Nearshore bathymetric data collection in the vicinity of western Alaska communities

Western Alaska LCC

WALCC 2012-5

Oceanographic System Drivers

Reconnaissance static occupation of tidal benchmarks in western Alaska

WALCC 2013-3

Landscape (Coastal) Systems

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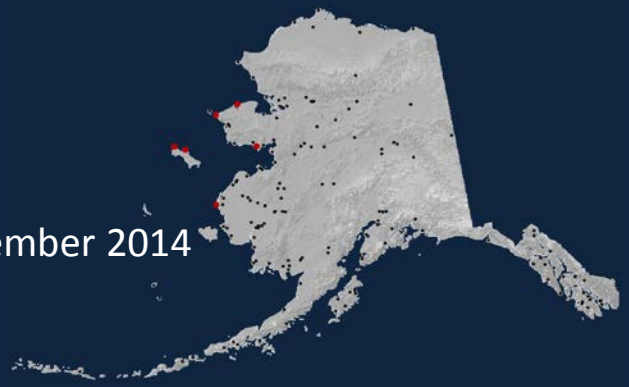
WALCC Coastal PI Webinar

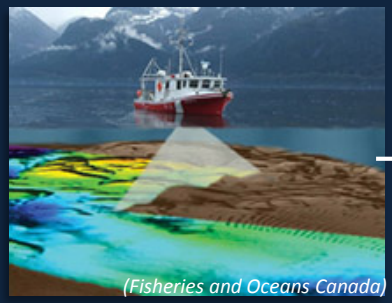
June 4, 2014

Updates in Brief:



- Nearshore bathymetry data files and report to be published by December 2014
  - Locations include: Shishmaref, Wales, Golovin, Gambell, Savoonga and Hooper Bay
- Additional tidal benchmark measurements in summer 2014 (Y-K Delta)
  - Fieldwork conducted by UAF/DGGS graduate research intern Kimber Tweet
  - OPUS shared benchmark solutions submitted to NGS: Elim, Unalakleet, Serpentine, Nome and Port Heiden
- Work has been featured in presentations/posters at:
  - 2013 Alaska Forum on the Environment
  - 2013 American Society of Photogrammetry and Remote Sensing
  - 2013 & 2014 Alaska Surveying and Mapping
  - 2014 Ocean Sciences Meeting
  - 2014 Alaska Geological Society
  - WALCC full-length webinars: May 2014 Bathymetry Project → presentation slides available online
    Fall 2014 Benchmark Project (Tweet presents)
- Emerging Collaborations & Projects
  - Both projects in support of graduate student research at UAF
  - Topobathy surface development to seed runup models for inundation mapping needs (USGS and UAF)
  - Has spurred investigation of alternative approaches to bathymetric data collection with remote sensing techniques
  - DGGS work in conjunction with NWS is benefitting from other WALCC projects (e.g. Grumbine and others)
- New DGGS Coastal Geoscience Program website ready for release in late summer 2014

Motivation for Bathymetry Project



→ ? ←

- Alaska lacks high-resolution nearshore bathymetric soundings, particularly in remote parts of the state

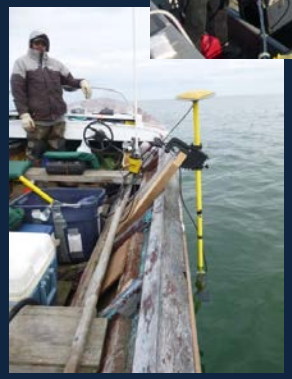
- Data necessary for:
  - Evaluation of wave exposure
  - Seasonal change detection and sediment budgets
  - Advanced 3-D inundation modeling
  - Coastal development/planning (vulnerability mapping, barge landing sites)
  - MLLW shoreline position

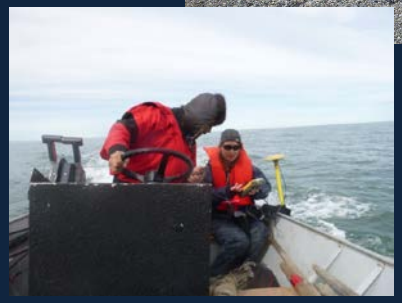
- DGGS has qualified scientific teams in remote coastal areas each year

