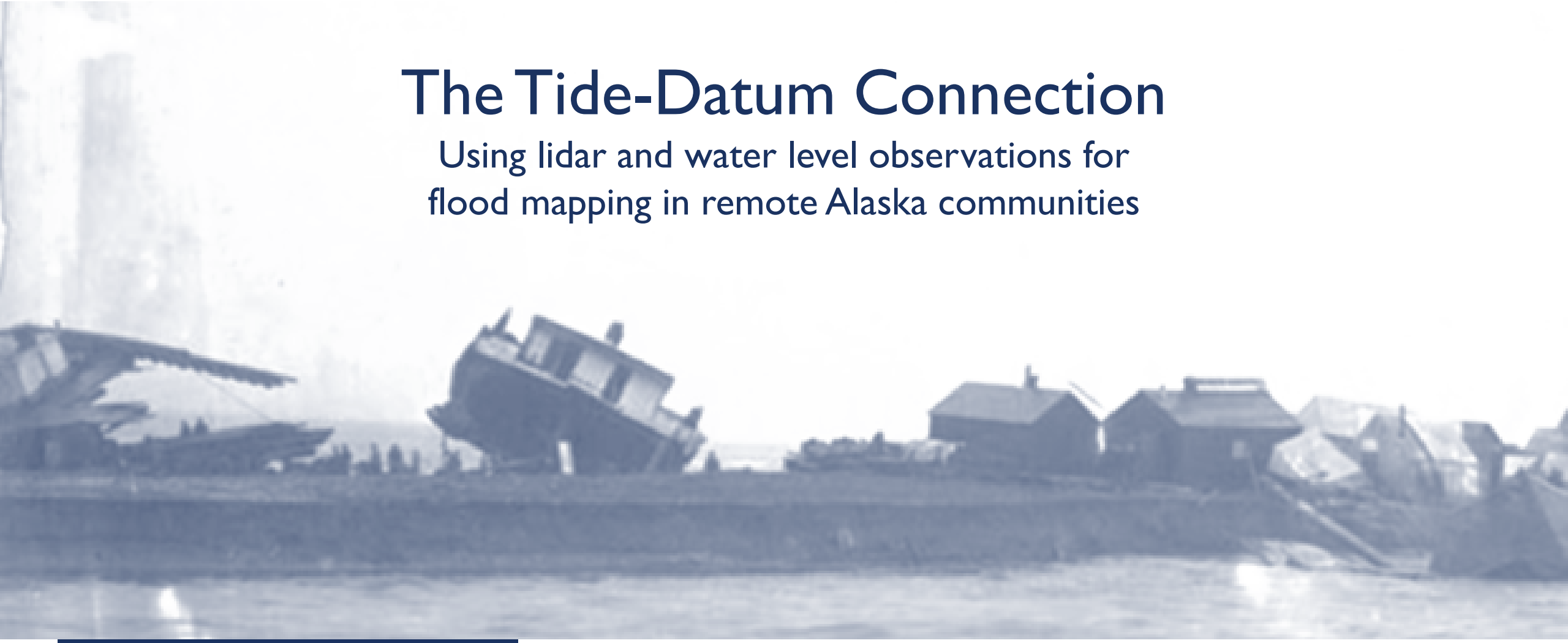
The Tide-Datum Connection

Using lidar and water level observations for flood mapping in remote Alaska communities



