yakutat good areas for remote sensing technology testing
- Types of areas:
    - Turbid areas where the satellite bathymetry won't work
    - River deltas
    - Different slope areas: Flat areas, steep slopes
    - forested areas
    - Areas influenced by Sea ice, there are specific data needs to collect the sea ice edge
    - Areas with permafrost for radar testing
    - populated areas
    - areas that have been mapped already
        - Existing corridors / populated areas / Areas that already get mapped regularly for data comparison to reduce access cost
            - Electricity infrastructure & road transportation vehicles, roads
            - Does the haul road (to Deadhorse) get flown with UAVs?
            - DOT monitored areas

        - Using same technologies and accuracies that we would in lower 48 with GLONASS satellites
        - How much infrastructure requires real-time monitoring?
            - Marine based: tailing ponds behind dams, dredging projects in Seward and Port of Anchorage
            - Land based: landfills & mines, hydro facility monitoring (high resolution scan of dams), utilities, bridges, wildfire areas that are monitored timber health & dryness
- Locations:
    - YK Delta a good test place for Bering/Arctic and has lots of existing data and relatively good access
    - The Arctic because it is so unique due to the high rate of change and that change is accelerating
    - The Aleutians are unique in their remoteness and challenges working in that area
- See if there any interest from USACE - CRREL, maybe there is something that could be of interest in Alaska or outside of Alaska.
    - Cold regions research and engineering lab
    - Scan now and then on Greenland to measure a glacier

G. COMMUNITY NEEDS/PRIORITY LOCATIONS

- Use threat assessments, immediate vs long term
- Take advantage of any additional funding partners
- Top priority for geospatial (high res) data would be the villages in the remote areas
- Get SAR every few years and then LIDAR specific areas for more detail
- Alaska's big challenge is our dynamic coastline.
- Community needs, threat assessment, immediate need, should play a big role.
    - The "Hydro Health" model is a risk based, weighted formula for refresh & maps. It is starting to be utilized by NOAA and weights refresh rates for bathymetric data needs in different areas according to the environment, human residence, type of use and economic value. The Hydro Health model is still under development and is expected to be publicly available before the end of 2018. https://nauticalcharts.noaa.gov/publications/national-hydrographic-survey-priorities.html
    - Could we build a similar model or formula that includes Alaska's offshore and onshore coastal zone?

- The group had a variety of thoughts on how to prioritize mapping. These included: areas with sea ice, permafrost, lack of roads; areas that are the flattest; areas where communities reside; areas where communities do not reside. We recognize the mixed messages in those last two items. However, a good point was brought up—some areas are never mapped because they are not close to a community. But there are areas that are moving up to 1 km a year (Yakutat/Glacier Bay). The danger of not mapping these locations is that you don't know what you don't know. There may be fault lines that haven't been mapped, for instance. To summarize, it was recognized that starting with coastal communities and expanding outward is the best approach, gaps could be filled by agencies as funding and study priorities align.
- Rock and gravel needs:
    - Communities desperately need gravel and rock resources in coastal areas, what technologies can help? For surficial mapping, would need combo of imagery and ground truthing. Some technologies may be available to automate the identification of gravel in particular from UAS collected imagery. Using multispectral processing to ID surface gravels. Kivalina's gravel resources were identified 10 miles inland, needed gravel to create a road to the resources, then get the resources to community. Is Alaska interested in using/identifying offshore gravel resources for dredging? We could do bathymetry plus contracting to measure seafloor depth and sand/gravel content. Can we use sand to make concrete or just use gravel? Can also use lidar return signal to identify gravel/rock—maybe a by-product or additional data product as a result of coastal mapping.
    - We must change our designs of revetments because of the cost of gravel/rock materials. FEMA won't pay for full design, look for less expensive rock.

H. REFRESH RATES

- Dependent on use/application
- How dynamic the area is depending on geomorphology?
- Permafrost and ground temperature monitoring sampling will need different refresh rates than areas without permafrost.
- It takes 1-2 survey to know what is rate of change in different areas
- Some areas are stable; some areas are moving. It would be good to make an attributed coastline that demonstrates rates of change and then use that as a tool to plan refresh rates. The group also acknowledged that it is hard to argue for refresh rates if some places haven't ever been mapped.
- Must closely space surveys better for the lower resolution technologies
- Fixed refresh rate not necessarily a good idea but should be determined for each area and the type of data
- High refresh rate for areas with villages and more intense coastal use or where change is occurring at a higher rate

- Form an acquisition stand point, costs can be scaled down if there is a program with a known acquisition or refresh rate
    - Can also allow the process to be refined with consistency of data collection schedules.
- Get high quality lidar data as baseline and then use satellite data to determine change every year after
- Temporal aspect, where change is happening fastest need to survey multiple time to quantify
- Create a weighted formula to drive re-survey periods

I. ELEMENTS OF THE COASTAL MAPPING STRATEGY

- More opportunities for national contracts
- Be open to emerging technologies. Look at outcomes or standards without being rigid to how it must be collected. Water levels and GPSC strategies have the same issue.
- Areas of needed training & training opportunities focused on coastal data collection/use for the Alaska geospatial community, a plan to chip away at gaps and refresh data where needed, investment in emerging technologies.
- The aspiration to collect the coastline at a continuous vector with recommended refresh rate. This would get CUSP filled up and keep it fresh.
- This project must be strong throughout. One piece can kill a project.
- The plan/strategy must speak to policy folks
- A mandate to give the data to the state would be ideal.

4. COORDINATION & COLLABORATION HIGHLIGHTS

A. COORDINATION

- The scale of data that is needed in Alaska is not going to happen. We need to pare down needs to identify priorities. What areas would provide the most impact. What areas need higher cost products. What areas can we test pilot projects. Use AGC coastal working group to do this and bring priorities to AGC—they have a coastal mapping priority, but no progress to-date.
- 3DEP is a successful program:
    - Economy of scale
    - 30-35% match makes it successful
    - USGS liaison connects people or pings directly
- There is an organized structure for 3DEP, but users can't get other end products from this program. Can we use the same structure with NOAA OCM? Yes.
- Projects need seed funding to go around to other agencies with, to ask for funds, and use BAA business structure.
- How do you put it out there that you have funds?
    - reach out to USGS (Brian Wright), Sea Alaska, Forest Service
- Scientists overseas value in simplified purchasing - government kickstarters, eliminate interagency coordination
- GSA - for small quantities, price per square KM possible, etc.
- Make it so if it's under a certain amount of money, then a government agency can kick in some money for SMALL projects
    - Simplify contracting/procurement process
    - Might work better with non-profits than government spending
    - GPSC - contracting a little more flexible, need memorandum of understanding
    - GSA - buy small quantities off the shelf data at a certain spec per scale per mile
        - Exchange funds in a relatively easy way
- Most projects need some set of characters with deep pockets - some guidance for contacts
- Is there a database showing all research efforts on the coast? LCC's funded this type of work, immediately outdated, but might be beneficial if someone could take this on continuously.
- Need a dashboard of coastal mapping activities along with a newsletter that keeps people up-to-date.