  Therefore… with a portable system, we can collect nearshore bathymetric measurements

Portable Single-beam System

- Low-cost (~$10k) system, field tested/used by NOAA (Hawaii, Washington)
- Ohmex SonarMite transducer + DGPS w/ field controller (TopCon), portable M8 tide gauge
- Adaptable transom mount with GPS antenna
- Alaska modifications:
  - Durable shipping container
  - Aluminum → Steel pole mount
  - Extended cables to keep equipment away from salt water





Local Boat Operators

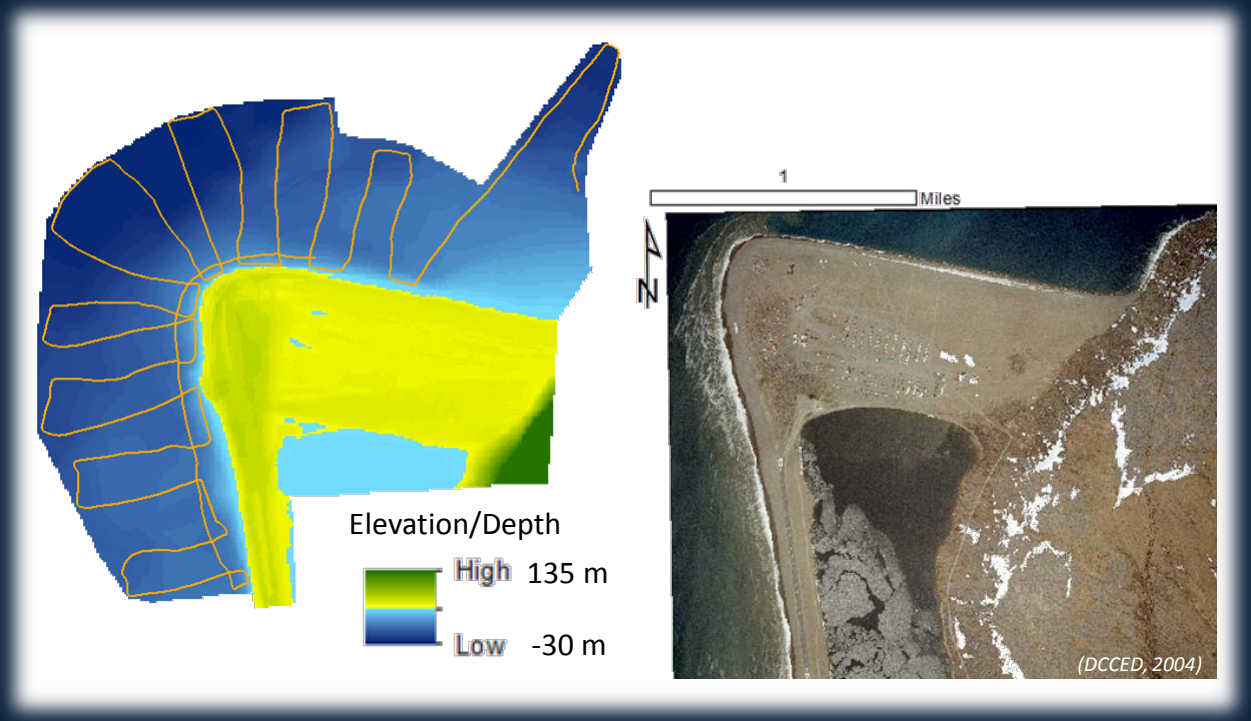
- Reduced mobilization expense
- Known areas of importance
- Expert boating skills
- Informed field planning based on conditions
- Local knowledge of related processes
- Community involvement

(Dylan Iya, Savoonga 2013)

Products

Published as DGGS Raw Data File w/ FGDC-compliant metadata

- All six study areas (2012-13)
- Project map figures
- Report with complete processing information and error analysis tables
- Ship tracks and processed soundings as data files (vertical RMSE ~25 cm)
- Interpolated raster surfaces, where possible