Presented by
Richard Buzard

Alaska Division of Geological
& Geophysical Surveys

NSGIC
National States Geographic Information Council

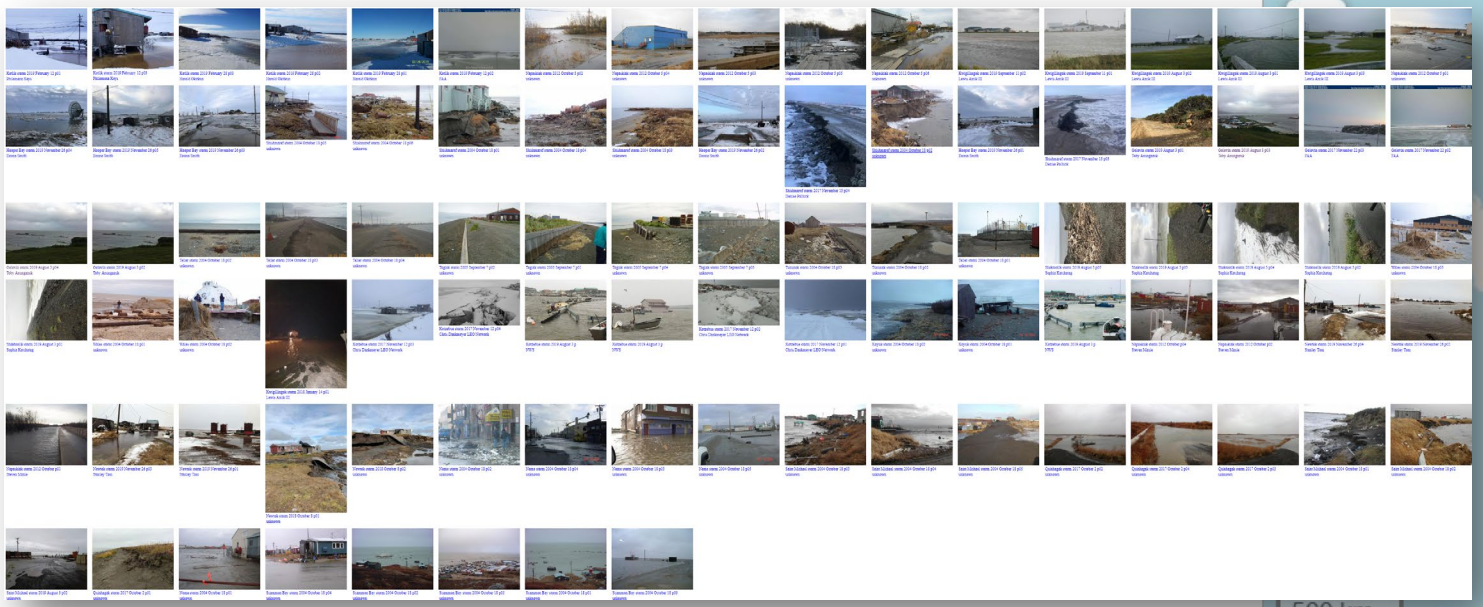
ALASKA NATIVE
TRIBAL HEALTH
CONSORTIUM

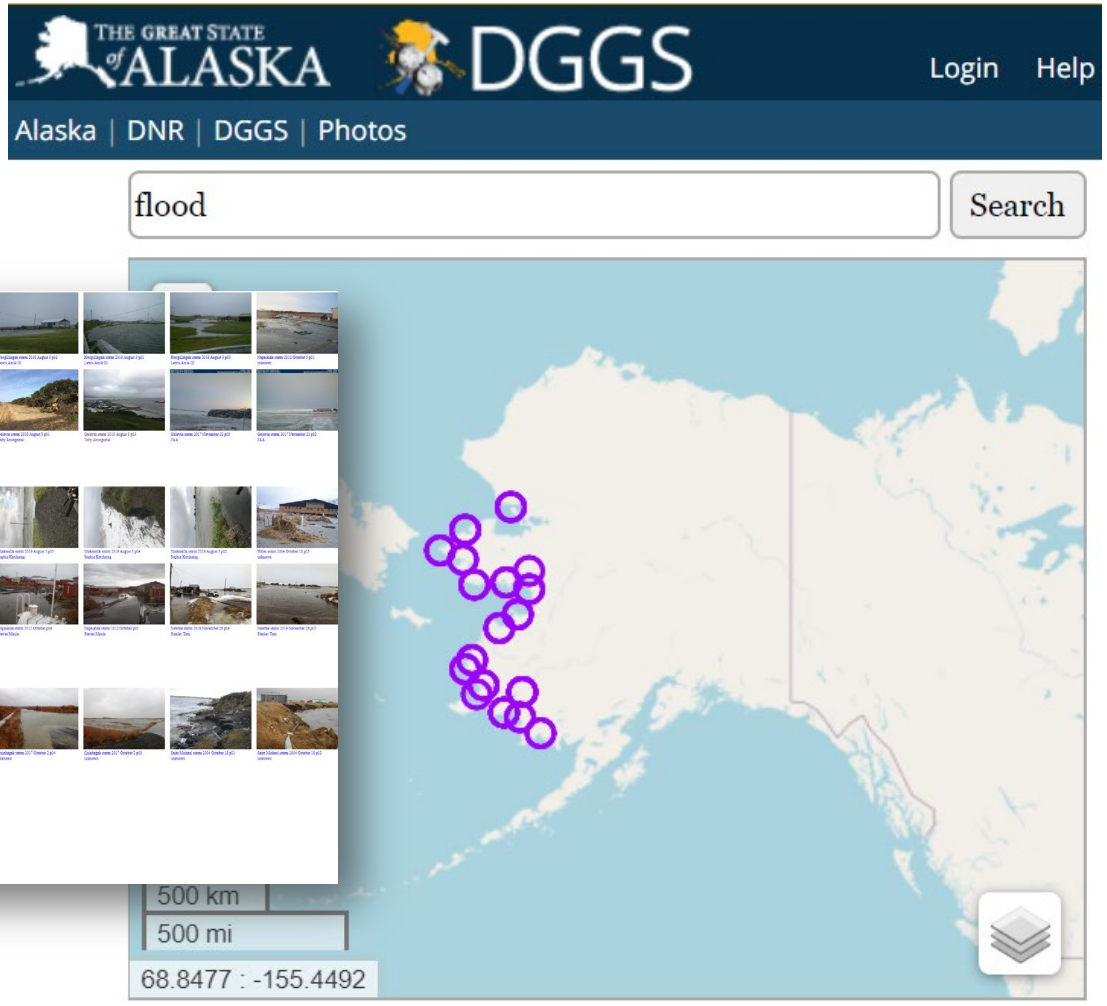
NFWF

AOOS
Alaska Ocean Observing System

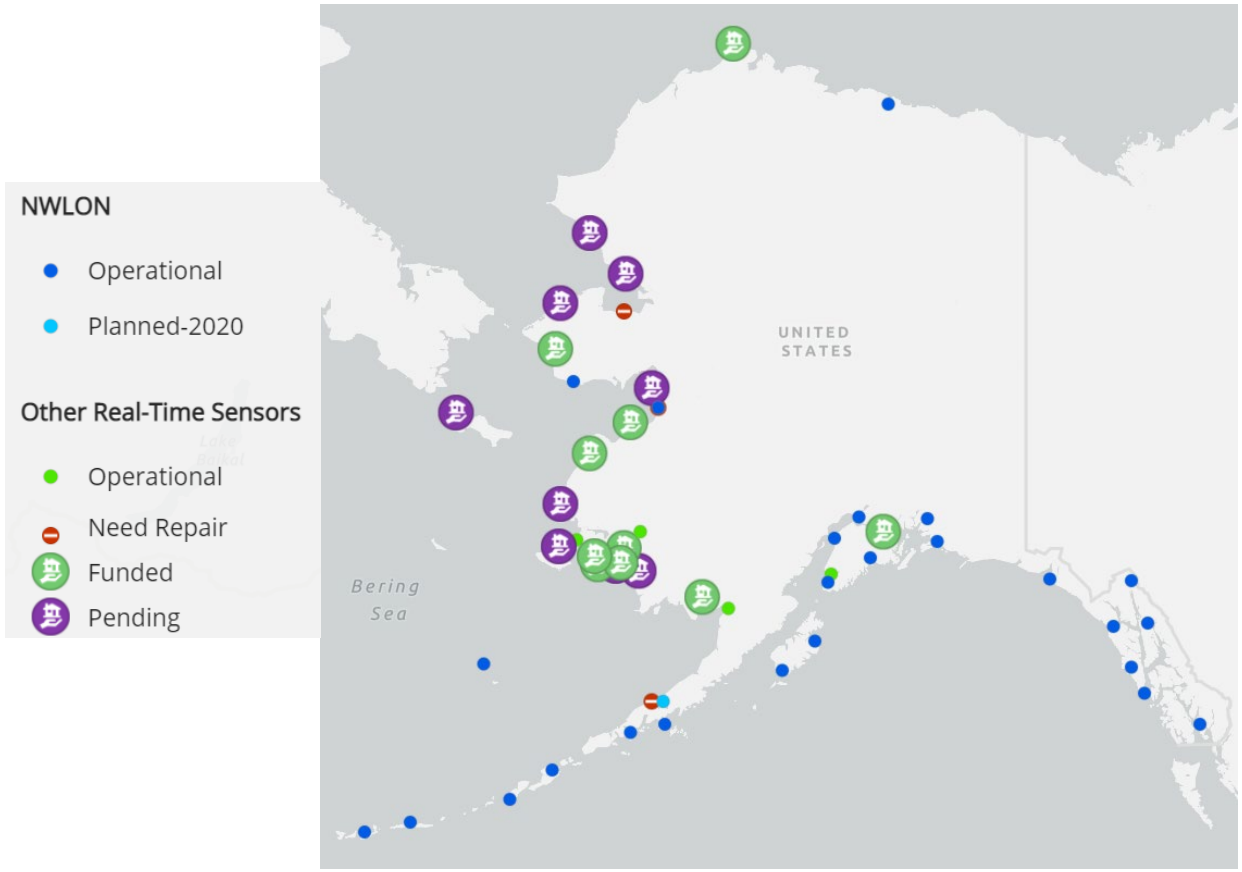
Storm surge flooding affects every coastal community in western Alaska

https://maps.dggs.alaska.gov/photodb/





On the west coast, water level sensors are scarce, so flood heights are unknown



Many documents describe flooding, so we started piecing them together (Golovin example)

- Flood is mentioned
- Flood is not mentioned
- Flood occurred outside time of source

"Standing water rose as high as Antone Street, but no significant overtopping occurred."

