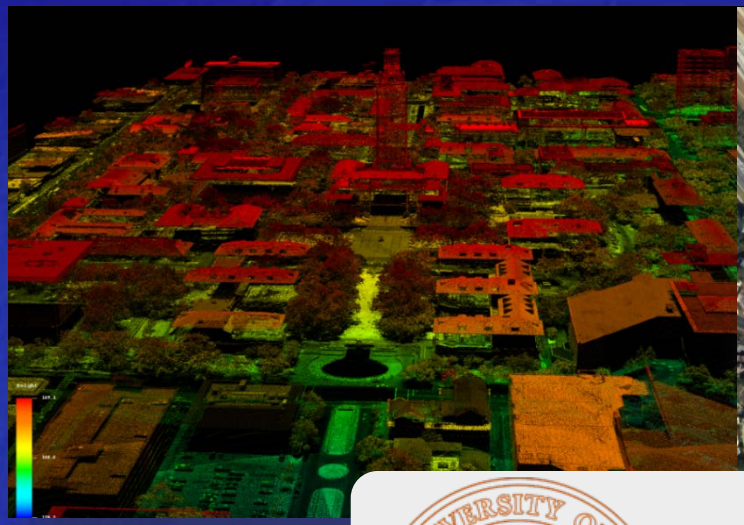
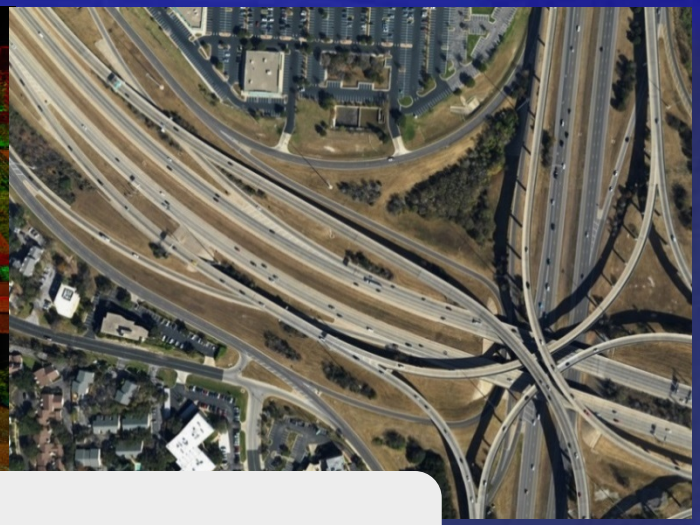
Airborne Lidar Research with AHAB Chiroptera I





THE UNIVERSITY OF TEXAS AT AUSTIN

Kutalmis Saylam
Lidar Group: Jeff Paine, Tiffany Caudle, Tom Tremblay, John Andrews, John Hupp
JALBTCX Workshop, June 2014

BUREAU OF ECONOMIC GEOLOGY

Bureau of Economic Geology / UT Austin

- An academic department of Jackson School of Geosciences, UT Austin
- Over 250 people,
- Conducting projects around the globe;
  - energy resources and economics,
  - coastal and environmental studies,
  - land resources and use,
  - geologic and mineral mapping,
  - hydrogeology,
  - geochemistry,
  - subsurface nanotechnology.

Earlier Lidar Research Activities

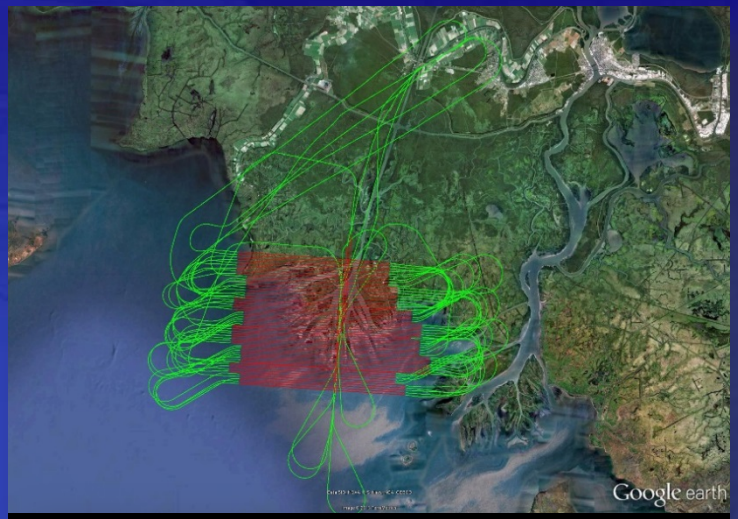
- Program started in 1997
- Optech ALTM 1225 (Toronto, Canada) system purchased in 2000
- System used mostly with a single engine Cessna 206 (TxDOT)
- Only topo NIR (red) wavelength @25Khz
- Averaged 1-3 surveys /year
- System retired in 2011.

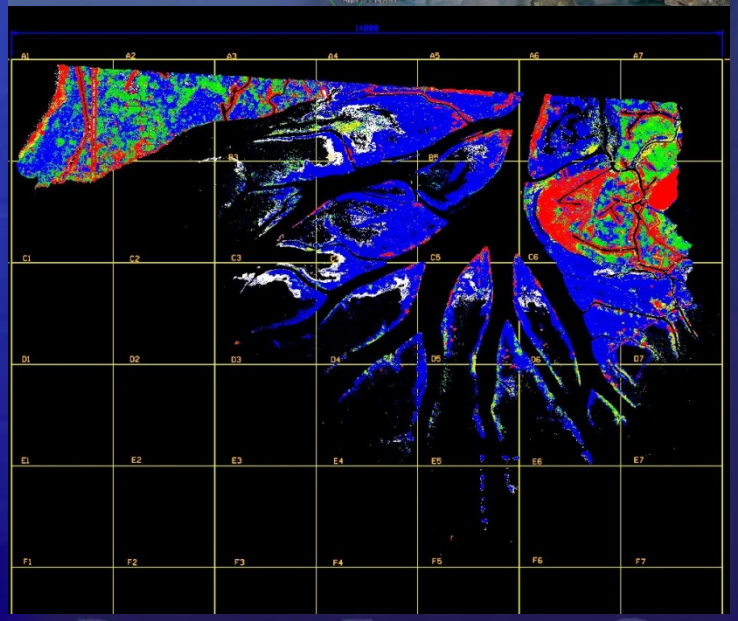
Current Lidar Research Activities

- AHAB Chiroptera I (Sweden) purchased with funding from General Land Office (GLO), State of TX
- System delivered in August 2012
- Chiroptera has ***red*** and ***green*** wavelength Lidar sensors
- Hasselblad integrated 50mb still image camera (RGB & CIR)
- Topo scanner operates @400 kHz
- Hydro scanner operates @35 kHz

Common Uses of Lidar System

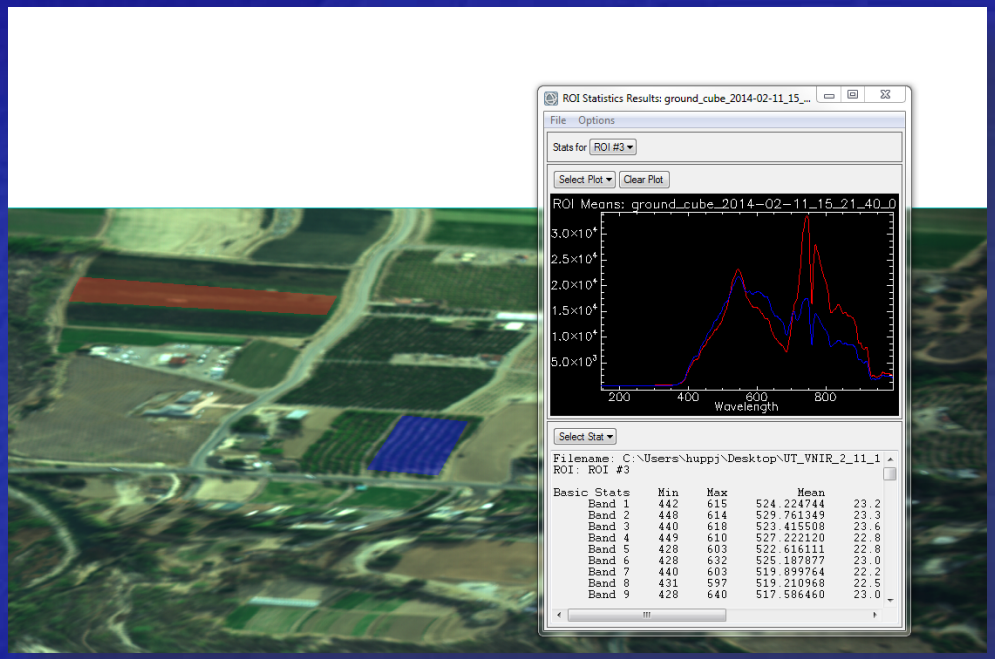
- Creating detailed watershed models
- Characterizing dynamic Earth systems and change over time
- Conducting rapid-response surveys for hazard assessment
- Quantifying vegetation assemblages
- Exploring endangered species habitat.





