

Contemporary shoreline retreat rates at Meshik in Port Heiden, Alaska



DGGS Coastal Hazards Program - Fairbanks, AK

Program Manager: Nicole Kinsman

nicole.kinsman@alaska.gov

907-451-5026

Co-author Alexander Gould

Find this and other publications at:

<http://www.dggs.alaska.gov/coast>



Division of Geological & Geophysical Surveys



- Program launched in 2011 with seed funding from Coastal Impact Assistance Program
- Available to field coastal questions from stakeholders (~10-20 weekly requests)
- Program objectives:
 - Increase quality/quantity of coastal baseline data
 - Provide shoreline change and coastal inundation tools
 - Encourage/develop coastal management resources for an Alaskan audience

Overview of 2013 DGGs Field Activities in Port Heiden

Summary of DGGs Preliminary Interpretative Report

- a) Coastal Setting
- b) Shoreline Change Assessment

Ongoing work

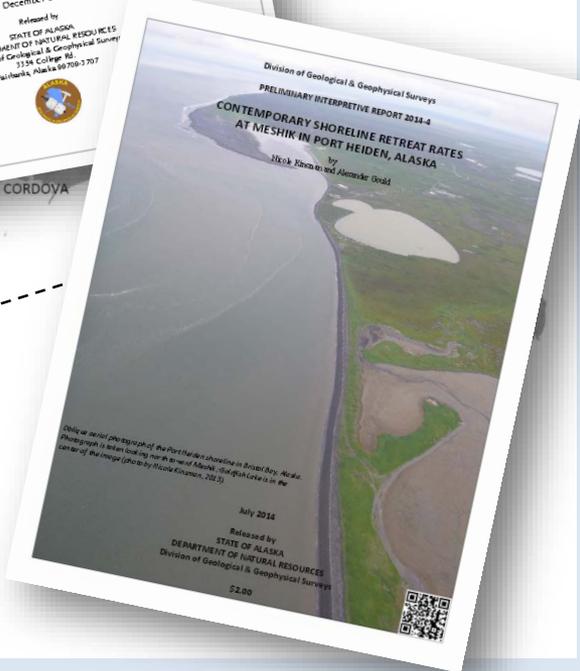
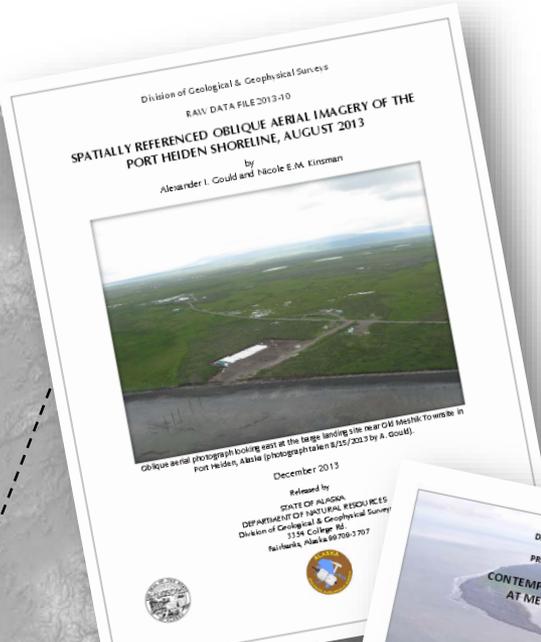
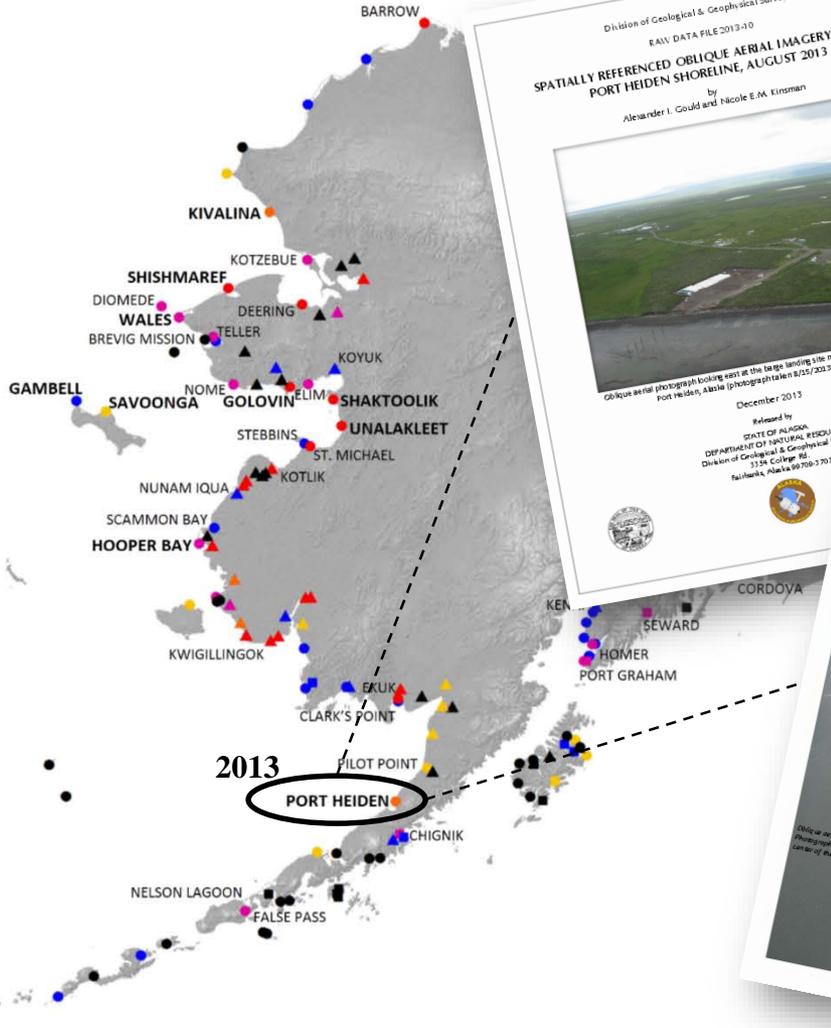
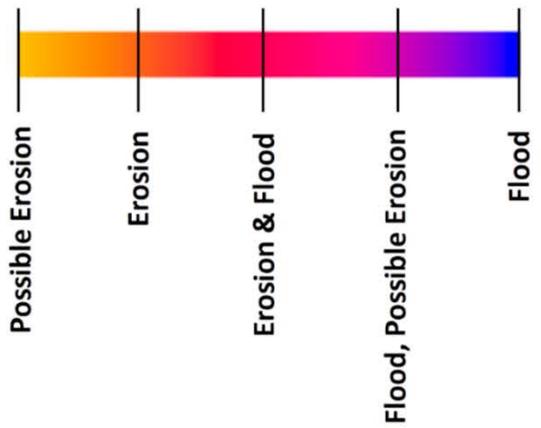
- a) Correlation of erosion trends to NWS storm surge reanalysis
- b) DGGs Interactive Shoreline Change tool and upcoming erosion resources



