TECHNIQUES FOR COASTAL MONITORING IN ALASKA

Beach Profiles

March 31, 2016
UAF Guest Lecture

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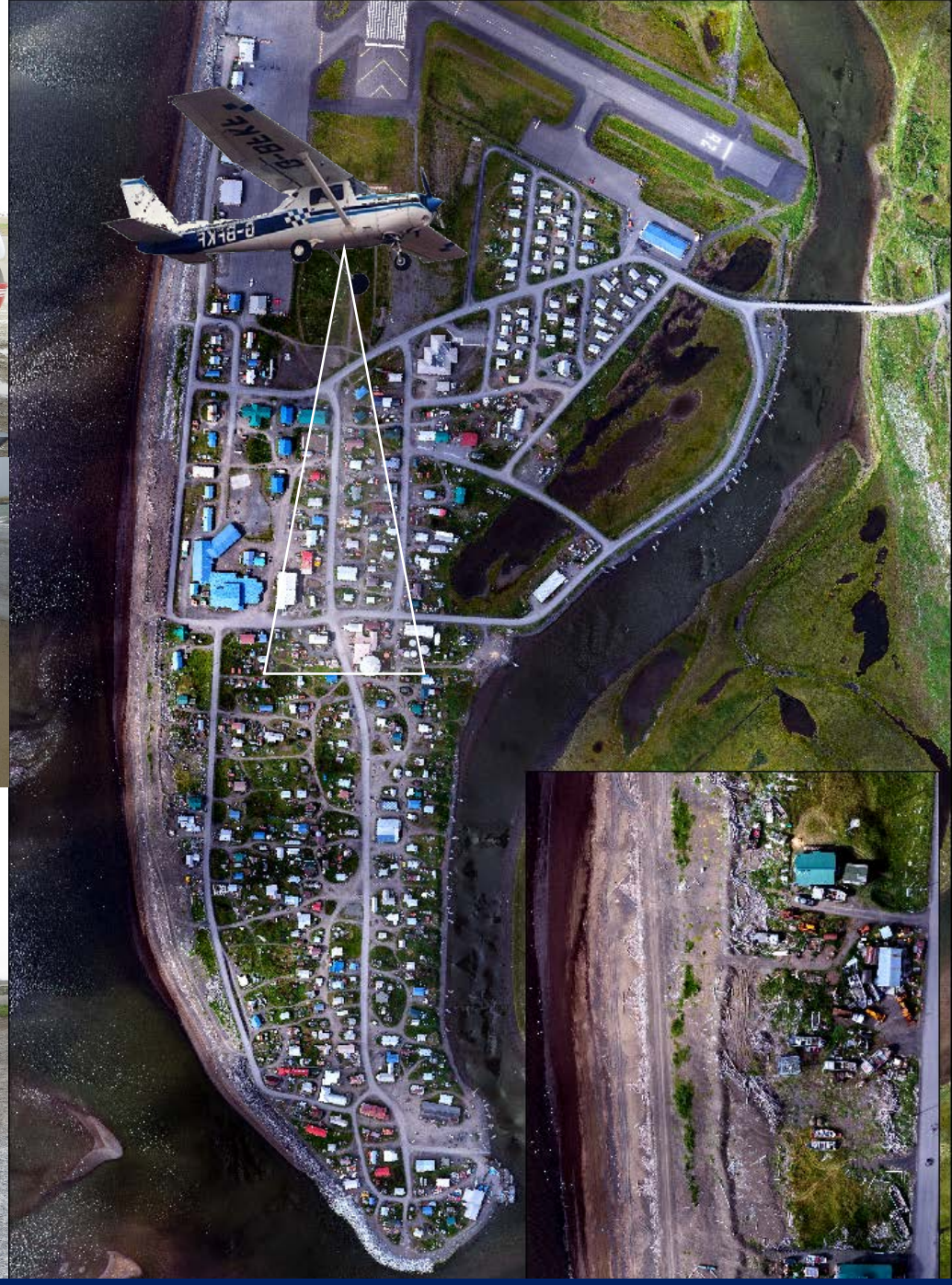
COASTAL HAZARDS PROGRAM AT DGGS