Hyper spectral Imaging – OKSI EarthScan

- System purchased in February 2014
- Custom-built system



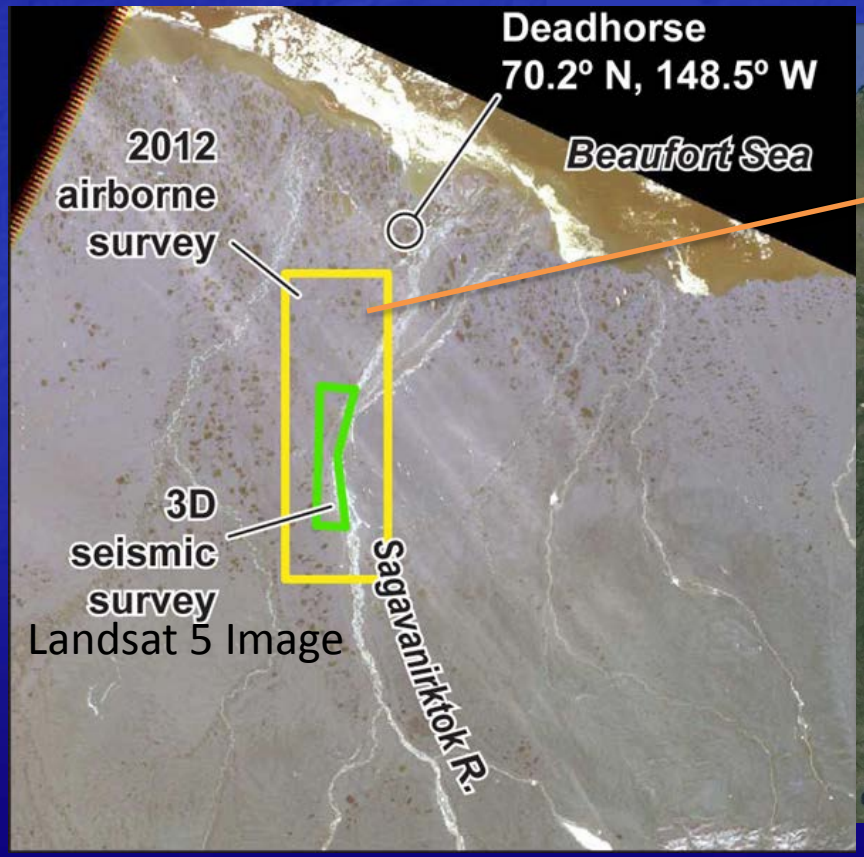
Hyper spectral Imagers	Wavelength & Resolution
VNIR pushbroom (Visible & Near Infrared)	**0.4** – 1.0 µm, 2400 x 2400
SWIR pushbroom (Short wave & Infrared)	0.9 – 2.5 µm, 1024 x 1024
MWIR – FLIR (Mid wave & Infrared)	3 – 5 µm, 1280 x 1024
MicroBolometer (Thermal)	7 – **14** µm, 1074 x 768

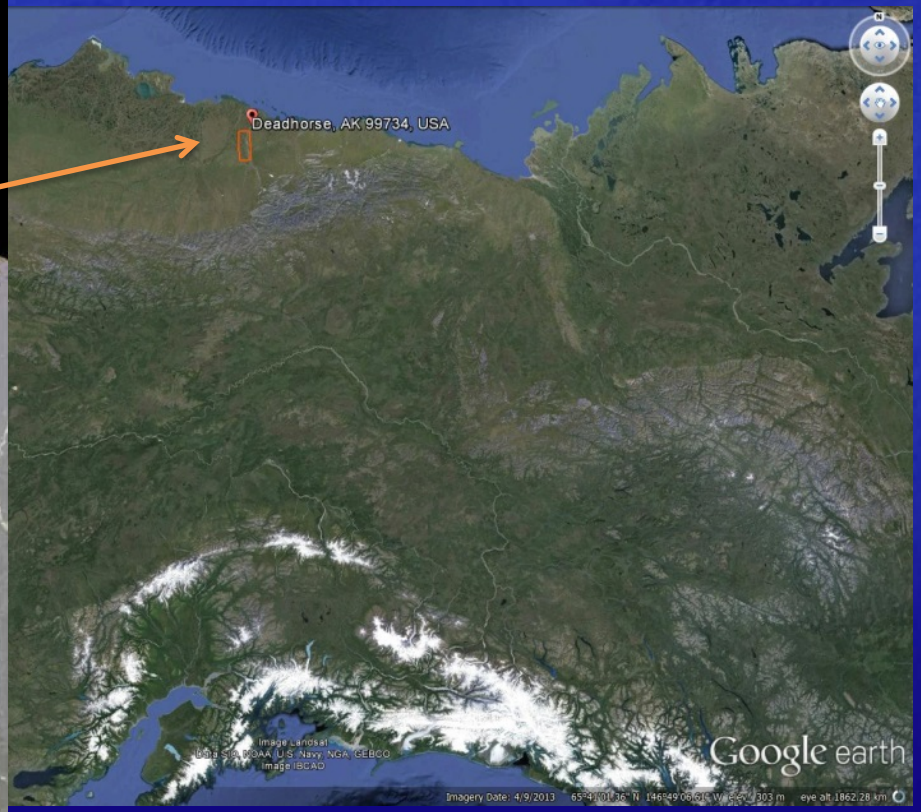
Prudhoe Bay, North Slope, Alaska

(August 2012)

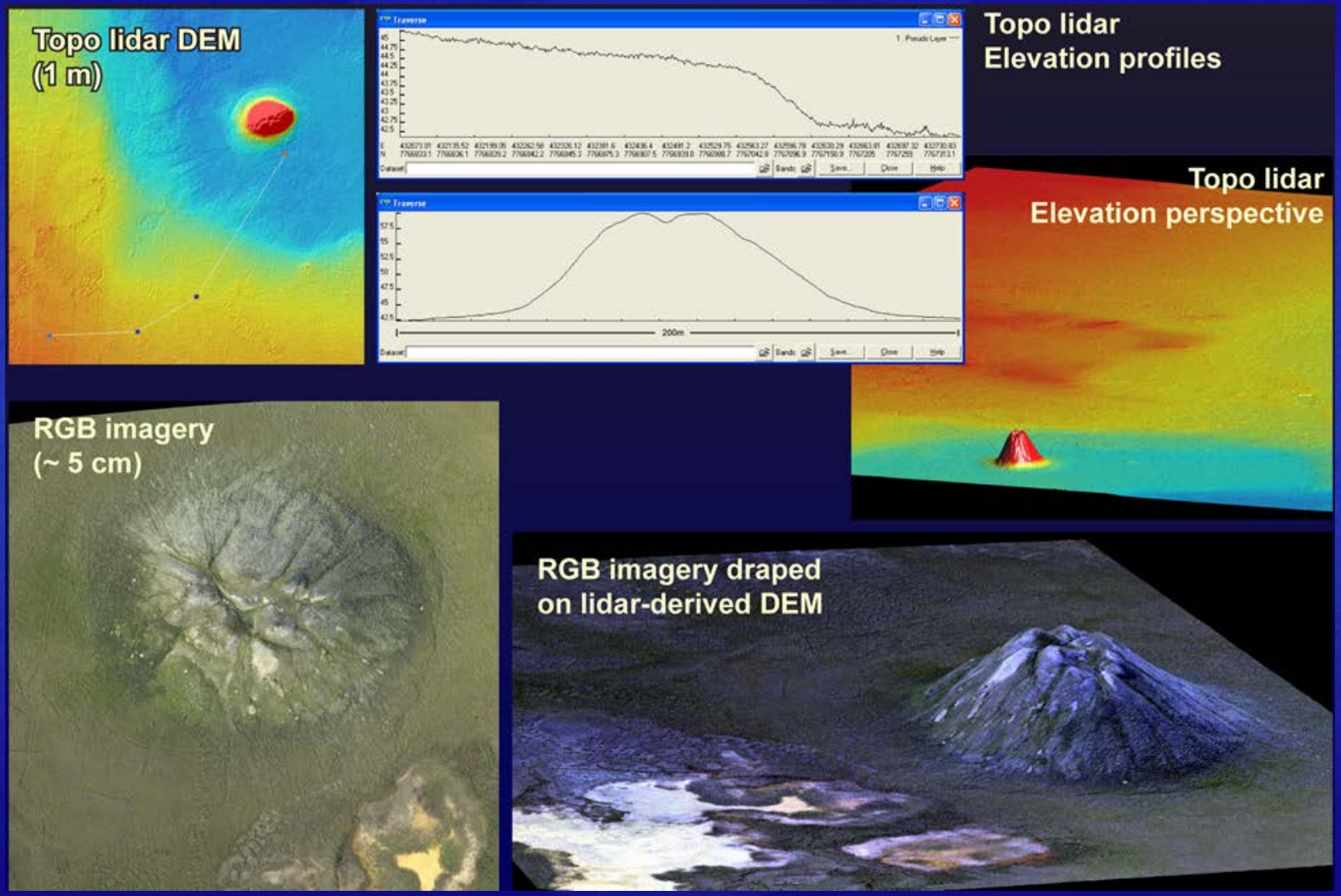
North Slope lake volumes and depths are critical biological and energy-development issues.

Establish baseline topography, bathymetry, and wetlands distribution to monitor future change.