Alaska Coastal Populations Vulnerable to Flooding and Erosion

Key

- Exposed Coast
- Sheltered Coast
- ▲ Riverine Coast



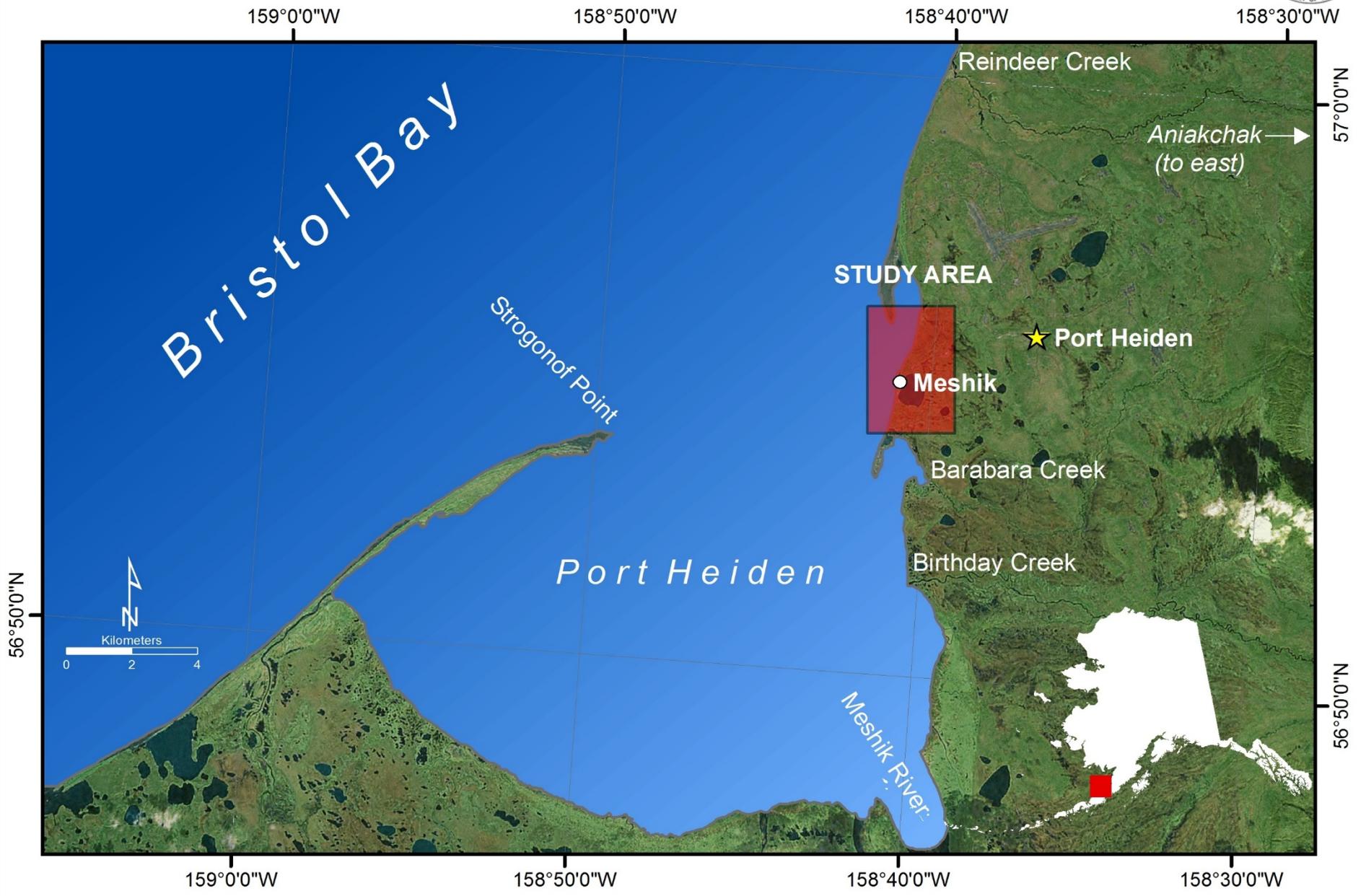
Field Activities in Port Heiden



- August 2013 baseline coastal measurements
 - Oblique aerial image collection
 - 38 coastal elevation profiles
 - Field evaluation of coastal landforms
 - Littoral grain size analysis (>100 samples)
 - 18 photo-identifiable GCPs
 - *NO* nearshore bathymetry collected
- Fall 2013 Short-term tide gauge
 - Tidal datum calculation (by JOA)
- October 2013 field measurements
 - 6 coastal elevation profiles



Coastal Setting - Location



Coastal Setting



Tank Farm

Meshik



2006



photos by ShoreZone



2013



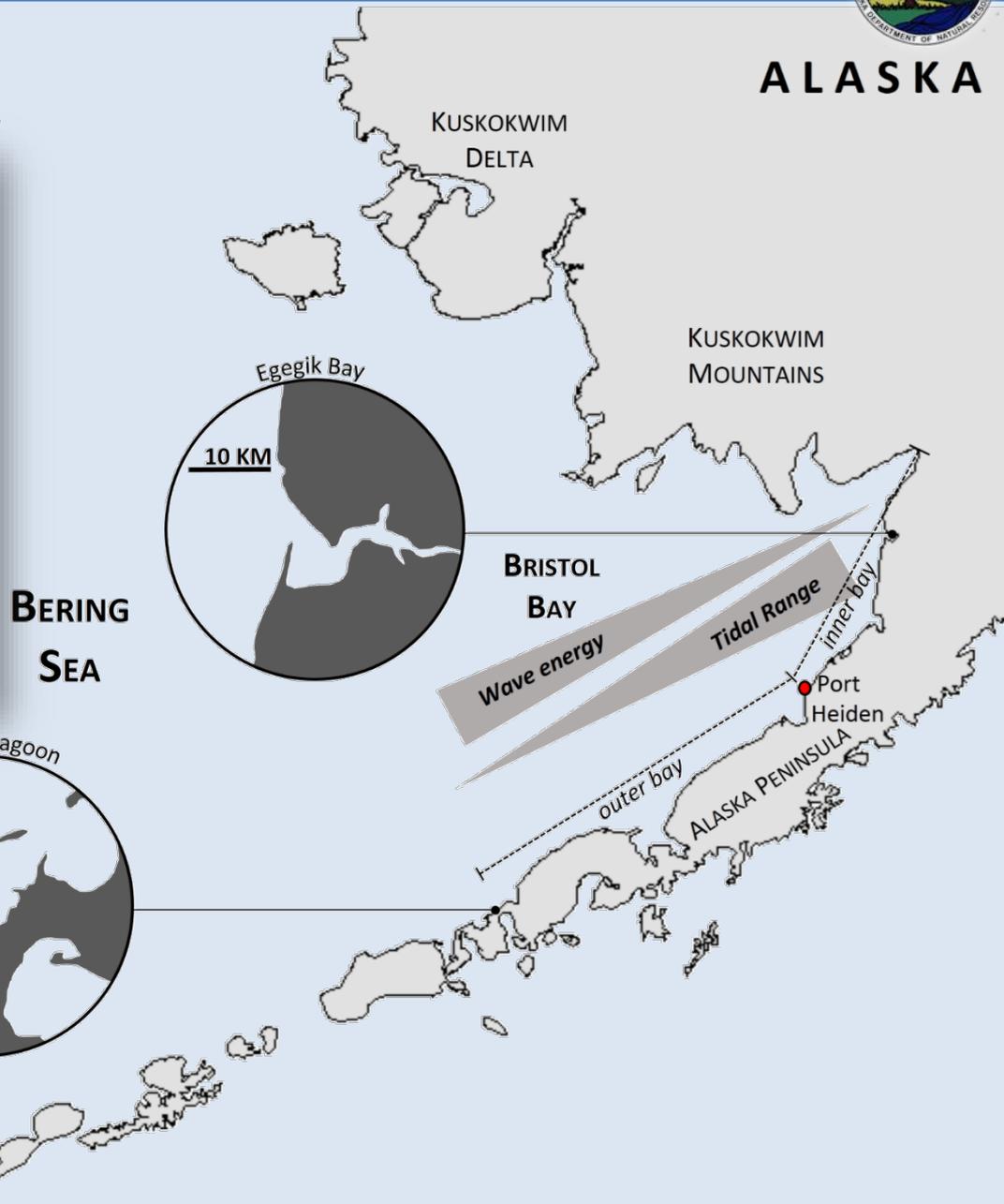
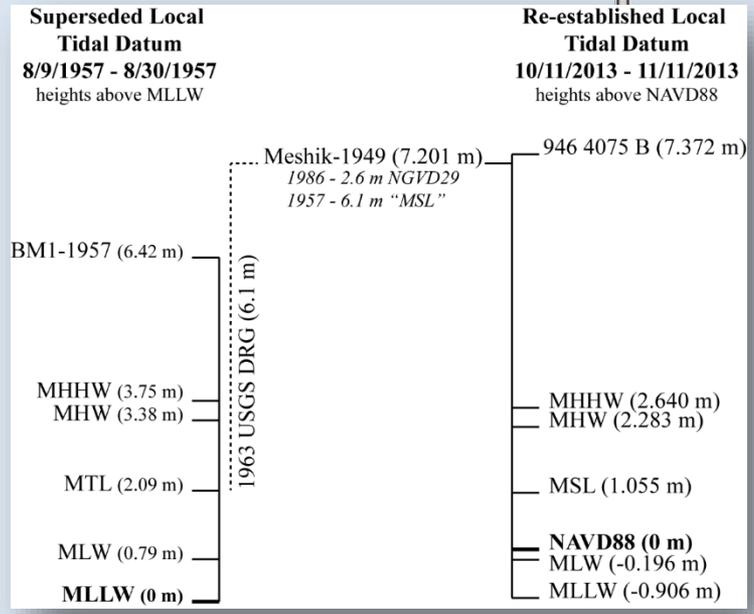
Average foreshore grain size = coarse sand