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- ShoreZone has had many partners through the years, but always 5 key federal agency partners, through IDIQ, allowing them to share funds. Coastal and Ocean Resources (CORI), the company that holds the NOAA IDIQ, can be flexible and work outside the fiscal year.
- For particular collection assets, like lidar plane for example. Once they get to the state ½ the battle is done, ½ the cost has been paid. How do we optimize those efforts?
- Field planning for private industry is happening in Feb-march, that is the best time to get in contact about opportunistic collects, but it could happen later in the year.
- Agencies or local jurisdiction can include the establishment of ground controls
- EPA IGAP Program (Indian General Assistance Program), build into work plan, required communication with communities and EPA coordinators https://www.epa.gov/tribal/region-10-tribal-environmental-gap-funding
- There may be a decision support role of Arctic observing network programs including the US AON (http://www.arctic.noaa.gov/Arctic-News/ArtMID/5556/ArticleID/386/United-States-Arctic-Observing-Network) and the NSF Arctic Observing Network (https://www.nsf.gov/funding/pgm_summ.jsp?pims_id=503222). There could be opportunities for collaboration and capacity building to access AON observing capacity for decision support products related to Alaska coastal mapping. How involved are the Alaska coastal mapping entities in the Arctic Observing Summits? What are some benefits and barriers/costs with such collaboration and how could barriers be overcome?
- University projects
    - Coordinate while project is being planned
    - Need policy people to explain how work is useful and how you can help in a direct way
    - Take time to go to meeting to find out what project are going on
    - We need the people writing RFPs to go out and do work, or at least understand how to do it.
    - Come contacts don't allow private funds
    - When feds get data, the data will be made public.
    - Have some sort of royalty system for data
    - Efforts for Universities to be more responsive to stakeholders and non-research projects
    - Linkage between non-research needs and needs to increase life-safety, etc.
    - Effectively engaging academia to enhance research product usability for users is a benefit. Workshops designed to get usability feedback from stakeholders on beta coastal map products are a good approach. Are other agencies doing workshops with traditional and non-traditional product users to expand data access, usability, and multiple uses? How much effort goes into effective stakeholder interaction

design to enhance usability including non-traditional product users? What are the agency incentives?

B. COMMUNICATIONS

- Statewide communications/announcements
- Need to communicate before RFP is written
- SeaSketch - feds & some state folks use it, locals don't use it
    - If SeaSketch could extract and feed to google earth
    - Could SeaSketch pushed through to google earth? Something similar to GINA best data layer or USGS earthquake data, that gets automatically pushed to your computer
    - SeaSketch has ArcGIS layer
    - Is ERMA in SeaSketch?
    - What about a name change for SeaSketch? It's not just about water areas.
    - How often do projects get added? IT varies among users.
    - Ability to select Geolocation area of interest and get push notifications
    - SeaSketch Organization - There is not a good place to put 'wish list' data acquisition areas. Only place for areas that already have some money committed to them.
    - Many of us haven't used SeaSketch since last meeting.
    - Private industry not interested in advertising work to everyone, but would be interested in sending information to an individual that could keep the pulse on coastal mapping projects and make the collaborative connections for them.
- Everyone has their own website is challenging, no info until project is done
- Make a network game-plan
    - Email Link or distribution list?
    - Email forum/chain, similar to the harbormaster's email list
    - Know where people are, talk to the right person at the right agencies
- How can we set up equipment sharing in remote locations/areas/field locations?
- University/Academic
    - Communication in project planning
    - Set up in advance
    - Student helpers

    - People in industry/government gave more stories to universities than people in university
- Advertise at AAUG, ASPLS meetings

C. WORKING WITH THE PRIVATE SECTOR

- When private industry makes data public, then they can't' resell data to someone else.
    - Can private sector lease data for a certain study or amount of time?
    - Certain data have a shelf life of usability
- How can we address the issue of industry data not being made public?
    - Industry's stock answer is no. Having a form or common document to show the lawyers specifically what is being asked for – so the answer becomes yes.
    - Have possible downscaling
    - Data does not have to become public, or there could be terms or limitations on when it could become public.
    - Get together a working group of industry lawyers to help.
    - Build a geospatial data sharing form
    - There could be tax incentives for sharing data.
- Encourage data of opportunity with private sector
    - Data for free vs. pay
    - Company contribution
    - In kind matching
    - Mutual agreements
    - Issues: culture is to be proprietary, competition plays into it
    - Should be incentives for private industry to share data
    - Recognize entity from which data is derived
    - Coordinate with private sector
    - Get folks to talk to us, personnel & networking
    - Presentation to ASCE, ASPLS or other professional organizations?
    - Get a website
    - People are wary of "consultant mafia" who come in and go out
        - No community engagement

        - Need to foster a better relationship
            - Tribal office, city
            - Inventory equipment onsite
            - Construction material inventory
        - Build this into the project budget and put in a line item for outreach
    - Private sector looks at adjacent land ownership when planning projects
        - Hard to find the right person
        - Hard to get them to pay for it if they could get it for free
        - Easier to get in kind matching, like control points or something
- How to make data public? Everything from Dewberry is produced for the public. Other smaller projects, not necessarily. Can private industry inform clients that having the data go public could be in their best interest? Is there a cost with making data public? Who can pay that?
- Private industry would be interested in collecting data opportunistically and providing on spec. There would need to be a regional coordinator, however, rather than just SeaSketch.

D. CROWDSOURCING DATA

- How can community-based or crowd-sourced data be better used? Need a reference system. Start from the same point. Lidar is useless if it has no reference/metadata.
- Standard for resolution needed
- Need to ensure good metadata (when, what, camera/equipment type)
- Consistent platform to upload it to
    - Distribute design for collecting data
    - Should be some sort of data check before distributed
- Hydro model
    - Olex - company out of Norway
        - Standardize equipment install
        - Service to share data
    - Coastal explorer -> coast survey was looking into it, so was Vitus Marine?
    - Need to time tag data to tidally correct
    - Need tidal data & tidal datums
- Photo-identifiable point to check every time for quality control

- Can we make it similar to geocache hunters for control points?
- Have well-trained volunteers for crowd sourced data is very important
    - There was support for involving Alaska native partners who are trained and paid and operating under a set structure. The example of the Bering Watch environmental observers was provided as a potential model. Another example of a "skipper science" program was provided, where training is provided in high school.
    - Need to educate communities on the values of data to get people to participate
- Is crowdsourcing appropriate for remote Alaska?
    - Citizen science projects directed by knowledgeable collectors would likely be more useful for small communities in Alaska
- Need a way to benchmark the quality of data
- Need to provide oversight for quality control
- Include something so that the data supplier won't be held responsible

E. POTENTIAL LEVERAGING OF COASTAL MAPPING ACTIVITIES OF OTHER STATES

- Lessons learned, what worked, what didn't
    - Lessoned learned from other states can lead to specifications that make it difficult to afford in Alaska, but we can learn from without making the same specifications for Alaska
    - AK can't afford to meet those specs
        - Don't have tax base or number of vendors
        - AK is different from other states
    - Drivers for different parts of AK are different
- Data Architecture
- Methodology
- Funding Sources
- How to tell your story, how to leverage
    - An example of good leveraging from another state is the USO landslide in Oso, Washington (https://www.usgs.gov/news/revisiting-oso-landslide). They were able to show lidar data in 3D before and after the USO landslide and leverage this story for funding.
- In Oregon, there are local science meetings, they result in good communications but are a lot of work to put on.

- Alaska's coastal communities are based on water transportation liquid or frozen. Does it have any bearing that Alaska doesn't have a coastal zone program?
    - The important thing for a coastal zone mapping-type support is a delivery pipeline in place for geospatial products, even if there is no coastal zone program. If we can demonstrate we have a pipeline in place to serve managers, that should be good enough. Must have the ability to deliver products and services.
- Florida has a steering committee for coastal mapping, but they know they need a strategist to make things happen. There are benefits to working with the Florida steering committee to see if there are ways to talk about coastal mapping in a way to sway national decisions. Alaskan case studies do catch attention. We also have AMEC, while Florida has lots of people and post hurricane supplemental.