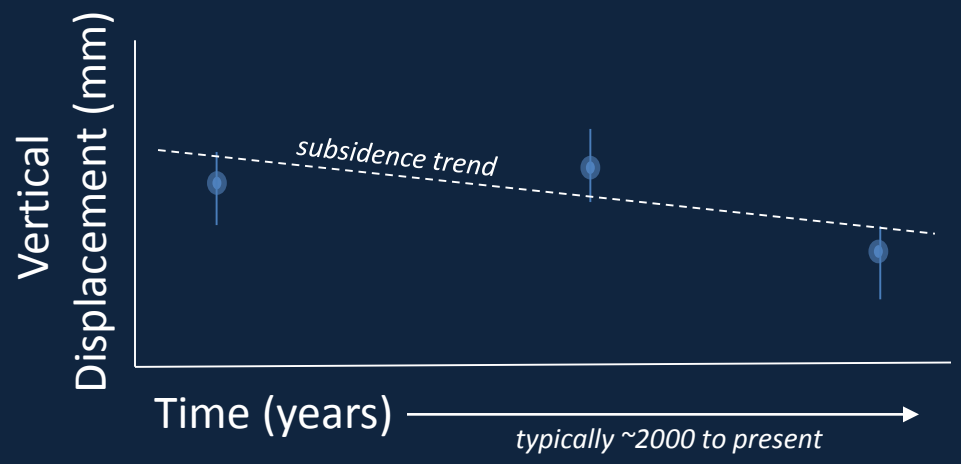
Example: Interpolated raster surface from Gambell, Alaska (2013 location) 12 m grid spacing

Bathymetric point clouds as 'bread crumb' ship tracks

Will be available on →

AOOS Alaska Ocean Observing System

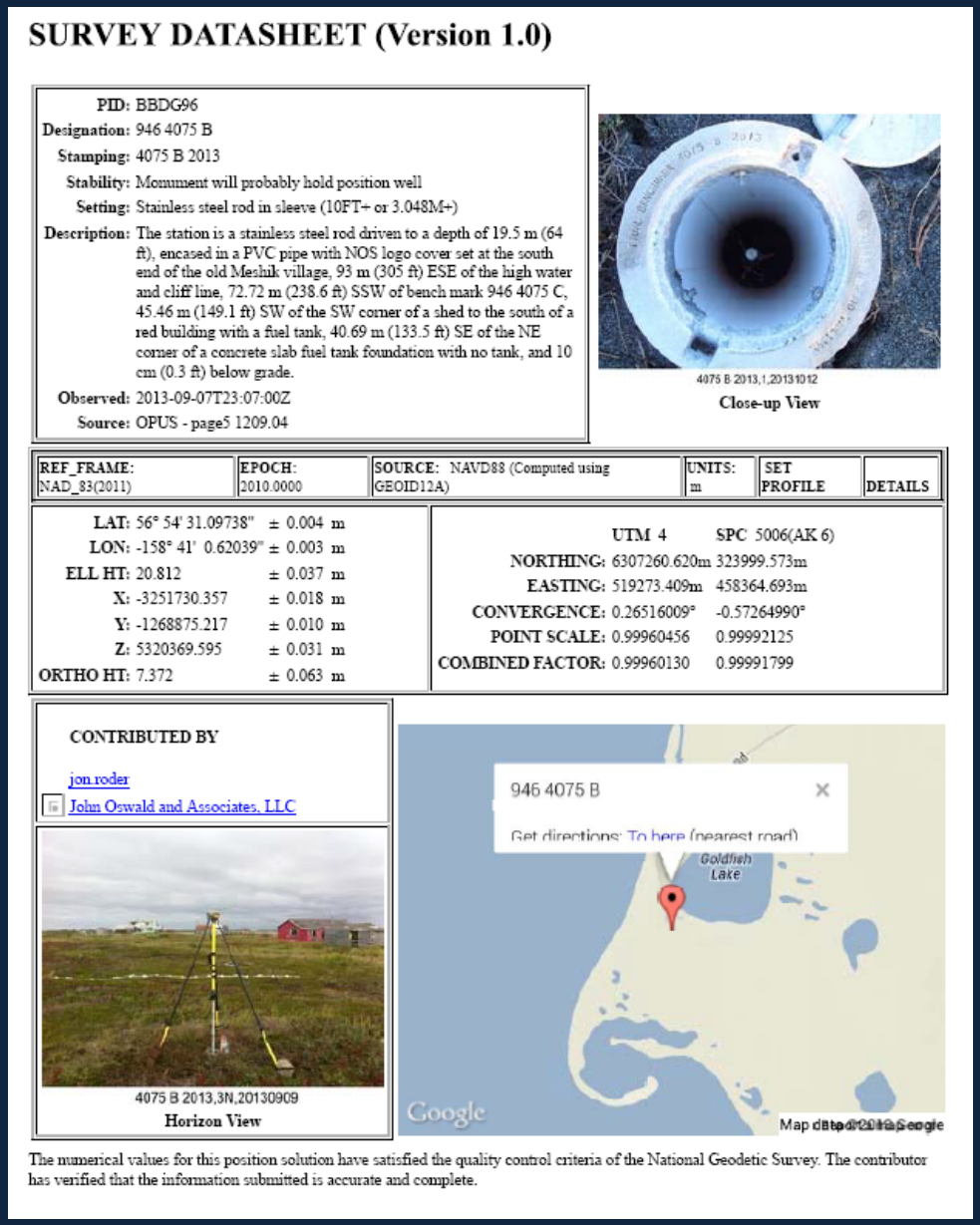
Motivation for Benchmark Reoccupation Project