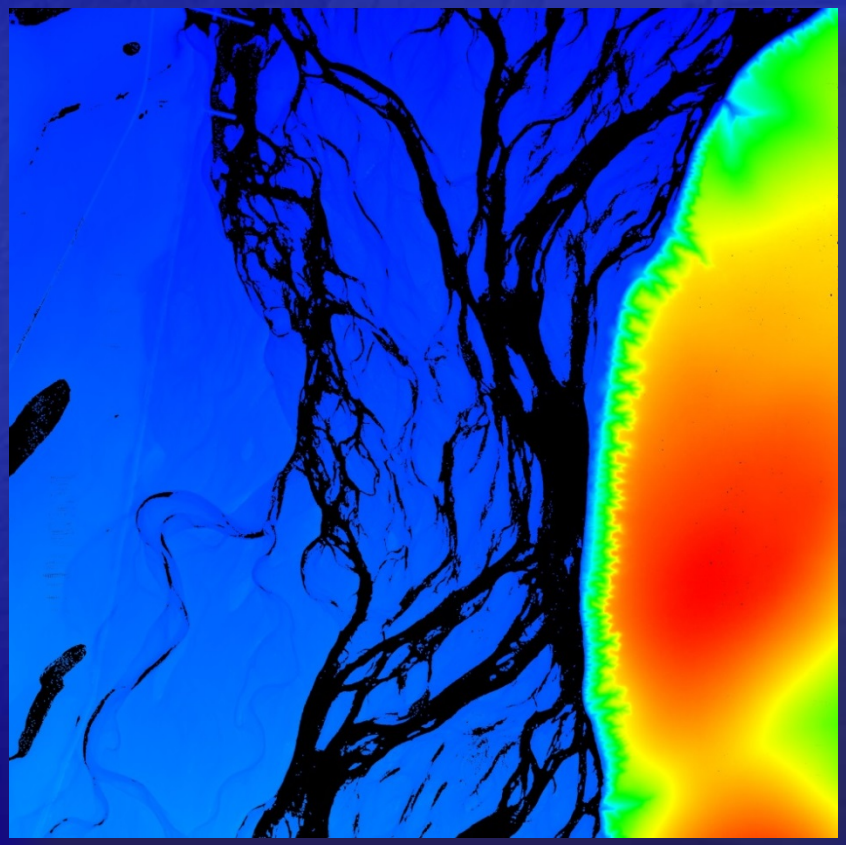
Combining Lidar & Imagery: Pingoes



Topographic and bathymetric mapping

PRF: 400kHz

Point density: 16 pp/m^2

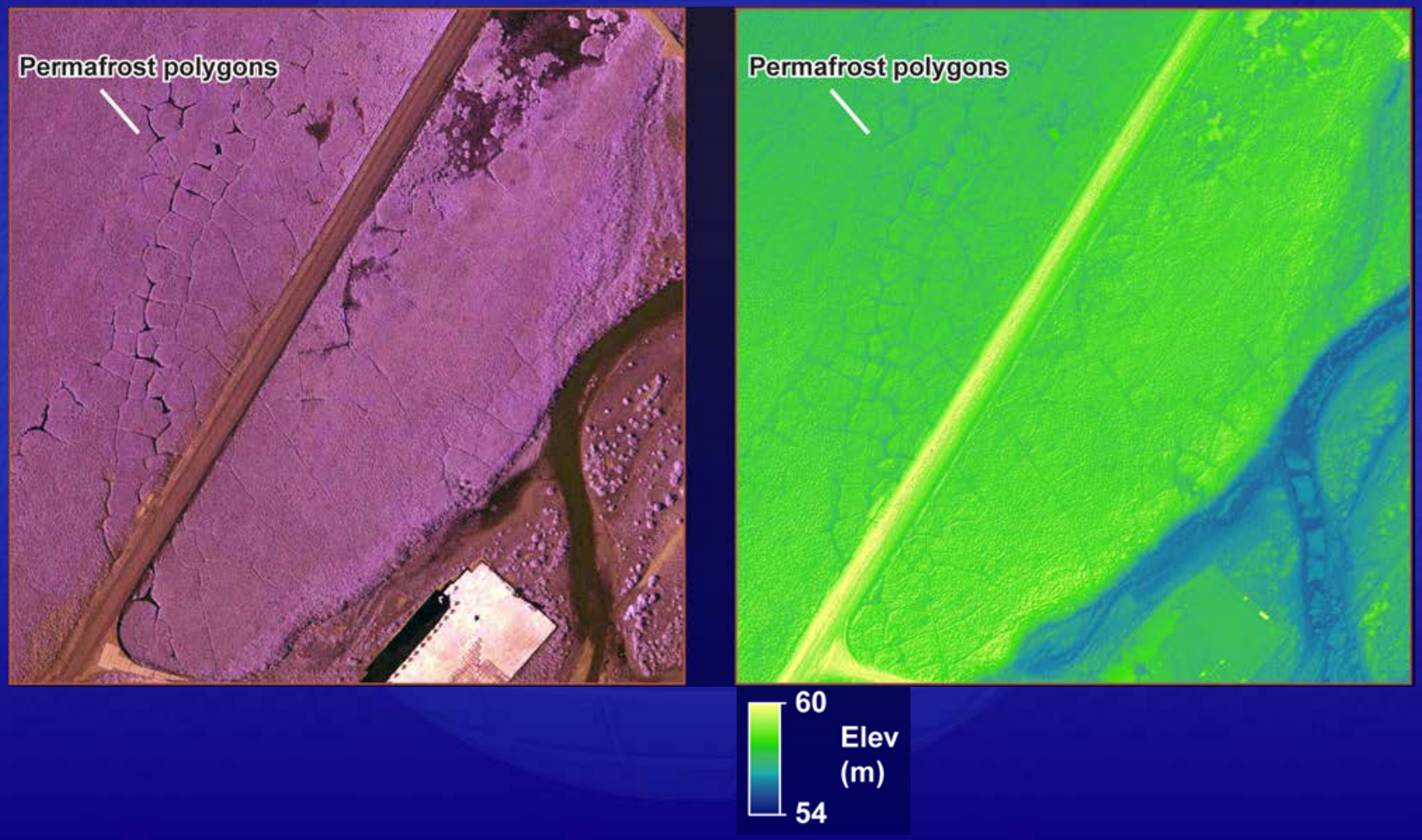


PRF: 35kHz

Point density: 2 pp/m^2

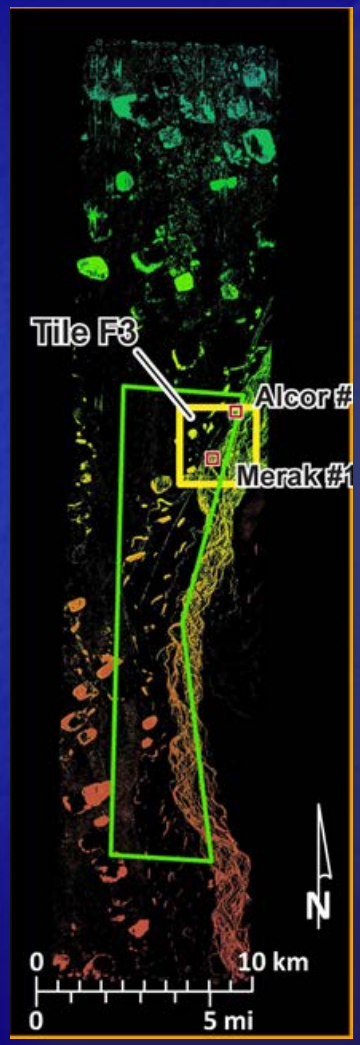