Coastal Setting – Tides and Waves



ALASKA

- Tidal range of 3.5 meters
- ~ stable relative sea level since 1960's



- Dominant western swell = persistent setup at Meshik
- Storms in late summer, early fall, spring
- Gradual one month delay in average sea ice arrival to region since 1950s

Coastal Setting – Wave Energy



October 17, 2005

a)



b)



November 30, 2005

c)



d)



photos by Scott Anderson

Coastal Setting – Wave Energy



December 2007

a)



b)

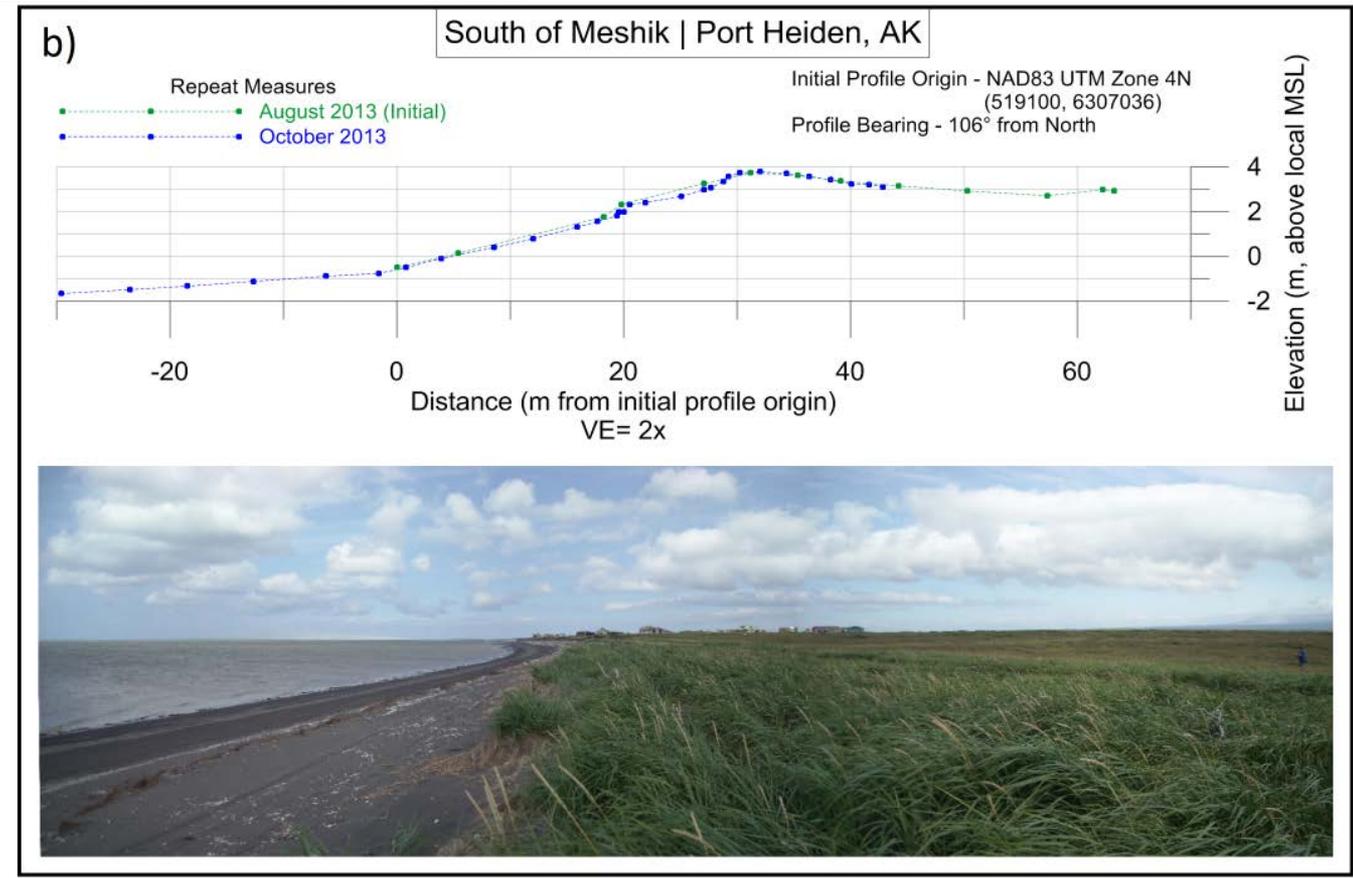
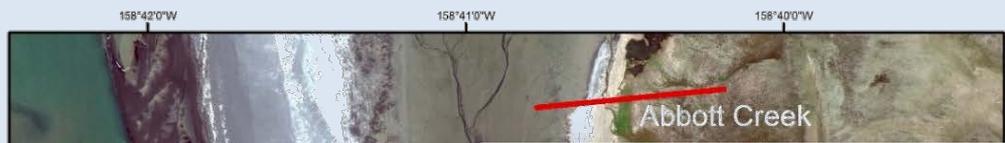


