Alaska's Coastal Hazards Program
Serving Communities at Risk

2023 Association of American State Geologists Meeting

June 11-15, 2023

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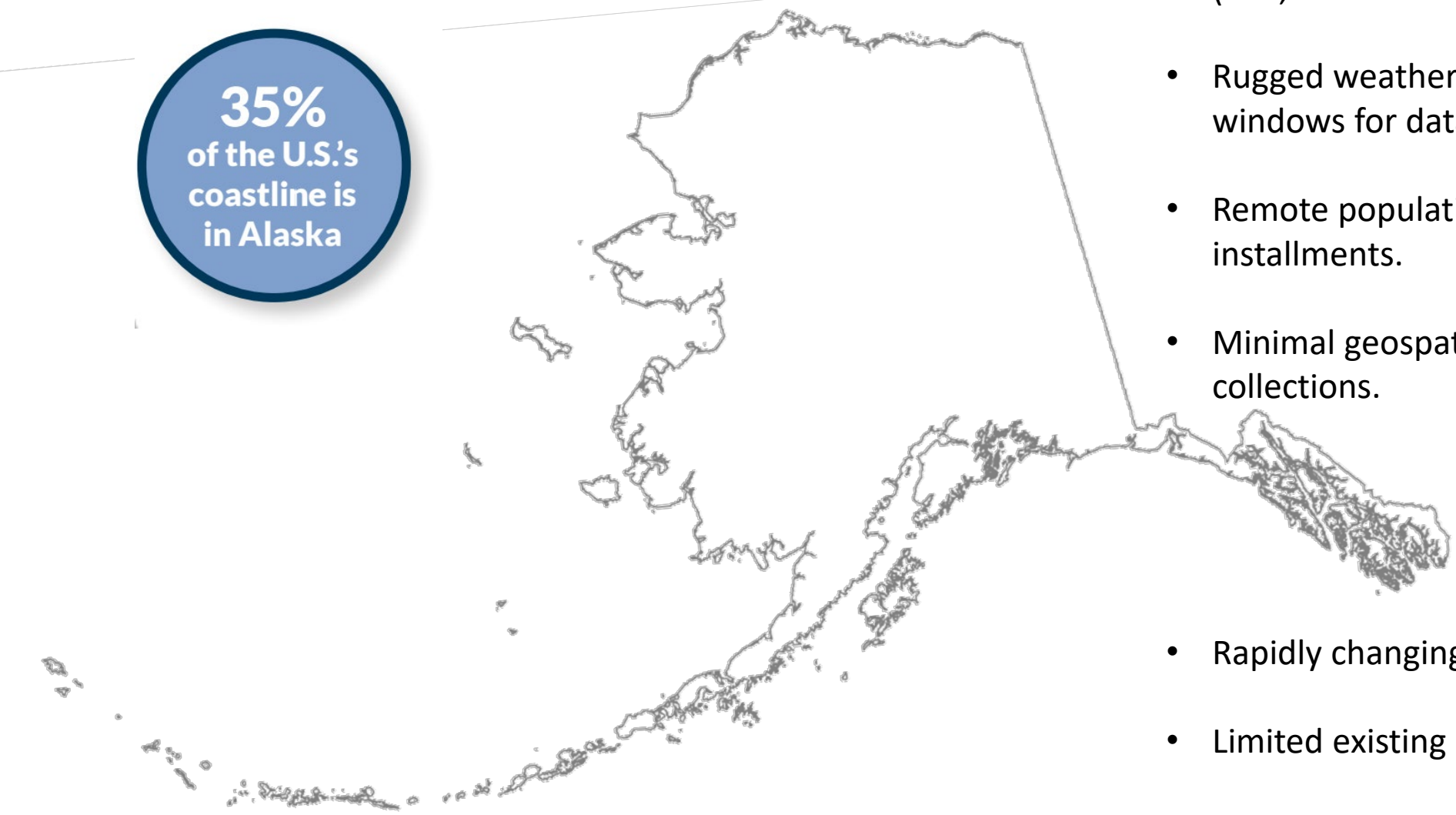
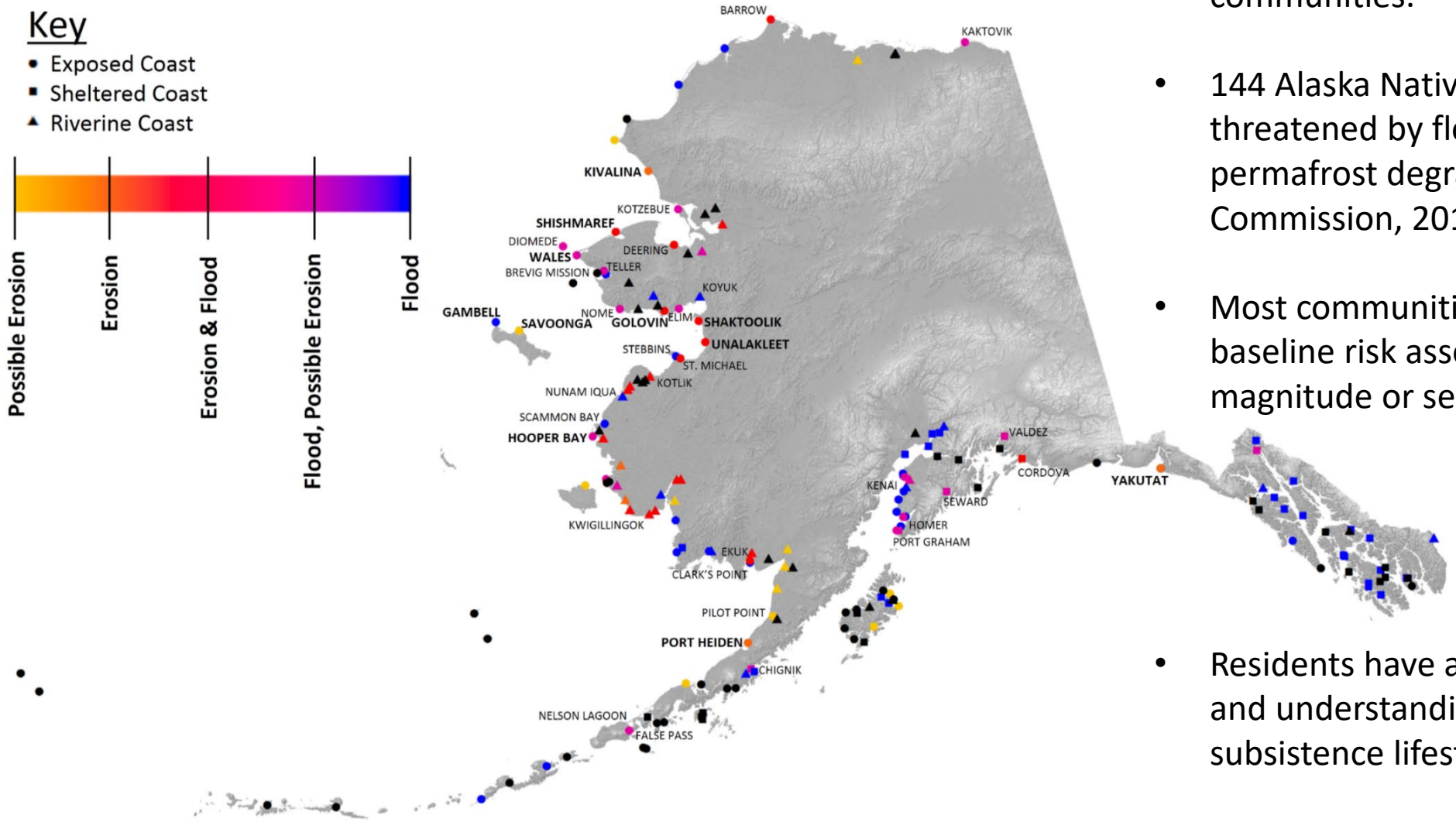
CHALLENGES