Flight altitude: 400mt

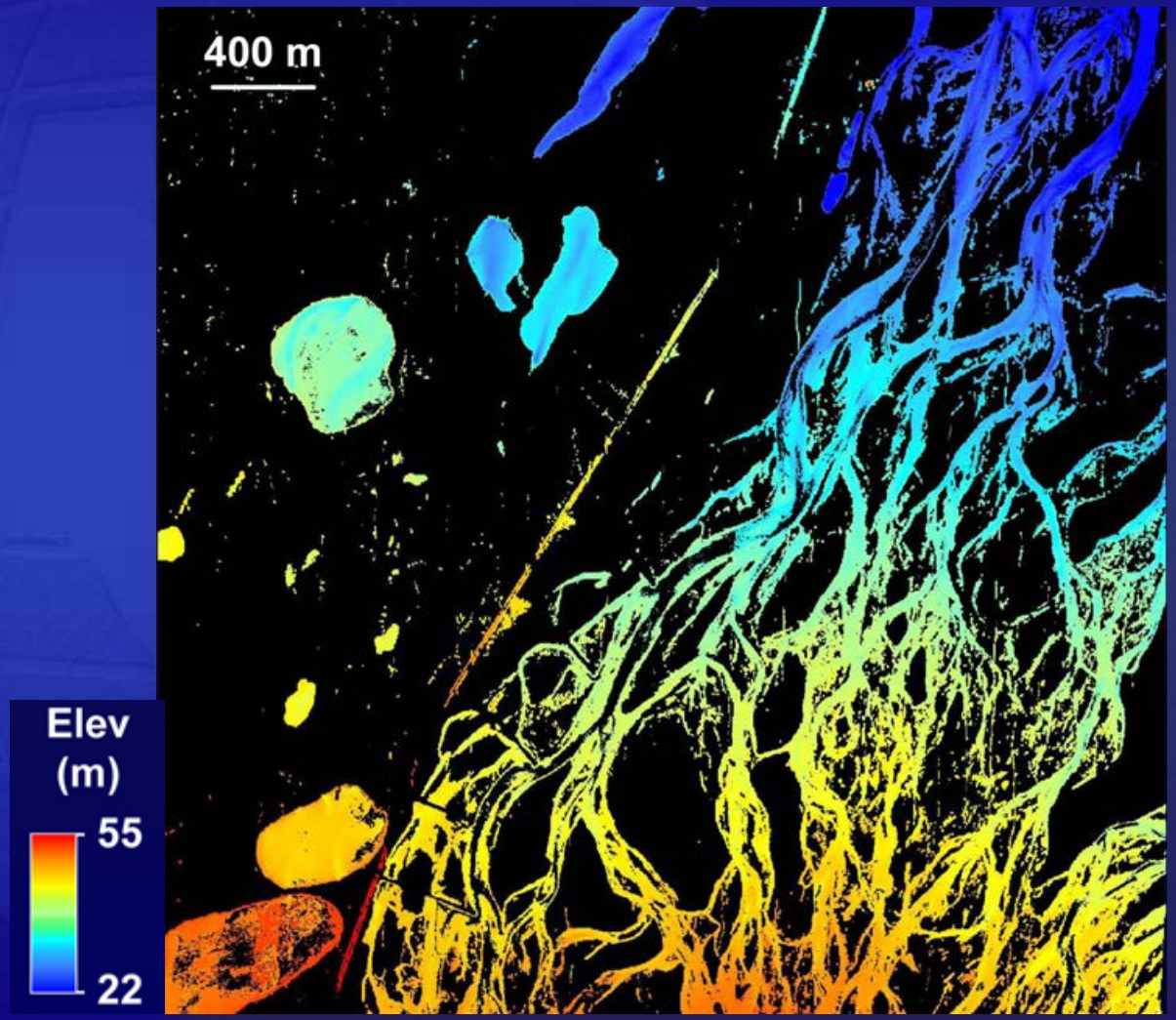
Arctic Topography



Water-Bottom Returns

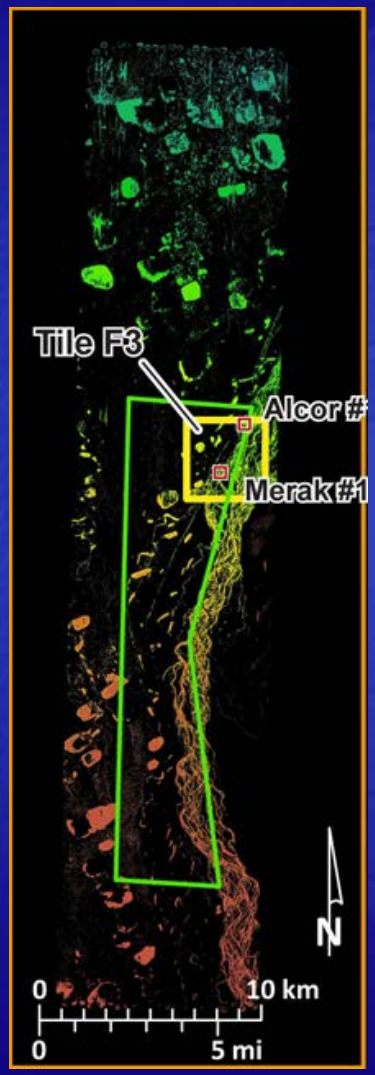
(Tile F3)

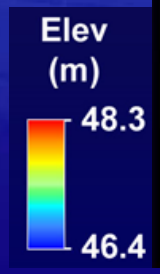


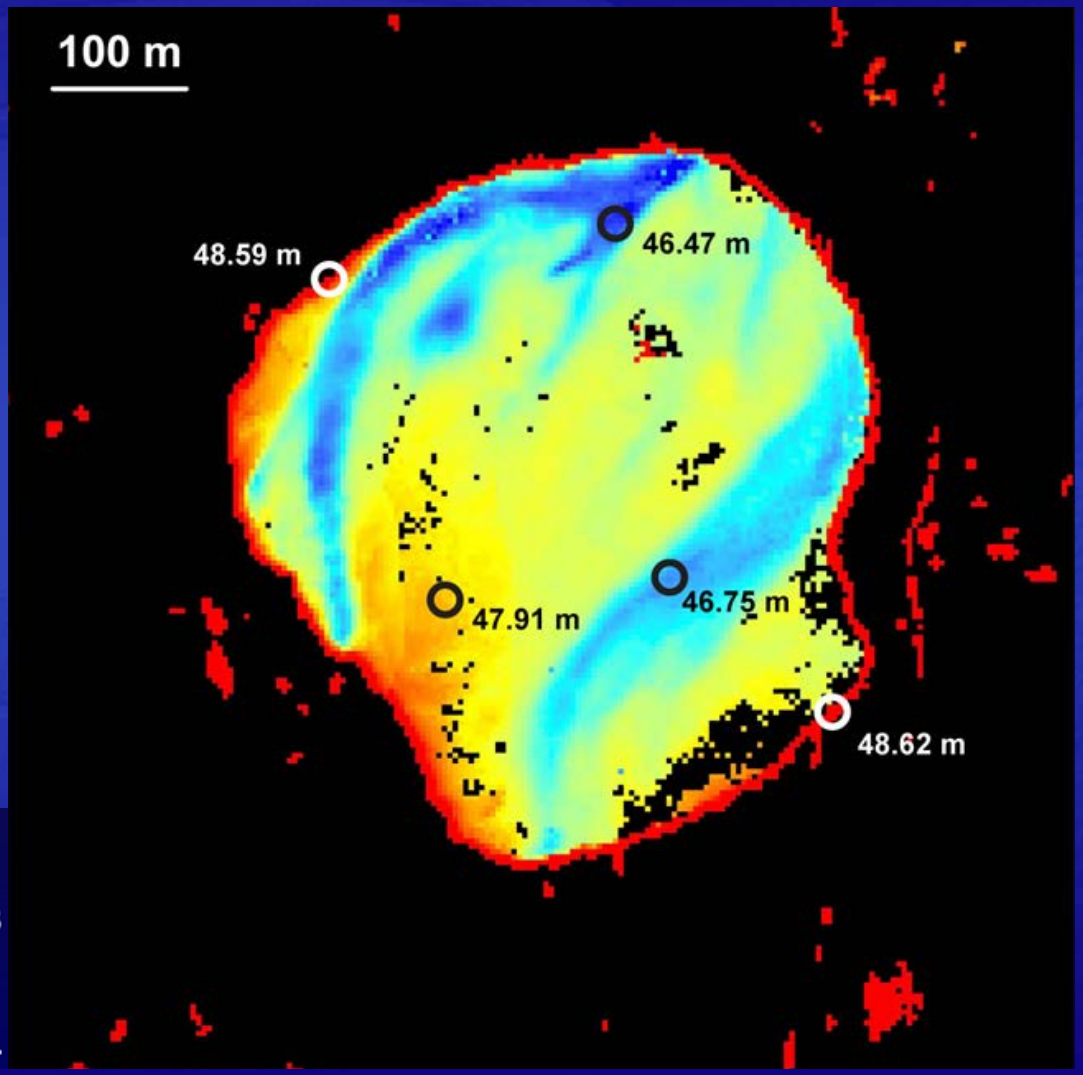


Water-Bottom Elevations

(Tile F3)