Storm surge flood events (23 total)

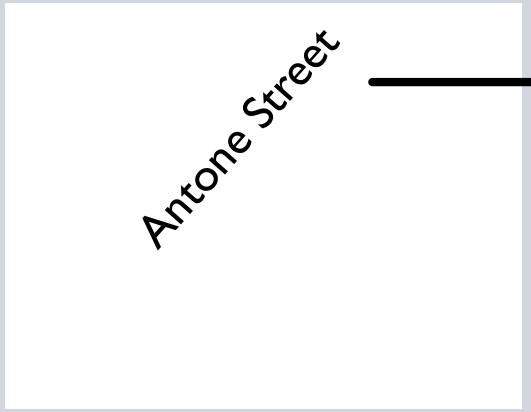
Source	Description	# of storms in report	1900-SEP-12	1913-OCT-05	1945-OCT-28	1946-OCT-25	1960-OCT-02	1974-NOV-10	1977-SEP-12	1992-OCT-05	2002-OCT-08	2003-SEP	2003-NOV-01	2004-OCT-19	2005-SEP-22	2008-JAN	2009-NOV-11	2011-NOV-08	2012-OCT-05	2013-NOV-09	2016-OCT-29	2016-DEC-30	2017-OCT-13	2019-FEB-11	2019-AUG-03
City of Golovin (2015)	Local HMP Update	9		■	■	■				■			■	■	■		■	■	□						
City of Golovin (2008)	Local HMP	10	■	■	■	■		■		■	■			■	■	■	■								
USACE (2017)	Local Flood Report (online)	3								■					■		■		□	□	□	□			
USACE (2007)	Local Erosion Report	4								■		■		■	■										
USACE (2000)	Local Flood Report (print)	3		■	■					■															
Wise *et al.* (1981)	State Storm Damage Report	4			■	■		■	■																
Chapman *et al.* (2009)	Regional Storm Surge Model	3					■	■						■											
These + others	Science, news, local reporting	**23**	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■

Measuring flood heights using observations and lidar

1) Take storm observation

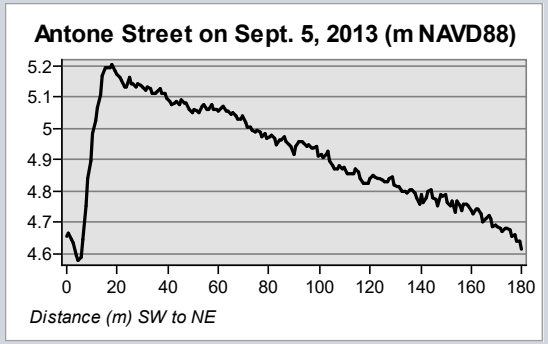
"Standing water rose as high as Antone Street, but no significant overtopping occurred."

2) Find location



3) Measure height

Elevation profile from lidar



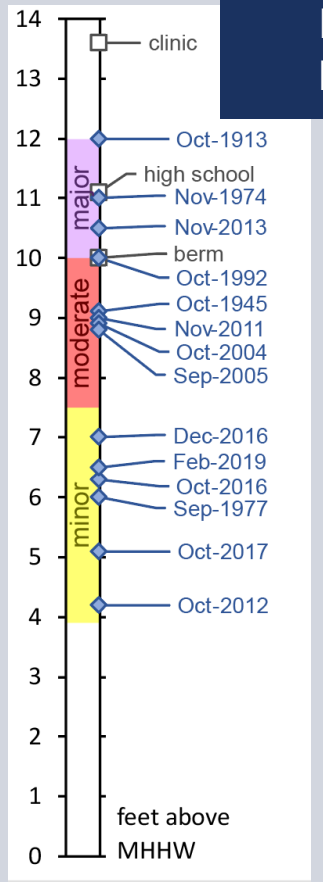
Still water height is min. road height:

4.6 m NAVD88

10.5 ft MHHW

4) Repeat

Flood History
Frequency
Height
Impact



To calculate height above
MLLW: add 1.7 ft
NAVD88: add 4.6 ft

Few communities have such good documentation

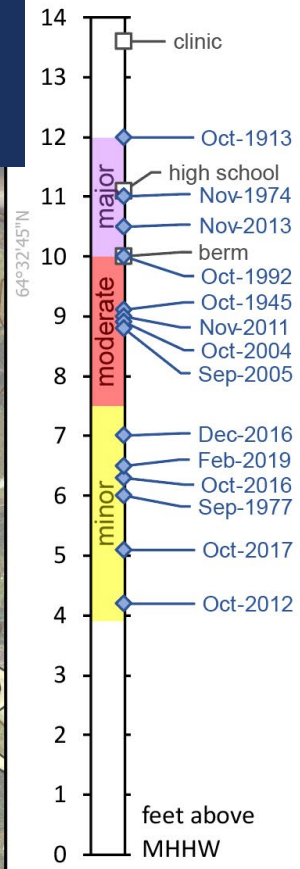
We need water level models

Map of Flood Categories

DRAFT Coastal Flood Impact
Golovin, Alaska

REPORT OF INVESTIGATIONS 2020-X
Buzard and others, 2020
SHEET GOLOVIN

Flood History
Frequency
Height
Impact



To calculate height above
MLLW: add 1.7 ft
NAVD88: add 4.6 ft

Projection: NAD 1983 2011 UTM Zone 3N
Orthoimagery available from elevation.alaska.gov
Contours drawn at 20 ft intervals above MHHW
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.