- Alaska has ~6,640 miles of coastline (>47,000 miles of tidal shoreline).
- Rugged weather conditions & short seasonal windows for data collection.
- Remote population centers & infrastructure installments.
- Minimal geospatial infrastructure to assist in collections.
- Rapidly changing environmental conditions.
- Limited existing data.

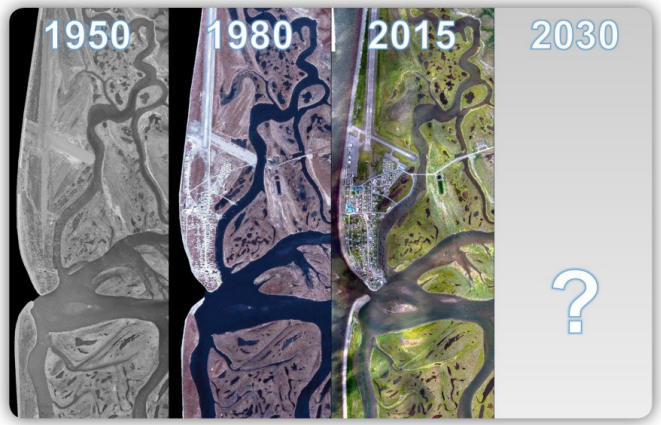
MOTIVATION



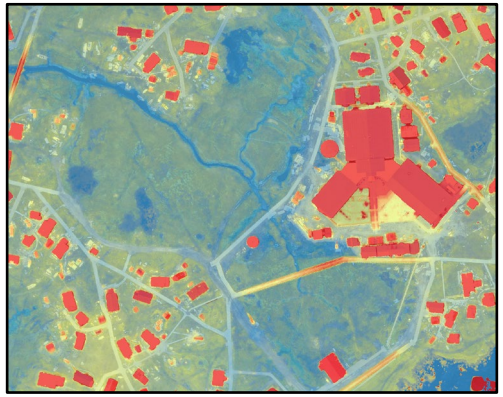
- 64% of Alaska residents live in coastal communities.
- 144 Alaska Native Communities are threatened by flooding, erosion, and/or permafrost degradation (Denali Commission, 2019).
- Most communities do not have access to baseline risk assessments to quantify the magnitude or severity of threats.
- Residents have a special relationship with and understanding of the coast given their subsistence lifestyles.