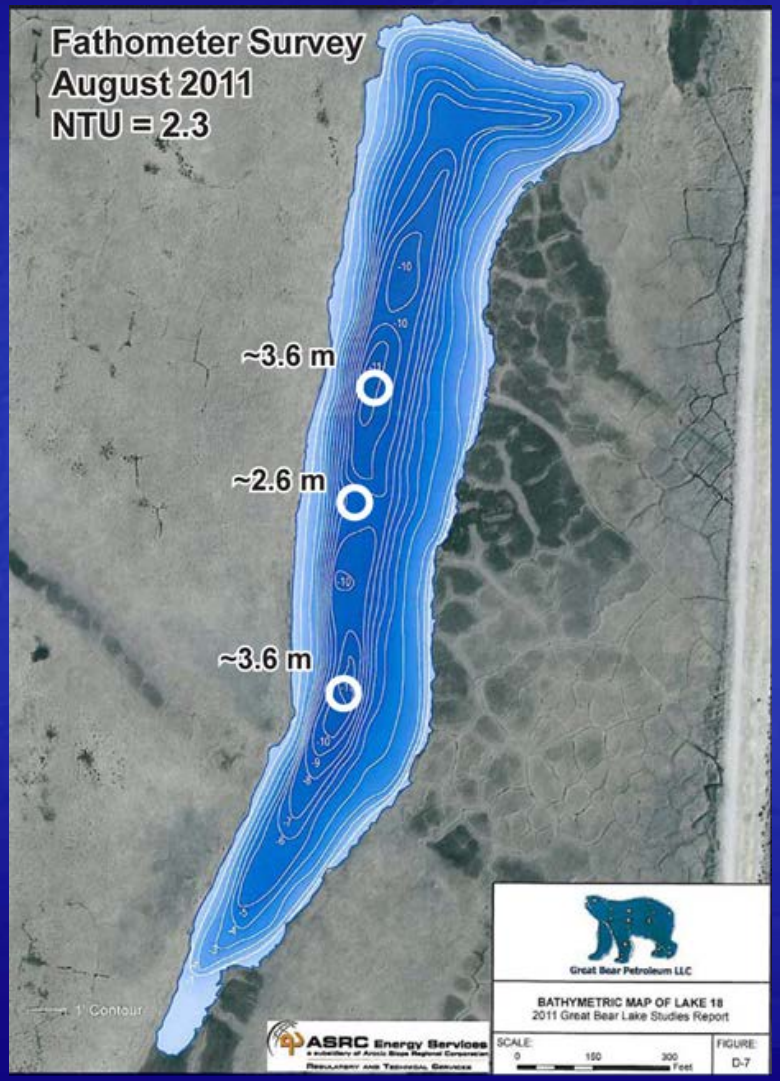


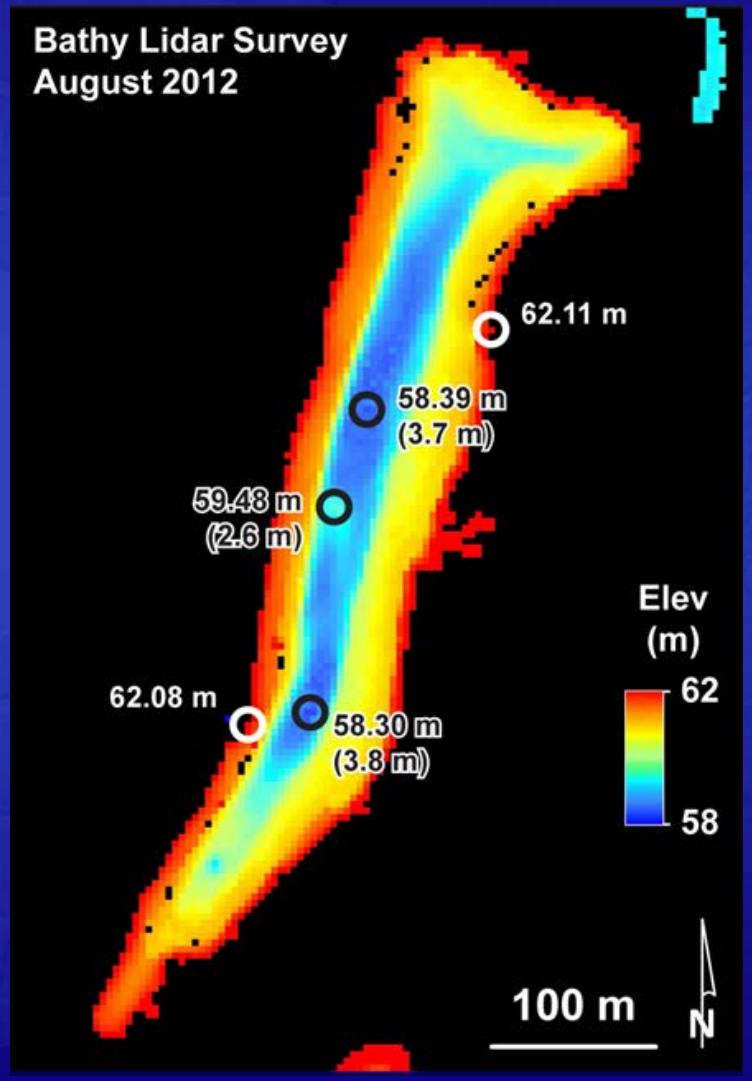




Sonar & Lidar Derived Depth Comparison

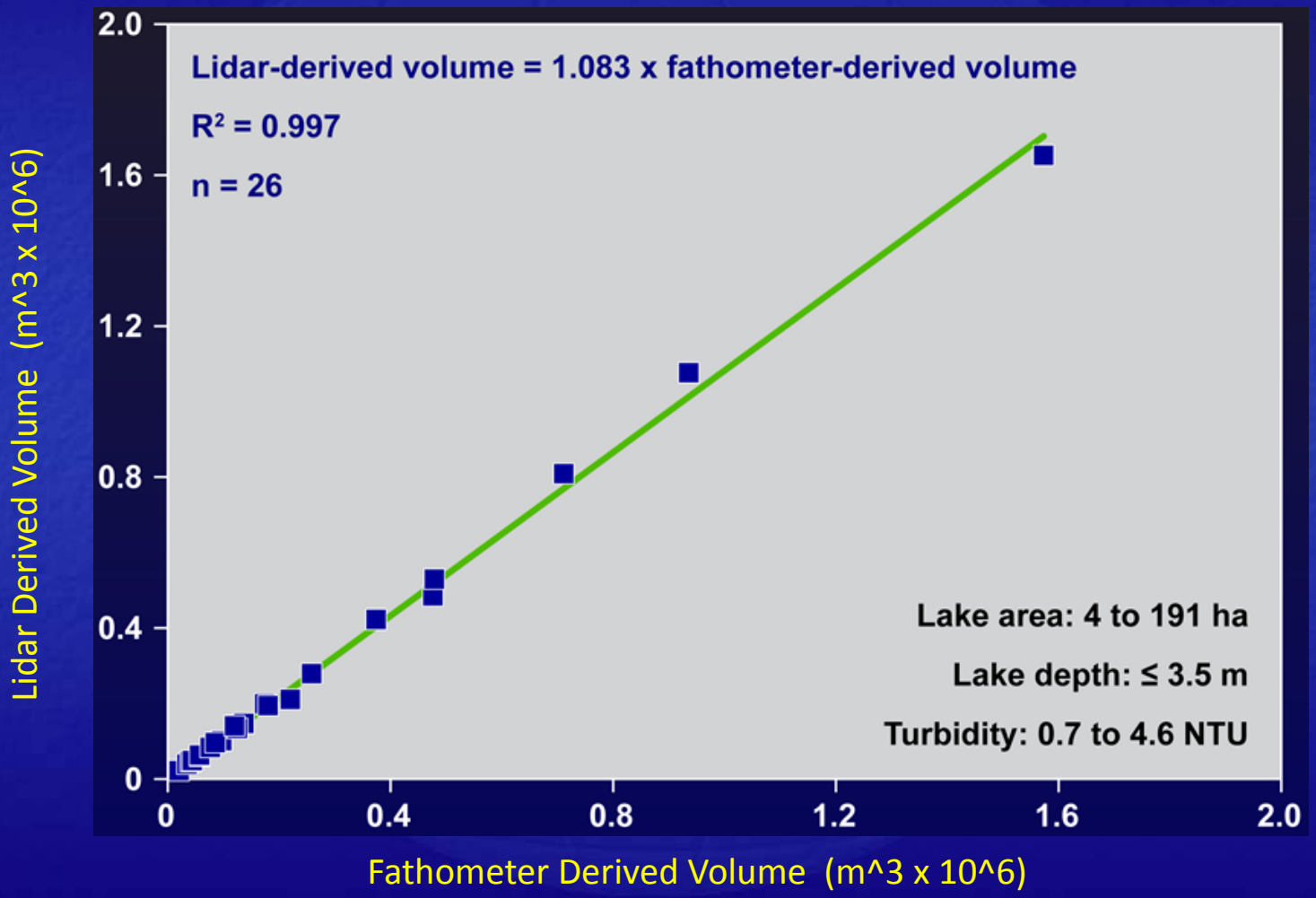
(Lake #18)





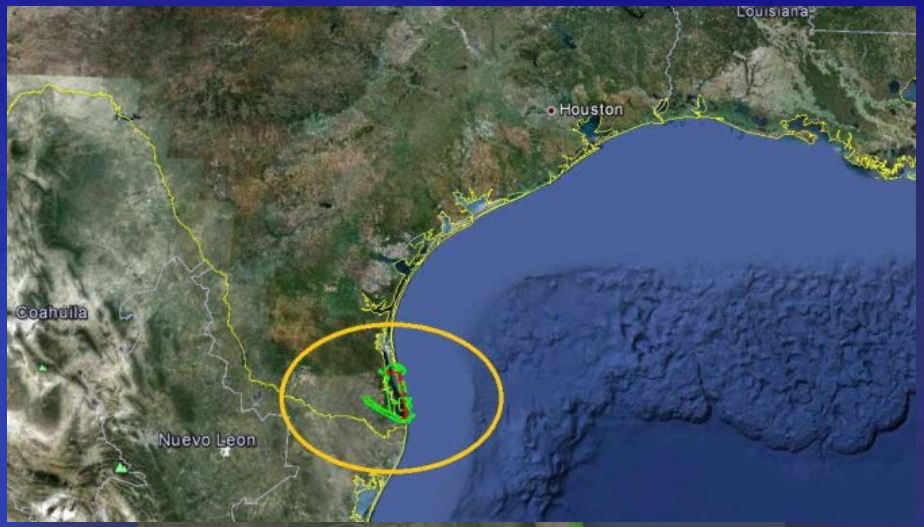
From ASRC 2012

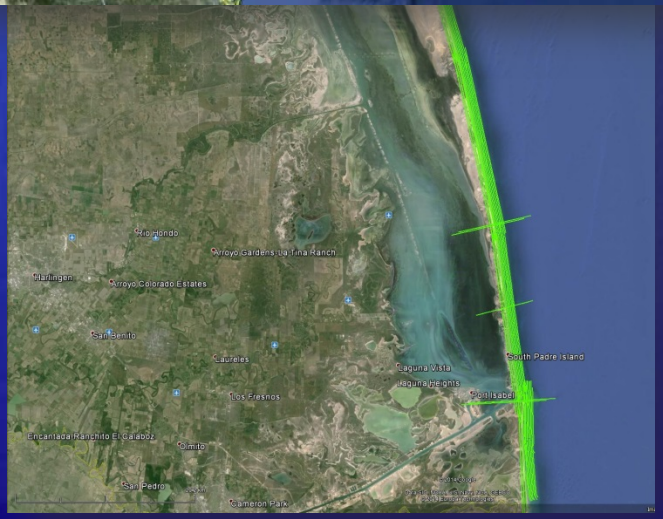
Sonar & Lidar Lake Volume Comparison



South Padre Island Shoreline Change detection

- Lidar survey completed in February 2013 and sonar survey completed in October, so it is expected that shoreline has changed over 8 months.
- Bathy data collected 1km seaward of shoreline.
  - 35kHz, full waveform
  - 400m altitude
- There are sonar profile sections into the water.
  - Single-beam echo sounder @200kHz.
  - Estimated precision 6-12cm.