F. NEXT STEPS/ROAD MAP STRATEGY DOCUMENT

- Partnerships for more money results in more data
    - Acquiring federal funds
    - Look for local resources
    - Native Corporations - USGC has good tribal coordination
- Establish a vision
- Get buy-in on vision from governor's office. Align with research needs of Alaska Climate Action Strategy to ensure Gov. buy-in.
- Identify needs, resources, stakeholders
- Strategy should include populated coastline first, then fill in the gaps
- Model to follow- Alaska DEM white paper. NRCS – NEA study. Now all kinds of congressional support. (QL1 CONUS update every 3 years → $21 million in savings?) Start with cost-benefit analysis and work with stakeholders. Document highest return on investment, they will advocate for it. One thing all success stories have in common is a strong Cost-Benefit analysis.
- The challenge with coastal mapping is cost might exceed the benefits in Alaska for a single standard. Need to think of where we need topo-bathy. Goal of something with a sound cost-benefit return might need to be less than 100% and take a tiered approach.
- It is easier to articulate the shoreline (separate from deeper water). Hopeful the 3D nation study will give AK ammunition. Map out where you want to be by when and set an implementation plan/schedule. JABLTEX schedule being mapped out for years enables planning and collaboration with other agencies to augment.
- We have discontinuous population along the coast – very different to lower 48 continuous population along the coast. Shallow bathymetry is a huge barrier. Topo-bathymetry may be more doable over a set of years if we focus on strategies that provides returns at the community level.

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- The original cost share for SMDI was 2/3 fed 1/3 state based on percent of land ownership. What the percent for state/federal ownerships are for the shoreline.
- Show authorities what they are missing.
    - Example: An individual said he needed a topographic map within 48 hours to show the zoning officials for a business he wanted to start. The map was made and the zoning officials loved it so much they asked for it is other places.
- It is not sure there is a mechanism in the state to create a continuous shoreline with SOA budget because the need is not enough to justify the effort. There have been reorganizations in the state due to budget. We are not sure how that impacts mapping initiative activities. Lots of the data collection funded by the State right now is directly project linked.
    - A continuous coastline would be useful for administrative boundaries. We should ask tidelands survey group at DNR for cost/benefit of having this feature? The National Park Service and Native Corporations might be interested too.
- What about aquaculture?
    - It's a bit different in Alaska because no support for fish farming. There is more focus on kelp, oysters, etc. Coastal marine spatial planning does have a need for understanding where this type of aquaculture might occur & to avoid permitting in places that might interfere with vessel traffic.
- Does the issue of baselines (for 3 miles limit) come up? Examples uplift in SE and erosion on the North Slope. Also – what do we use as the administrative lines? Where is HWL, and is there a "story that speaks" re: cost of bringing in State Department over an international boundary dispute/international affair? Freedom of Navigation information is a dollar value because it is useful to mariners and keeps other nations accountable in US waters.

G. 3D NATION SURVEY

- Get word out about survey
    - State agencies and government agencies
    - How to get private sector involved
    - Native corporations
- No one says they need coastal datums or mapping, but they ask for the information/products they get for that? When we are in national competitions, we look like Alaska is in the stone age. Would like to see better end-to-end linkages associated with geospatial data requests at the coast.
- There are some worries about the 3D nation study. We need their stories and they won't see themselves as the ones to respond (they will see technical folks as the target). Need Alaskans to help us get that.

    - Note: State 3D Nation Champion, Anne Johnson, plans to have small group meeting inclusive of leadership, management, technical and contracting staff within each state agency to help mitigate.

- We don't have a state level management program to respond so we will have very technical and very stakeholder oriented answers. Not sure what that will mean. This is a huge challenge. Coastal managers speak differently from local stakeholders and Geospatial community. How do we best get 3D nation input from the local level?
- What are the options to get information about 3D nation? What about tapping people at AFN or AFE? Perhaps there is value in having a 3D Nation Study Workshop there. We would need geospatial translators to put conversation into an appropriate national survey response
- There was a reasonable number of people talking about doing something at AFN vis-à-vis education on the 3D nation survey.
- Would there maybe be some way to crowdsource some subset of the 3D Nation Survey content on a platform like Facebook or Twitter?

V. TOOLS AND REPORTS FROM OTHER SOURCES

1. USCG REPORT BERING_STRAIT_PARS_FINAL_REPORT_12_27_16 APPENDIX E

2. FEMA'S UNDERSTANDING THE INPUTS AND IMPACTS ON FLOOD HAZARD IDENTIFICATION IN YOUR COMMUNITY: 100049589_FEMA_ASFPM_INPUTS_FINAL2.PDF

Appendix E – Marine Casualty Analysis

The Coast Guard reviewed its marine casualty database for the 2005 to 2016 timeframe and found numerous reportable marine casualties in the Bering Sea and adjacent areas. As the traffic volume in the study area is light, with a corresponding low number of marine casualties, the Coast Guard included data from an area of western Alaskan waters that is larger than the PARS study area in order to obtain a representative sample of the types of incidents that might occur. The vast majority of marine casualties involved commercial fishing vessels and mishaps leading to the injury of a member of the crew. The Coast Guard omitted accidents of this nature, as they are not preventable by ship routing measures. The enclosed list of marine casualties and subsequent analysis are from marine casualties meeting the following criteria: Occurred between 2005 and 2016, involved a commercial vessel other than a fishing vessel engaged in fishing, and did not involve an injury, controlled substance investigation, or other type of administrative investigation. The resulting list of 144 marine casualties revealed an accident history that the Coast Guard believes is representative of nearly any coastal environment with commercial vessel traffic.

The Coast Guard identified 38 incidents of reported commercial vessel groundings over this 10-year period, representing 26% of the marine casualties determined to be relevant for the purpose of this study. Most of these involved tug/barge traffic operating either in shallow, near shore environments or on river systems such as the Yukon, Kuskokwim and Naknek Rivers. This accident trend is normal and mirrors other parts of the country where vessel groundings are most common in shallow near coastal waters with reduced under keel clearances. As noted elsewhere in this study, much of western Alaska's Coastal waters have not been surveyed to modern standards. The Coast Pilot for this region specifically addresses this issue by noting "…charts must not be relied upon to closely, especially near shore."

Closer review of the 38 grounding incidents identified three vessel groundings directly attributed to incorrect charts. This does illustrate that charts based on unreliable hydrographic data are playing a role in vessel groundings, but it is difficult to quantify how much of a role it is playing without a baseline measure of groundings-per-transit. There are however, two notable exceptions to the typical profile of a tug/barge/landing craft grounding in a near-shore or river environment that are particularly informative to this report.

Grounding #1 (Casualty # 132): In July of 2015, a 9,300 gross ton research vessel with a draft of 27 feet struck an incorrectly charted area of shoal water near Dutch Harbor, Alaska, sustaining a hull fracture approximately 39 inches long and two inches wide. No injuries or pollution was associated with this accident. The vessel had just begun a voyage from Dutch Harbor, AK intending to transit the Bering Strait and continue on to the Chukchi Sea to participate in Outer Continental Shelf (OCS) exploratory drilling. The hydrographic survey information in the area of the grounding dated back to 1935. A NOAA Coast Survey ship was able to investigate immediately. While the chart showed shoal water with a least depth of 5 ¼ fathoms, or 31.5 feet, the actual depth was determined to be as little as 3 ¾ fathoms, or 22.5 feet.

The following figure illustrates how modern multi-beam hydrographic survey techniques can identify unknown hazards to navigation.