Enhance decision making support for coastal geohazard response and resource management by providing Alaskans with ***sound scientific investigations of coastal processes****.*

Baseline Data Collection

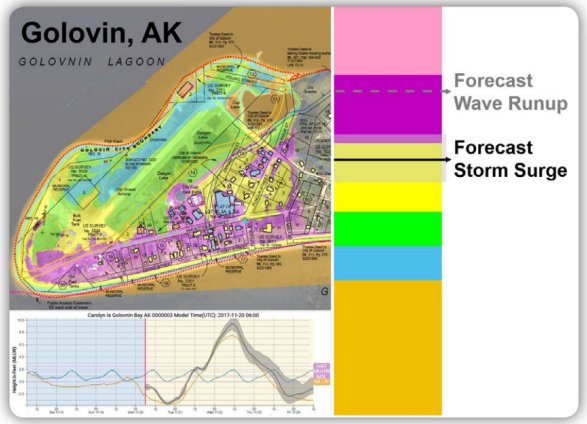


Coastal Data & Tools



Kipnuk, AK Digital Elevation Model

Statewide Flooding & Erosion Assessments



Community-based Monitoring for Flood & Erosion

Flood staff installation in Kongiganak, AK

Event Response

BASELINE DATA

Huge strides have been made to improve baseline coastal data related to flooding and erosion using new technology and collaborative approaches. However, **large gaps in baseline data still exist**.

Continuous monitoring efforts, both at the community level and statewide initiatives, are required to provide accurate assessments of vulnerability.

The DGGS Coastal Hazards Program regularly collects:

- UAS imagery/DSM
- Ground control points
- Historical flood points
- Coastal erosion profiles
- Historical flood assessments
- Single-beam bathymetry
- Water level sensor monitoring and replacement as needed

Alaskan Coastal & Riverine Communities at Risk

- Coastal communities of Western and Northern Alaska are regularly impacted by Bering Sea storms.
- Data gaps in national water level network and minimal oceanographic monitoring infrastructure are significant.

New Available Data

- Recent/upcoming releases of digital elevation models (DEM) and orthorectified aerial imagery over a large portion of western Alaska.
- DGGS Staff collects high-res orthoimagery and digital surface models (DSM) derived with photogrammetry.
- Community residents often collect on-the-ground photographs & can provide detailed accounts of historical storms.

Orthoimagery (2022) of Kivalina, AK.

Kotlik, AK.

Resident pointing out high water level.

Flood staff flood water levels (2017) Kwigillingok, AK.

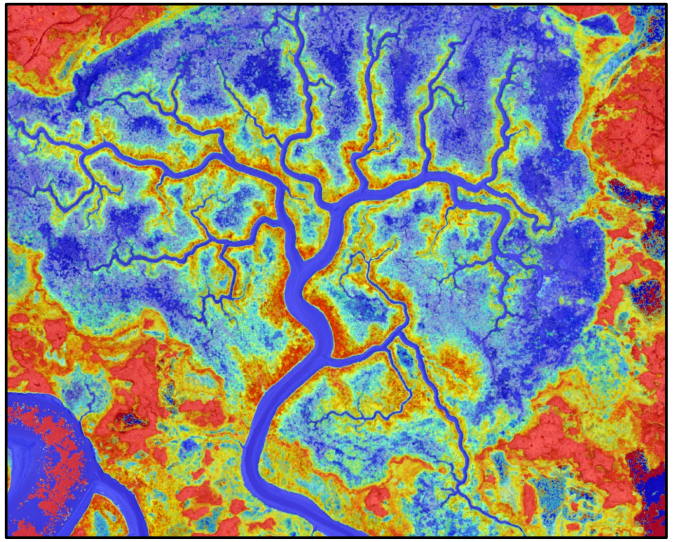
Other Resources

- Anecdotal accounts
- Photographs
- Remote sensing
- Orthorectified aerial imagery
- Digital elevation models (DEM)

Simulated elevation band flooding

Orthographic imagery on Kwigillingok, AK (2016)