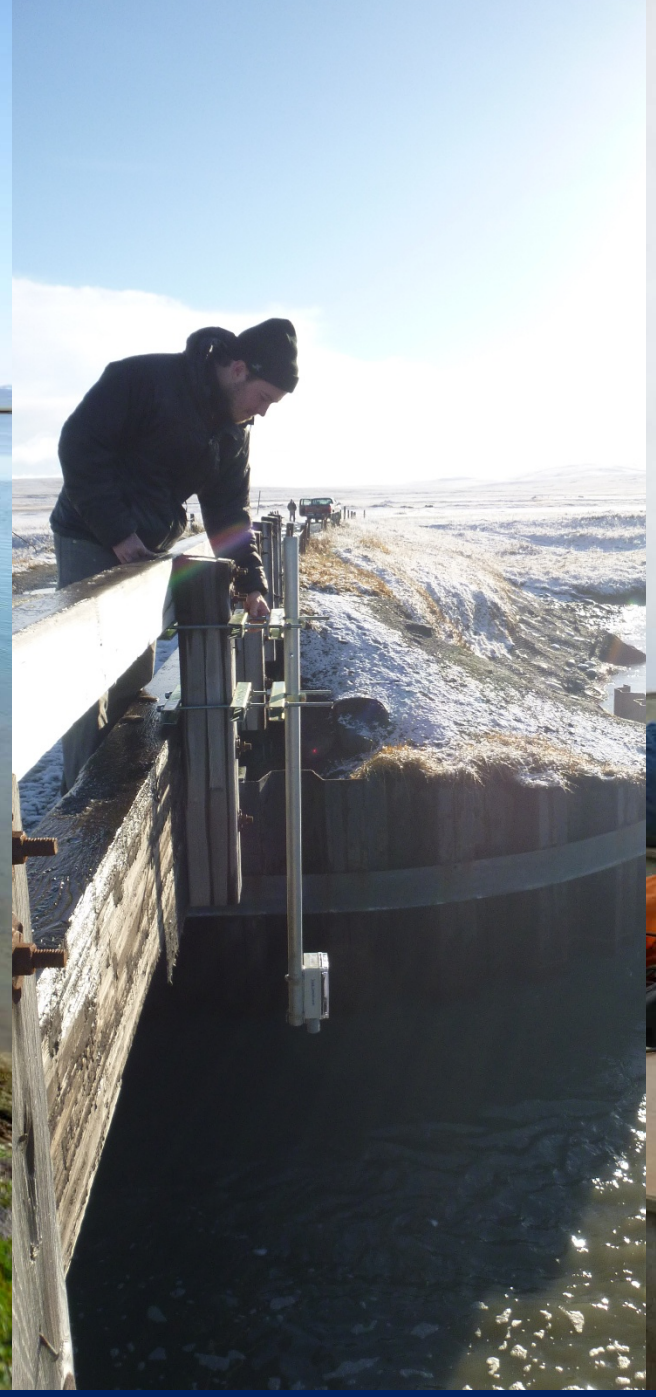
TOPICS OF INVESTIGATION

- Geohazard Evaluation and Geologic Mapping for Coastal Communities
- Coastal Topography
- Water Level Investigations
- Nearshore Bathymetry
- Coastal Preparedness
- Tsunami Research and Inundation Mapping for Alaska Communities

BACKGROUND



BACKGROUND



COASTAL PROFILES

What are they?

How do scientists use them?

How are they measured?

Let's go measure!

WHAT IS A COASTAL PROFILE?

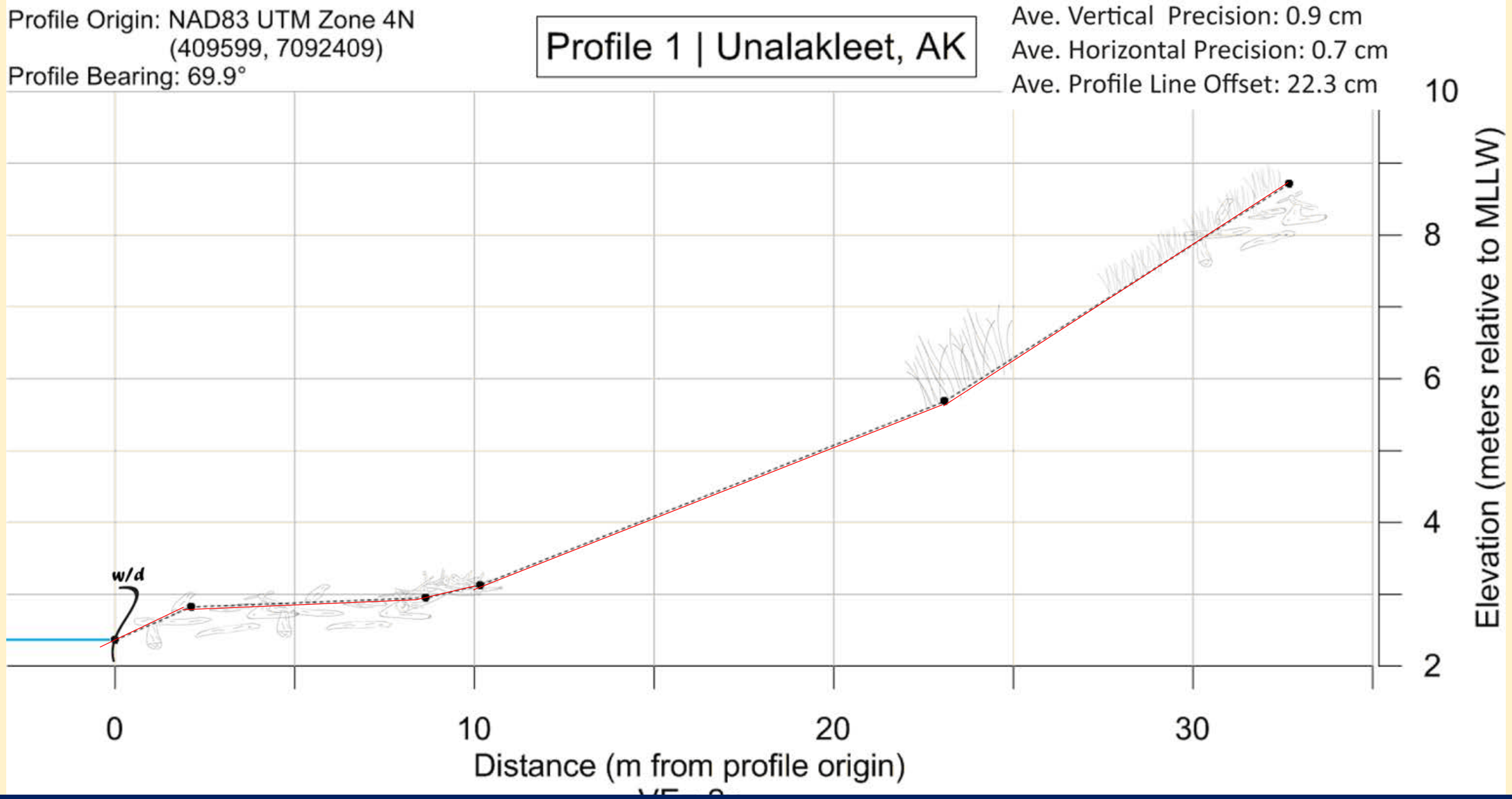
COASTAL PROFILES

Profile Origin: NAD83 UTM Zone 4N
(409599, 7092409)
Profile Bearing: 69.9°

Profile 1 | Unalakleet, AK

Ave. Vertical Error: 0.9 cm
Ave. Horizontal Error: 0.7 cm
Ave. Profile Line Offset: 22.3 cm