- Uplift and subsidence rates are not well-constrained in western Alaska
  - Can not constrain rates of relative sea level (RSL) change w/o rates of vertical land motion
- Shared geodetic positions are missing for tidal benchmarks in the region
  - Prevents conversion between tidal datums and onshore elevations

Methodology

- ‘Milk-run’-style trips by UAF graduate student Kimber Tweet
  - Seward Peninsula in 2013
  - Y-K Delta in planned in 2014
- Static GPS occupations
  - Trimble 5700 GPS receivers w/ Zephyr Geodetic antennae
  - Durations of 3-10 days
  - which are set up for static occupations for three to ten days
  - Precision: 1-2 mm horizontal
    3-5 mm vertical
- 2013 measurements (n=31) submitted to:
  - NGS OPUS shared database
  - Geophysical Institute models
  - DGGS tidal datum conversion tool



SURVEY DATASHEET (Version 1.0)

PID: BBDG96
Designation: 946 4075 B
Stamping: 4075 B 2013
Stability: Monument will probably hold position well
Setting: Stainless steel rod in sleeve (10FT+ or 3.048M+)
Description: The station is a stainless steel rod driven to a depth of 19.5 m (64 ft), encased in a PVC pipe with NOS logo cover set at the south end of the old Meshik village, 93 m (305 ft) ESE of the high water and cliff line, 72.72 m (238.6 ft) SSW of bench mark 946 4075 C, 45.46 m (149.1 ft) SW of the SW corner of a shed to the south of a red building with a fuel tank, 40.69 m (133.5 ft) SE of the NE corner of a concrete slab fuel tank foundation with no tank, and 10 cm (0.3 ft) below grade.
Observed: 2013-09-07T23:07:00Z
Source: OPUS - page5 1209.04

4075 B 2013,1,20131012
Close-up View

REF_FRAME:	EPOCH:	SOURCE:	UNITS:	SET PROFILE	DETAILS
NAD_83(2011)	2010.0000	NAVD88 (Computed using GEOID12A)	m		

LAT:	56° 54' 31.09738"	± 0.004 m
LON:	-158° 41' 0.62039"	± 0.003 m
ELL HT:	20.812	± 0.037 m
X:	-3251730.357	± 0.018 m
Y:	-1268875.217	± 0.010 m
Z:	5320369.595	± 0.031 m
ORTHO HT:	7.372	± 0.063 m