Aerial photograph of Tuntutuliak, AK

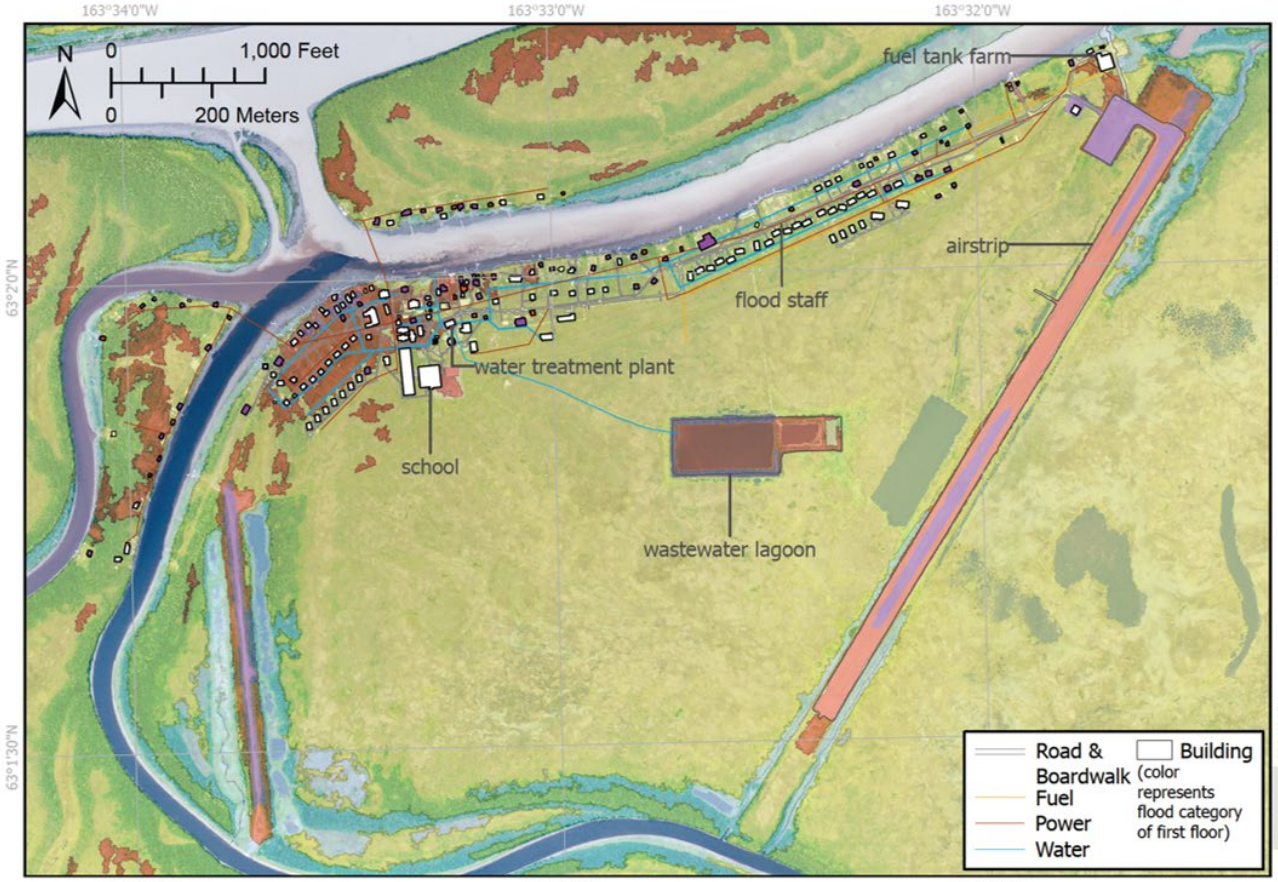


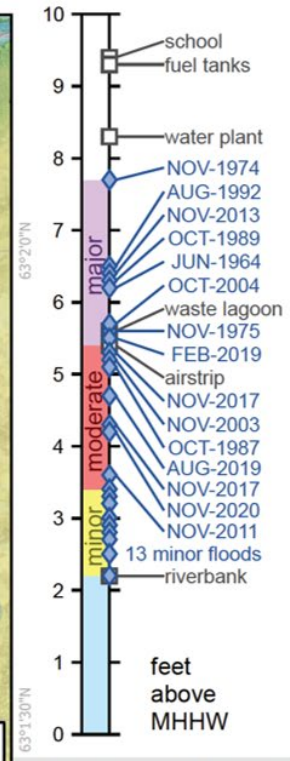
Digital elevation model (DEM) imagery

Aerial photograph of June 24, 2021 flood event in Kwigillingok, AK

Coastal Flood Impact Map
Kotlik, Alaska

REPORT OF INVESTIGATION 2021-1C
Buzard and others, 2021
KOTLIK, SHEET 1 OF 3





To calculate height above
MLLW: add 3.2 ft
NAVD88: add 6.3 ft

Projection: NAD 1983 2011 UTM Zone 3N
Orthoimagery available from elevation.alaska.gov
Houses or infrastructure may have moved since DCRA linework was completed

Major Flooding is defined to have extensive inundation of structures and roads. Significant evacuations of people and/or transfer of property to higher elevations are necessary.