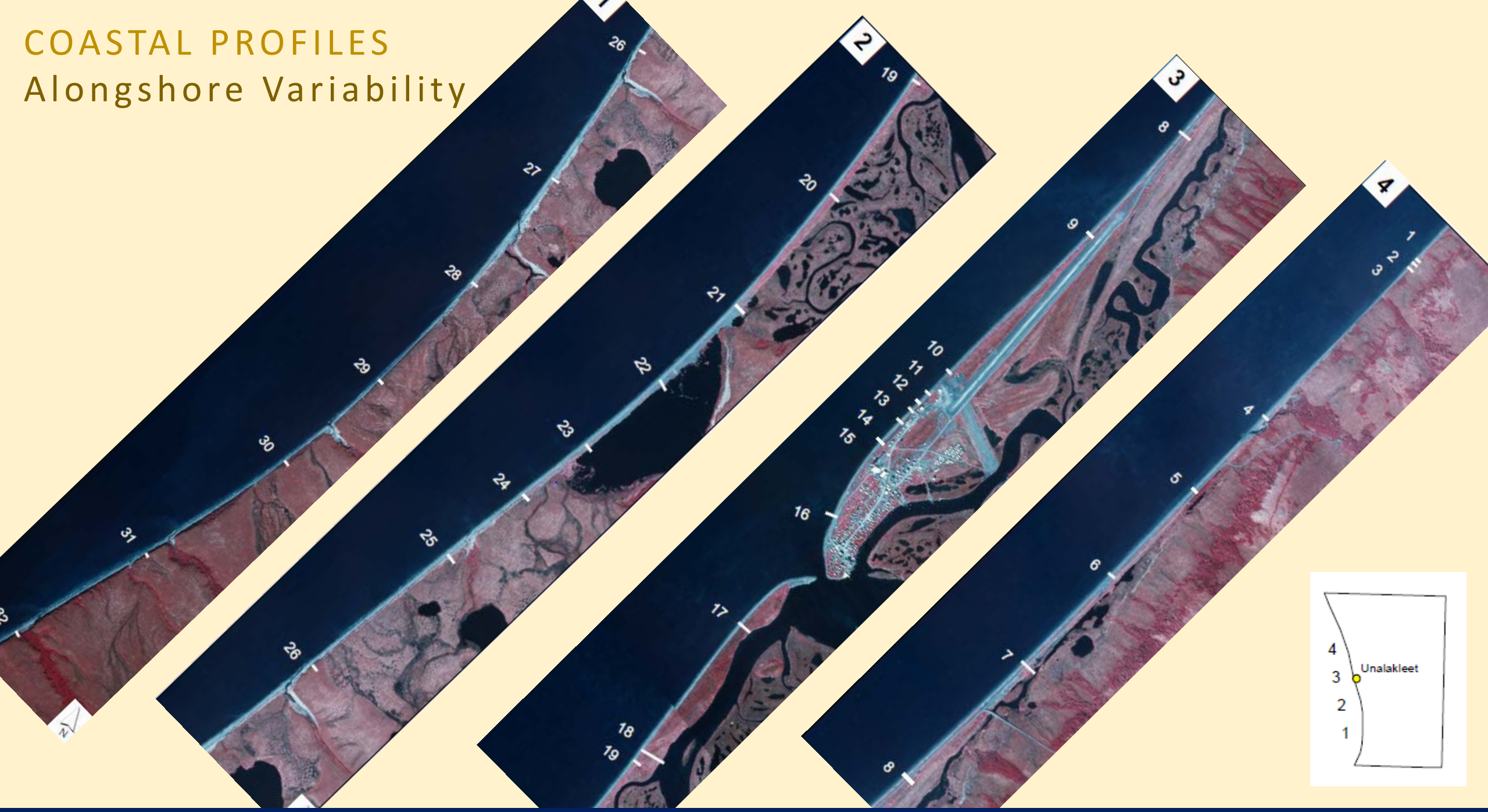
COASTAL PROFILES



COASTAL PROFILES

HOW DO SCIENTISTS USE COASTAL PROFILES?