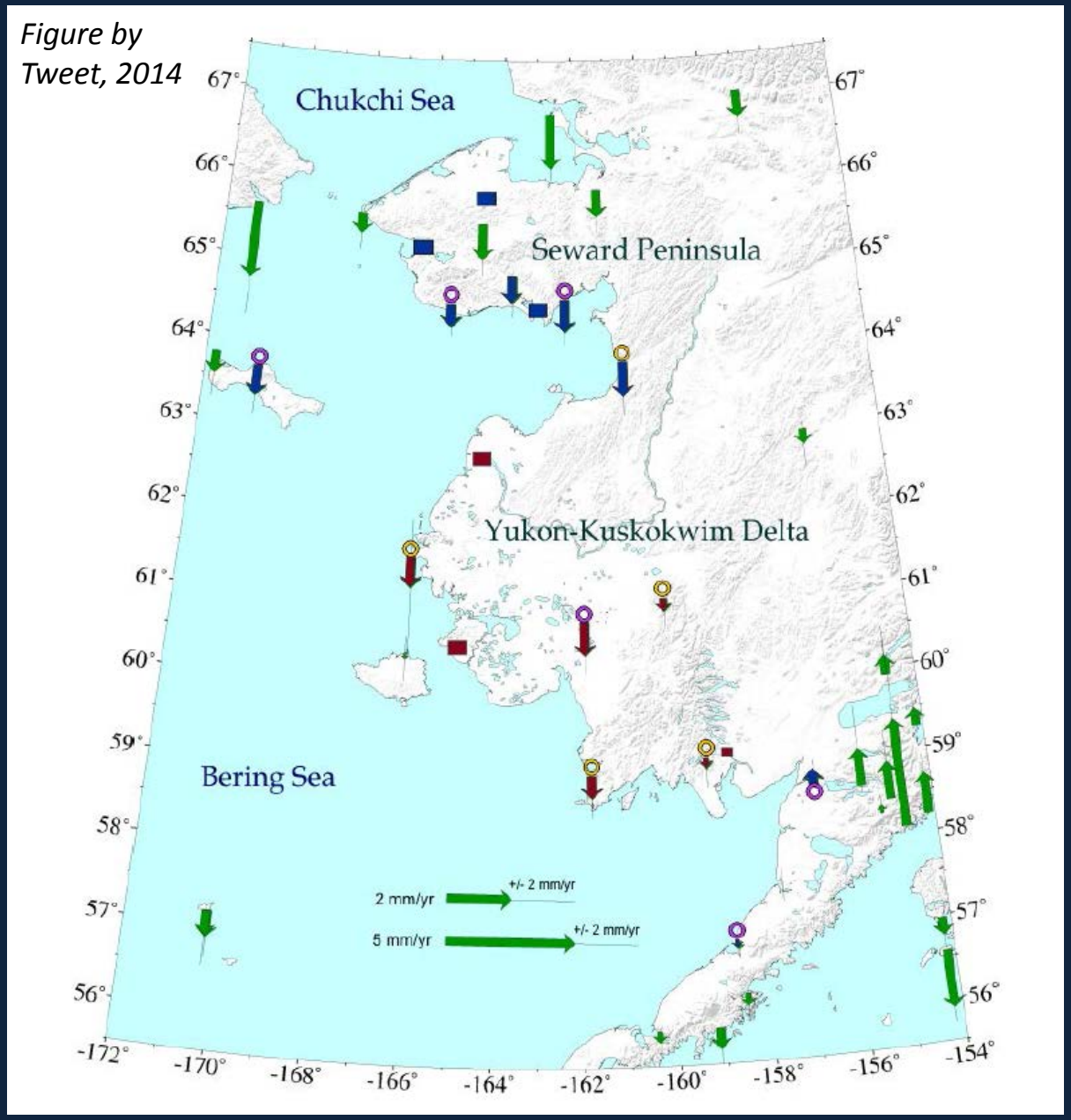
	UTM 4	SPC 5006(AK 6)
NORTHING:	6307260.620m	323999.573m
EASTING:	519273.409m	458364.693m
CONVERGENCE:	0.26516009°	-0.57264990°
POINT SCALE:	0.99960456	0.99992125
COMBINED FACTOR:	0.99960130	0.99991799

CONTRIBUTED BY
jon.roder
John Oswald and Associates, LLC

4075 B 2013,3N,20130909
Horizon View

The numerical values for this position solution have satisfied the quality control criteria of the National Geodetic Survey. The contributor has verified that the information submitted is accurate and complete.

Extended Results



- Preliminary vertical velocity map of western Alaska
  - Blue: this project 2013
  - Red: this project 2014
- ~ 1-4 mm/yr subsidence observed thus far
- Ongoing work by Tweet, Freymueller and Kinsman to derive contemporary RSL trends for western Alaska by 2015
- Kimber Tweet: kimberdgp@gmail.com

THANK YOU