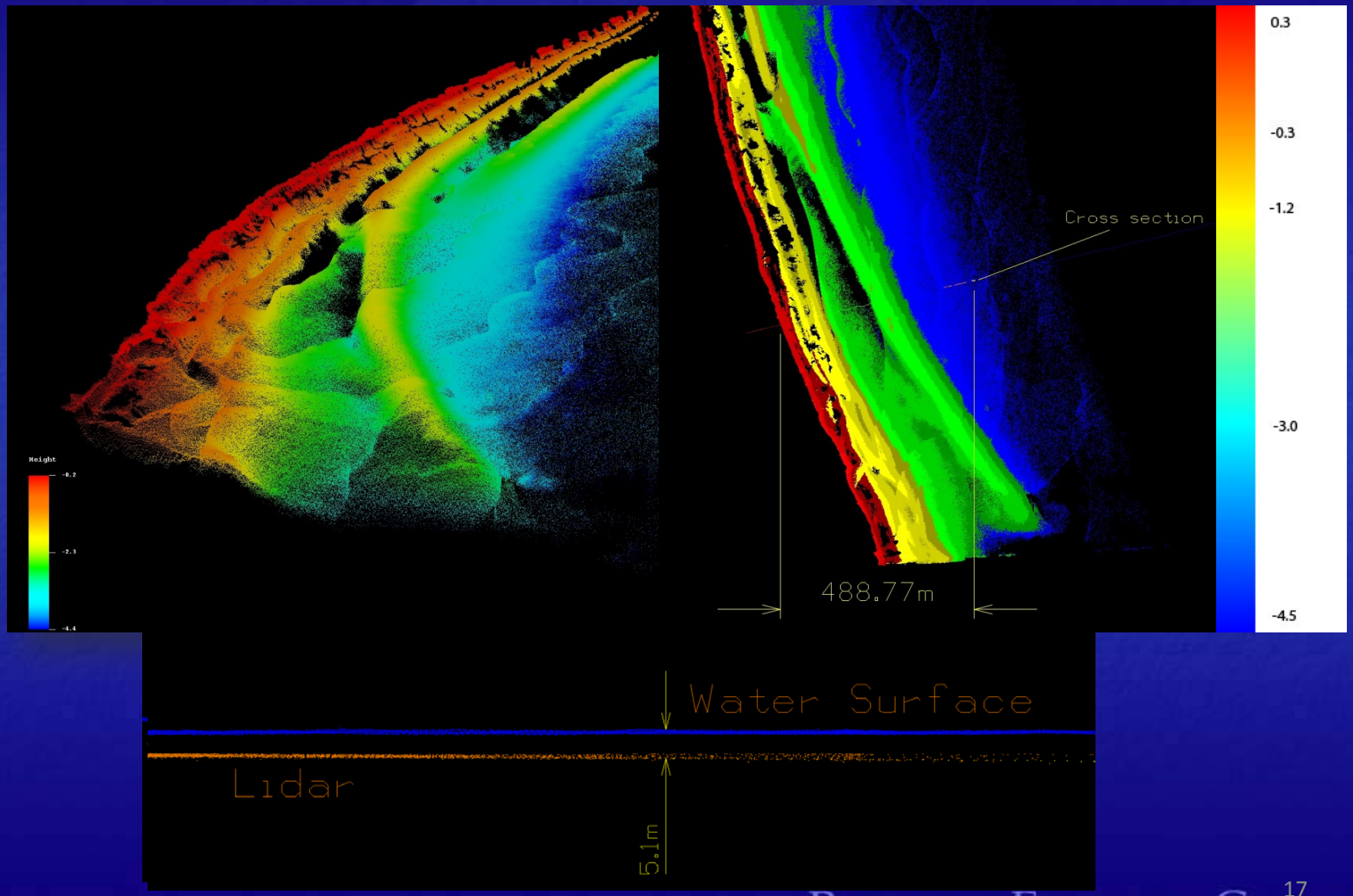


Sonar survey

Shoreline

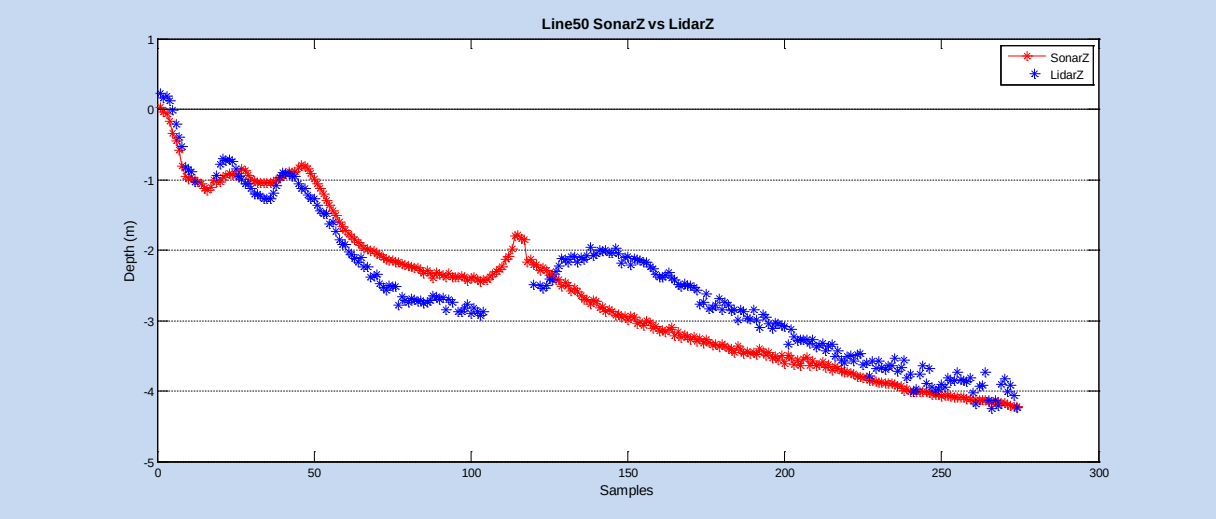
Sonar lines

Bathymetry

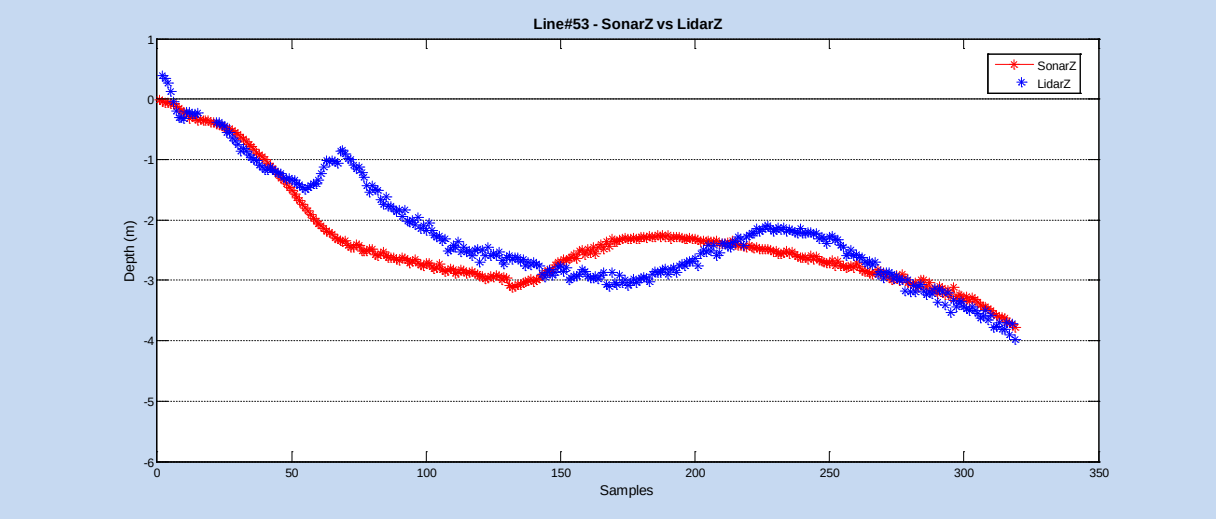

Height
-0.2
-2.3
-4.4
Cross section
488.77m
0.3
-0.3
-1.2
-3.0
-4.5
Water Surface
Lidar
5.1m