COASTAL PROFILES
Alongshore Variability



COASTAL PROFILES

Measure Change After Storms

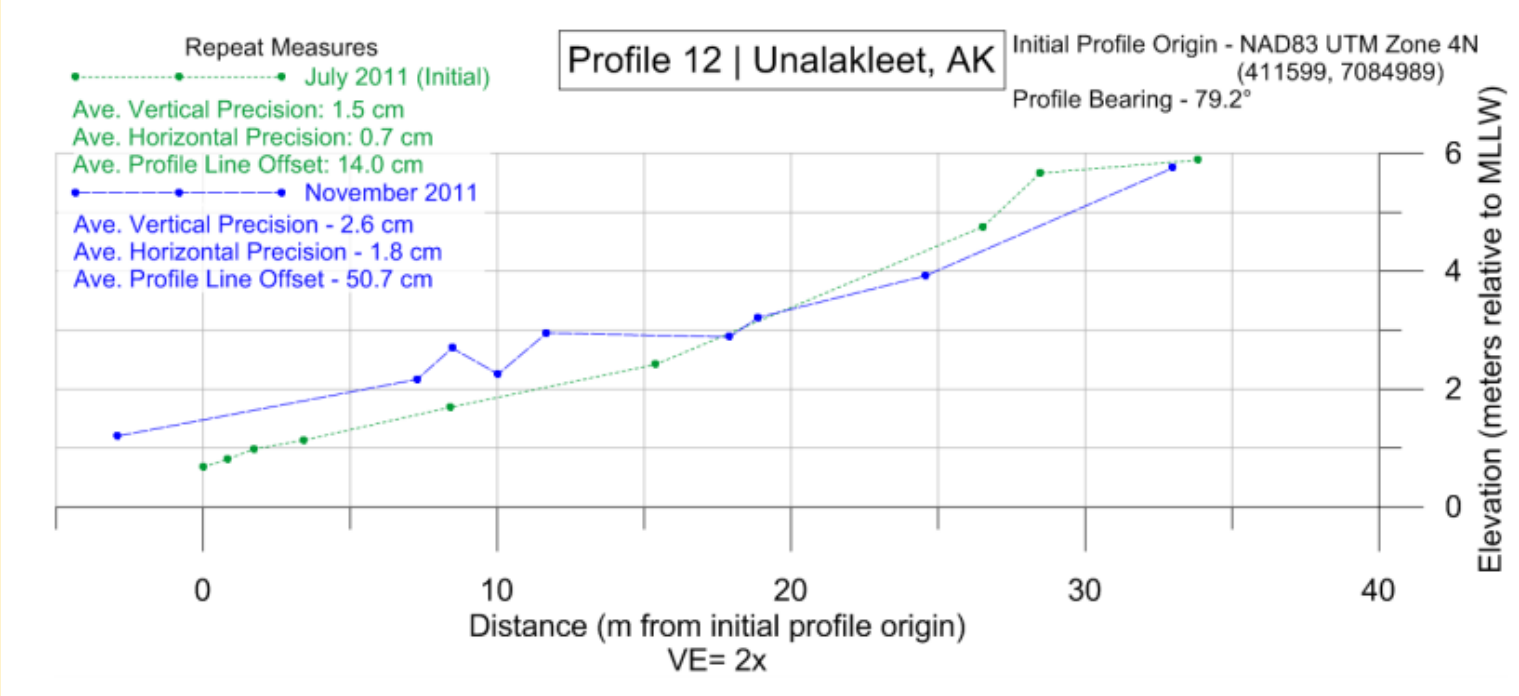
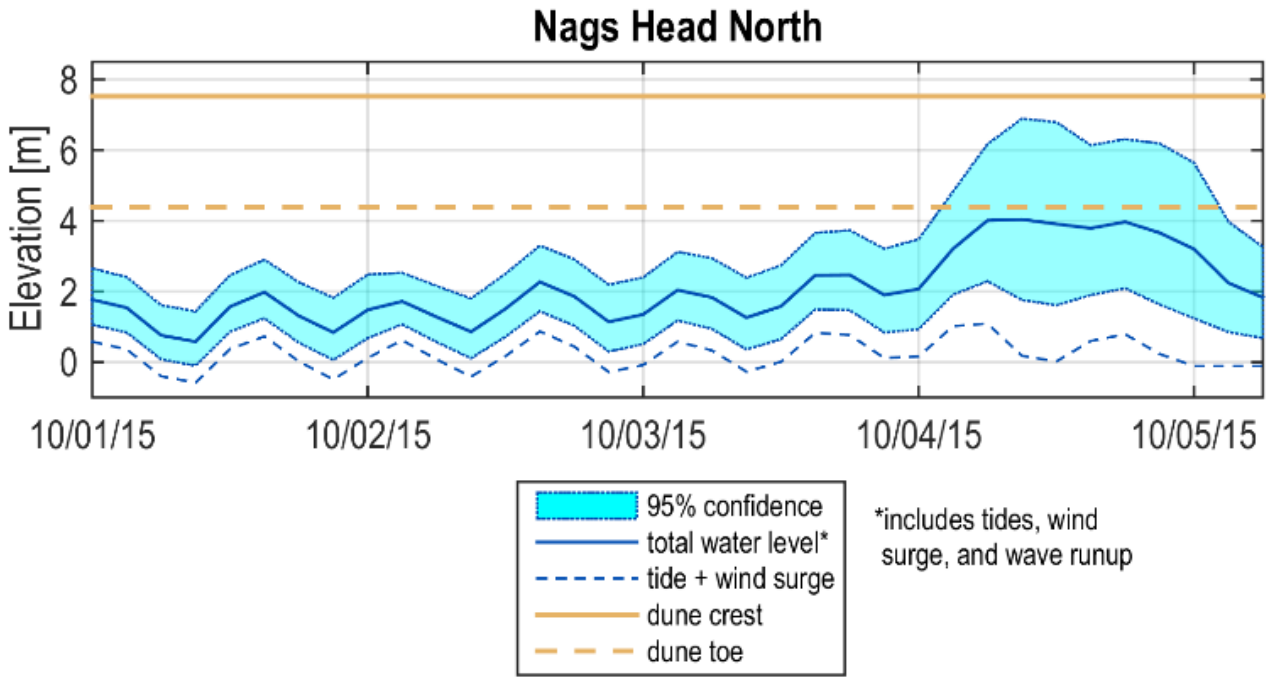


Photo by Harvey Smith, DOT&PF

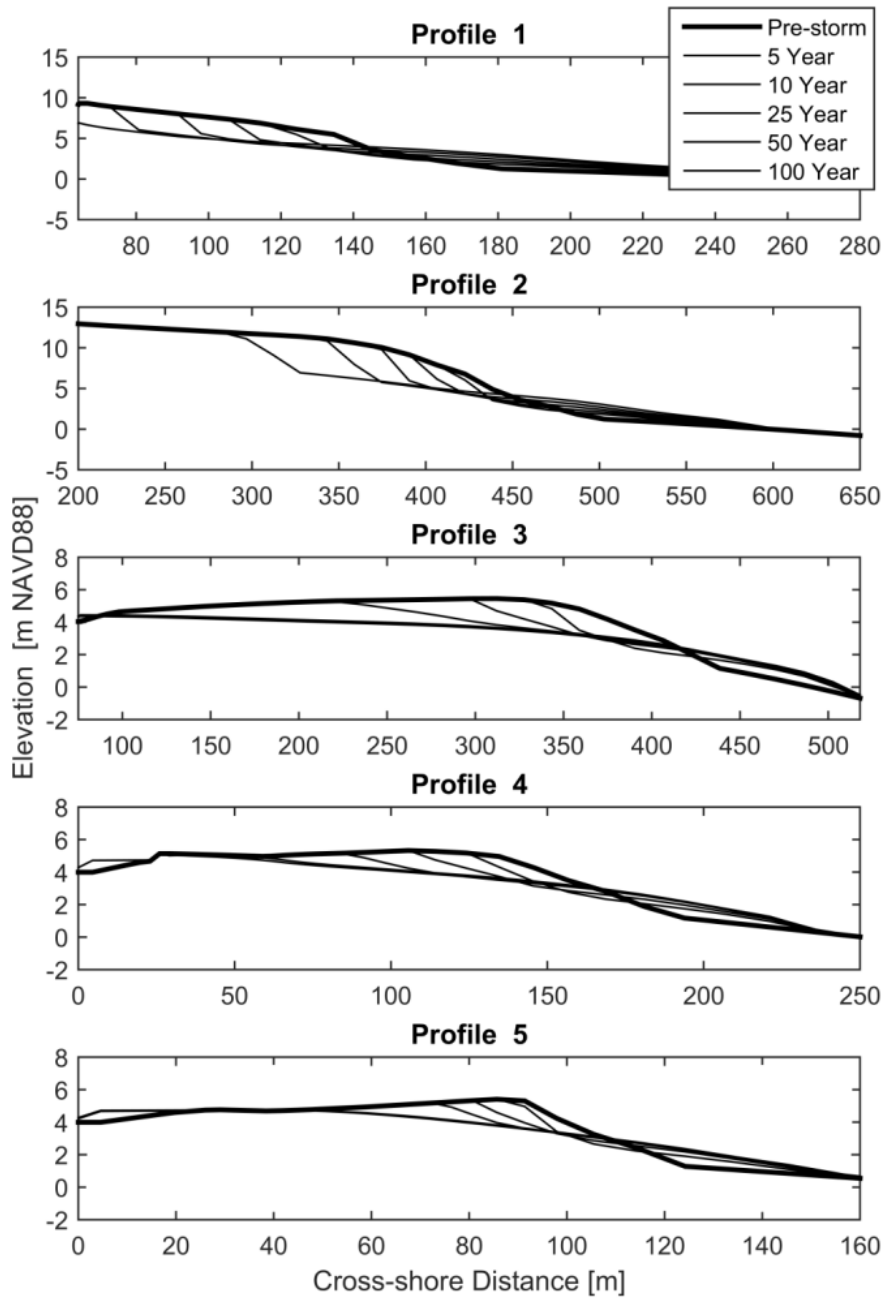
COASTAL PROFILES
Models of Flooding and Erosion