photos by Scott Anderson

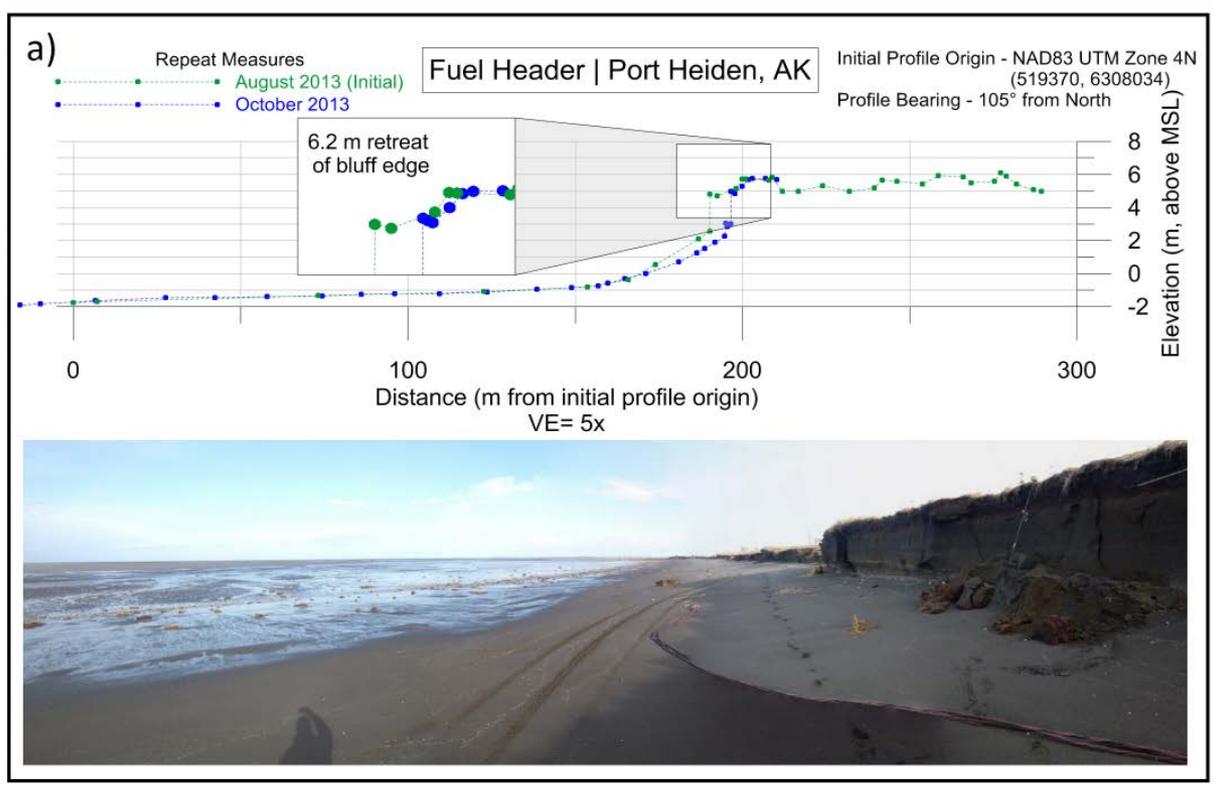


photos by Linda Anderson

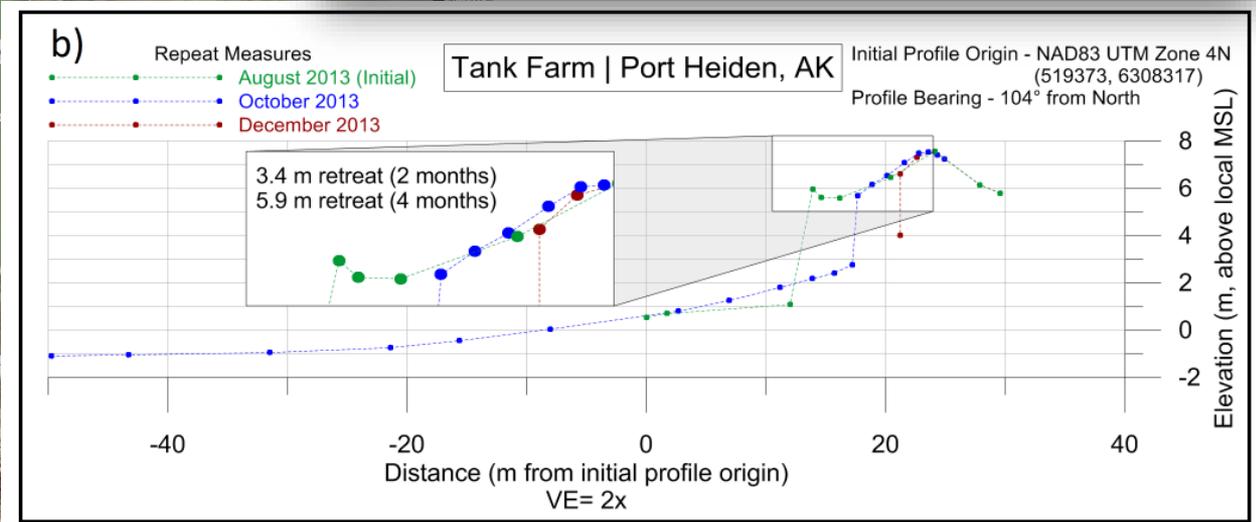
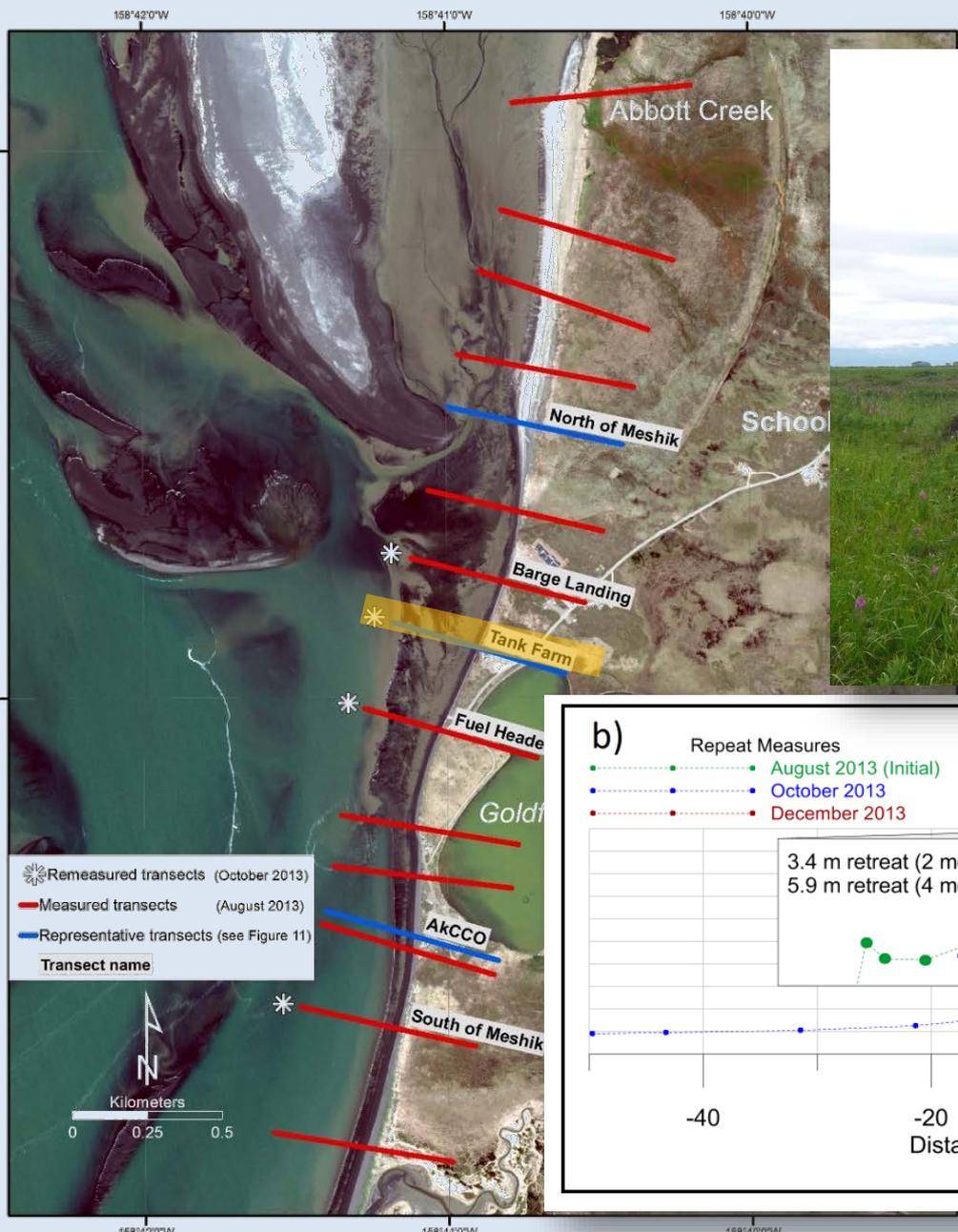
Shoreline Change



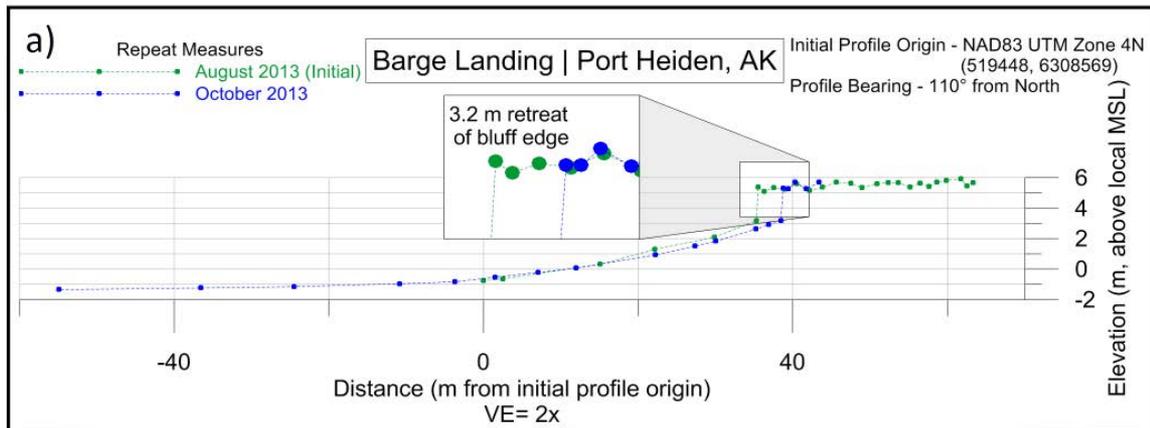
Shoreline Change



Shoreline Change



Shoreline Change



Shoreline Change Interactive Map



State of Alaska myAlaska My Government Resident Business in Alaska Visiting Alaska State Employees

Alaska Coastal Profile Tool (ACPT)

Alaska Division of Geological & Geophysical Surveys

State of Alaska > Natural Resources > Geological & Geophysical Surveys > Maps > ACPT

TO USE:
1. Click to zoom to a Region (O)
2. Select a Coastal Profile: One measurement Repeat measurements
3. Elevation Plot will appear. Adjust the vertical exaggeration to change the visible level of relief.
4. View multiple time-series, if available, by highlighting more than one collection Date (hold down Shift key).