Change Detection

Sonar line #50



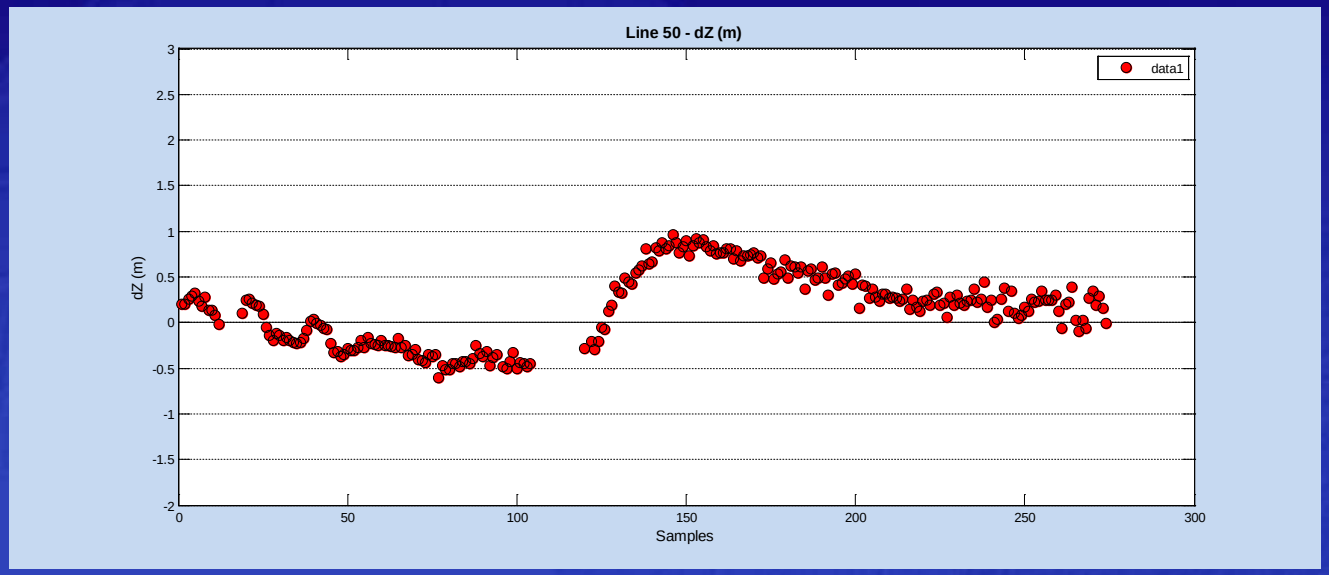
Sonar line #53



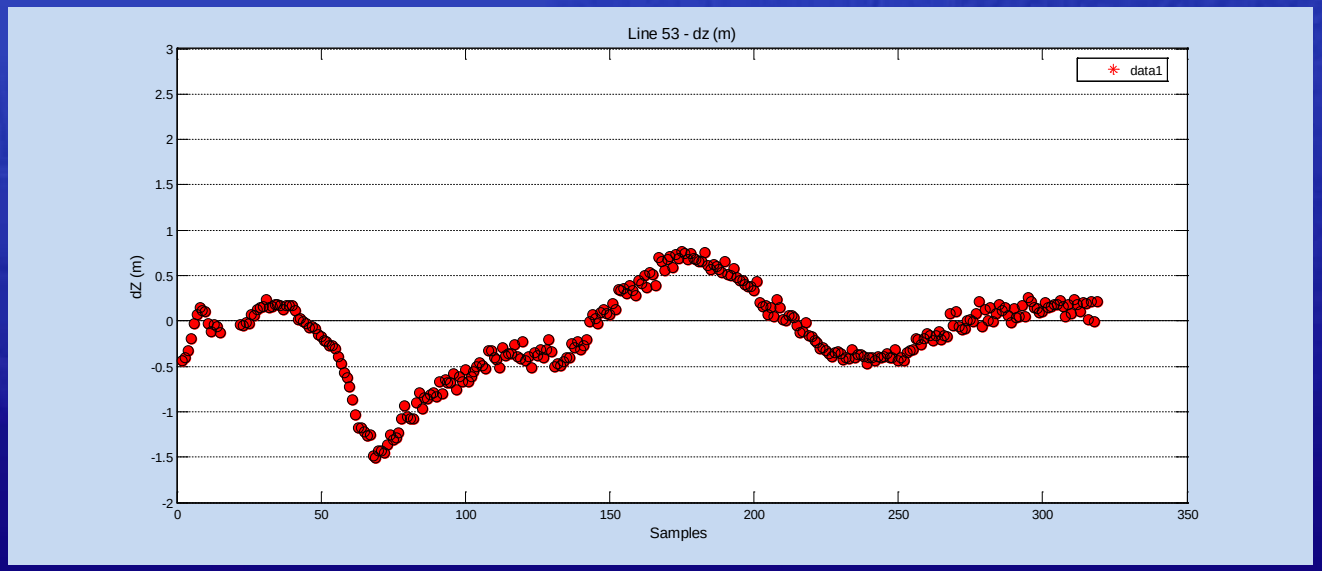
Shoreline change is evident in the comparison.

Difference dZ (m)

Average dZ (m)	0.17
Min dZ (m)	-0.60
Max dZ (m)	0.96
Median	0.21
Std deviation	0.40

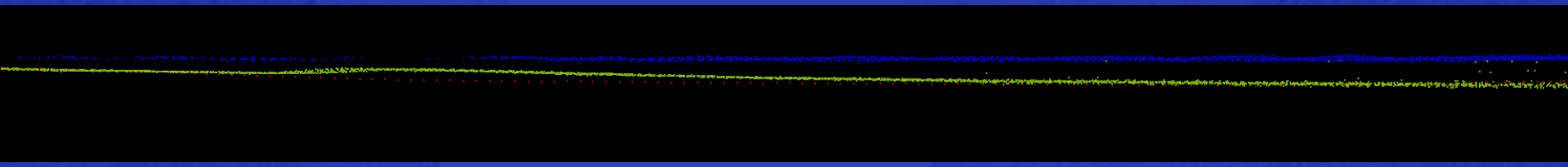


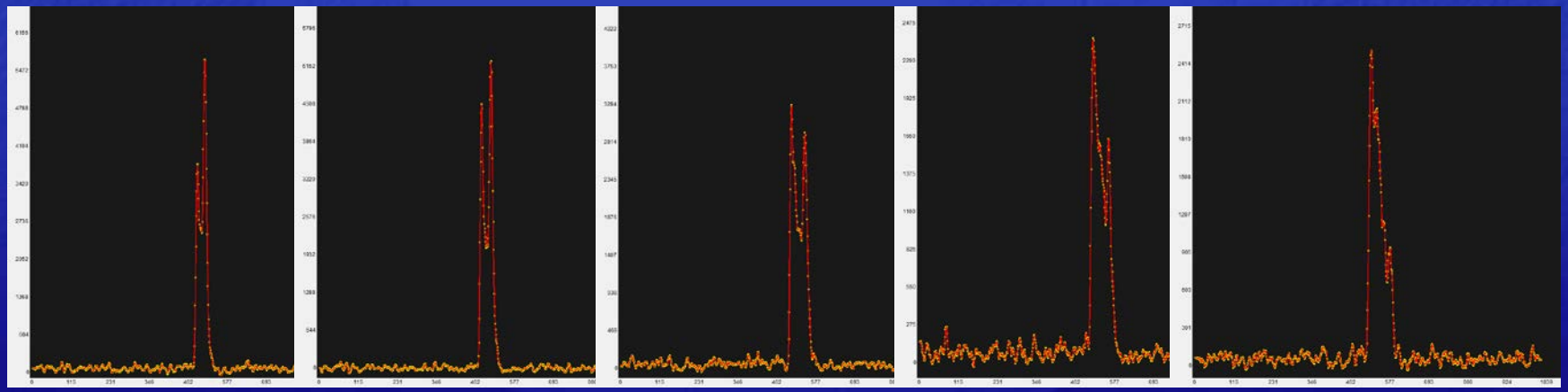
Average dZ (m)	-0.14
Min dZ (m)	-1.51
Max dZ (m)	0.77
Median	-0.06
Std deviation	0.47



Waveform peak shift

- Strong reflectivity from water surface and bottom lead to peak shifts.
- Water condition is fair and have less turbidity compared to north.
- Waveform gets noisier and less reliable farther away from shoreline (due to the tight processing threshold).