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

The State of Alaska makes no expressed or implied warranties (including warranties for merchantability and fitness) with respect to the character, functions, or capabilities of the electronic data or products or their appropriateness for any user's purposes. In no event will the State of Alaska be liable for any incidental, indirect, special, consequential, or other damages suffered by the user or any other person or entity whether from the use of the electronic services or products or any failure thereof or otherwise. In no event will the State of Alaska's liability to the Requestor or anyone else exceed the fee paid for the electronic service or product.

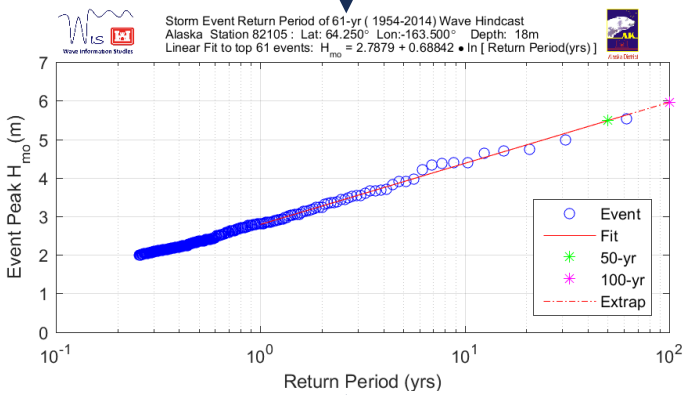
website: dggs.alaska.gov

This work is a part of the Digital Coast Fellowship project: Bringing Alaska to the Digital Coast. The analysis was paid for by the National Oceanic and Atmospheric Administration Office for Coastal Management, and the State of Alaska.

Determining flood **risk**

Risk is measured by **probability** and **severity** of hazards.

Water level model

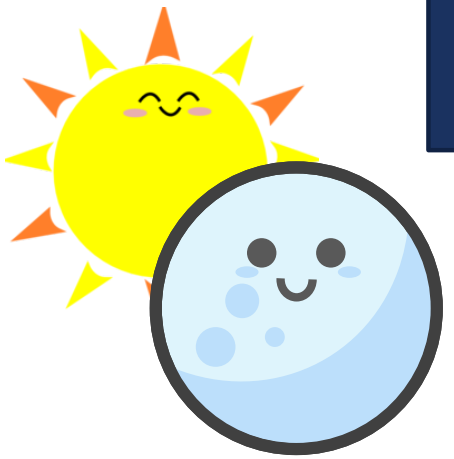


Elevation model

30-year event according to this model

- Each year, there is a 1 in 30 chance of a major flood

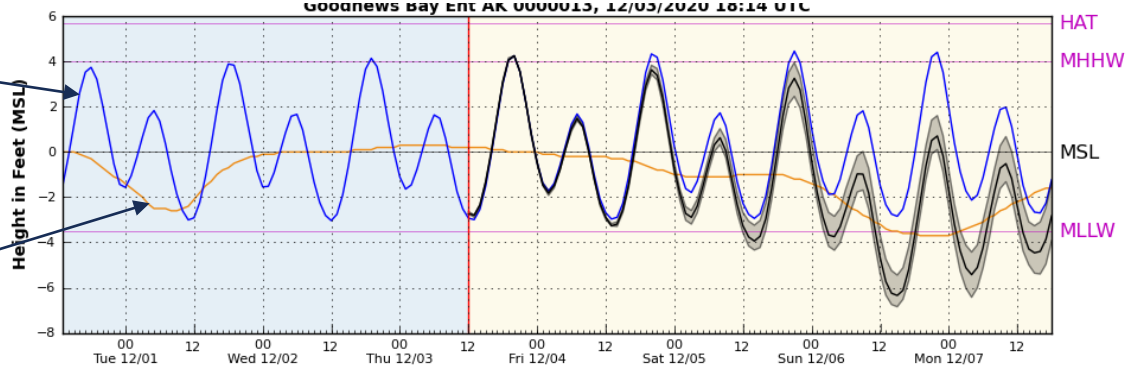
Why the disconnect?



Water level models

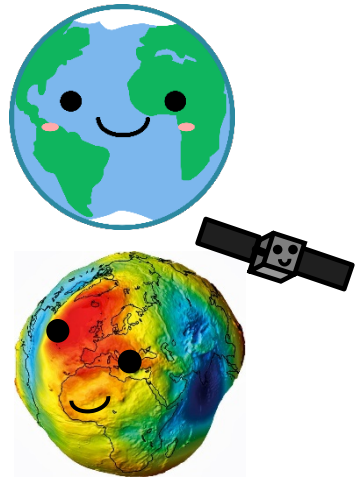
Tidal datum
Predicted sea level

Storm surge
Deviation from sea level



Why the disconnect?