Parameterized Models (e.g. Stockdon et al. 2006)

$$R_{2\%} = 1.1\left(0.35\beta_f(H_0L_0)^{\frac{1}{2}} + \frac{\left[H_0L_0\left(0.563\beta_f^2 + 0.004\right)\right]^{\frac{1}{2}}}{2}\right)$$

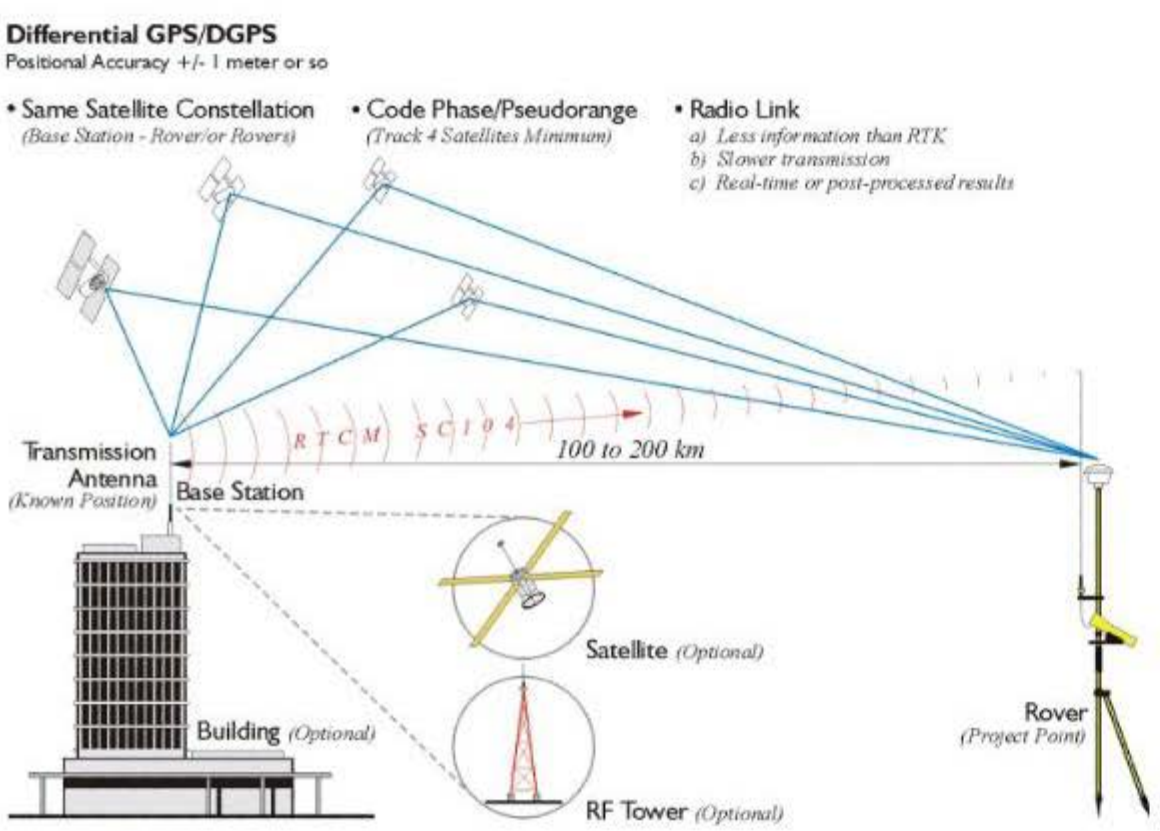


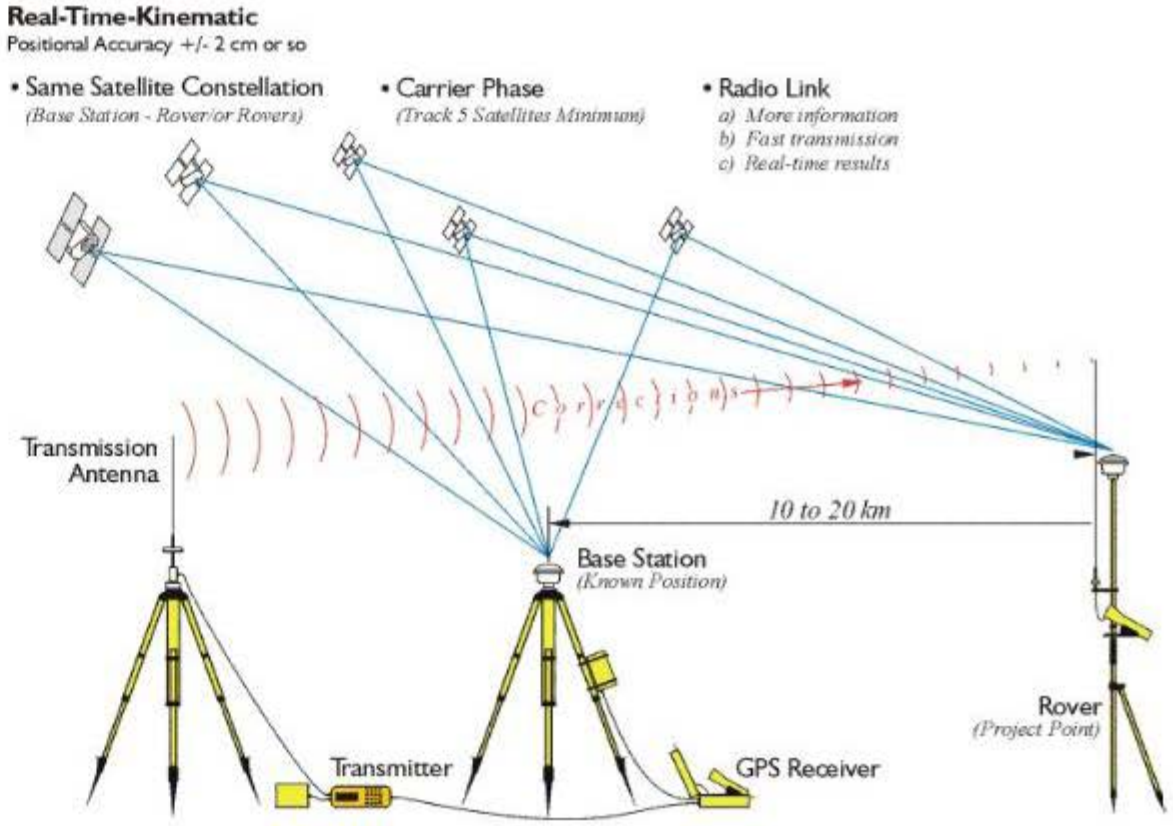
Numerical Models (e.g. Xbeach)