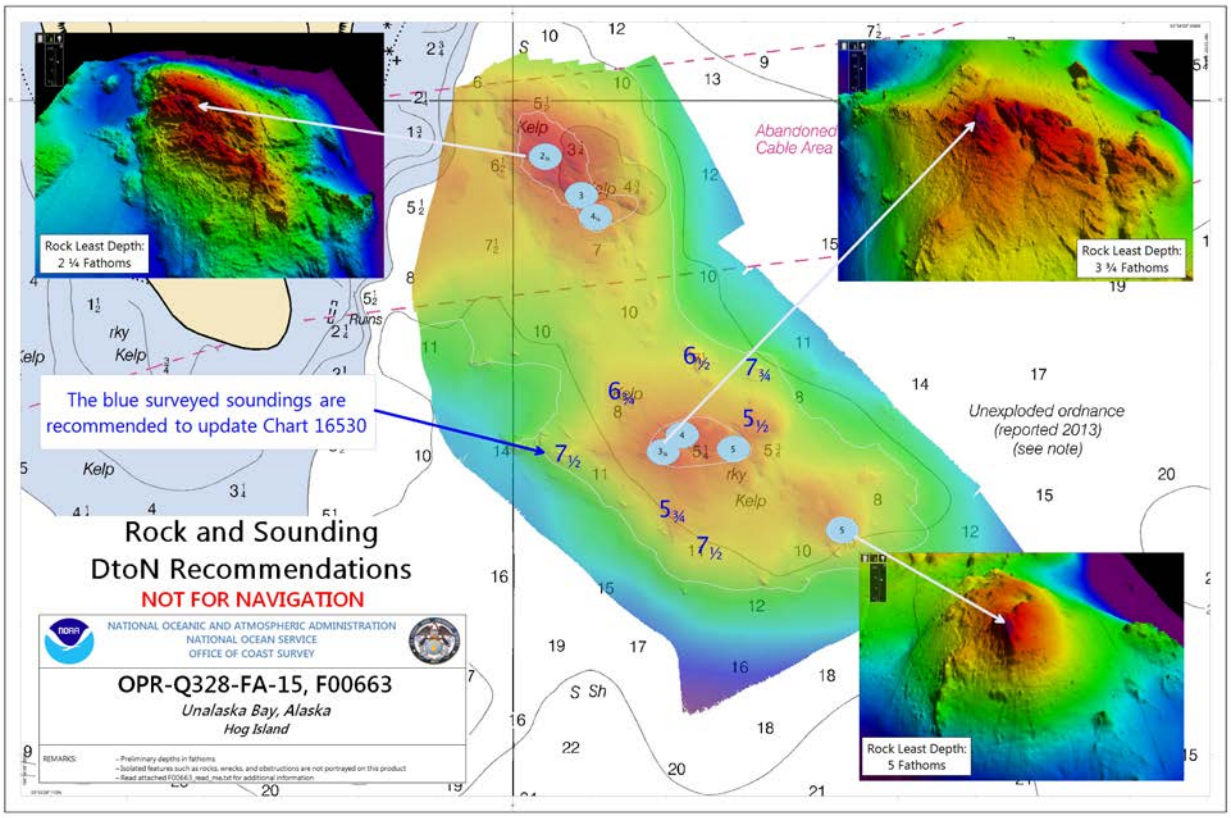

Figure 13: Example of modern multi-beam survey report finding previously uncharted dangers to navigation.

Grounding #2 (Casualty # 142):

In June of 2016, an oil tanker carrying refined petroleum products grounded approximately 10 miles from shore, southeast of Nunivak Island, AK. This 598 foot long, 27,500 gross ton, double hulled tanker was carrying in excess of 11 million gallons of fuel, a combination of bunker fuel, #2 fuel oil, and gasoline. At the time of the grounding, the ship was drawing 10.4 meters, or 34.2 feet forward, and 11.5 meters, or 37.3 feet aft. Charted depths in the area showed 9 fathoms, or 54 feet. The vessel was transiting at a slow speed of about four nautical miles per hour and refloated on a rising tide shortly after the grounding occurred. No pollution or injuries were associated with this accident. The grounding was attributed the vessel striking an uncharted shoal. Hydrographic survey information in the area of the grounding is of unknown origin, possibly dating back to a time prior to the purchase of Alaska from Russia in 1867. Single and double hulled oil tankers have been in use for many years to refuel foreign flagged, distant water fishing fleets operating in the western Bering Sea, but their use in lightering operations to transport fuel to western Alaska coastal communities is a relatively new development,

dating back to about 2012. Prior to that time, the typical method of delivery was almost exclusively through use of US flagged tugs and tank barges.

These two grounding incidents are reflective of the type of risk that the Coast Guard believes ship routing measures can mitigate. Identification of ship routing measures and investment in the form of modern hydrographic survey work will provide mariners with a more thorough understanding of the marine environment in which they operate and encourage vessel operators, where it is possible, to avoid areas that may have uncharted hazards. It is notable that both of these groundings are recent, involved vessels that did not have a long history of operating in the Bering Sea region, and were engaged in types of maritime activity that has only recently emerged. Any future significant increase in the number of vessels transiting the Bering Strait will include vessels with these same characteristics. Thus, installing routing measures now might help prevent future similar mishaps.

The 60 incidents in which a vessel lost all or partial mobility represent over 41% of the identified marine casualties. In 27 of these incidents, representing 19% of the 144 casualties, vessels completely lost either propulsion or steering. The exact causes vary widely but are usually the result of equipment failure to a vessel's propulsion plant or ship control systems. Regardless of the exact nature, in cases of a complete loss of mobility, the result is the same. The vessel is no longer able to travel where intended and is subject to winds and currents. Given enough time, the vessel might eventually drift to shallow water and ground. In some areas of the Bering Sea, the consequences arising from a loss of mobility casualty leading to a vessel grounding can be more severe than in other areas, since in many areas vessel traffic is sparse and response resources may be too far away to offer successful towing or salvage assistance before a situation deteriorates.

Some countries have developed routing measures that include some amount of "standoff distance" from the coast in order to afford additional response time for loss of mobility events. A good example of this in Arctic waters is off the North coast of Norway, where routing measures were installed for large ships (5,000 GT or larger) and tank ships to keep them further off the coast. Norway's routing measures intend to provide additional time before a vessel encounters shoal water in the event a navigational error took the ship off course, and provide additional time to respond to a loss of propulsion incident. The Coast Guard took a similar approach in developing proposed routing measures that will keep ships further offshore in areas of particular environmental or navigational concern for the same reasons, while minimizing the overall increase in the length of the voyage. The preliminary orientation of the proposed two-way route maximizes this "stand-off" distances at the closest approaches to land at both King Island and Fairway Rock. In both of these locations, the centerline of the two-way route is approximately 7.8 nautical miles away from each island, and the outer boundary of the two-way route is approximately 5.8 nautical miles away from the islands.

Four incidents (# 19, 86, 94, 135) involved either a tug colliding with its own barge or a collision between a tug/barge and a fishing vessel. The Coast Guard believes incidents such as these are unlikely to occur within the proposed two-way route since existing traffic patterns for tug/barge traffic are closer to shore. Most tug/barge traffic is "destinational" in nature to deliver supplies to coastal communities, and the Coast Guard believes it is unlikely that tug and barge traffic will choose to follow a

route well offshore even if routing measures are established. One incident (#53) involved vessels colliding while intentionally approaching to offload cargo. This type of activity is also unlikely to occur near the location of the proposed route.

Casualties #13 and 27, while representing less than 2% of the marine casualties reviewed, do provide evidence that collisions between ships carrying cargo and fishing vessels do occur in western Alaska, albeit infrequently. One must look much earlier into the accident history to find other useful examples. On March 3, 2003, the fishing vessel Katrina Em and the 617' containership Arkona Trader, both transiting Unimak Pass, were involved in a collision that significantly damaged the fishing vessel. In September of 1983, two Korean flagged freighters, the 551' bulk carrier Pan Nova and the M/V Swibon were involved in a collision in Unimak Pass. The collision occurred in the early morning hours before sunrise, but environmental conditions were good, with 10 knot winds, 2 foot seas, and 12 mile visibility. Response efforts rescued the crew of 26, but attempts to salvage the Pan Nova were unsuccessful and the ship ultimately sank due to damage resulting from the collision. While collisions occur with far less frequency than loss of maneuverability incidents, their consequences can be far more severe, with most damage occurring immediately, and subsequent damage due to fire, flooding and loss of vessel stability potentially occurring at an accelerated pace.