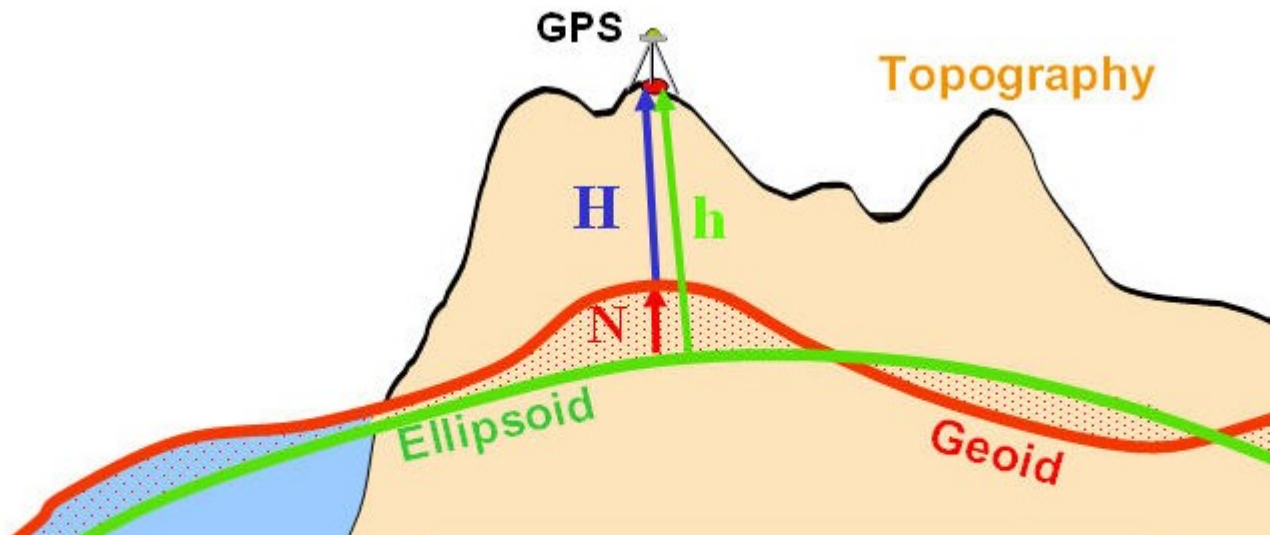
Elevation models



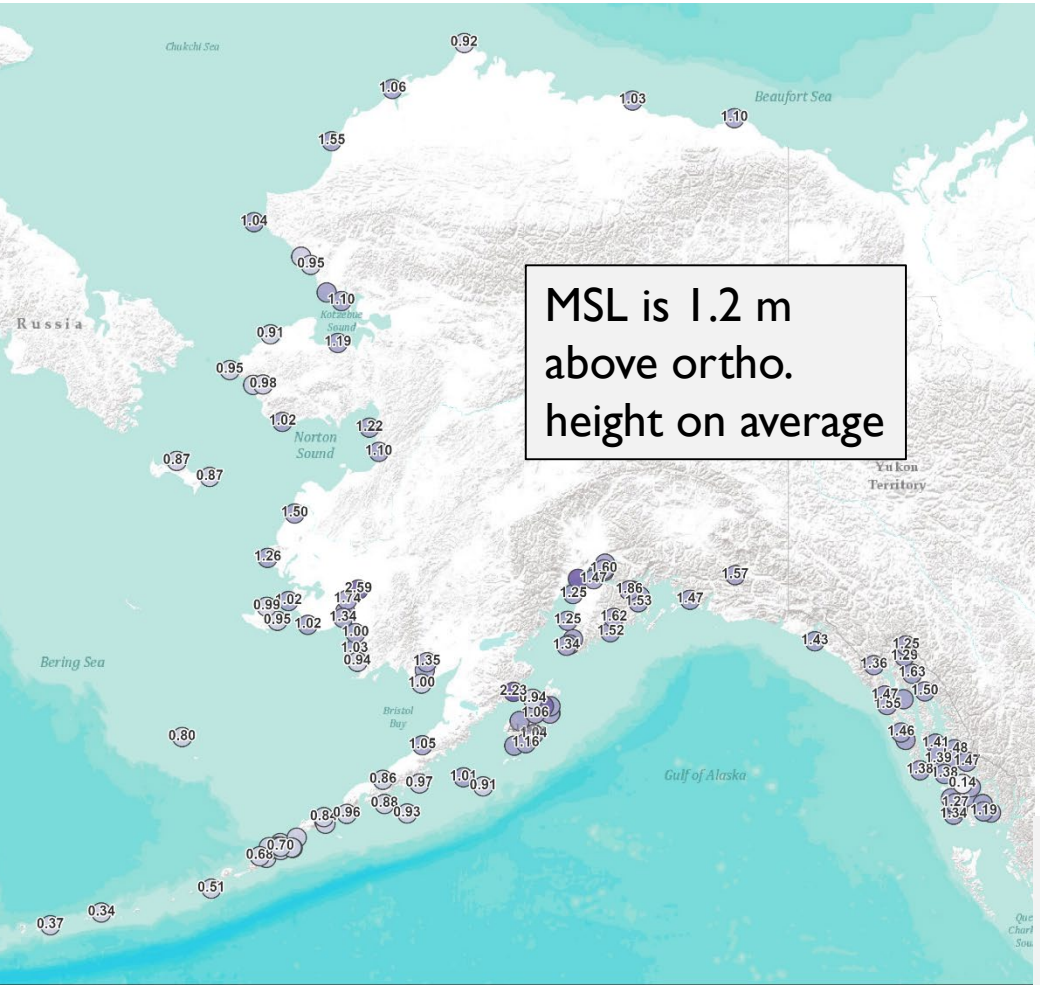
Lidar
Elevation above…

Orthometric height is for practical purposes
'height above sea level.'
- Wikipedia

Do you know why this makes coastal surveyors mad?