Moderate Flooding is defined to have some inundation of structures and roads near the water. Some evacuations of people and/or transfer of property to higher elevations may be necessary.

Minor Flooding is defined to have minimal or no property damage, but possibly some public threat.

This work was funded by Bureau of Indian Affairs Tribal Resilience Program through a collaborative project with the Native Village of Bill Moore's Slough.

STATE OF ALASKA
DEPARTMENT OF NATURAL RESOURCES
DIVISION OF GEOLOGICAL & GEOPHYSICAL SURVEYS

website: dggs.alaska.gov

Major flooding: At what height...

1. Have several buildings been flooded with over 1 foot of water?
2. Have the fuel storage or power generation facilities flooded?
3. Has the airstrip been completely inundated?
4. Has flood water reached the drinking water source?
5. Has flood water reached wastewater facilities?

Moderate flooding: At what height...

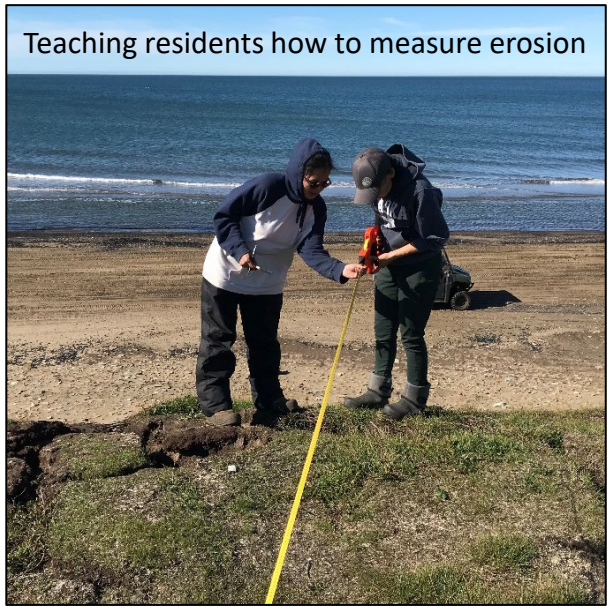
1. Have several buildings been flooded with up to 1 foot of water?
2. Have people in the lowest area(s) been evacuated to higher ground due to flooding?
3. Has flood water cut off access to larger parts of town?
4. Has flooding closed the airstrip?

Minor flooding: At what height...

1. Has water come into yards, or under elevated buildings?
2. Has flooding reached property (such as vehicles, not homes) in low lying areas?
3. Has flooding reached roads or the airport runway, but remained low enough to safely travel?

	Elevation Feature	Elevation (ft MHHW)	Vertical Uncertainty (ft)
Other	Evacuation center (school)	9.4	0.1
	Fuel tank farm platform	9.3	0.1
	Water treatment plant	8.3	0.1
Major	Highest recorded flood	7.7	0.4
	Several buildings (flooded 1 or more ft)	6.0	0.1
	Wastewater lagoon	5.6	1.3
	Lowest residences (flooded 0 to 1 ft)	5.5	0.5
	Airstrip covered	5.4	1.1
	Major	**5.4**	**1.1**
Moderate	Access way to lager parts of town	4.2	0.5
	Lowest building	4.1	0.1
	Airstrip use or access	3.5	0.5
	Moderate	**3.5**	**0.5**
Minor	Access road threatened	3.0	0.5
	Low-lying property	2.2	0.6
	Minor	**2.2**	**0.6**

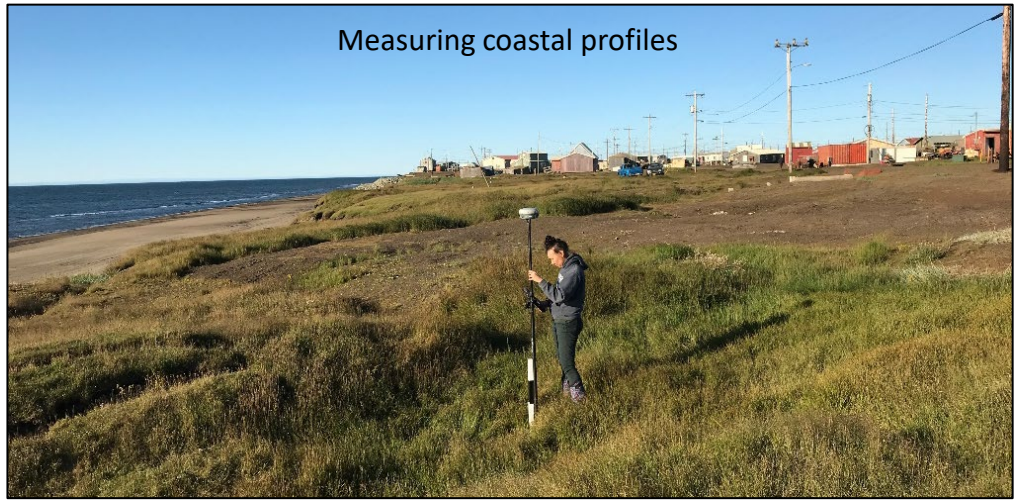
COMMUNITY-BASED MONITORING


Teaching residents how to measure erosion


Time-lapse camera


Community installing a flood staff in Kwigillingok, AK.