Since the proposed route crosses productive commercial fishing grounds in the southern Bering Sea, any future increase in traffic bound to or from the Bering Strait will result in increased interactions between fishing vessels and other large vessel traffic. The Coast Guard believes the proposed two-way route in this area offers definite advantages to these vessel interactions. Fishing vessels would know where to expect larger vessel traffic, which may be moving at much higher speeds than the other fishing vessels in the area. Display of routing measure boundaries on nautical charts and electronic charting displays will allow vessels to quickly determine whether another vessel is following the two-way route or not. This, in turn, affords more time for vessels to coordinate passing arrangements in situations where risk of collision exists.

With specific consideration toward reducing the risk of vessel collisions, the Coast Guard did consider other possible routing measures, such as a traffic separation scheme that would include a traffic separation zone. This type of measure would result in better separation of vessel traffic travelling in different directions, but it would limit the amount of sea room available for collision and ice avoidance. In the areas where high densities of commercial fishing activity exist, the Coast Guard believes that in the near term, implementation of a Traffic Separation Scheme could actually increase the risk of collisions. The reason for this is that the Traffic Separation Scheme alters the responsibilities between vessels for avoiding collisions. In a scenario with no routing measures, or in the case of a two-way route, a commercial ship is obligated under COLREGS to avoid vessels that are actually fishing. In a scenario with a traffic separation scheme, fishing vessels are obliged to avoid impeding the passage of other vessels that are following the lane of a traffic separation scheme. Currently, and for the near future, there are far more fishing vessels operating in the area where the two-way route crosses the fishing grounds. Most of them do not expect to see vessels other than other fishing vessels, but they do expect that they will have the right of way under COLREGS when they are actively fishing in this area and encounter another vessel that is not also fishing. Implementing a traffic separation scheme can thus

create a scenario could create a situation where two vessels (one actively fishing, one following a traffic separations scheme lane) might both believe they have the right of way. In a future scenario, where use of the routing measure by vessel traffic bound to or from the Bering Strait becomes more frequent, this is less of a concern.

Detailed information on marine casualties follows:

Marine Casualties
2005 - 2016

Number	Date	Vessel Type	GT	Accident Type	Lat DD	Long DD	Description
1	04/08/2005	Cargo Ship	24,479	Fire	53.7650	-178.8700	While underway, hotwork ignited wood-pulp cargo in hold #1.
2	08/08/2005	Freight Ship	76	Grounding	53.6233	-167.0750	While unloading onshore at Scan Bay, the wind pushed vessel onto a rock, resulting in minor damage to the hull.
3	09/22/2005	Freight Ship	76	Grounding	53.9500	-166.6000	While recovering fishing gear near shore, the vessel grounded on Eider Reef. Grounding re-open previously damage section of hull.
4	06/09/2006	Cargo Ship	4,964	Loss of Propulsion	54.0167	-166.4667	While in Dutch Harbor, vessel engine suffered overheat and shut-down. Vessel towed to berth for repairs.
5	07/10/2006	Cargo Ship	17,845	Equipment Failure	59.1450	-174.2100	On deck hydraulic pump leak resulting in 10 gallons hydraulic oil spilled.
6	07/17/2006	Tank Barge	495	Oil Spill	61.5167	-166.1000	During transfer on Kashunuk River less than 1 gallon of #1 diesel spilled, created sheen.
7	08/27/2006	Barge	1,856	Oil Spill	56.4167	-168.1333	While in Bristol Bay a cargo deck spill from ISO container on deck of freight barge resulted in 250 gallon diesel spill.
8	08/28/2006	Towing Vessel	146	Grounding	56.0569	-168.5214	Vessel hit a rock in St. George harbor, unconfirmed spill of 5 gallons of Number 4 fuel oil.
9	09/05/2006	Passenger Vessel	48,075	Reduction of Maneuverability	55.7099	-157.5150	While underway one propulsion pod suffered mechanical damage.
10	10/12/2006	Cargo Ship	4,392	Weather Damage	53.8778	-166.5778	While anchored near Unalaska, vessel dragged anchor.
11	01/23/2007	Towing Vessel	198	Reduction of Maneuverability	51.8500	-176.6333	Near Adak Harbor, a bearing on the starboard seized, shutting down one engine.
12	02/03/2007	Offshore Supply Vessel	3,534	Weather Damage	52.0000	-175.5000	While underway in Bering Sea, a wave broke loose a life-raft.

Number	Date	Vessel Type	GT	Accident Type	Lat DD	Long DD	Description
13	02/04/2007	Cargo Ship	3,475	Collision	51.5917	-176.6000	During extreme weather near Adak, F/T SEA FISHER collided with M/V Khana causing damage to both vessels.
14	03/09/2007	Cargo Ship	7,207	Loss of Propulsion	53.8778	-166.5778	While riding out a storm near Dutch Harbor, vessel suffered clogged fuel filters and lost all engines and generators.
15	06/03/2007	Towing Vessel	76	Grounding	63.5651	-165.0548	Muddy bottom grounding while towing alongside. No damage.
16	06/04/2007	Towing Vessel	143	Loss of Propulsion	55.3330	-160.5000	Near Sand Point, vessel suffered engine cooler failure resulting in a partial loss of propulsion.
17	06/12/2007	Tank Barge	495	Grounding	61.9667	-159.8833	Near Aniak, barge struck submerged object holing barge resulting in an 50 gallon oil spill.
18	06/20/2007	Research Vessel	195	Loss of Power	54.3667	-165.4167	While underway in Unimak Pass, vessel suffered loss of power due to an engine casualty on its generator.
19	07/13/2007	Towing Vessel	188	Collision	58.6967	-156.6761	On the Naknek river, the F/V ALCHEMIST and MALOLO collided dealing damage to both vessels, but not the towed barge.
20	08/04/2007	Research Vessel	3,779	Oil Spill	59.0444	-177.7250	Oil leaked from a small boat's hydraulic system where it discharged into the Chukchi Sea forming a sheen on the surface.
21	09/06/2007	Cargo Ship	5,286	Loss of Propulsion	54.0733	-166.3467	While entering Dutch Harbor, vessel switched to Heavy Fuel Oil, causing engines to shut-down.
22	09/07/2007	Cargo Ship	6,670	Loss of Propulsion	53.8778	-166.5778	While in Dutch Harbor, an o-ring blew off the air system causing the main engine to shut-down.
23	09/12/2007	Cargo Ship	5,286	Partial Loss of Propulsion	53.8778	-166.5778	No data.

Number	Date	Vessel Type	GT	Accident Type	Lat DD	Long DD	Description
24	09/13/2007	Passenger Vessel	2,174	Partial Loss of Propulsion	57.2150	-155.3083	While in Shelikof Strait, shut one engine down for repairs.
25	10/04/2007	Barge	2,898	Grounding	53.9047	-166.4462	Barge broke free from moorings and grounded in Summers Bay.
26	10/07/2007	Mobile Offshore Drilling Unit	10,264	Equipment Failure	53.8778	-166.5778	While in Dutch Harbor, vessel service generators shut down.
27	10/26/2007	Cargo Ship	3,264	Collision	51.8575	-176.6459	While near Adak, the SEAFREEZE ALASKA collided with the JACHA.
28	01/17/2008	Misc. Vessel	187	Loss of Propulsion	57.1167	-168.9333	While in Bering Sea, lost of control of controllable pitch propeller due to frozen control air lines.
29	01/26/2008	Cargo Ship	188	Oil Spill	51.8575	-176.6459	While near Adak, the vessel spilled 100 gallons of diesel.
30	07/05/2008	Research Vessel	370	Loss of Propulsion	59.0444	-177.7250	Enroute to Dutch Harbor vessel experience loss of CPP control due to water in CPP system.
31	09/27/2008	Freight Ship	95	Grounding	60.3867	-166.1750	Meykoyruk Beach, loss of hull integrity resulted in an estimated 50-100 gallon diesel spilled.
32	11/10/2008	Passenger Vessel	2,174	Partial Loss of Propulsion	54.4911	-165.3621	While in the Gulf of Alaska, vessel shut-down one engine due to high cooling water temperature.
33	02/08/2009	Misc. Vessel	111	Grounding	53.8778	-166.5778	While departing Dutch Harbor, vessel grounded.
34	03/18/2009	Cargo Ship	4,988	Loss of Propulsion	53.8778	-166.5778	While enroute to Dutch Harbor, vessel lost propulsion.
35	07/14/2009	Freight Ship	37,150	Loss of Power	53.9200	-166.4667	While underway in the Bering sea, the auxiliary generator tripped offline.
36	08/11/2009	Towing Vessel	171	Grounding	60.9833	-161.5000	While on the Kuskokwim river, tug grounded and subsequently collided with it's towed barge.