Profile ID: Port Heiden 9

Vertical Exaggeration: Maximum

Collection Dates:
2013-10-12
2013-08-14

2013-10-12
2013-08-14



- [DGGS Digital Data Series 7](http://maps.dggs.alaska.gov/acpt/)
- Raw data download
- <http://maps.dggs.alaska.gov/acpt/>

This interactive tool enables access to beach elevation profile measurements collected throughout Alaska since the 1960s. Users can explore profile measurements collected by DGGS and others as time-series plots and location-based images of the shoreface environment. The map has been designed to accommodate datasets collected with differing techniques, including differential leveling, survey-grade GPS or extraction from lidar-derived digital elevation models.

Lines on the overview map depict the position and shape of the most recent data at each coastal profile; remeasured profiles are displayed as coincident for comparative purposes, however, the precise location of past measurements may vary due to differing collection methods.

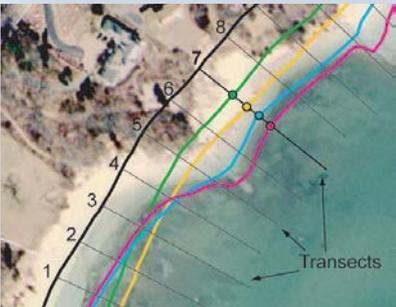
Shoreline Change

- No rigorous investigation of shoreline change existed previously
- Estimated erosion rates from previous work: 3-12 m/yr

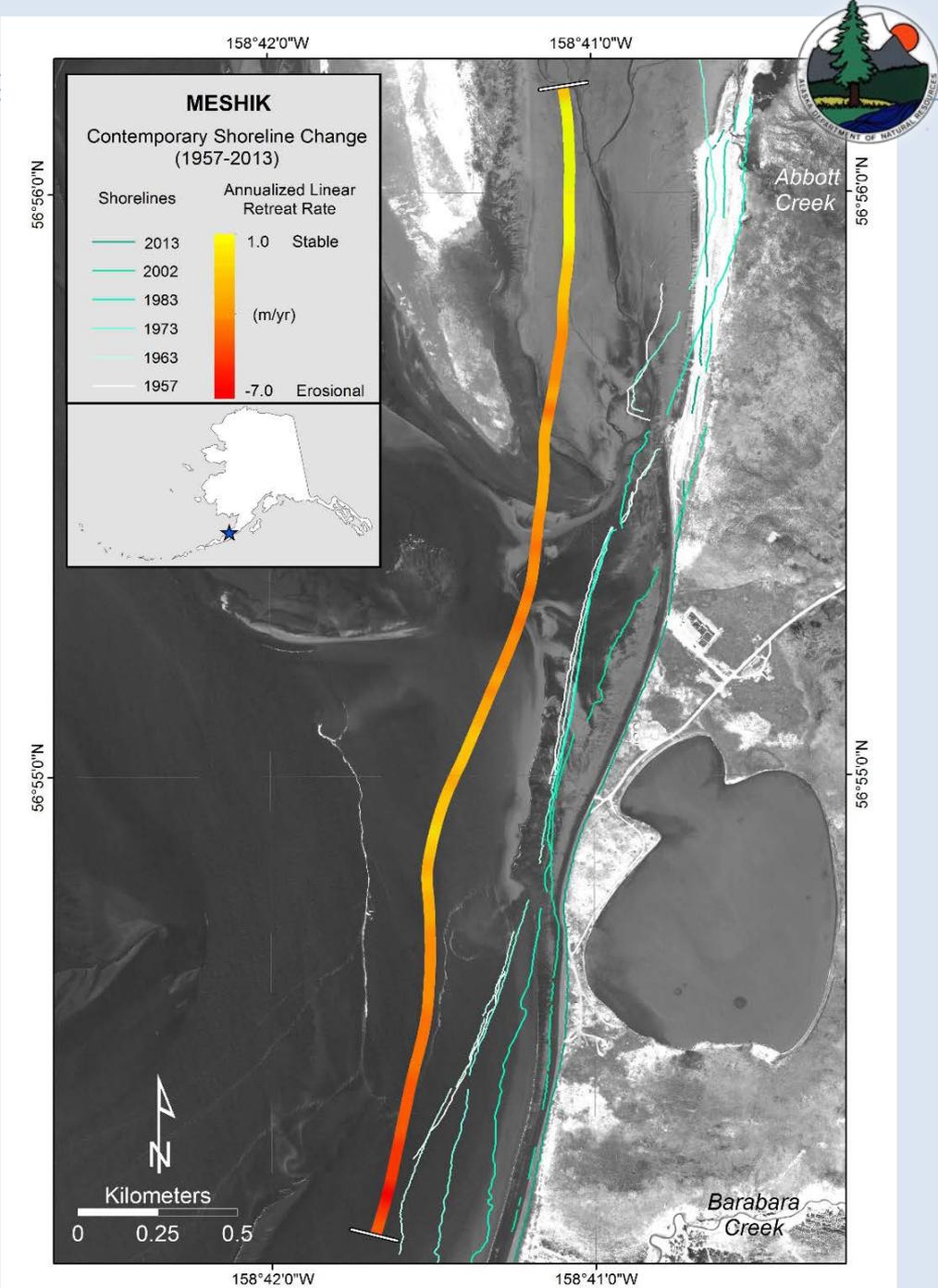
Methods:

- Historical orthoimagery from:

1957	1963	1973
1983	2002	2009
2011	2013	



- USGS Digital Shoreline Analysis System with DGGs-developed extension and transects at 50 m spacing
- Proxy indicator of shoreline position: bluff top/vegetation line
- Rigorous error analysis

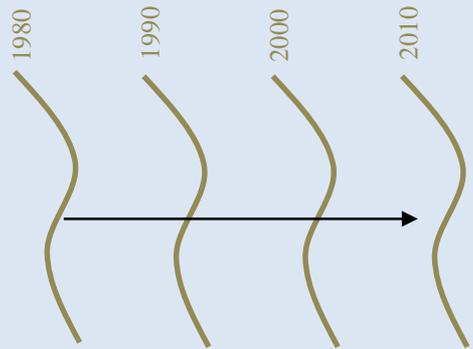




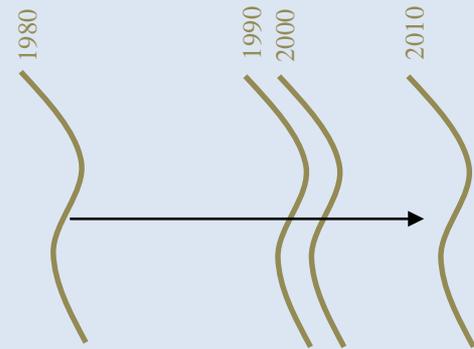
What does a projected shoreline mean?