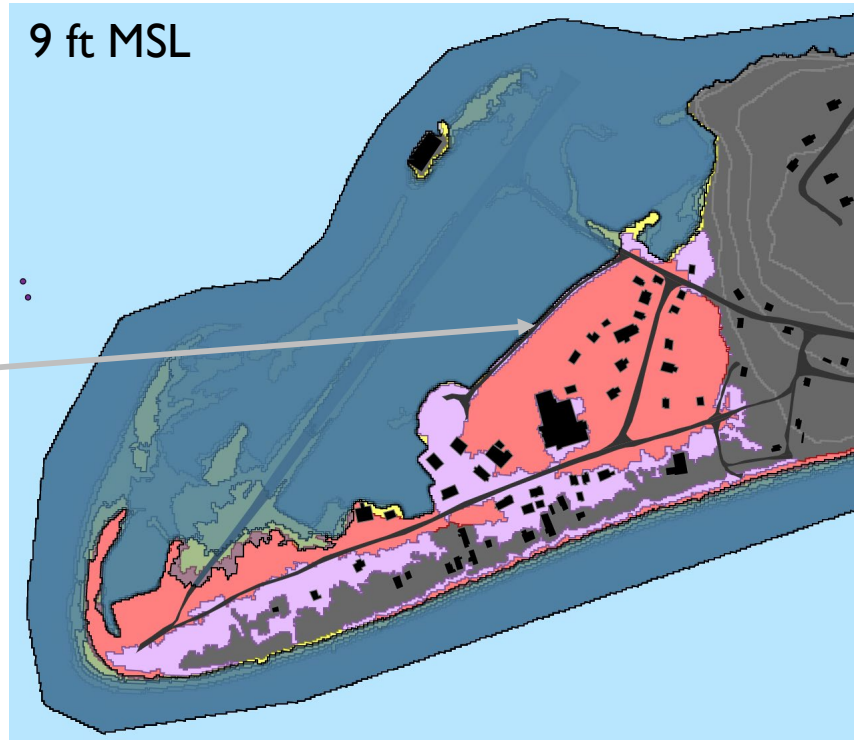


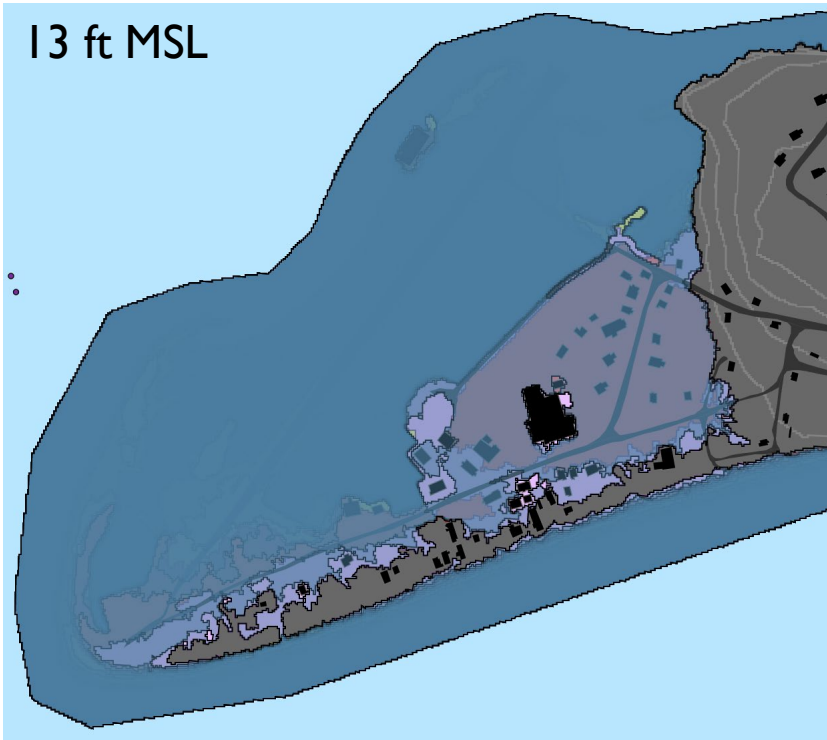
Orthometric height is not equal to MSL



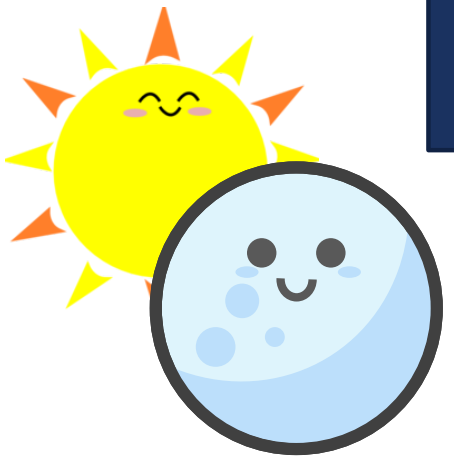
Tidal Datum Calculator
https://dggs.alaska.gov/hazards/coastal/ak-tidal-datum-portal.html

A difference of 1.2 m (4 ft) can drastically change a water level model





Connecting the tidal datum and elevation model is critical for flood models and forecasts

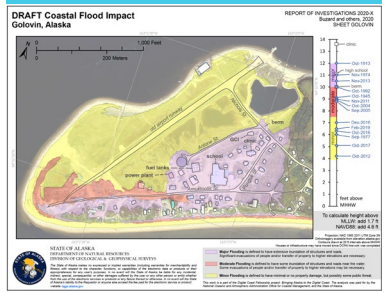


Water level models

Tidal datum
Predicted sea level

Storm surge