Number	Date	Vessel Type	GT	Accident Type	Lat DD	Long DD	Description
37	08/12/2009	Barge	3,350	Weather Damage	57.9320	-158.7410	While in Bristol bay, the barge dragged anchor due to weather and ended up grounded.
38	08/20/2009	Towing Vessel	171	Grounding	60.0650	-162.4675	While towing on the Kuskokwim river, vessel grounded.
39	08/26/2009	Towing Vessel	177	Loss of Propulsion	59.0099	-158.5000	While anchoring in Bristol Bay, vessel suffered engine casualty.
40	08/27/2009	Tank Barge	629	Grounding	59.0679	-161.7284	During intentional grounding for cargo offload near Goodnews bay, the vessel was unable to get off ground without additional assistance.
41	09/17/2009	Tank Barge	531	Grounding	59.3167	-164.3000	While in Quinhagak channel, barge grounded.
42	09/23/2009	Passenger Vessel	2,174	Loss of Power	53.8778	-166.5778	While departing Dutch Harbor, vessel lost power due to an overheated generator.
43	09/25/2009	Freight Ship	13,779	Loss of Propulsion	53.8778	-166.5778	While in Unalaska bay, vessel lost propulsion due to a bad air control valve.
44	01/22/2010	Freight Ship	25,644	Reduction of Maneuverability	54.0267	-166.4283	While entering Dutch Harbor, vessel lost steering.
45	06/21/2010	Towing Vessel	193	Loss of Propulsion	51.4517	-166.0367	While towing, vessel suffered a casualty on one of it's two clutches.
46	06/22/2010	Tank Barge	334	Grounding	61.8285	-156.4305	While on the Kuskokwim river, tank barge grounded on soft bottom.
47	07/09/2010	Towing Vessel	62	Oil Spill	59.0444	-177.7250	While conducting transfer in Nome harbor, approximately 1 gallon of diesel spilled.
48	07/11/2010	Freight Ship	4,295	Grounding	58.8355	-158.5747	Vessel drug anchor and struck bottom in the vicinity of Clark's Point.

Number	Date	Vessel Type	GT	Accident Type	Lat DD	Long DD	Description
49	09/20/2010	Towing Vessel	181	Loss of Propulsion	62.9215	-162.6583	While en route Pilot Station, AK from Russian Mission, AK, at approximately 2045, the TUG TANANA (272122) suffered a failure of their starboard engine.
50	10/14/2010	Towing Vessel	117	Oil Spill	58.6967	-156.6761	While on the Naknek river, vessel spilled 1 quart of gasoline.
51	10/16/2010	Barge	362	Grounding	54.8500	-163.5000	Towing vessel grounded, towline parted and barge grounded in rough weather near Bechevin bay.
52	02/15/2011	Towing Vessel	88	Loss of Maneuverability	57.0300	-155.1017	While in rough weather in Shelikof Strait, steering ram broke and towing wire parted.
53	05/25/2011	Freight Ship	4,457	Collision	58.6850	-160.3300	Vessels collided approaching for offloading.
54	06/26/2011	Towing Vessel	98	Sinking	56.8000	-167.3833	Enroute from Dutch Harbor to Nome, towing vessel rapidly developed list, overturned and sank in 300 ft of water, an unknown amount diesel onboard potentially, 29,000 gallons.
55	07/02/2011	Cargo Ship	8,665	Partial Loss of Propulsion	53.2033	-156.1783	Near Metrofania Bay, vessel suffered a turbocharger failure on one engine.
56	07/06/2011	Towing Vessel	193	Reduction of Maneuverability	55.0342	-161.9493	Near Liiasik pass Vessel experienced an issue with their starboard rudder/steering pump.
57	07/09/2011	Tank Barge	4,076	Grounding	59.0360	-158.4663	Nushagak river, tank barge grounded and tug became entangled in gill-net.
58	07/25/2011	Recreational Vessel		Grounding	53.8778	-166.5778	While attempting to enter the small boat harbor, vessel grounded on the rocks in the vicinity of East Point, Iliuliuk Bay.
59	07/29/2011	Cargo Ship	17,845	Loss of Maneuverability	54.3267	-166.5467	During pre-arrival checks for Dutch Harbor, vessel discovered number one steering gear to be non-operational.

Number	Date	Vessel Type	GT	Accident Type	Lat DD	Long DD	Description
60	08/04/2011	Cargo Ship	90	Grounding	54.1600	-165.6000	Vessel landed at Surf Beach near Akutan Island and fouled one of its propellers.
61	08/07/2011	Towing Vessel	193	Fire	57.1167	-155.9500	While transiting Shelikof Strait, vessel had a fire on the port generator.
62	08/13/2011	Towing Vessel	91	Fire	61.5833	-159.2500	While near the Kuskokwim river, vessel experience engine room fire which damaged one engine.
63	08/30/2011	Towing Vessel	93	Loss of Maneuverability	64.4997	-165.4323	While near Nome Harbor, fouled starboard screw with towline and grounded with barge on beach.
64	09/02/2011	Passenger Vessel	2,174	Equipment Failure	55.2083	-162.6950	While at the Cold Bay pier, detachable link failed on the anchor.
65	09/03/2011	Towing Vessel	193	Loss of Propulsion	55.0597	-162.3210	While approaching the dock at King Cove, propulsion was lost in the starboard main engine
66	09/10/2011	Towing Vessel	93	Grounding	64.5000	-165.4167	Near Port of Nome outer harbor, screws fouled resulting in grounding and 800 gallon diesel spill.
67	09/24/2011	Cargo Ship	4,429	Loss of Propulsion	53.9017	-166.5950	While in Unalaska bay, vessel lost propulsion due to a bad engine start valve.
68	11/01/2011	Towing Vessel	54	Equipment Failure	54.8500	-163.5000	In vicinity of Unimak Island, tug's winch failed when shortening tow. Rough weather caused the towline to break and the towed barge ALASKA VILLAGER grounded.
69	11/10/2011	Towing Vessel	51	Oil Spill	64.4967	-165.4086	In Nome small boat harbor, vessel partially submerged due to weather, resulted in 5 gallon lubricating oil spill.
70	11/16/2011	Towing Vessel	171	Partial Loss of Propulsion	54.7833	-163.0000	While in Ikatan Bay, one of three engines reported low lube oil pressure and was shut-down.