- Shoreline retreat is a highly episodic occurrence
- Most common shoreline projections are:
 - END POINT → Averages all of the change over the maximum timespan
 - LONG-TERM → Fits a linear regression to all known shoreline positions
 - SHORT-TERM → Uses only the most recent shorelines (event or annualized)
 - └ all perform best with minimal +/- trend in the rate

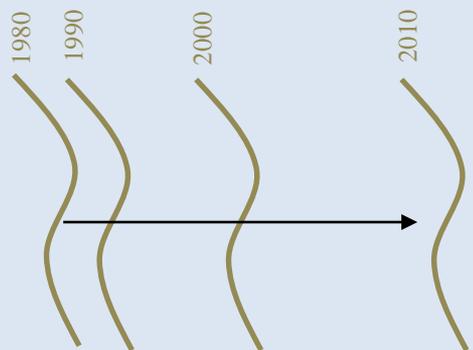
Example: 30 year record of shoreline positions



Linear
End point rate: 1 ft/year
Long-term rate: 1 ft/year
Short-term rate: 1 ft/year



'Random'
End point rate: 1 ft/year
Long-term rate: 0.93 ft/year
Short-term rate: 1 ft/year

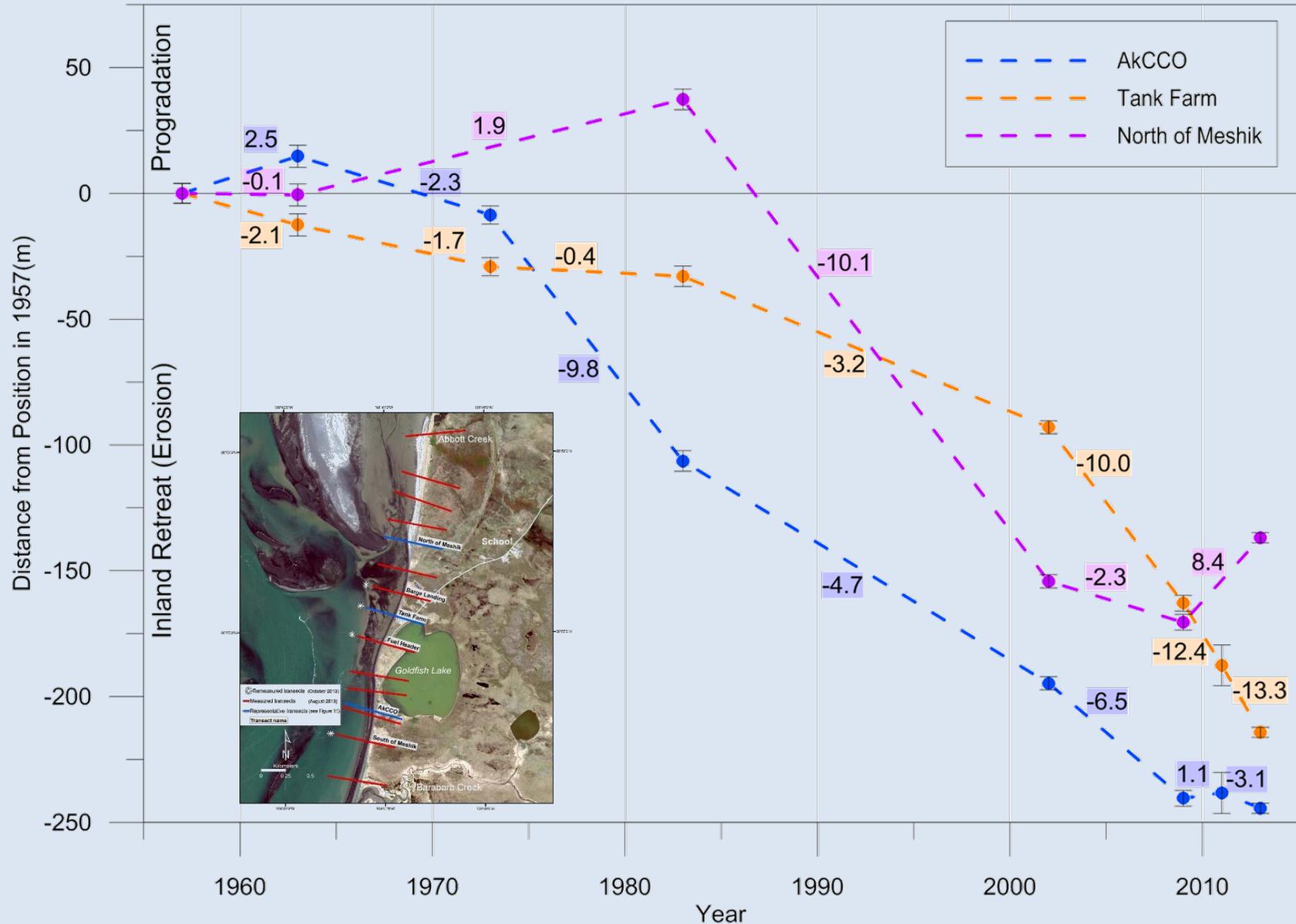


Accelerating
End point rate: 1 ft/year
Long-term rate: 1.01 ft/year
Short-term rate: 2 ft/year

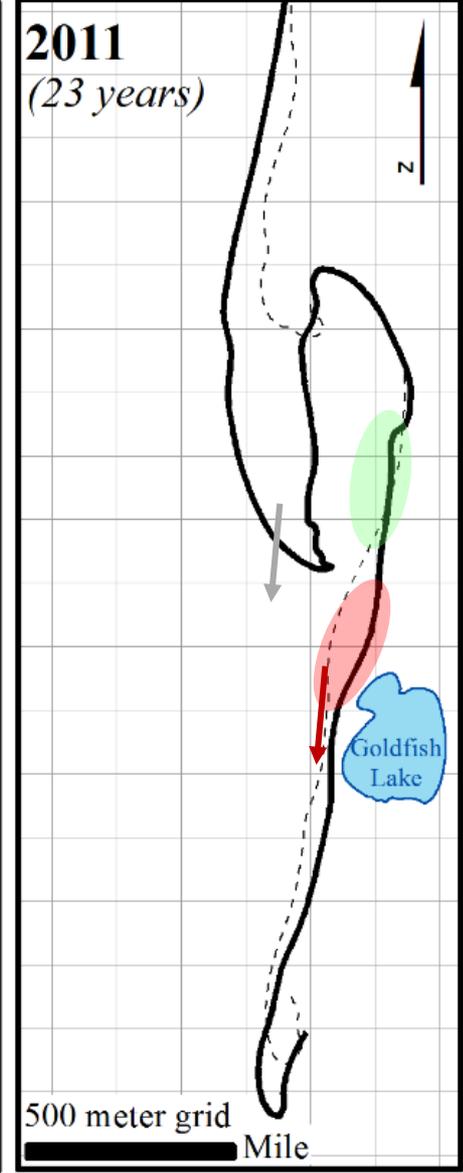
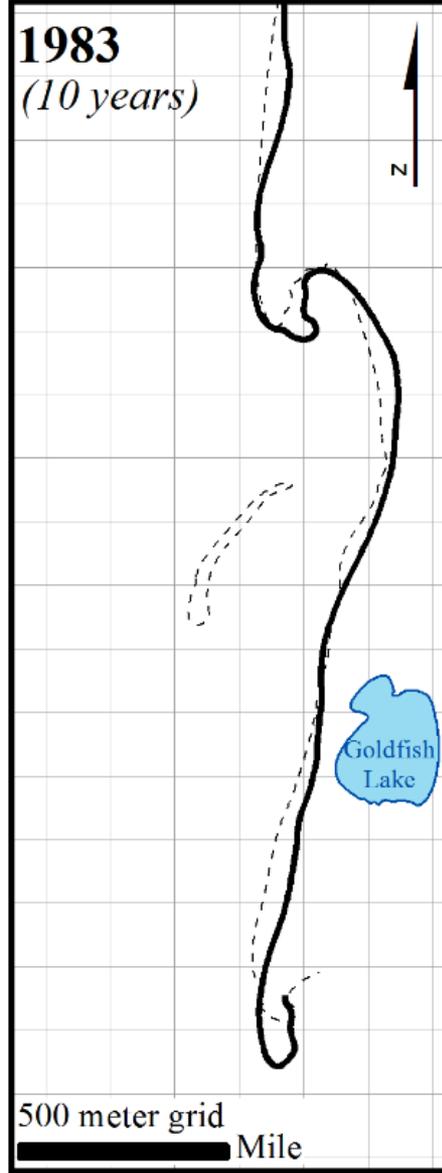
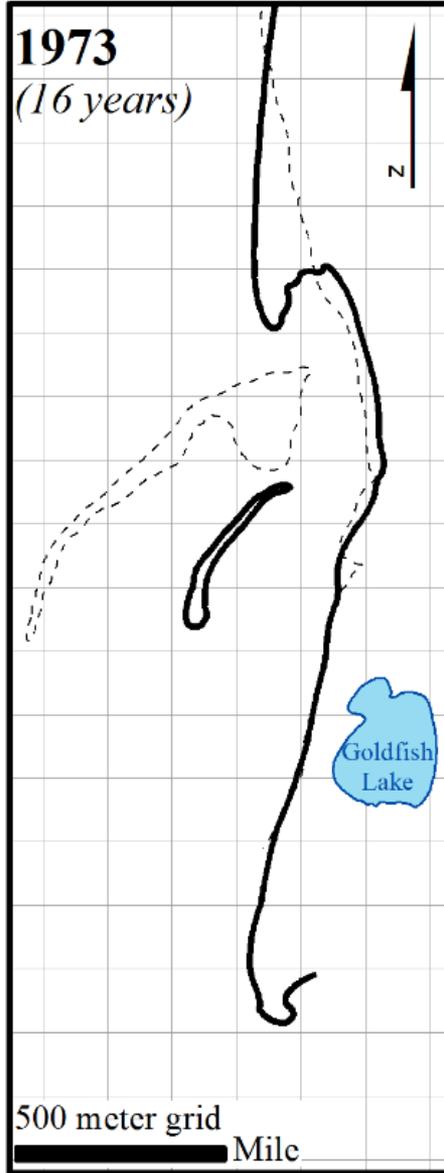
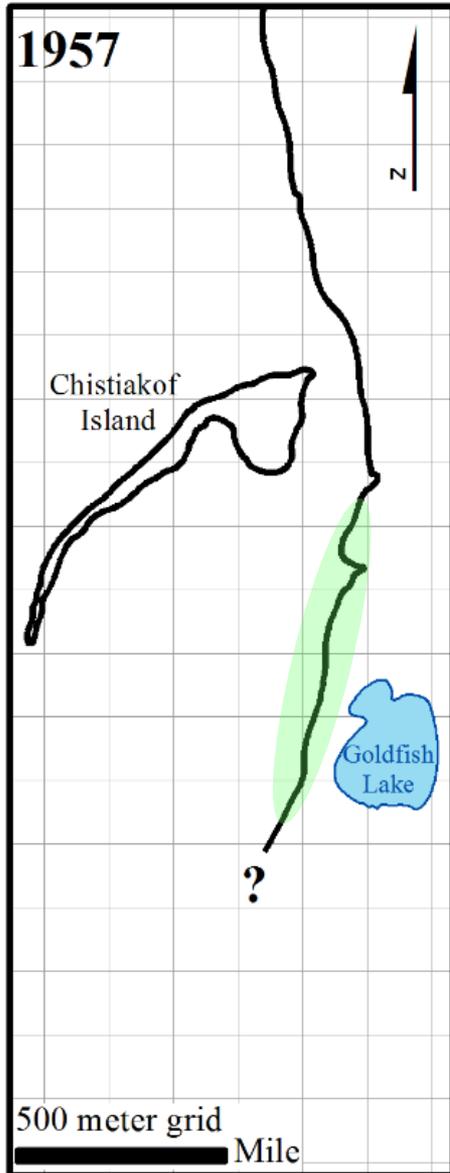
Shoreline Change