Deviation from sea level

Flood model
Flood history
Flood risk
Flood forecasts

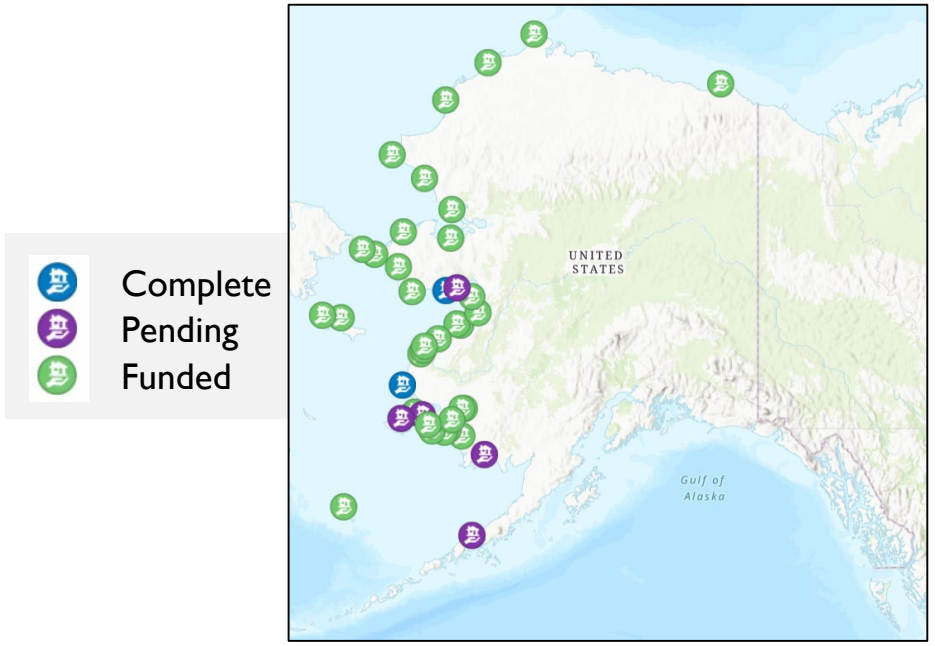


Elevation models

Lidar
Elevation above…

Flood histories are coming!

Richard Buzard
Coastal Geologist
richard.buzard@alaska.gov



Jacquelyn Overbeck
Program Manager
jacquelyn.overbeck@alaska.gov

Alaska Division of Geological & Geophysical Surveys
Coastal Hazards Program
https://dggs.alaska.gov/hazards/coastal/
907-451-5026

NSGIC
National States Geographic Information Council

AOOS
Alaska Ocean Observing System