Number	Date	Vessel Type	GT	Accident Type	Lat DD	Long DD	Description
71	11/23/2011	Towing Vessel	359	Partial Loss of Propulsion	53.8800	-166.5250	While assisting a vessel in Dutch Harbor, an engine control module failed shutting down one engine.
72	12/05/2011	Cargo Ship	51,334	Loss of Maneuverability	53.6833	-168.2833	In vicinity of Unimak Island, vessels steering gear failed due to bad bearing.
73	12/15/2011	Cargo Ship	19,311	Weather Damage	54.9833	-158.9167	While in the Gulf of Alaska, vessel sustained damage to it's bow bulwark.
74	01/04/2012	Tank Vessel	5,191	Partial Loss of Propulsion	54.0218	-166.5235	While in the vicinity of Dutch Harbor, vessel had an exhaust valve fail, reducing its speed.
75	05/14/2012	Towing Vessel	177	Partial Loss of Propulsion	52.7817	-173.5933	While near Shemya, water pump on one engine failed.
76	05/17/2012	Tank Barge	938	Grounding	56.5771	-169.6792	While under tow by CHUCKCHI SEA, tank barge grounded in harbor with no damage.
77	05/28/2012	Towing Vessel	196	Fire	54.5857	-165.1423	Near Unimak Island, vessel suffered a fire to it's switchboard and a subsequent loss of electrical power.
78	06/08/2012	Freight Ship	95	Oil Spill	61.5166	-166.1000	Near Hooper Bay, 1 gallon hydraulic oil spill.
79	06/25/2012	Towing Vessel	169	Partial Loss of Propulsion	58.4920	-158.6916	While in Bristol Bay, vessel fouled propeller with towing line.
80	07/11/2012	Towing Vessel	815	Grounding	62.5633	-164.8725	Tug and Tank Barge grounded on sand/silt in Kwiklokchun Channel.
81	07/11/2012	Freight Ship	49,985	Loss of Propulsion	53.8950	-166.5117	While in Dutch Harbor, vessel had issues with engine start air distributer.
82	07/14/2012	Mobile Offshore Drilling Unit	10,264	Weather Damage	53.8847	-166.5667	While anchored near Dutch Harbor high winds caused the vessel to drag anchor and nearly pushed the vessel aground.
83	07/19/2012	Towing Vessel	166	Fire	61.8358	-166.2142	In vicinity of Hooper Bay, battery charger caught fire. Vessel seaworthiness not affected.

Number	Date	Vessel Type	GT	Accident Type	Lat DD	Long DD	Description
84	08/02/2012	Towing Vessel	105	Fire	67.1600	-167.7467	Between Point Barrow and Prudhoe Bay an oily rag caught fire in the engine room. Vessel seaworthiness not affected.
85	08/06/2012	Barge	1,474	Grounding	66.8672	-162.6277	Near Kotzebue, barge grounded on bar due to heavy loading.
86	08/07/2012	Towing Vessel	4,721	Collision	53.9000	-166.5333	In Dutch Harbor tug and tank barge collided while doing a personnel transfer.
87	08/16/2012	Towing Vessel	93	Grounding	59.0099	-158.5000	Vessel grounded after departing from Bethel.
88	08/29/2012	Tank Barge	4,076	Flooding	71.3483	-156.7900	Worn fendering resulted in puncture of the barge side-shell.
89	08/31/2012	Freight Ship	12,892	Weather Damage	68.7400	-167.9467	While towing in the Chukchi Sea, vessel sustained weather damage.
90	09/17/2012	Towing Vessel	93	Barge Breakaway	68.3306	-166.8990	Near Point Hope, towline parted due to heavy weather. Barge was later recovered without damage.
91	09/17/2012	Towing Vessel	88	Grounding	60.6814	-161.9665	Vessel grounded on Kuskokwim river.
92	10/03/2012	Towing Vessel	169	Loss of Maneuverability	61.4783	-165.9667	While transiting from Chivak to Hooper bay the vessel lost one of three rudders due to a failed flange.
93	10/04/2012	Barge	673	Flooding	60.8190	-161.4540	On the Kuskokwim river, barge was pulled off of the riverbank and subsequently sunk due to unknown damage.
94	10/10/2012	Barge	1,469	Collision	60.7912	-161.7477	Tug lost control of barge in Adak Harbor, the barge collided with a skiff and sunk it.
95	10/12/2012	Towing Vessel	69	Grounding	63.5194	-162.0724	Tug ran aground on reef near St. Michael in Norton Sound. Unknown quantity of diesel spilled.

Number	Date	Vessel Type	GT	Accident Type	Lat DD	Long DD	Description
96	11/10/2012	Offshore Supply Vessel	12,892	Loss of Power	71.1750	-158.8417	While towing in the Arctic Ocean, the tug lost power and shortly thereafter all propulsion.
97	11/16/2012	Mobile Offshore Drilling Unit	10,264	Fire	53.9000	-166.5333	While making Dutch Harbor, vessel engine backfired rupturing exhaust, causing a small fire.
98	11/22/2012	Mobile Offshore Drilling Unit	10,265	Loss of Propulsion	54.1983	-163.7700	South of False pass vessel suffered a reduction of propulsion.
99	11/29/2012	Cargo Ship	64,502	Fire	53.9000	-166.5333	While mooring in Dutch Harbor, bow thruster caught fire.
100	12/03/2012	Offshore Supply Vessel	12,892	Weather Damage	53.8353	-166.5687	While moored in Dutch Harbor, vessel Fast Rescue Craft suffered cold weather damage.
101	01/05/2013	Misc. Vessel	90	Reduction of Maneuverability	54.1667	-166.0000	In Bearing Sea access, hovercraft suffered loss of one of three rudders.
102	01/24/2013	Misc. Vessel	90	Allision	54.1333	-165.7667	While getting underway at Akutan city, hovercraft contacted city dock and moored fishing vessel due to wind.
103	02/21/2013	Cargo Ship	44,234	Loss of Propulsion	54.4582	-165.0756	Near Unimak Pass, vessel was unable to start it's engine after extended period of drifting.
104	03/04/2013	Towing Vessel	1,038	Loss of Propulsion	55.7099	-157.5150	While towing in the Gulf of Alaska vessel clutch malfunctioned.
105	04/09/2013	Cargo Ship	9,438	Loss of Propulsion	54.2700	-165.9100	Vessel suffered engine casualty.
106	06/09/2013	Towing Vessel	96	Loss of Propulsion	59.0360	-158.4663	While transiting the Nushagak river, vessel and barge ran aground due to changing water levels.
107	06/11/2013	Freight Ship	187	Oil Spill	60.5183	-165.1000	Near Tokssook Bay, overfilled day-tank resulting in 30 gallon diesel spill.
108	06/28/2013	Towing Vessel	89	Loss of Maneuverability	63.6345	-163.0362	Near Stebbins, vessel struck a log, bending the port propeller, both other engines unaffected.

Number	Date	Vessel Type	GT	Accident Type	Lat DD	Long DD	Description
109	07/17/2013	Towing Vessel	629	Grounding	59.0556	-160.3167	While transiting to Togiak, barge struck unmarked boulder. Approximately 10 gallons of #1 diesel spilled.
110	07/22/2013	Barge	1,083	Grounding	70.5922	-160.1392	At Arctic Ocean access, vessel struck unmarked sandbar after guide vessel missed it.
111	07/24/2013	Tank Barge	495	Oil Spill	64.5820	-169.0635	While anchored near Wales, AK, 1 gallon of gasoline spilled.
112	07/26/2013	Barge	40	Grounding	69.6700	-163.1167	Vessel broke loose from it's mooring and grounded.
113	08/13/2013	Towing Vessel	89	Loss of Propulsion	64.0667	-169.6283	In vicinity of St. Lawrence Island, contaminated fuel caused the shut-down of all engines onboard.
114	08/27/2013	Research Vessel	9,088	Oil Spill	68.3266	-167.6608	Greywater discharge in Arctic Ocean, resulting in a sheen.
115	10/02/2013	Cargo Ship	65,531	Loss of Propulsion	54.4911	-165.3621	While in Unimak Pass vessel shut-down main engine to make repairs.
116	10/04/2013	Towing Vessel	590	Flooding	54.2317	-165.8500	Transiting from Dutch Harbor to Akutan, vessel developed a list due to flooding because of a bad gasket on a water-tight closure.
117	10/11/2013	Tank Barge	668	Oil Spill	64.6977	-165.1605	Spill during transfer near Norton Sound, 750 gallons of JP-5 into secondary containment. No oil in the water.
118	10/30/2013	Towing Vessel	198	Partial Loss of Propulsion	55.0563	-162.3192	Near King Cove, vessel voluntarily shut down one engine due to excessive smoke because of bad fuel.
119	10/31/2013	Towing Vessel	117	Partial Loss of Propulsion	59.0342	-158.4747	While getting underway at Dillingham vessel had an engine stall out.
120	11/05/2013	Passenger Vessel	88	Loss of Propulsion	60.5522	-165.2717	While towing in Etolin Strait, worn bearings on the reduction gear caused it to seize.