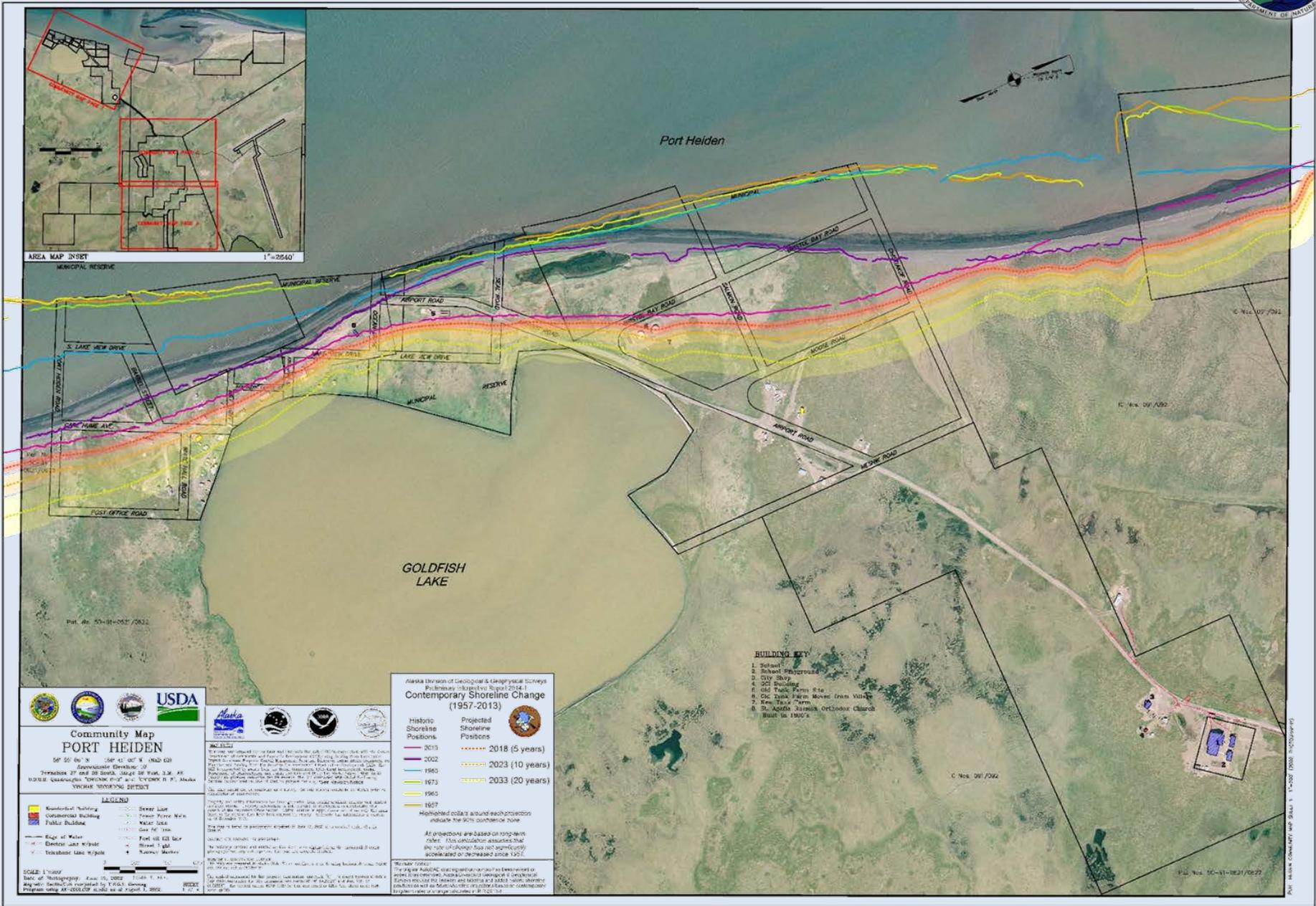
Changes in Shoreline Position (1957-2013)



PIR: Coastal Setting



Projected Shoreline Positions – revisited



GOLDFISH LAKE



**Community Map
PORT HEIDEN**
 56° 55' 00" N 156° 41' 00" W 10AD 031
 Approximate Elevations: 0'
 TOWNSHIP 07 AND 08 NORTH, RANGE 08 WEST, 3 & 4 W
 1015000 QUADRETER "CHICKEN EAT" and "TUCKER R. ST. ALASKA
 NAD83 TRANSVERSE MERCATOR

LEGEND

Residential Building	Sewer Line
Commercial Building	Water Main
Public Building	Water Lake
Water	Gas Line
Edge of Water	Food Oil Ctl Line
Electric Line 8/10kV	Power Line
Telephone Line 8/10kV	Survey Station

SCALE 1:5000
 Date of Digitization: June 25, 2002
 Date of Digitization: August 11, 2002
 Digitized by: Alaska Department of Natural Resources
 Projecting using: NAD83 UTM Zone 18N
 Projection using: NAD83 UTM Zone 18N
 Projection using: NAD83 UTM Zone 18N

Alaska Division of Geological & Geospatial Sciences
 Preliminary Interpretive Report 2014-1
**Contemporary Shoreline Change
(1957-2013)**

Historic Shoreline Positions
 2013
 2002
 1980
 1973
 1960
 1957

Projected Shoreline Positions
 2018 (5 years)
 2023 (10 years)
 2033 (20 years)

Highlighted collars around each projection indicate the 90% confidence zone.