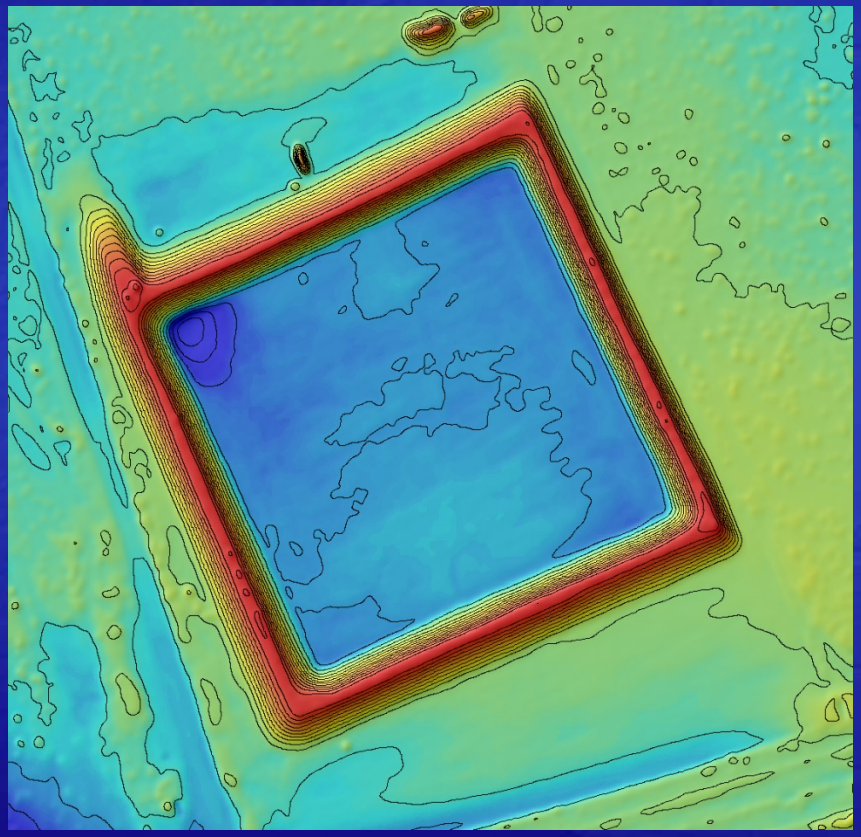




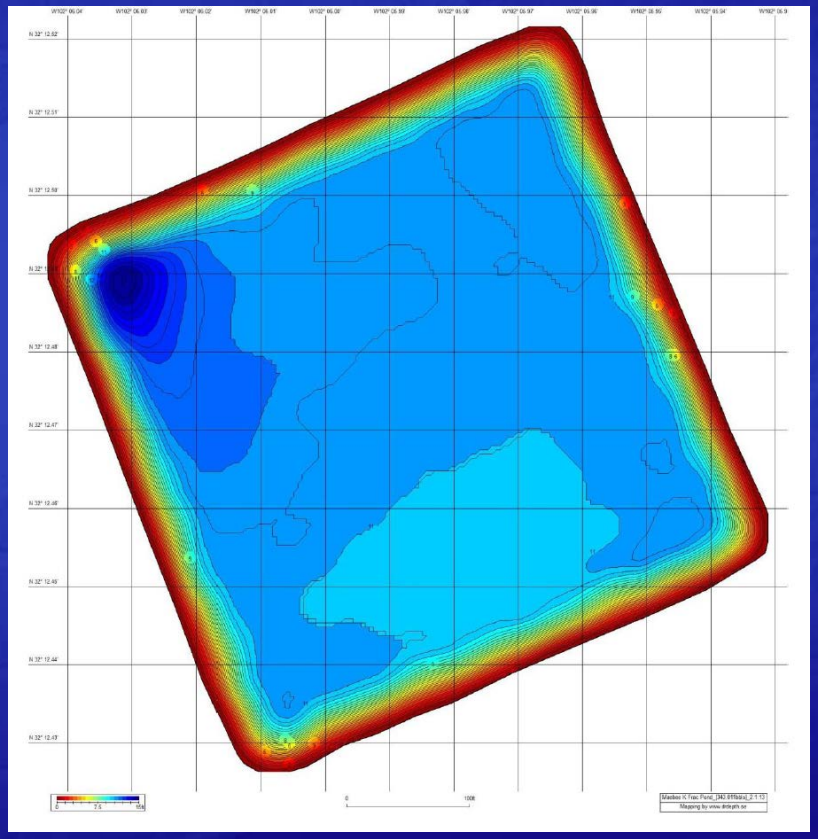
Hydraulic Frac Pit Volume Measurement

- Purpose is to determine the *existing* and *potential* water storage capacity in frac pits.
- Generated 3 main raster datasets; topo, bathy and water surface.
  - Derivative raster datasets
- Determined the water surface (bathy),
- Determined the lowest point on the berm where water can exit (topo),
- Created elevation grids to determine water volume and capacity at given user intervals.

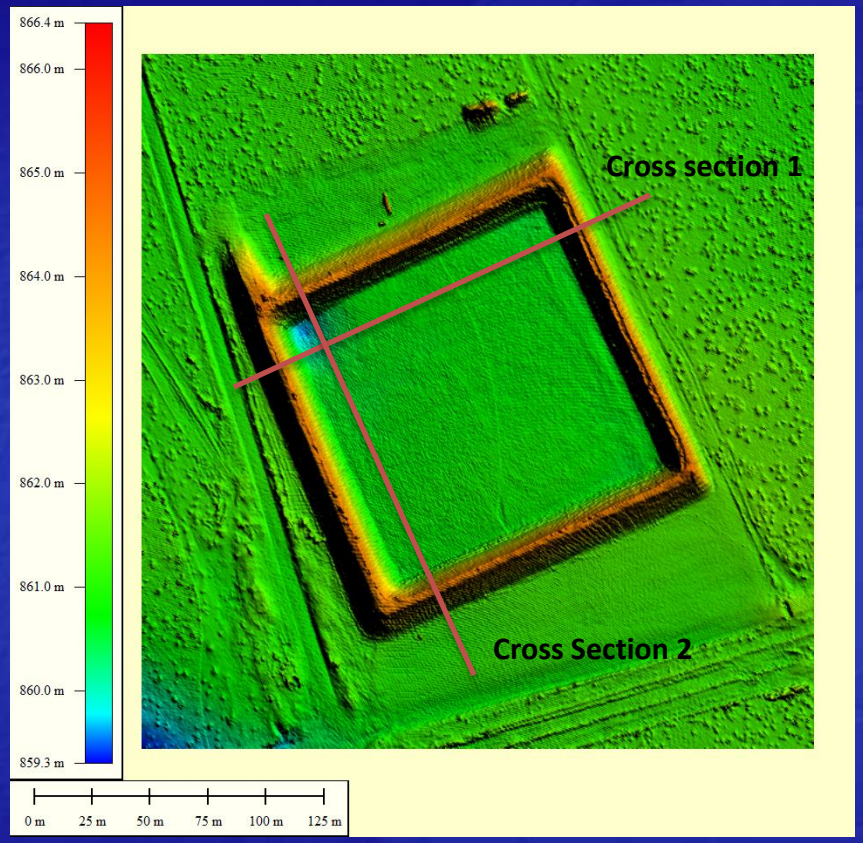
Lidar measurement



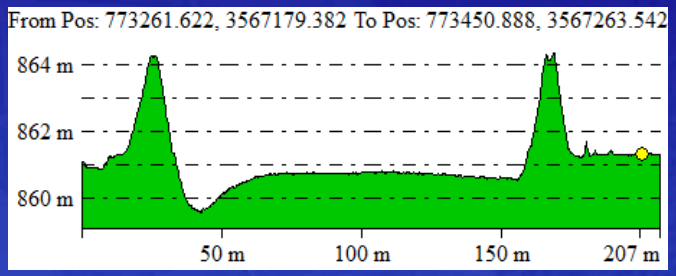
Sonar measurement



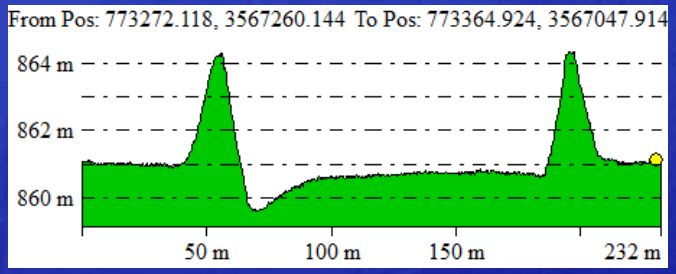
Sonar / Lidar Volume & Surface comparison



Cross Section 1

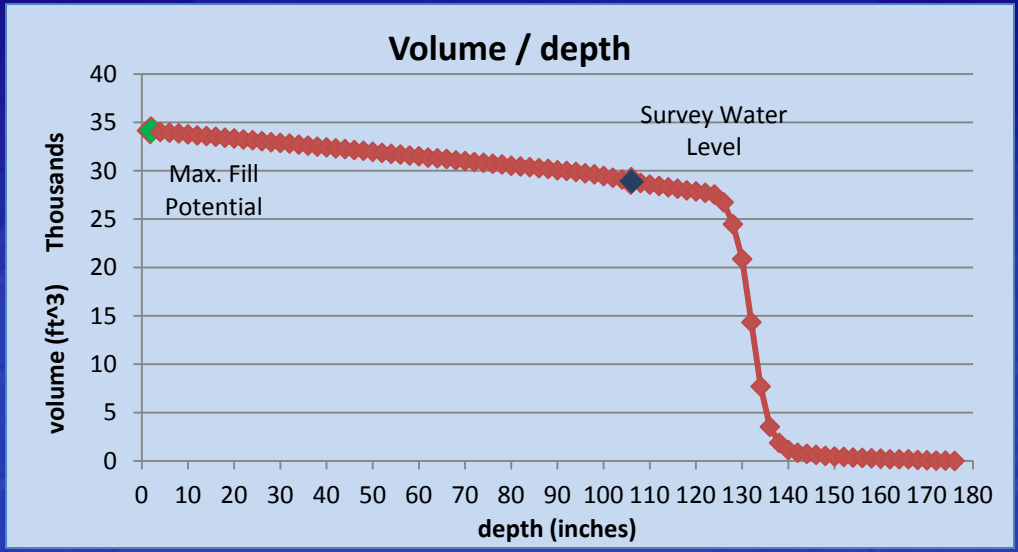


Cross Section 2



	Sonar	Lidar	Difference (%)
Volume (cu ft)	1,926,000	2,041,000	+ 6%
Surface (sq ft)	207,210	209,552	+ 1%

Hydraulic Volume Measurement



Upper Depth(in)	Lower Depth (in)	Interval Vol. (m^3)	Interval Vol. (ft^3)	Cumm. Vol. (m^3)	Cumm Vol. (ft^3)
0	2	967	34149	57794	2040977
2	4	963	34008	56827	2006828
100	102	829	29275	12653	446836
102	104	824	29099	11824	417561
Survey Water Level	----------	----------	----------	----------	----------
104	106	819	28922	11000	388461
106	108	814	28746	10181	359538
172	174	1	35	1	35
174	176	0	0	0	0
Water Surface Area (sq m, sq ft.)				**16305**	**175513**
Total Area (sq m, sq ft.)				**19250**	**207210**

Collaboration & Contact Info

- Open to collaboration with academic institutions, state agencies, government organizations
- Looking for projects with scientific mandate
- Expanding!

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