Number	Date	Vessel Type	GT	Accident Type	Lat DD	Long DD	Description
121	11/17/2013	Passenger Vessel	90	Partial Loss of Propulsion	54.1505	-165.6073	At Akun Island hovercraft ramp the shaft on starboard lift engine broke.
122	05/14/2014	Towing Vessel	97	Grounding	59.0307	-158.1945	10 miles from the mouth of the Nushagak River, vessel struck a rock and holed the main fuel tank resulting in a 5,500 gallon diesel spill.
123	07/04/2014	Towing Vessel	2,393	Grounding	55.9792	-160.5758	Near Port Moller, towing vessel grounded then was hit by the towed barge.
124	09/13/2014	Freight Ship	166	Grounding	61.5190	-166.1567	During intentional grounding for cargo offload near Bering Sea, hull breached resulting in 75 gallon #2 diesel spill.
125	09/15/2014	Towing Vessel	172	Reduction of Maneuverability	59.5964	-157.0589	While mooring in Dillingham, vessel's port steering arm failed.
126	10/07/2014	Towing Vessel	172	Partial Loss of Propulsion	58.8517	-158.5750	Near Clarke's Point vessel fouled propeller on safety line to towed barge, intentionally grounded vessel to detangle propeller.
127	11/01/2014	Cargo Ship	64,502	Weather Damage	54.0617	-161.2583	East of Unimak pass large wave damaged hatch to line scuttle hatch.
128	11/04/2014	Towing Vessel	106	Reduction of Maneuverability	54.3550	-166.1850	In vicinity of Akutan Island, vessel's clutch malfunctioned resulting in a reduction of maneuverability.
129	12/18/2014	Towing Vessel	171	Reduction of Maneuverability	65.2758	-166.3489	While enroute to Teller, vessel was found to be missing one of three rudders.
130	04/02/2015	Cargo Ship	128,929	Loss of Propulsion	54.1667	-166.0000	Approximately 10 miles from Akutan Island, vessel adrift due to required repairs to engine injector.
131	07/02/2015	Freight Ship	196	Partial Loss of Propulsion	53.8778	-166.5778	In Unalaska bay one of vessel's engines kept shutting down to excessive vibration on engine controls.

Number	Date	Vessel Type	GT	Accident Type	Lat DD	Long DD	Description
132	07/03/2015	Research Vessel	9,392	Grounding	53.8955	-166.5634	In vicinity of Dutch Harbor, vessel struck an un-marked shoal and sustained a hull fracture.
133	07/10/2015	Towing Vessel	1,038	Reduction of Maneuverability	53.9000	-166.5333	In Unalaska bay worn wiring in the clutch control system resulted in one engine declutching and shutting down.
134	07/11/2015	Towing Vessel	198	Grounding	58.7226	-156.9988	Vessel grounded in Naknek river, damaging both propellers.
135	07/28/2015	Fishing Vessel	1,856	Collision	58.7173	-157.0483	At mouth of Naknek river, fishing vessel lost steering and collided with moored barge.
136	09/11/2015	Cargo Ship	20,965	Loss of Propulsion	54.0500	-163.9333	On North Pacific ocean, enroute to Dutch Harbor, vessel shut-down engine to perform maintenance.
137	09/19/2015	Towing Vessel	41	Grounding	59.1175	-157.7061	While navigation on the Nushagak River, vessel and tow ran aground on sand bar.
138	10/03/2015	Offshore Supply Vessel	1,596	Partial Loss of Propulsion	71.1618	-163.3694	Near Wainright vessel suffered an engine casualty.
139	10/31/2015	Freight Ship	196	Grounding	57.0493	-156.6110	Near Point Wrangle, vessel was affected by wind and grounded while trying to anchor.
140	01/17/2016	Oil Response Barge	1,325	Grounding	53.8764	-166.5249	In Illiluik Bay vessel broke free from its moorings and drifted onto ground.
141	06/02/2016	Towing Vessel	85	Grounding	62.5564	-165.1356	While transiting the mouth of the Yukon river, vessel grounded on sandbar.
142	06/24/2016	Tank Vessel	27,547	Grounding	59.7500	-165.5033	While conducting lightering operations near Nunivak Island vessel grounded due to inaccurate soundings on chart.
143	06/29/2016	Towing Vessel	199	Reduction of Maneuverability	65.6883	-168.2700	While underway in Bering Strait a bolt failed in the steering system, requiring the vessel to be steered in an alternate control mode.

Number	Date	Vessel Type	GT	Accident Type	Lat DD	Long DD	Description
144	07/06/2016	Recreational Vessel	-	Equipment Failure	53.8440	-166.5787	While anchored in Captain's Bay, vessel's anchor failed causing the vessel to ground on rocks, resulting in the discharge of oily bilge wastes.

Understanding the

INPUTS AND IMPACTS ON FLOOD HAZARD IDENTIFICATION

in your community

Throughout the process of identifying the extent of flood hazards in a community, local engagement is critical. FEMA encourages citizens and local officials to get involved with the process by providing local flooding history; information on Federal, state, and local investment in mitigation infrastructure; and activities in the community that may have changed the patterns of flooding (development, new roads, etc.). This guide was developed to help communities identify the inputs that will have the most impact and allow for the best use of local resources.

STARR II Strategic Alliance for Risk Reduction

STARR II Strategic Alliance for Risk Reduction

UNDERSTANDING THE INPUTS AND IMPACTS ON FLOOD HAZARD IDENTIFICATION IN YOUR COMMUNITY

DECISION MAKING GUIDE

MODEL INPUTS AND THEIR IMPACTS WHEN ESTIMATING FLOOD HAZARDS[1]

Accurate flood hazard mapping is aided by better source data. The precision of the data used in flood modeling can sharply influence the resulting flood hazard depiction. This graphic shows several types of input data and when they may provide the best return on investment.

LAND TYPE	MANNING'S "N"			TERRAIN		STRUCTURES			
Different terrain situations can influence the decision on where to focus community resources	Representation of surface roughness/ resistance to flow			Topographic surface used by the model		Representation of bridges and culverts in the model			
	Good	Better	Best	Good	Better	Good	Better	Best	Superior
	One Value	Bank-Channel-Bank	Horizontal Variation	LiDAR	Channel Survey	None	As Weir	Assumed	Surveyed
FLAT	Minimum Standard	1	4	Minimum Standard	6	Minimum Standard	2	3	5
ROLLING		1	2		6		3	4	5
HILLY		1	3		5		No Benefit	2	4

[1] Based on the FEMA Report, "Impact of Flood Hazard Modeling Parameters on Base Flood Elevation (BFE) and Floodplain Top Width", published February 29, 2016.

[2] # Above numbers represent the recommended order in which to focus resources that provide the most impact to the floodplain width and flood depth using the least amount of resources, thus providing a greater return on investment. For example, in hilly areas, a focus to obtain information on Bank-Channel-Bank Manning's n data would be the best return on investment. If a community had additional resources to spend after that, gathering data related to Assumed Manning's n data would be the second best use of resources, and so on.