HOW ARE COASTAL PROFILES MEASURED?

GLOBAL POSITIONING SYSTEMS GPS





GLOBAL POSITIONING SYSTEMS GPS

Base Station

Gambell

GLOBAL POSITIONING SYSTEMS GPS

Base Station

Gambell

GLOBAL POSITIONING SYSTEMS GPS

RTK

Port Heiden

GLOBAL POSITIONING SYSTEMS GPS

GLOBAL POSITIONING SYSTEMS GPS

GLOBAL POSITIONING SYSTEMS GPS

Port Heiden

Shishmaref

EMERY ROD

Nome

EMERY ROD

EMERY ROD

Coastal Elevation Profile – 'Emery Rod' Data Sheet

Yakutat

Coastal Geoscience Program
Division of Geological & Geophysical Surveys
3354 College Road
Fairbanks, AK 99709

http://www.dggs.alaska.gov/

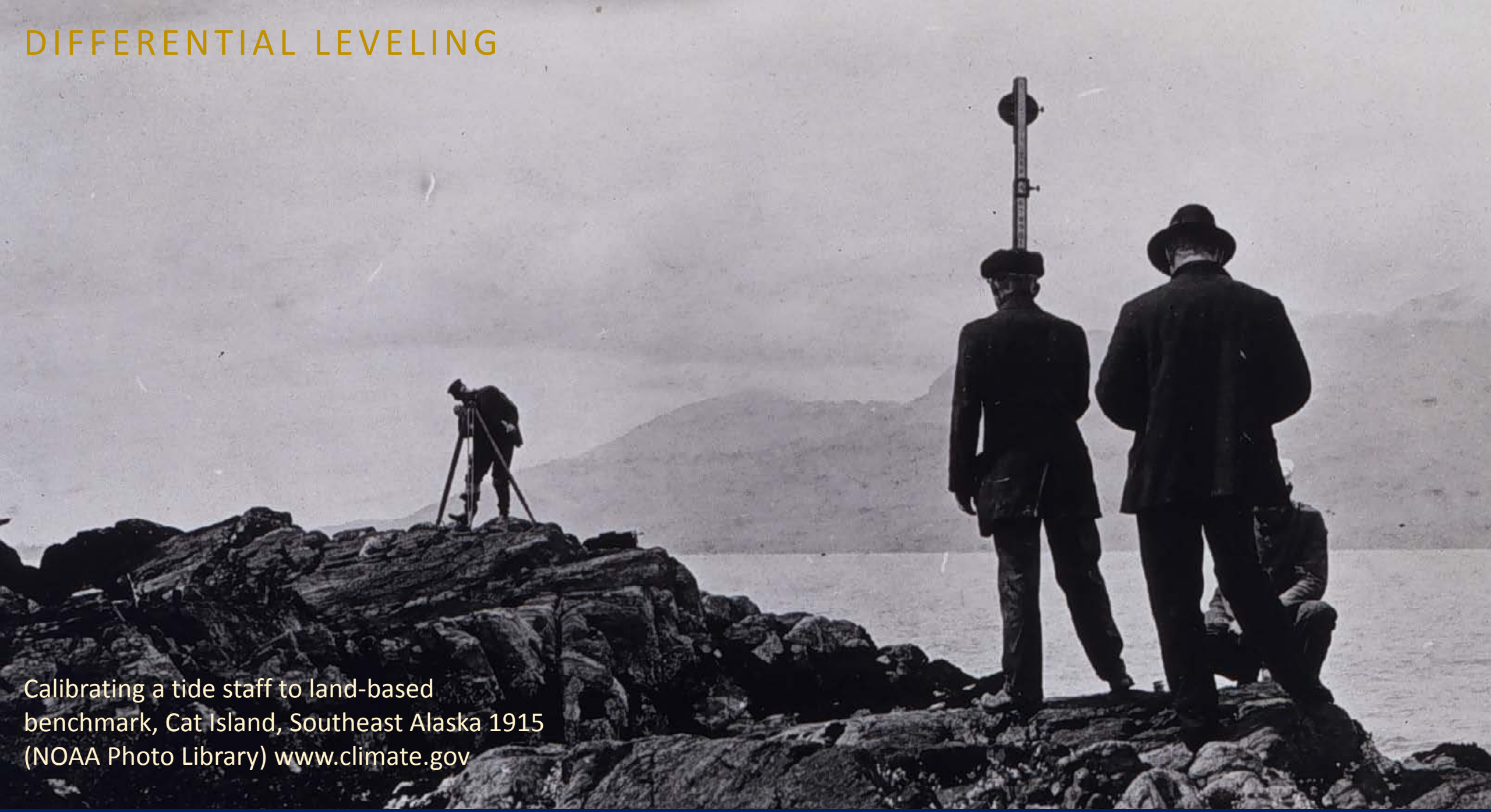
Date: Data collection team (names):	Fixed spacing (length of rope): Weather/wave conditions: Horizon visibility:

Location: Line number: Compass bearing:

Time at start:

Segment #	Spacing	Change in elevation	Sediment grain size or other notes
	❒ fixed or _____	_____ ❒ up ❒ down	
	❒ fixed or _____	_____ ❒ up ❒ down	

DIFFERENTIAL LEVELING



Calibrating a tide staff to land-based benchmark, Cat Island, Southeast Alaska 1915 (NOAA Photo Library) www.climate.gov

DIFFERENTIAL LEVELING

TIDES & CURRENTS

PRODUCTS
Data, Analyses, and Publications

PROGRAMS
Serving the Nation

ED
Tide

Home / Products / Datums / 9464212 Village Cove, St Paul Island, AK

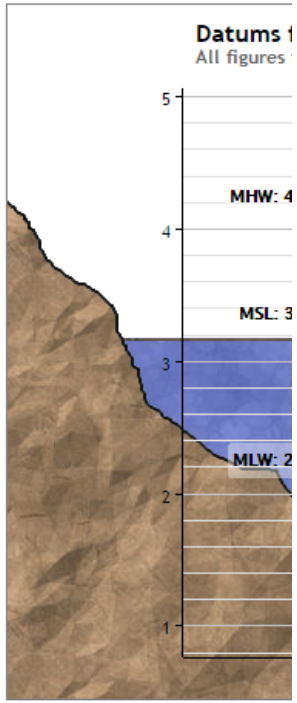
Station Info | Tides/Water Levels | Meteorological Obs. | Phys. Oceanography

Datums for 9464212, Village Cove, St Paul Island AK

Elevations on Station Datum

Station: 9464212, Village Cove, St Paul Island, AK
Status: Accepted (Dec 12 2011)
Units: Feet
T.M.: 135
Epoch: 1983-2001
Datum: STND

Datum	Value	Description
MHHW	4.56	Mean Higher-High Water
MHW	4.34	Mean High Water
MTL	3.29	Mean Tide Level
MSL	3.22	Mean Sea Level
DTL	2.91	Mean Diurnal Tide Level
MLW	2.23	Mean Low Water
MLLW	1.26	Mean Lower-Low Water
NAVD88		
STND	0.00	Station Datum
GT	3.30	Great Diurnal Range
MN	2.10	Mean Range of Tide
DHQ	0.22	Mean Diurnal High Water Inequality



U.S. DEPARTMENT OF COMMERCE
National Oceanic and Atmospheric Administration
National Ocean Service

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Station ID: 9464212 PUBLICATION DATE: 12/12/2011
Name: VILLAGE COVE, ST. PAUL ISLAND
ALASKA
NOAA Chart: 16382 Latitude: 57° 7.5' N
USGS Quad: PRIBILOF ISLANDS (C-4) Longitude: 170° 17.1' W

T I D A L D A T U M S

Tidal datums at VILLAGE COVE, ST. PAUL ISLAND based on:

LENGTH OF SERIES: 4 YEARS
TIME PERIOD: March 2007 - Feb. 2010 and Oct. 2010 - Sept. 2011
TIDAL EPOCH: 1983-2001
CONTROL TIDE STATION:

Elevations of tidal datums referred to Mean Lower Low Water (MLLW), in METERS:

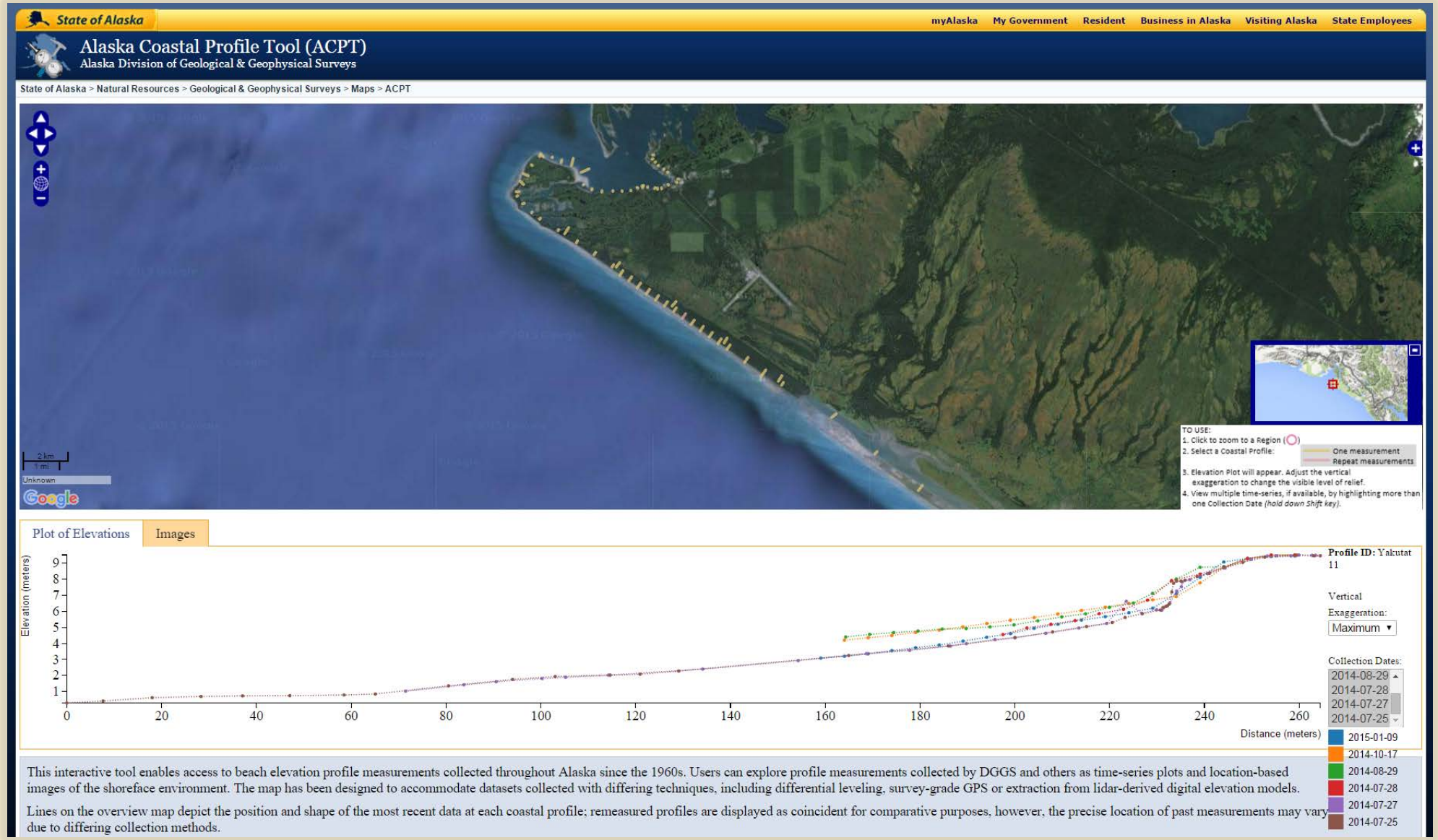
HIGHEST OBSERVED WATER LEVEL (12/08/2006)		=	1.604
MEAN HIGHER HIGH WATER	MHHW	=	1.005
MEAN HIGH WATER	MHW	=	0.938
MEAN TIDE LEVEL	MTL	=	0.618
MEAN SEA LEVEL	MSL	=	0.598
MEAN LOW WATER	MLW	=	0.297
MEAN LOWER LOW WATER	MLLW	=	0.000
LOWEST OBSERVED WATER LEVEL (12/06/2010)		=	-0.640