All projections are based on long-term trends. This calculation assumes that the rate of change has not significantly accelerated or decelerated since 1957.

Monitor Locations
 The major AAGAS monitoring network is implemented on a regular basis. AAGAS monitors are located at 11 locations. Further details are available in the AAGAS report, including a list of AAGAS monitoring stations and their locations. AAGAS reports are available on the AAGAS website or by request from the AAGAS office.

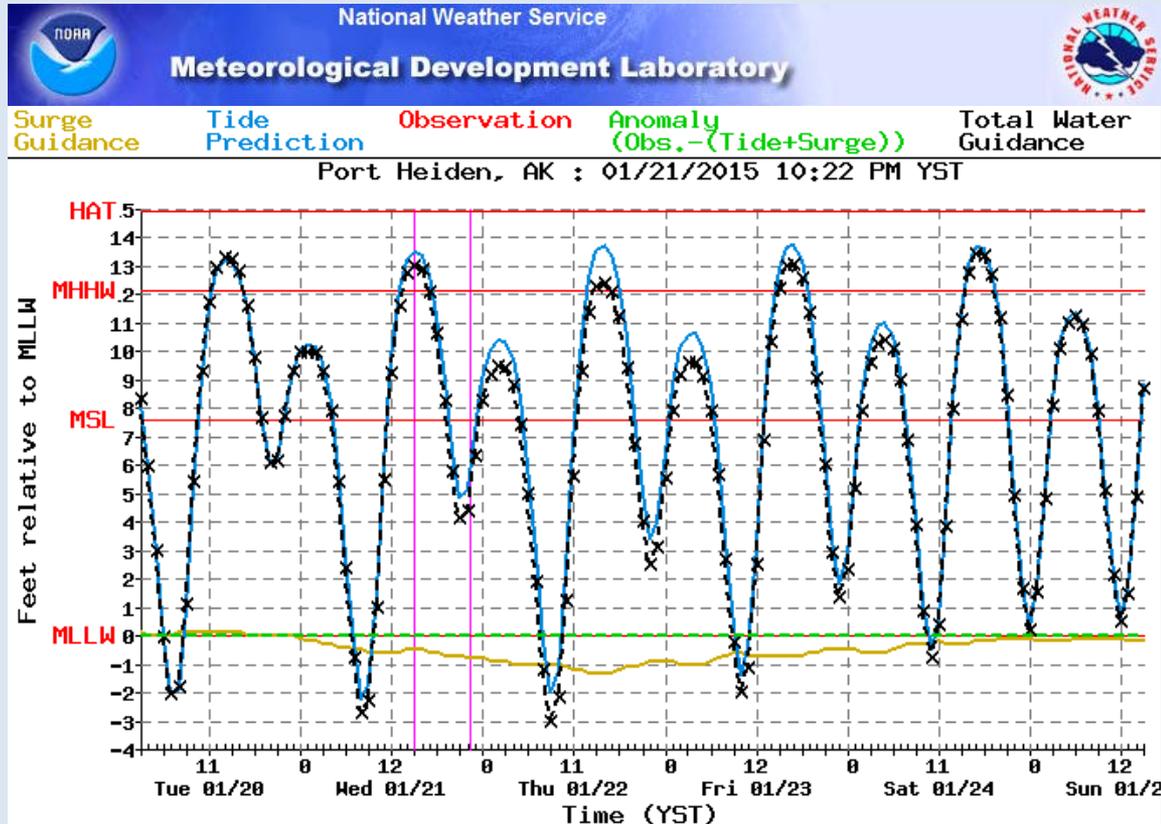
- BUILDING KEY**
- School
 - School Playground
 - City Shop
 - City Building
 - Old Tank Farm Site
 - Old Tank Farm Moved from Village
 - New Tank Farm
 - St. Agatha Russian Orthodox Church (Built in 1955)

PORT HEIDEN COMMUNITY MAP SCALE: 1" = 20540' (1:205400)

Ongoing work



- Extension of shoreline change assessment to 40 miles of shoreline, beyond Meshik
- Storm surge reanalysis work with NWS:



- Upcoming: Information Circular on shoreline change rates (w/ UAF science illustrator)
 - Types of shoreline indicators
 - Types of shoreline change
 - How shoreline change rates are calculated
 - Uncertainty associated with projected shoreline positions



New Interactive Map Resource (Spring 2015)

- Interactive map of historical and projected shoreline positions

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Shoreline

Alaska Division of Geological & Geophysical Surveys

State of Alaska > Natural Resources > Geological & Geophysical Surveys > Maps > Shoreline

Port Heiden [Zoom to extent]

- 1957
- 1963
- 1973
- 1983
- 2002
- 2009
- 2011
- 2013
- 2020 Projected
- 2025 Projected
- 2035 Projected

Unalakleet [Zoom to extent]

100 m
200 ft
Unknown
Google

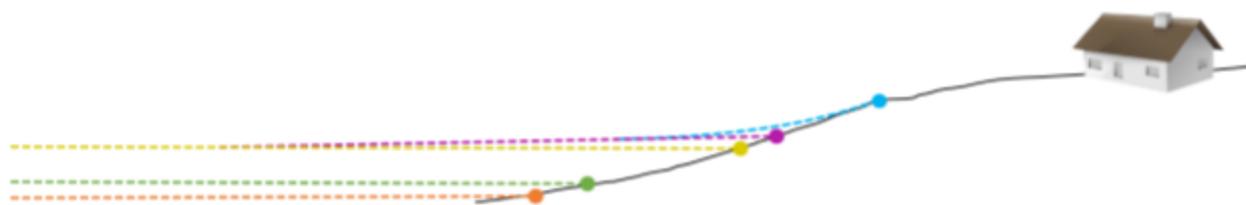
This interactive tool displays historic and predicted shoreline position throughout Alaska. Users can explore the coasts of the state to see where shoreline has been in the past, and where it will be in the future. Historic shoreline positions were determined by looking at aerial photographs and satellite imagery dating back to the 1950s. Using the Digital Shoreline Assessment Tool (DSAS), rates of shoreline change were calculated. These rates were then used to project shoreline positions. Each predicted shoreline has an uncertainty, shown by a collar of dashed lines, that represents a 90 percent confidence that the shoreline will be within that area for that year. Currently, historic shoreline data are available for download but predicted shoreline positions are not.

Thank you

- Coastal Impact Assistance Program
- Alaska Ocean Observing System



- Western Alaska Landscape Conservation Cooperative and Kimber Tweet (UAF)
- Scott Anderson (City of Port Heiden)
- Linda Anderson (LEO)
- Derek Luke
- Meagan DeRaps, Lauren Southerland and Rich Koehler (DGGS)
- Tatton Suter (USACE)



Coastal Storm Water Level Components			Full Definition	How determined	Easy Explanation
Mean Sea Level			The average height of all water levels in a local area under normal conditions	Tide Gauge	This is where the water level is usually located
Tide Level	Storm Tide Level	Total Water Level	Regular variation in the water level caused by sun/moon gravitational forces and the earth's rotation	Tidal Predictions modeled by NOAA	This includes both high and low tide levels under normal weather conditions
Storm Surge			Elevated ocean levels that arise from a combination of onshore-directed wind stresses and reduced atmospheric pressure	Forecasted by regional NWS ocean models	This is the overall rise in the water level due to storm conditions
Nearshore Setup			An increase in water level due to waves and the shoreward transport of water	Calculated or modeled based on local conditions and typical storm characteristics	An additional rise in the water level along open coastlines during a storm as waves 'pile up' against the shore
Wave Runup			The maximum height to which breaking waves can reach on a shoreface	Calculated or modeled based on local conditions and typical storm characteristics	Breaking waves have extra energy that can cause the water to rush up even higher in some locations. This is an elevation where your feet may be splashed but you are not standing in water.



Rates of Shoreline Change