Tuntutuliak, AK


Measuring coastal profiles

ON-THE-GROUND FLOOD ASSESSMENTS & EVENT RESPONSE

- Community observations and photographic evidence during the storm event are crucial for storm height estimates.
- Otherwise, high water marks can also be collected by observing debris lines, but timing these events can be more challenging.
- Typhoon Merbok (2022) mobilized rapid deployment of DNR staff to several communities to collect high water marks, coastal profile measurements, and photograph evidence of flooding and erosion.

Compiled imagery available:
https://experience.arcgis.com/experience/cb90406da3804e8c83e1d75bff7aad0d
Raw Data File in review.


High water mark survey (Shaktoolik, AK)


DGGS & DMLW staff meeting with Gov. Mike Dunleavy (front right) in Newtok, AK.

Flood inundation in Teller, AK during Typhoon Merbok (left) surveyed once water receded (right)

DATA ACCESSIBILITY

Community flooding, erosion, and permafrost risk assessment status
Use the dropdown in the top right to view data.

Type or Select Community
Kwigillingok

Kwigillingok

General Information

Population	333
Geographic Setting	coastal river

Statewide Threat Assessment

Community	Kwigillingok
Flood Group	3
Erosion Group	
Permafrost Group	
Combined Group	

Baseline Data

Historical Aerial Imagery:	Complete
Time Period:	1953, 1980, 2004, 2015
Date Completed:	2020
Source:	DGGS
Link:	
Modern Imagery:	Complete
Date:	2015
Note:	fixed-wing
Source:	DGGS
Link:	Ortho
Topography:	Funded
Date:	2021
Date:	2021

Monitoring

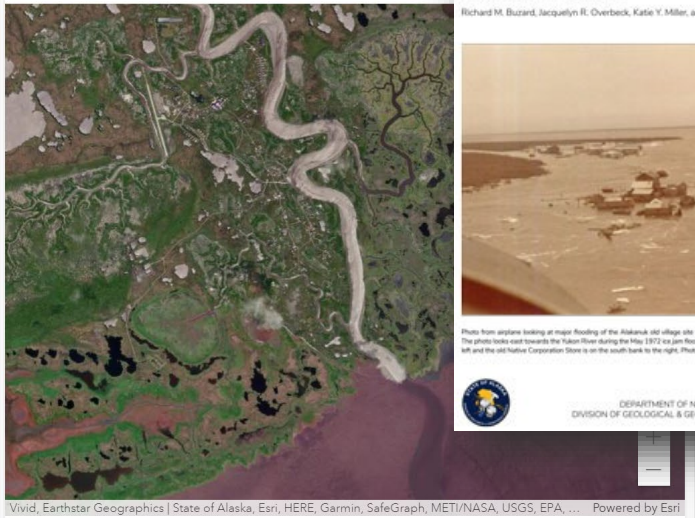
Coastal Elevation Profile Status	Not recommended
Date	
Source	
Link	
Community Based Erosion or Flood Monitoring	In progress
Date	2017, 2021
Source	Alaska Institute for Justice, AOOS, NCRF
Link	Monitoring Site

Risk Assessment

Historical Shoreline Change Rate:	Complete
Date:	2020
Source:	Denali Commission
Link:	Shoreline Change Report
Historical Flood Assessment:	Funded
Date:	2021
Source:	NCRF
Link:	
Baseline Erosion Forecast:	Complete
Date:	2021
Source:	Denali Commission
Link:	View
Hydrodynamic Flood Model:	Recommended
Date:	
Source:	
Link:	
Sediment Transport Mo	
Date:	
Source:	
Link:	
Permafrost Assessment:	
Date:	
Source:	
Link:	
Engineering Analysis:	
Date:	
Source:	
Link:	
Engineering Report:	
Date:	
Source:	
Link:	

Direct Link:
https://soa-dnr.maps.arcgis.com/apps/opsdashboard/index.html#/ba8ebf93adec4b6d9f601e2d59179fdd

Map for Search Results



Water Level Data
More information at Alaska Water Level Watch

NOAA Real-Time Water Level ID	None
Alternative Water Level Activity	iGage
Status	Operational
Date	2021
Source	View
NOAA Tidal Datum ID	9465911
Date	2019
Duration	2 months
Datum Tie PID	BBGM54
Status	Complete
Source	NOAA
Link	View