Bench Mark Elevation Information In METERS above:

Stamping or Designation	MLLW	MHW
RBD 1 1994	8.690	7.752
NO 4 1946	9.896	8.958
NO 3 1946	4.712	3.774
4212 N 2002	3.290	2.352
4212 P 2002	3.795	2.857

DIFFERENTIAL LEVELING

ALASKA COASTAL PROFILE TOOL

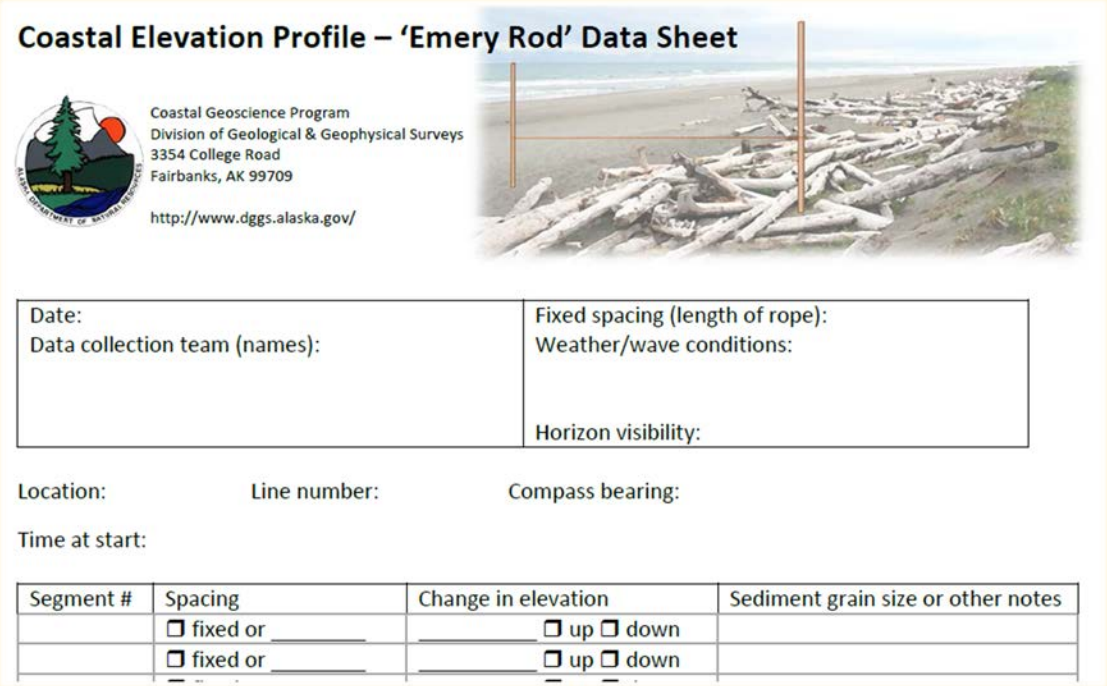


http://maps.dggs.alaska.gov/acpt/

LETS GO MEASURE!

DIRECTIONS

- Break into groups of three (*two people will place the rods and do the sighting, while one person will record elevation changes and other notes.*)
- Find a group leader with an Emery Rod set that will give you further directions.
- Establish a profile you want to measure, record the bearing using the compass and GPS lat/lon; describe your profile.
- Measure the elevation changes across your profile and the horizontal distances covered.
- Plot your data on graph paper.



Coastal Elevation Profile – 'Emery Rod' Data Sheet

Coastal Geoscience Program
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3354 College Road
Fairbanks, AK 99709

http://www.dggs.alaska.gov/

Date: Data collection team (names):	Fixed spacing (length of rope): Weather/wave conditions: Horizon visibility:

Location: Line number: Compass bearing:

Time at start:

Segment #	Spacing	Change in elevation	Sediment grain size or other notes
	❒ fixed or _____	_____ ❒ up ❒ down	
	❒ fixed or _____	_____ ❒ up ❒ down	

THANK YOU

REFERENCES

Division of Homeland Security and Emergency Management (DHS&EM), 2013. State of Alaska Hazard Mitigation Plan: Department of Military and Veterans Affairs, prepared by: Division of Homeland Security and Emergency Management, 528 pp.

Kinsman, Nicole and Jacquelyn Overbeck, 2015. Which comes first in the U.S. Arctic—the tidal datum or the shoreline position? AGU Fall Meeting, EP23A Arctic Coastal Zone Mapping and Hazards Posters, Poster 0936, Abstract 85370.

Swarzenski, Peter and Bruce Richmond, 2015. An Inside Lood at Eroding Coastal Bluffs on Alaska's North Slope: U.S. Department of the Interior, U.S. Geological Survey, found at: http://soundwaves.usgs.gov/2016/01/fieldwork2.html

http://marine.usgs.gov/coastalchangehazardsportal/

http://www.ngs.noaa.gov/NSDE/

CONTACT INFORMATION

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