Stillwater Tech iRadar Water-level Sensor

DGGS Coastal Hazard Photo Database

Title
Kipnuk Storm 2016 October 28 p01

Credit
Facebook

Description
Flood waters at Kipnuk clinic looking northeast

Taken
10/28/2016

Tagged
storm, flood, October, Kipnuk, 2016

Kipnuk Storm 2018 October 4 p01
Facebook

Kipnuk Storm 2016 October 28 p01
Facebook

Kipnuk Storm Oct 28 2016 p06
Kipnuk EPA IGAP

Kipnuk Storm Oct 28 2016 p03
Kipnuk EPA IGAP

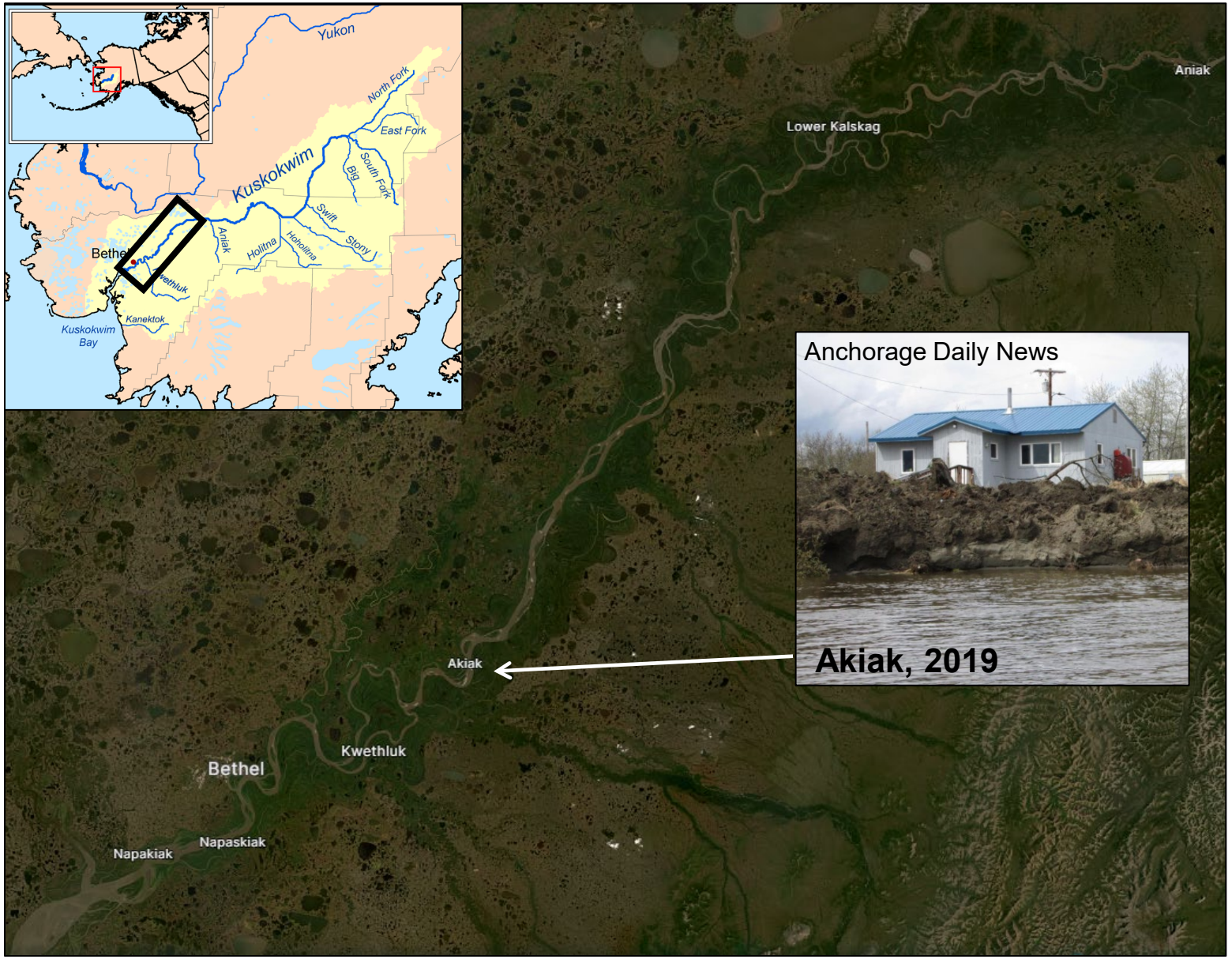
COMMUNITY CONNECTION

Historic accounts from village elders

Children in Stebbins supervising deployment of a bathymetry survey

Children in Kwigillingok helping w/ permafrost probe

Science outreach with children

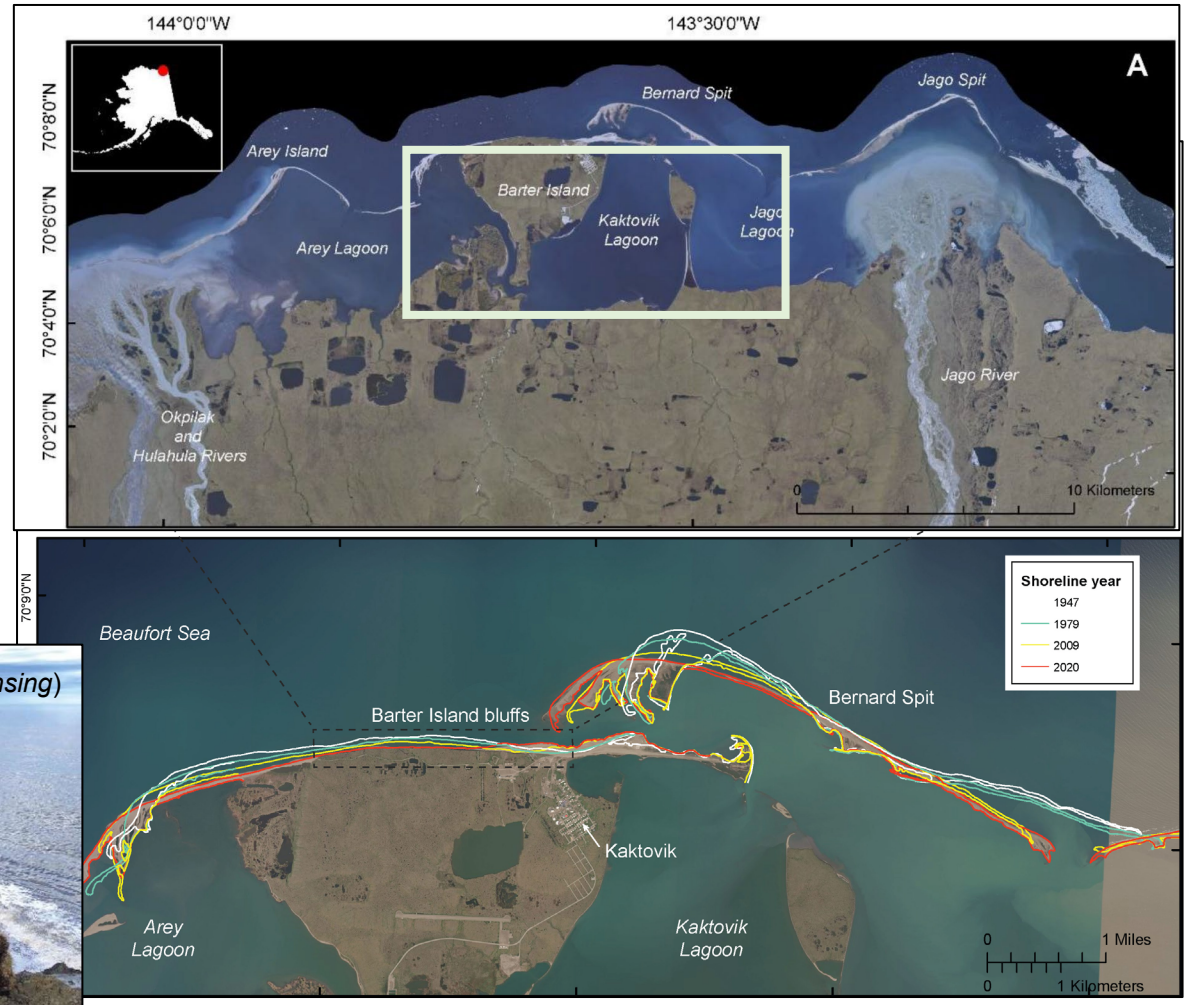


Addressing hazards faced by riverine communities

- Collect baseline data to inform flood & erosion modeling for threatened riverine communities.
- Perform geologic mapping of fluvial deposits (active & inactive channels, terraces, and alluvium).
- Incorporate historical aerial & satellite data to extend timescale of documented fluvial evolution.
- Collect targeted lidar & drone-based digital surface models around each community to provide necessary resolution for planning / decision making.

Coastal bluff geology, stability, outlook

- Perform geologic field mapping surrounding areas prone to coastal erosion.
- Document the underlying coastal bluff geology, stratigraphy, & ice content in areas that are experiencing significant change.
- Stratigraphy and composition of the bluffs plays an important role in coastal bluff erosion.
- Include assessment of bluffs along the coast to provide new **GEOLOGIC** information to Alaska's coastal communities.



Gibbs et al. (2021 *Remote Sensing*)

Thank you!

CONTACT INFORMATION

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